Ferris

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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S MANUAL

CV-2 AIRCRAFT

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1965

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CHAPTER 1
INTRODUCTION

Section I

Scope

Important ⇨ *In order to obtain complete information and derive maximum benefit from this manual, it is necessary to read this chapter carefully and thoroughly.*

1-1. General. This manual, issued expressly for operators, is an official document for Army Model CV-2 aircraft, Series CV-2B (Serial No. 60-3762 and subsequent). The purpose of this manual is to provide you with the latest information and performance data derived from flight test programs and operational experiences. The study and use of this manual will enable you to perform the assigned missions and duties with maximum efficiency and safety. Your ability and experience are recognized. It is not the function of this manual to teach the pilot how to fly; basic flight principles and elementary instructions are not included. The contents of this manual will provide you with a general knowledge of Army Model CV-2 aircraft, its flight characteristics, and specific normal and emergency operating procedures.

1-2. Reports necessary to comply with the Army Safety Program are prescribed in detail in Army Regulation 385-40.

1-3. Special Information. The following special information is applicable to Series CV-2B aircraft which are certificated for a maximum gross weight of 28,500 lb.

1-4. Flap configurations. Two groups of flap angles have been approved for use with Army Model CV-2 aircraft. Provided the gross weight limitations for the two groups of flap angles are observed, then either group may be used as appropriate in order to obtain the best performance under the existing conditions.

1-5. Code letters - normal technique. This manual covers the two groups of flap angles by designating one group as Flap Configuration (A) and the other group as Flap Configuration (B). In the text, only the code letters (A) or (B) are used to cover the flap configuration under discussion. The two groups of approved flap angles are as follows:

Flap configuration (A)		
En-route Climb and Cruise	0° (up)	Maximum Gross Weight 26,000 lb.
Take-off	15°	
Approach	19°	
Landing	40°	

Flap configuration (B)		
En-route Climb and Cruise	0° (up)	Maximum Gross Weight 28,500 lb.
Take-off	7°	
Approach	14°	
Landing	30°	

Note

When the gross weight is 26,000 lb or less, either Flap Configuration (A) or (B) may be used to obtain the best performance under a set of operating conditions (refer to Chapter 14 for examples). When the gross weight exceeds 26,000 lb, Flap Configuration (B) must be used.

1-6. Code letters - short field technique. The following groups of flap angles have been approved for short field technique, and are covered in the text in a similar manner as for normal technique, using the code letters (A) SF or (B) SF.

Flap configuration (A) SF		
Short Field Take-off	30°	Maximum Gross Weight 26,000 lb
Short Field Landing	40°	

Flap configuration (B) SF

Short Field Take-off	25°)	Maximum Gross
	)	Weight
Short Field Landing	40°)	28,500 lb

1-7. Index. The index lists in alphabetical order, every important subject under the topic which may be of significance to the operator. The listing is not a repetition of paragraph titles, but an extensive listing of subjects which will aid the operator in his use of the manual.

1-8. Appendix I. This appendix consists of a list of references applicable and available to the operator. The list includes official publications directly applicable to the Operator's Manual. All references called out in the text are reflected in this appendix.

1-9. Appendix II. This appendix references the Maintenance Allocation Chart contained in TM 55-1510-206-20.

1-10. Appendix III. This appendix references the Aircraft Inventory Master Guide, Appendix III, TM 55-1510-206-20.

1-11. Appendix IV. This appendix references the Operator's and Crew member's Checklist. The checklist contains normal and emergency procedures to be performed by the pilot (and/or crew member).

Section II

General

1-12. Information concerning distribution and revision is contained in Army Regulations 310-1.

1-13. Authorization for issue is contained in Army Regulations 310-3.

1-14. Mandatory requirements, are as stated in Army Regulations 310-1.

Note

The direct reporting of errors, omissions, and recommendations for improving this manual by the individual user is authorized and encouraged. DA Form 2028

will be used for reporting these improvements. This form will be completed using pen, pencil or typewriter and forwarded direct to the Commanding General, U.S. Army Aviation Materiel Command, P.O. Box 209, Main Office, St. Louis, Missouri 63166. One information copy will be provided to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc.).

1-15. Throughout this manual adjuncts to the text are used as defined in Army Regulations 310-3. These adjuncts and their definitions are as follows:

Note

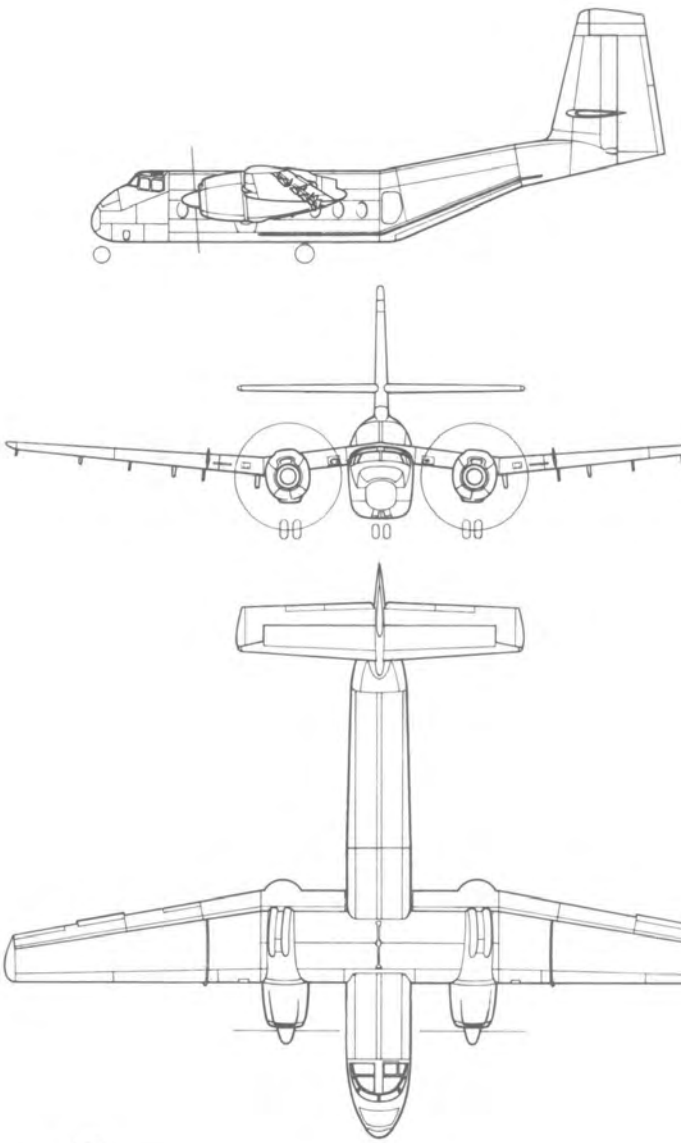
An operating procedure, condition, etc., which it is essential to highlight.

Caution

Operating procedures, practices, etc., which if not strictly observed will result in damage to, or destruction of, equipment.

Warning

Operating procedures, practices, etc., which will result in personal injury or loss of life if not correctly followed.





The aircraft

CHAPTER 2
DESCRIPTION

Section I

Scope

2-1. This chapter contains a description of the aircraft, and the systems and controls which contribute to the physical act of flying the aircraft.

2-2. Included in this chapter are all those items of emergency equipment which are not part of an auxiliary system.

Section II

Aircraft Systems and Controls Description

2-3. The Aircraft. The Model CV-2 aircraft, manufactured by de Havilland Aircraft of Canada, is an all-metal high-wing monoplane powered by two Pratt and Whitney Twin Wasp engines driving Hamilton Standard propellers. On aircraft prior to Serial No. 63-9718 the propellers are non-reversible; and on aircraft Serial No. 63-9718 and subsequent, the propellers are reversible. The aircraft is designed for passenger or cargo carrying, paratroop or supply dropping, or for casualty evacuation. The aircraft has a fully retractable tricycle landing gear and a power-operated cargo door and ramp which, in conjunction with the up-swept rear fuselage, permit direct cargo loading. The flight crew consists of pilot, copilot, and flight crew chief.

2-4. Dimensions.

Wing Span	95 ft 7 1/2 in.
Length	72 ft 7 in.
Height	31 ft 9 in.

Refer to figure 2-1 for minimum turning radius and ground clearances.

2-5. Weight. The gross weight of the Series CV-2B aircraft is 28,500 pounds. For additional weight information refer to Chapter 12.

2-6. Engine. The aircraft is powered by two Pratt and Whitney Twin Wasp R-2000-7M2 fourteen-cylinder, double-row radial engines. Each engine incorporates an engine-driven, single-stage, single-speed supercharger. Engine cooling is provided by an arrangement of diffusers and baffles, assisted by exhaust augmentor tubes. Engine fire detectors and an extinguishing system are provided.

2-7. Carburetor. The Stromberg carburetor on the engine intermediate rear case is operated by a throttle lever and a mixture lever. Air to the carburetor is governed by a carburetor heat lever and an air induction switch.

2-8. Throttle levers (non-reversible propellers). Two throttle levers, one for each engine, are located on the overhead console, and move in a quadrant marked CLOSED and OPEN. The throttles are connected to their respective engine throttle valves by individual mechanical linkage. When both throttles are retarded below a setting of approximately 13 - 15 inches Hg, a microswitch is actuated to energize the landing gear warning circuit. A friction lever on the left side of the console increases the friction of both throttles when rotated clockwise.

2-9. Throttle levers (reversible propellers). Two throttle levers, one for each engine, are located on the overhead console (figure 2-4), and move in a quadrant marked REVERSE PITCH and THROTTLE CLOSED at the aft end, and OPEN at the forward end. Propeller reversal is effected electrically, when both throttle levers are in the idling position, by moving the levers upwards approximately 1-inch. When the levers are raised, microswitches are contacted, hydraulic pressure moves the propeller blades to the reverse pitch

stops, and the PROP REVERSE blue lights illuminate. Engine power is increased by moving the throttle levers aft. Refer to paragraph 2-42.

2-10. Mixture levers. Two mixture levers, one for each engine, are mounted on the overhead console, (figure 2-4), and move in a quadrant marked IDLE CUT-OFF, AUTO LEAN, and AUTO RICH. The mixture levers are connected to their respective carburetors by mechanical linkage. A friction lever on the right side of the console increases the friction of both mixture levers when rotated clockwise. On aircraft Serial Number 61-2599 and subsequent, the mixture levers have a detent at the AUTO LEAN setting to minimize the possibility of inadvertent movement to the IDLE CUT-OFF position.

2-11. Carburetor hot-air levers. Two carburetor hot-air levers marked CARB HEAT, LH and RH, are located on the overhead console, (figure 2-4), and move in quadrants marked HOT and COLD. Each lever is mechanically linked to interconnected hot and cold air valves in the related carburetor intake duct. With the lever in COLD the hot air valve is closed and the cold air valve is open to admit ram air, filtered air, or alternate air, whichever is selected on the carburetor air induction switches. With the lever in HOT, the cold air valve is closed and, downstream, the hot air valve is open to admit exhaust heated air. Intermediate positions of the levers may be selected to give varying degrees of carburetor heat.

2-12. Carburetor air induction switches. Two carburetor air induction switches, one for each engine, are located on the overhead console. On aircraft with non-reversible propellers the switches are located left and right, outboard of the carburetor hot-air levers. On aircraft with reversible propellers both switches are located outboard of the right-hand carburetor hot-air lever. The switches are marked CARB AIR with positions ALTERNATE, FILTER, and RAM. When

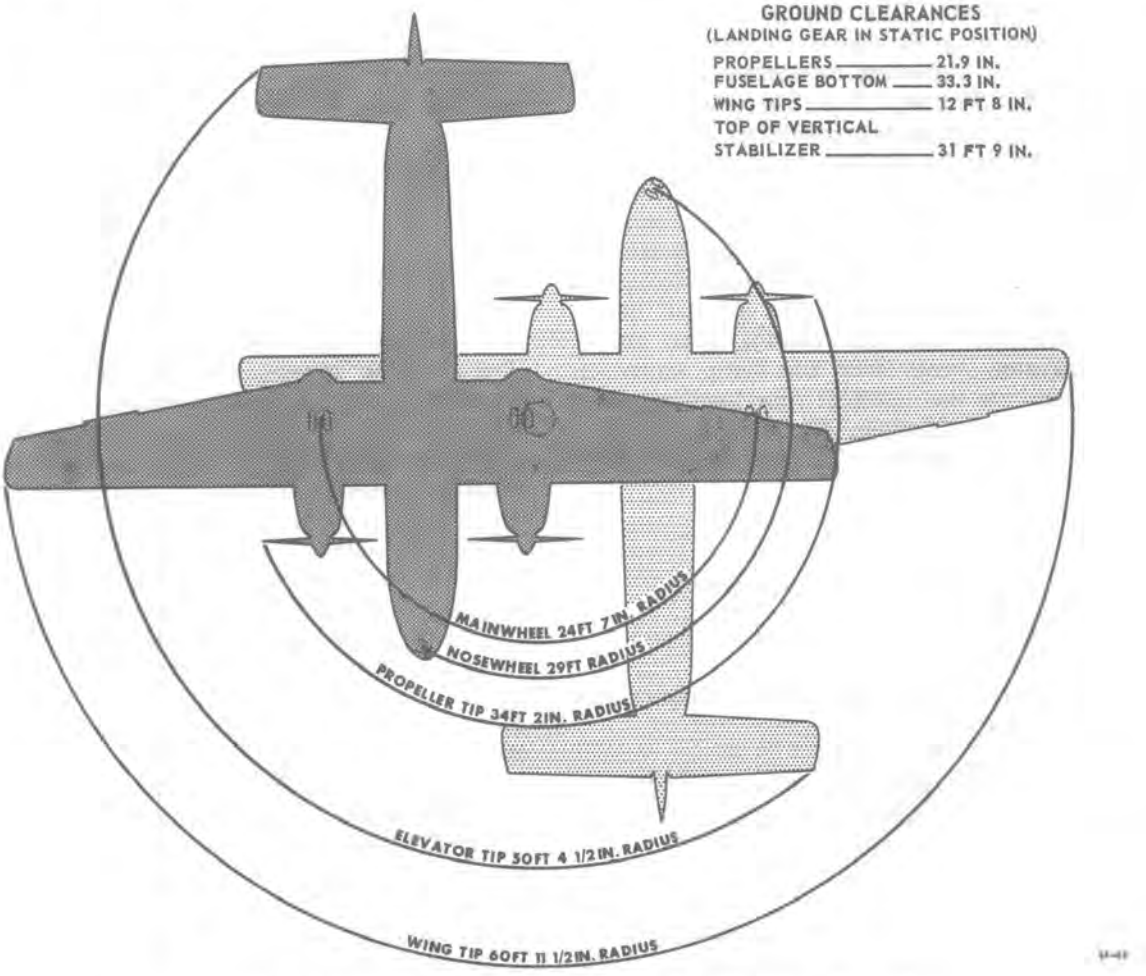


Figure 2-1. Minimum turning radius and ground clearance

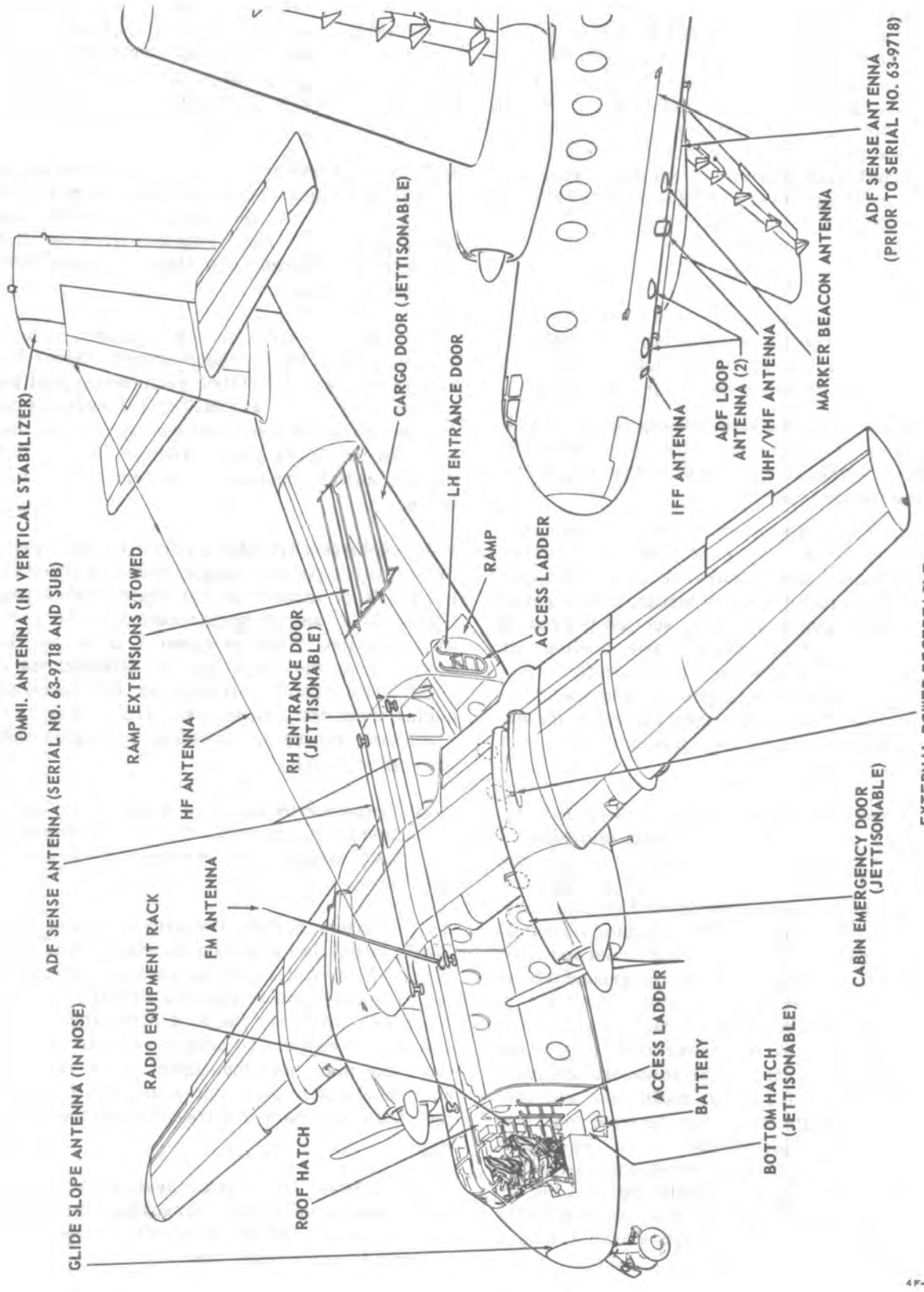


Figure 2-2. General arrangement

RAM is selected, the ram air valve at the entry of the duct is open and passes unfiltered air direct to the carburetor. When FILTER is selected, the ram air valve is closed and filtered air enters the duct. When ALTERNATE is selected, the ram air valve is closed and an alternate air valve is open to admit cylinder-heated unfiltered air into the duct. Irrespective of the switch selection, normal induction air is excluded when the carburetor hot-air lever is at HOT position. Power is supplied from the emergency bus.

Note

The valve actuator motors are of the reversible type. Should electrical failure deenergize the system, the valves will remain in the position at which the failure occurred.

2-13. Engine and Accessory Compartment Cooling Systems. Methods of cooling the engine and accessory compartments are discussed in the following paragraphs.

2-14. Engine cooling system. Silencer-type augmentor tubes, two for each engine, discharge engine exhaust gases rearward over the upper surface of the root flaps. By leading the hot gases through the augmentor tubes, suction is created ahead of the tubes, which draws cooling air through the engine cowling, and provides effective engine cooling. The expansion and discharge of the cooling air, under the heat from the exhaust gases, also produces a measurable amount of thrust.

2-15. Accessory compartment cooling system. Two doors on each engine cowling, immediately forward of the firewall, are provided to increase the flow of cooling air in the accessory compartment. The lower door opens inward to admit cooling air, and the upper door is spring-loaded to open outwards to allow heated air to escape from the accessory compartment on the ground during ground operation of the engine, or following engine shutdown. An actuator in each nacelle is directly connected to the lower door and to the upper door, by a cable. The actuators are electrically powered from the main bus and controlled by a weight switch on the nose gear, and a two-position selector switch on the engine switch panel. When the aircraft becomes airborne, the weight switch automatically operates the actuators and closes the doors; when the aircraft is on the ground, the actuators are operated to open the doors.

2-16. Accessory compartment cooling system selector switch. A two-position toggle switch on the engine switch panel (figure 2-12) is marked VENT DOORS with positions AUTO-OPEN and CLOSE-MAN. In the AUTO-OPEN position the actuators are automatically controlled by the weight switch on the nose gear. In the CLOSE-MAN position the weight switch is overridden and the doors will remain in the closed position.

2-17. Ignition System. The engine ignition system is a dual magneto type, both magnetos serving each cylinder. The left magneto fires the rear spark plugs, the right magneto fires the front spark plugs, thereby providing two independent sources of ignition.

2-18. Ignition switches. Two ignition switches are located on the overhead console (figure 2-4), and are marked IGNITION, each having positions marked OFF, R, L, and BOTH. The switches control the supply of electrical energy from the magnetos to the spark plugs. When in the OFF position the switch grounds the circuit of both magnetos.

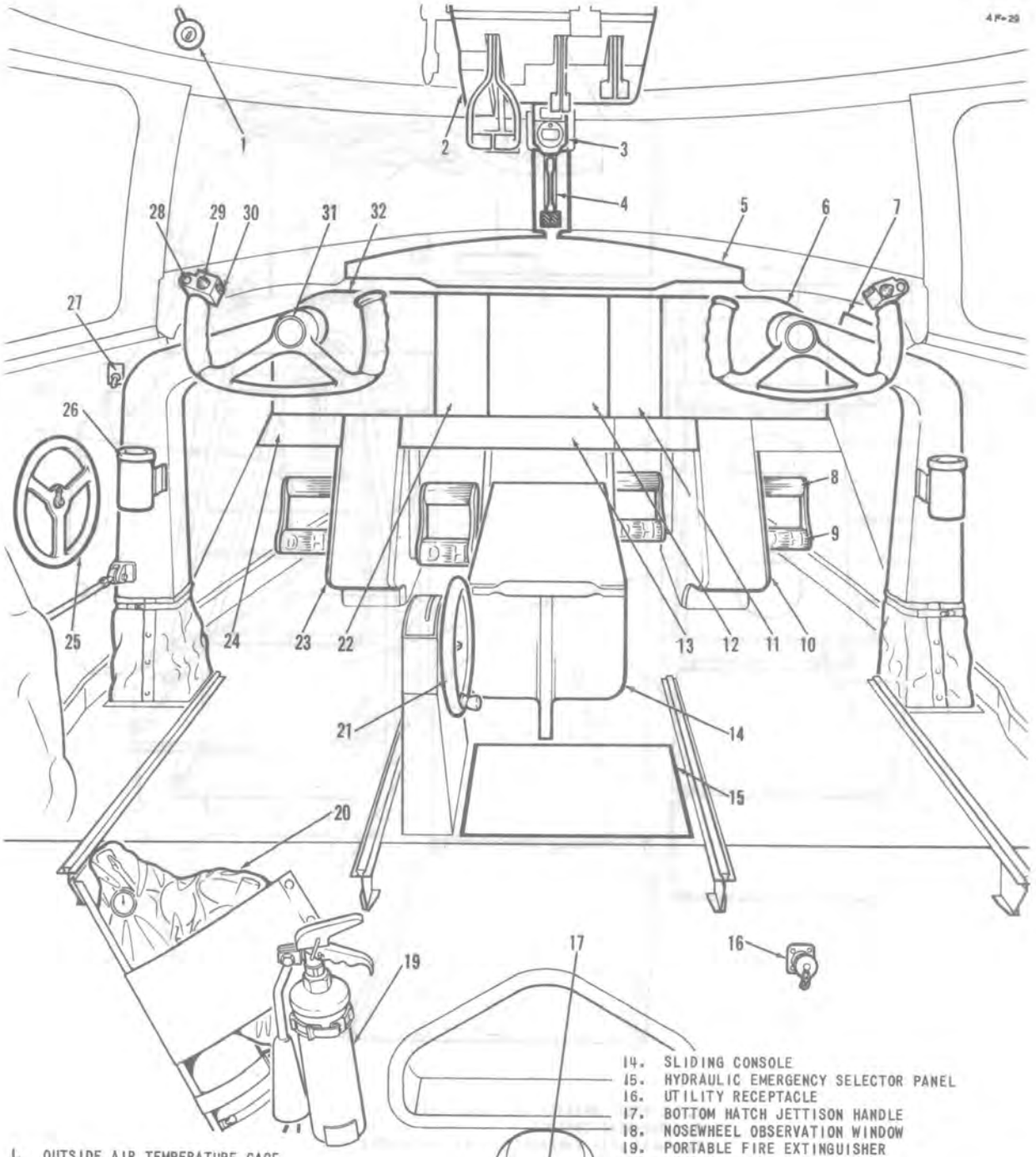
2-19. Induction vibrator switch. An induction vibrator, three-position toggle switch, marked VIB, L, and R is located on the engine switch panel (figure 2-12) and is spring-loaded to the center (off) position. When in either L or R position, power from the main bus is directed via the STARTING circuit breaker to the respective engine induction vibrator and from there to the right-hand magneto, providing a boosted spark for engine starting.

2-20. Engine Priming. The engine priming system provides for atomized fuel to be injected into the supercharger throat preparatory to starting the engine.

2-21. Primer switch. The primer three-position toggle switch is located on the engine switch panel (figure 2-12) and is spring-loaded to the center (off) position, and is marked PRIME, L, and R. When held in either the L or R position, the circuit to the respective primer valve is energized from the main bus, thus opening the valve and, with the booster pump operating, fuel is injected into the supercharger throat through the priming jets.

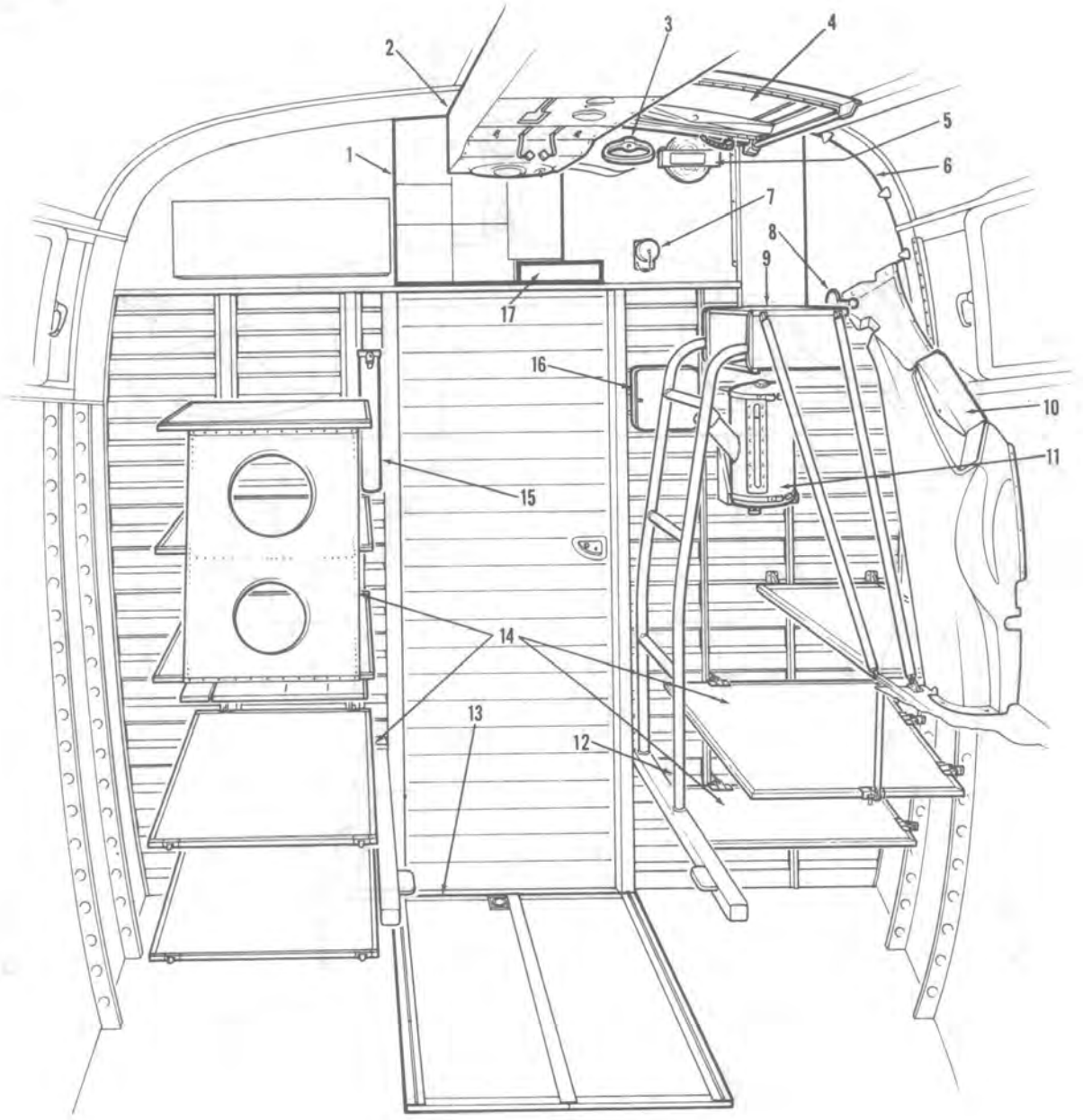
2-22. Starter. The starter system for each engine consists of a direct-cranking starter and a starter relay. Electrical power for the starter is taken from the main bus.

2-23. Starter switch. The starter three-position toggle switch is located on the engine switch panel



1. OUTSIDE AIR TEMPERATURE GAGE
2. OVERHEAD CONSOLE
3. STANDBY (MAGNETIC) COMPASS
4. EMERGENCY WHEEL BRAKES LEVER
5. EMERGENCY & SIDE PANELS
6. COPILOT'S FLIGHT INSTRUMENT PANEL
7. STICK SHAKER
8. BRAKE PEDALS
9. RUDDER PEDALS
10. COPILOT'S PEDESTAL
11. VOLTAMMETER, AC-DC POWER & DEICING PANELS
12. ENGINE INSTRUMENT PANEL
13. CENTER SWITCH PANEL
14. SLIDING CONSOLE
15. HYDRAULIC EMERGENCY SELECTOR PANEL
16. UTILITY RECEPTACLE
17. BOTTOM HATCH JETTISON HANDLE
18. NOSEWHEEL OBSERVATION WINDOW
19. PORTABLE FIRE EXTINGUISHER
20. PORTABLE OXYGEN EQUIPMENT
21. ELEVATOR TRIM TAB HANDWHEEL
22. FUEL, TROOP JUMP - PENDULUM RELEASE PANEL
23. PILOT'S PEDESTAL
24. ENGINE SWITCH PANEL
25. NOSEWHEEL STEERING WHEEL
26. ASH TRAY
27. NOSEWHEEL STEERING SWITCH
28. AUTO PILOT RELEASE BUTTON (PROVISION)
29. AILERON TRIM TAB SWITCH
30. MICROPHONE SWITCH
31. CONTROL COLUMN
32. PILOT'S FLIGHT INSTRUMENT PANEL

Figure 2-3. Flight compartment (sheet 1 of 2)



1. CIRCUIT BREAKER AND FUSE PANELS
2. OVERHEAD CONSOLE
3. MAIN GEAR EMERGENCY EXTENSION HANDLE
4. ROOF HATCH
5. EMERGENCY SLIDE
6. HEATING CONTROL PANELS
7. IGNITION ANALYZER RECEPTACLE
8. HYDRAULIC PRESSURE SHUT-OFF VALVE HANDLE
9. FIRST AID KIT STOWAGE
10. MAP AND DATA CASE
11. HYDRAULIC FLUID RESERVOIR AND SIGHT GAGE
12. ACCESS LADDER
13. FLOOR DOORS
14. RADIO EQUIPMENT RACKS
15. WEIGHT AND BALANCE COMPUTER
16. SPARE LAMPS AND FUSES STOWAGE
17. CARGO DOOR AND RAMP FORWARD SWITCH PANEL

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Figure 2-3. Flight compartment (sheet 2 of 2)

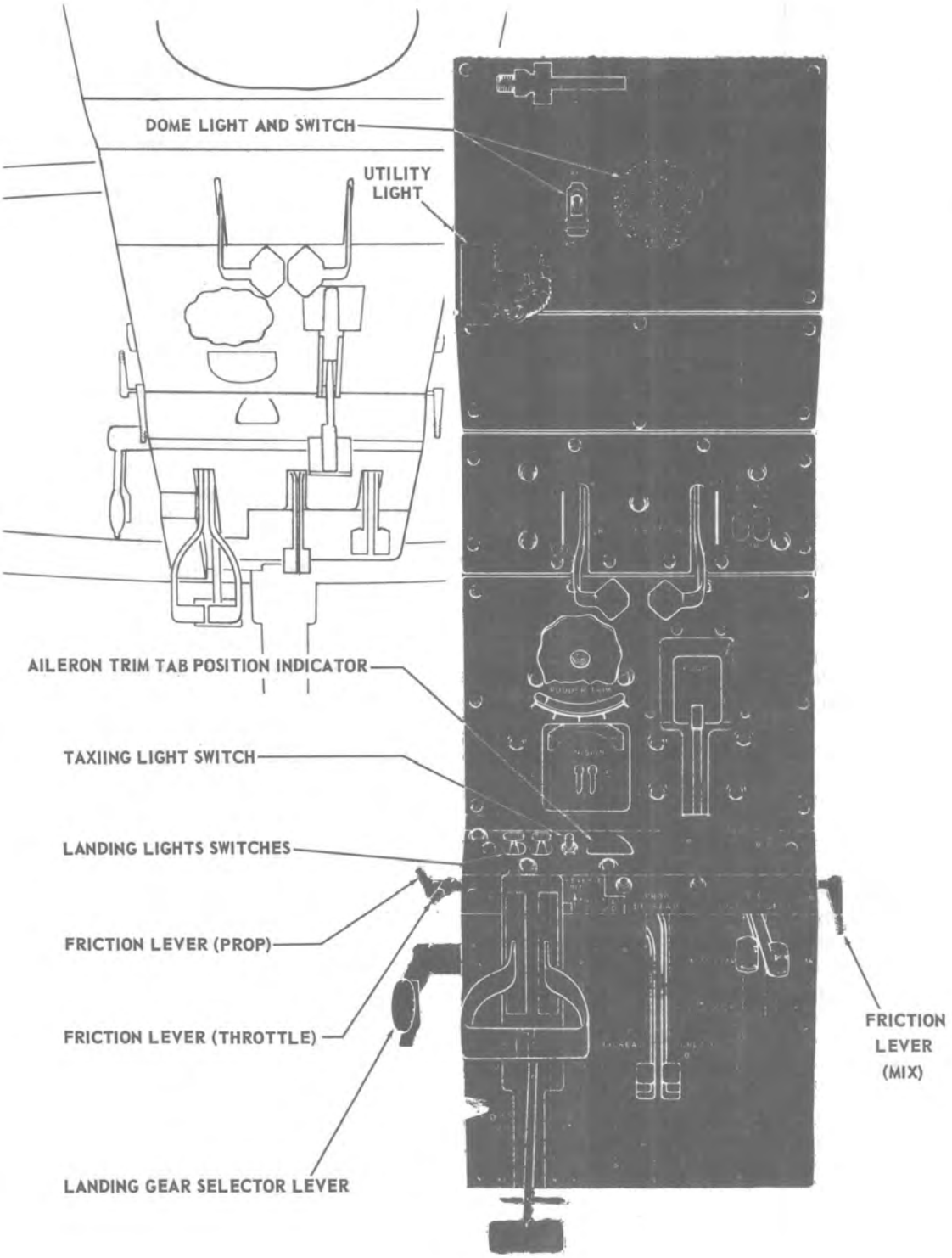


Figure 2-4. Overhead console - typical

(figure 2-12) and is marked L and R for the left-hand and right-hand engines respectively, and is spring-loaded to the center (off) position. When the switch is operated, power is supplied via the STARTING circuit breaker to the starter relay, which closes to complete the circuit to the starter motor.

2-24. Engine Instruments. The engine instruments, (figure 2-5) one complete set for each engine, are mounted on the engine instrument panel. On aircraft 61-2598 and subsequent, a single manifold pressure gage and a single tachometer are each dual instruments, combining readings from both engines on a single dial. See Chapter 7, figure 7-1 for the operating ranges and limitation markings.

2-25. Manifold pressure gage. The manifold pressure gage is an electrically-operated autosyn type and registers intake manifold pressure for the relevant engine. AC power is supplied by the operating inverter via the 26-volt, 400-cycle ac bus. On aircraft 61-2598 and subsequent, a single gage provides indications from both engines, dual pointers marked L and R registering for the left- and right-hand engines respectively on one dial.

2-26. Tachometer. The tachometer is powered by an engine-driven tachometer generator on the relevant engine, and indicates engine speed in rpm. On aircraft 61-2598 and subsequent, engine speed of both engines is registered on a single instrument dial, dual pointers marked L and R registering for the left- and right-hand engines respectively.

2-27. Carburetor air temperature gage. The carburetor air temperature gage is an electrically-operated resistance type and is connected to a resistance bulb located at the carburetor air intake of the relevant engine. Power is supplied from the emergency bus.

2-28. Cylinder head temperature gage. The cylinder head temperature gage is an electrically operated resistance type connected to a resistance bulb in No. 2 cylinder of the relevant engine. Power is supplied from the emergency bus.

2-29. Thrust indicator. Refer to paragraph 2-136.

2-30. Fuel and oil pressure gage. The fuel and oil pressure gage is an electrically-operated autosyn type with two scales, one registering oil pressure at the engine rear case, and the other registering fuel pressure at the carburetor inlet. Power is supplied by the inverter via the 26-volt, 400-cycle ac bus.

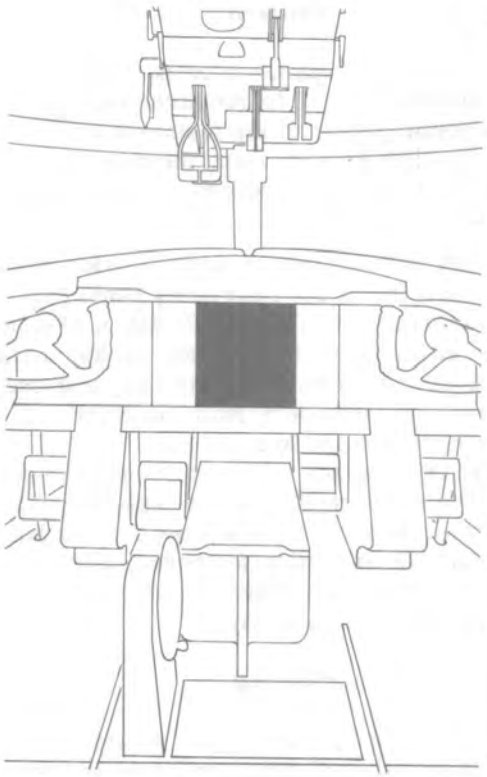
2-31. Oil temperature gage. The oil temperature gage is an electrically-operated resistance type and registers oil inlet temperature. Power is supplied from the emergency bus.

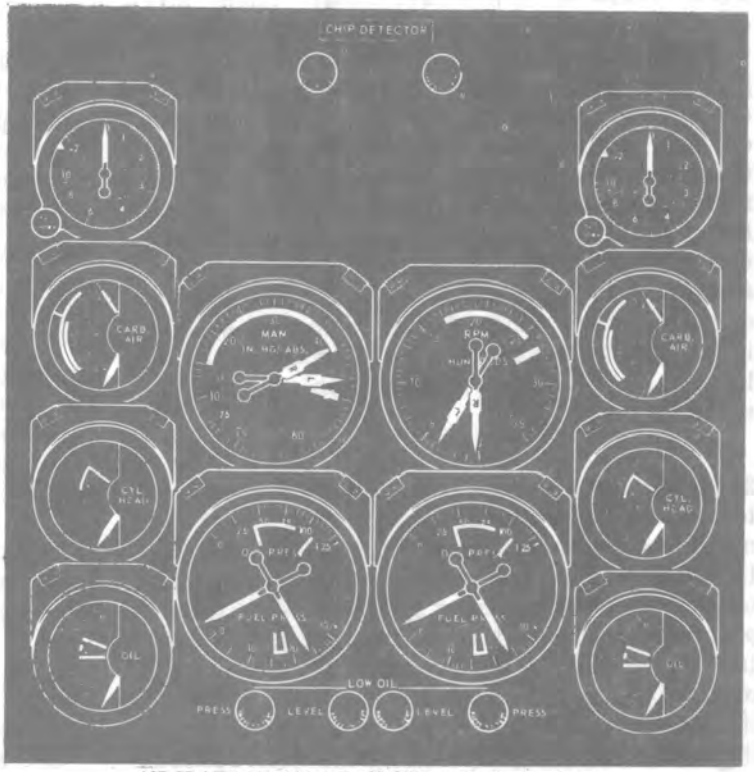
2-32. Oil low pressure warning light. An amber press-to-test warning light (figure 2-5) marked LOW OIL PRESS is provided for each engine and are located on the engine instrument panel. The light will illuminate when the respective engine oil pressure drops below 45 ± 2 psi. Power is supplied from the emergency bus and the circuit is protected by the 5-ampere circuit breaker marked PRESS WARN, FUEL & OIL.

2-33. Low oil level warning light. An amber press-to-test warning light (figure 2-5) marked LOW OIL LEVEL is provided for each engine oil tank, and are located on the engine instrument panel. The main purpose of the lights is to indicate when oil transfer should take place if long range ferry fuel and oil tanks are installed. (Refer to Chapter 9, Section II for ferry tanks installation.) The lights however, will provide an indication of low oil level at all times, and will illuminate when approximately 9 US gallons of oil have been used (approximately 9 usable US gallons remaining) in the respective tank. Power is supplied from the emergency bus and the circuit is protected by the 5-ampere circuit breaker marked PRESS WARN, FUEL & OIL.

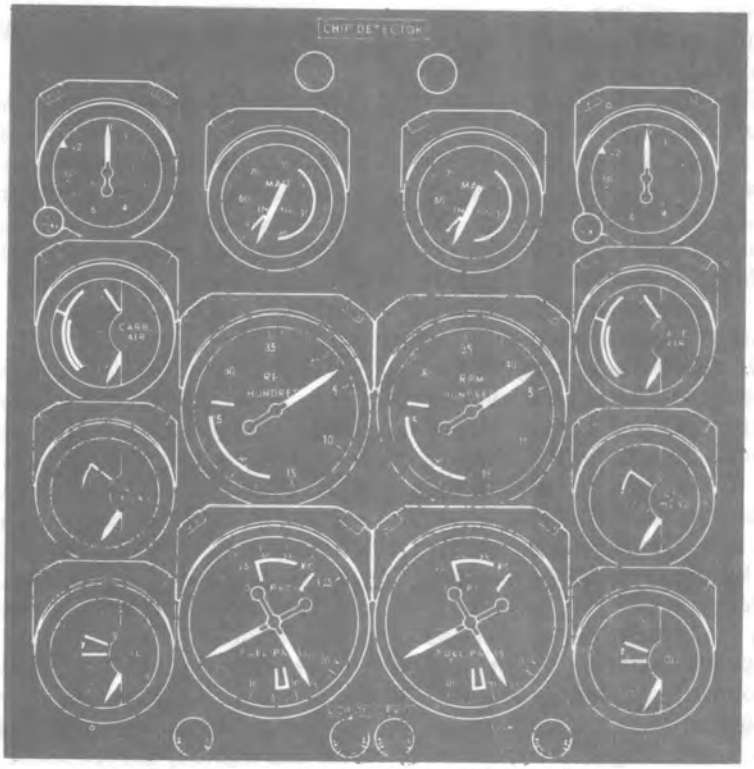
2-34. Fuel low pressure warning light. A red press-to-test warning light (figure 2-9) is provided for each engine. The lights are marked LH and RH ENGINE LOW PRESSURE, for the left-hand and right-hand engines respectively. A light will illuminate when fuel pressure at the carburetor inlet on the relevant engine drops below 15 psi. Power is supplied from the emergency bus and the circuit is protected by the 5-ampere circuit breaker marked PRESS WARN, FUEL & OIL.

2-35. Chip detector caution light. When MWO 55-1510-206-34/66 is embodied an amber press-to-test caution light (figure 2-5) marked CHIP DET is provided for each engine. The two lights are located side by side at the top of the engine instrument panel. Each light illuminates if ferrous chips or excessive fuzz are detected by a magnetic detector in the engine oil sump and in the rocker manifold. This gives an early warning of possible impending failure of an engine component. Action to be taken in the event of such a warning is included in Chapters 3 and 4.





AIRCRAFT SERIAL NO. 61-2598 AND SUBSEQUENT



AIRCRAFT SERIAL NO. 60-3762 THROUGH 61-2597

4F731

Figure 2-5. Instrument panel (engine)

2-36. Propellers (Non-Reversible). Some aircraft are equipped with three-bladed, fully feathering Hamilton Standard hydromatic propellers. A propeller governor on each engine automatically adjusts the pitch angle of the blades to maintain constant engine speed under varying flight conditions. Governor settings are controlled from the flight compartment by means of the propeller lever for the respective engine. Automatic and manual feathering controls are provided, autofeathering being provided for use during take-off only. The power supply for the feathering system is taken from the main bus; three circuit breakers, located on the circuit breaker panel, protect the system.

2-37. Propeller levers. Two propeller levers are located on the overhead console (figure 2-4) and move in a quadrant marked PROP. INCREASE, and DECREASE. Each lever is mechanically connected to its respective propeller governor, which incorporates a gear-type pump to boost engine lubricating oil to operate the propeller pitch changing mechanism. A friction lever marked PROP, on the left side of the overhead console, increases the friction of both propeller levers when rotated clockwise.

2-38. Propeller feathering buttons. Two guarded propeller feathering buttons are on the emergency panel (figure 2-20). Each button is marked FEATHER-PUSH, UNFEATHER-HOLD IN. The action of depressing a button operates the feathering oil pump, through the dc supply, and oil under pressure overrides the normal propeller governor action and feathers the propeller. During the feathering operation a red light in the button remains illuminated. When the feathering cycle is completed, the button is automatically released to the out position, and the light goes out. After feathering has started, the feathering cycle can be stopped by pulling the button to the out, or normal, position. If this is done before engine speed has dropped below approximately 500 rpm, the blades will return to the pitch corresponding to the rpm setting of the governor. If engine speed has dropped below 500 rpm, the normal unfeathering procedure should be observed. After a propeller has been completely feathered, unfeathering is accomplished by depressing the button and holding it in until propeller rotation begins and then releasing it; the button will then spring out. During the unfeathering operation the light in the button will illuminate, and will go out when the button is released. Once the propeller is rotating, the blades will return to the pitch setting of the governor.

Caution

As a precaution against overspeeding during unfeathering, it is recommended that the propeller lever of the feathered engine be set to DECREASE rpm, the throttle be closed and airspeed reduced to 130 knots or below.

2-39. Autofeathering switch. A two-position toggle switch at the left of the emergency panel (figure 2-20) is marked AUTO FEATHERING, ON and OFF. The switch electrically arms the automatic feathering circuit from the main bus, and once the system is armed operation is automatic. Any variation in thrust in excess of 45 ± 2 1/2% between the two engines will result in automatic feathering of the propeller on the engine developing the lower thrust. When a propeller has been automatically or manually feathered, a blocking relay in the circuit prevents the other propeller from feathering automatically.

Warning

The autofeathering switch must be selected ON before take-off only, and selected to OFF after the power reduction following initial climb. Its use during landing could be hazardous if a go-around is attempted and one propeller feathers due to uneven acceleration of the engines.

2-40. Autofeathering indicator light. A green, press-to-test, indicator light (figure 2-20) adjacent to the autofeathering switch, is powered from the main bus and will illuminate when the autofeathering switch is selected ON, and will go out when the switch is selected OFF. It will also go out if either propeller is feathered while the automatic feathering switch is ON.

2-41. Feather dilution arming switch. On aircraft Serial No. 60-3762 through 61-2594 a two-position toggle switch is installed at the left of the emergency panel (figure 2-20), and is marked FEATHER DILUTION, ON and OFF. On aircraft Serial No. 61-2595 and subsequent, the switch is located on the engine switch panel (figure 2-12), and is marked FEATH. DIL. and OFF. On all aircraft, selection of the switch arms both propeller feathering oil dilution circuits. When the corresponding propeller feathering button is operated, either automatically or manually, the oil dilution valve is energized and fuel is metered into, and dilutes, the propeller feathering oil. This insures satisfactory feathering and unfeathering of the propeller during operations in ambient temperatures below 0°C.

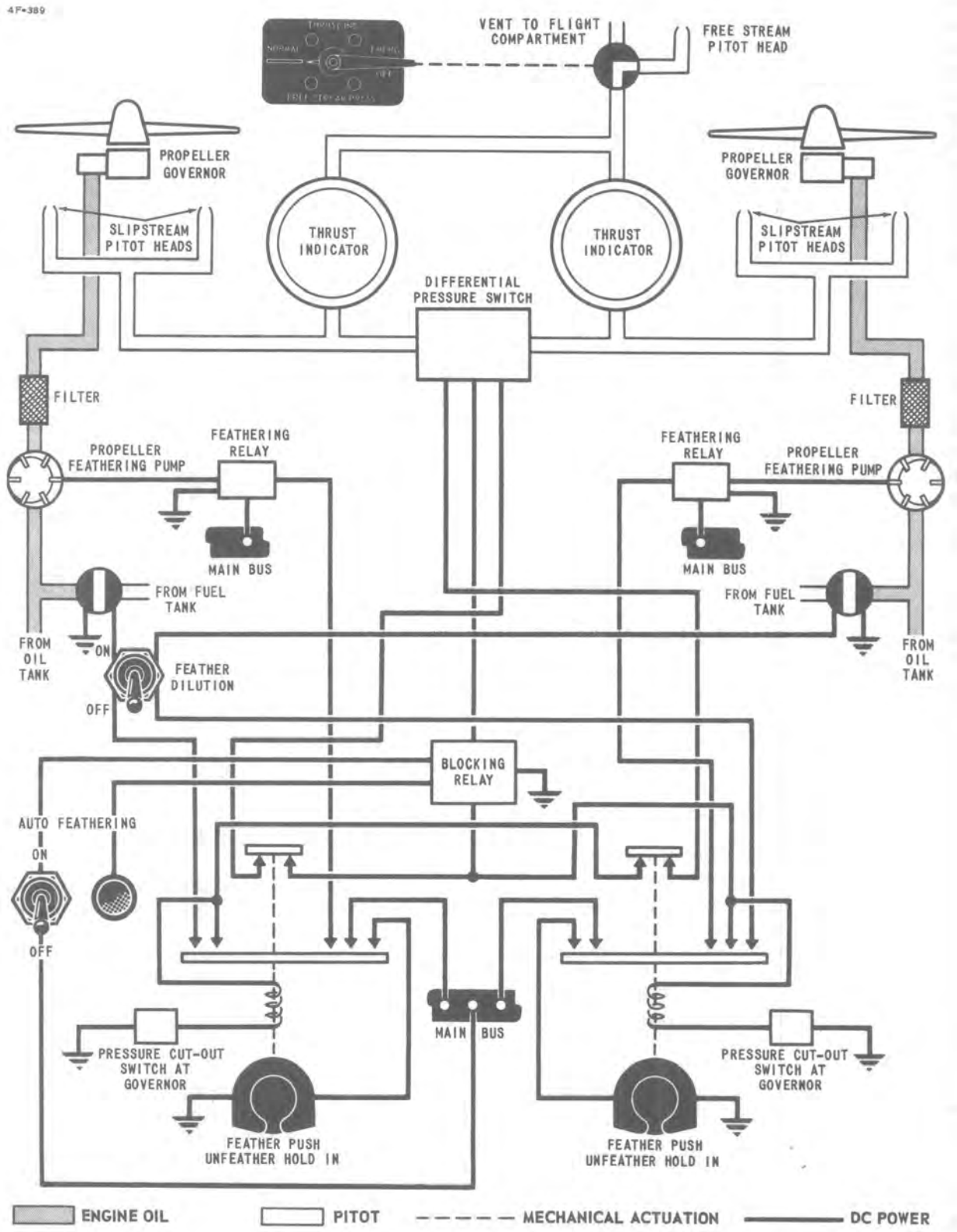


Figure 2-6. Non-reversible propellers system - schematic

2-42. Propellers (Reversible). Some aircraft are equipped with three-bladed, fully feathering, reversible pitch Hamilton Standard hydromatic propellers. Except for the reverse feature, the propellers are similar to the type they replace. Propeller reversing is effected electrically by moving the throttle levers approximately one inch upwards in the idling or closed position. Engine power is increased by moving the throttle levers further aft. Propeller governing does not take place in reverse pitch, the propeller acting as a fixed-pitch unit of minus 8 degrees. Engine speed must not be allowed to exceed 2700 rpm.

2-43. The propeller control unit contains the propeller system fluid supply, which is independent of the engine oil supply, and which is pressurized by a main pump geared to the engine shaft. An auxiliary pump and electrical motor provide pressurized fluid when needed to assist or take the place of the main pump. A governor in the unit controls the constant speed operation. The propeller electrical system is powered from the main bus through circuit breakers on the ENGINE circuit breaker panel. The propeller manual feathering circuits are protected by the 10-ampere LEFT and RIGHT circuit breakers, and the autofeathering switch circuit by the 5-ampere AUTOM. SW. circuit breaker. The propeller reverse circuit is protected by the 10-ampere PROP REV circuit breaker.

2-44. Propeller feathering buttons. Two guarded propeller feathering buttons are on the emergency panel (figure 2-20). Each button is marked FEATHER-PUSH, UNFEATHER-PULL. The action of depressing a button operates the auxiliary pump to supply hydraulic pressure to feather the propeller. During the feathering operation a red light in the button remains illuminated. When the feathering cycle is completed the button is automatically released to the neutral position. After feathering has started the feathering cycle can be stopped by pulling the button out to the neutral position. If this is done before engine speed has dropped below approximately 500 rpm, the blades will return to the pitch corresponding to the rpm setting of the governor. If engine speed has dropped below 500 rpm, the normal unfeathering procedure should be observed. After a propeller has been completely feathered, unfeathering is accomplished by pulling out the button until propeller rotation begins (500 - 600 rpm) and then releasing it, when it will return to the neutral position. During the unfeathering operation the light in the button will illuminate, and will go out when the button is released. Once the propeller is rotating, the blades will return to the pitch setting of the governor. See Caution, paragraph 2-38.

Caution

During feathering, unfeathering, and reversing cycles the propeller auxiliary pump motor is operating. To prevent burn-out of motor, propeller operations must be restricted to 20 seconds on (intermittent duty) and 10 minutes off.

2-45. Autofeathering switch. Refer to paragraph 2-39.

2-46. Autofeather indicator light. Refer to paragraph 2-40.

2-47. Feather dilution arming switch. This switch is deleted when reverse pitch propellers are installed. A separate hydraulic fluid supply is used for these propellers, and there is no requirement for feather dilution.

2-48. Propeller fluid low level lights. Two amber lights, one for each propeller hydraulic system are located adjacent to the respective feathering button, and are marked PROP OIL. A light will illuminate if the oil level in the respective propeller hydraulic fluid sump drops to 10 quarts approximately.

2-49. Propeller reverse indicator light. Two blue lights, one for each propeller, are mounted on the side panel to the left of the emergency panel, and marked PROP REVERSE. The lights are actuated by propeller blade microswitches when the blades reach approximately 7 degrees reverse pitch.

2-50. Throttle levers. Refer to paragraph 2-9.

2-51. Oil System. Each engine has a separate oil system. On aircraft with non-reversible propellers each system consists primarily of an oil tank, an oil cooler, an engine-driven oil pump, a propeller feathering pump, an oil emergency shutoff valve, an oil dilution valve, and the necessary piping and controls for engine lubrication, oil dilution, and propeller feathering. The oil tank has a total volume of 29.7 US gallons, consisting of 22.2 US gallons of oil, 18 US gallons of which is usable oil, and 7.5 US gallons airspace. A flap, adjustable on the ground, is incorporated in the oil cooler air exit duct and is normally set in the down (closed) position except in extreme hot weather conditions. For oil specification and grade, see figure 2-23; for oil quantity data table see figure 2-22. On aircraft with reversible propellers the propellers are controlled by individual hydraulic oil systems; there is no feathering well or feathering

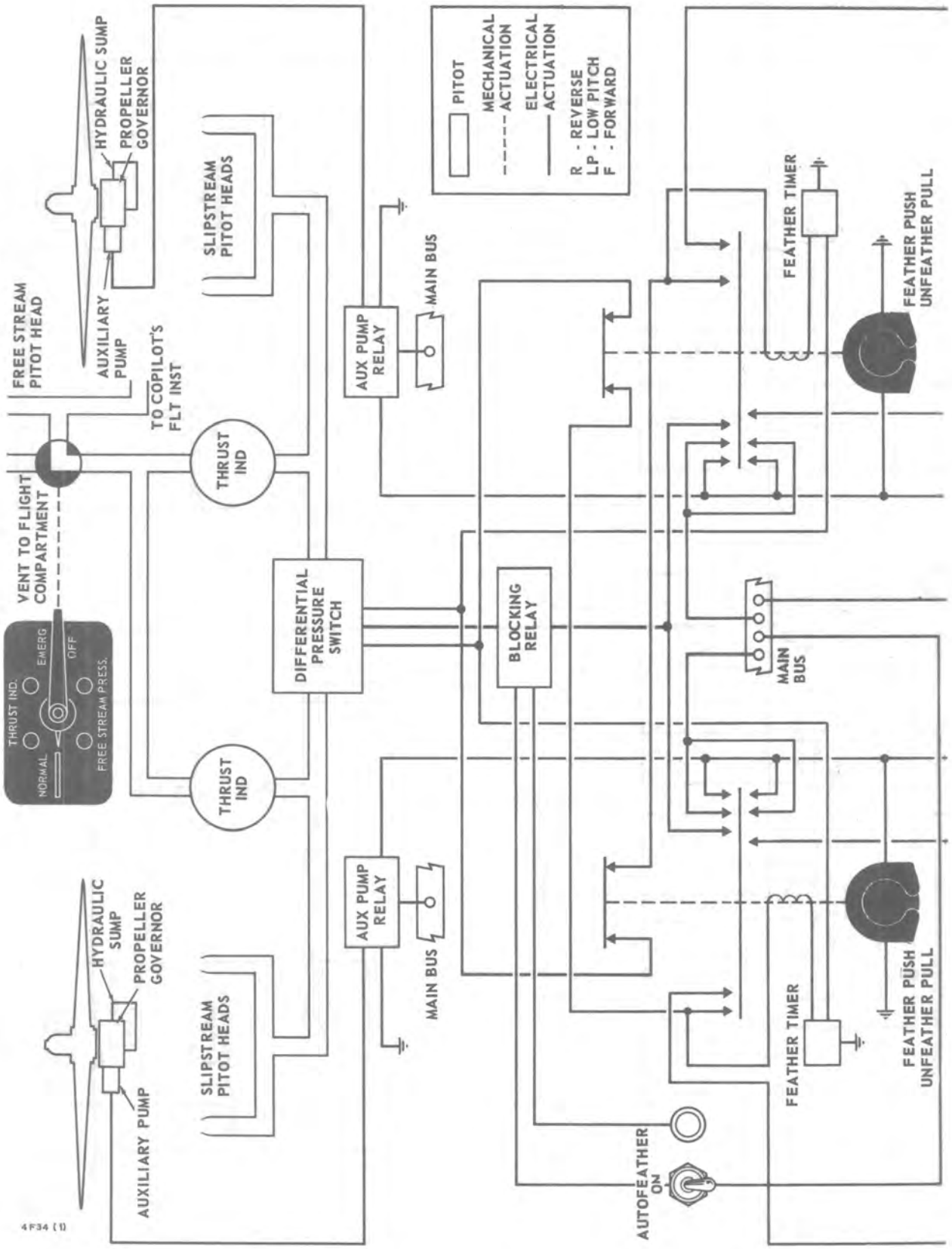


Figure 2-7. Reversible propellers system - schematic (sheet 1 of 2)

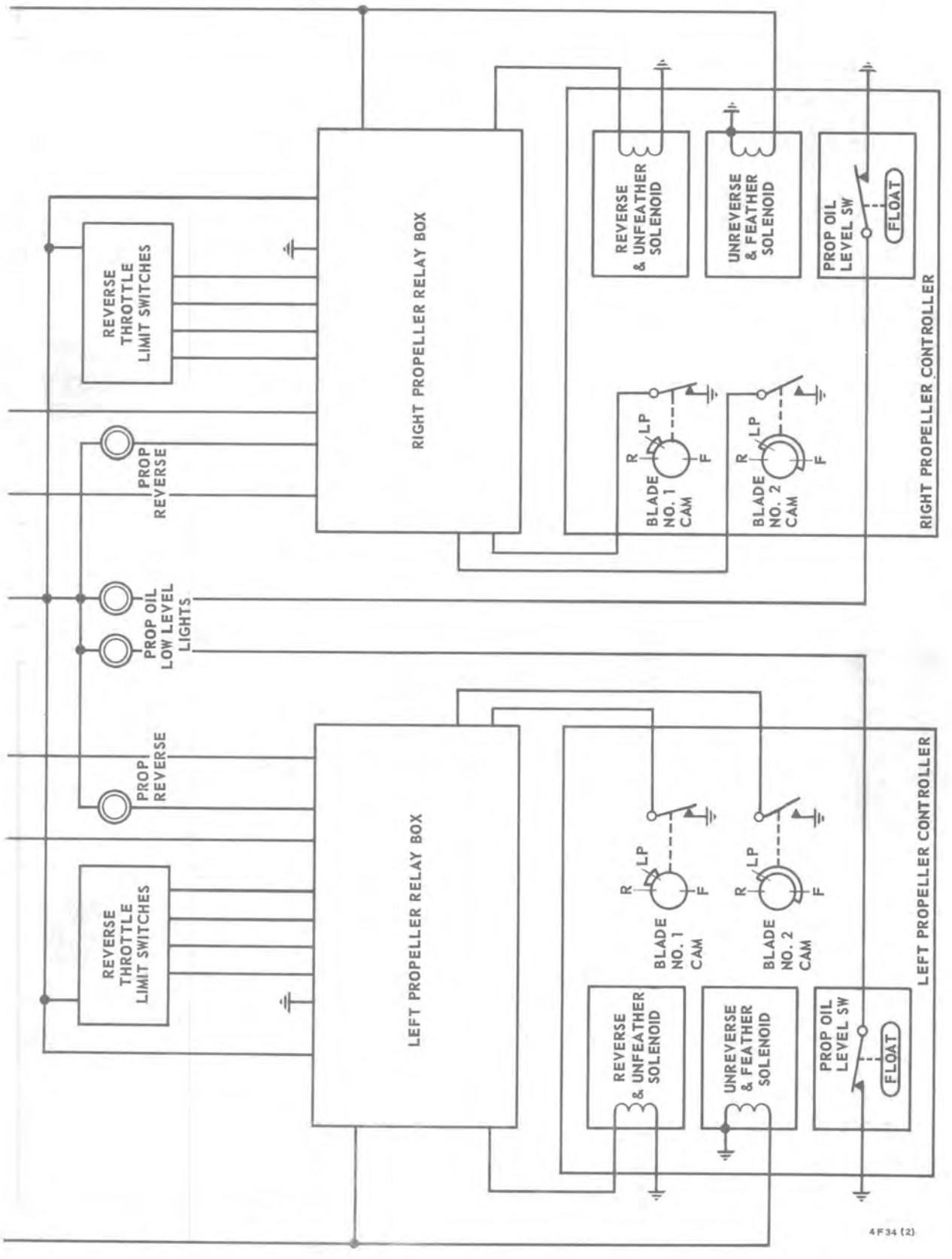


Figure 2-7. Reversible propellers system - schematic (sheet 2 of 2)

pump in the engine oil system. Therefore, the oil tank total volume of 29.7 US gallons on these aircraft consists of 22.2 US gallons of oil, 20.4 US gallons of which is usable oil, and 7.5 US gallons airspace.

2-52. Oil emergency shutoff switches. Two guarded oil emergency shutoff switches, one for each engine, are on the emergency panel, (figure 2-20) and each is marked OIL SHUT OFF with the guard marked HYD & ENG. Each switch is electrically connected to the fuel, hydraulic, and oil emergency shutoff valves of its respective engine and, in addition, the respective propeller deicing circuits are routed through this switch. When the switch is selected to the up position, the emergency shutoff valves of that engine are simultaneously closed by power from the emergency bus, and propeller deicing is rendered inoperative on that side.

2-53. Oil dilution switches. Two oil dilution switches, marked OIL DILUTION, L, R, and OFF and ON, are located at the extreme left-hand side of the engine switch panel (figure 2-12). They are two-position, momentary-contact, toggle switches spring-loaded to the OFF position. When the switches are held to the ON position the oil dilution valves in the fuel and oil systems are opened by power from the main bus to allow fuel to be metered into the oil system.

2-54. Oil pressure gage. Refer to paragraph 2-30.

2-55. Oil temperature gage. Refer to paragraph 2-31.

2-56. Oil low pressure warning light. Refer to paragraph 2-32.

2-57. Low oil level warning light. Refer to paragraph 2-33.

2-58. Fuel System. Fuel is carried in two main tanks (figure 2-8) which have a total capacity of 4968 pounds (828 US gallons). One tank is located in each outer wing and consists of ten rubber cells interconnected by a manifold which drains into the inboard (No. 1) cell. On aircraft Serial No. 62-4167 and subsequent, the inboard five cells in each wing are of self-sealing construction, with No. 1 cell having an armor plated cell access panel. The total capacity of the two main tanks which incorporate self-sealing cells is 4836 pounds (806 US gallons). Fuel is pumped from the inboard cell by an electrically-driven fuel booster pump in that cell, through a fuel-tank selector valve, strainer, fuel emergency shutoff valve, and engine-driven fuel pump to the engine on the same side as the tank; a crossfeed line and a fuel-tank crossfeed valve enable fuel from either tank to be supplied to the engine on the opposite side. Each tank has a filler neck in No. 7 cell, and is vented to the wing undersurface. For fuel specification see figure 2-23. A fuel panel marked FUEL SELECTOR (aircraft 60-3762 through 61-2598) or FUEL CONTROL (aircraft 61-2599 and subsequent) in front of the pilot and to the left of the engine instrument panel incorporates the fuel tank selector switch, booster pump switches, fuel quantity indicators, fuel low level warning lights, fuel quantity test switches, and fuel low pressure warning lights. (For long range ferry fuel system refer to Chapter 9, Section II.)

2-59. Fuel tank selector switch. The rotary type fuel-tank selector switch located on the fuel panel (figure 2-9), on aircraft Serial No. 60-3762 through 61-2598, has four positions marked, in sequence from the left, OFF, BOTH ON RH TANK, NORMAL, and BOTH ON LH TANK. On aircraft Serial No. 61-2599 and subsequent the switch has four positions marked, in sequence from the left, OFF, BOTH ON LH TANK, NORM, and BOTH ON RH TANK. On all Model CV-2 aircraft, when the switch is at OFF the fuel supply to both engines is shut off; at BOTH ON RH TANK fuel is pumped from the right-hand tank to both engines; at NORMAL the crossfeed valve is closed and fuel is fed from each tank to its respective engine; at BOTH ON LH TANK fuel is fed from the left-hand tank to both engines. The switch is connected electrically to two motor-driven selector valves and a motor-driven crossfeed valve in the fuel supply lines. Power is supplied from the emergency bus. A spring-loaded button, to the right of the selector, must be depressed before the switch can be moved to the OFF position. A line schematic of the fuel system is marked on the fuel panel and indicates the fuel flow to the engines both in the normal and crossfeed positions of the switch.

2-60. Fuel booster-pump switches. Two three-position toggle switches on the fuel panel (figure 2-9) are marked BOOST PUMP; the three positions are marked NORM, OFF, and HIGH. The switch should be in the NORM position for takeoff, climb, and landing to insure an adequate fuel supply at normal pressure in the event of failure of the engine-driven fuel pump. For cruising, the switch should be in the OFF position. In the HIGH position, sufficient pressure is available, should an engine-driven fuel pump fail, for the normal operation of both engines from one tank. The switches electrically control the actuation of the related fuel booster pumps and are powered from the main bus.

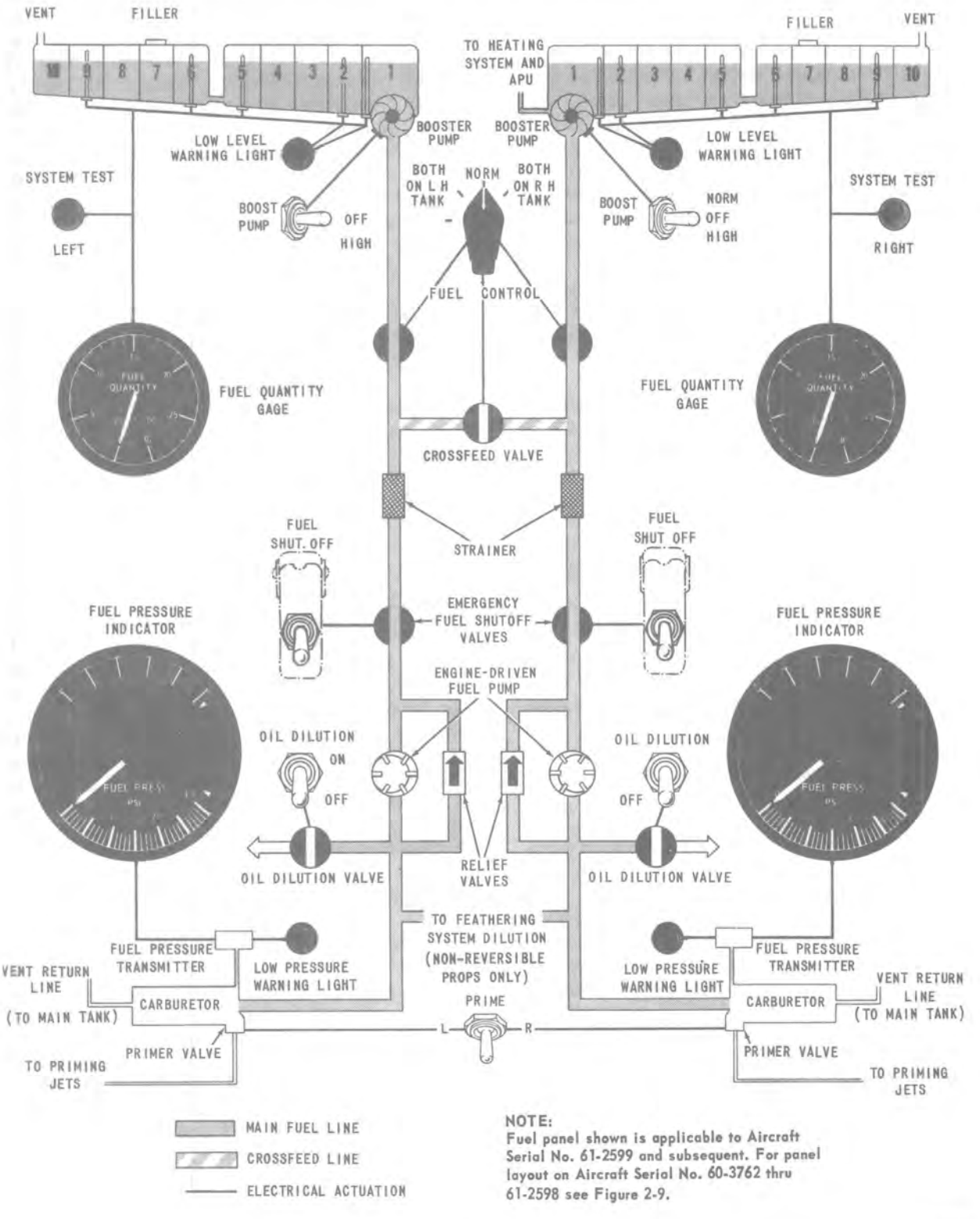


Figure 2-8. Fuel system - schematic

2-61. Fuel quantity gages. Two fuel quantity gages, are located on the fuel panel (figure 2-9). They are marked USABLE FUEL and are calibrated from 0 to 3000 pounds in 100 pound increments. The gages are used with electrical capacitance type probes to indicate the amount of usable fuel in the related tanks. Power is supplied from the ac bus.

2-62. Fuel quantity indicating system test switches. Two button-type test switches (figure 2-9) on the fuel panel, immediately above the fuel quantity gages, are marked SYSTEM TEST and LEFT and RIGHT respectively. When the switches are pressed, the pointers in the related fuel quantity gages should fall to zero.

2-63. Fuel low level warning lights. Two amber press-to-test fuel low level warning lights, one for each tank, are located on the fuel panel (figure 2-9) and marked LOW LEVEL. The warning lights are set to illuminate when the fuel in the relevant tank drops below 110 pounds (100 pounds when self-sealing tanks are installed). Power is supplied from the emergency bus.

2-64. Fuel emergency shutoff switches. Two guarded emergency switches marked FUEL-SHUT OFF are located on the emergency panel (figure 2-20). Each switch is connected to a shutoff valve in the fuel supply line to its respective engine. When selected up, the respective shutoff valve is closed.

2-65. Fuel pressure gage. Refer to paragraph 2-30.

2-66. Electrical Power Supply System. The electrical power supply system is primarily a 28-volt direct current installation. It is supplemented by a 115-volt, 400-cycle alternating current installation, powered by the dc system through an inverter.

2-67. Direct Current Power Supply System. The dc system is a 28-volt, single conductor system grounded to the aircraft structure. Power is supplied by two engine-driven, 300-ampere, 30-volt generators regulated to a nominal 28 volts, with a 24-volt, 34-ampere-hour battery as a standby source; and through an external power supply for ground operations. Power is distributed through a multiple bus network consisting of a main, secondary, emergency and battery bus.

2-68. Generator switches. Two generator switches are located on the electrical power panel (figure 2-14) in front of the copilot's position and



Figure 2-9. Fuel panel

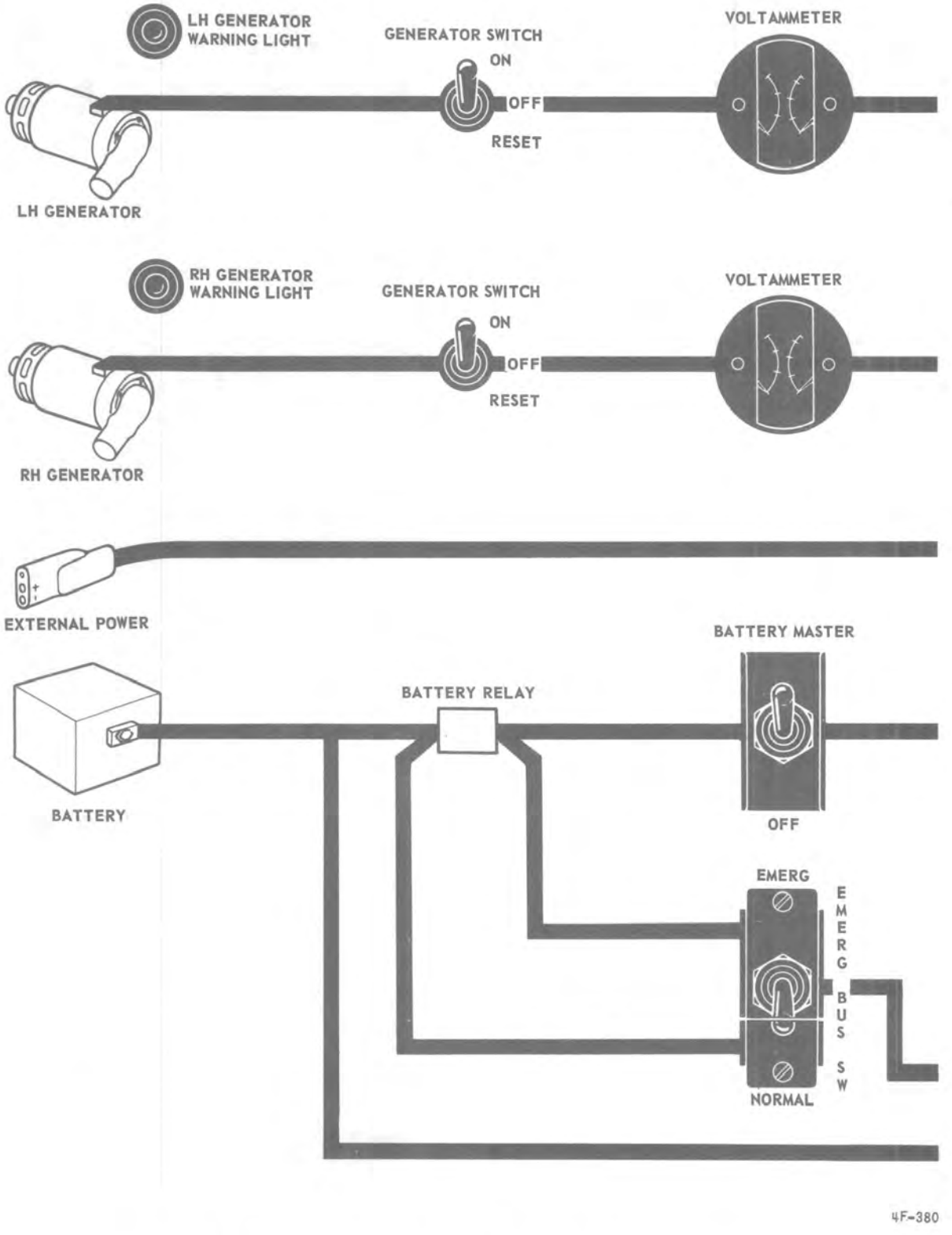


Figure 2-10. DC electrical system - schematic (sheet 1 of 2)

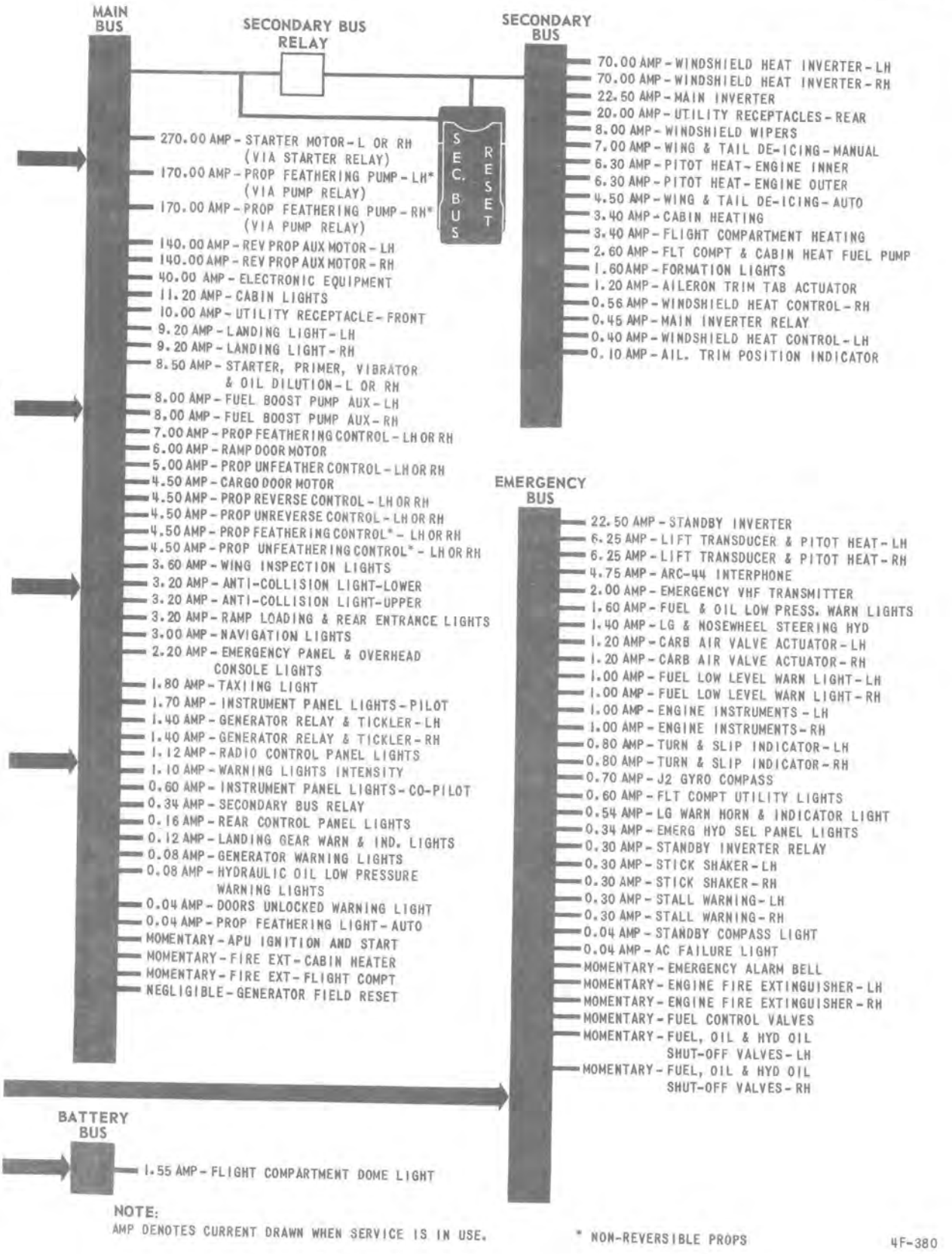


Figure 2-10. DC electrical system - schematic (sheet 2 of 2)

are marked LH GEN and RH GEN respectively with positions marked ON, OFF and RESET. With the switch at ON the respective generator will be connected to the main bus, provided the generator output is 0.35 to 0.70-volt greater than the main bus voltage. The RESET position of the switch restores the generator field circuit if the generator field relay trips due to excessive voltage in the system.

2-69. Generator warning lights. Two generator press-to-test red warning lights marked GEN WARN, are located adjacent to their respective generator switches on the electrical power panel (figure 2-14). The appropriate light will illuminate if the output of the respective generator does not exceed the main bus output by 0.35 to 0.70-volt. The lights intensity can be controlled by the warning lights intensity switch. Refer to Chapter 6, paragraph 6-90. The generator warning lights circuit is protected by the 5-ampere circuit breaker marked GEN WARN LIGHTS on the dc power section of the circuit breaker panel. (See figure 2-13.)

2-70. Voltammeters. Two voltammeters marked D.C., one for each generator, are located above the dc electrical power panel (figure 2-14), and indicate the main bus voltage and the amperage (or load) on the respective generator. Each indicator has two scales, one marked VOLTS and the other AMPS. Red and black colored test jacks, marked VOLTMETER, LH AMMETER and RH AMMETER, are located adjacent to the flight compartment heating control panel.

2-71. Battery. A 24-volt, 34-ampere-hour battery and a sump jar, are located below the flight compartment floor. (See figure 2-21.) Access is gained through a hatch in the flight compartment floor hatch well.

2-72. Battery master switch. The guarded battery master switch is located on the engine switch panel, (figure 2-12), and is marked BATTERY MASTER and OFF at the up and down positions respectively. With the switch in the BATTERY MASTER position, the battery energizes the main bus if generator output voltage is less than battery voltage. With the switch in the OFF position the battery supplies power to the battery bus only. With the battery master switch OFF and the emergency bus switch at EMERG, the battery is directly connected to the emergency bus.

2-73. Main bus. The main bus distributes power necessary for normal flight operation, and is energized by one or both generators when the appropriate generator switches are ON and a generator voltage output is 0.35 - 0.70-volt greater than the main bus voltage output, or output provided by external power. When the generator output is less than stipulated (e.g. two generator failure) the main bus will be energized by the battery, provided the battery master switch is at BATTERY MASTER.

2-74. Secondary bus. The secondary bus (figure 2-10) distributes power to electrical equipment considered of secondary importance to flight safety. The secondary bus is energized from the main bus through the secondary bus relay and two bus control relays. Each generator energizes its own bus control relay; should one generator fail, the secondary bus will be deenergized. However, should certain items of electrical equipment supplied by the secondary bus be required for flight, the secondary bus may be supplied from the remaining generator by selecting ON the SEC BUS RESET switch to override the secondary bus relay.

2-75. Secondary bus reset switch. The secondary bus reset switch is located on the circuit breaker panel (figure 2-13) and is marked SEC BUS RESET. The switch is guarded and when the guard is down the switch is OFF. If a generator fails, the guard and switch may be selected up to override the secondary bus relay and allow the selection of services normally powered from the secondary bus.

2-76. Emergency bus. The emergency bus distributes power to items of electrical equipment considered essential to flight safety, and is normally powered from the main bus. Should failure of both generators cause main bus power to fail, then the battery will automatically supply the main bus, and thus the emergency bus also. Under these conditions battery power should be conserved by switching the EMERG BUS SW to EMERG and the BATTERY MASTER switch to OFF. This will deenergize the main bus and allow the emergency bus to be supplied directly from the battery.

2-77. Emergency bus switch. The emergency bus switch is located on the circuit breaker panel (figure 2-13), and is marked EMERG BUS SW with positions EMERG and NORMAL. In the normal position, the main bus supplies the emergency bus; in the emergency position the emergency bus is connected directly to battery power. When an EMERG selection is necessary, the BATTERY MASTER switch should be set to OFF to isolate the main bus and conserve battery power.

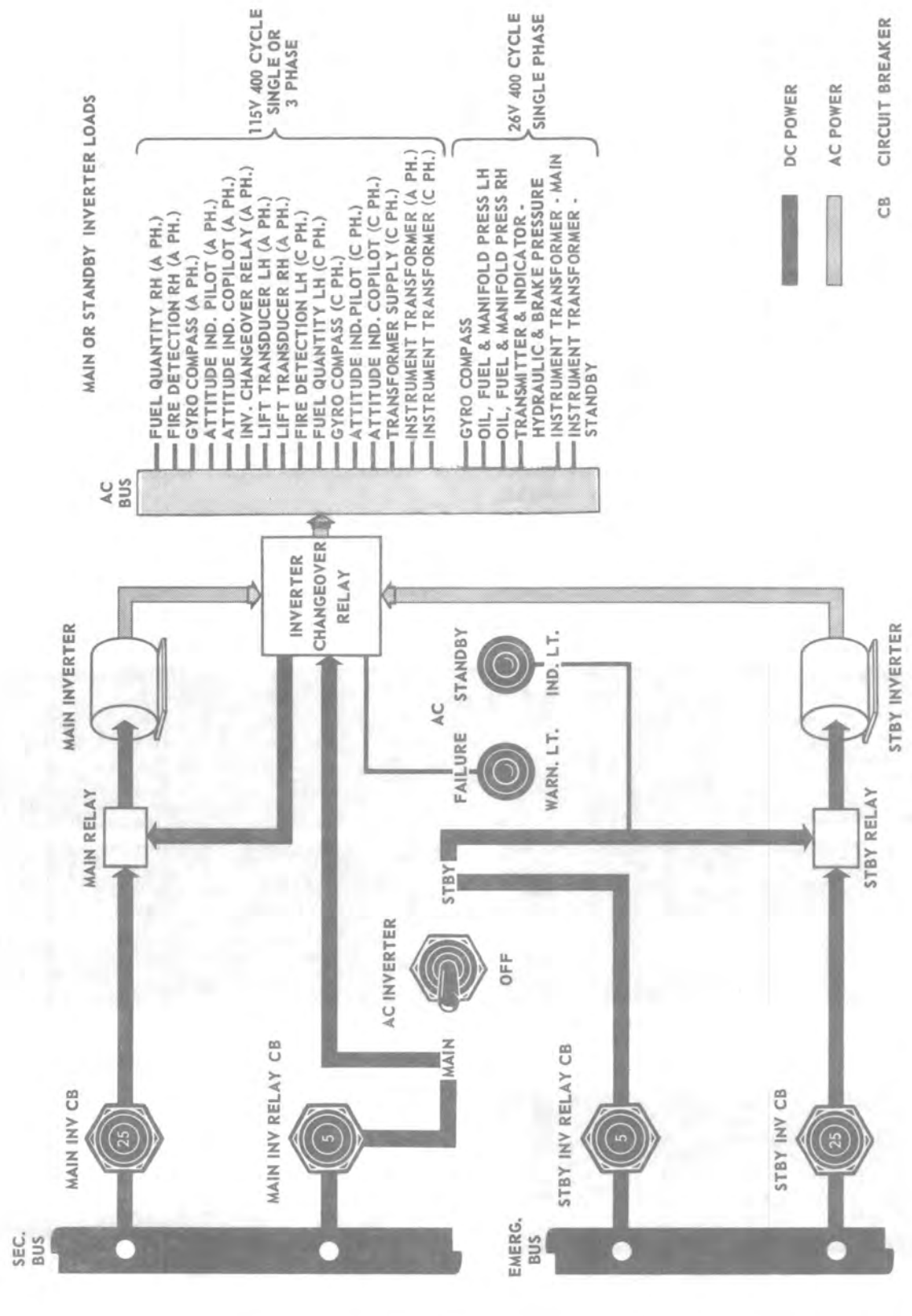


Figure 2-11. AC electrical system - schematic

2-78. Battery bus. The battery bus (figure 2-10) is energized from the battery and supplies power to the flight compartment dome and the utility light on the overhead console.

2-79. Circuit breakers. The circuit breakers are located on the circuit breaker panels (figure 2-13) on the forward face of the flight compartment rear bulkhead aft of the pilot's position. The circuit breakers are of the thermal, push-to-reset type.

2-80. External power receptacle. The external power receptacle (figure 2-21) is located on the left-hand side of the fuselage adjacent to the main gear. An access door protects the receptacle when not in use. When an external power source is connected to the receptacle the main and secondary buses are energized.

2-81. DC utility receptacle. Three covered dc utility receptacles are provided in the aircraft, one in the flight compartment on the right-hand side near the floor doors, one on the interior lights panel facing the left-hand passenger door, and one in the tail section aft of the cargo door opening. The flight compartment receptacle is powered from the main bus and is protected by the 10-ampere circuit breaker marked FRONT; the two rear receptacles are powered from the secondary bus and are protected by the 20-ampere circuit breaker marked REAR.

2-82. Alternating Current Power Supply System. Two three-phase, 400-cycle inverters, main and standby, convert 28-volt direct current to 115-volt alternating current. The ac instrument buses distribute power to the ac equipment (figure 2-11) and can be energized by either the main or standby inverter. The main inverter is powered from the secondary bus and the standby inverter from the emergency bus. With these two buses energized, automatic changeover from the main to standby inverter takes place if the main inverter fails, or if the external power source is disconnected from the aircraft when the engines are inoperative and the inverter switch and battery master switch are at MAIN and BATTERY MASTER respectively.

2-83. Inverter switch. The inverter switch is a three-position toggle switch located on the electrical power panel (figure 2-14) in front of the copilot's position. The switch is marked INVERTER with positions marked MAIN, OFF, and STBY. When selected to MAIN or STBY the re-

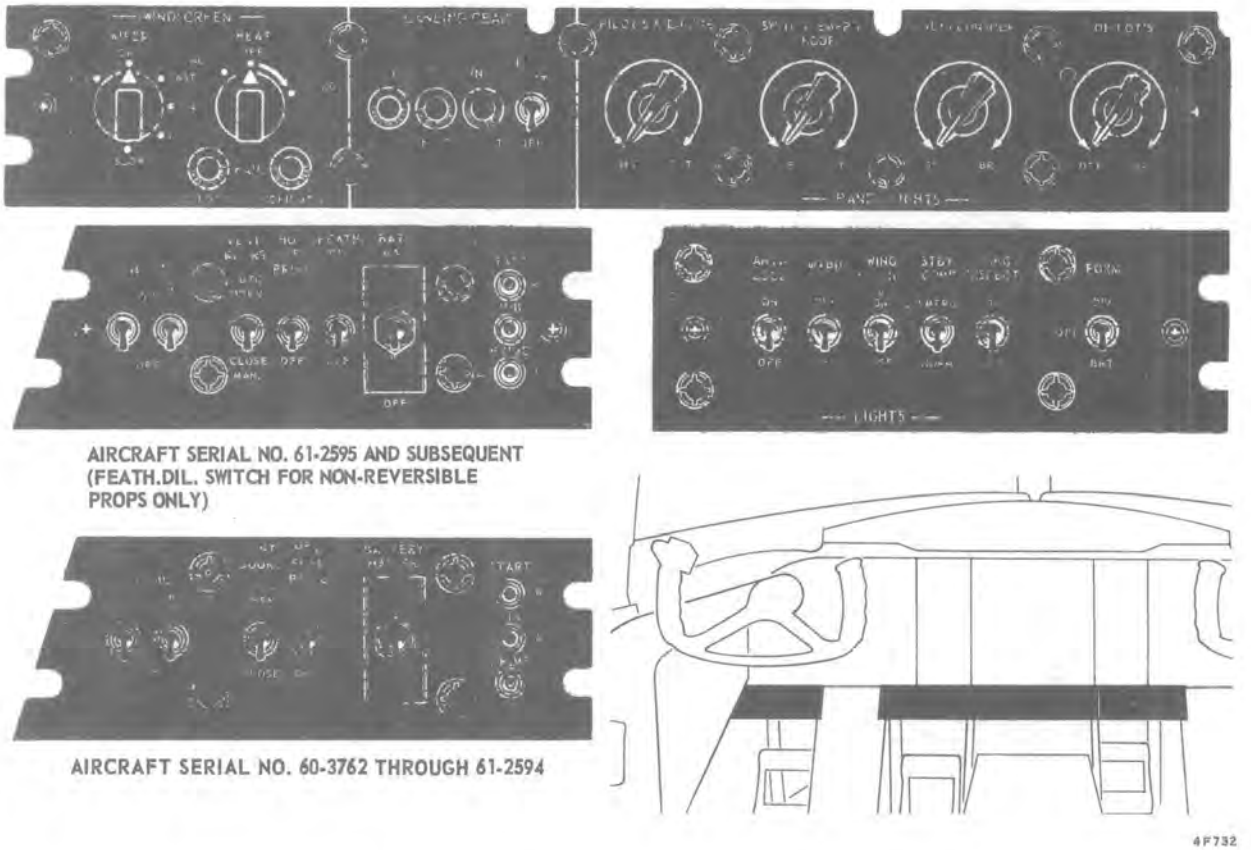
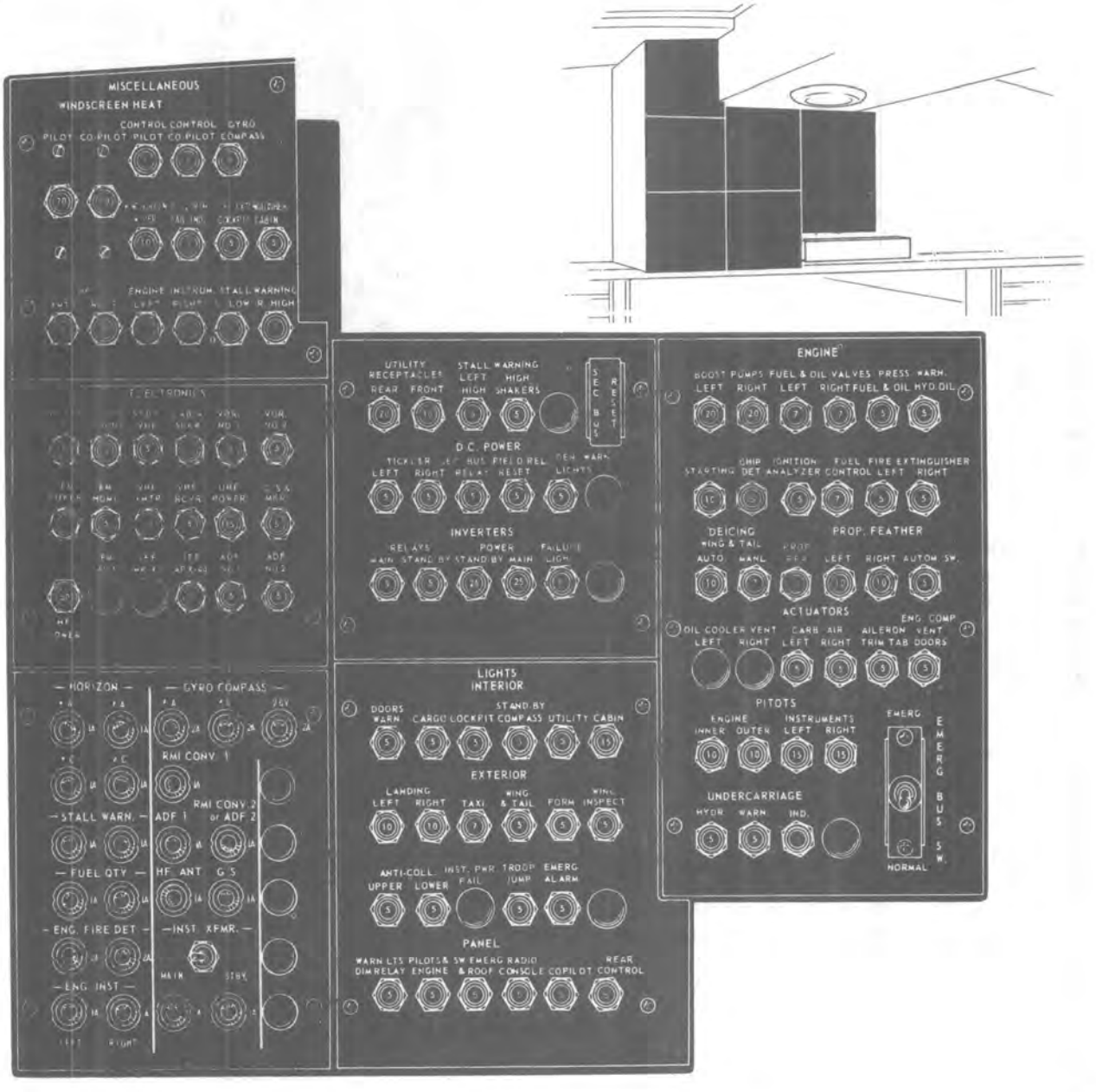


Figure 2-12. Electrical switch panels

spective inverter energizes the ac instrument buses. When the switch is selected to OFF, both inverter circuits are deenergized.

2-84. AC failure light. An ac failure warning light marked FAILURE is located on the ac power panel (figure 2-14). The light will illuminate if the inverter switch is at OFF, if the inverter switch is at STBY and the standby inverter fails, or if the inverter switch is at MAIN and both inverters fail. The light circuit is protected by the 3-ampere circuit breaker marked FAILURE LIGHT on the INVERTERS section of the circuit breaker panel.

2-85. AC standby inverter light. An ac standby light marked STANDBY is located on the electrical power panel (figure 2-14). The light will illuminate when the main inverter fails and the standby inverter comes into operation, and also



4F40

Figure 2-13. Circuit breaker and fuse panels - typical

when the inverter switch is in the STBY position. The light circuit is protected by the 5-ampere circuit breaker marked RELAYS - STAND-BY on the INVERTERS section of the circuit breaker panel.

2-86. Alternating current instrument transformers. Two 115/26 volt ac instrument transformers, main and standby, reduce the 115-volt ac supply from the inverter to provide 26-volt ac for the flight and engine instruments. Two one-ampere fuses, MAIN and STBY, protect the circuits to each transformer against overload.

2-87. Instrument transformer selector switch. An instrument transformer switch on the ac fuse panel (figure 2-13) is marked INST. TRANSFORMER, with positions MAIN and STBY. Malfunction of the main instrument transformer will be indicated by illumination of the 26 V.AC failure light. Positioning of the selector switch to STBY will allow the instruments to be powered via the standby instrument transformer.

2-88. Instrument transformer failure light. An instrument transformer failure light on the co-pilot's flight instrument panel (figure 2-18), is marked 26 V.AC. The light will illuminate if the 26-volt ac power from the main instrument transformer fails.

2-89. Hydraulic Power Supply System. The normal hydraulic system (figure 2-15) is primarily powered by two engine-driven hydraulic pumps, one on each engine, which supply fluid at pressure from the hydraulic reservoir to operate the landing gear, wing flaps, wheel brakes, and nose-wheel steering circuits. In the event of a malfunction of the engine-driven pumps, or when they are inoperative, power can be supplied for operation of all the circuits of the normal hydraulic system by means of a manually-actuated hydraulic handpump in the flight compartment, provided the handpump selector (figure 2-17) is positioned at NORMAL SYSTEM. In the event of low fluid level in the hydraulic reservoir, or malfunctioning of the system, the handpump can be used to supply power for the emergency system, provided the handpump selector is positioned at EMERGENCY SYSTEM. In this condition the handpump draws fluid from the emergency reserve level of the hydraulic reservoir to replenish the wheel brakes hydraulic accumulator and to extend the nose gear, provided the brake accumulator handpump charging and nose gear down handpump selectors are at ON.



Figure 2-14. AC-DC power panels

2-90. Normal Hydraulic System. The normal hydraulic system consists of the engine-driven hydraulic pumps, hydraulic reservoir, filters, check valves, thermal relief valves, a hydraulic system pressure gage, pressure switches, low pressure warning lights, a pressure shutoff valve, and the handpump. Fluid drawn from the reservoir by the engine-driven pumps is supplied at a regulated nominal pressure of 3000 psi to the actuating cylinders of the various hydraulic circuits, through a series of filters, selector valves, check valves, and restrictors. The handpump is used to supply power in the event of malfunctioning of the engine-driven pumps, or when they are inoperative. A reservoir sight-gage on the bulkhead behind the pilot has a label arrowed at the FULL and REFILL positions. It also states the quantity and specification of the hydraulic fluid used.

2-91. Hydraulic pressure shutoff valve lever. The hydraulic pressure shutoff lever is immediately forward of the cabin and flight compartment heating control panels, on the bulkhead behind the pilot's seat. The lever is marked HYDRAULIC PRESSURE SHUTOFF VALVE with positions marked ON and OFF, the forward position of the lever being ON and the aft position OFF. In the event of a serious loss of fluid in flight, selection of the lever to OFF shuts off the hydraulic fluid supply to all circuits. The fluid in the wheel brake system, however, will permit the brakes to be operated enough times for a normal landing, provided the brake hydraulic pressure gage is registering near normal pressure before applying the brakes.

Caution

The hydraulic pressure shutoff valve lever must not be left in an intermediate position between ON and OFF. A partially closed valve will cause excessive heating of the hydraulic fluid due to restriction of flow and resultant damage to hydraulic system seals.

2-92. Hydraulic system pressure gage. The hydraulic system pressure gage mounted on the pilot's pedestal (figure 2-16), is remotely operated by an electro-hydraulic pressure transmitter connected to the pressure line of the normal hydraulic system. Power is taken from the 26-volt, 400-cycle ac bus. The gage is marked SYSTEM HYDRAULIC PRESSURE and is calibrated from 0 to 4000 psi.

2-93. Hydraulic low pressure warning lights. Two hydraulic low pressure amber warning lights are mounted above the hydraulic pressure gage on the pilot's pedestal (figure 2-16) and are marked HYDRAULIC PUMPS, LOW PRESSURE, and LEFT and RIGHT respectively. The press-to-test lights are powered from the main bus and will go out when the pressure in their respective systems reaches 1500 psi, and will illuminate when the pressure drops to 1100 psi. Malfunctioning of one pump does not appreciably affect the system except for a slight increase in retraction time of the landing gear and does not, therefore, constitute an emergency or necessitate aborting the flight. The low pressure warning lights are provided to give an indication that a pump is defective.

Note

The low pressure warning lights may flicker during gear extension under certain conditions, but a momentary flicker does not indicate a fault in the system.

2-94. Emergency Hydraulic System. The emergency hydraulic system consists of the hydraulic handpump and four selector valves (figure 2-17). The four selector valves are for nosewheel down, brake accumulator charging, landing gear emergency down, and system selection. The system is used, in the event of low fluid level in the hydraulic reservoir or malfunctioning of the normal hydraulic system, to supply fluid at pressure from the emergency reserve level of the reservoir to replenish the wheel brakes hydraulic accumulator and to extend the nose gear. Before the system can be used, the handpump selector must be positioned at EMERGENCY SYSTEM and each of the other three selectors at ON as desired.

2-95. Hydraulic handpump and handle. The hydraulic handpump is beneath an access door in the flight compartment floor at the forward left-hand side of the sliding console (figure 2-17). The removable handpump handle is stowed in clips on the back of the copilot's seat and, when inserted into the handpump socket, can be actuated with a fore-and-aft motion to supply pressure to the hydraulic system.

2-96. Hydraulic handpump selector. The hydraulic handpump selector on the hydraulic emergency selector panel (figure 2-17) is marked HANDPUMP SELECTOR, with positions NORMAL SYSTEM and EMERGENCY SYSTEM. When positioned at NORMAL SYSTEM, the hydraulic handpump can be actuated to supply pressure to the normal hydraulic system in the event of malfunction of the engine-driven pumps or when they are inoperative. When positioned at EMERGENCY SYSTEM, the handpump can only be used to replenish the wheel brakes hydraulic accumulator and to extend the nose gear, provided their selectors are at ON.

Note

The emergency hydraulic system does not extend the main gear. The main gear emergency extension is mechanically actuated. Refer to paragraph 2-120.

2-97. Flight Control System. The primary flight control surfaces consist of ailerons, elevators, and rudder. They are actuated mechanically from either the pilot's or copilot's position by interconnected and conventional wheel-type control columns and rudder pedals. The range of aileron movement, however, varies in accordance with the position of the wing flaps. Trim tabs, operated from the flight compartment, are located on the right outboard aileron, the elevators, and on the

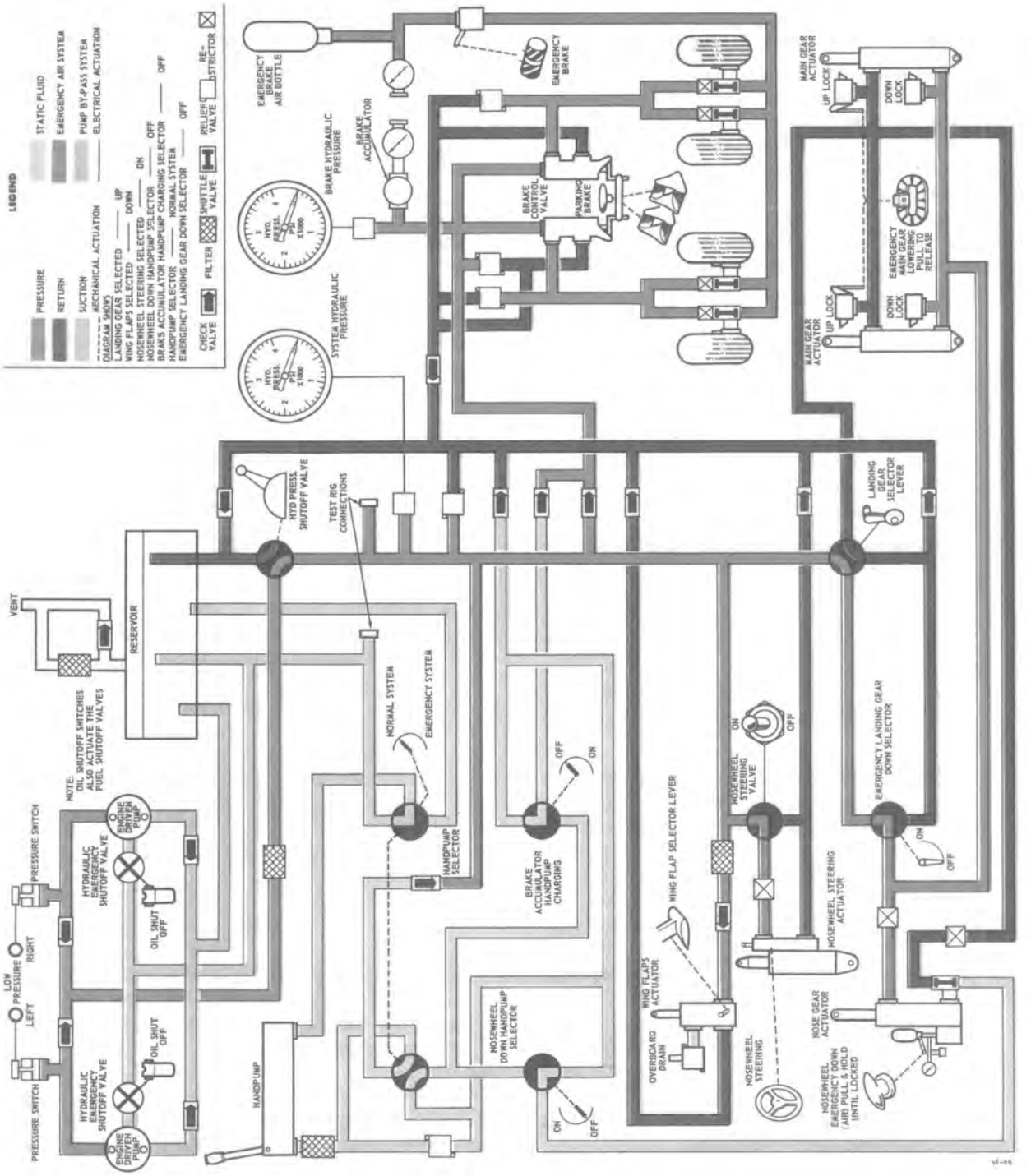


Figure 2-15. Hydraulic system - schematic

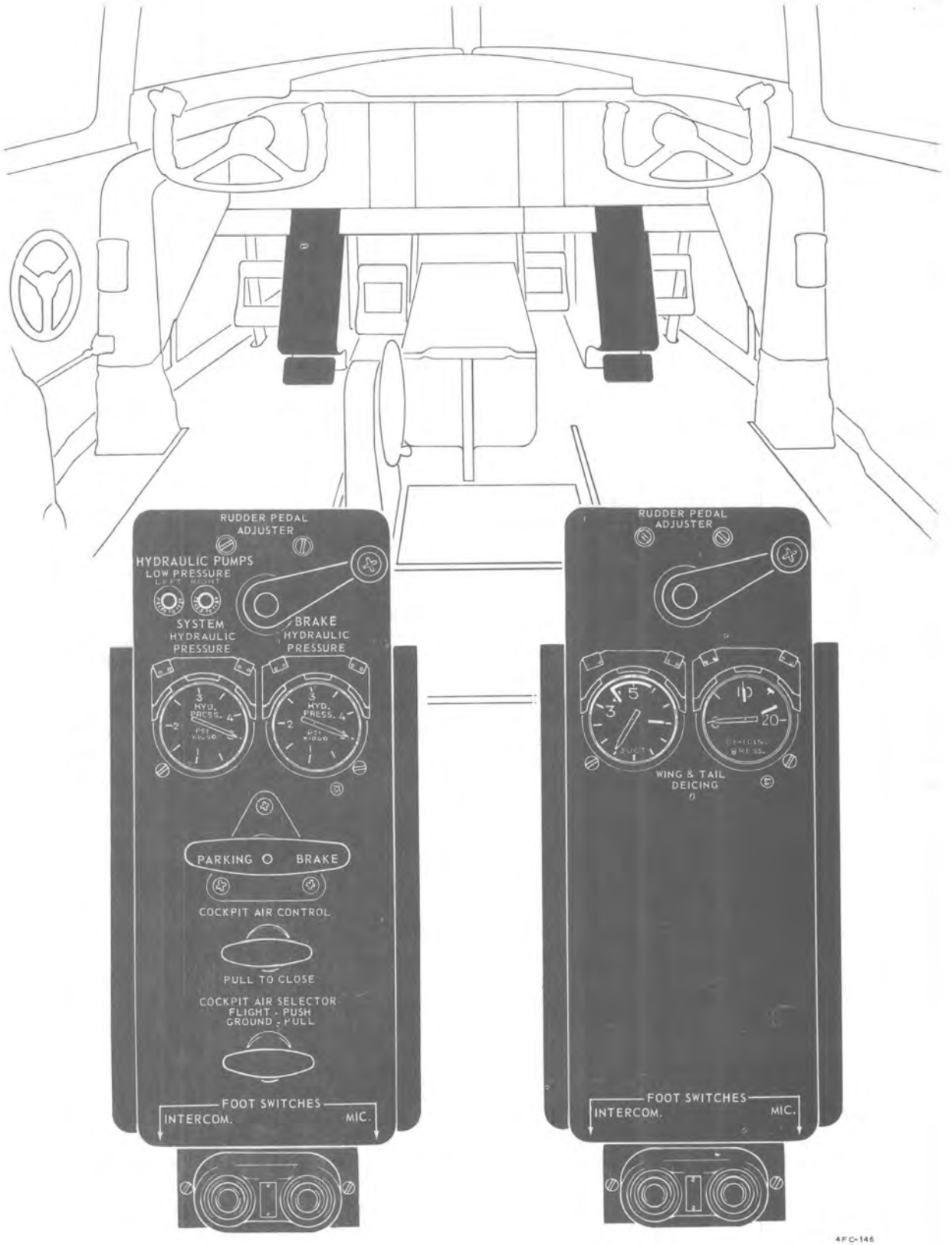


Figure 2-16. Pilot and copilot pedestals

rudder. An artificial stall warning system is incorporated.

2-98. Control column. A control column with a W-type control wheel (figure 2-3), is provided at both the pilot's and copilot's positions. Movement of the control column fore or aft mechanically actuates the elevators and controls the aircraft in the pitching plane. Rotation of the control wheel mechanically actuates the ailerons and provides lateral control of the aircraft. A momentary contact aileron trim tab switch, a microphone switch, and space provision for an automatic pilot release button are provided on the outboard handgrip of each control wheel.

2-99. Aileron trim switch. The momentary contact aileron trim tab switch on the control wheel (figure 2-3, sheet 1) is marked L/W DWN and R/W DWN with arrows indicating the direction of movement. The switch electrically operates the trim tab, hinged to the right outboard aileron, through an actuator in the aileron powered from the secondary bus. The deflection of the trim tab is shown on the aileron trim tab position indicator.

2-100. Aileron trim tab position indicator. The aileron trim tab position indicator is located on the overhead console (figure 2-4). The indicator is operated electrically, and is powered from the secondary bus. The pointer moves over a scale graduated in 15° increments and shows the deflection of the trim tabs. The extremities of the scale are marked L and R respectively.

2-101. Elevator trim tab handwheel. The elevator trim tab handwheel is mounted on a pedestal at the right of the pilot's seat (figure 2-3, sheet 1). Rotation of the handwheel mechanically actuates the elevator trim tabs. The position of the elevator trim tabs is indicated by a pointer in a window at the top of the pedestal which is marked NOSE DOWN (forward), TAKE-OFF RANGE, and NOSE UP (aft).

2-102. Microphone switch. Refer to Chapter 5.

2-103. Rudder pedals. Rudder pedals (figure 2-3, sheet 1), which mechanically operate the rudder, are provided at both the pilot's and copilot's positions. Toe brake pedals, which are an integral part of the rudder pedals, are located immediately above them. Each rudder bar can be adjusted for reach by a handle marked RUDDER PEDAL ADJUSTER, on the pedestals in front of the pilot's and copilot's positions.

2-104. Rudder trim tab handwheel. The rudder trim tab handwheel on the overhead console (figure 2-4) is marked RUDDER TRIM. Rotation of the handwheel mechanically actuates the rudder trim tab. The position of the trim tab is indicated by a pointer moving over a scale adjacent to the handwheel. The scale is graduated in increments of 20° and is marked LH at one end and RH at the other.

2-105. Controls gust lock handle. The gust lock handle is located immediately forward of the throttles on the overhead console (figure 2-4). The handle is marked CONTROLS LOCK, with two positions marked UNLOCKED forward and LOCKED aft. When in the LOCKED position with the aileron and rudder controls neutral and the control column forward, the controls will mechanically lock. The gust lock handle prevents the throttles being advanced beyond a position allowing approximately 1600 rpm. A trigger on the gust lock handle must be pulled down before the handle can be released.

2-106. Wing Flaps. A double-slotted full-span type wing flap system is actuated by pressure supplied from the normal hydraulic system (figure 2-15) to a wing flap actuator in the cabin roof; movement is then transmitted from the actuator through mechanical linkage to the flaps. Operation of the wing flaps is controlled by the wing flap selector lever in the flight compartment, through an internal follow-up valve which allows the flaps to be positioned at any point within flap range. Movement of the flaps is indicated on the wing flap position indicator in the flight compartment. Since the ailerons droop with the lowering of the flaps, the range of aileron movement varies in accordance with the position of the flaps. Movement of the flaps is also mechanically transferred to the horizontal stabilizer so that it trims automatically throughout the full flap range.

2-107. Wing flap selector lever. The wing flap selector lever is located in the overhead console (figure 2-4). A spring-loaded button is inset in the lever handle. The lever is marked FLAPS and has the normal operating settings marked 15° to 40° in 5° increments. Operation of the lever actuates the wing flaps through hydraulic and mechanical linkage, and the movement of the flaps is recorded on the wing flap position indicators. The spring-loaded button in the lever handle must be depressed before the lever can be moved from one position to another.

2-108. Wing flap position indicator. The wing flap position indicators are on the left-hand side

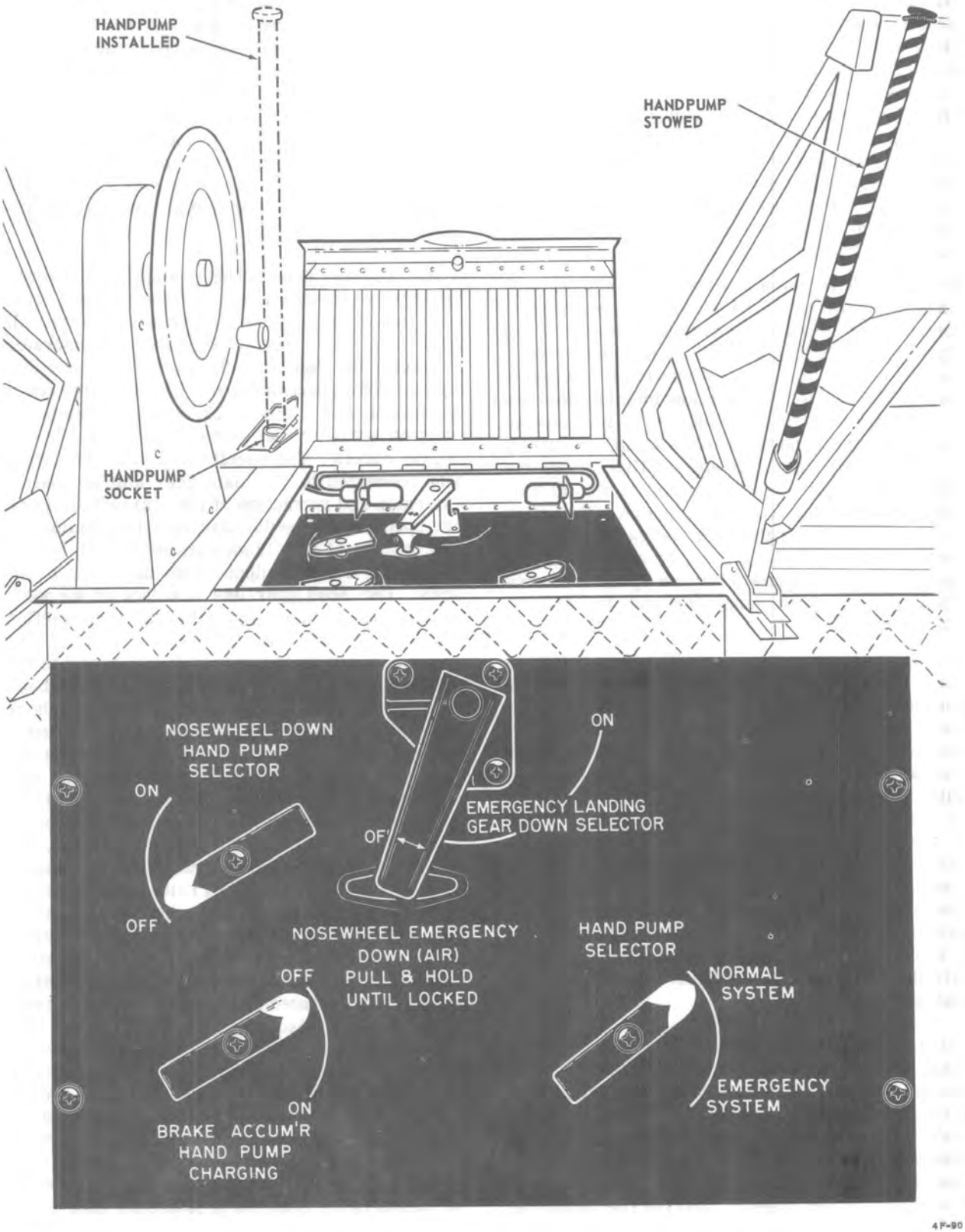


Figure 2-17. Emergency hydraulic selector panel

of the pilot's and copilot's flight instrument panels (figure 2-18) adjacent to the airspeed indicator. Each indicator is marked FLAP POSITION and is graduated in 5° increments from 0° to 40°, with numerals at the 10° marks. The indicators are mechanically operated and indicate wing flap position. Each indicator is mechanically connected to a color-coded ring on its adjacent airspeed indicator. As flap is extended or retracted the color ring moves around the airspeed indicators; counterclockwise as flap is extended and clockwise as flap is retracted. (Refer to paragraph 2-138 and Chapter 7, figure 7-1.)

2-109. Stall Warning System. An artificial two-stage, stall warning stick shaker system is incorporated into the flight control system. Low and high intensity stick shakers are mounted on each control column and are automatically energized during flight as follows; the low intensity shakers at approximately 8 knots above the stall speed, and the high intensity shakers at approximately 4 knots above the stall speed. This warns the pilot and copilot of the approach to the stall by vibration of both control columns. The stick shakers can be energized for test purposes, when the aircraft is on the ground, by means of a test switch. Electrical power for the systems is supplied from the emergency bus and the 115-volt, 400-cycle ac bus.

2-110. Low intensity stage. The low intensity stage consists of a left lift transducer, a flap position potentiometer, a lift computer, low intensity stick shakers, and a test switch. The circuit can only be tested in the left position of the test switch. The vane of the left lift transducer will respond to movement of the stagnation point as the stall is approached, and change the voltage to the lift computer. The lift computer compensates this voltage for flap position, detected by the flap position potentiometer, and operates the low intensity stick shakers to provide a mild vibration of both control columns at approximately 8 knots above the stalling speed. The low intensity stick shakers are operative through all flap and power settings.

2-111. High intensity stage. The high intensity stage is a duplication of the low intensity stage except that two lift transducers, two lift computers, and two flap position potentiometers are installed. In addition, the high intensity stage only operates when either or both throttles are more than 3/4 inch forward of the fully closed position measured on the console, and the flap setting is 19° or more. This stage provides a very pronounced control column vibration, compared to that of the low intensity stage.

2-112. Stall warning test switch. A three-position toggle switch on the pilot's instrument panel (figure 2-18) is marked STALL WARN TEST. The center (off) position is unmarked, and the other positions are marked LEFT and RIGHT respectively. Selection of LEFT or RIGHT enables a circuit continuity check of the high intensity stick shakers to be carried out. The circuits of both low intensity stick shakers can be checked only when the switch is selected to LEFT. The tests also insure that both ac and dc power are available to the systems.

2-113. Landing Gear. The landing gear is a tricycle type installation consisting of two main gear units and a steerable nose gear unit. All units are fully retractable and are operated hydraulically (figure 2-15). Each main gear unit consists of a pneudraulic shock strut, a drag strut, an up-lock and a down-lock, and a hydraulic retraction actuator that retracts the unit into the engine nacelle. The nacelle doors are mechanically connected to the main gear unit so that on extension and retraction of the gear unit the doors are opened and closed accordingly. Each main gear unit has two 11.00 x 12 wheels, one on each side of the shock strut, equipped with disc type brake units. The nose gear unit consists of an pneudraulic shock strut and a hydraulic retraction actuator that also serves as a drag strut. The actuator retracts the gear unit into a well in the fuselage nose. The doors are opened and closed by a mechanical linkage connected to the shock strut in such a way that the aft doors are closed and the forward fairing remains open when the gear unit is down. The steerable nosegear unit adjusts automatically in the fore-and-aft direction when the nosewheel tires are off the ground. The nose gear unit has two 7.50 x 10 wheels, one on each side of the shock strut. When the landing gear is fully retracted, all units are covered by their respective doors. Selection of the landing gear to either the up or down position is controlled by the landing gear selector lever on the overhead console. The landing gear selector valve, electrically operated by the lever from the emergency bus, is also electrically connected to a weight switch on each gear unit which prevents retraction of the landing gear when the shock struts are compressed. When all units are up and locked, the selector valve is arranged to automatically relieve the hydraulic pressure in the landing gear system. Should a system malfunction occur, the landing gear may be lowered by means of the controls provided for this emergency. These controls include the hydraulic emergency selector panel, the hydraulic handpump and handle, and the main gear emergency extension

handle. Refer to Chapter 4 for the procedure to be followed for emergency lowering of the landing gear.

2-114. Landing gear selector lever. The landing gear selector lever, on the left side of the overhead console (figure 2-4), is marked LANDING GEAR with positions UP and DOWN, and is electrically connected to the landing gear selector valve through a two-position switch. The selector lever, recognized by its wheel-shaped handle, has a trigger which must be depressed to release the lever locking pawl before the lever can be moved from one position to another. The wheel-shaped handle contains a red warning light. Power for the selector valve and warning light are supplied from the emergency bus.

2-115. Landing gear indicator lights. Three green, press-to-test indicator lights are on the electrical switch panel (figure 2-12) and are marked LANDING GEAR and LOCKED DOWN. The lights are individually marked LEFT, NOSE, and RIGHT and each will come on when its respective gear unit is locked down. The intensity of the lights is controlled by the warning lights intensity switch at the right-hand side of the electrical switch panel. Power is supplied from the main bus.

2-116. Landing gear index marks. A white and red index mark is painted on the inboard side of each main gear locking mechanism, and are visible from the cabin. Alignment of the marks on the individual gear indicates a locked down condition.

2-117. Landing gear warning horn and warning light. The landing gear warning horn in the flight compartment is powered from the emergency bus. The horn will sound and the red warning light in the landing gear selector lever handle will illuminate if both throttles are closed to approximately 13 - 15 in. Hg, and the landing gear is not locked down.

2-118. Landing gear warning horn and warning light test switch. A two-position toggle switch, spring loaded to OFF, is located on the electrical switch panel (figure 2-12), and is marked HORN TEST. The switch is used for ground testing the operation of the warning horn. If the throttle levers are closed, a test of the warning light in the landing gear selector lever can be made.

Note

The tests only check the operation of the horn and light and do not constitute a continuity check of the electrical system.

2-119. Emergency landing gear down selector handle. A handle on the emergency hydraulic selector panel (figure 2-17) is marked EMERGENCY LANDING GEAR DOWN SELECTOR with positions OFF and ON. The handle, when moved to ON, operates a valve which allows hydraulic return fluid from the up side of the landing gear actuators to bypass the landing gear selector valve and enter the common return line to the reservoir. This bypass action allows for any electrical or other malfunction of the landing gear selector valve, which might cause it to remain in the 'up' position. Therefore, for any emergency operation of the main gear or nose gear, the handle must be selected ON. As an additional safeguard this handle overrides the nose gear emergency extension handle, which cannot be pulled until the emergency landing gear down selector is moved to ON.

2-120. Main gear emergency extension handle. A main gear emergency extension handle, on the bulkhead behind the pilot's seat (figure 2-3, sheet 2) is marked EMERGENCY MAIN GEAR LOWERING PULL TO RELEASE. Pulling the handle mechanically releases each main gear up lock and allows the gear to extend and lock down by gravitational force and slipstream pressure.

2-121. Nose gear down handpump selector. A nose gear down handpump selector on the hydraulic emergency selector panel (figure 2-17) is marked NOSEWHEEL DOWN HANDPUMP SELECTOR with positions OFF and ON. When the selector is at ON, the nose gear may be pumped down by actuation of the hydraulic handpump, provided the HANDPUMP SELECTOR is at EMERGENCY SYSTEM, and the EMERGENCY LANDING GEAR DOWN SELECTOR is at ON.

2-122. Nose gear emergency extension handle. The nose gear emergency extension handle on the hydraulic emergency selector panel (figure 2-17) is marked NOSEWHEEL EMERGENCY DOWN (AIR) PULL & HOLD UNTIL LOCKED. Before pulling the handle, insure that the EMERGENCY LANDING GEAR DOWN SELECTOR is at ON. When the handle is pulled, it releases a compressed air charge from an air bottle to force the nose gear down. The handle must be held extended until the nose gear is locked down.

Note

The compressed air charge in the air bottle can only be used once in flight. It should be used only as a last resort if the gear unit cannot be extended by the emergency hydraulic system.

2-123. Nose gear observation window. An observation window at the left of the step in bulkhead 60.0 in the flight compartment permits visual in-flight inspection of the nose gear by a crew member should doubt exist regarding nose gear condition.

2-124. Hydraulic handpump and handle. For description of the hydraulic handpump and handle refer to paragraph 2-95.

2-125. Nosewheel Steering. Ground steering of the aircraft is controlled by a nosewheel steering wheel, through a 62° range of directional movement of the dual nosewheels, when the steering system is operative. The system consists of an electrical nosewheel steering switch, a hydraulic nosewheel steering valve, a hydraulic nosewheel steering actuator, and a nosewheel steering wheel that is connected mechanically to the steering actuator. Selection of the steering switch to ON actuates the steering valve, powered from the emergency bus, to allow pressure from the hydraulic system (figure 2-15) to pass to the steering actuator. Movement of the steering wheel mechanically selects the direction and amount of travel of the actuator, which hydraulically positions the dual nosewheels to the required angle. The system is irreversible so that the dual nosewheels maintain the direction and angle of displacement selected by the steering wheel when the steering switch is at ON. When the nose gear shock strut is fully extended, a weight switch overrides the hydraulic actuator and the dual nosewheels are centered by self-centering cams. When the system is inoperative, steering can be accomplished by differential application of the brake pedals, but turns should be made slowly and at a large radius to preclude imposing excessive side loads on the nose gear unit.

Caution

Do not attempt to restrain or operate the steering wheel when the steering switch is at OFF. Manual control of the steering wheel in this condition would cause fluid to be emptied from the nose gear shimmy damper during ground maneuvering.

2-126. Nosewheel steering wheel. The nosewheel steering wheel is on the left side of the flight compartment (figure 2-3, sheet 1) and is marked NOSEWHEEL STEERING. The rim of the wheel has a radial line, denoting nose gear centered, with directional arrows marked LEFT and RIGHT. An indicator pointer attached to the axle of the wheel provides a fixed datum reference.

2-127. Nosewheel steering switch. The nosewheel steering two-position switch is above and forward of the nosewheel steering wheel on the left side of the flight compartment (figure 2-3, sheet 1). The switch is marked NOSEWHEEL STEERING with positions marked ON and OFF.

2-128. Wheel brakes System. The wheel brakes system is controlled from the pilot's and copilot's brake pedals which are connected mechanically and hydraulically to disc type brakes in the main wheels. The brakes are operated by hydraulic fluid from the wheel brakes hydraulic accumulator, which is supplied with pressure from the hydraulic system (figure 2-15) and is fed through brake control valves and safety valves to the wheel brakes. A parking brake valve and handle is incorporated in the system. An emergency air system, consisting of an air bottle and an air control valve and a wheel brakes emergency lever, is connected directly to the wheel brakes.

2-129. Brake pedals. The pilot's and copilot's brake pedals are the upper portions of the rudder pedals in the flight compartment (figure 2-3, sheet 1). The brake pedals are connected mechanically to the wheel brake control valves, and must be depressed to transmit hydraulic pressure to the wheel brakes. The degree of braking action applied to the wheel brakes is dependent on the force exerted on the brake pedals.

2-130. Parking brake handle. The parking brake handle mounted on the pilot's pedestal (figure 2-16), is a push-pull, turn-to-lock type marked PARKING BRAKE. To apply the parking brakes, depress the brake pedals and pull the parking brake handle fully out, then turn it 90° clockwise to lock it in the extended position. To release the parking brake, the brake pedals should be depressed and, at the same time, the handle turned 90° counterclockwise and pushed fully in.

2-131. Emergency wheel brakes lever. The emergency wheel brakes lever is mounted on the windshield center post (figure 2-3, sheet 1) and is marked EMERGENCY BRAKE. Pulling the handle mechanically operates a valve in the emergency brake air system and allows the compressed air from the air bottle to be applied progressively to the brake discs of the main wheels, in the event of hydraulic system malfunction.

Caution

The emergency wheel brakes lever must not be operated with a pumping action otherwise the compressed air supply will be depleted rapidly.

2-132. Brake accumulator handpump charging selector. The brake accumulator handpump charging selector on the emergency hydraulic selector panel (figure 2-17), beneath an access door in the flight compartment floor, is marked BRAKE ACCUM'R HAND PUMP CHARGING with positions OFF and ON. The selector should be positioned at ON and the hydraulic handpump selector at NORMAL SYSTEM, in the event of a malfunction of the engine-driven hydraulic pumps or when they are inoperative or at EMERGENCY SYSTEM in the event of low fluid level. Actuation of the handpump will then replenish the brakes accumulator to a safe operating level.

2-133. Brake hydraulic pressure gage. The brake hydraulic pressure gage mounted on the pilot's pedestal (figure 2-16), is remotely operated by an electro-hydraulic pressure transmitter connected to the pressure line of the brake system. Power is taken from the ac instrument bus. The gage is marked BRAKE HYDRAULIC PRESSURE and is calibrated from 0 to 4000 psi.

2-134. Instruments. The pilot and copilot are each provided with a set of flight instruments, each set grouped on a panel directly in front of the individual. One magnetic standby compass and two clocks are installed.

Note

For information regarding instruments which are an integral part of a particular system, refer to the applicable paragraphs in this chapter and Chapter 7.

2-135. Pitot-Static System. The pitot-static system consists of two electrically-heated pitot heads mounted one on each side of the fuselage nose with two static openings below each head (figure 2-19). The left-hand pitot head is connected to the pilot's airspeed indicator, and the right-hand pitot head is connected to the copilot's airspeed indicator, and the two thrust indicators (paragraph 2-136) on the engine instrument panel. The right-hand pitot head also supplies pressure to the fan air pressure switch of the cabin heating and ventilating system. Each pitot head system is independent of the other and, in the event of a malfunction in the thrust indicating system, the thrust indicators can be isolated from the right-hand pitot head by means of a selector marked THRUST IND on the copilot's flight instrument panel. The upper and lower static openings are independent of each other. The lower opening on each side of the fuselage nose is connected to the pilot's airspeed indicator, altimeter, and vertical velocity indicator; the upper openings are connected to the copilot's airspeed indicator, altimeter, and vertical velocity indicator. The dc electrical circuit from the emergency bus to the pitot heads is controlled by the pitot heat switch on the deicing panel. (Refer to Chapter 6, paragraph 6-49.)

2-136. Thrust indicators. A thrust indicator (figure 2-5) is installed for each engine. Each indicator is a direct reading type and registers the difference between the dynamic pressure in its respective propeller slipstream and the dynamic pressure in the free-air stream. In addition to the connection with the copilot's pitot head (paragraph 2-135), the instrument has two associated pitot heads mounted one on each side of the relevant engine nacelle. A reference index, operated by a control at the base of the instrument, may be preset to the normal thrust setting to provide an immediate indication of thrust change.

2-137. Thrust indicating system selector handle. A thrust indicating system two-position selector handle on the copilot's flight instrument panel is marked THRUST IND FREE STREAM PRESS with positions NORMAL and EMERG OFF respectively. At NORMAL the free-air pressure at the pitot head on the right of the fuselage nose is fed to the thrust indicators (in addition to slipstream pressure), copilot's airspeed indicator and heating system fan air pressure switch. At EMERG OFF, the free-air pressure is fed only to the copilot's airspeed indicator. This position should be selected (counterclockwise 180°) if a malfunction occurs in the thrust indicating system.

Caution

If the thrust indicator free stream pressure selector handle is moved to EMERG OFF in flight the heating fan air pressure switch will be inoperative and the cabin heating system will revert to ground mode. In this event the combustion air fan circuit breaker on the CABIN HEAT & VENTILATION panel should be pulled to prevent damage to the combustion air fan. To insure that flight compartment heating system remains in flight mode, check that COCKPIT AIR SELECTOR is at FLIGHT position.

Note

Should a discrepancy occur between the readings of the pilot's and copilot's airspeed indicators, a malfunction of the thrust indicators or fan air pressure switch should be suspected.

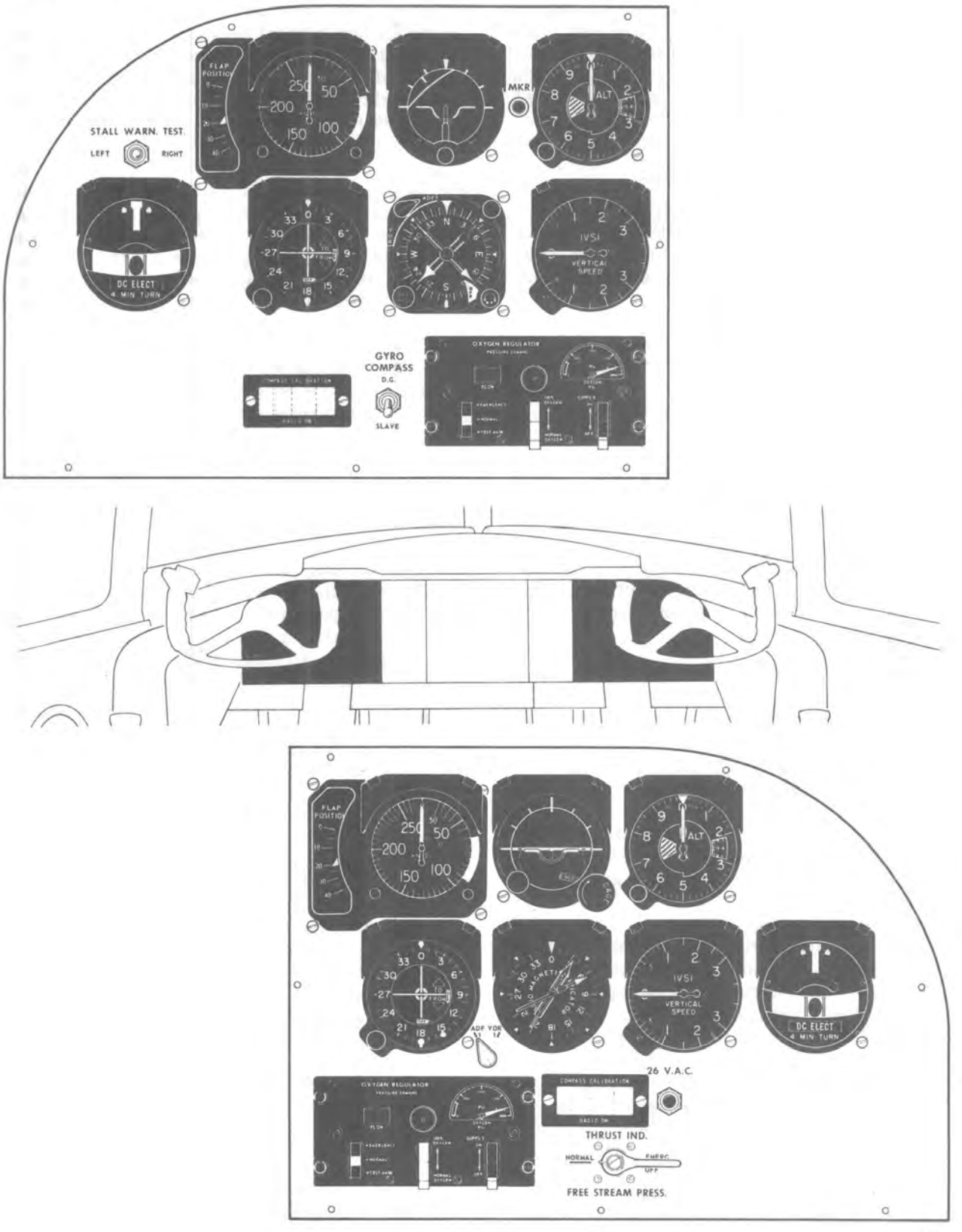


Figure 2-18. Instrument panels (flight)

2-138. Airspeed indicators. Two airspeed indicators (figure 2-18) are installed. Each instrument is graduated in 5-knot increments from 30 to 260 knots, with a numeral at the 30-knot graduation and at each 50-knot graduation thereafter. Each instrument is connected to a separate pitot and static source, thus providing independent operation. Colored markings are applied, with no parallex error, to the instrument glass to indicate ranges of airspeed. A white index mark provides indication of any movement of the glass face in relation to the instrument case. A color-coded annular ring is mechanically connected to the flap indicator. Extension or retraction of the flaps causes the ring to move around the airspeed indicator dial, and the color coding is visible through an unpainted portion of a plexiglass cover. The colored portion consists of a white arc and a yellow radial. The yellow radial indicates the maximum speed for flap selection, and will constantly show the maximum allowable flight speed at all flap angles. The white arc represents the range of airspeed for that particular amount of flap; the upper end of the white arc shows the level flight stall speed at maximum gross weight. (See Chapter 7, figure 7-1.)

2-139. Altimeters. Two altimeters (figure 2-18) are installed. Each altimeter has three pointers which indicate in feet as follows: long pointer - hundreds; intermediate pointer - thousands; short pointer - ten thousands. A knob to the left of the dial allows the barometric setting to be adjusted, or the pointers to be positioned; the barometric scale is visible through a window on the instrument face. A striped flag is visible when the altimeter reading is below 16,000 feet. The pilot's altimeter is connected to the lower static vents, while the copilot's is connected to the upper static vents.

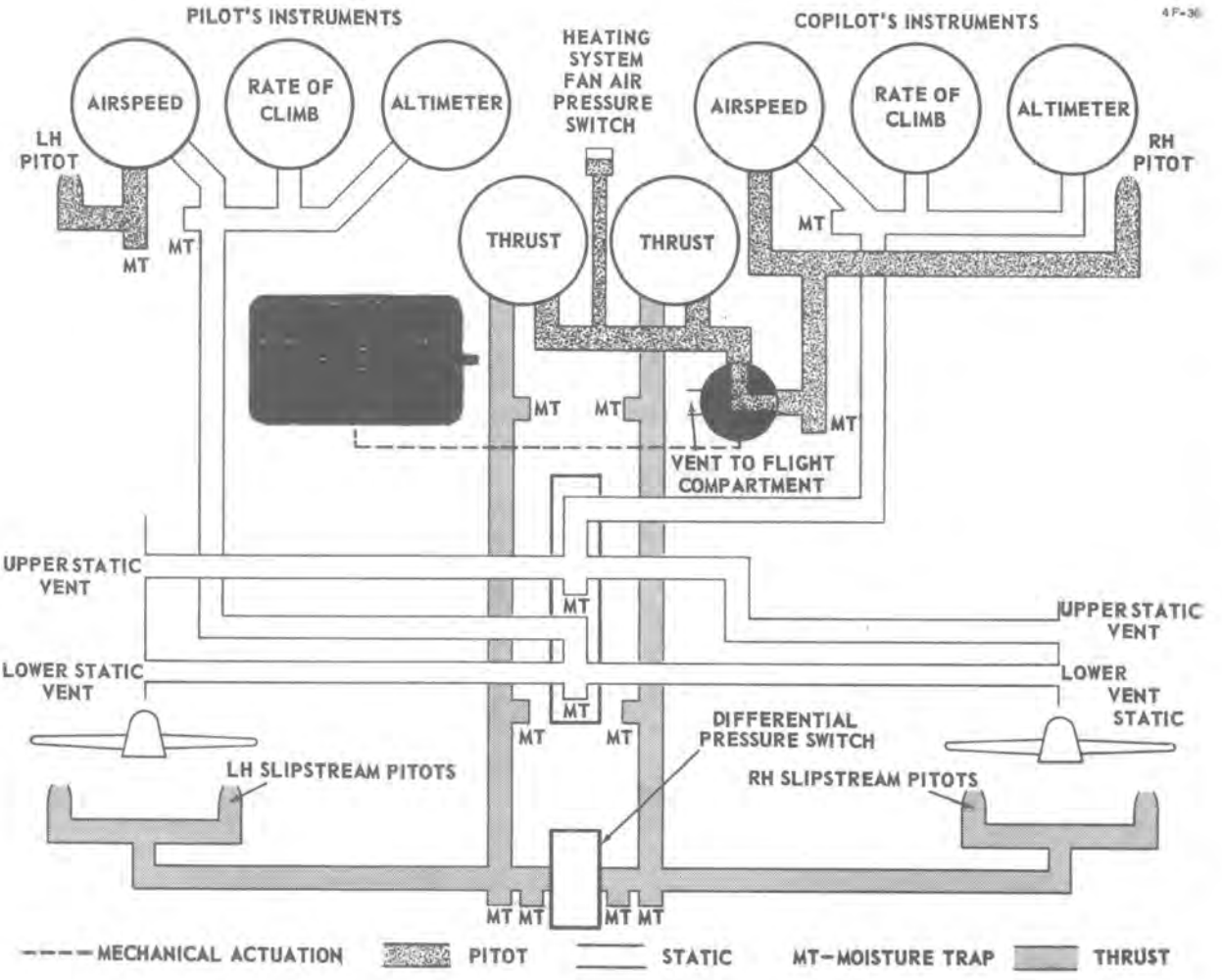


Figure 2-19. Pitot-static system - schematic

2-140. Turn and slip indicator. Two turn and slip indicators (figure 2-18) are installed. The instrument needle shows rate of turn, while the ball registers slip or skid. The instrument gyros are powered from the emergency bus.

2-141. Vertical velocity indicator. The vertical velocity indicators (figure 2-18) are installed. Each instrument is graduated in hundreds of feet per minute and registers rates of climb or descent from zero to 2000 feet per minute. The pilot's indicator is connected to the lower static vents, while the copilot's is connected to the upper static vents.

2-142. Attitude indicator. Two attitude indicators are installed, one on the pilot's and one on the copilot's flight instrument panel (figure 2-18). Each instrument provides a visual indication of the aircraft's attitude in relation to the horizon. A 115 volts, 400 cps, three phase ac supply from the inverter drives each instrument gyro, and two fuses in the ac fuse panel protects the circuit. The aircraft reference bar can be adjusted to compensate for pitch trim, by means of a knob at the lower edge of the instrument. The instrument is limited to indicate ± 27° in pitch, but is unlimited in bank. On aircraft prior to Serial No. 63-9718 the instrument gyro is self-erecting within three minutes after power is applied, and a warning flag on the dial face will oscillate. Low power or power failure will be indicated by the warning flag coming to a standstill. On aircraft Serial No. 63-9718 and subsequent the instrument gyro will gradually erect after power is applied, but may be fully erected after three minutes by pulling the knob marked PULL TO CAGE, at the lower right of the instrument dial, and releasing. Low power or power failure will be indicated by a warning flag marked OFF appearing on the instrument face.

Caution

The cage knob of the attitude indicator must be operated slowly and gently to avoid undesirable stresses on the internal assembly.

2-143. Magnetic standby compass. The magnetic standby compass is mounted on the windshield center post, (figure 2-3, sheet 1) with its correction card immediately above it.

2-144. Clocks. Two clocks of the elapsed time, eight-day type are each located on a side panel (figure 2-20). A stopwatch knob and a winding/setting knob are at the top-right and bottom-left respectively of each instrument. On aircraft 63-9718 and subsequent Type A-13A clocks replace the stopwatch clocks. Each A-13A clock is an eight-day center-second movement, and incorporates an elapsed time mechanism. An elapsed time, zero-reset flyback knob and a winding/setting knob are at the top-right and bottom-left respectively of each instrument.

2-145. Outside air temperature gage. A direct-reading outside air temperature gage is installed in the flight compartment roof (figure 2-3, sheet 1) above the pilot's seat and is graduated in degrees Fahrenheit and Centigrade.

2-146. Course selector-indicators. Two course selector-indicators (see figure 2-18) are installed. Each course selector-indicator is a combined cross-pointer meter and course selector (to-from) instrument. The vertical cross-pointer is pivoted at the top and moves left or right to provide heading information in conjunction with the runway localizer or VOR station, depending upon the receiver in use. The horizontal cross-pointer is pivoted at the left and moves up and down to provide glide slope information. A two-flag alarm system, one flag for each pointer, indicates when signals are unreliable, and the word OFF appears when such signals are not usable. Two windows, one marked TO and the other marked FROM, will indicate by an arrowhead whether the aircraft is flying to or from the received signals. The dial is a compass scale of 360° graduated in two-degree increments with numerical markings every 30°. The course selector knob at the bottom left of the instrument allows for the selection of any track to or from an omnidirectional range station, or a positional fix may be obtained using two stations. A blue and yellow band on the face of the instrument is used, in conjunction with the vertical needle and the range audio signal, for VAR (Visual-Aural Range) operation to identify the particular range quadrant.

2-147. Radio magnetic indicators. Two radio magnetic indicators (figure 2-18) are installed, a type C-6H for the pilot and a type ID-250/ARN for the copilot. Both indicators combine primary magnetic compass information with dual radio-magnetic indicators. The pilot's indicator has a SET HDG knob, a synchronization knob and a synchronization window, and a VOR/ADF knob. A narrow pointer (marked 1) and a broad pointer (marked 2) indicate ADF or VOR bearing information relative to aircraft heading on the compass dial. A flag will appear on the face of the instrument to warn of power failure. No control knobs are installed on the copilot's indicator on aircraft pre-

vious to 61-2384, however on aircraft 61-2384 and subsequent the indicator has an ADF/VOR control which enables ADF 1 or VOR 1 bearings to be indicated regardless of the selection of the pilot's ADF/VOR control. A two-position toggle switch is installed below the pilot's RMI and is marked GYRO COMPASS, with DG and SLAVE positions. With the switch in the SLAVE position, the compass card of the RMI is slaved to the gyro magnetic compass. In DG position, the magnetic sensing of the flux valve is discontinued and the card of the RMI functions as a gyro indicator, requiring resetting to compensate for the effects of precession. A compass calibration card is installed below each indicator. Power for the radio magnetic indicators is supplied from the 26-volt and 115-volt, 400-cycle ac bus.

2-148. Short-field approach speed indicator. A short-field approach speed indicator (figure 2-20) is installed on aircraft Serial No. 61-2595 and subsequent, and is located on the side panel above the pilot's flight instrument panel. An attached label, marked SHORT FIELD APPROACH SPEED, contains an index and weight reference. The indicator is calibrated only for the final approach phase of a short-field landing, flaps 40°.

2-149. The instrument dial is marked SLOW and FAST on the left- and right-hand side respectively, of a triangular shaped index mark. Alignment of the pointer with the triangle during the final approach represents the optimum approach speed for an aircraft gross weight of 28,500 lb, and allows a 23% speed margin above the CAS stall, flaps 40°. A diamond shaped index mark on the SLOW side of the dial represents the optimum approach speed for all aircraft gross weights up to 26,000 lb, and allows a 16% speed margin above the CAS stall, flaps 40°.

Note

The approach speeds appropriate to gross weight, as shown in Chapter 14, figure 14-109, will be maintained by use of the indicator.

2-150. The triangular index mark represents a 23% speed margin above the stall only for a gross weight of 28,500 lb, and as the gross weight decreases to 26,000 lb there is a decrease in the required speed margin above the stall of 7% (from 23% to 16%). For gross weights between 28,500 lb and 26,000 lb, short-field approaches are made by positioning the pointer between the two index marks, the exact location being decided by interpolation, depending upon gross weight. For example, at a gross weight of 27,250 lb the optimum approach speed indication would be midway between the two index marks.

2-151. The optimum approach speed is determined by the computation of factors supplied by the right-hand wing lift transducer, which compensates for variations in gross weight up to 26,000 lb. Maintaining the pointer in the correct location for gross weight will hold a constant angle of attack. Any change in the angle of attack will affect the location of the airflow stagnation point at the wing leading edge and vary the load on the lift transducer vane, thus producing a deflection of the indicator pointer to a fast or slow value.

2-152. Except for full glide approaches, the pointer should be held on the desired index mark by appropriate use of power, and the aircraft guided down the desired flight path by the normal use of elevator.

2-153. The instrument is connected to the right-hand lift computer, which is protected by the one-amp fuse on the circuit breaker panel marked STALL WARN R. A red OFF flag appears at the bottom of the instrument dial when electrical supply to the instrument ceases. Power is supplied from the 115-volt, 400 cycle ac bus.

2-154. Refer to Chapter 3, paragraph 3-21 for the pre-flight check.

2-155. Emergency Equipment. Emergency equipment in the aircraft consists of fire detecting and extinguishing systems for the engines and combustion heaters, portable fire extinguishers, an alarm bell system, emergency exits, first aid kits and a crash axe.

2-156. Fire Detecting and Extinguishing Systems. Fire detecting and extinguishing systems are provided to detect and combat fire in the engine nacelle and the combustion heaters. The engine fire detecting system employs continuous wire-type elements to monitor the engine areas, while the heater fire detecting system employs a bimetal type element in each heater combustion chamber. Power for the detecting system is taken from the 115-volt, 400-cycle ac bus, while dc power is taken from the emergency bus for engine fire extinguishing and from the main bus for heater fire extinguishing. Freon 13B1 for the engines and carbon dioxide for the heaters is stored under pressure in containers and is discharged into the overheat area by the operation of the applicable control. All fire controls are grouped on the emergency panel in the flight compartment. Indi-

cator discs are provided on the outside of the aircraft for ground checking of the container condition. A means of testing the warning lights and the engine fire detecting circuit is provided. For the purpose of engine fire detecting and extinguishing, each engine nacelle is divided into three zones; zone 1 is the front of the engine forward of the auxiliary firewall, zone 2 is between the auxiliary and the main firewalls and forms the engine accessories compartment, while zone 3 extends from the main firewall aft to the front spar and includes the main gear well. One fire detecting element monitors zone 1 while the other element monitors zones 2 and 3. Extinguishing agent is provided only for zones 2 and 3.

2-157. Engine fire extinguisher handles. Two engine fire extinguisher handles, one for each engine, are located on the emergency panel (figure 2-20) in the flight compartment. The handles are marked FIRE-PULL and incorporate red warning lights. When either handle is pulled a cartridge is electrically detonated and a slug is fired into the appropriate extinguisher container, instantly releasing the extinguishing agent to blanket the fire area in zones 2 and 3 of the appropriate engine. If

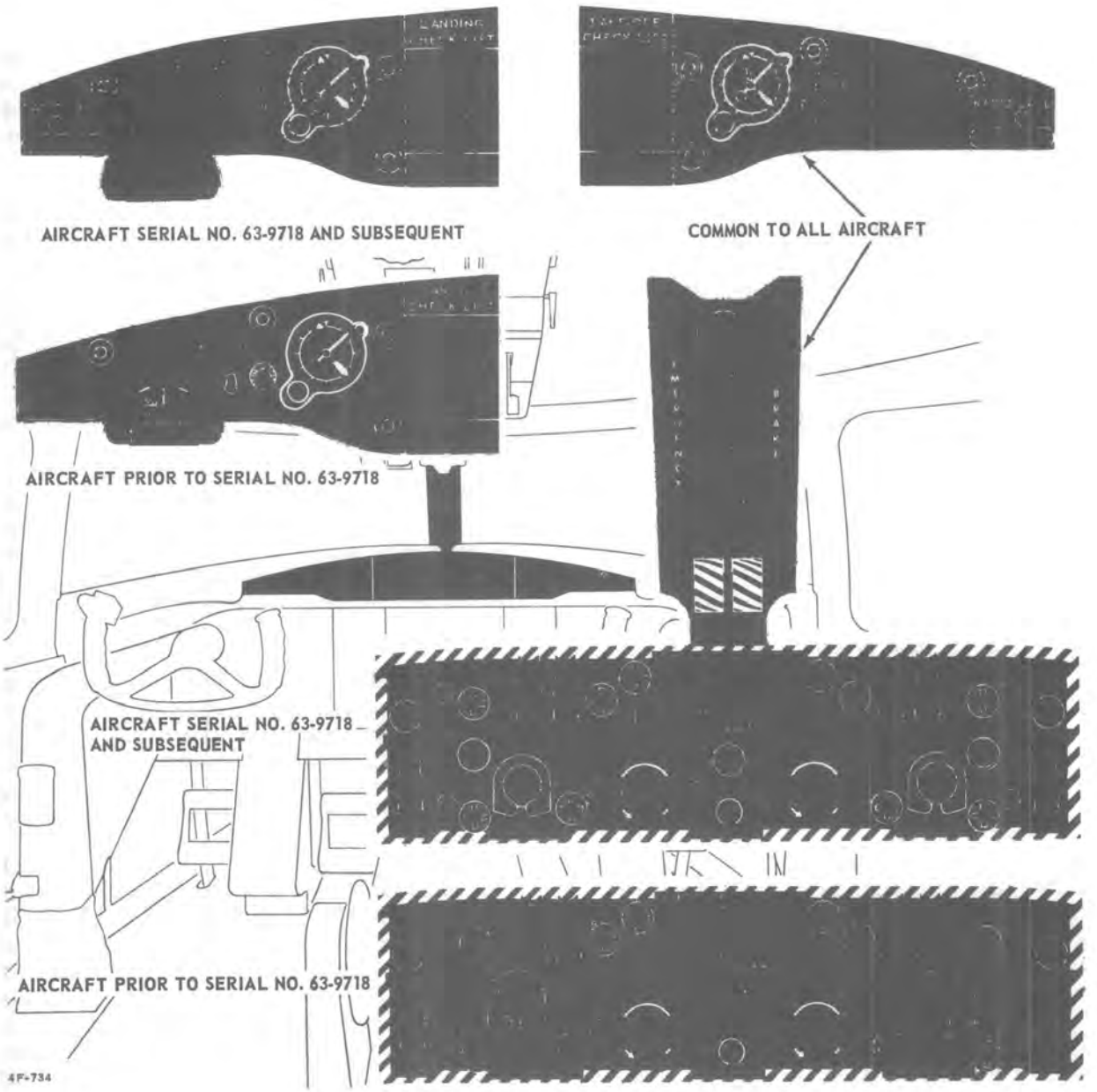


Figure 2-20. Emergency and side panels

a second release of extinguishing agent is required, the handle is pushed in and turned 90° counterclockwise and pulled again. In this case the second container will be discharged.

Note

Each container can be discharged once only. Therefore, both containers can be discharged into one engine, or each can be discharged into its respective engine.

2-158. Engine fire warning lights. Two engine fire warning lights are incorporated in the engine fire extinguisher handles (figure 2-20), marked RIGHT ENGINE ZONES 2 AND 3 and LEFT ENGINE ZONES 2 AND 3 respectively, and two on the emergency panel are marked ENG. FIRE ZONE 1.

Note

When a warning light illuminates to indicate an overheat condition in engine zones 2 and 3, it will go out when the condition no longer exists. The light will illuminate again if a further overheat condition occurs.

2-159. Engine fire detection test switch. A toggle switch marked FIRE DETECTION, is located in the center of the emergency panel (figure 2-20). The switch is spring-loaded to the down (off) position. When held (up) in the TEST position all engine fire warning lights should illuminate. Failure of the lights to illuminate indicates a fault in the detecting circuit, control units, or individual lights.

Note

The test switch is not connected to the heater fire warning lights.

2-160. Engine fire extinguisher indicating discs. A yellow and a red colored disc are located on the underside of each wing between the nacelle and the fuselage (figure 2-23). When a fire extinguisher handle is pulled, a plunger operated by the pressure of the extinguishing agent punctures the yellow disc. Should either container reach an excessive temperature, a thermal plug in the container will melt and allow the extinguishing agent to blow out the red disc and exhaust to atmosphere.

2-161. Heater Fire Detecting and Extinguishing Systems. The combustion heaters of the flight compartment and cabin heating systems are each provided with a fire detecting circuit and an indicator light, a one-pound bottle of carbon dioxide (CO_2) fire extinguishing agent, and two indicating discs. Each heater fire detecting and extinguishing system is independent of the other, but both function in the same manner. When the temperature in a heater becomes excessive, it causes a bi-metal fire detecting element in the heater combustion chamber to complete an electrical circuit, powered from the main bus, and the appropriate heater fire warning light on the emergency panel in the flight compartment will come on. When the light comes on, the guarded extinguisher switch below the light should be selected to its up position to complete an electrical circuit from the main bus. This energizes a solenoid which actuates a rod on the bottle, mounted on the heater tray, containing the extinguishing agent. The rod unseats the check and main valves at the top of the bottle and the contents pass through piping to the heater combustion chamber, and to a spray ring around the heater inlet duct. At the same time the yellow indicating disc is punched out to show that the extinguishing system has been operated. If the pressure in the bottle reaches a dangerous level, usually due to excessive temperatures, a disc in the flood valve of the bottle will break and the extinguishing agent released will blow out the red indicating disc. The red and yellow indicating discs for the flight compartment heater are on the left side of the fuselage nose, while those for the cabin heater are on the right-hand side of the fuselage forward of the wing.

2-162. Heater fire extinguisher switches. Two guarded heater fire extinguisher switches are provided below their respective warning lights on the emergency panel (figure 2-20) in the flight compartment. Selecting the appropriate switch operates a solenoid valve to release extinguishing agent in the heater combustion chamber and from a spray ring around the heater inlet duct.

Caution

The heater air control handles should be selected to close the air supply ducts when a heater fire is indicated.

2-163. Heater fire warning lights. Two press-to-test heater fire warning lights are mounted on the emergency panel (figure 2-20). The lights are marked FIRE CONTROL, COCKPIT HEATER FIRE WARN, and FIRE CONTROL, CABIN HEATER FIRE WARN respectively. The appropriate light will illuminate when an overheat condition exists in either the flight compartment or cabin heater.

2-164. Heater fire extinguisher indicating discs. A yellow and a red colored disc are provided for both the flight compartment and cabin heater fire extinguishing systems. The two discs for the flight compartment are on the left-hand side of the aircraft nose while those for the cabin are on the right-hand side of the fuselage, forward of the wing. The discs indicate in a similar manner to the engine fire extinguisher indicating discs in paragraph 2-160.

2-165. Portable Fire Extinguishers. Three Type CF_3Br portable fire extinguishers are mounted in quick release clips, one below the pilot's seat, one on the aft face of the cabin forward bulkhead, and one on the left cabin wall immediately aft of the cabin passenger door. The extinguishing agent is released when the hand-operated lever at the top of the extinguisher is depressed.

2-166. Alarm Bell System. Refer to Chapter 6.

2-167. Emergency Exits. Two emergency exits are provided in the flight compartment and four in the cabin (Chapter 4, figure 4-3).

2-168. Flight compartment. The flight compartment exits consist of a hatch in the roof, immediately aft of the pilot's position, and a bottom hatch in the well behind the pilot's and copilot's seats. Access to the bottom hatch is gained by opening the two doors in the flight compartment floor. The hatch may then be opened by pressing a button and turning a handle, marked EXIT RELEASE-PRESS BUTTON AND TURN HANDLE, located on the aft part of the hatch. The hatch may be jettisoned, if required, by operating a handle located in a recess in the bulkhead above the doors and marked BOTTOM HATCH JETTISON - OPEN INSIDE DOORS BEFORE PULLING HANDLE. The upper doors must be opened first as they would be difficult to open during flight with the lower hatch jettisoned. The roof hatch is opened by pressing a button adjacent to the handle and turning the handle, located on the roof at the hatch, marked EXIT RELEASE - PRESS BUTTON AND TURN HANDLE. The roof hatch is hinged on the right-hand side and is not jettisonable. A webbing strap marked EMERGENCY SLIDE is fitted below the roof hatch on the bulkhead and is provided to aid escape from the flight compartment. The flight compartment bottom hatch may be used for exit during flight but the roof hatch, due to its proximity to the propellers, is for use on the ground only with the engines stopped.

2-169. Cabin. The cabin emergency door, on the left of the cabin near the wing, is jettisonable. The handle is marked EMERGENCY EXIT - LIFT GUARD AND TURN HANDLE TO OPEN. The right-hand passenger door is jettisonable, and has a jettison lever handle above the door marked CABIN DOOR JETTISON - PULL LEVER DOWN. The cargo door may be opened but must not be jettisoned during flight. (Refer to Chapter 13 for operating procedures.) The left-hand passenger door is not jettisonable. The cargo door may be jettisoned on the ground to provide an additional emergency exit. The cargo door is jettisoned by pulling a handle, located on the left-hand side of the cabin aft of the passenger door, marked CARGO DOOR JETTISON - LIFT GUARD AND PULL HANDLE. When the cargo door is jettisoned, the draftproof door is automatically retracted. The cargo door may also be jettisoned from outside the aircraft by a handle, located on the right-hand side of the fuselage aft of the passenger door, marked CARGO DOOR JETTISON - OPEN HATCH AND PULL HANDLE.

2-170. Miscellaneous Equipment. The following paragraphs describe the miscellaneous items of equipment in the aircraft.

2-171. First aid kits. Four first aid kits are provided, one in the flight compartment and three in the cabin. The flight compartment kit is in a stowage above the access ladder on the left-hand side. The cabin kits are in brackets attached to the cabin walls, one on the left-hand side aft of the emergency door, one on the left-hand side forward of the passenger door, and one on the right-hand side forward of the passenger door.

2-172. Crash axe. A crash axe for emergency use is mounted on the cabin-flight compartment bulkhead, in the cabin to the left of the interconnecting door. The axe is strapped into position by Velcro tape which fastens around the handle, and is released by peeling one end of the tape off the other end.

2-173. Entrance Doors. Entrance to the aircraft may be made through either of two passenger doors, a flight compartment bottom hatch, or by the cargo door and ramp.

2-174. Passenger doors. Two passenger doors at the aft end of the cabin, one on either side, are provided. Both doors are fitted with flush handles which spring out for grasping when a button on the handle is pressed. Both doors are provided with door-stays to hold the doors open on the ground; the stays are stowed on the inside of each door at a position marked STOWAGE DOOR STAY.

2-175. Flight compartment bottom hatch. Entrance may also be made to the flight compartment by means of the flight compartment bottom hatch. The hatch incorporates a handle similar in operation to the passenger doors. When the flight compartment bottom hatch is opened from the outside, the folding doors in the flight compartment floor must be pushed upwards to gain access to the flight compartment.

2-176. Cabin/flight compartment door. A sliding door separates the flight compartment from the cabin. The door may be opened from either side by pressing down a spring-loaded knob marked OPEN. The door may be locked, from the flight compartment side only, by means of a slide catch marked LOCK ON-OFF. A label on the flight compartment side of the door reads THIS DOOR MUST REMAIN OPEN WHEN CARGO IS CARRIED. The door is held in the fully open position by a lever catch.

2-177. Cargo door and ramp. Refer to Chapter 13, paragraph 13-11.

2-178. Flight Compartment Seats. The pilot and copilot seats are identical and each is of tubular construction with a fiberglas seat pan and cushioned headrest and seat. Each seat is adjustable horizontally and vertically and can be located at the required position by means of spring-loaded levers at the sides and front of the seat respectively; arm rests are also provided and are hinged to the side frames of the seat back in such a manner that they can be raised and moved back when not required. Each seat is equipped with a Type MB-2A shoulder harness attached to the Type MA-1 inertia reel (Aircraft Serial No. 60-3762 thru 61-2600) or the Type MA-2 multidirectional harness reel (Aircraft Serial No. 62-4144 and subsequent). The reel is mounted behind the seat and is controlled by a lock lever at the left-hand side of the seat pan. A Type MD-1 safety belt is attached to the bottom of the seatback assembly. A hand-hold above each windshield is provided for use when vacating the seat.

2-179. Horizontal adjustment levers. The flight compartment seats can be individually adjusted horizontally through a range of four inches and locked at any one of five positions by means of two interconnected levers, one at each side of the seat base. The levers are spring-loaded to the down position, and pulling either of them up mechanically withdraws two eyebolts from their engagement holes in each guide rail and allows the seat to be moved forward or aft to the desired position. Releasing the spring-loaded levers allows the eyebolts to engage with the holes nearest to that position; slide seat fore or aft to engage locks.

2-180. Vertical adjustment lever. The flight compartment seats can be individually adjusted vertically through a range of seven inches and locked at any one of seven positions by means of a lever pivoted at the left-hand side under the front of the seat pan, and spring-loaded to the aft position. Pulling the lever forward from the right-hand side mechanically withdraws two eyebolts from their engagement holes in the frame assembly bottom slides, and allows the seat to be moved upward under the influence of two springs, or downward under the influence of the occupant's weight, to the desired position. Releasing the spring-loaded lever when the desired height is reached allows the eyebolt to engage with the holes nearest to that position. Insure that eyebolts are securely engaged.

2-181. Shoulder harness reel lock lever. A two-position shoulder harness reel lock lever, with quadrant assembly, is attached to the left-hand side of each pilot's seat pan. The lever is used to actuate the reel mechanism into the "manual lock" (lever forward), or the "automatic lock" (lever aft), position. In the manual lock position the seat occupant is restrained against any forward or sideways movement, and this position is used for take-off and landing. In the automatic lock position the seat occupant may lean forward 18 inches, if desired. In aircraft fitted with the Type MA-1 reel, should an inertia force of between 2 to 3g be subjected to the aircraft, the reel will lock and prevent the seat occupant from being thrown forward. It will also lock, at increased 'g' increments, within a 120° forward arc. In aircraft fitted with the Type MA-2 reel, should an acceleration be imparted to the seat occupant, in any direction, of between 2 to 3g, the reel will lock and prevent the seat occupant from being thrown forward or sideways. In both types of reel, after being locked automatically, unlocking is carried out by moving the reel lock lever fully forward and then fully aft. This will return the reel to the automatic lock position.

Warning

When the lever is in the forward position at manual lock, leaning forward is restricted. Therefore, prior to an emergency landing, all the required switching operations should be carried out before selecting manual lock.

FUEL QUANTITY DATA

FUEL TANK (STANDARD OR SELF-SEALING)			FULLY SERVICED US GAL	FUEL POUNDS *	USABLE IN LEVEL FLIGHT (APPROX) US GAL
NORMAL	LH WING TANK	Standard	414	2484	414
		Self-sealing	403	2418	403
	RH WING TANK	Standard	414	2484	414
		Self-sealing	403	2418	403
	TOTAL (NORMAL CONFIGURATION)	Standard	828	4968	828
		Self-sealing	806	4836	806
Ferrying System Fuel Management Panel					
FORWARD TANK			480	2880	480
REAR TANK			480	2880	480
Total (Maximum for ferry)			1788	10,728	1742

* Fuel weight is based on 6.0 lb per US gallon under standard day conditions. Total weight of fuel depends on specific gravity and the temperature. The fuel quantity gages do not have the notation full, and variations in gage readings should be anticipated when the tanks are full.

Figure 2-21. Fuel quantity data

2-182. Auxiliary Equipment. Equipment not directly contributing to the flight of the aircraft, but which enables the aircraft to perform certain specialized functions, is described in Chapter 6. The following systems and equipment are covered:

a. Heating and Ventilating Systems.

b. Deicing System.

c. Oxygen System.

d. Lighting Equipment.

e. Alarm Bell System.

f. Ignition Analyzer.

g. Winterization Equipment.

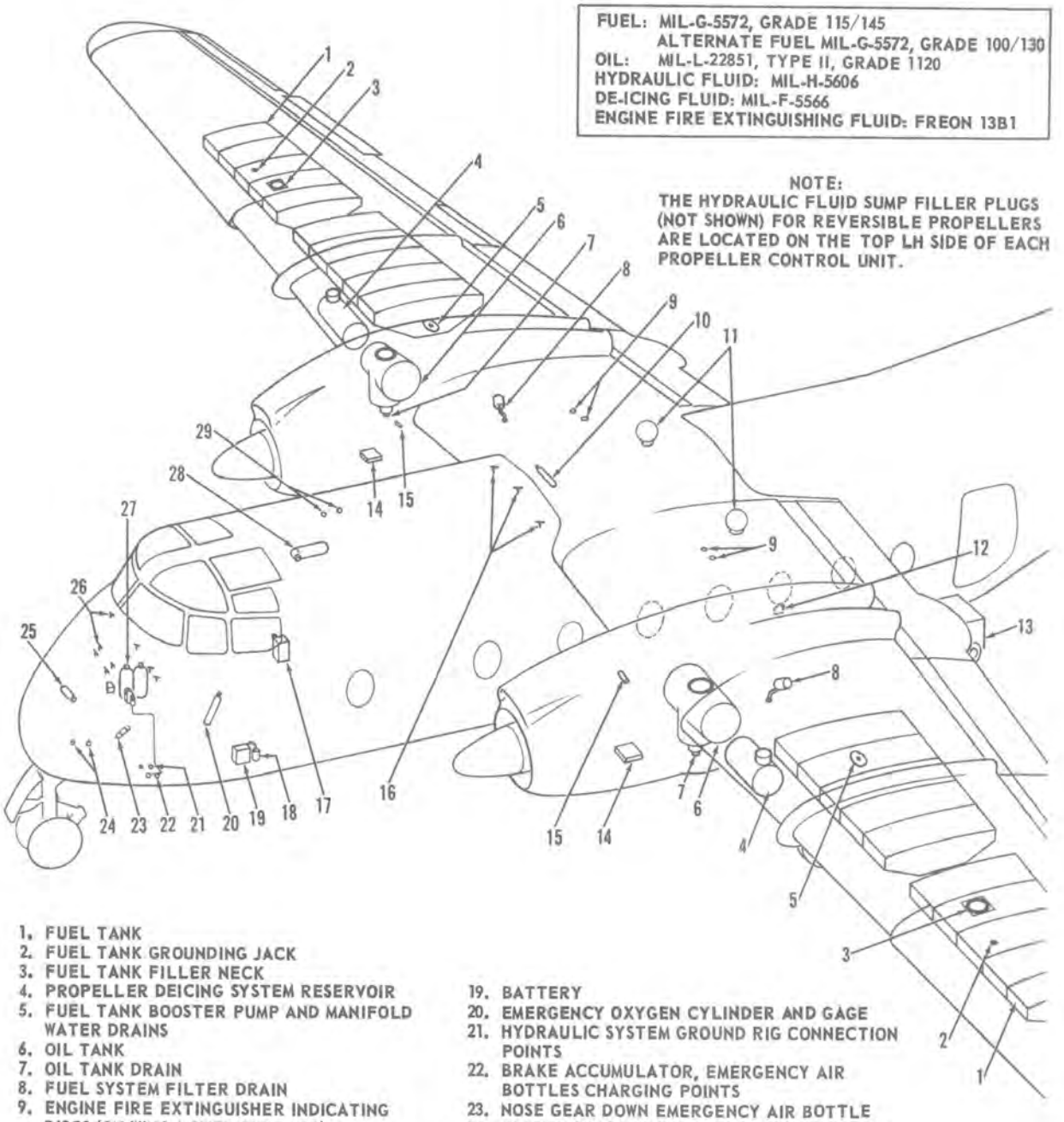
OIL QUANTITY DATA

EACH MAIN OIL TANK		US GAL
USABLE OIL	With Nonreversible Propellers	18.0
	With Reversible Propellers	20.4
FEATHERING WELL	With Nonreversible Propellers	2.4
	With Reversible Propellers	NIL
AIRSPACE		7.5
SUMP (Trapped to engine, but drainable)		1.8
TOTAL TANK VOL		29.7

NOTE: The oil capacity of a tank is 22.2 US gal, which is the oil required to replenish the tank after a complete oil change.

AUXILIARY OIL TANK (Used with long range ferry fuel tanks)	US GAL
USABLE OIL	18.0

Figure 2-22. Oil quantity data



1. FUEL TANK
2. FUEL TANK GROUNDING JACK
3. FUEL TANK FILLER NECK
4. PROPELLER DEICING SYSTEM RESERVOIR
5. FUEL TANK BOOSTER PUMP AND MANIFOLD WATER DRAINS
6. OIL TANK
7. OIL TANK DRAIN
8. FUEL SYSTEM FILTER DRAIN
9. ENGINE FIRE EXTINGUISHER INDICATING DISCS (ON WING LOWER SURFACE)
10. CABIN HEATER FIRE EXTINGUISHER CONTAINER
11. ENGINE FIRE EXTINGUISHER CONTAINER
12. EXTERNAL POWER RECEPTACLE (LH SIDE OF FUSELAGE)
13. EXTERNAL POWER CART
14. ENGINE DRAIN BOX
15. OIL PRESSURE TRANSMITTER (COLD WEATHER SERVICING POINT)
16. THRUST INDICATING SYSTEM MOISTURE TRAPS
17. HYDRAULIC SYSTEM RESERVOIR
18. BATTERY SUMP JAR
19. BATTERY
20. EMERGENCY OXYGEN CYLINDER AND GAGE
21. HYDRAULIC SYSTEM GROUND RIG CONNECTION POINTS
22. BRAKE ACCUMULATOR, EMERGENCY AIR BOTTLES CHARGING POINTS
23. NOSE GEAR DOWN EMERGENCY AIR BOTTLE
24. FLIGHT COMPARTMENT HEATER FIRE EXTINGUISHER INDICATING DISCS
25. FLIGHT COMPARTMENT HEATER FIRE EXTINGUISHER CONTAINER
26. PITOT STATIC SYSTEM MOISTURE TRAPS
27. OXYGEN CYLINDERS (2) AND GAGE (AIRCRAFT SERIAL NO. 62-4171 AND SUBSEQUENT). RH SIDE ACCESS DOOR.
28. OXYGEN CYLINDER (1) AND GAGE (AIRCRAFT PRIOR TO SERIAL NO. 62-4171)
29. CABIN HEATER FIRE EXTINGUISHER INDICATING DISCS (ON FUSELAGE SIDE)

AF-27

Figure 2-23. Servicing diagram

CHAPTER 3
NORMAL PROCEDURES

Section I

Scope

3-1. This chapter describes the steps of procedure and aircraft handling techniques for a non-tactical flight under normal conditions.

3-2. Coverage is given from the time a flight is planned until it is completed, with the aircraft parked and secure.

Section II

Flight Procedures

3-3. Preparation For Flight. Steps to be taken preparatory to flight are as follows:

3-4. Flight restrictions. Refer to Chapter 7 to determine the limitations imposed on the aircraft.

3-5. Flight planning. Flight planning data, such as required fuel, airspeed, power settings, etc, to complete the proposed mission should be determined, using the performance data contained in Chapter 14, Section II.

Note

All airspeeds quoted are for aircraft gross weights of 26,000 pounds with Flap Configuration (A), and 28,500 pounds with Flap Configuration (B). Speeds are applicable to sea level, standard day conditions.

3-6. Take-off and landing data cards. Prior to each flight the applicable data determined under FLIGHT PLANNING should be entered on the Take-off and Landing Data Cards, which form part of the pilot's condensed check list (TM 55-1510-206-10CL).

3-7. Weight and balance. Check the aircraft weight and balance (refer to DD Form 365C, in the DA Form binder), and Chapter 12 of this manual. Obtain take-off gross weight and loading data. From this and flight information, calculate anticipated landing gross weight and balance. Weight limitations are covered in Chapter 7. A weight and balance computer is provided with the aircraft, refer to Chapter 12 for use of the computer. DD Form 365F is the summary of the actual disposition of the load of the aircraft and records the balance status step-by-step. DD Form 365F (in conjunction with DD Form 175, if required) or a certification referring to a previously filed DD Form 365F, must be completed and filed. Refer to Army Regulation 95-16 for additional details covering DD Form 365F.

3-8. Preflight Checks. The preflight checks which must be accomplished prior to flight are BEFORE EXTERIOR INSPECTION, EXTERIOR INSPECTION (figure 3-1), and INTERIOR INSPECTION.

Note

The aircrew visual inspection procedures outlined in this chapter are predicated on the assumption that maintenance personnel have completed all the requirements of their inspection schedule. However, checks of any equipment involving safety of flight are duplicated in the preflight checklists.

3-9. Inspection requirements. Those items marked with an asterisk in the checklists are checks that must be performed before each flight, regardless of the type of operation. Those unmarked items are additional checks that may be performed at the discretion of the flight crew. All items listed under STARTING THE ENGINES, and subsequent phases, must be checked.

3-10. Before exterior inspection.

1. DA Form 2408 - Check:

a. Status today.

b. Servicing.

2. Battery master switch - OFF.

3. Ignition switches - OFF.

3-11. Exterior inspection. Carry out the exterior inspection as outlined in figure 3-1.

3-12. Interior inspection. This checklist has been arranged in chronological sequence. Generally speaking, it goes from rear to front and from left to right, as follows:

Cabin and Flight Compartment.

*1. Cargo and passenger doors - Closed.

*2. Ramp extensions - Stowed and secured.

3. Emergency equipment - Check:

a. Portable fire extinguishers (3).

b. First-aid kits (4).

c. Oxygen - Check:

(1) Portable oxygen unit.

(2) Crew oxygen system - 1800 psi.

d. Crash axe.

*4. Cargo - Correctly loaded and secured.

5. Engine preheat outlet cover - Secured.

*6. Emergency exits - Closed and secured.

7. Access ladder - Stowed.

*8. Circuit breaker panel - Check:

a. All circuit breakers - Set.

b. Emergency bus switch - NORMAL.

c. Secondary bus reset switch - down and guarded.

9. Main gear emergency extension handle - Secured.

10. Cabin and cockpit heater switches - OFF.

11. Heater intake anti-icing switches - OFF.

12. APU air inlet handle - Push to close.

*13. Hydraulic system - Check:

a. Hydraulic pressure shutoff valve lever - ON.

b. Hydraulic reservoir - Check fluid level.

c. Hydraulic panel - Check:

(1) Handpump selector - NORMAL SYSTEM.

(2) Emergency landing gear down selector - OFF.

(3) Nosewheel down selector - OFF.

(4) Brake accumulator charging selector - OFF.

d. Hydraulic handpump handle - Stowed.

Flight Compartment.

1. Pilot and copilot seats - Adjust as necessary.

2. Rudder pedals - Adjust to desired position.

*3. Safety belts and shoulder harness - Fasten and adjust.

*4. Parking brake - ON.

5. Cockpit air control and selector handles - As desired.

6. Nosewheel steering switch - ON.

7. Oil dilution switches - OFF.

8. Hot fuel prime switch - OFF.

9. Battery master switch - OFF.

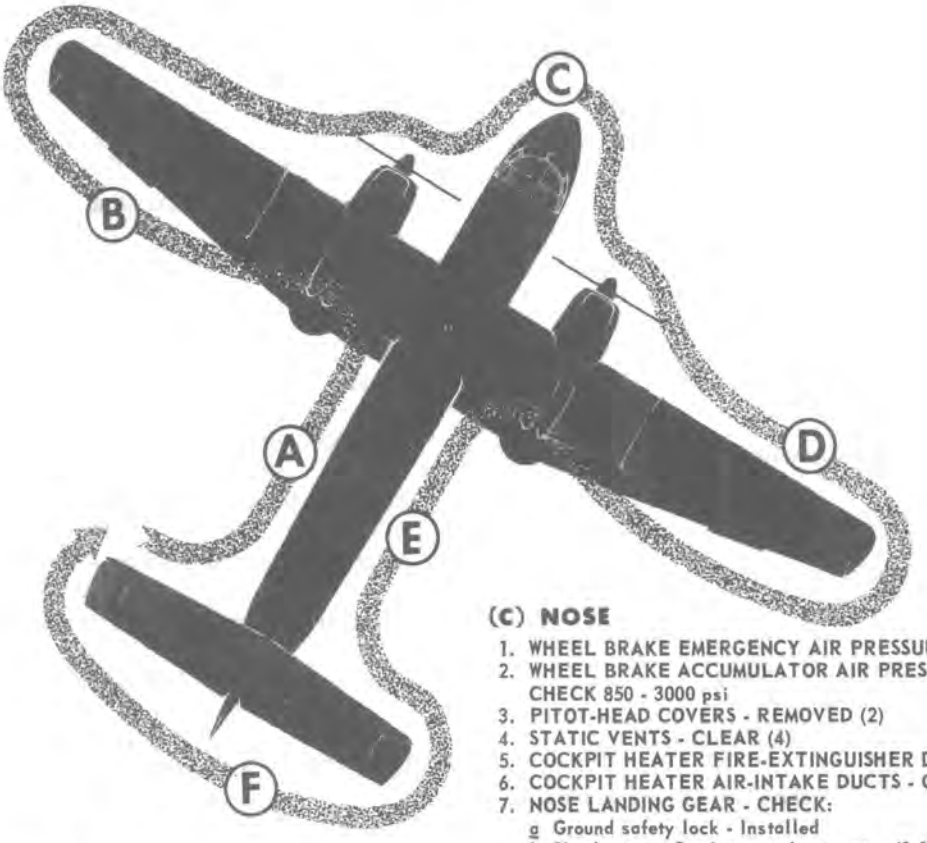
10. Windshield wiper switch - OFF.

11. Windshield heat switch - OFF.

12. Instrument light switches - OFF.

13. Anti-collision light switch - OFF.

14. Warning lights intensity switch - BRT.



(A) FUSELAGE LEFT-HAND SIDE

FUSELAGE SKIN - CONDITION

(B) LEFT-HAND WING

1. ENGINE FIRE-EXTINGUISHER INDICATING DISCS - INTACT
2. LEFT-HAND MAIN LANDING GEAR - CHECK:
   - a Doors - Condition and open
   - b Ground safety lock - Installed
   - c Weight-switch plug - Connected
   - d Shock strut - Condition and extension (7 1/2 - 9 1/2 inches)
   - e Tires - Condition and inflation (35 - 40 psi)
   - f Brake assembly - Condition
   - g Static ground - Condition
3. FUEL SYSTEM STRAINER - DRAIN
4. FLAPS AND AILERONS - CONDITION
5. CONTROL SURFACE HINGES - CONDITION
6. ACCESS PANELS - SECURED
7. FORMATION LIGHTS - CONDITION
8. WING TIP AND NAVIGATION LIGHT - CONDITION
9. WING SURFACE AND DEICER BOOTS - CONDITION
10. LANDING LIGHT AND WING INSPECTION LIGHT - CONDITION
11. PROPELLER - CONDITION
12. ENGINE COWLINGS AND ACCESS PANELS - CONDITION AND SECURED
13. THRUST INDICATOR PITOT-HEAD COVERS - REMOVED
14. ENGINE AIR INTAKES - CLEAR
15. CABIN HEATER AIR INTAKE (COMBUSTION) - CLEAR

(C) NOSE

1. WHEEL BRAKE EMERGENCY AIR PRESSURE - CHECK 1500 psi
2. WHEEL BRAKE ACCUMULATOR AIR PRESSURE - CHECK 850 - 3000 psi
3. PITOT-HEAD COVERS - REMOVED (2)
4. STATIC VENTS - CLEAR (4)
5. COCKPIT HEATER FIRE-EXTINGUISHER DISC - INTACT
6. COCKPIT HEATER AIR-INTAKE DUCTS - CLEAR
7. NOSE LANDING GEAR - CHECK:
   - a Ground safety lock - Installed
   - b Shock strut - Condition and extension (8 1/2 - 10 1/2 inches)
   - c Steering disconnect pins - Installed
   - d Weight-switch plug - Connected
   - e Tires - Condition and inflation (38 - 42 psi)
   - f Taxi light - Condition
   - g Doors - Condition and position (rear doors closed)
8. NOSE GEAR EMERGENCY AIR-BOTTLE PRESSURE - CHECK 1200 psi
9. OXYGEN SYSTEM PRESSURE SUPPLY - CHECK 1800 psi (Diluter Demand System)
10. ACCESS PANELS - SECURED
11. BOTTOM HATCH - SECURED
12. CABIN HEATER FIRE-EXTINGUISHER INDICATOR DISCS - INTACT

(D) RIGHT-HAND WING

- REPEAT CHECK AS FOR LEFT WING, PLUS:

1. CABIN HEATER AIR INTAKE (VENTILATION) - CLEAR
2. AILERON TRIM TAB - NEUTRAL
3. AILERON-RUDDER INTERCONNECT - CONDITION

(E) FUSELAGE RIGHT-HAND SIDE

1. FUSELAGE SKIN - CONDITION
2. WIRE ANTENNAS - CONDITION
3. ANTI-COLLISION LIGHT (UPPER AND LOWER) - CONDITION
4. FORMATION LIGHTS - CONDITION
5. PASSENGER DOOR - CONDITION AND CLOSED
6. CARGO DOOR JETTISON HANDLE - SECURED. ACCESS PANEL CLOSED.

(F) EMPENNAGE

1. VERTICAL STABILIZER, RUDDER AND TRIM TAB - CONDITION
2. HORIZONTAL STABILIZER, FAIRINGS, ELEVATORS, TRIM TABS - CONDITION
3. TAIL LIGHT - CONDITION
4. CARGO DOOR - CONDITION

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Figure 3-1. Exterior inspection

15. Wing-and-tail lights switch - OFF.

16. Standby compass light switch - NORM.

17. Wing inspection lights switch - OFF.

18. Formation lights switch - OFF.

19. All radio switches - Off.

*20. Pilot's flight instruments - Check. Set altimeter.

21. Gyro compass switch - SLAVE.

22. Fuel booster pump switches - OFF.

*23. Fuel tank selector switch - NORMAL.

24. Troop-jump and pendulum-release switches - OFF.

*25. Engine instruments - Check.

*26. Electrical power panel - Check:

a. DC generator switches - ON (Guarded).

b. Inverter switch - OFF.

27. Deicing panel - Check:

a. Pitot heater switch - OFF.

b. Propeller deicing switch - OFF.

c. Wing-and-tail mode switch - OFF.

*28. Copilot's flight instruments - Check.

29. Thrust indicator free-stream pressure selector - NORMAL.

30. Feather dilution arming switch (non-reversible propellers) - OFF.

31. Autofeathering switch - OFF.

32. Clocks - Check and set (2).

*33. Emergency panel - Check:

a. Cabin and cockpit heater fire extinguisher switches - Down and guarded (2).

b. Fuel and oil emergency shutoff switches - Down and guarded (4).

c. Fire-pull T-bar handles - In and horizontal.

34. Wheel brakes emergency lever - Forward and secured.

35. Standby compass - Check.

36. Overhead console - Check:

*a. Carburetor air induction switches - RAM.

*b. Carburetor hot-air levers - COLD.

c. Flap selector lever - Up.

*d. Rudder trim - Neutral.

*e. Ignition switches - OFF.

f. Taxi and landing light switches - Off.

*g. Mixture control levers - IDLE CUT-OFF.

*h. Propeller levers - Maximum INCREASE.

*i. Gust lock handle - LOCKED.

j. Throttles - Open to maximum with gust lock handle LOCKED. Adjust friction levers.

*k. Landing gear selector - DOWN.

*37. Battery master switch - BATTERY MASTER.

*38. DC warning and indicating lights:

a. Check on (12):

(1) Hydraulic low pressure (2).

(2) Landing gear down (3).

(3) Fuel low pressure (2).

(4) Oil low pressure (2).

(5) Generators (2).

(6) Main inverter failure (1).

b. Press-to-test (11) on non-reversible propeller aircraft, (15) on reversible propeller aircraft. Two additional lights are added if item (2) is incorporated.

(1) Fuel low level (2).

(2) Chip detector (2) - (with MWO 55-1510-206-34/66).

(3) Low oil level (2).

(4) Autofeathering (1).

(5) Cockpit heater fire (1).

(6) Cabin heater fire (1).

(7) Ramp door 15° position (1).

(8) Doors unlocked (1).

(9) Windshield heat (2).

(10) Propeller reverse (2).

(11) Propeller hydraulic oil level (2).

*39. Landing gear warning horn test switch - TEST. Check for illumination of gear selector lever light.

40. Alarm bell - Check operation.

41. Troop-jump lights - Check operation, flight compartment (2), cabin (4).

42. If external power is to be used:

a. Battery master switch - OFF.

b. External power - Connected.

c. Inverter switch - STBY. Check STANDBY light illuminates.
- OFF. Check FAILURE light illuminates and STANDBY light goes out.
- MAIN. Check that STANDBY and FAILURE lights go out, indicating that the main inverter is operating. Leave switch at MAIN.

3-13. Engine Procedures And Taxiing. Procedural steps for operating the engine and for taxiing are given in the following paragraphs.

3-14. Before starting the engines.

*1. Propellers - Clear.

*2. Wheel chocks - In place.

*3. Landing gear ground safety locks - Removed (3).

*4. Fire guard - Posted.

*5. Accessories compartment vent doors switch - AUTO-OPEN.

3-15. Starting the engines.

Caution

If a chip detector caution light comes on at any time before take-off shut down the affected engine immediately.

Note

Note the readings of the manifold pressure gages. This will later serve as the field barometric pressure during power and ignition checks.

1. Start left-hand engine as follows:

Note

If external power is used, start right-hand engine first and disconnect external power before starting left-hand engine.

a. Left-hand fuel booster pump switch - NORM.

Note

If the hot fuel prime system is to be used, proceed as in Chapter 6, paragraph 6-109.

b. Inverter switch to MAIN momentarily - Note fuel pressure registers. Return to OFF. (With external power, merely note pressure.)

c. Starter switch - L. Turn propellers through 15 blades on the initial start on any day, or 6 blades on subsequent starts to check for hydraulic lock. Do not operate the starter for a period exceeding 30 seconds. Allow a cooling period of at least 1-minute between attempts.

d. (CP) Left-hand ignition switch - BOTH (at required blade count).

e. Vibrator switch - L.

f. Primer switch - L. Prime as required.

Caution

Do not prime prior to this stage, as an intake manifold fire may result.

Note

Do not allow the initial surge to exceed 1100 rpm.

g. Starter and vibrator switches - Release.

h. Throttle - Adjust for 800 rpm.

i. Mixture lever - AUTO RICH, when engine is running smoothly on the prime.

Caution

Use of the mixture lever to assist the primer during normal starting will create an over-primed condition and subsequent risk of an engine fire.

j. Primer switch - Release when rpm starts to drop.

2. Left-hand generator switch - ON (OFF if external power is used).

3. Inverter switch - MAIN.

4. Oil pressure - 30 psi minimum.

Caution

If oil pressure fails to register, shut down the engine at once.

5. Left-hand fuel booster pump switch - OFF.

6. Repeat starting procedure for right-hand engine. (If external power was used - disconnect external power and turn battery master switch to MASTER, left-hand generator switch ON).

7. AC electrical power check - Press-to-test (6):

a. Fuel quantity indicating system (2).

b. Fire detecting system (4).

3-16. Engine ground operation. Warm up at 1000 rpm until oil temperature reaches 40°C with oil pressure 30 psi minimum.

3-17. Before taxiing.

1. (CP) Communications equipment - Test as desired. Refer to paragraph 5-72.

2. (CP) IFF - STBY.

3. Flight instruments - Check all indications normal. Set altimeter.

4. (CP) NO SMOKING and FASTEN SEAT BELTS switches - Up (on).

5. Hydraulic system pressure - 3000 psi approximately.

6. Brake system pressure - 3000 psi approximately.

7. Wheel chocks - Removed.

3-18. Taxiing.

1. Nosewheel steering switch - ON.

Caution

To prevent damage to nosewheel steering components, avoid excessive use of full steering when taxiing in gusty crosswinds. Do not use differential braking, especially when nosewheel is lightly loaded.

Note

During ground maneuvering with propellers operating in reverse pitch nosewheel steering must be selected ON.

2. Throttles - 800 rpm.

3. Parking brake - Release.

4. Wheel brakes - Check operation.

5. Flight instruments - Check operation during turns.

6. Head into the wind, and stop with nosewheel centered.

7. Parking brake - On.

3-19. Engine Run-up. Engine run-up procedure is as follows:

1. Throttles - Set at 1000 rpm. Check:

a. Wing flaps - Check. Operate through complete cycle. Check position indicators function correctly.

b. Ignition switches - Check. Select each switch in turn to L, R, and momentarily to OFF. At L and R, the engines should continue to run, but should cease firing at OFF.

Warning

Too long a pause in L and R will tend to foul the plugs. Switching to OFF and back to BOTH must be rapid to prevent severe backfiring; the duration of the pause being sufficient only to confirm that firing ceases in OFF. Should the engine continue to run in OFF, shut down at once and warn personnel to avoid the propeller area until the fault is rectified.

c. Mixture control - Move mixture control levers slowly toward IDLE CUT-OFF. As soon as rpm decreases, return to AUTO RICH.

d. Fuel crossfeed - Check:

(1) Fuel tank selector switch - BOTH ON LH TANK.

(2) LH fuel booster pump switch - HIGH. Check fuel pressure rise on both gages. Booster pump switch OFF.

(3) Fuel tank selector switch - BOTH ON RH TANK.

(4) RH fuel booster pump switch - HIGH. Check fuel pressure rise on both gages. Booster pump switch OFF.

(5) Fuel tank selector switch - NORMAL.

(6) Fuel booster pump switches - Both on HIGH. Check fuel pressure rise on both gages. Booster pump switches OFF.

e. Voltammeters - Check:

(1) Volt readings 24 V ± 0.5 V.

(2) Ammeter readings coincide within 10%.

(3) RH generator switch OFF. Note RH ammeter reading drops to zero and LH ammeter reading increases. RH generator switch ON.

(4) Repeat (3) for LH generator.

f. (CP) Inverters - With either generator switch OFF check that automatic changeover to standby inverter occurs and that the STANDBY light illuminates.

g. (CP) Pitot heat - Check (feel pitot heads).

h. Heater intake anti-icing - As required.

i. Wing and tail deicing pumps - Check:

(1) Mode switch - MAN.

(2) Deicing pressure 14-16 psi, suction 4-8 in. Hg.

(3) Mode switch - OFF.

j. (P) Temperature - Check:

(1) Oil temperature 40°C min.

(2) Cylinder head temperature 120°C min.

2. (P) Gust lock handle - UNLOCKED.

3. (P) Throttles - Set at 1900 rpm. Check:

a. (CP) Propellers - Move propeller levers to minimum DECREASE; check rpm falls to approximately 1300 rpm. Return propeller levers to maximum INCREASE; check rpm returns to 1900 rpm (perform three times for non-reversible propellers or once for reversible propellers, on initial run-up).

b. (CP) Carburetor heat - Select HOT; note rise in carburetor air temperature and decrease in rpm. Return to COLD; note increase in rpm and carburetor air temperature decreases.

4. (P) Throttles - Set at 2200 rpm. Check:

a. (P) Manifold pressure - Check for approximately field barometric pressure.

b. (CP) Ignition system - Check each engine in turn. Move ignition switch from BOTH to R and back to BOTH; from BOTH to L and back to BOTH. The normal drop in each case should be approximately 50 to 75 rpm, maximum 100 rpm. The spread between L and R should not exceed 40 rpm. Perform the check as rapidly as possible to prevent spark plug fouling.

5. (P) Throttles - CLOSED. Check:

a. Idling - 550 rpm ± 25 rpm.

b. Generator warning lights - Illuminated.

c. Standby inverter light illuminates automatically.

6. Propeller autofeathering system - Check:

a. (P) Throttles - Set at 800 rpm.

b. (P) Autofeathering switch - ON. Check autofeathering indicator light illuminates.

c. (P) Throttle:

(1) Open up LH throttle until right-hand feathering button pulls in. Button light should illuminate, autofeathering light should go out.

(2) Return throttle to 800 rpm.

(3) (CP) Simultaneously pull out the button to arrest the feathering cycle.

d. (P) Autofeathering switch, reset by turning-OFF then ON.

e. Repeat the procedure for LH system.

Note

At the instant feathering commences, a pressure differential of 45±2 1/2 percent thrust should be indicated.

If automatic feathering is inoperative check manual feathering at 1900 rpm by depressing each button in turn and pulling out after a drop of 100 rpm.

7. Autofeathering switch - OFF.

8. (P) Reversible pitch propellers (if fitted) - Check:

a. Throttles - Idling position. Move upwards into the propeller reverse position. Check PROP REVERSE blue lights illuminate. Move throttles slightly aft to check power increase.

b. Return throttles to the idling position, and allow to move down to the normal position. Check the blue lights go out.

Caution

Monitor oil and cylinder head temperatures during all reverse pitch operations.

9. (P) Gust lock handle - LOCKED.

3-20. Before Take-off. Checks to be made before take-off are as follows:

3-21. Take-off check.

1. (P) Trim settings - Check:

a. Rudder - Neutral.

b. Aileron - Neutral.

c. Elevator - TAKE-OFF RANGE.

2. (CP) Carburetor heat - COLD.

3. (CP) Mixture lever - AUTO RICH.

4. (CP) Propeller levers - Maximum INCREASE.

5. (P) Autofeathering switch - ON. Check indicator light.

6. (P) Fuel tank selector switch - NORM.

7. (P) Fuel booster pump switches - NORM.

8. (P) Hydraulic pressure indicator - 3000 psi approximately.

9. (P) Windshield heat switch - NORM.

10. (CP) Anti-collision light switch - ON.

11. (P) Engine instruments - Check all warning lights out.

12. (P) Flight instruments - Check:

a. Warning flags invisible.

b. Attitude indicators erected and adjusted for level flight.

13. (P) Stall warning system and short-field approach speed indicator - Check left and right stick shakers and indicator:

a. Throttles - CLOSED.

b. Flaps - 0°.

c. Stall warning test switch - Hold at RIGHT, then LEFT. Both low intensity stick shakers should operate at LEFT only. Feel copilot's control wheel to insure operation of copilot's low intensity shaker.

d. Holding switch at LEFT, lower flap beyond 19° - Both low intensity shakers should continue to operate. Select switch to RIGHT and stick shaker operation should stop.

e. Holding switch to RIGHT, advance both throttles approximately 3/4 inch from fully closed position - Both high intensity stick shakers should operate, and the approach speed indicator pointer should move fully into the SLOW zone.

f. Select switch to LEFT - Both high intensity stick shakers should continue to operate, augmented by both low intensity stick shakers. Indicator pointer should return to the triangular index.

g. Release switch to off position, close throttle, and raise flaps to 0°. Shakers may continue to operate for approximately 10 seconds. Indicator pointer should remain at the triangular index.

14. (CP) Wing flaps - As desired.

15. Parking brake - Release.

16. Taxi onto runway.

17. (CP) IFF Master Control - NORM. Mode and code as briefed.

3-22. Line-up check.

1. (P & CP) Shoulder safety harness inertia reel - LOCKED.

2. (P) Gust lock handle - UNLOCKED.

3. (P) Flight controls - Check for freedom, full range of movement, and correct response.

3-23. Take-off. Procedures for normal take-off, minimum run take-off and crosswind take-off are given in the following paragraphs.

3-24. Normal take-off. (Flaps 15° or 7° as appropriate.)

1. Nosewheel steering switch - ON. Taxi a short distance to align aircraft with the runway and to center the nosewheel.

2. Wheel brakes - Release as engine power is applied.

3. Throttles - Advance smoothly to take-off power ((P) 50 in. Hg and (CP) 2700 rpm at sea level).

Note

Consult engine handling chart (Chapter 14) for maximum manifold pressure at take-off altitude.

4. Control column - (Copilot should hold the control column in neutral until pilot transitions from nosewheel steering.) Ease back on the control column and allow the aircraft to lift-off at 69 knots IAS (A) at all weights up to 26,000 lb, or 82 knots IAS (B) at 28,500 lb. (For speeds at other weights in Flap Configuration (B) refer to Chapter 14, Section II.)

3-25. Minimum run take-off (short field) - (Flaps 25° or 30° as appropriate.)

1. Nosewheel steering switch - ON. Position the aircraft at the extreme threshold of the strip with the nosewheel centered.

2. Wheel brakes - Apply and hold.

3. Throttles - Advance smoothly to take-off power and allow engines to stabilize.

4. Wheel brakes - Release.

5. Control column. - (Copilot should hold control column in neutral until pilot transitions from nosewheel steering.) Ease back on the control column and allow the aircraft to lift-off at 53 knots IAS (A) or 62 knots IAS (B). (Speeds will decrease approximately 1 knot for each 1000 lb below appropriate maximum gross weight.)

3-26. Crosswind take-off. Taxi straight ahead on the runway to center the nosewheel, and check that the nosewheel steering switch is ON. In light crosswinds the nosewheel will maintain directional control until full rudder control is attained. In moderate to strong crosswinds, any tendency to weathervane can be corrected by leading with the upwind throttle. Take-off power on both engines should not be applied until effective rudder control is attained. Apply ailerons into the wind to maintain wings level. Hold the aircraft on the ground by use of the control column and at take-off speed lift the aircraft clear of the ground. For maximum permissible crosswind components and take-off speeds, refer to Chapter 14, Section II.

3-27. Climb. Procedures for normal climb and maximum climb are given in the following paragraphs.

3-28. Normal climb.

1. (P) Landing gear selector lever - UP as soon as definitely airborne. Check indicator lights.

2. (CP) Wing flaps - UP simultaneously with gear.

3. Establish 500 fpm rate of climb.

4. Power:

a. As soon as the airspeed passes through safe single-engine speed of 75 knots IAS (A) or 90 knots IAS (B), reduce to METO power ((P) 42.5 in. Hg and (CP) 2550 rpm at sea level).

b. After flaps are fully retracted and airspeed passes through 95 knots IAS (best rate-of-climb speed) reduce power to normal climb settings ((P) 35.0 in. Hg and (CP) 2250 rpm at sea level).

5. (P) Autofeathering switch - OFF.

6. Maintain 500 fpm rate of climb.

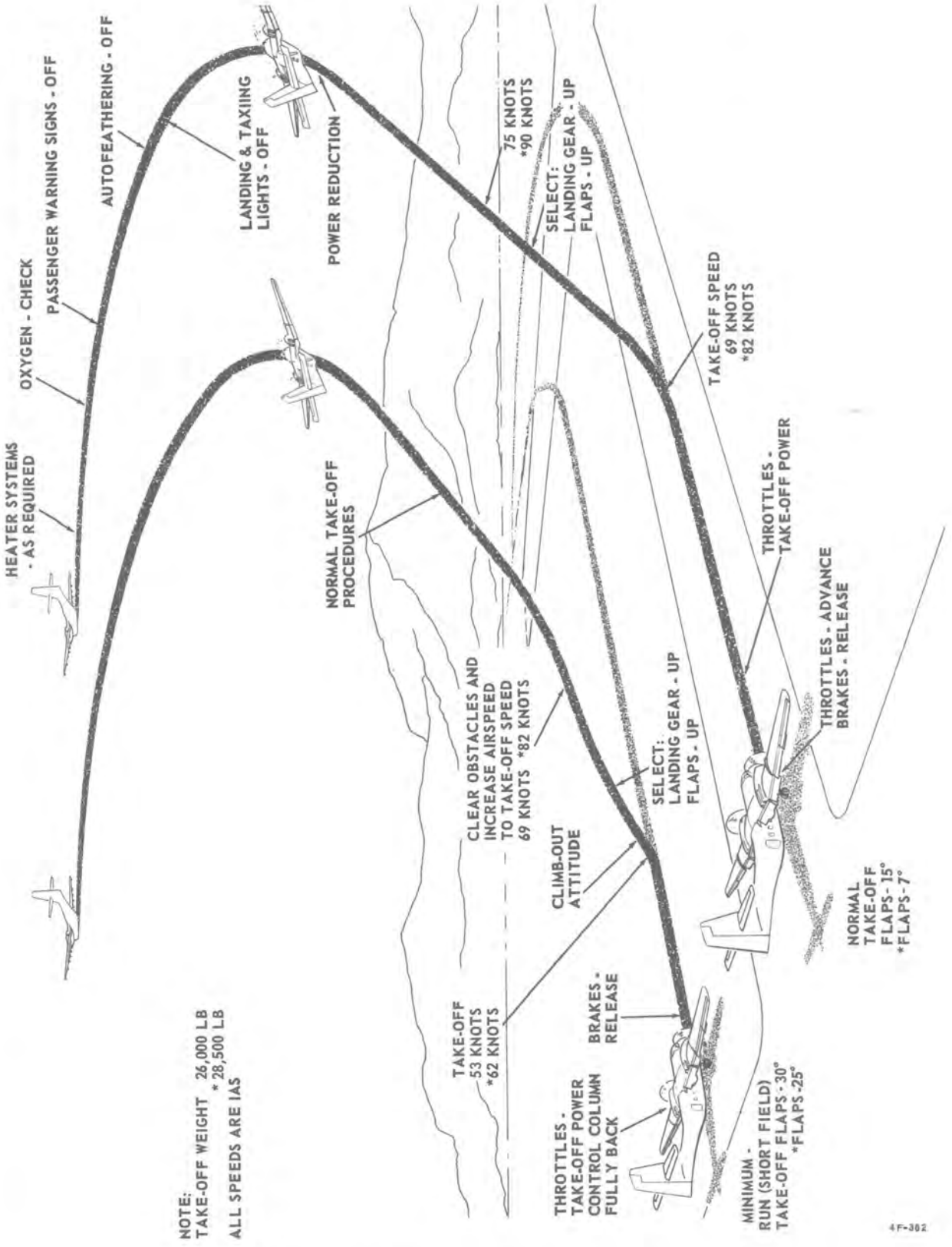


Figure 3-2. Take-off diagram (typical)

3-29. Maximum climb.

1. Landing gear selector lever - UP as soon as definitely airborne. Check indicator lights.

2. Wing flaps - UP simultaneously with gear.

3. Airspeed - Maintain 57 knots IAS until clear of all obstacles. Lower the nose to pick up safe single-engine speed of 75 knots IAS (A) or 90 knots IAS (B).

4. Power - After flaps are fully retracted, reduce to METO power ((P) 42.5 in. Hg and (CP) 2550 rpm at sea level).

5. Airspeed - Maintain 95 knots IAS to flight altitude.

6. Autofeathering switch - OFF.

3-30. Refer to Chapter 14, Section II for recommended climb values.

Caution

Continuous engine operation in the range 2310 to 2510 rpm is prohibited.

3-31. Cruise. Refer to Chapter 14, Section II for cruise data. Refer to Chapter 9 for engine and fuel system management.

1. Level off.

2. Engine power - Adjust to desired cruise settings after cruising speed has been reached.

3. Fuel booster pump switches - OFF.

4. Mixture - Select AUTO LEAN when cylinder head temperatures are within cruising range.

5. Carburetor heat - As required.

6. Carburetor air - As required.

3-32. Engine power setting for cruise. A power setting of 725 hp each (50 percent) is recommended for cruise on all flights when fuel consumption is not the primary consideration. This is the maximum continuous allowable in the AUTO LEAN mixture position, and gives the greatest fuel economy for the fastest cruising airspeed. For fuel economy on maximum range missions and on heavy load short range missions, 500 hp each should be used. An intermediate setting of 600 hp may be used if fuel is not critical; this setting requires less sacrifice in airspeed than the maximum economy setting. METO (maximum except for take-off) power is used for high speed runs and may be used indefinitely as long as the mixture control levers are in the AUTO RICH position.

3-33. Flight Characteristics. Refer to Chapter 8.

3-34. Descent. Conditions permitting, the descent from cruising altitude should be made using cruising rpm and a manifold pressure producing 500 fpm rate of descent. If a considerable reduction in manifold pressure is required, the rpm should be reduced accordingly to provide 100 rpm per in. Hg; for example, 1800 rpm at 18 in. Hg. If a rapid descent is necessary, clean up the aircraft and descend at 170 knots IAS, power off.

Caution

Should the descent necessitate passing through probable icing conditions, the mixture should be in AUTO RICH with carburetor heat applied prior to entry, and a carburetor air temperature of 15°C maintained throughout. It is possible that a rapid descent from a very cold level into visible moisture at a warmer level, can create airframe icing even though the ambient temperature may not be conducive to its formation.

3-35. Before Landing. Initiate the following on the base leg of the landing pattern:

Note

Change in aircraft gross weight should be estimated and compared with pre-flight estimate of landing gross weight. Refer to Chapter 7 for weight and CG limitations.

1. Throttles - Adjust to maintain airspeed below the landing gear extension speed of 120 knots IAS (approximately 18 in. Hg).

2. (CP) Carburetor heat - As desired.

3. (CP) Mixture levers - AUTO RICH.

4. (P) Fuel tank selector switch - NORMAL, or as required.

5. (P) Fuel booster pump switches - NORM, or as required.

6. (P) Nosewheel steering switch - ON.

7. (P) Hydraulic pressure - 3000 psi approximately.

8. (P) Landing gear selector lever - DOWN.

a. Check indicator lights (3).

b. (P & CP) Visually check each main gear down.

c. (CC) Visually check main gear down locks and index marks.

d. (P) Hydraulic pressure - Returns to approximately 3000 psi.

9. (CP) Flaps - As desired. Observe flap speed limitations.

10. Propellers - Maximum INCREASE on final approach after throttles are retarded below governing range.

11. (CP) Landing lights - As desired.

12. (P) Accessory compartment vent doors switch - As desired.

13. (P & CP) Safety harness inertia reel-LOCKED.

3-36. Landing. The following paragraphs describe the landing technique required to produce the results shown in Chapter 14, Section II (non-reversible propellers). Refer to Chapter 4 for landing emergencies.

3-37. Normal approach and landing. Complete the turn onto the final approach at least 500 feet above ground level with the landing gear down, 19° flap (A), or 14° flap (B) and 80 knots IAS (A), or 85 knots IAS (B). When on final approach and landing is assured lower the flaps to landing setting (A) or (B) as appropriate and reduce airspeed gradually to threshold speed of 70 knots IAS (A), or 75 knots IAS (B). Select propeller levers to maximum INCREASE when throttles are reduced below governing range. Flare out and ease off the power. In gusty conditions airspeed should be increased. Touchdown on the main wheels first at approximately 65 knots IAS (A), or 70 knots IAS (B), and lower the nosewheel to the ground before elevator control is lost. Maintain directional control by use of rudder, brake, and nosewheel steering if necessary. When the landing roll is complete and before turning out of wind, engage the gust locks.

Note

On aircraft with reversible propellers the ground roll distance can be reduced by proceeding as in paragraph 3-39, step 5. The propellers must be returned to forward pitch operation at the end of the landing ground roll.

3-38. Crosswind landing. Correct the approach drift by lowering the upwind wing and apply opposite rudder as required; maintain the correction through flare-out. Immediately after touchdown, lower the nosewheel to the ground. Maintain direction by use of rudder, aileron, power, brakes, and nosewheel steering as necessary. Refer to Chapter 14, Section II for maximum permissible crosswind components.

Caution

To prevent damage to nosewheel steering components, avoid excessive use of full steering when taxiing in gusty crosswinds. Do not use differential braking, especially when nosewheel is lightly loaded.

3-39. Minimum run landing (short field). Carry out short field landing as follows:

Caution

As in the related take-off procedure full application of this technique requires practice, experienced pilots and appropriate care.

Caution

Do not transmit on HF frequencies when flying below 90 knots IAS with flaps less than 19° down or below 70 knots IAS with flaps 19° or more down. The high RF energy level generated during transmission will affect lift transducer signals near stall speeds and nullify stick shaker operation and short field approach speed indication.

1. Before landing, flaps 30° or less, as wind conditions dictate.

2. On final approach, 30° flaps and 60 knots IAS (A) SF or 66 knots IAS (B) SF with partial power is recommended until obstacle clearance is assured; then lower 40° flaps and reduce power.

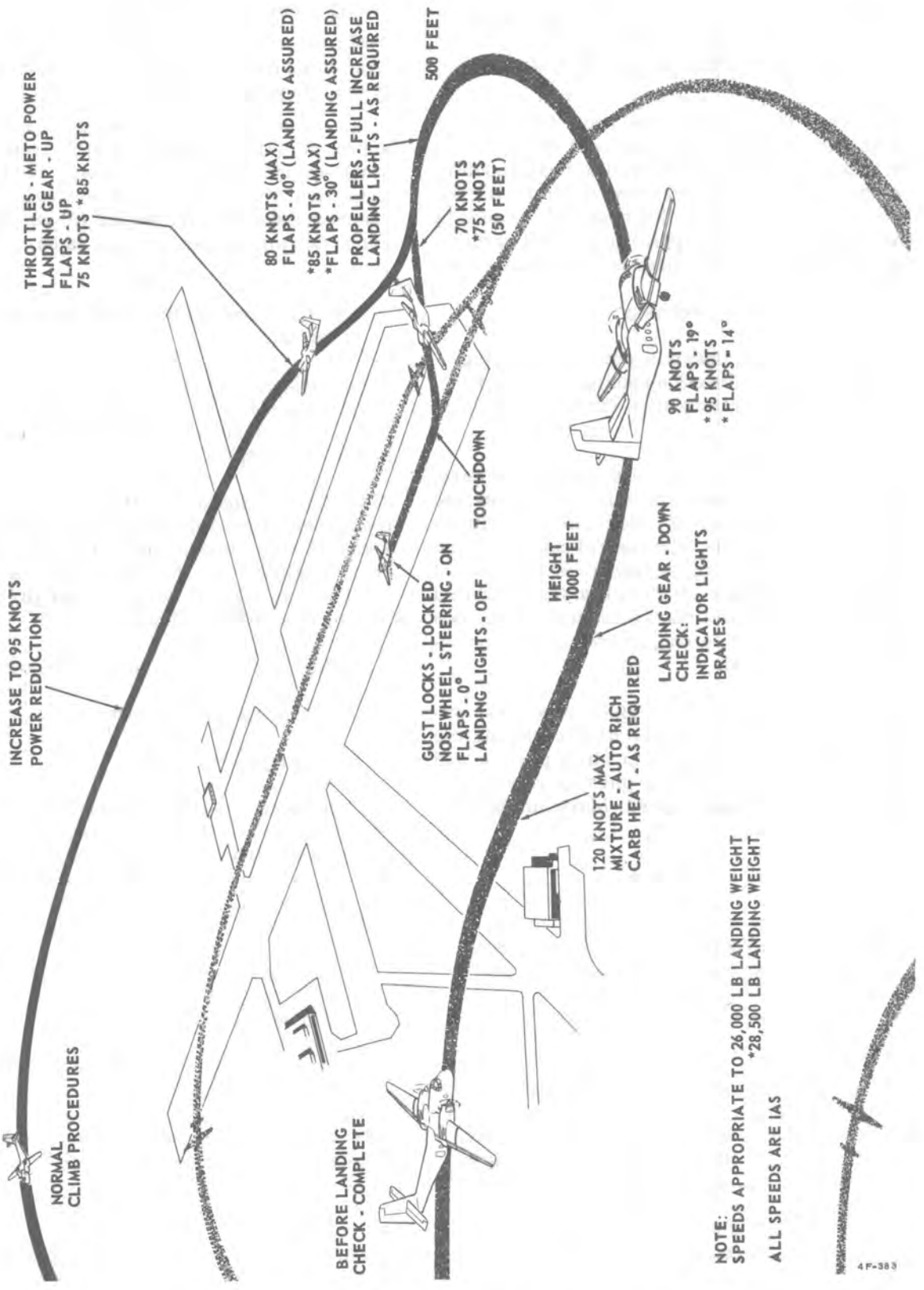


Figure 3-3. Landing and go-around diagram (typical)

Note

On aircraft Serial No. 61-2595 and subsequent, use the short-field approach speed indicator to maintain the optimum approach speed.

3. Cross the obstacle at 60 knots IAS (A) or 66 knots IAS (B) with power off, and maintain this airspeed to the flare altitude. The flare should be commenced at an altitude from which the aircraft can be rotated to a stalled nose-high attitude by the smooth but steady application of full up elevator, well ahead of touchdown on the main wheels.

Warning

To preclude the possibility of overstressing the center wing section upon landing, do not apply initial braking until the main wheels are on the ground.

4. On aircraft with non-reversible propellers, immediately the main wheels have contacted the ground, full use of intermittent maximum braking can be made. The control column should be held fully back until the nosewheel has touched the ground. The most effective braking is obtained by intermittent use of maximum brake for periods of at least one full second, followed by a momentary release period.

5. On aircraft with reversible propellers, immediately the main wheels have contacted the ground move the throttles to idling position and upwards to initiate reverse pitch operation, then aft to increase engine speed. Maximum braking should be used as in item 4.

Caution

Do not select reverse pitch prior to touchdown. Monitor engine oil and cylinder head temperatures during all reverse pitch operations.

Note

This aircraft, in common with most large aircraft capable of operating at low airspeeds, has low response rates to control deflection in the landing configuration. Therefore, during turbulent conditions, large control motions should be used. In addition, airspeed should be increased as appropriate to turbulence and wind conditions.

3-40. Touch-and-go landing. Touch-and-go landings are feasible but, due to the short landing roll and slow retraction rate of the flaps, are hardly considered advantageous.

3-41. Go-around. Procedures for going-around from an approach and from a touchdown are given in the following paragraphs.

3-42. From approach. In going around from the approach, METO power must be used and safe single-engine speed appropriate to flap configuration (A) or (B) maintained until flaps have reached take-off flap setting (A) or (B) during retraction and the landing gear is up.

Note

The flaps and landing gear may be raised at the same time.

Allow airspeed to increase during flap retraction to 95 knots IAS (A) or (B) and when flaps are fully retracted commence climbing, using normal power and airspeed.

3-43. From touchdown. When going around from touchdown, airspeed should be increased to 70 knots IAS (A) or 75 knots IAS (B) and should be maintained until the gear is up and the flaps retracted to take-off setting (A) or (B) as appropriate. Proceed as follows:

1. Throttles - Advance to take-off power.

2. (P) Landing gear - Select UP.

3. (CP) Flaps - Select UP.

4. Airspeed - Allow to increase to 70 or 75 knots IAS before flaps reach take-off setting (A) or (B) respectively during retraction.

5. Airspeed - Allow to increase to 95 knots IAS (A) or (B) during final flap retraction.

6. Engine power. - Reduce to METO (42 in. Hg and 2550 rpm). When clear of all obstacles, reduce to normal climb.

7. Climb - Continue as for normal climb after take-off.

3-44. After Landing. The procedures to be followed after landing are given as follows:

Note

On aircraft with reversible propellers, the throttles must be returned to forward pitch operation at the end of the landing ground roll.

1. (P) Gust lock handle - LOCKED before turning off runway.

2. (CP) Flap selector lever - UP.

3. (P) Fuel booster pump switches - OFF.

4. (P) Windshield heat switch - OFF.

5. (CP) Anti-collision light switch - OFF.

6. (CP) Deicing switches - Off.

7. (CP) Radio switches - Off, or as desired.

8. (CP) IFF - OFF.

Note

Turn off the IFF as soon as possible after landing to eliminate signals that may block the controller's scope and interfere with the control of airborne aircraft.

9. (CP) Taxi light switch - As required.

10. Taxi to parking area.

11. Center nosewheel - Nosewheel steering switch - OFF.

Note

Prior to parking, the nosewheel should be centered and the aircraft moved forward a few feet to relieve offset loads on the main gear.

12. (P) Parking brake - On.

13. (P) Throttles - Set at 1000 rpm.

3-45. Engine Shutdown. Engine shutdown procedure is as follows:

Note

If a subsequent cold weather start is anticipated, oil dilution should be carried out before shutting down the engine (refer to Chapter 10, Section III).

1. (P) Cylinder head temperatures - Run the engines at 1000 rpm until the temperatures stabilize below 200°C.

2. (CP) Ignition switches - Ground-out check. (Refer to paragraph 3-19, step 1.b.)

3. (CP) Radio switches - Off.

4. (CP) Inverter switch - OFF.

5. (CP) FM power switch - OFF.

6. (CP) Mixture levers - IDLE CUT-OFF.

7. (CP) Ignition switches - OFF, when propeller rotation ceases.

8. (P) Fuel tank selector switch - OFF.

Note

Should an engine continue firing in IDLE CUT-OFF, close the throttle, switch off the ignition, slowly open the throttle and turn off the fuel tank selector switch.

9. Battery master switch - OFF.

3-46. Before Leaving The Aircraft. The following procedure must be completed before leaving the aircraft:

1. (CC) Wheel chocks - In place.

2. (CC) All switches - Off.

3. (CC) Doors and hatches - Closed.

4. (CC) Landing gear ground safety locks - Installed.

5. (CC) Pitot head covers - Installed.

6. (CC) Complete DA Form 2408.

CHAPTER 4
EMERGENCY PROCEDURES

Section I

Scope

4-1. This chapter describes the procedures to be followed in dealing with any likely emergency.

4-2. Emergency procedures relative to auxiliary equipment are not included unless safety of flight is affected.

Section II

Engine

4-3. General. The two most significant factors for consideration while in flight under asymmetric power conditions are minimum control speed and safe single-engine speed. Minimum control speed (figure 4-1) is the lowest speed at which directional control is sufficient to maintain straight flight, and is 66 knots IAS (A) and 70 knots IAS (B). The minimum control speed is based on take-off configuration, inoperative engine propeller windmilling, take-off power on the operative engine, and no more than 5° of bank toward the operative engine. Under certain conditions it may be necessary to sacrifice altitude in order to maintain minimum control speed while cleaning up the aircraft. Chapter 14, figures 14-34 and 14-88, show that once the propeller of the inoperative engine is feathered an improvement in the rate of climb occurs. Alternately, an increase in airspeed will be obtained if the aircraft is kept at a constant altitude. Retracting the landing gear will result in a further increase in airspeed, or alternately a further improvement in the rate of climb. Safe single-engine speed (figure 4-1) is attained when the airspeed reaches 75 knots IAS (A) or 84 knots IAS (B). At these speeds a rate of climb of approximately 300 fpm will be possible with the propeller of the inoperative engine feathered, landing gear retracted, and flaps at take-off setting (A) or (B) as appropriate. These figures are based on standard day conditions at sea level, and with an increase in ambient temperature or altitude a deterioration in performance will result. For safe single-engine speeds at gross weights other than 26,000 and 28,500 pounds refer to Chapter 14, figures 14-25 and 14-79.

Note

Safe single-engine speed is based on 1.2 times the power-off stalling speed with take-off flap setting (A) or (B) as appropriate, and complies with civil air regulations.

4-4. Single-engine flight characteristics. On the take-off ground roll, should an engine become inoperative before take-off speed is attained and the take-off is aborted, the aircraft is easily controllable to a stop by use of rudder and wheel brakes. If an engine becomes inoperative at or above take-off speed, and the take-off is continued, the initial yawing tendency should be controlled by rudder. A bank angle of 3° to 5° should then be applied toward the operative engine; the resultant sideslip creates an angle of attack at the vertical stabilizer sufficient to relieve footloads and assist in directional control requirements. The aircraft trim controls can then be adjusted and the climb continued. At sea level, standard day, the aircraft will climb with the propeller of the inoperative engine feathered, landing gear extended and take-off flap setting, at approximately 200 fpm (A) or 120 fpm (B). If an engine becomes inoperative while in flight under cruise power, the resultant yaw is not severe and may easily be corrected by the rudder, and trim control applied. In addition to the yaw, the fact that an engine has become inoperative will be indicated by the thrust indicator, the cylinder head temperature gage and the airspeed. Depending on gross weight, altitude and ambient temperature, the power of the operative engine may have to be adjusted to provide satisfactory performance for continued flight.

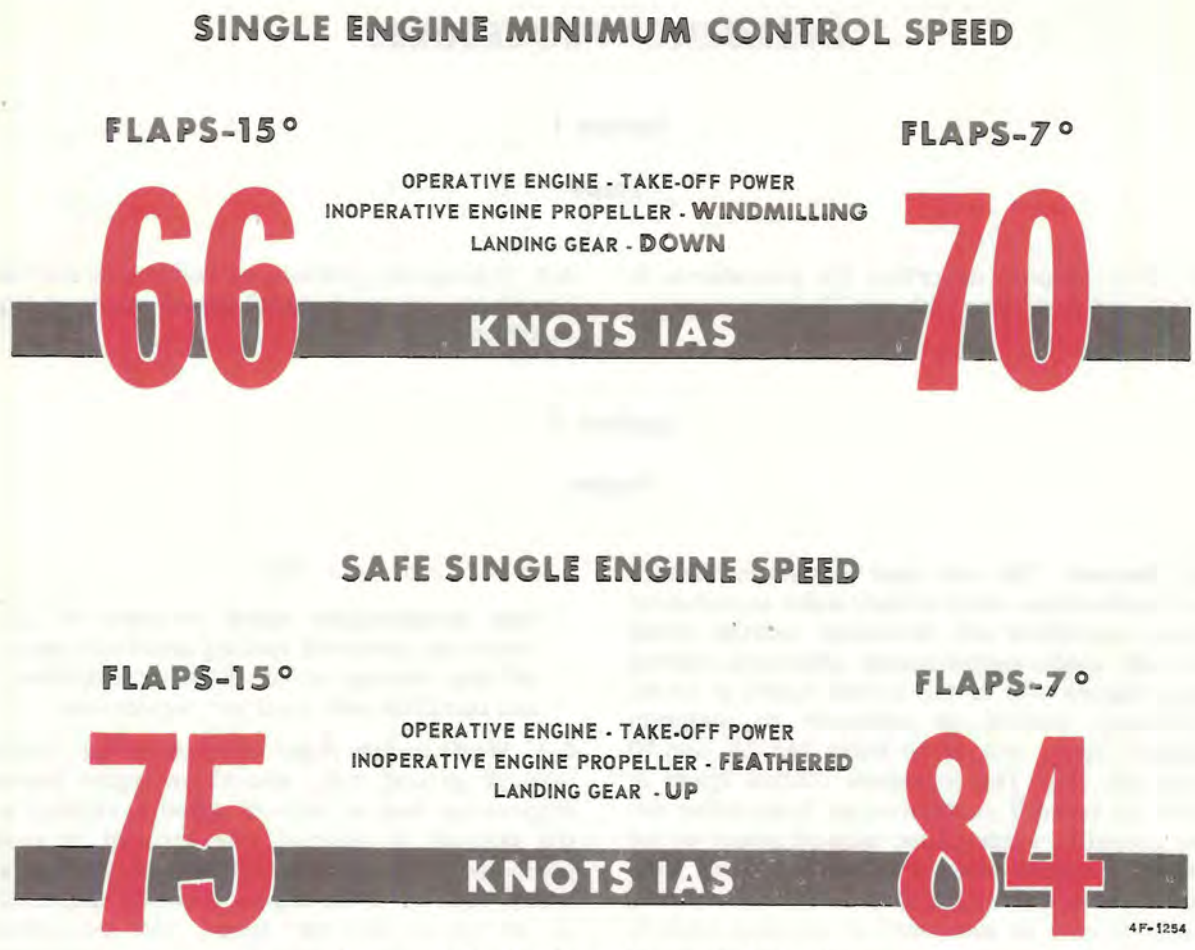


Figure 4-1. Single-engine control speeds

Caution

In the take-off or clean configuration, all normal maneuvers may be performed while under asymmetric flight conditions. However, the airspeed should be closely monitored and bank angles restricted sufficiently to be commensurate with flight safety.

4-5. Engine Failure During Take-off. In the event of engine failure during take-off, with the automatic feathering system active, the propeller will feather automatically.

4-6. Below take-off speed. Should an engine become inoperative before take-off speed is attained, the take-off must be aborted. If still on the ground, close the throttles and apply the wheel brakes as necessary to stop the aircraft. In order to provide the high performance take-off capability possessed by this aircraft using short field take-off flap (A) SF or (B) SF, single-engine performance must be regarded as secondary. This does not necessarily mean that flight ends in the event of an engine becoming inoperative under these conditions. If it is specifically desired to land straight ahead the moment after the engine becomes inoperative then this should be done. However, many factors can influence the situation sufficiently to change the pilot's course of action. High ambient temperature, altitude and aircraft gross weight will directly affect take-off performance under any given circumstances. If the pilot does not wish to land straight ahead the moment after the engine becomes inoperative he should insure that he has sufficient control of the aircraft to continue with the take-off. With take-off power on the operative engine, control will depend upon the indicated airspeed at which the engine becomes

inoperative. If that is so low that the pilot does not have sufficient lateral or directional control, he may then reduce power sufficiently to improve control. The aircraft can then be flown at whatever power proves suitable, to the point of desired touchdown. The longer the time between lift-off and the ensuing engine malfunction, the greater the possibility that the take-off can be continued. From this standpoint, the most adverse time at which an engine could malfunction is immediately after the aircraft leaves the ground. Therefore, if the landing gear and wing flaps are selected up at the same time, after the aircraft becomes airborne, the flaps will retract to the take-off setting, (A) or (B), in a maximum of 10 or 12 seconds respectively, since they retract at approximately 1.5 degrees per second. By this time, take-off speed will have been reached and the full single-engine performance schedule is available. To be fully familiar with this type of engine failure, pilots should practice with the aircraft in this configuration at safe altitudes.

4-7. Above take-off speed. Should an engine fail at or above normal take-off speed, the take-off should be continued as follows:

1. Determine which engine is out. This is best done in the aircraft by checking the thrust meters. Maintain directional control by rudder, and by raising the wing on the dead engine side not more than 5°.

2. Malfunctioning engine (low thrust indication) - Feather propeller.

3. Operative engine - METO power (42.5 in. Hg, 2550 rpm, at sea level).

4. Landing gear and flaps - UP. As the gear and flaps come up, drag is reduced.

5. Inoperative engine - Shut down.

a. Throttle - CLOSED.

b. Propeller lever - Full DECREASE.

c. Mixture lever - IDLE CUT-OFF.

6. Clean up - Proceed as in paragraph 4-8. (Refer to Chapter 14, Section II for cruise control on one engine.)

4-8. Clean-up.

1. Fuel emergency shutoff switch - UP.

Warning

Should an engine fire be the reason for shutdown, the oil emergency shutoff switch must also be operated at this stage.

2. Fuel booster pump switch - OFF.

3. Ignition switch - OFF (after propeller ceases rotating).

4. Generator switch - OFF.

5. Operative engine power - Adjust as required.

6. Fuel tank selector switch - As required.

Note

During extended flight on one engine, the fuel load should be maintained approximately equal on each side of the aircraft center line, by use of crossfeed selection.

7. Secondary bus reset switch - UP (guard up), if required.

8. Nonessential secondary bus loads - Switch off.

4-9. Engine Restart in Flight. Proceed as follows:

Caution

If the cause of an engine failure cannot be determined, or the nature of the failure is such that serious consequences may result in the continued operation of the engine, no attempt must be made to unfeather the propeller. If the period of a practice shutdown is to be prolonged in conditions of low ambient temperatures, the engine should be turned over by the starter every 30 minutes, and must be restarted before the oil temperature reaches a low value; otherwise, the propeller may be reluctant to windmill. A safe height must be attained for the unfeathering procedure.

1. Inoperative engine - Check temperatures.

2. Airspeed - Maximum for unfeathering 130 knots IAS.

Note

At 110 knots IAS or below, the airflow may be insufficient to windmill the propeller, and the starter may have to be used.

3. Throttle - CLOSED.

4. Propeller lever - Full DECREASE.

5. Mixture lever - IDLE CUT-OFF.

6. Ignition switch - BOTH.

7. Fuel emergency shutoff switch - DOWN (switch guard down).

8. Fuel booster pump switch - NORM.

9. Generator switch - ON.

10. Secondary bus reset switch - DOWN (switch guard down).

11. Auto feathering switch - OFF.

12. Propeller feathering button (non-reversible propellers) - Push and hold in. Hold button in until propeller rotation commences (500-600 rpm), then release. Check button returns to the out position.

13. Propeller feathering button (reversible propellers) - Pull out and hold. Hold button out until propeller rotation commences (500-600 rpm), then release. Check button returns to neutral position.

Warning

The feathering button should be released before 800 rpm is reached. As the propeller unfeathers, monitor the rpm for any sign of overspeeding. The rpm should govern at approximately 1200 rpm. If the rpm continues to increase unchecked above this figure, indicating a runaway propeller, press the feathering button to refeather the propeller. Refer to paragraph 4-16.

14. Mixture lever - AUTO RICH.

15. Throttle - Advance sufficiently to counteract drag of windmilling propeller.

Caution

If engine oil temperature is very low, engine must be operated at very low power, maintaining a manifold pressure and rpm relationship of 1 in. Hg for every 100 rpm, not to exceed 20 in. Hg until minimum operating temperatures are reached. Normal manifold pressure and rpm may be set up when oil temperature reaches 40°C and cylinder head temperature reaches 120°C.

16. Propeller lever - Select required operating rpm.

17. Throttle - Advance to required operating manifold pressure. Counteract yaw by rudder control.

18. Rudder trim - Reset.

19. Fuel booster pump switch - OFF.

4-10. Engine Chip Detection. If a chip detector caution light illuminates during flight, the instruments of the relevant engine must be observed immediately for abnormal readings. Dependent upon such readings, take appropriate action as follows:

a. If instruments indicate engine malfunction, feather propeller, shut down engine, and land as soon as possible.

b. If instruments do not indicate engine malfunction, continue flight with minimum power settings; closely monitor engine instruments until a safe landing can be made as soon as possible.

4-11. Single-engine Practice Maneuvers. The flight characteristics of the aircraft under asymmetric power are described in paragraph 4-4 and practice of the following procedures will provide thorough familiarization with flight under this condition.

Note

If numerous featherings are to be avoided, the feathered condition may be simulated by setting the power of the "failed" engine to indicate zero thrust.

4-12. Effect of power and airspeed on trim. For any given weight and/or configuration, the final factors affecting directional control are airspeed and operative-engine power setting. Either of these effects can be demonstrated in the following manner; having shut down one engine, trim the aircraft to fly straight and level, "hands and feet off". Gently ease back the power of the operative engine. The instant the thrust decreases, the aircraft will yaw toward the operative engine and the power will have to be reset or rudder applied to regain directional control. Regain "hands and feet off" condition. Now gently increase the power (thrust). The aircraft will immediately yaw toward the inoperative engine, control being regained as before. With a constant power setting, commence a gradual climb. As the airspeed decreases, so the effec-

tiveness of the rudder trim will decrease due to the reduction in aerodynamic load on the rudder trim tab, and the aircraft will yaw toward the inoperative engine. If the control column is now eased forward, the airspeed will increase, the effectiveness of the rudder trim tab will increase to counteract the yaw, and directional control will be regained. If a gentle dive is commenced, the increased effectiveness of the rudder trim tab will yaw the aircraft toward the operative engine. During any of the exercises, it will be found that a loss of control due to power setting change can be counteracted by a change in airspeed, and vice versa. If the power is constant and the airspeed slowly reduced, it will be found possible to maintain directional control down to exceptionally low speed values by use of rudder control and a slight bank toward the operative engine.

4-13. Simulated engine failure. At a safe height, in any take-off configuration and at take-off power, both at above and below the take-off speed, close one throttle fully and note the action necessary to maintain control in each case.

Note

In the short field take-off flap configuration (A) SF or (B) SF, particular attention should be paid to the minimum control speed, and any height loss necessary to maintain directional control while cleaning up the aircraft for continued flight.

4-14. Simulated go-around. In the appropriate approach configuration (refer to paragraph 4-48), open up the operative engine to take-off power. Note the loss of height from the time of starting to open the throttle until level flight is attained. Follow the same procedure in the appropriate landing configuration; in this instance, the descent will have to be continued while cleaning up the aircraft.

Section III

Propeller

4-15. Overspeeding. In the event of engine overspeeding, proceed as follows:

1. Throttles - Retard. Flight conditions permitting, reduce airspeed to just above stalling speed.

2. Propeller lever - Operate through complete range to exercise pitch control mechanism.

Caution

If the propeller cannot be brought under control, it must be feathered immediately.

4-16. Propeller Runaway. If excessive and unchecked overspeeding occurs, reduce the airspeed as quickly as possible and feather the propeller immediately. Should the propeller refuse to feather, check first the appropriate PROP. FEATHER circuit breaker then, if necessary, continue as follows:

1. Ignition switch - OFF.

2. Fuel emergency shutoff switch - UP.

3. Immediately move passengers away from propeller plane of rotation.

4. Airspeed - Reduce to just above the stall. If at fairly high altitude, extend gear and flaps and descend to a lower altitude.

Note

The denser atmosphere at low altitude will assist in reducing the overspeed.

5. Reattempt the feathering.

6. If still unable to feather propeller, land as soon as practicable.

Warning

If a runaway propeller is not brought under control immediately, and the engine is overspeeding at a very high rpm, excessive vibration, with possible blade failure, could occur.

Section IV

Fire

4-17. Engine Fire. The following paragraphs discuss the procedures to be carried out in the event of an engine fire.

4-18. Engine fire on the ground. If an engine fire develops during starting, discontinue priming, but keep the engine cranking over until it starts or until the fire recedes. If the engine is already running when a fire develops, open the throttle and attempt to blow it out. In both cases, should the ground crew signal to shut down the engine, immediately execute the following:

1. Mixture lever - IDLE CUT-OFF.
2. Fuel and oil emergency shutoff switches - UP.
3. Fuel booster pump switch - OFF.
4. Ground crew - Fight fire.

Note

A red colored push-in panel, located to the rear of each engine nacelle at the lower left cowl, is marked FIRE ACCESS. Pushing in the panel will allow access for a hand fire extinguisher, which may be discharged into the engine accessories compartment.

5. FIRE PULL T- bar - PULL. If ground crew cannot put fire out, or a fire warning light comes on, operate engine fire extinguisher. If first shot does not extinguish fire, push T-bar fully in, turn counterclockwise through 90°, and pull for second shot.
6. Ignition switch - OFF.
7. Generator switch - OFF.

Warning

Having discharged an engine fire extinguisher, avoid skin contact with the extinguishing agent. The Freon used can cause severe cold burns. Do not attempt to restart the engine unless the cause of the fire has been determined and rectified.

4-19. Engine fire in flight. A fire will be indicated by either or both Zone 1 and Zones 2 and 3 fire warning lights. In both cases the engine must be shut down immediately. Proceed as follows:

1. Mixture lever - IDLE CUT-OFF.
2. Fuel and oil emergency shutoff switches - UP.
3. Propeller feathering button - DEPRESS.
4. Fuel booster pump switch - OFF.

4-20. Zone 2 and 3 fire, continue as follows:

5. FIRE PULL T-bar - PULL.
6. Operate for second shot, if required.

Caution

Indiscriminate use of the second extinguisher shot should be avoided. If used unnecessarily, no extinguishing agent will be available should fire develop in the other engine.

7. Complete engine shutdown.

Warning

The fuel supply pump for the combustion heaters is located in the right-hand main gear well. In the event of fire in the right-hand engine, both heater systems must be shut down as quickly as possible.

Make no attempt to restart an engine that has been on fire. Land at an airfield as soon as practicable and have the cause investigated.

4-21. Combustion Heater Fire. A fire in either of the combustion heater systems will be indicated by the appropriate fire warning light on the emergency panel. For a flight compartment heater fire, proceed as follows:

1. Heater master switch - OFF.
2. Flight compartment air control handle - Pull to close.

3. Flight compartment heater extinguisher switch - UP.

4-22. For a fire in the cabin heater, proceed as follows:

1. Heater master switch - OFF.

2. Cabin air control handle - Pull to close.

3. Cabin heater extinguisher switch - UP.

4-23. Fuselage Fire. A fuselage fire should be fought with the portable fire extinguishers. The extinguishing agent (CF_3Br) should not be allowed to contact the skin, as it may cause frostbite or low temperature burns. The extinguishers should be discharged one at a time, and with care, in order to reduce inadvertent splashing. Until the fire is extinguished, the flight compartment side windows should be kept shut, the ventilating system closed, and normal respiratory precautions taken.

4-24. Wing Fire. Except for an engine fire that spreads to the wing, in all probability a wing fire will originate electrically. It is essential, therefore, to deenergize the offending circuit if it can be isolated and, as additional circuits could be damaged by the fire and create other possible hazards, to deenergize all nonessential services for the remainder of the flight. The actions to be taken subsequently depend entirely on whether or not the fire persists; its locality and severity, with due regard to the fuel tanks; and aircraft altitude. Sideslipping the aircraft will assist in diverting the fire as necessary. If the fire persists or increases, and indications of consequent structural failure are evident, the aircraft should be abandoned, ditched, or landed as soon as practicable, at the discretion of the pilot.

4-25. Electrical Fire. As already described under WING FIRE, an electrical fire must be dealt with by switching off the service involved if it can be identified, and by deenergizing the offending circuit through the use of the appropriate circuit breaker(s). If the fire is in the fuselage, use the emergency breathing equipment and fight the fire with the portable fire extinguishers.

4-26. Smoke Elimination. Until it is considered safe, no hatches or doors should be opened to relieve the discomfort of the smoke and fumes from a fuselage fire. By cutting down the fresh air supply to the fire, it will be more readily extinguished. Once the fire is out, the ventilating system may be switched on and the pilot's side windows and the cargo door opened to dissipate the smoke and fumes. Do not remove the emergency breathing equipment until considered safe.

Section V

Fuel System

4-27. Fuel Pressure Drop. The following paragraphs discuss procedures in the event of fuel pressure drop.

4-28. Fuel pressure drop - engine failure. Should a low fuel pressure warning light illuminate and the engine stop operating, the throttle should be closed and a check made of the fuel system controls. The booster pump switch should be switched to HIGH. If the condition persists, switch off the booster pump and turn the fuel tank selector switch to feed both engines from the other tank. The booster pump switch for that tank should be switched to HIGH while the crossfeed selection is made, then switched to NORM. If the condition still persists, shut down the engine.

4-29. Fuel pressure drop - engine operates normally. Normal fuel pressure range is 16 - 18 psi; should less than 16 psi be indicated, a fuel pressure drop exists. At 15 psi the fuel low pressure warning light illuminates.

Caution

If a fuel low pressure warning light illuminates, it must be accepted as indication of low fuel pressure, regardless of the fuel pressure indicated. Should the fuel pressure gage indicate a pressure below normal operating limit, but the warning light fails to illuminate, press-to-test the warning light and make visual checks for fuel leaks before deciding the fault is due to a defective gage only.

4-30. If the fuel pressure drops below normal operating limits, but the engine continues to function normally, make a visual check of the affected side for the presence of streaming fuel vapor, or signs of fire in the nacelle or at the aft end of the augmentor tubes. If the cause of the pressure drop cannot be determined and no evidence of a fuel leak exists, maintain the watch

for fire and shut down the engine completely before entering the landing pattern. Should there be positive evidence of a fuel leak, shut down the engine immediately and land as soon as possible.

Warning

It is possible to fly for several hours having a suspected fuel leak but no evidence of fire, and a false sense of security results. This condition may be due to the airflow with its cooling and dispersing effect, serving to prevent an outbreak, and it is only when throttles are retarded and the airspeed reduced that the airflow characteristics change and a fire develops. For this reason, the engine must be run at the same settings until no longer required, then shutdown completely by first moving the mixture lever to IDLE CUT-OFF, and then depressing the feathering button.

Section VI

Electrical System

4-31. Electrical Component Failures. The following paragraphs discuss procedures to be carried out in the event of certain electrical component failures.

4-32. One generator failure. If one generator warning light comes on, perform the following checks for the appropriate generator:

1. Generator switch - Check ON.

2. Generator field relay circuit breaker - Check IN. If circuit breaker is out, one attempt only should be made to reset.

3. Generator switch - RESET. If generator field relay has tripped, selecting switch to RESET and then to ON may reset relay. With a successful reset, warning light will go out. One attempt only should be made to reset relay. If warning light does not go out, proceed as follows:

4. Generator switch - OFF.

5. Switch off all unnecessary services.

6. Secondary bus reset switch - UP. The secondary bus is automatically deenergized when one generator fails. Action No. 6 is carried out only if certain services from secondary bus are necessary for flight.

7. Ammeter (operating generator) - Check for overload. Do not allow ammeter reading, for operating generator, to exceed 300 amperes.

4-33. Two generator failure. If both generator warning lights come on, perform the following checks for both generators:

1. Generator switches - Check ON.

2. Generator field relay circuit breakers - Check IN. If either or both circuit breakers are out, one attempt only should be made on each circuit breaker to reset.

3. Generator switches - RESET. If either or both generator field relays have tripped, selecting switches to RESET and then to ON may reset relays. With a successful reset, either or both warning lights will go out. One attempt only should be made to reset each relay. If warning lights do not go out, proceed as follows:

4. Emergency bus switch - EMERG.

5. Battery master switch - OFF. Emergency bus is now energized from battery.

6. Switch off any unnecessary services that take power from emergency bus, to conserve battery.

4-34. Ammeter failure. If the ammeter for either generator registers zero but other electrical indications are normal, check for a faulty ammeter as follows:

1. Generator switch for appropriate generator - OFF.

2. Ammeter - Check for increased reading on ammeter for other generator.

3. Generator switch - Reselect ON if reading increases. An increased reading will indicate that both generators are operating and that fault is in ammeter circuit.

4-35. Main inverter failure. If the standby inverter light comes on when the engines are operating at more than 600 rpm, proceed as follows:

1. Inverter circuit breakers - Check set.

2. DC power circuit breakers - Check set.

3. Inverter switch - Select OFF then return to MAIN.

Note

This action recycles the inverter circuit.

4. If standby light remains out - Leave switch at MAIN.

5. If standby light comes on - Select switch to STBY.

Note

When the standby light comes on, it indicates that the circuit has been automatically transferred to the standby inverter.

4-36. Standby inverter failure. When the standby inverter is in operation and the standby inverter light goes out, the ac failure light should come on to indicate complete ac power supply failure. To check on the state of malfunction, proceed as follows:

1. Inverter circuit breakers - Check set.

2. DC power circuit breakers - Check set.

3. Inverter switch - Select OFF then MAIN.

Note

This action recycles the inverter circuit. If the standby inverter light comes on permanently, it indicates that a temporary fault was in the standby inverter circuit.

4. If the ac failure light comes on - Select inverter switch OFF.

4-37. Aileron trim runaway. Should a defect create a runaway in the aileron trim system, physical control of the aircraft is not difficult. Reduce the airspeed to relieve the stick force and, if the trim can be reversed, pull the aileron trim circuit breaker as the trim passes through the neutral position.

Section VII

Hydraulic System

4-38. Main Power Supply. Failure of an engine-driven hydraulic pump will be indicated by the illumination of its respective warning light. The other pump will maintain sufficient system pressure to operate the hydraulic services. Should both hydraulic pumps malfunction, or if the engines are not running, loss of engine-driven pump pressure will result. In this case, the main delivery lines can be pressurized by use of the hydraulic handpump having the handpump selector in NORMAL SYSTEM. If a leak in the system is discovered or indicated, the hydraulic pressure shutoff valve must be selected to OFF immediately, and remain OFF for the remainder of the flight. The emergency system must then be used to extend the gear for landing.

4-39. Landing Gear Indicator Lights. Should one or more landing gear indicator lights fail to illuminate when the gear is selected, and the selector lever light remains illuminated, press to test the indicator light(s). If the light(s) illuminate when pressed, it can be assumed that the associated gear(s) is not locked down. Should the selector lever light illuminate only while the gear is in transit and the indicator light(s) fail to illuminate when pressed, it can be assumed that a fault exists in the circuit to the indicator light(s). In either case, the throttles should be closed to check the warning horn. A visual check should be made of the main gear red/white index marks for alignment, and of the nose gear condition through the nose gear observation window.

4-40. Landing Gear Emergency Lowering. Emergency extension of the landing gear is treated as two separate procedures, due to the different means of operation provided for the main gear and the nose gear.

4-41. Main gear. If either or both main gears fail to extend when a normal selection is made, proceed as follows:

1. Landing gear selector lever - DOWN.

2. Emergency landing gear down selector handle - ON.

3. Main gear emergency extension handle - PULL.

Note

If necessary, extension of the gear may be assisted by the application of 'g' forces, or an increase in IAS up to the landing gear limit speed.

4-42. Nose gear. If the nose gear fails to extend when a normal selection is made, proceed as follows:

1. If failure is due to loss of hydraulic system pressure, the handpump should be used first, as follows:

a. Handpump selector - EMERGENCY SYSTEM.

b. Emergency landing gear down selector handle - ON.

c. Nosewheel down handpump selector - ON.

d. Handpump - Operate until nose gear extends and locks. (Pump for approximately one minute.)

2. Should nose gear fail to extend having used both normal and handpump systems, continue as follows:

a. Emergency landing gear down selector handle - Check ON.

b. Nosewheel emergency down (air) selector - PULL. Pull and hold selector until gear locks down.

Caution

The nose gear emergency air bottle should be operated only in an emergency and immediately prior to landing, as the nose gear must remain extended until the system has been bled on the ground.

4-43. Wing Flaps Emergency Operation. To operate the wing flaps in the event of hydraulic failure proceed as follows:

1. Wing flap selector lever - As required.

2. Handpump selector - NORMAL SYSTEM. (All other selectors - OFF.)

3. Operate handpump lever until flaps are extended as required.

4-44. Wheel Brakes Emergency Operation. In the event of failure of both engine-driven hydraulic pumps, or low hydraulic fluid level, replenish the brake accumulator pressure as follows:

1. Handpump selector - NORMAL SYSTEM (in case of pump failure) or EMERGENCY SYSTEM (in case of low fluid level).

2. Brake accumulator handpump charging selector - ON. (All other selectors - OFF.)

3. Handpump lever - Actuate until an operating pressure of 3000 psi is shown on brake pressure gage. Copilot should continue pumping during landing.

4. On landing - Use brakes as little as possible.

5. If brake pressure is insufficient, pull emergency brake handle (on windshield center post) steadily aft. This action applies progressive air pressure to the wheel brakes.

Caution

The emergency brake handle must not be operated with a pumping action, as this will rapidly deplete the compressed air supply.

4-45. Nosewheel Steering Emergencies. Should a malfunction of the nosewheel steering system occur, the NOSEWHEEL STEERING switch should be selected OFF. The aircraft may be steered by use of the wheel brakes or, if the failure is due to loss of system pressure, by the use of asymmetric power.

Section VIII

Landing Emergencies and Ditching

4-46. Emergency Descent. Should a critical situation necessitate an emergency descent, the wing flaps and landing gear must be checked UP, the propeller pitch must be selected to full increase rpm, and the aircraft must be dived, power off, at the never exceed speed. This speed is 208 knots IAS below 10,000 feet for the Series CV-2B aircraft. For speeds above 10,000 feet, refer to Chapter 7, paragraph 7-15.

4-47. Single-engine Procedure. The following paragraphs discuss the procedures to be followed with one engine inoperative.

4-48. Landing. The airspeed should be kept above the safe single-engine speed until finally committed to land. (See figure 4-2.) The landing gear should be lowered just prior to completion of the downwind leg of the landing pattern. The flaps

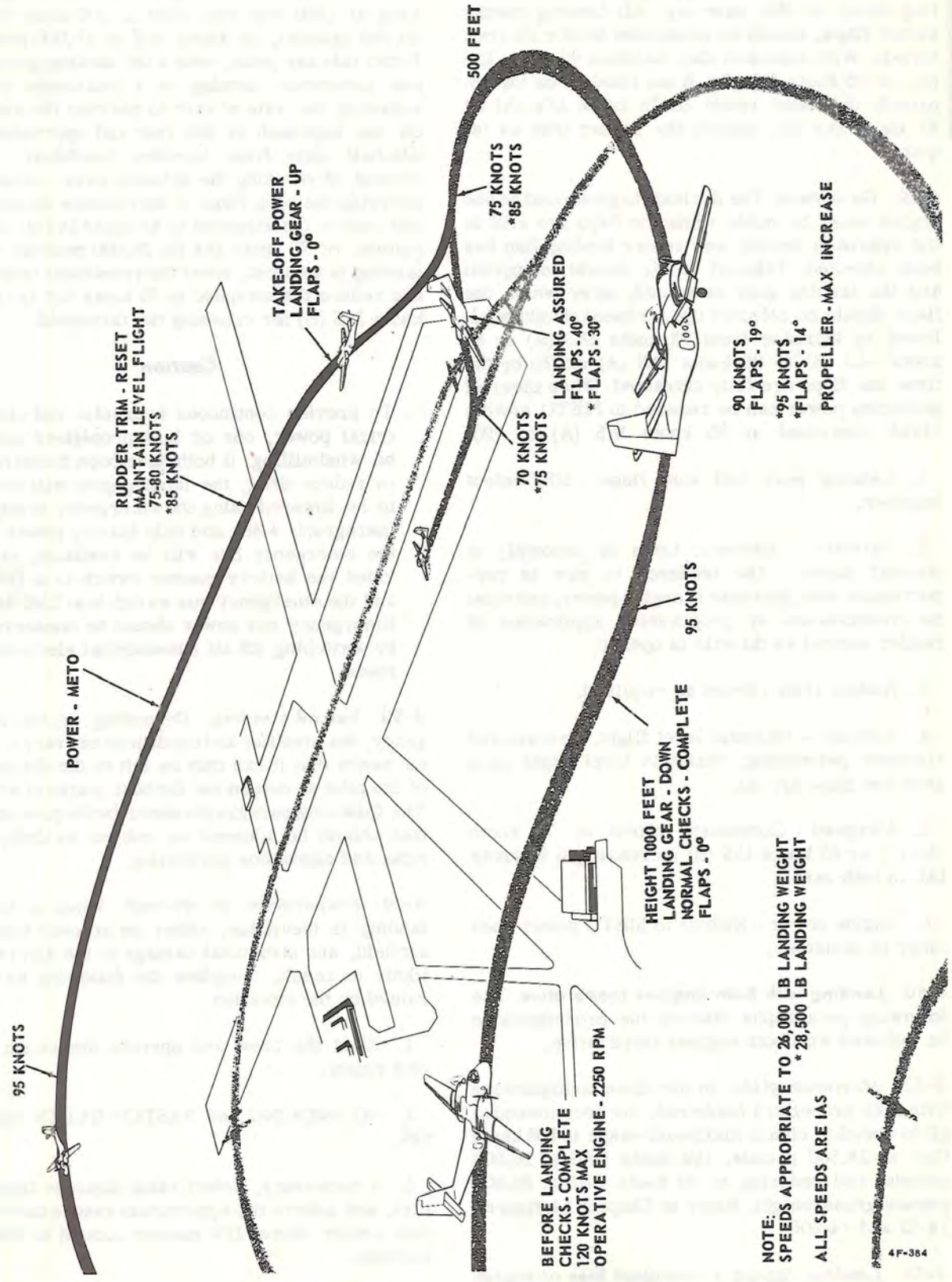


Figure 4-2. Single-engine landing and go-around diagram

should be lowered to the appropriate approach setting when on the base leg. All landing checks except flaps, should be completed before the final turn-in. With approach flap maintain 90 knots IAS (A) or 95 knots IAS (B). When lined up on the approach decrease speed to 75 knots IAS (A) or 85 knots IAS (B). Adjust the rudder trim as required.

4-49. Go-around. The decision to go-around on one engine must be made while the flaps are still at the approach setting and before landing flap has been selected. Take-off power should be applied and the landing gear retracted, after which the flaps should be selected up. Airspeed should be allowed to increase from 75 knots IAS (A) or 85 knots IAS (B) to 95 knots IAS (A) or (B) by the time the flaps are fully retracted. When clear of obstacles power can be reduced to METO, and the climb continued at 95 knots IAS (A) or (B).

1. Landing gear and wing flaps - UP. Select together.

2. Throttle - Advance. Open up smoothly to take-off power. The tendency to yaw is proportionate with increase in engine power, and must be counteracted by progressive application of rudder control as throttle is opened.

3. Rudder trim - Reset as required.

4. Attitude - Maintain level flight. Terrain and airspeed permitting, maintain level flight until gear and flaps are up.

5. Airspeed - Commence climb at 75 knots IAS (A) or 85 knots IAS (B) increasing to 95 knots IAS in both cases.

6. Engine power - Reduce to METO power when clear of obstacles.

4-50. Landing with Both Engines Inoperative. The following paragraphs discuss the procedures to be followed with both engines inoperative.

4-51. Maximum glide. In the clean configuration with both propellers feathered, the recommended glide speed to obtain maximum range is 105 knots CAS at 28,500 pounds, 102 knots CAS at 26,000 pounds, and reducing to 90 knots CAS at 20,000 pounds gross weight. Refer to Chapter 14, figures 14-52 and 14-106.

4-52. Landing. Should a complete loss of engine power necessitate a glide approach and deadstick landing, the descent should be planned with the aim to arrive over the threshold of the landing area at 1500 feet into wind at 105 knots IAS (at 28,500 pounds), 95 knots IAS (at 26,000 pounds). From this key point, select the landing gear down and commence turning in a continuous sweep, adjusting the rate of turn to position the aircraft on the approach at 800 feet and approximately one-half mile from intended touchdown. When certain of reaching the selected area, commence lowering the wing flaps in increments as desired, and reduce the airspeed to 85 knots IAS (at 28,500 pounds) or 75 knots IAS (at 26,000 pounds). When landing is assured, lower the remainder of the flap and reduce the airspeed to 70 knots IAS (A) or 75 knots IAS (B) for crossing the threshold.

Caution

To provide continuous hydraulic and electrical power, one or both propellers must be windmilling. If both have been feathered to reduce drag, the landing gear will have to be lowered using the emergency system (paragraph 4-40) and only battery power to the emergency bus will be available, provided the battery master switch is at OFF and the emergency bus switch is at EMERG. Emergency bus power should be conserved by switching off all nonessential electrical loads.

4-53. Forced Landing. Depending on the emergency, the situation and conditions can vary to such an extent that it can only be left to the discretion of the pilot to determine the best course of action. The following paragraphs describe the procedures that should be adhered to, subject to time, altitude, and conditions permitting.

4-54. Preparation of aircraft. When a forced landing is inevitable, either on or away from an airfield, and structural damage to the aircraft is likely to result, complete the following as warranted by the situation:

1. Alert the crew and operate the alarm bell (six rings).

2. NO SMOKING and FASTEN BELTS signs - ON.

3. If necessary, select radio distress frequencies, and inform the appropriate rescue coordination center. Select IFF master control to EMER. position.

4. Flight compartment and cabin heater master switches - OFF.

5. Switch off all nonessential electrical services and deenergize the unwanted circuits by means of the circuit breakers.

6. Safety harness - Tightly adjusted. Inertia reel - LOCKED.

7. Landing gear - DOWN.

8. Wing flaps - As desired.

9. Engine controls - As for a normal landing.

Note

If a propeller is already feathered, the blades should be moved by the starter to the 12-4-8 o'clock position.

10. Generator switches - OFF.

11. Emergency bus switch - EMERG.

12. Battery master switch - OFF.

4-55. If at night, the main and secondary buses must remain energized in order to power the instrument lights and landing lights respectively. The switching must be as follows:

1. Generator switches - OFF.

2. Emergency bus switch - EMERG.

3. Secondary bus reset switch - ON.

4. Battery master switch - BATTERY MASTER.

5. Immediately prior to touchdown - Battery master switch OFF.

4-56. Touchdown. Because of the slow landing speed and short landing roll, it is quite feasible that the aircraft could be force-landed intact, even when the landing is made off an airfield. If the nature of the terrain confirms this possibility, then it would be advisable to land with the gear down, adopting the normal approach and landing technique. Provided at least one engine is windmilling, hydraulic pressure will be sufficient to operate the landing gear and wing flaps, but at a reduced rate. If a gear-up landing is to be made, the reduced drag will extend the 'float'; the final approach, therefore, should be adjusted accordingly. When engine power is not available, and when certain of reaching the selected landing area, landing flap may be selected and the airspeed set up for a glide approach, aiming to overshoot slightly. Should the pilot decide he is undershooting, he may retract some flap and increase the airspeed to flatten the glide angle and thereby reach the point of intended touchdown. When the pilot closes the throttles for touchdown, he will immediately select the mixture to IDLE CUT-OFF and, at his command, the copilot will switch off the ignition and operate the fuel and oil emergency shutoff switches. Just prior to this stage, the passengers will be warned to brace by one long ring of the alarm bell. Pull the engine fire extinguisher control handles and abandon the aircraft the moment it comes to rest. See figure 4-3 for emergency routes of escape.

4-57. Landing with Flat Tire. Land normally, using nosewheel steering and if necessary, asymmetric power to maintain direction. Use the brakes as little as possible. If a nosewheel tire is involved, hold up the nose as long as possible and lower gently to the runway prior to loss of elevator control. Use nosewheel steering to maintain direction.

4-58. Landing with One Gear Retracted. Should one main gear fail to extend, the landing must be made with both main gears retracted. If the nose gear fails to extend, the landing should be made with the main gear extended. The nose should be held off the ground for as long as possible, but before elevator control is lost, it should be gently lowered to the runway. The brakes must not be applied until after the nose is on the runway, and then only gently. As soon as the mainwheels have touched down, select the mixture lever to IDLE CUT-OFF and switch off the ignition.

4-59. Emergency Exits. Two emergency exists are provided in the flight compartment and four in the cabin.

4-60. Flight compartment. The flight compartment exits consist of a hatch in the roof, immediately aft of the pilot's position, and a bottom hatch in the well behind the pilot's and copilot's seats. Access to the bottom hatch is gained by opening the two doors in the flight compartment floor. The hatch may then be opened by pressing a button and turning a handle, marked EXIT RELEASE-PRESS BUTTON AND TURN HANDLE, located on the aft part of the hatch. The hatch may be jettisoned, if required, by operating a handle located in a recess in the bulkhead above the upper doors and marked BOTTOM HATCH JETTISON - OPEN INSIDE DOORS BEFORE PULLING HANDLE. The upper doors must be opened first as they would be difficult to open during flight with the bottom hatch jettisoned. The roof hatch is opened by pressing a button

adjacent to the handle and turning the handle, located on the roof at the hatch, marked EXIT RELEASE - PRESS BUTTON AND TURN HANDLE. The roof hatch is hinged on the right-hand side and is not jettisonable. A webbing strap marked EMERGENCY SLIDE is fitted below the hatch on the bulkhead and is provided to aid escape from the flight compartment. The flight compartment bottom hatch may be used for exit during flight but the roof hatch, due to its proximity to the propellers, is for use on the ground only with the engines stopped.

4-61. Cabin. The cabin emergency door, on the left of the cabin near the wing, is jettisonable. The handle is marked EMERGENCY EXIT - LIFT GUARD AND TURN HANDLE TO OPEN. The right-hand passenger door is jettisonable and has a jettison lever handle above the door marked CABIN DOOR JETTISON - PULL LEVER DOWN. The cargo door may be opened but must not be jettisoned during flight. (Refer to Chapter 13 for operating procedures.) The left-hand passenger door is not jettisonable. The cargo door may also be jettisoned on the ground to provide an additional emergency exit. The cargo door is jettisoned by pulling a handle, located on the left side of the cabin aft of the passenger door, marked CARGO DOOR JETTISON - LIFT GUARD AND PULL HANDLE. When the cargo door is jettisoned, the draftproof door is automatically retracted. The cargo door may also be jettisoned from the outside by a handle, located on the right-hand side of the fuselage aft of the passenger door, marked CARGO DOOR JETTISON - OPEN HATCH AND PULL HANDLE. A broken yellow line, on the left-hand cabin wall at compartment C5, marks an area for emergency escape by means of chopping or cutting. It is marked CUT HERE FOR EMERGENCY EXIT. (See figure 4-3.)

4-62. Emergency Entrance. In an emergency, the aircraft may be entered via either passenger door, the cabin emergency door, and the flight compartment bottom hatch and roof hatch, all of which may be opened from outside the aircraft. In addition, the cargo door may be jettisoned using the control on the right side exterior of the aircraft, just forward of the door. A broken yellow line, on the left-hand side of the fuselage beneath the wing, marks an area for emergency entrance by means of chopping or cutting. It is marked CUT HERE FOR EMERGENCY RESCUE. (See figure 4-4.)

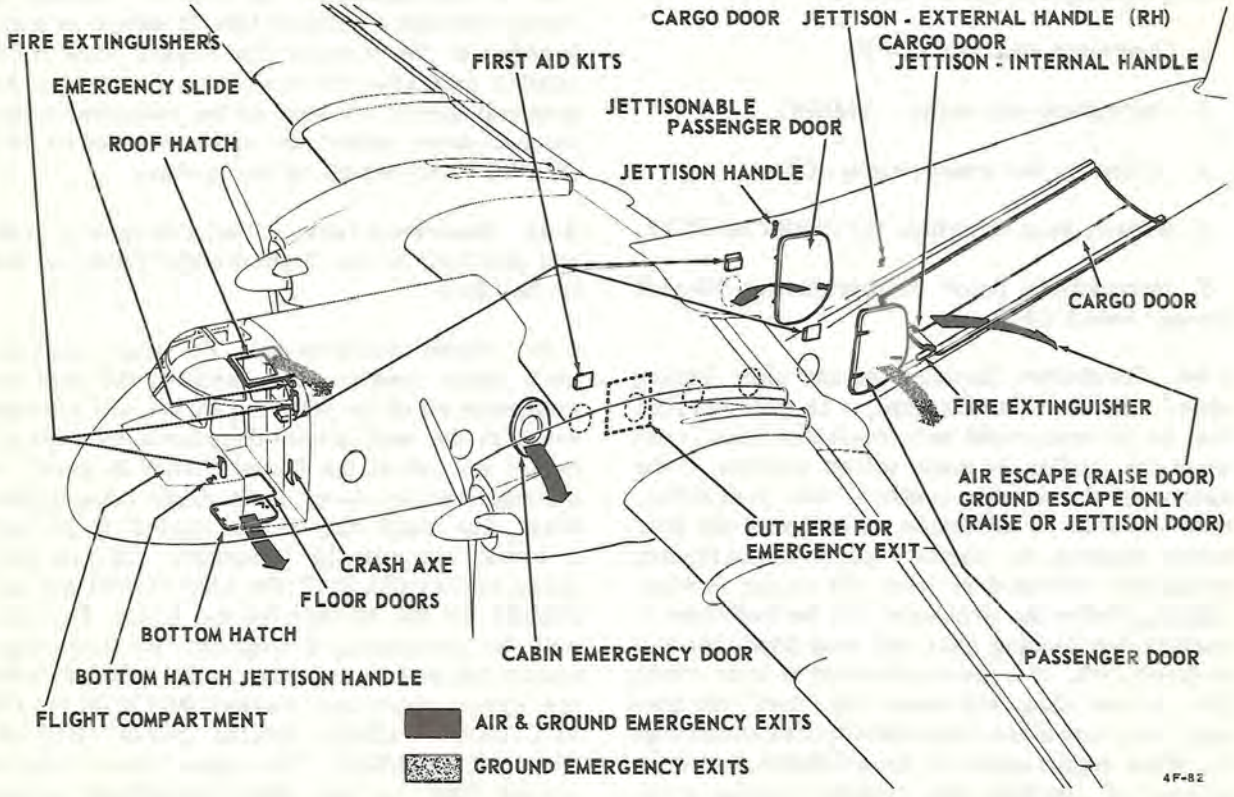


Figure 4-3. Emergency escape routes, exits and equipment

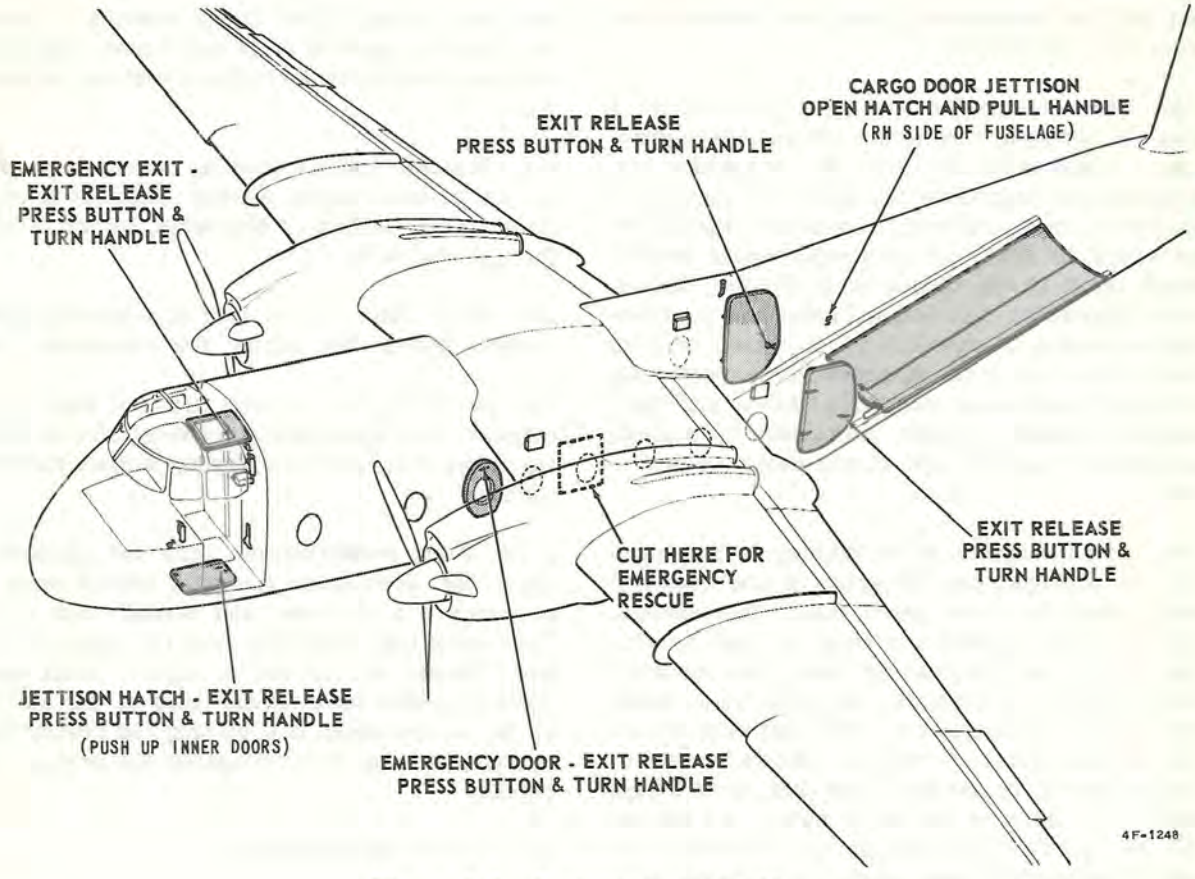


Figure 4-4. Emergency entrance

4-63. Ditching.

Warning

This aircraft should only be ditched as a last resort. It is recommended that the occupants bail-out rather than ditch, whenever possible. The decision to ditch or bail-out must be made by the pilot in view of the existing circumstances, but should not be delayed until the fuel supply is exhausted since the approach for ditching should be made with power on.

Scale model ditching tests indicate that the aircraft may be expected to experience a pronounced nose-down pitch after initial touchdown. The front fuselage may be momentarily immersed, resulting in damage to the fuselage structure; which will probably cause rapid flooding of the flight compartment and forward cabin area, up to the level of the wings. The aircraft will probably settle rapidly in a nose-down attitude.

4-64. The following paragraphs describe the general preparations to be carried out once the decision to ditch has been made, with a recommended procedure to be followed.

4-65. Emergency exits are described in paragraph 4-59 (see figure 4-3), and are repeated in Chapter 2, paragraph 2-166.

4-66. Preflight Preparations - Overwater Flight. It is assumed that the crew are familiar with, and practiced in, general ditching procedures. Prior to overwater flights a complete check must be made of the emergency equipment, with particular attention paid to the location of the life raft or rafts, and that their carrying capacity is adequate for the number of aircraft occupants. The method of releasing the raft must be understood. The raft will normally be strapped to the floor of the cabin, adjacent to the ramp, together with survival kit. When passengers are carried a preflight briefing should be conducted including instructions on the use of seat belts, life jackets, and ditching procedures. The method of jettisoning the emergency door and right-hand passenger door must be understood. Preflight planning shall also include a review of the emergency communications frequencies, rescue facilities, and surface vessels

that may be available to render assistance in the event of an emergency.

4-67. Preparation for Ditching. The moment a possible ditching emergency arises, the appropriate communication distress procedure and preparations should be initiated. All cargo and equipment, including ramp extensions, that can be jettisoned in the time available should be disposed of. If cargo cannot be jettisoned, its security should be checked and additional tie-down devices added, if possible. Fuel should be used down to the practical minimum, the empty cells providing additional buoyancy. Crew and passengers should remove parachute harnesses; back-packs may be left in the seats, if necessary.

4-68. Sea evaluation. If the ditching is in the open sea, in daylight, the direction of the wind and swell, and the wind speed must be assessed. This is best carried out from as high an altitude as the surface can be seen; two thousand feet or more, if possible. The primary or basic swell can be distinguished from high altitude and will be seen first. It may be hidden beneath another system or surface chop but, from a high altitude the largest and most dangerous system will be the first one recognized. Secondary or minor swells, if present, may not be visible until altitude is decreased, therefore a continual scanning of the sea is necessary. The wind-driven sea, if any, will be easily recognized by the appearance of whitecaps from which the wind velocity may be assessed as follows:

a. 4 to 6 knots - Small wavelets, short but pronounced; crests have a glassy appearance but do not break.

b. 11 to 16 knots - Small waves, becoming longer; fairly frequent whitecaps.

c. 17 to 21 knots - Moderate waves, taking a more pronounced form; many whitecaps.

d. 28 to 33 knots - Sea heaps up and white foam from breaking waves begins to be blown in well marked streaks along the direction of the wind.

e. 41 to 47 knots - High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll.

4-69. Once the primary and secondary systems are recognized, they should be checked by flying on various headings just above the water. When flying into any system the surface appears steep, fast and rough. When flying down the systems the surface appears much more calm. Select the ditching heading in accordance with the following rules:

a. The best ditching heading is usually parallel to the primary swell system. Attempt to touch down on the falling or back-side, rather than the face, of the swell.

b. Never ditch in the face of a primary swell system unless the winds are extremely high.

c. In moderately strong winds it may be desirable to compromise the above rules by ditching more into wind and slightly across the swell system.

4-70. Final preparations. Once the decision to ditch has been made the pilot should warn the passengers and crew, and should turn on the "NO SMOKING, FASTEN BELTS" sign. Passengers should be warned to tighten their safety belts and lean towards the nose of the aircraft as far as possible, half turning and resting head on arm, bracing the arm against the next seat occupant.

4-71. Check the following:

a. Life raft quickly removable from its straps.

b. Cargo door fully open.

c. Draft proof door UP and fully secure.

d. Ramp in fully UP position.

e. All items of equipment remaining in the aircraft - Secured.

4-72. Last minute preparations should be made at the discretion of the pilot. Among these are transmission of the latest navigational position and assumption of ditching stations by all personnel. Cabin interior lights, emergency exit lights, flash lights and life jacket lights should be turned on at this time if the ditching is conducted at night.

4-73. Ditching Procedure. From a suitable height proceed as follows:

1. Perform landing check, DO NOT lower the landing gear.

2. Shoulder harness tight, inertia reel - LOCKED.

3. Flaps - 40° (all weights).

4. Final approach - 72 knots IAS at 28,500 pounds gross weight. Reduce airspeed by 1 knot for each 1000 pounds reduction in gross weight below 28,500 pounds.

5. The copilot should signal one long ring on the alarm bell, approximately five seconds before touchdown, to warn all personnel to brace. Occupants should not relax until the aircraft has definitely stopped, since more than one shock may occur.

6. Touchdown - Approach power-on and insure that the aircraft is NOT brought into contact with the water in a fully stalled attitude. Model tests have indicated that best results are obtained by ditching in a moderate nose-up attitude. Throttles should be closed just before contact with the water, and all electrical power switched off.

7. Once the aircraft is completely stopped the life raft should be cast-off through the cargo door opening, and an orderly evacuation of the aircraft carried out in the shortest possible time. The emergency door and right-hand passenger door should be jettisoned, if above the water line.

8. When passengers are clear of the aircraft, exit by the flight compartment roof hatch as rapidly as possible.

Section IX

Flight Controls

Emergency procedures for flight controls are covered in electrical and hydraulic emergency procedures.

Section X

Bail-Out

4-74. General. Upon the decision to abandon the aircraft in flight, the pilot will alert the crew and passengers over the interphone and by three rings of the alarm bell. During the period taken by the passengers to ready themselves, proceed as follows:

Note

The recommended speed for bail out is 100 knots IAS.

1. Originate a distress call on the radio and switch the IFF master control to EMER position.

2. Jettison cabin emergency door and right-hand passenger door, and open cargo door.

3. Execute bail-out order by one long ring of alarm bell.

4. Trim aircraft for level flight away from populated areas. If time permits before leaving aircraft, the pilot should turn off all electrical services, feather propellers, switch off ignition operate fuel and oil emergency shutoff switches and, finally, switch off battery master switch.

CHAPTER 5
AVIONICS

Section I

Scope

5-1. Scope. This chapter covers the avionics equipment configurations installed in Army Model CV-2 aircraft. It includes a brief description of the electronic equipments, their technical characteristics, capabilities, and location. The chapter also contains complete operating instructions for both normal and emergency operation of all avionics equipment installed in the aircraft.

5-2. Nomenclature and Common Names. The nomenclature and common names assigned to the avionics equipment installed in the aircraft are given in Table 5-1. Equipment markings on control panels are capitalized. An asterisk (*) in the nomenclature is used to indicate all models of the equipment covered in this chapter.

Table 5-1. Nomenclature and common names

NOMENCLATURE	COMMON NAME
Radio Set AN/ARC-55B	Uhf command set
Receiver-Transmitter, Radio R/T-349B/ARC-55	Uhf receiver-transmitter
Panel, Control C-1827(*)/ARC-55	UHF control panel
Radio Set AN/ARC-51X	Uhf command set
Receiver-Transmitter, Radio RT-702/ARC-51X	Uhf receiver-transmitter
Cooler, Air, Electronic Equipment HD-615/ARC-51X	Uhf external blower
Panel, Control C-4677/ARC-51X	UHF control panel
Indicator, Standing Wave Ratio ID-1003/ARC	Uhf reflectometer
Radio Set AN/ARC-73, or -73A	Vhf command set
Receiver, Radio 51X-2B	Vhf receiver
Transmitter, Radio 17L-7A	Vhf transmitter
Panel, Control 614U-6, or -5 (Modified to MWO 11-5821-217-35/1)	VHF COMM control panel
Antenna AT-1108/ARC	Uhf-vhf antenna
Relay RE-275/AR	Vhf antenna relay
Radio Transmitter T-366A/ARC	Standby (emergency) vhf transmitter
Panel, Control DHC60001-1, or -3, or C-80B	Standby vhf control panel
Power Unit, Radio ARC Type P12	Standby vhf power unit
Radio Set AN/ARC-59	Hf radio set
Receiver-Transmitter, Radio 18S-4 (RT-380/AR)	Hf receiver-transmitter
Network, Impedance Matching 180L-2 (CU-991(*)/AR)	Hf antenna unit

Table 5-1 (cont)

NOMENCLATURE	COMMON NAME
Panel, Control 314S-6 (C-1982/AR)	HF control panel
Panel, Assembly C4R1704-1, or -3	Uhf-hf select panel
Antenna C4R1595	Hf antenna
Radio Set AN/ARC-102	Hf-ssb radio set
Receiver-Transmitter, Radio RT-698(*)/ARC-102, or Collins 618T-3	Hf-ssb receiver-transmitter
Inverter, Power PP-3072( )/ARC-102	Hf-ssb inverter
Network, Impedance Matching CU-991(*)/AR	Hf antenna unit
Panel, Control C-3940/ARC-94	HF-(ssb) control panel
Antenna C4R1844	Hf antenna
Radio Set AN/ARC-44	Fm liaison radio set
Receiver-Transmitter, Radio RT-294(*)/ARC-44	Fm receiver-transmitter
Panel, Control SB-327(*)/ARC-44	FM control panel
Dynamotor DY-107(*)/AR	Fm dynamotor
Panel, Signal Distribution, Radio SB-329(*)/AR	INT panel
Antenna AT-454(*)/ARC	Fm antenna
Coupler, Antenna CU-361/ARC	Fm antenna coupler
Panel, Switch Assembly SA-474/AR	Fm switch assembly
Panel, Control DHC60015-1	Fm auxiliary control panel
Panel, Control DHC60015-3	Fm squelch control panel
Network, Impedance Matching CU-435/AIC	Impedance matching network
Headset-Microphone H-101A/U	Headset-microphone
Control, Intercommunication Set C-1611A/AIC	INT panel
Radio Receiving Set AN/ARN-30D, or -30E	Omni radio set
Receiver, Radio R-1021(*)/ARN-30D	Omni receiver
Converter, Signal Data CV-265(*)/ARN-30A	Signal data converter
Panel Control C-3436/ARN-30D, or C-3436A/ARN-30E	Omni (VHF NAV) control panel
Dynaverter PP-2792( )/ARN-30D	Omni dynaverter
Antenna C4R1502-1	Omni antenna
Direction Finder Set AN/ARN-59	Adf radio set
Receiver, Radio R-836(*)/ARN-59	Adf receiver
Panel, Control C-2275(*)/ARN-59	ADF REC control panel
Dynamotor DY-150(*)/ARN	Adf dynamotor
Antenna, Loop AT-780(*)/ARN	Adf loop antenna
Antenna, Sense C4R1516	Adf sense antenna
Antenna, Sense C4R1857-1 and -2	Adf sense antenna
Coupler, Sense Antenna DHC60070-1	Adf sense antenna coupler

Table 5-1 (cont)

NOMENCLATURE	COMMON NAME
Radio Receiving Set AN/ARA-54	Glide slope receiving set
Receiver, Radio R-746/AR	Glide slope receiver
Panel, Control C4R1226	Glide slope control panel
Antenna 37P-4	Glide slope antenna
Radio Receiving Set AN/ARN-32	Marker beacon receiving set
Receiver, Radio R-666(*)/ARN-32	Marker beacon receiver
Panel, Control C4R1181	MARKER BEACON control panel
Assembly, Light MS25041-3	Marker beacon indicator
Antenna AT-640(*)/ARN	Marker beacon antenna
Radio Receiving Set R-1041/ARN	Marker beacon receiving set
Receiver, Radio R-1041(*)/ARN	Marker beacon receiver
Panel Control DHC60014-1	MKR control panel
Assembly, Light MS25041-3	Marker beacon indicator
Panel, Control DHC60055-3	MKR G/S control panel
Antenna AT-640(*)/ARN	Marker beacon antenna
Radio Receiving Set AN/ARN-58	Mb and gs receiving set
Receiver, Radio R-844(*)/ARN-58	Mb and gs receiver
Panel, Control DHC60055-5	MKR G/S control panel
Transponder Set AN/APX-44	Iff transponder set
Receiver-Transmitter, Radar RT-494(*)/APX-44	Iff transponder
Panel, Control C-2714(*)/APX-44	XPDR control panel
Antenna AT-884/APX-44	Iff antenna

Section II

Description and Data

5-3. Purpose and Use. The avionics equipment configurations provide the pilot and copilot with the facilities listed in Table 5-2. The configurations vary according to the theater of operations and the production series. Table 5-3 lists the configurations and Serial Numbers of the aircraft in which each configuration is installed. Table 5-4 lists the equipment comprising each configuration.

Table 5-2. Communication and associated electronic equipment

FACILITY	NOMENCLATURE	USE	RANGE DISTANCE AT SPECIFIC ALTITUDE	LOCATION OF CONTROLS	REMARKS
UHF command communications	Radio Set AN/ARC-55B, or -51X	Two-way voice communications in the frequency range of 225.0 to 399.9 mc voice reception on preset guard frequency.	Line of sight 50 miles at 3000 ft (approximately)	Figure 5-1	

Table 5-2 (cont)

FACILITY	NOMENCLATURE	USE	RANGE DISTANCE AT SPECIFIC ALTITUDE	LOCATION OF CONTROLS	REMARKS
VHF command communications	Radio Set AN/ARC-73, or -73A	Two-way voice communications. Reception in the frequency range of 108.00 to 151.95 mc (control panel 614U-5), or 116.00 to 151.95 mc (control panel 614U-6). Transmission in the frequency range of 116.00 to 149.95 mc (with either control panel).	Line of sight 50 miles at 3000 ft (approximately)		Complete provision made, set not installed.
VHF standby transmitter	Radio Transmitter T-366A/ARC	Emergency transmission in the frequency range of 116.0 to 132.0 mc. Used in conjunction with the omni radio receiver to provide two-way vhf communications in an emergency.	Line of sight 50 miles at 3000 ft (approximately)	Figure 5-1	
HF radio communications	Radio Set AN/ARC-59	Two-way voice communications in the frequency range of 2.0 to 18.5 mc.	Indefinite	Figure 5-1	
HF-SSB radio communications	Radio Set AN/ARC-102	Two-way voice communications in the frequency range of 2.0 to 30.0 mc.	Indefinite	Figure 5-1	
FM liaison communications	Radio Set AN/ARC-44	Two-way voice communications in the frequency range of 24.0 to 51.9 mc, and intercrew communications.	Line of sight up to 50 miles	Figure 5-1	AN/ARC-44 dynamotor (DY-107( )/AR) supplies power for operation of signal distribution panels (SB-329/AR)

Table 5-2 (cont)

FACILITY	NOMENCLATURE	USE	RANGE DISTANCE AT SPECIFIC ALTITUDE	LOCATION OF CONTROLS	REMARKS
FM auxiliary communications	Radio Receiver AN/ARR-46 or -49	Liaison auxiliary receiver.	Line of sight up to 50 miles		Operates in conjunction with AN/ARC-44 (when installed)
Intercommunications	Intercommunication Set C-1611A/AIC	Intercrew communications.	Within aircraft	Figure 5-1	Permits selective control of the facilities
VHF navigation (VOR, LOC)	Radio Receiving Set AN/ARN-30D, or -30E	Vhf navigational aid and Vhf voice reception in the frequency range of 108.0 to 126.9 mc.	Line of sight 50 miles at 3000 ft (approximately)	Figure 5-1	One of the two sets installed is used with the standby vhf transmitter for emergency two-way voice communications
Automatic direction finding	Direction Finder Set AN/ARN-59	Radio range and broadcast reception: automatic direction finding and homing in the frequency range of 0.19 to 1.75 mc.	200 miles at 3000 ft, depending on conditions	Figure 5-1	
Glide slope receiving	Radio Receiving Set AN/ARA-54	Visual indication of glide slope angle in the frequency range of 329.3 to 335.0 mc.	15 miles approximately	Figure 5-1	
Marker beacon receiving	Radio Receiving Set AN/ARN-32, or R-1041/ARN	Aural and visual indication of marker beacon location.	Vertical	Figure 5-1	
Marker beacon and glide slope receiving	Radio Receiving Set AN/ARN-58	Aural and visual indication of marker beacon location. Visual indication of glide slope angle: in the frequency range of 329.3 to 335.0 mc.	Marker beacon vertical; glide slope 15 miles approximately	Figure 5-1	
IFF identification	Transponder Set AN/APX-44	Identification, friend or foe, supplemented by selective identification feature.	Line of sight 50 miles at 3000 ft (approximately)	Figure 5-1	

Table 5-3. Configurations and serial numbers

CONFIGURATION	AIRCRAFT SERIAL NO.
A	60-3762 through 60-5444
B	61-2384 through 61-2600
C	62-4144 through 62-12584
D	63-9718 and subsequent

Table 5-4. Composition of configurations

FACILITY	CONFIGURATION			
	A	B	C	D
UHF Radio Set AN/ARC-55B	x	x	x	-
UHF Radio Set AN/ARC-51X	-	-	-	x
VHF Radio Set AN/ARC-73, or -73A	x[a]	x[a]	x[a]	x[a]
Standby VHF Transmitter T-366A/ARC	x	x	x	x
HF Radio Set AN/ARC-59	x[d]	x[d]	-	-
HF-SSB Radio Set AN/ARC-102, or 618T-3	x[a]	x[a]	x[a]	x[a]
FM Radio Set AN/ARC-44	x	x	x	x
Radio Signal Distribution Panel SB-329/AR	x	x	x	-
Intercommunication Set Control C-1611A/AIC	-	-	-	x
FM Auxiliary Radio Receiver AN/ARR-46	x[a]	x[b]	-	-
FM Auxiliary Radio Receiver AN/ARR-49	-	-	x[b]	x[b]
OMNI Radio Receiving Set AN/ARN-30D	x	x	-	-
OMNI Radio Receiving Set AN/ARN-30E	-	-	x	x
Glide Slope Radio Receiving Set R-746/AR	x	x	-	-
Glide Slope Radio Receiving Set AN/ARA-54	-	-	x	-
MB and GS Radio Receiving Set AN/ARN-58	-	-	-	x
Marker Beacon Radio Receiving Set AN/ARN-32	x	-	-	-
Marker Beacon Radio Receiving Set R-1041/ARN	-	x	x	-
Direction Finder Set AN/ARN-59	x[c]	x[c]	x[c]	x[c]
IFF Transponder Set AN/APX-44	x	x	x	x
IFF MK XII Interrogator Set	x[b]	x[b]	x[b]	x[b]

Table 5-4 (cont)

FACILITY	CONFIGURATION A	B	C	D
Course Indicator C-6A (pilot)	x	-	-	-
Azimuth Indicator ID-998/ASN (pilot)	-	x	x	x
Radio Magnetic Indicator ID-250/ARN	x	x	x	x
J-2 Gyro Magnetic Compass System	x	x	x	x

a. Complete provision only.
b. Space, weight (structural) and provision only.
c. Second adf radio set is installed as an alternative to second omni radio set.
d. Complete provision only; removed when hf-ssb radio set provisions installed.

5-4. Configurations. The facilities can be grouped into four major systems, depending on their function in the configuration, namely, communications, interphone, navigation, and identification systems. Technical characteristics of the facilities are listed in paragraphs 5-5 through 5-18. The systems are grouped as follows:

a. Communications system, consisting of:

(1) UHF Command Set.

(2) VHF Command Set (installed as an alternative to the UHF command set).

(3) HF Radio Set or HF-SSB Radio Set.

(4) FM Liaison Radio Set (with provision for use with an FM Homing Facility and FM Auxiliary Receiver).

b. Interphone system consisting of:

(1) Three INT panels SB-329(*)/AR (supplied with the fm liaison radio set), or five INT panels C-1611(*)/AIC.

(2) Headset-Microphone Assemblies H-101A/U.

(3) Microphone Switches (for pilot and copilot).

c. Navigation System, consisting of:

(1) OMNI Radio Set (two sets installed).

(2) ADF Radio Set (one set installed, with provision for a second set as an alternative to the second OMNI Radio Set).

(3) Marker Beacon Receiving Set.

(4) Glide Slope Receiving Set.

(5) Marker Beacon and Glide Slope Receiving Set (installed as an alternative to items (3) and (4)).

(6) J-2 Compass System.

d. Identification system, consisting of:

(1) IFF Transponder Set.

(2) IFF MK XII Interrogator Set (space, weight-structural, and power provision only).

5-5. Technical characteristics of radio set AN/ARC-55B.

Frequency range (receiving and transmitting[1])	1750 channels, 225.0 to 399.9 megacycles; channel separation 0.1 - megacycles.
Type of emission	Amplitude modulation.
Type of transmission	Voice.

Distance range:

Transmitting	Line of sight, varies with altitude, 50 miles (approximately) at 3000 feet.
Receiving	Line of sight, varies with altitude; 50 miles at 3000 feet.
Power requirements	Reception - 16.5 amperes. Transmission - 19.1 amperes. Channel switching - 25.5 amperes. (27.5 v dc).

[1]The guard band receiver is fix-tuned to 243.0 megacycles, the emergency uhf channel.

5-6. Technical characteristics of radio set AN/ARC-51X.

Frequency range (receiving and transmitting[1])	1750 channels, 225.0 to 399.9 megacycles; channel separation, 0.1 megacycle.
Type of emission	Amplitude modulation.
Type of transmission	Voice.
Distance range:	
(transmitting and receiving)	Line of sight, varies with altitude; 50 miles (approximately) at 3000 feet.
Power requirements	Reception 16.5 amperes. Transmission - 19.1 amperes. Channel switching - 25.5 amperes. (27.5 v dc).

[1]The guard band receiver is fix-tuned to 243.0 megacycles, the emergency uhf channel.

5-7. Technical characteristics of radio set AN/ARC-73, or -73A.

Frequency range:

Transmitter	680 channels, 116.00 to 149.95 megacycles; channel separation 50 kilocycles.
Receiver	720 channels, 116.00 to 151.95 megacycles; or 880 channels 108.0 to 151.95 megacycles depending on control panel used; channel separation 50 kilocycles.
Type of emission	Amplitude modulation.
Type of transmission	Voice.
Distance range:	
Transmitting	Line of sight, varies with altitude; 50 miles (approximately) at 3000 feet.
Receiving	Line of sight, varies with altitude; 50 miles (approximately) at 3000 feet.
Power requirements	Reception - 1.2 amperes. Channel switching - 3.3 amperes. Transmission - 7.3 amperes. Channel switching - 85 watts, peak; 55 watts, average for 4 seconds. (27.5 v dc).

5-8. Technical characteristics of radio transmitter T-366A/ARC.

Frequency range:	Five channels, in any 2 megacycle band, between 116.0 to 132.0 megacycles.
Type of emission	Amplitude modulation.
Type of transmission	Voice.
Distance range	Line of sight, varies with altitude; 50 miles (approximately) at 3000 feet.
Power requirements	Transmitting - 7.3 amperes. Channel switching - 85 watts, peak; 55 watts, average for 4 seconds. (27.5 v dc).

5-9. Technical characteristics of radio set AN/ARC-59.

Frequency range:	
Transmitter	20 channels, 2.0 to 18.5 megacycles am; 3.5 to 18.5 megacycles cw.
Receiver	20 channels, 2.0 to 18.5 megacycles.
Type of emission	Amplitude modulation.
Type of transmission	Voice and cw.
Distance range (transmitting and receiving)	Indefinite.
Power requirements	27.5 v dc, 38 amperes.

5-10. Technical characteristics of radio set AN/ARC-102.

Frequency range (transmitter and receiver)	28,000 channels, 2.000 to 29.999 megacycles; channel separation 1-kilocycle.
Type of emission	Amplitude modulation, single-sideband and continuous wave.
Type of transmission	Voice and cw.
Distance range (transmitting and receiving)	Indefinite.
Power requirements	27.5 volts dc at 950 watts.

5-11. Technical characteristics of radio set AN/ARC-44.

Frequency range	280 preset channels, 24.0 to 51.9 megacycles, channel separation 100 kilocycles.
Type of emission	Frequency modulation.
Type of transmission	Voice.
Distance ranges (transmitting and receiving)	Varies with altitude, terrain, and atmospheric conditions; 50 miles approximately.
Power requirements	27.5 volts dc at 3 amperes.

5-12. Technical characteristics of radio set AN/ARN-30D, or -30E.

Frequency range	190 channels, 108.0 to 126.9 megacycles; channel separation, 0.1 megacycle.
Type of modulation	Amplitude modulation.
Type of reception	VOR, localizer, and communications.
Distance range	Dependent upon altitude of aircraft. The approximate distance in miles is equal to the square root of the aircraft altitude in feet multiplied by 1.2.
Power requirements	27.5 v dc at 2.5 amperes.

5-13. Technical characteristics of direction finder set AN/ARN-59.

Frequency range	0.19 to 1.75 megacycles.
Modes of operation:	
AM or cw receiver	Provides reception of am or cw signals from a radio range or standard broadcast radio station. A beat frequency oscillator is included for reception of cw signals.
Manual radio direction finder	Operated as an am or cw receiver using loop antenna signals. The loop antenna is rotated by a control panel LOOP switch.
Automatic radio direction finder	Operated as for the manual radio direction finder except that the loop antenna automatically rotates to the maximum signal position.
Type of heading or bearing display provided	Bearing of radio station received is shown on synchro operated indicator that indicates on a 360° dial.
Type of reception	Voice or tone am, or cw.
Frequency band ranges:	
Band 1	0.19 to 0.40 mc.
Band 2	0.40 to 0.84 mc.
Band 3	0.84 to 1.75 mc.
Distance range	Reliable to 200 miles.
Power requirements	27.5 volts dc at 2.8 amperes.

5-14. Technical characteristics of radio receiving set AN/ARA-54.

Frequency range	20 channels, 329.3 to 335.0 megacycles; channel separation 0.3 megacycles.
Type of modulation	Amplitude modulation.
Type of reception	Visual display on indicator. No audio.
Altitude range	Zero to 70,000 feet.
Power requirements	27 v dc + 10% at 270 milliamperes maximum; 600 milliamperes maximum during channeling.

5-15. Technical characteristics of radio receiving set AN/ARN-32.

Frequency	Single channel, 75 megacycles, factory tuned and sealed.
Type of modulation	Amplitude modulated at 400, 1300, or 3000 cps.
Power consumption	27.5 v dc, 16 watts.
Visual output	Visual indicator lighted by relay circuit energized by the audio signal.

5-16. Technical characteristics of radio receiving set R-1041/ARN.

Frequency range	Single channel, 75.0 megacycles, factory tuned and sealed.
Type of modulation	Amplitude modulated at 400, 1300 or 3000 cps.
Power requirements	27.5 v dc at 16 watts.
Visual output	Visual indicator lighted by relay circuit energized by the audio signal.

5-17. Technical characteristics of radio receiving set AN/ARN-58.

Frequency range:	
Glide slope receiver	20 channels, 329.3 to 335.0 megacycles.
Marker beacon receiver	Single channel, 75.0 megacycles.
Type of modulation	Amplitude modulation.
Type of reception:	
Glide slope receiver	Visual display on indicator. No audio.
Marker beacon receiver	Visual display on indicator, plus audio.
Altitude range:	
Glide slope receiver and marker beacon receiver	Zero to 70,000 feet.
Power requirements	27.5 v dc + 10% at 270 milliamperes maximum; 600 milliamperes maximum during channeling.

5-18. Technical characteristics of transponder set AN/APX-44.

Frequency range:	
Receiver	1010 to 1030 megacycles (one preset frequency).
Transmitter	1090 to 1110 megacycles (one preset frequency).
Type of modulation	Pulsated radio-frequency.
Power requirements	27.5 v dc at 7.3 amperes.

5-19. Description of Configurations. The avionics equipment configurations (table 5-3), provide the pilot and copilot with uhf or vhf command communications and vhf liaison communications; vhf reception of omni ranges (vor), and runway localizers (loc); automatic direction finding (adf); marker beacon reception; glide slope reception; interphone among crew members; and coded identification facilities. A standby vhf transmitter is used in conjunction with an omni receiver, to provide standby (emergency) communications. Complete provision is made to install the vhf command set as an alternative to the uhf command set. Complete provision is made to install a second direction finder set (No. 2 adf) as an alternative to the second omni radio set. Complete provision is made to install hf radio set (AN/ARC-59) in configurations A and B, and complete provision is made to install hf-ssb radio set (AN/ARC-102 or Collins 618T-3) in configurations C and D, and in configurations A and B instead of HF radio set (AN/ARC-59). Fm auxiliary receiver (AN/ARR-46) can be installed in configurations A and B, and fm auxiliary receiver (AN/ARR-49) can be installed in configurations C and D. All radio inputs and outputs (except the glide slope receiver) are connected through the pilot's and copilot's INT panels in all configurations, for selection as required. Receiver audio can be monitored from the third station INT panel in the cabin, and from an extension headset at a fourth station in the cargo ramp area, in configurations A, B, and C; or from the crew chief, cabin, and cargo ramp INT panels in configuration D. In configurations A, B, C, a standby audio system is provided and can be selected in the event of failure of the pilot's or copilot's INT panels. The standby audio system is brought into operation automatically when the FM POWER circuit breaker is switched off. This permits the pilot or copilot to transmit on uhf, hf, or vhf (standard or emergency) radio, and receive signals from all facilities except the fm liaison radio set. In addition, the standby audio system permits interphone between the pilot and copilot. The third and fourth stations are cut off during standby audio operation. In configuration D the copilot's INT panel can be used as a standby in the event of malfunction of the pilot's INT panel. The facilities are described in paragraphs 5-20 through 5-34.

5-20. Description of interphone system in configurations A, B, and C. Three INT panels (SB-329/AR) form the basis of the aircraft interphone system on configurations A, B, and C (table 5-3). From their INT panels (figure 5-1) the pilot and copilot may select singly or in combination, the aircraft interphone channel, or any of the radio facilities. The third and fourth operators may monitor any radio facility but can transmit only on the interphone channel. (The fourth operator's headset is connected to the third station INT panel.)

5-21. Description of interphone system in configuration D. In configuration D (table 5-3) five INT panels C-1611(*)/AIC (figure 5-1) are installed to provide the aircraft interphone system. The system provides intercommunication between the pilot and copilot and three crew members, private interphone between the three crew members, monitoring of the radio receivers, and control of voice radio transmission through the receiver-transmitters from the pilot's and copilot's INT panels.

5-22. Description of uhf command set AN/ARC-55B or -51X. The uhf command set provides the pilot and copilot with two-way communications through the uhf command channels specifically set aside for military aircraft traffic communications. The main receiver and the transmitter are used for air-to-air and air-to-ground communication, and a guard receiver is used for the reception of distress and emergency messages. Operation of the guard receiver does not interfere with the operation of the main receiver and transmitter.

5-23. Description of vhf command set AN/ARC-73 or -73A. The vhf command set provides the pilot and copilot with two-way communications through the vhf command channels specifically set aside for military aircraft traffic communications.

5-24. Description of standby vhf transmitter T-366A/ARC. The standby vhf transmitter is used in conjunction with the omni receiver appropriate to the configuration, to provide the pilot and copilot with two-way communication through the vhf command channels set aside for military aircraft traffic communications in an emergency. The system is used for air-to-air and air-to-ground communication in the event of uhf or vhf command set malfunction.

5-25. Description of hf radio set AN/ARC-59. The hf radio set AN/ARC-59 (in configurations A and B only, table 5-3) provides the pilot and copilot with two-way voice communications through the hf channels specifically set aside for military aircraft traffic communications. The receiver and transmitter are used for air-to-air and air-to-ground communication.

5-26. Description of hf-ssb radio set AN/ARC-102. The hf-ssb radio set which can be installed

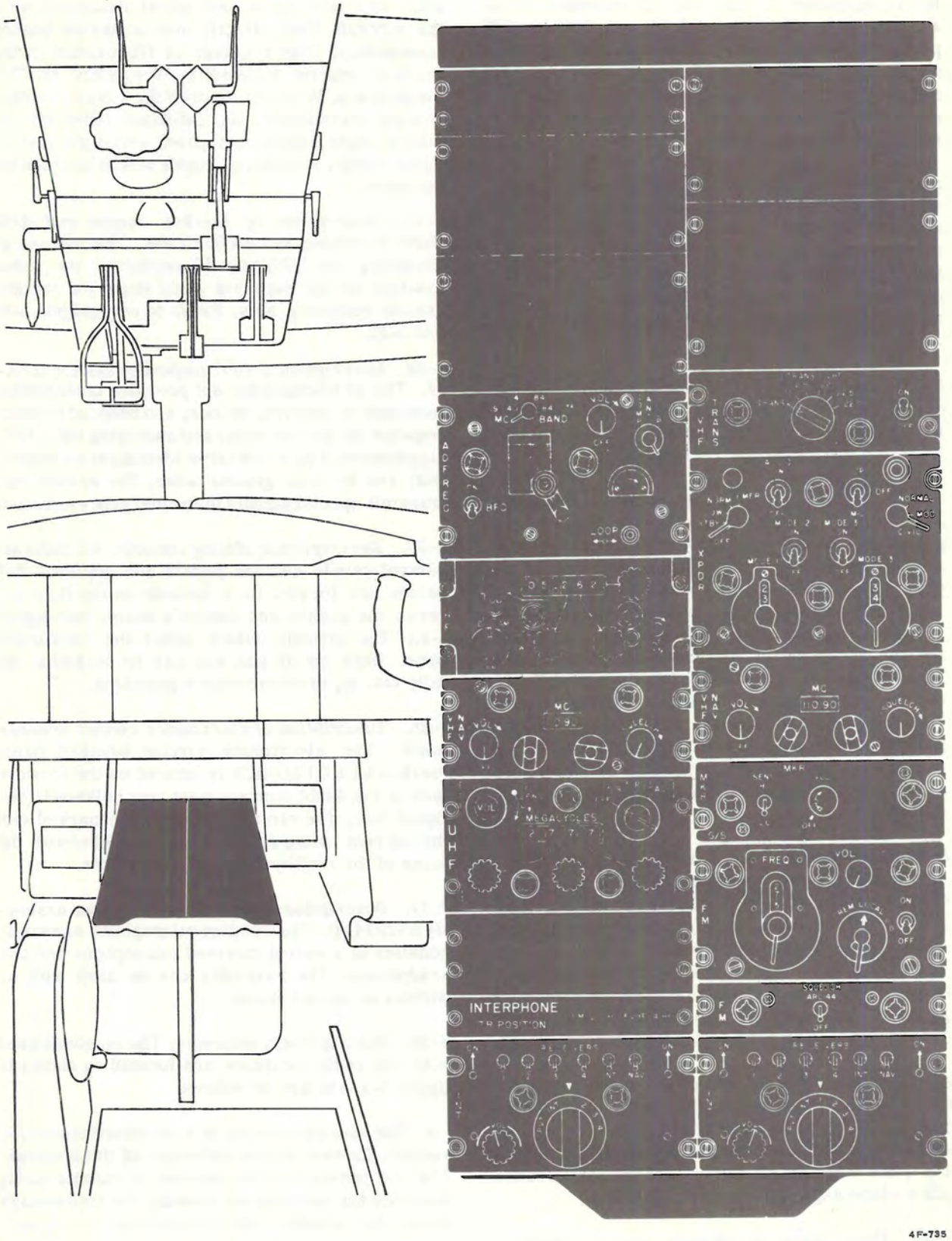


Figure 5-1. Sliding console radio panels - typical

in configuration D, and may be installed retroactively in configurations A, B, and C, (table 5-3) provides the pilot and copilot with two-way communications through the hf channels set aside for military aircraft communications. The receiver and transmitter are used for air-to-air and air-to-ground communication.

5-27. Description of fm liaison radio set AN/ARC-44. The fm liaison radio set provides the pilot and copilot with two-way voice communications through the tactical military frequency modulation (fm) channels. The receiver and transmitter are used for air-to-air and air-to-ground communications with armored, artillery, or infantry units in the field.

5-28. Description of fm auxiliary receiving set AN/ARR-46 or -49. The fm auxiliary receiving set, when installed, is provided as auxiliary equipment for the fm liaison receiver.

5-29. Description of omni radio set AN/ARN-30D or 30E. The omni radio set provides the pilot and copilot with very high frequency (vhf) navigation facilities. The radio set enables the pilot and copilot to make use of the omnirange (vor) and runway localizer transmissions for navigational purposes. The radio set can also be used for the reception of vhf communication signals. Two radio sets are installed in the aircraft with one set supplying information to the pilot's course selector-indicator and the other set to the copilot's course selector-indicator. One of the receivers is also used in conjunction with the standby vhf transmitter to provide standby vhf communications.

5-30. Description of adf radio set AN/ARN-59. The adf radio set provides the pilot and copilot with automatic visual indication of the direction from which incoming radio signals (low-frequency radio range or standard broadcast stations) are received. The reception of voice or cw signals provides directional information. The receiver also provides for reception of broadcast signals from transmitters operating within its frequency range.

5-31. Description of glide slope receiving set AN/ARA-54 or R-746/AR. The glide slope receiving set AN/ARA-54 in configuration C (table 5-3) or R-746/AR in configurations A and B, provides the pilot and copilot with visual indication of the glide slope angle on a runway approach.

5-32. Description of marker beacon receiving set AN/ARN-32, or R-1041/ARN. The marker beacon receiving set provides the pilot and copilot with both aural and visual indication when the aircraft flies directly over a marker beacon transmitter. The receiver is fixed-tuned to the marker beacon transmitter frequency of 75.0 megacycles. When the aircraft flies over a marker beacon transmitter, an indicator lamp on the pilot's flight instrument panel will light and an audio station identifying signal will be heard in the headsets.

5-33. Description of marker beacon and glide slope receiving set AN/ARN-58. The mb and gs receiving set AN/ARN-58 performs the same function as the separate glide slope and marker beacon receiving sets. Refer to paragraphs 5-31 and 5-32.

5-34. Description of iff transponder set AN/APX-44. The iff transponder set provides transponder functions to receive, decode, and respond to interrogation by ground radar stations using MK X IFF, supplemented by a selective identification feature (sif) and by civil ground radar. The system will transmit special signals in an emergency situation.

5-35. Description of sliding console. All radio set control panels and the pilot's and copilot's INT panels are located on a console on the floor between the pilot's and copilot's seats. (See figure 5-1.) The console slides under the instrument panel when not in use and can be locked in the fully out, in, or intermediate positions.

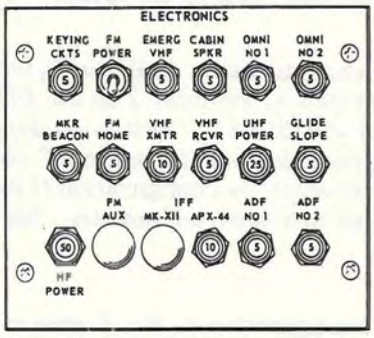
5-36. Description of electronics circuit breaker panel. The electronics circuit breaker panel marked ELECTRONICS is located on the forward face of the flight compartment rear bulkhead. (See figure 5-2.) The circuit breakers are marked with the current rating and the panel is labeled with the name of the facility which each protects.

5-37. Description of headset-microphone assembly H-101A/U. The headset-microphone assembly consists of a swivel mounted microphone and two headphones. The assembly can be used with or without an oxygen mask.

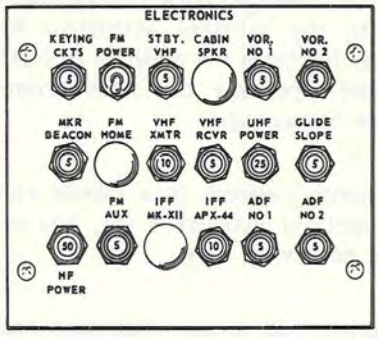
5-38. Description of antennas. The antennas used with the radio facilities are located as shown in figure 5-3, and are as follows:

a. The uhf-vhf antenna is a combined blade type antenna located on the underside of the fuselage. The vhf portion of the antenna is automatically switched for use with the standby vhf transmitter when the standby vhf transmitter is keyed.

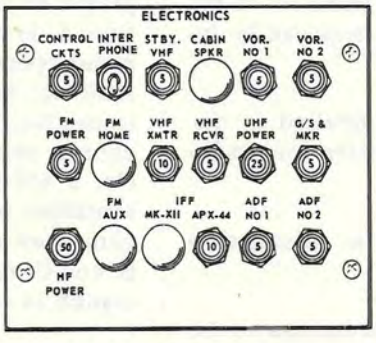
b. The fm antenna is the whip antenna on top of the fuselage.



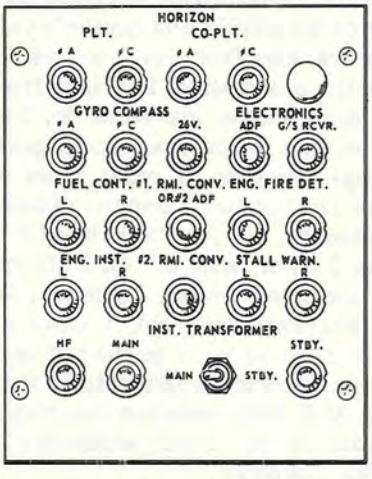
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60-3762 THROUGH 60-5444



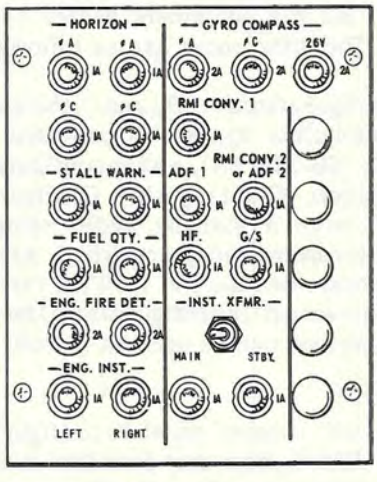
AIRCRAFT SERIAL NO.
61-2600 THROUGH 62-12584



AIRCRAFT SERIAL NO.
63-9718 AND SUBSEQUENT



AIRCRAFT SERIAL NO.
60-3762 THROUGH 61-2600



AIRCRAFT SERIAL NO.
62-4144 AND SUBSEQUENT

Figure 5-2. Electronics circuit breaker panel

c. The hf antenna is the wire antenna suspended between the vertical stabilizer and a mast on the fuselage. On configuration D only, the antenna is attached to the vertical stabilizer by a safety swivel which allows the antenna to fall free when broken and prevents the wire from whipping against the empennage.

d. The omni antenna is a dipole antenna built into the vertical stabilizer tip, and is used with both omni receiving sets.

e. Separate adf sense antennas and loop antennas are used for No. 1 and No. 2 adf radio sets. The sense antennas in configurations A, B, and C, are installed on the underside of the fuselage, and in configuration D on top of the fuselage. The adf loop antennas are installed on the underside of the fuselage. When No.2 adf radio set is not installed, No. 2 adf loop antenna must not be installed.

f. The glide slope antenna is installed in the nose section on the forward face of the front bulkhead.

g. The marker beacon antenna is installed on the underside of the fuselage.

h. The iff antenna is a blade type antenna on the underside of the fuselage.

5-39. Differences in Configurations. The facilities provided by the four configurations installed in aircraft Serial Numbers as listed in table 5-3 are the same, but the equipment varies as listed in table 5-4. The differences are as follows:

a. In configurations A, B, and C, the interphone-audio distribution system is provided by three INT panels (SB-329/AR), and in configuration D by five INT panels (C-1611A/AIC). Configurations A, B, and C have a standby audio system using headset-microphone adapters which are brought into operation when the FM POWER circuit breaker is switched off. In configuration D the pilot and copilot positions can be used as standby for each other.

b. The UHF control panel in configurations A, B, and C, differs from that installed in configuration D, but operation of both facilities is the same. (Refer to paragraph e. below.)

c. The standby vhf control panels differ in configurations A, B, and C, and D, but operation is the same.

d. The panel on which the fm squelch switch is installed differs in configurations A, B, and C and D, but the operation is the same.

e. In configurations A, B, and C, the hf radio set is connected to position 2 on the INT panels and the UHF-HF SELECT switch on the panel on the sliding console must be set to HF position for hf radio operation. In configuration D the hf radio is connected to a separate position, No. 4 on the INT panels.

f. In configuration A, No. 2 omni radio operates with the pilot's course selector-indicator and is also used for standby vhf communications; No. 1 omni radio operates with the pilot's course selector-indicator, and is removed when No. 2 adf set is installed. No omni bearings are available on the pilot's or copilot's course indicator in configuration A. In configurations B, C, and D, No. 1 omni radio operates with the pilot's course selector-indicator and is used for standby vhf communications; No. 2 omni radio is used with the copilot's course selector-indicator, and is removed when No. 2 adf radio is installed. Omni bearings are available on the pilot's and copilot's course indicators as selected by the pilot in configurations B and C, or selected individually by the pilot and copilot in configuration D.

g. In configuration A, No. 2 adf radio set is installed as an alternative to No. 1 omni radio; in configurations B, C, and D it is installed as an alternative to No. 1 omni radio. When No. 2 adf radio set is not installed, in configuration A, both pointers of the pilot's and copilot's course indicator read bearings from No. 1 adf radio; when No. 2 adf radio is installed, bearings from No. 1 adf are on No. 1 pointer and from No. 2 adf on No. 2 pointer on both indicators. In configurations B and C bearings from No. 1 omni radio or No. 1 adf radio are read on No. 1 pointer of both indicators as selected by the pilot's VOR-ADF switch, and from No. 2 omni radio or No. 2 adf radio (whichever is installed) on No. 2 pointer. In configuration D, bearings from No. 1 omni or No. 1 adf radio are read on No. 1 pointer of each indicator but can be selected separately by the pilot's and copilot's ADF-VOR switches; bearings from No. 2 omni radio or No. 2 adf (whichever is installed) are on No. 2 pointer.

h. In configurations A and B, the glide slope receiver frequency is set by the glide slope receiver control panel. In configurations C and D the glide slope receiver frequency is set when No. 1

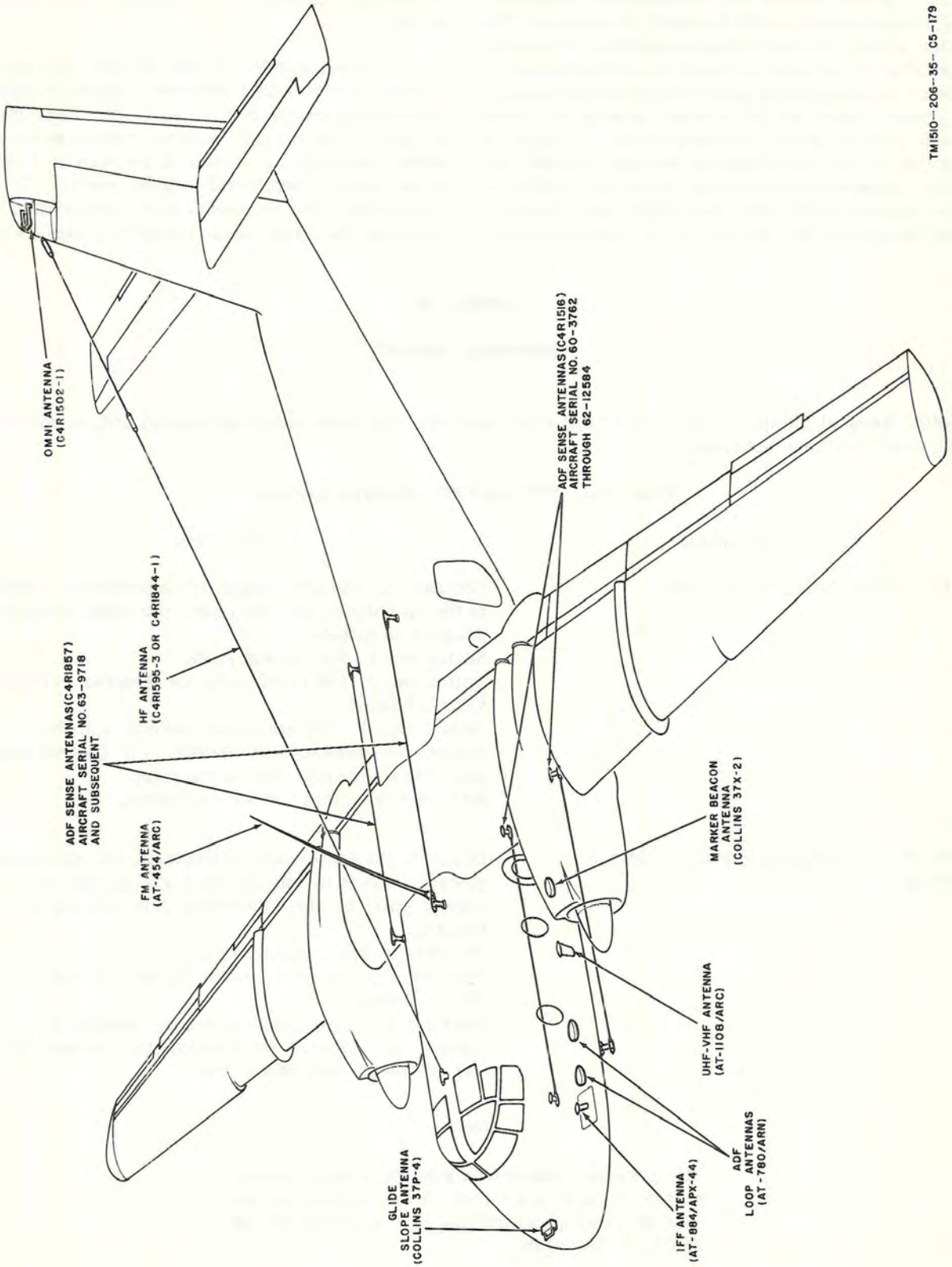


Figure 5-3. Antennas

omni control panel is set to a localizer frequency. In configurations A and B, power is applied to the glide slope receiver through the power switch on the glide slope control panel. In configuration C, power is applied to the glide slope receiver through a power switch on the marker beacon and glide slope control panel. In configuration D, power is applied to the combination marker beacon and glide slope receiver through the power switch on the marker beacon and glide slope control panel, but the glide slope receiver is not operative until a localizer frequency is set on No. 1 omni control panel.

i. In configuration A, the marker beacon receiver control panel contains a combined power switch and volume control only. In configurations B and D, the marker beacon control panel contains a sensitivity switch in addition to a combined power switch and volume control. In configuration C the marker beacon control panel also contains the glide slope receiver power switch.

Section III

Operating Controls

5-40. General. Tables 5-5 through 5-18 list the controls, with panel markings capitalized, in column 1, and their functions in column 2.

Table 5-5. INT panel (SB-329/AR) controls

CONTROL	FUNCTION
RECEIVERS selector switches.	Connect the receiver output to the associated headset in the up position and disconnect the output in the down position as follows: Switch No. 1 - Fm liaison radio. Switch No. 2 - Uhf or hf radio, as selected on UHF-HF SELECT panel. Switch No. 3 - Vhf command radio or standby vhf receiver as selected on standby vhf control panel. MB switch - marker beacon receiver. NAV switch - Omni and adf receivers.
TRANS (transmit/interphone) selector switch.	Connects the associated microphone, and microphone control circuit to the selected transmitter (pilot and copilot only) or the interphone line (all stations) as follows: Position 1 - Fm liaison radio. Position 2 - Uhf or hf radio as selected on UHF-HF SELECT panel. Position 3 - Vhf command set or standby vhf transmitter, as selected on standby vhf control panel. INT position - Interphone line. *Note* The receiver associated with the selected transmitter is also connected to the headset by the TRANS switch, regardless of the setting of the RECEIVERS switch.
VOL (volume) Control	Varies the audio level of mixed interphone and receiver audio, except the adf receiver(s) which bypass the volume control.

Table 5-6. INT panel (C-1611A/AIC) control

CONTROL	FUNCTION
RECEIVERS selector switches.	Connect the receiver or interphone output to the associated headset in the up position, and disconnect the output in the down position as follows: Switch No. 1 - Fm liaison receiver. Switch No. 2 - Uhf command receiver. Switch No. 3 - Vhf command receiver, or standby vhf receiver, as selected on standby vhf control panel. Switch No. 4 - Hf receiver. INT switch - Interphone system. NAV switch - Adf, omni (No. 1 and No. 2) and marker beacon receiver.
Transmit-interphone selector switch.	Connects the associated microphone and its control circuit to the selected transmitter (pilot and copilot only), or interphone line (all stations) as follows: Position 1 - Fm liaison radio. Position 2 - Uhf command radio. Position 3 - Vhf command radio, or standby vhf transmitter as selected on standby vhf control panel. Position 4 - Hf radio. INT position - Interphone line for all stations. PVT - Interphone line, for crew chief, cabin, and cargo ramp stations only. *Note* The receiver associated with the selected transmitter is also connected to the headset by the transmit-interphone switch, regardless of the setting of the RECEIVER selector switch.
VOL (volume) control.	Varies the audio level of mixed interphone and receiver audio, except the adf receiver(s) which bypass the volume control.

Table 5-7. Uhf command set AN/ARC-55B controls

CONTROL	FUNCTION
Function switch (OFF-T/R-TR+G REC-ADF).	Selects uhf command set operating mode. OFF position - The uhf command set is inoperative. T/R position - Permits operation of the main receiver and transmitter on the selected frequency. T/R+G REC position - Permits operation of the main receiver and transmitter on the selected frequency, and reception on the guard receiver frequency. ADF position - Permits operation of the main receiver and transmitter on the selected frequency and adf reception on the main receiver frequency (when adf equipment is installed). Renders the guard receiver inoperative.
VOL (volume) control.	Adjusts the audio level of main and guard receivers.
SENS (sensitivity) control.	Adjusts the sensitivity of the main receiver. When rotated fully clockwise it disables the squelch circuit.
Frequency selector (three controls).	Selects the desired frequency and displays it in the indicator window.

Table 5-8. Uhf command set AN/ARC-51X controls

CONTROL	FUNCTION
Function switch (OFF-T/R-T/R+G-ADF).	Selects the uhf command set operating mode. OFF position - The uhf command set is inoperative. T/R position - Permits operation of the main receiver and transmitter on the selected frequency. T/R+G position - Permits operation of the main receiver and transmitter on the selected frequency, and reception on the guard receiver frequency. ADF position - Permits operation of the main receiver and transmitter, and adf reception on the main receiver frequency (when adf equipment is installed). Renders the guard receiver inoperative.
VOL (volume) control.	Adjusts the audio level of main and guard receivers.
SENS (sensitivity) control.	Adjusts the sensitivity of the main receiver. When rotated fully clockwise it disables the squelch circuit.
Frequency selector (three controls).	Selects the desired frequency and displays it in the MEGACYCLES indicator window.

Table 5-9. Vhf command set AN/ARC-73 or -73A controls

CONTROL	FUNCTION
Power (ON-OFF) switch.	ON position - Permits operation of the vhf command set on the selected frequency. OFF position - The vhf command set is inoperative.
SCS-DCS/DCD switch.	Not used.
VOL (volume) control.	Adjusts the audio level of the receiver.
SQ (squelch) control.	Adjusts the squelch threshold level of the receiver output.
Frequency selector (two controls).	Selects receiver and transmitter frequency, and displays it in FREQ MC (frequency megacycles) window.

Table 5-10. Standby (emergency) vhf transmitter T-366A/ARC controls

CONTROL	FUNCTION
Power switch.	EMERG TRANS (or ON) position - Permits operation of the standby vhf transmitter on the frequency selected. OFF position - The standby vhf is inoperative.
Frequency selector.	Selects the transmitting frequency of the standby vhf transmitter, and connects the standby vhf or the standard vhf radio set to the INT panel. The positions are as follows: TRANS 1 or (STD VHF or ARC73) position - Connects the standard vhf radio set audio to the INT panel, and routes omni receiver audio to the NAV position on the INT panel. TRANS 2 - VHF (or positions 1 through 5) positions - selects the standby vhf transmitter frequency; and connects the standby vhf (omni) receiver to position 3 on the INT panel. Five frequencies are available; 121.5, 121.9, 122.1, 122.5 and 122.7 megacycles.

Table 5-11. Hf radio set AN/ARC-59 controls

CONTROL	FUNCTION
POWER (ON-OFF) switch.	ON position - Permits operation of the hf radio set on the selected frequency. OFF position - The hf radio set is inoperative.
VOL (volume) control.	Adjusts the audio level of the receiver.
CHAN (channel) selector switch.	Selects any one of 20 preset receiving and transmitting channels.
Function switch (CW-STDBY-PH).	Selects the mode of operation. CW position - Sets up equipment for transmission and reception of cw coded signals. (Not connected on this installation.) PH position - Sets up equipment for transmission and reception of voice signals. STDBY position - Sets up equipment for operation of the receiver only.
BFO (beat frequency oscillator) control.	Varies the tone of cw signals heard in the headset.

Table 5-12. Hf-ssb radio set AN/ARC-102 controls

CONTROL	FUNCTION
Function switch (OFF-USB-LSB-AM-DATA-CW).	Selects the hf-ssb radio set operating mode. OFF position - The hf-ssb radio set is inoperative. USB position - Selects the upper-side-band mode of operation. LSB position - Selects the lower-side-band mode of operation. AM position - Selects the amplitude-modulated mode of operation. DATA position - Permits use of auxiliary data equipment, (when installed). CW position - Selects continuous-wave mode of operation, (when signalling equipment is installed).
RS SENS, receiver sensitivity control.	Adjusts the sensitivity of the receiver.
Frequency selector (four knobs).	Selects the desired frequency and displays it in the indicator window.

Table 5-13. Fm liaison radio set AN/ARC-44 controls

CONTROL	FUNCTION
FREQ, (frequency) selector (two controls).	Selects the fm liaison radio set operating frequency and displays it in the window.
VOL (volume) control.	Adjusts volume of receiver audio. Clockwise rotation increases audio output.
REM-LOCAL switch.	Used only on installations having two or more fm control panels. Must always be in LOCAL position on this aircraft.
Power ON-OFF switch.	ON position - Permits operation of fm liaison radio set on the frequency selected. OFF position - The fm liaison radio set is inoperative.

Table 5-14. Radio receiving set AN/ARN-30D or -30E controls and indicators

CONTROL	FUNCTION
VOL-OFF, combined volume control and power switch.	Rotation clockwise turns the vhf navigation receiver on and increases audio output to the headset. Counterclockwise rotation decreases audio level; turns equipment off.
SQUELCH control.	Adjusts squelch circuit of receiver.
Frequency selector knobs.	Selects the desired frequency and displays it in the MC indicator window. No. 1 VHF NAV control panel frequency selector also sets the glide slope receiver frequency in configurations C and D only.
Course selector-indicator knob.	Permits selection or determination of magnetic bearing of the vor station.
TO-FROM meter.	Indicates direction TO or FROM the vor station.
Cross-pointer indicator.	Vertical pointer - Moves left and right to indicate relationship with runway localizer or vor station. When centered, indicates on-course. Horizontal pointer - Moves up and down to indicate relationship with glide slope beam. When centered, indicates on-beam.
Blue and yellow arc.	Used in conjunction with vertical pointer and range audio signal to identify the range quadrant of the visual-aural range.
OFF, flag alarms (one for each pointer).	If visible, indicates that signals actuating the respective pointer are unreliable.

Table 5-15. Direction finder set AN/ARN-59 controls and indicators

CONTROL	FUNCTION
MC BAND switch.	Selects the frequency band that the receiver can be tuned through. The frequency bands are as follows: 0.19 to 0.40 MC (190 - 400 kc) 0.40 to 0.84 MC (400 - 840 kc) 0.84 to 1.75 MC (840 - 1750 kc)
VOL-OFF, volume and power control.	Turns direction finder set on or off. Adjusts receiver audio level.
Function switch (COMP-ANT-LOOP).	Selects the mode of operation as follows: COMP position - Receiver operates with combined loop and sense antennas as a radio compass or automatic direction finder. ANT position - Receiver operates with sense antennas as a conventional receiver for receiving low-frequency radio range or standard broadcast signals. LOOP position - Receiver operates with the loop antenna only as a manual direction finder.
LOOP switch.	Positions the loop antenna when function switch is in either COMP or LOOP position. Loop antenna can be rotated clockwise or counterclockwise by holding the switch in the right or left position.

Table 5-15 (cont)

CONTROL	FUNCTION
Tuning crank.	Tunes the receiver to the desired signal frequency.
Tuning meter.	Indicates when receiver is accurately tuned.
BFO switch.	Turns the beat frequency oscillator on or off. The beat frequency oscillator is used when receiving cw signals or to aid in tuning.
C6H (ID-998/ASN) indicator.	Provides the pilot with aircraft magnetic heading and visual indication of relative bearings of signals received by the adf and omni receivers. (Installed in configurations B, C, and D only, table 5-3.) Transmits magnetic heading to copilot's indicator ID-250/ARN. Azimuth scale - indicates through 360° in increments of 2°. Numbers on dial are placed at 30° intervals. Heading index - Indicates fixed reference point with respect to aircraft heading. SET HDG control - Permits setting of indicator heading index to true or magnetic heading. Narrow (No. 1) indicator pointer - Indicates relative direction of aircraft from transmitting station, using No. 1 adf or No. 1 vor, as set by ADF-VOR switch. Broad (No. 2) indicator pointer - Indicates relative direction of aircraft from transmitting station, using No. 2 vor or No. 2 adf (whichever is installed). ADF/VOR control - Permits connection of signals received from the No. 1 adf or No. 1 vor sets to indicator No. 1 pointer. Synchronization knob and window - Permits manual synchronization of indicator. OFF flag alarm - Will appear when signals received are weak and unreliable. DG/SLAVE switch (on pilot's flight instrument panel) - Permits use of indicator as a directional gyro or as a gyro compass. When indicator is used for adf or vor operation, switch should be in SLAVE position.
C6A indicator.	Installed in configuration A only. Performs same functions as C6H installed in configurations B, C, and D, but relative bearing information on No. 1 and No. 2 pointers is from No. 1 adf radio only. (No rmi converters are installed, thus no omni bearings are available.) When No. 2 adf radio set is installed No. 1 pointer indicates bearings from No. 1 adf radio and No. 2 pointer from No. 2 adf radio.
ID-250/ARN indicator.	Provides copilot with aircraft magnetic heading and visual indication of relative bearings of adf or omni signals. The magnetic heading is transmitted from the pilot's indicator C6A or C6H, as applicable. In configuration A, the pointer read-outs are the same as for the pilot's indicator C6A. In configuration B the pointer read-outs are the same as for the pilot's indicator C6H as set by the pilot's ADF-VOR switch. In configuration C and D the copilot has a separate ADF-VOR switch for No. 1 pointer on his indicator.

Table 5-16. Marker beacon receiving set controls and indicator

CONTROL	FUNCTION
VOL-OFF control.	When turned clockwise from OFF position, applies power to receiver and increases audio level of received signal.
MKR-SENS switch (configurations B, C and D only).	HI position - Selects high sensitivity circuit of receiver. LO position - Selects low sensitivity circuit of receiver.
MKR indicator light.	Illuminates as aircraft passes over a 75-mc marker beacon, provided the marker beacon receiver is in operation.
G/S power switch (configuration C only, see paragraph 5-53).	ON position - Turns glide slope receiver on. OFF position - Turns glide slope receiver off.

Table 5-17. Glide slope receiving set controls and indicators

CONTROL	FUNCTION
VHF NAV frequency selector (configurations A and B).	Permits selection of glide slope receiver frequency to correspond with localizer frequency set on VHF NAV (omni) control panel.
VOL (volume) control (configurations A and B), or VOL-OFF control (configuration D).	A combined volume and power control. When rotated clockwise from OFF position, applies power to receiver. Also adjusts audio level.
G/S power switch (configuration C only).	ON position - Applies power to receiver. OFF position - Turns receiver off.
	Note On configurations C and D the glide slope receiver is automatically tuned (and switched on in configuration D) when No. 1 omni receiver is tuned and in operation on a localizer frequency.
Course selector-indicators.	Horizontal pointer indicates glide slope angle, when glide slope receiver is in operation, and aircraft is attempting a landing at an airfield equipped with a glide slope facility (refer to paragraph 5-50).

Table 5-18. Transponder set AN/APX-44 controls

CONTROL	FUNCTION
Master switch.	Turns transponder set off or on, selects receiver sensitivity, and provides for emergency operation. The switch positions are as follows: OFF position - Renders transponder set inoperative. STBY position - Place transponder set in warm-up (standby) condition. LOW position - Applies full power to transponder set with low receiver sensitivity in accordance with military characteristics to meet certain operational requirements for tactical conditions. NORM position - Applies full power to transponder set with maximum receiver sensitivity. EMER position - Permits automatic transmission of emergency signals. (This position is protected by a barrier.)

Table 5-18 (cont)

CONTROL	FUNCTION
Function switch.	Selects transponder set operational mode as follows: NORMAL position - Permits transponder set to reply with normal pulse codes, representing modes 1, 2, and 3. MOD position - Permits transponder set to reply with sif (selective identification feature) pulse codes, representing modes 1, 2, and 3. CIVIL position - Permits transponder set to reply with civil pulse codes, representing modes 1, 2, and 3.
I/P switch.	Selects i/p (identification of position) reply operation. MIC position - Connects i/p energizing circuits to microphone keying circuits and permits i/p signals for 30 seconds after microphone switch is released. OFF position - Disconnects microphone keying and i/p initiating circuits. I/P position - When momentarily actuated (spring-loaded), initiates i/p operation for 30 seconds.
AUDIO switch.	ON position - Permits monitoring of transponder (not connected to interphone system). OFF position - Switches off audio.
MODE 2 switch.	ON position - Permits transponder set to provide mode 2 replies for mode 2 interrogations.
MODE 3 switch.	ON position - Permits transponder set to provide mode 3 replies for mode 3 interrogations.
MODE 1 code control.	Selects and indicates two-digit, mode 1 code number.
MODE 3 code control.	Selects and indicates two-digit, mode 3 code number.
Pilot light.	Comes on when power is applied to the transponder. A shutter controls brilliance of pilot light. (A press-to-test feature is incorporated.)

Section IV

Types of Operating Facilities

5-41. General. The facilities available to the pilot and copilot are listed in table 5-2. The facilities included in each configuration are listed in table 5-4 and the aircraft Serial Numbers in which each configuration is installed are listed in table 5-3. The facilities can be grouped into four systems, namely, interphone, communications, navigation, and identification. In the event of failure of a communications or navigation facility, certain alternatives are available. These are listed in table 5-19.

5-42. Interphone Facilities. The interphone facilities in the aircraft are as follows:

a. The interphone facility in configurations A, B, and C is provided by three INT panels SB-329/AR. The INT panels permit the pilot and copilot to transmit on different facilities at the same time, and listen to selected facilities, in addition to providing interphone between pilot, copilot, and two crew members. Operating procedures are given in paragraph 5-50.

Note

Simultaneous transmission on uhf and fm sets should be kept to an absolute minimum.

The third station INT panel provides interphone and receiver monitoring only. The fourth station operator's headset-microphone is connected to the third station INT panel. In event of failure of the pilot's or copilot's INT panel the standby audio system can be brought into operation. In the standby audio mode, the pilot and copilot only have interphone available (the third and fourth stations are cut off), and only the facility in use should be switched on. Receiver audio does not pass through the INT panels, but the desired transmitter must be selected on the INT panel as for normal operation. Refer to paragraph 5-69, for standby audio operating procedures.

b. The interphone facility in configuration D is provided by five INT panels C-1611A/AIC. The INT panels permit the pilot and copilot to transmit on different facilities at the same time, in addition to providing interphone between the pilot, copilot and three crew members. The private interphone line permits interphone between the three crew station INT panels without interference to the pilot and copilot. Operating instructions are given in paragraph 5-50.

Table 5-19. Alternate electronic facilities

INOPERATIVE EQUIPMENT	ALTERNATE EQUIPMENT	OPERATION OF ALTERNATE EQUIPMENT (REF PARA)	REMARKS
Radio Set AN/ARC-44	Radio Set AN/ARC-55B, or -51X	Paragraph 5-51, or 5-52	On configurations A, B, and C interphone between pilot and copilot only, and operation of all uhf, hf, vhf, facilities is in the emergency standby audio mode (para 5-69).
	Radio Set AN/ARC-59, or -102	Paragraph 5-55, or 5-56	
	Radio Transmitter T-366A/ARC in conjunction with Radio Receiving Set AN/ARN-30D, or -30E.	Paragraph 5-54.	
Radio Set AN/ARC-55B, or -51X	Radio Set AN/ARC-44	Paragraph 5-57	No uhf channels available.
	Radio Set AN/ARC-59, or -102	Paragraph 5-55, or 5-56	
	Radio Transmitter T-366A/ARC in conjunction with Radio Receiving Set AN/ARN-30D, or -30E.	Paragraph 5-54	
Marker Beacon Receiving Set R-1941/ARN, AN/ARN-32, or -58	None		Marker beacon indicator (light) and audio may be inoperative singly or together.
Glide Slope Receiving Set R-746/AR, AN/ARA-54, or AN/ARN-58	None		Course selector-indicators (pilot and copilot) may be inoperative singly or together. If one is inoperative, the other should not be relied upon.
Radio Receiving Set AN/ARN-30D, or 30E	Direction Finder Set AN/ARN-59.	Paragraph 5-60.	
	Second Radio Receiving Set AN/ARN-30D, or -30E (if installed).	Paragraph 5-59.	

Table 5-19 (cont)

INOPERATIVE EQUIPMENT	ALTERNATE EQUIPMENT	OPERATION OF ALTERNATE EQUIPMENT (REF PARA)	REMARKS
Direction Finder Set AN/ARN-59	Radio Receiving Set AN/ARN-30D, or -30E.	Paragraph 5-59.	Loop antenna alone (loop), or loop antenna with the sense antenna (comp) may be inoperative singly or together.
	Second Direction Finder Set AN/ARN-59 (if installed).	Paragraph 5-60.	
Radio Set AN/ARC-59, or -102	Radio Set AN/ARC-44.	Paragraph 5-57.	
	Radio Set AN/ARC-55B or -51X, (or AN/ARC-73, or -73A, if installed).	Paragraph 5-51, 5-52, or 5-53.	
	Radio Transmitter T-366A/ARC in conjunction with Radio Set AN/ARN-30D, or -30E.	Paragraph 5-54.	
Radio Set AN/ARC-73, or -73A (if installed)	Radio Set AN/ARC-44	Paragraph 5-57.	When Radio Set AN/ARC-73, or -73A, is installed, it replaced Radio Set AN/ARC-55B, or -51X.
	Radio Set AN/ARC-59, or -102.	Paragraph 5-55, or 5-56.	
	Radio Transmitter T-366A/ARC in conjunction with Radio Set AN/ARN-30D, or -30E.	Paragraph 5-54.	

5-43. Communications Facilities. The communications facilities available in the aircraft are as follows:

a. Air-to-ground and air-to-air communications in the uhf airways command frequency spectrum is provided by the Radio Set AN/ARC-55B in configurations A, B, and C, and the AN/ARC-51X in configuration D. Refer to paragraphs 5-51 and 5-52 respectively for operating instructions.

b. Air-to-air and air-to-ground communications in the vhf airways command frequency spectrum is provided by Radio Set AN/ARC-73, or -73A as an alternative to the uhf command set. Operating procedures are given in paragraph 5-53.

c. Air-to-air and air-to-ground emergency transmission in the vhf airways command frequency spectrum is provided by Radio Transmitter T-366A/ARC. The transmitter is used in conjunction with Radio Receiving Set AN/ARN-30D, or -30E, to provide two-way emergency communication in the event of uhf or vhf command set failure. Operating procedures are given in paragraph 5-54.

d. Air-to-air and air-to-ground communication in the hf airways frequency spectrum is provided by Radio Set AN/ARC-59 or AN/ARC-102 (when installed). Operating procedures are given in paragraphs 5-55 and 5-56 respectively.

e. Air-to-air and air-to-ground communication in the fm frequency spectrum assigned to military tactical units (armored, artillery, and infantry) are provided by Radio Set AN/ARC-44. Operating procedures are given in paragraph 5-57. The fm dynamotor also provides power to the INT panels in configurations A, B, and C only.

5-44. Navigation Facilities. The radio navigation facilities available in the aircraft are as follows:

a. Omnidirectional range, and runway tone localizer reception is available through Radio Receiving Set AN/ARN-30D, or -30E. Two sets in-

stalled can be used simultaneously, one set supplying omnirange information to the pilot's course selector-indicator and the other to the copilot's course selector-indicator. In configurations B, C and D, both sets provide bearing information to the pilot's course indicator and copilot's radio magnetic indicator. One of the two sets is used in conjunction with Radio Transmitter T-366A/ARC to provide standby vhf communications. Operating procedures for the omni mode are given in paragraph 5-59, and for the standby vhf mode in paragraph 5-54.

b. Homing and position fixing by triangulation using the standard broadcast band transmitters or low-frequency radio ranges are provided by Direction Finder Set AN/ARN-59. Operating procedures are given in paragraph 5-60.

c. Marker beacon reception is made available through Marker Beacon Receiving Set AN/ARN-32, R-1041/ARN, or AN/ARN-58. (Refer to tables 5-3 and 5-4 for the set installed.) Indications (aural and visual) are provided in the headphones and on the pilot's flight instrument panel respectively, whenever the aircraft flies over a marker beacon transmitter. Operating procedures are given in paragraphs 5-63 through 5-65.

d. Visual indication of the glide slope angle on a runway approach is presented on the pilot's and copilot's course selector-indicators by Radio Receiving Set AN/ARA-54, R-746/AR or AN/ARN-58. (Refer to tables 5-3 and 5-4 for the set installed.) Operating procedures are given in paragraphs 5-61 through 5-63.

5-45. Identification Facility. The IFF Transponder Set AN/APX-44 provides identification of the aircraft in response to interrogation by ground radar stations. Operating procedures are given in paragraph 5-66.

Section V

Preliminary Starting Procedures

5-46. General. The avionics equipment configuration should be operated with the engines running and the generators supplying power, or with an external power source connected to the aircraft. The aircraft battery should only be used to operate the equipment in an emergency.

5-47. Preliminary starting procedure using external power source.

a. Set battery master switch to OFF, and set LH and RH GEN switches to OFF, then connect external power source to aircraft.

b. Pull out sliding console and insure all equipment is switched OFF on control panels.

c. Insure all circuit breakers are ON; insure that EMERG BUS switch is set to NORMAL.

d. Set INST TRANSFORMER switch on fuse panel to ON. Set AC INVERTER switch on electrical power panel to MAIN.

e. Plug in headset-microphone assemblies at pilot's, copilot's, and crew stations.

f. Set GYRO COMPASS switch on flight instrument panel to SLAVE.

5-48. Preliminary starting procedure with engines running.

a. When engines have been started, check that external power source is disconnected.

b. Set battery master switch ON; set LH and RH GEN switches ON.

c. Pull out sliding console and insure all equipment is switched OFF on control panels.

d. Insure all circuit breakers are ON; insure that EMERG BUS switch is set to NORMAL.

e. Set INST TRANSFORMER switch on fuse panel to ON; set AC INVERTER switch on electrical power panel to MAIN.

f. Set GYRO COMPASS switch on flight instrument panel to SLAVE.

Section VI

Operating Procedures

5-49. General. Operation of all avionics equipment depends on primary power supply applied from the aircraft electrical system through circuit breakers on the electronics circuit breaker panel. The circuit breakers should be set on and remain on. The signals are routed through the operator's INT panel to his headset-microphone; therefore, INT panel RECEIVERS switches and transmit-interphone switch should be set as noted on the adjacent label to permit reception, interphone and, at the pilot's and copilot's INT panels only, to transmit on the desired radio facility.

5-50. Interphone Operation. Refer to tables 5-3 and 5-4 for the type of INT panel installed in the aircraft, and proceed as detailed in a. or b. as applicable.

a. In aircraft with INT-panel SB-329/AR installed for normal operation proceed as follows. (Refer to paragraph 5-69 for standby audio operation.)

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure that FM POWER and KEYING CKTS circuit breakers are ON.

(3) Set INT panel TRANS (transmit-interphone) switch to INT position.

(4) At pilot's and copilot's stations press microphone switch on control wheel to I/C, or foot switch to INTERCOM, and at other stations press microphone switch on headset-microphone jacks, and speak into microphone. Sidetone should be heard in operator's headset while speaking, and other stations should hear interphone transmission. Adjust VOL controls on INT panels for comfortable audio level.

Note

It is not necessary for the transmit-interphone switch on all INT panels to be set to INT position for interphone. Interphone will be heard at the other stations when the switch on the calling station INT panel is switched to INT position.

b. In aircraft with INT panel C-1611A/AIC installed, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure that INTERPHONE and CONTROL CKTS circuit breakers are on.

(3) Set INT panel transmit-interphone switch to INT position; set RECEIVERS INT switch ON (up).

(4) At pilot's and copilot's stations press microphone switch on control wheel to I/C position, or foot-operated microphone switch to INTERCOM position; at other stations press microphone switch on headset-microphone jack and speak into microphone. Sidetone should be heard in operator's headset while speaking and other stations should hear interphone transmission. Adjust VOL controls on INT panels for comfortable listening level.

Note

It is not necessary for the transmit-interphone switch on all INT panels to be set to INT for interphone. Interphone will be heard at the other stations when the transmit-interphone switch on the calling station INT panel is set to INT, provided the RECEIVERS INT switches on the panels at the other stations are ON.

(5) At crew chief, cabin, and cargo ramp INT panels, set the transmit-interphone switches to PVT position. Press microphone switch at each station in turn, and speak into microphone; sidetone should be heard in operator's headset and interphone at other two stations only.

c. Turn off interphone equipment as follows:

(1) Set all RECEIVERS switches to OFF (down) position.

(2) Set TRANS (transmit-interphone) switch to INT position.

(3) Set appropriate circuit breakers on electronics circuit breaker panel to OFF position.

5-51. UHF Command Set (AN/ARC-55B) Operation. The uhf command set used in configurations A, B and C can be operated in normal or standby-audio modes. (Refer to paragraph 5-69 for standby audio operation.) Normal operation is described following.

a. For normal reception proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure UHF POWER, FM POWER and KEYING CKTS circuit breakers are set to ON position.

(3) On operator's INT panel, set RECEIVERS 2 switch in ON (up) position, and turn VOL control for maximum volume.

(4) On sliding console panel, set UHF-HF SELECT switch to UHF position.

(5) On UHF control panel:

(a) Set function switch to T/R position. If it is desired to also monitor the guard receiver, set function switch to T/R + G REC position. Allow approximately one minute for radio set to warm up.

Note

ADF position of function switch is not used in this configuration.

(b) Set required frequency using three frequency selectors.

(c) Turn VOL control fully clockwise for maximum volume. If necessary, adjust INT panel VOL control to obtain suitable audio level.

(d) Adjust SENS control fully counterclockwise, then clockwise until background hissing noise is eliminated. Do not turn SENS control any further than amount required for elimination of hissing sound, otherwise weak incoming signals will not be heard.

b. For normal transmission proceed as follows:

Caution

Do not transmit on distress frequency 243.0 mc, except in emergency.

(1) Turn on radio set, following procedure in a. above.

(2) On operator's INT panel, set TRANS (transmit-interphone) switch to position 2.

Note

When TRANS (transmit-interphone) switch on pilot's or copilot's INT panel is set to position 2 the uhf receiver is connected to headset microphone regardless of the RECEIVERS 2 switch setting.

(3) Perform two-way communications on selected frequency by pressing microphone switch on control wheel to TX, or foot-operated switch to MIC, and speaking into microphone. Sidetone will be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS 2 switch set to ON, uhf signals should be heard.

c. To stop uhf command set, turn function switch on UHF control panel to OFF; set transmit-interphone switch on control panel to INT position.

5-52. UHF Command Set (AN/ARC-51X) Operation. The uhf command set used in configuration D can be operated from the pilot's or copilot's station INT panels, but there is no standby-audio in this configuration. Normal operation is described following.

a. For reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure UHF POWER, INTERPHONE, and CONTROL CKTS circuit breakers are set to ON position.

(3) On operator's INT panel, set RECEIVERS 2 switch to ON (up) position, and turn VOL control for maximum volume.

(4) On UHF control panel:

(a) Set function switch to T/R position. If it is desired to also monitor guard receiver, set function switch to T/R+ G position. Allow approximately five minutes for radio set to warm up.

Note

ADF position of function switch is used only when adf equipment is installed, and is inoperative in this configuration.

(b) Set required frequency using three frequency selectors.

(c) Turn VOL control fully clockwise for maximum volume. If necessary, adjust INT panel VOL control to obtain suitable audio level.

(d) Adjust SENS control fully counterclockwise, then clockwise until background hissing

noise is eliminated. Do not turn SENS control any further than amount required for elimination of hissing sound, otherwise weak incoming signals will not be heard.

b. For transmission, follow the procedure detailed in paragraph 5-51, step b.

c. To turn off the equipment, follow the procedure detailed in paragraph 5-51, step c.

5-53. VHF Command Set (AN/ARC-73, or -73A) Operation. The vhf command set can be operated in the standby-audio mode in configurations A, B, and C only. (Refer to paragraph 5-69.) Normal operation for all configurations is described following.

a. For normal reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure VHF RCVR, VHF XMTR, FM POWER and KEYING CIRCUITS (or INTERPHONE and CONTROL CKTS) circuit breakers are ON.

(3) On operator's INT panel, set RECEIVERS 3 switch to ON (up) position, and turn VOL control for maximum volume.

(4) On standby vhf control panel set frequency selector for standard vhf reception (STD VHF, ARC-73, or TRANS 1 as applicable).

(5) On VHF COMM control panel:

(a) Set POWER switch to ON position. Allow approximately 15 minutes for radio set to warm up.

(b) Set required frequency using two frequency selectors.

(c) Adjust SQ control fully counterclockwise, then clockwise until background hissing noise is eliminated. Do not turn SQ control any further than amount required for elimination of hissing sound, otherwise weak incoming signals will not be heard.

(d) Adjust VOL control for suitable volume level of received signal.

b. For normal transmission proceed as follows:

Caution

Do not transmit on distress frequency 121.5 mc, except in emergency.

(1) Turn on radio set, following procedure in a. above.

(2) On operator's INT panel, set TRANS (transmit-interphone) switch to position 3.

Note

When pilot's or copilot's TRANS (transmit-interphone) switch is set to position 3 vhf receiver is connected to headset regardless of RECEIVERS 3 switch setting.

(3) Perform two-way communications on selected frequency by pressing microphone switch on control wheel to TX, or foot-operated switch to MIC, and speaking into microphone. Sidetone should be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS 3 switch to ON, vhf signals should be heard.

c. To stop vhf command set, turn power switch on VHF COMM control panel to OFF; set transmit-interphone (TRANS) switch on INT panel to INT position.

5-54. Standby VHF Facility Operation. The standby vhf facility can be operated in the standby-audio mode in configurations A, B, and C only. (Refer to paragraph 5-69.) Normal operation for all configurations, is described following.

a. For standby vhf reception on omni receiver proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure EMERG (or STBY) VHF, FM POWER and KEYING CKTS (or INTERPHONE and CONTROL CKTS), and OMNI No. 2 (or VOR No. 1) circuit breakers are ON.

(3) On emergency (standby) vhf control panel, set frequency selector to one of the standby channels (not distress frequency 121.5 mc), and set power switch to ON.

(4) On applicable VHF NAV control panel set power control to ON, and set frequency control to correspond with transmitter frequency.

(5) On operator's INT panel, set RECEIVERS 3 switch ON.

(6) Listen for receiver noise and adjust SQUELCH and VOL controls on VHF NAV control panel until correct squelch setting is obtained. (Refer to paragraph 5-59.)

b. For standby vhf transmission, proceed as follows:

Caution

Do not transmit on distress frequency 121.5 mc except in emergency.

(1) Turn on radio set following procedure in a. above.

(2) On operator's INT panel, set TRANS (transmit-interphone) switch to position 3.

Note

When pilot's or copilot's TRANS (transmit-interphone) switch is set to position 3, standby vhf receiver is connected to headset regardless of RECEIVERS 3 switch setting.

(3) Perform two-way communications by pressing microphone switch on control wheel to TX, or foot-operated switch to MIC, and speaking into microphone. Sidetone should be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS 3 switch set to ON, standby vhf signals should be heard.

c. To turn off standby vhf facility:

(1) On standby VHF TRANS (or COMM) control panel, set power switch to OFF position and set frequency selector to standard vhf position.

(2) On VHF NAV control panel, set power control to OFF.

(3) Set transmit-interphone switch on INT panel to INT position.

5-55. HF Radio (AN/ARC-59) Operation. The hf radio (when installed in configurations A and B only) can be operated in the standby audio mode. (Refer to paragraph 5-69.) Normal operation is described following.

a. For reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure that HF POWER, FM POWER, KEYING CKTS, HF XMTR, and HF RCVR circuit breakers are on.

(3) On operator's INT panel, set RECEIVERS 2 switch to ON (up) position, and turn VOL control clockwise.

(4) On sliding console, set UHF-HF SELECT switch to HF position, and set HF panel controls as follows:

(a) Set POWER switch to ON position.

Note

Allow 15 minutes for radio set to warm up.

(b) Set function switch to PH position.

(c) Set CHAN selector to desired operating channel. Allow approximately 10 seconds for channel selector tuning mechanism to operate.

Note

Label mounted beside UHF-HF SELECT switch lists preset frequencies of 20 channel numbers.

(5) Listen for receiver noise and adjust VOL control for comfortable audio level.

b. For voice transmission (cw is not connected) proceed as follows:

(1) Turn on radio set following procedure in a. above.

(2) On operator's INT panel, set TRANS (transmit-interphone) switch to position 2.

Note

When pilot's or copilot's TRANS switch is set to position 2, hf receiver is connected to headset regardless of RECEIVERS 2 switch setting.

(3) Perform two-way communications on selected frequency by pressing microphone switch on control wheel to TX, or foot-operated switch to MIC, and speaking into microphone. Sidetone should be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS 2 switch set to ON, hf signals should be heard.

c. To stop hf radio set:

(1) On HF control panel set POWER switch to OFF position.

(2) Set UHF-HF SELECT switch to UHF position.

(3) Set TRANS switch on INT panel to INT position.

5-56. HF Radio (AN/ARC-102) Operation. The hf radio set (when installed) in configurations A, B, and C only can be operated in the standby-audio mode. (Refer to paragraph 5-69.) Normal operation, for all configurations, is described following.

a. For normal reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure HF POWER, FM POWER and KEYING CKTS (configurations A, B, and C), INTERPHONE and CONTROL CKTS (configuration D) circuit breakers are on.

(3) On operator's INT panel; on configurations A, B, and C set RECEIVERS 2 switch to ON (up) position and on configuration D set RECEIVERS 4 switch to ON (up) position.

(4) On sliding console panel of configurations A, B, and C set UHF-HF SELECT switch to HF position.

(5) On HF (ssb) control panel:

(a) Set function switch to USB, LSB, or AM position, then allow several minutes for radio set to warm up.

(b) Tune desired operating frequency using four frequency selector knobs.

(c) Adjust RF SENS control for desired sensitivity or background noise level by rotating it fully counterclockwise, then clockwise until background hissing noise is almost eliminated.

b. For voice transmission (cw is not connected) proceed as follows:

Caution

Do not transmit when flying aircraft at or near stall threshold, as this will prevent stick-shakers and short-field approach speed indicator from functioning.

(1) Turn on hf radio set, following procedure in a. above.

(2) On operator's INT panel; in configurations A, B, and C, set TRANS (transmit-interphone) switch to position 2; in configuration D, set transmit-interphone switch to position 4.

Note

When pilot's or copilot's transmit-interphone switch is set as in step (2), hf receiver is connected to headset regardless of RECEIVERS switch setting.

(3) Perform two-way communications on selected frequency by pressing microphone switch on control wheel to TX, or foot-operated switch to MIC, and speaking into microphone. Sidetone should be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS switch (2 or 4 as applicable) set to ON, hf signals should be heard.

c. To turn off hf-ssb radio:

(1) On HF (ssb) control panel, set function switch to OFF.

(2) In configurations A, B, and C, set UHF-HF SELECT switch to UHF.

(3) Set transmit-interphone switch on INT panels to INT position.

5-57. FM Liaison Radio (AN/ARC-44) Operation. The fm liaison radio can only be operated in the normal mode (no standby-audio mode is available).

a. For reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure FM POWER and KEYING CKTS configurations A, B, and C), or INTERPHONE and CONTROL CKTS (configuration D), circuit breakers are on.

(3) On operator's INT panel, set RECEIVERS 1 switch to ON (up) position, and turn VOL control for maximum volume.

(4) On FM control panel:

(a) Set power switch to ON position.

Note

Allow approximately two minutes for radio set to warm up. A 400-cycle signal may be heard in headphones, lasting approximately six seconds.

(b) Set REM LOCAL switch to LOCAL position.

(c) Set required frequency by using two frequency selectors.

(d) Turn VOL control for maximum volume. If necessary, adjust INT panel VOL control to obtain suitable audio level.

(e) On FM squelch control panel (applicable to configuration) select squelch switch to unsquelch receiver and listen for characteristic receiver noise. Operate squelch switch and squelch receiver.

b. For transmission, proceed as follows:

(1) Turn on radio set, following procedure in a. above.

(2) On operator's INT panel, set TRANS (transmit-interphone) switch at position 1.

Note

When pilot's or copilot's TRANS (transmit-interphone) switch is set to position 1 fm receiver is connected to the headset regardless of RECEIVERS 1 switch setting.

(3) Perform two-way communications by pressing microphone switch on control wheel to TX, or foot switch to MIC, and speaking into microphone. Sidetone should be heard in operator's headset while transmitting. Release microphone switch for reception; clear signals should be heard.

(4) On INT panels at other stations, with RECEIVERS 1 switch set to ON, fm signals should be heard.

c. To turn off fm liaison radio:

(1) On FM control panel set power switch to OFF position.

(2) Set TRANS (transmit-interphone) switch on INT panel to INT position.

Note

In configurations A, B, and C, fm dynamotor remains on, to supply interphone system, even when fm radio is switched off.

5-58. OMNI Radio Set (AN/ARN-30D or-30E). Operating Modes. The omni radio set can be operated as a communications receiver (refer to paragraph 5-54), or as a navigational receiver. The navigational data can be used to perform the following:

a. Determine bearing of aircraft with respect to vor station.

b. Fly desired course to or from vor station.

c. Fly to objective other than vor station.

d. Make approximate groundspeed checks.

e. Fly to intersection of localizer and vor signal.

f. Approach runway associated with vor or localizer station.

5-59. Omni receiver operation. Refer to paragraph 5-54 for operating procedure using the omni receiver for standby vhf communications.

a. For reception in the omni mode, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure OMNI 1 (or VOR 1), OMNI 2 (or VOR 2), FM POWER and KEYING CKTS (or INTERPHONE and CONTROL CKTS) circuit breakers are ON.

(3) On operator's INT panel, set RECEIVERS NAV switch to ON; turn VOL control clockwise.

(4) On pilot's and copilot's VHF NAV (omni) control panels, turn VOL-OFF control clockwise; set frequency selectors to desired frequency (for communications or navigational mode) and allow approximately one minute for equipment to warm up.

(5) Turn SQUELCH control fully counterclockwise then clockwise until background noise is eliminated. Do not turn control any further than is necessary to eliminate hissing noise, or weak signals may not be heard.

(6) Listen for identifying signal from vor station and insure correct station is tuned in.

b. To determine bearing of aircraft with respect to vor station, proceed as follows:

(1) Perform starting procedure and tune in desired vor station as in step a. above.

(2) On associated course selector-indicator check that vertical pointer flag alarm disappears and TO-FROM meter reads TO or FROM.

Caution

If vertical flag alarm fluctuates or is visible, or TO-FROM meter does not indicate, bearings are unreliable.

(3) Rotate course selector knob until vertical pointer is centered and read bearing to which pointer is pointing; note reading TO or FROM for bearing of aircraft relative to vor station.

(4) On pilot's course indicator (ID-998/ASN) set ADF-VOR switch to VOR (in configuration B) and read vor bearing from No. 2 omni radio on No. 1 pointer; read same bearing on copilot's indicator (ID-250/ARN) No. 1 pointer; bearing on No. 2 pointer of both indicators is from No. 1 omni radio (this is not affected by ADF-VOR switch).

(5) In configurations C and D, set ADF-VOR switch on pilot's indicator (ID-998/ASN) to VOR; set ADF-VOR switch on copilot's flight instrument panel to VOR. Reading on No. 1 pointer of both indicators are bearings from No. 1 omni radio set; reading on No. 2 pointers on both indicators are from No. 2 omni radio (not affected by ADF-VOR switches).

c. To fly course to or from vor station, proceed as follows:

(1) Perform starting procedure and tune in desired vor station as in a. above.

(2) On course selector-indicator, check that vertical pointer flag alarm disappears and TO-FROM meter indicates TO or FROM.

(3) Rotate course selector knob until pointer points to desired course; check that TO-FROM meter has required reading for direction of flight.

(4) Turn aircraft until magnetic heading is same as bearing established in step (3); check TO-FROM meter and observe vertical pointer.

(5) On pilot's course indicator (C6A), in configuration A; check magnetic heading of aircraft is same as desired course and course selector-indicator bearing. On pilot's course indicator (C6H), in configurations B, C, and D, set ADF-VOR switch to VOR; check that magnetic heading, course selector-indicator bearing, and desired course are the same. (This step can also be performed using copilot's indicator (ID-250/ARN) and second omni radio.)

(6) Position aircraft on desired course by flying toward pointer on course selector-indicator, keeping pointer centered. Avoid overcorrecting.

(7) Fly desired course to vor station and watch for following indications that aircraft has arrived over station:

(a) Audio signal increases in volume and may be distorted.

(b) Vertical pointer swings abruptly from side to side.

(c) Vertical pointer flag alarm may fluctuate rapidly.

(d) TO-FROM meter will fluctuate then change sign.

Warning

Vor approach must be authorized and performed in accordance with published information.

d. To fly to objective other than vor station, proceed as follows:

(1) Perform starting procedure and tune in desired vor station as in step a. above.

(2) Determine magnetic bearing of objective from two closest vor stations.

(3) Fly desired course to or from one of the two vor stations as in step d. above; check vertical pointer frequently to stay on course.

(4) Using second set, tune to second vor station; rotate second course selector knob so that pointer is pointing to second vor station bearing; vertical pointer will swing to side of course selector-indicator on which vor station is located.

(5) Maintain course to first vor station, and when vertical pointer on second vor station centers, aircraft is over objective.

e. To make approximate groundspeed checks, proceed as follows:

(1) Perform starting procedure and tune in desired vor station as in step a. above.

(2) Chart desired course of flight in relation to a vor station.

(3) Set and fly desired course as in d. above; adjust heading to keep vertical pointer centered.

(4) Determine bearing of second vor station and mark position on chart. At end of a selected period of time, again determine bearing of second station and mark position on chart.

(5) Compute groundspeed by dividing distance between position marked in steps (3) and (4) by time period selected.

f. To fly to intersection of localizer and vor signals, proceed as follows:

(1) Perform starting procedure and tune in desired vor station as in step a. above.

(2) Determine magnetic bearing of intersect of localizer beam and vor station by referring to appropriate navigation map.

(3) Set and fly course to correspond to bearing of intersect point relative to vor station as in step d. above.

(4) Tune omni radio to localizer frequency as localizer station radio beam is approached; check vertical pointer on course-selector indicator; when center of beam is reached vertical pointer centers and intersection is reached.

g. To approach runway associated with vor or localizer station, proceed as follows:

(1) Perform starting procedure, to tune in desired localizer station as in step a. above.

(2) On course selector-indicator check that vertical flag alarm has disappeared.

(3) Perform preliminary flight procedures as specified in published information for approach being made.

(4) Fly toward pointer and check that when vertical pointer is to left of center (blue area on dial) a 150-cycle tone is heard in headset, and when pointer is to right of center (yellow area on dial) a 90-cps tone is heard in headset; make small heading changes in heading (2.5° from center of beam will cause full-scale deflection on pointer).

(5) Maintain course that keeps vertical pointer centered to make approach.

Note

On back course approach pointer indications are opposite to front course approach in step (4) above.

h. To turn off omni radio, set power control on VHF NAV (omni) control panel to OFF.

5-60. ADF Radio Set (AN/ARN-59) Operation. The adf radio set can be operated as a communications receiver for broadcast reception, or as a navigation receiver for homing or relative bearing information.

a. For broadcast reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure ADF No. 1, ADF No. 2 (if installed), FM POWER and KEYING CKTS (configurations A, B, and C), INTERPHONE and CONTROL CKTS (configuration D) circuit breakers are on.

(3) On operator's INT panel, set RECEIVERS NAV switch to ON (up) position, and turn VOL control for maximum volume.

(4) On ADF REC control panel:

(a) Turn VOL-OFF control clockwise to apply power to receiver, and adjust volume until background hissing noise is heard, allow approximately 30 seconds for radio set to warm up.

(b) Set function switch to ANT position.

(c) Set MC BAND switch to required frequency band.

(d) Rotate tuning crank until required operating frequency is indicated in frequency window. Tune for maximum meter deflection by slowly rotating tuning crank in vicinity of required frequency.

b. For automatic direction finding (radio compass) operation, proceed as follows:

(1) Perform starting procedure and tune in desired radio station as in a. above.

(2) Set function switch on ADF REC control panel to COMP; set BFO switch to ON.

(3) Check reading on pilot's and copilot's course indicators as follows:

(a) In configuration A, No. 1 and No. 2 pointers on both indicators give bearing of No. 1 adf. When second adf set is installed, No. 1 pointer of both indicators read No. 1 adf, and No. 2 pointer reads No. 2 adf.

(b) In configuration B, No. 1 pointer of both indicators read No. 1 adf bearing when ADF-VOR on pilot's indicator is set to ADF. No. 2 pointer on both indicators read No. 2 adf (when installed) (not affected by ADF-VOR switch).

(c) In configurations C and D, No. 1 pointer of pilot's indicator reads No. 1 adf when ADF-VOR switch on pilot's indicator is set to ADF; No. 1 pointer of copilot's indicator reads No. 1 adf when ADF-VOR switch on copilot's flight instrument panel is set to ADF; No. 2 pointer on both indicators read No. 2 adf (when installed) (not affected by ADF-VOR switches).

(4) Turn aircraft to heading that causes pointer on course indicator to swing to 0° position, adjust for drift if necessary and home on station.

c. For magnetic bearing determination by aural null method, proceed as follows:

(1) Perform starting procedure and tune in desired station as in step a. above.

(2) Set function switch to LOOP; set BFO switch to ON.

(3) Turn loop antenna by switching LOOP L-R switch to left or right until signal fades out (aural null); continue rotating loop until second aural null is obtained (180° from first null). Check bearing on pilot's course indicator or copilot's indicator (refer to step b. (3) above) and determine which is bearing and which is reciprocal.

(4) To determine which is bearing and which is reciprocal when general location is not known, proceed as follows:

(a) Turn aircraft to heading on which null is heard, and note heading.

(b) Turn aircraft 90° to left and maintain heading for five minutes (approximately).

(c) Turn aircraft back to heading noted in step (a).

(d) Rotate loop left or right with LOOP L-R switch and note in which direction least rotation produces null. When least rotation is to left, aircraft is flying from station; when least rotation is to right, aircraft is flying to station.

d. To turn off adf receiver, set power control on ADF REC control panel to OFF.

5-61. Glide Slope Receiver (R-746/AR) Operation (Configurations A and B). The glide slope receiver is normally operated in conjunction with the omni radio set. Refer to paragraph 5-59 for omni reception.

a. For glide slope receiver operation, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure GLIDE SLOPE circuit breaker is ON.

(3) On GLIDE SLOPE control panel, turn power switch ON and set frequency selector to correspond with localizer frequency set on VHF NAV (omni) control panel.

(4) On course-selector indicator check for indication on horizontal pointer.

b. To turn off glide slope receiver, set power switch to OFF.

5-62. Glide Slope Receiver (AN/ARA-54) Operation (Configuration C). The glide slope receiver normally operates in conjunction with No. 1 omni radio set. Refer to paragraph 5-59 for omni receiver operation.

a. For glide slope receiver operation, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure GLIDE SLOPE circuit breaker is ON.

(3) On MKR G/S control panel, set G/S power switch to ON.

(4) On No. 1 VHF NAV (omni) control panel, set frequency selector to localizer frequency. (This automatically sets glide slope receiver frequency.)

(5) On course selector-indicators check for indication on horizontal pointer.

b. To turn off glide slope receiver, set power switch on MKR G/S control panel to OFF, set power switch on omni control panel to OFF.

5-63. Marker Beacon and Glide Slope Receiver (AN/ARN-58) Operation (Configuration D). The glide slope receiver section of the combined marker beacon and glide slope receiver normally operates in conjunction with No. 1 omni radio set. Refer to paragraph 5-59 for omni receiver operation.

a. For glide slope receiver operation, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure G/S MKR, INTERPHONE and CONTROL CKTS are ON.

(3) On MKR G/S control panel, turn power switch ON.

(4) On No. 1 VHF NAV (omni) control panel, set frequency selector to localizer frequency. (This automatically sets glide slope receiver frequency and turns glide slope receiver ON.)

(5) On course selector-indicators, check for indication on horizontal pointer.

b. For marker beacon receiver operation, proceed as follows:

(1) Perform steps (1) through (3) detailed in step a. above.

(2) On operator's INT panel set RECEIVERS NAV switch ON; turn VOL control clockwise.

(3) On MKR G/S control panel set SENS switch to HI or LO for sensitivity as required, turn VOL control clockwise.

(4) Press MKR indicator light on pilot's flight instrument panel, to test light.

(5) When aircraft is over marker beacon, MKR indicator will light; identification signal will be heard in headset.

c. To turn off marker beacon and glide slope receiver, set power switch on MKR G/S control panel to OFF; set power switch on No. 1 VHF NAV (omni) control panel to OFF.

5-64. Marker Beacon Receiver (AN/ARN-32) Operation (Configuration A). The marker beacon receiver in configuration A can be operated in the normal or standby-audio mode. (Refer to paragraph 5-69 for standby-audio operation.)

a. For normal reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure MKR BEACON, FM POWER, and KEYING CKTS circuit breakers on electronics circuit breaker panel are on.

(3) On operator's INT panel, set RECEIVERS MB switch to ON (up) position; turn VOL control clockwise.

(4) On MARKER BEACON control panel, turn VOL-OFF control fully clockwise.

(5) Place SENS switch to HI or LO to provide high or low sensitivity as required.

(6) On pilot's flight instrument panel press MKR beacon light to test illumination of indicator lamp.

(7) When aircraft is flown over marker beacon transmitter MKR light will come on and audio identification signal will be heard in headset. Adjust MARKER BEACON control panel VOL control to obtain desired audio level of signals.

b. To turn off marker beacon facility turn MARKER BEACON control panel VOL-OFF control fully counterclockwise to OFF position.

5-65. Marker Beacon Receiver (R-1041/ARN) Operation (Configurations B and C). The marker beacon receiver in configurations B and C can be operated in the normal or standby-audio modes. Refer to paragraph 5-69 for standby-audio operation.

a. For normal reception, proceed as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure MKR BEACON, FM POWER and KEYING CKTS circuit breakers on electronics circuit breaker panel are on.

(3) On operator's INT panel, set RECEIVERS MB switch to ON position; turn VOL control clockwise.

(4) On MKR control panel, turn VOL control clockwise; set SENS switch to HI or LO for desired sensitivity.

(5) Press MKR indicator light on pilot's flight instrument panel to test light.

(6) When aircraft is flown over marker beacon transmitter, MKR indicator light will come on; identification signal will be heard in headset.

b. To turn off marker beacon receiver, turn power control on MKR control panel to OFF.

5-66. IFF Transponder Set (AN/APX-44) Operation. The iff transponder set can be operated in normal iff, sif, civil, i/p, and emergency modes, as described following.

a. The starting procedure for all modes of operation is as follows:

(1) Perform preliminary starting procedure. (Refer to paragraph 5-47 or 5-48.)

(2) Insure IFF APX-44, FM POWER and KEYING CKTS (or INTERPHONE and CONTROL CKTS) circuit breakers are on.

(3) On operator's INT panel, set TRANS (transmit-interphone) to position 2.

(4) On XPDR control panel:

(a) Turn master switch to STBY position. Pilot light should come on.

Note

If pilot light does not come on, press test button. If light does not come on, either light is burned out or power is not reaching transponder set.

(b) Adjust lens shutter for pilot light brilliance.

(c) Allow three to five minutes for transponder set to warm up.

b. For normal operation, set XPDR panel controls as follows:

Note

When function control is at NORMAL position all preset code combinations are disabled in all modes and a standardized reply will be automatically transmitted when interrogated.

(1) Mode 1 operation.

(a) Function switch to NORMAL.

(b) Master switch to LOW or NORM as required.

(c) MODE 2 switch OFF.

(d) MODE 3 switch OFF.

(e) I/P switch (refer to step e.).

(2) Combined Modes 1 and 2.

(a) Function switch to NORMAL.

(b) Master switch to LOW or NORM as required.

(c) MODE 2 switch ON.

(d) MODE 3 switch OFF.

(e) I/P switch (refer to step e.).

(3) Combined Modes 1 and 3.

(a) Function switch to NORMAL.

(b) Master switch to LOW or NORM as required.

(c) MODE 2 switch OFF.

(d) MODE 3 switch ON.

(e) I/P switch (refer to step e.).

(4) Combined Modes 1, 2, and 3.

(a) Function switch to NORMAL.

(b) Master switch to LOW or NORM as required.

(c) MODE 2 switch ON.

(d) MODE 3 switch ON.

(e) I/P switch (refer to step e.).

c. For operation in the selective identification feature (sif) mode, set XPDR panel controls as follows:

(1) Mode 1.

(a) Function switch to MOD.

(b) MODE 1 code control to assigned two-digit code number.

(c) Master switch to LOW or NORM as required.

(d) MODE 2 switch OFF.

(e) MODE 3 switch OFF.

(f) I/P switch (refer to step e.).

(2) Combined Modes 1 and 2.

(a) Function switch to MOD.

(b) MODE 1 code control to assigned two-digit code number.

(c) MODE 2 switch ON.

(d) Master switch to LOW or NORM as required.

(e) MODE 3 switch OFF.

(f) I/P switch (refer to step e.).

(3) Combined Modes 1 and 3.

(a) Function switch to MOD.

(b) MODE 2 switch OFF.

(c) MODE 3 switch ON.

(d) MODE 1 code control to assigned two-digit code number.

(e) MODE 3 code control to assigned two-digit code number.

(f) Master switch to LOW or NORM as required.

(g) I/P switch (refer to step e.).

(4) Combined Modes 1, 2, and 3.

(a) Function switch to MOD.

(b) MODE 1 code control to assigned two-digit code number.

(c) MODE 2 switch ON.

(d) MODE 3 switch ON.

(e) MODE 3 code control to assigned two-digit code number.

(f) Master switch to LOW or NORM as required.

(g) I/P switch (refer to step e.).

d. When the function switch is set to CIVIL position, all other operations remain the same as in step d. above. Additional reply information necessary for compatability with civil interrogations is automatically inserted by transponder set.

e. Aircraft position identification i/p signals can be transmitted to ground-based iff systems in response to normal iff interrogations (transponder must be interrogated). This type of operation is initiated by the pilot only when directed through aircraft communications set to identify position or upon arrival at pre-established i/p check points. To transmit i/p signals, proceed as follows:

(1) Momentarily hold I/P switch in I/P position.

(2) Release I/P switch. Spring-loaded switch will return to OFF position.

Note

Transponder will transmit i/p signals for approximately 30 seconds. This is normally sufficient time for ground-based control to identify aircraft's position. During this 30-second period it is normal procedure to acknowledge through aircraft communications set that i/p signals have been generated.

Caution

Do not place I/P switch in MIC position. This position is provided to permit transmission of i/p signals by depressing hand- or foot-operated microphone switch to TX or MIC position respectively; however this type of operation is not reliable, as under certain conditions no i/p signals will be generated or i/p signals will be inadvertently transmitted.

f. During flight emergency or distress condition, transponder set may be used to transmit specially coded emergency signals. These emergency signals are automatically set up and will be transmitted provided transponder set master switch remains in EMER position after transponder set is interrogated by ground-based iff system. These emergency signals will be transmitted automatically, regardless of any mode and function combination previously set up, and will provide

indications to the ground-based iff system that aircraft is in an emergency or distress condition. For operation in the emergency mode, proceed as follows:

(1) Depress and hold in emergency barrier.

(2) Turn master switch to EMER position.

(3) Release emergency barrier.

(4) Permit master switch to remain in EMER position for duration of emergency condition.

(5) When emergency condition is finished, return master switch to LOW or NORM position as required.

g. To stop transponder, set master switch on XPDR control panel to OFF position.

5-67. Emergency Operation. For emergency operation proceed as follows:

a. In the event of complete generator power failure, deenergize nonessential avionics circuits by means of individual remote control panel power controls, or circuit breakers on the electronics circuit breaker panel. Place emergency bus switch in EMERG position, and battery master switch in OFF position to energize emergency bus from battery; this isolates the main bus and conserves battery power.

b. To remove power from all avionics equipment, place all circuit breakers on the electronics circuit breaker panel in the deenergized position.

c. When one or more communication or navigation facilities fail, an alternate facility can be employed. Table 5-19 lists the facilities and alternate facility, and special considerations if a facility fails. Except for operation in emergency standby-audio mode (paragraph 5-69) and the possible substitution, as listed in table 5-19 there are no emergency methods of operation in case of circuit failure during flight.

5-68. Emergency communication channels. Transmission and reception through the uhf emergency channel is possible with the uhf command set AN/ARC-55B, or -51X. The channel set aside for this purpose is 243.0 mc. Except for emergency purposes, no transmission is to be made on this channel. Reception on this channel is automatic when the UHF control panel function switch is placed in T/R+G REC position. Reception on this channel does not affect operation of the uhf command set main receiver. The emergency vhf channel is 121.5 mc. This can be obtained on the vhf command set, when installed as an alternative to the uhf command set, and also on the standby set.

5-69. Standby-audio operation. An emergency standby audio system is provided on configurations A, B, and C in the event that the fm dynamotor or INT panel (SB-329/AR) fails. The receiver and microphone audio circuits bypass the INT panels but the desired transmitter must be selected by the TRANS (transmit-interphone) switch on the INT panel for uhf, hf, vhf (standard or standby) transmission. Communication through the fm liaison radio set is not possible. During emergency standby-audio operation, only the facility required should be turned on and the volume level adjusted by means of its control panel volume control. Interphone is available between the pilot and copilot only, in the standby-audio mode. For standby-audio operation proceed as follows:

a. Switch OFF FM POWER circuit breaker.

b. Switch OFF all facilities not required.

c. Set TRANS (transmit-interphone) switch on INT panel to position 2, or 3 as required for uhf or hf, vhf (standard or standby) operation.

d. Operate communications transmitter and receiver normally, but control receiver volume by its own control panel volume control (INT panel volume control is out of circuit).

e. Operate navigation receiver normally, but control volume by its own volume control (INT panel is out of circuit).

f. Switch OFF facility when not required.

Section VII

Inspections

5-70. General. The following inspections supplement procedures in the pilot's preflight checklist. The inspection consists of checking the avionics configuration for flight preparedness by performing a visual inspection and an operational test to discover defects and maladjustments. Inspections should be accomplished prior to the first flight of the day. The pilot or copilot should report any malfunctions or discrepancy noted in preflight inspection on DD Forms 7-1-1 and -2.

5-71. Preflight Inspection, Power Off. A power-off inspection of avionics equipment is part of the flight compartment Interior Inspection in paragraph 3-12 and consists of making sure all radio switches are off.

5-72. Operational Checks, Power On. The operational checks of the avionics equipment configuration with power on are contained in paragraphs 5-50 through 5-66. Communications equipment should be checked for, clarity of sidetone and received signals, quality and strength of transmission. Navigation equipment should be checked for reception only, on the ground, since transmitted signals on the ground are unreliable.

5-73. Flight Checks. Checks on navigation equipment should be performed as soon as practicable when airborne. Refer to paragraphs 5-59 through 5-65.

Section VIII

Operation of Avionics Equipment in Conjunction With Other Items

5-74. J-2 Compass System. The J-2 compass system provides magnetic heading information to the pilot's course indicator (C6A, or ID-998/ASN), for use with the radio navigation system. The magnetic heading is transmitted from the pilot's course indicator to the copilot's radio magnetic indicator (ID-250/ARN) which is also used with the radio navigation system. The J-2 compass system can be used as a free gyro, or a slaved gyro-magnetic compass. The GYRO COMPASS switch on the pilot's flight instrument panel must be set to the SLAVE position to slave the compass card on the pilot's course indicator to the magnetic heading. In the DG position the indicator acts as a directional gyro. During DG operation the indicator will require periodic checking to compensate for precession.

5-75. The J-2 compass system is supplied with power from the aircraft inverter (MAIN or STBY) and the inverter instrument transformer. Two inverters are installed and the standby inverter is brought into operation automatically in event of main inverter failure. The instrument transformer is manually switched from main to standby. The J-2 compass system is brought into operation in the preliminary starting procedures. (Refer to paragraphs 5-47 and 5-48.)

CHAPTER 6
AUXILIARY EQUIPMENT

Section I

Scope

6-1. This chapter includes the description, normal operation, and emergency operation of all equipment not directly contributing to flight but which enables the aircraft to perform certain specialized functions.

6-2. Exceptions to the foregoing are electronic navigation and communication equipment, cargo loading, troop, passenger and casualty carrying equipment, which are covered in other chapters.

Section II

Heating and Ventilating Systems

6-3. General. The flight compartment and cabin are each provided with a flight and ground operable heating system. The ducting and outlets of each system can also be used for ventilation on the ground and in flight provided its heater is not in operation. Each system consists of a combustion heater with the necessary components and ducting controls to regulate the temperature inside the flight compartment and cabin within a range of 40° to 80° F. Within each system are fans, recirculation ducts, and air selector valves to provide for ground operation; and an outlet from the cabin heating system provides hot air for preheating the engines on the ground. The electrical controls for each heater are on a panel mounted on the forward face of the bulkhead behind the pilot. Fuel for both heaters is provided from the fuel tank in the right-hand wing by an electrically driven fuel pump outboard of the engine nacelle. DC power for each temperature control system, and ground operation provision, is supplied from the secondary bus through push-to-reset circuit breakers, and through a switch-type circuit breaker for each heater fuel control system. Provision is made for hot-day ram air ventilation of the flight compartment and cabin. A fan air pressure switch which is operated by ram air from the copilot's pitot pressure line, serves both the flight compartment and cabin heating systems. In the cabin system the air selector valves are moved automatically to their ground or flight position by an electrical actuator operated by the fan air pressure switch. In flight the pressure switch maintains the combustion air fan and the ventilating air fan inoperative in both systems. The cabin heater mixing valve can be controlled manually in the event of malfunction of the automatic control circuit.

6-4. Flight Compartment Heating System. The flight compartment 50,000 BTU combustion heater, consuming 0.66 gallon of fuel per hour maximum, is mounted in the nose section of the fuselage and is accessible through a removable panel forward of the windshield. The left- and right-hand ram air ducts in the nose of the fuselage have 20- and 10-ampere electrically heated anti-icing intakes respectively, and both are powered from the secondary bus through the 25-ampere push-to-reset circuit breaker. They are both controlled by the 5-ampere switch-type circuit breaker, under the INTAKE ANTI-ICING marking, on the lower section of the heating control panel (figure 6-2). The left-hand duct supplies ram air, in flight, to the heater combustion chamber where it mixes with fuel and is ignited by a spark plug, current for which is supplied through normal or standby vibrator contacts in an ignition unit. The products of combustion flow through heat exchanger passages and are exhausted to atmosphere. The right-hand duct supplies ventilating ram air, in flight, which is passed over the hot walls of the heat exchanger; the resulting warmed air being distributed to ten outlets in the flight compartment. An air control handle and an air selector handle on the pilot's pedestal mechanically actuate valves in the heater outlet ducts and the ventilation ram duct. A microswitch is actuated when the

air control valve is in its fully closed position and deenergizes the heater electrical system. The air selector valve closes the ram air intake and energizes a fan for ground operation of the system. During ground operation of the heater, combustion ram air is drawn through the left-hand duct and is supplied to the heater combustion chamber by a fan in the heater intake duct, while ventilating ram air is drawn from the flight compartment by a fan in the air return duct, and is recirculated over the hot walls of the heat exchanger and fed to the compartment outlets. (See figure 6-1.)

6-5. Temperature control system. The temperature control system of the heater is automatic and consists of a heater outlet duct thermostat, compartment thermostat, temperature selector, and a temperature control box. Compartment temperature is automatically controlled at the setting of the temperature selector, and any variation is sensed by the compartment thermostat located at the rear of the overhead console, and by the heater outlet duct thermostat. Variations are signalled through the temperature control box to cycle the temperature control solenoid of the fuel control unit. The heater outlet duct thermostat is complementary to the compartment thermostat, anticipating temperature variations and providing fast response and more accurate temperature control. Heater output temperature is also determined by the amount of combustion ram air regulating the metering of the fuel to the heater fuel spray nozzle. This is accomplished by means of a sensed pressure difference between heater inlet and exhaust, thus controlling a fuel metering valve in the fuel control unit. The heater is protected from excessive operating temperatures by a cycling thermal switch and a high limit thermal switch in the heater outlet duct. The cycling switch, in conjunction with a relay, operates the cycling solenoid in the fuel control unit to restrict the continuous operating temperature to a maximum of 250° F. The high limit switch operates at 350° F to energize the heater electrical system should the cycling switch malfunction. A further safeguard is provided by a fire detecting element in the heater outlet duct which will illuminate the fire warning red light on the left side of the emergency panel if the temperature rises to 550° F.

6-6. Preparation for operation. Before the heater can be started on the ground or in flight, the following conditions must exist:

a. The cockpit air control handle on the pilot's pedestal must be pushed fully in (open).

b. The cockpit air selector handle on the pilot's pedestal must be positioned for ground or flight operation as appropriate.

c. A combustion ram air pressure equivalent to approximately 80 knots IAS must be sensed by the ram air pressure switch.

d. The heater discharge temperature must be less than 350° F.

Provided these conditions exist when the master switch and fuel pump switch are selected on, then the heater will start operating when the start switch is depressed; the start switch indicator light will illuminate to show that the system is energized.

6-7. Heater Controls. The lower section of the heating control panel (figure 6-2), on the bulkhead behind the pilot's seat, is marked COCKPIT HEAT & VENTILATION and contains the switches and controls necessary for operation of the flight compartment heater, and for control of the heater intake anti-icing elements.

6-8. Heater fuel pump switch. The heater fuel pump two-position switch is marked FUEL and OFF at its up (on) and down position respectively. The switch controls the electrical circuit of the fuel pump in the right wing, which supplies fuel to both the flight compartment and cabin heaters.

6-9. Heater ignition switch. The heater ignition switch is of the toggle type and has two positions, marked EMERG and NORMAL at its up and down positions respectively. At the NORMAL position, the system ignition unit normal vibrator contacts are selected. In the event of failure of the normal vibrator contacts, as indicated by a fall in flight compartment temperature, standby vibrator contacts are brought into use by moving the switch to EMERG. Failure of the normal vibrator contacts should be reported after flight.

6-10. Heater master switch. The heater master two-position toggle switch is marked MASTER SWITCH at its up (on) position. The switch controls the dc power from the secondary bus to the heater and fuel control system.

6-11. Heater start switch. The heater start push-type switch is marked PUSH TO START and controls the electrical power to a hold-in relay supplying the heater ignition unit electrical circuit. A light in the switch will illuminate when the circuit is energized. The master switch must be at the up (on) position before the start switch is depressed.

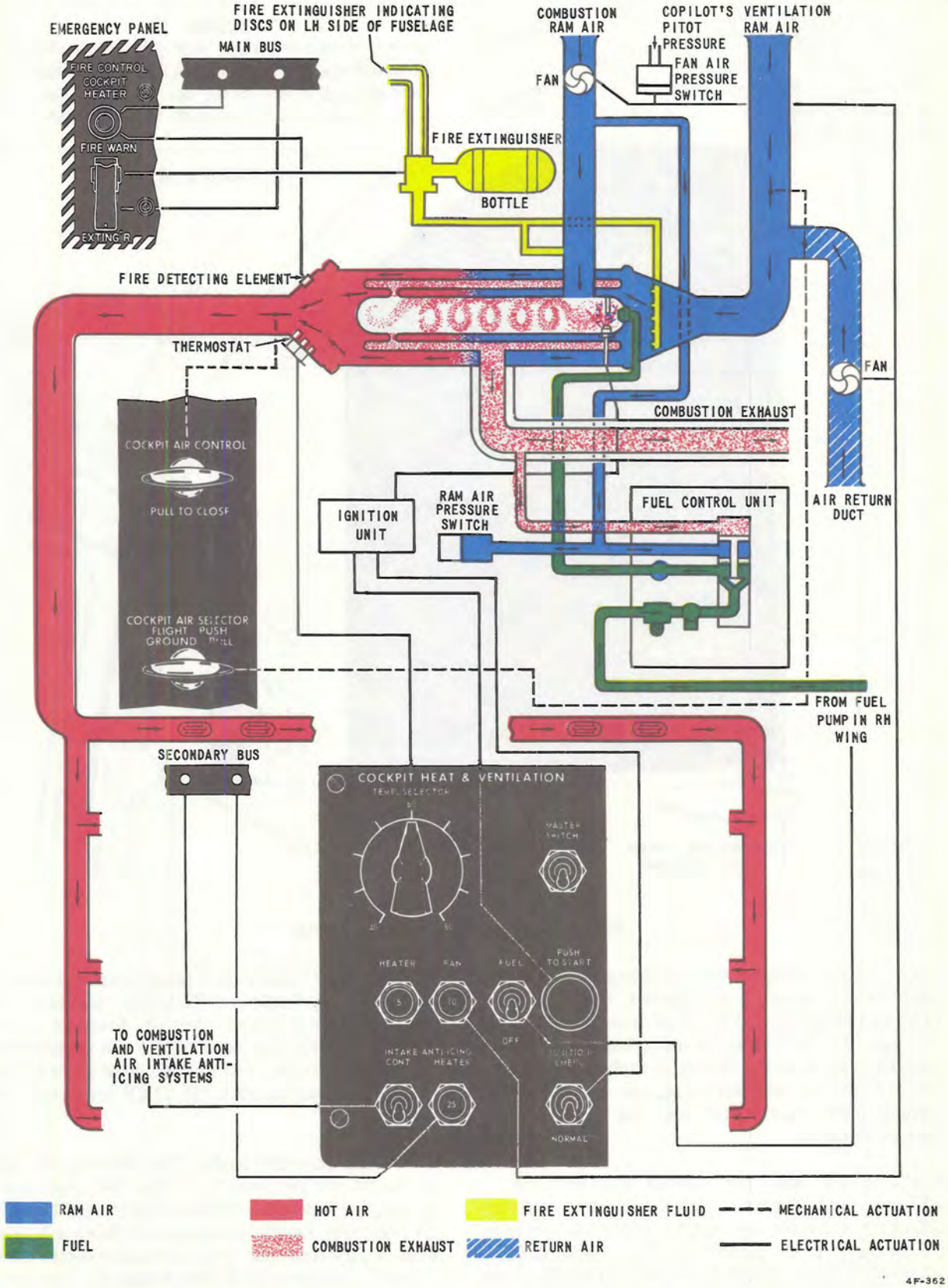


Figure 6-1. Flight compartment heating and ventilating system - schematic

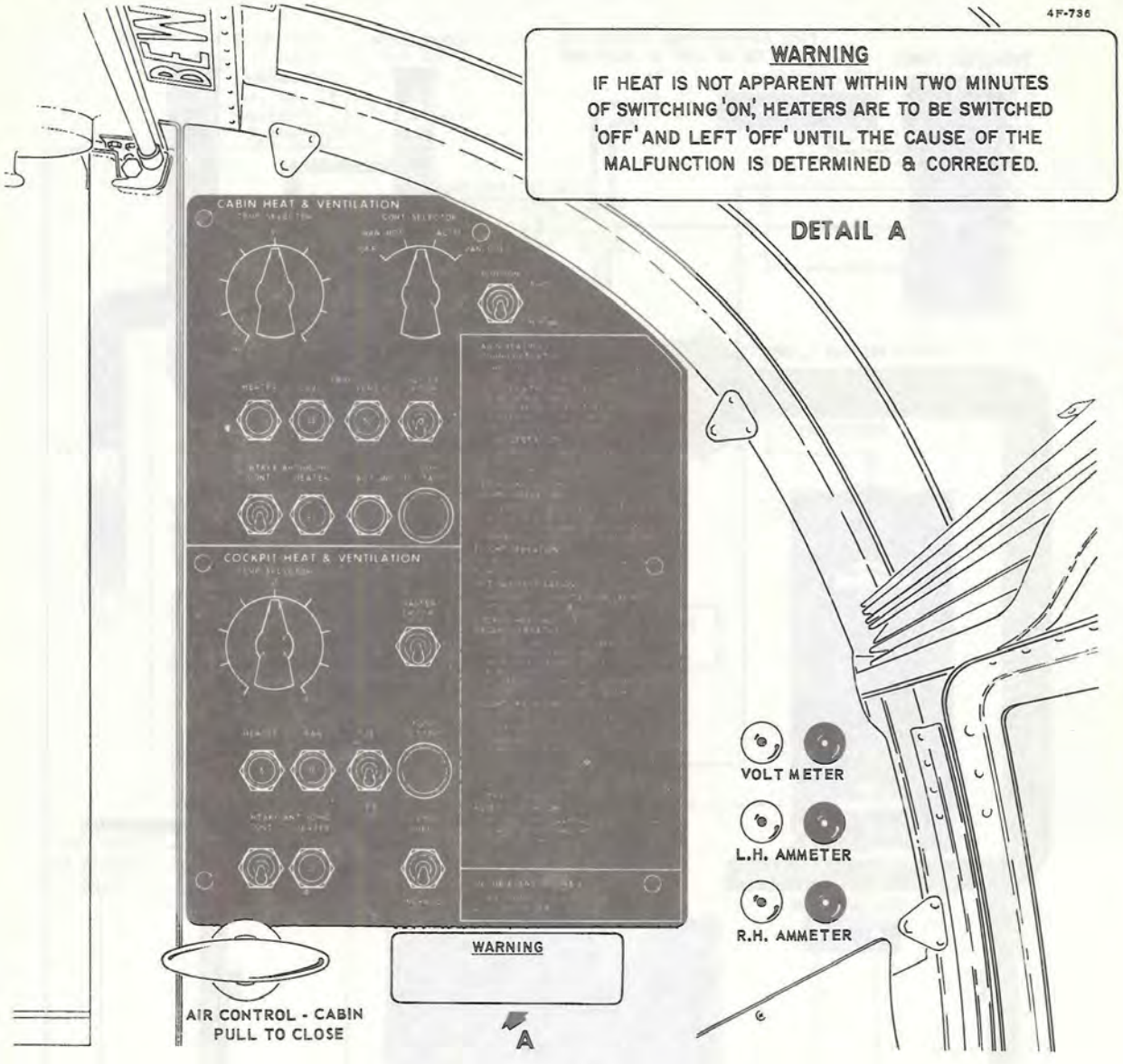


Figure 6-2. Heating Control Panel

6-12. Heater temperature selector. The heater temperature selector is marked TEMP SELECTOR and is graduated in ° F with numerals at 40, 60, and 80. The selector sets the temperature control system of the heater to maintain the temperature in the compartment, as sensed by the compartment thermostat and the heater outlet duct thermostat.

6-13. Heater and fan circuit breakers. A 5-ampere push-to-reset circuit breaker marked HEATER protects the heater electrical circuit. A 10-ampere push-to-reset circuit breaker marked FAN protects the circuits of the combustion ram air fan and ventilation return air fan.

6-14. Heater intake anti-icing circuit breakers. Below the INTAKE ANTI-ICING marking is a 5-ampere switch-type circuit breaker control marked CONT, for selection of the heater intake anti-icing circuit, and a 25-ampere push-to-reset circuit breaker marked HEATER for circuit protection.

6-15. Air control handle. The air control handle on the pilot's pedestal (see Chapter 2, figure 2-16) is marked COCKPIT AIR CONTROL and PULL TO CLOSE. The handle is used to mechanically adjust a butterfly-type valve in the heater outlet duct to regulate the amount of ventilating air entering the flight compartment. When the handle is pushed in,

the valve is opened and releases its pressure on a microswitch to allow operation of the heater. When the handle is pulled fully out, the valve closes and operates the microswitch to deenergize the heater electrical circuit; this position should be selected in the event of fire.

6-16. Air selector handle. The air selector handle on the pilot's pedestal (see Chapter 2, figure 2-16) is marked COCKPIT AIR SELECTOR, and FLIGHT-PUSH, GROUND-PULL. The handle is used to mechanically actuate two butterfly-type valves, one in the ventilating ram air intake duct and one in the ventilating air return duct. When the handle is pulled out to the GROUND position the ram air intake duct valve operates a microswitch which energizes two fans, one in the ram air intake duct to supply combustion air and one in the air return duct to recirculate the air from the flight compartment. An air pressure switch, in the fuselage nose section, deenergizes the circuit of the fans after take-off upon attaining an airspeed of approximately 85 knots IAS; and prevents operation of the fans should the air selector handle be inadvertently left at GROUND position during flight. The air pressure switch is pressurized from the copilot's pitot line and is common to both the flight compartment and cabin heating systems.

6-17. Operation. Ground and flight operation of the heating system is covered in the following paragraphs.

6-18. Ground operation.

a. Heater and fan circuit breakers - Set.

b. Cockpit air control handle - Push in (open).

c. Cockpit air selector handle - GROUND.

d. Fuel pump switch - Up (on).

e. Heater ignition switch - NORMAL.

f. Temperature selector - Set to desired temperature.

g. Master switch - Up (on).

h. Start switch - Depress.

i. Start switch indicator light - Should illuminate and remain on during heater operation.

Note

On transition from Ground to Flight operation of the heater it will be noted that only action c. and h. of paragraph 6-19 are necessary.

6-19. Flight operation.

a. Heater and fan circuit breakers - Set.

b. Cockpit air control handle - Push in (open).

c. Cockpit air selector handle - FLIGHT.

d. Fuel pump switch - Up (on).

e. Heater ignition switch - NORMAL (EMERG if NORMAL is inoperative).

f. Temperature selector - Set to desired temperature.

g. Master switch - Up (on).

h. Start switch - Depress.

i. Start switch indicator light - Should illuminate and remain on during heater operation.

6-20. Cabin Heating System. The cabin 200,000 BTU combustion heater, consuming 2.66 gallons of fuel per hour maximum, is mounted in the right side of the cabin roof forward of the wing front spar. The combustion ram air duct, in the leading edge of the right wing, does not have an anti-icing intake. In flight, the duct in the left wing supplies ram air to the heater combustion chamber where it mixes with fuel and is ignited by a spark plug, current for which is supplied through normal or standby vibrator contacts in an ignition unit. The products of combustion then flow through heat exchanger passages and are exhausted to atmosphere. The duct in the right wing supplies ventilating ram air, in flight, and the flow of air divides before reaching the heater. Some of the air passes over the hot walls of the heat exchanger, and some of it passes through a heater bypass duct. The heated air and cold bypass air rejoin at the discharge end of the heater, where the degree of mixing is controlled by an electrical actuator-operated mixing valve which is positioned according to cabin temperature selector requirements, and variations are sensed by the cabin thermostat in the rear exhaust outlet and the heater outlet duct thermostat. The flow then passes to eight outlets along each side of the cabin and to one outlet in the cabin roof at the rear. Two interconnected ventilating air exhaust outlets in the cabin roof pass used air to atmosphere, through the cabin exhaust vent, during flight. During ground operation, mechanically interconnected electrical actuator-operated valves in the combustion air duct, ventilation air duct and cabin exhaust vent are closed; and a com-

bustion air bypass duct and ventilating air bypass duct are opened, and a fan in each is energized. An amber colored CAUTION light will illuminate during operation of the fans. The combustion air fan draws air through the ram air intake in the left wing and passes it to the heater combustion chamber. The ventilation air fan draws cabin air through the cabin air exhaust outlets and recirculates it over the hot walls of the heat exchanger and then passes the heated air to the outlets on each side of the cabin. (See figure 6-3.)

6-21. Temperature control system. The temperature control system of the heater is basically automatic in operation but the heater mixing valve can be manually controlled, in the event of failure of the automatic control circuit, by means of a control selector on the upper section of the heating control panel. The system consists of a heater outlet duct thermostat, cabin thermostat, temperature selector, control selector, and a temperature control box. Cabin temperature is automatically controlled in a similar manner to that described in paragraph 6-5. The heater is protected from excessive operating temperatures and safeguarded in a similar manner to that described in paragraph 6-5, however, the fire warning red light for the cabin heater is on the right side of the emergency panel.

6-22. Preparation for operation. Before the heater can be started on the ground or in flight, the following conditions must exist:

a. The cabin air control handle, located below the heating control panel, must be pushed fully in to open the valves in the tee duct at the outlet end of the heater and allow the safety microswitch to complete the electrical circuit.

b. A combustion ram air-pressure equivalent to approximately 80 knots IAS must be sensed by the ram air pressure switch.

c. The heater discharge temperature must be less than 350° F.

Provided these conditions exist when the master switch and fuel pump switch are selected on, then the heater will operate when the start switch is depressed; the start switch indicator light will illuminate to show that the system is energized. The mechanically interconnected air selector valves are automatically positioned for the type of operation, ground or flight, by an electrical actuator operated by the fan air pressure switch in the fuselage nose section. When the air pressure sensed by the switch is less than the equivalent of 85 knots IAS the selector valves will be positioned for ground operation, and the fans energized and the CAUTION light illuminated. Above 85 knots IAS the selector valves will be positioned for flight operation, and the fans de-energized and the CAUTION light extinguished.

6-23. Heater Controls. The upper section of the heating control panel (figure 6-2), on the bulkhead behind the pilot's seat, is marked CABIN HEAT & VENTILATION and contains the switches and controls necessary for operation of the cabin heater, and for control of the heater combustion ram air intake anti-icing element. The heater fuel pump electrical circuit is controlled by the fuel pump switch on the lower section of the heating control panel. (Refer to paragraph 6-8.)

6-24. Heater ignition switch. Refer to paragraph 6-9 for description.

6-25. Heater master switch. Refer to paragraph 6-10 for description.

6-26. Heater start switch. Refer to paragraph 6-11 for description.

6-27. Heater temperature selector. The heater temperature selector is marked TEMP SELECTOR and graduated in ° F with numerals at 40, 60, and 80. The selector sets the temperature control system of the heater to maintain the temperature in the cabin, as sensed by the cabin thermostat and the heater outlet duct thermostat.

6-28. Heater control selector. The four-position control selector is marked CONT SELECTOR with positions OFF, MAN HOT, AUTO, and MAN COLD. The selector setting determines the type of operation of the heater. In the AUTO position the mixing valve, at the junction of the heater outlet and heater bypass duct, is automatically controlled by the temperature control system to regulate the amount of cold bypass air mixing with the heated air from the heater. In the MAN HOT position the temperature control system is bypassed and the mixing valve is moved to close the heater bypass duct to allow heated air only to be fed to the cabin outlets. In the MAN COLD position the temperature control system is bypassed and the mixing valve is moved to close the heater outlet to allow cold air only to be fed to the cabin outlets. During manual operation the mixing valve can be positioned at intermediate settings by moving the control selector to OFF when the desired setting is reached. The valve takes approximately 45 seconds to move from MAN HOT to MAN COLD.

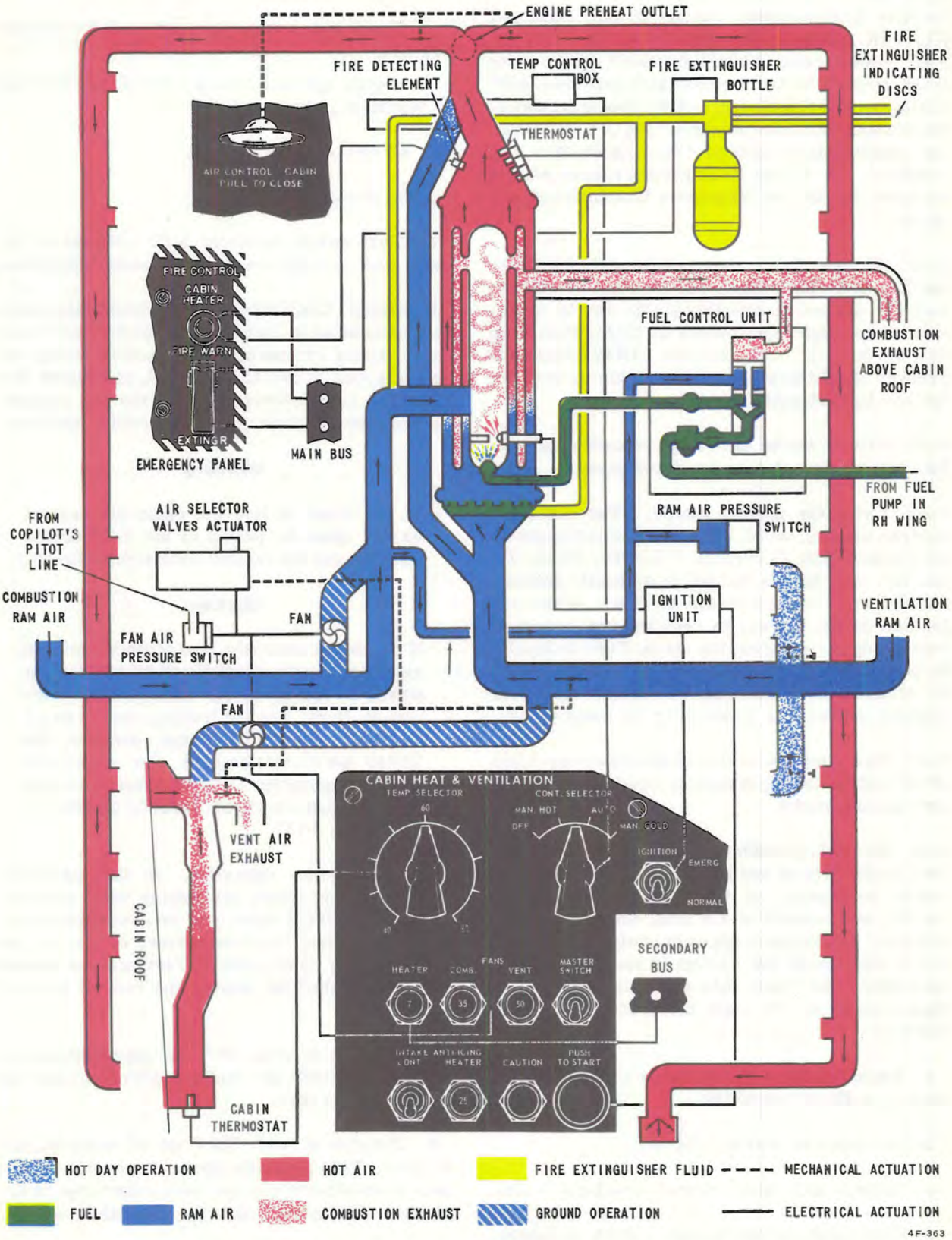


Figure 6-3. Cabin heating and ventilating system - schematic

6-29. Heater and fans circuit breakers. A 7-ampere push-to-reset circuit breaker marked HEATER protects the heater electrical circuit. Two push-to-reset circuit breakers protect the FANS circuit; the 5-ampere breaker marked COMB for the combustion air fan, and the 20-ampere breaker marked VENT for the ventilating air fan. When the winterization equipment hi-capacity fans are installed, the 5- and 20-ampere breakers will be replaced by 35- and 50-ampere breakers respectively.

6-30. Caution light. An amber colored light marked CAUTION will illuminate when the ventilating air fan and combustion air fan are in operation. If the light illuminates in flight, indicating that the fans are energized, the COMB fan circuit breaker should be pulled to deenergize combustion fan and light circuit.

6-31. Heater intake anti-icing circuit breakers. Refer to paragraph 6-14 for description.

6-32. Cabin air control handle. The cabin air control handle, below the heating control panel, is marked AIR CONTROL - CABIN, PULL TO CLOSE. The handle is used to manually position butterfly-type valves in the tee duct, at the outlet end of the heater, to regulate the amount of ventilating air entering the cabin. When the handle is pulled to fully close the valves, a microswitch is actuated to deenergize the heater electrical system; select this position in the event of fire.

6-33. Operation. Normal and emergency operation of the cabin heating system is covered in the following paragraphs.

6-34. Normal operation. Cabin heater operation, both on the ground and in flight, is similar. Automatic positioning of the system air selector valves, and control of the fans, occurs at an air pressure equivalent to approximately 85 knots IAS; below this speed the system is placed in ground operation, and above this speed it is placed in flight operation. To start the heater proceed as follows:

a. Engine preheat outlet cover - Check secure during preflight inspection.

b. Hot day duct valves - Closed.

c. Heater and fans circuit breakers - Set.

d. Cabin air control handle - Push in (open).

e. Fuel pump switch - Up (on).

f. Control selector - AUTO.

g. Temperature selector - Set to desired temperature.

h. Heater ignition switch - NORMAL (EMERG if NORMAL is inoperative).

i. Master switch - Up (on).

j. Start switch - Depress.

k. Start switch indicator light - Should illuminate and remain on during heater operation.

l. Amber CAUTION light - Should illuminate and remain on to indicate that the fans are energized during ground operation, and should go out at airspeeds above 85 knots IAS, to indicate that the fans are deenergized and the air selector valves are in their flight operating positions.

Warning

In the event of fire the cabin air control handle must be pulled to the fully closed position and the master switch moved to off.

Caution

If the thrust indicator free stream pressure selector, on the copilot's flight instrument panel, is moved to the EMERG OFF position in flight, and the heating control panel CAUTION light illuminates, pull out the COMB fan circuit breaker. For subsequent system operation on the ground, circuit breaker must be reset. Refer to Chapter 2, paragraph 2-137.

6-35. Emergency operation. If the automatic control of the heater air mixing valve malfunctions, the mixing valve can be controlled manually to regulate the temperature of the air being fed to the cabin outlets. Temperature control is accomplished by moving the control selector as follows:

a. Position at MAN HOT for approximately 30 seconds to move the mixing valve and close the heater bypass duct.

b. Position at MAN COLD for 10 seconds, then to OFF. This partially opens the heater bypass duct to admit cold air and reduce the temperature of the heated air fed to the cabin outlets.

c. Repeated adjustment in this manner, varying the number of seconds at MAN COLD, will modu-

late the heat supply until the desired temperature is obtained.

6-36. Operation of cabin vent air exhaust valve. When the system is switched off in the air, the cabin vent air exhaust valve remains open, the valve only closes when the system is in ground mode. To prevent rain or moisture entering the valve when the aircraft is on the ground, the master switch should be switched on for a few seconds before shutting down the engine. This action will motor the valve to ground mode and it will close. With the master switch ON, insure engine rpm are sufficient to charge both generators.

6-37. Flight Compartment Ventilating System. The flight compartment ventilating system utilizes the ducting and outlets of the heating system with the heater in a deenergized condition. For hot day use two cooling louvers are installed, one on each side of the flight compartment, to provide additional fresh air for the pilot and copilot. Each louver is installed at the aft end of a short ram air intake, forward of the windshield. The direction and amount of ventilating air flow can be adjusted by turning the spherical louver and rotating its shutter knob. An adjustable air exhaust louver is installed in the rear of the canopy to the right of the aircraft centerline. Maximum ventilating air is provided when the hot day louvers and the cockpit air control handle are at the fully open position.

6-38. Operation. Ground and flight operation of the flight compartment ventilating system is covered in the following paragraphs.

6-39. Ground operation.

a. Heater circuit breaker - Pull out.

b. Fan circuit breaker - Set.

c. Cockpit air control handle - Push in (open).

d. Cockpit air selector handle - GROUND.

e. Master switch - Up (on).

f. Hot day louvers - Open for maximum ventilating air, if required.

Note

On transition from Ground to Flight operation of the ventilating system it will be noted that only action d. and e. of paragraph 6-40 are necessary.

6-40. Flight operation.

a. Heater circuit breaker - Pull out.

b. Fan circuit breaker - Set.

c. Cockpit air control handle - Push in (open).

d. Cockpit air selector handle - FLIGHT.

e. Master switch - Down (off).

Warning

In the event of fire the cockpit air control handle must be pulled to the fully closed position.

6-41. Cabin Ventilating System. The cabin ventilating system utilizes the ducting and outlets of the heating system with the heater in a deenergized condition. For hot day use in flight, cold fresh air can be admitted to the cabin through ducting connected to the ventilating ram air intake in the leading edge of the right wing, and to three louvers in the cabin roof. Two of these louvers are ahead of the forward air exhaust outlet, and the third louver is just aft of the wing rear spar. The amount of fresh air admitted through the louvers is controlled by manually operated butterfly-type valves, one just aft of the forward louvers and one at the rear louver; both are marked HOT DAY VENTILATION ON-OFF. For hot day ventilation in flight, the cabin air control handle must be pulled fully out (close) to shut off the normal ventilating system and allow the maximum amount of cold fresh air to be directed to the three roof louvers, where the flow of air can be manually controlled. On the ground, fresh air ventilation can be supplied through the hot day louvers provided the right-hand engine is operating; the propeller slipstream produces a ram air effect at the ventilating ram air intake.

6-42. Operation.

a. Heater and fans circuit breakers - Set.

b. Cabin air control handle - Push in (open).

c. Master switch - Up (on).

d. Start switch - Do not depress.

e. Amber CAUTION light - Should illuminate and remain on to indicate that the fans are energized during ground operation, and should go out at airspeeds above 85 knots IAS to indicate that

the fans are deenergized and the air selector valves are in their flight operating positions.

Caution

If the thrust indicator free stream pressure selector, on the copilot's flight instrument panel, is moved to the EMERG OFF position in flight, and the heating control panel CAUTION light illuminates, pull out the COMB fan circuit breaker. For subsequent operation on the ground, circuit breaker must be reset. Refer to Chapter 2, paragraph 2-137.

6-43. Hot day ventilation operation.

a. Cabin air control handle - Pull out (close).

b. Hot day duct valves - Open.

Note

This operation can be used on the ground to supply fresh air ventilation, provided the right-hand engine is operating.

6-44. Operation of cabin vent air exhaust valve. Refer to paragraph 6-36.

Section III

Anti-icing and Deicing Systems

6-45. General. The ice protection facilities consist of windshield anti-icing, heater and ventilating air intake anti-icing, and pitot head anti-icing; propeller deicing, and wing and tail deicing.

6-46. Windshield Anti-icing. Both the pilot's and copilot's windshields are constructed of polyvinyl butyral sandwich panels. The laminations are heated electrically by current that passes through a transparent conductive coating between the sheets. In addition to providing anti-icing, heating of the panels prevents misting and also raises their birdproof qualities.

Note

Maximum 'bird proofing' qualities of the windshield are obtained when the vinyl interlayer is maintained in the temperature range of 68° to 130°F. The windshield heat system maintains a temperature of 100°F, and the windshield is therefore at its maximum strength with the heat on.

6-47. Single phase ac power for each windshield panel is derived from individual windshield inverters powered from the secondary bus; the circuits being protected by 70-ampere circuit breakers. The associated dc relay circuits are protected by 5-ampere circuit breakers. Operation of the windshield heat is controlled by the windshield heat switch on the center switch panel. The switch, marked WINDSCREEN HEAT, has three positions NORM, OFF, and EMERG. The switch should be set to NORM at least three minutes prior to take-off. Should the pilot's windshield power supply fail, switching to EMERG will transfer power to the pilot's panel from the copilot's panel, which will then cool. A warning light for each windshield inverter, marked FAIL, PILOT'S and COPILOT'S, is located adjacent to the control switch and will illuminate if its respective inverter fails.

Caution

If inverter failure is the cause of the defect, the appropriate circuit breaker should be pulled and no attempt must be made to reactivate the inverter, or further damage to the system may result.

6-48. Heater Intake Anti-icing. The inlets for the flight compartment heater combustion and ventilation air intakes, and the cabin heater combustion air intake, are electrically anti-iced. The cabin heater ventilation air intake is not anti-iced. Below the INTAKE ANTI-ICING marking on both the cockpit heating and cabin heating sections of the heating control panel, are provided a 5-ampere toggle-type circuit breaker control and a 25-ampere push-to-reset circuit breaker. The toggle-type circuit breaker marked CONT controls the heater intake anti-icing circuit and the push-to-reset circuit breaker marked HEATER protects the circuit. The anti-icing elements are powered from the secondary bus.

6-49. Pitot Head Anti-icing. Electrical anti-icing is provided for the four thrust-indicating pitot heads, and two pitot heads supplying the flight instruments. A switch marked PITOT is located on the deicing switch panel (figure 6-5). The switch also controls a heater at each stall warn-

ing lift transducer. Power for the flight instrument pitot heads and lift transducers is taken from the emergency bus through two 15-ampere circuit breakers, and for the thrust indicating pitot heads from the secondary bus through two 10-ampere circuit breakers.

6-50. Propeller Deicing. An alcohol deicing system is provided for each propeller. Each system consists of an 8.4 US gallon tank, an electrically operated shutoff valve, an electrically operated pump and the necessary piping to a slinger ring and cuffs. Both systems are controlled by a switch marked PROP on the deicing switch panel (figure 6-5). Power for each system is derived from the emergency bus via the left and right hydraulic and engine oil emergency shutoff switches respectively. When energized, the pump supplies fluid under pressure to the slinger ring, and is distributed to the leading edge of the propeller blades by centrifugal force. The shutoff valve is solenoid operated and remains open while the pump circuit is energized.

Note

The rate of flow of each propeller deicing system is 1.27 US gallons per hour, and will provide protection for 6.5 hours of continuous operation. However, as the alcohol deicing system is only used intermittently, the supply is sufficient for the endurance of the aircraft.

6-51. Wing and Tail Deicing System. The system, (figure 6-4) is of the inflatable rubber-boot type, deicing being provided at the horizontal stabilizer leading edges and the wing leading edges outboard of the landing lights. Included in the system are two engine-driven air pumps, two combination units, distributor valves, an electronic timer, and the control switches on the deicing panel. System pressure and suction is indicated by two gages, marked DEICING, and PRESS and SUCT respectively, located on the copilot's pedestal. Refer to Chapter 7, figure 7-1 for instrument markings. Electrical power for the system is taken from the secondary bus via two circuit breakers, AUTO and MANUAL, labeled DEICING WING & TAIL.

6-52. The deicer boots are arranged in sections. Two sections at the stabilizer, one left, one right; and two sections, an inboard and an outboard, at each wing. Each section is further divided into an inner and outer boot. A distributor valve serves each wing-boot section; one distributor valve is provided to serve both tail-boot sections. The distributor valve has a pressure inlet port, a suction outlet port and a dump port. Two additional ports "A" and "B" are connected to related "A" (inner) and "B" (outer) boot ports. Pressure and suction is alternated through the "A" and "B" ports by movement of a solenoid-operated servo valve. The distributor valves are each connected to a common pressure manifold and a common suction manifold; pressure and suction being applied by either or both engine-driven air pumps. The suction side of each pump is connected direct to the suction manifold; suction being indicated at all times on the gage. The pressure side delivery is routed through the combination unit from which pressure is dumped when the system is inactive or, when in use, is regulated to the pressure manifold to maintain 15 psi. Both pumps will provide satisfactory operation up to 20,000 feet. In the event of engine or pump failure, the remaining pump will provide satisfactory operation up to 15,000 feet.

6-53. An electronic timer is provided for automatic operation of the system; a separate circuitry being provided to by-pass the timer for manual operation. The normal cycle of the timer is 1-minute for excessive icing (29 seconds on, 31 seconds off) and 4 minutes for light to moderate icing (29 seconds on, 211 seconds off). When the system is switched on, there is an initial tube warm-up delay of 20 seconds, then the cycle commences with a 5-second period during which the solenoids of the combination units are energized to close the dump valves and pressurize the system. Thereafter, six contacts are energized successively, each for a period of 4 seconds during which the appropriate distributor-valve solenoids are in turn energized to fully inflate their respective boots. The boots are inflated and deflated once per cycle, in symmetrical pairs, consecutively from the inboard inner wing-boots to the outer tail-boots (see figure 6-4). Suction is applied to hold the boots flush with the leading edge during the intervening periods of the cycle. During the balance of the cycling time (31 or 211 seconds), the dump valves are open and system pressure is unloaded.

Note

If the system is switched OFF during a cycle, the timer will zero for commencement of another cycle.

6-54. Wing and tail deicing switches. Under WING & TAIL, a mode switch has three positions marked AUTO, OFF, and MAN; the function being self-explanatory (figure 6-5). A related two-

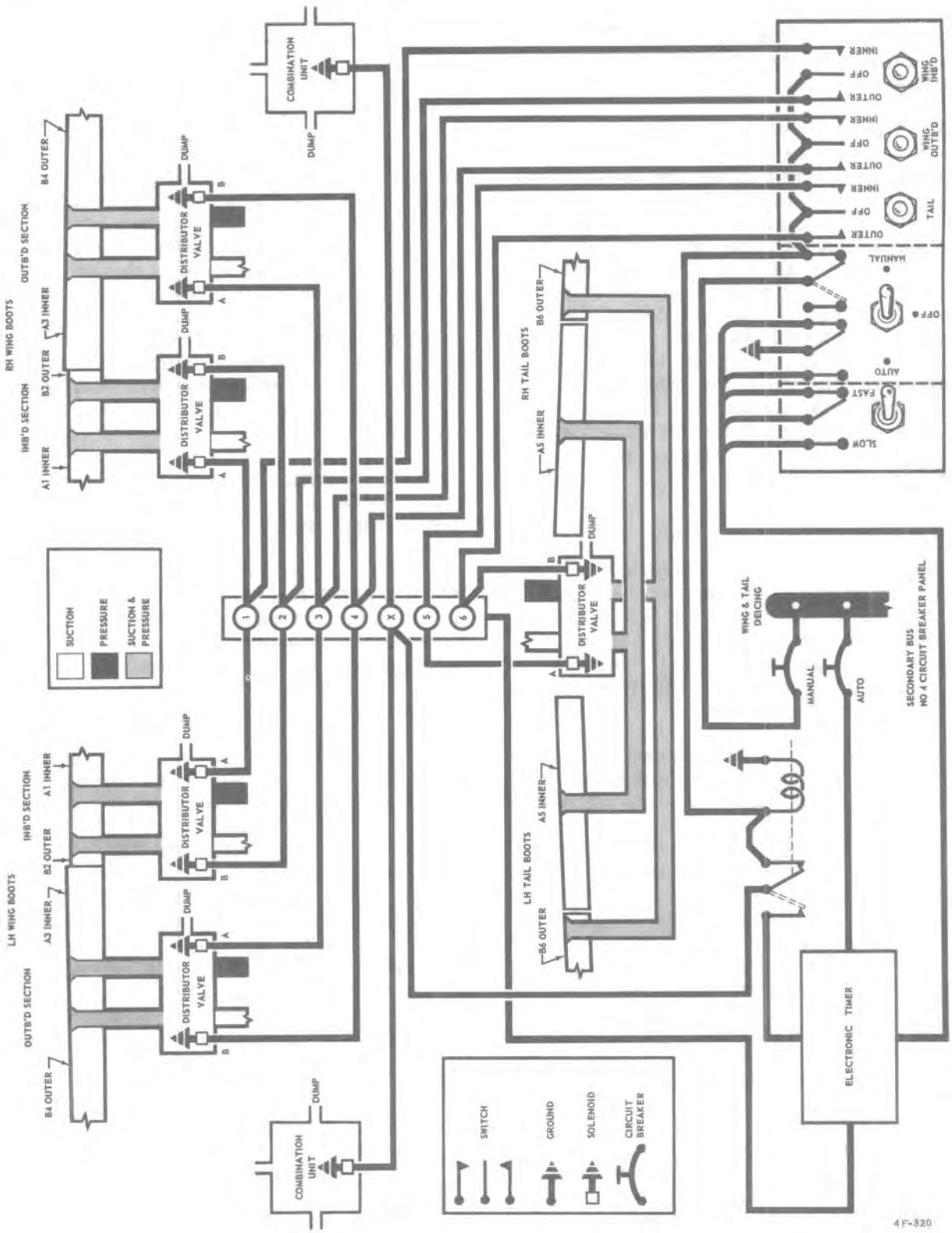


Figure 6-4. Wing and tail deicing system - schematic

position switch marked FAST-SLOW selects respectively the 1-minute or 4-minute cycle, and is operative only in the AUTO mode. Three BOOTS switches, INBD, OUTBD, and TAIL, have positions marked INNER-OFF-OUTER, and are for manual operation of the boots either when a particular icing condition makes manual mode preferable or in the event of failure of the automatic function. When manual mode is selected, the system remains loaded at 15 psi and the boot switches bypass the timer to route power direct to the distributor-valve solenoids; the boot remaining inflated while the switch is held selected.

6-55. Reference to figure 6-4 and the following example will show how the system is controlled and operates in the manual modes. In auto mode, the timer replaces the manual switches to provide the same function automatically. Commencing at the secondary bus and following the circuit to ground, power enters via the manual circuit breaker and is routed to the pole terminal of the mode switch MANUAL position. When the switch is selected to MANUAL, the circuit is completed to the pole terminals of the BOOTS switches (in OFF position), and simultaneously energizes the blocking relay which in turn operates to isolate the timer circuit and connect power via "X" terminal to the combination-unit solenoids. The system is now ready for use. If the WING INBD BOOT switch is selected to INNER, power is routed to terminal No. 1 and therefrom to "A" solenoid of each inboard distributor valve, thus admitting pressure to the inboard inner boots.

6-56. Normal operation.

a. WING & TAIL DEICING circuit breakers - Set.

b. Mode switch - AUTO.

c. System pressure and suction indicators - Check 15 psi and 4 in. Hg respectively.

d. Cycling switch - FAST or SLOW, as required.

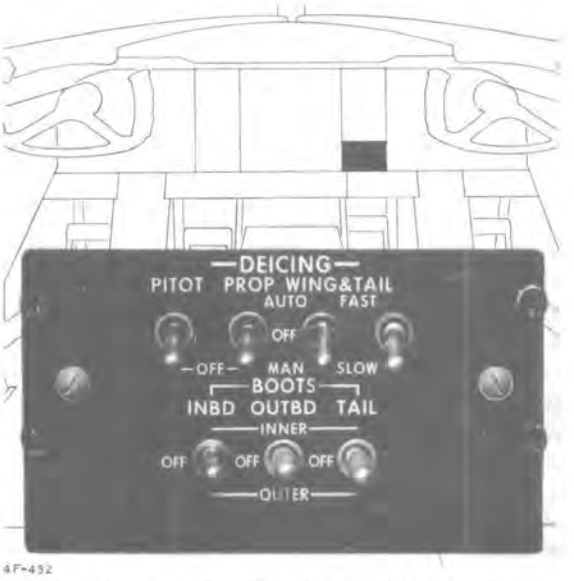


Figure 6-5. Deicing switch panel

Note

With the system operating automatically the build-up and shedding of ice should be closely observed, bearing in mind the fact that the characteristics of the icing condition may require a change in the manner of system operation. The wing inspection lights are provided for observations during night operation.

6-57. Manual operation. Should a failure in the timer, or characteristic of the icing condition require manual mode of operation, proceed as follows:

a. Mode switch - MAN.

b. System pressure and suction - Check.

c. BOOTS switches - Commencing with the INBD switch, hold each switch in turn first to the INNER position and then the OUTER position for a period of 4 seconds each approximately.

d. Repeat the cycle as necessary.

Section IV

Lighting Systems

6-58. Exterior Lighting System. The exterior lighting system consists of navigation, anti-collision, wing inspection, taxiing and landing lights. Formation lights are provided on aircraft 63-9718 and subsequent. The anti-collision lights are powered from the main bus, while the others are powered from the secondary bus. The circuits are controlled by individual switches on the electrical switch panel (Chapter 2, figure 2-12), and overhead console (Chapter 2, figure 2-4). Circuit protection is afforded by circuit breakers on the EXTERIOR LIGHTS section of the circuit breaker and fuse panel (Chapter 2, figure 2-13), on the forward face of the flight compartment rear bulkhead.

6-59. Navigation lights. The navigation lights are located in the wing tips, red in the left and green in the right, and the white tail position light is located in the trailing edge of the rudder. The lights are controlled by a switch on the electrical switch panel and the circuits are protected by a 5-ampere circuit breaker marked WING & TAIL on the circuit breaker panel.

6-60. Navigation lights switch. The navigation lights two-position toggle switch is on the copilot's side of the electrical switch panel and is marked WING & TAIL with ON and OFF at its up and down position respectively.

6-61. Anti-collision lights. The two anti-collision lights are located one on top of the rudder and the other below the fuselage and are powered from the main bus. Both lights are controlled simultaneously by a switch on the electrical switch panel, and the circuits are protected by the two 5-ampere circuit breakers marked ANTI-COLL, UPPER and LOWER on the circuit breaker panel. Each light is rotated by a dc motor within the beacon light housing and, due to blanking between the two lamps in the housing, a rotating beam of light is emitted at a predetermined angular separation which can be seen at 15° above to 10° below the horizontal plane of the aircraft.

6-62. Anti-collision lights switch. The anti-collision lights two-position toggle switch is on the copilot's side of the electrical switch panel and is marked ANTI-COLL with ON and OFF at its up and down positions respectively.

6-63. Wing inspection lights. The two wing inspection lights are mounted one on the outboard side of each engine nacelle and are directed towards the wing tip. Both lights are controlled simultaneously by a switch on the electrical switch panel, and the circuits are protected by the 5-ampere circuit breaker marked WING INSPECT on the circuit breaker panel.

6-64. Wing inspection lights switch. The wing inspection lights two-position toggle switch is on the copilot's side of the electrical switch panel and is marked WING INSPECT with ON and OFF at its up and down positions respectively.

6-65. Taxiing lights. The taxiing light is mounted on the nosewheel door fairing and is directed forward. The light is controlled by a switch on the overhead console and the circuit is protected by a 7-ampere circuit breaker marked TAXI on the circuit breaker panel.

6-66. Taxiing light switch. The taxiing light two-position toggle switch is on the overhead console immediately forward of the wing flap selector lever and is marked TAXI LT with ON at its up position.

6-67. Landing lights. The two 250-watt landing lights are located, one in the leading edge of each wing, outboard of the nacelles and set at a fixed angle. The lights are controlled by two individual switches on the overhead console and the circuits are protected by two 10-ampere circuit breakers marked LANDING LEFT and RIGHT on the circuit breaker panel.

6-68. Landing lights switches. The two landing lights two-position toggle switches are on the overhead console immediately forward of the ignition switch unit and are marked LANDING LTS, LH and RH with ON at the up position.

6-69. Formation lights. Formation lights are provided on aircraft 63-9718 and subsequent. Three of the lights are mounted on the top surface of the fuselage; two in tandem forward of the cabin doors and one aft of the cabin doors; and three lights are mounted in the rear upper surface of each outer wing panel. The lights are powered from the secondary bus through the 5-

ampere circuit breaker marked FORM on the exterior lights circuit breaker panel, and are controlled by a switch on the electrical switch panel marked LIGHTS.

6-70. Formation lights switch. The formation lights three-position toggle switch is on the copilot's side of the electrical switch panel and is marked FORM with DIM, OFF, and BRT at the up, middle, and down position respectively.

6-71. Interior Lighting System. The interior-light system consists of flight compartment, utility, magnetic standby compass, cabin, doors unlocked, cargo loading and rear entrance lights. These lights are powered from the battery, emergency or main bus, the circuits being controlled by individual switches on switch panels in the flight compartment and rear cabin. The circuits are protected by circuit breakers marked INTERIOR on the 'lights' section of the circuit breaker and fuse panel (Chapter 2, figure 2-13), on the forward face of the flight compartment bulkhead. In addition, an emergency lighting system for the aircraft exits, is installed.

6-72. Flight compartment dome light. The flight compartment dome light is located on the overhead console, aft of the carburetor heat control levers, and contains a red and a white lamp in the housing. The light is controlled by a guarded switch on the overhead console. The circuit is powered from the battery bus and protected by the 5-ampere circuit breaker marked COCKPIT on the circuit breaker panel.

6-73. Flight compartment dome light switch. The flight compartment dome light three-position toggle switch is at the left of the light on the overhead console and is marked RED, OFF, and WHITE, with a guard which must be displaced before the WHITE position can be selected.

6-74. Flight compartment bottom hatch light. The flight compartment bottom hatch light mounted on the lower forward face of the flight compartment rear bulkhead illuminates the compartment bottom hatch, and is powered from the emergency bus. The light is controlled by a micro switch at the hatch which deenergizes the circuit when the hatch is closed. The circuit is protected by the 5-ampere circuit breaker marked UTILITY on the circuit breaker panel.

6-75. Utility lights. Four utility lights are installed in the flight compartment; one each for the pilot and copilot stowed in brackets on the bulkhead behind each seat, one for the radio rack stowed on the bulkhead at the rack, and one for the cargo doors forward panel stowed near the flight compartment dome light. The lights are fixed to mounting brackets by ball and spring fixtures which engage a groove in a shaft attached to the light assembly. When required, the lights may be pulled from their brackets and a flexible coiled cable permits movement to the desired position. The pilot's and copilot's light may be moved to sockets on either side of the overhead console. The front section of the light assembly can be rotated to four positions to give spotlight or diffused light in either of two colors, red or white for the radio rack light, and red or amber for the remaining lights. A spring catch on the side of the light must be pulled back to change over from red, but the catch is automatically overridden when changing to red. This feature prevents inadvertent selection of white and safeguards night vision. The rear section of each light has an intensity switch marked OFF, DIM, and BRT and also contains a push button for momentary illumination. The light for the cargo doors forward panel is supplied from the battery bus and the circuit is protected by the 5-ampere INTERIOR LIGHTS - COCKPIT circuit breaker (which also protects the flight compartment dome light). The remaining utility lights are supplied from the emergency bus through the 5-ampere INTERIOR LIGHTS - UTILITY circuit breaker. This circuit breaker also protects the flight compartment floor hatch light and the emergency hydraulic selector panel lights.

6-76. Magnetic standby compass light. The magnetic standby compass light is contained in the compass assembly attached to the windshield center post and is powered from the emergency bus. The light is controlled by a switch on the center electrical switch panel, and the intensity of the light, when powered from the emergency bus, is controlled by the setting of the SWITCH, EMERG & ROOF switch on the section of the panel marked PANEL LIGHTS. The circuit is protected by either of the 5-ampere circuit breakers marked STANDBY COMPASS, and SW EMERG & ROOF on the circuit breaker panel, depending on switch position.

6-77. Magnetic standby compass light switch. The magnetic standby compass light two-position toggle switch is located on the copilot's side of the center electrical switch panel and is marked STBY COMP, with EMERG and NORM at its up and down positions respectively. In the NORM position the light is powered by the emergency bus and the intensity is controlled by the setting of the switch marked SWITCH, EMERG & ROOF, on the section of the center electrical switch panel

marked PANEL LIGHTS. In the EMERG position the light is powered from the battery through the emergency bus switch, and the intensity is dependent on the battery strength.

6-78. Cabin dome lights. The seven cabin dome lights are located in two rows in the cabin roof, four in one row and three in the other, and staggered to provide even distribution of illumination. Each dome light assembly contains a red and a white lamp. The lights are controlled by a guarded switch on the flight compartment rear bulkhead. The circuits are powered from the main bus and are protected by the 15-ampere circuit breaker marked CABIN on the circuit breaker panel.

6-79. Cabin dome light switch. The cabin dome light three-position toggle switch is mounted on a panel on the forward face of the flight compartment rear bulkhead aft of the pilot's seat and is marked RED, OFF, and WHITE, with a guard which must be displaced before the WHITE position can be selected.

6-80. Doors unlocked light. The doors unlocked amber light is located outboard of the take-off check list above the copilot's flight instrument panel. The light will come on if either the flight compartment bottom hatch, passenger doors, cargo door or ramp are not securely closed. The microswitches for the circuit of each door mechanism are powered from the main bus and the intensity of the light is dependent on the setting of the warning lights intensity switch on the center electrical switch panel. The circuit is protected by the 5-ampere circuit breaker marked DOORS WARN on the circuit breaker panel.

6-81. Cargo loading light and switch. The cargo loading light is a spotlight with a white lamp and a mechanically operated red shutter. The light is normally stowed in a mounting in the cabin roof aft of the rear entrance light, and is directed to shine on the cargo loading doors. It can be removed from its mounting and used as a portable light. A two-position slide switch marked ON and OFF is incorporated on the side of the light. The circuit is powered from the main bus and is protected by the 5-ampere circuit breaker marked CARGO on the circuit breaker panel.

6-82. Rear entrance light. The rear entrance light is located in the cabin roof directly above the cargo ramp. The circuit is powered from the main bus and the light is controlled by a switch on the interior lights panel at the aft end of the cabin. A ramp actuated switch automatically extinguishes the lights when the ramp is closed. The circuit is protected by the 5-ampere circuit breaker marked CARGO on the circuit breaker panel.

6-83. Rear entrance light switch. The rear entrance door light two-position toggle switch is on the panel marked INTERIOR LTS mounted at the aft end of the cabin and is marked REAR ENTRANCE and LIGHT at the up (ON) and down (OFF) position respectively. An intensity switch controlling the panel lights is marked PANEL LIGHTS, with OFF and BRIGHT at the ends of its control range.

6-84. Emergency Lighting System. The emergency lighting system is provided to illuminate the aircraft exits in the event of crash landing or complete electrical failure at night. White lights are beamed at the flight compartment roof hatch, the cabin emergency door, the passenger doors and cargo door. The system also includes a control unit mounted in the left-hand side of the cabin roof aft of the rear spar, and a guarded toggle switch marked EXIT LTS on the cabin lights switch panel on the flight compartment bulkhead. The toggle switch is used for manual operation and testing of the lights. The control unit incorporates an inertia switch which will automatically energize the circuit during crash landing, and a 6.6-volt 4-ampere-hour battery. The battery will power the lights for a minimum period of one hour.

6-85. Panel Lights. Panel and warning lights are discussed in the following paragraphs.

6-86. Passenger warning signs. The passenger warning signs are located above the doorway of the forward cabin bulkhead facing aft. The NO SMOKING sign and the FASTEN BELTS sign each contain five lamps. The lamps are powered from the main bus and are controlled by individual switches on the flight compartment rear bulkhead. The circuits are protected by the 15-ampere circuit breaker marked CABIN on the INTERIOR LIGHTS section of the circuit breaker panel.

6-87. Passenger warning sign switches. The two passenger warning sign two-position toggle switches are located on a panel mounted on the forward face of the flight compartment rear bulkhead behind the pilot's seat. The up (ON) position of the left and right switches are marked NO SMOKING and FASTEN BELTS respectively, being the indication of the warning sign they control.

6-88. Emergency hydraulic selector panel lights. The two lights on the emergency hydraulic selector panel under the hinged access door in the floor of the flight compartment are powered from the emergency bus and are controlled by a microswitch in the access door opening. When the door is opened the lights will come on provided the emergency bus is energized. The circuit is protected by the 5-ampere circuit breaker marked COCKPIT on the circuit breaker panel.

6-89. Panel lights intensity switches. The edge and eyebrow type lighting on all panels is powered from the main bus and, excepting the interior lights control panel at the rear of the cabin, the intensity can be adjusted by means of four switches on the section of the center electrical switch panel marked PANEL LIGHTS. The circuits are protected by the 5-ampere circuit breakers marked SW EMERG & ROOF on the circuit breaker panel. The four switches are marked PILOT'S & ENGINE; SWITCH, EMERG & ROOF; RADIO CONSOLE; COPILOT'S; and each has a range from OFF to BRT to control the intensity of the lighting of these circuits. The emergency and roof panel lights switch controls the lights on the emergency panel, electrical switch panel, overhead console, and the magnetic standby compass light when it is powered from the emergency bus. The interior lights control panel at the rear of the cabin has an independent switch which controls the intensity of the edge type lighting on that panel.

6-90. Warning lights intensity switch. The warning lights on the various panels are powered from the main bus and are adjusted for intensity by the setting of the two-position toggle switch marked WARN in the section of the electrical switch panel marked LIGHTS. The switch is marked DIM and BRT at the up and down positions respectively.

6-91. Pilot's and engine panel lights switch. The pilot's and engine panel lights intensity switch is located on the electrical switch panel and is marked PILOT'S & ENGINE, with OFF and BRT at the left and right end respectively of its range. The switch controls the eyebrow type lighting of the instrument, engine instrument, voltammeter, pilot's pedestal and fuel gage panels. The switch simultaneously controls the edge type lighting on the deicing, AC-DC power, elevator trim pedestal, left-hand switch, and fuel control panels.

6-92. Copilot's panel lights switch. The copilot's panel lights intensity switch is located on the electrical switch panel and is marked COPILOT'S, with OFF and BRT at the left and right end respectively of its range. The switch controls the eyebrow type lighting of the instruments on the copilot's panel.

Section V

Oxygen System

6-93. Constant Flow System (Aircraft prior to Serial No. 62-4172). The oxygen system supplies the pilot, copilot and crew chief. An oxygen cylinder, a main shutoff valve (marked SUPPLY VALVE - TURN ON FOR OXYGEN) and a charging point (marked OXYGEN CHARGING - CHARGING PRESSURE 1800 ± 50 PSI) and gage are located in the cabin roof left-hand side near the flight compartment bulkhead, access being by way of a zippered panel. A plug-in point for each pilot is provided on the side panel adjacent to his seat; the crew chief's plug-in point is located in the cabin roof adjacent to the oxygen cylinder installation. Three oxygen masks, each having a flow indicator, are stowed in a container marked OXYGEN MASKS, and are located on the right side of the copilot's seat. A regulator control panel is mounted adjacent to the copilot's plug-in point and contains a system pressure gage, an altitude flow meter and a manual control valve (marked ADJUST TO ALTITUDE). By use of the control valve in conjunction with the altitude flow meter, the copilot is able to adjust the oxygen flow to coincide with the existing flight altitude. The system pressure gages should indicate 1800 ± 50 psi when the system is fully charged. An oxygen duration table is shown in figure 6-6. When oxygen is required, the copilot's regulator control valve must first be closed (fully counterclockwise) before the main shutoff valve is slowly opened. After use, the system must be shut off at the main shutoff valve, then the regulator control valve must be turned fully OFF (counterclockwise).

6-94. Diluter Demand System (Aircraft Serial No. 62-4172 and subsequent). The oxygen system supplies the pilot, copilot and crew chief. See figure 6-7. The supply of gaseous oxygen is stored in two interconnected cylinders; at Stations 46.00 and 54.00. The cylinders are recharged through a filler valve at Station 33.2 and the nose RH access door, and a check valve on each cylinder

AF-727

OXYGEN DURATION IN HOURS

THREE CREW MEMBERS

CYLINDER: 1-TYPE AN6025 AX646-18 — **CONSTANT FLOW SYSTEM**

GAGE ALTITUDE (FEET)	GAGE PRESSURE - PSI				
	1800	1600	1400	1200	1000
8,000	8.1	7.2	6.4	5.4	4.5
10,000	6.7	5.9	5.3	4.5	3.7
12,000	5.6	5.0	4.5	3.8	3.2
14,000	4.6	4.0	3.6	3.0	2.5
15,000	4.3	3.8	3.4	2.9	2.4
20,000	3.2	2.9	2.6	2.2	1.9
25,000	2.6	2.3	2.1	1.7	1.5
30,000	2.2	1.9	1.7	1.5	1.2

Figure 6-6. Oxygen duration chart (constant flow system)

line. An adjacent oxygen cylinder pressure gage indicates the pressure in the cylinders; the nominal charging pressure is 1800 ±50 psi. A shutoff valve is provided on the flight compartment floor aft of the copilot's seat, and is turned counterclockwise for oxygen flow from the cylinders to the oxygen regulator pressure demand panel at each of the three crew positions, where the pressure is reduced to a breathable level. An oxygen hose connection for each crewmember is located adjacent to the crewmember's position for connection of Type A13A oxygen masks. When the system is in operation, and with the diluter switch set at NORMAL OXYGEN, air is drawn into the breathing system and is automatically mixed with oxygen from the supply cylinder to give the total needed oxygen up to approximately 30,000 ft, above this altitude 100% oxygen is delivered automatically. Refer to figure 6-8 for duration of oxygen supply at various altitudes with the diluter switch at NORMAL OXYGEN, and at the 100% OXYGEN position.

6-95. Oxygen regulator panels. A panel marked OXYGEN REGULATOR PRESSURE DEMAND, is provided adjacent to each crewmember position. The pilot's and copilot's regulator panel is located at the lower inboard corner of their respective flight instrument panel (figure 6-7), and the crew chief's regulator panel is on the left aft face of the cabin forward bulkhead. The three regulator panels are identical and each has an eyebrow type light in the center for panel illumination, a gage marked OXYGEN PSI calibrated from 0 to 2000 psi, with a white arc from 0 to 300 (low level) and FULL at 1800 psi. In addition, a blinker indicator marked FLOW which shows that oxygen is flowing on demand to the users mask, and three individually colored switches for controlling the oxygen supply flow are provided as follows:

a. Supply Switch (Green Color). The supply two-position switch on the right of the panel is marked SUPPLY with ON and OFF at the up and down position respectively. The switch is used to control the supply of oxygen at each panel.

b. Diluter Switch (Black Color). The diluter two-position switch on the lower center of the panel is marked 100% OXYGEN and NORMAL OXYGEN at the up and down position respectively. With the switch at NORMAL OXYGEN position the oxygen passes through a diluter demand route for normal operation. At 100% OXYGEN position the air-valve of the diluter demand route is closed and pure oxygen only is fed to the user's mask; this position should be selected if any doubt exists regarding the oxygen supply.

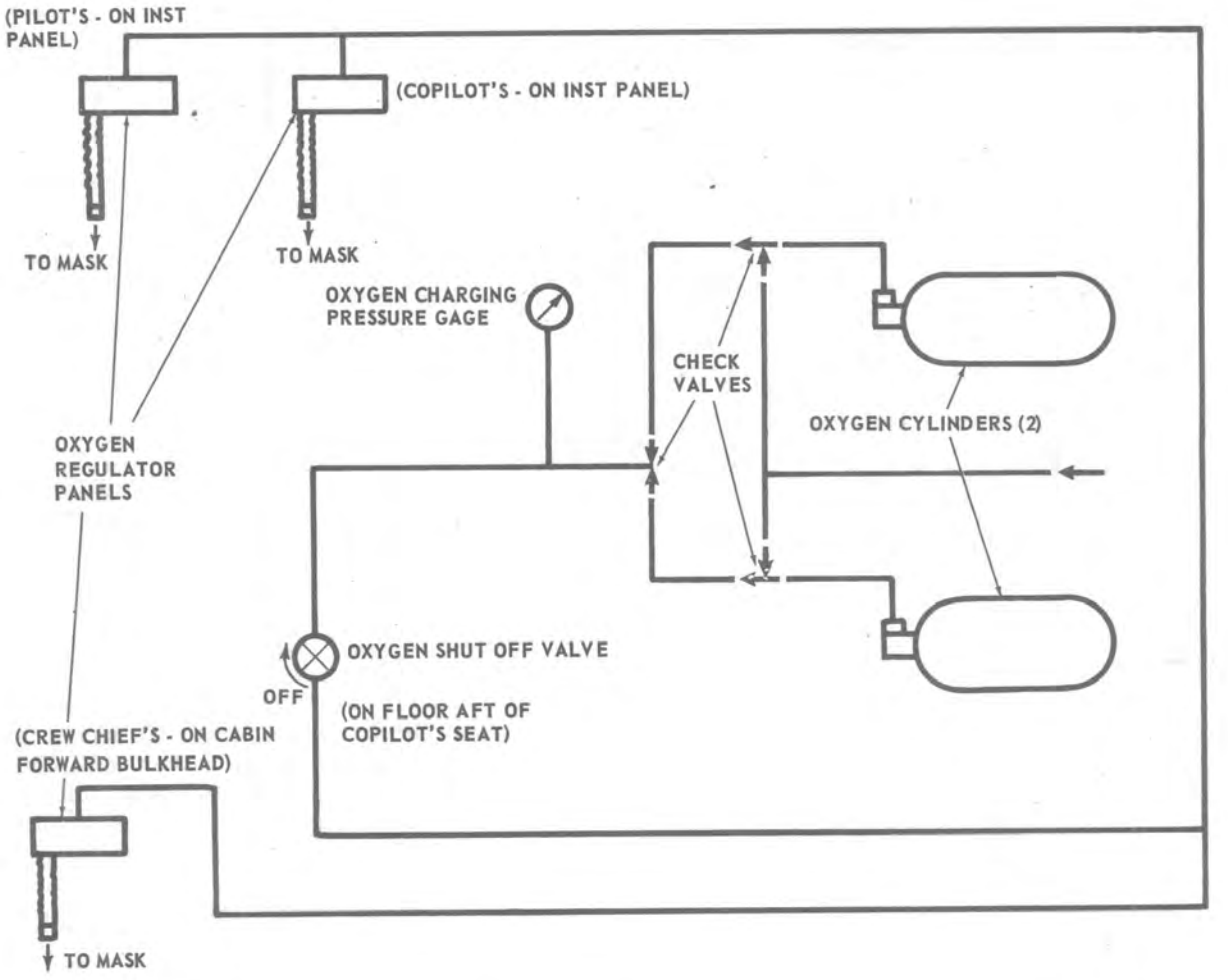
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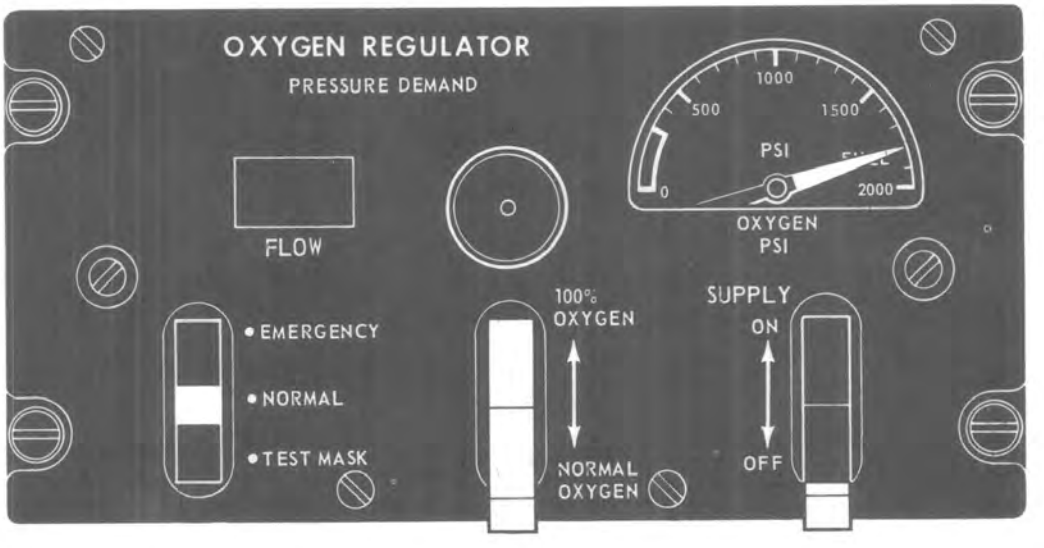
When 100% oxygen is used, the oxygen duration will be reduced.

c. Pressure Supply Switch (Red Color). The pressure supply three-position switch on the left of the panel is marked EMERGENCY and NORMAL at the up and center position respectively, and TEST MASK at the down (momentary) position which is selected against a spring tension. The switch should be at NORMAL position for routine operation to allow regulated oxygen pressure to be supplied to the user. At EMERGENCY position a continuous positive pressure of oxygen is supplied to the user regardless of altitude, to prevent hypoxia or unconsciousness. When the switch is held at TEST MASK position, oxygen at positive pressure is supplied to test the user's mask for leaks.

Caution

When positive pressures are required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to insure no leakage, then continued use of positive pressure under these conditions will result in the rapid depletion of the oxygen supply.





OXYGEN REGULATOR PANEL AT EACH CREW POSITION

4F32

Figure 6-7. Diluter demand oxygen system

OXYGEN DURATION IN HOURS

THREE CREW MEMBERS

CYLINDERS: 2-TYPE AN6025 AX386 — **DILUTER DEMAND SYSTEM**

ALTITUDE (FEET)	GAGE PRESSURE - PSI				
	1800	1600	1400	1200	1000
8000	0.8 3.3	0.7 2.9	0.6 2.6	0.5 2.2	0.4 1.8
10,000	0.8 3.6	0.7 3.2	0.6 2.8	0.6 2.4	0.5 2.0
12,000	0.9 4.0	0.8 3.6	0.7 3.1	0.6 2.7	0.5 2.2
14,000	1.1 4.4	1.0 3.9	0.9 3.5	0.7 3.0	0.6 2.5
15,000	1.2 4.6	1.1 4.1	0.9 3.6	0.8 3.0	0.7 2.5
20,000	1.5 4.2	1.3 3.8	1.2 3.3	1.0 2.8	0.8 2.4
25,000	2.0 2.4	1.8 2.1	1.6 1.9	1.3 1.6	1.1 1.3
30,000	2.6 2.6	2.4 2.4	2.1 2.1	1.8 1.8	1.5 1.5

NOTE: UPPER FIGURES INDICATE DILUTER SWITCH AT "100% OXYGEN"
LOWER FIGURES INDICATE DILUTER SWITCH AT "NORMAL OXYGEN"

4F33

Figure 6-8. Oxygen duration chart (diluter demand system)

6-96. Oxygen shutoff valve. The oxygen shutoff valve on the flight compartment floor aft of the copilot's seat is used to stop the flow of oxygen from the cylinders to the three oxygen regulator panels. The valve is marked OXYGEN SHUT OFF VALVE and OFF, and arrowed clockwise.

6-97. Cylinder filler valve and pressure gage. The cylinder filler valve and pressure gage are mounted to the right of the oxygen cylinders. The gage dial is marked OXYGEN CYLINDER PRESSURE and graduated from 0 to 2000 psi. A label below the gage is marked OXYGEN CHARGING, and below the filler valve it is marked CHARGING PRESSURE 1800 ± 50 PSI.

6-98. To turn on equipment. Before entering the aircraft check the oxygen cylinder pressure gage reading to insure there is sufficient oxygen for the mission. On entering the flight compartment turn the oxygen shutoff valve fully counterclockwise to allow the oxygen to flow to the oxygen regulator panels. When seated in position place the regulator panel supply switch to ON and check the oxygen supply pressure gage reading is within normal supply limits. Fit and connect mask then check oxygen flow and supply with diluter switch at 100% OXYGEN then at NORMAL OXYGEN with the pressure supply switch at NORMAL. Check supply with the pressure supply switch at EMERGENCY and at TEST MASK.

6-99. To turn off equipment. Move regulator panel supply switch to OFF. Before leaving the flight compartment turn the oxygen shutoff valve fully clockwise to OFF, and the regulator panel pressure supply switch to NORMAL.

Section VI

Auxiliary Power Unit

Refer to paragraph 6-115

Section VII

Armament System

Not Applicable

Section VIII

Photographic Equipment

Not Applicable

Section IX

Aerial Delivery Equipment

Refer to Chapter 13

Section X

Miscellaneous Equipment

6-100. Portable Oxygen Equipment. A portable oxygen unit, consisting of an oxygen bottle, sling and a face mask, is located on the rear of the pilot's seat. The unit is mainly for use in the event of a fire in the fuselage, or for use by a crew member having to go to the rear of the aircraft while at oxygen height.

6-101. Alarm Bell System. On aircraft 63-9718 and subsequent, a guarded spring-loaded toggle switch marked ALARM BELL is located on the TROOP JUMP - AIR SUPPLY panel (Chapter 13, figure 13-16), below the fuel control panel. On aircraft prior to 63-9718 the switch is located on the circuit breaker panel on the flight compartment bulkhead. Lifting the guard and holding the switch up will complete the circuit to a bell located on the right-hand cabin wall. The bell is of the vibrator type and will continue ringing until the switch is released. Power is supplied from the emergency bus.

6-102. Ignition Analyzer. An electrical connector is located on the forward face of the pilot's bulkhead, and is marked IGNITION ANALYZER. The connector is covered by a dust cap when not in use. A portable airborne-type ignition analyzer unit may be carried in the aircraft and, when operating, is used to detect, locate and classify any malfunction in the ignition system.

6-103. Windshield Wiper System. A windshield wiper system is installed for both the pilot's and copilot's windshield panels. The system consists of two interconnected windshield wipers, one for each panel, driven by a dc motor powered from the secondary bus and controlled by a rotary switch on the center switch panel.

6-104. Windshield wiper switch. The windshield wiper rotary switch located on the left of the electrical switch panel (Chapter 2, figure 2-12), is marked WIPER. The switch has six marked positions; PARK, OFF, FAST, 3/4, 1/2, and SLOW. To park the wipers, the switch is held momentarily in the PARK position and then released, when it will return to the OFF position.

Caution

An excessive load is imposed on the wiper motor if the wipers are operated on a dry windshield, and scratching of the windshield surface may result.

Note

If the switch is held in the PARK position for a prolonged period, the wipers will start to oscillate.

6-105. Mooring Points. On aircraft 61-2599 and subsequent, shackles are installed on the landing gear for the purpose of mooring the aircraft to the ground. On each main landing gear unit a shackle is bolted to the front of the shock strut at the drag strut attachment point. On the nose landing gear a shackle is bolted to the lug on the front of the shock strut.

6-106. Winterization. To improve the operational readiness of the aircraft at ambient temperatures below 32° F (0° C) certain systems and items of equipment can be installed. (See figure 6-9.) These consist of a hot fuel prime system, engine and engine accessory compartment preheat systems, and winterization covers.

6-107. Hot Fuel Prime System. A hot fuel prime system can be installed to facilitate engine starting in ambient temperatures below 32° F (0° C). Below ambient temperatures of 0° F (-18° C) engine preheat may be necessary in addition to hot fuel priming. The hot fuel priming system consists of hot fuel prime units, one in each engine nacelle, which heat the priming fuel enroute to the engines from the selected fuel tank. Each hot fuel prime unit is a compact heater unit, operating similar to the cabin heater, but with the electrical power being supplied from the primary bus through the up position of the hot fuel prime switch on the left-hand electrical switch panel. After the circuit has been powered for a few seconds to allow the heaters to reach operating temperature, the heated fuel is fed to the engine by actuating the engine primer switch as appropriate. When both engines are running smoothly, the hot fuel prime switch should be moved to OFF.

6-108. Hot fuel prime switch. The hot fuel prime toggle switch is adjacent to the battery master switch on the left-hand electrical switch panel and is marked HOT FUEL PRIME and OFF at the up and down position respectively. (See Chapter 2, figure 2-12.) The switch selects the electrical power to the heater circuit of the hot fuel prime units, and should be moved to the OFF position as soon as both engines have been primed and started through actuation of the engine primer switch.

6-109. Operation - Starting the Engines.

a. Appropriate fuel booster-pump switch - HIGH.

b. Inverter switch - MAIN. Note fuel pressure registers.

c. Hot fuel prime switch - HOT FUEL PRIME.

Note

Allow a few seconds for the heater units to reach operating temperature before proceeding further.

d. Ignition, starter and vibrator switches - As appropriate.

e. Engine primer switch - L or R as appropriate.

f. Throttle - Adjust for 800 rpm.

g. Mixture lever - AUTO RICH when engine is running smoothly on prime, then release engine primer switch when rpm starts to drop.

h. Generator switch - As appropriate.

i. Oil pressure - 30 psi minimum.

j. Repeat starting procedure for other engine.

k. Hot fuel prime switch - OFF, when both engines are running smoothly.

6-110. Engine Preheat System. An engine preheat system is provided to permit heating each engine and its accessory compartment to a reasonable temperature prior to starting the engines in still air temperatures of 0° F (-18° C) and below. The system consists of flexible piping which can be connected to an engine preheat outlet in the tee-duct at the discharge end of the cabin heater and to the snout of the engine covers. The cabin emergency exit door must be open to allow the flexible pipe to be connected to the engine preheat outlet. Air flow for ground operation of the cabin heater is supplied by a high-capacity fan in the combustion air bypass duct, and one in the ventilating air bypass duct. To obtain maximum flow of heated air through the engine preheat outlet, the cabin air control must be pulled to its closed position. The engine preheat flexible piping can be secured to the snout on the left-hand side of the engine covers for engine preheating, and/or to the preheat access at nacelle station 57.50, marked ACCESSORY COMPT PREHEAT CONNECT, for engine accessory compartment preheating. The preheat access adapter cover on each nacelle is secured by four quick-release fasteners; and has a spring-steel insert marked FIRE ACCESS which can be pushed in to allow fire extinguishing agent to be sprayed into the accessory compartment.

6-111. Operation.

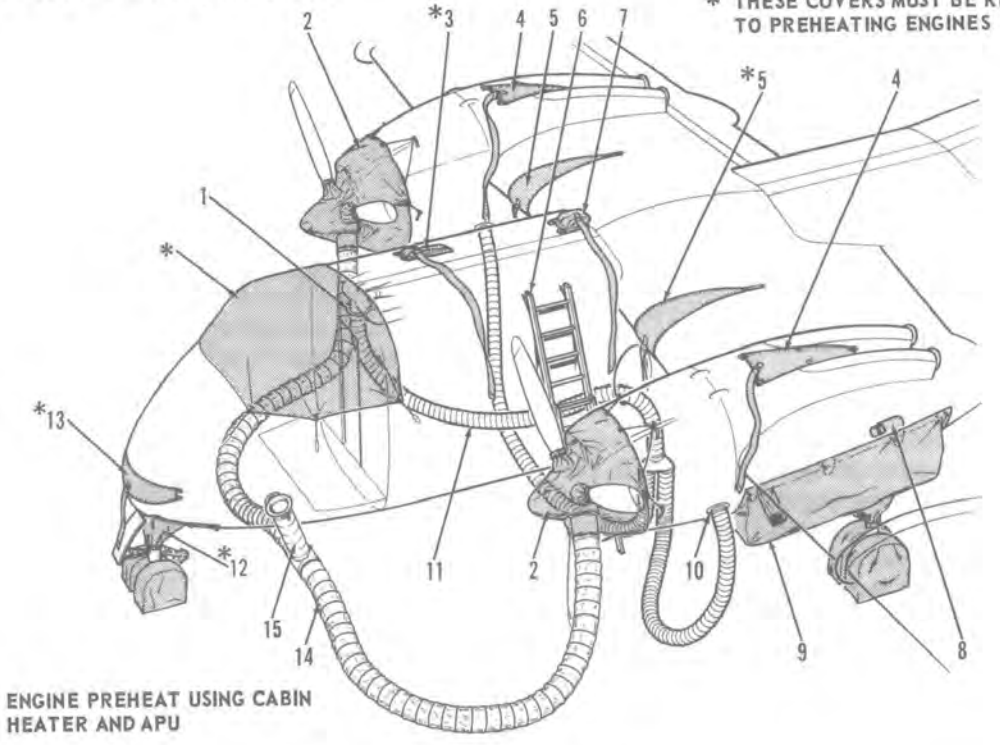
a. Flexible piping - Connect between engine preheat outlet and engine cover as appropriate.

Note

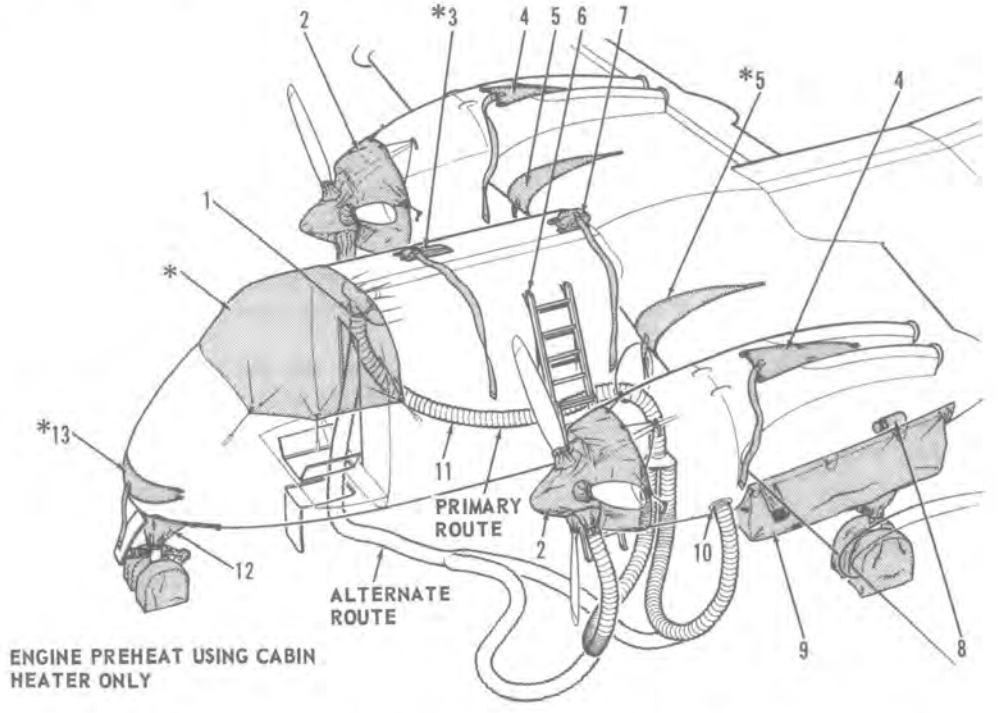
When the flexible piping is connected to the engine preheat outlet it actuates a cabin air control microswitch to permit operation of the cabin heater.

1. ENGINE PREHEAT OUTLET
2. SD5525-1 COVER, ENGINE
3. SD5606-1 COVER, AIR EXHAUST, CABIN HEATER
4. SD5638-1 COVER, AIR EXHAUST, OIL COOLER
5. SD5605-1 COVER, AIR INTAKE, LE CS WING
6. LADDER, FOLDING, LT WT
7. SD5607-1 COVER, AIR EXHAUST, CABIN HEATER
8. HOT FUEL PRIME UNIT (IN NACELLE)
9. SD5609-1 COVER, OPENING, MAIN LG
10. FIRE ACCESS AND PREHEAT ACCESS CONNECTION
11. PIPING, FLEXIBLE, ENGINE ACCESS. COMPT. PREHEAT
12. SD5611-1 COVER, OPENING, NOSE LG
13. SD5610-1 COVER, INLET AND EXHAUST, COCKPIT HEATER
14. PIPING, FLEXIBLE, ENGINE PREHEAT FROM APU EXHAUST
15. APU EXHAUST PIPE

* THESE COVERS MUST BE REMOVED PRIOR TO PREHEATING ENGINES



ENGINE PREHEAT USING CABIN HEATER AND APU



ENGINE PREHEAT USING CABIN HEATER ONLY

Figure 6-9. Winterization equipment - general arrangement

b. Flight compartment canopy cover, cabin heater forward air exhaust cover and left-hand wing air intake cover - Remove.

c. Cabin heater - Start as for ground operation, then pull the cabin air control to the closed (out) position.

Note

Secure cover on engine preheat outlet when preheat system is not in use, and push the cabin air control to its open (in) position.

d. Cockpit heater inlet and exhaust cover - Remove to permit ground operation of the flight compartment heater during preheating of the engine.

e. Engine preheat should be applied to one engine and its accessory compartment at the same time. Connect the preheat flexible piping to the preheat outlet, and to the engine cover snout and engine accessory compartment preheat access adapter. Maintain application of preheat until the cylinder head temperature gage indicates above 0°C, then transfer the flexible piping to the cold engine and its accessory compartment. Remove the engine cover and oil cooler air exhaust cover from the preheated engine, and start the engine using the hot fuel prime system (refer to paragraph 6-109). Allow the engine to warm up at 1000 rpm and carry out boil-off procedure detailed in Chapter 10, paragraph 10-27 and figure 10-2. Remove the flexible piping, engine cover, and oil cooler air exhaust cover from the engine being preheated when its cylinder head temperature gage indicates above 0°C, and proceed as for the operating engine. Select the hot fuel prime switch to OFF after both engines are operating.

6-112. Winterization Covers. Fifteen winterization covers are provided, twelve are installed externally and three internally. A lightweight folding ladder is provided for use when installing the external covers; the ladder length is 12 feet 1.7 inches when unfolded, and 7 feet 5.8 inches when folded.

6-113. External covers.

a. Engine Covers. Two engine covers, one for each engine, are stenciled ENGINE COVER SD5525-1, with TOP at the appropriate position to facilitate installation. Elastic cord assemblies with attachment rings are provided at the aft edge of each cover which are held secure to the nacelles by appropriately located ball-lok pins. Before installing an engine cover insure that the propeller blades are at the 2, 6, and 10 o'clock positions. The blade cuffs of the cover are secured to the propeller by means of elastic cord assemblies with ring and hook attachments. Insure that the heating duct snout of the cover is at approximately the 4 o'clock position.

b. Cabin heater intake and exhaust covers:

(1) Two covers, one for each cabin heater air intake in the leading edge of the wing center section, are stenciled SD 5605-1 COVER, AIR INTAKE LE CS WING and can be secured in position by means of two button fasteners. Each cover has a warning streamer. Remove left-hand cover before preheating the engines.

(2) A shaped cover stenciled SD 5606-1 COVER, AIR EXHAUST, CABIN HEATER can be slipped onto the cabin heater combustion air exhaust and secured in position by means of four button fasteners. The cover has a warning streamer. Remove this cover before preheating engines.

(3) A shaped cover stenciled SD 5607-1 COVER, AIR EXHAUST, CABIN HEATER can be slipped onto the cabin heater ventilating air exhaust and secured in position by means of two button fasteners. The cover has a warning streamer.

c. Landing gear covers:

(1) Two covers, one for each main landing gear opening, are stenciled SD 5609-1 COVER, OPENING, MAIN LG and FORWARD. Each cover can be secured in position by means of eight ball-lok pins, twenty button fasteners, and an elastic cord lacing at the rear panel.

(2) A cover for the nose landing gear opening is stenciled SD 5611-1 COVER, OPENING, NOSE LG and can be secured in position by means of fourteen button fasteners. Remove this cover before operating the APU, if installed.

d. Cockpit heater inlet and exhaust cover. A cover for the flight compartment heater air intakes and exhaust outlet is stenciled SD 5610-1 COVER, INLET AND EXHAUST, COCKPIT HEATER and can be secured in position by means of two button fasteners at the fuselage nose and to the heater exhaust on the right-hand side of the fuselage nose. The cover has a warning streamer.

Remove this cover before operating flight compartment heater during preheating of the engines.

e. Oil cooler air exhaust covers. Two covers, one for each oil cooler air exhaust, are stenciled SD 5638-1 COVER ASSY, OIL COOLER and can be secured in position by means of seven button fasteners. A warning streamer is attached to each cover adjacent to a stenciled instruction reading HANG WARNING STREAMER SD 2892-9 OVER LEADING EDGE OF WING. Remove appropriate cover before starting the engine.

6-114. Internal covers. Three covers colored sky-green are provided to block off the hot day ventilation louvers when the aircraft is being operated in winter climates. The covers are secured in position by means of the twelve existing attachment bolts at each louver.

6-115. Engine Preheat System (Using APU Exhaust Heat). On aircraft equipped with a gas turbine auxiliary power unit, an engine preheat system utilizing the APU exhaust heat is provided to permit heating both engines to a reasonable temperature prior to starting in still air temperatures of 0°F (-18°C) and below. The system (figure 6-9) comprises an exhaust pipe which can be connected to the APU exhaust outlet adapter on the left side of the fuselage nose, and a flexible duct assembly connected between the exhaust pipe tee-junction and the snout of each engine cover. Near the upper end of the exhaust pipe is a stub pipe which is engaged with the APU exhaust outlet adapter so that the lower tee end of the exhaust pipe is below the level of the fuselage. A chain is attached to the tee end of the exhaust pipe and the free end can be hooked onto an eyebolt marked APU EXHAUST PIPE SUPPORT on the fuselage left side above the battery location marking. The adapter ends of the flexible duct assemblies attach to the left and right ends of the tee-junction, and the other end connects into the respective engine cover snout. The exhaust pipe has two manually controlled butterfly-type valves, one at each end, and both are marked HOT and COLD at the closed and open position respectively. The upper valve controls the amount of cold ambient air entering the pipe to mix with the APU hot exhaust gases. The lower valve directs the hot gases to atmosphere when the valve is at the COLD position, or to the engine covers when the valve is at the HOT position. A bimetal thermometer with a range from 150° to 750°F (65.5° to 398.9°C) protrudes into the exhaust pipe just above the tee-junction and shows the temperature of the hot gases in the pipe.

6-116. Operation.

a. Remove APU exhaust outlet cover.

b. Securely install exhaust pipe on APU exhaust outlet adapter, hook chain to exhaust pipe support eyebolt.

c. Connect flexible duct assembly between exhaust pipe tee-junction and the respective engine cover snout.

d. Insure engine cover snout is securely laced to its flexible duct assembly.

e. Set exhaust pipe upper and lower valves to COLD position.

f. Remove nose gear well cover.

g. Start APU.

h. After one minute adjust exhaust pipe upper valve to give 250°F (121.1° C) maximum temperature.

i. Set exhaust pipe lower valve to HOT position to direct hot gases to engine cover snouts.

6-117. Engine Accessory Compartment Preheat System. The engine accessory compartment preheat system utilizes cabin heater hot air fed through an engine preheat outlet and a flexible duct assembly to each engine accessory compartment. The engine preheat outlet is on the tee-duct at the discharge end of the cabin heater. The engine accessory compartment preheat connection is on the left-hand side of each engine nacelle at station 57.50, and is marked ACCESSORY COMPT PREHEAT CONNECT. The preheat connection has a cover secured by four quick-release fasteners; and has a spring-steel insert marked FIRE ACCESS which can be pushed in to allow fire extinguishing agent to be sprayed into the accessory compartment. The flexible duct assembly has three ducts joined together at a Y-junction; the duct from the column of the junction is led into the fuselage and attaches to the engine preheat outlet of the cabin heater, and the ducts from the arms of the junction attach one to each engine accessory compartment preheat connection. Air flow for ground operation of the cabin heater is supplied by a high-capacity fan in the combustion air bypass duct, and one in the ventilating air bypass duct. To obtain maximum flow of heated air through the engine preheat outlet, the cabin air control must be pulled to its closed position.

6-118. Operation.

a. Remove engine accessory compartment preheat connection cover from each nacelle, and attach appropriate flexible duct.

b. Pass the flexible duct from the Y-junction column into the fuselage through the opened cabin emergency exit.

c. Remove engine preheat outlet cover and attach the flexible duct to the adapter.

d. Remove appropriate external covers from heater inlet and exhaust ducts.

e. Pull the cabin air control to its closed position.

f. Initiate cabin heater ground operation.

CHAPTER 7
OPERATING LIMITATIONS

Section I

Scope

7-1. This chapter covers all important limitations that must be observed during normal operation of the aircraft.

7-2. Certain other limitations that are characteristic only of a specialized phase of operation will be found in their appropriate chapters.

Section II

Limitations

7-3. Instrument Markings. Instrument markings, in accordance with TM 1-5-1-2, are shown in figure 7-1 and give limitations which are not repeated elsewhere in this manual. Limitations for a specific phase of operation will be found in the text under the appropriate heading.

7-4. Minimum Crew Requirements. The normal crew consists of a pilot, copilot and flight crew chief. Additional crew members as required will be added at the discretion of the commander, in accordance with appropriate Department of the Army Regulations.

7-5. Engine Limitations. Engine limitations are marked on the instruments (figure 7-1). In addition, the following limitations should be observed:

a. Cylinder head temperature before stopping engines (to prevent damage by rapid cooling): Maximum 200°C. Pre take-off cylinder head temperature: Maximum 170°C.

b. Oil Pressure:

Normal operating range:	
2000 - 2200 rpm	65 - 100 psi
1600 rpm	55 - 90 psi
1400 rpm	45 psi Minimum
Idling	15 psi Minimum
Take-off:	80 psi Minimum
	110 psi Maximum

7-6. Engine overspeeding. Whenever engine speed exceeds a limit of 3050 rpm, the aircraft should be landed as soon as possible. An engine inspection is a requirement under these conditions. An overspeed in excess of 3300 rpm requires engine removal.

7-7. Engine idling. Engines should idle at a speed of 550 ± 25 rpm.

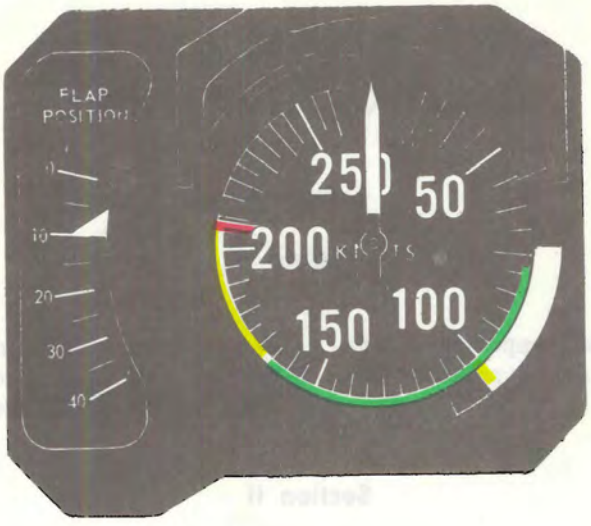
Note

Spark-plug fouling will result from prolonged idling below 1000 rpm.

7-8. RPM restriction. It is recommended that operation of the engine in the range 2310 to 2510 rpm be avoided. Climb should be at or below 2300 rpm, except where operational conditions may require the use of 2550 rpm. Avoidance of this rpm range will lessen the possibility of crankshaft failures.

7-9. Alternate Fuel Grade. The recommended alternate fuel is MIL-G-5572, Grade 100/130. (Refer to TB AVN 2.) The engine operating limits do not change when using this fuel.

7-10. Propeller Limitations. To reduce the possibility of propeller overspeeding during unfeathering, maintain the airspeed below 130 knots IAS. In addition, do not hold the unfeathering button in the unfeather position longer than necessary; it should be released before the engine speed reaches 800 rpm, preferably at 500 to 600 rpm.



AIRSPEED INDICATOR

FIXED MARKINGS.

73-165 KNOTS - STALL SPEED (FLAPS 0°/ GEAR UP) TO NORMAL OPERATING LIMIT SPEED

165-208 KNOTS - NORMAL OPERATING LIMIT SPEED TO NEVER EXCEED SPEED

208 KNOTS - NEVER EXCEED SPEED

MOVING MARKINGS IN RIM, DENOTING MAXIMUM FLAP SPEEDS AND STALLING SPEEDS. (NOTE: THE WHITE AND YELLOW MARKINGS MOVE TOGETHER)

FLAPS EXTENDED SPEED RANGE - FROM MAXIMUM FLAP SPEED TO STALLING SPEED

FLAP SELECTION AND EXTENSION SPEED - MAXIMUM



DE-ICING SUCTION

4--8 IN.Hg.NORMAL RANGE

4 AND 9 IN.Hg.MINIMUM AND MAXIMUM



DE-ICING PRESSURE

14 - 16 PSI. NORMAL RANGE

10 AND 18 PSI. MINIMUM AND MAXIMUM

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Figure 7-1. Instrument markings (sheet 1 of 3)



OIL/FUEL PRESSURE

- OIL - 45 - 90 PSI. NORMAL RANGE
- OIL - 45 AND 110 PSI. MINIMUM (AT 1400 RPM) AND MAXIMUM (AT TAKE-OFF)
- FUEL - 16 - 18 PSI. NORMAL RANGE
- FUEL - 16 AND 18 PSI. MINIMUM AND MAXIMUM



OIL TEMPERATURE

- 60°C - 75°C. NORMAL RANGE
- 40°C AND 93°C. MINIMUM (FOR RUN-UP) AND MAXIMUM (AT TAKE-OFF OR DURING CLIMB)



CARBURETOR AIR TEMPERATURE

- -30°C TO +10°C. UNDESIRABLE CONDITION MAY EXIST, DEPENDING ON ATMOSPHERIC CONDITIONS
- -30°C TO +38°C. BEST OPERATING CONDITION, DEPENDING ON ATMOSPHERIC CONDITIONS (MAXIMUM 38°C WHEN USING CARBURETOR HEAT)
- +50°C. MAXIMUM - DANGER OF DETONATION (MAXIMUM WITHOUT CARBURETOR HEAT)

FUEL GRADE 100/130

4F-101 (SHT 2)

Figure 7-1. Instrument markings (sheet 2 of 3)

TACHOMETER



- 1700 - 2200 RPM AUTO LEAN PERMITTED
- 2200 - 2310 RPM AUTO RICH REQUIRED
- 2510 - 2550 RPM AUTO RICH REQUIRED
- 2310 - 2510 RPM PROHIBITED - EXCEPT PASSING THROUGH
- 2700 RPM MAXIMUM TAKE-OFF (5 MIN LIMIT)

AIRCRAFT SERIAL NO. 60-3762 THRU 61-2597
HAVE 2 SINGLE POINTER INSTRUMENTS

MANIFOLD PRESSURE



- 15 - 33 IN. Hg AUTO LEAN PERMITTED
- 33 - 42.5 IN. Hg AUTO RICH REQUIRED
- 50 IN. Hg MAXIMUM TAKE-OFF AT SEA LEVEL (5 MIN LIMIT)

CAUTION:
REDUCE TAKE-OFF MANIFOLD PRESSURE 1.0 IN. Hg FOR EACH 10°C BELOW STANDARD CARBURETOR AIR TEMPERATURE

AIRCRAFT SERIAL NO. 60-3762 THRU 61-2597
HAVE 2 SINGLE POINTER INSTRUMENTS

CYLINDER HEAD TEMPERATURE



- 150°C - 232.2°C AUTO LEAN PERMITTED
- 232.2°C - 260°C AUTO RICH REQUIRED
- 260°C MAXIMUM - 1 HOUR LIMIT WITH 41.5 IN. Hg (42.5 IN. Hg AT SEA LEVEL) AND 2550 RPM

FUEL GRADE 100/130

4F-101(1) (SHT 3)

Figure 7-1. Instrument markings (sheet 3 of 3)

7-11. Airspeed Limitations. The instrument limit markings (figure 7-1), and other speeds noted in this chapter, show indicated airspeed values. They are applicable to an airspeed indicator without instrument error.

7-12. Flap lowering speed limitations. To avoid imposing excessive airloads on the aircraft structure, the following speeds must not be exceeded. These speeds are marked on the limitations label in the flight compartment. The moving yellow radial on the airspeed indicators will constantly indicate the maximum speed for each flap setting.

FLAP SETTING (All Engine Powers)	MAXIMUM AIRSPEED IAS - KNOTS
0 - 15°	105
20°	95
30°	85
40°	80

7-13. Maneuvering speed. Maneuvers which involve full application of rudder or aileron must be confined to speeds below 119 knots IAS. This is also the maximum penetration speed, and should not be exceeded when flying in turbulent air.

7-14. Normal operating speed. The normal operating speed below 10,000 feet is 165 knots IAS. Above 10,000 feet the IAS must be reduced by 3 knots for each 1000 feet increase in altitude.

7-15. Never exceed speed. The never exceed speed below 10,000 feet is 208 knots IAS. Above 10,000 feet the IAS must be reduced by approximately 1-knot for each 1000 feet increase in altitude.

7-16. Landing gear operating speed. The maximum speed for extending or retracting the landing gear, or flying with the gear down, is 120 knots IAS.

7-17. Prohibited Maneuvers. All aerobatics are prohibited. To clarify the meaning of aerobatics, the following list details maneuvers that are prohibited:

a. Loops.

b. Rolls.

c. Spins. (Refer to Chapter 8, paragraph 8-13.)

d. Steep turns above 60° bank angle.

e. Stall turns.

f. Stalls - Except under certain conditions. Refer to Chapter 8, paragraph 8-7, Warning.

g. Abrupt maneuvers involving full control deflection at airspeeds above 119 knots IAS.

h. Inverted maneuvers.

7-18. Acceleration Limitations. An Operating VG diagram is shown in figure 7-2 and applies from sea level to 10,000 feet. The boundary lines show airspeeds and load factors which must not be exceeded under any circumstances.

7-19. The maneuver speed line is marked at 119 knots IAS, and is the limit airspeed for maneuvers involving full control deflection. At or below this speed it is impossible to exceed the limit load factors, as the aircraft will stall. Above this speed maneuvers may be performed which do not involve full control movements, provided the limit load factors are not exceeded. Further, it must be remembered that turbulent air or gusts impose "g" loading on the aircraft structure even in straight and level flight, and this is additional to any loading the pilot is imposing through maneuvers. For this reason, on a gusty day, the aircraft should be slowed down to maneuver speed and pilot imposed "g" must be kept to a minimum. Refer to Chapter 10 paragraph 10-52, for thunderstorm penetration.

7-20. The red area on the VG diagram is the unsafe area, but if entered inadvertently it does not mean that the aircraft will fail structurally at this point. However, operation in this area involves an increasing risk of permanent deformation and may result in catastrophic failure.

7-21. Center of Gravity Limitations. When loading the aircraft, particular attention should be paid to keeping the center of gravity within the prescribed limits, shown on Chart E (Chapter 12, figure 12-4). With the cg at its forward limit the stalling speed of the aircraft is at its highest value. The stalling speeds given in Chapter 8 are with the cg at its forward limit with power for zero thrust. With the cg at its aft limit there is some deterioration in the stall characteristics, although the actual stalling speed is slightly lower. There is no effect on taxiing with the cg at either the fore or aft limit.

7-22. Weight Limitations. The maximum permissible weight at which the aircraft can be operated varies within broad limits, depending on certain weight controlling criteria. The following paragraphs show how the maximum permissible weight is dependent on this criteria.

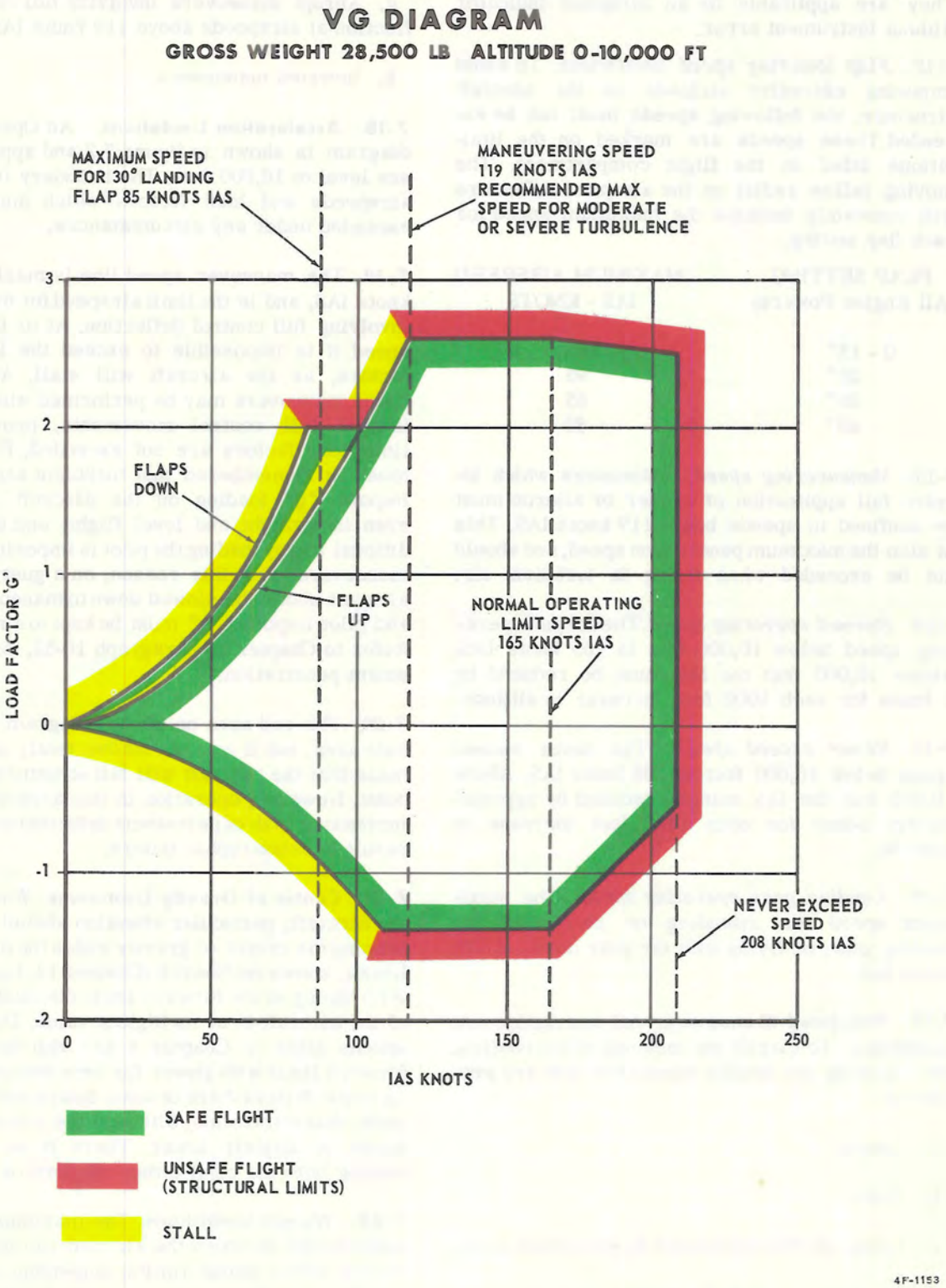


Figure 7-2. VG diagram

7-23. Operating weight. The operating weight on which the Weight Limitations Chart (figure 7-3) is based, is 19,446 pounds. This assumed value is an approximate weight which includes the average aircraft basic weight plus three crew and full oil. Since individual aircraft basic weights vary, it will be necessary to adjust the chart for specific aircraft as shown in the sample problems.

7-24. Gross weight. The maximum permissible gross weight is 28,500 pounds. At this weight all airworthiness requirements are met with a margin of safety. The maximum gross weight of the aircraft is indicated by the diagonal line shown on the Weight Limitations Chart (figure 7-3).

7-25. Margin of safety and load factors. As an aircraft is loaded to higher weights its ability to withstand additional loads, resulting from turbulent air or maneuvers, decreases proportionately. The amount of additional loading that the aircraft will withstand before failure occurs is termed the margin of safety. If the mission requires excessive maneuvering in turbulent air, a larger margin of safety should be maintained. Load factors are used as an indication of the margin of safety that is available.

7-26. Performance limitations. In some instances, it may be found necessary to limit the maximum permissible gross weight of the aircraft, not because of structural considerations but because of reduced performance due to the higher weight. Maximum take-off gross weight is limited by the ability of the aircraft to take-off within the available distance at a particular field elevation and to clear obstacles. (Refer to Take-off Performance Charts, Chapter 14.)

7-27. Weight Limitations Chart. The green area below the maximum gross weight line on the Weight Limitations Chart (figure 7-3) represents the loading conditions that present no particular problem with regard to strength or performance of the aircraft. The red area above the maximum gross weight line represents loadings which are not recommended except under emergency conditions. See Chapter 14, figure 14-15 or 14-69 for the Take-off Gross Weight Limitations under one engine fail conditions, to maintain a 100 fpm rate of climb.

7-28. Weight Limitations Chart examples. To arrive at the weight of fuel and cargo loads, subtract the weight of the crew, plus oil, plus the aircraft basic weight from the aircraft gross weight as shown in the following example:

Gross Weight (with standard tanks)		28,500 lb
Basic Weight (assumed)	18,576 lb	
Crew (3)	600 lb	
Oil (full)	270 lb	
Operating Weight	19,446 lb	
		19,446 lb
Fuel plus cargo load		9054 lb

Thus as long as any combination of fuel and cargo load does not exceed the 9054 lb (in this example) the aircraft is loaded within the normal weight. However, since the actual Basic Weight of each aircraft varies, (Chart C in the DA Form 2391 binder) and the Operating Weight on which the chart is based is 19,446 lb, it will be necessary to adjust the result from the chart accordingly. The intersection of the cargo load and fuel load axes at 0 represents the aircraft operating weight of 19,446 lb. If the actual basic weight is less than 18,576 lb, the aircraft can carry that amount more; if the actual basic weight is more than 18,576 lb, the aircraft can carry that amount less.

Example 1. What is the maximum cargo load that can be carried under normal conditions with full standard fuel tanks, if the Operating Weight is 19,000 lb?

Referring to figure 7-3, maximum fuel load is 4968 lb (with standard tanks) on the horizontal base line. Project vertically upward to intersect the 28,500 lb diagonal line. Project horizontally from this point to the cargo load line and read 4086 lb approximately. Since actual Operating Weight is 19,446 - 19,000 = 446 lb less than assumed, the cargo load that can be carried is 4086 + 446 = 4532 lb.

Example 2. What is the maximum fuel load that can be carried with a cargo load of 5000 lb when the Operating Weight is 19,600 lb, under normal conditions?

As the gross weight will be 28,500 lb; from the 5000 lb point on the cargo load scale project horizontally to the 28,500 lb diagonal line, then vertically down to the fuel load scale and read 4054 lb approximately. Since actual Operating Weight is 19,600 - 19,446 = 154 lb more than assumed, the fuel load that can be carried is 4054-154 = 3900 lb.

WEIGHT LIMITATIONS CHART

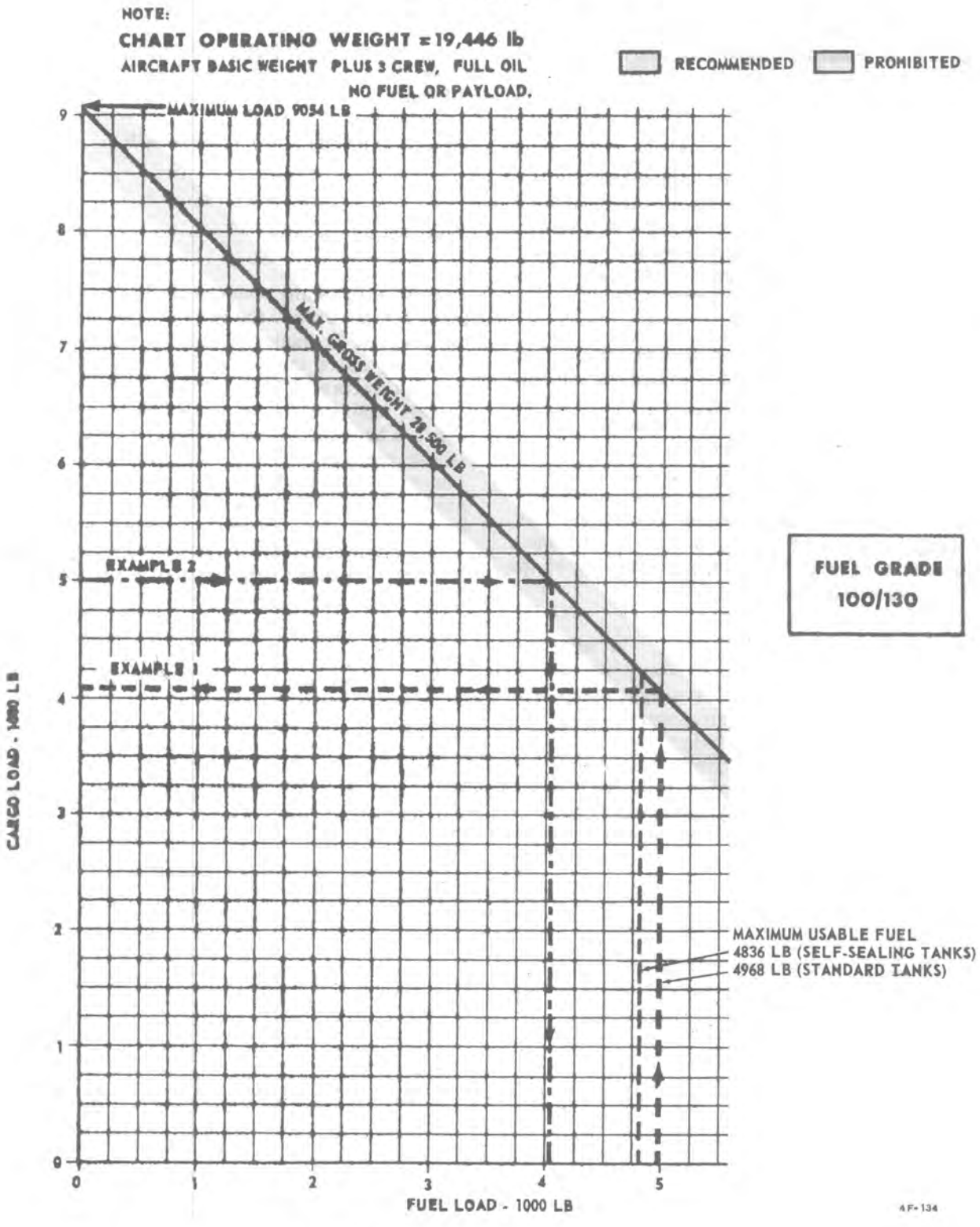


Figure 7-3. Weight limitations chart

7-29. Zero fuel weight. The zero fuel weight is defined as the design maximum weight with no disposable fuel, and determines the maximum weight which can be carried in the fuselage. The zero fuel weight is 27,000 lb maximum, and all weight in excess of this figure up to the maximum gross weight of 28,500 lb must consist of fuel for structural reasons. Fuel must be distributed equally on both sides of the aircraft center line.

7-30. Ground Pressure. The ground pressure of the aircraft's wheels on the runway is given in figure 7-4. The table is based on the assumption that the aircraft's tires are inflated to the normal operating pressures.

AIRCRAFT WEIGHT	CENTER OF GRAVITY	GROUND PRESSURE PSI*	
		MAIN WHEEL	NOSE WHEEL
OPERATING WEIGHT 19,446 LB	FWD (26% MAC)	39	46
	AFT (39% MAC)	40	45
GROSS WEIGHT 26,000 LB	FWD (31% MAC)	42.5	48
	AFT (39% MAC)	43	48
GROSS WEIGHT 28,500 LB	FWD (31% MAC)	43.5	48
	AFT (39% MAC)	44	48
*BASED ON TIRE PRESSURES OF 35 TO 40 PSI			4F-114

Figure 7-4. Ground pressure

CHAPTER 8
FLIGHT CHARACTERISTICS

Section I

Scope

8-1. This chapter describes the flight characteristics of the aircraft in various configurations.

8-2. Thorough coverage is given on stall characteristics and maneuvering flight.

Section II

Aircraft Systems and Controls Description

8-3. General. The aircraft has no unusual flight characteristics and is stable in all configurations. Handling of the aircraft is unaffected when flying with the ramp horizontal and cargo door open. Control is good over the entire speed range, and with power on and full flap lowered the aircraft is controllable down to speeds approaching the stall. (Refer to paragraph 8-10.) Relatively large control surfaces are used to attain this control at low speed, which may lead initially to a tendency to overcontrol in the higher speed ranges. A two-stage stall warning system is installed which operates control column shakers at a predetermined margin above the stalling speed in any configuration. The artificial warning system has been incorporated because prestall buffet, in most cases, is not evident.

8-4. Stalls. The following paragraphs describe the stall warning system, stalls, and stall characteristics.

8-5. Stall warning. A low and high intensity stick shaker stall warning system is installed which vibrates both control columns at a predetermined margin above the stalling speed. As the aircraft approaches stall speed the vane of a lift transducer in the wing leading edge responds to movement of the airflow stagnation point and varies the voltage to a lift computer. The lift computer compensates this voltage for flap position, detected by a flap position potentiometer, and operates the stick shakers to vibrate both control columns. The low intensity stick shakers operate at approximately 10 knots above stalling speed at all power and flap settings. The high intensity stick shakers provide a stronger vibration at approximately 5 knots above stalling speed when either or both throttles are more than 3/4 inch forward of the fully closed position on the console, and the flap setting is greater than 19°. A stall warning test switch on the pilot's instrument panel allows for testing the system.

8-6. Aerodynamic buffet. Aerodynamic buffet is very slight and can only be felt if the stick shaker stall warning system is inoperative.

8-7. Stall characteristics. Powerful high lift devices have been employed to provide very low stalling speeds. As a result the handling characteristics approaching the actual stall are not identical for all combinations of center of gravity, flap and power settings. However, under all conditions, the initial warning is provided by the artificial two-stage stall warning stick shaker system.

Warning

It is recommended that a deliberate approach to the stall for training or demonstration purposes be terminated at the onset of artificial warning, in all flap and power configurations. The aircraft will be loaded to maintain a mean or forward CG.

8-8. Power-off stall -all configurations. The stall, with engines set for zero thrust and flaps at 0° to 40°, is straightforward. Refer to figure 8-1 for applicable airspeed and flap settings.

8-9. Power-on stall - clean configuration. With power-on (defined as approximately 600 bhp per engine) in the clean configuration, the approach to the stall is straightforward with little tendency to

4F-740

STALLING SPEEDS VS ANGLE OF BANK

POWER FOR ZERO THRUST

MODEL: CV-2
DATE: APRIL 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR) **CG-FORWARD LIMIT**

ANGLE OF BANK			0°	15°	30°	45°	60°
LOAD FACTOR			1.0	1.04	1.15	1.41	2.0
GROSS WEIGHT POUNDS	WING FLAPS	LANDING GEAR	STALLING SPEED - CAS KNOTS				
20,000	0°	UP	64	65	68	76	90
	7°	UP	59	60	63	70	83
	15°	UP	55	57	59	66	79
	25°	UP	52	53	56	62	73
	30°	DOWN	50	51	54	60	71
	40°	DOWN	47	48	51	56	67
22,000	0°	UP	67	68	71	79	94
	7°	UP	62	63	67	74	88
	15°	UP	58	59	62	69	83
	25°	UP	54	55	58	64	77
	30°	DOWN	53	54	57	63	74
	40°	DOWN	50	51	53	59	70
24,000	0°	UP	69	70	74	82	98
	7°	UP	64	66	69	77	91
	15°	UP	60	62	65	72	86
	25°	UP	56	57	61	67	80
	30°	DOWN	55	56	59	65	78
	40°	DOWN	52	53	55	61	73
26,000	0°	UP	72	73	77	85	102
	7°	UP	67	68	72	80	95
	15°	UP	63	64	67	74	89
	25°	UP	58	59	63	69	83
	30°	DOWN	57	58	60	68	80
	40°	DOWN	54	54	58	64	76
28,500	0°	UP	75	76	80	89	106
	7°	UP	70	71	75	83	98
	25°	UP	61	62	65	72	86
	30°	DOWN	59	60	64	70	84
	40°	DOWN	56	57	60	66	79

Figure 8-1. Stall speed chart

yaw. At the point of stall the nose falls away and either wing may drop with a slight tendency for the aircraft to roll.

8-10. Power-on stall - landing configuration. With power-on in the landing configuration, the stall occurs at 43 knots CAS (A); 46 knots CAS (B); and 45 knots CAS (B) SF. During the approach to the stall, approximately 20% right rudder is required to maintain direction, while the wings are held level through the normal use of the aileron. During the stall the wings may be maintained level through the combined use of full aileron and rudder, until the aircraft pitches nose down. The airspeed indicator does not register these speeds, but falls well below them.

8-11. Stall recovery. Recovery from the stall is effected in the normal manner. As soon as flying speed is regained the aircraft should be eased out of the ensuing dive. If the gear or flaps are down, avoid exceeding the limiting airspeed for gear or flaps. 208Kts reducing with alt under

8-12. Practice stalls. Practice stalls may be carried out at a safe altitude provided the Warning following paragraph 8-7 is observed.

8-13. Spins. Intentional spins are prohibited. If a spin is entered inadvertently, normal recovery procedure for a two-engine aircraft is recommended i.e. close the throttles, apply full opposite rudder and ease the control column progressively forward until the spin stops. If the spin does not stop, apply power to the inner engine.

8-14. Diving. During a dive all flight control pressures increase with airspeed. Use normal recovery methods from a dive and do not exceed the maximum speed for altitude stated in Chapter 7, paragraph 7-15.

8-15. Maneuvering Flight. Turns should be entered, sustained and completed with coordinated movements of the flight controls. A turn should be entered with sufficient airspeed to insure that an inadvertent stall will not occur. Refer to Stall Speed Chart, figure 8-1. Steep turns, up to 60° bank angle, can be completed without loss of height provided sufficient power and airspeed are attained before entering the turn. Maneuvers which involve full movement of a flight control should be entered at or below an airspeed of 119 knots IAS.

8-16. Single-engine Flight Characteristics. Refer to Chapter 4.

Section III

Control Characteristics

8-17. Flight Controls. Aileron, elevator, rudder and trim tab control is normal throughout the speed range of the aircraft. The controls are light and effective at all aircraft gross weights, down to the very low speeds at which the aircraft can be flown. Refer to Chapter 2, Section II for description of the flight controls.

8-18. Ailerons. The ailerons are effective down to the stall, and lateral control is adequate; larger control movements being required as speed is reduced. With the flaps up, the range of movement of the outer ailerons is 21° up and 16.5° down, while that of the inboard ailerons is only 9.5° up and 5° down. As the flaps are lowered the ailerons droop with the flaps and, in addition, the available range of aileron movement increases. With full flap lowered the outer ailerons range is 22.5° both up and down; while the range of the inboard ailerons increases considerably, to 20° up and 14.5° down. This has the effect of 'heavying-up' the aileron controls as the flaps are lowered. However, lateral control is augmented by having the increased aileron surface available at low speeds. At high speeds, with the flaps up, the aileron forces are light and comfortable.

8-19. The hinged tab on the inboard right-hand aileron is actuated by rudder movement and has the effect of increasing the dihedral and raising the low wing in a sideslip. The geared tabs, one on each outboard aileron, reduce the force which the pilot requires to move the aileron control. The trim tab, on the right-hand outboard aileron, is used to trim the aircraft laterally in flight.

8-20. Elevator. The elevator is effective throughout the speed range of the aircraft and to below the stall. Two trim tabs and two spring tabs are fitted to the elevator. The trim tabs are used to trim the aircraft longitudinally during all flight conditions. In addition, longitudinal trim is automatically maintained by an interconnect between

the flap mechanism and the horizontal stabilizer when the flaps are operated. The horizontal stabilizer angle of incidence is altered during flap operation to compensate for trim changes incurred by flap movement. The spring tabs move by the initial pilot effort at the control column and lighten the elevator loads. The amount the tabs move, for a given pilot force, varies with airspeed so that less assist is given at the higher speeds.

8-21. Rudder. The rudder, due to its relatively large area, is particularly effective at very low speeds and also during asymmetric flight. A geared trim tab and a spring tab are fitted to the rudder. The geared trim tab is used to trim the aircraft about the normal axis, particularly during asymmetric flight. In addition, this tab is geared to the rudder control and reduces the force the pilot requires to move the control. The spring tab operates in a similar manner to the spring tab fitted to the elevator.

8-22. Level Flight Characteristics Under Various Speed Conditions. Provided the center of gravity is within the prescribed limits and the aircraft is correctly trimmed, level flight characteristics are smooth and normal throughout the speed range of the aircraft. At 28,500 pounds gross weight with the landing gear extended and 30° flap, the aircraft can be flown level at 55 knots IAS. When flying the aircraft at slow speeds a large application of the aileron control will be required to maintain wings level. In addition, any lateral displacement should be corrected rapidly, particularly in gusty conditions. If a wing is allowed to drop beyond the corrective action of full aileron, power should be increased immediately to regain level flight.

CHAPTER 9
SYSTEMS OPERATION

Section I

Scope

9-1. This chapter provides information, in some cases additional to that already covered in other chapters, regarding the operation of certain aircraft systems.

9-2. Lengthy or involved procedures applicable to a system which could not be appropriately located in any other single place in the manual are included in this Chapter.

Section II

Systems

9-3. Power Plant and Related Systems. The following paragraphs discuss the power plant and its related systems.

9-4. Exhaust system and engine cooling. The exhaust gases from each engine pass from two groups of four exhaust pipes into augmentor tubes and are directed rearward over the upper surface of the root flaps. An open space exists between the exhaust stacks and the mouth of the augmentor tubes. When the engine is operating, exhaust gas is ejected from the stacks into the augmentors and the force of the exhaust creates a partial vacuum at the mouth of each augmentor, causing air that has entered the engine section around the propeller hubs to rush into the augmentors. This action continuously draws cooling air across the engine, in addition to the normal airflow caused by the aircraft speed. The augmentor cooling air is automatically proportioned to the power setting at all times, and this is an advantage when climbing with high power and low forward speed. The action of the high velocity exhaust gases through the augmentors gives a jet thrust effect which provides some positive thrust power at low airspeeds and high power settings. The thrust is considered sufficient to eliminate cooling drag.

9-5. Detonation. Detonation is one of the principal hazards associated with the operation of a high output engine. It is the result of sudden exploding of the charge in the cylinder, as compared to the steady release of energy occurring in the progressive and relatively slow burning of the mixture during normal combustion. During detonation severe pressure waves and excessive heat develops and may cause engine damage if prolonged. An engine "knock" is present but usually is not audible, and the only warning a pilot has is a rapid increase in cylinder head temperature. The following factors contribute to the tendency of detonation in an engine: excessive manifold pressure; insufficient cooling; lean fuel-air mixture; excessive carburetor air temperature; faulty ignition system; fuel of low anti-knock (octane) value. If engines are operated within the specified limits, on the recommended grade of fuel, and with carburetor and ignition systems in normal condition, detonation should not occur.

9-6. Power settings. It is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. If a large reduction in power is necessary during descent, reduce rpm as well as manifold pressure. It is recommended that for each 100 rpm at least 1 in. Hg manifold pressure be maintained. Operation at high rpm and low manifold pressure should be kept to a minimum.

9-7. Carburetor air temperature. The carburetor air temperature gage registers the temperature of the air in the air intake of the relevant engine. The instrument markings shown in Chapter 7, figure 7-1, for this gage do not attempt to show a definite temperature at which carburetor heat should be used. Atmospheric conditions conducive to carburetor icing, together with the air tem-

perature, must be taken into account when deciding upon the use of carburetor heat. The following paragraphs discuss icing conditions, and will aid in this decision.

9-8. Carburetor icing. The following atmospheric conditions contribute to carburetor icing:

a. Visible freezing or subfreezing moisture which forms ice in the air intake, and in and on the carburetor metering elements.

b. High atmospheric humidity with a carburetor air intake temperature below +3°C forms ice on the throttle valve at partial throttle opening.

c. High atmospheric humidity with a carburetor air intake temperature below +10°C forms ice in the region between the carburetor and the impeller.

d. Severe low temperature conditions, when the aircraft is exposed for many hours, can lower the fuel temperature to a point where it will cause icing in the internal passages of the carburetor during subsequent operation in a high humidity atmosphere. This condition is not likely to occur when the temperature of the fuel entering the carburetor is at or above 0°C.

9-9. Indications of carburetor icing generally appear as follows:

a. Decrease in power and possibly manifold pressure.

b. Erratic engine operation due to ice on the metering elements.

c. Drop in cylinder head temperature.

d. In some cases jamming of the throttle valve as evidenced by erratic response of manifold pressure to throttle lever positioning.

9-10. If carburetor icing conditions are anticipated or suspected, apply carburetor heat to maintain +15°C. The use of carburetor heat for the prevention of ice, and the consequent loss of power in a high-moisture atmosphere, is most effective if applied and maintained in advance of encountering these conditions.

9-11. If it is suspected that ice has already formed in the carburetor, move the mixture lever to AUTO RICH and apply full carburetor heat for 30 seconds, but do not exceed +38°C carburetor air temperature. Slowly return the carburetor heat lever toward COLD to see if manifold pressure has been restored to nearly its former indication. Adjust preheat to maintain +15°C carburetor air temperature.

9-12. If the temperature of the fuel is well below freezing during icing conditions, a rapid loss of power due to mixture control bleed icing may occur. The use of maximum heat and a lean mixture, if in the cruise range, should restore the normal power condition.

9-13. Spark-plug fouling. Spark-plug fouling is usually caused by a build-up of lead or carbon deposits which cause shorting at the plugs. Grade 115/145 fuel contains a relatively high lead content and under certain conditions of temperature and pressure the lead will condense out on the spark-plug insulators. In the presence of excess carbon as a reducing agent, the lead may form metallic particles which cause misfiring, or prevent firing, across the plug electrodes. In general, spark-plug fouling involves a build-up of deposits through prolonged operation under a fixed set of conditions. If action is taken to vary these conditions, improved ignition will result. The following preventive measures may be taken:

a. After each ten minutes of ground running, the engine should be run at field barometric manifold pressure for one minute.

b. Cylinder head temperature should be below 170°C prior to the take-off in order to take advantage of the increased bhp. There will also be less tendency for misfiring with a relatively cool cylinder head temperature during take-off.

c. During cruising flight a periodic change in engine conditions should be made. This may be done at hourly intervals by either using auto-rich mixture for five minutes, a change in manifold pressure of 3 to 5 in. Hg, or a change of 100 to 130 rpm. A reduction in power level, followed by an increase, is recommended.

d. When descending, use power settings to maintain engine conditions approximating cruise power work levels, if possible.

9-14. Fuel system management. The fuel system crossfeed may be used to supply both engines from either tank or, during single-engine operation, one engine from either tank. During flight on one engine, fuel should be used alternately from each tank in order to maintain the weight of fuel on each side approximately equal. Prior to making a crossfeed selection the booster pump of

the selected tank should be switched to HIGH, the fuel pressure gage on that side should then read approximately 20 psi. After the crossfeed selection has been made, if supplying both engines, both fuel pressure gages should read approximately 20 psi. Two minutes should be allowed for the system to rid itself of any trapped air and the booster pump then switched to NORM. Whenever crossfeeding fuel, the booster pump of the selected tank should remain in the NORM position.

9-15. Prior to returning to the normal fuel selection, the booster pump of the tank not being used should be switched to NORM. After the selection has been made, two minutes should be allowed for the system to rid itself of trapped air. At the pilot's discretion, booster pumps may then be switched off.

9-16. In addition to using the booster pumps for engine starts, take-offs, climbs, landings and fuel crossfeeding, they should also be used in flight whenever fuel pressure fluctuates within limits (16 to 18 psi), and for flights above 10,000 feet.

Warning

The booster pump must not be turned on if fuel pressure drops below the low limit while the engine continues to operate normally. A fuel leak may be responsible for the pressure drop. Refer to Chapter 4 for the procedure to be followed under these conditions.

9-17. Oil dilution system. (Refer to Chapter 10.) The oil dilution system provides a method for introducing a controlled quantity of fuel into the engine oil system and, in addition on aircraft with non-reversible propellers, into the propeller feathering oil reservoir. The purpose of oil dilution is to lower the viscosity of the oil during cold weather and provide easier starting, to provide an immediate supply of lubricant to all moving parts, and also to minimize the risk of bursting flexible hose lines and oil coolers. Oil dilution also prevents the accumulation of internal engine sludge and carbon deposits. The washing action of the fuel dislodges these deposits, which are subsequently collected by the main oil filter.

9-18. Wheel Brakes. The proper use of the wheel brakes is emphasized in order to reduce accidents due to brake failure and cut down maintenance work. To minimize brake and tire wear, the following precautions should be observed as far as is practicable:

a. Use extreme care when applying brakes immediately after touchdown, or at any time when there is considerable lift on the wings, to prevent skidding the tires and causing flat spots. A heavy brake pressure can result in locking the wheels more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the aircraft is on the wheels. A wheel once locked in this manner immediately after touchdown will not become unlocked as the load is increased, as long as brake pressure is maintained. Proper braking action cannot be expected until the tires are carrying heavy loads.

b. If maximum braking is required after touchdown, lift should be decreased as much as possible by raising the flaps and lowering the nosewheel to the ground before applying brakes. This procedure will improve braking action by increasing the friction between the tires and the runway.

c. For short landing rolls the most effective braking is obtained by intermittent use of maximum brake for periods of at least one full second, followed by a momentary release period.

d. It is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the slipstream, and a minimum of 30 minutes between landings where the landing gear has been retracted, to allow for cooling if brakes are used for steering, crosswind taxiing operation, or a series of landings are performed.

e. The full landing roll should be utilized to take advantage of aerodynamic braking and to use the brakes as little and as lightly as possible.

f. After the brakes have been used excessively for an emergency stop and are in a heated condition, the aircraft should not be taxied into a crowded parking area or the parking brake set. Peak temperatures occur in the wheel and brake assembly from 5 to 15 minutes after a maximum braking operation.

g. The brakes should not be dragged when taxiing, and should be used as little as possible for turning the aircraft on the ground.

9-19. Efficiency of brakes. Brakes themselves can merely stop the wheels from turning, but stopping the aircraft is dependent upon the friction of the tires on the runway. For this purpose it is easiest to think in terms of coefficient of friction, which is equal to the frictional force

divided by the load on the wheel. It has been found that optimum braking occurs with approximately a 15 to 20 percent rolling skid i.e. the wheel continues to rotate but has approximately 15 to 20 percent slippage on the surface so that the rotational speed is 80 to 85 percent of the speed which the wheel would have were it in free roll. As the amount of skid increases beyond this amount, the coefficient of friction decreases rapidly so that with a 75 percent skid the friction is approximately 60 percent of the optimum and, with a full skid, becomes even lower. There are two reasons for this loss of braking effectiveness with skidding. First, the immediate action is to scuff the rubber, tearing off small pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. NACA figures have shown that for an incipient skid with an approximate load of 10,000 pounds per wheel, the coefficient of friction on dry concrete is as high as 0.8, whereas the coefficient is in the order of 0.5 or less with a 75 percent skid. Therefore, if one wheel is locked during application of brakes there is a definite tendency for the aircraft to turn away from that wheel and further application of brake pressure will offer no corrective action. Since the coefficient of friction goes down when the wheel begins to skid, it is apparent that a wheel, once locked, will never free itself until brake pressure is reduced so that the braking effect on the wheel is less than the turning moment remaining with the reduced frictional force.

9-20. Long Range Ferry Fuel and Oil System. Additional fuel and oil necessary for long range ferry flights may be carried in special tanks installed in the cabin. The package assembly consists of one or two auxiliary fuel tanks, and one auxiliary oil tank. Each fuel tank has a capacity of approximately 480 US gallons, and the oil tank has a usable capacity of 18 US gallons. Each fuel tank is secured in position by MC-1 tie-down devices, while the oil tank is supported in an alclad cradle which is bolted to the floor on the RH side of the cabin. A removable fuel control panel is secured to the LH side of the cabin, forward of the emergency door. A fuel level control valve is incorporated in cell No. 5 of each wing tank assembly. Auxiliary fuel and oil lines in each wing and two low oil level warning lights on the engine instrument panel in the flight compartment, a float switch on each main oil tank, and associated wiring, are permanent installations in the aircraft. (For fuel quantity data table see Chapter 2, figure 2-21.) A fuel tank repair kit is located adjacent to the fire extinguisher on the auxiliary oil tank cradle. The kit is used for temporary repairs to the ferrying fuel rubber tanks.

9-21. Auxiliary fuel tanks. The two auxiliary fuel tanks are similarly constructed of flexible 4-ply rayon tire cord reinforced rubber, with an inner liner of Buna "N" compound. They are 68 inches long and 58 inches in diameter. Inside the tank are two flexible hoses, one a vent hose and the other a fuel hose. A float is attached to the vent hose, while a filler screen assembly is clamped to the fuel hose. The filler assembly will remain on the bottom of the fuel tank during and after refueling.

9-22. When operational, the tanks are pressurized to a regulated 5 psi, the pressure being supplied by the deicer boot pumps or alternatively, for ground testing, from an external pressure source. This pressure is also used to transfer the fuel from the auxiliary fuel tanks to the wing fuel tanks, (See figure 9-2.) A sight gage, consisting of transparent tubing marked from 50 to 500 US gallons, on each fuel tank gives visual indication of fuel content. The fuel tanks are connected by flexible hose directly to the control panel for purpose of refueling and transfer to the main tanks. Any excess pressure in the tanks can be vented to atmosphere through the control panel.

9-23. Auxiliary oil tank. The auxiliary oil tank is clamped in a metal cradle and the cradle is bolted to the cabin floor utilizing the 5000 pound cargo tie-down rings at positions D3 and D5, and the appropriate drillings in the lower seat support rail on the RH side of the aircraft. The oil tank contains a sight gage, marked with a red line indicating the half full condition used during oil transfer. Two LOW OIL LEVEL amber lights (Chapter 2, paragraph 2-33), one for each engine oil tank, is installed on the engine instrument panel to indicate when oil transfer should be carried out. Half of the auxiliary oil tank contents should be transferred to each main oil tank. A hand-operated rotary pump and a transfer valve assembly with positions marked OFF, LH, and RH enables oil transfer to the appropriate side engine oil tank to be carried out. The auxiliary oil tank is vented to atmosphere at the same location as the auxiliary fuel tanks.

9-24. Fuel management panel. The fuel management panel (figure 9-1) is installed in the cabin forward of the emergency door. Each auxiliary fuel tank has its own selector valve marked FORWARD TANK SELECTOR VALVE and REAR TANK SELECTOR VALVE. Each selector has positions marked as follows:

a. OFF - Shuts off fuel supply from the auxiliary tank.

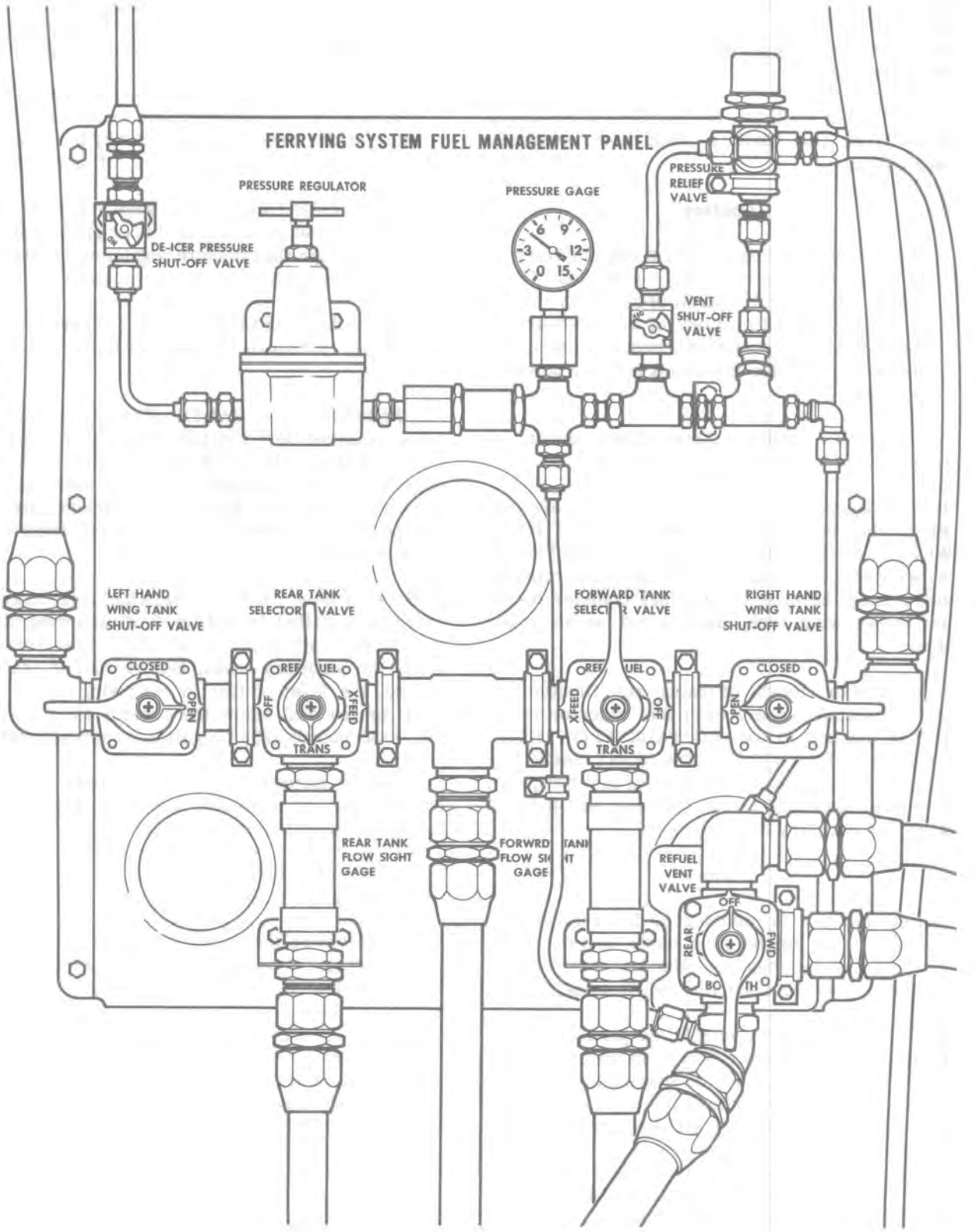


Figure 9-1. Ferrying system fuel management panel

b. TRANS - Allows fuel to flow from the auxiliary tank to the associated wing tank i.e. Forward auxiliary tank fuel flows to the right-hand wing tank, rear auxiliary tank fuel flows to the left-hand wing tank.

c. X FEED - Allows fuel to flow to both wing tanks from one auxiliary tank (other auxiliary tank OFF).

Caution

When cross-feeding fuel from one auxiliary tank to both main tanks insure that the TANK SELECTOR VALVE of the empty auxiliary tank is OFF. Loss of air pressure and failure to transfer will result if the selector valve of the empty tank is in any other position.

d. REFUEL - Allows the auxiliary tank to be refueled.

9-25. Adjacent to the selector valves are the wing tank shut-off valves marked LEFT HAND WING TANK SHUT-OFF VALVE, and RIGHT HAND WING TANK SHUT-OFF VALVE. The appropriate valve must be open during fuel transfer to the particular wing tank, and closed at all other times.

9-26. A short length of transparent flexible tubing is located beneath each fuel selector valve, and is marked FORWARD TANK FLOW SIGHT GAGE and REAR TANK FLOW SIGHT GAGE. The tubing allows visual indication of fuel flow, and, by the presence of air in the line, will indicate when the auxiliary tank is empty.

Note

Because fuel is transferred from the auxiliary tanks to the wing tanks, and not directly to the engines, the standard wing tank gages are used for fuel management.

9-27. Air pressure control. Air pressure to the auxiliary tanks is controlled from the fuel control panel in the cabin, and the deicing switch panel in the flight compartment. The fuel control panel has the following air pressure controls:

a. DEICER PRESSURE SHUT-OFF VALVE - This valve has positions marked ON and OFF. It must be ON during fuel transfer to obtain air pressure to the auxiliary fuel tanks, and during descent, if required. At all other times the valve must be OFF.

b. VENT SHUT-OFF VALVE - This valve has positions marked ON and OFF, and is used to relieve excess air pressure from the auxiliary tanks. At all other times the valve must be OFF.

c. PRESSURE REGULATOR - This regulator is normally preset on the ground to obtain a 5 psi reading on the pressure gage. It may be reset in flight to obtain this pressure, if necessary.

d. PRESSURE GAGE - This gage registers the air pressure supplied by the deicer pumps, after passing through the pressure regulator, and shows air pressure delivered to the auxiliary tanks.

e. PRESSURE RELIEF VALVE - This valve will relieve air pressure in excess of 6 psi, to atmosphere.

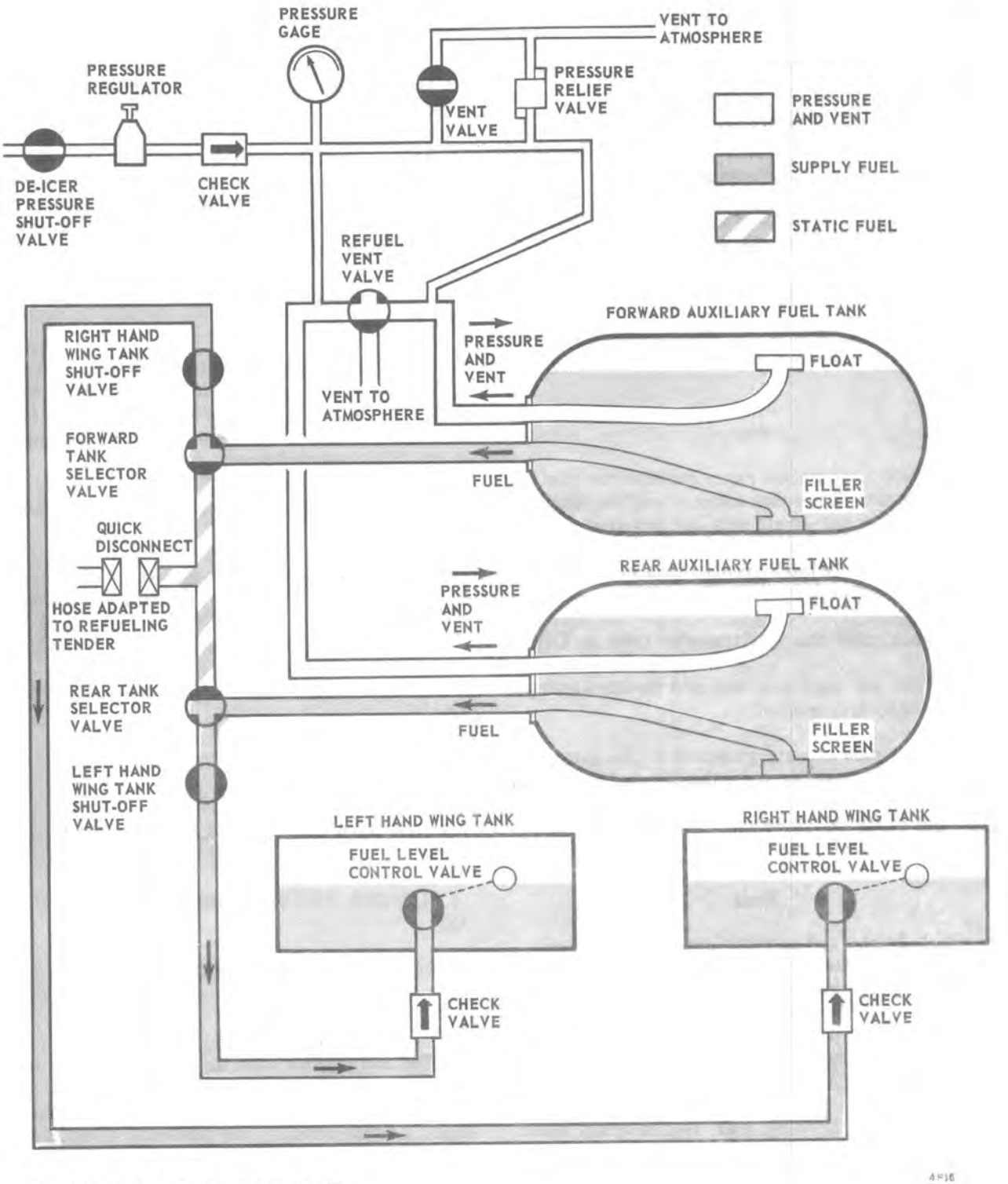
f. REFUEL VENT VALVE - This valve has positions marked OFF, FWD, BOTH and REAR. When refueling the auxiliary tanks the valve must be selected to the appropriate tank or tanks being refueled. This will allow the displaced air to escape to atmosphere. At all other times the valve must be OFF.

9-28. Fuel level control valve. A fuel level control valve is installed in cell No. 5 of each wing tank to prevent overfilling when fuel is transferred from the auxiliary tanks. Before fuel is transferred, the level of fuel in each wing tank must first be lowered below the control valve level, i.e. 1550 pounds (258 US gallons) approximately.

9-29. Fire extinguisher. A hand-operated fire extinguisher is provided, and is clamped to a bracket attached to the auxiliary oil tank cradle.

9-30. Low oil level caution lights. Refer to Chapter 2, paragraph 2-33.

9-31. Refueling the Auxiliary Tanks. The auxiliary fuel tanks are refueled by attaching a short length of flexible hose, connected to the appropriate tee fitting on the control panel, to the nozzle of a conventional gravity type fuel tender. The hose is led out of the aircraft through the emergency door. The connection is made via a quick disconnect coupling, one-half of which is on the refueling hose while the other half is attached to a rubber hose adapter which can be slipped over the fuel tender refueling nozzle and secured by suitable hose clamps. Three rubber hose adapters of varying sizes are supplied in the ferry kit, and when not in use should be stowed in the aircraft together with the main oil tank dipstick.



NOTE: NORMAL FUEL TRANSFER SHOWN

Figure 9-2. Long range ferry fuel system - schematic

9-32. Ferry Tank Operation. The following procedures should be followed when using the long range ferry system. The checks and procedures are additional to those given in Chapter 3.

9-33. Preflight checks. The following checks should be considered as additional items to the normal interior inspection:

Warning

Smoking is not allowed in the cabin or flight compartment at any time.

1. Check for any sign of fuel leakage in the cabin.

2. Check the sight gages for quantity of fuel in each auxiliary fuel tank and oil in the auxiliary oil tank.

Note

The top of the sight gage, between the vent connection in the tank and the top of the tank, should be full of air with the remainder of the sight gage full of fuel. Tapping the tank with a blunt object will also locate the level of fuel in the tank.

3. Check that the oil transfer cock is OFF.

4. Check all auxiliary fuel tank tie-down straps for security and tension.

5. Check that the air pressure in the auxiliary fuel tanks, as read on the control panel pressure gage, is between 1 and 2 psi. Pressure in excess of 2 psi should be vented. When the required pressure is obtained, turn the vent shut-off valve OFF.

Note

With fueled and pressurized auxiliary fuel tanks and the vent shut-off valve selected ON, it is possible that fuel mixed with air will be vented to atmosphere.

6. Check all auxiliary fuel and oil valves are OFF or CLOSED, as applicable.

7. Check Prop, Wing and Tail deicing mode switches are OFF.

9-34. Engine start.

1. Start the engines normally, using the wing tanks.

2. Check the deicing suction gage for normal suction of 4 in. Hg.

Note

A deicer pump is operated by each engine. The above check, with both engines operating, does not constitute a check of both pumps. Engines must be run individually if a check of each pump is required.

9-35. Take-off. The take-off is made using the normal wing tank selection. Insure that the deicing mode switches are OFF.

9-36. In-flight fuel control. For in-flight fuel supply, proceed as follows:

1. Continue to operate on the NORMAL tank selection until the supply of fuel in each wing tank falls below approximately 1550 pounds (258 US gallons), as indicated on the standard fuel gages in the flight compartment.

2. Select the DEICING, AUTO-OFF-MAN mode switch to MAN.

3. Select the controls on the FERRYING SYSTEM FUEL MANAGEMENT PANEL as follows:

a. REAR TANK SELECTOR VALVE - TRANS.

b. FORWARD TANK SELECTOR VALVE - TRANS.

c. LEFT and RIGHT HAND WING TANK SHUT-OFF VALVE - OPEN.

d. Check: VENT SHUT-OFF VALVES - OFF
REFUEL VENT VALVES - OFF.

e. DEICER PRESSURE SHUT-OFF VALVE - ON.

f. PRESSURE REGULATOR - Adjust the regulator to obtain a pressure of 5 psi on the PRESSURE GAGE.

4. The switch and valve selections made in this paragraph are retained until all ferry fuel has been transferred from either or both auxiliary tanks, as indicated by the presence of air in the appropriate flow sight gage.

9-37. Completion of fuel transfer. When transfer of fuel is completed from either or both auxiliary tanks, prevent an unnecessary build-up of air pressure in the wing tanks by selecting

the controls on the fuel management panel for the appropriate, or both, auxiliary fuel tanks as follows:

1. LEFT HAND and/or RIGHT HAND WING TANK SHUT-OFF VALVE - CLOSED.

2. FORWARD and/or REAR TANK SELECTOR VALVE - OFF.

3. DEICER PRESSURE SHUT-OFF VALVE - OFF (When both auxiliary fuel tanks are empty.)

4. DEICING, AUTO-OFF-MAN mode switch - OFF (Unless required for deicing.)

9-38. Fuel crossfeed. To crossfeed fuel from one auxiliary tank to both main tanks, select the controls on the FERRYING SYSTEM FUEL MANAGEMENT PANEL as follows:

1. LEFT HAND and RIGHT HAND WING TANK SHUT-OFF VALVE - OPEN

2. FWD TANK SELECTOR VALVE - XFEED REAR TANK SELECTOR VALVE - OFF. (If transferring from REAR TANK)

OR

REAR TANK SELECTOR VALVE - XFEED FWD TANK SELECTOR VALVE - OFF. (If transferring from REAR TANK)

3. When both auxiliary fuel tanks are empty, or ferry fuel ceases to be a requirement, select the switches and controls as directed in paragraph 9-37.

9-39. Air pressure control. If, when descending from altitude, a decrease in air pressure in the auxiliary fuel tanks below 2 psi is indicated, proceed as follows:

Note

Repeat this procedure as necessary to prevent the flexible tanks from collapsing.

1. DEICING, AUTO-OFF-MAN mode switch - MAN.

2. DEICER PRESSURE SHUT-OFF VALVE - ON.

3. When the PRESSURE GAGE reads 2 psi, select the switch and valve - OFF.

9-40. In-flight oil supply. The normal engine oil supply is used until a LOW OIL LEVEL caution light, on the engine instrument panel, illuminates steadily. This indicates that approximately 8.4 to 9.6 US gallons of oil have been used from that side engine main oil tank. Transfer oil from the auxiliary tank as follows:

Caution

Do not transfer oil until the LOW OIL LEVEL caution light illuminates steadily.

1. Auxiliary oil control level - LH or RH. (Select to the side indicated by the illuminated LOW OIL LEVEL light.)

2. Turn the rotary hand pump approximately 175 turns until the oil level registers at the red line on the auxiliary oil tank sight gage.

3. Upon illumination of the other LOW OIL LEVEL caution light, transfer the remainder of the auxiliary oil by selection of the oil control lever to the appropriate position and operation of the rotary pump.

9-41. Operating Limits. When long range ferry tanks are installed in the aircraft the following operating limitations must be observed, in addition to the applicable limitations specified in Chapter 7.

Note

Operation of the aircraft in the ferry tank configuration at a gross weight of 31,000 pounds must have special authorization from the appropriate Army agency.

9-42. Weight and balance. The gross weights at which the aircraft may be operated are as follows:

a. Gross Weight	-Ramp Weight	31,300 lb
	-Take-off (Sea level)	31,000 lb
	-Landing (Sea level)	28,500 lb

Note

Take-off gross weight may be further limited by operational factors such as temperature, altitude and available runway length. The extent of the limitation required may be determined by the responsible authority in the light of performance data at 31,000 pounds contained in this section. Landing performance at a gross weight of 28,500 pounds is contained in Chapter 14.

b. Zero wing fuel weight 27,000 lb

9-43. Center of gravity. At weights above 28,500 pounds the aircraft CG must be maintained between 31% and 39% MAC (wheels down).

9-44. Airspeed limitations. The airspeed limitations applicable to an aircraft gross weight of 28,500 pounds apply when operating at a gross weight of 31,000 pounds.

9-45. Flight load factors. Limit maneuver load factors between Maneuvering Speed and Normal Operating Limit Speed are +2.6 g and -1.0 g.

9-46. Take-off. Take-off at a gross weight of 31,000 pounds requires a paved runway of a minimum length of 6000 feet. Take-off is made with 0° flap, and lift-off should be made at 92 knots IAS.

9-47. Emergency Operation. The following paragraphs discuss the operation of the aircraft under certain emergency conditions.

9-48. Minimum control speed. The minimum control speed at a gross weight of 31,000 pounds with 0° flap remains the same as at a gross weight of 28,500 pounds with 7° flap i.e. 70 knots IAS.

9-49. Safe single engine speed. The safe single engine speed at a gross weight of 31,000 pounds with 0° flap and landing gear up is 92 knots IAS.

9-50. Stall speed. The stall speed at a gross weight of 31,000 pounds with 0° flap, landing gear up and power for zero thrust, is 78 knots IAS.

9-51. Emergency procedures - engine failure. Should an engine failure occur during take-off or in flight at a gross weight of 31,000 pounds, it is recommended that an emergency landing be carried out directly, rather than remaining airborne on one engine while burning off fuel to the approved landing weight of 28,500 pounds. The primary consideration in a single engine landing at high weight in this aircraft is performance, and not the structural strength of the landing gear. Single engine rate-of-climb at take-off power, gear down, flaps up, is approximately 75 fpm at sea level (standard day). The aircraft structure and landing gear are adequate to sustain a carefully executed landing at 31,000 pounds. In view of increased brake energy requirements, runway length should be 6,000 feet or more.

9-52. Landing. The airspeed should be kept above the safe single engine speed of 92 knots IAS until finally committed to land; 95 knots IAS is recommended at 31,000 pounds gross weight. The landing gear should be lowered just prior to completion of the down wind leg or at the beginning of the base leg, depending on altitude. The flaps should not be lowered until on the final approach and only when assured of a landing. All landing checks, except flaps, should be completed before final turn in. Maintain 95 knots IAS on the approach and when landing is assured lower 14° to 30° flaps as required, decreasing airspeed to 80 knots IAS as flaps are lowered. Adjust rudder trim as required. Cross the threshold at 80 knots IAS and execute a careful touchdown.

9-53. Go-around. The decision to go-around must be made before flap is lowered. The 31,000 pound aircraft cannot maintain height at an airspeed of 95 knots with gear and approach flap extended. Take-off power should be applied and the landing gear retracted. Airspeed should be maintained at 95 knots IAS and, when clear of obstacles and the gear is up, power should be reduced to METO. Rate-of-climb will be approximately 130-140 fpm under standard conditions.

9-54. Climb Performance. The following climb performance figures are based upon flight test data, at an aircraft gross weight of 31,000 pounds, and under standard day conditions. Allowances should be made for non-standard conditions, turbulence and variations in the performance of individual aircraft.

a. Single-engine performance - flaps 0°

(1) First segment climb (Take-off power, gear down, sea level) 75 fpm

(2) Second segment climb (Take-off power, gear up, sea level) 285 fpm

(3) En route climb (METO power, sea level) 140 fpm
En route climb (METO power, 5000 ft) 100 fpm

b. Two-engine performance - flaps 0°

(1) En route climb (METO power, 5000 ft, calculated) 1140 fpm

CHAPTER 10
WEATHER OPERATION

Section I

Scope

10-1. This chapter provides information relative to operation under the following conditions: instrument flight, turbulent air, extreme cold and hot weather, and desert operation.

10-2. Except where repetition is necessary for purposes of emphasis, clarity or continuity, this chapter is complementary to Chapter 3 and describes weather procedures only insofar as they differ from, or are in addition to, the normal handling procedures. Discussions relative to systems operation are contained in Chapters 6 and 9. It is assumed that while under instrument flight conditions, a standard operating technique exists between the pilot and copilot to provide for power adjustments and systems control by the copilot, thereby permitting the pilot to concentrate on instrument flight. Instrument flight proficiency, correct flight planning, and observance of instrument flight rules are also assumed.

Section II

Instrument Flight Procedures

10-3. General. The aircraft has satisfactory instrument flight characteristics in all phases of operation. Steep turns and abrupt maneuvers should be avoided. For ease and precision of flight, all turns should be limited to bank angles not exceeding 30°. No special technique due to aircraft configuration or operation is required. The radio and navigational aids provide adequate coverage for practically all conditions of instrument flight. See figure 10-1 for a table of recommended power settings, airspeeds and flap settings to be used during the various phases.

10-4. Instrument Take-off. Instrument take-off procedure is in two phases as follows:

10-5. Before take-off. Line up visually with the runway and note the direction-indicator heading. Recheck all flight instruments.

Note

The anti-collision lights should be turned OFF during night instrument flight as the rotating reflections may subject the pilot to vertigo.

10-6. Take-off. Maintain direction by reference to the direction indicator. At take-off speed, and with reference to the attitude indicator, raise the nose to approximately 4 pitch-bar widths above the horizon bar, and allow the aircraft to fly off. Establish the climbout and retract the landing gear and flaps when the altimeter and vertical velocity indicator show a definite climb. (See figure 10-1.)

10-7. Instrument Climb. The climb on instruments should be conducted using normal airspeeds and power settings.

10-8. Instrument Cruising Flight. To prevent pilot fatigue and eyestrain during long periods of cruising, control of the aircraft should be alternated between the two pilots. If possible, and especially at night, the forecast icing level should be avoided. Under conditions where turbulence is anticipated, an airspeed should be selected with due regard to the penetration speed (refer to paragraph 10-52).

Warning

When use of the magnetic standby compass is necessary, the windshield heat switch must be selected to OFF. While in operation, the cycling of electrical power creates erratic magnetic deviation and thereby unreliable standby compass readings.

10-9. Speed range. Instrument flight handling is satisfactory throughout the speed range.

10-10. Descent. For a normal instrument descent, cruising airspeed may be used; there being no unusual problems. The power settings should be adjusted to give 500 fpm rate of descent. For a rapid rate of descent, the normal procedure may be used, with due regard to airframe and engine limitations, and penetration speed.

10-11. Holding. Depending on altitude, holding patterns should be flown using an appropriate economical engine power setting (see figure 10-1 and refer to Chapter 14). If fuel economy is not of prime importance, a higher airspeed will facilitate navigational accuracy.

10-12. Instrument Approaches. The handling characteristics are satisfactory for all types of instrument approach. Where possible, the before landing check should be completed prior to the let down into the landing approach pattern. Let down as for a normal descent.

10-13. Radio approaches. When accomplishing a VOR approach (radio range or ADF), complete the before landing checks while homing to the beacon, and initiate the landing checks while on the outbound radial. On completion of a procedure turn, when the inbound leg is intercepted, recheck the landing gear down. The speed throughout should be 100 to 105 knots IAS. Continue as in ILS procedure described in the following paragraph.

10-14. ILS approach. Home to the VOR beacon or ILS outer marker at the ILS transition altitude. Turn outbound on the localizer at 110 knots IAS and initiate the landing check. Continue outbound and make a normal procedure turn and intercept the localizer inbound heading. When the turn is complete, descend to the published glide slope interception altitude, maintaining 105 knots

INSTRUMENT FLIGHT-RECOMMENDED SETTINGS

PHASE	IN. HG - STANDARD DAY	RPM	KNOTS - IAS	FLAPS
TAKE-OFF - 26,000 LB 28,500 LB	50.0 50.0	2700 2700	70 85	15° 7°
INITIAL CLIMB - ALL WEIGHTS	42.5	2550	INCREASING TO 95	COMING UP
SUSTAINED CLIMB - ALL WEIGHTS	35.0*	2250*	95	0°
CRUISE - ALL WEIGHTS	725 BHP			0°
DESCENT - 26,000 LB 28,500 LB	AS DESIRED AS DESIRED		100 105	0° 0°
HOLDING - GEAR UP 26,000 LB 28,500 LB	 23.0 25.0	 2000 2000	 110 110	 0° 0°
HOLDING - GEAR DOWN 26,000 LB 28,500 LB	 28.0 29.0	 2000 2000	 110 110	 0° 0°
APPROACH AND LET-DOWN 26,000 LB 28,500 LB	 23.0 22.0	 2000 2000	 110-85 110-95	 0-15° 0-15°
LANDING	AS DESIRED			
NOTE: WHEN VISUAL CONTACT IS ESTABLISHED AND LANDING ASSURED, PROCEED AS FOR NORMAL APPROACH AND LANDING				
* OR METO POWER				4F-619-1

Figure 10-1. Instrument flight - recommended settings

IAS maximum, gear and flaps as desired. Turn onto the localizer beam and maintain altitude until the glide slope is intercepted. When visual contact is established and the landing is assured, select flaps as desired and perform a normal landing.

10-15. Ground-controlled approach. During a GCA the before landing check should be completed while on the downwind leg of the pattern. When visual contact is established and landing is assured, select flaps as desired and perform a normal landing.

10-16. Single-engine Instrument Flight. The procedures in Chapter 4 should be adhered to as closely as conditions permit. The controllability of the aircraft is such that a normal instrument climbout can be made, should an engine failure occur during take-off and after take-off speed is attained. Normal procedures may be employed for instrument approaches and let downs. To facilitate instrument flight accuracy and ease of execution, adjust the power to maintain 110 knots IAS and trim the aircraft. Lower the landing gear and 10 to 15° flap, either (A) or (B), at the start of the descent on the final approach. The flaps should only be extended further when visual contact is established and the landing assured.

10-17. Night Flying. Night flying presents no unusual problems; normal procedures being used. Before take-off the intensity of the instrument lights should be adjusted so that they are not reflected on the windshield. All unnecessary lighting should be turned off. Before taxiing, the navigation and anti-collision lights should be checked; the landing lights tested, then selected OFF.

Section III

Cold Weather Operation

10-18. General. During cold weather operations it is important that the correct preflight and post-flight procedures are observed. The use of oil dilution and of winterization equipment should permit engine starts to be made regardless of the outside air temperatures encountered. Refer to Chapter 6, Section X for winterization equipment.

10-19. Preflight Procedures. The preflight procedures for cold weather operation are given in the following paragraphs.

10-20. Before entering the aircraft. In addition to the checks detailed in Chapter 3, the following items are to be checked:

a. Check for the removal of snow, ice and frost from the wings, fuselage, stabilizer, all flight control surfaces and hinges, fuel and oil vents and drains, static vents and pitot heads, heater vents, carburetor and oil cooler air intakes.

b. Do not direct removal of protective covers until just before starting the engines.

c. Check engine preheating, if available. Preheat is required if temperatures are below 0°F (-18°C) even though oil dilution was accomplished at shutdown. Preheat should not be considered adequate unless fluid oil will flow from the oil tank sump drains. In addition, if an engine is too stiff to start, the clutch in the starter will slip.

d. After removal of the main and nosewheel covers, check the landing gear struts, actuating cylinders, locking mechanism, wheels and brakes for freedom from ice, snow or slush.

e. Check that the tires are not frozen to the ground.

f. Check pitot drains for freedom from ice.

10-21. On entering the aircraft. Check the following:

a. Determine that heat has been applied generally to the cabin and the flight compartment.

b. Check passenger doors, cargo door, emergency exits and flight compartment windows to see that they open easily. Close and secure.

c. Check that the parking brake handle is in the OFF position. If the handle is found to have been left ON, the brakes may be frozen. Notify the ground crew and, if necessary, direct that heat be applied to the brake discs and cylinders.

d. The last action prior to starting should be to remove all protective covers.

10-22. Starting engines. Except as noted in the following paragraphs, make cold weather starts using the procedures described in Chapter 3, Section II. If the aircraft is equipped with a hot fuel prime system, and the ambient temperature is 32°F (0°C) or below, proceed as in Chapter 6, paragraph 6-109.

Note

If it is determined that sufficient heat has been applied to the engine, and the starter clutch slips during starting, a hydraulic lock probably exists. Remove spark plugs from the bottom cylinders, let cylinders drain and pull propeller through by hand. Reinstall plugs and attempt another start.

a. It may be necessary to run the engine on prime alone for a longer period than normal, prior to moving the mixture lever to AUTO RICH, if it will not run smoothly in auto-rich initially.

b. If possible the engine should be kept running on the first starting attempt. Ice may form on the spark plugs within a few seconds if the engine fires and then stops. If the engine has not started after two or three attempts, it is recommended that several spark plugs be removed and examined for ice. If icing has occurred, the front plugs should be removed and heated to dry the electrodes before making another starting attempt.

c. If the oil pressure does not register almost immediately after starting, the engine should be shut down and the cause investigated.

Note

The oil pressure may be abnormally high immediately upon starting. As the oil temperature increases, the pressure should drop to normal. Do not increase engine speed until oil temperature and pressure are within limits.

d. Move carburetor hot air lever to HOT, as soon as the engine is firing regularly, to improve vaporization and combustion. Return the lever to COLD when the engine is operating satisfactorily.

10-23. Warm up. If the weather is extremely cold, oil may congeal in the oil cooler. The first indication of this will be a very high oil temperature with a decrease in oil pressure. As the congealed oil is forced into the system, a sudden drop in temperature and a large increase in pressure will occur. A careful check must be maintained on oil pressure and temperature and sufficient time allowed for a thorough engine warm-up. If oil pressure registers and then drops below normal after a few minutes of operation, the engine should be shut down and checked for a failed pressure gage, blown oil lines, oil cooler, or shearing of the oil pump drive.

10-24. Propeller feathering line oil dilution. On aircraft equipped with non-reversible propellers, dilution of the oil in the propeller feathering lines should be carried out during ambient temperatures of 0°C and below, whenever engine oil dilution is performed. (Refer to paragraph 10-36.) In addition, feather dilution must be carried out with the engines running, prior to the initial flight of the day under the same temperature conditions. The feather dilution arming switch should remain at FEATH. DIL. position (aircraft Serial No. 61-2595 through 62-12584), or at ON position (aircraft prior to Serial No. 61-2595), during flight.

Note

In ambient temperatures above 0°C the feather dilution arming switch must be at OFF position, and no dilution must be carried out.

10-25. Wing flap check. The wing flaps should be operated fully down and up while being observed by a ground crew member. Check the flap position indicator to make certain the flaps reach their extreme positions without hindrance from undetected snow or ice. Stop the flaps at various positions to determine if the control and position indicators are in working condition.

10-26. Oil dilution boil-off. Boil-off is the action of raising the engine operating temperature, and maintaining it at a sufficiently high level, to vaporize the fuel that was introduced into the oil during the oil dilution procedure (paragraph 10-36). The vapor leaves the engine through the engine drain and breather box vent. Adequate boil-off is essential to avoid the possibility of oil venting from the engine or oil tank breather. If insufficient boil-off has been allowed, insufficient engine lubrication will result. In addition the high engine temperatures associated with take-off will rapidly vaporize the fuel in the oil and, if this action is too rapid, the vapor may not separate from the oil fast enough and froth will form in the engine crankcase. This results in an overpres-

surization of the system, forcing oil out of the engine drain and breather box vent, and can only be stopped by reducing engine power. Should this occur, the aircraft should be landed as soon as possible and, after the oil level is checked, a complete boil-off procedure should be carried out.

10-27. Boil-off procedure. Figure 10-2 lists the time required to boil-off the excess fuel, commencing when the oil temperature reaches 45°C. The oil temperature should, and normally will, continue to increase from this temperature, but must not exceed 75°C. If the previous oil dilution period was for less than one minute, no boil-off procedure is required. If the dilution period was for more than one minute, carry out the following procedure:

a. Fit the restrictors to the augmentor tubes to decrease the cooling effect of the tubes.

b. Start the engines in accordance with the cold weather procedure, (paragraph 10-22).

c. Warm-up at 1000 rpm; maintain this rpm setting for at least 10 minutes. Continue running if necessary, until the oil temperature reaches 5°C.

d. Warm-up at 1200 rpm; maintain this rpm setting for at least 5 minutes. Continue running, if necessary, until the oil temperature reaches 20°C.

e. Warm-up at 1400 rpm; maintain this rpm setting for at least 5 minutes. Continue running, if necessary, until oil temperature is 40°C. Increase manifold pressure to 28 in. Hg while maintaining 1400 rpm with the propeller lever.

f. Warm-up at 1600 rpm and 28 in. Hg until the oil temperature is 45°C and commence boil-off time check.

Note

A cylinder head temperature of 200° C, and an oil temperature of 75° C, must not be exceeded during the warm-up and boil-off procedure.

10-28. Taxiing. Observe the following:

a. Pitot heater switch - Check on.

b. Before starting to taxi, direct the ground crew to check that the tires are not frozen to the ground.

c. Check that wheels are rotating. Use nosewheel steering and taxi slowly when ice is present on the ground. Use brakes as little as possible.

d. Insure all instruments have warmed up sufficiently. Check for sluggish operation during taxiing.

e. Taxiing will allow the engines to cool, and a sudden increase in power may result in engine cutting. On reaching the take-off position, insure that engines are warm and that power is increased gradually.

10-29. Before Take-off. Before take-off, accomplish the following procedure:

a. Windshield heat switch - NORM.

b. Carburetor air induction switch - As required.

OIL DILUTION AND BOIL-OFF TABLE

ANTICIPATED TEMPERATURE °F	°C	DILUTION PERCENT	MINUTES TO DILUTE AT 1400 RPM	NO. OF TIMES TO EXERCISE NON-REVERSIBLE PROPELLER	MINUTES TO BOIL-OFF. OIL TEMP 55 TO 75°C	HOT FUEL PRIME	PREHEAT (UNTIL CYL HD TEMP IS ABOVE 0° C)
32 TO 0	0 TO -18	6	1	1	NONE	YES	NONE
0 TO -20	-18 TO -29	17	2	2	25	YES	YES +
-20 TO -35	-29 TO -37	20	2¼	2	30	YES	YES +
-35 TO -50	-37 TO -46	25	2¾	3	35	YES	YES +
-50 TO -65	-46 TO -53	30	3	3	40	YES	YES +

+ INCLUDING AIR PUMP

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Figure 10-2. Oil dilution and boil-off

c. Carburetor hot air levers - As required.

Note

Carburetor heat may be used during the take-off to assist in the vaporization of fuel and reduce rough running and to avoid loss of power. Do not allow the temperature to exceed the maximum permissible of +38° C, to prevent detonation; otherwise a loss of power will result during the climb.

d. Feather dilution arming switch (non-reversible propellers) - Check.

Note

At all ambient temperatures below 0°C, the feather dilution arming switch must be at FEATH. DIL. position (aircraft Serial No. 61-2595 through 62-12584), or at ON position (aircraft prior to Serial No. 61-2595), during the propeller autofeathering system check, and also during flight.

10-30. Take-off.

Warning

Do not attempt a take-off with snow, ice or frost accumulations on the wing and tail surfaces.

Open up against the brakes and insure that engine power increases smoothly. If a crosswind take-off is necessary on an icy surface, use asymmetric engine power to maintain direction, remembering that the take-off distance will be increased.

Caution

For take-off in colder than standard conditions, avoid over-powering the engine beyond its rating. Reduce take-off manifold pressure 1 in. Hg for each 10°C below standard carburetor air temperature.

10-31. After Take-off. After take-off from a slush-covered surface and after reaching a safe height, the landing gear and flaps should be exercised through a few complete cycles to prevent their freezing in the retracted position.

10-32. During Flight. At very low ambient temperatures, low cylinder head and carburetor air temperatures may cause rough running. This condition may be corrected by applying carburetor heat; if this is not sufficient the mixture lever can be placed in AUTO RICH. On aircraft with non-reversible propellers, the propellers should be exercised approximately every 30 minutes to circulate warm engine oil through the governing system.

10-33. Descent. If a temperature inversion is expected during a descent, a close watch must be kept on engine temperatures, even when using a high power setting. If necessary, the landing gear may be lowered, so that higher power settings may be used. Carburetor heat should be used as necessary.

10-34. Approach and Landing. Glide approaches should not be used under cold weather conditions. Normal powered approaches are recommended in order that engine temperatures can be maintained. Use carburetor heat as necessary. If the landing surface is slush covered, the flaps should be retracted as soon as possible after touchdown. Maintain direction by coarse use of the rudder and, if the surface is icy or a crosswind exists, by the use of asymmetric engine power. Make the turn-off slowly to avoid skidding.

Caution

Careful use of the brakes is required when landing on an ice covered surface.

10-35. Engine Shutdown. If a subsequent cold weather start is anticipated, oil dilution should be carried out prior to engine shutdown. The extent of dilution depends entirely on the anticipated temperature during the period of shutdown. (Refer to figure 10-2.) A check must be made to insure that the oil tank level is 3 gallons below the full mark. The engines must be idled until the oil temperature is below 40°C (or stopped and cooled, then restarted) before the dilution procedure is commenced.

Note

Do not attempt oil dilution at oil temperatures above 45°C.

10-36. Oil dilution. Proceed as follows for each engine:

a. Fuel tank selector switch - NORMAL.

b. Fuel booster pump switch - OFF.

c. Feather dilution arming switch (non-reversible propellers) - FEATH. DIL. (aircraft Serial

No. 61-2595 through 62-12584), ON (aircraft prior to Serial No. 61-2595).

d. Autofeathering switch - OFF.

e. With the oil temperature at 40°C, propeller lever at full INCREASE, adjust the throttle to give 1600 rpm.

f. On aircraft with non-reversible propellers, depress the feathering button and allow a drop of 300 rpm before pulling out the button to arrest the feathering action.

Note

This dilutes the feathering line between the oil tank and the propeller governor.

g. Leave the throttle in the position required for step e. and select 1400 rpm with the propeller lever.

h. Select the appropriate engine oil dilution switch to its on position for the required time. (Refer to figure 10-2.)

Note

The time quoted is the elapsed time from selecting dilution to selecting idle cut-off. After selecting idle cut-off, the propeller will continue to rotate for approximately 10 seconds, during which time the dilution switch should be retained in its on position.

i. On aircraft with non-reversible propellers move the propeller lever to full DECREASE after each minute of dilution, then to full INCREASE. Reset the propeller lever to 1400 rpm. This constitutes one cycle.

Note

The dilution table (figure 10-2) shows the number of propeller-pitch cycles required for oil dilution of the non-reversible propeller feathering system.

j. When prescribed time has elapsed, select mixture lever to idle cut-off.

Note

Do not run the engines or add oil to the system after dilution is completed. Do not allow the oil pressure to drop below 45 psi during the dilution procedure.

10-37. Before Leaving the Aircraft. Check the parking brake is released after the wheels are chocked. To prevent the window panels becoming frosted, leave an opening through which the air can circulate but through which snow or sleet will not drift. If the aircraft is to remain idle for an extended period, remove the battery for storage in a warm place. Check that all the necessary covers and protective equipment is in place.

10-38. Ice and Snow. The aircraft is equipped with wing and tail deicers, propeller deicers, carburetor heat, pitot heaters, windshield anti-icers, and heater intake anti-icers; and may be flown with safety under icing conditions.

Caution

Although the aircraft is equipped to combat the formation of ice, prolonged flight in icing conditions should be avoided where possible.

10-39. Wing and tail deicing. The wing and tail deicers should be used with care when airframe icing is prevalent. Indiscriminate use of the system at the first sign of ice may render the facility useless in severe conditions by creating an ice build-up outside the inflated contour of the boot, the break up of the accumulation then being impossible. The system is designed specifically to deice and not to anti-ice and, therefore, during icing conditions, a moderate accumulation should be allowed to develop before the system is operated. Except in the most severe icing conditions (greater than 1/4 inch build-up per minute), the slow boot-cycle is quite capable of dealing with light to moderate accumulations.

Warning

An excessive accumulation of ice on the leading edges will disrupt the airflow and produce increased weight if the build-up becomes extensive over the aircraft. If a build-up takes place on the nose section it may create erratic effects at the static vents and cause unreliable airspeed indications, even though the vents themselves are not iced up. The actual stalling speed may be higher than normal, therefore, approach and landing speeds should be selected with care, using familiar engine power settings and approach angle.

10-40. Pitot heat, propeller deicing and windshield anti-icing. Pitot heat, and heater intake

anti-icing, should be on at all times when in flight and a check only is necessary prior to entering icing conditions. The circuit for each stall warning lift-transducer vane anti-icer is routed via the pitot heater switch. Windshield heat should be on for the duration of the flight, a check only being necessary prior to entering icing conditions; use of the wipers will keep the windshield panels clear. Propeller deicing should be used when necessary. The propeller deicer should be operated for short periods only. Appreciable accumulation of ice on the propeller can cause engine vibration. To stop vibration, switch on the propeller deicer and, if necessary, increase engine speed to 2550 rpm to throw off the ice. Then return the rpm to normal and switch off the deicer. Propeller icing is more likely to occur at the lower rpm settings.

10-41. Carburetor heat. Carburetor icing may occur in moisture or precipitation at ambient temperatures above the icing range. When carburetor icing is suspected, carburetor heat should be applied as necessary to maintain +15°C carburetor air temperature. If icing conditions are anticipated, apply carburetor heat 15 minutes before entering the icing area. (Refer to Chapter 9, paragraph 9-8.)

Section IV

Desert and Hot Weather Operation

10-42. General. In desert and hot weather operational areas, exposure of the aircraft to sand, dust, and heat should be kept to a minimum. Ventilate the aircraft as much as possible on the ground, when sand and dust are not blowing, by opening windows and doors.

10-43. Before Entering the Aircraft. Check that the fuel system has been drained of any water. Check that all exterior surfaces, control hinges, vents and intakes, are free from sand and dust. Check the tires for signs of deterioration caused by heat, and check that all the landing gear shock struts, actuators, up and down locks and brake assemblies are clean. If the exposed portions of the shock struts and actuators are dirty, direct that they be cleaned with a cloth moistened in hydraulic fluid, and then wiped dry to prevent the adhesion of sand and dust. If sand is blowing, do not order the removal of any protective equipment or covers until immediately prior to starting the engines. Where possible, the engine run-up should be conducted on a hard surface free from sand and dirt. To avoid engine overheating, face the aircraft into wind whenever possible prior to starting.

10-44. On Entering the Aircraft. All emergency exits must be checked for freedom of operation then closed and secured. Check the flight controls and engine controls for ease of operation. Direct the removal of all the remaining protective covers and equipment.

10-45. Engine Starting. Use normal procedures, with care to avoid overpriming. Carburetor induction air should be selected as required.

Note

Engine ground running time should be kept to a minimum to avoid overheating and to reduce sand and gravel erosion of the propeller blades.

10-46. Taxiing. Unnecessary use of the brakes will create overheating of the brake units. Run-up and taxi time should be limited.

10-47. Take-off. Unless absolutely necessary, do not take-off during a sand or dust storm, or in the wake of another aircraft. The lower air density associated with hot weather causes a loss in aircraft performance with the result that take-off distances will be increased and rate of climb will be reduced. Refer to Chapter 14.

10-48. Climb and Cruise. Refer to Chapter 14 for performance data.

10-49. Landing. The landing roll will be increased due to the lower air density. Select carburetor induction air as required.

10-50. Engine Shutdown. Park the aircraft and complete the engine shutdown as soon as possible to prevent excessive cylinder head temperatures.

10-51. Before Leaving the Aircraft. Check that all the protective equipment and covers are installed; the engine covers only when the engines have cooled. Leave one or two of the flight compartment windows slightly open to insure air circulation. If chocks are not available, the parking brake should be applied only after the brakes have cooled.

Caution

If a sand or dust storm is anticipated, the doors and windows must be tightly secured, and every effort made to prevent the entry of dust into the aircraft interior, engine nacelles, air intakes, and vents.

Section V

Turbulence and Thunderstorms

10-52. General. Areas of severe turbulence should be avoided where possible and thunderstorms should only be penetrated intentionally if it is impossible to go around them, or when specifically authorized. However, instances arise during routine flights that necessitate a certain amount of thunderstorm flying. For example, at night it may not be possible to detect and avoid a thunderstorm. The aircraft has good control response in turbulent conditions and may flown through a thunderstorm. The optimum penetration speed of 110 knots IAS should be set up prior to entering the storm zone and the aircraft flown with due regard to the VG diagram (Chapter 7, figure 7-2).

10-53. Approaching the storm. Select an altitude below 10,000 feet and proceed as follows:

a. Check that all passengers and crew are seated, and that all safety belts and harnesses are correctly fastened and tight.

b. Pitot heater switch - Check on.

c. Heater intake anti-icing switches - Check on.

d. Windshield heat switch - Check NORM.

e. Propeller levers - Adjust to 2200 rpm.

f. Throttles - Adjust to maintain 110 knots IAS (optimum penetration speed).

g. Communications equipment - Reduce volume of any radio equipment badly affected by static.

h. At night, turn flight compartment lights full bright to minimize blinding effect of lightning.

i. Do not lower landing gear or wing flaps.

10-54. In the storm. Proceed as follows:

a. Maintain the original power setting and pitch attitude throughout the storm. If these are maintained, airspeed indicator fluctuations can be disregarded. Maintain attitude by reference to the attitude gyro indicator.

b. Maintain the original heading. Do not make any turns unless absolutely necessary.

c. Do not correct for airspeed indicator fluctuations, since doing so may result in extreme aircraft attitudes, with a danger of stalling.

d. Use as little elevator control as possible in order to minimize the stresses imposed on the aircraft.

e. The altimeter may be unreliable due to differential barometric pressure within the storm. An indicated gain or loss of several hundred feet is not uncommon, and should be allowed for in determining minimum safe altitude.

Note

Altitudes between 10,000 and 20,000 feet are usually the most turbulent areas in a thunderstorm.

CHAPTER 11
CREW DUTIES

Section I

Scope

11-1. This chapter covers the responsibility of each crew member and includes their primary and alternative functions when accomplishing a mission in the aircraft.

11-2. This materiel is in a compact form; details of each crew member's individual duties are given in Chapter 3.

Section II

Responsibilities

11-3. Pilot. The pilot has the over-all responsibility for the aircraft and for the efficient performance of all duties. He will familiarize himself with the mission requirements and ascertain whether or not the aircraft and crew have the capability of fulfilling the assigned mission. In addition, he will outline specifically the crew duties and what is expected of each crew member, at a preflight briefing. It will be the responsibility of the pilot to insure that a thorough inspection of the aircraft and all equipment is properly conducted in sufficient time before departure to permit correction of discrepancies without incurring delays. He will personally inspect all items of bail-out, ditching (if carried) and survival equipment.

11-4. Copilot. The copilot must be able to substitute for the pilot in any of his duties. An understanding of each member's duties should exist, and to whom each of these duties is delegated. The following paragraphs discuss the duties to be delegated to the copilot.

11-5. Before flight. Aid the pilot by performing the preflight inspection, and reporting the condition of the aircraft, radio and navigational equipment to the pilot.

11-6. Loading. Supervise the refueling of the aircraft. Check the cargo loading and compute for the center of gravity, check that it is within limits. Check that the weight of the fuel plus cargo are within the limits. If transporting personnel, coordinate with the flight crew chief to provide parachutes, if necessary. Make certain adequate belts, safety equipment and other items are available.

11-7. Prestarting and take-off checklists. Read orally the printed checklist, at which time the pilot will acknowledge that each item is in the correct position and ready for flight. In some cases the items are more accessible to the copilot and may be checked by him.

11-8. Take-off. Follow instructions as outlined in Chapter 3.

11-9. In-flight. Tune the radio equipment as required, copy clearances, make position reports, maintain flight log, periodically monitor all flight and engine instruments, fuel gages and hydraulic oil quantity gage. Periodically check cargo tiedowns for security and tension. If passengers are carried, check that the cabin heating or ventilating system has been adjusted for their comfort.

11-10. Landing. Read orally the Before Landing Checklist and report to the pilot that the gear is down and locked. Set the flaps to the desired setting on command of the pilot during the approach.

11-11. After landing. Perform the after landing and engine shutdown checks. Secure the aircraft and complete DA Form 2408.

11-12. Flight Crew Chief. The flight crew chief will assist in all matters pertaining to the safety of the passengers and the flight crew, assist in the performance of preflight duties, and perform any other duties assigned. The following paragraphs discuss the duties performed by the flight crew chief.

11-13. Aircraft loading. Prior to loading check DA Form 2408 and perform the preflight inspection, check fuel, oil, anti-icing, oxygen and hydraulic systems for servicing. Visually check for security of filler caps. The emergency equipment, and passenger seats and equipment, should be checked for serviceability and completeness. Inspect the emergency exits, which should be closed and secured. Buffet supplies and the cabin lighting should be checked.

11-14. During loading check the cargo load is maintained within proper weight and cg limits and insure that the cargo is correctly tied down and secured.

11-15. After loading, the cargo manifest and the passenger manifest should be checked and aboard. Passengers should be briefed regarding emergency procedures, and seating arrangements detailed. All baggage and loose equipment should be secured. The cabin and flight compartment entrance ladders and the ramp extension should be stowed and secured. When the ramp and cargo doors are closed, report readiness to the pilot.

11-16. During engine starting. The auxiliary power supply should be connected and the landing gear ground locks removed. Stand fire guard until the engines are started. Disconnect the external power supply and remove the wheel chocks. In the event of an engine fire during starting, signal the pilot to switch off the ignition and, when the propeller has stopped, apply the fire extinguisher agent into the front of the nacelle, and into the engine or accessory compartment at the source of the fire.

11-17. During engine run-up. Visually check for flap operation and all control movements.

11-18. Before take-off. Check that the NO SMOKING - FASTEN BELTS signs are illuminated and that these orders are obeyed by the passengers. Report to the pilot readiness for take-off.

11-19. In flight. Periodically inspect the engine nacelles for oil, fuel or hydraulic leaks. Operate the cabin heating or ventilating system for passenger comfort and periodically check cargo tiedowns for tension. Be on call to the pilot to perform any other duties he may require.

11-20. Prior to landing visually inspect the main gear downlocks, and check that the red/white index marks are aligned. Check the condition of struts and tires. Complete any preplanning required for off-loading.

11-21. After landing. Attach the landing gear ground locks and chock the wheels. Supervise the off-loading of passengers, cargo and baggage. Make an inventory of equipment and check with the pilot for desired servicing and fuel quantity. Check the aircraft for cleanliness.

CHAPTER 12
WEIGHT AND BALANCE COMPUTATION

Section I

Scope

12-1. Sufficient data is provided in this Chapter to enable the using activity, knowing the basic weight and moment of the particular Model CV-2 aircraft, to compute any combination of weight and balance.

12-2. A weight and balance computer (also called a load adjuster) is supplied with each aircraft. Instructions on the use of the computer are provided in this Chapter.

Section II

Introduction

12-3. Charts and Forms. The necessary charts and forms required to compute the weight and balance for loading Model CV-2 aircraft are, currently, the DD 365 series. Refer to AR95-16. The charts and forms may change from time to time, but the principle on which they are based will not change. This chapter contains a complete set of Chart E for the CV-2 aircraft, a sample Chart C (DD Form 365C) and two samples of Form F (DD Form 365F). Further information regarding weight and balance responsibilities is contained in TM 55-1510-206-20, Maintenance Allocation Chart (Appendix II).

12-4. Aircraft Weighing. Aircraft must be weighed periodically as required by pertinent directives (refer to AR95-16), when major modifications or repairs are made, when the pilot reports unsatisfactory flight characteristics (nose or tail heaviness), and when the basic weight data contained in the records is suspected to be in error. Crew members have available the current basic weight, moment, and computer index in the DA Form binder in the individual aircraft.

Note

The basic weight and cg location can only be as accurate as the scales equipment employed.

Section III

Definitions

12-5. Weight Definitions. The following paragraphs discuss the various weight definitions.

12-6. Basic weight. The basic weight of an aircraft is that weight which includes all fixed operating equipment and trapped fuel and oil, to which it is only necessary to add the variable or expendable load items for the various missions.

Note

The basic weight of an aircraft varies with structural modifications and changes in the fixed operating equipment. The term "basic weight", when qualified with a word indicating the type of mission such as "Basic Weight for Combat", "Basic Weight for

Ferry", etc, may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flights which are not normally carried on combat missions will be included in "Basic Weight for Ferry" but not in "Basic Weight for Combat".

12-7. Operating weight. The operating weight of an aircraft is the basic weight plus those variable items which remain substantially constant for the type of mission. These items include oil, crew, crew baggage, steward's equipment, emergency and extra equipment that may be required.

Note

The operating weight of the Model CV-2 aircraft is the weight of the aircraft including the crew, full oil and all equipment required for the mission, but not including fuel or payload.

12-8. Gross weight. The gross weight is the total weight of an aircraft and its contents.

12-9. Take-off gross weight. The take-off gross weight is the operating weight plus the variable and expendable load items which vary with the mission. These items include fuel, cargo and passengers.

12-10. Landing gross weight. The landing gross weight is the take-off gross weight minus the expended load items.

12-11. Crew, troop and passenger weights. The following policy regarding weights of crew, troops and passengers will be adhered to when computing weight and balance on Model CV-2 aircraft.

12-12. When aircraft are operated at gross weights approaching the maximum, the exact weight of each individual occupant, plus equipment, shall be used. If weighing facilities are not available, or if the tactical situation dictates otherwise, loads will be computed as follows:

a. Combat equipped soldiers: 240 lb/individual.

b. Combat equipped paratroopers: 260 lb/individual.

c. Crew and passengers with no equipment: Compute weight according to each individual's estimate.

12-13. Balance Definitions. The following paragraphs discuss the factors connected with the balance of the aircraft.

12-14. Reference datum. Reference datum is an imaginary vertical plane at or forward of the nose of the aircraft from which all horizontal distances are measured for balance purposes. The aircraft diagram in Chart E shows this reference datum as balance station zero.

Note

On Model CV-2 aircraft the reference datum is 193.0 inches forward of the jig point. The jig point is marked on a plate on the underside of the fuselage.

12-15. Arm. Arm for balance purposes is the horizontal distance in inches from the reference datum to the cg of the item. Arms may be determined from Chart E.

Note

Arm locations, and not station locations, are given in this manual. Station locations are primarily structural designations, and differ from arms.

12-16. Moment. Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits.

Note

On Model CV-2 aircraft it will be found that inches and Moment/1000 have been used on Charts A and C (refer to DA Form binder), and on Chart E. The same units of dimensions for Arm and the SAME moment/constant MUST be used consistently for any revisions or additions to Charts A, C and E.

12-17. Average arm. Average arm is the arm obtained by adding the weights and adding the moments of a number of items, and dividing the total moment by the total weight.

12-18. Basic moment. Basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum. (Refer to Chart C in DA Form binder.)

12-19. Center of gravity (cg). Center of gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the aircraft.

12-20. Cg limits. Cg limits are the extremes of movement which the cg can have without making the aircraft unsafe to fly. The cg of the loaded aircraft must be within these limits at take-off, in the air, and on landing. In some cases, separate take-off and landing limits may be specified. (Refer to the CG diagram in Chart E.)

12-21. Balance computer index. Balance computer index is a number representing the moment which, when considered in conjunction with the weight, gives the cg position.

Section IV

Chart Explanations

12-22. Chart C - Basic Weight and Balance Record. For sample Chart C, see figure 12-1. Chart C is the Basic Weight and Balance Record (DD Form 365C) and forms a continuous history of the basic weight, moment and balance computer index, resulting from structural and equipment changes in service. At all times THE LAST WEIGHT, MOMENT/1000 AND INDEX ENTRY IS CONSIDERED THE CURRENT WEIGHT AND BALANCE STATUS OF THE BASIC AIRCRAFT. The basic index for the balance computer can be determined by means of the index scale, refer to paragraph 12-35, or index formula on the computer. The index formula is as follows:

$$\text{INDEX} = 100 - \frac{\text{WEIGHT X (350 - ARM)}}{10{,}000}$$

Note

There is an error in the denominator of the index formula on the balance computer. The correct formula is as shown above.

12-23. Use of chart C. When the aircraft is delivered, the basic weight, moment/1000 and index will have been entered on the chart by the manufacturer. The itemized list of equipment included therein is shown and checked on Chart A in the DELIVERY EQUIPMENT column. Additions or subtractions to the basic weight, moment and index in Chart C are made under the following circumstances:

a. Whenever equipment is added to or removed from the aircraft. If the item is listed on Chart A, enter the identical item number, description and applicable weight, arm, moment data and index on Chart C. If the item is not listed on Chart A, determine its actual weight and arm and record this information on both Chart A and Chart C.

Note

Do not enter check marks on Chart A for these items until a complete inventory is made, but enter the date in parentheses following the description.

b. Whenever a complete inventory reveals equipment changes not previously recorded. Post equipment changes as noted above. Date the newly calculated basic weight and moment to correspond with the date entered at the head of the CHECK column on Chart A identifying the equipment content of the new figures. It is also helpful to record the check column number which substantiates this new basic weight and moment.

c. Whenever structural changes are made in the aircraft. If the structural changes are provisions for equipment, list them separately from the equipment to be installed thereon.

d. Whenever the aircraft is reweighed. Before weighing, make a complete inventory and bring calculated Chart C figures up-to-date. Enter the new "As Weighed" basic weight and moment from the Airplane Weighing Record (DD Form 365B).

12-24. Any change or modification which is caused by a specific order should carry a reference to the order number and date which authorizes the change.

Note

The date entered on Chart C must be consistent with the Delivery Date or the date entered on the top of the CHECK column on Chart A, and with the date on the Airplane Weighing Record, if used.

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CHART C—BASIC WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL: CV-2 | SERIAL NO.: 12345 | PAGE NO.: 1

DATE	ITEM NO. IN	ITEM NO. OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	ARM (IN)	MOMENT[1]/1000	WEIGHT CHANGE REMOVED (–) WEIGHT	ARM (IN)	MOMENT[1]/1000	RUNNING TOTAL BASIC AIRPLANE WEIGHT	MOMENT[1]/1000	INDEX[1]
Same as on ChartA	-	-	Basic Weight - Delivery Condition							18477	6546.9	108.0
Aug 2 1960			Incorporate Mod X.	50	355	17.8				18527	6564.7	107.9
Aug 9 1960			Incorporate Mod Y.				10	166	1.7	18517	6563	108.1

SAMPLE

[1] *Enter constant used below line.* [1] *Balance computer index.*

DD FORM 1 SEP 54 365 C — PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED.

Figure 12-1. Chart C - basic weight and balance record

12-25. Chart E - Loading Data. The series of charts, (figure 12-4), that comprise Chart E supply all the information that is necessary to solve any particular loading problem for Model CV-2 aircraft. The Weight and Balance Computer, supplied with the aircraft, will also solve all loading problems. Less computation is required when using the computer than by the chart method. Refer to paragraph 12-32 for use of the computer. Chart E consists of 27 pages and information is supplied as follows:

a. Weighing Instructions. (Sheet 1.)

b. Aircraft Diagram. (Sheet 2.)

c. Fuel Table. (Sheets 3 and 5.)

d. Oil Table. (Sheets 4 and 5.)

e. Cabin and Tie-Down Locations. (Sheet 6.)

f. Compartment Cargo Tables. (Sheets 7 to 10.)

g. Seating and Litters. (Sheets 11 and 12.)

h. Personnel and Personnel Movement Tables. (Sheets 13 to 20.)

i. Center of Gravity Tables. (Sheets 21 to 26.)

j. Center of Gravity Diagram. (Sheet 27.)

12-26. From the tables, weight and moment/1000 are obtained for all variable load items and are added to the current basic weight and moment/1000, from Chart C, to obtain the gross weight and moment. The cg of the loaded aircraft is represented by a moment figure. If the aircraft is loaded within the forward and aft cg limits, the moment figure will fall numerically between the limiting moments on the Center of Gravity Tables. The effect on the cg of the expenditure of such items as fuel, supplies or paratroops dropped from the aircraft etc., may be checked by subtracting the weights and moments of such items from the take-off gross weight and moment, and checking the new moment with the cg table. This check should be made to determine whether or not the cg will remain within limits during the entire flight.

Section V

Weight and Balance Clearance Form F, DD Form 365F

12-27. Purpose of Form F. Form F is the summary of the actual disposition of load of the aircraft. It records the balance status of the aircraft step-by-step. It serves as a work sheet on which to record weight and balance calculations, and any corrections that must be made to insure that the aircraft will be within weight and cg limits. It is necessary to complete Form F prior to flight whenever an aircraft is loaded in a manner for which no previous valid Form F is available.

12-28. Form F is furnished as separate sheets, an original and carbon are prepared for each loading. The original sheets, carrying the signature of responsibility, serve as certificates of proper weight and balance as required by existing clearance directives. The duplicate copy must remain in the DA Form binder in the aircraft for the duration of the flight. On a cross-country flight this form aids the weight and balance technician, or flight crew chief, at refueling bases and stopover stations. There are two versions of this form; SPECIAL MISSION (TRANSPORT) and TACTICAL. They were designed to provide for the respective loading arrangements of these two types of aircraft. It will be noted that the general use and fulfillment of either version is the same. Specific instructions for filling out the SPECIAL MISSION version of the form are given in the following paragraphs.

12-29. Use of Form F. A sample Form F is shown in figures 12-2 and 12-3, and reflects the problem in paragraph 12-30. The form is completed as follows:

a. Insert the necessary identifying information at the top of the form. In the blank spaces of the LIMITATIONS table, enter the gross weight and cg restrictions obtained from Chapters 7 and 13.

b. Ref 1. Enter the aircraft basic weight and index or moment/constant. Obtain these figures from the last entry of Chart C (in DA Form binder). Refer to figure 12-1 for sample Chart C.

Note

If the balance computer is used in loading the aircraft, enter opposite Ref 1 the index figure obtained from Chart C and use index

WEIGHT AND BALANCE CLEARANCE FORM F

TRANSPORT

(USE REVERSE FOR TACTICAL MISSIONS)

Cross Reference: RAF Form 2870; RCAF Form F. 115 C; 50M 5-51 (6797)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRPLANE TYPE	FROM	HOME STATION
Oct 3/1963	CV-2B	X2	X2
MISSION/TRIP/FLIGHT/NO.	**SERIAL NO.**	**TO**	**PILOT**
7	12345	YP	Capt. Doe

LIMITATIONS			
CONDITION	TAKEOFF	LANDING	LIMITING WING FUEL
[2] ALLOWABLE GROSS WEIGHT	28500	28500	27000
TOTAL AIRPLANE WEIGHT (*Ref. 11*)	23068		
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT		20427	
OPERATING WEIGHT (*Ref. 8*)			20077
ALLOWABLE LOAD (*Ref. 18*) (*use SMALLEST figure*)	5432	8073	6923
[3] PERMISSIBLE C. G. TAKEOFF	FROM 29.9	TO (% *M.A.C.*) 39.0	
[4] PERMISSIBLE C. G. LANDING	FROM 26.0	TO (% *M.A.C.*) 39.0	
[5] LANDING FUEL WEIGHT	350		

REMARKS

REF	ITEM	WEIGHT	MOM/1000
1	BASIC AIRPLANE (*From Chart C*)	19177	6793
2	OIL (40 Gal.)	300	97
3	CREW (*No.*) 3	600	105
4	CREW'S BAGGAGE		
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8	OPERATING WEIGHT	20077	6995
9	TAKEOFF FUEL (480 Gal.)	2880	1025
10	~~WATER-METH.~~ FLUID (de-ice	111	37
11	TOTAL AIRPLANE WEIGHT	23068	8057

12 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)

UPPER COMPARTMENTS				LOWER COMPARTMENTS			
COMPT	PASSENGERS NO.	PASSENGERS WEIGHT	CARGO	COMPT	PASSENGERS NO.	PASSENGERS WEIGHT	CARGO
A				C1			
B				C2			100
C				C3			500
D				C4			1000
E				C5			
F				C6			
G				C7			
H				C8			1000
I				C9			1000
J							
K							
L							
M							
N							
O							
P							
FWD	BELLY						
AFT	BELLY						

TOTAL FREIGHT	3500
TOTAL MAIL	100
COMPUTER PLATE NUMBER (*If used*)	

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 15).*
[4] *Applicable to gross weight (Ref. 18).*
[5] *Ref. 9 minus Ref. 17.*

SAMPLE

CORRECTIONS (*Ref. 14*)			
COMPT	ITEM	CHANGES (+ or −) WEIGHT	[1] ~~INDEX OR~~ MOM/1000
C8	Cargo	-1000	-493
C9	Cargo	-1000	-526
C5	Cargo	+1000	+373
C6	Cargo	+1000	+413
TOTAL WEIGHT REMOVED		-2000	-1019
TOTAL WEIGHT ADDED		+2000	+ 786
NET DIFFERENCE (*Ref. 14*)		0	-233

13	TAKEOFF CONDITION (*Uncorrected*)	26668 / 9581
14	CORRECTIONS (*If required*)	-233
15	TAKEOFF CONDITION (*Corrected*)	26668 / 9348
16	TAKEOFF C. G. IN % M. A. C. OR IN.	350.53 IN. or 33.5%
17	LESS FUEL	2530 / 900
18	LESS AIR SUPPLY LOAD DROPPED	3500 / 1266
19	MISC. VARIABLES	
20	ESTIMATED LANDING CONDITION	20638 / 7182
21	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	347.99 IN. or 31.4%

COMPUTED BY: J. Jones (SIGNATURE)

WEIGHT AND BALANCE AUTHORITY: F. Smith (SIGNATURE)

PILOT: J. Doe (SIGNATURE)

NOTE.—THIS TRANSPORT CLEARANCE FORM HAS RESULTED FROM TRIPARTITE AGREEMENT AND NO FURTHER CHANGES MAY BE MADE TO IT WITHOUT PRIOR CONSIDERATION BY TRIPARTITE AUTHORITIES.

DD FORM 1 SEPT 54 365F

GPO: 1955 O - 515288

Figure 12-2. Weight and Balance Clearance Form F (using Chart E)

figures throughout the form. Enter plate number of the computer, (located on the edge of the weight/cg graph and on the slide), under REMARKS. If Chart E is used instead of a balance computer, enter moment/1000 values throughout the form.

c. Ref 2. Enter the amount and weight of oil.

d. Ref 3. Enter the number and weight of crew. Use actual crew weights, plus equipment, if available. (Refer to paragraph 12-11.)

e. Ref 4. Enter the weight of the crew's baggage.

f. Ref 5. Enter the weight of the steward's equipment.

g. Ref 6. Enter the weight of the emergency equipment.

h. Ref 7. Enter the weight of any extra equipment.

i. Ref 8. Enter the sum of the weights for Ref 1 through Ref 7 inclusive, to obtain OPERATING WEIGHT.

j. Ref 9. Enter the number of gallons and weight of the fuel load at take-off. The weight of fuel used in warm-up and taxi should not be included.

Note

List under REMARKS the fuel tanks concerned and the amount of fuel in each tank. If fuselage-tank fuel is carried, make appropriate entries to that effect in the space provided.

k. Ref 10. Enter the number of gallons and weight of the water injection fluid.

Note

On Model CV-2 aircraft deicing fluid should be entered in place of the water injection fluid.

l. Ref 11. Enter the sum of the weights for Ref 8 through Ref 10, inclusive, to obtain TOTAL AIRPLANE WEIGHT.

m. Determine the ALLOWABLE LOAD based on take-off, landing or limiting wing fuel restrictions by use of the LIMITATIONS table in the upper left-hand corner of the form, as follows:

(1) Enter the ALLOWABLE GROSS WEIGHT for TAKE-OFF and LANDING. For aircraft which have a gross weight restriction above which all weight must be fuel in the wings (e.g., a zero wing fuel gross weight), enter the ALLOWABLE GROSS WEIGHT for LIMITING WING FUEL in the last column of the LIMITATIONS table. Refer to Chapter 7, paragraph 7-29.

(2) Enter the TOTAL AIRPLANE WEIGHT (from Ref 11). Estimate the fuel to be aboard at time of landing, and enter the OPERATING WEIGHT (from Ref 8) and OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT.

(3) Subtract the above weights from the respective "allowable gross weights" to obtain the respective "allowable loads". The smallest of these "allowable loads" is the ALLOWABLE LOAD, and represents the maximum amount of weight which may be distributed throughout the aircraft in the various compartments without exceeding the limiting gross weight of the aircraft.

n. Ref 12. Using the same compartment letter designation as shown on the balance computer or on Chart E, enter the number and weight of passengers plus their equipment, and the weight of cargo (baggage, mail, etc.). Use actual passenger plus equipment weights, if available. Enter the total for each compartment in the WEIGHT column. If desired for statistical purposes, the "total freight" and "total mail" weights may also be listed in the space provided under "Remarks".

Note

The sum of the compartment totals must not exceed the ALLOWABLE LOAD determined in the LIMITATIONS table.

o. Ref 13. Enter the sum of Ref 11 and the compartment totals under Ref 12 opposite TAKE-OFF CONDITION (Uncorrected). At this point, if not already completed, calculate and enter the index or moment/1000 for Ref 1 through Ref 13 inclusive.

p. Check the weight figure, Ref 13, against the GROSS WEIGHT TAKE-OFF in the LIMITATIONS table. Check the index or moment/1000 figure opposite Ref 13 by means of the balance computer or Chart E, respectively, to ascertain that the indicated cg is within allowable limits.

q. If changes in amount or distribution of load are required, indicate necessary adjustments by proper entries in the CORRECTIONS table in lower left-hand corner of the form. Enter a brief description of the adjustment made in the column

WEIGHT AND BALANCE CLEARANCE FORM F
TRANSPORT
(USE REVERSE FOR TACTICAL MISSIONS)

Cross Reference
RAF Form 2870
RCAF Form F. 115 C
50M 5-51 (6797)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRPLANE TYPE	FROM	HOME STATION
Oct 3/1963	CV-2B	XZ	XZ

MISSION/TRIP/FLIGHT/NO.	SERIAL NO.	TO	PILOT
7	12345	YP	Capt. Doe

LIMITATIONS				REF	ITEM	WEIGHT	INDEX OR MOM.
CONDITION	TAKEOFF	LANDING	LIMITING WING FUEL				
[2] ALLOWABLE GROSS WEIGHT	28500	28500	27000	1	BASIC AIRPLANE (*From Chart C*)	19177	108.4
TOTAL AIRPLANE WEIGHT (*Ref. 11*)	23068			2	OIL (40 Gal.)	3000	
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT		20427		3	CREW (*No.*) 3	600	
OPERATING WEIGHT (*Ref. 8*)			20077	4	CREW'S BAGGAGE		
ALLOWABLE LOAD (*Ref. 18*) (*use SMALLEST figure*)	5432	8073	6923	5	STEWARD'S EQUIPMENT		
[3] PERMISSIBLE C. G. TAKEOFF	FROM 29.9	TO (% *M.A.C.* ~~or IN.~~) 39.0		6	EMERGENCY EQUIPMENT		
[4] PERMISSIBLE C. G. LANDING	FROM 26.0	TO (% *M.A.C.* ~~or IN.~~) 39.0		7	EXTRA EQUIPMENT		
[5] LANDING FUEL WEIGHT	350			8	OPERATING WEIGHT	20077	96.8
				9	TAKEOFF FUEL (.480 Gal.)	2880	
				10	~~WATER-INJ.~~ FLUID (de-ice ~~Gals.~~)	111	
				11	TOTAL AIRPLANE WEIGHT	23068	98.3

REMARKS

TOTAL FREIGHT	3500
TOTAL MAIL	100
COMPUTER PLATE NUMBER (*If used*)	DH102

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 15).*
[4] *Applicable to gross weight (Ref. 18).*
[5] *Ref. 9 minus Ref. 17.*

12 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)

COMPT	UPPER COMPARTMENTS PASSENGERS NO.	UPPER COMPARTMENTS PASSENGERS WEIGHT	UPPER COMPARTMENTS CARGO	COMPT	LOWER COMPARTMENTS PASSENGERS NO.	LOWER COMPARTMENTS PASSENGERS WEIGHT	LOWER COMPARTMENTS CARGO		
A				C1					
B				C2			100	100	
C				C3			500	500	
D				C4			1000	1000	
E				C5					
F				C6					
G				C7					
H				C8			1000	1000	
I				C9			1000	1000	
J									
K									
L									
M									
N									
O									
P									
FWD	BELLY								
AFT	BELLY								

SAMPLE

CORRECTIONS (*Ref. 14*)			
COMPT	ITEM	CHANGES (+ or −) WEIGHT	[1] INDEX ~~OR MOM.~~
C8	Cargo	-1000	
C9	Cargo	-1000	
C5	Cargo	+1000	
C6	Cargo	+1000	
TOTAL WEIGHT REMOVED		-2000	-
TOTAL WEIGHT ADDED		+2000	+
NET DIFFERENCE (*Ref. 14*)		0	-22.9

13	TAKEOFF CONDITION (*Uncorrected*)	26668	124.1
14	CORRECTIONS (*If required*)		-22.9
15	TAKEOFF CONDITION (*Corrected*)	26668	101.0
16	TAKEOFF C. G. IN % M. A. C. ~~OR IN.~~	33.3%	
17	LESS FUEL	2530	
18	LESS AIR SUPPLY LOAD DROPPED	3500	
19	MISC. VARIABLES		
20	ESTIMATED LANDING CONDITION	20638	93.0
21	ESTIMATED LANDING C. G. IN % M. A. C. ~~OR IN.~~	31.2%	

COMPUTED BY: J. Jones — SIGNATURE

WEIGHT AND BALANCE AUTHORITY: F. Smith — SIGNATURE

PILOT: J. Doe — SIGNATURE

DD FORM 1 SEPT 54 365F

NOTE.—THIS TRANSPORT CLEARANCE FORM HAS RESULTED FROM TRIPARTITE AGREEMENT AND NO FURTHER CHANGES MAY BE MADE TO IT WITHOUT PRIOR CONSIDERATION BY TRIPARTITE AUTHORITIES.

Figure 12-3. Weight and Balance Clearance Form F (using balance computer)

marked ITEM. Add all the weight and moment decreases, and insert the totals in the space opposite TOTAL WEIGHT REMOVED. Add all the weight and moment increases and insert the totals in the space opposite TOTAL WEIGHT ADDED. Subtract the smaller from the larger of the two totals and enter the difference (with applicable + or - sign) opposite NET DIFFERENCE. If the balance computer is used, the revised index for each correction item, rather than plus or minus index changes, is entered. Transfer these NET DIFFERENCE figures to the spaces opposite Ref 14.

r. Ref 15. Enter the sum of/or the difference between Ref 13 and Ref 14. Recheck to assure that these figures do not exceed allowable limits.

s. Ref 16. By referring to the cg table on Chart E, or to the cg grid on the balance computer, determine the take-off cg position. Enter this figure in the space provided opposite TAKE-OFF CG. Enter under PERMISSIBLE CG TAKE-OFF in the LIMITATIONS table, the cg limits for the take-off condition (Ref 15) by reference to the CG DIAGRAM in Chart E, or the balance computer. Check that the take-off cg position is within these limits.

t. Ref 17. Estimate the weight of fuel which may be expended before landing. Enter figures together with index or moment/1000 in the space provided.

Note

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

u. Ref 18. Enter the weight of AIR SUPPLY LOAD to be dropped before landing, with index or moment/1000.

v. Ref 19. Enter the weight of MISCELLANEOUS items to be expended before landing, with index or moment/1000, and enter shift of crew to landing positions, with index or moment/1000 change due to crew movement1 Explain under "Remarks", if necessary.

w. Ref 20. Enter the differences in weights and index or moment/1000 between Ref 15 and the total of Ref 17, 18 and 19.

x. Ref 21. By again referring to the cg table on Chart E, or to the cg grid on the balance computer, determine the estimated landing cg position. Enter this figure opposite ESTIMATED LANDING CG. Enter under PERMISSIBLE CG LANDING in the LIMITATIONS table, the cg limits for the estimated landing condition (Ref 20) by reference to the CG DIAGRAM in Chart E, or on the balance computer. Check that the estimated landing cg position is within these limits.

y. The necessary signatures must appear at the bottom of the form.

12-30. Sample Weight and Balance Problem Using Form F. A series CV-2B aircraft is to make an air supply drop of general cargo at a point 300 nautical miles from its base, and is to land 200 nautical miles from the dropping zone. The gross weight of the cargo is 3600 lb of which 3500 lb is to be dropped. The required crew consists of pilot, copilot and crew chief. A fuel reserve of 350 lb, sufficient for 45 minutes cruise at 2 x 500 bhp, is to be allowed.

12-31. Samples of Form F. Form F, covering the sample problem is shown in figures 12-2 and 12-3. Figure 12-2 shows a form completed using moment/1000, while figure 12-3 shows a form completed using the computer index. Chart C must be checked for the basic weight and moment/1000 (or index) of this particular aircraft, and is found to be as follows:

Basic weight	19,177 lb
Basic moment/1000	6792.9
Index	108.4

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 1 OF 27

WEIGHING INSTRUCTIONS

The basic weight condition is established with landing gear extended, flaps up, radio console aft, controls in the neutral and locked position, all doors and exits closed, unusable fuel and trapped oil in aircraft, and hydraulic system full.

Moment/1000 for retraction of landing gear is minus (-) 38.1 lb in.

To drain fuel from all fuel cells use tank sump drain (1" Dia.) and manifold water drain (3/8" Dia.) located at 2nd access panel on under side of wing, outboard of the nacelles, with the aircraft in a level attitude.

Fuel remaining in the system after defueling in the above manner is the trapped fuel. This fuel plus the unusable fuel in excess of trapped is included in the aircraft basic weight. See Check List for both quantities.

To drain oil from oil tanks, drain while hot, using tank drain (1" Dia.) located at base of tank in landing gear wells, with the aircraft in level attitude.

Oil remaining in the system after draining in the above manner is the trapped oil. This oil is included in the aircraft basic weight. See Check List for quantity.

For leveling purposes, plumb bob suspension and target brackets are located on port side of doorway in the cabin forward bulkhead. Access may be gained through the cockpit bottom hatch.

Jig point is located 193.0 inches aft of the reference datum and is marked by a plate attached to the underside of the fuselage center line. See aircraft diagram.

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 1 of 27)

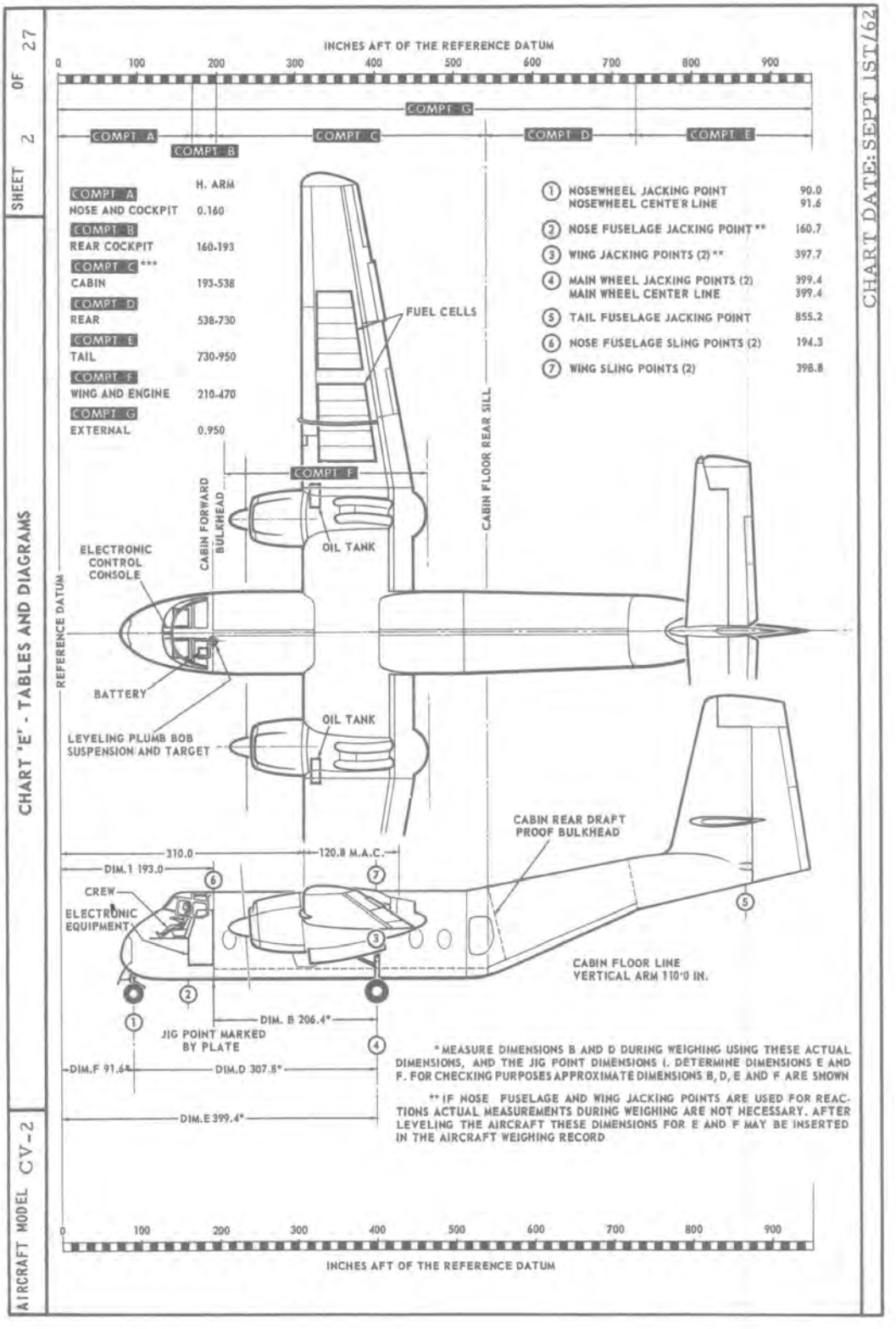


Figure 12-4. Chart E - loading data (sheet 2 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 3 OF 27

FUEL TABLE

STANDARD TANKS - CAPACITY 414 US GAL/PORT AND STBD TANK EACH
SELF-SEALING TANKS - CAPACITY 403 US GAL/PORT AND STBD TANK EACH } ARM 355.8

US GAL	*WEIGHT LB	MOMENT 1000 LB IN.	US GAL	*WEIGHT LB	MOMENT 1000 LB IN.	US GAL	*WEIGHT LB	MOMENT 1000 LB IN.
10	60	21	260	1560	555	510	3060	1089
20	120	43	270	1620	576	520	3120	1110
30	180	64	280	1680	598	530	3180	1131
40	240	85	290	1740	619	540	3240	1153
50	300	107	300	1800	640	550	3300	1174
60	360	128	310	1860	662	560	3360	1195
70	420	149	320	1920	683	570	3420	1217
80	480	171	330	1980	704	580	3480	1238
90	540	192	340	2040	726	590	3540	1260
100	600	213	350	2100	747	600	3600	1281
110	660	235	360	2160	769	610	3660	1302
120	720	256	370	2220	790	620	3720	1324
130	780	278	380	2280	811	630	3780	1345
140	840	299	390	2340	833	640	3840	1366
150	900	320	400	2400	854	650	3900	1388
160	960	342	410	2460	875	660	3960	1409
170	1020	363	420	2520	897	670	4020	1430
180	1080	384	430	2580	918	680	4080	1452
190	1140	406	440	2640	939	690	4140	1473
200	1200	427	450	2700	961	700	4200	1494
210	1260	448	460	2760	982	710	4260	1516
220	1320	470	470	2820	1003	720	4320	1537
230	1380	491	480	2880	1025	730	4380	1558
240	1440	512	490	2940	1046	740	4440	1579
250	1500	534	500	3000	1067	750	4500	1601

CHART DATE: JUNE/63

Figure 12-4. Chart E - loading data (sheet 3 of 27)

4F-1206

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 4 OF 27

FUEL TABLE continued. . . . . .

CAP. 414 US GAL/TANK ARM 355.8 (STANDARD TANKS)
CAP. 403 US GAL/TANK ARM 355.8 (SELF SEALING TANKS)

US GAL	*WEIGHT LB	MOMENT 1000 LB IN.
760	4560	1622
770	4620	1644
780	4680	1665
790	4740	1686
800	4800	1708
**806	4836	1721
810	4860	1729
820	4920	1751
828	4968	1768

* Fuel weight is based on 6.0 lb per US gal (fuel MIL-G-5572 at 60°F). Total weight of fuel is dependent upon the specific gravity and the temperature. Therefore the notation "full" does not appear on the fuel gages. Variation should be anticipated in gage readings when tanks are full.

** Capacity of self-sealing tanks.

OIL TABLE (USABLE)

18.0 US GAL/TANK ARM 322.2 (NON-REVERSIBLE PROPS)
20.4 US GAL/TANK ARM 322.2 (REVERSIBLE PROPS)

US GAL	*WEIGHT LB	MOMENT 1000 LB IN.
5	38	12
10	75	24
15	113	36
20	150	48
25	188	61
30	225	72
36	270	87
** 40.8	306.1	98

* Oil weight is based on 7.5 lb per US gal.

** Usable capacity when reversible propellers are installed

CHART DATE: Nov /63

Figure 12-4. Chart E - loading data (sheet 4 of 27)

4F-1207

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 5 OF 27

FUEL & OIL TABLES - LONG RANGE TANKS

TANKS COMBINED ARM = 364.65 IN.		
US GAL	WT - LB	MOMENT / 1000
40	240	87.5
80	480	175.0
120	720	262.5
160	960	350.0
200	1200	437.6
240	1440	525.1
280	1680	612.6
320	1920	700.1
360	2160	787.6
400	2400	875.2
440	2640	962.7
480	2880	1050.2
520	3120	1137.7
560	3360	1225.2
600	3600	1312.7
640	3840	1400.3
680	4080	1487.8
720	4320	1575.3
760	4560	1662.8
800	4800	1750.3
840	5040	1837.8
880	5280	1925.4
920	5520	2012.9
960	5760	2100.4

FORWARD TANK ONLY ARM = 331.7 IN.		
US GAL	WT - LB	MOMENT / 1000
40	240	79.6
80	480	159.2
120	720	238.8
160	960	318.4
200	1200	398.0
240	1440	477.6
280	1680	557.3
320	1920	636.9
360	2160	716.5
400	2400	796.1
440	2640	875.7
480	2880	955.3

REAR TANK ONLY ARM = 397.6 IN.		
US GAL	WT - LB	MOMENT / 1000
40	240	95.4
80	480	190.8
120	720	286.3
160	960	381.7
200	1200	477.1
240	1440	572.5
280	1680	668.0
320	1920	763.4
360	2160	858.8
400	2400	954.2
440	2640	1049.7
480	2880	1145.1

LONG RANGE OIL			
US GAL	WT-LB	ARM-IN.	MOMENT / 1000
18	135	248.0	33.5

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 5 of 27)

4P-1204

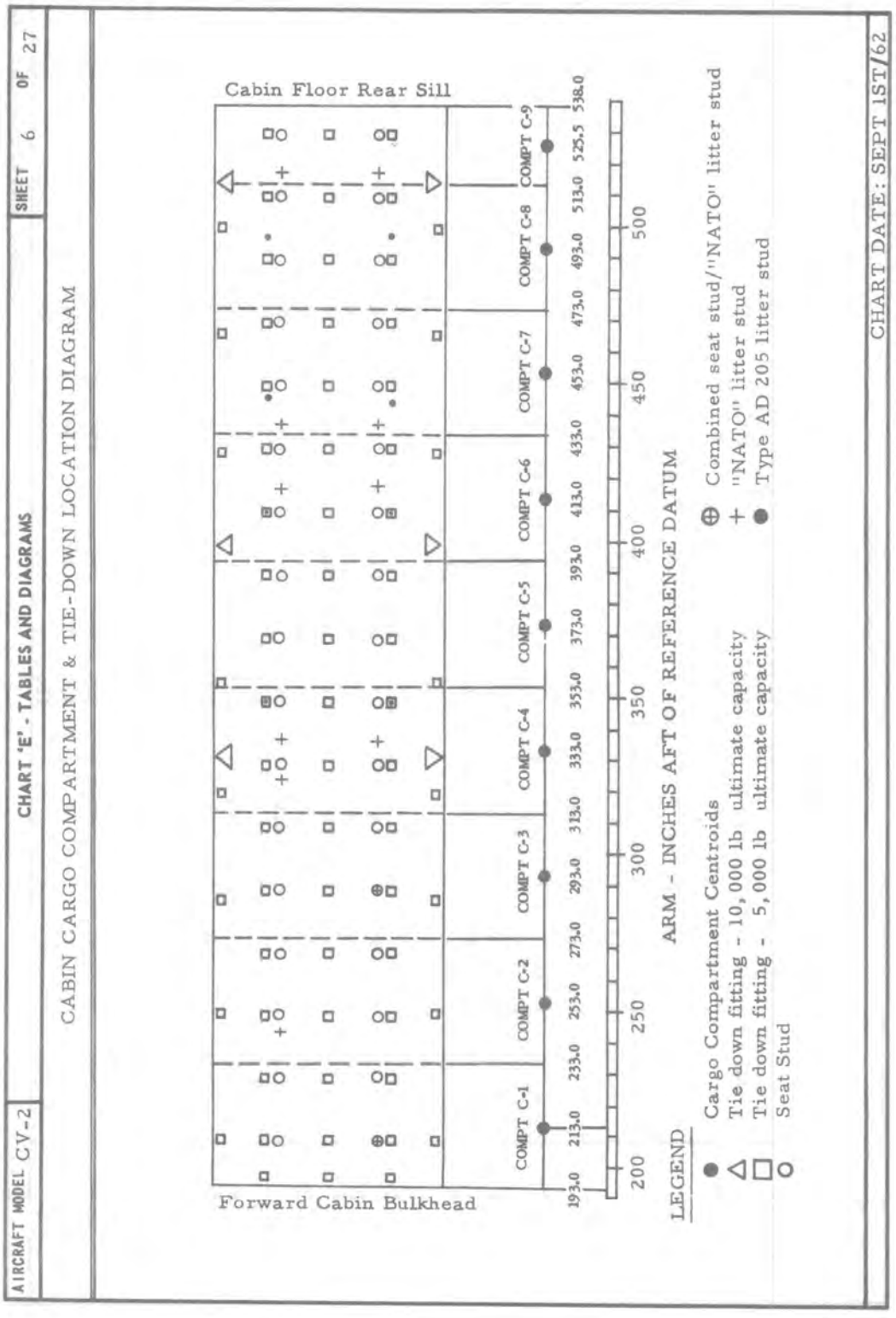


Figure 12-4. Chart E - loading data (sheet 6 of 27)

AIRCRAFT MODEL CV-2 | CHART 'E' - TABLES AND DIAGRAMS | SHEET 7 OF 27

COMPARTMENT CARGO TABLE

CARGO WEIGHT LB	MOMENT/1000 LB IN.								
	COMPT C-1 ARM 213.0	COMPT C-2 ARM 253.0	COMPT C-3 ARM 293.0	COMPT C-4 ARM 333.0	COMPT C-5 ARM 373.0	COMPT C-6 ARM 413.0	COMPT C-7 ARM 453.0	COMPT C-8 ARM 493.0	COMPT C-9 ARM 525.5
50	11	13	15	17	19	21	23	25	26
100	21	25	29	33	37	41	45	49	53
150	32	38	44	50	56	62	68	74	79
200	43	51	59	67	75	83	91	99	105
250	53	63	73	83	93	103	113	123	131
300	64	76	88	100	112	124	136	148	158
350	75	89	103	117	131	145	159	173	184
400	85	101	117	138	149	165	181	197	210
450	96	114	132	150	168	186	204	222	236
500	107	127	147	167	187	207	227	247	263
550	117	139	161	183	205	227	249	271	289
600	128	152	176	200	224	248	272	296	315
650	138	164	190	216	242	268	294	320	342
700	149	177	205	233	261	289	317	345	368
750	160	190	220	250	280	310	340	370	394
800	170	202	234	266	298	330	362	394	420
850	181	215	249	283	317	351	385	419	447
900	192	228	264	300	336	372	408	444	473
950	202	240	278	316	354	392	430	468	499
1000	213	253	293	333	373	413	453	493	526
1050	224	266	308	350	392	434	476	518	552
1100	234	278	322	363	410	454	498	542	578
1150	245	291	337	383	429	475	521	567	604
1200	256	304	352	400	448	496	544	592	631
1250	266	316	366	416	466	516	566	616	657

CHART DATE: SEPT 1ST/62

4F-1209

Figure 12-4. Chart E - loading data (sheet 7 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 8 OF 27

COMPARTMENT CARGO TABLE (CONTINUED)

CARGO WEIGHT LB	MOMENT/1000 LB IN.								
	COMPT C-1 ARM 213.0	COMPT C-2 ARM 253.0	COMPT C-3 ARM 293.0	COMPT C-4 ARM 333.0	COMPT C-5 ARM 373.0	COMPT C-6 ARM 413.0	COMPT C-7 ARM 453.0	COMPT C-8 ARM 493.0	COMPT C-9 ARM 525.5
1300	277	329	381	433	485	537	589	641	683
1350	288	342	396	450	504	558	612	666	709
1400	298	354	410	466	522	578	634	690	736
1450	309	367	425	483	541	599	657	715	762
1500	320	380	440	500	560	620	680	740	788
1550	330	392	454	516	578	640	702	764	815
1600	341	405	469	533	597	661	725	789	841
1650	351	417	483	549	615	681	747	813	867
1700	362	430	498	566	634	702	770	838	893
1750	373	443	513	583	653	723	793	863	920
1800	383	455	527	599	671	743	815	887	946
1850	394	468	542	616	690	764	838	912	972
1900	405	481	557	633	709	785	861	937	998
1950	415	493	571	649	727	805	883	961	1025
2000	426	506	586	666	746	826	906	986	1051
2050	437	519	601	683	765	847	929	1011	1077
2100	447	531	615	699	783	867	951	1035	1104
2150	458	544	630	716	802	888	974	1060	1130
2200	469	557	645	733	821	909	997	1085	1156
2250	479	569	659	749	839	929	1019	1109	1182
2300	490	582	674	766	858	950	1042	1134	1209
2350	501	595	689	783	877	971	1065	1159	1235
2400	511	607	703	799	895	991	1087	1183	1261
2450	522	620	718	816	914	1021	1110	1208	1287
2500	533	633	733	833	933	1033	1133	1233	1314

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 8 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 9 OF 27

COMPARTMENT CARGO TABLE (CONTINUED)

CARGO WEIGHT LB	MOMENT/1000 LB IN.								
	COMPT C-1 ARM 213.0	COMPT C-2 ARM 253.0	COMPT C-3 ARM 293.0	COMPT C-4 ARM 333.0	COMPT C-5 ARM 373.0	COMPT C-6 ARM 413.0	COMPT C-7 ARM 453.0	COMPT C-8 ARM 493.0	COMPT C-9 ARM 525.5
2550	543	645	747	849	951	1053	1155	1257	
2600	554	658	762	866	970	1074	1178	1282	
2650	564	670	776	882	988	1094	1200	1306	
2700	575	683	791	899	1007	1115	1223	1331	
2750	586	696	806	916	1026	1136	1246	1356	
2800	596	708	820	932	1044	1156	1268	1380	
2850	607	721	835	949	1063	1177	1291	1405	
2900	618	734	850	966	1082	1198	1314	1430	
2950	628	746	864	982	1100	1218	1336	1454	
3000	639	759	879	999	1119	1239	1359	1479	
3050	650	772	894	1016	1138	1260	1382	1504	
3100	660	784	908	1032	1156	1280	1404	1528	
3150	671	797	923	1049	1175	1301	1427	1553	
3200	682	810	938	1066	1194	1322	1450	1578	
3250	692	822	952	1082	1212	1342	1472	1602	
3300	703	835	967	1099	1213	1363	1495	1627	
3350	714	848	982	1116	1250	1384	1518	1652	
3400	724	860	996	1132	1268	1404	1540	1676	
3450	735	873	1011	1149	1287	1425	1563	1701	
3500	746	886	1026	1166	1306	1446	1586	1726	
3550	756	898	1040	1182	1324	1466	1608	1750	
3600	767	911	1055	1199	1343	1487	1631	1775	
3650	777	923	1069	1215	1361	1507	1653	1799	
3700	788	936	1084	1232	1380	1528	1676	1824	
3750	799	949	1099	1249	1399	1549	1699	1849	

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 9 of 27)

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AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 10 OF 27

COMPARTMENT CARGO TABLE (CONTINUED)

CARGO WEIGHT LB	MOMENT/1000 LB IN.								
	COMPT C-1 ARM 213.0	COMPT C-2 ARM 253.0	COMPT C-3 ARM 293.0	COMPT C-4 ARM 333.0	COMPT C-5 ARM 373.0	COMPT C-6 ARM 413.0	COMPT C-7 ARM 453.0	COMPT C-8 ARM 493.0	COMPT C-9 ARM 525.5
3800	809	961	1113	1265	1417	1569	1721	1873	
3850	820	974	1128	1282	1436	1590	1744	1898	
3900	831	987	1143	1299	1455	1611	1767	1923	
3950	841	999	1157	1315	1473	1631	1789	1947	
4000	852	1012	1172	1332	1492	1652	1812	1972	

SUPPLEMENTARY CARGO DATA

CABIN CARGO COMPARTMENT SECTIONS	CENTROID ARM IN.	ARM LIMITS IN.	MAXIMUM CAPACITY LB	FLOOR AREA SQ FT	VOLUME CU FT	MAX. UNIFORMLY DISTRIBUTED LOAD LB/FOOT RUN	* MAXIMUM CONCENTRATED LOAD LB/SQ FT
C-1	213.0	193 - 233	4000	20.0	134	1200	2000
C-2	253.0	233 - 273	4000	20.0	134	1200	2000
C-3	293.0	273 - 313	4000	20.0	134	1200	2000
C-4	333.0	313 - 353	4000	20.0	132	1200	2000
C-5	373.0	353 - 393	4000	20.0	131	1200	2000
C-6	413.0	393 - 433	4000	20.0	134	1200	2000
C-7	453.0	433 - 473	4000	20.0	134	1200	2000
C-8	493.0	473 - 513	4000	20.0	134	1200	2000
C-9	525.5	513 - 538	2500	12.5	83	1200	2000

* Maximum floor capacity may NOT be increased when supplementary or overlay flooring is used

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 10 of 27)

4F-1282

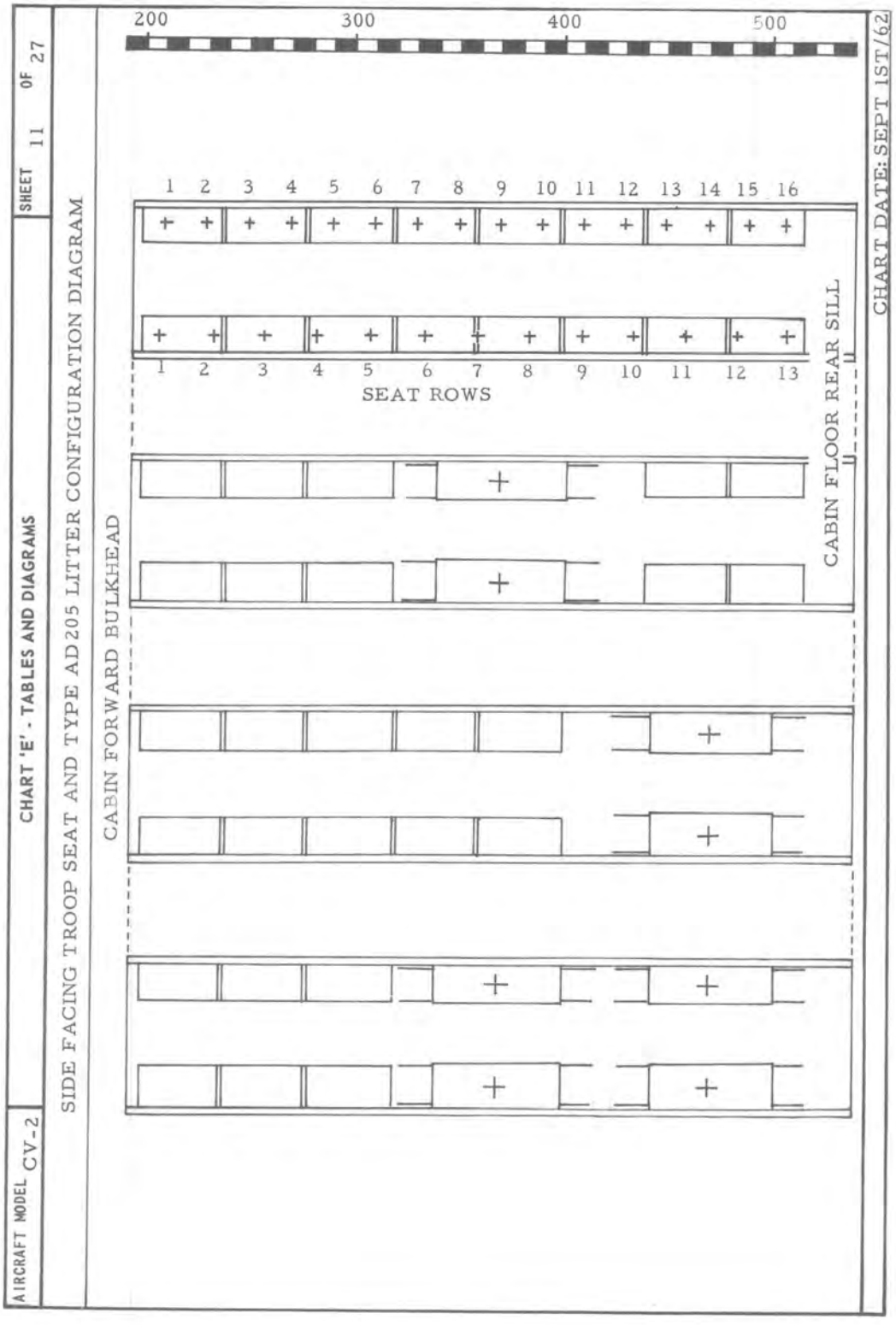


Figure 12-4. Chart E - loading data (sheet 11 of 27)

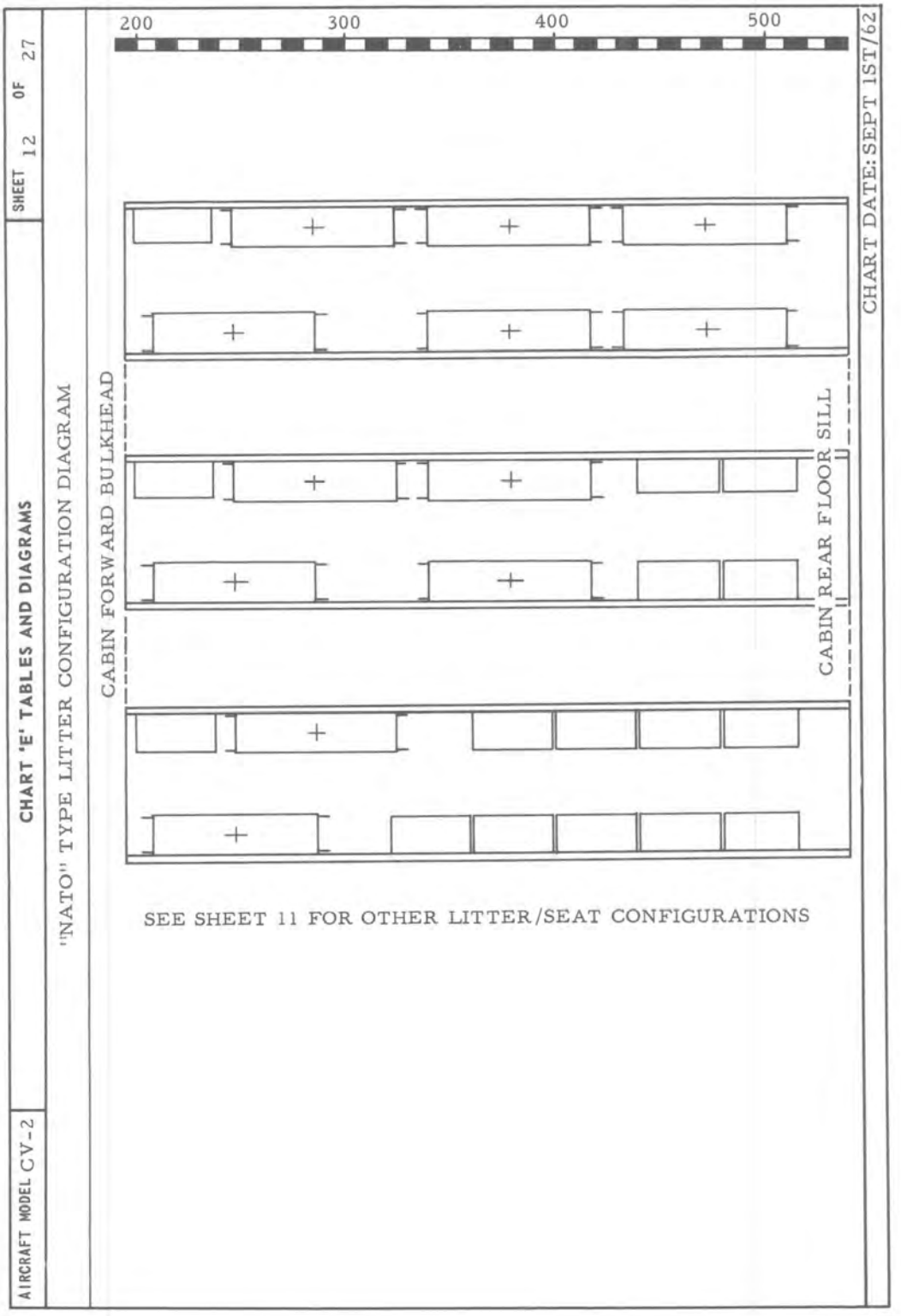


Figure 12-4. Chart E - loading data (sheet 12 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 13 OF 27

PERSONNEL TABLE

POSITION		WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.
Crew Seats							
Pilot		200	158	31.6	220	158	34.8
Copilot		200	158	31.6	220	158	34.8
Side Facing Troop Seats with Sixteen Persons per side							
Row 1	Port	200	208	41.6	220	208	45.8
	Stbd	200	208	41.6	220	208	45.8
Row 2	Port	200	228	45.6	220	228	50.2
	Stbd	200	228	45.6	220	228	50.2
Row 3	Port	200	248	49.6	220	248	54.6
	Stbd	200	248	49.6	220	248	54.6
Row 4	Port	200	268	53.6	220	268	59.0
	Stbd	200	268	53.6	220	268	59.0
Row 5	Port	200	288	57.6	220	288	63.4
	Stbd	200	288	57.6	220	288	63.4
Row 6	Port	200	308	61.6	220	308	67.8
	Stbd	200	308	61.6	220	308	67.8
Row 7	Port	200	328	65.6	220	328	72.2
	Stbd	200	328	65.6	220	328	72.2
Row 8	Port	200	348	69.6	220	348	76.6
	Stbd	200	348	69.6	220	348	76.6

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 13 of 27)

4T-1214

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 14 OF 27

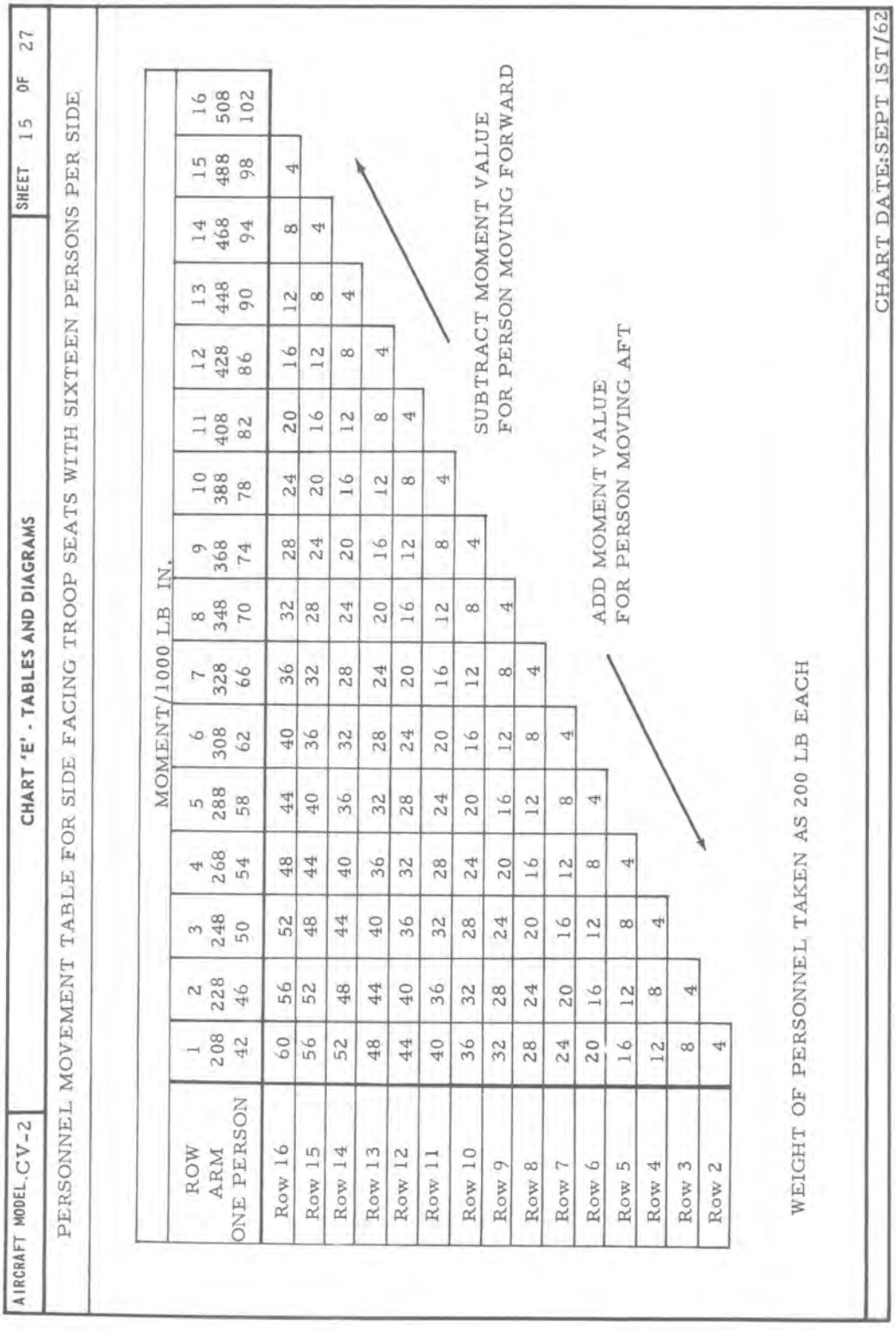
PERSONNEL TABLE (Continued)

POSITION		WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.
Side Facing Troop Seats with Sixteen Persons per side							
Row 9	Port	200	368	73.6	220	368	81.0
	Stbd	200	368	73.6	220	368	81.0
Row 10	Port	200	388	77.6	220	388	85.4
	Stbd	200	388	77.6	220	388	85.4
Row 11	Port	200	408	81.6	220	408	89.8
	Stbd	200	408	81.6	220	408	89.8
Row 12	Port	200	428	85.6	220	428	94.2
	Stbd	200	428	85.6	220	428	94.2
Row 13	Port	200	448	89.6	220	448	98.6
	Stbd	200	448	89.6	220	448	98.6
Row 14	Port	200	468	93.6	220	468	103.0
	Stbd	200	468	93.6	220	468	103.0
Row 15	Port	200	488	97.6	220	488	107.4
	Stbd	200	488	97.6	220	488	107.4
Row 16	Port	200	508	101.6	220	508	111.8
	Stbd	200	508	101.6	220	508	111.8

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 14 of 27)

4F-1215



AIRCRAFT MODEL.CV-2 | CHART 'E' - TABLES AND DIAGRAMS | SHEET 15 OF 27

PERSONNEL MOVEMENT TABLE FOR SIDE FACING TROOP SEATS WITH SIXTEEN PERSONS PER SIDE

ROW ARM ONE PERSON	MOMENT/1000 LB IN.															
	1 208 42	2 228 46	3 248 50	4 268 54	5 288 58	6 308 62	7 328 66	8 348 70	9 368 74	10 388 78	11 408 82	12 428 86	13 448 90	14 468 94	15 488 98	16 508 102
Row 16	60	56	52	48	44	40	36	32	28	24	20	16	12	8	4	
Row 15	56	52	48	44	40	36	32	28	24	20	16	12	8	4		
Row 14	52	48	44	40	36	32	28	24	20	16	12	8	4			
Row 13	48	44	40	36	32	28	24	20	16	12	8	4				
Row 12	44	40	36	32	28	24	20	16	12	8	4					
Row 11	40	36	32	28	24	20	16	12	8	4						
Row 10	36	32	28	24	20	16	12	8	4							
Row 9	32	28	24	20	16	12	8	4								
Row 8	28	24	20	16	12	8	4									
Row 7	24	20	16	12	8	4										
Row 6	20	16	12	8	4											
Row 5	16	12	8	4												
Row 4	12	8	4													
Row 3	8	4														
Row 2	4															

SUBTRACT MOMENT VALUE
FOR PERSON MOVING FORWARD

ADD MOMENT VALUE
FOR PERSON MOVING AFT

WEIGHT OF PERSONNEL TAKEN AS 200 LB EACH

CHART DATE:SEPT 1ST/62

4F-1216

Figure 12-4. Chart E - loading data (sheet 15 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 16 OF 27

PERSONNEL TABLE

POSITION		WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.
Crew Seats										
Pilot		180	158	28.4	200	158	31.6	220	158	34.8
Copilot		180	158	28.4	200	158	31.6	220	158	34.8
Side Facing Troop Seats with Thirteen Persons per side										
Row 1	Port	200	208	41.6	240	208	49.9	260	208	54.1
	Stbd	200	208	41.6	240	208	49.9	260	208	54.1
Row 2	Port	200	233	46.6	240	233	55.9	260	233	60.6
	Stbd	200	233	46.6	240	233	55.9	260	233	60.6
Row 3	Port	200	258	51.6	240	258	61.9	260	258	67.1
	Stbd	200	258	51.6	240	258	61.9	260	258	67.1
Row 4	Port	200	283	56.6	240	283	67.9	260	283	73.6
	Stbd	200	283	56.6	240	283	67.9	260	283	73.6
Row 5	Port	200	308	61.6	240	308	73.9	260	308	80.1
	Stbd	200	308	61.6	240	308	73.9	260	308	80.1
Row 6	Port	200	333	66.6	240	333	79.9	260	333	86.6
	Stbd	200	333	66.6	240	333	79.9	260	333	86.6
Row 7	Port	200	358	71.6	240	358	85.9	260	358	93.1
	Stbd	200	358	71.6	240	358	85.9	260	358	93.1

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 16 of 27)

4F-1217

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 17 OF 27

PERSONNEL TABLE (CONTINUED)

POSITION		WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.
Side Facing Troop Seats with Thirteen Persons per side										
Row 8	Port	200	383	76.6	240	383	91.9	260	383	99.6
	Stbd	200	383	76.6	240	383	91.9	260	383	99.6
Row 9	Port	200	408	81.6	240	408	97.9	260	408	106.1
	Stbd	200	408	81.6	240	408	97.9	260	408	106.1
Row 10	Port	200	433	86.6	240	433	103.9	260	433	112.6
	Stbd	200	433	86.6	240	433	103.9	260	433	112.6
Row 11	Port	200	458	91.6	240	458	109.9	260	458	119.1
	Stbd	200	458	91.6	240	458	109.9	260	458	119.1
Row 12	Port	200	483	96.6	240	483	115.9	260	483	125.6
	Stbd	200	483	96.6	240	483	115.9	260	483	125.6
Row 13	Port	200	508	101.6	240	508	121.9	260	508	132.1
	Stbd	200	508	101.6	240	508	121.9	260	508	132.1

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 17 of 27)

4F-1218

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 18 OF 27

PERSONNEL MOVEMENT TABLE FOR SIDE FACING TROOP SEATS WITH THIRTEEN PERSONS PER SIDE

	MOMENT/1000 LB IN.												
ROW ARM ONE PERSON	1 208 54.1	2 233 60.6	3 258 67.1	4 283 73.6	5 308 80.1	6 333 86.6	7 358 93.1	8 383 99.6	9 408 106.1	10 433 112.6	11 458 119.1	12 483 125.6	13 508 132.1
Row 13	78.0	71.5	65.0	58.5	52.0	45.5	39.0	32.5	26.0	19.5	13.0	6.5	
Row 12	71.5	65.0	58.5	52.0	45.5	39.0	32.5	26.0	19.5	13.0	6.5		
Row 11	65.0	58.5	52.0	45.5	39.0	32.5	26.0	19.5	13.0	6.5			
Row 10	58.5	52.0	45.5	39.0	32.5	26.0	19.5	13.0	6.5				
Row 9	52.0	45.5	39.0	32.5	26.0	19.5	13.0	6.5					
Row 8	45.5	39.0	32.5	26.0	19.5	13.0	6.5						
Row 7	39.0	32.5	26.0	19.5	13.0	6.5							
Row 6	32.5	26.0	19.5	13.0	6.5								
Row 5	26.0	19.5	13.0	6.5									
Row 4	19.5	13.0	6.5										
Row 3	13.0	6.5											
Row 2	6.5												

SUBTRACT MOMENT VALUE FOR PERSON MOVING FORWARD

ADD MOMENT VALUE FOR PERSON MOVING AFT

WEIGHT OF PERSONNEL TAKEN AS 260 LB EACH INCLUDING PARACHUTES

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 18 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 19 OF 27

PERSONNEL TABLE - LITTERS TYPE AD205

POSITION	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT 1000 LB IN.
CENTER LITTER LOCATIONS						
1st PLACE	220	372.5	82	250	372.5	93
2nd PLACE	220	372.5	82	250	372.5	93
3rd PLACE	220	372.5	82	250	372.5	93
4th PLACE	220	372.5	82	250	372.5	93
5th PLACE	220	372.5	82	250	372.5	93
6th PLACE	220	372.5	82	250	372.5	93
REAR LITTER LOCATIONS						
1st PLACE	220	470.0	103	250	470.0	118
2nd PLACE	220	470.0	103	250	470.0	118
3rd PLACE	220	470.0	103	250	470.0	118
4th PLACE	220	470.0	103	250	470.0	118
5th PLACE	220	470.0	103	250	470.0	118
6th PLACE	220	470.0	103	250	470.0	118
7th PLACE	220	470.0	103	250	470.0	118
8th PLACE	220	470.0	103	250	470.0	118

Note: See diagrams on sheet 11

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 19 of 27)

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AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 20 OF 27

PERSONNEL TABLE - LITTERS "NATO" TYPE

POSITION	WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.	WEIGHT LB	ARM IN.	MOMENT / 1000 LB IN.
FWD LH LITTER LOCATIONS						
1st PLACE	220	248.0	55	250	248.0	62
2nd PLACE	220	248.0	55	250	248.0	62
3rd PLACE	220	248.0	55	250	248.0	62
FWD RH LITTER LOCATIONS						
1st PLACE	220	285.0	63	250	285.0	71
2nd PLACE	220	285.0	63	250	285.0	71
3rd PLACE	220	285.0	63	250	285.0	71
CENTER LITTER LOCATIONS						
1st PLACE	220	378.0	83	250	378.0	95
2nd PLACE	220	378.0	83	250	378.0	95
3rd PLACE	220	378.0	83	250	378.0	95
4th PLACE	220	378.0	83	250	378.0	95
5th PLACE	220	378.0	83	250	378.0	95
6th PLACE	220	378.0	83	250	378.0	95
REAR LITTER LOCATIONS						
1st PLACE	220	472.0	104	250	472.0	118
2nd PLACE	220	472.0	104	250	472.0	118
3rd PLACE	220	472.0	104	250	472.0	118
4th PLACE	220	472.0	104	250	472.0	118
5th PLACE	220	472.0	104	250	472.0	118
6th PLACE	220	472.0	104	250	472.0	118
7th PLACE	220	472.0	104	250	472.0	118
8th PLACE	220	472.0	104	250	472.0	118

Note: See diagrams on sheet 12

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 20 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 21 OF 27

CENTER OF GRAVITY TABLE

GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27% MAC ARM 342.61	28% MAC ARM 343.82	29% MAC ARM 345.03	30% MAC ARM 346.24	31% MAC ARM 347.45	39% MAC ARM 357.11
18,100	6180	6201	6223	6245	6267	6289	6464
18,200	6214	6236	6258	6280	6302	6324	6499
18,300	6248	6270	6292	6314	6336	6358	6535
18,400	6282	6304	6326	6349	6371	6393	6571
18,500	6316	6338	6361	6383	6405	6428	6607
18,600	6350	6373	6395	6418	6440	6463	6642
18,700	6384	6407	6429	6452	6475	6497	6678
18,800	6419	6441	6464	6487	6509	6532	6714
18,900	6453	6475	6498	6521	6544	6567	6749
19,000	6487	6510	6533	6556	6579	6602	6785
19,100	6521	6544	6567	6590	6613	6636	6821
19,200	6555	6578	6601	6625	6648	6671	6857
19,300	6589	6612	6636	6659	6682	6706	6892
19,400	6623	6647	6670	6694	6717	6741	6928
19,500	6657	6681	6704	6728	6752	6775	6964
19,600	6692	6715	6739	6763	6786	6810	6999
19,700	6726	6749	6773	6797	6821	6845	7035
19,800	6760	6784	6808	6832	6856	6880	7071
19,900	6794	6818	6842	6866	6890	6914	7106
20,000	6828	6852	6876	6901	6925	6949	7142
20,100	6862	6886	6911	6935	6959	6984	7178
20,200	6896	6921	6945	6970	6994	7018	7214
20,300	6931	6955	6980	7004	7029	7053	7249
20,400	6965	6989	7014	7039	7063	7088	7285
20,500	6999	7024	7048	7073	7098	7123	7321

*SEE NOTE ON SHEET 26

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 21 of 27)

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AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 22 OF 27

CENTER OF GRAVITY TABLE (continued)

GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27.0% MAC ARM 342.61	28.0% MAC ARM 343.82	29.0% MAC ARM 345.03	30.0% MAC ARM 346.24	31.0% MAC ARM 347.45	39.0% MAC ARM 357.11
20,600	7033	7058	7083	7108	7133	7157	7356
20,700	7067	7092	7117	7142	7167	7192	7392
20,800	7101	7126	7151	7177	7202	7227	7428
20,900	7135	7161	7186	7211	7236	7262	7464
21,000	7170	7195	7220	7246	7271	7296	7499
21,100		7229	7255	7280	7306	7331	7535
21,200		7263	7289	7315	7340	7366	7571
21,300		7298	7323	7349	7375	7401	7606
21,400		7332	7358	7384	7410	7435	7642
21,500		7366	7392	7418	7444	7470	7678
21,600		7400	7427	7453	7479	7505	7714
21,700		7435	7461	7487	7513	7540	7749
21,800		7469	7495	7522	7548	7574	7785
21,900		7503	7530	7556	7583	7609	7821
22,000		7537	7564	7591	7617	7644	7856
22,100		7572	7598	7625	7652	7679	7892
22,200		7606	7633	7660	7687	7713	7928
22,300		7640	7667	7694	7721	7748	7964
22,400		7674	7702	7729	7756	7783	7999
22,500		7709	7736	7763	7790	7818	8035
22,600			7770	7798	7825	7852	8071
22,700			7805	7832	7860	7887	8106
22,800			7839	7867	7894	7922	8142
22,900			7873	7901	7929	7957	8178
23,000			7908	7936	7964	7991	8214

*SEE NOTE ON SHEET 26

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 22 of 27)

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 23 OF 27

CENTER OF GRAVITY TABLE (continued)

GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27.0% MAC ARM 342.61	28.0% MAC ARM 343.82	29.0% MAC ARM 345.03	30.0% MAC ARM 346.24	31.0% MAC ARM 347.45	39.0% MAC ARM 357.11
23,100			7942	7970	7998	8026	8249
23,200			7977	8005	8033	8061	8285
23,300			8011	8039	8067	8096	8321
23,400			8045	8074	8102	8130	8356
23,500			8080	8108	8137	8165	8392
23,600			8114	8143	8171	8200	8427
23,700			8149	8177	8206	8235	8464
23,800			8183	8212	8241	8269	8499
23,900			8217	8246	8275	8304	8535
24,000			8252	8281	8310	8339	8571
24,100				8315	8344	8374	8606
24,200				8350	8379	8408	8642
24,300				8384	8414	8443	8678
24,400				8418	8448	8478	8713
24,500				8453	8483	8513	8749
24,600				8488	8518	8547	8785
24,700				8522	8552	8582	8821
24,800				8557	8587	8617	8856
24,900				8591	8621	8652	8892
25,000				8626	8656	8686	8928
25,100				8660	8691	8721	8963
25,200				8695	8725	8756	8999
25,300				8729	8760	8790	9035
25,400				8764	8794	8825	9071
25,500				8798	8829	8860	9106

*SEE NOTE ON SHEET 26

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 23 of 27)

4F-1223

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 24 OF 27

CENTER OF GRAVITY TABLE (continued)

GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27.0% MAC ARM 342.61	28,0% MAC ARM 343.82	29.0% MAC ARM 345.03	30.0% MAC ARM 346.24	31.0% MAC ARM 347.45	39.0% MAC ARM 357.11
25,600					8863	8895	9142
25,700					8898	8929	9178
25,800					8933	8964	9213
25,900					8968	8999	9249
26,000					9002	9034	9285
26,100					9037	9068	9321
26,200					9071	9103	9356
26,300					9106	9138	9392
26,400					9141	9173	9428
26,500					9175	9207	9463
26,600					9210	9242	9499
26,700					9245	9277	9535
26,800					9279	9312	9571
26,900					9314	9346	9606
27,000					9348	9381	9642
27,100						9416	9678
27,200						9451	9713
27,300						9485	9749
27,400						9520	9785
27,500						9555	9821
27,600						9590	9856
27,700						9624	9892
27,800						9659	9928
27,900						9694	9963
28,000						9729	9999

*SEE NOTE ON SHEET 26

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 24 of 27)

4F-1224

AIRCRAFT MODEL/CV-2	CHART 'E' - TABLES AND DIAGRAMS						25 OF 27
CENTER OF GRAVITY TABLE (continued)							
GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27.0% MAC ARM 342.61	28.0% MAC ARM 343.82	29.0% MAC ARM 345.03	30.0% MAC ARM 346.24	31.0% MAC ARM 347.45	39.0% MAC ARM 357.11
28,100						9762	10,035
28,200						9798	10,071
28,300						9833	10,106
28,400						9868	10,142
28,500						9902	10,178
28,600						9937	10,213
28,700						9972	10,249
28,800						10,007	10,285
28,900						10,041	10,320
29,000						10,076	10,356
29,100						10,111	10,392
29,200						10,146	10,428
29,300						10,180	10,463
29,400						10,215	10,499
29,500						10,250	10,535
29,600						10,285	10,570
29,700						10,319	10,606
29,800						10,354	10,642
29,900						10,389	10,678
30,000						10,424	10,713
30,100						10,458	10,749
30,200						10,493	10,785
30,300						10,528	10,820
30,400						10,562	10,856
30,500						10,597	10,892

NOTE: WEIGHTS & MOMENTS SHOWN IN EXCESS OF 28,500 LB ARE APPLICABLE TO FERRY MISSIONS ONLY, WITH LONG RANGE TANKS INSTALLED.

* SEE NOTE ON SHEET 26

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 25 of 27)

4F-1225

AIRCRAFT MODEL CV-2	CHART 'E' - TABLES AND DIAGRAMS	SHEET 26 OF 27

CENTER OF GRAVITY TABLE (continued)

GROSS WEIGHT LB	* MOMENT/1000 LB IN.						
	26.0% MAC ARM 341.41	27.0% MAC ARM 342.61	28.0% MAC ARM 343.82	29.0% MAC ARM 345.03	30.0% MAC ARM 346.24	31.0% MAC ARM 347.45	39.0% MAC ARM 357.11
30,600						10,632	10,928
30,700						10,667	10,963
30,800						10,701	10,999
30,900						10,736	11,035
31,000						10,771	11,070
31,100						10,806	11,106
31,200						10,840	11,142
31,300						10,875	11,178

* Note:

All moments/1000 shown in the center of gravity table are for landing gear extended position.
Loadings based on this condition which fall within the limiting moments/1000 will be satisfactory for flight with landing gear retracted.
Moment/1000 for retraction of the landing gear is minus (-) 38.1 lb in.

Remarks:

1. Maximum gross weight for take-off = 28,500 lb
2. Maximum gross weight for landing = 28,500 lb
3. Maximum zero fuel weight = 27,000 lb
4. Maximum ramp weight for ferry missions only = 31,300 lb

CHART DATE: SEPT 1ST/62

Figure 12-4. Chart E - loading data (sheet 26 of 27)

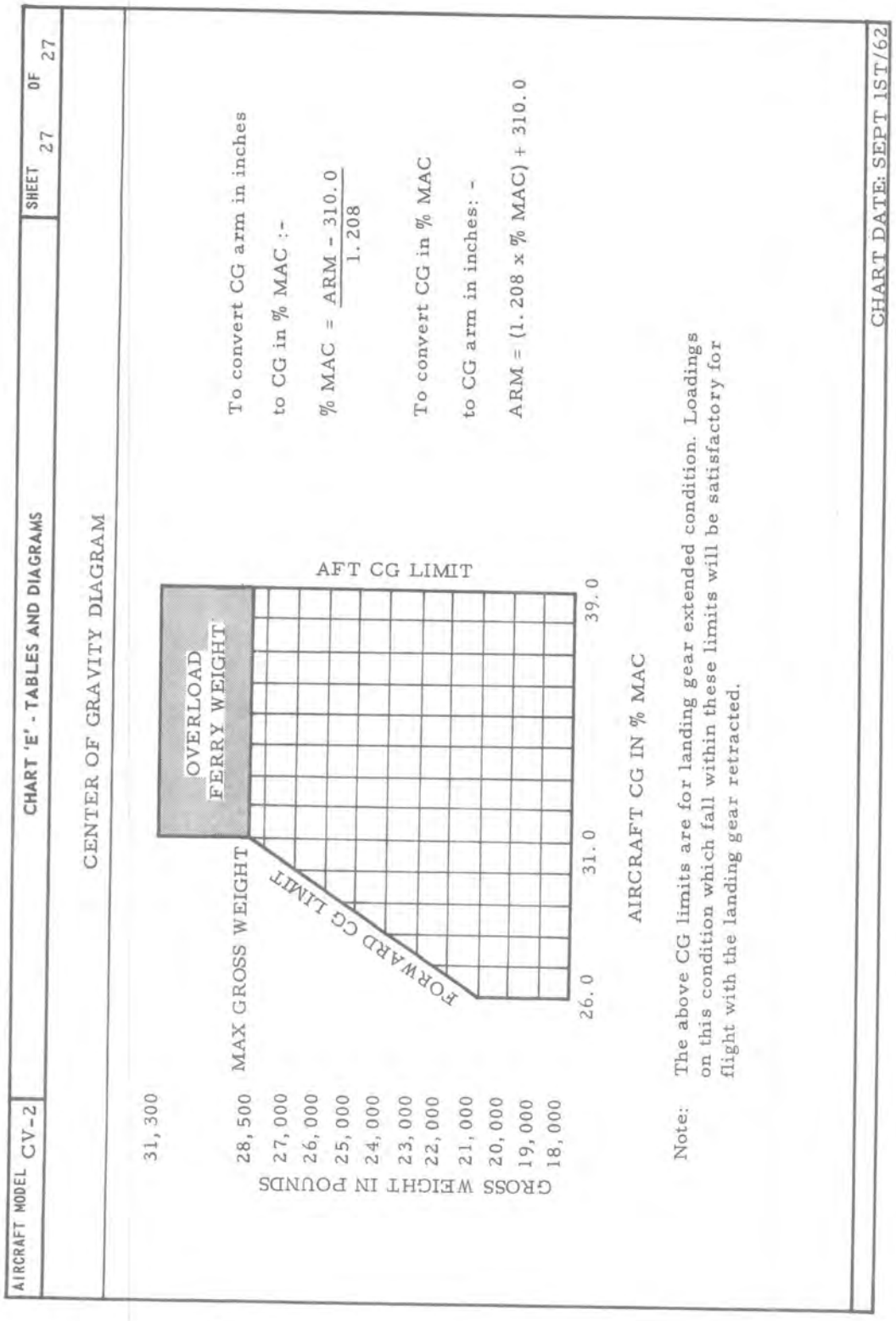


Figure 12-4. Chart E - loading data (sheet 27 of 27)

Section VI

Weight and Balance Computer (Load Adjuster)

12-32. Use of the Weight and Balance Computer. The computer (figure 12-5) provides a simple, compact and accurate method of calculating aircraft weight and balance. It permits the use of a weight/center of gravity graph and loading vectors. The computer gives step-by-step indication of a loading with respect to the aircraft limits, and permits a direct reading of weight, center of gravity, and moment index at any stage without calculation. The moment index, or balance computer index, is a number representing the moment which, when considered in conjunction with the weight, gives the cg position. (See paragraph 12-22.) The effect of each item or group of items added to or removed from the aircraft is registered individually, and a mistake can be readily seen. Adjustments may be made to offset adverse weight or cg trends as they develop. Several loading combinations can be rapidly tried by marking the starting point on the graph. Important locations such as basic, take-off, and landing conditions may also be marked for in-flight reference, with the soft pencil provided inside the computer. The mechanical operation of the computer is such that small errors encountered during actual use will balance out over a complete loading, and in practice high accuracy can be achieved. It is strongly recommended however, that as a check the loaded-in items are finally removed, thus returning to the original basic condition on the graph, and positively confirming an accurate loading.

12-33. Description of the Computer. The computer consists of three basic parts, the body, the slide and the cursor. The body is a tube over which the other two parts slide, and has a raised portion at the left-hand end on which the weight/cg graph is attached. The slide is a spring tensioned tube on which the load item vector diagrams are attached. The cursor is also a spring tensioned tube and has a clear plastic face disposed between, and extending over, both the graph and vectors. A removable tag, showing the current basic aircraft condition, (aircraft registration, basic weight, index and cg) is slipped under the face. Slide and cursor must move smoothly over the body. To clean or remove any sticking, wipe the rule thoroughly with a clean damp cloth.

12-34. Computer Operating Instructions. It is most important to hold the computer correctly. It should be held approximately horizontal in the left hand by gripping the left-hand end of the body at the graph location when operating the rule. All movement of the slide and cursor should be accomplished with the right hand to prevent inadvertent movement of these parts, and subsequent loading errors. Any initial difficulty encountered with this technique will be quickly overcome after a few practice loadings. Position the cursor so that the left-hand cross-hair line (at the countersunk hole) is over the graph at the aircraft current basic weight and center of gravity location. This point is at the intersection of the applicable weight and moment index. Next, position the slide so that the ZERO point of the required item vector is under the right-hand cross-hair line of the cursor. Now move the cursor so that the right-hand cross-hair line moves along the selected vector line the desired distance. It will be noted that the left-hand cross-hair line followed a similar course over the graph. The aircraft's new condition will now be shown under the left-hand cross-hair line and will include the added item. Thus, any desired combination of items or groups of items can be added or removed (in this case reverse the setting and direction moved along the vector line) by repeating this procedure. All graduations on the vector scales are given in pounds so that actual weights rather than standard weights may be used if greater accuracy is required.

12-35. Index Value. To obtain the initial index value after a revision to the basic aircraft condition has been made, move the slide and cursor fully to the left and set the cursor hair line over the arrow on the body at INDEX. Rotate the slide so that the applicable basic weight on the spiral scale (upper graduation) is also under the cursor hair-line. Now rotate the cursor, insuring that the slide does not move, until the hair-line is over the applicable basic moment/1000 on the same spiral scale (lower graduation). The new index value can be read under the cursor hair-line at the index scale together with the center of gravity at the applicable weight. Repeat this procedure as a check and then enter the new condition on the tag.

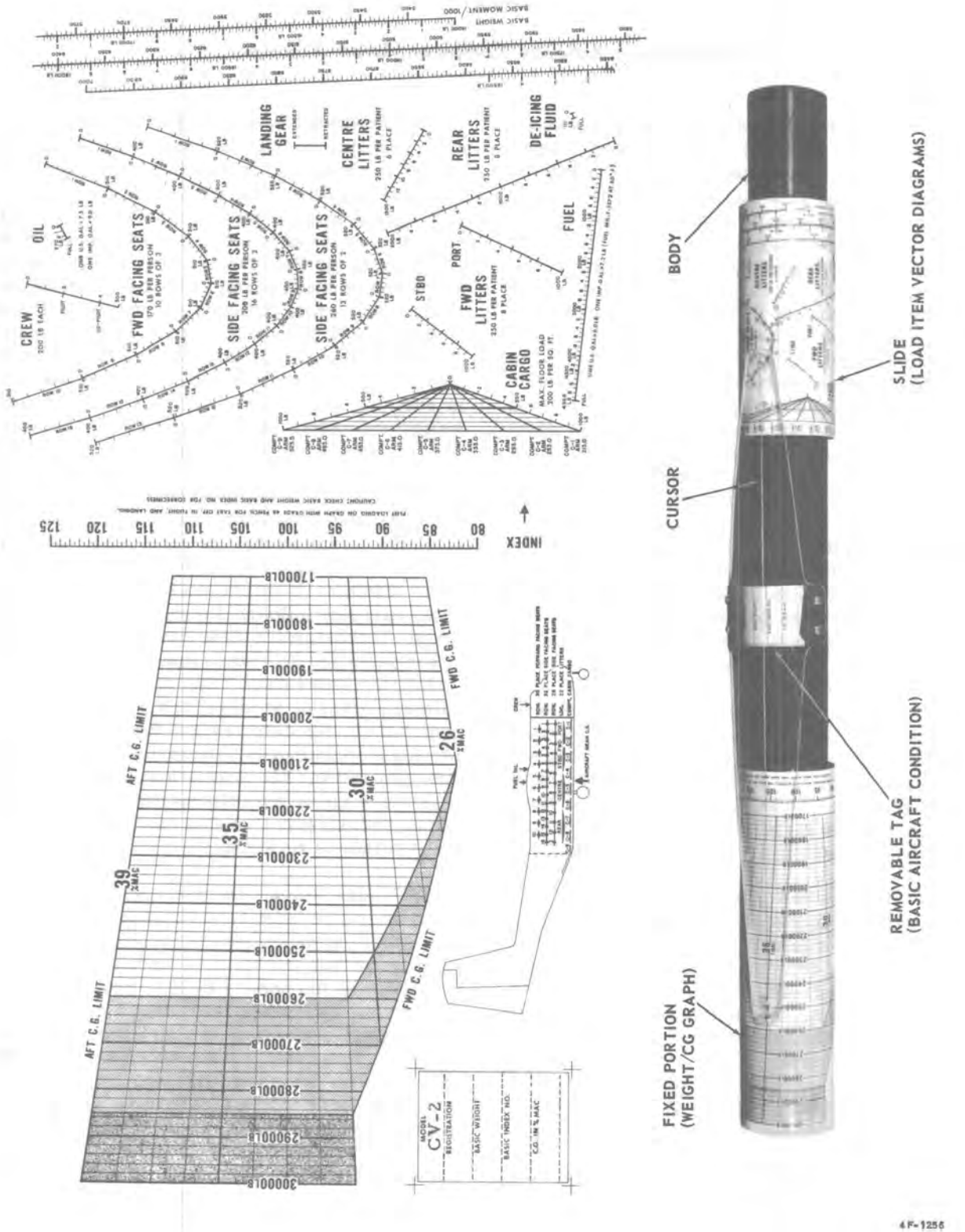


Figure 12-5. Weight and balance computer

CHAPTER 13
AIRCRAFT LOADING

Section I

Scope

13-1. The purpose of this chapter is to supply the loading personnel and the aircraft crew with the necessary information to insure that the aircraft is loaded and unloaded safely and efficiently in order to successfully perform its various roles.

13-2. This chapter should be used in conjunction with Chapter 12, Weight and Balance Computation.

Section II

Aircraft Cargo Features

13-3. Cabin. The cabin (figure 13-1), which extends from arm 193.0 to arm 538.0, is uniform in height and width and has a volume of 1150 cubic feet. It has two passenger doors at the aft end, one on each side of the cabin, with a removable access ladder which fits into either door opening. A cargo door, aft of the cabin, consists of a large door which hinges upwards from the rear, and a ramp which is an extension of the cabin floor. A heating duct extends along each side of the cabin at floor level. Wall type troop seats, comprising eight units per side, may be installed to accommodate 32 troops or 26 combat equipped troops. With ten aft seat units removed, 14 litters may be installed. On aircraft Serial No. 61-2599 and subsequent, the cabin is adapted for 20 litters and 1 troop seat unit. Fixed fittings are provided for the installation of air delivery equipment.

13-4. Cabin floor. The cabin floor is of aluminum alloy honeycomb sandwich construction. Removable plywood panels, with aluminum alloy skid strips to facilitate cargo handling, are provided for floor protection. The floor supporting structure is a grid with three continuous longitudinal keels which occupy the space between the floor and the outside section. The keels will act as skids in the event of a wheels-up landing. Tiedown rings rated at 5000 pounds are provided in the floor, and studs are installed for the attachment of seats and litter supports.

13-5. Cabin floor strength - bulk cargo. The cabin floor will not withstand the same load over its entire area. The honeycomb panelling is designed to withstand a load of 40 psi at any point; this is an expression of the inherent strength of the panelling, and while the panelling itself will withstand this load, the strength of other parts of the fuselage may be exceeded. For this reason, there are other factors which limit the load which may be placed on the cabin floor. The local footprint pressure of individual load items must not exceed 1000 pounds per square foot, while at the same time a loading of 1200 pounds per running foot must not be exceeded. A "running foot" is measured fore-and-aft, parallel to the longitudinal axis of the aircraft. In other words, a running foot is a one-foot strip the full width of the cabin floor. If bulk cargo will exceed either of these limits, shoring must be used to spread the weight over a larger area. (Refer to paragraph 13-109.)

13-6. Cabin floor strength - vehicle loads. Figure 13-2 shows the floor treadway areas, both for aircraft loading or unloading and for take-off, flight and landing. Loads on the vehicle treadways must not exceed 2000 pounds per wheel during loading and unloading. This is also the maximum wheel loading on the treadways forward of arm 397.6 during take-off, flight and landing. On the treadway areas aft of arm 397.6 during take-off, flight and landing, and the remainder of the floor area under all conditions, the loading must not exceed 1000 pounds per wheel.

Caution

These limits are based on a vehicle tire pressure of not more than 40 psi. Before loading a vehicle into the aircraft insure that tire pressures do not exceed this value.

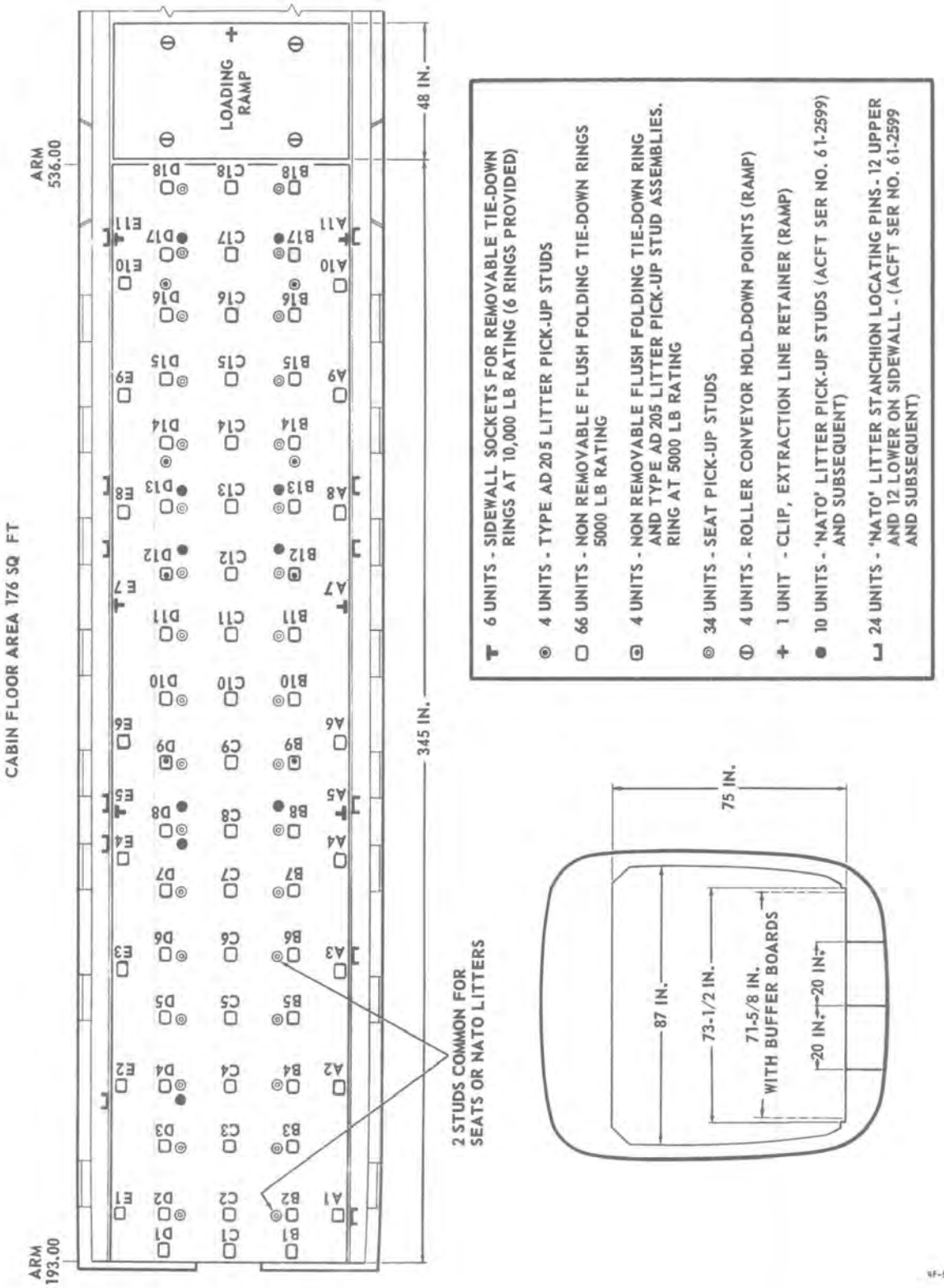


Figure 13-1. Cabin - Dimensions and floor fittings location

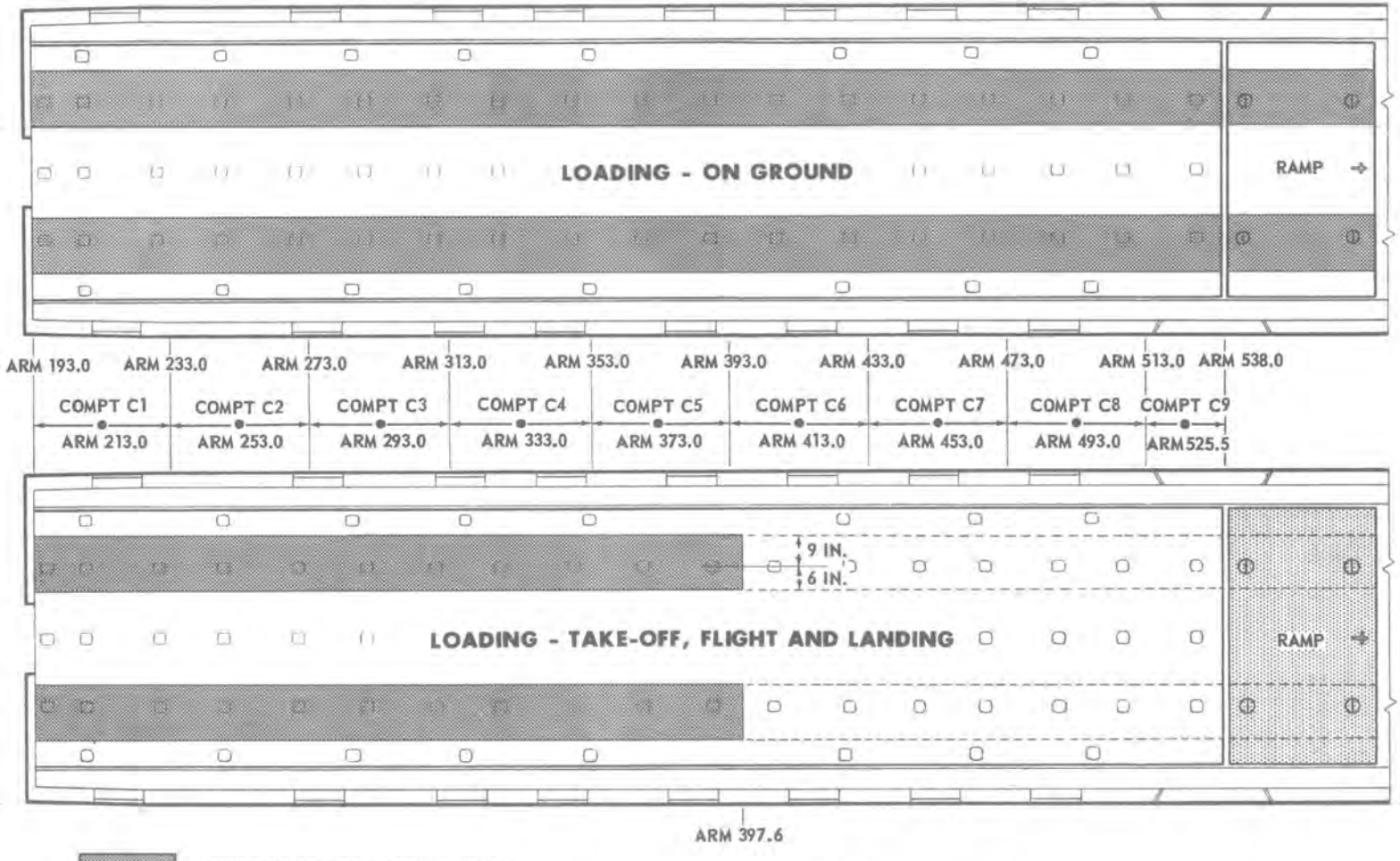


Figure 13-2. Vehicle treadways and cargo loading compartments

13-7. Cabin floor overlay. The removable plywood floor panels are normally laid over and screwed to the metal floor for protection. Cut-outs are provided in the panels for the tie-down rings and studs. The design of the panels allows them to be reversed should one side become damaged, i.e. the center panels may be turned over, while the outer panels should be exchanged with each other and then turned over. The treadway areas are painted on the plywood panels for the cabin floor and ramp. They are colored black from Arm 193 to Arm 297, and maroon from Arm 297 to the aft edge of the ramp.

13-8. Cargo Tie-Down Rings. Cargo tie-down rings (figure 13-3) are installed in the cabin floor, and in the cabin wall at floor level. Each floor tie-down ring fits into a recessed sheet-metal pan, which allows the ring to be clear of the cabin floor. The rings will swivel through 360°, and each ring and its attachment is capable of withstanding a load of 5000 pounds ultimate. The rings are arranged in five rows (see figure 13-1), each outside row has eight rings, while each of the three center rows has eighteen rings, making a total of seventy rings rated at 5000 pounds ultimate. Four of the recessed pans contain studs to which litter supports may be attached. The wall tie-downs consist of six removable rings, three on each side of the cabin at floor level, and are rated at 10,000 pounds ultimate. A recess in the floor at each ring allows clearance for the tie-down device. All tie-down rings are coded to enable ring positions to be located. Each ring is labeled with a letter and a numeral; the letter indicating the row and the numeral indicating the ring position in the row.

13-9. Cargo Door and Ramp. The cargo door and ramp are used primarily for loading and unloading cargo, troops or casualties, or for air delivery operations. The door and ramp may be opened or closed independently by electrical or mechanical actuation.

Note

The cargo door may be used as an emergency exit, both in the air or on the ground. In the air the door should be opened, while on the ground it may be opened or jettisoned. (Refer to Chapter 4, paragraph 4-58.)

13-10. Cargo door operation. The cargo door is attached at its aft end to the rear fuselage by two ball and socket type hinges. The door is raised and lowered by a chain and cable system, driven by a 24-volt motor powered from the main dc bus. The motor is mounted to a frame on the left-hand side of the rear fuselage and its dc power is controlled by a CARGO DOORS MASTER switch on the circuit breaker panel, behind the pilot. With the master switch on, the cargo door may be opened or closed from either of two locations; by the CARGO DOOR, OPEN-OFF-CLOSE switch in the flight compartment on the circuit breaker panel (figure 13-5), or by the CARGO DOOR OPEN-CLOSE switch located in the cabin roof, inboard of the left-hand passenger door (figure 13-6). Limit switches are fitted which cut-out the motor when the cargo door is in the fully open or fully closed position. An amber warning light (Chapter 6, paragraph 6-80) on the right-hand side of the emergency panel in the flight compartment, marked DOORS UNLOCKED, will illuminate and indicate if the cargo door, ramp, bottom hatch or either passenger door is not fully secured. Manual operation of the cargo door is achieved by means of a handcrank aft of the left-hand passenger door on the side of the fuselage. The handcrank is connected via a torque tube to the motor, and the handle is held by a spring in the manual-disengage position. Pushing the handle to the rear against the spring disengages the motor, and turning the handle clockwise will open the door, counterclockwise will close it. For cargo door operating instructions refer to paragraph 13-82.

Warning

The cargo door must be visually checked fully open before an air delivery, as no indication is given in the flight compartment should the door not be completely open.

13-11. Ramp operation. The ramp is hinged to the aft end of the cabin and is raised or lowered by two screw jacks driven by a 24-volt motor through a system of torque tubes, shafts and gears. The motor, powered from the main dc bus, is mounted on the right-hand side of the roof in the rear fuselage. The ramp dc power is controlled by the CARGO DOORS MASTER switch in the flight compartment on the circuit breaker panel. With the master switch on and the aircraft resting on its wheels, the ramp may be lowered or raised from either of two locations; by the RAMP DOOR, OPEN-OFF-CLOSE switch in the flight compartment on the circuit breaker panel (figure 13-5), or by the RAMP DOOR, OPEN-CLOSE switch located in the cabin roof, inboard of the left-hand passenger door (figure 13-6). Limit switches are fitted which cut-out the motor when the ramp is in the fully up or fully down position, when the aircraft is on the ground. When the aircraft is airborne, a weight switch on the landing gear limits

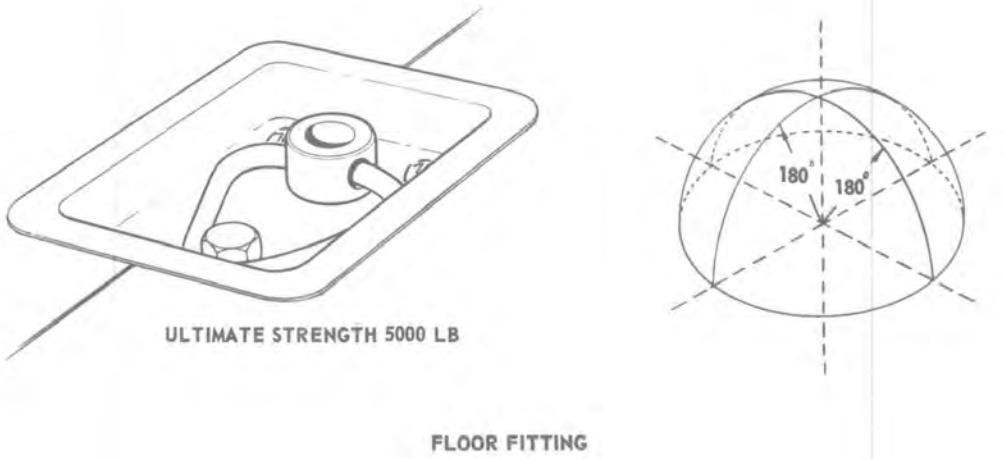


Figure 13-3. Tie-down fittings with cone of action

the ramp lowering position to 15° below the horizontal. The 15° position is required for air delivery operations, and is indicated in the flight compartment by the illumination of a green press-to-test light on the circuit breaker panel marked 15° POSITION, RAMP DOOR. A guarded override switch spring-loaded to off, is provided on the same panel, marked OVERRIDE, with switch positions RAMP DOWN and OFF. Raising the guard and selecting and holding the switch to RAMP DOWN will override the 15° limit switch, then selection of the RAMP DOOR, OPEN-OFF-CLOSE switch to OPEN will enable the ramp to be lowered as desired. The doors UNLOCKED light functions as described in Chapter 6, paragraph 6-80. Manual operation of the ramp is by means of a detachable handcrank, clipped to the cabin wall aft of the left-hand passenger door and marked STOWAGE RAMP DOOR HANDLE. Before attempting to lower the ramp manually the motor must first be disengaged by means of a knob on the motor. The crank handle may then be positioned in the socket, provided in the cabin roof adjacent to the door switch panel, marked MANUAL CONTROL RAMP DOOR. Turning the handle counterclockwise will lower the ramp, clockwise will raise it. For ramp operating instructions refer to paragraph 13-85.

13-12. Troop Entrance. The passenger doors or the cargo door opening may be used by troops to enter or exit. Ramp extensions may be used as walkways, and an assist handle is installed on each side of the cargo door opening between Frames 2 and 3. Refer to paragraph 13-89 for installation of ramp extensions.

13-13. Troop Seating. Wall type seats (figure 13-4) are provided, accommodating 32 troops at 20-inch pitch, or 26 combat equipped troops at 25-inch pitch. The seats are made up of eight two-man units per side, and attach together to form one long seat on each side. Each seat assembly consists of a tubular metal front edge member, spreader bars and legs, a nylon fabric seat and nylon back webbing. Each seat attaches by two legs to studs in the cabin floor, and to upper and lower rails on the cabin wall. Each seat is linked to adjacent seats by male and female tubular couplings, slide fasteners in the seat fabric and snap fasteners in the back webbing. Seats may be stowed by folding up against the wall or for more compact stowage, by folding both legs and spreader bars, which clip onto the lower wall support tubes, and detaching the seat back hooks from the upper tube; the seats may then be rolled up and secured by the straps provided. Seat belts are provided for each occupant, and are attached by quick-release fasteners to rings on the fittings, which also clamp the lower seat support rails to the structure. The rings and clamps may be fitted 20 inches or 25 inches apart to suit the troop seating arrangement. For installation of the troop seats refer to paragraph 13-66.

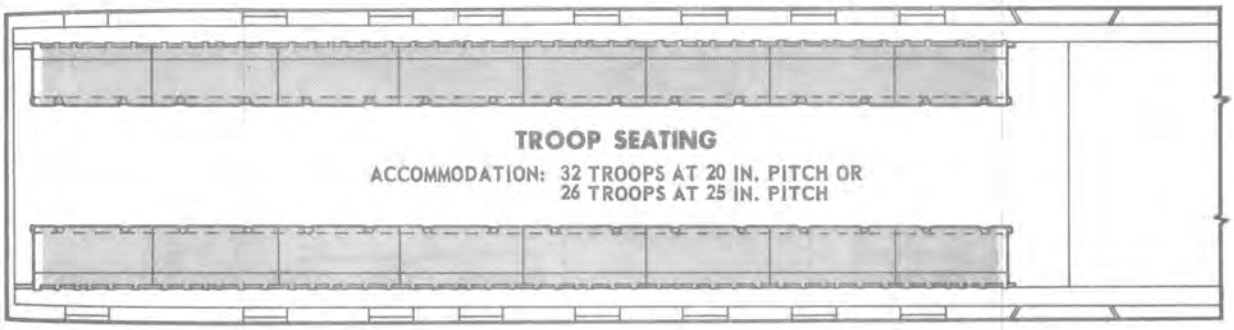
13-14. Comfort Provisions. The aircraft is provided with three relief tubes, one each for the pilot and copilot clipped just below their respective seats, and one for passenger use clipped to the side of the cabin just aft of the right-hand passenger door.

13-15. Draftproof Door. A retractable draftproof semi-rigid door separates the cabin from the tail of the aircraft and cargo door. Turning the handle on the lower portion of the upper panel of the door clockwise will release latches and allow springs to fold and retract the door into its stowed position in the roof. A strap and a cable are provided as hand grips to be used for extending the door and for reducing the spring assist during retraction. The draftproof door will automatically retract when the cargo door is jettisoned.

13-16. Draftproof door restraining strap. The draftproof door is secured in its stowed position by attaching the clip ends of two straps (one strap is suspended from a bracket on each side of Frame 3), to their respective special screws provided near the edge of the door bottom panel. Separate the Velcro tape, which holds each strap doubled to itself, and connect the clip to the screw on the door, then press the Velcro tape together again.

13-17. Cargo Loading and Unloading Aids. The following paragraphs describe the apparatus used in loading and unloading cargo.

13-18. Fuselage steady strut. As a safety measure against the aircraft tipping when loading and unloading cargo, an adjustable strut is supplied as part of the ground equipment. When loading items of cargo weighing more than 1500 pounds, the steady strut should be used. The strut consists of a base plate, a locking nut, and a tube assembly incorporating a screw thread. A pin, normally stowed in a clip at the fork end of the strut, is used to attach the strut to the anchor fitting on the center underside of the fuselage, just forward of the passenger doors. Angular adjustment of the base plate may be made up to approximately 15° to suit uneven ground, and the plate can be locked in position by turning the lock nut in the direction indicated by an arrow on the plate. Adjustment for height is made by turning the upper portion of the tube assembly, and should normally be adjusted so



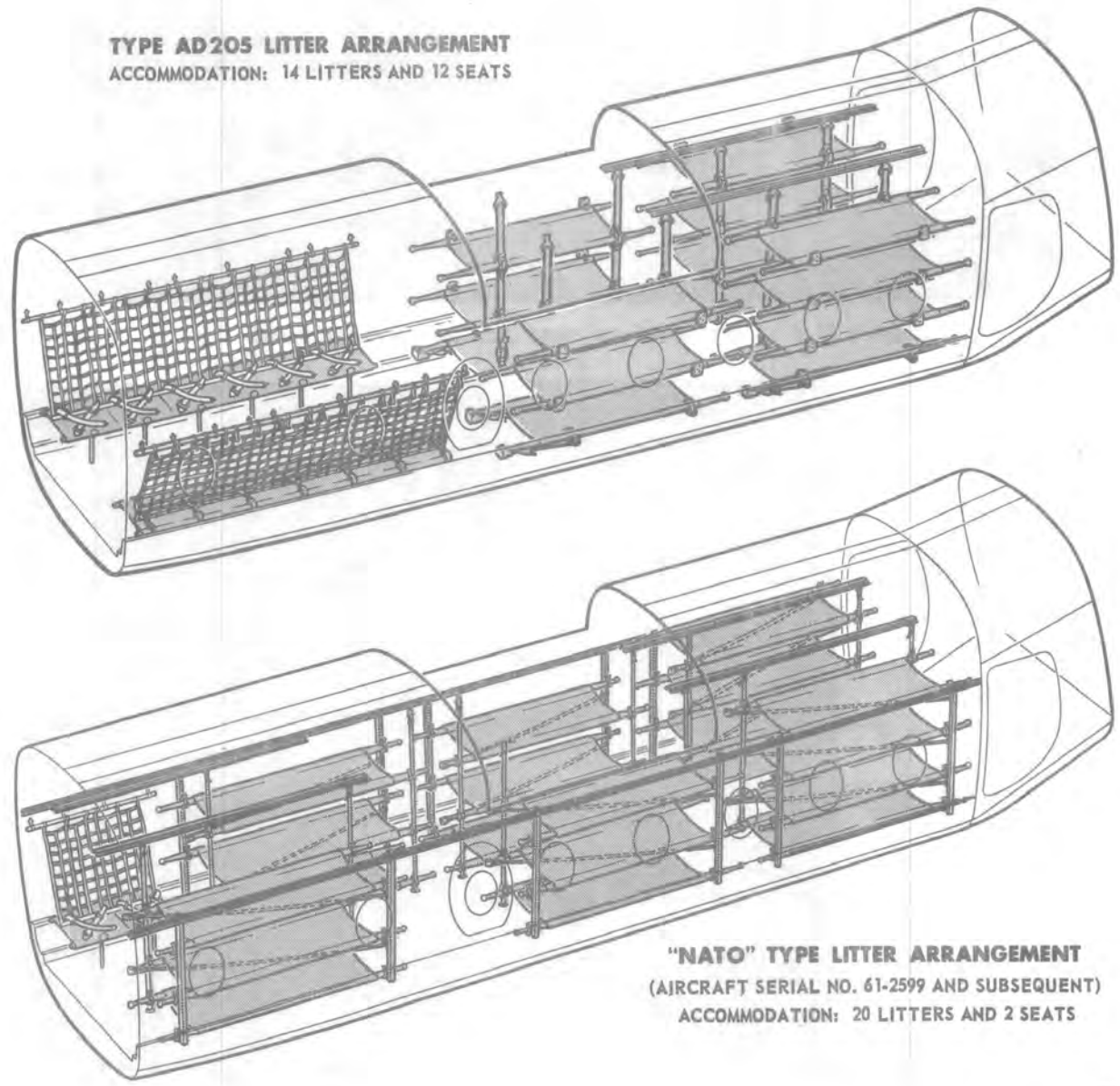


Figure 13-4. Troop seating and litter arrangements (typical)

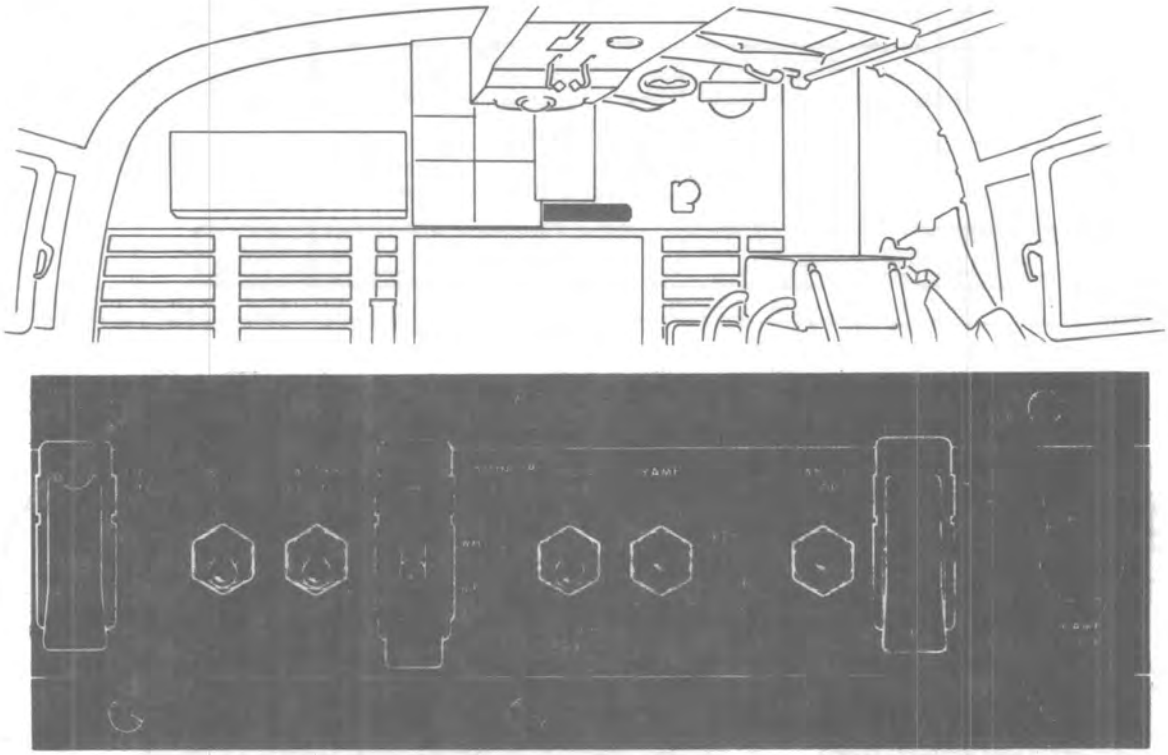


Figure 13-5. Cargo door and ramp switches (forward panel)

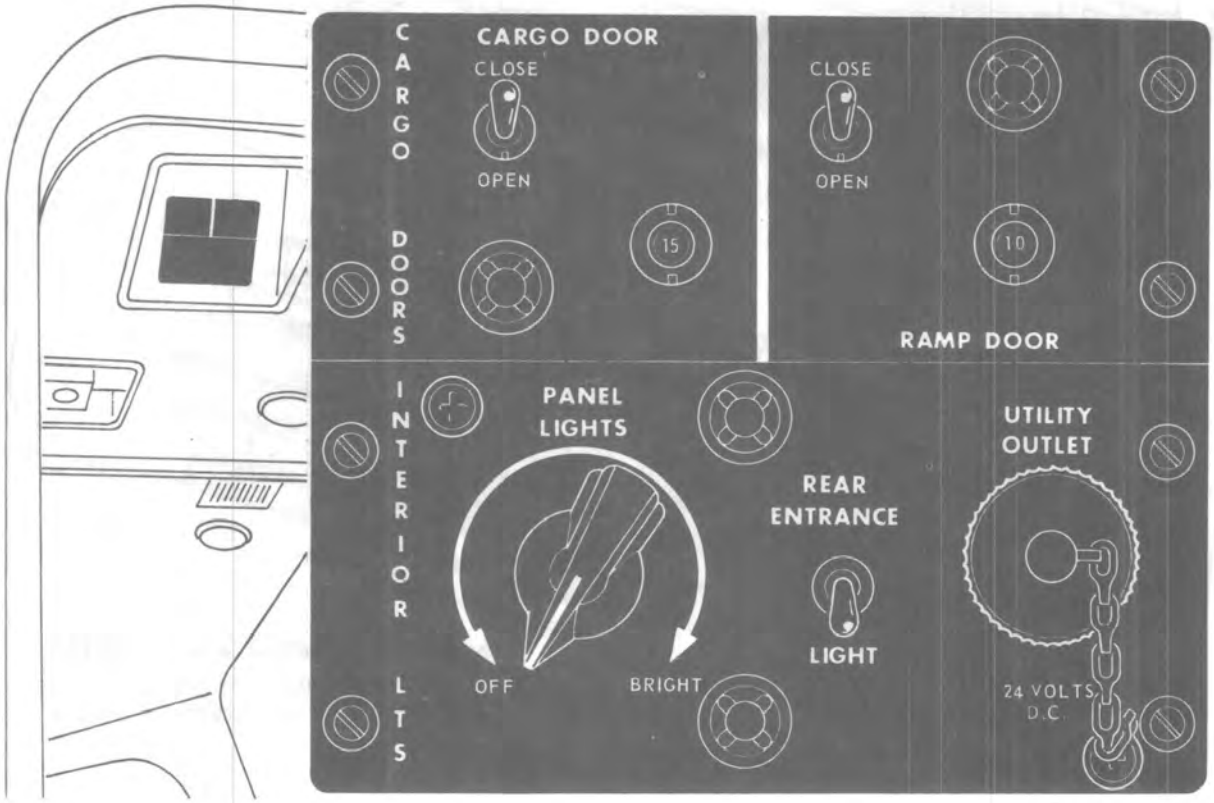


Figure 13-6. Cargo door and ramp switches (aft panel)

that the base plate is approximately 3 inches off the ground. Should the pilot inadvertently taxi the aircraft with the strut in position, the strut will pull away from a light spring retainer clip and release from the aircraft. For installation of the fuselage steady strut refer to paragraph 13-88.

13-19. Monorail crane provision. A corrugated web structure supporting an extruded carrier member runs the length of the cabin at the roof. It extends from the flight compartment bulkhead to fuselage Frame No. 2, just aft of the passenger doors. The structural provisions are for a monorail crane assembly, with a 2000 pound capacity, for loading or unloading of cargo. At present the carrier member is used to provide a guide for the cable of the extraction parachute manual release control.

13-20. Winching provisions. The three forward floor tie-down rings may be used, with a system of pulleys, to winch cargo into the cabin. Pulleys may be attached to other combinations of floor tie-down rings further aft, if necessary.

Caution

The rated loads designated for cargo tie-down rings are ultimate (i.e. application of loads in excess of those stated in paragraph 13-8 and figure 13-3 would result in structural failure of the tie-down ring or supporting structure). Therefore, if the tie-down points are used for any purpose other than for securing cargo, a safety factor of 4 must be allowed. Refer to paragraph 13-108, Loading Check List.

13-21. Ramp extensions. Two ramp extensions, 120 inches long and 15 inches wide, are supplied with each aircraft. When not in use the extensions may be stowed in special racks above the cargo door. The ramps are reversible and both sides have a non-skid surface. One side is provided with edge members for use of wheeled vehicles, while the opposite side has a flat surface to facilitate cargo movement when using rollers etc. Each end of the ramp extensions are provided with a projecting edge lip and two spring-loaded plungers. The edge lip fits into the groove along the aft end of the ramp and the plungers engage with any two holes along the ramp aft face; the holes are spaced every two inches. The ramp extensions should be installed so that the distance between them matches, as closely as possible, the width of the tread of any vehicle to be driven over them. In addition, they should be an equal distance on both sides of the centerline of the aircraft. Refer to paragraphs 13-89 and 13-90 for installation and stowage of the ramp extensions.

13-22. Cargo Securing Equipment. The following paragraphs discuss the apparatus used for securing cargo.

13-23. Tie-down devices. The tie-down devices supplied with each aircraft consist of six Type MB-1 chain devices, twenty Type MC-1 webbing devices, and one Type A-2 cargo net.

13-24. MB-1 device. The MB-1 device (figure 13-7) has an ultimate strength of 10,000 pounds and consists of a 9-foot steel chain with a grab-hook attached to one end. The other end of the chain passes through a hooked device which locks the chain when in tension. A quick release lever on the device makes it possible to detach the two components instantly, regardless of the tension on the chain. A take-up unit, in the form of a knurled ring on the device, allows final tensioning of the chain to be carried out. In use, the grab-hook end of the chain is passed around part of the load, such as the axle of a vehicle, and the hook then engaged with a link of the chain. The hook of the device is then engaged with a tie-down ring.

13-25. MC-1 device. The MC-1 device (figure 13-8) has an ultimate strength of 5000 pounds and consists of a webbing strap on which are two metal hooks, one fixed and one movable. The movable hook has a pre-tension lever which enables final tensioning of the strap to be carried out. In use, the fixed hook on the end of the strap is hooked to any one of the tie-down fittings. The strap is then passed over the load, and the movable hook is hooked to another tie-down fitting. The strap is then tightened by pulling its free end through the movable hook, which will automatically lock in place. Final tensioning is made by closing the pre-tension lever, which engages with a spring-loaded retainer bar. To remove the device, tension on the strap is released by moving the spring-loaded retainer bar against the spring, and then raising the pre-tension lever.

13-26. A-2 cargo net. The A-2 cargo net measures 15 feet by 15 feet and is made of 1/8 inch diameter cable with a grid size of 7 inches by 7 inches. Two adjacent sides are fitted with hooks for engagement with floor tie-down fittings, while the opposite sides have rings for attachment of tie-down devices. The net has a capacity of 10,000 pounds, which is the load the net will withstand without breaking provided all the hooks and rings are secured. This does not mean the net can withstand 10,000 pounds of cargo, as the res-

traint factors (paragraph 13-116) must be taken into account. More than one net, if available, may be used to secure a load. The net may be used for securing palletized cargo, boxes of C rations, drums, or any small items stacked together.

Caution

A cargo net can easily be overloaded. Check the load carefully and take into account the restraint factors.

13-27. Palletized loads. When possible, load small items of cargo on pallets before loading them into the aircraft. When this is done, the loading time is reduced and the load is more easily secured in the aircraft, in addition the unloading time will also be reduced.

13-28. Precautions for palletized loads. Observe the following precautions when loading and securing pallets:

a. Secure items loaded on pallets to the pallets, in the correct manner for ease of handling and tying down in the aircraft.

b. Ascertain the weight of the loaded pallet before loading it into the aircraft, so that the weight and balance calculations can be made.

c. Do not overload the pallet. The loaded pallet must not exceed cabin floor weight limits. Use shoring as required.

13-29. Stowage of Equipment. The following paragraphs describe the stowage and methods of stowing ramp extensions, cargo securing equipment, and blackout curtains.

13-30. Ramp extensions stowage. Two stowage racks are provided, one for each ramp extension, in the rear fuselage between Frames No. 5 and No. 12. The racks are pivoted at their aft ends, and when lowered rest on integral legs supported by the closed cargo door. The ramp extensions must be stowed in the racks in one position only; an instruction is marked on both sides of the extensions as follows: STOW WITH THIS END FORWARD AND UP, and an arrow shows the side to be uppermost. The extension cannot be hooked to the support rod in any other position. When the racks are raised and locked in the stowed position, the cargo door may be fully opened without interference. The racks themselves must be raised and locked in the stowed position if the extensions are not to be carried. A T-shaped locking handle, secured by a spring clip, is fitted centrally in each

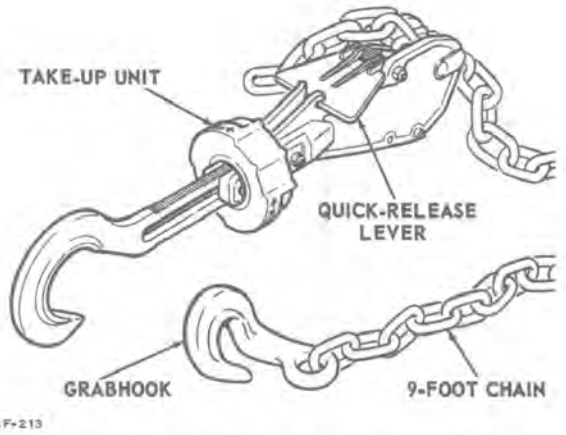


Figure 13-7. MB-1 tie-down device

rack cross-bar. Releasing the clip and pulling the handle forward will allow the support rod to pivot and the hooks may then be disengaged and the rack lowered. The forward part of the rack consists of an end plate welded to a telescopic tube, which is secured by a pip-pin attached to a chain. To install an extension in a stowage rack, the pip-pin is removed and the end-plate moved forward slightly to allow engagement of the two plunger pins, at the end of the ramp extension, with two holes in the plate. Two hooks on the end plate support the rack only when the rack is stowed minus a ramp extension. When a rack is stowed with an extension, the projecting end lip of the extension hooks over the pivoted support rod. When the rack is raised, the locking handle is pushed aft and bears on the end plate or ramp extension, preventing any movement. Refer to paragraph 13-91 for stowage procedure.

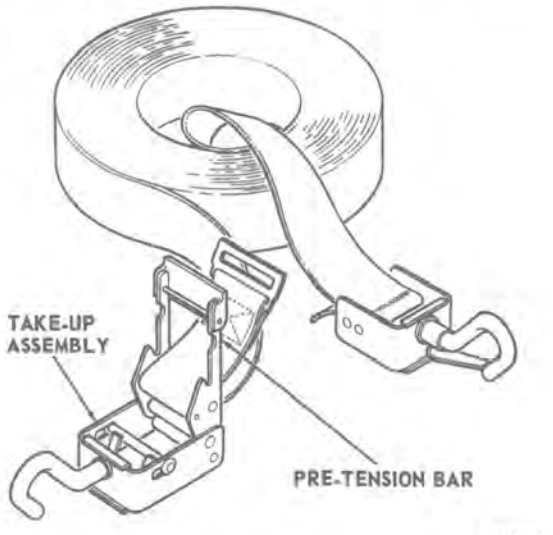


Figure 13-8. MC-1 tie-down device

13-31. Tie-down device stowage. Two stowage boxes are provided, one is installed on each side of the forward part of the cabin, for the stowage of the cargo tie-down equipment. The box covers are hinged and are secured by Velcro tape hooks. The following equipment should be stowed in the boxes:

a. Twenty MC-1 tie-down devices.
b. Six MB-1 tie-down devices.
c. One A-2 Cargo net.
d. Canvas bag containing twenty conveyor hold-down clamps.

13-32. Blackout curtains. The sixteen blackout curtains for the cabin windows are stowed in a canvas bag, marked BLACKOUT WINDOW CURTAINS, secured to the aft face of the flight compartment bulkhead, on the left-hand side. The bag is secured with Velcro tape.

13-33. Emergency Exits. Refer to Chapter 4, paragraph 4-58 and Figure 4-3 for Emergency Escape Routes and Exits.

13-34. Air Delivery System. The aircraft is equipped for the air delivery of supplies and equipment, rigged on platforms or in containers, by the extraction, gravity or manual ejection methods. Parachutists may also air-drop from the aircraft.

13-35. Refer to TM 10-500 for general information on air delivery, and TM 10-500-5 series for specific operating instructions for the air delivery of supplies and equipment from the Model CV-2 aircraft.

13-36. Air Delivery Equipment. The essential equipment, which is either readily removable or stowable, consists of the following:

a. Two anchor line cables.
b. A roller type static line retriever cable extension for each anchor line.
c. A static line retriever winch.
d. A pendulum system.
e. Eight buffer boards.
f. Eight roller conveyors, with hold-down clamps.

13-37. Loose equipment supplied with the aircraft includes twenty MC-1 and six MB-1 tie-down devices, and sixteen blackout curtains.

13-38. The outboard surface of each passenger doorway rear frame is reinforced with a stainless steel skin, and metal guards are provided on the right-hand side of the cargo door opening between Frames 5 and 8 to protect against static line chafing. Controls, and warning and indicating lights are installed in the flight compartment and cabin for controlling the air delivery operation.

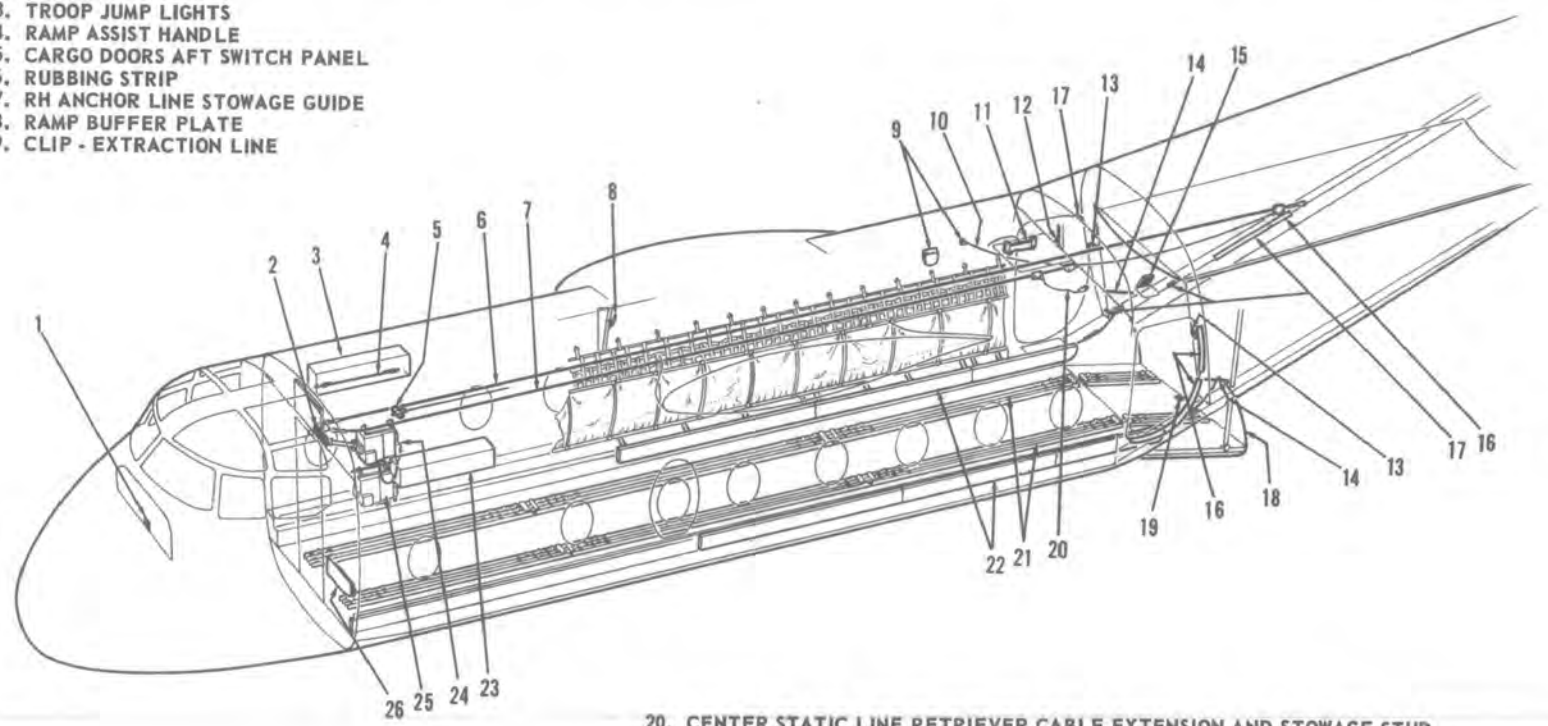
13-39. Anchor line cables. Two anchor line cables, a center and a RH side cable, are provided in the cabin. The RH side cable extends from a forward fitting at the center of the cabin roof, to a fitting at the aft end of the cabin at the junction of Frame No. 8 and the edge of the cargo door opening. The side cable is used to provide attachment of static lines when making air drops from the cargo door opening. The center cable extends along the center of the cabin, from a fitting adjacent to the side cable forward attachment, to a fitting at the top of Frame No. 2, and is used as a static line attachment point when using the side door openings for air drops. The anchor lines are 3/8 inch diameter steel cable, and turnbuckles at the forward end of each allow for tension adjustment. When not in use the side anchor line must be stowed along the RH side of the cabin using the elastic cord, brackets and clips provided, in order that the cargo door may be closed. The center anchor line does not require stowage provisions, and remains in the installed position.

13-40. Static line retriever cable extension. The static lines remain on the anchor lines after cargo or paratroops are dropped, and are withdrawn into the cabin either by hand operation, or by means of the retriever winch. The retriever extension cables, one for each anchor line, are attached to and run along their respective anchor line, and are used to draw the static lines into the cabin. Each retriever extension cable assembly consists of a four-roller assembly linked to a cable 150-inches long for the RH retriever, and 18.6 inches long for the center retriever. Each retriever extension has a quick release hook for connecting to the retriever winch cable.

13-41. Retriever winch. A static line retriever winch, powered from the main dc bus through a plug-in socket, is provided. The winch can be quickly mounted on the center anchor line and by attaching the retriever cable to the extension cable, may be used to withdraw the parachute static lines into the aircraft after an air-drop has been completed; should the drag be too great for hand retrieving of the lines. The winch has a capacity of 1500 pounds and may also be used for retrieving in the event of a hang-up.

13-42. Pendulum System. A pendulum release system is provided for extraction or gravity release

1. TROOP JUMP - PENDULUM RELEASE CONTROL PANEL
2. CARGO DOORS FORWARD SWITCH PANEL
3. RH EQUIPMENT STOWAGE BOX
4. RH ANCHOR LINE STOWAGE ELASTIC CORD
5. PENDULUM RELEASE EMERGENCY HANDLE AND CABLE
6. RH ANCHOR LINE
7. CENTER ANCHOR LINE
8. RH ANCHOR LINE STOWAGE HOOK
9. RH STATIC LINE RETRIEVER CABLE EXTENSION STOWAGE BAG AND STUD
10. RH STATIC LINE RETRIEVER CABLE EXTENSION
11. EJECTOR RACK
12. PENDULUM HOOK
13. TROOP JUMP LIGHTS
14. RAMP ASSIST HANDLE
15. CARGO DOORS AFT SWITCH PANEL
16. RUBBING STRIP
17. RH ANCHOR LINE STOWAGE GUIDE
18. RAMP BUFFER PLATE
19. CLIP - EXTRACTION LINE



20. CENTER STATIC LINE RETRIEVER CABLE EXTENSION AND STOWAGE STUD
21. WHEELED CONVEYORS
22. BUFFER BOARDS
23. LH EQUIPMENT STOWAGE BOX
24. RETRIEVER WINCH INSTALLED
25. RETRIEVER WINCH STOWED
26. BLACKOUT CURTAIN STOWAGE BAG

4F2

Figure 13-9. Air delivery components

of loads. The installation consists of an ejector rack (MK VIII bomb shackle), a pendulum hook at Frame No. 2 and a release clip at the aft end of the ramp. The ejector rack is located at the aft end of the cabin roof between Arm 515 and Frame No. 2. The extraction or release parachute is released from the rack electrically by actuation of the PENDULUM RELEASE switch in the flight compartmen (figure 13-10). Power is taken from the emergency bus and a 5-amp circuit breaker, marked TROOP JUMP on the EXTERIOR LIGHTS section of the circuit breaker panel, is provided.

13-43. The extraction or release parachute may be released manually by means of a handle located in the forward part of the cabin roof.

13-44. Side buffer boards. Six buffer boards and two metal panels (figure 13-11) are supplied for use with the air delivery system. The boards are installed on each side of the cabin at floor level, while a metal panel is attached to each side of the ramp, and moves with the ramp. The boards and panels provide a smooth surface at the cabin sides at floor level, and prevent any snagging of platforms or skids when leaving the aircraft on air delivery. In addition, the ramp panels protect the ramp support arms.

13-45. Buffer board construction. Four square-ended boards are installed in the forward part of the cabin. They are 79.9 inches long by 6 inches wide and are constructed of a 3/8 inch balsa wood core, faced on both sides with 1/8 inch birch plywood and covered with sheet aluminum. The remaining two boards have a rounded end and are installed at the rear of the cabin. They are 55 inches long and 6 inches wide and are constructed of 5/8 inch plywood, with an aluminum plate insert on the rear-inboard side; the remainder of the board is faced with aluminum sheet.

13-46. Roller conveyors. The roller conveyors (figure 13-12.) used in the air delivery system consist of standard and modified sections of skate-wheel conveyors conforming to Specification MIL-C-5927B, Style II. Eight conveyor sections are supplied, consisting of four standard 120-inch lengths, two 98-inch lengths, and two 43.5-inch lengths. All sections are one-foot wide, and when installed in two rows, extend the length of the cabin.

13-47. The frames of the conveyors are made of aluminum alloy, while the wheels and axles are of steel. Sections are coupled together (except the ramp section) by attached hooks at one end and rods at the other. They are secured to the cabin floor tie-down rings, and ramp pan assemblies, by special clamps.

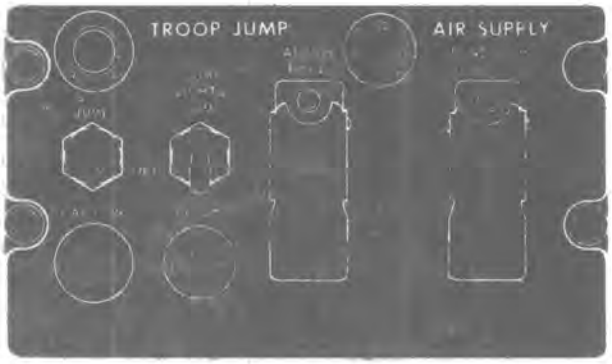
13-48. Roller conveyor hold-down clamps. Twenty conveyor hold-down clamps are supplied. A canvas bag is provided for storing the clamps, marked CONVEYOR HOLD-DOWN CLAMPS, and when not in use should be kept in an equipment stowage box. Each clamp consists of three parts; a hook welded to a spacer, a hook welded to a special nut and a screw which joins the two. In use, with the slotted screw head uppermost, the lower hook is engaged with a convenient tie-down ring (or ramp pan assembly) and the top hook is attached to an axle of the roller conveyor section. The screw is then tightened until the conveyor section is firmly held at that point. Do not overtighten as the axle may bend. Three clamps are used for each 120-inch roller conveyor section and two clamps for each of the other sections. The clamps should be positioned one as near each end of a conveyor section as convenient, and in the center on the 120-inch sections. Install the end clamps at angles which will prevent the conveyor section sliding either fore or aft. (See figure 13-12.) Do not install them slanting all in one direction, as when a load is moved the conveyor may slide out from the hooks.

13-49. Blackout curtains. Sixteen blackout curtains are provided for the cabin windows for use during night operations. Refer to paragraph 13-32, for stowage provisions when the curtains are not in use. Each curtain has Velcro tape around the edges and four equally spaced webbing tabs. Each window has Velcro tape cemented around the window frame, and four equally spaced black index marks. The curtains are installed by positioning the curtain tabs to line up with the index marks on the window frame, and pressing the Velcro tape. The curtains are removed by using the webbing tabs to separate the Velcro tape.

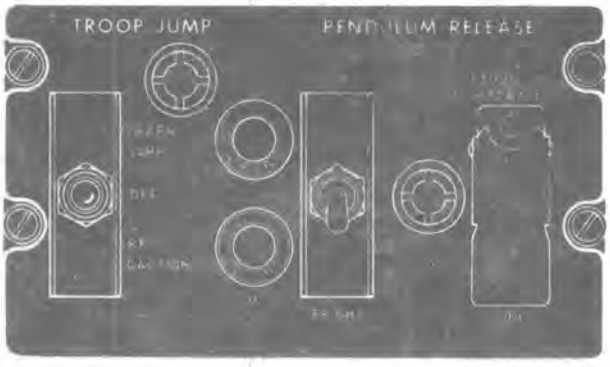
13-50. Troop jump lights. Two troop jump lights (figure 13-9) are installed on the aft frame of each passenger door. Each pair of press-to-test lights consists of a GREEN JUMP and a RED CAUTION light, and are controlled from the TROOP JUMP panel on the pilot's instrument panel. Power is taken from the emergency bus, and a 5-ampere circuit breaker, on the EXTERIOR LIGHTS section of the circuit breaker panel, is marked TROOP JUMP.

13-51. Troop jump panel. The TROOP JUMP panel (figure 13-10), located below the fuel control panel in the flight compartment, has a three-

position troop jump switch, a red and a green press-to-test light and a dim-bright switch. The panel layout differs slightly between aircraft as shown in figure 13-10. The troop jump switch controls the jump lights in the cabin, and also the lights adjacent to the switch. The dim-bright switch controls the intensity of the jump lights in the cabin. The intensity of the jump lights in the flight compartment is controlled by the WARN lights intensity switch on the LIGHTS panel.



SERIAL NO. 63-9718 AND SUBSEQUENT



SERIAL NO. 60-3762 THRU 63-9717

Figure 13-10. Troop jump - pendulum release panel

13-52. Installation of Equipment. The installation of air delivery equipment is as follows:

13-53. Installation of side buffer boards. The side buffer boards are supplied with their brackets attached. Four brackets are positioned on each of the four square-ended buffer boards; while two brackets are positioned on each of the two round-end buffer boards, each bracket is secured to a board by four recessed screws and nuts. Each board has Arm numbers stencilled on its inboard face and, when installed, the Arm numbers on the boards must correspond with the Arm numbers stencilled on the cabin walls. Brackets have Dzus fasteners at their lower ends, and a fork-slot at their upper ends. The round-end buffer boards have two Dzus fasteners on the boards, in addition to the brackets. Each ramp metal panel is bolted to an angle bracket on the edge of the ramp by seven recessed screws and nuts. Nylon rubbing strips are provided on the sides of the cargo door opening for the ramp metal panels.

13-54. Install the side buffer boards as follows:

a. Stow the troop seats, if installed, by tipping or rolling the seats.

b. Select the two square-ended buffer boards that bear the stencil COMPT C4, ARM 333. Match these boards to their appropriate side of the cabin by the similar stencil on the cabin walls.

c. Attach one side buffer board by engaging the fork-slots, in each of the four brackets, under the appropriate lug on the seat support rail. Align and fasten the four Dzus fasteners by turning clockwise one-half turn.

d. Install the other three square-ended buffer boards in a similar manner to the first board, noting the stencils agree with those on the cabin wall. The square-ended boards are structurally interchangeable, except for the Arm stencils.

e. Position the two round-end boards so that stencils agree with those on the cabin wall. Engage the fork-slots in each of the two brackets with their respective lugs, then align and fasten the two Dzus fasteners on the brackets, and the two Dzus fasteners on the boards.

f. Insure that the buffer boards, when installed, provide a smooth surface along the cabin sides.

13-55. Installation of roller conveyors. Install the roller conveyors as follows:

a. Open the cargo door, and lower the ramp to the horizontal position.

b. Remove, or stow in their correct position, all seats, seat supporting equipment and loose equipment.

c. Clean the cabin floor. Carefully check for any loose bolts, tools etc. that could prevent the air delivery system from functioning.

d. Turn all tie-down rings into their recesses.

e. Inspect the eight roller conveyor sections for damage, and check the wheels and rollers for freedom.

f. Inspect the 20 conveyor tie-down clamps for damaged or bent hooks, stripped threads etc.

g. Center the two short conveyors over the ramp pan assemblies, also center a 120-inch conveyor section over cabin tie-down rings, Rows B and D, with the couplers facing aft. (See figure 13-12.) Fore-and-aft alignment will be aided by the floor treadway markings.

h. Adjust each 120-inch section so that the distance between the rear face of the conveyor, and the end of the cabin floor at Arm 538, is one inch.

i. Adjust each conveyor section on the ramp so that the distance between the front face of each ramp section, and the rear face of each 120-inch section, is 2.5 inches. This will allow sufficient space between the conveyors for clearance when the ramp is raised.

j. Position two clamps for each ramp conveyor. Connect the hooks to the ramp pan assemblies, and to a convenient axle on the conveyor, so that each conveyor has a clamp sloping forward and one sloping aft. Tighten the clamps and insure that the conveyor does not move from the location measured in step i.

k. Attach three clamps to each 120-inch section, one close to each end as convenient, and one near the center. Attach these clamps each to a convenient tie-down ring and to an axle on the conveyor. Insure that the front and rear clamps are sloping in different directions.

l. Install the two remaining 120-inch conveyors, and then the two 98-inch conveyors. Insure the couplers face aft, and then engage the coupler hooks between each conveyor section before attaching the clamps.

m. Check that the conveyors are aligned fore and aft, and are parallel.

n. Tape all unused couplers to prevent snagging of equipment during air delivery operations.

13-56. Ejector rack installation. The ejector rack is installed on the mounting brackets attached to the cabin roof structure at Arm 515. The release unit should be fitted to the ejector rack before installing on the aircraft. Proceed as follows:

a. Position the ejector rack with the mark FRONT facing forward, and hook the rack onto the two support brackets by tilting the rack sideways.

b. Attach the two screws securing the clamp to the structure, at the forward end of the rack.

c. Attach the bolt and nut connecting the manual release cable to the ejector rack release arm.

d. Connect the electrical cable at the plug on the release unit, and secure with clip.

13-57. Retriever winch installation. The winch is installed on the center anchor line by means of the two locking jaws. The jaws are opened and locked over the anchor line using a similar procedure as for stowing the winch. (Refer to paragraph 3-61.) When installed, the anchor ring must face forward. The winch is secured against movement by means of a strap assembly attached from the anchor ring to the hook portion of the center anchor line fitting. A plug-in receptacle marked STATIC LINE RETRIEVER, and a 50-amp circuit breaker are on a panel on the LH side of the cabin adjacent to the winch stowage location. The receptacle has an attached dust cap.

13-58. Stowage of Equipment. Methods of stowage of some items of air delivery equipment is as follows:

13-59. Side anchor line stowage. To stow the RH anchor line, withdraw the retriever cable extension until the roller assembly is in the cabin, then refer to figure 13-13 and proceed as follows:

a. Release the anchor line from the forward fitting by pressing and releasing the "ball-lok" pin. Replace the "ball-lok" pin into the fitting for stowage.

b. Route the cable through the stowage guard and hooks, commencing at the aft end of the cable, as follows:

(1) A straight guard above the cargo door opening at Frames 6 and 7.

(2) Around the base of Frame 5 and beneath a hook between Frames 4 and 5 (behind the structure).

(3) A straight guard at Frame 4 and beneath a hook between Frames 3 and 4 (behind the structure).

(4) Around the base of Frame 3, and in the curved guard at the base of Frame 2.

(5) Around the curved guard at the top of the door opening.

(6) Along the cabin wall to a hook at Arm 335.

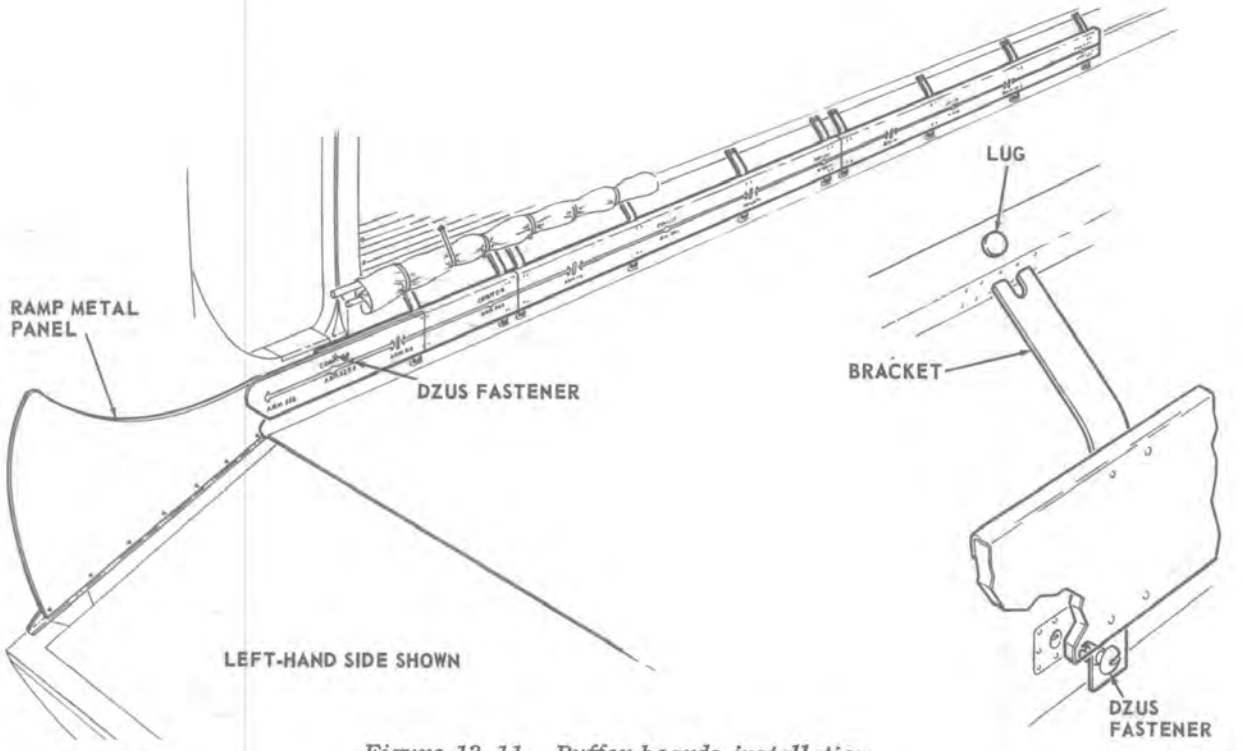


Figure 13-11. Buffer boards installation

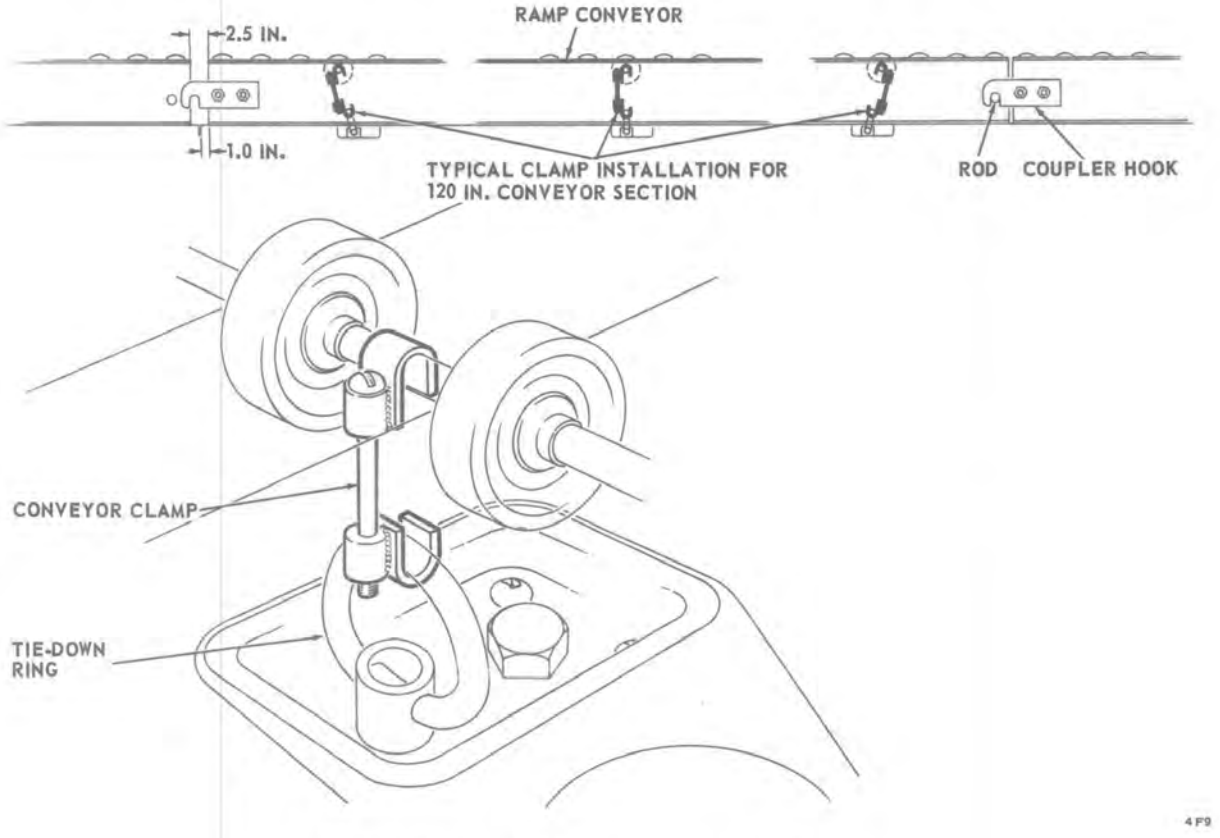


Figure 13-12. Roller conveyors installation

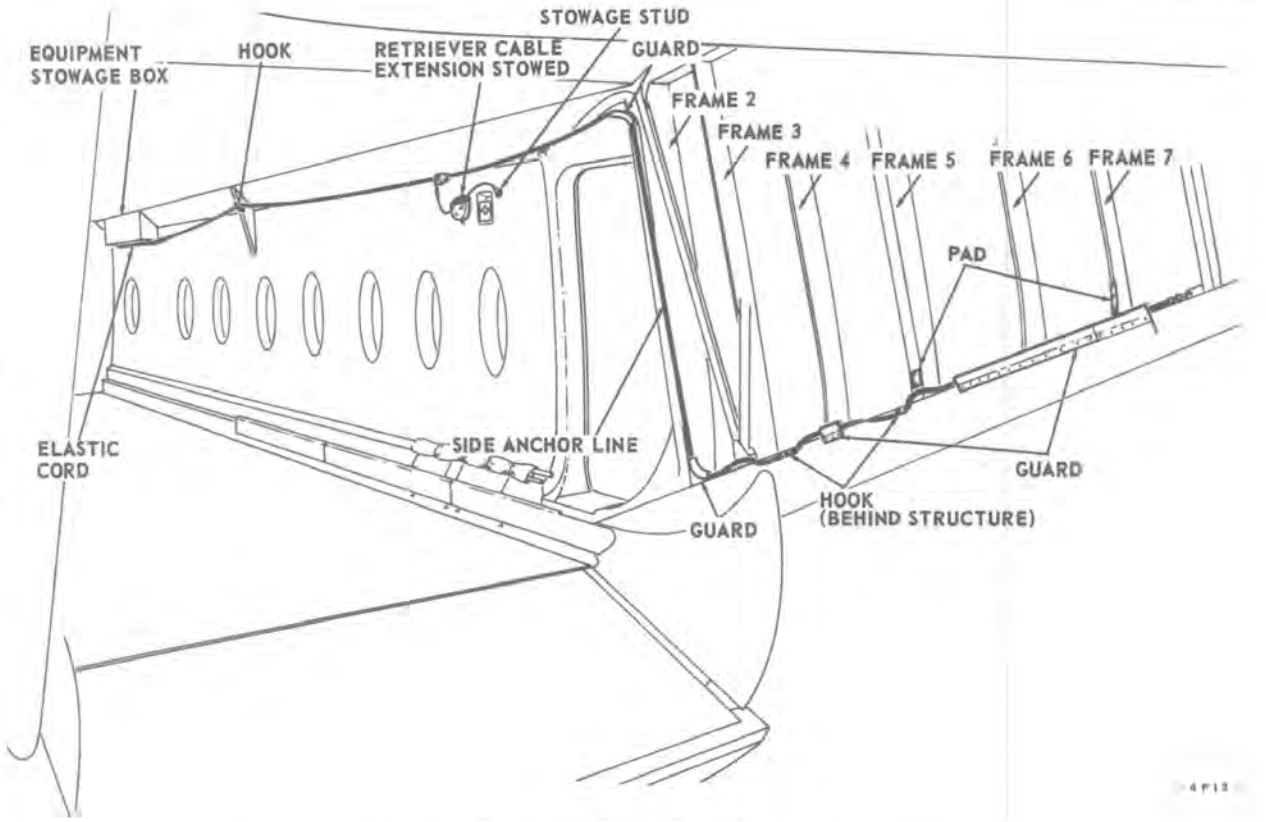


Figure 13-13. Side anchor line stowage

c. Release the hook bracket of the elastic cord assembly, located beneath the RH equipment stowage box, stretch the cord and connect the anchor line turnbuckle to the hook bracket by sliding in the turnbuckle end.

13-60. Retriever cable extension stowage. When not in use the center retriever cable extension must be stowed by engaging the hook onto the stowage stud installed in the cabin roof at the aft end, LH side, of the center anchor line. The RH side retriever cable extension must be stowed by drawing the cable forward until the roller assembly is over the stowage pocket. The cable is then looped in a circle to fit into the stowage pocket (at Arm 479), while the hook connector end is attached to the stowage stud installed at Arm 497, the cable going over the first aid kit stowage box.

13-61. Winch stowage. The winch is stowed on the LH side of the cabin, just aft of the flight compartment bulkhead, close to the roof. A metal rod is provided, between the bulkhead and the equipment stowage box, on the LH side. The two locking jaws at the top of the winch are opened by means of the handle, the winch is lifted so that the two hooks engage with the rod, the anchor ring facing forward. With the winch hanging from the hooks, the handle is then turned over the hooks (inboard), thus locking the two jaws over the rod. A fabric strap, when adjusted, holds the winch bumper against a bracket on the side of the cabin and prevents any movement of the winch.

13-62. Securing Air Delivery Cargo. When restraining an air delivery load, the restraint factors to be used are as follows:

DIRECTION	RESTRAINT FACTOR(g)
Forward	4.0g
Aft	1.5g
Lateral	1.5g
Vertical (Up)	2.0g

13-63. The forward factor is less than that used for restraining an air-transported load. When solving the formulas for an air delivery load, substitute the restraint factors given in the previous paragraph for those given in paragraph 13-116.

13-64. Weight of load. Insure that the weight used in calculating the number of tie-down devices required is the gross weight of the rigged load, this includes the weight of the platform or skid assembly, and of the recovery parachutes.

Section III

Preparation of Aircraft and Personnel Cargo for Loading and Unloading

13-65. Personnel Loading and Unloading. In addition to the standard preflight procedures the following checks should be accomplished when preparing the aircraft for the transportation of personnel.

a. Remove all unnecessary articles from the cabin and sweep the floor.

b. Check that all tie-down rings in the floor are flush.

c. If cargo is also being carried, check that it is properly secured and clear of doorways and escape hatches.

d. Install troop seats and/or litters, as required.

e. Check that the correct number of seat safety belts are fitted and check their condition.

f. Check emergency equipment for serviceability. Fire extinguishers charged, first aid kits unopened and crash axe stowed.

g. Check door operating mechanisms for operation. Inspect jettison mechanisms on emergency door, right-hand passenger door and cargo door.

h. Check relief tube for cleanliness and proper stowage.

13-66. Troop seat installation. The upper and lower rails, complete with hook fittings, strap assemblies, buffers and clamps are assumed to be already installed in the cabin. If this is not the case, they must be screwed into their locations before proceeding with the following:

a. Arrange each seat unit in approximate position on the cabin floor.

b. Attach the first three seat units, starting at the flight compartment bulkhead on either side, to the top rail by means of the hooks on the back webbing.

c. Fit the rear support rail, complete with stowage straps, through the seat web of the first three seats and secure the rail by means of the clamps fitted to the side wall.

Note

This rear support rail is the length of two and one-half seats.

d. Unfold the seat legs and spreader bars of the first seat and engage the seat legs with the first and second seat pick-up studs in the cabin floor.

e. Couple the male and female joints of the front tubular members of the first and second seats together. Clip the spreader bars to the rear support rail.

f. Engage the legs of the second seat with the floor studs and couple the second and third front tubular members together. Clip the spreader bars to the rear support rail.

g. Proceed in the same manner with the other seats, noting that the next rear support rail to be assembled is the length of two and one-half seats, while the last rail is the length of three seats.

h. Close the slide fasteners, and engage the snap fasteners, between each seat unit.

i. Clip the seat safety belts to the appropriate rings on the rear support rail clamps to suit the troop seating arrangement. The seat pitch is marked 20 inches and 25 inches, to accommodate 32 men or 26 men respectively.

13-67. Troop seat safety belts. The troop seats are equipped with safety belts which are operated as follows:

a. To fasten the safety belt, move the buckle lever away from the belt and engage the RH belt clip with the buckle.

b. Move the buckle lever down to the belt, thus engaging the clip.

c. Tighten the belt by pulling on the two fabric tabs on the side.

13-68. Troop Loading and Unloading Procedures. The procedures for loading and unloading troops are as follows:

13-69. Troop loading. Troops may be loaded through the cargo door or passenger door as follows:

a. Set aircraft parking brake and chock main wheels. Do not chock the nosewheels.

b. Open cargo door and ramp, and install ramp extensions. If a passenger door is to be used, install access ladder.

c. Seat troops from fore to aft.

d. When troops are seated, check that safety belts are fastened.

13-70. Troop unloading. To unload troops, reverse the loading procedure.

13-71. Computation of troop load. The troop load should be computed in accordance with paragraph 12-12.

13-72. Litters. In aircraft serial No. 60-3762 through 61-2598 provision is made for the installation of 14 standard military litters (Type AD205) at the aft end of the cabin. (See figure 13-4.) The center litter group consists of six litters in two tiers of three, while the rear group consists of eight litters in two tiers of four. A canvas bag, colored olive drab, is supplied for each of the two litter groups, in which to store the clamps, straps and floor supports when not in use. Aircraft serial number 61-2599 and subsequent are equipped to receive 20 "Nato" type litters, the arrangement of the litters in the cabin being the same as that for type AD205, with the additional six litters being installed in tiers of three on each side of the forward section of the cabin. Sufficient space remains for one troop seat unit on the right-hand side of the cabin immediately aft of the flight compartment bulkhead, and gangway clearance for the emergency door on the left side. This type of litter installation provides for height and level adjustment for individual litters to accommodate variations in the desired physical attitudes of casualty passengers. Stanchions and strap assemblies for the "Nato" type litters are in three groups, each group has a black nylon bag for stowage purposes. Type AD205 litters may be installed in the "Nato" type installation.

13-73. Installation and loading of type AD205 litters. Install the rear litter supports and load the litters as follows; the center litter kit is installed in a similar manner:

a. Obtain the two litter kit bags, marked REAR 8 LITTER KIT and CENTER LITTER KIT.

b. Check that the REAR 8 LITTER KIT contains the following:

Four floor supports.
Four strap assemblies (rear).
Twelve litter clamp supports.

c. Check that the CENTER LITTER KIT contains the following:

Four floor supports.
Four strap assemblies (center).
Eight litter clamp supports.

d. Attach the floor supports for the rear litter kit. Insure that the two forward supports, marked LH SIDE and RH SIDE respectively, are in their correct location, with their attached litter restraining straps pointing forward. Each support is engaged with a floor stud, and two marked supports at arm 443 and the two unmarked supports at arm 498, by engaging the keyway in the support base with the stud, and sliding the support outboard. A locking pin is then engaged to lock the support to the side wall. The pin is secured to the support by a chain to prevent loss.

e. Fit the twelve litter support clamps to the cabin wall by inserting the locking stud into a socket plate and turning the clamp to the vertical position.

f. Attach the side straps by hooking the solid metal hook to the flush brackets in the cabin roof, approximately above the floor support studs, making sure the clamps face outboard.

g. Loosen all clamps by the adjusting screw.

h. Position the litters in the clamps, working downwards from the top litter. Tighten the clamps as each litter is installed. The bottom support litter clamp is adjustable sideways. The end stops of the litter restraining straps must be engaged over the handles of the bottom litters, and the straps tensioned.

i. Connect the bottom steel rod hook of the side straps to the top bolt in the floor support clamps.

j. Tighten the side straps by means of the web lock buckles.

13-74. Installation and loading of "Nato" type litters. Install and load the "Nato" type litters as follows:

a. Obtain two litter kits marked CV-2 CARIBOU LITTER KIT FOR 6 and one kit marked CV-2 CARIBOU LITTER KIT FOR 8.

b. Check that litter kits FOR 6 each contain the following:

Four strap assemblies, each with three litter brackets.
Two stanchion assemblies, each with three litter brackets.
Two stanchion assemblies, each with three litter brackets and two diagonal straps.

c. Check that litter kit FOR 8 contains the following:

Four strap assemblies, each with four litter brackets.
Two stanchion assemblies, each with four litter brackets.
Two stanchion assemblies, each with four litter brackets and three diagonal straps.

d. The three litter kits may be installed in any order, the two tiers of 4 at the aft end of the cabin, and the four tiers of 3 at the center and forward end of the cabin as shown in figure 13-4.

e. Install the stanchions with diagonal straps at the rear station of each tier, at arms 188.0, 317.0 and 411.0 on the left side and arms 225.0, 317.0 and 411.0 on the right side of the cabin.

f. Install stanchions without diagonal straps at the forward station of each tier, at arms 108.0, 239.0 and 333.0 on the left side and arms 145.0, 239.0 and 333.0 on the right side of the cabin.

g. Install each stanchion by engaging the two holes in the lower end with the two relative pins on the bottom ledge at the appropriate station; lift the stanchion and locate the holes in the upper end with the two relative pins in the side wall rail. Lock the stanchion by engaging the spring-loaded pin at the lower end in the adjacent receptacle in the bottom ledge.

h. Install each strap assembly opposite its relative stanchion by engaging the hook at the upper end with the pin in the receptacle in the cabin roof, with the litter brackets facing outboard.

i. If necessary, adjust the litter brackets on each stanchion to align with the black position markers on the side of each stanchion, then adjust the litter brackets on the straps accordingly. This will insure the correct level and spacing of litters. The stanchion litter brackets are readily adjusted by raising the small lever beneath the bracket and sliding the bracket to the required position, whereupon the locking pin will engage itself in the selected stanchion hole. The strap litter brackets are adjusted by depressing the lock pin on one side of the bracket and pushing the eared pivot channel over the pin to release the bracket for up or down adjustment.

j. Open all litter brackets to receive the litters by disengaging the locking handle from the locking bar and swivelling the locking bar to its open position.

k. Position the litters in the brackets, working downwards from the top of each tier and secure each bracket lock as each litter is installed.

l. Anchor the lower end of each strap by attaching the spring clip to the stud recessed in the floor immediately below the roof fitting. Tighten the strap by pulling on the free end emerging from the spring clip.

m. Extend the diagonal strap for each litter (bottom litters excepted) by releasing the adjustment buckle lever and pulling the buckle. Place the sock on the end of the strap over the forward, inboard litter handle. Tighten the strap until snug by pulling on the free end of the strap emerging from the buckle.

13-75. Unloading of type AD205 litters. The litters are unloaded by loosening the clamp adjusting screws and removing the litters, working from the bottom litter upwards. The litter supports are dismantled in the reverse manner to installation.

13-76. Unloading of "Nato" type litters. "Nato" type litters are unloaded by releasing the diagonal straps, unlocking the litter brackets and removing the litters, working from the bottom litter of each tier upwards. The stanchion assemblies and strap assemblies are removed by reversing the installation procedure.

13-77. Comfort Provision Checklist. Check passengers relief tube as follows:

a. Installation properly cleaned.

b. Extension cord, hose and funnel in serviceable condition, with hose firmly attached to the telescoping tube and funnel in clip.

13-78. Emergency Equipment Checklist. Check the emergency equipment as follows:

a. Check the three CF_3Br type fire extinguishers, one below the pilot's seat, one on the cabin bulkhead to the left of the flight compartment door and one on the cabin wall aft of the left-hand passenger door.

b. Check the four first aid kits for unbroken seals. The kits are located as follows: one in the flight compartment immediately above the access ladder, one on both the left and right walls of the cabin forward of the passenger doors, and one on the left wall of the cabin aft of the emergency door.

c. Check that the crash axe is stowed on the cabin bulkhead.

13-79. Equipment Loading and Unloading. Procedures to be carried out prior to loading and unloading equipment are as follows:

13-80. Assembly of equipment. Prior to loading and unloading vehicles and equipment, observe the following check list.

a. Check the ramp extensions, fuselage steady strut and winching provisions for serviceability.

b. Refer to paragraph 13-120 for the number of tie-down devices to be used, and to figure 13-1 for the location of tie-down rings. Inspect the devices for serviceability.

13-81. Preparation of cabin. To prepare the cabin, stow all troop seats. Refer to paragraph 13-92.

13-82. Cargo Door Operation. Procedural steps for operating the cargo door are as follows:

13-83. Electrical operation. The cargo door is opened and closed electrically as follows:

a. If an external power supply is to be used, check that the battery master switch and the generator switches are OFF.

b. Check that the interior of the rear fuselage is clear of obstructions and that the ramp extension stowage racks are locked in their stowed positions. Check that the side anchor line is in the stowed position.

c. Pull back on the cargo door manual crank handle to insure that the brake and clutch of the motor are engaged.

d. Select the CARGO DOORS master switch to CARGO DOORS.

e. Select the CARGO DOOR operating switch, on either the fore or the aft panel, to OPEN. Return switch to the center position when doors are fully open.

f. To close the door, select the CARGO DOOR operating switch to CLOSE. Return the switch to the center position when the operation is completed.

g. Select the CARGO DOORS master switch off.

h. Disconnect the external power supply, if used.

13-84. Manual operation. The cargo door is opened and closed manually as follows:

a. Check that the interior of the rear fuselage is clear of obstructions and that the ramp extension stowage racks are locked in their stowed positions. Use the aircraft lighting and ramp loading light, if necessary.

b. Push the MANUAL CONTROL CARGO DOOR handle to the rear against the spring until the handle is at 90° to the torque tube.

c. Turn the handle clockwise until the door is open.

d. To close the door, maintain the handle position at 90° to the torque tube, and turn handle counterclockwise.

e. When the manual operation is completed, pull handle fully back to insure engagement of the brake and motor clutch.

13-85. Ramp Operation. Procedural steps for operating the ramp are given in the following paragraphs.

13-86. Electrical operation. The ramp is opened and closed electrically as follows:

Caution

The ramp is not to be operated when supporting a load.

a. If an external power supply is to be used, check that the battery master switch and the generator switches are OFF.

b. Check the ground clearance below the ramp and remove any obstructions.

Caution

With the aircraft on level ground, and normal payload, the fully open ramp may have a ground clearance of only one inch. The amount of ground clearance depends upon the setting of the limiting switch, which can be adjusted to provide up to six inches clearance.

c. Check that the ramp floor is clear. Use the aircraft lighting and ramp loading light, if necessary.

d. Check that the ramp motor is engaged with the drive. When engaged, the knob on the motor is protruding slightly from the unit and is spring-loaded out.

Caution

Do not engage or disengage while the motor is running.

e. Select the CARGO DOORS master switch to CARGO DOORS.

f. Select the RAMP operating switch, on either the fore or the aft panel, to OPEN. Return switch to the center position when the ramp is in the required position.

g. To raise the ramp, select the RAMP operating switch to CLOSE. Return the switch to the center position when the operation is completed.

h. Select the CARGO DOORS master switch off.

i. Disconnect the external power supply, if used.

13-87. Manual operation. The ramp is opened and closed manually as follows:

a. Check the ground clearance below the ramp and remove any obstructions.

b. Check that the ramp floor is clear. Use the aircraft lighting and ramp loading light, if necessary.

c. Disengage the motor from the drive by pushing in the knob on the motor and turning it approximately 180° until the knob locks in.

d. Remove the RAMP DOOR HANDLE from its STOWAGE and engage it in the MANUAL CONTROL RAMP DOOR socket.

e. Turn the handle counterclockwise until the ramp is in the required position.

f. To raise the ramp, turn the handle clockwise.

g. Reengage the motor by turning the knob approximately 180° until it springs to the out position.

13-88. Installation of Fuselage Steady Strut. When individual items of cargo weigh more than 1500 pounds, support the fuselage with the steady strut before loading as follows:

a. Position the aircraft on level ground, if possible.

b. Position the strut directly under the fuselage anchor fitting at arm 513, insuring the ground under the strut base is even.

c. Adjust the strut for height by turning the upper tube until it is approximately 3 inches from the anchor fitting on the fuselage.

d. Remove the support pin from its clip on the strut and engage it through the strut fork end and anchor fitting.

e. Adjust the strut so that the base is 2 to 3 inches above the ground. If the ground is not even, angular adjustment of the base plate may be made up to approximately 15°. Lock the base plate by means of the lock nut.

Note

If the base plate is resting on the ground prior to loading, it may be difficult to remove the strut after the aircraft is loaded.

13-89. Installation of Ramp Extensions. Install the ramp extensions to the ramp as follows:

a. Open the cargo door.

b. Adjust the ramp to a convenient position.

c. Hook the edge-lip of the extension into the recess at the aft edge of the ramp, positioning it according to the track width of the vehicle to be moved, and with the desired side uppermost.

d. Lower the extension and allow the plungers to engage in convenient holes in the ramp.

e. Install the other extension in a similar manner.

f. Adjust the ramp so that the bed of the ramp and extensions are in line, with the aft end of the extensions on the ground.

13-90. Stowage Provisions. Stowage provisions for cargo loading equipment are given in the following paragraphs.

13-91. Stowage of ramp extensions. Stow the ramp extensions into their stowage racks as follows:

a. Cargo door closed. Release the spring clip on the stowage rack locking handle and pull the handle forward.

b. Raise the rack slightly and pivot the support rod forward so that the hooks are disengaged.

c. Lower the rack until it rests on its legs on the cargo door.

d. Remove the pip-pin at the forward end of the rack and pull the end plate forward.

e. Hold the ramp extension, with the end marked STOW WITH THIS END FORWARD AND UP, in the correct position.

f. Lower the aft end of the extension to the rack and slide the extension along the rack until it fits into the end clamps.

g. Lower the forward end of the extension to the rack and push the end plate back to engage the two extension plungers with the holes in the end plate. Secure with the pip-pin.

h. Raise the rack to the support bar, pivot the bar forward and engage the projecting end lip of the extension over the support bar.

i. Push back the locking handle until the spring clip engages.

j. Stow the other ramp extension in a similar manner.

13-92. Stowage of troop seats. The seats may be tipped, or they may be rolled with the back webbing and strapped against the cabin wall. Proceed as follows:

a. Detach the seat legs from the floor studs by pulling up on bottom leg tube.

b. Fold the seat legs, and tilt the seat back. Clip the elastic support straps around each seat unit to their brackets. To roll the seats, carry out action a. and b. but do not clip the straps, continue as follows:

c. Unclip the seat spreader bars from the rear support rail and fold the bars.

d. Unhook the back webbing from the top rail and fold into the seat.

e. Roll the seat, with webbing and safety belts included, and secure by clipping the eight elastic support straps to their brackets.

13-93. Stowage of litter kits. The bags containing litter kits may be secured to floor tie-down fittings. The "Nato" type litter kit bags are supplied with the straps for this purpose. Type AD205 litter kit bags are not supplied with straps.

13-94. Stowage of weight and balance computer. The computer case is secured to the bulkhead behind the pilot by hooking the leather loop of the case over the metal clip provided.

13-95. Preparation of General Cargo. The following procedures must be carried out preparatory to loading items of general cargo.

13-96. Check list.

a. Remove excess packaging to reduce shipping weight.

b. Weigh individual pieces of cargo.

c. Measure all cargo items which appear to have a critical dimension for loading.

d. Insure all items are clearly labeled.

e. Measure contact area of heavy pieces of cargo for calculation of footprint pressure.

13-97. Weight and balance. Refer to Chapter 12, Weight and Balance Computation, and the computer, for the final load positioning.

Section IV

General Instructions for Loading, Securing, and Unloading Cargo

13-98. Cargo Center of Gravity Planning. The "Allowable Cargo Center of Gravity" graph, figure 13-14 is provided to enable approximate positioning of the cargo in the aircraft and shows the permissible locations of the cargo center of gravity with various combinations of fuel loads from full to empty.

Note

The cargo cg is not necessarily the same as the aircraft cg. As long as the cg of the cargo lies within the boundaries of the chart, and within the fuel limit lines, it will not cause the aircraft cg to fall outside its limits.

13-99. The graph shows cargo weight versus the arm of the load. The arm lengths represent distance in inches aft of the reference datum. The data derived from the graph is intended for planning purposes only, the results are approximate and are applicable only to the aircraft basic weight shown on the appropriate graph. Final loading calculations must be checked for the particular aircraft using the Weight and Balance Computation in Chapter 12 of this manual, and the balance computer. Operating instructions for the weight and balance computer are given in Chapter 12.

13-100. Fuselage interior markings. The arms (figure 13-2) are stenciled on both sides of the cabin wall, close to the floor, and are marked every 20 inches from Arm 193.0 at the flight compartment bulkhead, to Arm 513.0 at the join of the center and rear fuselage. Two further arms are marked at 12.5 inch intervals, Arms 525.5 and 538.0. Loading compartments are also marked, in conjunction with the arms, from COMPT C1 to COMPT C9, each compartment being 40 inches long with the exception of C9, which is 25 inches long. The compartments are an aid to the computation of the cargo center of gravity.

13-101. Computation of Cargo Center of Gravity. The location of cargo center of gravity is determined using the compartment method. The cabin is divided into nine compartments and for approximate planning purposes cargo loaded into any compartment will have its center of gravity acting through the center of that compartment. When an item of cargo extends over two or more compartments the center of gravity of the item should be placed over the center of whichever compartment is convenient, and its weight treated as though it were acting in that compartment only. If this cannot conveniently be done, the moment of the item must be calculated from the particular arm at which its center of gravity is located.

13-102. Determination of center of gravity of a load. To determine the center of gravity of a cargo load proceed as follows:

a. Check that the total weight of the anticipated cargo plus the required range fuel is within the maximum allowable load.

b. Record the weight of all the items of cargo contained within each compartment.

c. Using Chart E in Chapter 12, Weight and Balance Computation, obtain the moments for each compartment and add together. (Moment = Weight x Arm).

d. To the result obtained in step c, add the moment of any items of cargo which must be loaded partly in one compartment and partly in another.

e. Calculate the total weight of cargo.

f. Divide the results of step d. by step e.

g. Check that this cg location is within the limits of figure 13-14.

13-103. Sample problem. The following cargo loads and moments are recorded for the various compartments of the aircraft. Find the cargo cg. Required range fuel 2500 pounds.

Compartment	Load (lb)	Moment / 1000
C1	-	-
C2	550	139
C3	-	-
C4	600	200
C5	750	280
C6	500	207
C7	-	-
C8	-	-
C9	-	-
	2400	826

The total moment/1000 = 826

The total load = 2400

$$\text{Cargo center of gravity} = \frac{826 \times 1000}{2400} = 344.2$$

Therefore the cargo center of gravity is at arm 344.2

13-104. On the graph (figure 13-14) the forward limit for a load of 2400 pounds with 2500 pounds of fuel is 288 while the aft limit is 420. Since the arm of the sample load is between these limits, the loading is satisfactory and it will not cause the aircraft cg to fall outside its limits. For aircraft cg limits, see figure 13-15.

13-105. Vehicle center of balance. It may be required to find the center of balance of a two-axled vehicle without reference to the aircraft, knowing the weight on each axle and the distance between them. To do this, multiply the weight on either axle by the distance between the centers of the axles, and divide by the sum of the weights on both axles. The result will be the distance of the center of balance from the other axle. Using the letters in figure 13-16 the formula is as follows:

$$\text{Center of Balance } (x) = \frac{B \times Y}{A + B}$$

13-106. Cargo center of balance. The center of balance of an item of cargo may be determined by balancing the cargo on a roller and marking the point of balance. An alternative method consists of supporting the item at one end and weighing at the opposite end as shown in figure 13-16. The center of balance may then be calculated using the formula:

$$d = \frac{wD}{W}$$

where:

d = Distance from support to center of balance.
w = Scale reading.
D = Distance between support and scale attachment point.
W = Total weight.

13-107. Personnel load. Provided the majority of personnel remain in their seats it is unlikely that they alone would cause the aircraft cg to fall outside the limits. However, a mixed load of personnel and cargo might do this. Therefore the effect of personnel on the center of gravity of the load must always be calculated. The procedure for doing this is the same as with other cargo. The "average man" weight is multiplied by the arm at the center of his seat, and the total moment is divided by the total weight.

13-108. Loading Procedure. Cargo should be loaded by the most practical method available which will not cause damage to the aircraft or cargo. When planning a cargo load the following points should be noted:

a. Check the aircraft gross weight in Chart E and insure that this value is not exceeded.

b. Check Form F for the maximum allowable cargo weight.

c. Cargo should be weighed and marked to expedite placement in the aircraft and reduce loading times to a minimum.

13-109. Loading check list. Carry out the following:

a. Aircraft parking brakes on. Check the main wheels but not the nosewheels.

b. Fuselage steady strut in position and adjusted, if cargo load is 1500 pounds or more.

c. Open cargo door fully and lower ramp to suit either truck bed height or ramp extensions.

d. Install ramp extensions, if required.

e. Check that the cabin is clear of obstructions, the floor is clean and floor tie-down rings are in their recesses.

f. Have roller conveyors and shoring available.

g. Install a suitable winching harness to any two of the forward tie-down rings on the floor. Use a wall tie-down ring to displace the cable sideways to clear wide loads, if required.

ALLOWABLE CARGO CENTER OF GRAVITY

GROSS WEIGHT 28,500 LB
ZERO FUEL WEIGHT 27,000 LB

FUEL GRADE 100/130

NOTE:
1. CHART DATA SHOWN IS CORRECT FOR AN AIRCRAFT BASIC WEIGHT OF 18,650 LB, CG ARM 355.73 IN.
2. ALL FIGURES APPLY TO AN AIRCRAFT WITH A CREW OF 3 (PILOT & COPILOT - NORMAL SEATS, CREW CHIEF - FORWARD CABIN SEAT)

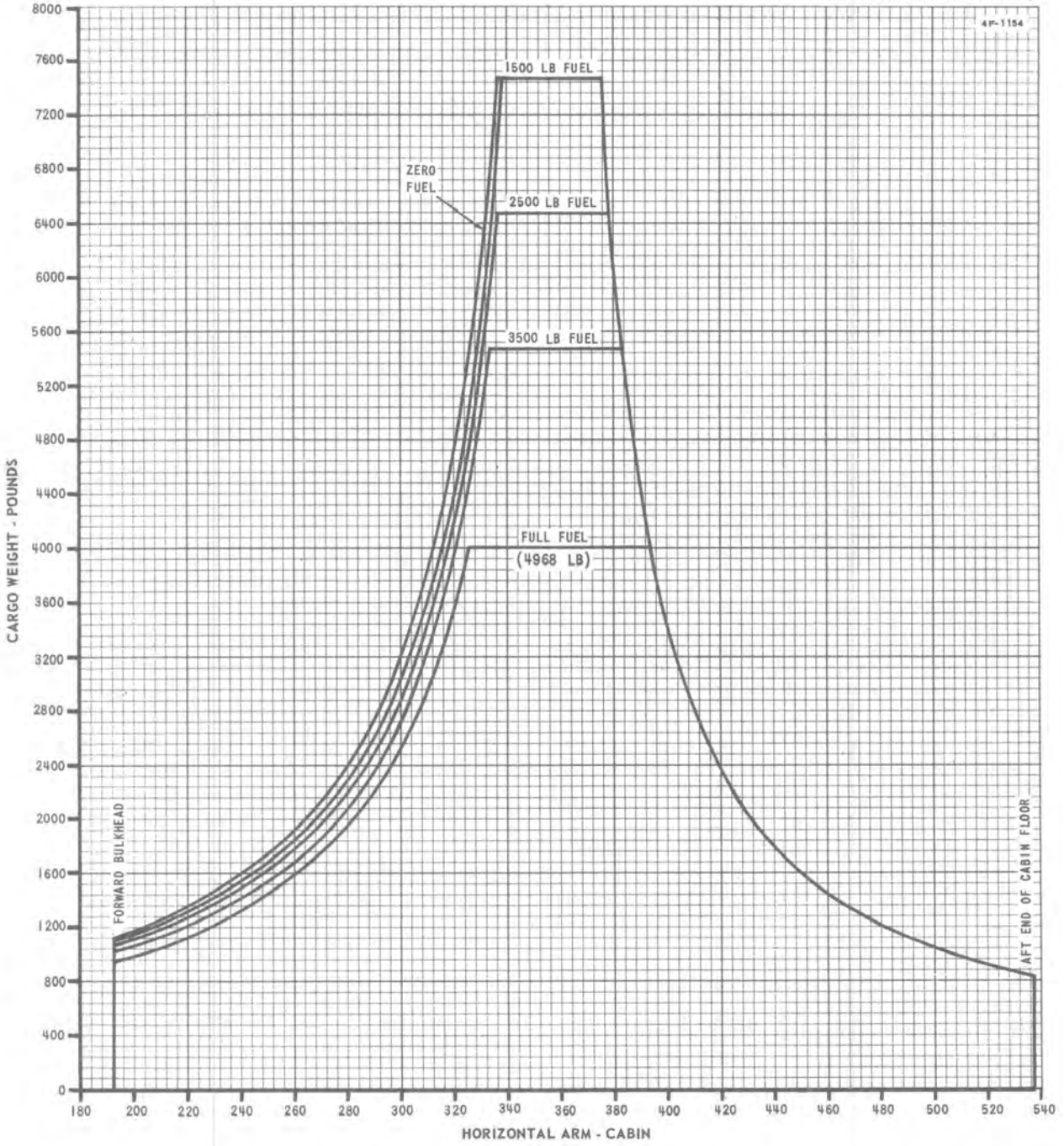
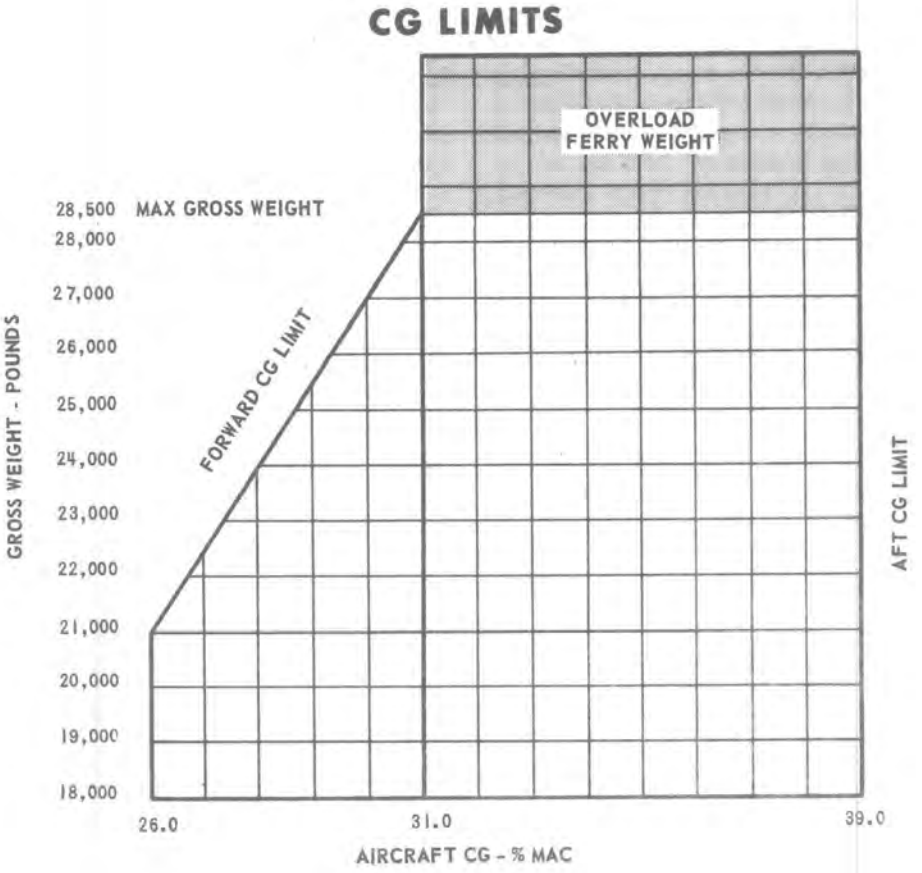


Figure 13-14. Allowable cargo center of gravity



REMARKS:

TO CONVERT CG ARM IN INCHES
TO CG IN % MAC:-

$$\% \text{ MAC} = \frac{\text{ARM} - 310.0}{1.208}$$

TO CONVERT CG IN % MAC
TO CG ARM IN INCHES:-

ARM = (1.208 x % MAC) + 310.0

NOTE:

THE ABOVE CG LIMITS ARE FOR LANDING GEAR DOWN CONDITION. LOADINGS ON THIS CONDITION WHICH FALL WITHIN THESE LIMITS WILL BE SATISFACTORY FOR FLIGHT WITH THE LANDING GEAR UP.

Figure 13-15. Center of gravity limits

Caution

When using tie-down rings as anchors (in conjunction with an auxiliary winch or block-and-tackle equipment) to load or unload an aircraft, the maximum static load likely to be imposed on the tie-down ring must be calculated. The calculated load must include any additional load due to leverage, and the result multiplied by a safety factor of 4 to allow for shock-effect and prevent permanent deformation of the tie-down. If the resulting figure is less than the rated load for the tie-down point, its use as an anchorage point is acceptable.

13-110. Shoring for weight distribution. By the use of shoring to spread the weight of cargo over a larger floor area, it is often possible to carry weights in excess of the maximum footprint pressures. However, it must be realized that the weight of a load resting on shoring is not evenly spread over the entire area of contact between the shoring and the floor. The spreading effect will be a great deal less than this. In general, it is safe to assume only that shoring will increase the area over which a load is distributed to whatever area is developed by extending a plane downward and outward from the peripheral line of contact of the load, at an angle of 45°, until it intersects the surface on which the shoring rests. In

figure 13-17 the area of contact has been nearly doubled, but the increase will not always be so proportionately great. In this case, with shoring two inches thick, we have enlarged the contact area of the box base by a border of two inches wide all around. This border is as wide as the shoring is thick. If the shoring were one-inch thick, the border added would be one-inch wide. If it were three inches thick, the border added would be three inches wide, and so forth. The larger the object shored, the smaller the proportion of increase of the contact area, as the addition occurs only around the edge of the area of contact.

13-111. Shoring for protection. Before certain vehicles can be loaded, it may be necessary to cover the cabin floor with shoring to protect it against damage from cleats, studs or any other gripping devices with which the wheels or treads may be equipped. This is in addition to the standard floor covering of plywood panels which are supplied with the aircraft.

13-112. Preparation of a vehicle for loading. Carry out the following checks prior to loading:

a. Check the vehicle for general condition. Tighten any loose parts.

b. When necessary remove any loose or removable parts and stow them securely in the vehicle.

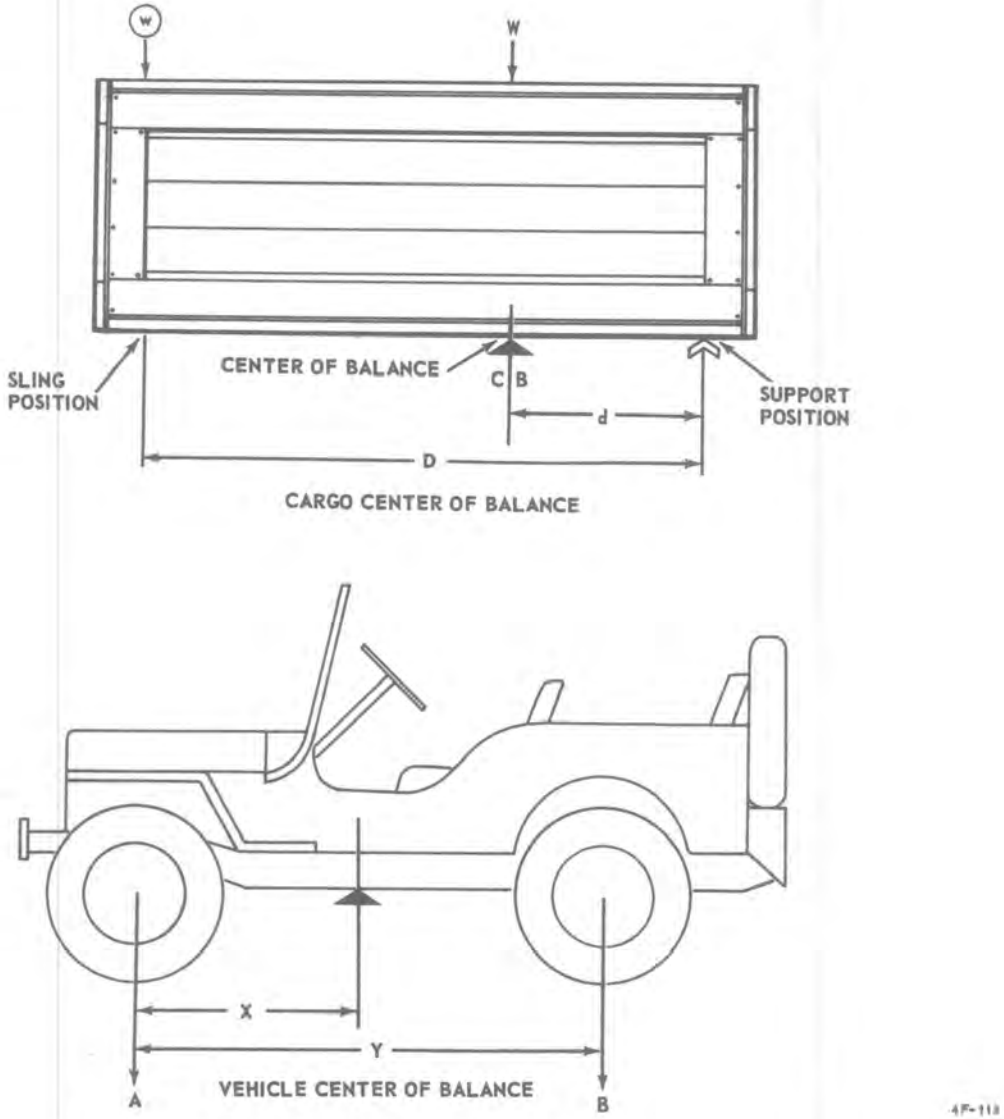


Figure 13-16. Center of balance

c. Fold rear view mirrors, tail gates, windshields, aerials and similar items of equipment when necessary.

d. If the vehicle contains a load, make sure it is properly secured.

e. Tighten the fuel tank, radiator, battery and oil filler caps.

f. Make certain that the fuel tank is not more than three-quarters full, or fuel will spill during maneuvers or in turbulent air. In addition, expansion of entrapped air at altitude may force fuel out.

g. Check the vehicle brakes prior to loading.

h. Place the ramp extensions at the proper width for the vehicle to be loaded.

Caution

Vehicle tire pressures must not exceed 40 psi.

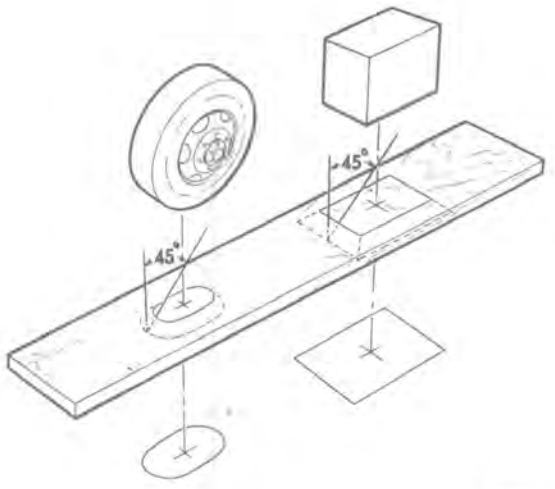


Figure 13-17. Shoring for weight distribution

13-113. Loading a vehicle. Observe the following when loading a vehicle:

a. Whenever possible, back the vehicle into the aircraft so that it may be driven forward for speed in unloading.

b. Use low gear and four wheel drive.

c. When driving or backing vehicles into the aircraft, exercise care to avoid damage to the aircraft. Have one or more guides to give signals.

d. Stop the vehicle at the proper fuselage location or arm.

e. Set the brakes, transmission in low gear and shut off the engine.

13-114. Lashing a vehicle. When it has been determined that the vehicle is in the correct position, it must be restrained for flight to meet the required restraint criteria. The rules for application of tie-down devices are given in paragraph 13-120.

13-115. Securing Loads - Air Transported Items. The security of items of cargo is discussed in the following paragraphs.

13-116. Restraint criteria. The amount of restraint that must be used to keep the cargo from moving in any direction is usually expressed in units of force of gravity, or 'g's. When calculating the required restraint for a load, this force is called the "restraint factor". When the weight of the load is multiplied by this factor we obtain the required restraint. This may be stated as WEIGHT x RESTRAINT FACTOR = REQUIRED RESTRAINT.

13-117. The following is the restraint criteria for air transported items; refer to paragraph 13-62 for the restraint criteria to be used for air delivery items.

DIRECTION	RESTRAINT FACTOR ('g')
Forward	8
Aft	2
Vertical (Up)	2
Lateral	1.5

13-118. Restraint names and devices. Any restraint is given the name of the direction in which it is meant to keep the cargo from moving. A vertical down restraint factor is not used in calculating the number of restraints required, as this factor is incorporated in the strength of the cabin floor. The restraint devices are those used to apply the required restraint to the cargo, and are generally referred to as tie-down devices, and are described in paragraph 13-23. Each device has a rated strength and should be used with the appropriate tie-down fitting.

13-119. Effect of applying restraint at angles. The full rated strength of a tie-down device is only available as a restraint if the force is exerted parallel to the length of the device. As the angle of the device alters, so does its effective restraint

value decrease in that plane, but as it decreases in that particular plane it increases its value in another plane. By introducing a further angle to the device, we make available restraint in three directions simultaneously, longitudinal, lateral and vertical. By attaching the tie-down devices in pairs at the rear, some on the right-hand side of the cargo and some on the left, the cargo is restrained against moving in any direction except aft. Restraint against aftward motion is achieved by attaching other pairs of tie-down devices to the forward side of the cargo. Far more restraint is required to keep the cargo from moving forward than in any other direction. This being so, it can be calculated that ATTACHING THE TIE-DOWN DEVICES AT ANGLES OF 30° WILL PRODUCE THE BEST COMPROMISE, (see figure 13-18). Fewer devices will have to be attached to provide adequate forward restraint, while at the same time lateral and vertical restraint will also be adequate. If it is not possible or convenient to attach the tie-downs at angles of 30°, figure 13-19 shows the percentages of vertical, longitudinal and lateral restraint available at combinations of angles from 5° to 85°.

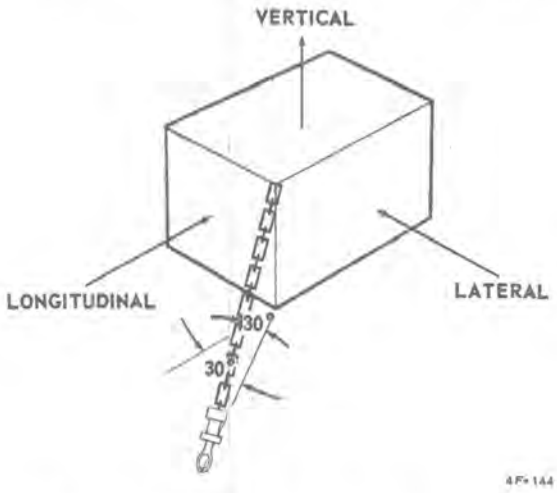


Figure 13-18. Tie-down devices attached at two 30° angles

13-120. Rules For The Application of Tie-Down Devices. When employing tie-down devices the following rules must be observed.

a. Rule 1. Fasten the tie-down devices to the cabin floor so that they will form an angle of 30° with the cabin floor, and an angle of 30° with the longitudinal axis of the aircraft. Approach as close to these angles as possible, (see figure 13-18).

b. Rule 2. The strength of the cargo tie-down fittings, and of the point of attachment on the equipment, will have to be considered. A tie-down device will restrain no more than the weakest point of attachment. Some vehicles will have tie-down rings permanently installed, if not use axles, tow-hooks, bumper supports, vehicle frame or spring mounts on axles as attachment points. Be careful to select a solid attachment.

c. Rule 3. Always use an even number of tie-down devices, attached in pairs, for both forward and aft restraint. The tie-down devices should be attached in a regular pattern by using corresponding points of attachment on opposite sides of the equipment, and corresponding tie-down fittings on each side of the center line of the cabin floor.

d. Rule 4. When Rules 1, 2 and 3 are complied with, it will only be necessary to calculate the number of tie-down devices needed for forward and aft restraint. The required lateral and vertical restraint will be automatically furnished.

13-121. Calculation of the Number of Tie-Down Devices Required. The following method is used to calculate the number of tie-down devices that will be required to restrain a load against movement in any direction, using the restraint criteria in paragraph 13-117 for air transported items. For air delivery items, use the same method but substitute the restraint criteria given in paragraph 13-62.

13-122. Problem. How many tie-down devices, rated at 10,000 lb and 5000 lb and placed at 30° with floor and 30° with aircraft longitudinal axis, will be required to restrain a box weighing 3000 lb?

13-123. Calculations.

a. FORWARD RESTRAINT. (Using the 10,000 lb tie-down rings.)

Formula: $\frac{\text{Wt of box x Restraint factor}}{\text{75\% of Rated strength of device}}$ = Number of devices required

Solution: $\frac{3000 \text{ lb} \times 8}{0.75 \times 10{,}000} = \frac{24{,}000}{7500} = 3.2$

Since an even number of devices are used (Rule 3, paragraph 13-120), this number is increased to the next highest even number. Therefore four tie-down devices will be required for forward restraint.

b. AFT RESTRAINT. (Using the 5000 lb tie-down rings.)

Formula: $\frac{\text{Wt of box x Restraint factor}}{\text{75\% of Rated strength of device}}$ = Number of devices required

4F-618

PERCENTAGE RESTRAINT CHART

NOTE: 1. Angles across the top are those formed between the tie-down device and the cabin floor.
2. Angles down the side are those formed between the tie-down device and the longitudinal axis of the aircraft.
* Vertical restraint is related only to the angle between the tie-down device and the cabin floor. The lateral angle has no bearing on it.
** The toned area indicates the "best compromise" position of Rule No. 1 of paragraph 13-106

		5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
	VERTICAL*	8.7	17.4	25.9	34.2	42.3	50.0	57.4	64.3	70.7	76.6	81.9	86.6	90.6	93.9	96.6	98.5	99.6
5°	LONG.	99.2	98.1	96.2	93.6	90.2	86.3	81.6	76.3	70.4	64.0	57.2	49.8	42.1	34.1	25.8	17.3	8.7
	LAT	8.7	8.6	8.4	8.2	7.9	7.5	7.1	6.7	6.2	5.6	4.9	4.4	3.7	2.9	2.3	1.5	0.8
10°	LONG.	98.1	97.0	95.2	92.6	89.2	85.3	80.7	75.5	69.6	63.3	56.5	49.3	41.7	33.7	25.5	17.1	8.6
	LAT	17.3	17.1	16.8	16.6	15.8	15.1	14.3	13.3	12.3	11.2	9.9	8.7	7.4	5.9	4.5	3.0	1.5
15°	LONG.	96.2	95.2	93.3	90.8	87.5	83.7	79.1	73.9	68.3	62.1	55.4	48.3	40.9	33.0	25.0	16.8	8.4
	LAT	25.8	25.5	25.0	24.3	23.5	22.4	21.2	19.8	18.3	16.7	14.9	12.9	10.9	8.9	6.7	4.5	2.3
20°	LONG.	93.6	92.6	90.8	88.4	85.2	81.4	76.9	72.0	66.5	60.4	53.9	47.0	39.8	32.1	24.3	16.6	8.2
	LAT	34.1	33.7	33.0	32.1	30.9	29.6	28.0	26.2	24.2	21.9	19.6	17.1	14.5	11.7	8.9	5.9	2.9
25°	LONG.	90.2	89.2	87.5	85.2	82.1	78.5	74.2	69.4	64.1	58.3	52.0	45.3	38.3	30.9	23.5	15.8	7.9
	LAT	42.1	41.7	40.9	39.8	38.3	36.6	34.6	32.4	29.9	27.2	24.3	21.2	17.9	14.5	10.9	7.4	3.7
30°	LONG.	86.3	85.3	83.7	81.4	78.5	**74.9	70.9	66.3	61.2	55.7	49.7	43.3	36.6	29.6	22.4	15.1	7.5
	LAT	49.8	49.3	48.3	47.0	45.3	43.3	40.9	38.3	35.4	32.2	28.7	25.0	21.2	17.1	12.9	8.7	4.4
35°	LONG.	81.6	80.7	79.1	76.9	74.2	70.9	67.1	62.7	57.9	52.7	47.0	40.9	34.6	28.0	21.2	14.3	7.1
	LAT	57.2	56.5	55.4	53.9	52.0	49.7	47.0	43.9	40.6	36.9	32.9	28.7	24.3	19.6	14.9	9.9	4.9
40°	LONG.	76.3	75.5	73.9	72.0	69.4	66.3	62.7	58.7	54.2	49.3	43.9	38.3	32.4	26.2	19.8	13.3	6.7
	LAT	64.0	63.3	62.1	60.4	58.3	55.7	52.7	49.3	45.5	41.3	36.9	32.2	27.2	21.9	16.7	11.2	5.6
45°	LONG.	70.4	69.6	68.3	66.5	64.1	61.2	57.9	54.2	49.9	45.5	40.6	35.4	29.9	24.2	18.3	12.3	6.2
	LAT	70.4	69.6	68.3	66.5	64.1	61.2	57.9	54.2	49.9	45.5	40.6	35.4	29.9	24.2	18.3	12.3	6.2
50°	LONG.	64.0	63.3	62.1	60.4	58.3	55.7	52.7	49.3	45.5	41.3	36.9	32.2	27.2	21.9	16.7	11.2	5.6
	LAT	76.3	75.5	73.9	72.0	69.4	66.3	62.7	58.7	54.2	49.3	43.9	38.3	32.4	26.2	19.8	13.3	6.7
55°	LONG.	57.2	56.5	55.4	53.9	52.0	49.7	47.0	43.9	40.6	36.9	32.9	28.7	24.3	19.6	14.9	9.9	4.9
	LAT	81.6	80.7	79.1	76.9	74.2	70.9	67.1	62.7	57.9	52.7	47.0	40.9	34.6	28.0	21.2	14.3	7.1
60°	LONG.	49.8	49.3	48.3	47.0	45.3	43.3	40.9	38.3	35.4	32.2	28.7	25.0	21.2	17.1	12.9	8.7	4.4
	LAT	86.3	85.3	83.7	81.4	78.5	74.9	70.9	66.3	61.2	55.7	49.7	43.3	36.6	29.6	22.4	15.1	7.5
65°	LONG.	42.1	41.7	40.9	39.8	38.3	36.6	34.6	32.4	29.9	27.2	24.3	21.2	17.9	14.5	10.9	7.4	3.7
	LAT	90.2	89.2	87.5	85.2	82.1	78.5	74.2	69.4	64.1	58.3	52.0	45.3	38.3	30.9	23.5	15.8	7.9
70°	LONG.	34.1	33.7	33.0	32.1	30.9	29.6	28.0	26.2	24.2	21.9	19.6	17.1	14.5	11.7	8.9	5.9	2.9
	LAT	93.6	92.6	90.8	88.4	85.2	81.4	76.9	72.0	66.5	60.4	53.9	47.0	39.8	32.1	24.3	16.6	8.2
75°	LONG.	25.8	25.5	25.0	24.3	23.5	22.4	21.2	19.8	18.3	16.7	14.9	12.9	10.9	8.9	6.7	4.5	2.3
	LAT	96.2	95.2	93.3	90.8	87.5	83.7	79.1	73.9	68.3	62.1	55.4	48.3	40.9	33.0	25.0	16.8	8.4
80°	LONG.	17.3	17.1	16.8	16.6	15.8	15.1	14.3	13.3	12.3	11.2	9.9	8.7	7.4	5.9	4.5	3.0	1.5
	LAT	98.1	97.0	95.2	92.6	89.2	85.3	80.7	75.5	69.6	63.3	56.5	49.3	41.7	33.7	25.5	17.1	8.6
85°	LONG.	8.7	8.6	8.4	8.2	7.9	7.5	7.1	6.7	6.2	5.6	4.9	4.4	3.7	2.9	2.3	1.5	0.8
	LAT	99.2	98.1	96.2	93.6	90.2	86.3	81.6	76.3	70.4	64.0	57.2	49.8	42.1	34.1	25.8	17.3	8.7

Figure 13-19. Percentage restraint chart

Solution: $\frac{3000 \text{ lb} \times 2}{0.75 \times 5000} = \frac{6000}{3750} = 1.6$

Therefore two tie-down devices will be required for aft restraint.

c. LATERAL RESTRAINT. All of the devices used for forward and aft restraint furnish 43% of the rated strength of each device for lateral restraint. See figure 13-19. One half of the devices will furnish restraint to one side, while the other half of the devices will furnish restraint to the other side. This is due to the devices being fastened at an angle to the longitudinal axis.

Formula: Wt of box x Restraint factor = Pounds of restraint required.

Solution: 3000 lb x 1.5 = 4500 lb of restraint required.

Each tie-down device used will furnish 43% of its rated strength for lateral restraint. (Figure 13-10.)

Formula: 43% of Rated strength of device x No. of devices used = Total pounds of lateral restraint furnished.

Solution: For the 10,000 lb devices: -
0.43 x 10,000 x 4 = 17,200 lb of restraint furnished.

For the 5000 lb devices: -
0.43 x 5000 x 2 = 4300 lb of restraint furnished.

Therefore total restraint furnished is 17,200 lb + 4300 = 21,500 lb. Only half of this restraint is furnished to each side, therefore this figure must be divided by two.

$\frac{21,500}{2}$ = 10,750 lb of restraint furnished to each side.

Thus, the 10,750 lb of lateral restraint furnished to each side is more than enough, since only 4500 lb of restraint is needed.

d. VERTICAL RESTRAINT. All of the devices used for forward and aft restraint furnish 50% of the rated strength of each device for vertical restraint. (Figure 13-19.)

Formula: Weight of box x Restraint factor = Pounds of restraint required.

Solution: 3000 x 2 = 6000 lb of restraint required.

Each tie-down device used will furnish 50% of its rated strength for vertical restraint. (Figure 13-19.)

Formula: 50% of Rated strength of device x No. of devices used = Total pounds of vertical restraint furnished.

Solution: For the 10,000 lb devices: -
0.5 x 10,000 x 4 = 20,000 lb of restraint furnished.

For the 5000 lb devices: -
0.5 x 5000 x 2 = 5000 lb of restrain furnished.

Therefore total restraint furnished is 20,000 lb + 5000 lb = 25,000 lb. Thus the 25,000 lb of vertical restraint furnished is more than enough as only 6000 lb of restraint is required.

13-124. Refer to paragraph 13-5 for floor strength limitations. Assume the box in the previous example has a base of 4 ft x 2 ft then:

Actual floor loading = $\frac{3000 \text{ lb (box weight)}}{4 \times 2 \text{ (cargo footprint)}}$
= 375 psf

As the 375 psf load is within the maximum local footprint pressure of 1000 psf, no load spreaders are required.

13-125. The box should be loaded in a fore- and -aft direction in the aircraft so that the maximum loading of 1200 lb per running foot is not exceeded.

Running Load = $\frac{3000}{4}$ = 750 lb per running foot.

Note

If loaded laterally in the aircraft, the running load would be 1500 pounds per running foot, which would exceed the allowable limit.

13-126. Special precautions. The following special precautions must be observed when tie-downs are in use:

a. All tie-downs must be arranged to prevent slippage, and tension throughout the devices must be equal.

b. The tie-downs should be applied to the top of the tie-down ring and not to the side.

c. All tie-downs should be checked during flight, particularly during turbulence, and tension readjusted, if necessary.

d. Check all tie-downs prior to landing.

e. Do not allow tie-downs to chafe on the aircraft structure or cargo.

CHAPTER 14
PERFORMANCE DATA

Section I

Scope

14-1. This chapter contains all performance data charts necessary for preflight and inflight mission planning, and includes explanatory text on the use of the data presented.

14-2. The information contained on the charts is based on, and is consistent with, the recommended operating procedures and techniques set forth in other chapters of this manual.

Section II

Charts

14-3. General. Two complete sets of performance charts are provided in this chapter, one set (figures 14-4 through 14-57) covers aircraft in the weight range of 20,000 -26,000 lb using Flap Configuration (A); while the other set (figures 14-58 through 14-111) covers aircraft in the weight range of 20,000 - 28,500 lb, using Flap Configuration (B). Standard charts are also included. As explained in Chapter 1, Section I; provided the gross weight limitations for the two groups of flap angles are observed, then either group may be used as appropriate in order to obtain the best performance under the existing conditions.

14-4. All airspeeds are given in CAS or TAS, except that IAS is given for take-off and landing data which allows for primary system airspeed calibrations. All airspeeds quoted throughout the manual are applicable to either airspeed indicator. Data basis, either flight test or estimated, is stated in the title block of each chart. The date of data determination is also stated. Unless otherwise noted, the charts are based on zero wind and ICAO standard atmosphere (ISA). Where possible, performance is summarized in tabular form on the relevant chart for gross weights of 26,000 and 23,000 lb (Configuration(A)) and 28,500, 26,000 and 23,000 lb (Configuration(B)).

14-5. Aircraft configuration and weight. The aircraft configuration and gross weight is presented on all charts.

14-6. Fuel grade. The performance data presented in this chapter is based on fuel grade 100/130, Specification MIL-G-5572, which has a normal density of 6.0 lb/gal. The maximum usable fuel is 4968 lb (828 US gal). The fuel grade and density is noted in the lower right-hand corner of the title block of each chart.

14-7. Standard Charts. The following paragraphs discuss the standard meteorological charts used.

14-8. Standard Atmosphere Table. The Standard Atmosphere Table, figure 14-1, shows standard atmosphere values, as defined by ICAO, and represents an approximation of the average atmosphere of the world. The ICAO assumes a temperature of 59°F (15°C) and a pressure of 29.92 in. Hg for sea level conditions. The temperature decrease with height is approximately 3.5°F (2°C) per 1000 feet from sea level to 35,000 feet.

14-9. Density Altitude Chart. The Density Altitude Chart, figure 14-2, provides a means of determining density altitude for a given temperature and pressure altitude. To find density, enter the chart at the temperature scale, and proceed vertically to the given pressure altitude, then horizontally to the left to the density altitude scale. Project horizontally to the right and find the conversion factor ($1/\sqrt{\sigma}$) which, when multiplied by CAS results in TAS.

14-10. Psychrometric Chart. The Psychrometric Chart, figure 14-3, provides the relationship between wet and dry bulb temperatures, dew point temperature, relative humidity, vapor pressure (in. Hg) and specific humidity. To find specific

humidity, locate coinciding point of wet and dry bulb temperatures at correct pressure altitude. Project horizontally to the right for vapor pressure, and to the left for dew point. Continue horizontally to the left, then parallel to the nearest guide line to the correct pressure altitude, and read specific humidity.

14-11. Position Error Correction Charts. Position error correction charts for indicated airspeed and altimeter are discussed in the following paragraphs.

14-12. Indicated airspeed. Figures 14-4 and 14-58 give the position error correction to be applied to the indicated airspeed when the aircraft is accelerating on take-off with the wheels in contact with the runway. Figures 14-5, 14-6 and 14-59, 14-60 give the correction to be applied when the aircraft is airborne and above the influence of ground effect. Ground effect is not considered significant above a height of 50 feet.

14-13. Altimeter. Figures 14-7 thru 14-10, and 14-61 thru 14-64 enable the correction to be applied to the altimeter, at various speeds and configurations, to be determined.

14-14. Engine Operating Limits Charts. The engine operating limits in Auto Rich and Auto Lean mixture are given in figures 14-11, 14-65 and 14-12, 14-66 respectively. In each chart the sea level performance is given in the left-hand graph and the altitude performance in the right-hand graph. Use of the sea level graph is self explanatory. The altitude graph is plotted at constant rpm and full throttle, the brake horsepower is almost directly proportional to the density ratio. Accordingly lines of constant rpm are plotted on the graph, the horizontal scale being labeled with standard altitudes corresponding to their appropriate density ratios. Curves indicating full throttle manifold pressure are shown sloping diagonally upwards to the right. For a given rpm and manifold pressure the variation in bhp with altitude on a standard day may be found graphically. In the left-hand graph plot the given rpm and manifold pressure, then project horizontally to the right and find the sea level bhp. Enter the right-hand graph at this bhp at sea level and draw a straight line to the intersection of the given rpm and manifold pressure. Along this line the variation of bhp with alteration in altitude can be found up to the full throttle altitude. Above this altitude the given rpm line will have to be followed and the full throttle manifold pressure will start to decrease.

14-15. Humidity Correction for Take-off. In figures 14-13 and 14-67 it will be seen that the loss in take-off power due to the humidity at sea level may be restored by increasing the manifold pressure from the value given by the zero humidity line to that given by the appropriate humidity line.

14-16. Brake Horsepower Available for Take-off. In figures 14-14 and 14-68 the curves at the left of the reference line give the maximum bhp in dry air for conditions of altitude and temperature variation from standard day values (ISA). To the right of the reference line the reduction in bhp for various dew point temperatures may be found from the guide lines. The solid guide lines denote sea level and the dashed guide lines 10,000 feet. For intermediate altitudes the reduction in bhp must be found by interpolation. Refer to Caution, Chapter 10, paragraph 10-30.

14-17. Take-off Gross Weight Limitation. Figures 14-15 and 14-69 give the gross weight at which a 100 feet per minute rate of climb can be maintained with one propeller feathered and the other engine operating at take-off power. The effect of flap setting, landing gear position and altitude at various gross weights are shown on the chart.

14-18. Crosswind Component Chart. Figures 14-16 and 14-70 enable the effective crosswind component, and headwind component to be found. To find the crosswind component, the chart is entered with the wind velocity (using maximum gust velocity) and the wind angle relative to the runway. The headwind component is found by entering the chart with the steady wind velocity and wind angle relative to the runway. The maximum crosswind component tested for aircraft certification was 18 knots; however, this does not represent the critical value. Included on the charts is the recommended speed for take-off, and the recommended speeds for landing with various flap settings.

14-19. Take-off Curves. Take-off distances determined from plotted curves are discussed in the following paragraphs.

14-20. Ground roll. Figures 14-17 and 14-71 (normal technique) and 14-22 and 14-76 (short field technique) are provided to enable determination of the ground roll distance required from brake release to the point of take-off for various conditions of gross weight, temperature, wind and altitude. Take-off configuration is with both engines operating at take-off power, and flaps extended to 15° or 7° (normal technique) or, 30° or 25° (short field technique).

14-21. Total distance to clear 50 feet. Figures 14-19 and 14-73 (normal technique) and 14-23 and 14-77 (short field technique) are provided to enable determination of the conversion of the ground roll, as obtained from figures 14-17, 14-71 and 14-22, 14-76, to the total distance required from brake release to clearance of a 50-foot obstacle. The charts are based on the same take-off configurations as in figures 14-17 14-71, and 14-22, 14-76. Figures 14-25 and 14-79 enable determination of the total distance to clear 50 feet in the event of failure of one engine after take-off speed is attained.

14-22. Accelerate-stop distance. Figures 14-18 and 14-72 are provided to enable determination of the distance required to stop the aircraft during the ground roll before attaining take-off speed, in the event of a malfunction of one engine. A reaction time of 2.5 seconds has been allowed for application of brakes and closing of both throttles after the engine failure occurs.

14-23. Stopping distance - aborted take-off. Figures 14-24 and 14-78 are presented in terms of stopping distance in feet with correction curves for density altitude. Each chart is intended for use in take-off planning in determining the distance required to stop after an aborted take-off. The data is based on the use of brakes on a dry hard-surface runway, with flaps set at 15° or 30° (Configuration (A)), or 7° or 25° (Configuration (B)).

14-24. Climb-out Curves. The use of charts for determining climb-out data is discussed in the following paragraphs.

14-25. Normal technique (both engines operating). Figures 14-20, 14-74 and 14-21, 14-75 enable the horizontal distance traversed, and the height above the runway, at the five minute point to be determined.

14-26. Emergency technique (one propeller feathered). Figures 14-26 thru 14-29 and 14-80 thru 14-83 enable the distance traversed and height gained during landing gear retraction, and the distance traversed and height gained to the five minute point, to be determined. On reaching the five minute point, the engine power settings must be reduced to METO.

14-27. Climb Curves. The use of charts for determining climb data is discussed in the following paragraphs.

14-28. Both engines operating at METO. Figures 14-30, 14-84 and 14-31, 14-85 enable the horizontal distance traversed and fuel consumed during the climb, and time to height, to be determined. The altitude at which the rate of climb is 100 feet per minute, relevant to the gross weight, is also shown.

14-29. One engine inoperative - Propeller feathered. Figures 14-32, 14-86 and 14-33, 14-87 provide distance, fuel, and time data for climb with one engine operating at METO, and the propeller of the other engine feathered.

14-30. Emergency Climb. The Emergency Climb charts, figures 14-34, 14-88 enable the airspeed and rate of climb, with one engine inoperative and the propeller feathered, to be determined for various gross weights and configurations.

14-31. Emergency Ceiling. The Emergency Ceiling charts, figures 14-35, 14-89, show the gross weight relevant to the altitude at which a 100 feet per minute rate of climb is possible with one engine operating at METO, and the propeller of the other engine feathered.

14-32. Nautical Miles Per Pound of Fuel. The following paragraphs discuss the charts used for determining distance/fuel consumption ratios.

14-33. Both engines operating. Figures 14-36 thru 14-40 and 14-90 thru 14-94, define the nautical miles that can be traveled for each pound of fuel consumed, and are presented in terms of nautical miles per pound of fuel versus airspeed (TAS and CAS) for gross weights of 20,000 to 26,000 pounds and 20,000 to 28,500 pounds. The charts are based on altitudes from sea level to 20,000 feet, in increments of 5000 feet. Each chart shows the bhp necessary to attain a specific airspeed or fuel consumption, and also contains a table giving recommended engine power settings, mixture strength, and fuel consumption per engine, at various bhp. Dashed lines are shown, representing recommended long range, and recommended maximum endurance, from which the airspeed for a specific gross weight can be determined.

14-34. One engine inoperative - propeller feathered. Figures 14-41 thru 14-43 and 14-95 thru 14-97, for altitudes from sea level to 10,000 feet in increments of 5000 feet define data similar to that in figures 14-36 thru 14-40 and 14-90 thru 14-94, but with one engine inoperative and the propeller feathered.

14-35. Long Range Summary. The Long Range Summary charts, figures 14-44, 14-98 (both engines operating) and 14-45, 14-99 (one engine inoperative - propeller feathered), summarize the CAS, engine power settings, and nautical miles per pound of fuel, for various gross weights and altitudes.

14-36. Maximum Endurance. The Maximum Endurance charts, figures 14-46, 14-100 (both engines operating) and 14-47, 14-101 (one engine inoperative-propeller feathered), enable the CAS, engine power settings, and fuel flow in pounds per hour, for various gross weights and altitudes, to be determined.

14-37. Long Range Prediction. The Long Range Prediction charts, figures 14-48, 14-102 and 14-49, 14-103 (both engines operating) and figures 14-50, 14-104 and 14-51, 14-105 (one engine inoperative-propeller feathered), are used to predict distance traveled and elapsed cruising time. The charts are presented in terms of gross weight versus distance and time, for ICAO standard day conditions. An example of how to use the charts is contained in figures 14-48 and 14-49. The other prediction charts are read in a similar manner.

14-38. Descent Range. The Descent Range charts, figures 14-52 and 14-106, enable the horizontal distance traveled in nautical miles, during an emergency descent, to be determined. A table included on each chart shows the recommended CAS at various gross weights from 20,000 to 26,000 pounds, and 20,000 to 28,500 pounds. The charts are based on the aircraft in the clean configuration with power off and both propellers feathered. An example is included in each chart.

14-39. Landing Distance. The following paragraphs discuss the charts used for ascertaining landing distance.

14-40. Ground roll. Figures 14-53 and 14-107 (normal technique) and 14-55 and 14-109 (short field technique) are provided to enable determination of the ground roll distance required from touchdown to the point of stopping after landing, for various conditions of gross weight, temperature, wind, and altitude, with flap setting of 40°. Included in each chart is a graph from which the recommended approach speed (IAS) at 50 feet, relevant to the gross weight, can be obtained.

14-41. Landing distance from 50 feet. Figures 14-54, 14-108 (normal technique) and 14-56, 14-110 (short field technique) are provided to enable determination of the conversion of ground roll, as obtained from figures 14-53, 14-107 and 14-55, 14-109, to the total landing distance required from a height of 50 feet.

14-42. Stalling Speed. The power off stalling speeds (CAS) with the center of gravity at the forward limit at gross weights from 20,000 to 26,000 pounds and 20,000 to 28,500 pounds, with various configurations, can be obtained from the Stalling Speed charts, figures 14-57 and 14-111.

14-43. Use of the Charts. The following paragraphs illustrate the use of the charts in preparing a flight plan for a typical mission. The problems are based on a Series CV2B aircraft operating at the stated gross weight. A comparison of performance is made between the two configurations, (A) and (B) in paragraph 14-54.

14-44. Problem. (Refer to figure 14-16.) What are the crosswind and headwind components under the following conditions?

Runway - 330°
Wind - 267°/18 knots

14-45. Solution.

a. Runway wind angle = 330° - 267° = 63°.

b. At a wind velocity of 18 knots at 63°, the crosswind component is 16 knots and the headwind component is 9 knots.

c. A 16-knot crosswind component has been tested. Take-off at 69 knots IAS.

14-46. Under a crosswind landing condition, the chart is read in a similar manner. Flap angle and approach speed should be adjusted to the prevailing conditions.

14-47. Problem. It is required to fly to a base 200 nautical miles distant at an altitude of 5000 feet.

Known factors.

a. Required range - 200 nautical miles.

b. Weather - Clear. Zero wind at altitude. Standard day.

c. Aircraft gross weight - 25,780 pounds.

d. At take-off airfield:

(1) Altitude - Sea level.

(2) Temperature - 95° F (35° C).

(3) Dew point - 68° F (20° C).

(4) Headwind component reported at 50 feet - 15 knots.

e. At cruise:

(1) Altitude - 5000 feet.

(2) Atmospheric conditions - Standard day.

f. At landing airfield:

(1) Altitude - 2500 feet.

(2) Temperature - 59° F (15° C).

(3) Headwind component reported at 50 feet - 10 knots.

14-48. Engine ground running. In this problem the fuel required for warm-up and take-off is assumed to be equal to that used in 10 minutes at METO at sea level, on a standard day. Referring to figure 14-36 it is found that:

a. Fuel consumption at METO (1200 bhp) = 843 lb/hr/eng.

b. Fuel used = 2 x 843 x 10/60 = 281 pounds.

14-49. Take-off.

a. Gross weight = 5,780 - 281 = 25,499 pounds (25,500 pounds approximately)

b. From figure 14-17: Ground roll = 705 feet.

c. From figure 14-19: Total distance to clear 50 feet = 1165 feet.

14-50. Climb-out curve.

a. From figure 14-20: Horizontal distance to 5-minute point = 33,200 feet.

b. From figure 14-21: Height at 5 minute point = 5220 feet.

14-51. Climb curve.

a. Gross weight at start of climb = 25,500 pound.

b. Climb from sea level to 5000 feet:

(1) From figure 14-30: Distance during climb = 5 nautical miles.

Fuel used during climb = 100 pounds.

(2) From figure 14-31: Time taken during climb = 3 minutes.

14-52. Cruise.

a. Gross weight at start of cruise = 25,500 - 100 = 25,400 pounds.

b. Distance = 200 - 5 = 195 nautical miles.

c. Altitude = 5000 feet.

d. From figure 14-37:

(1) Airspeed = 118 knots CAS (128 knots TAS).

(2) Nautical miles per pound of fuel = 0.275.

e. Fuel consumed = 195/0.275 = 709 pounds (cruise and descent).

f. Time at altitude = 195/128 = 1.52 hours.

14-53. Landing (short field technique).

a. Gross weight = 25,400 - 700 = 24,700 pounds.

b. From figure 14-55: Ground roll = 410 feet

c. From figure 14-56: Distance from 50 feet = 860 feet.

14-54. Optimum Performance Configuration. When the aircraft is operated at a gross weight of 26,000 pounds or less, either (A) or (B) flap configuration may be used to obtain the best performance under a set of operating conditions, as illustrated in the following examples.

a. Example 1.

To find which of the take-off flap settings (15° or 7°) gives the shorter take-off field length.

Note

The take-off field length is defined as the greater of (1) Emergency take-off distance to clear 50 ft obstacle or (2) Accelerate-stop distance.

Take-off weight	25,800 lb
Airfield pressure altitude	4000 ft
Airfield temperature	27° C (ISA + 20° C)
Zero wind, level runway, dry air.	

Take-off Flap	Emergency Take-off Distance to Clear 50 ft	Accelerate - Stop Distance	Take-off Field Length
7°	3750 ft (figure 14-79)	3500 ft (figure 14-72)	3750 ft
15°	4000 ft (figure 14-25)	2820 ft (figure 14-18)	4000 ft

Take-off flap setting of 7° gives shorter take-off field length.

b. Example 2.

Take-off weight	25,800 lb
Airfield pressure altitude	Sea level
Airfield temperature	15°C (ISA)
Zero wind, level runway, dry air.	

Take-off Flap	Emergency Take-off Distance to Clear 50 ft	Accelerate - Stop Distance	Take-off Field Length
7°	2400 ft (figure 14-79)	2700 ft (figure 14-72)	2700 ft
15°	2400 ft (figure 14-25)	2400 ft (figure 14-18)	2400 ft

Take-off flap setting of 15° gives shorter take-off field length.

c. Example 3.

To find the flap setting that permits the higher take-off weight for the following conditions:

Airfield pressure altitude	3000 ft
Airfield temperature	19°C (ISA + 10°C)
Field length available	3000 ft
Reported headwind at 50 ft	5 knots
Level runway, dry air.	

Take-off Flap	Maximum Weight Permitted for Emergency Take-off	Maximum Weight Permitted for Accelerate - Stop	Maximum Take-off Weight
7°	26,150 lb (figure 14-79)	26,450 lb (figure 14-72)	26,150 lb
15°	25,950 lb (figure 14-25)	More than 26,000 lb (figure 14-18)	25,950 lb

The 7° flap setting permits a take-off weight which is 200 lb higher than that with the 15° flap setting.

Note

The choice of take-off flap setting may be affected by factors other than runway length. Climb requirements, take-off obstacle clearance, and the improvement in handling at light weights with 15° flap setting, may all influence the decision.

List of Charts

Standard Charts

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Stall Speed	14-111

STANDARD ATMOSPHERE TABLE

STANDARD S L CONDITIONS:

TEMPERATURE 15°C (59°F)
PRESSURE 29.921 IN. Hg 2116.216 LB/SQ FT
DENSITY .0023769 SLUGS/CU FT
SPEED OF SOUND 1116.89 FT/SEC 661.7 KNOTS

CONVERSION FACTORS:

1 IN. Hg 70.727 LB/SQ FT
1 IN. Hg 0.49116 LB/SQ IN.
1 KNOT 1.151 M P H
1 KNOT 1.688 FT/SEC

ALTITUDE FEET	DENSITY RATIO σ	$\sigma^{-1/2}$ $\frac{1}{\sqrt{\sigma}}$	TEMPERATURE °C	TEMPERATURE °F	SPEED OF SOUND KNOTS	PRESSURE IN. Hg	PRESSURE RATIO δ
0	1.0000	1.0000	15.000	59.000	661.7	29.921	1.0000
1000	.9711	1.0148	13.019	55.434	659.5	28.856	.9644
2000	.9428	1.0299	11.038	51.868	657.2	27.821	.9298
3000	.9151	1.0454	9.056	48.302	654.9	26.817	.8962
4000	.8881	1.0611	7.076	44.735	652.6	25.842	.8637
5000	.8617	1.0773	5.094	41.169	650.3	24.896	.8320
6000	.8359	1.0938	3.113	37.603	648.7	23.978	.8014
7000	.8106	1.1107	1.132	34.037	645.6	23.088	.7716
8000	.7860	1.1279	-0.850	30.471	643.3	22.225	.7428
9000	.7620	1.1456	-2.831	26.905	640.9	21.388	.7148
10,000	.7385	1.1637	-4.812	23.338	638.6	20.577	.6877
11,000	.7155	1.1822	-6.793	19.772	636.2	19.791	.6614
12,000	.6932	1.2011	-8.774	16.206	633.9	19.029	.6360
13,000	.6713	1.2205	-10.756	12.640	631.5	18.292	.6113
14,000	.6500	1.2403	-12.737	9.074	629.0	17.577	.5875
15,000	.6292	1.2606	-14.718	5.508	626.6	16.886	.5643
16,000	.6090	1.2815	-16.699	1.941	624.2	16.216	.5420
17,000	.5892	1.3028	-18.680	-1.625	621.8	15.569	.5203
18,000	.5699	1.3246	-20.662	-5.191	619.4	14.942	.4994
19,000	.5511	1.3470	-22.643	-8.757	617.0	14.336	.4791
20,000	.5328	1.3700	-24.624	-12.323	614.6	13.750	.4595
21,000	.5150	1.3935	-26.605	-15.889	612.1	13.184	.4406
22,000	.4976	1.4176	-28.587	-19.456	609.6	12.636	.4223
23,000	.4806	1.4424	-30.568	-23.022	607.1	12.107	.4046
24,000	.4642	1.4678	-22.549	-26.588	604.6	11.597	.3876
25,000	.4481	1.4938	-34.530	-30.154	602.1	11.103	.3711
26,000	.4325	1.5206	-36.511	-33.720	599.6	10.627	.3552
27,000	.4173	1.5480	-38.492	-37.286	597.1	10.168	.3398
28,000	.4025	1.5762	-40.474	-40.852	594.6	9.725	.3250
29,000	.3881	1.6052	-42.455	-44.419	592.1	9.297	.3107
30,000	.3741	1.6349	-44.436	-47.985	589.5	8.885	.2970

4F-406

Figure 14-1

DENSITY ALTITUDE CHART

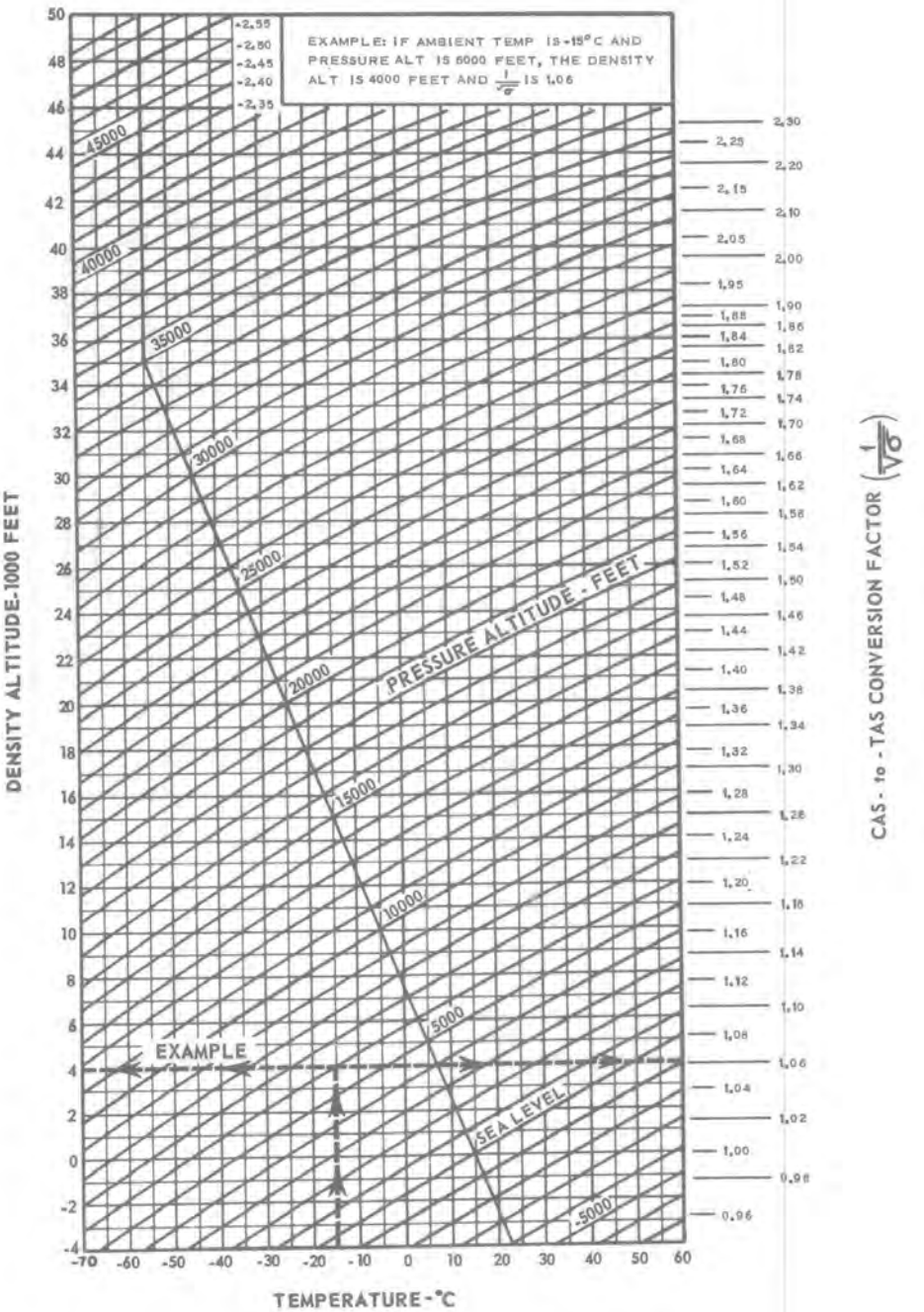


Figure 14-2

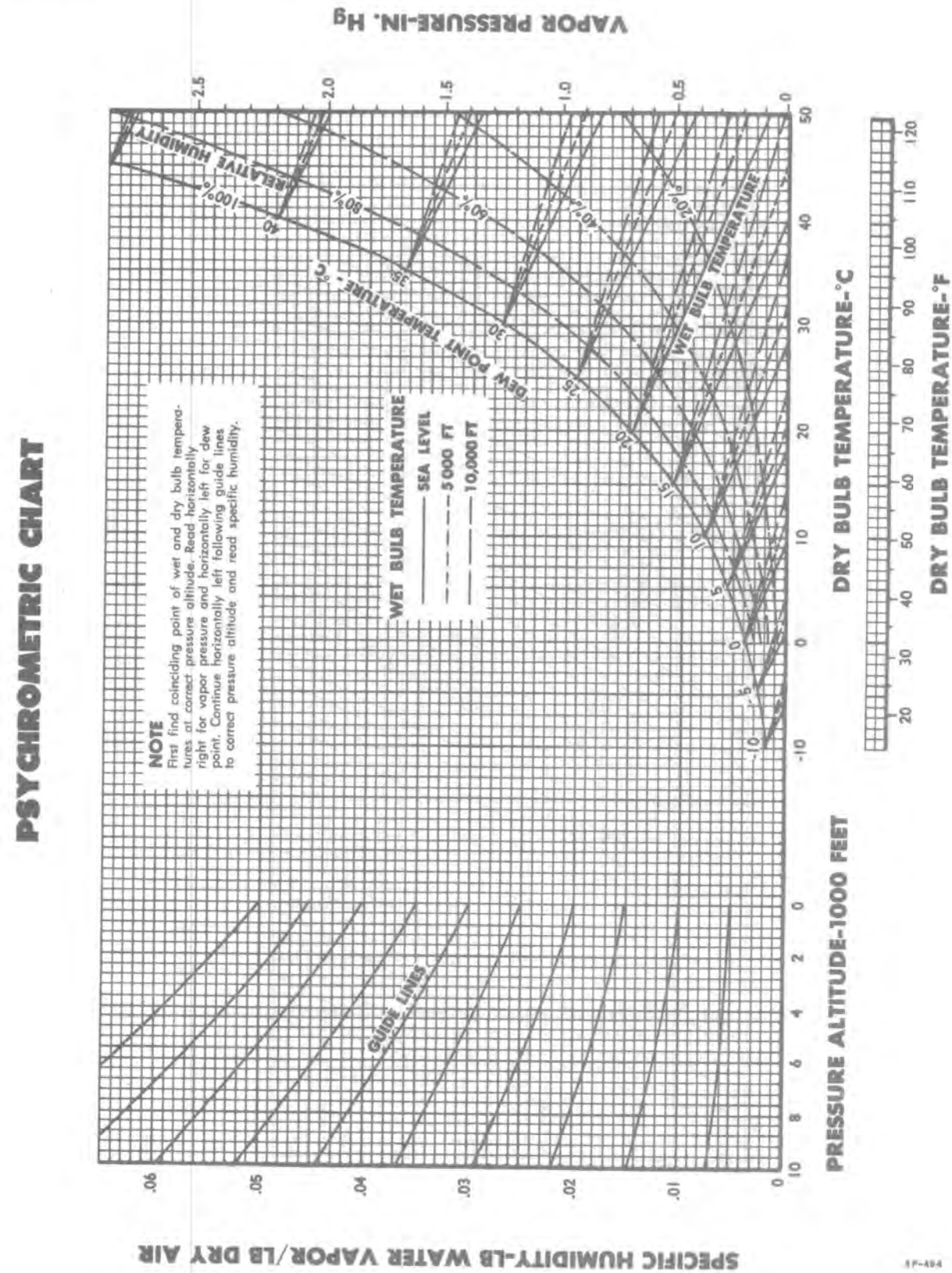

PSYCHROMETRIC CHART
VAPOR PRESSURE-IN. Hg
2.5
2.0
1.5
1.0
0.5
0
RELATIVE HUMIDITY
100%
80%
60%
40%
20%
DEW POINT TEMPERATURE - °C
40
35
30
25
20
15
10
5
0
-5
-10
WET BULB TEMPERATURE
NOTE
First find coinciding point of wet and dry bulb temperatures at correct pressure altitude. Read horizontally right for vapor pressure and horizontally left for dew point. Continue horizontally left following guide lines to correct pressure altitude and read specific humidity.
WET BULB TEMPERATURE
SEA LEVEL
5000 FT
10,000 FT
GUIDE LINES
.06
.05
.04
.03
.02
.01
0
SPECIFIC HUMIDITY-LB WATER VAPOR/LB DRY AIR
PRESSURE ALTITUDE-1000 FEET
DRY BULB TEMPERATURE-°C
DRY BULB TEMPERATURE-°F
1F-484

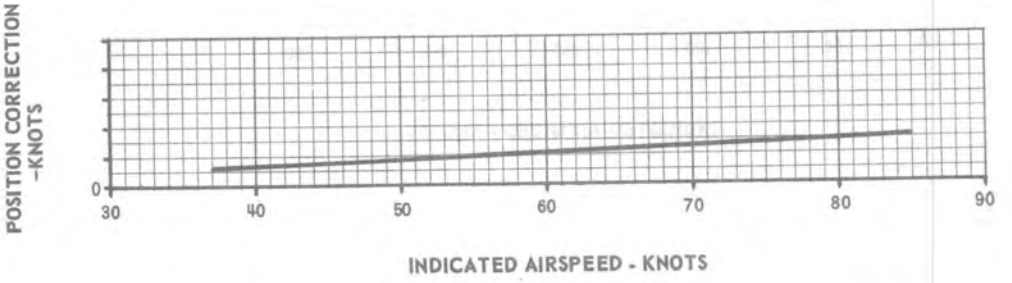
Figure 14-3

POSITION ERROR CORRECTION TO INDICATED AIRSPEED DURING GROUND ROLL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
FLAPS - TAKE-OFF
ENGINES - TAKE-OFF POWER
ALL WEIGHTS



4F-498

Figure 14-4

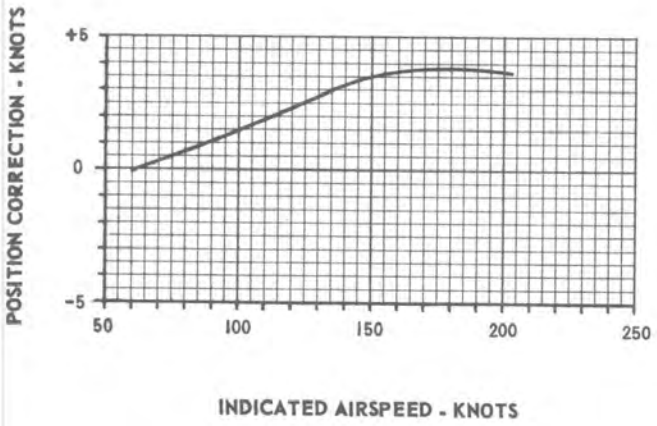
POSITION ERROR CORRECTION TO INDICATED AIRSPEED

ALL AIRCRAFT WEIGHTS - CLEAN CONFIGURATION

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



REMARKS:
INDICATED AIRSPEED (IAS) = INSTRUMENT READING + INSTRUMENT CORRECTION
CALIBRATED AIRSPEED (CAS) = IAS + POSITION CORRECTION

4F-441

Figure 14-5

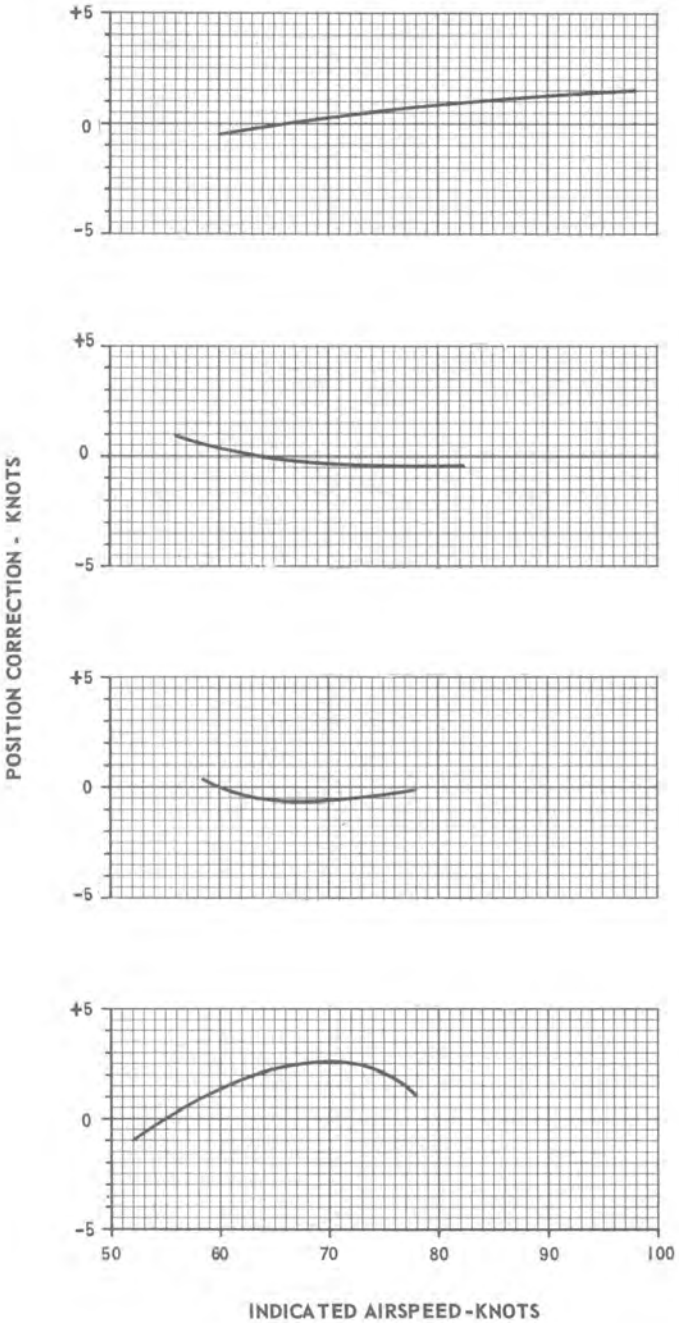
POSITION ERROR CORRECTION TO INDICATED AIRSPEED

ALL AIRCRAFT WEIGHTS - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

INDICATED AIRSPEED (IAS) = INSTRUMENT READING + INSTRUMENT CORRECTION
CALIBRATED AIRSPEED (CAS) = IAS + POSITION CORRECTION



REMARKS:
FLAPS: 15° AND 19°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 30°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED
POWER FOR ZERO THRUST

4F-442

Figure 14-6

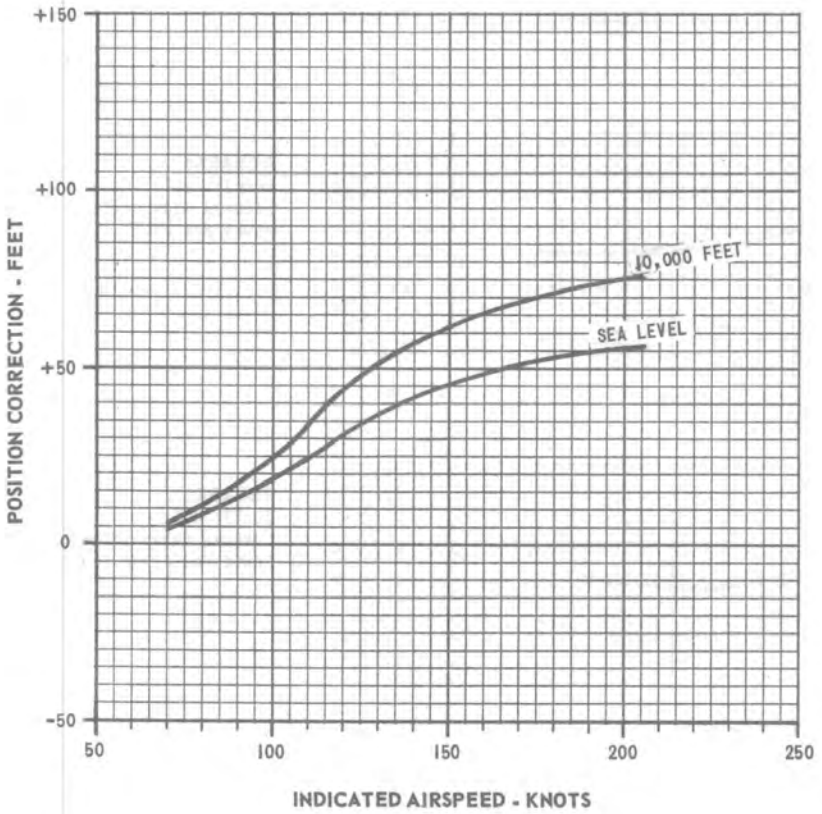
POSITION ERROR CORRECTION TO ALTIMETER

AIRCRAFT WEIGHT 20,000LB - CLEAN CONFIGURATION

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



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Figure 14-7

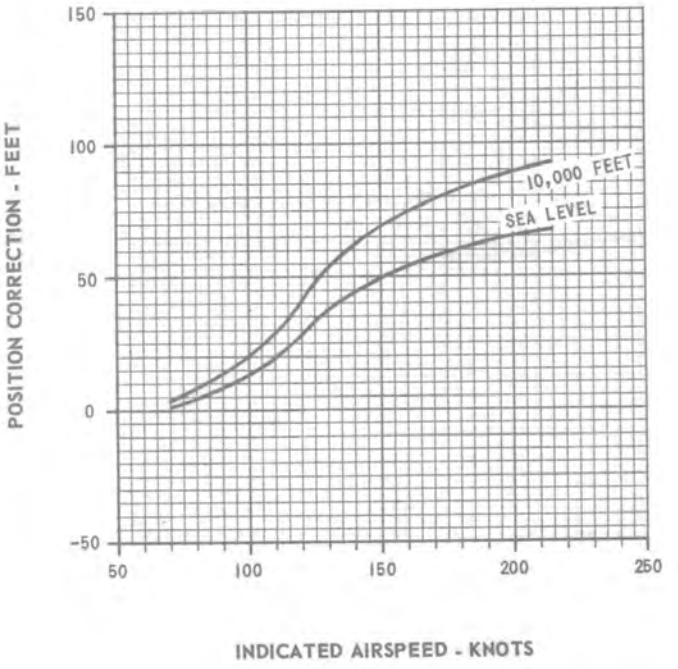
POSITION ERROR CORRECTION TO ALTIMETER

AIRCRAFT WEIGHT 26,000LB - CLEAN CONFIGURATION

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



4F-444

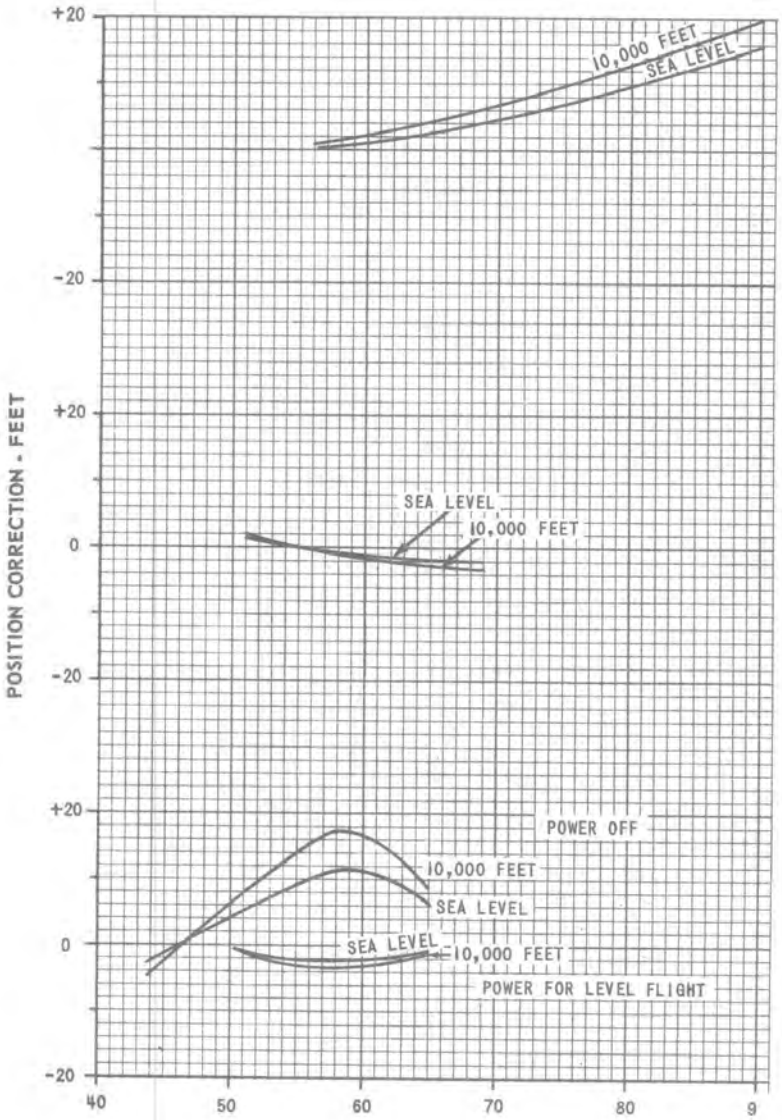
Figure 14-8

POSITION ERROR CORRECTION TO ALTIMETER

AIRCRAFT WEIGHT 20,000LB - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



REMARKS:
FLAPS: 15° AND 19°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 30°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED

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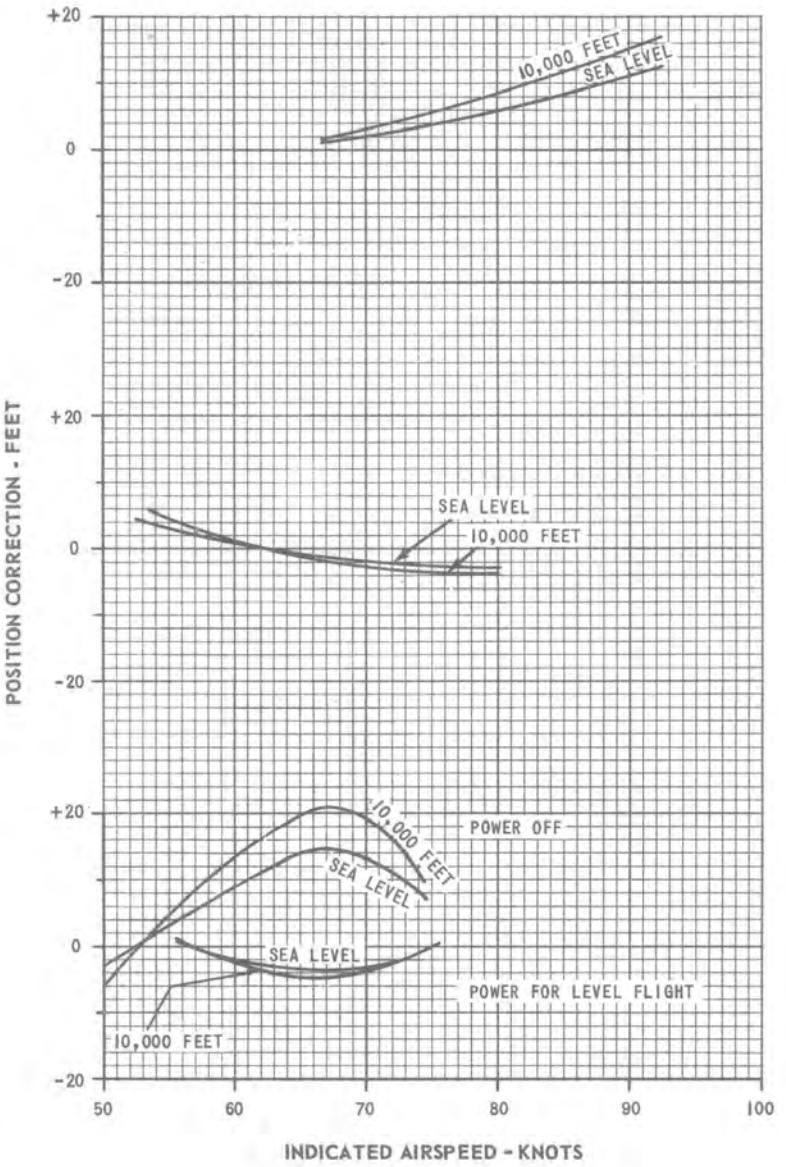
Figure 14-9

POSITION ERROR CORRECTION TO ALTIMETER

AIRCRAFT WEIGHT 26,000LB - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



REMARKS:
FLAPS: 15° AND 19°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 30°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED

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Figure 14-10

ENGINE OPERATING LIMITS
AUTO RICH

MODEL: CV-2
DATE: APRIL 1948
DATA BASIS: ENGINE CONTRACTOR

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

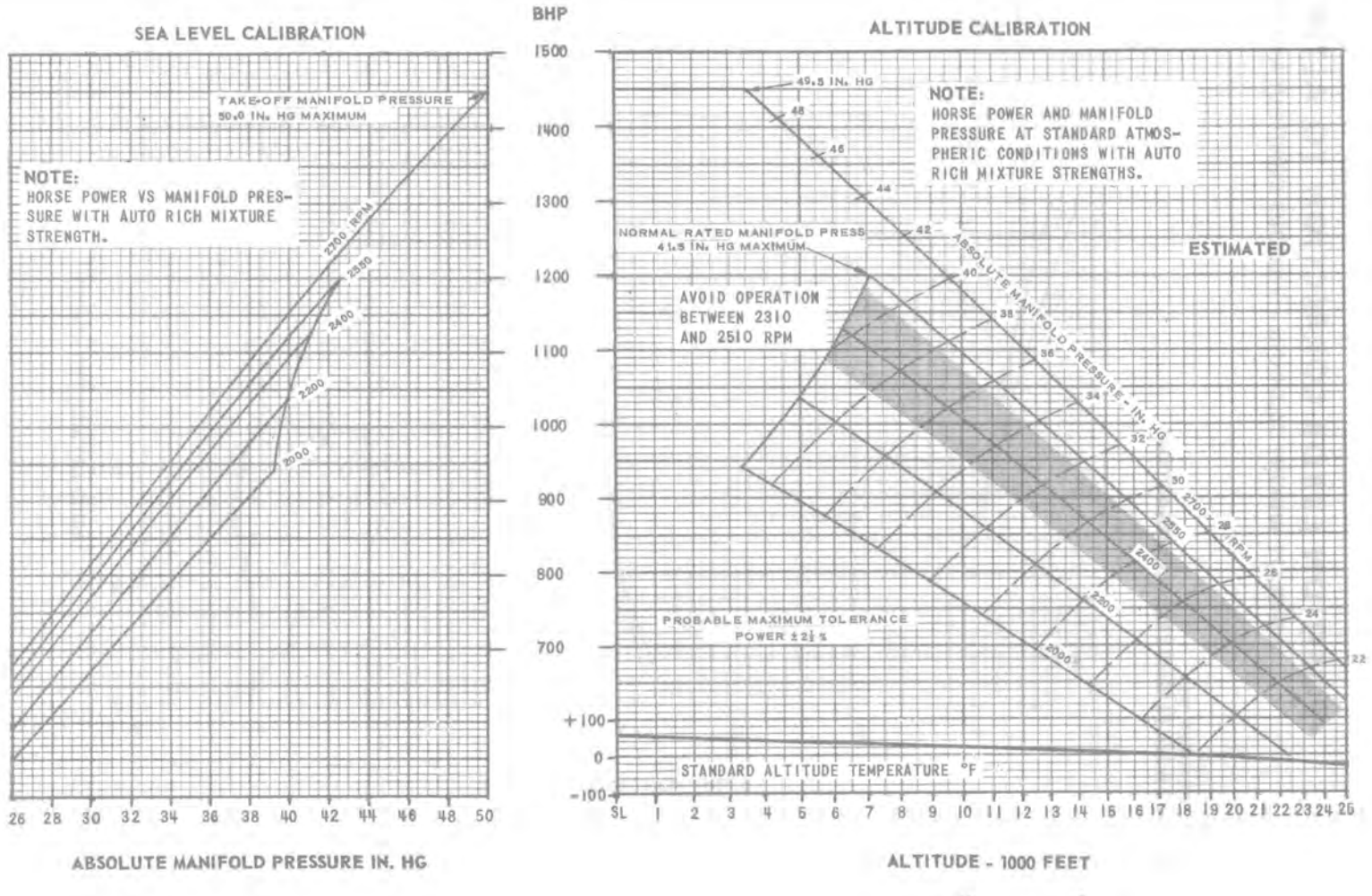


Figure 14-11

4F-447 (SHT 1)

ENGINE OPERATING LIMITS
AUTO LEAN

MODEL: CV-2
DATE: APRIL 1948
DATA BASIS: ENGINE CONTRACTOR

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

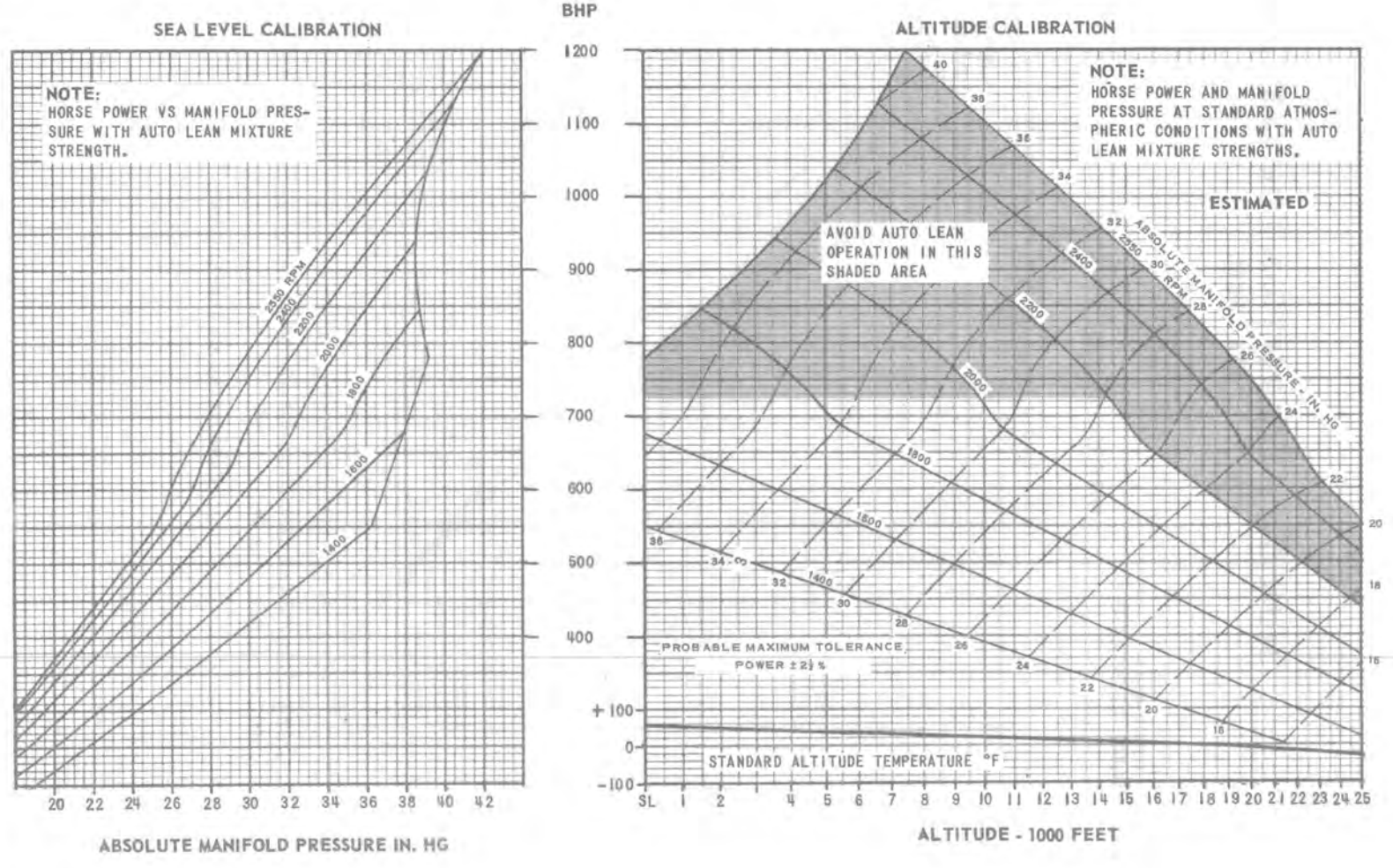


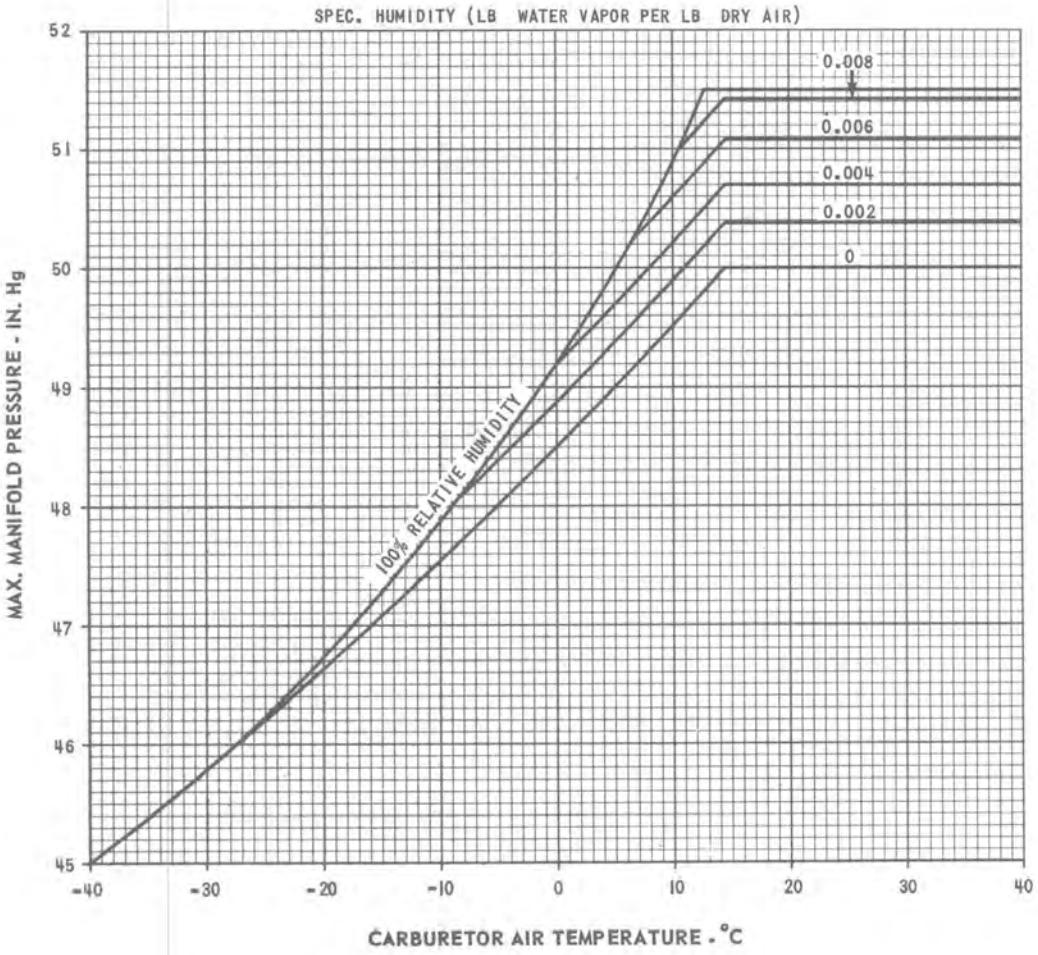
Figure 14-12

HUMIDITY CORRECTION FOR TAKE-OFF
SEA LEVEL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: ESTIMATED

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE: FOR PSYCHROMETRIC CHART SEE FIG. 14-3



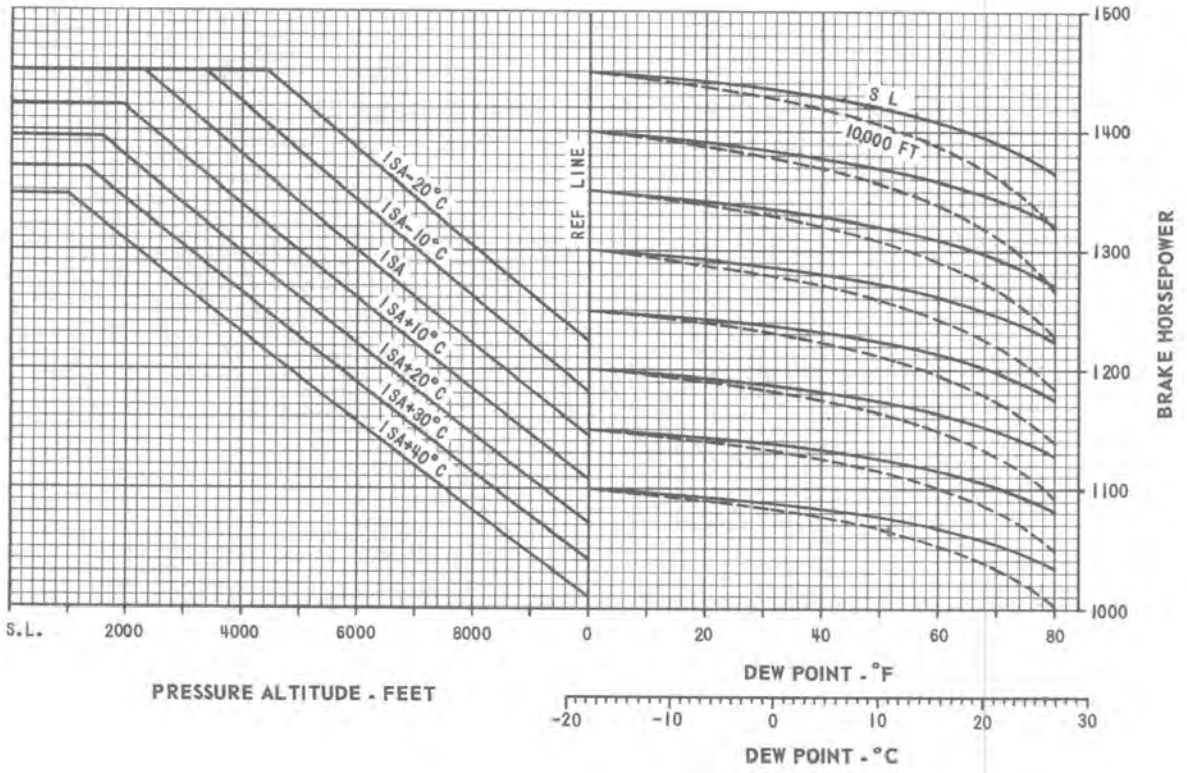
4F-448

Figure 14-13

BRAKE HORSEPOWER AVAILABLE FOR TAKE-OFF

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-449

Figure 14-14

TAKE-OFF GROSS WEIGHT LIMITATION

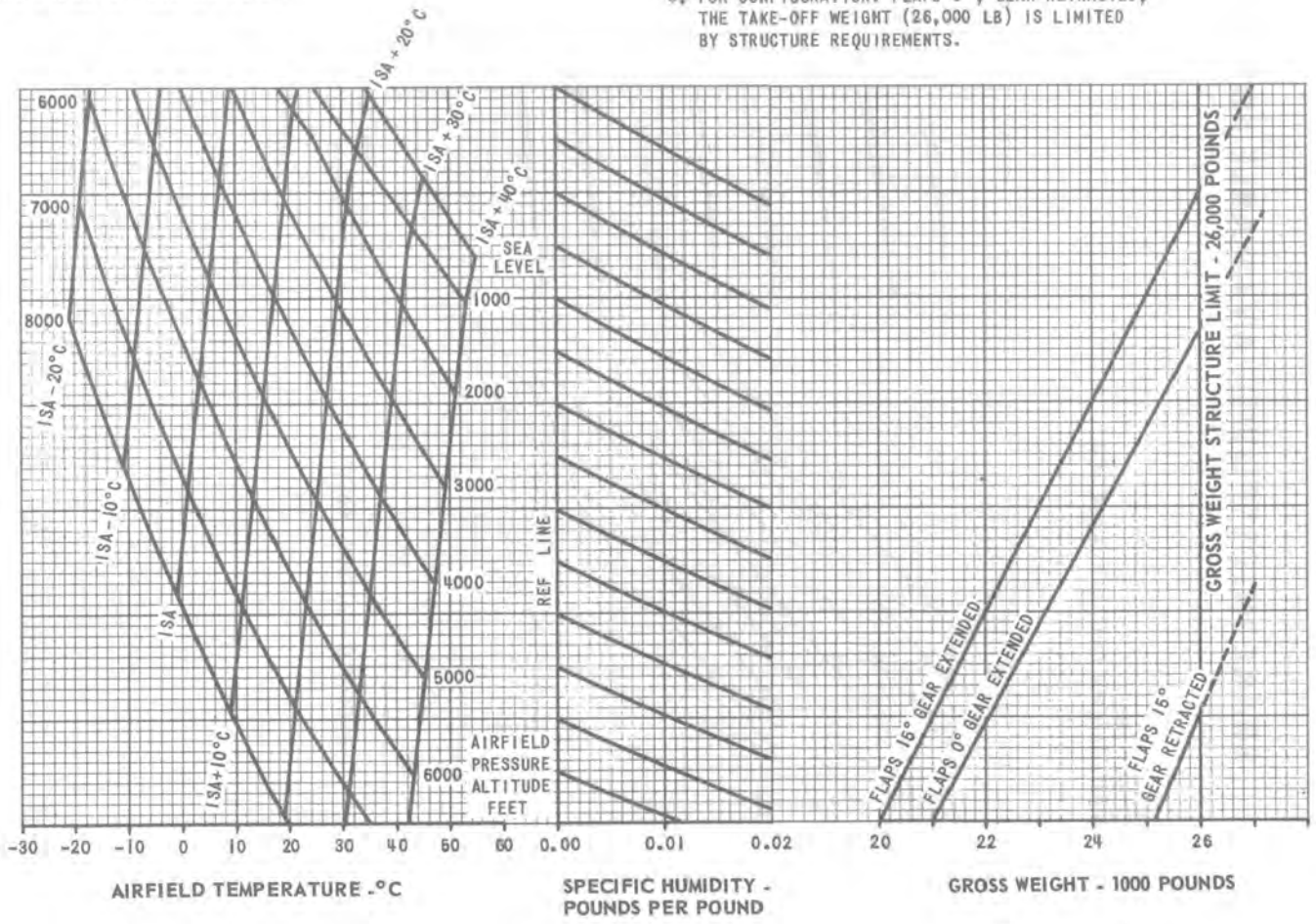
ONE ENGINE INOPERATIVE

MODEL: CV-2
DATE: SEPTEMBER 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
PROPELLER FEATHERED
OTHER ENGINE AT TAKE-OFF POWER

NOTE:
1. LIMIT BASED ON A RATE OF CLIMB OF 100 FPM FOLLOWING A NORMAL TAKE-OFF.
2. RECOMMENDED CLIMB SPEED:
   -WITH FLAPS 0° 95 KNOTS IAS
   -WITH FLAPS 15° 75 KNOTS IAS
3. FOR CONFIGURATION: FLAPS 0°, GEAR RETRACTED, THE TAKE-OFF WEIGHT (26,000 LB) IS LIMITED BY STRUCTURE REQUIREMENTS.



4F-450

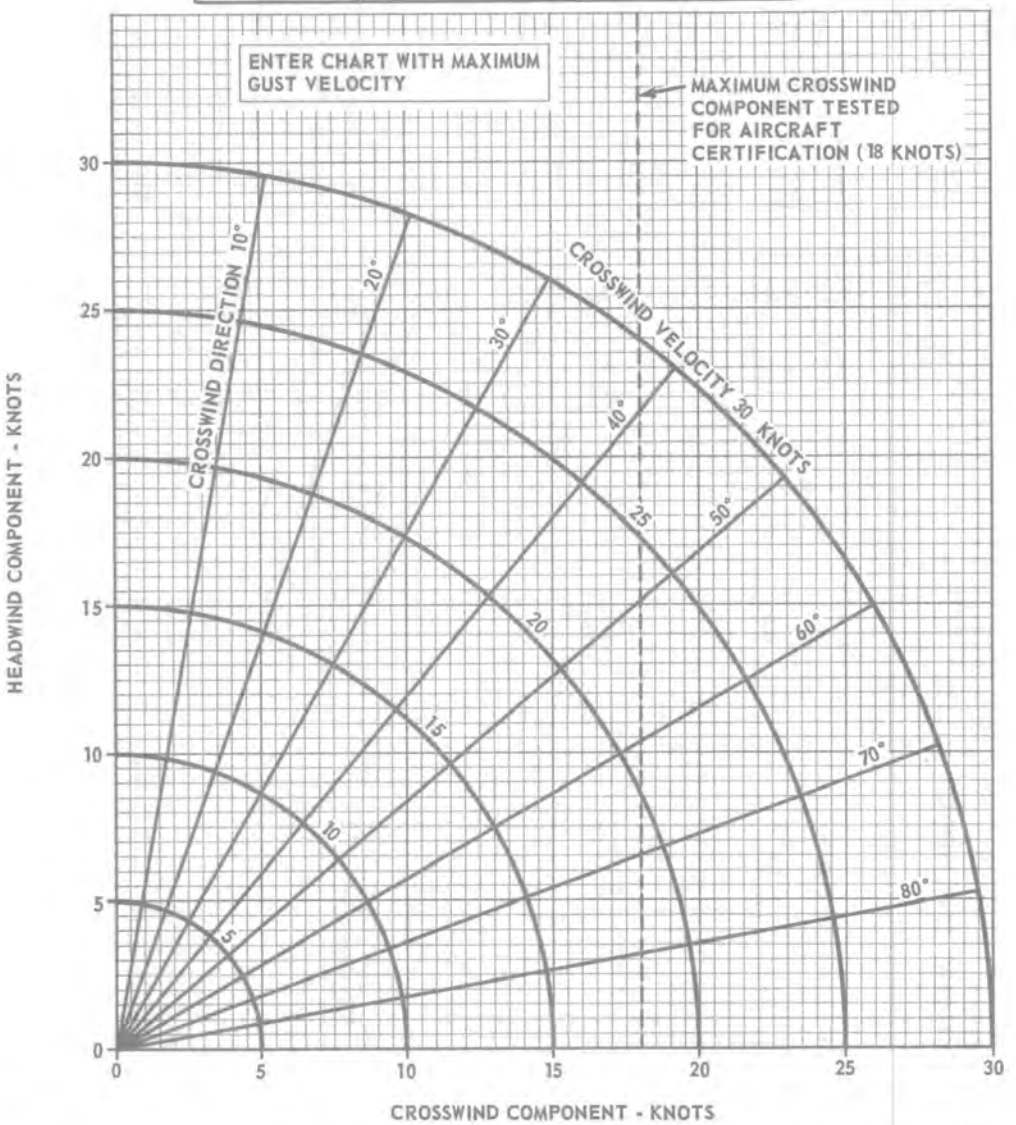
Figure 14-15

CROSSWIND COMPONENT CHART

MODEL: CV-2
DATE: DECEMBER 1961
DATA BASIS: ESTIMATED

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

TAKE-OFF AND LANDING SPEED APPROPRIATE TO ALL CROSSWIND CONDITIONS		
GROSS WEIGHT 26,000 LB		
FLAP SETTING	TAKE-OFF SPEED (1) KNOTS, IAS	LANDING APPROACH SPEED (2) KNOTS, IAS
15°	69	81
19°		78
40°		70(3)



NOTE: 1. KEEP NOSEWHEEL ON GROUND UNTIL RUDDER BECOMES EFFECTIVE DURING TAKE-OFF
2. TOUCHDOWN IAS IS APPROXIMATELY 10 KNOTS LESS THAN IN APPROACH
3. INCREASE APPROACH SPEED BY 5 KNOTS IN GUSTY CONDITIONS

4P-451(D)

Figure 14-16

TAKE-OFF CURVE
GROUND ROLL - NORMAL TECHNIQUE (FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA) : DRY AIR					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50 FT-FT	GROUND ROLL-FT	CLEAR 50 FT-FT
26,000	SEA LEVEL	910	1490	465	790
	5000	1035	1675	545	910
23,000	SEA LEVEL	795	1305	385	660
	5000	900	1470	455	765

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED
FOR DISTANCE TO CLEAR 50 FT OBSTACLE REFER TO FIGURE 14-19

REMARKS:
FOR ALL WEIGHTS AND ALTITUDES
TAKE-OFF SPEED 69 KNOTS IAS
SPEED AT 50 FT OBSTACLE 75 KNOTS IAS

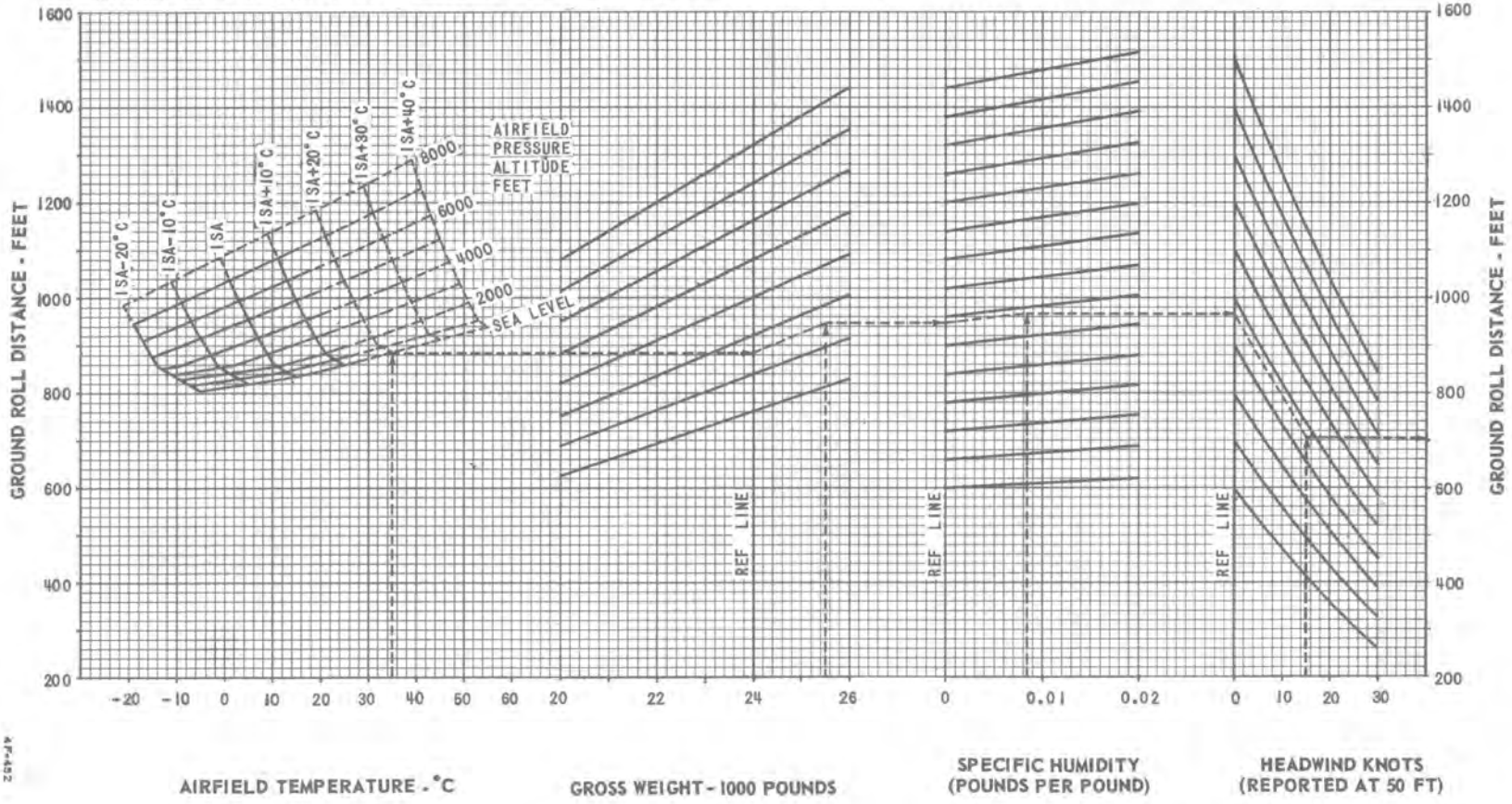


Figure 14-17

ACCELERATE-STOP DISTANCE
(FLAPS 15°)

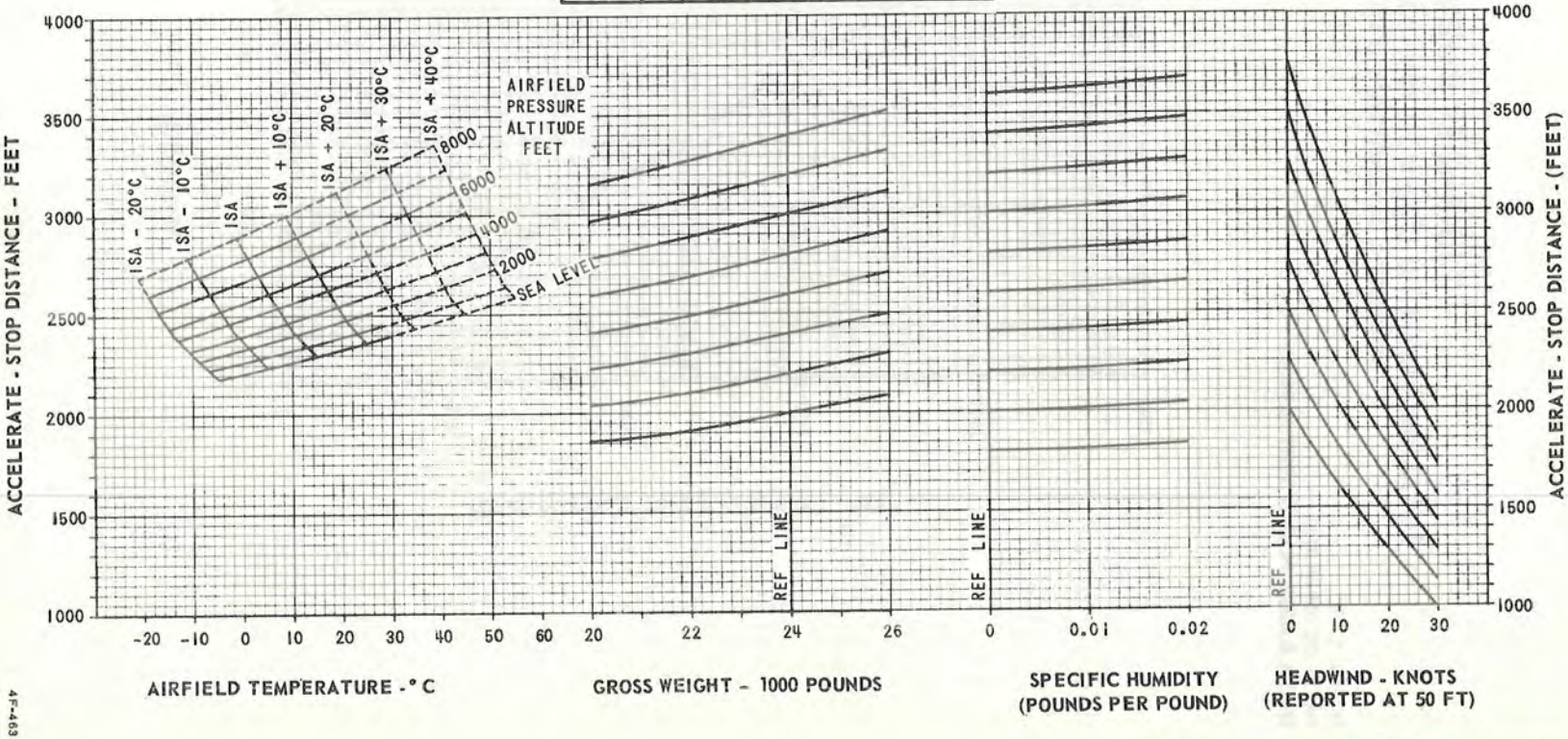
MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA) ; DRY AIR			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
26,000	SEA LEVEL	2400	2190
	5000	2720	2450
23,000	SEA LEVEL	2250	2070
	5000	2560	2320

NOTE:

1. ENGINE FAILURE AT TAKE-OFF SPEED FOR ALL WEIGHTS AND ALTITUDES (69 KNOTS IAS.)
2. DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.



4F-493

Figure 14-18

TAKE-OFF CURVE

TOTAL DISTANCE TO CLEAR 50 FEET VERSUS GROUND ROLL
NORMAL TECHNIQUE (FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

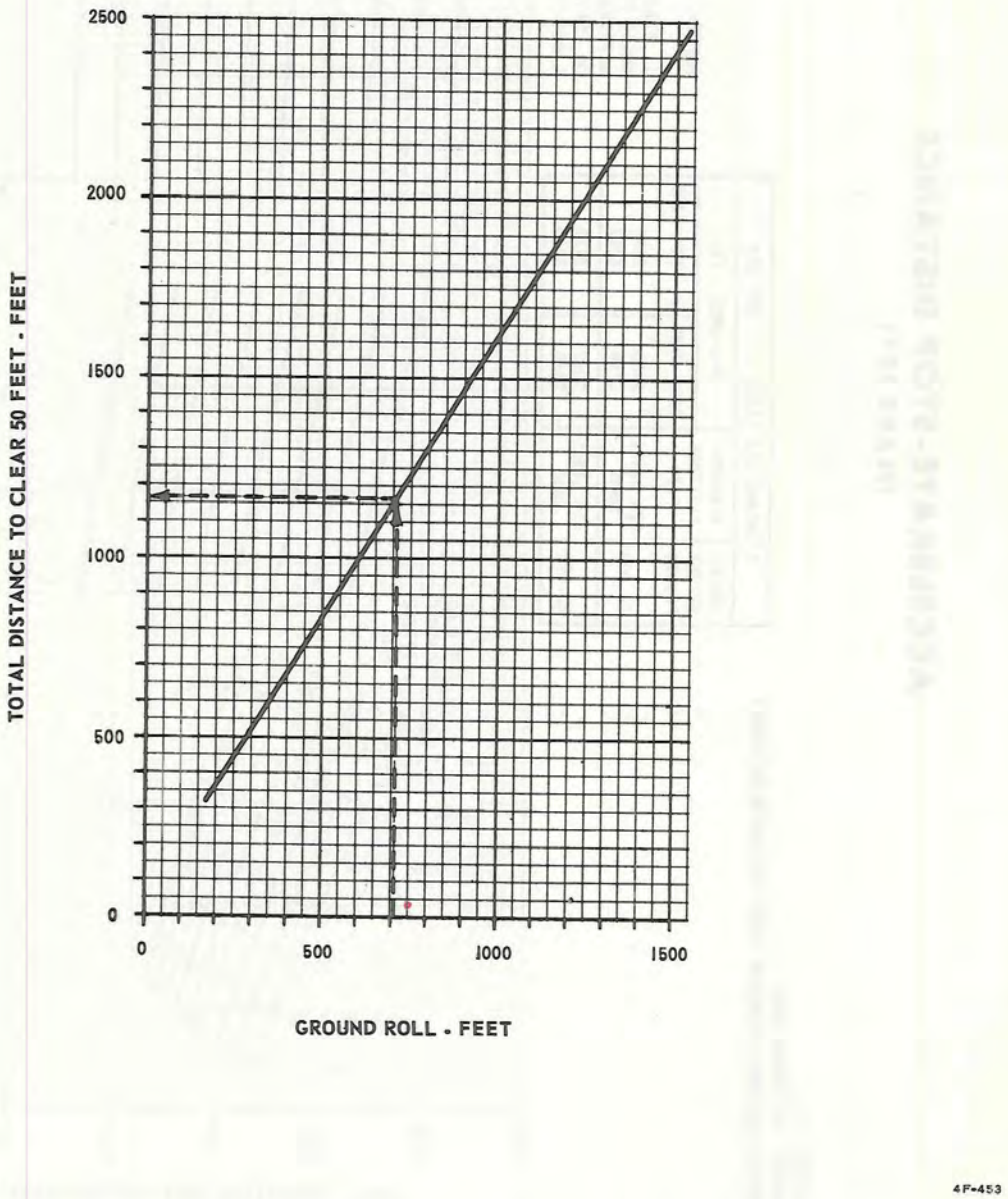


Figure 14-19

CLIMB-OUT CURVE

HORIZONTAL DISTANCE TRAVERSED FROM 50 FEET TO FIVE MINUTE POINT

NORMAL TECHNIQUE (FLAPS 15°)

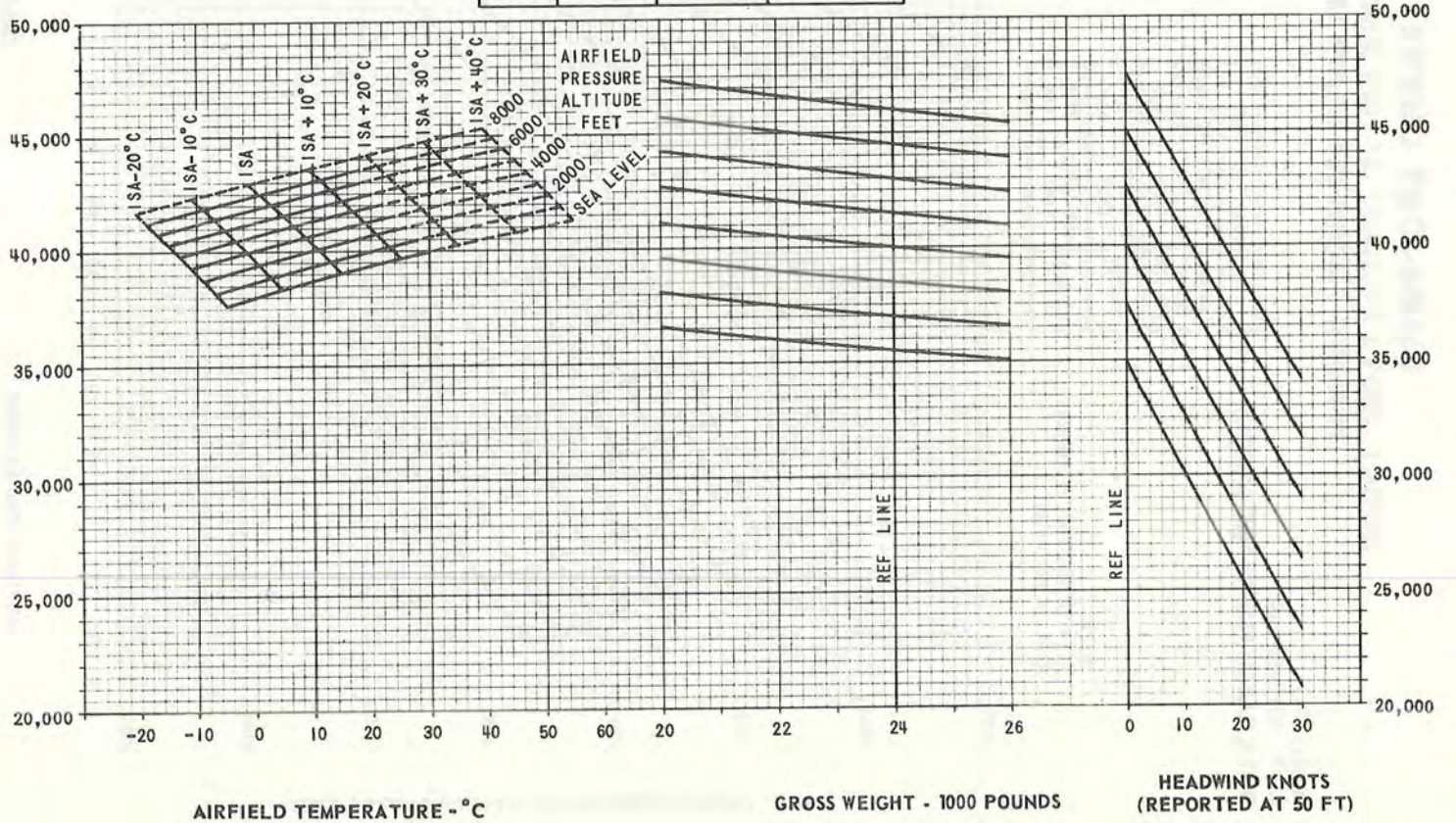
MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HORIZONTAL DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
26,000	SEA LEVEL 5000	38,500 41,100	24,600 27,600
23,000	SEA LEVEL 5000	39,300 41,900	25,500 28,500

NOTE:
DATA REPRESENTED BY BROKEN LINE IS ESTIMATED

REMARKS:
LANDING GEAR RETRACTED
CLIMB SPEED FOR ALL WEIGHTS AND ALTITUDES
75 KNOTS IAS



4F-454

Figure 14-20

CLIMB-OUT CURVE

HEIGHT ABOVE RUNWAY AT FIVE MINUTE POINT
NORMAL TECHNIQUE (FLAPS 15°)

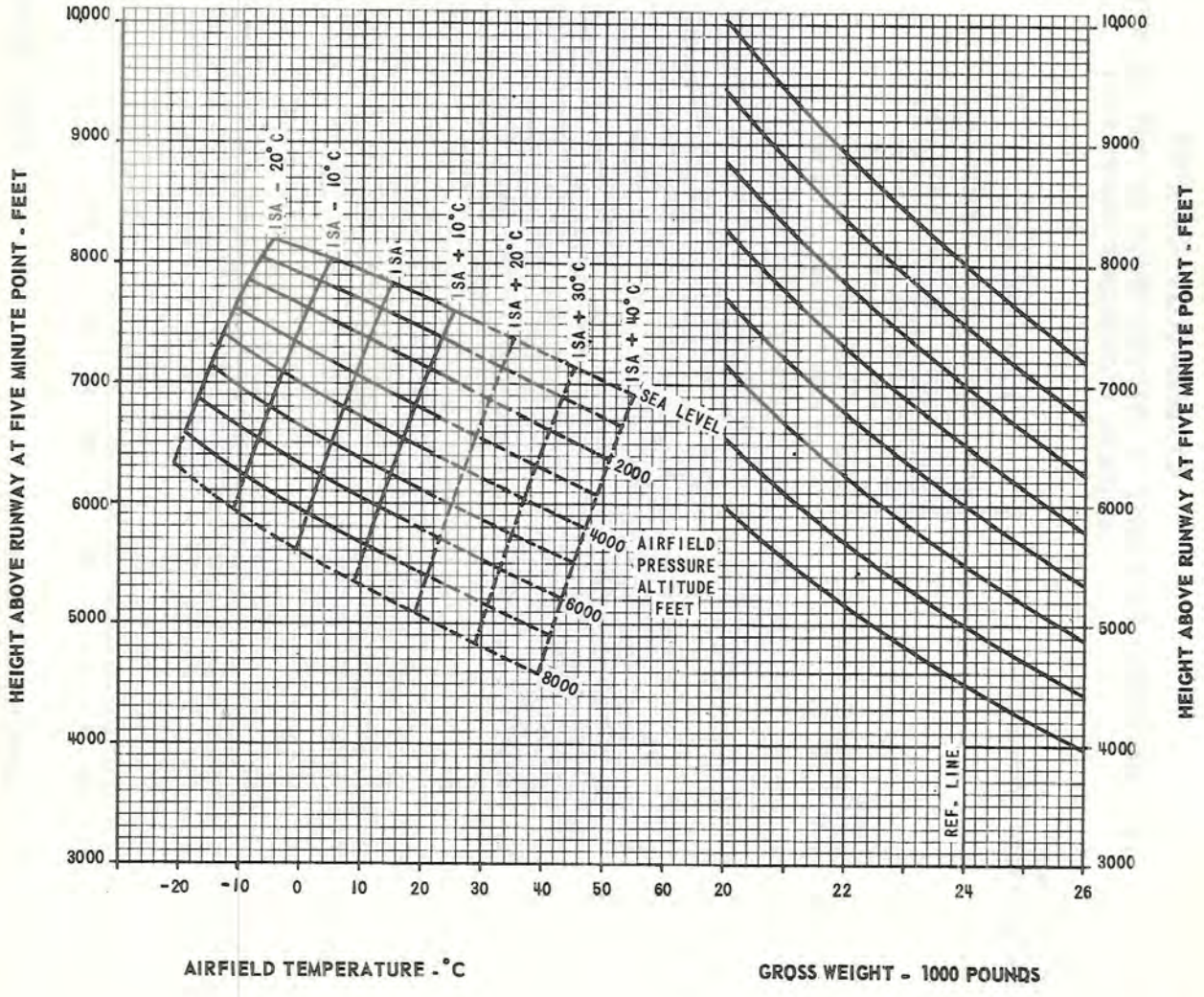
MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA)		
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HT ABOVE RUNWAY FEET
26,000	SEA LEVEL 5000	7050 5800
23,000	SEA LEVEL 5000	8300 6900

REMARKS:
LANDING GEAR RETRACTED
CLIMB SPEED : 75 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
DATA REPRESENTED BY BROKEN LINE IS ESTIMATED



4F-455

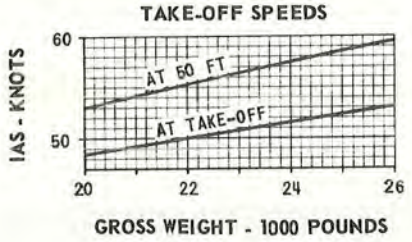
Figure 14-21

TAKE-OFF CURVE
SHORT-FIELD TECHNIQUE (FLAPS 30°)
GROUND ROLL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA); DRY AIR					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT	GROUND ROLL-FT	CLEAR 50FT-FT
26000	SEA LEVEL	600	1110	220	430
	5000	820	1500	330	630
23000	SEA LEVEL	450	840	145	290
	5000	600	1110	220	430



NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.
FOR DISTANCE TO CLEAR 50 FT OBSTACLE REFER TO FIGURE 14-23

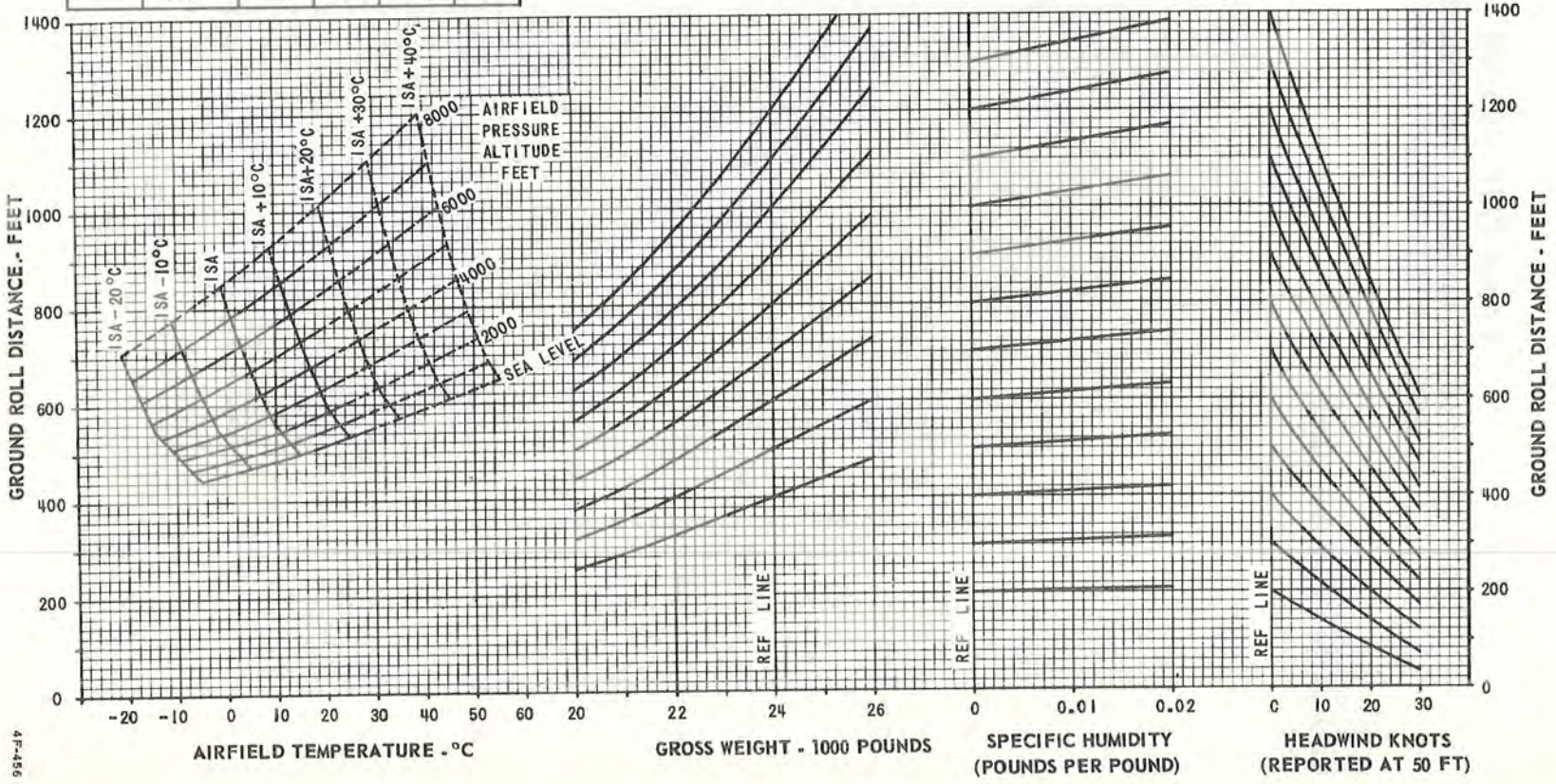


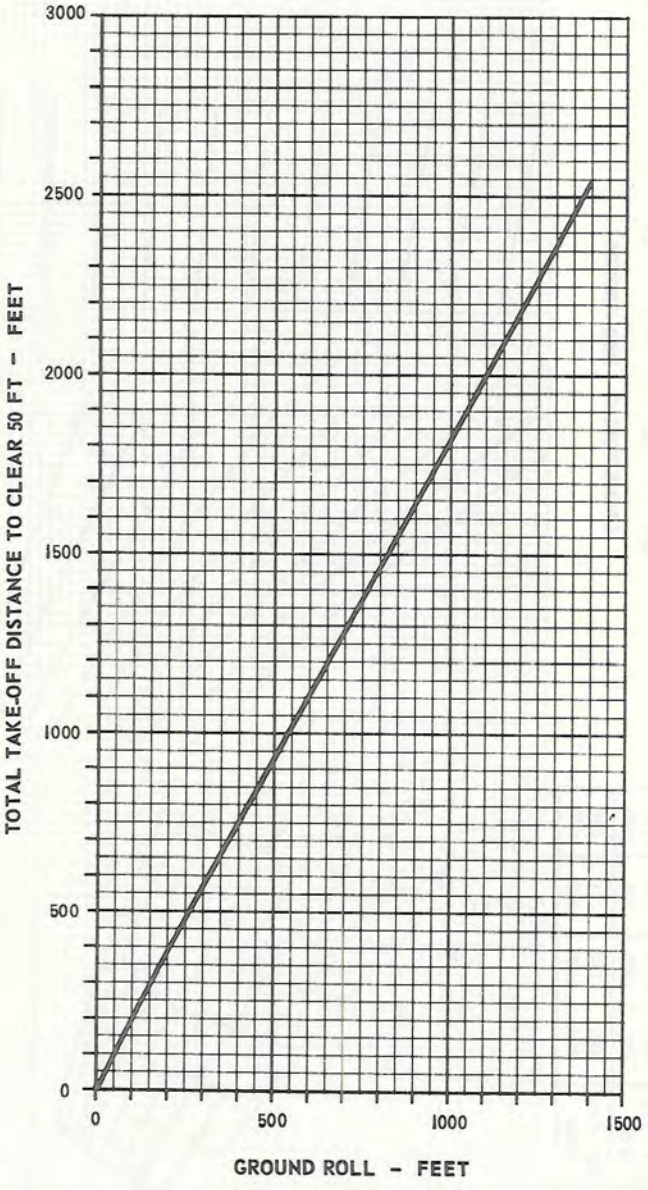
Figure 14-22

TAKE-OFF CURVE

TOTAL DISTANCE TO CLEAR 50 FEET VERSUS GROUND ROLL SHORT-FIELD TECHNIQUE (FLAPS 30°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-457

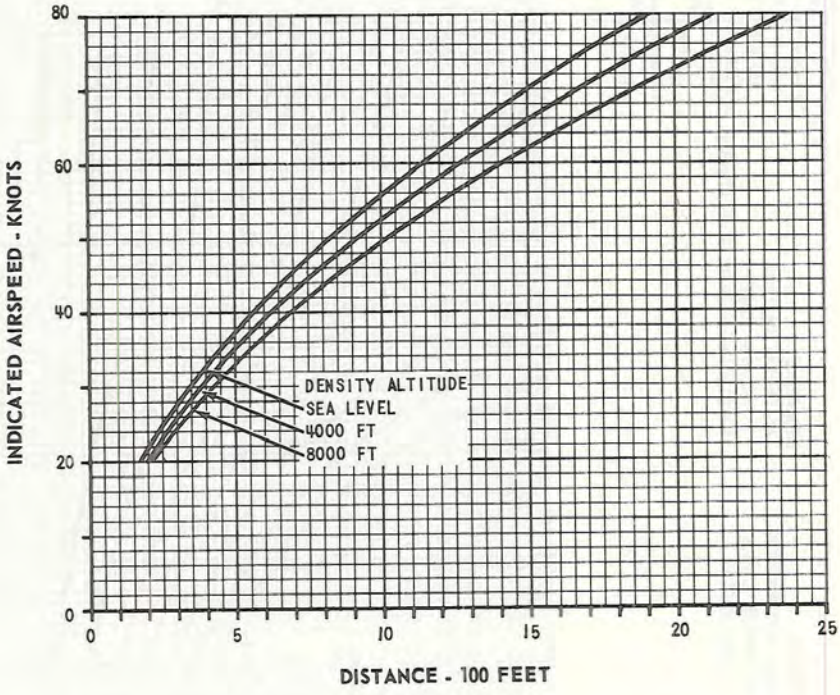
Figure 14-23

STOPPING DISTANCE
ABORTED TAKE-OFF

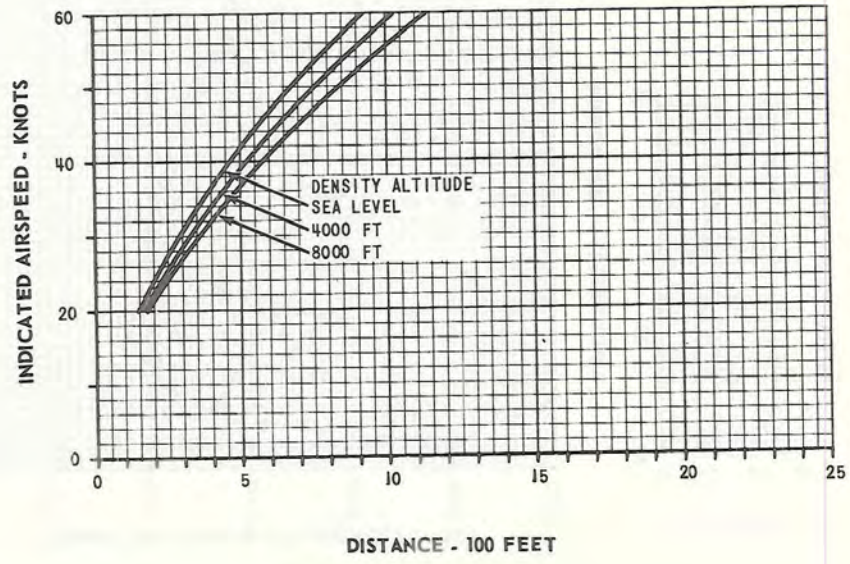
MODEL.: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
ALL AIRCRAFT WEIGHTS
DRY CONCRETE



FLAPS 15°



FLAPS 30°

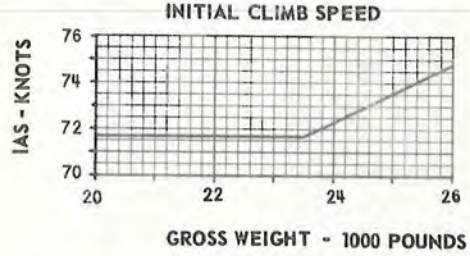
4F-464

Figure 14-24

TAKE-OFF CURVE - ENGINE FAILURE
(FLAPS 15°)
DISTANCE TO CLEAR 50 FOOT OBSTACLE

MODEL: CV-2

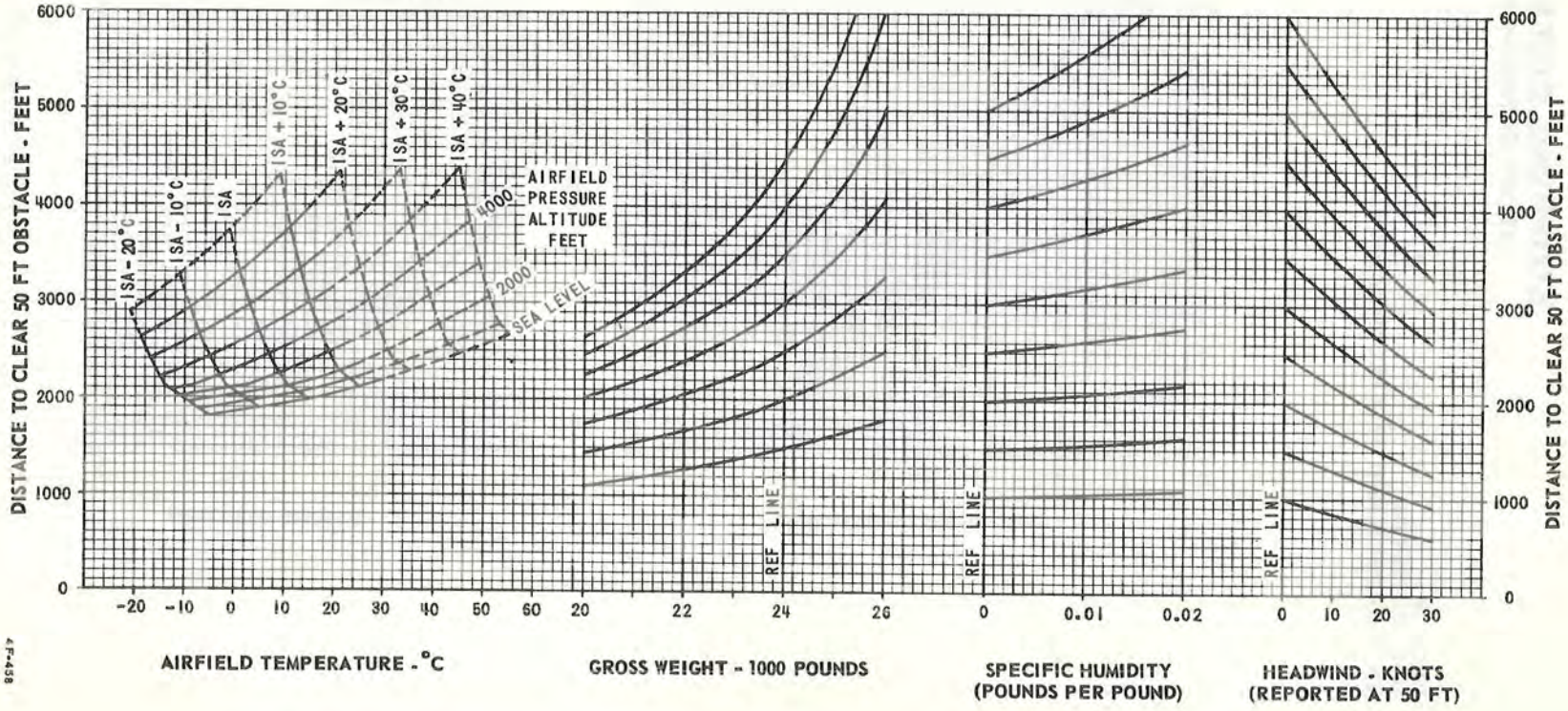
ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.

REMARKS:
ONE ENGINE FAILURE
AT TAKE-OFF SPEED
INOPERATIVE PROPELLER FEATHERED

STANDARD DAY (ISA) : DRY AIR			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE TO CLEAR 50 FT FEET	
		ZERO WIND	30 KNOT WIND
26000	SEA LEVEL	2480	1590
	5000	3570	2320
23000	SEA LEVEL	1800	1130
	5000	2400	1530



4F-458

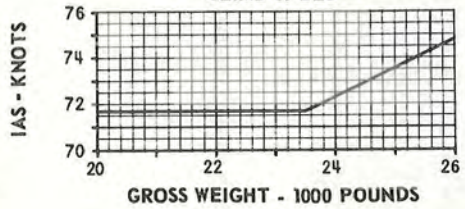
Figure 14-25

EMERGENCY CLIMB-OUT CURVE
HORIZONTAL DISTANCE TRAVERSED DURING LANDING GEAR RETRACTION
(FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

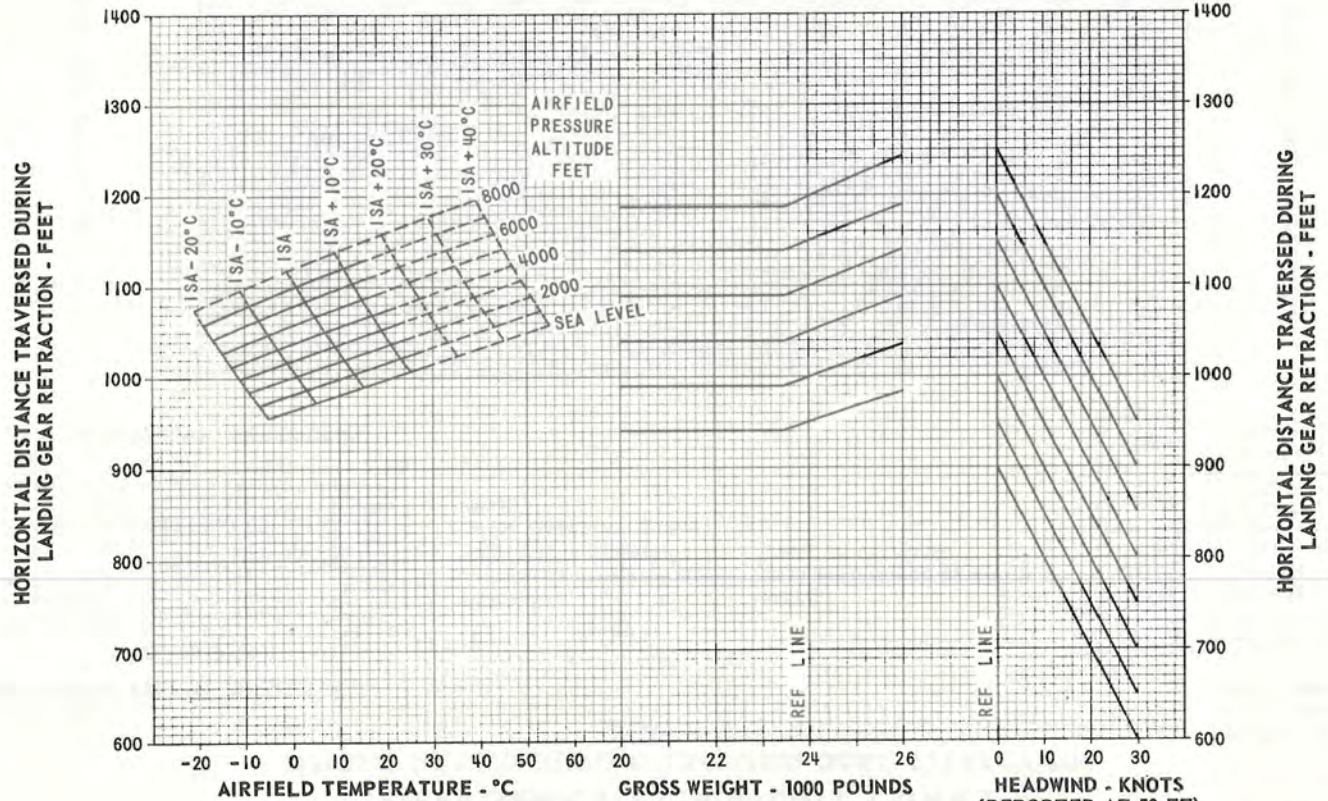
CLIMB SPEED



NOTE
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

REMARKS:
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED; OTHER ENGINE AT TAKE-OFF POWER

STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
26,000	SEA LEVEL	1025	725
	5000	1108	808
23,000	SEA LEVEL	980	680
	5000	1068	768



4F-459

Figure 14-26

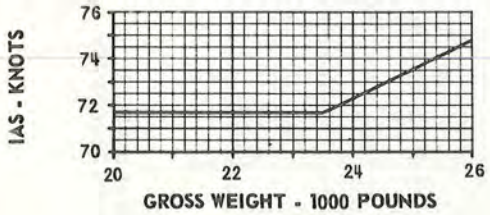
EMERGENCY CLIMB-OUT CURVE

HEIGHT GAINED DURING LANDING GEAR RETRACTION (FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

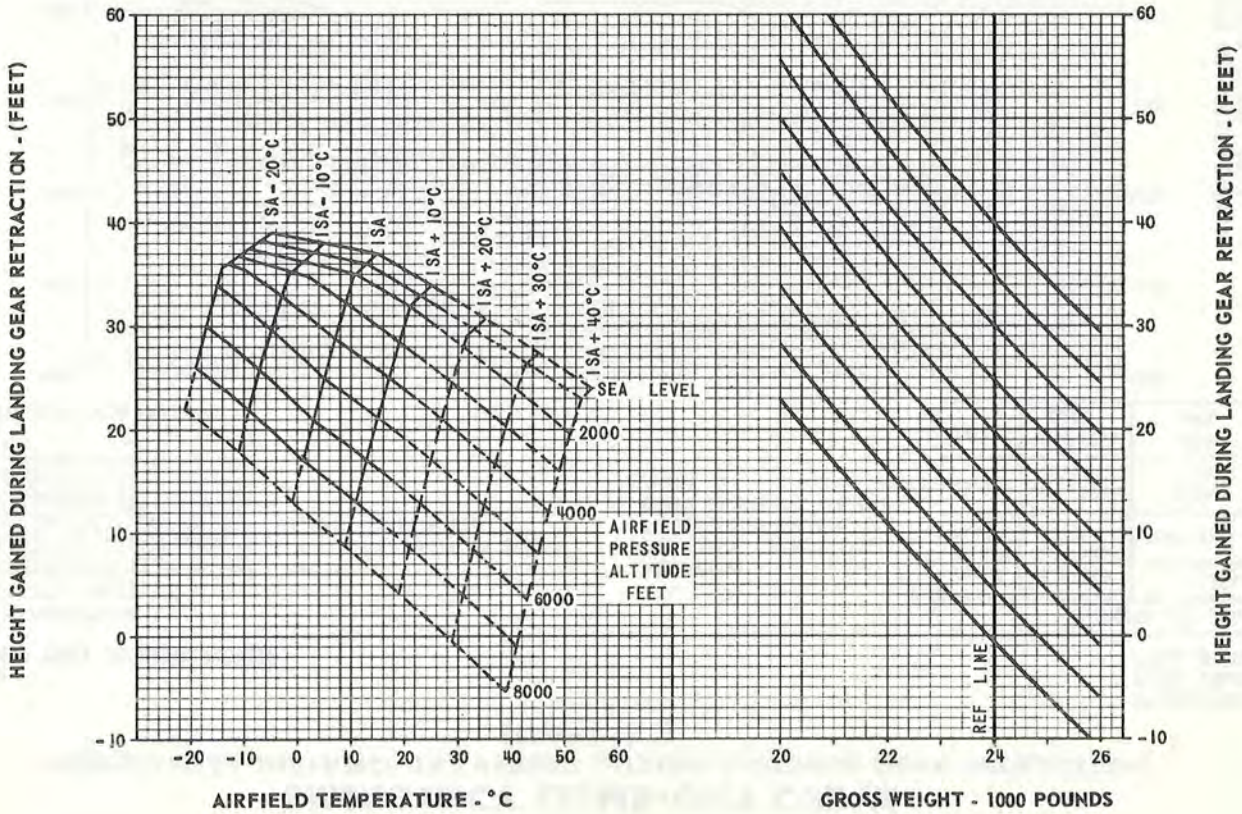
CLIMB SPEED



REMARKS:
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED; OTHER ENGINE AT TAKE-OFF POWER

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

STANDARD DAY (ISA)		
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HEIGHT GAINED
26000	SEA LEVEL	26 FT
	5000	14 FT
23000	SEA LEVEL	43 FT
	5000	30 FT



4F-460

Figure 14-27

EMERGENCY CLIMB-OUT CURVE

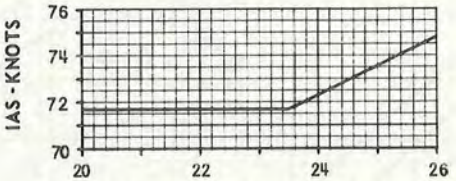
HORIZONTAL DISTANCE TRAVERSED FROM GEAR RETRACTION POINT TO FIVE MINUTE POINT (FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

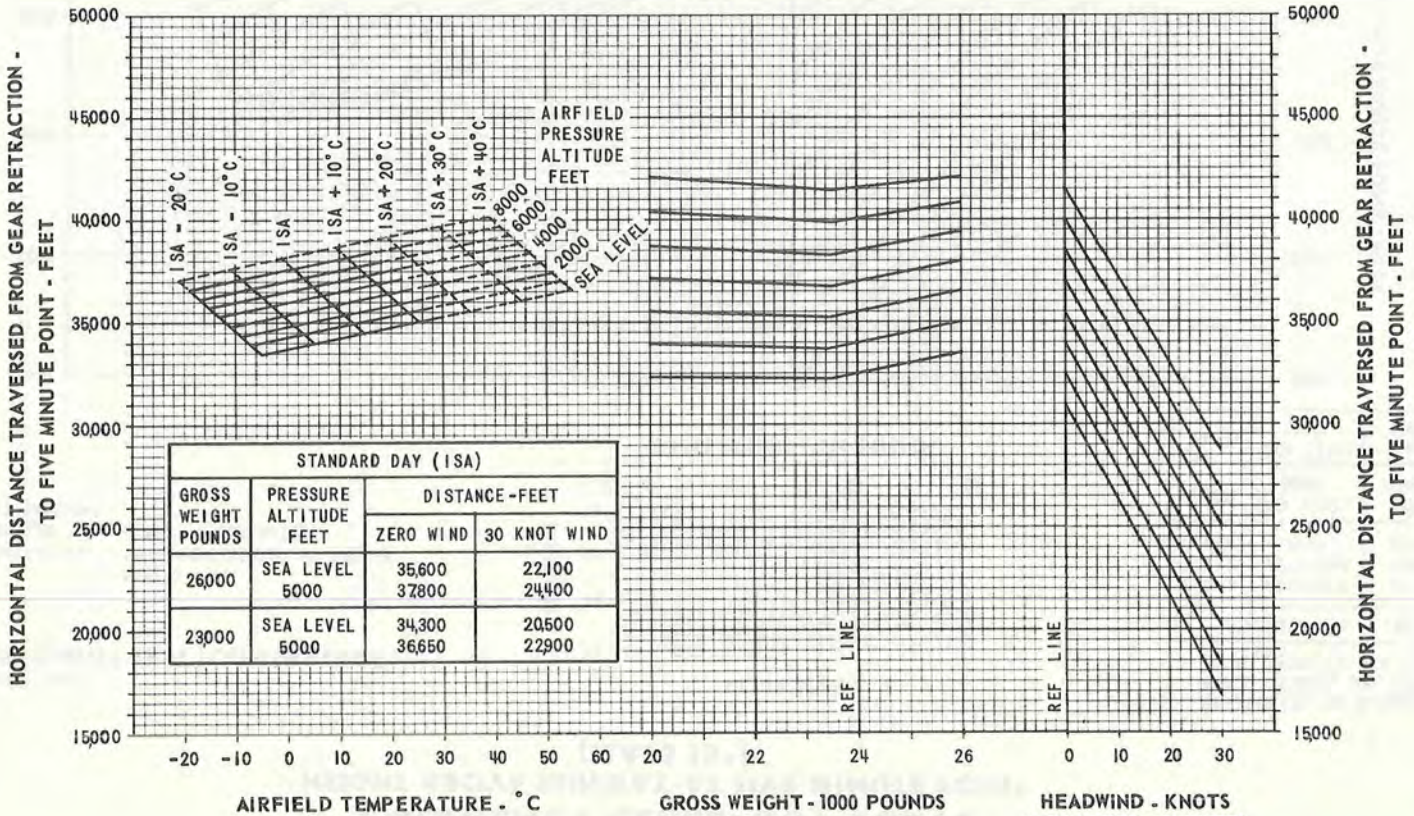
ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED: OTHER ENGINE AT TAKE-OFF POWER

CLIMB SPEED



NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.



STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
26000	SEA LEVEL	35,600	22,100
	5000	37800	24,400
23000	SEA LEVEL	34,300	20,500
	5000	36,650	22,900

Figure 14-28

4F-461

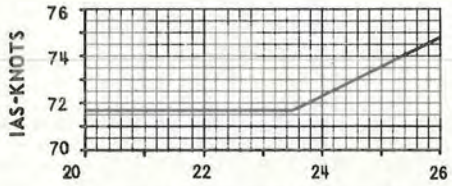
EMERGENCY CLIMB-OUT CURVE
HEIGHT ABOVE RUNWAY AT FIVE MINUTE POINT
(FLAPS 15°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

REMARKS:
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED: OTHER ENGINE AT TAKE-OFF POWER

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.

CLIMB SPEED



ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA)		
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HEIGHT ABOVE RUNWAY
26000	SEA LEVEL 5000	1450 FT 1050 FT
23000	SEA LEVEL 5000	2050 FT 1650 FT

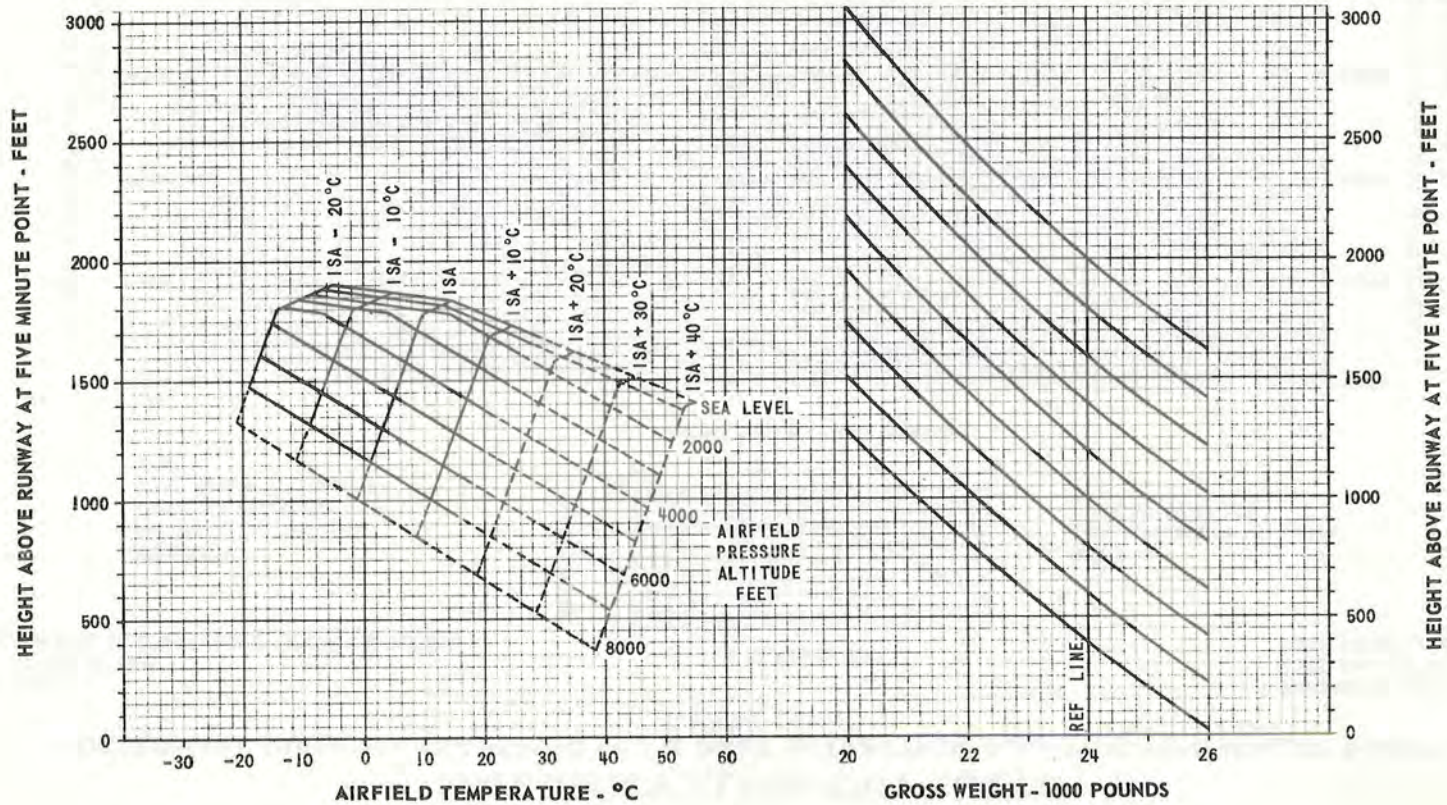


Figure 14-29

4F-462

CLIMB CURVE – DISTANCE AND FUEL

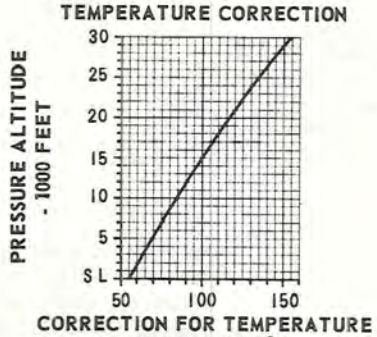
BOTH ENGINES METO POWER

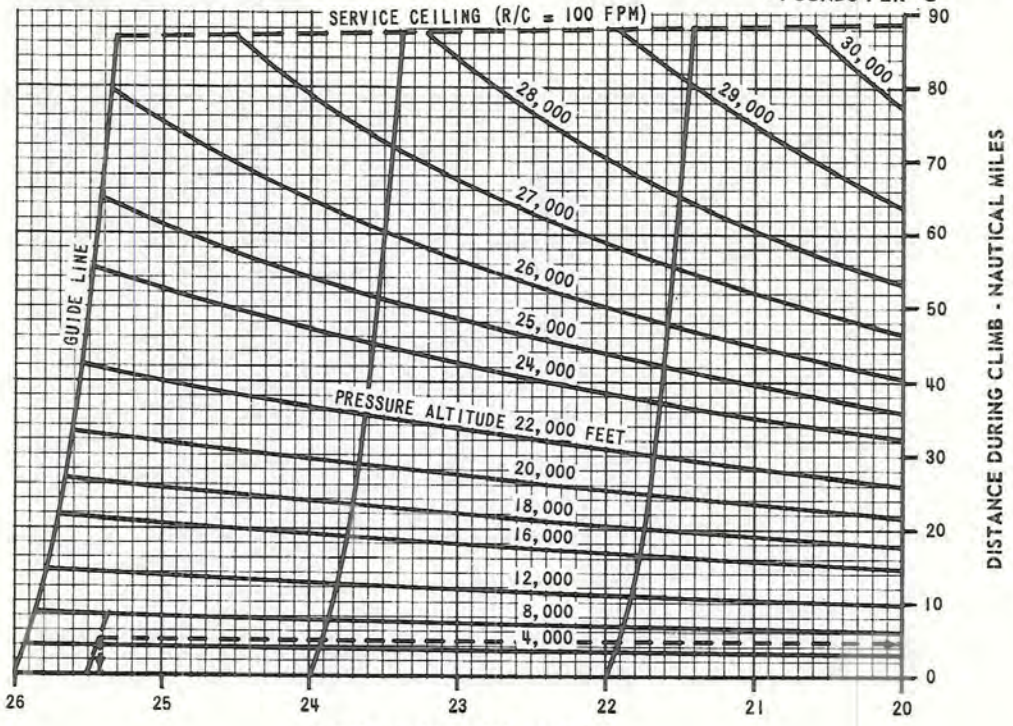
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS - EN ROUTE (0°C)
LANDING GEAR - RETRACTED
CLIMB SPEED - 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T. ADD TO ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION





PRESSURE ALTITUDE FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS			
	26,000		23,000	
	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS
SEA LEVEL	0	0	0	0
5000	5	90	4	70
10,000	11	180	9	140
15,000	20	280	16	220

4F-466

Figure 14-30

CLIMB CURVE - TIME

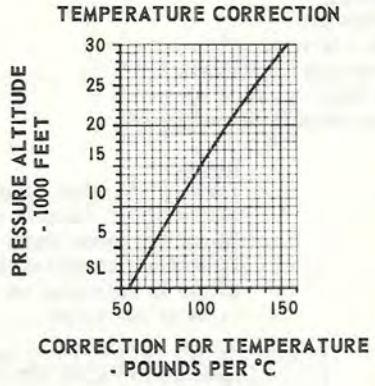
BOTH ENGINES METO POWER

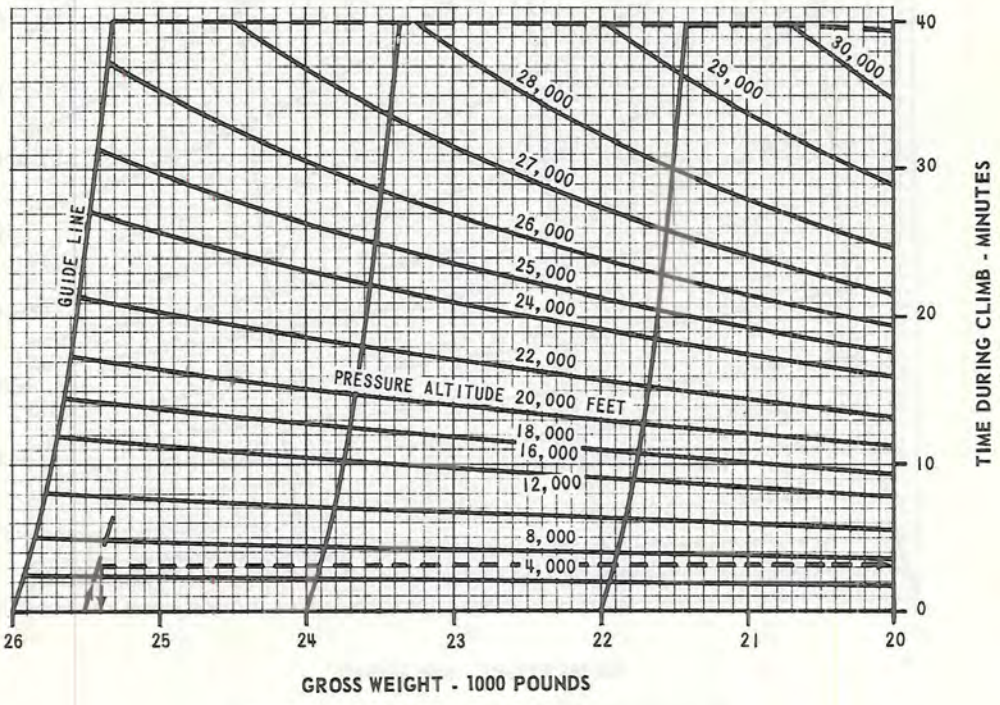
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T. ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION





PRESSURE ALTITUDE -FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS	
	26,000	23,000
	TIME DURING CLIMB -MINUTES	
SEA LEVEL	0	0
5000	3.1	2.4
10,000	6.4	5.2
15,000	10.8	8.1

4F-467

Figure 14-31

CLIMB CURVE - DISTANCE AND FUEL

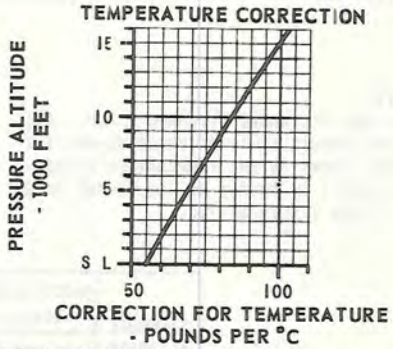
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED OTHER ENGINE METO POWER

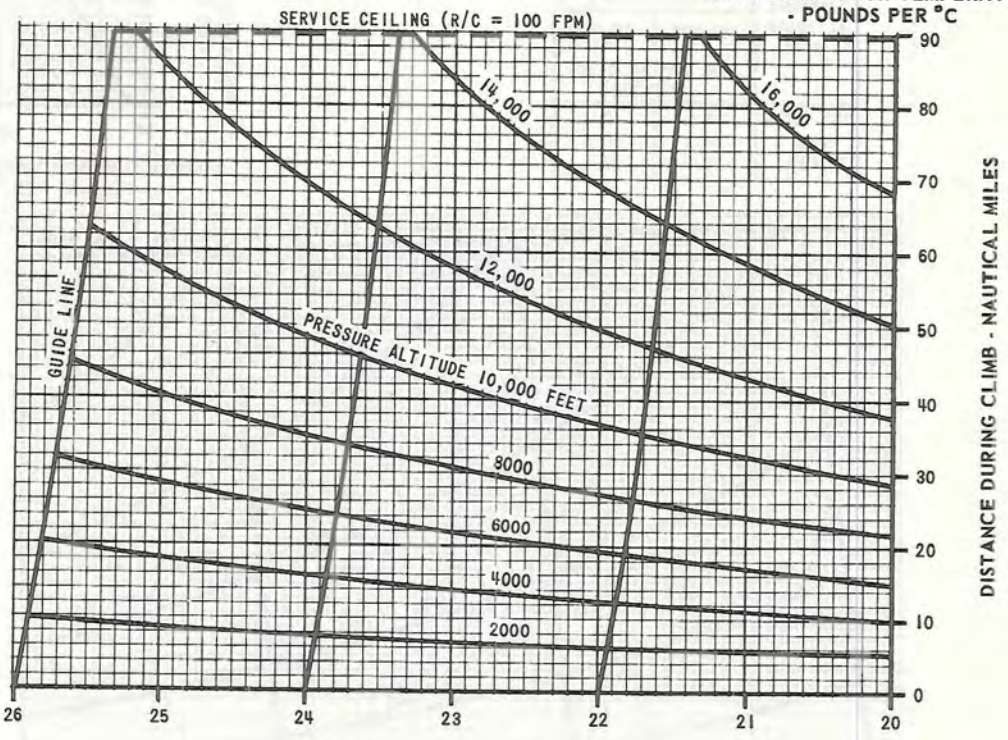
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T., ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION.





PRESSURE ALTITUDE - FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS			
	26,000		23,000	
	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS
SEA LEVEL	0	0	0	0
5000	25.5	210	17	150
10,000	63	500	37.5	320

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Figure 14-32

CLIMB CURVE-TIME

ONE ENGINE INOPERATIVE - PROPELLER FEATHERED
OTHER ENGINE METO POWER

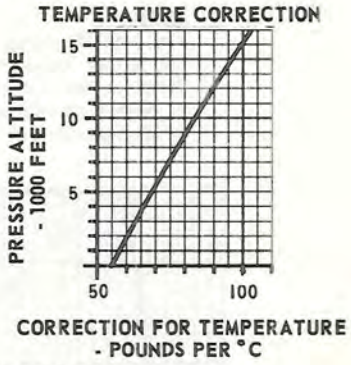
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

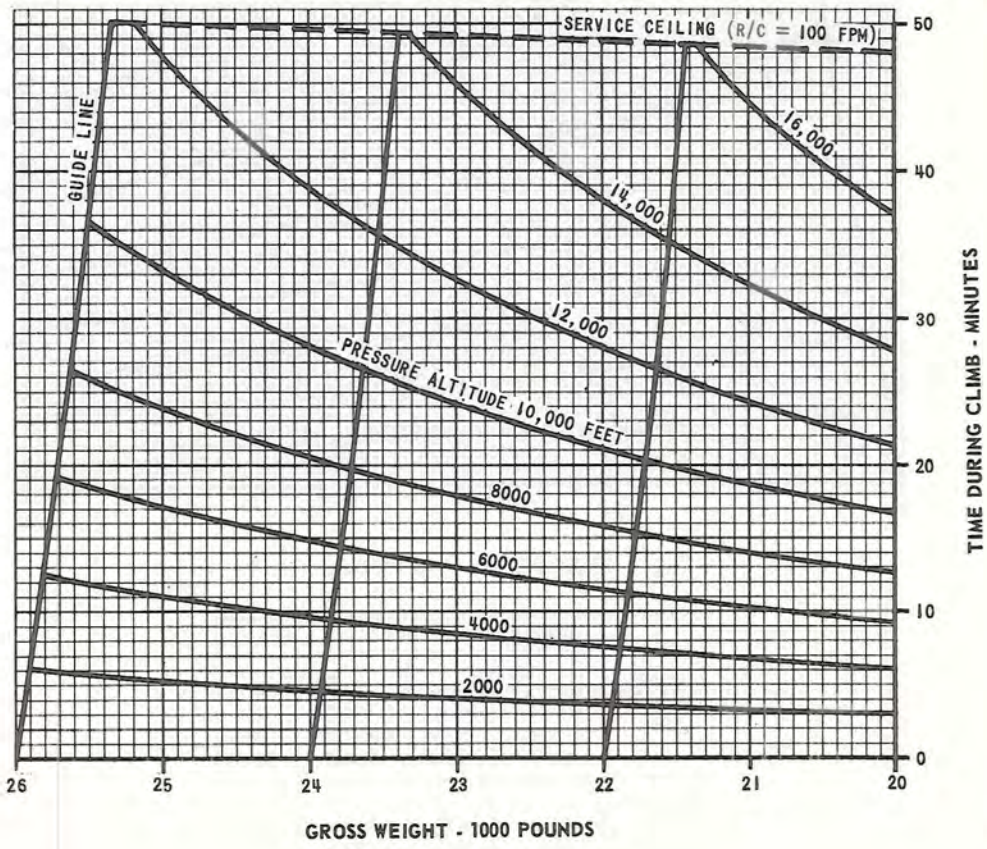
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T., ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION.

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

PRESSURE ALTITUDE - FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS	
	26,000	23,000
	TIME DURING CLIMB - MINUTES	
SEA LEVEL	0	0
5000	15.7	10.3
10,000	36.7	23.0





4F-469

Figure 14-33

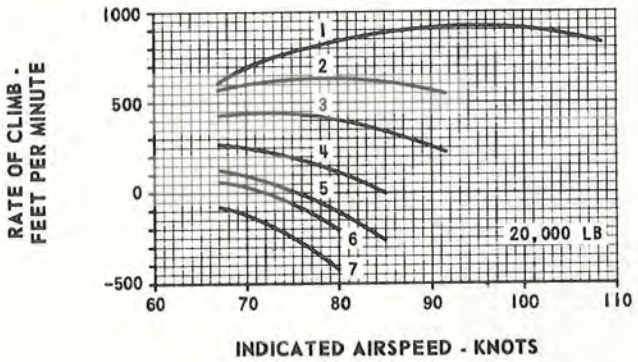
EMERGENCY CLIMB
ONE ENGINE INOPERATIVE

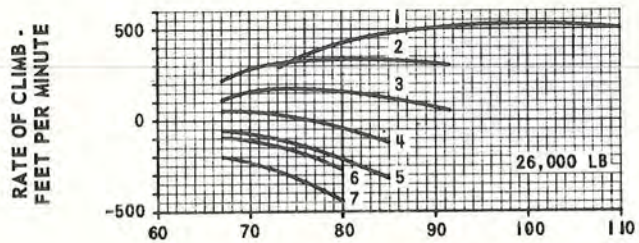
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR) FLAPS 0° AND 15°
ESTIMATED FLAPS 30° AND 40°

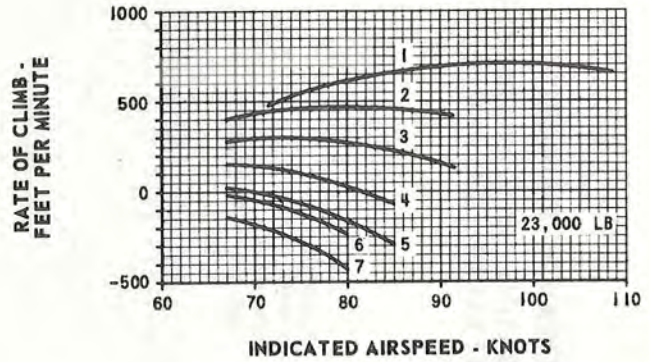
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

CURVE IDENTIFICATION:
1. FLAPS 0° - GEAR UP
2. FLAPS 15° - GEAR UP
3. FLAPS 15° - GEAR DOWN
4. FLAPS 30° - GEAR UP
5. FLAPS 30° - GEAR DOWN
6. FLAPS 40° - GEAR UP
7. FLAPS 40° - GEAR DOWN

REMARKS:
OPERATIVE ENGINE AT TAKE-OFF POWER.
UNLESS OTHERWISE STATED THE INOPERATIVE PROPELLER IS FEATHERED.
SEA LEVEL.
STANDARD DAY.







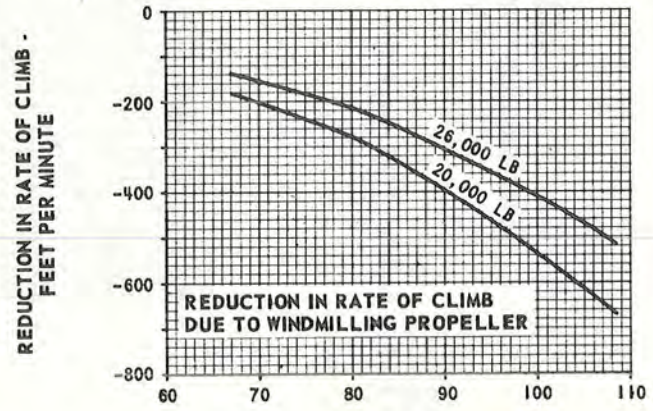


Figure 14-34

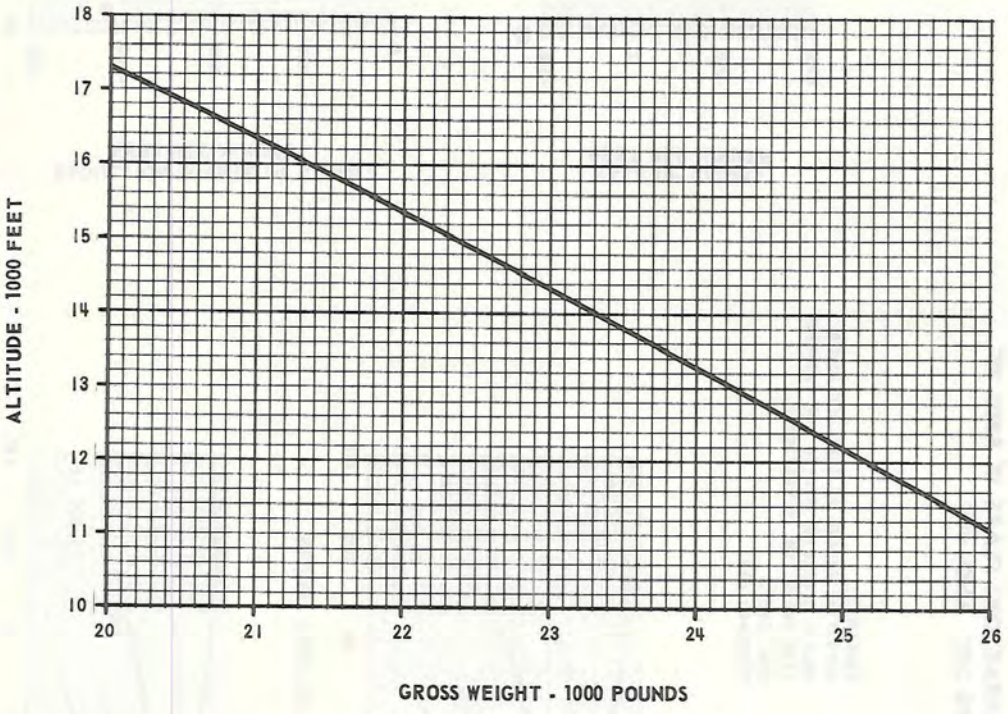
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EMERGENCY CEILING
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED
RATE OF CLIMB = 100 FPM

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
METO POWER
FLAPS AND GEAR RETRACTED



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Figure 14-35

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE - SEA LEVEL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	
250	A L	1800	18.6	142	700	A L	2000	32.6	329
300	A L	1800	20.7	165	725	A L	2000	33.0	351
350	A L	1800	22.7	186	725	A R	2000	31.7	425
400	A L	1800	24.7	205	750	A R	2000	32.6	444
450	A L	1800	26.5	222	800	A R	2000	34.4	482
500	A L	1800	28.4	237	900	A R	2000	37.8	563
550	A L	1800	30.2	251	1000	A R	2200	38.7	649
600	A L	1800	32.0	269	1100	A R	2550	39.3	742
650	A L	1900	32.6	295	1200	F C	2550	42.5	843

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

NOTE:
WIND CORRECTION TO NAUTICAL MILES / POUND.

$$\text{GROUND N.MI / LB} = \text{AIR N.MI / LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

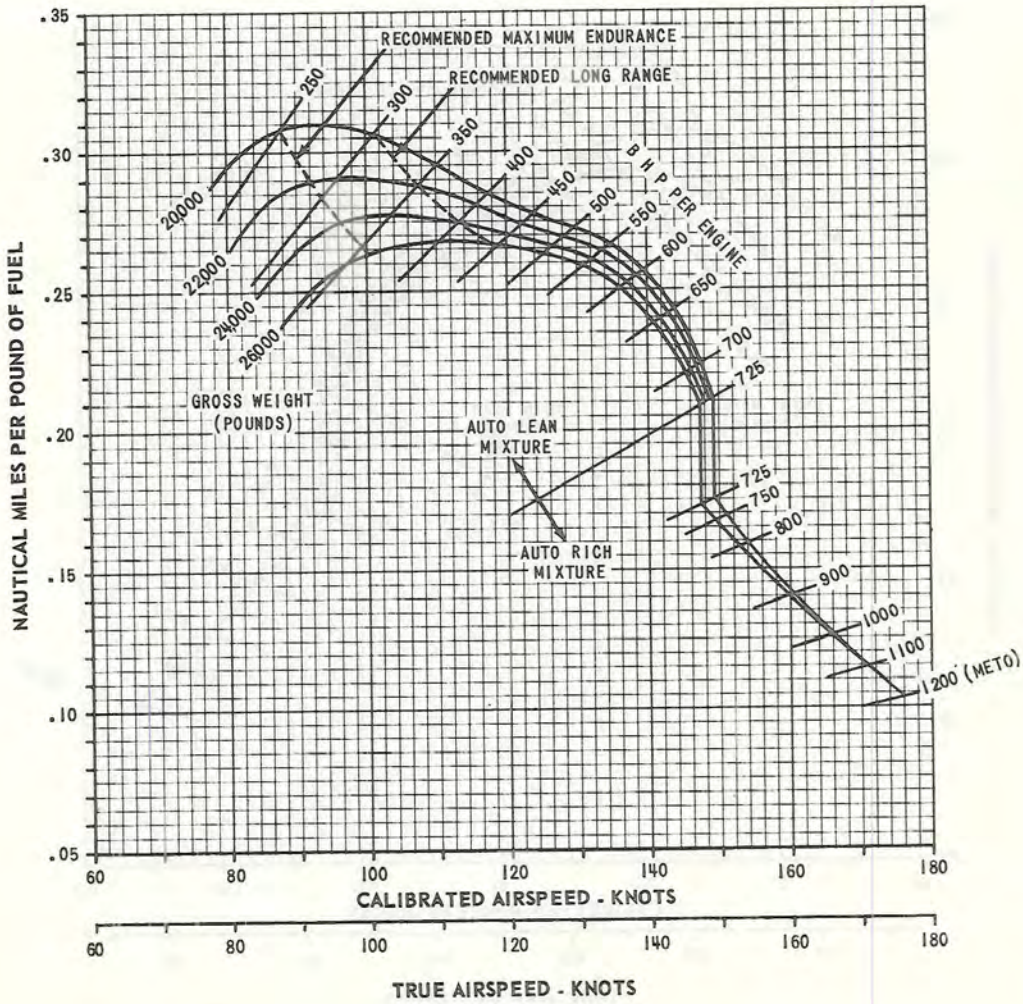


Figure 14-36

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-5000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

BHP	MIX.	RPM	M P		BHP	MIX.	RPM	M P	F C
300	A L	1800	19.0	165	725	A L	2000	32.0	357
350	A L	1800	21.0	186	725	A R	2000	30.6	425
400	A L	1800	23.0	205	750	A R	2000	31.3	444
450	A L	1800	25.0	222	800	A R	2000	33.2	482
500	A L	1800	26.8	237	900	A R	2200	34.6	563
550	A L	1800	28.7	251	1000	A R	2200	38.0	649
600	A L	1800	30.6	270	1100	A R	2550	38.0	745
650	A L	1900	31.2	297	1200		2550	41.8	854
700	A L	2000	31.3	333					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

NOTE:
WIND CORRECTION TO NAUTICAL MILES/ POUND

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

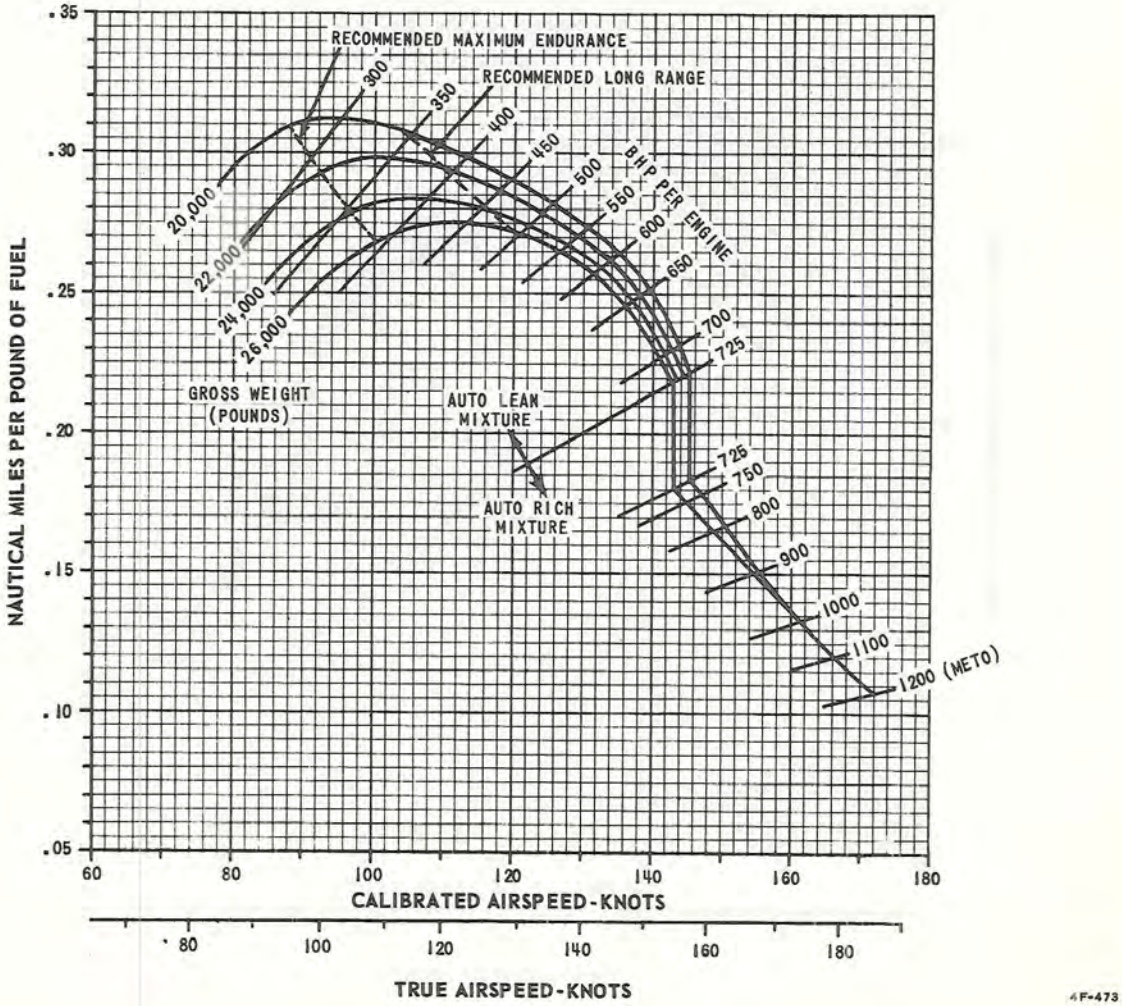


Figure 14-37

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-10,000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/ POUND.

$$\text{GROUND N.MI / LB} = \text{AIR N.MI / LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
300	A L	1800	17.6	165	700	A L	2000	30.4	342
350	A L	1800	19.7	186	725	A L	2100	29.7	367
400	A L	1800	21.8	205	725	A R	2000	29.5	425
450	A L	1800	23.6	222	750	A R	2000	30.5	444
500	A L	1800	25.6	237	800	A R	2200	30.2	482
550	A L	1800	27.4	254	900	A R	2550	31.2	563
600	A L	1800	28.3	275	1000	A R	2550	34.3	652
650	A L	2000	29.1	302					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

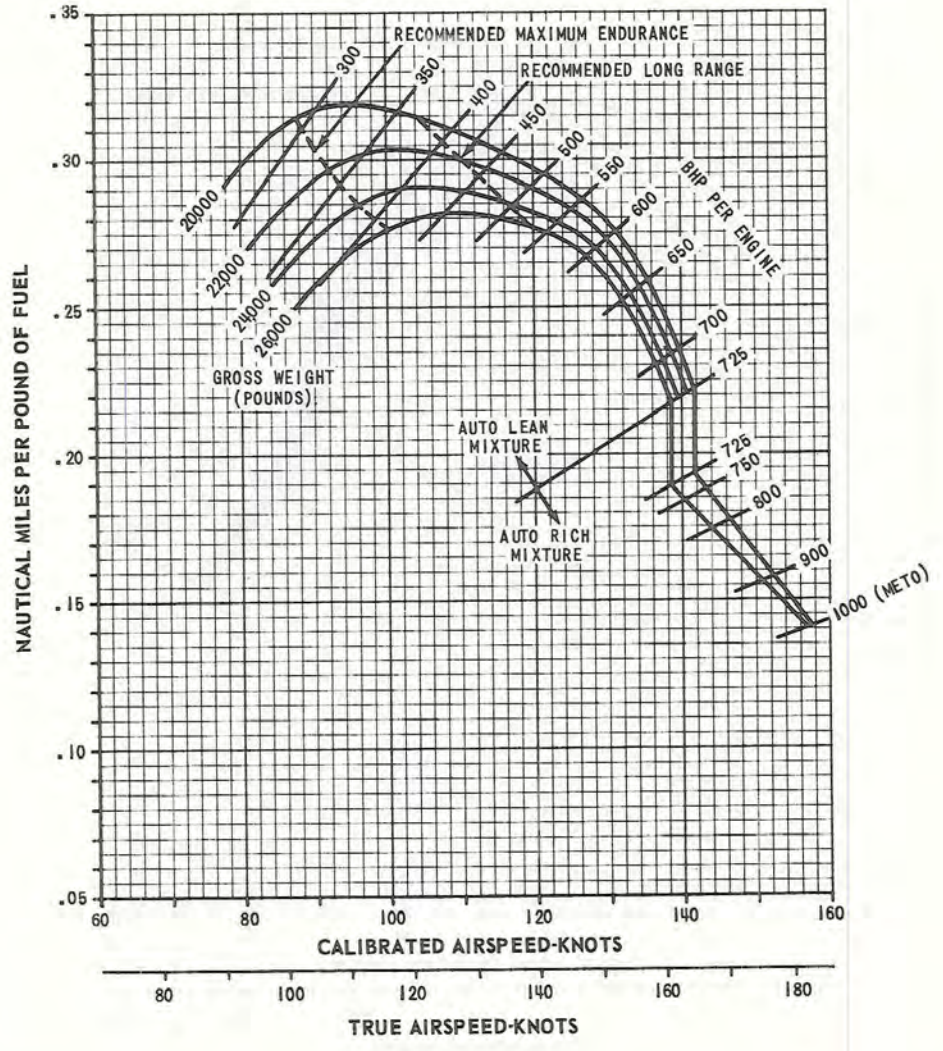


Figure 14-38

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-15,000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
300	A L	1800	16.6	165	650	A L	2200	26.3	322
350	A L	1800	18.4	186	695	A L	2200	F.T.	366
400	A L	1800	20.3	205	695	A R	2200	25.8	403
450	A L	1800	22.3	222	750	A R	2550	25.6	444
500	A L	1900	23.5	237	800	A R	2550	27.3	483
550	A L	2000	24.3	258	900	A R	2550	30.2	575
600	A L	2100	25.5	285					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH
F.T. FULL THROTTLE

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND.

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

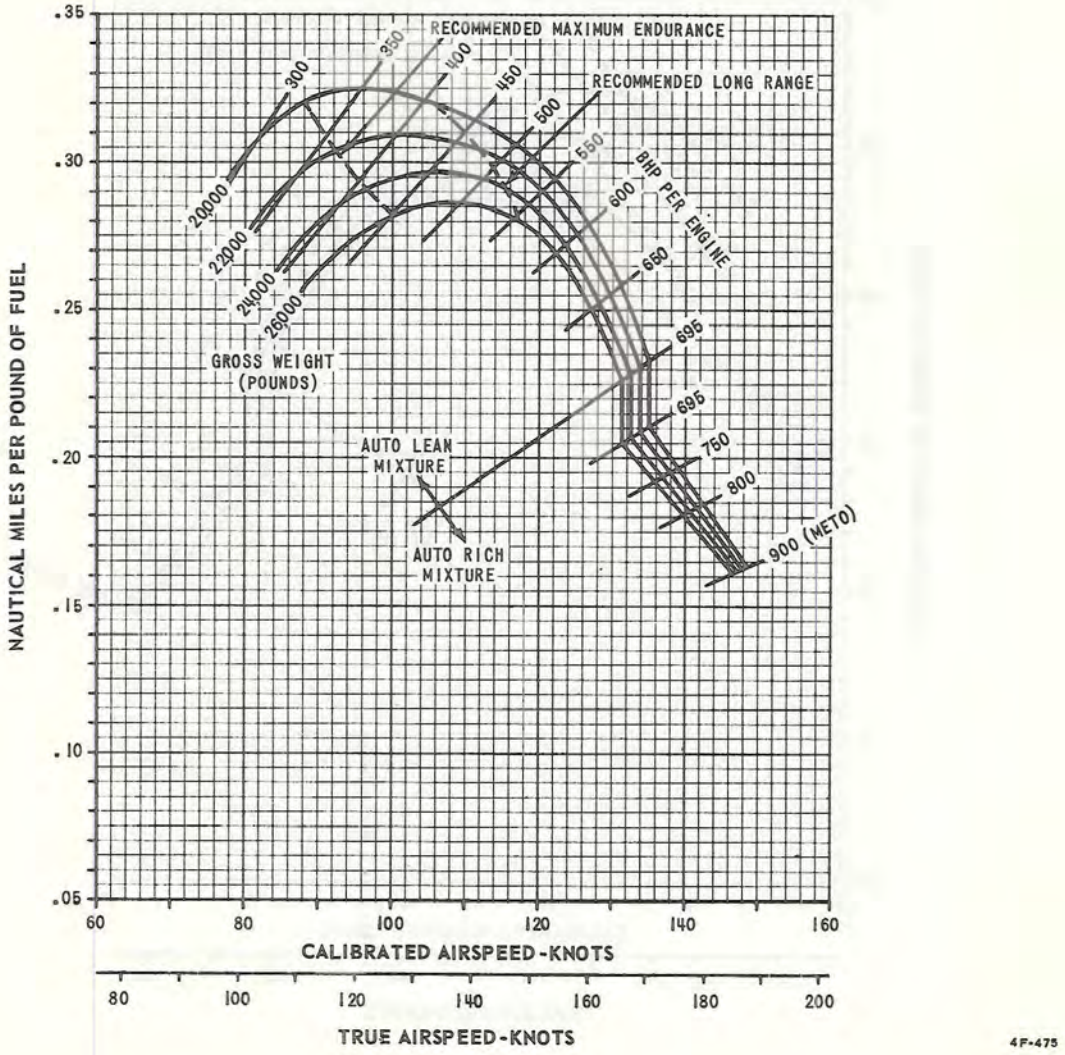


Figure 14-39

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-20,000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
350	A L	1800	17.4	186	550	A R	2200	20.5	304
400	A L	1900	18.7	205	600	A R	2200	21.9	338
450	A L	2000	19.9	222	650	A R	2550	22.0	373
500	A L	2100	21.1	238	700	A R	2550	23.5	413
550	A L	2200	F.T.	265	750	A R	2550	24.9	463

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH
F.T. FULL THROTTLE

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND-

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

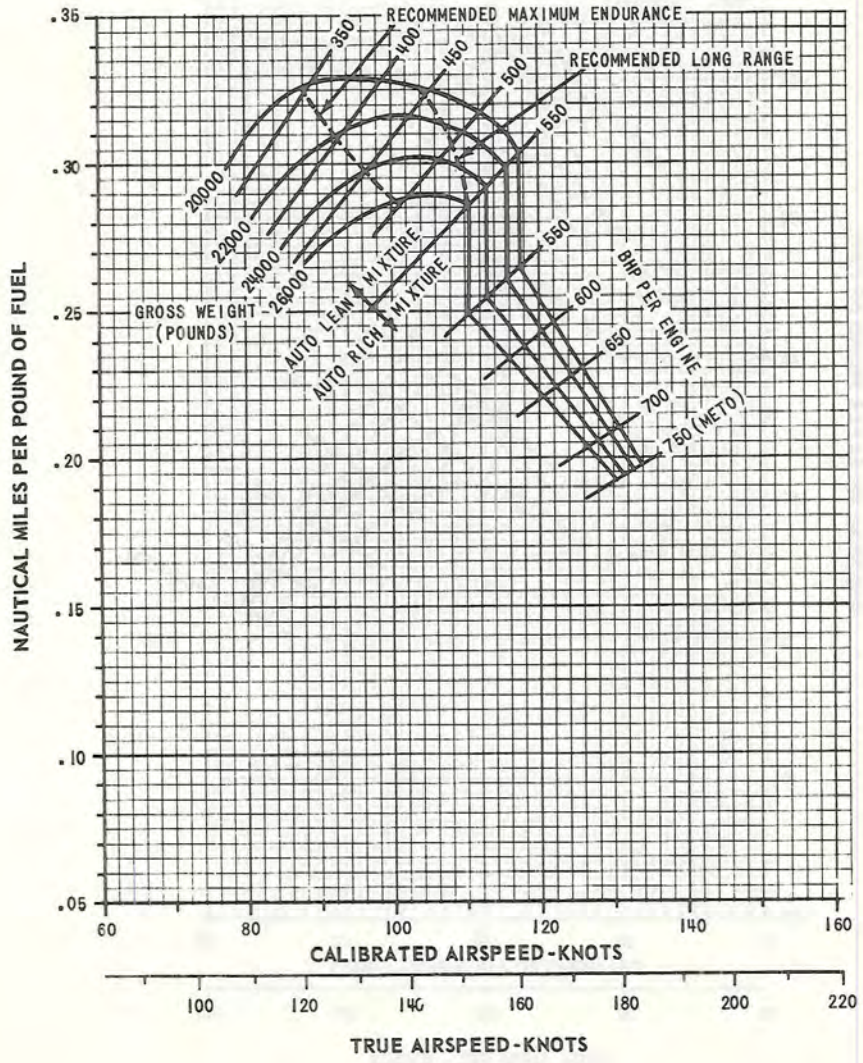


Figure 14-40

NAUTICAL MILES PER POUND OF FUEL

ONE ENGINE INOPERATIVE – PROPELLER FEATHERED
ALTITUDE-SEA LEVEL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND-

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	
550	A L	1800	30.2	251	750	A R	2000	32.6	444
600	A L	1800	32.0	269	800	A R	2000	34.4	482
650	A L	1900	32.6	295	900	A R	2000	37.8	563
700	A L	2000	32.6	329	1000	A R	2200	38.7	649
725	A L	2000	33.0	351	1100	A R	2550	39.3	742
725	A R	2000	31.7	425	1200	A R	2550	42.5	843

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

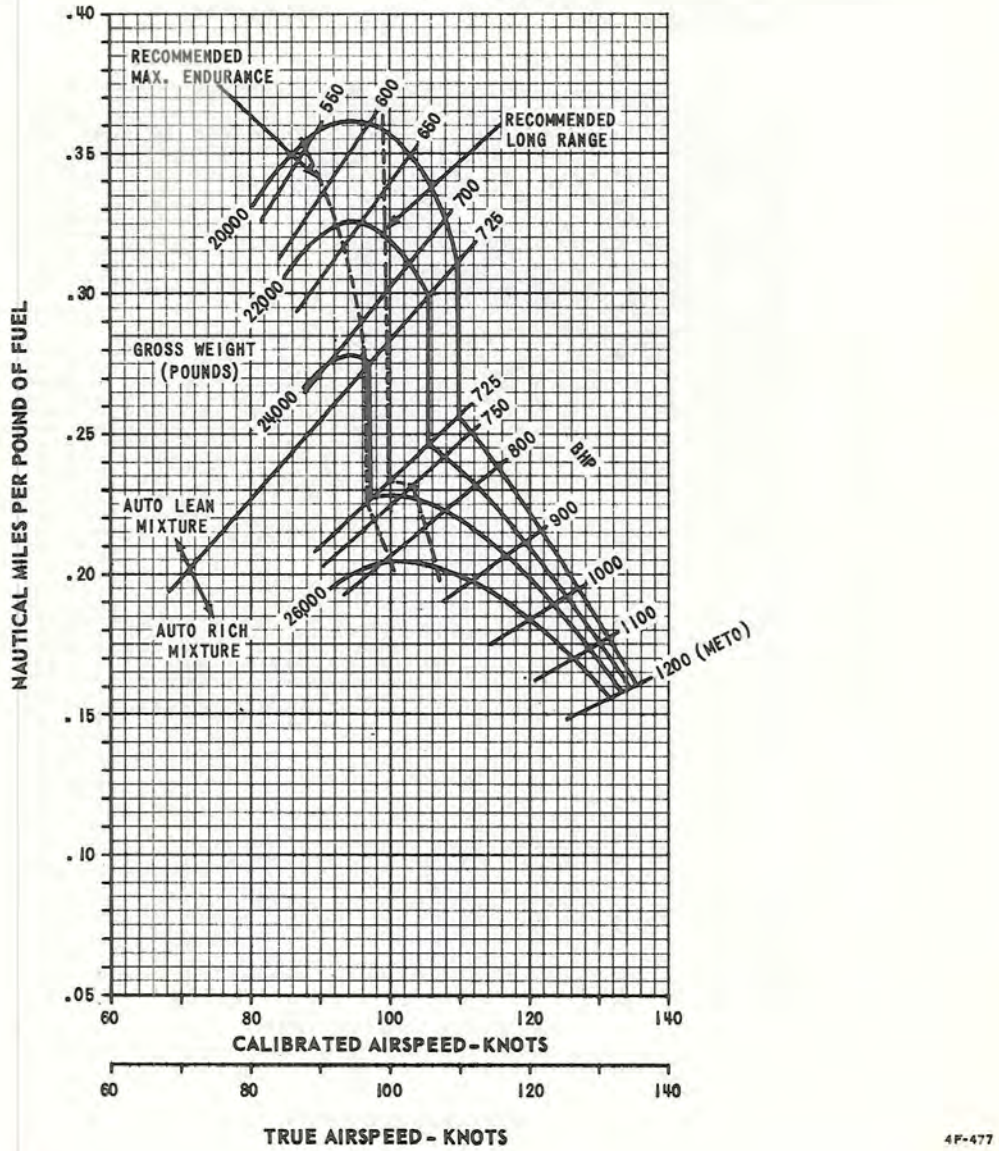


Figure 14-41

NAUTICAL MILES PER POUND OF FUEL

ONE ENGINE INOPERATIVE – PROPELLER FEATHERED
ALTITUDE-5000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES / POUND

$$\text{GROUND N. MI / LB} = \text{AIR N. MI / LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
600	A L	1800	30.6	270	800	A R	2000	33.2	482
650	A L	1900	31.2	297	900	A R	2200	34.6	563
700	A L	2000	31.3	333	1000	A R	2200	38.0	649
725	A L	2000	32.0	357	1100	A R	2550	38.0	745
725	A R	2000	30.6	425	1200	A R	2550	41.8	854
750	A R	2000	31.3	444					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

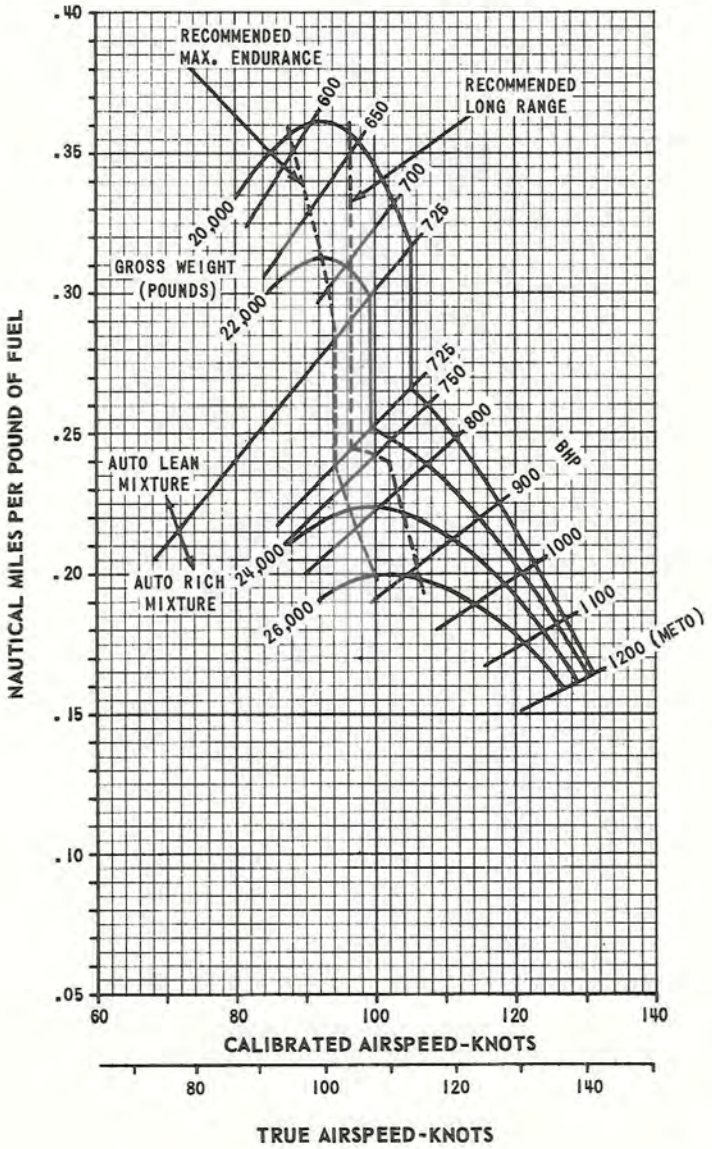


Figure 14-42

NAUTICAL MILES PER POUND OF FUEL
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED
ALTITUDE-10,000 FEET

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND-

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
650	A L	2000	29.1	302	800	A R	2200	30.2	482
700	A L	2000	30.4	342	900	A R	2550	31.2	563
725	A L	2100	29.7	367	1000	A R	2550	34.3	652
725	A R	2000	29.5	425	1095	A R	2550	37.5	757
750	A R	2000	30.5	444					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

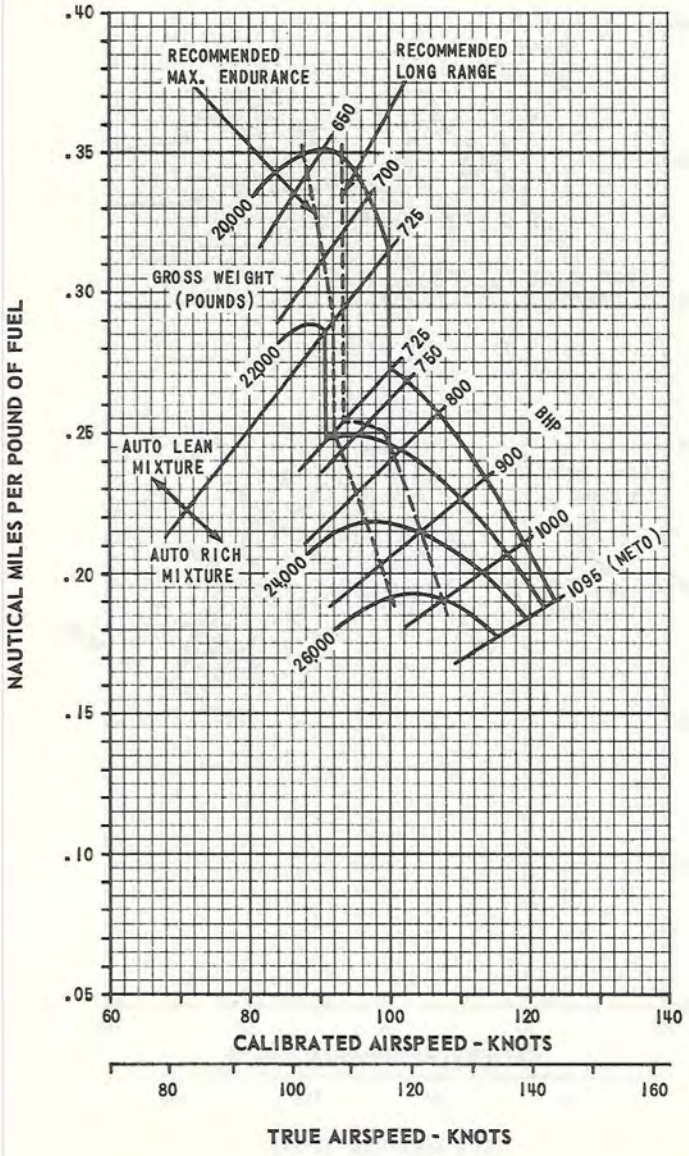


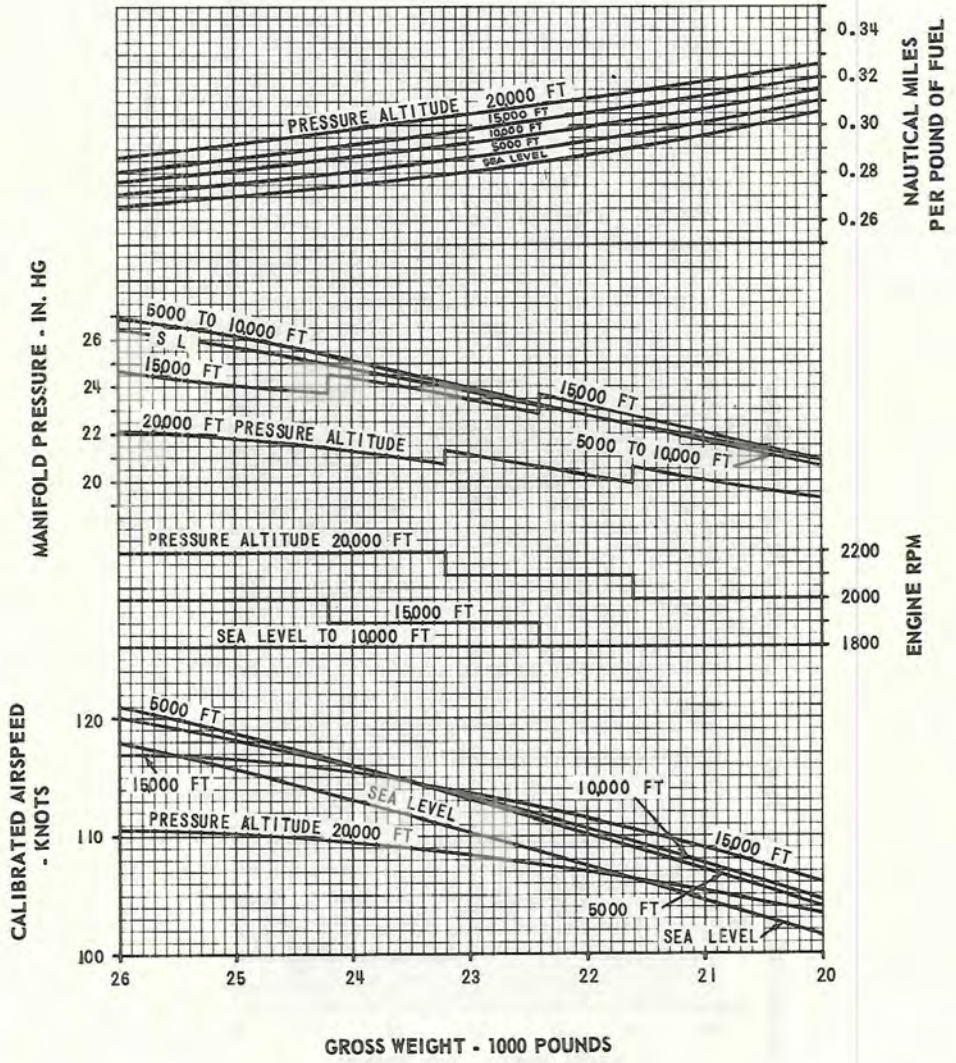
Figure 14-43

LONG RANGE SUMMARY
BOTH ENGINES OPERATING

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
AUTO LEAN MIXTURE



WEIGHT	26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	NAUTICAL MILES PER POUND	MIX.	R P M	M P IN. HG	C A S KNOTS	NAUTICAL MILES PER POUND	MIX.	R P M	M P IN. HG	C A S KNOTS
SEA LEVEL	0.266	A L	1800	26.4	118.0	0.280	A L	1800	23.8	110.3
5000	0.271	A L	1800	26.9	121.0	0.287	A L	1800	23.9	113.0
10,000	0.276	A L	1800	26.9	120.0	0.293	A L	1800	23.9	113.4

4F-480

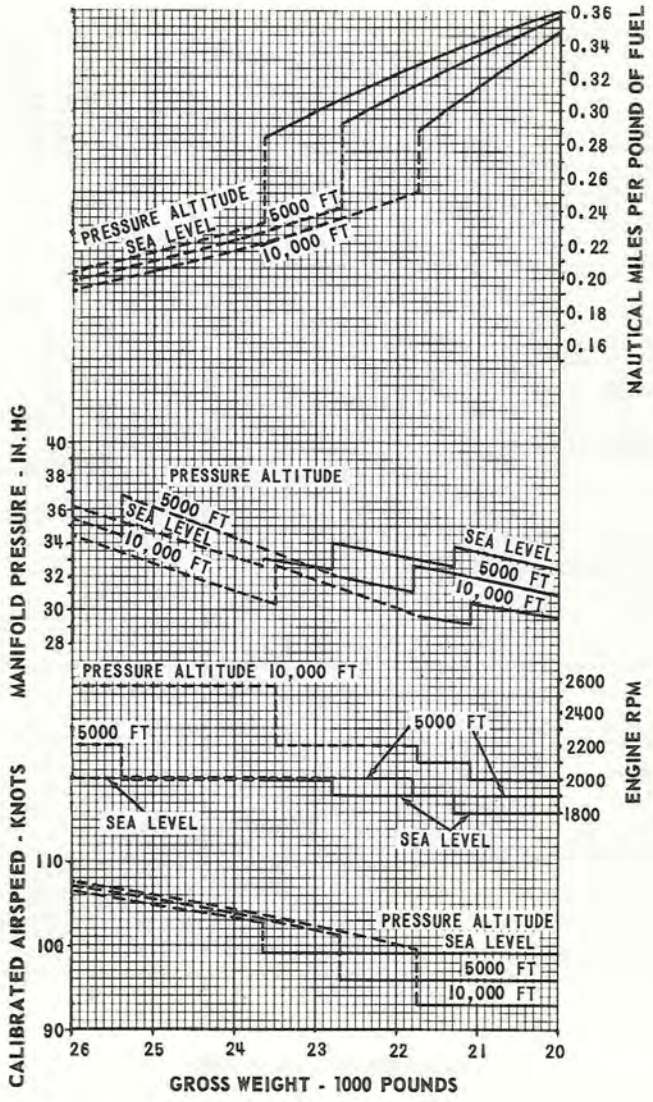
Figure 14-44

LONG RANGE SUMMARY
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——— AUTO LEAN (AL)
- - - - - AUTO RICH (AR)



WEIGHT	26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	NAUTICAL MILES PER POUND	MIX.	RPM	M P IN. HG	C A S KNOTS	NAUTICAL MILES PER POUND	MIX.	RPM	M P IN. HG	C A S KNOTS
SEA LEVEL	0.203	A R	2000	36.2	106.5	0.300	A L	2000	32.6	99.0
5000	0.198	A R	2200	35.4	107.0	0.237	A R	2000	32.5	102.0
10,000	0.191	A R	2550	34.5	107.6	0.230	A R	2200	31.8	102.5

4F-481

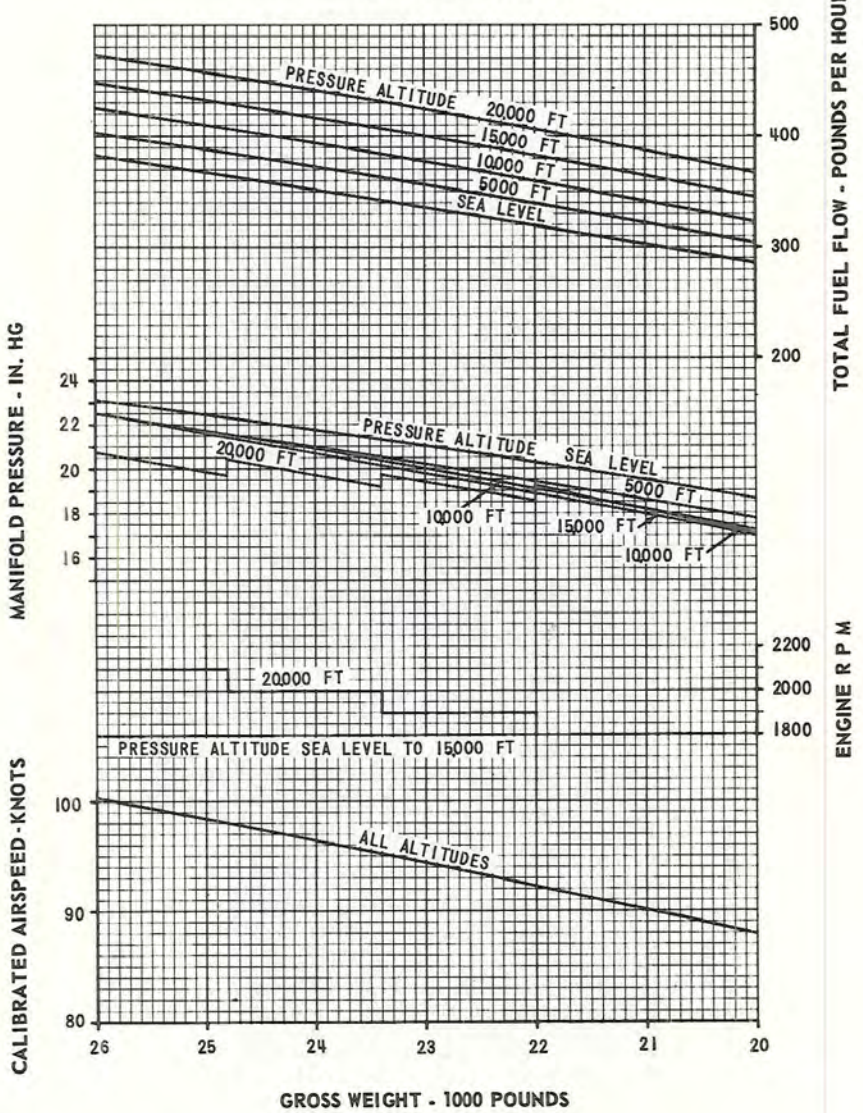
Figure 14-45

MAXIMUM ENDURANCE
BOTH ENGINES OPERATING

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
AUTO LEAN MIXTURE (A L)



WEIGHT	26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	LB PER HOUR	MIX.	R P M	M P IN. HG	C A S KNOTS	LB PER HOUR	MIX.	R P M	M P IN. HG	C A S KNOTS
SEA LEVEL	382	A L	1800	23.1	100.3	336	A L	1800	21.0	94.4
5000	402	A L	1800	22.5	100.3	357	A L	1800	20.2	94.4
10000	426	A L	1800	22.5	100.3	377	A L	1800	20.0	94.4

4F-482

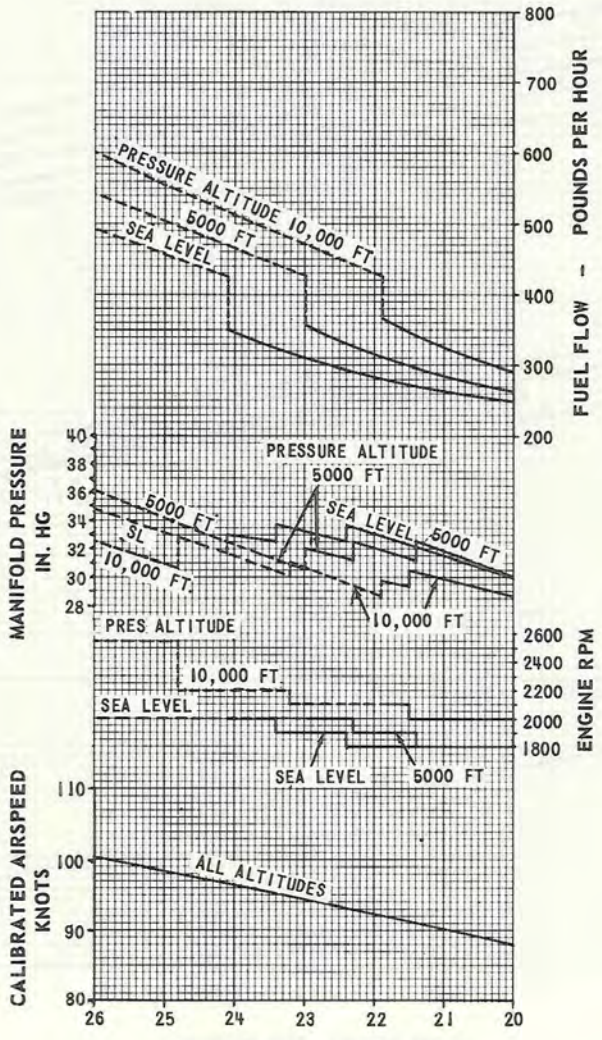
Figure 14-46

MAXIMUM ENDURANCE
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——— AUTO LEAN (A L)
– – – – AUTO RICH (A R)



WEIGHT	26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	LB PER HOUR	MIX.	RPM	M P IN. HG	C A S KNOTS	LB PER HOUR	MIX.	RPM	M P IN. HG	C A S KNOTS
SEA LEVEL	493	A R	2000	34.8	100.3	310	A L	1900	33.3	94.4
5000	542	A R	2000	36.2	100.3	427	A R	2000	30.6	94.4
10,000	602	A R	2550	32.6	100.3	470	A R	2100	30.7	94.4

4F-483

Figure 14-47

LONG RANGE PREDICTION - DISTANCE
BOTH ENGINES OPERATING

MODEL CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

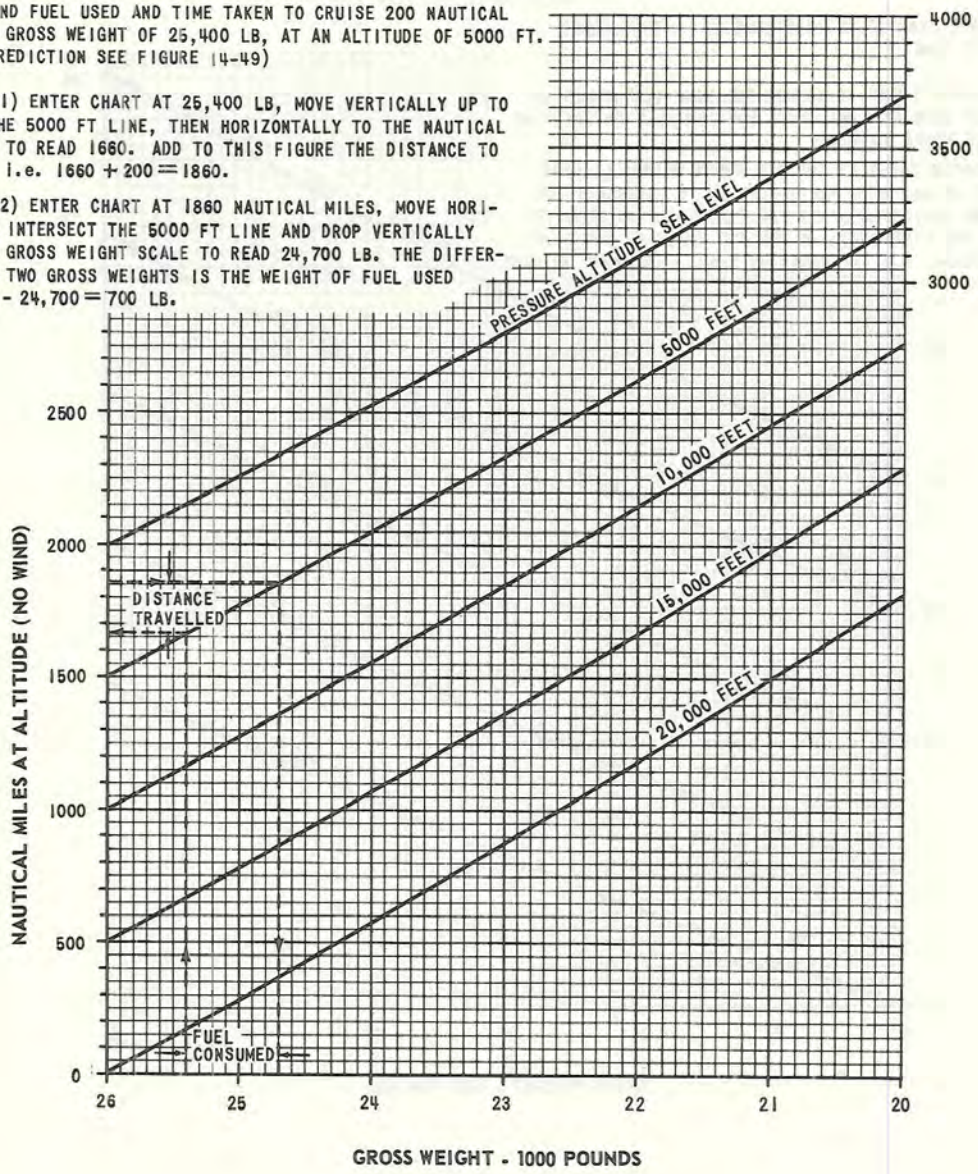
ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
BASED ON RECOMMENDED
LONG RANGE CRUISING SPEED

EXAMPLE: FIND FUEL USED AND TIME TAKEN TO CRUISE 200 NAUTICAL MILES, AT A GROSS WEIGHT OF 25,400 LB, AT AN ALTITUDE OF 5000 FT. (FOR TIME PREDICTION SEE FIGURE 14-49)

SOLUTION: (1) ENTER CHART AT 25,400 LB, MOVE VERTICALLY UP TO INTERSECT THE 5000 FT LINE, THEN HORIZONTALLY TO THE NAUTICAL MILES SCALE TO READ 1660. ADD TO THIS FIGURE THE DISTANCE TO BE COVERED, i.e. 1660 + 200 = 1860.

(2) ENTER CHART AT 1860 NAUTICAL MILES, MOVE HORIZONTALLY TO INTERSECT THE 5000 FT LINE AND DROP VERTICALLY DOWN TO THE GROSS WEIGHT SCALE TO READ 24,700 LB. THE DIFFERENCE IN THE TWO GROSS WEIGHTS IS THE WEIGHT OF FUEL USED i.e. 25,400 - 24,700 = 700 LB.



4F-484

Figure 14-48

LONG RANGE PREDICTION - TIME
BOTH ENGINES OPERATING

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

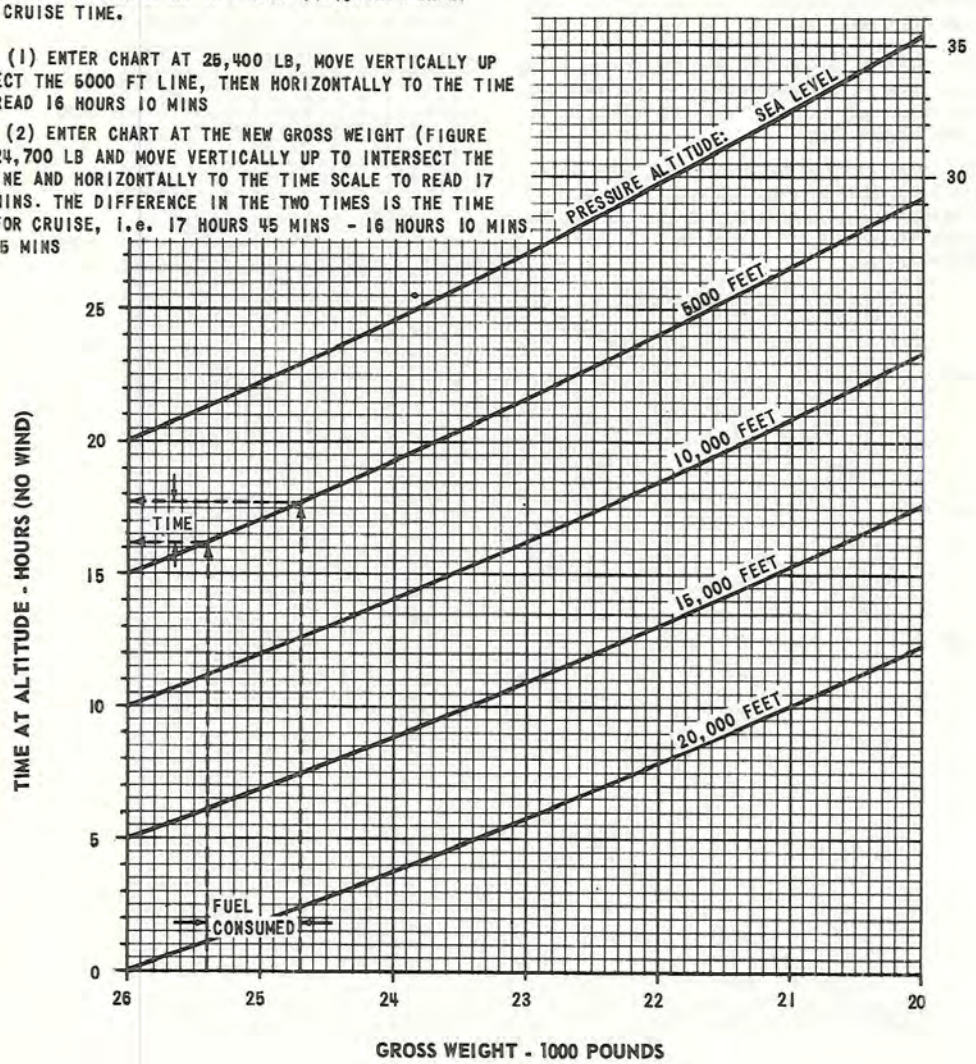
ENGINE (S): (2) R 2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
BASED ON RECOMMENDED
LONG RANGE CRUISING SPEED

EXAMPLE: USE SAME EXAMPLE AS IN FIGURE 14-48. THIS CHART GIVES THE CRUISE TIME.

SOLUTION: (1) ENTER CHART AT 25,400 LB, MOVE VERTICALLY UP TO INTERSECT THE 5000 FT LINE, THEN HORIZONTALLY TO THE TIME SCALE TO READ 16 HOURS 10 MINS

(2) ENTER CHART AT THE NEW GROSS WEIGHT (FIGURE 14-48) OF 24,700 LB AND MOVE VERTICALLY UP TO INTERSECT THE 5000 FT LINE AND HORIZONTALLY TO THE TIME SCALE TO READ 17 HOURS 45 MINS. THE DIFFERENCE IN THE TWO TIMES IS THE TIME REQUIRED FOR CRUISE, i.e. 17 HOURS 45 MINS - 16 HOURS 10 MINS =1 HOUR 35 MINS



4F-485

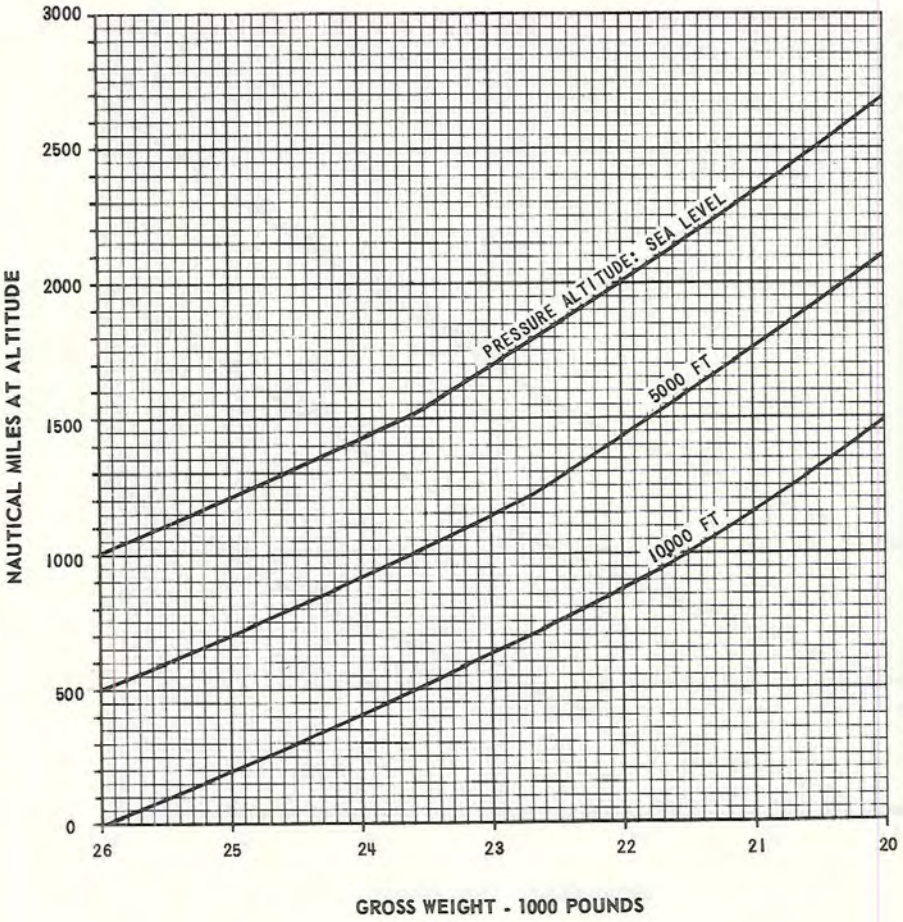
Figure 14-49

LONG RANGE PREDICTION - DISTANCE
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED

MODEL.: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINES: (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED
BASED ON RECOMMENDED
LONG RANGE CRUISING SPEED



4F-486

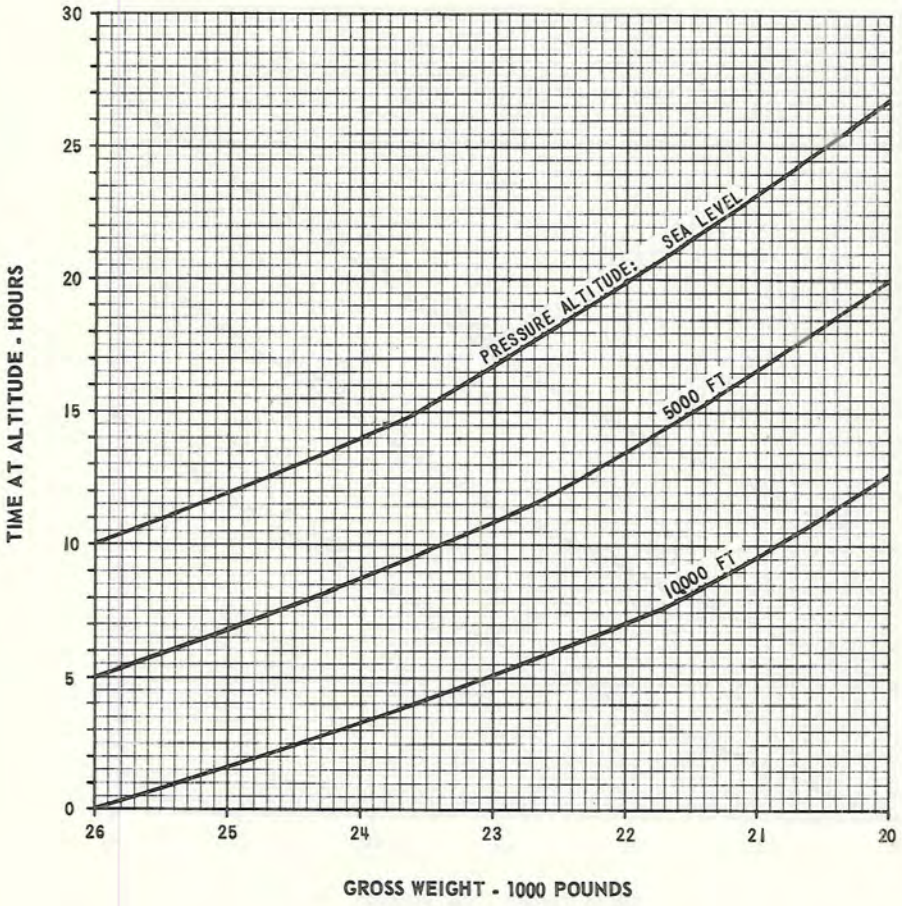
Figure 14-50

LONG RANGE PREDICTION - TIME
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
BASED ON RECOMMENDED
LONG RANGE CRUISING SPEED



4F-487

Figure 14-51

DESCENT RANGE

CLEAN CONFIGURATION - BOTH PROPELLERS FEATHERED

MODEL: CV-?
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

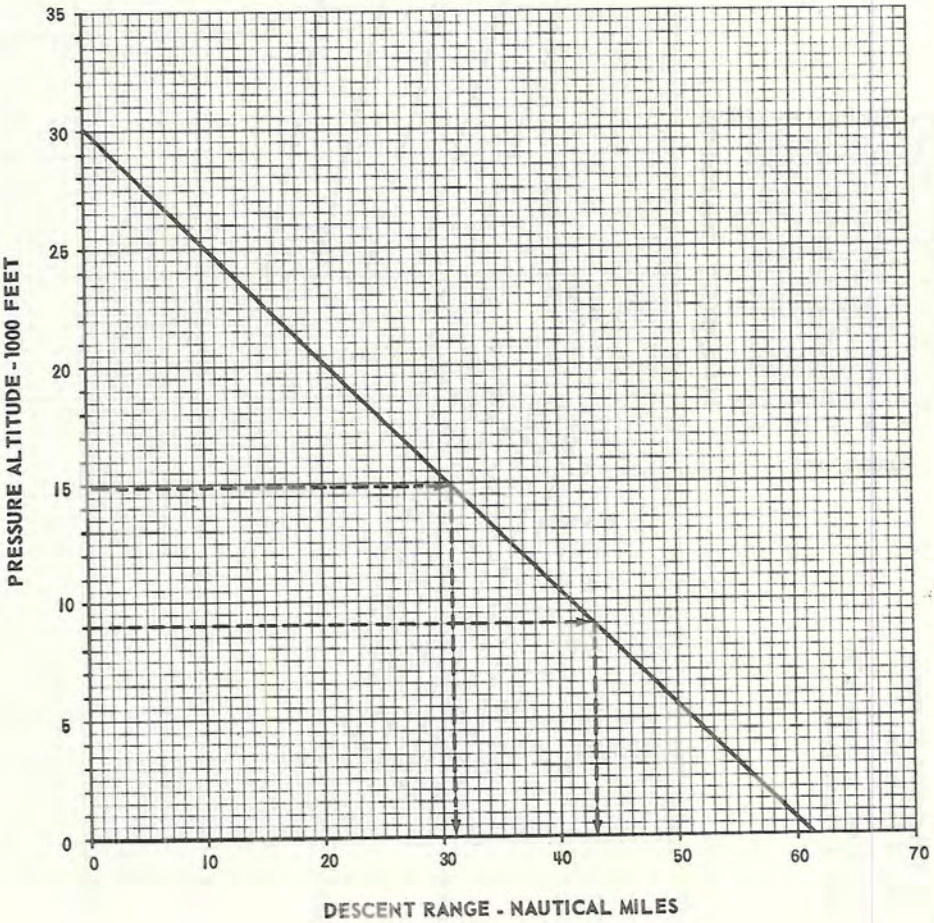
EXAMPLE: (----→)
FIND DISTANCE FLOWN DURING DESCENT FROM 14,900 FEET TO 9000 FEET.

ENTER CHART AT 14900 FEET ON VERTICAL SCALE AND FIND THE CORRESPONDING VALUE OF 31 NAUTICAL MILES ON THE HORIZONTAL SCALE.

REPEAT THE PROCESS AT 9000 FEET AND FIND CORRESPONDING VALUE OF 43 NAUTICAL MILES.

THE DESCENT RANGE = 43 - 31 = 12 NAUTICAL MILES.

GROSS WEIGHT POUNDS	C A S KNOTS
20,000	90
22,000	94
24,000	98
26,000	102



4F-495

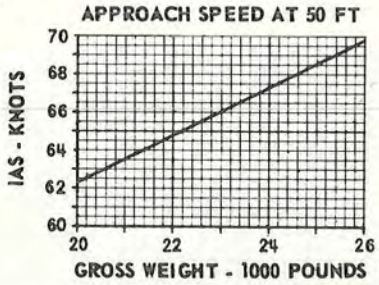
Figure 14-52

LANDING DISTANCE
GROUND ROLL. NORMAL TECHNIQUE (FLAPS 40°)

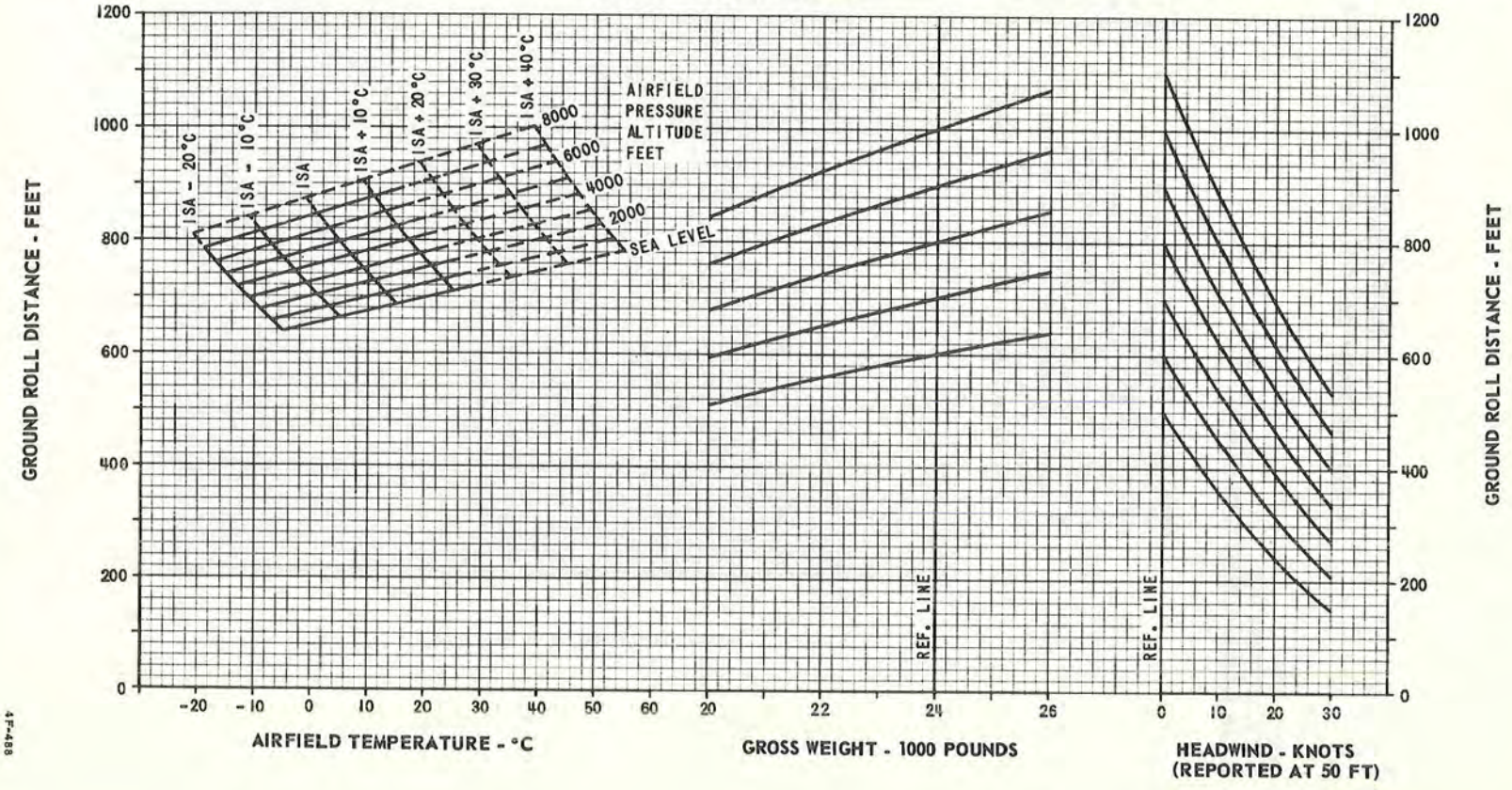
MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
1. DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.
2. FOR DISTANCE TO CLEAR 50 FT REFER TO FIGURE 14-54



STANDARD DAY (ISA)					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT	GROUND ROLL-FT	CLEAR 50FT-FT
26000	SEA LEVEL	735	1540	290	830
	5000	850	1750	365	950
23000	SEA LEVEL	660	1440	245	750
	5000	770	1620	315	870



4F-488

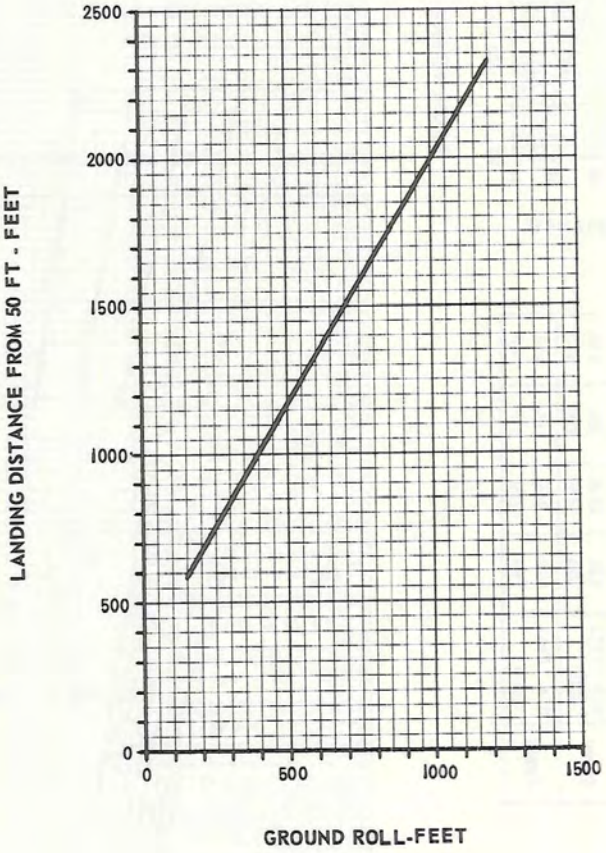
Figure 14-53

LANDING DISTANCE

LANDING DISTANCE FROM 50 FEET VERSUS GROUND ROLL
NORMAL TECHNIQUE (FLAPS 40°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-489

Figure 14-54

LANDING DISTANCE

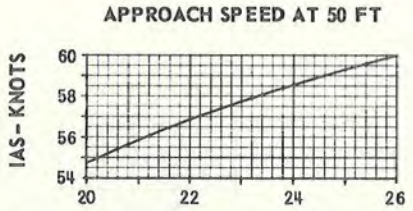
GROUND ROLL. SHORT-FIELD TECHNIQUE (FLAPS 40°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
1. DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.
2. FOR DISTANCE TO CLEAR 50 FT REFER TO FIGURE 14-56

STANDARD DAY (ISA)					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT	GROUND ROLL-FT	CLEAR 50FT-FT
26000	SEA LEVEL	525	1030	195	470
	5000	605	1160	250	570
23000	SEA LEVEL	470	950	165	410
	5000	545	1060	210	500



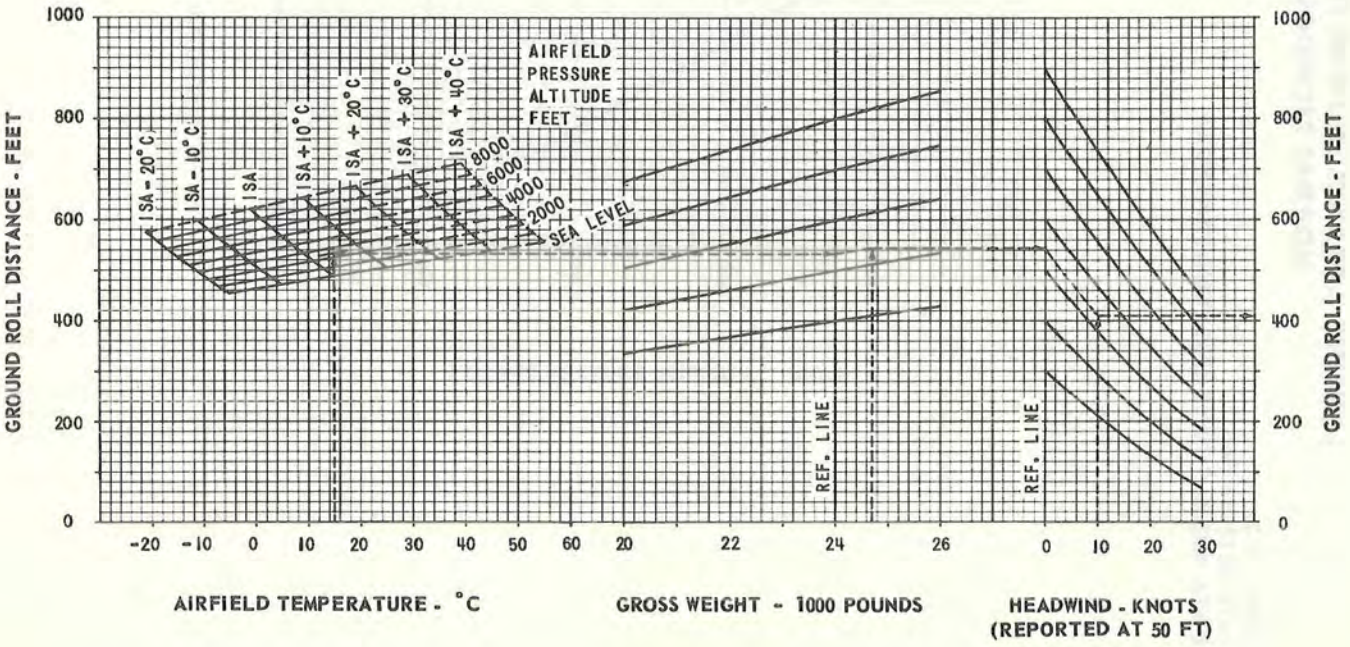


Figure 14-55

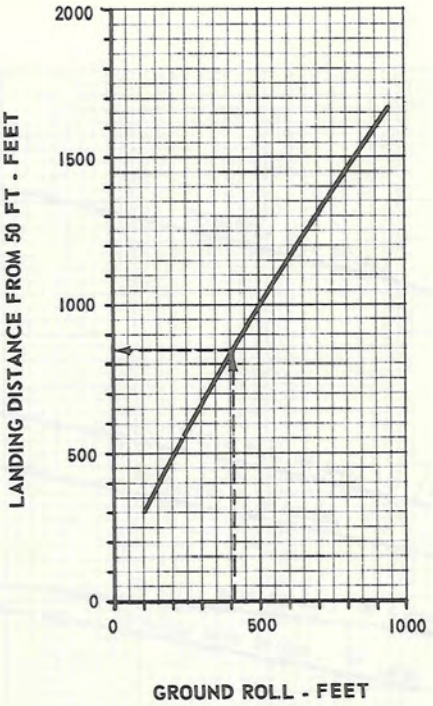
4F-490

LANDING DISTANCE

LANDING DISTANCE FROM 50 FEET VERSUS GROUND ROLL
SHORT-FIELD TECHNIQUE (FLAPS 40°)

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



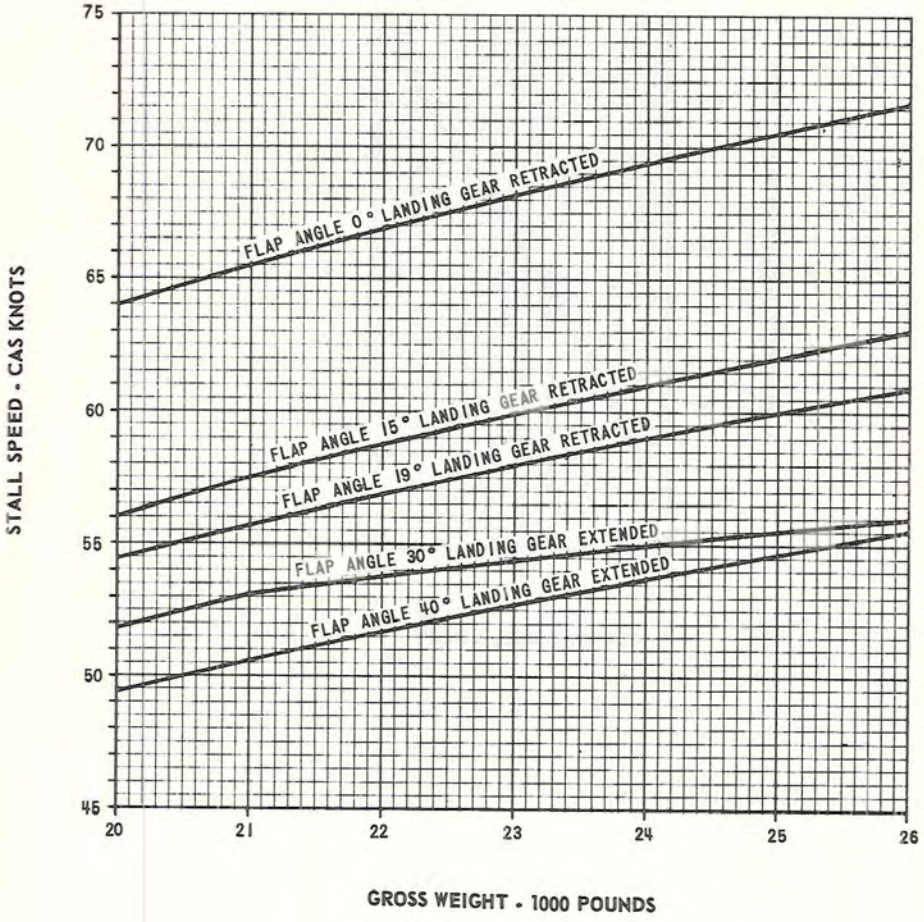
4F-491

Figure 14-56

STALL SPEED
POWER OFF
CG AT FORWARD LIMIT

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-492

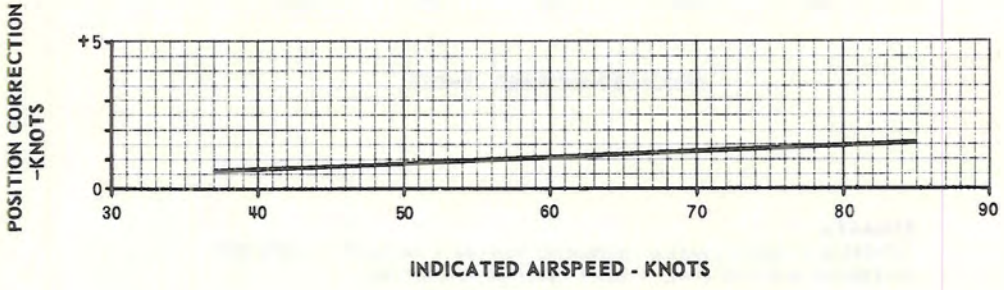
Figure 14-57

POSITION ERROR CORRECTION TO INDICATED AIRSPEED DURING GROUND ROLL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
FLAPS - TAKE-OFF
ENGINES - TAKE-OFF POWER
ALL WEIGHTS



4F-1228

Figure 14-58

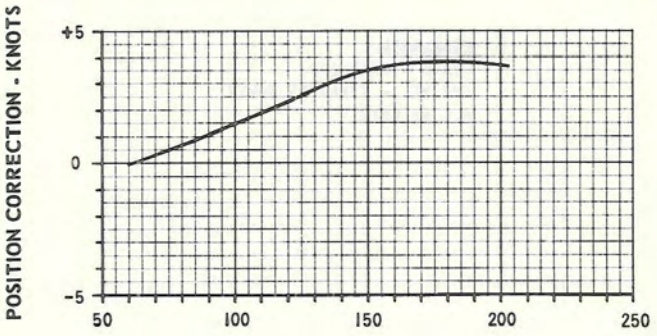
POSITION ERROR CORRECTION TO INDICATED AIRSPEED

ALL AIRCRAFT WEIGHTS - CLEAN CONFIGURATION

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



REMARKS:
INDICATED AIRSPEED (IAS) = INSTRUMENT READING + INSTRUMENT CORRECTION
CALIBRATED AIRSPEED (CAS) = IAS + POSITION CORRECTION

4F-1229

Figure 14-59

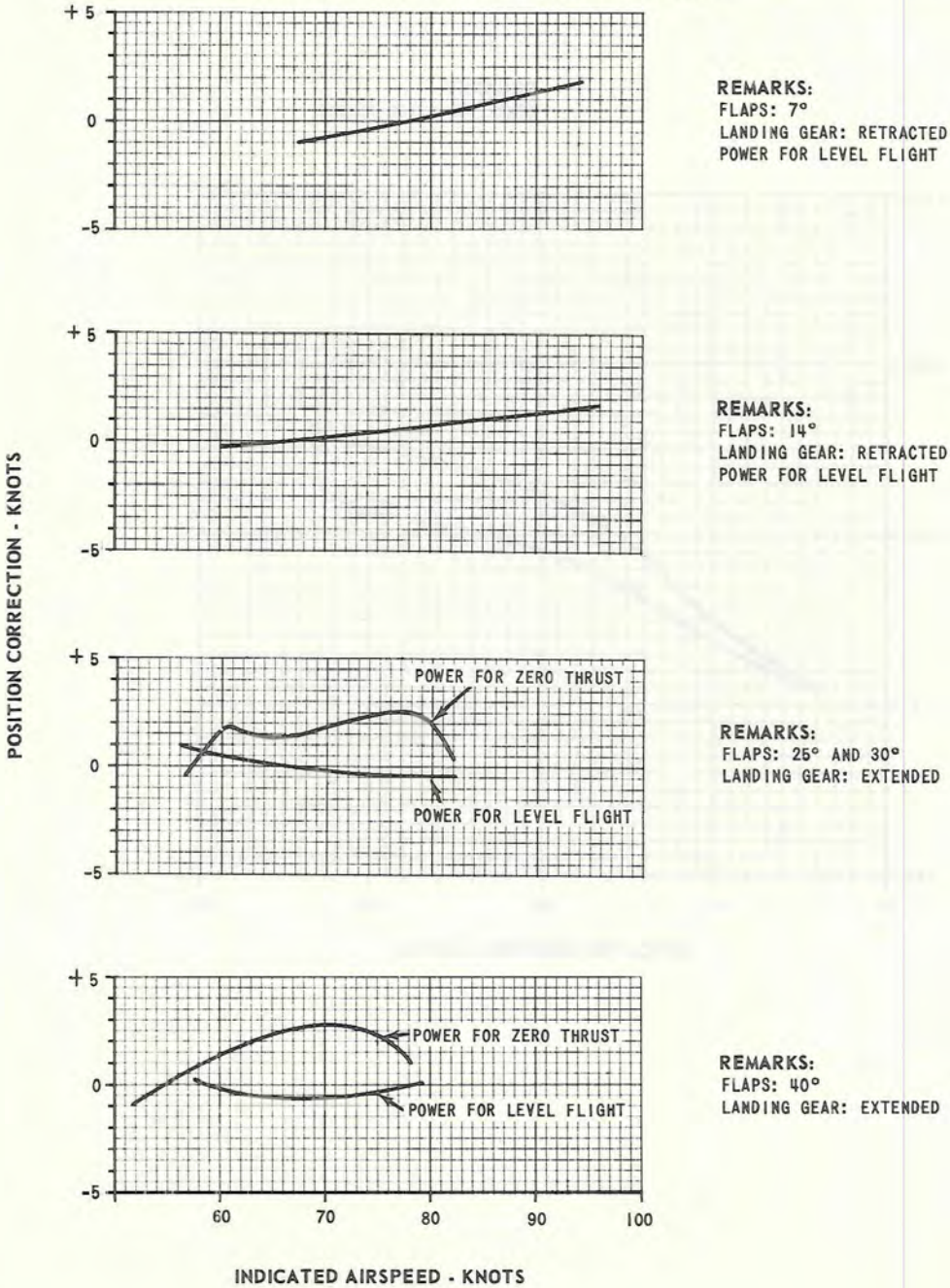
POSITION ERROR CORRECTION TO INDICATED AIRSPEED

ALL AIRCRAFT WEIGHTS - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: APRIL 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

INDICATED AIRSPEED (IAS) = INSTRUMENT READING + INSTRUMENT CORRECTION
CALIBRATED AIRSPEED (CAS) = IAS + POSITION CORRECTION



REMARKS:
FLAPS: 7°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 14°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 25° AND 30°
LANDING GEAR: EXTENDED

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED

4F-1158

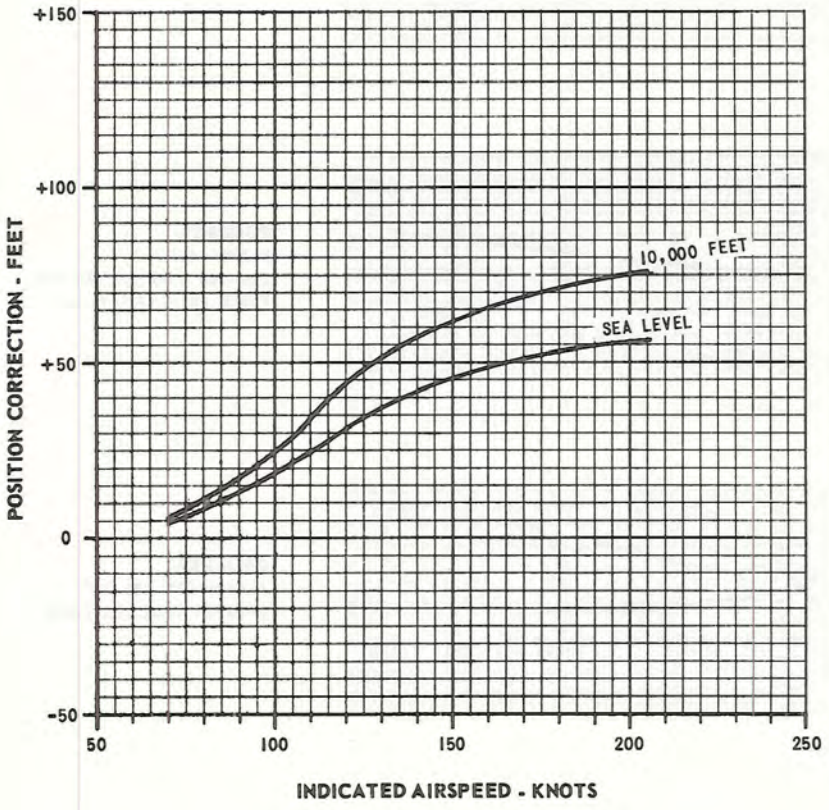
Figure 14-60

POSITION ERROR CORRECTION TO ALTIMETER
AIRCRAFT WEIGHT 20,000LB - CLEAN CONFIGURATION

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



4F-1230

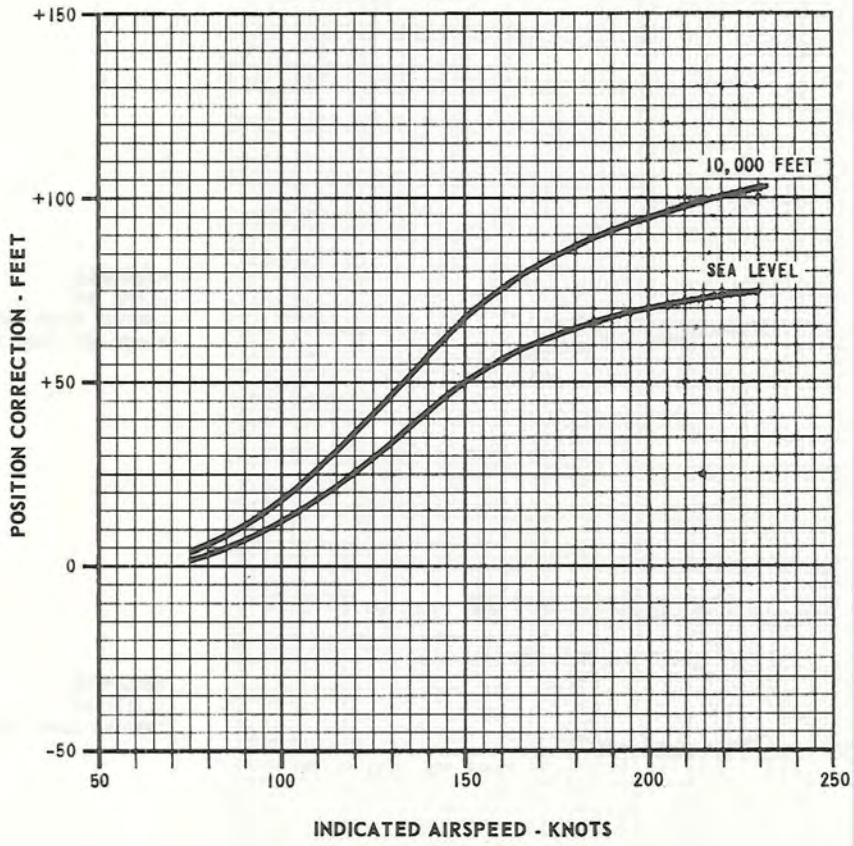
Figure 14-61

POSITION ERROR CORRECTION TO ALTIMETER
AIRCRAFT WEIGHT 28,500 LB. - CLEAN CONFIGURATION

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
POWER FOR LEVEL FLIGHT



4F 1159

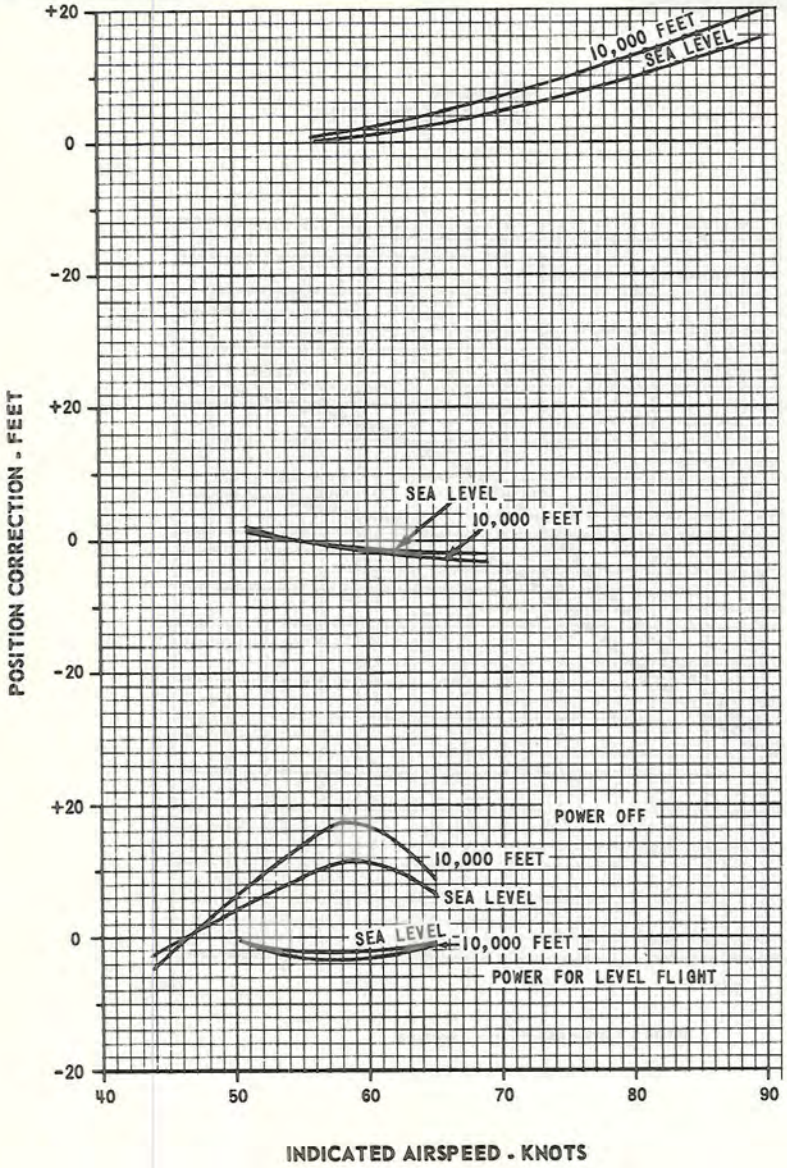
Figure 14-62

POSITION ERROR CORRECTION TO ALTIMETER

AIRCRAFT WEIGHT 20,000LB - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



REMARKS:
FLAPS: 7° AND 14°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 30°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED

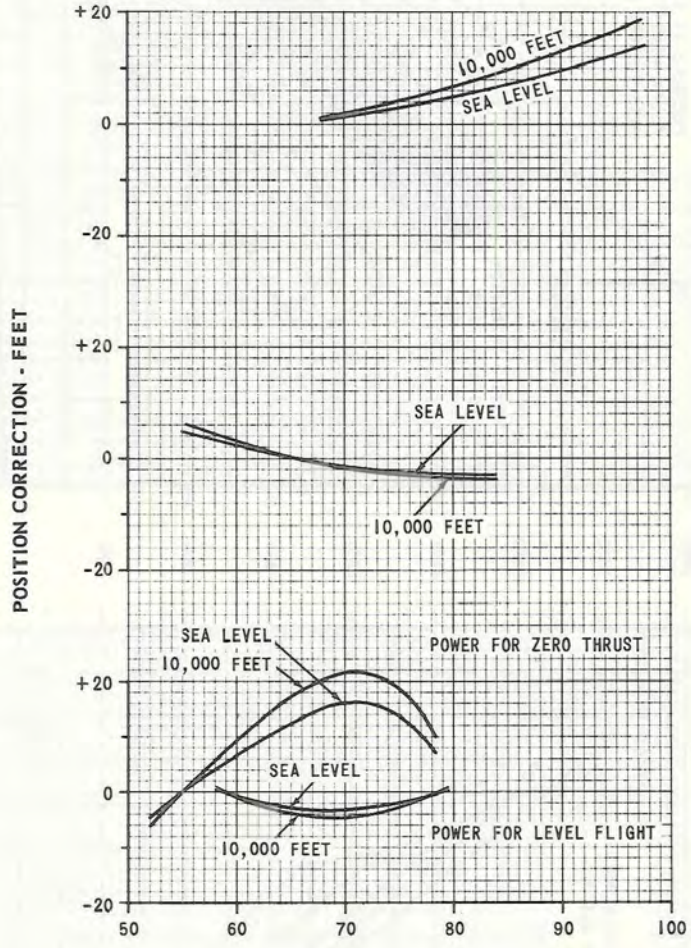
4F-1160

Figure 14-63

POSITION ERROR CORRECTION TO ALTIMETER
AIRCRAFT WEIGHT 28,500LB - VARIOUS CONFIGURATIONS

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



REMARKS:
FLAPS: 7° AND 14°
LANDING GEAR: RETRACTED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 25° AND 30°
LANDING GEAR: EXTENDED
POWER FOR LEVEL FLIGHT

REMARKS:
FLAPS: 40°
LANDING GEAR: EXTENDED

4F-1161

Figure 14-64

ENGINE OPERATING LIMITS
AUTO RICH

MODEL: CV-2
DATE: APRIL 1948
DATA BASIS: ENGINE CONTRACTOR

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

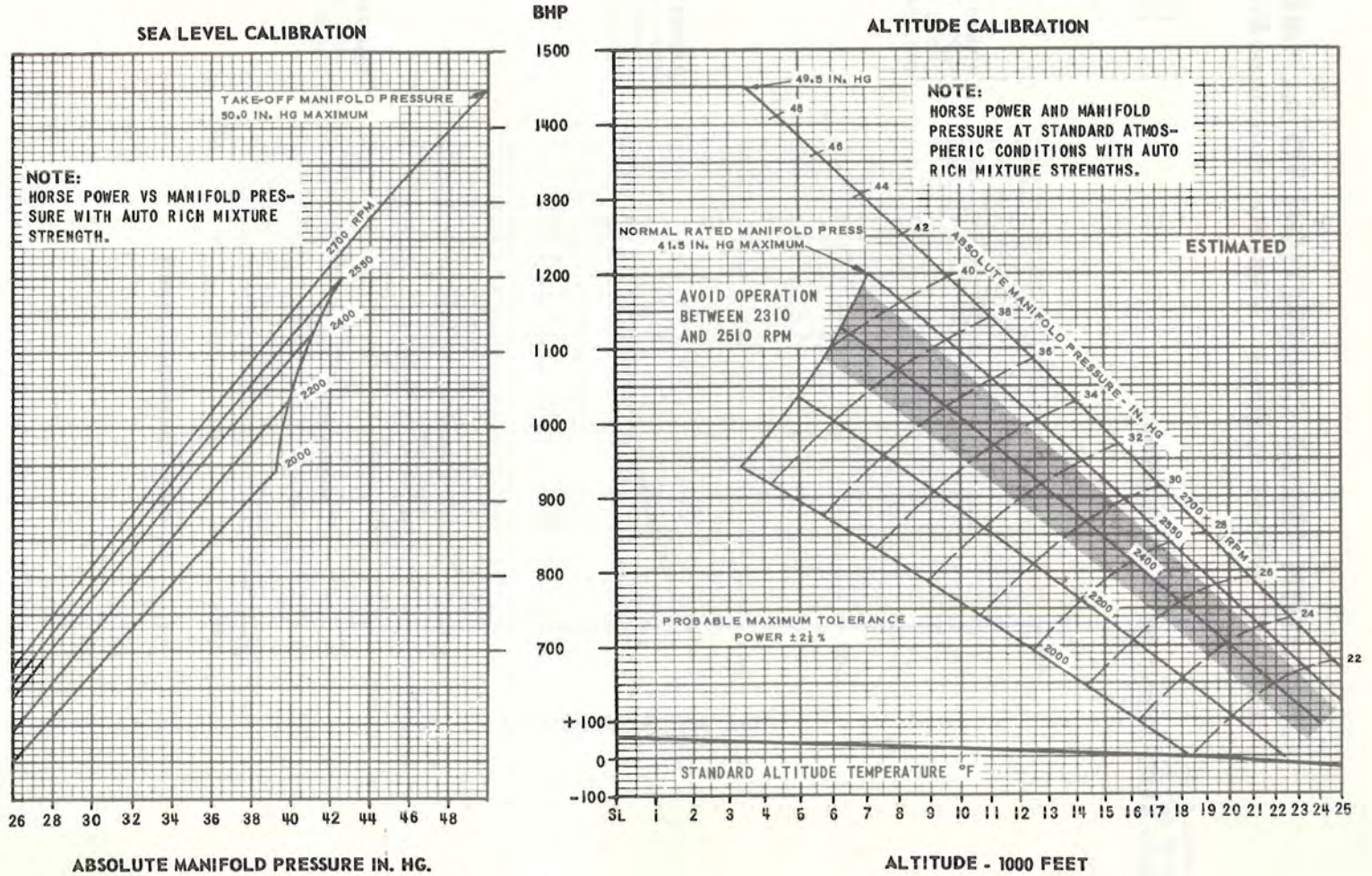


Figure 14-65

ENGINE OPERATING LIMITS
AUTO LEAN

MODEL: CV-2
DATE: APRIL 1948
DATA BASIS: ENGINE CONTRACTOR

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

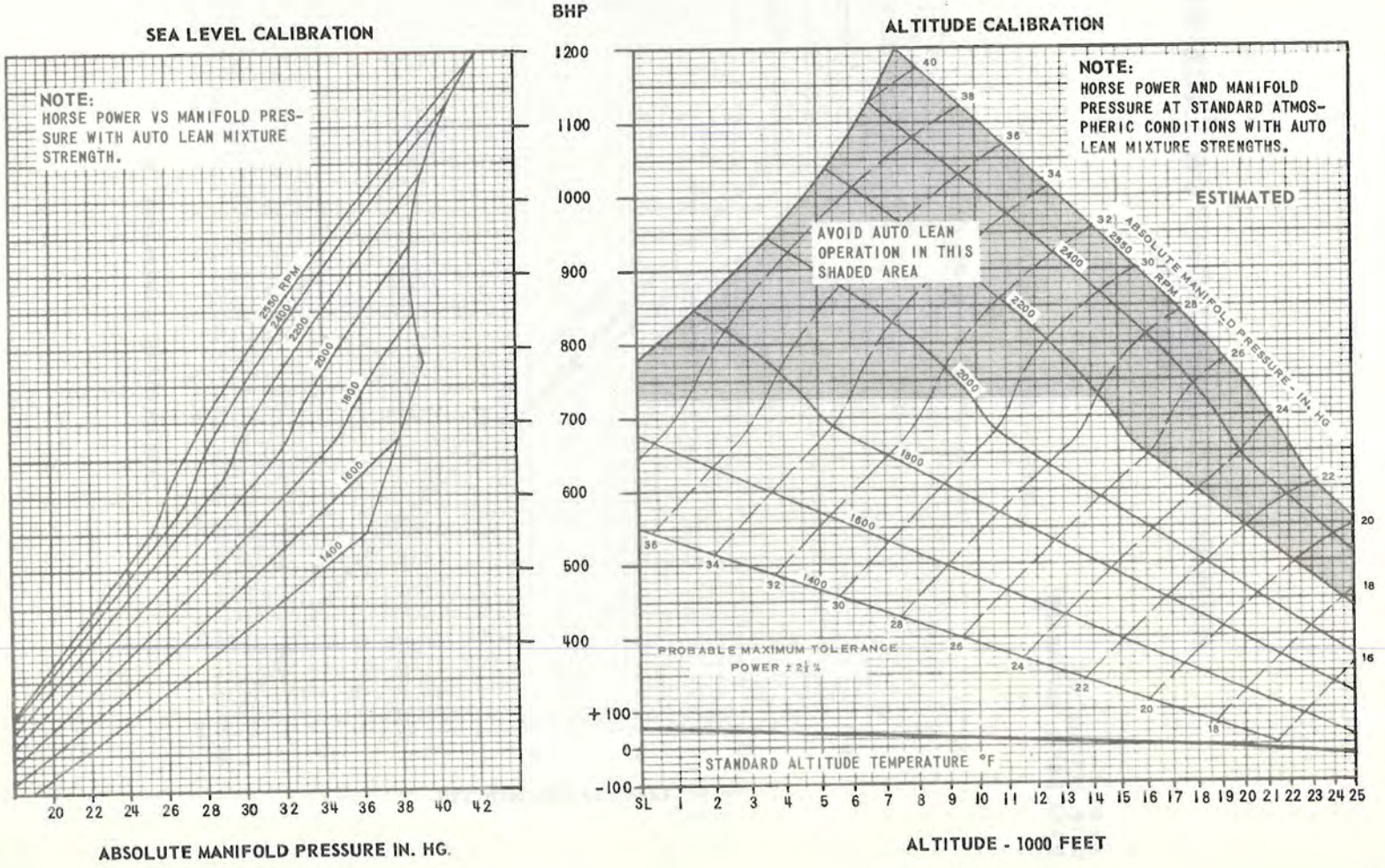


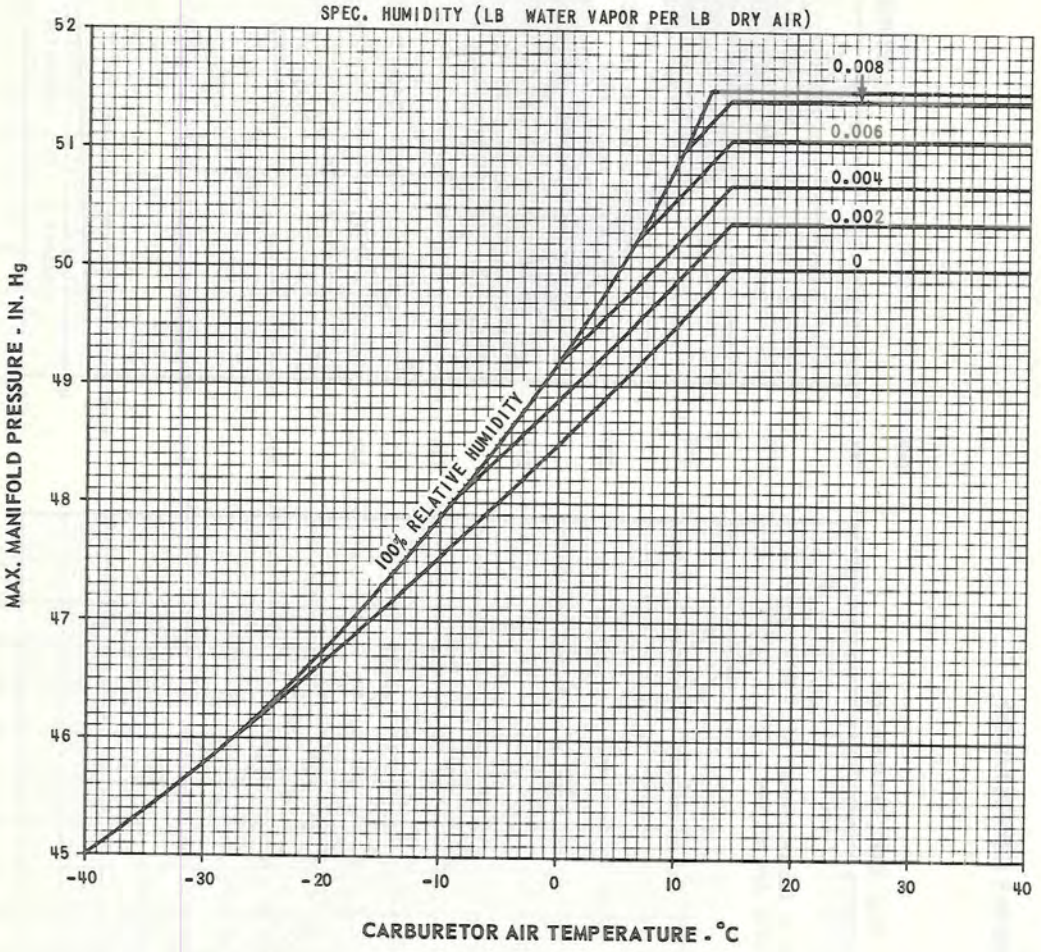
Figure 14-66

HUMIDITY CORRECTION FOR TAKE-OFF
SEA LEVEL

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: (ESTIMATED)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE: FOR PSYCHROMETRIC CHART SEE FIG. 14-3



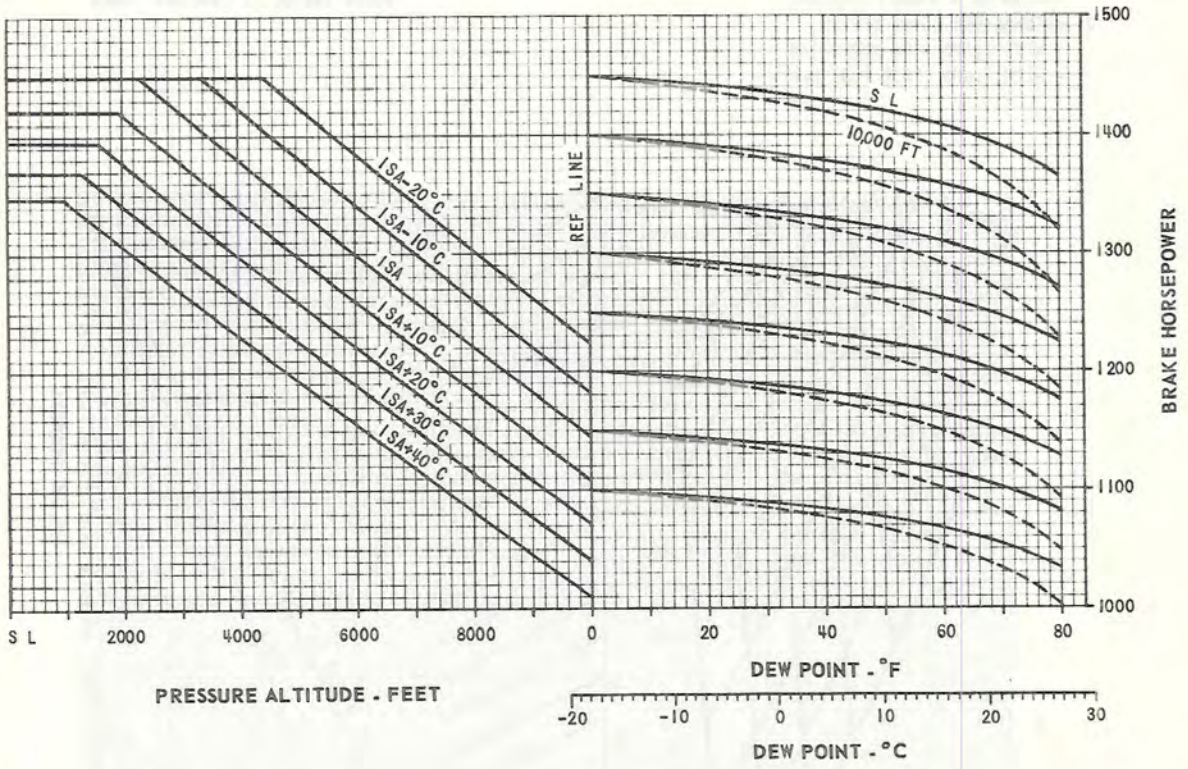
4F-1233

Figure 14-67

BRAKE HORSEPOWER AVAILABLE FOR TAKE-OFF

MODEL: CV-2
DATE: OCTOBER 1960
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-1234

Figure 14-68

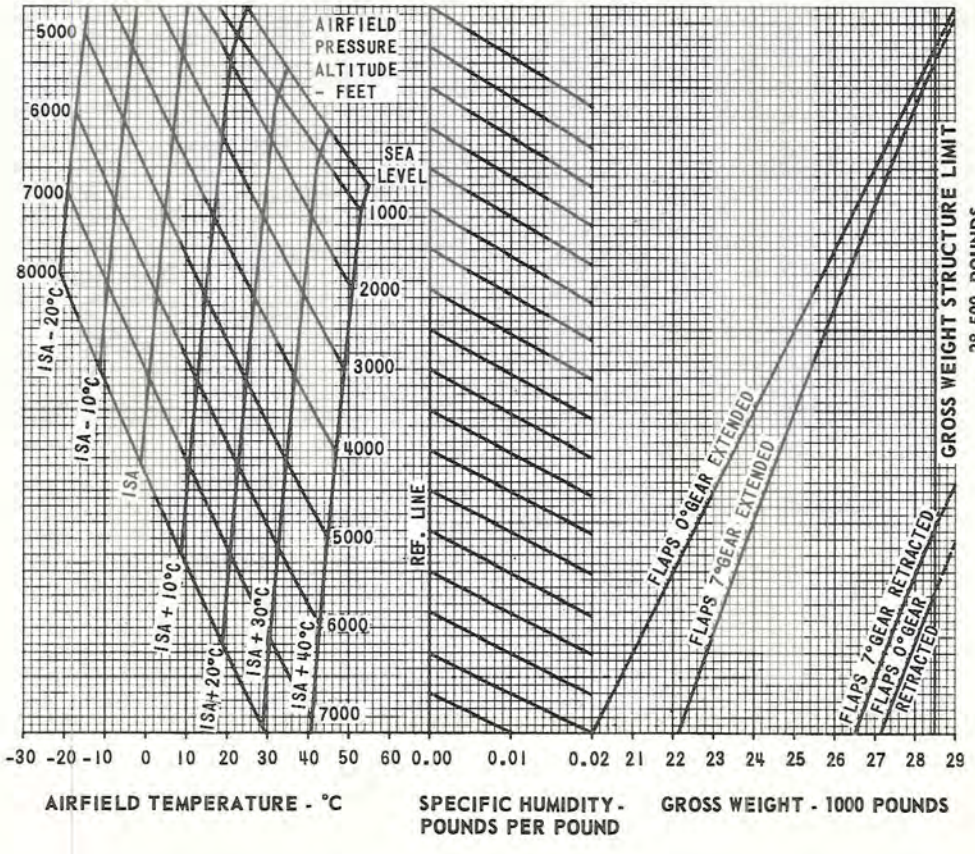
TAKE-OFF GROSS WEIGHT LIMITATION
ONE ENGINE INOPERATIVE

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
1. LIMIT BASED ON A RATE OF CLIMB 100 FPM FOLLOWING A NORMAL TAKE-OFF
2. RECOMMENDED CLIMB SPEED:
   - WITH FLAPS 0° 95 KNOTS IAS
   - WITH FLAPS 7° SEE FIG. 14-71

REMARKS:
PROPELLER FEATHERED
OTHER ENGINE AT TAKE-OFF POWER



4F-1162

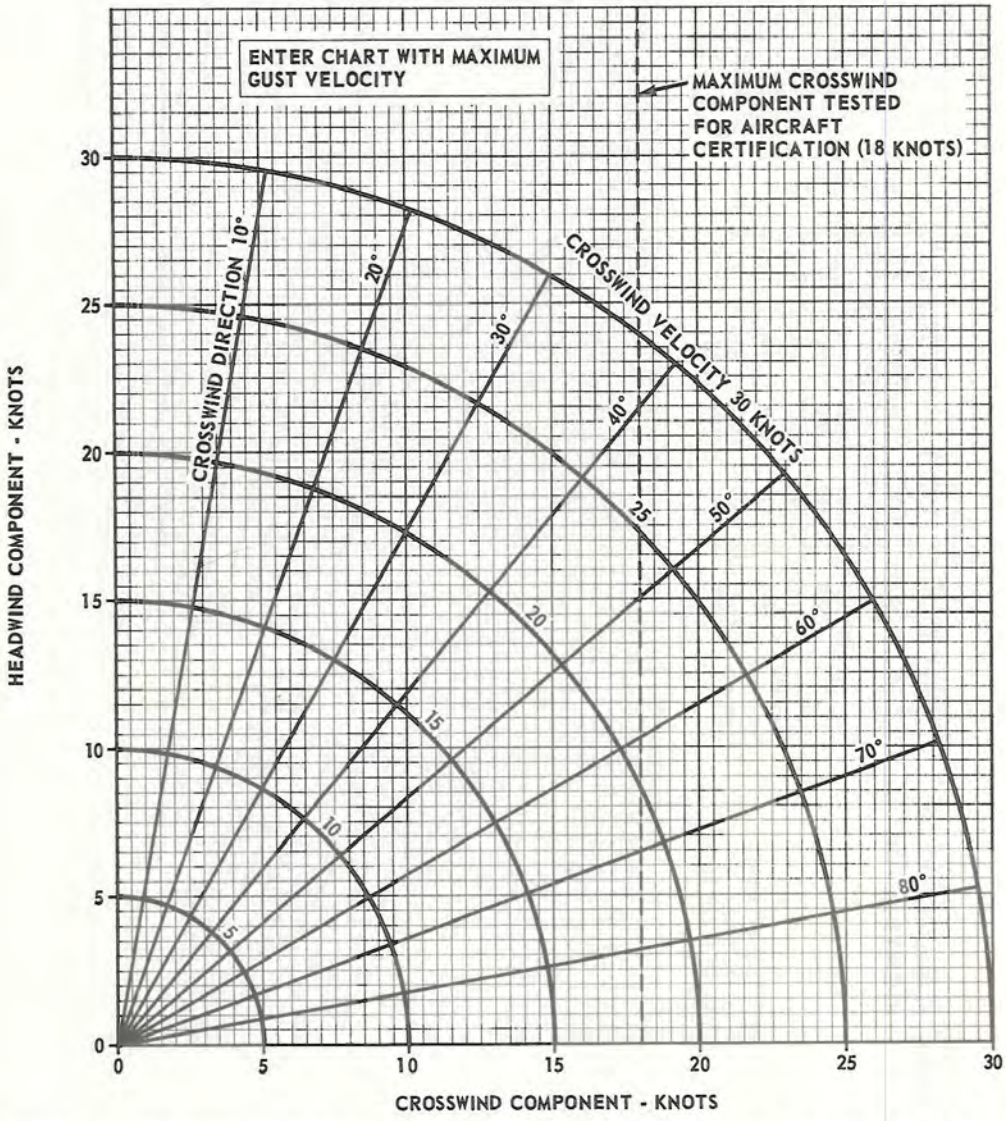
Figure 14-69

CROSSWIND COMPONENT CHART

MODEL: CV-2
DATE: DECEMBER 1961
DATA BASIS: ESTIMATED

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

TAKE-OFF AND LANDING SPEED APPROPRIATE TO ALL CROSSWIND CONDITIONS		
GROSS WEIGHT 28,500 LB		
FLAP SETTING	TAKE-OFF SPEED (1) KNOTS, IAS	LANDING APPROACH SPEED (2) KNOTS, IAS
7°	82	—
14°	—	84
30°	—	74 (3)



NOTE:
1. KEEP NOSEWHEEL ON GROUND UNTIL RUDDER BECOMES EFFECTIVE DURING TAKE-OFF
2. TOUCHDOWN IAS IS APPROXIMATELY 10 KNOTS LESS THAN IN APPROACH
3. INCREASE APPROACH SPEED BY 5 KNOTS IN GUSTY CONDITIONS

4F-1235

Figure 14-70

TAKE-OFF CURVE

GROUND ROLL - NORMAL TECHNIQUE (FLAPS 7°)

MODEL CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA)						
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND			30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT		GROUND ROLL-FT	CLEAR 50FT-FT
28,500	SEA LEVEL	1300	2000		720	1220
	5000	1780	2650		1020	1620
26,000	SEA LEVEL	1060	1670		570	1010
	5000	1430	2170		800	1320
23,000	SEA LEVEL	820	1350		430	820
	5000	1090	1720		590	1040

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.
FOR DISTANCE TO CLEAR 50 FT REFER TO FIG. 14-73

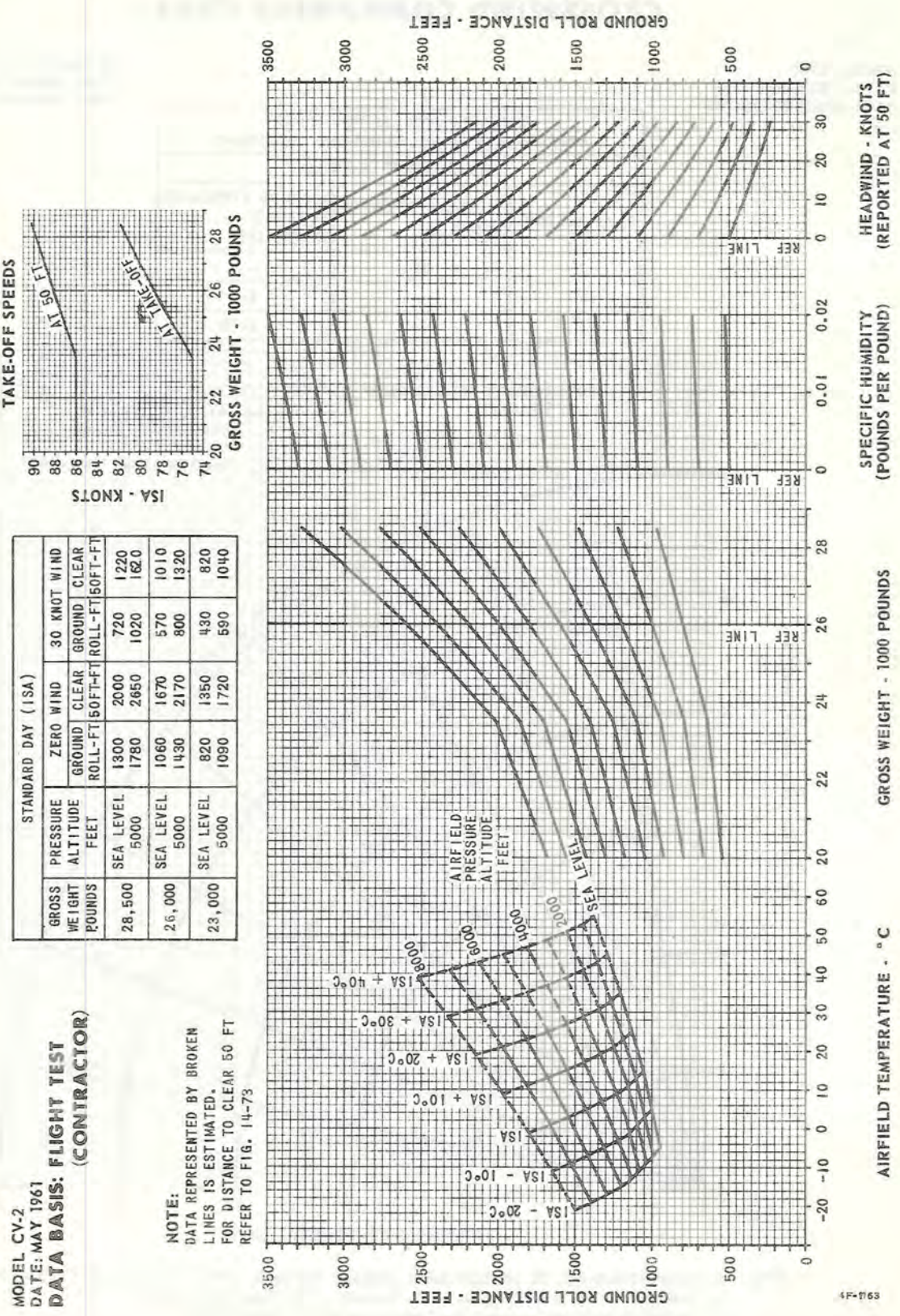


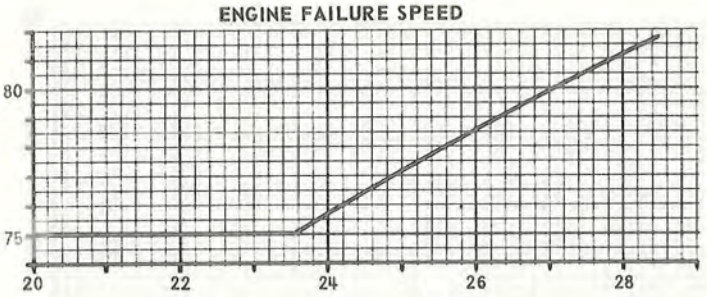
Figure 14-71

ACCELERATE-STOP DISTANCE

(FLAPS 7°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

STANDARD DAY (ISA); DRY AIR			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
28,500	SEA LEVEL 5000	3110 4420	1775 2545
26,000	SEA LEVEL 5000	2730 3350	1515 1940
23,000	SEA LEVEL 5000	2370 2860	1265 1600

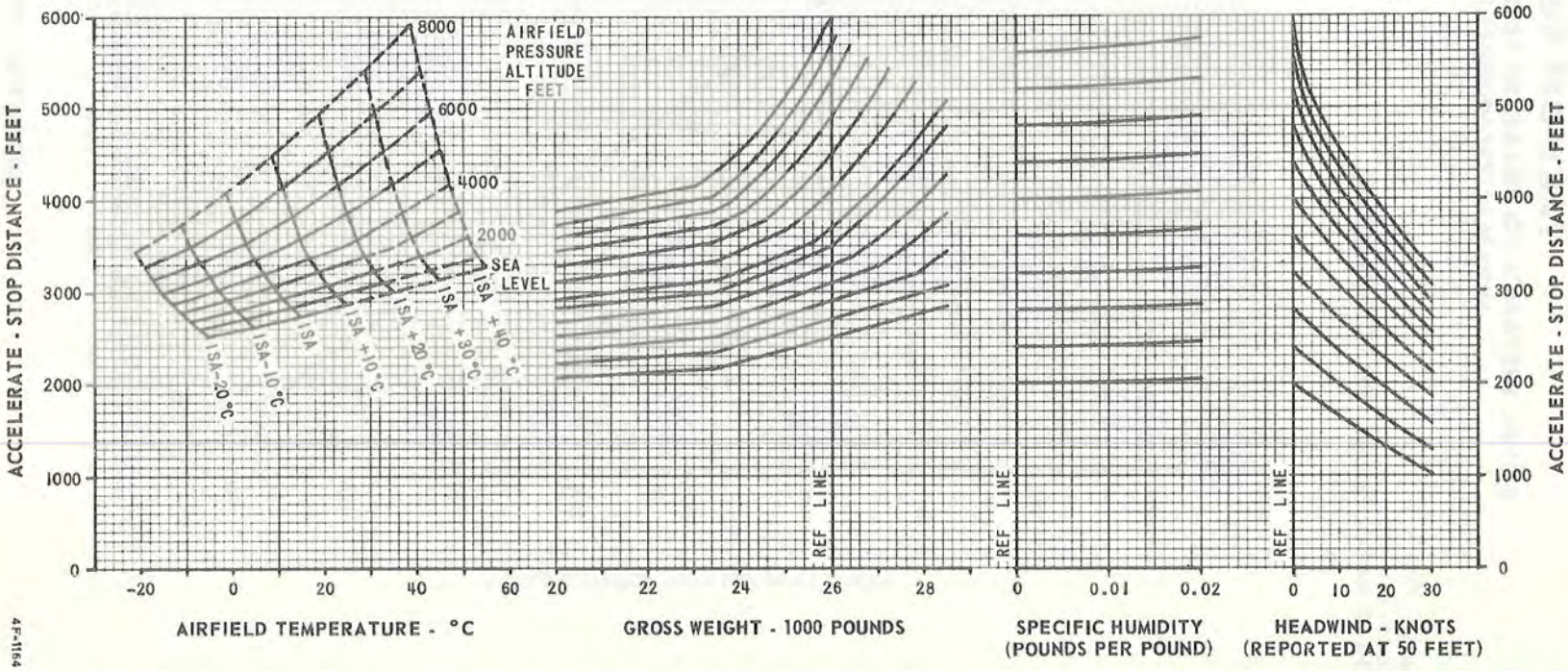


Figure 14-72

TAKE-OFF CURVE

TOTAL DISTANCE TO CLEAR 50 FEET VERSUS GROUND ROLL
NORMAL TECHNIQUE (FLAPS 7°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

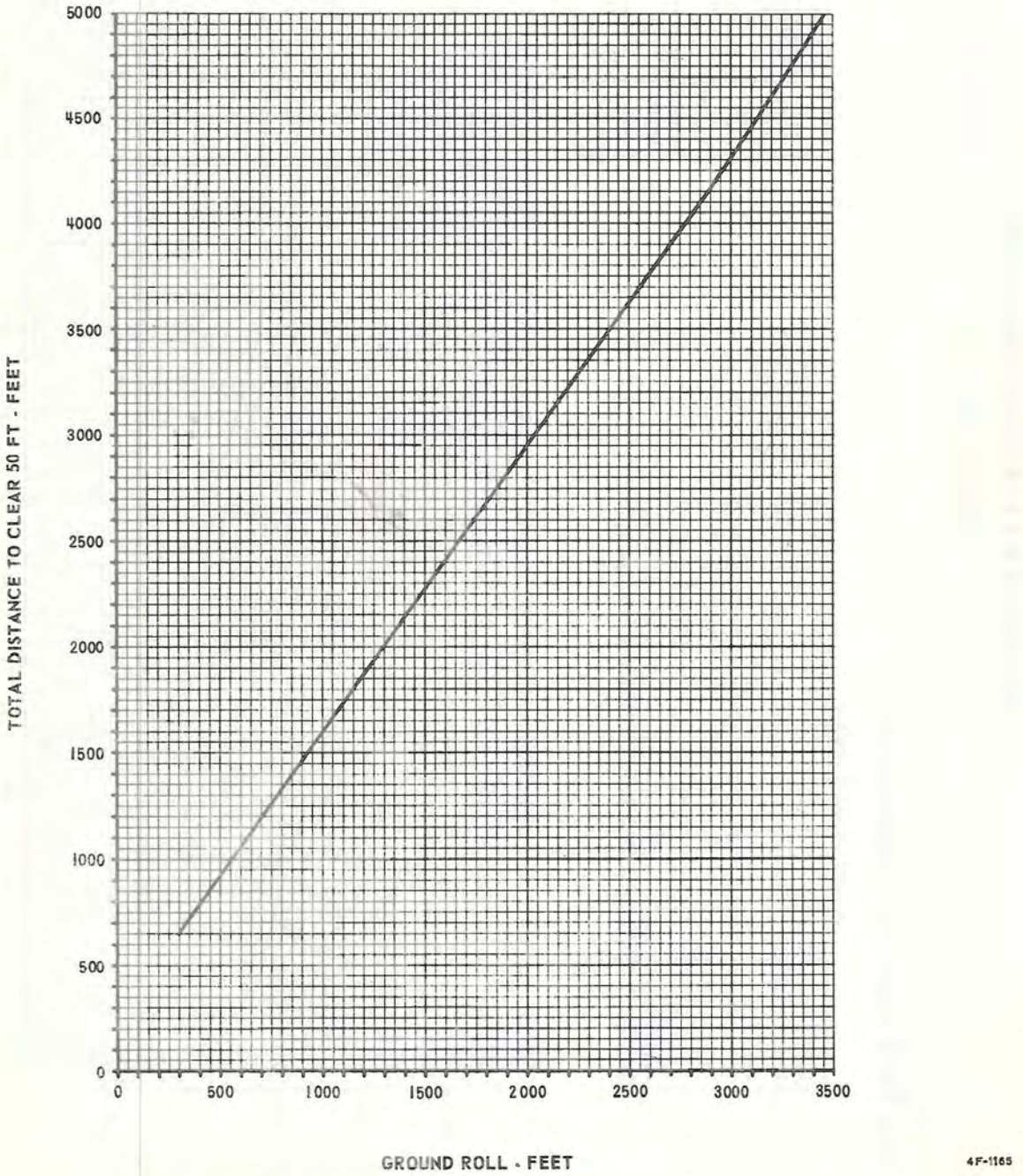


Figure 14-73

CLIMB-OUT CURVE

HORIZONTAL DISTANCE TRAVERSED FROM 50 FEET TO FIVE-MINUTE POINT

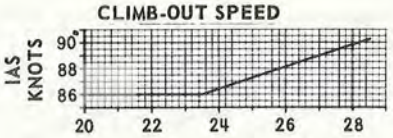
NORMAL TECHNIQUE (FLAPS 7°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

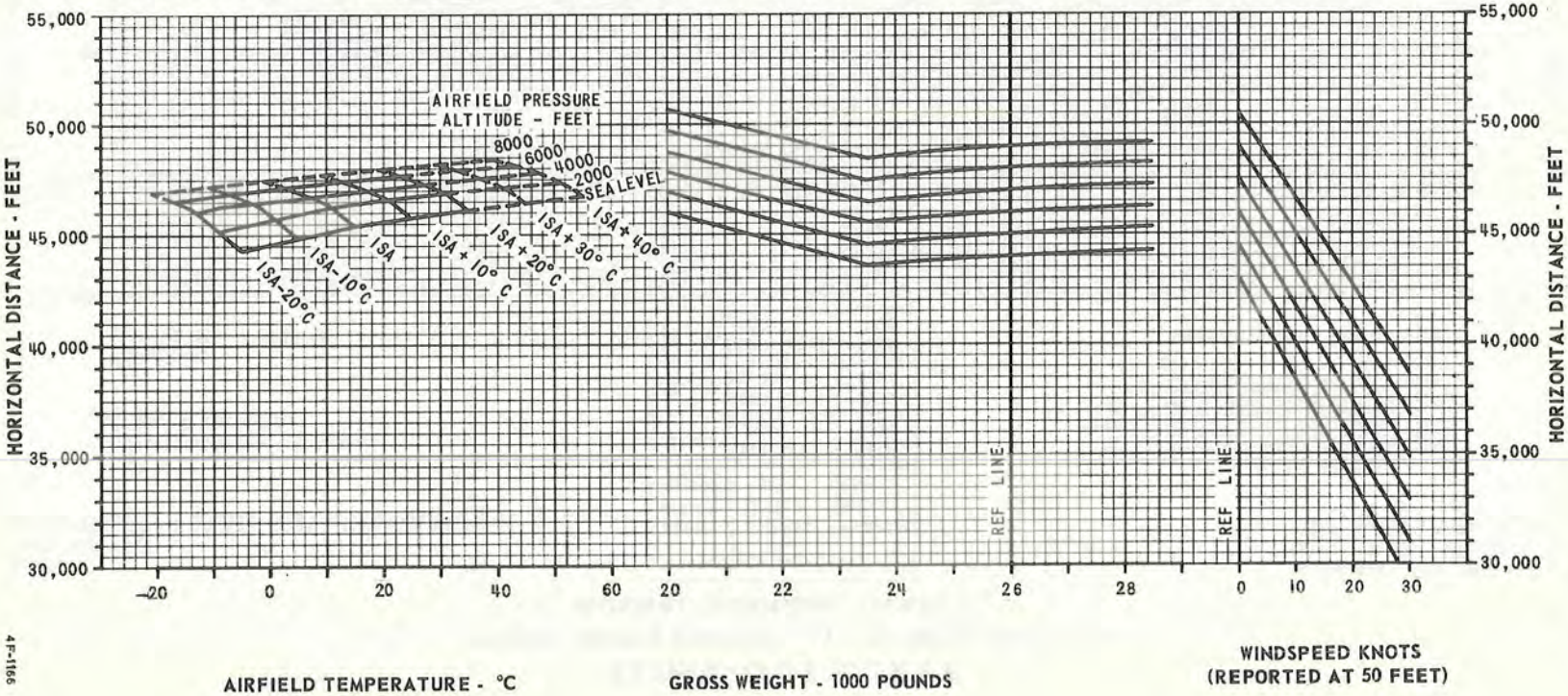
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HORIZONTAL DISTANCE - FT	
		ZERO WIND	30 KNOT WIND
28,500	SEA LEVEL	45,700	32,600
	5000	47,100	34,500
26,000	SEA LEVEL	45,400	32,200
	5000	46,900	34,200
23,000	SEA LEVEL	45,200	31,800
	5000	46,700	33,900

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

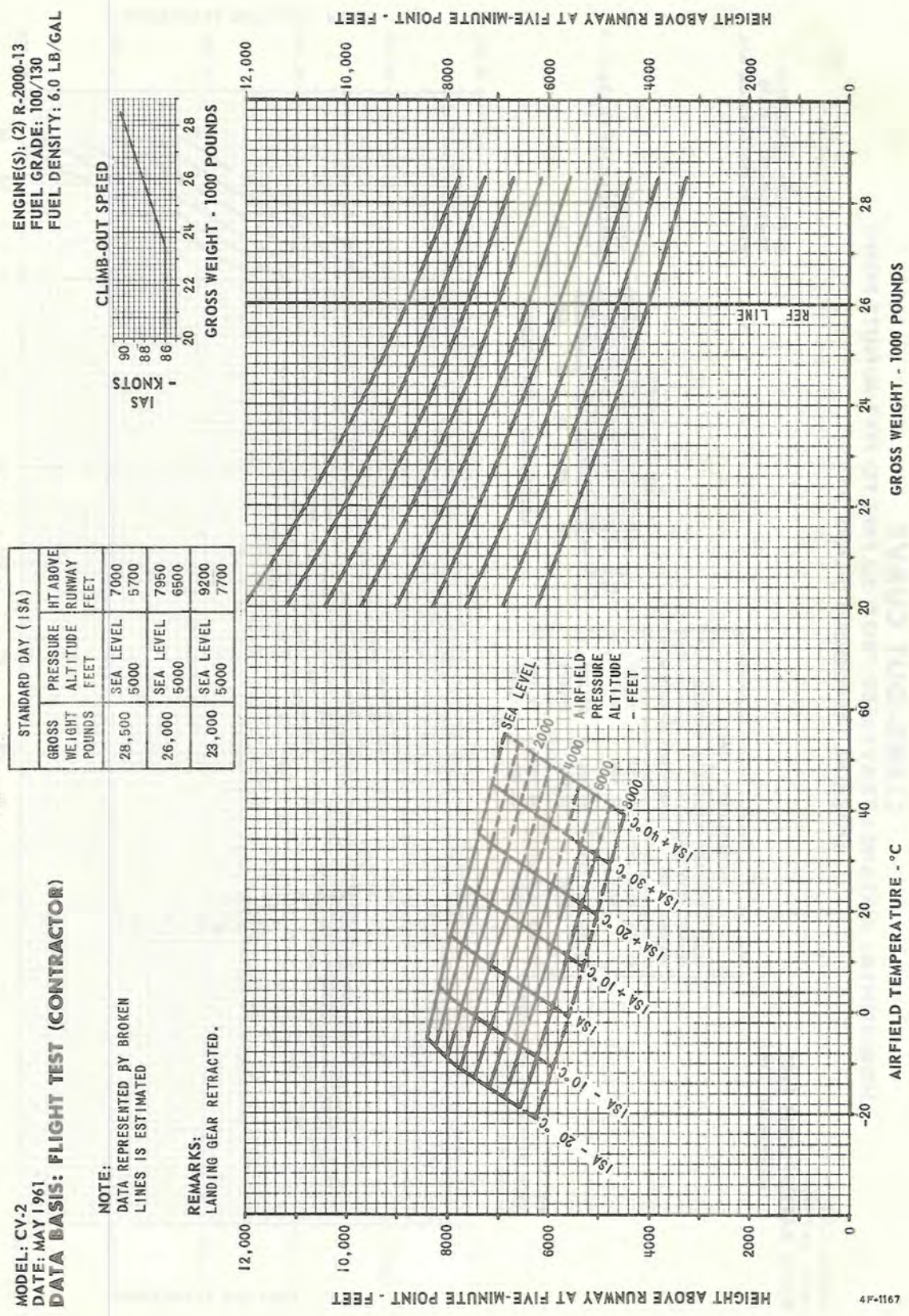


REMARKS:
LANDING GEAR RETRACTED



4F-1166

Figure 14-74



STANDARD DAY (ISA)		
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HT ABOVE RUNWAY FEET
28,500	SEA LEVEL	7000
	5000	5700
26,000	SEA LEVEL	7950
	5000	6500
23,000	SEA LEVEL	9200
	5000	7700

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

REMARKS:
LANDING GEAR RETRACTED.

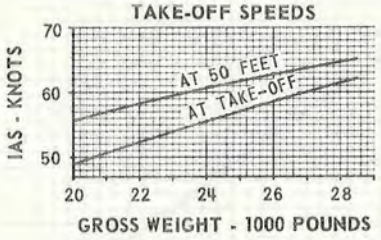
Figure 14-75

TAKE-OFF CURVE
SHORT-FIELD TECHNIQUE (FLAPS 25°)
GROUND ROLL

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/ 130
FUEL DENSITY: 6.0 LB/GAL

STANDARD DAY (ISA): DRY AIR					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT	GROUND ROLL-FT	CLEAR 50FT-FT
28,500	SEA LEVEL	735	1205	320	640
	5000	1035	1605	495	880
26,000	SEA LEVEL	565	980	230	510
	5000	785	1275	340	670
23,000	SEA LEVEL	400	755	130	350
	5000	560	975	225	500



NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED.
FOR DISTANCE TO CLEAR 50-FT OBSTACLE REFER TO FIGURE 14-77

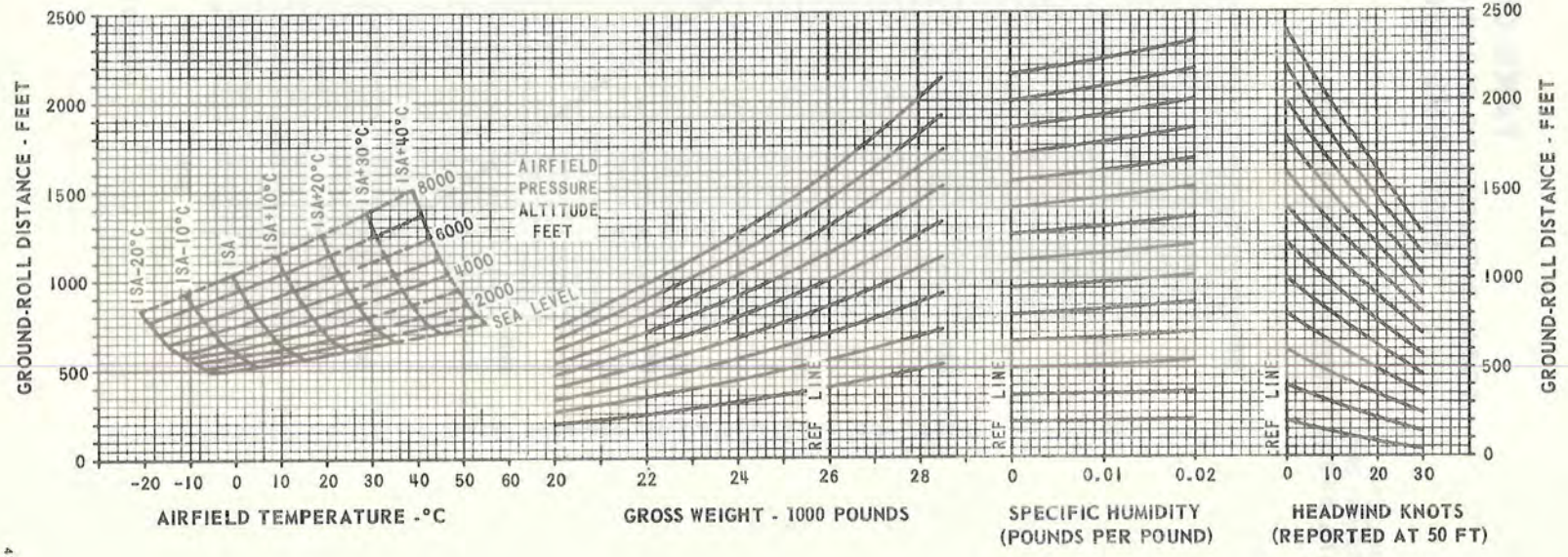


Figure 14-76

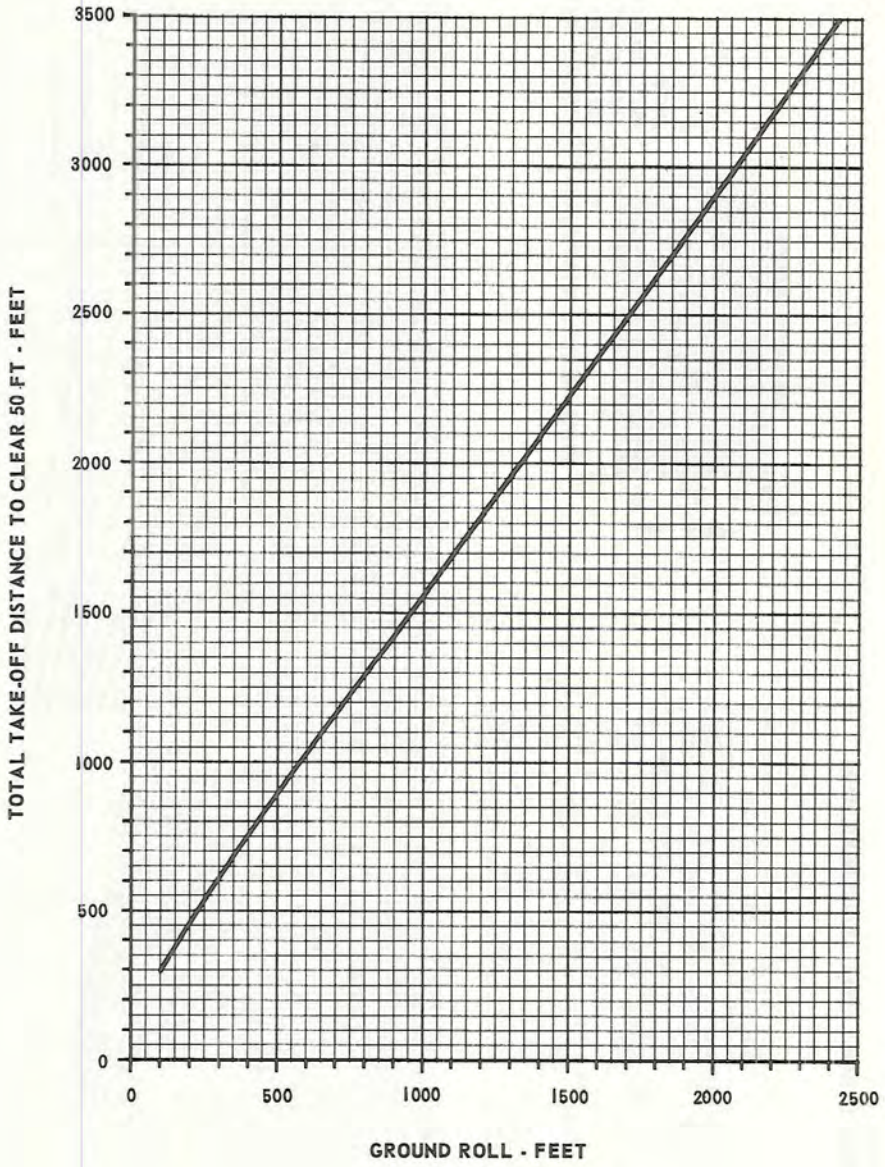
4 FI-1916

TAKE-OFF CURVE

TOTAL DISTANCE TO CLEAR 50 FEET VERSUS GROUND ROLL SHORT-FIELD TECHNIQUE (FLAPS 25°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



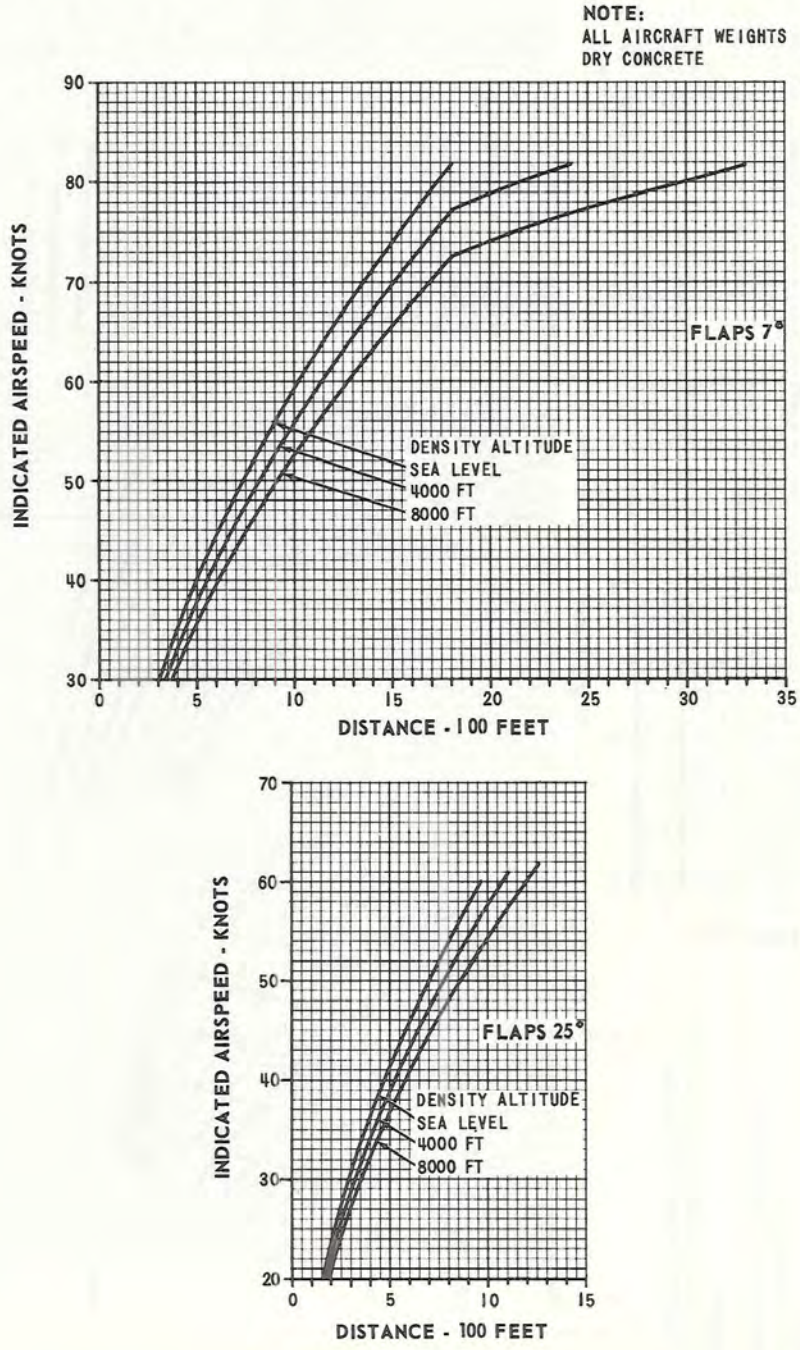
4F-1169

Figure 14-77

STOPPING DISTANCE
ABORTED TAKE-OFF

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-1170

Figure 14-78

TAKE-OFF CURVE-ENGINE FAILURE

DISTANCE TO CLEAR 50-FT OBSTACLE
(FLAPS 7°)

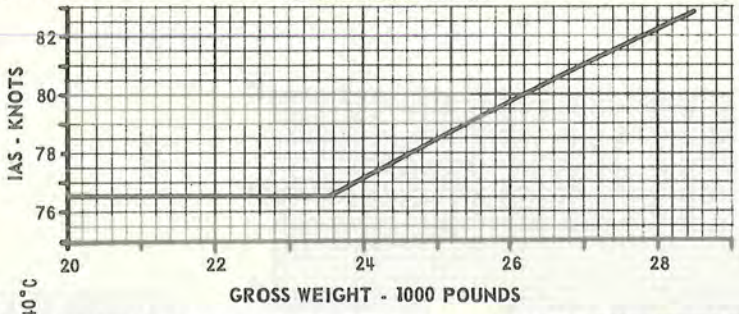
MODEL: CV-2
DATE: APRIL 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
DATA REPRESENTED BY
BROKEN LINES IS ESTIMATED

REMARKS:
ONE ENGINE FAILURE AT TAKE-OFF SPEED
INOPERATIVE PROPELLER FEATHERED

INITIAL CLIMB SPEED



STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE TO CLEAR 50 FT FEET	
		ZERO WIND	30 KNOT WIND
28,500	SEA LEVEL 5000	3200 4770	2120 3200
26,000	SEA LEVEL 5000	2460 3430	1600 2280
23,000	SEA LEVEL 5000	1850 2460	1160 1600

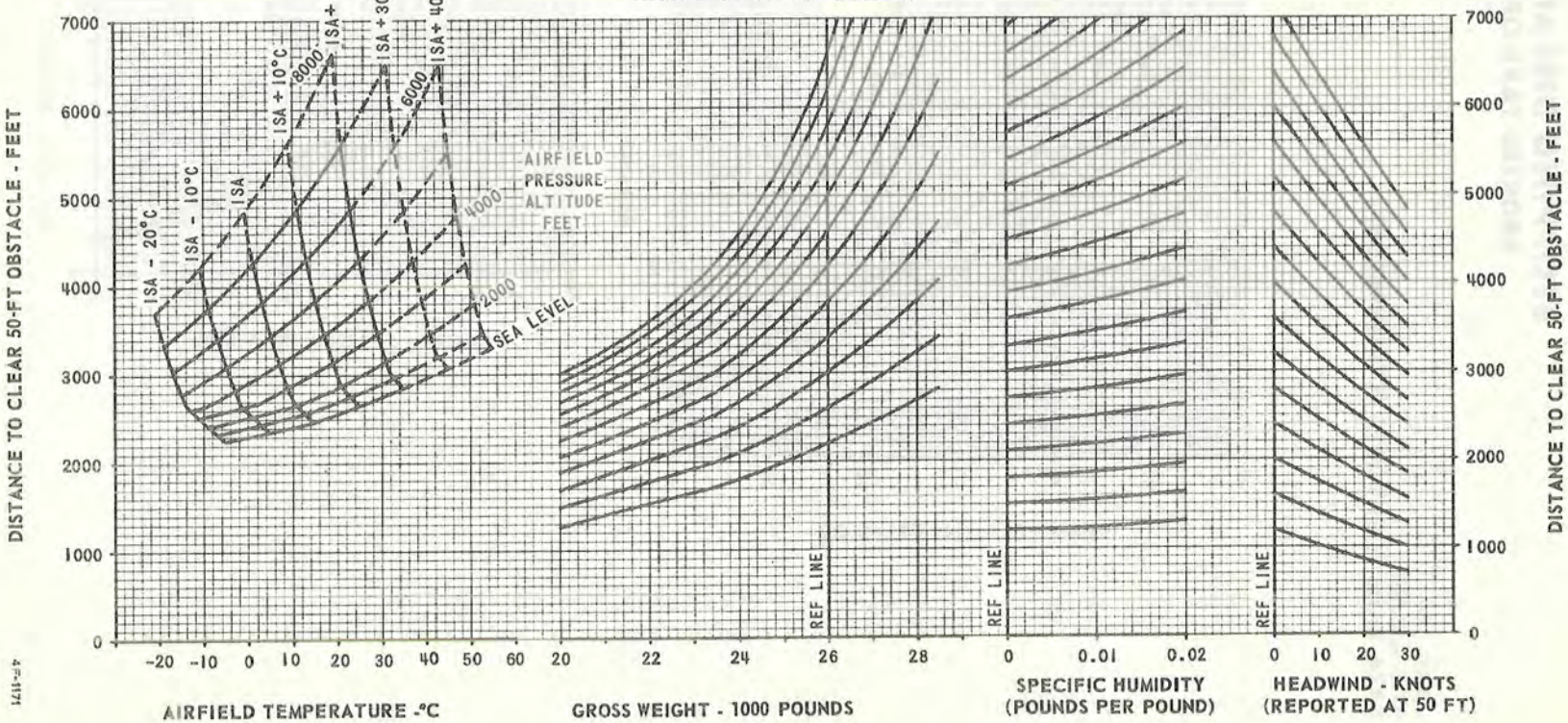


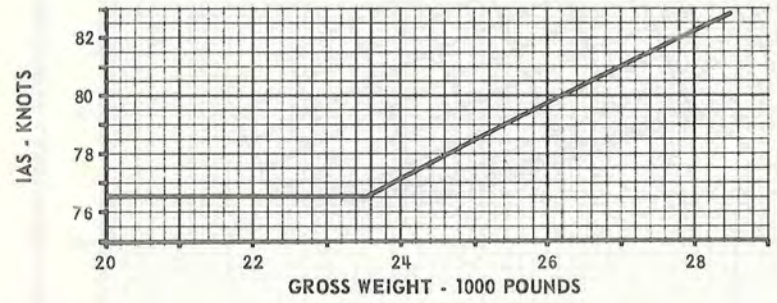
Figure 14-79

EMERGENCY CLIMB-OUT CURVE
HORIZONTAL DISTANCE TRAVERSED DURING LANDING GEAR RETRACTION
(FLAPS 7°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

CLIMB SPEED



REMARKS:
ONE ENGINE INOPERATIVE
PROPELLER FEATHERED
OTHER ENGINE AT
TAKE-OFF POWER

NOTE:
DATA REPRESENTED
BY BROKEN LINES
IS ESTIMATED

STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
28,500	SEA LEVEL	1125	830
	5000	1215	920
26,000	SEA LEVEL	1080	780
	5000	1165	870
23,000	SEA LEVEL	1030	730
	5000	1115	815

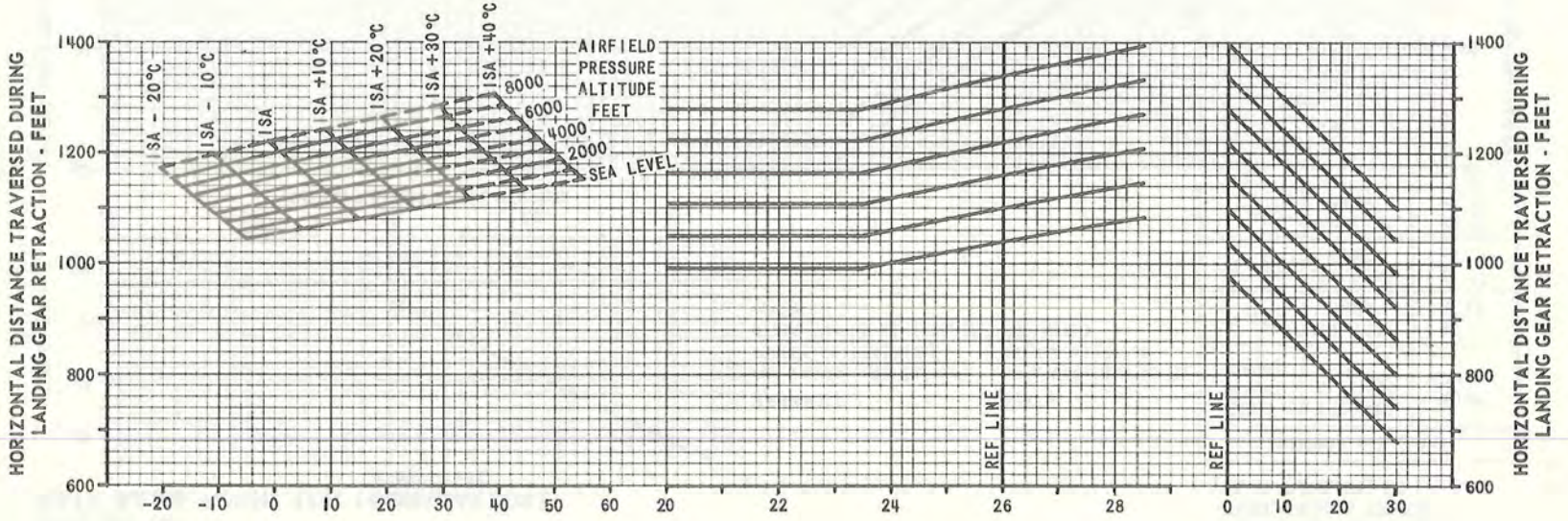


Figure 14-80

4F-1172

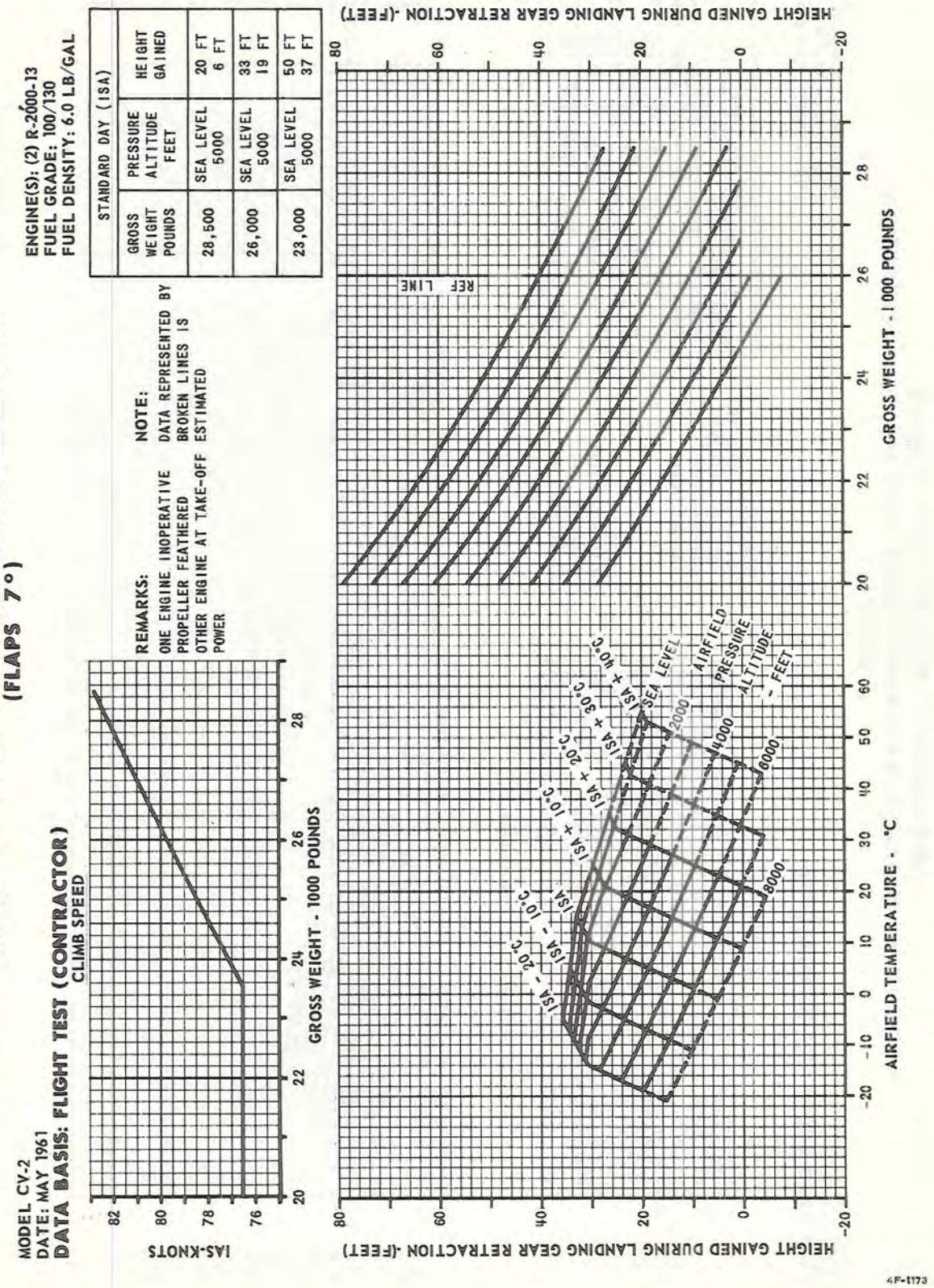

EMERGENCY CLIMB-OUT CURVE
HEIGHT GAINED DURING LANDING GEAR RETRACTION
(FLAPS 7°)
MODEL CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)
CLIMB SPEED
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL
STANDARD DAY (ISA)
GROSS WEIGHT POUNDS
PRESSURE ALTITUDE FEET
HEIGHT GAINED
28,500 SEA LEVEL 20 FT
5000 6 FT
26,000 SEA LEVEL 33 FT
5000 19 FT
23,000 SEA LEVEL 50 FT
5000 37 FT
NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED
REMARKS:
ONE ENGINE INOPERATIVE
PROPELLER FEATHERED
OTHER ENGINE AT TAKE-OFF POWER
IAS-KNOTS
GROSS WEIGHT - 1000 POUNDS
HEIGHT GAINED DURING LANDING GEAR RETRACTION -(FEET)
REF LINE
ISA - 20°C
ISA - 10°C
ISA
ISA + 10°C
ISA + 20°C
ISA + 30°C
ISA + 40°C
SEA LEVEL
2000
4000
6000
8000
AIRFIELD PRESSURE ALTITUDE - FEET
AIRFIELD TEMPERATURE - °C
GROSS WEIGHT - 1 000 POUNDS
4F-1173

Figure 14-81

EMERGENCY CLIMB-OUT CURVE

HORIZONTAL DISTANCE TRAVERSED FROM GEAR-RETRACTION POINT TO FIVE-MINUTE POINT (FLAPS 7°)

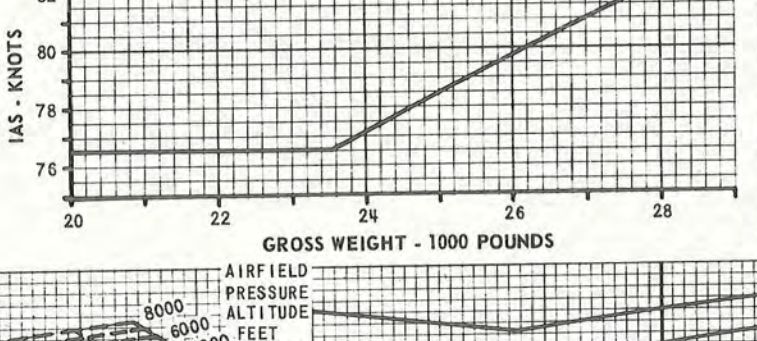
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

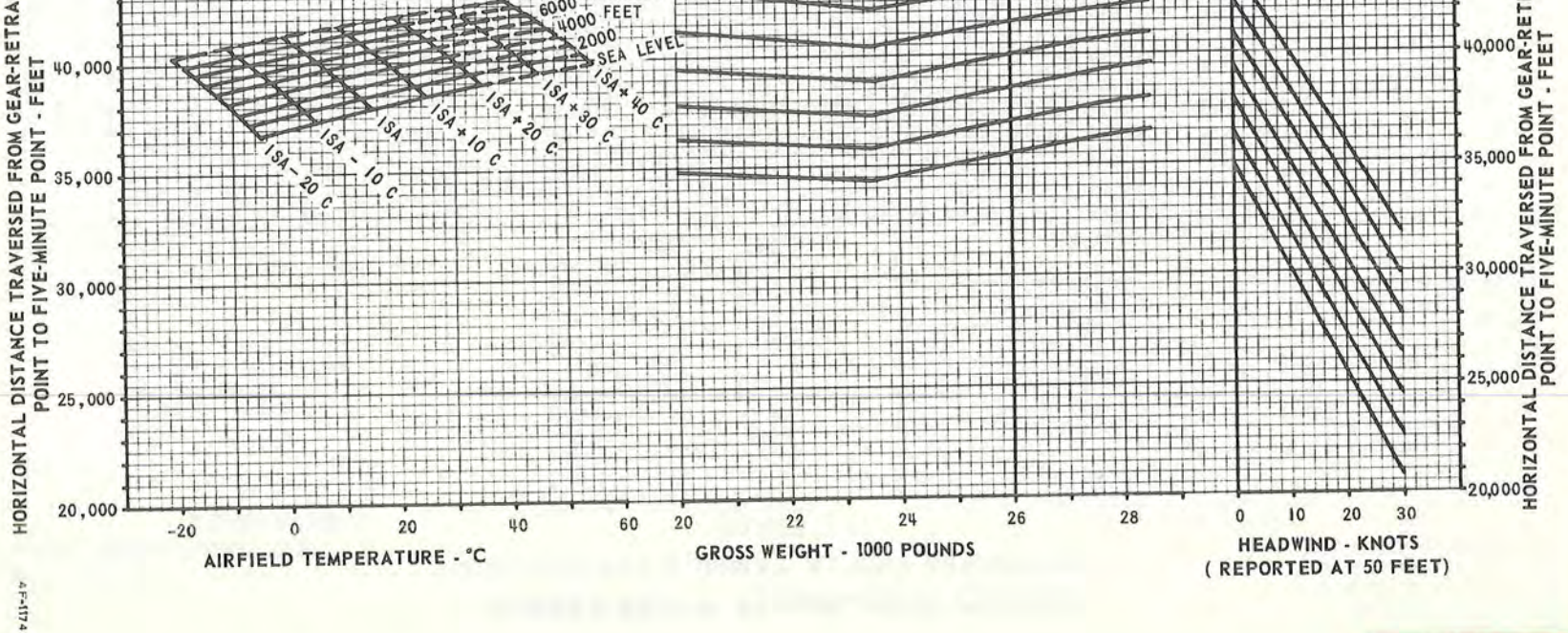
NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

REMARKS:
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED
OTHER ENGINE AT TAKE-OFF POWER.
LANDING GEAR RETRACTED.

CLIMB SPEED

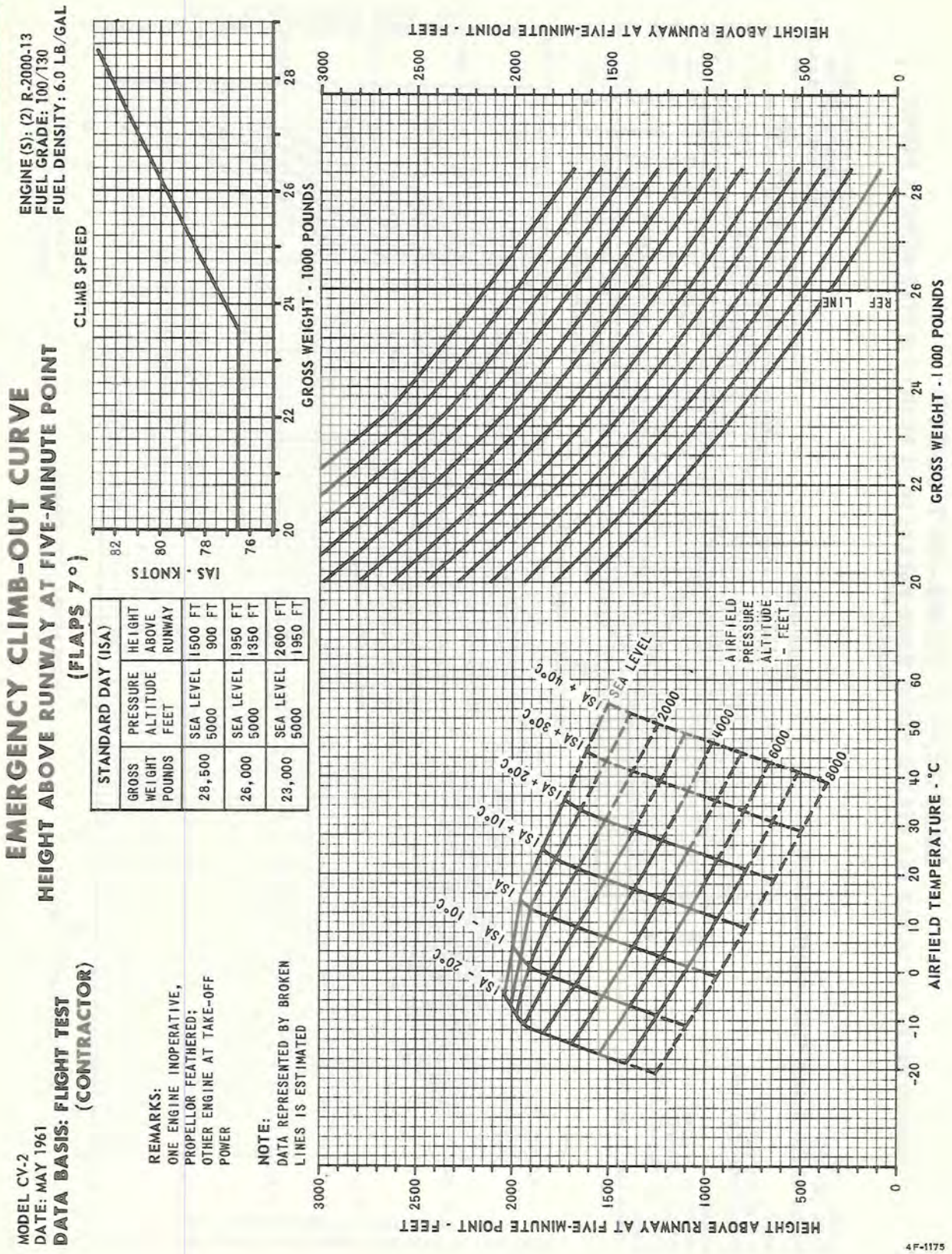


STANDARD DAY (ISA)			
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	DISTANCE - FEET	
		ZERO WIND	30 KNOT WIND
28,500	SEA LEVEL	38,970	25,590
	5000	41,030	28,120
26,000	SEA LEVEL	37,920	24,310
	5000	40,110	26,990
23,000	SEA LEVEL	36,830	22,970
	5000	39,040	25,690



4-F-117

Figure 14-82



STANDARD DAY (ISA)		
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	HEIGHT ABOVE RUNWAY
28,500	SEA LEVEL 5000	1500 FT 900 FT
26,000	SEA LEVEL 5000	1950 FT 1350 FT
23,000	SEA LEVEL 5000	2600 FT 1950 FT

REMARKS:
ONE ENGINE INOPERATIVE, PROPELLOR FEATHERED; OTHER ENGINE AT TAKE-OFF POWER

NOTE:
DATA REPRESENTED BY BROKEN LINES IS ESTIMATED

Figure 14-83

CLIMB CURVE - DISTANCE AND FUEL

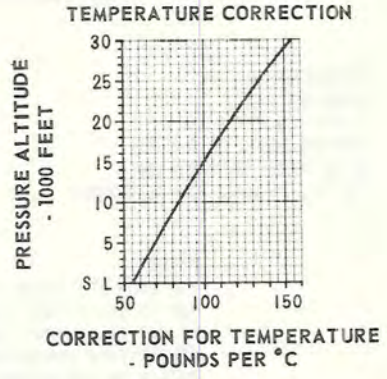
BOTH ENGINES METO POWER

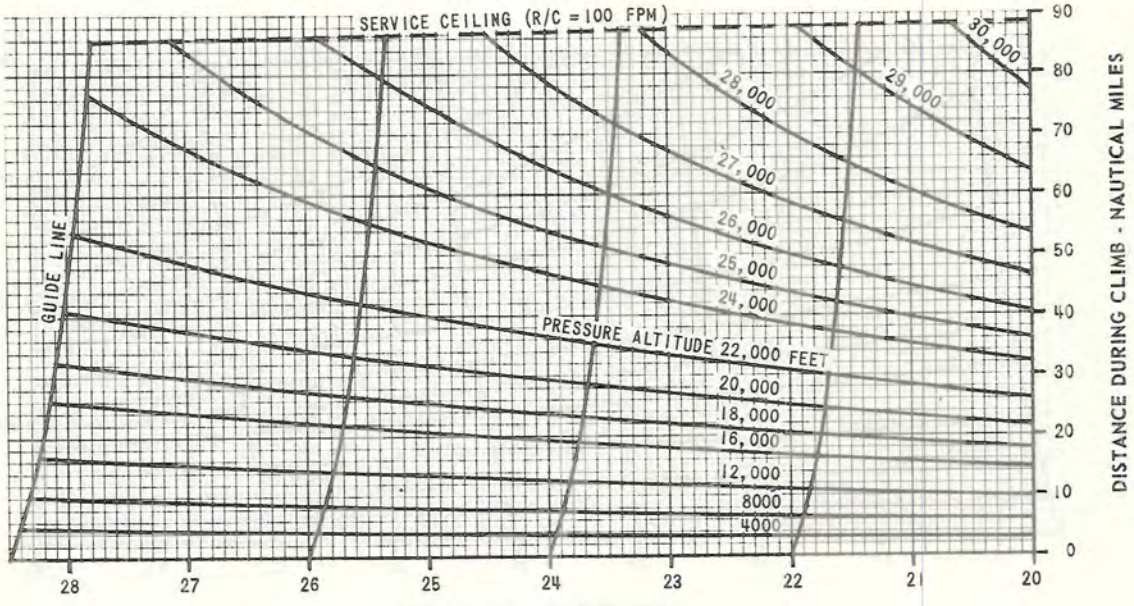
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS - EN ROUTE (0°)
LANDING GEAR - RETRACTED
CLIMB SPEED - 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T. ADD TO ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION





PRESSURE ALTITUDE FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS					
	28,500		26,000		23,000	
	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS
SEA LEVEL	0	0	0	0	0	0
5000	6.5	100	5	90	4	70
10,000	13.5	210	11	180	9	140
15,000	24	330	20	280	16	220

4F-1176

Figure 14-84

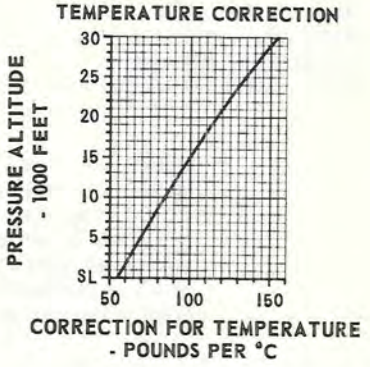
CLIMB CURVE - TIME
BOTH ENGINES METO POWER

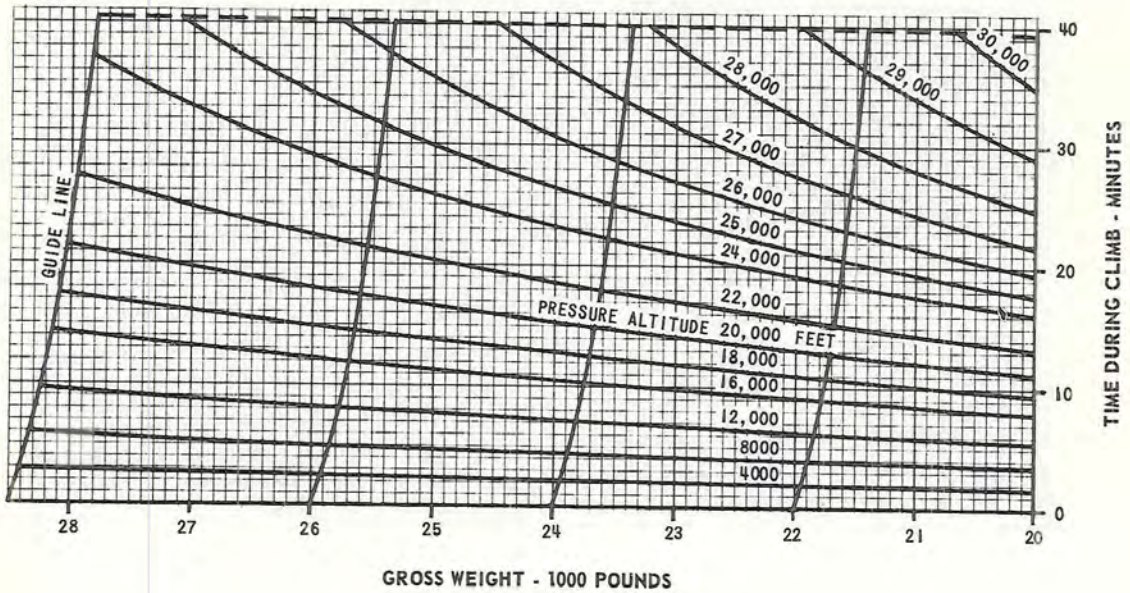
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 96 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1° C ABOVE STANDARD O.A.T. ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION.





PRESSURE ALTITUDE -FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS		
	28,500	26,000	23,000
	TIME DURING CLIMB -MINUTES		
SEA LEVEL	0	0	0
5000	3.6	3.1	2.4
10,000	7.9	6.4	5.2
15,000	13.2	10.8	8.1

4F-1177

Figure 14-85

CLIMB CURVE - DISTANCE AND FUEL

ONE ENGINE INOPERATIVE - PROPELLER FEATHERED OTHER ENGINE METO POWER

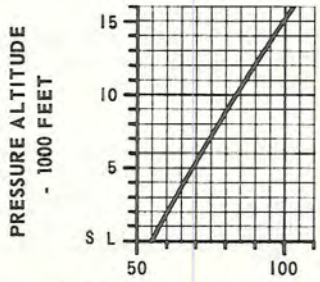
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

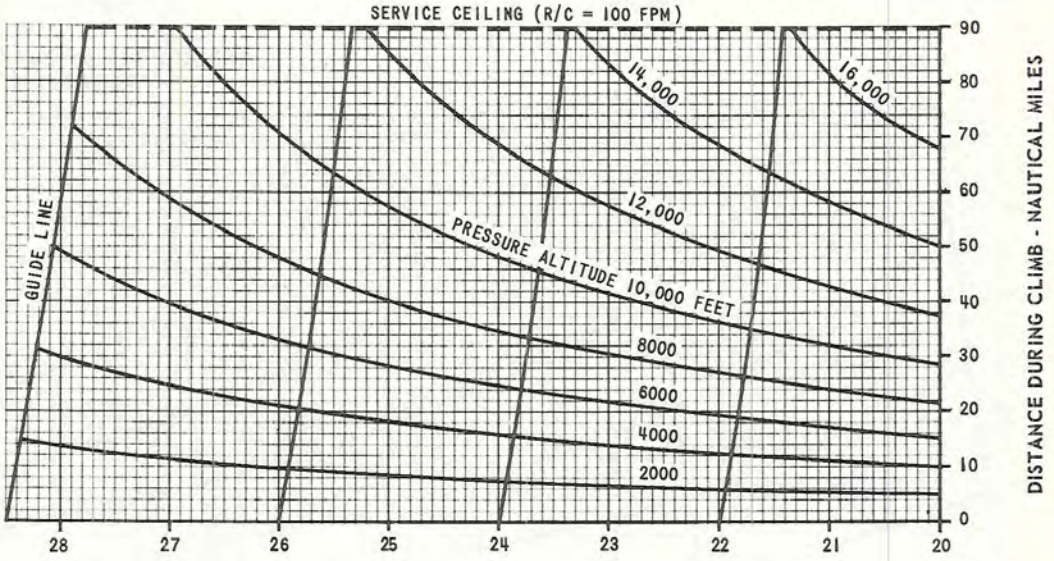
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T., ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION.

TEMPERATURE CORRECTION





PRESSURE ALTITUDE - FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS					
	28,500		26,000		23,000	
	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS	DISTANCE NAUTICAL MILES	FUEL USED POUNDS
SEA LEVEL	0	0	0	0	0	0
5000	40	340	25.5	210	17	150
10,000	-	-	63	500	39.5	320

4F-1178

Figure 14-86

CLIMB CURVE - TIME

ONE ENGINE INOPERATIVE - PROPELLER FEATHERED
OTHER ENGINE METO POWER

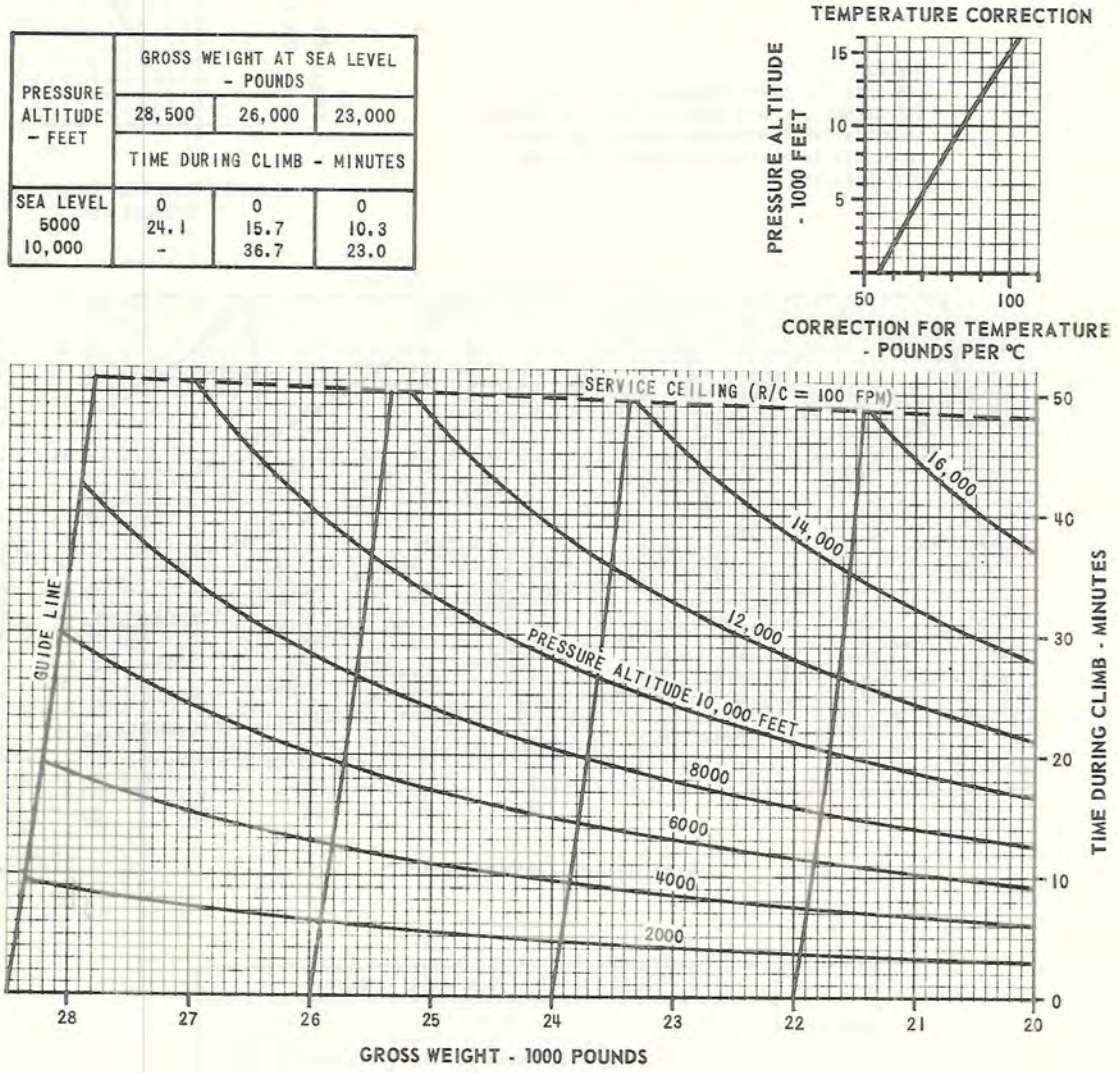
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
FOR EACH 1°C ABOVE STANDARD O.A.T., ADD TO THE ACTUAL AIRCRAFT GROSS WEIGHT THE AMOUNT SHOWN IN THE TEMPERATURE CORRECTION CHART TO OBTAIN AN EQUIVALENT WEIGHT FOR CLIMB DETERMINATION.

REMARKS:
STANDARD DAY
FLAPS: EN ROUTE (0°)
LANDING GEAR: RETRACTED
CLIMB SPEED: 95 KNOTS IAS
FOR ALL WEIGHTS AND ALTITUDES

PRESSURE ALTITUDE - FEET	GROSS WEIGHT AT SEA LEVEL - POUNDS		
	28,500	26,000	23,000
	TIME DURING CLIMB - MINUTES		
SEA LEVEL	0	0	0
5000	24.1	15.7	10.3
10,000	-	36.7	23.0



4F-1179

Figure 14-87

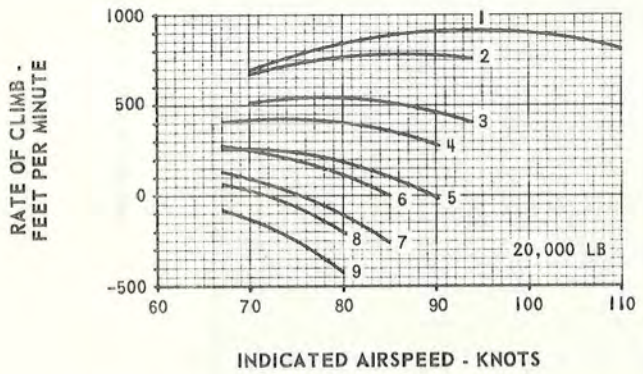
EMERGENCY CLIMB
ONE ENGINE INOPERATIVE

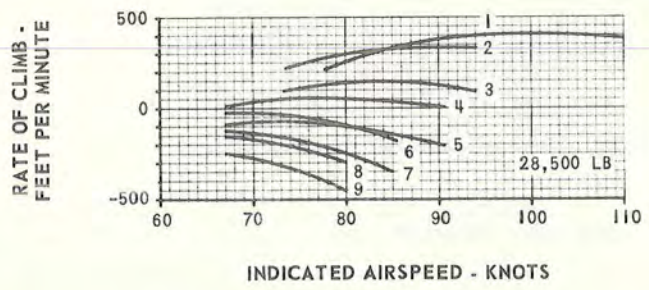
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR) FLAPS 0° AND 7°
ESTIMATED FLAPS 25°, 30° AND 40°

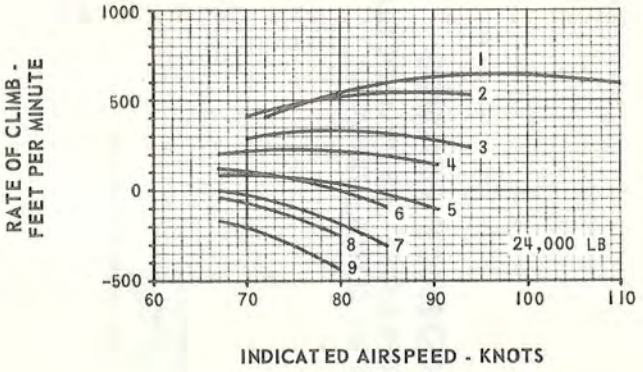
ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

CURVE IDENTIFICATION:
1. FLAPS 0° - GEAR UP
2. FLAPS 7° - GEAR UP
3. FLAPS 7° - GEAR DOWN
4. FLAPS 25° - GEAR UP
5. FLAPS 25° - GEAR DOWN
6. FLAPS 30° - GEAR UP
7. FLAPS 30° - GEAR DOWN
8. FLAPS 40° - GEAR UP
9. FLAPS 40° - GEAR DOWN

REMARKS:
OPERATING ENGINE AT TAKE-OFF POWER.
UNLESS OTHERWISE STATED THE INOPERATIVE PROPELLER IS FEATHERED.
SEA LEVEL.
STANDARD DAY.







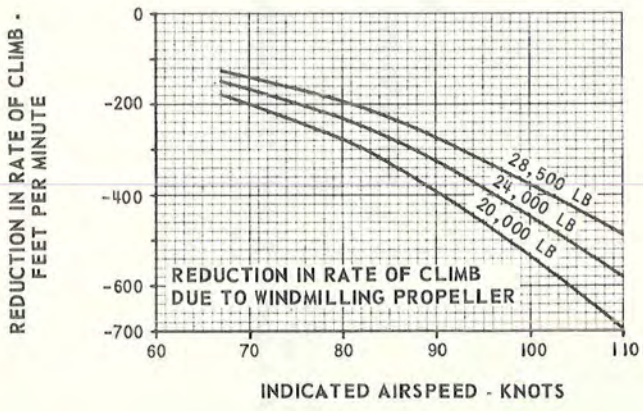


Figure 14-88

4F-1180

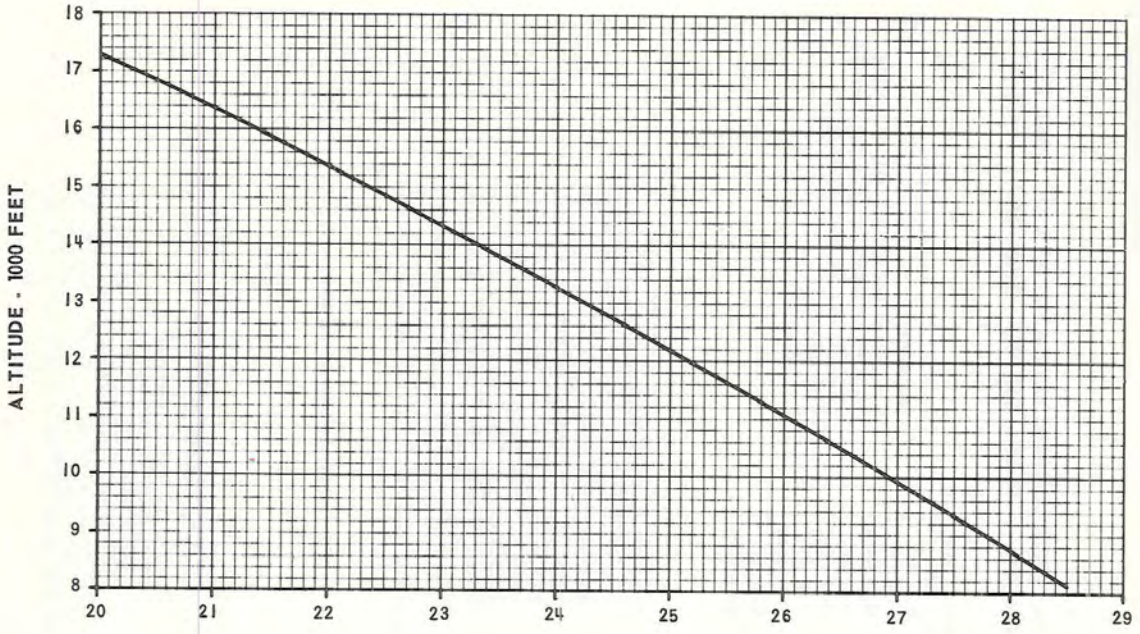
EMERGENCY CEILING

ONE ENGINE INOPERATIVE - PROPELLER FEATHERED
RATE OF CLIMB = 100 FPM

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
METO POWER
FLAPS AND GEAR RETRACTED



4F-1181

Figure 14-89

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE - SEA LEVEL

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND.

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
250	A L	1800	18.6	142	700	A L	2000	32.6	329
300	A L	1800	20.7	165	725	A L	2000	33.0	351
350	A L	1800	22.7	186	725	A R	2000	31.7	425
400	A L	1800	24.7	205	750	A R	2000	32.6	444
450	A L	1800	26.5	222	800	A R	2000	34.4	482
500	A L	1800	28.4	237	900	A R	2000	37.8	563
550	A L	1800	30.2	251	1000	A R	2200	38.7	649
600	A L	1800	32.0	269	1100	A R	2550	39.3	742
650	A L	1900	32.6	295	1200	A R	2550	42.5	843

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

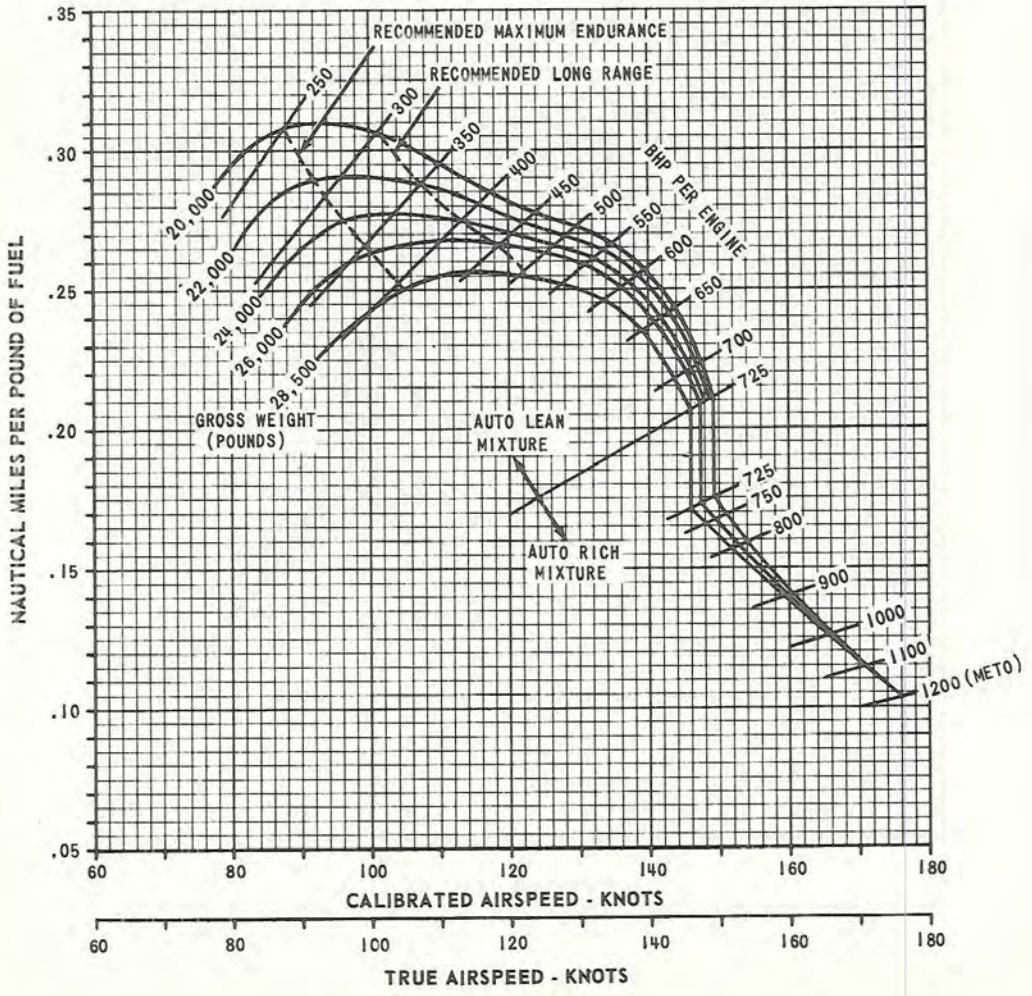


Figure 14-90

NAUTICAL MILES PER POUND OF FUEL
BOTH ENGINES OPERATING
ALTITUDE-5000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND.

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
300	A L	1800	19.0	165	725	A L	2000	32.0	357
350	A L	1800	21.0	186	725	A R	2000	30.6	425
400	A L	1800	23.0	205	750	A R	2000	31.3	444
450	A L	1800	25.0	222	800	A R	2000	33.2	482
500	A L	1800	26.8	237	900	A R	2200	34.6	563
550	A L	1800	28.7	251	1000	A R	2200	38.0	649
600	A L	1800	30.6	270	1100	A R	2550	38.0	745
650	A L	1900	31.2	297	1200	A R	2550	41.8	854
700	A L	2000	31.3	333					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

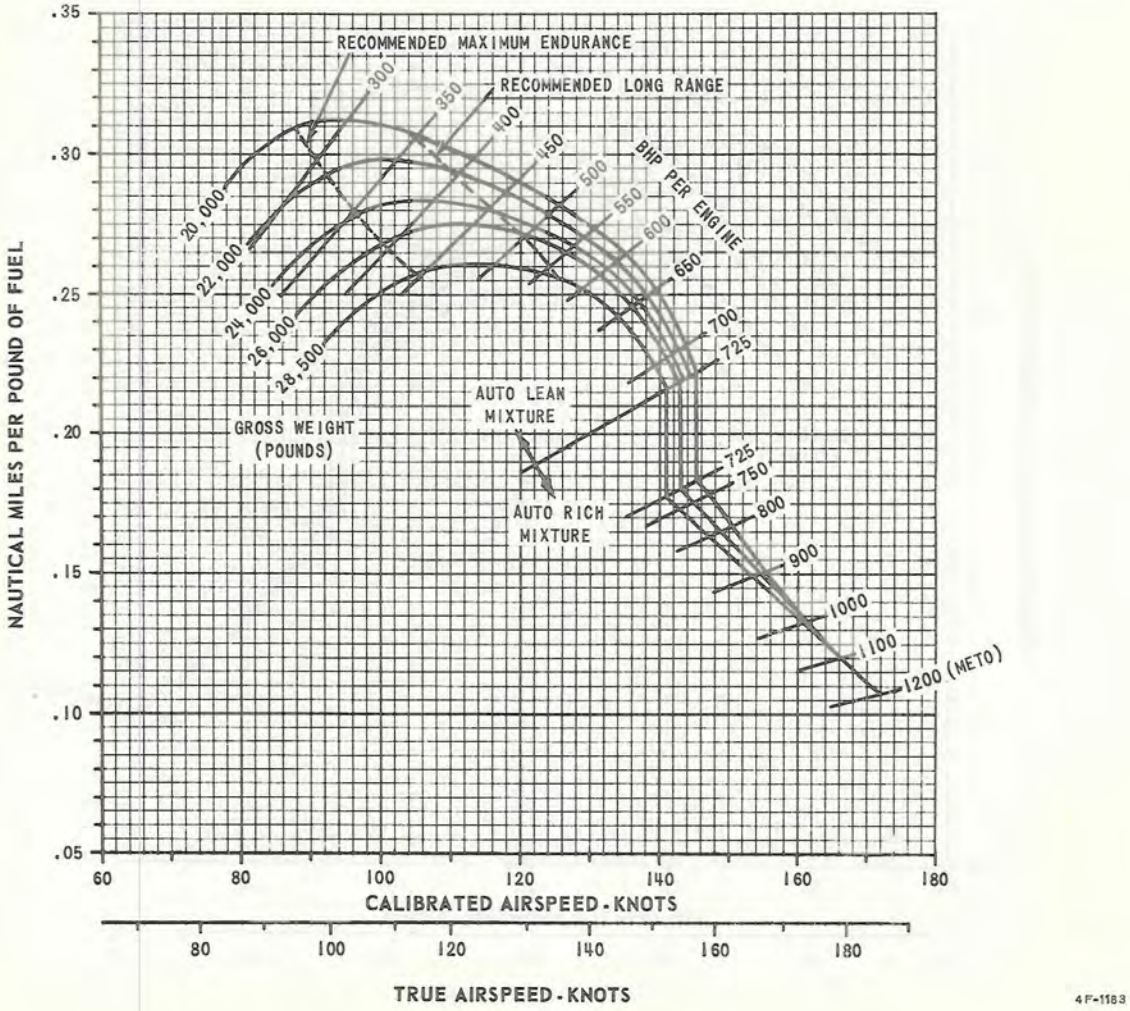


Figure 14-91

NAUTICAL MILES PER POUND OF FUEL
BOTH ENGINES OPERATING
ALTITUDE-10,000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
300	A L	1800	17.6	165	700	A L	2000	30.4	342
350	A L	1800	19.7	186	725	A L	2100	29.7	367
400	A L	1800	21.8	205	725	A R	2000	29.5	425
450	A L	1800	23.6	222	750	A R	2000	30.5	444
500	A L	1800	25.6	237	800	A R	2200	30.2	482
550	A L	1800	27.4	254	900	A R	2550	31.2	563
600	A L	1900	28.3	275	1000	A R	2550	34.3	652
650	A L	2000	29.1	302					

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND.

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

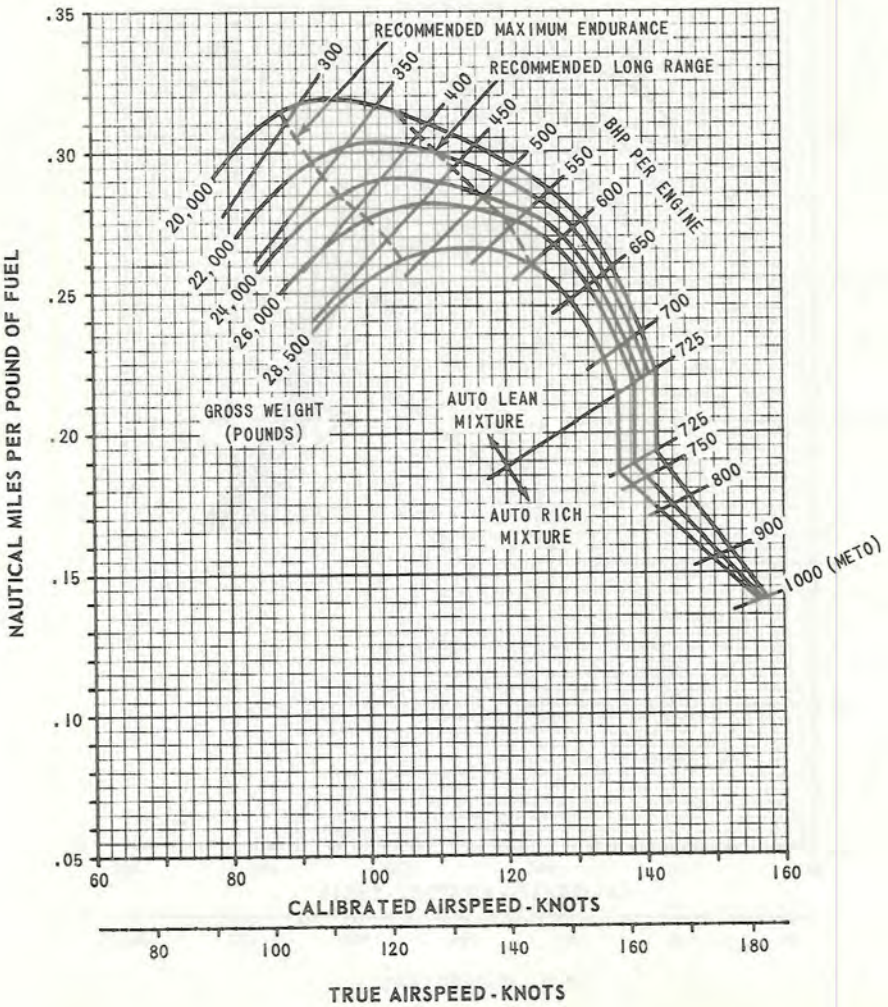


Figure 14-92

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-15,000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

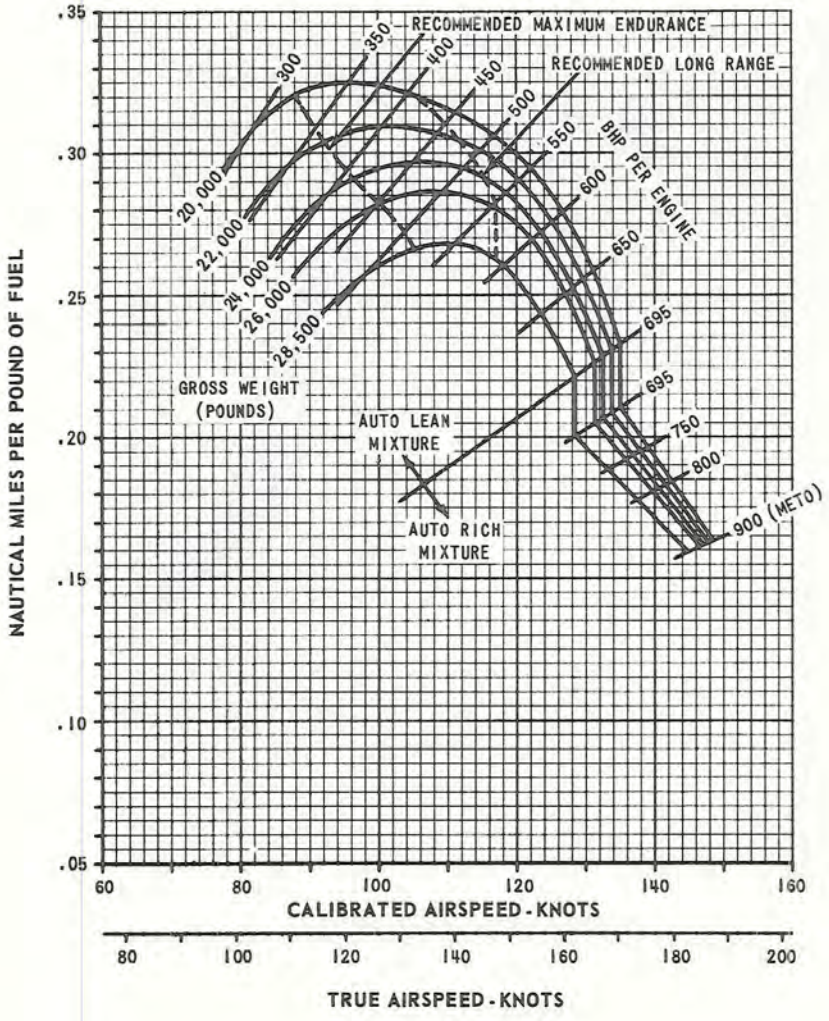
NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND.

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
300	A L	1800	16.6	165	650	A L	2200	26.3	322
350	A L	1800	18.4	186	695	A L	2200	F T	366
400	A L	1800	20.3	205	695	A R	2200	25.8	403
450	A L	1800	22.3	222	750	A R	2550	25.6	444
500	A L	1900	23.5	237	800	A R	2550	27.3	483
550	A L	2000	24.3	258	900	A R	2550	30.2	575
600	A L	2100	25.5	285					

M P — MANIFOLD PRESSURE - IN. HG
F C — FUEL CONSUMPTION PER ENGINE - LB/HR
A L — AUTO LEAN
A R — AUTO RICH
F T — FULL THROTTLE



4F-1185

Figure 14-93

NAUTICAL MILES PER POUND OF FUEL

BOTH ENGINES OPERATING
ALTITUDE-20,000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND-

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
350	A L	1800	17.4	186	550	A R	2200	20.5	304
400	A L	1900	18.7	205	600	A R	2200	21.9	338
450	A L	2000	19.9	222	650	A R	2550	22.0	373
500	A L	2100	21.1	238	700	A R	2550	23.5	413
550	A L	2200	F.T.	265	750	A R	2550	24.9	463

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION PER ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH
F.T. FULL THROTTLE

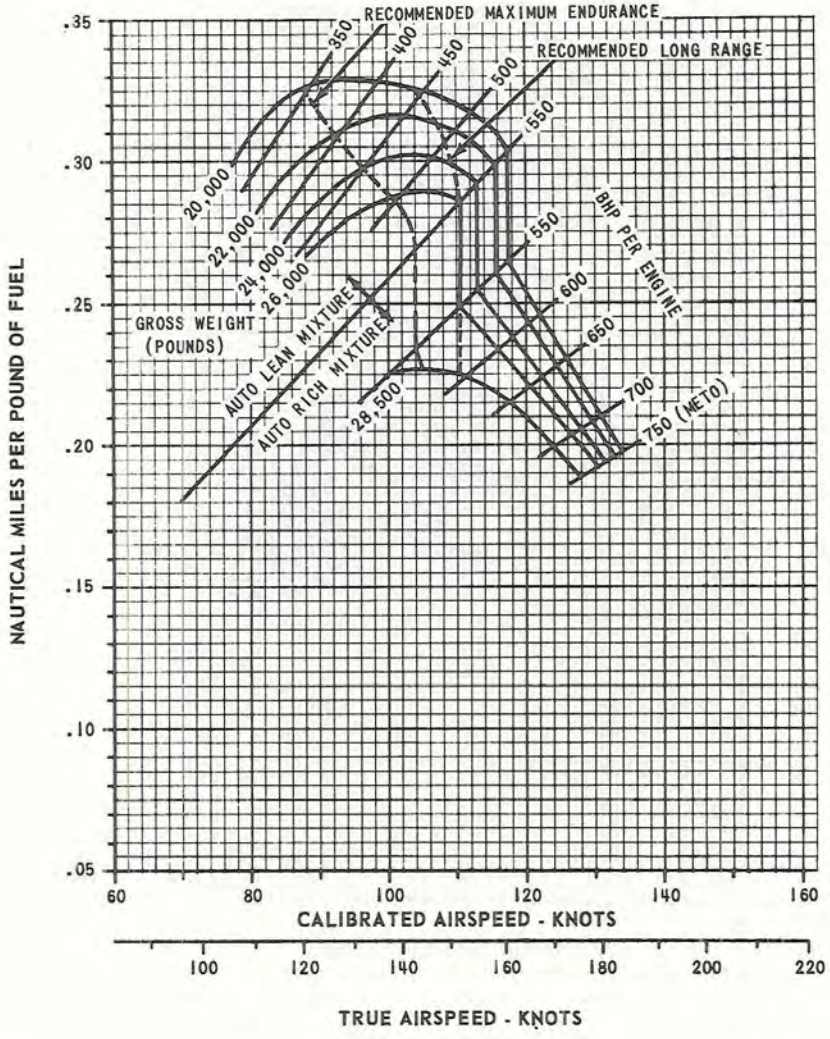


Figure 14-94

NAUTICAL MILES PER POUND OF FUEL

ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

ALTITUDE - SEA LEVEL

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND -

$$\text{GROUND N.MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
550	A L	1800	30.2	251	750	A R	2000	32.6	444
600	A L	1800	32.0	269	800	A R	2000	34.4	482
650	A L	1900	32.6	295	900	A R	2000	37.8	563
700	A L	2000	32.6	329	1000	A R	2200	38.7	649
725	A L	2000	33.0	351	1100	A R	2550	39.3	742
725	A R	2000	31.7	425	1200	A R	2550	42.5	843

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH

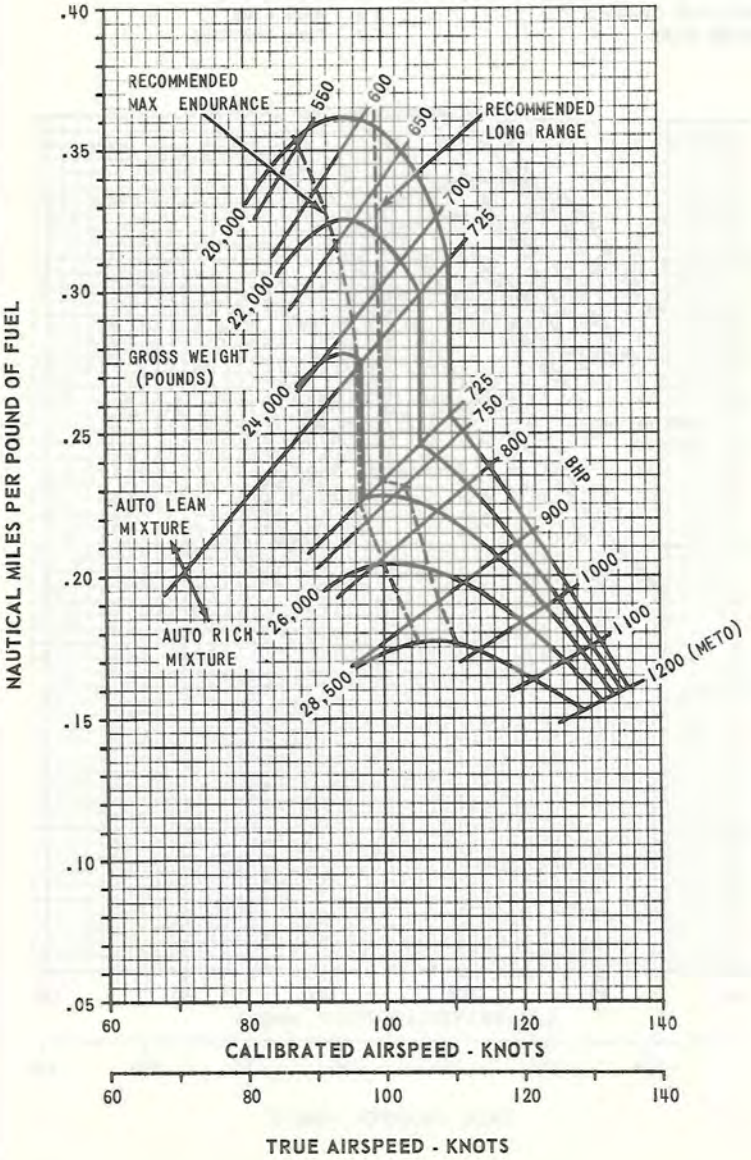


Figure 14-95

NAUTICAL MILES PER POUND OF FUEL

ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

ALTITUDE-5000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

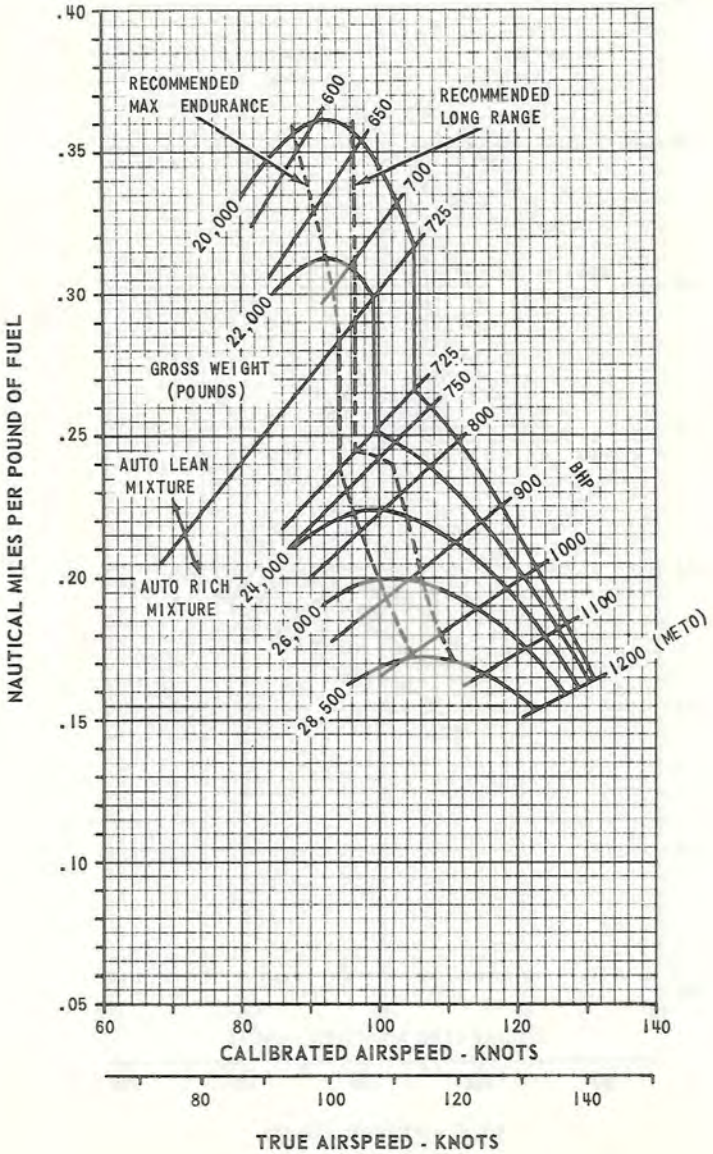
NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND

$$\text{GROUND N. MI/LB} = \text{AIR N.MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
600	A L	1800	30.6	270	800	A R	2000	33.2	482
650	A L	1900	31.2	297	900	A R	2200	34.6	563
700	A L	2000	31.3	333	1000	A R	2200	38.0	649
725	A L	2000	32.0	357	1100	A R	2550	38.0	745
725	A R	2000	30.6	425	1200	A R	2550	41.8	854
750	A R	2000	31.3	444					

M P MANIFOLD PRESSURE - IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE - LB/HR
A L AUTO LEAN
A R AUTO RICH



4F-1188

Figure 14-96

NAUTICAL MILES PER POUND OF FUEL
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED
ALTITUDE-10,000 FEET

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY, NO WIND
FLAPS AND GEAR RETRACTED

NOTE:
WIND CORRECTION TO NAUTICAL MILES/POUND

$$\text{GROUND N. MI/LB} = \text{AIR N. MI/LB} \times \frac{\text{V Ground}}{\text{V Air}}$$

WHERE: V Air = AIRCRAFT TRUE AIRSPEED
V Ground = GROUND SPEED

BHP	MIX.	RPM	M P	F C	BHP	MIX.	RPM	M P	F C
650	A L	2000	29.1	302	800	A R	2200	30.2	482
700	A L	2000	30.4	342	900	A R	2550	31.2	563
725	A L	2100	29.7	367	1000	A R	2550	34.3	652
725	A R	2000	29.5	425	1095	A R	2550	37.5	757
750	A R	2000	30.5	444					

M P MANIFOLD PRESSURE – IN. HG
F C FUEL CONSUMPTION OPERATING ENGINE – LB/HR
A L AUTO LEAN
A R AUTO RICH

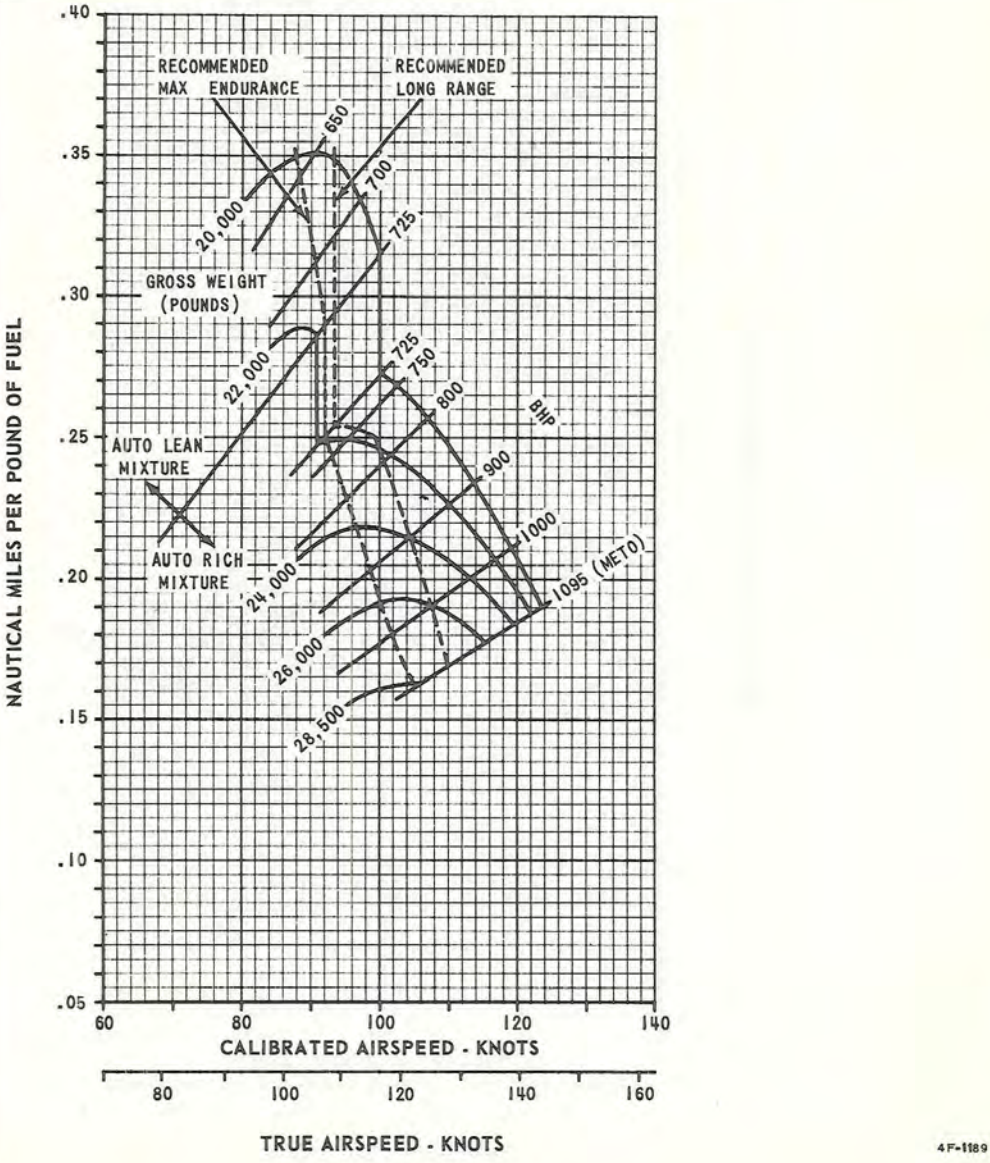


Figure 14-97

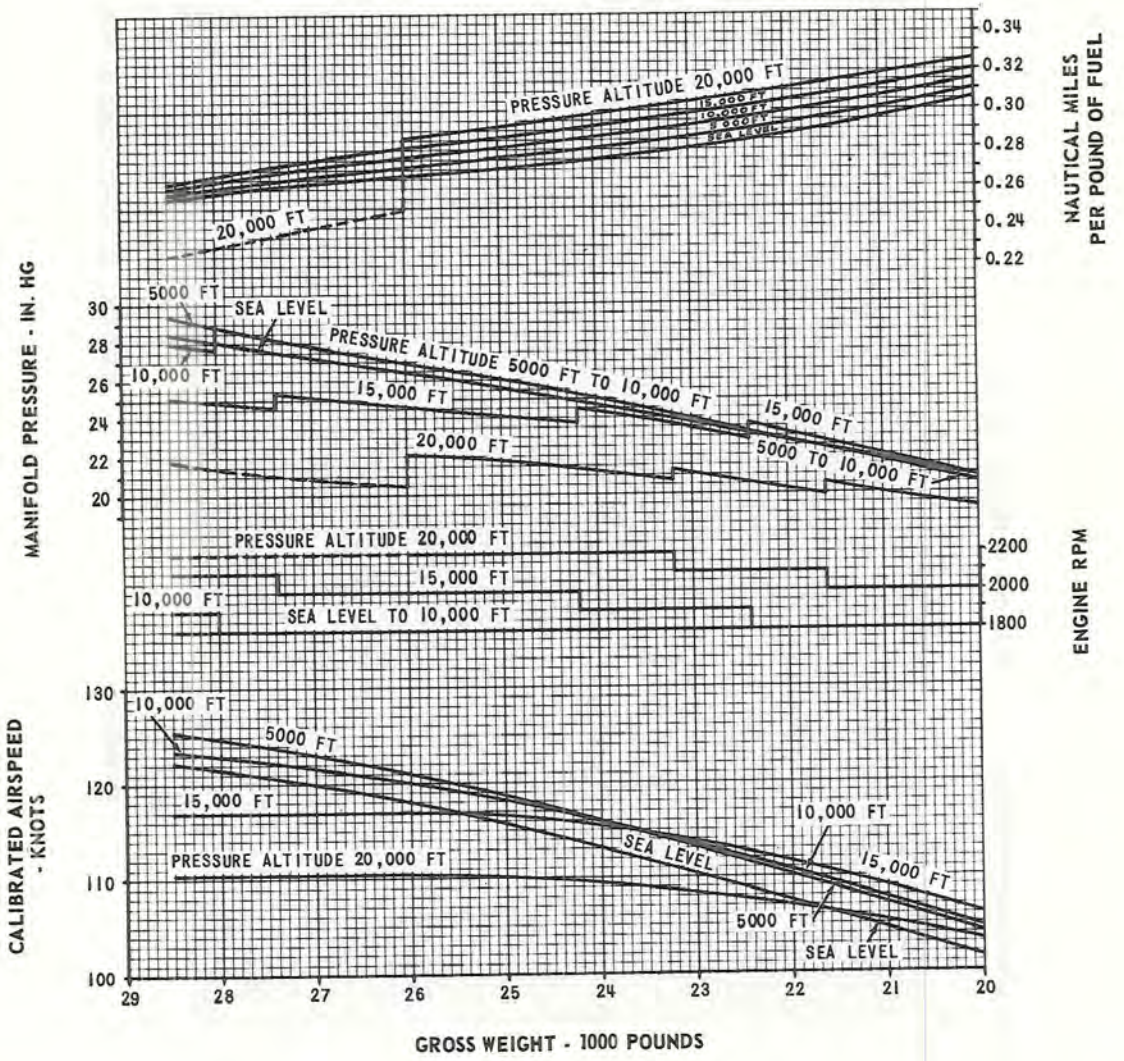
LONG-RANGE SUMMARY
BOTH ENGINES OPERATING

4F-1190

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——— AUTO LEAN MIXTURE
– – – – AUTO RICH MIXTURE



WEIGHT	28,500 LB					26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS
SEA LEVEL	0.255	AL	1800	28.5	122.3	0.266	AL	1800	26.4	118.0	0.280	AL	1800	23.8	110.3
5000	0.257	AL	1800	29.4	125.5	0.271	AL	1800	26.9	121.0	0.287	AL	1800	23.9	113.0
10,000	0.260	AL	1900	28.0	123.4	0.276	AL	1800	26.9	120.0	0.293	AL	1800	23.9	113.4

Figure 14-98

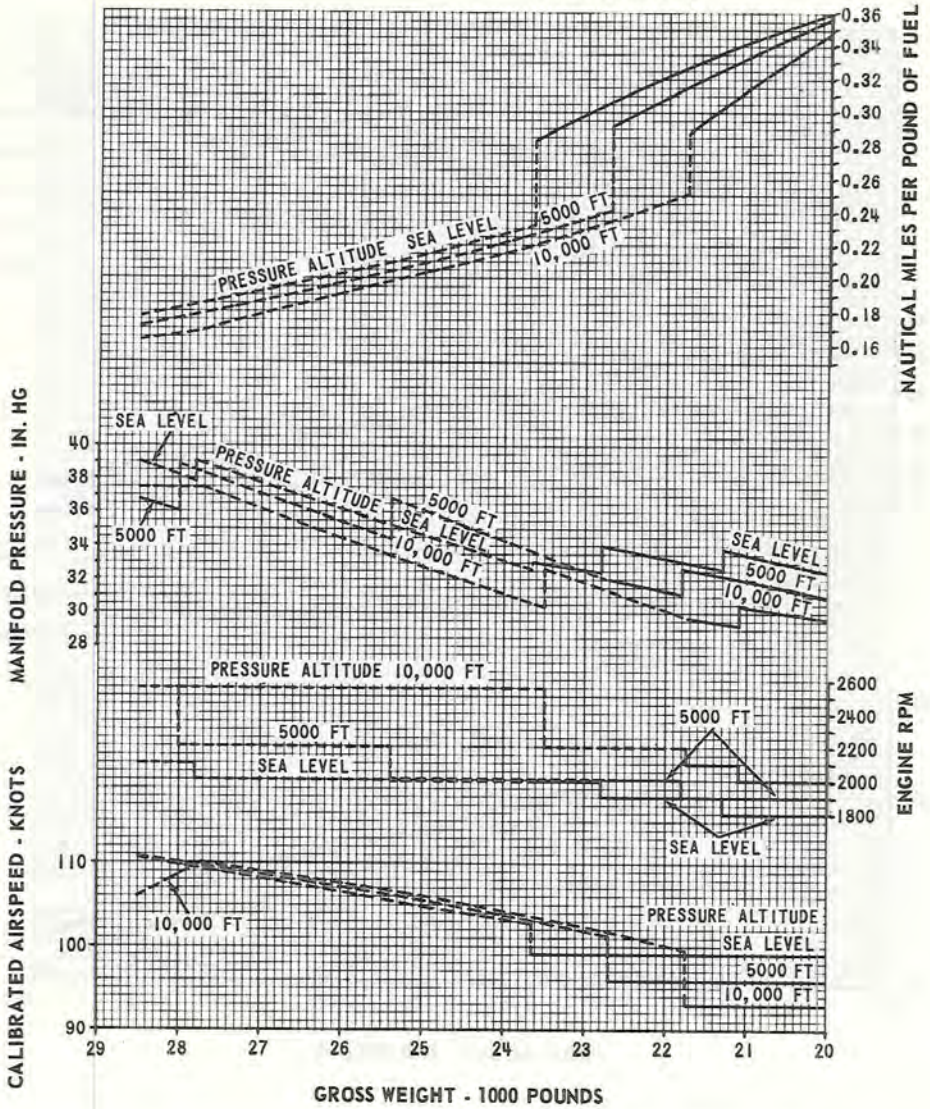
LONG RANGE SUMMARY
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

4F-1191

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——— AUTO LEAN MIXTURE
– – – – AUTO RICH MIXTURE



WEIGHT	28,500 LB					26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS	NAUTICAL MILES PER POUND	MIX.	RPM	MP IN. HG	CAS KNOTS
SEA LEVEL	0.177	AR	2100	39.0	110.6	0.203	AR	2000	36.2	106.5	0.300	AL	2000	32.6	99.0
5000 FT	0.171	AR	2550	36.7	110.8	0.198	AR	2200	35.4	107.0	0.237	AR	2000	32.5	102.0
10,000 FT	0.163	AR	2550	37.5	106.0	0.191	AR	2550	34.5	107.6	0.230	AR	2200	31.8	102.5

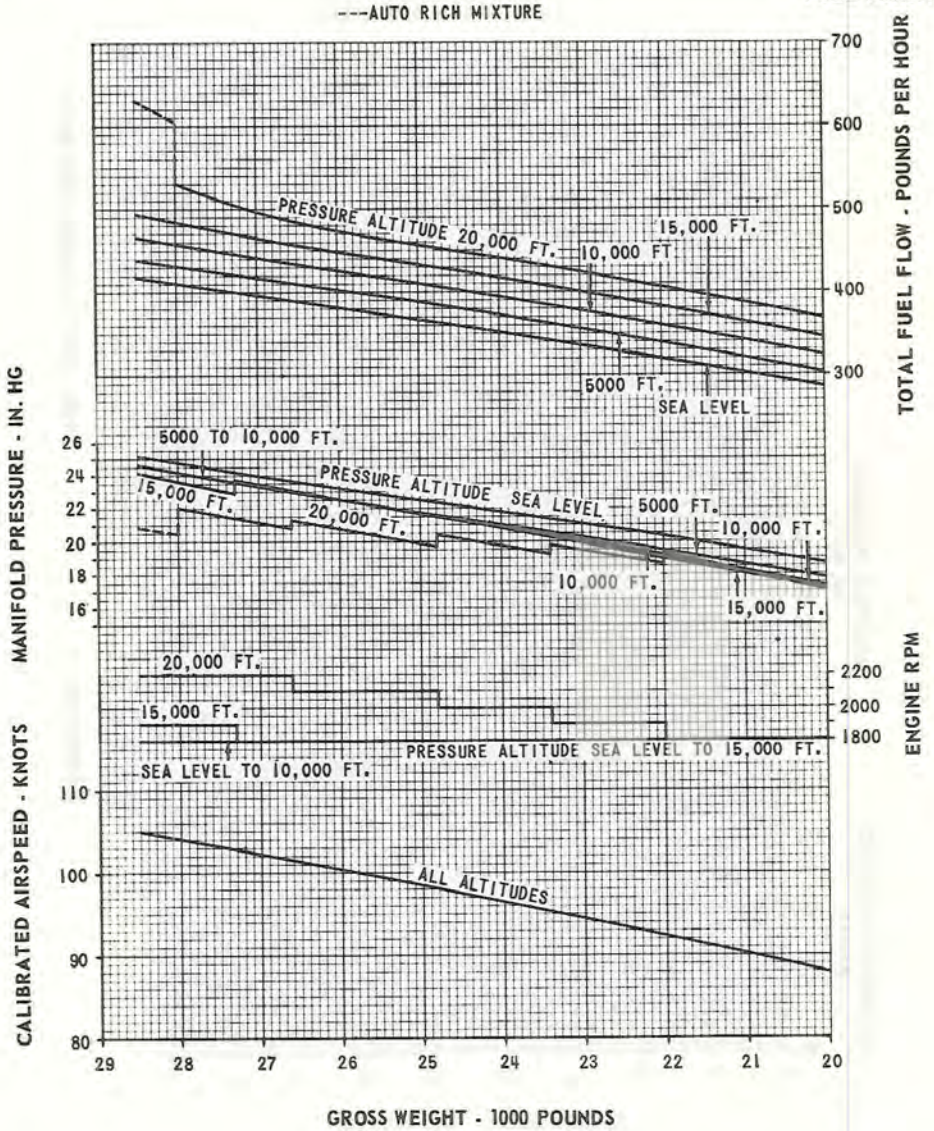
Figure 14-99

MAXIMUM ENDURANCE
BOTH ENGINES OPERATING

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——AUTO LEAN MIXTURE
---AUTO RICH MIXTURE

ENGINE (S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



WEIGHT	28,500 LB					26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	LB PER HOUR	MIX.	RPM	MP IN. HG	CAS KNOTS	LB PER HOUR	MIX.	RPM	MP IN. HG	CAS KNOTS	LB PER HOUR	MIX.	RPM	MP IN. HG	CAS KNOTS
SEA LEVEL	420	AL	1800	25.2	105	382	AL	1800	23.2	100.3	336	AL	1800	21.0	94.4
5000	440	AL	1800	24.6	105	403	AL	1800	22.5	100.3	357	AL	1800	20.2	94.4
10,000	465	AL	1800	24.6	105	426	AL	1800	22.5	100.3	377	AL	1800	20.1	94.4

4F-1192

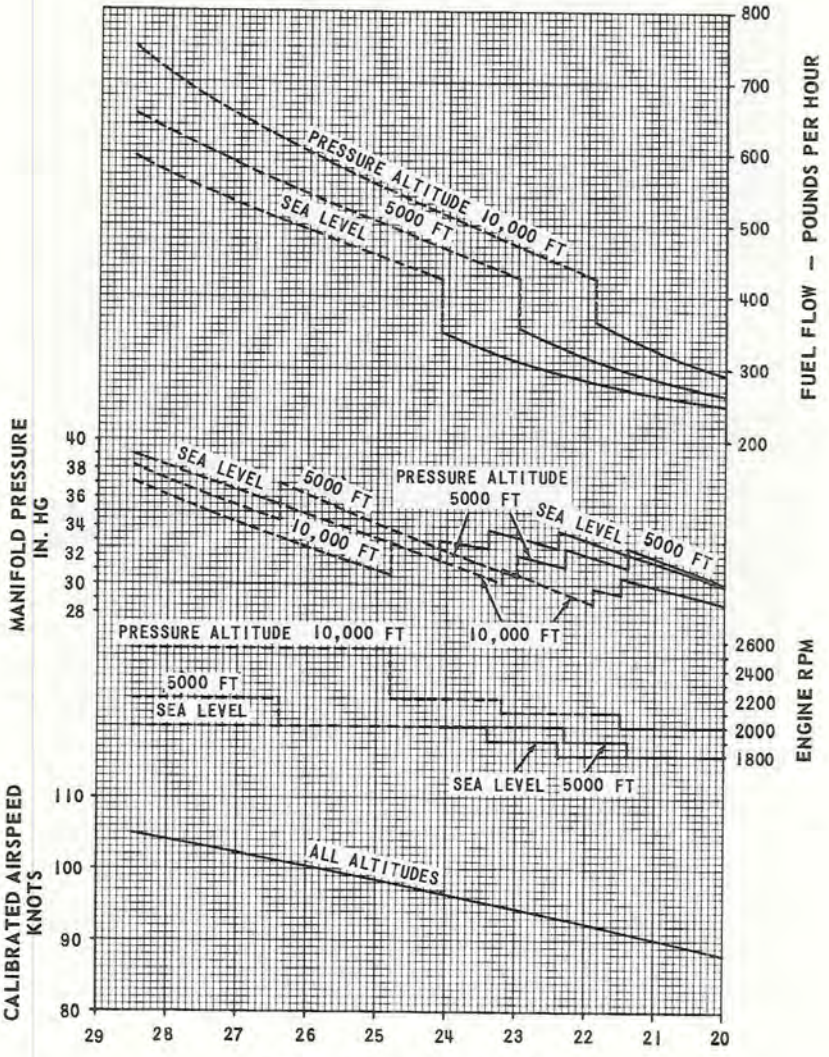
Figure 14-100

MAXIMUM ENDURANCE
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED

MODEL: CV-2
DATE: MAY 1961
DATA BASIS. FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
——— AUTO LEAN MIXTURE
– – – – AUTO RICH MIXTURE



WEIGHT	28,500 LB					26,000 LB					23,000 LB				
PRESSURE ALTITUDE FEET	LB PER HOUR	MIX.	RPM	M P IN. HG	C A S KNOTS	LB PER HOUR	MIX.	RPM	M P IN. HG	C A S KNOTS	LB PER HOUR	MIX.	RPM	M P IN. HG	C A S KNOTS
SEA LEVEL	595	AR	2000	39.0	105	493	AR	2000	34.8	100.3	310	AL	1900	33.3	94.4
5000	655	AR	2200	38.2	105	542	AR	2000	36.2	100.3	427	AR	2000	30.6	94.4
10,000	750	AR	2550	37.1	105	602	AR	2550	32.6	100.3	470	AR	2100	30.7	94.4

4F-1193

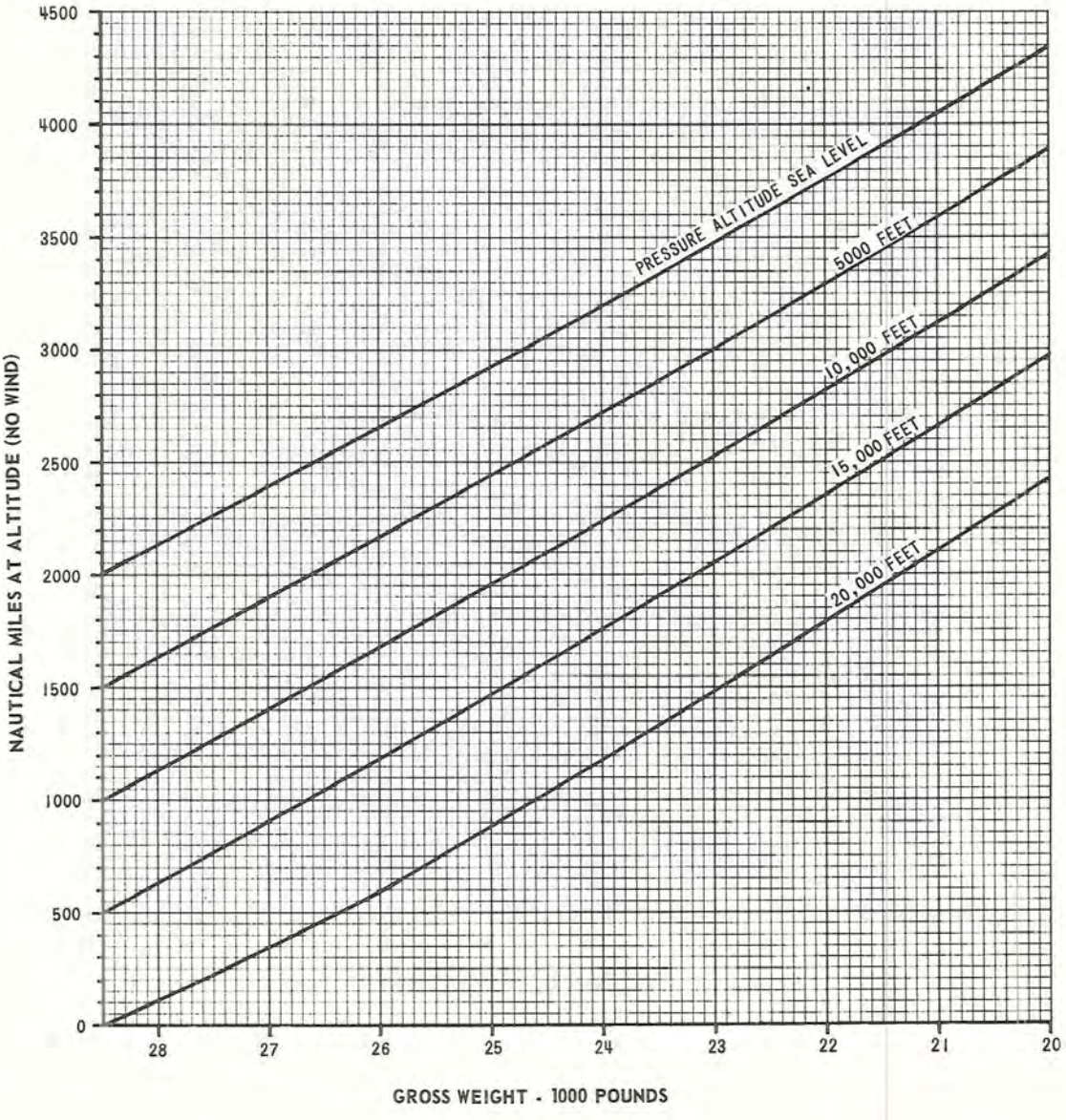
Figure 14-101

LONG-RANGE PREDICTION - DISTANCE
BOTH ENGINES OPERATING

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
LONG-RANGE CRUISING SPEED



4F-1194

Figure 14-102

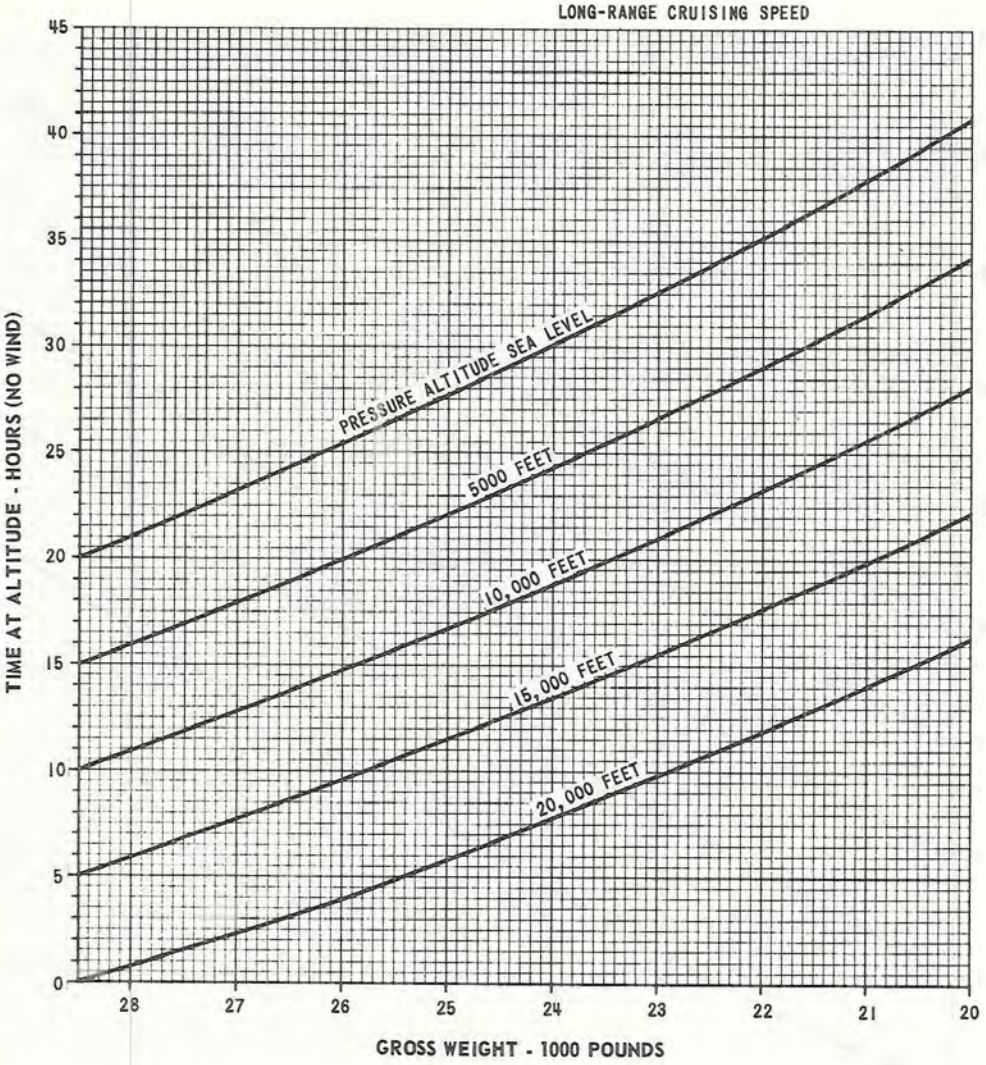
LONG-RANGE PREDICTION - TIME

BOTH ENGINES OPERATING

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
LONG-RANGE CRUISING SPEED



4F-1195

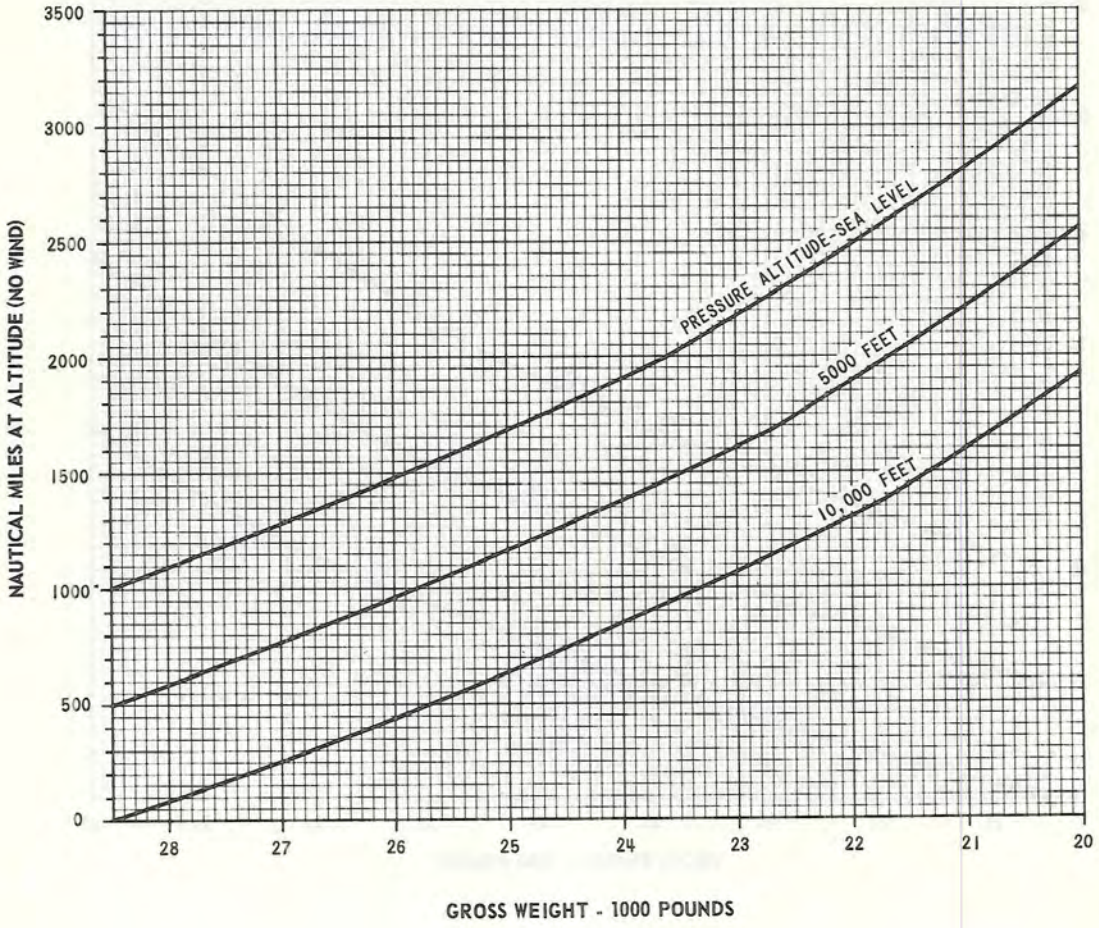
Figure 14-103

LONG-RANGE PREDICTION - DISTANCE
ONE ENGINE INOPERATIVE – PROPELLER FEATHERED

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
LONG-RANGE CRUISING SPEED



4F-1196

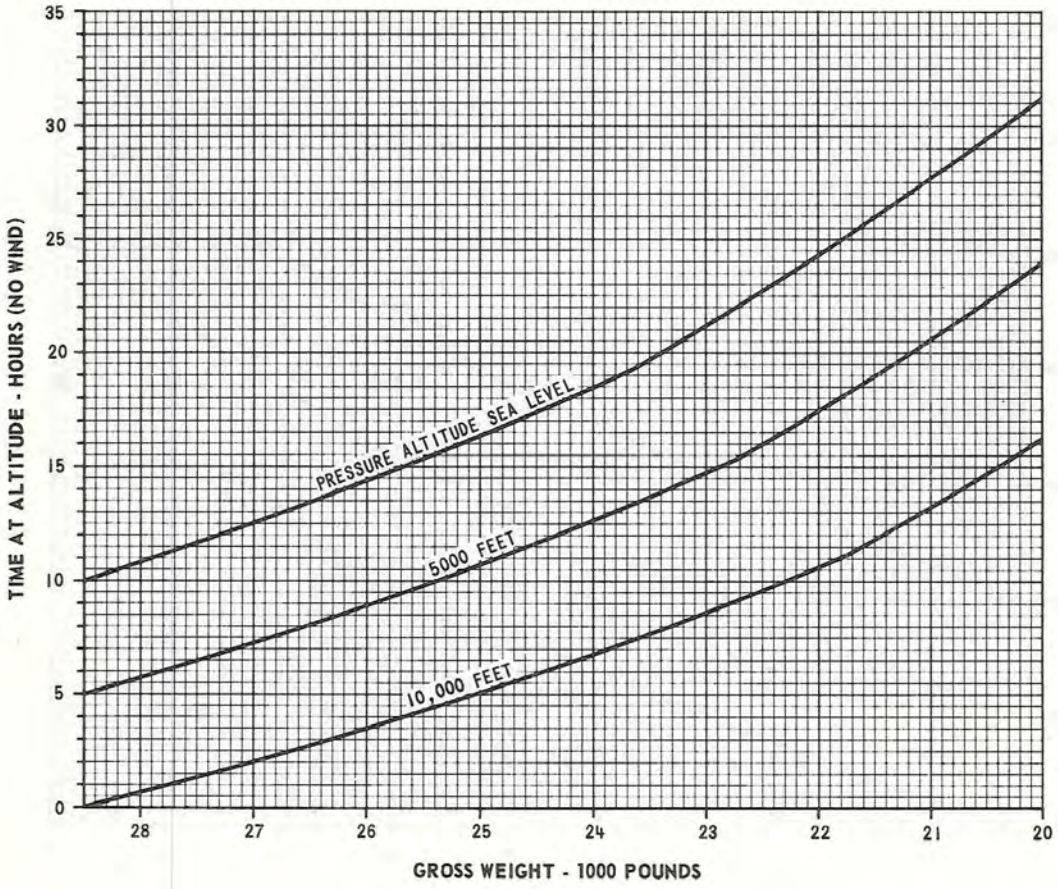
Figure 14-104

LONG-RANGE PREDICTION - TIME
ONE ENGINE INOPERATIVE - PROPELLER FEATHERED

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

REMARKS:
STANDARD DAY
FLAPS AND GEAR RETRACTED
LONG-RANGE CRUISING SPEED



4F-1197

Figure 14-105

DESCENT RANGE

CLEAN CONFIGURATION - BOTH PROPELLERS FEATHERED

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (AFFTC)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

EXAMPLE:
FIND DISTANCE FLOWN DURING DESCENT FROM 14,900 FEET TO 9000 FEET.

ENTER CHART AT 14,900 FEET ON VERTICAL SCALE AND FIND THE CORRESPONDING VALUE OF 31 NAUTICAL MILES ON THE HORIZONTAL SCALE.

REPEAT THE PROCESS AT 9000 FEET AND FIND CORRESPONDING VALUE OF 43 NAUTICAL MILES.

THE DESCENT RANGE = 43-31=12 NAUTICAL MILES.

GROSS WEIGHT POUNDS	C A S KNOTS
20,000	90
22,000	94
24,000	98
26,000	102
28,500	107

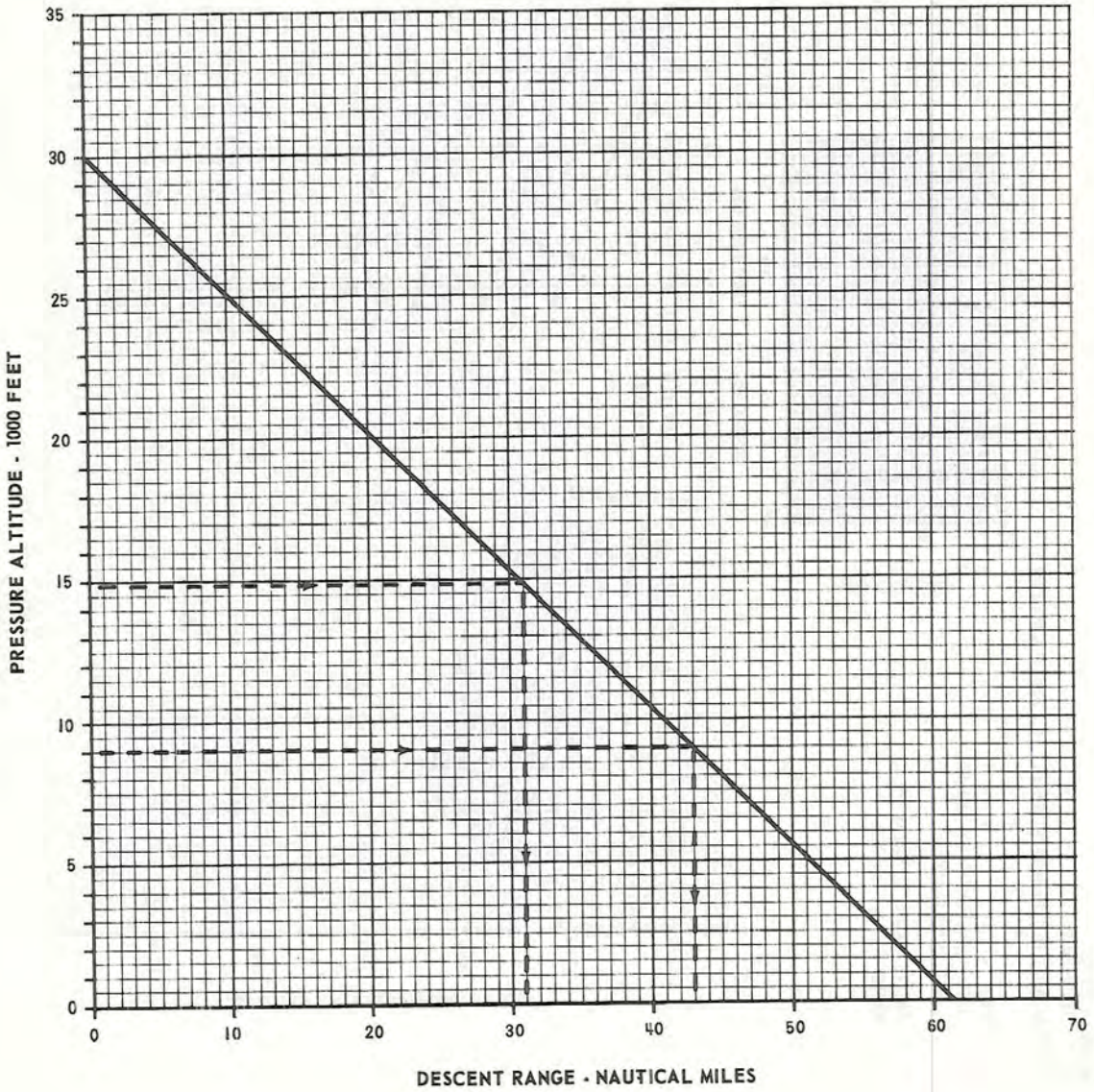


Figure 14-106

LANDING DISTANCE

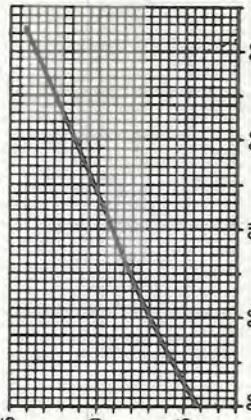
GROUND ROLL, NORMAL TECHNIQUE (FLAPS 30°)

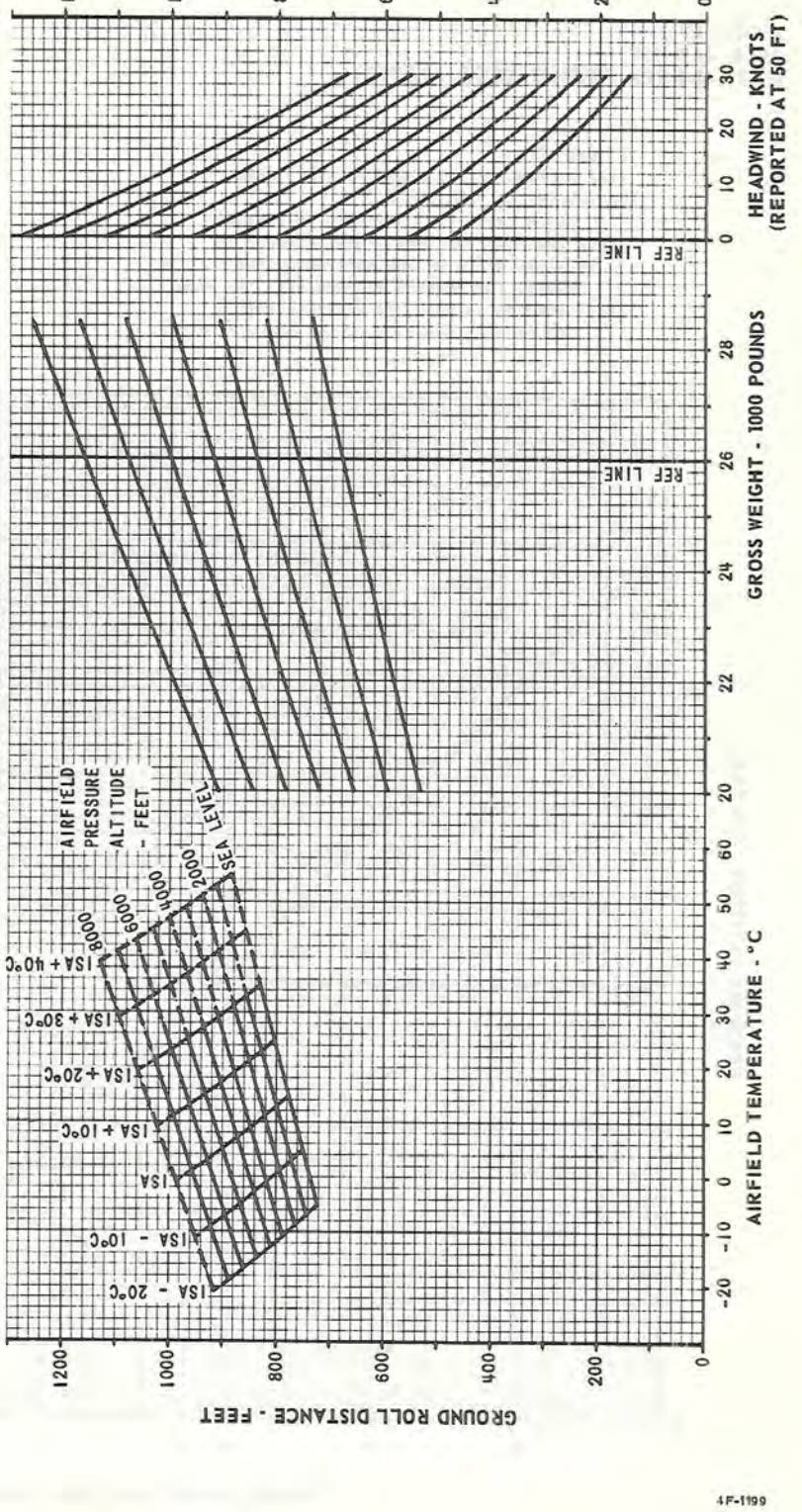
MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	STANDARD DAY (ISA) ZERO WIND GROUND ROLL-FT	ZERO WIND CLEAR 50FT-FT	30 KNOT WIND GROUND ROLL-FT	30 KNOT WIND CLEAR 50FT-FT
28,500	SEA LEVEL	841	1790	366	1000
	5000	975	2010	460	1160
26,000	SEA LEVEL	776	1680	325	930
	5000	900	1880	415	1080
23,000	SEA LEVEL	695	1550	275	860
	5000	805	1730	345	970

APPROACH IAS FOR ALL ALTITUDES





NOTE:
1. DATA REPRESENTED BY BROKEN LINES IS ESTIMATED
2. FOR DISTANCE TO CLEAR 50 FT REFER TO FIG. 14-108

4F-1199

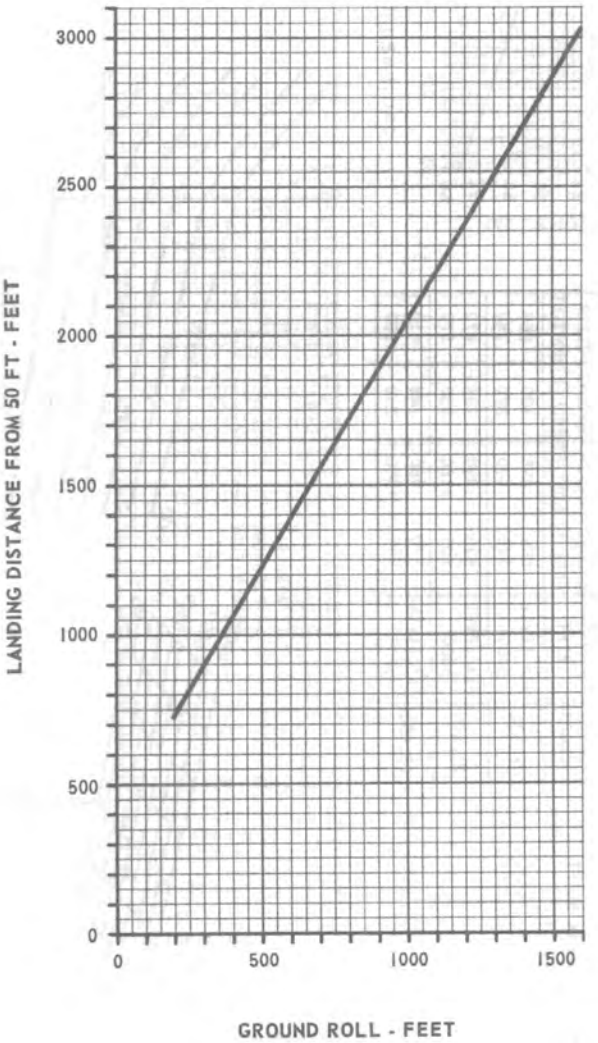
Figure 14-107

LANDING DISTANCE

LANDING DISTANCE FROM 50 FEET VERSUS GROUND ROLL NORMAL TECHNIQUE (FLAPS 30°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-1200

Figure 14-108

LANDING DISTANCE

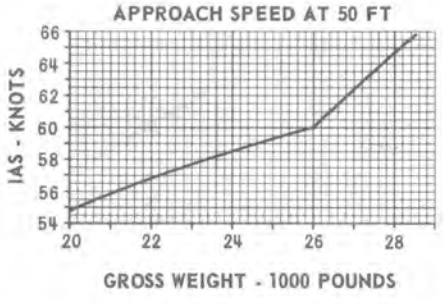
GROUND ROLL. SHORT-FIELD TECHNIQUE (FLAPS 40°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

NOTE:
1. DATA REPRESENTED BY BROKEN LINES IS ESTIMATED
2. FOR DISTANCE TO CLEAR 50 FT REFER TO FIGURE 14-110

STANDARD DAY (ISA)					
GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FEET	ZERO WIND		30 KNOT WIND	
		GROUND ROLL-FT	CLEAR 50FT-FT	GROUND ROLL-FT	CLEAR 50FT-FT
28,500	SEA LEVEL	665	1245	300	660
	5000	780	1420	370	780
26,000	SEA LEVEL	525	1030	195	470
	5000	605	1160	250	570
23,000	SEA LEVEL	470	950	165	410
	5000	545	1060	210	500



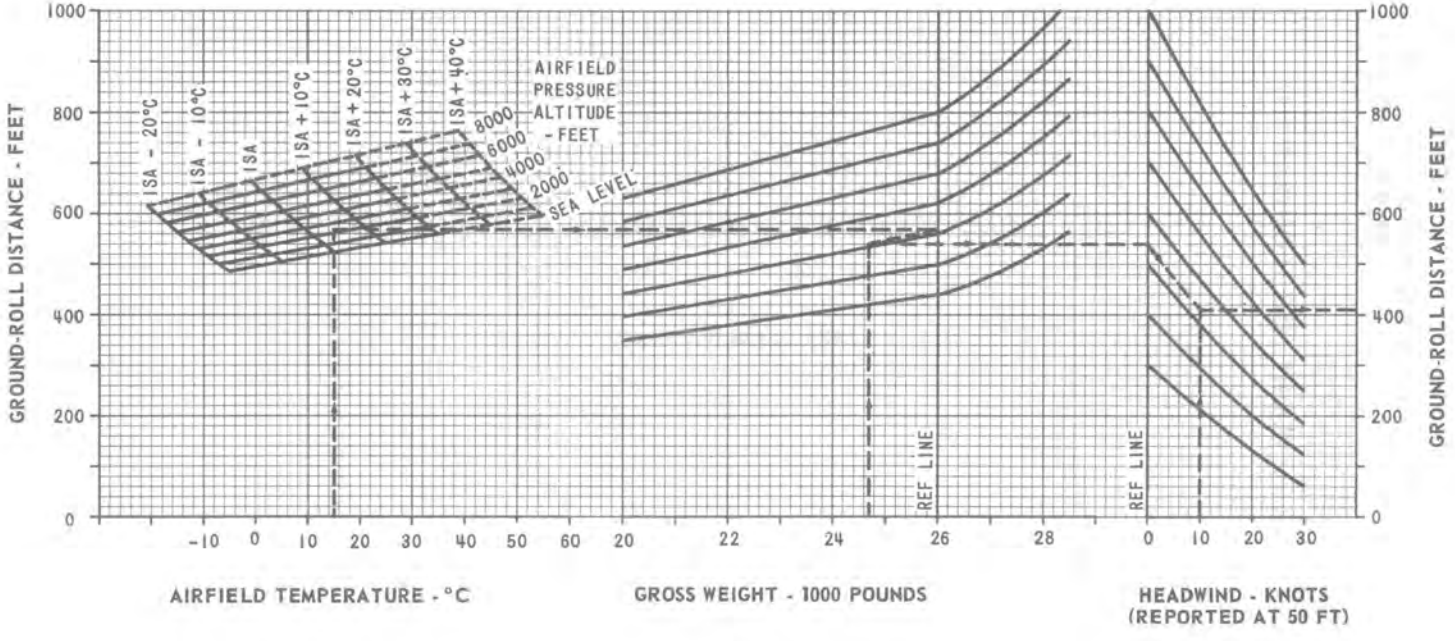


Figure 14-109

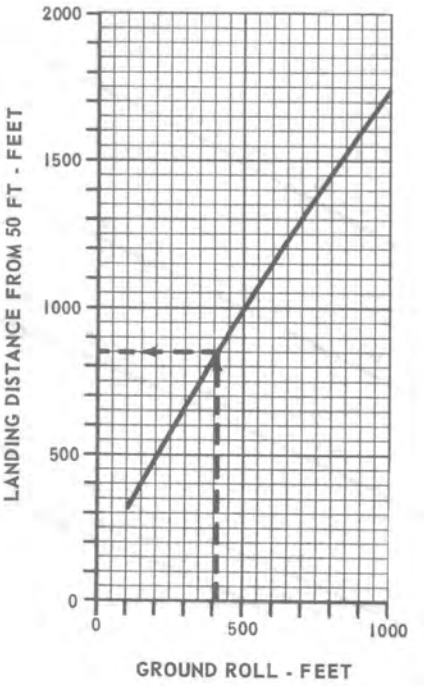
4F-1201

LANDING DISTANCE

LANDING DISTANCE FROM 50 FT VERSUS GROUND ROLL SHORT-FIELD TECHNIQUE (FLAPS 40°)

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



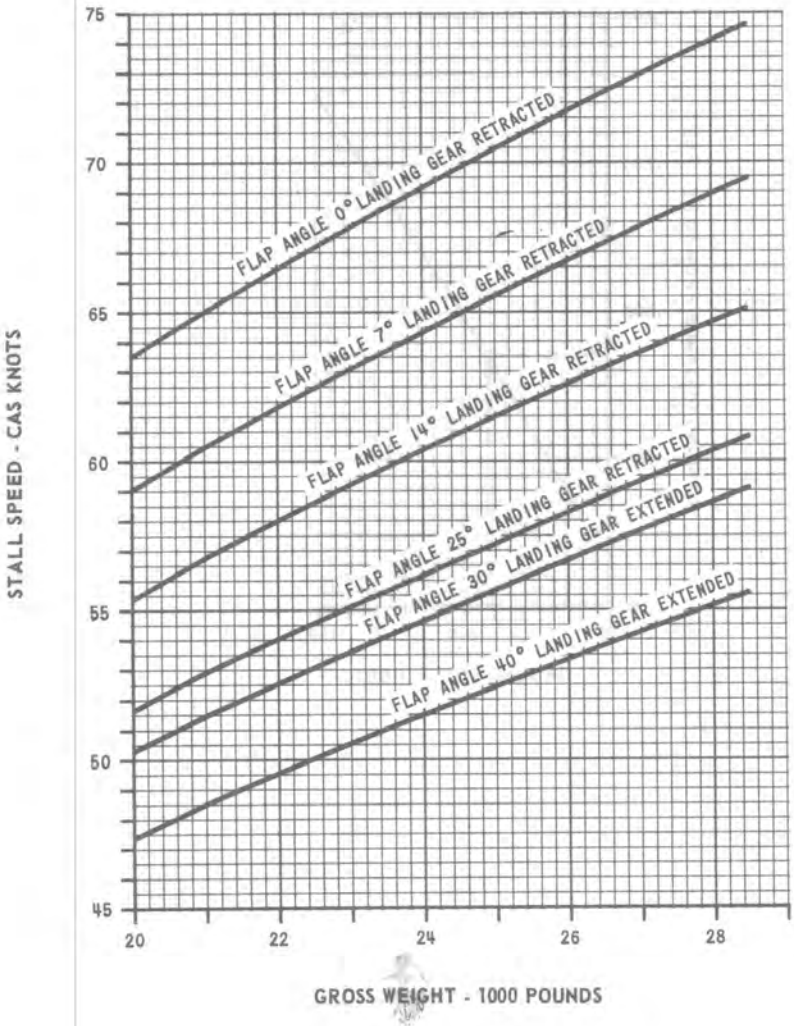
4F-120 2

Figure 14-110

STALL SPEED
POWER FOR ZERO THRUST
CG AT FORWARD LIMIT

MODEL: CV-2
DATE: MAY 1961
DATA BASIS: FLIGHT TEST (CONTRACTOR)

ENGINE(S): (2) R-2000-13
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



4F-1203

Figure 14-111

APPENDIX I
REFERENCES

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AR 95-2	Flight Regulations, Army Aircraft.
AR 95-9	Navigational Facilities and Instrument Approach Procedures.
AR 95-11	Flight Service Interphone Communications System Procedures.
AR 95-14	Army Aviation, Flight Information.
AR 95-15	Aerial Flights; Piloting Aircraft; Parachute Jumps.
AR 95-28	Performance Records by United States Military Aircraft.
AR 715-232	Emergency Purchase of Army Aviation Fuels, Oils, Parts, Supplies, Equipment, and necessary Services from Commercial Sources.
TB AVN 2	Recommended and Alternate Grade Fuels, Engine and Transmission Oils for Army Aircraft - Engine Combinations.
TB AVN 23-16	Test Flights and Maintenance Operational Checks of Army Aircraft.
TM 10-500	Air Delivery of Supplies and Equipment; General.
TM 10-500-5	Air Drop of Supplies and Equipment: (CV-2 Caribou Aircraft) Preparation, Loading, and Load Release Procedures.
TM 10-500-5-1	Air Drop of Supplies and Equipment: Rigging M170 1/4-ton Frontline Ambulance on Combat-Expendable Platform (CV-2 Caribou Aircraft).
TM 10-500-5-2	Air Drop of Supplies and Equipment: Rigging the M38A1 1/4-ton Truck on Combat-Expendable Platform (CV-2 Caribou Aircraft).
TM 10-500-5-3	Air Drop of Supplies and Equipment: Rigging M274 1/2-ton 4 x 4 Infantry Light Weapons Carrier on Skidboard (CV-2 Caribou Aircraft).
TM 38-750	Army Equipment Records Procedures.
TM 55-405-9	Army Aviation Maintenance Engineering Manual (Weight and Balance).

APPENDIX II
MAINTENANCE ALLOCATION CHART

The Maintenance Allocation Chart will be found only in TM 55-1510-206-20, Appendix II.

APPENDIX III
AIRCRAFT INVENTORY MASTER GUIDE

The Aircraft Inventory Master Guide will be found only in TM 55-1510-206-20, Appendix III.

APPENDIX IV
OPERATOR'S AND CREWMEMBER'S CHECKLIST

The Condensed Checklist is issued as
TM 55-1510-206-10CL

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