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FLIGHT MANUAL

USAF SERIES C-47,A,B,D,HC-47,C-117A,B,C
NAVY MODELS R4D-1,C-47H,C-47J,
TC-47K AIRCRAFT

MODELS REDESIGNATED IN ACCORDANCE WITH AFR 66-11, DATED 28 SEPTEMBER 1962.

SEE WEEKLY INDEX, T. O. 0-1-1A, FOR CURRENT STATUS OF SAFETY OF FLIGHT SUPPLEMENT.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS TECHNICAL PUBLICATION TO THE ATTENTION OF ALL AIR FORCE PERSONNEL CLEARED FOR OPERATION OF AFFECTED AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

15 MARCH 1963

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INTRODUCTION

SCOPE. This manual contains the necessary instructions for safe and efficient operation of the C-47, C-117 and R4D. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGEMENT. Instructions in this manual are for a crew inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgement. Multiple emergencies adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from Service Engineering Division (WRNEO), Warner Robins Air Material Area, Robins Air Force Base, Georgia, before any questionable operation is attempted which is not specifically permitted in this manual.

STANDARDIZATION AND ARRANGEMENT. Standardization assures that the scope and arrangement of all flight manuals are identical. The manual is divided into ten fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the airplane. The remaining sections provide important information for safe and efficient mission accomplishment.

SAFETY OF FLIGHT SUPPLEMENTS. Information involving safety will be promptly forwarded to you by Safety of Flight Supplements. Supplements covering loss of life will get to you in 48 hours by T W X, and those concerning serious damage to equipment within 10 days by mail. The current status of each Safety of Flight Supplement affecting your airplane can be determined by referring to the Weekly Index of Safety of Flight Supplements (T. O. 0-1-1A). The title page of the Flight Manual and the title block of each Safety of Flight Supplement should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements - current supplements must be complied with, but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

CHECKLIST. The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as seperate technical orders - see the back of the title page for T. O. numbers and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety of Flight Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement will be issued. This will keep hand-written entries of Safety of Flight Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety of Flight Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel - it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirements Table (T. O. 0-3-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to "Warnings", "Cautions", and "Notes" found throughout the manual.

WARNING Operating procedures techniques, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

NOTE An operating procedure, technique, etc., which is considered essential to emphasize.

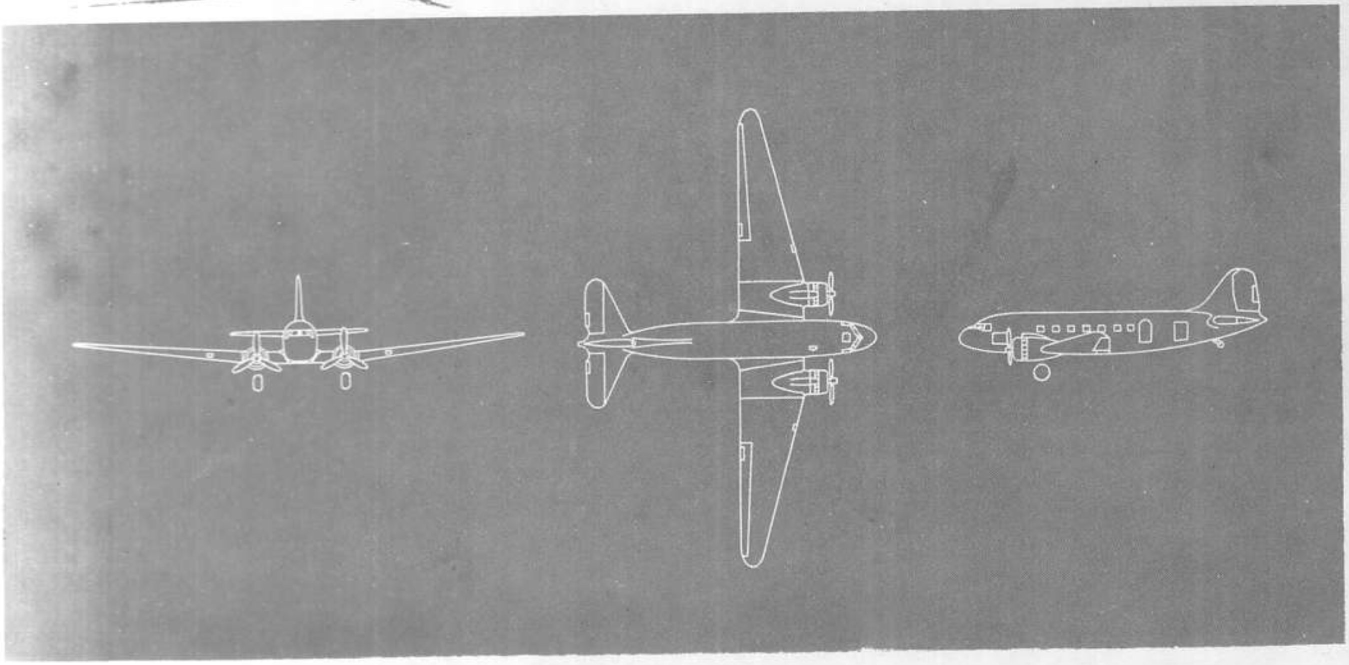
YOUR RESPONSIBILITY – TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters, in accordance with T. O. 00-5-1, to Warner Robins Air Material Area (WRNEO, Robins Air Force Base, Georgia.

AIRCRAFT SERIES DESIGNATION. The C-47, C-47A, C-47B, C-47D and SC-47 aircraft will be referred to in this manual as C-47 SERIES AIRCRAFT, and the C-117A, C-117B, and C-117C Aircraft will be referred to as C-117 SERIES AIRCRAFT. The R4D-1, R4D-5, R4D-6, and R4D-7 aircraft will be designated as R4D SERIES AIRCRAFT. Information common to all series will not carry a designation, except differences which are common to specific aircraft.

NOTE

Aircraft with the R-1830-92 engine installed were designated C-47, C-47A, SC-47, R4D-1, or R4D-5. Aircraft with the R-1830-90C engine installed were designated C-47B, C-117A, or R4D-6. Aircraft with the R-1830-90D engine installed were designated C-47D, C-117B, or R4D-7. The SC-47 is a C-47 modified for long range missions. Coverage of the VC-47 (personnel transport) aircraft in this manual, as a result of varied modifications, will consist only of installations that are common to the C-47 SERIES AIRCRAFT.

The Aircraft



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DESCRIPTION

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THE AIRCRAFT.

The C-47, C-47A, C-47B, C-47D, SC-47, C-117A, C-117B, C-117C, R4D-1, R4D-5, R4D-6, and R4D-7 aircraft, manufactured by the Douglas Aircraft Company, Inc., are twin-engine, low-wing monoplanes, equipped with a retractable main landing gear. The C-47 series and R4D series aircraft are designed for use as cargo, ambulance or troop transports, while the C-117 series aircraft are personnel transports. The SC-47 is a C-47 series aircraft modified by Land Air, Cheyenne, Wyoming, for long range missions. Some aircraft have provisions for carrying propellers and releasable parachute packs on the underside of the fuselage.

MAIN DIFFERENCES TABLE.

The main differences table shows both the C-47 and C-117 series aircraft for cumulative comparison.

AIRCRAFT DIMENSIONS.

The principal dimensions of the aircraft are:

Span	95 feet
Length	64 feet 5½ inches
Height	16 feet 11 inches

AIRCRAFT GROSS WEIGHT

The design gross weight is 26,000 pounds; however, the maximum permissible weight of the aircraft can vary within broad limits, depending on certain weight controlling criteria. For more detailed weight information, see Operational Weight Limitations, Section V.

INTERIOR ARRANGEMENT.

The C-47 series and R4D series aircraft are designed to carry various loads. Folding benches for 27 or 28

MAIN DIFFERENCES TABLE

ITEM	*C-47, C-47A*	*C-47B, C-47D*	*SC-47*	*C-117A, C-117B*	*R4D-1, R4D-5*	*R4D-6*	*R4D-7*
ENGINE	R-1830-92	R-1830-90C, C-47B R-1830-90D, C-47D	R-1830-90D	R-1830-90C, C-117A R-1830-90D, C-117B	R-1830-92	R-1830-90C	R-1830-90D
ASTRODOME	YES	SOME	YES	NO			
CARGO DOORS	YES	SOME	YES	NO			
AIRLINER SEATS	NO	SOME	NO	YES			
MAIN CABIN EMERGENCY EXIT	2	2	2	3			
CARGO SPACE HEATER	NO	NO	SOME	NO			
APP	SOME	SOME	SOME	SOME			
BUFFET	NO	NO	NO	YES			
NAVIGATOR'S STATION	YES	YES	YES	NO			
FUEL TANKS	4	4	8	4			
SKIS	SOME	SOME	SOME	NO			
ALARM AND WARNING SYSTEM	YES	YES	YES	NO			
STEWARD'S SEAT	NO	NO	NO	YES			
PARA PACK PROVISIONS	YES	YES	YES	NO			
PARATROOP PROVISIONS	YES	YES	YES	NO			
JATO	YES	YES	YES	NO			

passengers are installed along both sides of the main cabin compartment. When used as an ambulance transport, 15 to 24 litters (depending on litter arrangement) can be installed. Loading provisions permit transport of a variety of cargo (figure 1-1).

On C-117 series aircraft, the main cabin is equipped with 21 adjustable reclining passenger seats and one folding seat for the flight steward. The passenger seats are arranged in seven rows of three seats each, with double seats on the left side of the aisle and single seats on the right. A buffet is installed at the rear of the main cabin on the left side just aft of the passenger entrance door and a lavatory compartment is located aft of the main cabin (figure 1-1).

FLIGHT CREW (C-47 AND R4D SERIES AIRCRAFT)

Accommodations are provided for a crew of five: pilot, co-pilot, radio operator, loadmaster, navigator, and flight mechanic (figure 1-1).

FLIGHT CREW (C-117 SERIES AIRCRAFT).

Accommodations are provided for a crew of four: pilot, co-pilot, radio operator, and steward (figure 1-1). A folding seat is also provided on some aircraft, aft of and between the pilot and co-pilot, for a flight examiner.

ENGINE.

The aircraft is powered by a two 14-cylinder, twin-row, radial, air cooled Pratt and Whitney R-1830-90C, R-1830-90D, or R-1830-92 engines. The R-1830-90D or R-1830-92 engine incorporates a single speed integral supercharger, and the R-1830-90C engine incorporates a single-stage 2-speed integral supercharger. On some aircraft, with the R-1830-90C engine installed, the high blower has been made inoperative. An injection type carburetor and a direct-cranking starter, or a combination electric-inertia, direct cranking starter is installed.

MAGNETIC CHIP DETECTOR (R4D SERIES AIRCRAFT).

A magnetic chip detector system, for the engine main oil sump plug, is provided to warn of internal engine failure. The magnetic chip detector warning lights are mounted on the right side of the main instrument panel. 28-volt dc power is supplied through circuit breakers on the radio circuit breaker panel.

SUPERCHARGERS.

On aircraft with the R-1830-90D or R-1830-92 engine installed, and integral single-speed supercharger with an impeller gear ratio of 7.15 to 1, is provided. On aircraft with the R-1830-90C engine installed, a single-stage, 2-speed supercharger with a low blower ratio of 7.15 to 1 and a high blower ratio of 8.47 to 1, is provided. The high gear ratio allows the engine to maintain higher power at greater altitudes than would be possible with only the low ratio. On some aircraft, the high blower has been made inoperative.

Supercharger Handle (Some Aircraft).

On some aircraft with the R-1830-90C engine installed, a 2-position supercharger handle, mechanically connected to a hydraulic control valve, is located below the side window, to the left of the pilot's seat (1, figure 1-2 and 4, figure 1-8). The handle has the following positions: LOW BLOWER and HI BLOWER. When the handle is moved to the HI BLOWER position, hydraulic fluid pressure from the main hydraulic system actuates a small hydraulic cylinder located on the rear crankcase of each engine. The actuating cylinder positions an engine oil selector valve, which directs engine oil under pressure to the high blower clutch to shift the clutch into the high ratio position. When the handle is moved to the LOW BLOWER position, the hydraulic fluid pressure actuates the hydraulic cylinders, moving the engine oil selector valves to direct engine oil under pressure to shift the low blower clutches into the low ratio position.

High Blower Indicator Lights (Some Aircraft).

Two 28-volt d-c high blower indicator lights are located immediately forward of the supercharger control valve handle (2 and 3, figure 1-2). These push-to-test lights, placarded L.H. MOTOR and R.H. MOTOR, will illuminate when the supercharger control valve handle is placed in the HI BLOWER position and the hydraulic actuating cylinder positions the engine oil selector valve into high blower. Failure of one or both of these lights to illuminate when the control valve handles are in the HI BLOWER position, is an indication that the supercharger control hydraulic system is not functioning properly.

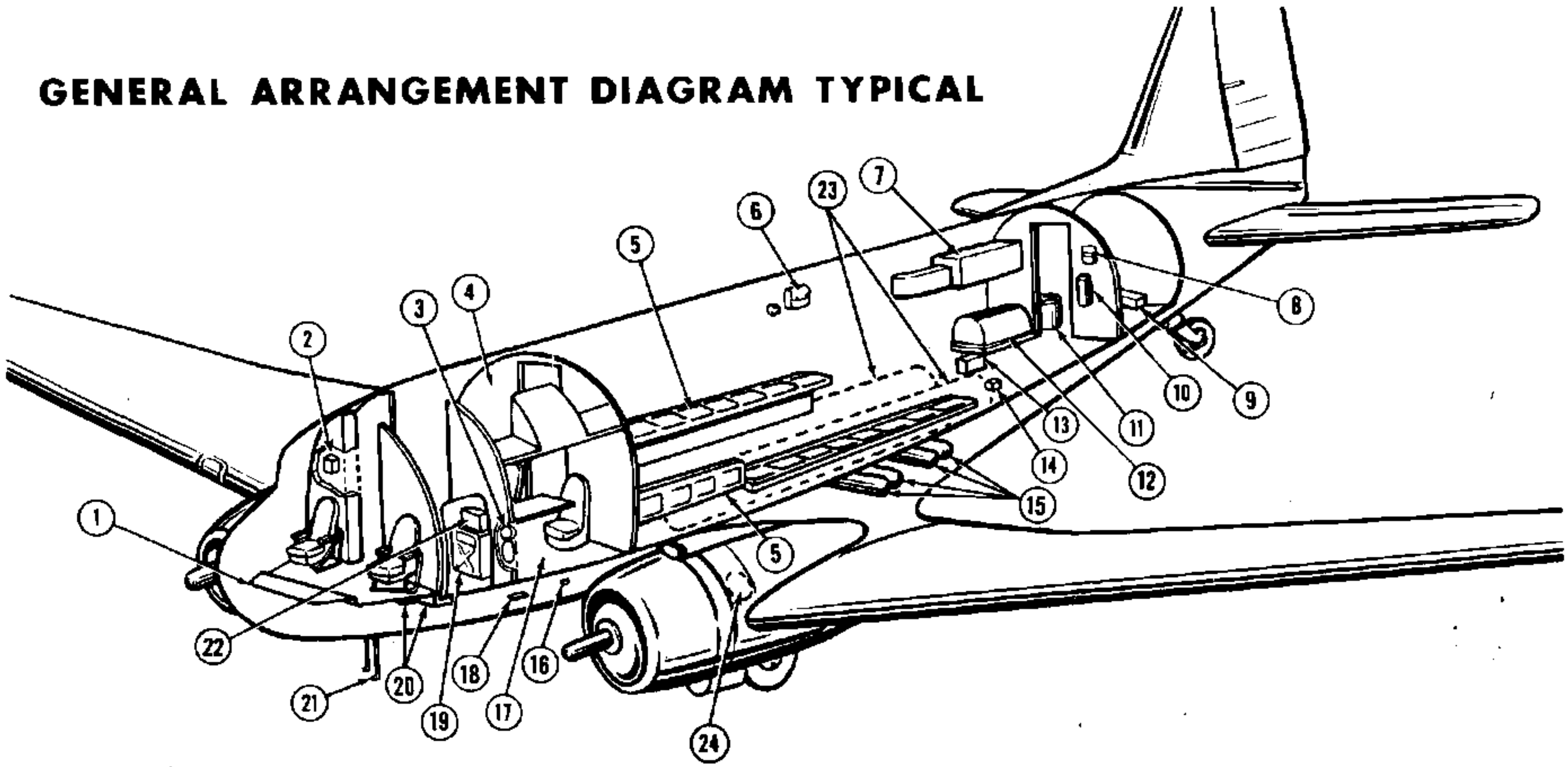
THROTTLE LEVERS AND FRICTION LOCK.

Two throttle levers, mounted on the control pedestal (3, figure 1-10), are connected by a cable system to the throttle control on each carburetor. The throttles are mechanically operated and equipped with a friction-type lock to prevent creeping of the controls (6, figure 1-10). The placarded throttle positions are CLOSE and OPEN. The throttle range between these positions is used for the desired power setting.

MIXTURE CONTROL LEVERS AND THUMB LATCH LOCK.

Two mixture control levers, mounted on the upper right side of the control pedestal (4, figure 1-10) are

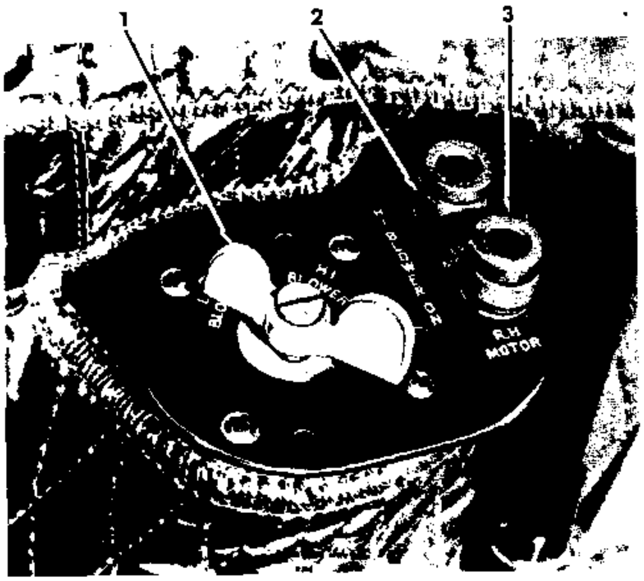
GENERAL ARRANGEMENT DIAGRAM TYPICAL



1. PILOTS COMPARTMENT
2. HYDRAULIC PRESSURE ACCUMULATOR
3. PORTABLE OXYGEN CYL.
4. RADIO OPERATORS COMP.
5. FOLDING TROOP SEATS
6. LITTER HANGER
7. SPACE HEATER
8. MISC. STOWAGE
9. ENG. COVER STOWAGE
10. SURFACE CONTROL LOCKS STOWED
11. TOILET
12. A.P.P.
13. PARAPACK CONTROL JUNCTION BOX
14. LOW PRES. SYS. OXY. FILLER VALVE
15. LOW PRES. SYS. OXY. TANKS
16. ALTERNATE STATIC SOURCE
17. NAVIGATORS COMPARTMENT
18. EXTERNAL POWER RECEPTACLE
19. MAIN ELECTRICAL JUNCTION BOX
20. BATTERIES
21. PITOT STATIC TUBE
22. POWER SYSTEMS JUNCTION BOX
23. L.R. FUEL TANKS
24. C.B. CONTAINER

Figure 1-1

SUPERCHARGER HANDLE AND HIGH BLOWER INDICATOR LIGHTS



1. SUPERCHARGER HANDLE
2. HIGH BLOWER INDICATOR LIGHTS (LH)
3. HIGH BLOWER INDICATOR LIGHTS (RH)

Figure 1-2

connected by a cable system to the mixture control on each carburetor. The mixture control levers have the following positions: IDLE CUT-OFF, AUTO-LEAN, and AUTO-RICH. The IDLE CUT-OFF position cuts off all fuel flow to the engine, except for priming. The AUTO-LEAN position automatically provides the fuel air ratio required for cruise operation with normal cylinder head temperature. The AUTO-RICH position provides a richer fuel-air ratio for the higher power settings. Each mixture control lever is equipped with a thumb-latch lock which mechanically releases the lever when depressed.

CARBURETOR AIR SYSTEMS.

One of three types of carburetor air induction systems is installed in the aircraft: ram, ram-filtered, or ram-nonram filtered.

RAM-TYPE CARBURETOR AIR SYSTEM.

The ram-type carburetor air system (figure 1-3) provides two ways of supplying air to the carburetor. A small duct, located on the top forward edge of the engine accessory cowling, routes cold ram air directly to the carburetor throat, or, ram air flows inside the cowling past the exhaust collector ring and is preheated prior to entering the carburetor throat. The source of air supply is determined by the position of the carburetor air preheat door in the carburetor air intake throat.

Carburetor Air Control Levers and Friction Lock Lever.

Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically control the movement of their respective preheat door in the carburetor air intake throat. The control levers have HOT and COLD placarded positions. In the HOT position, the carburetor air preheat door shuts off the ram air flow to allow the preheated air to flow from inside the cowling past the exhaust collector ring and into the carburetor. In the COLD position, the preheat door shuts off the preheated air flow and allows ram air to flow from the scoop to the carburetor (figure 1-3). Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

RAM FILTERED-TYPE CARBURETOR AIR SYSTEM.

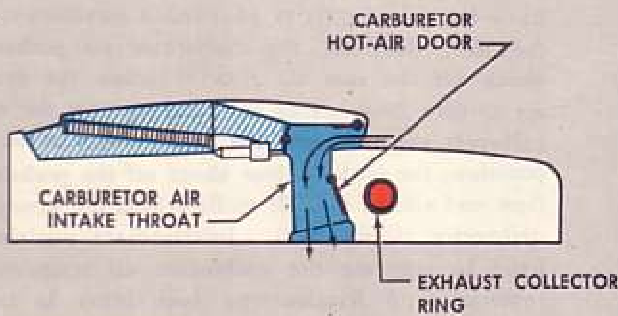
The ram filtered-type carburetor air system (figure 1-3) provides two ways of supplying air to the carburetor. Cold ram air is routed through a detachable filter duct unit, mounted on top of the nacelle, and directed down into the throat of the carburetor, or ram air flows inside the cowling past the exhaust collector ring and is preheated prior to entering the carburetor throat. The source of air supply is determined by the position of the carburetor air preheat door in the carburetor air intake throat.

Carburetor Air Control Levers and Friction Lock Lever.

Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically operate the movement of their respective preheat door in the carburetor air intake throat. The control levers are placarded HOT and COLD. In the HOT position, the carburetor preheat door shuts off the ram air flow to allow the preheated air to flow from inside the cowling past the exhaust collector ring and into the carburetor. In the COLD position, the preheat door shuts off the preheated air flow and allows filtered ram air to flow from the scoop to the carburetor (figure 1-3). Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

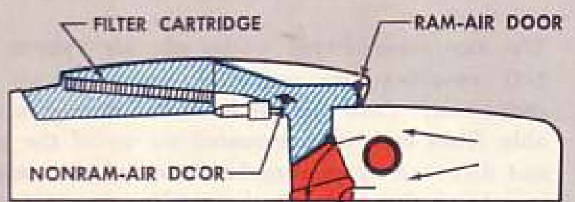
CARBURETOR AIR SYSTEMS

RAM-NONRAM TYPE CARBURETOR AIR SYSTEM



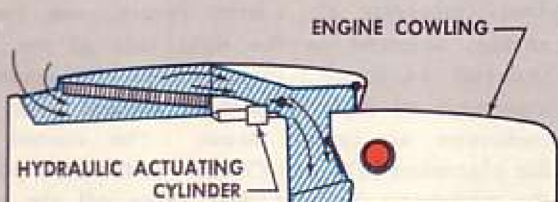
RAM AIRFLOW

Nonram-air door closed. Hot-air door closed. Direct unfiltered air to carburetor.



HOT AIRFLOW

Ram-air door closed. Nonram air shut off by hot air door in open position. Hot air to carburetor.



NONRAM FILTERED AIRFLOW

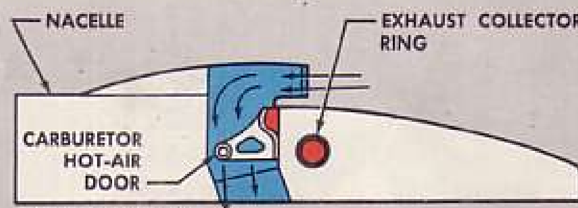
Ram-air door closed. Hot-air door closed. Nonram filtered air to carburetor.

RAM AIR

NONRAM AIR

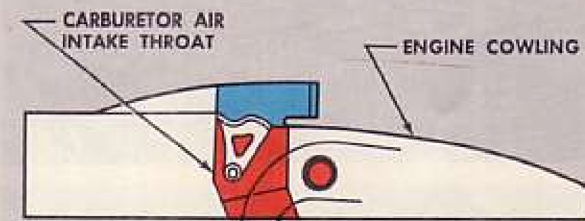
HOT AIR

RAM-TYPE CARBURETOR AIR SYSTEM



RAM AIRFLOW

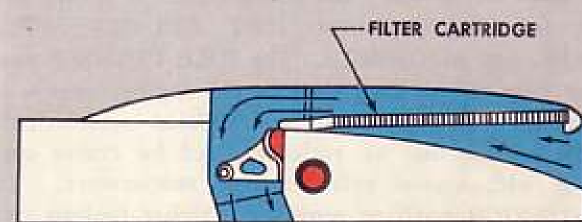
Carburetor hot-air door closed. Direct ram air to carburetor.



HOT AIRFLOW

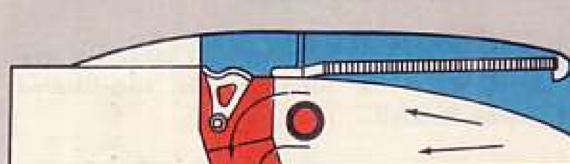
Carburetor hot-air door open. Ram air shut off by hot-air door in open position. Hot air to carburetor.

RAM FILTERED-TYPE CARBURETOR AIR SYSTEM



RAM FILTERED AIRFLOW

Carburetor hot-air door closed. Direct filtered ram air to carburetor.



HOT AIRFLOW

Carburetor hot-air door open. Filtered ram air shut off by hot-air door in open position. Hot air to carburetor.

Figure 1-3

RAM-NONRAM CARBURETOR AIR FILTER CONTROL VALVE HANDLE

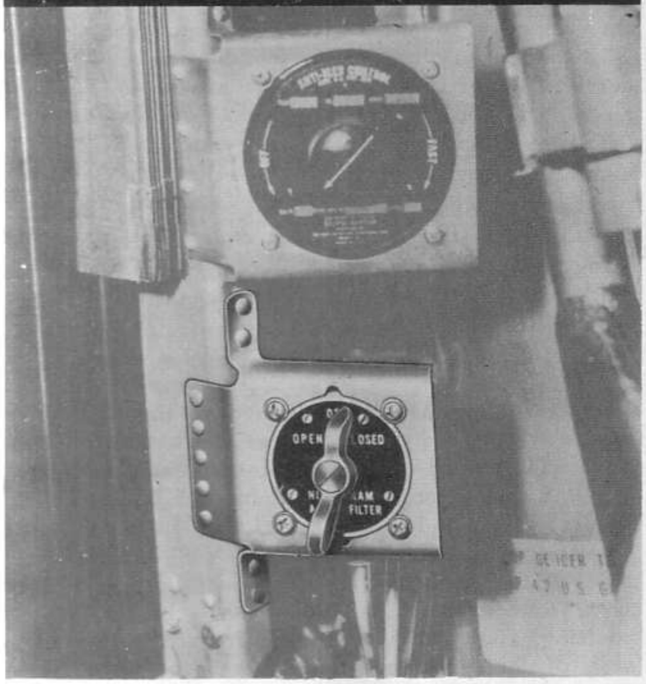
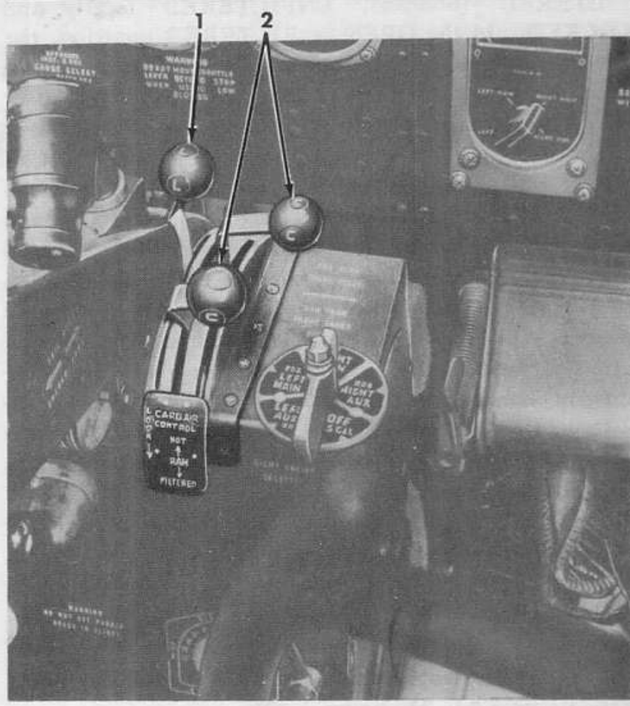


Figure 1-4

CARBURETOR AIR CONTROL LEVERS
LATE AIRCRAFT



1. CARBURETOR AIR CONTROL FRICTION LOCK LEVER.
2. CARBURETOR AIR CONTROL LEVERS.

Figure 1-5

RAM-NONRAM FILTERED-TYPE CARBURETOR AIR SYSTEM.

The ram-nonram filtered-type carburetor air system (figure 1-3) provides three ways of supplying air to the carburetor. An airscoop fairing extending from the leading edge of the engine accessory cowling to approximately halfway back on top of the nacelle has two openings. Cold ram air flows through the front scoop opening directly down into the carburetor throat. Cold nonram air is drawn through the aft opening of the fairing and flows through a filter unit down into the carburetor throat. Preheated air flows from inside the engine cowling past the exhaust collector ring and into the carburetor throat. The source of air supply is determined by the position of the ram, nonram, and carburetor preheat door in the carburetor air intake throat. On some aircraft, the positioning of the induction valve door and the aft door, is controlled electrically by switches located in the cockpit. On other aircraft, the induction valve door is controlled manually by levers located in the cockpit, while the floating aft door is positioned automatically by the pressure differential within the scoop.

Carburetor Air Control Levers and Friction Lock Lever.

Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically control the movement of their respective preheat door in the carburetor air intake throat. The control levers have HOT and COLD placarded positions. In the HOT position, the carburetor air preheat door shuts off the ram and nonram air flow to allow the preheated air to flow from inside the cowling, past the exhaust collector ring, and into the carburetor. In the COLD position, the preheat door shuts off the flow of preheated air and allows ram or nonram filtered air to flow from the scoop to the carburetor. Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

Air Filter Control Handle.

The ram-nonram carburetor air filter control handle, located on the bulkhead aft of the pilot's seat (figure 1-4), mechanically controls a hydraulic valve that directs the flow of hydraulic pressure for the operation of the ram door and the nonram door in each carburetor airscoop. On some aircraft, this control handle has OPEN (nonram), CLOSED (ram), and OFF positions. On other aircraft, the positions are: FILTERED (nonram), UNFILTERED (ram), and LOCKED. In the OPEN or FILTERED position, the ram door shuts off the ram air flow and the nonram door is opened to allow nonram filtered air to flow to the carburetor, provided the preheat control lever is in the COLD position. In the CLOSED or UNFILTERED position, the nonram door shuts off the nonram filtered air flow and the ram door is opened to permit ram air to flow to the carburetor, provided the preheat control lever is in the COLD position (figure 1-3). When the air filter control handle is placed in a desired position, sufficient time must be allowed for hydraulic actuation before the air filter control handle is returned to OFF or LOCKED to relieve the system pressure. The doors will remain in this position until the control handle is used to select another position.

Carburetor Air Temperature Indicators.

A 28-volt d-c dual carburetor air temperature indicator, graduated in degrees centigrade from -50° to $+150^{\circ}$, is mounted on the main instrument panel (15, figure 1-11, 23, figure 1-12).

Carburetor Air Control Selector Switches (Some Aircraft).

Two rotary, 5-position carburetor air control selector switches, one for each carburetor, are located on the left side of the cockpit immediately aft of the main instrument panel. Each switch has the following positions: HOT AIR, OFF, FULL COLD, FILTER, and FULL COLD. The HOT AIR position of the switch energizes a 28-volt d-c motor which, through a cam and cable system, closes the aft (nonram) door and the induction valve (forward) door to shut off the ram air supply admitting preheated air to the carburetor (figure 1-3). The FULL COLD positions of the switch energizes the motor to close the aft (non-ram) door and the induction valve door to shut off the preheated air supply, admitting ram airflow to the carburetor. The FILTER position of the switch energizes the motor to position the induction valve door to shut off the flow of ram and preheated air, and open the aft (non-ram) door to supply filtered non-ram air to the carburetor. The OFF position opens the circuit to deenergize the motor. The electrical circuit for the motor incorporates micro and limit switches which automatically shut off the motor when the doors are properly positioned for the selected airflow.

COWL FLAPS.

Hydraulically operated cowl flaps are attached to the aft edge of the engine cowling. On aircraft with the ram or ram-nonram air induction system, the center flap of the top segment is stationary. On aircraft with the ram filtered air induction system, the three flaps in the top segment are fixed. A hydraulic actuating cylinder, installed on the lower part of the engine cowling, is connected to each movable cowl flap by a series of tie rods and operating levers. Movement of the cowl flaps is controlled by the cowl flap hydraulic controls in the cockpit.

COWL FLAP HANDLES.

Two cowl flap handles attached to the hydraulic valves are located on the side of the fuselage to the right and forward of the co-pilot's seat (14, figure 1-7 and 24, figure 1-9), and have CLOSE, OFF, TRAIL, OFF, and OPEN positions. In the CLOSE position, hydraulic fluid pressure is directed to one side of the actuating cylinder and the cowl flaps move toward the closed position. In the OPEN position, hydraulic pressure is directed to the other side of the actuating cylinder and the cowl flaps move toward the open position. In the OFF position, the hydraulic pressure is trapped in the actuating cylinder to hold the cowl flaps in any desired position. In the TRAIL position, both sides of the actuating cylinder are unpressurized, allowing the cowl flaps to move in either direction, depending on the balance of the air loads on the cowl flaps.

CAUTION

In any position other than OFF, system pressure may be lost if leakage occurs in the cowl flap hydraulic system.

IGNITION SYSTEM.

The ignition system consists of two magnetos, installed in the rear accessory section of each engine, which distribute the current to the spark plugs through ignition switches, wiring, and a high tension ignition harness.

Ignition Switches.

The ignition switch unit is located above the vee of the windshield (6, figure 1-6) and incorporates a master ON-OFF switch and an ignition switch for each engine. Each engine ignition switch has four positions: OFF, L, R, and BOTH. The master ON-OFF switch grounds out all four magnetos (both magnetos of each engine) when in the OFF position. The ON position leaves the control of the magnetos to each engine ignition switch. When the engine ignition switch is positioned to L, the left magneto provides ignition for the rear spark plugs and the right magneto is grounded. When the engine ignition switch is positioned to R, the right magneto provides ignition for the front spark plugs and the left magneto is grounded. When the engine ignition switch is positioned to OFF, both magnetos for that engine are grounded and both front and rear spark plugs will not fire. When the ignition switch is in the BOTH position, both magnetos for that engine are able to generate current for the ignition system and all spark plugs can fire.

PRIMING SYSTEM.

The priming system functions as an aid in starting the engines by injecting fuel from a primer line into the upper eight cylinders.

Primer Switch (C-47 and C-117 Series Aircraft).

A 3-position, 28-volt d-c engine primer switch, mounted on the electrical control panel (15, figure 1-13), is a momentary-type switch spring loaded to the OFF position. The RIGHT (down) position of the switch energizes the right engine primer solenoid valve to direct fuel under pressure to the right engine for priming. The LEFT (up) position energizes the left engine primer solenoid valve to direct fuel under pressure to the left engine for priming. The OFF position opens the engine primer circuit. Priming fuel pressure is provided by the booster pumps (if installed) when the booster pump is ON or by manually operating the hand wobble pump (if installed).

HAND PRIMER HANDLE.

On some aircraft, a hand primer is installed on the co-pilot's side of the cockpit. The handle of the primer is turned to the left to UNLOCK, then pushed in and pulled out to pump the fuel to the engine. The handle of the primer is pushed in, then turned to the right to LOCK. The valve handle for selecting the LEFT or RIGHT engine is adjacent to the hand primer.

Oil Dilution and Primer Switches (Some Aircraft).

Two 3-position, 28-volt d-c oil dilution and primer switches, one for each engine, are mounted on the electrical control panel (20, figure 1-14). These switches are the momentary-type, spring loaded to the OFF position. When either switch is placed in the ENGINE PRIMER (down) position, the respective engine primer solenoid valve is energized to direct fuel under pressure to the engine for priming. When either switch is held in the OIL DILUTION (up) position, a 28-volt d-c circuit energizes the oil dilution solenoid, and fuel is introduced into the engine oil inlet line for dilution of the engine oil to aid in cold weather starting. Priming fuel pressure is provided by the booster pumps (if installed) when the booster pump is ON or by manually operating the hand wobble pump (if installed).

STARTING SYSTEM.

A direct cranking or, on some aircraft, a combination inertia-direct-cranking starter with a solenoid meshing device, is mounted on each engine. The starters are operated by switches located in the cockpit.

Starter Switches (Direct Cranking).

Two 2-position starter switches, one for each engine, are mounted on the electrical control panel. The RIGHT switch engages the 28-volt d-c starter for the right engine; the LEFT switch engages the starter for the left engine.

Some aircraft are equipped with one 3-position spring-loaded switch. The down position engages the starter for the RIGHT engine; the up position engages the starter for the left engine. The switch is spring loaded to the off (center) position.

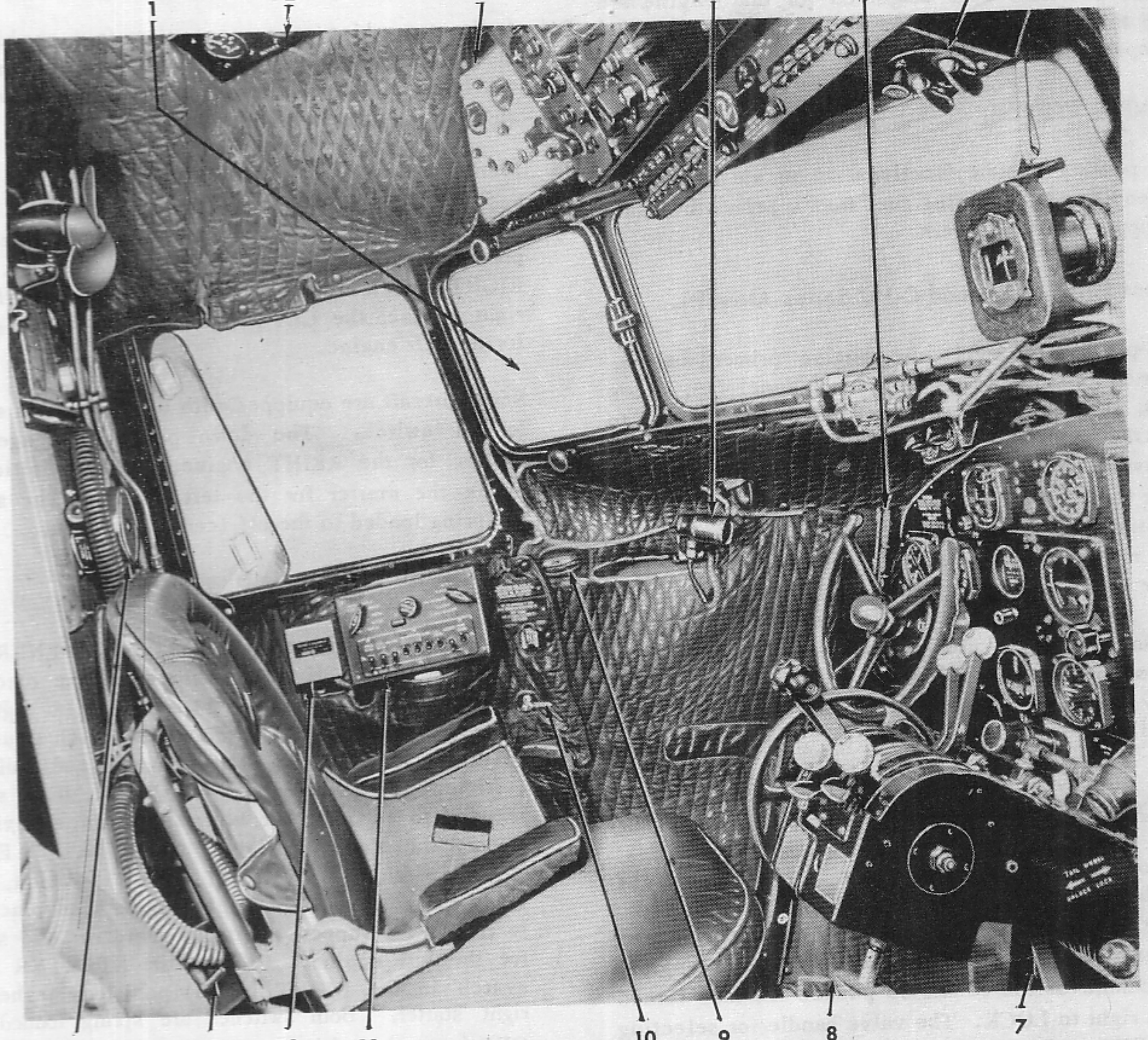
Starter Switches (Inertia-Direct Cranking).

Two 3-position starter switches, one for ENERGIZE and one for MESH, are mounted on the electrical control panel (16, figure 1-13, and 17, 18, figure 1-14). The STARTER ENERGIZE switch is used to energize the 28-volt starter motor and build up sufficient inertia before the STARTER MESH switch is used to energize the solenoid meshing device to engage the starter. Placing the STARTER ENERGIZE switch in the RIGHT (down) position, energizes the starter for the right engine, and placing it in the LEFT (upper) position, energizes the starter for the left engine. Placing the STARTER MESH switch in the RIGHT (down) position meshes the right starter. Both switches are spring loaded to the OFF (center) position.

ENGINE INSTRUMENTS.

All engine instruments are dual indicating. A direct-reading manifold pressure gage on the main instrument panel indicates the pressure in inches Hg in each engine intake manifold. A 28-volt d-c carburetor air temperature indicator and a self-generated cylinder head temperature indicator (which indicates temperature for the right engine from No. 1 cylinder and for the left engine from No. 13 cylinder), all calibrated in degrees centigrade, are mounted on the main instrument panel (13, 15, figure 1-11, and 23, 27, figure 1-12). A self-generated tachometer is installed on the main instrument panel.

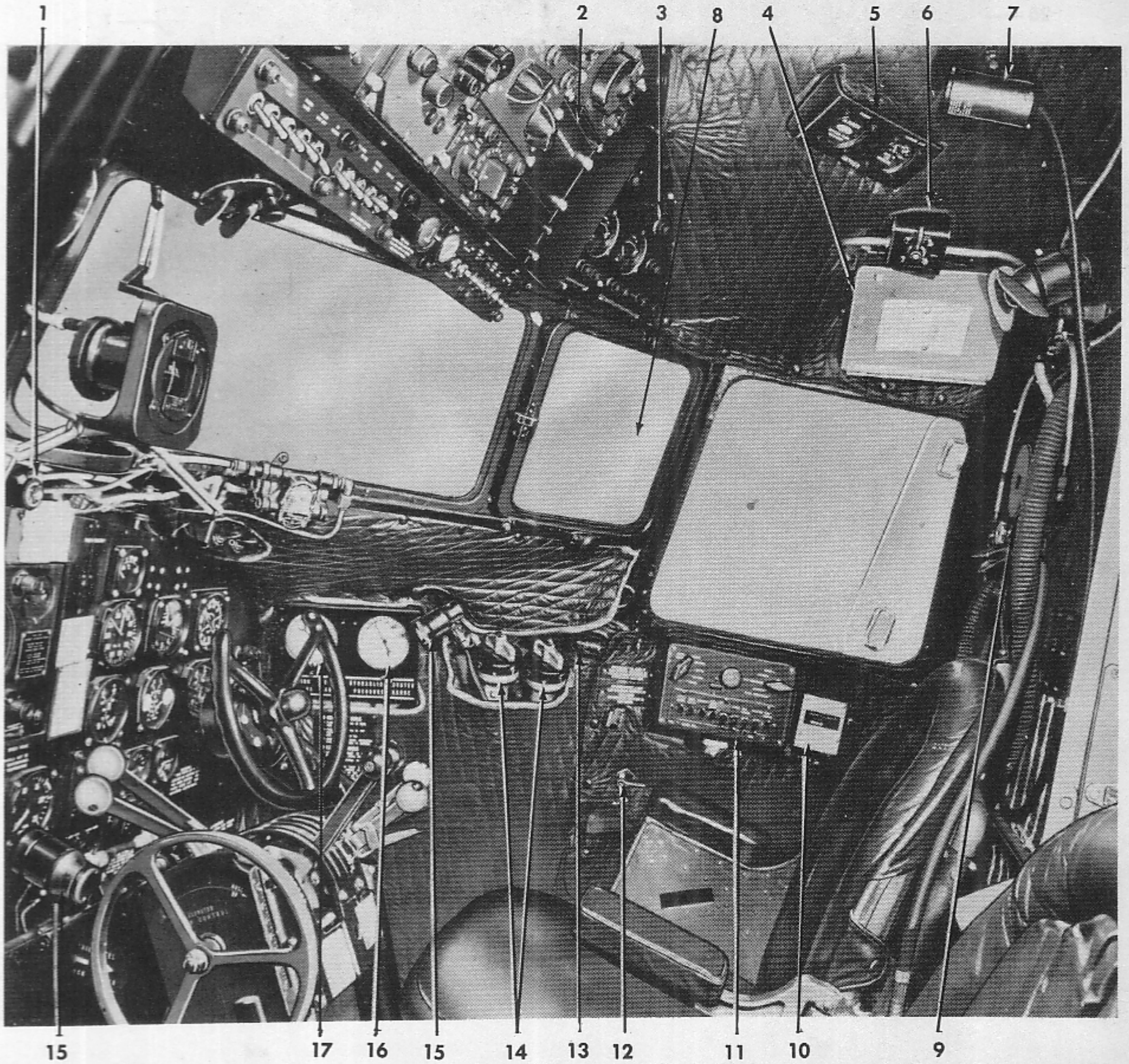
COCKPIT ARRANGEMENT—TYPICAL
LEFT SIDE



1. CLEAR VISION WINDOWS
2. OXYGEN PRESSURE GAGE AND FLOW INDICATOR
3. LEFT ELECTRICAL PANEL
4. FLUORESCENT INSTRUMENT PANEL LIGHT
5. WING FLAP POSITION INDICATOR
6. IGNITION SWITCHES
7. TAIL WHEEL LOCK LEVER
8. THROTTLE FRICTION LOCK
9. SHIELDED MAP READING LIGHT
10. WINDSHIELD ALCOHOL DE-ICING VALVE CONTROL HANDLE
11. INTERPHONE CONTROL PANEL
12. RADIO FILTER
13. PROPELLER DE-ICER RHEOSTAT SHUTOFF VALVE AND TANK
14. OXYGEN FLOW REGULATOR

Figure 1-6

COCKPIT ARRANGEMENT—TYPICAL
RIGHT SIDE

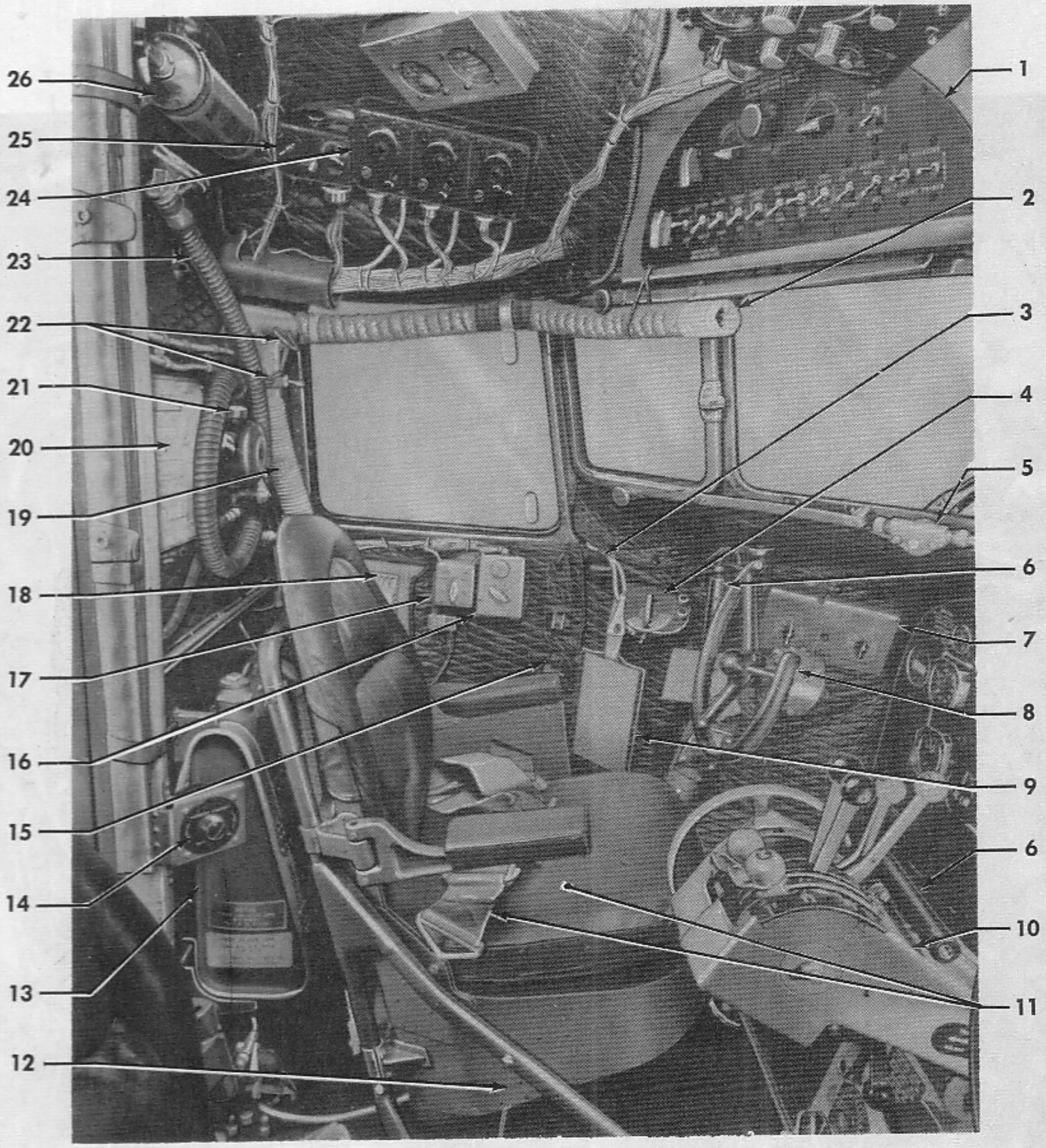


1. WINDSHIELD WIPER CONTROL VALVE
2. PILOT'S RADIO CONTROL PANEL
3. RIGHT ELECTRICAL PANEL
4. SPARE LIGHTS
5. OXYGEN PRESSURE GAGE AND FLOW INDICATOR
6. CARBURETOR DE-ICING CONTROL VALVE HANDLE
7. CO-PILOT'S OVERHEAD FLUORESCENT LIGHT
8. CLEAR VISION WINDOW
9. OXYGEN FLOW REGULATOR
10. RADIO FILTER
11. INTERPHONE CONTROL PANEL
12. WINDSHIELD DE-ICING CONTROL VALVE HANDLE
13. SHIELDED MAP READING LIGHT
14. COWL FLAP HANDLES
15. FLUORESCENT INSTRUMENT LIGHT
16. HYDRAULIC SYSTEM PRESSURE GAGE
17. LANDING GEAR PRESSURE GAGE

Figure 1-7

COCKPIT ARRANGEMENT—TYPICAL

LEFT SIDE R4D SERIES AIRCRAFT

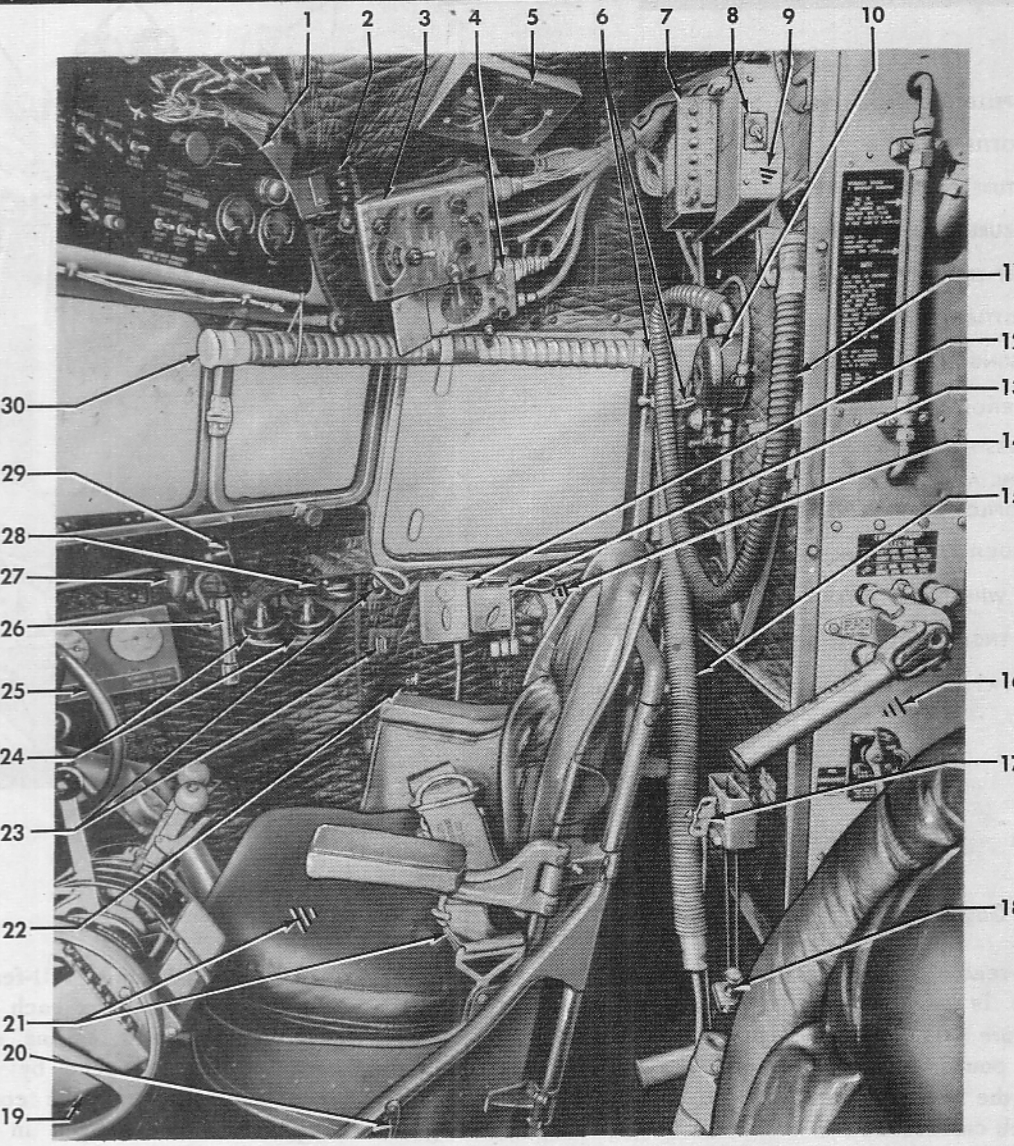


1. ELECTRICAL CONTROL PANEL
2. WINDSHIELD DEFROSTER HOSE
3. SHIELDED LAMP
4. SUPERCHARGER HANDLE (SOME AIRCRAFT)
5. WINDSHIELD WIPER OPERATING MECHANISM
6. FLUORESCENT LAMP
7. CARBURETOR AIR CONTROL SELECTOR
8. CONTROL WHEEL
9. PILOT'S CHECK LIST
10. CONTROL PEDESTAL
11. SEAT AND SAFETY BELT
12. FORWARD AND AFT SEAT ADJUSTING CONTROL
13. PROPELLER DE-ICING FLUID SUPPLY TANK
14. PROPELLER DE-ICING RHEOSTAT
15. WINDSHIELD DE-ICING CONTROL VALVE HANDLE
16. INTERPHONE JUNCTION BOX
17. RADIO FILTER BOX
18. SUIT HEAT RHEOSTAT
19. FLEXIBLE HAND WARMER AND DEFROSTER HOSE
20. FUEL SYSTEM FLOW DIAGRAM
21. OXYGEN REGULATOR
22. WINDSHIELD DEFROSTER AND HAND WARMER CONTROL VALVE HANDLES
23. OXYGEN REGULATOR TO MASK HOSE
24. COMMAND RECEIVER PANEL CONTROL HEAD
25. COMMAND TRANSMITTER CONTROL PANEL
26. HAND FIRE EXTINGUISHER

Figure 1-8

COCKPIT ARRANGEMENT—TYPICAL

RIGHT SIDE R4D SERIES AIRCRAFT



1. ELECTRICAL CONTROL PANEL
2. RADIO COMPASS SWITCH
3. RADIO COMPASS REMOTE CONTROL UNIT
4. AZIMUTH CONTROL
5. OXYGEN PRESSURE GAGE AND FLOW INDICATOR
6. WINDSHIELD DEFROSTER AND HAND WARMER CONTROL VALVE HANDLES
7. VHF COMMAND RADIO CONTROL PANEL
8. LIAISON RADIO POWER SWITCH
9. CO-PILOT'S JUNCTION BOX
10. OXYGEN REGULATOR
11. OXYGEN REGULATOR TO MASK HOSE
12. INTERPHONE JUNCTION BOX
13. RADIO FILTER BOX
14. SUIT HEATER RHEOSTAT
15. FLEXIBLE HAND WARMER HOSE
16. HYDRAULIC CONTROL PANEL
17. WING AND EMPENNAGE DE-ICING SYSTEM CONTROL HANDLE
18. COCKPIT MIXING CHAMBER CONTROL KNOB
19. CONTROL PEDESTAL
20. FORWARD AND AFT SEAT ADJUSTING CONTROL
21. SEAT AND SAFETY BELT
22. WINDSHIELD DE-ICING CONTROL VALVE
23. MICROPHONE HOOK AND HOLDER
24. COWL FLAP HANDLES
25. CONTROL WHEEL
26. FLUORESCENT LAMP
27. SHIELDED LAMP
28. SHIELDED MAP READING LAMP
29. WINDSHIELD DE-ICING HAND PUMP HANDLE
30. WINDSHIELD DEFROSTER HOSE

Figure 1-9

CONTROL PEDESTAL — TYPICAL

1. PROPELLER CONTROL LEVERS
2. THROTTLE LEVERS
3. MIXTURE CONTROL LEVERS
4. CARBURETOR AIR CONTROL LEVERS
5. RIGHT ENGINE FUEL TANK SELECTOR
6. THROTTLE LEVER FRICTION LOCK
7. PARKING BRAKE CONTROL KNOB
8. AILERON TRIM TAB CRANK AND INDICATOR
9. CROSS-FEED CONTROL VALVE HANDLE (SOME A MODELS)
10. AUTOPILOT CONTROL VALVE HANDLE
11. RUDDER TRIM CRANK AND INDICATOR
12. TAIL WHEEL LOCK LEVER
13. LEFT ENGINE FUEL TANK SELECTOR
14. ELEVATOR TRIM TAB WHEEL AND INDICATOR

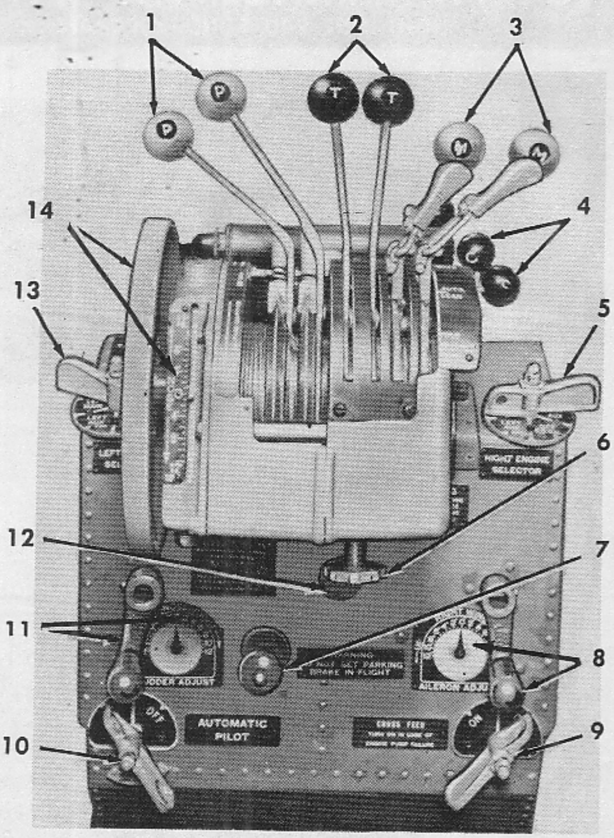


Figure 1-10

Fuel Pressure Gage.

A dual, direct-reading, hydrostatically operated, fuel pressure gage is mounted on the main instrument panel (26, figure 1-11. and 30, figure 1-12), and is calibrated in pounds per square inch. Two lines connected to the fuel pressure gage in the cockpit connect to each carburetor.

Oil Pressure Gage.

A dual, direct-reading, hydrostatically operated oil pressure gage is mounted on the main instrument panel (27, figure 1-11, and 31, figure 1-12) and is calibrated in pounds per square inch.

Oil Temperature Indicator.

A dual, 28-volt d-c oil temperature indicator, graduated in degrees centigrade, is mounted on the main instrument panel (25, figure 1-11, and 16, figure 1-12). A temperature bulb on the rear of the engine accessory case or in the oil supply pipe aft of the oil dilution fuel pipe connection furnishes remote indication to the temperature indicator of the oil entering the engine.

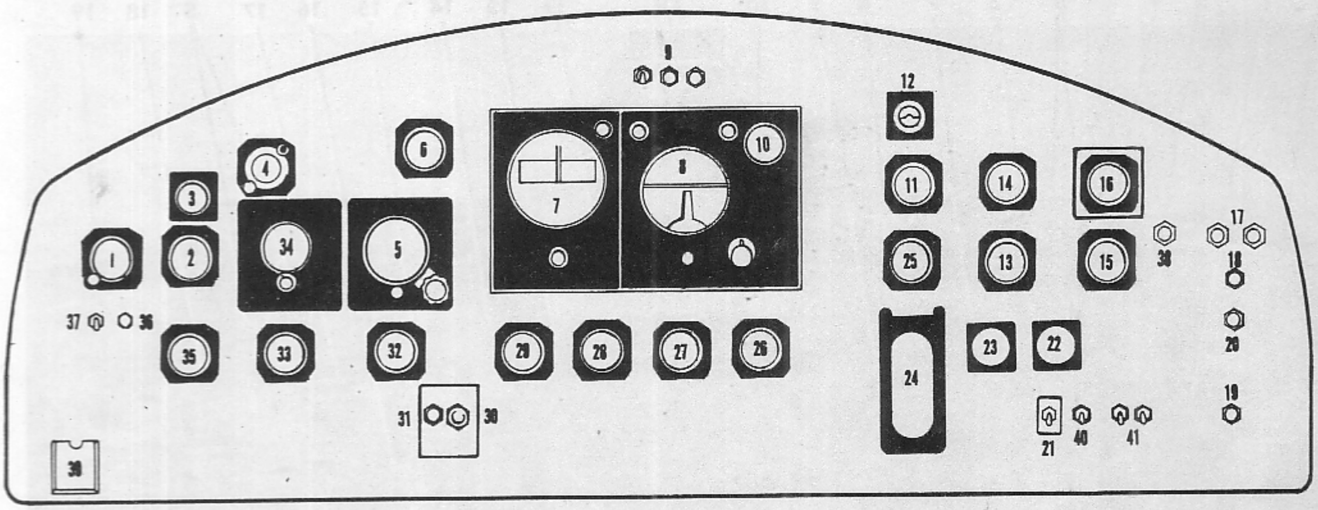
PROPELLERS.

A Hamilton Standard 3-bladed, full-feathering, hydromatic propeller is provided for each engine. The propeller governor on each engine automatically maintains constant engine speed by changing the propeller blade angle through the constant speed range to compensate for changes in altitude and throttle setting. The blade angle is changed hydraulically by the flow of engine oil under pressure. The engine oil for propeller feathering is supplied from a reserve in the bottom of the oil tank, and pressure is provided by a 28-volt d-c propeller feathering pump.

PROPELLER CONTROL LEVERS.

Two propeller control levers, located on the control pedestal (1, figure 1-10), through mechanical linkage provide for adjustment of the propeller governor on the nose section of each engine. The control levers have INCREASE (high rpm) and DECREASE (low rpm) placarded positions. Intermediate positions of the levers are used to regulate rpm as desired. The governors maintain constant propeller speed, as selected by the control levers.

MAIN INSTRUMENT PANEL—TYPICAL
C-47 AND C-117 SERIES AIRCRAFT



1. FLUX GATE COMPASS REPEATER INDICATOR
2. AIRSPEED INDICATOR, PILOT'S
3. CLOCK
4. COURSE INDICATOR AND MARKER BEACON LIGHT
5. ATTITUDE INDICATOR
6. RADIO MAGNETIC INDICATOR (RMI)
7. AUTOPILOT DIRECTIONAL INDICATOR
8. AUTOPILOT ATTITUDE INDICATOR
9. ENGINE FIRE DETECTION WARNING LIGHTS AND TEST SWITCH
10. AUTOPILOT VACUUM GAGE
11. AIRSPEED INDICATOR, CO-PILOT'S
12. FREE AIR TEMPERATURE INDICATOR
13. CYLINDER HEAD TEMPERATURE INDICATOR (DUAL)
14. ALTIMETER, CO-PILOT'S
15. CARBURETOR AIR TEMPERATURE INDICATOR (DUAL)
16. RADIO MAGNETIC INDICATOR (RMI)
17. CRITICAL TEMPERATURE WARNING LIGHTS
18. LANDING GEAR INDICATOR LIGHT (RED)
19. DOOR OPEN WARNING LIGHT
20. LANDING GEAR INDICATOR LIGHT (GREEN)
21. STATIC PRESSURE SELECTOR VALVE
22. AUTOPILOT OIL PRESSURE GAGE
23. DE-ICING SYSTEM PRESSURE GAGE
24. FUEL QUANTITY INDICATOR
25. OIL TEMPERATURE INDICATOR (DUAL)
26. FUEL PRESSURE GAGE (DUAL)
27. OIL PRESSURE GAGE (DUAL)
28. MANIFOLD PRESSURE GAGE (DUAL)
29. TACHOMETER (DUAL)
30. CARBON MONOXIDE WARNING LIGHT (C-117)
31. CARBON MONOXIDE RESET BUTTON (C-117)
32. VERTICAL VELOCITY INDICATOR
33. TURN-AND-SLIP INDICATOR
34. DIRECTIONAL INDICATOR
35. ALTIMETER, PILOT'S
36. FLUX GATE COMPASS WARNING LIGHT
37. FLUX GATE COMPASS CAGING SWITCH
38. HEAT SYSTEM WARNING LIGHT
39. ALTIMETER CORRECTION CARD
40. FUEL CROSSFEED SWITCH
41. FUEL DUMP SWITCHES

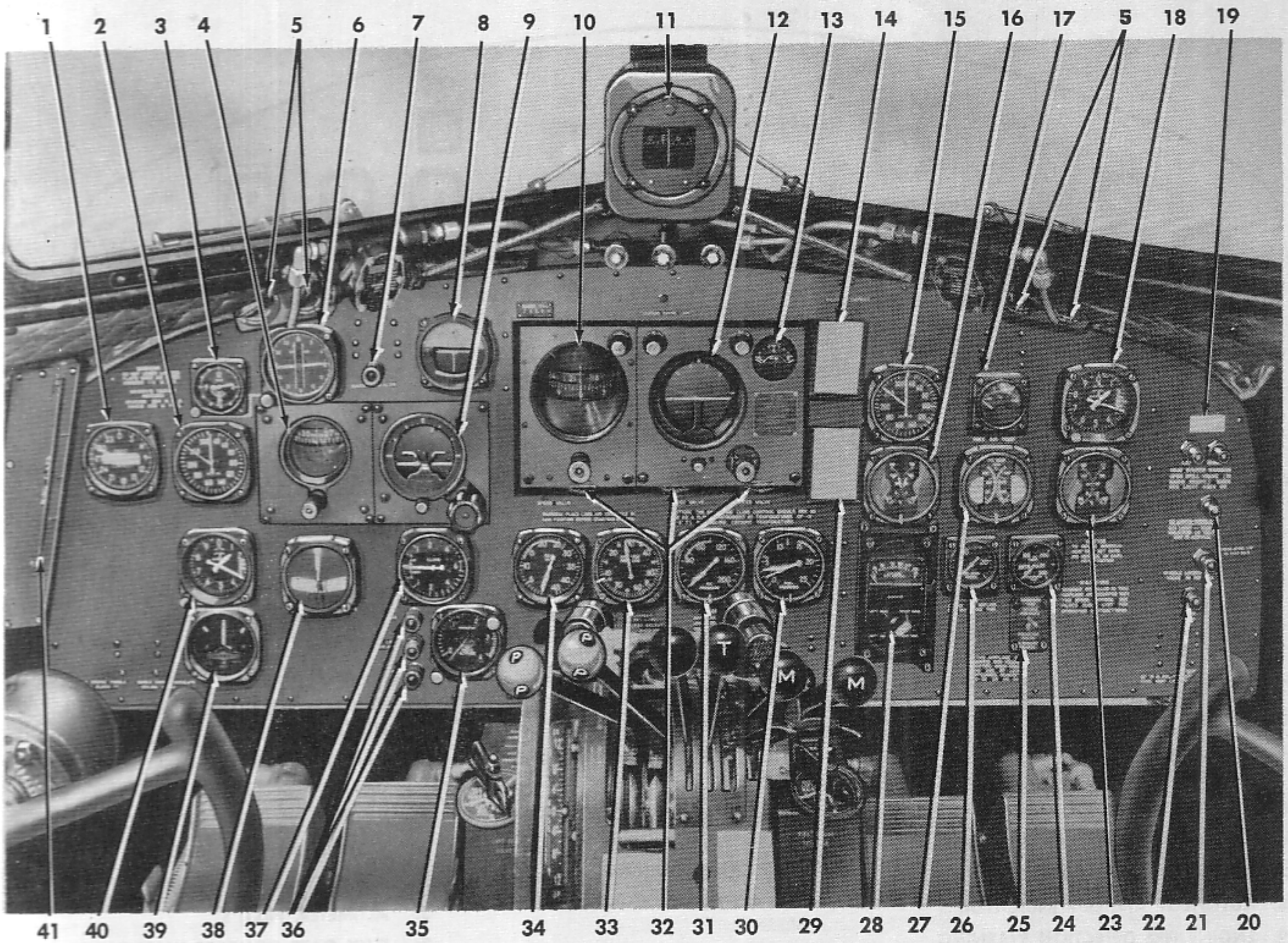
Figure 1-11

PROPELLER FEATHERING SWITCHES.

Two pushbutton propeller feathering switches, one for each propeller system, are mounted on the electrical control panel (17, 18, figure 1-13, and 3, 9, figure 1-14). Each switch is used, in conjunction with a propeller feathering relay and a pressure limit switch, to control a feathering pump motor. When either propeller feathering switch is pushed IN to feather a propeller, a 28-volt d-c holding coil holds the switch in. A pressure limit switch in the propeller governor releases the holding coil when the propeller is feathered, at which time the switch pops out to the normal position. The feathering operation may be interrupted by manually pulling out the feathering switch. When the propeller feathering switch is pushed IN to unfeather a propeller, it must be held in manually until the propeller has moved out of the feathered position.

MAIN INSTRUMENT PANEL—TYPICAL

R4D SERIES AIRCRAFT



1. RADIO MAGNETIC INDICATOR (RMI)
2. AIRSPEED INDICATOR (PILOT'S)
3. CLOCK
4. DIRECTIONAL INDICATOR
5. FLUORESCENT LIGHT SWITCHES
6. REMOTE COMPASS INDICATOR
7. MARKER BEACON INDICATOR LIGHT
8. GLIDE SLOPE AND COURSE INDICATOR
9. ALTITUDE INDICATOR
10. AUTOPILOT DIRECTIONAL INDICATOR
11. MAGNETIC (STANDBY) COMPASS
12. AUTOPILOT ATTITUDE INDICATOR
13. AUTOPILOT VACUUM GAGE
14. COMPASS CORRECTION CARD
15. AIRSPEED INDICATOR (CO-PILOT'S)
16. OIL TEMPERATURE INDICATOR (DUAL)
17. FREE AIR TEMPERATURE INDICATOR
18. ALTIMETER (CO-PILOT'S)
19. CRITICAL TEMPERATURE WARNING LIGHTS
20. LANDING GEAR INDICATOR LIGHT (RED)
21. LANDING GEAR INDICATOR LIGHT (GREEN)
22. DOOR-OPEN WARNING LIGHT
23. CARBURETOR AIR TEMPERATURE INDICATOR (DUAL)
24. AUTOPILOT OIL PRESSURE GAGE
25. STATIC PRESSURE SELECTOR VALVE SWITCH
26. DE-ICING SYSTEM PRESSURE GAGE
27. CYLINDER HEAD TEMPERATURE INDICATOR (DUAL)
28. FUEL QUANTITY INDICATOR
29. REMOTE COMPASS CORRECTION CARD
30. FUEL PRESSURE GAGE (DUAL)
31. OIL PRESSURE GAGE (DUAL)
32. AUTOPILOT SPEED CONTROL VALVE KNOBS
33. MANIFOLD PRESSURE GAGE (DUAL)
34. TACHOMETER (DUAL)
35. RADIO ALTIMETER
36. ALTITUDE LIMIT INDICATOR LIGHTS
37. VERTICAL VELOCITY INDICATOR
38. TURN-AND-SLIP INDICATOR
39. ALTITUDE LIMIT INDICATOR
40. ALTIMETER (PILOT'S)
41. WING FLAP POSITION INDICATOR

Figure 1-12

ELECTRICAL CONTROL PANELS —TYPICAL

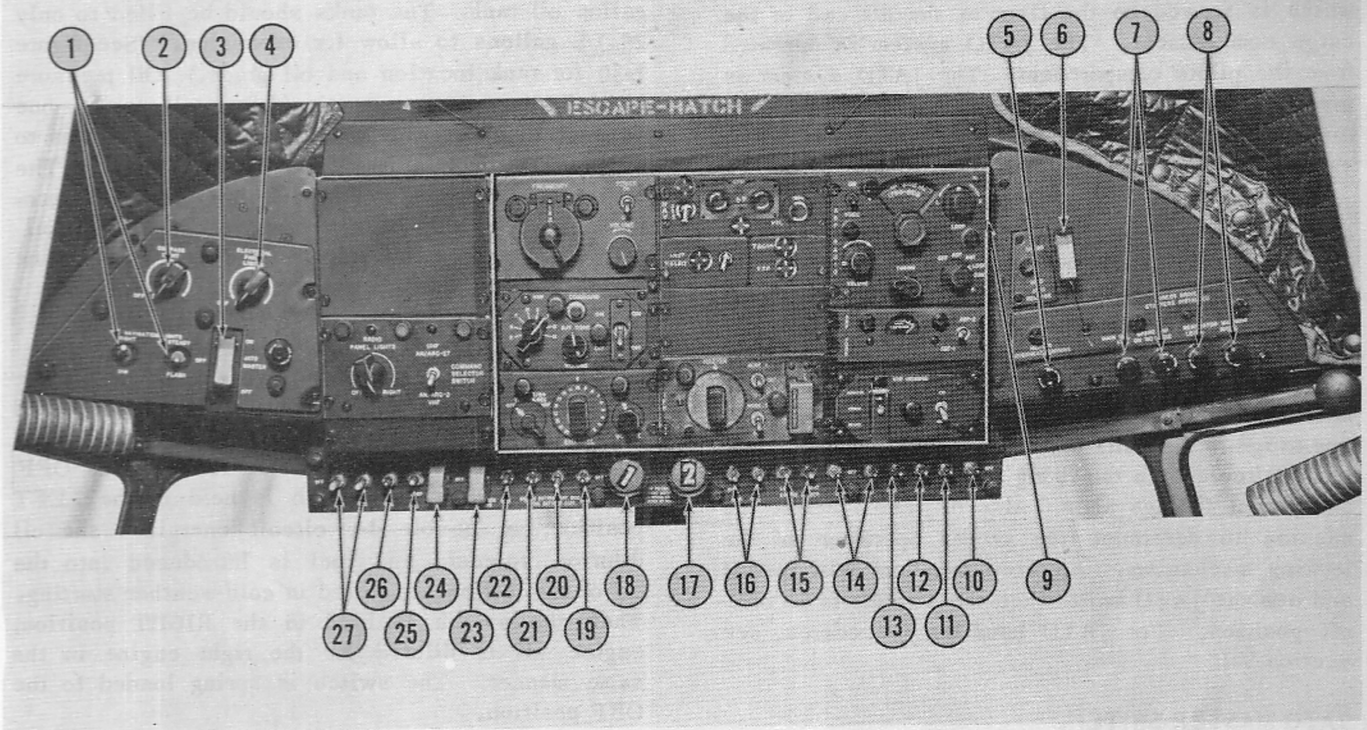


Figure 1-13

1. NAVIGATION LIGHTS SWITCH
2. COMPASS LIGHT RHEOSTAT
3. JATO MASTER SWITCH
4. ELECTRICAL PANEL LIGHTS RHEOSTAT
5. HEATER OVERHEAT WARNING LIGHT
6. JATO RELEASE SWITCH
7. MAIN INVERTER FAIL WARNING LIGHT
8. GENERATOR FAILURE WARNING LIGHTS
9. RADIO CONTROL PANEL
10. AFT PITOT HEATER SWITCH
11. FORWARD PITOT HEATER SWITCH
12. PROP DEICER SWITCH
13. CARB. AND WINDSHIELD DEICER SWITCH
14. BOOSTER PUMP SWITCHES
15. OIL DILUTION AND ENGINE PRIMER SWITCHES
16. STARTER SWITCHES
17. RIGHT ENGINE PROP FEATHERING SWITCH
18. LEFT ENGINE PROP FEATHERING SWITCH
19. BATTERY MASTER SWITCH
20. EMERGENCY POWER SWITCH
21. COCKPIT LIGHTS SWITCH
22. ANTI-COLLISION LIGHT SWITCH
23. PARAPACK SALVO SWITCH
24. BAILOUT WARNING SWITCH
25. JUMP WARNING SWITCH
26. PASSING LIGHTS SWITCH
27. LANDING LIGHTS SWITCHES

JATO SYSTEM.

Some aircraft are equipped with bomb type shackles for attaching four canted JATO units beneath the fuselage. A four bottle cradle is located in the cargo compartment to secure the units until they are needed. Igniters are stored in an ignitor box which is stowed on the floor at the aft end of the cargo compartment. The JATO system is operated from the pilots' compartment. The JATO system as installed on this aircraft permits the use of four different types of JATO bottles; the 14AS-1000, 14DS-1000 Mark IV Model 2, 14DS-1000 M-8, and 14NS-1000 M-15. These bottles are designed to give 1000 pounds of thrust for an average of 14 to 16 seconds. Temperature limits for firing are -55°F - 130°F. Expended units may be jettisoned either electrically or mechanically. The aircraft electrical firing circuit should be thoroughly inspected before departure on a mission requiring JATO. It should be determined that there is sufficient current and voltage to ignite the units and that there is no electricity in the circuit when the firing switches are off. JATO attachment fittings should also be tested before the mission to determine the proper operation of the locking mechanism. Air crew members will install and arm the JATO units when the aircraft is in take-off position. For JATO handling procedures, see Section VII.

JATO MASTER SWITCH.

The JATO MASTER switch is a guarded ON-OFF switch located on a panel to the left and above the pilot (3, figure 1-13). The switch must be placed to the ON position before the JATO can be fired.

JATO FIRING SWITCH.

The JATO FIRING SWITCH is a button type switch mounted on the wheel of the pilot's control column. The JATO is fired by depressing the button. The switch will not operate unless the JATO MASTER switch is ON.

JATO RELEASE SWITCH.

The JATO RELEASE switch is a safety - wired guarded 2-position switch (6, figure 1-13), with OUTBD and INDB decals. Expended JATO units can be jettisoned by moving the JATO release switch to the INBD position then to the OUTBD position releasing two bottles each time.

JATO MANUAL RELEASE.

In the event of a failure in the electrical system for jettisoning JATO bottles a manual system is installed in the aircraft. In the main cargo compartment in the wall are two handles decaled CAUTION MANUAL JATO RELEASE OUTBD INBD. JATO bottles may be jettisoned by pulling the handles.

OIL SYSTEM.

Each engine oil system is supplied from a 29 US gallon oil tank. The tanks should be filled to only 25 US gallons to allow for expansion. (See figure 1-30 for tank location and oil grade.) Oil pressure is maintained by two engine-driven oil pumps, one on each engine. The oil from the engine returns to the tank through a free-flow-type oil cooler. The quantity of oil flowing through the cooler is automatically regulated by thermostatic control. An oil dilution system is provided for dilution of the engine oil when a cold weather start is anticipated.

OIL DILUTION SWITCH (Some Aircraft).

A 3-position, 28-volt d-c oil dilution switch is mounted on the electrical control panel (15, figure 1-13 and 20, figure 1-14) and has LEFT, RIGHT, and OFF positions. When the switch is held in the LEFT position, a 28-volt d-c circuit energizes the oil dilution solenoid and fuel is introduced into the oil of the left engine to aid in cold-weather starting. When the switch is held in the RIGHT position, engine oil is diluted for the right engine in the same manner. The switch is spring loaded to the OFF position.

OIL DILUTION AND PRIMER SWITCHES (Some Aircraft).

Refer to the paragraph on Oil Dilution and Primer Switches under Priming System, this Section.

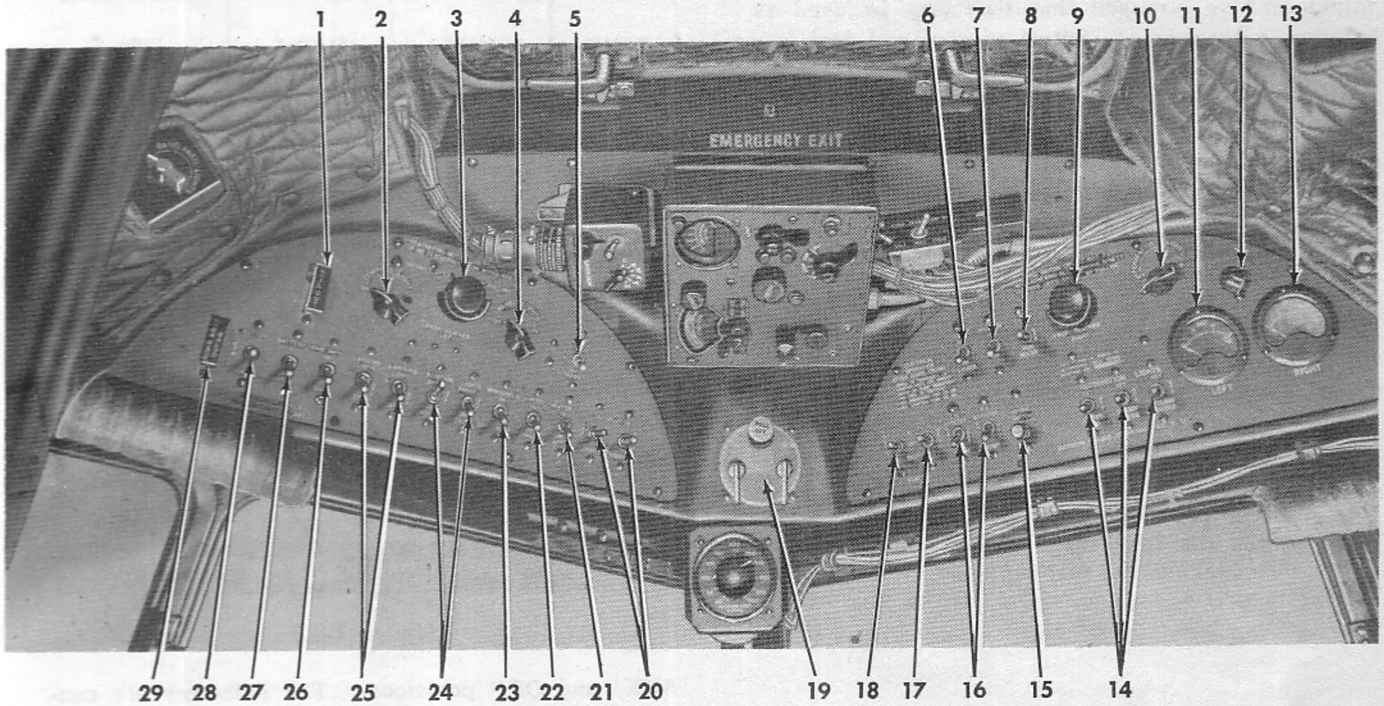
FIREWALL SHUTOFF VALVES.

See the paragraph on Firewall Shutoff Valve Handles, this section.

FUEL SYSTEM.

Fuel is supplied from two main tanks and two auxiliary tanks installed in the center wing section (figure 1-16). The fuel quantity is measured by a 28-volt liquidometer system and indicated by the fuel quantity indicator in the cockpit. During normal operation, the left engine is supplied by fuel from the left tanks, and the right engine by the right tanks; however, by using the fuel tank selectors in the cockpit, fuel may be supplied from any tank to either engine. Lines lead from the selector valves to the two wobble pumps which are hand-operated by a single control. These pumps are used to raise the fuel pressure when starting the engines, or before the engine-driven pumps are in operation. A cross-

ELECTRICAL CONTROL PANEL—TYPICAL
R4D SERIES AIRCRAFT



1. BAIL-OUT SWITCH
2. COMPASS LIGHT RHEOSTAT
3. LEFT PROPELLER FEATHERING CONTROL
4. INSTRUMENT PANEL LIGHTS RHEOSTAT
5. PROPELLER DE-ICER SWITCH
6. PILOTS' COMPARTMENT LIGHTS
7. INVERTER SWITCH
8. CARBURETOR DE-ICER SWITCH
9. RIGHT PROPELLER FEATHERING CONTROL
10. FORMATION LIGHTS RHEOSTAT
11. LEFT AMMETER
12. PANEL LIGHT
13. RIGHT AMMETER
14. RECOGNITION LIGHT SWITCHES
15. KEYING SWITCH
16. FUEL BOOSTER PUMP SWITCHES
17. STARTER MESH SWITCH
18. STARTER ENERGIZE SWITCH
19. IGNITION SWITCHES
20. ENGINE OIL DILUTION AND PRIMER SWITCH
21. PITOT HEATER SWITCH (AFT)
22. PITOT HEATER SWITCH (FORWARD)
23. WINDSHIELD DE-ICER SWITCH
24. POSITION LIGHTS SWITCHES
25. LANDING LIGHTS SWITCHES
26. PASSING LIGHT SWITCH
27. BATTERY MASTER SWITCH
28. CAUTION JUMP LIGHT SWITCH
29. PARA PACK SALVO SWITCH

Figure 1-14

feed line is connected on the pressure side of each engine-driven pump, and the two cross-feed valves in this line are operated by a single control in the cockpit. The cross-feed system enables both engines to receive fuel from one engine-driven pump in case either pump fails. On late aircraft, the wobble pumps are replaced by two electric booster pumps with a control switch located on the electrical control panel. On aircraft equipped with booster pumps, there is no cross-feed system. The booster pumps will furnish ample pressure and fuel supply for operation in case either engine-driven pump fails. A vapor overflow line connects from the top chamber of the carburetor to the main and auxiliary tanks. During operation, the maximum return flow is approximately 10 gallons per hour. The majority of the return flow will be directed to the main tanks. A fuel line from each carburetor operates the fuel pressure gage in the cockpit. For fuel grades, see figure 1-30; for fuel grade operating limits, refer to Section V, Operating Limitations. See figure 1-15 for Fuel Quantity Data.

LONG-RANGE FUEL SYSTEM (Some Aircraft).

On some aircraft, provisions have been made for two, long-range fuel tanks. The tanks have a 500 gal. capacity and are installed on cradles at the forward end of the main cargo compartment, one on each side. The tanks are cylindrical metal, non-selfsealing.

WARNING

Due to the slope of the main cargo compartment floor when the aircraft is on the ground, the long-range fuel tank capacity is limited to 385 gallons each (380 gallons of usable fuel).

Each tank is provided with a booster pump, vent, filler, drain, and fuel line connections. Two manually operated globe valves (figure 1-17) are located at the forward end of the main cargo floor. These valves are so arranged that they may be used as selector valves or as shutoff valves, and fuel from either tank may be diverted to either engine, or both, or turned off completely.

WARNING

- The main fuel tank selector valves must be in the OFF position, when the long-range fuel system is being used, to prevent gravity fuel flow or fuel under booster pump pressure from overflowing the main fuel tanks. When the long-range fuel tanks are empty, the valves must be in the OFF position or air will be drawn from the long range tanks, causing air locks in the fuel system.
- Do not operate the aircraft APP at anytime long-range fuel tanks are installed to preclude possibility of fire.

LONG RANGE FUEL TANKS BOOSTER PUMPS (Some Aircraft).

A booster pump is mounted in the forward end of each long-range fuel tank. Each pump receives 28-volt d-c power from the main electrical junction box, and is operated by an ON, OFF switch on the fuel pump control panel, mounted on the aft side of the main cargo compartment forward bulkhead.

LONG-RANGE FUEL TANK DUMP VALVE (Some Aircraft).

A manually operated long-range fuel tank dump valve is installed in the fuel dump line on the right side of the catwalk between the long-range fuel tanks. The dump valve is normally safety-wired CLOSED. When the valve is moved to the OPEN position, fuel will be dumped overboard, either under booster pump pressure or gravity flow.

Fuel Tank Selectors.

Two fuel tank selectors, one for each engine, are mounted on the left and right sides of the control pedestal (5, 13, figure 1-10). Each selector has LEFT AUX, LEFT MAIN, RIGHT MAIN, RIGHT AUX, and OFF positions. The selectors are connected mechanically to the valves by rods and cables. When the selector is placed in any position, fuel will be supplied from the tank corresponding to that position.

FUEL QUANTITY DATA CHART

GALLONS

TANK	NUMBER OF TANKS	USABLE FUEL (EACH)	FUEL SERVICE (EACH)
MAIN	2	202.0	204.0
AUXILIARY	2	199.0	202.0

TOTAL USABLE FUEL............................802 GALLONS

LONG-RANGE FUEL TANKS .... 385 GALLONS EACH

INSTALLATION OF TWO TANKS POSSIBLE

TOTAL USABLE FUEL IN EACH LONG RANGE FUEL TANK .... 380 GALLONS

Note: Level flight assumed to be 3 degrees nose up.

Figure 1-15

Long-Range Fuel Shutoff Valves.

Two long-range fuel shutoff valves (figure 1-17), one for each side of the fuselage, are installed with the long-range tanks and lines. The valves are located in front of and between the front two long-range tanks in the main cabin compartment. The valves may be opened manually by rotating the handles in a counterclockwise direction.

WARNING

Do not operate internally installed auxiliary power plant at any time long-range auxiliary fuel tanks are installed.

Fuel Booster Pump Switches.

The 28-volt d-c electrically driven booster pumps are energized by the two booster pump ON-OFF switches mounted on the electrical control panel (14, figure 1-13, and 16, figure 1-14). Positioning either switch to ON completes the 28-volt d-c circuit to its respective booster pump motor.

Fuel Quantity Indicator.

A 28-volt d-c liquidometer fuel quantity indicator is installed on the main instrument panel (24, figure 1-11), and 28, figure 1-12) to indicate the fuel quantity in the two main and two auxiliary tanks. A selector handle on the indicator has LEFT AUX, LEFT MAIN, RIGHT MAIN, and RIGHT AUX position. As the selector is moved from one position to another, the calibrated dial for the new position flips up into the window of the indicator and the quantity of fuel in the corresponding tank may be read.

CAUTION

The selector must be turned clockwise to prevent jamming.

FIREWALL SHUTOFF VALVES.

See the paragraph on Firewall Shutoff Valve Handles, this section.

FUEL SYSTEM (Some SC-47 Aircraft).

Fuel is supplied from two main tanks, two auxiliary tanks, and four wing tanks. The main and auxiliary tanks are installed in the center wing section, and the elliptical drum type metal wing tanks are installed in each outer wing panel on each side of the center spar between the rear and front spar; these two tanks are connected with an equalizing line on the bottom inboard end which allows the tanks to function as a single storage unit. The wing tanks have an electrically operated dump valve which is located in each dump line. The valve is controlled by a switch in the cockpit. The fuel quantity is measured by a 28-volt d-c liquidometer system and indicated by the fuel quantity indicator in the cockpit. During normal operation, the left engine is supplied by fuel from the left tanks and the right engine by the right tanks; however by using the cross feed valve controls in the cockpit, fuel may be supplied from one wing to the opposite engine. Fuel lines lead from the selector valves to the two booster pumps, one from each engine, which furnish pressure and fuel supply for operation in case either engine driven pump fails (figure 1-16). A vapor vent return line connects from the top chamber of each carburetor to the main and auxiliary tanks. During operation, the maximum return flow is approximately 10 gallons per hour. The majority of return flow will be directed to the main tanks. A fuel line from each carburetor operates the fuel pressure gage in the cockpit. For fuel grades see figure 1-30; for fuel grade operating limits, refer to section V, Operating Limits. For Fuel Quantity Data, see chart.

FUEL QUANTITY DATA CHART-GALLONS.

FULLY SERVICED AND USABLE			
TANK	NUMBER OF TANKS	USABLE FUEL (each)	FULLY SERVICED
Main	2	202	204
Auxiliary	2	199	200
Wing(outer)	4	200	200
TOTAL USABLE FUEL			1602

FUEL TANK SELECTORS (Some SC-47 Aircraft).

Two fuel tank selectors, one for each engine, are mounted on the left and right sides of the control pedestal, (5, 13, figure 1-10). The valves operate independent of each other since with the installation of the outer wing tanks, the fuel system feeds the right engine from the right tanks and the left engine from the left tanks. The right selector has R. H. AUX 200 GALS, R. H. MAIN 202 GALS, R. H. WING 400 GALS and OFF positions. The positions on the left selector are L. H. AUX 200 GALS, L. H. MAIN 202 GALS, L. H. WING 400 GALS and OFF. The selectors are connected mechanically to the valves by rods and cables. When the selector is placed in any position, fuel will be supplied from the tank corresponding to that position.

FUEL CROSS-FEED SWITCH (Some SC-47 Aircraft).

The electrically operated cross-feed valve is energized by a three position switch installed on the lower right side of the instrument panel (40, figure 1-11). The cross-feed switching system incorporates a red warning light, located on the right side of the cross-feed switch, which illuminates during the time that the valve is closing or opening. In the OPEN position the valve is energized to open. In the OFF position the circuit is neutral and the CLOSED position shuts the valve off. To operate the cross-feed system, place the fuel selector to the tank to be used. Place cross-feed switch ON and turn opposite selector valve (engine receiving cross-feed fuel) to OFF.

NOTE

The engine being fed fuel during this operation will show an approximate two pound fuel pressure fluctu-

FUEL SYSTEM—TYPICAL

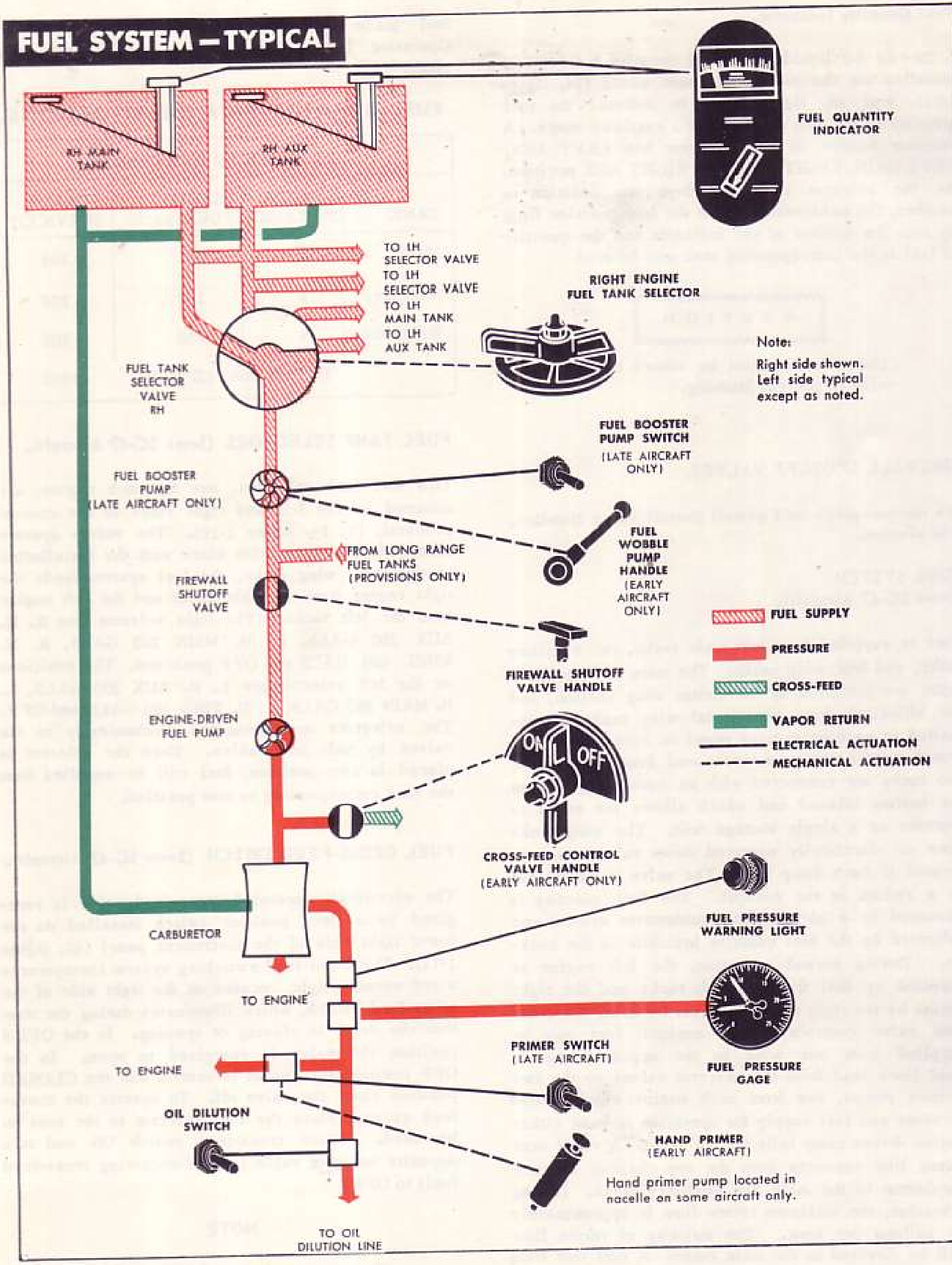


Figure 1-16 (Sheet 1 of 2)

FUEL SYSTEM (SOME SC-47 AIRCRAFT)

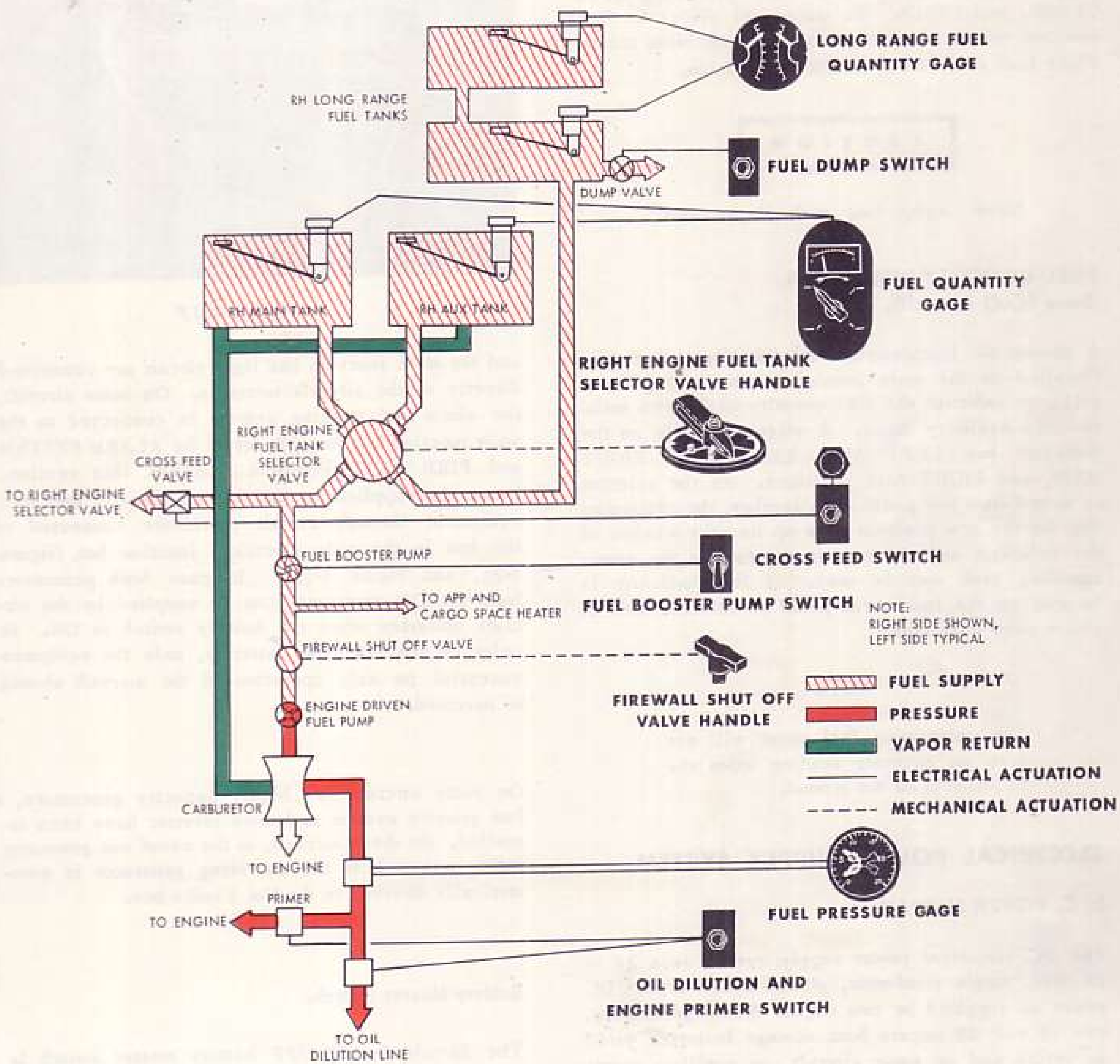


Figure 1-16 (Sheet 2 of 2)

ation because of the added fittings in the line. The pressure fluctuation will not be sufficient to hinder engine operation.

FUEL DUMP SWITCHES (Some SC-47 Aircraft).

Two 28-volt d-c three position guarded switches (41, figure 1-11) operate the dump valves in the outer wing tanks. The switches are placarded OFF, CLOSE, and DUMP. To dump fuel place the fuel selector valves to tanks other than outer wing tanks. Place both switches to the DUMP position.

CAUTION

Never dump fuel with flaps down.

FUEL QUANTITY INDICATORS.
(Some SC-47 Aircraft).

A 28-volt d-c liquidometer fuel quantity indicator is installed in the main instrument panel (24, figure 1-11), to indicate the fuel quantity in the two main and two auxiliary tanks. A selector handle on the indicator has LEFT AUX, LEFT MAIN, RIGHT MAIN, and RIGHT AUX positions. As the selector is moved from one position to another, the calibrated dial for the new position flips up into the window of the indicator and the quantity of fuel in the corresponding tank may be read. A fuel indicator is located on the instrument panel to indicate fuel in either outer wing tank.

NOTE

The outer wing fuel meter will not give an accurate reading when the airplane is on the ground.

ELECTRICAL POWER SUPPLY SYSTEM.

D. C. POWER SUPPLY.

The DC electrical power supply system is a 24 to 28 volt, single conductor, ground return type, DC power is supplied by two engine driven generators, two 12 volt 88 ampere hour storage batteries wired in series and on some aircraft, an auxiliary power plant. On the ground, power may be supplied from an external power unit when plugged into the external power receptacle. Each generator circuit includes a voltage regulator and a reverse current relay. For DC power distribution see figure 1-18. The CB fire extinguishing system, alarm and warning system and the main junction box light circuit are connected directly to the aircraft batteries. On some aircraft, the alarm and warning system is connected to the main junction box bus. Refer to the ALARM SYSTEM and FIRE EXTINGUISHER SYSTEM, this section. Power is supplied to the DC electrically operated equipment through circuit protectors connected to the bus in the main electrical junction box (figure 1-21, and figure 1-22). In case both generators fail, the DC equipment can be supplied by the aircraft batteries when the battery switch is ON. In order to conserve the batteries, only the equipment essential for safe operation of the aircraft should be operated.

LONG-RANGE FUEL SHUTOFF VALVES

LOCATION: FORWARD MAIN CABIN — FLOOR LEVEL

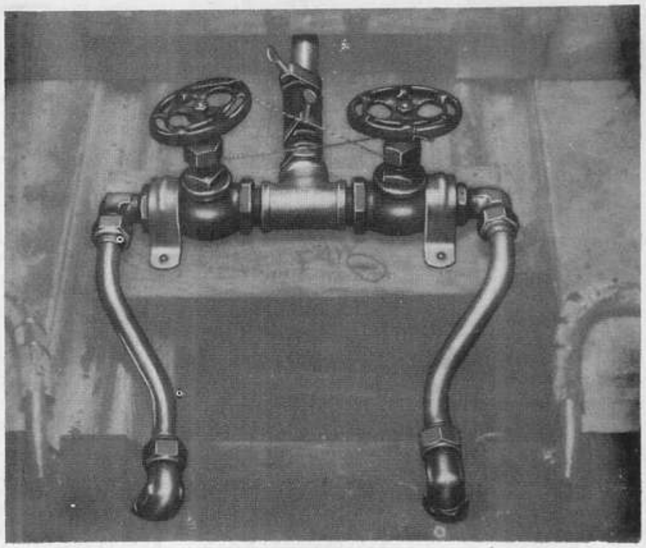


Figure 1-17

On some aircraft two higher capacity generators, a bus priority system and third inverter have been installed. On these aircraft, in the event one generator fails, power from the surviving generator is automatically directed to the No. 1 radio bus.

Battery Master Switch.

The 28-volt d-c ON-OFF battery master switch is located on the electrical control panel (19, figure 1-13, and 27, figure 1-14). Operation of the switch will open or close the battery circuit. The battery switch should be in the OFF position when an external power source is plugged in. To assure fully charged batteries, the battery master switch should be turned ON before take-off.

Generator (Main Line) Switches.

Two ON-OFF switches are incorporated into the main line circuit to select either or both of the generators to supply current to the electrical system. The ON position of the switches closes the generator circuits and the battery circuit through the circuit breaker bus in the main electrical junction box. The OFF position opens the circuits. These switches are located in the main electrical junction box on the aft wall of the forward baggage loading door companionway (19, figure 1-1).

External Power Receptacle.

A ground power receptacle is located on the underside of the fuselage aft of the batteries (18, figure 1-1), and connects the external d-c power to the aircraft electrical system when the ground power supply is plugged in.

Utility Power Outlet.

Utility power outlets are installed at various locations throughout the aircraft. On some aircraft, one utility power outlet is installed on the left side of the main cargo compartment, immediately forward of the main cargo door. On C-117 series aircraft, two power outlets are installed at the buffet.

Generator Warning Lights.

Two 28-volt d-c generator warning lights, one for each generator, are mounted on the electrical control panel to provide indication of generator failure (8, figure 1-13). On some aircraft, generator warning lights are also located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway (figure 1-21). If the output voltage of a generator becomes less than that of the batteries, the respective reverse-current relay will prevent current flowing from the bus to the generator and will illuminate the generator warning light for the faulty generator.

GROUND TEST POWER SWITCH (Some Aircraft).

The ground test power switch (19, figure 1-21) is provided to over ride the bus priority relay for those aircraft equipped with the 200 ampere generator priority bus system. On aircraft equipped with this system, the bus priority relay will automatically disconnect the main junction box number two bus and the radio junction box number two bus when either or both generators are not supplying power to the electrical system. Until all critical equipment is relocated from the number two to the number one bus system, the ground test power switch should be in the ON position at all times. The ground test power switch is located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway.

Ammeters.

Two ammeters, one for each generator, are provided to measure the amperage output of the generators (figure 1-18). The ammeters are located on the right side of the electrical control panel (11, 13, figure 1-14). On some aircraft, the ammeters are located on the power systems junction box controls panel, mounted on the aft wall of the forward cargo loading door companionway.

A-C POWER SUPPLY.

Two inverters are operated by the DC system to supply 115 volt, 400 cycle, AC power for operation of various items of electrical and electronic equipment (figure 1-18). The AC power is supplied to the equipment through circuit protectors located on the radio circuit breaker panel (figure 1-20), and is controlled by switches located on the electrical control panel. (See 7, figure 1-14.)

On some aircraft, to provide additional AC power, one spare and two main inverters have been installed in conjunction with a bus priority system (Figure 1-18). No. 1 and No. 2 inverters supply power to the No. 1 and No. 2 AC busses respectively. The spare inverter may supply power to either bus in the event one inverter fails. The inverters are controlled by switches located on the power systems junction box control panel (figure 1-21).

Inverter Switch.

An ON-OFF inverter switch, located on the electrical control panel (7, figure 1-14) completes the 28-volt d-c circuit to the inverter when in the ON position. On aircraft equipped with a generator-inverter and bus priority system, the inverter ON-OFF switches for the No. 1 and No. 2 inverters and the spare inverter are located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway (figure 1-21).

HYDRAULIC POWER SUPPLY SYSTEM.

A pressure accumulator hydraulic power supply system (figure 1-23) operates the landing gear, wing flaps, brakes, cowl flaps, nonram carburetor air filter mechanism, and the windshield wipers, skis, and blower clutches.

Hydraulic fluid is supplied by gravity from the hydraulic fluid reservoir to the engine-driven hydraulic pumps (one on each engine), which supply fluid pressure for the hydraulic system and the autopilot

MAIN POWER DISTRIBUTION SCHEMATIC-TYPICAL

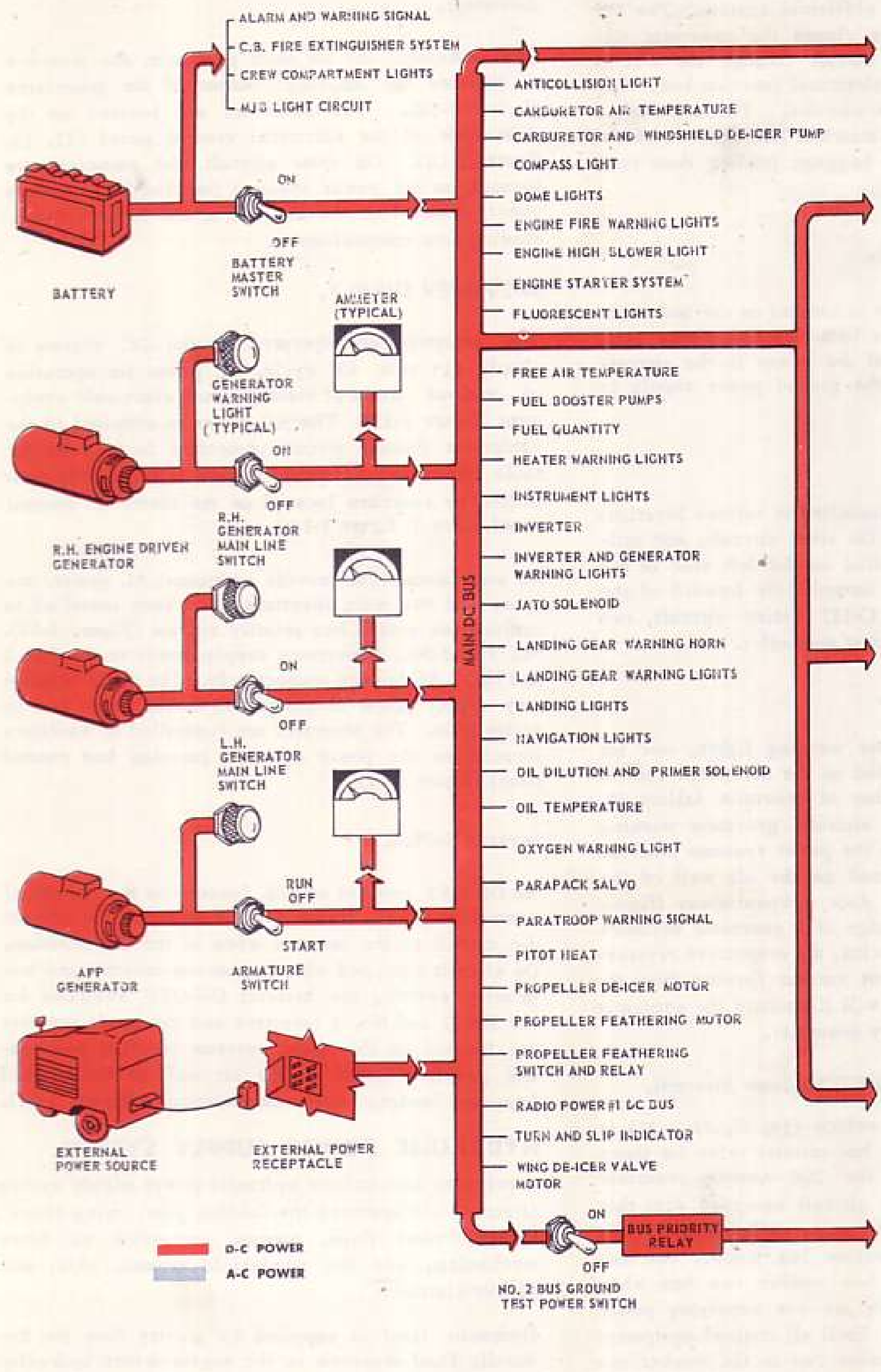


Figure 1-18 (Sheet 1 of 2)

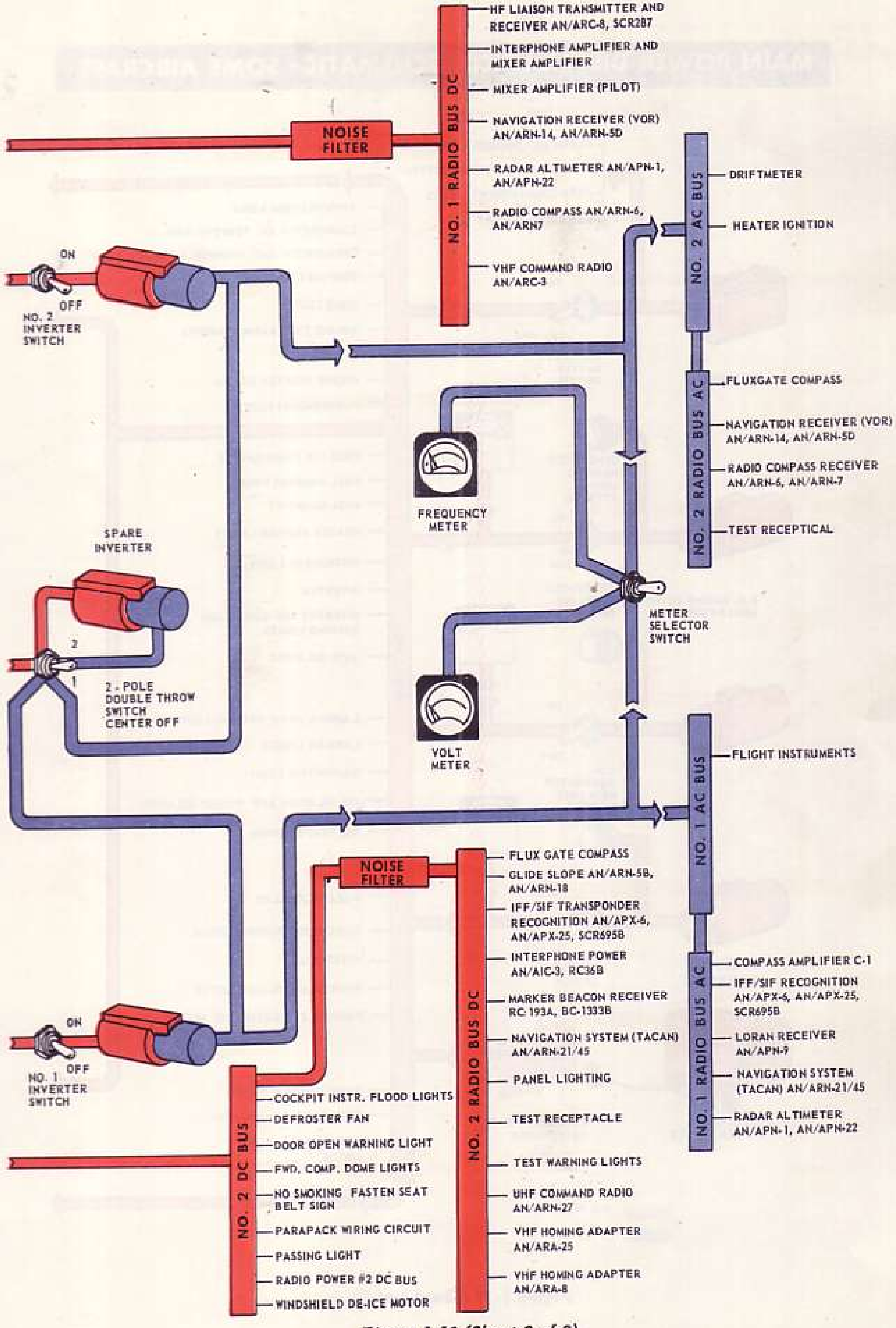


Figure 1-18 (Sheet 2 of 2)

MAIN POWER DISTRIBUTION SCHEMATIC - SOME AIRCRAFT

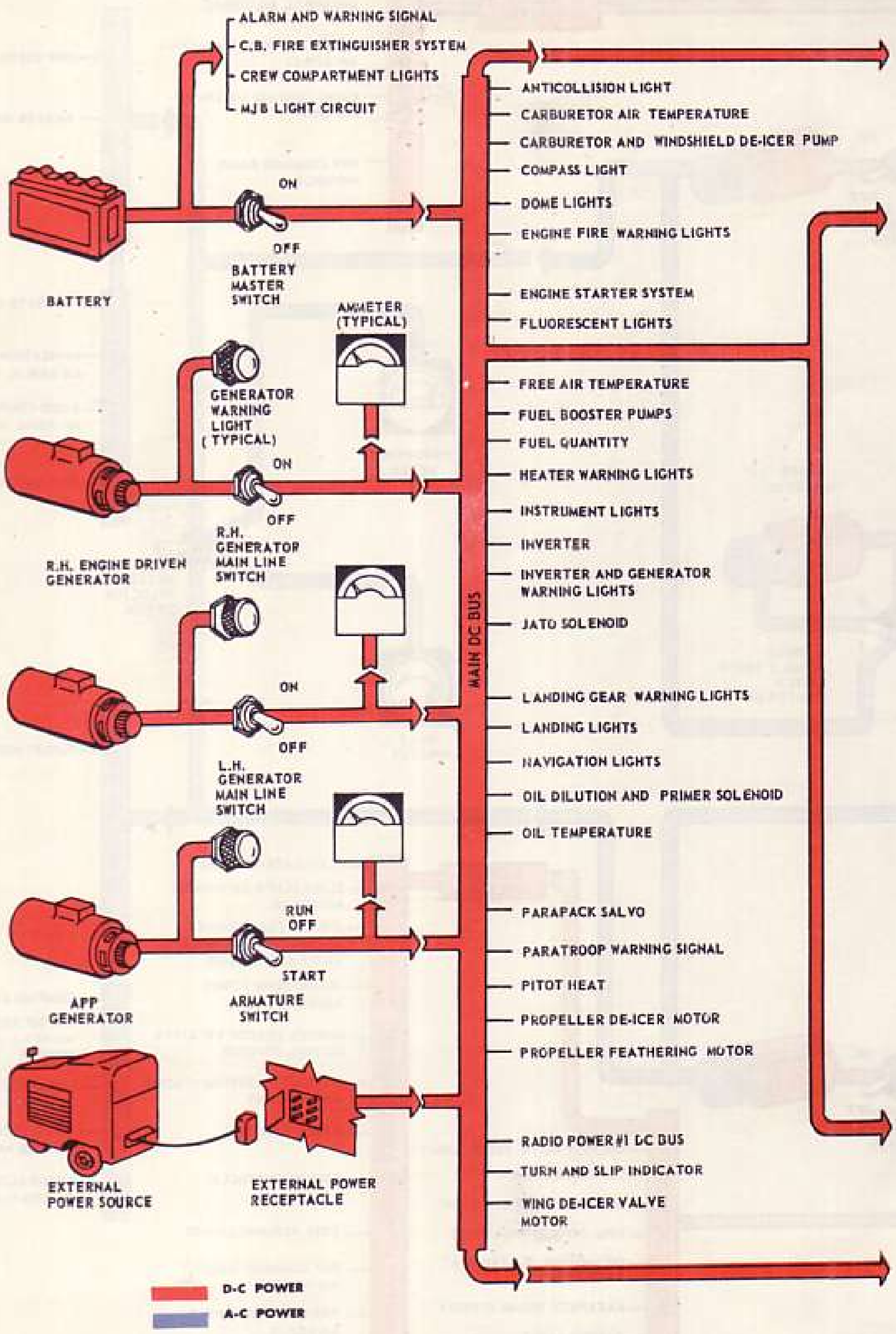


Figure 1-19 (Sheet 1 of 2)

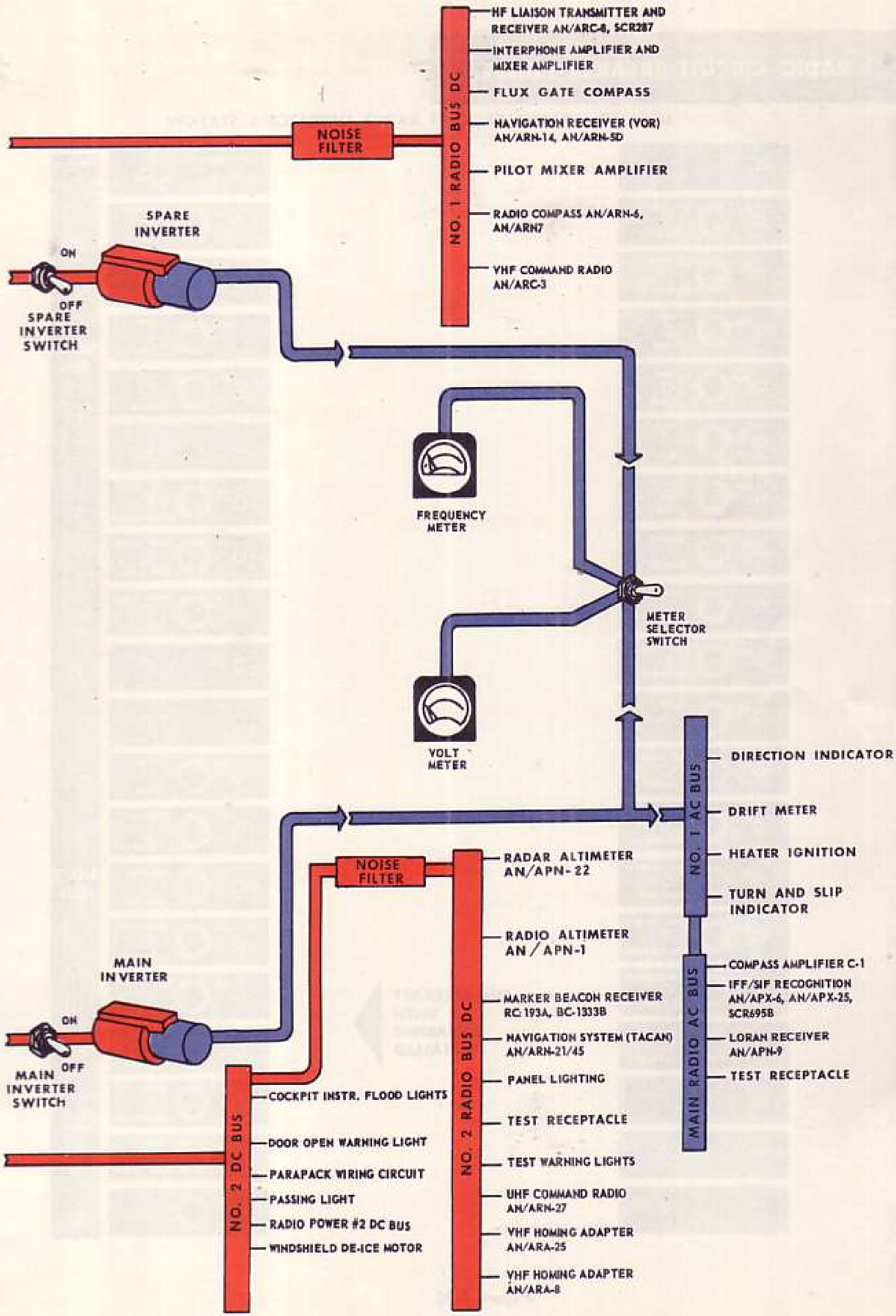


Figure 1-19 (Sheet 2 of 2)

RADIO CIRCUIT BREAKER PANEL

LOCATED: RADIO RACK AT RADIO OPERATOR'S STATION

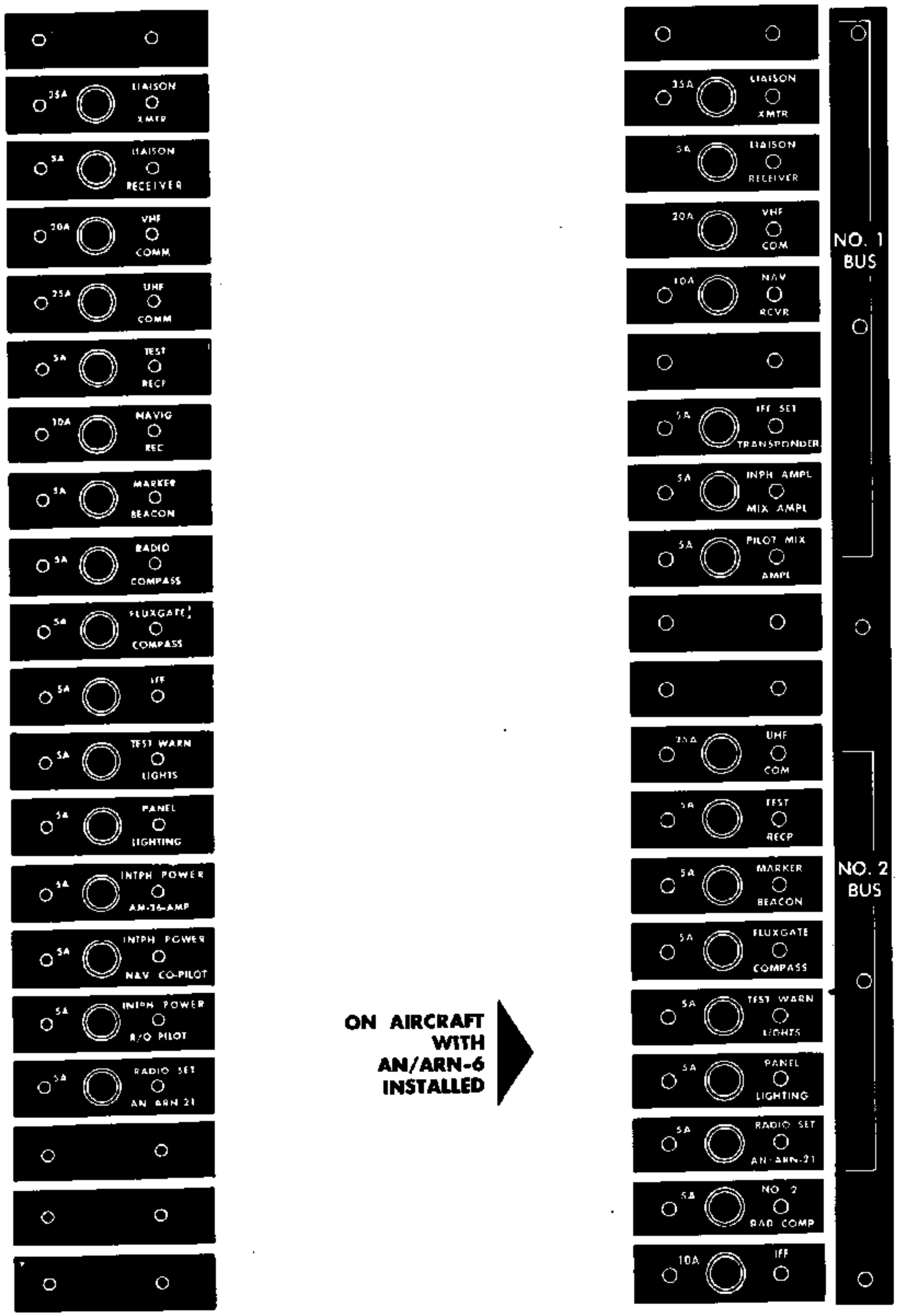


Figure 1-20

system. However, the fluid flow from the engine-driven pumps may be selected by means of the hydraulic pump selector valve, located on the hydraulic control panel in the flight compartment. The hydraulic pressure accumulator is attached to a bracket adjacent to the hydraulic fluid reservoir and aft of the bulkhead behind the co-pilot's seat. The lower chamber of the pressure accumulator is charged with air through the air valve fitting to an initial pressure of 250 psi. A system pressure relief valve, installed in the hydraulic system fluid pressure line, functions to protect the hydraulic system from excessive fluid pressure when the system pressure increases to 1000 (± 50) psi. A hydraulic hand pump is incorporated in the system for use when the engine-driven pumps fail to supply sufficient pressure or for ground operation of the hydraulic system when the engines are not running. A pressure regulator is installed in the main system pressure line to regulate system pressure between 600 and 875 psi. When system pressure is below 600 psi, the accumulator is charged until system pressure reaches this value. If system pressure exceeds 875 psi, fluid is ported to return until the pressure drops below 875 psi. The fluid capacity of the hydraulic reservoir is 10 quarts. Seven quarts are available to the engine-driven hydraulic pumps, while the remaining 3 quarts in the reservoir sump are available only to the hydraulic hand pump for emergency operation. For fluid specification and reservoir location, see figure 1-30.

HYDRAULIC PUMP SELECTOR VALVE LEVER.

The hydraulic pump selector valve lever located on the hydraulic control panel (4, figure 1-24), controls the flow of fluid for operation of the hydraulic system. Selection of the hydraulic engine pump is governed by the position of the selector valve lever. For normal operation, the lever is placed in the LEFT ENG. HYDR. SYS. – RIGHT ENG. GYRO PILOT (aft) position and the left engine pump supplies pressure for the hydraulic system and the right engine pump supplies pressure for the autopilot system. When the control lever is in the LEFT ENG. GYRO PILOT – RIGHT ENG. HYDR. SYS. (forward) position, the systems for which the pumps supply pressure are reversed. The control lever operates in a notched quadrant and it is necessary to lift the lever slightly before moving it from one position to another. There is no difference in the functioning of the hydraulic system when the fluid delivery of the engine-driven pumps is changed.

HYDRAULIC PUMP SELECTOR VALVE LEVER (MODIFIED AIRCRAFT).

On aircraft modified in accordance with T. O. 1C-47-507, or T. O. 1C-1-514, the hydraulic pump selector valve lever provides selection for two modes of operation (4, figure 1-24), TAKE-OFF POSITION and GYRO PILOT POSITION. In the TAKE-OFF POSITION, both the left and right engine pumps supply pressure for the hydraulic system. In the GYRO PILOT POSITION, the left engine pump supplies pressure for the autopilot system and the right engine pump supplies pressure for the hydraulic system.

HYDRAULIC HAND PUMP.

The hydraulic hand pump, located at the bottom of the hydraulic control panel, has a handle that extends between the pilot's and co-pilot's seats (9, figure 1-24). This hand pump is used when the engine-driven hydraulic pumps fail to supply sufficient pressure, when the hydraulic fluid supply (except the hand pump reserve) has been lost, or for ground operation of the hydraulic system when the engines are not running. The hand pump may be used to supply pressure to any unit operated by the hydraulic system, except the autopilot.

STAR VALVE.

The hand pump to pressure accumulator shutoff valve handle, (star valve), located on the hydraulic control panel (6, figure 1-24) has two placarded positions, ON and OFF. When the star valve is turned to the ON (open) position, the hydraulic hand pump can be used to increase hydraulic pressure in the pressure accumulator for operation of the hydraulic units when the aircraft is on the ground and the engines are not running. When the star valve is turned to the OFF (closed) position, the hydraulic units (except the autopilot) may be actuated directly by operation of the hydraulic hand pump. The star valve should be safetywired to the OFF (closed) position.

Hydraulic Fluid Quantity Sight Gage.

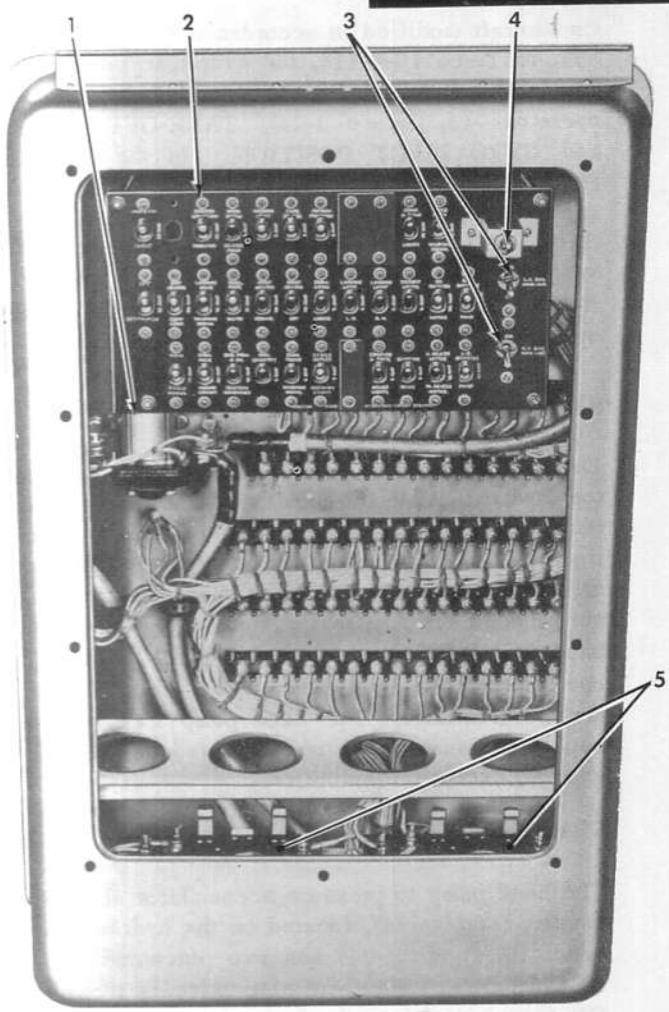
A hydraulic fluid quantity sight gage is located at the top of the hydraulic control panel (2, figure 1-24) to indicate fluid quantity. A placard for servicing instructions is mounted adjacent to the sight gage.

Hydraulic System Pressure Gages.

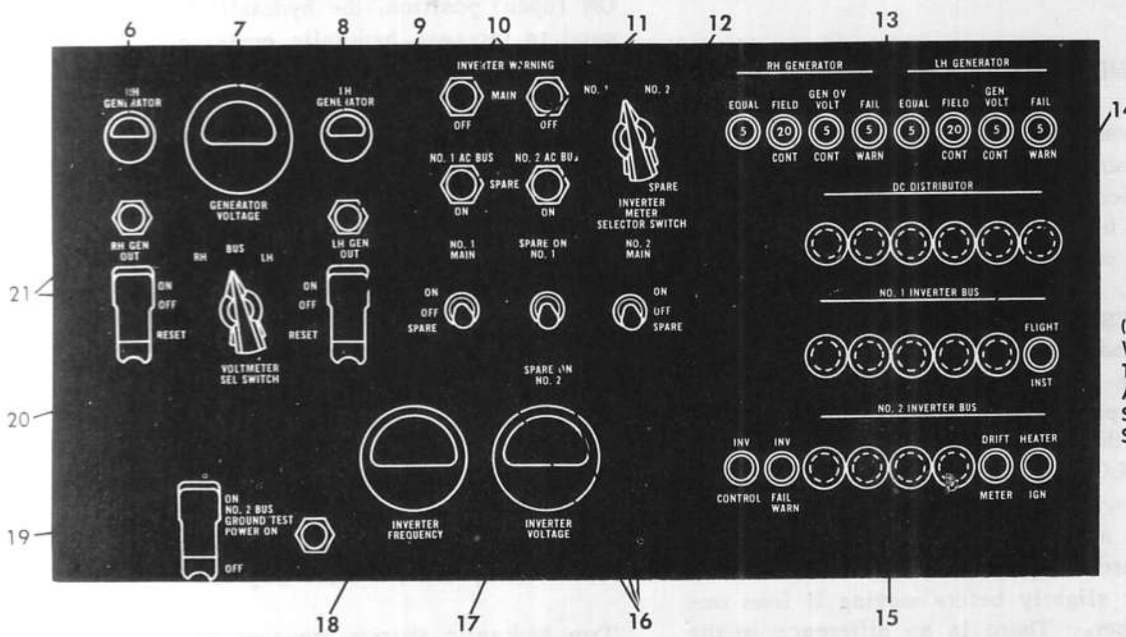
Two hydraulic system pressure gages mounted in a bracket assembly below the right windshield at the co-pilot's station (16, 17, figure 1-7), are direct-

MAIN ELECTRICAL JUNCTION BOX

C-47 AND R4D SERIES AIRCRAFT



1. BATTERY CONNECTOR RELAY
2. CIRCUIT BREAKER PANEL
3. GENERATOR MAIN LINE SWITCHES
4. JUNCTION BOX LAMP SWITCH
5. VOLTAGE REGULATOR MOUNTS
6. RH GENERATOR LOADMETER
7. VOLTMETER
8. LH GENERATOR LOADMETER
9. LH GENERATOR SWITCH AND LIGHT
10. MAIN INVERTER WARNING LIGHTS
11. SPARE INVERTER WARNING LIGHTS
12. INVERTER METER SELECTOR SWITCH
13. GENERATOR CIRCUIT BREAKERS
14. NO. 1 INVERTER BUS. CIRCUIT BREAKERS
15. NO. 2 INVERTER BUS CIRCUIT BREAKERS
16. INVERTER SWITCHES
17. INVERTER VOLTAGE METER
18. INVERTER FREQUENCY METER
19. GROUND TEST POWER SWITCH
20. VOLTMETER SELECTOR SWITCH
21. RH GENERATOR SWITCH AND LIGHT



JUNCTION BOX CONTROL PANEL

(ON AIRCRAFT WITH GENERATOR-INVERTER AND BUS PRIORITY SYSTEMS INSTALLED)

Figure 1-21

reading, pressure operated gages calibrated from 0 to 2000 psi. One gage indicates the fluid pressure in the hydraulic system and the other indicates the fluid pressure in the landing gear DOWN line when the landing gear control lever is in the DOWN or NEUTRAL position.

FIREWALL SHUTOFF VALVES.

See paragraph on the Firewall Shutoff Valve Handles, this section.

FLIGHT CONTROL SYSTEM.

The flight control system consists of independent elevator, aileron, and rudder systems. All flight controls are directly controlled and are operated by dual wheel and rudder pedals. The elevator, aileron, and rudder systems incorporate trim tabs.

RUDDER PEDALS.

The rudder is mechanically controlled by a duplicate set of hinged rudder pedals incorporating toe brakes. The pedals can be adjusted forward or aft for proper length by means of the adjusting lever mounted on each rudder pedal.

Rudder Trim Crank.

Rudder trim is mechanically controlled by a rotatable crank mounted on the aft face of the control pedestal (11, figure 1-10). Movement of the trim tab is shown on the indicator immediately below the crank.

CONTROL COLUMNS.

Dual control columns, mounted forward of the pilot's and co-pilot's seats, provide mechanical control of the ailerons and elevators. The columns incorporate a wheel for aileron control, while elevator control is gained by forward and aft movement of the column.

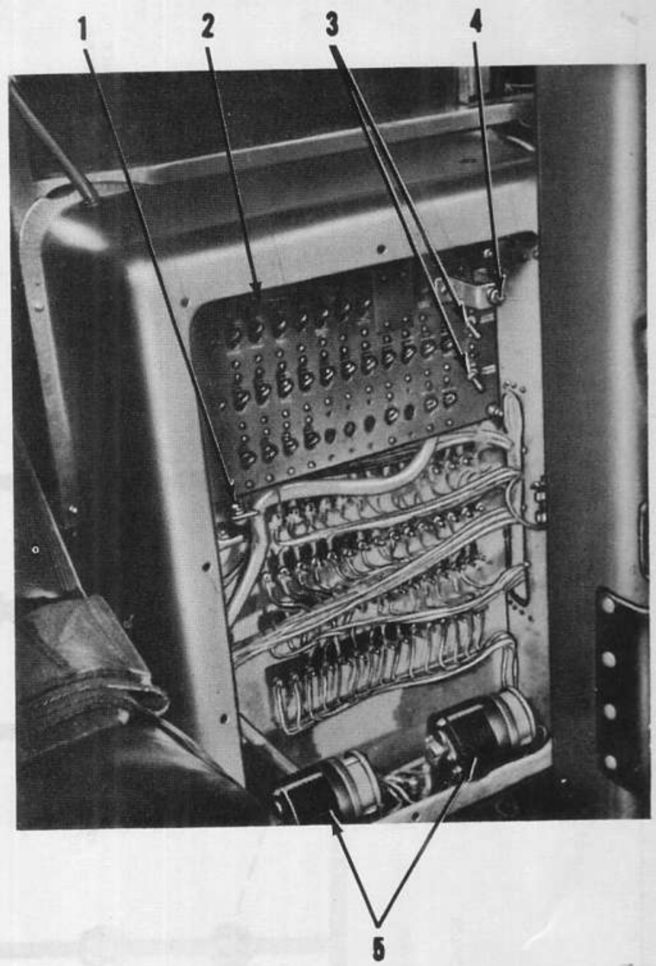
Aileron Trim Crank.

Right aileron trim is mechanically controlled by a rotatable crank mounted on the aft face of the control pedestal (8, figure 1-10). Movement of the trim tab is shown on the indicator immediately below the crank.

Elevator Trim Wheel.

Elevator trim is mechanically controlled by a hand-wheel located on the pilot's side of the control pedestal (14, figure 1-10). Movement of the trim tabs is shown on an indicator adjacent to the handwheel.

MAIN ELECTRICAL JUNCTION BOX
C-117 SERIES AIRCRAFT



1. BATTERY CONNECTOR RELAY
2. CIRCUIT BREAKER PANEL
3. GENERATOR MAIN LINE SWITCHES
4. JUNCTION BOX LAMP SWITCH
5. VOLTAGE REGULATORS

Figure 1-22

CONTROL-SURFACE LOCKS.

The rudder, both ailerons, and both elevators are locked while on the ground by use of 5 control-surface locks. The locks are felt-padded and equipped with small bungees which hold them firmly in place when slipped into position between the control surface and fixed surface. When not in use, the locks are stowed in the lavatory compartment (10, figure 1-1). On C-117 series aircraft, the locks are are stowed in the aft baggage compartment.

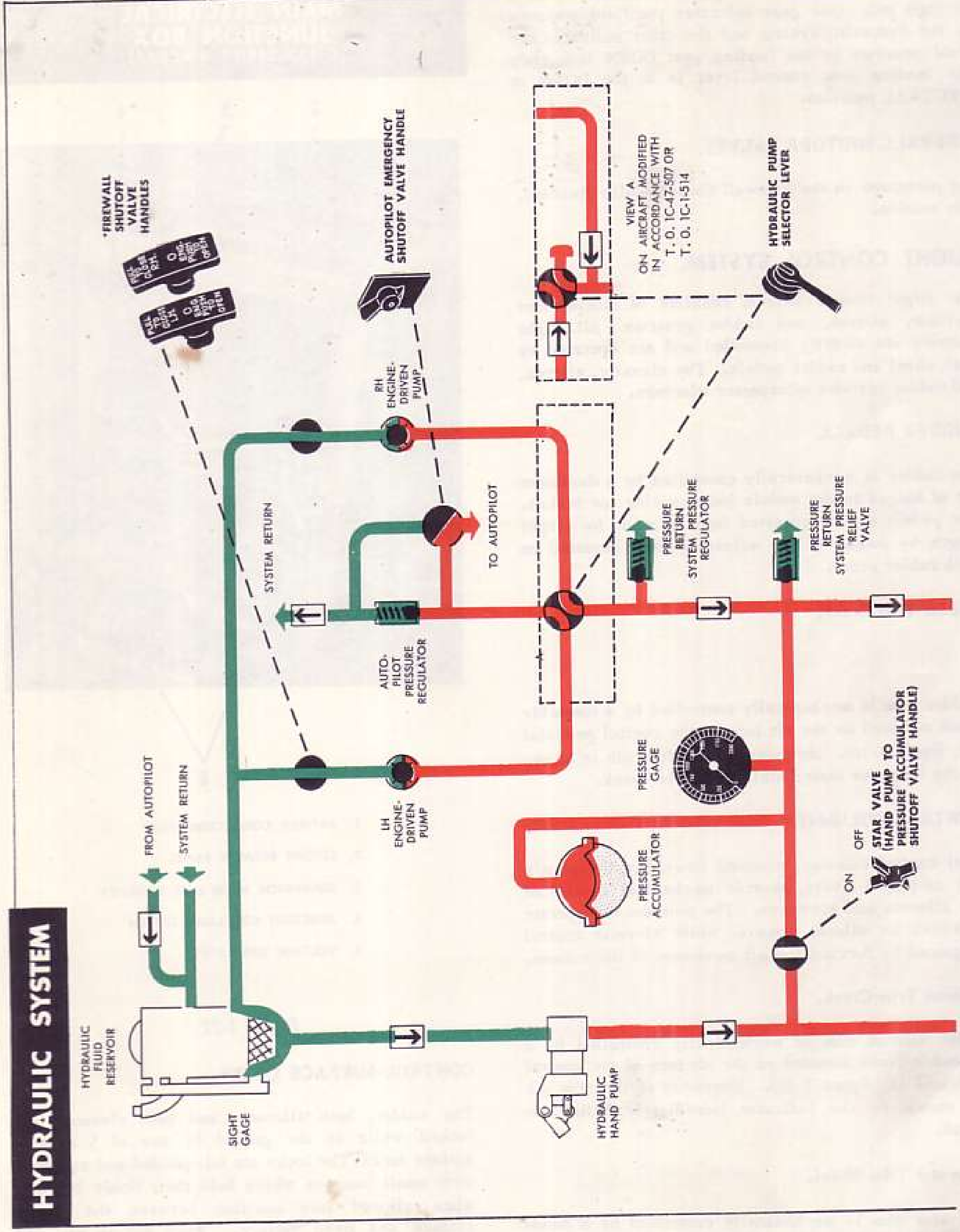


Figure 1-23 (Sheet 1 of 2)

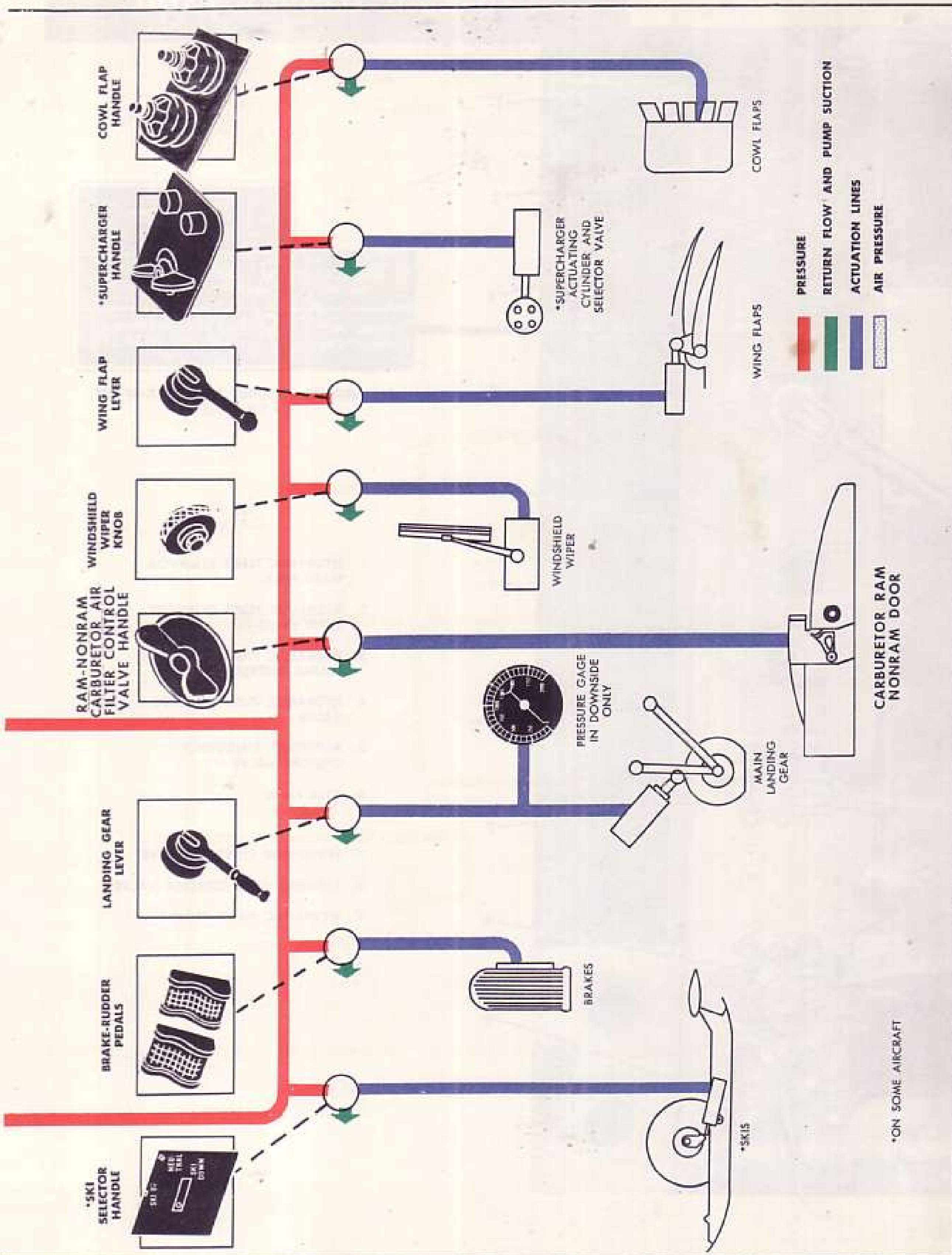
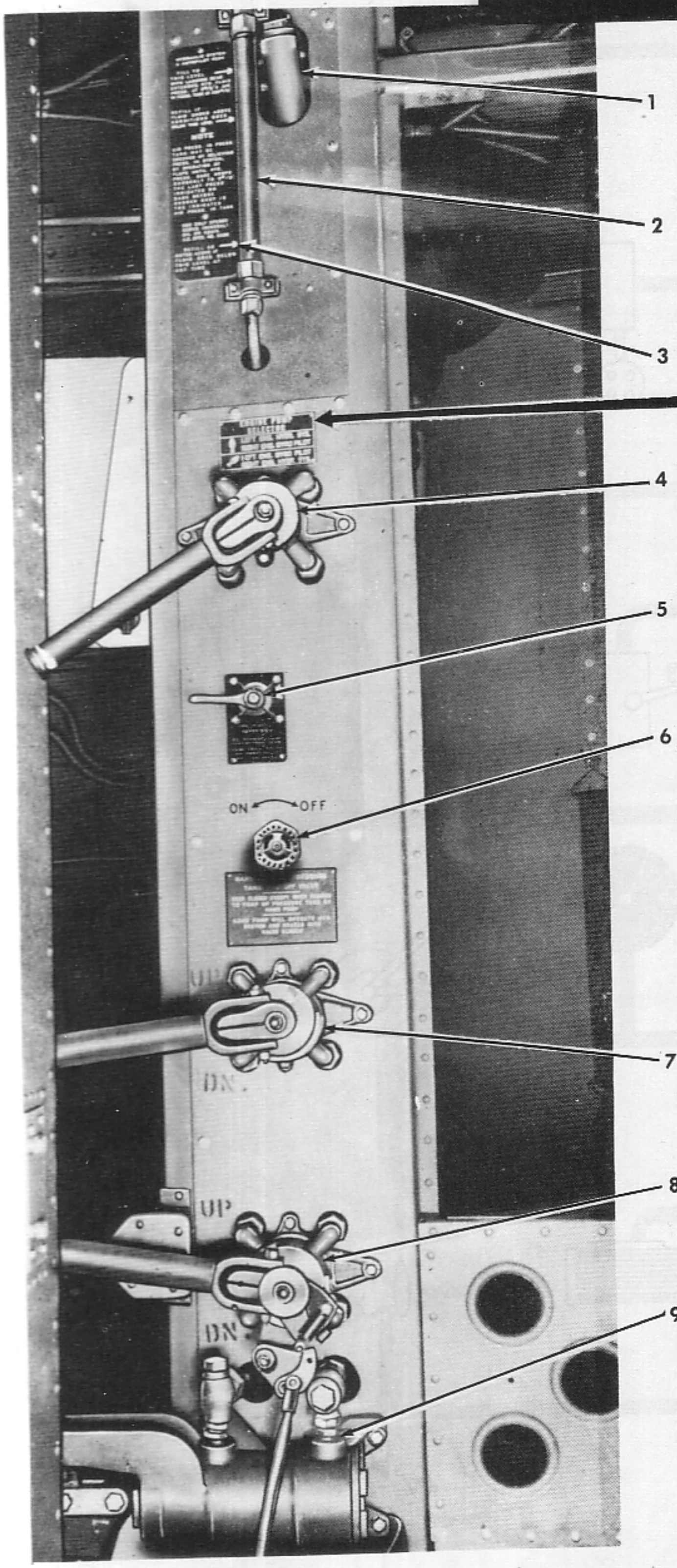


Figure 1-23 (Sheet 2 of 2)

HYDRAULIC CONTROL PANEL



ENGINE PUMP SELECTOR

TAKE-OFF POSITION	LEFT ENG HYDR SYS RIGHT ENG HYDR SYS
GYRO PILOT POSITION	LEFT ENG GYRO PILOT RIGHT ENG HYDR SYS

ON AIRCRAFT MODIFIED TO T.O. 1C-47-507 OR T.O. 1C-1-514

1. HYDRAULIC FLUID RESERVOIR FILLER NECK
2. HYDRAULIC FLUID QUANTITY SIGHT GAGE
3. HYDRAULIC FLUID RESERVOIR FILLING INSTRUCTIONS
4. HYDRAULIC PUMP SELECTOR VALVE
5. AUTOPILOT EMERGENCY SHUTOFF VALVE
6. STAR VALVE
7. WING FLAP CONTROL VALVE
8. LANDING GEAR CONTROL VALVE
9. HYDRAULIC HAND PUMP

Figure 1-24

LANDING GEAR LATCH LEVER

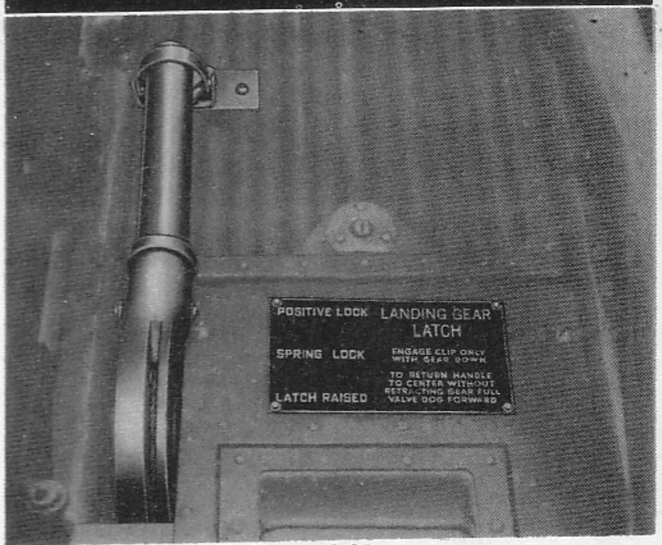


Figure 1-25

WING FLAPS.

The metal wing flaps are composed of four sections which extend from the inboard end of the left wing aileron under the fuselage to the inboard end of the right wing aileron and are of the split trailing-edge type. The flaps are hinged to the under side of the center wing section, and are hydraulically lowered or raised as a unit. The flaps have a travel of 0 to 45 degrees. Wing flap movement is hydraulically controlled by a lever located in the cockpit. Movement of the flaps is indicated by the wing flap position indicator located in the cockpit.

WING FLAP CONTROL LEVER.

The wing flap control lever, located on the hydraulic control panel (7, figure 1-24), has UP, DOWN, and NEUTRAL positions. Movement of the control lever to the DOWN position directs hydraulic fluid pressure to the wing flap actuating cylinder downline to lower the flaps. When the control lever is placed in the UP position, the flow of fluid is reversed to raise the flaps. When the flaps are positioned UP or DOWN as required, the control lever should be returned to the NEUTRAL (halfway) position to trap the fluid in the actuating cylinders and hold the desired flap setting.

Wing Flap Position Indicator.

A mechanically actuated wing flap position indicator is mounted either vertically, at the left of the pilot's main instrument panel, or horizontally, on the bottom of the pilot's main instrument panel (5, figure 1-6 and 41, figure 1-12). Any movement of the wing flap actuating cylinder is shown by an equivalent movement of the pointer on the indicator by means of a flexible steel wire, sheathed in a tube and connected to the actuating cylinder at one end and to the indicator needle at the other end. The placarded positions indicated are UP –¼ –½ –¾ –DOWN.

LANDING GEAR SYSTEM.

The landing gear consists of main landing gear and a tail gear. The hydraulically operated main gear is extended or retracted by two hydraulic actuating cylinders (figure 1-23), one located in each nacelle, and controlled by a lever located on the hydraulic control panel in the cockpit. A mechanical safety latch is provided to prevent inadvertent raising of the main landing gear. In the event of a landing gear hydraulic line failure, the gear will free fall when the landing gear control lever is moved to the DOWN position. The tail wheel is not retractable, but is full swiveling and can be locked in the trail position.

LANDING GEAR LEVER.

The landing gear lever, located on the hydraulic control panel (8, figure 1-24), has DOWN, NEUTRAL, and UP positions. Movement of the lever to the DOWN position directs hydraulic fluid pressure to the landing gear downline to extend the main gear. When the lever is placed in the UP position, the flow of fluid is reversed to the upline to retract the main gear. When the lever is in the NEUTRAL position, fluid flow is blocked to both the upline and the downline. When the main gear is extended or retracted as required, the lever should be returned to the NEUTRAL (halfway) position to hold the desired setting.

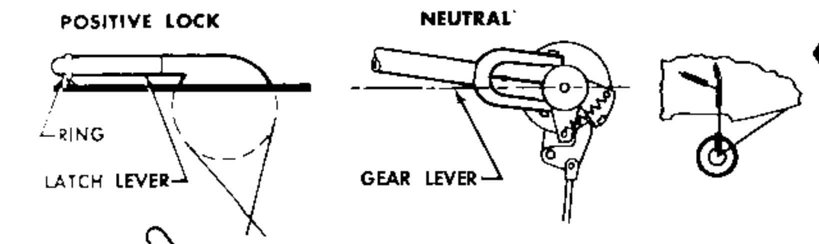
NOTE

> The landing gear latch must be released (LATCH RAISED position) before the main gear can be retracted because a catch and dog prevent the landing gear lever from being moved into the UP position.

LANDING GEAR LATCH LEVER.

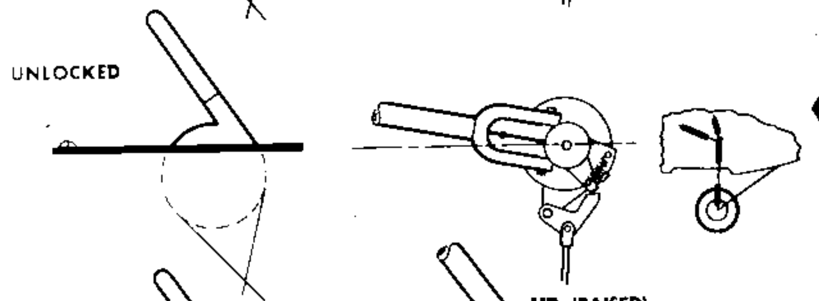
The landing gear safety latches for both main gear are controlled simultaneously by cables connected to the landing gear latch lever, located on the floor to the right of the pilot's seat (figure 1-25). The safety latch automatically latches to lock the landing gear when the landing gear is fully extended, by engaging a slot in the lower end of the actuating cylinder piston rod. For operation of the landing gear safety latch lever, see figure 1-26.

LANDING GEAR LATCH LEVER OPERATION



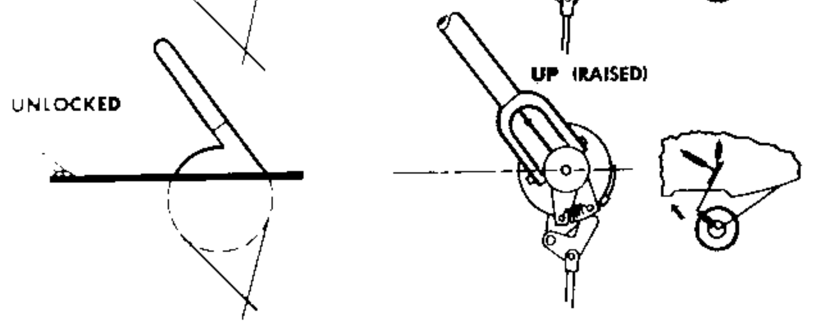
BEFORE TAKE-OFF:

1. LANDING GEAR LEVER—NEUTRAL
2. LATCH LEVER—POSITIVE LOCK

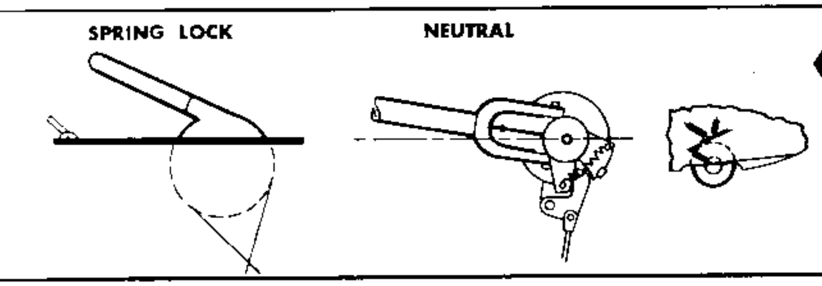


AFTER TAKE-OFF:

1. LATCH LEVER—RAISED

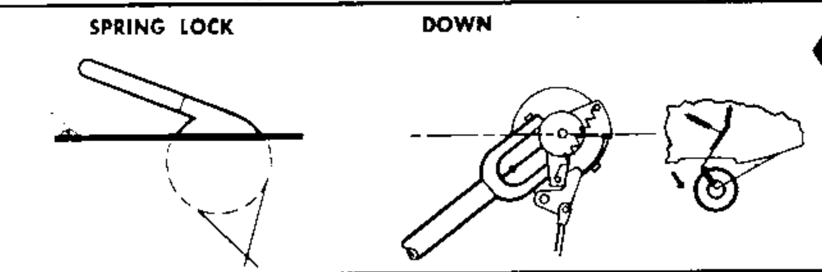


2. LANDING GEAR LEVER—UP



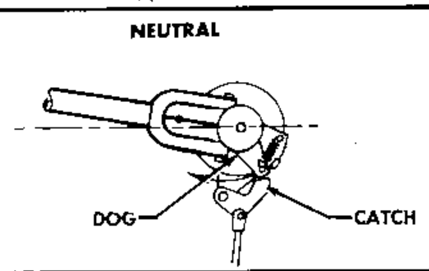
DURING FLIGHT:

1. LANDING GEAR LEVER—NEUTRAL
2. LATCH LEVER—SNAPS AUTOMATICALLY TO SPRING-LOCK POSITION



LANDING:

1. LANDING GEAR LEVER - DOWN
2. PRESSURE - UP
3. LEVER - NEUTRAL
4. GEAR WARNING LIGHT - GREEN
5. LATCH - POSITIVE LOCK



SHOULD LATCH LEVER BECOME JAMMED IN UNLOCKED POSITION BY OUT-OF-SEQUENCE OPERATION, PULL DOG FORWARD TO ALLOW CATCH TO SPRING INTO PLACE. LATCH LEVER WILL THEN RETURN TO SPRING-LOCK POSITION.

Figure 1-26

LANDING GEAR LATCH LEVER AND GEAR SAFETY PIN

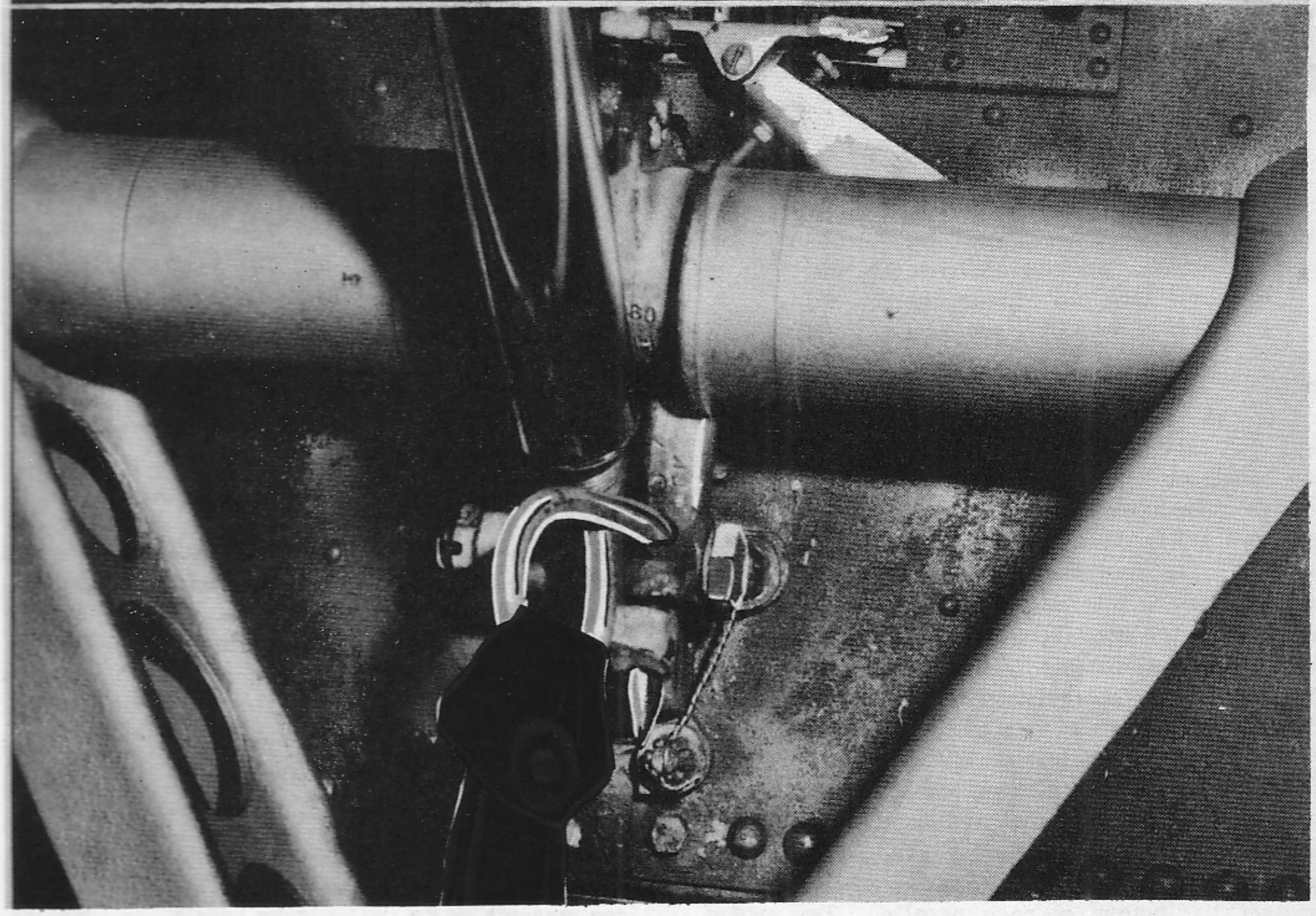


Figure 1-27

Landing Gear Safety Pins.

Landing gear safety pins are provided to prevent inadvertent retraction of the landing gear when the aircraft is on the ground (figure 1-27). When not installed, the safety pins are stowed in the canvas pocket on the aft bulkhead of the main cabin compartment (8, figure 1-1).

Landing Gear Indicator Lights.

The 28-volt d-c landing gear red and green indicator lights are located on the right side of the main instrument panel (18 and 20, figure 1-11, and 20 and 21, figure 1-12). 28-volt d-c microswitches are mounted next to the landing gear lever and on each main gear. These switches are actuated by movement of the landing gear lever and the main gear to indicate the position of the main gear and lever by means of the red and green indicator lights. The green light will be illuminated when both main gears are down and locked and the lever is in the NEUTRAL position. If the landing gear is retracted, or in any intermediate position or down and unlatched, or the landing gear is down and latched with the lever not in NEUTRAL position, the red indicator light will be illuminated. The red indicator light will go out when the landing gear is down and locked and the lever is in the NEUTRAL position. On some aircraft, the red indicator light will go out when the gear is fully retracted.

Landing Gear Warning Horn.

The 28-volt d-c landing gear warning horn, located in the fuselage to the left of the pilot's seat, will sound when one or both throttles are less than approximately ¼ open and the landing gear is not down and locked with the lever in the NEUTRAL position, or when the landing gear lever is not in the NEUTRAL position. No switch is provided for silencing the horn.

Tail Wheel Lock Lever.

The mechanically operated tail wheel lock lever is located on the control pedestal below the throttle levers (12, figure 1-10), and has LOCK and UNLOCK positions. The LOCK position locks the tail wheel in the trailing position for take-offs and landings; the UNLOCK position allows free swiveling of the wheel for taxing.

NOTE

> The tail wheel must be in the centered position before the tail wheel lock pin will engage the tail wheel in the LOCK position.

SKIS.

The ski installation provides a ski for each main gear and one for the tail gear. The main skis are designed for a gross weight of 15,000 pounds each. The tail ski is designed for a gross wieght of 4000 pounds. The main skis add approximately 1026 lb. to the gross weight and the tail ski adds approximately 61 pounds to the aircraft gross weight. The main skis are allowed a maximum pitching range from normal, of approximately 20° negative to 15° positive, enabling the skis to follow uneven terrain while taking-off, taxiing, or landing. The pitching range is controlled by limiting cables to prevent the skis from overtraveling their maximum safe operating limits. When the main landing gear is up and the skis are retracted on the wheels, the skis rest against the bottom of each nacelle. Two rubber bumper pads are installed on each ski to prevent vibration or damage when the skis and landing gear are both retracted. During flight when the main gear is extended, the main skis are held in proper position by means of aerodynamic riggers. These riggers consist of airfoils attached to the aft section of the skis. The main skis may be extended or retracted permitting the airplane to take-off and land on a clear runway, as well as on one covered with ice or snow. When the skis are retracted, the tires extend approximately 8 inches below the bottom surface of the skis. The tail ski is not retractable. Limiting cables installed fore and aft prevent pitching beyond safe angles of incidence and lateral rotation. A mechanical rigger holds it in the proper flight position.

SKI SELECTOR HANDLE.

A 3-position ski selector handle is installed on the floor below the control pedestal to provide for retraction and extension of the main wheel skis. When the selector is turned to the SKI UP position, the control valve is positioned to direct hydraulic fluid pressure to the up side of the actuating cylinder for retracting the skis. Turning the selector handle to SKI DOWN, directs hydraulic fluid pressure to the down side of the actuating cylinder to extend the skis. When the selector is turned to the NEUTRAL position, pressure and return fluid is locked in the lines, preventing movement of the skis from the set position.

BRAKE SYSTEM.

The main landing gear wheel hydraulic brakes may be applied independently or simultaneously by means of two brake control valves, which are contained in a single housing and linked to the rudder brake pedals. Application of toe pressure on the rudder brake pedals allows hydraulic fluid under pressure to flow through the brake control valves and brake operating lines to the brake actuating cylinders. The brake actuating pistons force the brake shoes against the brake drums to produce the braking action. The pressure applied to the brakes is proportional to the toe pressure applied to the rudder pedals. When the rudder brake pedal is released, springs return the brake shoes to the off position, and the excess hydraulic fluid flows through the brake operating line to the brake control valve and into the return line to the hydraulic reservoir. A parking brake mechanism is provided to hold the brakes on when the aircraft is parked.

HYDRAULIC BRAKE CONTROLS.

The hydraulically operated brakes are controlled by toe pressure on the rudder brake pedals. Full braking action is possible even when the landing gear is retracted.

Parking Brake Control Knob.

The main wheel brakes may be locked on for parking by means of the mechanical parking brake control knob mounted on the lower portion of the control pedestal (7, figure 1-10). To set the parking brake, the pilot's rudder brake pedals should be fully depressed and the parking brake control knob pulled out. The rudder brake pedals should be released before the parking brake control knob is released. To release the parking brake, toe pressure should be applied on the rudder brake pedals. The brakes on both wheels should be locked and released simultaneously.

NOTE

> The parking brakes are locked and released by use of the pilot's rudder brake pedals only.

INSTRUMENTS.

The dual manifold pressure gage is a direct-reading instrument. The free air temperature indicator is electrically operated. The vacuum-operated instruments include the attitude indicator, the directional indicator, and the turn-and-slip indicator. For proper operation of the vacuum instruments, engine rpm should be at least 1000.

VACUUM SYSTEM.

The vacuum system consists of two engine-driven vacuum pumps, two vacuum relief valves, two check valves, a vacuum manifold, two air filters, a vacuum restrictor for the turn-and-slip indicator, and the connecting lines. A direct-pressure-operated vacuum gage mounted on the main instrument panel (10, figures 1-11 and 13, figure 1-12) indicates the vacuum pressure in inches Hg. (See the paragraph on the Autopilot, Section IV.)

PITOT-STATIC SYSTEM.

The pitot-static system instruments and equipment consist of two airspeed indicators, two altimeters, and a vertical velocity indicator, all installed on the main instrument panel (figures 1-11 and 1-12); and two pitot-static tubes mounted on masts on the underside of the fuselage nose section (21, figure 1-1), a static selector, and the connecting lines. The static selector control switch mounted on the main instrument panel (21, figure 1-11, and 25, figure 1-12), provides for selection of an alternate static source (16, figure 1-1) in the event of malfunctioning of the normal static source. On some aircraft, the alternate static source is located in the left aft fuel tank bay. The selector switch is safetywired to the normal static source. The pitot-static tubes are protected from ice by integral heating elements.

ELECTRICALLY OPERATED INSTRUMENTS. (Some Aircraft).

The attitude indicator and the directional indicator are driven by AC power. The turn and slip indicator is driven by DC power and has a separate switch directly to the battery. Reference, Ground Test Power switch, this section.

FREE AIR TEMPERATURE INDICATOR.

One 28-volt d-c free air temperature indicator is mounted on the main instrument panel (12, figure 1-11, and 17, figure 1-12). The indicator is connected to the thermometer resistance bulb on the underside of the nose section so that changes in the temperature of the outside air will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The indicator is calibrated in degrees centigrade.

EMERGENCY EQUIPMENT.

FIRE EXTINGUISHING SYSTEM.

The aircraft is equipped with a single-shot bromochloromethane (CB) engine fire extinguishing system. The system incorporates two CB spherical containers, one located in each engine nacelle (24, figure 1-1), the necessary piping for routing the agent to the spray ring mounted on each engine, and the controls for operation of the system. Each CB container is pressurized with nitrogen to 410 psi standard day and incorporates a pressure gage for checking pressure within the container. A fire detection circuit is also provided for each engine.

NOTE

The CB fire extinguishing system is connected directly to the batteries and will operate regardless of battery switch position.

Two portable hand fire extinguishers, one mounted on the bulkhead above the pilot's seat, and one mounted on the rear section of the main cabin door or, on C-117 series aircraft, immediately forward of the passenger entrance door, are provided for combating fires in the fuselage.

WARNING

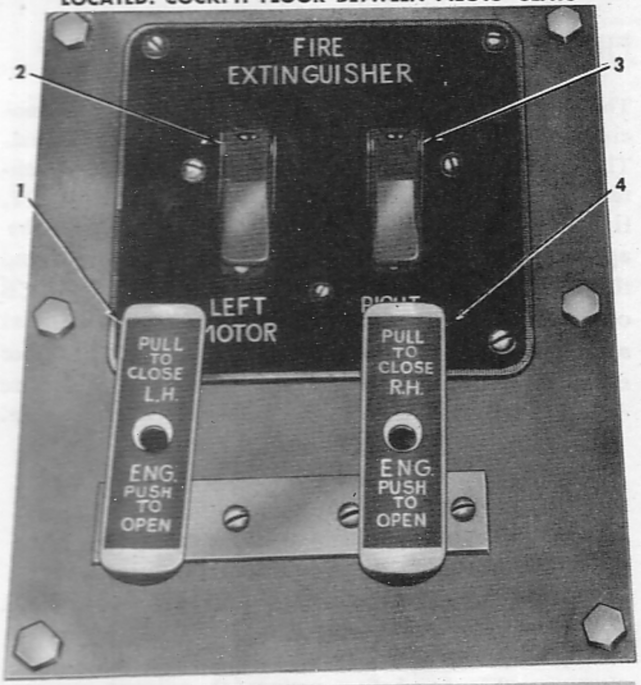
Prolonged exposure (5 minutes or more) to high concentrations of bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride or methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure (pronounced irritation of eyes and nose), including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

Engine Fire Extinguisher Switches.

Two guarded ON-OFF fire extinguisher switches (2 and 3, figure 1-28), one for the left engine and one for the right engine, are located under the hinged

ENGINE FIRE EXTINGUISHER CONTROLS

LOCATED: COCKPIT FLOOR BETWEEN PILOTS' SEATS



1. LEFT ENGINE FIREWALL SHUTOFF VALVE HANDLE
2. LEFT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
3. RIGHT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
4. RIGHT ENGINE FIREWALL SHUTOFF VALVE HANDLE

Figure 1-28

door on the flight compartment floor between the pilot's and co-pilot's seats. When either switch is placed in the ON position, a 28-volt d-c circuit is energized to discharge the CB agent to the respective spray ring around the engine.

CB Container Pressure Gages.

A pressure gage mounted on each CB container indicates the charge in psi within the container. When the container is fully charged the indicator should read 410 psi standard day.

Firewall Shutoff Valve Handles.

The firewall shutoff valve handles for shutting off the flow of fuel, engine oil, and hydraulic fluid are located under the engine fire extinguisher access door between the pilot's and co-pilot's seats (1 and 4, figure 1-28). The shutoff valves are connected by cables to the handles. In case of fire in either engine, the corresponding handle is pulled, shutting off the flow of fuel, engine oil, and hydraulic fluid to that engine.

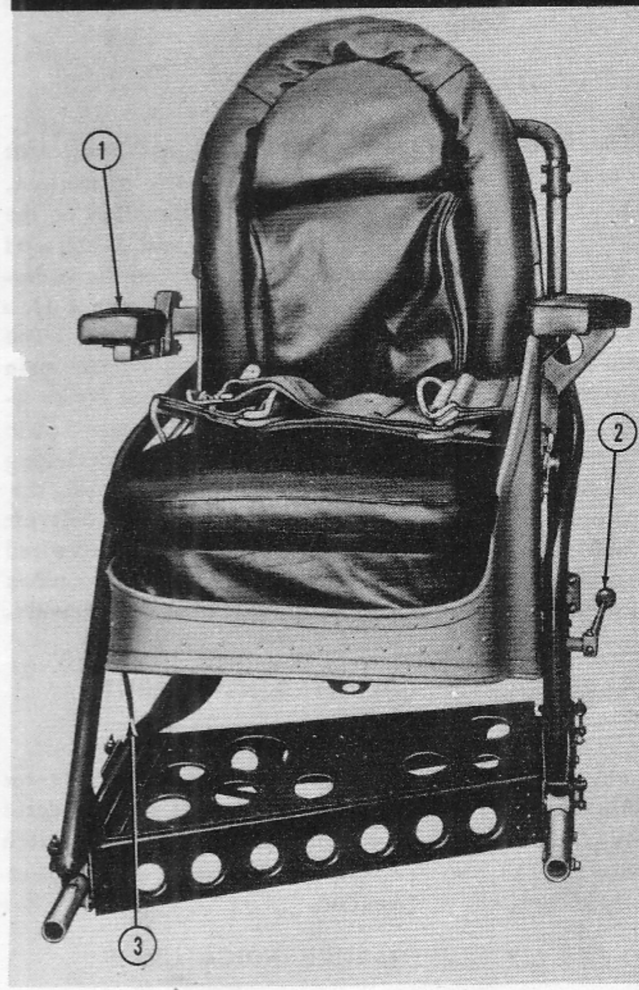
NOTE

When a firewall shutoff valve handle is actuated, oil for propeller feathering and hydraulic pressure for cowl flap operation is still available.

ENGINE FIRE DETECTION WARNING SYSTEM. (IF INSTALLED).

Two 28-volt d-c fire detection press-to-test warning lights, one for each nacelle, are located on the main instrument panel (9, figure 1-11). The system has a thermocouple circuit for detecting fire. When either engine fire detector circuit detects fire, the respective fire warning light for that circuit illuminates.

PILOT'S SEAT



1. MOVABLE ARM REST
2. VERTICAL ADJUSTMENT LEVER
3. FORWARD AND AFT ADJUSTMENT CONTROL

Figure 1-29

A circuit breaker for the fire detection system is provided on the upper right side of the main junction box.

Fire Detector Test Switch.

A 28-volt d-c fire detector pushbutton test switch, located adjacent to the warning lights, provides a method of checking the fire detection warning circuits. When the test switch is held in for 10 seconds or less, both warning lights should illuminate. If the warning lights do not illuminate when the test switch is held in, the circuit is defective.

ALARM AND WARNING SYSTEM.

An emergency warning bell is mounted on the left side of the main cargo compartment forward bulkhead. The bell is operated by a 28-volt d-c switch mounted on the electrical control panel (24, figure 1-13 and 1, figure 1-14); on some aircraft it is wired directly to the aircraft batteries, and on other aircraft to the main junction box bus. See Section III for Emergency Alarm Bell Procedures.

FIRE EXTINGUISHER SYSTEM (R4D-7).

The aircraft is equipped with a one-shot, mechanically controlled CO_2 fire extinguisher system for the protection of each engine accessory section. Strategically located fire detectors actuate fire warning lights on the main instrument panel. A yellow celluloid indicator is mounted on the right side of the fuselage nose section skin, to indicate manual discharge of CO_2.

FIRE EXTINGUISHER SELECTOR VALVE CONTROL (R4D-7).

A three position fire extinguisher selector valve control is located under an access door in the floor between the pilot's and co-pilot's seat for selecting engine for CO_2 discharge.

DISCHARGE CONTROL HANDLE (R4D-7).

One CO_2 discharge control handle is located under an access door in the floor between the pilot's and co-pilot's seats.

LIFE RAFTS (C-47 AND R4D SERIES AIRCRAFT).

Provision is made from stowage of suitable life rafts on the right side of the main cabin compartment (5, figure 3-3).

EXTENSION LADDER.

A 3-section extension ladder is stowed on the aft side of the forward baggage compartment bulkhead. When fully extended, it provides a means for emergency exit or entrance through the small baggage door.

EMERGENCY TRANSMITTER.

The aircraft is equipped with an emergency radio transmitter which is strapped on the bulkhead next to the cargo door.

EMERGENCY EXITS (C-47 AND R4D SERIES AIRCRAFT).

The five emergency exits consist of the hatch above the pilot and co-pilot, the forward panel of the main cargo door; the fifth window aft on both sides of the main cargo compartment, and the small baggage door in the forward baggage compartment (figure 3-5).

EMERGENCY EXITS (C-117 SERIES AIRCRAFT).

The six emergency exits include the hatch above the pilot and co-pilot, the small baggage door in the forward baggage compartment, the fifth and sixth windows aft on the right side of the main cabin, the fifth window aft on the left side of the main cabin, and the main cabin entrance door (figure 3-5).

MISCELLANEOUS EMERGENCY EQUIPMENT.

The following miscellaneous emergency equipment is shown on figure 3-3.

- Hand fire extinguishers.
- First aid kits.
- Fire axe.
- Pyrotechnic pistol (C-47 and R4D series aircraft).
- Parachute stowage (C-47 and R4D series aircraft).
- Parachute flare release tubes (SC-47 and C-117 series aircraft).

ENTRANCE DOORS.

Entrance to the aircraft is normally made through the forward cargo (passenger) loading door, located on the aft left side of the fuselage. External and internal latch handles, located on the aft end of the forward door, are provided for latching or unlatching the door. A clip is provided to secure the door against the fuselage when fully opened. If entry through the cargo doors is not feasible, an extension ladder is provided for entrance through the small forward baggage loading door, located on the left side of the fuselage immediately aft of the pilot's station. A door open warning light is installed on the extreme right hand side of the instrument panel (figure 1-11 and 1-12) to indicate when either or both of the doors is not correctly locked.

PILOTS' SEATS.

The pilot's and co-pilot's seats (figure 1-32) provide forward, aft, and vertical adjustments. The inboard armrest of each seat can be pivoted to provide easy access to the seat.

PILOTS' SEAT FORWARD AND AFT ADJUSTMENT CONTROLS.

A short cable at the lower right of the pilot's seat and the lower left of the co-pilot's seat (3, figure 1-29) operates the horizontal release catch to adjust the seat forward or aft on two horizontal tracks. Adjustment is accomplished by shifting body weight as required.

PILOTS' SEAT VERTICAL ADJUSTMENT LEVERS.

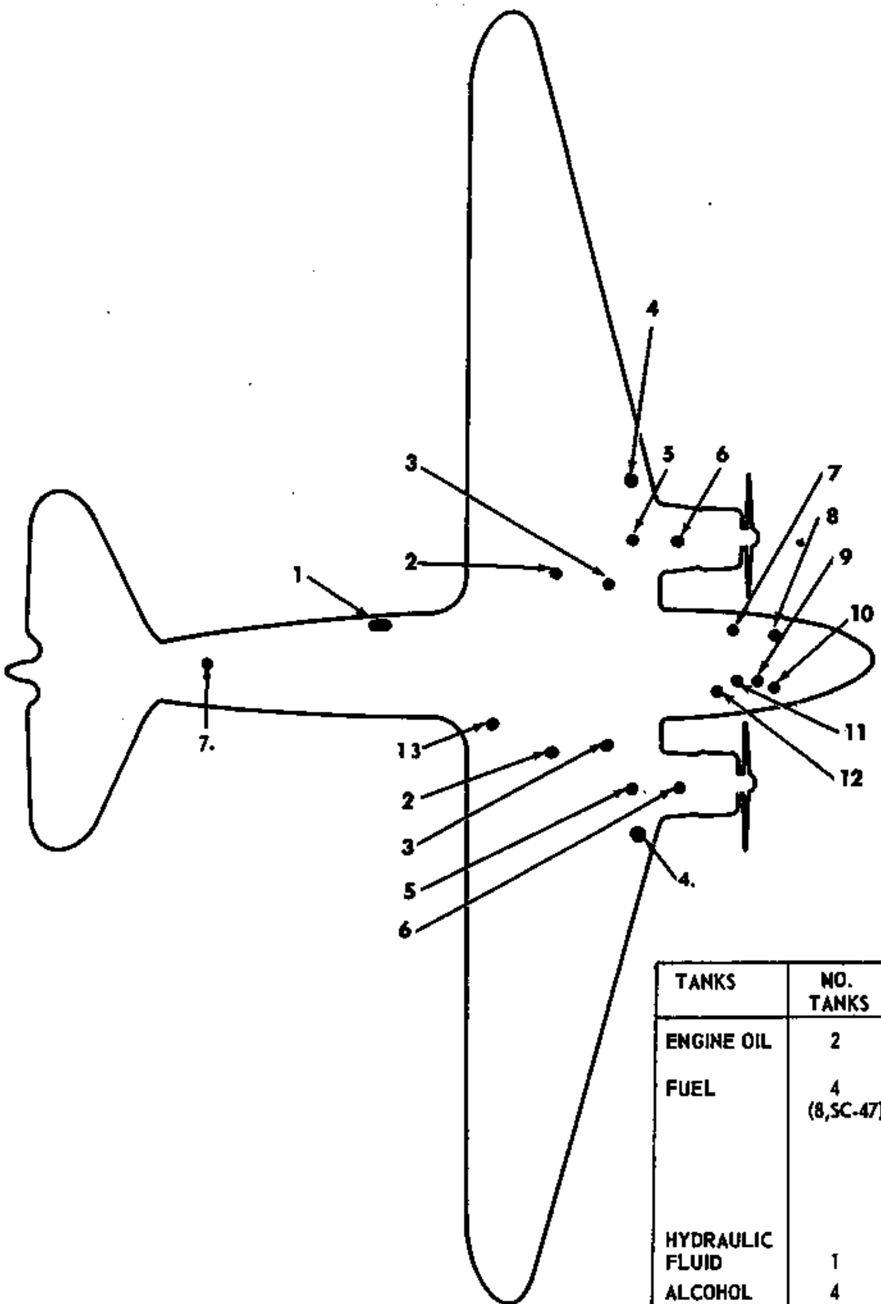
A lever at the left of the pilot's seat and the right of the co-pilot's seat (2, figure 1-29) operates the vertical release catch to adjust the seat vertically on vertical tracks. The seat is raised by bungees when the vertical adjustment catch is released. Adjustment is accomplished by increasing or decreasing body weight as required.

AUXILIARY EQUIPMENT.

The following auxiliary equipment is described in Section IV:

Heating and ventilating system.
Anti-icing and deicing systems.
Oxygen systems.
Communication equipment.
Autopilot.
Navigation equipment.
Lighting system.
Cargo tie-down provisions.
Casualty carrying provisions.
Cargo loading equipment.
Troop carrying equipment.
Passenger carrying equipment.
Auxiliary power plant (APP).
Miscellaneous equipment.
Loudspeaker system (SC-47).

SERVICING DIAGRAM



1. OXYGEN FILLER VALVE (SOME AIRCRAFT)
2. AUXILIARY FUEL TANK FILLER NECK
3. MAIN FUEL TANK FILLER NECK
#4. OUTER WING TANK FILLER NECK
5. OIL TANK FILLER NECK
6. OIL TANK DIPSTICK ACCESS PANEL
7. WATER SUPPLY TANK FILLER
8. PROPELLER DEICING TANK FILLER NECK
9. HYDRAULIC RESERVOIR FILLER NECK
10. INFLIGHT WINDSHIELD AND CARBURETOR DEICING TANK FILLER NECK (SOME AIRCRAFT)

† 11. WINDSHIELD DEICING TANK FILLER NECK

† 12. CARBURETOR DEICING TANK FILLER NECK

* 13. WINDSHIELD AND CARBURETOR DEICING TANK FILLER NECK

TANKS	NO. TANKS	USAF SPECIFICATION	NATO SYMBOL
ENGINE OIL	2	MIL-L-6082 GRADE 1100-A	0-117
FUEL	4 (8,SC-47)	MIL-F-5572 RECOMMENDED GRADE 100-130	F-18
		ALTERNATE GRADE 115-145	F-22
		91-96	F-15
HYDRAULIC FLUID	1	MIL-O-5606	H-515
ALCOHOL	4	UNCHANGED	-
OXYGEN	-	MIL-O-27210	-
WATER	2	-	PORTABLE WATER
APP OIL	-	-	MIL-L-8303

* C-47 and C-117 series aircraft

† R4D series aircraft

#SC-47 series aircraft

Figure 1-30

SECTION II
NORMAL PROCEDURES

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PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

For flight restrictions on the aircraft, refer to Section V of this Flight Manual.

FLIGHT PLANNING.

Preflight planning data, such as required fuel, airspeed, power settings, etc, to complete the proposed mission should be determined, using the operating data contained in Appendix of this Flight Manual. Refer to Section V for alternate fuel grade limits.

TAKEOFF AND LANDING DATA CARD.

A takeoff and Landing Data Card is contained in the Pilot's Abbreviated Flight Crew checklist T. O. 1C-47-CL-1-1. Compute the Takeoff and Landing Data Card as illustrated in the Appendix.

WEIGHT AND BALANCE.

Check the aircraft weight and balance (refer to the Handbook of Weight and Balance, T. O. 1-1B-40). Refer to Section V of this handbook for the weight, limitations of the aircraft, and check the take-off and anticipated landing gross weights. Make certain that the weight and balance clearance (Form 365F) is current and correct. Make certain that the weight, grades of fuel, oil, and any special equipment carried are suited to the mission to be performed.

CHECKLISTS.

The Flight Manual now contains only amplified checklists; the abbreviated checklists have been issued as separate technical orders. T. O. 1C-47-CL-1-1, -2, -3, -4, and -5. Refer to CHECKLISTS in the Introduction.

NOTE

The term "climatic" as used in the checklists indicates equipment operation or settings which may be necessary for other than daylight VFR conditions. This includes IFR, night, cold weather, tropic, and desert conditions. The equipment operation or setting will vary depending on the prevailing conditions. In practice, the response to climatic items will be the required switch or control position.

ENTRANCE. (See figure 3-5).

PREFLIGHT CHECKS.

It shall be the responsibility of the pilot to insure that an interior and exterior visual inspection as outlined, and a PREFLIGHT inspection as required by the Handbook of Inspection Requirements, T. O. 1C-47A-6 have been performed. It shall also be the responsibility of the pilot to insure that each crew member has accomplished his individual inspection requirement as outlined in this Section and in Section VIII.

NOTE

The air crew visual inspection procedures outlined in this section are predicated on the assumption that maintenance personnel have completed all the requirements of the Manual of Inspection Requirements, T. O. 1C-47A-6. Therefore, duplicate inspections and operational checks of systems by air crew members have been eliminated, except for certain items required in the interest of flying safety.

THRU FLIGHT CHECKLIST.

The thru-flight checklist is to be accomplished only when the airplane is assigned missions which require intermediate stops by the same flight crew and no maintenance is performed during these stops. Thru-Flight checklists items are indicated by an asterisk (*). Asterisked items must be accomplished during an intermediate stop. The remaining items may be accomplished at the discretion of the flight crew. All items under BEFORE TAKEOFF and subsequent checks must be accomplished for all flights.

AIRCRAFT STATUS.

Check Form 781 for the status of the aircraft and determine that the maintenance pre-flight has been accomplished. The pilot will make certain that the inspection as outlined by the Handbook of Inspection Requirements T. O 1C-47A-6 has been performed and ascertain that the crew has been briefed. The checklists presented in this Section are depicted showing personnel normally responsible for execution of the required action or assuring that such action is completed. P, CP, and FM denote pilot, copilot, and flight mechanic respectively.

EXTERIOR INSPECTION.

1. Control surface locks – REMOVED.

Pilot will determine that the control surface locks are removed and stowed aboard the aircraft.

2. Pitot covers – REMOVED.

Remove pitot covers and stow aboard the aircraft.

INTERIOR INSPECTION.

1. Survival equipment (if installed) – CHECKED.
2. Cargo and equipment security – CHECKED.
3. Passenger briefing – COMPLETED.
4. Long range shutoff valves (if installed) – OFF.
5. Master compass indicator – ZERO.
6. Oxygen system – CHECKED.

Check mask and regulator for proper operation.

BEFORE STARTING ENGINES.

*1. Seat and rudder pedals – ADJUSTED. P, CP

*2. Seat belt – FASTENED. P, CP

*3. Landing gear latch lever – POSITIVE LOCK. P

*4. Hydraulic pump selector – LEFT ENG. GYRO PILOT – RIGHT ENG. HYDR. SYS: on modified aircraft – GYRO PILOT POSITION. P

5. Autopilot emergency shutoff valve – ON and safetied. P

6. Star valve – OFF and safetied. P

7. Wing flap lever – NEUTRAL. P

8. Hydraulic hand pump and pressure – CHECKED. CP (Operate hand pump until landing gear pressure is within limits).

*9. Landing gear lever – NEUTRAL. P

NOTE

The landing gear lever should be moved rapidly to NEUTRAL position in order to trap landing gear down pressure.

10. Fire extinguisher switches – OFF. P

11. Firewall shutoff valves – OPEN (Handles down). P

NOTE

Leave cover open during engine starting.

12. Autopilot – OFF. P

*13. Parking Brakes – SET. P

*14. Cross Feed – OFF. P (SC-47 only)

*15. Fuel dump switches – OFF. CP (SC-47 only)

16. Ski selector handle (if installed) – AS REQUIRED. P

17. JATO master switch (if installed) – OFF. P

18. Radio and electrical switches – OFF. P, CP

*19. Alarm bell – CHECKED. P

*20. Chocks – In place (R & L). P, CP

*21. Battery switch – ON (OFF, if external power is used). P

*22. APP (if installed) – START and on the line. FM

WARNING

Do not operate internally installed auxiliary power plant at any time with long range auxiliary fuel tanks installed.

*23. Command radio – ON. P

*24. No smoking and fasten seat belt sign switches (if installed) – ON. CP

*25. Lights – CLIMATIC. P, CP

*26. Ignition switches – Set master ignition switch ON, individual ignition switches OFF. P

*27. Fire detection System - TEST. P,CP

*28. Cowl flaps – OPEN, then OFF. CP

29. Static selector switch – NORMAL. P, CP

*30. Fuel quantity – CHECK. P, CP

CAUTION

The selector must be turned clockwise to prevent jamming.

*31. Fuel tank selectors – MAIN or fullest tanks. P, CP

*32. Carubretor air – RAM/CLIMATIC. P, CP

CAUTION

The use of carburetor heat requires constant monitoring to preclude exceeding CAT limits. Allow 15 seconds delay for actuation of the door system to each position.

*33. Mixture controls – IDLE CUT-OFF. P

*34. Throttles – CRACKED. P

*35. Propeller levers – FULL INCREASE. P

*36. Manifold pressure – CHECKED. P
Check gage reading and state inches of Hg.

*37. Crew Briefing – COMPLETED. P

STARTING ENGINES.

The co-pilot will start the right engine and the pilot will start the left engine. It is recommended that the right engine be started first.

*1. Propellers clear, fire guard posted. P, CP

*2. Fuel booster pump switch (if installed) – ON: or wobble pump (if installed) – Operate. Operate until fuel pressure gage indicates 3 psi. P, CP

*3. Starter switch – ENGAGE. P, CP

NOTE

To clear the engine and insure proper lubrication, pull the propellers through 15 blades with continuous starter operation. Fifteen blades are required for any start made after a 2-hour shutdown period. Eight blades will insure elimination or detection of hydraulic lock of engine starts made within 2 hours of last shutdown. If inertia starters are installed and the engine has been shut down 2 hours or more, the propeller will be turned through with the starter. The starter will be used as a direct cranking starter, using the energize and mesh switches simultaneously.

*4. Ignition switch – BOTH. P, CP

*5. Prime – AS REQUIRED. P, CP

CAUTION

If the engine does not start, continuous use of the engine starter should be limited to 60 seconds. Allow 5 to 10 minute cooling periods between attempted starts.

*6. Mixture control – AUTO-RICH. P, CP.

Make transition from primer operation to carburetor operation as engine starts by moving the mixture control from IDLE CUT-OFF to AUTO-RICH, and then stop priming.

NOTE

The engine will run rough on prime only.

*7. Oil pressure – WITHIN LIMITS. P, CP

CAUTION

If oil pressure is not indicated within 30 seconds, stop the engine and determine the reason.

*8. Throttle – ADJUSTED. P, CP.

Operate the engine at 1000 to 1200 rpm until oil temperature and oil pressure are within limits.

CAUTION

Prolonged idling below 800 rpm may damage the spark plug elbow insulation, as the cylinder head temperature will rise quickly and may exceed limits.

*9. Fuel booster pump switch – OFF. P, CP

Turn the booster pump OFF after the engine is running smoothly.

*10. Fuel pressure – WITHIN LIMITS. P, CP

*11. Vacuum pressure – CHECK. P

*12. Deicer pressure – CHECK. P

*13. Hydraulic system pressure – CHECK. P

a. Test the right engine-driven pump with the landing gear lever in NEUTRAL and move the wing flap lever to DOWN.

NOTE

As the wing flaps are lowered, the hydraulic system pressure gage indication should decrease.

b. When the wing flaps have reached full down, the hydraulic system pressure should immediately increase to within limits.

*14. Gear safety pins – REMOVED. P.

Pilot will signal for ground crew to remove the safety pins.

*15. Start the left engine repeating steps 1 through 10. P

*16. External power (if used) – DISCONNECTED.

Pilot will signal for ground crew to disconnect the external power source.

*17. Battery switch – ON. P

BEFORE TAXIING.

*1. IFF/SIF – STANDBY. P

*2. Hydraulic pump selector – LEFT ENG. HYDR. SYS. – RIGHT ENG. GYRO PILOT; on modified aircraft – GYRO PILOT POSITION. P

*3. Wing flap lever – UP. P

*4. Hydraulic system pressure – CHECK. P

NOTE

As the wing flaps are raised, the hydraulic system pressure gage indication should decrease. When the flaps reach full up, hydraulic pressure should immediately increase to within limits.

*5. Inverters – CHECKED and ON. Check spare and main-on. FM, CP

*6. Radios and interphone – CHECKED. P, CP

*7. Alarm bell – CHECKED. P

*8. Deicer boots – CHECKED, then OFF. CP, P

*9. Hydraulic pump selector (on modified aircraft)– TAKE-OFF POSITION. P

10. Fuel tank selectors – CHECK. P, CP.

Check by operating the engines three minutes on all positions. Proper operation: OFF, RIGHT AUXILIARY, RIGHT MAIN, LEFT MAIN, LEFT AUXILIARY. Check cross feed if installed, then OFF.

NOTE

This check will be initiated at this point and completed prior to take-off.

*11. Engine instruments – WITHIN LIMITS. P, CP

*12. Taxi clearance – CHECK. P, CP

*13. Altimeter – SET. P, CP

WARNING

The altimeter should be checked closely to assure that the 10,000 foot pointer is reading correctly. Due to previous settings of the altimeter, the setting knob could have been rotated until eventually the numbers reappeared from the opposite side, thus indicating a 10,000 foot error.

*14. Flight instruments – CHECK. P.

Check instruments as follows:

a. Airspeed indicator – ZERO.

b. Vertical velocity indicator – ZERO.

c. Turn-and-slip indicator needle – CENTERED.

d. Directional indicators – SET AND UNCAGED.

e. Attitude indicators – SET AND UNCAGED.

f. Clock – SET AND RUNNING.

15. Ignition grounding check (idle) – CHECK. P

Pull master ignition switch OFF momentarily and note that the engines cease firing completely.

CAUTION

This check should include a check of the left and right positions of the individual ignition switches to prevent possible damage during the subsequent power and ignition check.

*16. Chocks – REMOVED. P, CP.

Upon direction of pilot ground crew will remove chocks.

*17. Gear safety pins and pitot covers – STOWED. P

*18. Doors and hatches – SECURED (door warning light OUT). CP

*19. Before taxiing check – COMPLETE. CP

TAXIING.

For Turning Radius Diagram, See Figure 2-1.

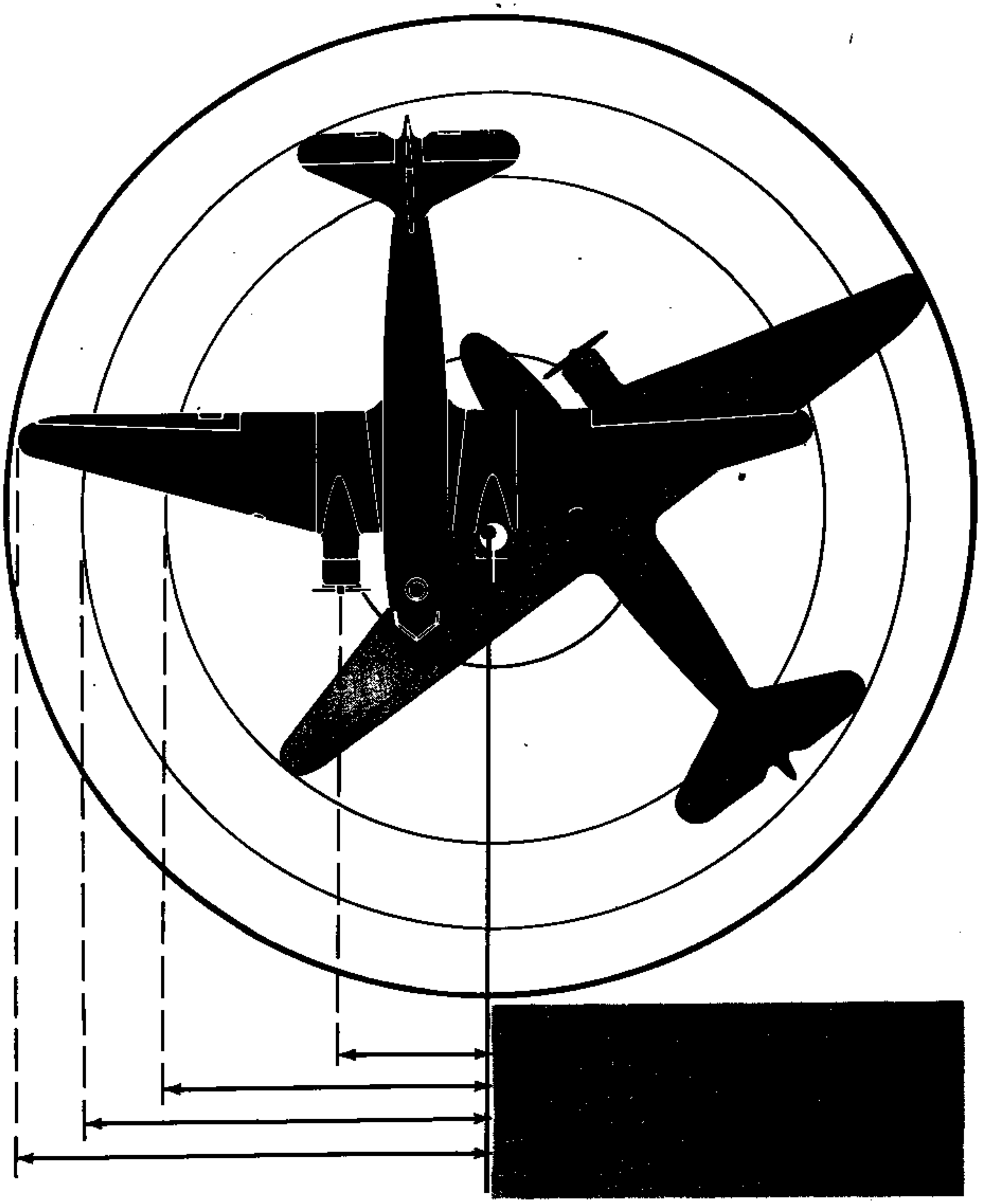
*1. Parking brake – RELEASED. P

*2. Brakes – CHECK. P, CP

CAUTION

Do not turn the aircraft with the brakes fully applied to one wheel, since this may damage the tire.

TURNING RADIUS DIAGRAM



VERTICAL CLEARANCES

PROPELLERS . . . . 12 FT 4 IN.
WING TIP . . . . 9 FT 4 IN.
FUSELAGE . . . . 16 FT. 11 1/2 IN.

Figure 2-1

*3. Tail wheel – UNLOCKED. CP, P

NOTE

Roll the aircraft forward to relieve the tail wheel locking pin from possible side load.

*4. Flight instruments – CHECK. P, CP

*5. Hydraulic pressure – MONITOR. CP

TAXIING WITH SKIS.

A. Considerably more power is necessary to keep the aircraft moving during taxiing in snow. The control column should be held back firmly, the flaps should be up at all times, and taxiing should be done at minimum speeds. Choose the taxi course carefully and, if possible, avoid taxiing cross drift. Avoid using excessive differential engine power since it may result in bending or breaking the skis. The aircraft should be stopped on the hardest available surface to prevent possible ski break-through or sticking. Downwind taxiing on ice should be done very slowly with the control column held well forward.

NOTE

Do not use brakes while taxiing with skis.

B. Several methods may be successfully employed for unsticking the skis; however, these methods are not completely satisfactory under all conditions and the pilot must thoroughly evaluate every situation and use good judgment in determining the method to be used. If the surface is ice and has a thin layer of snow (not more than a foot), the skis may be freed by retraction and extension. If the snow is deep and soft, a rope can be drawn back and forth under the ski. If this fails to free the ski, it may be necessary to dig the snow from under the wheels, insert a support under the wheels, and then dig the snow from under the skis. Care should be exercised to insure that the supports used under the wheels do not damage the tail surfaces when taxiing off.

C. Maximum power may be required to start the aircraft moving, particularly if heavily loaded. Always insure that the engines have reached proper operating temperatures and the oil is warm enough to use high throttle settings before attempting to taxi. If it is difficult to break the aircraft free, use a simultaneous back and forth rocking of the control column with application of right and left rudder, while applying sufficient throttle to break the aircraft loose. This method should be used only when absolutely necessary; caution should be exercised to prevent nose-over and tail section damage. It may be necessary to dig away more snow or ice from the sliding surfaces of the skis, or to pack the snow for a short distance forward of the skis by snowshoeing. If all else fails to free the aircraft, apply take-off power and then retract the skis. When the aircraft starts to move, place the ski selector handle in DOWN position and continue run.

CAUTION

Do not use JATO to free the aircraft.

D. After the aircraft begins to move, retard throttles as necessary to maintain desired speed. On glare ice, keep the forward speed at a minimum by intermittent applications of power. Avoid rapid opening and closing of the throttle. Use extreme care while taxiing under these conditions, particularly in strong winds. When turning out of the wind, or when operating in comparatively deep, loose snow, turns can best be accomplished by a blast of the slipstream on the rudder while pushing forward on the control column to take as much weight off the tail as possible without nosing up. Excessive power during turns will cause a more or less lateral drifting to the outside of the turn. This may be dangerous if the outside ski tends to dig in, or strikes a hard drift or hidden rock. Excessive speed during a turn from downwind to upwind during good sliding conditions will result in an exaggerated lateral movement. If it is desired to make a small radius turn, it is advisable to remove the tail ski bungee cord, if attached. When making turns on deep snow, difficulty in maintaining forward speed may be experienced. This is caused by too great a reduction of power on the engine inside the turn. It is generally necessary to retain about half throttle in order to prevent the aircraft from stopping. An accepted procedure is to follow the form of an octagon rather than a circle when executing turns under difficult conditions.

CAUTION

If taxiing is necessary for an extended period, use caution to prevent overheating of the engines, especially when snow conditions require high power settings for taxiing.

ENGINE RUNUP.

If possible, head the aircraft into the wind for runup. If the aircraft is not headed into the wind the power and magneto check may be affected. Maintain controls in a neutral position during runup.

*1. Tail wheel – LOCK. CP, P

*2. Parking brakes – SET. P

*3. Manifold valves – BLEED. P

*4. Engine instruments – WITHIN LIMITS. P, CP

CAUTION

Cooling of the cylinder heads, barrels and ignition harness is insufficient for prolonged periods of ground operation above 1400 rpm. Do not allow cylinder head temperature to exceed 232°C. See Section V.

*5. Fuel tank selectors – MAIN OR FULLEST TANK, cross feed – OFF. P, CP

*6. Propellers – EXERCISED. P

With engines operating at 1700 rpm, move propeller controls to DECREASE RPM, then to full INCREASE RPM (minimum governing speed is 1200 rpm). Repeat this procedure three times during cold weather.

*7. Generators – CHECK. CP

Check ammeters for parallel; check paralleling during rpm decrease and increase.

*8. Fluxgate compass – CAGED. P

9. Propeller feathering check (1700 rpm) – CHECK. P, CP

Push right feathering button and allow for 200 rpm drop, then pull out feathering button (check ammeter for change during feathering). Check left propeller feathering using same procedure.

10. Two-speed supercharger (if installed and operative) – CHECK. P

a. This test is made to desludge and to check the operation of the blower mechanism. Set the throttles to 1700 rpm. Oil pressure should indicate at least 40 psi. Shift to HI BLOWER position and at the same time watch for a momentary drop in oil pressure, and check the manifold pressure gage to make certain the manifold pressure does not drop. (Prolonged fluctuation or loss of manifold pressure indicates improper clutch engagement. In this case, return the supercharger control to LOW BLOWER, reduce engine speed to 1000 rpm, and repeat the test.) While in HI BLOWER, open throttles to obtain manifold pressure slightly below that prescribed for cruising, with engines running at not more than 2000 rpm. Lock the throttles at this setting and make certain the oil pressure, cylinder head temperature and fuel pressure are within limits. Immediately shift to LOW BLOWER without hesitation (in order to avoid dragging or slipping the clutches) and at the same time observe the manifold pressure gage for a sudden pressure drop.

NOTE

If malfunction is suspected allow two-minute clutch cooling period prior to recycling.

11. Propellers – EXERCISED. P

To insure warm oil for propeller governing by replacing cold oil put in by feathering action.

12. Carburetor air and deicer alcohol – CHECK. P, CP

a. Carburetor air – HOT. Note increase on carburetor air temperature gage.

b. Carburetor deicer alcohol – ON.

Note decrease on carburetor air temperature gage; then OFF.

c. Return carburetor air to RAM.

*13. Power and ignition check – CHECK. P, CP

a. Power and ignition check: This check will be performed on one engine at a time to prevent nose-up and brake slipping accidents. Retard one throttle to 1000 rpm, and advance opposite throttle to a manifold pressure equal to field barometric pressure. Tachometer should read 2450 ± 50 rpm on aircraft equipped with paddle blade propellers and 2350 ± 50 rpm on aircraft equipped with narrow blade propellers. Turn the ignition switch from BOTH to LEFT then back to BOTH, and from BOTH to RIGHT, then back to BOTH pausing at each position to allow rpm to stabilize. Observe rpm drop (65 rpm maximum, 25 rpm normal). Retard throttle to 1000 rpm, and repeat check on other engine. If rpm drop exceeds 65 rpm on either magneto of either engine, the difference in drop between magnetos on either engine exceeds 40 rpm, or excessive engine vibration exists, shutdown the engines and inspect for malfunction.

NOTE

- The limits for the above power check are desirable; however, unpredictable local conditions may cause the tolerances to be exceeded even though the propeller-engine combination is performing satisfactorily.

- When heading into the wind, add approximately two rpm for each one mph wind velocity; when tailing into the wind, subtract approximately 2 rpm for each one mph wind velocity. Crosswinds will cause buffeting and rpm surging.

CREW BRIEFING-TYPICAL.

Crew briefing – COMPLETE. The pilot will brief the co-pilot, navigator (if applicable) and flight mechanic on the following:

a. Type takeoff (normal, minimum run, JATO etc.).

b. Power application and abort procedures.

c. Oral and visual signals for gear retraction.

d. Emergency procedures.

e. Departure instructions.

BEFORE TAKE-OFF.

1. Supercharger handle (if installed) – LOW BLOWER. P
2. Wing flaps – UP. P
3. Engine and flight instruments – CHECKED. P, CP
4. Hydraulic pressure – WITHIN LIMITS. P
5. Cowl flaps – TRAIL. CP
6. Carburetor air – RAM/CLIMATE. CP, P

CAUTION

The use of carburetor heat requires constant monitoring to preclude exceeding CAT limits.

7. Mixture controls – AUTO-RICH. P
8. Propeller controls – FULL INCREASE. P
9. Trim – AS REQUIRED. P
10. Autopilot – OFF. P
11. Cross feed – OFF. CP (SC-47 only)
12. Flight controls – CHECK FOR FREEDOM OF MOVEMENT. P
13. Take off clearance – OBTAINED. CP
14. Crew briefed and passengers checked. Take-off and landing data card reviewed. P
15. Fuel booster pump switches – ON. CP
16. Windshield wipers and defrosters – CLIMATIC. P, CP
17. Pitot heat – CLIMATIC. CP
18. Anti-icers – CLIMATIC. CP
19. Landing lights – CLIMATIC. P, CP
20. Anti-collision light – CLIMATIC. P
21. IFF/SIF – AS REQUIRED. CP
22. Throttle friction lock – ADJUSTED. P
23. Tail wheel – LOCKED. CP, P

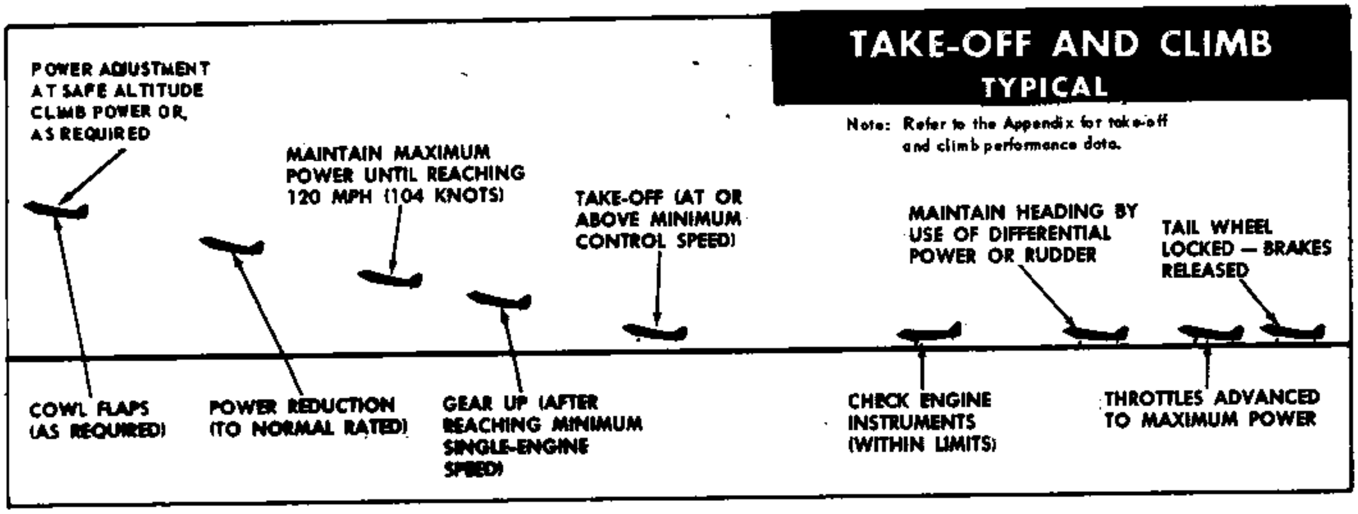


Figure 2-2

TAKE-OFF AND CLIMB. (See figure 2-2.)

Release brakes and advance throttles to maximum power. Check instruments within limits after power application and after engine instruments have stabilized. As the brakes are released, a slight change in heading may occur; correct by use of differential power or rudder application. It is recommended that brake application, to maintain directional control, be used only when absolutely necessary. Allow the aircraft to accelerate without operating the elevator control, and the tail will rise to level flight attitude between 43 and 52 knots (50 and 60 mph). Continue accelerating and allow the aircraft to fly off at minimum control speed or higher.

1. Landing gear – RETRACT. CP
   a. Landing gear latch lever – LATCH RAISED.
   b. Landing gear lever –UP.
   c. Landing gear lever – NEUTRAL, after gear is fully retracted.

NOTE

The landing gear latch lever will automatically return to SPRING LOCKED position.

2. METO Power – 42.5" HG. 2550 RPM. CP
3. Landing lights (if used) – OFF. P, CP
4. Climb power – 36" HG 2350 RPM. CP

NOTE

86 per cent METO power is recommended during climb to prevent high CHT; however, lower powers may be used when necessary.

5. Cowl flaps – ADJUSTED. CP

NOTE

If CHT cannot be maintained within limits during climb by adjustment of the cowl flaps, increase airspeed or adjust power as necessary.

6. Engines, wings, and fuel syphoning – CHECK. FM.
7. APP (If installed) – OFF. FM
8. No smoking and fasten seat belts signs – AS REQUIRED. CP, P
9. Fuel booster pump switches (if installed) – OFF. CP

Check fuel pressure and turn fuel booster pumps off, one at a time after reaching a safe altitude (1000 feet).

MINIMUM RUN TAKEOFF/JATO TAKEOFF.

The minimum run takeoff technique described here will produce the results stated in the takeoff charts in the Appendix. For minimum run takeoff, hold the brakes on and apply maximum power. Holding back pressure on the column, release the brakes, and gradually release back pressure on the control column. At approximately 39 knots (45 mph), lower ¼ flaps, keeping the aircraft in a tail low attitude.

The aircraft will become airborne at 52 to 61 knots (60 to 70 mph). When the aircraft is safely airborne, the gear should be raised and normal climb established. If JATO is being used, best results are obtained if the jet assist is fired at approximately 30 knots (35 mph).

WARNING

Lift-off can be made at speeds less than minimum control speed; however, it must be remembered that in the event of engine failure, under these conditions, power will have to be reduced on the operative engine to maintain directional control.

1. Perform "Before Takeoff" - CHECK. P, CP
2. Passengers and baggage - READY FOR TAKEOFF. FM
3. JATO Master switch - ON. P
4. Brakes - ON. P
5. Power - 48" HG MAXIMUM. P
6. Power output - CHECKED. CP, P
7. Brakes - OFF. P
8. JATO - FIRE AT OPTIMUM SPEED. P
9. Wing flaps - ¼ DOWN at approximately 39 knots (45 mph). CP
10. Landing gear lever - UP - on order. CP
11. Flap lever - UP at 87 knots. CP

CAUTION

Expended (fired) JATO units should not be jettisoned until the aircraft is airborne. If JATO units are dropped before the aircraft is airborne, varying degrees of fuselage damage will result, depending upon the attitude of the aircraft and the type of runway surface being utilized.

OBSTACLE CLEARANCE.

Use the minimum run takeoff procedure. Climb at 76 knots (88 mph) with maximum power and wing flaps set at ¼ until the obstacle is cleared. When the obstacle is cleared, increase airspeed to 87 knots (100 mph), and retract the wing flaps, increase airspeed to 104 knots (120 mph) and reduce power to METO. Drop JATO (if used), JATO master switch off, and proceed with normal climb.

CROSS-WIND TAKEOFF.

Before takeoff, refer to the takeoff and landing crosswind chart and determine the minimum liftoff speed. Liftoff should be made at the speed computed from the takeoff and landing crosswind chart or minimum single engine speed, whichever is greater. In a crosswind condition, roll aileron into the wind and apply power as for a normal takeoff. Differential power may be necessary to maintain directional control. Should this be necessary, retard the desired throttle and reapply it as is required to maintain directional control. The tail should be raised as soon as rudder control becomes effective to lessen the possibility of the upwind wing rising before the downwind wing. As speed is increased, the amount of aileron displacement should be gradually reduced, but keep some control applied until ready to lift off. The aircraft should be lifted off at the computed lift off speed. When safely airborne, apply sufficient drift correction to maintain a track over the runway.

NOTE

It is recommended that brake application, to maintain directional control, be used only when absolutely necessary.

SKI TAKE-OFF.

The ski take-off is similar to the normal wheel takeoff. The run may be longer depending upon prevailing sliding conditions and the gross weight of the aircraft. Take-off from hard-packed snow or rough ice will neccessitate variations to fit the individual case. If the wind is not too strong and the snow is wind-packed in drifts, line up parallel to the drifts (drifts usually follow a definite pattern as a result of prevailing winds).

NOTE

Depending upon snow conditions, it may be advisable to prepare several tracks along the proposed take-off course by taxiing over the length of the run several times prior to takeoff. This procedure will assist in shortening the take-off run.

After starting the take-off ground run, it is recommended that the wing flaps be lowered to ¼ DOWN. If there is possibility of damaging the flaps by flying chunks of snow or ice, they may be left in the UP position until an airspeed of 35 knots (40 mph) is indicated. To preclude the possibility of nose-over, the entire ground run should be made in a 3-point or tail low attitude. Excessive back pressure on the control column will cause the tail wheel to dig in and increase drag. Do not force the aircraft into the air; if it bounces off and is not ready to fly, allow the aircraft to settle back. Maintain directional control by use of the rudder (torque will be more noticeable during the ski take-off than during a normal wheel take-off on a hard surface).

NOTE

If take-off is attempted on rough snow or ice, severe strain and buffeting will be sustained by the aircraft. Therefore, the best procedure to use is the one which will get the aircraft off as soon as possible. Normally 45 inches MP is used.

After becoming airborne, relax back pressure immediately and continue accelerating until a safe airspeed is attained. The flaps should be "milked up" between 70 and 96 knots (80 and 110 mph). The landing gear should be raised as soon as the skis have been retracted. The climb procedure should be the same as for normal climb.

CAUTION

Check that the skis are UP before raising the gear. To prevent damage to the cowling, ski retraction should be made at 100 to 104 knots (115 to 120 mph). If the skis do not completely retract against the cowl, slow the aircraft slightly to allow the skis and gear to retract.

NOTE

Approximately 20 seconds should be allowed for the retraction of the skis prior to raising the gear. The hydraulic pressure gage will provide indication when the skis stop traveling. Place ski selector in NEUTRAL after skis are fully retracted.

CRUISE.

Level off upon reaching cruising altitude and maintain the climb power setting until the desired cruising airspeed is attained. Refer to the Appendix and set power to obtain the cruise conditions desired. For Supercharger Operation, refer to Section VII.

1. Cruise power – SET. CP
2. Engine instruments – WITHIN LIMITS. CP
3. Mixture controls – AS REQUIRED. CP
4. Cowl flaps – AS REQUIRED TO OBTAIN INFLIGHT CHT. CP

FLIGHT CHARACTERISTICS.

Refer to Section VI for detailed information on aircraft flight characteristics.

DESCENT.

The rate of descent is determined by altitude, distance from the field, terrain, and weight of the aircraft. The rate of descent should be held constant.

CAUTION

If flying conditions in descent require a large reduction in power, reduce rpm as well as manifold pressure. For descents or other low power maneuvers, or perhaps a simulated engine failure, 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. As a rule of thumb, it is well to remember that each 100 rpm requires at least 1 inch Hg manifold pressure; for example, 23 inches Hg at 2300 rpm. Operation at high rpm and low manifold pressure should be kept to a minimum.

1. Approach and landing data –CHECKED. P, CP

Check landing gross weight, altimeter setting, approach minimums, field elevation, and wind conditions.

2. Passengers – BRIEFED. P
3. Fuel tank selectors – FULLEST TANKS. P, CP

4. APP (if installed) – START. FM

5. Autopilot – OFF. P

6. Hydraulic fluid level – CHECK. CP, FM

7. Superchargers (if installed) – AS REQUIRED. P

BEFORE LANDING.

1. No smoking and fasten seat belt signs – ON. CP, P

2. Deicer boots – CLIMATIC. CP

3. Carburetor air – RAM/CLIMATIC. CP, P

CAUTION

The use of carburetor heat requires constant monitoring to preclude exceeding CAT limits.

4. Carburetor deicer alcohol – CLIMATIC. CP

5. Heaters – CLIMATIC. CP, FM (SC-47 only)

6. Fuel booster pump switches – ON. CP

7. Mixture controls – AUTO-RICH. CP

8. Propeller controls – 2350 RPM. CP

9. Landing gear controls – DOWN and POSITIVE LOCK. CP

When the landing gear has reached the extended position and landing gear hydraulic pressure has built up to 850 psi, move the landing gear lever rapidly to NEUTRAL, check the green indicator light ON, and the red warning light OFF. Position the landing gear latch control to POSITIVE LOCK and visually check that the gear is down.

10. Ski selector handle (if installed and required)– DOWN and NEUTRAL. P

11. Wing flaps – AS REQUIRED. CP

12. Landing lights – CLIMATIC. CP, P

NOTE

After established on final and prior to touchdown, props full increase rpm.

LANDING.

Normal Landing. (See figure 2-3.)

Touch down main wheels first in a slight tail low attitude. When the main wheels contact runway, check power off, relax pressure, flaps up. As the aircraft decelerates, lower the tail wheel gently on the runway. Maintain directional control utilizing rudder, differential power, and brakes, as necessary. Maintain back pressure on column until landing roll is completed. When landing at gross weights above 26,000 pounds, touch down at less than 300 fpm rate of descent in a tail-high attitude.

CAUTION

- Landing gross weight should be limited on the basis of single-engine performance in the same manner that weight is limited for takeoff. At high temperature or elevations, adequate single-engine performance is assured only if the airplane is operated in accordance with performance charts in the Appendix.

- 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. Heavy brake pressure can result in locking the wheel more easily immediately after touchdown, than when 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 the brake pressure is maintained. Proper braking action cannot be expected until the tires are carrying heavy loads.

CROSS-WIND LANDING.

NOTE

Landing distance over a 50-foot height and landing ground roll will be increased during crosswind landings. Refer to the Takeoff and Landing Crosswind Chart in the Appendix, and determine the minimum touchdown speed.

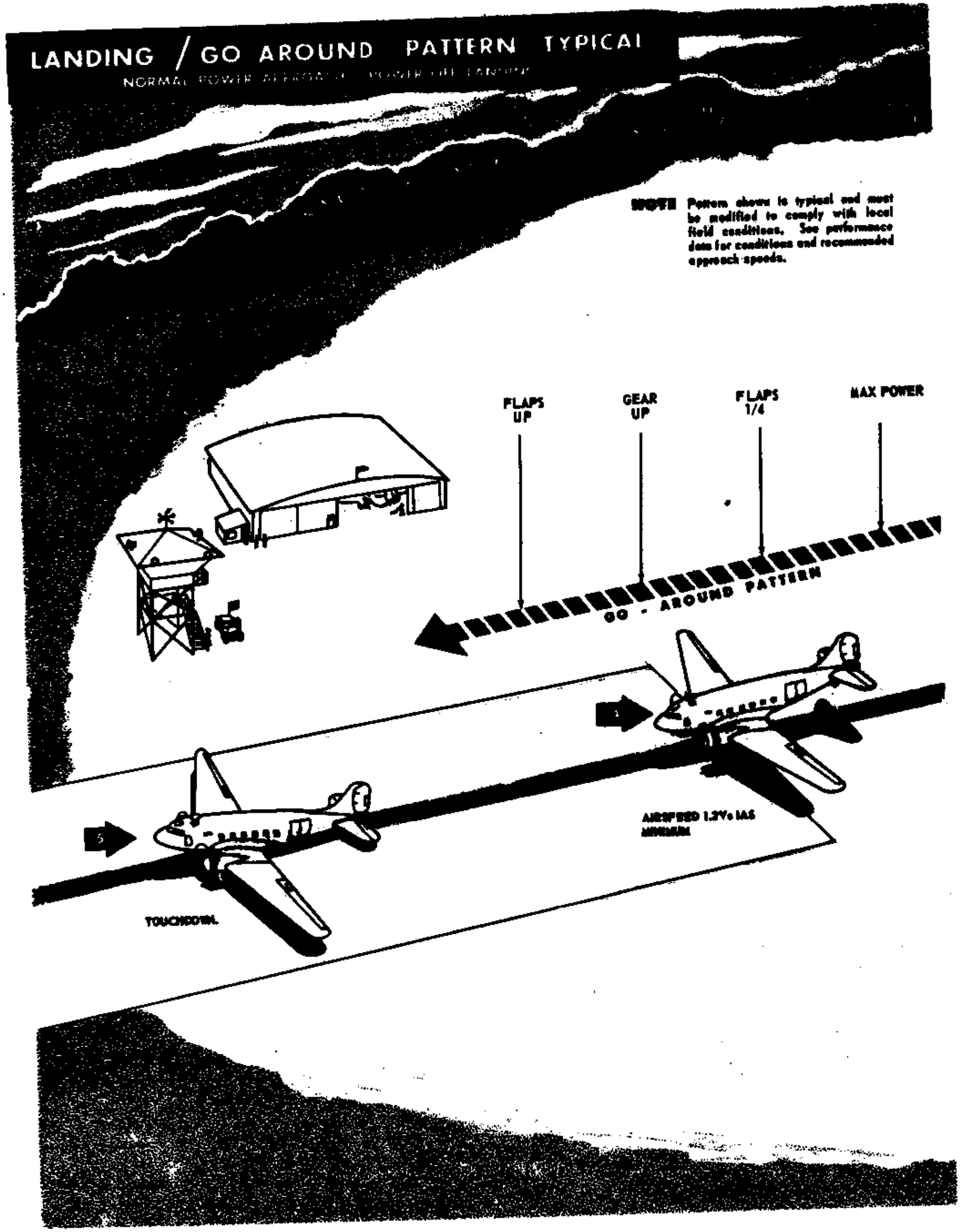


Figure 2-3 (Sheet 1 of 2)

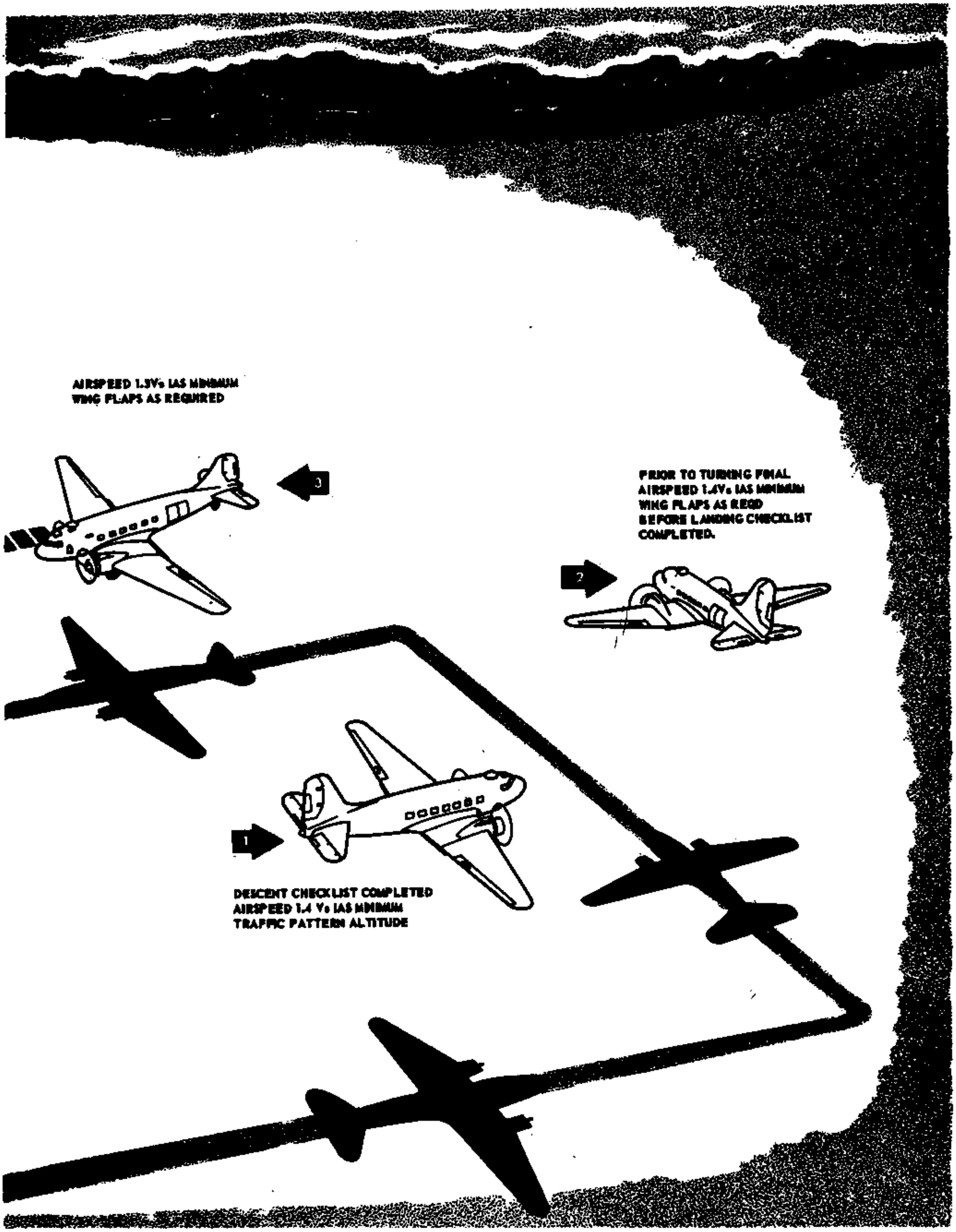


Figure 2-3 (Sheet 2 of 2)

On final approach, use half flaps or less during the approach and touchdown, using a combination of drift correction and wing-down to keep aligned with the runway. When the wind is gusty, increase the final approach speed approximately 8 knots (10 mph). At approximately 100-200 feet above the runway, align the nose of the airplane with the runway with rudder control and increase the amount of "wing-down" into the wind. When the normal flare-out point is reached, slow the airplane to minimum touchdown speed and decrease the rate of descent. Allow the airplane to fly onto the runway at the minimum touchdown speed. Do not allow the airplane to touchdown in a lateral drift; keep the nose aligned with the runway by use of rudder control, and compensate for drift across the runway by increasing or decreasing the amount of wing-down correction. When the wheels contact the runway, ease the control column forward slightly, flying the downwind wheel onto the runway. Adjust the power of the upwind engine as necessary and direct the co-pilot to raise the flaps. Gradually increase the amount of aileron pressure into the wind as the airplane decelerates. Maintain directional control with rudder, differential power and brakes.

MINIMUM RUN LANDING.

The procedure for a minimum run landing is the same as for a normal power-on approach - power-off landing, except for the following differences: Under most minimum run landing conditions, it is preferable to make a wheel landing rather than a 3-point landing. A wheel landing allows better control for immediate use of brakes to come to a quick stop. Retract the wing flaps immediately upon contact with the ground. This will prevent the aircraft from leaving the ground again and thus make the brake more effective.

CAUTION

Caution should be exercised when using this technique on sod fields since the possibility of locking a wheel and digging in exists.

SKI LANDING.

Determination of snow and ice conditions should be made before making a ski landing. The proposed landing site should be dragged at low altitude and a landing should not be effected until the pilot determines that the surface conditions will afford a landing consistent with safety and the urgency of the mission.

Normal procedure is used on approach and landing. Snow conditions generally result in a much shorter landing slide than the normal landing; however, sufficient space should be allowed for landing slide and taxiing. A reference point should be picked to aid in maintaining direction. It is recommended that half flaps be used; however, this may vary depending upon surface conditions. If the surface is rough, there is less risk of flap damage when less flaps are used. The skis should be extended as soon as the landing gear has been lowered. All ski landings should be made tail low, slightly above stalling speed. The round out should be started slightly high to minimize the danger of snubbing the skis. Immediately upon touchdown, reduce power, hold the control column full back and raise the flaps as soon as possible.

When landing with low visibility and no horizon, depth perception is difficult especially when no visual reference points are available. Under these conditions, it is necessary to establish a constant rate of descent and attitude with the use of power and "fly on" at a slow sinking rate until contact with the surface is made in the tail low (3-point) landing attitude.

NOTE

Under average load conditions with gear and skis down and half flaps, a descent of approximately 300 feet per minute at an airspeed of 78 to 82 knots (90 to 95 mph) is recommended.

After landing, the aircraft should not be parked until the skis are allowed to cool. This can be accomplished by stopping for a few minutes, then moving forward and stopping again. This procedure can be repeated until the skis have cooled completely.

LANDING ON SLIPPERY RUNWAY.

Wet Landing.

Generally, if a runway is well drained, a normal landing can be executed. However, if the runway contains low spots or is covered with water of undetermined depth, use reduced wing flap settings to prevent damage to the flap surfaces. If the runway is slippery, or water conditions are such that directional control of the aircraft might be difficult, use rudder and differential power to maintain directional control. During initial phase of the landing ground roll, use brakes cautiously and only when necessary. Overuse of the brakes could result in a locked wheel and an uncontrollable skid. Brakes should be applied intermittently with equal pressure.

Landing On Icy Runway.

NOTE

If operation on icy runway is anticipated, the aircraft should be equipped with ice grip tires if possible.

Landing on ice-covered runway is considered hazardous and should be attempted only when necessitated by the nature of the mission.

AFTER LANDING.

1. Wing flaps – UP, then NEUTRAL after checking indicator. CP
2. Cowl flaps – OPEN, then OFF. CP
3. Tail wheel – UNLOCKED. CP, P
4. Fuel booster pump switches – OFF. CP
5. Hydraulic pressure – CHECK. CP
6. Anti-icers – OFF. CP
7. Trim – NEUTRAL. CP
8. Radios – All unnecessary radio equipment OFF. CP
9. Anticollision light – OFF. P
10. IFF/SIF – CFF. CP
11. Heaters – OFF. FM, CP

TOUCH AND GO LANDINGS.

CAUTION

Touch-and-go landings introduce a significant element of risk because of the many rapid actions which must be executed while rolling on the runway at high speed. Furthermore, because of the varied technique that may be used, it is impossible to predict with accuracy the length of runway that will be required. Touch-and-go landings should be made only when authorized or directed by the major command concerned. Before starting the final approach, brief the co-pilot to assure that he knows his duties. Use the approach and landing procedure for the type landing desired.

When the airplane is on the runway, the co-pilot accomplishes the following:

1. Wing flaps – UP. CP
2. Propeller controls – FULL INCREASE. CP
3. Elevator trim – ZERO. CP
4. Cowl flaps – TRAIL. CP

The co-pilot advises the pilot when these actions are completed. The pilot then advances power and continues with a normal takeoff.

CAUTION

If power is applied rapidly at a high airspeed, propellers may overspeed. To avoid exceeding limits, advance throttles slowly until the governors "stabilize", then advance power normally.

For AFTER TAKEOFF – CLIMB and BEFORE LANDING (after touch and go), normal procedures apply.

TWO-ENGINE GO-AROUND.

If the pilot considers it necessary to make a go-around, he will accomplish the following:

a. Give the command, "Go around", to the co-pilot.

b. Open the throttles to power as required.

c. At the pilot's direction the co-pilot will position the flaps at ¼, provided more than ¼ flaps were extended at time of decision to go around.

d. As soon as the pilot determines that the aircraft will not be touched down, or after breaking ground if contact is made, he will direct the co-pilot to retract the landing gear.

e. Accelerate to best climb speed (104 knots or 120 mph).

f. After the aircraft has reached safe speed, the pilot will direct the co-pilot to retract the remaining ¼ flaps.

g. The co-pilot will position the cowl flaps to TRAIL.

h. Proceed with normal takeoff.

POST FLIGHT ENGINE CHECK.

Following the final flight of the day and before engine shutdown, perform the following checks for the purpose of determining and reporting any malfunctioning system or units. These checks should be made with the aircraft headed into the wind.

1. Tail wheel – LOCKED. CP, P

2. Parking brake – SET. P

3. Idle speed and mixture check – CHECK. P

   a. Propeller control – FULL INCREASE.

   b. Cylinder head temperature – WITHIN LIMITS.

   c. Oil temperature – WITHIN LIMITS.

   d. Mixture control – AUTO-RICH.

   e. Throttle – IDLE RPM (500 rpm ± 50).

   f. Move mixture control slowly and evenly toward IDLE CUT-OFF.

   NOTE

   "Slowly" may be defined as the rate of movement which would require 12 to 15 seconds to move the mixture control lever from AUTO-RICH to IDLE CUT-OFF position. This slow movement of the lever is necessary so that the engine can respond to the change in fuel-air ratio and an accurate reading can be obtained as the best power mixture is reached.

   g. If a rise of more than 10 rpm or a drop in manifold pressure exceeding ¼ inch Hg is noted, the IDLE rpm fuel-air ratio is too rich. If no rise in rpm is noted, the IDLE rpm fuel-air ratio is too lean. After maximum rpm rise has been obtained and rpm starts to decrease with further movement of the mixture control, return the mixture control to AUTO-RICH position.

   NOTE

   The IDLE rpm fuel-air ratio must check according to the above procedure to prevent spark plug fouling.

4. Ignition grounding check – CHECK. P

Perform ignition grounding check as shown under Before Taxiing.

5. Bleed manifold pressure – STATION PRESSURE NOTED. P

6. Power and ignition check – CHECK. P

Perform Power and Ignition Check as outlined under Engine Runup.

CAUTION

Heat damage to ignition system components and oil seals may result if engines are shut down when CHT is above 200°C. If necessary run engine at 1200 rpm to lower CHT.

ENGINE SHUTDOWN.

1. Tail wheel – LOCKED. CP, P

2. Parking brakes – SET. P

3. Throttles – 1200 RPM. P

4. Oil dilution – CLIMATIC. CP, P

5. Inverters – OFF. FM, CP

6. Right engine mixture control – IDLE CUT-OFF (Do not advance throttle). P

7. Vacuum and deicer pressure – CHECK. P, CP

8. Left engine hydraulic check (on modified aircraft only) – CHECK. P

Perform hydraulic check for left engine-driven pump as outlined in step 13 under Starting Engines.

9. Left engine mixture control – IDLE CUT OFF (do not advance throttle). P
10. Ignition switches – OFF. P
11. Radio equipment – OFF. P, CP

BEFORE LEAVING AIRCRAFT.

1. Fuel tank selectors – OFF. P, CP
2. Carburetor air – FILTER/CLOSED. CP
3. Hydraulic controls – SET. P, CP
   a. Landing gear lever – DOWN.
   b. Wing flap lever – UP.
   c. Cowl flaps – AS REQUIRED – OFF.
4. Wheel chocks – IN PLACE AND BRAKES RELEASED. P, CP
5. APP (if installed) – OFF. FM
6. All switches (except generator switches) – OFF. P, CP
7. Form 781 – COMPLETED. P

CAUTION

In addition to the established requirements for reporting any system defects, unusual and excessive operations, the flight crew will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.

8. Windows, hatches, and doors – SECURED. P, CP, FM
9. Gear safety pins, control surface locks, and pitot covers – INSTALLED. FM

NOTE

On aircraft equipped with skis, when parking overnight or for longer periods, place some suitable protection under the skis to prevent their freezing fast.

ABBREVIATED CHECKLIST.

Your normal abbreviated checklists are now contained in T. O. 1C-47-CL-1-1, -2, -3, -4, and -5.

SECTION III

EMERGENCY PROCEDURES

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INTRODUCTION.

This section describes procedures for meeting emergencies that can reasonably be expected to occur. No attempt has been made to cover every conceivable malfunction or emergencies that are complicated by failure of other systems. A sound knowledge of these procedures and the basic airplane systems will, however, provide the necessary background to properly evaluate and cope with multiple emergencies and those situations not covered herein.

In any emergency situation, contact should be established with an appropriate ground station as soon as possible after completing the initial corrective action. Include position, altitude, course, ground speed, and the nature of the emergency and pilot's intentions in the first transmission, and thereafter keep the ground station informed of the progress of the flight and of any changes or developments in the emergency.

The pilot should make full use of the co-pilot and other crew members in combating an emergency so that his primary attention may be directed to the control of the airplane. Although certain items require immediate action, the difficulty may be compounded by hurried commands to the crew. Analyze the situation carefully before taking any corrective action and give the proper commands clearly and

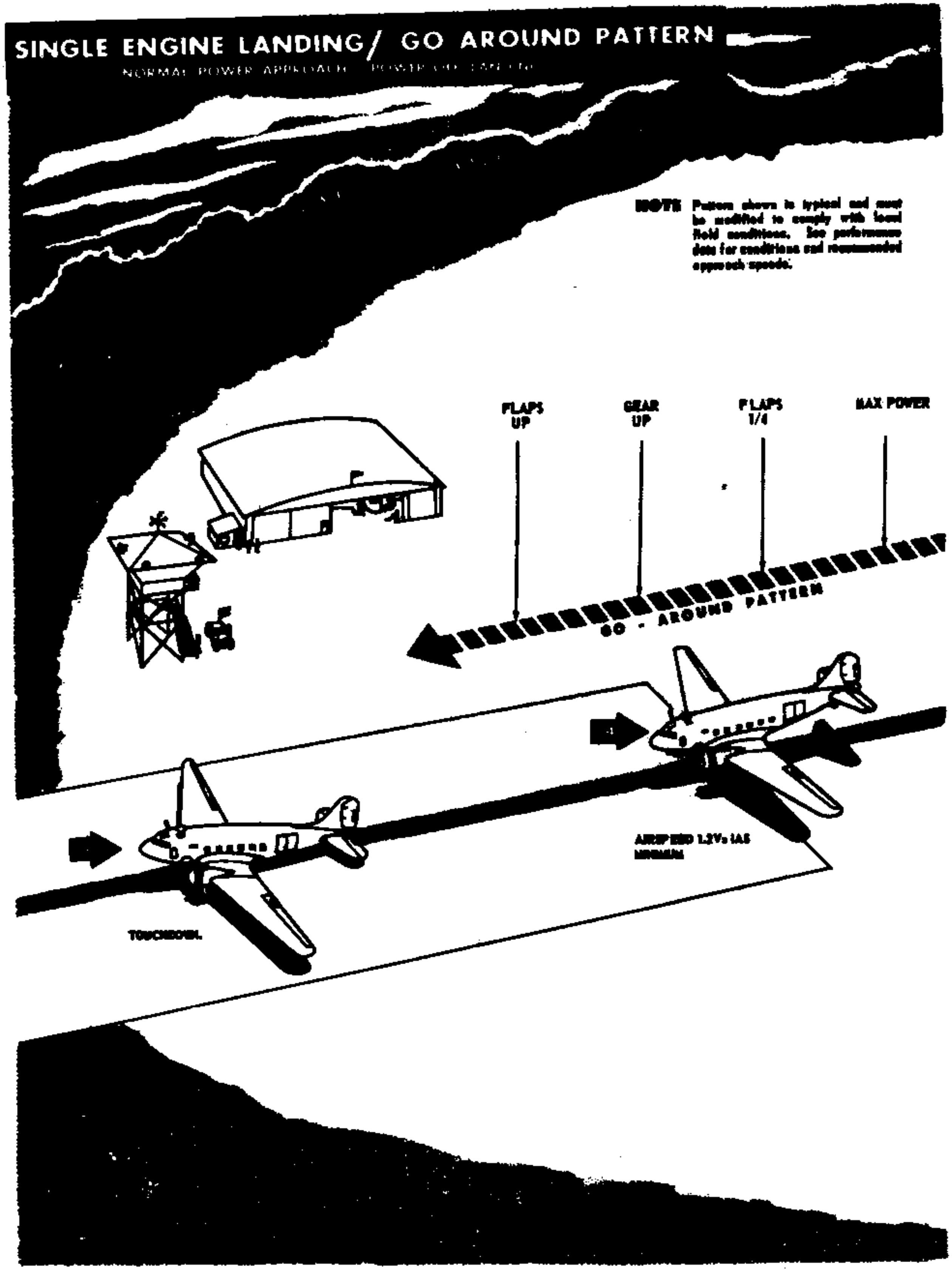


Figure 3-1. (Sheet 1 of 2).

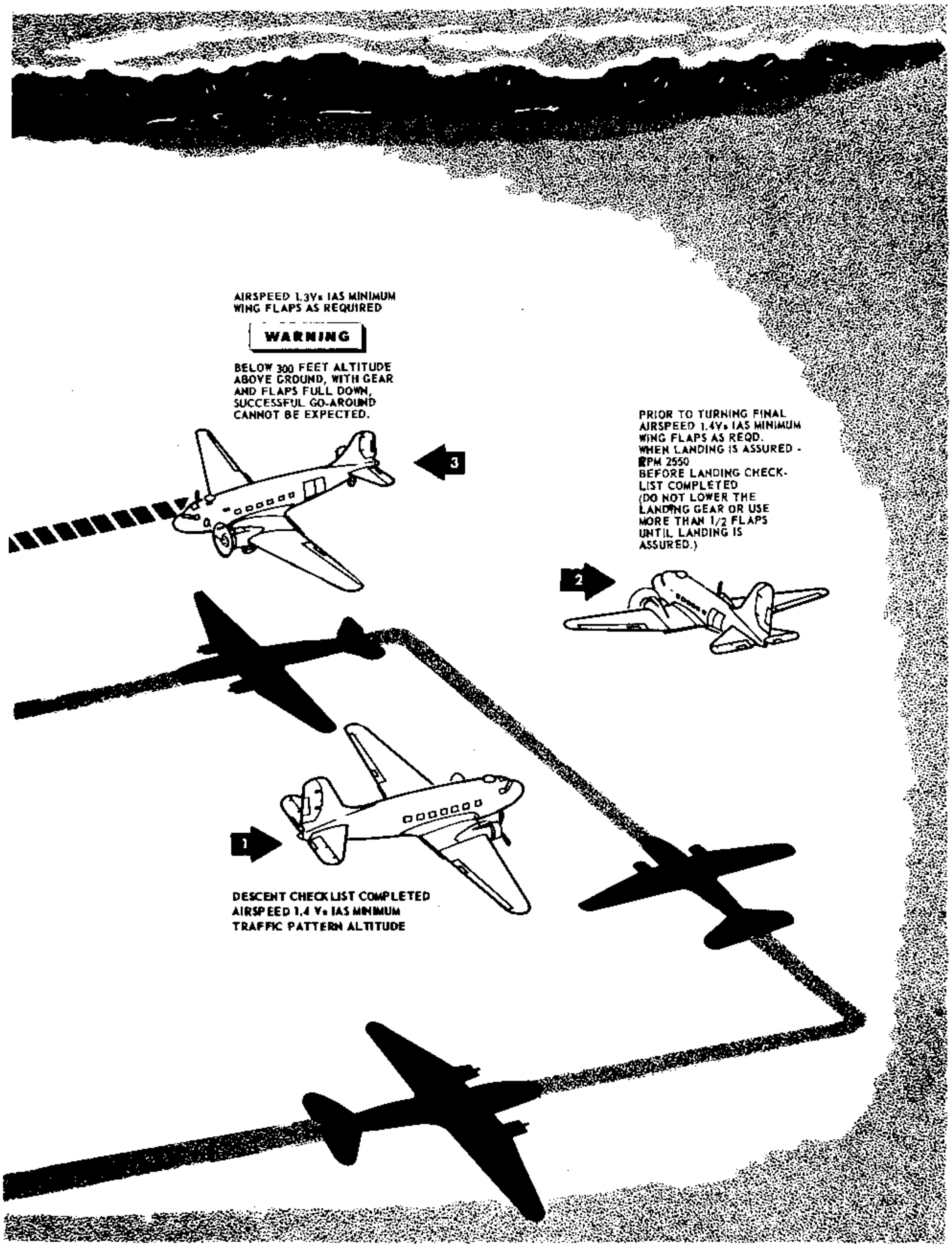


Figure 3-1. (Sheet 2 of 2).

concisely, allowing time for acknowledgement and execution before issuing further instructions. Certain actions are of such urgency that they must be performed immediately, from memory, to prevent further damage and avoid aggrevating the emergency. These "Immediate Action" items are printed in bold face capital letters. The remaining steps are considered to be less urgent and must be accomplished by direct reference to the checklist.

ENGINE FAILURE.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS.

With the proper understanding of single-engine procedures and single engine flight principles, the aircraft can be flown and landed safely with one engine inoperative. Single engine performance is reduced during operation at high altitude, high temperature, and high humidity. The maximum gross weight that will permit safe operation will vary widely. You must therefore, consider the effect of non-standard atmospheric conditions upon the performance of the airplane prior to flight and adjust the gross weight to provide adequate single-engine performance, not only for takeoff, but also for enroute terrain clearance and landing. The propeller of the inoperative engine must be feathered for the airplane to obtain the results shown in the single-engine performance charts. If the propeller is not feathered, the best that can be expected is a controlled descent.

MINIMUM CONTROL SPEED.

Minimum control speed (MCS) is that speed required to provide sufficient control to enable the airplane to fly a straight flight path over the ground when one engine has failed. This MCS is based on takeoff configuration, propeller on dead engine windmilling, with takeoff power on the good engine and no more than 5 degrees of bank angle away from the failed engine. It may be necessary to sacrifice altitude for airspeed while putting the aircraft in a clean configuration and obtaining sufficient airspeed to climb.

NOTE

MINIMUM CONTROL SPEED in flight is 76 knots (88 mph) IAS.

SAFE SINGLE ENGINE SPEED.

Safe single engine speed (SSE) is that speed that will permit the airplane to maintain 100'/minute rate of climb after clean configuration has been established and the propeller on the inoperative engine is feathered. See Appendix for emergency climb data.

NOTE

SAFE SINGLE-ENGINE SPEED is never less than 110% minimum control speed (84 knots IAS or 97 mph), or 110% of POWER-OFF STALL SPEED (clean configuration) for the given gross weight, WHICHEVER AIRSPEED IS THE GREATEST.

ENGINE FAILURE INDICATION.

The first indication of engine failure will probably be the change in directional trim. The aircraft has a tendency to yaw towards the failed engine. Engine failure may also be detected by the following:

A. A drop in manifold pressure, rpm, and cylinder head temperature.

B. Observing the affected engine for roughness, spewing of oil, or evidence of fire or smoke (see figure 3-4).

ENGINE FAILURE/FIRE IN FLIGHT.

(See Figure 3-4 for engine smoke and flame identification.)

WARNING

- As a result of exhaustive tests and research, it has been proven that the greatest degree of effectiveness from the fire extinguishing agent will only be attained after the propeller has been feathered. Therefore, it is mandatory that the first action that shall be taken in the event of engine fire is to actuate the feathering switch. (Accomplish item 6 through 14 prior to items 1 through 5.)

- Whenever fuel pressure drops and the engine continues to operate normally, it is mandatory that the first action that shall be taken is to move the mixture control to IDLE CUT-OFF.

- Maintain controlled flight. Advance the power on the good engine as necessary to assist in maintaining airspeed and altitude, and perform the following steps:

1. HYDRAULIC PUMP SELECTOR – OPERATIVE ENGINE.
2. LANDING GEAR – UP.
3. WING FLAPS – UP.
4. SKIS (If installed) – DOWN.
5. THROTTLE – CLOSED (Inoperative Engine).
6. PROPELLER – FEATHER.
7. MIXTURE CONTROL – IDLE CUTOFF.
8. FIREWALL SHUTOFF VALVE – CLOSED.
9. FIRE EXTINGUISHER – DISCHARGE AGENT (If fire exists).
10. COWL FLAPS – TRAIL.
11. IGNITION SWITCH – OFF.
12. FUEL TANK SELECTOR – AS REQUIRED. (SC-47 only)
13. FUEL CROSS-FEED – AS REQUIRED (SC-47 only)
14. FUEL DUMP – AS REQUIRED (SC-47 only)
15. Carburetor alcohol – OFF.
16. Propeller alcohol – OFF.
17. Booster pump switch – OFF.
18. Fuel tank selector – OFF.
19. Trim – AS REQUIRED.
20. Propeller control – DECREASE RPM.
21. Generator switch – OFF.
22. Oxygen – AS REQUIRED.
23. Skis (if installed) – UP.
24. Wing flaps, landing gear, and ski controls – NEUTRAL.
25. IFF/SIF – EMERGENCY.

ENGINE RESTART DURING FLIGHT.

If it becomes necessary to unfeather the propeller after an engine shutdown in flight, perform the following:

1. Airspeed to 117 knots IAS (135 mph) or below.
2. Skis (if installed) – DOWN.
3. Firewall shutoff valve – PUSH TO OPEN.
4. Turn propeller 8 blades with starter before unfeathering (to check for hydraulic lock).
5. Fuel tank selector – As required (to supply fuel to engine being started).
6. Carburetor air – RAM.
7. Throttle – CLOSE.
8. Propeller control – DECREASE RPM.
9. Ignition switch – BOTH.
10. Fuel booster pump switch – ON.
11. Propeller feathering button – Push IN (until 800 to 1000 rpm).

NOTE

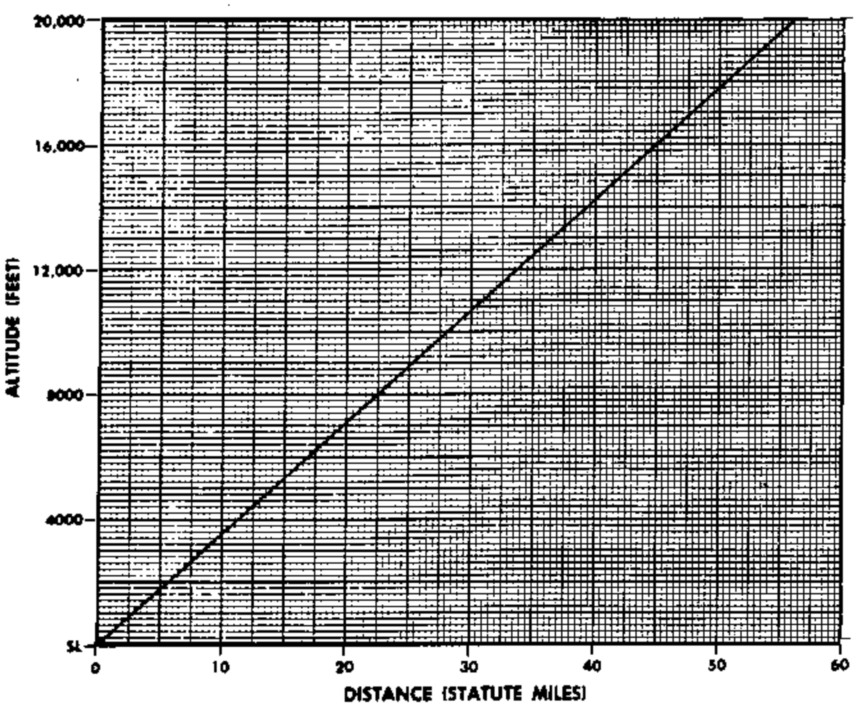
If the feathering button is held in, overspeeding could occur. When engine speed reaches 800 to 1000 rpm, release the feathering button and allow governor to take over.

12. Mixture control – AUTO RICH.
13. Warm engine thoroughly (to insure complete oil circulation), then increase power to desired settings.
14. Generator switch – ON.
15. Fuel booster pump switch – OFF.
16. Skis (if installed) – UP.
17. Trim – AS REQUIRED.

MAXIMUM GLIDE.

The minimum glide angle for the aircraft, power off and both propellers feathered, is computed to be

MAXIMUM GLIDE



Conditions:
1. Power Off
2. Both Propellers Feathered
3. Gear and Flaps Up
4. No Wind

GROSS WEIGHT (POUNDS)	INDICATED GLIDE SPEED (IAS) MPH	KNOTS
20,000	106	92
23,000	114	99
26,000	120	104
29,000	127	110

Figure 3-2.

3.88 degrees and will result in the maximum glide range. This angle may be obtained, regardless of the gross weight of the aircraft, by maintaining the airspeeds for the given gross weights listed on the Maximum Glide chart (figure 3-2). The chart lists the glide ranges resulting from the various altitudes when these glide speeds are maintained. The rate of sink at 20,000 pounds gross weight is approximately 680 feet per minute (11.3 feet per second) at 5000 feet; at a gross weight of 29,000 pounds, the rate of sink is approximately 815 feet per minute (13.5 feet per second) at 5000 feet.

SINGLE-ENGINE LANDING.

Single-engine landings are made in the same way as normal power-off landings except for the following (see Figure 3-1):

1. Landing gear – DOWN (when landing is assured).
2. Wing flaps – as required.
   Do not use more than one-half flaps until landing is assured.

WARNING

Never allow the airspeed to drop below minimum control speed before a power-off landing is assured and all possibilities of a go-around have been eliminated; however, due to the decreased drag of the feathered propeller, caution should be exercised to prevent overshooting.

SINGLE-ENGINE GO-AROUND.

WARNING

Below 300 feet altitude above the ground with gear and flaps full down, a successful go-around cannot be expected.

If it becomes necessary to make a single-engine go-around, refer to figure 3-1 and use the following procedure.

1. COMMAND "GO-AROUND".

   The pilot gives the command "Go-Around" to the co-pilot.

2. APPLY MAXIMUM POWER.
3. WING FLAPS – RETRACT TO 1/4.

   At the pilot's direction, the co-pilot will position the flaps at 1/4, provided that 1/4 or more flaps were extended at time of decision to Go-Around.

4. LANDING GEAR – UP.

   As soon as the pilot determines that the aircraft will not be touched down, he will direct the co-pilot to retract the landing gear.

5. WING FLAPS – UP.

   After the aircraft has reached safe single engine climb speed. The pilot will direct the co-pilot to retract the remaining 1/4 flaps.

NOTE

Single engine climb speed should be attained without gaining altitude and, if necessary and feasible, sacrifice a little altitude. Attain the single engine climb speed as safely and quickly as possible.

6. Power – As required. Reduce power, if practicable, and continue climb-out.

CAUTION

CHT should not exceed limits during any phase of single engine operation. If necessary, to maintain CHT within limits, increase airspeed by reducing the rate of climb or, if feasible, sacrifice a little altitude and/or using full OPEN cowl flaps.

SINGLE-ENGINE PRACTICE MANEUVERS.

To become thoroughly familiar with the single-engine characteristics of the aircraft, practice the procedures and maneuvers listed in the following paragraphs.

CAUTION

When maneuvering with low power or during descents with low power, it is important to cushion the high inertia loads on the master rod bearings which occur at high rpm and low manifold pressure. As a rule of thumb, each 100 rpm requires at least 1 inch Hg manifold pressure. Use high rpm and low manifold pressure only when necessary.

FAILURE OF ONE ENGINE ON TAKE-OFF — BEFORE MINIMUM CONTROL SPEED.

Simulate take-off conditions at altitude, using normal rated power, gear down, at 61 to 65 knots (70 to 75 mph) IAS. Reduce power on one engine and note that to maintain directional control it is necessary to reduce power on the good engine, with a consequent loss of altitude that would require discontinuing take-off.

FAILURE OF ONE ENGINE ON TAKE-OFF AT MINIMUM CONTROL SPEED AND MINIMUM RECOMMENDED SINGLE-ENGINE SPEEDS.

Simulate take-off at altitude using normal rated power. Practice this maneuver using the two different configurations: minimum control speed (76 knots or 88 mph IAS) — gear down; and minimum recommended single-engine speed (84 knots or 97 mph IAS) — gear down. With power reduced on one engine, apply normal rated power on the other engine, gear up (flaps up when practicing single-engine go-around). Simulate engine feathering by applying 1500 rpm and 15 inches Hg on the bad engine, and go through the motions of completing the steps listed under Engine Failure During Take-Off, but do not actually complete the action. Practice in these maneuvers and procedures will demonstrate the capabilities of both the aircraft and the pilot, and will be helpful in making a decision when engine failure is encountered during actual conditions.

SINGLE-ENGINE TURNS.

Single-engine turns can be made safely in either direction if safe single-engine airspeed is maintained.

a. Roll into the turn smoothly and slowly.

b. Maintain a constant airspeed throughout the turn. The importance of maintaining a constant airspeed cannot be over-emphasized, as it is the key to safe single-engine turns. With a constant airspeed, the thrust of the one engine is balanced by the trimmed rudder and aileron.

c. Practice turns in both directions at shallow and medium angles of bank.

EFFECT OF PROPELLER PITCH ON TRIM.

If it is impossible to feather the propeller, much of the drag can be removed by moving the dead engine propeller rpm control to full DECREASE RPM. To determine the effect on trim from an unfeathered propeller, retard one throttle and propeller rpm control to full decrease position, good engine at 2550 rpm and 41 inches Hg, and trim the aircraft. Advance the dead engine propeller rpm control to 2550 rpm. As the propeller changes toward low pitch, the additional drag causes the aircraft to turn toward the dead engine, necessitating a change in trim.

EFFECT OF AIRSPEED ON TRIM.

The importance of airspeed in single-engine flight may be demonstrated as follows: Simulate single-engine flight and trim the aircraft at a constant airspeed and power setting. With feet on the floor, ease back on the control column. As the airspeed decreases, the trim becomes less effective because of decreased air flow over the control surfaces, and the aircraft will turn toward the dead engine. Push the control column forward until the original airspeed is exceeded and, as the trim becomes more effective with the increased air flow over the control surfaces, the aircraft will turn toward the good engine.

EFFECT OF POWER REDUCTION ON TRIM.

Practice directional control on single-engine by using the throttle only. Simulate single-engine flight and trim the aircraft. Place feet on floor and pull control column back slowly. As speed decreases, gradually reduce power on the good engine to prevent the aircraft from turning into the dead engine. It is possible to maintain directional control in this manner up to the point of stall. This demonstrates the importance of reducing power to maintain directional control in case of engine failure during take-off or slow flying when the airspeed is below safe single-engine airspeed.

SINGLE-ENGINE STALLS.

The aircraft can be stalled with one engine operating, provided the principle of reducing power to maintain directional control is observed.

CAUTION

This aircraft has stall characteristics which allow the outer wing tip to stall before the center wing, and, if the tips stall unsymmetrically, it will cause the aircraft to roll violently. Minimum altitude for practicing approach to stalls is 5000 feet above terrain.

SIMULATED SINGLE-ENGINE LANDING.

Practice single-engine landings at a safe altitude, applying the principles discussed in the previous paragraphs.

SIMULATED SINGLE-ENGINE GO-AROUND.

Practice simulated single-engine approaches and go-arounds at a safe altitude.

a. Set up landing approach.

b. At 500 feet above simulated field elevation, start go-around by applying maximum power to the good engine.

c. Wing flaps — Retract to 1/4.

d. Landing gear — UP.

e. Accelerate to speed for best climb – 89 to 94 Knots (102 to 108 mph). Never allow airspeed to drop below minimum control speed.

f. Wing flaps — UP.

Note that when proper technique is used, very little altitude is lost.

To demonstrate an attempt to go around below 300 feet with full flaps and below minimum control speed:

a. Set up landing approach.

b. At 300 feet above simulated field elevation, lower full flaps, reduce power, and slow aircraft below minimum control airspeed.

c. Start go-around by applying power to the good engine, but not enough to lose directional control; maintain heading.

d. Raise the gear and flaps, and accelerate to safe single-engine airspeed as soon as possible.

e. Note loss of altitude; 500 to 600 feet will probably be lost, which should emphasize the importance of maintaining safe single-engine airspeed and using only half flaps until landing is assured.

PROPELLER FAILURE.

HUNTING OR SURGING.

To correct hunting or surging and to bring it back into synchronization, use the following procedure:

1. Propeller control – DECREASE RPM.

   After reaching a safe altitude, decrease RPM on malfunctioning engine.

2. Fuel booster pump switch – ON.

   Check fuel pressure and supply; change to another tank and turn the fuel booster pump – ON.

3. Propeller control – INCREASE RPM; then DECREASE RPM.

   Adjust propeller control of the malfunctioning propeller to INCREASE RPM and then DECREASE RPM 3 or 4 times.

4. If malfunction is not corrected – Shut down engine.

   If the malfunction has not been corrected, and the hunting and surging is excessive, feather the propeller and shut down the engine according to the procedure listed under ENGINE FAILURE/FIRE DURING FLIGHT, this section.

CAUTION

The propeller feathering circuits are not protected. If the feathering action does not occur in 90 seconds, pull out the feathering button.

PROPELLER FAILURE TO FEATHER.

WARNING

- In a clean configuration the aircraft will not maintain altitude with a windmilling propeller, even at weights below normal landing gross weights.
- **If a propeller fails to completely feather and is still windmilling, open the firewall shutoff valve to supply oil to the engine, after making sure no fire hazard exists.**

1. Minimum control speed.

   Slow aircraft to nearly minimum control speed.

2. Mixture control – IDLE CUT-OFF.

3. Propeller control – FULL DECREASE RPM.

4. Throttle – Full OPEN.

5. Propeller – Feather.

   If appreciable reduction in RPM is realized, make further attempt to feather the propeller.

6. If still unable to completely feather propeller, the pilot must evaluate all circumstances involved and make the decision to:

   (a) Land at the nearest installation.

   (b) Bail out passengers and crew.

   (c) Crash land or ditch aircraft.

   (d) Attempt any combination of the above.

WARNING

Attempt to freeze the engine by oil starvation only as a last resort. Freezing the engine may result in an uncontrollable fire or in separation of the engine and/or propeller from the airplane. If the left propeller separates, it will probably come through the cockpit.

OVERSPEEDING AND RUNAWAY PROPELLER.

An overspeeding propeller is one that has exceeded 2700 rpm but is controllable by the propeller control lever. At the first indication of overspeeding, move the control lever toward DECREASE. If this is ineffective, it is considered to be a runaway propeller. Proceed as follows:

NOTE

If the propeller controls are inactive, the governor is spring loaded so that the rpm will be positioned at 2000-2200.

DURING TAKEOFF.

If the propeller malfunction occurs before reaching refusal speed on refusal distance, close the throttles and stop the aircraft. If the propeller malfunction occurs after refusal speed or refusal distance is attained, and power from the malfunctioning engine is required for terrain or obstacle clearance, leave the throttle set at maximum power and control RPM within limits by operating the feathering button intermittently. Climb at best single-engine climb speed to a safe altitude and proceed as follows:

1. THROTTLE – CLOSE.
2. PROPELLER – FEATHER.
3. SHUTDOWN ENGINE USING PROCEDURES FOR ENGINE FAILURE/FIRE IN FLIGHT, THIS SECTION.

IN FLIGHT.

1. REDUCE AIRSPEED (NOT BELOW SAFE SINGLE–ENGINE SPEED).
2. THROTTLE – CLOSE.
3. PROPELLER CONTROL – DECREASE RPM.
4. FEATHERING BUTTON – IN.

   Intermittently push the feathering button IN. When RPM drops below 2700 RPM, pull the button OUT. If the governor does not hold after two or three attempts, feather the propeller, using the procedure for ENGINE FAILURE/FIRE IN FLIGHT, this section.

   Overspeeding sometimes occurs after a fuel tank has been run dry, or while changing fuel supply from one tank to another, with the usual result of a momentary power loss that is followed by the return to full power.

When overspeeding is caused by fuel starvation, accomplish the following:

a. Throttle – CLOSE.

b. Mixture control – AUTO-RICH.

c. Fuel tank selector - Change to fullest tank.

d. Fuel booster pump switch – ON.

e. If overspeeding continues, apply the procedure for OVERSPEEDING AND RUNAWAY PROPELLER IN FLIGHT, this section.

FIRE.

ENGINE FIRE ON THE GROUND.

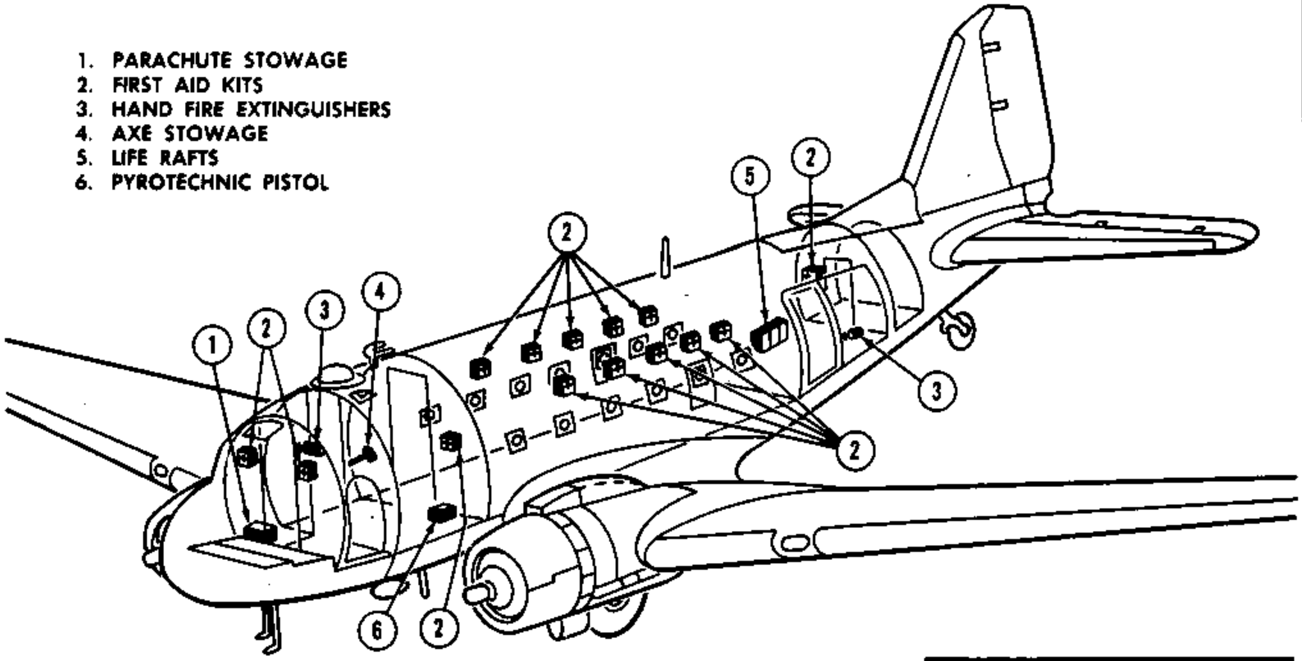
If an induction fire occurs during an engine start, proceed as follows:

1. MIXTURE CONTROL - IDLE CUT-OFF (KEEP THE ENGINE TURNING WITH THE STARTER).
2. THROTTLE – OPEN.
3. IGNITION SWITCH – OFF.
4. FUEL BOOSTER PUMP SWITCH – OFF.
5. FUEL TANK SELECTOR VALVE – OFF.
6. FIREWALL SHUTOFF VALVE – CLOSED.
7. SIGNAL GROUND STANDBY CREW TO COMBAT THE FIRE.
8. FIRE EXTINGUISHER – DISCHARGE AGENT (IF NECESSARY).

   If the ground crew is not successful in extinguishing the fire, discharge the engine fire extinguisher and notify the tower.

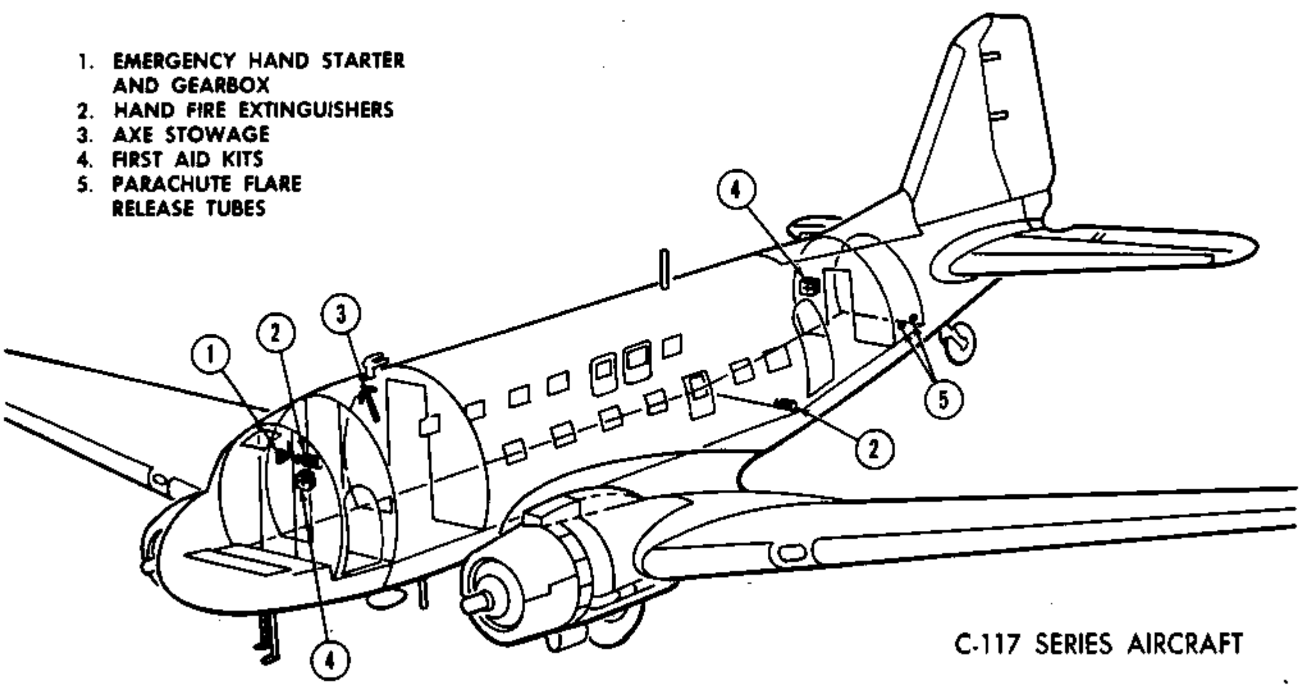
C-47 AND R4D SERIES AIRCRAFT

1. PARACHUTE STOWAGE
2. FIRST AID KITS
3. HAND FIRE EXTINGUISHERS
4. AXE STOWAGE
5. LIFE RAFTS
6. PYROTECHNIC PISTOL



MISCELLANEOUS EMERGENCY EQUIPMENT

1. EMERGENCY HAND STARTER AND GEARBOX
2. HAND FIRE EXTINGUISHERS
3. AXE STOWAGE
4. FIRST AID KITS
5. PARACHUTE FLARE RELEASE TUBES



C-117 SERIES AIRCRAFT

Figure 3-3.

9. STOP THE OTHER ENGINE (IF OPERATING).

10. EVACUATE THE AIRCRAFT.

11. Do not restart the affected engine after the engine fire extinguisher has been discharged.

FUSELAGE FIRE.

When a fire occurs in flight, regardless of type or location, all crew members and passengers should be instructed immediately to put on their parachutes and stand by in readiness to abandon the aircraft. If the fire is not extinguished, accomplish emergency descent and land immediately. If a landing is not feasible, bail out, altitude permitting. In case of smoke or fire in the cockpit or cabin, perform the following steps immediately, before taking any fire control action. After these preliminary steps have been taken subsequent operations will depend upon the various types of fire, as detailed below:

1. CLOSE ALL HATCHES, DOORS, AND VENTILATING DUCTS.

2. MIXING CHAMBER CONTROLS – HOT.

   Adjust the mixing chamber controls to the full HOT positions.

3. NACELLE SPILL VALVE CONTROL KNOBS – SPILL.

   Turn both nacelle spill valve control knobs to the SPILL (dump) position.

4. OXYGEN MASK – ON (100% OXYGEN).

5. BAIL-OUT WARNING SWITCH – ON.

   Signal personnel to prepare to abandon aircraft (see BAIL-OUT, this section). If alarm bell is not provided, alert crew over interphone.

6. COMBAT FIRE WITH HAND FIRE EXTINGUISHERS.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a anesthetic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the less usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken, including the use of oxygen when available.

WING FIRE.

There are no provisions installed for combating wing fire. If the following procedure fails to extinguish the fire and a landing cannot be made immediately, abandon the aircraft.

1. SHUTOFF ALL SYSTEMS THAT MAY BE FEEDING THE FIRE.

   Take the necessary steps to isolate the fire by shutting off any and all systems that may be feeding the fire.

2. SIDESLIP THE AIRCRAFT AWAY FROM THE FIRE.

   Attempt to extinguish the fire by side-slipping the aircraft away from the fire.

3. OPEN THE AIRCRAFT EMERGENCY EXITS IF FIRE IS NOT EXTINGUISHED.

ELECTRICAL FIRES.

If smoke or fire is definitely found to be of electrical origin, and the source is discovered immediately pull the circuit breaker, if source is unknown proceed as follows:

1. BATTERY AND GENERATOR SWITCHES – OFF.

2. USE HAND FIRE EXTINGUISHERS TO COMBAT THE FIRE.

3. OXYGEN – 100%.

4. VENTILATION – AS REQUIRED.

5. ALL SWITCHES AND CIRCUIT BREAKERS – OFF/TRIPPED.

The preceding steps have eliminated electrical power in all circuits. The following steps should be initiated progressively to determine the defective electrical circuit.

6. Generator switches (one at a time) – ON.

7. Battery switch – ON.

8. Inverter switch – ON.

9. Check circuit breakers in the main junction box.

ENGINE SMOKE AND FLAME IDENTIFICATION CHART

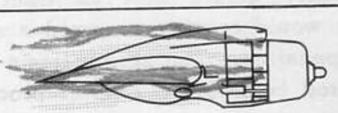
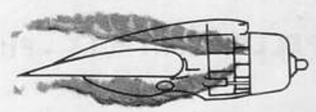
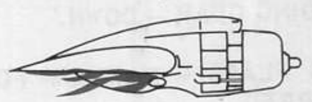
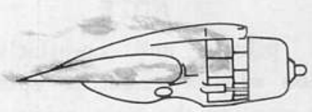
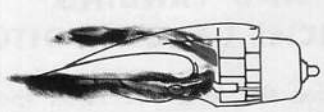
CAUSE	ACTION	SMOKE AND FLAME PATTERN
Detonation, afterfire, and backfire, Also fouled plugs or failing valves. If fuel pump drive shaft is broken, engine receives insufficient fuel and mixture leans excessively. Indicated generally by high CHT, high CAT, fluctuating MAP, fuel flow, and fuel pressure drop. Lean mixtures cause high CHT. High CAT, above 40°C (104°F), produces detonation. Fluctuation in MAP and fuel flow will result from violent backfire. If detonation continues, engine failure and fire are imminent.	Decrease CAT and CHT and enrich mixture, checking for proper rpm and MAP correlation. Increase airspeed.	 PUFFS OF BLACK SMOKE FROM EXHAUST. ROUGH ENGINE.
Oil leaking onto exhaust stacks and vaporizing. Not a dangerous condition if oil leak is not excessive. No instrument indications except for possible drop in oil quantity.	Normally, no action is necessary unless fire developes. If fire occurs, shut down engine, removing source of heat and fuel, and fire should go out.	 THIN WISPS OF BLUISH-GREY SMOKE FROM COWL FLAPS AND EXHAUST AREAS.
Cylinder failure, exhaust stack failure. If condition results in blown cylinder head or open exhaust stack, fire and black smoke will appear in exhaust stream.	During takeoff or when more than single engine power is required for safety, reduce power slightly and let engine operate until safe altitude and airspeed are obtained, then feather engine.	 GREY SMOKE COMING FROM COWL FLAP OR FORWARD ENGINE SECTION.
On ground at idling speeds indicates too rich mixture. In flight, usually at high power settings, this can occur and indicates too rich mixture. There will be no instrument indications.	On ground, increase throttle and blow fire out. In flight, move mixture control slightly to lean mixture.	 LIGHT ORANGE-COLORED FIRE COMING FROM EXHAUST.
Induction fire. Instruments will indicate sudden drop of MAP and rpm CAT is not reliable indicator because instrument records temperature of air flowing through carburetor, not induction system heat.	Perform engine failure fire procedure. Fire should burn itself out without damaging engine.	 HEAVY BLACK SMOKE FROM EXHAUST.
Induction fire in advanced stages. Very dangerous condition. CAT will rise rapidly to maximum reading.	Action in above should have been taken to extinguish fire before it reaches this stage. Use engine failure/fire procedures. Alert crew for bail out. If fire does not go out within 30 seconds, it maybe best to order crew to bail out as fire will probably cause explosion in wing.	 DENSE WHITE SMOKE FROM EXHAUST AND/OR COWL FLAP AREAS.
Oil fire in accessory section. Fire warning light should come on. CAT will be abnormally high, accompanied by loss of power	Use engine failure/fire procedures.	 BLACK SMOKE FROM ACCESSORY SECTION.
Fuel fire in accessory section generally caused by broken fuel line. Low fuel pressure and abnormally high CHT are instrument indications. Fire warning light will come on. Engine operation may be eratic, depending upon malfunction.	Shut off fuel as quickly as possible and use engine failure/fire procedures. Prepare to abandon aircraft if fire does not go out.	 BLACK SMOKE AND ORANGE FLAME FROM ACCESSORY SECTION.

Figure 3-4.

NOTE

Watch for recurrence of smoke or fire while resetting the circuit breakers one at a time.

10. WHEN THE SOURCE OF SMOKE OR FIRE HAS BEEN FOUND, LEAVE THE INVOLVED CIRCUIT INOPERATIVE AND RESTORE POWER TO THE REMAINING CIRCUITS.

11. LAND AS SOON AS PRACTICABLE.

EMERGENCY DESCENT.

The possibility exists that an emergency could arise which would require as rapid a descent from altitude as possible. The action items listed below are considered best for an overall procedure for an expedited descent.

1. THROTTLES - CLOSED.
2. PROPELLER CONTROLS - FULL INCREASE RPM.
3. MIXTURE CONTROLS - AUTO-RICH.
4. LANDING GEAR - DOWN.
5. WING FLAPS - MAXIMUM FOR INDICATED AIRSPEED.

SMOKE ELIMINATION.

FLIGHT COMPARTMENT AND CABIN.

Under no circumstance should any hatch or door, other than the clear vision windows and the main cabin door, be opened during an inflight fire for smoke elimination.

NOTE

The pilot's and co-pilot's clear vision windows must be opened before opening the main cabin door, to reduce smoke and flame induction.

BATTERY FUMES.

If battery fumes are detected, turn the battery switch OFF and use oxygen.

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING).

In this section the term "decision speed" is used to denote that speed and/or point during the takeoff where the pilot elects to continue or to abort the takeoff. The term is used so that emergency procedures refer to the moment of decision regardless of the concept used.

CAUTION

Combustion type heaters must be turned off to eliminate fire hazard during emergency landings.

ABORT.

Any crew member who observes a hazardous malfunction before "decision speed" is reached will call out ABORT. The takeoff will be aborted as follows:

1. Throttles – CLOSED.
2. Brakes – APPLIED.

NOTE

If it is impossible to stop on the runway, it may be desirable to ground loop the aircraft or to retract the landing gear to obtain a more sudden stop.

3. After landing check – COMPLETED.

AFTER REACHING DECISION SPEED.

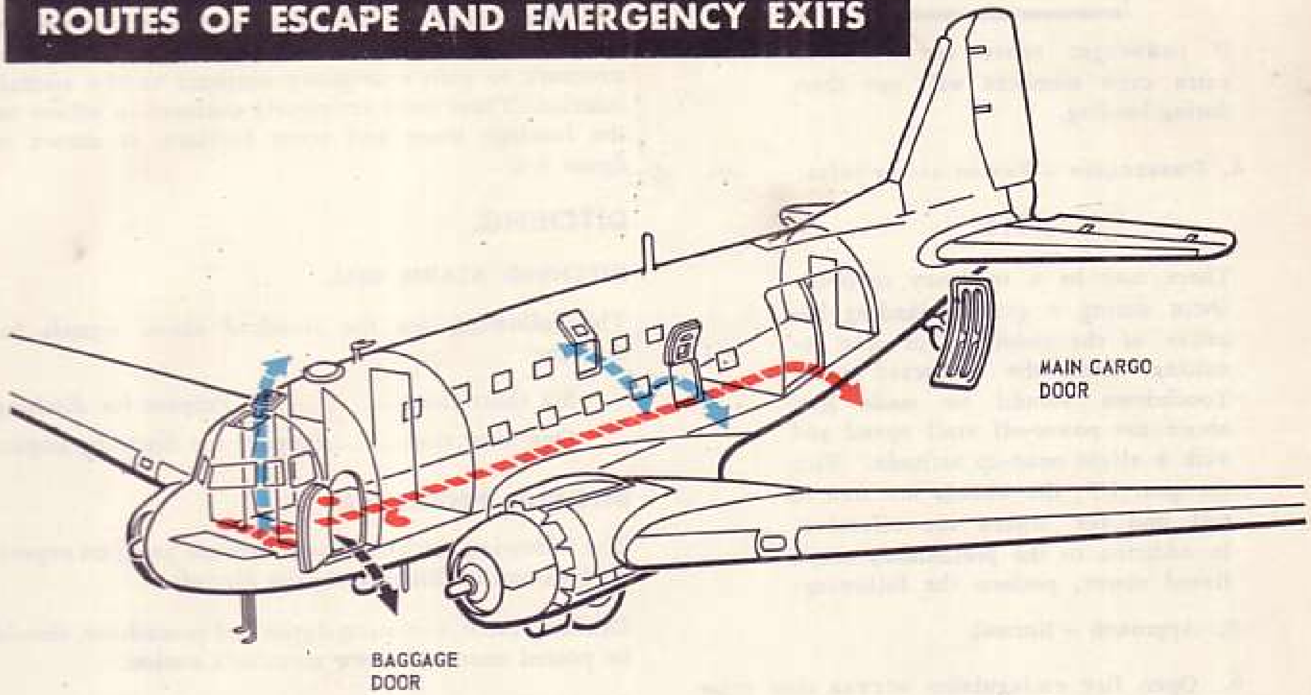
After reaching decision speed, continue the takeoff and the malfunction will be treated as an inflight emergency. (Refer to ENGINE FAILURE/FIRE IN FLIGHT this section.)

GEAR UP LANDING.

When it is definitely established that a gear-up landing is to be made, prepare the aircraft and alert the crew and passengers, according to the expected conditions. The following preliminary steps must be taken before any emergency landing is attempted.

1. Unlock emergency escape doors and hatches (see figure 3-5).
2. Pilot and co-pilot – Fasten safety belt and shoulder harness.
3. Other crew members will be seated in passenger seats (if available) otherwise they will sit on the cabin floor with back and shoulders against the bulkhead (facing aft) and if cushioning material is not available place hands behind their head.

ROUTES OF ESCAPE AND EMERGENCY EXITS



C-47 AND R4D SERIES AIRCRAFT

C-117 SERIES AIRCRAFT

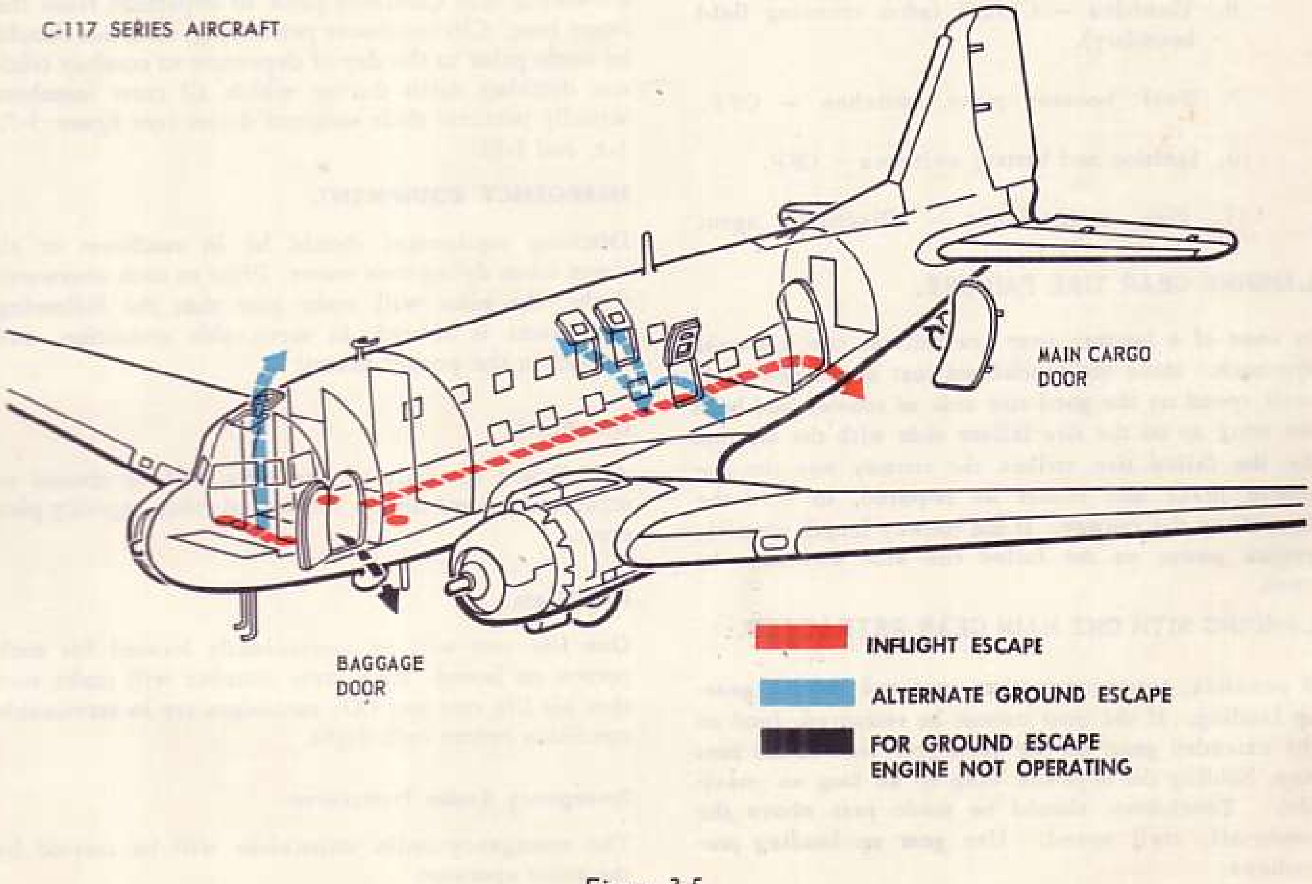


Figure 3-5.

WARNING

If passenger seats are available extra crew members will use them during landing.

4. Passengers – Fasten safety belts.

NOTE

There may be a tendency to overshoot during a gear-up landing because of the reduction in drag resulting from the retracted gear. Touchdown should be made just above the power-off stall speed and with a slight nose-up attitude. With the gear UP, the wheels are free to roll and the brakes are effective. In addition to the preliminary steps listed above, perform the following:

5. Approach – Normal.
6. Open fire extinguisher access door prior to ground contact.
7. Wing flaps – DOWN (when landing is assured).
8. Throttles – CLOSE (after crossing field boundary).
9. Fuel booster pump switches – OFF.
10. Ignition and battery switches – OFF.
11. Fire extinguisher – Discharge agent (if fire exists).

LANDING GEAR TIRE FAILURE.

In case of a landing gear tire failure, use a normal approach. Make the touchdown just above power-off stall speed on the good tire side of runway and hold the wing up on the tire failure side with the aileron. As the failed tire strikes the runway use the opposite brake and rudder as required, to hold the aircraft on the runway. If the runway length permits, engine power on the failed tire side may also be used.

LANDING WITH ONE MAIN GEAR RETRACTED.

If possible, retract the other gear and make a gear-up landing. If the gear cannot be retracted, land on the extended gear, on the good gear side of the runway, holding the opposite wing up as long as possible. Touchdown should be made just above the power-off, stall speed. Use gear up landing procedures.

EMERGENCY ENTRANCE.

The structure of the fuselage is so designed in various areas that ground personnel can chop through the structure to gain emergency entrance to the aircraft interior. These areas are clearly outlined in yellow on the fuselage inner and outer surfaces, as shown in figure 3-6.

DITCHING.

DITCHING ALARM BELL.

The following are the standard alarm signals for ditching:

Six short rings ....Prepare for ditching

One long ring ....Prepare for ditching impact

DITCHING PROCEDURE.

The following ditching procedures are based on experience gained in ditching similar aircraft.

Ditching cards, outlining duties and procedures, should be posted near each crew member's station.

Ditching an aircraft requires more coordination on the part of each crew member than does any other emergency procedure. In order to develop coordination, the pilot must require each crew member to demonstrate his knowledge of ditching duties by answering oral questions prior to departure from the home base. Circumstances permitting, an effort should be made prior to the day of departure to conduct trial-run ditching drills during which all crew members actually perform their assigned duties *(see figure 3-7, 3-8, and 3-9).*

EMERGENCY EQUIPMENT.

Ditching equipment should be in readiness at all times when flying over water. Prior to each overwater flight, the pilot will make sure that the following equipment is aboard, in serviceable condition, and stowed in the proper places:

Life Rafts.

A sufficient quantity of life rafts will be aboard to accommodate maximum authorized cabin capacity plus crew.

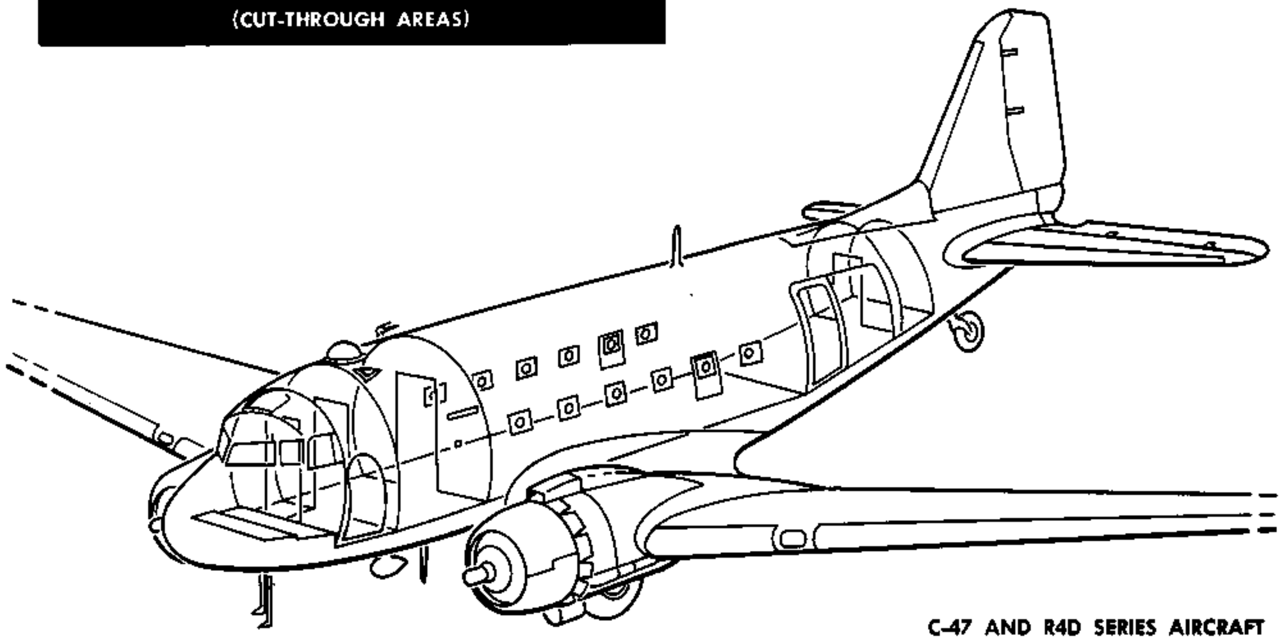
Life Vests.

One life vest will be conveniently located for each person on board. Each crew member will make sure that his life vest and CO_2 cartridges are in serviceable condition before each flight.

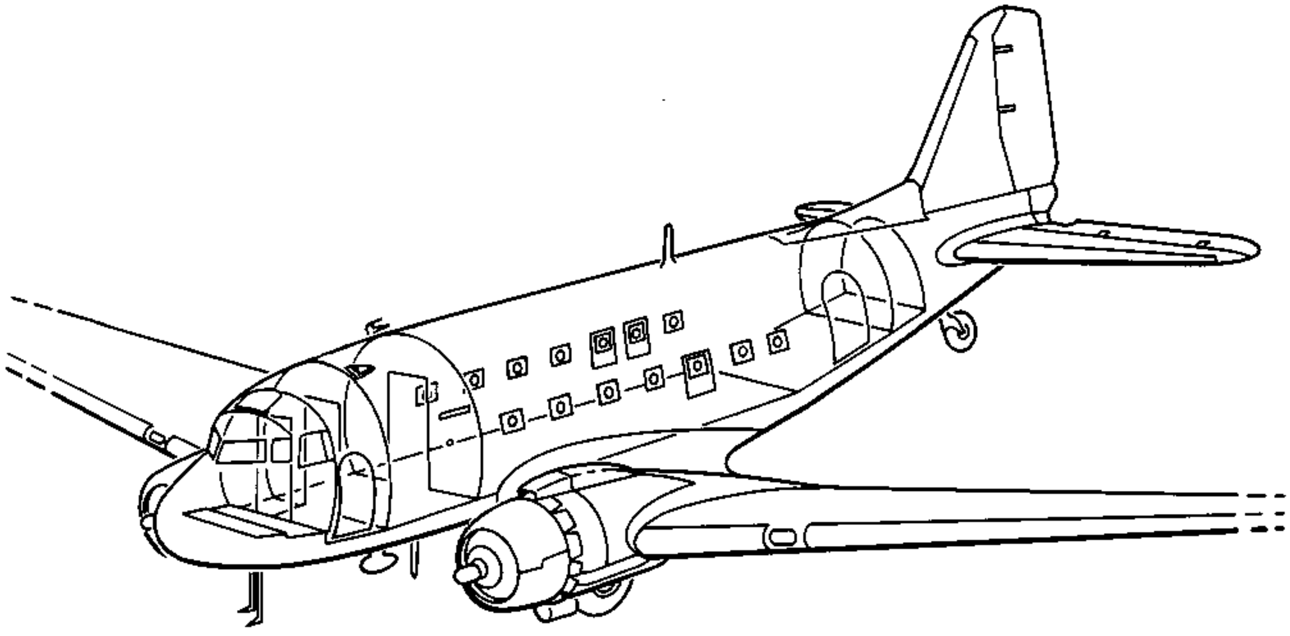
Emergency Radio Transceiver.

The emergency radio transceiver will be carried by the radio operator.

EMERGENCY ENTRANCES
(CUT-THROUGH AREAS)



C-47 AND R4D SERIES AIRCRAFT

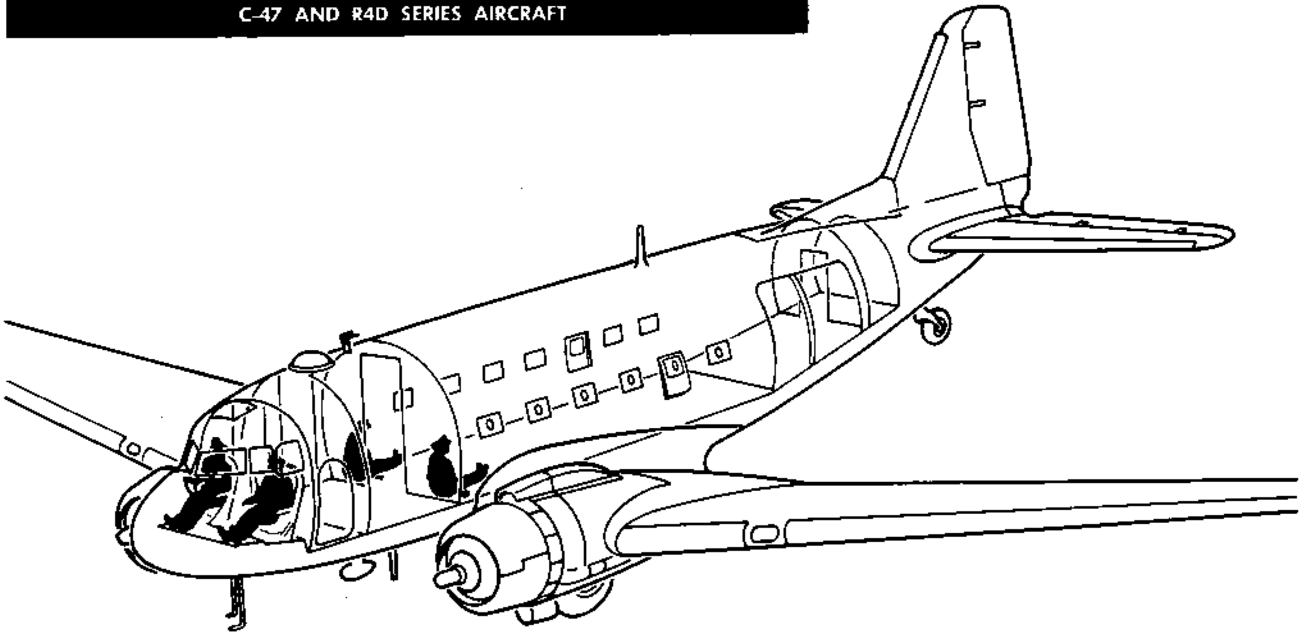


C-117 SERIES AIRCRAFT

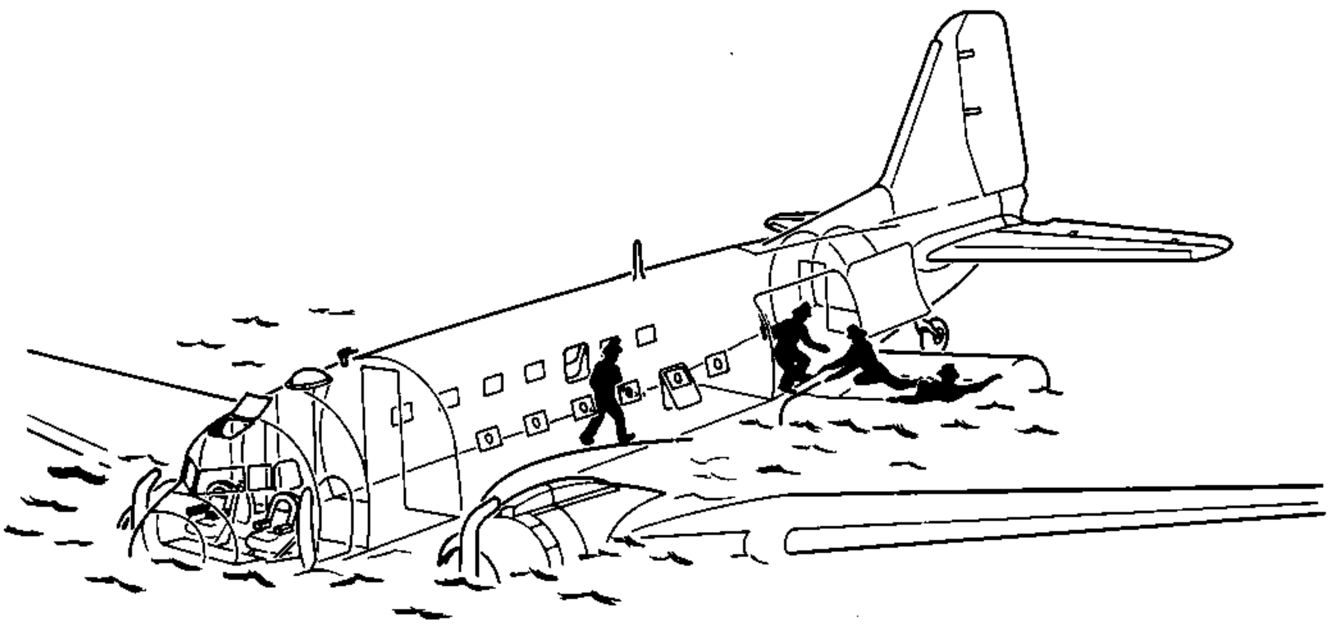
Figure 3-6.

DITCHING AND CRASH LANDING STATIONS

C-47 AND R4D SERIES AIRCRAFT



CREW POSITIONS PRIOR TO DITCHING

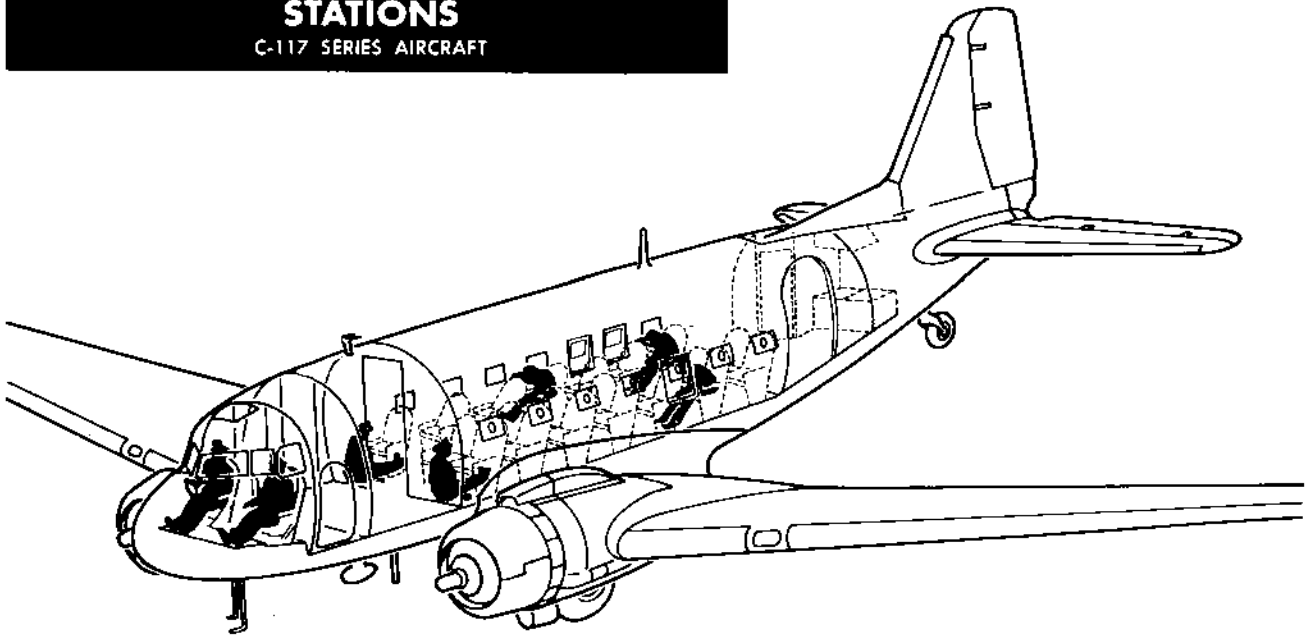


BOARDING THE LIFE RAFTS

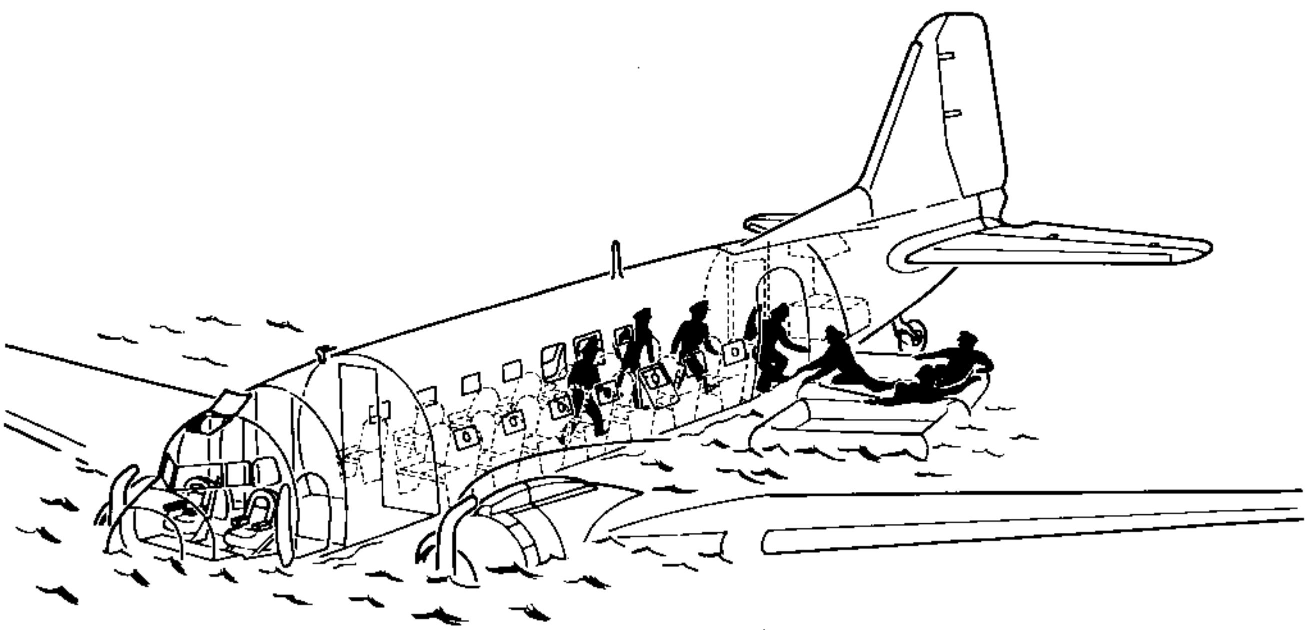
Figure 3-7.

DITCHING AND CRASH LANDING STATIONS

C-117 SERIES AIRCRAFT



CREW POSITIONS PRIOR TO DITCHING



BOARDING THE LIFE RAFTS

Figure 3-8.

Antiexposure Suits.

One antiexposure suit will be conveniently located for each person on board.

ASSIGNMENT OF EVACUATION CONTROLLER.

When passengers are being carried, the pilot will appoint, before take-off, one crew member as an evacuation controller. On C-117 series aircraft, the steward will assume the duties of evacuation controller. This crew member will be responsible for briefing the passengers before flight on the use of emergency equipment. This briefing should be done in a calm, professional manner so as to instill confidence in the passengers and forestall apprehension of an emergency.

PREPARATION FOR DITCHING.

(See figures 3-7, 3-8, and 3-9.)

Wind Speeds and Directions.

Surface winds are fairly predictable from the way they affect the water. Use the following reference for estimating the surface wind velocity.

a. Sea like a mirror....................Less than 1 knot

b. Ripples with the appearance of scales are formed, but without foam crest....................1 to 3 knots

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

d. Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered whitecaps....................7 to 10 knots

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

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

g. Large waves begin to form; the white foam crests are more extensive. (Probably some spray)....................22 to 27 knots

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

i. Moderately high waves of great length; edges of crests break into spindrift. The foam is blown in well-marked streaks along the direction of the wind......34 to 40 knots

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

k. Very high waves with long overhanging crests. Foam is blown in dense white streaks along the direction of the wind. On the whole, the surface of the sea takes a white appearance....................48 to 55 knots

Plans for ditching cannot be made without taking the wind direction into consideration. Waves move downwind, and the spray from wave crests is also blown downwind. Swells, however, do not always indicate wind directions and can be very large even when the wind is calm. Over a sea, a pilot must be more exacting and alert when judging height.

Flight Compartment.

At the time the "Prepare for Ditching" order is given by the pilot, the crew assignments will be:

Pilot and co-pilot will don antiexposure suits and life vests, and remain in their seats to fly the aircraft.

The radio operator will don an antiexposure suit and life vest, switch the IFF to EMERGENCY, and stand by his radio to transmit any necessary emergency signals.

On C-47 and R4D series aircraft, the flight mechanic, or on C-117 series aircraft, the steward, will place essential equipment, crew water, first aid kits, Very pistol, signal flares, and smoke signals in the emergency equipment bag. He then stows this equipment until after ditching. Upon completion of these duties, he will put on his antiexposure suit and life vest and take his station for ditching *(figures 3-7 and 3-8)*.

Main Cabin Compartment.

When the necessity for ditching is evident, the pilot will alert the crew by giving the command "Prepare for ditching" over the interphone. (This alert should not be confused with the six short rings of the alarm bell, which are the signal to assume ditching positions.) Upon receiving the command "Prepare for Ditching," a crew member designated by the pilot, or the steward on C-117 series aircraft, will accomplish the following:

Advise passengers of the impending emergency.

Jettison as much cargo as possible.

See that all doors which may take in water are closed and latched.

Open all accessible emergency escape hatches.

Loosen his tie, don an antiexposure suit and life vest, and make certain that the passengers are prepared in the same manner. After the above procedures have been accomplished, he notifies the pilot over the interphone that the passengers are prepared for ditching.

Upon hearing six short rings of the alarm bell, or when receiving signal over interphone, he checks that all passengers are properly seated and have their safety belts fastened. Upon hearing one long ring of the alarm bell or signal over interphone, he checks that all passengers assume the "Brace for Ditching" position.

ABANDONING AIRCRAFT.

Evacuation of the aircraft in an orderly manner after ditching should be accomplished in the shortest time possible. This cannot be done well without practice. Far less can it be expected in a dark fuselage filling with water, unless the drill is perfect. Practice makes perfect. A very large number of crews have thus saved themselves and have finally been rescued by surface craft. The crew and passengers must not leave ditching positions until the aircraft comes to rest. Directly after the aircraft comes to rest, the additional necessary emergency equipment must be collected and equally distributed to the groups on both sides of the main cabin compartment. Each group of passengers, plus the crew, must evacuate the aircraft in the correct order, through the exit previously assigned to them, carrying the equipment that has been allotted to them. They must also see to it that each piece of equipment for use in the raft is secured by lines to prevent its being lost overboard in passing from aircraft to raft.

Flight Compartment.

When it is certain that the aircraft has come to a complete stop, each crew member performs the following duties:

The radio operator insures that the rafts have been properly launched, inflated, and secured to the aircraft. After he has ascertained that all equipment is properly stowed aboard rafts, he boards raft. The flight mechanic or steward, as applicable, retrieves the emergency equipment bag and hands it to the radio operator in the raft. He then joins the radio operator in the raft. The pilot and co-pilot will check on each other to see if either one has been injured. It is quite possible for the pilots to receive severe blows on the head or other parts of the body, making it impossible for them to leave the aircraft under their own power.

The pilot and co-pilot will leave through the main cabin door and join the other crew members in the raft.

Main Cabin Compartment.

The smooth, orderly, and expeditious evacuation of passengers depends upon how well the duties are performed. The crew member designated will insure that all additional emergency equipment is equally distributed, and that orderly evacuation is immediately effected.

When it is certain that the aircraft has come to a complete stop, he will proceed with the following duties:

a. Life rafts will be launched, with the aid of the passengers if necessary. The CO_2 release should not be pulled until after the raft is in the water.

   The first raft should be tied to the escape rope, the second raft tied to the first, and so on, to prevent them from drifting apart and away from the aircraft.

b. Each group will exit through the main cabin forward door in the assigned order, taking along their emergency equipment, and board a raft.

DITCHING TECHNIQUES.

Normal Power-On Ditching.

Experience gained in ditching similar aircraft has shown that the best results are obtained by following the procedure outlined below:

a. If possible, use up most of the fuel supply to lighten the aircraft and reduce stalling speed. Empty tanks also contribute to flotation.

b. **Ditch while power is available. Power will allow you to choose the spot for ditching that affords the best possible sea conditions and the most favorable landing position and attitude.**

c. Radio Low Altimeter – ON.

d. Use flap setting of half-down.

e. Ditch at 10 knots above stalling speed, which will give an approximate angle of ditching of slightly above level flight. Under no circumstances should the aircraft be stalled in, since this will result in severe impact and cause the aircraft to nose into the sea.

f. In daylight, it is recommended that the aircraft be ditched along the top of the swell, parallel to the rows of the swells, if the wind does not exceed 30 knots. In high winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed. However, it must be remembered that the possibility of ramming nose-on into a wave is increased, as is the possibility of striking the tail on a wave crest and nosing in.

Partial Power Failure Ditching.

In ditching with one engine inoperative, the following should be borne in mind:

a. Use power as required to give flattest approach and a forward speed of 10 knots above stalling speed.

b. On letdown with an engine inoperative, it is advisable to hold speed 20 knots above stalling speed until flare-out, at which time speed will be reduced to 10 knots above stalling speed.

Cross-Wind Ditching.

The basic rules for ditching, listed in Normal Power-On Ditching, will still apply, in addition to the following:

a. Crab the aircraft to kill drift.

b. Land on the downwind side of the swell or wave.

DITCHING CHART

CREW MEMBER/DUTY

PILOT

Warn crew to prepare for ditching. Order evacuation controller to assume duties. Order radio operator to start emergency procedures. Order all on board to secure themselves in ditching position.

CO-PILOT

As directed by pilot.

FLIGHT MECHANIC

Assume evacuation controller duties.

Supervise preparation of passengers.

Stow essential navigation equipment and crew water tank in emergency equipment bag.

NAVIGATOR

Passes information on speed, course, altitude, position, estimated ditching position, and distance to nearest land to radio operator for inclusion in distress signal. Then passes this information on to all crew members. Assumes duties as assistant evacuation controller.

RADIO OPERATOR

Send emergency signal (SOS) giving position, altitude, course, speed, and intention of aircraft pilot as to ditching.

NOTE: On C-117 series aircraft, the duties listed for the navigator will be performed by a crew member designated by the pilot. The steward will perform the duties of evacuation controller.

Figure 3-9 (Sheet 1 of 2).

When ditching is imminent (10 minutes left), each crew member and passenger will don antiexposure suit and life vest

PROVIDE	POSITION	EXIT
Flashlight	Pilot's seat	Main cargo door
Emergency radio transceiver	Co-pilot's seat	Main cargo door
Life rafts Emergency radio transceiver	If seat is not available, seated on floor of main cabin, forward bulkhead	Main cargo door
Emergency equipment bag	If seat is not available, seated on floor of main cabin, forward bulkhead	Main cargo door
Life raft Emergency radio transceiver at No. 2 exit	If seat is not available, seated on floor of main cabin, forward bulkhead	Main cargo door

Figure 3-9 (Sheet 2 of 2).

Upwind Ditching.

The basic rules for ditching, listed in "Normal Power-on Ditching," will still apply, in addition to the following:

a. Maintain nose-up condition — avoid nose striking wave face.

b. Touch down immediately before the crest of a rising wave.

c. Hold the nose up after first impact.

Night Ditching.

a. Night ditching will be conducted with the aid of instruments to establish proper attitude of aircraft.

b. Make an instrument letdown, holding the airspeed 20 knots above stalling speed and at the lowest possible rate of descent.

c. Use landing lights as necessary.

d. Hold wings level to avoid digging a wing into the water and cartwheeling the aircraft.

e. Land at 10 knots above stalling speed, using flap setting of half-down.

Note

If no power is used, no flaps should be employed.

PILOT.

First Actions.

1. Warn crew to prepare for ditching, giving approximate time remaining.
2. IFF/SIF – EMERGENCY.
3. Order crew members to assist in briefing passengers.
4. Order the radio operator to transmit a distress signal and position report and continue to do so.
5. Order co-pilot to don antiexposure suit and life vest, and fasten safety belt and harness.
6. Loosen tie, don life vest and antiexposure suit, and fasten shoulder harness and safety belt.
7. Take over controls from co-pilot and prepare to ditch.

When Ditching Is Imminent (10 Minutes Left).

1. Alert cabin personnel; six short rings on alarm bell, or give signal over interphone.
2. Order the radio operator to send final distress signal.
3. Order the co-pilot to assist him as required.
4. Orders all crew members and passengers to turn on emergency flashlights connected to life vests.

   This procedure will provide light after ditching and will aid in locating persons injured during ditching.
5. Order all on board to secure themselves in ditching position.
6. If at night, turns on formation lights.
7. Immediately before ditching, give signal No. 2: "Brace for Impact" or give signal over interphone.

Ditching Station — Pilot's seat.

After Ditching.

Leave the aircraft through the main cargo door and assist with the life rafts. Take command.

CO-PILOT.

First Actions.

1. Take over the controls while the pilot adjusts his equipment.
2. Loosen tie, and don antiexposure suit and life vest.
3. Fasten shoulder harness and safety belt.

When Ditching Is Imminent (10 Minutes Left).

Assists pilot.

Ditching Station — Co-pilot's seat.

After Ditching.

Leave through the main cargo door.

NAVIGATOR

First Actions.

1. Give speed, course, altitude, position, and estimated ditching position to the radio operator for inclusion in the distress signal.
2. Loosen tie, and don antiexposure suit and life vest.
3. Stow essential equipment (Very pistol, signal flares, smoke signals, navigation aids, crew water tank, etc) in emergency bag, and stow the bag in the lavatory.

When Ditching Is Imminent (10 Minutes Left).

Assist pilot as directed.

Ditching Station — Seated on floor, back braced against main cargo compartment forward bulkhead.

After Ditching.

Pass out the emergency equipment bag and leave through the main cargo door.

STEWARD OR FLIGHT MECHANIC.

First Actions.

1. Assist and brief passengers.
2. Loosen tie, and don antiexposure suit and life vest.
3. Stow essential emergency equipment in emergency bag, and stow the bag in the lavatory.

When Ditching Is Imminent (10 Minutes Left).

1. Assist pilot as directed.
2. Make certain the passengers are prepared.

Ditching Station — Seated on left side near main cargo door.

After Ditching.

Pass out the emergency equipment bag and leave through the main cargo door.

RADIO OPERATOR.

First Actions.

1. On pilot's orders, send an emergency signal (SOS), followed as soon as possible by an emergency message giving position, flight time, nature of the emergency, and any other information available.
2. Obtain Direction Finding Service, bearing, etc, on normal air ground frequency if possible.
3. Loosen tie, don antiexposure suit and life vest, and fasten shoulder harness and safety belt.
4. Continue the outlined emergency procedure every 10 minutes.

When Ditching Is Imminent (10 Minutes Left).

1. Send final distress signal (SOS), position, altitude, course, speed, and intention of pilot as to ditching.
2. Screw the emergency key down.

Ditching Station — Seated on floor, back braced against the main cabin compartment forward bulkhead.

After Ditching.

a. Launches fife raft through main cargo door.

b. Leaves through main cargo door.

ABANDONING THE AIRCRAFT.

Leave the aircraft as quickly as possible. Do not overlook necessary equipment or assigned duties. Hold ditching position until the aircraft comes to rest, then proceed as follows:

a. Crew members detailed to life raft removal will launch life rafts through the main cargo door and inflate.

b. Crew members and other personnel will leave through assigned escape exit and, upon emerging, inflate life jackets.

BAIL-OUT.

BAIL-OUT ALARM BELL

The following are the standard alarm signals for bail-out:

Three short rings .... Prepare to bail out

One long ring ....Bail out

BAIL-OUT PROCEDURE.

When the decision has been made to abandon the aircraft in flight, the pilot will give a warning signal to "Prepare for bail-out." This signal will be three short rings on the alarm system, a verbal signal over the interphone/PA system. When all the crew members (and passengers, if carried) are ready, the pilot will be notified. When the pilot desires to have all on board abandon the aircraft, he will give a warning signal to "Bail out," which will be one long sustained ring, or a verbal signal over the interphone/PA system. In addition to the alarm signals, the pilot will give verbal warnings over the interphone. If passengers are carried, a crew member will brief them. Primary exit from the aircraft will be through the main cargo door, which can be jettisoned from the aircraft.

Pilot.

The pilot will:

a. Notify crew and receive acknowledgement. Ring alarm bell three short rings, or give verbal signal over interphone for crew members to perform all preparatory duties for bail-out. IFF/SIF - EMERGENCY.

MALFUNCTIONS OF MULTI-GENERATOR D-C ELECTRICAL SYSTEM

FAILED GENERATOR AMMETER	FAILED GENERATOR WARNING LIGHT	OTHER GENERATOR AMMETER	OTHER GENERATOR WARNING LIGHT	RESULTS AND CAUSES OF D-C ELECTRICAL SYSTEM FAILURE
1 ZERO	ON	ABOVE NORMAL	OFF	GENERATOR MECHANICAL FAILURE, ARMATURE OPEN, BROKEN BRUSH, REVERSE CURRENT RELAY NOT CLOSING, ONE POLE OF GENERATOR SWITCH OPEN.
2 ZERO	OFF	ABOVE NORMAL	OFF	MAIN BUS OPEN TO REVERSE CURRENT RELAY, GENERATOR FAILURE WITH WARNING LIGHT FAILURE, OPEN GENERATOR SWITCH, REVERSE CURRENT RELAY MAIN COIL NOT CLOSING.
3 ZERO	OFF	NORMAL	OFF	AMMETER CIRCUIT OPEN.
4. LOW	OFF	ABOVE NORMAL	OFF	IMPROPER PARALLELING, EQUALIZER COIL IN REGULATOR NOT WORKING, REGULATOR SET LOW OR STICKING.
5. ABOVE NORMAL	OFF	LOW — OR ZERO	OFF	EQUALIZER COIL NOT WORKING, REGULATOR MALFUNCTION.
6. OFF SCALE HIGH	OFF	OFF SCALE HIGH OR ABOVE NORMAL	OFF	MAIN BUS GROUNDED.
7 OFF SCALE HIGH	OFF	LOW — OR ZERO	OFF	REGULATOR MALFUNCTION.
8. OFF SCALE HIGH	OFF	ZERO	ON	OVERVOLTAGE DUE TO REGULATOR MALFUNCTION OR FIELD TO ARMATURE LEAD SHORTED.
9. NORMAL	ON	NORMAL	OFF	FAILURE OF WARNING LIGHT RELAY CIRCUIT.
10. REVERSED AND PEGGED	OFF	OFF SCALE HIGH OR ABOVE NORMAL	OFF	REVERSE CURRENT RELAY WELDED WITH GENERATOR LEAD GROUNDED. FAILED REVERSE CURRENT RELAY COIL.
11 OFF SCALE HIGH TO GENERATOR FAILURE THEN TO ZERO.	OFF THEN ON	HIGH UNTIL FAILURE OF OTHER GENERATOR, THEN ABOVE NORMAL. MAY NOT GO AS HIGH AS FAILED GENERATOR. MAY GO LOW AFTER OTHER GENERATOR FAILURE DUE TO BURNED-OUT LOADS.	OFF	OVERVOLTAGE.
12. OFF SCALE LOW AND PEGGED THEN TO ZERO.	ON	OFF SCALE HIGH THEN BACK TO ABOVE NORMAL.	OFF	GENERATOR FEEDER GROUNDED.

NOTES

1 GENERATOR SWITCH CONTROLS: REVERSE CURRENT RELAY, VOLTAGE REGULATOR EQUALIZING WINDING CROSS CONNECTION, WARNING LIGHT POWER CONNECTION.

2. ALL AIRCRAFT HAVE ONE WARNING LIGHT PER GENERATOR, OPERATED BY A LIGHT RELAY. THE LIGHT COMES ON WHEN THE GENERATOR SWITCH IS POSITIONED TO ON AND GENERATOR REVERSE CURRENT RELAY IS NOT CLOSED. THE LIGHT GOES OFF WHEN THE GENERATOR REVERSE CURRENT RELAY PILOT COIL IS ENERGIZED AND OPERATES THE LIGHT RELAY.

3a. DO NOT REMOVE VOLTAGE REGULATOR EXCEPT IN AN EMERGENCY.

b. MAKE CERTAIN THE ELECTRICAL SYSTEM (REGULATOR, GENERATOR, REVERSE CURRENT RELAY, AND WARNING LIGHT CIRCUIT) IS FUNCTIONAL AFTER ANY INSPECTION OR OVERHAUL WHICH MAY AFFECT THE ELECTRICAL SYSTEM.

c. WHEN CHECKING THE ELECTRICAL SYSTEM, TURN OFF ALL ELECTRICAL EQUIPMENT (BATTERY, RADIO, RADAR LIGHTS, ETC) WHICH WOULD BE AFFECTED BY OVERVOLTAGE. EVERY EFFORT SHOULD BE MADE TO KEEP VOLTAGE BELOW 35 VOLTS.

d. IN EVENT AN ELECTRICAL SYSTEM MALFUNCTION TRIPS ONE OR BOTH GENERATORS OF BUS, TURN OFF.

Figure 3-10 (Sheet 1 of 2).

MALFUNCTIONS OF MULTI-GENERATOR D-C ELECTRICAL SYSTEM

IMMEDIATE ACTION	CORRECTIVE ACTION
PLACE FAILED GENERATOR SWITCH IN OFF POSITION. (SEE NOTE 3f.)	1. PLACE GENERATOR SWITCH TO ON POSITION AND SEE IF GENERATOR PICKS UP LOAD. IF AMMETER DOES NOT SHOW LOAD, PLACE GENERATOR SWITCH TO THE OFF POSITION.
PLACE GENERATOR SWITCH TO OFF THEN ON. IF GENERATOR DOES NOT SHOW LOAD, PLACE SWITCH IN THE OFF POSITION. (SEE NOTE 3f.)	2. NONE
TURN GENERATOR SWITCH OFF. (SEE NOTE 3f.)	3. NONE
SEE NOTE 3g.	4. CHECK VOLTAGE REGULATOR FOR OPEN OR SHORTED CONTACTS ON REGULATOR BASE.
OPERATE GENERATOR SWITCHES INDIVIDUALLY TO OFF THEN ON. IF SYSTEM DOES NOT OPERATE CORRECTLY PROCEED PER NOTE 3g.	5. SAME AS 4.
ACT FAST. TURN OFF BATTERY SWITCH. TURN OFF GENERATOR SWITCHES. OPERATE ON EMERGENCY POWER IF AVAILABLE.	6. NONE
PLACE THE GENERATOR MAIN LINE SWITCH TO OFF. (SEE NOTE 3f.)	7. SAME AS 4.
SWITCH OFF AFFECTED GENERATOR; BE PREPARED FOR POSSIBLE GENERATOR FIRE (SEE NOTE 3f.) REMOVE VOLTAGE REGULATOR IF POSSIBLE. (SEE NOTE 3a.)	8. SAME AS 4.
REPLACE BURNED OUT LIGHTS (SEE NOTE 3g.)	9. PRESS FIXTURE TO TEST LAMP. OPERATE GENERATOR SWITCH OFF AND ON TO CLEAR POSSIBLE OPEN SWITCH CONTACT. REPLACE LAMP AND RECHECK BY PRESSING FIXTURE.
ACT FAST. TURN OFF BATTERY SWITCH. TURN OFF GENERATOR SWITCHES. OPERATE ON EMERGENCY POWER IF AVAILABLE.	10. NONE
ACT FAST. SWITCH OFF BATTERY. SWITCH OFF GENERATORS. SWITCH BATTERY ON. SWITCH LOW GENERATOR ON. MONITOR LOAD FOR NORMAL OPERATION. MOST LIGHTING AND RADIO CIRCUITS WILL PROBABLY BURN OUT. REPLACE BURNED-OUT LAMPS.	11. REMOVE REGULATOR. SAME AS 4. (SEE NOTE 3a.)
REMOVE VOLTAGE REGULATOR IF POSSIBLE. PLACE GENERATOR SWITCH TO OFF (SEE NOTES 3f AND 3a.)	12. NONE

BATTERY SWITCH IMMEDIATELY. TURN ON EMERGENCY POWER SYSTEM IF AVAILABLE. DO NOT PLACE BATTERY ON LINE PRIOR TO CLEARING ELECTRICAL SYSTEM MALFUNCTION.

e. WITH BATTERY SWITCH OFF AND BATTERY RELAY OPEN, POWER IS SUPPLIED TO THREE ITEMS.

1. BAIL-OUT BELL.
2. MAIN JUNCTION BOX INTERNAL LIGHT.
3. CB FIRE EXTINGUISHING SYSTEM.

f. IF GENERATOR FAILURE OCCURS, THE AMMETER OF THE REMAINING GENERATOR SHOULD BE IMMEDIATELY CHECKED FOR OVERLOAD AND NON-ESSENTIAL ELECTRICAL EQUIPMENT TURNED OFF. IF NECESSARY, MONITOR REMAINING GENERATOR AMMETER TO PREVENT OVERLOADS.

g. IF TWO-GENERATOR POWER CAPACITY IS REQUIRED, MONITOR BOTH AMMETERS FOR POSSIBLE OVERLOAD. TURN OFF ALL NON-ESSENTIAL ELECTRICAL EQUIPMENT. IT IS PREFERRED THAT THE DEFECTIVE GENERATOR BE TURNED OFF.

Figure 3-10 (Sheet 2 of 2)

b. Reduce the airspeed, if possible, to approximately 100 knots (115 mph) IAS.

c. Put aircraft on autopilot control.

d. Don an antiexposure suit and life vest if over water, adjust parachute.

e. Place alarm bell on continuous signal, give signal for "bail-out" over interphone/PA system.

f. After receipt of "All clear" signal from the co-pilot, the pilot will order him to bail out and will follow him out.

Co-Pilot.

The co-pilot will:

a. Acknowledge the pilot's bail-out instructions and adjust his parachute. Don an antiexposure suit and life vest if over water. Adjust parachute.

b. Transmit emergency voice signals.

c. Turn on landing lights (night only).

d. Assist pilot until bail-out signal is given.

e. Evacuate aircraft on the final bail-out signal.

Navigator (C-47 and R4D Series Aircraft).

The navigator will:

a. Acknowledge pilot's bail-out instructions, adjust his parachute, and don an antiexposure suit and life vest if over water.

b. Give final aircraft position report to the pilot, co-pilot, and radio operator.

c. Unlock door and kick down on the yellow emergency release latch at the main cargo door forward end and push the door from the aircraft.

WARNING

The person jettisoning cargo door will be secured to the interior of the aircraft fuselage.

NOTE

On some aircraft there is no provision for jettisoning the air stair door.

d. Evacuate aircraft on final bail-out signal.

Radio Operator.

The radio operator will:

a. Acknowledge pilot's bail-out instructions.

b. Transmit distress signal and position report, and continue to do so until the final bail-out signal.

c. Don an antiexposure suit and life vest if over water, adjust parachute.

d. Screw down the transmitter key.

e. Evacuate the aircraft on final bail-out signal, taking code book and radio operator's flimsy (notebook).

Flight Mechanic or Steward.

The flight mechanic or the steward will:

a. Prepare passengers for bail-out.

b. Don an antiexposure suit and life vest if over water, adjust parachute.

c. Control movement of passengers to main cargo door.

d. Bail out after all passengers have evacuated.

OVERWATER RECOMMENDATIONS.

Bail-out is not recommended unless visual contact is made with adequate surface help. If no rescue vessels are in the vicinity, bail-out should be used only as a last resort because of the extreme difficulty of getting the crew together in the water. The life rafts offer survival and signaling equipment. In any but the warmest seas, a man will survive only a few hours if kept afloat by means of a life vest alone. Wearing an anti-expsoure suit will increase this time, but this still cannot compare with the length of time survival is possible in a life raft. If bail-out is required or decided upon, the following procedure is recommended:

a. If surface help is available, it is much easier for rescue crews to find and rescue 2 or 3 men at a time in a small area than to rescue 10 or more men strung out in a long line in the water. Always head the aircraft in a direction to allow the crew to drift into the course and just ahead of rescue vessel.

b. If surface help is not available, it is still important to keep the crew as close together as possible in the water. Individual members can aid each other, especially if some of them are injured. Most important of all, a group of life rafts is much easier to find than a single individual. This is true whether the search is from a surface vessel or from an aircraft. Therefore, inflated rafts should be jettisoned if possible. Then the aircraft should be flown in as tight a circle as conditions will permit, bailing out three or four men at a time, and then come around in relation to the other men or the surface vessel, before bailing out the other members. This will place the members as close as possible to the other men or the surface vessel.

c. As in ditching, try to plan the bail-out before the last minute. The pilot must warn the crew as soon as bail-out is decided upon. Give three short rings on the alarm bell, or warn the crew on the interphone and receive acknowledgements.

d. When the bail-out warning is given, crew members should check each other's equipment to insure that all straps and packs are properly secured and adjusted. Upon receiving the bail-out signal, crew and passengers will leave with the least possible delay, through the main cabin door, in accordance with the above procedure, or as prescribed by the pilot to cope with the particular emergency.

FUEL SYSTEM FAILURE.

VAPOR LOCK.

Vapor lock can cause malfunction of the fuel system when the fuel boils or when the fuel is supersaturated with air. The usual indications start with regular and rapid engine surging at high frequency, usually followed by an irregular surge of greater magnitude with extreme fuel pressure fluctuation. Vapor lock can be corrected by retarding the throttle and placing the fuel booster pump ON.

ELECTRICAL POWER SYSTEM FAILURE.

GENERATORS.

(See figure 3-10, Malfunctions of Multi-Generator D-C Electrical Systems.)

If there is no indication on one ammeter, but the other indicates a normal reading, make the following check.

If the switch for the malfunctioning generator is ON, turn it OFF and see whether the reading of the other ammeter increases. If it does, the trouble may be attributed to the instrument and the generator may be turned on again.

On aircraft with the priority bus system installed, if the bus priority relay disconnects the No. 2 bus system for any reason, the remaining generator will automatically supply power to the failed bus.

HYDRAULIC POWER SYSTEM FAILURE.

Failure of the normal hydraulic system will usually be indicated by the loss of both system pressure and of fluid in the sight gage on the hydraulic control panel.

NOTE

During flight when hydraulic units are being operated, the movement of fluid within the reservoir may draw the fluid from the level sight gage; however, when no hydraulic units are being operated, the fluid level in the sight gage will rise.

In the event of system failure place the controls of all hydraulically operated units in the OFF positions.

NOTE

The hydraulic fluid reserve of 3 quarts does not show on the sight gage.

COWL FLAP EMERGENCY OPERATION.

If a loss of hydraulic pressure occurs and it is necessary to operate the cowl flaps, turn the cowl flap handle to the required position, operate the hydraulic hand pump until the desired cowl flap position is obtained, and turn the cowl flap handle to the OFF position.

WING FLAP EMERGENCY OPERATION.

If a loss of hydraulic pressure occurs and it is necessary to operate the wing flaps, move the wing flap lever to the desired position, actuate the hydraulic hand pump, then return flap lever to neutral.

LANDING GEAR SYSTEM FAILURE.

LANDING GEAR EMERGENCY EXTENSION.

a. Star valve – OFF.

b. Landing gear lever – DOWN.

c. Operate the hydraulic hand pump until the gear is down and spring locked. Visually observe the gear position.

d. Landing gear lever – NEUTRAL.

CAUTION

Place latch lever in POSITIVE LOCK position only after the gear is fully extended and normal pressure is indicated, since the spring lock action catch is locked closed in the POSITIVE LOCK position.

e. Check landing gear warning lights – Green light ON, red light OFF.

f. Landing gear latch lever – POSITIVE LOCK.

g. Check landing gear warning horn for gear down and locked indication by retarding a throttle.

LANDING GEAR HYDRAULIC LINE FAILURE.

In the event of a complete line failure, the gear can be snapped down so that the latches will engage. Return the landing gear lever to NEUTRAL as soon as it is certain that the safety latches have engaged, so as to conserve all the fluid and pressure possible for wing flap and brake operation. If the above condition exists, the green landing gear warning light will go on when the lever is returned to NEUTRAL, but the pressure shown on the landing gear system pressure gage may fall rapidly to zero.

LANDING GEAR SAFETY LATCH FAILURE.

The aircraft may be safely landed whether or not the landing gear safety latches are engaged, providing the landing gear is fully down, the hydraulic system pressure is 850 to 900 psi, and the landing gear lever is in the DOWN position. Pressure in the landing gear actuating struts is indicated on the landing gear pressure gage. The horn will continue to sound and the red light will stay on, since the switches are connected to the safety latch and landing gear lever. When landing under these conditions, the gear is held in the extended position by the pressure of the hydraulic fluid against the retracting strut pistons. When the brakes are applied, the resulting rotative force will have a tendency to cause the gear to retract, moving the pistons up in the struts and resulting in an increased pressure in the landing gear downlines. To eliminate the possibility of a line failure due to the excessive rise in pressure caused by the piston moving up in the strut, the brakes should be used only if absolutely necessary. If the length of the runway necessitates the use of the brakes, apply them as lightly as possible and, in any event, limit the pressure applied to the brakes so that the pressure indicated on the landing gear pressure gage does not exceed 1500 psi.

LANDING WITHOUT HYDRAULIC SYSTEM PRESSURE.

A landing without fluid pressure would be necessary only in case of failure in the lines from the hand pump to the retracting struts. In this case, the landing gear down position latches will hold the gear in place, and a safe landing can be made. Move the landing gear lever to the DOWN position to allow as much fluid as possible to get into the actuating strut, and then zoom the aircraft as required to snap down the gear and engage the latches. Return the control handle to NEUTRAL. If the warning light is green, it indicates that the latches have engaged and a normal landing can be made.

BRAKE SYSTEM FAILURE.

If the pressure gage reads below 600 psi and the hydraulic system is connected to the operating engine, or if both engines are operating and the pressure gage reads below 600 psi, carry out the hydraulic braking operation with the aid of the hydraulic hand pump, leaving the star valve in the OFF position. The co-pilot should operate the hydraulic hand pump to supply pressure to the brakes. The pump handle will move each time the brakes are applied. About 50 pounds pull should be exerted on the pump handle continuously until the brakes are no longer required. When the brakes are hand-operated in this manner, no pressure will show on the gage. Apply the brakes with one steady application.

EMERGENCY ABBREVIATED CHECK LIST.

Your emergency abbreviated checklists are now contained in T. O. 1C-47-CL-1-1, -1-2, -1-3, -1-4, and -1-5.

SECTION IV
DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

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HEATING AND VENTILATING SYSTEM

This heating and ventilating system *(figure 4-1)* is the exhaust-heated type and consists of two heat exchangers, one mounted on each engine exhaust tailpipe, two mixing chambers, two nacelle spill valves, a 28-volt d-c emergency defrosting blower for windshield and astrodome defrosting, four 28-volt d-c critical temperature warning lights, two critical temperature thermoswitches, the necessary insulated ducting, airscoops, outlet valves, and controls. Ram air entering the heat exchanger is heated by the exhaust tailpipe, then routed through the nacelle spill valve to the mixing chamber. Here the heated air is mixed with ram air from a scoop in the proportions necessary for regulating the temperature, and routed to the various outlets. The left heat exchanger supplies heated air to the main cabin outlets, the windshield and astrodome defroster outlets, the pilots' handwarmer outlets, and the navigator's station outlets. The right heat exchanger supplies heated air to the radio operator's station outlets, the pilots' footwarmer outlets, and the autopilot servo unit housing. The hot air flow from the heat exchangers is continuously supplied to the heating system when the engines are operating. Heating system operation is discontinued by positioning the nacelle spill valve controls to spill the hot air flow, from the left and/or right heat exchanger, overboard. Ventilation for hot weather operation is obtained by spilling the heated air overboard and permitting only the ram air flow from the mixing chamber airscoops to be routed through the system. In addition, each outlet location is provided with a control valve to regulate the flow of heated or ventilated air, as desired. Two control boxes, one located in the cockpit and one located at the radio operator's station, contain the necessary controls for regulating the temperature in the fuselage compartments. The two spill valves, one in each nacelle, are controlled from the radio operator's control box. A defrosting control valve at the navigator's station controls the flow of air to the main cabin and defrosting outlets, and turns on the emergency defrosting blower.

MIXING CHAMBER CONTROL KNOBS

Two push-pull mixing chamber control knobs placarded HOT-COLD, one located on the control box *(figure 4-1)* at the radio operator's station, and the other located on the control box *(figure 4-1)* behind the co-pilot's seat, are used to mechanically position the butterfly valves in the left and right mixing chambers respectively. When the knob on the co-pilot's control box is in the HOT position, the valves in the right mixing chamber are positioned to shut off the ram air flow from the airscoop and open the hot air flow from the right heat exchanger to supply the respective outlets with heated air. When the knob is in the COLD position, the valves are positioned to shut off the hot air flow from the right heat exchanger and open the ram air flow from the airscoop to supply the respective outlets with ventilating air. Any intermediate position of the control knob will provide a mixture of ram and heated air in proportion to the control knob setting. The left mixing chamber control knob at the radio operator's station controls the ram and hot air flow from the left mixing chamber, and functions in the same manner as the right mixing chamber control knob at the co-pilot's station.

NACELLE SPILL VALVE CONTROL KNOBS

Two nacelle spill valve control knobs, placarded HEAT-SPILL, are located on the control box *(figure 4-1)* at the radio operator's station. These push-pull knobs are used to spill the heated air overboard when heating system operation is not desired, or during hot weather operation when cold air flow is desired or when a critical temperature warning light illuminates. When either control knob is in the SPILL position, the corresponding spill valve is opened mechanically to exhaust the heated air overboard. When the knob is in the HEAT position, the spill valve is closed, and the heated air is routed to the mixing chamber and distribution ducts. No intermediate positions are provided for the spill valves.

DEFROSTING CONTROL VALVE HANDLE

A mechanically operated defrosting control valve handle *(figure 4-1)*, located at the navigator's station, controls the flow of heated air from the left heat exchanger to the windshield, astrodome, and the main cabin compartment, and also turns ON the emergency defroster blower. The control handle has the following placarded positions: NORMAL DEFROST-BLOWER OFF, CABIN HEAT, and EMER DEFROST-BLOWER ON. When the control handle is placed in NORMAL DEFROST-BLOWER OFF position, the control valve is positioned to shut off the heated air flow to the main cabin and route heated air to the pilots' handwarmer outlets and to the windshields and astrodome for defrosting. When the handle is positioned to CABIN HEAT, the control valve shuts off the heated air flow to the defroster outlets and routes heated air to the main cabin compartment. When the control handle is moved to the EMER DEFROST-BLOWER ON position, the emergency defrosting control valve shuts off the cabin heat, routes the heated air flow to the emergency defrosting blower, and automatically positions a 28-volt d-c spring-loaded switch to turn ON the emergency defrosting blower motor to supply an increased quantity of heated air to the pilots' handwarmer outlets and to the windshields and astrodome for defrosting. When the control is moved from this position, the switch automatically returns to OFF position, shutting off the blower motor.

AIR OUTLET CONTROL HANDLES

The air outlet control handles, one located at each air outlet at the crew stations, mechanically control the amount of air released through the outlets.

CRITICAL TEMPERATURE WARNING LIGHTS

Four 28-volt d-c critical temperature warning lights are provided, two on the main instrument panel (17, figure 1-11, 17, and 19, figure 1-12), and two above the control box at the radio operator's station. The two warning lights at each station, one for the RIGHT spill valve and one for the LEFT spill valve, are illuminated by thermoswitches located on the right and left spill valve assemblies (figure 4-1) when temperatures exceed approximately 232°C (450°F). The respective warning light or lights will go out when the temperature falls below these limits.

DEFROSTER FANS AND SWITCHES

Two 28-volt d-c defrosting fans are installed, one above and aft of the pilot's seat, and the other above and aft of the co-pilot's seat. A defroster fan switch is located on top of each fan. When the switch is positioned ON, a 28-volt d-c circuit is closed to start the fan motor. When the switch is positioned OFF, the fan circuit is opened.

HEATING AND VENTILATING SYSTEM OPERATION

Heating (Flight or Ground).

1. Individual air outlet control handles — Open (as required).
2. Mixing chamber control knobs — HOT (or as required for desired temperature).
3. Nacelle spill valve control knobs — HEAT.
4. Defrosting control valve handle — CABIN HEAT (if required).

HEATING AND VENTILATING SYSTEM - TYPICAL

C47 AND R4D SERIES AIRCRAFT

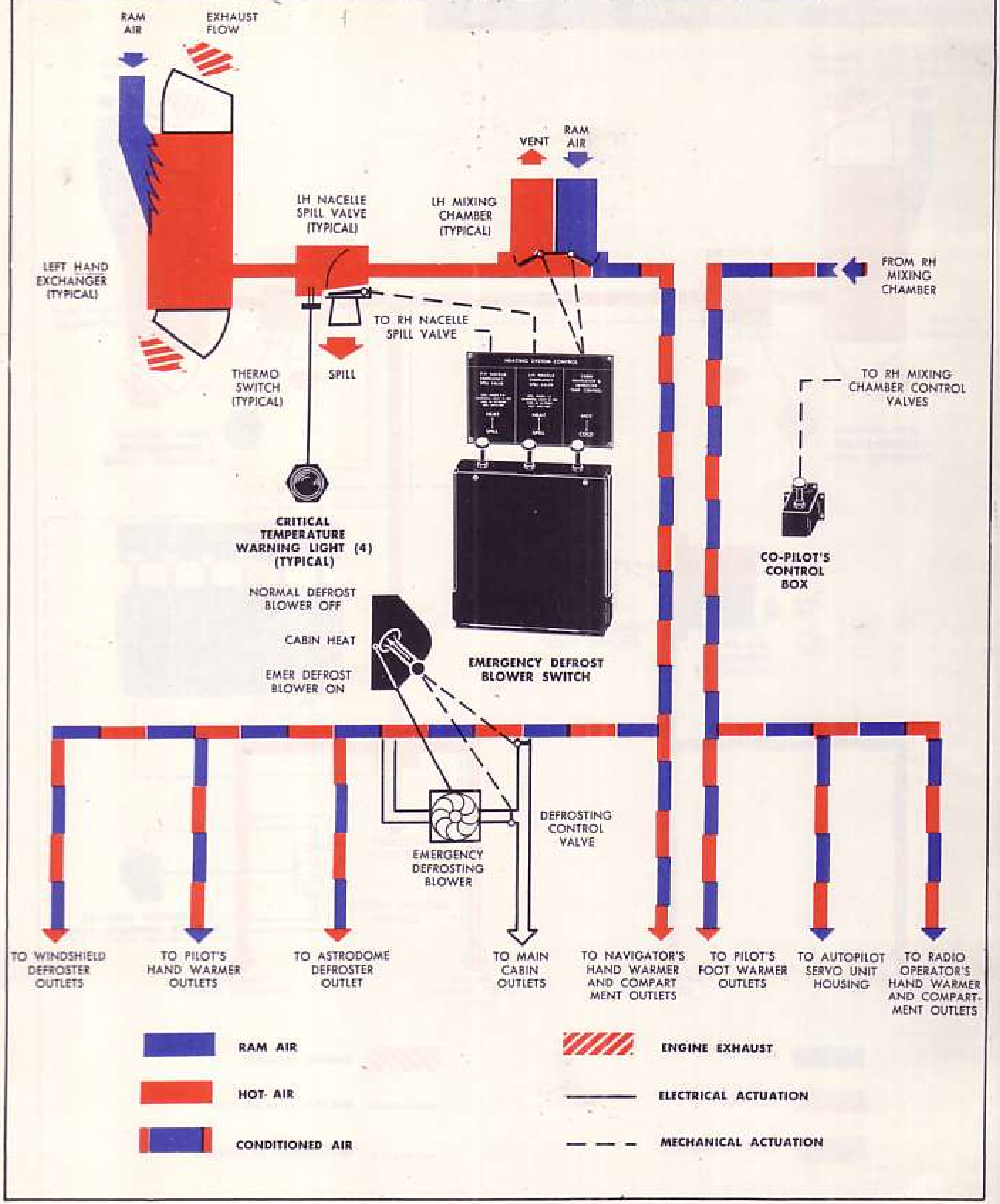


Figure 4-1

HEATING AND VENTILATING SYSTEM
C117 SERIES AIRCRAFT

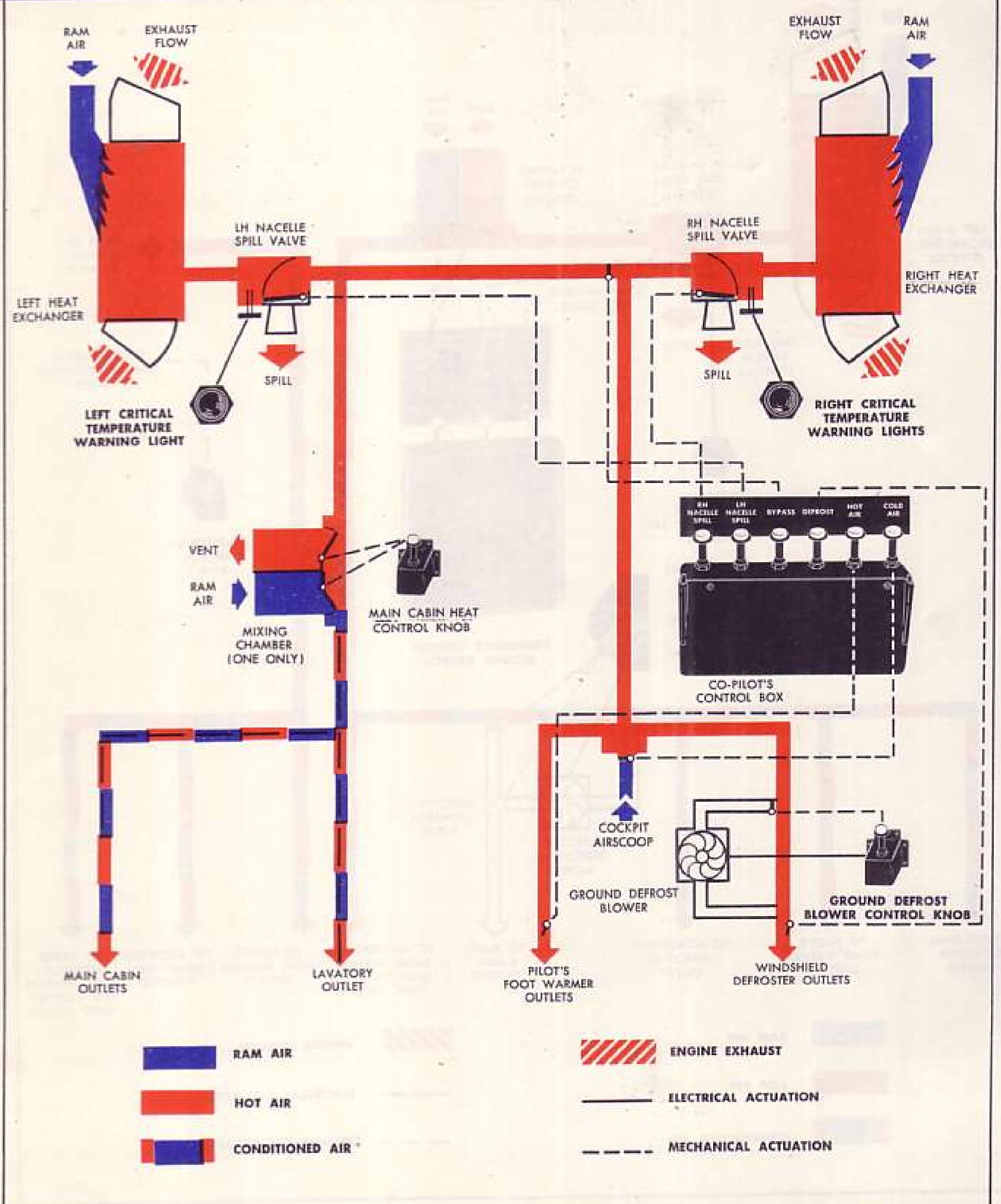


Figure 4-2

CAUTION

If a critical temperature warning light illuminates, it is imperative that the respective nacelle spill valve be opened immediately to spill the heated air overboard. When the light goes out, the spill valve may be closed again.

If an engine is feathered, the respective spill valve should be opened to spill the air overboard, and the respective mixing chamber control knob should be placed in HOT position, to eliminate air flow through the system.

Ventilating.

1. Individual air outlet controls — OPEN (as required).
2. Nacelle spill valve control knobs — SPILL.
3. Mixing chamber control knobs — COLD (or as required for desired ventilation).
4. Defrosting control valve handle — CABIN HEAT (if main cabin ventilation is required).

Windshield and Astrodome Defrosting (Normal Operation).

1. Navigator's station heat outlet — CLOSED.
2. Mixing chamber control knob at radio operator's station — HOT.
3. Left nacelle spill valve control knob — HEAT.
4. Defrosting control valve handle — NORMAL DEFROST-BLOWER OFF.

Note

Cabin heat is not available during defrosting operation. The mixing chamber control knob at the co-pilot's station may be positioned to HOT to furnish heat to the cockpit and the radio operator's station, as desired, during defrosting operation.

Windshield and Astrodome Defrosting (Emergency Operation).

1. Navigator's station heat outlet — CLOSED.
2. Mixing chamber control knob at radio operator's station — HOT.
3. Left nacelle spill valve control knob — HEAT.
4. Defrosting control valve handle — EMER DEFROST-BLOWER ON.

CARGO SPACE HEATER.

A gasoline heater, with a rated output of 200,000 BTU per hour is installed in the aft end of the cargo compartment. It is a fuel injection type heater. For operation the heater requires gasoline, from the regular fuel system, under pressure, electric current for ignition, and a flow of combustion and ventilating air. A control panel is mounted on the heater.

HEATER OPERATION:

1. Turn on inverter at the power systems junction box.
2. Put manual heater valve in the OPEN position.
3. Turn the heater switch ON.
4. Use manual heat control to obtain the required cabin temperature.

HEATER OPERATION FOR VENTILATION:

1. Turn heater switch OFF.
2. Put manual heater valve in OPEN position.
3. Maximum ventilation is obtained when the manual heat control is in the OPEN position.

NOTE

To shut off all airflow put the manual heater valve in the CLOSED position and the manual heat control in the HOT position.

HEATING AND VENTILATING SYSTEM (C-117 SERIES AIRCRAFT).

The heating and ventilating system *(figure 4-2)* is the exhaust-heated type and consists of two heat exchangers, one mounted on each engine exhaust tailpipe, one mixing chamber, two nacelle spill valves, a 28-volt d-c ground defroster blower for windshield defrosting, two 28-volt d-c critical temperature warning lights, two critical temperature thermoswitches, the necessary insulated ducting, airscoops, outlet valves and controls. Ram air entering the heat exchangers is heated by the exhaust tailpipe, then routed through the nacelle spill valves to the mixing chamber. Here the heated air is mixed with ram air from a scoop in the proportions necessary for regulating the temperature in the main cabin and lavatory. A bypass duct is connected to the ducting from the right heat exchanger to route the heated air through a bypass valve to the cockpit for the pilots' footwarmer outlets, and the windshield defroster outlets. When the bypass control valve is positioned to route the maximum quantity of heated air to the cockpit outlets, 80 per cent of the heated air from the right heat exchanger will bypass the mixing chamber and be routed to the cockpit outlets. The heated air from the left heat exchanger and a portion of the heated air from the right heat exchanger (depending on the position of the bypass valve control) is routed to the mixing chamber for distribution to the main cabin and lavatory outlets *(figure 4-2)*. Ventilation for hot weather operation is obtained by spilling the heated air overboard and permitting only the cold air flow through the system. The two spill valves, one in each nacelle, are controlled from the cockpit. During flight, ventilation for the main cabin is supplied by two ram air ducts extending along either side of the main cabin ceiling, with outlets at the passenger seat locations and in the lavatory. The supply of ventilating air to the main cabin is regulated by controls on the main cabin forward bulkhead. A ground air conditioning inlet, located on the right side of the aircraft adjacent to the lavatory, provides for ventilation of the main cabin from an external source. Two control boxes, one located in the cockpit and one located on the right forward side of the main cabin bulkhead, contain the necessary controls for regulating the temperature in the cockpit and the main cabin areas. An airscoop, mounted on the fuselage below the cockpit, is provided to admit ram air through the ducting to the pilots' footwarmer outlets for ventilation, or for mixture with the heated air flow during heating system operation. A control is provided in the cockpit to regulate the air flow from the scoop. The ground defroster blower is energized by a control in the cockpit. A carbon monoxide warning system is provided to indicate the presence of carbon monoxide in the heating system by illuminating a warning light in the cockpit.

MAIN CABIN HEAT CONTROL KNOB (C-117 SERIES AIRCRAFT).

A main cabin heat control knob *(figure 4-2)*, located on the right forward side of the main cabin bulkhead, is used to mechanically position the butterfly valves in the mixing chamber. The control knob has COLD and HOT positions. When the knob is moved to the COLD position, the valves in the mixing chamber are positioned to shut off the hot air flow and open the ram air flow. When the control knob is moved to the HOT position, the valves are positioned to shut off the ram air flow and open the hot air flow. Intermediate positions of the control knob will provide a mixture of ram and hot air in proportion to the control knob setting.

NACELLE SPILL VALVE CONTROL KNOBS (C-117 SERIES AIRCRAFT).

Two nacelle spill valve control knobs, one for the right nacelle spill valve and one for the left nacelle spill valve, are located on the control box *(figure 4-2)* behind the co-pilot's seat. These push-pull control knobs placarded HEAT-DUMP are used to spill the heated air overboard when heating system operation is not desired, or during hot weather operation when a cold air flow is desired, or when a critical temperature warning light illuminates. When either control knob is moved to the DUMP position, the spill valve is mechanically opened to exhaust the heated air overboard. When the knob is moved to the HEAT position, the spill valve is closed, and the heated air is routed to the mixing chamber and distribution ducts. No intermediate positions are provided for the spill valves.

BYPASS CONTROL KNOB (C-117 SERIES AIRCRAFT).

A bypass control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, mechanically regulates the bypass valve to control the proportion of hot air desired in the cockpit. When the control knob is moved to the PILOT position, the bypass valve is positioned to deliver a maximum quantity of heated air to the cockpit. When the knob is moved to the MIXING CHAMBER position, the bypass valve is positioned to deliver a maximum quantity of heated air to the mixing chamber. Intermediate positions of the control knob will provide a flow of hot air in proportion to the control knob setting.

COLD AIR CONTROL KNOB (C-117 SERIES AIRCRAFT).

A cold air control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, is used to regulate the valve in the inlet of the cockpit airscoop. When the control knob is in the COLD position, the valve is mechanically positioned to admit ram air through the ducting to the pilots' footwarmer outlets and windshield defroster outlets. When the knob is in the OFF position, the valve is positioned to shut off the ram air supply. Intermediate positions of the control knob will provide a flow of ram air in proportion to the control knob setting.

DEFROSTER HEAT CONTROL KNOB (C-117 SERIES AIRCRAFT).

A defroster heat control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, controls the flow of hot air to the windshield for defrosting by positioning a valve in the outlet ducting. When the control knob is moved to the ON position, the valve is opened to route hot air to the windshield for defrosting. When the knob is moved to the OFF position, the valve is closed, shutting off the hot air flow to the windshield. Intermediate positions of the control knob provide heated air flow in proportion to the control knob setting.

HOT AIR CONTROL KNOB (C-117 SERIES AIRCRAFT).

A hot air control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, is placarded MAX. DEFROST and COCKPIT and is used to position a valve in the pilots' footwarmer outlets. When the control knob is moved to the MAX. DEFROST position, the valve is mechanically closed and a greater quantity of heated air is routed to the defroster outlets. When the knob is moved to the COCKPIT position, the valve is opened to supply hot air to the pilots' footwarmers. Intermediate positions provide a hot air flow to the footwarmers in proportion to the control knob setting.

GROUND DEFROSTER BLOWER CONTROL KNOB (C-117 SERIES AIRCRAFT).

A ground defroster blower control knob *(figure 4-2)*, located above and to the rear of the co-pilot's seat, has the placarded positions GROUND BLOWER and FLIGHT. When the knob is moved to the GROUND BLOWER position, a valve in the blower duct is opened and a spring-loaded switch is automatically positioned to close a 28-volt d-c circuit in order to turn ON the ground defroster blower to supply air to the windshields for defrosting during ground operation. When the control knob is moved to the FLIGHT position, the blower switch automatically returns to the OFF position, shutting off the blower motor, and the valve is closed. During flight, the ground defroster blower control should be in the FLIGHT position; however, during emergency defrosting conditions, the GROUND BLOWER position may be used to supply an increased quantity of heated air to the windshields.

CRITICAL TEMPERATURE WARNING LIGHTS (C-117 SERIES AIRCRAFT).

The two 28-volt d-c critical temperature warning lights, placarded RIGHT and LEFT, are located on the main instrument panel (17, figure 1-11). The warning lights are illuminated by thermoswitches located in the right and left spill valve assemblies *(figure 4-2)* when temperatures exceed approximately 232°C (450°F). The respective warning light or lights will go out when the temperature falls below these limits.

CARBON MONOXIDE WARNING LIGHT AND RESET BUTTON (C-117 SERIES AIRCRAFT).

A 28-volt d-c carbon monoxide warning light, installed on the main instrument panel (30, figure 1-11), is controlled by a 28-volt d-c carbon monoxide control box and signal assembly mounted on the left forward side of the main cabin bulkhead. This assembly samples the air from the heat exchangers, and, if concentrations of more than 0.005 to 0.007 per cent of carbon monoxide are detected, a bimetal element switch is activated and in turn illuminates the carbon monoxide warning light. The 28-volt d-c reset button, located immediately left of the carbon monoxide warning light (31, figure 1-11), is used to check the warning light circuit.

DEFROSTER FANS AND SWITCHES (C-117 SERIES AIRCRAFT).

Two 28-volt d-c defrosting fans are installed, one above and aft of the pilot's seat, and the other above and aft of the co-pilot's seat. A 28-volt d-c ON-OFF switch is located on top of each fan. When the switch is positioned to ON, a 28-volt d-c circuit is closed to start the fan motor. When the switch is positioned to OFF, the fan circuit is opened.

CABIN COLD AIR VENTILATION SYSTEM (C-117 SERIES AIRCRAFT).

Additional ventilation for the main cabin is supplied by two ram airscoops, one located on either side of the fuselage. The ram air from the scoops is ducted along either side of the main cabin interior to the adjustable swivel-type outlets at each passenger seat location and in the lavatory. Controls for regulating the ram air flow through the system are located on the main cabin forward bulkhead.

Cabin Cold Air Control Knobs.

Two cabin cold air control knobs, with OPENED and CLOSED positions, are located on the main cabin forward bulkhead, one on either side. When the control knobs are in the OPENED position, the inlet valve in each cabin cold air duct is mechanically opened to admit ram air to the main cabin. When the control knobs are in the CLOSED position, the inlet valves are closed to shut off the cold air supply.

HEATING AND VENTILATING SYSTEM OPERATION (C-117 SERIES AIRCRAFT).

Heating (Flight or Ground).

1. Nacelle spill valve control knobs — HEAT.
2. Mixing chamber control knob — HOT.
3. Cold air control knob — OFF.
4. Bypass control knob — PILOT (or as desired).
5. Hot air control knob — COCKPIT.

6. Defroster heat control knob — OFF.

CAUTION

If a critical temperature warning light illuminates, it is imperative that the respective nacelle spill valve be opened immediately to spill the heated air overboard. When the light goes out, the spill valve may be closed again. If an engine is feathered, the respective nacelle spill valve should be opened to spill the air overboard, and the mixing chamber control knob should be placed in the HOT position, to eliminate air flow through the system.

Ventilating.

1. Nacelle spill valve control knobs — DUMP.
2. Cold air control knob — ON.
3. Main cabin heat control knob — COLD.
4. Bypass control knob — MIXING CHAMBER.
5. Hot air control knob — COCKPIT.
6. Cabin cold air control knobs — OPENED.
7. Main cabin individual cold air outlets — As desired.

Windshield Defrosting (Normal Operation).

1. RH nacelle spill valve control knob — HEAT.
2. Cold air control knob — OFF.
3. Bypass control knob — PILOT.
4. Defroster heat control knob — ON.
5. Hot air control knob — MAX. DEFROST (if required).
6. Ground defroster blower control knob — FLIGHT.

Windshield Defrosting (Emergency Operation).

1. RH nacelle spill valve control knob — HEAT.
2. Cold air control knob — OFF.
3. Bypass control knob — PILOT.
4. Defroster heat control knob — ON.
5. Hot air control knob — MAX. DEFROST.
6. Ground defroster blower control knob — GROUND BLOWER.

CARBON MONOXIDE INDICATION (C-117 SERIES AIRCRAFT).

If the carbon monoxide warning light illuminates, check for presence of carbon monoxide as follows:

1. Flight crew — Don oxygen masks and place diluter lever at 100% OXYGEN.
2. Press the carbon monoxide reset button for a minimum of 3 seconds.
3. Place the right nacelle spill valve control knob in the HEAT position.
4. Place the left nacelle spill valve control knob in the DUMP position.
5. Wait a few seconds for the signal assembly to indicate. If the red light illuminates, carbon monoxide is in the right heat exchanger.
6. Reverse the positions of the nacelle spill valve control knobs and test the left heat exchanger in the same manner.
7. Place the nacelle spill valve control knob for the faulty heat exchanger in the DUMP position.
8. Place the main cabin heat control knob in the COLD position to ventilate.

ANTI-ICING AND DEICING SYSTEMS.

PROPELLER DEICING SYSTEM.

The propeller deicing system utilizes isopropyl alcohol supplied from a 4 US gallon supply tank located behind the pilot's seat. The system includes a pump mounted on a 28-volt d-c motor, a filter, a shutoff valve, a slinger ring on each propeller hub, and the necessary piping. A switch and rheostat is located in the cockpit to energize the pump motor circuit and control the speed of the pump motor. The fluid is pumped from the supply tank through the shutoff valve and filter into the slinger rings. Distributor lines from the rings supply each blade. For fluid specification and filler point location, see figure 1-30.

Propeller Deicer Switch.

An ON-OFF propeller deicer switch is mounted on the electrical control panel (12, figure 1-13, 10, and 5, figure 1-14). When the propeller deicer switch is in the ON position, a 28-volt d-c circuit is completed to the propeller deicer rheostat. The OFF position opens the circuit to the rheostat.

Propeller Deicer Rheostat.

A propeller deicer rheostat, located to the right of and behind the pilot's seat (13, *figure* 1-6 *and 14, figure* 1-8), completes a 28-volt d-c circuit to the pump motor and controls the speed of the motor. When the rheostat is in the ON position, the pump motor is energized, provided the propeller deicer switch is in the ON position. When the rheostat is in the full clockwise position, fluid will flow at the minimum rate (approximately ½ gallon per hour). When the rheostat is turned COUNTERCLOCKWISE from the full clockwise position, the fluid flow gradually increases until a maximum flow (approximately 3 gallons per hour) is reached when the rheostat is in the fully counterclockwise position. If the rheostat is turned counterclockwise beyond the maximum flow position, the pump motor will be turned OFF.

NOTE

On some aircraft the rheostat is reversed.

Propeller Deicer Valve Handle.

A propeller de-icer valve handle, located behind the pilot's seat and below the deicing fluid supply tank, mechanically positions the shutoff valve that controls deicing fluid flow to the propellers. The handle has unmarked OPEN and CLOSE positions. When the deicer valve is moved to the OPEN position (aligned with supply line), the shutoff valve is mechanically opened to supply deicing fluid to the propellers. Moving the deicer valve handle to the CLOSE position (at right angle to the supply line), closes the shutoff valve, stopping fluid flow through the system.

Propeller Deicer System Operation

1. To start, propeller deicer valve handle—OPEN (aligned with supply line).
2. Propeller deicer switch—ON.
3. Propeller deicer rheostat—ON (regulate as required).
4. To stop, propeller deicer rheostat—OFF.
5. Propeller deicer, switch—OFF.
6. Propeller deicer valve handle—CLOSE (right angle with supply line).

CARBURETOR DEICING SYSTEM

The carburetor deicing system furnishes alcohol to the carburetor air intake throat for the removal of ice. The carburetor deicing system and the windshield de-icing system utilize a common supply tank with a capacity of 11.5 US gallons. The supply tank is located under the right wing fillet, with the filler neck extending through the fillet. On some aircraft, a filler neck is also located behind the co-pilot's seat to replenish the carburetor and windshield alcohol supply during flight, if required. The system includes a pump mounted on a 28-volt d-c motor, a filter, and a relief valve to allow excess fluid to flow back into the tank in the event of excessive pressure. Operation of the pump motor is controlled by a switch located in the cockpit. A control valve is also provided in the cockpit to shut off the alcohol supply when carburetor de-icing is not required. With continuous operation, the fluid output of the pump is approximately 8 gallons per hour. For fluid specification and filler points, see figure 1-30.

Carburetor and Windshield Deicer Switch

The carburetor deicer switch, located on the electrical control panel (13, figure 1-13 and 8, figure 1-14), has ON and OFF positions. When the switch is placed ON, a 28-volt d-c circuit is closed to energize the pump motor to supply alcohol to the carburetors under pressure for continuous operation, provided the control valve handle is ON. In the OFF position, the circuit is opened to discontinue system operation. On some aircraft a 3-position 28-volt d-c windshield deicing switch (13, figure 1-13 and 23, figure 1-14) is located on the electrical control panel. When the switch is placed ON, the circuit is closed to energize the pump motor to supply alcohol to the windshield under pressure for continuous operation, provided the control valve handle is turned ON. When the switch is placed in the MOM (spring-loaded) position, momentary operation of the system is provided for occasions when it is desired to operate the system only during short intervals. In the OFF position, the circuit is opened to discontinue system operation.

Carburetor Deicing Control Valve Handle

The carburetor deicing control valve handle, located to the right of and above the co-pilot's seat *(6, figure* 1-7), controls the supply of alcohol from the supply tank to the carburetors. The handle is turned ON to supply alcohol for operation of the carburetor deicing system, provided the carburetor deicer switch is ON. The handle is turned OFF to shut off the fluid supply to the carburetors.

CARBURETOR DEICER SYSTEM (R4D SERIES AIRCRAFT).

The carburetor deicing system utilizes a 28-volt d-c pump motor to supply alcohol to the carburetor air intake throat for the removal of ice. The 11 US. gallon supply tank is located in the right forward baggage compartment. A shutoff valve is located immediately below the supply tank. Operation of the pump motor is controlled by a switch located in the cockpit. The fluid output of the pump for continuous operation is approximately 8 gallons per hour. For fluid specification and filler points, see figure 1-30.

Carburetor Deicer Switch (R4D Series Aircraft).

The carburetor deicer switch, located on the electrical control panel *(8, figure* 1-14), has ON, MOM, and OFF positions. When the switch is placed ON, a 28-volt d-c circuit is closed to energize the pump motor and supply alcohol to the carburetors under pressure for continuous operation, provided the shutoff valve below the supply tank is opened. When the switch is placed in the MOM (spring-loaded) position, momentary operation for short intervals is provided. In the OFF position, the circuit is opened to shut off the pump motor.

WINDSHIELD DEICING SYSTEM

The windshield deicing system is designed to furnish alcohol to the outside of the windshields to remove ice. The system utilizes the same supply tank and pump motor as the carburetor deicing system (see the paragraph on Carburetor Deicing System, this section). The alcohol sprayed on the front windshields can be used in conjunction with the windshield wipers. The pump is controlled by a switch in the cockpit, and the rate of alcohol flow to the windshields is controlled by a needle valve control located in the cockpit. A control valve is also provided to shut off the fluid supply when system operation is not necessary. For fluid specification and filler point location, see figure 1-30.

Windshield Deicing Control Valve Handles

Two windshield deicing control valve handles, one located to the left of the pilot's seat and one located to the right of the co-pilot's seat (10, *figure* 1-6 *and* 12, *figure* 1-7), control the supply of alcohol from the supply tank to the windshields. The handle is turned ON to supply alcohol for operation of the windshield deicing system, provided the windshield deicer switch is ON. The handle is turned OFF to shut off the fluid supply to the windshields.

Windshield Alcohol Speed Control Knob

The windshield alcohol speed control knob, located in the vee of the windshield above the main instrument panel, controls the quantity of fluid flow to the windshields. When the knob is turned counterclockwise, the opening becomes wider for the passage of more fluid in proportion to the knob setting and, when the knob is turned clockwise, the opening becomes smaller to reduce the fluid flow.

Windshield Deicing Hand Pump Handle (Some Aircraft).

A windshield deicing hand pump handle is located forward and to the right of the co-pilot's station. Operation of the pump handle forces alcohol through the perforated tubing that outlines the frames on the side windshields and the sliding window panels.

WINDSHIELD DEICING SYSTEM (R4D SERIES AIRCRAFT).

The windshield deicing system furnishes alcohol to the outside of the windshields from a 6.5 US. gallon supply tank, located in the right forward baggage compartment (11, *figure* 1-30). This system contains two units with the same source of supply. The first unit sprays alcohol by means of a hand pump onto the right and left windshields and both sliding window panels; the second unit sprays alcohol by means of a 28-volt d-c motor driven pump onto the front windshields, and can be used in conjunction with the windshield wipers. The pump motor is controlled by a switch, and the alcohol rate of flow is controlled by a needle valve, both located in the cockpit. A control valve is also provided to shut off the fluid when system operation is not necessary. For fluid specification and filler point location, see figure 1-30.

Windshield Deicing Hand Pump Handle (R4D Series Aircraft).

The windshield deicing hand pump handle is located forward and to the right of the co-pilot's station *(29, figure* 1-9). Operation of the pump handle forces alcohol through the perforated tubing that outlines the frames on the side windshields and the sliding window panels.

Windshield Deicing Switch (R4D Series Aircraft).

The 3-position, 28-volt d-c windshield deicing switch is located on the electrical control panel *(23, figure* 1-14). When the switch is placed ON, the circuit is closed to energize the 28-volt d-c pump motor and spray alcohol on the front windshields. When the switch is placed in the MOM (spring-loaded) position, momentary operation of the system for short intervals is provided. In the OFF position, the circuit is opened to discontinue system operation.

Windshield Deicing Control Valve Handles (R4D Series Aircraft).

Two windshield deicing control valve handles, one located to the left of the pilot's seat and one located to the right of the co-pilot's seat *(15, figure* 1-8 *and* *22, figure* 1-9), control the supply of alcohol from the hand pump to the right and left windshields and both sliding window panels. When the handle is turned on, the supply line is opened; when the handle is turned OFF, the supply to the side windshields is shut off.

Windshield Alcohol Speed Control Knob (R4D Series Aircraft).

The windshield alcohol speed control knob, located in the vee of the windshield above the main instrument panel, controls the quantity of fluid flow to the front windshields. When the knob is turned clockwise, the opening becomes wider for the passage of more fluid in proportion to the knob setting, and, when the knob is turned counterclockwise, the opening becomes smaller to reduce the fluid flow.

WING AND EMPENNAGE DEICING SYSTEM.

A wing and empennage deicing system is installed on the aircraft for the purpose of removing ice after it

WING AND EMPENNAGE DE-ICING SYSTEM

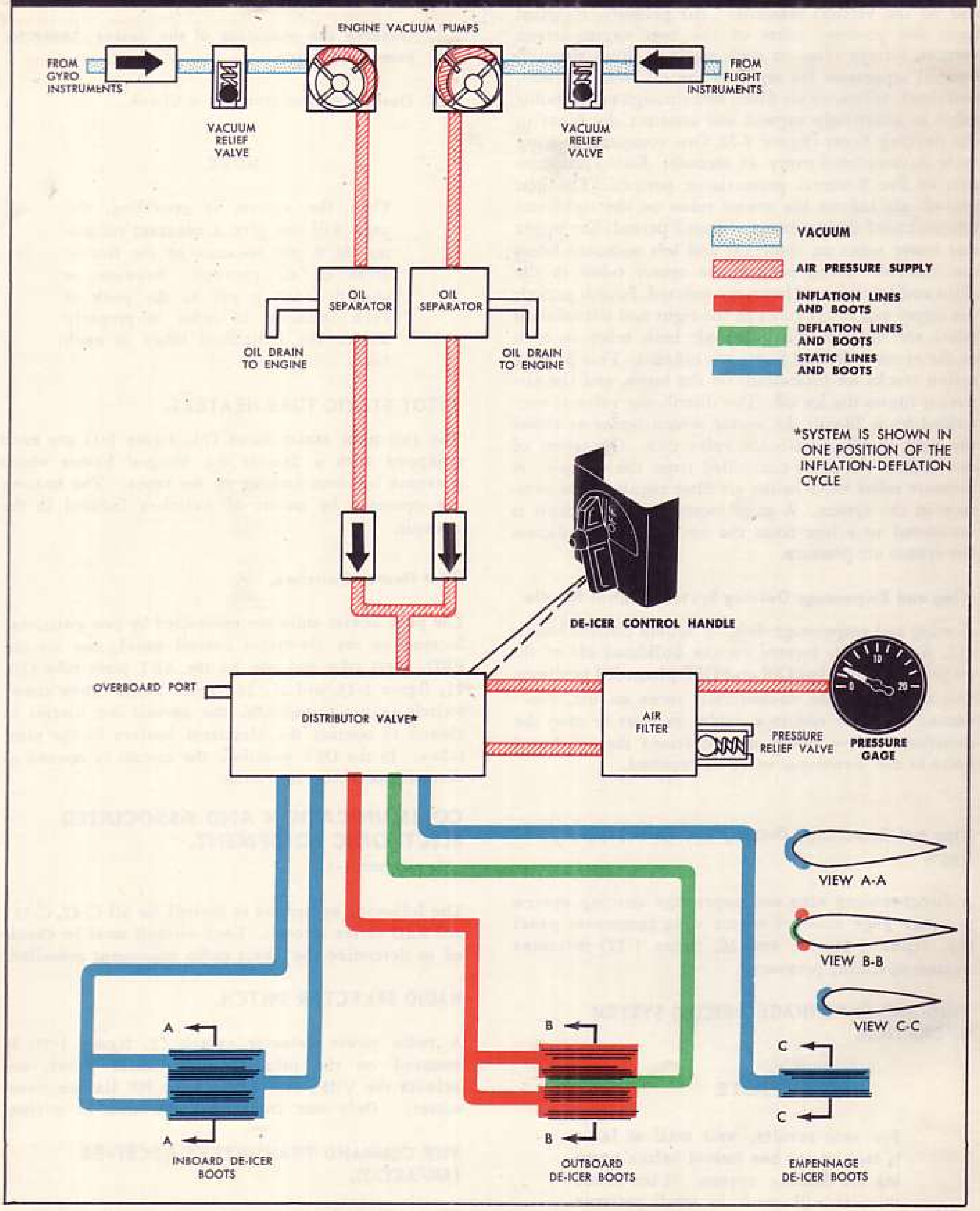


Figure 4-3

has formed. Rubber deicing boots are installed on the leading edge of each wing, each horizontal stabilizer, and on the vertical stabilizer. Air pressure, supplied from the pressure ports of the two engine-driven vacuum pumps (one on each engine), flows through two oil separators (to separate the oil from the air), two check valves, an air filter, and through a distributor valve to alternately expand and contract the tubes in the de-icing boots *(figure 4-3)*. One complete de-icing cycle is completed every 40 seconds. Each cycle consists of five 8-second pressurizing periods. The first period: air inflates the center tubes on the right and left outboard de-icer boots. Second period: the upper and lower tubes on the right and left outboard boots are inflated. Third period: the center tubes in the right and left inboard boots are inflated. Fourth period: the upper and lower tubes in the right and left inboard boots are inflated. Fifth period: both tubes in each of the three stabilizer boots are inflated. This pulsing action cracks ice formations on the boots, and the airstream blows the ice off. The distributor valve is controlled by a 28-volt d-c motor which opens or closes the port in the distributor valve unit. Operation of the electric motor is controlled from the cockpit. A pressure relief valve in the air filter regulates the pressure in the system. A gage located in the cockpit is connected to a line from the air filter and indicates the system air pressure.

Wing and Empennage Deicing System Control Handle

A wing and empennage deicing system control handle (17, *figure* 1-9), located on the bulkhead aft of the co-pilot's station, has ON and OFF placarded positions. The control handle mechanically turns an arm, connected at either end to a cable, to start or stop the distributor valve motor, and positions the overboard ports in the distributor valve as required.

Wing and Empennage Deicing System Pressure Gage.

A direct-reading wing and empennage deicing system pressure gage mounted on the main instrument panel (23, figure 1-11, 27, and 26, figure 1-12) indicates system operating pressure.

WING AND EMPENNAGE DEICING SYSTEM OPERATION.

NOTE

For best results, wait until at least ¼ inch of ice has formed before starting the deicing system. If ice is too thin, it will crack in small patterns and will not have enough weight and body to be blown off by the slipstream.

Start the system by turning the deicing control handle to the ON position.

1. Observe the pulsation of the deicer boots for proper operation.
2. Deicer system pressure – Check.

NOTE

When the system is operating, the gage will not give a constant recording of 8 psi because of the fluctuation of air pressure; however, it should reach 8 psi at the peak of each inflation in order to properly inflate the individual tubes in each boot.

PITOT STATIC TUBE HEATERS.

The two pitot static tubes (21, figure 1-1) are each equipped with a 28-volt d-c integral heater which prevents ice from forming on the tubes. The heaters are operated by means of switches located in the cockpit.

Pitot Heater Switches.

The pitot heater units are controlled by two switches, located on the electrical control panel, one for the FWD. pitot tube and one for the AFT pitot tube (10, 11, figure 1-13, and 21, 22, figure 1-14). When either switch is positioned ON, the 28-volt d-c circuit is closed to operate the electrical heaters in the pitot tubes. In the OFF position, the circuit is opened to discontinue heater operation.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

(See figure 4-4.)

The following equipment is typical for all C-47, C-117 and R4D series aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

RADIO SELECTOR SWITCH.

A radio power selector switch (2, figure 1-7), is mounted on the pilot's radio control panel, and selects the VHF, the UHF, or the HF liaison transmitter. Only one transmitter operates at a time.

VHF COMMAND TRANSMITTER RECEIVER (AN/ARC-3).

The VHF transmitter-receiver is controlled from the pilot's control panel and receives its power from the 28-volt d-c Radio Junction Box Bus No. 1. The

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

The following list is typical for all C-47, C-117, and R-4D series aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
VHF COMMAND	AN/ARC-3	SHORT-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	PILOT AND CO-PILOT	LINE OF SIGHT	PILOT'S RADIO CONTROL PANEL
UHF COMMAND	AN/ARC-27	SHORT-RANGE, TWO-WAY VOICE COMMUNICATION	PILOT, CO-PILOT AND RADIO OPERATOR	LINE OF SIGHT	PILOTS' RADIO CONTROL PANEL AND RADIO OPERATOR'S CONTROL PANEL
HF LIAISON	AN/ARC-8 OR SCR-287	LONG-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	RADIO OPERATOR	200 TO 2500 MILES	RADIO OPERATOR'S STATION
LF RECEIVER	BC-453	LOW-FREQUENCY RADIO RANGE RECEIVER	PILOT	200 MILES	PILOT'S STATION
OMNI-RANGE AND INSTRUMENT APPROACH	AN/ARN-14 AND AN/ARN-5B	OMNI-RANGE LOCALIZER AND GLIDE PATH INDICATION	PILOT AND CO-PILOT	LINE OF SIGHT TERMINAL AREA	PILOTS' RADIO CONTROL PANEL
LOCALIZER AND GLIDE PATH	RC/103 AND AN/ARN-5D	INDICATES GLIDE ANGLE FOR LANDING AND LATERAL ALIGNMENT WITH RUNWAY	PILOT AND CO-PILOT	TERMINAL AREA	ABOVE THE LEFT ELECTRIC CONTROL PANEL
INTERPHONE	AN/AIC-3 OR RC-36B	INTERCREW COMMUNICATION	ALL CREW MEMBERS	WITHIN THE AIRCRAFT	CONTROL PANEL IN EACH CREW MEMBER'S STATION
AUTOMATIC RADIO COMPASS MANUAL RADIO COMPASS	AN/ARN-6 (DUAL) AN/ARN-7 AN/ARN-11	RECEPTION OF VOICE OR CODE COMMUNICATION: POSITION FINDING, HOMING	PILOT, CO-PILOT, NAVIGATOR	20 TO 200 MILES	PILOT'S RADIO CONTROL PANEL AND NAVIGATOR'S STATION
RADIO LOW ALTIMETER	AN/APN-1	ABSOLUTE ALTITUDE 0 TO 4000 FEET	PILOT	AIRCRAFT TO TERRAIN OR WATER	MAIN INSTRUMENT PANEL
MARKER BEACON	RC-193A OR BC-1333-B	RECEIVES LOCATION MARKER SIGNAL ON NAVIGATIONAL BEAM	PILOT AND CO-PILOT	OVER STATION	INDICATOR LIGHT IN COCKPIT VISIBLE TO PILOT AND CO-PILOT
TACAN	AN/ARN-21	AID TO NAVIGATION	PILOT AND CO-PILOT	LINE OF SIGHT 195 MILES MAXIMUM	PILOT'S RADIO CONTROL PANEL
IFF OR SIF	AN/APX-25 AN/APX-6 SCR/695B	PROVISIONS ONLY IDENTIFICATION	PILOT OR CO-PILOT	LINE OF SIGHT	PILOT'S RADIO CONTROL PANEL
EMERGENCY TRANSMITTER	AN/CRT-3	EMERGENCY SEA RESCUE		LINE OF SIGHT	STRAPPED ON AFT MAIN CABIN DOOR OR NAVIGATOR'S STATION
RADAR ALTIMETER	AN/APN-22	ABSOLUTE ALTITUDE 0 TO 20000 FT.	PILOT	AIRCRAFT TO TERRAIN OR WATER	MAIN INSTRUMENT PANEL
DIRECTION FINDER	AN/ARA-25	UHF DIRECTION FINDER	PILOT CO-PILOT		RADIO OPERATOR'S STATION
HOMING ADAPTOR	AN/ARA-8	VHF HOMING DEVICE	PILOT CO-PILOT	LINE OF SIGHT	PILOT'S OVERHEAD RADIO CONTROL PANEL
"LORAN" NAVIGATION	AN/APN-9	"LORAN" NAVIGATIONAL EQUIPMENT	NAVIGATOR		PILOT'S OVERHEAD RADIO CONTROL PANEL
	AN/ARC-65		RADIO OPERATOR NAVIGATOR		
VHF COMMAND FM	AN/ARC-44	SHORT RANGE, TWO WAY VOICE COMMUNICATION, HOMING	PILOT, CO-PILOT NAVIGATOR	LINE OF SIGHT 50 MILES	PILOT'S OVERHEAD RADIO CONTROL PANEL, NAVIGATOR'S STATION

Figure 4-4

equipment is line-of-sight VHF and is used for 2-way voice communication, air-to-air or air-to-ground. The set is turned on by placing the VHF 2-position ON-OFF switch in the ON position. To turn the equipment off, place the switch in the OFF position.

UHF COMMAND TRANSMITTER-RECEIVER (AN/ARC-27).

The UHF transmitter-receiver is controlled from the pilot's radio panel, and receives its power from the 28-volt d-c Radio Junction Box Bus No. 2. The transmitter-receiver has been designed to provide radio telephone communication in the frequency range of 225.0 to 399.9 megacycles between aircraft and ground or between aircraft. The transmitter may be tone modulated (A2) at 1020 cycles per second for emergency or direction-finding purposes. The transmitter-receiver provides 1750 frequency channels in this range and provision has been made for the pilot's remote selection of any of the 18 or 20 preset frequencies or operation of a guard frequency. On some installations, a quick manual tuner is installed on the radio panel. On these airplanes, the pilot is able to select any one of the available 1750 frequency channels which include 18 or 20 preset ones and guard. Transmission and reception are line-of-sight on the same frequency and antenna. To turn the equipment on, rotate the function switch clockwise from the off position. To turn the equipment OFF, rotate the function switch counterclockwise to OFF.

CAUTION

- To preclude damage to the equipment, allow at least one minute for the set to warm up before operating.
- Do not rotate the channel selector while the tuning cycle is in progress.

HF LIAISON TRANSMITTER AND RECEIVER. (AN/ARC-8 or SCR-287).

The HF liaison transmitter and receiver are controlled from the radio operator's station (1, and 5, figure 4-7) and are operated by power from the 28-volt d-c Radio Junction Box Bus No. 1. The HF liaison set provides long-range 2-way code and voice communication. A key for the operation of CW (3, figure 4-7) is mounted on the radio operator's table. To turn on the transmitter, place the radio power selector switch in the LIAISON position and rotate the emission selector switch clockwise to VOICE, CW, or MCW as required. To turn off the transmitter, place the emission selector switch in the OFF position. To turn on the receiver, place the radio power selector switch in the LIAISON position and move the function selector switch either to MVC or AVC, as desired. To turn off the receiver, place the function selector switch in the OFF position.

INTERPHONE SYSTEM.

Multiple interphone control panels are located in the flight compartment, adjacent to each crew member's station; headsets and hand microphones are also provided. These are operated from the interphone control panels (figure 4-6) at each crew member's station The interphone equipment provides communication facilities between all crew members and enables the the flight compartment crew members to use the VHF command set, VHF navigation set, the liaison set, the automatic radio compass, and the marker beacon. The power source is the 28-volt d-c Radio Junction Box Bus No. 2. To turn on the interphone equipment, turn on the aircraft power supply and see that the radio power circuit breaker in the main junction box and the three circuit breakers on the radio circuit breaker panel (figure 1-20) are in the ON position. To turn off the interphone equipment on the ground, turn off the aircraft power supply. In an emergency, to turn off the interphone in flight, open the circuit breakers.

INTERPHONE SYSTEM (SOME AIRCRAFT).

The interphone system provides a means of communication between crew members and also permit crew participation in radio operations. Five interphone control panels are provided, one for each crew member and one at the rear of the main cabin compartment. The pilot and co-pilot are each provided with a mixer control box and a filter control, which make it possible to monitor all radio sets, or isolate as desired. Selection at the navigator's station interphone control panel and radio operator's station interphone panel differs in that the radio operator cannot select the VHF navigation radio and the navigator cannot select the liaison radio. Selection at the rear cabin compartment interphone control panel is the same as at the radio operator's station with the exception that, in the LIAISON position, only reception is possible.

The MIXED SIGNALS COMM position, on the pilot's and co-pilot's interphone control panels, permits HF, VHF, or UHF transmission and reception, depending on the position of the microphone selector switch and the audio switches on the interphone control panel.

The radio power switch must be set to correspond. The power source is the 28-volt d-c Radio Junction Box Bus No. 2. To turn on the interphone equipment, turn on the aircraft power supply and see that the radio power circuit breaker in the main junction box and the three circuit breakers on the radio circuit breaker panel (figure 1-20) are in the ON position. To turn off the interphone equipment on the ground, turn off the aircraft power supply. In an emergency, to turn off the interphone equipment in flight, pull the circuit breakers.

RADIO LOW ALTIMETER (AN/APN-1).

This equipment is controlled from the pilots' compartment. Power for operation is supplied from the 28-volt d-c bus. The function of the equipment is to provide a positive altitude reading of the aircraft above the existing terrain or the surface of the water. The equipment's range is from 0 to 4000 feet. An altitude limit switch located below the ignition switches in the vee of the windshield, presets the desired altitude to be maintained. A radio altimeter (35, figure 1-12) provides positive measurement of altitude. Three indicator lights (36, figure 1-12) function as follows:

RED – Indicates flight below the preset altitude.

AMBER – Indicates flight at the preset altitude.

GREEN – Indicates flight above the preset altitude.

To turn on the equipment, rotate the switch, incorporated on the radio altitude indicator, clockwise to ON. To turn the equipment off, rotate the switch on the radio altitude indicator to the OFF position.

WARNING

Do not rely on your SCR-718, AN/APN-21, or AN/APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

RADAR ALTIMETER SYSTEM (LOW-RANGE, AN/APN-22).

The AN/APN-22 radar altimeter system is a microwave altimeter, and receives power from the 28-volt DC No. 1 radio bus and 115 volt AC power from No. 1 radio bus. The system measures the terrain clearance of the aircraft through a transmitted and received frequency – modulated microwave carrier. The system is reliable from 0 to 10,000 feet over land and from 0 to 20,000 feet over water. The indication accuracy is ± 2 feet from 0 to 40 feet, and ± 5 percent of the indicated altitude from 40 to 20,000 feet. The system ON-LIMIT control switch is located on the height indicator. ON turns on the power for the system. LIMIT sets the bug pointer at the desired. altitude. Indication that the aircraft is above the set altitude is obtained by comparing the indicator pointer with the bug pointer, or by observing illumination of a red light on the face of the indicator. The indicator pointer will go behind a mask on the indicator if the system is inoperative or a dropout altitude is reached. The dropout altitude is the altitude when the return signal is too weak to operate the system. The signal will be too weak above 10,000 feet over land and above 20,000 feet over water, or in banks of 60 degrees or more, and climbs and dives of 70 degrees or more.

WARNING

Do not rely on your AN/APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

IFF/SIF EQUIPMENT.

Power for the identification radio equipment is provided by the 28-volt d-c Radio Bus No. 2 and the 115 volt a-c Radio Bus No. 1. Refer to appropriate manual for operating instructions.

MARKER BEACON RECEIVER (RC-193A or BC-1333-B).

The 28-volt d-c marker beacon receiver has no controls, but comes on automatically when power is supplied to the No. 2 Radio d-c bus. The marker beacon indicator light is mounted on the main instrument panel. When the aircraft is within the radiation pattern of a 75 megacycle marker beacon transmitter, the indicator light illuminates and the aural signal is received.

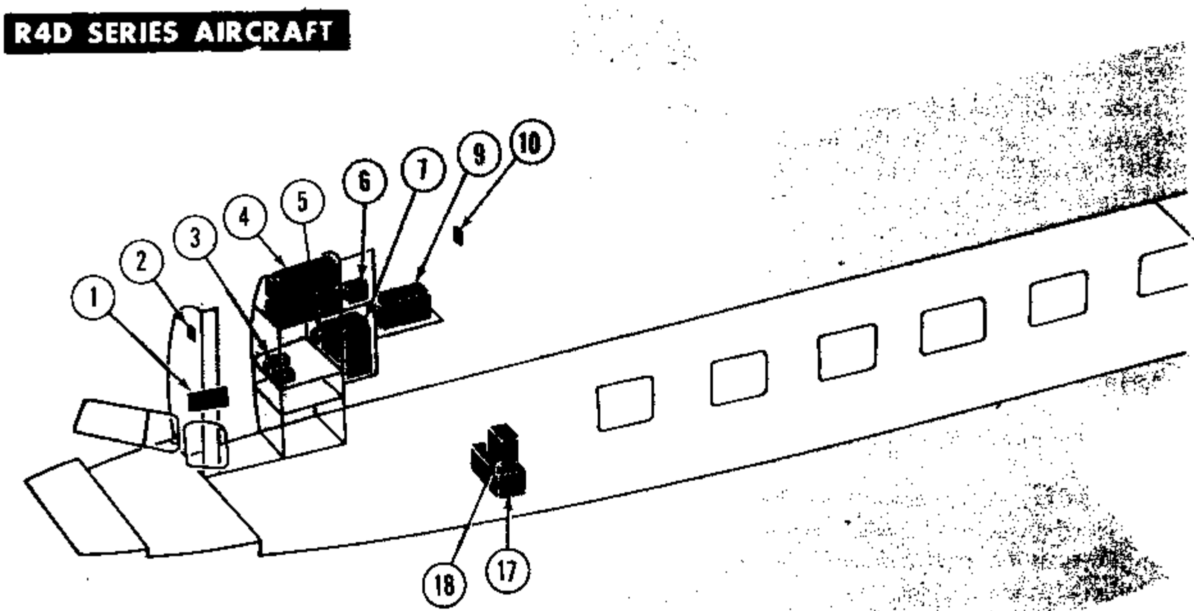
LF RECEIVER (BC-453).

The LF receiver is operated by power from the 28-volt d-c bus, and is controlled from the LF radio control panel (24, figure 1-8) located above the pilot's side window. This receiver is used to monitor low-frequency radio range signals. To turn on the receiver, place the function selector switch on either CW or MCW, as desired. To turn off the receiver, place the function selector in the OFF position.

AUTOMATIC RADIO COMPASS (AN/ARN-6).

The radio compass, AN/ARN-6, is used for the reception of radio voice or code communication, and for navigation and homing. It has a frequency range from 100 to 1750 kilocycles. Power is supplied to the equipment from the 28-volt No. 1 Radio d-c bus and 115V a-c No. 2 Radio Bus.

COMMUNICATION AND ASSOCIATED ELECTRONIC



1. LF CONTROL PANEL
2. VHF COMMAND RADIO CONTROL PANEL
3. LOCALIZER AND GLIDE PATH RECEIVER
4. LIAISON TRANSMITTER SPARE TUNING UNITS
5. MARKER BEACON RECEIVER
6. LF RECEIVER
7. LIAISON RADIO TRANSMITTER
8. VHF COMMAND FM
9. LIAISON RADIO RECEIVER
10. INTERPHONE AMPLIFIER
11. CARGO COMPARTMENT INTERPHONE CONTROL PANEL
12. RADIO LOW ALTIMETER TRANSMITTER-RECEIVER
13. MICROPHONE JACK BOX
14. VHF COMMAND RADIO TRANSMITTER-RECEIVER
15. IFF RADIO TRANSMITTER-RECEIVER
16. EMERGENCY TRANSMITTER (GIBSON GIRL)—MOUNTED ON INSIDE OF CARGO DOOR
17. AUTOMATIC RADIO COMPASS RECEIVER
18. FREQUENCY METER
19. VHF RADIO RECEIVER
20. RADIO CIRCUIT BREAKER PANEL
21. VHF RADIO TRANSMITTER
22. OMNI BEARING INDICATOR
23. COMPASS REPEATER AMPLIFIER
24. FLUXGATE COMPASS AMPLIFIER
25. GLIDE PATH RECEIVER
26. RADIO BEARING INDICATOR
27. TACAN RADIO TRANSMITTER — RECEIVER
28. OMNI LOCALIZER RECEIVER
29. LIAISON RADIO DYNAMOTOR
30. OMNI LOCALIZER RECEIVER DYNAMOTOR
31. UHF TRANSMITTER-RECEIVER
32. INTERPHONE CONTROL PANEL
33. LIAISON MONITOR SWITCH

Figure 4-5 (Sheet 1 of 2)

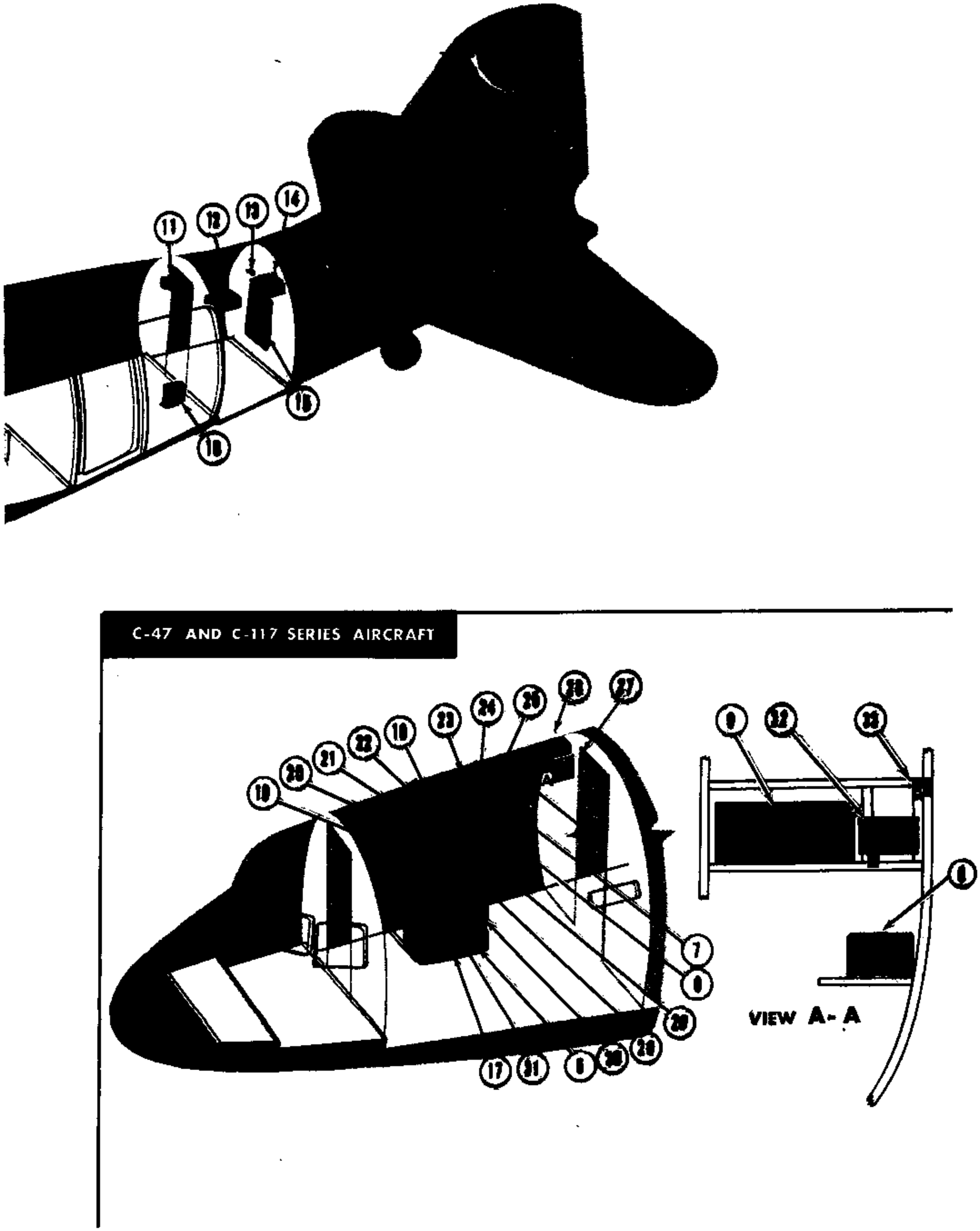


Figure 4-5 (Sheet 2 of 2)

INTERPHONE CONTROL PANEL—TYPICAL
C47 AND C117 SERIES AIRCRAFT

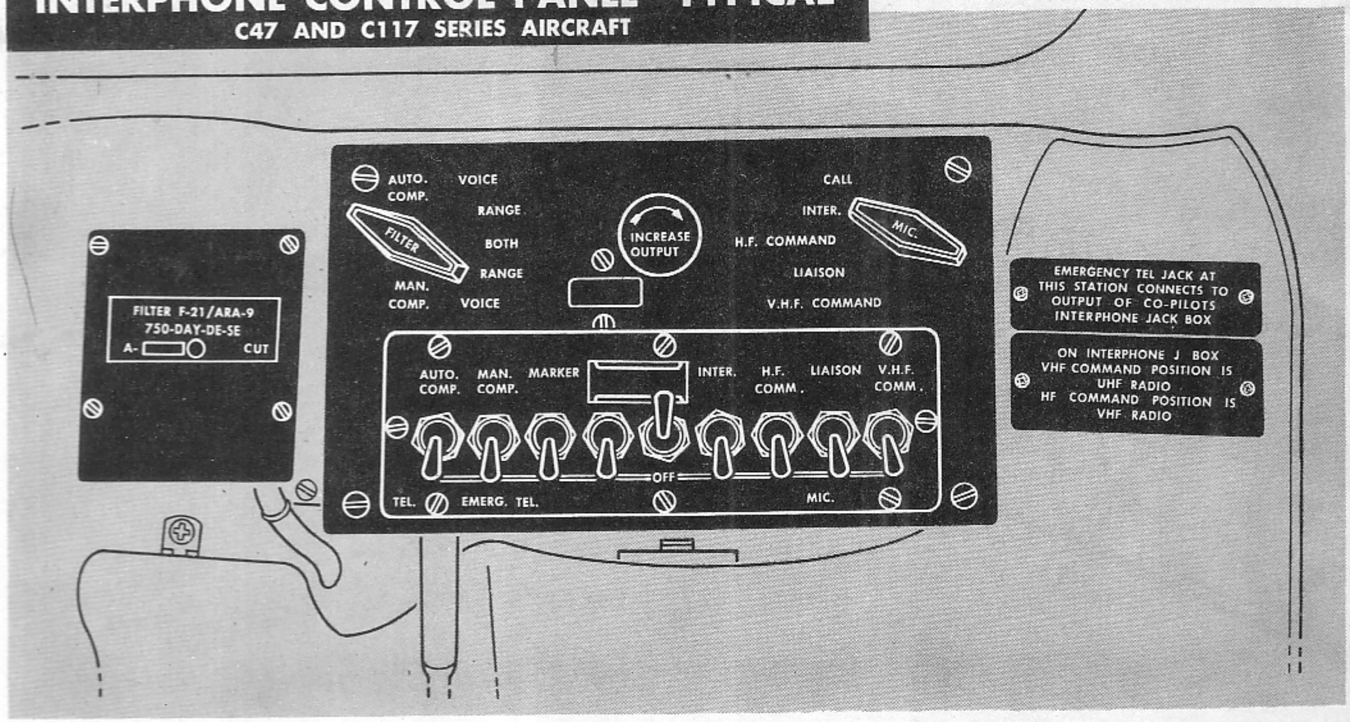


Figure 4-6

The equipment consists of the following units: one radio compass unit, R-101/ARN; one loop antenna, AS-313/ARN-6; two control boxes C-1514/A; two tuning meters installed as auxiliary equipment, one at each control location; three bearing indicators, ID-250/ARN; a lighting plate located at each indicator, ID-250/ARN; a wire sense antenna; and a coupling unit, CU-65/ARN-6.

The AN/ARN-6 is operated from the pilot's and co-pilot's overhead radio control panel and from the navigator's compass control panel (figure 4-12). To turn ON the automatic compass, place the function selector switch on the direction finder control, C-1514/A, to COMP, ANT, or LOOP position, as desired. To turn the equipment OFF, place the function selector switch in the OFF position.

AUTOMATIC RADIO COMPASS (AN/ARN-7).

The radio compass is operated from the radio control panel (2, figure 1-7) in the pilots' compartment. Power is supplied to the equipment from the 28-volt d-c bus and from the 115-volt inverter system. The automatic compass system is used for the reception of radio voice or code communications and for navigation and homing. To turn on the radio compass, place the function selector switch on the automatic compass tuning control panel at COMP, ANT, or LOOP, as desired. To turn the equipment off, place the function selector switch in the OFF position.

LOCALIZER RECEIVER AND GLIDE PATH RECEIVER (RC/101 and AN/ARN-5).

This equipment is controlled from the LOCALIZER control panel located above the electrical control panel in the pilots' compartment. Its power sources are the 28-volt d-c bus localizer and the 115-volt a-c bus glide slope. Instrument landing approach system localizer channels are selected on the control panel. Channels U, V, W, X, Y, and Z may be selected by placing the selector switch handle in the position required. Glide path frequencies are automatically paired with their respective localizer channels. Localizer and glide path course deflection is indicated on the glide path indicator installed on the pilot's instrument panel. To turn on the receivers, place the ON-OFF toggle switch on the localizer control panel in the ON position. To turn the equipment off, place the ON-OFF toggle switch in the OFF position.

OMNI-RANGE AND LOCALIZER RECEIVER AND GLIDE PATH RECEIVER (AN/ARN-14 and AN/ARN-5B).

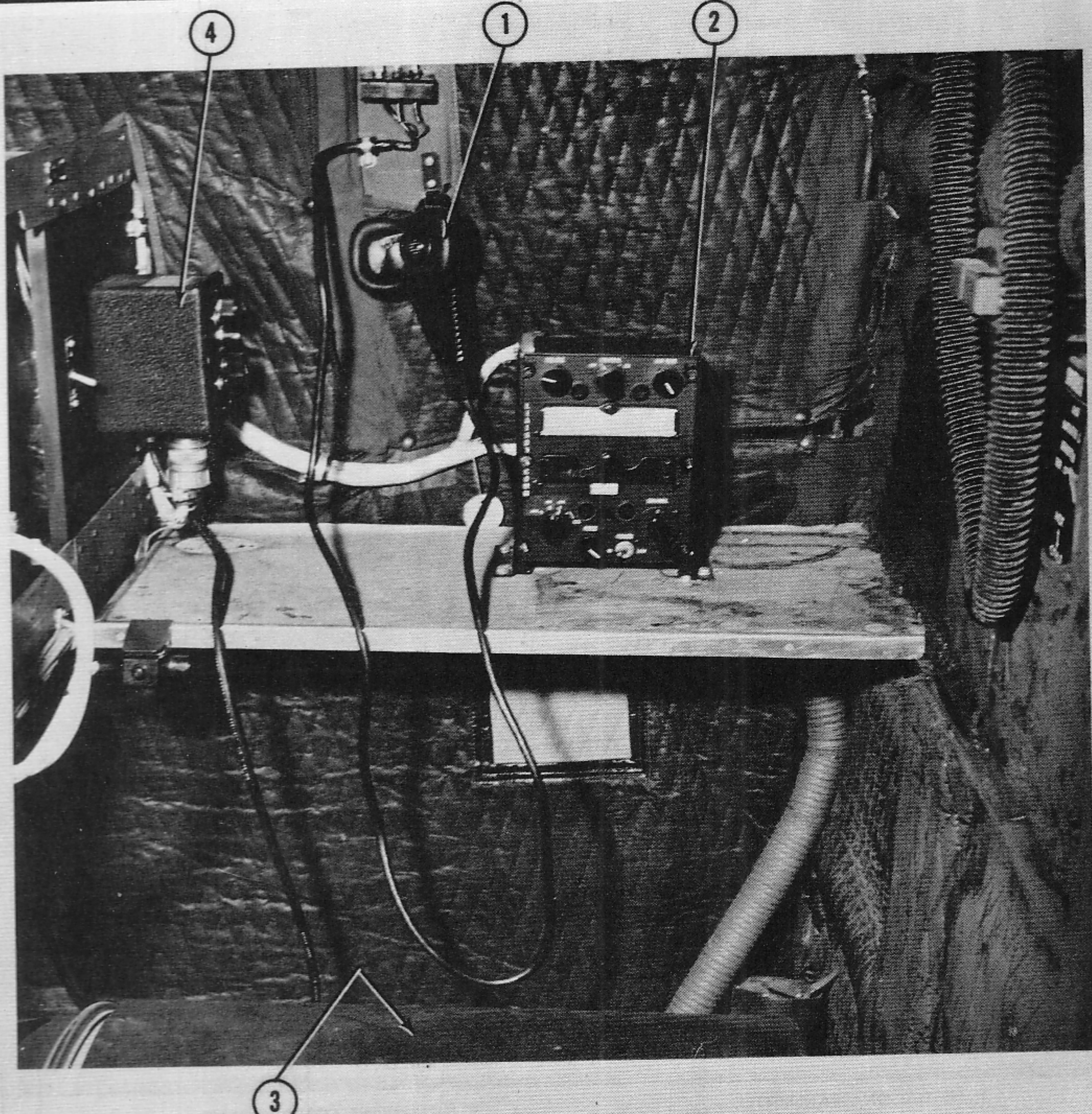
This equipment is controlled from the VHF NAV radio control panel in the pilot's compartment (2, figure 1-7). Its power sources are the 28-volt d-c No. 1 Radio Bus for the course indicator (ID 249) except the heading pointer. 115V AC power from the No. 2 a-c radio bus is required for the heading pointer, and the radio magnetic indicator (ID 250). Omni-range

RADIO OPERATOR'S STATION
TYPICAL

1. HF LIAISON TRANSMITTER
2. KEYER
3. INTERPHONE CONTROL PANEL
4. HF LIAISON RECEIVER

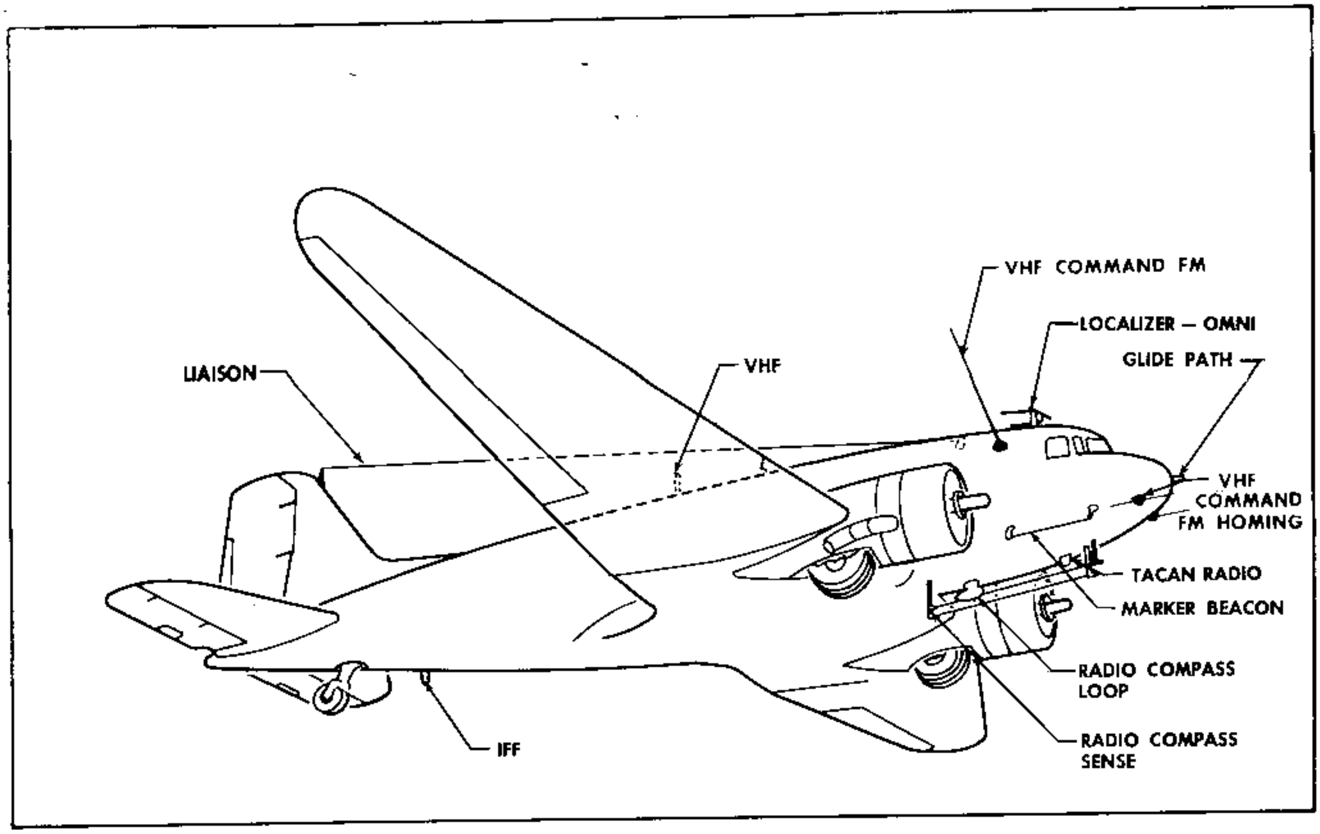
Figure 4-7 (Sheet 1 of 2)

RADIO OPERATOR'S STATION
SOME SC-47 AIRCRAFT



1. MICROPHONE
2. CONTROL BOX
3. HF LIAISON TRANSMITTER-RECEIVER
4. SPEAKER CONTROL BOX

Figure 4-7 (Sheet 2 of 2)


VHF COMMAND FM
LOCALIZER — OMNI
GLIDE PATH
LIAISON
VHF
VHF COMMAND FM HOMING
TACAN RADIO
MARKER BEACON
RADIO COMPASS LOOP
RADIO COMPASS SENSE
IFF

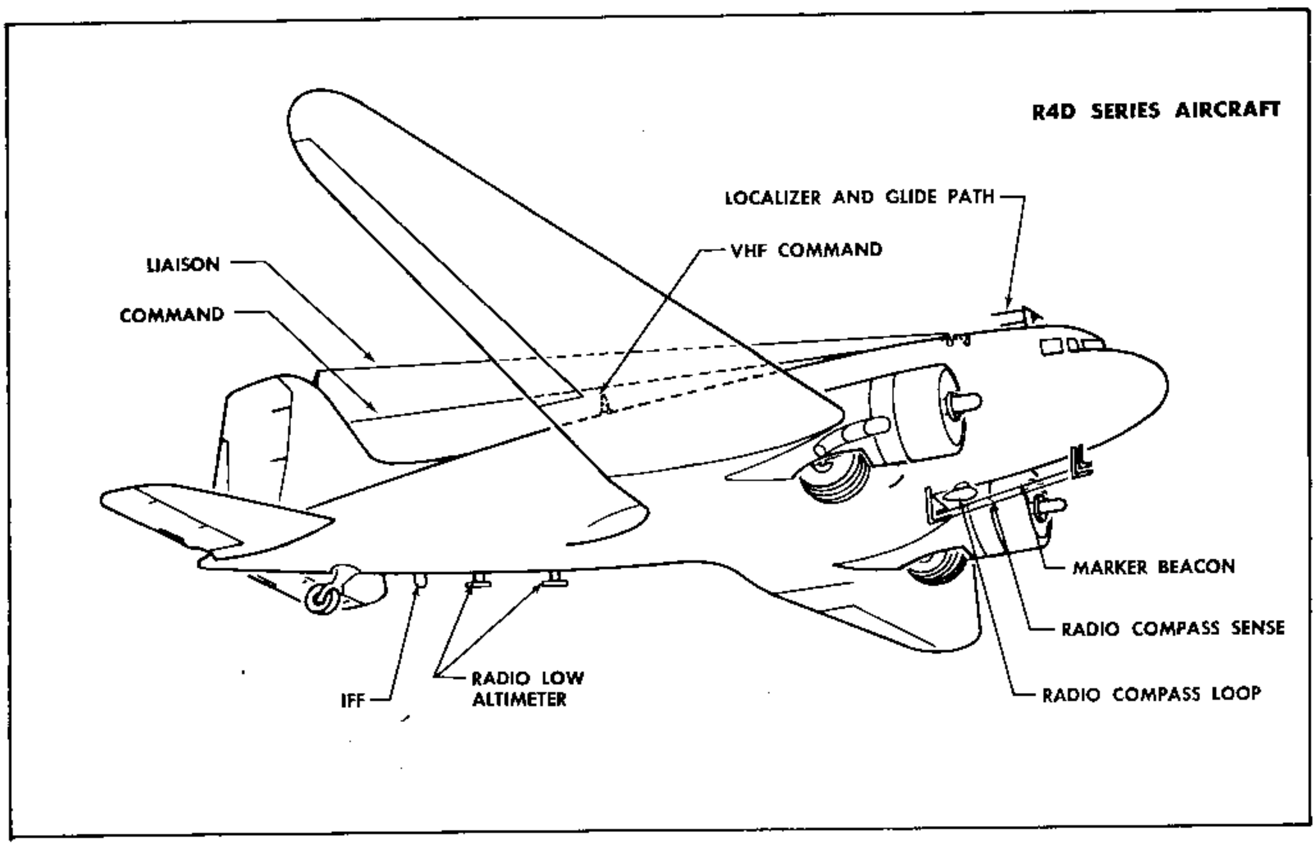

R4D SERIES AIRCRAFT
LOCALIZER AND GLIDE PATH
VHF COMMAND
LIAISON
COMMAND
MARKER BEACON
RADIO COMPASS SENSE
RADIO COMPASS LOOP
IFF
RADIO LOW ALTIMETER

Figure 4-8

and instrument landing system approach localizer frequencies are selected on the frequency control unit. Glide path frequencies are automatically paired with their respective localizer frequencies. Omni-range courses are selected with reference to the head or tail of the (VOR No. 2) bearing indicator and set in the course selector window located on the main instrument panel. The function of the equipment is radio navigation and instrument landing. To turn on the equipment, place the VHF NAV POWER switch in the ON position. To turn off the equipment, turn the VHF NAV POWER switch OFF.

WARNING

- Power source for glide indication will vary from aircraft to aircraft. Determine power source prior to flight.
- During a VOR instrument approach, turn the Tacan set off at the Tacan control panel. This will prevent an automatic switchover to Tacan in the event of a VOR power failure during a VOR approach.

NOTE

In case of complete inverter failure power is still available to operate the CDI of the ID 249 when used with the ARN-14.

TACAN RADIO (AN/ARN-21/45).

Tacan is designed to operate in the UHF frequency band in conjunction with a radio navigation system called TACAN (Tactical Air Navigation). The system enables an equipped aircraft to obtain continuous indications of its distance and bearing from any selected tacan surface (station beacon) located within a line-of-sight distance of approximately 195 nautical miles. Tacan consists essentially of a receiver-transmitter, radio bearing indicator (ID 307) located at the radio equipment rack and a DME. The AN/ARN-21/45 components available to the pilot in flight are the radio magnetic indicator (ID 250), the course indicator (ID 249), the Tacan Range indicator DME (ID 310), Tacan Control Panel, and a Navigation instrument selector switch. There are 126 frequency channels any one of which may be selected by setting the proper controls on the control panel. Tacan is powered by both 28-volt d-c Radio Junction Box Bus No. 2 and 115-volt a-c Radio Bus No. 1.

TACAN CONTROL PANEL.

The Tacan control panel located on the pilot's radio control panel, has a power switch with OFF, REC and T/R positions, two channel selector knobs, a channel window, and a volume-control knob. With the power switch in the REC position, the distance function of the set is disabled, and only bearing information is available. With the power switch in the T/R position, both bearing and distance information is displayed on the indicators. The left or outside on the concentric channel selector knob selects the first two figures of the Tacan beacon channel number, and the right or inside channel selector knob selects the third number. The volume control knob is used to adjust the volume of aural identification signals received from the Tacan surface beacon.

Navigation Instrument Selector Switch.

A navigation instrument selector switch with TACAN and VOR positions, is located on the pilots' radio control panel. When the switch is positioned to VOR, the omni-range receiver controls the course indicator and the No. 2 needle of the radio magnetic indicator (RMI). When the switch is positioned to TACAN, the Tacan radio controls the course indicator and the No. 2 needle of the radio magnetic indicator. The switch receives power from the 28-volt d-c system through a circuit breaker on the radio circuit breaker panel (figure 1-23).

COURSE INDICATOR (ID 249/ARN).

The course indicator ID 249 (8, figure 1-12) is used in conjunction with both the VOR and Tacan. Signals received from either radio are relayed to the course deviation indicator of the course indicator. Deviation of the aircraft course either left or right of the selected course will be indicated by displacement of the course deviation indicator, regardless of position of aircraft in relation to the station.

RADIO MAGNETIC INDICATOR ID 250.

The radio magnetic indicator (1, figure 1-12) is also used with AN/ARN-21 (Tacan) as well as with the AN/Radio Compass. It consists of a rotating compass card, actuated by the directional indicator (slaved) system, and two bearing indicators. The bearing indicators are connected to function as a single unit and are actuated by the receiver portion of the AN/ARN-21 when Tacan is selected. Azimuth signals from the Tacan surface beacon are then received by the AN/ARN-21 and relayed to the radio magnetic indicator, causing the bearing indicators to indicate the magnetic bearing of the Tacan surface beacon. With the control switch in the REC position bearing information may be received even though the transmitter portion of the set is not energized.

TACAN RANGE INDICATOR.

A Tacan range indicator is installed on the pilot's instrument panel. The indicator displays the slant range distance in nautical miles between the airplane and the Tacan surface beacon. The numerals in the window are controlled by the range circuits of the AN/ARN-21 Tacan. While the indicator is "searching" for the correct range or when the switch is in the REC position, the rotating numbers are partially covered by a red flag, which warns the pilot against reading incorrect distance indications.

TACAN RADIO OPERATION.

1. Navigation instrument selector switch – TACAN.
2. Function switch – T/R or REC.
3. Channel selector knobs – Desired Channel.
4. Volume control knobs – As Required.
5. Bearing selector knob (course indicator) – Desired Bearing.
6. To Stop, function switch – OFF.

WARNING

The course indicator (localizer and glide path needles) is unreliable for instrument approaches (ILS) when the navigation instrument selector switch is in the TACAN position.

"LORAN" NAVIGATIONAL EQUIPMENT (AN/APN-9).

The "Loran" navigational equipment is located at the navigator's station and receives, amplifies, and detects "Loran" signals and provides a method of navigation. The equipment is controlled by switches located on the receiver.

UHF DIRECTION FINDER (AN/ARA-25).

A UHF direction finder device is installed in the aircraft to indicate the relative bearing of and to home on radio signal sources in the 225.0 to 400 megacycle range. The relative bearing of the signal source is indicated on the course indicators located on the main instrument panel and navigator's station. To turn on the equipment, turn the selector switch on UHF control unit to the ADF position. To turn equipment off, turn the selector switch on the UHF control unit to the OFF position.

VHF HOMING ADAPTER (AN/ARA-8).

The AN/ARA-8 homing adapter receives 28-volt d-c power through the number 2 radio bus, is used with the VHF command set, and will provide the pilot with means to home on any radio signal course within the frequency range at 120 to 140 megacycles. To turn the equipment on, position the switch on the pilot's overhead radio control to the HOMING position.

LIAISON RADIO (AN/ARC-65).

The AN/ARC-65 (Figure 4-7) provides long-range voice communication from aircraft to aircraft, or aircraft to ground in a frequency range from 2 to 23.9995 megacycles in 500-cycle steps, giving a total of 44,000 available frequencies. Any 20 of the 44,000 frequencies can be set at Radio Set Control C-451A/ARC-21 and then switch-selected as desired during use.

Tune-up of the receiver on a newly selected channel is automatically completed in a few seconds. Transmitter tune-up is completed the first time the key or push-to-talk button is pressed after changing channels. Presetting the 20 channels requires only the use of a small tool located inside the top cover of the channel setting drums. No conversion charts or codes are required for presetting the channels since the markings for the frequency determining button indicates frequencies directly.

RADIO SET CONTROL C-451A/ARC-21

This unit, located at the Radio Operator's station (figure 4-7), provides facilities for presetting 20 of the 44,000 available frequencies, and for permitting complete control and operation of the equipment. The settings on the switch that selects the mode of operation are: Amplitude Modulation Equivalent (AME), Single Sideband (SSB), Continuous Wave (CW) and Frequency Shift Keying (FSK). The number of the channel in use is visible through an illuminated window, together with the numbers of the preceding and succeeding channels. In the center of the panel are two covers, held closed by thumb screws, which enclose the drums on which the desired frequencies are preset. A matte-surfaced plastic sheet for recording the preset channels is mounted on the top cover. Illumination is provided by installing four panel lights through a brilliance control.

There are no provisions for manual tuning. CW operation is possible when a keying adapter is available. Audio input or output for the equipment is obtained through the interphone system, utilizing the same headphones and microphone for reception and transmission as used for intercommunication in the aircraft.

SPEAKER SYSTEM (SOME SC-47 AIRCRAFT).

GENERAL.

The speaker system consists of 4 booster amplifiers, 4 loud speakers, 1 preamplifier and 3 microphones. The system is controlled by an ON-OFF switch located in the aft side of the radio rack (figure 4-7), receives 115-volt 400 cycle a-c power from the auxiliary inverter and is protected by a circuit breaker on the radio circuit breaker panel. The system is designed to provide airborne communication with ground personnel.

AUXILIARY INVERTER.

The auxiliary inverter is located on the floor under the navigator's table and provides power for operation of the speaker system and the ARC-65 radio. The inverter is controlled by an ON-OFF switch located on the main electrical junction box control panel. The auxiliary inverter reset button is located on the side of the main electrical junction box control panel.

A three position selector switch, placarded OFF, ARC-65 and SPEAKER SYSTEM, located on the main electrical junction box control panel, is provided to supply power to either the speaker system or ARC-65 in the event of auxiliary inverter failure. When the switch is placed in either the ARC-65 or SPEAKER SYSTEM position, the unit selected receives power from the number 1-AC bus, and the heater ignition, test receptacle, APN-9 receiver indicator, and the APN-22 control amplifier are automatically disconnected from the number 1-AC bus.

BOOSTER AMPLIFIERS.

The 4 booster amplifiers are located in the forward left side of the lavatory compartment and are protected by a 1 Amp and 3 Amp slow blow fuse on the face of each amplifier. An ON-OFF switch is located on the rear side of each amplifier and must be in the On (up) position at all times.

NOTE

The booster amplifiers are wired so that if one or more of the top 3 amplifiers fail or the switch on the rear side of the amplifier is OFF (Down), the remaining amplifiers will operate. However, if the bottom amplifier fails or is turned off, the complete system will be inoperative. In this event, the bottom amplifier may be removed and replaced with one of the other amplifiers or the wiring from the bottom amplifier may be moved up to the next amplifier. The speaker switch must be OFF while replacing amplifiers or wiring.

LOUDSPEAKERS.

The 4 loud speakers are mounted externally on the underside of the fuselage between the center wing section and the main cargo doors and are provided with covers for use during extended storage.

CAUTION

The speaker covers must be removed prior to ground or flight operation of system.

PREAMPLIFIER.

The preamplifier is located on the aft side of the radio rack and is controlled by the volume control knob located on the face of the preamplifier.

MICROPHONES.

The 3 microphones are located, one on the upper left side of the bulkhead behind the co-pilot's seat, one on the right side of the navigator's compartment (1, figure 4-7) aft of the radio rack and one on the right side of the cargo compartment aft bulkhead. Switches are incorporated in each microphone assembly and are ON when the switch is pressed in.

SPEAKER SYSTEM OPERATION.

1. Auxiliary inverter switch – ON.
2. Speaker switch – ON.

Allow 3 to 5 minutes for system to warm up prior to transmitting.

3. Volume control – as required.

The operator will hold the microphone firmly against his mouth before pressing the microphone switch to eliminate engine noise and prevent possible damage to the system. With the aircraft on the ground and the APU on the line, turn the volume up as high as possible for maximum readibility, then increase the volume until words are slightly garbled. This volume setting will provide the best in-flight results. The operator should pronounce each syllable in a normal voice leaving a space between each word. The final word should be spoken with the same emphasis as all other words. To turn system off, turn speaker switch to OFF.

NOTE

To prevent possible damage to system, the speaker switch should be in the OFF position when system is not in use.

Chart of approximate altitude, speed and time of usable signals.

Altitude	Speed KTS	Post Target Delay Seconds	Range Time Seconds
100	130	2-4	40
400	130	2-4	40
600	130	2-4	35
1500	130	5-8	30
3000	130	5-8	30

NOTE

Composition of message should be such that it can be repeated twice during the range time indicated.

RADIO SET AN/ARC-44 (SOME SC-47 AIRCRAFT).

The AN/ARC-44 radio set is a frequency modulated (FM) radio receiver transmitter (rt) set operating in a frequency range of 24.0 to 51.9 megacycles (mc). It provides two-way air to air or air to ground communication and may also be used to "home" on any signal within its frequency range. The effective operating range is limited by line-of-sight considerations to approximately 50 miles. The system may be controlled from the pilot's, co-pilot's or navigator's position and is operated through the existing aircraft interphone system.

The radio set consists of the following components: dynamotor, radio receiver-transmitter, two control panels, two radio signal distribution panels, two separate antenna systems (communication and homing), and a switch assembly. Power for operation is supplied from the number 2, 28 volt dc radio bus and is protected by a 10 amp circuit breaker located on the number 2, dc radio circuit breaker panel.

Dynamotor.

The dynamotor, mounted on the radio operator's table, supplies high voltage dc power and 400 cycle per second ac power for operation of the radio set. Two 0.5 amp output circuit fuses are accessible at the front of the chassis, below the dynamotor assembly.

Radio Receiver-Transmitter (RT)

This unit is mounted on the radio operator's table. The unit tuning drive mechanism, which is remotely controlled by the control panel, automatically tunes the receiver stages and transmitter stages to the frequency selected at the control panel. Included with the receiver circuits are the homing circuits for detection of the signals which are coded in the homing antenna group. An external switch is used to energize the homing circuits. A test switch and test jack is located behind the front cover. The SQUELCH and HOMING controls are located above the handle on the left side of the front panel, behind the sliding panel.

Control Panel.

Two control panels containing the receiver transmitter unit frequency selectors, the power switch, and the receiver volume control are mounted, one on the pilot's radio control panel and one above the navigator's interphone control panel. Each unit provides a choice of remote or local operation. The frequency selectors are mounted on concentric shafts which also mount the corresponding "whole" and 1/10 megacycle re-entrant switch sections. The selected frequency appears in the window above the 1/10 megacycle lever.

Radio Signal Distribution Panel.

Two radio signal distribution panels are located, one on the left side of fuselage at the navigator's station and one at the pilot's radio control panel.

Antenna.

The communication (whip) antenna is mounted on top of the fuselage above the baggage compartment.

Antenna Group.

The antenna group consists of a keyer, two impedance matching networks, and four antenna elements. Two antenna elements and one impedance matching network make up a homing antenna. There are two homing antennas, one mounted on each side of the fuselage below and forward of the pilot's compartment.

Switch Assembly.

The switch assembly is located forward of the pilot's oxygen pressure gage and flow indicator. The unit has five switches, only two of which are part of the radio set, the other three are spares. The switch functions are as indicated on the panel.

OPERATING PROCEDURES.

Preliminary Starting Procedures.

1. Control Panel.

   a. Turn the ON-OFF Switch to OFF. (Pilot's and navigator's panel.)

   b. Rotate the VOL control to the full counterclockwise position. (Pilot's and navigator's panel.)

   c. Turn the REM-LOCAL selector on the pilot's panel to the LOCAL position.

   NOTE

   When the ON-OFF switch is turned to the ON position, the control box not selected for LOCAL operation will automatically switch to REM.

2. Radio Signal Distribution Panel.

   a. Place the RECEIVERS "1" switch to the up position. (Pilot's and navigator's panel.)

   b. Place the RECEIVERS 2, 3, MB, and NAV switches to the down position (pilot's and navigator's panel).

   c. Rotate the TRANS selector lever so that INT shows in the indicator window (pilot's and navigator's panel).

   d. Rotate the headset amplifier VOL control to the full counterclockwise position.

3. Switch Assembly. Place all toggle switches to the down position.

FM Reception.

Turn the aircraft circuit breaker for the AN/ARC-44 on and perform the following:

1. Radio Signal Distrubution Panel.

   a. Rotate the headset amplifier VOL control on the pilot's and navigator's panel clockwise until either a slight amount of noise or an intercommunications signal is heard in the headset. (Operator's own sidetone should be audible during intercommunications.)

   b. Rotate the TRANS selector lever so that "1" appears in the indicator window.

2. Control Panel.

   a. Turn the ON-OFF switch ON at either the pilot's or navigator's station. Allow a minimum of one minute for the set to warm up.

   NOTE

   Cycling (gear rotating), indicated by a continuous 400 cycle tone in the headset, should not continue longer than approximately 6 seconds.

   b. Rotate the "whole" 1/10 mc selectors to the desired frequency (indicated on the pilot's control panel).

   c. Rotate both the pilot's and navigator's receiver radio VOL control approximately 1/2 turn clockwise.

   NOTE

   The receiver-transmitter unit will not operate properly if the REM-LOCAL selector is manually turned to the REM position. Should this occur, return the selector to its LOCAL position and repeat step 1. (a). above.

The system will now operate as an FM communications receiver and the receiver signal can be heard at both the pilot's and navigator's stations.

3. Switch Assembly.

   If the received signals are too weak to unsquelch the receiver, place the FM SQUEL switch on the switch assembly in the up position. This will disable the squelch circuit and allow reception of weak signals.

FM TRANSMISSION.

The pilot, co-pilot or navigator may transmit by using their respective existing microphones.

HOMING RECEPTION

To operate the equipment as a homing receiver, place the FM HOME switch on the switch assembly to the up position and tune to the desired frequency. The coded D and U signals or steady 400 cps on-course tone should be audible.

The three types of signals that are heard during homing operation are described below.

SIGNALS	MEANING
1. A keyed 400 cps tone with the code character "D" dah-dit-dit predominant.	The transmitting station is left of course heading. Turn left until a steady 400 cps tone is heard.
2. A keyed 400 cps tone with the code character "U" dit-dit-dah predominant.	The transmitting station is right of course heading. Turn right until a steady 400 cps tone is heard.
3. A steady 400 cps tone.	On course.

NOTE

It is possible to receive a 400 cps tone when heading directly away from the transmitting station. This may be determined by turning either right or left. If a turn to the RIGHT produces a "U" or a turn to the LEFT produces a "D", the aircraft is headed away from the transmitting station. Correct this condition by continuing the right or left turn until a steady 400 cps tone only is audible.

To turn the unit off, place the ON-OFF switch on both the pilot's and navigator's control panels to the OFF position.

NOTE

For maintenance and test procedures, refer to T. O. 12R2-2ARC44-11.

EMERGENCY RADIO TRANSCEIVER.

Some aircraft are equipped with an emergency radio transceiver.

LIGHTING EQUIPMENT.

All lights are wired to the 28-volt d-c power supply system through their respective circuit breakers and switches, except that, on some aircraft, the fluorescent lights use 26-volts a-c, supplied through a transformer, for power (figure 1-19).

EXTERIOR LIGHTING.

Navigation (Position) Lights and Switches

Navigation (position) lights are installed on the aircraft as follows: a green light on the right wing tip, a red light on the left wing tip, and a clear lens on the tail cone. Two navigation light switches are mounted on the electrical control panel (1, figure 1-13 and 24, figure 1-14). These are 3-position toggle switches, one with BRIGHT and DIM positions, the other with STEADY and FLASH positions. The center position of the switches is the OFF position. When the STEADY FLASH switch is placed on FLASH, the wing tip lights and tail cone light flash on and off. When the switch is in the STEADY position, the lights remain illuminated continuously. The BRIGHT-DIM switch controls the intensity of the lights when the FLASH-STEADY switch is in either position.

Formation Lights and Switch (R4D Series Aircraft).

Nine formation lights are installed on R4D series aircraft, three on top of the center fuselage and three on the top of each wing. The lights are controlled by a rheostat located on the electrical panel (10, figure 1-14). The switch has OFF and ON positions. It is OFF when rotated to the left, and the intensity increases as the switch is rotated 180 degrees to the right to the full ON position.

Anticollison Light and Switch.

On aircraft modified in accordance with T. O. 1C-1-525, a red rotating beacon anticollision light is installed on top of the vertical stabilizer to minimize the possibility of inflight collision. The light is controlled by an ON-OFF switch located on the pilot's electrical control panel.

NOTE

> The rotating anticollision light should be turned OFF during flight through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the light against the clouds. In addition, the light would be ineffective as an anticollison light during these conditions since it could not be observed by pilots of other aircraft.

Recognition Lights and Switches (R4D Series Aircraft).

Three downward recognition lights are installed on the underside of the fuselage below the main cargo door. Looking forward, the lenses are amber, green, and red, respectively. One upward recognition light with a clear lens protrudes from the top of the fuselage, above the radio operator's compartment. The lights are controlled by three toggle switches and a keying switch, located on the electrical control panel (14, figure 1-14). Each of the three switches has KEY, OFF, and STEADY positions. When the switch or switches are in the KEY position, the lights may be operated intermittently for code signalling by means of the pushbutton keying switch. When the switches are in the STEADY position, the lights are on and the keying switch is inoperative.

Landing Lights and Switches.

One landing light is permanently installed in the leading edge of each outer wing panel. Two ON-OFF landing light switches (27, figure 1-13 and 25, 1-14) are installed on the electrical control panel for individual operation of the lights. The left landing light is adjusted to project a beam of approximately 430 feet, and the right landing light to project one of about 380 feet, when the aircraft is in 3-point ground position.

NOTE

> There is no restriction on the use of the landing lights.

Aldis Lamp (Some Aircraft).

On some aircraft, an aldis lamp is provided in a holder located on the bulkhead behind the co-pilot's seat. The lamp may be plugged into the receptacle at the co-pilot's station when the light is required. The aldis lamp may be used to advantage during taxiing at night and during night flying to check for wing icing.

INTERIOR LIGHTING.

Instrument Lights and Switches.

The instrument lights consist of three dashlights controlled by the ON-OFF cockpit lights switch located on the electrical control panel (21, figure 1-13 and 6, figure 1-14). On some aircraft, Grimes instrument lights are installed. Illumination of the electrical control panels is controlled by the light rheostat (4, figure 1-13 and 4, figure 1-14) on the left electrical control panel. The compass light is controlled by the compass light rheostat (2, figures 1-13, and 1-14) located on the electrical control panel left of the instrument lights rheostat.

INSTRUMENT LIGHTS AND SWITCHES (Some Aircraft).

On some aircraft, a Grimes red lighting system is installed on the main instrument panel. The panel lights in the main instrument panel are controlled by three rheostats, one for the pilot's instrument panel, one for the center instrument panel and one for the co-pilot's instrument panel. The lights on the overhead radio panel are controlled by a rheostat on the command selector box and the lights in the electrical panel are controlled by a rheostat on the pilots overhead panel. The compass light is controlled by a rheostat in the electrical panel.

Fluorescent Lights and Switches.

On some aircraft, four fluorescent ultraviolet lights are installed, one on each side of the pilots' compartment and two on the control pedestal (6, figure 1-6 and 17, figure 1-7), and are used for the illumination of the instrument panel. Four rheostat-type switches (one for each light) are located immediately above the main instrument panel, two on the pilot's side and two on the co-pilot's side, and are used to turn the lights ON and adjust the brilliancy. The rheostats are placarded OFF, DIM, ON, and START. The switch must be positioned to START in order to put the lights in operation. The ON position provides the brightest illumination and, as the knob is turned past DIM toward OFF, the brilliancy is decreased. The OFF position turns the light OFF.

EXTENSION LIGHT AND SWITCH.

An extension light is installed on the bulkhead behind the co-pilot's seat. The light is operated and adjusted by a red knurled rheostat at the bottom of the light and a red momentary switch button on top and at the end of the light.

Navigator's Table Light and Switch.

The navigator's table light (3, figure 4-11 and 7, figure 4-12) is controlled by a switch mounted on a wooden support plate directly over the table. The switch is a toggle-type placarded WORK LIGHT.

Dome Lights and Switches.

Nine dome lights are installed in the following locations; one in the forward passageway, one in the radio operator's compartment, one in the navigator's compartment, four in the main cabin, one in the lavatory, one in the tail compartment, and, on C-117 series aircraft, one at the steward's station. Except for the main cabin lights, each light is controlled by a switch mounted beside it. On C-47 and R4D series aircraft, the main cabin compartment dome lights are controlled by either of two switches located at each end of the main cabin compartment ceiling. On C-117 series aircraft, the main cabin dome lights are controlled by a switch at the steward's station. The navigator's dome light is controlled by a switch mounted on the navigator's dome light panel (1, figure 4-11 and 8, figure 4-12).

Passenger Warning Sign and Switches (Some Aircraft).

A passenger warning sign, located on the upper center of the main cabin forward bulkhead, when illuminated will read NO SMOKING – FASTEN SAFETY BELT. The control switches for operation of the warning sign are located on the electrical control panel in the cockpit.

OXYGEN SYSTEM.

NOTE

As an aircraft ascends to high altitudes where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 37.8°C (100°F) decrease in temperature in the cylinders, the gage pressure can be expected to drop 20 per cent. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the aircraft descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the aircraft is in level flight, or while it is descending, is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

A gaseous oxygen system is installed which incorporates diluter-demand regulators for the crew and automatic continuous-flow regulators for the passengers and, on C-117 series aircraft, for the steward. The complete oxygen system is filled through a filler valve located in an access door forward of the main cabin door (1, figure 1-30). It is not possible to supplement the passengers' constant-flow system from the supply for the demand system because of check valves installed in the line, but the crew's oxygen system may be supplemented from the supply of the constant-flow system by opening the line valve.

CREW OXYGEN SUPPLY.

On C-47 and R4D series aircraft, the crew members are supplied by five to ten oxygen cylinders. On C-117 series aircraft, the crew members are supplied by three type G-1 cylinders. For combat safety, check valves are installed between the pilots' oxygen supply and the other crew members' oxygen supply. A diluter-demand oxygen regulator is installed at each flight crew's station (14, figure 1-6 and 9, figure 1-7). Type A-1 diluter-demand portable units and portable recharger assemblies are installed, in C-47 and R4D series aircraft, at the pilot's, copilot's, and navigator's stations. When oxygen is needed, the tube on the regulator is connected to the hose on the user's mask. Inhaling opens the valve in the regulator, which automatically supplies a proper mixture of air and oxygen at all times. A line shutoff valve, located just forward of the main cabin door, is provided in the filler line between the crew's and passenger sections of the oxygen system. The line valve may be opened to charge the complete oxygen system, and closed when it is desired to charge only the crew's section of the oxygen system. The approximate duration of the crew's oxygen system is given in figure 4-9.

Oxygen Regulator Diluter Lever.

A diluter lever is provided on each regulator to select NORMAL OXYGEN for all normal usage or to select 100% OXYGEN for emergency use. When the lever is placed in the NORMAL OXYGEN position, the air inlet valve is opened so that the regulator automatically supplies a proper mixture of air and oxygen to the mask at all altitudes. When the lever is placed in the 100% OXYGEN position, the air inlet valve is closed and the regulator supplies 100 per cent oxygen to the mask.

Oxygen Regulator Emergency Valve.

The emergency valve of the oxygen regulator is for use in case the demand oxygen regulator becomes inoperative. The valve should be opened only in an emergency to provide a means of manually supplying oxygen pressure to the mask in the event of regulator failure.

Oxygen Pressure Gages.

A direct-reading oxygen pressure gage that indicates system pressure is installed at the pilot's and co-pilot's stations and, on C-47 and R4D series aircraft, at the navigator's station (2, *figure* 1-6, 5, *figure* 1-7, 2, *figure 4-11, and 1, figure 4-12)*. An oxygen pressure gage is also installed at the rear of the main cabin for the passenger's oxygen system.

Oxygen Flow Indicators.

An oxygen flow indicator is installed at each flight crew station.

OXYGEN SYSTEM NORMAL OPERATION.

Note

Each flight crew member should check his gage and oxygen regulator with the diluter valve first at the NORMAL OXYGEN position and then at the 100% OXYGEN position as follows: Remove the mask and blow gently into the end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a faulty demand diaphragm or diluter air valve, or a leak in the mask-to-regulator tubing.

Use only a demand oxygen mask. Set the regulator diluter lever at the NORMAL OXYGEN position.

OXYGEN SYSTEM EMERGENCY OPERATION.

With the first symptoms of hypoxia, accomplish the following:

1. Break safety wire and open oxygen regulator emergency valve by turning the red knob counterclockwise.
2. After determining that a sufficient amount of oxygen is being received, turn the regulator diluter lever to the 100% OXYGEN position, and close regulator emergency valve.
3. If 100% oxygen is adequate, check equipment to determine if the NORMAL OXYGEN position may again be used. If conditions permit, turn regulator diluter lever to the NORMAL OXYGEN position.

If smoke or fumes should enter the cabin, accomplish the following:

1. Turn regulator diluter lever to the 100% OXYGEN position.
2. After the emergency condition has been corrected, turn regulator diluter lever to the NORMAL OXYGEN position.

CAUTION

Use of 100% oxygen or opening the regulator emergency valve exhausts the oxygen supply very rapidly. After the emergency condition has been corrected, close the regulator emergency valve and return the regulator diluter lever to the NORMAL OXYGEN position. If for any reason the emergency valve must be left open or the diluter lever in the 100% OXYGEN position, the pilot will be notified so that he may descend to a lower altitude. During all oxygen system emergency operations, oxygen pressure will be monitored closely.

OXYGEN SYSTEM FOR PASSENGERS, TROOPS, OR LITTER PATIENTS.

The passengers, troops, or litter patients are supplied by one type J-1 cylinder. The approximate man-hour duration of the passengers' system is given in figure 4-9. There are no controls for this system. Oxygen will automatically be supplied to the mask when the mask bayonet is inserted into the outlet coupling. Flow is automatically cut off when the bayonet is removed.

Note

Only a continuous-flow oxygen mask must be used.

A continuous-flow portable unit is installed on the main cabin aft bulkhead. Portable recharger assemblies are located on the main cabin forward and aft bulkheads.

NORMAL OPERATION.

The regulators and a pressure gage for the passengers' system are installed at the rear of the main cabin. The passengers' system regulators are automatic and supply the proper oxygen for the altitude of the aircraft. Oxygen outlet couplings are provided at each passenger's station. The coupling automatically opens to supply a proper oxygen flow when the oxygen mask bayonet is attached to the coupling. The coupling automaticaly closes when the mask bayonet is disconnected.

EMERGENCY OPERATION.

If the passengers' oxygen regulator should become inoperative, descend to an altitude where oxygen is not required.

AUTOPILOT.

The type A-3 or A-3A-1 autopilot is a gyroscopically controlled, hydraulically actuated system which automatically operates the flight control cable systems to maintain a desired magnetic heading and a normal stabilized attitude. An autopilot control panel *(figure 4-10)*, installed in the center of the main instrument panel, contains controls necessary for actuation of the

OXYGEN CONSUMPTION TABLES

OXYGEN DURATION, HOURS

BASED ON ONE TYPE G-1
CYLINDER PER CREW MEMBER

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
30,000	4.3	3.7	3.1	2.5	1.8	1.2	0.6	EMERGENCY Descend to altitude not requiring oxygen
	4.4	3.8	3.1	2.5	1.9	1.3	0.6	
25,000	3.3	2.8	2.4	1.9	1.4	0.9	0.5	
	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
20,000	2.5	2.2	1.8	1.4	1.1	0.7	0.4	
	4.7	4.0	3.4	2.7	2.0	1.4	0.7	
15,000	2.0	1.7	1.4	1.2	0.9	0.6	0.3	
	5.7	4.9	4.1	3.3	2.5	1.6	0.8	
10,000	1.6	1.4	1.2	0.9	0.7	0.5	0.2	
	7.6	6.5	5.4	4.3	3.3	2.2	1.1	

Note: For hours duration multiply figure by number of bottles and divide by number of crew members.

BLACK FIGURES INDICATE DILUTER LEVER AT NORMAL

RED FIGURES INDICATE DILUTER LEVER AT 100%

OXYGEN DURATION, MAN HOURS

PASSENGER
ONE TYPE J-1 CYLINDER

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
30,000	48.8	41.9	35.0	28.0	21.0	14.0	7.0	EMERGENCY Descend to altitude not requiring oxygen
25,000	53.1	45.5	38.0	30.4	22.8	15.2	7.6	
20,000	58.5	50.1	41.7	33.4	25.9	16.7	8.4	
15,000	65.0	55.6	46.3	37.0	27.8	18.6	9.3	
10,000	73.0	62.5	52.0	41.6	31.3	20.8	10.4	

FIGURES INDICATE CONSTANT FLOW

Figure 4-9

20,170

AUTOPILOT CONTROL PANEL - TYPICAL

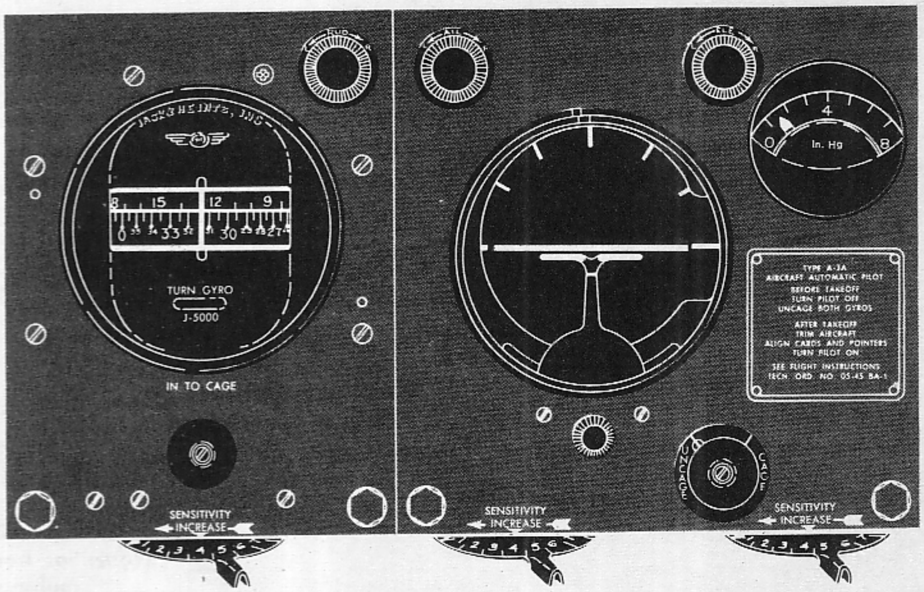


Figure 4-10

autopilot in maneuvering and trimming the aircraft. Bypass valves in the servo units are operated by the autopilot control valve handle on the control pedestal. Relief valves in each servo unit permit overpowering of the autopilot control in the event of an emergency by limiting the oil pressure in each servo cylinder.

CAUTION

The autopilot shall be engaged or disengaged with the flight control systems only when the aircraft is in a level flight attitude.

AUTOPILOT CONTROL VALVE HANDLE.

A manually operated autopilot control valve handle (10, *figure* 1-10), mounted on the aft lower face of the control pedestal, has ON and OFF positions. When the handle is placed in the ON position, a bypass valve in each servo unit is mechanically closed, and hydraulic fluid pressure enters the servo cylinders to actuate the autopilot system. Placing the handle in the OFF position opens the bypass valve in the servo unit and permits the hydraulic fluid to bypass the servo cylinders and return to the hydraulic reservoir.

CAUTION

Trimming the aircraft shall not be accomplished with the autopilot engaged since undue loads will be imposed on the autopilot system.

AUTOPILOT EMERGENCY SHUTOFF VALVE HANDLE.

A manually operated autopilot emergency shutoff valve handle (*5, figure* 1-24) mounted on the hydraulic control panel has ON and OFF positions. The handle is safetywired in the ON position for normal autopilot operation. When the handle is placed in the OFF position, a shutoff valve installed in the hydraulic fluid pressure line is mechanically closed to divert the flow of oil from the autopilot system in case of damage to the oil lines resulting in fluid loss.

ELEVATOR CONTROL KNOB.

The elevator control knob, located on the autopilot control panel (*figure 4-10*), controls the aircraft in pitch attitude. Rotating the knob counterclockwise results in a nose-up attitude; rotating the knob clockwise produces a nose-down attitude.

RUDDER CONTROL KNOB.

The rudder control knob, located on the autopilot control panel (*figure 4-10*), controls the aircraft about the vertical axis. Rotating the knob clockwise produces a right turn; rotating the knob counterclockwise results in a left turn.

AILERON CONTROL KNOB.

The aileron control knob, located on the autopilot control panel (*figure 4-10*), controls the aircraft about the roll axis. Turning the control knob toward the high wing will bring the aircraft to a level attitude.

AUTOPILOT INDICATORS.

A vacuum-operated gyro turn indicator and gyro bank-climb indicator is incorporated in the autopilot control panel (*figure 4-10*) to provide visual indication of the autopilot signal in each axis. If the needles diverge more than one pointer width from the respective index, an excessive out-of-trim condition exists and should be corrected.

Vacuum Gage.

A direct-pressure-operated vacuum gage, installed on the autopilot control panel (*figure 4-10*), indicates the vacuum pressure of the vacuum system in inches of Hg. Vacuum pressure indication is taken directly from the vacuum manifold.

Autopilot Oil Pressure Gage.

A direct-pressure-operated autopilot oil pressure gage mounted on the right side of the main instrument panel (*22, figure* 1-11 *and* 24, *figure* 1-12), indicates the autopilot system oil pressure.

Caging Knobs.

Caging knobs for the autopilot gyro instruments are installed on the autopilot control panel (*figure 4-10*). The limit of the gyro turn unit is 55° from vertical in bank, glide, or climb. The limit of the bank-climb gyro unit is 50° from vertical in bank, climb, or glide. Any maneuver that exceeds these limits will result in gyro spill or tumble causing the instruments to give incorrect indications. Pushing the gyro turn caging knob to the IN position, and turning the bank-climb caging knob clockwise to the CAGE position will mechanically set the gyro gimbal rings of each unit in their proper positions. After resetting the gyro units for proper heading and indication, the gyro turn caging knob may be pulled to full OUT, and the bank-climb caging knob may be turned counterclockwise to the UNCAGE position for gyro operation of both units.

Note

Instruments should be uncaged at all times, except during maneuvers that exceed their operational limits.

Sensitivity Dials.

On aircraft with the A-3A-1 autopilot installed, three manually operated sensitivity dials, one for each flight control, are installed on the autopilot control panel (*figure 4-10*). Each dial has seven settings: 0 through 6. Moving the dials toward higher numbers stimulates quicker flight control response. The sensitivity dials mechanically control the amount of air flow through an air relay valve diaphragm chamber connected to a balanced oil valve that controls the flow of oil in each servo unit.

Speed Control Valve Knobs.

On aircraft with the A-3 autopilot installed, three manually operated speed control valve knobs (*32, figure* 1-12), one for each flight control, are installed on the main instrument panel directly in front of the pilot's station. Each control knob has an indicator dial with seven settings: 0 through 6. Rotating the dials toward higher numbers stimulates quicker flight control response. The speed control valve knobs mechanically control the flow of oil from the servo cylinders to the hydraulic reservoir.

AUTOPILOT OPERATION.

Preflight Ground Test.

To perform an autopilot preflight ground test, proceed as follows:

1. Autopilot emergency shutoff valve handle – Safetied ON.
2. Fluid level in hydraulic reservoir – Check sight gage.
3. Autopilot control valve handle – OFF.
4. Operate engines at approximately 1000 rpm.
5. Autopilot vacuum gage – Within limits.
6. Check selector right engine – Forward Position (Modified aircraft).
7. Autopilot oil pressure gage – Within limits.
8. Uncage the bank-climb gyro unit.
9. Set the gyro turn unit to desired heading and uncage.
10. Flight controls – Neutral.
11. Set the rudder followup card to match the gyro turn card, set the aileron followup index to match the bank index, and set the elevator followup index to match the elevator alignment index.
12. On the type A-3A-1 autopilot, set each sensitivity dial to position 3. On the type A-3 autopilot, open each speed control valve knob to position 6.
13. Autopilot control valve handle – ON.
14. Check autopilot operation by turning each trimmer control knob.
15. Check the manual override by operating the flight controls against the autopilot.

Note

If the flight controls are moved too far from the automatic control position when overpowering the A-3A-1 autopilot, they will not return automatically when released, because the indexes of the autopilot gyro instruments will be moved out of alignment, and the signal response from the flight control surfaces to the autopilot followup cable system will be disrupted. Disengage the autopilot, align the indexes, and reengage the autopilot.

16. Turn off the autopilot by placing the autopilot control valve handle in the OFF position. Leave the instruments uncaged.
17. Hydraulic Selector – Both (Modified aircraft).

During Flight.

To operate the autopilot during flight, proceed as follows:

1. Trim the aircraft to fly "hands off."
2. Hydraulic Pump Selector – Right engine (Modified aircraft).
3. Select the desired aircraft heading and align the followup cards and indexes on the control panel.
4. Sensitivity dials or speed control valve knobs – Set (as desired).
5. Autopilot control valve handle – ON.
6. Trim the aircraft in the axis indicated by the gyro indexes with the autopilot in operation.

To turn off the autopilot, place the autopilot control valve handle in the OFF position.

NAVIGATION EQUIPMENT.

For instrument approach equipment, see Communication and Associated Electronic Equipment, this section.

For instrument approach procedures, see Section IX.

DRIFTMETER.

A type B-5 driftmeter (8, figure 4-11), installed on a wooden shelf located aft of the navigator's table, is used by the navigator to measure the angle of drift while in flight. On some aircraft, a type B-3 driftmeter is located aft of the navigator's table.

ASTROCOMPASS.

Some aircraft, facilities for mounting an astrocompass are located directly under the astrodome.

FLUX GATE COMPASS.

The flux gate compass system consists of a flux gate transmitter and gyro caging motor, both installed in the right outer wing panel, a flux gate compass master indicator installed at the navigator's station (5, figure 4-11 and 4, figure 4-12), a repeater indicator in the main instrument panel (1, figure 1-11), and a C-1 compass signal amplifier installed in the radio rack. The compass system receives its a-c power from the a-c inverter that is installed on the floor at the radio operator's station. The master indicator provides compensated compass readings by means of a direct-reading, 360-degree dial. The dial shows the four cardinal headings as well as intermediary headings which are marked every 5 degrees and numbered every 30 degrees. The small window on the lower face of the instrument will show a reciprocal reading. The master indicator actuates the repeater indicator on the main instrument panel.

CARGO LOADING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

The aircraft is equipped to handle diversified types of cargo in the main cabin *(figure 4-14)*. Fittings are provided for carrying external load items. Loading of the aircraft is accomplished through the double cargo loading doors, with a snatch block and idler pulley, a small and large platform, and a set of loading ramps.

WARNING

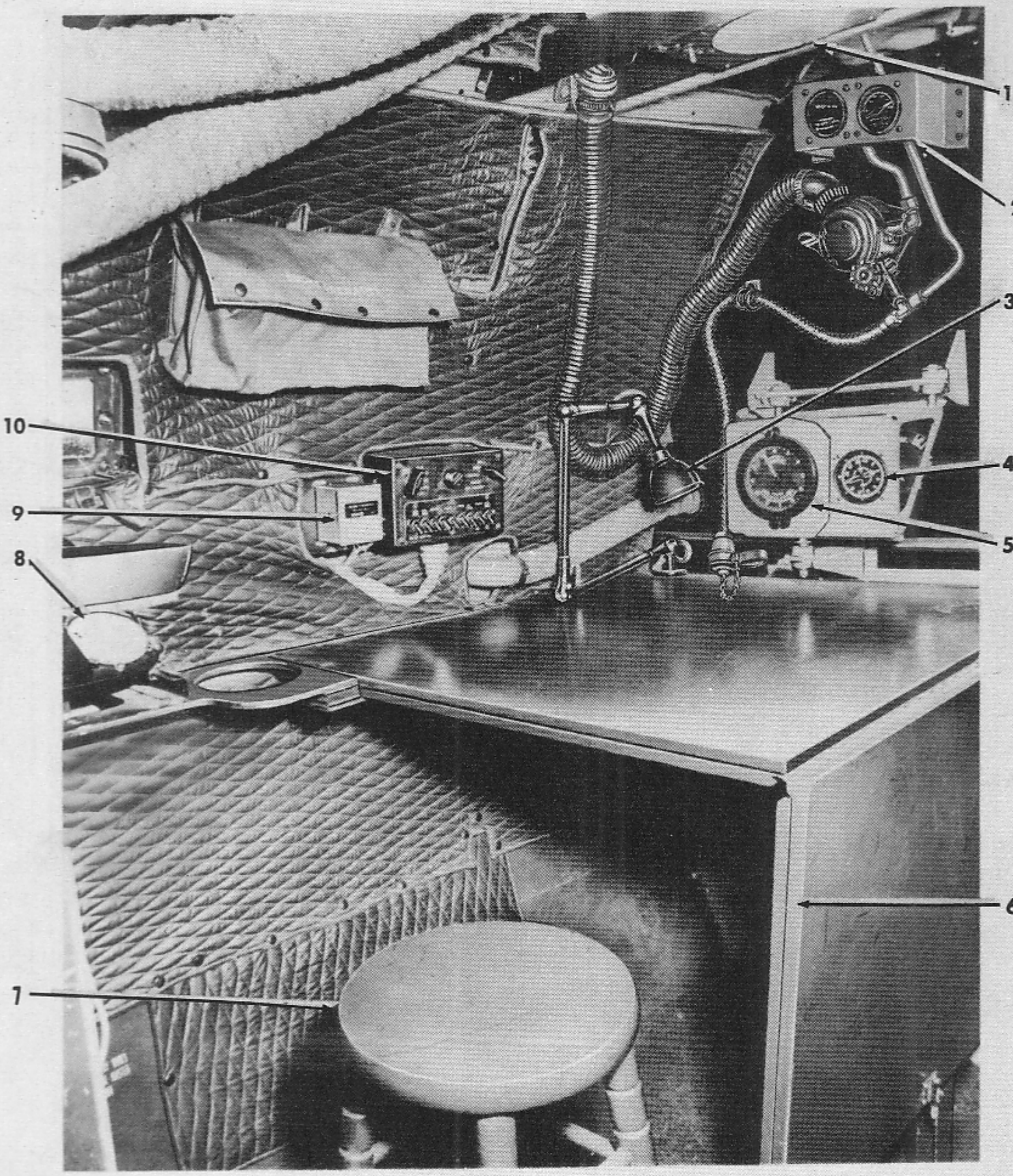
If possible, all personnel carried in the main cabin shall be located aft of the cargo.

For detailed information concerning cargo loading and dimensional limitations, refer to the applicable handbook of maintenance instructions.

TIE-DOWN FITTINGS AND RINGS.

Tie-down rings, installed along the sides of the main cabin compartment, are used for securing cargo, with fittings stowed in the miscellaneous stowage bag (8, *figure* 1-1) on the main cabin compartment aft bulkhead.

NAVIGATOR'S STATION—TYPICAL
C-47 SERIES AIRCRAFT

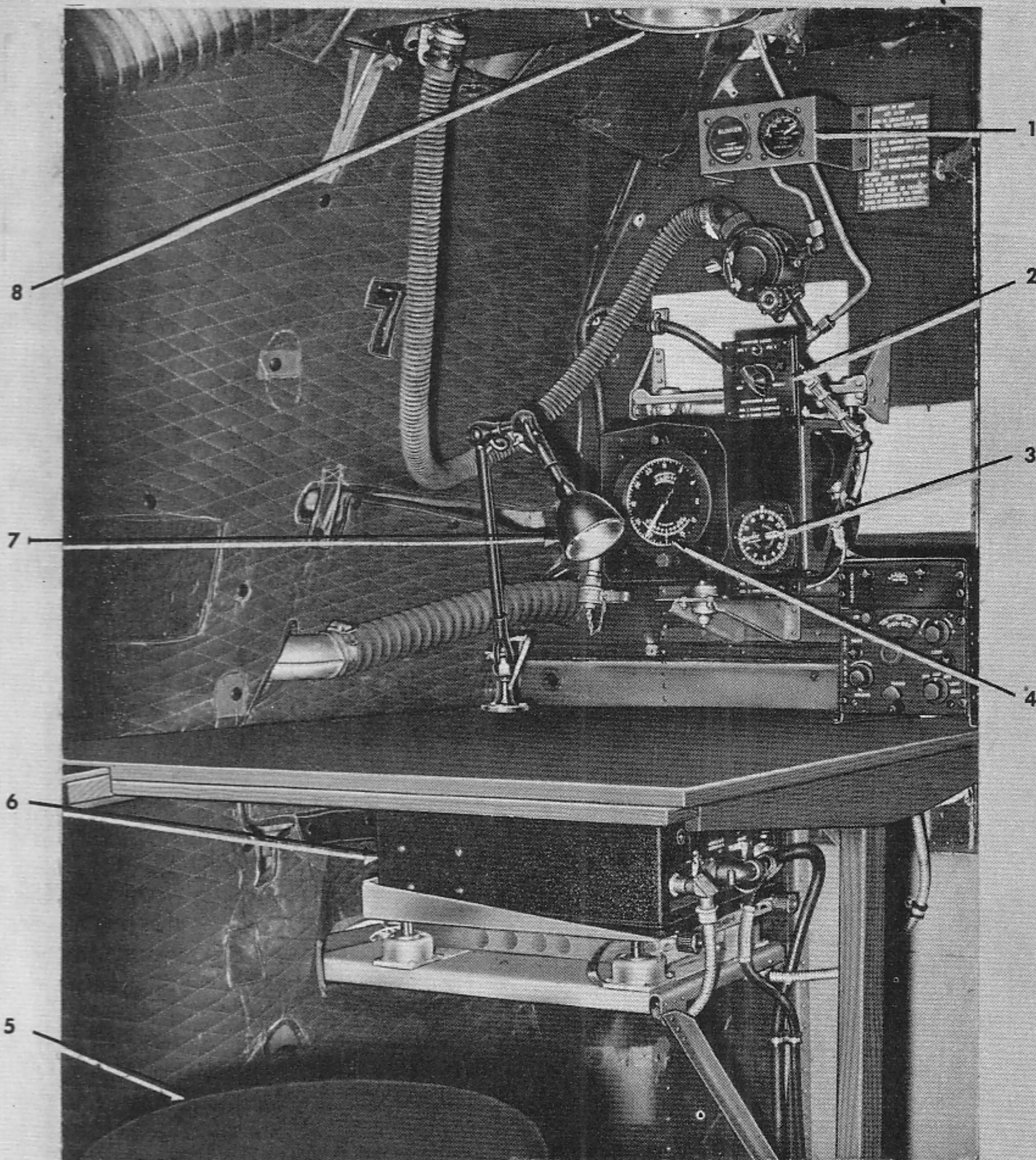


1. DOME LIGHT
2. OXYGEN FLOW PANEL
3. TABLE WORK LAMP
4. RADIO MAGNETIC INDICATOR
5. FLUX GATE COMPASS MASTER INDICATOR
6. DROP LEAF TABLE
7. NAVIGATOR'S STOOL
8. DRIFTMETER
9. RADIO FILTER
10. INTERPHONE CONTROL PANEL

Figure 4-11

NAVIGATOR'S STATION - TYPICAL

C-47 SERIES AIRCRAFT WITH AN/ARN-6 INSTALLED



1. OXYGEN FLOW PANEL
2. RADIO COMPASS SWITCH
3. RADIO MAGNETIC INDICATOR
4. FLUX GATE COMPASS MASTER INDICATOR
5. NAVIGATOR'S STOOL
6. R-101/ARN-6 COMPASS RECEIVER
7. TABLE WORK LAMP
8. DOME LIGHT

Figure 4-12

INTERIOR ARRANGEMENT—TYPICAL
C117 SERIES AIRCRAFT

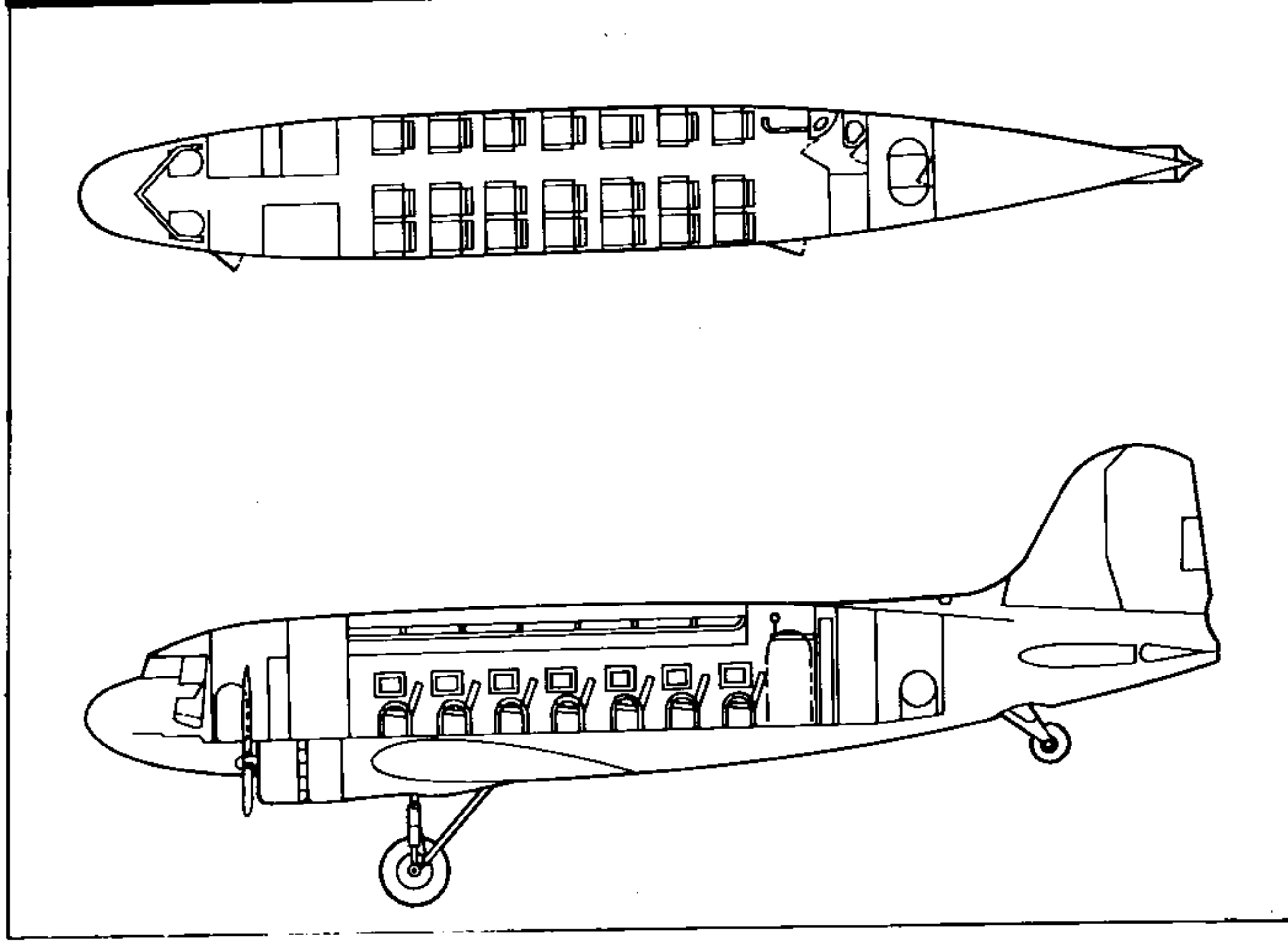


Figure 4-13

CARGO DOORS.

Double cargo doors, divided in the center, are mounted on hinges that swing outward. The doors may be secured against the side of the fuselage, in the open position, to permit unobstructed cargo loading operations. The main cargo door incorporates a smaller door that is used as a paratroop exit in flight, and for personnel entrance and exit when the aircraft is on the ground. The cargo door is also equipped with an emergency release mechanism that pulls the hinge pins if it becomes necessary to jettison the door while the aircraft is in flight. The two cargo doors may be removed from their hinges, if necessary, when loading heavy equipment. On some aircraft, the rear cargo door hinges have been redesigned to permit the door to swing farther aft and make removal for cargo loading unnecessary.

Main Cargo Door Latch Handles.

Two external and two internal door handles are located at the aft end of the forward cargo door. The lower handle controls the upper and lower latches of the forward cargo door, and the upper handle controls the center latching mechanism between the forward and aft cargo doors.

Main Cargo Door Emergency Release Handle.

The main cargo door is equipped with an internal emergency release handle should it become necessary to remove the door. The emergency release handle, located just above the lower hinge of the forward door and attached to the forward door jamb, is painted yellow and must be pushed down to remove the door. The handle operates as a direct lever in pulling the hinge pins.

Main Cargo Door Paratroop Door Handles.

The main cargo door incorporates a paratroop exit door which may be opened for the exit of paratroops by turning the two handles located near the top of the forward cargo door and pulling inboard.

Aft Cargo Door Latch Handles.

The aft cargo door can be opened only from the interior of the aircraft by means of two latch handles, one located on top and one located on the lower forward end of the aft cargo door.

LOADING RAMPS.

Holes for the attachment of loading ramps are provided in the sill of the main cargo loading doors.

CARGO CARRYING EQUIPMENT — EXTERIOR (C-47 AND R4D SERIES AIRCRAFT).

Fittings are installed on the underside of the fuselage for carrying two propellers.

PARA PACK PROVISIONS — EXTERIOR (C-47 AND R4D SERIES AIRCRAFT).

Provisions are made for carrying six para pack racks on the underside of the fuselage. The racks are attached to fittings that are installed flush with the fuselage skin. Standard bomb shackles in the para pack racks contain the carrying and releasing mechanism for the para packs, when para packs are carried. A para pack electrical control panel, installed on the para pack control junction box (13, *figure* 1-1) on the left fuselage wall forward of the main cargo doors, contains the necessary switches and indicator lights for operation of the release mechanisms.

Para Pack Master Switch and Circuit Breaker Switch.

A para pack master switch mounted on the para pack electrical control panel has ON and OFF positions. When the master switch is in the OFF position, a red warning light on the control panel is illuminated to indicate that the para packs cannot be released until the master switch is placed in the ON position to energize the 28-volt d-c para pack circuit. The red warning light is placarded WARNING—RED LIGHT MUST BE OFF TO RELEASE PACKS. An ON-OFF toggle circuit breaker switch, mounted on the para pack electrical control panel, protects the para pack circuit.

Para Pack Selective Control Switches.

Six para pack selective control switches are installed on the para pack electrical control panel for releasing the para packs. Each ON-OFF toggle switch, when placed in the ON position, completes a 28-volt d-c circuit to electrically energize a solenoid that actuates the electrical release mechanism on the respective para pack rack. Any para pack or combination of para packs may be released by actuating the selected toggle switch.

Para Pack Series Release Switch.

A para pack button-type release switch is connected to the para pack electrical control panel by a 2-foot length of flexible cable. Each time the switch button is depressed, a 28-volt d-c circuit is closed and the para pack release mechanisms are electrically actuated through individual solenoids to drop the para packs in the following sequence: (1) right aft, (2) left aft, (3) right center, (4) left center, (5) right forward, and (6) left forward.

Indicator Lights.

Six green 28-volt d-c indicator lights, installed above the selective control switches on the para pack electrical control panel, indicate that the para pack electrical circuit is armed. As each para pack is released, its respective indicator light will automatically go out.

Para Pack Salvo Switch.

A para pack salvo switch (23, *figure* 1-13 *and* 29, *figure* 1-14), located on the electrical control panel, has ON and OFF positions. When the switch is placed in the ON position, a 28-volt d-c circuit is closed and the six para pack electrical solenoids are simultaneously energized, allowing the electrical release mechanisms to drop all six para packs in the event of an emergency.

Para Pack Manual Salvo Release Handle.

A manually operated para pack salvo release handle is installed directly below the para pack electrical control panel. The handle is placarded PULL UP FOR PARACHUTE PACK SALVO RELEASE. When the handle is pulled to the full out position, a manual release mechanism is mechanically actuated, permitting the six para packs to be released simultaneously in the event of electrical failure.

TROOP CARRYING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

Folding bench-type seats are provided in the main cabin for the seating of 27 or 28 troops (*figure 4-14*). Each seat is fitted with a safety belt.

PARACHUTE RIP CORD CABLE (STATIC LINE).

A parachute rip cord anchorage cable is installed along the top of the main cabin interior to the left of the centerline. When not in use, the cable may be stowed by snapping it into four spring clips, located directly above it, which are provided for that purpose.

PARACHUTE TROOP EXIT PANEL.

On some aircraft, the inside panel of the forward half of the main cargo door is removable inward by turning the handles near the top of the door and lift-

INTERIOR ARRANGEMENT—TYPICAL
C-47 AND R5D AIRCRAFT

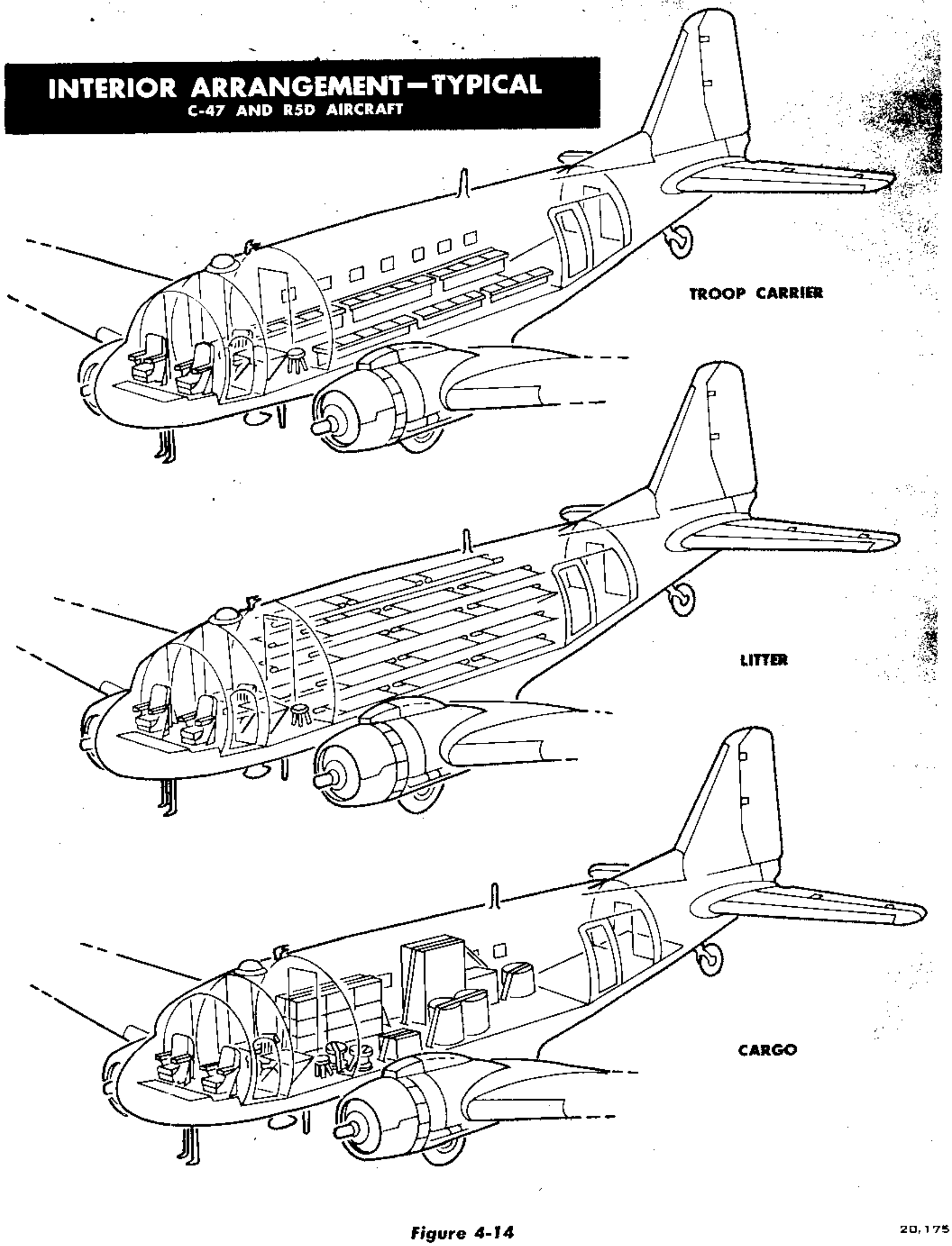


Figure 4-14

20,175

ing it out. This is used as the exit for parachute troops. Four hooks and bungee rings, installed on the right side of the fuselage opposite the main cargo loading door, are provided for stowing the panel while using the exit. The door is stowed by holding it against the side of the fuselage and hooking the bungees over it to secure it to the side.

CASUALTY CARRYING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

On some aircraft, 18 sets of metal supports are carried for setting up litter accommodations *(figure 4-14)*. The supports are stowed in red fiber boxes beneath the aft end of the main cabin compartment floor, and are accessible by removing the screws from the center floor panel and raising the floor. In use, the supports attach to built-in fittings in the floor. On other aircraft, leather strap supports are provided, making possible the installation of 24 litters. Canvas bags, marked LITTER STRAP STOWAGE, are snapped to the longerons in the main cabin compartment.

PASSENGER CARRYING EQUIPMENT (C-117 SERIES AIRCRAFT).

Adjustable upholstered seats are provided in the main cabin for the seating of 21 passengers *(figure 4-13)*. A lever is located at the side and front of each seat to make adjustments for the various settings. Each seat is fitted with a detachable safety belt and ash tray. A reading light and switch are located above each outboard seat. A cabin attendant's call button is also located on each reading light panel. Hat racks extend along either side of the main cabin ceiling. Adjustable cold air outlets are provided above each outboard seat. A passenger oxygen outlet door is provided below each main cabin window.

AUXILIARY POWER PLANT (APP).

The auxiliary power plant (APP), is located in the aft section of the main cargo compartment *(figure 1-1)*. The APP is used to supply 28-volt d-c power to the aircraft for emergency purposes or to ground check electrical equipment on the aircraft. The unit consists essentially of a two-cylinder gasoline engine and generator with a normal rated capacity of 0 to 175 amperes, and an emergency capacity of 175 to 200 amperes. The gasoline engine is supplied fuel from the main fuel system. Oil is supplied the engine by a self-contained oil tank with a capacity of 3 quarts. The APP is preheated by means of a combustion heater and an enclosure. The APP receives 28-volt d-c power through circuit breakers on the auxiliary power plant control panel *(figure 4-15)*.

CAUTION

- Do not operate the APP at emergency capacity (175 to 200 amperes) for a duration of more than 5 minutes, since damage to the APP may result.
- To preclude the possibility of a fire, do not operate the APP at any time long-range fuel tanks are installed.

APP OIL TEMPERATURE AND CYLINDER HEAD TEMPERATURE INDICATOR.

A combination oil temperature and cylinder head temperature indicator is mounted above the auxiliary power plant control panel *(figure 4-15)*.

STARTING APP.

1. Battery switch and APP fuel valve — ON.
2. For cold weather starts, preheat switch — ON.
3. When APP is warm, preheat switch — OFF.
4. Generator control switch — OFF.
5. APP ignition — ON.
6. Start control switch — START, hold in START position, operating choke as necessary. Allow 2- to 3-minute period for warmup.
7. APP throttle and start control switch — RUN, after APP has warmed up.
8. Generator control switch — RESET, THEN ON after 5-minutes of operation.

TO STOP.

1. Generator control switch — OFF.
2. APP throttle — IDLE.
3. Start control switch — OFF.
4. APP fuel valve — OFF, after 5-minutes of operation.
5. APP ignition — OFF.

PREHEATER.

A heater is installed on the forward end of the enclosure surrounding the APP. The heater system is intended to be used in temperatures below −6.6°C (20°F) to bring engine oil temperature up to −6.6°C (20°F). The oil temperature gage located on the auxiliary power plant control panel will indicate when this temperature is reached. Fuel is supplied to the heater from the main fuel system. Power for the igniter system is supplied from the 28-volt d-c bus. The heater has a rated output of 200 BTU and consumes approximately 0.4 of a gallon of fuel per hour. The heater is controlled by a preheater switch located on the auxiliary power plant control panel.

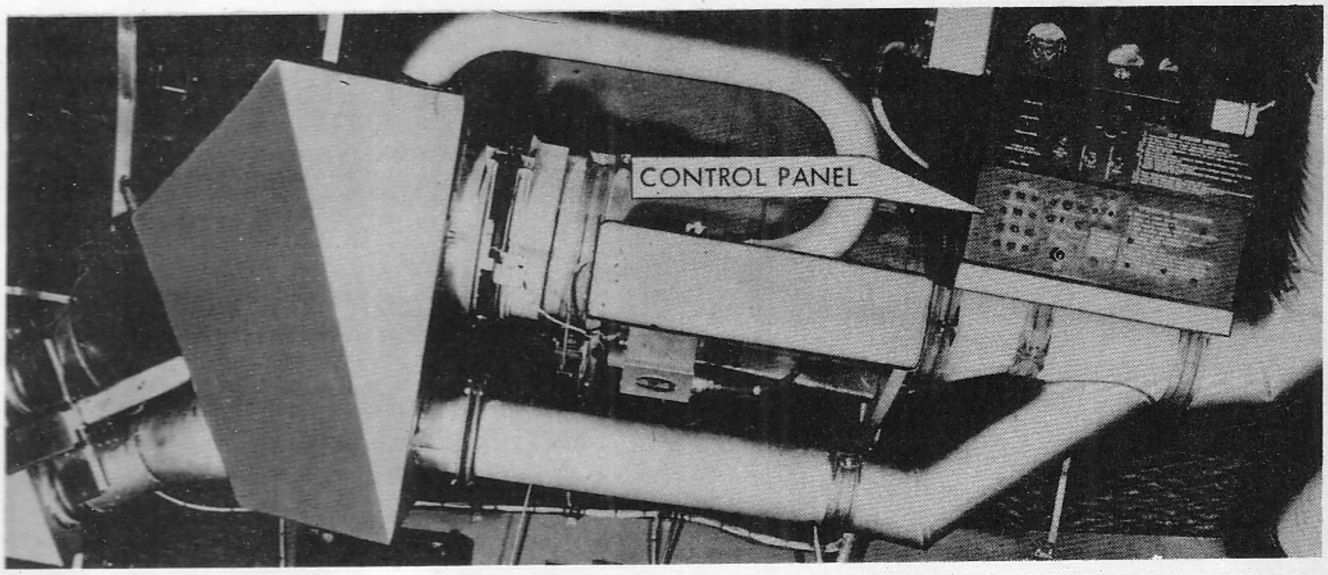


Figure 4-15

MISCELLANEOUS EQUIPMENT.

STEWARD'S SEAT (C-117 SERIES AIRCRAFT).

The steward's folding seat is installed on the left side of the main cabin just aft of the main passenger entrance door. The seat is fitted with a quick-detachable safety belt.

RADIO OPERATOR'S CHAIR.

A light metal swivel-type chair secured to the floor is provided for the radio operator. The chair swivels through a 180-degree angle and may be locked at any of four points through this angle by a locking pin beneath the seat. The seat is equipped with a quick-detachable safety belt.

NAVIGATOR'S STOOL/CHAIR (C-47 AND R4D SERIES AIRCRAFT).

NAVIGATOR'S SEAT/STOOL.

A bucket type adjustable seat is installed at the navigator's position. The seat may be adjusted vertically and laterally by means of the levers located below the seat. The seat is fitted with cushions and a safety belt and shoulder harness. On some aircraft, a wooden stool is provided at the navigator's station. The stool is secured near the bulkhead which serves as a backrest. No safety belt is provided for the navigator's stool.

WINDSHIELD WIPERS.

A windshield wiper system is provided for the two forward windshields. The windshield wipers are hydraulically operated and controlled by two needle-type control valve knobs, one for each windshield *(1, figure 1-7)*, located in the vee of the windshield above the main instrument panel. To operate either wiper, slowly open the control valve until the desired speed of the wiper blade is obtained. During heavy rain, or if ice forms on the windshield, the windshield wipers may be operated in conjunction with the windshield de-icing system. See the paragraph on Windshield De-icing System, this section.

CAUTION

Do not operate the windshield wipers on dry windshields.

ACCESSORY OUTLET RHEOSTATS (C-47 AND R4D SERIES AIRCRAFT).

On some aircraft, five accessory outlet rheostats are installed, one at each crew member's station, and one in the forward passageway.

DATA CASES.

Two data cases are installed, one at the pilot's station and one at the co-pilot's station.

CABIN ENTRANCE LADDER.

A dural cabin entrance step ladder is stowed either on the bulkhead in front of the lavatory or within the lavatory.

WINDSHIELD DEFROSTER PANELS.

On some aircraft, windshield defroster panels are stowed in the left forward baggage compartment and may be attached to the front windshields to provide a space between the windshield and the defroster panel for entry of hot air from the heating system. Each defroster panel has an outlet for connection to the flexible windshield ducts of the heating system.

RELIEF TUBES.

Two relief tubes are installed, one beneath the pilot's seat, and one beneath the co-pilot's seat.

LAVATORY.

The lavatory compartment is located aft of the main cabin and includes a toilet, a wash basin, a water tank, and a relief tube.

SECTION V
OPERATING LIMITATIONS

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INTRODUCTION.

This section includes the engine and aircraft limitations that must be observed during normal operation. The instrument markings *(figure 5-1)*, which form a part of these limitations, must be referred to, as they are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENT.

The minimum crew for a flight is a pilot and a co-pilot. Additional crew members, as required, will be added at the discretion of the commander.

INSTRUMENT LIMIT MARKINGS.

The limits marked on the aircraft instruments are shown in figure 5-1.

Note

The limitations marked on the instruments apply to flight conditions and are not intended to indicate ground operating limits.

ENGINE LIMITATIONS.

Refer to figure 5-1 for normal engine operating limits. Overspeed limitations on the engine are 3100 to 3300 rpm for complete inspection and above 3300 rpm for replacement. Note all conditions of overspeed on Form 781.

ENGINE POWER TIME LIMITATIONS.

The engines are approved for 5 minutes of operation at maximum power during takeoff and climb at takeoff speed. There is no limitation in the use of METO power.

ENGINE (OVERBOOST OR) EXCESSIVE MANIFOLD PRESSURE.

Use of manifold pressures in excess of those specified under normal and alternate fuel grade operating limits, this section, is not permitted. If excessive manifold pressure is experienced, the following limits apply:

1. At or above METO power an excessive manifold pressure over 15 seconds duration requires engine removal.
2. At any power setting 10 or more inches Hg excessive manifold pressure required engine removal.
3. Below METO power 5 to 10 inches Hg excessive manifold pressure from 5 to 15 seconds duration required engine inspection.

ALTERNATE FUEL GRADE (91/96) OPERATING LIMITS.

Take-Off	2700 rpm 46 in. Hg at SL auto-rich mixture
Max Continuous	2550 rpm 41 in. Hg at SL auto-rich mixture
Max Auto-Lean	2250 rpm 34 in. Hg at SL

When 115/145 fuel grade is used, the limits for fuel grade 100/130 apply.

AIRSPEED LIMITATIONS.

Item	26,000 Lb Gross Wt	29,000 Lb Gross Wt	31,000 Lb Gross Wt	33,000 Lb Gross Wt
Max level flight (indicated)	177 Knots (204 mph)	169 Knots (195 mph)	148 Knots (171 mph)	129 Knots (149 mph)
Max allowable	221 Knots (255 mph)	202 Knots (233 mph)	170 Knots (196 mph)	140 Knots (160 mph)
Max for extending landing gear (indicated)	140 Knots *(160 mph)			
Max for extending full wing flaps (indicated)	97 Knots *(112 mph)			
Max for extending ½ wing flaps (indicated)	100 Knots *(115 mph)			
Max for extending ¼ wing flaps (indicated)	104 Knots *(120 mph)			

*Not Affected By Gross Wt.

PROHIBITED MANEUVERS.

All acrobatic flight maneuvers are prohibited.

CENTER OF GRAVITY LIMITATIONS.

Gear down	Forward 11% MAC	Aft 28% MAC
Gear up	Forward 11% MAC	Aft 28% MAC

For additional information, refer to *Basic Weight Check List and Loading Data, T.O. 1C-47-5.*

OPERATIONAL WEIGHT LIMITATIONS.

Weight, more than any other single factor, will determine the capability and performance of your aircraft. In designing an aircraft, weight has always been a primary restrictive factor as it has a direct effect on aircraft configuration, power, and range. Aircraft are designed with sufficient strength to accomplish a certain basic mission without undue allowance for overloading or improper weight distribution. Every effort is made to eliminate unnecessary weight; however, the weight penalty for making an aircraft foolproof is prohibitive. Weight limitations, therefore, are necessarily involved in the operation of the aircraft. If these limitations are exceeded, a loss in the performance of the aircraft is inevitable and structural failure is quite probable. When an aircraft is loaded beyond the established limits, ceiling and range are decreased, control forces and stalling speeds become higher, and the rate of climb falls off rapidly as the maximum gross weight is exceeded. The take-off and landing rolls increase appreciably with an increase in gross weight. Likewise, the braking power is insufficient for checking the forward momentum of the aircraft and the wings are more vulnerable to airloads during maneuvers or flight through turbulent air. These effects can reach serious proportions when the weight limitations of a specific aircraft are disregarded. In cargo aircraft, particular attention must be paid to the weight problem. In order that cargo of various sizes may be accommodated, the cargo compartment is of such proportions that space is not usually a restrictive factor; consequently, overloading is entirely possible and weight limitations must be complied with if the aircraft is to be operated efficiently, economically, and safely. A consideration of the weight factors involved, particularly as they apply to this aircraft, appears in the succeeding paragraphs.

WEIGHT AND LOADS.

Due to the effect of gravity on the mass of your aircraft, the aircraft possesses weight. More exactly, this weight is a force which gravity exerts on the material used in the fabrication of the aircraft and which pulls the aircraft toward the earth. In any condition of static equilibrium during straight and level flight or at rest on the ground, the aircraft is subjected to this pull of gravity, the strength of which is spoken of as 1G. As fuel, cargo, passengers, crew members, and additional equipment are added in order that the aircraft may accomplish a specific mission, the additional weight constitutes a force acting on the aircraft structure. The weight of the aircraft, or the force that gravity imposes on the aircraft, may also be considered as a load. On the ground, this load must be sustained by the landing gear; in flight, by the wings. There is a limit to the load which the landing gear is capable of supporting during taxi, take-off, and landing operations; there is likewise a limit to the load which the wings can sustain in flight. During maneuvering and flight through turbulent air, additional loads are imposed on the aircraft. These loads, caused by the acceleration of the aircraft, are the result of forces which, in addition to that of gravity, act upon the total mass of the loaded aircraft. Both types of force tend to produce undesirable and potentially dangerous loads on the aircraft structure and its members. This is particularly true of the wings, which must sustain the aircraft in flight. When the weight of the aircraft is increased, the wings become more and more vulnerable to the loads imposed by sudden changes in air currents or manipulation of the controls. The ultimate strength of the aircraft structure is eventually exceeded by the combined forces of weight and airloads. When this condition occurs, structural failure results. Since the maximum weight which the aircraft can safely carry is dependent upon distribution of the weight throughout the aircraft and its capacity to sustain airloads in accelerated flight, an understanding of weight limitations is required to accomplish a mission successfully.

LOAD FACTORS.

A load factor is the ratio of the load imposed on the aircraft when accelerated in any direction, as compared with the load imposed on the aircraft by gravity in any condition of static equilibrium. The load factor denotes the strength of the forces acting on the aircraft as a result of sudden changes in air currents and manipulation of the controls, and is expressed by the term G, which is the gravitational force. By definition, then, all aircraft at rest on the ground or in straight and level flight possess a load factor of 1G because the force acting upon the aircraft under either of these conditions is merely that of gravity. When the aircraft enters a region of turbulent air or the pilot elects to maneuver the aircraft, additional forces are imposed on the structure. The additional load on the wings resulting from these forces is expressed in relation to the gravitational force and is referred to as 0.5G, 2.0G, 3.0G, etc, which mean that the forces exerted on the wing structure and its members are .5, 2, or 3 times the force exerted by gravity. For example, if the normal weight of the aircraft is 25,000 pounds and the load factor at some given moment of accelerated flight is 3.0G, the total force which the wings must sustain is 75,000 pounds, or three times the normal weight of the aircraft in straight and level flight.

MARGIN OF SAFETY.

The margin of safety is the range of forces which exist between the load factor the aircraft is sustaining at any given moment and the load factor at which structural damage will occur. If, for example, the aircraft is incapable of sustaining a load factor greater than 3.0G, and during flight through turbulent air is subjected to a force of 1.5G, the margin of safety at this particular moment is 1.5G. When fuel and cargo loads are increased, the margin of safety decreases. This increase in weight actually becomes a component of the forces acting on the aircraft, and, as such, lessens the capacity of the aircraft to sustain further loads due to accelerated flight. For this reason, it is advisable in loading an aircraft to maintain a margin of safety that will never be exceeded during any period of flight.

WARNING

If the combined weight of cargo and fuel is such that the aircraft is incapable of sustaining a force of 3.0G, turns and pull-outs should be made with caution to minimize the resulting airloads.

EXPLANATION OF CHART.

The weight limitations chart *(figure 5-2)* is intended to present graphically the weight-carrying capabilities of the aircraft as defined by the various criteria which provide limits for safe and efficient operation. The chart will help the flight planner to recognize the weight limitations that will restrict operation in a specific mission and to determine what margin of safety may be established.

Note

Although the chart indicates the limitations involved in the loading of the aircraft, the authority for operating the aircraft at a given gross weight remains the responsibility of the local authority.

GROSS WEIGHTS.

The data in this chart is based on an initial operating weight of the aircraft exclusive of fuel and cargo. The zero point of the chart at the junction of the fuel and cargo load axes represents an operating weight of 20,000 pounds. Because individual operating weights may vary, it will be necessary to adjust the chart for the specific aircraft involved. The operating weight plus the fuel and cargo required in a mission can be shown by gross weight lines that slope at a 45-degree angle to the axis of the chart. These diagonal lines also indicate various structural and performance limitations. However, any gross weight line may be plotted to obtain a graphic representation of the limitations involved in the fuel-weight combination that a mission may require.

Note

The gross weight of the aircraft should never exceed that required for the mission, since unnecessary risk and wear of the equipment will otherwise result. Take-off gross weights must also be considered in the light of available runways, surrounding terrain, altitude, atmospheric conditions, and the requirements and urgency of the mission.

INSTRUMENT MARKINGS

OIL TEMPERATURE

- (red) 40°C Minimum
- (green) 60°C To 80°C Normal
- (red) 100°C Maximum

OIL PRESSURE

- (red) 65 Psi Minimum For Flight
- (green) 65 To 110 Psi Normal
- (red) 110 Psi Maximum

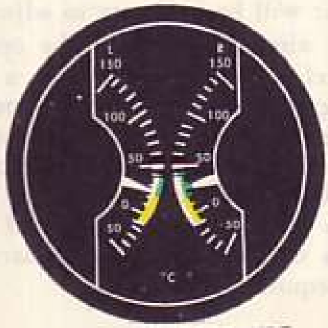
FUEL GRADE 100/130 or 115/145

MANIFOLD PRESSURE

- (blue) 28-30.5 In. Hg — A.L. Permitted
- (green) 30.5-42.5 In. Hg — A.R. Reqd
- Above 42.5 In. Hg — 5 Min Limit A.R. Reqd
- (green) 42.5 In. Hg — Meto Power
- (red) 48 In. Hg — Maximum

TACHOMETER

- (red) 1300 To 1700 Rpm — Dangerous Empennage Vibration
- (blue) 1700 To 2050 Rpm — A.L. Permitted
- (green) 2050 To 2550Rpm — A.R. Reqd
- Above 2550 Rpm — 5 Min Limit A.R. Reqd
- (green) 2550-Meto Power
- (red) 2700 Rpm — Maximum



CARB AIR TEMPERATURE

- (yellow) —10°C To 15°C — Possible Icing
- (green) 15°C To 38°C — Normal
- (red) 50°C — Detonation

CYL-HEAD TEMPERATURE

- (blue) 150°C — 232°C — A.L. Permitted
- (green) 232°C To 260°C — A.R. Reqd
- (red) 260°C — Maximum

Figure 5-1 (Sheet 1 of 2)

FUEL PRESSURE

- 14 psi — Minimum for flight (red)
- 14 to 16 psi — Normal (green)
- 16 psi — Maximum (red)

AIRSPEED-KNOTS

- 97 Knots—Full flaps (yellow)
- 221 Knots-Maximum allowable (red)

AIRSPEED-MPH

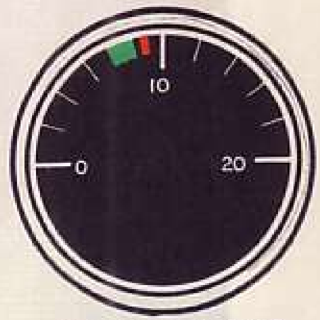
- 112 mph — Full flaps (yellow)
- 255 mph — Maximum allowable (red)

AUTOPILOT OIL PRESSURE

- 105 psi — Minimum (red)
- 110 to 130 psi — Normal (green)
- 140 psi — Maximum (red)

SUCTION GAGE

- 3.75 in. Hg — Minimum (red)
- 3.75 to 4.25 in. Hg — Normal (green)
- 4.25 in. Hg — Maximum (red)

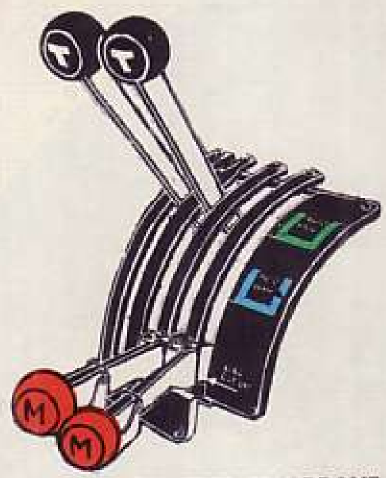


DE-ICING PRESSURE

- 7.5 to 8.5 psi — Normal (green)
- 9 psi — Maximum (red)

HYDRAULIC PRESSURE

- 600 psi — Minimum (red)
- 600 to 875 psi — Normal (green)
- 900 psi — Maximum (red)



MIXTURE CONTROL QUADRANT

- Auto — Lean (blue)
- Auto — Rich (green)

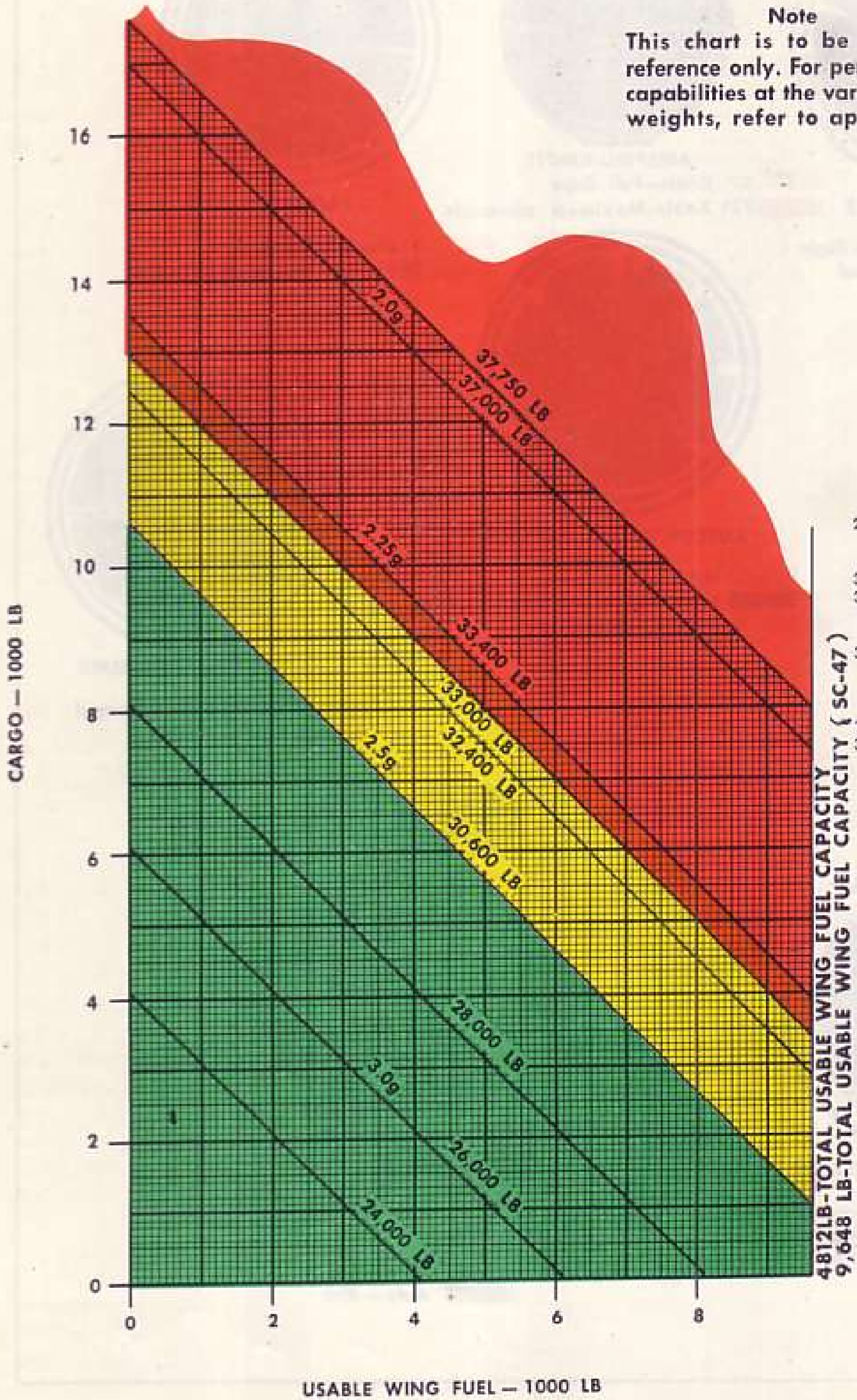
Figure 5-1 (Sheet 2 of 2)

WEIGHT LIMITATIONS CHART - TYPICAL

BASIC OPERATING WEIGHT OF 20,000 LB

Note

This chart is to be used for reference only. For performance capabilities at the various gross weights, refer to appendix I.



26,000 — DESIGN GROSS WEIGHT AT 3.0g WING LOAD FACTOR. NORMAL LANDING WEIGHT.
30,600 — 2.5g WING LOAD FACTOR.
32,400 — 100 FPM, SL, HOT DAY, SINGLE ENGINE CLEAN CONFIGURATION, MAXIMUM POWER.
33,000 — 100 FPM, SL, STANDARD DAY, SINGLE ENGINE, CLEAN CONFIGURATION, MAXIMUM POWER, MAXIMUM RECOMMENDED LANDING WEIGHT.
37,000 — 2.0g WING LOAD FACTOR.
37,750 — 500 FPM, SL, STANDARD DAY BOTH ENGINES OPERATING, CLEAN CONFIGURATION, METO POWER.

RECOMMENDED

CAUTIONARY

NOT RECOMMENDED

Figure 5-2

WING FUEL LOAD.

At the base of the chart along the horizontal axis, the weight of the fuel normally carried in the wing tanks is indicated in thousands of pounds.

LONG-RANGE FUEL LOAD.

When long-range fuel tanks are installed in the main cabin to increase the range of the aircraft or to transport fuel, the total weight of this fuel and the tanks should be computed as cargo load. By computing the fuel in the long-range tanks as cargo load, detailed chart work is eliminated, as are the individual calculations involved in adding the weight of the long-range fuel to the fuel load and the weight of the long-range tanks to the cargo load. Whenever long-range fuel is carried, a reduction in the cargo load is necessary to compensate for the weight of the long-range fuel and tanks.

CARGO LOAD.

In any mission, range and fuel consumption directly determine the fuel that must be carried, and indirectly the cargo that can be transported. With the necessary fuel for the mission established, cargo loading is variable within the limits established by the strength and performance of the aircraft. The payload, as carried in the cargo compartment, appears in thousands of pounds along the vertical axis of the chart. When long-range fuel is utilized to increase the range of the aircraft, the combined weight of the fuel and tanks should be computed as cargo load.

WING LOAD FACTORS.

The loads which the wing will sustain under different weight conditions are represented by the wing load factor lines on the chart. Under most loading conditions, which are normally limited by single-engine performance, the margin of safety provided by the wing load factors is very small. However, when flight through turbulent air is anticipated, the highest practical wing load factor is desirable.

SPEED.

The loads on the wing increase as the gross weight increases. This effect may be largely nullified by a reduction in speed. Refer to the paragraph on Airspeed Limitations, this section, for recommended speeds at various gross weights.

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routine operation at a gross weight of 26,000 pounds at a maximum contact sinking speed of 9 fps limit. This is the maximum recommended landing weight for normal operation. The maximum recommended landing weight under emergency conditions is 33,000 pounds. This weight is based on the fact that the landing gear fittings become critical at this weight when landing in the tail down attitude. Therefore, when landing at weights in excess of 26,000 pounds, the tail down attitude should be avoided if at all possible. At a landing weight of 33,000 pounds, the brakes are good for 100 stops. The main wheels and tail wheel and tire become critical for strength at 33,000 pounds gross weight.

SKI LIMITATIONS.

The main skis are designed for a gross weight capacity of 15,000 lbs. each. The tail ski is designed for a gross weight capacity of 4000 lbs.

PERFORMANCE LIMITATIONS.

In the case of 2-engine aircraft, it is generally inherent that performance rather than structural limitations restricts the weight which the aircraft can carry. Obviously, the gross weight must necessarily be limited by the ability of the aircraft to take off within available runway length and clear any obstacles. But the primary consideration is the ability of the aircraft to fly with partial power. Single-engine performance, then, is the major restrictive factor in the loading of the aircraft. Note the gross weight lines on the chart, particularly those which separate the loading areas. Each of these lines defines a specific limitation and several of the lines are wholly performance limitations. These performance limitations are based on the gross weight at which an adequate rate of climb can be maintained under various conditions of power, temperature, and configuration.

POWER LOSS AND PERFORMANCE.

On this aircraft, the effect of an engine failure on performance is immediate. The loss of half the total thrust normally developed by both power plants and the asymmetric power condition that results produce a marked decrease in the rate of climb. The significance of gross weight and configuration immediately becomes apparent, for the aircraft with partial power is unable to maintain an adequate rate of climb at gross weights above 33,000 pounds, or in a configuration where the landing gear and wing flaps are extended. Power losses due to temperature, humidity, and engine deficiency exert a considerable influence on the rate of climb, even when both engines are operating. It is not difficult to visualize the effect which engine failure will produce on the rate of climb, but it is interesting to note the remarkable difference in aircraft performance resulting from a rise in temperature and a corresponding fall in air density. As the weight limitations chart illustrates, the difference between a standard day and a hot day requires a cargo adjustment of approximately 600 pounds. For purposes of standardization, the temperature of a standard day is 15°C (59°F) and that of a hot day, 38°C (100.4°F) at sea level. Naturally, variations of temperature and altitude within this range will give similarly graduated values in brake horsepower and rate of climb. The effect of humidity and engine deficiency on brake horsepower and, ultimately, on the gross weight at which the aircraft may be operated, has not been included in the weight limitations chart because there are so many variable conditions involved.

CONFIGURATION AND PERFORMANCE.

The configuration of the aircraft also imposes a penalty on performance. In other than clean configurations, the increase in drag produces a decrease in the rate-of-climb and requires a readjustment of the gross weight at which the aircraft may be operated. As with power losses, this condition is most critical at take-off when, of necessity, the landing gear is extended and the cowl flaps and oil cooler flaps are open. The drag created by a windmilling propeller and the extended landing gear during the take-off roll is such that no attempt to take off should be made unless the safe single-engine airspeed for the aircraft gross weight has been achieved.

RECOMMENDED LOADING AREA.

The green area on the chart represents the loading conditions that present no particular problem in regard to the strength or performance of the aircraft. Operation of the aircraft at weights outside this recommended loading area should be avoided unless the dictates of the mission require it. The green area is bounded by the 2.5G wing load factor line.

CAUTIONARY LOADING AREA.

The yellow area on the chart represents loadings of progressively increasing risk as the red area is approached. Caution must be exercised because single-engine performance at these gross weights is marginal, depending upon configuration, altitude, and ambient air temperature. This area is defined by the gross weight diagonal which indicates a rate of climb of 100 feet per minute at sea level on a standard day with one propeller feathered, gear and flaps up, and maximum power on the operative engine.

LOADING NOT RECOMMENDED.

Note

Whenever flights are conducted at weights shown in the red area of the chart, entry of this fact in Form 781 is required.

The red area represents loadings which are not recommended because the margin of safety, from the standpoint of both performance and structural limitations, is something less than the most desirable or practical. Under conditions of extreme emergency when safety of flight is of secondary importance, the commander will determine whether the degree of risk warrants operation of the aircraft at gross weights appearing in the red zone.

USE OF CHART.

A sample problem is presented to illustrate the application of the chart.

1. Assume that a C-47 aircraft calls for a 10,500-pound payload and 3000 pounds of fuel. Starting with the operating weight of 20,000 pounds at "0," proceed along the vertical axis to 10,500 pounds; this increases the gross weight to 30,500 pounds. Next proceed along the horizontal axis to 3000 pounds and project a line vertically to intersect the horizontal projection of the 10,500 pound line. By interpolation, the intersection will indicate a gross weight of 33,500 pounds. This value is above the maximum recommended gross weight, and in order to keep within the cautionary envelope, the cargo or fuel must be reduced by 500 pounds.

2. Another example to demonstrate a problem where the operating weight of the aircraft is greater than that shown on the chart: assume an operating weight of 22,000 pounds instead of 20,000 pounds, or a difference of 2000 pounds. Using the same requirements as in the previous example and proceeding as before, the gross weight will be found to be 33,500 pounds by interpolation; but, to this value, 2000 pounds must be added to the cargo scale to correct the chart for the heavier aircraft. This increases the total gross weight to 35,500 pounds. This value is above the maximum recommended gross weight, and in order to keep within the cautionary envelope, the cargo or fuel must be reduced by 2500 pounds.

SECTION VI
FLIGHT CHARACTERISTICS

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Stalls 6-1
Spins 6-1
Diving 6-1

GENERAL.

The flight characteristics are normal for a twin-engine transport aircraft. The aircraft is very stable around all axes and is easily trimmed to fly *hands off.* Very minor trim changes are required to maintain the desired aircraft attitude. Control forces required for maneuvering throughout the speed range are normal. Rudder and aileron control is excellent and elevator forces are normal at high and low airspeeds.

STALLS.

The power-off stalling characteristics for this aircraft are normal. Stall warning comes in the form of a comparatively mild buffeting of the horizontal stabilizer. Stalling speed increases with the degree of bank and increase in gross weight, as shown in figure 6-1. The ailerons are effective up to the point of stall. No violent rolling action either precedes or accompanies the power-off stall under any flap setting. However, as in the case of most multi-engine aircraft, stall encountered with power on will probably cause violent rolling movements. The extended landing gear has no appreciable effect on the stalling characteristics. Recovery from a stall is normal and should be made by nosing the aircraft down and applying power. Apply power smoothly and avoid an abrupt pull-out.

PRACTICE APPROACH TO STALLS.

Practice approach to stalls at a safe altitude, applying the principles discussed in the above paragraph. Minimum altitude for practicing approach to stalls is 5000 feet above the terrain.

SPINS.

Intentional spins are prohibited. However, in case a spin is entered into accidentally, use normal spin recovery procedure to regain level flight. If the normal spin recovery procedure does not stop the spin, a *blast of power* on the inside engine may expedite the recovery. This is not a normal procedure, however, since the thrust from the blast of power may increase airspeed beyond the maximum design structure limits.

DIVING.

Placarded airspeed should not be exceeded in a dive. Recovery from a dive should be accomplished smoothly, and abrupt pull-outs avoided.

APPROXIMATE STALLING SPEEDS – POWER OFF

MPH AND KNOTS IAS

Note: The extended landing gear has no appreciable effect on the stalling characteristics.

GROSS WEIGHT (POUNDS)	0 FLAP LEVEL KNOTS	0 FLAP FLIGHT MPH	0 FLAP 30 DEG KNOTS	0 FLAP BANK MPH	0 FLAP 45 DEG KNOTS	0 FLAP BANK MPH	1/4 FLAPS LEVEL KNOTS	1/4 FLAPS FLIGHT MPH	1/4 FLAPS 30 DEG KNOTS	1/4 FLAPS BANK MPH	1/4 FLAPS 45 DEG KNOTS	1/4 FLAPS BANK MPH
33,000	76	88	82	95	91	105	71	82	77	89	86	99
31,000	73	85	79	91	88	101	69	79	75	86	83	96
29,000	71	81	76	88	85	98	67	77	72	83	80	92
27,000	68	78	73	84	82	94	64	74	69	80	77	89
25,000	65	75	70	81	78	90	62	71	66	77	74	85
23,000	62	72	67	77	75	86	59	68	63	73	71	82
21,000	59	68	64	74	71	82	56	64	60	70	68	78

GROSS WEIGHT (POUNDS)	1/2 FLAPS LEVEL KNOTS	1/2 FLAPS FLIGHT MPH	1/2 FLAPS 30 DEG KNOTS	1/2 FLAPS BANK MPH	1/2 FLAPS 45 DEG KNOTS	1/2 FLAPS BANK MPH	FULL FLAPS LEVEL KNOTS	FULL FLAPS FLIGHT MPH	FULL FLAPS 30 DEG KNOTS	FULL FLAPS BANK MPH	FULL FLAPS 45 DEG KNOTS	FULL FLAPS BANK MPH
33,000	68	78	73	83	81	92	65	75	70	81	79	90
31,000	65	75	70	81	78	89	63	72	68	78	76	87
29,000	63	72	68	78	75	86	61	70	66	76	73	88
27,000	61	70	65	75	72	83	59	67	63	73	70	81
25,000	58	67	62	72	69	79	56	65	60	70	68	78
23,000	55	64	60	69	66	76	53	62	58	69	64	74
21,000	53	61	57	65	63	72	51	59	55	63	61	71

Figure 6-1

SECTION VII
SYSTEMS OPERATION

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CARBURETOR ICING.

Immediately prior to beginning the take-off roll, advance the throttles sufficiently to make carburetor heat available. Hold the control column full back to prevent nose over. Set the carburetor air controls to FULL HOT to obtain temperatures within the continuous operating range as indicated by the instrument markings. Maintain this temperature for the time required to insure complete removal of any ice previously formed in the induction systems. The increase in CAT. will be accompanied by a drop in MP of an inch or two. If an appreciable quantity of ice has formed in the vicinity of the throttle valve, the MP will increase an inch or so as the ice is removed. If no rise in MP is observed, either no throttle icing existed or the ice has not yet melted. The pilot will have to decide which circumstance exists. Turn the carburetor alcohol deicer switch ON (the carburetor deicing control valve handle must also be ON). Observe that a drop in CAT. occurs. When satisfied that no ice remains in the induction system, move the carburetor air controls to the FULL COLD (RAM) position, and begin the take-off roll immediately. When the aircraft is airborne and power is reduced to climb settings, adjust the CAT as required to operate outside the probable carburetor icing range, as indicated by the instrument markings, and turn the carburetor deicing system OFF. A gradual loss of manifold pressure greater than that expected due to increase in altitude, without the throttles being moved, is an indication of carburetor icing. Apply carburetor deicing fluid as required until the ice has been eliminated, as indicated by recovery of the manifold pressure. Readjust the CAT to avoid further carburetor icing.

CAUTION

Conserve the carburetor alcohol supply for momentary use during flight, for use during landing, or for an emergency.

BACKFIRING.

To prevent backfiring during starting, movement of the mixture control from IDLE CUT-OFF to AUTO-RICH should occur slightly before ceasing to prime, in order to allow the carburetor to come up to operating pressures and start functioning in a normal manner. The transition should be smooth.

SPARK PLUG ANTI-FOULING PROCEDURES

GENERAL.

Spark plug fouling is a principal cause of ignition trouble, which in turn is one of the most common engine maintenance and operating problems with aircraft engines using 100/130 or 115/145 grade fuel. These grades of fuel may contain a relatively high lead content, up to 4.6 cc per gallon. Such fouling might be defined as an accumulation of deposits which cause misfiring or prevent firing across the spark plug electrodes. The most common types of fouling are lead fouling and carbon fouling, with lead fouling the main trouble-maker. Cause, prevention, and cure of spark plug fouling are all linked to the chemistry and physics of the combustion cycle, which in turn are subject to wide variation under different ground and flight engine operating conditions. A logical treatment of the problem involves a separate discussion of each aspect of typical engine operation including ground running, takeoff, cruise, and descent. Prevention is the most profitable line of attack to the problem.

IMPORTANT FACTS.

Tetraethyl lead is the most important basic cause of lead fouling. Scavenger agents such as bromine in the tetraethyl lead are provided to combine with the lead during combustion, removing it with the exhaust gases. However, under certain conditions of temperature and pressure, the lead will condense out on the spark plug insulator as lead oxide or lead bromide. In the presence of excess carbon as a reducing agent, these may form metallic lead particles. All such deposits can prevent ignition or firing. Other pertinent factors which influence plug misfiring include the condition of the ignition system, spark plug characteristics and age, general engine conditioning including the care and handling of spark plugs, the operating requirements and characteristics of the particular engine installation, and the specific engine operation conditions. In general, spark plug fouling involves a buildup of deposits through prolonged operation under a fixed set of conditions. Prevention and remedy for plug fouling, therefore, depend on taking action to vary these conditions, upsets the chemistry of the fouling cycle, and restore good ignition.

IDLE MIXTURE CHECK.

Idle mixture adjustment is one of the most important factors to be considered in providing protection against fouled spark plugs. When performing a post-flight check, the pilot must check the idle mixture at minimum idle rpm and at the most commonly used ground idle rpm for a rise not to exceed 10 rpm. Too much emphasis cannot be placed on slow movement of the manual mixture lever during the check. Best power mixture must be obtained and held for at least five seconds. Best power is when a maximum rise in rpm is noted. Any further movement past this point will cause a drop in rpm; therefore, the pilot should move the mixture lever slowly until he has obtained maximum rpm and the rpm has started to decrease. The mixture lever should then be moved very slowly back to the point where the maximum rpm rise was obtained. After ascertaining that the best power mixture has been obtained and maximum rpm rise has been noted, return the mixture control to the appropriate setting. If no rpm rise was noted when slowly moving the mixture lever toward IDLE CUT-OFF, the mixture is too lean. If over a 10 rpm rise is noted, the mixture is too rich and the mixture should be manually leaned to obtain best power or maximum rpm. If the rpm rise was less than 10 rpm the mixture control may be placed in either the AUTO LEAN or AUTO RICH position. This condition will be noted on Form 781. It must be remembered that cylinder head temperature has a direct bearing upon the results obtained; therefore, the pilot must have a cylinder head temperature between 160°C and 180°C when performing an idle mixture check. When the aircraft is at the home station and the idle mixture is found to be out of adjustment, it is recommended that corrective maintenance be performed prior to releasing the aircraft for flight. Idle mixture strength does change with altitude changes. Therefore, when an aircraft is operating away from its home station, the idle mixture could be too rich and cause fouling of the spark plugs. Naturally, this will be noted by the pilot when he performs the idle mixture check. This will not be cause for rejection of the aircraft, as the mixture will be correct when the aircraft is returned to the home station. In these cases, the pilot will manually lean the mixture for any extended periods of ground operation. The mixture will be manually leaned to obtain maximum rpm, which will be best power mixture. Further, a minimum of 150°C cylinder head temperature should be maintained. The most critical fouling range for the R-1830 engine is between 900 and 1100 rpm.

SPARKPLUG CLEANOUT FOR GROUND OPERATION.

Whenever excessive rpm drop is noted during power and ignition check proceed as follows:

1. Propellers – FULL INCREASE.

2. Mixture – RICH.

3. Operate engine at Field Barometric Manifold Pressure until CHT reaches 180-200°C.

4. Advance power slowly to 5 inches above field barometric and hold for one minute.

5. Recheck ignition.

6. If spark plugs are not cleared after this procedure has been tried twice, corrective maintenance must be performed. During extended periods of ground idling it is recommended that mixtures be manually leaned to obtain maximum rpm. After each 10 minutes of ground operation at low rpm, the throttles shall be advanced slowly (3 to 5 seconds per 100 rpm) to a manifold pressure 5 inches above field barometric pressure. This power shall be held for one minute; however, maximum ground operating cylinder head temperature will not be exceeded.

NOTE

Another ignition check will be performed just prior to takeoff, when time since the last engine runup ignition check exceeds 10 minutes.

INFLIGHT PREVENTION.

A periodic change in engine conditions will usually prevent lead fouling during cruise. After each hour at cruise settings, one for the following procedures should be used to prevent fouling:

1. The use of auto-rich mixture for a two-minute period.

2. A change in power of 3 to 5 inches of manifold pressure or a change of 100 rpm. A reduction in the power level followed by an increase in the power level appears to the most effective approach to prevention of fouled spark plugs.

INFLIGHT DEFOULING.

If spark plug fouling occurs in flight the rich-mixture method of prevention should be tried first. If this is not effective reduce manifold pressure slowly until plugs resume firing and maintain this power for approximately one minute. Slowly increase power, and repeat the previous process until all plugs have resumed firing and manifold pressure has been increased to the desired cruise setting.

CAUTION

Whenever appreciable power changes are made it is important to cushion the high inertia loads on the master rod bearings which occur under these conditions. As a rule of thumb, each 100 rpm requires at least 1 inch Hg manifold pressure (for example, 23 inches Hg at 2300 rpm). Operation at high rpm and low manifold pressure should be kept at a minimum.

CHANGING POWER CONDITIONS DURING FLIGHT.

The most economical engine operation at low power can be obtained by operating at low engine rpm and high manifold pressure up to the maximum bmep limit (see Appendix).

To prevent excessive cylinder pressures when changing power conditions, use the following procedure:

INCREASING POWER.

1. Mixture controls — At the proper setting for the desired power condition.
2. Propeller controls — Adjust to obtain the desired engine rpm.
3. Throttles — Adjust to obtain the desired manifold pressure.

REDUCING POWER.

1. Throttles — Adjust to obtain the desired manifold pressure.
2. Propeller controls — Adjust to obtain the desired engine rpm.
3. Throttles — Readjust as necessary.
4. Mixture controls — Adjust to the proper setting for the desired cruising condition.

CAUTION

When maneuvering with low power or during descent with low power, it is important to cushion the high inertia loads on the master rod bearings which occur at high rpm and low manifold pressure. As a rule of thumb, each 100 rpm requires at least 1 inch Hg manifold pressure. Use high rpm and low manifold pressure only when necessary.

COWL FLAP OPERATION.

Full open cowl flaps create high drag which results in a reduction of the load-carrying capability of the aircraft, and, in addition, requires higher power settings to maintain the desired cruise speed. A reduction in cowl flap opening will result in improved performance as the drag is reduced. Under most conditions of flight, optimum performance will be obtained with the cowl flaps in the TRAIL position; however, the cowl flaps should be set, as required, to maintain inflight cylinder head temperatures.

SUPERCHARGER OPERATION (IF INSTALLED AND OPERATIVE).

When shifting from low to high blower, partially close the throttle to reduce manifold pressure 3 to 4 inches Hg and shift the supercharger control rapidly, without pausing to HI BLOWER position. With the blower control in HI BLOWER position, operate the engine essentially as a single-speed engine. If possible, avoid excessively high rates of change in engine rpm when operating in HI BLOWER position.

CAUTION

Do not exceed maximum allowable manifold pressure.

If the aircraft is being operated with the blower controls continuously in one position, shift the blower controls, at each odd hour of the clock, to the other position (either HI or LOW) until the engine instruments stabilize. This will serve to wash away any sludge which may have accumulated in the blower clutches.

FUEL SYSTEM MANAGEMENT.

FUEL TANK SELECTION.

When the engines are operated, the main fuel tanks or the auxiliary fuel tanks can be selected to supply fuel to a single engine or to both engines. During flight, the long-range fuel tanks (if installed) can be selected, through the shutoff valves at the front tanks, to supply fuel to either or both engines. The fuel tank selectors, used with fuel booster pumps, make selection from all tanks possible *(figure 7-1).*

NORMAL FUEL TANK PROCEDURE.

When running fuel tanks empty in flight, keep a close check on the fuel pressure gage. It is advisable to switch to another tank as soon as the fuel pressure begins to drop. If a tank is allowed to run dry to the extent that the engine slows down, the throttle should be moved toward the CLOSE position before the fuel tank selector is moved, in order to prevent the engine from overspeeding. All take-offs and landings should be made with the fuel tank selector set to the fullest (main or auxiliary) tanks.

CAUTION

Unless the fuel is required to complete the mission, it is advisable to select a new fuel supply before running a tank empty (approximately 20 gallons remaining) in order to prevent engine failure because of fuel starvation.

Note

It is very important upon reaching a cruising altitude that fuel be consumed from main tanks first and auxiliary tanks last. This procedure is necessary, since the majority of the return flow will be routed to the main tanks. This procedure will also permit using a minimum amount of elevator tab to trim the aircraft.

LONG-RANGE FUEL TANK OPERATION (IF INSTALLED).

To prevent drawing air into the fuel supply lines, which will result in a fuel system air lock, take-off is not permitted with less than 25 gallons of fuel in each long-range tank.

CAUTION

Take-off is not permitted using fuel from the long-range fuel supply. The long-range shutoff valves must be turned OFF prior to take-off.

The long-range fuel tank shutoff valves *(figure 1-20)* will be turned to the OFF position in sufficient time to maintain a minimum of 25 gallons of fuel in each tank. Since the fuel booster pumps are installed downstream from the main, auxiliary, and long-range tanks, they have a tendency to pump air from the empty tanks or leaking valves; therefore, the fuselage tanks should not be permitted to run dry in flight unless the fuel is needed for emergency purposes.

Note

If the long-range fuel tanks run dry and the engines are allowed to slow down, move the throttles toward the CLOSE position before moving the right and the left fuel tank selectors from the OFF positions. This will prevent the engines from overspeeding. Turn ON the booster pumps until the engine runs smoothly.

In the event that air locks occur with the fuel boost pumps operating, the condition will in all probability be aggravated; however, a new fuel supply should be selected immediately. For long-range fuel tank operation, proceed as follows:

1. When cruising altitude has been reached, turn the long-range fuel shutoff valves ON.
2. Turn the right and left engine fuel tank selectors OFF.

3. When the fuel supply in the long-range fuel tanks becomes low, turn the left and right fuel tank selectors to the LEFT MAIN and the RIGHT MAIN positions respectively.
4. Turn the long-range fuel shutoff valves OFF.

CAUTION

Do not operate with both normal and long-range fuel systems on at the same time; turn OFF the long-range fuel system shutoff valves when operating on main or auxiliary tanks to prevent air locks. Do not climb at a steep angle when operating on the long-range fuel system and the fuel level is low in the tanks, since air locks will occur from fuel being trapped in the tanks.

FUEL BOOSTER PUMPS.

1. Operate the fuel system, using the fuel booster pumps if necessary, to obtain the desired fuel pressure.
   a. Turn the fuel booster pump switch ON for desired engine.
   b. Turn the fuel tank selector for the desired engine to the appropriate position: RIGHT MAIN, RIGHT AUX., LEFT MAIN, LEFT AUX. (or OFF, if using long-range fuel).
2. During climbs and flight, use the booster pumps whenever the engine-driven pumps alone do not supply adequate fuel pressure.
3. When the desired altitude has been reached, wait 3 or 4 minutes before turning the booster pumps OFF in order to allow the fuel tank internal pressure to become equalized with atmospheric pressures. The booster pumps should be turned OFF one at a time, and then only if the engine-driven pumps maintain sufficient pressure.
4. In switching from one tank to another, use the booster pumps to help displace any air that may have entered the system, and to assure sufficient fuel pressure.

FUEL SYSTEM MANAGEMENT.

FUEL TANK SELECTION.

Each engine is supplied independently by the tanks in the corresponding wing. The fuel may be supplied from the main tank, auxiliary tank or the outer wing tank but cannot be used from any tank to the opposite engine without using the cross-feed. It is advisable that both engines be operated from their respective wing tanks to maintain proper balance. Fuel management will vary with the mission to be flown, aircraft gross weight and distribution of the fuel load. When the normal fuel load is carried (204 gallons in each main tank, 50 in each auxiliary tank, and 200 gallons in each outer wing tank), the main tanks will be used for take-off, climb, and circumstances permitting, in cruise until 100 gallons remain in each main tank (figure 7-1).

CAUTION

Whenever possible maintain sufficient fuel in the main and auxiliary tanks to permit flight to an emergency landing field should the necessity arise to dump outer wing tank fuel.

When a mission requires more fuel than the normal fuel load, the outer wing tanks will be serviced to capacity before servicing the auxiliary wing tnaks.

NORMAL FUEL TANK PROCEDURE.

Should it be necessary to completely exhaust fuel in the outer wing and auxiliary tanks in order to consolidate fuel available in the main tanks, use fuel from the outer wing and auxiliary tanks until 50 gallons remain in each tank. Next, use fuel from the outer wing tank until 20 gallons remain in each outer wing tank. At this time place one selector on the main tank and continue using fuel from the outer wing tank for one engine. Note the time and monitor the fuel pressure on the engine using fuel from the outer wing tank. When a drop in pressure is noted switch the selector to the main tank position. When fuel pressure is again normal note the time and place the other selector to outer wing tank position. Monitor the fuel pressure on the engine on the outer wing tank and when a drop in fuel pressure is noted turn the selector to the auxiliary tank position again noting the time. When fuel pressure is again normal place the other fuel tank selector to the auxiliary position and repeat this procedure with the main and auxiliary tanks, when the fuel level reaches 20 gallons in the auxiliary tanks. By checking time to run tanks dry an accurate fuel consumption rate can be determined.

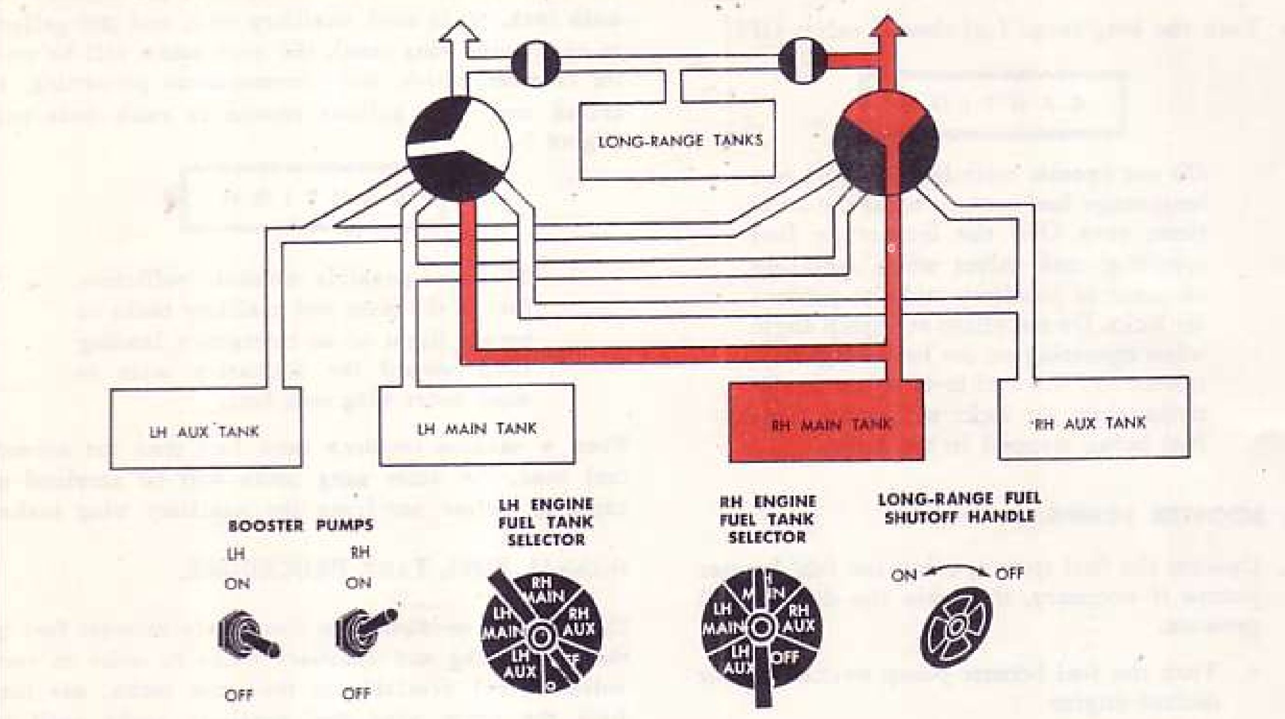
CAUTION

Do not completely exhaust fuel in any tank at less than 1000 feet above the terrain except when necessary.

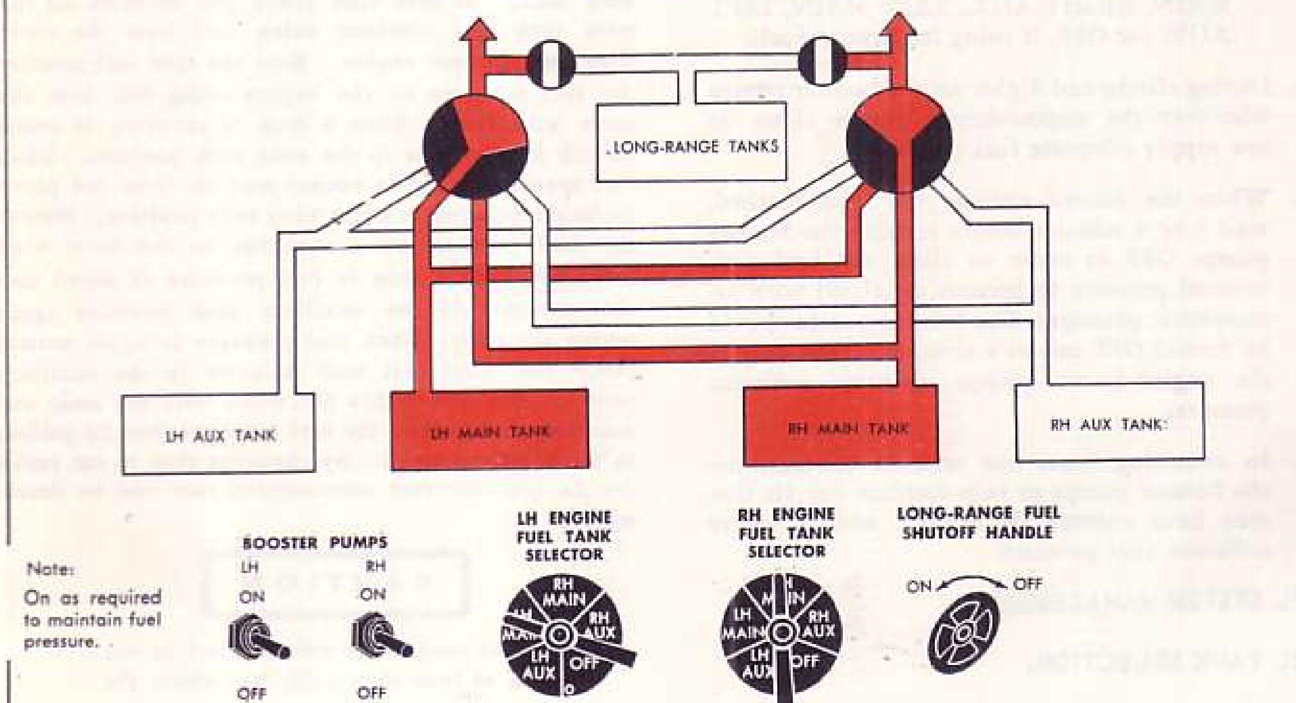
NOTE

If a tank is allowed to run dry to the extent the engine slows down, the throttle should be closed before the

FUEL SYSTEM MANAGEMENT



NORMAL ENGINE STARTING OPERATION.
BOOSTER PUMP ON TO ENGINE BEING STARTED.



TAKE-OFF, LANDING, AND GROUND OPERATION.
MAIN TANKS TO RESPECTIVE ENGINES.

Note: If all tanks are full, use main tanks first.

Figure 7-1 (Sheet 1 of 2)

FUEL SYSTEM MANAGEMENT

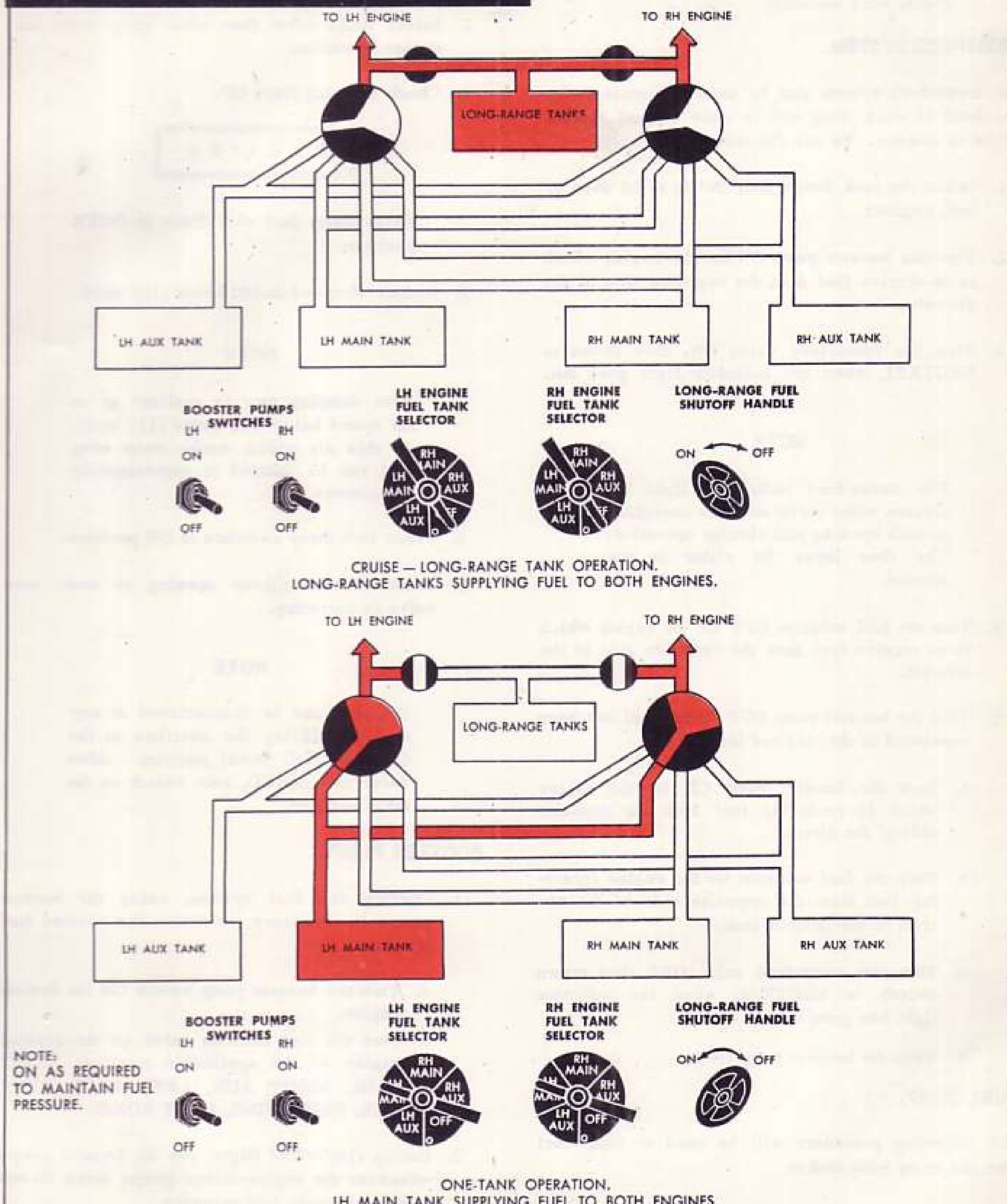


Figure 7-1 (Sheet 2 of 2)

tank selector is moved in order to prevent the engine from overspeeding. Operate fuel booster pump until the engine runs smoothly.

CROSSFEED SYSTEM.

The cross-feed system can be used to equalize the fuel load in each wing and in case of fuel system failure or damage. To use the cross-feed:

1. Select the tank from which fuel is to be used by both engines.

2. Turn the booster pump ON for the engine which is to receive fuel from the opposite side of the aircraft.

3. Turn the cross-feed valve ON, then return to NEUTRAL when the indicator light goes out.

NOTE

The cross-feed indicating light indicates when valve motor is energized in both opening and closing operation. The time lapse for either is one second.

4. Turn the fuel selector OFF for the engine which is to receive fuel from the opposite side of the aircraft.

5. Turn the booster pump OFF. When fuel has been consumed to the desired level:

   a. Turn the booster pump ON for the engine which is receiving fuel from the opposite side of the aircraft.

   b. Turn the fuel selector for the engine receiving fuel from the opposite side of the aircraft to the desired tank.

   c. Turn the cross-feed valve OFF then return switch to NEUTRAL when the indicator light has gone out.

   d. Turn the booster pump OFF.

FUEL DUMP.

The following procedure will be used to dump fuel from the outer wing tanks;

NOTE

Fuel dumping should be considered as an emergency procedure only, since the aircraft can be landed at weights up to 33,000 pounds if proper precautions are taken.

1. Select tanks other than outer wing tanks for engine operation.

2. Check the wing flaps UP.

CAUTION

Never dump fuel with flaps in DOWN position.

3. Reduce airspeed to 100 knots (115 mph).

NOTE

Best dumping rate is realized at an air speed below 100 knots (115 mph). At this air speed, entire outer wing fuel can be dumped in approximately 3½ minutes.

4. Place both dump switches in ON position.

5. Visually check dump opening to make sure valve is operating.

NOTE

Dumping can be discontinued at any time by placing the switches in the CLOSED (full down) position. After valve is CLOSED, turn switch to the OFF position.

BOOSTER PUMPS.

1. Operate the fuel system, using the booster pumps if necessary, to obtain the desired fuel pressure.

   a. Turn the booster pump switch ON for desired engine.

   b. Turn the fuel selector valve for the desired engine to the applicable position: RIGHT MAIN, RIGHT AUX, LEFT MAIN, LEFT AUX, RIGHT WING, LEFT WINGS.

2. During climbs and flight, use the booster pumps whenever the engine-driven pumps alone do not supply adequate fuel pressure.

3. The booster pumps should be turned OFF one at a time, and then left OFF only if the engine-driven pumps maintain sufficient pressure.

4. In switching from one tank to another, use the booster pumps to help displace any air that may have entered the system, and to assure sufficient fuel pressure.

JATO CHECK OUT PROCEDURES.

GENERAL.

The aircraft electrical firing and release circuit should be thoroughly inspected before departure on a mission requiring JATO. The manual release system should be checked out at this time. It should be determined that there is sufficient current and voltage to ignite the circuit. Insure that there is no electrical current in the firing circuit when the JATO master switch is OFF. JATO attaching fittings should also be tested before the mission, to determine the proper operation of the locking mechanism. Air crew member will arm the JATO units (plug igniter into aircraft) when the aircraft is in the take-off position.

PREFLIGHT OF JATO SYSTEM.

1. Check Manual JATO Bottle Release:

    a. Cock JATO racks (located under fuselage aft of wing trailing edge) by pulling rack lock hooks down and forward.

    b. Pull manual release cable, two handles located just forward of main cargo door on left wall at seat level (one handle for left inboard and one handle for left outboard bottle. The other two handles are located directly across the aircraft on the right hand side. These two handles release the right inboard and outboard bottles. If locking hooks have had little use, it may be necessary to push hooks to the rear lightly with a screwdriver at the same time manual release is operated.

2. Check Electrical JATO Bottle Release:

    a. Cock rack as in paragraph 1.a. above.

    b. Turn battery switch ON or APP to RUN.

    c. Move JATO release switch (located in the cockpit on the left side of the electrical control panel) up then down. Each action releases two JATO bottles. Aid release of hook with screwdriver as in paragraph 1.b. above, if necessary.

3. Check Electrical Firing Circuits:

    a. Turn battery switch ON or APP to RUN.

    b. Turn JATO master switch ON (located on left side of electrical control panel). A red light illuminates when the switch is in the ON position.

    c. Press JATO firing switch (on pilot's control wheel.)

    NOTE

    The firing switch will not operate unless the JATO master switch is ON.

    d. While the firing switch is depressed, check voltage through JATO igniter arming nipple (located between the JATO hooks on A/C). Meter should show the same voltage as in aircraft electrical system.

4. Electrical Residue Check:

    a. Leave battery or APP power ON, master JATO switch ON, and JATO firing switch OFF.

    b. Temporarily ground the JATO igniter arming nipple to the aircraft with a screwdriver.

    c. Use meter and check voltage thru nipple. The voltage reading should be zero.

    WARNING

    It is important that no voltage is detected in the circuit. Even very low voltage may be sufficient to initiate operation of the igniter.

5. Attaching JATO to Aircraft.

    a. If no stray voltage is found in system after check out as outlined in paragraph 4, attach bottles to aircraft.

    b. After bottles are attached, check for security locking by attempting to remove bottle by shaking. Two (2) men must handle bottles at all times.

    NOTE

    Approximate weight of each bottle is 185 pounds.

6. Installing Igniter to Bottle:

    a. Remove JATO igniter hole plug from bottle.

b. Remove igniter from packing container, put compound on threads and screw in where plug was removed.

CAUTION

Igniter contains black powder.

c. Leave igniter pig-tail on shorting plug of igniter until ready for arming.

d. Tighten igniter firmly in bottle.

7. Arming JATO:

a. Position aircraft in takeoff position on runway.

b. Have engines running, check for stray voltage as in paragraph 4 with JATO master switch ON and firing switch OFF.

c. After stray voltage check is completed, crew member will signal the pilot the circuit is satisfactory. The pilot will then insure that JATO master switch is OFF and fingers are off the firing button. The pilot will signal crew member that he is ready for JATO arming.

d. Remove end of igniter pig-tail from shorting plug of igniter and place on JATO firing circuit nipple. Push FIRMLY into place, remove red tag (this could cause pig-tail to come off).

e. Aircraft is now ready for JATO takeoff.

8. JATO Takeoff Away From Home Base:

a. JATO system should be checked out thoroughly before departure.

b. JATO bottle igniter plugs should be loosened and replaced before loading on cargo storage rack in aircraft. This will insure removal with the finger or a light tap with a screwdriver.

BRAKE OPERATION.

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. Heavy brake pressure can result in locking the wheel more easily immediately after touchdown, than when 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.

Although brakes can stop the wheel from turning, stopping the aircraft is dependent on the friction of the tires on the runway. For this purpose, it is easiest to think in terms of coefficient of rolling friction which is the frictional force divided by the load on the wheel. It has been found that optimum braking occurs with approximately a 15 to 20 per cent rolling skid; i.e. the wheel continues to rotate, but has approximately 15 to 20 per cent slippage on the surface, so that the rotational speed is 80 to 85 per cent 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 per cent skid, the friction is approximately 60 per cent of the optimum and, with a full skid, becomes even lower.

There are two reasons for this loss in braking effectiveness with skidding. First, the immediate result of the skid is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated by the skid friction 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 lbs per wheel, the coefficient of friction on dry concrete is as high as .8, whereas the coefficient is of the order of .5 or less with a 75 per cent skid. Therefore, if one wheel is locked during application of brakes there is a very 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.

The following procedures will apply for brake operation:

1. If maximum braking is required after touchdown, lift should first be decreased as much as possible by raising the flaps before applying brakes. This procedure will improve braking

action by increasing the frictional force between the tires and the runway.

CAUTION

Immediately following maximum braking while landing, little or no braking action may be available because of brake fade.

2. For short landing rolls, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.
3. When the brakes are used to stop the aircraft, it is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the slip stream, and a minimum of 30 minutes between landings where the landing gear has been retracted, to allow sufficient time for cooling between brake applications. Additional time should be allowed for cooling if brakes are used for steering, cross-wind taxiing operation, or a series of landings are performed.
4. 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.
5. After the brakes have been used excessively for an emergency stop, and are in the heated condition, the aircraft should not be taxied into a crowded parking area or the parking brakes set. Peak temperatures occur in the wheel and brake assembly from 5 to 15 minutes after a maximum braking operation. To prevent brake fire and possible wheel assembly explosion, the specified procedures for cooling brakes should be followed.
6. The brakes should not be dragged when taxiing, and should be used as little as possible for turning the aircraft on the ground.

NOTE

Taxiing with one engine inoperative is not recommended.

FUEL SYSTEM DIAGRAM - SOME SC-47 AIRCRAFT

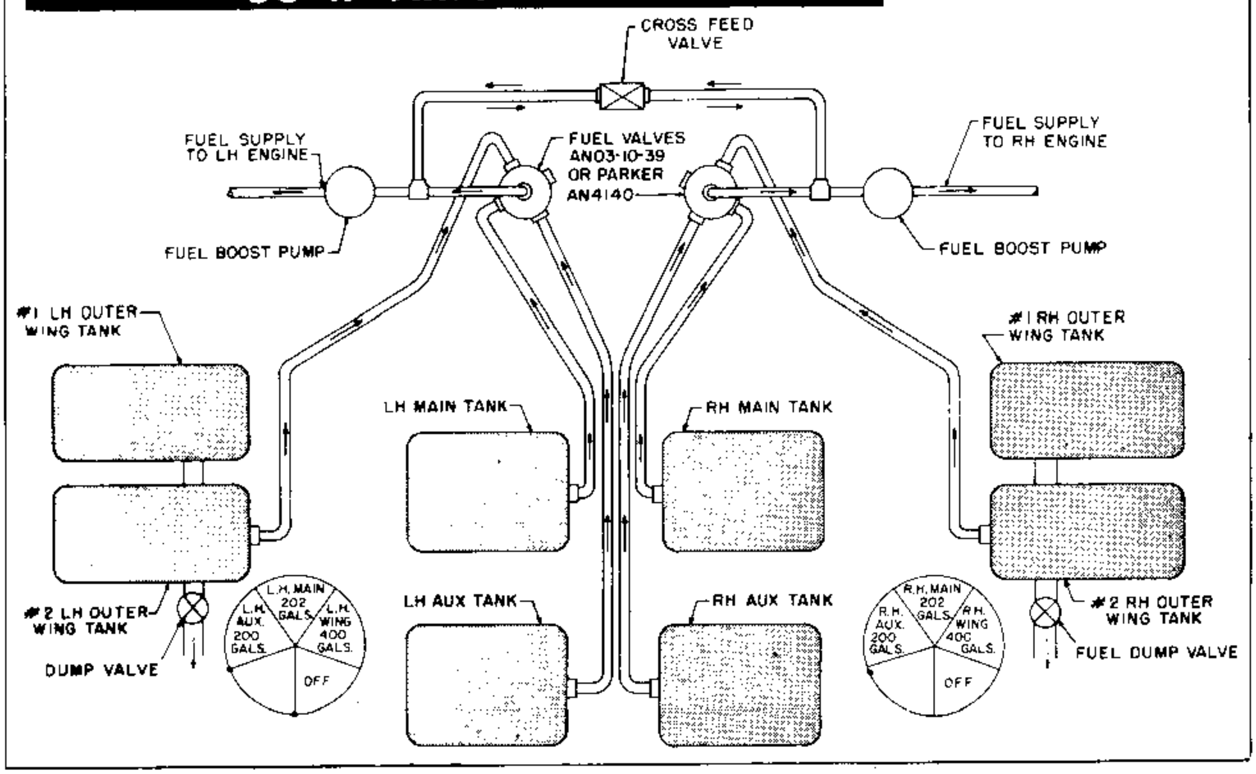


Figure 7-2

SECTION VIII
CREW DUTIES

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INTRODUCTION.

This section lists duties, other than primary functions, performed by crew members.

PILOT.

It will be the duty of the pilot to insure that a thorough inspection of the aircraft and all equipment it conducted before departure. The pilot will personally inspect all items of bail-out, ditching, and survival equipment. The check lists for the pilot are covered in detail in Section II and III.

CO-PILOT.

The co-pilot will aid the pilot, as directed, to accomplish the assigned mission.

FLIGHT MECHANIC / STEWARD.

The flight mechanic/steward will assist in all matters pertaining to the comfort and safety of the passengers and flight crew, and will perform any other duties assigned. He will also assist in the performance of preflight duties and perform the following:

FLIGHT MECHANIC'S/STEWARD'S INSPECTION.

PRIOR TO LOADING (POWER OFF).

1. Form 781 – CHECK.
2. Fuel, oil, alcohol oxygen quantities and servicing – Visually Checked.
3. Emergency Equipment – CHECK.
4. Passengers seats and equipment – CHECK.
5. Hat racks – Clean (unnecessary items removed).
6. Floor covering – In place and secured.
7. Emergency exits – Closed and Secured.
8. Buffet supplies – CHECK.

Food and equipment stowed.

9. Lavatory – CHECK. Check equipment and supplies.

10. Rear baggage compartment – CHECK.

Check for condition (equipment stowed).

PRIOR TO LOADING (POWER ON).

1. Cabin lighting – CHECK. Check dome and reading lights.
2. Buffet Operation – CHECK.
3. Lavatory lighting – CHECK.
4. No smoking – fasten seat belt sign – Check operation.
5. Oxygen system – CHECKED.

Check mask and regulator for proper operation.

AFTER LOADING.

1. Passenger manifest – CHECKED AND ABOARD.
2. Passenger briefing and seating – COMPLETED.
3. Baggage and loose equipment – SECURED.
4. Cabin entrance ladder – STOWED.
5. Passenger entrance door – CLOSED AND LOCKED.
6. Report readiness to pilot.

BEFORE TAKE-OFF.

1. Passengers – CHECKED.

Check that passengers are seated, safety belts fastened, and no smoking.

2. Seat Belt – FASTENED.

CRUISE.

1. Engine and Wings – CHECKED.

Periodically check engine and wings for any indication of malfunction.

2. Equipment operation – MONITOR.

Be on watch during flight for mechanical irregularties, and perform any duties indicated by the pilot.

3. Fuel Management – MONITOR.

Have a complete understanding of fuel management and monitor fuel tank usage during flight. Maintain Cruise Control Log when required.

BEFORE LANDING.

1. Passengers – CHECKED.

Check that passengers are seated, safety belts fastened, and no smoking.

2. Seat belt – FASTENED.

BEFORE LEAVING AIRCRAFT.

1. Off-load passengers and baggage – SUPERVISED AND CHECKED.
2. Form 781 – COMPLETE.
3. Inventory of equipment – COMPLETE.
4. Aircraft – CLEAN.

NAVIGATOR.

The navigator will be primarily responsible for directing the aircraft to its destination over preplanned routed. The navigator's basic responsibilities are outlined in the following checklist:

PREFLIGHT (POWER OFF).

1. Form 781 – CHECKED.

Check Form 781 for any write-ups which may affect navigation.

2. Personal navigation equipment – CHECKED.
3. FLIP and letdown charts – CHECKED.
4. Celestial tables and emergency map kits – CHECKED.
5. Airspeed calibration card – CHECKED.
6. Spare VHF crystals – ABOARD AS REQUIRED.
7. Aircraft Clocks – SET.
8. Standby compass cards – CHECK FOR CURRENCY.
9. Astrodome stand – CHECKED.
10. Astrodome – CHECKED.
11. Astrocompass and mount – CHECK ALIGNMENT ALL POSITIONS.

12. Driftmeter – OFF AND CAGED.

Check driftmeter lens for cleanliness and fogging due to moisture or dirt. Clean if required.

13. Driftmeter alignment card – CHECKED.

14. Altimeter – SET TO FIELD ELEVATION.

15. Oxygen system and equipment – CHECKED.

16. Flux gate compass – SET VARIATION ZERO.

PREFLIGHT (POWER ON).

1. Navigator's compartment lights – CHECKED.

2. Driftmeter – CHECK OPERATION AND ALIGNMENT.

3. Radio Compasses – CHECKED AND TUNED.

4. LORAN – CHECKED.

5. Fluxgate compass – CHECKED AGAINST STANDBY COMPASS.

6. Altimeter – CHECKED AND SET.

   a. Rotate the setting knob until the current altimeter setting appears in the kollsman window and compare the altimeter reading against the field elevation previously set. (max error – 75 feet).

   b. Apply this known altimeter error to all subsequent altimeter readings during the flight.

WARNING

The altimeter should be checked closely to assure that the 10,000 foot pointer is reading correctly. Due to previous setting of the altimeter, the setting knob could have been rotated until eventually the numbers reappear from the opposite side, thur indicating a 10,000 foot error.

7. Sextant – CHECK OPERATION AND LIGHTING.

8. Seat Belt and Shoulder Harness – FASTENED.

9. Interphone – ON STATION.

INFLIGHT.

NOTE

The navigator will occupy the navigator's station during all take-offs and landings and will monitor all instrument departures and approaches.

1. Over water position reports – Prepare as required.

2. Navigator's Log – Maintain as required.

3. Fuel Management – MONITOR.

The navigator will monitor fuel consumption during all over water flights and maintain the required charts.

4. Emergency landing fields – MONITOR WHILE ENROUTE.

BEFORE LANDING.

1. Interphone – ON STATION.

2. Navigation equipment – SECURE.

3. Seat belts and shoulder harness – FASTENED.

AFTER LANDING.

1. Radio compasses – OFF.

2. LORAN – OFF.

3. Driftmeter – OFF AND CAGED.

4. Fluxgate compass – ZERO VARIATION.

5. Navigation equipment – STOWED.

6. Navigator's log – COMPLETE.

7. Form 781. Complete as required.

8. Lights – OFF.

RADIO OPERATOR (WHEN ASSIGNED).

The radio operator must be proficient in the utilization of all radio equipment installed in the airplane and in addition, be current in the use of CW and voice procedures. He must be thoroughly familiar with emergency procedures as they pertain to his duties as radio operator.

MISSION PLANNING.

1. Communications Requirements – COMPLETE.

Complete requirements for briefed routes to be flown. Coordinates with crew members, as required, for reporting points, crystal and frequency requirements, alternate and emergency airfields, etc.

2. Applicable Pilot's Manuals – CURRENT AND COMPLETE.

Check applicable pilot's manuals (Enroute Charts, Enroute Supplements, Terminal Charts), for current and complete contents. Correct publications as required.

3. Communications Kit – COMPLETE.

Communication flimsy, forms, radio logs, frequency cards, crystals and tool kit (where applicable). ACP's (125B-1, 131 and 135).

EXTERIOR INSPECTION.

1. Antennas – CHECKED.

Inspect all antennas for security of mounts, cleanliness, grease spots for exhaust carbon on stub masts, cracks on base, ground wire secure on stub type.

2. Static Dischargers – CHECKED.

Check all static dischargers for length (at least six inches). Wick should be approximately one inch long and not frayed or ragged.

INTERIOR INSPECTION.

1. Personal Equipment – STOWED.

Stow all personal equipment not necessary for flight.

2. Oxygen System – CHECKED.

Check mask and regulator for proper operation.

3. Required Publications – STOWED.

Stow applicable pilot's manuals, mission data, and communications publications in the control cabin.

4. Form 781 – CHECKED.

Check for status of communications equipment.

5. Radio G-File – CHECKED.

Check for completeness and condition.

6. Frequency Charts – CHECKED.

Check the VHF/UHF/HF frequency charts for current frequency assignments and channelization.

7. VHF Radio Channelization – CHECKED.

Check for proper crystals and thumb wheel settings.

8. UHF Radio Channelization – CHECKED.

Check all channels for proper settings.

9. VHF radio Operation – CHECKED.

Check operation of transmitter and receiver, sidetone level, DF tone; and background noise.

10. UHF Radio Operation – CHECKED.

Check operation of transmitter and receiver, sidetone level and background noise.

11. Radio Compass – CHECKED.

Check control panel for proper alignment. Check operation of receiver on all bands and selector positions. Check indicator for proper operation on LOOP AND COMPASS position with local range station. Check operation of CW switch and panel lights.

12. VOR Receiver – CHECKED.

Tune in station by selecting the proper channel. Check the Bearing Indicator for proper homing. Set the reading indicated by the Bearing Indicator into the course set window of the course indicator. Check the CDI on the course indicator for centering and the TO/FROM window for a TO indication. Set the reciprocal reading, indicated by the Bearing Indicator, in the course set window. Check the CDI on the course indicator for centering and the TO/FROM window for a FROM indication.

13. Glide Slope Receiver – CHECKED.

Set the localizer frequency in the OMNI receiver. Check the glide path alarm pointer (red flag) and horizontal bar for movement.

14. TACAN – CHECKED.

Tune in station by selecting the proper channel. Check the Bearing Indicator for proper homing. Place the function selector switch to T/R and check the range indicator. Place the instrument select switch to TACAN and check the CDI on the course indicator for proper indication. Return the instrument select switch to VOR.

15. Marker Beacon Receiver – CHECKED.

Check background noise and push-to-test light.

16. Interphone Stations – CHECKED.

Check operation of all crew member interphone stations on both NORMAL AND CALL positions.

17. Liaison Receiver – CHECKED.

Place power switch to MVC. Check dial lights, crystal filter switch, beat frequency knob, CW OSC switch, antenna alignment and reception on all bands.

18. Liaison Transmitter – CHECKED.

Check channalization for mission requirement frequencies. Key transmitter and check PA Plate and Grid readings. Check operation with an Air-Ground station.

19. Emergency Radios – CHECKED.

Inspect the emergency radios for correct stowage and current inspection dates.

BEFORE TAKEOFF.

1. Preflight Inspection – COMPLETED.

2. Form 781 – COMPLETED.

Enter all discrepancies in the Form 781 and bring them to the attention of the pilot.

3. Radios – ON AS REQUIRED.

4. Radio Log – INITIATED.

Initiate radio log and monitor frequencies as required.

5. Safety Belt – FASTENED.

AFTER TAKEOFF AND CLIMB.

1. Radio Contact – established – AS REQUIRED.

Establish contact with and obtain primary and secondary frequencies from the ground station. Send departure report.

INFLIGHT.

1. Radio Log – MAINTAINED.

Set up the log in such a manner that events of the mission may be reconstructed.

2. Radios – MONITORED AS REQUIRED.

Monitor assigned frequencies as required.

3. Reports – TRANSMITTED AS REQUIRED.

When reporting is required, procedures will be as outlined in current directives and publications.

4. Emergency Communications – AS REQUIRED.

When circumstances require emergency transmissions, the pilot will authorize the type message required. Format and procedures will be as outlined in current directives and publications. Perform inflight maintenance, if possible, to maintain communications.

NOTE

No transmission will be made on emergency distress frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

DESCENT AND BEFORE LANDING.

1. HF Radio Equipment – OFF.

Turn HF equipment off when not required for approach or landing communications.

2. Trailing Wire Antenna – CHECKED IN.

3. Off Watch – LOGGED.

Sign off watch if not required to operate radios for approach or landing.

4. Safety Belt – FASTENED.

AFTER LANDING AND POSTFLIGHT.

1. Form 781 – COMPLETED.

Enter all radio discrepancies in the Form 781.

2. Radio Log – COMPLETED.

Complete radio log and have it certified by the pilot.

3. Radio Operator's Station – CLEANED.

4. Radio Logs, Codes and Ciphers – TURNED IN.

Collect and turn in to the proper authority all logs, codes and ciphers.

LOADMASTER

PRIOR TO LOADING.

1. Cargo and Passengers – Preplan Loading.
2. Manifests – Prepare AS REQUIRED.
3. Form 365F and load adjuster – CHECK.
4. Special loading and aerial delivery equipment – CHECK.
5. Tie-Down Equipment – CHECK.
6. Static lines and extensions – CHECK.
7. Safety belts – Check number and condition.
8. Emergency and survival equipment – Check condition and stowage.
9. Oxygen system – CHECKED.

Check mask and regulator for proper operation.

10. Interphone and cabin lighting – CHECK.
11. Cabin and latrine – Clean and secure.
12. Assist flight mechanic – As required.

AFTER LOADING.

1. Cargo Tie-Down – CHECK.
2. Loose Equipment – SECURED.
3. Jettison Plan – COMPLETED.
4. Form 365F – COMPLETED.
5. Passengers – BRIEFED AND SEATED.

BEFORE TAKEOFF.

1. Main Cargo and Baggage Doors – CHECKED AND SECURE.
2. Passenger's seat belts – FASTENED.
3. Cabin Secure – Notify Pilot.

AFTER TAKEOFF.

1. Cargo Tie-Down – CHECK.
2. No smoking and fasten seat belt sign – AS REQUIRED.

AERIAL DELIVERY (PERSONNEL)

TWENTY MINUTE WARNING.

1. Alert – Relayed from Pilot.
2. Notify Jumpmaster.
3. Interphone – MONITOR.
4. Static lines – CHECK.
5. Jump door – REMOVED.
6. Static Line Buffer Bar – INSTALLED.
7. 20 Minute Check Complete – NOTIFY PILOT.

TEN MINUTE WARNING.

1. Notify Jumpmaster.
2. Safety Line – HOOK UP.
3. Ten Minute Check Complete – NOTIFY PILOT.

SIX MINUTE WARNING (RED LIGHT).

1. Notify Jumpmaster.
2. Red Light On – NOTIFY PILOT.

ONE MINUTE WARNING

1. Notify Jumpmaster.
2. Ready for Drop – NOTIFY PILOT.

JUMP.

1. Jump on Green Light.

AFTER JUMP.

1. Static Lines – RETRIEVE.
2. Static Line Buffer Bar – REMOVED.
3. Jump Door – REPLACE.
4. After Jump Check – COMPLETE (Notify Pilot).

AERIAL DELIVERY (EQUIPMENT)

TWENTY MINUTE WARNING.

1. Alert Relayed from Pilot.
2. Interphone – MONITOR.
3. Static Lines – CHECK.
4. Jump Door – REMOVED.

5. Static Line Buffer Bar – INSTALLED.
6. Parachutes Secured to Equipment – CHECKED.
7. 20 Minute Check Complete –NOTIFY PILOT.

TEN MINUTE WARNING.

1. Tie-Downs – LOOSEN (Vertical and Lateral).
2. Safety Line – HOOK UP.
3. 10 Minute Check Complete – NOTIFY PILOT.

SIX MINUTE WARNING.

1. Tie-Downs – REMOVE.
2. Cargo – Move to Drop Position.
3. Parachutes – Secured to Equipment.
4. Static Lines – HOOKED UP.
5. 6 Minute Check Complete – NOTIFY PILOT.

ONE MINUTE WARNING (RED LIGHT).

1. Prepared to Drop – NOTIFY PILOT.

DROP.

1. Ten Seconds Prior to Drop (Special Forces) — –GO– GREEN LIGHT.
2. On CARP (All Others) – GREEN LIGHT.
3. On Proper Signal – DROP CARGO.

AFTER DROP.

1. Static Lines – RETRIEVE.
2. Static Line Buffer Bar – REMOVED.
3. Jump Door – REPLACE.
4. After Drop Check – COMPLETE (Notify Pilot).

BEFORE LANDING.

1. Cargo Tie-Down – CHECKED.
2. No Smoking, Fasten Seat Belt Sign – AS REQUIRED.
3. Drop Equipment – SECURED.
4. Before Landing Check – COMPLETE (Notify Pilot).

AFTER LANDING.

1. Customs Form – COMPLETE AS REQUIRED.
2. Offload – AS REQUIRED.
3. Tie-Downs and Loose Equipment – STOWED.
4. Cabin and Latrine – CHECKED FOR CLEANLINESS.
5. Assist flight mechanic – AS REQUIRED.

SECTION IX

ALL-WEATHER OPERATION

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INTRODUCTION.

Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ from, or are in addition to, the normal operating instructions covered in Section II. Discussions relative to systems operation are covered in Section VII.

Instrument Flight Procedures

The aircraft has excellent maneuverability characteristics for instrument flying. Stability in all axes is excellent. Maneuverability on Ground Control Approach and Instrument Landing System is very good. Before attempting any instrument flight, check that all radios, radio aids, and flight instruments are operating properly.

INSTRUMENT TAKE-OFF.

CAUTION

Take-off should be avoided when both temperature and dew point are within the area of 31° to 33°F and the runway is wet or rain or snow is falling. When the above conditions exist, ice may accumulate on the empennage during runup and take-off, and wing and carburetor icing may occur immediately after take-off.

Planning for instrument take-off should include the possibility of return to the field, and suitable precautions should be taken, including the monitoring of the take-off by GCA or other instrument facilities.

INSTRUMENT CLIMB.

Climbing airspeed and attitude are easily maintained. Banks in excess of 30° are not recommended.

CRUISING.

Cruising under instrument conditions does not differ from cruising under VFR conditions; however, the following checks should be made:

1. Check the directional indicators periodically with the standby compass.
2. Before entering known or suspected icing or visible moisture, turn on the pitot heat and be alert for propeller, wing, and carburetor ice. If ice starts to form on unheated parts of the windshield, it is an indication that ice is forming on the propeller. Turn on the propeller deicing system.

CAUTION

If deicer boots are used, do not operate them continuously, since this may result in ballooning the ice immediately over the boots and render them ineffective. Allow the ice to build up to approximately ¼ inch thickness, then turn the boots on to remove it. After the ice is removed, turn the boots off until the ice builds up again.

SPEED RANGE.

Stability and flight characteristics are good throughout the full range of speed, and instrument flight should be conducted in accordance with the power charts (see Appendix).

DESCENT.

To descend from altitude, use the same procedure as during VFR flight to the minimum instrument altitude for the range being used and in accordance with instructions received from Air Traffic Control.

HOLDING.

Hold with the landing gear and wing flaps up, and use enough power to maintain an IAS of 105 knots (121 mph).

INSTRUMENT APPROACHES.

The general qualities and capabilities of the aircraft are excellent for instrument approaches. A study of all approach procedures must be made before starting the initial approach. Complete the prelanding checks before final approach, so that full attention can be given to flying during the approach.

RADIO RANGE APPROACH.

See Figure 9-1. For detailed instrument approach procedures, see AFM 51-37.

GROUND CONTROLLED APPROACH (GCA).

There is very little difference between a GCA and range approach. The approach is accomplished by reference to basic instruments and execution of instructions issued by a ground controller (figure 9-1).

INSTRUMENT LANDING SYSTEM (ILS).

An ILS differs from a GCA only in that the required procedures must be interpreted from instrument presentation (figure 9-1).

AUTOMATIC DIRECTION FINDER (ADF) APPROACH. (See figure 9-1.)

OMNI-RANGE (VOR) APPROACH.
(See figure 9-1.)

TACAN APPROACH.
(See figure 9-1.)

Ice and Rain

Rain without icing conditions presents no particular problems other than restricted visibility. When icing conditions are encountered, the following procedure will apply:

1. Known regions of severe icing will be avoided.
2. Before entering an icing region, turn on the pitot heaters and check deicer system pressure.

NOTE

Climb or cruise at 10 to 15 knots above normal during icing conditions; reducing the angle of attack minimizes the accumulation of ice on under surfaces.

VFR & IFR RANGE, ADF, VOR, ILS, GCA, AND TACAN APPROACH PROCEDURE.

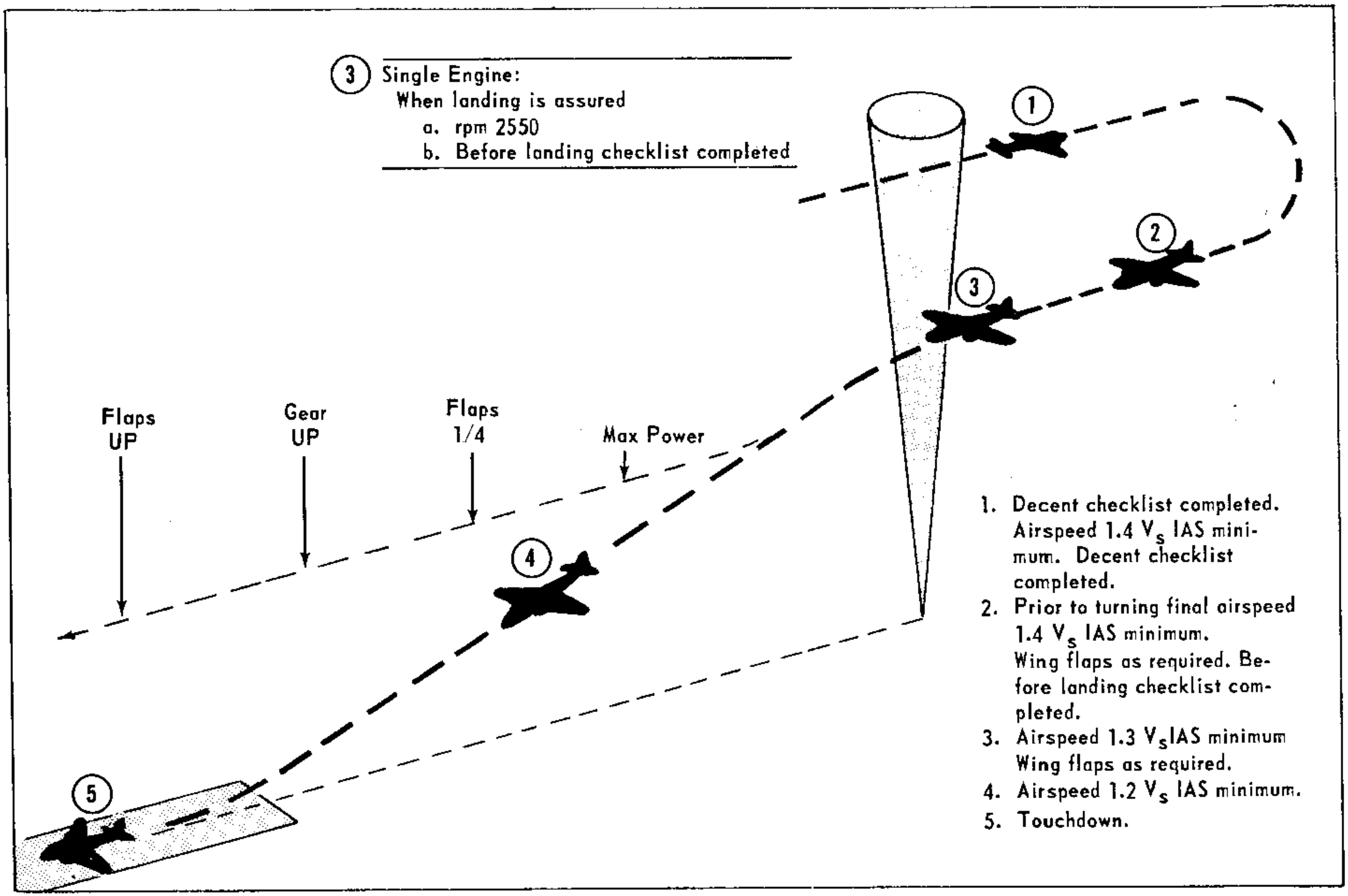

Figure 9-1

3. Regulate carburetor heat to maintain CAT within limits and adjust the cowl flaps as required to maintain proper CHT during flight through the icing region.

4. Operate the wing and empennage deicer system as required (see the paragraph on Wing and Empennage Deicing System Operation, Section IV).

5. If ice forms on the wing area aft of the deicer boots, change the flight path and leave icing region.

WARNING

Ice accumulation on the aircraft will result in higher stall speeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice build-up. Approach and landing speeds must be increased accordingly.

Flight in Turbulence and Thunderstorms

WARNING

Flight through a thunderstorm or clear air turbulence should be avoided if at all possible. However, should circumstances force a flight into a zone of severe turbulence, the desired penetration airspeed of the aircraft, which is 60 mph above the stalling speed for its gross weight, should be established before entering the storm. The following recommended techniques aid in reducing structural strain to the aircraft.

Power settings and propeller pitch are the keys to proper flight technique in turbulent air. (Severe turbulence is defined as a condition of sufficient disturbance to make the safety of the aircraft and its occupants the pilot's primary concern.) In selecting a speed for operation in severe turbulence, a compromise must be made between the desire to keep the speed low enough to permit the structure to withstand the greatest possible gusts and the desire to keep the speed high enough to prevent closely approaching the stalling point.

APPROACHING STORM.

It is imperative that the aircraft be prepared as follows before entering the zone of turbulence (if the storm cannot be seen, its proximity may be detected by radio crash static).

1. Disengage the autopilot.
2. Reduce airspeed as required.
3. Mixture controls – AUTO-RICH.
4. Propeller controls – 2350 rpm.
5. Pitot heater switch – ON.
6. Carburetor heat – As required.
7. Throttles – As required.
8. Check the power source and gyro stabilized instruments settings.
9. Safety belt (and shoulder harness if installed)–Tightened. (Check with crew members.)
10. Turn off any radio equipment rendered useless by static.
11. Turn the cockpit lights full bright to minimize the blinding effect of lighting.

CAUTION

Do not lower the flaps or gear, since structural damage may occur.

PENETRATING STORM.

Penetrate the storm as follows:

1. Maintain the power and pitch settings established before entering the storm to hold the airspeed constant, regardless of an erratic airspeed indication caused by heavy rain partially blocking the pitot heads.
2. Devote full attention to flying the aircraft. Concentrate principally on holding a level attitude by reference to the attitude indicator and maintaining as constant an altitude as possible.

CAUTION

Do not chase the airspeed indicator or altimeter since undue stress might be imposed on the aircraft.

3. The altimeter is unreliable in severe turbulence because of differential barometric pressures. A gain or loss of several thousand feet may be expected, and allowance for this error must be made in determining minimum safe altitude.

Note

Altitudes nearest the freezing level are usually the most turbulent.

4. Do not attempt to keep up with the airspeed indicator, which may be off as much as 60 knots as a result of heavy rain partially blocking the pitot heads.
5. Use as little elevator control as possible in maintaining attitude in order to minimize the stresses imposed on the aircraft.

Night Flying

On aircraft not equipped with landing light shields, a glare from the landing lights will be noticed in the cockpit.

Cold-Weather Procedures

The following operating instructions are written to supplement the instructions in Section II and should be complied with when cold weather conditions are encountered. The success of extreme weather operation depends greatly on the preparation made during engine shutdown as outlined in this section; upon this depends the success of the next day's starting operation. Most cold weather operating difficulties are encountered on the ground. The most critical periods in the operation of the aircraft are the postflight and preflight periods. Proper diligence on the part of crew members concerning ground operation is the most important factor in successful cold weather operation.

WARNING

To prevent engine oil starvation due to congealed oil in the engine oil tanks, the procedures for oil preheat and oil dilution must be strictly adhered to. Oil in the tank must be heated to −12°C (+10°F) or above before starting engines.

BEFORE ENTERING AIRCRAFT.

WARNING

All ice, frost, and snow must be removed before flight is attempted.

Apply external heat to the engines and accessory sections. Preheat the engine nacelle until cylinder head temperatures reach 4°C. The time requirements on the following list are rough estimates for engine heating at various temperatures. These requirements will vary with wind velocities and percentage of engine oil dilution. The tabulation below is based on an oil dilution of approximately 25 per cent and no wind.

−6.7° to −18°C (20° to 0°F)............ ½ hour (approx)

−18° to −32°C (0° to −25°F)............... ½ to 1 hour

−32° to −40°C (−25° to −40°F)....1½ to 2½ hours

Check the oil drains for oil flow. If no oil flow is obtainable, continue preheat until oil flow is readily obtained. In addition to external heating, oil immersion heaters may be used; however, no special fittings are provided in the oil tanks for immersion heaters on some aircraft. If the immersion heaters are to be effective in keeping the oil warm during the night, they should be placed in the oil tanks immediately after landing. Use a portable heater to heat the flight instruments, defrost the windshields, and warm the radios, the dynamotors, the inverter, and other equipment within the aircraft. Remove all external coverings, pitot head covers, wing covers, etc. Clean the shock struts and landing gear actuating cylinders of ice and dirt, and check the struts for proper inflation. The hydraulic system is limited to −40°C (−40°F) and will not operate below this temperature. Check for engine stiffness periodically to determine when sufficient heat has been applied. Generally, if an engine is stiff enough to require more than three men to move a propeller, it is considered too stiff to start.

ON ENTERING AIRCRAFT.

1. Operate all the flight control surfaces and tabs through full travel three or four times to check ease of operation. When lowering flaps during normal preflight, the flaps should be lowered in approximately 10-degree increments to check ease of operation.
2. Check functioning of those instruments that can be checked without engine operation.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

3. Exert light pressure on the brake pedals several times before setting parking brakes to assure adequate pressure for parking brake operation.

BEFORE STARTING ENGINES.

Before starting the engines, perform the following:

1. Remove the oil immersion heaters.
2. Remove the ground heater ducts.
3. Remove the engine nacelle shields (or covers, if installed).
4. Pull the propellers through 15 blades by hand.

STARTING ENGINES.

1. Open the cowl flaps.

CAUTION

Do not close cowl flaps to expedite engine warmup.

2. If the oil pressure is not within limits after 30 seconds running, or if the pressure drops below limits after a few minutes of ground operation,

   shut down and check for blown lines or coolers and recheck for congealed oil or ice at the drains.

Note

Oil congealing in a radiator produces unusual and often misleading indications. The usual indication is high oil temperature together with a reduction in pressure, often followed by a sudden drop in oil temperature accompanied by high pressure as the congealed oil is forced into the system.

3. Carburetor air preheat (not to exceed carburetor air temperature limits), should be applied immediately after starting in order to assist vaporization and combustion.
4. Check all instruments for proper operation.
5. Operate the wing flaps at least once.
6. When warming up an engine after an oil dilution operation, it is preferable to allow the oil temperature to rise above 60°C (140°F) and to increase the engine speed during the runup to dissipate as much of the fuel as possible to allow the oil to return to its normal viscosity. Below this temperature and at low engine speeds, very little fuel will be dissipated from the oil.

WARM-UP AND GROUND TESTS.

Use the procedure under Engine Runup, Section II.

TAKE-OFF.

Carburetor heat may be required so that the fuel will vaporize properly at extremely low temperature. Monitor and regulate the carburetor heat to maintain carburetor air temperature within the proper limits during engine runup, climb and cruise (see the paragraph on Carburetor Icing, Section VII).

The heating system should be operating so that the windshield defrosting can be utilized during take-off, if necessary, and so that the flight instruments will not cool and give erroneous indications. Pitot heaters should be ON if precipitation is encountered or if icing conditions are anticipated immediately after take-off. Remember that the flight indicators are not very reliable at temperatures below −43°C (−45°F) and that all flight instruments should be cross-checked.

CAUTION

Do not use surface de-icers during take-off because of resultant disturbance of air flow spoiling the lift of the wing.

AFTER TAKE-OFF.

After take-off, cycle the gear several times to remove slush and snow and to prevent the gear from freezing in the retracted position.

DURING FLIGHT.

Periodically exercise prop controls to provide a supply of warm oil in the prop dome.

APPROACH AND LANDING.

Follow normal prelanding procedures. Apply carburetor heat as required, to prevent carburetor icing and to keep engine running smoothly. At extremely low temperatures it would be wise to use a power-on approach, thus helping keep the cylinder head temperature from becoming critically low. Whenever carburetor heat is used, allowance must be made for the power reduction associated with application of heat. Drain the water supply systems.

ENGINE SHUTDOWN.

Oil dilution is preferred, if the expected minimum temperature is below 4°C (40°F), in order to minimize the requirement for preheat prior to the next engine start.

OIL DILUTION PROCEDURE.

The aircraft is equipped with an engine oil dilution system to facilitate cold weather starting. When a cold weather start is anticipated, the engine oil should be diluted with fuel before the engines are stopped, provided that the engine oil temperature is maintained below 50°C (122°F). Above this temperature, dilution is not effective, since the fuel introduced into the system will vaporize.

When the oil temperature exceeds 50°C (122°F) during the dilution period, stop the engine and wait until oil temperatures have fallen below 40°C (104°F) before again starting the engine and resuming the dilution operation. During conditions of extremely low OAT, it may be necessary to break the dilution period up into two or more short periods because of oil temperature limits for dilution.

If it is necessary to service the engine section oil tanks, the oil dilution period must be divided so that part of the dilution is accomplished before the oil tanks are serviced and the remainder after the tanks are serviced. If the oil tank is full and more than 3 minutes dilution time is required, some oil should be drained from the tank to prevent overflowing during the dilution period of subsequent engine run.

Perform the oil dilution operation as follows (operation of the oil dilution system is indicated by a drop in fuel pressure, followed later by a drop in oil pressure):

1. Operate each engine at 1000 to 1200 rpm.
2. Maintain oil temperatures below 50°C (122°F), stopping an engine for a short period if the temperature exceeds this limit.
3. Turn booster pumps (wobble pump) ON.
4. Operate the oil dilution solenoid switches for the following periods for indicated anticipated temperatures:

   4° to —12°C (40° to 10°F) .... 2 minutes

   —12° to —29°C (10° to —20°F) ...... 4 minutes

   —29° to —46°C (20° to —50°F) ...... 7 minutes
5. Move the propeller controls from INCREASE to DECREASE three times to dilute oil in the propeller domes. The time required to actuate the propeller controls from INCREASE RPM to DECREASE RPM three times should not exceed 1 minute total time. This 1 minute will be dilution time in addition to the time required to dilute for each anticipated ambient temperature.
6. To dilute oil in the propeller feathering system, push right feathering button and allow for 200 RPM drop, then pull out feathering button. Dilute oil in left propeller feathering system using same procedures.
7. A short acceleration period of approximately 10 seconds at the end of the dilution run will usually clear the spark plugs of any fouling condition resulting from the prolonged idling.

After the oil has been diluted as specified above, and the propeller feathering system checked out during dilution, position the carburetor mixture controls to IDLE CUT-OFF, and continue to hold the oil dilution switch ON until the propeller stops turning.

Desert Procedures

Wind-blown sand is the main concern of operation in the desert. Many of the malfunctions which occur will be found to originate from improper care on the ground. Since most of the procedures given in Section II apply as well to Desert Procedures, only specific information for care of the aircraft during ground and flight operation will be given in this section. Carburetor air filters may be required for all operations.

Unless absolutely necessary do not take off during sand or dust storms.

HIGH ALTITUDE PROCEDURES.

The following procedures are recommended when operating from fields with an elevation that results in density altitudes of approximately 6000 to 16,000 feet.

STARTING.

The engine is more prone to flooding upon starting at density altitudes above 6000 feet, due primarily to reduction in density of the air flowing through the carburetor. The following techniques should be employed when starting at these altitudes.

1. Use larger throttle openings when starting.
2. Start in low blower.
3. When bringing in the mixture, move it to the AUTO-LEAN position.

TAXIING.

Above 6000 feet density altitude, taxiing should be done at 1200 rpm in AUTO-LEAN. If necessary, manually lean mixtures to achieve a smooth idle.

ENGINE RUNUP.

Normal runup procedures will be used at altitudes below 10,000 feet density altitude. At altitudes above 10,000 feet, where high blower will be used for takeoff, eliminate normal sequence of high blower check. Shift to high blower at 1700 rpm, just prior to advancing throttles for takeoff.

TAKEOFF.

At altitudes below 10,000 feet, use low blower and normal takeoff procedures. Above 10,000 feet altitude, high blower should be used.

APPROACH AND LANDING.

Normal low altitude traffic patter, approach and threshold-indicated airspeeds are recommended; however, bear in mind that true airspeed increases with altitude for the same indicated airspeed and consequently, the landing ground roll will be appreciably extended at high elevations. Another factor to consider is the decrease in ground cushioning effect during the flare out. Close adherence to the recommended approach speeds and flap settings are mandatory for the successful completion of either a landing or go-around. After touchdown place mixture in AUTO-LEAN and blowers in LOW.

APPENDIX
PERFORMANCE DATA

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PART ONE
INTRODUCTION

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GENERAL INFORMATION.

The information in the Appendix is presented to assist operating personnel to a better understanding of the performance capabilities and limitations of the aircraft. The objective of the Appendix is to provide specific performance values in graphical form covering all reasonable conditions under which the aircraft will be operated to enable operating personnel to utilize the aircraft efficiently.

DISCUSSION OF CHARTS.

The take-off charts are presented in such a manner that performance may be determined for any set of atmospheric conditions. The climb data is presented for standard day and hot day atmospheric conditions. Range performance may be determined for any atmospheric temperature condition by considering the altitude specified in the charts as density altitude. The performance charts are identified according to their type and condition of operation by colored page borders conforming to the following code:

Normal Operation ....Plain Corner
Emergency Operation .... Red Corner
Hot Day Operation .... Yellow Corner

DEFINITION OF TERMS

AIRSPEED – the speed of the aircraft relative to the air through which it is moving.

AMBIENT CONDITIONS – conditions of the air surrounding the aircraft at any given time under consideration.

AUTO-LEAN – the mixture control lever at the lean detent.

AUTO-RICH – the mixture control lever at the rich detent.

BMEP DROP – a loss in BMEP due to a manual adjustment of the mixture control.

CALIBRATED AIRSPEED – indicated airspeed corrected for instrument and position error.

COMPRESSIBILITY ERROR – an error in the airspeed indicator reading and the outside air temperature indicator reading caused by air being slightly compressed by the moving aircraft.

DENSITY ALTITUDE – the altitude obtained from a standard density altitude chart for any given pressure altitude and temperature or for any density ratio factor ($1/\sqrt{\sigma}$).

DEW POINT – the temperature at which consensation occurs in a cooling mass of air.

DRY BULB TEMPERATURE – the air temperature as indicated by a thermometer with a dry bulb (true air temperature).

EFFECTIVE WIND (HEAD OR TAILWIND) – The component of the existing wind condition which acts opposite to or in the direction of travel. For takeoff or landing, this component will be computed from the take-off and landing crosswind chart.

EQUIVALENT AIRSPEED – calibrated airspeed corrected for compressibility.

INCHES HG – a measure of air pressure which compares it to the weight of a column of mercury.

INDICATED AIRSPEED – airspeed indicator reading uncorrected (assuming the mechanical error in the instrument is negligible).

LOW BLOWER – the engine supercharger in low gear ratio.

NAUTICAL MILES PER POUND – the number of nautical miles traveled while consuming a pound of fuel.

OPERATING WEIGHT EMPTY – the weight of the aircraft and its contents, not including payload, fuel or regular engine oil, when the aircraft is equipped with all provisions necessary to complete a mission.

POSITION ERROR – the error in the airspeed indicator reading and the altimeter reading caused by the inability of the static orifices to experience the true ambient air pressure.

PRESSURE ALTITUDE – the altitude obtained from a standard atmosphere table, for any given value of air pressure (measured in inches Hg). This is the altitude that an altimeter will show (after correcting for position error) when set to 29.92 inches Hg.

RAM – the increase in air pressure at the entrance to an airscoop due to the speed of the aircraft.

RECOMMENDED LONG RANGE CRUISE SPEED – the speed at which it is recommended to fly the aircraft when long range is of more concern than high speed.

REFUSAL DISTANCE – the distance required to accelerate to the refusal speed.

REFUSAL SPEED – maximum speed to which the aircraft can accelerate and then stop in the available runway length.

RELATIVE HUMIDITY – the ratio of the amount of water vapor in a given mass of air to the maximum amount of water vapor that the mass of air could hold at the same temperature.

SPECIFIC HUMIDITY – the ratio of the amount of water vapor in a given mass of air to the mass of dry air, measured in pounds.

SPECIFIC RANGE – nautical miles per pound of fuel.

STANDARD ATMOSPHERIC CONDITIONS – an arbitrarily selected set of atmospheric conditions chosen to approximate the average atmosphere of the world.

STANDARD DAY – a day on which standard atmospheric conditions are assumed to exist.

THRESHOLD SPEED – the speed at which the aircraft crosses the end of the runway during a normal landing (120 percent of the stall speed for wing flaps in the landing position).

TOUCHDOWN SPEED – the speed at which the aircraft comes in contact with the runway during a normal landing (110 percent of the stall speed for wing flaps in the landing position).

TRUE AIRSPEED – the true speed of the aircraft relative to the air through which it is moving (equal to EAS time $1/\sqrt{\sigma}$).

TRUE ALTITUDE – altitude above sea level.

VAPOR PRESSURE – the partial pressure of water vapor existing in the air.

$V_{L/D}$ – the speed for maximum lift to drag ratio.

V_{SO} – the zero thrust stalling speed with wing flaps in the landing configuration.

V_{TO} – takeoff speed (110 percent of the stalling speed with the wing flaps in the takeoff configuration).

WET BULB TEMPERATURE. – the temperature indicated by a thermometer whose bulb has been kept moist with water and which has been circulated in the air. This temperature, along with the dry bulb temperature, is used in conjunction with a psychrometric chart to determine the degree of humidity.

LIST OF ABBREVIATIONS

Alt.	Altitude
BHP	Brake horsepower
BMEP	Brake mean effective pressure
°C	Degrees Centigrade
CAS	Calibrated airspeed
CAT	Carburetor air temperature
CHT	Cylinder head temperature
Crit.	Critical
EAS	Equivalent airspeed
Eng.	Engine
°F	Degrees Fahrenheit
Fld.	Field
Ft.	Feet
Hg.	Mercury
IAS	Indicated airspeed
ICAO	International Civil Aviation Organization
In.	Inch
Kts.	Knots
Lbs.	Pounds
MP	Manifold pressure
METO	Maximum except takeoff
Min.	Minute
OAT	Outside air temperature
PSI	Pounds per square inch
Pt.	Point
RPM	Revolutions per minute
S. L.	Sea level
Std.	Standard
T	Absolute temperature
TAS	True airspeed
V_{CO}	Climbout speed
$V_{L/D}$	Speed for maximum lift to drag ratio
V_{MC}	Minimum control speed
V_{NE}	Maximum dive speed
V_{NO}	Maximum speed for normal operation
V_R	Refusal speed
V_S	Stalling speed
V_{SO}	Stalling speed with zero thrust and wing flaps in landing configuration
V_{TO}	Takeoff speed
Wt.	Weight
δ	Delta; ratio of ambient air pressure to standard sea level air pressure
σ	Sigma; ratio of ambient air density to standard sea level air density

AIRSPEED TERMINOLOGY

Airspeed terminology used in this Appendix is defined as follows:

TERM	ABBREVIATION	DEFINITION
Indicated Airspeed	IAS	*Airspeed Indicator reading uncorrected.
Calibrated Airspeed	CAS	Indicated airspeed corrected for position error.
Equivalent Airspeed	EAS	Calibrated airspeed corrected for compressibility.
True Airspeed	TAS	TAS = EAS X $1/\sqrt{\sigma}$

*IAS is used in this Appendix as though the mechanical error in the instrument is zero.

All airspeeds of importance in takeoff and landing procedures are shown in this Appendix as indicated airspeed (IAS).

All airspeed data relating to take-off and landing procedures are given as indicated airspeed. Indicated airspeed for ground run is based on an estimated position error equal to zero. Since all cruise and climb data is given as calibrated airspeed, the airspeed position error charts are included to obtain the corresponding indicated airspeed. The characteristic take-off speeds chart and the characteristic landing speeds chart give indicated airspeed based on inflight calibrations. The take-off performance--ground run chart and the take-off performance--refusal speed chart give indicated airspeed based on negligible ground run position error.

AIRSPEED POSITION ERROR CORRECTION.

This chart (figure A1-1) shows the correction that must be applied to the indicated airspeed to determine the calibrated airspeed.

CALIBRATED AIRSPEED CORRECTION FOR COMPRESSIBILITY.

The calibrated airspeed correction for compressibility chart (figure A1-2) is used in determining EAS from CAS. A sample problem on the chart illustrates its use.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY CHART.

This chart (figure A1-3) shows the correction that must be subtracted from the outside air temperature indicator reading to determine the true outside air temperature. For example, assume that the airplane is cruising at 125 knots CAS (point A) at an altitude of 10,000 feet (point B). The chart shows that the correction is 2.5°C (point C). This amount must be subtracted from the indicated air temperature to determine the outside air temperature. If the instrument read 6°C, then the outside air temperature would be 6-2.5, or 3.5°C. If the instrument read −12°C, then the outside air temperature would be −12-2.5, or −14.5°C.

DENSITY ALTITUDE CHART.

The density altitude chart (figure A1-4) is used in determining the density altitude and the value $1/\sqrt{\sigma}$ for any pressure altitude and ambient temperature. A sample problem on the chart illustrates its use.

ICAO STANDARD ATMOSPHERE TABLE.

The ICAO standard altitude table (figure A1-5) presents the density altitude factor tabulated for thousands and hundreds of feet; and the values of sigma (σ), the density ratio of ambient air to standard sea level air, tabulated for thousands of feet. The value $1/\sqrt{\sigma}$ is chiefly used in obtaining the true airspeed (TAS) from equivalent airspeed (EAS) by the relationship, TAS = EAS X $1/\sqrt{\sigma}$

TEMPERATURE CONVERSION CHART.

The temperature conversion chart (figure A1-6) is provided to facilitate the conversion of either Fahrenheit temperatures to Centigrade, or Centigrade temperatures to Fahrenheit.

PSYCHROMETRIC CHART.

The Psychrometric Chart (Figure A1-8) graphically relates the various measures of water vapor in the atmosphere. Although it is the dew point which is commonly furnished the pilot, occasionally humidity may be available as wet and dry bulb temperatures, and less often, as relative humidity. To meet all such situations the psychrometric chart provides a means of converting from one variable to another.

Three examples for obtaining specific humidity are given below which differ as to which quantities are known.

Example 1:

Given: Pressure altitude = 5000 ft.

Dew Point = 54.5°F

Find: Specific humidity

1. Locate 54.5°F dew point temperature on curved line for 100% relative humidity (point B). This point can be found either by interpolation between 50°F and 60°F along curved line or by entering at 54.5°F on dry bulb temperature scale (point A) and projecting vertically upward to curved line for 100% relative humidity.

2. From point B, proceed horizontally to left base line and then follow along curved path interpolated between guide lines to 5000 ft. pressure altitude (point C).

3. Project horizontally to specific humidity scale at extreme left (point D) and read .0108.

4. If vapor pressure is desired, project horizontally from point B to extreme right (point E) and read 0.425 inches Hg.

Example 2:

Given: Pressure altitude = 5000 ft.

Wet bulb temperature = 17°C

Dry bulb temperature = 26°C

Find: Dew point and specific humidity

1. Enter with 26°C dry bulb temperature (point F) and proceed vertically upward to intersection with imaginary slant line for 17°C wet bulb temperature (point G). Note that the 17°C wet bulb temperature line can be located by interpolation between the 15°C and 20°C wet bulb lines for 5000 ft. altitude. To assist interpolation, the upper end of this line can be located by entering the dry bulb temperature scale at 17°C (point H) and projecting vertically upward to the 100% relative humidity line (point I). Draw slant line through point I parallel to 5000 ft. wet bulb dashed lines to intersection (point G) with vertical projection of point F.

2. From point G, project horizontally to left to dew point scale (point B) and read dew point, 54.5°F.

3. Continue left as in Example 1 (points C and D) to obtain a specific humidity of .0108.

4. From point G, project horizontally to right to obtain 0.425 inches Hg vapor pressure (point E).

Example 3:

Given: Relative humidity = 43%

Dry bulb temperature = 26°C

Find: Dew point and specific humidity

1. Enter dry bulb temperature scale at 26°C (point F) and proceed vertically upward to intersection with 43% relative humidity line, interpolated between 40% and 60% (point G).

2. Project horizontally to the left to the dew point scale (point B) and read dew point, 54.5°F.

3. To obtain specific humidity project horizontally to left base line and continue as in example 1 (points C and D) to read .0108.

4. From point G project horizontally to right to obtain 0.425 inches Hg vapor pressure (point E).

FUEL DENSITY TABLE.

The fuel density table (figure A1-9) presents variations in fuel density of 100/130 and 115/145 grades fuel as related to variations in temperature.

AIRSPEED POSITION ERROR CORRECTION

(NO INSTRUMENT ERROR INCLUDED)

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) A-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

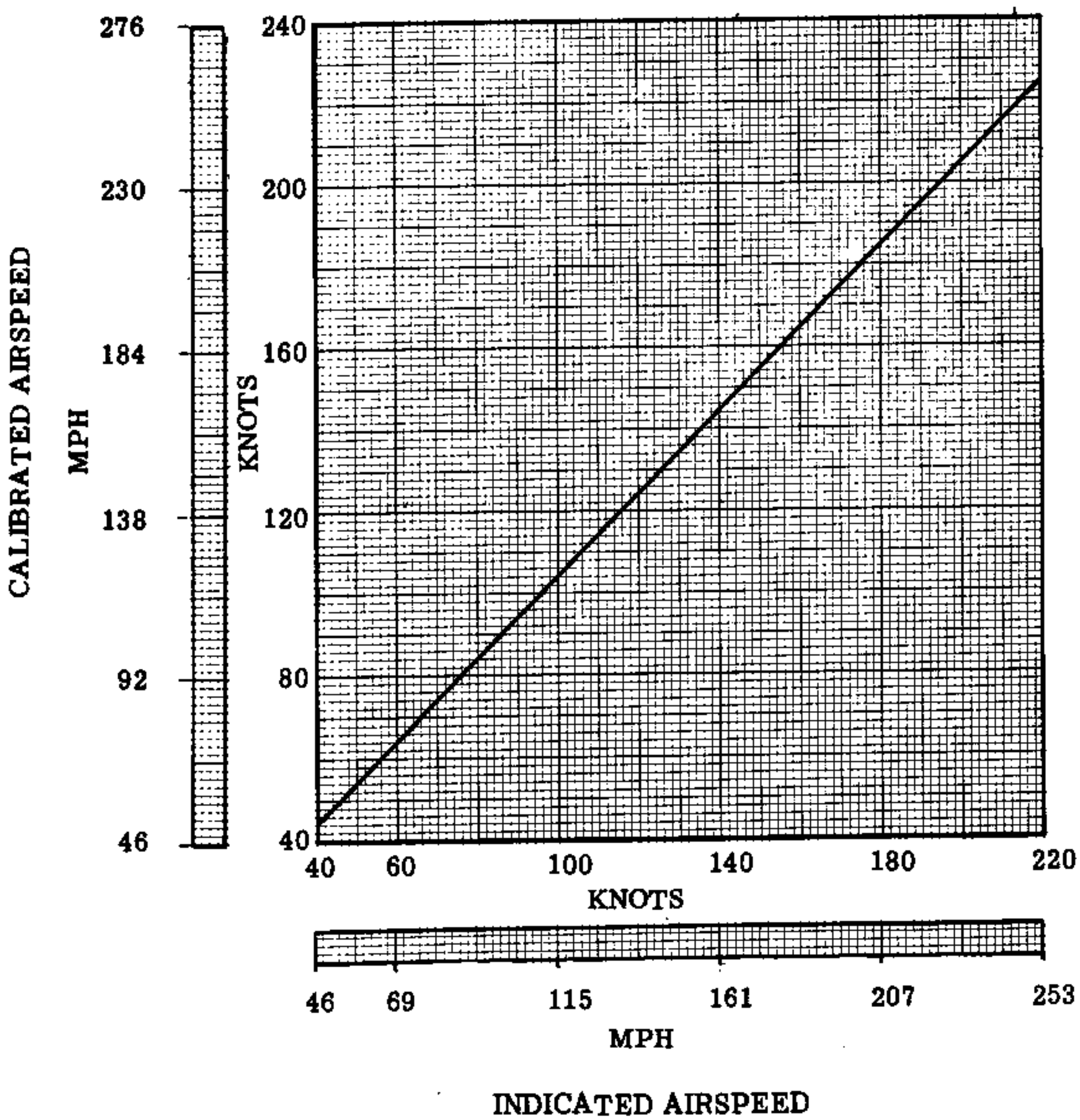


Figure A1-1. Airspeed Position Error Correction.

CALIBRATE AIRSPEED CORRECTION FOR COMPRESSIBILITY

SAMPLE PROBLEM

GIVEN: PRESSURE ALTITUDE = 15000 FEET
CALIBRATED AIRSPEED = 120 KNOTS
A = ENTER CHART AT 120 KNOTS
B = AT 15000 FEET READ CORRECTION
C = CORRECTION = 0.6 KNOTS OR MPH

NOTE
SUBTRACT CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED

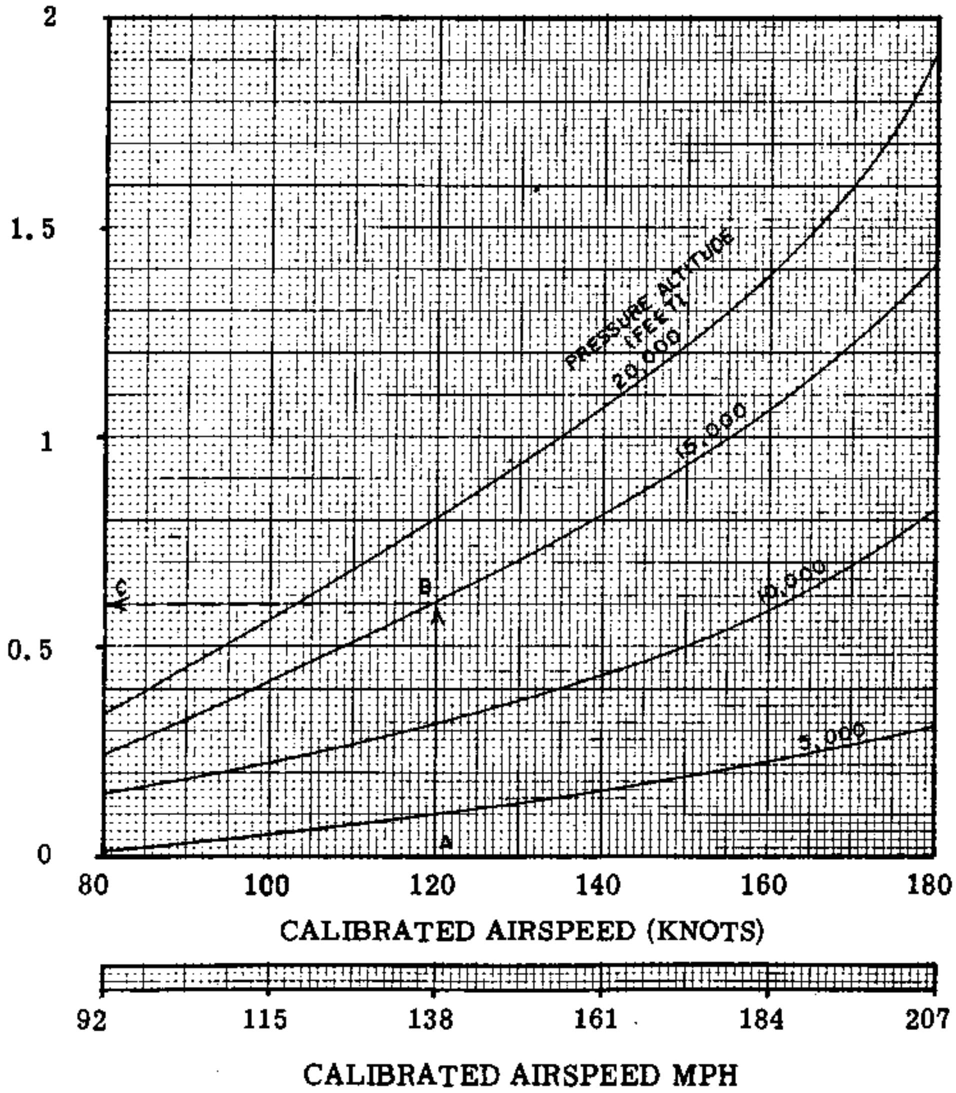


Figure A1-2. Calibrate Airspeed Correction For Compressibility.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

NOTE:
A SUBTRACT CORRECTION FROM INDICATED AIR TEMPERATURE TO OBTAIN FREE AIR TEMPERATURE °C OR °F
B TEMPERATURE RECOVERY COFFICIENT 80%

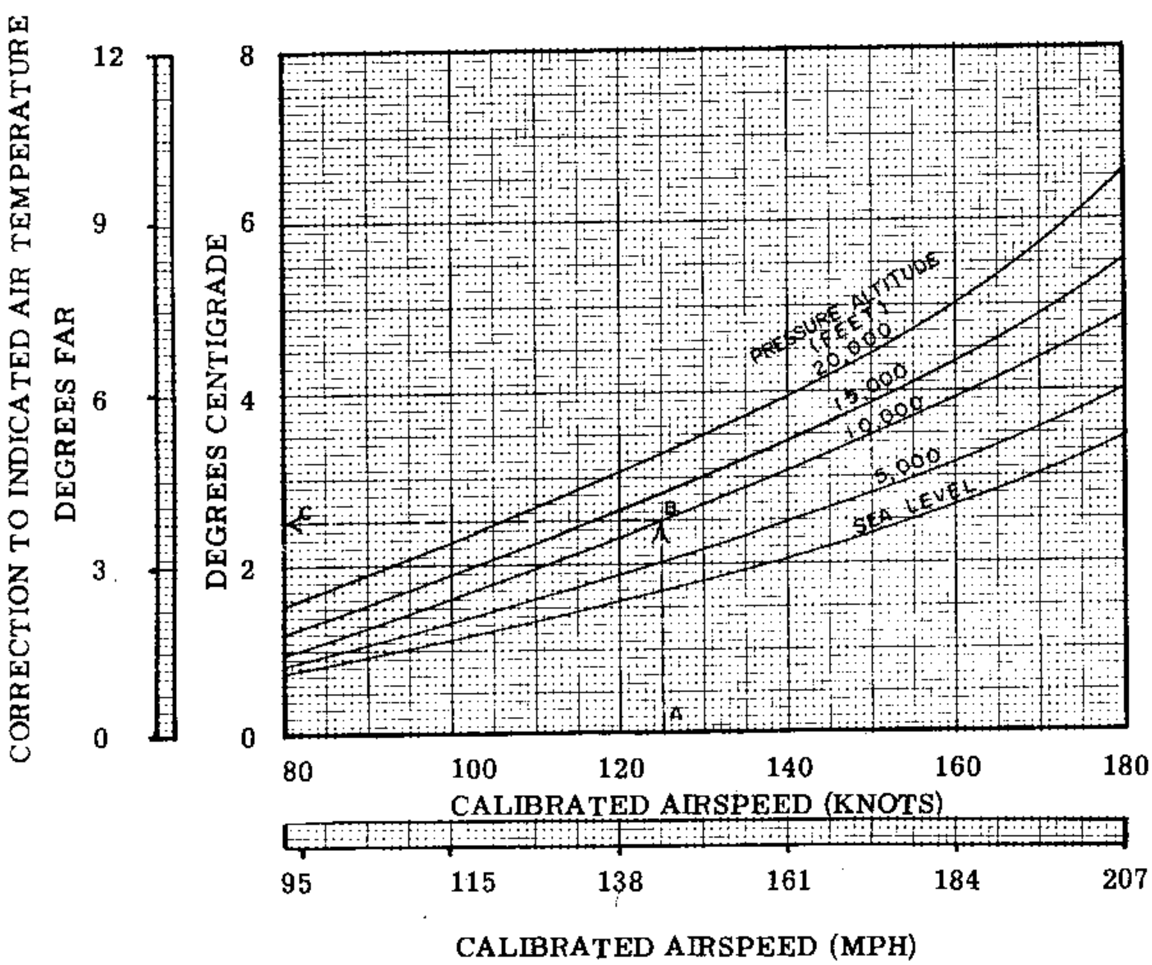
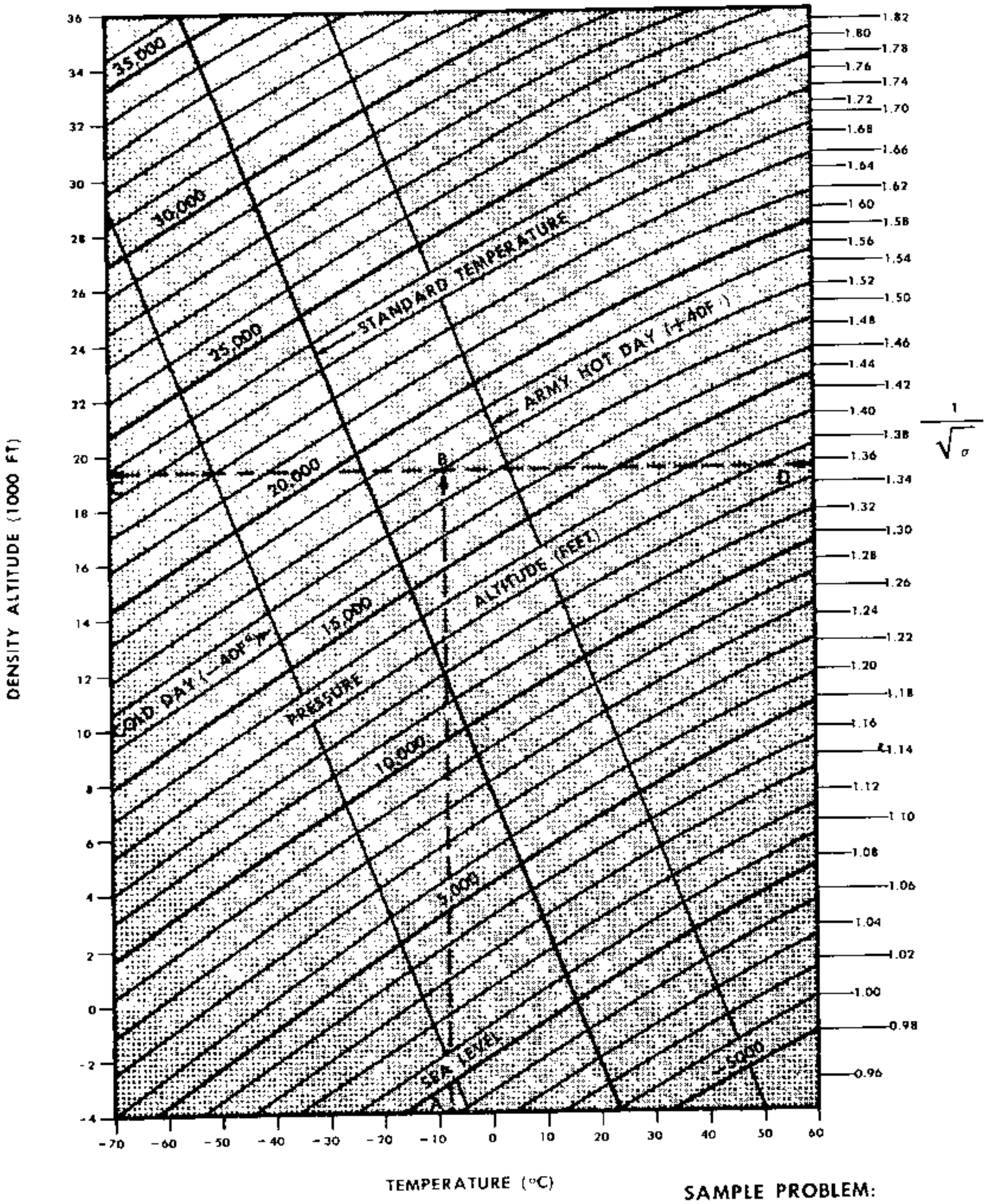


Figure A1-3. Temperature Correction For Compressibility.

DENSITY ALTITUDE CHART



SAMPLE PROBLEM:
(A) Free air temperature −8 °C
(B) Pressure altitude 18,000 ft
(C) Density altitude 19,400 ft
(D) $1/\sqrt{\sigma}$ 1.356

Figure A1-4. Density Altitude.

ICAO STANDARD ATMOSPHERE TABLE

STANDARD S. L. CONDITIONS:

Temperature = 15°C (59°F)
Pressure = 29.921 In. Hg (2116.216 psf)
Density = .0023769 slugs/cu ft
Speed of sound = 1116.89 fps (661.7 knots)

CONVERSION FACTORS:

1 in. Hg = 70.727 psf
1 in. = 0.49116 psi
1 Knot = 1.151 mph
1 Knot = 1.688 fps

Altitude Feet	Density Ratio σ	$\frac{1}{\sqrt{\sigma}}$	Temperature °C	Temperature °F	Speed of Sound (Knots)	Pressure In. Hg	Pressure Ratio δ
0	1.000	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	.4800	1.4424	−30.568	−23.022	607.1	12.107	.4046
24,000	.4642	1.4678	−32.549	−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
31,000	.3605	1.6654	−46.417	−51.551	586.9	8.488	.2837
32,000	.3473	1.6968	−48.398	−55.117	584.4	8.106	.2709
33,000	.3345	1.7291	−50.379	−58.683	581.8	7.737	.2586
34,000	.3220	1.7623	−52.361	−62.249	579.2	7.382	.2467
35,000	.3099	1.7964	−54.342	−65.816	576.6	7.041	.2353
36,000	.2981	1.8315	−56.323	−69.382	574.0	6.712	.2243
36,089	.2971	1.8347	−56.500	−69.700	573.7	6.683	.2234
37,000	.2843	1.8753	−56.500	−69.700	573.7	6.397	.2138
38,000	.2710	1.9209	−56.500	−69.700	573.7	6.097	.2038
39,000	.2583	1.9677	−56.500	−69.700	573.7	5.811	.1942
40,000	.2462	2.0155	−56.500	−69.700	573.7	5.538	.1851
41,000	.2346	2.0645	−56.500	−69.700	573.7	5.278	.1764
42,000	.2236	2.1148	−56.500	−69.700	573.7	5.030	.1681
43,000	.2131	2.1662	−56.500	−69.700	573.7	4.794	.1602
44,000	.2031	2.2189	−56.500	−69.700	573.7	4.569	.1527
45,000	.1936	2.2728	−56.500	−69.700	573.7	4.355	.1455

Figure A1-5. ICAO Standard Atmosphere Table (Sheet 1 of 2).

ICAO STANDARD ATMOSPHERE TABLE

ALTITUDE IN 100-FOOT INCREMENTS AND $\frac{1}{\sqrt{\sigma}}$

Altitude Feet	$\frac{1}{\sqrt{\sigma}}$	Altitude Feet	$\frac{1}{\sqrt{\sigma}}$	Altitude Feet	$\frac{1}{\sqrt{\sigma}}$	Altitude Feet	$\frac{1}{\sqrt{\sigma}}$	Altitude Feet	$\frac{1}{\sqrt{\sigma}}$
100	1.0015	6100	1.0955	12,100	1.2030	18,100	1.3269	24,100	1.4704
200	1.0029	6200	1.0971	12,200	1.2049	18,200	1.3291	24,200	1.4729
300	1.0044	6300	1.0988	12,300	1.2069	18,300	1.3313	24,300	1.4755
400	1.0059	6400	1.1005	12,400	1.2088	18,400	1.3335	24,400	1.4781
500	1.0074	6500	1.1022	12,500	1.2107	18,500	1.3358	24,500	1.4807
600	1.0088	6600	1.1039	12,600	1.2127	18,600	1.3380	24,600	1.4833
700	1.0103	6700	1.1056	12,700	1.2146	18,700	1.3403	24,700	1.4860
800	1.0118	6800	1.1073	12,800	1.2166	18,800	1.3425	24,800	1.4886
900	1.0133	6900	1.1090	12,900	1.2185	18,900	1.3448	24,900	1.4912
1000	1.0148	7000	1.1107	13,000	1.2205	19,000	1.3470	25,000	1.4938
1100	1.0163	7100	1.1124	13,100	1.2224	19,100	1.3493	25,100	1.4965
1200	1.0178	7200	1.1141	13,200	1.2244	19,200	1.3516	25,200	1.4991
1300	1.0193	7300	1.1158	13,300	1.2264	19,300	1.3539	25,300	1.5018
1400	1.0208	7400	1.1175	13,400	1.2284	19,400	1.3561	25,400	1.5045
1500	1.0223	7500	1.1193	13,500	1.2303	19,500	1.3584	25,500	1.5071
1600	1.0238	7600	1.1210	13,600	1.2323	19,600	1.3607	25,600	1.5098
1700	1.0253	7700	1.1227	13,700	1.2343	19,700	1.3630	25,700	1.5125
1800	1.0269	7800	1.1245	13,800	1.2363	19,800	1.3653	25,800	1.5152
1900	1.0284	7900	1.1262	13,900	1.2383	19,900	1.3677	25,900	1.5179
2000	1.0299	8000	1.1279	14,000	1.2403	20,000	1.3700	26,000	1.5206
2100	1.0314	8100	1.1297	14,100	1.2423	20,100	1.3723	26,100	1.5233
2200	1.0330	8200	1.1314	14,200	1.2444	20,200	1.3746	26,200	1.5260
2300	1.0345	8300	1.1332	14,300	1.2464	20,300	1.3770	26,300	1.5287
2400	1.0360	8400	1.1350	14,400	1.2484	20,400	1.3793	26,400	1.5315
2500	1.0376	8500	1.1367	14,500	1.2504	20,500	1.3817	26,500	1.5342
2600	1.0391	8600	1.1385	14,600	1.2525	20,600	1.3840	26,600	1.5370
2700	1.0407	8700	1.1403	14,700	1.2545	20,700	1.3864	26,700	1.5397
2800	1.0422	8800	1.1420	14,800	1.2565	20,800	1.3888	26,800	1.5425
2900	1.0438	8900	1.1438	14,900	1.2586	20,900	1.3911	26,900	1.5453
3000	1.0454	9000	1.1456	15,000	1.2606	21,000	1.3935	27,000	1.5480
3100	1.0469	9100	1.1474	15,100	1.2627	21,100	1.3958	27,100	1.5508
3200	1.0485	9200	1.1492	15,200	1.2648	21,200	1.3983	27,200	1.5536
3300	1.0501	9300	1.1510	15,300	1.2668	21,300	1.4007	27,300	1.5564
3400	1.0516	9400	1.1528	15,400	1.2689	21,400	1.4031	27,400	1.5592
3500	1.0532	9500	1.1546	15,500	1.2710	21,500	1.4055	27,500	1.5620
3600	1.0548	9600	1.1564	15,600	1.2731	21,600	1.4079	27,600	1.5649
3700	1.0564	9700	1.1582	15,700	1.2752	21,700	1.4103	27,700	1.5677
3800	1.0580	9800	1.1600	15,800	1.2773	21,800	1.4128	27,800	1.5705
3900	1.0595	9900	1.1618	15,900	1.2794	21,900	1.4152	27,900	1.5734
4000	1.0611	10,000	1.1637	16,000	1.2815	22,000	1.4176	28,000	1.5762
4100	1.0627	10,100	1.1655	16,100	1.2836	22,100	1.4201	28,100	1.5791
4200	1.0643	10,200	1.1673	16,200	1.2857	22,200	1.4225	28,200	1.5819
4300	1.0659	10,300	1.1692	16,300	1.2878	22,300	1.4250	28,300	1.5848
4400	1.0676	10,400	1.1710	16,400	1.2899	22,400	1.4275	28,400	1.5877
4500	1.0692	10,500	1.1729	16,500	1.2921	22,500	1.4299	28,500	1.5906
4600	1.0708	10,600	1.1747	16,600	1.2942	22,600	1.4324	28,600	1.5935
4700	1.0724	10,700	1.1766	16,700	1.2963	22,700	1.4349	28,700	1.5964
4800	1.0740	10,800	1.1784	16,800	1.2985	22,800	1.4374	28,800	1.5993
4900	1.0757	10,900	1.1803	16,900	1.3006	22,900	1.4399	28,900	1.6022
5000	1.0773	11,000	1.1822	17,000	1.3028	23,000	1.4424	29,000	1.6052
5100	1.0789	11,100	1.1840	17,100	1.3049	23,100	1.4449	29,100	1.6081
5200	1.0806	11,200	1.1859	17,200	1.3071	23,200	1.4474	29,200	1.6110
5300	1.0822	11,300	1.1878	17,300	1.3093	23,300	1.4499	29,300	1.6140
5400	1.0838	11,400	1.1897	17,400	1.3115	23,400	1.4525	29,400	1.6170
5500	1.0855	11,500	1.1916	17,500	1.3136	23,500	1.4550	29,500	1.6199
5600	1.0871	11,600	1.1935	17,600	1.3158	23,600	1.4576	29,600	1.6229
5700	1.0888	11,700	1.1954	17,700	1.3180	23,700	1.4601	29,700	1.6259
5800	1.0905	11,800	1.1973	17,800	1.3202	23,800	1.4627	29,800	1.6289
5900	1.0921	11,900	1.1992	17,900	1.3224	23,900	1.4652	29,900	1.6319
6000	1.0938	12,000	1.2011	18,000	1.3246	24,000	1.4678	30,000	1.6349

Figure A1-5. ICAO Standard Atmosphere Table (Sheet 2 of 2).

TEMPERATURE CONVERSION CHART

SAMPLE PROBLEM

A. AIR TEMPERATURE 60° F
C. AIR TEMPERATURE 18° C

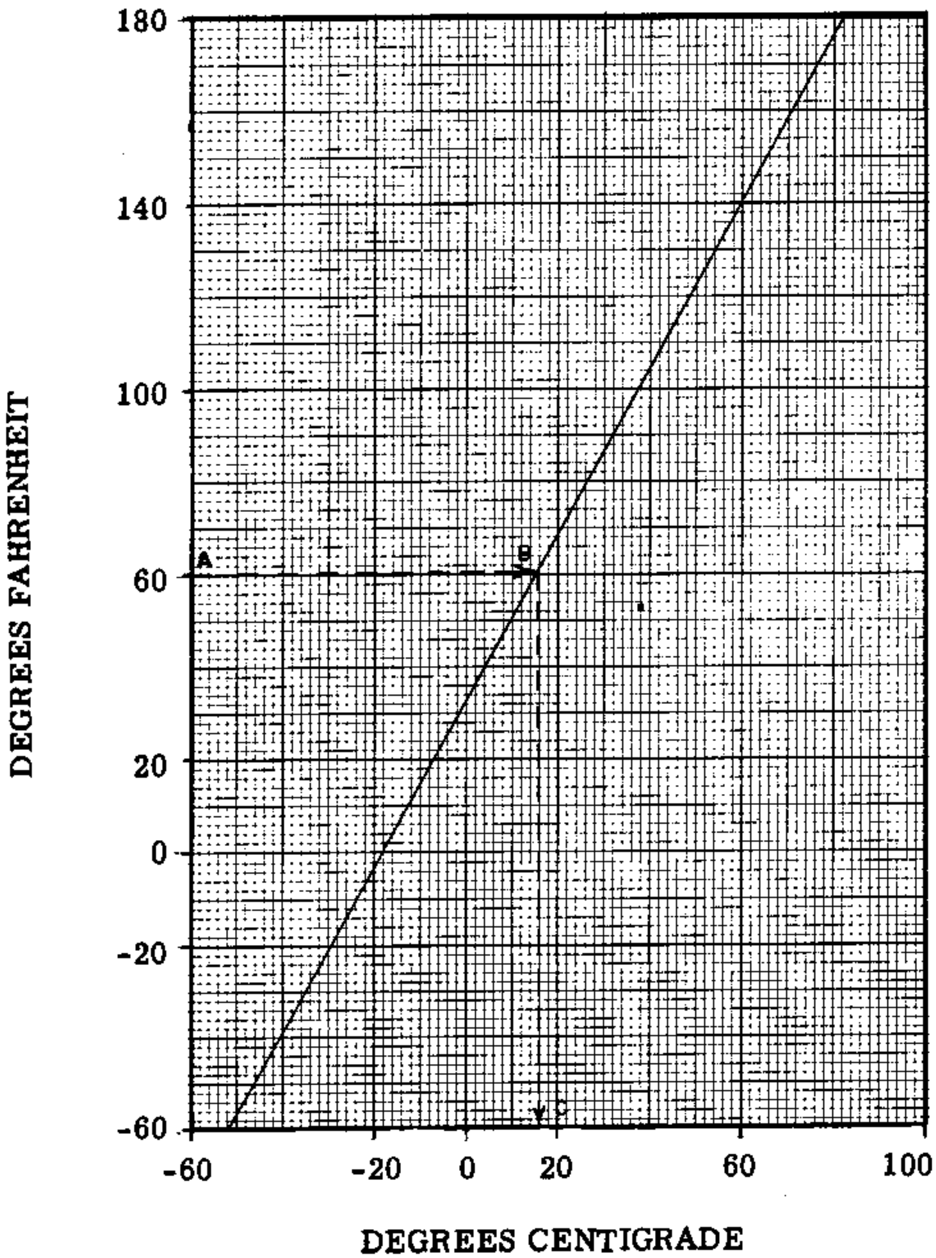


Figure A1-6. Temperature Conversion.

MPH - KNOTS CONVERSION CHART

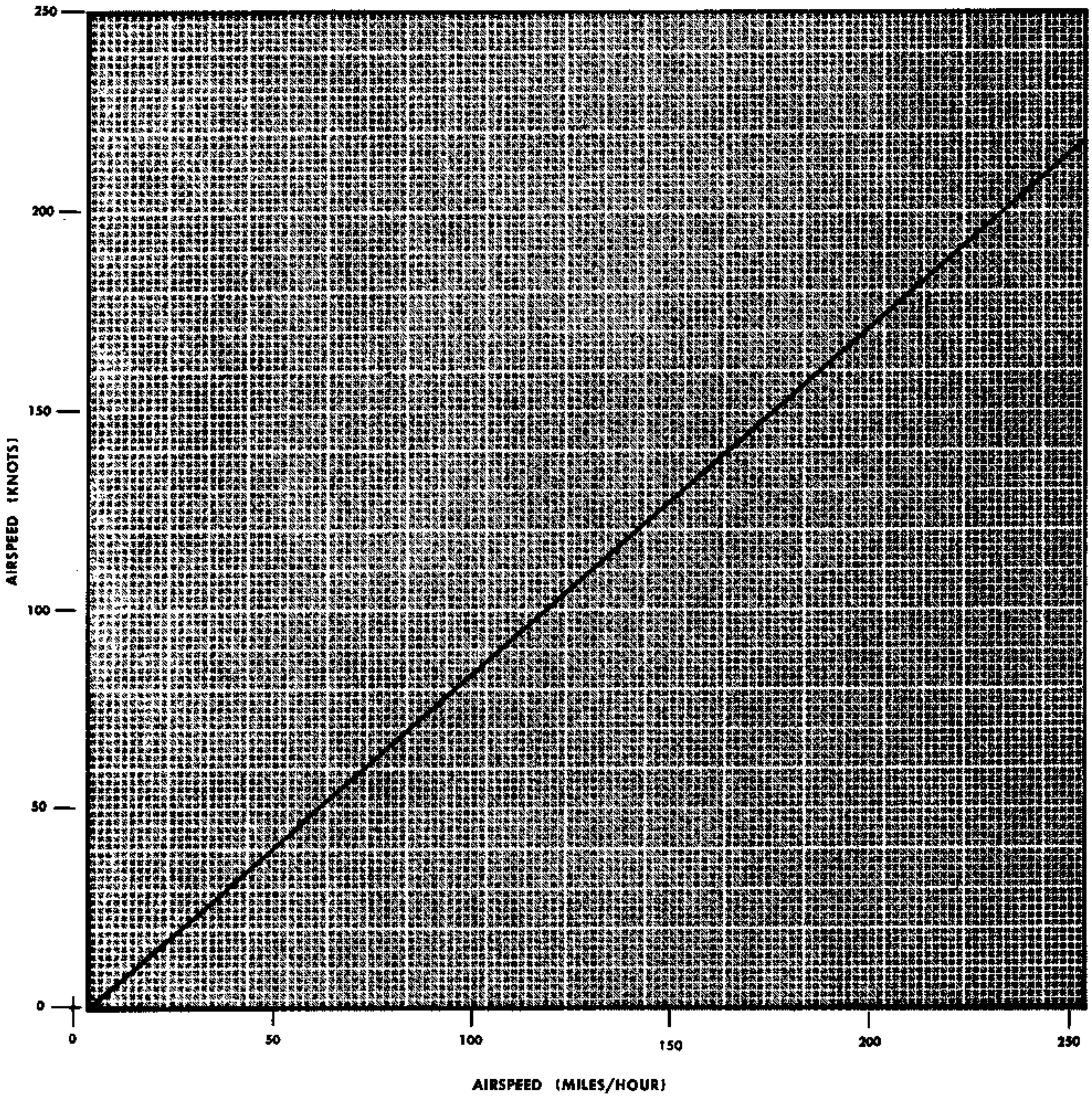


Figure A1-7. MPH - Knots Conversion.

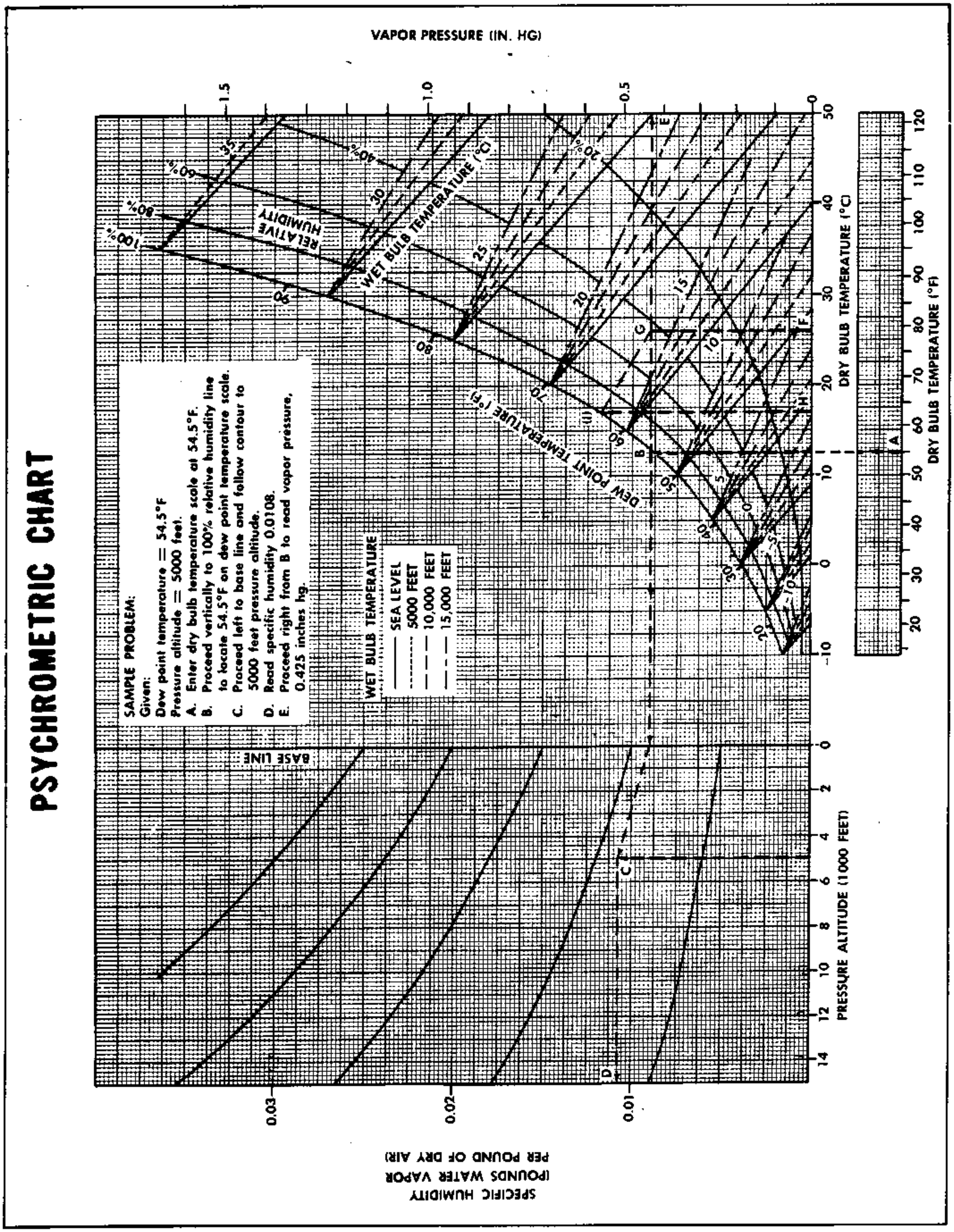


Figure A1-8. Pyschrometric Chart.

FUEL DENSITY TABLE 100/130 AND 115/145 GRADE FUEL		
FUEL TEMPERATURE		FUEL DENSITY
°C	°F	LB/GAL
50	122	5.67
40	104	5.73
30	86	5.80
20	68	5.87
10	50	5.93
0	32	6.00
−10	14	6.07
−20	−4	6.14
−30	−22	6.21
−40	−40	6.27
−50	−58	6.34

Figure A1-9

PART TWO
ENGINE DATA

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Discussion of Charts A2-2

LIST OF CHARTS

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DISCUSSION OF CHARTS.

Engine characteristics are presented in the engine calibration curve charts (figures A2-12 and A2-13) for the "no ram" condition. Recommended rpm and manifold pressure settings for desired cruising power are given on the constant cruise power setting charts. These settings are based on standard atmospheric conditions.

Manifold pressure (MP) is intake manifold pressure given in inches Hg. absolute (based on zero pressure).

All performance charts specify engine operation with auto rich or auto lean with 100/130 grade fuel.

All flight performance is based on the carburetor air levers remaining in the COLD position. If carburetor heat is applied at a constant manifold pressure, engine power will be decreased because of the higher carburetor air temperature. In addition, the normal air induction system is partially restricted and the carburetor air is taken from a location behind the cylinders. This air, having passed over the engine section, has less ram energy remaining, so that lower manifold pressures will be obtained with a fixed throttle setting.

The power looses attributable to atmospheric conditions may be estimated. The effect of temperature on brake horsepower can be approximated by the following equations, where T_1 and T std are absolute temperatures:

$$\frac{bhp_{std}}{bhpT_1} = \sqrt{\frac{T_2}{T_{std}}}$$ For part throttle constant manifold pressure operation

$$\frac{bhp_{std}}{bhpT_1} = \frac{T_1}{T_{std}}$$ For full throttle operation

Absolute temperature = ambient temperature (degrees centigrade) + 273.

The following rules of thumb may be used to quickly approximate the effect of temperature on power:

1. For part throttle, constant manifold pressure operation, a 10°C temperature increase above standard results in approximately 1.7 percent power loss. Similarly, a 10°C temperature decrease below standard results in approximately 1.7 percent power gain.

2. For full throttle operation, a 10°C temperature increase above standard results in approximately 3.5 percent power loss. Similarly, a 10°C temperature decrease below standard results in approximately 3.5 percent power gain.

3. The variation in manifold pressure with temperature in order to maintain constant power is approximately 1/2-inch Hg increase for every 10°C above standard OAT. In order to maintain constant power for cold day cruise operation, the manifold pressure should be decreased approximately 1/2-inch Hg for every 10°C below standard OAT. During take-off under cold temperature conditions, when overpowering is possible, reduce manifold pressure approximately 1 inch Hg for every 10°C below standard OAT.

$$MP_{corr} = MP_{std}\sqrt{\frac{\text{CAT absolute Temperature}}{\text{Std. Absolute Temperature}}}$$

The effect of humidity on engine power output is as follows:

1. Effective pressure and density altitudes are increased because of the presence of vapor pressure.

2. Fuel-air ratio is increased because fuel is metered on total flow through the venturi, and the total flow includes water vapor as well as air.

3. The thermal efficiency of the combustion process is reduced because of the presence of water vapor. The effect of humidity on power output for take-off is shown on figure A2-1.

4. For cruise operation, the bhp loss associated with humidity is normally cancelled out by the gain in bhp due to increased ram effect with airspeed; therefore, although the engine calibration charts are labeled zero ram, data obtained will approximate actual performance.

NOTE

On all charts in the Appendix, the term METO (Maximum Except Take-Off) is substituted for normal rated power and the term MAXIMUM for take-off power.

POWER SETTINGS

Various permissable combinations of manifold pressure, and rpm settings for pressure altitudes from sea level to 20,000 feet and carburetor air temperatures from −20°C to 20°C are presented in the constant cruise power settings charts (figures A2-4 through A2-11), the METO power settings chart (figure A2-2), and the climb power settings chart (figure A2-3). The constant cruise power settings charts are based on auto lean operation and the METO power settings and climb power settings charts are based on auto rich operation. Resultant bmep, and resultant fuel flow in pounds per hour for one engine and for two engines are also indicated on the charts.

Enter the chart with the given altitude and carburetor air temperature to determine the correct manifold pressure. Without crossing the guide lines, proceed to the right of the chart to obtain the corresponding RPM, BMEP, and fuel flow.

ENGINE CALIBRATION CURVE

The engine calibration curve charts (figure A2-12 and A2-13) are presented in facing pairs of charts, and provide the necessary information to calculate manifold pressure, brake horsepower, RPM and/or critical altitude (the maximum altitude that may be reached with a given manifold pressure and rpm). A pair of charts is included for both the auto-lean and auto-rich condition.

These charts are the basis for take-off, climb, and cruise data shown throughout the Appendix. They are intended to provide a graphic presentation of the two types of engine power limitations; those imposed by the engine manufacturer to prevent detonation and other effects of overboosting, and those due to the decreasing density of air with increasing altitude. From these charts, power and altitude conditions, not covered in Part 4 CLIMB, or Part 5 RANGE, may be found.

The first chart of each pair (Sheet 1 of 2) shows the variation of BHP with manifold pressure for the range of operating rpm's for sea level calibration.

The second chart (Sheet 2 of 2) shows the variation of BHP and manifold pressure with altitude for operating RPM when maintaining full throttle. On both charts, the upper end of each RPM line is terminated at the BHP limit for that RPM. This altitude is known as the critical altitude for that particular RPM, MP, mixture setting, and atmospheric condition.

The problems which involve the use of operating curves fall generally into one of two types, A– The calculation of BHP, when manifold pressure, RPM, and altitude are known and B– The calculation of manifold pressure, when BHP, RPM and altitude are known.

NOTE

In the interest of clarity sample problem "A" is shown on figure A2-12 and sample problem "B" is shown on figure A2-13. However, both problems can be applied to either chart.

SAMPLE PROBLEM "A":

Given:

1. Manifold pressure = 27.2 in. Hg
2. RPM = 2000
3. Altitude = 9000 feet

To Find:

BRAKE HORSEPOWER

Solution:

1. Locate the intersection of the given RPM and manifold pressure lines on the sea level calibration curve (Point A).
2. Project this intersection (Point A) horizontally to the BHP scale and read 500 BHP (Point B).
3. Enter the altitude calibration curve with this value (Point C).
4. Locate the intersection (Point D) of the full throttle, constant RPM line and the full throttle constant manifold pressure line, corresponding respectively to the given RPM (2000) and manifold pressure (27.2 in. Hg).
5. Connect C and D with a straight line.
6. Locate the intersection of the line CD with the given altitude line – 9000 feet (Point E).
7. Project this intersection horizontally to the BHP axis (Point F). The required BHP is 560.

EXPLANATION:

The engine's sea level BHP at the given combination of RPM and manifold pressure is found from the sea level calibration curve at B. The BHP at the full throttle critical altitude for the same combination is found from the altitude calibration curve at D. The line CD is, therefore, the part throttle, constant RPM, constant manifold pressure line for the given combination of RPM and manifold pressure. The BHP for any altitude between sea level and critical altitude is then determined by the location of the intersection of the given altitude line with the part throttle line, CD.

SAMPLE PROBLEM "B":

Given:

1. Brake horsepower = 750

2. RPM = 2200

3. Altitude = 9000 feet

FIND:

MANIFOLD PRESSURE

Solution:

1. Locate the intersection of the given altitude and BHP lines on the altitude calibration chart (Point A).

2. Select any constant manifold pressure line (33 in Hg) estimated to be close to the required answer, and locate its intersection with the full throttle, constant RPM line corresponding to the given RPM line (Point B).

3. Transfer these values (33 in Hg manifold pressure and 2200 RPM) to the sea level calibration curve, and locate this intersection (Point C).

4. Project this intersection horizontally to the BHP scale and read 730 BHP (Point D).

5. Enter the altitude calibration curve with this value (Point E).

6. Construct line EB.

7. Through Point A draw line FG parallel to line EB.

8. Locate the intersection of line FG and the full throttle constant (2200) RPM line (Point H). The required manifold pressure is 32.2 inches Hg.

EXPLANATION:

Since all part throttle, constant RPM, constant manifold pressure lines are approximately parallel, it follows that, if we determine the slope of one such line, EB, we can draw the corresponding line, FG, through the given BHP—altitude point, A. Inasmuch as manifold pressure is constant at all points on the line, FG, its value may be found at that point, H, where the part throttle, constant RPM, constant manifold pressure line, intersects (or, better, terminates in) the full throttle, constant given RPM line. The more closely we can estimate the desired manifold pressure, the more accurate will be our construction; and in this case experience might have suggested that we use 32 in. Hg for our preliminary estimate of manifold pressure instead of 33 in.

FUEL FLOW PER ENGINE

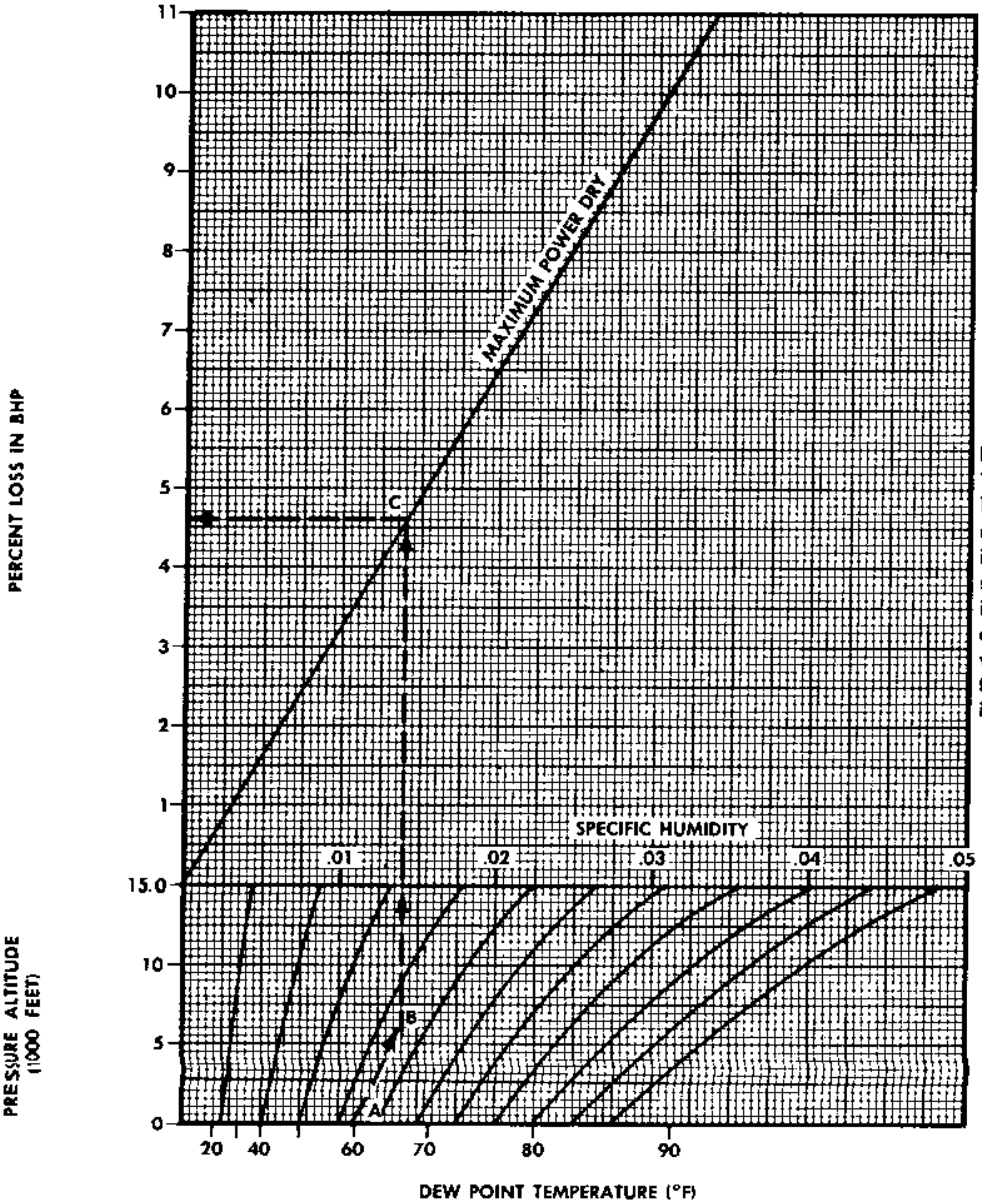
The fuel flow per engine chart (figure A2-14) is used to determine fuel consumption for various brake horsepower settings when using either auto lean or auto rich mixture settings. Fuel flow may be determined in either pounds per hour or gallons per hour. Since fuel consumption is dependent on RPM as well as BHP, the values shown on this chart are average.

EFFECT OF HUMIDITY ON POWER OUTPUT

MODEL: C-47, C-117,
AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D, AND -92

SAMPLE PROBLEM:
A. Dew point temperature = 60°F.
B. Pressure altitude = 6000 feet.
C. Effect of humidity on maximum power is a 4.6% loss in power.



Note:
This chart shows the percent loss in BHP for any given manifold pressure. However, it is permissible to regain some of this loss by increasing manifold pressure by an amount equal to the water vapor pressure present in the air, up to a limit of 1.5 inches Hg.

BASED ON: ESTIMATED DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A2-1. Effect of Humidity on Power Output.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

METO POWER SETTINGS

1050 BRAKE HORSEPOWER PER ENGINE

AUTO RICH

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN Hg) AT CARBURETOR AIR TEMPERATURE (^{0}C)						RPM	FUEL FLOW LB/HR	
	-20^{0}	-10^{0}	0^{0}	+ 10^{0}	+ 20^{0}	+ 30^{0}		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000									
9,000									
8,000									
7,000	39.4	40.2	40.9						
6,000	39.3	40.1	40.9	41.6	42.3				
5,000	39.5	40.3	41.1	41.8	42.6	43.3			
4,000	39.7	40.5	41.3	42.0	42.8	43.5			
3,000	39.9	40.7	41.5	42.2	43.0	43.7			
2,000	40.0	40.8	41.6	42.3	43.1	43.8	2550	735.00	1470.00
1,000	40.0	40.8	41.6	42.3	43.1	43.8			
0	40.0	40.8	41.6	42.3	43.1	43.8			

Figure A2-2. METO Power Settings.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CLIMB POWER SETTINGS

850 BRAKE HORSEPOWER SETTINGS
AUTO RICH

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	33.7	34.3							
9,000	33.7	34.4	34.8	35.3	35.7	36.1			
8,000	33.8	34.4	34.8	35.4	35.8	36.2			
7,000	33.8	34.5	34.9	35.5	35.9	36.3	2350	500	1000
6,000	33.8	34.5	34.9	35.6	36.0	36.4			
5,000	33.9	34.6	35.0	35.6	36.0	36.4			
4,000	33.9	34.6	35.0	35.7	36.1	36.5			
3,000	34.0	34.7	35.1	35.8	36.2	36.6			
2,000	34.2	34.7	35.2	35.9	36.3	36.7			
1,000	34.3	34.8	35.3	35.9	36.3	36.7			
0	34.4	34.8	35.4	36.0	36.4	36.8			

Figure A2-3. Climb Power Settings

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

600 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000	27.0	27.6							
12,000	27.1	27.6	28.2	28.7					
11,000	27.2	27.7	28.3	28.8	29.3	29.8			
10,000	27.4	27.9	28.5	29.0	29.5	30.0	2050	265.50	531.00
9,000	29.2	29.8	30.3	29.2	29.7	30.2			
8,000	29.2	29.8	30.3	30.9	31.4	32.0			
7,000	29.2	29.8	30.3	30.9	31.4	32.0			
6,000	29.3	29.9	30.4	31.0	31.5	32.1			
5,000	29.4	29.9	30.5	31.1	31.6	32.1			
4,000	29.5	30.0	30.6	31.2	31.7	32.2	1900	255.00	510.00
3,000	29.5	30.1	30.7	31.2	31.8	32.3			
2,000	29.7	30.3	30.9	31.4	32.0	32.5			
1,000	29.9	30.5	31.1	31.6	32.2	32.7			
0	30.0	30.6	31.2	31.7	32.3	32.8			

Figure A2-4. Constant Cruise Power Settings, 600 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

550 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000	25.2								
14,000	25.2	25.7	26.2	26.7					
13,000	25.4	25.9	26.3	26.8	27.3	27.7			
12,000	26.9	27.2	26.3	26.8	27.3	27.7	2050	241.90	483.80
11,000	27.1	27.5	27.9	28.3	27.3	27.7			
10,000	28.4	27.6	28.0	28.4	28.7	29.0			
9,000	28.5	29.0	29.5	28.7	28.9	29.2	1900	236.50	473.00
8,000	28.7	29.2	29.5	30.0	30.4	30.7			
7,000	28.8	29.3	29.6	30.1	30.5	30.8			
6,000	28.9	29.5	29.8	30.3	30.6	30.9			
5,000	29.0	29.6	29.9	30.4	30.7	31.0			
4,000	29.1	29.7	30.0	30.5	30.8	31.1	1800	232.65	465.30
3,000	29.3	29.8	30.1	30.6	31.0	31.3			
2,000	29.4	30.0	30.3	30.8	31.1	31.4			
1,000	29.6	30.1	30.4	30.9	31.3	31.6			
0	29.7	30.2	30.5	31.0	31.4	31.7			

Figure A2-5. Constant Cruise Power Settings, 550 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

500 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000	23.0	23.5							
16,000	23.0	23.5	23.9	24.4					
15,000	23.2	23.7	24.2	24.6	25.0				
14,000	24.8	25.2	24.4	24.8	25.2	25.7			
13,000	25.0	25.3	25.6	25.9	25.4	25.8	2050	224.20	448.40
12,000	25.9	25.5	25.8	26.1	26.4	26.7			
11,000	26.1	26.5	27.0	26.3	26.7	27.0	1900	219.00	438.00
10,000	27.5	26.6	27.0	27.3	27.5	27.8			
9,000	27.7	28.0	28.5	27.5	27.9	28.2	1800	215.00	430.00
8,000	27.9	28.4	28.7	29.1	29.5	29.8			
7,000	28.0	28.5	28.9	29.3	29.6	29.9			
6,000	28.2	28.6	29.0	29.4	29.8	30.1			
5,000	28.3	28.7	29.2	29.6	29.9	30.2			
4,000	28.4	28.8	29.3	29.8	30.0	30.3	1700	210.00	420.00
3,000	28.5	28.9	29.4	29.9	30.2	30.5			
2,000	28.7	29.1	29.6	30.0	30.4	30.7			
1,000	28.8	29.2	29.7	30.2	30.5	30.8			
0	28.9	29.4	29.8	30.3	30.7	31.0			

Figure A2-6. Constant Cruise Power Settings, 500 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

450 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000	20.9								
19,000	21.0	21.4	21.8						
18,000	21.0	21.4	21.9	22.3	22.6				
17,000	22.5	21.7	22.1	22.5	22.9	23.3			
16,000	22.5	23.0	23.4	22.6	23.0	23.4	2050	202.50	405.00
15,000	22.8	23.3	23.4	23.8	24.0	24.3			
14,000	23.8	24.2	23.6	23.8	24.3	24.5	1900	199.80	399.60
13,000	24.0	24.3	24.5	24.8	25.3	25.6			
12,000	25.0	25.5	24.6	25.0	25.3	25.6	1800	197.55	395.10
11,000	25.1	25.5	25.9	26.3	25.5	25.8			
10,000	25.4	25.7	26.0	26.3	26.5	26.8			
9,000	25.5	25.8	26.3	26.5	26.9	27.1			
8,000	25.5	25.8	26.3	26.7	26.9	27.1			
7,000	25.7	26.0	26.4	26.9	27.1	27.4			
6,000	25.9	26.2	26.6	27.1	27.3	27.6			
5,000	26.1	26.3	26.8	27.2	27.5	27.8	1700	193.50	387.00
4,000	26.3	26.5	27.0	27.4	27.7	28.0			
3,000	26.4	26.7	27.2	27.6	27.9	28.2			
2,000	26.6	27.0	27.4	27.8	28.1	28.4			
1,000	26.7	27.2	27.6	27.9	28.2	28.5			
0	26.9	27.4	27.8	28.1	28.4	28.7			

Figure A2-7. Constant Cruise Power Settings, 450 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

400 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000	22.5	22.0	22.2	22.4	22.8	23.2	1800	184.00	368.00
14,000	22.8	23.1	23.4	23.7	23.0	23.4			
13,000	22.8	23.2	23.7	23.9	24.3	24.5			
12,000	23.0	23.5	23.8	24.2	24.4	24.6			
11,000	23.1	23.6	23.9	24.3	24.5	24.7			
10,000	23.3	23.7	24.0	24.3	24.6	24.9			
9,000	23.4	23.7	24.1	24.4	24.7	25.0	1700	177.50	355.00
8,000	23.5	23.8	24.3	24.4	24.8	25.1			
7,000	23.6	24.0	24.4	24.6	24.9	25.2			
6,000	23.8	24.1	24.5	24.8	25.1	25.4			
5,000	23.9	24.3	24.6	25.0	25.3	25.6			
4,000	24.0	24.4	24.8	25.2	25.5	25.8			
3,000	24.2	24.6	24.9	25.4	25.7	26.0			
2,000	24.4	24.8	25.1	25.5	25.9	26.3			
1,000	24.6	25.0	25.3	25.7	26.1	26.5			
0	24.8	25.3	25.5	25.8	26.3	26.8			

Figure A2-8. Constant Cruise Power Settings, 400 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

350 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	21.1	21.4	21.7	22.0	22.2	22.4			
9,000	21.3	21.6	21.9	22.2	22.4	22.6			
8,000	21.4	21.7	22.0	22.3	22.5	22.7			
7,000	21.6	21.9	22.2	22.5	22.7	22.9	1700	158.50	317.00
6,000	21.7	22.0	22.3	22.6	22.8	23.0			
5,000	21.9	22.2	22.5	22.8	23.0	23.2			
4,000	22.0	22.3	22.6	22.9	23.1	23.3			
3,000	22.2	22.6	22.9	23.1	23.4	23.7			
2,000	22.4	22.8	23.1	23.4	23.6	23.8			
1,000	22.6	23.1	23.4	23.6	23.9	24.1			
0	22.8	23.3	23.6	23.8	24.1	24.4			

Figure A2-9. Constant Cruise Power Settings, 350 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

300 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	18.8	19.2	19.4	19.6	19.9	20.2			
9,000	19.0	19.3	19.6	19.8	20.1	20.3	1700	142.00	284.00
8,000	19.2	19.5	19.8	20.0	20.3	20.6			
7,000	19.4	19.7	19.9	20.2	20.5	20.8			
6,000	19.6	19.9	20.1	20.5	20.7	20.9			
5,000	19.8	20.0	20.2	20.7	20.9	21.1			
4,000	20.0	20.2	20.4	20.9	21.1	21.3			
3,000	20.2	20.5	20.7	21.1	21.3	21.5			
2,000	20.4	20.7	20.95	21.3	21.5	21.7			
1,000	20.6	21.0	21.2	21.5	21.7	21.9			
0	20.8	21.2	21.5	21.7	21.9	22.1			

Figure A2-10. Constant Cruise Power Settings, 300 Bhp Per Engine.

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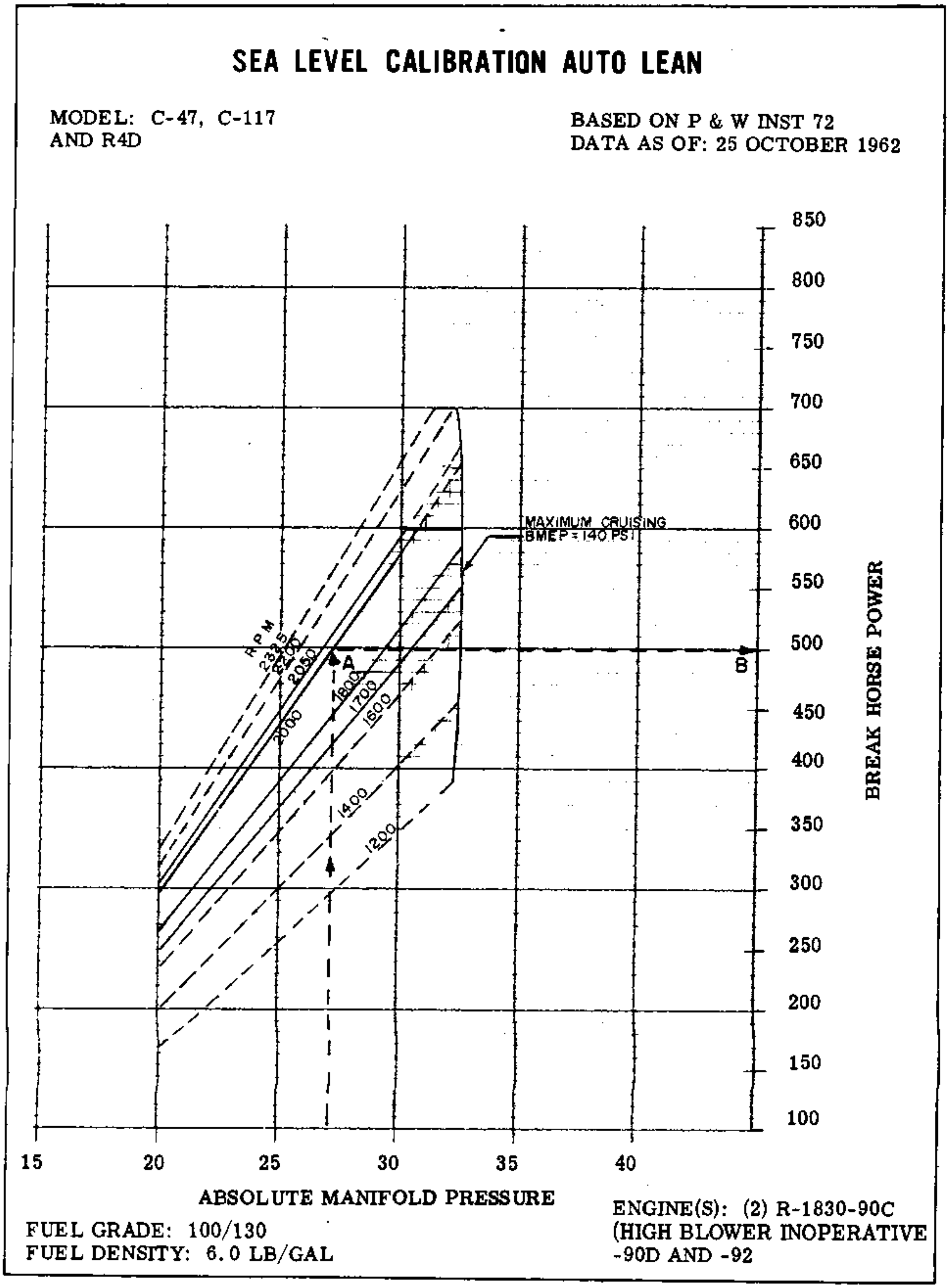


Figure A2-11. Engine Calibration Curve - Auto Lean. (Sheet 1 of 2).

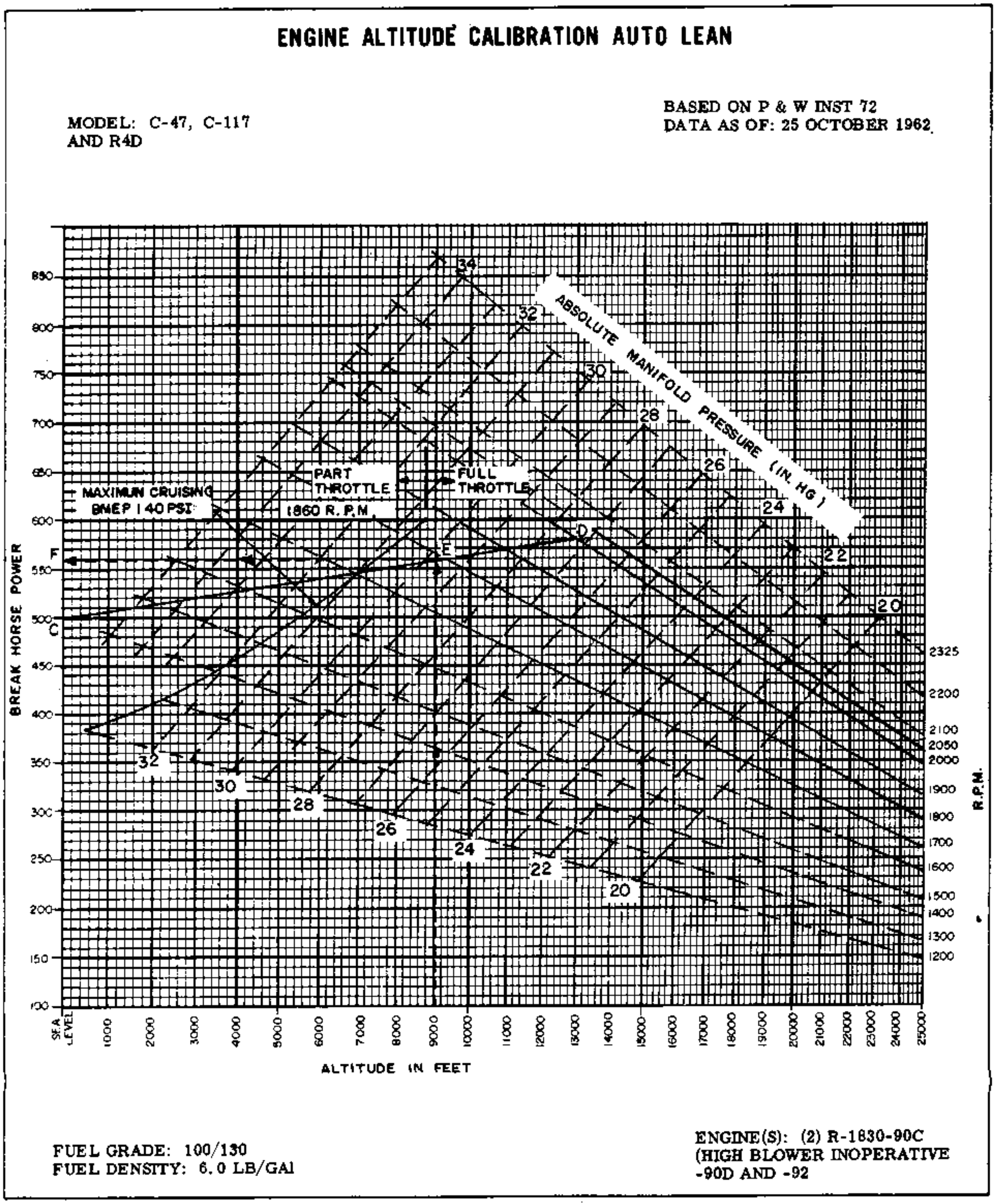


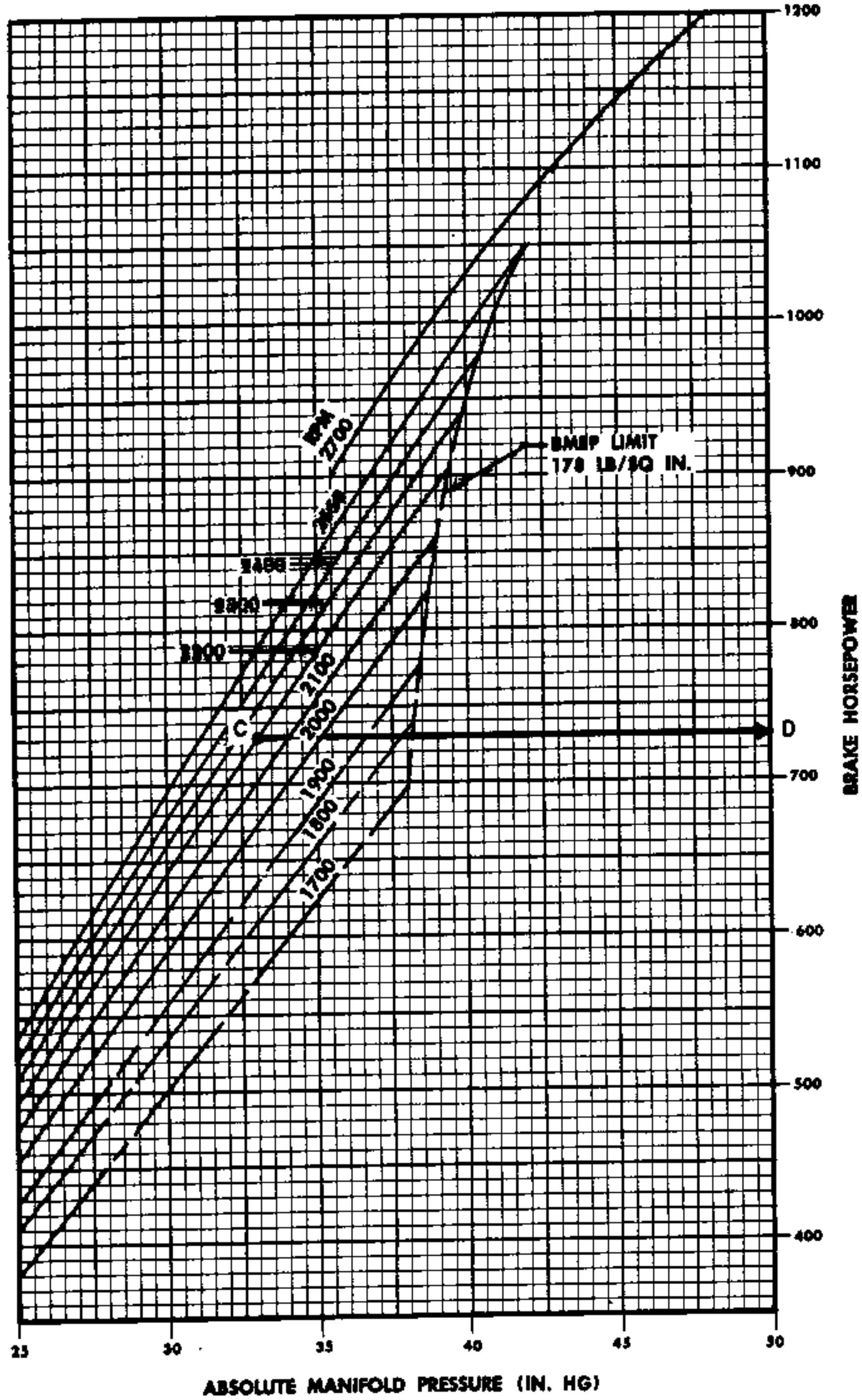
Figure A2-11. Engine Calibration Curve - Auto Lean (Sheet 2 of 2).

ENGINE CALIBRATION CURVE

AUTO-RICH
SEA LEVEL CALIBRATION

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

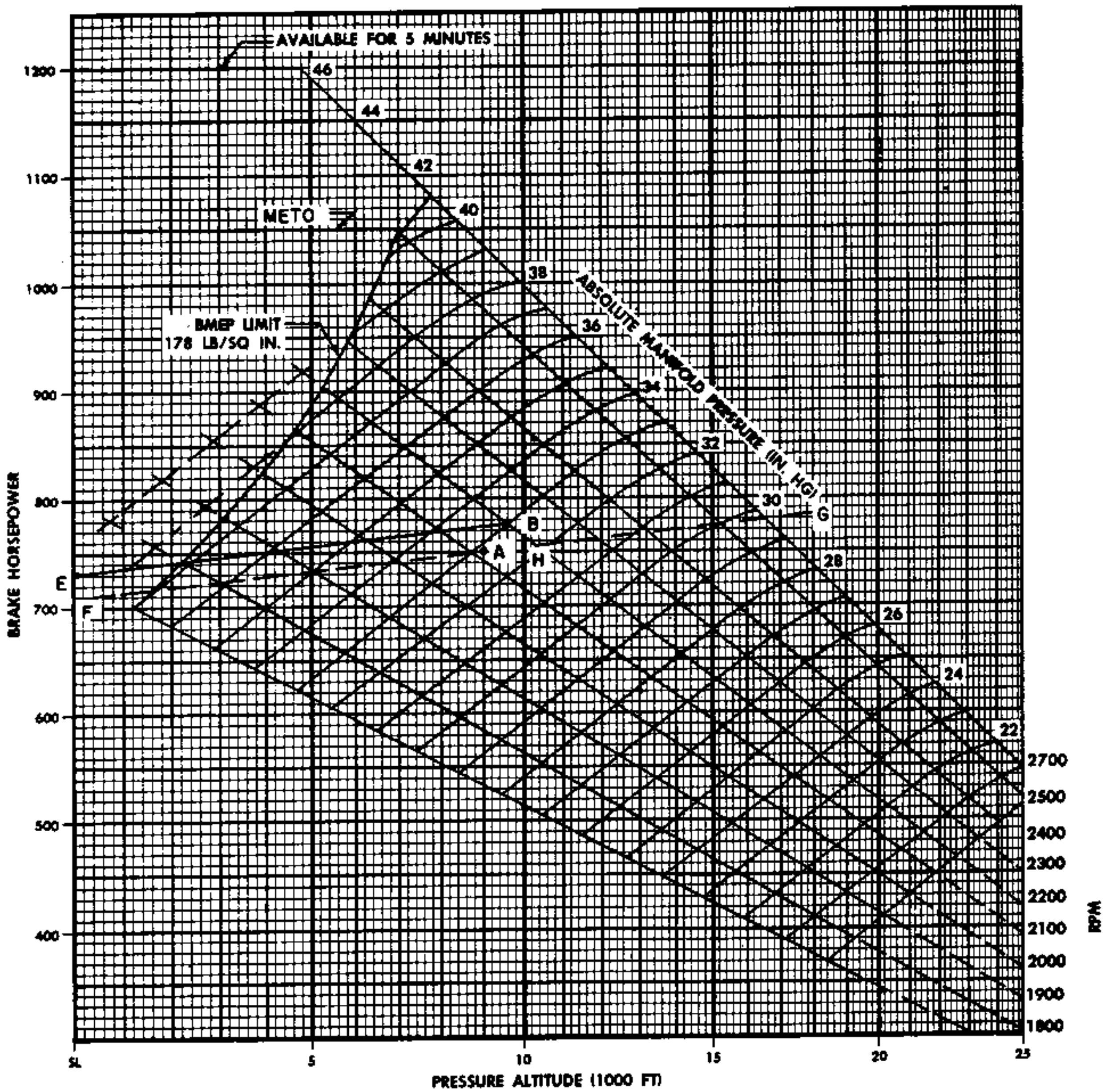
Figure A2-12. Engine Calibration Curve - Auto Rich (Sheet 1 of 2).

ENGINE ALTITUDE CALIBRATION CURVE

AUTO-RICH
WITHOUT RAM
NACA STANDARD DAY

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

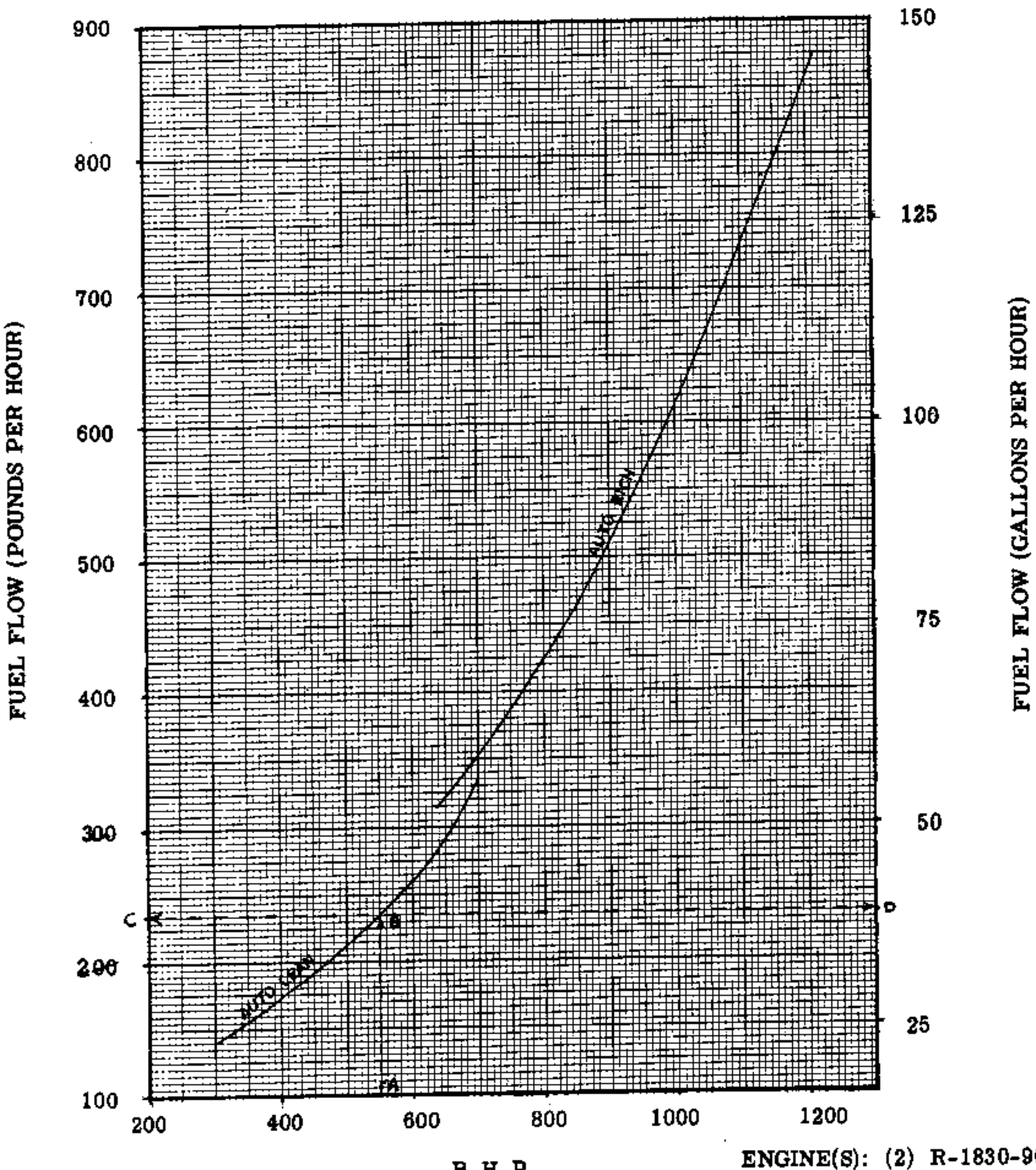
Figure A2-12. Engine Calibration Curve - Auto Rich (Sheet 2 of 2).

FUEL FLOW PER ENGINE

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

SAMPLE PROBLEM:
ENTER CHART AT BRAKE HORSEPOWER SETTING, POINT A. PROJECT A LINE VERTICALLY TO INTERSECT THE FUEL FLOW LINE, POINT B. PROJECT A LINE CD HORIZONTALLY FROM POINT B AND READ FUEL FLOW POUNDS PER HOUR AT POINT C, AND GALLONS PER HOUR AT POINT D.



FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

Figure A2-13. Fuel Flow Per Engine.

PART THREE
TAKE - OFF

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Discussion of Charts A3-2

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A3-15	Take-off and Landing Crosswind Chart	A3-19/A3-20

DISCUSSION OF CHARTS.

INTRODUCTION.

The take-off and climbout charts are presented for various gross weights and altitudes for standard atmospheric conditions. Headwind, runway surface condition, specific humidity, and nonstandard temperatures may be taken into account by use of the correction plots. A runway slope correction chart is also included.

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid. This allows a safety margin for fluctuation of wind velocity. It is assumed that the wind velocity is measured at a height of 50 feet above the ground. Allowance is made for wind gradient from 50 feet down to the approximate height of the aircraft on the ground, where the wind velocity is slightly reduced.

The engine manufacturer's limiting maximum brake horsepower of 1200 is observed. The take-off and climbout performance charts are discussed in detail in the following paragraphs. A sample problem is presented on each chart.

MAXIMUM TAKE-OFF GROSS WEIGHT.

Safe operation of the aircraft requires that take-offs not be attempted at gross weights for which acceleration, rate-of-climb, or obstacle clearance capability are marginal. There are four primary factors which must be considered when determining a safe limit for the take-off gross weight.

1. The ability of the structure to withstand taxiing loads and inflight maneuvering loads are shown as design take-off gross weights in the weight limitations chart (figure 5-2).

2. The ability to take off within the available runway is shown on the take-off performance chart (figure A3-11).

3. The ability to have adequate rate of climb when airborne is shown on the take-off gross weight limited by single-engine climb performance chart (figure A3-1).

4. The ability to clear obstacles within the take-off corridor is shown on the take-off path chart (figure A3-13).

For a given set of take-off conditions, each of these four considerations will permit a different gross weight. Any one of the four weights may be the lowest, depending on the conditions. For this reason, all four factors must be considered for each take-off, even though in many cases one or more of them may be eliminated after cursory examination. The lowest weight determined by these factors will be the maximum take-off gross weight.

TAKE-OFF GROSS WEIGHT LIMITED BY SINGLE-ENGINE CLIMB PERFORMANCE.

This chart (figure A3-1), based on one engine operating at maximum power, cowl flaps trail position, wing flaps up, landing gear up, and propeller on inoperative engine feathered, shows the maximum gross weights at which a 100 FPM rate of climb may be maintained for single-engine operation for various altitudes. For structural gross weight limitations, refer to figure 5-2 in Section V.

TAKE-OFF GROUND RUN DISTANCE CHARTS

The Take-Off Ground Run Charts (figure A3-2 through A3-8) are provided for several aircraft configurations, to determine the take-off ground run distance at various field altitudes, outside air temperatures, specific humidities, and gross weights, corrected for wind and runway surface conditions. The effect of runway slope on take-off ground run may be determined from the runway slope correction chart (figure A3-10).

TAKE-OFF PERFORMANCE - SPEED DURING GROUND RUN

The take-off performance - speed during ground run chart (figure A3-9) is based on the average acceleration characteristics of the aircraft during the take-off ground run with both engines operating at maximum power. Each line gives a particular relationship of indicated speed to the distance from the start of the take-off run for various aircraft configurations. The configuration of the aircraft is accounted for by entering the chart with the take-off ground run distance from the appropriate take-off ground run chart corrected for run way slope. Speed is obtained from the characteristic take-off speed chart. In this way the appropriate contour is located. This chart is also used to determine refusal distance. Sample problems are shown on the chart to illustrate its use.

RUNWAY SLOPE CORRECTION

This chart (figure A3-10) is to be used to correct data obtained from the Ground Run charts (figure A3-2 through A3-8) when runways have other than zero slopes. A sample problem is shown on the chart to illustrate its use.

TAKE-OFF PERFORMANCE - REFUSAL SPEED

The refusal speed as shown on this chart (figure A3-11) is the maximum speed which may be reached, accelerating from a standstill with two engines operating at maximum power, and from which a stop may be made within a given runway length. This chart is based on a dry, hard surface runway and includes correction grids for outside air temperature, pressure altitude, specific humidity, wind component and gross weight. In addition, a three second time delay after reaching refusal speed is allowed before cutting the engines and applying the brakes. Refusal speeds are given in indicated airspeeds. Refusal speeds above take-off speeds are not shown.

Enter the chart with outside air temperature (point A). Draw a line horizontally from Point A to the pressure altitude line (point B). Draw a vertical line from Point B to the specific humidity base line (Point C) and a line parallel to the contour line from Point C to the given specific humidity (Point D). Then enter chart at the given runway length (Point E) and draw a horizontal line to intersect the base line (Point F). From Point F, draw a line following the trend of the contour lines until it intersects a vertical line drawn from Point D. This intersection is (Point G). From Point G, draw a horizontal line to the zero wind line (Point H). From Point H, draw a line following the trend of the contour lines, to the given wind component (Point I). Then enter chart at given gross weight (Point J) and draw a vertical line to intersect a horizontal line drawn from Point I. This intersection (Point K) is the refusal speed.

DISTANCE TO STOP – ABORTED TAKE-OFF CHART

The distance to stop - - aborted take-off chart (figure A3-12) provides the distance required to stop from any indicated speed up to the highest take-off speed at altitudes from sea level to 16000 feet. The stopping curves assume windmilling propellers and a take-off wing flap deflection of zero degrees. No runway slope correction has been included. See the characteristic take-off speeds chart (figure A3-14) for the recommended take-off speed.

TAKE-OFF ABORT CRITERIA

Due to the take-off characteristics of C-47 aircraft, the abort criteria is based on refusal speed and refusal distance. The refusal speed is determined from the take-off performance – refusal speed chart (figure A3-11) and is based on temperature, pressure altitude, specific humidity, runway length, wind component and gross weight. The refusal distance is obtained from the take-off performance speed during ground run chart (figure A3-9).

TAKE-OFF PATH

A take-off path - - chart (figure A3-13) is included for a two-engine take-off climb with a wing flap deflection of zero degrees. This curve is presented to enable study of terrain or obstacle clearance problems peculiar to various airfields.

The flight path chart gives relationship between height attained above the runway surface and horizontal distance traveled from the start of the take-off roll. Each curve is for a specified two-engine take-off distance over a 50-foot height. This curve can be used for the various combinations of gross weight, altitudes, and atmospheric conditions that result in the given take-off distance. It is for this reason that gross weight and altitude do not appear explicitly.

This chart was prepared assuming a constant acceleration to 95 knots; zero degree flaps. Landing gear retraction is initiated at take-off and requires approximately 7 seconds to be completed. The drag of the fully extended landing gear is assumed to exist until the landing gear is completely retracted. The flight path chart terminates at a height of 400 feet. In no case is the 5-minute maximum power limit exceeded.

For a known obstacle height and location (distance from start of take-off roll), the flight path chart can be used to read the take-off distance over a 50-foot height for a zero wind, zero runway slope, and hard surface runway condition.

Enter chart with given headwind component (Point A). Draw a horizontal line from Point A to the given obstacle distance contour line (Point B) (distance from start of take-off run). Then enter chart at obstacle height (Point C) and draw a horizontal line from Point C to intersect a vertical line drawn from Point B. This intersection is Point D and is the gear down take-off distance to clear a 50-foot height with zero wind and zero runway slope. Divide this distance by 1.95 (ratio of distance over a 50-foot obstacle to take-off ground roll distance) to obtain the ground roll distance with zero wind, zero runway slope and hard surface runway. Using given outside air temperature, pressure altitude and specific humidity determine density altitude. Using the above derived ground roll distance, enter takeoff ground roll distance chart through the ground roll scale. Draw a vertical line from this point until it intersects a horizontal line drawn from the predetermined density altitude. This intersection indicates the maximum gross weight which will allow a take-off over the given obstacle under the given conditions.

CHARACTERISTIC TAKE-OFF SPEED CHART

The characteristic take-off speeds chart (figure A3-14), presents lift off speeds (1.1Vs) for zero and 1/4 wing flap settings for the range of probable take-off gross weights.

TAKE-OFF AND LANDING CROSS-WIND CHART.

The minimum touchdown or lift-off speed, under cross-wind conditions, may be determined by reference to the take-off and landing cross-wind chart (figure A3-15). A diagonal line (recommended touchdown or lift-off speed) indicates the minimum speed at which directional control can be maintained with the use of rudder ONLY for various combinations of aircraft and cross-wind velocities. If take-off or touchdown is accomplished at a speed less than recommended, the aircraft will turn into the wind, tending to veer off the runway.

After obtaining the runway heading and existing surface winds, compute the wind angle relative to the runway. Using the wind angle, enter the chart at zero headwind and zero cross-wind component. Proceed parallel with the appropriate wind angle line (as determined by interpolation) to the appropriate wind velocity curve (Point A). From Point A project a line vertically to the diagonal line and from the diagonal line horizontally to the speed scale (Point B), and read the minimum touchdown or lift-off speed. If the speed as determined from figure A3-14 is less than the speed shown at Point B, the speed shown at Point B should be used for takeoff or touchdown. If the speed as determined from figure A3-14 is greater than the speed shown at Point B, the speed as determined from figure A3-14 should be used for takeoff or touchdown.

The headwind component can be determined by projecting a line from Point A horizontally to the headwind component scale (Point C). The cross-wind component can be determined by projecting a line vertically from Point A to the cross-wind component scale (Point D).

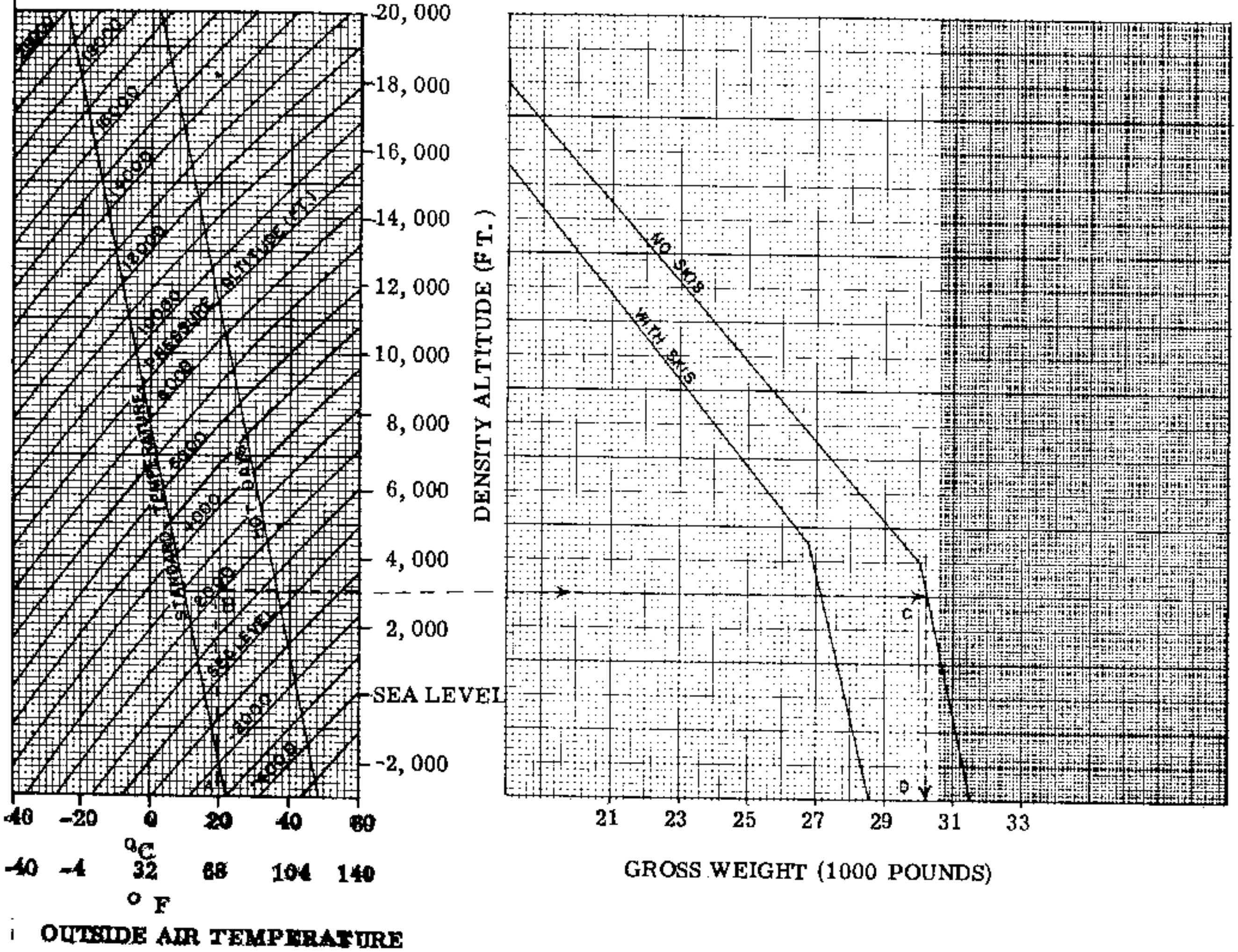
TAKE - OFF GROSS WEIGHT LIMITED BY 100 FEET PER MINUTE SINGLE ENGINE RATE OF CLIMB

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47
C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



ONE ENGINE OPERATING AT MAXIMUM POWER (48 IN HG, 2700 RPM)
COWL FLAPS TRAIL
LANDING GEAR UP
WING FLAPS = UP
PROPELLER - FEATHERED ON INOPERATIVE ENGINE

SAMPLE PROBLEM:

GIVEN:

1. OUTSIDE AIR TEMPERATURE = 20°C (POINT A)
2. PRESSURE ALTITUDE = 2000 FEET (POINT B)
3. NO SKI CONFIGURATION (POINT C)

FIND:

1. MAXIMUM GROSS WEIGHT FOR 100 FEET PER MINUTE SINGLE-ENGINE RATE OF CLIMB = 30200 POUNDS (POINT D)

Figure A3-1. Take-Off Gross Weight Limited by 100 Ft/Min - Single-Engine Rate of Climb.

TAKE - OFF PERFORMANCE GROUND RUN DISTANCE

WING FLAPS = UP

TAKE-OFF SPEED = 1.1 V_s

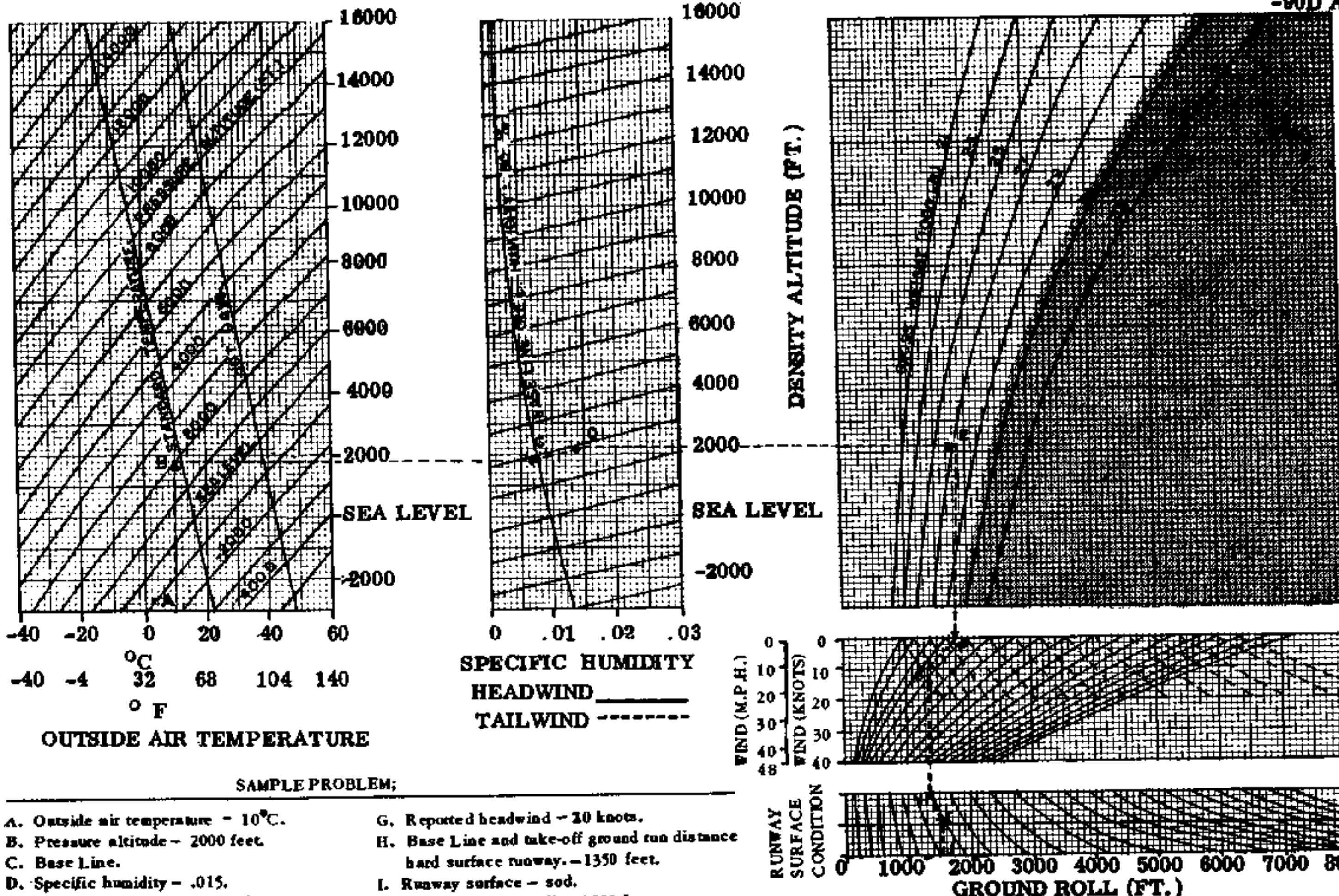
MAXIMUM POWER WITH 2700 RPM

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117
AND R4D

COWL FLAPS - TRAIL POSITION
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



NOTE

1. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

2. See figure A3-10 for runway slope correction.

NOTE

To obtain the approximate distance over a 50 foot obstacle, multiply the zero wind, hard surface runway take-off ground roll distance by 1.95 (ratio of distance over a 50 foot obstacle to take-off ground roll distance).

SAMPLE PROBLEM;

A. Outside air temperature - 10°C.
B. Pressure altitude - 2000 feet.
C. Base Line.
D. Specific humidity - .015.
E. Gross weight - 27000 pounds
F. Base Line.
G. Reported headwind - 20 knots.
H. Base Line and take-off ground run distance hard surface runway. - 1350 feet.
I. Runway surface - sod.
J. Take-off ground roll - 1550 feet.

Figure A3-2. Take-Off Performance Ground Run Distance - Flaps Up.

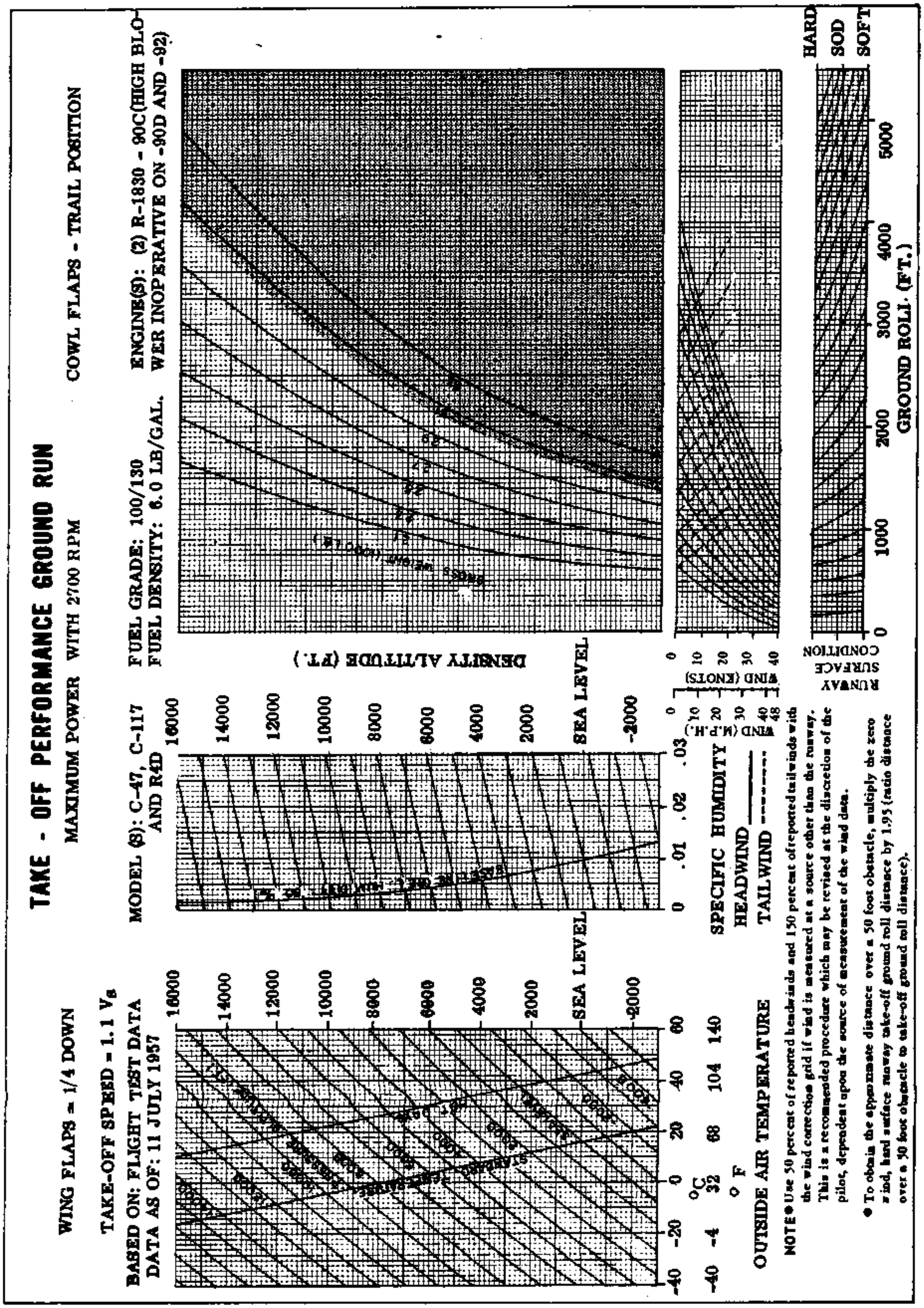


Figure A3-3. Take-Off Performance Ground Run - Wing Flaps - 1/4 Down.

TAKE - OFF PERFORMANCE GROUND RUN

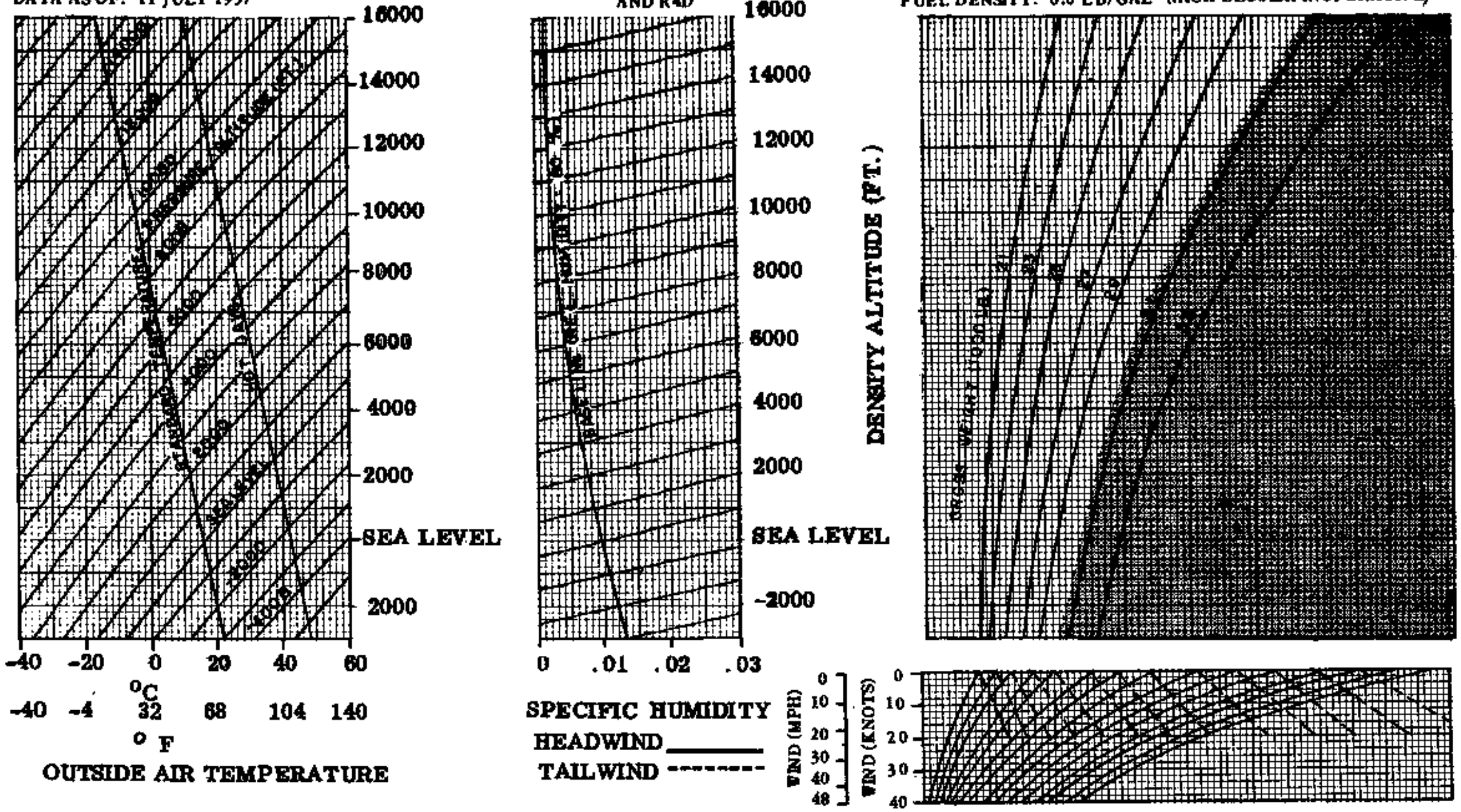
2 JATO UNITS - 1000 LB THRUST EACH - 5 SECOND FIRING DELAY
MAXIMUM POWER WITH 2700 RPM

WING FLAPS = 1/4 DOWN   TAKE-OFF SPEED = 1.1 V_s
COWL FLAPS — TRAIL POSITION

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

FUEL GRADE: 100/130   ENGINE(S): (2) R-1830-90C -90D AND -92)
FUEL DENSITY: 6.0 LB/GAL (HIGH BLOWER INOPERATIVE)



NOTE

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

Figure A3-4. Take-Off Performance Ground Run - Two JATO Units.

TAKE - OFF PERFORMANCE GROUND RUN

4 JATO UNITS -- 1000 LB THRUST EACH -- 0 SECOND FIRING DELAY WING FLAPS = 1/4 DOWN TAKE-OFF SPEED = 1.1V$_S$ MAXIMUM POWER WITH 2700 RPM

COWL FLAPS - TRAIL POSITION

BASED ON: FLIGHT TEST DATA

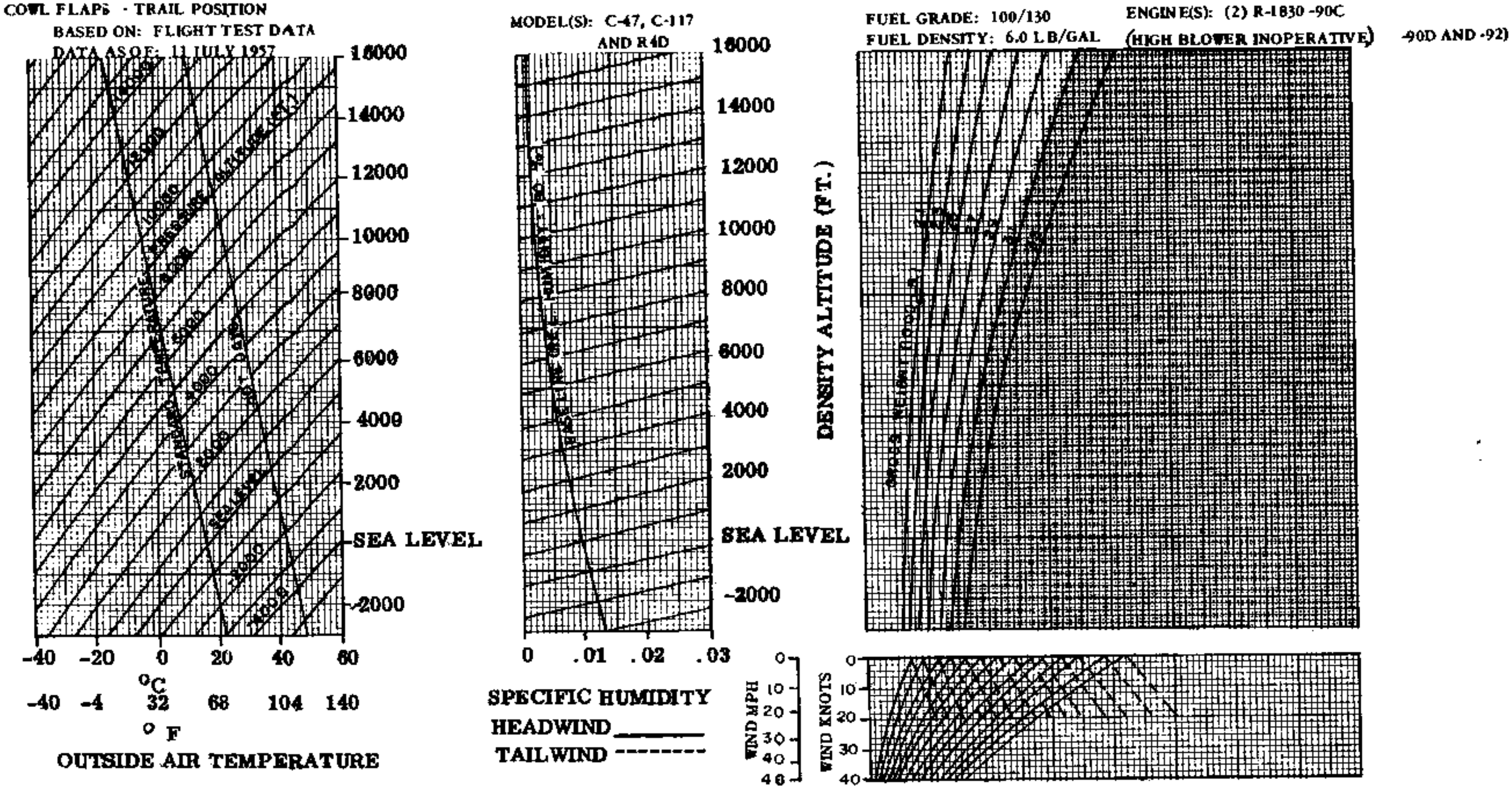
DATA AS OF: 11 JULY 1957

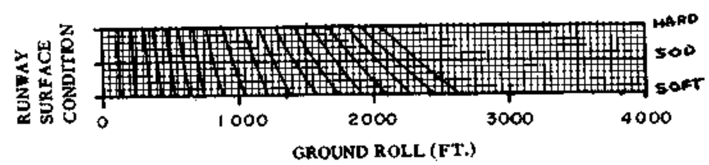
MODEL(S): C-47, C-117 AND R4D

FUEL GRADE: 100/130

FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830 -90C -90D AND -92) (HIGH BLOWER INOPERATIVE)





NOTE

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

Figure A3-5. Take-Off Performance Ground Run - Four JATO Units.

TAKE - OFF PERFORMANCE GROUND RUN WITH SKIS

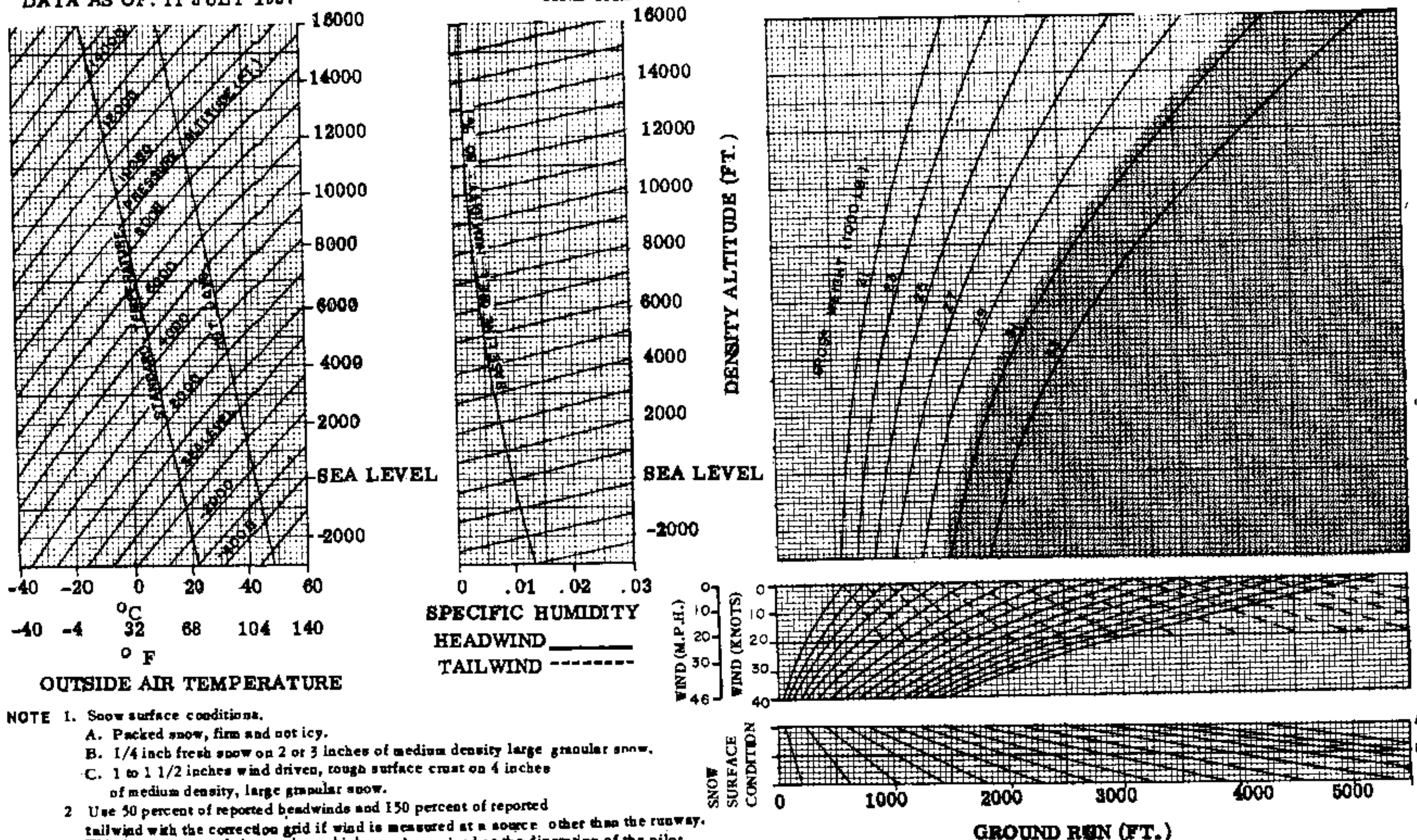
WING FLAPS = 1/4 DOWN TAKE-OFF SPEED = 1.1 V_s MAXIMUM POWER WITH 2700 RPM COWL FLAPS -- TRAIL POSITION

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL (S): C-47, C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): R-1830 - 90C -90D AND -92
(HIGH BLOWER INOPERATIVE)



NOTE 1. Snow surface conditions.
A. Packed snow, firm and not icy.
B. 1/4 inch fresh snow on 2 or 3 inches of medium density large granular snow.
C. 1 to 1 1/2 inches wind driven, rough surface crust on 4 inches of medium density, large granular snow.

2 Use 50 percent of reported headwinds and 150 percent of reported tailwind with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

Figure A3-6. Take-Off Performance Ground Run - With Skis.

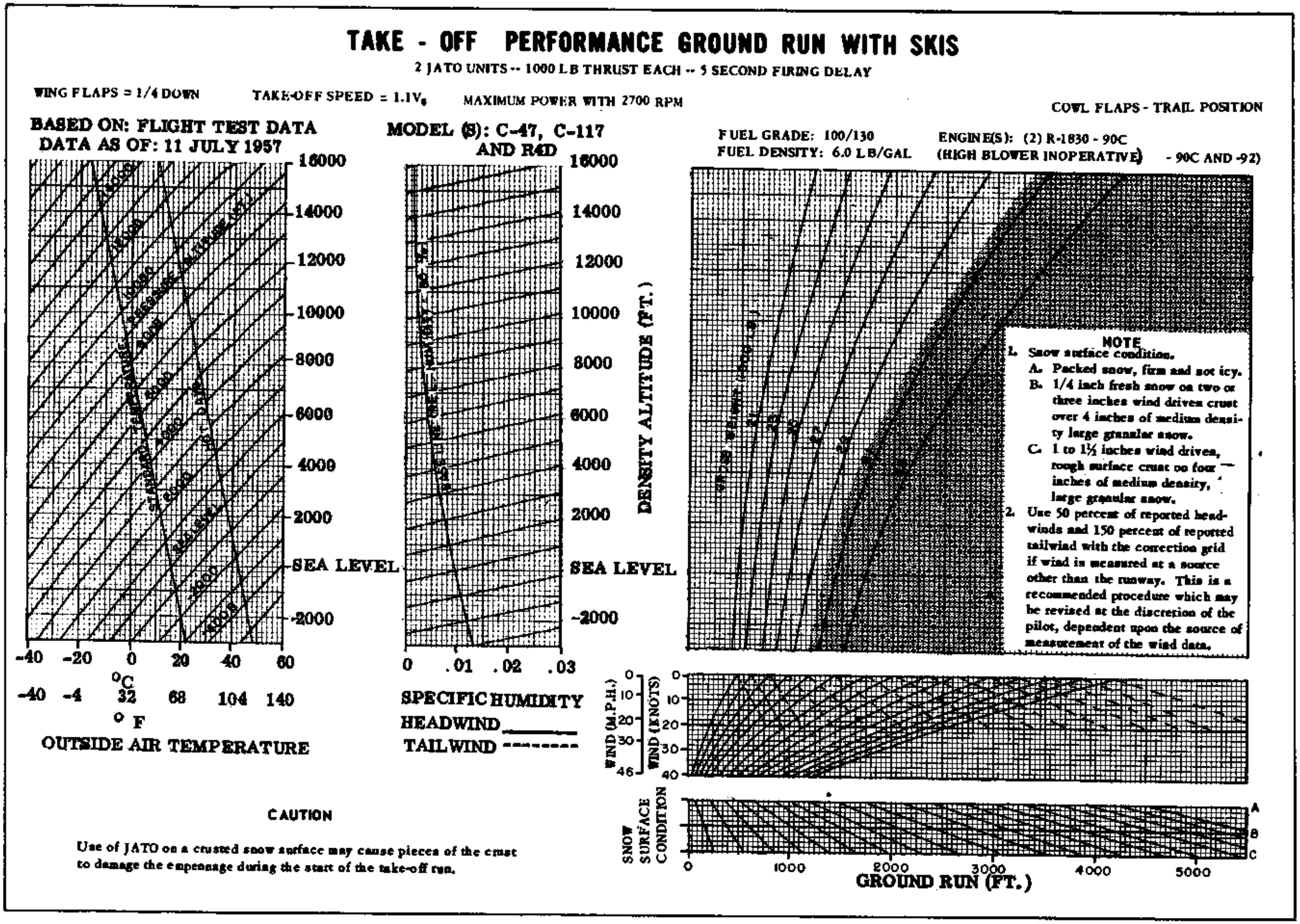


Figure A3-7. Take-Off Performance Ground Run - With Skis - Two JATO Units.

TAKE - OFF PERFORMANCE GROUND RUN WITH SKIS

4 JATO UNITS--1000 LB THRUST EACH--0 SECOND FIRING DELAY

WING FLAPS = 1/4 DOWN   TAKE-OFF SPEED = 1.1V_s MAXIMUM POWER WITH 2700 RPM

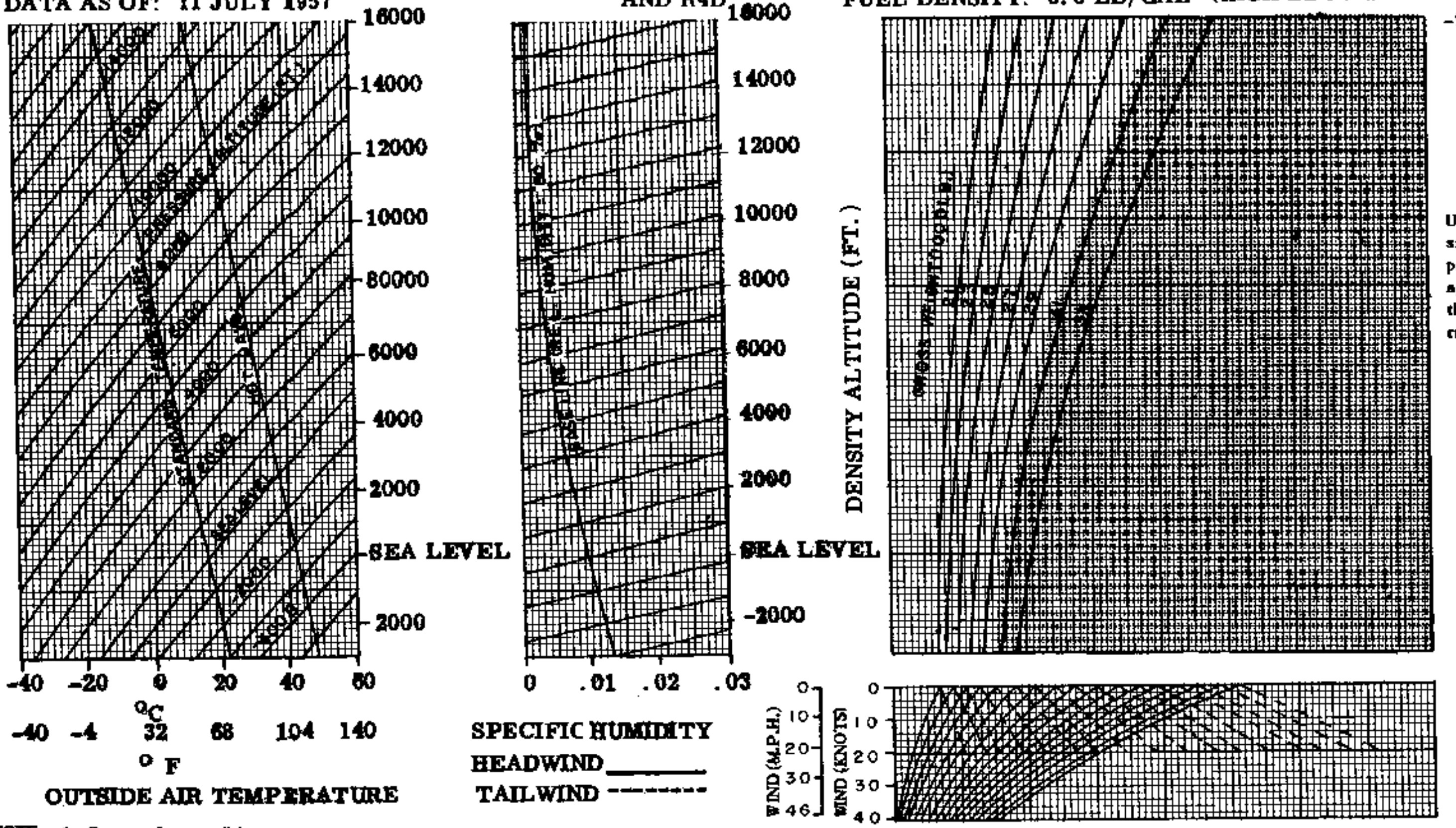
COWL FLAPS - TRAIL POSITION

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

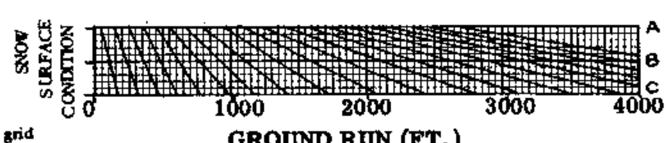
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92)



CAUTION

Use of JATO on a crusted, snow surface may cause pieces of the crust to damage the empennage during the start of the take-off run.



NOTE: 1. Snow surface condition.

A. Packed snow, firm and not icy.

B. 1/4 inch fresh snow on two or three inches wind driven crust over 4 inches of medium density large granular snow.

C. 1 to 1 1/2 inches wind driven, rough surface crust on four inches of medium density, large granular snow.

2. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

Figure A3-8. Take-Off Performance Ground Run - With Skis - Four JATO Units.

TIME TO CLIMB-STANDARD DAY

CLIMB POWER . . TWO-ENGINE

WITH SKIS

▣R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

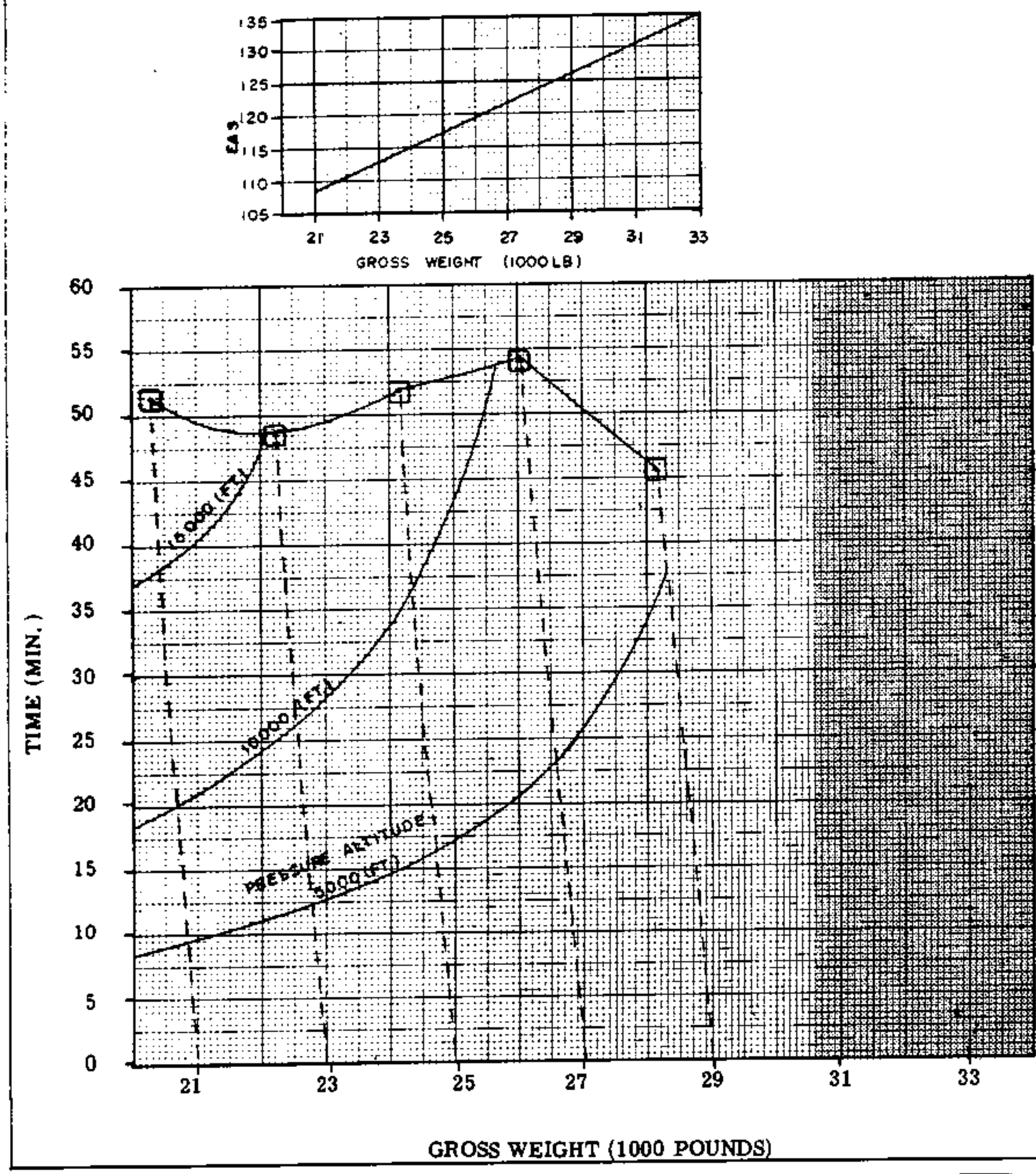


Figure A4-11. Time To Climb - Standard Day - Climb Power - Two Engine - With Skis. (Sheet 1 of 2)

DISTANCE TO CLIMB - STANDARD DAY

CLIMB POWER TWO-ENGINE

WITH SKIS

[·]R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

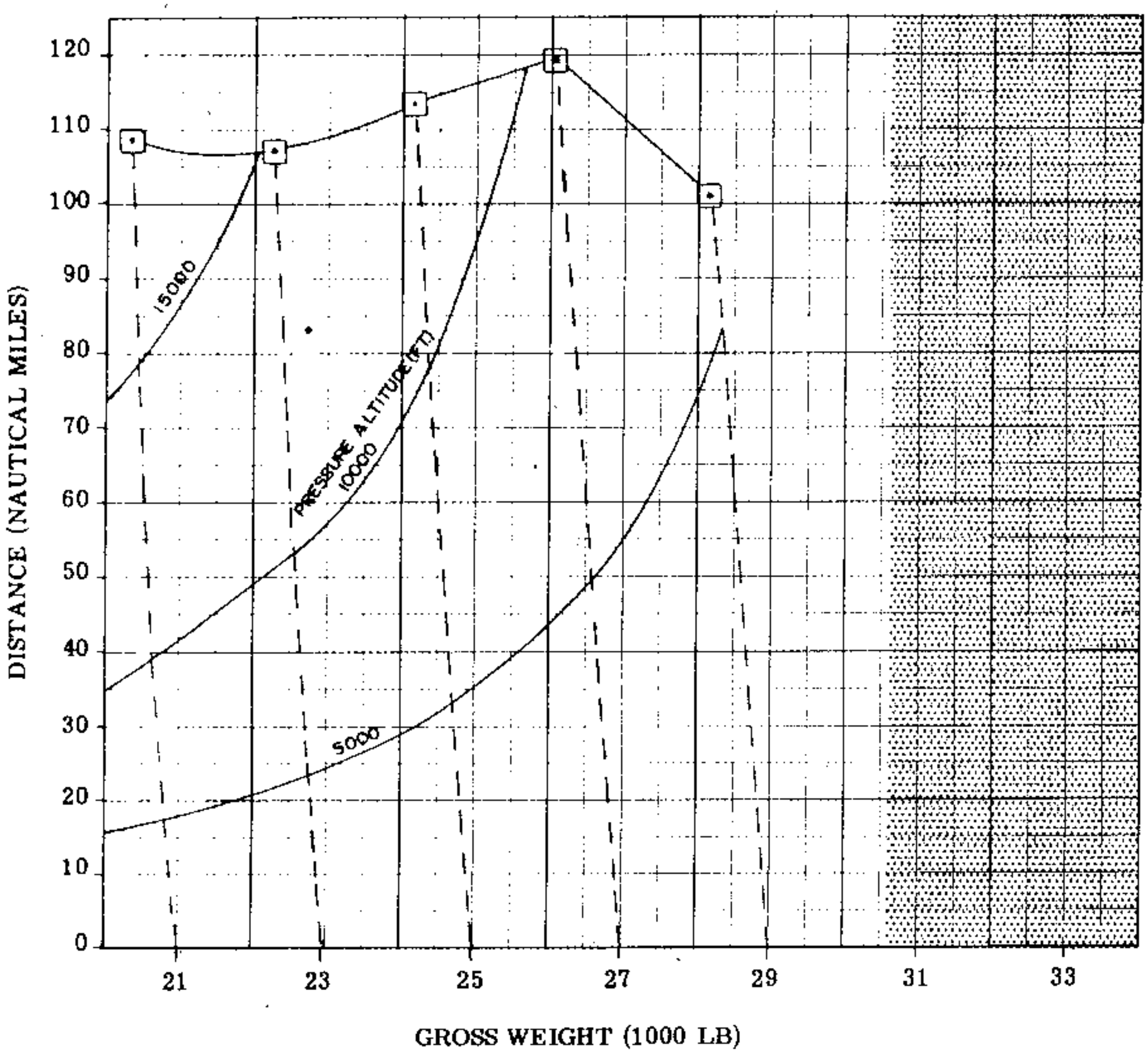


Figure A4-11. Distance To Climb - Standard Day - Climb Power - Two Engine - With Skis. (Sheet 2 of 2)

TIME TO CLIMB HOT DAY

CLIMB POWER TWO ENGINE

WITH SKIS

⊡ R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

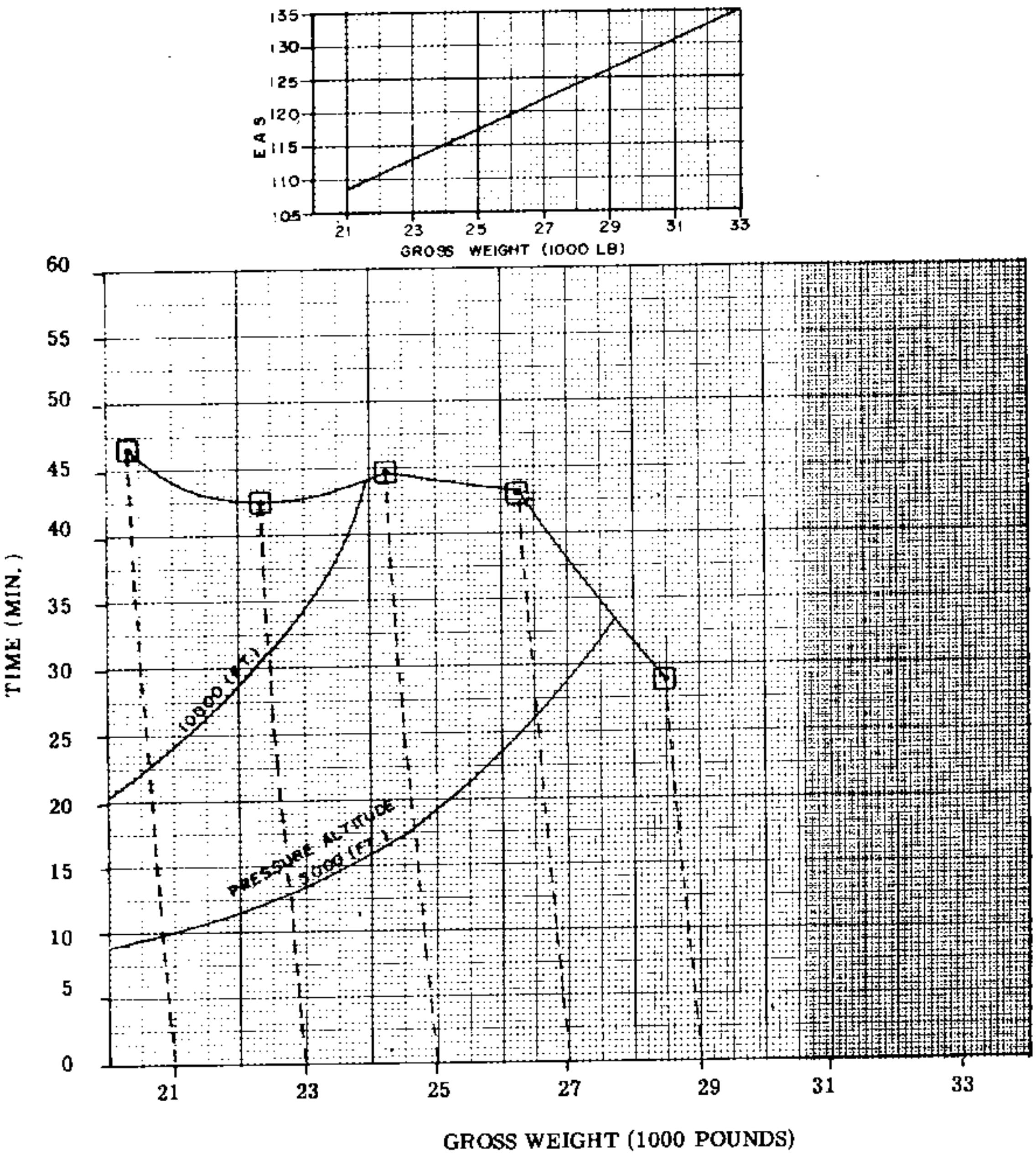


Figure A4-12. Time To Climb - Hot Day - Climb Power - Two Engine - With Skis. (Sheet 1 of 2)

DISTANCE TO CLIMB - HOT DAY

CLIMB POWER TWO ENGINE

WITH SKIS

⊡ R/C = 100 FT/MIN

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

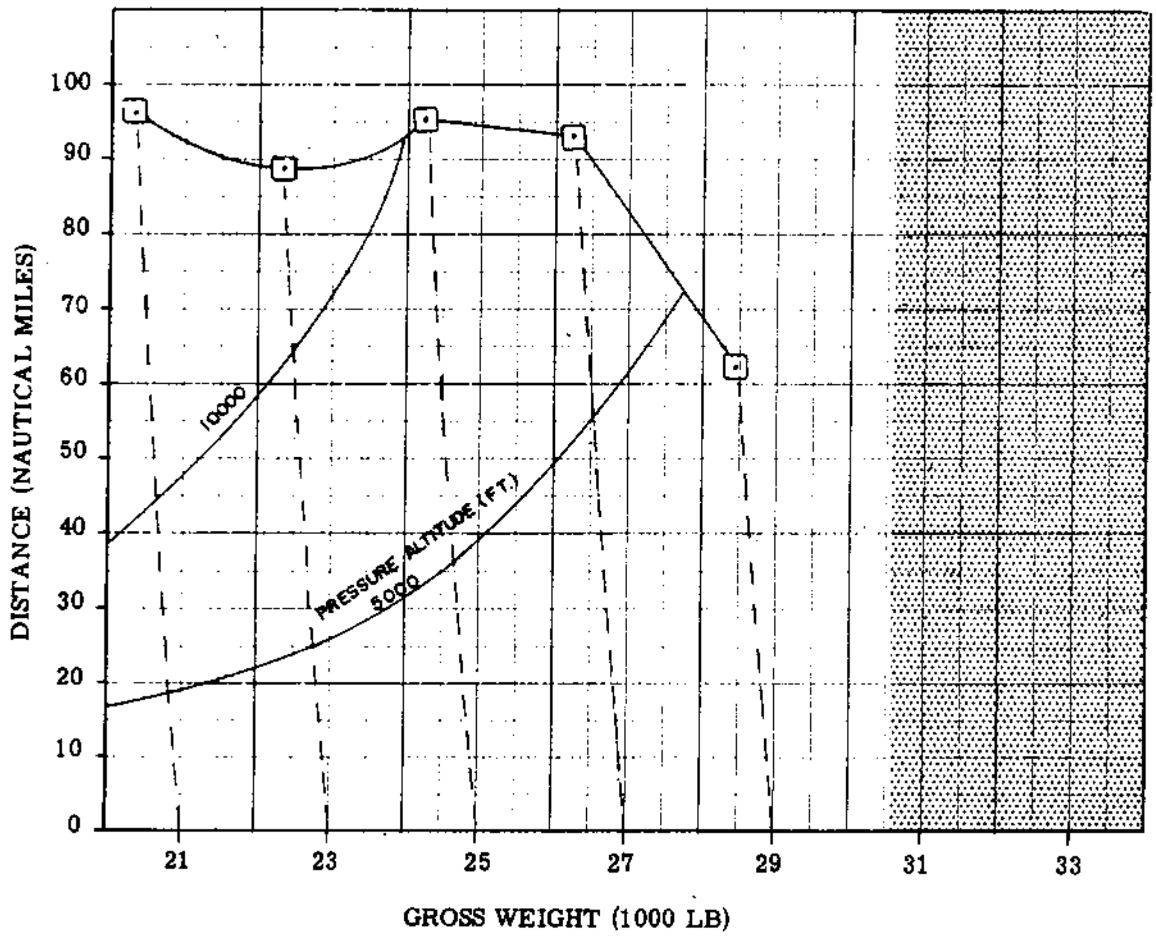


Figure A4-12. Distance To Climb - Hot Day - Climb Power - Two Engine - With Skis. (Sheet 2 of 2)

TIME TO CLIMB - STANDARD DAY

MAXIMUM POWER SINGLE-ENGINE

WITH SKIS

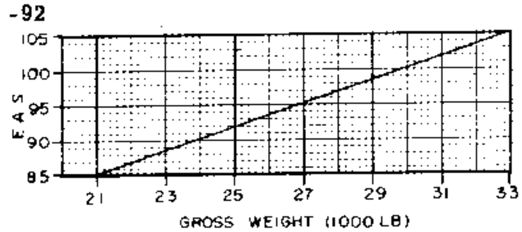
[•] R/C = 100 FT/MIN

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



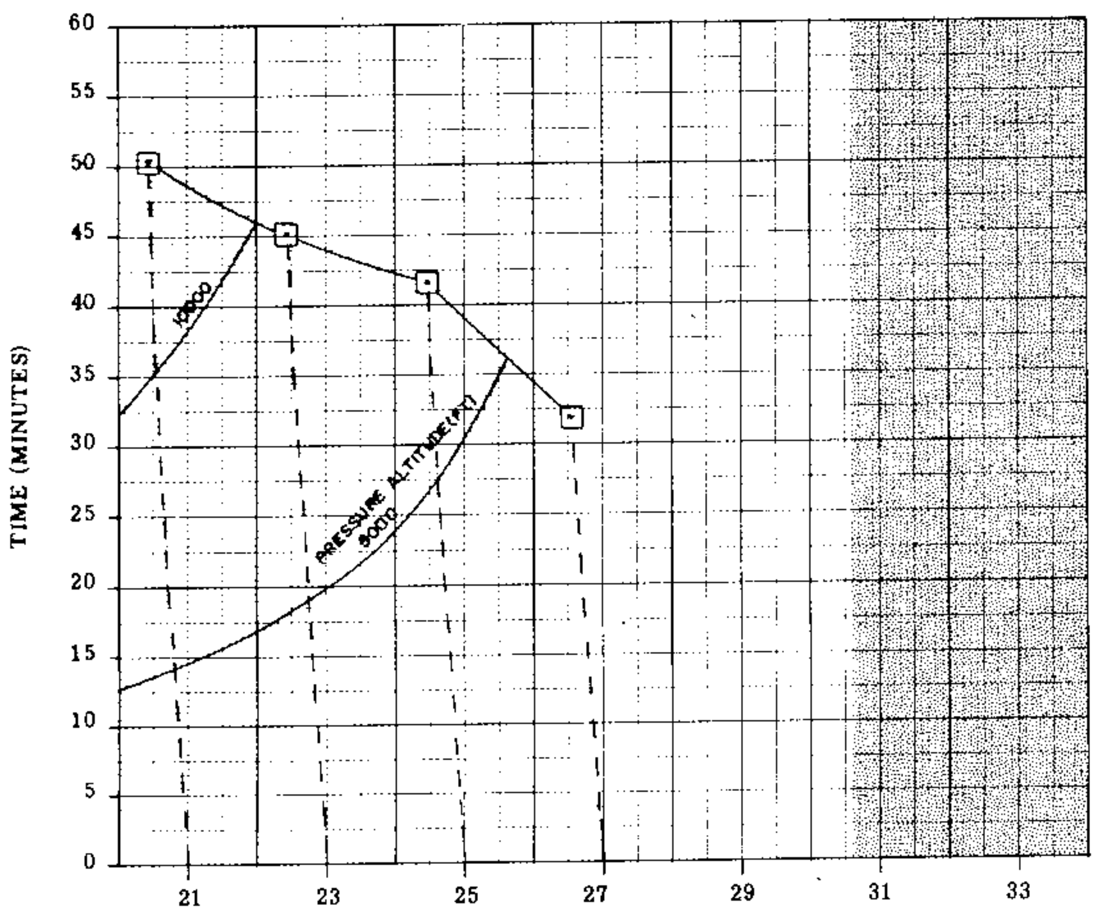


Figure A4-13. Time To Climb - Standard Day - Maximum Power Single Engine - With Skis. (Sheet 1 of 2)

DISTANCE TO CLIMB - STANDARD DAY

MAXIMUM POWER SINGLE-ENGINE

WITH SKIS

[•] R/C = 100 FT/MIN

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

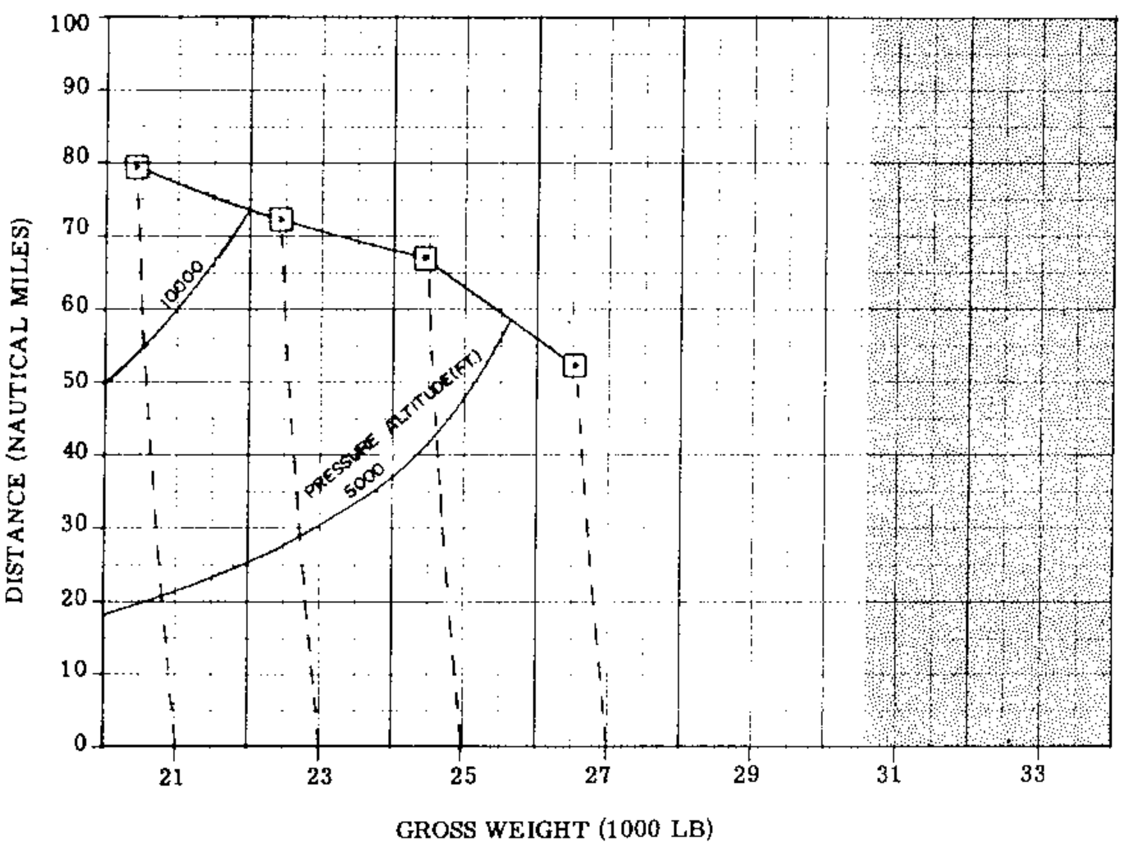


Figure A4-13. Distance To Climb - Standard Day - Maximum Power Single Engine - With Skies. (Sheet 2 of 2)

TIME TO CLIMB - HOT DAY

MAXIMUM POWER SINGLE-ENGINE

WITH SKIS

⊡ R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

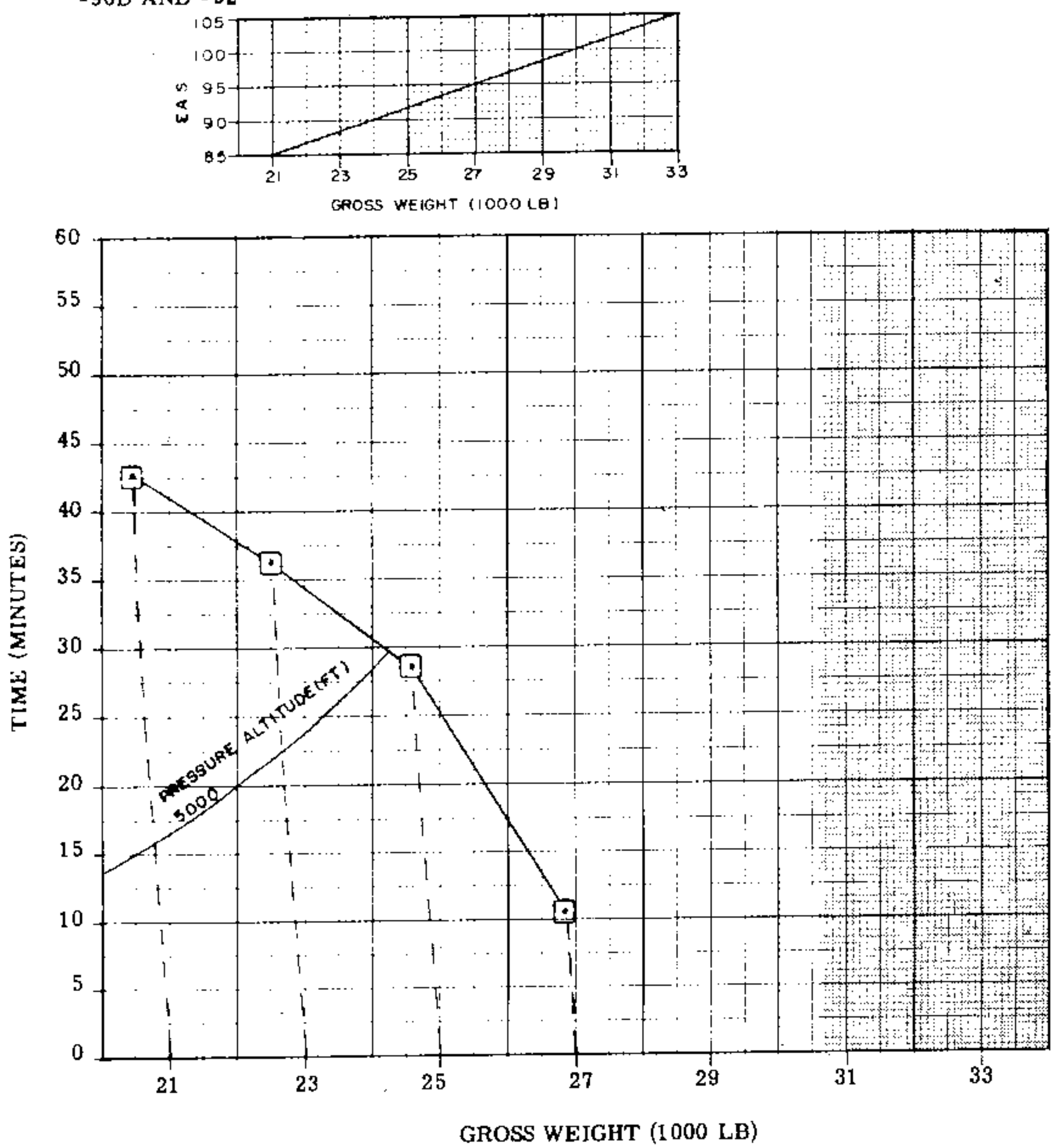


Figure A4-14. Time To Climb - Hot Day - Maximum Power - Single Engine - With Skis. (Sheet 1 of 2)

DISTANCE TO CLIMB - HOT DAY

MAXIMUM POWER SINGLE-ENGINE

WITH SKIS

⊡R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

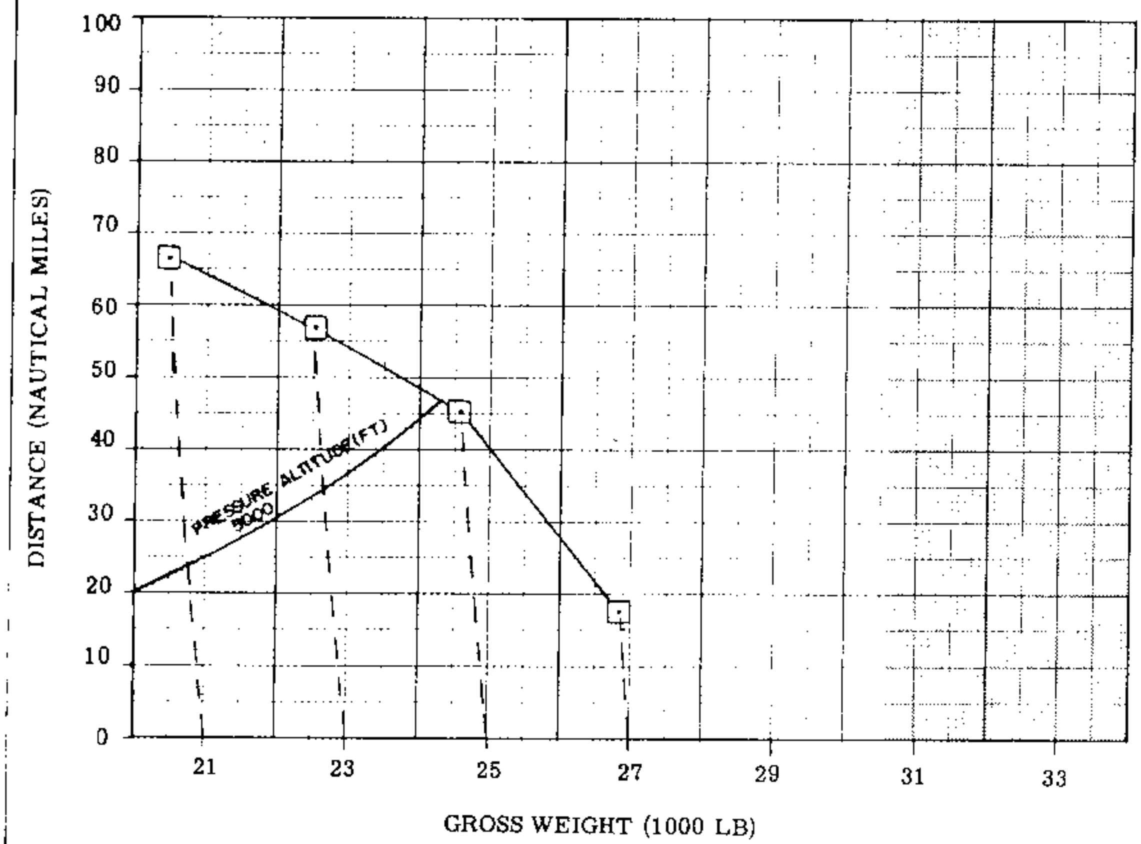


Figure A4-14. Distance To Climb - Hot Day - Maximum Power - Single Engine - With Skis. (Sheet 2 of 2)

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB METO POWER

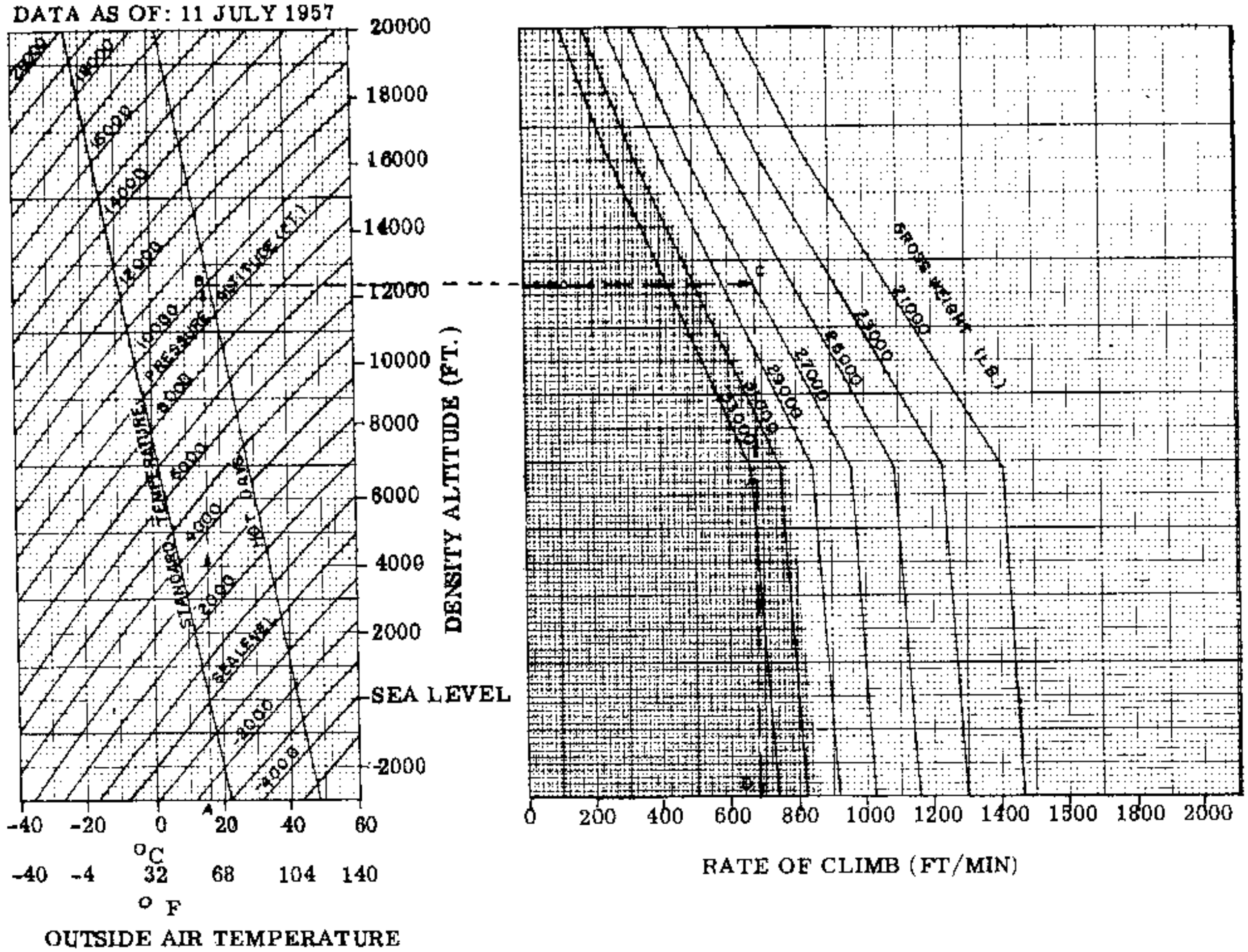
TWO-ENGINE WING FLAPS - UP COWL FLAPS - TRAIL POSITION

2550 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957



SAMPLE PROBLEM:

A. Outside air temperature = 16° C.
B. Pressure altitude = 10,000 feet.
C. Gross Weight = 27,000 pounds.
D. Rate of Climb = 680 feet per minute.

Figure A4-15. Rate of Climb - METO Power - 2550 RPM - Two Engine.

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB CLIMB POWER

TWO ENGINE - 2350 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE,
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

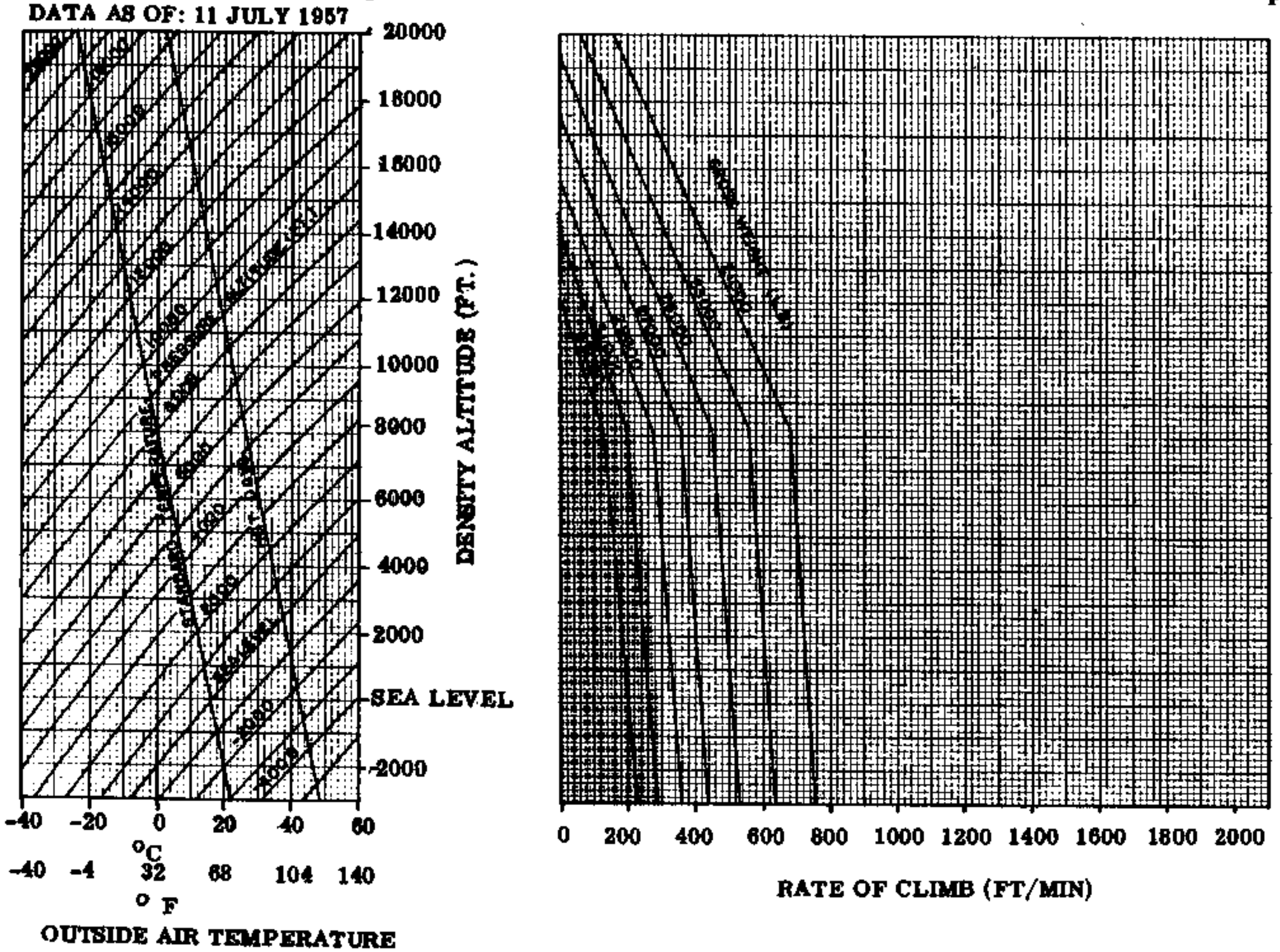


Figure A4-16. Rate of Climb - Climb Power - 2350 RPM - Two Engine.

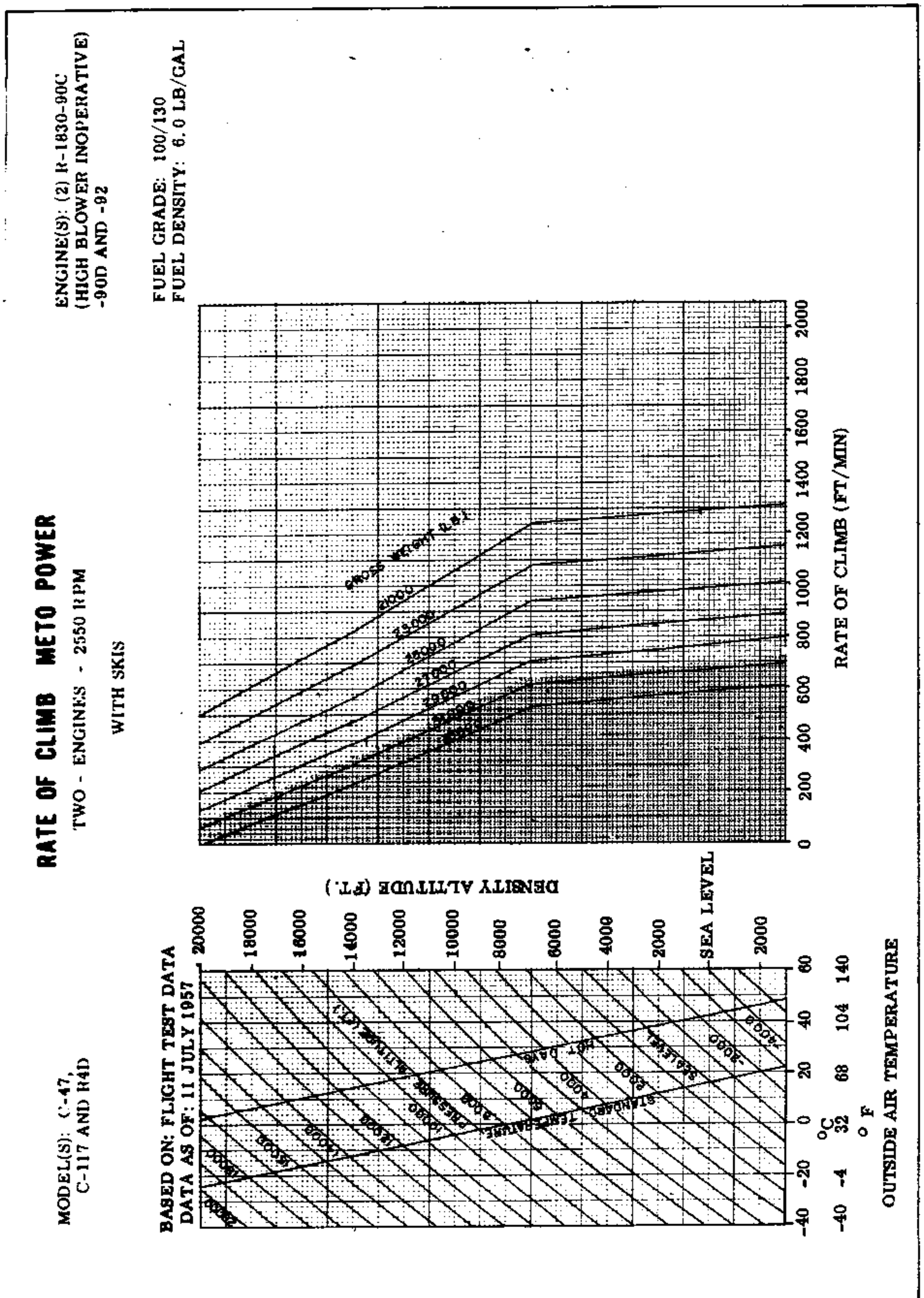


Figure A4-17. Rate of Climb - METO Power - 2550 RPM - Two Engine - With Skis.

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB – CLIMB POWER

TWO ENGINE WITH SKIS

2350 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

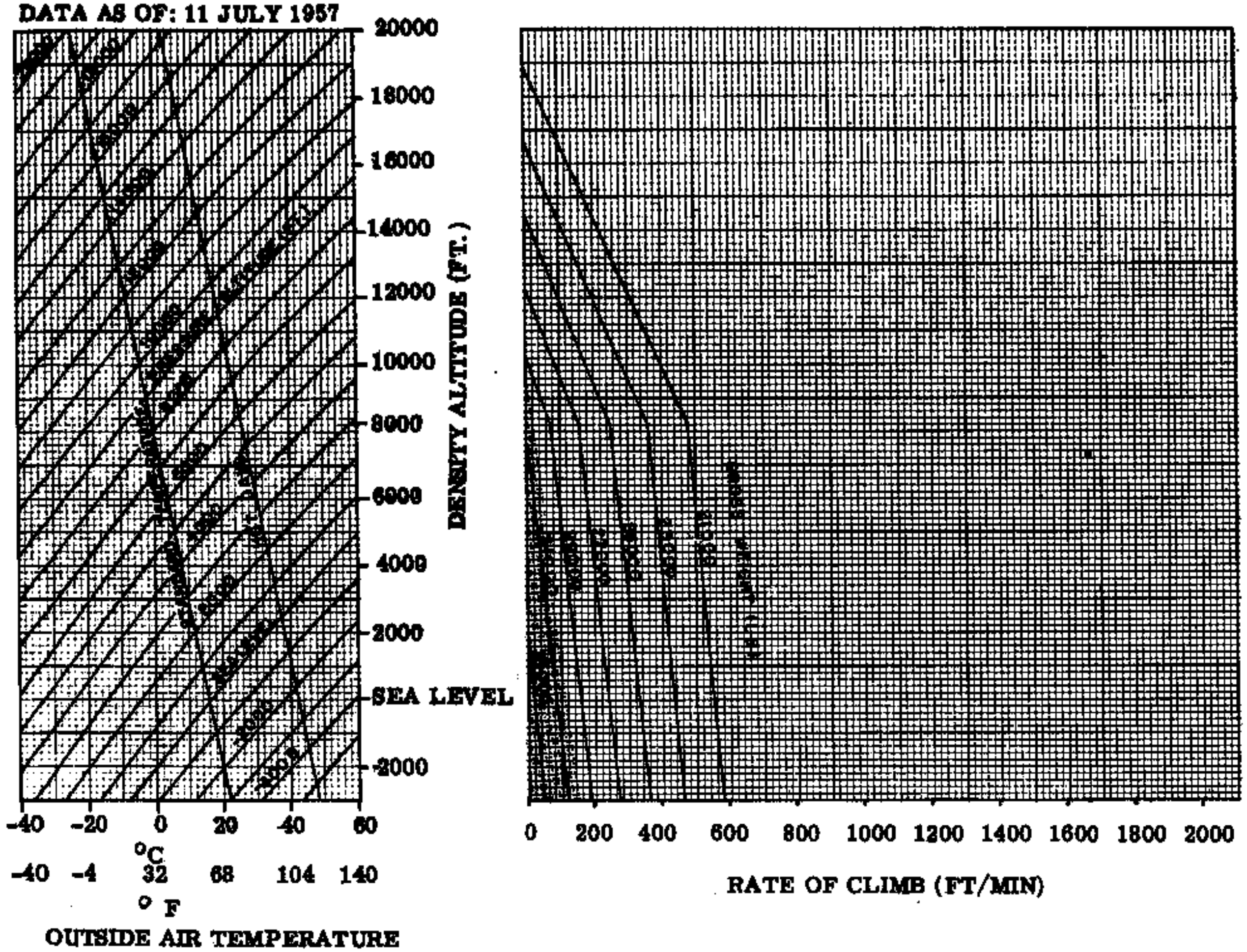


Figure A4-18. Rate of Climb - Climb Power - 2350 RPM - Two Engine - With Skis.

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB - MAX POWER

SINGLE ENGINE
PROPELLER - FEATHERED ON INOPERATIVE ENGINE

2700 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

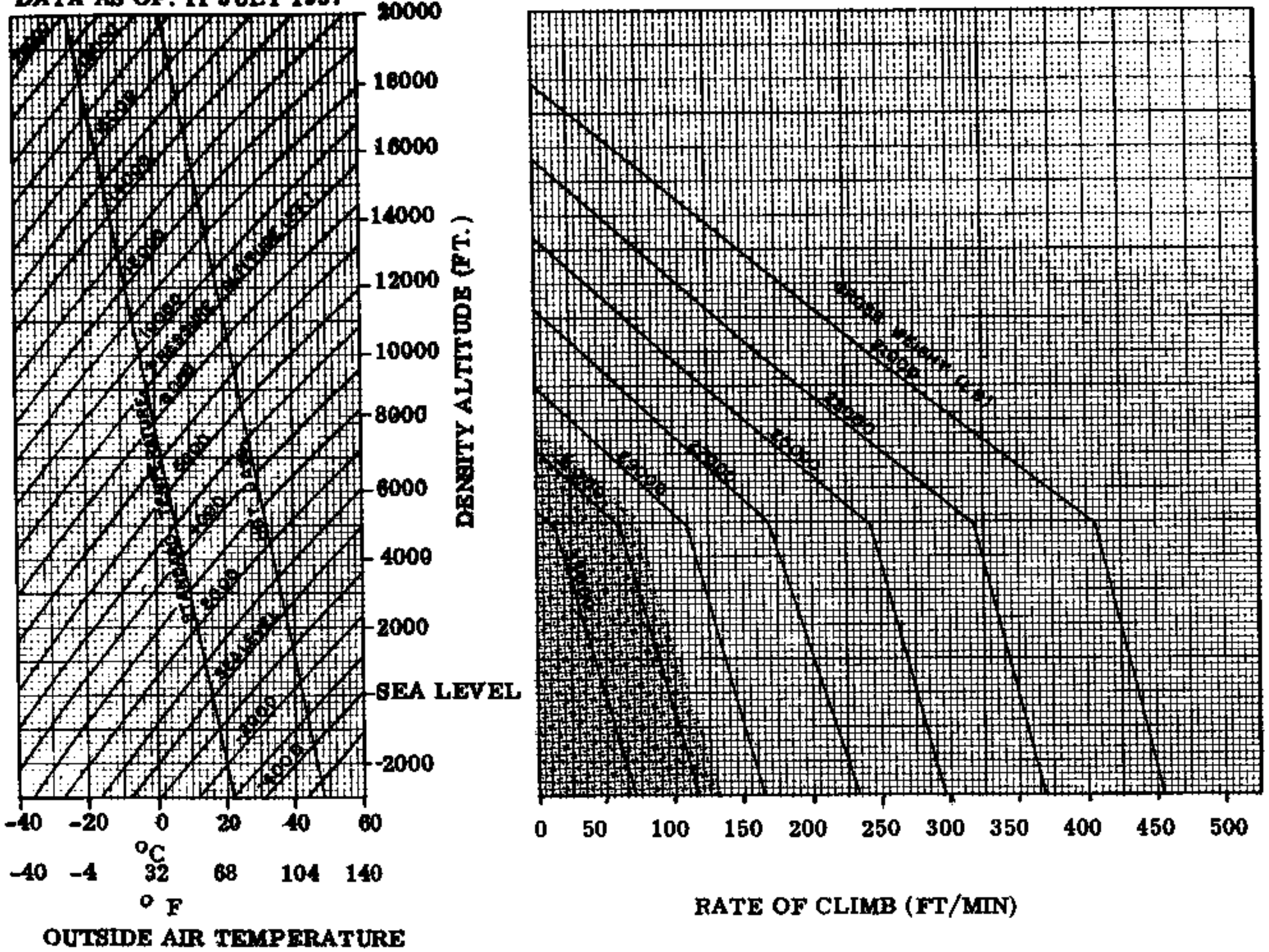


Figure A4-19. Rate of Climb - Maximum Power - 2700 RPM - Single Engine.

RATE OF CLIMB — METO POWER

MODEL(S): C-47, C-117 AND R4D

SINGLE ENGINE   PROPELLER - FEATHERED ON INOPERATIVE ENGINE

2550 RPM

WING FLAPS - UP   COWL FLAPS - TRAIL POSITION

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

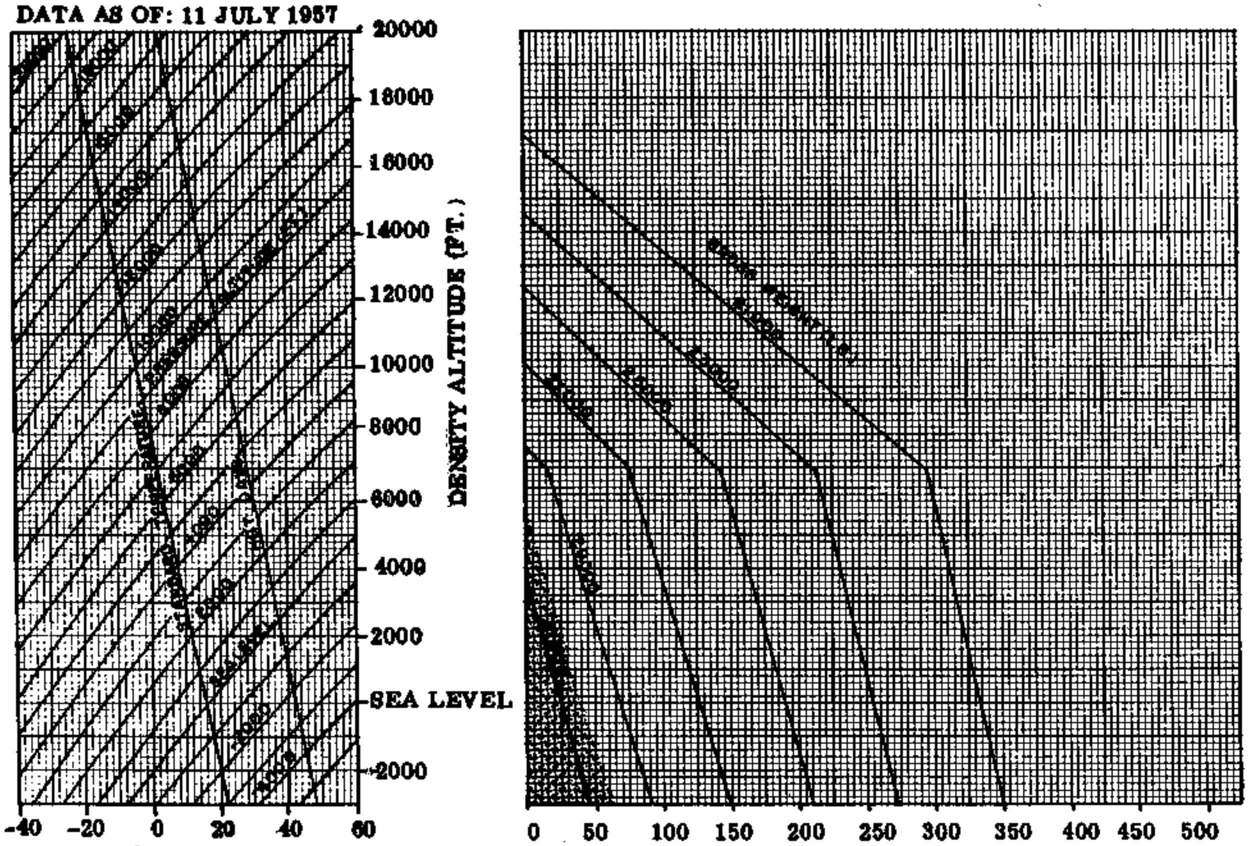


Figure A4-20. Rate of Climb - METO Power - 2550 RPM - Single Engine.

MODEL(S): C-47, C-117 AND R4D

RATE OF CLIMB — CLIMB POWER

SINGLE ENGINE-PROPELLER FEATHERED ON INOPERATIVE ENGINE

2350 RPM

WING FLAPS - UP · COWL FLAPS - TRAIL POSITION

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

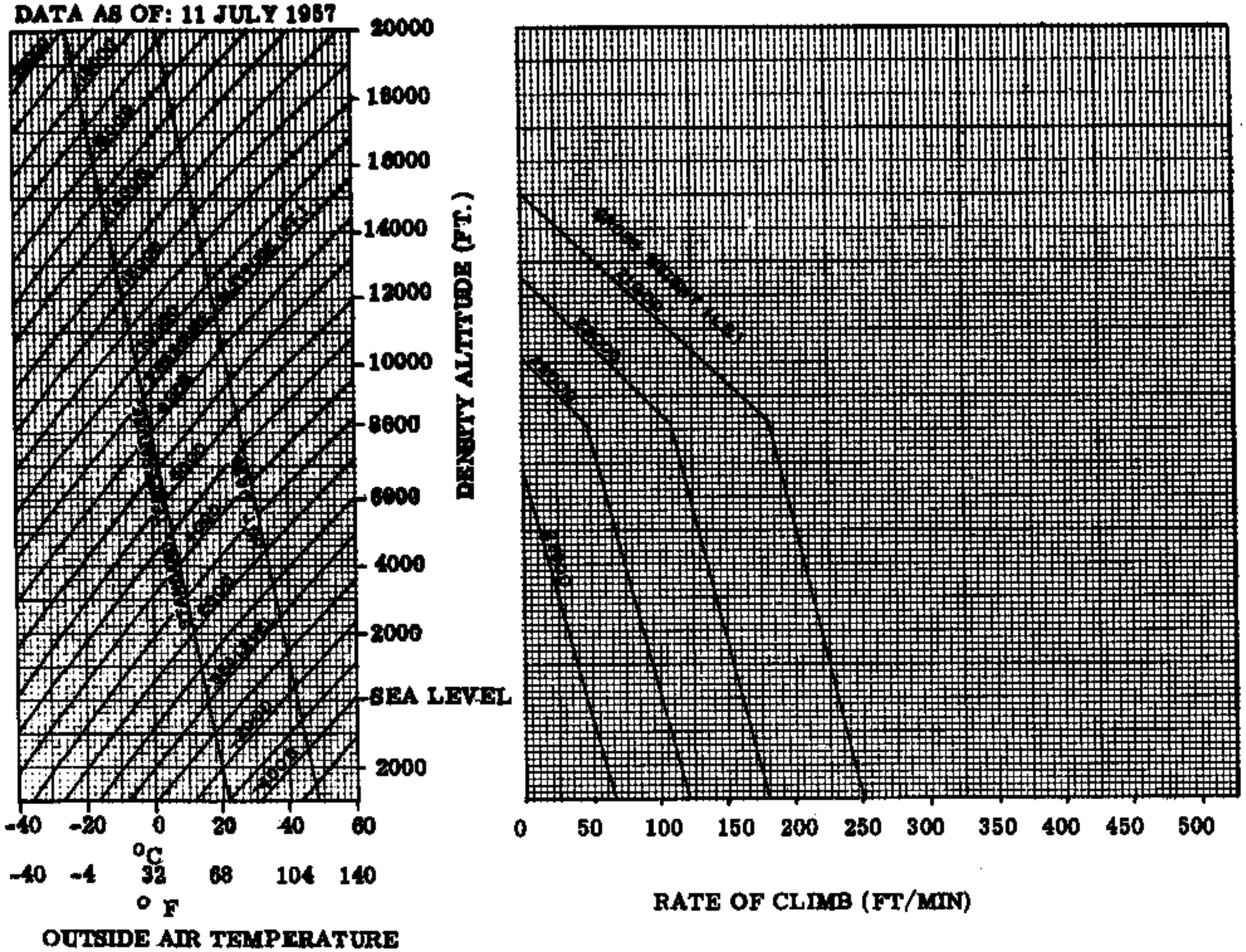


Figure A4-21. Rate of Climb - Climb Power - 2350 RPM - Single Engine.

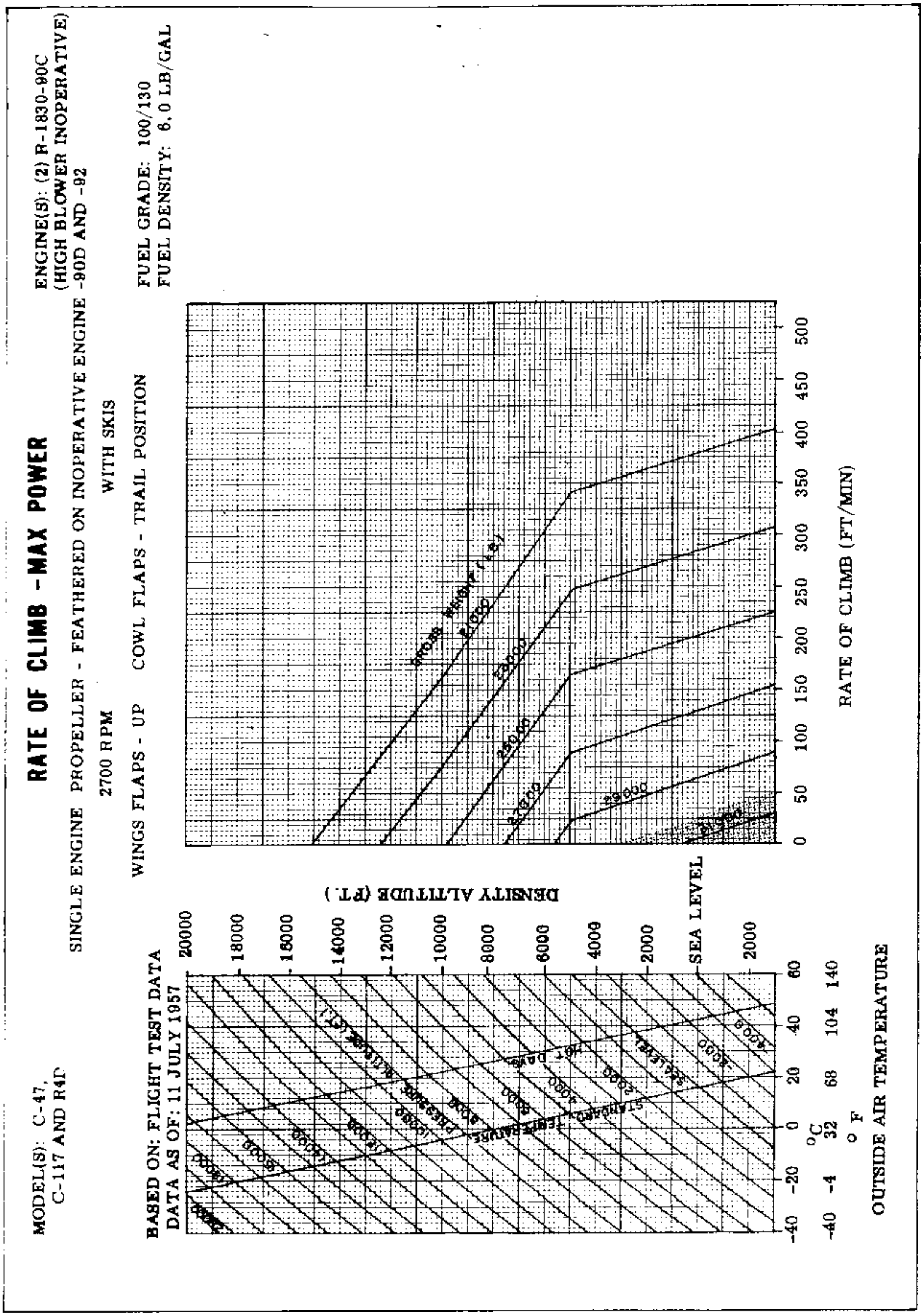


Figure A4-22. Rate of Climb - Maximum Power - 2700 RPM - Single Engine - With Skis.

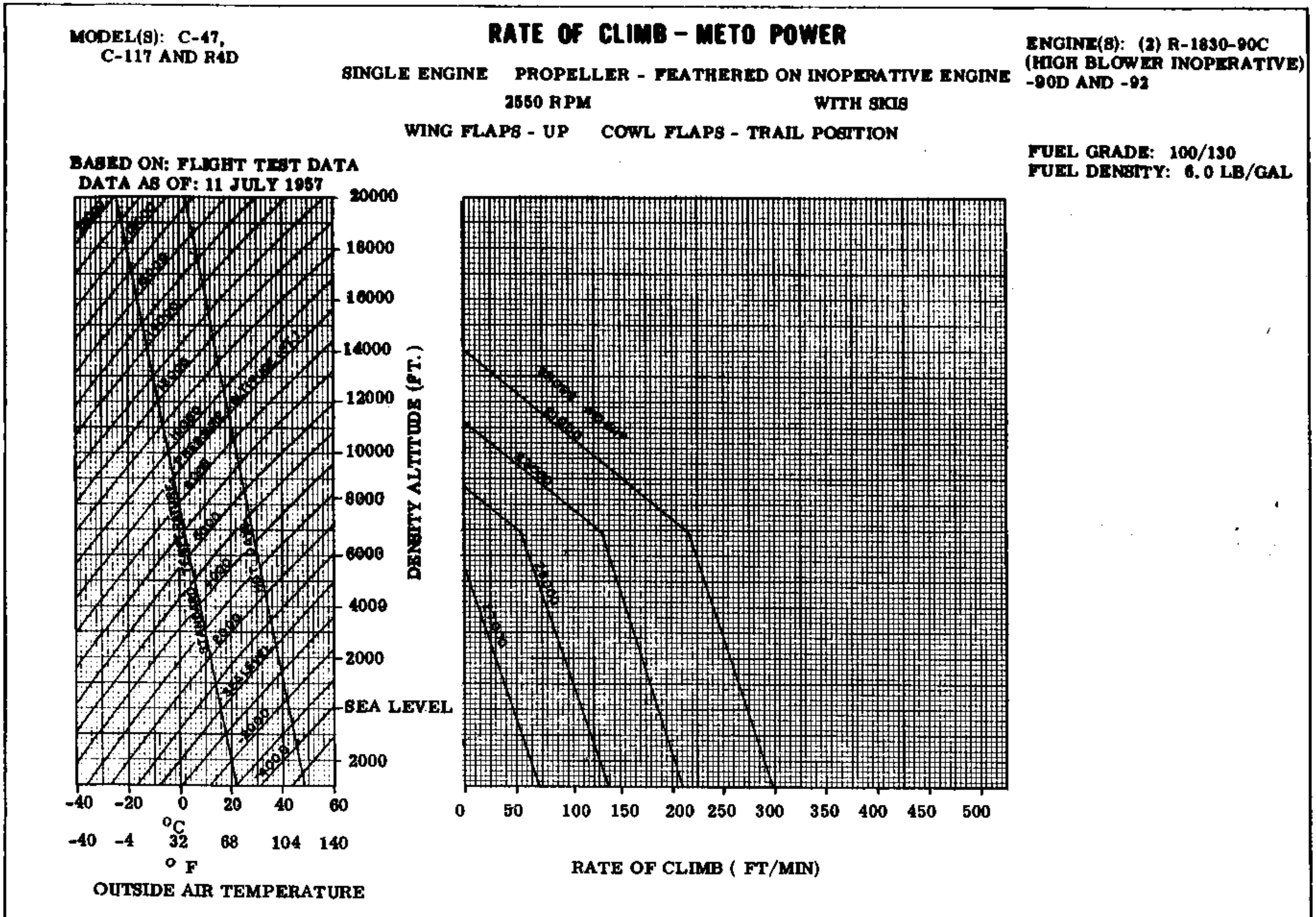


Figure A4-23. Rate of Climb - METO Power - 2550 RPM - Single Engine – With Skis.

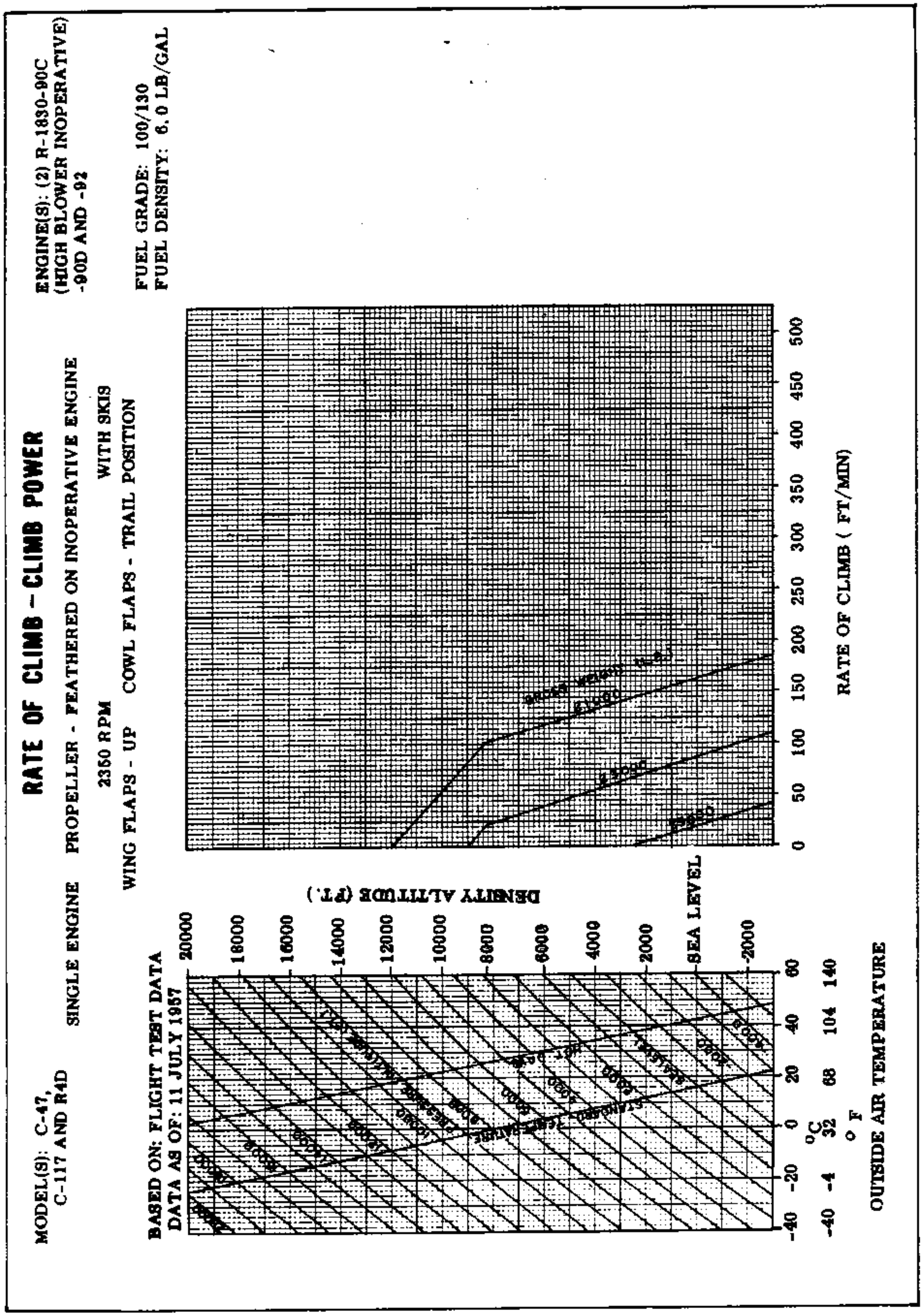


Figure A4-24. Rate of Climb - Climb Power - 2350 RPM - Single Engine.

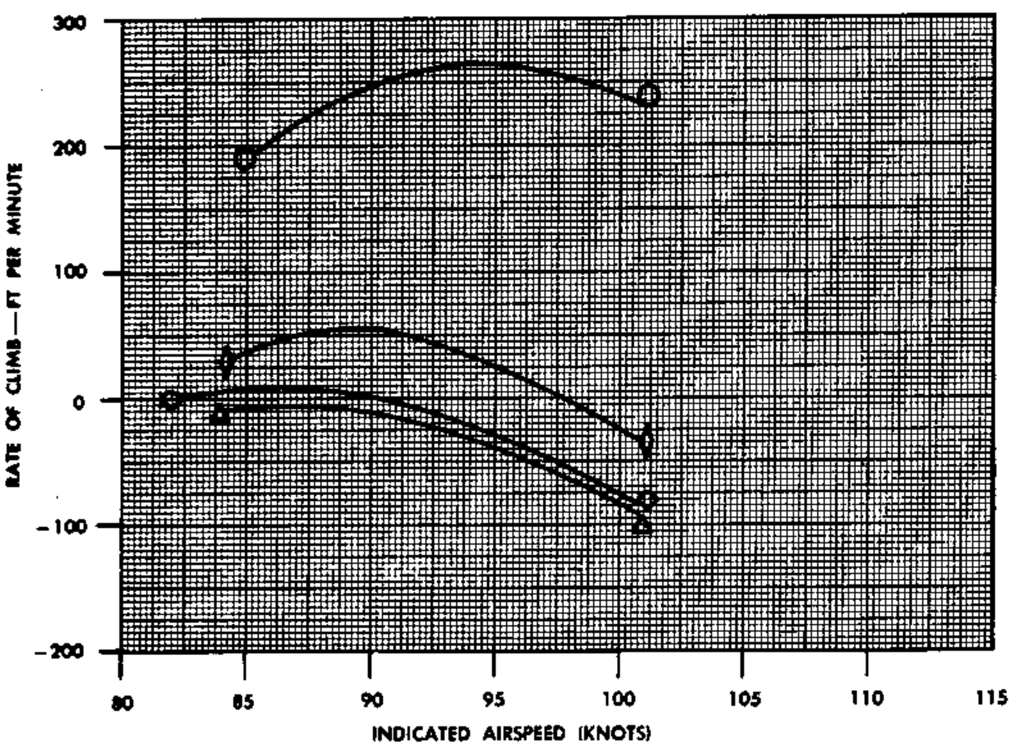
SINGLE-ENGINE SAWTOOTH CLIMB

CONFIGURATION 1 (CLEAN)
FLAPS UP
COWL FLAPS CLOSED ON INOPERATIVE ENGINE
TAKEOFF POWER AND COWL FLAPS TRAIL
ON OPERATING ENGINE
GROSS WEIGHT—26,000 LBS

MODEL(S): C-47, C-117 AND R4D

CONDITIONS
3000 FEET
NACA STANDARD DAY

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957



○- PROP FEATHERED, GEAR UP
◊- PROP FEATHERED, GEAR DOWN
◇- PROP WINDMILLING, GEAR UP
△- PROP WINDMILLING, GEAR UP, 4 ATO UNITS INSTALLED

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A4-25. Single Engine Sawtooth Climb.

EMERGENCY CEILING STANDARD DAY

100 FT/MIN RATE OF CLIMB AT METO POWER

CLEAN CONFIGURATION

SAMPLE PROBLEM:
A. GROSS WEIGHT = 27000 POUNDS.
B. TWO ENGINE - WITH SKIS CURVE.
C. PRESSURE ALTITUDE = 22000 FEET.

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

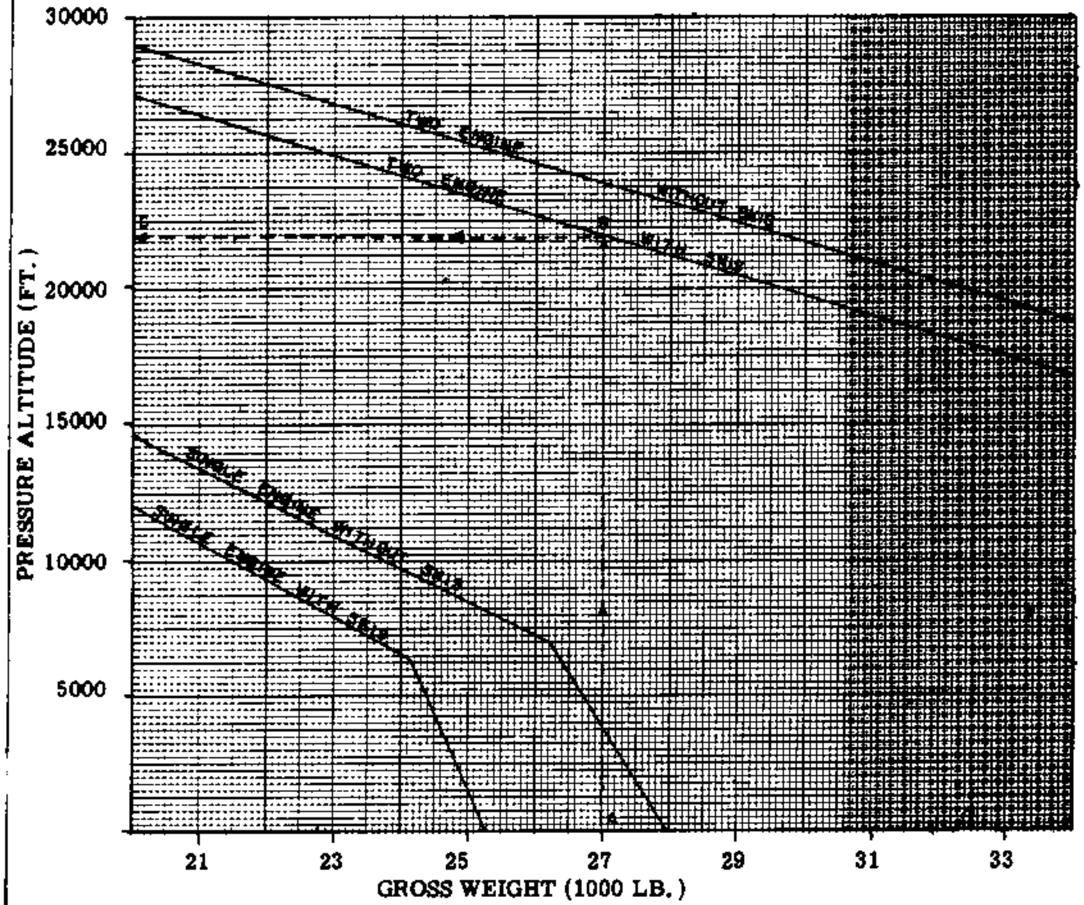


Figure A4-26. Emergency Ceiling - Standard Day.

PART FIVE
RANGE

TABLE OF CONTENTS

Discession of Charts A5-2

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A5-15	Maximum Endurance Power Condition – with Skis – Two Engines	A5-22

DISCUSSION OF CHARTS.

The range performance is presented in three types of charts: long range power condition, flight planning for long range cruise condition, and level flight performance. Maximum endurance power conditions charts are also provided.

LEVEL FLIGHT PERFORMANCE

The level flight performance charts (figure A5-1 and A5-2) are used to determine the equivalent and true airspeeds, and the brake horsepower required per engine for level flight performance with and without skis during two engine operation at various combinations of gross weight and density altitude.

Enter the chart at the recommended long range airspeed curve, Point A, and proceed to the known gross weight curve, Point B. From this intersection, proceed horizontally to the known density altitude and read the required brake horsepower per engine for two engine operation, Point C. To determine the correct equivalent airspeed at this setting, proceed from Point B, vertically to the equivalent airspeed scale, Point D. The true airspeed may be determined by projecting a line vertically from Point D to the known density altitude, Point E, and interpolating the true airspeed at this point.

LONG RANGE POWER CONDITIONS

The long range power conditions charts (figure A5-3 through A5-6) are presented with sheet 1 of 2 and 2 of 2 on facing pages. Sheet 1 of 2 shows recommended true airspeed (TAS), brake horsepower, RPM, and manifold pressure. Sheet 2 of 2 shows fuel flow (pounds per hour) and specific range (nautical miles per pound of fuel). Charts are included for two engine and single engine long range operation at various weights in low blower, auto rich and auto lean carburetor settings. Enter each chart at the aircraft's initial cruise gross weight (or any desired intermediate gross weight) and proceed vertically from bottom to top. To gain maximum range efficiency from use of the chart, recompute power settings at least once each hour for the new gross weight (decreased as fuel is consumed). These charts are based on the recommended long range airspeed curve (99 percent maximum range) on the level flight performance charts (figure A5-1 and A5-2). A sample problem is presented on the first chart of this series.

FLIGHT PLANNING CHART FOR LONG RANGE CRUISE CONDITION

The flight planning charts for long range cruise condition (figures A5-7 through A5-13) are used to determine the fuel consumed and the time elapsed for a cruise operation when the required distance to cruise and either the initial or final aircraft cruise gross weight are known. In the event initial and final cruise gross weights are known, both the range and time to cruise may be obtained from the charts.

The charts are constructed for use with two and single-engine power conditions. The vertical scales labeled range and time, are presented only to find the difference in nautical miles (aircraft range) or time in (100 minutes) due to fuel consumption between initial and final cruise gross weights. A sample problem is included on the first chart of this series (figure A5-7).

Enter the chart with the given gross weight (Point A). Draw a line vertically to the time curve (Point B). Extend the line vertically from Point B to the range curve (Point C). Draw a line horizontally from Point C to the range scale (Point D). Subtract mission range from the value shown at Point D and reenter the range scale with this value (Point E). Draw a line horizontally from Point E to intersect the range curve (Point F). From Point F, draw a line vertically to the time curve (Point G) and extend to the gross weight scale (Point H). Subtract the value at Point H from the value at Point A to obtain the fuel required for the mission range. Similarly, time may be found by drawing a horizontal line from the time curve Point B and Point G, to the time scale, Point I and Point J. The difference between the values shown at Point I and Point J is the time corresponding to the mission range.

MAXIMUM ENDURANCE POWER CONDITIONS

The maximum endurance power conditions charts (figures A5-14 and A5-15) present the calibrated airspeed (CAS), brake horsepower, rpm, manifold pressure and fuel flow for maximum endurance conditions at various gross weights for operation with two engines. Where applicable, the charts contain altitude curves which show operation in auto rich or auto lean mixture in low blower.

To determine CAS, power, rpm, manifold pressure, and fuel flow values, enter the chart at the aircraft gross weight and proceed vertically. The desired values may then be read as the vertical line intersects the particular curve. The endurance in hours is obtained by dividing the amount of fuel remaining to be used by the average total fuel flow in pounds per hour occuring between the initial and final gross weights. Where sudden changes occur in the fuel flow curve, the endurance calculation should be separated into parts at the gross weight where the break occurs, and the separate endurance times added together.

LEVEL FLIGHT PERORMANCE
TWO ENGINE

MODEL(S): C-47,
C-117 AND R4D

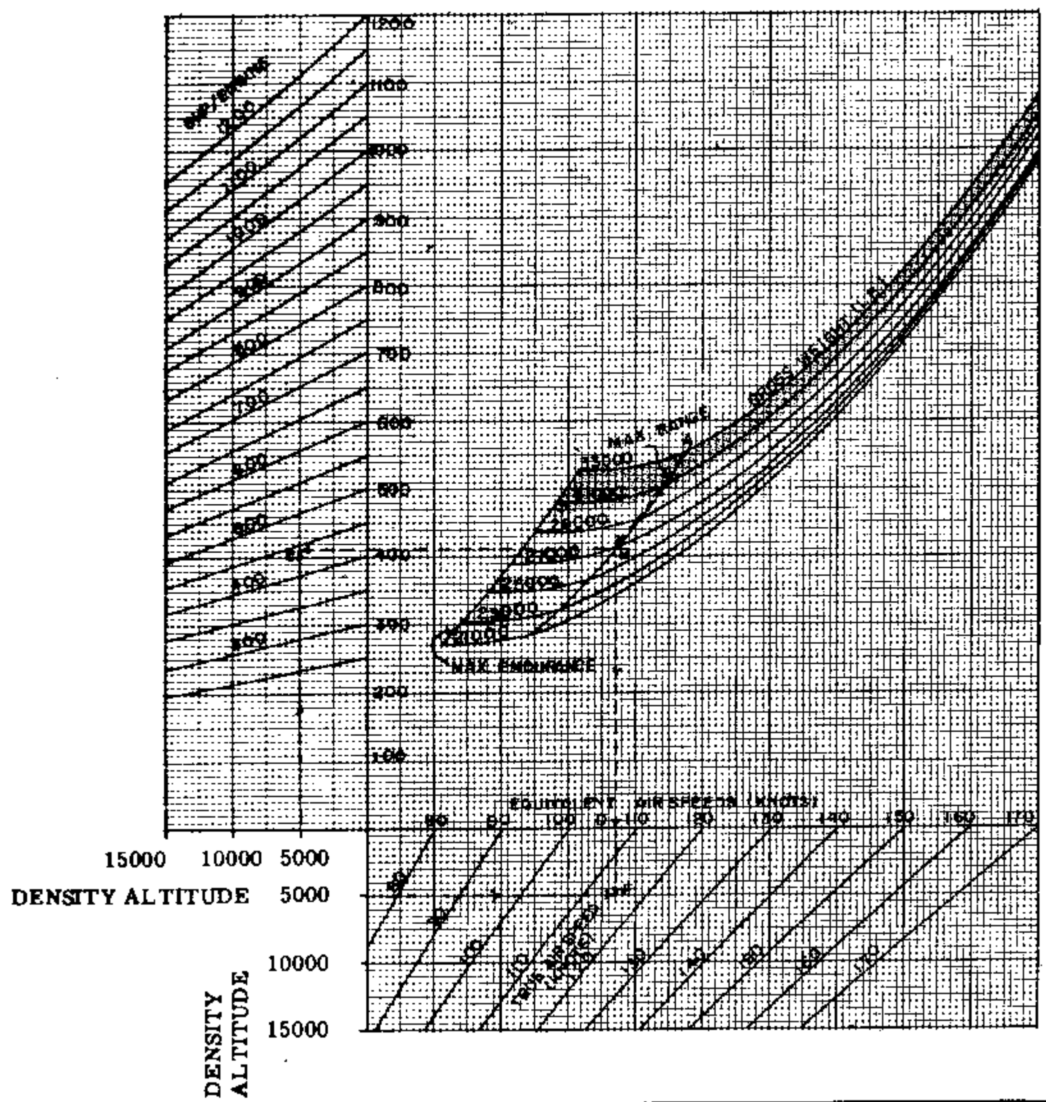
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY· 6.0 LB/GAL

SAMPLE PROBLEM:

A. MAXIMUM RANGE.
B. GROSS WEIGHT = 27000 POUNDS.
C. BRAKE HORSEPOWER PER ENGINE = 440 AT 5000 FEET DENSITY ALTITUDE.
D. EQUIVALENT AIRSPEED = 107 KNOTS.
E. TRUE AIRSPEED = 115 KNOTS AT 5000 FEET DENSITY ALTITUDE.



A5-1. Level Flight Performance – Two Engines.

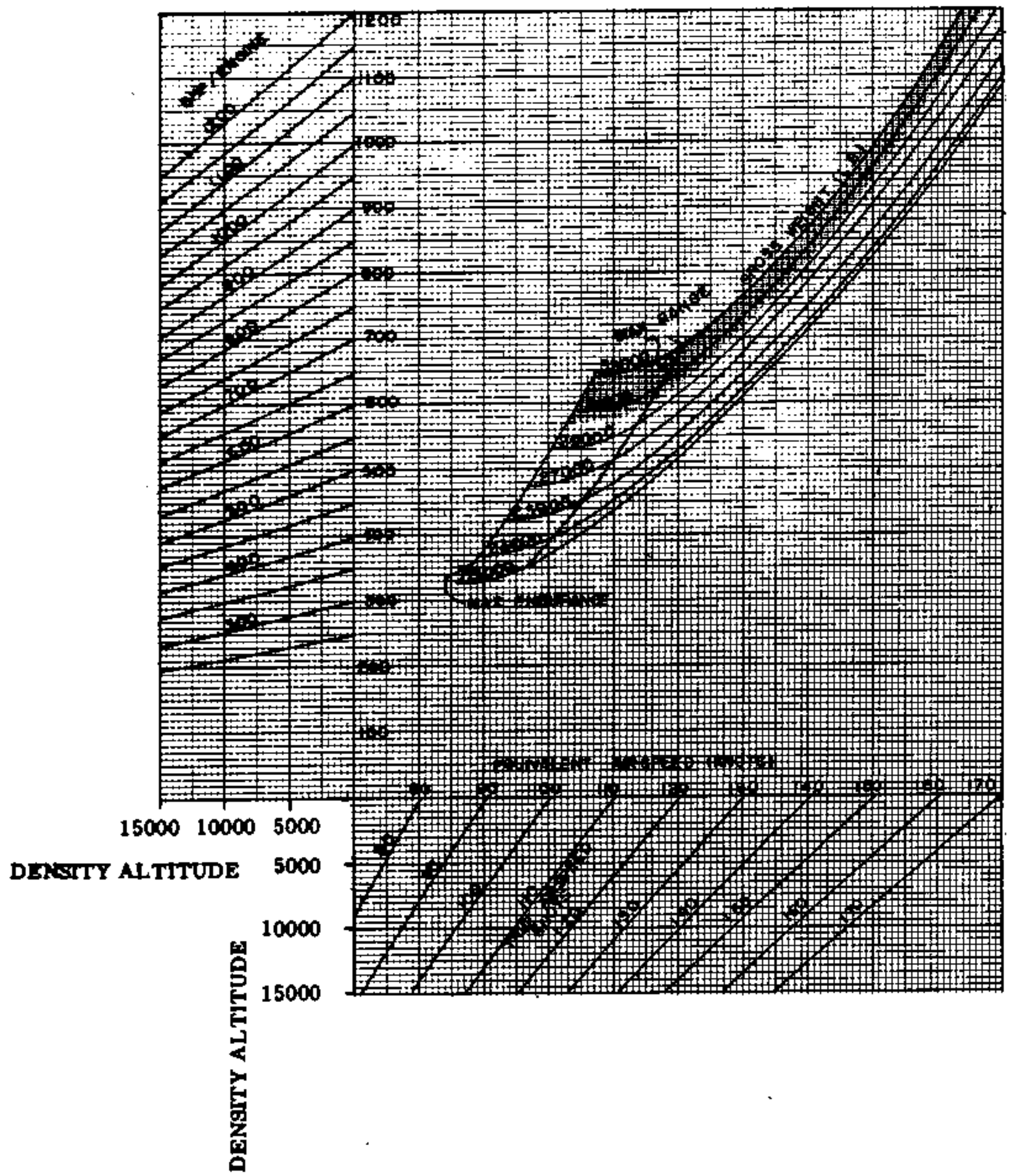
LEVEL FLIGHT PERFORMANCE - WITH SKIS
TWO ENGINE

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



A5-2. Level Flight Performance – Two Engines - With Skis.

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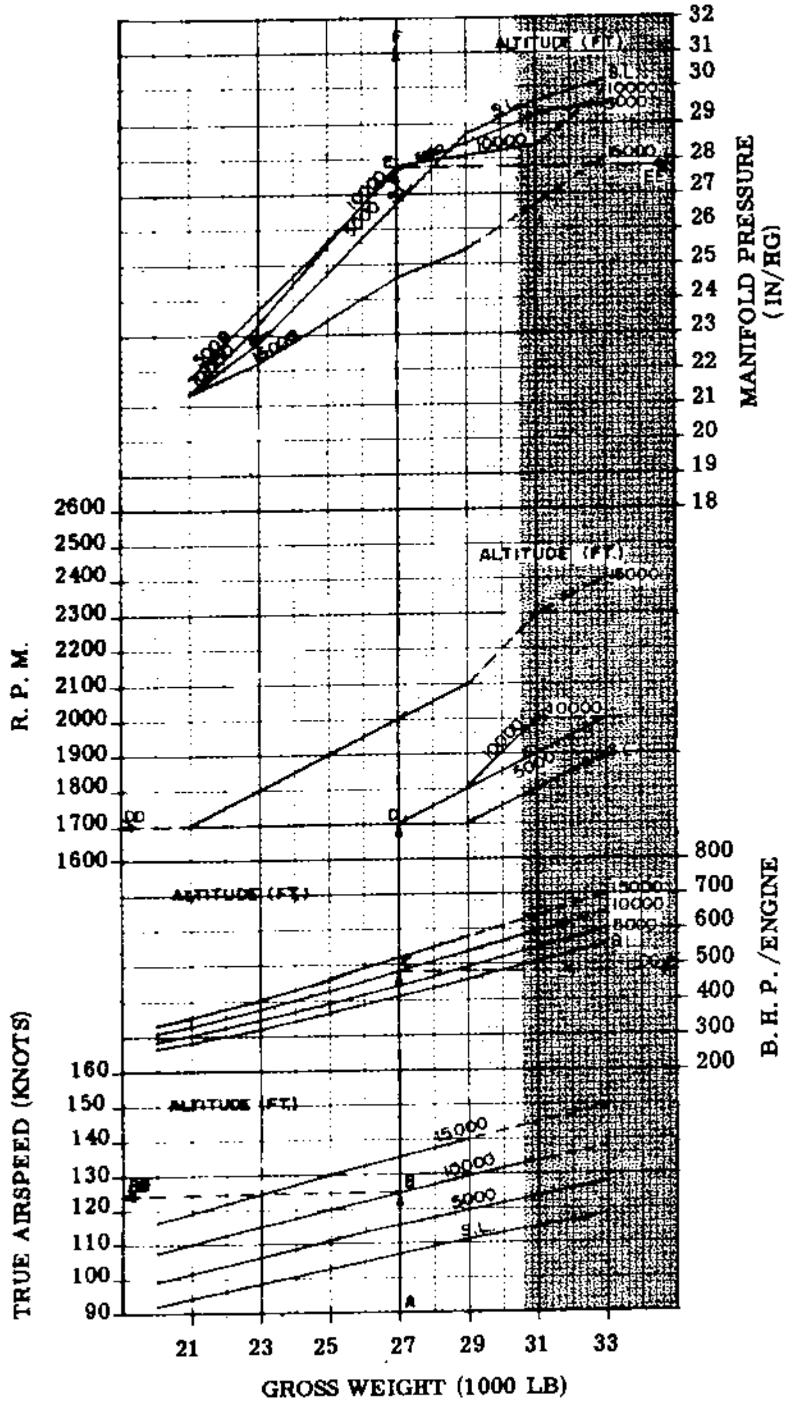
LONG RANGE POWER CONDITIONS
STANDARD DAY – TWO ENGINES



MODEL(S): C-47; C-117; and R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BASED ON: FLIGHT TEST DATA AS OF: 11 JULY 1957

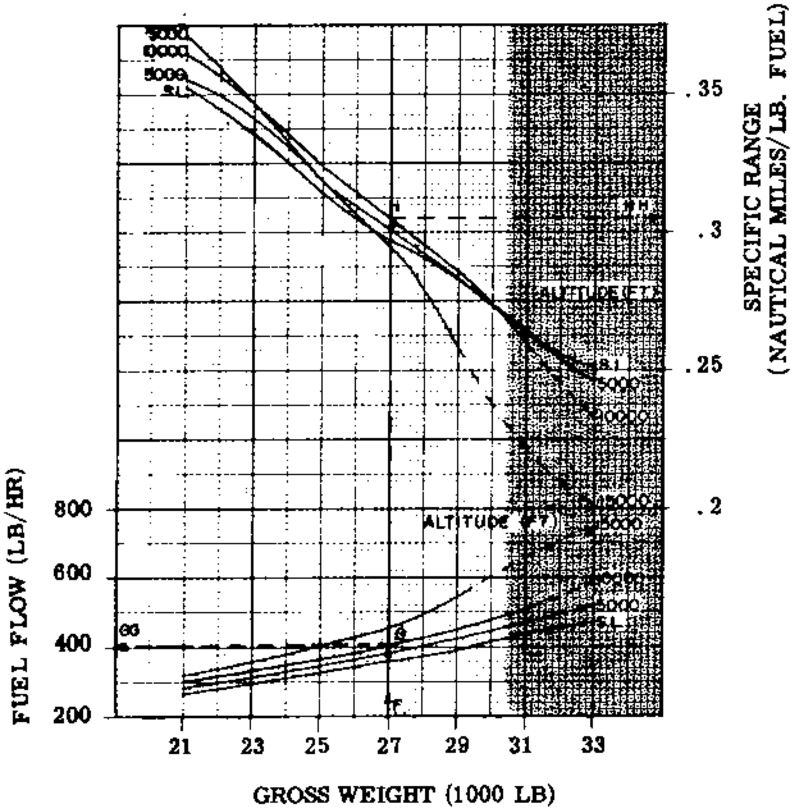
AUTO LEAN ________

AUTO RICH -----------

SAMPLE PROBLEM:
A, F. GROSS WEIGHT - 27000 pounds.
B, C, D, E, G and H. Altitude - 10,000 feet, standard day.
BB. True airspeed - 124.5 knots.
CC. Brake horsepower - 480.
DD. RPM - 1700.
EE. Manifold pressure - 27.5 IN. HG.
GG. Fuel flow - 405 pounds per hour.
HH. Specific range - .305 nautical miles per pound of fuel.

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 1 of 2)

LONG RANGE POWER CONDITIONS
STANDARD DAY-TWO ENGINES



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ________

AUTO RICH ---------

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 2 of 2)

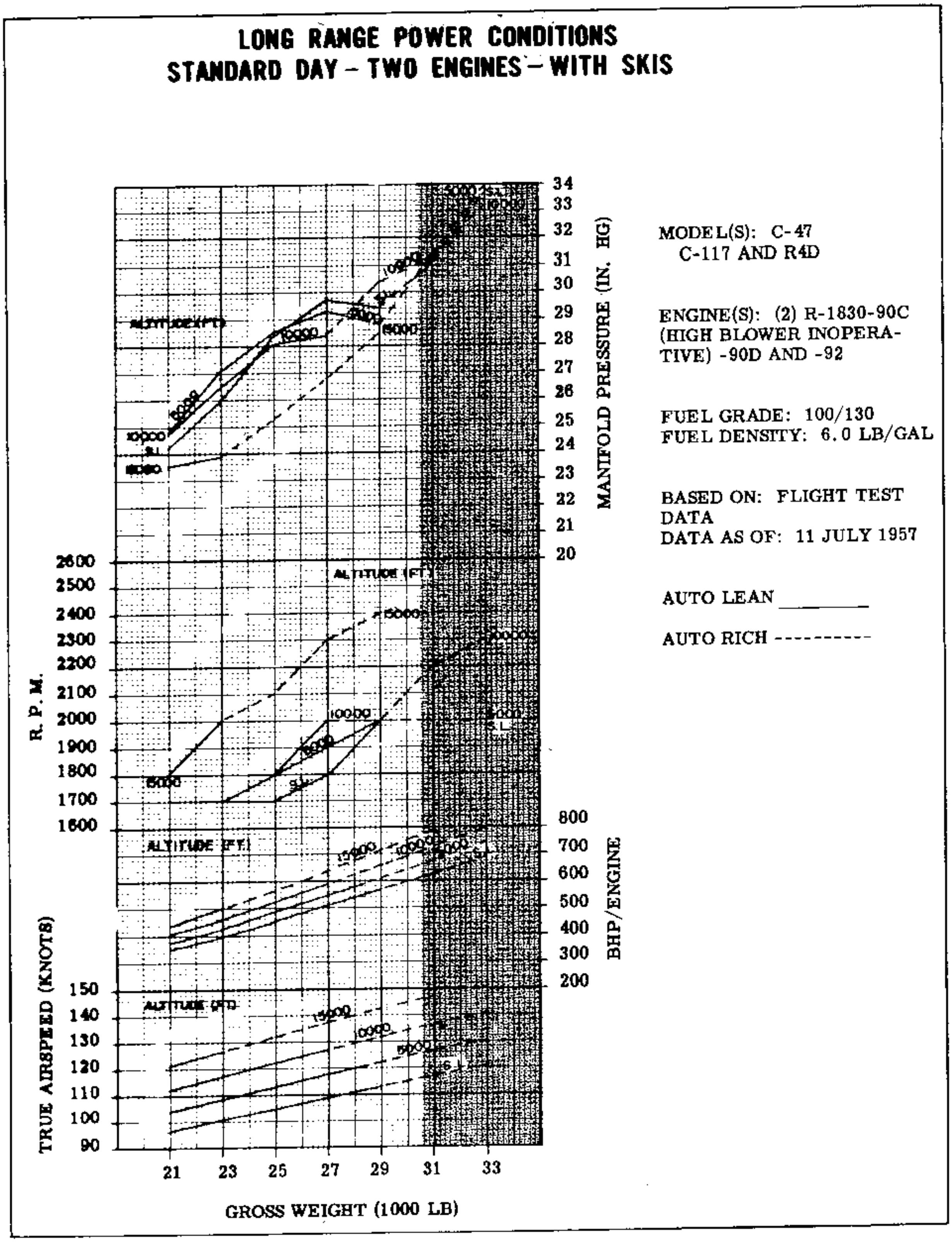
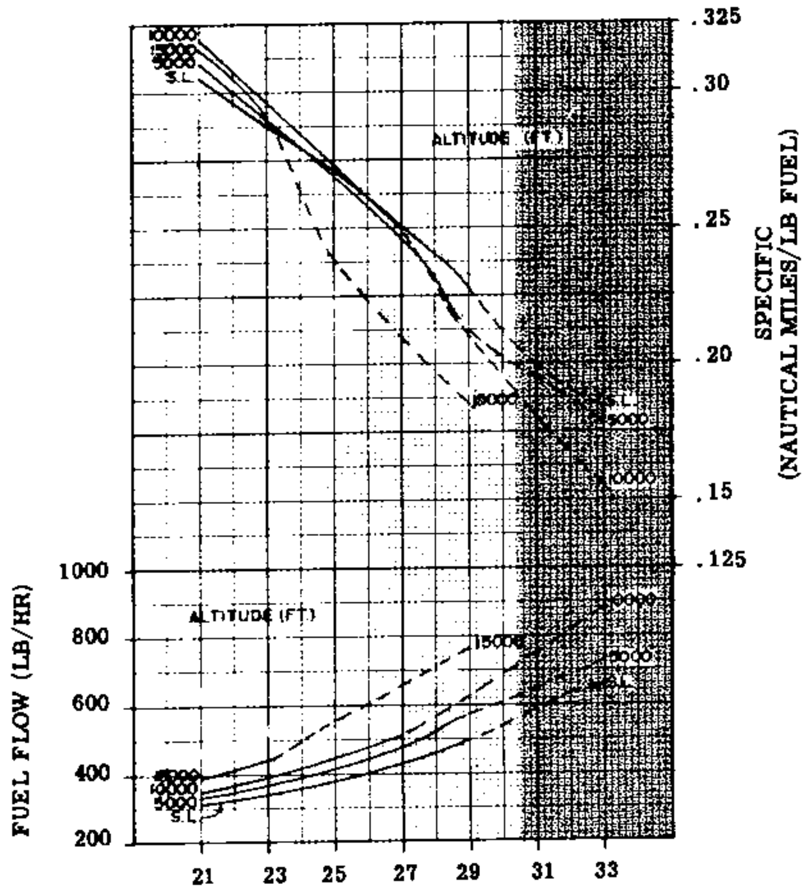


Figure A5-4. Long Range Power Conditions - Standard Day - Two Engines - With Skis (Sheet 1 of 2)

LONG RANGE POWER CONDITIONS
STANDARD DAY - TWO ENGINES - WITH SKIS



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ______

AUTO RICH -------

Figure A5-4. Long Range Power Conditions - Standard Day - Two Engines - With Skis (Sheet 2 of 2)

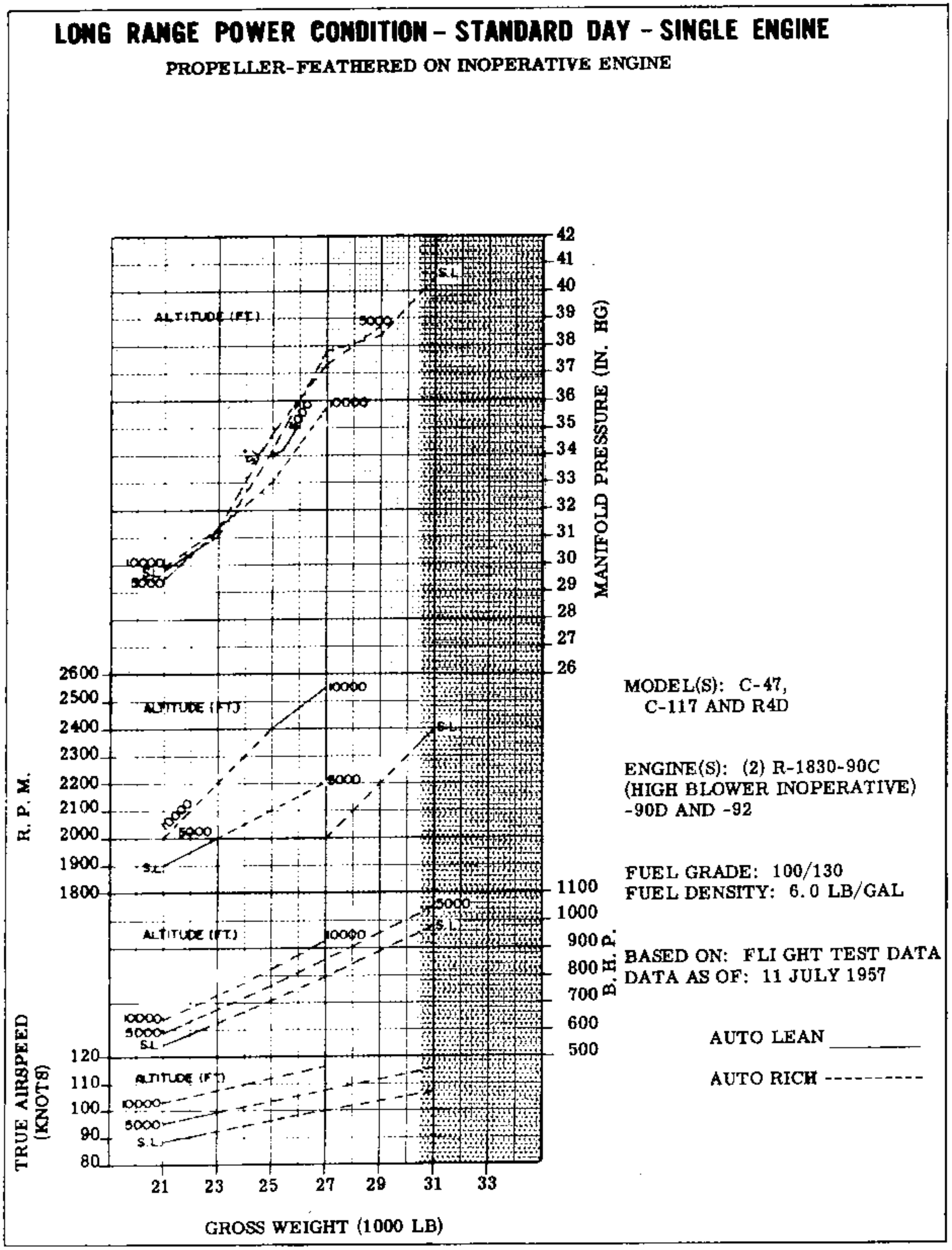
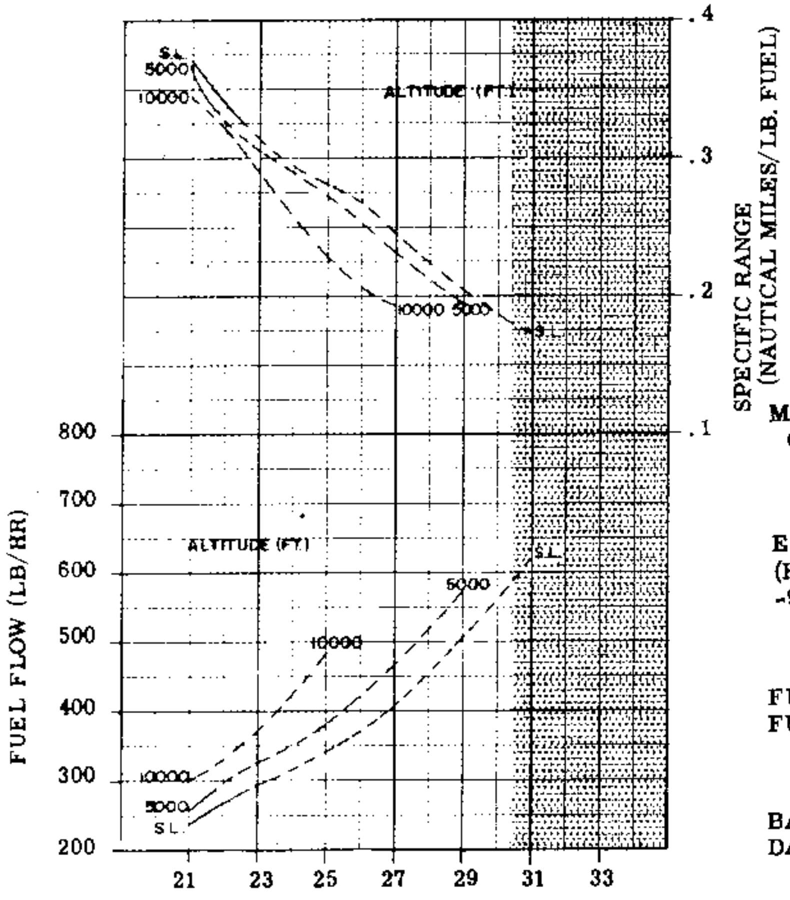


Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 1 of 2)

LONG RANGE POWER CONDITION-STANDARD DAY-SINGLE ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ______

AUTO RICH - - - - -

Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 2 of 2)

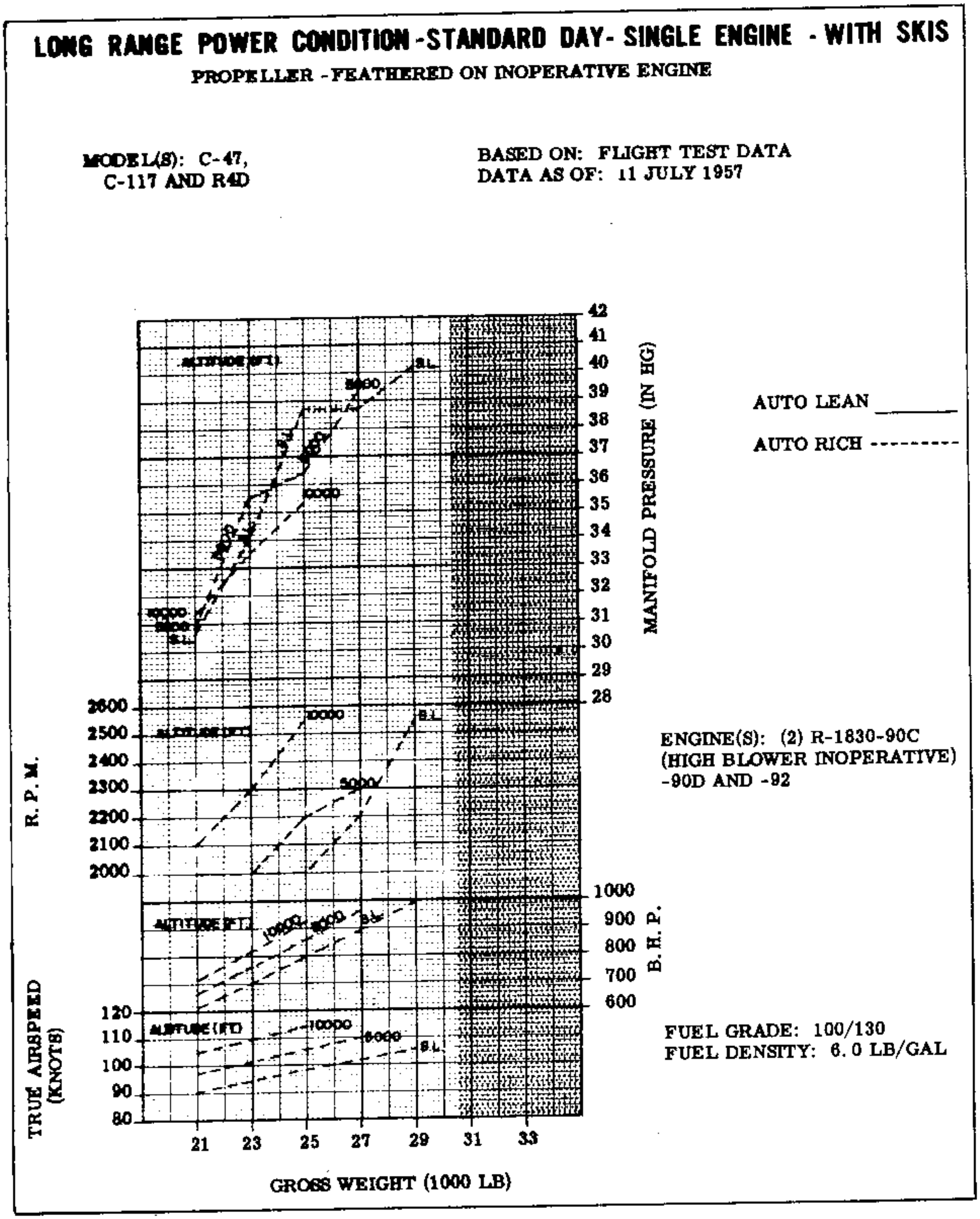
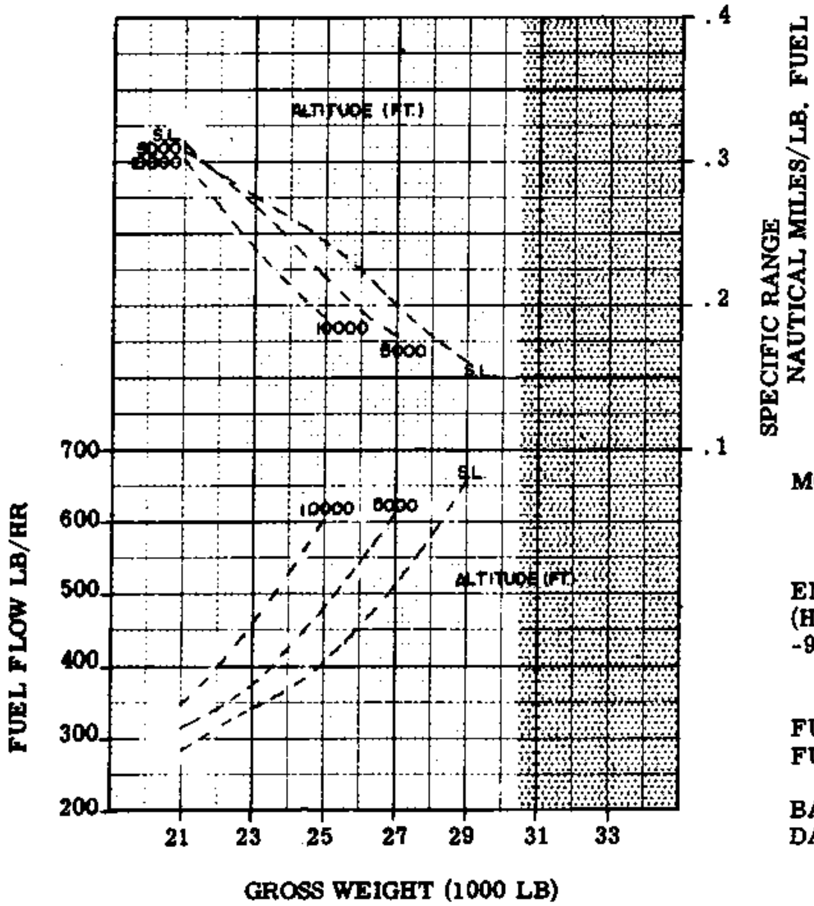


Figure A5-6. Long Range Power Condition - Standard Day - Single Engine - With Skis (Sheet 1 of 2)

LONG RANGE POWER CONDITION - STANDARD DAY - SINGLE ENGINE - WITH SKIS

PROPELLER - FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ________
AUTO RICH -----------

Figure A5-6. Long Range Power Condition - Standard Day - Single Engine - With Skis (Sheet 2 of 2)

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE SEA LEVEL

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

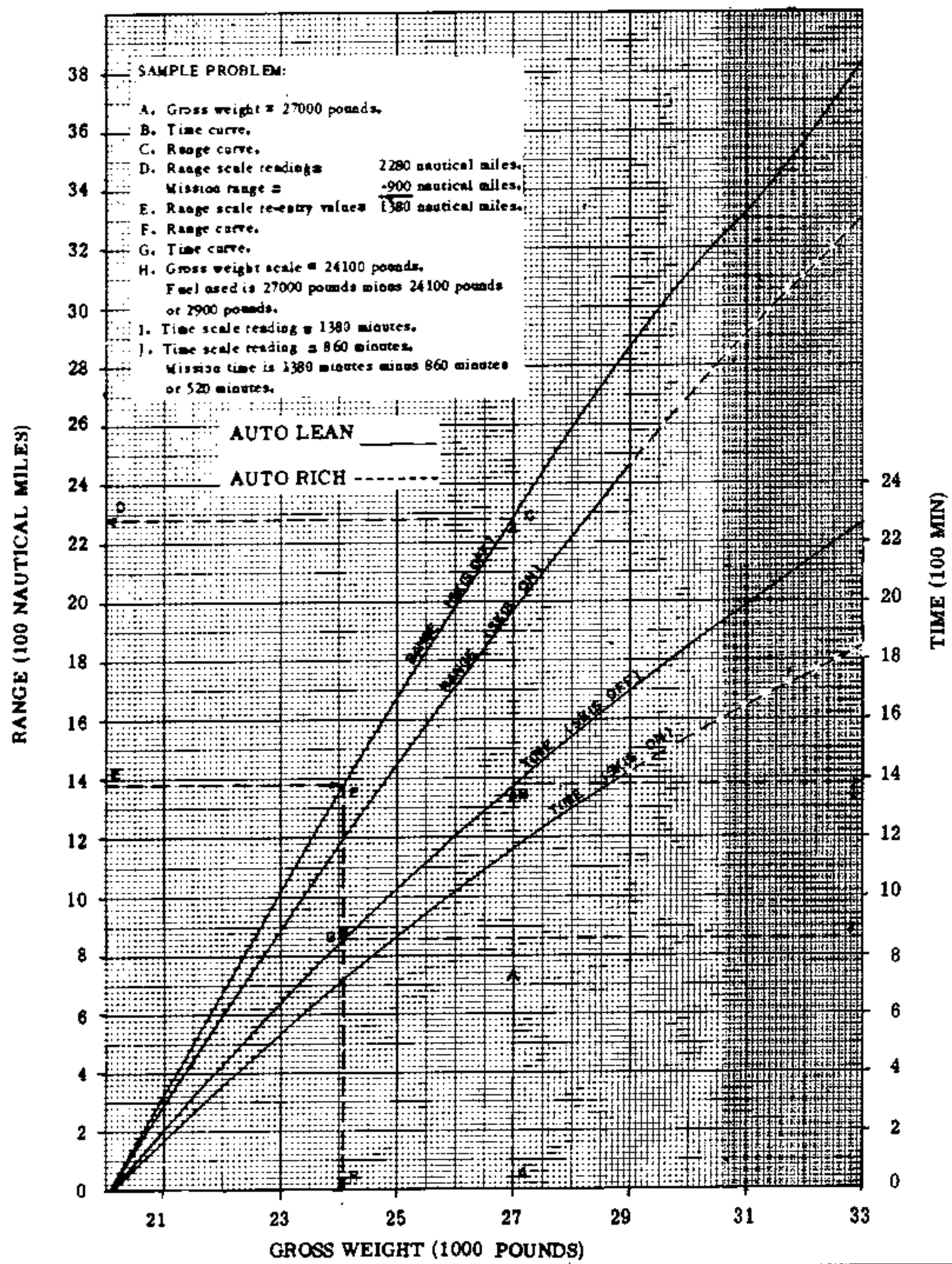


Figure A5-7. Flight Planning for Long Range Cruise Condition - Two Engines - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE 5000 FT. ALTITUDE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

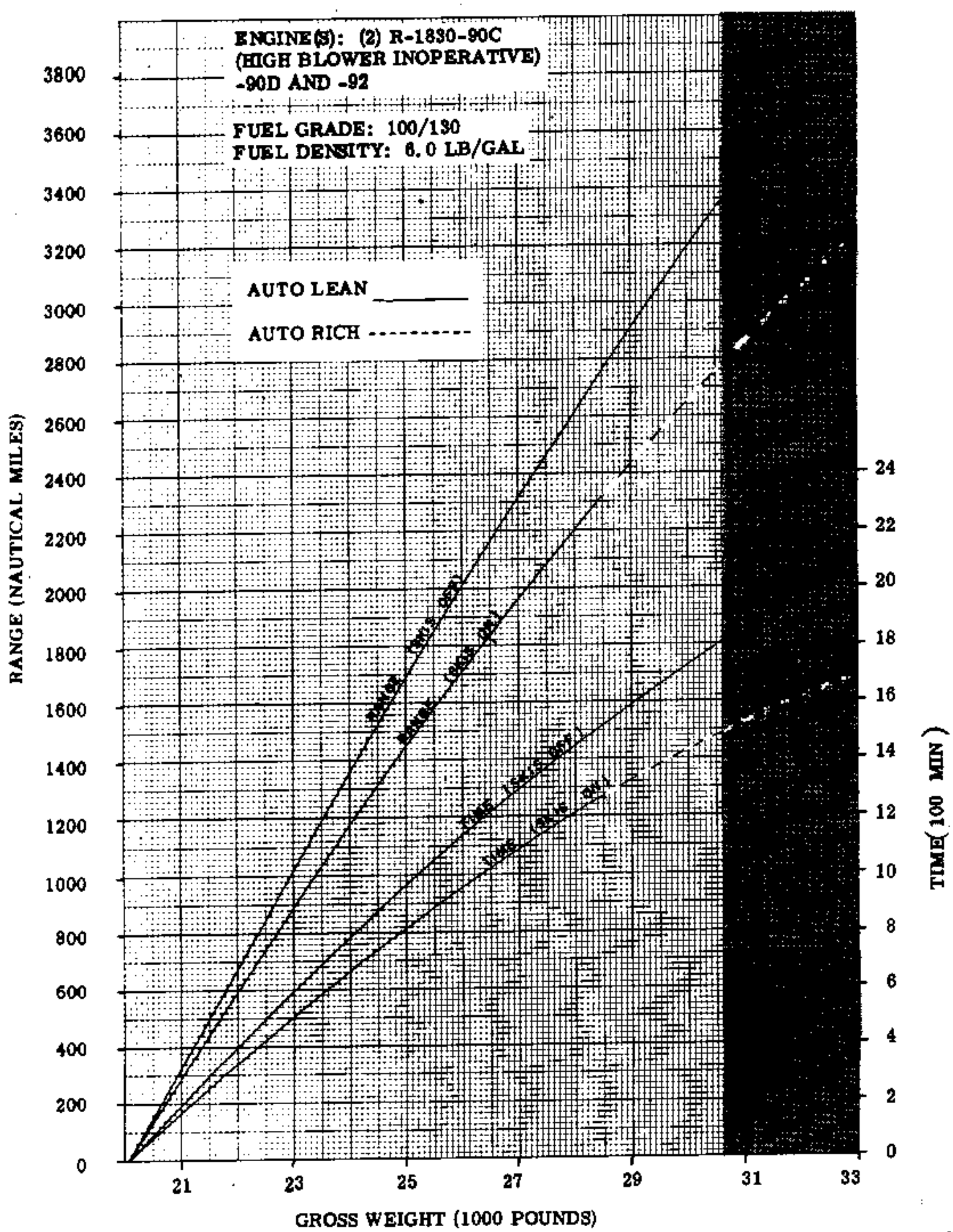


Figure A5-8. Flight Planning for Long Range Cruise Condition - Two Engines - 5000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE 10000 FT. ALTITUDE

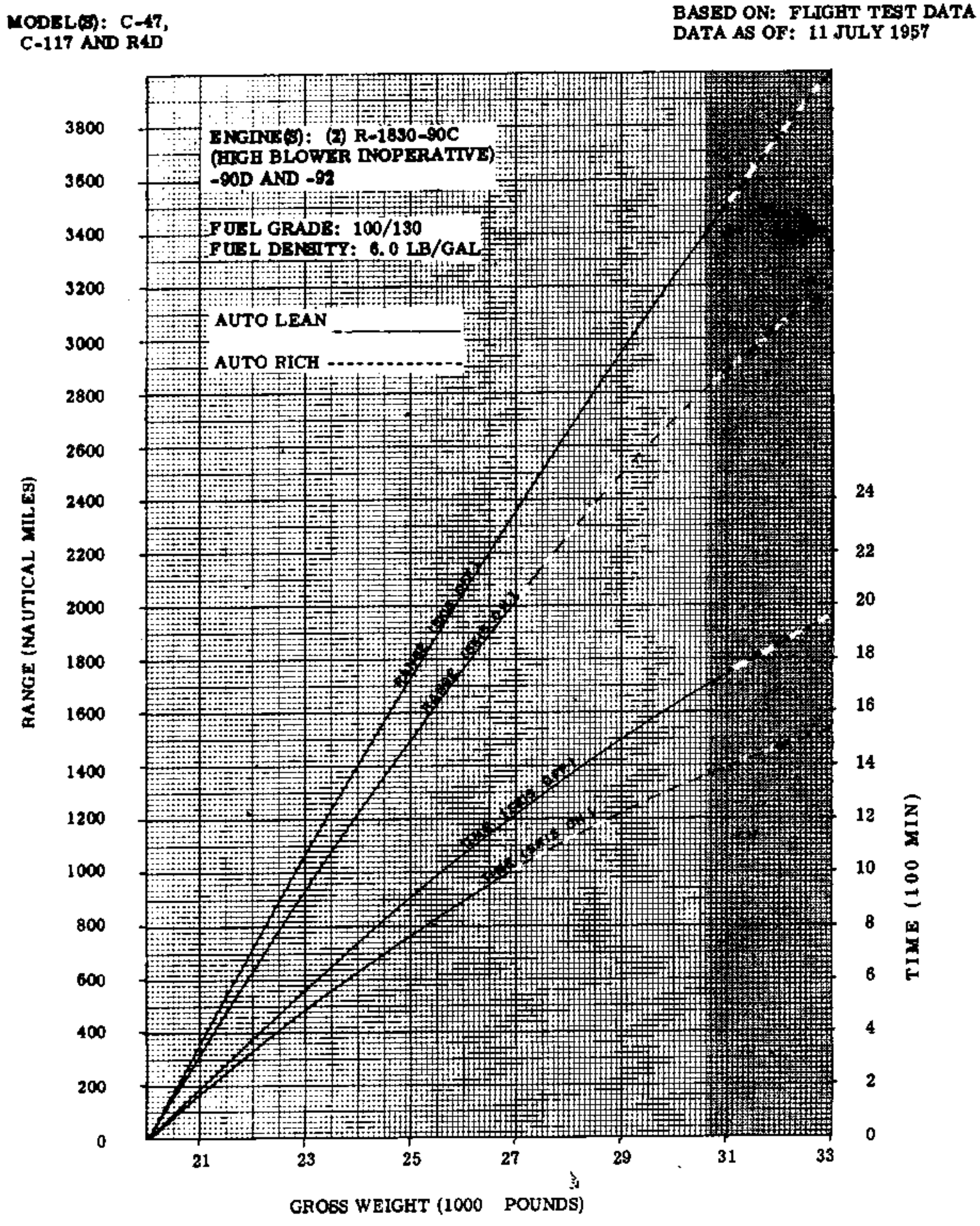


Figure A5-9. Flight Planning for Long Range Cruise Condition - Two Engines - 10000 Ft.

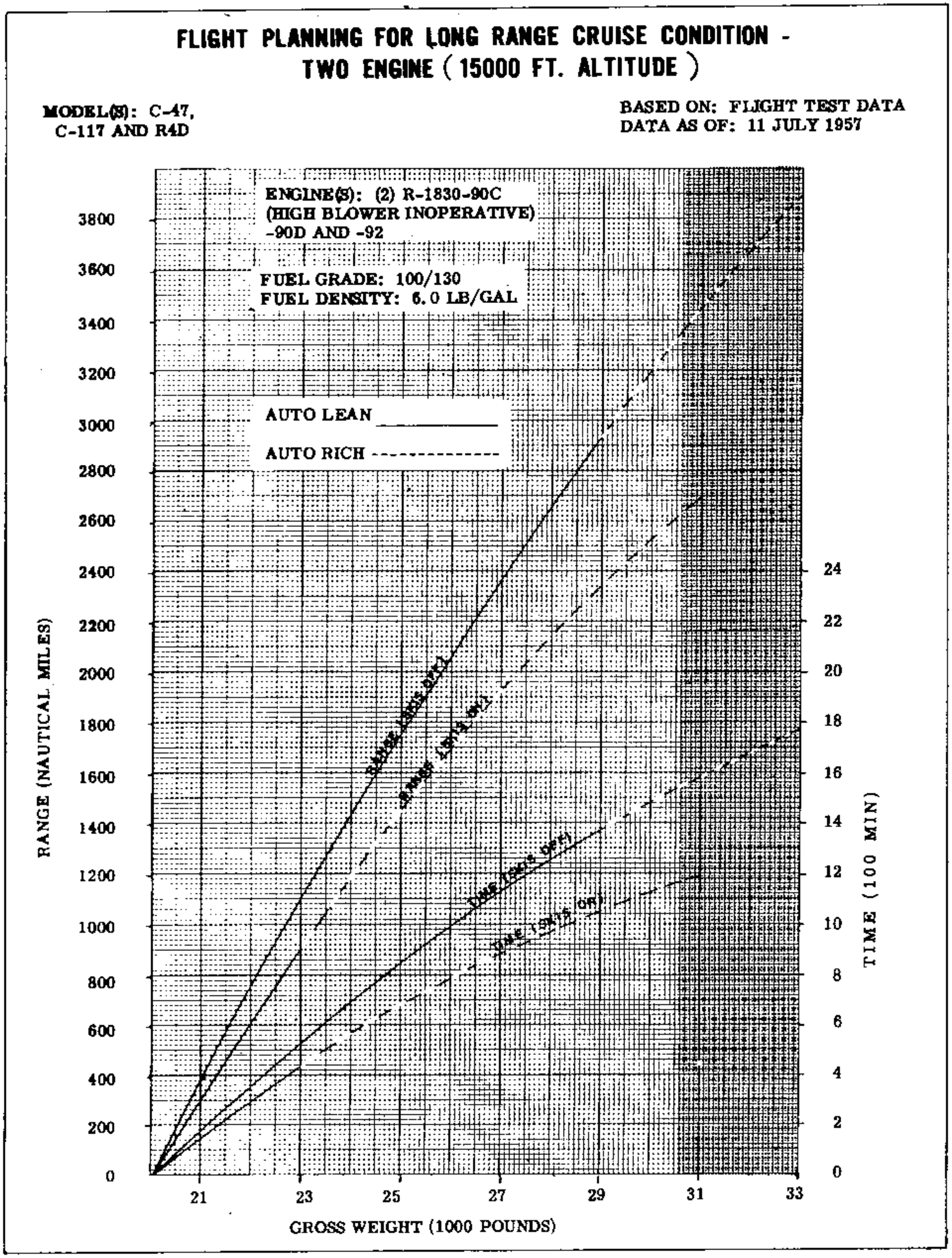


Figure A5-10. Flight Planning for Long Range Cruise Condition - Two Engines - 15000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION
SINGLE-ENGINE SEA LEVEL

PROPELLER: FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

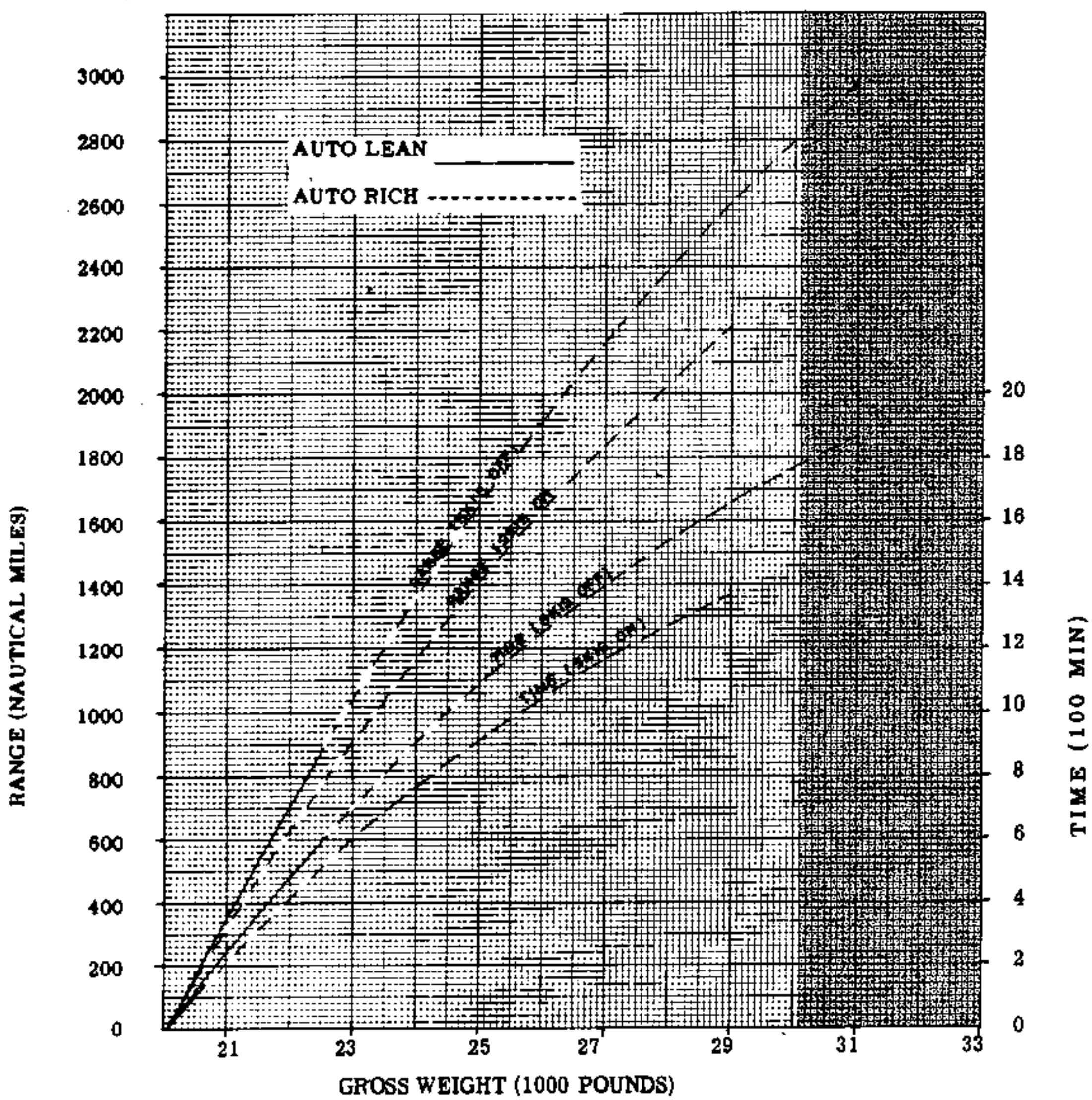


Figure A5-11. Flight Planning for Long Range Cruise Condition - Single Engine - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION SINGLE ENGINE (5000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

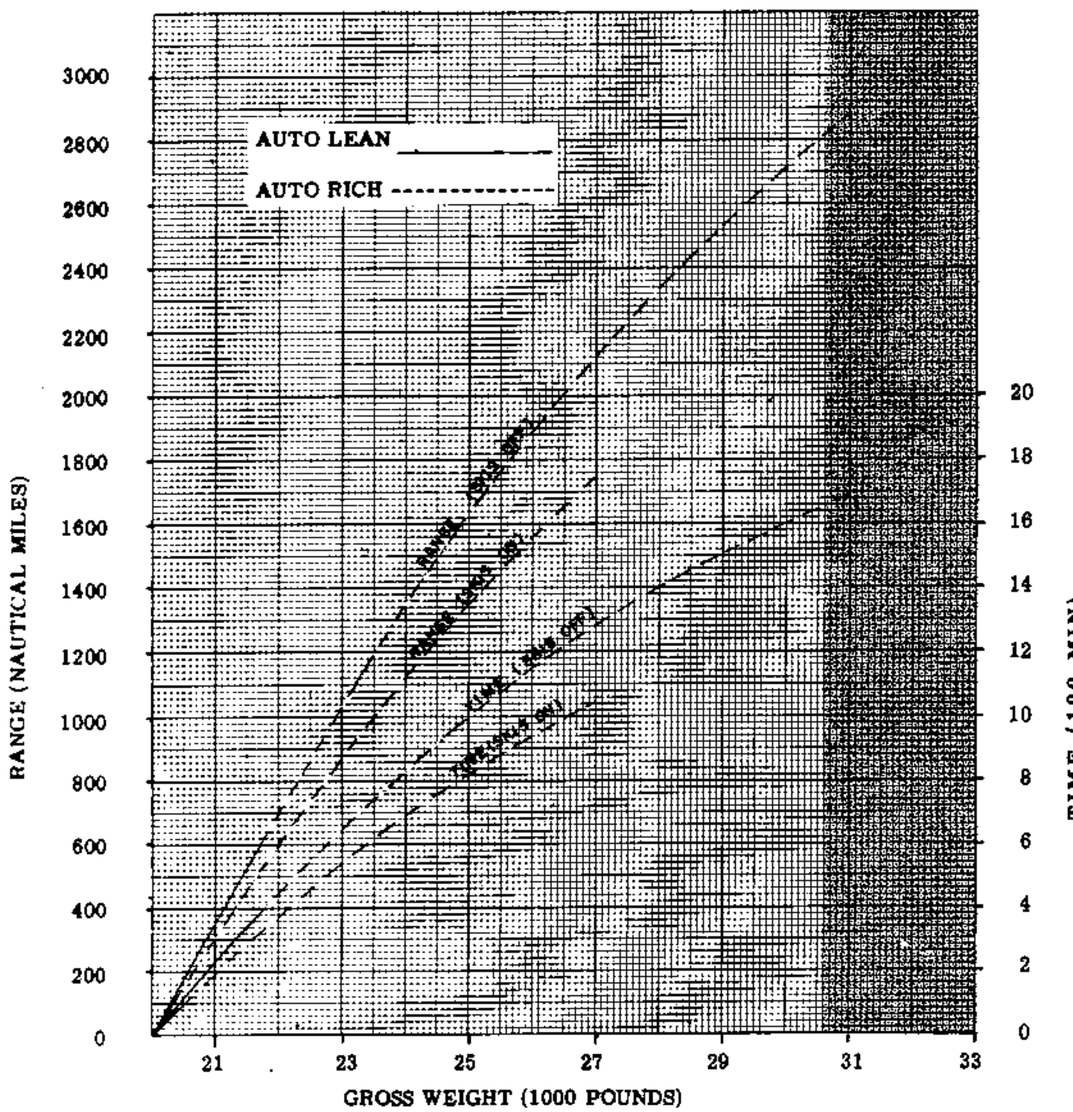


Figure A5-12. Flight Planning for Long Range Cruise Condition - Single Engine - 5000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - SINGLE-ENGINE (10000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

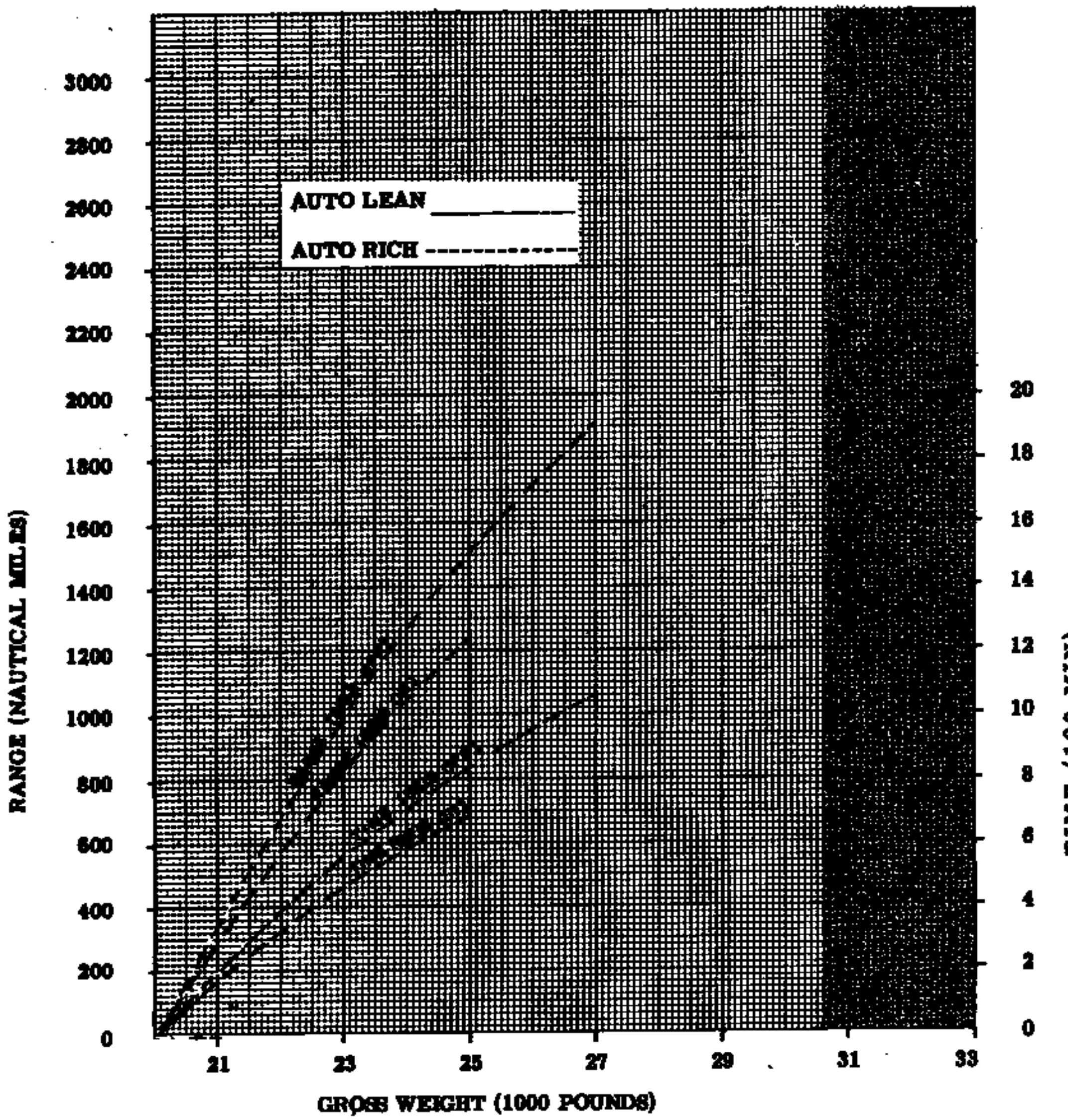


Figure A5-13. Flight Planning for Long Range Cruise Condition - Single Engine - 10000 Ft.

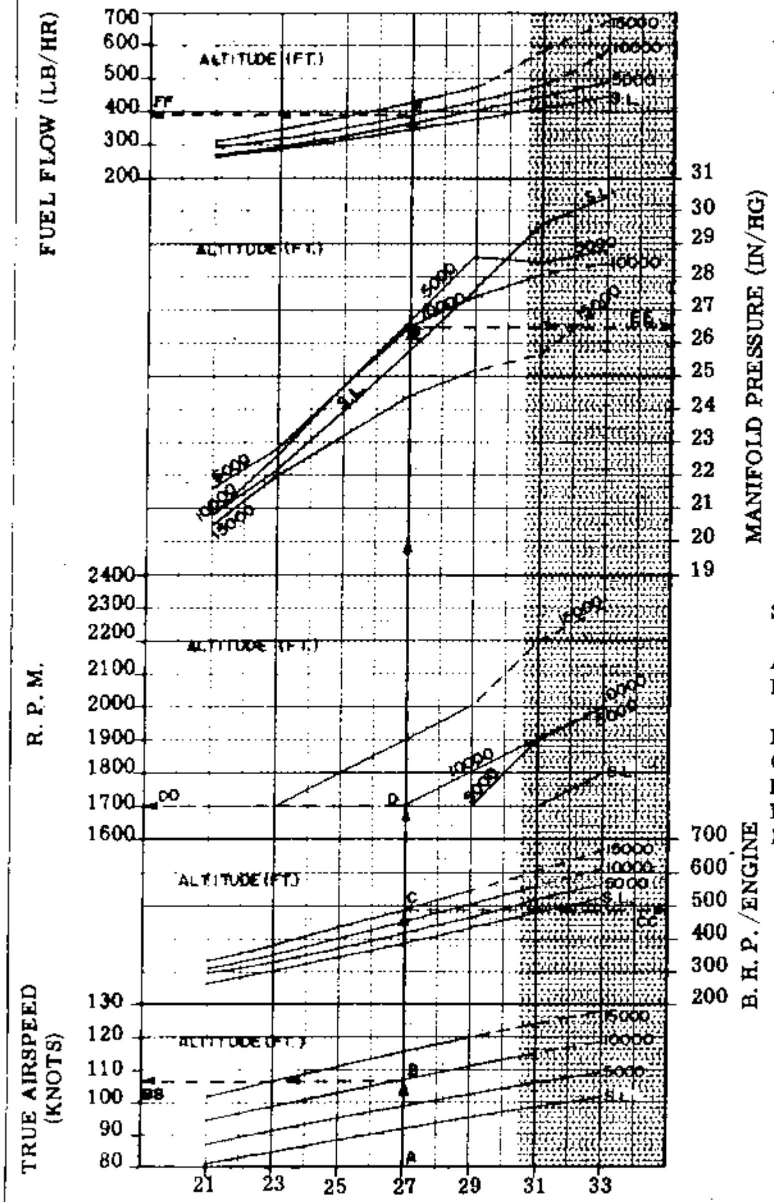
MAXIMUM ENDURANCE POWER CONDITION - TWO-ENGINE
STANDARD DAY

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

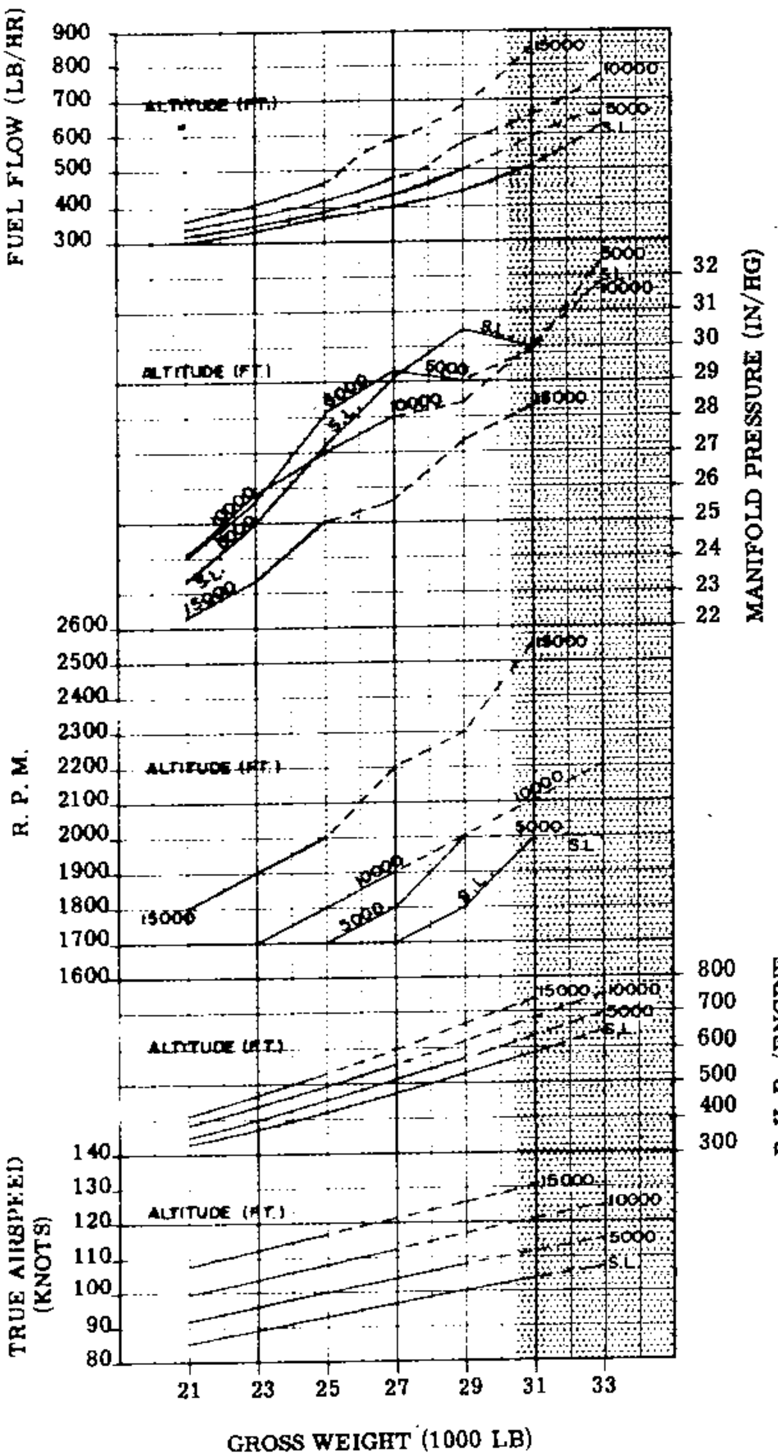


SAMPLE PROBLEM

A. GROSS WEIGHT = 27000 POUNDS.
B, C, D, E AND F = 10,000 FEET ALTITUDE.
BB. TRUE AIRSPEED = 106.5 KNOTS.
CC. BRAKE HORSEPOWER = 490.
DD. RPM = 1700.
EE. MANIFOLD PRESSURE = 26.5.
FF. FUEL FLOW = 390 POUNDS PER HOUR.

Figure A5-14. Maximum Endurance Power Condition - Two Engines.

MAXIMUM ENDURANCE POWER CONDITION - WITH SKIS - TWO ENGINES STANDARD DAY



AUTO LEAN ________

AUTO RICH ----------

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A5-15. Maximum Endurance Power Condition - With Skis - Two Engines.

PART SIX
LANDING

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Discussion of Charts A6-2

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DISCUSSION OF CHARTS.

The landing charts are included to enable the pilot to determine the length of the runway necessary to land the aircraft safely under various conditions of wind, temperature, altitude, and runway surface. Since the length of the landing ground run depends to a great extent on the coefficient of friction (μ) numerical values of μ are shown on the landing ground run charts (figures A6-1 through A6-4) corresponding to the most commonly encountered runway surface conditions.

LANDING GROUND RUN

The landing ground run charts (figures A6-1 through A6-4) are used to determine that landing ground run distance at various combinations of OAT, pressure and density altitudes (up to 16,000 feet), gross weight, actual wind component, and runway surface condition. The charts are based on the recommended touchdown speed obtained from the characteristic landing speeds chart (figure A6-5). These charts give ground run only; to compute landing distance from a 50-foot height, first determine landing ground run for prevailing runway surface conditions, then add 95 percent of the landing ground run for hard runway surface. The sum of these two distances will give the approximate total landing distance from a 50-foot height. A sample problem is included on each chart.

CHARACTERISTIC LANDING SPEEDS.

The characteristic landing speed chart (figure A6-5) presents recommended touchdown speeds in both knots and MPH indicated airspeed with zero, ¼, ½, and full flaps for various aircraft gross weights. All lines represent the 110 percent power off stall speed for the flap position shown. Enter the chart at the planned landing gross weight and proceed vertically to the appropriate speed curve, then proceed horizontally to the indicated airspeed.

POWER-OFF STALL SPEEDS.

Power-off stall speed charts (figure A6-6 through A6-9) are included for zero, ¼, ½ and full DOWN (45°) flap settings. The power-off stall speeds were determined with the throttles in the CLOSED position. When power is maintained on the engines, the airflow over the wings behind the propellers is increased and therefore increases lift and lower the stalling speed. This effect varies with power setting.

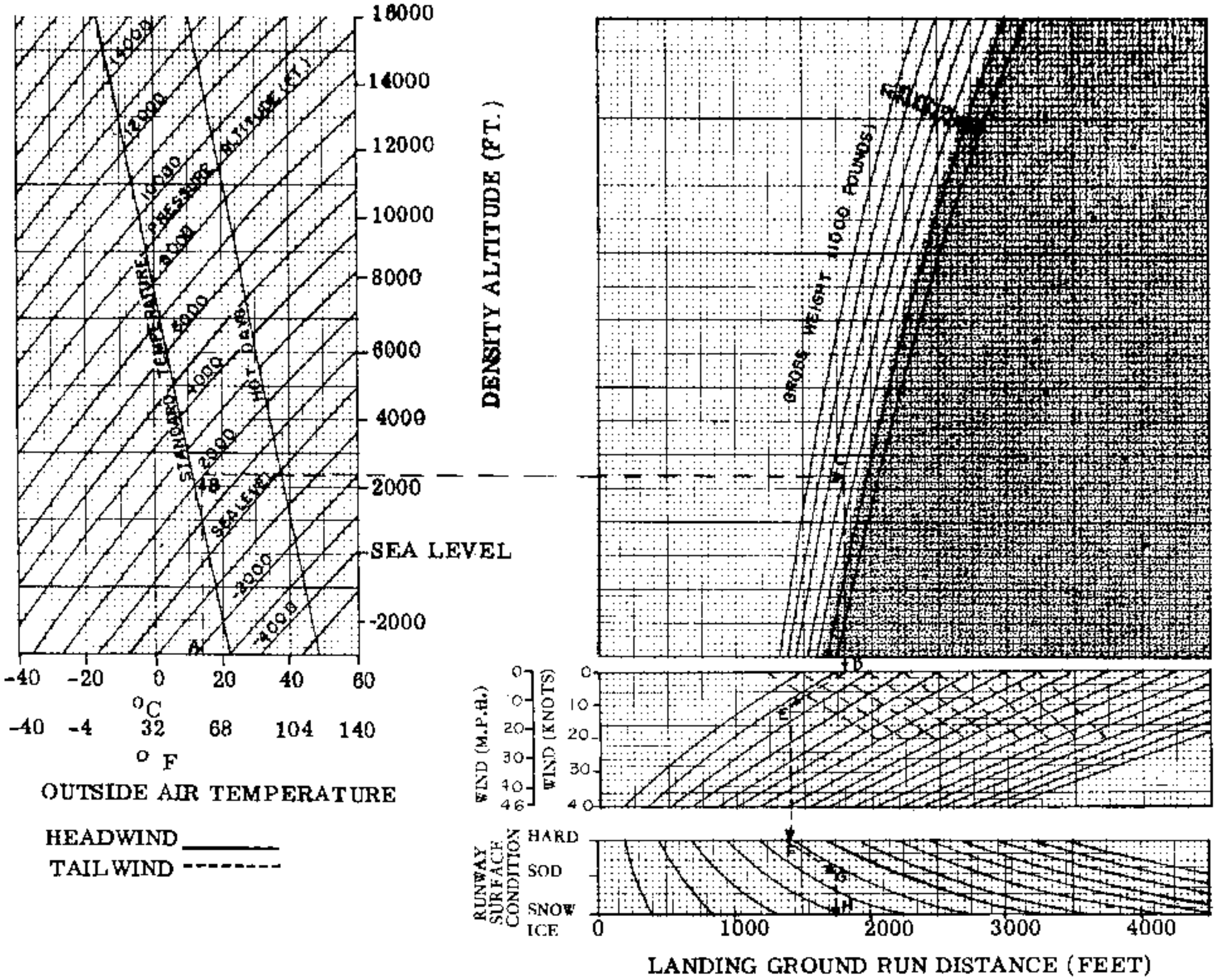
LANDING GROUND RUN

TOUCHDOWN AT 1.1Vs
WING FLAPS = 45 DEGREES
IDLE POWER

MODEL(S): C-47, C-117
AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



SAMPLE PROBLEM:

A. Outside air temperature = 14° C.
B. Pressure altitude = 2000 feet.
C. Gross weight = 27000 pounds.
D. Base line.
E. Reported headwind = 20 knots.
F. Base line and run distance on hard surface runway = 1400 feet.
G. Runway surface condition = sod.
H. Ground run distance on sod surface = 1750 feet.

NOTE:

1. Speed at 50 foot height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 45 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 foot height to touchdown is approximately 85 percent of landing ground run on hard surface for 45 degrees flap. Total landing distance from a 50 foot height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

Figure A6-1. Landing Ground Run – Touchdown at $1.1V_s$ – Wing Flaps - 45 Degrees.

MODEL(S): C-47, C-117 AND R4D

RATE OF CLIMB - MAX POWER

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

SINGLE ENGINE PROPELLER - FEATHERED ON INOPERATIVE ENGINE

2700 RPM

WITH SKIS

WINGS FLAPS - UP

COWL FLAPS - TRAIL POSITION

FUEL GRADE: 100/130

FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

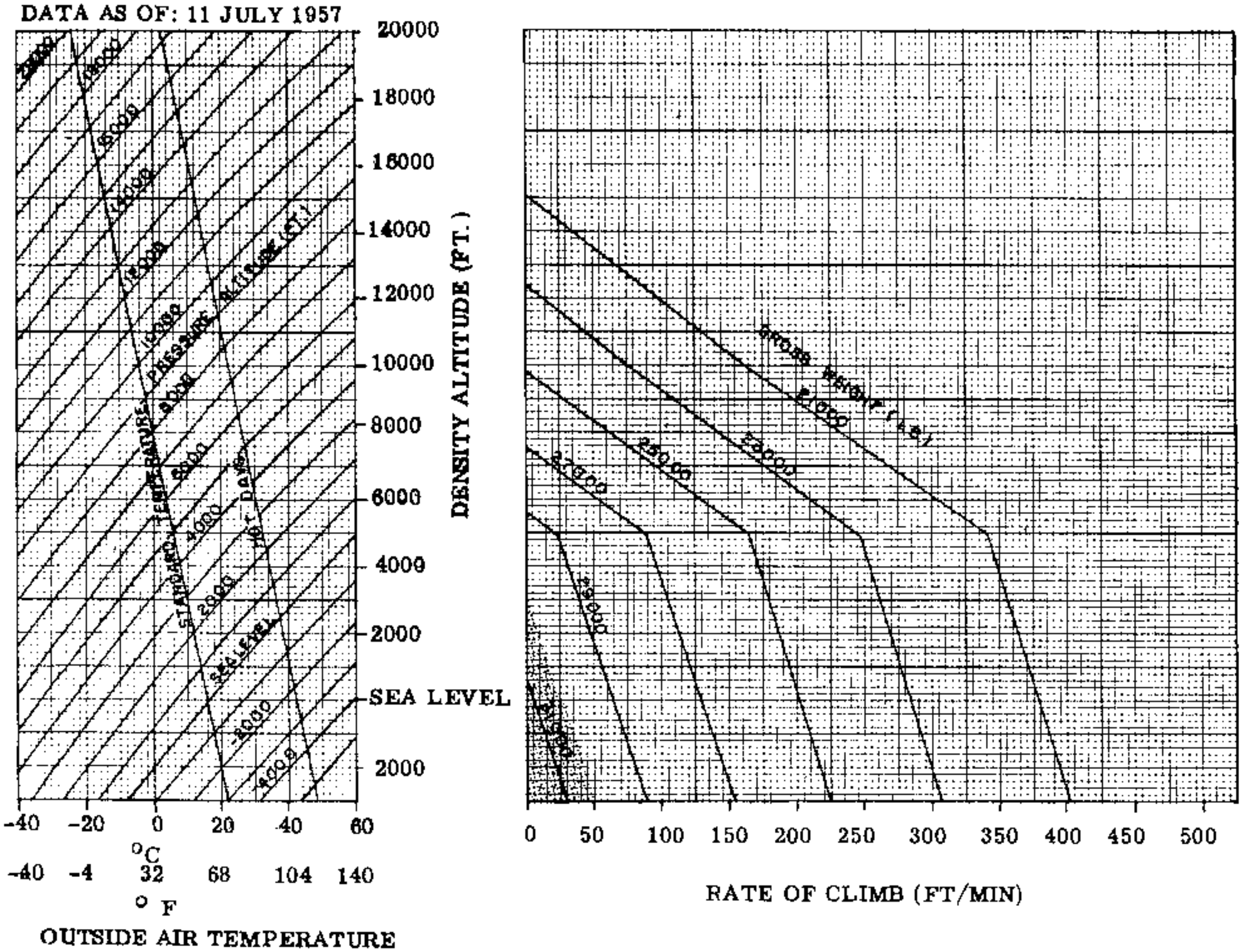


Figure A4-22. Rate of Climb - Maximum Power - 2700 RPM - Single Engine – With Skis.

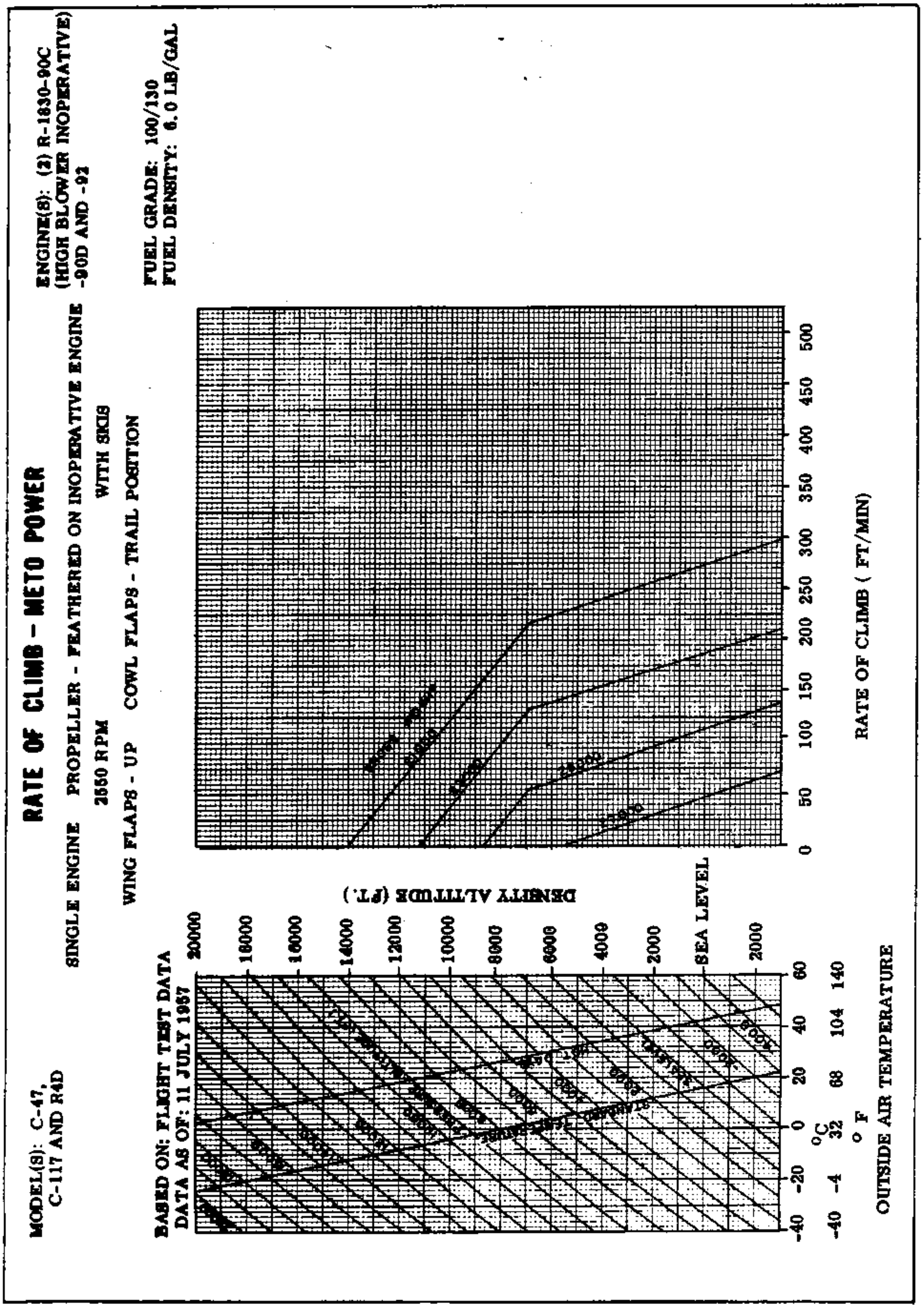


Figure A4-23. Rate of Climb - METO Power - 2550 RPM - Single Engine – With Skis.

RATE OF CLIMB – CLIMB POWER

MODEL(S): C-47,
C-117 AND R4D

SINGLE ENGINE PROPELLER - FEATHERED ON INOPERATIVE ENGINE

2350 RPM WITH SKIS

WING FLAPS - UP COWL FLAPS - TRAIL POSITION

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

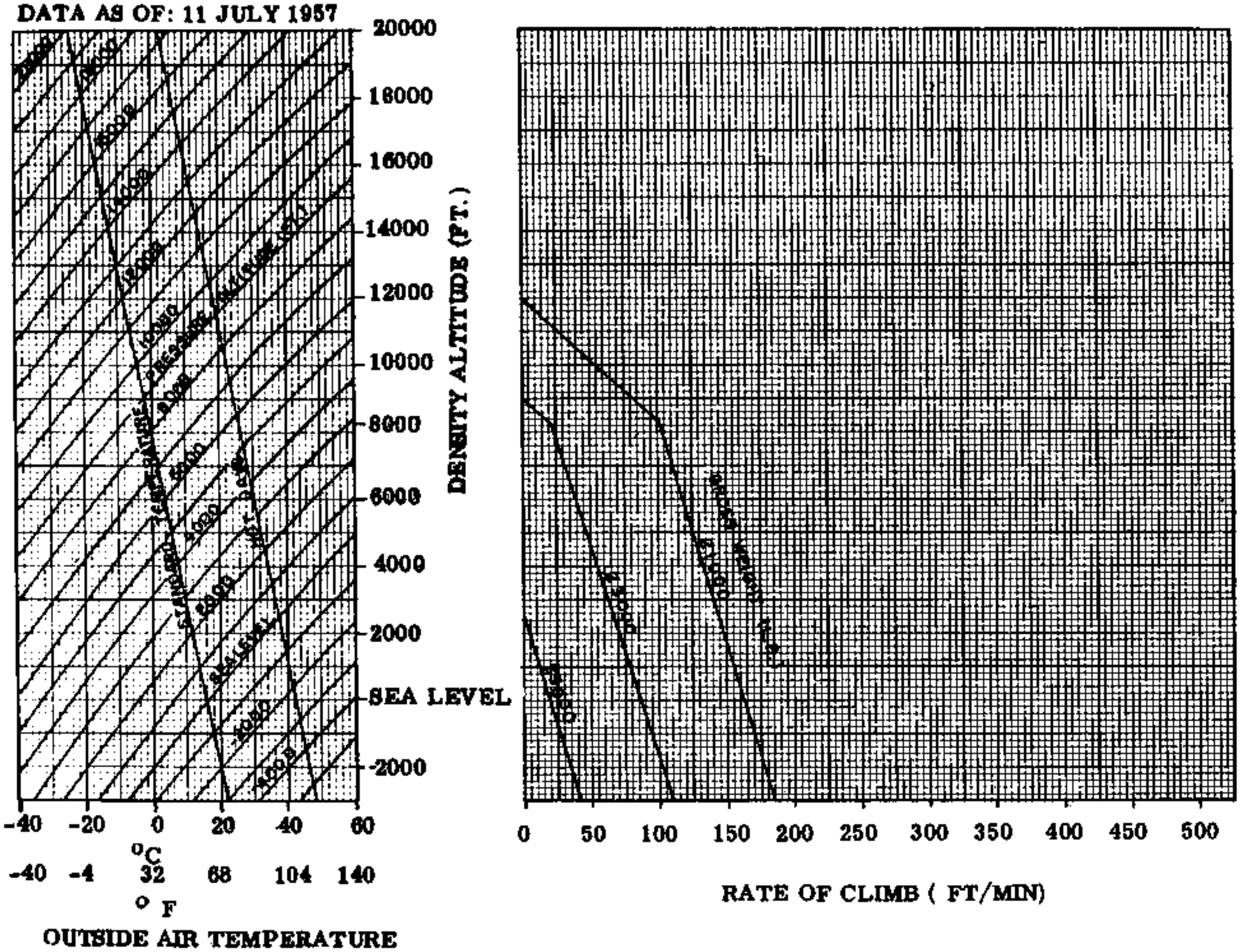


Figure A4-24. Rate of Climb - Climb Power - 2350 RPM - Single Engine.

SINGLE-ENGINE SAWTOOTH CLIMB

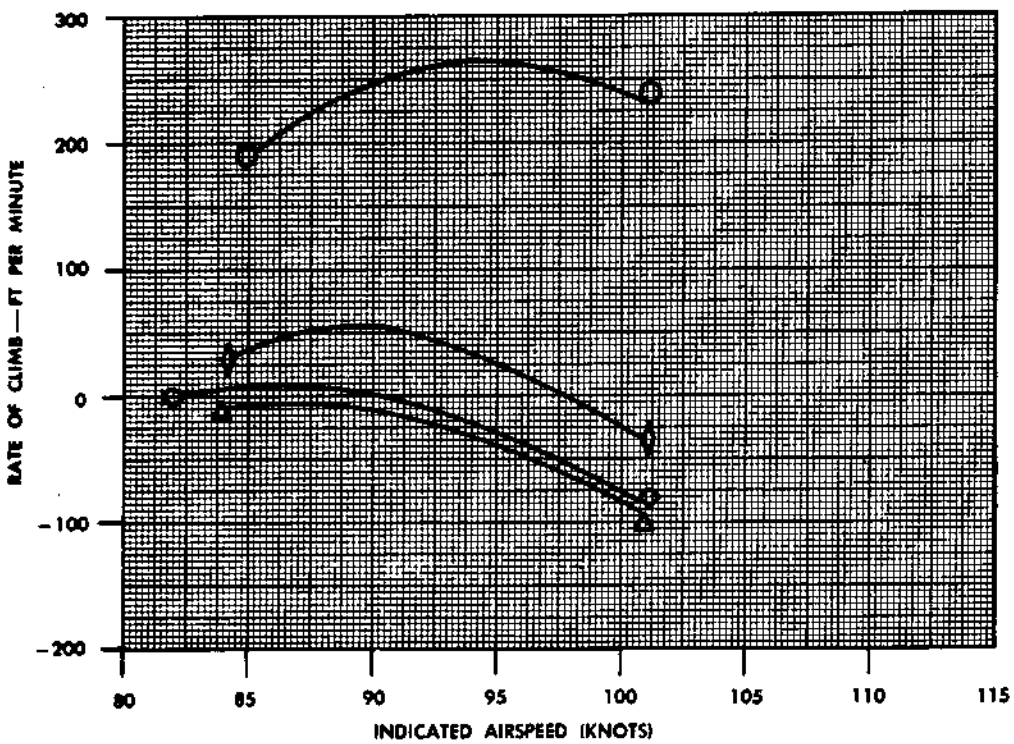
CONFIGURATION 1 (CLEAN)

FLAPS UP
COWL FLAPS CLOSED ON INOPERATIVE ENGINE
TAKEOFF POWER AND COWL FLAPS TRAIL
ON OPERATING ENGINE
GROSS WEIGHT—26,000 LBS

MODEL(S): C-47, C-117 AND R4D

CONDITIONS
3000 FEET
NACA STANDARD DAY

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957



○- PROP FEATHERED, GEAR UP

◊- PROP FEATHERED, GEAR DOWN

◇- PROP WINDMILLING, GEAR UP

△- PROP WINDMILLING, GEAR UP, 4 ATO UNITS INSTALLED

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A4-25. Single Engine Sawtooth Climb.

EMERGENCY CEILING STANDARD DAY

100 FT/MIN RATE OF CLIMB AT METO POWER

CLEAN CONFIGURATION

SAMPLE PROBLEM:
A. GROSS WEIGHT = 27000 POUNDS.
B. TWO ENGINE - WITH SKIS CURVE.
C. PRESSURE ALTITUDE = 22000 FEET.

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

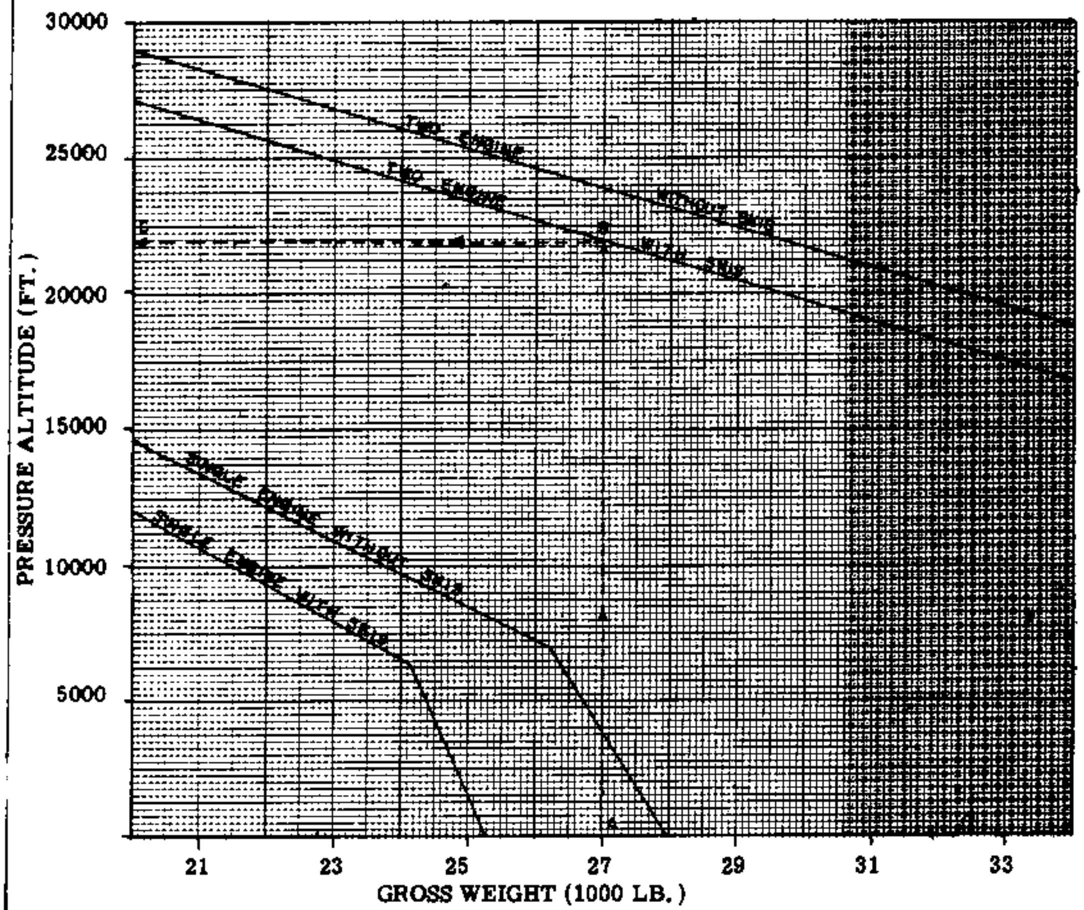


Figure A4-26. Emergency Ceiling - Standard Day.

PART FIVE
RANGE

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Discession of Charts A5-2

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DISCUSSION OF CHARTS.

The range performance is presented in three types of charts: long range power condition, flight planning for long range cruise condition, and level flight performance. Maximum endurance power conditions charts are also provided.

LEVEL FLIGHT PERFORMANCE

The level flight performance charts (figure A5-1 and A5-2) are used to determine the equivalent and true airspeeds, and the brake horsepower required per engine for level flight performance with and without skis during two engine operation at various combinations of gross weight and density altitude.

Enter the chart at the recommended long range airspeed curve, Point A, and proceed to the known gross weight curve, Point B. From this intersection, proceed horizontally to the known density altitude and read the required brake horsepower per engine for two engine operation, Point C. To determine the correct equivalent airspeed at this setting, proceed from Point B, vertically to the equivalent airspeed scale, Point D. The true airspeed may be determined by projecting a line vertically from Point D to the known density altitude, Point E, and interpolating the true airspeed at this point.

LONG RANGE POWER CONDITIONS

The long range power conditions charts (figure A5-3 through A5-6) are presented with sheet 1 of 2 and 2 of 2 on facing pages. Sheet 1 of 2 shows recommended true airspeed (TAS), brake horsepower, RPM, and manifold pressure. Sheet 2 of 2 shows fuel flow (pounds per hour) and specific range (nautical miles per pound of fuel). Charts are included for two engine and single engine long range operation at various weights in low blower, auto rich and auto lean carburetor settings. Enter each chart at the aircraft's initial cruise gross weight (or any desired intermediate gross weight) and proceed vertically from bottom to top. To gain maximum range efficiency from use of the chart, recompute power settings at least once each hour for the new gross weight (decreased as fuel is consumed). These charts are based on the recommended long range airspeed curve (99 percent maximum range) on the level flight performance charts (figure A5-1 and A5-2). A sample problem is presented on the first chart of this series.

FLIGHT PLANNING CHART FOR LONG RANGE CRUISE CONDITION

The flight planning charts for long range cruise condition (figures A5-7 through A5-13) are used to determine the fuel consumed and the time elapsed for a cruise operation when the required distance to cruise and either the initial or final aircraft cruise gross weight are known. In the event initial and final cruise gross weights are known, both the range and time to cruise may be obtained from the charts.

The charts are constructed for use with two and single-engine power conditions. The vertical scales labeled range and time, are presented only to find the difference in nautical miles (aircraft range) or time in (100 minutes) due to fuel consumption between initial and final cruise gross weights. A sample problem is included on the first chart of this series (figure A5-7).

Enter the chart with the given gross weight (Point A). Draw a line vertically to the time curve (Point B). Extend the line vertically from Point B to the range curve (Point C). Draw a line horizontally from Point C to the range scale (Point D). Subtract mission range from the value shown at Point D and reenter the range scale with this value (Point E). Draw a line horizontally from Point E to intersect the range curve (Point F). From Point F, draw a line vertically to the time curve (Point G) and extend to the gross weight scale (Point H). Subtract the value at Point H from the value at Point A to obtain the fuel required for the mission range. Similarly, time may be found by drawing a horizontal line from the time curve Point B and Point G, to the time scale, Point I and Point J. The difference between the values shown at Point I and Point J is the time corresponding to the mission range.

MAXIMUM ENDURANCE POWER CONDITIONS

The maximum endurance power conditions charts (figures A5-14 and A5-15) present the calibrated airspeed (CAS), brake horsepower, rpm, manifold pressure and fuel flow for maximum endurance conditions at various gross weights for operation with two engines. Where applicable, the charts contain altitude curves which show operation in auto rich or auto lean mixture in low blower.

To determine CAS, power, rpm, manifold pressure, and fuel flow values, enter the chart at the aircraft gross weight and proceed vertically. The desired values may then be read as the vertical line intersects the particular curve. The endurance in hours is obtained by dividing the amount of fuel remaining to be used by the average total fuel flow in pounds per hour occuring between the initial and final gross weights. Where sudden changes occur in the fuel flow curve, the endurance calculation should be separated into parts at the gross weight where the break occurs, and the separate endurance times added together.

LEVEL FLIGHT PERORMANCE
TWO ENGINE

MODEL(S): C-47,
C-117 AND R4D

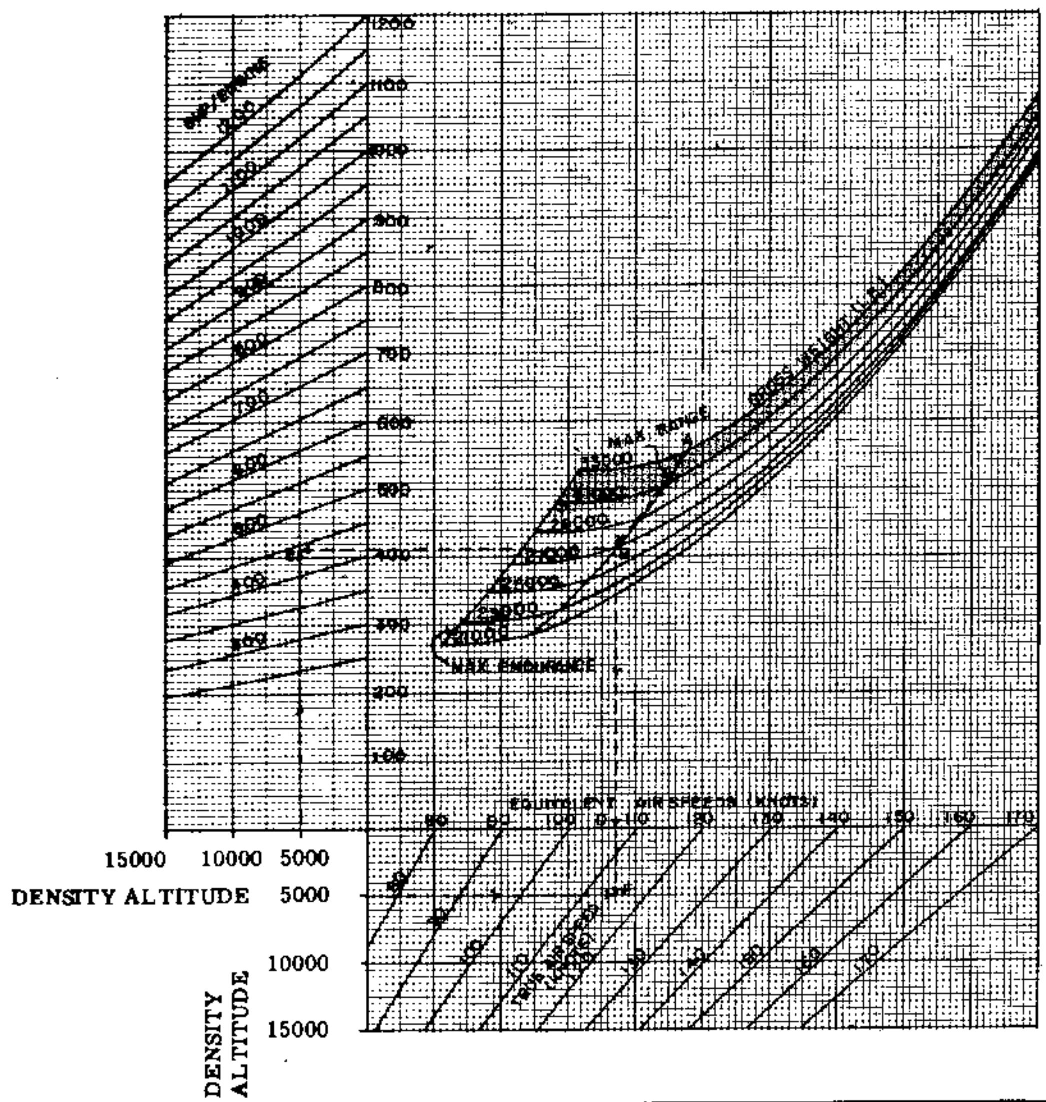
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

SAMPLE PROBLEM:

A. MAXIMUM RANGE.
B. GROSS WEIGHT = 27000 POUNDS.
C. BRAKE HORSEPOWER PER ENGINE = 440 AT 5000 FEET DENSITY ALTITUDE.
D. EQUIVALENT AIRSPEED = 107 KNOTS.
E. TRUE AIRSPEED = 115 KNOTS AT 5000 FEET DENSITY ALTITUDE.



A5-1. Level Flight Performance – Two Engines.

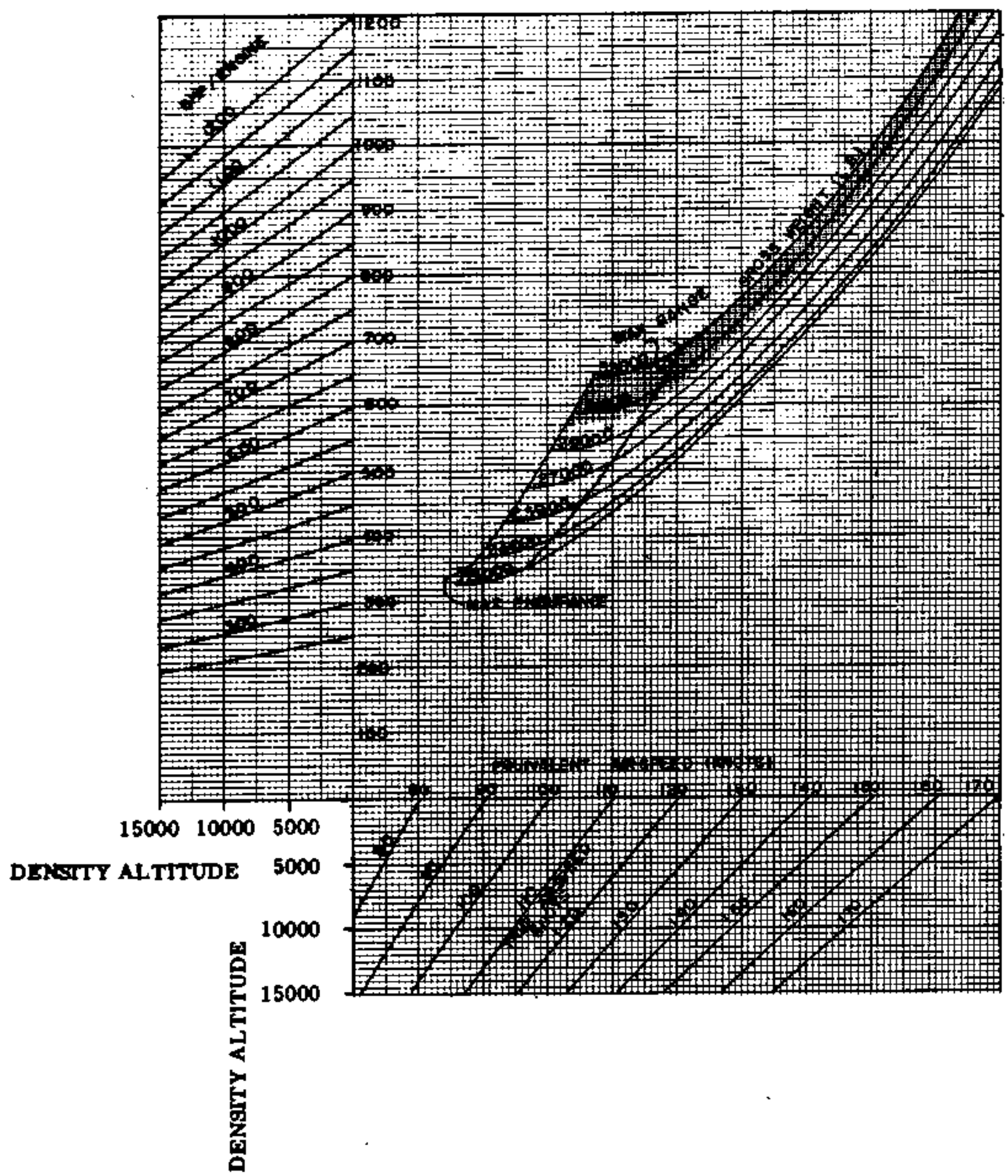
LEVEL FLIGHT PERFORMANCE - WITH SKIS
TWO ENGINE

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



A5-2. *Level Flight Performance – Two Engines - With Skis.*

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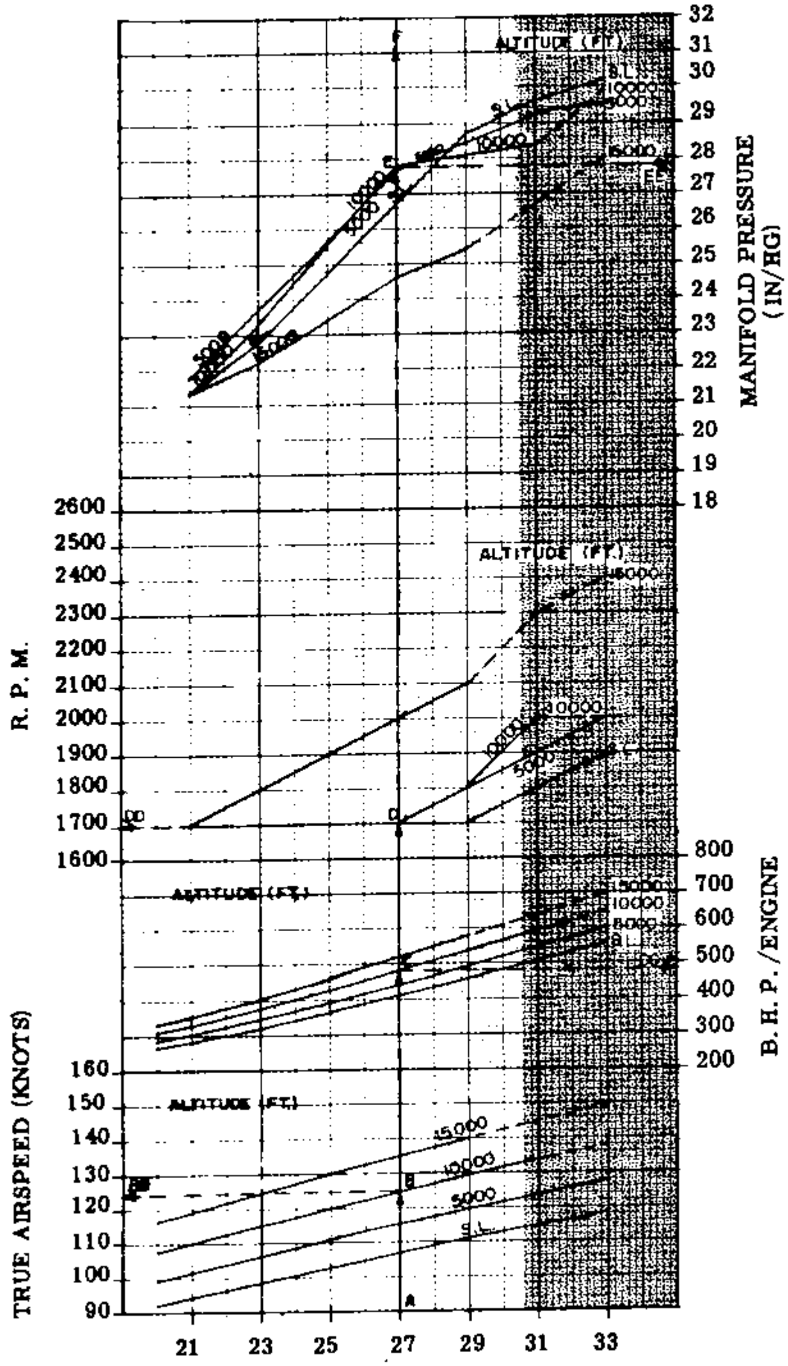
LONG RANGE POWER CONDITIONS
STANDARD DAY – TWO ENGINES



MODEL(S): C-47; C-117; and R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BASED ON: FLIGHT TEST DATA AS OF: 11 JULY 1957

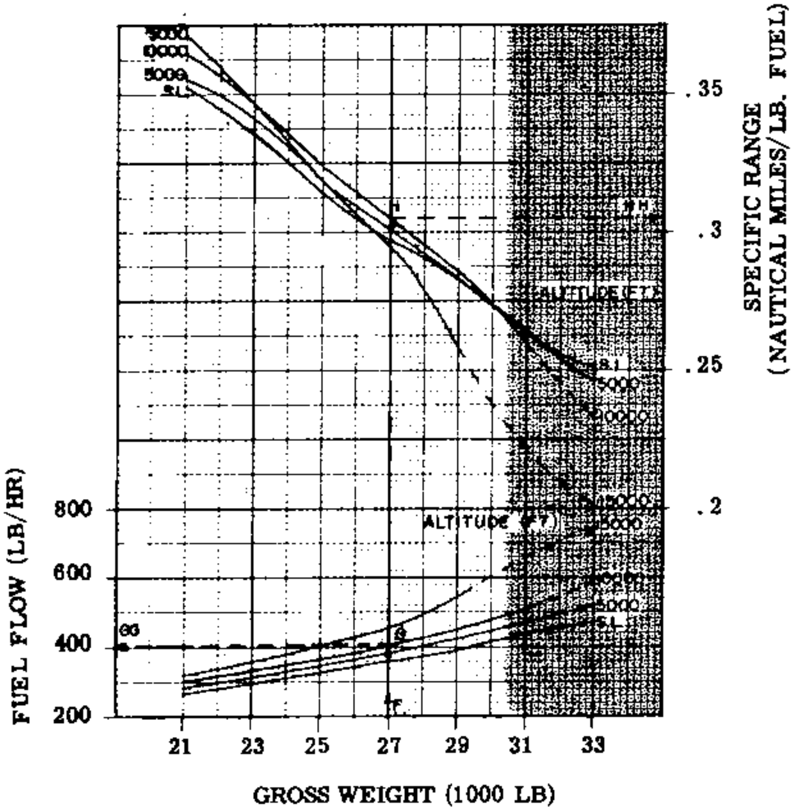
AUTO LEAN ________

AUTO RICH -----------

SAMPLE PROBLEM:
A, F. GROSS WEIGHT - 27000 pounds.
B, C, D, E, G and H. Altitude - 10,000 feet, standard day.
BB. True airspeed - 124.5 knots.
CC. Brake horsepower - 480.
DD. RPM - 1700.
EE. Manifold pressure - 27.5 IN. HG.
GG. Fuel flow - 405 pounds per hour.
HH. Specific range - .305 nautical miles per pound of fuel.

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 1 of 2)

LONG RANGE POWER CONDITIONS
STANDARD DAY-TWO ENGINES



MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ————

AUTO RICH ---------

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 2 of 2)

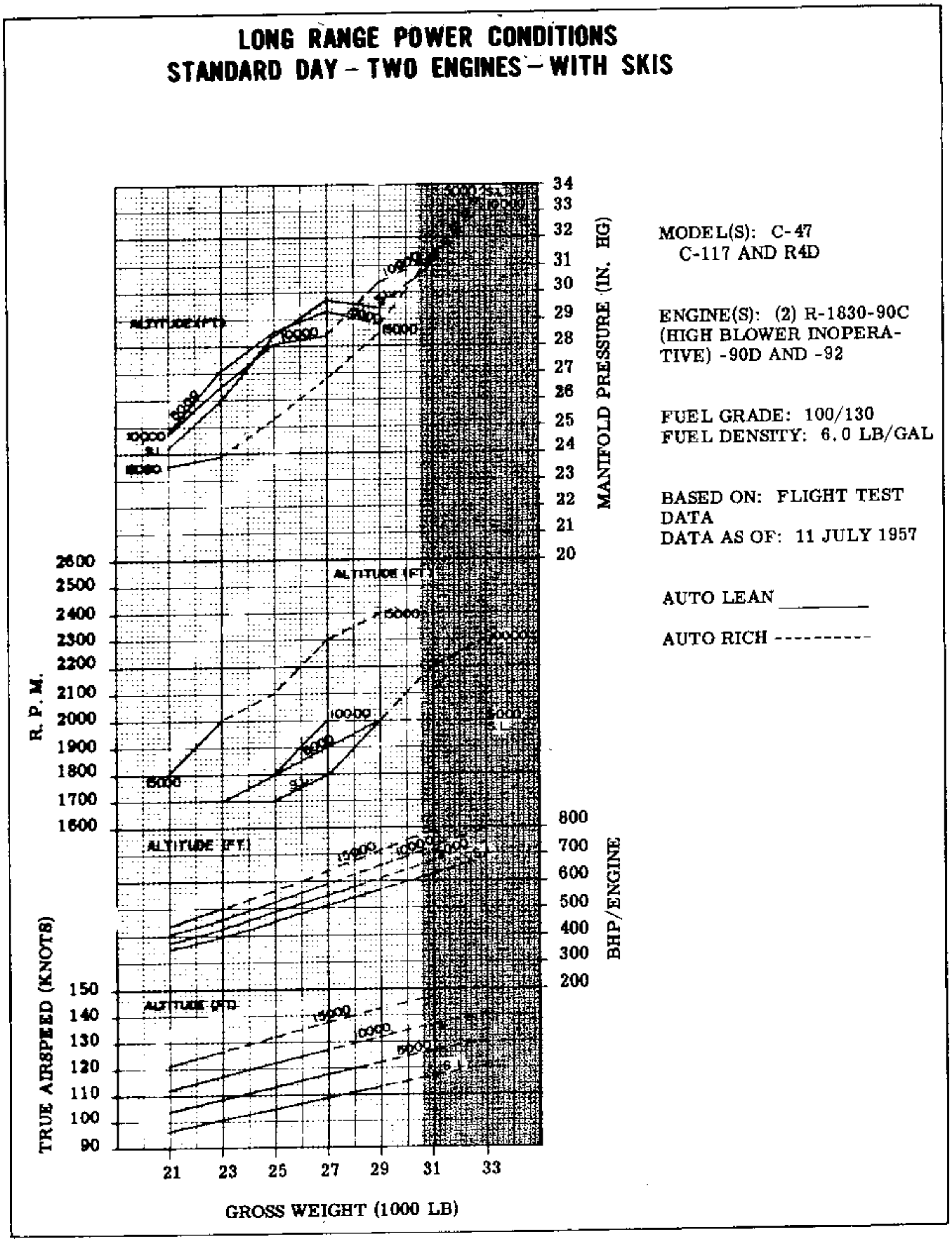
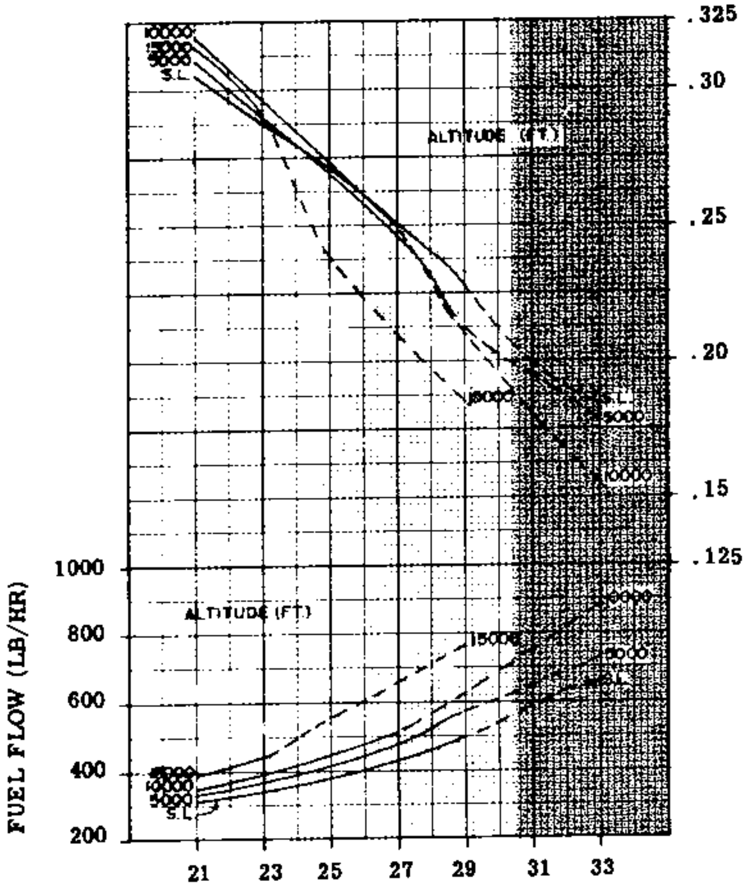


Figure A5-4. Long Range Power Conditions - Standard Day - Two Engines - With Skis (Sheet 1 of 2)

LONG RANGE POWER CONDITIONS
STANDARD DAY - TWO ENGINES - WITH SKIS



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ______

AUTO RICH -------

Figure A5-4. Long Range Power Conditions - Standard Day - Two Engines - With Skis (Sheet 2 of 2)

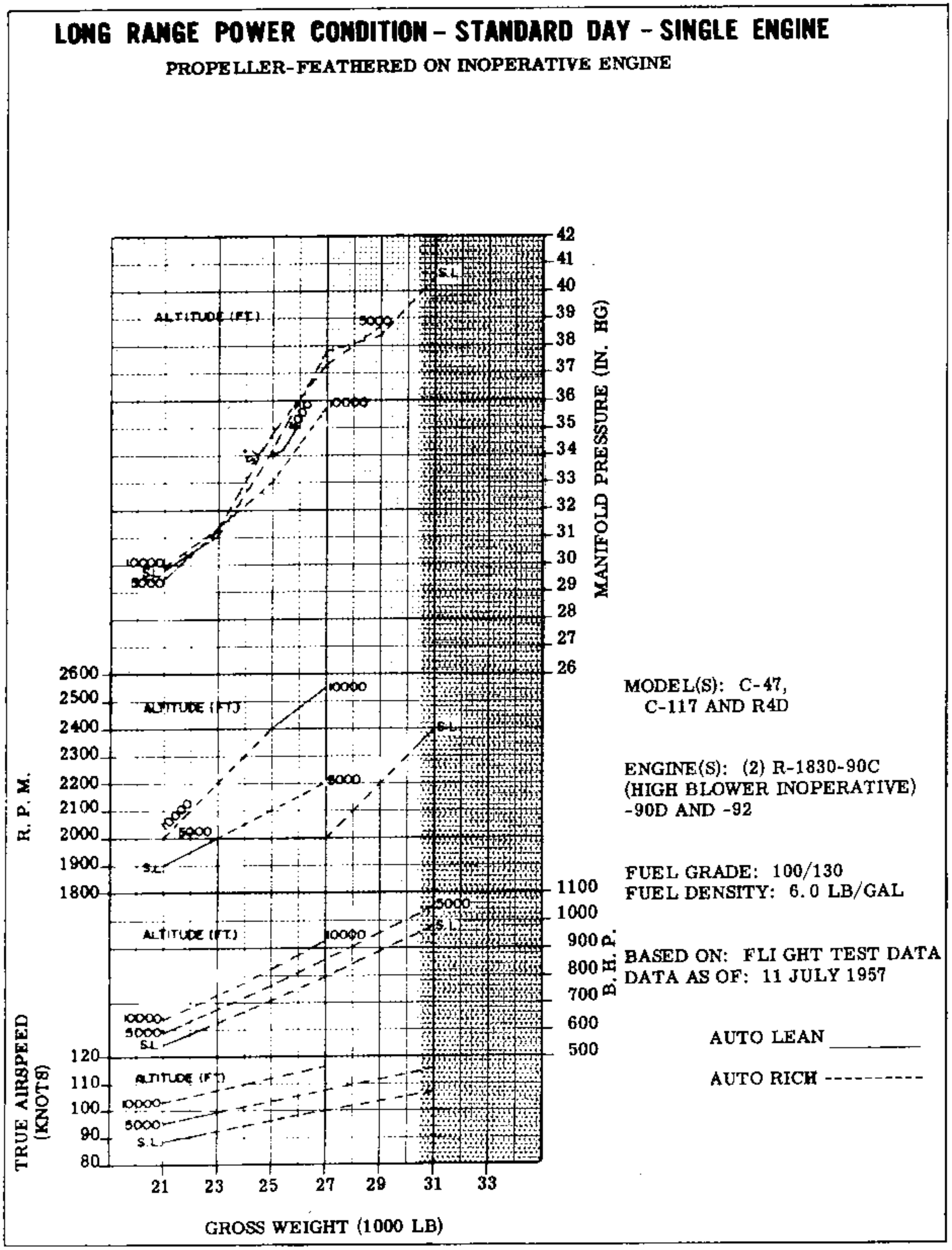
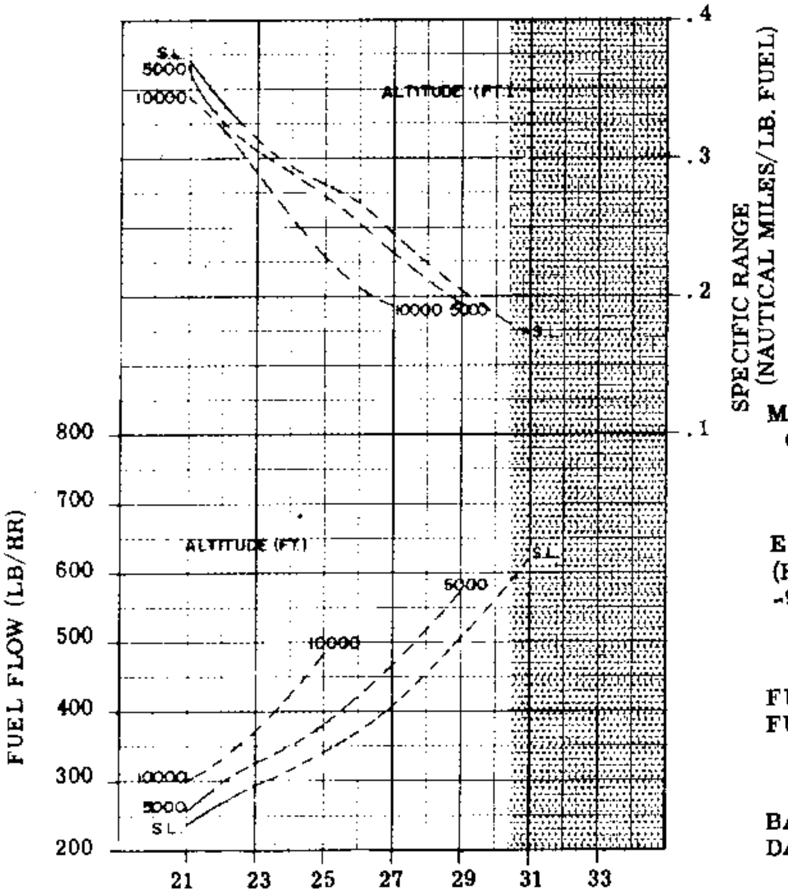


Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 1 of 2)

LONG RANGE POWER CONDITION-STANDARD DAY-SINGLE ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ______

AUTO RICH - - - - -

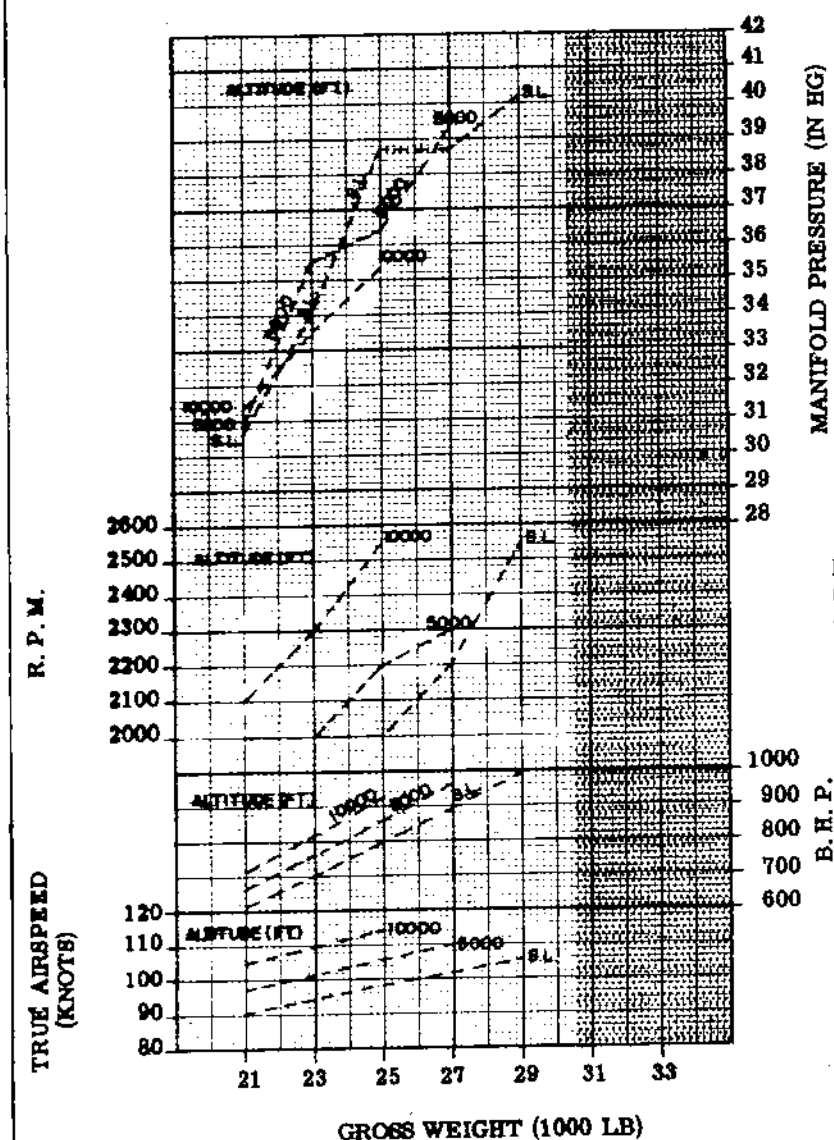
Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 2 of 2)

LONG RANGE POWER CONDITION - STANDARD DAY - SINGLE ENGINE - WITH SKIS

PROPELLER - FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957



AUTO LEAN ________

AUTO RICH ---------

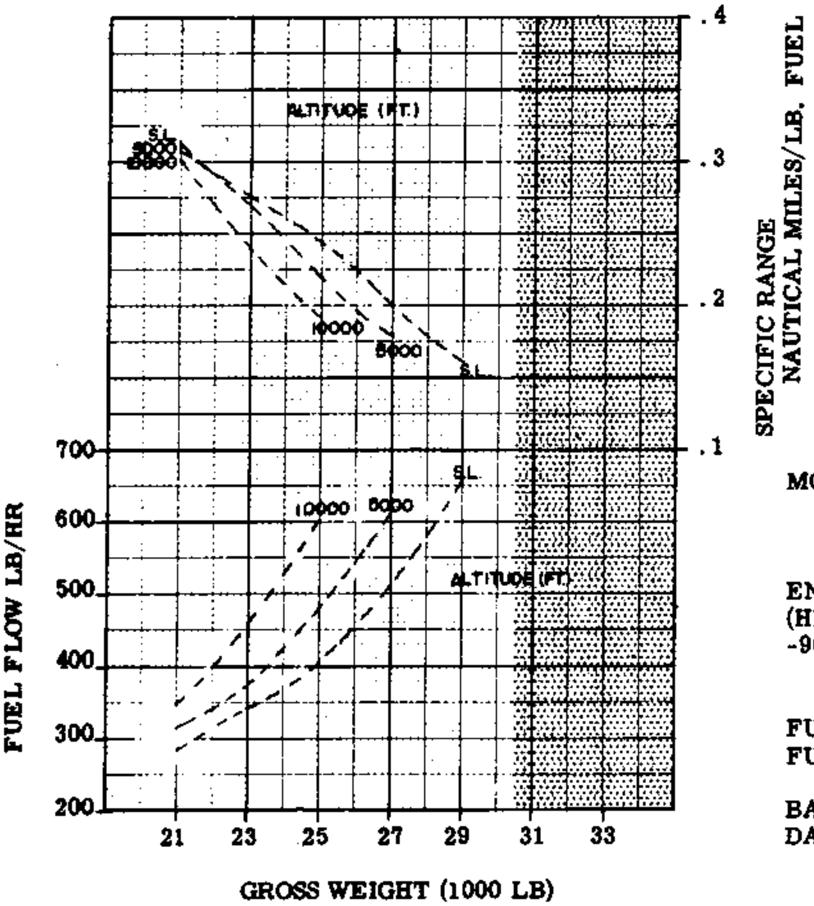
ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A5-6. Long Range Power Condition - Standard Day - Single Engine - With Skis (Sheet 1 of 2)

LONG RANGE POWER CONDITION - STANDARD DAY- SINGLE ENGINE -WITH SKIS

PROPELLER - FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ________
AUTO RICH -----------

Figure A5-6. Long Range Power Condition - Standard Day - Single Engine - With Skis (Sheet 2 of 2)

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE SEA LEVEL

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

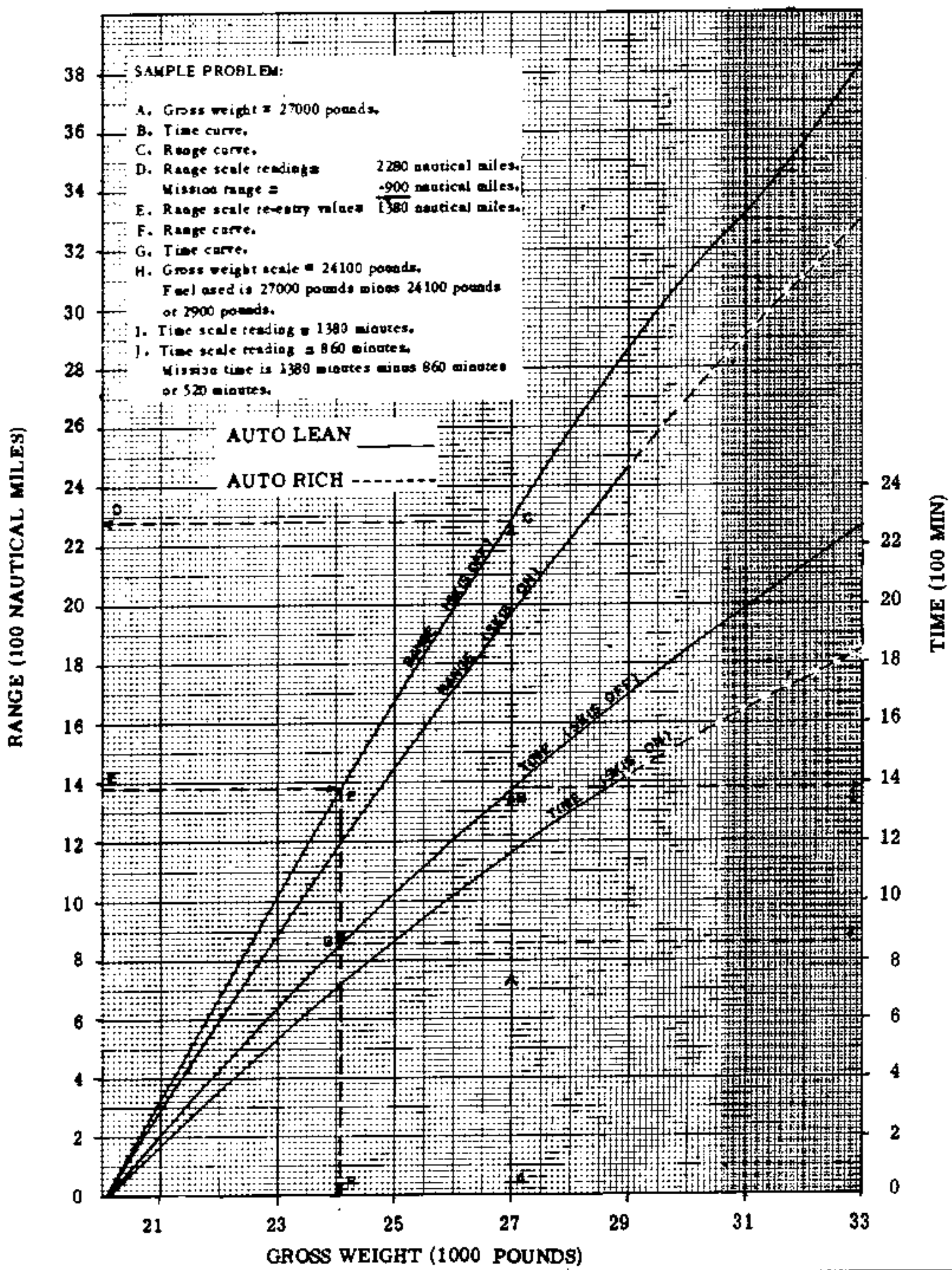


Figure A5-7. Flight Planning for Long Range Cruise Condition - Two Engines - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE 5000 FT. ALTITUDE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

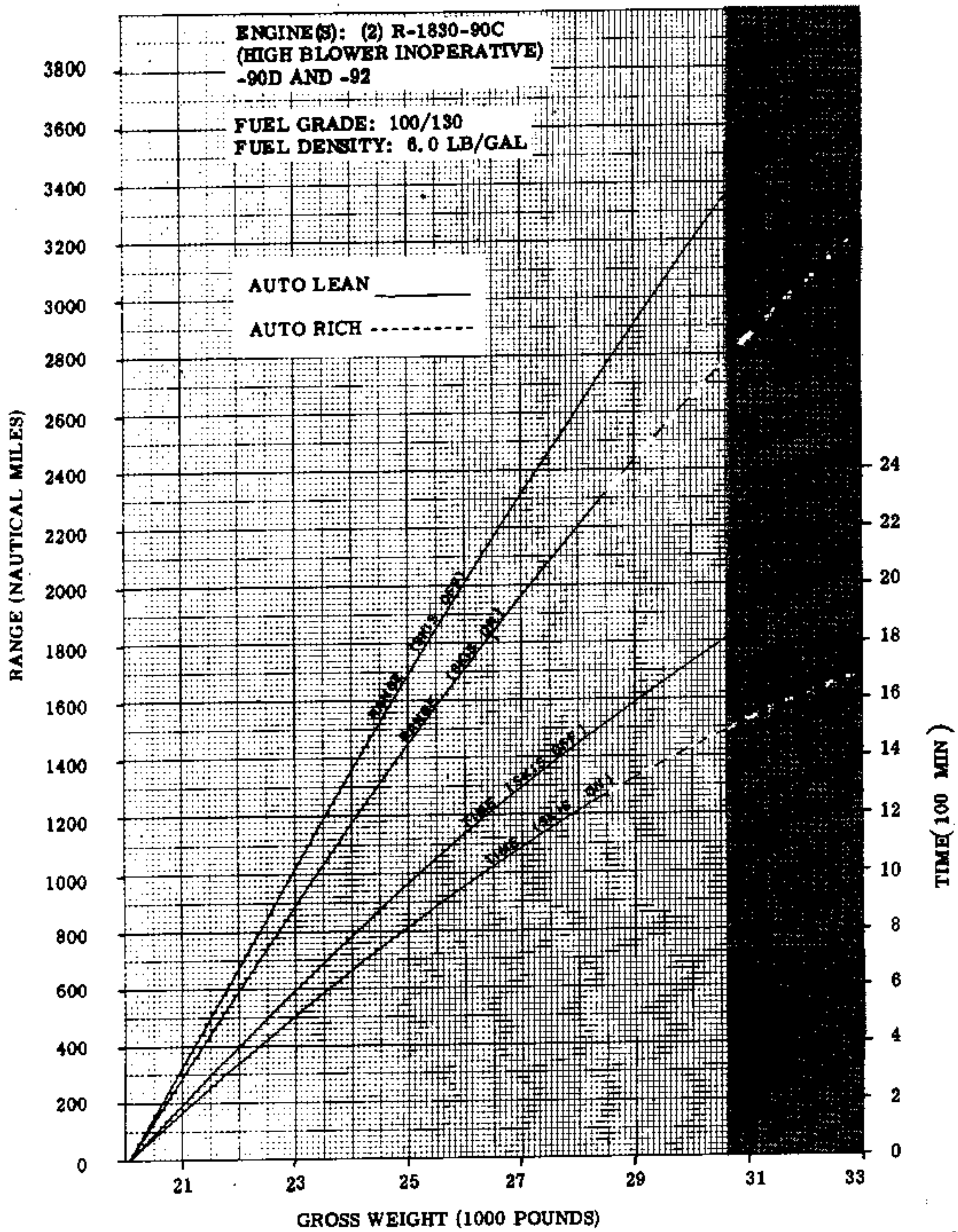


Figure A5-8. Flight Planning for Long Range Cruise Condition - Two Engines - 5000 Ft.

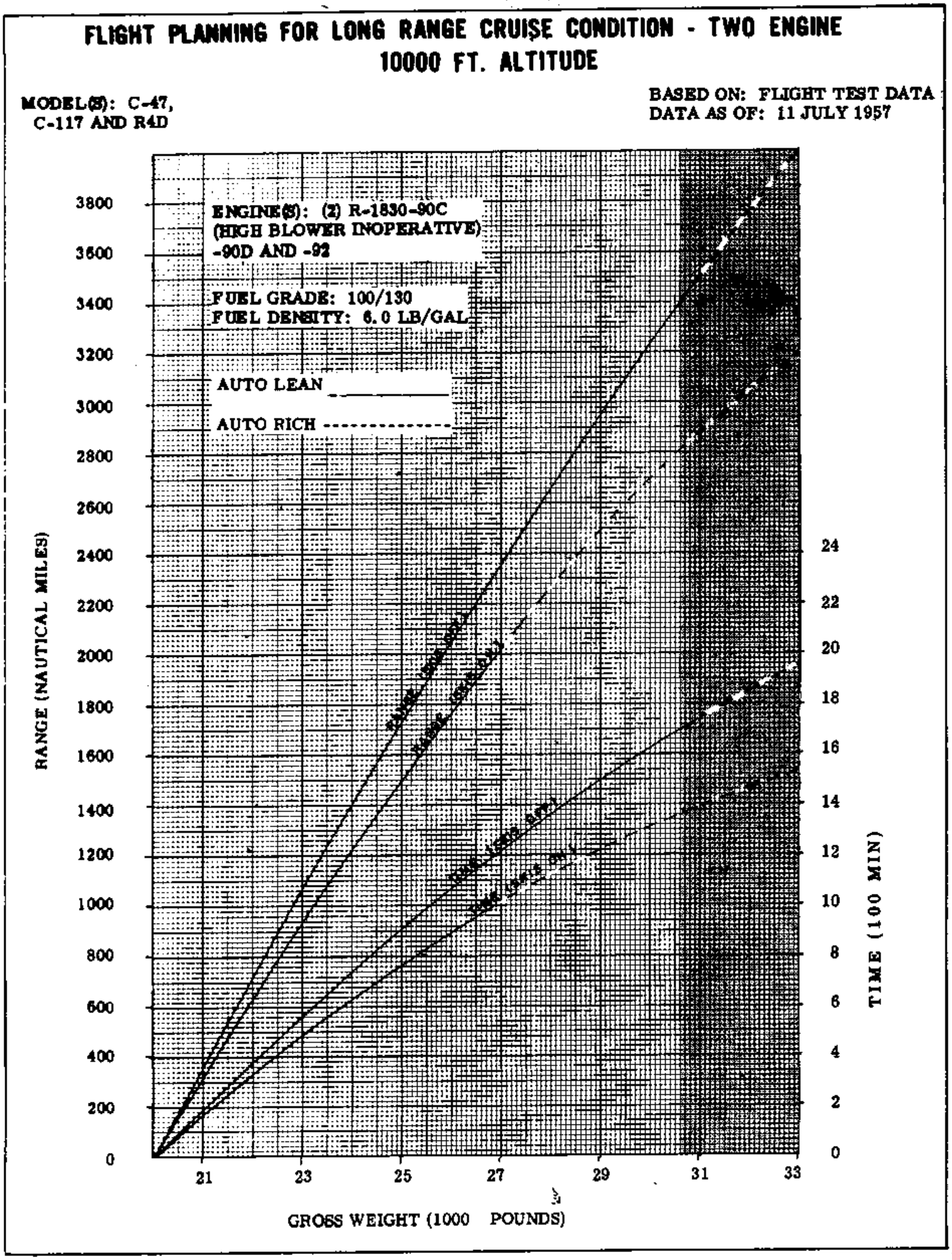


Figure A5-9. Flight Planning for Long Range Cruise Condition - Two Engines - 10000 Ft.

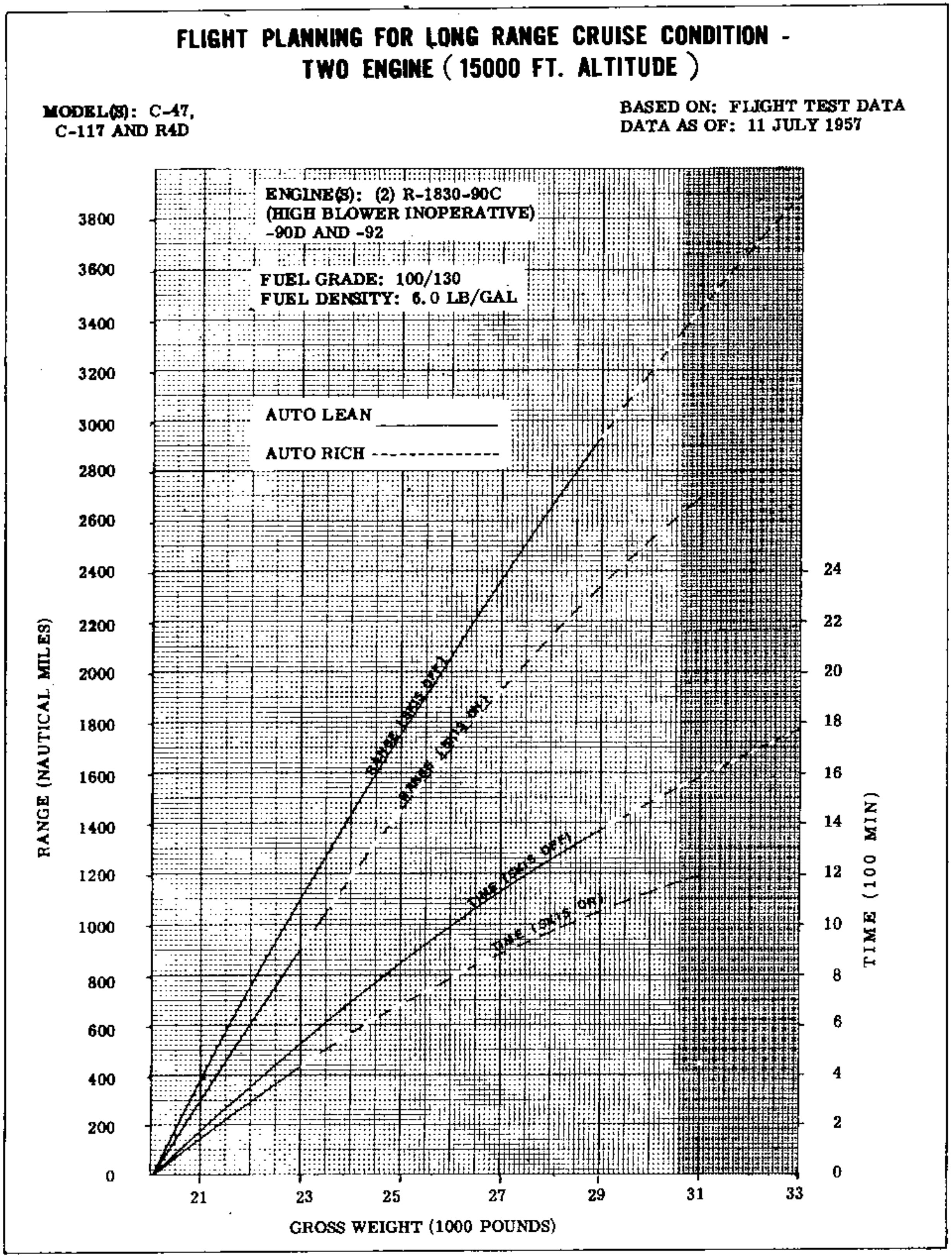


Figure A5-10. Flight Planning for Long Range Cruise Condition - Two Engines - 15000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION
SINGLE-ENGINE SEA LEVEL

PROPELLER: FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

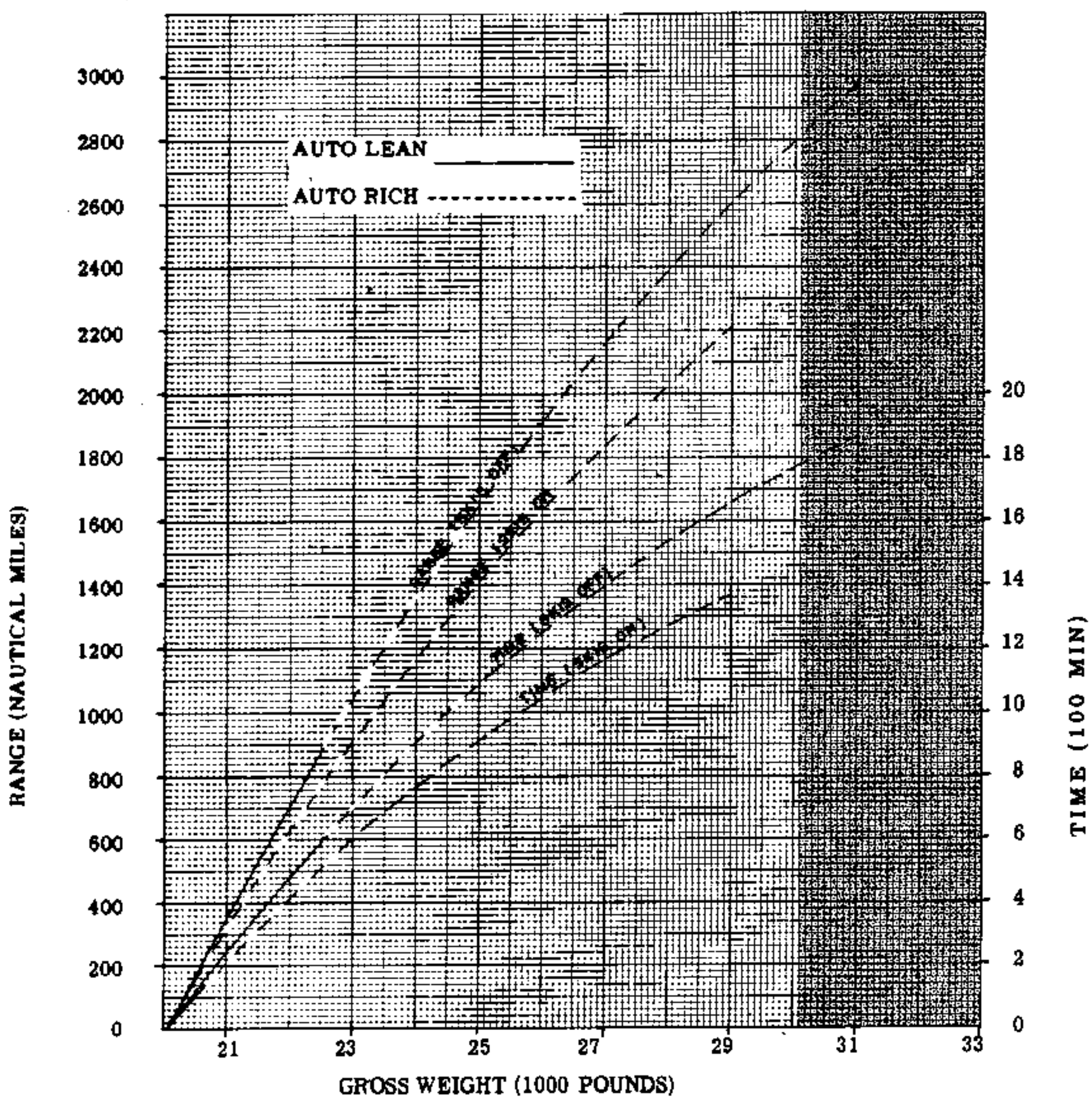


Figure A5-11. Flight Planning for Long Range Cruise Condition - Single Engine - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION
SINGLE ENGINE (5000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

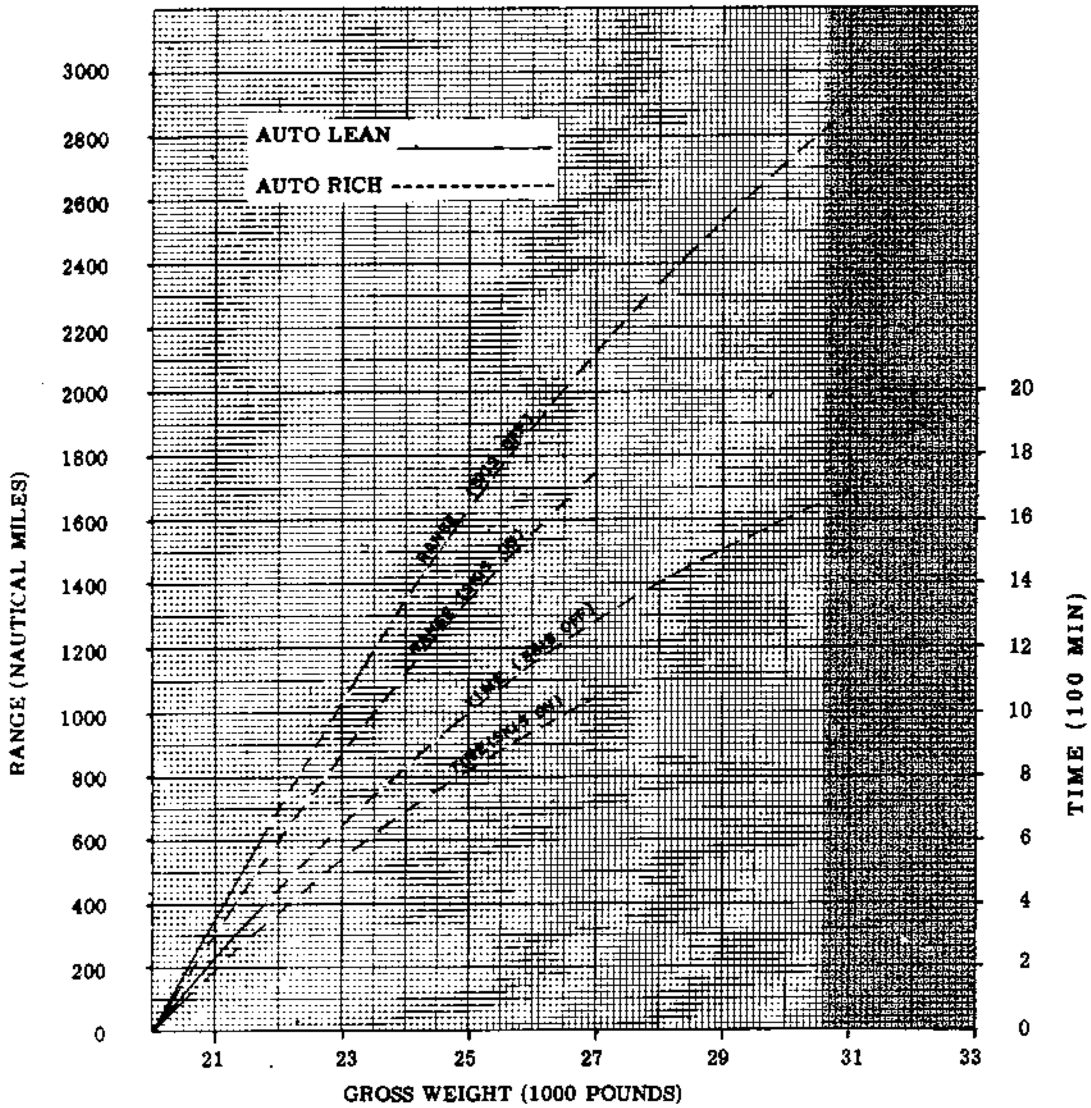


Figure A5-12. Flight Planning for Long Range Cruise Condition - Single Engine - 5000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - SINGLE-ENGINE (10000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

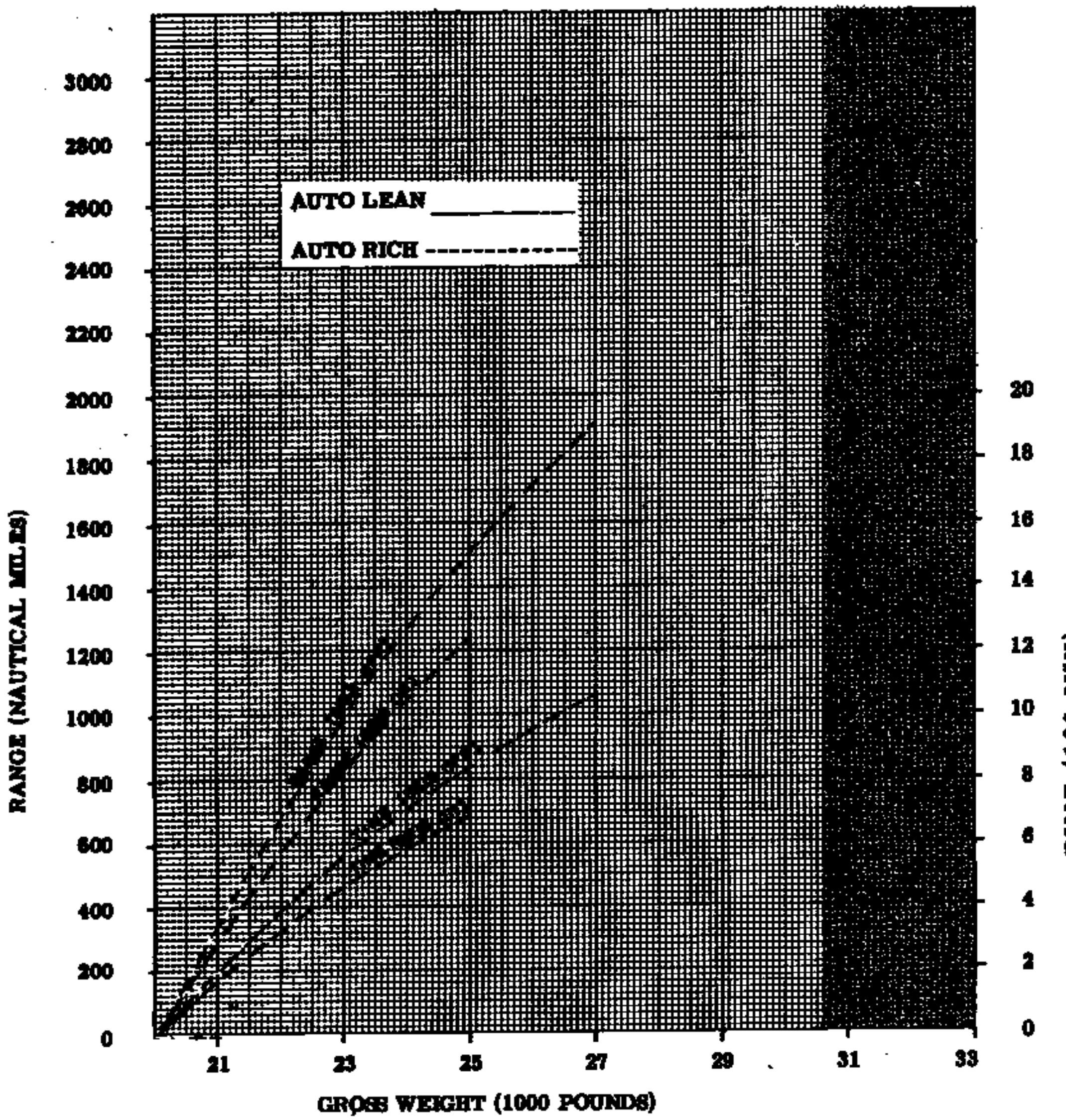


Figure A5-13. Flight Planning for Long Range Cruise Condition - Single Engine - 10000 Ft.

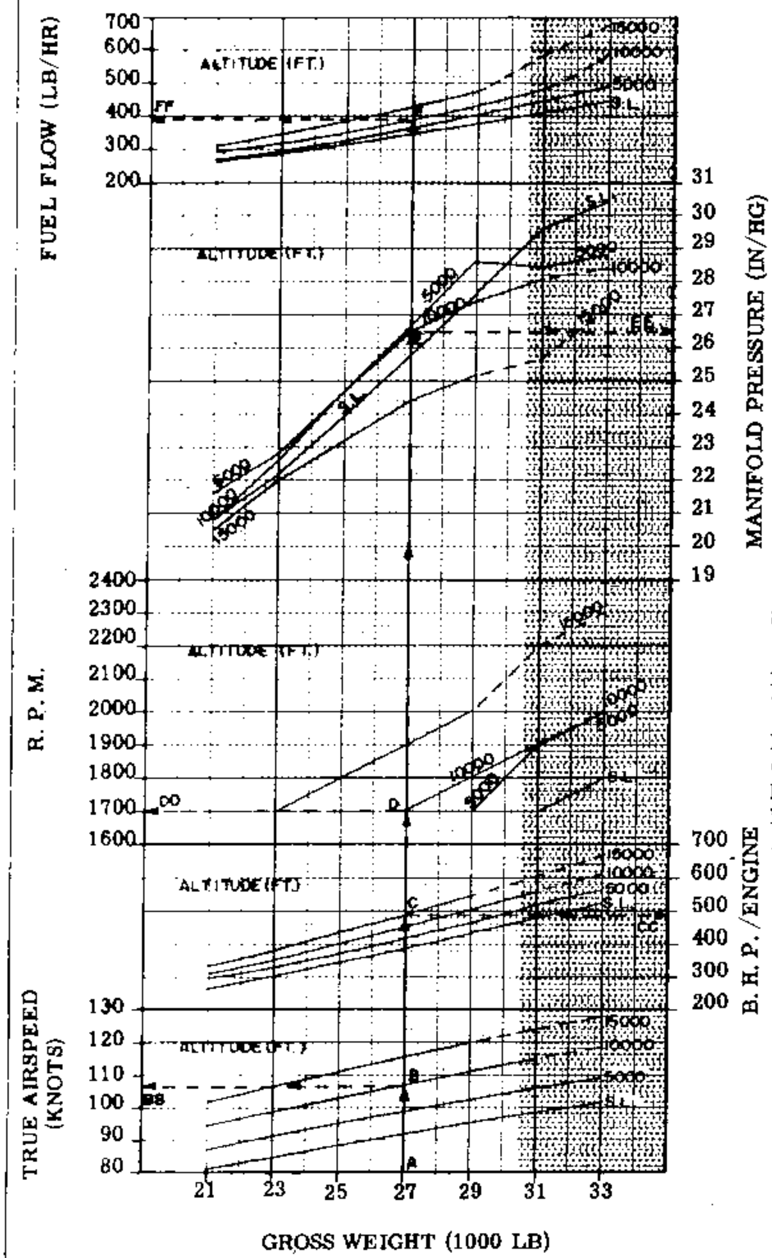
MAXIMUM ENDURANCE POWER CONDITION - TWO-ENGINE
STANDARD DAY

MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



AUTO LEAN ________

AUTO RICH ----------

SAMPLE PROBLEM

A. GROSS WEIGHT = 27000 POUNDS.
B, C, D, E AND F = 10,000 FEET ALTITUDE.
BB. TRUE AIRSPEED = 106.5 KNOTS.
CC. BRAKE HORSEPOWER = 490.
DD. RPM = 1700.
EE. MANIFOLD PRESSURE = 26.5.
FF. FUEL FLOW = 390 POUNDS PER HOUR.

Figure A5-14. Maximum Endurance Power Condition - Two Engines.

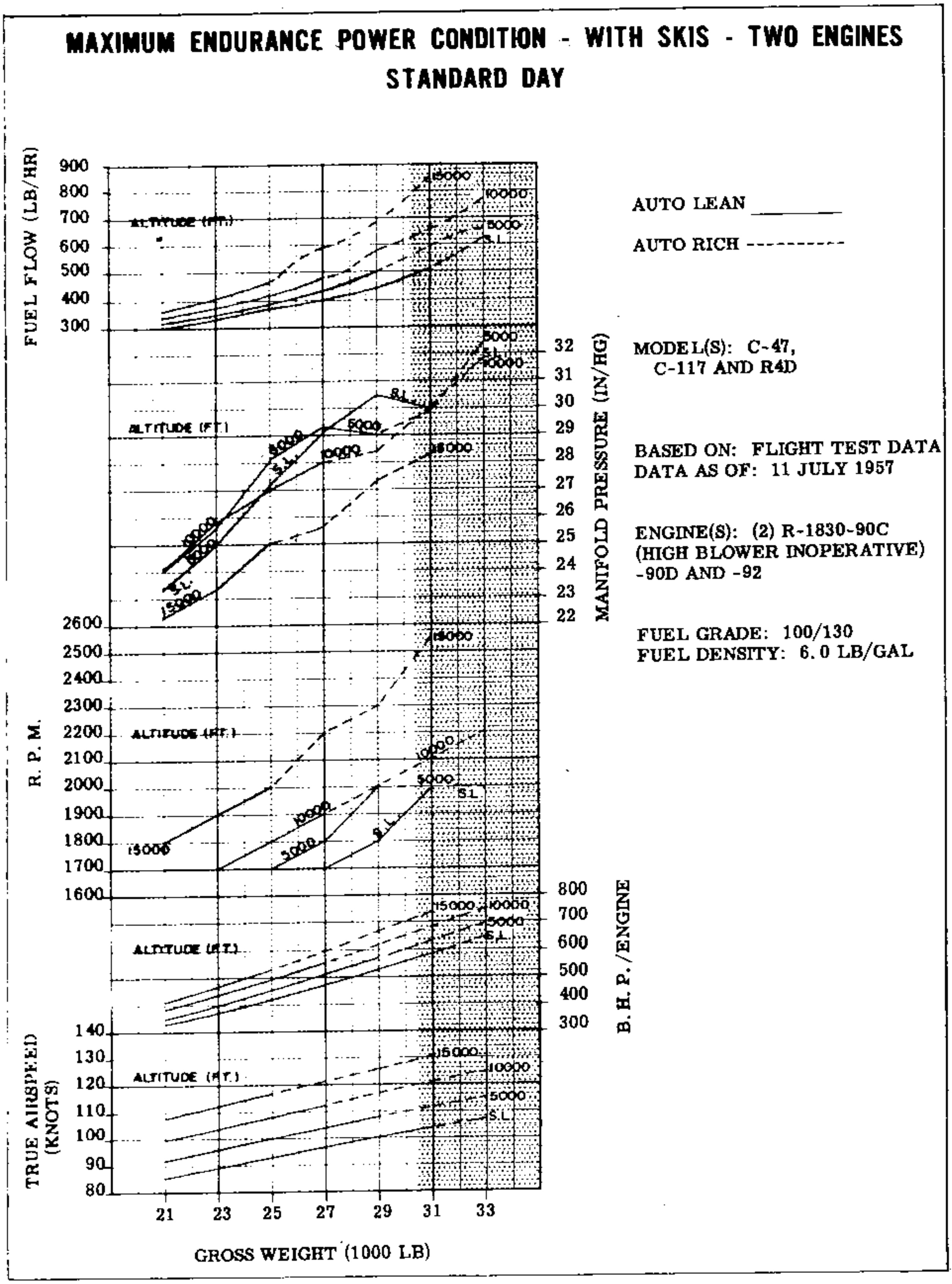


Figure A5-15. Maximum Endurance Power Condition - With Skis - Two Engines.

PART SIX
LANDING

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DISCUSSION OF CHARTS.

The landing charts are included to enable the pilot to determine the length of the runway necessary to land the aircraft safely under various conditions of wind, temperature, altitude, and runway surface. Since the length of the landing ground run depends to a great extent on the coefficient of friction (μ) numerical values of μ are shown on the landing ground run charts (figures A6-1 through A6-4) corresponding to the most commonly encountered runway surface conditions.

LANDING GROUND RUN

The landing ground run charts (figures A6-1 through A6-4) are used to determine that landing ground run distance at various combinations of OAT, pressure and density altitudes (up to 16,000 feet), gross weight, actual wind component, and runway surface condition. The charts are based on the recommended touchdown speed obtained from the characteristic landing speeds chart (figure A6-5). These charts give ground run only; to compute landing distance from a 50-foot height, first determine landing ground run for prevailing runway surface conditions, then add 95 percent of the landing ground run for hard runway surface. The sum of these two distances will give the approximate total landing distance from a 50-foot height. A sample problem is included on each chart.

CHARACTERISTIC LANDING SPEEDS.

The characteristic landing speed chart (figure A6-5) presents recommended touchdown speeds in both knots and MPH indicated airspeed with zero, ¼, ½, and full flaps for various aircraft gross weights. All lines represent the 110 percent power off stall speed for the flap position shown. Enter the chart at the planned landing gross weight and proceed vertically to the appropriate speed curve, then proceed horizontally to the indicated airspeed.

POWER-OFF STALL SPEEDS.

Power-off stall speed charts (figure A6-6 through A6-9) are included for zero, ¼, ½ and full DOWN (45°) flap settings. The power-off stall speeds were determined with the throttles in the CLOSED position. When power is maintained on the engines, the airflow over the wings behind the propellers is increased and therefore increases lift and lower the stalling speed. This effect varies with power setting.

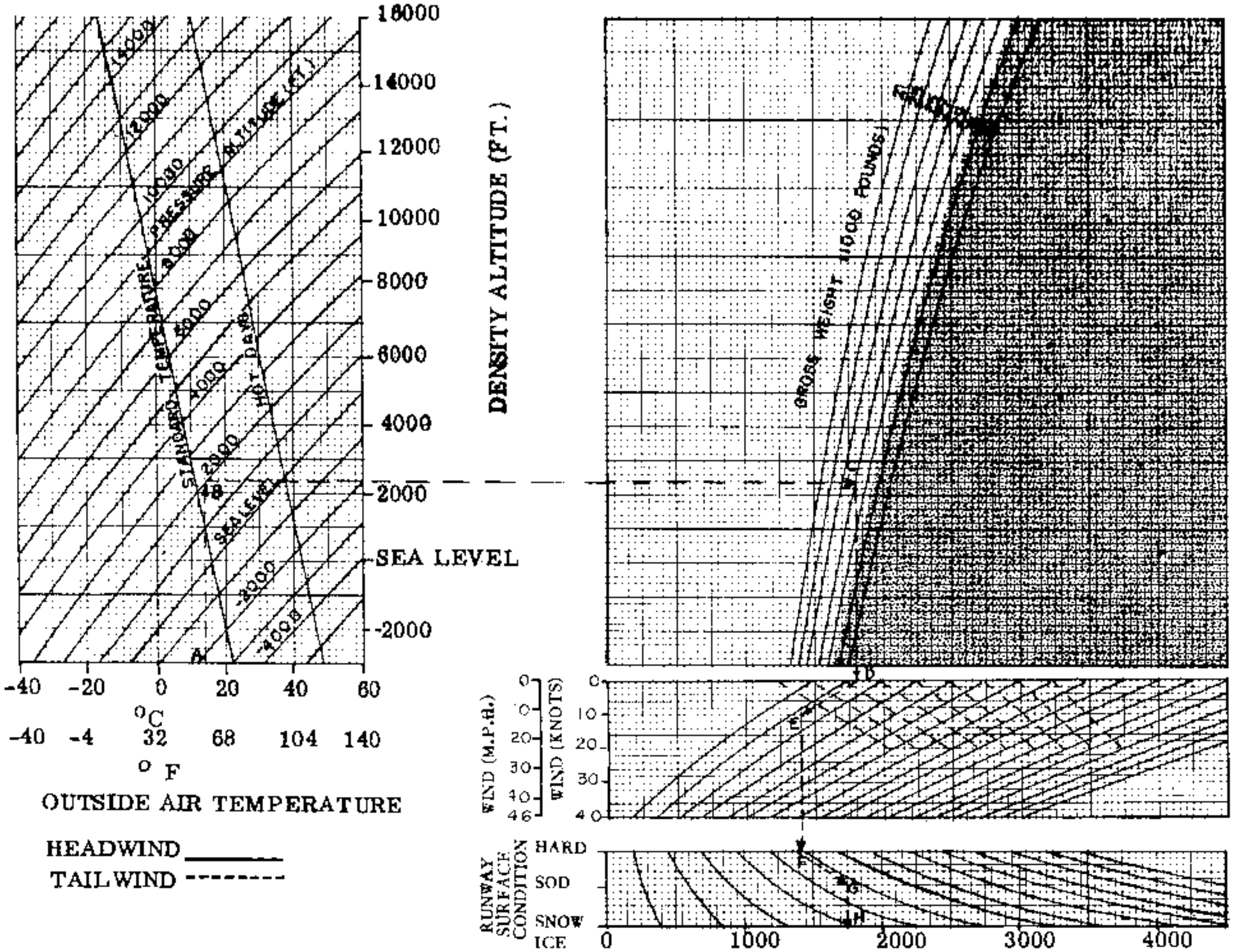
LANDING GROUND RUN

TOUCHDOWN AT 1.1Vs
WING FLAPS = 45 DEGREES
IDLE POWER

MODEL(S): C-47, C-117
AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



SAMPLE PROBLEM:

A. Outside air temperature = 14°C.
B. Pressure altitude = 2000 feet.
C. Gross weight = 27000 pounds.
D. Base line.
E. Reported headwind = 20 knots.
F. Base line and run distance on hard surface runway = 1400 feet.
G. Runway surface condition = sod.
H. Ground run distance on sod surface = 1750 feet.

NOTE:

1. Speed at 50 foot height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 45 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 foot height to touchdown is approximately 85 percent of landing ground run on hard surface for 45 degrees flap. Total landing distance from a 50 foot height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

Figure A6-1. Landing Ground Run – Touchdown at 1.1V_s – Wing Flaps - 45 Degrees.

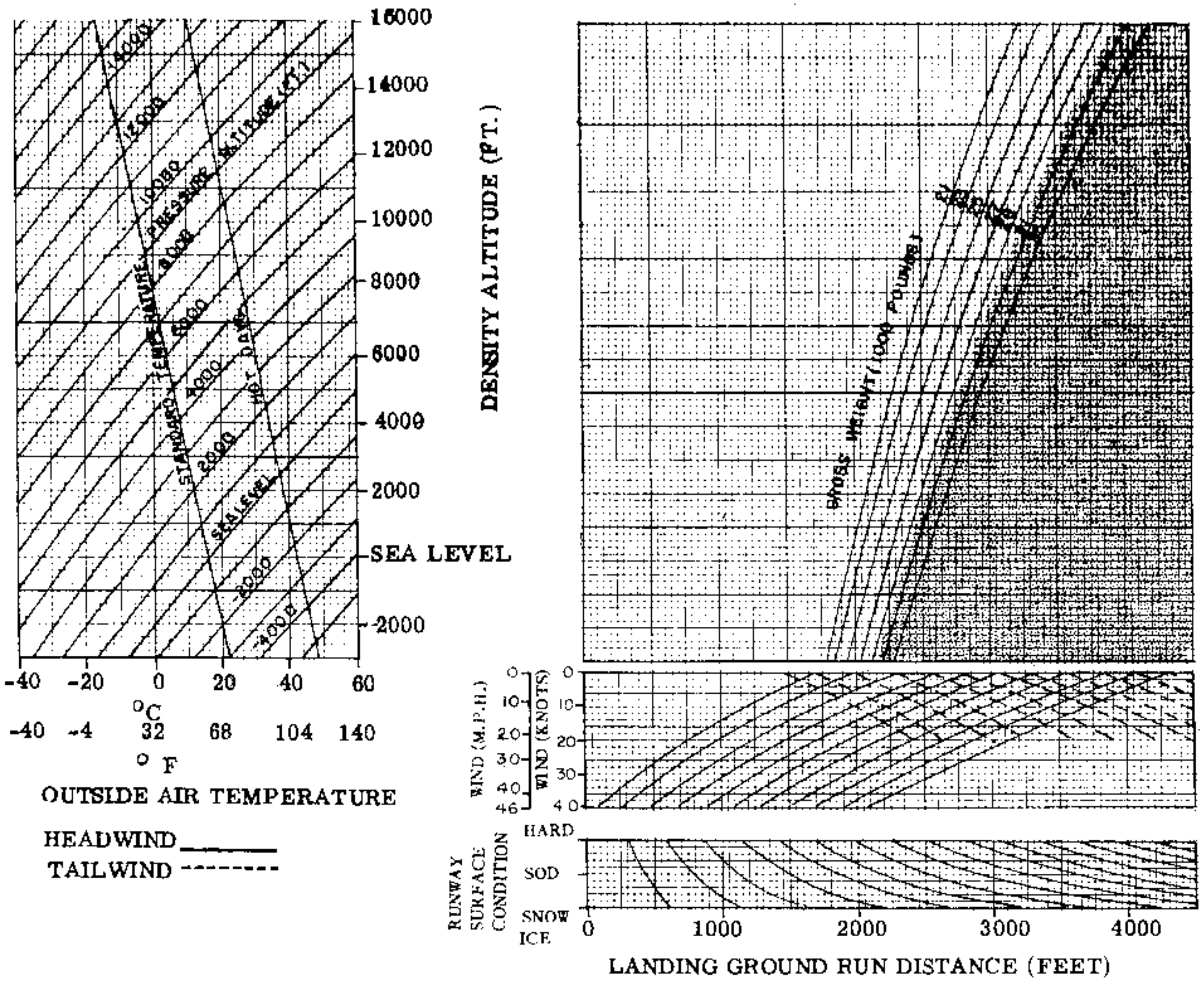
MODEL(S): C-47, C-117
AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

LANDING GROUND RUN

TOUCHDOWN AT 1.1V$_S$
WING FLAPS = 0 DEGREES
IDLE POWER

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



NOTE:

1. Speed at 50 feet height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 0 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 feet height to touchdown is approximately 50 percent of landing ground run on hard surface for 0 degrees flap. Total landing distance from a 50 feet height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

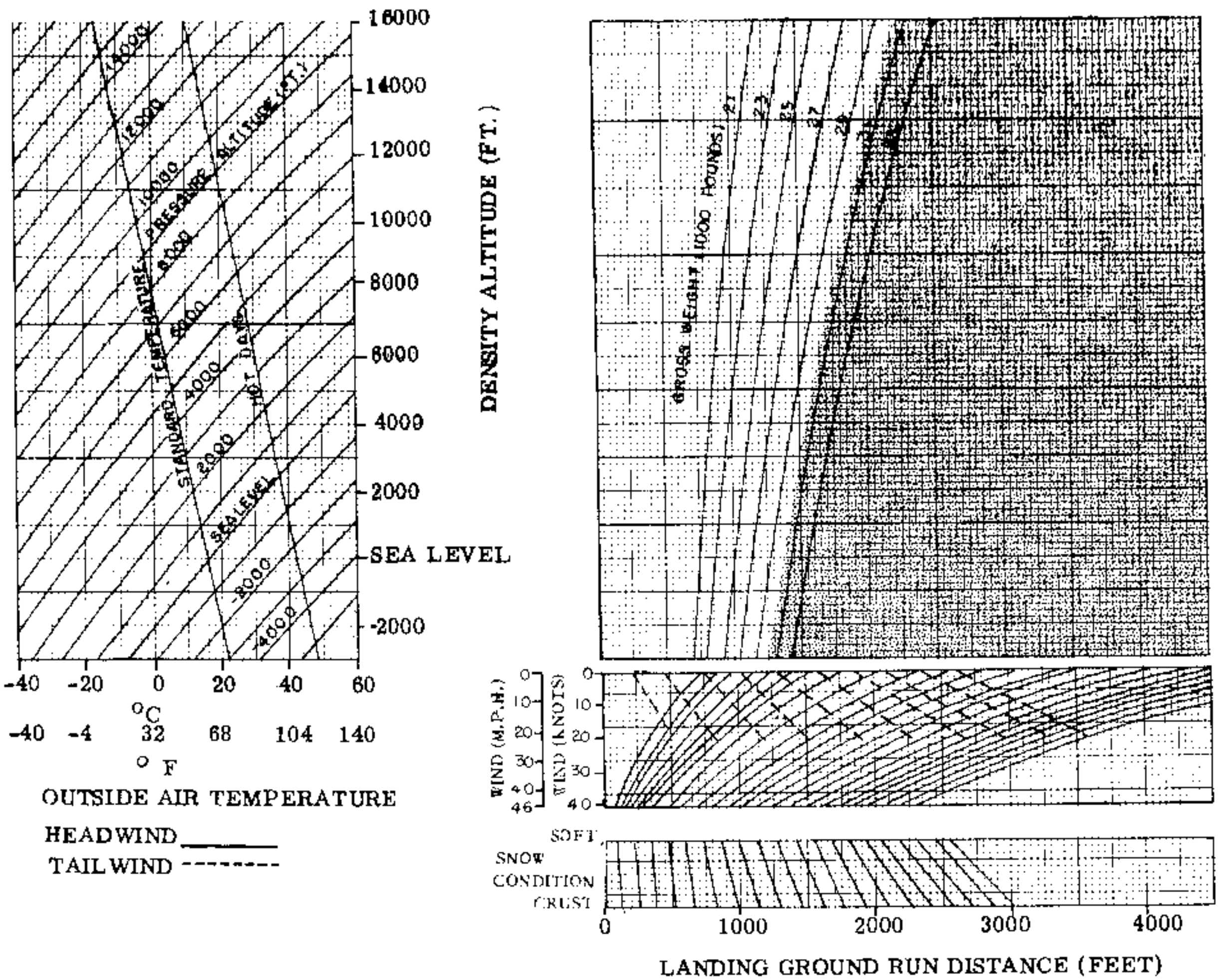
Figure A6-2. Landing Ground Run – Touchdown at 1.1V$_S$ – Wing Flaps - 0 Degrees.

SNOW LANDING GROUND RUN SKIS DOWN

TOUCHDOWN AT 1.1 V_s
WING FLAPS - 45 DEGREES
IDLE POWER

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117
AND R4D



NOTE:

1. Speed at 50 feet height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 45 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 feet height to touchdown is approximately 75 percent of landing ground run on hard surface for 45 degrees flap. Total landing distance from a 50 feet height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

Figure A6-3. Snow Landing Ground Run – Skis Down - Touchdown at $1.1V_s$ – Wing Flaps - 45 Degrees.

PACKED SNOW LANDING GROUND RUN (WITH SKIS)

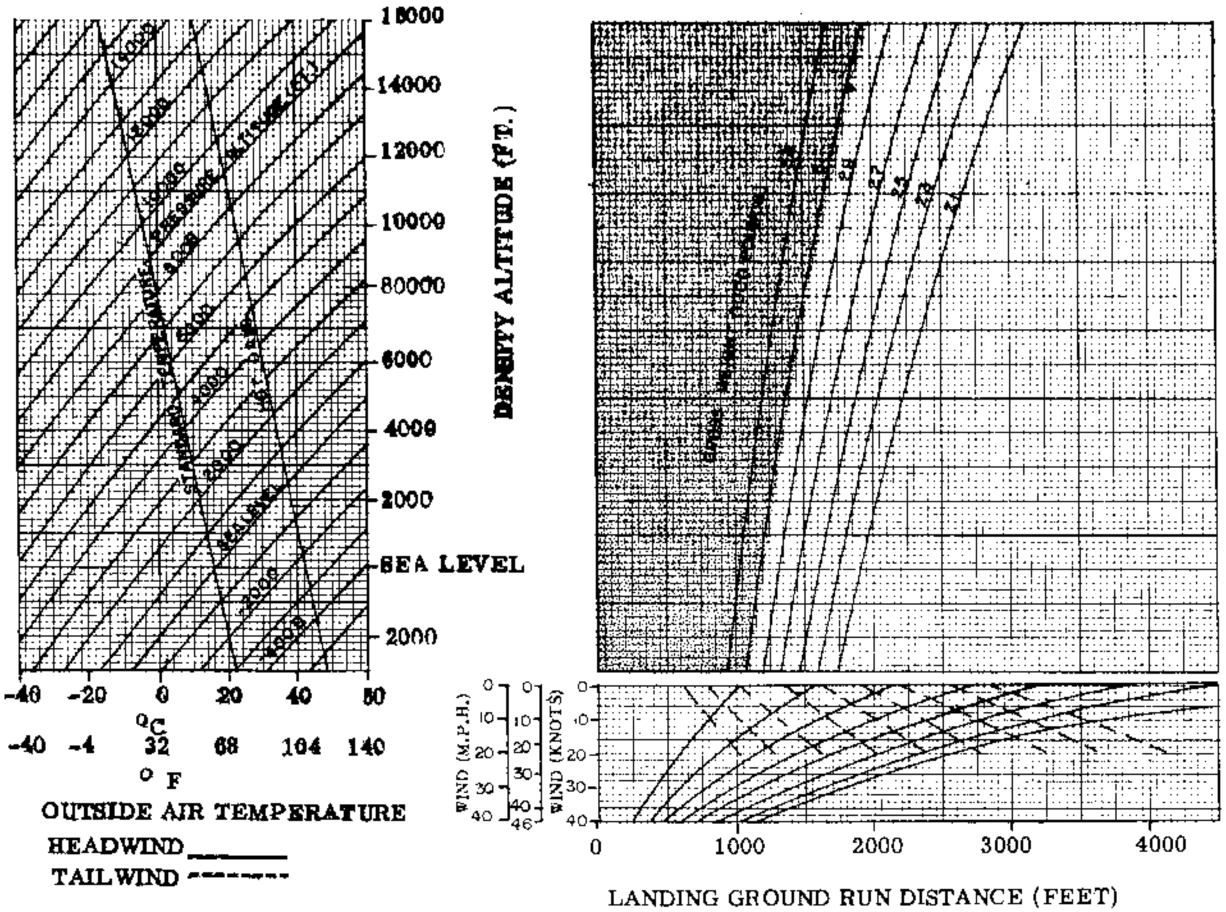
TOUCHDOWN AT 1.1Vs

WING FLAPS 45 DEGREES

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

IDLE POWER



NOTE:

1. Speed at 50 feet height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 45 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 feet height to touchdown is approximately 75 percent of landing ground run on hard surface for 45 degrees flap. Total landing distance from a 50 feet height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other that runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

CAUTION

This landing data is based on the following conditions:

1. Touch down with landing gear down, skis fully extended.
2. Retract skis and apply brakes at normal braking conditions.

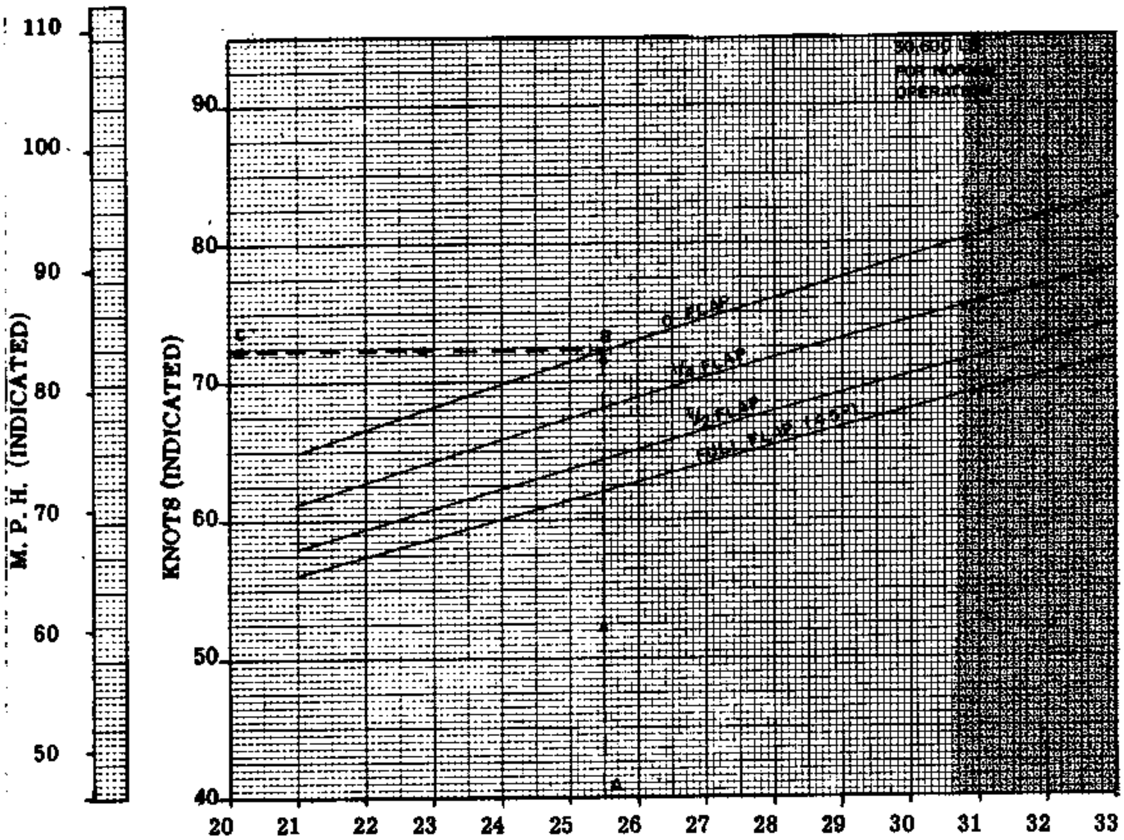
Figure A6-4. Packed Snow Landing Ground Run – Skis Down – Touchdown at $1.1V_s$ – Wing Flaps - 45 Degrees.

CHARACTERISTIC LANDING SPEEDS
TOUCHDOWN AT1.1Vs

MODELS: C-47, C-117,
AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH JBLOWER INOPERATIVE)
- 90D and -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949



CONVERSION TABLE	
TO GET FROM TOUCHDOWN SPEED $1.1V_s$ TO:	MULTIPLY BY
THRESHOLD ($1.2V_{stall}$)	1.09
FINAL APPROACH ($1.3V_{stall}$)	1.182
BEFORE TURNING FINAL ($1.4V_{stall}$)	1.272

NOTE:
1. SPEED OVER A 50 FEET HEIGHT IS $1.2V_s$.
2. SPEEDS GIVEN ARE AIRSPEED INDICATOR READINGS.
3. A FIVE KNOT CORRECTION FOR POSITION ERROR HAS BEEN SUBTRACTED.
4. NO INSTRUMENT ERROR IS INCLUDED.

SAMPLE PROBLEM:

GIVEN:
1. GROSS WEIGHT = 25,500 POUNDS (POINT A).
2. WING FLAP SETTING = ZERO (POINT B).

FIND:
1. TOUCHDOWN SPEED = 72.2 KNOTS (POINT C).

Figure A6-5. Characteristic Landing Speeds – Touchdown at $1.1V_s$.

POWER OFF STALL SPEEDS 0 FLAPS

MODEL(S): C-47, C-117
AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

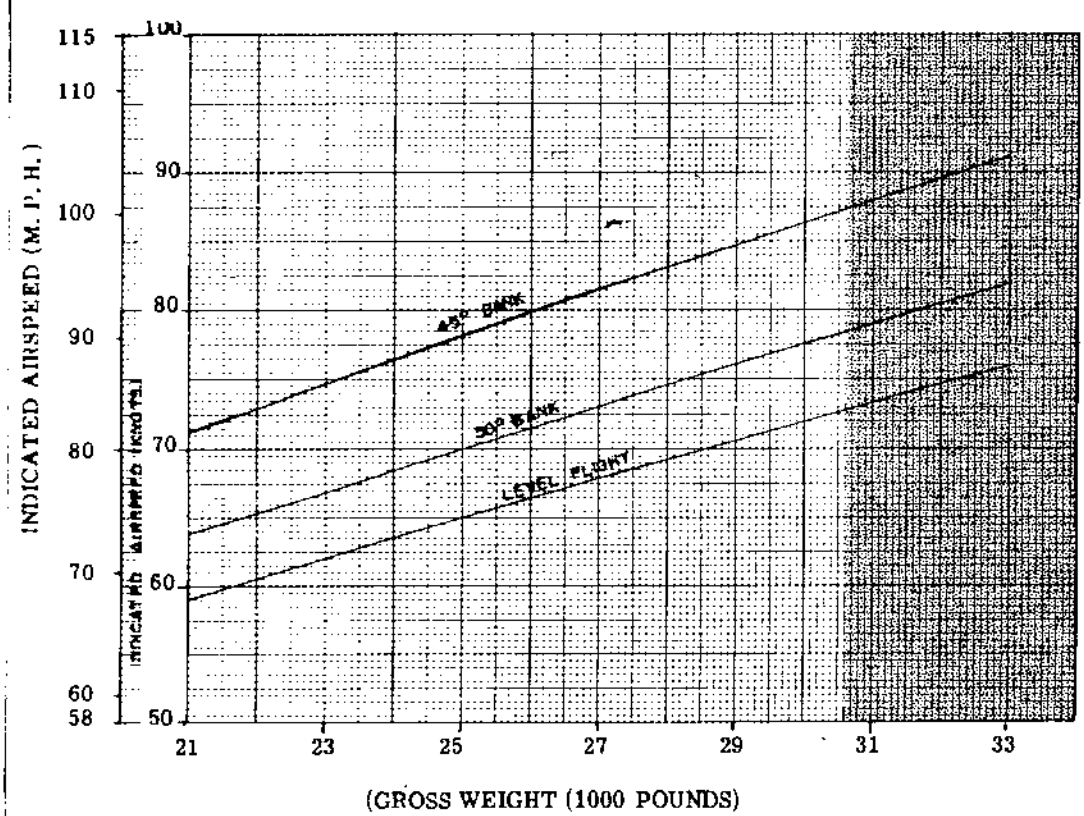


Figure A6-6. Power Off Stall Speeds – 0 Flaps.

POWER OFF STALL SPEEDS
1/4 FLAPS

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

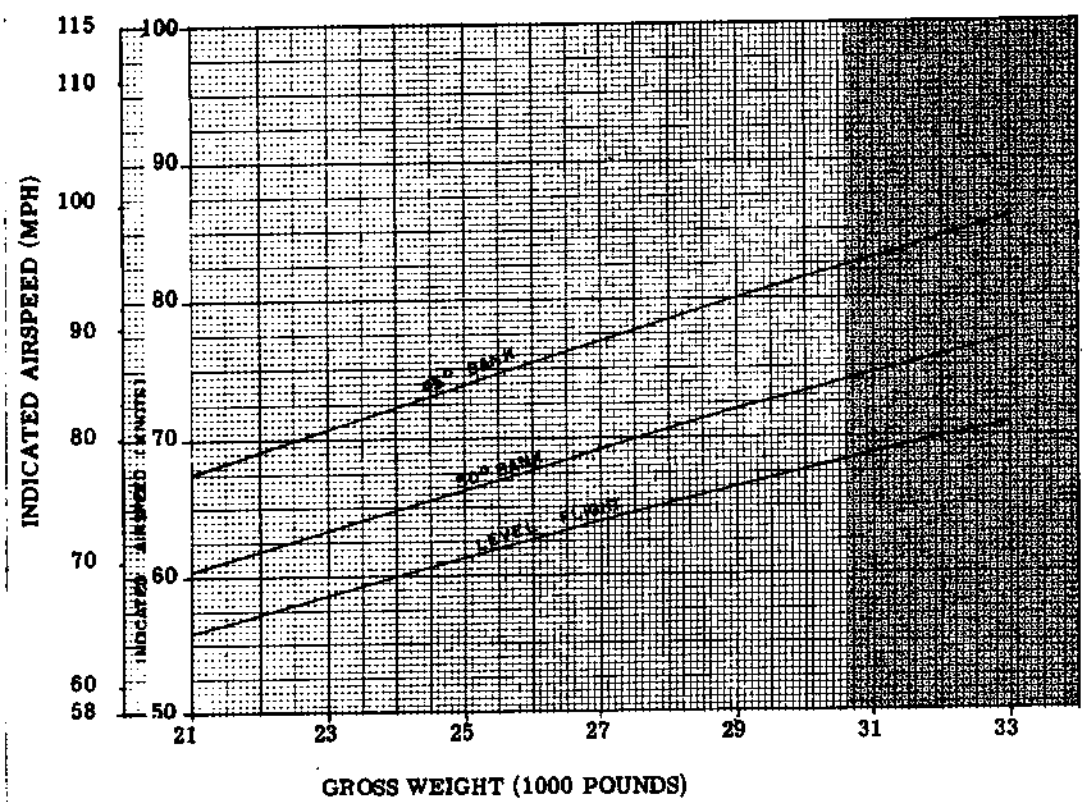


Figure A6-7. Power Off Stall Speeds – ¼ Flaps.

POWER OFF STALL SPEEDS
1/2 FLAPS

MODEL(S): C-47, C-117, AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S); (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

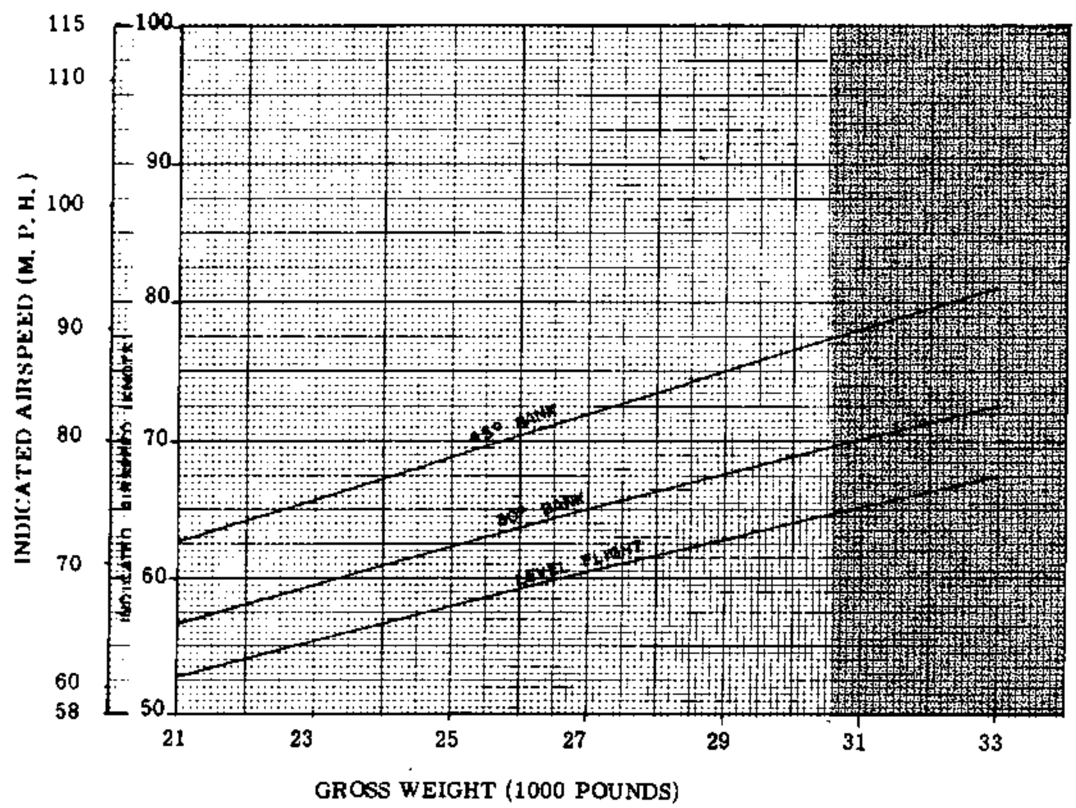


Figure A6-8. Power Off Stall Speeds – ½ Flaps.

POWER OFF STALL SPEEDS
FULL FLAPS

MODEL(S): C-47, C-117, and R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

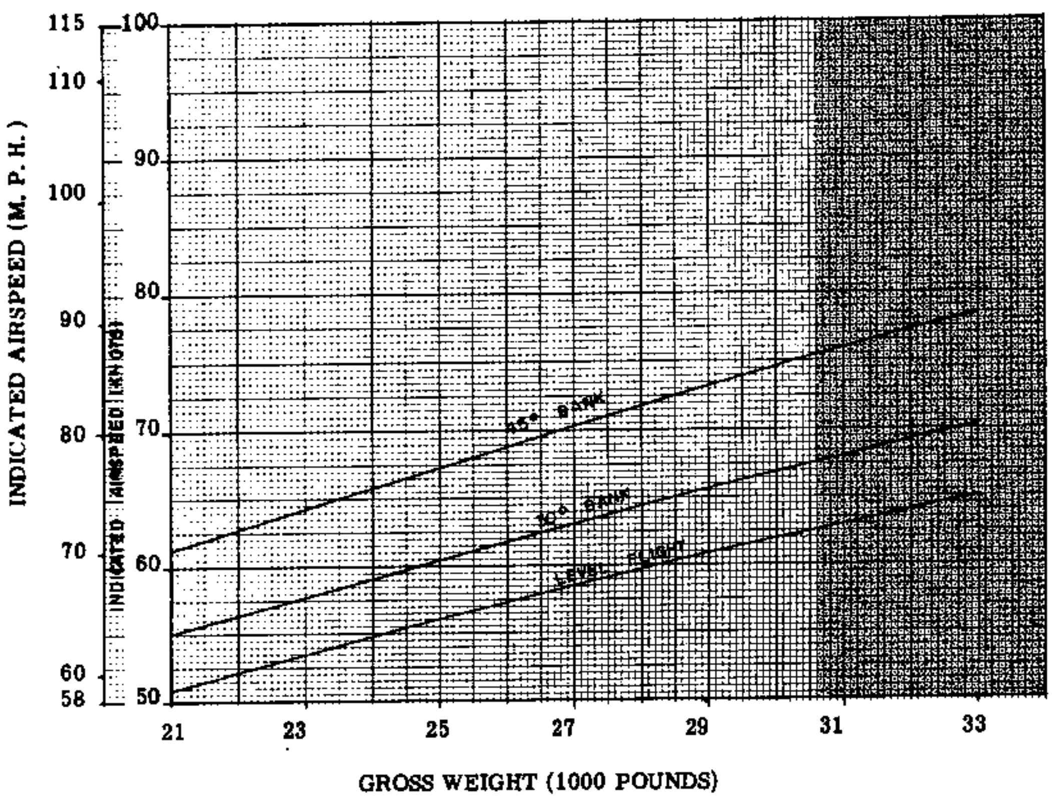


Figure A6-9. Power Off Stall Speeds – Full Flaps.

PART SEVEN
MISSION PLANNING

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TAKE-OFF AND LANDING DATA CARD

A take-off and landing data card is included in T. O. 1C-47-CL-1-1 to provide readily available information for take-off and landing. Prior to each flight, applicable data should be computed and entered on the cards. This information can then be reviewed by the pilot or read aloud by the copilot as a checklist item immediately prior to take-off and landing. A sample is shown on page A7-5.

SOURCES OF INFORMATION

Information for items on the take-off and landing data cards may be found in the following paragraphs.

TAKE-OFF DATA

Refusal Distance---Obtained from the Take-Off Performance--Speed During Ground Run chart (figure A3-9).
Refusal Speed---Obtained from the Take-Off Performance--Refusal Speed chart (figure A3-11).
Take-Off Speed---Obtain from the Take-Off Performance-Characteristic Take-Off Speed chart (figure A3-14).

LANDING IMMEDIATELY AFTER TAKE-OFF DATA

120 Percent Power-Off Stalling Airspeed--Obtained from the Characteristic Landing Speed chart (figure A6-5).
110 Percent Power-Off Stalling Airspeed--Obtained from the Characteristic Landing Speed chart (figure A6-5).
Take-Off Speed---Obtained from the Take-Off Performance--Characteristics Take-Off Speed chart (figure A3-14).

CONDITIONS DATA

Gross Weight (Actual)---Basic aircraft operating weight, plus fuel, cargo, and crew.
Gross Weight Limited by Single-Engine Climb--Obtained from the Take-Off Gross Weight Limited by Single-Engine Climb Performance chart (figure A3-1).
Pressure Altitude---Obtained from weather briefing or tower operator.
Outside Air Temperature---Obtained from aircraft temperature gage.
Dew Point---Obtained from weather briefing.
Specific Humidity---Obtained from weather briefing.
Density Altitude---Obtained from the Density Altitude Chart (figure A1-4).
Runway Length---Obtained from operations or Flight Information Publications (FLIP) charts.
Runway Slope---Obtained from operations or Flight Information Publications (FLIP) charts.
Wind Component---Obtained from weather briefing.

LANDING DATA

Landing Gross Weight---Take-Off weight less fuel consumed.
Wind Component---Obtained from tower operator.
Threshold Airspeed (120) percent of Power-Off Stalling Airspeed)---Obtained from the Characteristic Landing Speeds Chart (figure A6-5).
Touchdown Speed (110 Percent of Power-Off Stalling Airspeed) – Obtained from the Characteristic Landing Speed chart (figure A6-5).
Take-Off Speed---Obtained from the Take-Off Performance--Characteristic Take-Off Speed chart (figure A3-14).

SAMPLE PROBLEM

Sample problems are provided to clarify the use of the performance charts where applied to a typical mission and to emphasize the need for adequate mission planning.

LONG RANGE OPERATION PROBLEM

The following sample problem is a typical search mission for this type aircraft. The mission requires that the aircraft Take-Off - Climb to 10,000 feet density altitude; cruise out for 1 hour at 10,000 feet density altitude then descend to 1000 feet density altitude; search for 4 hours at 1000 feet density altitude; climb to 7000 feet density altitude; then cruise at 7000 feet density altitude and land at the point of departure. All climbs will be made using climb power settings. Both cruises will be made using recommended long range airspeeds and power settings. The 1000 foot search will be made using the recommended maximum endurance airspeeds and power settings. The mission requires that the aircraft return to the base with sufficient fuel to cruise 30 minutes at sea level, plus an additional 10 percent of Take-Off fuel load.

CONDITIONS

TAKE–OFF CONDITIONS

Pressure Altitude -----Sea Level
Outside Air Temperature-----24°C
Specific Humidity----0.015
Headwind at 50-foot Height-----20 Knots.
Runway Length Available-----4000 Feet
Runway Slope (up hill) -----0.015
Runway Surface Condition-----Hard Surface

TAKE–OFF GROSS WEIGHT

Take-Off gross weight limited by single-engine climb performance (see figure A3-1)---30,600 pounds.
Aircraft operating weight, empty, including oil (gross weight less fuel and cargo)-----21,000 pounds.

CRUISE CONDITIONS

Headwind ——None
Temperature at 10,000 feet density altitude ---- −5°C
Temperature at 7000 feet density altitude --- 1°C
Temperature at 1000 feet pressure altitude ---- 11°C

TAKE–OFF AND ABORT CRITERIA

Take-Off ground run (see figure A3-2)-------- 2050 feet.
Take-Off ground run as corrected by the runway slope correction chart (see figure A3-10) ------- 2250 feet.
Take-Off speed (see figure A3-14)-------- 80 KIAS.
Refusal speed (see figure A3-11) -------- 72 KIAS.
Refusal distance (see figure A3-9) ------- 1820 feet.
Fuel consumed during warmup and take-off (estimated) ------------ 270 pounds.
Distance to clear a 50 foot obstacle ------ (figure A3-2) -----------— 4480 feet.

CLIMB TO 10,000 FEET DENSITY ALTITUDE

Climb to 10,000 feet density altitude will be made at climb power settings. The gross weight at start of climb is 30,330 pounds (30,600 − 270 = 30,330). The time and distance to climb, and the gross weight at end of climb are determined from figure A4-3 as follows:

Time to climb ------ 41.5 minutes.
Distance to climb ------ 97 nautical miles.
Gross weight at end of climb ----- 29,600 pounds.
Fuel consumed during climb is 730 pounds -------- ---(30,330 − 29,600 = 730).

CRUISE AT 10,000 FEET DENSITY ALTITUDE

Cruise at 10,000 feet density altitude and descent to 1000 feet pressure altitude will be made at long range power settings. The gross weight at beginning of cruise is 29,600 pounds. Range during cruise and gross weight at end of cruise for a zero wind condition are determined from figure A5-9 as follows:

Range ------- 120 nautical miles.
Gross weight at end of cruise ---- 29, 150 pounds.
Fuel consumed during cruise is 450 pounds ------ ----(29,600 − 29,150 = 450).
The average airspeed is 120 knots.

The recommended power settings and airspeed during cruise for an initial gross weight of 29,600 pounds are determined from figure A5-3 and are as follows:

Calibrated airspeed ------ 130.5 Knots.
Brake horsepower per engine ------ 550.
RPM ---------- 1860.
Manifold pressure ----- 28.2 inches Hg.
Fuel flow ------ 470 pounds per hour.
Nautical miles per pound ------ 0.278.

NOTE

The long range power condition charts are based on long range cruising operation; therefore, it is essential that conditions of the 99 percent maximum range power conditions curves be followed. Power settings should be changed at least every hour in order that range and time performance on the long range prediction curves be attainable. The fuel flow data will facilitate the determination of the new gross weight at the time of the power change. At the end of one hour cruise at the initial power setting, the gross weight will be 29,150 pounds (29,600 − 450 = 29,150). New power settings can then be read at this new weight.

SEARCH AT 1000 FEET DENSITY ALTITUDE

Search at 1000 feet density altitude with zero degrees wing flaps will be made at the speed and power settings recommended for the maximum endurance. To maintain operation at optimum efficiency, it is necessary to recompute and readjust power settings at least once each hour based on the gross weight change due to fuel consumed. The recommended brake horsepower for the first hour's operation is determined from figure A5-14 as follows:

True airspeed -------------- 96 Knots.
Brake horsepower per engine --------- 445.
Fuel consumed during the first hour of cruise is determined to be 385 pounds per hour from figure A5-14.

Power settings for the first hour of cruise at 445 bhp per engine are determined from figures A5-14 as follows:

Manifold pressure ------ 28 inches Hg
RPM ------ 1700.
Fuel consumed (for two engines) ----- 385 pounds.

At the beginning of the second hour's cruise the gross weight will be 28,765 pounds (29150 − 385 = 28,765). Power settings and fuel consumption for each remaining hour of cruise are computed in the same manner.

After computing power settings and fuel flow for all 4 hours of cruise, the total fuel consumed is determined to be 1495 pounds and the gross weight at end of cruise is 27655 pounds (29150 − 1495 = 27655). Range during cruise is estimated to be 380 nautical miles by multiplying time during cruise by average true airspeed during cruise (4 x 95 = 380).

CLIMB TO 7000 FEET DENSITY ALTITUDE.

Climb to 7000 feet density altitude will be made at climb power settings. The gross weight at start of climb is 27,655 pounds. The time and distance to climb, and the gross weight at end of climb are determined from figure A4-3 as follows:

Time to climb ----- 16.8 minutes.
Distance to climb ------ 37.7 nautical miles.
Gross weight at end of climb ------ 27,280 pounds.
Fuel consumed during climb from 1000 feet to 7000 feet is 375 pounds (27,655 – 27,280 = 375).

CRUISE AT 7000 FEET DENSITY ALTITUDE

Cruise at 7000 feet density altitude will be made at long range power settings. The gross weight at beginning of cruise is 27,280 pounds. The range to cruise to point of departure is determined to be 179.3 nautical miles. Time during cruise and gross weight at end of cruise for zero wind conditions are determined by interpolation from figures A5-8 and A5-9 and are as follows:

Time ------- 90 minutes.
Gross weight at end of cruise ----- 26,700 pounds.
Fuel consumed during cruise is 580 pounds.

The recommended power settings and airspeed during cruise for an initial gross weight of 27,280 pounds are determined from figure A5-3 and are as follows:

True airspeed ------ 119 Knots.
Brake horsepower --------- 465.
RPM ---------- 1720.
Manifold pressure ------- 27.9 inches Hg.
Fuel flow ---------- 400 pounds per hour.
Nautical miles per pound ---------- 0.299.

NOTE

The long range power condition charts are based on long range cruising operation; therefore, it is essential that conditions of the 99 percent maximum range power conditions curves be followed. Power settings should be changed at least every hour in order that range and time performance on the long range prediction curves be attainable. The fuel flow data will facilitate the determination of the new gross weight at the time of the power change.

RESERVE FUEL AND CARGO

To determine the amount of cargo that can be carried, the reserve fuel load must be computed. The reserve fuel for this sample problem is 10 percent of the total mission fuel plus sufficient fuel to cruise for 30 minutes at sea level. Fuel required to cruise for 30 minutes at sea level, for gross weight at end of cruise at 7000 feet density altitude is determined from figure A5-3 as follows. Fuel flow per engine is determined to be 180 lb/hr. Therefore, fuel required to cruise 30 minutes is 180 pounds. Ten percent of the total mission fuel plus sufficient fuel to cruise for 30 minutes at sea level is 408 pounds. Therefore, the total reserve fuel is 588 pounds (180 + 408 = 588). Fuel load at take-off can now be determined as follows:

Fuel required for mission --- 3900 pounds (30,600 – 26,700 = 3900).
Reserve fuel ------ 588 pounds.
Total fuel load at take-off ------ 4489 pounds.

Operating weight empty plus fuel load at take-off is 25489 pounds (21000 + 4489 = 25489). Therefore, maximum cargo load is 5111 pounds (30600 – 25489 = 5111).

LANDING

IMMEDIATE LANDING

Pressure altitude ------ sea level.
Outside air temperature ------ 24°C.
Headwind at 50-foot wheight ------ 10 knots.
Runway surface condition ------ hard surface.
Landing gross weight ------ take-off gross weight less fuel consumed.
For warm-up and take-off (270 pounds) --- 30600 – 270 = 30330 pounds.
Threshold speed (figure A6-5) ------ 87 knots.
Touchdown speed (figure A6-5) ----- 80 knots.
Landing ground roll distance with full flaps (figure A6-1) ------ 1675 feet.

DESTINATION LANDING

Pressure altitude ---- sea level.
Outside air temperature ----- 30°C.
Headwind at 50-foot height ------ 16 knots.
Runway surface condition ------ hard surface.
Landing gross weight ------ 26700 pounds.
Threshold speed (figure A6-5) ------ 81 knots.
Touchdown speed (figure A6-5) ------ 74 knots.
Landing ground roll distance with full flaps (figure A6-1) ------ 1400 feet.

TAKEOFF AND LANDING DATA CARD

GROSS WEIGHT 30,600 LB.

RUNWAY LENGTH 4,000 FT. SLOPE 0.015 UP HILL.

PRESSURE ALTITUDE SEA LEVEL.

OAT 75 °F 24 °C SPECIFIC HUMIDITY 0.015.

TAKEOFF PERFORMANCE

REFUSAL SPEED 72 KIAS.

REFUSAL DISTANCE 1,820 FT.

TAKEOFF SPEED 80 KIAS. TAKEOFF DISTANCE 2250 FT.

SINGLE ENGINE CLIMB SPEED 101 EAS.

IMMEDIATE/DESTINATION LANDING

THRESHOLD SPEED 75/69 KIAS. TOUCHDOWN SPEED 69/64 KIAS.

LANDING DISTANCE 1675/1400 FT.

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29 APR 1963

T.O. 1C-47-SS-1-10

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

C-47, A, B, D, HC-47, C-117A, B, C

NAVY SERIES

R4D-1, C-47H, C-47J, TC-47K

AIRCRAFT

(Models Redesignated IAW AFR 66-11 dated 18 September 1962)

THIS PUBLICATION SUPPLEMENTS T.O. 1C-47-1/(BUWEPS) NW 01-40NC-1 AND REPLACES SAFETY OF FLIGHT SUPPLEMENT 1C-47-SF-1-8 DATED 7 NOVEMBER 1962 WITH CHANGES TO THE TEXT. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

18 APRIL 1963

NOTE

The attached charts, Figure 1 and Figure 2 replaces the Runway Surface Condition grids on Figure A6-2, page A6-4 and Figure A6-3, page A6-5 respectively. The chart in T.O. 1C-47-SF-1-8, which was inserted in your checklist binder, shall be removed and destroyed.

1. PURPOSE.

To provide landing on slippery runway distance factors and to advise flight crews of the new runway conditions reporting system.

2. GENERAL.

Explanation of Terms

RCR - Runway condition reading

AF-RAFB APR 63 - 40,500

P - Patchy

WR - Wet runway

SLR - Slush on runway

LSR - Loose snow on runway

PSR - Packed snow on runway

IR - Ice on runway

a. In order to notify pilots of slippery runway conditions at terminal airfield, the following system of reporting has been established:

(1) A teletype sequence will report runway conditions as a series of letters followed by a two digit number. The letter portion is the runway surface condition; the number portion is the runway condition reading (RCR). The letter "P" may follow this sequence to indicate patchy conditions. A report of SLR 06 P would indicate slush on runway, RCR of 06, and patchy conditions.

(2) Air Traffic Control will report information concerning Runway Surface Condition and RCR in plain language for aircraft enroute and anticipating a landing.

3. INSTRUCTIONS.

a. Determine landing ground run distance for hard runway from the Appendix of the Flight Manual.

b. Use appropriate curve in this Safety Supplement for your planned landing configuration.

c. Enter the unusual runway conditions chart with this landing ground run distance, go right to the reported RCR line and then down to obtain the actual ground run distance.

NOTE

- If no RCR is available, use 12 for wet runways and 06 for icy runways.
- When using ICAO Reports, use RCR 23 for GOOD; RCR 12 for MEDIUM; RCR 06 for POOR.

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODEL(S): C-47, C-117
AND R4D
BASED ON ESTIMATED DATA
DATA AS OF: 1 APRIL 1963

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT $1.1V_s$
WING FLAPS 0 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

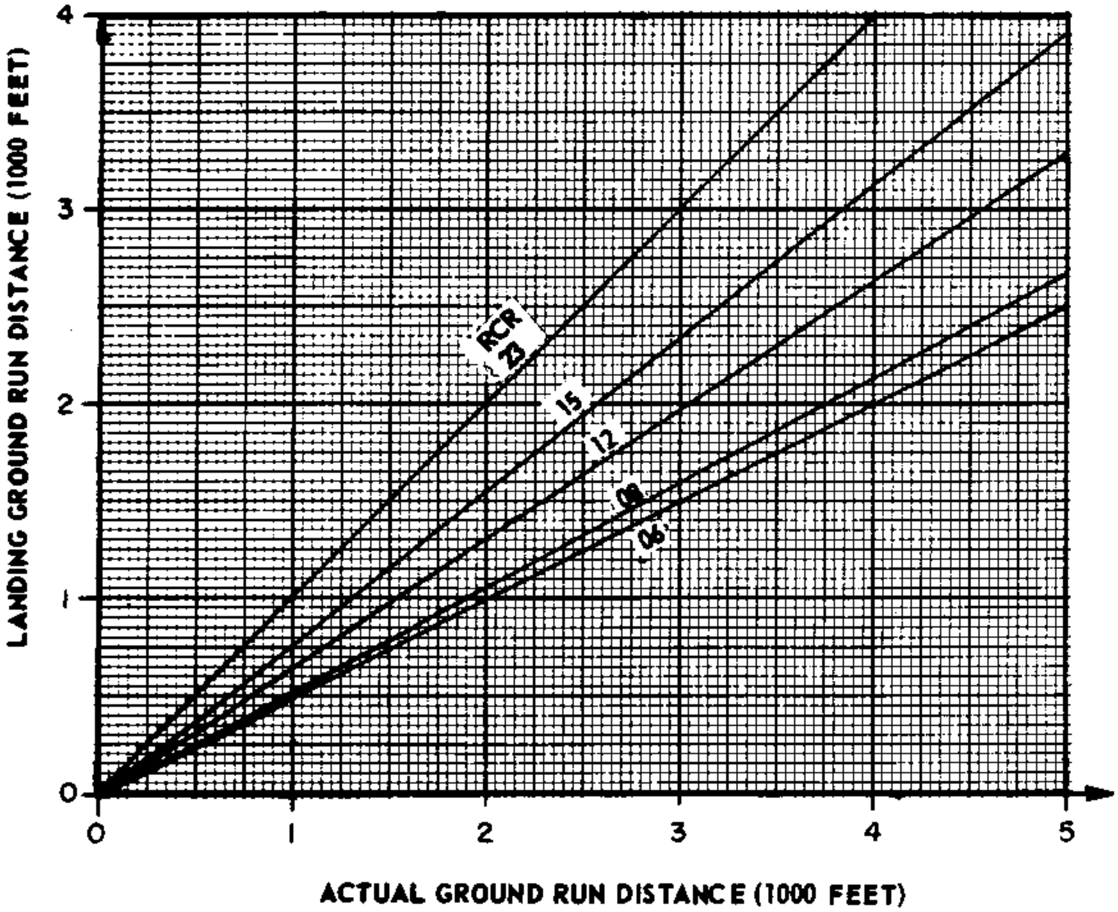

Figure 1

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODELS(S) C-47, C-117
AND R4D
BASED ON: ESTIMATED DATA
DATA AS OF: 1 APRIL 1963
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT $1.1V_s$
WING FLAPS 45 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

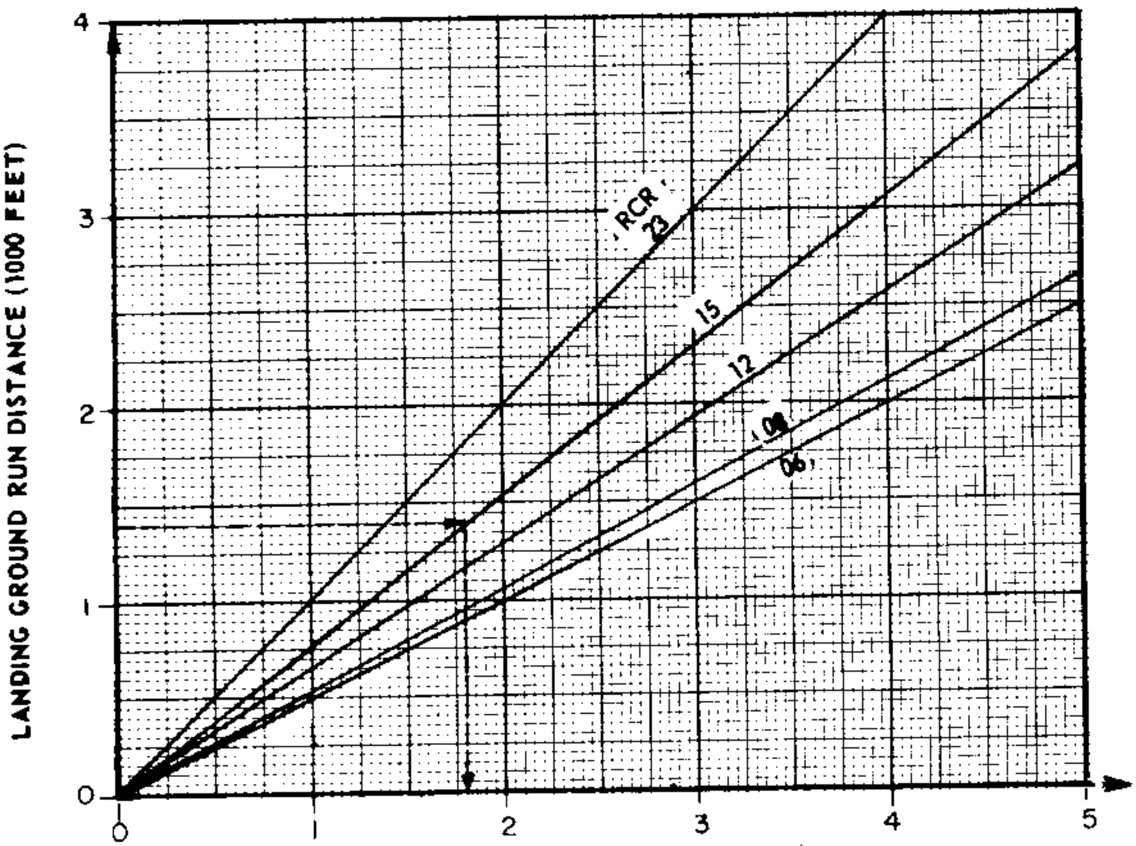

Figure 2

END

SS SS SS SS SS SS SS SS SS SS SS SS

17 MAY 1963

T.O. 1C-47-SS-1-11

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

C-47, A, B, D, HC-47, C-117A, B, C

NAVY SERIES

R4D-1, C-47H, C-47J, TC-47K

AIRCRAFT

(Models Redesignated IAW AFR 66-11 dated 18 September 1962)

THIS PUBLICATION SUPPLEMENTS T. O. 1C-47-1/(BUWEPS) NW 01-40NC-1 AND REPLACES SAFETY SUPPLEMENT 1C-47-SS-1-10 DATED 18 APRIL 1963 TO MAKE CORRECTIONS IN THE NOTE PRECEDING PARAGRAPH 1. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

16 MAY 1963

NOTE

The attached charts, Figure 1 and Figure 2 replace the Runway Surface Condition grids on Figure A6-1, page A6-3 and Figure A6-2, page A6-4 respectively.

1. PURPOSE.

To provide landing on slippery runway distance factors and to advise flight crews of the new runway conditions reporting system.

2. GENERAL.

Explanation of Terms

RCR - Runway condition reading

AF RAFB MAY 63 - 40,300

SS SS SS SS ... SUPPLEMENT ... SS SS SS SS

P - Patchy

WR - Wet runway

SLR - Slush on runway

LSR - Loose snow on runway

PSR - Packed snow on runway

IR - Ice on runway

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c. Enter the unusual runway conditions chart with this landing ground run distance, go right to the reported RCR line and then down to obtain the actual ground run distance.

NOTE

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- When using ICAO Reports, use RCR 23 for GOOD; RCR 12 for MEDIUM; RCR 06 for POOR.

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODEL(S): C-47, C-117
AND R4D
BASED ON ESTIMATED DATA
DATA AS OF: 1 APRIL 1963

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT $1.1V_s$
WING FLAPS 0 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

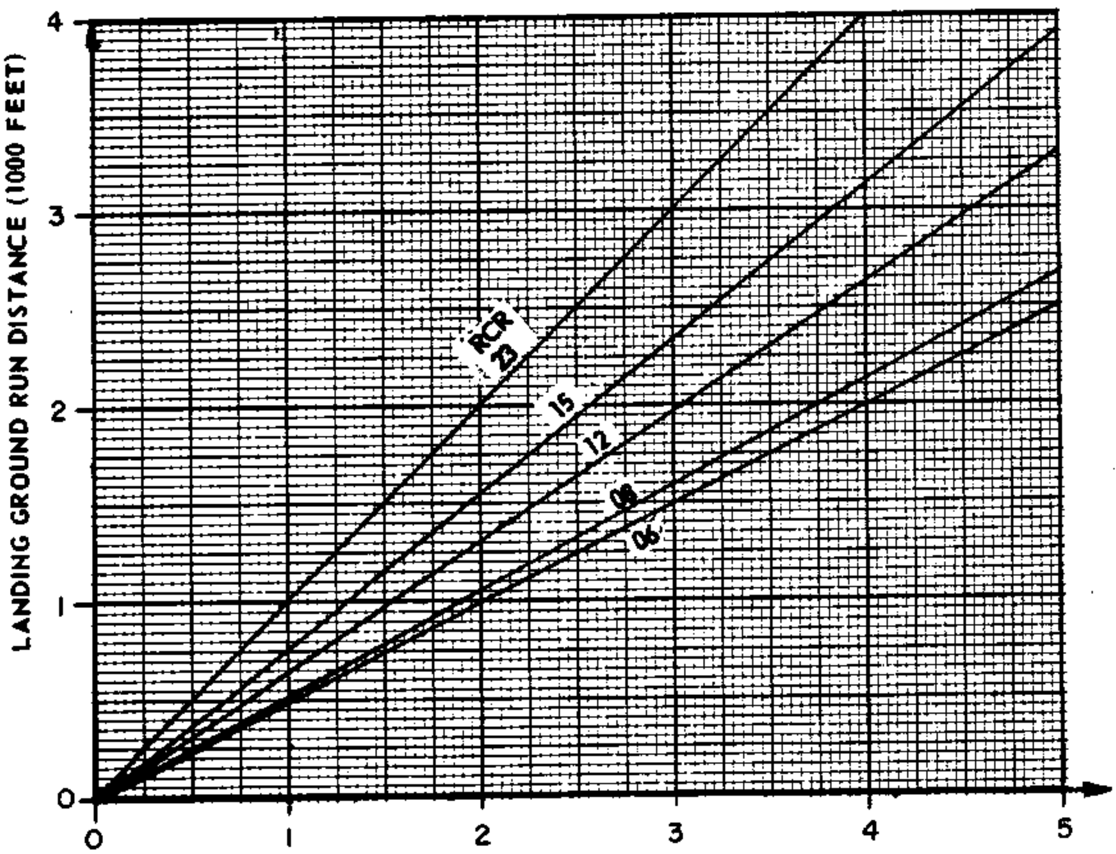

Figure 1

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODELS(S) C-47, C-117
AND R4D
BASED ON: ESTIMATED DATA
DATA AS OF: 1 APRIL 1963
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT $1.1V_s$
WING FLAPS 45 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

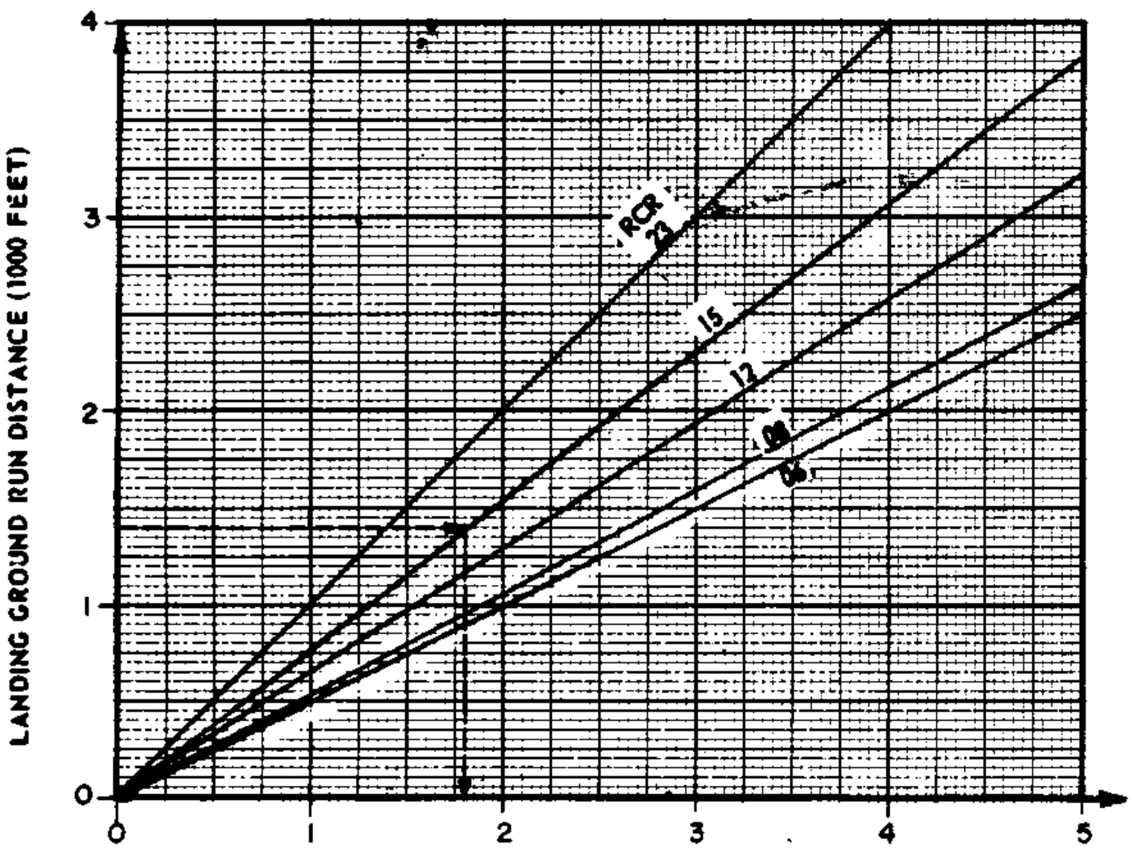

Figure 2

END

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SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES
C-47, A, B, D, HC-47, C-117A, B, C

NAVY SERIES
R4D-1, C-47H, C-47J, TC-47K

AIRCRAFT

(Models Redesignated IAW AFR 66-11 dated 18 September 1962)

THIS PUBLICATION SUPPLEMENTS T.O. 1C-47-1 (BUWEPS) NW 01-40NC-1. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

25 JUNE 1963

1. PURPOSE.

To caution flight crew members that TACAN may lock-on a false bearing.

2. GENERAL.

Occasionally TACAN equipment will "Lock-On" to a false bearing which will be 40^{0} or a multiple of 40^{0} in error. These errors can be on either side of the correct bearing. When the TACAN "Locks-On" a false bearing, switching to another channel and then back to the desired channel, or turning the set off and then back on will recycle the search mode. This will most probably result in a correct "Lock-On."

This deficiency does not effect the DME display provided by the TACAN equipment.

3. INSTRUCTIONS.

a. When using TACAN, cross check for false "Lock-On" with ground radar, airborne radar, VOR, dead reckoning or other available means. These cross checks are especially important when switching channels or when turning set on.

b. If a false "Lock-On" is suspected, switch to another channel, check it for correct bearing and then switch back to the desired channel.

c. Check for correct "Lock-On."

d. If false "Lock-On" is still suspected, turn set off and then ON.

e. Recheck for correct "Lock-On."

f. If false "Lock-On" persists, utilize the other equipment or aids available.

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