T.O. 1C-118A-1

FLIGHT MANUAL

USAF SERIES

C-118A AND VC-118A

AIRCRAFT

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Introduction

SCOPE. This manual contains all the information necessary for safe and efficient operation of the C-118A and VC-118A aircraft. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the aircraft, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT. The instructions in this manual are designed to provide for the needs of a crew inexperienced in the operation of this aircraft. This book provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc, may require modification of the procedures contained herein.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Manual. Clearance must be obtained from Service Engineering Division, Warner Robins Air Materiel Area, ATTN: WRNEO before any questionable operation is attempted which is not specifically covered in the Flight Manual

STANDARDIZATION. Once you have learned to use one Flight Manual, you will know how to use them all – closely guarded standardization assures that the scope and arrangement of all Flight Manuals are identical.

ARRANGEMENT. The manual has been divided into 10 fairly independent sections, each with its own table of contents. The objective of this subdivision is to make it easy both to read the book straight through when it is received and thereafter to use it as a reference manual. The independence of these sections also makes it possible for the user to rearrange the book to satisf his personal taste and requirements. The first three sections cover the minimum information required to safely get the aircraft into the air and back down again. Before flying any new aircraft, these three sections must be read thoroughly and fully understood. Section IV covers all equipment not essential to flight but which permits the aircraft to perform special functions. Sections V and VI are obvious. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular aircraft in question. The experienced pilot will probably be aware of the information in this section, but he should check it for any possible new information. The contents of the remaining sections are fairly obvious.

YOUR RESPONSIBILITY. These Flight Manuals are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these manuals. In this regard, it is essential that you do your part! If you find anything you don't like about the book, let us know right away. We cannot correct an error whose existence is unknown to us.

HOW TO GET COPIES. *If you want to be sure of getting your manuals on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements.* Technical Order 00-5-2 explains how to order Flight Manuals, classified supplements thereto, and Safety of Flight Supplements so that you automatically will get all original issues, changes, and revisions. Basically, all you have to do is order the required quantities in the Publications Requirement Table (T.O. 0-3-1). *Talk to your Senior Materiel Staff Officer – it is his job to fulfill your Technical Order requests.* Make sure to establish some system that will rapidly get the books and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS. Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements.

It is critically important that you remain constantly aware of the status of all supplements—you must comply with all existing supplements but there is no point in restricting the operation of your aircraft by complying with a supplement that has been replaced or rescinded. Technical Order 00-5-1 covers some additional information regarding these supplements.

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

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

CAUTION —Operating procedures, practices, etc which if not strictly observed will result in damage to equipment.

Note —An operating procedure, condition, etc which is essential to emphasize.

CHECKLISTS. The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders--see the back of the title page for T. O. number 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.

COMMENTS AND QUESTIONS. Comments and questions regarding any phase of the Flight Manual program are invited and should be forwarded through your command headquarters to Service ing Division Warner Robins Air Materiel Area, ATTN: WRNEO.

Figure 1-1

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SECTION I

description

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LIST OF ILLUSTRATIONS

THE AIRCRAFT.

The C-118A and VC-118A aircraft, manufactured by Douglas Aircraft Company, Inc., are long-range low-wing monoplanes, each equipped with a fully retractable tricycle landing gear and a pressurized cabin, and are designed for use as diversified cargo, personnel, ambulance, or staff transports *(figures 1-1 and 1-2)*. The VC-118A aircraft are used as staff transports only.

AIRCRAFT DIMENSIONS.

The principal dimensions of the aircraft are:

Span	117 feet 6 inches
Length (overall)	106 feet 10 inches
Height	28 feet 8 inches
Height (with anticollision light)	29 feet 1 inch
Stabilizer span	46 feet 6 inches

For turning radius and ground clearances, refer to Section II.

AIRCRAFT GROSS WEIGHT.

The aircraft design gross weight is 107,000 pounds. For complete weight information, see Section V.

INTERIOR ARRANGEMENT.

The aircraft is designed for carrying various loads, i.e., 79 troops when used as a personnel transport, 60 litter patients with provisions for seven medical attendants when used as an ambulance transport, or cargo when used as a cargo transport.

VC-118A aircraft AF53-3229 and AF53-3240 interiors feature flight and passenger compartments, a sleeping or conference compartment, stateroom and lounge, coatrooms, and two lower compartments.

On AF53-3229, provisions are made to seat 14 passengers or sleep 10 passengers. On AF53-3240, provisions are made to seat 30 passengers or sleep 9 passengers.

Not all of the equipment configurations of various groups of aircraft numbers will be correct due to local, contract, and depot modifications. The majority of the aircraft are being modified continuously with new equipment to keep the operation as modern as possible.

FLIGHT CREW.

On C-118A aircraft, accommodations are provided for a crew of 5 members: pilot, copilot, crew engineer, radio operator, and navigator *(figures 1-3 and 1-5)*, except on AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, and AF53-3241 through AF53-3305 which have no provisions for a radio operator.

On VC-118A aircraft AF53-3229 and AF53-3240, accommodations are provided for a crew of 9 members: pilot, copilot, two crew engineers, radio operator, navigator, two flight attendants, and one ACM *(figure 1-4)*.

ENGINE.

The aircraft is powered by four 18-cylinder, twin-row, air-cooled Pratt & Whitney R-2800-52W engines. Each engine is equipped with a single-stage, 2-speed supercharger, a metering injection carburetor, a direct cranking starter, and an ADI (water-alcohol injection) system.

THROTTLES.

The two banks of four throttles on the control pedestal *(1, figure 1-7)* are equipped with a friction-type throttle lock lever and are operated conventionally. In addition to conventional operation, the throttles also serve to control propeller reversing. The throttles have a range through the following positions.

OPEN	(Normal full throttle)
CLOSE	(Normal closed throttle)
REVERSE	(Entrance to propeller reverse thrust range of operation)
OPEN	(Open throttle for braking purposes)

Note

On some aircraft, the throttle cannot be moved to the propeller reverse position unless the aircraft is on the ground and the THROTTLES FREE TO REVERSE indicator flag on the control pedestal is up and visible.

The throttles are mechanically restrained by the control-surface lock *(figure 1-33)* through an interlock system which prevents the application of maximum power to all four engines with the surface lock engaged. With the interlock engaged, both engines on one side, or both outboard engines, can be run up together, the other two throttles being limited to approximately 1700 rpm.

Note

On VC-118A aircraft AF53-3229 and AF53-3240, with the interlock engaged, both outboard or both inboard engines can be run up together, the other two throttles being limited to approximately 1700 rpm.

The propellers can be placed in reverse thrust for braking purposes on the ground by pulling the throttles aft of the CLOSE position. On some aircraft, a solenoid-operated mechanism, energized by a switch on the nose gear and by a switch on the right main

MAIN DIFFERENCES TABLE				
	Aircraft AF51-3818 through AF51-3835	*Aircraft AF51-17626 through AF51-17661, AF51-17667, and AF51-17668*	*Aircraft AF53-3223 through AF53-3305 except AF53-3229 and AF53-3240*	*VC-118A Aircraft AF53-3229 and AF53-3240*
Radio Operator's Station	Yes	Yes	No	Yes
Radio	USAF Installation	Navy Installation	USAF Installation	Special Installation
Compass System	S-2 Directional Indicator	G-2 or S-2 Directional Indicator	S-2 Directional Indicator	S-2 Directional Indicator and A-12 Autopilot Compass
Flight Instruments	USAF Installation	Navy Installation	USAF Installation	USAF Installation (Modified)
Auxiliary Radio Rack	Yes	No	Yes	Modified
APU	GTP70-9 with Dual Generators	Type D-2 or GTP70-60	GTP70-9 with Dual Generators	GTP70-9 with Dual Generators
Main Gear Wheels and Brakes	Type II, Goodrich Expander Tube Brakes	Type II, Goodrich Expander Tube Brakes	Type II, Goodrich Expander Tube Brakes	Type I, Goodyear Spot Brakes
Wash Water System	25 Gallon	25 Gallon	25 Gallon	Special Installation, 55 Gallon
Galley	Aft, Buffet Type	Aft, Buffet Type (Some Aircraft)	Aft, Buffet Type	Special Installation, Forward
Electric Ladder	None	None	None	Rear Entrance Door
Lavatories and Wash Rooms	1 Crew Compartment (Some Aircraft) 2 Aft Cabin	Three	1 Crew Compartment (Some Aircraft) 2 Aft Cabin	Four

Figure 1-2

gear, prohibits reverse-thrust operation until the weight of the aircraft on either gear actuates the switch. At that time, a THROTTLES FREE TO REVERSE indicator flag on the control pedestal becomes visible to indicate that the throttles are free to be moved aft to the reverse thrust range. In the event of failure of the landing gear actuating switches, the indicator flag can be pulled up manually to permit propeller reversal on the ground.

WARNING

Propeller reversing during flight is prohibited.

On AF51-3818 through AF51-3835 and AF53-3223 through AF53-3305, a reverse throttle lock release bar, located on the control pedestal above the propeller control panel, prevents the throttles from moving into the reverse range unless the four throttles are in the CLOSE position and the reverse throttle lock release bar is pulled aft to the released position. *(See 8, figure 1-8, sheet 1; and 6, sheet 3.)*

Note

The throttle of any inoperative engine must be placed in either the full OPEN or full CLOSE position before the reverse throttle lock release bar can be actuated *(figure 3-2)*.

The throttles may be moved past the detent into the reverse range and then further aft to apply reverse thrust power as required. After completion of the reversing operation, the reverse throttle lock release bar will automatically return to the forward or locked position when one or more throttles are advanced to the forward thrust idling position. Four amber propeller reverse indicator lights, one for each propeller, are installed on the propeller control panel *(6, figure 1-8, sheet 1; and 7, figure 1-8, sheet 3)*. When the blades of a propeller move to within 5 degrees of full reverse pitch, a switch on the No. 2 cam is actuated which closes a 28-volt d-c circuit and illuminates the respective indicator light. When the throttle is moved toward the forward thrust range and the blades of the propellers return to within two degrees of forward thrust, the switch on the number two CAM will open and the indicator light will go out.

MIXTURE CONTROL LEVERS.

Four mixture control levers are located on the aft face of the control pedestal *(24, figure 1-8, sheet 1; 22, sheet 2; and 25, sheet 3)* and are equipped with a friction-type lock lever. The levers have the placarded positions IDLE CUTOFF, AUTO LEAN, and AUTO RICH. In addition, some aircraft are equipped with a stop just above the IDLE CUTOFF position. This stop prevents inadvertent movement of the mixture controls to IDLE CUTOFF when the autopilot servos are being manipulated.

COWL FLAP SWITCHES.

Four 4- position cowl flap switches are mounted on the aft overhead panel *(figure 1-12)* and have the following positions: POSITIONING, OFF, OPEN, and CLOSE. When in POSITIONING, the switch permits the cowl flap rheostats to function; when in OFF, the cowl flap door actuators are deenergized; and when in OPEN or CLOSE, the cowl flaps will move in the respective direction until the limit of travel is reached or until the switch is turned to OFF. The switches are spring loaded in the OPEN and CLOSE positions, but hold in OFF and POSITIONING positions.

COWL FLAP RHEOSTATS.

Four cowl flap rheostats, mounted on the upper instrument panel *(figure 1-11)*, provide a means of choosing various preset cowl flap positions. Each rheostat is calibrated in degrees between the OPEN and CLOSE positions. The cowl flap switches must be set to POSITIONING before the cowl flap remote control rheostats will function. The recommended cowl flap positions are:

Takeoff and climb .... Plus 3 degrees; maximum head temperature 260°C

Normal cruise and descent .... As required; maximum head temperature 232°C, desired 200°C

Approach .... Plus 3 degrees

Note

Each degree of cowl flap opening from −2 degrees to full OPEN on all four engines will decrease indicated airspeed approximately 3 knots.

Note

On aircraft not equipped with a spinner propeller assembly, the cowl flap rheostats will be set at +4 degrees for takeoff, climb, and approach.

CARBURETOR AIR CONTROL LEVERS.

Four mechanical carburetor air control levers are mounted on the right side of the control pedestal *(20, figure 1-8, sheet 1; 18, sheet 2; and 21, sheet 3)*. The indicated positions are HOT and COLD, with intermediate positions available. A thumb latch lock is provided on each control lever to lock the controls in position.

ENGINE SUPERCHARGER SWITCHES.

Four electrical 2-position supercharger switches are mounted on the upper instrument panel *(figure 1-11)*. The two positions are LOW for low blower ratio and HIGH for high-blower ratio.

ADI (WATER-ALCOHOL INJECTION) SYSTEM.

The antidetonation (water-alcohol injection) system provides for an increase in engine maximum power. The injection of water serves as a detonation suppressant, allowing engine operation with best power mixture when operating in excess of the dry limits. The tendency to detonate is normally suppressed by enriching the mixture beyond best power and using the excess fuel for cooling. The volume of water injected replaces the volume of fuel normally used as a coolant. The fluid supply is carried in four tanks, one for each engine *(4, 13, figure 1-36)*.

Each outboard tank has a usable capacity of 9.4 gallons, and each inboard tank a usable capacity of 10.24 gallons. The supply is adequate for approximately 5 minutes operation at maximum power.

ADI (Water-Alcohol Injection) System Switches.

Four ADI (water-alcohol injection) system switches, one for each engine, are located on the aft overhead panel *(figure 1-12)* and have the positions ON and OFF. The switches close the 28-volt d-c ADI pump electrical circuits, energizing the pumps when the respective engine oil pressure switch is closed. The oil pressure switch will not permit the pump to operate when engine oil pressure is below 25 psi.

ADI (Water-Alcohol Injection) System Pressure Indicators.

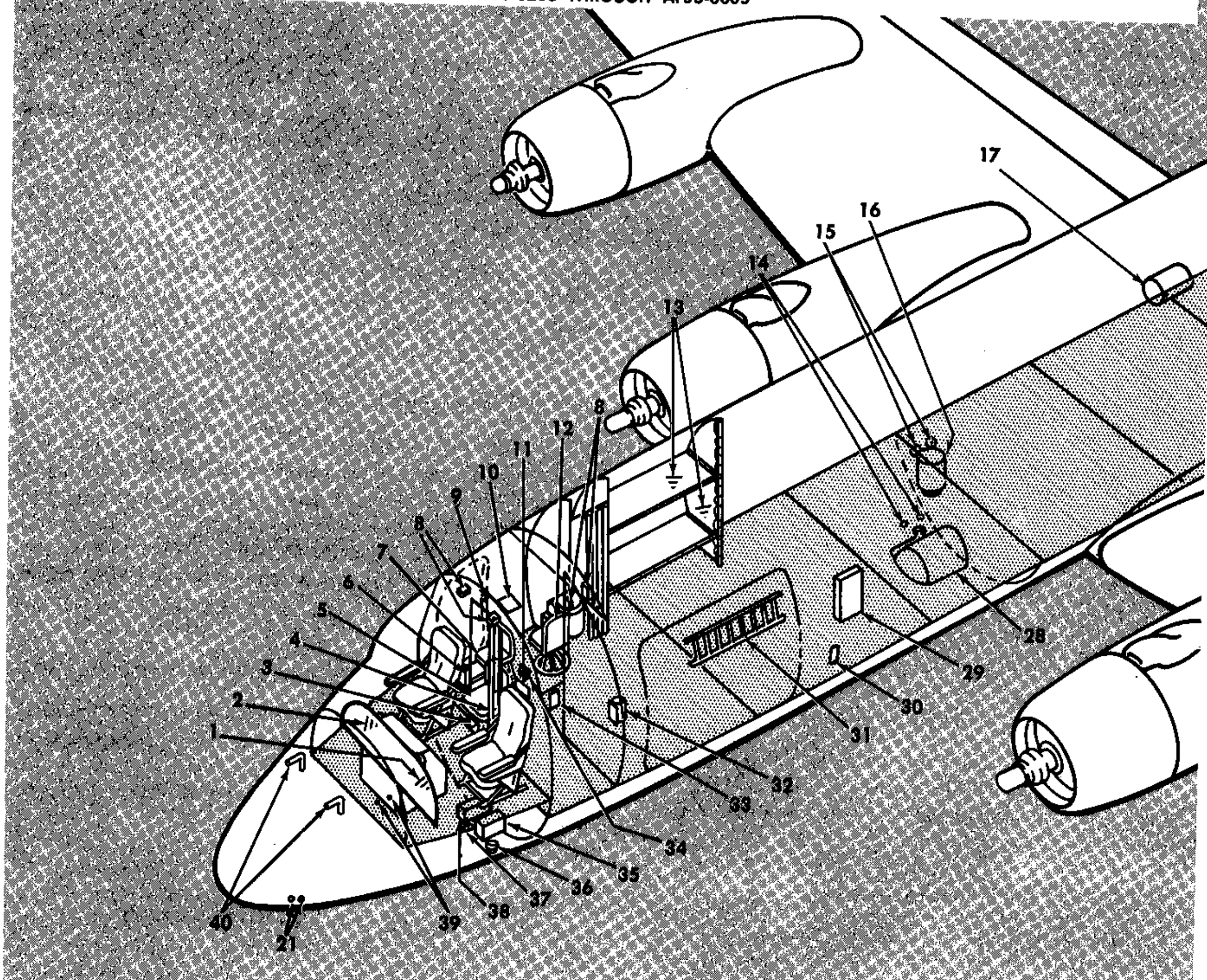
Two dual ADI system pressure indicators, mounted on the main instrument panel *(31, figure 1-9)*, indicate ADI pressure for each engine in pounds per square inch.

Note

Gage readings from 8 to 12 psi are normal when the ADI is turned OFF. A rapid indicated pressure drop to zero when the system is turned OFF indicates that leakage exists within the system.

GENERAL ARRANGEMENT

1. PILOT'S STATION
2. COPILOT'S STATION
3. DRIFTMETER (IF INSTALLED)
4. COCKPIT ANTIGLARE CURTAIN
5. FLIGHT ENGINEER'S STATION
6. LOAD ADJUSTER AND DATA CASE
7. NAVIGATOR'S SEAT
8. UTILITY POWER OUTLETS (5)
9. AIRCRAFT IDENTIFICATION PLATE
10. ASTRODOME COVER
11. SPARE LIGHT BULB CASE
12. RADIO OPERATOR'S SEAT (AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668)
13. RELIEF CREW'S QUARTERS
14. CO_2 DISCHARGE INDICATOR DISCS — D-2 APU INSTALLATION (AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17660, AF51-17667, AND AF51-17668)
15. MAIN HYDRAULIC PRESSURE ACCUMULATORS (2)
16. HYDRAULIC RESERVOIR
17. ALCOHOL TANK
18. PERSONNEL RETAINING HARNESS STOWAGE CONTAINER (AF51-3818, AF51-3819, AF51-3821, AF51-3823 THROUGH AF51-3835, AF53-3223 THROUGH AF53-3228, AF53-3231 THROUGH AF53-3239, AF53-3241 THROUGH AF53-3281, AND AF53-3283 THROUGH AF53-3305
19. AUXILIARY POWER UNIT, GTP70-6 OR GTP70-9 (SOME AIRCRAFT)
20. CO_2 DISCHARGE INDICATOR DISCS, GTP70-6 OR -9 (AF51-17661 AND AF53-3223 THROUGH AF53-3305)
21. CO_2 DISCHARGE INDICATOR DISCS
22. AFT CABIN WATER SUPPLY (2)
23. BUFFET AND FOOD STORAGE (AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668)
24. POWER RECEPTACLE FOR AFT CARGO LIFT (2) (AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668)



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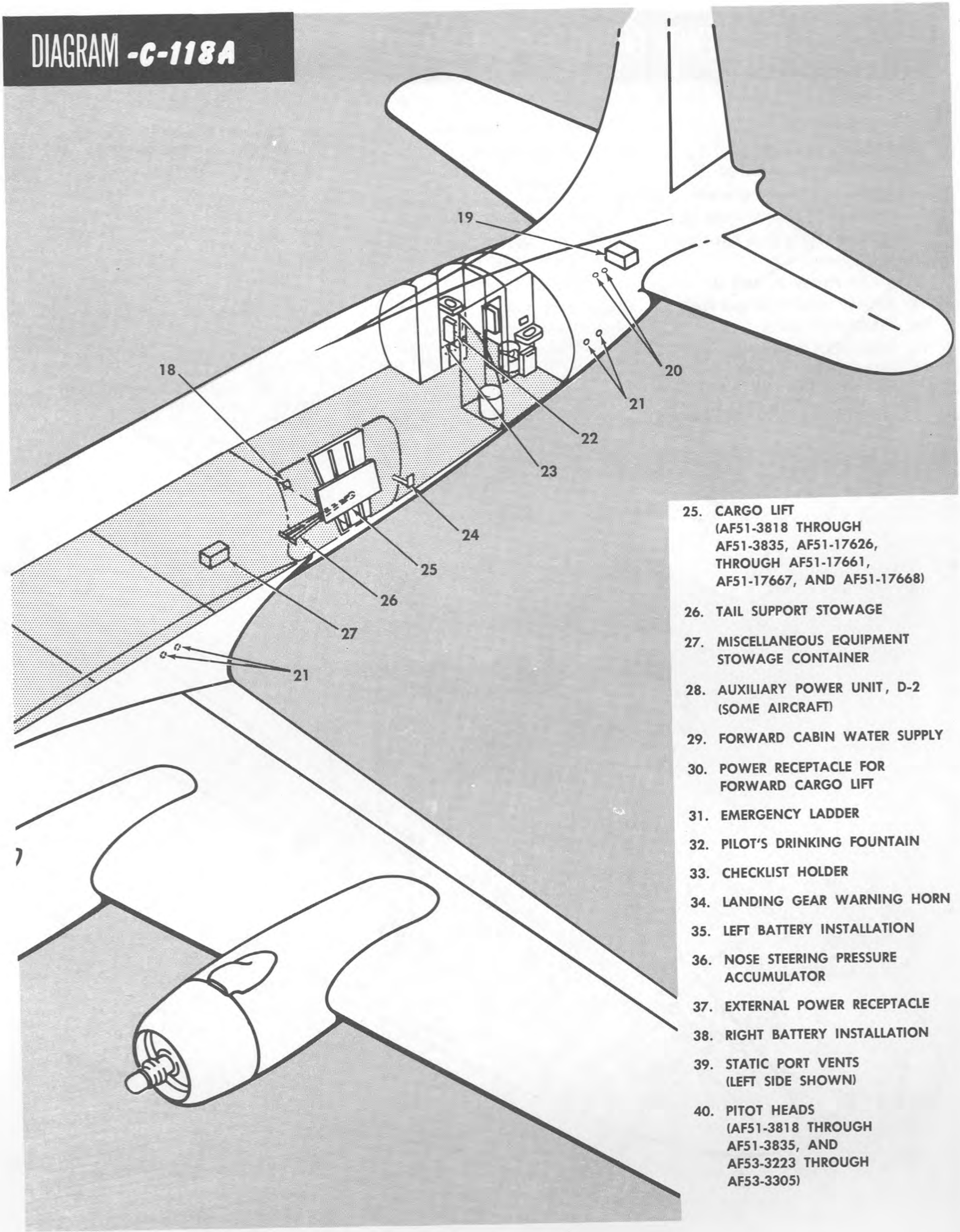
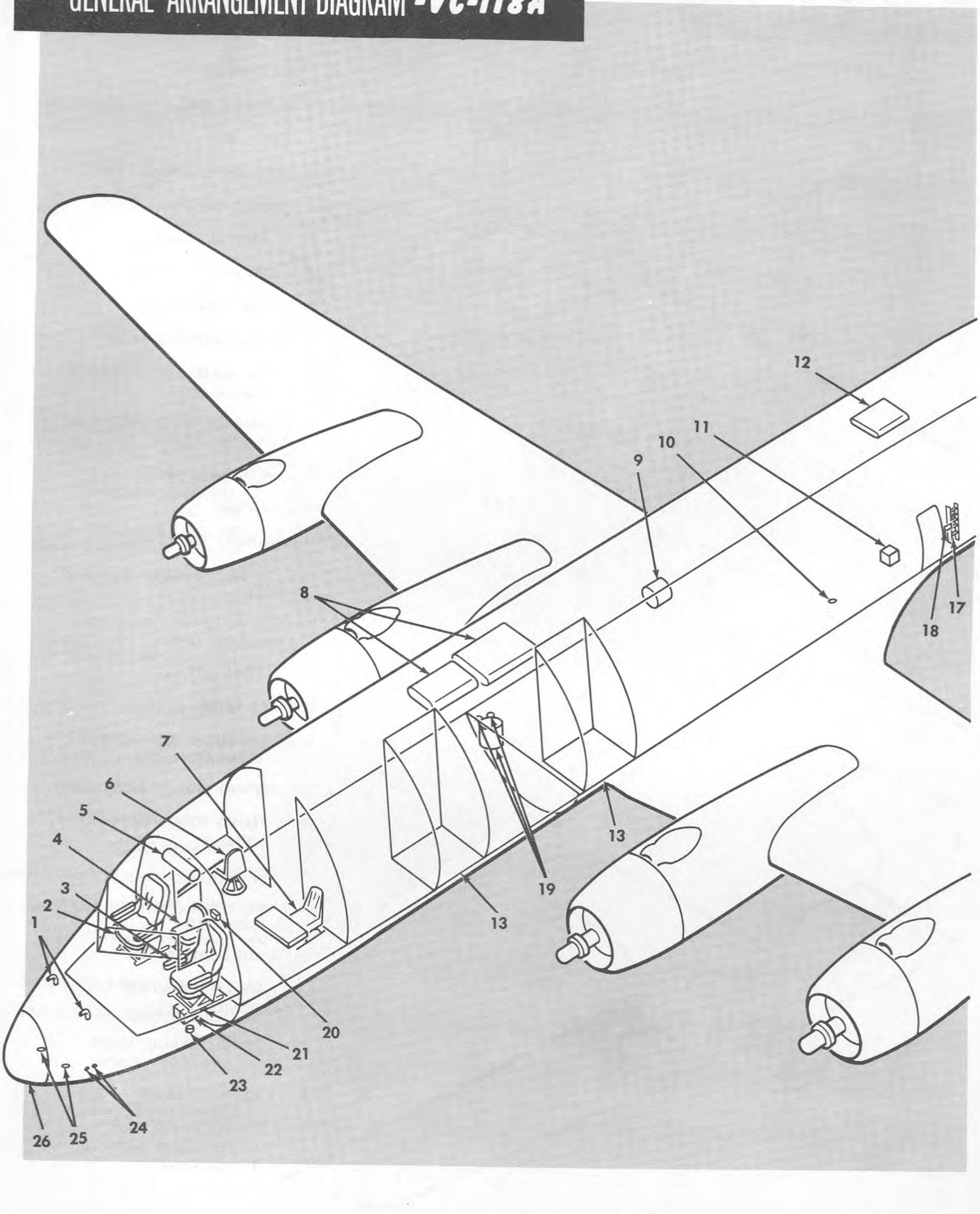


25. CARGO LIFT (AF51-3818 THROUGH AF51-3835, AF51-17626, THROUGH AF51-17661, AF51-17667, AND AF51-17668)
26. TAIL SUPPORT STOWAGE
27. MISCELLANEOUS EQUIPMENT STOWAGE CONTAINER
28. AUXILIARY POWER UNIT, D-2 (SOME AIRCRAFT)
29. FORWARD CABIN WATER SUPPLY
30. POWER RECEPTACLE FOR FORWARD CARGO LIFT
31. EMERGENCY LADDER
32. PILOT'S DRINKING FOUNTAIN
33. CHECKLIST HOLDER
34. LANDING GEAR WARNING HORN
35. LEFT BATTERY INSTALLATION
36. NOSE STEERING PRESSURE ACCUMULATOR
37. EXTERNAL POWER RECEPTACLE
38. RIGHT BATTERY INSTALLATION
39. STATIC PORT VENTS (LEFT SIDE SHOWN)
40. PITOT HEADS (AF51-3818 THROUGH AF51-3835, AND AF53-3223 THROUGH AF53-3305)

Figure 1-3 (Sheet 2 of 2)

GENERAL ARRANGEMENT DIAGRAM -VC-118A



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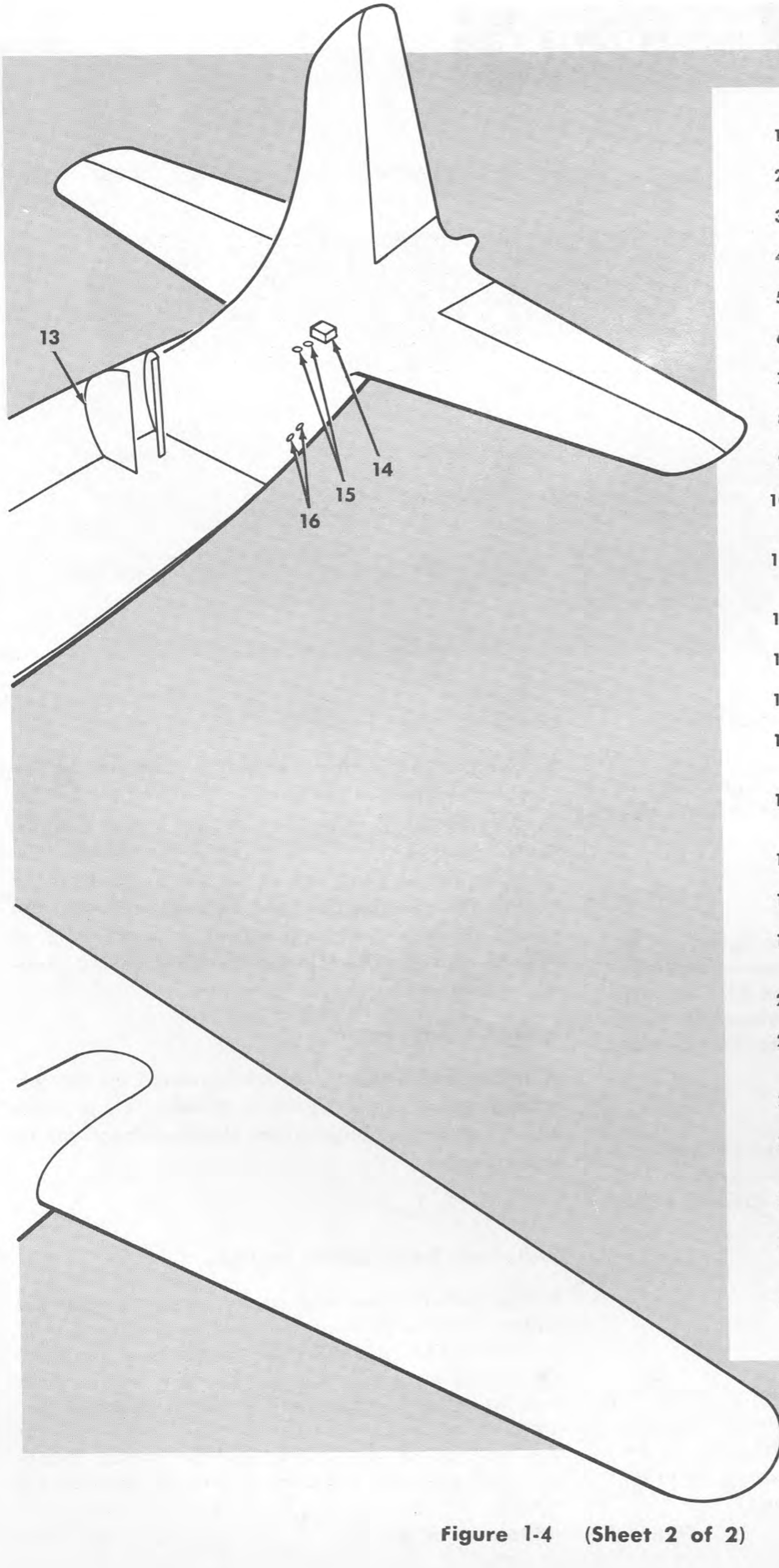


1. PITOT HEADS
2. CO-PILOT'S SEAT
3. PILOT'S SEAT
4. THIRD CREW MEMBER'S SEAT
5. COCKPIT ANTIGLARE CURTAIN
6. NAVIGATOR'S SEAT
7. RADIO OPERATOR'S SEAT
8. WATER SUPPLY TANKS
9. DE-ICING ALCOHOL TANK
10. CABIN HEATER CO_2 DISCHARGE INDICATOR DISCS
11. EMERGENCY EVACUATION SLIDE STOWAGE
12. WATER SUPPLY TANK
13. LAVATORY
14. AUXILIARY POWER UNIT
15. APU CO_2 DISCHARGE INDICATOR DISCS
16. TAIL HEATER CO_2 DISCHARGE INDICATOR DISCS
17. ELECTRIC LADDER
18. FLAG PANEL
19. HYDRAULIC RESERVOIR AND ACCUMULATORS
20. LANDING GEAR WARNING HORN
21. EXTERNAL POWER SUPPLY RECEPTACLE
22. BATTERIES
23. NOSE WHEEL STEERING ACCUMULATOR
24. STATIC VENTS
25. MAIN CO_2 DISCHARGE INDICATOR DISCS
26. RADOME NOSE

Figure 1-4 (Sheet 2 of 2)

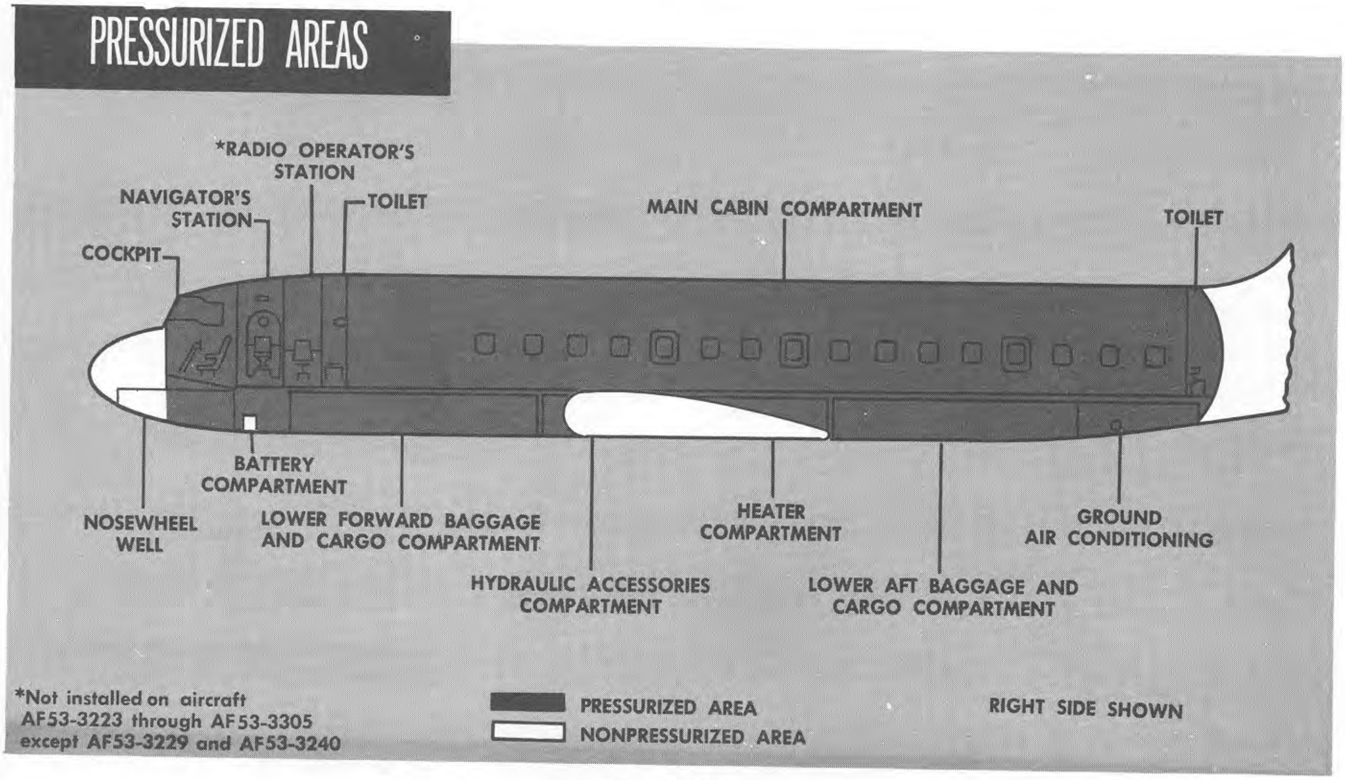


Figure 1-5

ADI (Water-Alcohol Injection) System Quantity Indicators.

Two dual ADI system quantity indicators, mounted on the upper instrument panel *(figure 1-11)*, indicate water-alcohol supply in US gallons.

ADI (Water-Alcohol Injection) System Pressure Warning Lights.

Four ADI system red pressure warning lights, one for each engine, located on the main instrument panel *(30, figure 1-9, sheets 1 and 3; and 29, sheet 2)*, illuminate when water pressure is below the allowable limits of 18 (±0.5) psi. The lights are operated by the water pressure switches.

IGNITION.

Four conventionally operated ignition switches are provided on the forward overhead panel *(figures 1-13 and 1-14)* and have the positions OFF, RIGHT, LEFT, and BOTH.

STARTING SYSTEM.

Engine Selector Switch.

Each engine is individually selected for starting by means of a selector switch on the forward overhead panel *(figures 1-13 and 1-14)*. The switch must be set to the engine being started before the starter or priming switch will function for that engine.

Primer.

A spring-loaded priming switch is mounted on the forward overhead panel *(figures 1-13 and 1-14)*. The priming switch will function in any position of the engine selector switch, except the OFF position. The priming system functions as an aid in starting the engines by injecting fuel into the engine blower case throat. On a normal engine start, it is necessary to operate the fuel booster pumps in LOW during priming to supply adequate fuel pressure.

Ignition Booster Switch.

A spring-loaded booster switch, mounted on the forward overhead panel *(figures 1-13 and 1-14)*, provides additional electric boost to the distributor for engine starting only.

Starter and Starter Safety Switches.

Spring-loaded starter and starter safety switches are mounted on the forward overhead panel *(figures 1-13 and 1-14)*. The engine selector switch must be set to the engine being started, and the engine safety switch and the starter switch must be depressed simultaneously before the starter will function. This is true for any position of the engine selector switch, except the OFF position, whether or not the engines are running.

ENGINE INSTRUMENTS.

All engine instruments are dual indicating with the exception of the torquemeters. Two direct-reading dual manifold pressure gages on the main instrument panel indicate the pressure in inches Hg in each engine intake manifold. Two dual carburetor air temperature indicators, two dual oil temperature indicators, and two dual cylinder head temperature indicators, all calibrated in degrees centigrade, are mounted on the main instrument panel. Two dual oil pressure indicators on the main instrument panel indicate in pounds per square inch (oil pressure is taken from the pressure side of each engine-driven pump). Four torquemeters are installed on the main instrument panel and indicate in pounds per square inch of bmep (torque pressure). The torque pressure reading is a direct measure of the power being supplied to the propeller.

MANIFOLD PRESSURE PURGE VALVES.

Four push-type purge valves are mounted below the left center section of the main instrument panel for use in purging or clearing the indicator supply lines of condensation. The lines should be purged prior to the first daily flight with the manifold pressure less than barometric pressure; otherwise, the lines will fill rather than purge. The manifold pressure lines can be purged in flight provided manifold pressure is less than cabin pressure at flight altitude.

PROPELLERS.

Each engine is equipped with a 3-bladed, full-feathering, reversible-pitch, constant-speed-type propeller. Constant engine rpm can be maintained automatically or manually through changes in propeller blade angles. All four propellers are maintained in automatic synchronization by an electrical synchronizer system. The pilot is provided with a master synchronizing control and four manual selector switch controls. The controls consist of four individual selector switches, a master engine selector switch, a master rpm control lever, a resynchronizing switch and four feathering buttons. The reversing switches are throttle controlled.

PROPELLER SELECTOR SWITCHES AND INDICATOR LIGHTS.

Four spring-loaded, 3-position selector switches are mounted on the propeller control panel *(6, figure 1-8, sheets 1 and 2; and 7, sheet 3).* The INC and DEC positions provide speed variation for any engine independently of the others with the system in either manual or automatic control. The center position is the OFF position.

Note

A blue indicator light, adjacent to each selector switch, illuminates when the corresponding propeller governor has reached its high or low rpm limit. A corresponding amber light illuminates when the respective propeller has reached the minus three degree blade angle (reverse pitch).

MASTER ENGINE SELECTOR SWITCH.

A 3-position master engine selector switch, mounted on the propeller control panel *(6, figure 1-8, sheets 1 and 2; and 7, sheet 3)*, provides a means of selecting either the No. 2 or No. 3 engine to serve as the master engine to which the remaining engines are slaved. The MANUAL position permits manual control of the propeller system. When the selector switch is in MANUAL position, the master rpm control lever is inoperative and therefore automatic synchronization is also inoperative.

PROPELLER MASTER RPM CONTROL LEVER.

A master rpm control lever is installed on the control pedestal *(4, figure 1-8)* and serves to vary the rpm of all four engines simultaneously. The lever has full quadrant range, from INCREASE RPM to DECREASE RPM, with intermediate positions of master rpm selection available. In the full INCREASE RPM position, the synchronizer system is inoperative, allowing each engine to seek its maximum rpm. In automatic, if a selector switch is used to change the speed of a slave engine more than plus or minus 3 percent, the master engine will not pull the slave engine back into synchronization.

RESYNCHRONIZING BUTTON.

A resynchronizing button, mounted on the propeller control panel *(6, figure 1-8, sheets 1 and 2; and 7, sheet 3)*, serves to synchronize the system without overshooting when one or more engines are out of synchronization with the master engine. Depressing the button allows each engine to progress approximately 3 percent toward the master engine speed each time the button is depressed and released. Wait 10 seconds for stabilization.

PROPELLER FEATHERING BUTTONS.

Four guarded push-pull-type propeller feathering buttons, one for each propeller, are mounted on the forward overhead panel *(figures 1-13 and 1-14)*. When the desired feathering button is depressed to feather the selected propeller, a 28-volt d-c circuit is closed to energize the feathering pump motor. An electrical holding coil holds the feathering button *in* until the propeller is full feathered. The feathering button then returns to the normal position.

COCKPIT ARRANGEMENT

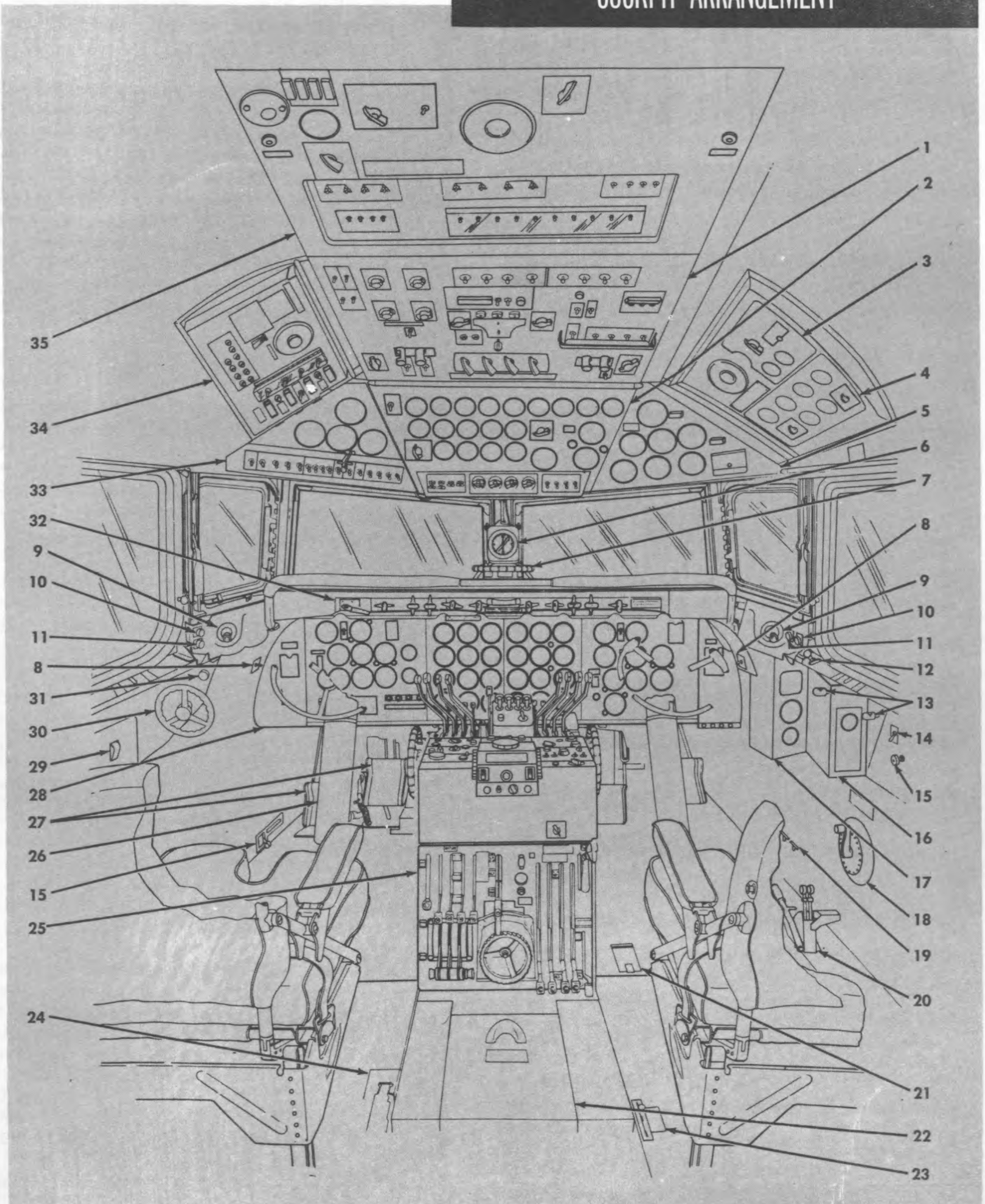


Figure 1-6 (Sheet 1 of 2)

Typical

1. Forward Overhead Panel
2. Upper Instrument Panel
3. Cabin Temperature Control Panel
4. Ammeter-Voltmeter Panel
5. Cabin Pressure Control Panel
6. Compass
7. Rudder Trim Tab Wheel
8. Static Source Selector Switch
9. Cold Air Orifice
10. Map Light Switch
11. Flight Instruments—Red Light Switch
12. Windshield Anti-Icer Exhaust Valve Handles
13. Hydraulic Panel Light
14. Emergeney Hydraulic Pump Switch
15. Windshield Alcohol De-Icing Control
16. Oxygen Panel
17. Hydraulic Instrument Panel
18. Cabin Emergency Altitude Control Handle
19. Emergency Landing Glares Control
20. Cabin Supercharger Clutch Control Levers and Cabin Emergency Depressurization Control Lever.
21. Nose Gear Latch Observation Window
22. Fuel Dump Levers
23. Emergency Hydraulic Pump Selector Valve Lever
24. Control-Surface Lock Lever
25. Control Pedestal
26. Control Column
27. Rudder Pedals
28. Main Instrument Panel
29. Ash Tray
30. Nose Wheel Steering Wheel
31. Windshield Wipe Control Knob
32. Main Fire Control Panel
33. Heater Control Panel
34. Heater Fire Control Panel
35. Aft Overhead Panel

AA1-115

Figure 1-5 (Sheet 2 of 2)

Note

If the feathering button does not return to the normal position within 15 seconds after the propeller is fully feathered, the button should be pulled out to normal.

The feathering operation may be interrupted by pulling the feathering button to the center position. This allows propeller rpm to return to the previous control setting. When the feathering button is pulled full *out* to unfeather the propeller, it must be held *out* manually for not over 2 seconds, then released. This procedure must be repeated until the tachometer indicates 600 rpm or until the relay (if installed) clicks, indicating the propeller has reached its high pitch position. For emergency operation, see Section III.

TACHOMETERS AND ISOLATION SWITCHES.

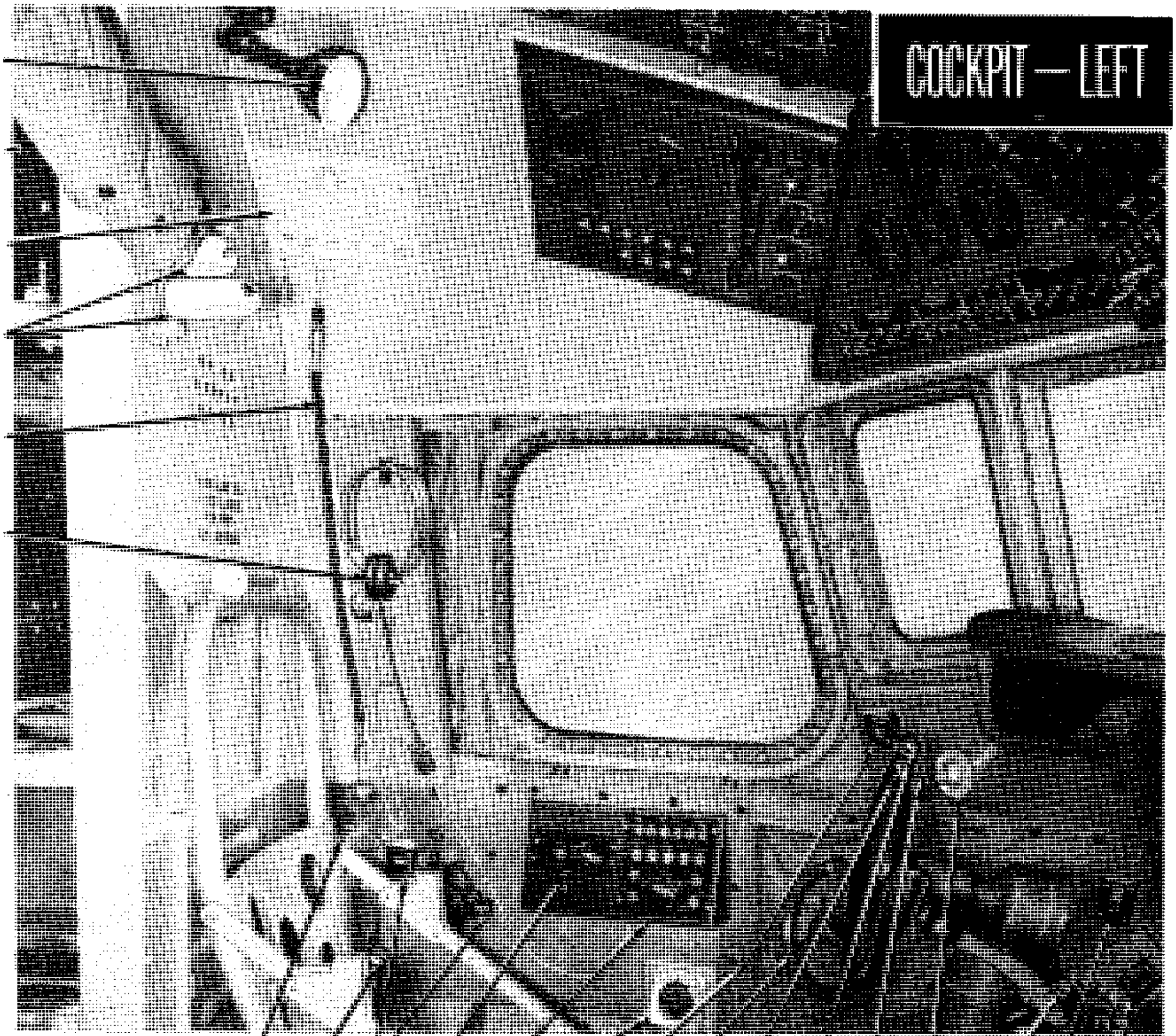
Two dual-indicating tachometers on the main instrument panel *(22, figure 1-9, sheet 1; and 23, sheets 2 and 3)*, calibrated in increments of 100, indicate engine rpm. Two isolation switches, placarded ON-DISCONNECT and ganged together, are mounted on the bulkhead aft of the pilot's seat *(8, figure 1-7, sheet 1; and 9, sheet 3)*. They are used to isolate the propeller synchronizer from the tachometer system in event of synchronizer malfunctioning.

OIL SYSTEM.

An independent oil system is provided for each engine. Oil is supplied to the engine from an oil tank (with a usable capacity of 35 gallons) through an oil tank shutoff valve, and is returned to the tank through a free-flow type oil cooler. An auxiliary oil tank with a usable capacity of 26 gallons of diluted oil (13 gallons of usable oil) is installed for transferring oil to the engine oil tanks. An oil dilution system also is provided for dilution of oil when a cold weather start is anticipated. *(For oil grade and specification, see figure 1-36.)*

OIL COOLER AIR EXIT DOOR SWITCHES.

Each oil cooler is electrically controlled, either automatically or manually, by a 4-position switch on the aft overhead panel *(figure 1-12)*. The switches are normally placed in the AUTOMATIC position, which provides automatic compensation for oil temperature variations to maintain a constant temperature level. The doors may, however, be opened or closed to manually control the temperature level by momentarily holding the respective switch in the OPEN or CLOSE position, repeating the operation until the desired temperature is attained. The switches have the following range of positions.

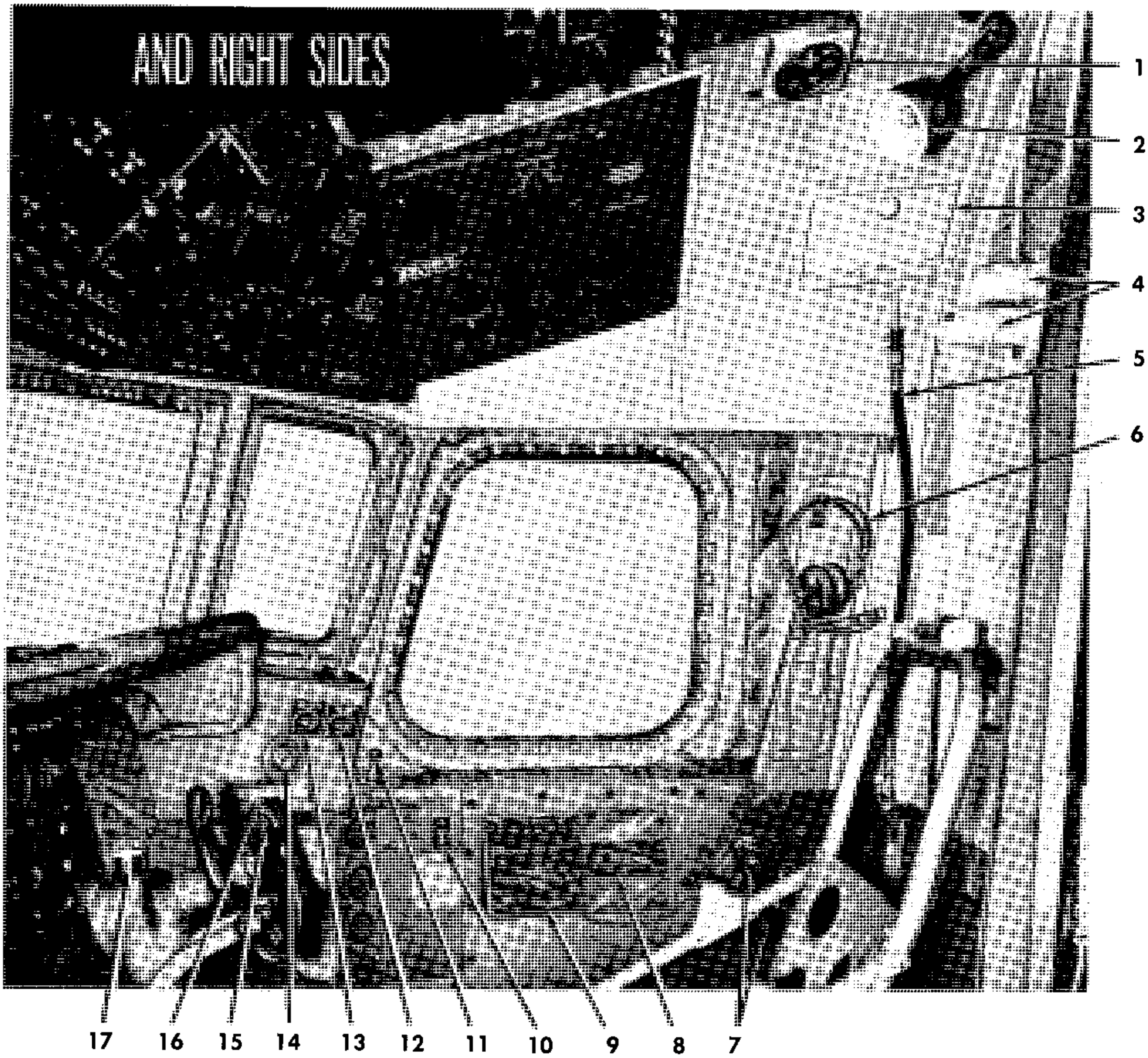


1. COCKPIT FLOODLIGHT (WHITE)
2. ANTIGLARE CURTAIN
3. OXYGEN MASK STOWAGE
4. UPPER INSTRUMENT AND SWITCH PANELS RED AND WHITE LIGHTS
5. PORTABLE OXYGEN CYLINDER RECHARGER LINE
6. HEADSET AND MICROPHONE
7. INVERTER CIRCUIT BREAKERS
8. TACHOMETER ISOLATION SWITCHES
9. OXYGEN REGULATOR AND FLOWMETER
10. INTERPHONE FILTER SWITCH
11. INTERPHONE CONTROL PANEL
12. OXYGEN PRESSURE GAGE
13. PILOT'S MAP LIGHT (WHITE) RHEOSTAT
14. NOSEWHEEL STEERING WHEEL
15. AUTOPILOT ELECTRICAL RELEASE BUTTON
16. MICROPHONE BUTTON
17. PILOT'S INSTRUMENT LIGHT (RED) RHEOSTAT
18. COLD-AIR ORIFICE
19. SEARCH RADAR SCOPE
20. STATIC SOURCE SELECTOR SWITCH
21. ANTISKID SWITCH AND INOPERATIVE LIGHT

Note: Seat cushions removed for clarity.

AA1-107

Figure 1-7 (Sheet 1 of 6)

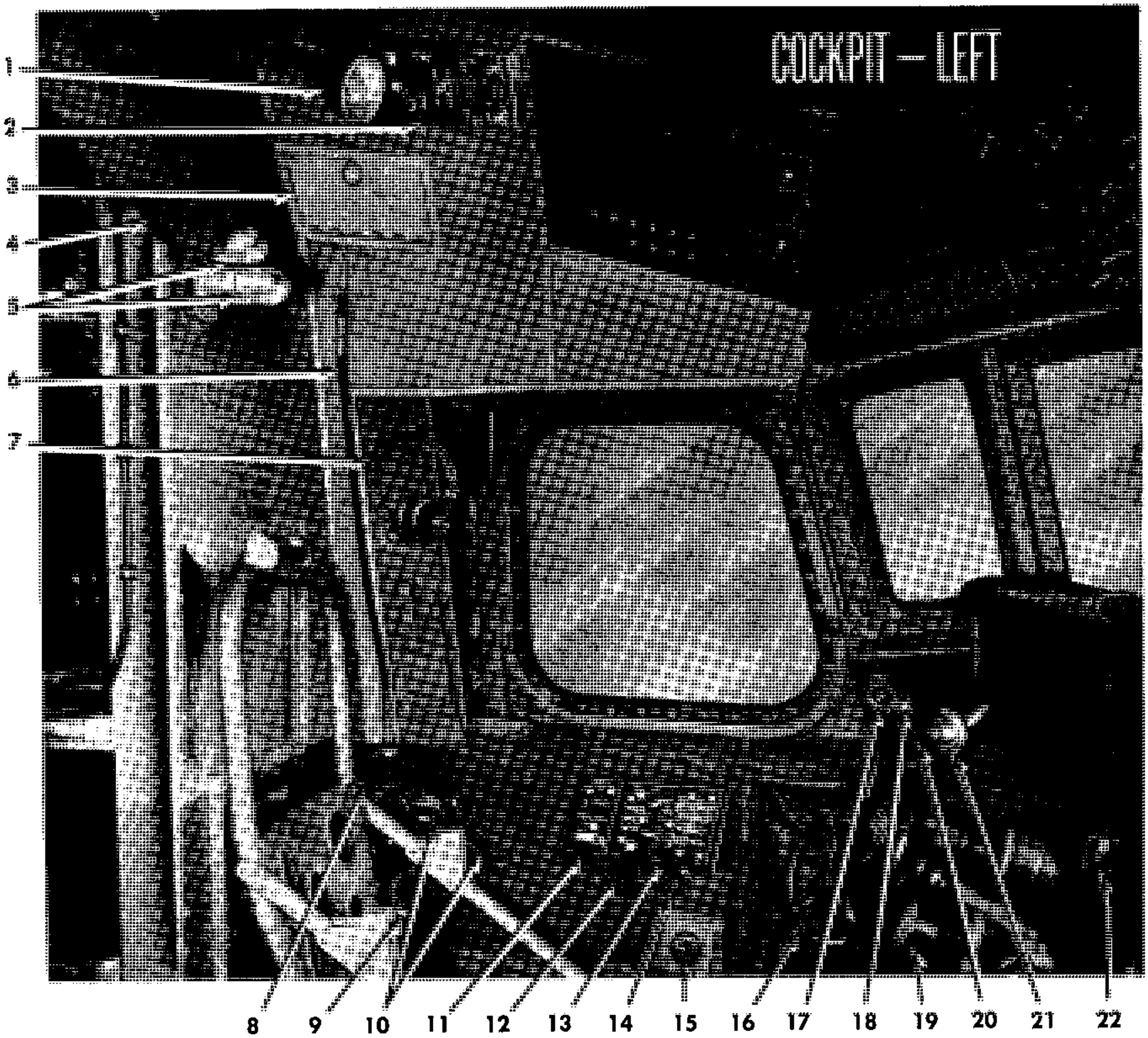


1. CABIN SUPERCHARGER DUCT PRESSURE INDICATOR
2. COCKPIT FLOODLIGHT (WHITE)
3. OXYGEN MASK STOWAGE
4. UPPER INSTRUMENT AND SWITCH PANELS LIGHTS (RED AND WHITE)
5. PORTABLE OXYGEN BOTTLE RECHARGER FITTING
6. COPILOT'S HEADSET AND MICROPHONE
7. OXYGEN REGULATOR AND FLOWMETER
8. INTERPHONE FILTER CONTROL PANEL
9. INTERPHONE CONTROL PANEL
10. EMERGENCY HYDRAULIC PUMP SWITCH
11. WINDSHIELD AIR EXHAUST HANDLE
12. COPILOT'S MAP LIGHT RHEOSTAT (WHITE)
13. COPILOT'S INSTRUMENT LIGHT RHEOSTAT (RED)
14. COLD AIR ORIFICE
15. MICROPHONE BUTTON
16. AUTOPILOT ELECTRICAL RELEASE BUTTON
17. STATIC SOURCE SELECTOR SWITCH

Note: Seat cushions removed for clarity.

AA1-108

Figure 1-7 (Sheet 2 of 6)

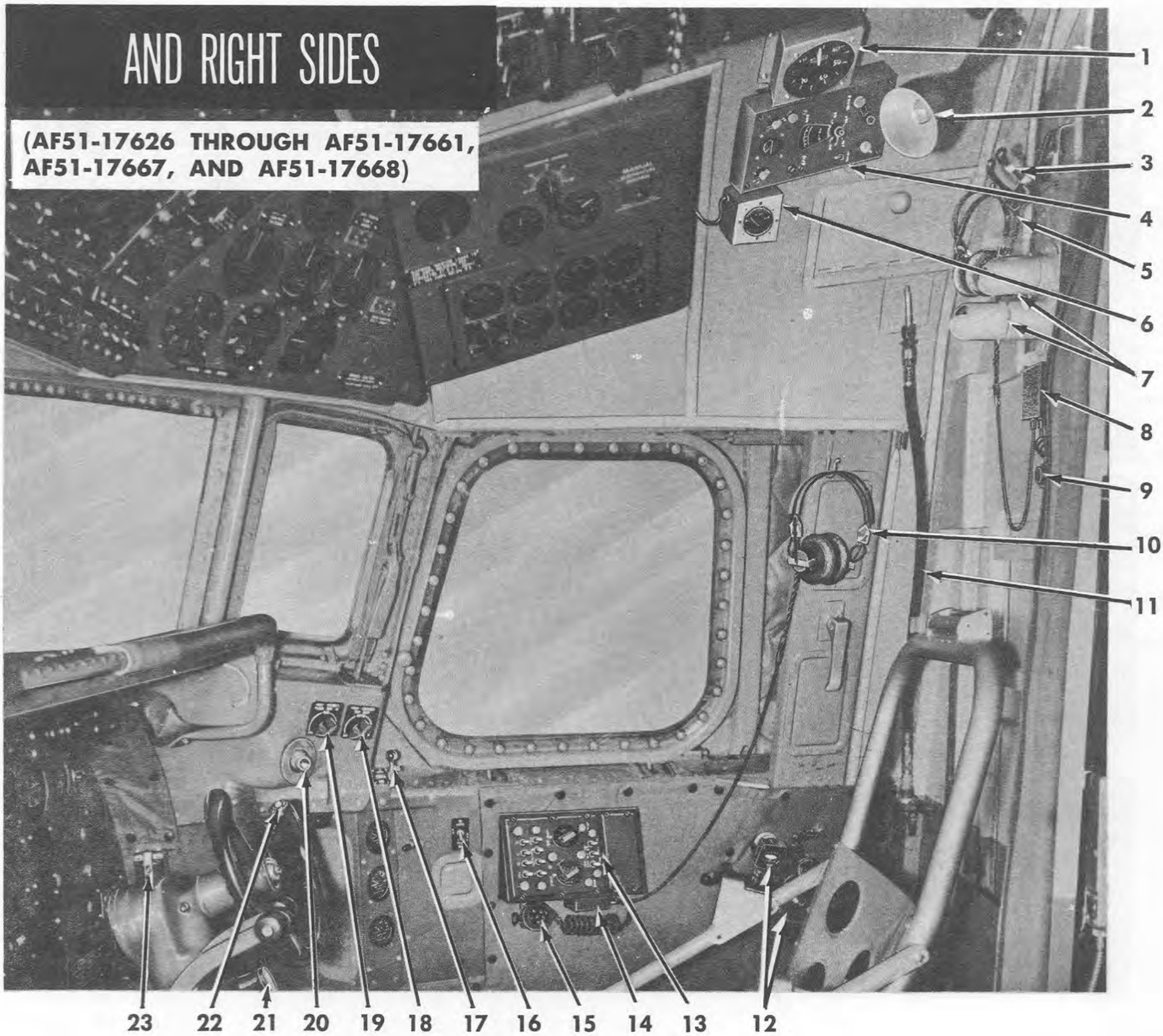


1. COCKPIT FLOODLIGHT (WHITE)
2. ADF CONTROL PANEL
3. OXYGEN MASK STOWAGE
4. ANTIGLARE CURTAIN
5. UPPER INSTRUMENT AND SWITCH PANELS LIGHTS (RED AND WHITE)
6. PORTABLE OXYGEN CYLINDER RECHARGER LINE
7. PILOT'S HEADSET
8. INVERTER CIRCUIT BREAKERS
9. TACHOMETER ISOLATION SWITCHES
10. OXYGEN REGULATOR AND FLOWMETER
11. IFF CONTROL PANEL
12. INTERPHONE JACKBOX
13. INTERPHONE CONTROL PANEL
14. MICROPHONE
15. OXYGEN PRESSURE GAGE
16. NOSEWHEEL STEERING WHEEL
17. PILOT'S MAP LIGHT RHEOSTAT (WHITE)
18. AUTOPILOT ELECTRICAL RELEASE BUTTON
19. SEARCH RADAR SCOPE
20. PILOT'S INSTRUMENT LIGHT RHEOSTAT (RED)
21. COLD AIR ORIFICE
22. STATIC SOURCE SELECTOR SWITCH

Note: Seat cushions removed for clarity.

AA1-105

Figure 1-7 (Sheet 3 of 6)

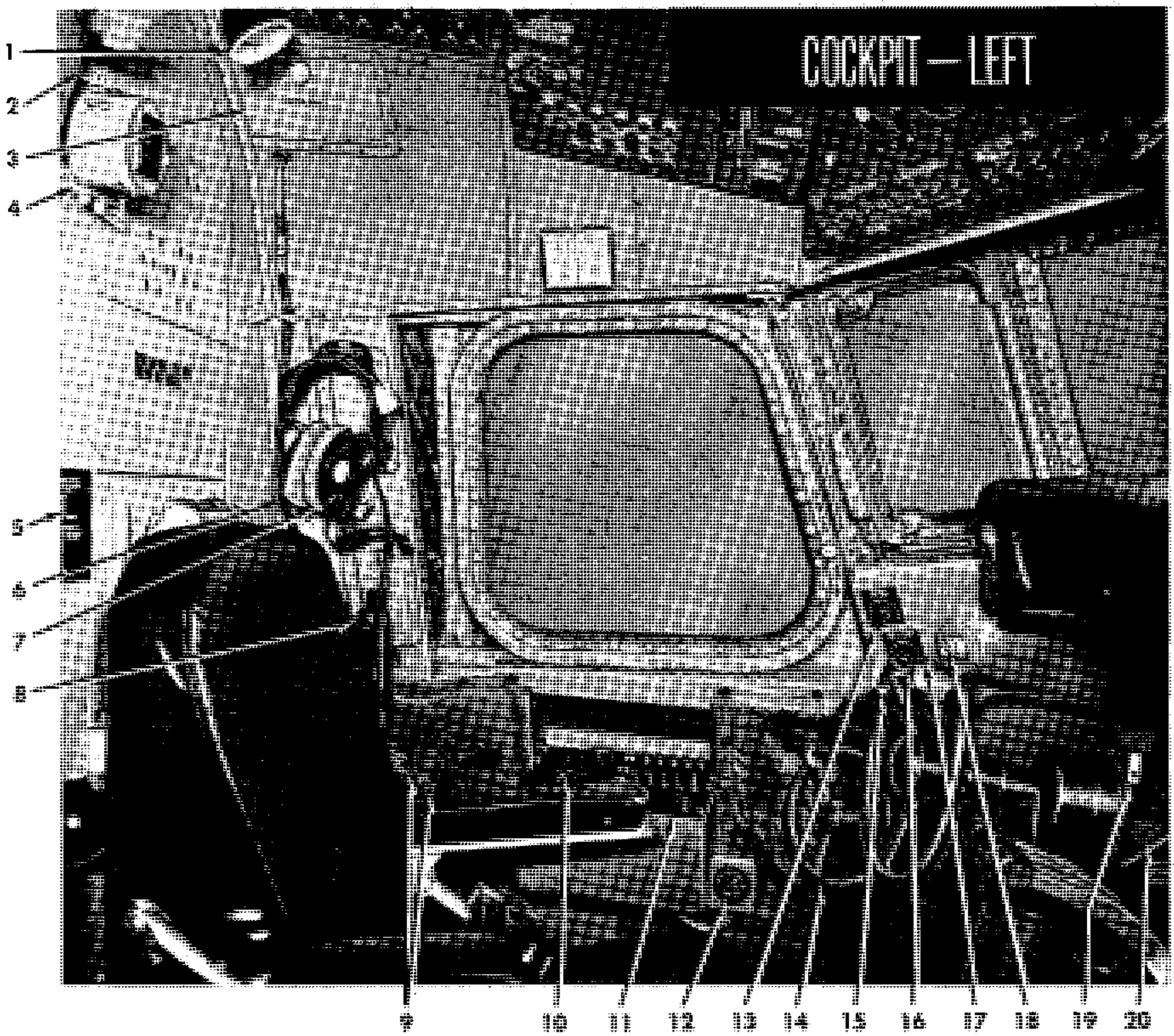


1. CABIN SUPERCHARGER DUCT PRESSURE
2. COCKPIT FLOODLIGHT (WHITE)
3. INTERPHONE HOLDER
4. ADF CONTROL PANEL
5. FLIGHT MECHANIC'S HEADSET
6. FREQUENCY METER AND SELECTOR SWITCH
7. UPPER INSTRUMENT AND SWITCH PANELS LIGHTS (RED AND WHITE)
8. FLIGHT MECHANIC'S MICROPHONE JACKBOX
9. FLIGHT MECHANIC'S MICROPHONE
10. COPILOT'S HEADSET
11. PORTABLE OXYGEN CYLINDER RECHARGER LINE
12. OXYGEN REGULATOR AND FLOWMETER
13. INTERPHONE CONTROL PANEL
14. INTERPHONE JACKBOX
15. MICROPHONE
16. EMERGENCY HYDRAULIC PUMP SWITCH
17. WINDSHIELD AIR EXHAUST HANDLE
18. COPILOT'S MAP LIGHT RHEOSTAT (WHITE)
19. COPILOT'S INSTRUMENT LIGHT RHEOSTAT (RED)
20. COLD AIR ORIFICE
21. SEARCH RADAR SCOPE
22. AUTOPILOT ELECTRICAL RELEASE BUTTON
23. STATIC SOURCE SELECTOR SWITCH

Note: Seat cushions removed for clarity.

AA1-106

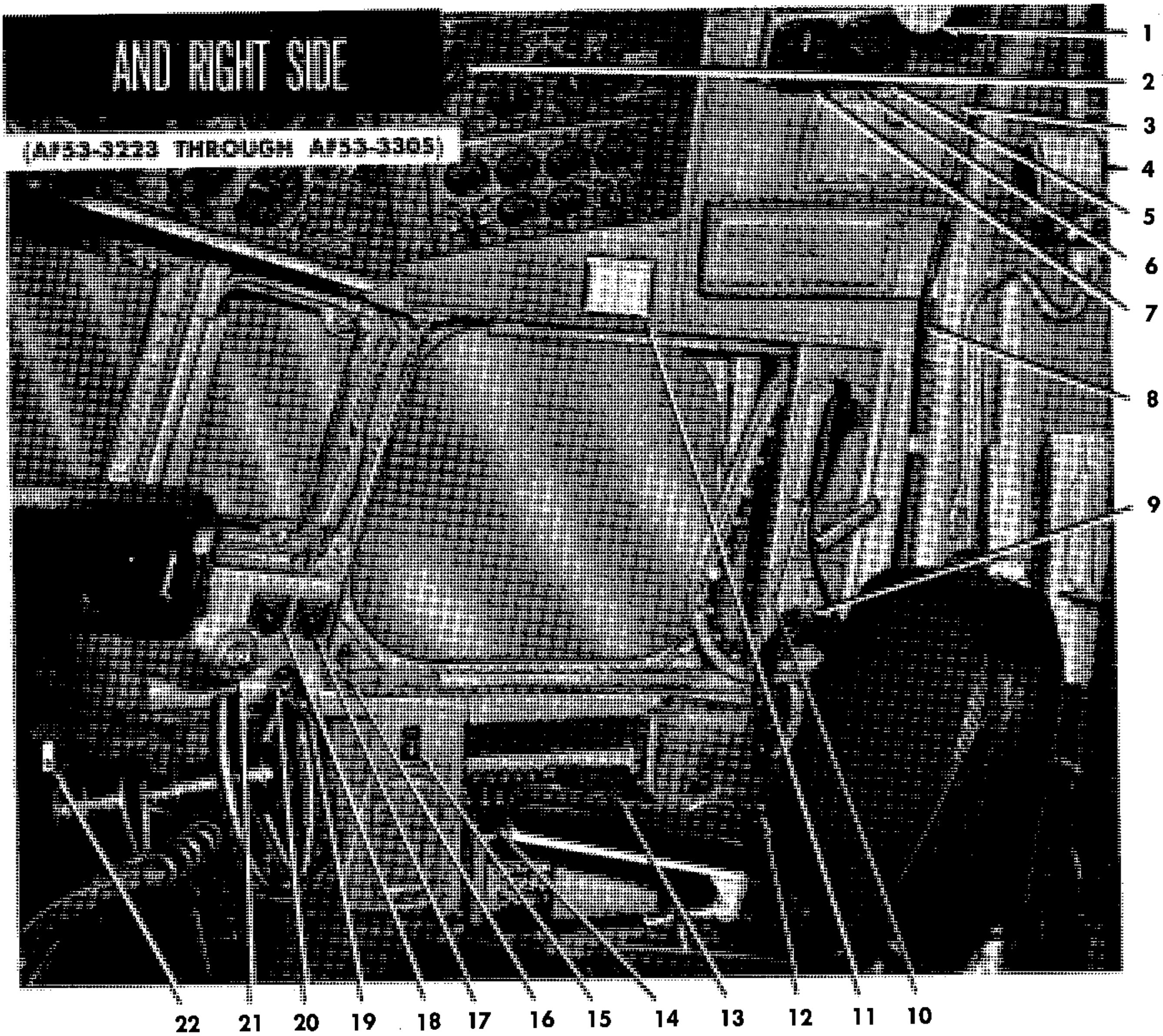
Figure 1-7 (Sheet 4 of 6)



1. COCKPIT FLOODLIGHT (WHITE)
2. ANTIGLARE CURTAIN
3. OXYGEN MASK STOWAGE
4. OVERHEAD AND UPPER INSTRUMENT PANEL LIGHTS (RED)
5. EMERGENCY BATTERY AND INVERTER OPERATION PLACARD
6. PORTABLE OXYGEN BOTTLE RECHARGER LINE
7. HEADSET AND MICROPHONE
8. PILOT'S HAND MICROPHONE
9. OXYGEN REGULATOR AND FLOWMETER
10. INTERPHONE FILTER CONTROL PANEL
11. INTERPHONE CONTROL PANEL
12. OXYGEN PRESSURE GAGE
13. PILOT'S MAP LIGHT RHEOSTAT (WHITE)
14. NOSEWHEEL STEERING WHEEL
15. AUTOPILOT ELECTRICAL RELEASE BUTTON
16. MICROPHONE BUTTON
17. PILOT'S INSTRUMENT LIGHT RHEOSTAT (RED)
18. COLD AIR ORIFICE
19. STATIC SOURCE SELECTOR SWITCH
20. ANTISKID SWITCH AND OPERATIVE LIGHT

AA1-109

Figure 1-7 (Sheet 5 of 6)



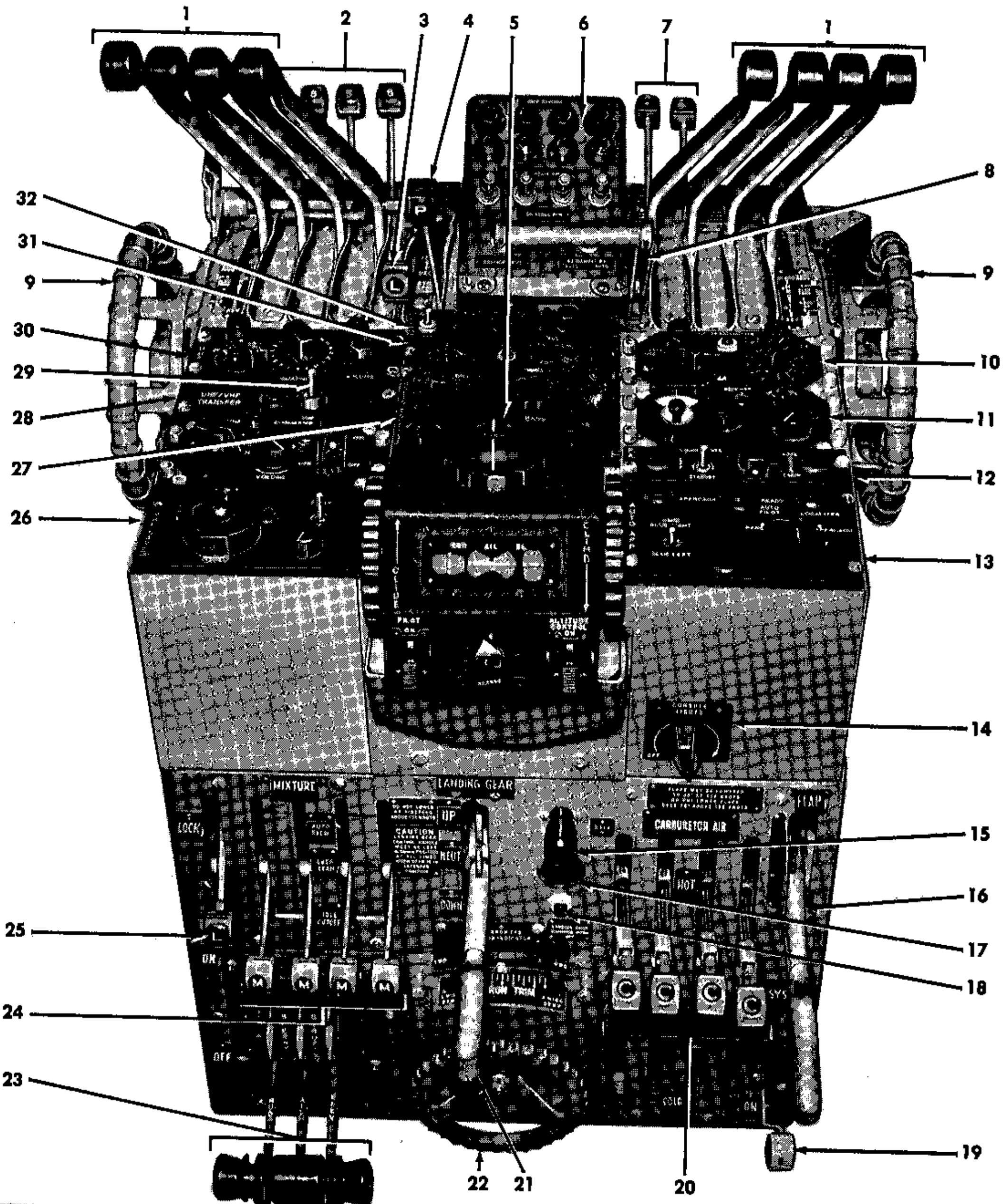
1. COCKPIT FLOODLIGHT (WHITE)
2. COCKPIT FLOODLIGHT RHEOSTAT (WHITE)
3. OXYGEN MASK STOWAGE
4. OVERHEAD SWITCH AND INSTRUMENT LIGHT (RED)
5. FREQUENCY METER
6. FREQUENCY SELECTOR SWITCH
7. CABIN SUPERCHARGER DUCT PRESSURE INDICATOR
8. PORTABLE OXYGEN BOTTLE RECHARGER LINE
9. COPILOT'S HEADSET
10. COPILOT'S MICROPHONE
11. VHF AND UHF FREQUENCY CARD
12. OXYGEN REGULATOR AND FLOWMETER
13. INTERPHONE FILTER CONTROL PANEL
14. INTERPHONE CONTROL PANEL
15. EMERGENCY HYDRAULIC PUMP SWITCH
16. WINDSHIELD AIR EXHAUST HANDLE
17. COPILOT'S MAP LIGHT RHEOSTAT (WHITE)
18. COPILOT'S INSTRUMENT LIGHT RHEOSTAT (RED)
19. AUTOPILOT ELECTRICAL RELEASE BUTTON
20. MICROPHONE BUTTON
21. COLD AIR ORIFICE
22. STATIC SOURCE SELECTOR SWITCH

AA1-110

Figure 1-7 (Sheet 6 of 6)

CONTROL PEDESTAL—Typical

(AF51-3818 THROUGH AF51-3835)



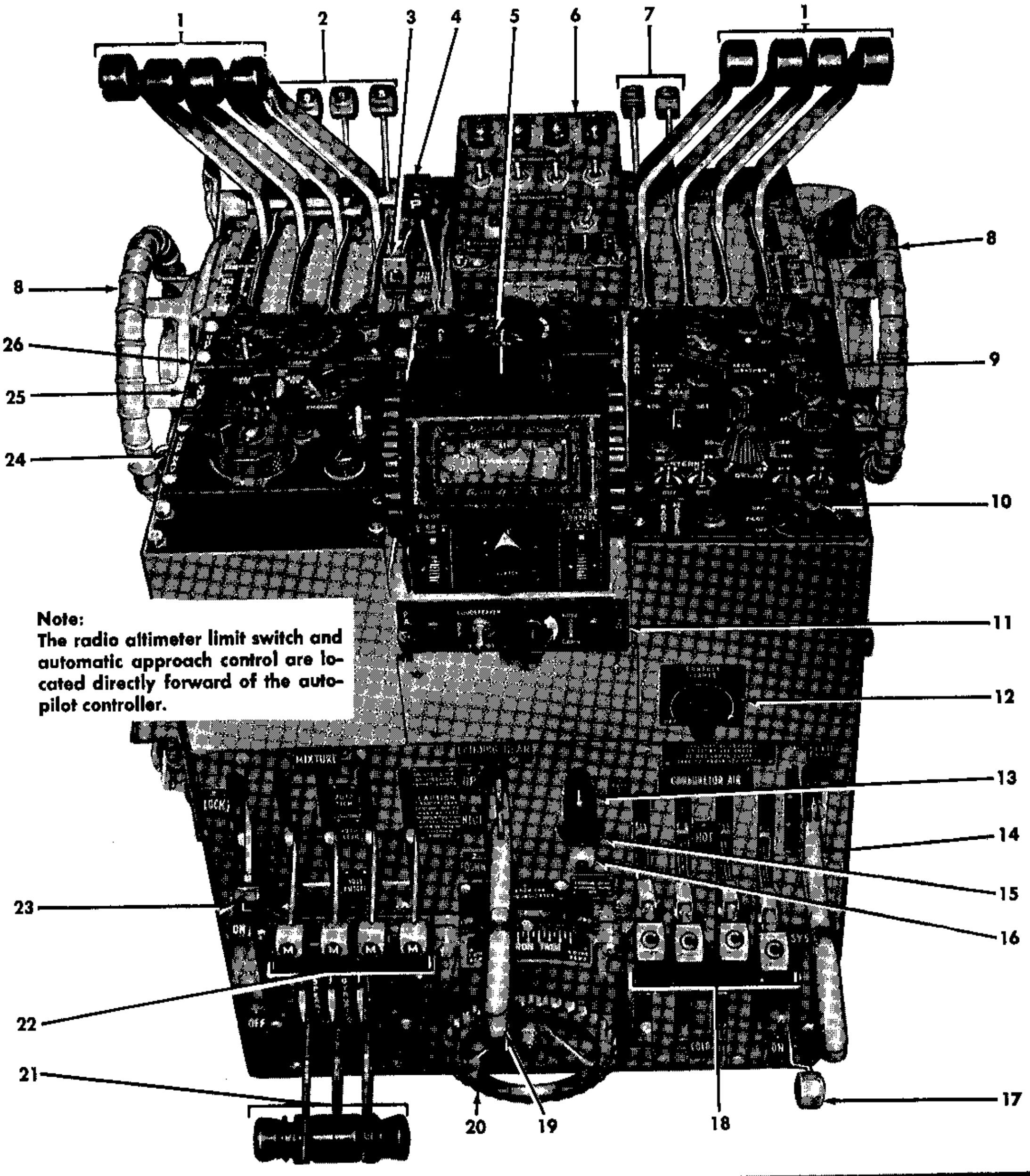
1. THROTTLES (2)
2. MAIN AND ALTERNATE FUEL SELECTOR LEVERS
3. THROTTLE LOCK LEVER
4. MASTER RPM LEVER
5. AUTOPILOT CONTROLLER
6. PROPELLER CONTROL PANEL
7. CROSSFEED LEVERS
8. REVERSE THROTTLE LOCK RELEASE BAR
9. ELEVATOR TRIM TAB WHEELS (2)
10. HF TRANSMITTER CONTROL PANEL
11. HF RECEIVER CONTROL PANEL
12. PUBLIC ADDRESS CONTROL PANEL
13. AUTOMATIC APPROACH CONTROLLER
14. RADIO PANEL LIGHTS RHEOSTAT
15. LANDING GEAR SAFETY SOLENOID RELEASE LIGHT
16. WING FLAP LEVER
17. LANDING GEAR SAFETY SOLENOID RELEASE ACCESS HOLE
18. LANDING GEAR WARNING HORN CUTOFF SWITCH
19. HYDRAULIC SYSTEM BYPASS LEVER
20. CARBURETOR AIR LEVERS
21. LANDING GEAR LEVER
22. AILERON TRIM TAB WHEEL
23. AUTOPILOT MECHANICAL ENGAGING LEVERS
24. MIXTURE LEVERS
25. MIXTURE LOCK LEVER
26. VHF NAVIGATION CONTROL PANEL
27. ADF CONTROL PANEL
28. VHF CONTROL PANEL
29. UHF-VHF TRANSFER SWITCH
30. UHF CONTROL PANEL
31. VOR-TACAN TRANSFER SWITCH
32. TACAN CONTROL

Figure 1-8 (Sheet 1 of 3)

AA1-112

CONTROL PEDESTAL—Typical

(AF51-17626 THROUGH AF51-17661
AF51-17667 AND AF51-17668)



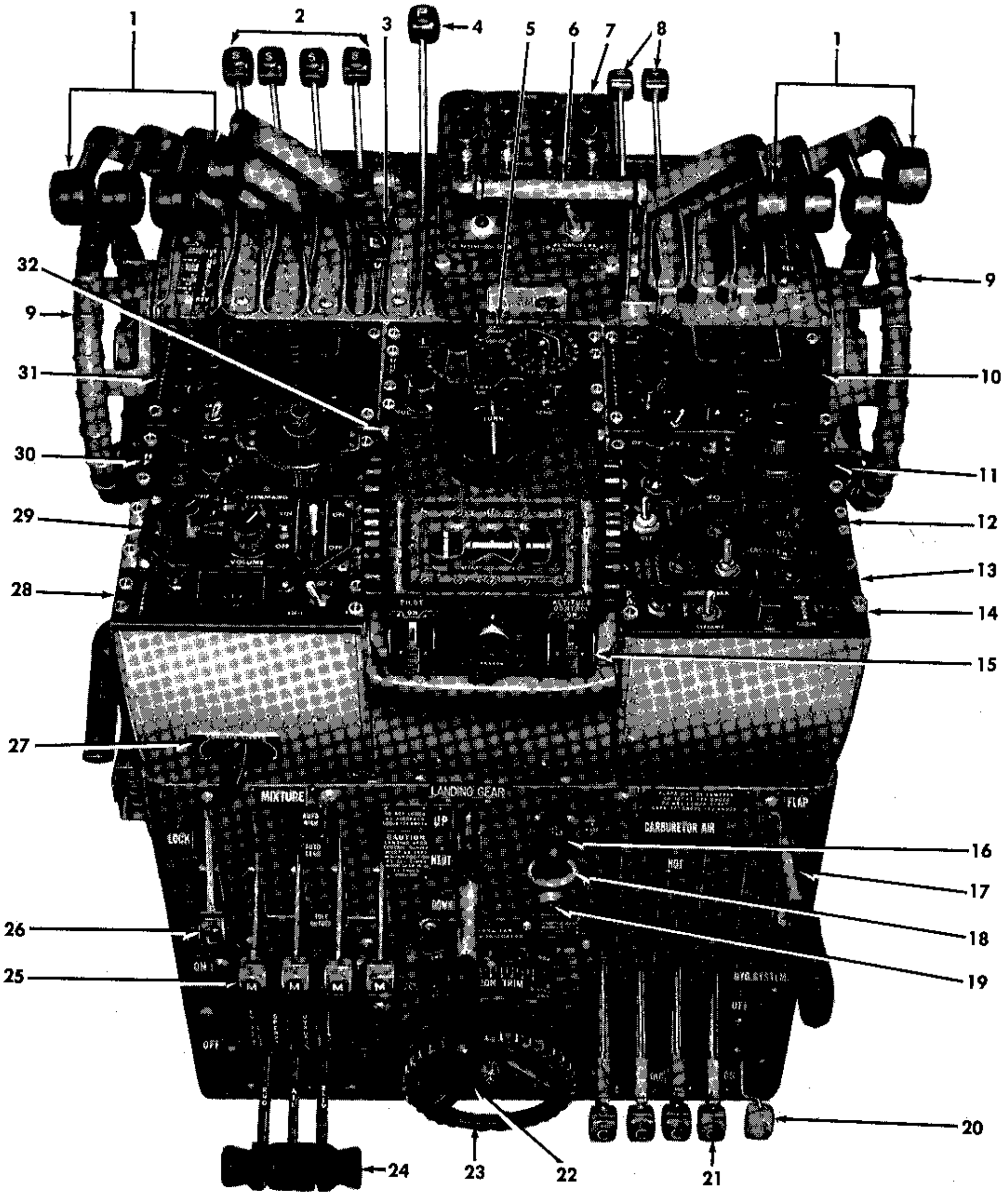
1. THROTTLES (2)
2. MAIN AND ALTERNATE FUEL SELECTOR LEVERS
3. THROTTLE LOCK LEVER
4. MASTER RPM LEVER
5. AUTOPILOT CONTROLLER
6. PROPELLER CONTROL PANEL
7. FUEL CROSSFEED LEVERS
8. ELEVATOR TRIM TAB WHEEL (1)
9. SEARCH RADAR CONTROL PANEL
10. SEARCH RADAR MASTER SWITCH
11. PUBLIC ADDRESS CONTROL PANEL
12. RADIO PANEL LIGHTS RHEOSTAT
13. LANDING GEAR SAFETY SOLENOID RELEASE LIGHT
14. WING FLAP LEVER
15. LANDING GEAR SAFETY SOLENOID RELEASE ACCESS HOLE
16. LANDING GEAR WARNING HORN CUTOFF SWITCH
17. HYDRAULIC SYSTEM BYPASS LEVER
18. CARBURETOR AIR LEVERS
19. LANDING GEAR LEVER
20. AILERON TRIM TAB WHEEL (2)
21. AUTOPILOT MECHANICAL ENGAGING LEVERS
22. MIXTURE LEVERS
23. MIXTURE LOCK LEVER
24. VHF NAVIGATION CONTROL PANEL
25. VHF CONTROL PANEL
26. UHF CONTROL PANEL

AA1-111

Figure 1-8 (Sheet 2 of 3)

CONTROL PEDESTAL—Typical

(AF53-3223 THROUGH AF53-3305)



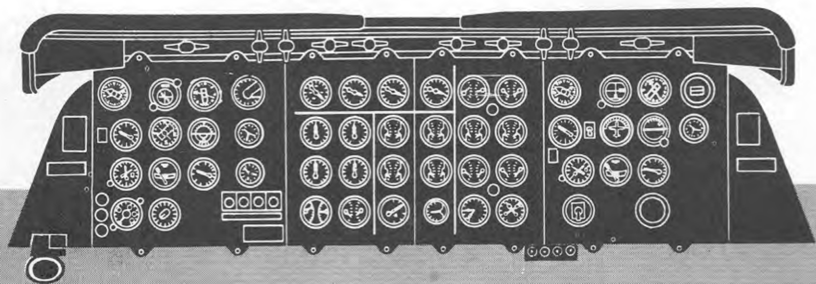
1. THROTTLES (2)
2. MAIN AND ALTERNATE FUEL SELECTOR LEVERS
3. THROTTLE LOCK LEVER
4. MASTER RPM LEVER
5. UHF CONTROL PANEL
6. REVERSE THROTTLE LOCK RELEASE BAR
7. PROPELLER CONTROL PANEL
8. FUEL CROSSFEED LEVERS
9. ELEVATOR TRIM TAB WHEEL (2)
10. ADF-2 CONTROL PANEL
11. HF-2 CONTROL PANEL
12. TACAN CONTROL
13. VOR-TACAN TRANSFER SWITCH
14. PUBLIC ADDRESS PANEL
15. AUTOPILOT CONTROLLER
16. LANDING GEAR SAFETY SOLENOID RELEASE LIGHT
17. WING FLAP LEVER
18. LANDING GEAR SAFETY SOLENOID RELEASE ACCESS HOLE
19. LANDING GEAR WARNING HORN CUTOFF SWITCH
20. HYDRAULIC SYSTEM BYPASS LEVER
21. CARBURETOR AIR LEVERS
22. LANDING GEAR LEVER
23. AILERON TRIM TAB WHEEL
24. AUTOPILOT MECHANICAL ENGAGING LEVERS
25. MIXTURE LEVER
26. MIXTURE LOCK LEVER
27. RADIO PANEL LIGHTS RHEOSTAT
28. ADF TUNING PANEL
29. VHF CONTROL PANEL
30. HF-1 CONTROL PANEL
31. ADF-1 CONTROL PANEL
32. VHF NAVIGATION CONTROL PANEL

Figure 1-8 (Sheet 3 of 3)

AA1-104

MAIN INSTRUMENT PANEL—Typical (C-118A)

(AF51-3818 THROUGH AF51-3835)



1. RADIO MAGNETIC INDICATOR
2. COURSE INDICATOR (2)
3. A-12 COMPASS HEADING SELECTOR
4. TORQUEMETER
5. OIL PRESSURE INDICATOR
6. RANGE INDICATOR
7. COMPASS CORRECTION CARD (2)
8. INVERTER WARNING LIGHT (2 RED)
9. AIRSPEED INDICATOR (2)
10. DIRECTIONAL INDICATOR (2)
11. ATTITUDE INDICATOR (2)
12. CLOCK (2)
13. MANIFOLD PRESSURE GAGE
14. CARBURETOR AIR TEMPERATURE INDICATOR
15. OIL TEMPERATURE INDICATOR
16. OIL PRESSURE WARNING LIGHT
17. AIRSPEED CORRECTION CARD (2)
18. ALTIMETER (2)
19. TURN-AND-SLIP INDICATOR (2)
20. VERTICAL VELOCITY INDICATOR (2)
21. ELAPSED TIME CLOCK
22. TACHOMETER INDICATOR
23. CYLINDER HEAD TEMPERATURE INDICATOR
24. FUEL PRESSURE INDICATOR
25. ANTISKID SWITCH AND INOPERATIVE LIGHT
26. RADIO ALTIMETER LIGHTS
27. RADIO ALTIMETER
28. RADIO ALTIMETER LIMIT SWITCH
29. DISTANCE MEASURING EQUIPMENT (PROVISIONS ONLY)
30. ADI SYSTEM WARNING LIGHTS (RED)
31. ADI SYSTEM PRESSURE INDICATOR
32. GEAR AND FLAP POSITION INDICATOR
33. OUTSIDE AIR TEMPERATURE INDICATOR
34. LANDING GEAR WARNING LIGHT (RED)
35. FUEL FLOWMETER
36. FUEL PRESSURE WARNING LIGHT (RED)
37. WARNING LIGHT DIMMING SWITCH
38. TRUE INDICATED AIRSPEED PLACARD
39. COMPASS CONTROLLER PANEL (2)
40. RADAR SCOPE
41. FUEL AND OIL PRESSURE WARNING LIGHTS ISOLATION SWITCHES

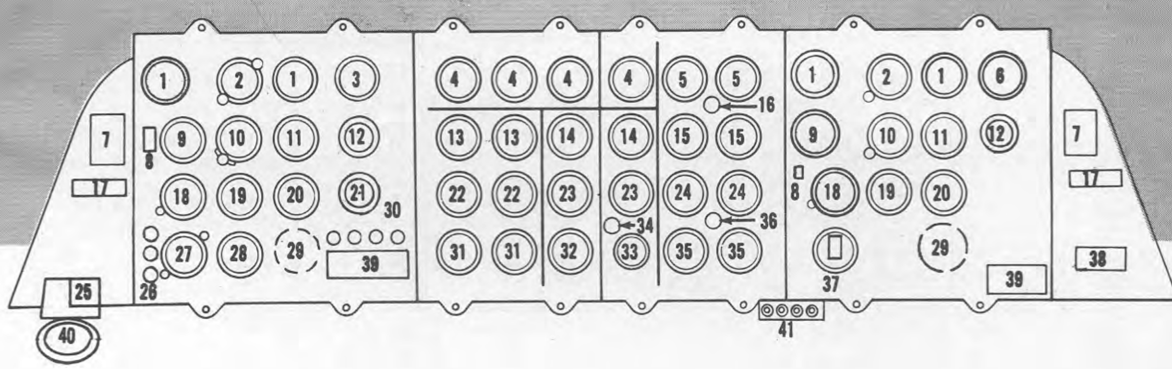
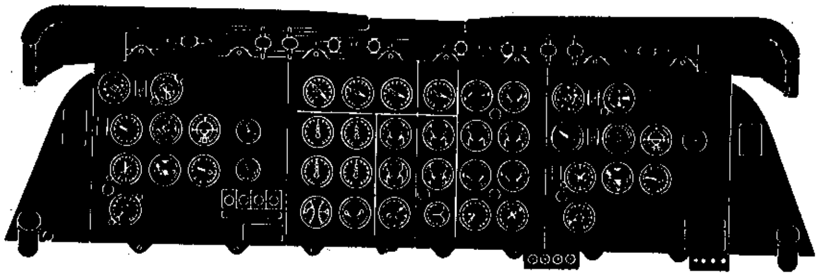


Figure 1-9 (Sheet 1 of 3)

MAIN INSTRUMENT PANEL—Typical (*C-118A*)

(AF51-17627 THROUGH AF51-17661, AF51-17667, AND AF51-17668)



1. RADIO MAGNETIC INDICATOR (RMI)
2. VOR/TAC SELECTOR SWITCH
3. COURSE INDICATOR (2)
4. RADIO MAGNETIC INDICATOR (RMI)
5. TORQUEMETER
6. OIL PRESSURE INDICATOR
7. COMPASS CORRECTION CARD (2)
8. INVERTER WARNING LIGHT (2 RED)
9. AIRSPEED INDICATOR (2)
10. A-12 HEADING SELECTOR
11. ATTITUDE INDICATOR—(H-5)
12. CLOCK
13. MANIFOLD PRESSURE GAGE
14. CARBURETOR AIR TEMPERATURE INDICATOR
15. OIL TEMPERATURE INDICATOR
16. OIL PRESSURE WARNING LIGHT (RED)
17. G2 COMPASS SLAVING SWITCH
18. DIRECTIONAL INDICATOR
19. ALTIMETER
20. TURN-AND-SLIP INDICATOR
21. VERTICAL VELOCITY INDICATOR
22. ELAPSED TIME CLOCK
23. TACHOMETER INDICATOR
24. CYLINDER HEAD TEMPERATURE INDICATOR
25. FUEL PRESSURE INDICATOR
26. RADAR SCOPE (2)
27. RADIO ALTIMETER WARNING LIGHT (2 RED)
28. RADIO ALTIMETER
29. ADI SYSTEM WARNING LIGHT (RED)
30. AIR SPEED CORRECTION CARD (2)
31. ADI PRESSURE INDICATOR
32. GEAR AND FLAP POSITION INDICATOR
33. OUTSIDE AIR TEMPERATURE INDICATOR
34. LANDING GEAR WARNING LIGHT (RED)
35. FUEL FLOWMETER
36. FUEL PRESSURE WARNING LIGHT (RED)
37. MAX PERMISSIBLE INDICATED AIRSPEED PLACARD
38. HEATER FIRE WARNING LIGHT INDICATORS
39. TACAN RANGE INDICATOR (10310)
40. FUEL AND OIL PRESSURE WARNING LIGHTS ISOLATION SWITCHES
41. VOR/ADF SELECTOR SWITCH

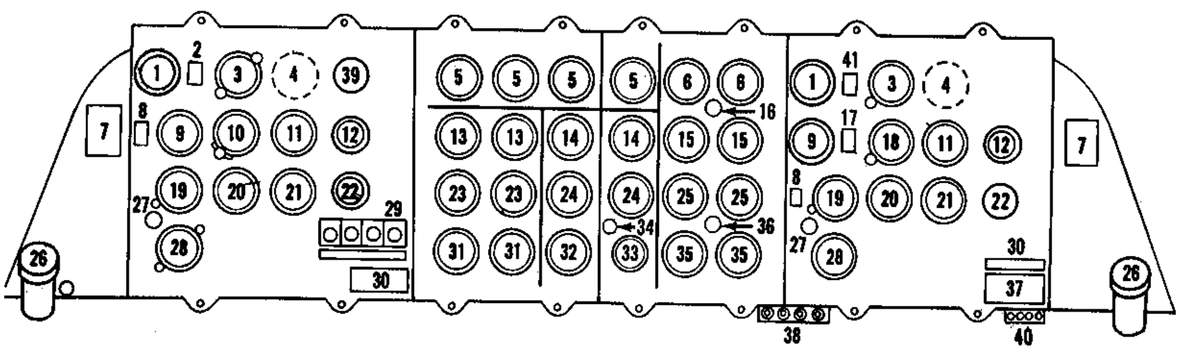
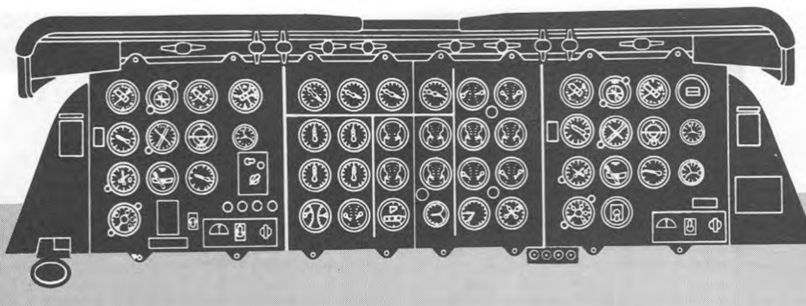


Figure 1-9 (Sheet 2 of 3)

MAIN INSTRUMENT PANEL—Typical (C-118A)

**AF53-3223 THROUGH AF53-3228
AF53-3230 THROUGH AF53-3239
AND AF53-3241 THROUGH AF53-3305**



1. ADF RADIO MAGNETIC INDICATOR (2)
2. COURSE INDICATOR (2)
3. VOR RADIO MAGNETIC INDICATOR (2)
4. A-12 COMPASS HEADING SELECTOR
5. TORQUEMETER
6. OIL PRESSURE INDICATOR
7. RANGE INDICATOR
8. RADIO CALL PLACARD (2)
9. COMPASS CORRECTION CARD (2)
10. INVERTER WARNING LIGHT (2 RED)
11. AIRSPEED INDICATOR (2)
12. DIRECTIONAL INDICATOR (2)
13. ATTITUDE INDICATOR—H-5 (2)
14. CLOCK (2)
15. MANIFOLD PRESSURE GAGE
16. CARBURETOR AIR TEMPERATURE INDICATOR
17. OIL TEMPERATURE INDICATOR
18. OIL PRESSURE WARNING LIGHT (RED)
19. ALTIMETER (2)
20. TURN-AND-SLIP INDICATOR (2)
21. VERTICAL VELOCITY INDICATOR (2)
22. AUTOPILOT FUNCTION SELECTOR
23. TACHOMETER INDICATOR
24. CYLINDER HEAD TEMPERATURE INDICATOR
25. FUEL PRESSURE INDICATOR
26. ELAPSED TIME CLOCK
27. RADAR SCOPE
28. RADIO ALTIMETER (2)
29. MARKER BEACON SELECTOR SWITCH
30. ADI SYSTEM WARNING LIGHTS (RED)
31. ADI SYSTEM PRESSURE INDICATOR
32. GEAR AND FLAP POSITION INDICATOR
33. LANDING GEAR WARNING LIGHT (RED)
34. OUTSIDE AIR TEMPERATURE INDICATOR
35. FUEL FLOWMETER
36. FUEL PRESSURE WARNING LIGHT (RED)
37. WARNING LIGHT DIMMING SWITCH
38. AIRSPEED CORRECTION CARD
39. COMPASS CONTROLLER PANEL
40. TRUE INDICATED AIRSPEED PLACARD
41. ANTISKID SWITCH AND INOPERATIVE LIGHT
42. FUEL AND OIL PRESSURE WARNING LIGHTS ISOLATION SWITCHES

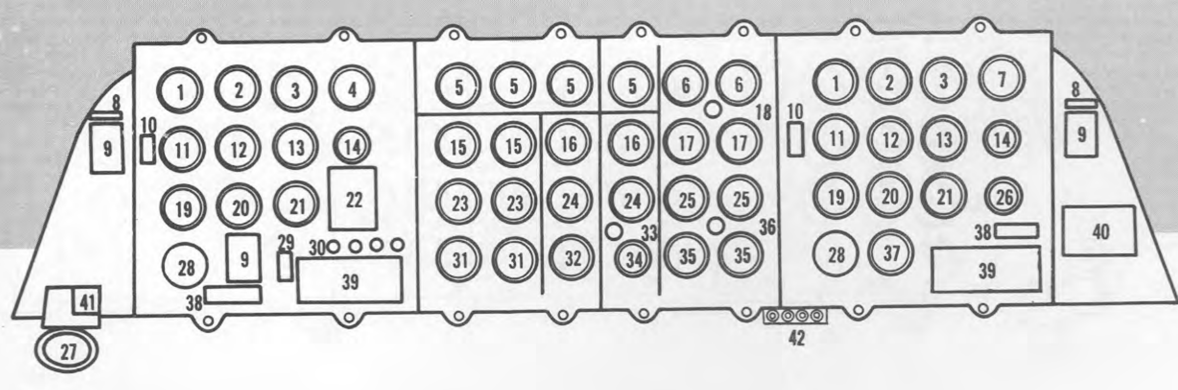
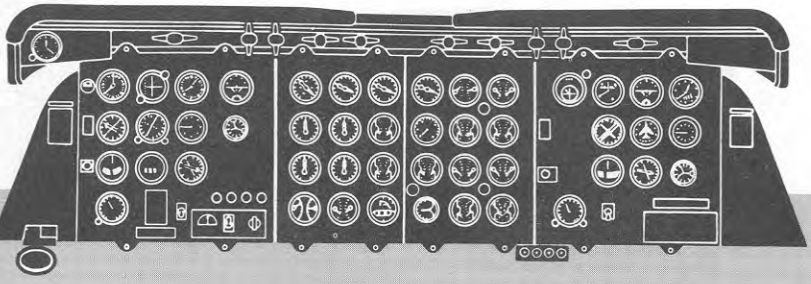


Figure 1-9 (Sheet 3 of 3)

MAIN INSTRUMENT PANEL—Typical (VC-118A)



1 ELAPSED TIME CLOCK
2 GYRO MONITOR INDICATOR
3 AIRSPEED INDICATOR (2)
4 IFS APPROACH HORIZON INDICATOR
5 MARKER BEACON LIGHT (2)
6 ALTIMETER (2)
7 ATTITUDE INDICATOR H-5 (2)
8 TORQUEMETER (4)
9 OIL PRESSURE INDICATOR (2)
10 OIL PRESSURE WARNING LIGHT
11 COURSE INDICATOR
12 RADIO CALL PLACARD (2)
13 COMPASS CORRECTION CARD (2)
14 INVERTER WARNING LIGHT (RED) (2)
15 ADF RADIO MAGNETIC INDICATOR (2)
16 IFS COURSE LINE INDICATOR
17 VERTICAL VELOCITY INDICATOR (2)
18 EIGHT DAY CLOCK (2)
19 MANIFOLD PRESSURE GAGE (2)
20 FUEL FLOWMETER (2)
21 FUEL PRESSURE INDICATOR (2)
22 A-12 COMPASS REPEATER INDICATOR
23 GLIDE SLOPE ENGAGED INDICATOR (2)
24 TURN-AND-SLIP INDICATOR (2)
25 DISTANCE MEASURING EQUIPMENT INDICATOR (DME)
26 VOR-1 AND VOR-2 (OR TACAN) RADIO MAGNETIC INDICATOR (RMI) (2)
27 ADI SYSTEM WARNING LIGHTS (RED)
28 TACHOMETER INDICATOR (2)
29 CYLINDER HEAD TEMPERATURE INDICATOR (2)
30 OIL TEMPERATURE INDICATOR (2)
31 FUEL PRESSURE WARNING LIGHT (RED)
32 RADIO ALTIMETER (2)
33 AIRSPEED CORRECTION CARD (2)
34 MARKER BEACON SWITCH (HI-LO)
35 S-2 COMPASS CONTROL PANEL
36 ADI SYSTEM PRESSURE INDICATOR
37 LANDING GEAR AND FLAP POSITION INDICATOR
38 LANDING GEAR WARNING LIGHT (RED)
39 OUTSIDE AIR TEMPERATURE INDICATOR (OAT)
40 CARBURETOR AIR TEMPERATURE INDICATOR
41 WARNING LIGHT DIMMING SWITCH
42 TRUE INDICATED AIRSPEED PLACARD
43 RADAR SCOPE
44 FUEL AND OIL PRESSURE WARNING LIGHTS ISOLATION SWITCHES

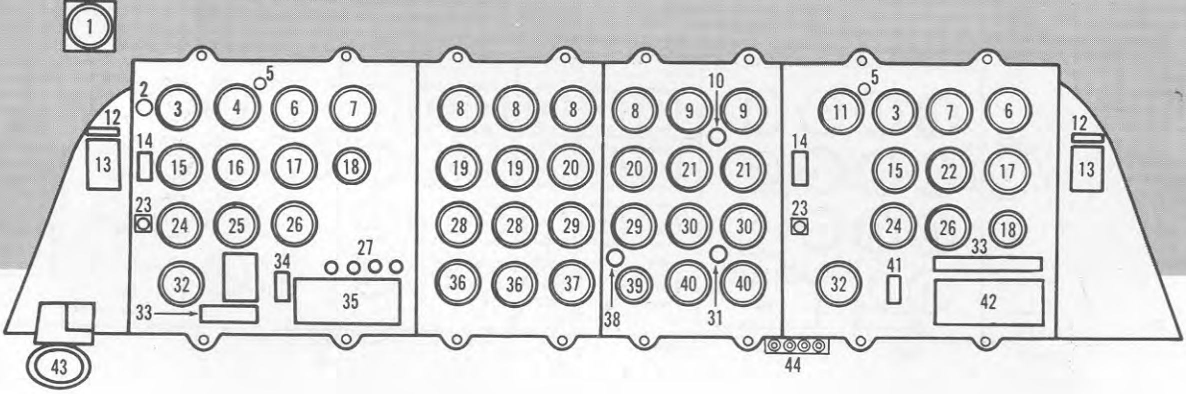


Figure 1-10

UPPER INSTRUMENT PANEL

AF53-3223
THROUGH AF53-3305

AF51-17626 THROUGH
AF51-17661, AF51-17667,
AND AF51-17668

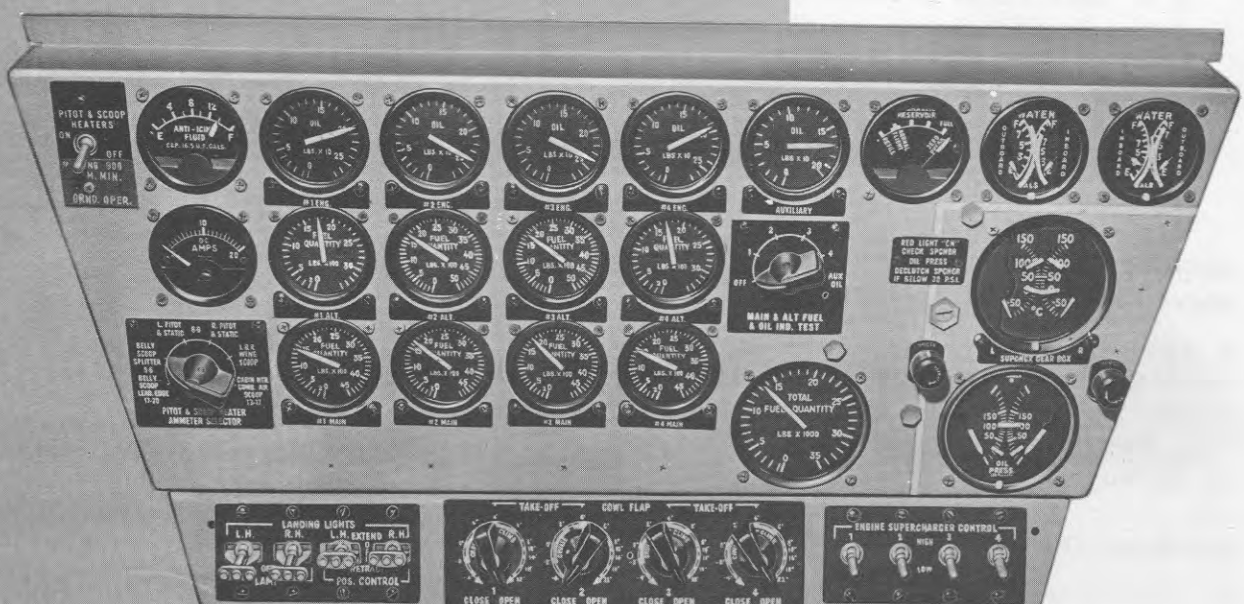


Figure 1-11

AUTOMATIC (Automatic operation)

OFF (Oil cooler air exit door actuator inoperative)

OPEN **CLOSE** (Manual operation)

Note

It requires approximately 20 seconds for the doors to travel through their full range from OPEN to CLOSE during flight.

OIL DILUTION SWITCHES.

Four spring-loaded oil dilution switches are installed on the aft overhead panel *(figure 1-12).*

OIL SYSTEM EMERGENCY SHUTOFF VALVE HANDLE.

A mechanically actuated shutoff valve, controlled from the cockpit by means of the fire extinguisher selector valve handle *(figure 1-35),* is installed at each engine section oil tank to shut off the flow of oil. See Emergency Equipment, this section, for detailed information concerning emergency shutoff valve handles.

Note

If an engine cannot be completely stopped, the respective fire extinguisher selector valve handle should be pushed in until checked by the spring clip located below the valve handle. This will partially open the oil system emergency shutoff valve and allow some oil to reach the engine.

AUXILIARY OIL TANK SELECTOR VALVE SWITCH.

A 5-position auxiliary tank selector valve switch, located on the aft overhead panel *(figure 1-12),* directs auxiliary oil to any of the four engine nacelle oil tanks. The OFF position shuts off all oil flow from the auxiliary tank.

AUXILIARY OIL TANK PUMP SWITCH.

An auxiliary oil tank pump switch, located on the aft overhead panel *(figure 1-12),* has the placarded positions ON and REVERSE and is spring loaded to off. The switch should be held in the REVERSE position for approximately 1 minute after transferring oil to an engine nacelle oil tank in order to purge the line and prevent stoppage resulting from congealed oil. The auxiliary oil tank selector valve switch must be positioned to an engine nacelle oil tank before the pump will function. To avoid excessive foaming, oil tanks must not be filled above the 20-gallon or 150-pound level by use of the oil transfer system.

OIL QUANTITY INDICATORS.

Four electrically actuated engine oil quantity indicators, one for each engine, are mounted on the upper instrument panel *(figure 1-11).* An indicator for the auxiliary oil tank is also mounted on the upper instrument panel.

OIL PRESSURE INDICATORS.

Two dual oil pressure indicators, calibrated in pounds per square inch, are mounted on the main instrument panel *(5, figure 1-9, sheet 1; and 6, sheets 2 and 3).*

OIL PRESSURE WARNING LIGHT AND ISOLATION SWITCHES.

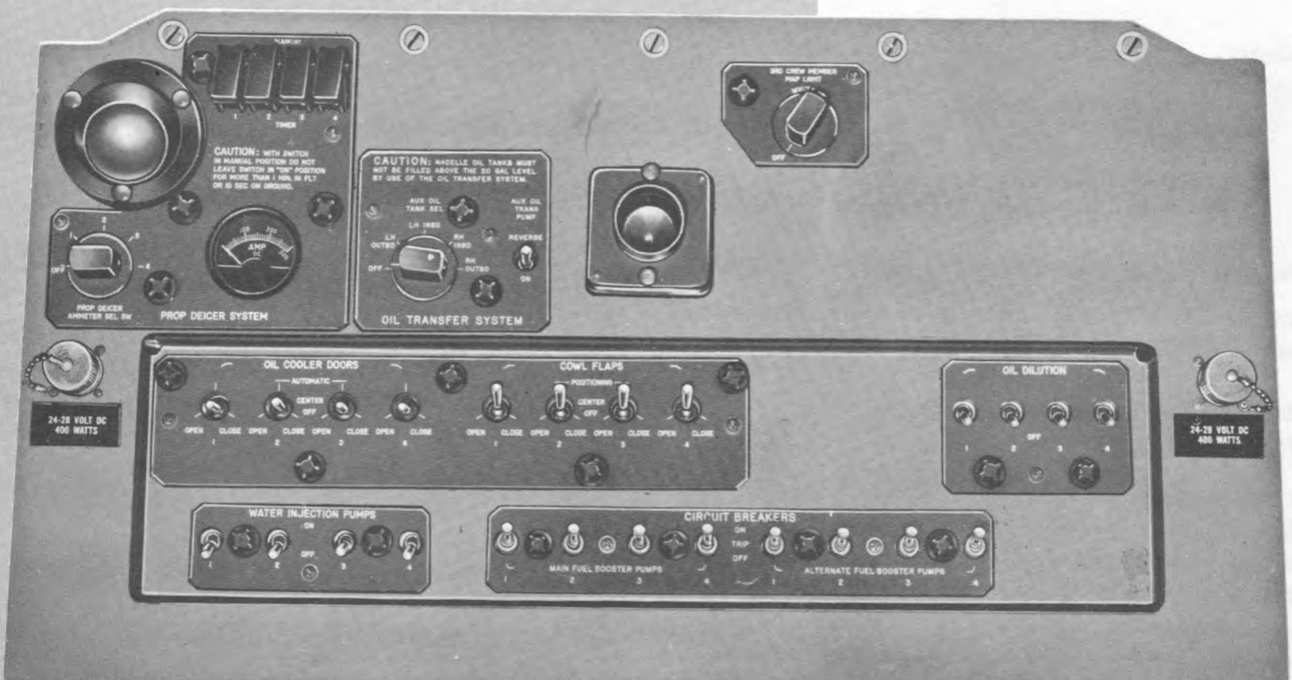
One push-to-test red oil pressure warning light is installed on the main instrument panel *(6, figure 1-9), sheets 1 and 2; 18, sheet 3; and 10, figure 1-10),* and illuminate whenever the oil pressure of any engine drops below 50 (±5) psi.

On some aircraft, four fuel and oil pressure warning isolation switches *(41, figure 1-9, sheet 1; 38, sheet 2; 42, sheet 3; and 44, figure 1-10)* are located on the lower right section of the main instrument panel. Each isolation switch is safetied in the ON position; when the switch is placed in the OFF position, the circuit from the respective engine is deenergized and the lights will go out, permitting the fuel and oil pressure warning lights to function with one or more engines inoperative.

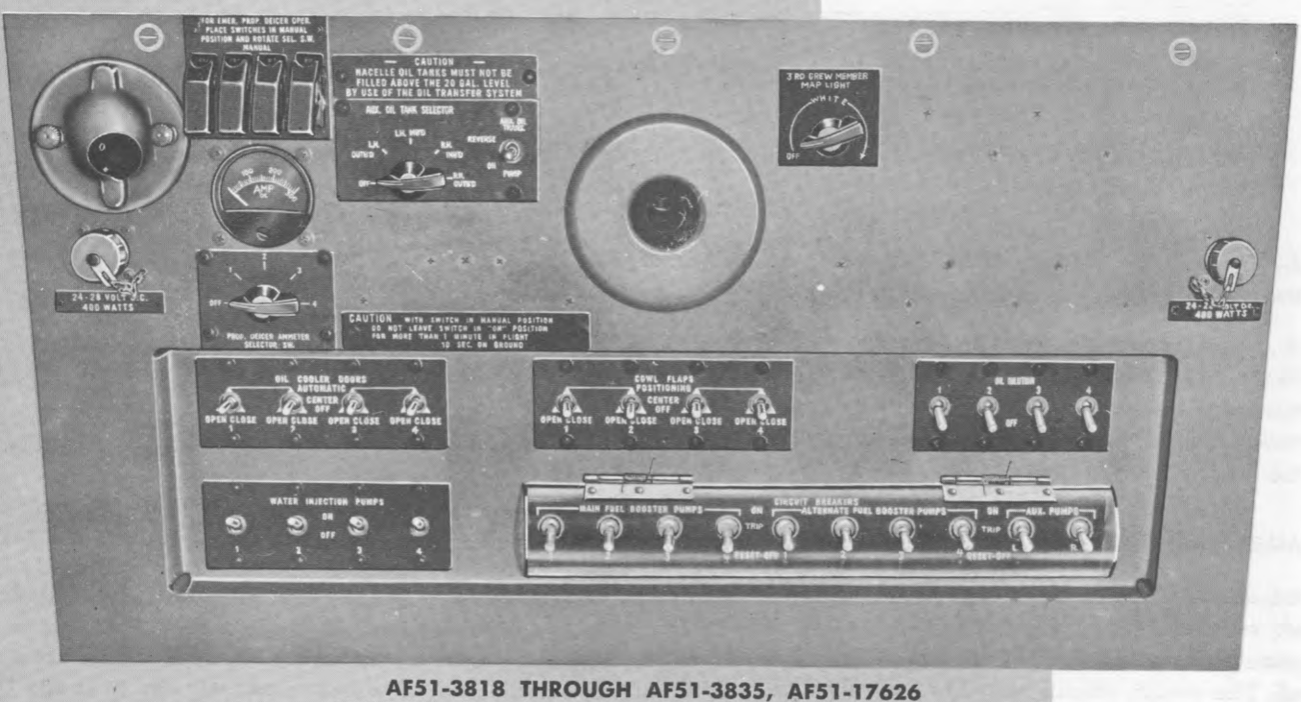
FUEL SYSTEM.

The fuel system *(figure 1-15)* furnishes fuel for the engines, for oil dilution, for the auxiliary power unit, and for the combustion heaters. The system includes eight fuel tanks (four main and four alternate), eight electrically driven booster pumps, four engine-driven fuel pumps, four firewall shutoff valves, and the necessary fuel flow, pressure and quantity indicators. The system provides an independent supply of fuel (a main and an alternate tank) for each engine. With the tanks interconnected by a crossfeed system, numerous tank-to-engine fuel flow combinations are possible *(figure 7-2).* Each tank is vented overboard and is suitable for aromatic fuel. A fuel dump system also is provided *(figure 3-5).* See figure 1-36 for fuel grade and filler points and figure 7-3 for fuel quantity.

AFT OVERHEAD PANEL



AF53-3223 THROUGH AF53-3305



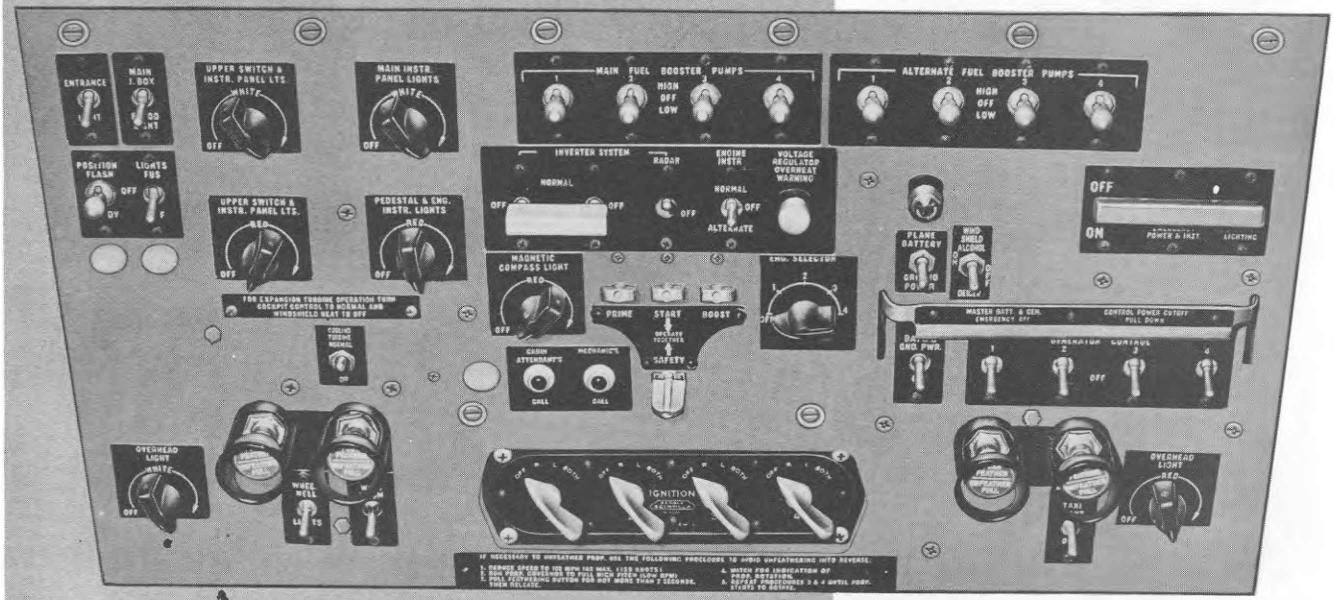
AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668

AA1-120

Figure 1-12

FORWARD OVERHEAD PANEL — Typical

(D-2 APU)



AF51-17661

AA1-121

Figure 1-13

FORWARD OVERHEAD PANEL—Typical

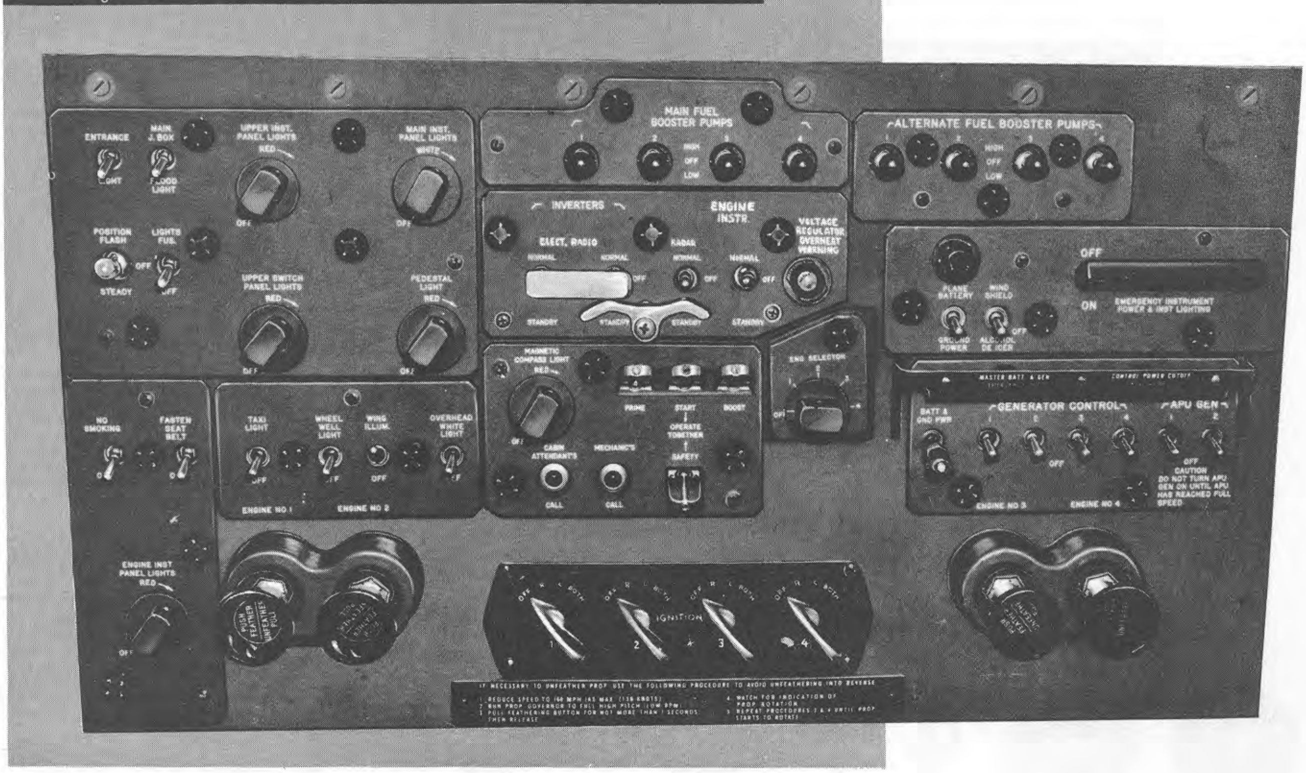


Figure 1-14

FUEL SELECTOR LEVERS.

Four fuel selector levers are located on the forward face of the control pedestal *(2, figure 1-8)*. Each lever has the following positions.

MAIN AND ALTERNATE FUEL SELECTOR LEVERS

MAIN ON	(Main tank supplying respective engine)
ALT ON	(Alternate tank supplying respective engine)
OFF	

FUEL CROSSFEED SELECTOR LEVERS.

Two fuel crossfeed selector levers are located on the forward face of the control pedestal *(7, figure 1-8, sheets 1 and 2; and 8, sheet 3)* and provide a means of supplying any engine with fuel from any tank. Each lever has the following positions:

LEFT CROSSFEED LEVER

OFF	(Left wing crossfeed system closed)
ENG. 1-2	(Engines No. 1 and 2 being supplied from same left wing fuel tank)
ALL ENG. TO CROSSFEED	(Makes fuel from right side of aircraft available to left engines when right crossfeed lever is in same position)

RIGHT CROSSFEED LEVER

OFF	(Right wing crossfeed system closed)
ENG. 3-4	(Engines No. 3 and 4 being supplied from same right wing fuel tank)
ALL ENG. TO CROSSFEED	(Makes fuel from left side of aircraft available to right engines when left crossfeed lever is in same position)

FUEL BOOSTER PUMP SWITCHES.

Eight electrically driven fuel booster pumps, one for each main and alternate fuel tank, are controlled by individual 3-position switches, located on the forward overhead panel *(figures 1-13 and 1-14)*. The switches

FUEL SYSTEM—8 TANKS

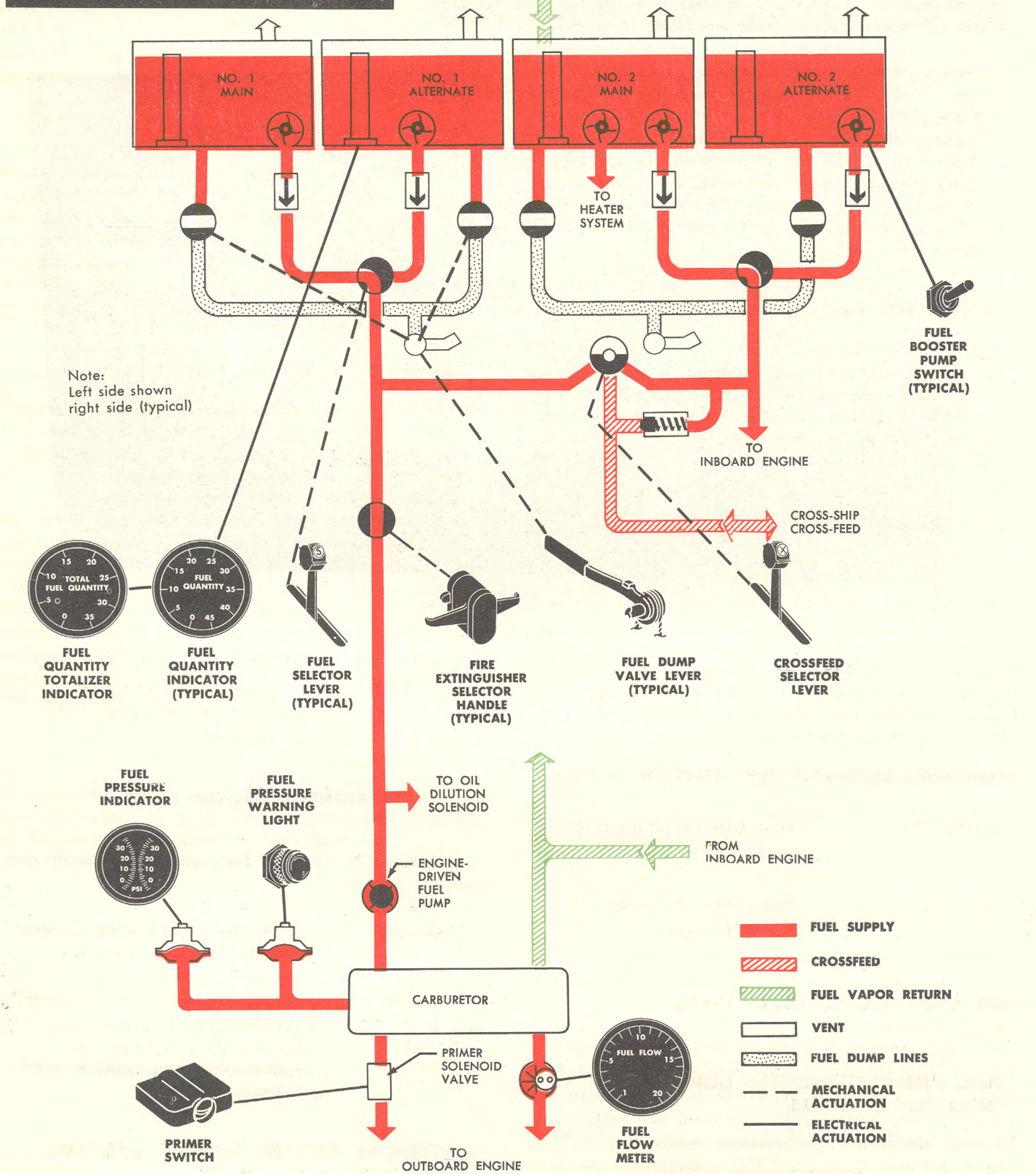


Figure 1-15

have the positions LOW, OFF, and HIGH. The pumps should be operated in LOW whenever possible; the HIGH position is provided primarily for use in the event of engine-driven pump failure. It is recommended that the engines normally be started with the booster pumps in LOW. However, in extremely cold weather, HIGH boost may be used for starting the engines, provided LOW boost is used first to pressurize the system up to the carburetor. The switch from LOW to HIGH should be made as rapidly as possible. In turning the fuel booster pumps off, turn them off one at a time, making certain that each engine-driven pump is supplying sufficient pressure after the booster pump is turned off.

FUEL SYSTEM EMERGENCY SHUTOFF VALVE.

A mechanically actuated fuel system emergency shutoff valve, controlled from the cockpit by means of the respective fire extinguisher selector valve handle *(figure 1-35)*, is installed at each nacelle firewall to shut off the flow of fuel through the firewall. See Fire Extinguishing System, this section.

FUEL QUANTITY INDICATORS.

Eight fuel quantity indicators, one for each tank, are installed on the upper instrument panel *(figure 1-11)*. Fuel quantity is registered by a capacitor indicating system in each tank. Since capacitor systems automatically compensate for fuel density changes, the weight in pounds, rather than the volume of the fuel, is indicated. A fuel quantity totalizer is mounted on the upper instrument panel.

FUEL FLOWMETERS.

Two dual flowmeters, indicating fuel flow in pounds per hour, are installed on the main instrument panel *(35, figure 1-9)*.

FUEL PRESSURE INDICATORS.

Two dual-indicating fuel pressure indicators, calibrated in pounds per square inch, are installed on the main instrument panel *(24, figure 1-9, sheet 1; and 25, sheets 2 and 3)*.

FUEL PRESSURE WARNING LIGHT AND ISOLATION SWITCHES.

A red push-to-test fuel pressure warning light *(36, figure 1-9 and 31, figure 1-10)*, installed on the main instrument panel, will illuminate when the fuel pressure of any engine drops below 18 psi. On some aircraft, four fuel and oil pressure warning light isolation switches *(41, figure 1-9, sheet 1; 38, sheet 2; 42, sheet 3; and 44, figure 1-10)* are located on the lower right section of the main instrument panel. Each isolation switch is safetied in the ON position; when the switch is placed in the OFF position, the circuit from the respective engine is deenergized and the lights will go out, permitting the fuel and oil pressure warning lights to function with one or more engines inoperative.

VAPOR VENT RETURN SYSTEM.

Vapor vent return lines are connected to each engine carburetor. The vent lines from the No. 1 and 2 carburetors are routed back to the No. 2 main tank, and the vent lines from No. 3 and 4 carburetors are routed back to the No. 3 main tank. The return flow will normally be less than 2 gallons per engine per hour. A maximum flow of 20 to 30 gallons per engine per hour may result because of carburetor malfunction.

FUEL DUMP SYSTEM.

Fuel dumping facilities are provided for the emergency jettisoning of fuel in flight in order to decrease aircraft gross weight. Each main and alternate tank is fitted with a dump valve. A standpipe is installed in each main tank so that when all possible fuel is dumped in level flight, sufficient fuel will remain in the main tanks for approximately 30 minutes of flight on four engines and 40 minutes on three engines at METO power. (See figure 3-5 for remaining fuel.) Fuel is dumped overboard from an extended chute at the rear of each nacelle *(figure 3-4)*. Both the landing gear and the landing flaps must be retracted during the dumping operation. For operation of the fuel dump system, refer to the Fuel Dumping paragraph and figure 3-5 in Section III.

Fuel Dump Levers

Four mechanically actuated fuel dump levers are located beneath the floor plate, aft of the control pedestal *(figure 1-16)*. Each lever controls one chute and its respective dump valves, and has the following positions.

CLOSE (Dump valve closed, chute fully retracted)

DRAIN (Dump valve closed, chute partially extended)

OPEN (Dump valve open, chute fully extended)

ELECTRICAL POWER SUPPLY SYSTEM.

The electrical system is a 24- to 28-volt, direct-current, single-wire type, in which the aircraft structure is used for the ground return. D-c power is furnished by four engine-driven generators, one auxiliary power plant (for ground use only), and two storage batteries.

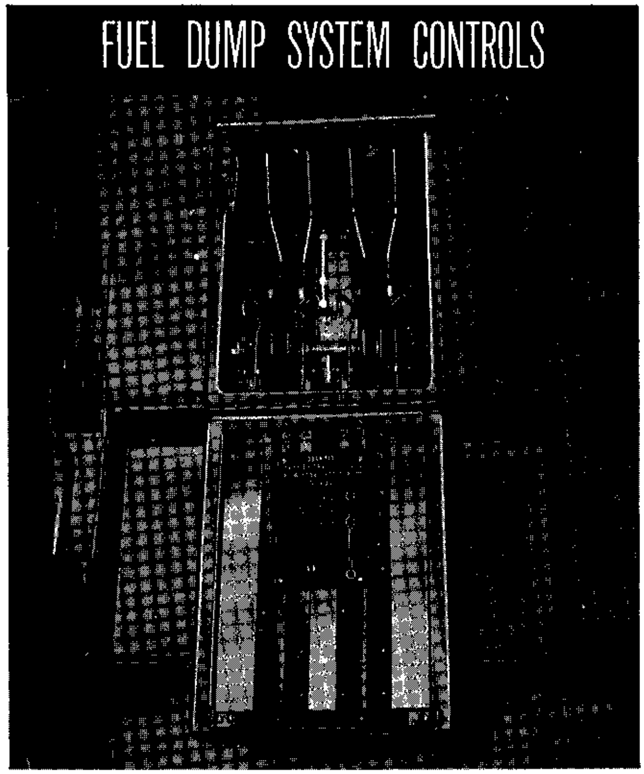
On aircraft equipped with a GTP70-9 auxiliary power unit, the unit may be operated during takeoff, landing, or in flight. The 115-volt, 400-cycle a-c power is supplied by two main inverters operated from the d-c system bus. Emergency a-c power is supplied by an emergency inverter operated by the aircraft batteries. A flight instrument inverter is also installed on some aircraft to supply a-c power to the gyro flight instruments. On aircraft AF53-3223 through AF53-3305 and all 51 series aircraft that have been modified in accordance with TCTO 572. Power is distributed to various units by bus bars and/or feeder cables (*figures 1-17, 1-18, 1-19, and 1-20*). Circuit protection is provided by circuit breakers and fuses (*figures 1-23, 1-24, 1-25, and 1-26*). See Section IV for information on the auxiliary power unit. The following is a list of d-c and a-c operated equipment:

D-C OPERATED EQUIPMENT

Alarm and Warning System	Oil Cooler Air Exit Door
All Electrical Pumps	Position Indicators
Auxiliary Power Unit	Primers
Buffet	Propellers
Turn-and-Slip-Indicators	
Communication	Quantity Indicators (Water, Alcohol, Hydraulic)
VHF	
UHF	
ADF-1 and ADF-2 Audio	
Omni	
Inverters	
Lights	
Motors	
Cowl Flaps	Starters
Electric Deicing Systems	Temperature Indicating Systems
Heaters	
Ignition	Utility Power Outlet

A-C OPERATED EQUIPMENT

Driftmeter	Radio Altimeter — High Range
Engine Analyzer	Torquemeter
Fluid Pressure Indicators	Utility Power Outlet
Fuel Flow	Attitude and Directional Indicators
Mixing Valve Position Indicator	



AA1-27

Figure 1-16

A-C AND D-C OPERATED EQUIPMENT

UHF Directional Equipment

HF-1 and HF-2

Autopilot	LORAN
Cabin Pressurization System	IFF
Radar System	Fuel Quantity

Radio Altimeter — Low Range ARC-58 (AF53-3229 and AF53-3240)

TACAN

SELF-GENERATED EQUIPMENT

Cabin and airfoil heater temperature indicators

Tachometers

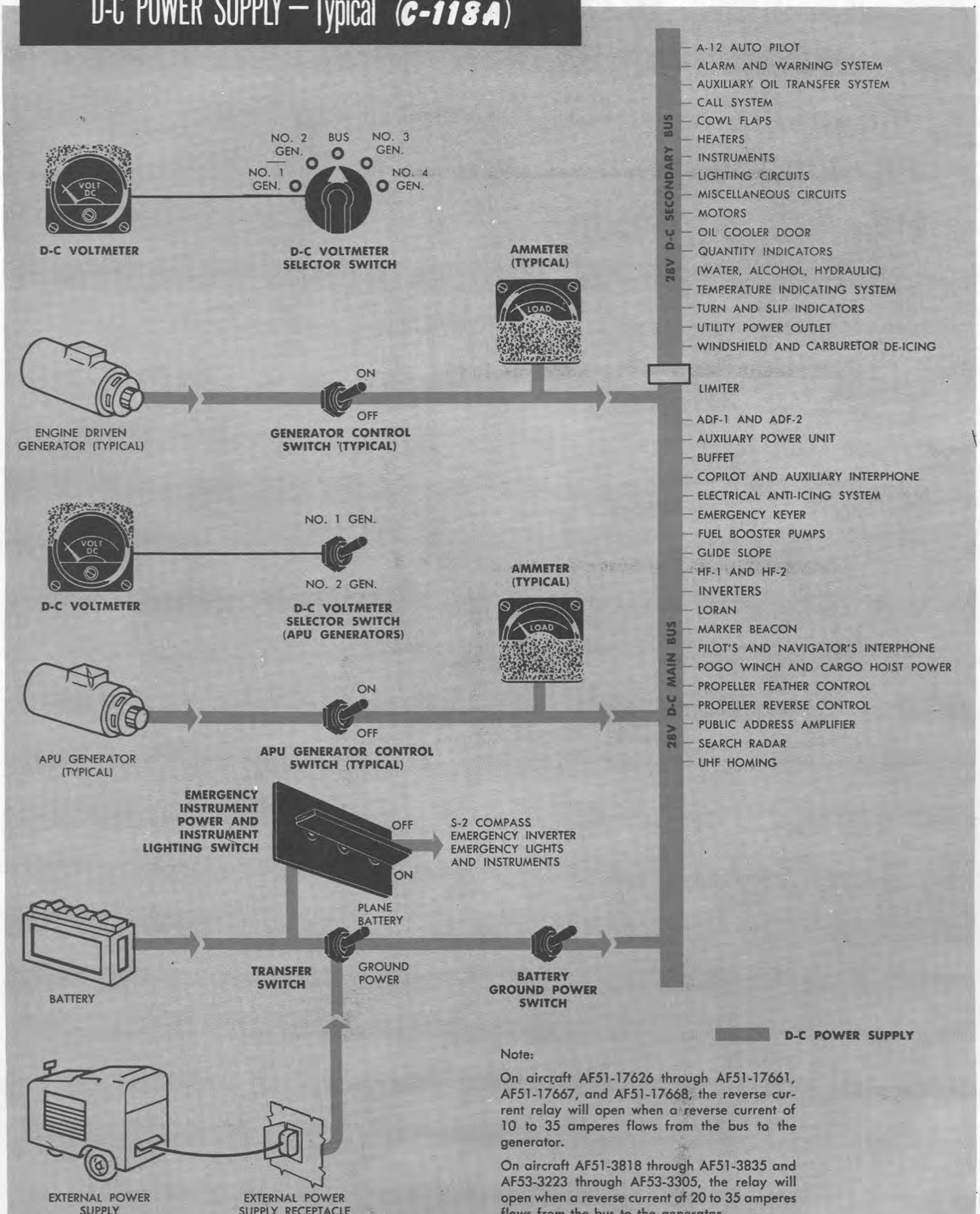
BATTERY MASTER SWITCH.

A 2-position battery selector switch is mounted on the forward overhead panel (*figures 1-13 and 1-14*) and has the positions OFF and BATT & GND PWR. The BATT & GND PWR position serves to connect the batteries or an external source to the main bus.

Note

A minimum battery voltage of approximately 18 volts is required to close the battery relay. The relay must be closed before the generators can recharge the battery.

D-C POWER SUPPLY—Typical (C-118A)



Note:

On aircraft AF51-17626 through AF51-17661, AF51-17667, and AF51-17668, the reverse current relay will open when a reverse current of 10 to 35 amperes flows from the bus to the generator.

On aircraft AF51-3818 through AF51-3835 and AF53-3223 through AF53-3305, the relay will open when a reverse current of 20 to 35 amperes flows from the bus to the generator.

Figure 1-17

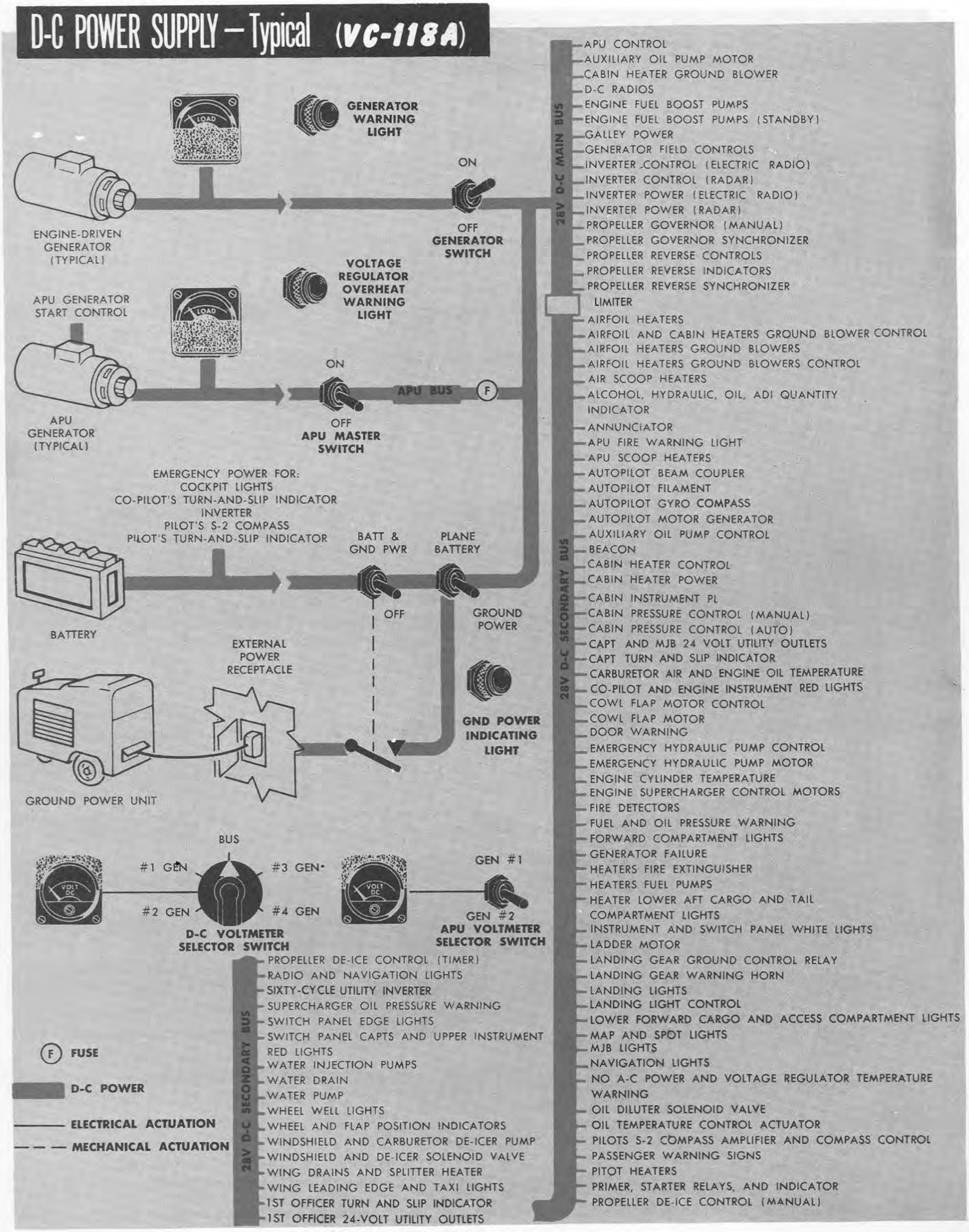
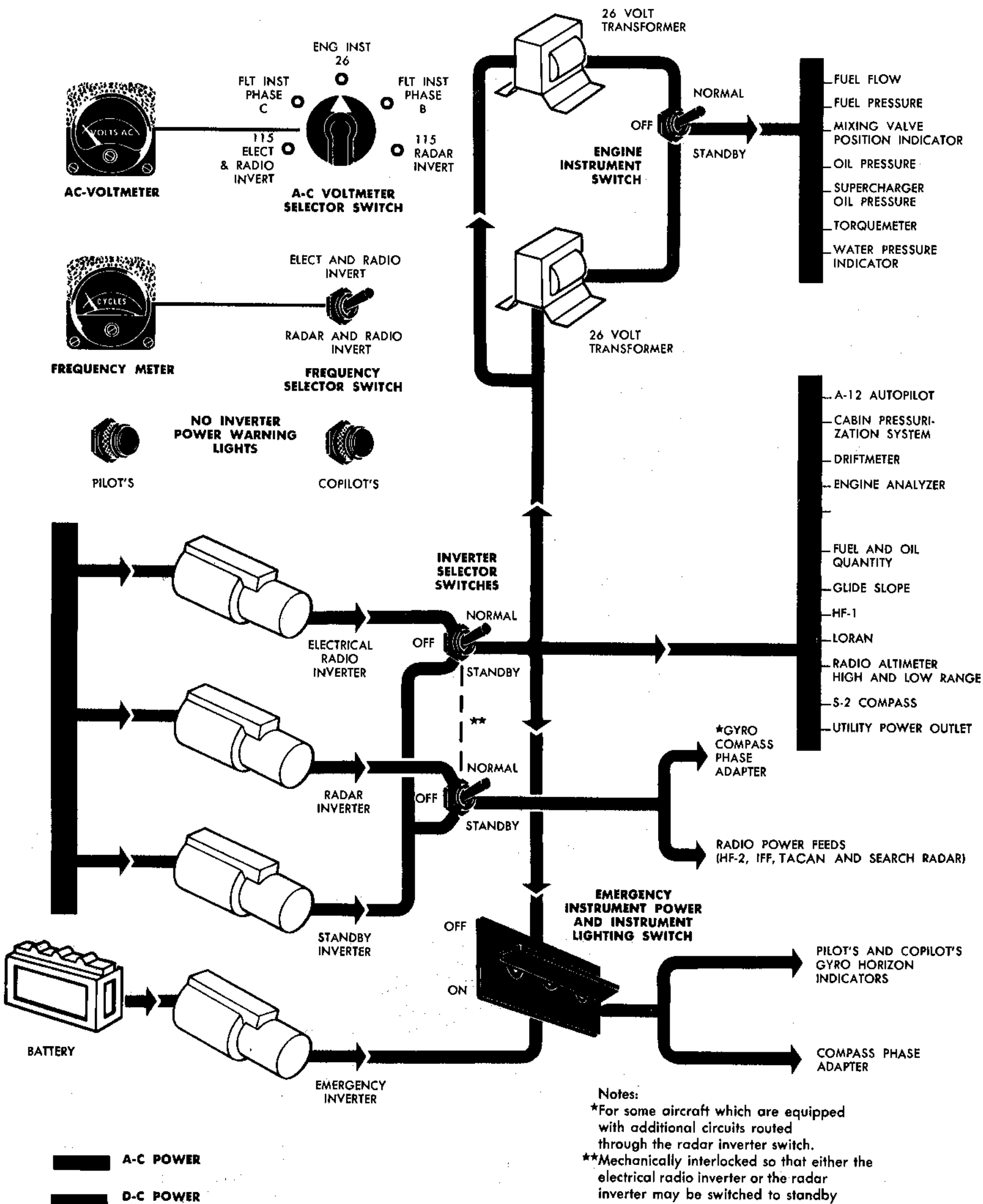

D-C POWER SUPPLY — Typical (VC-118A)
GENERATOR WARNING LIGHT
LOAD
ON
OFF
GENERATOR SWITCH
ENGINE-DRIVEN GENERATOR (TYPICAL)
VOLTAGE REGULATOR OVERHEAT WARNING LIGHT
APU GENERATOR START CONTROL
LOAD
ON
APU BUS
F
OFF
APU MASTER SWITCH
APU GENERATOR (TYPICAL)
EMERGENCY POWER FOR:
COCKPIT LIGHTS
CO-PILOT'S TURN-AND-SLIP INDICATOR
INVERTER
PILOT'S S-2 COMPASS
PILOT'S TURN-AND-SLIP INDICATOR
BATT & GND PWR
PLANE BATTERY
OFF
GROUND POWER
BATTERY
EXTERNAL POWER RECEPTACLE
GND POWER INDICATING LIGHT
GROUND POWER UNIT
BUS
#1 GEN
#3 GEN
#2 GEN
#4 GEN
VOLT DC
D-C VOLTMETER SELECTOR SWITCH
GEN #1
GEN #2
APU VOLTMETER SELECTOR SWITCH
28V D-C MAIN BUS
APU CONTROL
AUXILIARY OIL PUMP MOTOR
CABIN HEATER GROUND BLOWER
D-C RADIOS
ENGINE FUEL BOOST PUMPS
ENGINE FUEL BOOST PUMPS (STANDBY)
GALLEY POWER
GENERATOR FIELD CONTROLS
INVERTER CONTROL (ELECTRIC RADIO)
INVERTER CONTROL (RADAR)
INVERTER POWER (ELECTRIC RADIO)
INVERTER POWER (RADAR)
PROPELLER GOVERNOR (MANUAL)
PROPELLER GOVERNOR SYNCHRONIZER
PROPELLER REVERSE CONTROLS
PROPELLER REVERSE INDICATORS
PROPELLER REVERSE SYNCHRONIZER
LIMITER
28V D-C SECONDARY BUS
AIRFOIL HEATERS
AIRFOIL AND CABIN HEATERS GROUND BLOWER CONTROL
AIRFOIL HEATERS GROUND BLOWERS
AIRFOIL HEATERS GROUND BLOWERS CONTROL
AIR SCOOP HEATERS
ALCOHOL, HYDRAULIC, OIL, ADI QUANTITY INDICATOR
ANNUNCIATOR
APU FIRE WARNING LIGHT
APU SCOOP HEATERS
AUTOPILOT BEAM COUPLER
AUTOPILOT FILAMENT
AUTOPILOT GYRO COMPASS
AUTOPILOT MOTOR GENERATOR
AUXILIARY OIL PUMP CONTROL
BEACON
CABIN HEATER CONTROL
CABIN HEATER POWER
CABIN INSTRUMENT PL
CABIN PRESSURE CONTROL (MANUAL)
CABIN PRESSURE CONTROL (AUTO)
CAPT AND MJB 24 VOLT UTILITY OUTLETS
CAPT TURN AND SLIP INDICATOR
CARBURETOR AIR AND ENGINE OIL TEMPERATURE
CO-PILOT AND ENGINE INSTRUMENT RED LIGHTS
COWL FLAP MOTOR CONTROL
COWL FLAP MOTOR
DOOR WARNING
EMERGENCY HYDRAULIC PUMP CONTROL
EMERGENCY HYDRAULIC PUMP MOTOR
ENGINE CYLINDER TEMPERATURE
ENGINE SUPERCHARGER CONTROL MOTORS
FIRE DETECTORS
FUEL AND OIL PRESSURE WARNING
FORWARD COMPARTMENT LIGHTS
GENERATOR FAILURE
HEATERS FIRE EXTINGUISHER
HEATERS FUEL PUMPS
HEATER LOWER AFT CARGO AND TAIL COMPARTMENT LIGHTS
INSTRUMENT AND SWITCH PANEL WHITE LIGHTS
LADDER MOTOR
LANDING GEAR GROUND CONTROL RELAY
LANDING GEAR WARNING HORN
LANDING LIGHTS
LANDING LIGHT CONTROL
LOWER FORWARD CARGO AND ACCESS COMPARTMENT LIGHTS
MAP AND SPOT LIGHTS
MJB LIGHTS
NAVIGATION LIGHTS
NO A-C POWER AND VOLTAGE REGULATOR TEMPERATURE WARNING
OIL DILUTER SOLENOID VALVE
OIL TEMPERATURE CONTROL ACTUATOR
PILOTS S-2 COMPASS AMPLIFIER AND COMPASS CONTROL
PASSENGER WARNING SIGNS
PITOT HEATERS
PRIMER, STARTER RELAYS, AND INDICATOR
PROPELLER DE-ICE CONTROL (MANUAL)
28V D-C SECONDARY BUS
PROPELLER DE-ICE CONTROL (TIMER)
RADIO AND NAVIGATION LIGHTS
SIXTY-CYCLE UTILITY INVERTER
SUPERCHARGER OIL PRESSURE WARNING
SWITCH PANEL EDGE LIGHTS
SWITCH PANEL CAPTS AND UPPER INSTRUMENT RED LIGHTS
WATER INJECTION PUMPS
WATER DRAIN
WATER PUMP
WHEEL WELL LIGHTS
WHEEL AND FLAP POSITION INDICATORS
WINDSHIELD AND CARBURETOR DE-ICER PUMP
WINDSHIELD AND DE-ICER SOLENOID VALVE
WING DRAINS AND SPLITTER HEATER
WING LEADING EDGE AND TAXI LIGHTS
1ST OFFICER TURN AND SLIP INDICATOR
1ST OFFICER 24-VOLT UTILITY OUTLETS
F FUSE
D-C POWER
ELECTRICAL ACTUATION
MECHANICAL ACTUATION

Figure 1-18

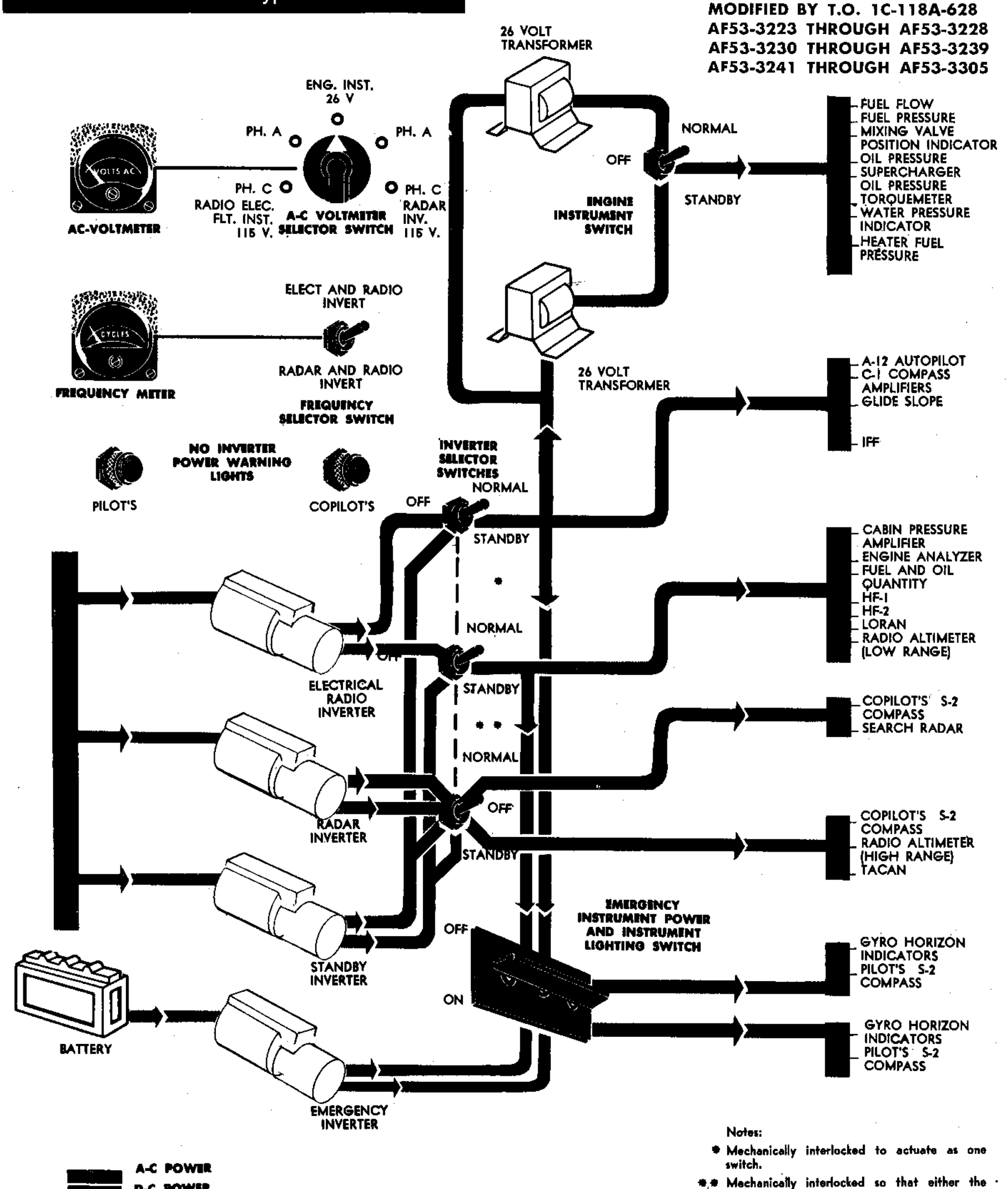
A-C POWER SUPPLY—Typical (C-118A)



Notes:
*For some aircraft which are equipped with additional circuits routed through the radar inverter switch.
**Mechanically interlocked so that either the electrical radio inverter or the radar inverter may be switched to standby inverter but not to both simultaneously.

Figure 1-19

A-C POWER SUPPLY — Typical (C-118A)



Notes:

* Mechanically interlocked to actuate as one switch.

** Mechanically interlocked so that either the electrical radio inverter or the radar inverter may be switched to standby inverter but not to both simultaneously.

Figure 1-20

A-C POWER SUPPLY—Typical (VC-118A)

AF53-3229 AND AF53-3240

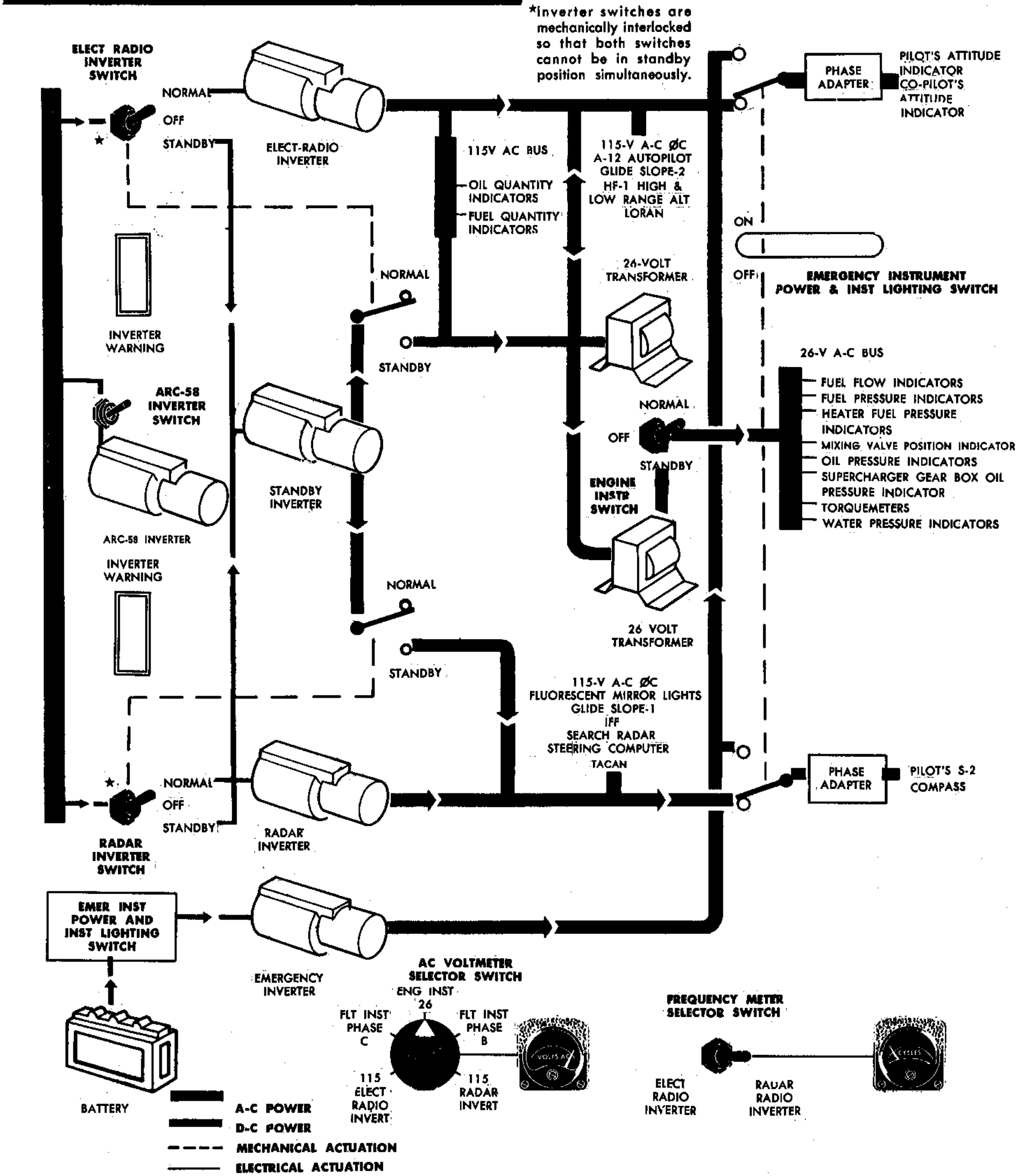


Figure 1-21

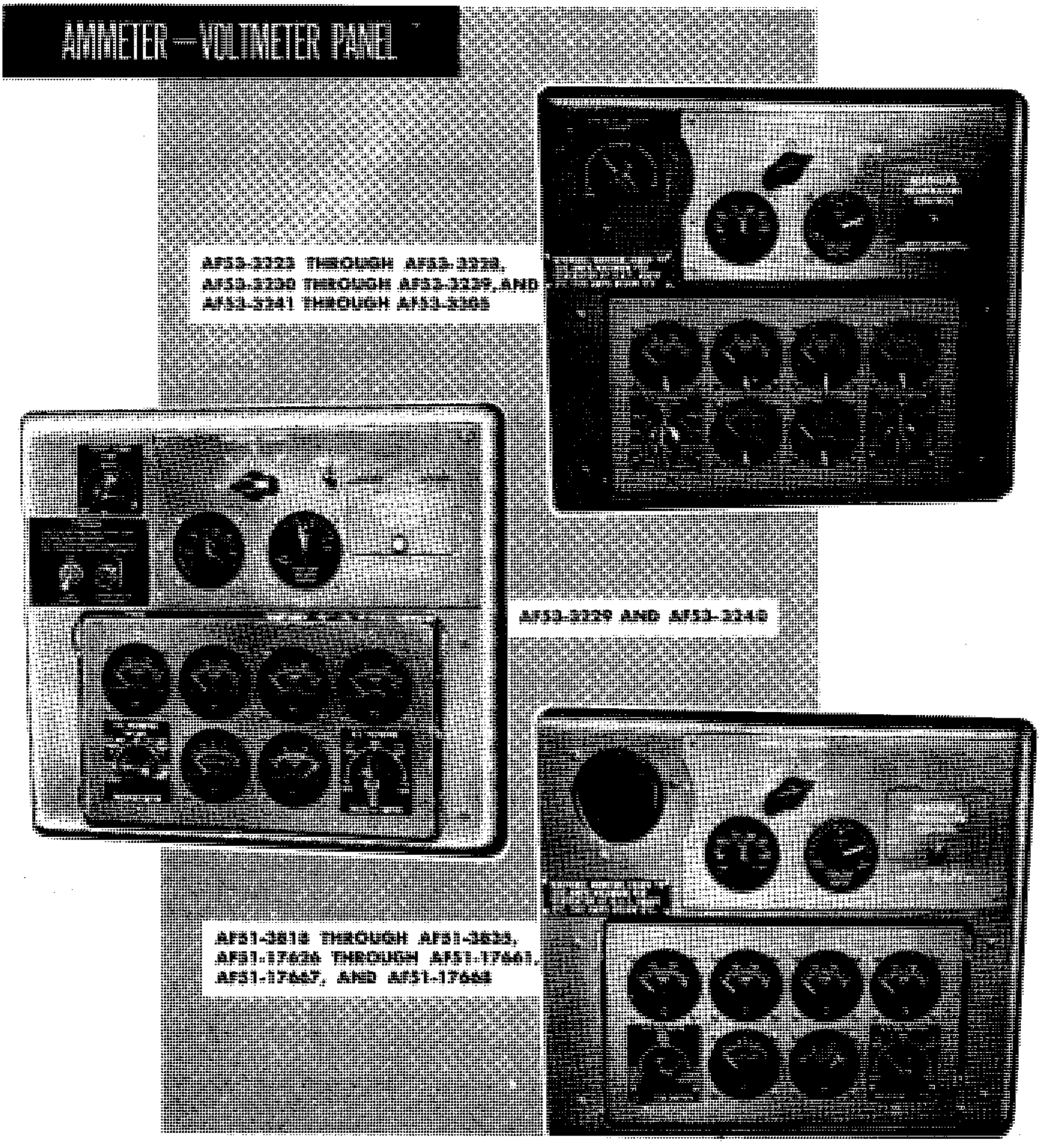


Figure 1-22

BATTERY SELECTOR SWITCH.

A 2-position battery selector switch is mounted on the forward overhead panel *(figures 1-13 and 1-14)* and has the positions PLANE BATTERY and GROUND POWER. The switch should be positioned to GROUND POWER at all times when a ground power supply is connected to the aircraft.

GENERATOR SWITCHES.

Four conventional ON-OFF generator switches are mounted on the forward overhead panel *(figures 1-13 and 1-14)* and normally are left in the ON position at all times. A master shutoff bar is provided to turn off all generator switches and batteries in case of an emergency.

GENERATOR WARNING LIGHT.

On VC-118A aircraft AF53-3229 and AF53-3240, a red generator warning light is located on the ammeter-voltmeter panel *(figure 1-22)*. When a generator is off the line, a 28-volt d-c circuit is energized and the light is illuminated.

D-C VOLTMETER AND SELECTOR SWITCH.

A d-c voltmeter and a 5-position d-c selector switch are mounted on the ammeter-voltmeter panel *(figure* The selector switch permits checking the voltage output of each engine generator and the main bus. The selector switch should be positioned to BUS when not selecting either of the four generator positions. The normal indication is approximately 28 volts.

AMMETERS.

Four ammeters are mounted on the ammeter-voltmeter panel *(figure 1-22)* to indicate the amperage output of the four generators.

MAIN INVERTER SWITCHES.

On AF51-3818 through AF51-3835, AF51-17626 through AF51-17661, AF51-17667, and AF51-17668, two ganged inverter switches are installed on the forward overhead panel *(figure 1-13)* and have the positions NORMAL, OFF, and ALTERNATE. Moving the ganged inverter switches to either the NORMAL or the ALTERNATE position closes a 28-volt d-c circuit to energize the respective inverter, which will supply 115-volt 400-cycle a-c power to the bus.

When the ganged switches are in the NORMAL position the radar switch located on the forward overhead panel *(figure 1-13)* may be positioned to RADAR. This will energize the alternate (radar) inverter to supply a-c power for operation of the radar and radio altimeter equipment. However, in case the normal inverter fails and the inverter switches are moved to the ALTERNATE position, the radar and radio altimeter equipment will be automatically disconnected and the alternate (radar) inverter will supply power directly to the a-c bus.

On AF53-3229 through AF53-3305 which have not been modified in accordance with T.O. 1C-118A-628, two 3-position inverter switches, placarded ELEC-RADIO and RADAR-RADIO, are mounted on the forward overhead panel *(figure 1-14)* and serve to place either the NORMAL inverters or the STANDBY inverter into operation to supply a-c power. The center position of the switches is the OFF position. The inverter switches are mechanically interlocked so that either switch may be positioned to STANDBY, but not both simultaneously. For normal operation, the inverter switches should be in the NORMAL position. In the event of a failure of either normal inverter, the respective inverter switch may be positioned to STANDBY.

The ELEC-RADIO switch supplies all electrical loads and the primary radio loads. The RADAR-RADIO switch energizes the circuit that supplies the search radar, IFF, HF-2 systems, TACAN, and copilots S-2 compass system (if installed).

Note

On VC-118A aircraft AF53-3229 and AF53-3240, the RADAR-RADIO switch energizes the circuit that supplies power to the search radar, glide slope-1, intergrated flight system, IFF, and TACAN. HF-2 has been replaced by a Collins ARC-58 single side band radio with power supplied from an additional inverter installed in the forward cargo compartment. For description and operation of the 60-cycle inverter and the ARC-58 inverter, see Section IV.

On AF53-3223 through AF53-3305 which have been modified in accordance with T.O. 1C-118A-628, two 3-position inverter switches placarded ELECT. RADIO and one 3-position switch placarded RADAR are mounted on the forward overhead panel *(figure 1-14)* and serve to place either the NORMAL inverters or the STANDBY inverter into operation to supply a-c power. The center position of the switches is the OFF position: The ELECT. RADIO switches are ganged together to operate as one switch and are interlocked with the RADAR switch so that either may be positioned to STANDBY, but not simultaneously. For normal operation, the inverter switches should be in the NORMAL position. In event of the failure of either normal inverter, the respective inverter switch or switches may be positioned to STANDBY.

The ELECT. RADIO switch supplies all electrical loads and the primary radio loads. The RADAR switch supplies power to the copilot's S-2 compass, search radar, radio altimeter (high range), and TACAN.

INVERTER WARNING LIGHTS.

Two inverter warning lights *(8, figure 1-9, sheets 1 and 2; 10, sheet 3; and 14, figure 1-10.)*, if installed on the main instrument panel, provide indication of power failure to the gyro flight instruments and/or the phase adapter for the H-5 gyro horizon. If the lights illuminate, the other inverter (upper or lower, main or standby, normal or alternate) or the emergency invrter should be energized to supply a-c power for the gyro flight instruments.

Note

On AF53-3223 through AF53-3305, if the gyro flight instruments are not already running, the instrument power warning light will not go out until approximately 1 minute after the inverter is turned on.

A-C VOLTMETER AND SELECTOR SWITCH.

A voltmeter located on the ammeter-voltmeter panel *(figure 1-22)*, indicates the a-c voltage being supplied to the selected circuit. A rotary-type selector switch, installed adjacent to the voltmeter, has the placarded positions, 115 UPPER INVERTER, ENG. INST. 26, and 115 LOWER INVERTER. The selector switch may be used to connect the voltmeter to any one of the three positions. Normally, the switch should remain in the ENG. INST. 26 position.

On AF53-3223 through AF53-3305, a voltmeter, located on the ammeter-voltmeter panel *(figure 1-22)*, indicates the a-c voltage being supplied to the selected circuit. On aircraft which have not been modified in accordance with T.O. 1C-118A-628, a rotary-type selector switch, installed adjacent to the voltmeter, has the placarded positions 115 ELEC. & RADIO INVERT., FLT. INST. PHASE C, ENG. INST. 26, FLT. INST. PHASE B, and 115 RADAR INVERTER. On aircraft which have been modified in accordance with T.O. 1C-118A-628, a rotary-type selector switch, installed adjacent to the voltmeter, has placarded positions RADIO ELEC. FLT. INST. 115V, PH.C, PH.A, ENG. INST. 26V, PH.A, PH.C, and RADAR INV. 115V. The selector switch may be used to connect the voltmeter to any one of the positions. Normally, the selector switch should remain in the ENG. INST. 26V position.

EMERGENCY INSTRUMENT POWER AND INSTRUMENT LIGHTING SWITCH.

A gang bar ON-OFF emergency instrument power and instrument lighting switch is mounted on the forward overhead panel *(figures 1-13 and 1-14)*. Moving this switch to the ON position turns on the emergency inverter to supply a-c power to the gyro flight instruments, disconnects the a-c power supply from the main inverters to the flight instruments, and connects the aircraft batteries to supply d-c power to the emergency inverter and dc-operated emergency lighting and instruments. The a-c gyro flight instruments are the pilot's and copilot's attitude indicator and the G-2 or S-2 compass system. On AF53-3223 through AF53-3305, the pilot's and navigator's S-2 compass system will operate. The d-c operated emergency instruments are the pilot's and copilot's turn-and-slip indicators. The dc-operated lights are the magnetic compass light, the periscopic sextant and mount light, instrument white lights, the pilot's overhead floodlight, and the emergency inverter warning lights. The main inverters will continue to supply a-c power to the remaining electrical equipment not affected by the emergency switch, unless the inverter switches are turned off. On AF53-3223 through AF53-3305 which have not been modified in accordance with T.O. 1C-118A-628, at any time that the emergency inverter is operating, FLT. INST. PHASE C and FLT. INST. PHASE B positions on the a-c voltmeter selector switch will indicate the emergency inverter output. On AF53-3223 through AF53 3305 which have been modified in accordance with T.O. 1C-118A-628, at any time the emergency inverter is operating, RADIO ELECT. FLT. INST 115V PH.C and RADIO ELECT. FLT. INST 115V PH.A positions on the a-c voltmeter selector switch will indicate emergency inverter output.

ENGINE INSTRUMENT TRANSFORMER SWITCH.

The engine instrument transformer switch mounted on the forward overhead panel *(figures 1-13 and 1-14)* connects either the NORMAL or ALTERNATE (STANDBY) 26-volt transformer to provide a-c power for the engine instruments. The center position is the OFF position.

EXTERNAL POWER SUPPLY RECEPTACLE.

One 3-pronged, polarized receptacle is provided on the undersurface of the fuselage to permit the introduction of external power for starting engines or for operating other aircraft equipment *(37, figure 1-3)*. A polarized relay will prevent the ground power relay from closing if polarity of the ground power unit is reversed. If ground power supply voltage drops to 18 volts or less, the aircraft batteries will automatically be connected to the main bus.

EXTERNAL POWER SUPPLY LIGHT.

A red light for the external power supply is mounted on the forward overhead panel *(Figures 1-11 and 1-12)* and illuminates when external power supply is plugged in and operating, the master battery switch is turned on and the battery selector switch is positioned to ground power position.

Note

If the red light is off, check the ground power circuit breaker, located overhead and aft of the cockpit entrance.

CIRCUIT PROTECTORS.

The circuit protectors are located on the main circuit protector panel and the radio rack panel *(figures 1-23, 1-24, 1-25, and 1-26)*. The circuit protectors for the fuel booster pumps are located on the aft overhead panel *(figure 1-12)*.

HYDRAULIC POWER SUPPLY SYSTEM.

The hydraulic power supply system operates the retractable tricycle landing gear, the wheel brakes, the nosewheel steering system, the windshield wipers, the wing flaps, the forward cargo door, and the aft section of the main cargo door *(figure 1-27)*. Two main pressure accumulators, each equipped with a pressure gage, are installed in the hydraulic accessories compartment A nosewheel steering pressure accumulator and pressure gage are installed in the nosewheel well. An engine-driven hydraulic pump capable of maintaining system pressure within limits is installed on each inboard engine to deliver hydraulic fluid under pressure to the system during normal operation. An electrically driven auxiliary hydraulic pump provides an emergency source of pressure. The auxiliary pump can be used if the engine-driven pumps fail or if pressure is desired while the aircraft is on the ground and the engines are inoperative.

Note

On VC-118A aircraft AF53-3229 and AF53-3240, the cargo doors have been sealed shut. The hydraulic lines to the cargo doors are capped off and the cargo door switches and actuating cylinders removed.

HYDRAULIC SYSTEM BYPASS VALVE LEVER.

A hydraulic system bypass valve lever is mounted on the control pedestal *(19, figure 1-8, sheet 1; 17, sheet 2; and 20, sheet 3)*, and has the positions ON and OFF. In the OFF (system inoperative) position, the bypass valve is opened, allowing the fluid to bypass the pressure regulator and return to the reservoir. In the ON position, fluid is directed to all units in the hydraulic system except the cargo doors.

EMERGENCY HYDRAULIC PUMP SWITCH.

A spring-loaded ON-OFF emergency pump switch is mounted on the hydraulic and oxygen instrument panel to the right of the copilot's seat *(figure 1-29)*.

EMERGENCY HYDRAULIC PUMP SELECTOR VALVE LEVER.

An emergency hydraulic pump selector valve lever, installed on the floor to the left of the copilot's seat *(figure 1-28)*, controls the hydraulic fluid delivery from the emergency hydraulic pump only. Hydraulic pressure is delivered to the brakes in all positions of the selector valve. However, in the BRAKE SYSTEM position, pressure from the pump will be delivered only to the brakes and cargo doors; it is recommended that the control lever normally be left in this position. The positions of the selector valve lever are as follows:

BRAKE SYSTEM (forward position) — Fluid directed to brakes and cargo doors only.

GENERAL SYSTEM (center position) — Fluid directed to general system, brakes, and cargo doors.

PRESS ACCUM (aft position) — Fluid directed to brakes, general system, pressure accumulators, and cargo doors.

HYDRAULIC SYSTEM EMERGENCY SHUTOFF VALVES.

A mechanically actuated shutoff valve, controlled from the cockpit by means of the respective fire extinguisher selector valve handle *(figure 1-35)*, is installed at each inboard nacelle firewall to shut off the flow of hydraulic fluid through the firewall.

HYDRAULIC SYSTEM PRESSURE INDICATOR.

A hydraulic system pressure indicator is mounted on the hydraulic and oxygen instrument panel *(figure 1-29)*; it normally indicates approximately 3000 psi.

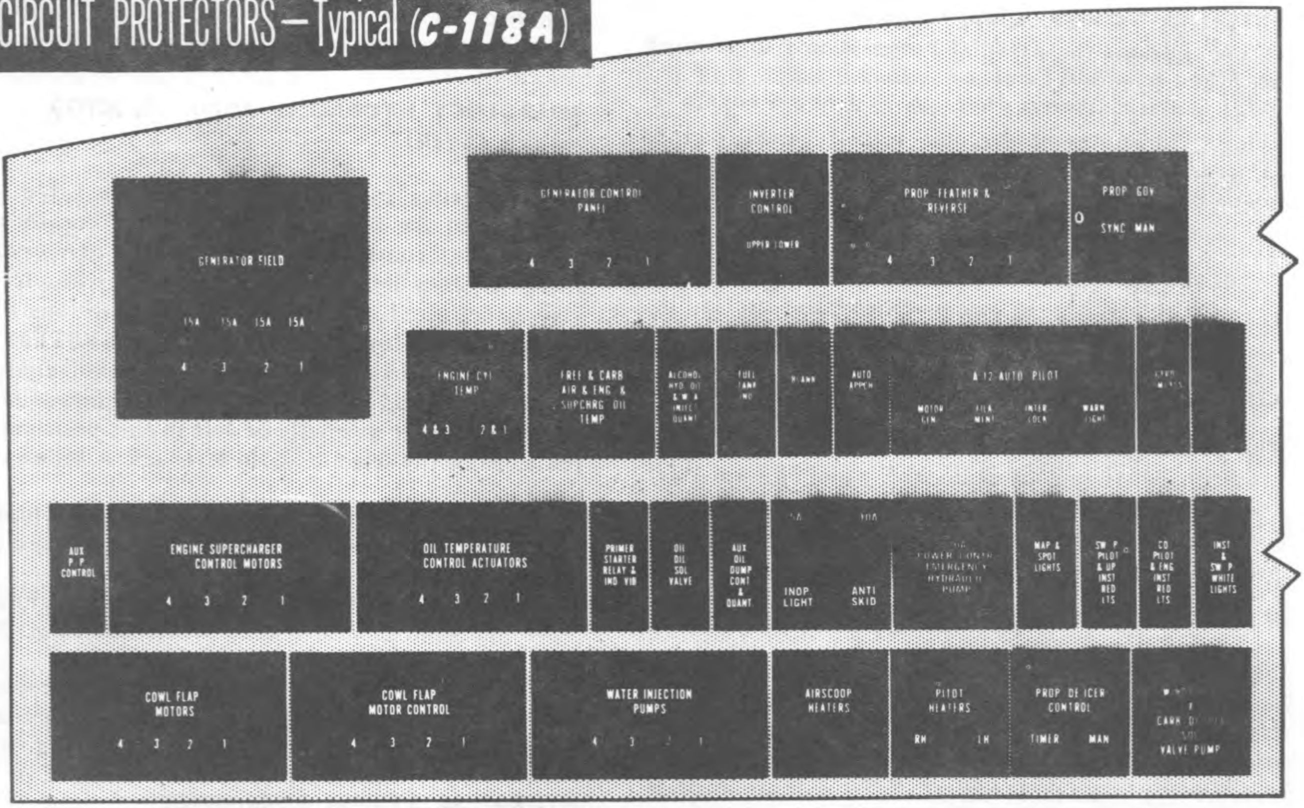
HYDRAULIC SYSTEM QUANTITY INDICATOR.

A hydraulic system quantity indicator is mounted on the upper instrument panel *(figure 1-11)*. With the engines inoperative, the fluid level should indicate FULL at zero pressure. With the engines operating, the fluid level should indicate at NORMAL FLIGHT. The REFILL position indicates insufficient hydraulic fluid quantity.

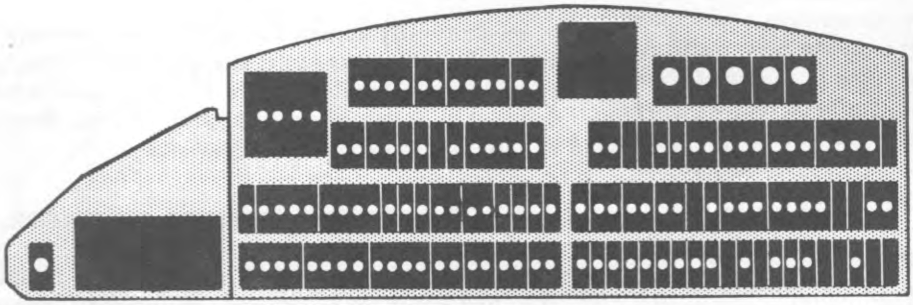
FLIGHT CONTROL SYSTEM.

All flight controls are conventionally operated by dual wheel and rudder pedal controls *(26, 27, figure 1-6)*. Trim tabs are mechanically controlled and both ailerons, both elevators, and the rudder are equipped with spring control tabs *(figure 1-30)*. The wing flaps are operated hydraulically.

CIRCUIT PROTECTORS—Typical (C-118A)

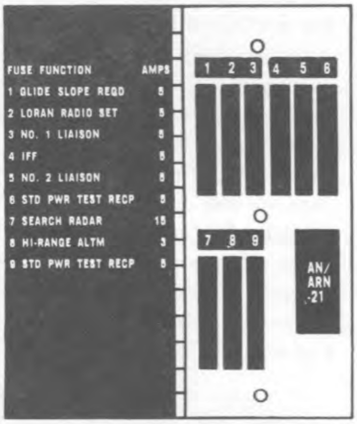


MAIN JUNCTION BOX

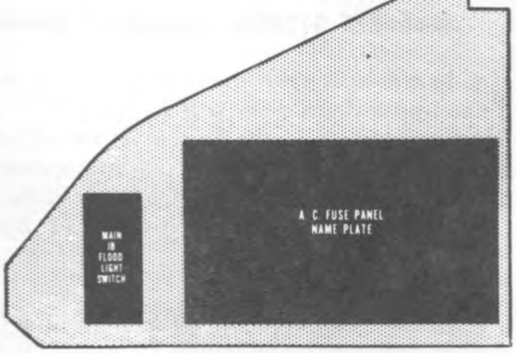


RIGHT ANNEX

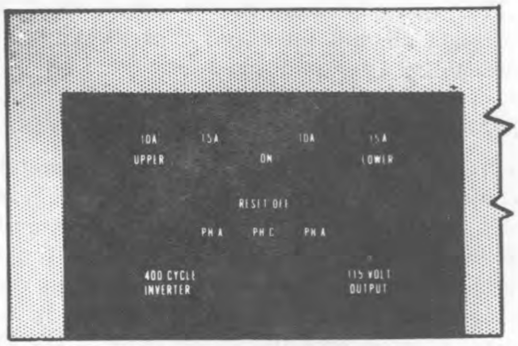
MAIN JUNCTION BOX



RADIO FUSE PANEL



MAIN JUNCTION BOX RIGHT ANNEX



INVERTER CIRCUIT BREAKERS

Figure 1-23 (Sheet 1 of 2)

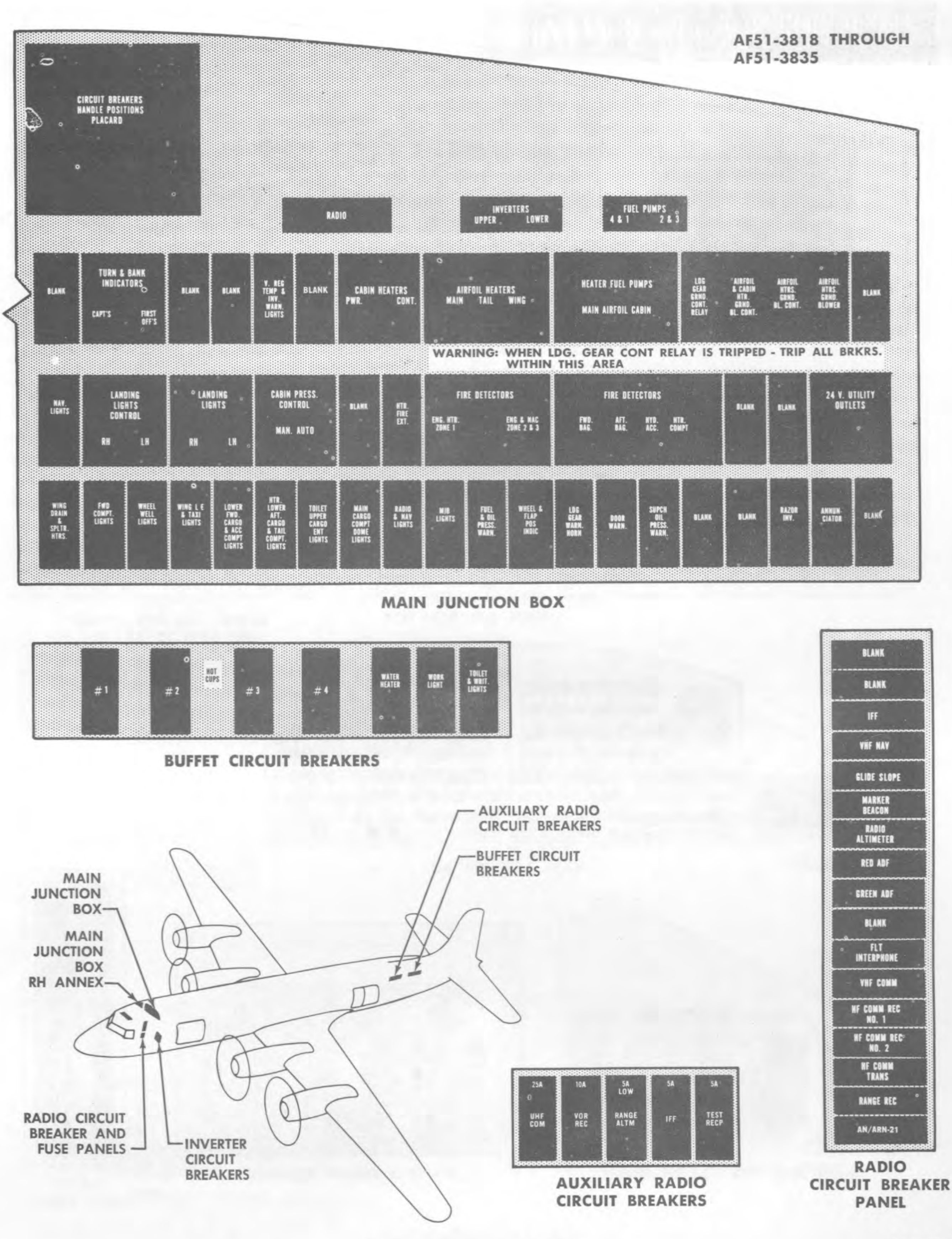


Figure 1-23 (Sheet 2 of 2)

CIRCUIT PROTECTORS—Typical (C-118A)

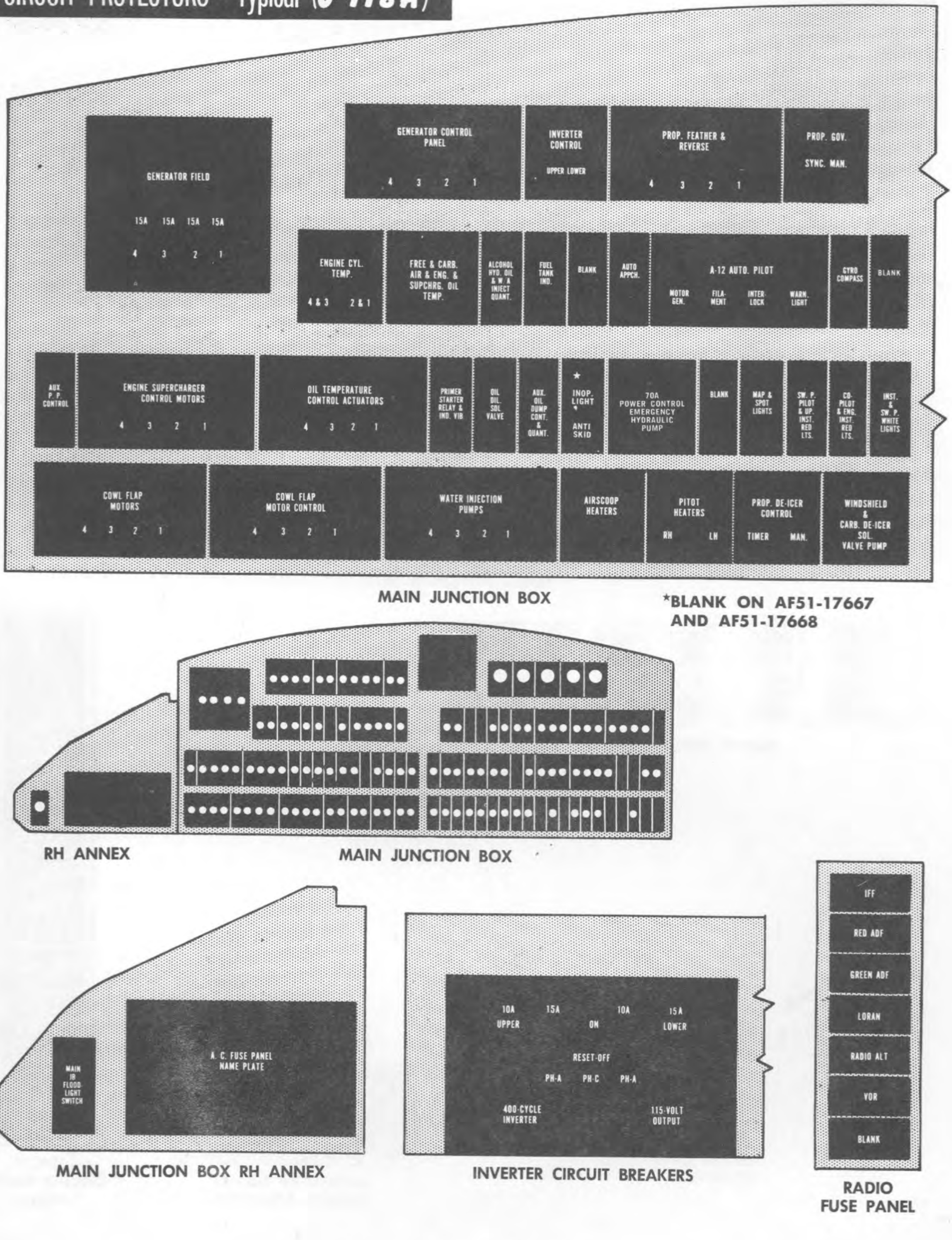
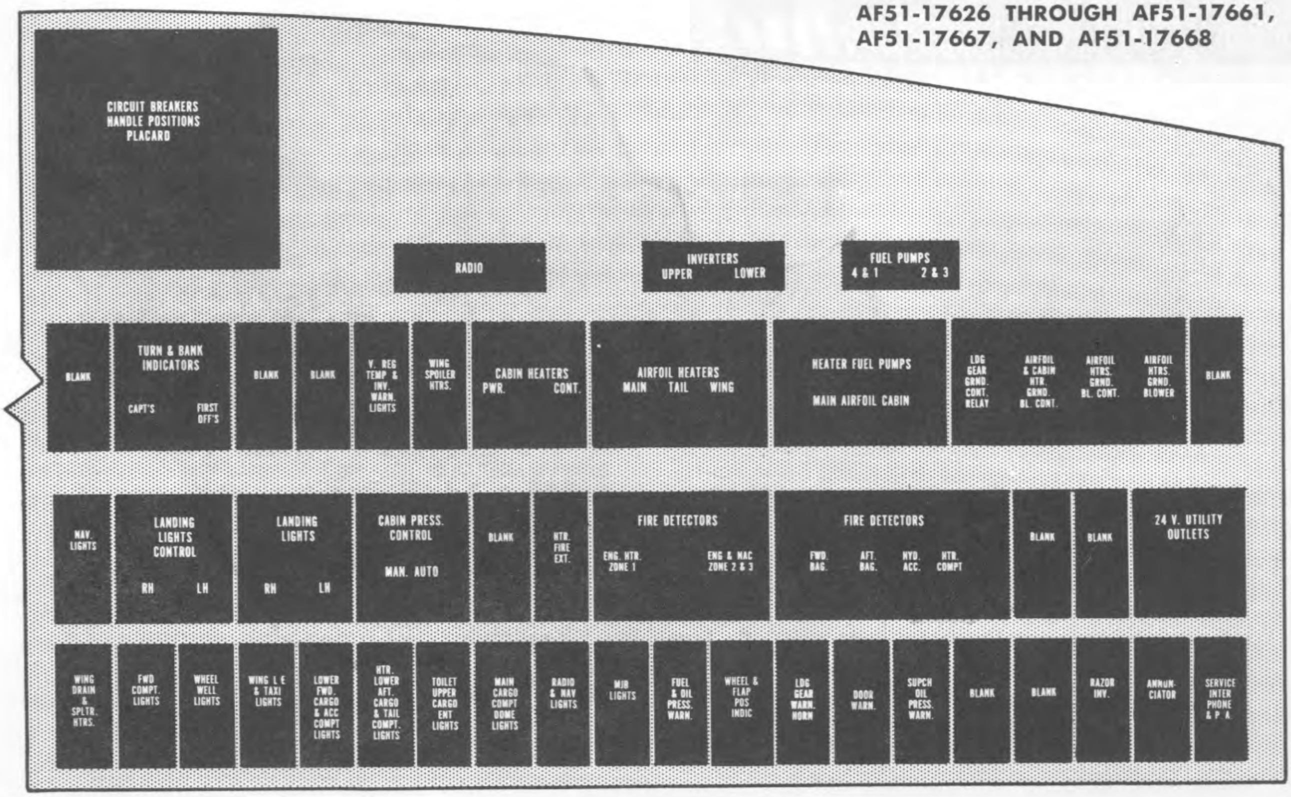
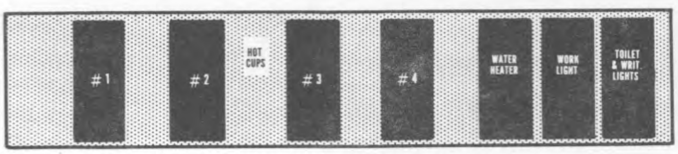


Figure 1-24 (Sheet 1 of 2)

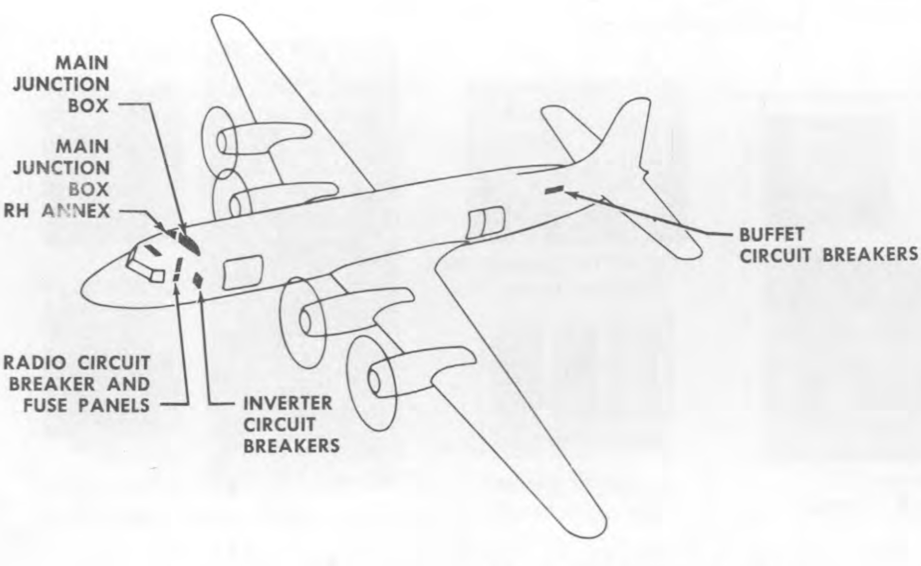
AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668



MAIN JUNCTION BOX



BUFFET CIRCUIT BREAKERS



RADIO CIRCUIT BREAKER PANEL

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Figure 1-24 (Sheet 2 of 2)

CIRCUIT PROTECTORS—Typical (C-118A)

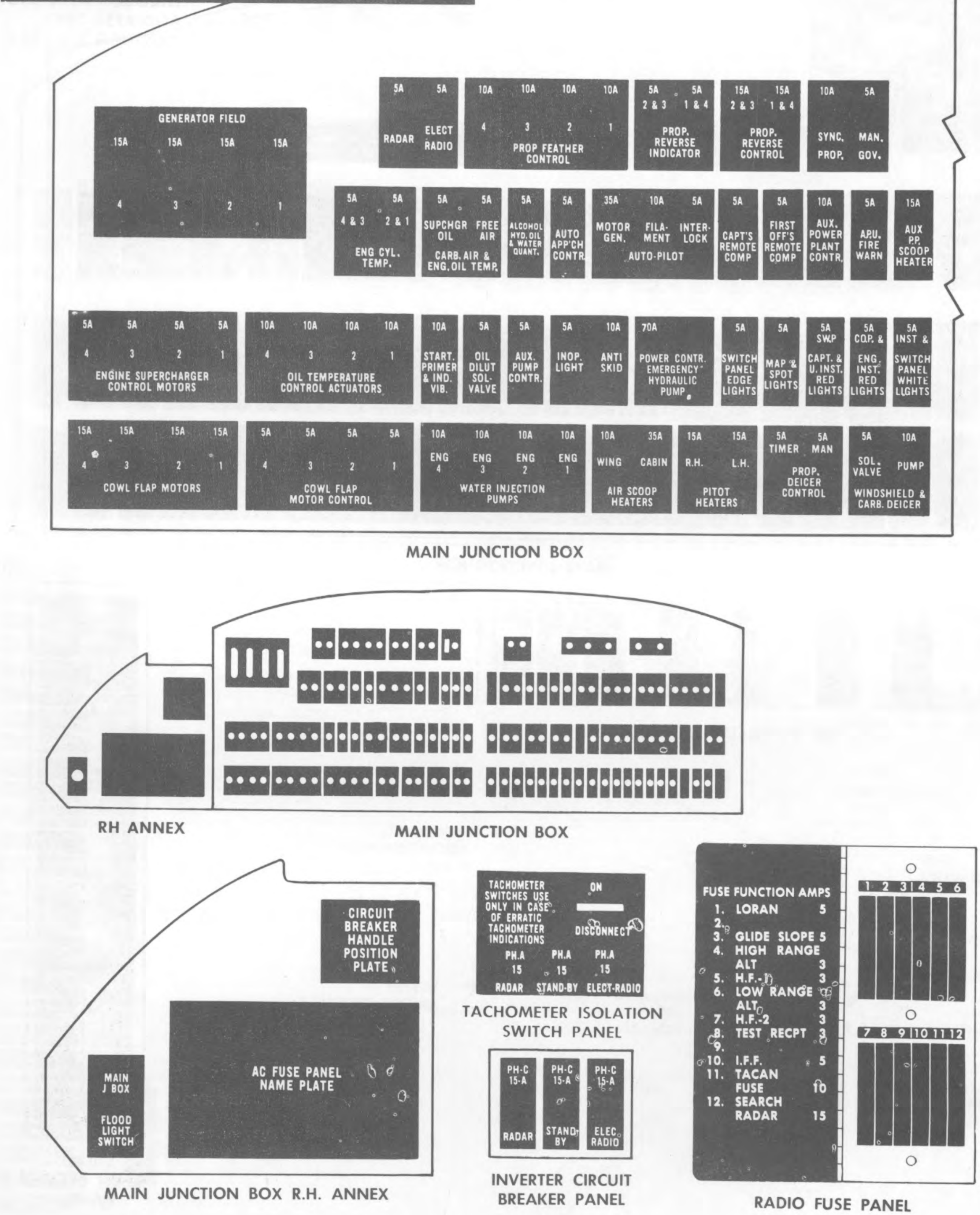
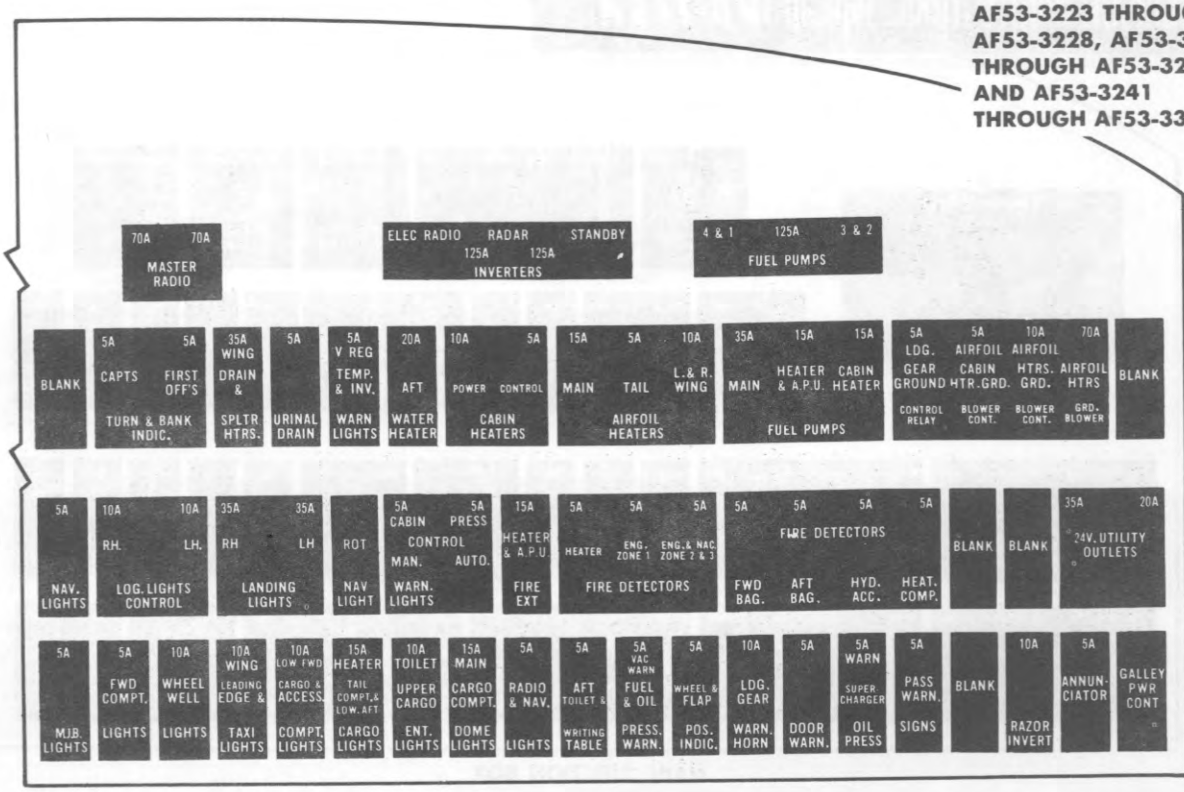


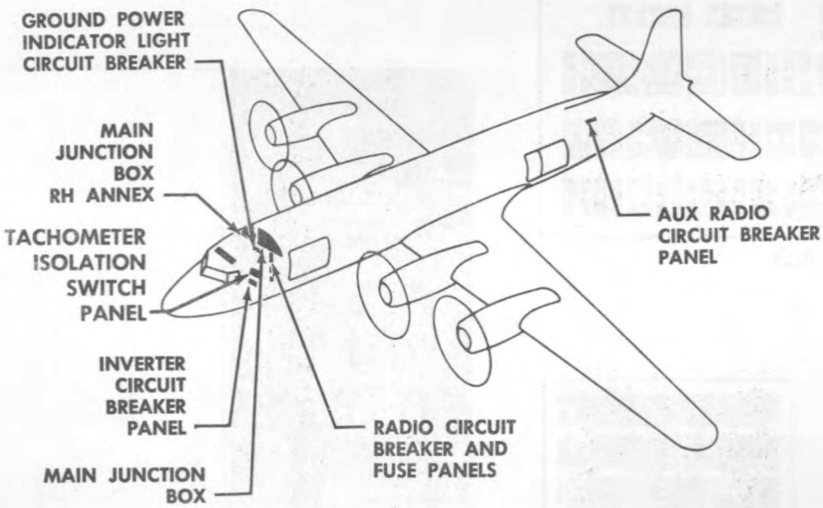
Figure 1-25 (Sheet 1 of 2)

AF53-3223 THROUGH AF53-3228, AF53-3230 THROUGH AF53-3239, AND AF53-3241 THROUGH AF53-3305

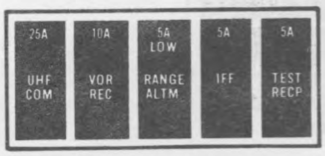


MAIN JUNCTION BOX

GROUND POWER INDICATOR LIGHT CIRCUIT BREAKER



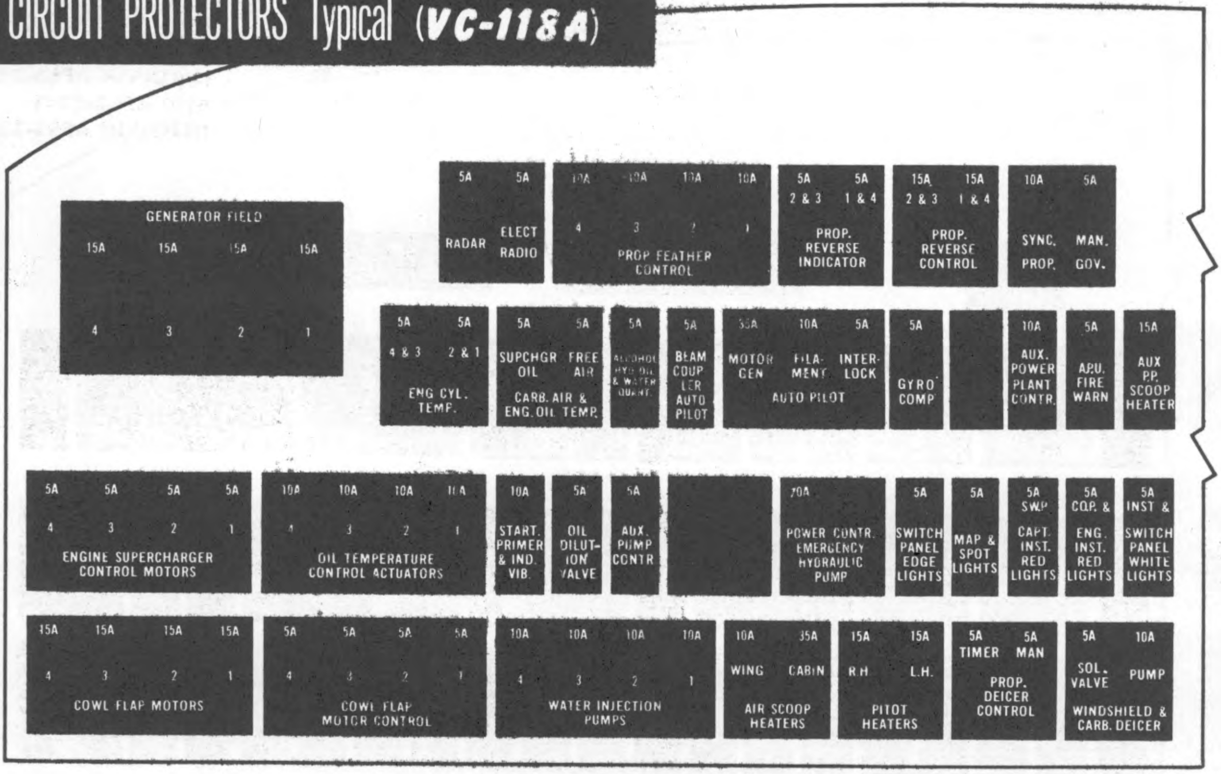
RADIO CIRCUIT BREAKER PANEL



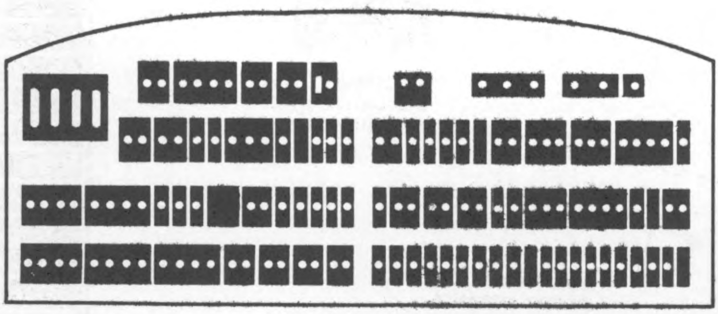
AUX RADIO CIRCUIT BREAKER PANEL

Figure 1-25 (Sheet 2 of 2)

CIRCUIT PROTECTORS Typical (VC-118A)

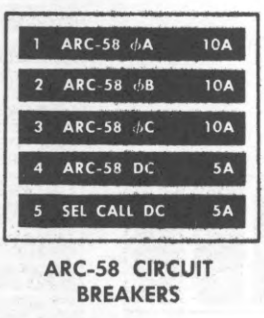


MAIN JUNCTION BOX

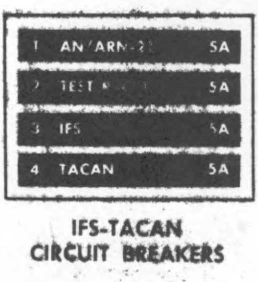


MAIN JUNCTION BOX

RADIO FUSE PANEL

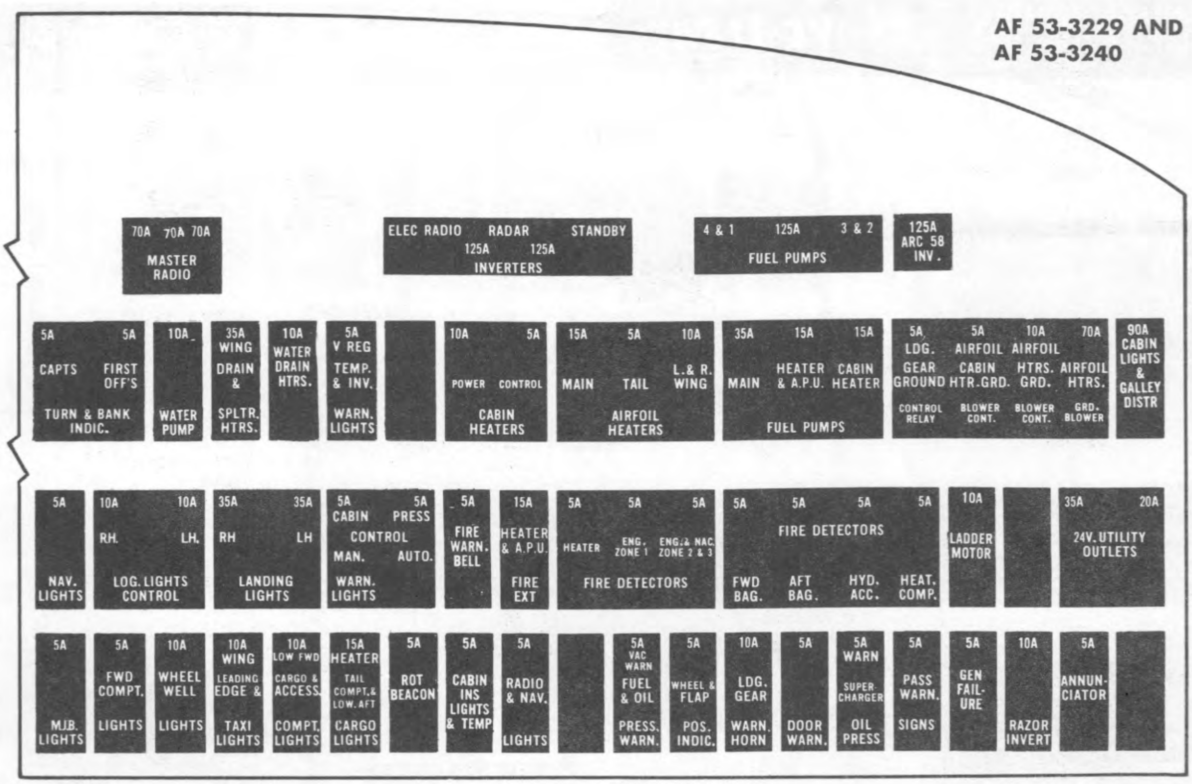


ARC-58 CIRCUIT BREAKERS

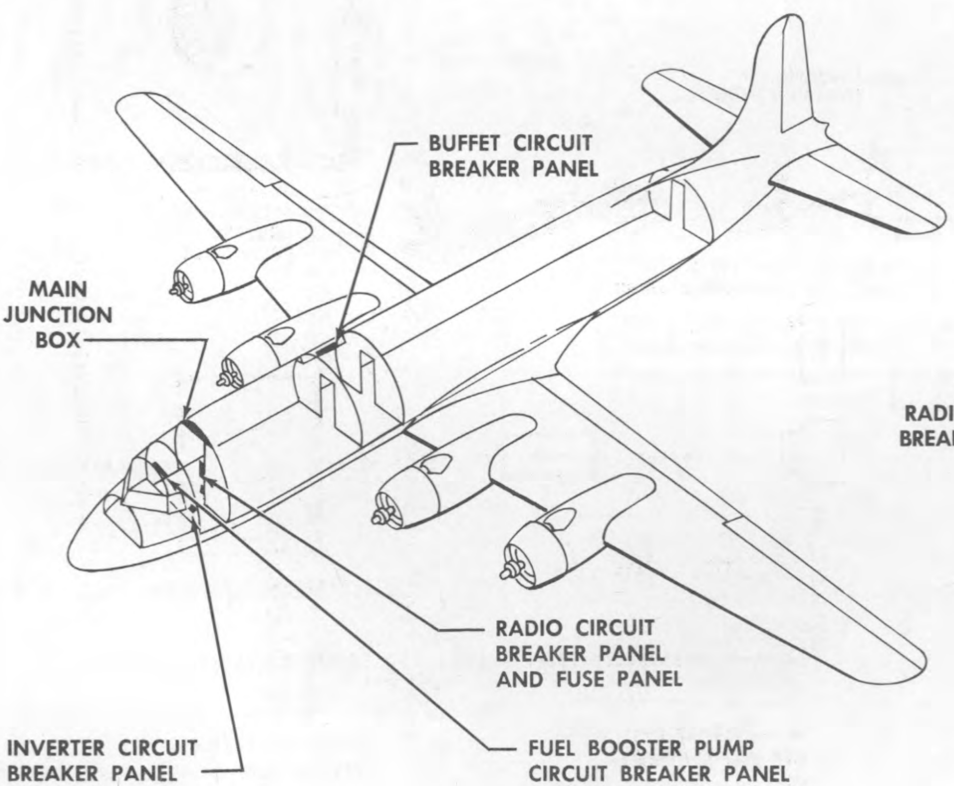


IFS-TACAN CIRCUIT BREAKERS

Figure 1-26 (Sheet 1 of 2)



MAIN JUNCTION BOX



RADIO CIRCUIT BREAKER PANEL

Figure 1-26 (Sheet 2 of 2)

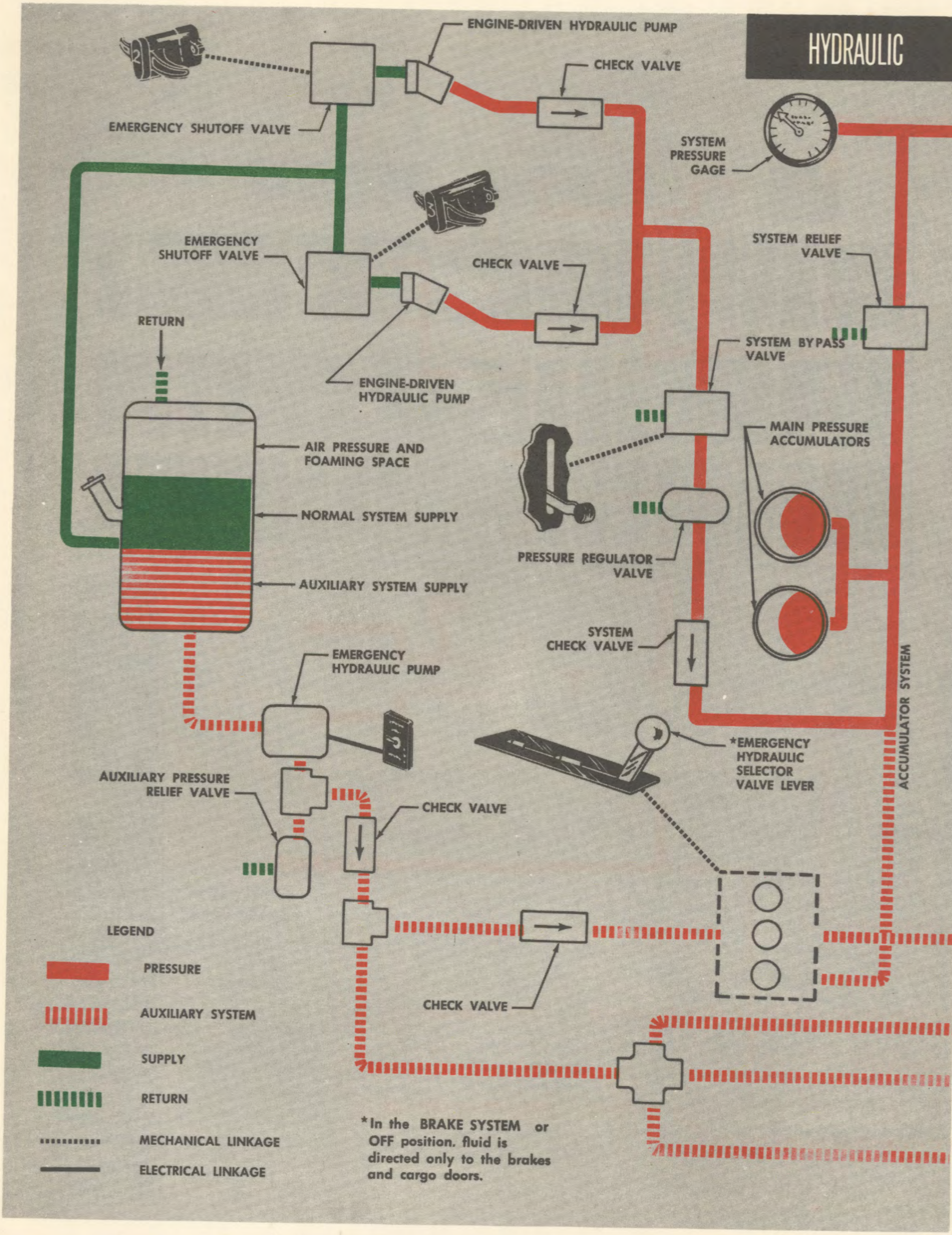


Figure 1-27 (Sheet 1 of 2)

AA1-181

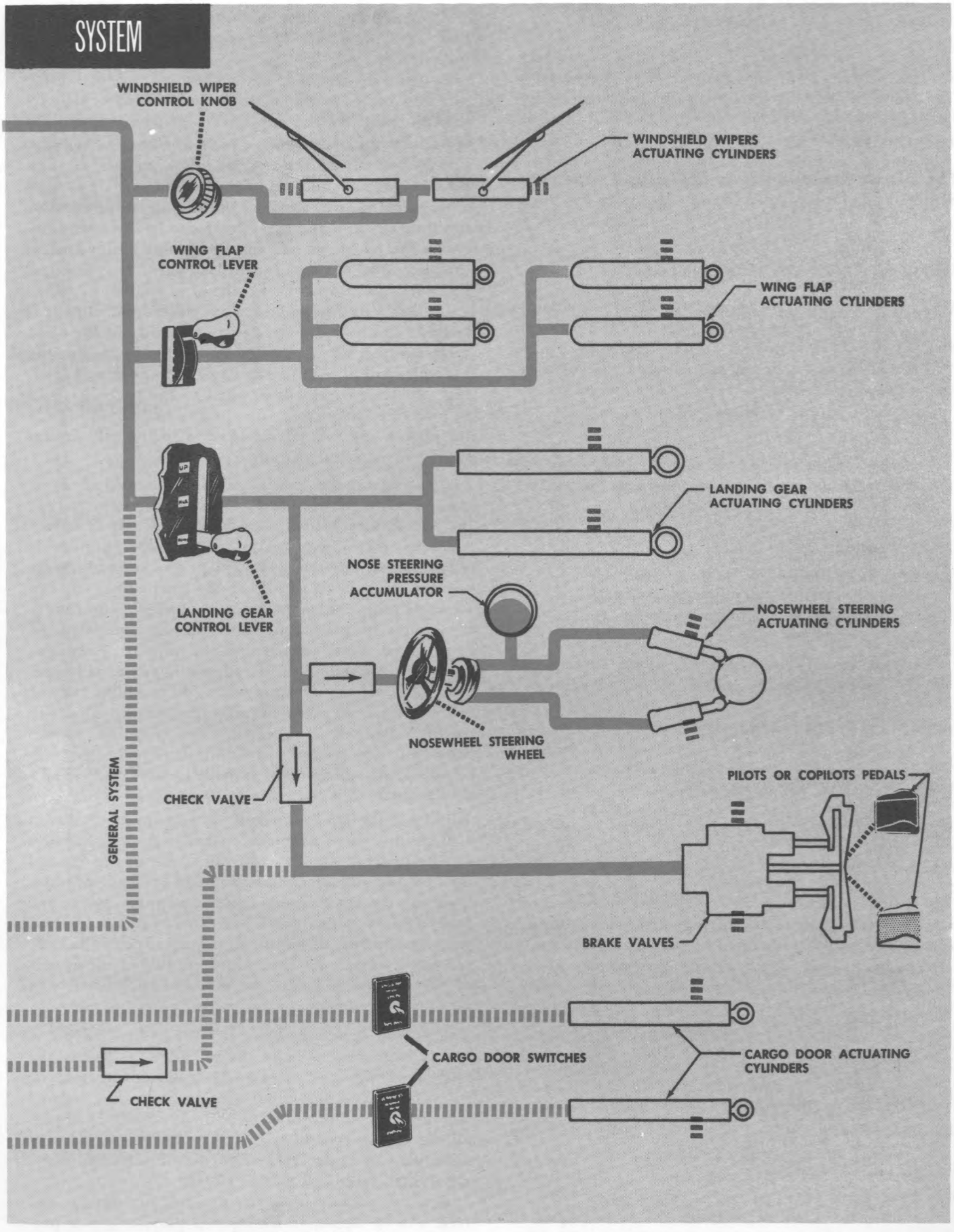


Figure 1-27 (Sheet 2 of 2)

RUDDER TRIM TAB HANDWHEEL.

The rudder trim tab is controlled by a handwheel mounted at the vee of the windshield *(7, figure 1-6)*. The degree of trim is shown on an indicator below the wheel.

AILERON TRIM TAB HANDWHEEL.

The aileron trim tabs are controlled by a handwheel mounted on the control pedestal *(22, figure 1-8, sheet 1; 20, sheet 2; and 23, sheet 3)*. The degree of trim is indicated above the handwheel.

ELEVATOR TRIM TAB HANDWHEELS.

The elevator trim tabs are controlled by two handwheels mounted on the control pedestal *(9, figure 1-8, sheets 1 and 3; and 8, sheet 2)*. The degree of trim is shown on an indicator on the inboard side of each handwheel.

Note

> Pitch limits on the elevator trim tab handwheels are calibrated from 0 to 9 degrees nose up and from 0 to 6 degrees nose down. **Less than four degrees nose up tab will allow 22 degrees of elevator travel, however, full elevator travel of 25 degrees is available with more than four degrees nose up tab. During preflight check of the elevator trim control a slight drag or binding on the control at approximately the four degree nose up position is no cause for alarm as this is due to the readjustment of the elevator travel.**

SPRING CONTROL TABS.

Both ailerons, both elevators, and the rudder are equipped with spring control flying tabs. The tabs are spring-loaded and designed to utilize aerodynamic loads on the spring control tabs to provide aerodynamic boost to the main control surfaces, thus reducing what would otherwise be high stick forces.

The spring control tab is actually an intermediate arrangement *(figure 1-30)* giving stick forces somewhere between those obtained by controlling the main surfaces directly (a direct control system), and those forces obtained by controlling a tab directly (a pure flying tab or servo tab system). Spring tabs have been found necessary because pilot forces arising from the use of direct control were too high, while those obtained by using a servo tab were much too low (pilot forces that are too low deprive the pilot of "feel," since friction in the control system conceals the small forces).

The spring control tab system functions as follows. The pilot force required to move the main control surface directly is about 10 times the force required to operate a control tab directly and have the tab, in turn, move the main surface. Suppose, for example, a 100-pound stick force is required for direct control; then a 10-pound stick force is required when a spring-loaded servo tab is used. By applying 8 pounds of pilot force to the tab, 80 percent of the total force required to move the main surface is performed by the tab itself. By the application of an additional 20 pounds of stick force to the main surface, the remaining 20 percent of the required 100 pounds of stick force is made up, and the total pilot effort is 28 pounds. Theoretically, it is possible, by suitable adjustment of the linkage, to make the pilot force lie anywhere between the 10-pound and the 100-pound limits used in this example *(figure 1-30)*. However, for practical purposes, the range of adjustment is limited by minimum link lengths and structural clearances. Since it is possible to adjust the aerodynamic balance of the main surface which effects the 100-pound figure used in the example, and to modifiy the 10-pound figure by adjusting the spring normally applied to the control tab, it is therefore possible to obtain desirable pilot forces for almost any size aircraft with a spring tab control system of practical design.

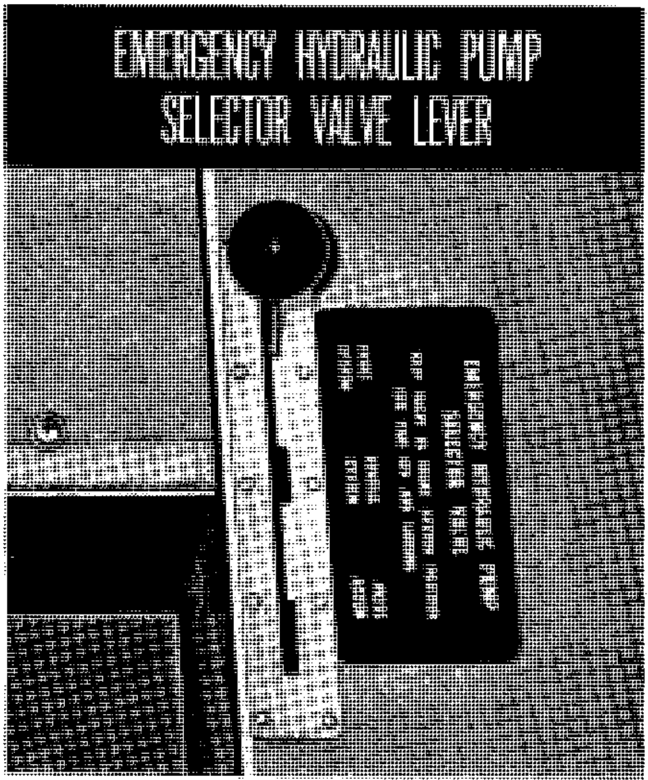
The spring on the control tab is preloaded to overcome system friction and to center the tab. Except for the rudder system, the preload is set to barely overcome the system friction. The rudder preload is much higher in order to make the control forces heavier. This is accomplished by preventing the tab from helping the main surface until approximately 65 pounds of pilot force are applied. This type of control has been chosen for the aircraft since the boost that is obtained by aerodynamic power is always available, and, in an emergency, the standby control system and emergency actuator disconnects that are usually required by designs incorporating power boost are not needed. In addition, use of the less complicated spring tab system reduces specialized maintenance to a minimum.

Note that the spring control systems for both rudder and elevator have different operational characteristics on the ground (no airload). Since the spring control tabs for the rudder and elevator are preloaded, movement of the stick under these conditions moves the main surface while the tab remains fixed at neutral position (because of the springs) until the main surface reaches its stops. At this point, continued movement of the stick will deflect the tab, and stick force will be felt as a result of the action of the tab springs.

The aileron spring tabs are not preloaded; therefore, any ground movement of the aileron will deflect the aileron spring control tabs. This movement will be shown on the aileron tab motion indicator, located just forward of the aileron trim indicator. In flight, all the spring control tabs will be deflected with any movement of their respective control surfaces.

CONTROL-SURFACE LOCK LEVER.

While the aircraft is on the ground, the control surfaces can be locked in the neutral positions, as a protection against damage from high wind velocities, by a mechanical control-surface lock system. The system is



AA1-53

Figure 1-28

engaged with the control surfaces by a lever mounted on the floor to the right of the pilot's seat *(figure 1-33)*. To engage the control-surface lock lever, hold the controls centered and pull the lock lever to the ENGAGED (up) position. This locks only the control surfaces and not the spring control tabs. The lock lever is retained in the ENGAGED (up) position by a retaining handle pulled out from the left side of the control pedestal *(figure 1-8)*. A latch on the floor secures the control-surface lock lever in the DISENGAGED (down) position, to which position the lever is spring loaded. The control-surface lock lever is connected to a restraining mechanism on top of the control pedestal to restrict simultaneous throttle application of takeoff power to all four engines when the control-surface lock is in the ENGAGED position.

Note

Since partial movement of the flight controls is possible with the control-surface lock ENGAGED, due to the spring control tab linkage, it is imperative that a full-throw control check be made just prior to takeoff to make certain that the control-surface lock is DISENGAGED.

WING FLAPS.

The vane-type wing flaps are hydraulically operated and extend from the wing-to-fuselage fillet to the inboard end of the ailerons. A 2-speed flap control valve is installed for the purpose of restricting flap retraction speed between 20 degrees DOWN and the full UP position.

Note

At a speed of 105 knots, the flaps will fully extend in 10 to 15 seconds, retract from 50 degrees to 20 degrees in 9 (±2) seconds, and retract from 20 degrees to the full UP position in 13 (±2) seconds.

A relief valve is provided in the wing flap control hydraulic system to provide overload protection in the event of sudden gust loads while the aircraft is being operated within placarded airspeeds. This valve allows the flap to retract slightly until the load on the flap surface is relieved; it then returns the flap to the flap setting being used. This valve does not provide protection for flap operation in excess of the placarded limits.

WING FLAP LEVER.

The wing flaps are controlled by a pre-position grip-type lever mounted on the control pedestal *(16, figure 1-8, sheet 1; 14, sheet 2; and 17, sheet 3)*. Movement of the flaps is limited to the degree of movement of the lever. No neutral position is provided. However, the OFF position of the wing flap hydraulic valve is at the 5 °DOWN position.

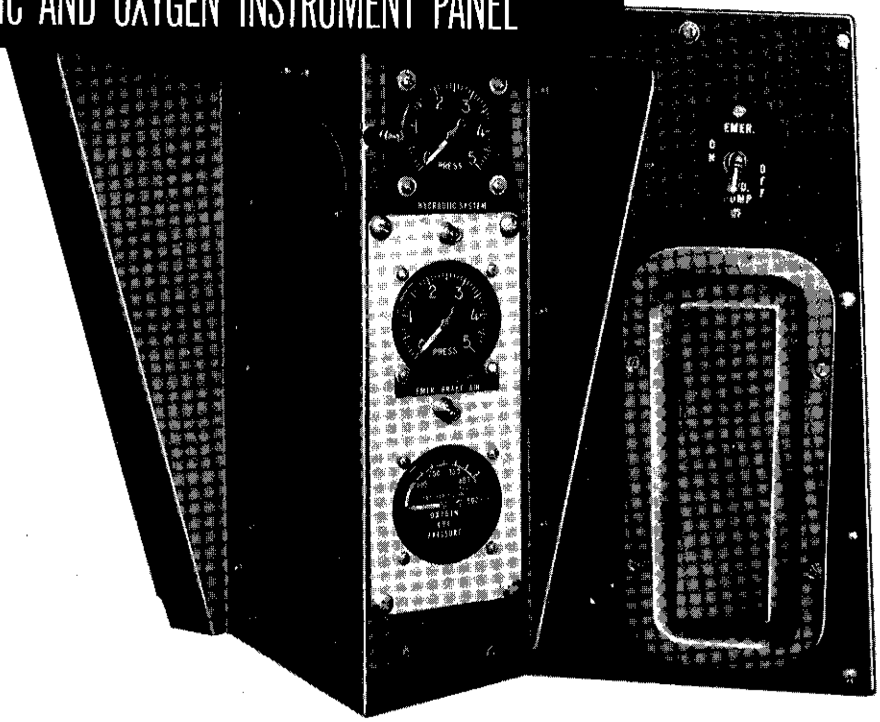
WING FLAP PRE-POSITION INDICATORS.

Two quadrants, one mounted to the inboard of the wing flap control lever for the pilot and the other mounted on the right side of the control pedestal for the copilot, indicate the position of the wing flap control lever. The quadrants are marked in increments from 0° (full UP) to 50° (full DOWN). The markings are: 0°, 10°, 15°, 20°, 25°, 30°, 40°, and 50°.

WING FLAP POSITION INDICATOR.

A remote-indicating flap position indicator, mounted on the main instrument panel *(32, figure 1-9)*, indicates wing flap position setting.

HYDRAULIC AND OXYGEN INSTRUMENT PANEL



AA1-54

Figure 1-29

LANDING GEAR SYSTEM.

The landing gear is composed of two main gears with dual wheels and a steerable nose gear with a single wheel. The main gears and the nose gear are extended and retracted hydraulically. In the event of hydraulic failure, the gear can be lowered by releasing the uplatches and allowing the gear to extend and lock by its own weight and air load. The uplatches are released mechanically by placing the landing gear control lever in the DOWN position. Both the nose and main gear doors are actuated mechanically in conjunction with the landing gear. A safety solenoid that keeps the landing gear control lever from being moved out of the DOWN position while any load remains on the gear prevents inadvertent retraction of the gear on the ground. When the aircraft leaves the ground, the safety solenoid is energized, allowing free movement of the landing gear control lever. A fingerhole in the control pedestal cover *(17, figure 1-8, sheet 1; 15, sheet 2; and 18, sheet 3)* provides a means of manually releasing the solenoid.

Landing gear ground safety pins should be installed in the landing gear retracting links to prevent inadvertent collapsing of the gear while on the ground *(figure 1-34)*. The ground safety pins are stowed in the aircraft when not in use *(27, figure 1-3)*.

LANDING GEAR CONTROL LEVER.

The landing gear is controlled by a lever on the control pedestal *(21, figure 1-8, sheet 1; 19, sheet 2; and 22, sheet 3)*. The lever positions are UP, NEUT, and DOWN, and is conventional in operation. The lever should be left in the DOWN position whenever the landing gear is in the extended position. After takeoff, when the gear is UP and locked, the lever should be returned to NEUT to hang the gear on the uplatch, thus relieving the hydraulic gear retraction cylinders of hydraulic pressure.

Note

The landing gear will retract in 7 to 10 seconds and normally extend by free-fall within 20 seconds.

LANDING GEAR POSITION INDICATORS.

Three landing gear position indicators (one for each gear), incorporated in a single instrument, are mounted on the main instrument panel *(32, figure 1-9)*, and indicate the position of each gear. When each gear is up and locked, its respective indicator reads UP. When each gear is down and locked, a picture of a gear and wheel appears on the face of each indicator. When the landing gear doors are open and the gears are

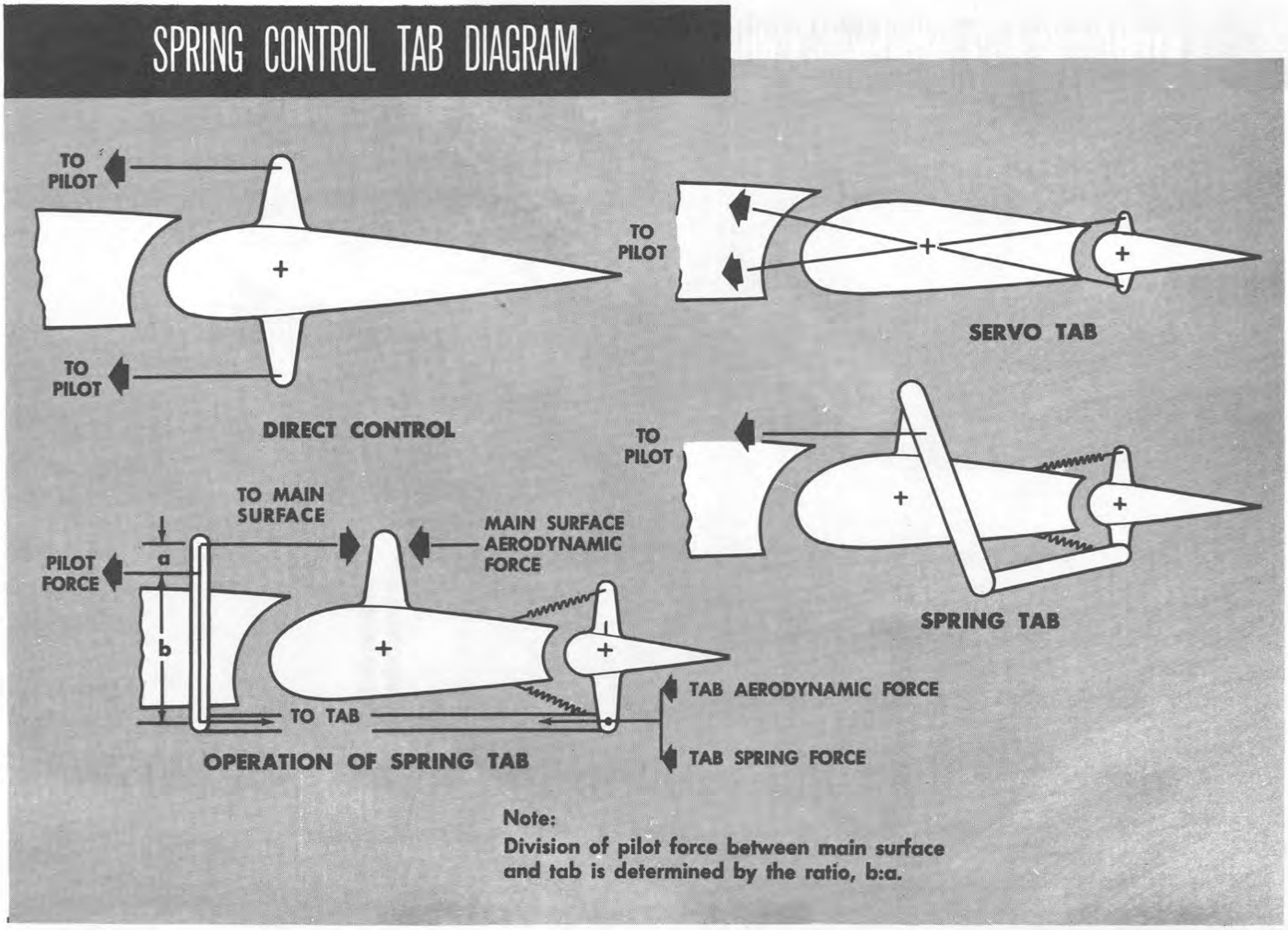


Figure 1-30

either retracting or extending, or d-c power is not supplied, a striped marker shows in each indicator. A landing gear red warning light, mounted on the main instrument panel *(34, figure 1-9, sheets 1 and 2; and 33, sheet 3)*, illuminates when the landing gear is in any position other than locked up or down, or when the landing gear control lever is not in the full DOWN position and the gear is down and locked.

LANDING GEAR WARNING HORN AND CUTOFF SWITCH.

A landing gear warning horn, mounted in back of the pilot's seat *(34, figure 1-3)*, automatically sounds when any throttle is retarded and the gear is in any position other than full DOWN and locked. The horn may be silenced and reset for future action by the use of the landing gear warning horn cutoff switch, mounted on the control pedestal *(18, figure 1-8, sheet 1; 16, sheet 2; and 19, sheet 3)*, in the event operation must be continued with the throttle retarded.

NOSEWHEEL STEERING SYSTEM.

The nosewheel is hydraulically controlled by a steering wheel located on the pilot's auxiliary control panel *(30, figure 1-6)* and can be turned 67 degrees either side of center. The nosewheel will caster freely with or without hydraulic pressure and will automatically return to the center position before retraction. The nosewheel steering system is provided with a pressure accumulator which maintains fluid in the steering strut. The landing gear control lever must be in the DOWN position and the nosewheel strut compressed before the nosewheel steering system will function.

MAIN GEAR WHEEL AND BRAKE ASSEMBLY—TYPE I AND TYPE II.

Each main landing gear is equipped with one of two types of dual wheel and brake assemblies. The type I main gear incorporates a type I (Goodyear) wheel and brake assembly, the type II main gear incorporates type II (Goodrich) wheel and brake assembly *(figures 1-31 and 1-32)*.

EMERGENCY AIRBRAKE SYSTEM

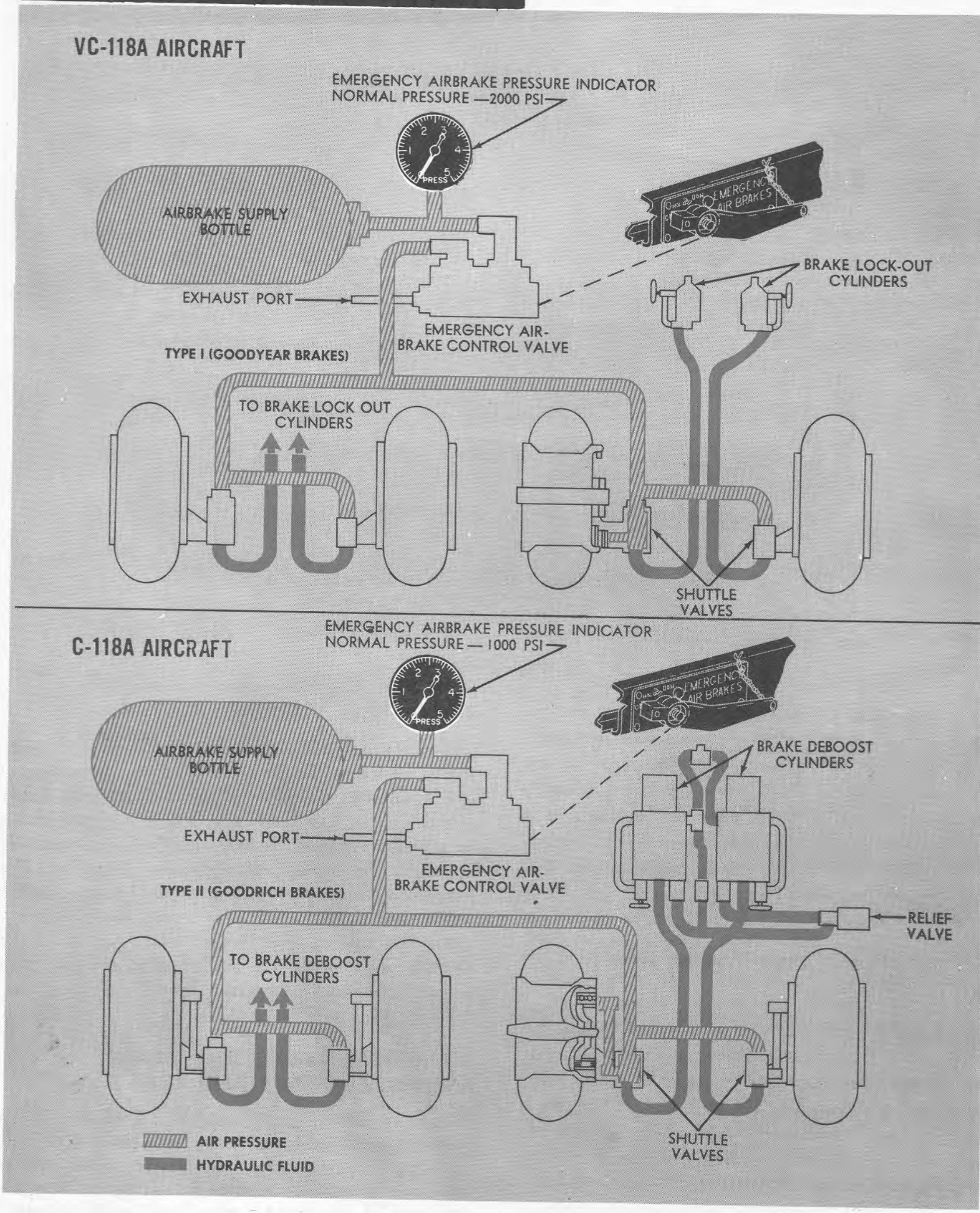
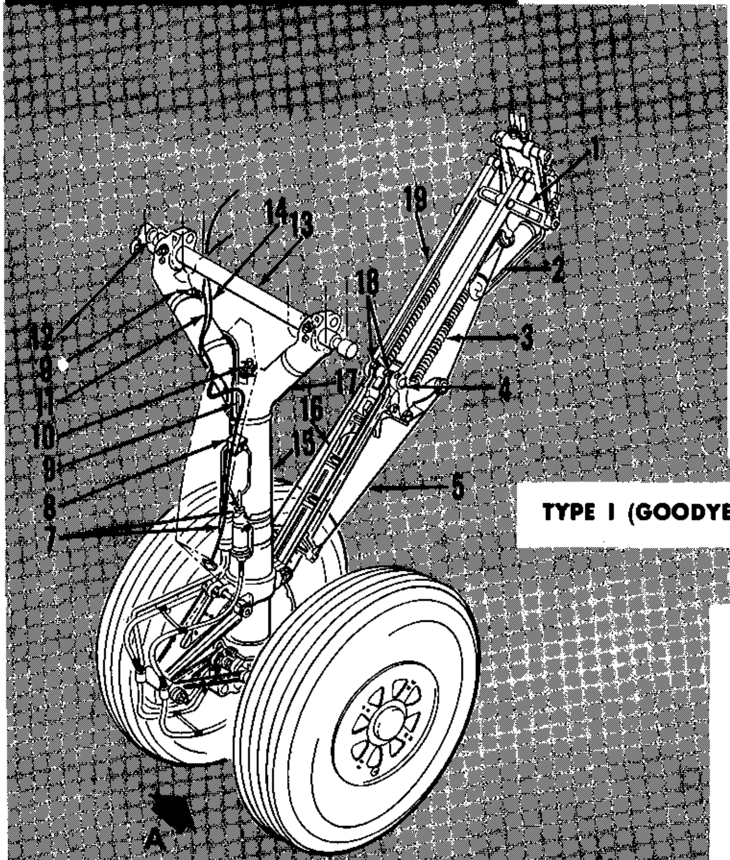
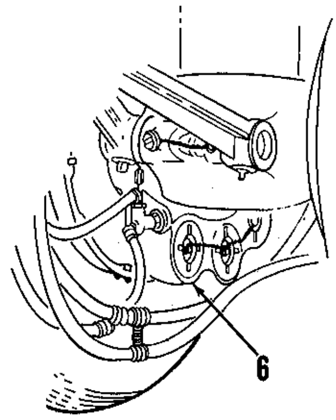


Figure 1-31

MAIN GEAR

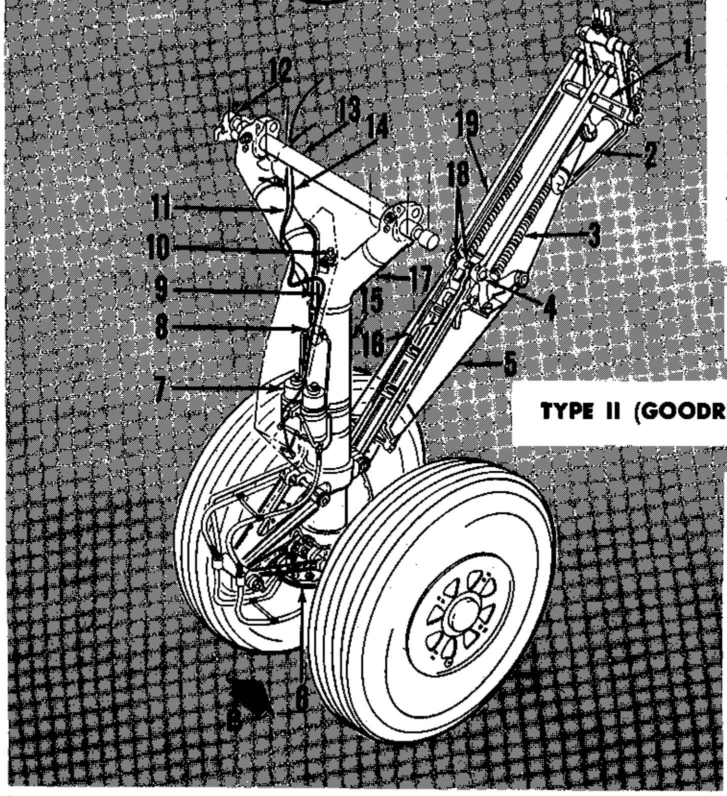


TYPE I (GOODYEAR BRAKES)

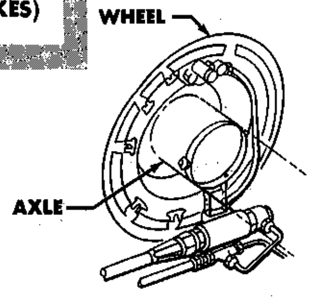


VIEW A

1. ACTUATING STRUT LINKAGE
2. HYDRAULIC ACTUATING STRUT
3. BUNGEE SPRING
4. DRAG LINKAGE KNEE
5. BUNGEE CABLES
6. SELF ADJUSTING SPOT BRAKE ASSEMBLY (TYPE I ONLY)
6. EXPANDER TUBE BRAKE ASSEMBLY (TYPE II ONLY)
7. BRAKE LOCK-OUT CYLINDERS (TYPE I ONLY)
7. BRAKE DEBOOST CYLINDERS (TYPE II ONLY)
8. WYE FITTING
9. HYDRAULIC BRAKE LINE
10. SHOCK STRUT OIL-AIR VALVE
11. AIR BRAKE LINE
12. HYDRAULIC BRAKE GLAND
13. AXIS TUBE
14. CONDUIT FROM SAFETY SWITCH (RIGHT MAIN GEAR ONLY)
15. SHOCK STRUT
16. LOWER DRAG LINKAGE
17. SHOCK STRUT FORK
18. ZERK FITTINGS (TYPICAL)
19. UPPER DRAG LINKAGE



TYPE II (GOODRICH BRAKES)



VIEW B

Figure 1-32

BRAKE SYSTEM.

Both the normal and emergency hydraulic systems and the emergency airbrake system can be used to operate the brakes installed in each main gear wheel for constant braking. Differential braking is available with the hydraulic system only. The landing gear control lever must be in the DOWN position before hydraulic braking is available. An antiskid brake control system is installed to prevent locking of the braked wheels during the landing roll due to excessive pressure being metered to the brakes by the pilot. Normal stopping distance under varying conditions should be determined from the Distance to Stop charts in the Appendix. It will be noted that this stopping distance is with normal use of brakes. To compensate for a 50-foot altitude over threshold, 140 percent of actual stopping distance is used.

For VC-118A aircraft AF53-3229 and AF53-3240, the type I wheel assembly incorporates a type I brake assembly which is a single-disc, self-adjusting (Goodyear) spot brake. It is actuated by hydraulic pressure only when the landing gear control lever is in the DOWN position. The brake assembly consists of two opposing units of brake lining separated by a floating annular disc to accomplish stopping action. No adjustment of brakes is required during the lifetime of the lining.

HYDRAULIC BRAKE NORMAL CONTROL.

The hydraulic brakes are normally actuated by toe pressure applied to the hinged rudder pedals (*27, figure 1-6*). The pressure applied to the brakes is in proportion to the pressure applied to the brake pedals.

HYTROL ANTISKID BRAKE SYSTEM.

The Hytrol antiskid brake system, a modulated automatic skid-corrective type of control, operates as an auxiliary to the regular braking system. It assists the pilot during landing by automatically preventing wheel skidding, thus providing the greatest possible braking efficiency and helping to prevent blowouts. The system prevents wheel skidding by automatically controlling the metered brake pressure applied by the pilot on the brake pedals. This control is made possible by means of detector units in the main landing gear axles, and electrical control circuit, a brake-pressure, modulating accumulator, and electrically operated valves in the brake metered pressure lines.

Normal antiskid braking technique should be used. The Hytrol equipment applies control of the braking operation only when the landing gear wheels approach a skid condition. The Hytrol system is designed to remain safe in case of unit malfunction, and it can be turned off by the pilot to revert the brake system to normal operation.

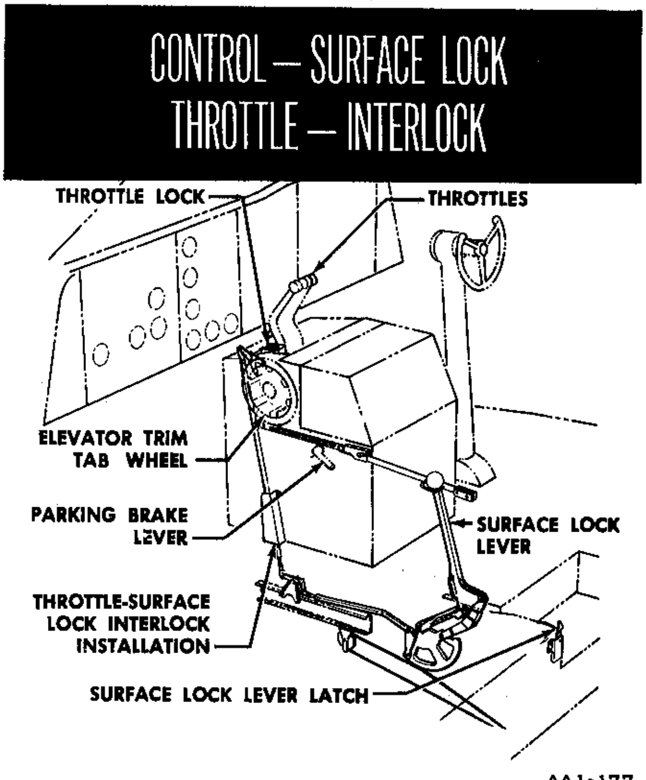


Figure 1-33

CAUTION

As the Hytrol brake is a friction-type brake, steady application may cause overheating; therefore intermittent application is recommended.

Note

Not installed on VC-118A aircraft AF53-3229 and AF53-3240 (Goodyear spot brakes).

Antiskid Switch and Warning Light.

An ON-OFF antiskid switch and a warning light are installed on the support bracket of the pilot's radar scope (*21, figure 1-7, sheet 1; and 20, sheet 5*). The switch is used to select either normal braking (OFF position) or antiskid braking (ON position). When the switch is placed in the ON position and the warning light is off, the system is operating normally. When the switch is placed in the OFF position, or the system has malfunctioned, the warning light will illuminate. When the antiskid system fails, the fail-safe circuit is energized to automatically revert the brake system to standard. A circuit breaker, placarded INOP. LIGHT – ANTISKID, is located on the main junction box circuit breaker panel (*figures 1-23 through 1-25*).

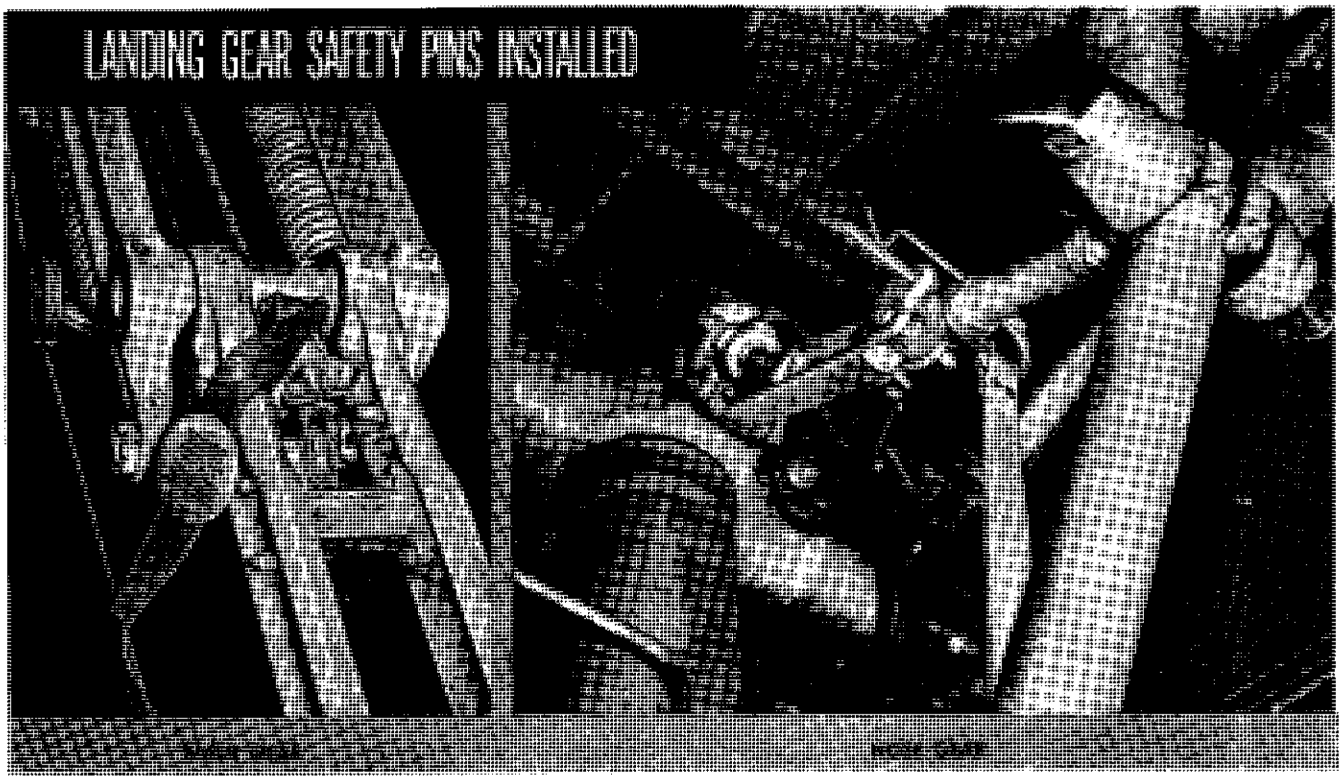


Figure 1-34

CAUTION

It is possible to have a malfunction or material failure of the antiskid system and not get an accompanying warning light indication. Whenever a malfunction is noted or suspected the first action should be to turn the antiskid system OFF. Caution should be taken to insure the brake pedals are not depressed when the switch is turned off.

HYDRAULIC BRAKE EMERGENCY CONTROL.

If the normal hydraulic system fails to deliver sufficient pressure to the brakes, the emergency hydraulic pump selector valve lever *(figure 1-28)* should be positioned to BRAKE SYSTEM and the emergency hydraulic pump switch turned ON to supply emergency hydraulic pressure to the brakes.

CAUTION

Under no circumstances should the main landing gear hydraulic brakes be applied by use of the emergency hydraulic pump, either during or after gear retraction.

Note

- In the BRAKE SYSTEM position, the emergency hydraulic pump selector valve will direct pressure from the emergency hydraulic pump to the brakes and the cargo doors only. All other hydraulically actuated units will be inoperative.

- On VC-118A aircraft AF53-3229 and AF53-3240 in the BRAKE SYSTEM position, the emergency hydraulic pump selector valve will direct pressure from the emergency hydraulic pump to the brakes only. The cargo doors are sealed shut.

PARKING BRAKE HANDLE.

The parking brake handle is mounted on the control pedestal *(figure 1-8)*. To set the parking brakes, make certain full hydraulic pressure is available, depress the brake pedals, and then move the parking brake handle to the ON poistion, releasing the brake pedals while holding the parking brake handle position. Brake engagement can be checked by moving the parking brake handle forward. Freedom of movement indicates that the parking brake is engaged. To release the parking brakes, fully depress brake pedals.

Note

Minimum pressure for satisfactory setting of the parking brakes is 1400 psi.

CAUTION

Care should be taken when setting the parking brake because it is possible to inadvertently set the brakes in the wheels of one side only.

EMERGENCY AIRBRAKE HANDLE.

An emergency airbrake handle, installed on the main fire control panel *(figure 1-35)* has positions OFF, HOLD, and ON. In operation, the handle controls and meters the release of pressurized air into the brake system for emergency operation. The brake hydraulic system must be bled after operation of the airbrake system to eliminate erratic hydraulic brake operation.

Note

Sufficient air pressure is available for three full applications of the brakes.

EMERGENCY AIRBRAKE PRESSURE INDICATOR.

An emergency airbrake pressure indicator, located on the hydraulic and oxygen instrument panel *(figure 1-29)*, indicates pressure of the airbrake supply bottle. When the supply bottle used with the type II (Goodrich) brakes is full, the indicator should read 1000 psi. When the supply bottle used with the type I (Goodyear) brakes is full, the indicator should read 2000 psi.

INSTRUMENTS.

TORQUEMETER.

Four torquemeters *(4, figure 1-9, sheet 1; and 5, sheets 2 and 3)*, one for each engine, are located in the center of the main instrument panel and are energized by 26-volt ac. Each torquemeter is calibrated from 60 to 254 in psi of brake mean effective pressure.

MANIFOLD PRESSURE GAGES.

Two direct-reading dual-indicating manifold pressure gages, one for engines No. 1 and 2 and the other for engines No. 3 and 4 *(13, figure 1-9, sheets 1 and 2; and 15, sheet 3)*, are installed in the center of the main instrument panel. Each gage is calibrated from 10 to 75 in inches Hg.

TACHOMETERS.

Two self-energized dual-indicating tachometers *(22, figure 1-9, sheet 1; and 23, sheets 2 and 3)* are installed in the center of the main instrument panel. Each tachometer is calibrated from 0 to 4500 in rpm.

CYLINDER HEAD TEMPERATURE INDICATORS.

Two dual-indicating cylinder head temperature indicators *(23, figure 1-9, sheet 1; and 24, sheets 2 and 3)*, located in the center of the main instrument panel, are energized by 28-volt dc. Each indicator is calibrated from −50 to +300 in degrees centigrade.

ADI SYSTEM PRESSURE INDICATORS.

Two dual-indicating ADI (water-alcohol) system pressure indicators *(31, figure 1-9)*, located in the center of the main instrument panel, are energized by 26-volt ac. Each indicator is calibrated in psi from 0 to 35 and registers the ADI system pressure to its respective engine.

FUEL PRESSURE INDICATORS.

Two dual-indicating fuel pressure indicators *(24, figure 1-9, sheet 1; and 25, sheets 2 and 3)*, located in the center of the main instrument panel, are energized by 26-volt ac. Each indicator is calibrated in psi from 0 to 35.

FUEL FLOWMETERS.

Two dual-indicating fuel flowmeters *(35, figure 1-9)*, located in the center of the main instrument panel, are energized by 26-volt ac. Each indicator is calibrated in pounds per hour from 100 to 2000.

OIL PRESSURE INDICATORS.

Two dual-indicating oil pressure indicators *(5, figure 1-9, sheet 1; and 6, sheets 2 and 3)*, located in the center of the main instrument panel, are energized by 26-volt ac. Each indicator is calibrated in psi from 0 to 200.

OIL TEMPERATURE INDICATORS.

Two dual-indicating oil temperature indicators *(15, figure 1-9, sheets 1 and 2; and 17, sheet 3)*, located in the center of the main instrument panel, are energized by 28-volt dc. Each indicator is calibrated in degrees centigrade from −70 to +150.

CARBURETOR AIR TEMPERATURE INDICATORS.

Two dual-indicating carburetor air temperature indicators *(14, figure 1-9, sheets 1 and 2; and 16, sheet 3)*, located in the center of the main instrument panel, are energized by 28-volt dc. Each indicator is calibrated in degrees centigrade from −70 to +150.

OUTSIDE AIR TEMPERATURE INDICATORS.

Two outside air temperature indicators *(33, figure 1-9, sheets 1 and 2; and 4, sheet 3)* are energized by 28-volt dc and are located as follows: one in the center of the main instrument panel and the other on the instrument panel at the navigator's station *(figure 4-20)*. Each indicator is calibrated in degrees centigrade from —50 to +50.

AIRSPEED INDICATORS.

Three airspeed indicators are installed as follows: one in front of each pilot, on the main instrument panel *(9, figure 1-9, sheets 1 and 2; and 11, sheet 3)*, and one on the instrument panel at the navigator's station *(figure 4-20)*. Each indicator is actuated by ram air pressure obtained from the pitot heads and static pressure. The indicators are calibrated in knots from 0 to 400.

VERTICAL VELOCITY INDICATORS.

Two vertical velocity indicators are located on the main instrument panel *(20, figure 1-9, sheet 1; and 21, sheets 2 and 3)*, one in front of each pilot. The indicators are operated by static air pressure obtained from the main static vents or the ice-free alternate static source. The indicators are calibrated in feet-per-minute climb and descent from 0 to 6000 up and from 0 to 6000 down.

TURN-AND-SLIP INDICATORS.

Two turn-and-slip indicators are installed on the main instrument panel *(9, figure 1-9, sheet 1; and 20, sheets 2 and 3)*, one in front of each pilot's station. The turn needle gyro of each indicator is energized by 28-volt dc.

ALTIMETERS.

Three pressure altimeters are installed as follows: two on the main instrument panel, one in front of each pilot's station *(18, figure 1-9, sheet 1; and 19, sheets 2 and 3)*, and one on the instrument panel at the navigator's station *(figure 4-20)*. Each altimeter is sensitive to changes in barometric pressure and is operated by static air pressure from the main static vents or from the ice-free alternate static source. The altimeter measures feet of pressure altitude in 20-foot increments from 0 to 50,000. A barometric setting knob, located on the rim of the instrument, permits setting the applicable barometric pressure, which is indicated through a window on the dial face of the instrument. Three hands on the face of the altimeter are of unequal length and function as follows: The longer hand indicates altitudes between 0- and 1000-foot intervals in 20-foot increments; the intermediate hand indicates 1000-foot intervals; and the short hand indicates 10,000-foot intervals. Two triangular reference pointers are on the dial face of the altimeter; each moves with respect to the calibrated scale. The pointer on the outside of the scales reads in hundreds of feet and the pointer on the inside of the scale reads in thousands of feet.

CLOCKS.

Three eight-day clocks are installed as follows: two on the main instrument panel, one in front of each pilot's seat *(12, figure 1-9, sheets 1 and 2; and 14, sheet 3)*, and one on the instrument panel at the navigator's station *(figure 4-20)*. Each clock is spring actuated and has a sweep second hand.

ATTITUDE INDICATOR (H-5, H-6, OR J-8).

The aircraft is equipped with the H-5, H-6, or J-8 attitude indicator *(11, figure 1-9, sheets 1 and 2; and 13, sheet 3)*.

Note

Aircraft AF53-3223 through AF53-3305 are equipped with the H-5 indicator. AF51-3818 through AF51-3835 have the J-8 indicator, and AF51-17626 through AF51-17661, AF51-17667, and AF51-17668 have either the H-6 or J-8 indicator.

The attitude indicator provides a constant visual indication of the pitch and roll attitudes of the aircraft. Quck erection of the H-6 or J-8 gyro must be accomplished immediately after power is supplied to the indicator by pulling out the caging knob on the front bezel. The knob should be held in the extended position until the horizon bar and bar and bank index cease to oscillate, at which time they should indicate zero roll and pitch within approximately 3 degrees. The caging time will depend upon the position of the gyro; however, the longest time will be approximately 10 seconds. Instantaneous erection may be obtained by holding the caging knob in the extended position when the power supply is turned on.

WARNING

Since the caging device cages the gyro to the true attitude of the aircraft and not to the true vertical, the indicator should not be caged in flight unless the aircraft is known to be in straight and level flight during the caging procedure.

WARNING

A slight amount of pitch error in the indication of the J-8 attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the aircraft is flying straight and level. This error will be most noticeable at the time the aircraft breaks ground during the takeoff run. At this time, a climb indication error of about 1½ bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

The indicator contains a warning flag that is visible whenever there is a shutoff of the power supply, an improper phase rotation, or an open or short circuit in the instrument. During normal operation, the flag will disappear from view.

WARNING

The J-8 or H-6 indicator should not be relied upon for flight indications if the warning flag is visible in the face of the insrument.

The H-5 indicator will erect and assume the proper operating position within 3 degrees roll and pitch in from 20 to 30 seconds after d-c power is supplied to the erection magnet. After the d-c erection cycle, normal a-c power is supplied to operate the system. The indicator will stabilize to indicate true attitude within approximately 1 to 2½ minutes and a warning flag will be visible on the face of the indicator.

WARNING

Failure of the warning flag to oscillate approximately one time per second indicates insufficient or out-of-phase power supply, or malfunction of the system. The attitude indicator should not be relied upon under these circumstances.

Note

The H-5 attitude indicator cannot be caged manually.

S-2 COMPASS SYSTEM (AF51-3818 THROUGH AF51-3835 AND AF53-3223 THROUGH AF53-3305).

The aircraft is equipped with two separate S-2 compass systems. One system incorporates both the pilot's and the navigator's directional indicators, and the other system incorporates the copilot's directional indicator.

For VC-118A aircraft AF53-3229 and AF53-3240, see S-2 COMPASS SYSTEM — AF53-3229 AND AF53-3240 and A-12 AUTOPILOT SYSTEM — AF53-3229 AND AF53-3240.

S-2 DIRECTIONAL INDICATOR.

The S-2 directional indicator combines the functions of both a directional gyro and a magnetic compass to provide a stable directional indication. The S-2 directional indicator controller panel, located on the main instrument panel *(39, figure 1-9, sheets 1 and 3)*, is provided with a 2-position toggle switch to select SLAVED GYRO for normal operation or FREE GYRO for operation in regions near the magnetic poles, or in other areas where severe magnetic distortion occurs. In SLAVED GYRO operation, the S-2 directional indicator repeaters, located on the pilot's and copilot's main instrument panel *(10, figure 1-9, sheet 1; 18, sheet 2; and 12, sheet 3)* and on the instrument panel at the navigator's station *(figure 4-20)*, will indicate the magnetic heading of the aircraft. In FREE GYRO operation, the reading indicated is a gyro heading reference. In FREE GYRO operation only, the manual set heading switch on the controller panel will increase or decrease the indicated heading of the gyro and cause the annunciator pointer on the controller panel to deflect to the right or left with respect to its zero center position. The zero center position indicates that the system is aligned to the magnetic meridian.

S-2 COMPASS SYSTEM — AF53-3229 AND AF53-3240.

The S-2 compass combines the functions of both a directional gyro and a magnetic compass to provide a stable directional indication. The S-2 compass controller panel *(35, figure 1-10)* located on the main instrument panel, is provided with a 2-position toggle switch to select SLAVED GYRO for normal operation, or FREE GYRO for operation in regions near the magnetic poles, or in other areas where severe magnetic distortion occurs. In SLAVED GYRO operation, the magnetic heading of the aircraft is furnished to the cards of the following instruments: The VOR-1 omni-bearing indicator at the radio operator's station, the copilot's VOR and ADF radio magnetic indicators (RMI's), the navigator's ADF radio magnetic indicator (RMI), and the pilot's VOR course indicator (IFS) on the main instrument panel in front of the pilot's seat. In FREE GYRO operation, the reading indicated on the instruments is a gyro heading reference. In FREE GYRO operation only, the manual set heading switch on the controller panel will increase or decrease the indicated heading of the gyro, and cause the SYNC SIGNAL pointer on the compass controller panel to deflect to the right or left with respect to its zero center position. The zero center position indicates that the system is aligned to the magnetic meridian. The S-2 compass gyro is nontumbling and does not require caging. The S-2 compass system is energized when power is supplied the 28-volt d-c and 115-volt a-c buses through the RADAR inverter switch.

A-12 AUTOPILOT SYSTEM — AF53-3229 AND AF53-3240.

An A-12 autopilot compass system is installed to furnish the magnetic heading of the aircraft to the cards of the following instruments: The VOR-2 omni-bearing indicator (OBI) at the radio operator's station, the pilot's VOR and ADF radio magnetic indicators (RMI's), the navigator's VOR radio magnetic indicator (RMI), and both compass (A-12) repeater indicators, which are located as follows; one on the main instrument panel in front of the copilot's seat, and one on the instrument panel at the navigator's station. The compass has no northerly turning error, therefore, drift is eliminated. There are no caging controls and the compass does not require resetting. The A-12 compass system is energized when power is supplied to the 28-volt d-c and 115-volt a-c buses, through the RADIO-ELECTRIC inverter.

G-2 DIRECTIONAL INDICATOR.

Some early aircraft are equipped with the G-2 directional indicator, which provides a stabilized gyro compass reading by combining the advantages of the remote indicating compass and the free directional gyro in one instrument. The long period accuracy of the average compass heading is retained and also the short time accuracy of the gyro, while the short period oscillation of the compass and the long time drift error of the gyro are eliminated.

The correspondent indicator, located in the center of the dial of the master direction indicator, is electrically connected to the remote compass transmitter, furnishing an unstabilized magnetic compass reading at all times.

For normal operation of the G-2 directional indicator, the toggle selector switch on the main instrument panel should be positioned to REMOTE COMPASS. However, in magnetically unreliable regions, such as encountered in higher latitudes, the main dial of the master direction indicator can be utilized as a free gyro, by setting the toggle selector switch to FREE DIR. GYRO position. Under this condition, the effect of the remote compass transmitter is removed from the heading of the gyro element and the compass operates subject to the inherent drift induced by the earth's rotation.

The resetting knob on the indicator permits manual setting of the main dial to any desired heading. Proceed as follows:

A. Depress the knob firmly and rotate the main dial to the desired heading.

B. Keep the knob fully depressed at the new heading for at least 2 seconds.

C. Release the knob, avoiding any twisting motion.

The normal correction rate of the remote compass transmitter on the gyro element is 4 degrees per minute. If the difference between the correspondence indicator reading and the main dial gyro reading is large, as when starting the gyro, several minutes will be required before complete agreement between the transmitter and the gyro is effected. To eliminate this delay, the system may be synchronized by use of the manual resetting knob.

The compass gyro is of a non-tumbling type which does not require caging.

PITOT STATIC SYSTEM.

A ram and static pressure system is installed for operation of the altimeters and the airspeed, vertical velocity, autopilot altitude control, and cabin pressure control instruments. The system consists of two pitot heads located on top of the nose structure *(40, figure 1-3)*, with two main static sources *(39, figure 1-3)*, and an ice-free alternate static source located inside the fuselage, aft of the rear pressure dome in the tail cone. The pitot heads and main static vents are protected against ice accretion by internal electric heating elements controlled by the pitot heater switch mounted on the upper instrument panel *(figure 1-11)*.

Note

Some aircraft have sealed tail cones. On these aircraft, when the alternate static source is being used, the readings on the airspeed indicators and altimeters will be approximately the same as when the main static sources are being used. If the tail cone is unsealed, the alternate static source will provide sub-normal readings. *(See Appendix.)*

On VC-118A aircraft AF53-3229 and AF53-3240, the airspeed indicator and altimeter installed in the stateroom are connected to the copilot's pitot static system.

STATIC SOURCE SELECTOR SWITCH.

Two static source selector switches, one outboard of the pilot's seat *(20, figure 1-7, sheet 1; 22, sheet 3; and 19, sheet 5)*, and one outboard of the copilot's seat *(17, figure 1-7, sheet 2; 23, sheet 4; and 22, sheet 6)*, permit selection of either the NORMAL static source or the ALTFRNATE ice-free source, for either set of instruments.

EMERGENCY EQUIPMENT.

FIRE EXTINGUISHING SYSTEM.

Each engine nacelle area, the lower cargo compartments, the hydraulic accessories compartment, the heater compartment, and the wing anti-icing heaters are protected by the main CO_2 fire extinguisher system. Six CO_2 cylinders in two banks (three in each bank) are installed in the fuselage nose section. The three cylinders in each bank are manifolded to a single tube serving as a common supply line to any area protected by the main CO_2 system. The wing and tail anti-icing heaters and the cabin heater CO_2 systems are electrically actuated; the four nacelles and the underfloor compartment CO_2 systems are mechanically actuated. The tail anti-icing heater, the cabin heater, and the auxiliary power unit are protected by individual bottles of CO_2. The cabin heater is also protected by the main CO_2 system. Strategically located fire detectors actuate fire warning lights on the main fire control panel, the auxiliary power unit control panel, and on the heater fire control panel.

Note

Each nacelle is divided into three zones: Zone I, the power zone; Zone II, the engine accessories sections; and Zone III, the area aft of the firewall. Zone I has fire detectors only, while Zones II and III have both fire detectors and CO_2 protection.

Celluloid blowout discs, red for thermal expansion and yellow for manual discharge of CO_2, are installed in the area of the CO_2 cylinder locations *(14, 20, and 21, figure 1-3)* to give visual indication that CO_2 has been discharged and that the respective CO_2 cylinders must be replaced. Five portable hand-operated fire extinguishers are provided *(1, figure 3-4)* for use on fires in the cockpit and cabin.

Main Fire Extinguisher Selector Valve Handles.

Eight fire extinguisher selector valve handles are mounted in a row on the main fire control panel *(figure 1-35)* immediately below the glareshield. The handles are identified from left to right, starting inboard of the left CO_2 discharge handle, as follows: FWD BAG, HYD ACC COMPT, engines 1, 2, 3, 4, HEATER COMPT, and AFT BAG. Each handle selects the area for CO_2 discharge but does not discharge CO_2. The engine section selector valve handles also operate the emergency shutoff valves at the firewall.

Main Fire Extinguisher CO_2 Discharge Controls.

Two CO_2 discharge handles, one for each bank of CO_2, are mounted on the outboard ends of the main fire control panel *(figure 1-35)* and are identified as follows: LH CYL and RH CYL (see Section IV for heater fire controls).

Fire Detector Test Switches.

Fire detector test switches, mounted on the heater fire control panel *(figure 4-10)*, provide a means of testing the detector circuits.

Auxiliary Power Unit CO_2 Discharge Switch.

One guarded CO_2 discharge switch is installed on the auxiliary power unit panel *(figure 4-28, sheet 1)*. Operation of the switch will automatically discharge CO_2 into the auxiliary power unit housing. On AF53-3223 through AF53-3305, the auxiliary power unit CO_2 selector and discharge switches are located on the heater fire control panel *(figure 4-10, sheet 1)*.

Main Fire Extinguishing System Indicators.

Dual warning lights, mounted in each fire extinguishing selector valve handle and CO_2 discharge handle *(figure 1-35)*, are illuminated by action of thermal fire detectors installed in the critical areas or by actuation of the respective fire detection test switches. Dual lights are installed to insure indication in the event of failure of either bulb. Thermocouple-type fire detectors are mounted in each nacelle area, for-

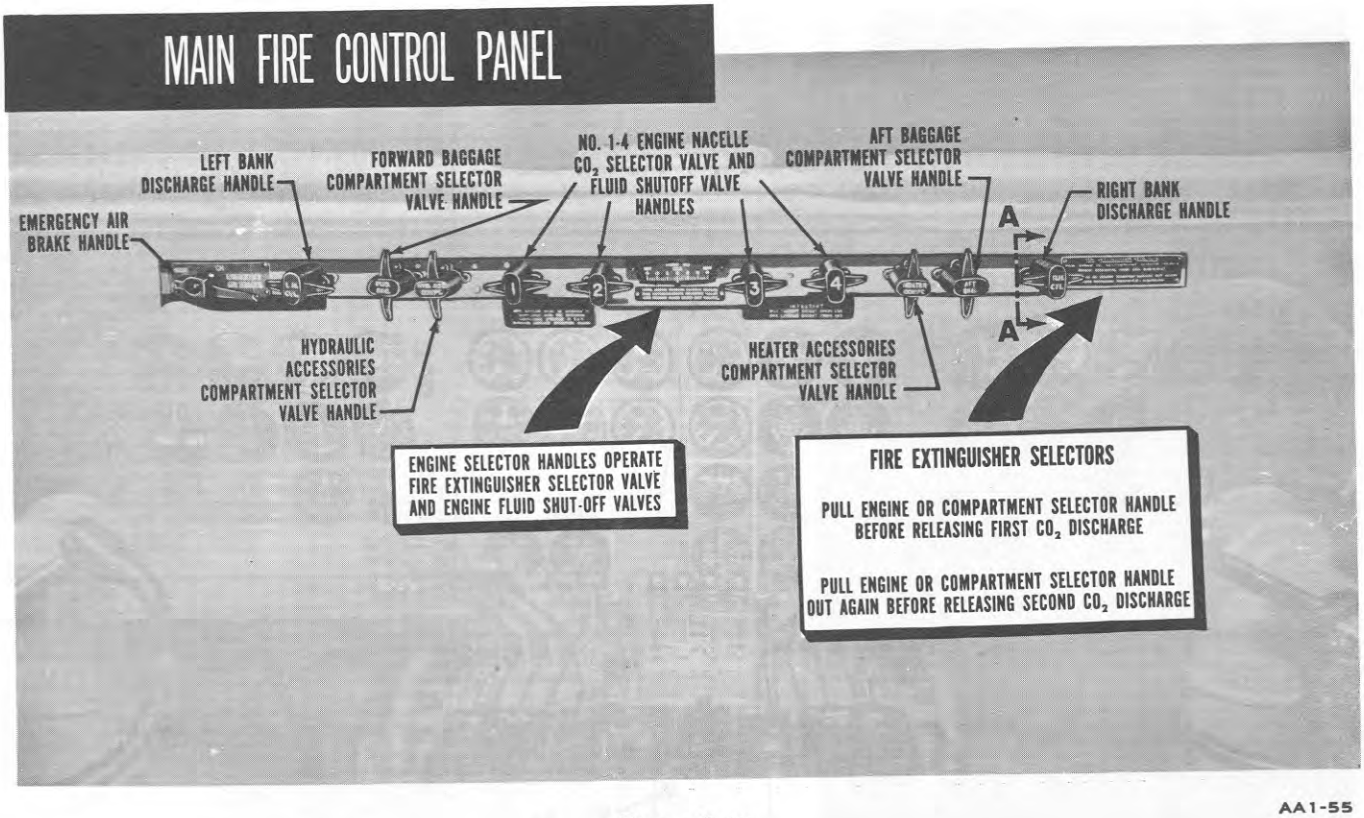


Figure 1-35

ward and aft of the firewall, and thermal switch fire detectors are located in the lower fuselage compartments. If a fire is detected in an area protected by CO_2, the light on the appropriate selector valve handle and the lights on both CO_2 discharge handles will illuminate. In the veent of a fire warning in Zone I of a nacelle, the light on the respective selector valve control handle will illuminate, but the lights on the discharge handles will not illuminate, since no CO_2 discharge is provided for Zone I.

Auxiliary Power Unit Fire Extinguishing System Indicator.

On AF51-3818 through AF51-3835, AF51-17626 through AF51-17660, AF51-17667, and AF51-17668, a dual red light is installed adjacent to the auxiliary power unit CO_2 discharge switch on the auxiliary power unit panel *(figure 4-28, sheet 2)* and will illuminate in the event of a fire warning in the auxiliary power unit.

On AF51-17661 and AF53-3223 through AF53-3305, a dual red warning light is installed on the heater fire control panel *(figure 4-11)*, and on the auxiliary power unit panel *(figure 4-28, sheets 3 and 4)*. The warning lights on both panels will illuminate to indicate a fire warning from the auxiliary power unit, or will illuminate when the respective test switch is depressed.

Firewall Shutoff Valves.

Fuel, oil, and hydraulic fluid (inboard nacelles only) emergency shutoff valves are mounted in the nacelle area to shut off the flow of fluids to the engine section. The valves are mechanically actuated by the respective engine fire extinguisher selector valve handles mounted on the main fire control panel *(figure 1-35)*.

CREW LIFERAFT.

One liferaft is provided for the flight crew and is stowed in the flight compartment *(12, figure 3-3)*.

CABIN LIFERAFTS.

A sufficient number of liferafts are stowed aboard the aircraft to accommodate the crew and all passengers.

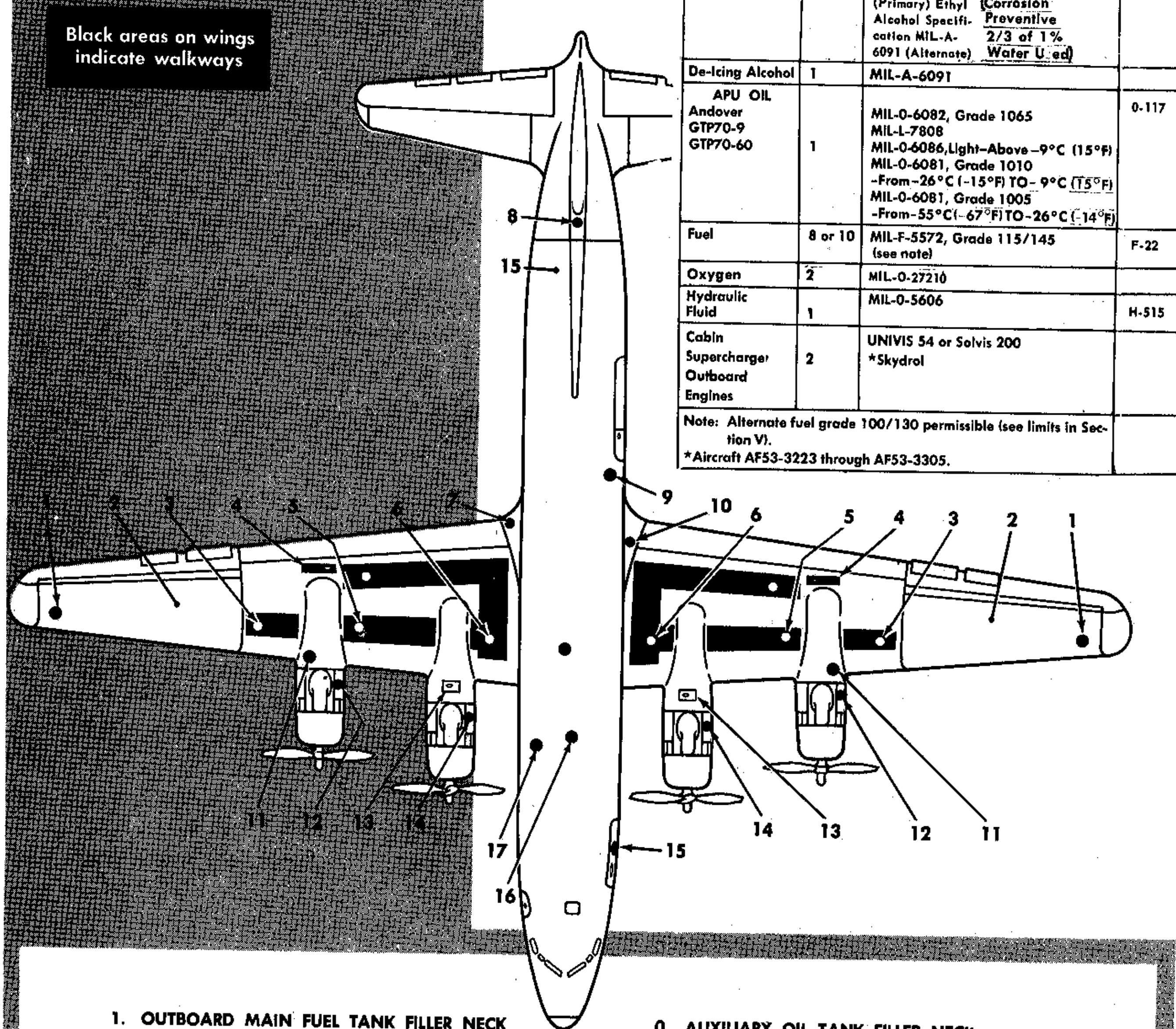
EMERGENCY RADIO TRANSMITTER.

An emergency sea rescue radio transmitter is stowed in the flight compartment *(11, figure 3-3)*.

ESCAPE ROPES.

Escape ropes *(3, figure 3-3)*, attached to the cabin structure above the emergency exits, are of sufficient length to provide safe contact with the ground.

SERVICING DIAGRAM



	NO. TANKS	FLUID SPECIFICATIONS	NATO SYMBOL
Engine Oil	4	MIL-0-6082, Grade 1065 Cold Weather MIL-0-6082, Grade 1100 Normal	0-117 0-117
Auxiliary Oil	1	MIL-0-6082 Diluted 50% with fuel	0-117
Water–Alcohol	4	Methyl Alcohol Specification 0-M-32, Grade A (Primary) Ethyl Alcohol Specification MIL-A-6091 (Alternate) — 50/50 Mixture (60/40 Mixture Below -40°C (-40°F)) (Corrosion Preventive 2/3 of 1% Water Used)	
De-Icing Alcohol	1	MIL-A-6091	
APU OIL Andover GTP70-9 GTP70-60	1	MIL-0-6082, Grade 1065 MIL-L-7808 MIL-0-6086, Light–Above –9°C (15°F) MIL-0-6081, Grade 1010 -From -26°C (-15°F) TO -9°C (15°F) MIL-0-6081, Grade 1005 -From -55°C (-67°F) TO -26°C (-14°F)	0-117
Fuel	8 or 10	MIL-F-5572, Grade 115/145 (see note)	F-22
Oxygen	2	MIL-0-27210	
Hydraulic Fluid	1	MIL-0-5606	H-515
Cabin Supercharger Outboard Engines	2	UNIVIS 54 or Solvis 200 *Skydrol	

Note: Alternate fuel grade 100/130 permissible (see limits in Section V).

*Aircraft AF53-3223 through AF53-3305.

1. OUTBOARD MAIN FUEL TANK FILLER NECK
2. FUEL TANK DIPSTICK STOWAGE
3. OUTBOARD ALTERNATE FUEL TANK FILLER NECK
4. OUTBOARD WATER-ALCOHOL TANK FILLER NECK
5. INBOARD MAIN FUEL TANK FILLER NECK
6. INBOARD ALTERNATE FUEL TANK FILLER NECK
7. ALCOHOL DE-ICING TANK FILLER NECK
8. GTPU-70 APU OIL FILLER NECK
9. OXYGEN FILLER VALVE
10. AUXILIARY OIL TANK FILLER NECK
11. CABIN SUPERCHARGER OIL TANK FILLER NECK
12. OUTBOARD ENGINE OIL TANK FILLER NECK
13. INBOARD WATER-ALCOHOL TANK FILLER NECK
14. INBOARD ENGINE OIL TANK FILLER NECK
15. WATER SUPPLY TANK FILLER VALVE
16. ANDOVER APU OIL FILLER NECK
17. HYDRAULIC RESERVOIR FILLER NECK

Figure 1-36

RETAINING HARNESS KITS.

Some aircraft are equipped with retaining harness kits to provide for the safety of personnel during emergency jettisoning. The kits are stowed in a container attached to the rear cargo door.

EMERGENCY ESCAPE HATCHES.

Five emergency escape hatches, two on the left side and three on the right side, are provided *(figure 3-6)*. The hatches are opened by means of handles located in the lower portion of each hatch and are operated from the inside or outside of the aircraft.

MISCELLANEOUS EMERGENCY EQUIPMENT.

Miscellaneous emergency equipment is shown in *(figure 3-3)* for C-118A and VC-118A aircraft.

SEATS.

Pilots' Seats.

The pilots' seats are installed on tracks and provide forward-and-aft and vertical adjustment as well as reclining adjustment. Each seat is equipped with a safety belt and shoulder harness attachment. The controls for seat adjustment are mounted on the outboard side of each seat and are conventional in operation. The seats are moved to the extreme rear position to facilitate entry.

Third Crew Member Seat.

An auxiliary seat, adjustable forward and aft, is provided for the use of a third crew member and is located aft of the control pedestal. When stowed, the seat folds against the side of the companionway. A safety belt is fastened to the seat.

AUXILIARY EQUIPMENT.

The following operational equipment is described in Section IV:

- Air Conditioning System
- Cabin Pressurization System
- Anti-Icing Systems
- Deicing Systems
- Communication and Associated Electronic Equipment
- Lighting Equipment
- Oxygen System
- Auxiliary Power Unit Navigation Equipment Autopilot
- Troop Carrying Equipment
- Passenger Carrying Equipment
- Cargo Loading Equipment
- Miscellaneous Equipment

SECTION II

normal procedures

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

BEFORE ENTERING THE AIRCRAFT.

FLIGHT RESTRICTIONS.

For flight restrictions on the aircraft, refer to Section V.

FLIGHT PLANNING.

Flight planning data, such as required fuel, airspeed, power settings, etc, necessary to complete the proposed mission, should be determined by using the operating data contained 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).* Check the takeoff and anticipated landing gross weights. Make certain that the weight and balance clearance (Form F) is satisfactory. A load adjuster is stowed in the flight compartment *(6, figure 1-3).* Make certain that the weight grades of fuel, oil, and special equipment carried are suited to the mission to be performed. Refer to Section V for weight limitations of the aircraft.

TAKEOFF AND LANDING DATA CARDS.

Takeoff and landing data cards are contained in the pilot's Abbreviated Flight Crew Checklists, T.O. 1C-118A-CL-1-1. Compute the takeoff and landing data cards as illustrated in the mission planning section of the Appendix.

CHECKLISTS.

Flight crew checklists are provided in both amplified and abbreviated form. The Flight Manual contains only the amplified checklists; the abbreviated checklists are issued as separate technical orders.

The checklists appearing hereafter will cover two categories:

(A) Mandatory Checklists--these cover phases of action that shall be performed in conjunction with direct reference to the appropriate checklist.

(B) Non-Mandatory Checklists--these cover phases of action which cannot be performed safely in conjunction with direct reference to a checklist. The flight crew is required to review these checklists before entering the indicated phase of action or to use them for cleanup purposes after an emergency procedure has been completed.

All checklists in Sections II and VIII are mandatory, with the exception of the takeoff and landing checklists.

The pilot is responsible for proper use of the checklists. Accomplishment of each item will be indicated by the proper response. Steps that require coordination between crew members are indicated by a circle around the sequence number and the letter, in parenthesis, following the action taken indicates the responsible crew member, (i.e. (P)). These will be completed by the challenge and reply method while all other steps will be completed silently by the crew engineer.

Whenever a checklist item is affected by climatic conditions or hours of darkness, CLIMATIC or AS REQUIRED will be indicated on the checklist for the usual action entry. During accomplishment of the checklist, the actual position of the unit may be stated in response.

INTERPHONE PROCEDURES AND PHRASEOLOGY.

To implement standard interphone procedures and phraseology, the following will be used during all ground and air operations.

Nomenclature: For purposes of identification of crew members, the following list is submitted:

A. Pilot: The occupant of the left seat in the cockpit regardless of his position on the crew.

B. Copilot: The occupant of the right seat in the cockpit regardless of his position on the crew. Frequently, during training, the instructor pilot or the student pilot will occupy the right seat; nevertheless, he will be referred to as copilot.

C. Crew engineer: The crew member seated aft of the control pedestal and between the pilots.

Identification: The crew member who is being called will be identified first, followed by the identification of the transmitter, for example, engineer from pilot.

Sequence: Pilots will always state the unit they desire to be actuated first, and then state what is to be done second, for example, gear up, flaps 20 degrees, rpm 2300, manifold two five, etc.

Terminology: The following will be stated as indicated to prevent ambiguous, confusing, or incomprehensive terminologies:

A. Rpm: Twenty-three fifty or two thousand.

B. Throttle setting: Manifold two two or manifold four five.

C. Flaps: Twenty degrees or full up.

Acknowledgement: Prior to execution, every command will be repeated by the receiver to insure proper understanding of the transmission. An exception to the above rule may be made during the final approach on a GCA letdown. Here, the pilot may direct the copilot not to acknowledge his commands to prevent interphone transmission from interfering with the controller's instructions. In this situation, if it is not certain what the command was, the copilot will momentarily press his mike button and state, "Say again." The pilot will then repeat his original transmission. After the original contact has been established, it is not necessary during subsequent transmissions to identify the crew member being called.

AIR CREW VISUAL INSPECTION.

Check Form 781 for status of the aircraft. It will be the responsibility of the pilot to insure that an interior and exterior visual inspection is completed. It will also be the responsibility of the pilot to insure that each crew member has accomplished his individual inspection requirement as outlined in Sections II and VIII (see figure 2-1 for suggested route to be followed).

Note

- The air crew visual inspection procedures described in this section are predicated on the assumption that maintenance personnel have completed all the requirements of the *Handbook of Inspection Requirements, 1C-118A-6* for Preflight or Thru Flight; 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.
- When the aircraft is flown in regularly scheduled airline type operations, or when assigned missions requiring intermediate stops, it is unnecessary for the flight crew to perform all the normal inspections enroute. Under these conditions only a portion of the normally required inspection checks is necessary for safe operation. Accordingly, for those instances when thru-flights will occur, only those items marked with an asterisk must be performed or accomplished. However, additional checks may be performed at the discretion of the flight crew.

PILOT'S PREFLIGHT CHECKLIST.

WARNING

As a preflight check, special attention should be given the altimeter to assure that the 10,000-foot pointer is reading correctly. It is possible for the correct reading to be set in the Kollsman window while the altimeter reading is 10,000 feet in error.

BEFORE EXTERIOR INSPECTION.

1. Form 781 — CHECKED.
2. Ignition switches — OFF.
3. Trim tabs — NEUTRAL.

EXTERIOR INSPECTION.

NOSEWHEEL WELL.

1. Radome — CHECK FOR CRACKS, DENTS, AND GENERAL CONDITION AND ALIGNMENT.
2. Pitot heads — CHECK THAT COVERS ARE REMOVED, GENERAL CONDITION, AND ALIGNMENT.
3. CO_2 discharge discs — RIGHT AND LEFT FOR CONDITION AND INSTALLATION (YELLOW: MANUAL DISCHARGE; RED: THERMAL DISCHARGE).
4. Static source intake holes — OPEN, NOT PLUGGED OR PAINTED OVER (RIGHT AND LEFT).
5. CO_2 bottles — TWO BANKS OF THREE BOTTLES EACH, ONE BANK ON EACH SIDE OF NOSEWHEEL WELL.
6. General condition — CHECK GENERAL CONDITION OF HYDRAULIC LINES, CABLES, DUCTING FOR WINDSHIELD AND RADOME HEATING, TIRE FRICTION BRAKE, WIRING, DOORS, AND ACTUATING STRUTS.
7. Gear uplatch — CHECK FOR PROPER UNLATCH POSITION, EVIDENCE OF DAMAGE, AND GENERAL CONDITION.
8. Nose gear — CHECK STRUT, TIRE WHEEL PLATE, CRACKS IN TORQUE LINK, AND NOSEWHEEL COLLAR. STRUT SHOULD BE EXTENDED 2 TO 10 INCHES. CHECK WHEEL FOR GENERAL CONDITION, AND TIRE FOR INFLATION AND SLIPPAGE; CHECK MICROSWITCH ON SCISSORS, GROUND STATIC WIRE, TAXI LIGHT FOR CLEANLINESS, AND GENERAL CONDITION OF NOSE GEAR.
9. Outside air temperature bulbs — CHECK FOR SECURENESS (LEFT AND RIGHT).

NOSE TO BELLY SCOOP.

1. Pressure dump door — CHECK GENERAL CONDITION AND PROPER POSITIONING.
2. APU air intake and exhaust port (if installed) — CHECK TO BE CLEAR OF OBSTRUCTION.
3. APU CO_2 discharge indicating discs (if installed) — CHECK FOR GENERAL CONDITION AND INSTALLATION.
4. Wing leading edge — CHECK FOR CRACKS, DENTS, OR HOLES.
5. Service access plates and inspection plates — CHECK TO BE SECURE AND FLUSH WITH FUSELAGE. FOR FUEL TANK DRAIN ACCESS PLATES TO BE CLOSED AND SECURED, IT IS NECESSARY THAT THE VALVE BE IN THE TANK TO SYSTEM POSITION DUE TO POSITIONING SAFETY DEVICE INSTALLED.
6. Fuselage skin and fairing — CHECK FOR CUTS, SCRATCHES, DAMAGE BY GROUND EQUIPMENT, AND EXCESSIVE STRESSES AND STRAINS AS INDICATED BY PULLED RIVETS OR OIL CANS; ALSO, CHECK FOR GENERAL CONDITION.
7. Belly scoop — CHECK FOR GENERAL CONDITION, DENTS, AND FREEDOM FROM OBSTRUCTION.

FUSELAGE TO RIGHT MAIN GEAR.

1. Fuel leaks — CHECK GENERAL APPEARANCE ALONG SPAR.
2. Wing drain holes — CHECK THAT ALL HOLES ARE UNPLUGGED.
3. Skin — CHECK FOR CUTS, SCRATCHES, EXCESSIVE STRAINS, DAMAGE BY GROUND EQUIPMENT, OIL CANNING, CORROSION, AND GENERAL CONDITION.
4. Pressure control valve opening — CHECK OPENING FOR FOREIGN MATTER AND DENTED OR BROKEN BAFFLE PLATES.
5. Main gear — CHECK STRUT FOR GENERAL CONDITION, OLEO EXPOSED A MINIMUM OF APPROXIMATELY 3 1/4 INCHES (FOUR FINGERS), FITTINGS FOR LEAKAGE, AND TIRES FOR GENERAL CONDITION AND SLIPPAGE. CHECK ACTUATING CYLINDERS, LINES, FITTINGS, AND LUGS FOR TIGHTNESS AND SECURENESS; CHECK MICROSWITCHES FOR GENERAL CONDITION AND BUNGEES AND CABLES FOR TAUTNESS AND EVIDENCE OF FRAYING.
6. Fuel drain chutes — CHECK TO BE RETRACTED AND FLUSH WITH NACELLE FAIRING; CHECK FOR EVIDENCE OF LEAKAGE AND GENERAL CONDITION.
7. No. 3 water-alcohol vent — CHECK TO BE CLEAR OF OBSTRUCTION.

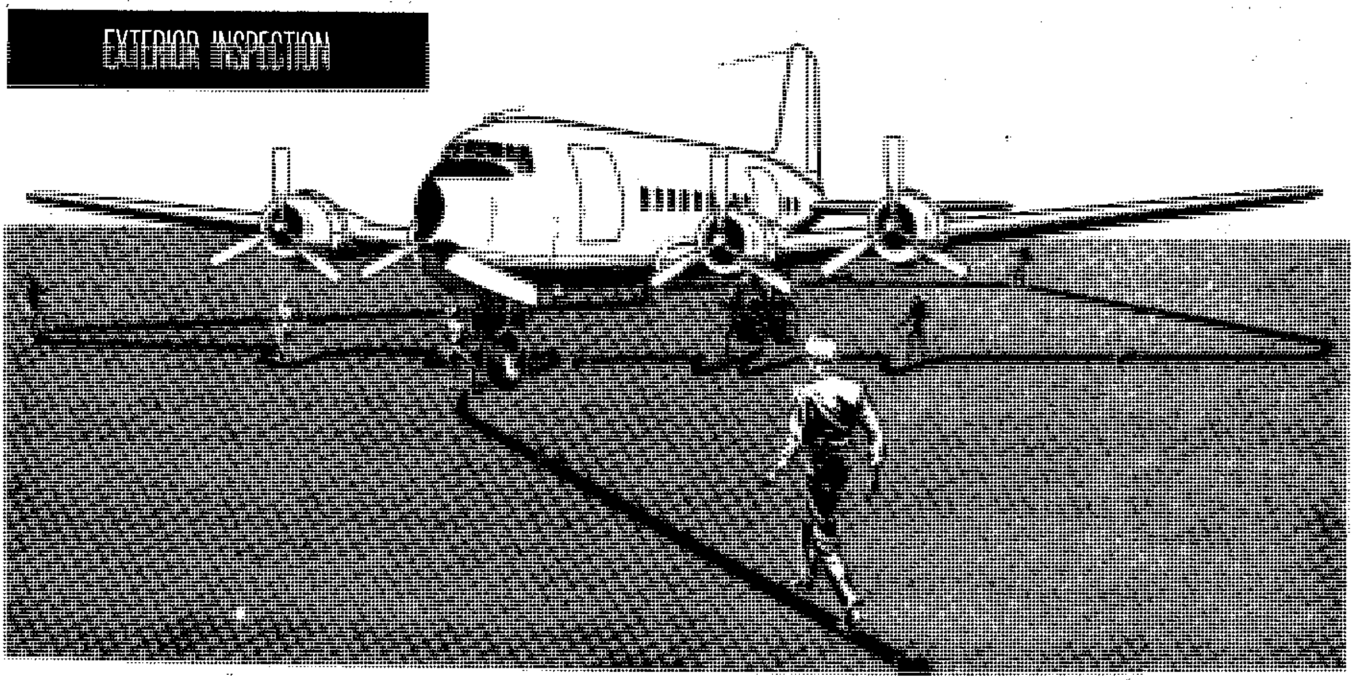


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Figure 2-1

INSIDE WHEEL WELL NO. 3 CHECK.

1. Parker drain valve, booster pumps, and tank selector valve - CHECK BULKHEAD PLATES FOR STRAINS AND GAS LEAKS, AND ALL VALVES, PUMPS, AND FUEL LINES FOR CONDITION AND LEAKAGE. CHECK VALVES FOR POSITION AND SAFETYING.
2. Wheel well area - CHECK GENERAL CONDITION OF EXPOSED WIRING, CONDUITS, FITTINGS, CABLES, PULLEY, TUBING, AND ACTUATING STRUTS AND SPARS FOR CRACKS.
3. Heater fuel selector valve - CHECK TO BE IN TANK SYSTEM POSITION AND SAFETIED.
4. Gear uplatch - CHECK FOR EVIDENCE OF STRAINING AND JAMMING AND THAT THE LATCH IS POSITIONED APPROXIMATELY 45 DEGREES FROM A VERTICAL LOCATION.
5. Water-alcohol tank - CHECK GENERAL CONDITION.
6. Water-alcohol pump and strainer - CHECK PUMP FOR PEELED PAINT OR CRACKED HOUSING, WHICH INDICATES A BURNED-OUT MOTOR. CHECK STRAINER FOR GENERAL CONDITION, SECURENESS, AND DRAIN VALVE TO BE CLOSED.
7. Water-alcohol drain valve - CHECK TO BE IN TANK TO SYSTEM POSITION AND SAFETIED.
8. Firewall shutoff valves - CHECK THAT VALVE IS CONNECTED WITH ACTUATING LINKAGE AND POSITIONED AT APPROXIMATELY 45 DEGREES TO THE HORIZONTAL POSITION.
9. Hydraulic dampener - CHECK FOR SECURENESS AND GENERAL CONDITION.
10. Heater fuel strainer drain valve - CHECK FOR LEAKAGE.

NO. 3 NACELLE CHECK.

1. Cowl flaps - CHECK FOR EXCESSIVE WEAR, BINDING, LOOSE OR BENT CONNECTING LINKS, LUBRICATION, AND GENERAL CONDITION.
2. Exhaust stacks and deflectors - CHECK EXHAUST BAFFLING, COLLECTOR RING, AND CLAMPS FOR INSTALLATION AND SECURENESS.
3. Intake stacks - CHECK FOR FUEL LEAKS.
4. Rear of engine - CHECK FOR LOOSE ARTICLES, RAGS, INDICATIONS OF LEAKS, AND FIRE DETECTORS ON DISHPAN.
5. Engine oil leaks - CHECK NACELLE AND GROUND UNDER THE ENGINE FOR OIL LEAKAGE.
6. Carburetor air and oil radiator airscoops - CHECK GENERAL CONDITION OF SCOOP COWLING, THAT NO FOREIGN MATTER IS IN THE SCOOP INTAKE AREAS, AND GENERATOR BLAST TUBE IS CLEAR AND UNOBSTRUCTED.
7. Cowling - CHECK THAT ALL CAM LOCKS ARE SECURE AND THAT COWLING FITS PROPERLY.

8. Front of engine – CHECK FOR LOOSE OR FRAYED IGNITION CABLES AND LEADS, FOREIGN MATTER, AND EXCESSIVE OIL LEAKS.

9. Prop anti-icer brush block – CHECK GENERAL CONDITION, SECURENESS, AND THAT THE BRUSH BLOCK IS BOLTED IN PLACE.

10. Propeller blades and dome – CHECK FOR BLADE LOOSENESS, PITTING, NICKS AND CRACKS, PROPELLER DOME FOR EXCESSIVE OIL LEAKS, DOME RETAINER NUT BE BE SAFETIED, AND FOR BURNED OR CHARRED AREA WHERE THE LEAD ENTERS THE BOOT. CHECK THE BLADE SWITCH LEADS FOR SECURENESS.

11. Nacelle condition – CHECK GENERAL CONDITION OF THE NACELLE SKIN.

BETWEEN NO. 3 AND NO. 4 NACELLE CHECK.

1. Leading edge – CHECK FOR CRACKS, DENTS, OR HOLES.

2. Supercharger and wing beater airscoop – CHECK FOR ANY FOREIGN MATTER.

3. Skin – CHECK GENERAL CONDITION, CRACKS, AND PULLED RIVETS.

4. Underside of wing – CHECK FOR FUEL LEAKS.

5. Landing light – THE LANDING LIGHT SHOULD BE FULLY RETRACTED, CLEAN AND UNDAMAGED, WITH SHIELD ON INBOARD SIDE.

NO. 4 NACELLE CHECK.

1. No. 4 nacelle – REPEAT INSPECTION GIVEN IN NO. 3 NACELLE CHECK.

2. Wing heater deicing exhaust – CHECK GENERAL CONDITION AND FOR ANY FOREIGN MATTER THAT MIGHT OBSTRUCT EXHAUST.

3. Supercharger access door – CHECK THAT THE SUPERCHARGER ACCESS DOOR IS SECURE AND THAT NO EXCESS OIL IS SEEPING FROM AROUND THE DOOR.

NO. 4 NACELLE TO RIGHT WING TIP CHECK.

1. Leading edge – CHECK FOR CRACKS, DENTS, OR HOLES.

2. Fuel tank vents and drains – CHECK FOR GENERAL CONDITION AND FREEDOM FROM OBSTRUCTION. (There is a filler neck drain for each fuel tank located on the underside of each wing. There is also a vent for each fuel tank. The vent for each outboard main tank is located near each wing tip, and the three other vents are grouped together outboard of the wing splice on the underside of each wing. The No. 4 water-alcohol tank vent also is located there.)

3. Underside of wing – CHECK FOR FUEL LEAKS, ESPECIALLY AROUND GROUND TANK INSPECTION PLATES.

4. Inspection doors and plates – CHECK ALL INSPECTION DOORS AND PLATES TO BE IN PLACE AND SECURE.

5. Skin – CHECK SKIN FOR GENERAL CONDITION AND EVIDENCE OF DAMAGE BY GROUND EQUIPMENT.

6. Airfoil hot air outlet – CHECK FOR GENERAL CONDITION AND FREEDOM FROM OBSTRUCTION.

TRAILING EDGE RIGHT WING CHECK.

1. Aileron – CHECK AILERON SURFACES FOR GENERAL CONDITION. CHECK THAT THE SIX STATIC DISCHARGE RIBBONS ARE IN PLACE AND IN GOOD CONDITION.

2. Tabs – CHECK POSITION AND CONDITION OF AERODYNAMIC TABS. CHECK GROUND ADJUSTABLE TRIM TAB ON RIGHT AILERON ONLY TO MAKE CERTAIN ALL SCREWS ARE TIGHT.

3. Flaps – CHECK FLAPS FOR POSITIONS AND FLAP SURFACES FOR GENERAL CONDITION AND WARPING. CLEARANCE BETWEEN FLAP AND AILERON IS APPROXIMATELY 1/2 INCH.

4. Inspection plates – CHECK PLATES TO BE IN PLACE AND SECURE.

RIGHT WING FILLET AND ROOT TO TAIL RIGHT SIDE CHECK.

1. Tail heater ram air intake – CHECK FOR FOREIGN MATTER.

2. Skin – CHECK FOR CONDITION AS BEFORE.

3. Escape hatches – CLOSED AND FLUSH.

4. Access plates – CHECK ACCESS PLATES IN WING FILLET FOR CLOSED POSITION AND FLUSH WITH SKIN OF FILLET.

5. Cabin pressure relief valves – CHECK VALVES FOR SECURENESS AND CONDITION.

TAIL CHECK.

1. Leading edges – CHECK FOR CRACKS, DENTS, OR HOLES.

2. Stabilizers, horizontal and vertical – CHECK FOR EVIDENCE OF STRAIN, PULLED RIVETS, ETC, AND GENERAL CONDITION.

3. APU – CHECK DOORS, AIR INTAKE, EXHAUST, AND CO_2 DISCHARGE INDICATOR; CHECK FOR INDICATIONS OF FUEL LEAKAGE.

4. Elevators and rudder – CHECK ELEVATORS FOR GENERAL CONDITION AND THAT STATIC DISCHARGE WICKS ARE IN PLACE. CHECK RUDDER FOR TEARS IN FABRIC AND GENERAL CONDITION.

5. Airfoil hot air outlets – CHECK GENERAL CONDITION AND FOR FOREIGN MATTER.

6. Tabs – CHECK AERODYNAMIC TABS AND TRIM TABS.

7. Tail skid – CHECK GENERAL CONDITION.

8. Tail heater ground blower intake – CHECK INTAKE FOR ANY FOREIGN MATTER.

9. CO_2 discharge indicator discs for tail heater – CHECK HEATER CO_2 DISC THE SAME AS THE OTHER DISCS.

10. Tail heater exhaust outlet – CHECK OUTLET FOR GENERAL CONDITION AND FREEDOM FROM OBSTRUCTION.

CABIN DOOR TO LEFT WING FILLET.

1. Skin – CHECK SKIN FOR GENERAL CONDITION AND EVIDENCE OF DAMAGE BY GROUND EQUIPMENT.

2. CO_2 discharge disc for cabin heater – CHECK DISCHARGE DISC AS BEFORE.

3. Cabin heater exhaust port – CHECK FOR GENERAL CONDITION AND FOREIGN MATTER.

4. Ground blower intake for cabin heater – CHECK FLAPPER DOOR FOR FREEDOM OF MOVEMENT AND GENERAL CONDITION.

5. Belly scoop air outlet – CHECK AIR OUTLET PORT FOR GENERAL CONDITION AND FOREIGN MATTER.

6. Inspection plates – CHECK ALL INSPECTION PLATES FOR SECURENESS.

LEFT WING CHECK.

1. Trailing edge – REPEAT ITEMS IN TRAILING EDGE, RIGHT WING CHECK, EXCEPT FOR GROUND ADJUSTABLE TAB.

2. Left wing tip to No. 1 nacelle check – REPEAT ITEMS IN NO. 4 NACELLE TO RIGHT WING TIP CHECK.

3. No. 1 nacelle check – REPEAT ITEMS IN NO. 4 NACELLE CHECK.

4. Between No. 1 and No. 2 nacelle check – REPEAT ITEMS IN BETWEEN NO. 3 AND NO. 4 NACELLE CHECK.

5. No. 2 nacelle check – REPEAT ITEMS IN NO. 3 NACELLE CHECK.

6. No. 2 wheel well check – REPEAT ITEMS IN INSIDE WHEEL NO. 3 CHECK.

7. Wing section – REPEAT ITEMS IN FUSELAGE TO NO. 3 ENGINE CHECK. CHECK CABIN HEATER COMBUSTION AIR INTAKE FOR CONDITION AND FOREIGN MATTER.

BETWEEN LEFT WING ROOT AND FORWARD CARGO DOOR CHECK.

1. Fuselage skin and fairing – CHECK SKIN AND FAIRING FOR CUTS, SCRATCHES, AND DAMAGE BY GROUND EQUIPMENT. CHECK FOR EXCESSIVE STRESSES, INDICATED BY PULLED RIVETS OR OIL CANS.

FORWARD CARGO DOOR TO NOSEWHEEL.

1. Skin – CHECK SKIN FOR SCRATCHES, CUTS, OR DAMAGE BY GROUND EQUIPMENT.

CREW ENGINEER'S PREFLIGHT CHECKLIST.

The crew engineer will perform a complete preflight inspection prior to departure and determine whether the condition of the aircraft is satisfactory for the mission.

PRE-INSPECTION.

*1. Wheels--CHOCKED.

*2. Gear Safety Pins--INSTALLED.

*3. Ground Power Unit--PROPERLY POSITIONED (NOT CONNECTED).

4. Ladder and Fire Bottle--AVAILABLE.

5. Batteries--LOWERED (AT LEAST ONE WHEN EXTERNAL POWER IS TO BE USED).

6. Oil Drain Cans--DRAINED.

*7. Form 781--CHECKED.

*8. Circuit breakers--AS REQUIRED.

*9. Ignition switches--OFF.

10. Engine Selector switch--OFF.

11. Propeller deicing switch--CHECKED AND OFF.

12. Master switch--OFF.

13. Batteries-UP..

•14. Emergency Inverter --CHECKED AND OFF. (With the emergency inverter operating and the warning lights out, check main panel white lights, check the voltage with the A-C voltmeter and the selector switch in the following positions:)

a. FLT. INST. PHASE C - 115 (±3) volts.

b. FLT. INST. PHASE B - 115 (+15,-3) volts.

On aircraft modified in accordance with T.O. 1C-118A-628:

a. FLT. INST. PHASE A - 115 (± 3) volts.

b. FLT. INST. PHASE C - 115 (±3) volts.

c. Frequency - 380-420 cycles

d. Emergency Inverter - OFF.

15. Master switch - ON.
Place Battery switch to ground power position and check that ground power indicator light is on.

16. Pitot heat - CHECKED; THEN OFF.

•17. APU (when utilized) — ON.
Place battery switch to GROUND POWER position and check that ground power indicator light is on.

Note

If ground power indicator light is not monitored while exterior preflight is being completed, one battery should be lowered.

18. GTP70 (when utilized) — ON.
Place battery switch to PLANE BATTERY position; start GTP70 and place GTP 70 generator switches ON.

•19. Bus voltage — CHECKED, 26 TO 29 VOLTS.

20. Emergency pump and hydraulic pressure — CHECKED.

21. Wing flaps — SET FOR EXTERIOR INSPECTION, PRESSURE RELIEVED.

•22. Oxygen system — CHECKED 100%.
Check oxygen regulators, pressure, and masks; set regulator on 100%.

23. Trim tabs — CHECKED 5 DEGREES TRAVEL, THEN NEUTRAL.

24. Carburetor air doors — CHECKED FOR OPERATION.

25. Oil coolers — CHECK OPERATION; SET OPEN FOR EXTERIOR INSPECTION.

26. Cowl flap — CHECK OPERATION; SET OPEN.

•27. Inverters and instrument switches — CHECKED.

a. On aircraft equipped with a standby inverter, proceed as follows:

(1) Radar inverter — NORMAL.

(2) Radio-electric inverter — STANDBY.

(3) Instrument switch — STANDBY.

(4) With the inverter warning lights out, check voltage with the a-c voltmeter and selector switch in the following positions:

(a) 115 ELECT. & RADIO INVERT. — 115 (±3) volts.

(b) FLT. INST. PHASE C — 115 (±3) volts.

(c) ENG. INST. 26 — 26 (±0) volts.

(d) FLT. INST. PHASE B — 115 (+15, −3) volts.

(e) 115 RADAR INVERTER — 115 (±3) volts.

(f) Check frequency (AF51-3818 through 51-3835 and AF53-3223 through 53-3305) — 380 to 420 cycles per second on both 115 ELECT. & RADIO INVERT. and 115 RADAR INVERTER positions.

(5) Radar inverter — STANDBY.

(6) Radio-electric inverter — NORMAL.

(7) Instrument switch — NORMAL.

(8) Repeat procedures for step (4) in reverse order.

(9) Radar inverter — NORMAL.

b. On aircraft not equipped with standby inverter, proceed as follows:

(1) Inverter and instrument switch — ALTERNATE.

(2) With the inverter warning light out, check voltages with the selector switch in the 115 UPPER INVERTER position. Check a-c voltage output for 115 (±3) volts.

(3) With the selector switch ENG. INST. 26 position, check for a rise from zero on the voltmeter (26 volts).

(4) Inverter and instrument switch – NORMAL.

(5) Repeat steps (2) and (3).

c. On aircraft modified in accordance with T.O. 1C-118A-628, proceed as follows:

(1) Radar inverter – NORMAL.

(2) Radio-electric inverter – STANDBY.

(3) Instrument switch – STANDBY.

(4) With the inverter warning lights out, check voltage output with the a-c voltmeter and selector switch in the following positions:

(a) RADIO ELEC. FLT. INV. 115V. – 115 (±3) volts.

(b) PH. A – 115 (±3) volts.

(c) PH. C – 115 (±3) volts.

(d) ENG. INST. 26V. – 26 (±0) volts.

(e) RADAR INV. 115V—115 (±3) volts.

(f) PH. A—115 (±3) volts.

(g) PH. C—115 (±3) volts.

(h) Check frequency – 380 TO 420 CYCLES PER SECOND ON BOTH RADIO ELEC. FLT. INV. 115V. AND RADAR INV. 115V. POSITIONS.

(5) Radar inverter—STANDBY.

(6) Radio-electric inverter—NORMAL.

(7) Instrument switch—NORMAL.

(8) Repeat procedures for step (4) in reverse order.

(9) Radar inverter—NORMAL.

*28. Booster pumps—ON.
Pressure check fuel system, leaving all booster pumps operating, all tank selector levers to MAIN ON, and crossfeed selector levers positioned to ALL ENG. TO CROSSFEED.

29. Directional indicators, RMI's, and standby compass—CHECKED.
Place the pilot's S-2 compass switch in the FREE GYRO position. Hold manual knob to the increase and decrease position and check the S-2 compass heading changes accordingly. Return toggle switch to SLAVED GYRO position (check that navigator's S-2 compass indicates the same as pilot's S-2 compass). Repeat this procedure on the copilot's S-2 compass or G-2 compass on aircraft AF51-17626, thru AF51-17668. Cross reference all RMI cards, heading selector, and S-2 compasses to read the same as the B-16 standby compass and that the B-16 agrees with the heading of the parked aircraft.

*30. Inverters—OFF.

31. Landing lights—**CHECKED.**
Check landing lights for operation; retract, and turn off.

32. Windshield alcohol—**CHECKED.**
Check windshield alcohol for proper operation, then turn off.

33. External lights—**CHECKED.**
Check external lights for operation, then turn off.

Note

Use of the anticollision light on the ground should be kept to an absolute minimum. Excessive heat created is detrimental to bulb life. During ground emergencies the light could cause possible confusion with emergency vehicles having a similar light.

*34. Fuel quantity – **CHECKED.**
Use dipstick to check quantity of fuel. Check tank caps and covers for security. When refueling is completed, all fuel sump drains must be drained, drain valve in proper position, and covers secured. Secure dipstick.

*35. Oil quantity – **CHECKED.**
Visually check all oil tanks for proper quantity. Check filler caps and covers for security.

*36. Water-alcohol quantity – **CHECKED.**
Visually check quantity. Check filler cap and cover for security.

37. Auxiliary oil quantity – **CHECKED.**
Check oil quantity. Check filler cap and cover for security.

38. Top of wing and fuselage areas – **CHECKED.**
Check top of wing and fuselage area skin for damage, corrosion, and general condition. Inspect wing illumination light for cleanliness and general condition.

EXTERIOR INSPECTION.

NOSEWHEEL WELL.

1. Downlock mirror – CHECK FOR CLEANLINESS.

2. Pitot tubes and static ports – CHECK ALIGNMENT OF PITOT TUBES AND COVERS REMOVED. DRAIN BOTH SYSTEMS AND CHECK VALVES TO BE CLOSED. STATIC PORTS SHOULD BE UNOBSTRUCTED.

3. CO_2 bottles and discharge discs – CHECK SECURENESS AND INSPECTION DATE. CHECK DISCHARGE DISCS NOT RUPTURED.

4. Antiskid brake accumulator – CHECK FOR PROPER PRESSURE WITHIN LIMITS.

5. Gear uplatch – CHECK FOR PROPER POSITION AND EVIDENCE OF DAMAGE.

*6. Nose gear – CHECK STRUT (MINIMUM EXTENSION OF 2 INCHES AT MAXIMUM GROSS LOADING), TIRE WHEEL PLATE FOR CRACKS IN TORQUE LINKS, SAFETY PIN ENGAGED AND SEATED, AND NOSEWHEEL COLLAR. CHECK WHEEL FOR GENERAL CONDITION AND TIRE FOR INFLATION AND SLIPPAGE. CHECK MICROSWITCHES ON SCISSORS, FOLLOWUP CABLES, GROUND STATIC WIRE, TAXI LIGHT FOR CLEANLINESS AND SECURENESS.

*7. General condition – CHECK HYDRAULIC LINES, CABLES, DUCTING FOR RADOME HEATING, TIRE FRICTION BRAKE, WIRING, AND DOORS.

NOSE TO BELLY SCOOP.

1. Nosewheel steering valve – CHECK FOR HYDRAULIC LEAKS, SECURENESS OF CABLES, AND SNUBBING PRESSURE WITHIN LIMITS.

2. Battery compartments – CHECK FOR EVIDENCE OF SPILLED ACID, SECURENESS, CORROSION, AND GENERAL CONDITION.

3. Crew compartment door – CHECK GENERAL CONDITION OF DOOR SEALS.

4. Forward baggage compartment – CHECK APU WEBBING AND HOUSING (IF INSTALLED) TO BE IN PLACE AND SECURED. CHECK GENERAL CONDITION OF COMPARTMENT DOOR AND SEALS. AFTER INSPECTION, LIGHTS SHOULD BE OUT AND COMPARTMENT DOOR SECURED.

5. APU CO_2 discharge discs (if installed) – CHECK DISCS NOT RUPTURED.

6. Hydraulic compartment – CHECK ACCUMULATOR PRESSURE, FLUID LEVEL, AND FOR EVIDENCE OF LEAKS. CHECK CABLES, FLAP CONTROL VALVE, AND GENERAL CONDITION OF COMPARTMENT. AFTER INSPECTION, LIGHTS SHOULD BE OUT AND COMPARTMENT SECURED.

7. Belly scoop – CHECK FOR GENERAL CONDITION, DENTS AND FOREIGN MATTER.

BELLY SCOOP TO RIGHT MAIN GEAR.

*1. Main gear – CHECK TIRES FOR GENERAL CONDITION AND SLIPPAGE; HYDRAULIC AND AIR LINES FOR SECURENESS, LEAKS AND FRAYING; MICROSWITCHES AND STRUT EXPOSURE (MINIMUM 3 1/4 INCHES). CHECK GENERAL CONDITION OF STRUT, DEBOOSTER EXTENSION (MINIMUM 2 1/2 INCHES WITH MAXIMUM SEPARATION OF 1/2 INCH) ACTUATING CYLINDERS, AND LINES, FITTINGS, AND LUGS FOR SECURENESS. CHECK BUNGEE CABLES FOR TAUTNESS AND EVIDENCE OF FRAYING.

2. Fuel dump chute – CHECK TO BE RETRACTED AND FLUSH WITH NACELLE FAIRING. CHECK FOR EVIDENCE OF LEAKING AND GENERAL CONDITION.

3. No. 3 water-alcohol tank vent – CHECK TO BE UNOBSTRUCTED AND NO EVIDENCE OF FUEL IN WATER-ALCOHOL TANKS.

INSIDE WHEEL WELL NO. 3 CHECK.

*1. Parker drain valve, booster pumps, and tank selector – CHECK DRAIN VALVE POSITION AND SAFETY. CHECK BULKHEAD PLATES FOR STRAINS AND FUEL LEAKS. CHECK PUMPS AND FUEL LINES FOR CONDITION AND LEAKAGE.

*2. Wheel well area – CHECK GENERAL CONDITION OF EXPOSED WIRING, CONDUITS, FITTINGS, CABLES, PULLEYS, TUBING, AND SPARS.

3. Heater fuel selector valve (if installed) – CHECK TO BE IN TANK TO SYSTEM POSITION AND SAFETIED.

4. Gear up latch – CHECK FOR EVIDENCE OF STRAINING AND JAMMING, AND THAT THE LATCH IS POSITIONED APPROXIMATELY 45 DEGREES FROM VERTICAL.

5. Electrical junction box – CHECK COVERS TO BE IN PLACE AND SECURED AND FOR EVIDENCE OF BURNING THAT WOULD INDICATE SHORTING CIRCUITS.

6. Water-alcohol pump and strainer – CHECK PUMP FOR PEELED PAINT OR CRACKED HOUSING WHICH INDICATES A BURNED-OUT MOTOR. CHECK STRAINER FOR GENERAL CONDITION, SECURENESS, AND DRAIN VALVES TO BE CLOSED.

7. Water-alcohol drain valve – CHECK TO BE IN TANK TO SYSTEM POSITION AND SAFETIED.

8. Firewall shutoff valves – CHECK THAT VALVE IS CONNECTED WITH ACTUATING LINKAGE AND POSITIONED APPROXIMATELY 45 DEGREES TO THE HORIZONTAL POSITION.

9. Hydraulic dampener – CHECK FOR SECURENESS AND GENERAL CONDITION.

*10. Heater fuel strainer drain valve – CHECK FOR LEAKAGE.

NO. 3 ENGINE, PROPELLER AND NACELLE.

*1. Cowl flaps – CHECK FOR EXCESSIVE WEAR, BINDING, LOOSE OR BENT CONNECTING, LINKS, BONDING, LUBRICATION, AND GENERAL CONDITION.

*2. Exhaust stacks – CHECK EXHAUST BAFFLING COLLECTOR RING AND CLAMPS FOR INSTALLATION AND SECURENESS.

*3. Intake pipes – CHECK FOR FUEL LEAKS.

*4. Rear of engines – CHECK FOR LOOSE ARTICLES, RAGS, INDICATIONS OF LEAKS AND SECURENESS OF FIRE DETECTORS OR DISHPAN.

5. Engine oil leaks – CHECK NACELLE FOR OIL LEAKAGE.

6. Carburetor air and oil radiator airscoops – CHECK FOR GENERAL CONDITION OF SCOOP COWLING, FOREIGN MATTER IN SCOOP INTAKE AREA, AND BLAST TUBE INTAKE UNOBSTRUCTED.

*7. Cowling – CHECK THAT ALL QUICK-RELEASE FASTENERS ARE SECURE AND THAT COWLING FITS PROPERLY (APPROXIMATELY 1/2-INCH SEPARATION; IF OVER 3/4-INCH SEPARATION; CHECK FOR POSITIVE LOCK).

*8. Front of engine – CHECK GENERAL CONDITION OF BMEP TRANSMITTER, DISTRIBUTORS, MAGNETO, AND PROPELLER GOVERNOR. CHECK FOR LOOSE OR FRAYED IGNITION CABLES, FOREIGN MATTER AND EXCESSIVE OIL LEAKS.

9. Propeller deicer brush block – CHECK GENERAL CONDITION AND SECURENESS.

10. Propeller blades and dome – CHECK FOR BLADE LOOSENESS, PITTING, NICKS AND CRACKS; PROPELLER DOME FOR EXCESSIVE OIL LEAKS, DOME RETAINER NUT TO BE SAFETIED, AND FOR BURNED OR CHARRED AREA WHERE THE LEAD ENTERS THE BOOT. CHECK CONDITION AND SECURENESS OF DEICER BOOT. CHECK THE LEADS TO THE BLADE SWITCHES.

11. Nacelle condition – CHECK GENERAL CONDITION OF THE NACELLE.

BETWEEN NO. 3 AND NO. 4 NACELLES.

1. Leading edge – CHECK FOR CRACKS, DENTS OR HOLES.

2. Supercharger and wing heater airscoop – CHECK FOR ANY FOREIGN MATTER.

3. Skin – CHECK FOR GENERAL CONDITION, CRACKS AND PULLED RIVETS.

*4. Fuel leaks – CHECK UNDERSIDE OF WING FOR FUEL LEAKS.

5. Landing lights – THE LANDING LIGHT SHOULD BE FULLY RETRACTED, CLEAN, AND UNDAMAGED.

NO. 4 ENGINE, PROPELLER AND NACELLE.

*1. Repeat inspection given for No. 3 engine, propeller and nacelle.

2. Supercharger – CHECK SUPERCHARGER FOR GENERAL CONDITION AND EVIDENCE OF OIL LEAKS. CHECK GENERAL CONDITION AND INTERIOR OF NACELLE.

3. Fuel dump chute – CHECK TO BE RETRACTED AND FLUSH WITH NACELLE FAIRING. CHECK FOR EVIDENCE OF LEAKAGE AND GENERAL CONDITION.

OUTER WING PANEL.

*1. Fuel leaks – CHECK UNDERSIDE OF WING FOR FUEL LEAKS, ESPECIALLY AROUND GROUND TANK INSPECTION PLATES. CHECK FUEL TANK VENTS AND DRAINS AND NO. 4 WATER-ALCOHOL TANK VENT.

2. Skin – CHECK THE LEADING EDGE OF THE WING FOR CRACKS, DENTS, OR HOLES. CHECK

THE GENERAL CONDITION OF THE SKIN, AND ALL INSPECTION DOORS, PLATES, AND AIRFOIL VENTILATING AIR EXHAUST.

3. Navigation lights – CHECK FOR GENERAL CONDITION AND OPERATION (STEADY AND/OR FLASH).

WING TRAILING EDGE.

1. Flaps – CHECK FLAP SURFACES FOR GENERAL CONDITION, POPPED RIVETS, AND WARPING. CLEARANCE BETWEEN FLAP AND AILERON IS APPROXIMATELY 1/2 INCH.

RIGHT WING FILLET TO EMPENNAGE.

1. Alcohol gage, pressure filler neck and access door – CHECK ALCOHOL QUANTITY AND FILLER VALVE IN OFF POSITION AND DRAIN VALVE TANK TO SYSTEM. CHECK PUMP FOR EVIDENCE OF BURNED-OUT MOTOR. ACCESS DOOR SECURE.
2. Heater compartment – CHECK COMPARTMENT FOR CONDITION AND SECURENESS OF UNITS. WHEN FINISHED, TURN OUT COMPARTMENT LIGHT. COMPARTMENT DOOR SECURE.
3. Aft baggage compartment – CHECK GENERAL CONDITION OF COMPARTMENT AREA, DOOR AND SEALS. WHEN FINISHED, TURN OUT COMPARTMENT LIGHT. COMPARTMENT DOOR SECURE.
4. Ground heater hose inlet and access door – CHECK GENERAL CONDITION. ACCESS DOOR SECURE.
5. Water service panel – CHECK THAT THE FILLER VALVE IS IN THE OFF POSITION, AND THAT THE CAP IS ON THE VENT LINE AND LOCKED. ACCESS DOOR SECURE.

EMPENNAGE SECTION.

1. Tail compartment access door – CHECK SECURENESS OF TAIL COMPARTMENT ACCESS DOOR.
2. Emergency relief valves – CHECK GENERAL CONDITION AND PROPER SEATING OF EMERGENCY RELIEF VALVES.
3. Tail skin – CHECK GENERAL CONDITION OF TAIL SKIN.
4. APU air intake, exhaust port and CO_2 discharge discs (if installed) – CHECK FOR FOREIGN MATTER AT APU AIR INTAKE DOOR, EVIDENCE OF BURNED THROUGH EXHAUST DUCT OR CRACKED EXHAUST DUCT, AND CO_2 DISCHARGE DISCS NOT RUPTURED.
5. Skin – CHECK THE LEADING EDGES FOR CRACKS, DENTS, OR HOLES. CHECK THE GENERAL CONDITION OF THE SKIN.
6. Tail lights and tail cone – CHECK TAIL LIGHTS FOR CONDITION AND OPERATION (FLASH AND/OR STEADY). CHECK TAIL CONE FOR GENERAL CONDITION, SECURENESS, AND STATIC DISCHARGE WICK IN PLACE.

EMPENNAGE TO LEFT WING FILLET.

1. Lavatory service panel (if installed) – CHECK SECURENESS OF LAVATORY SERVICE PANEL ACCESS.
2. Cabin and cargo doors (outside) – CHECK GENERAL CONDITION OF DOORS, SEALS, AND PRESSURIZATION WARNING LIGHTS.
3. Auxiliary oil transfer lines – CHECK FOR SECURENESS AND EVIDENCE OF LEAKS. ACCESS DOOR SECURE.
4. Ground blower intake and CO_2 discharge discs for cabin heater – CHECK FLAPPER DOOR FOR FREEDOM OF MOVEMENT AND DISCHARGE DISCS NOT RUPTURED.
5. Belly scoop air outlet – CHECK AIR OUTLET PORT FOR GENERAL CONDITION AND FOREIGN MATTER.

*6. Radio antennas – CHECK ALL ANTENNAS FOR MOUNTING AND CONDITION.

LEFT WING INSPECTION.

*1. The left wing inspection is identical to the complete right wing inspection, with two exceptions. Check the wing flap position indicator for general condition; check the cabin heater combustion air intake for general condition and foreign matter.

LEFT WING TO NOSE.

1. Skin – CHECK SKIN FOR SCRATCHES, CUTS, OR DAMAGE BY GROUND EQUIPMENT.
2. Forward cargo door – CHECK GENERAL CONDITION OF DOOR AND THAT PRESSURIZATION WARNING LIGHTS ARE NOT OBSCURED.

INTERIOR INSPECTION.

Note

The interior inspection will be performed by the pilot, copilot, or the crew engineer.

MAIN CARGO COMPARTMENT OR PASSENGER CABIN.

1. Cargo compartment lights — CHECK THE ENTRANCE LIGHTS (BRIGHT AND DIM)' IMPACT LIGHTS, AND PILOT'S CALL BY OPERATING THE SWITCHES ON THE LEFT SIDE FORWARD OF THE MAIN ENTRANCE DOORS. CHECK PRESSURIZATION LIGHTS AND MAKE CERTAIN THEY ARE NOT PAINTED OVER OR OBSTRUCTED.

2. Pressure dome access plate — IN PLACE AND SECURE.

3. Water filler valve — OFF.

4. Hand fire extinguishers — CHECK DATE OF INSPECTION (TO BE WITHIN 6 MONTHS) AND SAFETYWIRE ON THE TWO HAND FIRE EXTINGUISHERS, ONE ON THE LEFT SIDE FORWARD OF THE MAIN CABIN DOOR AND ONE ON THE RIGHT SIDE OF COMPARTMENT M.

5. Aft cargo door — CHECK CARGO DOOR CRANK TO BE STOWED ADJACENT TO THE CABIN DOOR EMERGENCY RELEASE HANDLE. CHECK DOOR LATCHES AND SAFETY LATCH TO BE ENGAGED. MAKE CERTAIN THAT SAFETY PIN IS INSTALLED AND SECURE. CHECK OPERATION OF EMERGENCY HYDRAULIC PUMP BY ACTUATING THE CARGO DOOR CONTROL SWITCH. INSPECT CARGO DOOR ACTUATING CYLINDER AND LINES FOR EVIDENCE OF HYDRAULIC LEAKS.

6. Cabin door emergency releases and hinges — INSPECT THE EMERGENCY DOOR HINGES RELEASE HANDLE TO BE DOWN AND SECURE. TRANSPARENT PLASTIC COVERING MUST BE IN PLACE AND UNBROKEN. STENCILING ON PLASTIC COVER MUST BE LEGIBLE. INSPECT THE DOOR RELEASE CABLES FOR SIGNS OF FRAYING (CABLES ARE VISIBLE AT EACH DOOR HINGE WHEN DOOR IS OPEN).

7. Escape chute — INSTALLED.

8. Emergency exits — CHECK THE EMERGENCY ESCAPE HATCHES (TWO ON THE LEFT SIDE AND THREE ON THE RIGHT SIDE) FOR SECURENESS. HANDLES SHOULD BE HORIZONTAL AND SAFETIED. EMERGENCY ESCAPE HATCHES ARE FOR EMERGENCY USE ONLY AND SHALL NOT BE USED FOR ANY OTHER PURPOSE.

9. Thermister — CHECK THAT THE THERMISTER VENT, LOCATED ON THE RIGHT SIDE, FORWARD AND ABOVE THE CENTER EMERGENCY EXIT, IS CLEAR. EXTREME CARE MUST BE TAKEN TO KEEP THE THERMISTER CLEAR OF OBSTRUCTION WHEN CARGO IS LOADED ON THE RIGHT SIDE OR WHEN THE SIDE LUGGAGE NETS ARE INSTALLED.

10. Fire (hand) ax — STOWED.

CREW COMPARTMENT CHECK.

1. Forward cargo door latches are engaged, that safety latch is engaged, and that safety pin with securing wire is installed and secure. Check the cargo door actuating cylinder and lines for evidence of hydraulic leakage.

2. Emergency escape ladder — CHECK THAT THE COLLAPSIBLE EMERGENCY ESCAPE LADDER IS INSTALLED AND SECURE.

3. Fire ax — CHECK THAT A FIRE AX IS INSTALLED AND SECURE.

4. Portable oxygen bottles — CHECK THE PRESSURE ON THE PORTABLE OXYGEN BOTTLES. CHECK THAT THEY ARE SECURELY MOUNTED.

5. Lights — CHECK OPERATION OF PASSENGER CABIN LIGHTS AND CARGO DOOR ENTRANCE LIGHTS BY ACTUATING SWITCH FORWARD OF THE CARGO DOOR. CHECK OPERATION OF BELLY COMPARTMENT LIGHTS BY OPERATING THE LIGHT SWITCH ON THE FORWARD BULKHEAD OF THE CREW LAVATORY (AMBER LIGHT ADJACENT TO THE SWITCH INDICATES PROPER OPERATION).

6. Fire extinguishers — CHECK DATE OF INSPECTION (TO BE WITHIN 6 MONTHS) AND SAFETYING OF THE FORWARD FIRE EXTINGUISHERS. THREE FIRE EXTINGUISHERS ARE LOCATED IN THE CREW COMPARTMENT.

*7. Circuit breakers — CHECK THAT ALL CIRCUIT BREAKERS ON THE MAIN CIRCUIT BREAKER PANEL ARE SET. CHECK ALL CIRCUIT BREAKERS AND FUSES ON THE RADIO RACK CIRCUIT BREAKER PANEL. CHECK ALL FUSES IN A-C FUSE PANEL.

8. Anticipator bulb desiccators — CHECK THE ANTICIPATOR BULB DESICCATORS ABOVE THE CREW COMPARTMENT DOOR (IF INSTALLED) FOR DISCOLORATION.

9. Compartment viewer — CHECK THAT THE COMPARTMENT VIEWER IS CLEAN AND STOWED IN ITS CONTAINER.

10. Curtains – CHECK THAT NIGHT FLYING CURTAINS ARE INSTALLED.

11. Aldis lamp (if installed) – CHECK THAT THE LAMP IS ABOARD AND OPERATIVE.

12. Oxygen and smoke masks – CHECK MASKS FOR CLEANLINESS. AN OXYGEN MASK MUST BE INSTALLED FOR EACH CREW MEMBER. CHECK OXYGEN SYSTEM PRESSURE TO BE 400 (+25, –0) PSI.

13. Crew call – CHECK BY PUSHING CREW CALL BUTTONS ON OVERHEAD INSTRUMENT PANEL.

*14. Windshield and windows – MAKE SURE THAT ALL WINDOWS AND WINDSHIELDS ARE CLEAN.

*15. General condition of compartment – ASSURE THAT THE COMPARTMENT IS NEAT AND ORDERLY, EARPHONES AND MICROPHONES ARE IN PLACE, CHECKLIST IN PLACE, AND TOOL BOX ABOARD.

PRE-COCKPIT CHECK—CREW ENGINEER'S

The following check will be performed by crew engineer before the pilot comes aboard.

1. Propeller de-icers – OFF.
2. Pitot heaters – OFF.
3. Battery switch – AS REQUIRED.
4. All warning lights – CHECKED.
5. Emergency air pressure – 1000 (±50) PSI.
6. Oxygen system -CHECKED ON 100% OXYGEN MASKS INSTALLED.
7. Inverter circuit breakers – ON.
8. Tachometer isolation switch – NORMAL.
9. Emergency propeller deicers – OFF.
10. Oil transfer – OFF.
11. Oil coolers – AUTOMATIC.
12. Cowl flap switches – POSITIONING.
13. Water-alcohol – OFF.
14. Booster pump circuit breakers – ON.
15. Booster pumps – OFF.
16. Navigation, cockpit, and seat belt – NO SMOKING lights – SET.
17. Ignition switches – OFF.
18. Engine selector – OFF.
19. Generators – ON.
20. Cockpit temperature – SET.
21. Windshield heat – SET.
22. Radome anti-icing – OFF.
23. Fire warning – TESTED.
24. Wing heater CO_2 selector – LEFT BANK.
25. Heater control panel – SET.
26. Landing lights – SET
27. Blowers – LOW.
28. Turbine switch – OFF.
29. Cabin temperature control – SET.
30. Emergency cabin altitude control – SET.
31. Cabin superchargers – SET.
32. Firewall selectors – IN.
33. Emergency air brakes – SAFETIED OFF.
34. Static selectors – NORMAL.
35. Fuel selectors – MAINS.
36. Crossfeeds – OFF.
37. Propeller master lever and engine selector switch – FORWARD AND ON NO. 3.
38. Throttles – SET.
39. Mixtures – IDLE CUTOFF.
40. Gear lever – DOWN.
41. Gear safety solenoid – VISUALLY CHECKED.
42. Trim tabs – CHECKED AND SET.
43. Carburetor air doors – CHECKED AND OPEN.
44. Wing flap lever – UP.
45. Passenger briefing - COMPLETED.

BEFORE STARTING ENGINES.

Note

Use of the anticollision light on the ground should be kept to an absolute minimum for reasons of shortened light bulb life and possible confusion with emergency vehicles having a similar light.

1. Pre-cockpit check — COMPLETED.
2. Master switch — ON. (P)
3. APU — ON.
4. Bus voltage — 26-29 VOLTS.
5. Emergency inverter — CHECKED, THEN OFF.
6. Inverter and instrument switches — NORMAL.
   a. On aircraft with a standby inverter, place both inverter switches and the instrument switch in the NORMAL position. Check inverter voltages and cycles.
   b. On aircraft not equipped with a standby inverter, place the inverter and instrument switches in the NORMAL position. Check voltage and cycles.
7. Circuit breakers — AS REQUIRED.
8. VHF and UHF radio — ON. (CP)
9. Emergency hydraulic pump and pressure — CHECKED. (CP)
10. Parking brakes — SET. (P)
11. Gear safety pins — REMOVED. (P)
12. Hydraulic bypass lever — DOWN. (ON).
13. Hydraulic selector — BRAKES.
14. Quantity gages — CHECKED.
15. Cowl flaps — OPEN. (P-CP)
16. Cabin pressure controls — AS REQUIRED. (CP)
17. Manifold pressure — CHECKED. (P)
18. Directional indicator — SET. (P-CP)
19. Autopilot — SET; THEN OFF. (P)
20. Servos — DISENGAGED.
21. Gear safety pins — ABOARD.
22. Anti-skid brakes — OFF. (P)
23. IFF/SIF — STANDBY. (P-N)

STARTING ENGINES.

The following procedure shall be rigidly adhered to in the operation of the aircraft.

1. Door warning lights — OUT. (P)
2. Chocks — IN PLACE. (P-CP)
3. Ground power unit — POSITIONED. (P)
   The pilot will insure that the ground power unit is properly positioned.
4. Fire guard — POSTED. (P-CP)
   The pilot or copilot will visually check to insure that propellers and adjacent areas are clear of personnel and obstacles, and states "Fire guard posted No. 3; start No. 3." (4-2-1).
5. Start engines — START (P). Upon the pilot's command "Start No. ——, the crew engineer. places applicable booster pump to LOW, engine selector switch to engine being started and states "Turning No.——." He then depresses safety and start switches, checking voltage drop. If voltage is less than 24 volts, he turns inverter switches OFF and advises pilot. Crew responsibilities are as follows:
   a. Pilot and copilot will inform crew engineer of propeller rotation by counting nine blades (3, 6, 9) while watching for evidence of hydraulic locks (rotation also pre-oils engine).

   Note

   When the engines have been operating within the previous 6 hours, they may be started after 6 blades.

   b. Upon count of "nine blades" the crew engineer will place the ignition switch to BOTH, hold ignition boost switch to ON, and prime as required.
   c. After engine fires, crew engineer will continue constant priming until 800 to 1000 rpm is stabilized with throttle. He then moves mixture control lever to AUTO RICH and releases the primer switch at the initial drop of rpm.
   d. Copilot will monitor throttle to maintain 800 to 900 rpm for warm-up.
   e. If inverter was turned OFF in step 4, crew engineer will place inverter switch to ON position.
   f. After engine is started, crew engineer will call, "Booster pump off; oil pressure, fuel pressure, and hydraulic pressure checked." For outboard engines he will also call "Supercharger oil pressure and airflow checked".
   g. Repeat steps 3 through 5f for starting engines No. 4, 2, and 1.

CAUTION

If fire occurs during engine start, follow the procedure outlined under Engine Fire on the Ground, Section III.

h. After all engines are started, complete the Before Taxiing Check.

CAUTION

Allow starter to cool at least 1 minute before second attempt. If engine fails to start on second attempt, allow 5 minutes for cooling.

Note

- Maximum cranking time during engine start is 1 minute.
- If oil pressure does not rise within 30 seconds after engine start, shut down engine and investigate.
- Cowl flaps will normally be in the full open position during ground operation.
- Aircraft batteries may be used for emergency starting only. Maximum cranking time when using the aircraft batteries is 30 seconds. Turn off all unnecessary electrical equipment before attempting a battery start. When engine starts, its generator must be operating properly before attempting to start another engine.
- If necessary to eliminate condensation in the manifold pressure lines, depress each purge valve for 30 seconds with manifold pressure less than field barometric pressure.

CAUTION

Do not exceed 100 rpm maximum until oil temperature reaches 40° C and supercharger oil temperature reaches 15° C. However, 1200 rpm may be used to leave the blocks before these temperatures are reached, if oil pressure of each engine does not exceed 100 psi and power in excess of 1000 rpm will not be required during taxiing.

BEFORE TAXIING CHECK.

1. Starter selector — OFF.
2. External power — DISCONNECTED (GTP70 on line)* (P)
3. Battery switch — PLANE BATTERY.
4. Radios and radio altimeters — ON. (P-CP)
5. Hydraulic pressure — CHECKED. (CP)
6. Door warning lights — OFF. (P)
7. Engine analyzer — ON.
8. Cabin report — SECURE.
   A male crew member will check the cabin as follows immediately after the main door is closed:
   a. Passenger door and crew door handles — Straight up against internal stops.
   b. Door latch indices — Aligned with guide marks.
   c. Cargo doors — Closed, locked, and safety pins installed.
   d. Emergency window exit handles — Horizontal and safetied.

   Note

   If after the above check, a warning light is on, the cause of the warning must be definitely established as a warning system malfunction. If the cause of the warning is not established, the aircraft must be returned to maintenance.

   e. Passengers — SECURED.
9. Altimeter setting — SET. (P-CP-N)

TAXIING.

Normal taxiing is accomplished with all operating engines set at 800 to 900 rpm, depending upon generator requirements. Turn by use of nosewheel steering (*figure 2-2*). Use full flaps and as little power as necessary when moving away from the ramp to avoid dusting personnel and equipment. Avoid high taxiing speeds and excessive movement of the nosewheel. Begin a turn with a slight change in direction of the nosewheel and gradually increase it until the desired rate of turn is established. Use the same technique to straighten out the turn. The rolling inertia of the aircraft resists turning which may cause sidewise skipping and skidding of the nosewheel, especially when the surface is slick. In this case, and only in this case, may outboard engines be used in turning. Avoid sharp turns at high speeds. Sudden acceleration or deceleration of engines should be avoided to prevent backfiring, which imposes severe stress on engines and mounts. Always stop the aircraft with the nosewheel straight; otherwise, severe side loads and strain will be placed on the nosewheel tire and strut during engine runup. In stopping, depress the brake pedal, and, as the aircraft slows, gradually release brake pressure so that when the aircraft stops very little pressure is being applied to the pedals. Make certain the aircraft has stopped prior to setting the parking brakes. Use caution at all times while taxiing to avoid accidents. Monitor hydraulic pressure.

Note

- During ground operation in high gust conditions with control-surface locks on, any tendency of the control wheel to move may be resisted by holding the wheel in neutral. Restraint should not be applied by holding the wheel against the stops.

Note

- When operating on airfields at high altitude, or during prolonged periods of ground operation; it is permissible to use mixture settings leaner than AUTO RICH.

TAXIING CHECK.

During taxiing, the following items should be checked for operation as described:

1. Brakes — CHECKED. (P)
   Check brakes as soon as practical after the aircraft starts to roll.
2. Fuel selectors and crossfeeds — CHECKED AND SET FOR TAKEOFF.
   The crew engineer will perform a complete check of the alternate tanks and crossfeed systems during taxiing. The following steps will be accomplished:

   Note

   A minimum of 1 minute will be used for each step.

   a. Alternate tank selector levers — ALT ON.

   b. Crossfeed selector levers — ENG. 1-2 and ENG. 3-4.
   Place No. 2 and No. 3 alternate selector levers to OFF.

   c. Place crossfeed levers to ALL ENG. TO CROSSFEED and to No. 4 alternate selector lever to OFF. When check is completed, return all selector levers to MAIN ON and crossfeed levers to OFF.
3. Flight instruments — CHECKED. (P-CP-N)
   While taxiing, the pilot, copilot, and navigator will observe the directional indicators for operation and the attitude indicators for erection. They also will check the needle deflection of the turn-and-slip indicators in both right and left turns.

ENGINE RUNUP.

The pilot parks the aircraft into the wind with the nosewheel centered and calls for the Engine Runup checklist.

*1. Parking brakes — Set. (P)
Pilot will set parking brakes and call for 800 rpm on all engines. Copilot will position throttles to 800 rpm and crew engineer will set APU as required.

Note

- If the propeller reversing system was checked during the engine runup by maintenance personnel, as is the normal procedure, it is not necessary for the pilot to repeat the procedure. At en route stops, it is not necessary to check the system if reversing was used during landing. During the propeller reversing check, the aircraft should be on a clean hard surface.
- If the propeller reversing check is made during engine runup, it should not be performed until the engine oil temperature is at least 40°C to avoid imposing a severe load on the propeller system.

*2. Wing flaps — 20 DEGREES. (CP)
Copilot will set wing flaps to 20 degrees.

*3. Temperatures and pressures — CHECKED.
Crew engineer will check all temperatures and pressures within operating limits.

*4. Mixtures — AUTO RICH.

*5. Engines — 1500 RPM. (P-CP)
Pilot and copilot advance all throttles to 1500 rpm.

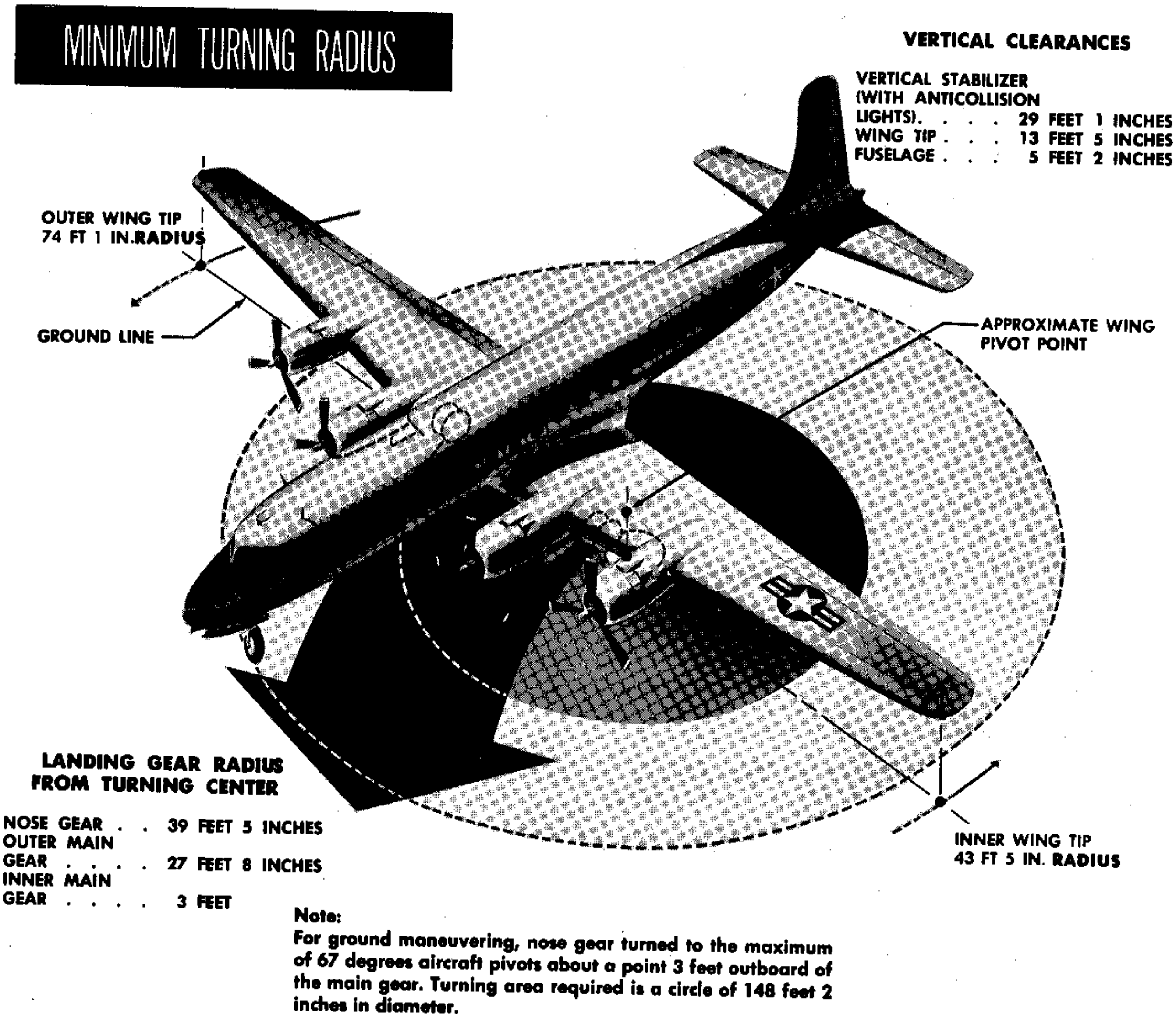


Figure 2-2

6. Heaters and deicers—CHECKED.
   Use the following procedure to check heaters and deicer:

   a. Heater fuel crossfeed—NORMAL SYSTEM.

   b. Heater fuel and ignition selector switch—SYSTEM #2.

   c. Heater ignition selector switches—CHECK (SINGLE IGNITION).

   d. Master heater switch—ON.

   e. Fuel pressure and temperature— CHECK FOR RISE.

   f. Master heater switch—OFF.

   g. Heater fuel and ignition selector switches—SYSTEM #1.
   (Wait 30 seconds before turning master heater switch to ON).

   h. Master heater switch—ON.

   i. Fuel pressure and temperature— CHECK FOR RISE.

Note

For airflow and cabin heater operation, the No. 2, 3, and 4 engines (No. 2 and 3 for cabin, and No. 2 and 4 for airfoil) must be operating at an rpm above generator cut-in speed. This will provide the required ram air and electrical power for these systems. The cabin heater any be operated by ground power.

j. Master heater switch — OFF.

CAUTION

Prolonged ground checking of airfoil heaters can cause a tail heater fire warning indication after heater is turned off. This is due to residual heat in heater and lack of purging air from ground blower. If the tail heater warning light illuminates after a heater check, turn off the 5-ampere tail heater circuit breaker on the main junction box and turn the airfoil heater switch to ON. This will cut off fuel and ignition to the tail heater and will permit continued ground blower operation. If the warning light goes out within 10 seconds, turn master heater switch to OFF and visually inspect tail heater for possible damage. If warning light remains illuminated, execute emergency procedures for tail heater fire and record in Form 781.

k. Heater ignition selector switches — NORMAL (DUAL IGNITION).

The propeller deicing switch should be turned to ON and the propeller deicing ammeter checked for a 20-second cycle for each propeller. The switch should then be placed in the OFF position. The desired amperage during this check is 180 to 200 amperes. A reading below 150 or above 225 amperes indicates a malfunction and requires that the equipment be throughly checked by maintenance personnel.

Note

If anti-icing equipment was used during the previous flight without the crew changing or if the equipment was checked at point of departure, a ground check at en route stops is not required.

7. **Propellers — CHECKED AND ON NO. 3. (P)**
Pilot will check propellers as follows:

a. Place master engine selector switch in the MANUAL position; toggle propeller switches to DECREASE RPM and hold until 1200 (±50) rpm is reached and the limit lights illuminate.

b. Move propeller selector switches to INCREASE RPM until the limit lights illuminate.

c. With the master engine selector switch in No. 2 position, pull the master rpm control levers to the full DEC position and wait until 1200 (±50) rpm is reached and the limit lights illuminate.

d. Places the master engine selector switch in No. 3 position, and push master rpm control lever to the full INC position; make certain that 1500 rpm is reached and the limit lights illuminate.

8. Generators — **CHECKED. (CP)**
Copilot will check generator bus voltage while pilot is checking propellers. Voltage should be 27.5 to 28.5 volts with GTP70 generators off. Amperage readings should be steady and within 10 percent of the average load and in no case should the difference between highest and lowest reading be greater than 30 amperes. (It is only necessary to rotate the generator selector switch to determine which generator circuit is malfunctioning in the event of unbalanced amperage draw).

*9. Propeller feathering — **CHECKED. (P-CP)**
Copilot will push in No. 4 propeller feathering button and then pull button out after noting drop of 200 to 300 rpm; repeat procedure for No. 3 engine. After copilot has checked No. 3 engine, pilot will push in No. 2 feathering button and pull out after noting drop of 200 to 300 rpm; repeat procedure for No. 1 engine.

Note

If rpm increases and then decreases (or remains constant), the propeller was (or is) in reverse pitch.

10. Throttles — **FIELD BAROMETRIC. (P)**
Pilot will advance throttles one at a time to field barometric pressure, normally beginning with No. 1 engine; check for an rpm of approximately 2070 to 2170 and a fuel flow of 600 (±50) pounds per hour.

Note

- A fuel flow which is lower or higher than the normal rate of flow may be observed because of changes in temperature, humidity, pressure, and field elevation.

- Crew engineer will make engine analyzer check for all engines, beginning check as soon as a steady picture is indicated; and run through each engine left and right, on fast sweep to check for any ignition malfunction. When plug fouling is suspected, use technique described in Controlled Spark Plug Anti-fouling Procedures, Section VII.

- Two engines may be run up simultaneously at the pilot's discretion.

11. Blowers — CHECKED, AND ON LOW. (CP)
Upon orders from pilot for blower check, copilot shifts blower to HIGH and checks manifold pressure and bmep fluctuations; copilot will then shift blower to LOW and notes opposite indications.

12. Magnetos — CHECKED. (P)
After blowers are checked, pilot will call out, "Checking mags". Pilot individually positions the ignition switches to BOTH to R to BOTH, and BOTH to L to BOTH. Normal drop of each magneto is 50 to 75 rpm and should not exceed 100 rpm nor a maximum difference of 40 rpm between the left and right magnetos. The normal bmep drop is 6 bmep, and the maximum is 12 bmep. Crew engineer will perform grounding and ignition performance check as follows:

a. Cycle switch on slow sweep.

b. Condition switch on left magneto No. 1 engine.

c. Pilot will check engine No. 1 by placing ignition switch to R. Crew engineer checks for grounded magneto side and switches to B position in order to check for normal ignition pattern. Crew engineer will then call, "Checked".

d. Pilot places ignition switch to BOTH.

e. Pilot will continue checking engine No. 1 by positioning ignition switch to L. Crew engineer checks B position for normal ignition pattern and switches to R, checking for grounded magneto side. Crew engineer will then call, "Checked".

13. Water-alcohol — AS REQUIRED (P). When planning a wet takeoff the pilot will turn on the ADI pump switches and check that the ADI warning lights go off, fuel flow drops approximately 100 pounds and ADI pressure is 27-32 psi. After the ADI check, the co-pilot returns throttles to 800 rpm and the crew engineer monitors engines to maintain 800 rpm.

Note

A visual inspection should be made for any leakage of fluids, excessive vibrations, and general condition of the engines.

After the ADI check, the copilot returns throttles to 800 rpm and the crew engineer monitors engines to maintain 800 rpm.

*14. Booster pumps — LOW
Crew engineer will place main booster pump switches in LOW position.

*15. Trim tabs — SET. (P)
Pilot will adjust trim tabs for takeoff.

*16. Radios - SET. (P)
Copilot sets radios as directed.

17. APU GTP70 — AS REQUIRED. (P)

*18. Safety belt and shoulder harness — FASTENED. (P-CP-E)

*19. Flight instruments — CHECKED. (P-CP-N)

*20. Crew briefing — COMPLETE. (P-CP-E)
Copilot and crew engineer acknowledge understanding of crew briefing.

Note

Prior to starting engines, the crew should be briefed on performance and clearance data. Any deviations from normal procedure should be clearly defined.

*21. Anticollision light — ON.

*22. Windows — CLOSED AND LOCKED. (P-CP)

Note

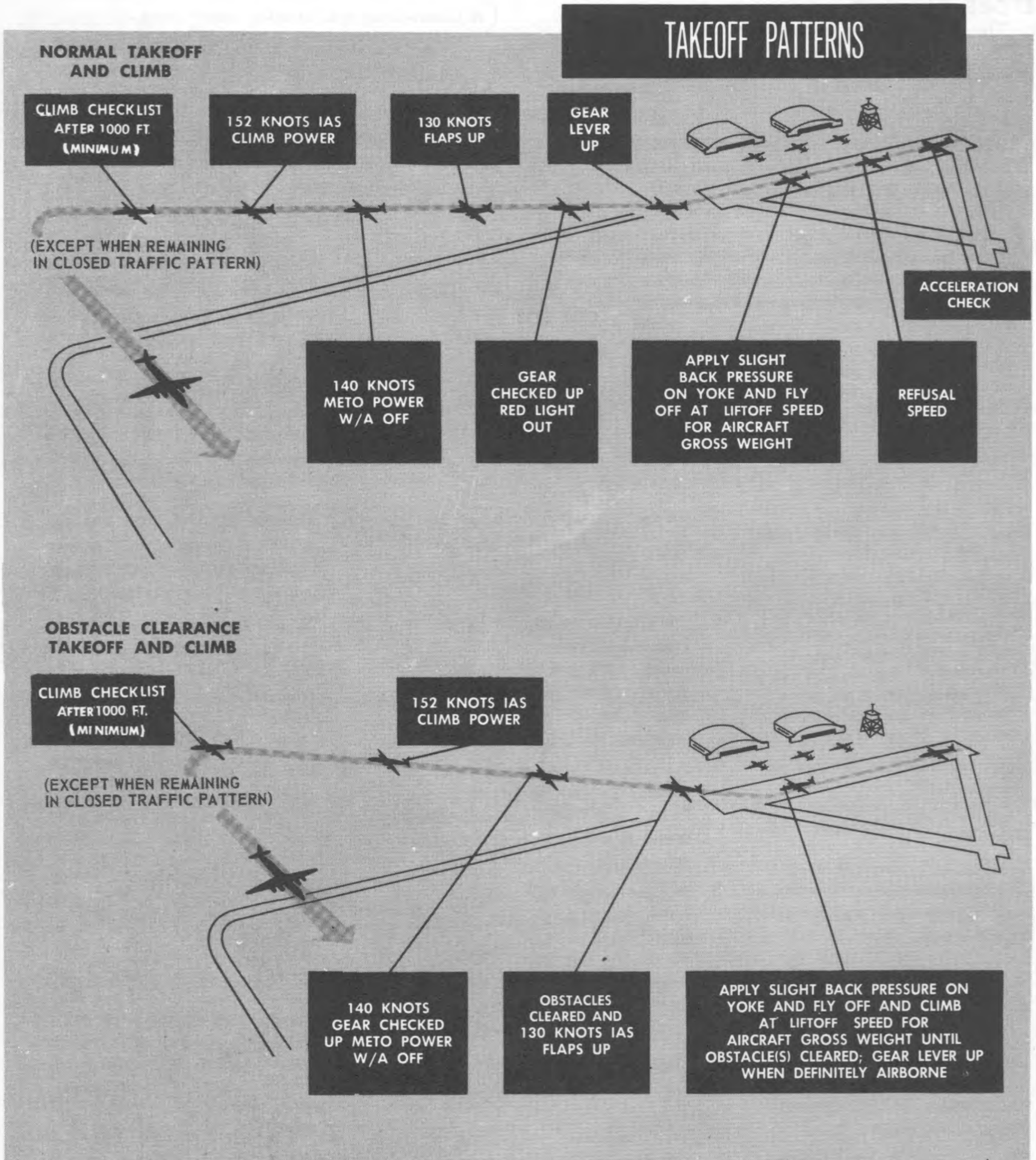
*On training flights and thru flights after first complete engine runup, only those items marked by an asterisk need be accomplished. Items 5 and 9 may be deleted if reversing was not used after landing.

BEFORE TAKEOFF.

1. Controls – UNLOCKED AND FREE. (P)
Pilot will check all controls for proper travel and freedom of movement.
2. Mixtures – AUTO RICH AND LOCKED. (P)
Pilot will check that mixture control levers are in AUTO RICH position.
3. Anti-icing and deicing equipment – CLIMATIC (P)
4. Antiskid – ON. (P)
5. Cowl flaps – THREE DEGREES. (P).
6. IFF – SET. (P)

TAKEOFF.

PILOT	***COPILOT***	***CREW ENGINEER***
A. Calls for Before Takeoff checklist.	A. Monitors Before Takeoff checklist.	A. Reads checklists and reports completion of Before Takeoff checklist.
B. Advances throttles and monitors with right hand (*figure 2-3*).	B. Steadies control column, starts elapsed time clock when takeoff roll begins.	B. Follows up on throttles and adjusts to maximum power. Observes power indications and other engine instruments.
C. Releases steering wheel at 90 knots and transfers left hand to the control column. Pilot makes decision to take-off or abort based on information from copilot or crew engineer (*figure 2-3*).	C. Monitors acceleration by use of copilot's airspeed. If airspeed is satisfactory at acceleration check point, remain silent. If acceleration is below designated tolerance he calls, "Reject."	C. Monitors power indication and engine instruments and calls "Reject" when an unacceptable condition is observed.
D. Flies aircraft off runway at liftoff speed.	D. At refusal speed, calls "GO" if refusal is below liftoff speed. Calls "LIFTOFF" when liftoff speed is reached on copilot's instruments.	D. Monitors power indications.
E. When safely airborne, calls out, "Gear up," and gives visual signal.	E. Acknowledges and actuates gear lever, stating, "Gear coming up."	E. Monitors engine instruments. When gear is up states, "Gear up, light out."
At 130 knots with positive climb established, calls, "Flaps up."	F. Acknowledges and actuates flap lever stating, "Flaps coming up."	F. Monitors engine instruments.
G. At 140 knots with gear retracted and red light out, calls out, "METO power, water-alcohol off."	G. Monitors flight instruments.	G. Acknowledges and establishes METO power. Turns water-alcohol off.
H. At 152 knots, orders "Climb power" (1400 or 1500 brake horsepower).	H. Monitors flight instruments.	H. Acknowledges and establishes climb power from appropriate performance chart.
I. Climbs at 152 knots and after reaching 1000 feet above field elevation, calls for After Takeoff Climb checklist. (1000 feet minimum except when remaining in closed traffic pattern)	I. Scans outside area for other aircraft and completes radio communications as required.	I. Completes After Takeoff Climb checklist. States, "After Takeoff Climb checklist completed."



Note: This pattern is designed to provide:

(a) More rapid rate of climb after becoming airborne.

(b) Altitude and stability to preclude possible settling at low altitudes.

(c) Less changing of attitude at low altitudes during night operations from airfields where, after becoming airborne, there are few or no visual reference lights.

Figure 2-3

PRECAUTIONS.

A. The term maximum power is used to indicate the maximum allowable power settings under standard conditions, which are as follows: wet, 62 inches manifold pressure and 253 bmep; dry, 60 inches manifold pressure and 222 bmep. At temperatures above standard, reference should be made to the Wet Takeoff Bmep at Various Conditions of Temperature and Humidity (Appendix) to correct for vapor pressure by increasing manifold pressure to a maximum of 63.4 inches. At temperatures below standard, the limiting value of bmep may be attained prior to the limiting manifold pressure; therefore, when temperatures are below standard, proceed as follows:

Note

Manifold pressure or bmep, whichever is reached first, will be the governing factor in establishing maximum power.

Note

The CAT. expected at takeoff is arrived at by adding 5° to OAT. (or, preferably, to the runway temperature, if available) to compensate for the rise in CAT. due to ram effect during the takeoff run.

B. The copilot will crosscheck flight instruments, including magnetic compass, on all night and instrument takeoffs and during climb under these conditions. He will report immediately any failure or suspected malfunction of flight instruments, particularly the pilot's instruments.

C. In the event of a refused takeoff, crew members will assume the following duties:

a. The decision to abort any takeoff will be made by the pilot.

b. The pilot will handle the throttles.

c. The crew engineer will release the throttle lock and arm the reverse bar upon the pilot's command, Reverse.

d. The copilot will hold forward pressure on the yoke.

D. Acceleration speed and refusal speed are defined as follows:

a. Acceleration speed is the minimum acceptable speed at the acceleration check point.

b. Refusal speed is the maximum speed to which the aircraft can accelerate and then stop in the available runway length.

E. The minimum takeoff speed is the faster of either 1.15 times the stall speed in the takeoff configuration or 1.1 times the minimum control speed in the air.

F. On the initial takeoff, the left hand should be on the steering wheel until the rudder becomes effective (at approximately 60 knots), at which time directional control should be maintained with the rudder. After passing 90 knots IAS, the left hand should be shifted to the yoke and a slight back pressure may be applied to lighten the load on the nosewheel. When it reaches the takeoff speed, the aircraft should be flown off the ground by a smooth application of back pressure on the yoke.

G. If obstacle clearance is necessary immediately after takeoff, climb at takeoff speed until obstacles are cleared (gear up, flaps 20 degrees).

H. In case of an aborted takeoff, the following procedure is recommended:

a. Retard all throttles.

b. Apply braking and reverse thrust as necessary.

Note

With dry runway, reversing three engines is permissible. With slick or icy runways, reverse symmetrically.

MAXIMUM DECELERATION.

A. Banking and turning tendencies encountered at the instant of engine failure in normal thrust become opposite in direction as soon as reverse thrust is applied. These tendencies may be controlled by the application of rudder and aileron, by the use of nosewheel steering, and by the amount of symmetrical or asymmetrical reverse thrust applied.

B. During an aborted takeoff or a three-engine landing, before using reverse thrust, first obtain positive directional and lateral control of the aircraft. Next, apply symmetrical reverse thrust by simultaneously reversing opposite inboard or outboard engines. The third engine may be reversed as soon as speed has decreased below normal landing speed. As soon as corrective control action has been taken to compensate for symmetrical reverse thrust, power on the remaining engine may be increased to the limits of directional and lateral control.

C. During a two-engine landing with two engines on the same side inoperative, before using reverse thrust, first obtain positive directional and lateral control of the aircraft. Next, below normal landing speed, reverse the inboard engine; then, after corrective control action has been taken, reverse the remaining engine. Increase power in reverse thrust slowly to prevent exceeding the limits of directional and lateral control.

D. A crosswind will materially affect the amount of corrective control action required to compensate for bank and yaw tendencies during either symmetrical or asymmetrical reversing.

E. Experience indicates that the pilot should maintain directional control by the use of rudder and nosewheel steering and by the amount of reverse power applied. The copilot must maintain a wings level attitude by use of the aileron control, and also should apply "down elevator" to provide maximum effectiveness from nosewheel steering.

F. To obtain maximum braking, retract the wing flaps immediately and apply reverse thrust (this increases weight on the wheels); then apply brakes by first partly depressing the brake pedals and gradually increasing braking pressures up to the maximum possible without sliding tires. There is little or no indication to the pilot of tire slide; therefore, if condition of the runway warrants, or if tire slide is suspected, momentarily release the brakes, reapply, release, reapply, etc.

CROSSWIND TAKEOFF.

During takeoff, aileron displacement is required to keep the wings level. The amount of aileron displacement depends upon the crosswind component (see Takeoff and Landing Crosswind Chart, Figure A3-18, in the Appendix). In severe crosswinds the takeoff run should be started with full aileron deflection to depress the upwind wing. As the aircraft accelerates, deflection is reduced as necessary to maintain directional control. A slight amount of bank into the wind can be used effectively to assist in maintaining directional control. After takeoff, the aircraft should be crabbed into the wind to maintain a straight path on climbout.

NOTE

Thirty knots is the maximum recommended crosswind component regardless of weight configuration, or liftoff speed.

CYLINDER HEAD TEMPERATURE MANAGEMENT.

Minimum cylinder head temperatures, within limits, should be secured prior to takeoff for the following reasons:

A. The power available at 2800 rpm increases with decreasing cylinder head temperature (CHT) at approximately 30 bhp (3 bmep) per 20°C, below 260°C.

B. Increasing temperatures are conducive to common types of spark plug fouling, which can be reduced through control of maximum CHT.

C. CHT will rise from 40°C to 60°C during takeoff. Minimum CHT can be maintained by making a brief engine runup to perform the necessary checks and by keeping cowl flaps fully open until ready to apply takeoff power. Pre-takeoff CHT should not exceed 150°C with ambient temperature of 40°C or less and should never exceed 170°C.

MANIFOLD PRESSURE CONTROL.

As the aircraft accelerates during takeoff and up to the point of the first power reduction, increasing ram effect will cause a rise in manifold pressure of from 1 to 3 inches. This increase in manifold pressure should be anticipated to prevent exceeding limitations.

WATER-ALCOHOL (ADI) SYSTEM MANAGEMENT.

When water-alcohol injection is used during a takeoff, the ADI system pressure, fuel flow, manifold pressure, and bmep must be monitored by the crew engineer, and any discrepancies must be reported to the pilot immediately. As throttles are advanced beyond 38 to

42 inches manifold pressure, the ADI pressures should drop to a normal flow of from 22 to 24 psi as a result of ADI flow. If the drop in pressure should fail to occur on any water pressure indicator or if water pressure drops but no derichment is indicated, reduce power to the maximum dry manifold pressure and turn ADI switch OFF for the respective engine. During takeoff, if the ADI pressure drops below 18 psi (light on) and carburetor enrichment is in excess of 1800 psi, it is possible that a fuel, oil, or ADI leak exists within the engine nacelle. Takeoff should be discontinued and the cause of the pressure drop investigated. If the failure of the ADI system can be attributed to an electrical malfunction, the affected ADI system may be left in the OFF position and the takeoff continued provided performance requirements are met.

WARNING

If the loss of ADI pressure cannot be attributed to an electrical malfunction, takeoff should not be attempted until an inspection reveals that a leak does not exist.

AFTER TAKEOFF CLIMB.

* 1. Water-alcohol—OFF. Crew engineer checks that ADI switches are in the OFF position.

* 2. Landing lights—OFF AND RETRACTED. (P)

* 3. Gear lever—NEUTRAL. Crew engineer moves gear control lever from UP to NEUTRAL position.

4. Hydraulic bypass lever – UP(OFF). Crew engineer moves lever to the OFF position.

* 5. Pressurization and doors – CHECKED. Crew engineer checks the cabin rate of climb and cabin altitude for proper indication and checks that door warning lights are off.

* 6. Fuel flows—CHECKED.

7. No smoking-seat belt lights—AS REQUIRED. (P)

8. Antiskid brakes—OFF. (P)

9. APU (GTPU 70-9)—OFF.

EN ROUTE CLIMB.

En route climb is 152 knots IAS. Lower speeds at equal cowl flap gap would provide a slightly higher rate of climb, but the additional cowl flap opening required to maintain the desired cylinder head temperature of 190° to 200°C offsets this, and the mileage made good during climb would be reduced for the same climb time. A climbing air speed of 135 knots will provide the approximate maximum angle of climb in order to comply with air traffic control (ATC) clearances, crossing altitudes, etc. CHT should be carefully observed when this procedure is used.

A. En route climb power is 1500 bhp at 2400 rpm for gross weights above 95,000 pounds, and 1400 bhp at 2300 rpm for gross weights below 95,000 pounds.

B. Throttles should be adjusted to provide equal manifold pressure on all four engines, as selected from the appropriate climb chart for existing carburetor air temperature and pressure altitude (Appendix). Bmep differences among engines with equal manifold pressure, rpm, carburetor air temperature, and fuel flow are due entirely to unequal accessory loads, engine conditions and/or instrument accuracy. Maximum indication of any existing discrepancies will be provided through control of manifold pressure to chart values.

C. It is important that fuel flow be monitored throughout the climb to ascertain that it is within prescribed limits. The minimum fuel flow limit is not an engine limit at normal climb power. It is, however, a carburetor limit designed to obviate damage which might otherwise result at higher power, where the margin between a safe fuel flow and engine detonation is diminishing. At climb power, therefore, it is considered safe to continue operation when the fuel flow is at or 50 pounds per hour below the minimum fuel flow shown in figure A2-13, providing CHT and CAT. limits are observed. If the climb fuel flow falls more than 50 pounds per hour below published minimum, power should be reduced by increments of 100 bhp until the fuel flow is not more than 50 pounds per hour below the limit for that particular reduced power. CHT and CAT. limits must still be monitored. For a carburetor whose fuel flow is below published minimums, a complete write-up should be made in the log and corrective maintenance accomplished at the next landing. En route climb power must be set according to climb chart manifold pressure rather than bmep in order that chart fuel flow limits be valid. The effects of any existing mechanical discrepancy are thus largely eliminated from evaluation of climb carburetion.

D. Minimum chart climb rpm is the most desirable, due to propeller efficiency, cowl flap drag, fuel flow, and cabin noise level considerations. Therefore, full throttle in high blower ratio should be reached before rpm is advanced.

E. Doors and emergency latches.

a. After Takeoff Climb checklist is completed and pressurization is begun, a male crew member will check pressurization and alignment of bayonets on all doors.

b. Doors and emergency latches must not be tampered with during pressurized flight. In the event a pressure leak develops or a door warning light illuminates, passengers should be removed from the danger area (6 feet) and the area roped off and guarded by a flight crew member.

c. If door handle or bayonets are not in place, descend to 12,000 feet or below, as terrain clearance permits, and depressurize. Continue nonpressurized flight to station of next intended landing.

CRUISE.

Level off upon reaching cruising altitude and maintain climb power setting until desired cruising airspeed is attained.

1. Cruise power — SET (see Appendix).
2. Radio altimeters — OFF. (P-CP)
3. Cabin pressurization — CHECKED.
4. Tank selectors — AS REQUIRED. (See Section VII for fuel management procedures.)
5. Booster pumps — AS REQUIRED. (See Section VII for booster pump operations.)
6. Water alcohol quantity — CHECKED.

BLOWER SHIFTING.

The shock associated with a blower shift will be minimized by reducing the pumping load on the supercharger through a momentary manifold pressure reduction to approximately 25 inches Hg while affecting the shift from low to high ratio. The use of autorich mixture during the shift from low to high or high to low ratio is beneficial because the change in fuel/air ratio obtained in moving from manual lean to autorich changes the temperature pattern within the combustion chambers and causes lead and carbon deposits to be carried out the exhaust, thus prolonging spark plug life.

FLIGHT CHARACTERISTICS.

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

SYSTEMS OPERATION.

Refer to Section VII for detailed information regarding operation of the various aircraft systems.

DESCENT.

For a normal cruising descent, the use of cruise power settings (manual lean adjusted for altitude) or auto lean is permissible. Airspeed should be limited by considerations such as placard airspeeds, clearance, and use of the autopilot. Whenever a power lower than normal cruise is required, it is suggested that the necessary power reduction be made with manifold pressure and rpm. Blowers may be shifted to low ratio when at or above low blower critical altitude. Positive indication of a shift renders a check shift unnecessary during the next ground runup. Do not exceed 155 bmep in low blower while using manual lean mixture. Compare fuel flows at equal manifold pressure to check for stuck automatic mixture control (AMC) units.

Note

- Whenever icing conditions are anticipated, auto-rich mixture and 15 CAT. are desirable.
- A minimum of 1 inch manifold pressure should be maintained for each 100 rpm.

CRUISING DESCENT CHECK

1. Safety belt and shoulder harness — FASTENED. (P-CP-E)
2. Start marker — AS REQUIRED. (See Section IV for operation of pressurization system.)
3. Mixtures — AS REQUIRED. (P)
4. Blowers — LOW.
5. Windshield heat — CLIMATIC.
6. Antiskid brakes — ON. (P)

*7. Fuel tank selectors — MAIN ON.
Crew engineer moves all fuel tank selectors to the MAIN ON position.

*8. Reverse flag (if installed) — DOWN.

9. Altimeters — AS REQUIRED. (P-CP-N)
Pilot, copilot, and navigator will set their altimeters to meet local requirements.

WARNING

Special attention should be given the

altimeter to assure that the 10,000 foot pointer is reading correctly. It is possible for the correct reading to be set in the Kollsman window while the altimeter reading is 10,000 feet in error.

10. Radio altimeters — SET. (P-CP)

*11. Crew briefing — COMPLETE. (P)

MANEUVERING DESCENT CHECK

1. Mixture — AUTO RICH.
   Crew engineer sets mixture controls to AUTO RICH.
2. Hydraulic bypass lever — DOWN. (ON).
   Crew engineer moves hydraulic bypass lever to the ON (down) position
*3. Rpm — 2100. (P)
   Crew engineer sets rpm at 2100 when directed by pilot.
4. Booster pumps — LOW.
   Crew engineer will place main booster pump switches in the LOW position.
5. Cabin pressure — LESS THAN 1.8 PSI.
   Crew engineer will check cabin pressure control instruments for proper indication.
*6. Wing flaps - AS REQUIRED. (P)
   Pilot will determine required flap setting based on flight conditions and ATC clearances.
*7. Landing lights-AS REQUIRED.
8. APU (GTP70-9)-ON.
   Crew engineer turns APU (GTP70-9) ON.
9. Seat belt and No smoking lights-ON.
   Crew engineer positions switches to the on position.
10. Cabin report-SECURE.

BEFORE LANDING.

A setting of 2100 rpm is recommended for the normal four-engine approach configuration before gear down. If approach conditions make it advisable to use carburetor heat, the heat should be retained at 20°C and carefully monitored to avoid excessive CAT. in the event of a go-around. If carburetor heat is not needed during an approach, it should be removed at least 2 minutes prior to landing to allow the mixture control to adjust properly to ambient temperature, and therefore not cause unduly lean mixture in the event of a go-around.

Water-alcohol should be switched on in time, for 5 to 10 seconds, to bleed the system if it is desired to use full wet takeoff power in the event of a go-around. At bhp less than 1000 (118 bmep at 2400 rpm), water-alcohol flow will be negligible.

PRECAUTIONS.

A. The turn to final approach must not be less than 600 feet above the terrain and not less than 2 miles from end of the runway.

B. The landing procedure, modified to fit the situation, will be used by the pilot when making a long base leg or straight in approach.

C. The pilot is responsible for the proper use of the checklist. The crew engineer will read the checklist and challenge crew members for the proper accomplishment of each item on the checklist. Accomplishment of each item will be indicated by the proper response.

BEFORE LANDING CHECK.

1. Rpm — 2400. (P)
   Pilot states "Rpm 2400." Engineer sets rpm of all propellers to 2400 and states, "Rpm set."
2. Landing gear — DOWN. (P-CP-E)
   When pilot gives command, "Gear Down," co-pilot places gear lever in the DOWN position and states, "Gear going down." Pilot checks gear indicators and gear warning light for proper indications; co-pilot checks gear is down and locked; engineer checks gear indicators, warning light, hydraulic pressure and quantity.
3. Cowl flaps — AS REQUIRED.
4. Water-alcohol — AS REQUIRED. (P)
   Engineer positions water-alcohol switches as directed by the pilot.
5. Before landing check — COMPLETED. (P-CP)
   Crew engineer challenges both pilot and copilot, who answer, "check completed," signifying their knowledge that the gear is down and all steps of the before landing checklist have been completed.

LANDING.

Prior to landing, it is recommended that the pilot thoroughly brief the crew by stating performance data and by giving any necessary instructions.

NORMAL LANDING.

PILOT	COPILOT	CREW ENGINEER
A. Reduces airspeed to 170 knots (figures 2-4 and 2-5). Call for, Rpm 2100, flaps 20 degrees, and completes descent checklists. On entering traffic pattern, reduces airspeed to 140 knots.	A. On command, extends wing flaps to 20 degrees and states, "Flaps set 20 degrees."	A. On command, sets rpm at 2100. Reads checklist and assists in completing items. After completion, states, "Descent checklist complete."
B. Proceeds downwind at pattern altitude and 140 knots IAS. Turning base, calls for, Rpm 2400, gear down, flaps 30 degrees, and Before Landing checklist. Establishes base so as to roll out on final at a minimum altitude of 600 feet above field elevation, 120 knots IAS, and 2 miles from approach end of runway.	B. On command, places gear lever in DOWN position and states, "Gear going down, flaps set at 30 degrees." Checks gear indicators, warning light and hydraulic pressure for proper indications, and states, "Gear down and locked."	B. Set rpm at 2400. On command "Gear down", checks gear indicators, warning light, hydraulic pressure and quantity for proper indications and states, "Gear down and locked."
C. When gear is down, checks landing gear position indicator for gear down indication and red warning light to be out, then states, "Gear down and locked."		C. Continues with checklist, positioning cowl flaps and water-alcohol switches. Challenges both pilot and co-pilot on completion of BEFORE LANDING CHECK.
D. Rolls out on final at 600 feet minimum altitude above field elevation, airspeed 120 knots, and 2 miles from approach end of runway.		
E. States, "Pilot's throttles, engineer follow, recheck gear."	E. Checks gear indicators, red light out and hydraulic pressure.	E. Follows up on copilot's throttles adjusting manifold pressure as requested by pilot. Rechecks gear indicators and warning light and reports, "Gear down Before Landing Check complete."
F. Calls for flaps full above 200 feet.	F. Sets wing flaps as ordered and states, "Flaps set."	F. Monitors engine instruments. Follows up on throttles.
G. Gradually decreases airspeed to 130 percent of stall speed (V_{S0}).	G. Call out airspeeds below 120 knots.	G. Monitors engine instruments. Follows up on throttles.
H. Crosses threshold at a minimum height of 50 feet. Airspeed 130 percent of stall speed. Maintains a minimum of 15 inches.Hg until touchdown with main gear.		H. Monitors engine instruments. Follows up on throttles.
I. Orders actuation of reverse throttle lock release bar (if installed). Reverses propellers if required.	I. Steadies control column.	I. Actuates reverse bar on pilot's command. Advises pilot of any malfunctions and opens cowl flaps after reversing is completed.
J. As aircraft clears runway, calls for After Landing checklist.	J. Assists in completing After Landing checklist.	J. Reads checklist and assists in completing steps, states, "After Landing Check completed."

GUST CORRECTIONS.

When gusty winds exist, a correction factor should be added to best flare speed to compensate for maneuver loads which the pilot may impose on the aircraft while correcting for gusts. The gust correction factor is determined by taking one-half of the reported gust velocity, that is, one-half of the amount the wind is gusting over the constant wind. For example, if the wind is reported at 30 knots with gust to 42 knots, the gust velocity would be 12 knots. One-half of 12 is 6, which is the gust correction in knots that should be added to best flare speed. The maximum gust correction that should be added is 10 knots. Gust correction is introduced only on the final approach and is not applied throughout the landing pattern.

NOTE

Use of a correction factor for gusts or other accelerations which may affect the aircraft should be undertaken with consideration of all the factors involved. If a correction is required to compensate for a given gust velocity, the value of the correction must be the same regardless of wind direction. This is true because the objective is to provide a safety margin for maneuver loads while flying the aircraft through a series of accelerations. The accelerations can be equally severe whether they are produced by headwind, crosswind, or tailwind. However, since a pilot cannot estimate the frequency or timing of gusts with practical accuracy, it is possible for the aircraft to arrive at the flare point with gust correction added during an interval when gusts have stopped momentarily. Under such conditions, the distance consumed dissipating excess airspeed could move the touchdown point further down the runway than planned. Therefore, whenever a correction factor is added for gusts or other accelerations, the pilot must be prepared to accept a correspondingly higher approach speed with the possibility of increased landing distance. If stopping distance available beyond the maximum estimated touchdown point is marginal, the pilot should select a longer runway or proceed to an alternate base.

AFTER LANDING.

When reversing, pause momentarily at the reverse idle detent before applying appreciable reverse thrust. This will reduce the yawing tendency which would accompany differing rates of blade actuation or engine power response. Propellers should be returned to forward thrust in case of malfunction. If yaw is encountered during the landing roll, the following sequence should be used to maintain directional control: rudder, nosewheel, brakes, and asymmetrical power.

Cowl flaps should be positioned to full OPEN as soon as reversing is completed. The engine baffles, cowling, and CHT instrumentation are designed for forward-to-aft airflow, and are not effective during reverse pitch operation at low airspeed.

Propellers should normally be returned to forward thrust before the aircraft has decelerated to 50 knots. Below 40 knots, rudder and elevator control buffeting is encountered and exhaust fumes enter the cabin airscoop in objectionable quantity. Throttles should be returned smoothly to forward thrust position and then retarded as required for taxiing. At low airspeeds, reverse propeller wash tends to starve the carburetor scoops, thus enriching the fuel/air mixture at low rpm to the point that afterfiring on stoppage may occur at the IDLE position of the throttles.

Note

Stoppage may be corrected by manual leaning.

WARNING

Due to the possibility of damage to the aircraft and injury to crew members and passengers, the After Landing Check will not be made until the aircraft is off the active runway and clear of all obstructions.

AFTER LANDING CHECK.

1. Cowl flaps - OPEN.
   Crew engineer positions cowl flap rheostats to OPEN.
2. Pitot heat - OFF.
3. Gear safety solenoid - VISUALLY CHECKED.
4. Propellers - FORWARD.
5. Anti-icers - OFF.
6. Cabin heaters - SET.
7. Booster pumps - OFF.
   Crew engineer places each booster pump switch in the OFF position.
8. Water-alcohol - OFF.
   Crew engineer moves ADI switches to the OFF position.
9. Wing flaps - UP (CP)
   Copilot moves flap lever to the UP position.
10. Cabin Pressure - WINDOW OPEN.

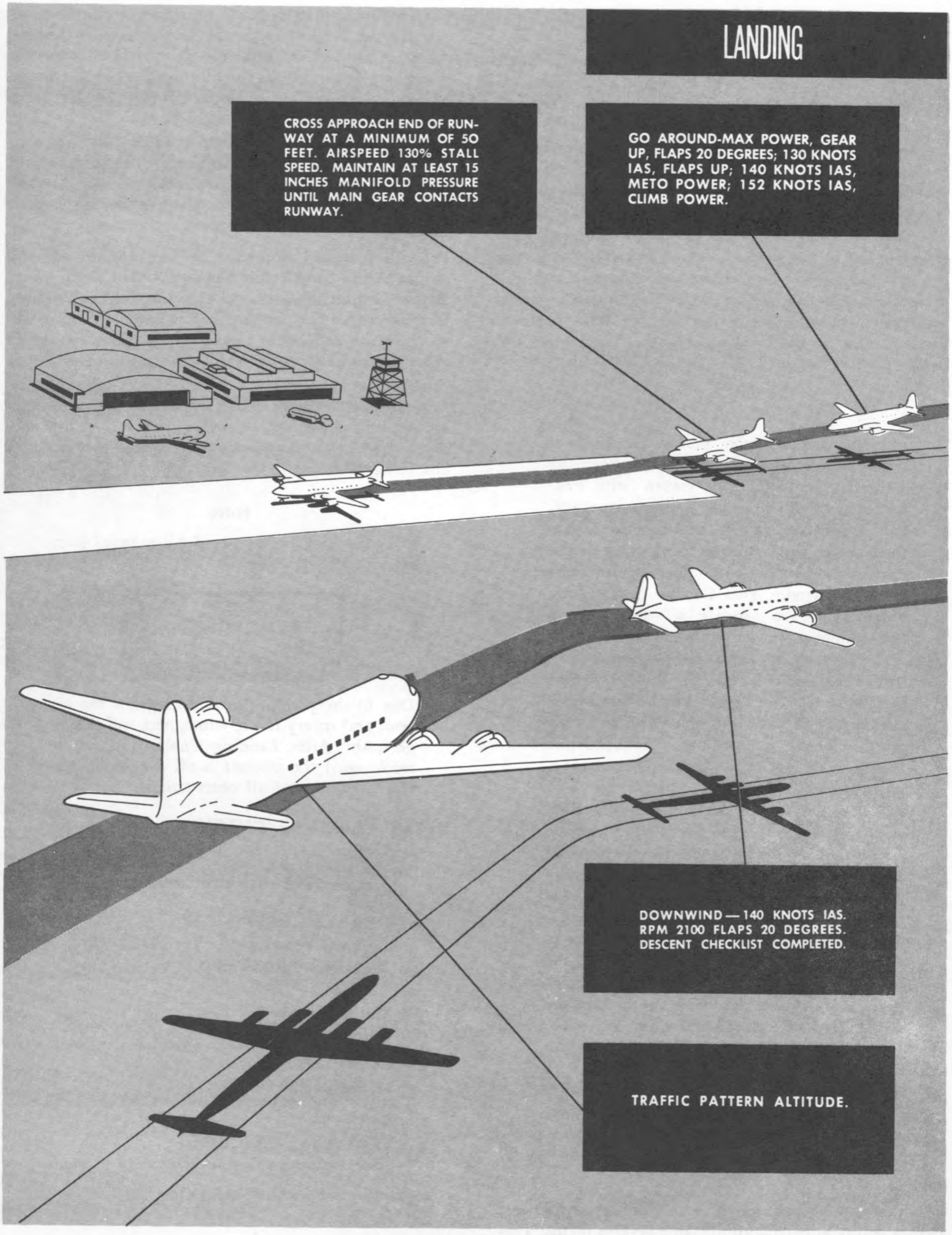


Figure 2-4 (Sheet 1 of 2)

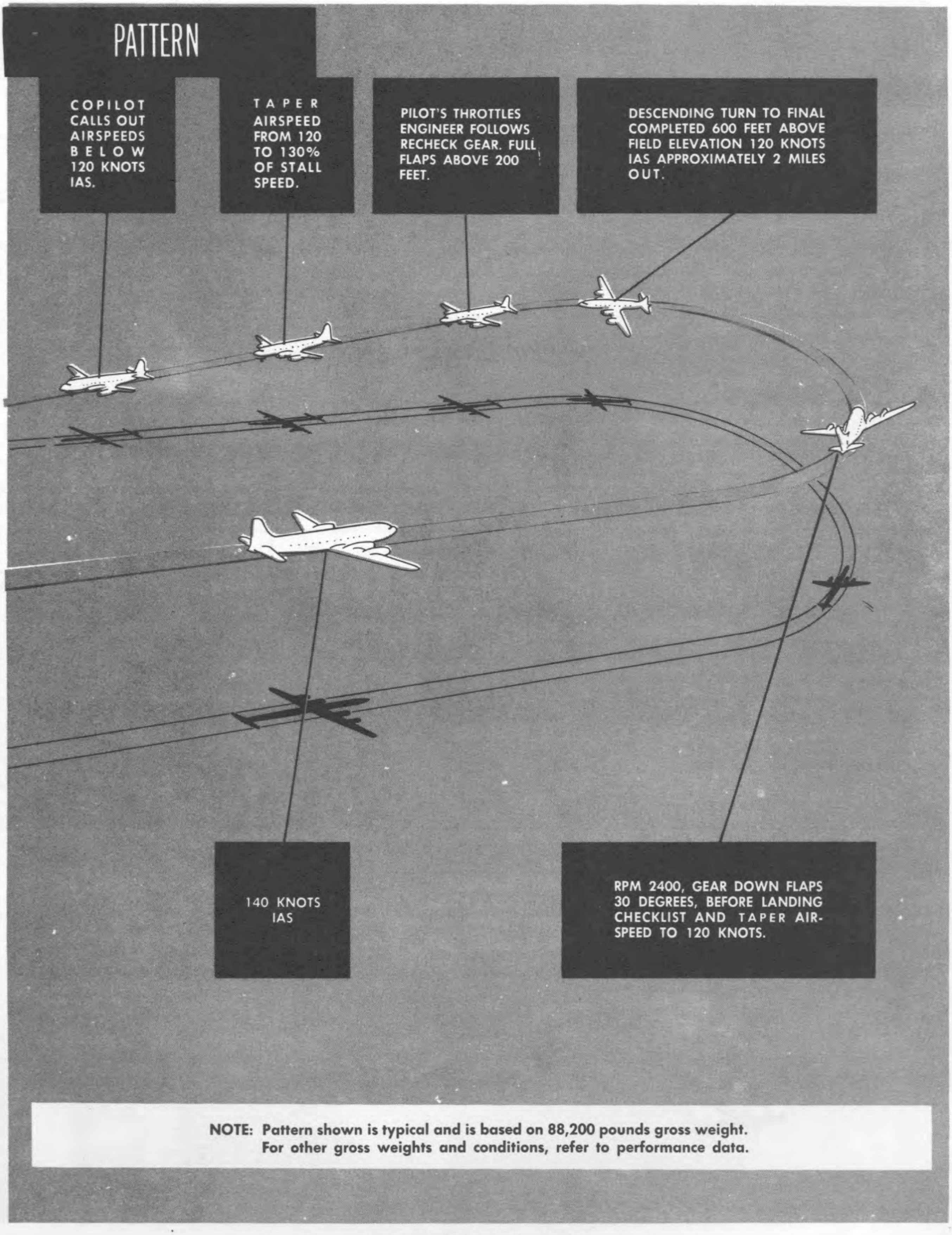


Figure 2-4 (Sheet 2 of 2)

LIFTOFF, LANDING, AND STALL SPEEDS

PILOT'S INDICATED AIRSPEED — KNOTS (IAS)

	Dump Time	Liftoff Speed	V_s for Zero Angle of Bank				Threshold Airspeeds 130% V_{so}				
Wing Flap Setting		20°	0°	20°	30°	Full Down	0°	20°	30°	Full Down	Wing Flap Setting
Gross Weight Pounds		115% V_s									Gross Weight Pounds
112,000	9.0	120	118	105	97	92	153	136	127	120	112,000
110,000	8.2	118	116	103	96	91	151	134	125	119	110,000
107,000	7.0	117	114	102	95	90	148	133	124	117	107,000
105,000	6.2	116	113	101	94	89	147	131	122	116	105,000
100,000	4.2	113	111	99	92	87	144	129	120	113	100,000
95,000	2.5	110	108	96	90	85	140	125	117	111	95,000
92,610	1.7	109	107	95	89	84	139	124	116	109	92,610
90,000	.6	107	105	94	88	83	137	122	114	108	90,000
88,200	0	106	104	93	87	82*	135	121	113	107	88,200
85,000	0	104	102	91	85	81*	133	118	111	105	85,000
80,000	0	101	99	89	83	78*	129	116	108	101	80,000
75,000	0	98	96	86	80*	76*	125	112	104	99	75,000
70,000	0	95	93	83	78*	73*	121	108	101	95	70,000
65,000	0	92	90	80*	75*	71*	117	104	98	92	65,000
60,000	0	91**	86	77*	72*	68*	112	100	94	88	60,000

Note: Stall speed at zero thrust (V_s).

*Less than minimum control speed (V_{mc}) with one engine out in the air (83 knots IAS).

**110 percent of minimum control speed (91 knots IAS).

BASED ON: FLIGHT TEST DATA

DATA AS OF 2-15-59

Figure 2-5

11. Controls - Locked. (P)
Crew engineer pulls the control-surface lock lever to the ENGAGED (up) position and locks the controls.
12. Anticollision light - OFF.
13. Turbine switch - OFF.
14. Antiskid brake - OFF. (P)
15. IFF - OFF. (P-N)

NOTE

Turn pitot heat OFF as soon as possible to prevent overheating due to decreased air flow over pitot head.

CROSSWIND LANDING.

In making a crosswind landing, the following items must be considered:

A. Wind velocity.
B. Wind component.
C. Runway length and condition.
D. Wind gust velocity.

Note

Maximum recommended crosswind component is 30 knots except in emergency. See Takeoff and Landing Crosswind Chart, in Appendix. (Figure A3-18).

Establish a slightly longer final approach than normal; either crab into the wind or align the axis of the aircraft with the runway and lower the upwind wing. Use opposite rudder as required to maintain a straight course. Align the aircraft with the runway before touchdown and contact the runway with the upwind gear. Lower the nosewheel and apply forward pressure on the control column to assure positive steering control. Continue to roll the aileron control toward the wind as speed decreases. It is recommended that only the inboard propellers be reversed in extreme crosswind conditions. Apply braking action as necessary.

LANDING ON STEEL MAT RUNWAYS.

When landing on steel mat runways, touch down in the center of the mat to avoid sharp edges. Apply brakes cautiously and intermittently to prevent humping the pierced steel planks and avoid excessive wear on the tires.

LANDING ON SLICK OR ICY RUNWAYS.

When landing on slick or icy runways, use full flaps and make the touchdown at minimum speed with power on. Reverse propellers, apply brakes cautiously, and taxi slowly. Directional control can be maintained by use of the outboard engines, as nosewheel steering is frequently inadequate.

The antiskid system is very effective on icy and slippery runways; it assists the pilot during the landing operation by automatically preventing wheel skidding. This provides the greatest possible braking efficiency and reduces landing roll and tire wear.

MINIMUM RUN LANDING.

The procedure for a minimum run landing is the same as for a normal power-on approach and landing, except for the following:

A. Make a normal landing with flaps full, touching the main wheels as near the approach end of the runway as possible.
B. Allow the nosewheel to touch as soon as possible and apply full reverse thrust and maximum braking without skidding the tires.
C. Wing flaps should be raised immediately after touchdown to assure more positive braking action at higher speeds.

TOUCH-AND-GO-LANDINGS

Note

Touch-and-go landings introduce a significant element of danger because of the many actions which must be swiftly executed while rolling on the runway at high speed or while flying in immediate proximity to the ground. Touch-and-go landings should be made only when authorized and directed by the major command concerned.

The procedures for pattern, approach and landing are identical to those of a typical normal approach and landing. Prior to the approach, the pilot will brief the co-pilot and flight engineer regarding their duties after landing. After touchdown the following procedures will be used.

PILOT	COPILOT	CREW ENGINEER
A. Indicates decision to go around, advances throttles and calls for "MAX POWER". As soon as rate of descent is stopped, calls for "GEAR UP" and "FLAPS 20 degrees".	A. Steadies control column.	
B. Calls for props full forward and flaps 20 degrees.	B. Moves wing flap control to 20° position and states, "flaps coming up to 20°."	B. Places props full forward and with indicator lights on states, "props full forward."
C. Advances throttles and calls for maximum power.	C. Adjusts elevator trim tab and states, "Trim Set."	C. Follows up on throttles and adjusts to maximum power.
D. Releases steering wheel at 90 knots (if applicable) and places left hand on yoke and flies aircraft off runway at lift off speed.	D. Steadies control column.	D. Monitors engine instruments.
	E. Calls out lift off speed.	

Procede as in a normal takeoff. (Reference TAKEOFF procedure this Section).

FOUR-ENGINE GO-AROUND.

If the pilot considers it necessary to make a go-around, he will proceed as follows:

A. If on the runway:

a. Retract wing flaps to 20 degrees.

b. Propeller master lever to full increase rpm.

c. Trim aircraft as necessary and proceed as during a normal takeoff.

B. If airborne:

PILOT	COPILOT	CREW ENGINEER
A. Indicates decision to go-around and advances throttles, calls for "MAX POWER, GEAR UP," after descent is stopped, calls for "Flaps 20 degrees."	A. Moves gear handle to UP position and calls out "GEAR COMING UP," moves wing flap lever to 20 degree position and states, "FLAPS COMING UP to 20 DEGREES."	A. Repeats "MAX POWER," advances propellers and throttles as required, watches for overspeed, and monitors engine instruments.
B. When 130 knots IAS is attained, calls for, "FLAPS UP."	B. Retracts flaps and states, "FLAPS COMING UP."	B. When propellers are set, states RPM. Adjusts cowl flaps as required.
		C. Monitors engine instruments.

Note

Climb at liftoff speed with maximum power and wing flaps 20 degrees if obstacle clearance is required. Compute minimum climbing airspeed for landing gross weight from takeoff speed chart.

TAXIING AND SHUTDOWN.

A. Normally, cowl flaps should be full open for ground operation, to prevent excessive temperatures which are not evident in CHT indications.

B. Taxi at an rpm adequate to provide generator output (800 to 900 rpm).

CAUTION

Do not leave parking brakes set if brakes are overheated.

C. Shut down with mixture controls whenever CHT has dropped to 150°C. It is suggested that throttles be positioned to 800 rpm. Make an idle mixture check as follows:

a. Propeller levers — FORWARD.

b. Cylinder head temperature — NORMAL.

c. Oil temperature — NORMAL.

d. Manual mixture control — AUTO RICH.

e. Retard throttle to IDLE RPM.

f. Move mixture control slowly and evenly to IDLE CUTOFF.

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 CUTOFF. This slow movement of the lever is necessary to make the engine respond to the change in fuel/air ratio and to obtain an accurate reading 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 mixture fuel/air ratio is too rich. If no rise in rpm is noted, the idle rpm mixture 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.

Note

The idle rpm fuel/air ratio must check according to the above procedure to prevent spark plug fouling, which causes excessive magneto drop at ignition check, incorrect fuel/air ratio in the cruise range, and low torque oil pressure during takeoff.

D. Do not close cowl flaps for 15 minutes after shutdown, in order to allow residual engine heat to escape.

Note

Critical engine temperatures rise immediately after shutdown and may not begin to drop again until 15 to 30 minutes have elapsed. However, the cylinder head temperature indication begins to drop immediately.

BEFORE LEAVING AIRCRAFT.

1. Engine analyzer — OFF.
2. Parking brakes — Set. (P)
3. Mixtures — IDLE CUTOFF.
4. Ignition switches — OFF.
   Crew engineer places the ignition switches in the OFF position after each propeller has stopped.
5. Oil coolers — OFF.
6. Cowl flaps — OFF.
7. Inverters and instrument switches — OFF.
   Crew engineer places each switch in the OFF position.
8. Battery selector switch — GROUND POWER.
   Crew engineer places selector switch in the GROUND POWER position.

9. Radios and radio altimeters – OFF. (P-CP-N)

   Pilot and copilot turn off all radio switches.

10. Fuel selectors – MAIN ON.
    Crew engineer moves all fuel tank selectors to MAIN ON.

11. Carburetor air doors – SET.

12. Chocks – IN PLACE. (P-CP)

13. Brakes – OFF. (P)

14. Seat belt light – OFF.

15. Gear safety pins – INSTALLED. (P)

16. Circuit breakers – SET.

17. APU (GTP70) – AS REQUIRED.

18. Master switch – AS REQUIRED.

19. Lights – AS REQUIRED.

CAUTION

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

STRANGE FIELD PROCEDURES.

When compelled to operate through bases not normally visited by the aircraft and the ground crew is not familiar with the aircraft, the flight crew will perform the required inspections contained in T.O. 1C-118A-6.

ABBREVIATED CHECKLIST.

The pilot's normal abbreviated checklist is now contained in T.O. 1C-118A-CL-1-1.

SECTION III

emergency procedures

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

EMERGENCY PROCEDURES

This section contains what is considered the best procedures for meeting the various emergencies that may be encountered during flight and ground operations. It is realized that each emergency may present a different problem. A thorough knowledge of the procedures contained herein will enable the aircrew to cope better with those emergencies which they may encounter.

NOTE

- Although many inflight emergencies require immediate corrective action, frequently difficulties are compounded by the tempo of the pilot's command and a too hurried execution by the crew. It is essential that the pilot carefully analyze the difficulty prior to issuing instructions. The pilot must exercise positive control of the crew by allowing time for acknowledgment and execution of his orders. This will eliminate confusion and ensure efficient and expeditious handling of the emergency.
- Critical emergency procedure actions, those that must be performed immediately and instinctively if the emergency is not to be aggravated, are identified on the checklists by bold face type and must be memorized and performed in proper sequence without direct reference to the checklist. Following completion of the bold face items, the applicable checklist will be completed in its entirety by delegated crew members.
- Non-critical emergency procedure actions are those which contribute to an orderly sequence of events; assure that all necessary preparations are made prior to initiating the emergency action or serves as a completed review of action taken. These are completed by direct reference to the applicable checklist.

ENGINE FAILURE.

Only at maximum power and slow speeds does the aircraft require a great amount of control force to compensate for turning action caused by engine failure. Very little trim is required at cruise power. As airspeed is decreased, more rudder deflection is necessary to counteract unbalanced thrust. The minimum speed that the aircraft can be controlled in flight is that speed required to provide sufficient control to enable the aircraft to be flown on a straight flight path when the critical engine (No. 1) has failed. This speed is based on takeoff configuration with gear up, propeller on failed engine windmilling, takeoff/MAX Power available on the remaining engines and not more than five degrees of bank away from the failed engine. The minimum control speed, with two engines out on one side (propellers windmilling) and maximum power applied to the remaining engines, is 99 knots IAS. Minimum control airspeed with the critical engine (No. 1) propeller windmilling and the other three engines at maximum power is 83 knots IAS. However note that the stalling speed exceeds 83 knots IAS for aircraft gross weights greater than approximately 69,000 pounds. In determining which engine is inoperative, check for below normal bmep or any abnormal indication of the engine instruments.

PROCEDURE UPON ENCOUNTERING ENGINE FAILURE.

Of primary importance, upon encountering an engine failure, is to maintain airspeed and directional control at all times while executing the proper emergency procedures.

ENGINE FAILURE, FIRE, AND FEATHERING.

NOTE

It is mandatory that the first action taken in the event of engine fire in flight is to actuate the feathing button. Actual tests have shown an enormous advantage in extinguishing an engine fire when the propeller was feathered as compared to when the propeller was not feathered. (On identical tests, almost 7 times more Bromochloromethane was required to extinguish a fire on an engine in which the propeller was not feathered). While the feathering action is progressing, other critical items on the engine fire procedure will be completed so that the extinguishing agent can be discharged with the least possible time delay.

1. **THROTTLE - CLOSED (NOT APPLICABLE FOR ENGINE FIRE).**
2. **FEATHERING BUTTON - PUSHED IN.**
3. **FUEL SELECTOR LEVERS - MAIN; SELECTOR FOR FAILED ENGINE - OFF; CROSSFEEDS-OFF.**

Note

Complete visual inspection after step 3 to determine any evidence of fire. Steps 4 through 8 may be omitted if fire is not evident.

4. **FIRE EXTINGUISHER SELECTOR VALVE HANDLE - ARMED.**
5. **COWL FLAPS - 8 DEGREES.**
6. **CREW OXYGEN - MASKS ON: 100% OXYGEN.**
7. **CO_2 DISCHARGE HANDLE - PULLED.**

Note

Accomplish steps 9 through 16 when time permits.

8. Combustion heaters—OFF.
9. Booster pump switch — OFF.
10. Oil cooler door switch — CLOSED AND OFF.
11. Cowl flaps switch — CLOSED AND OFF (after fire, if any, is extinguished).
12. Generator switch — OFF.
13. Turbine switch — SET.
14. Ignition switch — OFF.
15. Propeller master selector switch — SELECT OPPOSITE ENGINE IF PROPELLER OF MASTER ENGINE WAS FEATHERED.
16. Mixture control — IDLE CUTOFF.
17. Propeller — TOGGLE TO LOW.

NOTE

After the propeller has feathered, the position of the feathering button should be checked to ensure it has returned to the neutral position. (If a propeller is feathered due to loss of oil quantity, the feathering button should be manually pulled out as soon as the propeller is feathered to conserve oil. The feathering timer is set at approximately 15 seconds and the pump will continue to operate during this period). If the propeller continues to windmill and will not feather, the fire extinguisher selector valve handle should be pushed in to the spring stop to provide oil to the engine *(figure 3-1)*. If after feathering, the propeller windmills backwards, momentarily pull the feathering button to stop rotation. However, care should be exercised so as not to cause propeller to unfeather.

CAUTION

Normally, do not exceed 190 knots IAS; but never exceed 215 knots IAS with propeller feathered, except in an emergency.

UNFEATHERING.

If it should become necessary to unfeather the propeller after an engine shutdown in flight, proceed as follows:

1. Airspeed — 135 KNOTS.
2. Oil cooler door switch — AUTOMATIC.
3. Cowl flap switch — POSITIONING.
4. Booster pump switch — LOW.
5. Generator switch — ON.
6. Blower switch — LOW.
7. Fire extinguisher selector valve handle — IN.
8. Fuel selector lever — ON (pressure checked).
9. Propeller selector switch — TOGGLE TO DECREASE RPM; indicator light — ON.
10. Throttle — CLOSED.
11. Carburetor air control lever — COLD.
12. Propeller deicer — OFF.
13. Turn through nine blades with starter (starter selector switch — OFF).
14. Feathering button — PULL INTERMITTENTLY (maximum 2 seconds).
15. Rpm stabilized — 1200 RPM.
16. Ignition switch — BOTH.
17. Mixture — AUTO RICH.
18. Engine instruments — CHECKED.

NOTE

Check for congealed oil in oil cooler. Warm up engine at 1500 rpm and 20 inches Hg. If engine is cold soaked (+20° C oil temperature or lower), attempt to warm up engine at 1200 rpm. If the engine has been feathered as a precautionary measure, and is to be started again for landing, consideration should be given to diluting the oil prior to shutdown.

ENGINE FAILURE DURING TAKEOFF.

Prior to each takeoff, the acceleration and refusal speed for the takeoff configuration must be determined by reference to the applicable charts in the Appendix. During takeoff if an engine fails prior to reaching refusal speed, reject the takeoff. For reject procedures refer to Takeoff and Landing Emergencies, this section. If an engine fails at or above refusal speed, proceed as follows:

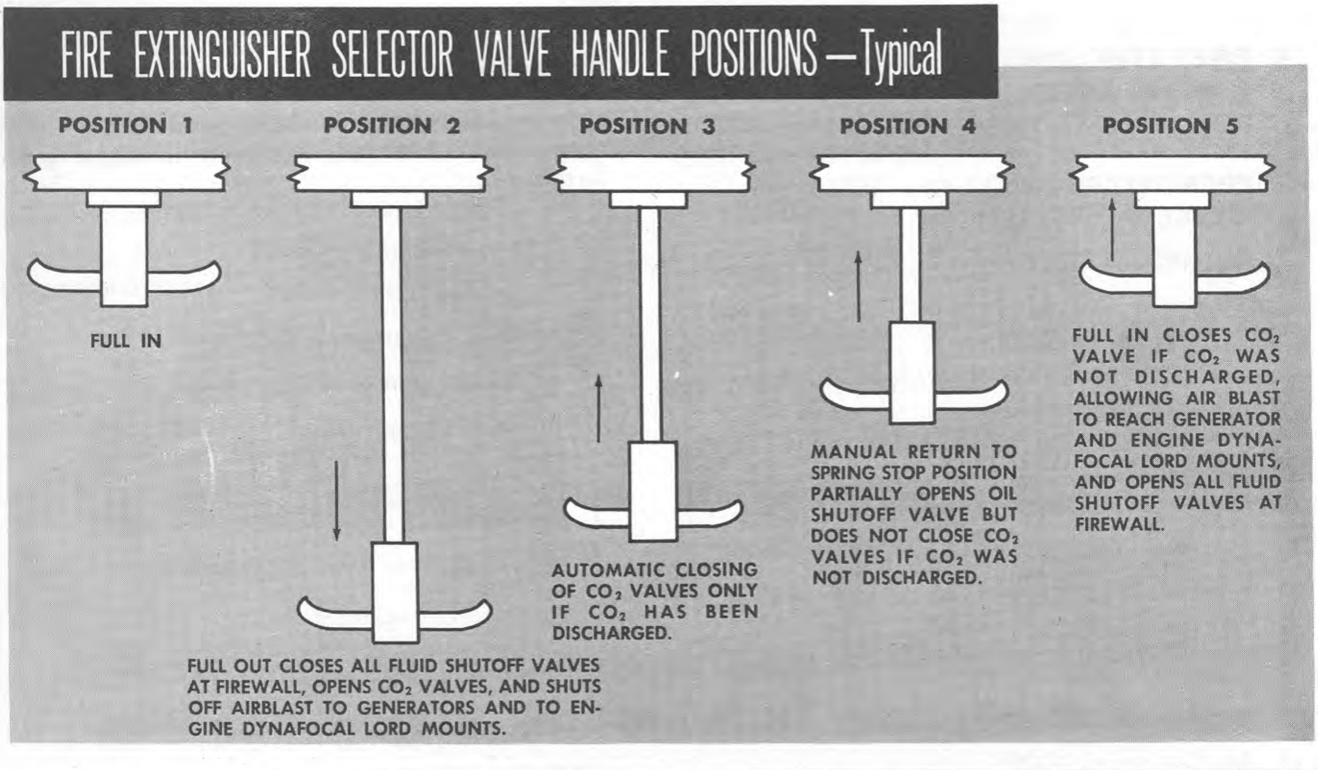


Figure 3-1

A. Takeoff and climb at liftoff speed.

B. Raise the landing gear after being safely airborne.

C. Feather the propeller of the failed engine.

D. After obstacles are cleared, retract wing flaps at the appropriate airspeed and accelerate to the en route climb airspeed.

E. Complete the ramaining steps under Engine Failure, Fire, and Feathering.

ENGINE FAILURE DURING FLIGHT.

If an engine fails during flight, and it is imperative that the propeller be feathered, perform the following operations for that engine:

A. Maintain flying speed and directional control. (See the Appendix for information on three-engine performance.)

B. Perform all the steps under Engine Failure, Fire, and Feathering.

C. Try to discover the cause of failure. Check fuel and oil quantity gages, fuel valve controls, fuses, circuit breakers, lines, and wiring as much as possible.

D. Descend gradually at long range airspeed to the lowest possible altitude consistent with power and fuel available at recommended long range airspeed. If this altitude cannot be maintained because of the terrain, dump fuel to reduce gross weight. If terrain altitude cannot be maintained, provisions are made for jettisoning the aft small entrance door as a last resort, making it possible to jettison equipment and cargo.

WARNING

The cabin must be depressurized before jettisoning the door. (This door, when jettisoned, may strike or wrap around the horizontal stabilizer.)

Note

Monitor the electrical load on the remaining generators.

FAILURE OF TWO ENGINES.

If two engines fail after takeoff, with a gross weight of 107,000 pounds in the clean configuration, under standard Day, sea level conditions, it is possible to establish a rate of climb of at least 100 feet per minute at takeoff speed. If a speed of 140 knots IAS can be attained, it is possible to establish a rate of climb of 225 feet per minute. See Two-Engine

Emergency Climb Chart in the Appendix for specific data. When two engines are out and the feathering procedure has been accomplished, maintain METO power and cowl flaps as required to maintain head temperatures under 232°C.

Note

Monitor the electrical load on the remaining generators.

Lighten aircraft, jettison fuel if necessary (carefully compute fuel requirements to intended point of landing prior to jettisoning), and be careful not to jettison any emergency equipment or clothing needed in case of emergency landing or ditching. (Prepare for emergency landing or ditching.) Proceed to the nearest suitable airfield, if possible, using only that power necessary to maintain safe flying speed.

Note

It has been determined that even small amounts of wing flaps do not add to the performance of the aircraft on two engines.

For cruising with three or two engines operating, the best range is obtained with power required to maintain, long range airspeed. As altitude is decreased, power required to maintain this speed also decreases, therefore, in case one or more engines fail during cruising flight, altitude should be reduced gradually by the amount necessary to bring power requirements within cruise power limits. If the terrain permits, a gradual let down should be made at long range airspeed, with maximum cruise power used on the remaining engines. With this technique, the aircraft will level off at the maximum ceiling for this power. If above the three- or two-engine service ceiling and if maximum operating altitude is required, it will be obtained by use of the speed for en route climb and METO power, with a gradual let down being made. Using this speed and power, the aircraft will level off at its ceiling.

To obtain best efficiency in either of these operating conditions, eliminate all unnecessary drag from such items as out of trim, cowl flaps, oil cooler doors, etc.

FAILURE OF THREE ENGINES.

It is not possible to maintain level flight at any gross weight with three engines inoperative.

FUEL PRESSURE DROP—ENGINE OPERATING NORMALLY.

During Ground Operation.

If the fuel pressure drops below the operating limits during ground operation, but the engine continues to operate normally, stop the aircraft, set the fire extinguisher selector to the affected engine, and shut down immediately. *Do not take off.* Investigate the cause and correct.

During Flight.

If the fuel pressure drops below the operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage, oil dilution solenoid leakage, engine-driven fuel pump bypass valve leakage, clogged pressure line, instrument failure, or line leakage. Possible courses of action, depending on the cause of the pressure drop, are listed below.

WARNING

Whenever fuel pressure drops and the engine continues operating normally, the first concern of the crew must be to guard against the outbreak of an engine fire. The greatest danger lies in the fact that the crew develops a false sense of security because no fire exists at the time that the fuel pressure drop is noticed nor after several hours of flight. However, when the throttle is retarded (as in preparation for a landing), an engine fire develops and the results are usually disastrous. What has happened is that a fuel leak existed, but the cooling and dispersing effect of the airflow through the engine nacelle at cruising speed has prevented the start of a fire. When the throttle was retarded, the airspeed dropped and the airflow was reduced sufficiently to permit ignition of the leaking fuel. Any change in the airflow pattern, such as feathering the propeller or entering a climb, can start a fire if a fuel leak exists. Increasing the power is less likely to start a fire since airspeed will be increased, but even here there is a possibility of fire since the exhaust heat and flame pattern may change sufficiently to outweigh the increase in cooling airflow. Accordingly, it must be the objective of the crew to eliminate the fuel before any change is made to the airflow or exhaust pattern.

A. If power is not necessary to sustain flight or to reach a safe destination, cut the engine immediately by moving the mixture control to IDLE CUTOFF and the Propeller FEATHERING BUTTON to FEATHER; and close the firewall shutoff valve by pulling the applicable Engine Selector Valve Handle on the Main Fire Control Panel.

B. *Keep the affected engine in operation at or above cruising speed while maintaining watch for fire.* This can be done if it cannot be de-

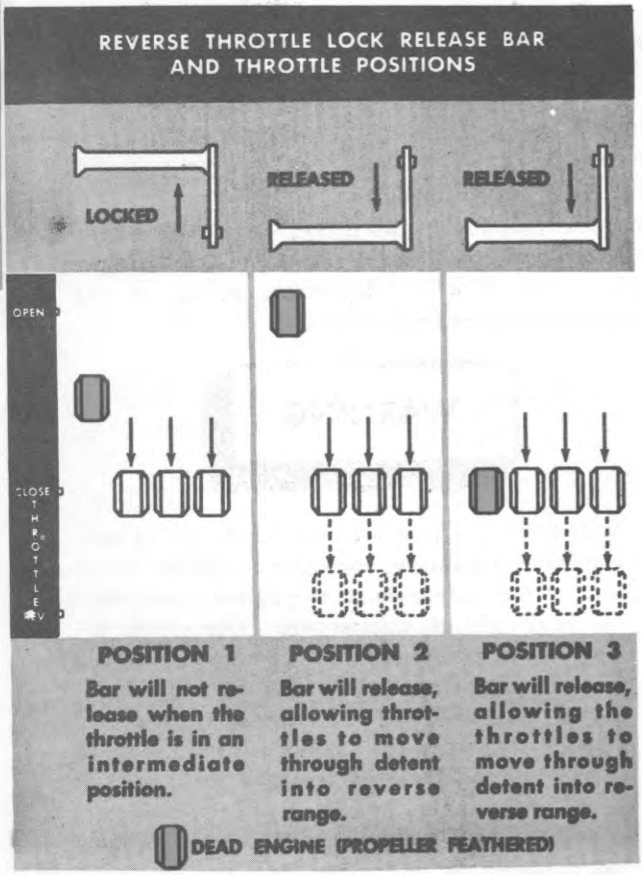


Figure 3-2

termined whether or not an actual leak exists and the engine is required to either sustain flight or maintain the required altitude for arrival at a safe destination. However, prior to power reduction for entrance to the landing pattern, cut the affected engine completely (as cited in step 1 above, and not by retarding the throttle) and accomplish a partial power landing. Unless the added power is absolutely essential to effect a safe landing, do not reduce airspeed until the affected engine is shut down.

C. *Continue operating the engine normally.* This may be done if it can be reasonably ascertained that the indicated fuel pressure drop has not resulted from a fuel leak.

Note

All other factors being equal, step 1 above is generally the best. However, action to be taken depends entirely upon the circumstances existing at the time. Such factors as the known condition of the airplane and the remaining engines, the stage and requirements of the mission, and power requirements of the aircraft should all be considered.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE.

In all landings with one or more engines inoperative, the ADI water-alcohol injection system should be ON for the engines in operation. In case any of the inoperative engines can be safely used for any amount of additional power, and a fire hazard does not exist, unfeather the propeller, start the engine, and operate it during the final approach.

On aircraft equipped with a reverse bar, if an engine is inoperative or feathered on landing, the throttle for that engine must be in either the OPEN (full forward) or CLOSE (normal idling) position before reversing can be accomplished on the remaining engines (*figure 3-2*).

WARNING

Reversing in flight is possible. Reversing must not be used except for ground operation.

Landing With One Engine Inoperative.

Use the following procedure during a landing with one engine inoperative.

A. Make a normal approach and landing except rpm at 2400 on descent check. When at high aircraft gross weights, make the approach slightly higher than normal.

B. Do not extend the wing flaps past 30 degrees until certain that the field can be reached.

C. Rpm – 2600 ON THE BEFORE LANDING CHECKLIST.

Landing With Two Engines Inoperative.

Use the following procedure during a landing with two engines inoperative:

A. Upon entering traffic pattern, RPM 2600, gear and flaps up, airspeed 150% V_s. On base leg taper airspeed to 140% V_s.

B. On final approach, maintain 140 knots and do not extend wing flaps past 20 degrees. When it is certain that the field can be reached, position the landing gear control lever to DOWN, operate at 2800 rpm, and use wing flaps as required.

C. If both inboard engines are inoperative, proceed as follows to operate the wing flaps, landing gear, and hydraulic brakes.

D. Emergency hydraulic pump selector valve lever – GENERAL SYSTEM.

E. Emergency hydraulic pump switch – HOLD IN THE ON POSITION.

F. After gear and flaps are positioned for landing, position the emergency hydraulic pump selector valve lever to BRAKE SYSTEM.

GO-AROUND WITH ONE ENGINE INOPERATIVE.

Use the following procedure in case it is necessary to make a go-around with one engine inoperative:

A. Apply maximum power (wet) and attain best climb airspeed.

B. Retract landing gear.

C. Retract wing flaps to 20 degrees. If obstacle clearance is required, climb at liftoff speed. When obstacles are cleared, make the transition to en route climb configuration and speed.

D. Proceed as during a normal takeoff. Be alert to meet control requirements resulting from application of maximum power at low airspeeds. Maximum power should not be applied if speed is below minimum control speed (83 knots IAS). Make the transition to the en route climb configuration and speed.

GO-AROUND WITH TWO ENGINES INOPERATIVE.

If a two-engine go-around is necessary when operating within the range of normal gross weights from an airspeed below two-engine climb airspeed (140 knots IAS), gear and flaps extended, then transition to two-engine climb configuration and airspeed must be made before a positive rate of climb can be established The amount of altitude lost during this transition will vary with gross weight, degree of flaps extended, and airspeed existing at the time the go-around is initiated. Proceed as follows:

A. Apply maximum power (wet)

B. Retract landing gear, wing flaps 20 degrees, and accelerate to 120 knots IAS.

Note

A wing flap retraction airspeed of 120 knots is based upon 115 percent of the stalling airspeed at 88,200 pounds gross weight, gear and flaps up.

C. Retract wing flaps and continue acceleration to two-engine climb airspeed (140 knots IAS).

Note

If obstacle clearance is necessary, start climb only after reaching 130 knots IAS. After obstacles are cleared, complete flap retraction and increase speed to two-engine climb airspeed (140 knots IAS).

D. Maintain maximum power until sufficient altitude is reached to maneuver; then reduce power to the amount required to maintain level flight at 150% Vs. At minimum control speed (V_{mc}) plus 10 percent margin (110 knots IAS) with two engines on one side operating, as power is applied for the overshoot, nearly full rudder, one-half to two-thirds aileron, and a 5-degree bank angle toward the two operating engines will be required to maintain a constant heading.

With two engines on one side inoperative, a small gain in rate of climb will result from using approximately a 5-degree bank angle toward the two operating engines. Maintain correct climb airspeed, and trim out directionally with reference to the turn-and-slip indicator by displacing the ball aproximately one-quarter width away from the inoperative engines. Use power as required up to the maximum available for terrain clearance, and METO power for en route climb.

If a two-engine go-around is required from a speed at or above the two-engine climb airspeed, and the aircraft is in the clean configuration, apply maximum, power, establish two-engine climb airspeed, maintain maximum power until sufficient altitude is reached to maneuver, then reduce power to the amount required to maintain level flight at 150% Vs.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE.

Engine failures may be simulated for practice. To simulate a feathered propeller condition, establish zero thrust on the failed engine (approximately 17 inches Hg and 1700 rpm). The items on the Engine Failure, Fire, and Feathering checklist may be called out without actually performing steps.

PRACTICE ENGINE FAILURE ON TAKEOFF BEFORE REACHING REFUSAL SPEED.

If a throttle is retarded during takeoff prior to reaching refusal speed, close all throttles and stop.

PRACTICE ENGINE FAILURE ON TAKEOFF AFTER REACHING REFUSAL SPEED.

If engine failure is simulated after refusal speed is reached, continue the takeoff, using rudder and ailerons to maintain directional control. Raise the landing gear as soon as possible after liftoff and climb at takeoff speed until clear of obstacles. Retract the wing flaps at approporiate speed and accelerate to en route climb airspeed and configuration.

PRACTICE LANDING WITH ONE OR TWO ENGINES INOPERATIVE.

To simulate a landing with one or two engines inoperative, set the throttles and rpm as recommended under Practice Maneuvers With One or More Engines Inoperative, and trim the aircraft for directional control. Unbalanced power can also be used to maintain directional control. When turning final approach for landing set rpm of the inoperative engines to the same rpm as the operative engines so that rapid power applications may be made if needed. Refer to LANDING WITH ONE OR MORE ENGINES INOPERATIVE, this Section.

PRACTICE GO-AROUND.

Practice go-around using three engines at altitude and notice altitude loss during the manuever. Notice also the amount of power that can be applied on the three engines without loss of directional control.

THREE-ENGINE FERRY OPERATING LIMITATIONS.

Maximum takeoff weight limitation — 76,000 pounds. Center-of-gravity limitations:

Forward limit (landing gear down) .... 11 percent

Aft limit (landing gear down) .... 28 percent

THREE-ENGINE TAKEOFF PROCEDURE.

There are two types of three-engine takeoffs: one is made with an inboard engine inoperative and the other made with an outboard engine inoperative. In either case, observe the following precautions:

A. Adjust seat and rudder pedals so that full rudder travel may be obtained.

B. The propeller of the inoperative engine must be feathered or removed, the ignition off, and the cowl flaps full closed.

C. Set the trim tabs to zero.

D. Extend the wing flaps to 20 degrees.

E. Keep the nosewheel in contact with the ground until minimum of 91 knots IAS is attained.

TAKEOFF WITH AN INBOARD ENGINE INOPERATIVE.

To accomplish a takeoff with an inboard engine inoperative, proceed as follows:

A. Align the aircraft with the runway and hold the brakes; advance the throttles on engines No. 1 and 4 to maximum power and release brakes.

B. As the aircraft starts the takeoff roll (approximately 9 to 17 knots), gradually advance the throttle on the inboard operative engine to maximum power.

C. Maintain direction with nosewheel steering. Apply down-elevator, as required, to increase nosewheel traction. With an aft cg, down-elevator is required throughout the takeoff run.

D. Apply full rudder opposite the inoperative engine until a speed of 61 to 69 knots is attained, and then decrease rudder deflection to the amount required to hold the aircraft straight. (This will be approximately one-half of full rudder throw at 87 knots.)

E. When the throttles of the operative engines are set for maximum power, apply approximately one-half aileron toward the side with the two operative engines.

F. Directional control must be maintained by use of nosewheel steering up to 61 to 69 knots. From this speed up to liftoff speed, directional control is maintained by use of nosewheel steering and displacement of the rudder and ailerons.

At liftoff speed (minimum 91 knots IAS), fly the aircraft off and establish a 5-degree bank away from the inoperative engine, which will decrease the amount of rudder required to maintain a straight course.

G. If obstacle clearance is required, climb at takeoff speed. When obstacles are cleared, make the transition to en route climb configuration and speed.

H. Proceed as during a normal takeoff.

TAKEOFF WITH ONE OUTBOARD ENGINE INOPERATIVE.

To accomplish a takeoff with an outboard engine inoperative, proceed as follows:

A. Align the aircraft with the runway and hold the brakes; advance the throttles on engines No. 2 and 3 to maximum power and release brakes.

B. Gradually advance the throttle on the operative outboard engine to obtain maximum power at approximately 61 to 69 knots.

C. Maintain direction with nosewheel steering. Apply down-elevator as required, to increase nosewheel traction. With an aft cg, down-elevator is required throughout the takeoff run.

D. Apply full rudder opposite the inoperative engine until after liftoff; then decrease rudder deflection to the amount required to establish best performance attitude.

E. When the throttles of the operative engines are set for maximum power, apply approximately two-thirds to three-quarters aileron toward the side with the two operative engines.

F. Directional control must be maintained by use of nosewheel steering up to 61 to 69 knots. From this speed to liftoff speed, directional control is maintained by use of nosewheel steering and displacement of the rudder and ailerons. At liftoff speed (minimum 91 knots IAS), fly the aircraft off and establish a 5-degree bank away from the inoperative engine, which will decrease the amount of rudder required to maintain a straight course.

G. If obstacle clearance is required, climb at takeoff speed. When obstacles are cleared, make the transition to en route climb configuration and speed.

H. Proceed as during a normal takeoff.

PROPELLER FAILURE.

PROPELLER MANUAL RPM CONTROL MALFUNCTION.

On early aircraft, if a short circuit occurs in the propeller automatic rpm control circuit, an automatic control circuit breaker will trip, causing the automatic system to become inoperative. Propeller manual rpm control is normally accomplished by simultaneous actuation of the four propeller selector switches located on the control pedestal; however, in case a short circuit exists in any one of the four individual manual control circuits and the propeller selector switches are toggled simultaneously, a 10-ampere propeller manual control circuit breaker, located on the main circuit breaker panel, will trip, and further rpm control will be impossible until the manual control circuit breaker is reset. To change propeller rpm manually when a short circuit exists in an undetermined individual manual control circuit, proceed as follows:

A. Reset the propeller manual control circuit breaker.

B. Toggle each propeller selector switch separately until the malfunctioning circuit is found (circuit breaker tripped).

C. Reset the propeller manual control circuit breaker.

D. Toggle only the remaining propeller selector switches for rpm change. (Full rpm control is available for the remaining propellers.)

E. Land as soon as possible.

WARNING

Do not actuate the propeller selector switch for the propeller in which a short circuit exists, as the manual control circuit breaker will trip.

On later aircraft, the 10-ampere magnetic-type manual control circuit breaker is replaced with a 5-ampere thermal-type circuit breaker. A 5-ampere fuse in each of the individual manual rpm control circuits is replaced with a 2-ampere slow-blow fuse. These changes permit simultaneous actuation of the propeller selector switches, as the 2-ampere slow-blow fuse will open and isolate the shorted circuit without tripping the manual control circuit breaker.

ALL ENGINES HUNTING OR SURGING.

If all engines are hunting or surging, attempt to establish synchronized operation as follows:

A. Position the master engine selector switch to the opposite engine.

B. If this does not correct the trouble, place the master engine selector switch in the MANUAL position.

C. If the engines continue to hunt or surge, place the tachometer isolation switches in the EMERGENCY position.

INDIVIDUAL PROPELLER OUT OF SYNCHRONIZATION.

If an individual propeller is out of synchronization in AUTOMATIC and the remaining propellers are functioning properly, perform the following:

A. Push the resynchronizing button repeatedly until the propeller is in synchronization.

B. If this does not correct the condition, actuate the respective propeller control switch to bring the propeller back into synchronization.

C. If the propeller does not stay in synchronization, place the master engine selector switch in the opposite inboard engine position and push the resynchronizing button.

D. If the propeller will not stay in synchronization, place the master engine selector switch in the MANUAL position and operate the individual propeller selector switches for synchronizing and change of rpm.

E. If the engine tachometers continue to fluctuate, place the tachometer isolation switches in the EMERGENCY position, which deletes automatic operation.

PROPELLER OVERSPEEDING.

If an engine tends to seriously overspeed, indicating that the propeller is not functioning to reduce rpm, proceed as follows:

1. THROTTLE CLOSE.
2. AIRSPEED - DECREASE TO 135 KNOTS IAS.
3. FEATHERING BUTTON - AS REQUIRED.
4. PROPELLER SELECTOR SWITCH - TOGGLE TO DECREASE RPM.
5. ENGINE FEATHERING PROCEDURE - AS REQUIRED.

Note

The two most important factors to be considered in the event of propeller overspeeding are the true airspeed of the aircraft and the power to the engine. If overspeeding occurs during cruise, feather the propeller, reduce all throttles, and increase the angle of attack (if conditions permit), in order to slow the aircraft to the recommended 135 knots IAS as soon as possible. If engine feathering is impossible, reduce the throttle and maintain rpm within limits by regulating the TAS of the aircraft.

Airspeed may be resumed after the propeller becomes stationary. In a high rpm windmilling condition, passengers should be moved aft of the plane of propeller rotation. A high rpm windmilling condition may be partially restored to normal by descending to a lower altitude, inasmuch as the propeller windmilling characteristics are a function of true airspeed.

When engine overspeeding occurs, land at the nearest base. The following information should be noted on Form 781 and reported to maintenance personnel: The maximum rpm and manifold pressure that were obtained during flight, duration in minutes of the overspeed condition and overpower condition, and the reason for overspeed, if known. Allowable rpm is 2800 to 2950, while an inspection is required at 2950 to 3400 rpm. An engine change is required when rpm exceeds 3400 rpm.

Note

Engine overspeeding usually occurs after a momentary power loss that is followed by a return to full engine power.

ENGINE SURGING AS RESULT OF MALFUNCTIONING FUEL SYSTEM.

It should be remembered that vapor locking of the fuel system, either in the fuel lines or in the carburetor chamber itself, can result in alternating slugs of fuel and vapor entering the engine, resulting in intermittent power loss and subsequent surging. See Fuel System Failure, this section, for corrective steps.

ENGINE SURGING RESULTING FROM EXCESSIVE LEAN MIXTURE.

If, after correcting the preceding conditions, engine surging is still evident, the trouble is probably originating in the engine itself. Place the fuel booster pumps in LOW, then place the mixture control in the AUTO RICH position and apply carburetor heat for several minutes. If necessary, actuate the primer to furnish additional fuel supply to the engine. This will usually correct the trouble, and the carburetor temperature then may be returned to the desired range.

UNREVERSING IN FLIGHT.

If a propeller is inadvertently reversed during flight, proceed as follows:

A. Reduce the airspeed to 135 knots IAS or less.

B. Move the throttle forward of detent to the CLOSE position.

C. Depress the feathering button.

Note

In case a propeller is reversed immediately after takeoff, make certain the throttle is forward of the detent and feather the propeller.

FAILURE OF PROPELLER TO UNREVERSE DURING GROUND OPERATION.

A. If one or more reverse indicator lights remain on after the throttles are returned to forward thrust position (or if failure to unreverse is suspected on aircraft not equipped with reverse indicator lights), check the propeller deicing ammeter for load. If load is indicated, trip affected reverse control circuit breaker(s) and momentarily depress feathering button to position blades to forward thrust position. If no load is indicated on the ammeter, momentarily depress the feathering button.

B. If the above procedure fails to accomplish unreversing, secure the engine as follows:

a. Throttle – REVERSE RANGE.

b. Propeller reverse and feathering control circuit breaker – TRIPPED.

c. Mixture control lever – IDLE CUTOFF.

d. Engine – SECURE.

C. If propeller feathering pump continues to operate beyond usual point of automatic cutoff after unreversing (malfunctioning blade cutout switch), immediately trip the reverse control circuit breaker to prevent full feathering of propeller. Propeller blades should automatically return to the low pitch, high rpm setting. If propeller has reached full feather position, secure the engine as outlined in step B.

Note

If an engine has stopped immediately after coming out of reverse, or is in the feathered position when coming out of reverse, the engine should be restarted prior to servicing the oil tank. This will preclude overfilling the oil tank when excess oil (pumped into engine nose section by the feathering pump) is returned to the oil tank.

FIRE.

ENGINE FIRE ON GROUND.

If an engine fire occurs during an engine start, perform the following:

A. Throttle – CLOSE.

Note

If an induction fire occurs, advance the throttle to full OPEN and keep the engine turning with the starter, while the following steps are being performed.

B. Mixture control lever – IDLE CUTOFF.

C. Ignition switch – OFF.

D. If the fire continues to burn, pull the fire extinguisher selector valve control handle for the affected engine full out and discharge CO_2, open the cockpit side windows, and signal the ground crew to use portable fire extinguishing equipment.

E. If the fire continues, summon fire fighting equipment.

F. Shut down the other engines, if operating.

G. Proceed with, and assist in, the evacuating of passengers.

H. Do not attempt to restart the engine after discharging CO_2.

ENGINE SECTION FIRE BEFORE TAKEOFF.

If a fire occurs in an engine section or nacelle while taxiing, as indicated visually or by a fire warning light, perform the following immediately:

1. Close the throttles.
2. Open the side windows.
3. Fire extinguisher selector valve handle for the affected engine — PULL OUT.
4. Either CO_2 discharge handle — PULL OUT.
5. Complete the engine shutdown.
6. Proceed with, and assist in, the evacuating of passengers.

ENGINE FIRE IN FLIGHT.

Complete the steps under Engine Failure, Fire, and Feathering checklist.

Note

All cockpit crew members must put on oxygen masks before or simultaneously with the discharge of CO_2. The crew member delegated to discharge CO_2 to the fire zone, however, may delay putting on his mask until after this operation is accomplished.

CAUTION

If a fire occurs in any engine, turn off all heaters.

After an engine fire has been extinguished and it becomes necessary to use the airfoil heaters or the cabin heaters, proceed as follows:

A. If the fire occurred in engine No. 1 or No. 4, the cabin heater may be operated normally. Do not operate the airfoil heaters unless absolutely necessary. If it can be determined that the fire was limited to zone 1, the airfoil heaters can be operated on the normal system.

B. If the fire occurred in engine No. 2, turn off the cabin heater fuel pump circuit breaker and use crossfeed fuel for operation of the cabin heater. If it can be determined that the fire was limited to zone 1, the cabin heater can be operated in the normal system.

C. If the fire occurred in engine No. 3, turn off the airfoil heater fuel pump circuit breaker and use crossfeed fuel for operation of the airfoil heaters.

OVERHEATED BRAKES.

During training flights, when frequent landings are being made or when excessive braking is required in an emergency stop, it is possible to overheat the brake system and cause a fire.

To avoid the possibility of retracting a gear with hot brakes into the wheel well and having it burst into flames, it is desirable to have a visual brake check made while taxiing or prior to takeoff. If brakes have been used excessively during taxiing, or during repeated landings, it may be advisable to leave the gear down for cooling while making the entire pattern around the field.

BRAKE FIRE.

In case of brake fire, proceed as follows:

A. Upon detecting a brake fire, notify tower to dispatch crash equipment and stop aircraft by means of opposite brake and reversing of outboard engines. After aircraft is stopped, hold aircraft by means of opposite brake and nose wheel steering.

B. Shut down all engines except the inboard engine on the side of the affected brake, and advance the throttle to blow combustible fluids away from the burning brake.

C. Send someone aft to see if the fire is out and to alert the flight attendant for possible evacuation.

D. If unable to extinguish the fire, order the evacuation of personnel as quickly as possible.

E. The remaining engine should be shut down and the crew evacuated when the crash equipment arrives.

Note

If the left gear is burning, it may not be feasible to evacuate the passengers from the main exit. In this event, they should be evacuated through the forward crew entrance door. One crew member should be stationed on the ground to keep people away from the turning propeller and also to keep them a safe distance from the fire because of the danger of an explosion.

GENERAL FIRE PROTECTION INFORMATION.

Note

The engine and nacelle area is divided into three zones: Zone I is the power section (forward of the inner ring), Zone II is the accessory section (between the inner ring and the firewall), and Zone III is the area aft of the firewall.

While there is no CO_2 protection in Zone I, a fire may burn through this zone into Zone II or III; therefore, CO_2 should be discharged regardless of zone indicated. With the cowl flaps open, some CO_2 will be drawn forward into Zone I to aid in preventing the fire from spreading; the CO_2 discharged into Zones II and III will also serve to cool the heated surfaces in those areas and will help prevent the ignition of fuel and oil. Zones II and III, both equipped with thermal detectors and CO_2 discharge systems, are to be considered as one zone since the thermal detectors are interconnected to a common warning light system, and CO_2 discharges simultaneously into both zones. The thermal detectors for both Zones II and III will illuminate the respective engine selector handle and both CO_2 discharge handles.

CAUTION

If a nacelle selector valve handle is pulled completely out, and CO_2 is not discharged to the area, the system will remain open until the selector handle is manually returned to the FULL IN position. Pushing the handle into the spring stop position will not close the system, thus permitting a split shot of CO_2 if another selector valve handle is pulled out and CO_2 is discharged. If the selector valve handle for an engine has been pulled to the FULL OUT position with no fire present and a fire subsequently develops in another area protected by the main aircraft system, it is necessary to momentarily return the previously selected handle to the FULL IN position prior to the discharge of CO_2 to the new area. Approximately 5 seconds after the system has been discharged, the handle selected originally may be returned to the FULL OUT position in order to again close the fuel and oil shutoff valves *(figure 3-1).*

The landing gear or flaps should not be extended until the last possible moment before landing, thus preventing extensive fire damage to the landing gear system or flaps. Leave the selector valve handle in the OUT position. Approximately 2 seconds after CO_2 is discharged, the selector valve handle should return ¾ inch toward the OFF position to close the selector valve. This automatic closing eliminates the necessity of manually closing the selector valve before CO_2 is released into another area. If a second fire occurs in the same area, or if the first fire is not extinguished with one charge of CO_2, *pull the selector valve handle completely out again* and then pull the other CO_2 discharge handle. However, do not release the second CO_2 discharge until the first has proved ineffective, to avoid wasting CO_2. If the propeller of the inoperative engine cannot be feathered, and no fire is present, the fire extinguisher selector valve handle may be pushed into the spring stop (approximately one-half of the total travel distance). This will partially open the oil shutoff valve and permit oil flow to reach the engine, reducing the possibility of an engine seizure. The fuel and hydraulic fluid valves will remain closed when the handle is returned to the spring stop from the FULL OUT position.

AIRFOIL ANTI-ICING HEATER FIRE.

The tail anti-icing heater is equipped with an individual CO_2 cylinder, while the wing anti-icing heaters are protected by CO_2 discharge from the two banks of large CO_2 cylinders in the main system.

WING ANTI-ICING HEATER FIRE.

In the event of a wing anti-icing heater fire, proceed as follows:

1. When either wing anti-icing heater warning light illuminates, use the heater master switch gang bar on the heater control panel to turn OFF both the airfoil and the cabin heater master switches; this will shut off the heater fuel pumps, fuel cycling valves, and heater ignition systems.

2. Declutch the cabin supercharger on the affected side. The supercharger oil, under pressure, is a fire hazard, and the possibility of smoke being drawn into the cabin is reduced by disengaging the supercharger.

3. Turn back the hinged plastic cover on the heater fire control panel and depress the heater fire extinguisher selector switch opposite the illuminated light. This energizes the circuit for

the heater selected and shuts off the fuel supply to all airfoil heaters.

Note

In case of improper actuation of the heater fire extinguisher selector switch, the selected switch may be repositioned by pressing the three quick-release fasteners on the heater fire control panel, dropping the control panel and resetting the improper selected switch to the normal position.

4. Crew oxygen masks on 100 percent.

WARNING

All cockpit crew members must put on oxygen masks before or simultaneously with the discharge of CO_2. The crew member delegated to discharge the CO_2 to the fire zone, however, may delay putting on his mask until this operation is accomplished.

5. Wait 5 to 10 seconds to clear the heater of fuel; then push the CO_2 discharge button adjacent to the wing heater selector switches. The button must be held in the depressed position for approximately 2 seconds.

   a. If a second discharge of CO_2 into the same wing heater becomes necessary, position the CO_2 bottle selector switch on the heater fire control panel to the opposite bank and again depress the discharge button for approximately 2 seconds.

   b. After discharging a bank of CO_2 cylinders into either wing anti-icing heater, reposition the CO_2 selector switch to the RIGHT BANK.

Note

If the second bank of CO_2 is discharged to the opposite wing anti-icing heater, the discharge will be divided between the two heaters, thus reducing the total amount of CO_2 discharged into the subsequently selected heater.

If the fire is not under control, land as soon as possible. If the fire is out, it is advisable to land as soon as practicable.

If necessary, the cabin heater may be restarted, provided the heater fuel system crossfeed is not used.

LOWER COMPARTMENT, CABIN, TAIL HEATER, OR APU (TAIL) FIRE.

In case of fire in the lower compartment, cabin, tail heater, or APU (if the APU is located in the tail section of the aircraft), the following procedures will be used in their entirety or in part. Specific items to be followed are prescribed in the paragraph dealing with the particular location of the fire.

1. HEATERS - OFF.
2. COPILOT OXYGEN - MASK ON; 100% OXYGEN.
3. HEATER AIR SHUTOFF SWITCH - EMER (or cabin temperature controls (65°F).
4. EMERGENCY DEPRESSURIZATION LEVER - UP.
5. HEATER FIRE CONTROL SELECTOR - ARMED.
6. CREW OXYGEN - MASKS ON: 100% OXYGEN.
7. CO_2 - DISCHARGED.
8. Hydraulic bypass lever - AS REQUIRED.
9. Emergency descent - AS REQUIRED.
10. Cockpit temperature - NORMAL.
11. Windshield heat - OFF.
12. Turbine switch - OFF.
13. Alcohol de-icer - OFF.
14. Fuel selector levers - SET.
15. Compartment - INSPECT.

Note

Immediately after CO_2 discharge, accomplish items 8 through 16.

TAIL ANTI-ICING HEATER FIRE.

In the event of a tail anti-icing heater fire, proceed as follows:

A. When the tail anti-icing heater warning light illuminates, use the heater master switch gang bar on the heater control panel to turn OFF both the airfoil and the cabin heater master switches. This will shut off the heater fuel pumps, fuel cycling valves, and heater ignition systems.

B. Complete steps 2, 3, and 4 under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure.

C. Turn back the hinged plastic cover on the heater fire control panel and depress the heater selector switch opposite the illuminated light.

D. Wait 5 to 10 seconds to clear the heater of fuel; then push the CO_2 discharge button for the tail heater. The button must be held in the depressed position for approximately 2 seconds.

E. Complete steps 8 through 15 under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure, and then inspect the tail compartment.

F. If the fire is not under control, remove pressure dome and apply CO_2 with hand extinguisher; land as soon as possible. If the fire is out, it is advisable to land as soon as practicable.

G. Do not use any of the airfoil heaters or APU following an airfoil heater fire or APU (Tail) fire. If necessary, however, the cabin heater may be restarted, provided the heater fuel system crossfeed is not used.

D-2 APU FIRE.

In case of fire in the D-2 APU, located in the forward baggage compartment, proceed as follows:

1. Ignition – OFF.
2. Crew oxygen – MASKS ON; 100% OXYGEN.
3. CO_2 – DISCHARGED.
4. APU throttle – DOWN.

GTP70 APU FIRE.

In case of fire in the GTP70 APU, located in the tail section, complete steps 1 through 16 under Lower Compartment, Cabin, Tail heater, or APU (Tail) Fire procedure.

LOWER COMPARTMENT PROCEDURES (SMOKE OR FUMES).

Note

These procedures are to be used in all cases where underfloor inspection is specified as a part of emergency procedures, or if underfloor smoke or fire is suspected for reasons other than those described.

A. If accessible, inspect the indicated or suspected compartment through the holes provided, using the viewer both with and without the compartment lights on.

B. If fire exists, remove the viewer, close and latch the cover over the viewer inspection hole, and proceed with Underfloor Fire procedures for the compartment involved.

C. If no fire is visible, inspect the remainng underfloor compartments, if viewer holes are accessible.

D. If no fire is observed in any underfloor compartment but smoke is present, investigate other possible sources of fire and continue to inspect compartments until landing is made.

LOWER COMPARTMENT FIRE PROCEDURES.

If a fire is indicated in any of the lower fuselage compartments (evidenced by both an illuminated fire extinguisher selector handle and both CO_2 discharge handles) complete all steps under Lower Compartment, Cabin, Tail Heater or APU (Tail) Fire procedure and proceed as follows:

Note

When the cabin emergency depressurization control lever is actuated, the cabin pressure regulator valve closes, the emergency depressurization valves lock in the OPEN position, and the superchargers lock in the DECLUTCH position. These positions should be maintained until reset by the ground crew.

WARNING

Do not discharge the second bank of CO_2 cylinders into the fuselage in less than 3 minutes. Earlier discharge of the second bank can cause dangerously high concentrations of CO_2 in the habitable portions of the aircraft. The use of one bank of CO_2 cylinders on fuselage fires should provide adequate protective concentration in most cases.

A. If accessible, inspect the lower compartment to make sure the fire is out.

Note

In case of fire in the hydraulic accessory compartment, the bypass control should be placed in the UP position and the hydraulic system pressure relieved.

CAUTION

Under most CO_2 discharge conditions, fog is formed momentarily and may be mistaken for smoke; therefore, extreme caution should be used in inspection of the compartment affected to determine the actual existence of a fire.

WARNING

Winterized CO_2 contains nitrogen and is invisible a few seconds after discharge. Caution should be used before entering the compartment or releasing a second CO_2 discharge.

B. If a second discharge of CO_2 into the lower compartment becomes necessary, pull the selector valve handle completely out again, then pull out the other CO_2 discharge handle.

C. If the fire is not under control, land as soon as possible. If the fire is out, it is advisable to land as soon as practicable.

CABIN HEATER FIRE.

The cabin heater is protected by an individual CO_2 cylinder that discharges directly into the combustion air and the ventilating air duct, and also by the main CO_2 system which protects both the cabin heater and the heater compartment. If the cabin heater fire warning light illuminates, complete steps 1 through 4 under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure, and proceed as follows:

Note

If the lights in the heater compartment main CO_2 selector valve handle, the CO_2 discharge handle, and the cabin heater fire warning light illuminate, the main CO_2 system should be operated rather than the control on the heater fire control panel.

A. Turn back the hinged plastic cover on the heater fire control panel and depress the cabin heater selector switch (opposite the illuminated warning light).

B. Pilot's oxygen mask—ON; 100% OXYGEN.

C. Wait 10 seconds to clear the heater of fuel; then push the CO_2 discharge button for the cabin heater.

The button must be held in the depressed position for approximately 2 seconds to discharge the 1.3-pound individual CO_2 bottles into the cabin heater.

D. Complete steps 8 through 15 under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure; then inspect the heater accessories compartment to make certain that the fire has been extinguished.

E. If a second discharge of CO_2 into the cabin heater becomes necessary, either bank of CO_2 cylinders may be discharged into the cabin heater and the heater compartment by pulling out the HEATER COMPT. selector valve handle and by pulling out either CO_2 discharging handle.

F. If accessible, inspect the heater accessories compartment.

CAUTION

Under most CO_2 discharge conditions, fog is formed and may be mistaken for smoke; therefore, extreme caution should be used in inspection of the compartment affected to determine the actual existence of a fire.

G. If the fire is not under control, pull the selector valve handle completely OUT again and then pull the other main CO_2 discharge handle.

WARNING

Do not discharge the second main bank of CO_2 into the fuselage in less than 3 minutes, because earlier discharge of the second bank can cause dangerously high concentrations of CO_2 in the habitable portions of the fuselage. The use of one bank of CO_2 on fuselage fires should provide adequate protection concentrations in most cases.

H. If the fire is still not under control, land as soon as possible. If the fire is out, it is advisable to land as soon as practicable.

I. Do not operate the cabin heater following a fire. However, if it becomes necessary to use the airfoil heaters, they may be restarted, provided the heater fuel system crossfeed is not used.

Note

Step 3 under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure is mandatory. If CO_2 is discharged with the mixing valve in the heater port, it is possible to induce CO_2 fumes into the cabin.

ELECTRICAL FIRE.

If the smoke or fire is definitely identified as being of electrical origin, proceed as follows:

1. EMERGENCY INVERTER - ON.
2. BATTERY AND GENERATOR GANG BAR - OFF (down).
3. CREW OXYGEN MASKS - ON: 100% OXYGEN.
4. ENGINE BLOWERS - LOW.

Note

When all d-c power is disconnected from the normal bus the engine blowers automatically return to LOW position. In order to prevent damage to the engines when d-c power is restored, engine supercharger switches must be positioned to the LOW position.

5. ISOLATE AFFECTED UNIT/CIRCUIT AND FIGHT FIRE.

WARNING

Prolonged exposure (5 minutes or more) to high concentration (pronounced irritation of eye and nose) 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 techachloride, methylbromide). However especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

If the source of smoke or fire is definitely identified as being of electrical origin and the source is not determined, continue as follows:

a. All circuit breakers — TRIPPED.

Note

The above steps have eliminated electrical power in all circuits except the emergency inverter. The following steps should be initiated progressively to determine the defective electrical circuit. It may be necessary to perform the steps under Lower Compartment, Cabin, Tail Heater, or APU (Tail) Fire procedure.

b. Battery and generator switches — ON.

c. Generator and field circuit breakers (one circuit at a time) — SET.

d. Either inverter circuit — ON.

e. Circuit breakers (one at a time) — SET IN ORDER OF IMPORTANCE, AS CIRCUMSTANCES REQUIRE.

f. Emergency inverter — OFF.

When the source of the smoke has been found in the above manner, leave that circuit inoperative and restore power to the remaining circuits.

MISCELLANEOUS CABIN OR FLIGHT COMPARTMENT FIRE.

Hand fire extinguishers are located in the cabin and flight compartment to be used at the crew's discretion on localized fires *(figure 3-3)*. Operating instructions are attached to each extinguisher.

SMOKE ELIMINATION.

In the event of heavy smoke concentrations in the cabin or cockpit, perform the following steps:

1. Crew oxygen masks — ON; 100% OXYGEN.
2. Emergency cabin altitude control — OPEN (FULL COUNTERCLOCKWISE).
3. Cabin to cockpit door — CLOSED.
4. Emergency descent — STARTED (IF REQUIRED)

Heavy smoke concentrations may be reduced in the cockpit by opening the copilot's side window after depressurizing. (If installed, open the hinged window in the flight compartment door.)

MISCELLANEOUS EMERGENCY EQUIPMENT — Typical

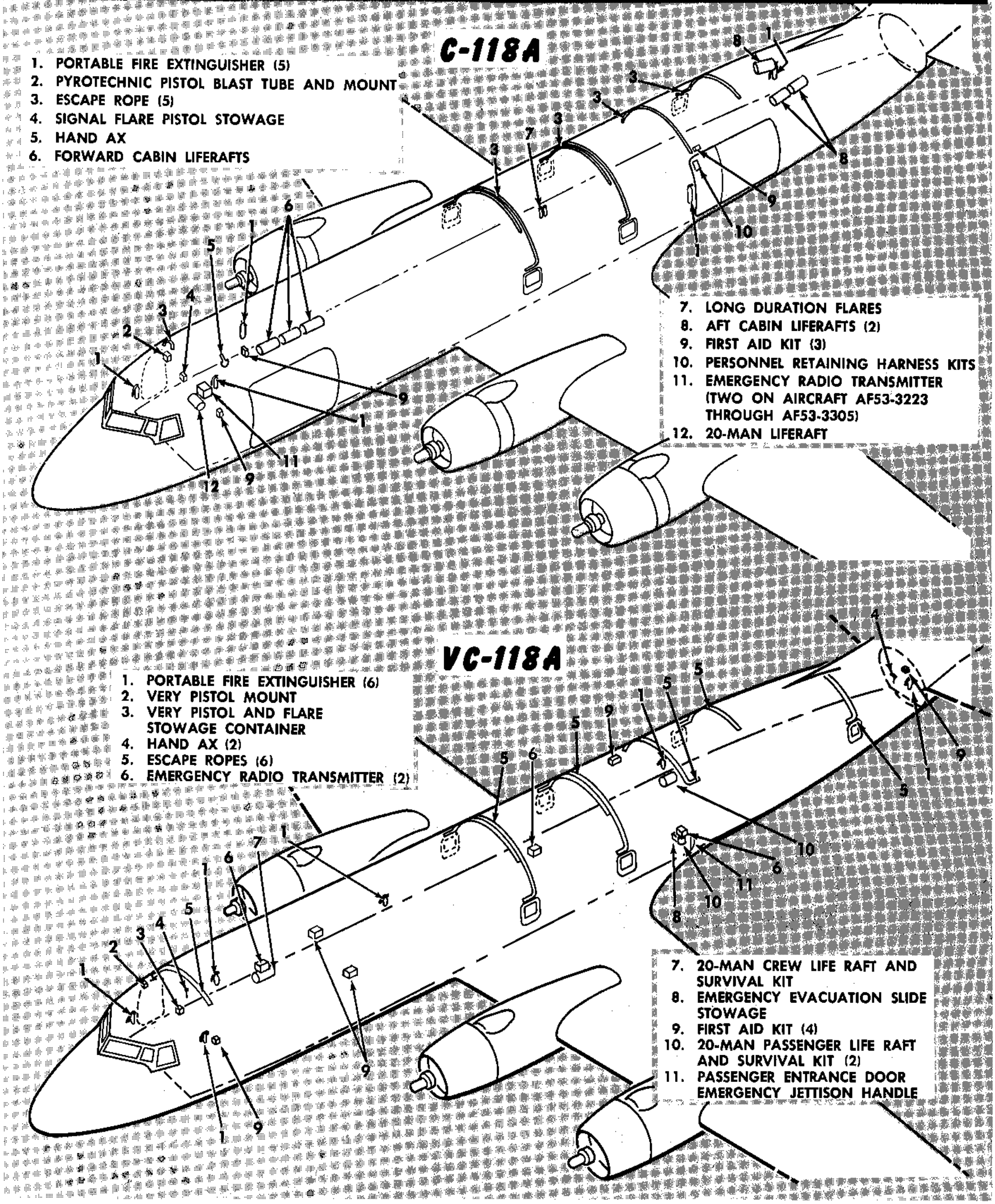


Figure 3-3

CAUTION

Do not exceed 260 knots IAS with a window open to avoid excessive negative pressure in the fuselage.

Heavy smoke concentrations in the main cabin area may be reduced by opening a forward emergency exit over the wing, after depressurizing and below 195 knots IAS.

WARNING

Do not open the crew entrance door in flight, and do not exceed 220 knots IAS with an emergency exit over the wing open. Maximum IAS for opening the emergency cabin exits and cockpit and exit door windows is 195 knots.

CAUTION

Do not exceed 220 knots IAS with the exit open to avoid excessive negative pressures in the fuselage.

WARNING

Judgment must be used when opening the emergency exit, since this will produce an increased airflow through the ventilating system with the possible result of increasing the fire hazard.

EMERGENCY DESCENT PROCEDURE.

CAUTION

If nature of flying conditions in descent requires 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 hundred 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.

There are two procedures for emergency descent, one with the aircraft clean and the other with the gear and flaps down. For discussion, these will be known as procedure A and procedure B, respectively.

Procedure A.

A. Gear — UP.

B. Wing flaps — UP.

C. Propellers — SET.

D. Throttles — SET.

E. Mixtures — SET.

Procedure B.

A. Gear — DOWN.

B. Wing flaps — DOWN.

C. Propellers — 2800 (full high rpm).

D. Throttles — CLOSE.

E. Airspeed — 152 knots.

F. Mixtures — SET.

Procedure A will be used mainly when a high airspeed is needed to cover a long distance from start of letdown to the point of intended landing. When practicable, descend at maximum dive speed (Vno).

Caution should be used to govern airspeed so that penetration speed is not exceeded during turbulent conditions.

Procedure B is used when the distance from start of letdown to the point of landing is short and when landing is to be effected immediately. Maximum rpm provides maximum propeller drag; however, high rpm should be avoided except in an emergency.

TAKEOFF AND LANDING EMERGENCIES.

Note

Combustion heaters should be turned off prior to all emergency landings.

REJECT.

If an engine fails prior to refusal speed or it is necessary to reject the takeoff for any reason before refusal speed has been reached, proceed as follows:

A. Retard all throttles.

B. Apply braking and reverse thrust as necessary.

NOTE

With dry runway, reversing three engines is permissible. With slick or icy runways, reverse symmetrically.

LANDING GEAR TIRE FAILURE.

A. If a tire is blown during takeoff and the remaining runway is sufficient to stop the aircraft, close the throttles and maintain directional control by using brakes and nosewheel steering. Use reverse thrust as necessary. If the remaining runway is not sufficient to accomplish a safe stop, continue the takeoff, but do not retract the landing gear, since the blown tire may jam the gear in the wheel well.

B. If the nosewheel tire is flat at time of landing, keep this wheel off the ground as long as possible, with aft cg at 33 percent.

Note

With a normal passenger load, the optimum cg is 25 to 28 percent aft. Moving two passengers from the center cabin area to the rear cabin area will shift the cg aft approximately 1 percent. Also, during flight, the cg will move forward slightly due to the depletion of fuel. During landing, keep the nosewheel off the ground as long as possible and use a minimum of braking.

C. If one or both tires are flat on one main gear, drop the nose gear as quickly as possible. There is very little actual danger in landing with one flat tire on one main gear. The landing should be made smoothly and taxiing should be done slowly.

D. If both tires are flat on one main gear as a result of striking some object on the runway, damage in addition to the flat tires may have occurred. For example, a hydraulic hose may also have been torn loose, a wheel may have been broken, or the landing gear itself may have been sprung. Move passengers forward, as seating permits, to obtain a forward cg which will place more weight on the nosewheel and provide positive steering after touchdown. Make a normal approach and landing. After touchdown, the aircraft will tend to swerve in the direction of the blown tires; therefore, land the aircraft on the side of the runway away from the blown tires to allow space for possible swerve during deceleration. The use of aileron on the flat tire side will ease the weight on the blown tires. When the aircraft has slowed, reverse thrust may be used on the outboard engine opposite the side of the blown tires to aid in maintaining directional control. Do not apply brakes to the wheels with the blown tires during the landing roll nor attempt to taxi after the aircraft has stopped.

NOSE GEAR RETRACTED—MAIN GEAR DOWN.

Landing with the nose gear up and the main gear down is much the same as landing in deep mud or snow, when the nose is held up as long as possible. Use the following procedure:

A. Shift the passengers in the cabin to give an aft cg of approximately 33 percent and fasten seat belts.

Note

With a normal passenger load, the optimum cg is 25 to 28 percent. Moving two passengers from the center cabin area to the rear cabin area will shift the cg approximately 1 percent.

B. Make a normal landing on the runway in a slightly tail-down attitude.

C. Immediately upon ground contact, apply sufficient up-elevator to keep the aircraft in a level attitude.

D. Maintain this level attitude until full up-elevator position is reached and the nose pitches over. If the tail is too low just before elevator effectiveness is lost, the nose contact with the ground will be severe.

Note

With the cg at 33 percent, the nose will contact the ground at approximately 52 knots at zero wind.

E. Apply as little braking as possible.

F. During initial rolling contact on the main gear, the fuel selector levers should be placed in the OFF position, electrical gang bar OFF, mixture levers in the IDLE CUTOFF position, ignition switches OFF, and all four main fire extinguisher selector valve handles should be pulled full out. If a fire breaks out in any nacelle, discharge *both* banks of CO_2. After the aircraft has stopped, personnel with hand fire fighting equipment should stand by.

Note

If desired, the load can be adjusted by moving passengers aft to obtain a cg of 35 percent to attain a stop with the tail resting on the ground. When the aircraft does come to rest with the tail on the ground, do not allow any movement of passengers within the cabin, since this may result in upsetting the balance of the aircraft. Wait until the ground crew can either install jacking equipment under the nose or tie the tail to a ground securing point.

BELLY LANDING.

There is a tendency to overshoot during a belly landing because of the reduction in drag resulting from the gear being fully retracted. Perform the following steps prior to making a belly landing:

A. Reduce gross weight by dumping fuel. Refer to the Fuel Dumping procedure, this section, and to figure 3-5 for fuel dumping system and total disposable fuel and dumping rates table.

B. If time permits, it is recommended that flares be jettisoned, pilot's and copilot's oxygen pressure be bled off, and the deiclng alcohol be depleted.

Emptying these systems minimizes the danger of fire.

C. Open the emergency exits after dumping fuel *(figure 3-8).*

D. Warn the crew and passengers to assume a crash or ditching position.

E. Make a normal approach.

F. Wing flaps — Full down as soon as landing on the field is assured.

G. Throttles — CLOSE immediately prior to ground contact. (Ground contact should be made in level to slightly tail-low attitude.)

H Battery and generator gang bar — OFF.

I Ignition switches — Off.

J. Firewall selector — ARMED.

K. Upon ground contact, discharge both banks of CO_2.

Note

If one main gear fails to extend, retract the gear if possible, and make a belly landing.

LANDING WITH ZERO WING FLAPS

A. Compute total landing distance from 50 feet over runway threshold as follows:

a. Obtain landing ground roll from *figure A6-1.* Multiply ground roll by 140%. This figure represents total landing distance for full flap configuration.

b. Multiply total landing distance for full flaps by 165%. This figure will represent total runway required to stop aircraft, after landing from 50 feet over threshold.

c. Based on computation made above, select a runway for landing which provides adequate safety margin.

B. Proceed downwind at pattern altitude and 150% V_s *(See figure 2-5.)*

C. Upon turning base, complete before landing checklist and maintain not less than 140% V_s (approximately 10 knots below downwind speed).

D. Roll out on final a minimum of 600 feet above field elevation and approximately two miles from end of runway. It may be desirable to plan the roll-out at a distance greater than two miles in order to provide more time to stabilize the approach angle and/or airspeed. If this is done; however, altitude above the runway must be increased proportionately so that a minimum descent rate of 500 fpm can be maintained.

Note

Due to increased airspeed there will be a tendency to overshoot the turn onto final approach. Plan the approach accordingly.

E. Taper airspeed in order to cross the runway threshold at 130% Vs and approximately 50 feet. During the no-flap approach and touchdown, aircraft attitude will be more nose high than experienced during normal landings. The abnormal attitude should pose no problem to forward visibility when the proper descent of approximately 500 fpm is maintained.

F. Touchdown at 120% Vs. Touchdown below 120% V_{s0} should not be attempted since it is possible to drag the tail skid at lower airspeeds.

G. Nose wheel contact with the runway can be severe due to the abnormally nose-high attitude at touchdown and lack of cushioning effect from wing flaps. The nose has a tendency to pitch forward sharply after touchdown. Although it is advisable to lower the nose as soon as possible so that braking can be initiated, the pitching tendency should be anticipated and the nose lowered promptly but gently.

H. Use reverse thrust and brakes as required.

FUEL DUMPING.

Whenever it becomes necessary to dump fuel *(figures 3-4 and 3-5)* use the following procedure:

1. Maximum airspeed — 185 KNOTS IAS.
2. Gear and wing flaps — UP.
3. Combustion heaters — OFF.
4. Fuel selector levers — MAIN.
5. Crossfeeds — OFF.
6. APU — OFF.
7. Unnecessary radio/radar equipment — OFF.
8. Pull fuel dump control handles completely aft to the OPEN position. (The first two-thirds of the control handle travel, to the detent, extends the chute; the final one-third of travel opens the fuel dump valve.)

Note

After fuel dumping has started, visual reference should be made of the fuel gages to determine the flow of fuel from each tank. In the event of a malfunction in any of the dump valves or chutes that would result in unbalanced fuel dumping, the operation should be stopped. Dumping can be stopped at any time after it is started.

AFTER FUEL DUMPING.

If fuel dumping procedure has been used, proceed as follows after the necessary weight of fuel has been dumped:

A. Push each dump control handle forward to the detent or DRAIN position. This closes the dump valves but leaves the chutes extended. Leave the control handles in the DRAIN position for 5 minutes to allow proper drainage.

B. It is required that a crew member visually check the chutes during the drain period to make certain the valves have closed and no fuel is running out. All chutes can be checked from the aft cabin area.

C. Place the control handles in the CLOSED (full down, forward) positions to retract the dump chutes.

CARGO JETTISONING

In the event it becomes necessary to jettison cargo during flight the following procedures are recommended.

Note

The main entrance door can be jettisoned in flight; however, this procedure is not recommended unless absolutely necessary due to the possibility of serious damage to the horizontal stabilizer.

CAUTION

Do not open the rear cargo loading door for jettisoning cargo.

A. Extend wing flaps to 30 degrees and maintain 120 to 130 knots IAS. (Extension of wing flaps may be limited by the instantaneous emergency or engine power available; however, it should be remembered that a reduced airspeed and use of wing flaps are vital to the success of cargo jettisoning.)

B. Depressurize aircraft by opening the cabin emergency dump valves.

C. Personnel designated to jettison cargo through the main entrance door should don safety harness and attach harness to a cargo tie down ring on the opposite side of the aircraft. At least two persons are necessary to jettison cargo through the door as one person is required to hold the door open.

CAUTION

Disperse cargo from floor level in order to preclude striking the horizontal stabilizer.

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 airplane interior.

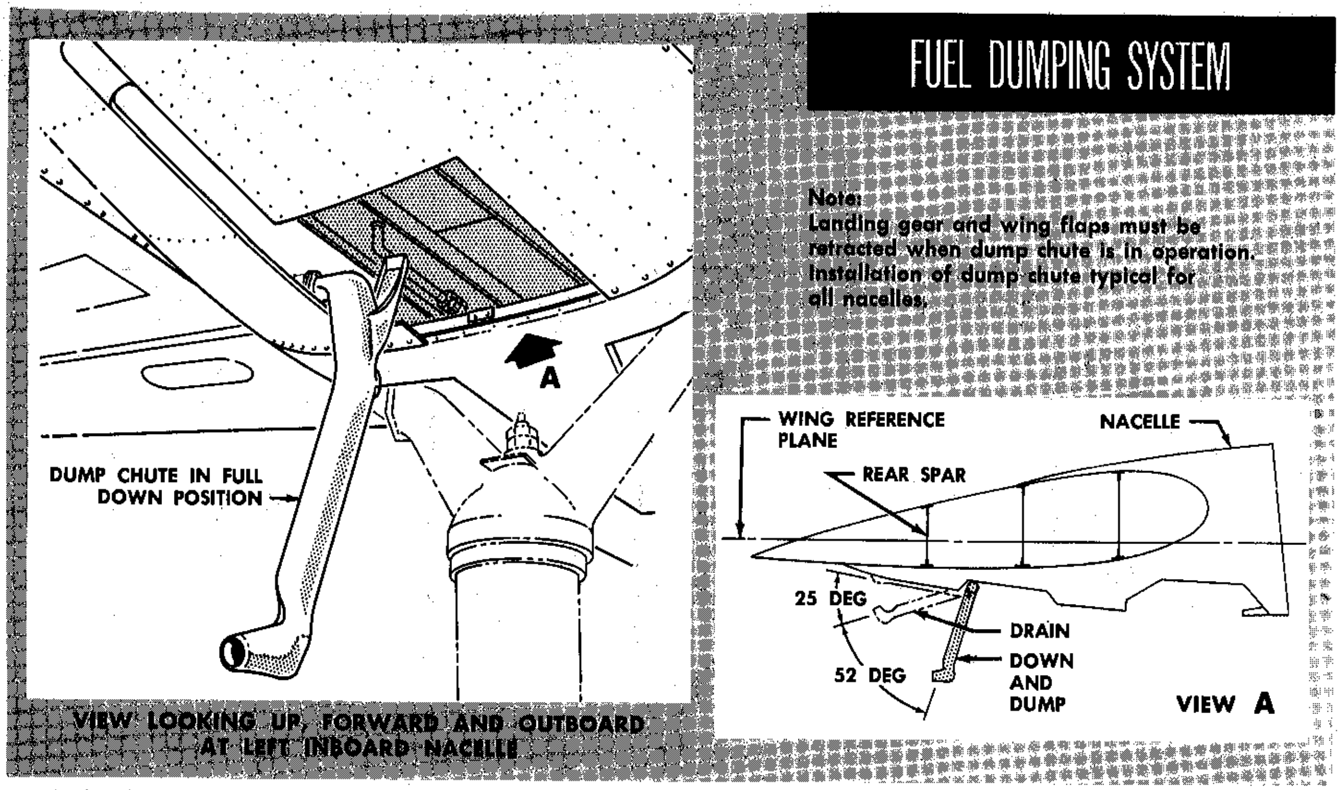


Figure 3-4

DITCHING AND SURVIVAL.

The procedure outlined herein for each phase of ditching and survival together with related information is a consolidation of the data and recommendations of the NACA Research Laboratory, US Coast Guard, the aircraft manufacturer, and commercial and military operations. The tests conducted by NACA clearly indicate that the ditching characteristics of the aircraft are good and that the reaction of the aircraft upon ditching and during the subsequent runout will be very similar to that of the C-54.

The successful ditching of an aircraft and subsequent survival differ from other emergencies in that a highly coordinated and cooperative effort is vital on the part of each and every crew member. Therefore, it is essential that all crew members be thoroughly trained in all phases of ditching and survival. Wet and dry ditching drills should be conducted frequently and as realistically as possible. The equipment utilized for drills should be identical to that carried on overwater flights. Written examinations should be comprehensive. Emphasis should always be placed upon a thorough knowledge of individual duties, including the care and use of emergency equipment. In general, the duties of other crew members should be understood in the event that one or more crew members become incapacitated.

Ditching cards outlining specific duties will be posted near each crew member's duty station. This card serves as a checklist, provided time permits. It will allow each crew member to review his duties on the ground or in the air. It may be used by supervisory personnel to check on the knowledge of crew members during ditching drills. It should be pointed out to all crew members that ditching cards list the most essential duties, in the sequence of importance and in consideration of the time element. The responsibilities of the crew member do not end with the completion of the duties specified on the ditching card. A number of variable factors will be present, such as the result of the emergency which dictates a ditching, the success of the ditching itself, and the measures taken thereafter to insure survival until rescue is accomplished.

The utilization of 20-man liferafts provides a number of advantages. There is a definite reduction in overall weight when compared to the number of small rafts which must be carried to accommodate the same passenger load. There is an overall reduction in space required for stowage. The size of the raft, its construction, and its emergency equipment content are definitely advantages in the open sea. The general acceptance of the 20-man liferaft places it in the category of standard equipment. Ditching procedures are therefore based upon the 20-man raft. In the event that liferafts with a capacity other than 20 men is utilized, the unit concerned will be responsible for the proper assignment of crew personnel and duties. These assignments will be consistent with the procedure specified herein and will be governed, basically, by the number and types of rafts installed.

TOTAL DISPOSABLE FUEL AND DUMPING RATES TABLE

FUEL SYSTEM	TOTAL USABLE FUEL		TOTAL DUMPABLE FUEL		TOTAL DUMPING RATES PER MINUTE		TOTAL DUMPING TIME (APPROXIMATE)	TOTAL USABLE FUEL AFTER DUMPING	
	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	MINUTES	GALLONS	POUNDS
COMBINED OUTBOARD TANKS (NO. 1 AND NO. 4 MAIN, NO. 1 AND NO. 4 ALTERNATE)	2442	14652	2210	13260	232	1392	9.5	232	1392
COMBINED INBOARD TANKS (NO. 2 AND NO. 3 MAIN, NO. 2 AND NO. 3 ALTERNATE)	2962	17772	2638	15828	224	1344	11.8	324	1944

AA1-131

Figure 3-5

Additional crew members may be handled as passengers; however, it is recommended that they be assigned to a crew member to assist in performing duties designated by the pilot or crew member concerned. Additional crew members who are familiar with or qualified in any crew position can be particularly useful.

Prior to each overwater flight, the pilot or his designated crew member representative will determine that the following equipment is on board and is properly stowed:

A. Liferafts — Adequate to accommodate the maximum cabin capacity plus maximum crew complement.

B. Life vests — A minimum of one life vest will be aboard for each person.

Note

- For aeromedical evacuation requirements, consult directives in effect.
- Seat belts, utilizing deck tie down are provided for crew members use aft of any cargo when no seats are available.

Basic emergency equipment, other than liferafts and life vests, will be placed aboard in the quantities specified in the directives of the major air command concerned. Additional equipment will be placed aboard in consideration of the areas involved and at the discretion of lowest echelon of command to which such authority is delegated.

Cabin exits are numbered one through six commencing with the main cabin door as No. 1 and numbering forward on the left side to the crew compartment. Continuing with the right forward window exit as number 4, number to the rear of the cabin to the No. 6 window exit *(figure 3-6)*.

The flight attendant will, before departure, divide the passengers into a maximum of four groups and inform each of the groups as to the exit to be used in case of ditching.

COMMUNICATION.

A ditching may be highly successful; however, the possibility of surviving until rescued will be greatly reduced unless it is known that you are in distress. It should be remembered that the necessity for ditching an aircraft is usually the result of more than one difficulty or emergency condition. Therefore, whenever you are in trouble, the most intelligent thing to do is to advise a station, ship, or other aircraft of your problems and intentions. Any message may be amplified or cancelled by another message. This should be done on the same frequency to insure that the stations originally intercepting a message may take necessary action to continue or discontinue their efforts in your behalf.

EMERGENCY EXITS — Typical

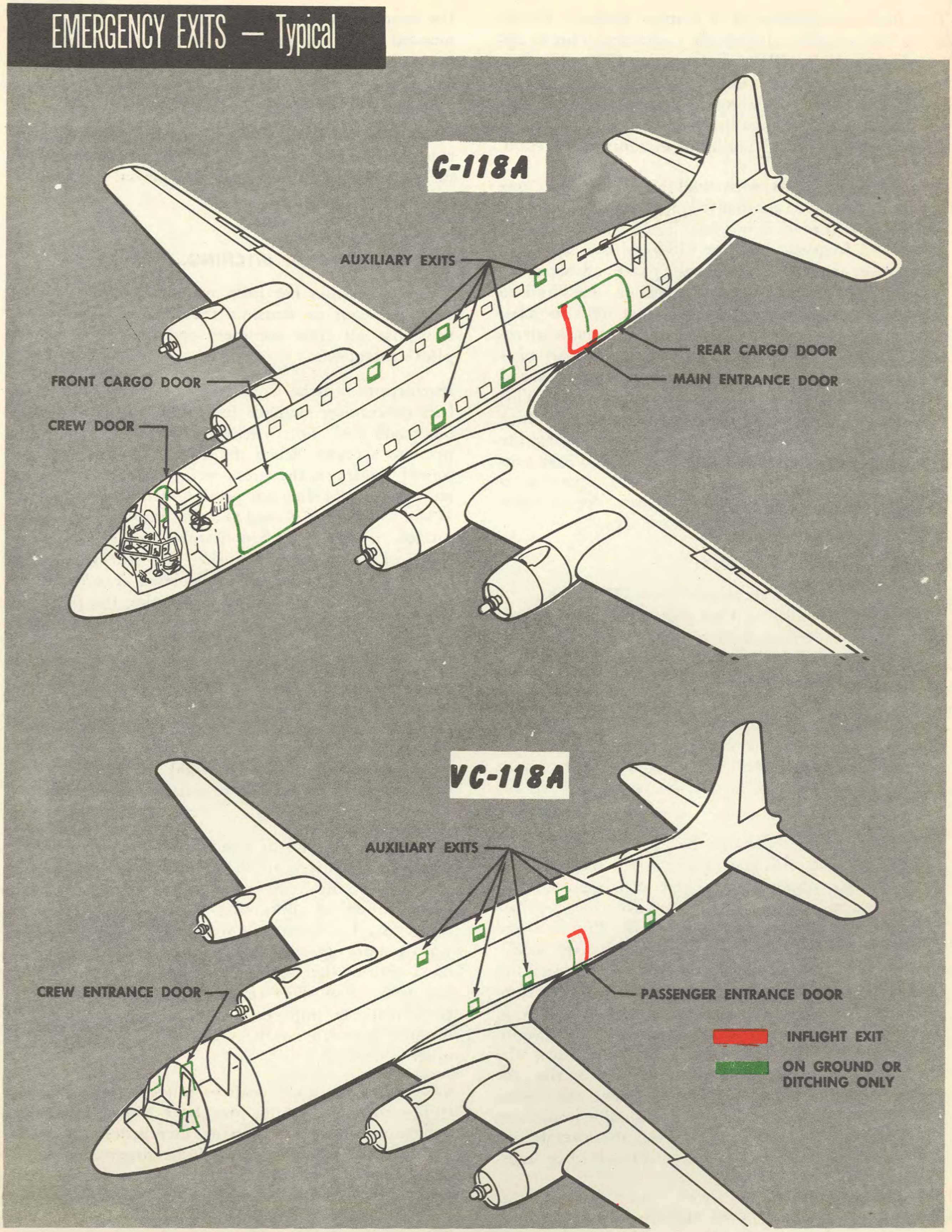


Figure 3-6

The first transmission of a distress message should be on the assigned air-ground frequency. This is applicable on VHF, UHF, HF, Voice, or CW, and when flying on airways, advisory routes, or uncontrolled routes over land or water. If acknowledgement is received, do not change frequency until directed to do so or a change in condition warrants such action.

In aircraft equipped with dual HF equipment, one set can be shifted to another frequency, preferably 8364 kilocycles. If contact is not established on the assigned air-ground frequency, utilize 8364 and call any ship, station, or aircraft. Should this prove unsuccessful, shift to 500 kilocycles and transmit in the blind to any or all stations. After the first call on 500 kilocycles, precede all subsequent calls with the automatic alarm signal of twelve 4-second dashes with intervals of 1 second between dashes (i.e., 4-second dash, 1-second interval; 4-second dash, 1-second interval; etc). This signal will automatically sound an alarm on all ships at sea. This system is employed on ships when the complement of radio operators does not allow continuous 24-hour coverage. The radio operator is berthed near the alarm and is therefore alerted when the alarm is activated by the above signal.

Note

Simultaneous transmission on HF-618S-1 radios is impossible. Care should be taken so as not to interfere with radio contact on one HF set by using the other.

The frequencies referred to above are a few of the many frequencies which can be employed in establishing contact with rescue facilities. Current procedures and frequencies are listed in the Supplementary Flight Information Document and Radio Facility Charts for the area concerned.

Serious consideration should be given to establishing communications with the nearest ocean station vessel at the earliest opportunity. These vessels guard 8364 kilocycles and 500 kilocycles in addition to a number of other frequencies, including UHF. Provided the aircraft can establish contact and reach the ocean station vessel, the possibility of a successful ditching is excellent. This course of action is highly recommended. Ocean station vessels are equipped to provide a modified radar approach, bearing and distance information, illumination of the ditching area, the conditions of the sea, distance between swells, the recommended ditching heading, weather conditions, and rescue boats. These vessels will take immediate action to close the distance between the aircraft and the vessel when a distress message is received or intercepted.

When an airfield or ocean station vessel cannot be reached, the heading should be altered to intercept the nearest surface ship. In this regard it is recommended that ship positions be obtained prior to an overwater flight. By plotting the ship's position, course, and speed, an intercept heading can readily be computed to the nearest ship.

Consult the Supplementary Flight Information Document and Radio Facility Chart for current procedures for alerting rescue facilities with partial or complete loss of communications.

PREPARATION FOR DITCHING.

When a decision has been reached, immediate steps will be taken to transmit the distress message and to advise all crew members and passengers of the pilot's intentions.

Instructions will be issued to appropriate crew members concerning methods for jettisoning cargo equipment and fuel. This matter can normally be covered prior to a flight. When the aircraft is used as a personnel transport, the gross weight cannot be greatly reduced, except for the possible jettisoning of fuel. When the aircraft is used as a cargo transport, extreme caution is advised when jettisoning. The resultant effect of raising and lowering the rear cargo door during flight has not been calculated. Therefore, the drag induced by jettisoning or opening the passenger door and opening the main cargo door is not known. With the passenger door streamed open, it is believed that the main cargo door can be opened and closed; however, it is possible that these doors may be jammed in such an operation. In case cargo is to be jettisoned, the crew members concerned will be securely fastened to the aircraft. The length of the securing line should allow movement, but not beyond the cargo door. It will probably be advisable to station one man on each side of the door.

In jettisoning cargo or equipment, serious consideration must be given to the possibility of the loss in structural strength incurred by jettisoning the door. By dumping or consuming fuel, buoyancy will be improved. A reduction in weight will reduce the forward momentum after touchdown. This will provide for a shorter deceleration period and a reduction in impact force. A short runout or deceleration distance is particularly important in the Atlantic, since the distance between swells is usually less than that in other waters.

The initial stowage and subsequent relocation of equipment for ditching may have a profound effect on the possibility of survival. Emergency equipment and liferafts in particular should be dispersed throughout the cabin. The importance of this matter has been proven in aircraft wherein the rear section parted upon ditching and the emergency equipment was lost. When a particular configuration does not lend itself to a permanent stowage plan which provides for adequate dispersal, a plan should be developed for relocation in flight. All loose equipment should be securely fastened to prevent injury to personnel from flying objects. This is particularly true of food and water containers, portable lights, stores, temporary tables, and navigator tables.

Do not conduct an evaluation of sea conditions at extremely low altitudes, except at night when flares are not available, or when information cannot be obtained from surface vessels, etc. This is important since there are usually two or more swell systems in the open sea. Combined with the height of the swell, currents and wind conditions, the sea will appear confused at low altitude. The primary, or basic, swell can be distinguished readily from high altitude and will first be seen during descent. Once low altitude (1500 feet or so) is reached, the primary swell may disappear from view. After selecting a ditching heading based upon a reasonable sea evaluation, the heading should not be altered more than 10 degrees. Serious considerations should be given to the relationship between swell and wind direction. There are times when a landing parallel to the swell may be accomplished in a crosswind of more than 30 knots. An actual ditching of a C-54 alongside an ocean station vessel was accomplished in a crosswind of approximately 40 knots. In this instance, the swell and wind movement were in the same direction. It is interesting to note that in this ditching, a second impact did not occur.

The forward speed of the aircraft, at touchdown, must be as low as possible, consistent with the desired angle of attack and gross weight. NACA tests have concluded that a full flap configuration (50 degrees), a forward speed of 94 knots at touchdown and a nose-up attitude of 7 degrees is the best possible combination. This will provide for a runout distance of approximately 600 feet. The maximum "g" force with the foregoing combination is expected to be 2 g's. This force would probably be less when landing parallel to the swell. Although the runout distance would be reduced to 450 feet, utilizing 12 degrees nose up, full flaps, and 85 knots at touchdown, this combination is not recommended. A nose-high attitude will result in greater damage to the underside and empennage and greater deceleration forces. With this combination, a deceleration force of 2.5 g's may be expected, together with greater damage.

The following information should be carefully studied in order to conduct a sea evaluation prior to ditching:

DEFINITIONS.

Sea — A wave, or undulating motion, caused by local disturbance.

Swell — A wave, or undulating motion, caused by a remote disturbance.

Length of swell — The horizontal distance from the crest of one wave to the crest of the adjoining wave.

Height of swell — The vertical distance between the trough and the crest of the wave.

Period — The time in seconds for the crest of two adjacent waves to pass a given point.

When the probability of a ditching exists, every effort should be made to determine the direction of the swell, the length and height of the swell, the period and velocity of the swell, and the wind direction and velocity. The swell is the primary factor in evaluating the sea for ditching since it normally is the greatest force or factor. In the event that essential information is not available through a ship or station, the sea may be evaluated through the use of smoke or light flares. By timing the rise of the flare to the crest of two adjacent swells, a period is determined. Usually, the period is determined as an average of the time over five swells. When a period has been determined, the length and velocity can be calculated from the formula, L equals $5P^2$ and V equals 3P, when L equals length in feet, P equals period in seconds, and V equals velocity in knots. The height of the sea will be very difficult to estimate from the aircraft. The following information will be helpful in the Atlantic Ocean. The average swell has a slope of 1 to 14 feet, and runs 6 to 8 feet in height. The maximum height seldom exceeds 10 to 12 feet. The length of the swell will average about 125 feet. It should be emphasized that the sea must be evaluated at 1500 feet or above in order to determine the direction of primary swell. At lower altitudes, it is almost impossible to observe the primary swell system. The wind can be determined by flying parallel to the wind streaks on the surface and solving the 180-degree ambiguity by watching the white caps. The white caps will break into the wind; however, the spray will be carried downwind.

No white caps — 0 to 10 mph.

Few white caps — 10 to 20 mph.

Many white caps — 30 to 40 mph.

Many white caps with spray — 40 mph plus.

When the sea evaluation has been completed, the pilot is in a position to decide upon a ditching heading. There are three major ditching possibilities. Given the following conditions, we can then further evaluate ditching possibilities: P (period) equals 10 seconds; L equals 500 feet; velocity equals 30 knots; then the runout average is 600 feet in 8 seconds (determining period mathematically, L equals $5P^2$ and V equals 3P, as previously explained).

DITCHING INTO SWELL.

In this instance, the swell moves toward the aircraft at the rate of 30 knots or approximately 260 feet in 8 seconds, so that the effective distance between swells would be only 240 feet (L equals 500 feet – 260 feet, or 240 feet) and the aircraft tends to nose into the swell. This course of action is not recommended and should be avoided when possible.

DITCHING DOWN SWELL.

In this instance, the swell moves with a velocity of 30 knots in the same direction as the aircraft. The aircraft is touched down with the receding swell and realizes an effective distance of 760 feet to come to rest. This is practical where the swells are far apart. This approach is not normally recommended in the Atlantic with its short swells.

DITCHING CROSS SWELL.

The third major condition is to ditch cross swell. This is a practical and recommended procedure. This procedure will usually provide a crosswind so that crabbing is necessary. Do not lower the wing more than is necessary. Ditching crosswind can be made in the trough, parallel to the swell or on the receding (back) side of the crest, parallel with the swell. The sun should be kept at the pilot's back when practical and altitude should be maintained by reference to the swell rather than the horizon. Do not attempt to land on the face of a rising swell. The existence of a wind may create a sea condition, as well as a swell system. If a wind and swell oppose each other long enough, the swell will decrease. If the wind and swell are at right angles, a normal trough is provided, and ditching can be made into the wind as well as parallel to the swells. In the average condition, the wind and swells are moving in the same direction, so that ditching parallel to the swell provides a crosswind. The following criteria have been established to aid the pilot in determining the effect of wind on the ditching pattern:

A. Winds from 0 to 20 knots – Land parallel with the major swell and down swell to the secondary swell system.

B. Winds from 20 to 35 knots – This is a difficult area for decision, wherein the best choice appears to be a heading at an angle to the wind line and slightly cross swell.

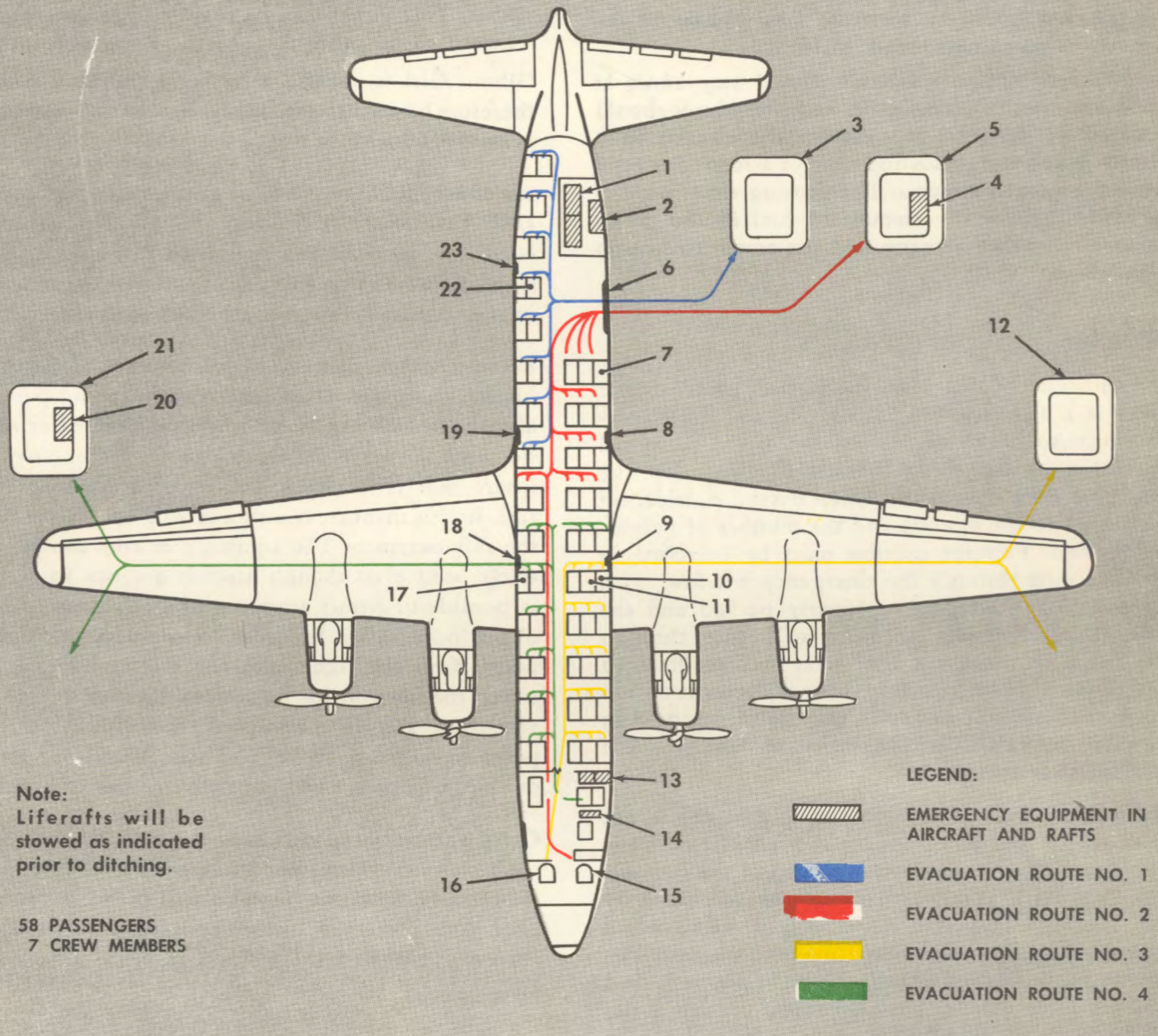
C. Winds over 35 knots – Head into the wind. The reduction in ground speed due to a high wind will improve the overall ditching problem.

When ditching at night or under instrument conditions, information concerning sea conditions may not be available unless ditching near an ocean station vessel or other surface ship. In these circumstances, the best course of action is to use the known wind and set up a landing pattern in that direction. Use flight instruments to establish proper attitude of the aircraft. Hold wings level to avoid dragging a wing into the water and cartwheeling the aircraft. Caution is advised concerning the use of landing lights. The pilot will probably be blinded, particularly at low altitudes. It is recommeded that the copilot be utilized to determine vertical distance visually and the pilot and copilot utilize the radio altimeter.

The wing flaps will (in all probability) be carried away at touchdown and, therefore, will not provide a plane to give a nose-down action. It must be remembered that the jagged metal, where the flaps are torn loose, will provide an area dangerous to the liferaft and personnel during evacuation. This is particularly true when evacuating through the exits over or near the wing. In addition to utilizing full flaps to reduce speed, the vertical descent must be as low as possible at touchdown. Therefore, ditch while power is still available. The rate of descent should not exceed 200 feet per minute during the approach nor 100 feet per minute just prior to touchdown. When the approach is made with power, the aircraft may be dragged along the approach until a comparatively calm sea is found for touchdown. While this procedure is permissible, it should be emphasized that the judgment of height, particularly at night, will be difficult; therefore, during darkness it would be preferable to establish the lowest possible rate of descent and maintain this descent until contact.

After touchdown, the aircraft should be held on the water. This does not mean that the control column is to be forced into the nose-down position. The control column should not be pulled full back, or nose-up, immediately after contact since it is possible for the aircraft to become airborne again. The resultant stall and damage can be considerable. The force to be applied to the control column will depend upon the planning action encountered. That is, when an appreciable nose-down or nose-up force is felt, an approximate counteracting force should be applied. When the counteracting force is in effect, caution is advised to avoid a porpoising effect. Porpoising is basically the result of overcontrol and planing due to sea conditions. Unless the pilot has had previous experience in seaplanes or ditching, a neutral position of the control column throughout the runout is recommended. The runout distance is relatively short and the design of the landplane fuselage does not indicate that an appreciable change in attitude can be accomplished in the time available. Shoulder straps will greatly reduce the possibility of personal injury to crew members. When installed, these straps must be worn during ditching. Although rearward- and forward-facing seats are designed for the same stress (6 to 9 g's), there are advantages in the rearward-facing seats. A normal sitting position with the back and head against the seat, in an upright position, eliminates the seat belt and bracing problems common to

TYPICAL EVACUATION PLAN—DITCHING



1. LIFERAFTS NO. 1 AND 2 (STOWED POSITION)
2. NO. 1 GIBSON GIRL RADIO (STOWED POSITION)
3. LIFERAFTS NO. 1 — NAVIGATOR AND 15 PASSENGERS
4. GIBSON GIRL RADIO
5. LIFERAFT NO. 2 — PILOT, 1ST FLIGHT ATTENDANT AND 13 PASSENGERS
6. EXIT NO. 1
7. 1ST FLIGHT ATTENDANT
8. EXIT NO. 2
9. EXIT NO. 3
10. 2ND FLIGHT ATTENDANT
11. RADIO OPERATOR
12. LIFERAFT NO. 3 — COPILOT, RADIO OPERATOR, 2ND FLIGHT ATTENDANT, AND 14 PASSENGERS
13. LIFERAFTS NO. 3 AND 4 (STOWED POSITION)
14. NO. 2 GIBSON GIRL (IF ABOARD), VERY PISTOL, AND FLARES
15. PILOT
16. COPILOT
17. CREW ENGINEER
18. EXIT NO. 4
19. EXIT NO. 5
20. NO. 2 GIBSON GIRL RADIO (IF ABOARD)
21. LIFERAFT NO. 4 — CREW ENGINEER, AND 16 PASSENGERS
22. NAVIGATOR
23. EXIT NO. 6

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Figure 3-7

forward-facing seats. When seats are not available, personnel should be seated in rows of three, bobsled fashion facing the rear of the aircraft, with the back of the forward man braced against a bulkhead (wall). Where forward-facing seats are utilized, the seat belt should be fastened tight and low on the hip bones and with the head down and braced on the knees. An alternate position would be with the head braced on the back of the seat immediately in front.

The average transport aircraft should stay afloat at least 3 minutes. Ditching drills and procedures should therefore be designed to evacuate the aircraft in 3 minutes. The average floating time of aircraft has been between 5 and 12 minutes. The floating time is basically influenced by the amount of fuel in the tanks, amount of fuselage damage, and the amount of cargo on board.

SURVIVAL.

Survival action begins when the aircraft comes to rest *(figure 3-7)*. The launching of liferafts and the evacuation of personnel must be orderly. Crew personnel responsible for launching liferafts should utilize the main cabin door exit to the fullest extent, considering the damage to the aircraft and the number of personnel involved. Extreme caution must be exercised in removing rafts through the emergency window exits. Provided that liferafts are properly packed and the shape is maintained, the rafts will pass through these exits. In the event that rafts become flattened through stacking or by piling other equipment on top of rafts, considerable difficulty may be experienced in removing the raft. The possibility of damaging the raft will also be increased.

Rafts that are launched over the wing area should not be inflated in the vicinity of the flap area. If possible, remove the raft to a position outboard of the flap section. Flaps will, in all probability, be carried away upon landing. This will leave jagged metal edges which may cause considerable damage to the raft. The launching and inflation of rafts should be accomplished by two or more people. The assignment of such duties may be made to other than crew personnel at the pilot's discretion. When rafts are loaded, a check should be made to ascertain that all personnel are accounted for. At night, display lights to enable any missing persons to locate the rafts. As soon as possible, check survivors for injuries and administer necessary first aid.

An important item aboard the raft is the Gibson Girl transmitter. As soon as practical, the antenna should be raised and the unit placed in operation. Do not rush the period of inflation for the balloon utilized to raise the antenna. It will normally require 30 minutes to fully inflate this antenna balloon. When fully inflated, the balloon is capable of sustaining the full length of the antenna in reasonably high wind. The minimum recommended diameter of the balloon is 40 inches. Do not kink the antenna. Use the instructions and checkoff list which accompany this equipment. Prepare distress signal messages for immediate use. It is recommended that the first signal be used for actuating the automatic alarm on surface ships on 500 kilocycles. Shift the transmitter to manual and transmit twelve 4-second dashes with 1-second intervals between dashes. This signal may be repeated between messages transmitted on other frequencies. Remember that the Gibson Girl is energized by hand cranking and may therefore be used continuously. Rotate this duty among personnel aboard the raft.

An effort should be made to insure that spare portable URC-4 radios are carried into the raft. This equipment is battery operated and is limited in range to line of sight. Conserve this equipment until rescue parties are in the vicinity or aircraft are observed in the vicinity.

Remove other distress signals from the accessories kit for ready use. Distribute signals among personnel aboard the raft and assign responsibility. After removing equipment from the accessory kit at any time, insure that it is closed and remains attached to the raft. In this manner, equipment will not be lost should the raft overturn. The signaling mirror can be effectively used even though aircraft are not in sight. It is possible to attract attention of aircraft at a distance of 30 to 40 miles. In order to establish the sighting point, flash the light onto the raft and align. Next sweep the horizon for maximum distance to signal an aircraft or ship in the vicinity, establish the sighting point as outlined above, and aim directly at aircraft or ship. Conserve flashlight batteries and smoke flares.

Carry antiexposure suits into the raft if not worn at the time of ditching. Put the suit on over wet clothes if necessary. The suit can be useful for many purposes oher than protection from exposure; e.g., it may be cut into strips to fashion slit goggles, to bind splints, etc.

As early as practicable, equipment should be set up to collect and manufacture water. The equipment aboard the raft includes solar stills which require some time to make water. Chemical desalting kits are also included. The kits are a positive means of obtaining drinking water and should not be used until all other means for obtaining water are exhausted. The taste of water can be improved by utilizing the purification tablets contained in the ration kits. The canopy should be used to trap water during periods of rain. The canopy cover should be installed to provide exposure protection from extremes of cold and heat and to attract attention. One side of the canopy is flourescent red in color and is visible at considerable distance, depending upon sea and light conditions.

Other important means of exposure protection from the cold are the wearing of the antiexposure suit over all possible clothing and keeping as dry as possible. Protection from the sun can be accomplished by keeping the body covered and applying protective ointment to exposed areas. The opposite side of the canopy is blue in color, and is used primarily for camouflage purposes.

20-Man Raft.

The following information concerns the operation of the 20-man raft:

All inflation valves and other appurtenances attached to the raft are identified by placards so that their functions may be easily understood.

CO_2 Inflation.

Only the main tubes of the raft are inflated by carbon dioxide equipment. The boarding section of both the upper and lower tubes is not inflated by CO_2.

Manual Inflation.

The uninflated chambers, one in each main tube, and the blister in the center of the floor, must be inflated manually. Placards adjacent to the valves indicate the chambers or sections to which they lead.

Sea Anchor.

The sea anchor is tied to the raft and, when trailing in the water, retards the drift of the raft. The position of the raft relative to the direction of the wind can be changed by moving the sea anchor attachment to another position of the raft. The raft is always downwind from the sea anchor.

Operating Instructions for 20-Man Raft.

The rafts are circular in shape and consist of twin tubes assembled one above the other. The round shape gives the most room for the least weight and span and is also most stable. The deck is placed between the two tubes and insures the raft's being right side up no mater how it comes out of the aircraft, it being the same on either side. The reason for this construction is the impracticability of righting a large capsizable raft.

Deck.

The deck, which is between the two tubes, traps air underneath it and makes a warmer and more comfortable seat for passengers. In order to prevent sagging of the deck, there is an inflatable section in the center which is inflated by the hand pump furnished with the raft.

Buoyancy.

The flotation is more than double that normally required. With a full load, only 80 percent of one tube is submerged. The tubes are independently airtight with the equalizer in place. If by accident the raft should be punctured, it can be quickly repaired by a Schrader leak plug, several of which are available in the accessories container.

Inflation.

A steel cylinder of carbon dioxide gas inflates both tubes in a few seconds. Jerking on the PULL handle actuates the valve on the cylinder, releasing the gas into the raft. The raft gets very cold, because of the expansion of gas, and in some spots may freeze hard and deposit snow which will soon thaw out. The raft will also grow more firm as it warms the gases. A small section of each tube remains uninflated and is blocked off by bulkheads. These sections are called boarding stations, and make it necessary to climb over the upper tube.

Operation.

Each raft with its accessories is individually packed in a carrying case and is carried on the aircraft in a position where it is quickly available. A PULL handle, connected by a cable to the inflation valve, is attached to the outside of the case under a warning cover designed to guard against inadvertent inflation. When the raft, still inside its case, is thrown overboard, the pull handle is held either by hand or by a line attached to the aircraft. The weight of the raft in falling provides the pull which actuates the valve. The raft is partially inflated by its fall and is quickly rounded by rapidly expanding gas. The raft is now ready to board, via the boarding station. Numerous labels, with arrows attached to the outside of the raft, guide personnel to the boarding station which also has handles for easy entrance. A strong webbing lifeline extends around the raft to enable personnel to hang on until able to board the raft.

Operation After Boarding Raft.

An accessories container, attached to the raft by a nylon cord, will be floating in the water. The container carries the following items:

1 Pump

1 Repair Kit with Pliers

5 Plastic Water Containers

1 Fishing Kit

1 Knife Assembly

1 Survival Manual

1 Nonliquid Compass

2 Sunburn-Preventive Cream

4 Chapping Lipsticks

1 Nylon Cord, 30 feet

4 Distress Signals

1 URC-4 Emergency Radio

1 Canopy Plus Mast and Poles

1 Bailing Bucket

2 Cellulose Sponges

2 Mattress Valve Washers

1 Emergency Signaling Mirror

6 First Aid Kits, Individual

12 Seawater Desalting Kits

2 Seawater Distilling Kits

8 Survival Rations

Remove the pump from the accessories container. To use the pump, screw the hose into the valve caps, open the valve caps two turns, then pump up the raft and close the valves. Ten valves are located in the raft, five on either side. These valves service the upper and lower tubes, the upper and submerged boarding stations, and the submerged deck compartment. These valves for submerged parts of the raft are accessible through sleeves in the deck. The boarding station should be inflated to gain added buoyancy and to close the gap in the tube. The submerged deck support in the middle of the raft should then be inflated. Main tubes should not be allowed to become too taut (remedy this situation by letting air escape from the valves). The action of cold water on the tubes at night may cause the tubes to become flabby, but additional air can be pumped in by means of the hand pump. Leak repair clamps are available in the accessories container, if leaks become apparent. The raft is equipped with an equalizer tube to equalize the pressure in both tubes. The equalizer tube has a shut-off valve, which is open at initial inflation. *This valve should be shut off after CO_2 has penetrated the tubes to prevent loss of CO_2 in case of a leak in either tube.*

The canopy carried in the accessories container is designed to protect occupants from sun and weather exposure. The canopy has 12 supporting rods and a canopy mast. The lower edge of the spray shield has an elastic cord threaded through it, the two ends of which can be snapped together. After snapping the cords together, the canopy should be stretched over the sides of the raft until the cord rests in the hollow between the top and bottom tubes. Next, erect the canopy mast on the center support from which to hang the canopy. Two sockets are provided for this purpose, one at the top of the canopy and one in the center support of the raft, which is folded down on the deck. The shield can then be supported by the 12 tube supports which fit into small sockets on the deck and into sockets at its upper side. The canopy and spray shield are then snapped together. Either the spray shield or the canopy can be opened for ventilation. The canopy and spray shield fits either side of the raft. After the canopy is erected, the sea anchor should be put out to hold the raft steady and decrease drift.

CREW MEMBERS' DUTIES.

Note

> The following aircrew procedures represent crew duties for a typical configuration *(figure 3-8).*

PILOT (AIRCRAFT COMMANDER).

First Actions.

A. Warns crew to prepare for ditching, giving approximate time left.

B. Alerts cabin personnel over public address system.

C. Orders radio operator or copilot to start emergency procedures.

D. Decides whether or not to dump fuel (all heaters OFF during this operation).

E. Checks and dons life vest.

F. Fastens safety belt and shoulder harness, loosens collar, and removes tie.

G. Takes over controls of aircraft from copilot.

H. Orders copilot to declutch superchargers.

I. If fuel is dumped, orders copilot to return dump valve handles to DRAIN position.

J. Turns on radio altimeter.

When Ditching is Imminent (10 Minutes Remaining).

A. Orders radio operator to send final distress signal and lock key down or actuate the automatic emergency transmitting equipment (if installed), unless HF contact has been established.

B. Resets altimeter from 29.92 to local area pressure.

C. Orders all heaters turned OFF.

D. Orders navigator to take charge of cabin and ascertains that preparations for ditching are complete.

E. Orders all personnel to secure themselves in their ditching positions. Has crew engineer check and report.

F. If at night, turns on wing illumination lights.

G. Immediately prior to ditching, orders crew engineer to take ditching station and informs everyone to "Brace for impact."

H. Orders copilot to return dump valves to OFF position, and to check depressurization to be completed.

Ditching Station.

A. Pilot's seat.

After Ditching.

A. After making certain all personnel have left aircraft, boards No. 2 liferaft through Exit No. 1 (main cabin door) and assumes command.

COPILOT.

First Actions.

A. Takes over controls while pilot adjusts equipment.

B. If radio operator is not aboard, assumes his first action duties, No. 1 and 2.

C. Takes emergency action on VHF/UHF (transmits "MAYDAY" and identification three times, followed by distress message).

D. Checks and dons life vest, fastens safety belt and shoulder harness, loosens collar, and removes tie.

E. On order of pilot:

a. Declutches superchargers.

b. Returns dump valves to DRAIN position.

When Ditching is Imminent (10 Minutes Remaining).

A. Assists pilot.

B. Returns dump valves to OFF position.

Ditching Station.

A. Copilot's seat.

After Ditching.

A. Leaves aircraft through Exit No. 3 and boards liferaft No. 3, after assisting passengers in loading, and assumes command.

NAVIGATOR.

First Actions.

A. Gives position, time, course, speed, altitude, nature of distress, and intentions of pilot to the radio operator or copilot for inclusion in distress message. (Complete Emergency Rescue Communications Procedures are listed in the appropriate Supplementary Flight Information Document.) Turns IFF to emergency position.

B. Lights forward exit lights.

C. Dons vest containing URC-4 emergency radio.

D. Checks and dons life vest, loosens collar, and removes tie.

E. Secures navigator's chair to deck near forward door and places table in stowed position.

F. Stows essential navigational equipment, including Very Pistol, flares, and aircraft compass, in bag.

When Ditching is Imminent (10 Minutes Remaining).

A. If at night, orders all crew members to light emergency flashlights connected to life vest.

B. Takes navigational gear to rear of aircraft and secures it near ditching station.

C. Insures that all preparations for ditching are complete.

DITCHING CHART *(C-118A)*

PILOT

A. Warns crew to prepare for ditching; gives time left.

B. Alerts cabin personnel.

C. Orders radio operator or copilot to start emergency procedures.

D. Dumps fuel if necessary. (All heaters must be OFF for this operation.)

E. Checks and dons life vest.

F. Fastens safety belt and shoulder harness.

G. Takes over aircraft controls.

H. Orders copilot to declutch superchargers.

I. If fuel dumped, orders copilot to return dump valve handles to DRAIN position.

J. Turns on radio altimeter.

COPILOT

A. Takes over controls while pilot adjusts equipment.

B. If radio operator not aboard, assumes his first action duties, No. 1 and No. 2.

C. On pilot's orders, sends MAYDAY followed by distress message.

D. Dons life vest and fastens safety belt and shoulder harness.

E. On order of pilot, declutches superchargers and returns dump valves to DRAIN.

NAVIGATOR

A. Gives position, time, course, speed, altutide, nature of distress, and intentions of pilot to radio operator for inclusion in distress message. Turns IFF to emergency.

B. Lights forward exit lights.

C. Dons vest containing URC-4 emergency radio.

D. Dons life vest.

E. Secures navigator's chair and places table in stowed position.

F. Stows Very pistol, flares, aircraft compass and other essential navigational equipment in bag.

CREW ENGINEER

A. Procures life vest for pilot, copilot, navigator, and radio operator.

B. Secures all loose objects in crew compartment.

C. Removes first aid kits and Gibson Girl radio at appropriate exits.

D. Dons vest containing URC-4 radio.

E. Dons life vest.

Figure 3-8 (Sheet 1 of 4)

[redacted]

WHEN DITCHING IS IMMINENT (10 MINUTES LEFT)	POSITION	AFTER DITCHING
A. Orders radio operator to send final distress signal. B. Resets altimeter from 29.92 to local area pressure. C. Orders all heaters turned off. D. Orders navigator to take charge of cabin; ascertains that ditching preparations are complete. E. Orders all personnel to secure themselves. F. If at night, turns on wing illumination lights. G. Immediately prior to ditching, warns, "Brace for impact." H. Orders copilot to return dump valves to OFF and to check that depressurization is complete.	Pilot's seat.	A. Makes certain all personnel have left aircraft and then exits through Exit No. 1.
A. Assists pilot. B. Returns dump valves to OFF.	Copilot's seat.	A. Assists passengers, then leaves aircraft through Exit No. 3.
A. If at night, orders crew members to light emergency flashlights. B. Secures navigational gear near ditching station at rear of aircraft. C. Insures all ditching preparations are complete.	Rear seat near Exit No. 1.	A. Launches liferaft No. 1 through Exit No. 1. B. Assists passengers in boarding liferaft No. 1. C. Boards liferaft No. 1 with navigational gear and first aid kit.
A. Checks and reports that all personnel are at ditching stations.	Seat near Exit No. 4	A. Launches liferaft No. 4 through Exit No. 4. B. Assists passengers in boarding liferaft No. 4. C. Enters liferaft No. 4 with first aid kit and Gibson Girl radio.

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Figure 3-8 (Sheet 2 of 4)

DITCHING CHART *(C-118A)*

FIRST ACTIONS

RADIO OPERATOR

A. On orders from pilot, sends emergency distress signal, followed immediately by distress message.

B. Obtains bearings and fixes if requested by pilot.

C. Dons life vest.

D. Continues emergency radio procedure.

FLIGHT ATTENDANT

A. Orders all passengers to remove shoes, check and don life vests, and fasten safety belts.

B. On order from pilot, jetfisons all cargo and baggage not necessary for survival.

C. Secures loose equipment in cabin.

SECOND FLIGHT ATTENDANT

A. Assists first flight attendant as directed.

Figure 3-8 (Sheet 3 of 4)

Ditching Station.

A. Rear seat near Exit No. 1.

After Ditching.

A. Launches liferaft No. 1 through Exit No. 1.

B. Assists passengers in boarding liferaft No. 1.

C. Boards liferaft No. 1 with navigational gear and first aid kit, and assumes command.

CREW ENGINEER.

First Actions.

A. Procures life vests for pilot, copilot, navigator, and radio operator.

B. Secures all loose objects in crew compartment.

C. Removes first aid kits and Gibson Girl radio and secures them at appropriate exits.

D. Dons vest containing URC-4 radio.

E. Checks and dons life vest, loosens collar, and removes tie.

When Ditching is Imminent (10 Minutes Remaining).

A. Checks and reports all personnel at ditching stations.

Ditching Stations.

A. Seat near Exit No. 4.

WHEN DITCHING IS IMMINENT (10 MINUTES LEFT)	POSITION	AFTER DITCHING
A. Sends final distress signal and message. B. On order from pilot, screws key down and proceeds to ditching station.	Seat near Exit No. 3	A. Launches liferaft No. 3 through Exit No. 3. B. Assists passengers in boarding liferaft No. 3. C. Enters liferaft No. 3 with one first aid kit.
A. Turns on emergency cabin lights. B. Cautions passengers not to smoke. C. Checks life vests and safety belts of passengers. D. If at night, orders all passengers to turn on flash-lights. E. Briefs passengers as to location of exits and liferaft assignments. F. Removes safety wire on each exit. (Does not open exits.)	Seat near Exit No. 1	A. Launches liferaft No. 2 through Exit No. 1. B. Assists passengers in boarding liferaft No. 2. C. Enters liferaft No. 2 with first aid kit and Gibson Girl radio.
	Seat near Exit No. 3	A. Launches liferaft No. 3 through Exit No. 3. B. Assists passengers in boarding liferaft No. 3. C. Collects any additional equipment and rations and boards liferaft No. 3.

Figure 3-8 (Sheet 4 of 4)

After Ditching.

A. Launches liferaft No. 4 through Exit No. 4.

B. Assists passengers in boarding liferaft No. 4 at Exit No. 4.

C. Enters liferaft No. 4 with first aid kit and second Gibson Girl radio (if aboard) and assumes command.

RADIO OPERATOR.

First Actions.

A. On orders from pilot, sends emergency distress signal (on air-ground frequency in use at the time), followed as soon as possible by emergency message containg position, time, course, speed, altitude, nature of distress, and intentions of pilot obtained from navigator. (Complete Emergency Rescue Communications Procedures are listed in the appropriate Supplementary Flight Information Documents.)

B. Obtains bearings and fixes if requested by pilot.

C. Checks and dons life vest, loosens collar, and removes tie.

D. Continues emergency radio procedure.

DITCHING CHART (VC-118A)

FIRST ACTIONS

PILOT (AIRCRAFT COMMANDER)

A. Warns crew to prepare for ditching, giving approximate time left.

B. Alerts cabin personnel over public address system.

C. Orders radio operator or copilot to start emergency procedures.

D. Decides whether or not to dump fuel. (All heaters must be off for this operation.)

E. Checks and dons life vest.

F. Fastens safety belt and shoulder harness, loosens collar, and removes tie.

G. Takes over controls of aircraft from copilot.

H. Orders copilot to declutch superchargers.

I. If fuel is dumped, orders copilot to return dump valve handles to DRAIN position.

J. Turns on radio altimeter.

COPILOT

A. Takes over controls while pilot adjusts equipment.

B. If radio operator is not aboard, assumes his first action duties No. 1 and NO. 2.

C. Takes emergency action on VHF/UHF. (Transmits "MAYDAY" and identification three times, followed by distress message.)

D. Checks and dons life vest, fastens safety belt and shoulder harness, loosens collar, and removes tie.

E. On order of pilot:

a. Declutches superchargers.

b. Returns dump valve handles to DRAIN position.

NAVIGATOR

A. Passes position, time, course, speed, altitude, nature of distress, and intentions of pilot to the radio operator or copilot for inclusion in distress message. (Complete Emergency Rescue Communications Procedures are listed in the appropriate Supplementary Flight Information Document.) Turns IFF to emergency position. Reports nearest ship position to pilot.

B. Dons vest containing URC-4 emergency radio.

C. Checks and dons life vest, loosens collar, and removes tie.

D. Secures navigator's chair and places table in stowed position.

E. Stows essential navigational equipment, including Very pistol, flares, and aircraft compass, in bag.

Figure 3-9 (Sheet 1 of 6)

DITCHING CHART

WHEN DITCHING IS IMMINENT (10 MINUTES REMAINING)	DITCHING STATION	AFTER DITCHING
A. Orders radio operator to send final distress signal and lock key down or actuate the automatic emergency transmitting equipment unless HF contact has been established. B. Resets altimeter from 29.92 to local area pressure. C. Orders all heaters turned off. D. Orders navigator to take charge of cabin and ascertain that preparations for ditching are complete. E. Orders all personnel to secure themselves in their ditching positions. Has first engineer check and report. F. If at night, turns on illumination lights. G. Immediately prior to ditchir g orders first engineer to take ditching station and informs everyone to "Brace for impact." H. Orders copilot to return dump valve handles to OFF position and to check that depressurization is complete.	Pilot's seat.	A. After assuring all personnel have left aircraft, boards liferaft No. 2 through Exit No. 3 and assumes command. B. Secures to liferaft No. 1 as soon as practicable.
A. Assists pilot. B. Returns dump valve handles to OFF position.	Copilot's seat.	A. Leaves aircraft through Exit No. 3 and boards liferaft No. 2.
A. If at night, orders all crew members to light emergency flashlights connected to life vest. B. Takes navigational gear to rear of aircraft and secures it near ditching station. C. Insures that all preparations for ditching are complete.	Rear seat near Exit No. 1.	A. Launches liferaft No. 1 through Exit No. 1. B. Boards liferaft No. 1 with navigational gear and first aid kit and assumes command. C. Assists passengers in boarding liferaft No. 1. D. Secures to liferaft No. 2 as soon as practicable.

Figure 3-9 (Sheet 2 of 6)

DITCHING CHART (VC-118A)

FIRST ACTIONS

RADIO OPERATOR

A. On orders from pilot, sends emergency distress signal (on air-ground frequency in use at time) followed as soon as possible by emergency message containing position, time, course, speed, altitude, nature of distress, and intentions of pilot obtained from navigator. (Complete Emergency Rescue Communications Procedures are listed in the appropriate Supplementary Flight Information Document.)

B. Obtains bearings, fixes, and ditch heading.

C. Checks and dons life vest, loosens collar, and removes tie.

D. Continues emergency radio procedure.

FIRST ENGINEER

A. Procures life vest for pilot, copilot, navigator, and radio operator.

B. Secures all loose objects in crew compartment.

C. Dons vest containing URC-4 emergency radio.

D. Checks and dons life vest, loosens collar, and removes tie.

SECOND ENGINEER

A. Checks both life rafts for proper stowage near appropriate exits.

B. Collects all first aid kits and Gibson Girl radios and secures them at appropriate exits.

C. Collects emergency water, food, blankets, and extra flashlights and secures them at appropriate exits.

D. Checks and dons life vest, loosens collar, and removes tie.

E. Secures all cabin aisle doors open. (Tie open with rope.)

F. Performs any other duties as directed by the pilot.

Figure 3-9 (Sheet 3 of 6)

WHEN DITCHING IS IMMINENT (10 MINUTES REMAINING)	DITCHING STATION	AFTER DITCHING
A. Sends final distress signal and message. B. On order from pilot, locks down key, or actuates the automatic emergency equipment, and proceeds to ditching station.	Aisle seat in crew compartment, facing aft.	A. Assists pilot as necessary. B. Boards liferaft No. 2 through Exit No. 3 with Gibson Girl radio and one first aid kit.
A. Checks and reports all personnel in ditching stations.	Seat near Exit No. 3.	A. Launches liferaft No. 2 through Exit No. 3. B. Boards liferaft No. 2 at Exit No. 3.
A. Proceeds to ditching station.	Seat near Exit No. 3.	A. Assists first engineer in launching liferaft No. 2. B. Assists crew in boarding liferaft No. 2 at Exit No. 3. C. Boards liferaft No. 3 through Exit No. 3 after ascertaining that all available water, rations, blankets, etc, are aboard.

Figure 3-9 (Sheet 4 of 6)

DITCHING CHART (VC-118A)

FIRST ACTIONS

FIRST FLIGHT ATTENDANT

A. Orders all passengers to remove shoes, check and don life vests, fasten safety belts, remove ties, loosen collars, remove glasses, dentures, and all sharp objects from their person. Checks and dons life vest.

B. On order from pilot, jettisons all cargo and baggage not necessary for survival after ditching.

C. Secures loose equipment in cabin.

SECOND FLIGHT ATTENDANT

A. Assists first flight attendant as directed.

Figure 3-9 (Sheet 5 of 6)

When Ditching is Imminent (10 Minutes Remaining).

A. Sends final distress signal and message.

B. On order from pilot, screws key down, or actuates the automatic emergency equipment (if installed), and proceeds to ditching station.

Ditching Station.

A. Seat near Exit No. 3.

After Ditching.

A. Launches liferaft No. 3 through Exit No. 3.

B. Assists passengers in boarding liferaft No. 3 at Exit No. 3.

C. Enters liferaft No. 3 with one first aid kit.

FLIGHT ATTENDANT.

First Actions.

A. Orders all passengers to remove shoes, check and don life vests, fasten safety belts, remove ties, loosen collars, and remove glasses, dentures, and all sharp objects from their person.

B. On order from pilot, jettisons all cargo and baggage not necessary for survival after ditching.

C. Secures loose equipment in cabin.

When Ditching is Imminent (10 Minutes Remaining).

A. Turns on emergency cabin lights.

B. Cautions passengers not to smoke.

C. Checks all passengers for proper wearing of life vest and security of safety belts.

[redacted]

WHEN DITCHING IS IMMINENT (10 MINUTES REMAINING)	DITCHING STATION	AFTER DITCHING
A. Turns on emergency cabin lights. B. Cautions passengers not to smoke. C. Checks all passengers for proper wearing of life belts and secure safety belts. D. If ditching is during darkness, orders all passengers to turn on flashlights attached to life vests. E. Again briefs passengers as to location of exits and raft assignments. F. Removes safety wire on each exit. (Do not open.)	Seat near Exit No. 1.	A. Assists navigator in launching liferaft No. 1. B. Assists passengers and crew in boarding liferaft. C. Boards liferaft No. 1 last, through Exit No. 1.
	Seat near Exit No. 1.	A. Assists passengers in boarding liferaft No. 1 at Exit No. 1. B. Collects any additional equipment, including Gibson Girl radio, large first aid kit, rations, and water, and boards liferaft No. 1 through Exit No. 1, next to last.

Figure 3-9 (Sheet 6 of 6)

D. If ditching is during darkness, orders all passengers to turn on flashlights attached to life vests.

E. Again briefs passengers as to location of exits and liferaft assignments.

F. Removes safety wire on each exit. (Do not open.)

Ditching Station.

A. Seat near Exit No. 1.

After Ditching.

A. Launches liferaft No. 2 through Exit No. 1.

B. Assists passengers in boarding liferaft No. 2 at Exit No. 1.

C. Enters liferaft No. 2 with first aid kit and Gibson Girl radio.

SECOND FLIGHT ATTENDANT.

First Action.

A. Assists first flight attendant as directed.

Ditching Station.

A. Seat near Exit No. 3.

After Ditching.

A. Launches liferaft No. 3 through Exit No. 3.

B. Assists passengers in boarding liferaft No. 3 at Exit No. 3.

C. Collects any additional equipment and rations and enters liferaft No. 3.

FLIGHT NURSE.

First Actions.

A. Advises patients of situation.

B. Checks and fastens life vests on all patients.

C. Checks and fastens litter safety belts on all patients, checking security of litters and litter straps.

D. Checks and dons life vest.

E. Loosens collar.

F. Collects necessary medical supplies.

G. Instructs patients as to procedures of evacuation of aircraft.

When Ditching is Imminent (10 Minutes Remaining).

A. Gives final warning to patients.

B. Fastens safety belt.

Ditching Station.

A. Seat near Exit No. 1.

After Ditching.

A. Directs loading of patients into life rafts No. 1 and 2.

B. Enters liferaft No. 2 with medical supplies.

SECOND FLIGHT NURSE.

First Action.

A. Assists first flight nurse as directed.

Ditching Station.

A. Seat as near Exit No. 1 as possible.

After Ditching.

A. Enters liferaft No. 1.

MEDICAL TECHNICIAN.

First Actions.

A. Assists nurse in fastening life vests on patients and checking litter straps and safety belts.

B. Checks and dons life vest.

C. Loosens collar and removes tie.

When Ditching is Imminent (10 Minutes Remaining).

A. Assists nurse as directed.

B. Fastens safety belt.

Ditching Station.

A. Rear seat.

After Ditching.

A. Assists patients into liferafts as directed by nurse.

B. Enters liferaft No. 2 unless directed otherwise by nurse.

ADDITIONAL MEDICAL TECHNICIANS.

First Action.

A. Assist nurse as directed.

Ditching Station.

A. Will be designated by nurse before flight.

After Ditching.

A. Assists patients in boarding liferafts.

B. Board liferaft assigned by nurse assigned before flight.

Note

- Ditching procedures listed above are based on use of the 20-man liferaft. Other type rafts or unusual loading configurations will require procedure modification.

- ACM personnel qualified in a particular crew position will assist in the respective position ditching procedure, as directed.

- If seats are not available, crew members or passengers will be seated on the deck with ditching belt secured to deck tiedown rings.

BAILOUT.

BAILOUT PROCEDURE.

When decision is made to abandon the aircraft in flight, use the following procedure:

A. If possible, reduce airspeed to approximately 135 knots IAS with 20 degrees of flaps. Trim aircraft slightly nose down and head toward an uninhabited area.

B. Give warning over interphone for bailout. Receive acknowledgement from each crew member and officer in charge of the passengers.

C. Give command over interphone to bail out.

D. Crew and other personnel bail out through bailout exit.

SYSTEM FAILURES.

FUEL SYSTEM FAILURE.

Fuel Pressure Drop During Ground Operation.

If the fuel pressure of the engine drops to zero during ground operation, shut down the respective engine and investigate.

Fuel Stoppage in Flight.

If an engine fails in flight because of loss of fuel pressure, immediately perform the following steps to return the engine to operation:

A. Check for adequate fuel in the tank supplying the failing engine.

B. If fuel in sufficient quantities is present, retard the throttle and switch the fuel booster pump for that tank to LOW.

C. If this does not immediately bring the pressure up, a failure other than that of the engine-driven fuel pump is indicated, and the failing engine should be isolated.

D. If crossfeed is being used, immediately switch the operating engine on the side affected to its respective tank system, and do not use fuel from the tank in which failure occurred.

E. If, while the engine is being operated, the fuel pressure indication suddenly drops to zero and the warning light comes on, but the engine continues to run smoothly, shut it down immediately. The fuel line to the pressure transmitter may have broken, in which case continued operation will pump fuel into the nacelle area, creating a dangerous fire hazard. The fuel pressure warning switch is set at 18 ($\pm\frac{1}{2}$) psi. If the fuel pressure indication fails, but the warning light does not come on, and the fuel flowmeter shows normal flow rate, the fuel pressure transmitter has probably failed.

Vapor Lock.

The fuel system can malfunction as a result of a vapor lock, a condition which occurs when the fuel boils or when it becomes supersaturated with air. The usual indication of a vapor lock starts with regular and rapid engine surging at high frequency, coupled with rapid fuel pressure and fuel flow fluctuations. This is usually followed by an irregular surge of greater magnitude, with extreme full pressure and flow fluctuations. In the final stage, the surge can become great enough to lead to complete engine failure. Any type of vapor lock can be rapidly and completely broken by placing the fuel booster pump switch in the LOW position to pressurize the main fuel system line and force the air and fuel vapor back into solution with the fuel and deaerate the fuel in the tank.

ELECTRICAL POWER SYSTEM FAILURE.

Circuit Breakers.

If a circuit breaker opens, disconnecting power to any circuit, it indicates an overload or short in that circuit. If the circuit breaker reopens after being reset, do not use that circuit unless the safety of the aircraft depends upon its continued operation.

WARNING

Manually holding a circuit breaker closed after it has been reset and has reopened constitutes a fire hazard, inasmuch as the circuit is then functioning without adequate protection.

Generators.

If there is no indication on one ammeter, but the other indicates normal readings, make the following check:

A. Check the generator voltage, which should be the same as that of the other generators (approximately 28 volts).

B. If the switch for the malfunctioning generator is ON, turn it OFF and note if the readings of the other ammeters increase. If they do, the trouble may be attributed to the ammeter. Check ammeter fuses in the main junction box. Turn the generator switch back ON and leave it there.

C. If the generator voltage and the amperage readings are zero, an inoperative generator is indicated. The generator control switch should be turned off to remove excessive load from the equalizer circuit. If reading is zero amps but residual voltage (1½ to 3 volts) is indicated, check the field circuit breaker or the overvoltage control. Field circuit breakers may be reset one time in flights. (This unit protects the system against d-c current surges.) The overvoltage control should be reset only once in flight.

CAUTION

It may be necessary to monitor the electrical load before turning off a generator to prevent the remaining generators from becoming overloaded. Maximum generator loads are 350 amperes per generator above 0°C OAT., and 400 amperes below 0°C OAT.

D. Should generator malfunctioning or an electrical short be evident in any one of the four generator circuits, as indicated by system instrumentation or otherwise, or should an emergency arise where it is desired to deenergize an individual or all generator circuits in addition to turning off the normal generator switch(es), the corresponding circuit breaker(s) should be placed in the OFF position. This action assures a fully dead generator(s) by breaking the field circuit(s), thus eliminating all hot wires in these circuits between the corresponding engine nacelle(s) and the main electrical junction box.

E. If amperage indications on one generator exceed the load of the other generator by more than 30 amperes, turn OFF the high generator (at least ½ hour is required for voltage regulators to warm up and stabilize).

F. If the voltage regulator overheat light illuminates, drop the voltage regulator access door to get maximum ventilation and cooling for regulators. Isolate the regulator and turn off the affected generator.

G. If neither voltage nor amperage is indicated, check (ammeter-voltmeter) fuses for the generator affected; also check the field circuit breaker and reverse current circuit breaker.

CAUTION

Do not attempt to reset the reverse current circuit breaker in flight.

If operating on one or two generators, proceed as follows:

A. Reduce d-c electrical load as much as possible.

B. Turn OFF buffet equipment and keep cabin lights to a minimum.

C. Operate minimum amount of radio equipment continuously.

If operating with a total generator failure, use one of the following procedures:

A. For minimum safe flight, turn battery switch on and all circuit breakers off with the exception of the following: fire detector and warning lights, propeller feathering and reverse, navigation lights, turn-and-slip circuit, and other circuit breakers as deemed necessary.

B. Emergency inverter — ON (limit of approximately 2½ hours with a fully charged battery).

a. Master switch and all generator switches turned OFF to conserve battery for operating flight instruments (pull all generator field circuit breakers).

b. The following equipment will remain operative: pilot's and copilot's attitude indicators, directional indicator (G-2 or S-2), pilot's and copilot's turn-and-slip indicator, inverter warning lights and instrument white light, self-energized engine instruments, magnetic compass light, periscopic sextant light, and pilot's overhead floodlight.

c. Prior to landing, turn battery switch on momentarily and advance propeller to 2400 rpm.

Inverters.

In the event the normal inverters fail, the emergen inverter, which supplies power to the gyro instrumer only, can be started by placing the emergency instr ment power and instrument lighting switch in t ON position. All a-c engine instruments are inope tive when operating only on the emergency invert

HYDRAULIC POWER SYSTEM FAILURE.

Isolation of Hydraulic System Leak.

If a failure in the hydraulic system is evidenced the loss of hydraulic fluid (as indicated on the quant gage), return all control levers for hydraulically ope ed units to the OFF positions, and isolate the le as follows:

A. Landing gear control lever — NEUTRAL.

B. Wing flap lever — 5 DEGREES DOWN (va CLOSED position).

C. Windshield wipers — OFF.

D. With the bypass valve closed, build up system pressure. If the pressure falls from 3000 (+100, −50) psi to 2700 (±50) psi in less than 1 minute, the drop is excessive. If the drop in pressure is not excessive, move the landing gear control lever to the UP position and check for an excessive drop in pressure. If the drop in pressure is not excessive, move the flap control lever to the full UP position and again check for an excessive drop in pressure.

E. If the trouble still has not been isolated, extend the landing gear only when in the landing area; then check for excessive drop in pressure. Hold the brakes in the ON position and check for adequate pedal back pressure and excessive drop in pressure. If the failure is in the gear downline, immediately return the landing gear control lever to NEUTRAL to prevent the loss of hydraulic fluid. Extend the landing flaps for the approach and landing before placing the landing gear control lever in the DOWN position (which is mandatory).

F. If the main hydraulic system fluid supply is lost, the nosewheel steering will be inoperative with the auxiliary pump selector in the brake system position. For brake operation from the auxiliary supply, place the auxiliary (emergency) hydraulic pump selector valve control in the BRAKE SYSTEM (forward) position and operate the auxiliary (emergency) hydraulic electric pump for hydraulic brake pressure. (The auxiliary emergency hydraulic electric pump control switch is spring loaded and must be held in the ON position for continued operation.)

Note

The emergency hydraulic fluid supply is adequate for a full extension of the wing flaps, landing gear, and for operation of the brakes in a normal landing roll. Gear retraction time using the emergency hydraulic pump requires approximately 2 to 5 minutes.

G. In the event of excessive pressure or overheating of the hydraulic system, open the bypass valve. Do not close the bypass valve until it becomes necessary to operate one of the hydraulic units.

LANDING GEAR MALFUNCTIONS (GENERAL)

A. When difficulty is experienced with either gear retraction or extension, it is recommended that the gear be secured in the DOWN position and landing be made as soon as practical. No attempt should be made to diagnose gear malfunctions by cycling gear during flight.

B. If any of the landing gears do not secure properly on the uplocks it is recommended that the aircraft be landed as soon as practical. Maintaining landing gear UP by use of hydraulic pressure should not be attempted for extended periods of flight. Continuous operation and heating of the hydraulic system is conducive to hydraulic malfunction and/or loss of up-line pressure.

LANDING GEAR SYSTEM FAILURE.

Failure of Main Landing Gear Downlatch.

A. If a main landing gear downlatch fails to engage (gear down; red light illuminated), return the landing gear control lever to the NEUTRAL position momentarily. Place the emergency hydraulic pump selector valve lever in the GENERAL SYSTEM (center) position, place the emergency hydraulic pump switch in the ON position, and move the landing gear control lever to the DOWN position. This should lock the gear as indicated by the landing gear position indicators. Place the emergency hydraulic pump selector valve in the BRAKE SYSTEM (forward) position. If the main gear will not latch in the down position, make a normal approach and landing. After touchdown, make contact with the nosewheel as soon as possible to relieve the weight of the aircraft on the main gear. Apply light brake action to the wheels of the defective gear during the landing roll to prevent the gear from collapsing. When the aircraft has stopped rolling, feather the two propellers on the defective gear side and apply propeller reverse thrust on the opposite outboard engine with the brakes set to maintain continuous back tension on the defective gear. Do not move the aircraft nor unreverse the propeller of the outboard engine until the defective gear has been secured.

NOTE

Inboard engine opposite defective gear should be operated to provide hydraulic pressure.

B. If the nose gear downlatch fails (bungee link not on center; wheel down), hold the nosewheel off the ground as long as possible after ground contact is made. Use the brakes sparingly, taking advantage of the entire available runway length to lose speed.

C. The landing gear normally can be extended without hydraulic pressure by moving the landing gear control lever to the DOWN position. This releases the uplatches, opens the gear-up hydraulic lines to return, and allows the gear to extend and lock by its own weight.

Note

If the uplatches fail to release after the landing gear control lever has been placed in the DOWN position (no hydraulic pressure), full downline hydraulic pressure from the auxiliary hydraulic pump will shear the uplatch shear bolts, permitting the gear to extend.

Nosewheel Shimmy.

Nosewheel shimmy is an indication of an unbalanced condition of the nosewheel or failure of the steering system. If this occurs during takeoff, decreasing the load on the nosewheel will decrease the shimmy tendency; therefore, pull the nosewheel off the ground as soon as possible. If shimmy occurs during the landing roll decelerate gradually, since loading the nosewheel will increase the shimmy tendency. In landing with a known shimmy condition, keep the nosewheel off the ground as long as possible.

BRAKE SYSTEM FAILURE.

Emergency Hydraulic Brakes.

If the main hydraulic system fails, proceed as follows:

A. Emergency hydraulic pump selector valve lever — BRAKE SYSTEM (forward position).

B. Emergency hydraulic pump switch — ON (hold on).

C. Brakes — HOLD ON UNTIL STOP IS COMPLETED.

D. Use reversing and airbrakes as required.

Metered Airbrake System.

If no hydraulic pressure is available to the brakes, stop the aircraft with the airbrake system as follows:

A. Before landing, break the safetywire.

B. Turn the emergency airbrake control handle full clockwise to the ON position; then return it to HOLD immediately. If less braking action is desired, return the handle to the OFF (dump) position, then set it immediately to HOLD.

C. Turn the handle to ON as necessary for additional braking.

D. Do not return handle to the OFF position unless desired to relieve braking action, since air pressure will he lost, reducing number of brake applications.

E. Air pressure of 1000 pounds will allow sufficient application of the brakes to assure stopping.

Note

Apply the brakes slowly and intermittently after groundspeed has been reduced by an extended roll, gradually increasing the braking power rather than applying it suddenly. Braking power will not be felt the instant air pressure is applied, but will lag slightly behind the application of air.

F. Do not leave the handle in the ON position until braking action is felt, since this will lock the brakes and skid the tires.

G. Do not taxi the aircraft. Place the handle in the HOLD position and stand by for tow.

EMERGENCY WING FLAP EXTENSION.

For emergency extension of the wing flaps, proceed as follows:

A. Gear handle – NEUTRAL.

B. Emergency hydraulic pump selector valve lever – GENERAL SYSTEM.

C. Wing flap control lever – AS DESIRED.

D. Hold the emergency hydraulic pump switch in the ON position until wing flaps extend to desired setting. (Wing flaps will remain in position unless there is a leak in the up [retract] line.)

Note

During flight, the wing flaps will retract by air pressure when the flap handle is placed in the UP position.

EMERGENCY WINDSHIELD WIPER OPERATION.

For emergency operation of the windshield wipers, proceed as follows:

A. Emergency hydraulic pump selector valve lever – GENERAL SYSTEM.

B. Windshield wiper control knob – ON.

C. Landing gear control lever – NEUTRAL.

D. Emergency hydraulic pump switch – ON.

CAUTION

Prior to landing, the landing gear control lever must be placed in the DOWN position and the emergency hydraulic pump selector valve lever in the BRAKE SYSTEM position.

ENGINE OIL SYSTEM FAILURE.

The indications of oil system failure that may lead to engine failure are loss of oil pressure, oil temperature increase, and loss of oil quantity indication. High oil temperatures may result from failure of the oil cooler door to function in AUTOMATIC. If the oil cooler door switch is on AUTOMATIC, switch to OPEN and hold in that position to make certain that the door will open and that the temperature drops. However, in the event of congealed oil, opening the oil cooler will only aggravate the trouble; in this case, the door should be closed and a close watch maintained of the oil temperature. As soon as the temperature shows a further rise, open the door slightly and wait for the temperature to stabilize, gradually opening the door as the congealed oil thins out.

If a propeller has been feathered for a considerable length of time, it is probable that oil in the oil cooler is congealed. After unfeathering the propeller and starting an engine, check the bmep and fuel flow for a positive indication of engine power. Also check the engine temperature and pressure instruments for indication within limits. If the engine oil temperature indicator continues to rise above normal limit, a congealed oil cooler is indicated and the oil cooler air exit door should be closed by manual operation of the oil cooler door switch.

Note

If the oil cooler air exit door switch is left in the AUTOMATIC position, heating of the congealed oil in the cooler will be delayed since excessive engine oil temperature causes the oil cooler door to remain fully open.

Continue to monitor the oil temperature indicator until the oil temperature decreases to normal; then place the oil cooler air exit door switch in the AUTOMATIC position.

ABBREVIATED EMERGENCY CHECKLISTS.

The pilot's emergency abbreviated checklist is now contained in a separate publication, T.O. 1C-118A-CL-1-1. See flight manual "A" page for date of current checklist.

SECTION IV

description and operation of auxiliary equipment

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

AIR CONDITIONING SYSTEM.

Air for pressurization and air conditioning enters through scoops located between the nacelles in each wing leading edge. The air is routed through the engine-driven superchargers for pressurized flight or through the supercharger bypass valves during unpressurized flight. The air then passes into the fuselage through check valves which serve to prevent the backflow of air in case one supercharger becomes inoperative. Air from the two superchargers then enters the heater compartment where it can be routed through the cabin heater, or the aftercooler, or through the aftercooler and expansion turbine *(figure 4-1)*. The selection of the route is made by a cabin temperature mixing valve that has three ports (Port A – turbine, Port B – aftercooler, Port C – heater). The valve can select air from any one of the three sources, or a mixture of two. Air from the mixing valve passes into the air distribution system, which consists of a main duct that distributes air to lateral branch ducts which discharge the conditioned air into the cabin through openings above the windows. Air from the cabin temperature mixing valve is also supplied to individual ducts for distribution to the cockpit temperature mixing valve and the aft fuselage. The cockpit temperature mixing valve can obtain hot air from the cabin heater through the windshield anti-icing valve *(figure 4-11)*. Air from the cockpit temperature mixing valve is ducted to louvered footwarmer outlets located outboard of the rudder pedals. The position of the footwarmer louvers is adjusted by push-pull controls located in the cockpit. The cockpit temperature mixing valve is positioned by the cockpit temperature control rheostat. Hot air for windshield anti-icing is routed from the cabin heater through the windshield anti-icing valve. This valve is positioned by the windshield heat selector switch located in the cockpit. Hot air from the windshield anti-icing valve is discharged between the double windshield panels and is exhausted through windshield anti-icing air exhaust valves. The air exhaust valves permit the air to be discharged underneath the floor or into the cockpit, as selected by the windshield anti-icing air exhaust control handles located in the cockpit. If warmer conditioned air is desired in the cockpit, a branch duct from the windshield anti-icing valve supplies hot air to the cockpit temperature mixing valve.

On some aircraft, a defogging bypass *(figure 4-11)* is provided to prevent fogging of the windshield. A defogging control valve and flow limiting venturi allow a small quantity of air to flow to the windshield. The defogging bypass opens when the windshield heat selector switch is in the 10° to 0° (DEFOG) position. Air for the individual cold air outlets and voltage regulator cooling is ducted directly from the discharge of the turbine.

Air is exhausted overboard through flow-limiting devices across the cabin temperature sensing element (thermister), at each toilet vent, and at the radio rack. The remainder of the air is exhausted from the main cabin to the underfloor area. Under the floor, the air passes along the baggage compartments to the heater compartment and overboard through a cabin pressure regulator valve. The valve opening is varied automatically by instruments that sense cabin pressure. While on the ground with the engines not running and ground power connected, air for ventilation and combustion air for the cabin heater are supplied by a blower located in the left wing fillet.

CABIN TEMPERATURE MIXING VALVE.

The cabin temperature mixing valve is a 3-port valve *(figure 4-1)*. The inlet ports are selected by a motor that receives its signal from the cabin temperature control circuit. The position of the cabin temperature mixing valve is shown on an indicator in the cockpit. Air is selected from the ports to provide conditioned air to the cabin at any desired temperature from 65°F to 85°F. A restrictor damper at the discharge of the mixing valve is positioned by a separate motor that receives its signal from the windshield heat selector switch through a compression ratio limit switch. The restrictor damper is used to increase the pressure in the duct system and force larger quantities of air through the windshield anti-icing duct when the windshield heat selector switch is in the ANTI-ICING position. If the consequent back pressure causes the superchargers to approach an overload, the compression ratio limit switch will cause the motor to reverse. This decreases the restriction and thus lowers the duct pressure.

CABIN HEATER.

The cabin heater, located in the heater accessories compartment, is rated at 300,000 BTU's per hour. Ventilating air for the cabin passes on the outside of the combustion chamber. Combustion air for the heater is supplied through a scoop on the leading edge of the wing between the No. 2 nacelle and the fuselage. During ground operation of the heater, ventilating air and heater combustion air are provided by a ground blower. Fuel is normally supplied by a heater fuel pump from the No. 2 main fuel tank, an alternate being available from the No. 3 main fuel tank by crossfeed from the airfoil anti-icing heaters fuel pump. A heater accessories container located in the left wing fillet contains two independent fuel control systems. Each system has a fuel pressure regulator, two cycling solenoid valves, and a fuel strainer. A fuel pressure transmitter serves both systems. Either fuel control system can be selected by the cabin heater fuel selector switch located in the cockpit. Fuel consumption of the heater is between 2 and 4 gallons or 9½ pounds per 100,000 BTU's per hour. Fuel pressure at the nozzle is shown on an indicator in the cockpit.

Heater fuel cycling valves are controlled by temperature cycling switches, installed in the heater discharge airstream, which control the temperature output of the heater by turning the fuel supply on and off. Cycling temperature is 115° to 135° C. Heater discharge air temperature is shown on an indicator in the cockpit. Ignition of fuel in the heater combustion chamber is accomplished by dual spark plugs and ignitions units. Either system may be selected by an ignition selector switch located in the cockpit. Dropout switches are provided to deenergize the heater circuits in case the heater overheats. When the heater is off, the temperature of the air at the heater discharge will be dependent upon the heat of compression generated as the air passes through the cabin superchargers. The cabin heater is provided with an individual single-shot CO_2 cylinder and is also protected by the main fire extinguishing system. (See Fire Extinguishing System, Section I.)

Cabin Heater Master Switch.

A cabin heater master switch located on the heater control panel *(figure 4-2)* has the positions ON and OFF. Placing the switch in the ON position energizes the cabin heater electrical circuit, allowing the heater to operate when the cockpit temperature control rheostat or the windshield heat selector switch is properly positioned. Placing the switch in the OFF position deenergizes the heater ignition and shuts off the cabin heater fuel supply and fuel pump.

Cabin Heater Fuel Switch.

A cabin heater fuel switch located on the heater control panel *(figure 4-2)* has the positions NORMAL SYSTEM and HTR. FUEL CROSSFEED. Placing the switch in NORMAL SYSTEM position permits fuel to be supplied to the cabin heater through the heater fuel pump from the No. 2 main fuel tank. When the switch is in the HTR. FUEL CROSSFEED position, fuel is supplied to the heater from the No. 3 main fuel tank by crossfeed from the airfoil anti-icing heaters fuel pump. Normally, the switch should remain in the NORMAL SYSTEM position.

Cabin Heater Fuel and Ignition Selector Switches.

A cabin heater fuel selector switch and a cabin heater ignition selector switch are installed on the heater control panel *(figure 4-2)*. Each switch is placarded CABIN and has the positions SYSTEM #1 and SYSTEM #2. Normally, the switches should remain in the SYSTEM #1 position. In case of failure of fuel supply or ignition in either system, the other system may be selected to operate the cabin heater. On AF51-3818 through AF51-3835 and AF53-3223 through AF53-3305, a single cabin heater fuel and ignition selector switch placarded CABIN is located on the heater control panel *(figure 4-2)*. The switch has the positions #1 FUEL AND (#1 IGN. CHECK) and #2 FUEL AND (#2 IGN. CHECK). The switch may be used to select either fuel and ignition system as required.

Cabin Heater Ignition Selector Check Switch.

A cabin heater ignition selector check switch placarded CABIN is located on the heater control panel *(figure 4-2)* and has the positions NORM (DUAL IGNITION) and CHECK (SINGLE IGNITION). The switch is used to check the individual ignition systems. When the heater ignition selector check switch is in the NORM (DUAL IGNITION) position, both spark plugs in the heater will fire simultaneously. Placing the switch in the CHECK (SINGLE IGNITION) position will permit one of the spark plugs to fire when #1 FUEL is selected; when #2 FUEL is selected, the other spark plug will fire.

Cabin Heater Fire Extinguisher System Switches.

The cabin heater is protected by an individual electrically actuated fire extinguishing system, which incorporates a single-shot CO_2 cylinder. A cabin heater selector switch and a CO_2 discharge switch are located on the heater fire control panel *(figure 4-10)*. The heater compartment is also protected by the main fire extinguisher system. (See the Cabin Heater Fire paragraph, Section III.)

Cabin Heater Fire Warning Light.

A cabin heater fire warning light is located on the heater fire control panel *(figure 4-10)*. When the cabin heater fire detectors are actuated, a 28-volt d-c circuit is energized, causing the fire warning light to illuminate.

Cabin Heater Air Temperature Indicator.

A thermocouple-actuated cabin heater air discharge temperature indicator, calibrated in degrees centigrade, is installed on the heater control panel *(figure 4-2)*.

Cabin Heater Fuel Pressure Indicator.

An electrically actuated cabin heater fuel pressure indicator, calibrated in psi, is installed on the heater control panel *(figure 4-2)*.

AFTERCOOLER.

The aftercooler *(figure 4-1)* consists of a number of tubes through which air, heated during compression in the superchargers, passes to the cabin. Outside air flows over the tubes, cooling the cabin air. At full coolant airflow, the cabin air is cooled to approximately outside air temperature. The coolant air for the aftercooler enters through a belly scoop located in the wing area, on the underside of the fuselage. The air is ducted through the aftercooler, through a fan, and exhausted overboard through an exhaust door installed in the fillet area on the underside of the left wing. In flight, the exhaust door automatically controls the aftercooler coolant airflow. During ground operation, air is drawn through the coolant circuit by the fan driven by the turbine.

COOLING TURBINE.

The cooling turbine *(figure 4-1)* receives air from the aftercooler that has been cooled to slightly above ambient temperature. In the turbine, the high-pressure air is allowed to expand and drive the turbine wheel connected to the fan in the coolant circuit. The removal of energy from the turbine by the fan cools the air below outside temperature. Since the superchargers are limited in the amount of pressure rise they can produce, a compression ratio limit switch is used to prevent the pressure from exceeding prescribed values with a resultant stalling of the supercharger. As the prescribed value of pressure rise is approached, the compression ratio limit switch stops the mixing valve from forcing larger percentages of air through the turbine. If the cabin pressure is then increased, the compression ratio limit switch will signal the mixing valve to reverse and allow a smaller percentage of the air to pass through the turbine and thus prevent overloading of the supercharger. In other words, as the cabin pressure is increased, the refrigeration available from the expansion turbine decreases.

Cooling Turbine Switch.

A cooling turbine switch located either on the cabin pressure control panel *(figure 4-2)* or on the forward overhead panel *(figures 1-13 and 1-14)* has the positions NORMAL and OFF. The cooling turbine switch should be in the NORMAL position unless the following conditions exist:

A. Both cabin superchargers inoperative.

B. Supercharger airflow rate indicators fluctuating severely over a period of time.

C. Cabin supercharger gearbox oil pressures or temperatures not within normal limits.

Note

For cooling turbine operation, turn the cockpit temperature control rheostat to NORMAL and the windshield heat selector switch OFF.

CABIN GROUND BLOWER.

The cabin ground blower *(figure 4-1)* provides ventilating air for the cabin areas and combustion air for the cabin heater when the aircraft is on the ground. With the battery master switch turned ON and the ground blower circuit breakers pushed in, blower operation is automatic when an external power source is connected to the aircraft, when the aircraft APU is operating, or when engines No. 2 and 3 are operating above the generator cut-in speed.

CABIN PRESSURIZATION SYSTEM.

Cabin pressurization is effected by superchargers that pressurize the ram air entering the system and a cabin pressure regulator valve that controls the rate of air exhaust to maintain the desired pressure within the cabin. In addition, two pressure relief valves and a negative pressure relief valve are provided. The cabin pressure regulator valve is electrically actuated by a motor that receives its signals from the cabin pressure control instruments *(figure 4-2)*. Upon landing, the valve opens automatically at a rate of pressure decrease dictated by the cabin pressure control instruments. Cabin pressure can be maintained at sea level pressure during flight at altitudes up to 9000 feet, and the same pressure differential can be maintained at altitudes up to 20,000 feet. Manual switches are installed to control the pressurization system in case of malfunction of the automatic cabin pressure control system. A cabin altitude emergency control is also provided in the cockpit to regulate cabin pressure in case of failure of the cabin pressure regulator valve or motor.

CABIN SUPERCHARGERS.

A cabin supercharger is installed in each outboard nacelle. Power for operation of each supercharger is supplied through a disconnect clutch, drive shaft, and variable speed transmission gearbox. The clutch is connected by cables to a supercharger clutch control lever located in the cockpit. Each supercharger incorporates an integral lubrication system, containing an oil pump, oil cooler, filter, and oil lines with the necessary relief valves. Supercharger gearbox oil temperature and oil pressure are indicated in the cockpit. In case of abnormal oil temperature or oil pressure, the supercharger should be declutched *(figure 5-1)*. Speed of the supercharger is automatically controlled by an

AIR CONDITIONING, WINDSHIELD, AND RADOME ANTI-ICING SYSTEM

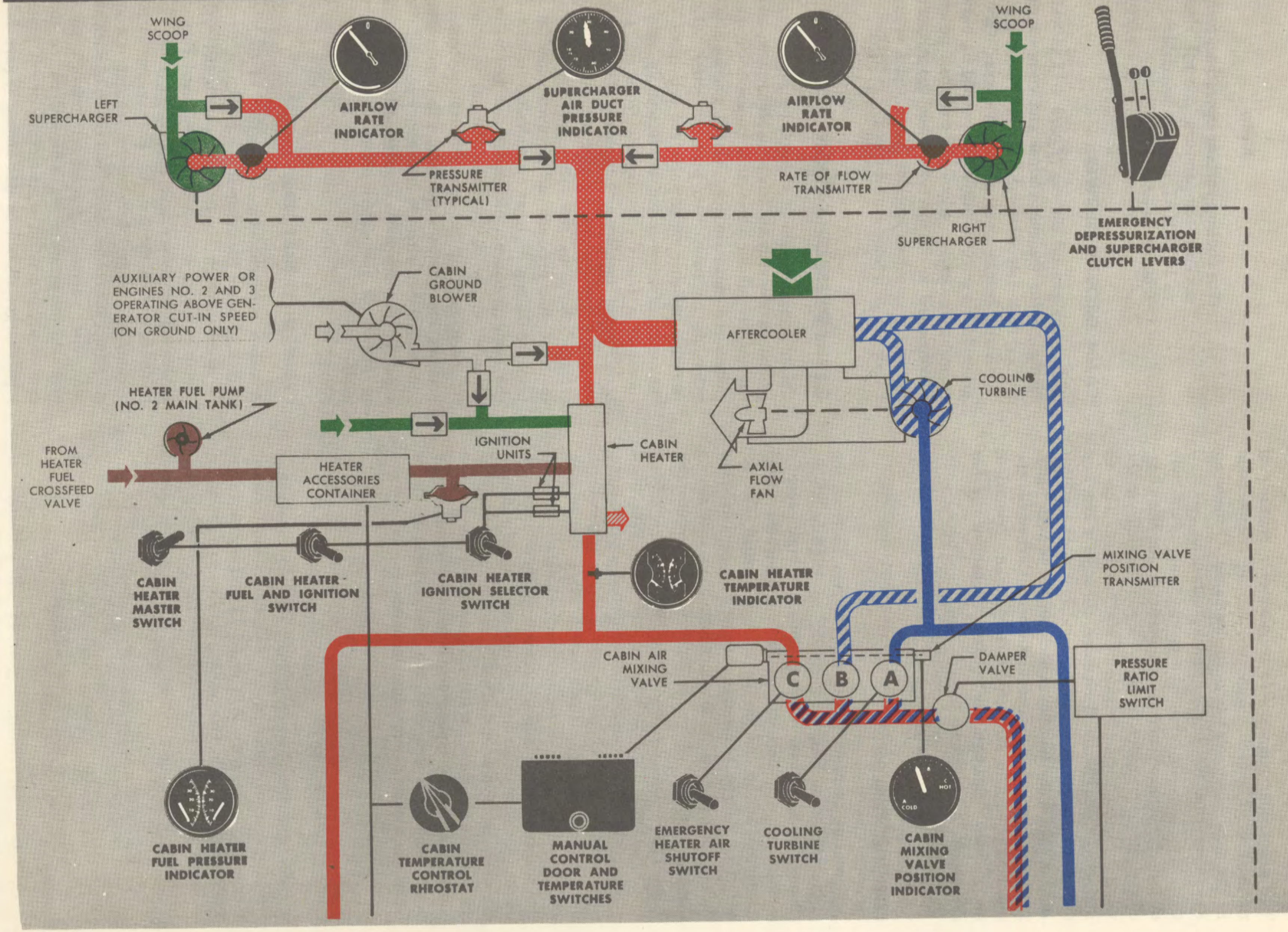

Figure 4-1 (Sheet 1 of 2)

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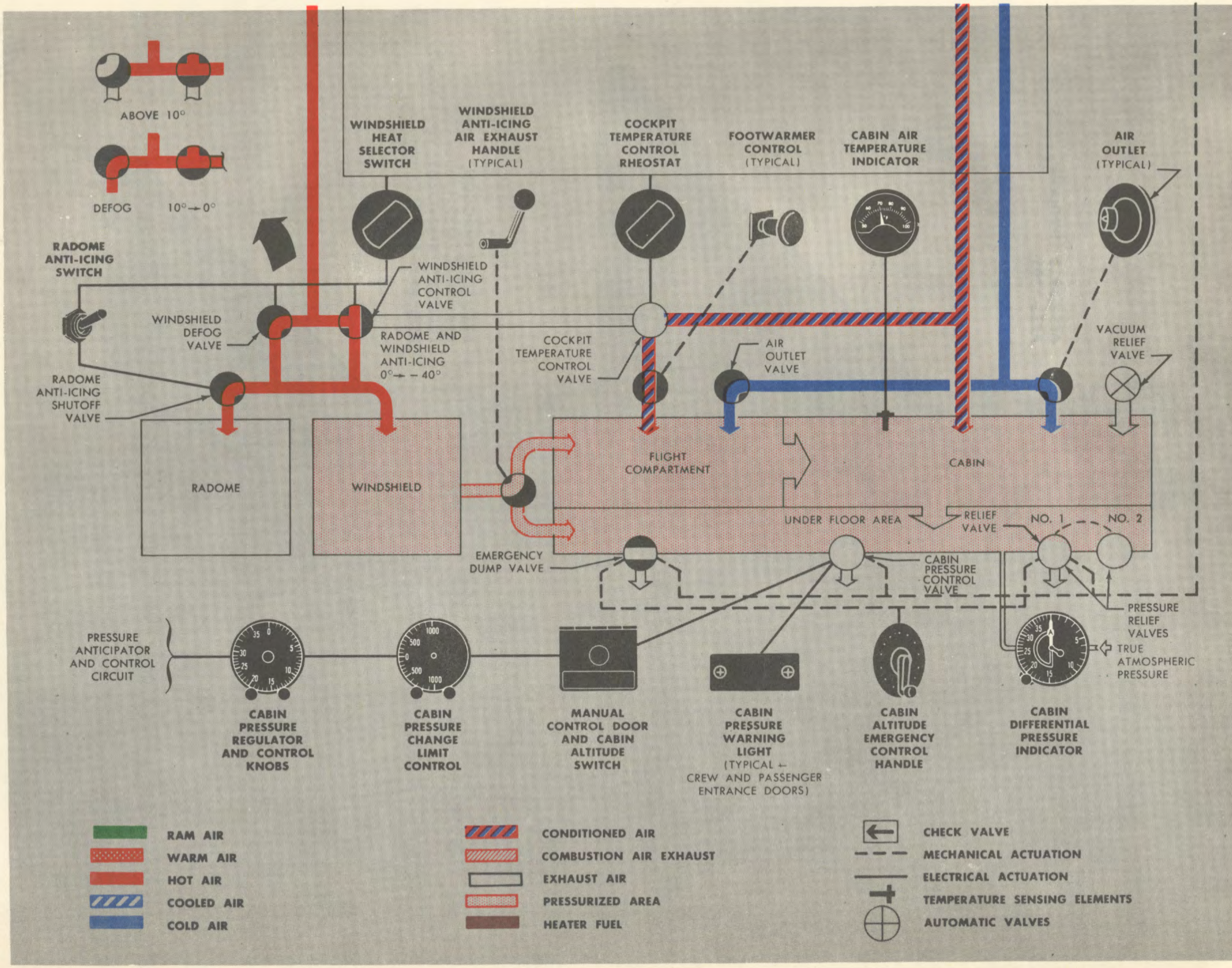
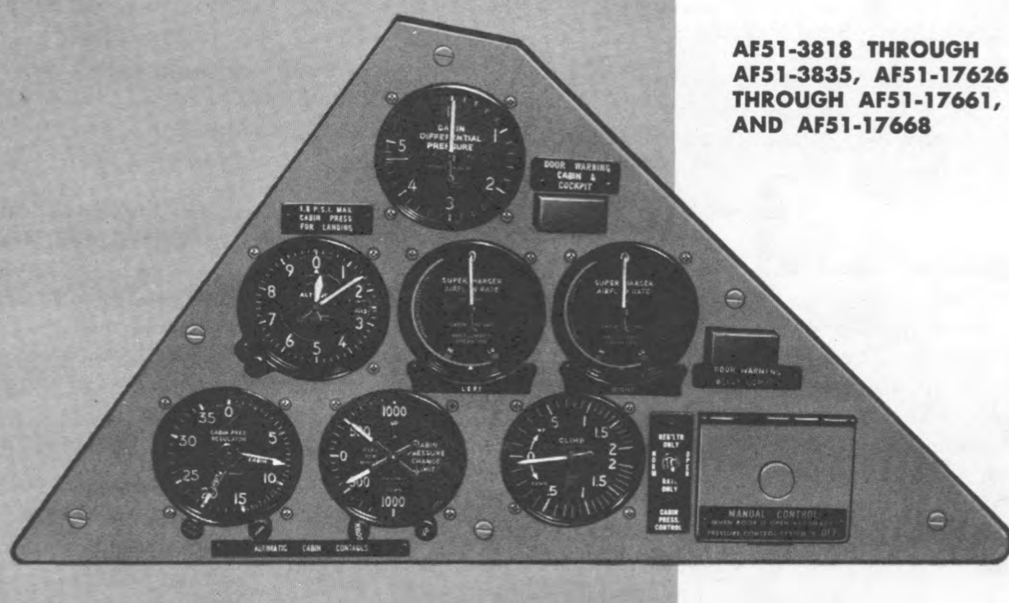


Figure 4-1 (Sheet 2 of 2)

CABIN PRESSURE CONTROL PANEL

AF53-3223 THROUGH AF53-3305



AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668

AA1-187

Figure 4-2

airflow control valve located in the discharge air duct. When the rate of airflow varies, the control valve is moved. Movement of the valve actuates an oil valve and a piston that controls the variable speed transmission which drives the supercharger. A supercharger airflow rate indicator for each supercharger is located in the cockpit. Because of high duct pressures with the turbine operating, engine speed should remain at 1200 rpm or above to prevent stalling the superchargers. If the superchargers stall, as evidenced by fluctuation of the supercharger airflow rate indicators, increase engine rpm or place the cooling turbine switch in the OFF position to reduce the load. If stall indication continues, determine which supercharger is causing the disturbance and disengage it.

Cabin Supercharger Clutch Control Levers.

Two cabin supercharger clutch control levers *(figure 4-5)*, one for each supercharger, are located on the floor outboard of the copilot's seat, and have the placarded positions ENGAGED and DISENGAGED. Pulling either lever up to the DISENGAGED position declutches the respective supercharger. Disengaging should be accomplished rapidly, since moving the lever slowly can cause damage to the clutch.

CAUTION

If a supercharger is declutched, the respective engine must be stopped before again engaging the clutch.

Cabin Supercharger Airflow Rate Indicators.

Two cabin supercharger airflow rate indicators, one for each supercharger, are located on the cabin pressure control panel *(figure 4-2)*, and indicate existing pressures at the flow control valve.

Cabin Supercharger Air Duct Pressure Indicator.

A dual indicating cabin supercharger air duct pressure indicator, located above the copilot's seat *(figure 1-7)*, is calibrated in inches Hg. The indicator registers the existing air pressure in the supercharger discharge duct. Duct leakage can be detected by comparing the duct pressure indication against the Supercharger Duct Maximum Pressure Chart *(figure 4-3)*. Use of this chart requires mixing valve tube in full "A" port and the cabin unpressurized.

Cabin Supercharger Gearbox Oil Temperature Indicator.

A dual indicating cabin supercharger gearbox oil temperature indicator, calibrated in degrees centigrade, is located on the right side of the upper instrument panel *(figure 1-11)*.

Cabin Supercharger Gearbox Oil Pressure Gage.

A dual indicating cabin supercharger gearbox oil pressure gage, calibrated in psi, is located on the right side of the upper instrument panel *(figure 1-11)*.

Cabin Supercharger Gearbox Oil Pressure Warning Lights.

Two gearbox oil pressure warning lights, one for each cabin supercharger, are located on the upper instrument panel *(figure 1-11)*. If the gearbox oil pressure in either supercharger drops below 30 psi, the respective warning light will illuminate and the supercharger must be declutched.

CABIN PRESSURE CONTROL INSTRUMENTS.

The following cabin pressure control instruments are utilized to control cabin pressurization: a cabin pressure regulator, a cabin pressure change limit control, and a cabin pressure limit control. The cabin pressure regulator and cabin pressure limits controls minimlze oscillations in cabin pressure by utilizing an anticlpator circuit that functions essentially as a miniature cabin. The pressure of the mlniature cabin is established by balancing the pressure between the air inlet duct and the cabin pressure regulator valve at the cabin exhaust. (Pressures in the miniature cabin change more rapidly than ln the main cabin.) Pressure in the miniature cabin is fed to the cabin pressure regulator and cabin pressure limits control instruments which transmit signals through an amplifier to energize the motor on the cabin pressure regulator valve, positioning the valve as required. The cabin pressure change limlts control only receives air from the cabin pressure regulator valve at the cabln exhaust.

Cabin Pressure Regulator.

The cabin pressure regulator located on the cabin pressure control panel *(figure 4-2)* is the control instrument for RATIO operation, and is calibrated in feet of pressure altitude from 0 to 35,000. Two control knobs located on the instrument are placarded START MARKER and HANDS. Turning the START MARKER knob positions a pointer on the rim of the instrument that determines the flight altitude at which cabin pressurization will begin and end. Rotating the HANDS knob moves dual pointers on the instrument, one pointer placarded CABIN, the other FLIGHT. The fixed space between the pointers is a predetermined ratio which is based upon the maximum allowable pressure differential on the fuselage.

Cabin Pressure Change Limit Control.

The cabin pressure change limit control located on the cabin pressure control panel *(figure 4-2)* is the

SUPERCHARGER DUCT MAXIMUM PRESSURE CHART

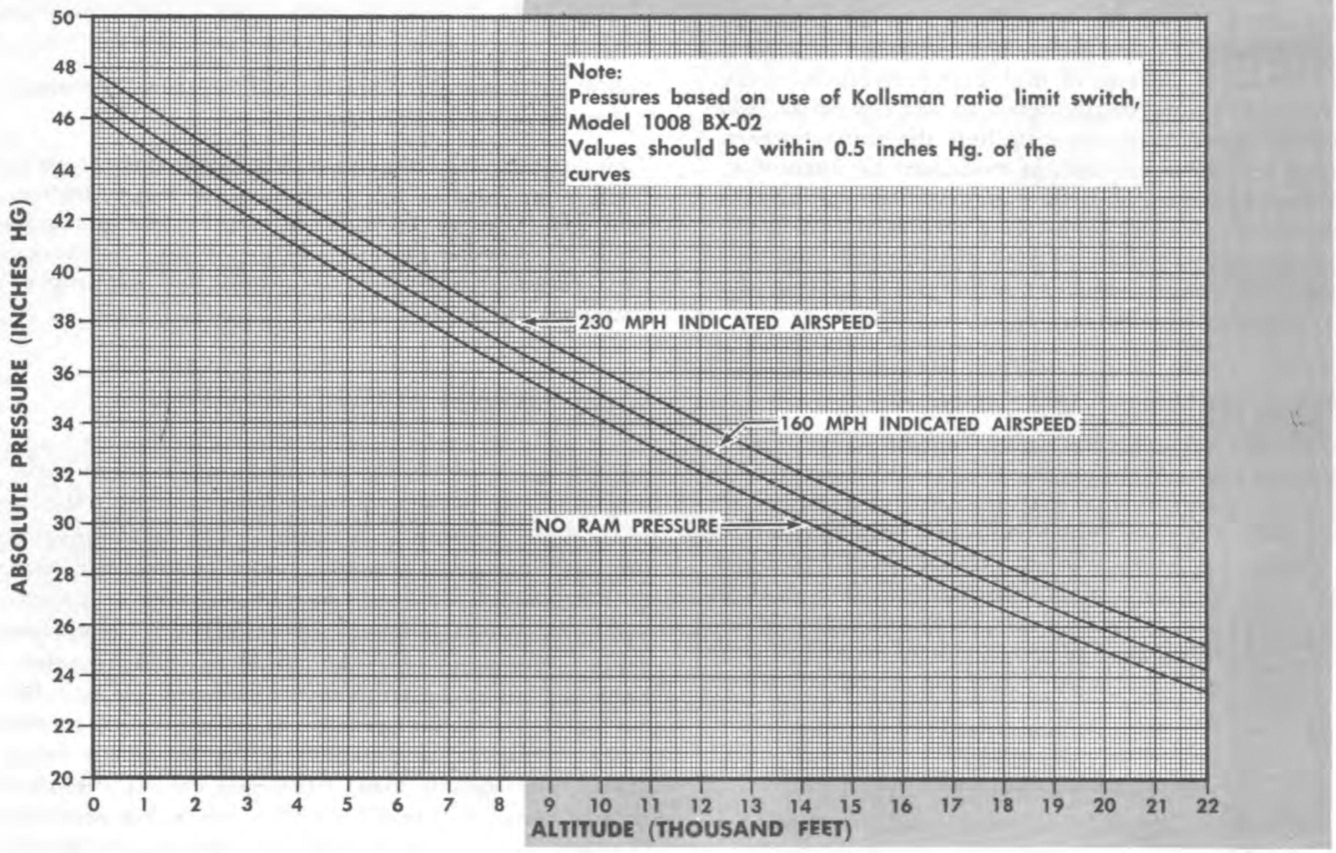


Figure 4-3

control instrument for RATE operation and determines the rate of change of cabin altitude under certain conditions. The instrument is calibrated in feet per minute from 0 to 1000 UP, and 0 to 1000 DOWN. Two control knobs are located on the instrument, one placarded UP, the other DOWN. Each knob controls a separate pointer on the instrument. The pointers may be set as recommended or as necessary to obtain the desired rate of cabin pressure change.

Cabin Pressure Limit Control.

The cabin pressure limit control located under a cover on the wall above the copilot's seat is not visible to the crew, and has no controls. This instrument prevents the differential pressure across the cabin from exceeding a specified limit.

Cabin Altimeter.

A cabin altimeter installed on the cabin pressure control panel *(figure 4-2)* is calibrated in feet of pressure altitude from 0 to 10,000 feet and indicates cabin altitude. The altimeter should be set at 29.92 barometric pressure prior to takeoff. On AF53-3223 through AF53-3305, a dual altimeter and differential pressure gage installed on the cabin pressure control panel *(figure 4-2)* is calibrated in feet of pressure altitude from 0 to 35,000. Placarded pointer A indicates the aircraft altitude; placarded pointer C indicates the cabin altitude. Differential pressure between the aircraft altitude and the cabin altitude is shown in psi through a window on the face of the instrument.

Cabin Differential Pressure Indicator.

A cabin differential pressure indicator mounted on the cabin pressure control panel *(figure 4-2)* is calibrated in psi from 0 to 5 pounds and indicates the difference between cabin pressure and outside air pressure.

Cabin Rate-of-Climb Indicator.

A cabin rate-of-climb indicator located on the cabin pressure control panel *(figure 4-2)* indicates the rate of climb or descent in feet per minute.

Rate and Regulator Control Switch.

A rate and regulator control switch is installed on the cabin pressure control panel *(figure 4-2)* and has the following placarded positions: REG'LTR ONLY,

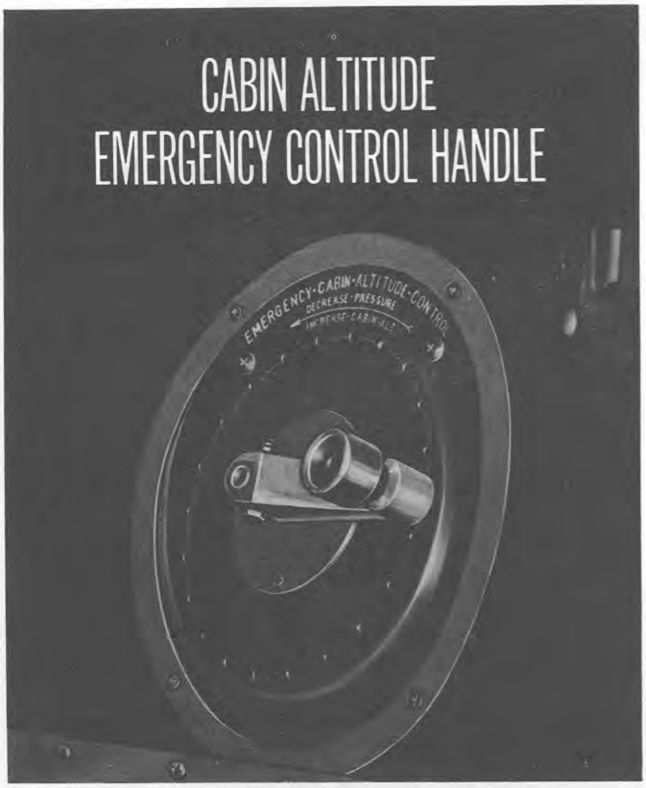


Figure 4-4

NORM OPER, and RATE ONLY. The switch permits withdrawing either the cabin pressure regulator or the cabin pressure change limit control from the automatic circuit in case of failure of either unit. Normally, the switch should be in the NORM OPER position.

Manual Control Door and Cabin Altitude Switch.

A manual control door is installed on the cabin pressure control panel *(figure 4-2)*. When the door is opened, a switch is actuated which deenergizes the cabin pressure automatic control system. Closing the door returns the system to automatic control. A cabin altitude momentary contact switch located behind the door has the positions INCREASE (up) and DECREASE (down). The cabin altitude may be increased or decreased as required by holding the switch in the respective position.

CAUTION

To prevent excessive rate of pressure change while controlling cabin pressure manually, the manual controls should be operated intermittently.

Cabin Pressure Warning Lights.

A cabin pressure warning light is installed adjacent to each cargo door and the crew entrance door inside the aircraft. The handle on each door is placarded CAUTION – CHECK PRESSURE WARNING LIGHT BEFORE OPENING DOOR. When the aircraft is on the ground, the light will be illuminated if the cabin pressure regulator valve is more than 15 degrees from the open position.

Door-Open Warning Lights.

Two door-open warning lights, one for the cargo and crew entrance doors and the other for the belly compartment doors, are located on the cabin pressure control panel *(figure 4-2)*. In case any door is not closed and latched while the aircraft is on the ground or during flight, the respective warning light will be illuminated.

Cabin Altitude Emergency Control Handle.

A cabin altitude emergency control handle *(figure 4-4)*, located on the wall outboard of the copilot's seat, has the placarded positions of NORMAL and DECREASE PRESSURE. The handle is connected by cables to two cabin pressure relief valves and a cabin emergency dump valve. In case of failure of the actuating motor on the cabin pressure control valve, the emergency control handle may be moved counterclockwise to equalize cabin pressure with outside air pressure. Turning the handle to full counterclockwise position opens fully the cabin emergency dump valve and both cabin pressure relief valves. Returning the handle to the NORMAL position closes the valves and permits cabin pressure to increase. The cabin pressure relief valve No. 1 will begin opening automatically at 4.20 psi differential and valve No. 2 will begin opening at 4.34 psi differential. Both valves will be fully open at 4.67 psi differential. The cabin emergency dump valve is used primarily for smoke elimination or elimination of CO_2 concentration in the flight compartment.

Cabin Emergency Depressurization Control Lever.

A cabin emergency depressurization control lever *(figure 4-5)*, located on the floor outboard of the copilot's seat, has down and up positions. Normally, the control lever remains in the down position. Pulling the lever rapidly to the up position operates a cable system which declutches both superchargers, closes the cabin pressure control valve, opens both cabin pressure relief valves, and opens the cabin emergency dump valve.

Note

On VC-118A aircraft AF53-3229 and AF53-3240 when the cabin emergency depressurization control lever is pulled, a switch located behind the copilot's seat, under the floor, is tripped, shutting off the galley exhaust fan. This switch must be reset for operation of the galley exhaust fan.

In case CO_2 has been discnarged into the underfloor area, smoke has filled the flight compartment, or an emergency exists that requires cabin depressurization, the emergency depressurization control lever may be actuated for immediate release of cabin pressure.

CAUTION

> If the emergency depressurization control lever has been actuated, do not again engage the superchargers during flight.

CABIN PRESSURIZATION SYSTEM CONTROLS.

Before flight, rotate the START MARKER knob until the marker on the face of the indicator is set at the altitude of the takeoff field, as shown by the 29.92 inches Hg setting of the cabin altimeter. This is the altitude at which the cabin will start pressurizing. The HAND knob should then be rotated until the FLIGHT pointer is set at the maximum anticipated flight altitude if this altitude allows the cabin HAND to be above the START MARKER setting. If not, set the cabin HAND to coincide with the START MARKER. The CABIN pointer then will indicate the altitude the cabin will reach when the aircraft attains the maximum anticipated flight altitude. Place the rate and regulator control switch in the NORM OPER position. As the aircraft takes off and climbs to the maximum anticipated flight altitude, the cabin altitude climbs, at a slower rate and the cabin pressure builds up, relative to outside air pressure, until it reaches the maximum differential pressure of 4.16 ($\pm$0.01) psi as the aircraft reaches its maximum anticipated flight altitude.

The rate of climb of the cabin depends upon the setting of the cabin pressure regulator and the rate of climb of the aircraft, but no rate calculations are necessary as the pressurization takes place automatically. If the landing field altitude is the same as that of the takeoff field, no adjustment of the instrument in flight is necessary. As the aircraft descends, the cabin will descend at a slower rate. As the cabin does not have as far to descend as the aircraft, the cabin pressure will be zero at the same time that the aircraft lands at the altitude previously preset on the START MARKER. However, if the altitude of the landing field is different from that of the takeoff field, then at any time after the aircraft reaches the maximum anticipated flight altitude and before starting the descent, set the START MARKER to the altitude of the landing field. Thus, as the aircraft descends to the landing altitude, the cabin will also descend, but more slowly, to the same altitude as that set on the START MARKER *(figure 4-8).*

For hot weather operation, if it is desirable to obtain maximum cooling for the comfort of the passengers, the setting of the cabin pressure regulator should be such as to demand pressurization of the cabin only

CABIN EMERGENCY DEPRESSURIZATION CONTROL LEVER AND SUPERCHARGER CLUTCH CONTROL LEVERS

AA1-90

Figure 4-5

after the cabin has cooled to a comfortable temperature following takeoff. Under a hot weather condition, the recommended setting of the START MARKER knob is 5000 feet, so that pressurization of the cabin will not begin prior to this altitude. The cooling turbine can then be operated to obtain its maximum efficiency in cooling the aircraft. In other words, maximum cooling can only be obtained at the sacrifice of pressurization. The START MARKER cannot be rotated around the dial past the CABIN pointer. If this is attempted, the marker will merely push the pointer around ahead of it resulting in internal damage to the instrument.

The following table lists comparisons between the actual altitude of the aircraft and the pressure altitude inside the fuselage when the cabin is at its maximum differential pressure of 4.16 psi.

Aircraft Altitude	*Pressure Altitude Inside Fuselage*
9,000 feet	Sea level
10,000 feet	815 feet
15,000 feet	4,500 feet
20,000 feet	8,000 feet
25,000 feet	11,000 feet

RATIO CONTROL FLIGHT.

Ratio control is fully automatic and can be used for most flights. The controlling instrument for ratio control is the cabin pressure regulator. With this method, all controls can be set for a predetermined flight plan and the cabin altitude and rates of climb and descent will be proportional to the rates of the aircraft. The maximum differential pressure of 4.16 psi will be reached when the aircraft is at the flight altitude selected. *(See figure 4-6).*

The rate and regulator control switch should be in the NORM OPER position for ratio control flight unless a malfunction is indicated, in which event the switch can be placed in the REG'LTR ONLY position, provided no change of the settings of the cabin pressure regulator is required.

CAUTION

When the rate and regulator control switch is in the REG'LTR ONLY position, any change in the cabin pressure regulator controls will cause a simultaneous corresponding change in cabin pressure.

If a change in the cabin pressure regulator control is necessary during flight and the rate and regulator control switch is in the REG'LTR ONLY position, open the manual control door and change the cabin pressure manually.

RATE CONTROL FLIGHT.

When using rate control, the cabin altitude and rates of pressure change are controlled independently of any change in aircraft altitude. This method is not fully automatic, and the pilot must assume the duties of the cabin pressure regulator. The pilot must calculate the proper rate of change, taking into consideration time, maximum differential pressure, and the capabilities of the system. He must make certain that the cabin rate of ascent is not held to such a low value or the aircraft climbed so rapidly that the maximum differential pressure will be reached while the aircraft is still climbing. (With maximum differential, the cabin will climb at the same rate as the aircraft.) During descent, the operator must be sure that the cabin rate of descent is not held to such a high value that the cabin becomes depressurized while the aircraft is still descending. Although ratio control should normally be used, rate control can be used to advantage as shown in figure 4-7. Rate control governed by the rate limit control can be obtained by setting both the UP and DOWN hands to the desired rate of ascent (above zero) or descent (below zero) and setting both the cabin HAND and START MARKER of the regulator at the desired cabin altitude. The cabin will then descend or ascend at the selected rate regardless of the aircraft altitude changes, provided the operator's calculations involving time, maximum differential pressure, and complete depressurization are correct.

The rate and regulator control switch should be in the NORM OPER position for rate control flight unless a malfunction is indicated, in which event the switch can be placed in the RATE ONLY position. When the desired cabin altitude is attained, set both hands of the cabin pressure change limit control to zero in order to maintain the cabin at the selected altitude.

NORMAL OPERATION.

Before Starting Engines.

Make certain before starting the engines that the following instruments are adjusted as indicated.

A. All system circuit breakers—Set.

B. Cabin pressure warning light—OFF.

C. Cabin emergency depressurization control – Lever full DOWN.

D. Cabin supercharger clutch control levers—ENGAGED.

E. Cabin altitude emergency control handle—NORMAL position.

F. Manual pressure control door—CLOSED.

G. OAT. – Above —40°C (lower temperature requires supercharger preheating).

H. START MARKER set to the reading of the cabin altimeter for a 29.92 inches Hg setting.

I. FLIGHT hand on the cabin pressure regulator set to maximum anticipated flight altitude if this setting allows the CABIN POINTER to be above the START MARKER. If the CABIN POINTER will not be above the START MARKER, set the CABIN POINTER to coincide with the START MARKER setting.

J. UP hand on the pressure change limit control set to 600 feet per minute.

K. DOWN hand on the pressure change limit control set to 300 feet per minute.

L. Rate and regulator control switch – NORM OPER.

M. Cooling turbine switch in the OFF position.

On Starting Outboard Engines.

A. Cabin supercharger oil pressure should read a minimum of 30 psi within 30 seconds after starting. If not, declutch the supercharger.

B. Airflow indicators should register an airflow that is stabilized within the green arc within 2 minutes after starting. If not, stop the engine and check the system.

C. During engine runup, check frequently to make certain that the following cabin supercharger pressure and temperature ranges are indicated.

CABIN SUPERCHARGER OIL PRESSURE	
Desired	45 to 65 psi
Minimum	30 psi
Maximum	120 psi

CABIN SUPERCHARGER OIL TEMPERATURE	
Desired	60° to 80°C
Minimum	—23°C
Maximum	110°C

Takeoff, Climb, and Cruise.

A. Cooling turbine switch—NORMAL.

B. All door warning lights—OFF for takeoff.

C. Cockpit side windows—CLOSED.

D. The cabin supercharger oil pressure, oil temperature, and airflow indicators should indicate within the normal range. The airflow indicators may indicate above the green band during takeoff as a result of high engine rpm.

E. No change will normally be required on the FLIGHT hand. If it is necessary to change the cabin pressure regulator setting during flight, reset only during level flight and wait until the cabin rate of climb becomes zero before climbing or descending.

F. To obtain maximum cooling on a hot day with both cabin superchargers operating, fly the aircraft unpressurized to an altitude above the takeoff field, allowing sufficient time for normal cooling with the turbine operating at its maximum efficiency. In order to accomplish this operating condition, the START MARKER on the cabin pressure regulator should be set initially at 5000 feet and the cooling turbine switch should be in the NORMAL position at takeoff. This will allow the cabin superchargers to deliver maximum quantity of ventilating air through the cooling turbine, which in turn will operate at its maximum efficiency to lower the temperature of the air in the cabin.

Note

On hot, humid days, condensation may appear inside the aircraft.

At such times as the cabin has cooled adequately following takeoff, presumably at an altitude of about 5000 feet, the START MARKER can be reset if necessary below the aircraft altitude so that pressurization can begin. When the cabin reaches a comfortable temperature, pressurized operation may be started with no discomfort to the passengers.

G. When it is desired to fly the aircraft pressurized with single supercharger operation, maximum cooling may be obtained by using the cooling turbine (cooling turbine switch NORMAL). This will not only supply the maximum quantity of air from one supercharger operation (cabin pressurized), but also will supply the coldest air. However, if outside air temperatures are excessively high, it is desirable, with one supercharger operating, to fly unpressurized and follow procedures outlined in step H below. At cruising speeds, this will permit a greater flow of air to cool the cabin than is normally supplied by both superchargers under pressurized cabin or cooling turbine operating conditions.

H. When flying with both superchargers inoperative, it is necessary that the pressure control valve be fully open to provide cabin ventilation. This is accomplished by opening the manual control door and actuating the manual cabin altitude switch to INCREASE. Do not close the manual control door since the automatic controls will then attempt to pressurize the cabin by preventing ventilation. Also, rotate the cabin altitude emergency control handle in a counterclockwise direction until the stop is reached. This will provide ventilating flow to the cabin through the supercharger bypass ducts. During this operation, the cooling turbine switch must be OFF.

Descent and Landing.

A. If the destination field altitude differs from the takeoff field, the START MARKER must be reset to the landing field pressure altitude after reaching the cruising altitude, and before descending for the approach (*figure* 4-8). This procedure will eliminate any sudden change of cabin pressure altitude during the final stages of the approach. When the cabin is pressurized, do not change the START MARKER during climb or descent.

B. Do not land with a differential pressure exceeding 1.8 psi. If necessary, dump the excess pressure overboard by using the manual cabin altitude switch.

C. Do not open windows or doors after landing until the cabin pressure warning lights are OUT and/or the differential pressure gage indicates zero pressure.

D. If it becomes necessary to hold an altitude after a letdown from cruising altitude, it is possible, if desirable, to descend the cabin at a slow and uniform rate of descent by setting the CABIN hand to the landing field altitude. This will pressurize the cabin at the rate previously set on the cabin pressure change limit control. If the aircraft remains at altitude long enough for the cabin either to reach the landing field altitude or the maximum differential pressure of 4.16 psi, whichever occurs first, the descent can then be made at the highest rate possible with no discomfort to passengers. However, as a result of the added load thrown onto the cabin superchargers, the cabin may heat up to an uncomfortable degree, particularly if ambient air temperatures exceed 29.4°C (85°F), as a result of the inability of the cooling turbine to remove sufficient heat from the compressed air.

EMERGENCY OPERATION.

Cabin Supercharger Gearbox Oil Pressure.

A. If the cabin supercharger gearbox oil pressure drops suddenly below 30 psi with little resultant rise in temperature, declutch the supercharger.

B. If the cabin supercharger gearbox oil pressure drops slowly to 30 psi with a resultant oil temperature rise, place the cooling turbine switch in the OFF position. If this does not cause the pressure to rise and temperature to decrease, declutch the supercharger.

Cabin Supercharger Airflow.

A. If there is no indication of airflow on the indicator and pressure and temperature are normal, declutch the supercharger.

B. If the airflow indicator fluctuates wildly or remains out of normal operating range, place the cooling turbine switch in the OFF position. If this does not correct the condition, increase the engine rpm substantially and then decrease it to the previous setting. If this still does not correct the condition, declutch the supercharger.

Cabin Pressure Controls.

A. In the event of malfunctioning cabin automatic pressure controls, place the rate and regulator control switch in the RATE ONLY position. If desired, adjustments can be made on the change limit control. If a malfunction is still indicated, the REG'LTR ONLY position may be used, provided no change of the settings of the cabin pressure regulator is required. If a change in the cabin pressure regulator is necessary during flight and the rate and regulator switch is in the REG'LTR ONLY position, open the manual control door and change the cabin pressure manually.

B. If this fails to provide the desired control, the cabin pressure may be controlled by use of the cabin altitude emergency control handle. (Leave the manual control door open for this operation.)

Excessive Cabin Differential Pressure.

If the cabin differential pressure exceeds 4.2 psi, open the manual control door and operate the manual cabin altitude switch to INCREASE. If this does not correct the condition, proceed as follows:

A. Decrease the cabin pressure by operating the cabin altitude emergency control handle.

B. Check that the following circuit breakers on the main circuit breaker panel are set:

Manual cabin pressure control

Cabin automatic pressure control

Cabin pressure control amplifier fuse (on the a-c section of the main circuit breaker panel)

TEMPERATURE CONTROL SYSTEM.

Cabin and cockpit temperature is controlled automatically, but may be controlled manually if necessary. Automatic temperature control is accomplished by an electrical cricuit which contains elements that sense outside air temperature, cabin temperature mixing

CABIN PRESSURE SYSTEM OPERATION – RATIO CONTROL FLIGHT

EXAMPLE CONDITION

TAKEOFF ALTITUDE, 0 FEET
LANDING ALTITUDE, 4000 FEET
MAXIMUM FLIGHT ALTITUDE, 20,000 FEET

INSTRUMENT SETTINGS AND OPERATION

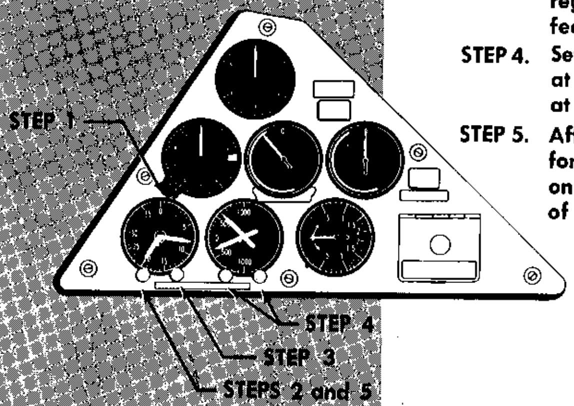
STEP 1. Set cabin altimeter to 29.92 and note field altitude indicated.

STEP 2. Set START MARKER on cabin pressure regulator to field altitude as read on cabin altimeter.

STEP 3. Set FLIGHT pointer (HAND knob) on cabin pressure regulator for anticipated flight altitude of 20,000 feet.

STEP 4. Set UP knob on cabin pressure change limit control at recommended 600 FPM ascent and DOWN knob at recommended 300 FPM descent.

STEP 5. After reaching maximum flight altitude B and before descending to landing field D, set START MARKER on cabin pressure regulator to landing field altitude of 4000 feet.



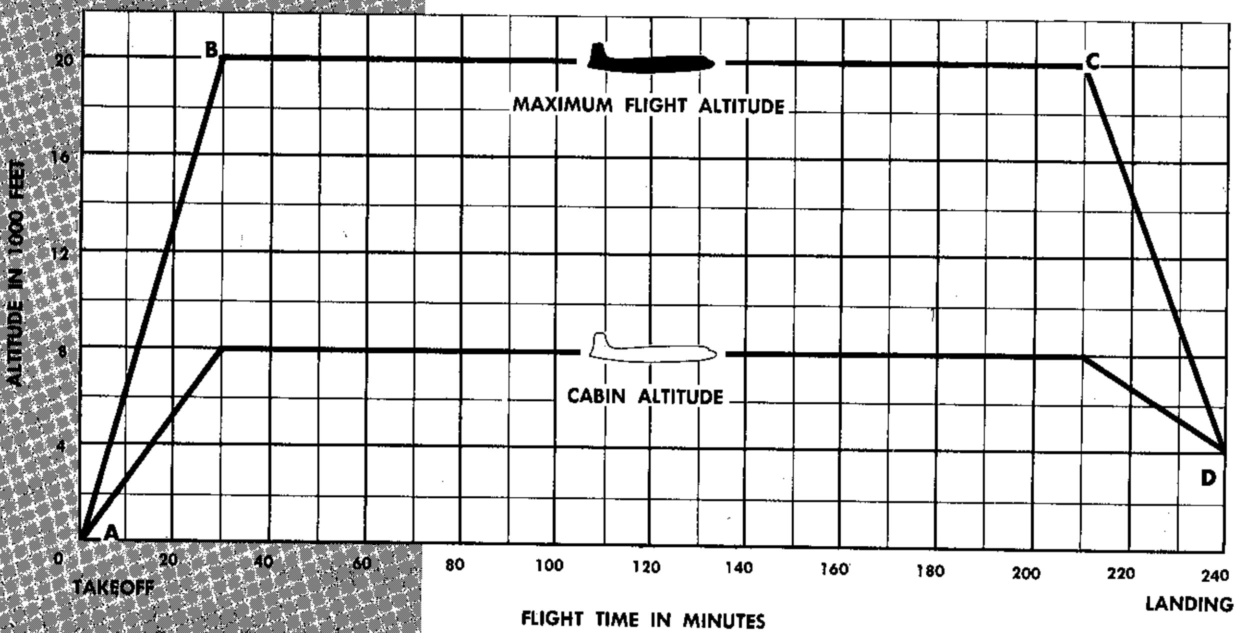


Figure 4-6 (Sheet 1 of 3)

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RATIO CONTROL FLIGHT

EXAMPLE CONDITION

TAKEOFF AND LANDING ALTITUDE, BOTH AT SEA LEVEL
MAXIMUM FLIGHT ALTITUDE, 20,000 FEET

INSTRUMENT SETTINGS AND OPERATION

STEP 1. Set cabin altimeter to 29.92 and note field altitude indicated.

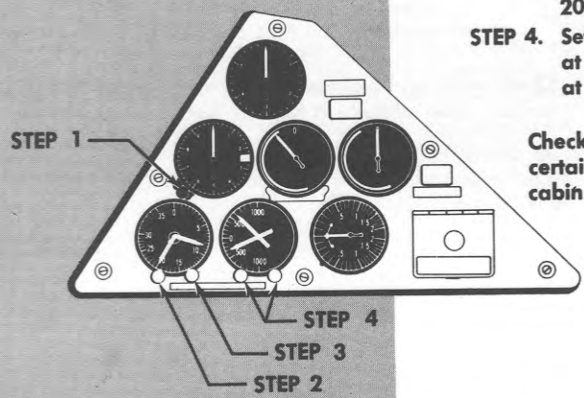
STEP 2. Set START MARKER on cabin pressure regulator to field altitude as read on cabin altimeter.

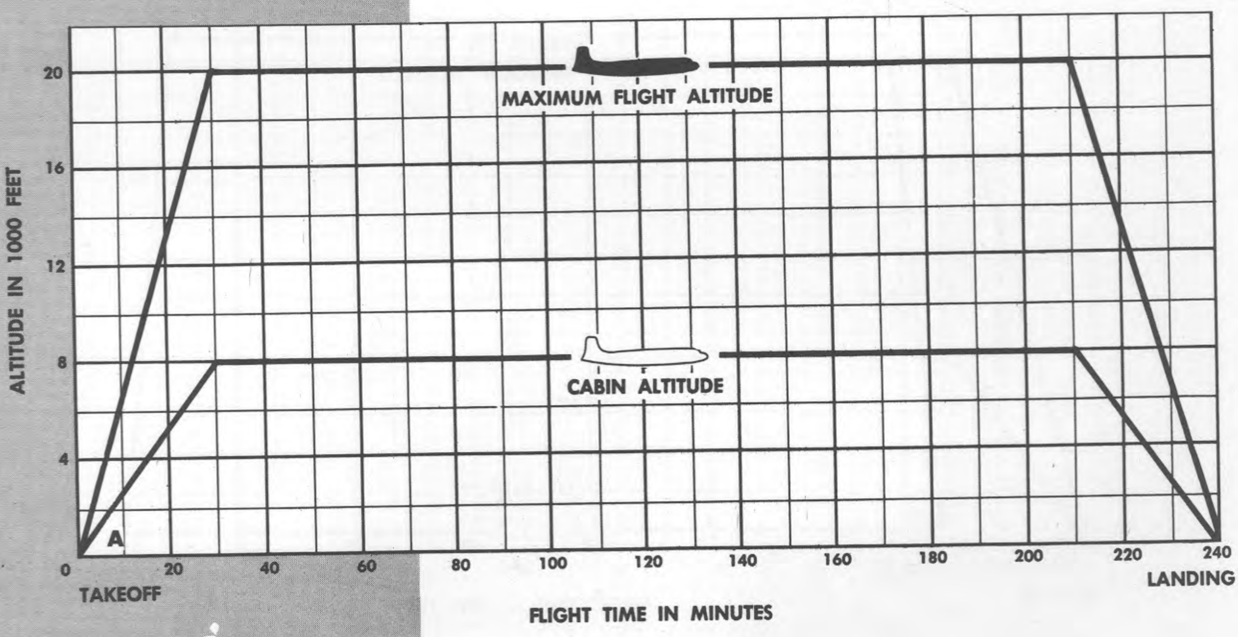
STEP 3. Set the FLIGHT pointer (HAND knob) on cabin pressure regulator for anticipated flight altitude of 20,000 feet.

STEP 4. Set UP knob on cabin pressure change limit control at recommended 600 FPM ascent and DOWN knob at recommended 300 FPM descent.

Note:

Check cabin and flight altimeters occasionally to make certain altitude differential is same as that shown on cabin pressure regulator indicator.





AA1-133

Figure 4-6 (Sheet 2 of 3)

CABIN PRESSURE SYSTEM OPERATION

EXAMPLE CONDITION

TAKEOFF AND LANDING AT SEA LEVEL (APPROXIMATELY) MAXIMUM FLIGHT ALTITUDE, 8500 FEET

INSTRUMENT SETTINGS AND OPERATION

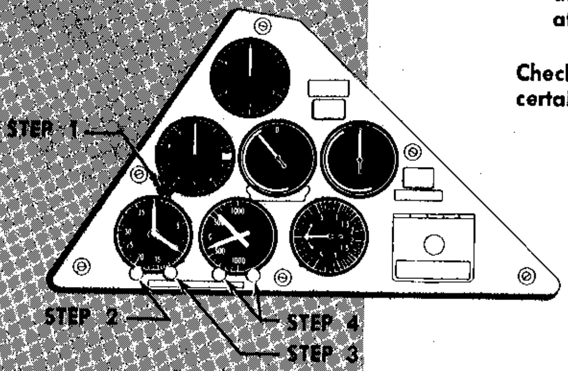
STEP 1. Set cabin altimeter at 29.92 and note the field altitude indicated.

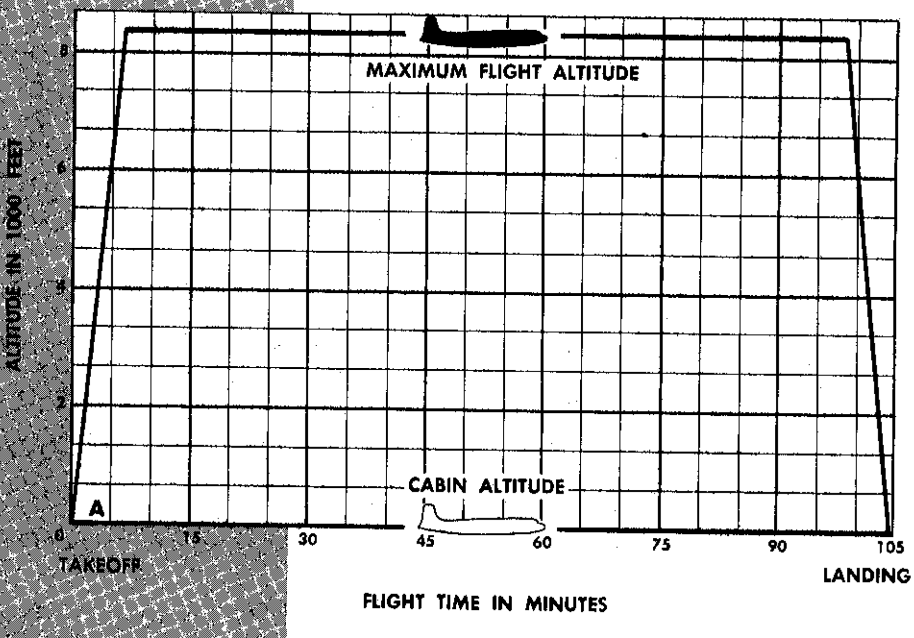
STEP 2. Set START MARKER on cabin pressure regulator to field altitude as read on cabin altimeter.

STEP 3. Set FLIGHT pointer (HAND knob) on cabin pressure regulator for anticipated flight altitude of 8900 feet.

STEP 4. Set UP knob on cabin pressure change limit control at recommended 600 FPM ascent and DOWN knob at recommended 300 FPM descent.

Note:
Check cabin and flight altimeters occasionally to make certain cabin altitude is held at start marker altitude.





AA1-142

Figure 4-6 (Sheet 3 of 3)

CABIN PRESSURE SYSTEM OPERATION—RATE CONTROL FLIGHT

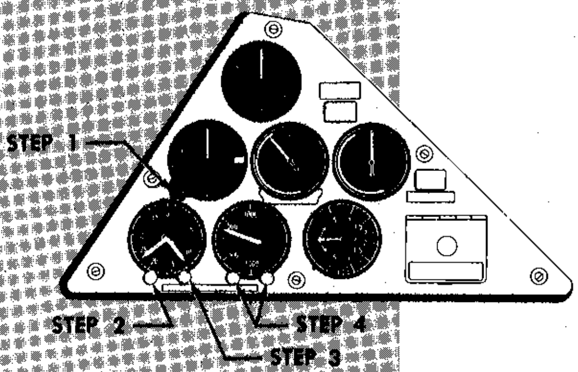
EXAMPLE CONDITION

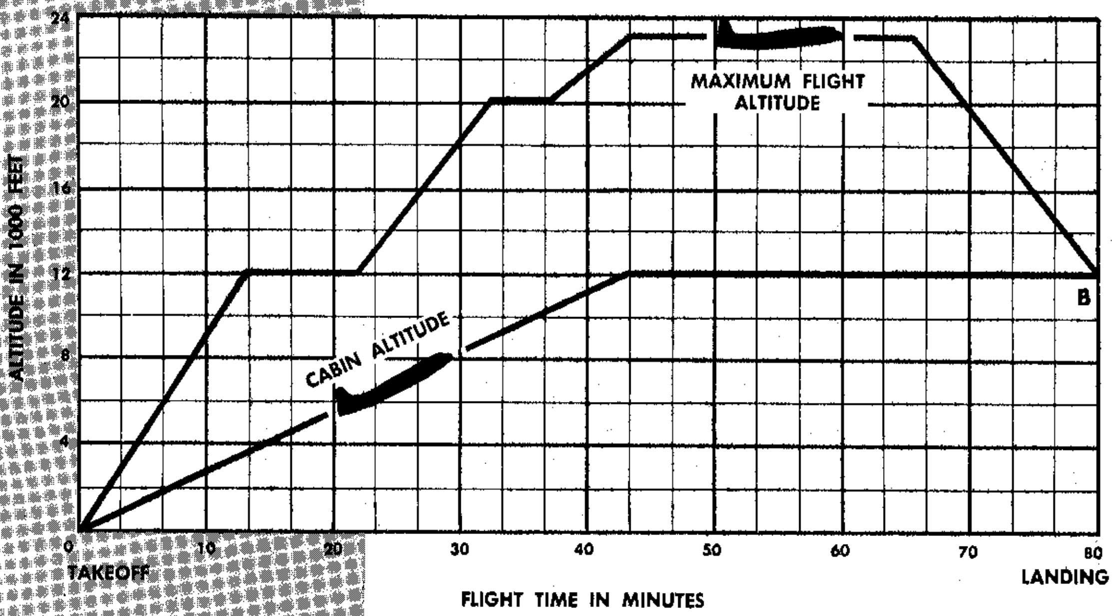
TAKEOFF ALTITUDE, 0 FEET
LANDING ALTITUDE, 12,000 FEET
MAXIMUM FLIGHT ALTITUDE, BELOW 25,000 FT.

INSTRUMENT SETTINGS AND OPERATION

STEP 1. Set cabin altimeter to 29.92
STEP 2. Set START MARKER on cabin pressure regulator to 12,000 feet (landing altitude B).
STEP 3. Set CABIN pointer (HAND knob) on cabin pressure regulator to 12,000 feet (landing altitude B).
STEP 4. Set both UP and DOWN knobs on cabin pressure change limit control to 300 FPM UP.
STEP 5. Spread hands on cabin pressure change limit control when desired cabin altitude is reached.

Note:
In this case, since cabin pressure change is to be constant regardless of flight altitude fluctuations, setting of cabin pressure change limit control is determined by dividing flight altitude by total anticipated flight time from takeoff to maximum flight altitude.





AA1-145

Figure 4-7

CABIN PRESSURE SYSTEM OPERATION — CHANGING FLIGHT ALTITUDE

EXAMPLE CONDITION

TAKEOFF ALTITUDE, 0 FEET. LANDING ALTITUDE, 5000 FEET. MAXIMUM FLIGHT ALTITUDE, 20,000 FEET. MAXIMUM FLIGHT ALTITUDE CHANGED TO 10,000 FEET DURING FLIGHT AND BEFORE LANDING.

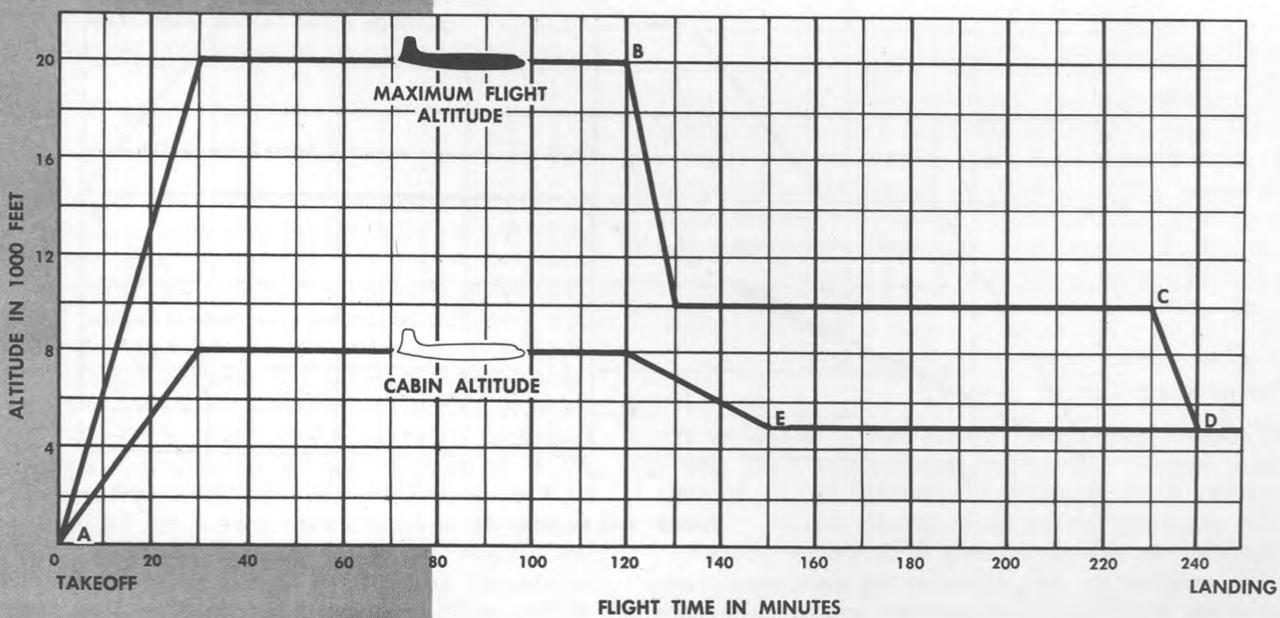
INSTRUMENT SETTINGS AND CONDITIONS

STEP 1. Set cabin altimeter at 29.92 and note field altitude indicated.
STEP 2. Set START MARKER to field altitude as read on cabin altimeter.
STEP 3. Set FLIGHT pointer at 20,000 feet.
STEP 4. Set UP knob at 600 FPM UP.
STEP 5. Set DOWN knob at 300 FPM DOWN.

Notes:

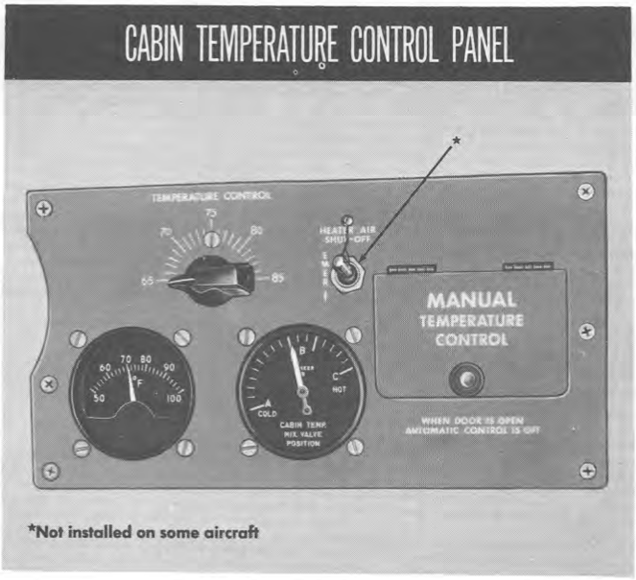
A. These altimatic pressure control settings are correct. The cabin will begin to pressurize at takeoff, and full cabin differential pressure will be obtained when the aircraft reaches the maximum anticipated flight altitude of 20,000 feet.

B. The correct method of operation to maintain maximum passenger comfort is as follows: After reaching the maximum flight altitude of 20,000 feet and before changing the altitude of the aircraft at point B to 10,000 feet, set the START MARKER to landing field altitude of 5000 feet. Set CABIN pointer to 5000 feet. Set UP knob to 100 FPM DOWN. Set DOWN knob to 100 FPM DOWN. With these settings, when the aircraft descends, the cabin altitude will descend to point E and level off at the desired landing field altitude, point D, of 5000 feet. Before the aircraft reaches the point of final descent at C, be sure to reset the UP knob to 600 FPM UP, and the DOWN knob to 300 FPM DOWN.



AA1-141

Figure 4-8



*Not installed on some aircraft

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Figure 4-9

valve position, air distribution system inlet temperature, cabin air temperature, cabin temperature control rheostat setting, windshield heat selector switch setting and cockpit temperature control rheostat setting. If the automatic temperature control system fails, the cabin temperature mixing valve must be positioned manually. This is accomplished by opening a manual temperature control door, located in the cockpit, and operating two pushbuttons which are connected by direct circuit to the cabin temperature mixing valve motor.

TEMPERATURE CONTROLS.

Cabin Temperature Control Rheostat.

A cabin temperature control rheostat located on the cabin temperature control panel (*figure* 4-9) has a placarded temperature range of from 65 to 85 degrees Fahrenheit. The temperature control rheostat may be used to select the desired cabin air temperature. If supercharged heated air is insufficient to heat the cabin, the cabin heater may be turned on.

Manual Temperature Control Door and Temperature Control Switches.

A manual temperature control door is located on the cabin temperature control panel (*figure* 4-9). Opening the door actuates a microswitch that deenergizes the automatic temperature control circuit. Closing the door returns the system to automatic operation. Two pushbuttons, located under the door, control the position of the cabin temperature mixing valve. One pushbutton will energize the mixing valve motor to close Port A (COLD) of the mixing valve and open Port C (HOT). The other pushbutton will reverse the mixing valve motor and mixing valve movement. To prevent cabin temperature overshoot, move the cabin temperature mixing valve in small increments and wait for temperature changes. Manual control will not open "A" port unless the turbine switch is on.

Heater Air Shutoff Switch.

A 2-position emergency heater air shutoff switch is located on the cabin temperature control panel (*figure* 4-9). The switch has a placarded EMER position and is safetied to the up (off) position. Breaking the safetywire and moving the switch to the EMER position causes automatic closure of Port C in the cabin temperature mixing valve to prevent airflow across the heater and into the cabin air distribution system during an emergency.

Cabin Temperature Mixing Valve Position Indicator.

A cabin temperature mixing valve position indicator, located on the cabin temperature control panel (figure 4-9), indicates the position of the mixing valve. It is not unusual during normal operation of the cabin temperature control system for the mixing valve to move from one extreme to the other in satisfying the circuit requirements.

Cabin Air Temperature Indicator.

A cabin air temperature indicator, located on the cabin temperature control panel (*figure* 4-9), is calibrated in degrees Fahrenheit from 50 to 100. The indicator registers the existing air temperature of the main cabin.

Cockpit Temperature Control Rheostat.

A cockpit temperature control rheostat, located on the heater fire control panel (*figure* 4-10), has the placarded positions NORMAL, WARMER, and HOT. The switch may be positioned at any intermediate setting to obtain desired cockpit air temperature. Power is supplied to the heater circuits when the cabin heater master switch is in the ON position and the cockpit temperature control rheostat is within the last 32 degrees of travel toward the HOT position. Normally, air to the cockpit is at the same temperature as that supplied to the cabin. Rotating the cockpit temperature control rheostat clockwise toward the HOT position will increase the temperature of the air, provided the windshield heat selector switch is not in the ANTI-ICING position. If the switch is in the ANTI-ICING position, return the cockpit temperature control rheostat to the NORMAL position to maintain the flow of air to the cockpit footwarmer outlets. Additional heat to the cockpit may be obtained by moving the windshield anti-icing air exhaust valve handles to the TO COCKPIT position.

Windshield Heat Selector Switch.

A windshield heat selector switch, located on the heater fire control panel *(figure 4-10)*, has the positions OFF, 10° TO 0°, TO −40°, and ANTI-ICING. On AF53-3223 through AF53-3305, the 10° TO 0° position of the windshield heat selector switch also incorporates a DEFOG position *(figure 4-11)*. Power is supplied to the heater circuits when the cabin heater master switch is in the ON position and the windshield heat selector switch is in the 0° to −40° or ANTI-ICING positions. Placing the switch in either of these positions also automatically discontinues cooling turbine operation to allow heated air to flow to the windshield for defogging or anti-icing.

Note

When windshield anti-icing heat is being applied, the cockpit temperature control rheostat should be in the NORMAL position.

Footwarmer Controls.

Two footwarmer push-pull controls are located in the cockpit, one on the wall outboard of each control column. The controls may be adjusted as desired to regulate the flow of heated air through the footwarmers.

Windshield Anti-Icing Air Exhaust Valve Handles.

Two windshield anti-icing air exhaust valve control handles are located in the cockpit, one on the wall outboard of each control column *(figure 1-6)*. Each handle has the positions TO COCKPIT and UNDERFLOOR. In the TO COCKPIT position, windshield anti-icing air exhaust is directed to the cockpit to provide warmer cockpit air temperature. Placing the handle in the UNDERFLOOR position exhausts the windshield anti-icing air under the cockpit floor.

TEMPERATURE CONTROL SYSTEM — NORMAL OPERATION.

Ground Heating.

A. With engines not running and an external power source connected, place battery selector switch in GROUND POWER position.

If engines are running, operate engines No. 2 and 3 above generator cut-in speed. Place battery selector switch on PLANE BATTERY.

B. Heater fuel switch — NORMAL SYSTEM.

C. Cabin heater fuel and ignition selector switch — #1 FUEL or #2 FUEL.

D. Cabin heater ignition selector switch — NORM (DUEL IGN.).

E. Cockpit temperature control rheostat — Last 32 degrees of travel or windshield heat selector — 0-40°.

F. Manual temperature control door — CLOSED.

G. Cabin temperature control rheostat — DESIRED. temperature.

H. Check for ground blower operation.

I. Cabin heater master switch — ON.

J. Windshield air exhaust handle — COCKPIT (if desired).

K. Check cabin heater temperature indicator for cycling indication. The indication should stabilize at approximately 115° to 135°C. Cabin heater temperature must not be allowed to exceed 145°C for over 5 minutes and in no case be allowed to exceed 150°C.

If these temperatures are not maintained, switch the cabin heater fuel and ignition control switches to the opposite system.

L. Check cabin heater fuel pressure indicator for cycling indication. The cabin heater fuel pressure limits on the ground are 3 to 7 psi, with the ground blower operating.

Inflight Heating.

A. Repeat steps B through L under GROUND HEATING.

B. Indicator readings in steps K and L will be dependent on airspeed, altitude, and OAT.

C. During a large percentage of flight operations, the cabin heater may not be required to operate, since the air from the cabin supercharger will be heated sufficiently by compression to maintain the cabin temperature within comfortable limits. When both superchargers are operating and the cabin is fully pressurized, the cabin heater is not required to supply heat when OAT is approximately −12°C (10°F) or above.

Ground Cooling.

A. Cabin heater master switch – OFF.

B. Cooling turbine switch – NORMAL.

C. Cabin temperature control rheostat (cooler than OAT.) – Desired temperature.

D. Cockpit temperature control rheostat – NORMAL.

E. Windshield heat selector – OFF.

F. Operate No. 1 and/or No. 4 engines above 1200 rpm so that the turbine will operate to cool the cabin areas.

G. Monitor the supercharger duct pressure indicator to be within limits.

Inflight Cooling.

A. Repeat steps A through D under GROUND COOLING.

B. Windshield heat selector switch – OFF or 10° TO 0° if windshield ventilation is required.

AIRFOIL ANTI-ICING SYSTEM.

The leading edges of the wings and the stabilizers are anti-iced by means of internal combustion heaters (*figure 4-12*) which receive their normal fuel supply from the No. 3 main fuel tank. A crossfeed system is provided, supplying fuel from the No. 2 main fuel tank. Two ignition systems and two identical fuel control assemblies are provided for each heater. The system is controlled by a group of switches on the heater control panel. In flight, the heaters are supplied with ventilating air and combustion air from their respective air-scoops. During heater ground operation, the wing heaters are supplied by a combination of ram air for ventilation from the No. 2 and 4 engine propeller blasts and air for combustion from the ground blowers, both necessary for heater operation. In the tail anti-icing system, both ventilating air and combustion air are supplied by a ground blower.

With the left main gear shock strut compressed, No. 2 and 4 engine generators supplying power and the airfoil deicer master switch ON, the ground blowers are automatically put into operation.

The circuits for the airfoil heaters are automatically opened when the throttle for the No. 2 and 4 engines is in reverse pitch position.

A group of cycling and overheat thermoswitches in the air ducts downstream from the heaters regulate the temperature of the air, which is supplied to the leading edge structure. The discharge air temperature of each airfoil heater is indicated in the cockpit. The tail anti-icing heater is protected by a single-shot CO_2 cylinder. The wing anti-icing heaters are protected by the main fire extinguishing system. (See Fire Extinguishing System, Section I.)

AIRFOIL DEICING SYSTEM CONTROLS.

Airfoil Deicing Switch.

An airfoil deicing switch located on the heater control panel has the positions ON and OFF. The function of the switch is to control the circuits of the airfoil anti-icing heaters. Placing the switch in the ON position energizes the wing and tail anti-icing heater circuits to allow the heaters to operate during flight or when engines No. 2 and 4 are running during ground operation. Placing the switch in the OFF position deenergizes the circuits of the airfoil heaters.

Heater Fuel Switch.

A heater fuel switch located on the heater control panel has the positions NORMAL SYSTEM and CROSSFEED. Placing the switch in NORMAL SYSTEM permits fuel to be supplied to the three airfoil heaters from the No. 3 main fuel tank. In flight, if the airfoil heater pump cannot maintain pressure to the heaters, the fuel switch may be positioned to CROSS-FEED and the cabin heater pump will provide an alternate source of fuel through crossfeed from the No. 2 main fuel tank.

Heater Fuel and Ignition Selector Switches.

Three heater fuel selector switches and three heater ignition selector switches, one for each airfoil anti-icing heater, are located on the heater control panel Each switch is placarded for the respective airfoil heater it controls and has the positions SYSTEM #1 and SYSTEM #2. Normally, the switches should remain in SYSTEM #1 position. In case of failure of fuel supply or ignition in either system, the other system may be selected to operate the respective heater. On some aircraft, a single heater fuel and ignition selector switch for each heater is located on the cabin heater control panel. Each switch has the positions #1 FUEL AND (#1 IGN. CHECK), and #2 FUEL AND (#2 IGN. CHECK). The switches may be used to select either fuel and ignition system, as required.

Heater Ignition Selector Check Switches.

Three heater ignition selector check switches, one for each airfoil anti-icing heater, are located on the heater control panel. Each switch has the positions NORM (DUAL IGNITION) and CHECK (SINGLE IGNITION). The switches are used to check the individual ignition systems of the anti-icing heaters. When a heater ignition selector check switch is in the NORM (DUAL IGNITION) position, both spark plugs for the

Figure 4-10 *(Sheet 1 of 2)*

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Figure 4-10 (Sheet 2 of 2)

respective heater will fire simultaneously. Placing the switch in the CHECK (SINGLE IGNITION) position will permit one of the spark plugs to fire when #1 FUEL is selected; when #2 FUEL is selected, the other spark plug will fire.

Airfoil Heaters Fire Extinguisher System Switches.

The airfoil heaters are protected by individual electrically actuated fire extinguisher systems. The tail anti-icing heater incorporates a single-shot CO_2 bottle. The wing anti-icing heaters are connected to the main fire extinguisher system CO_2 supply. An airfoil heater selector switch for each heater is located on the heater fire control panel *(figure 4-10)*. A 2-position CO_2 bottle selector switch for the wing heaters with LEFT BANK and RIGHT BANK positions, is located on the heater fire control panel. A CO_2 discharge switch that serves either wing anti-icing heater and a CO_2 discharge switch for the tail anti-icing heater are installed on the heater fire control panel. (See the paragraph on Airfoil Anti-Icing Heater Fire, Section III.)

Airfoil Anti-Icing Heaters Fire Warning Lights.

Three fire warning lights, one for each airfoil anti-icing heater, are located on the heater fire control panel *(figure 4-10)*. When the fire detectors for any heater are actuated, a 28-volt d-c circuit is energized, causing the warning light for the respective heater to illuminate.

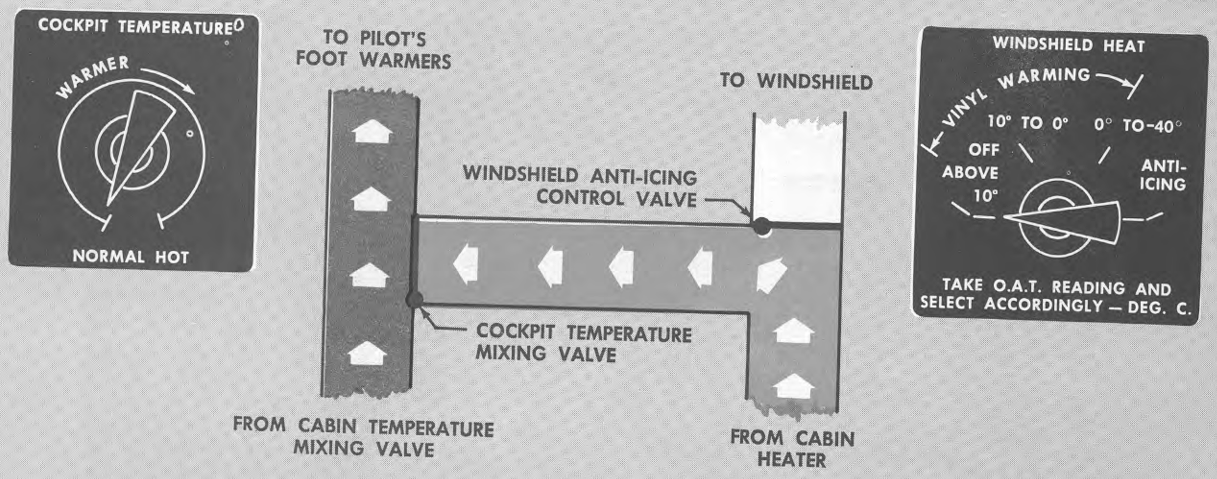
Airfoil Heaters Air Temperature Indicators.

A thermocouple-actuated heater air discharge temperature indicator for each airfoil heater is installed on the heater control panel and is calibrated in degrees centigrade.

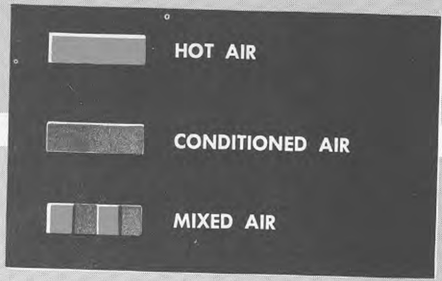
Airfoil Heaters Fuel Pressure Indicators.

An electrically actuated fuel pressure indicator for each airfoil heater is located on the heater control panel and is calibrated in psi.

COCKPIT AND



SCHEMATIC A



SCHEMATIC C

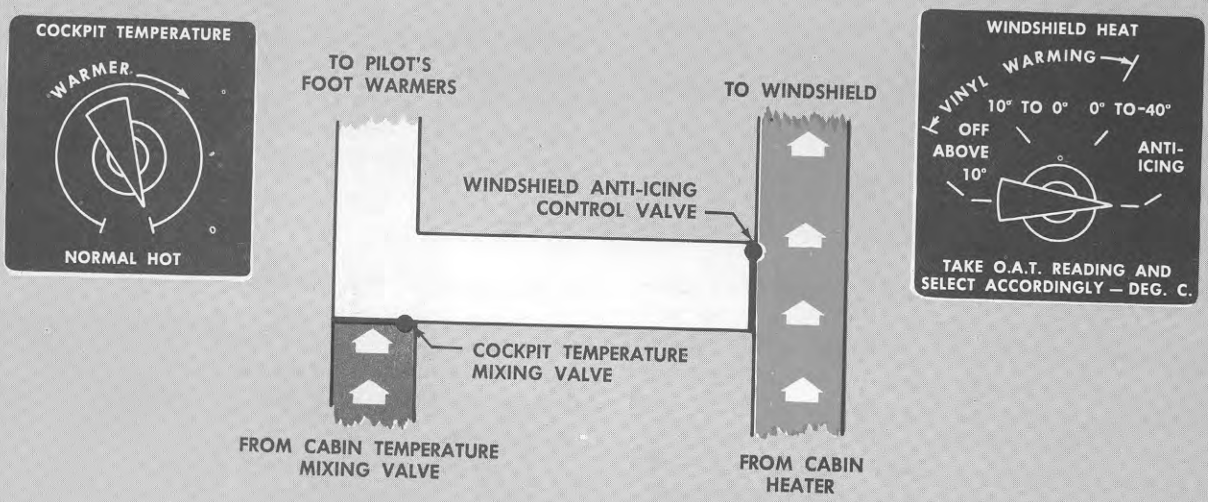


Figure 4-11 (Sheet 1 of 4)

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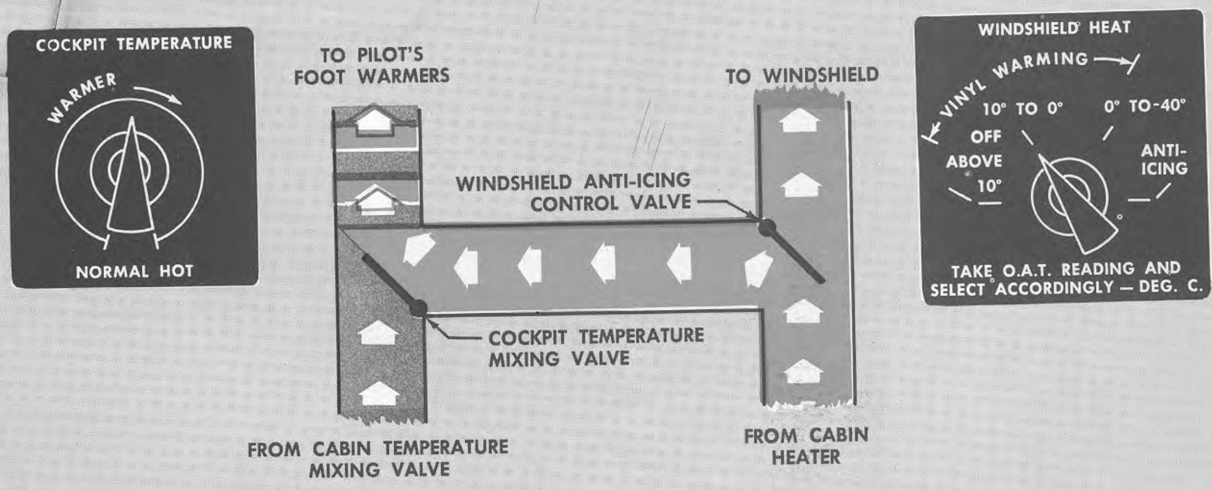
WINDSHIELD AIRFLOW SCHEMATIC

(AF51-3818 THROUGH AF51-3835, AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668)



SCHEMATIC B

SCHEMATIC D

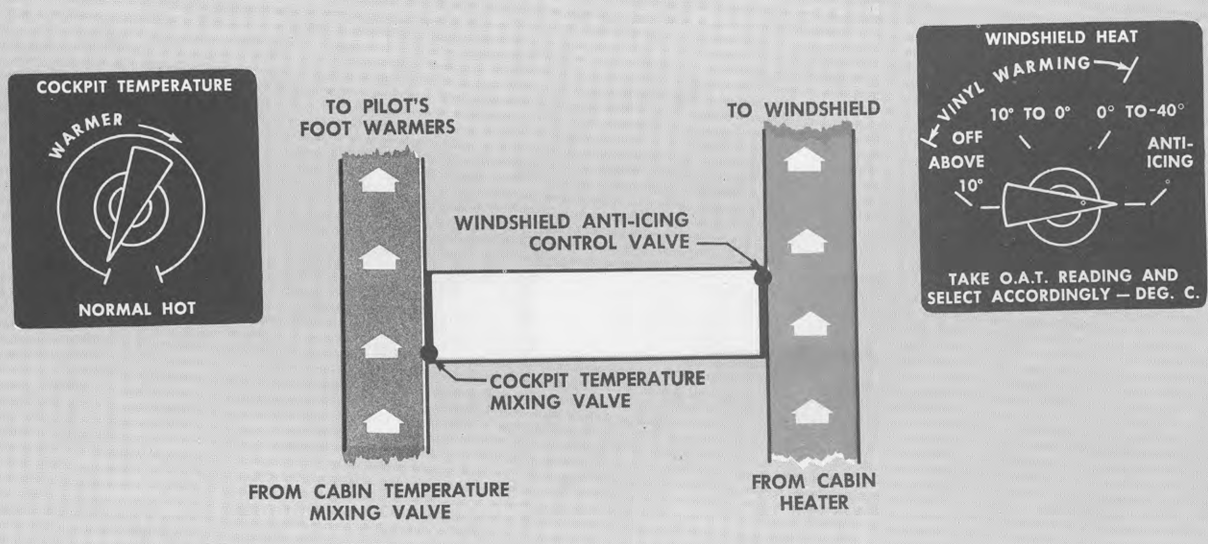


Figure 4-11 (Sheet 2 of 4)

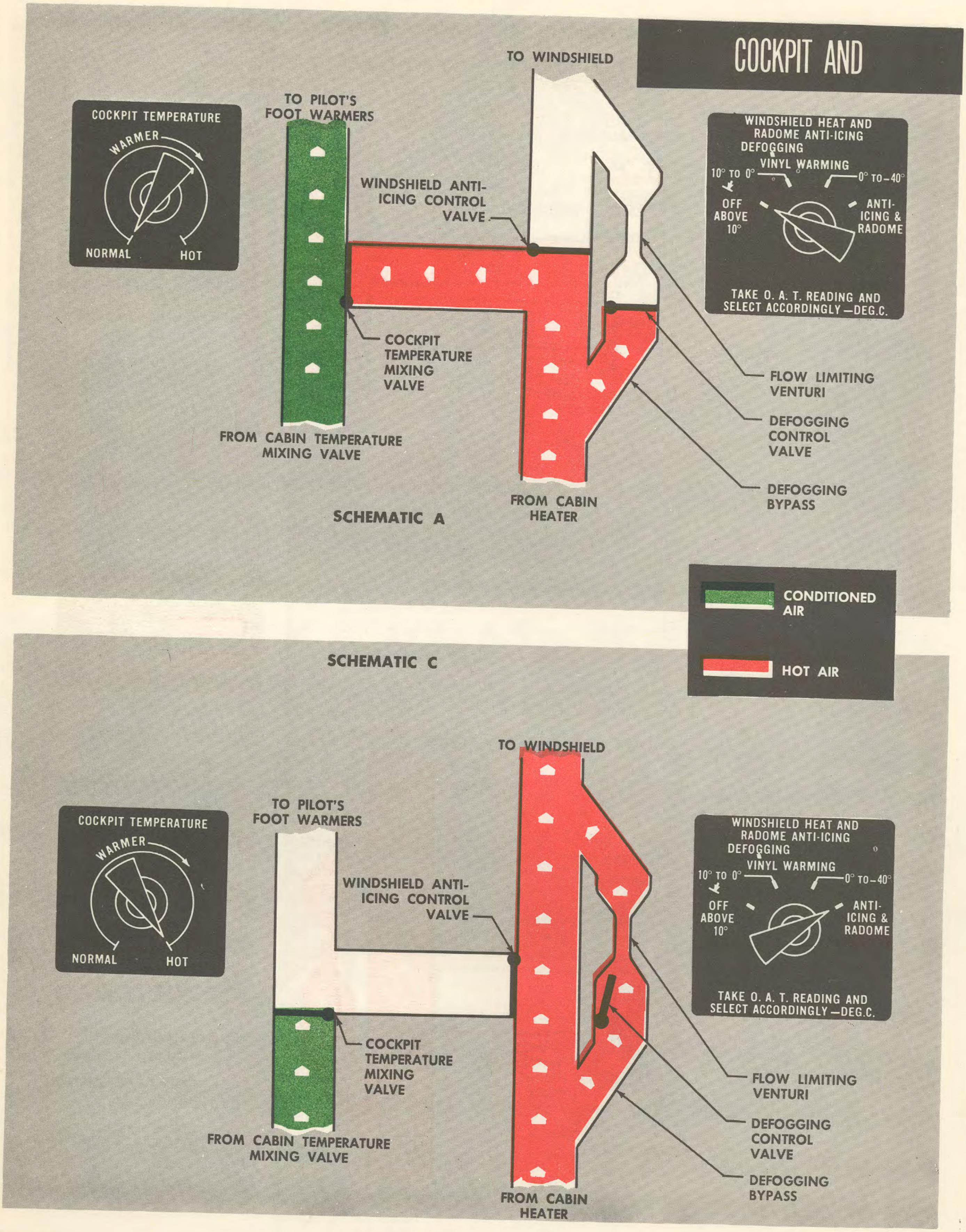


Figure 4-11 (Sheet 3 of 4)

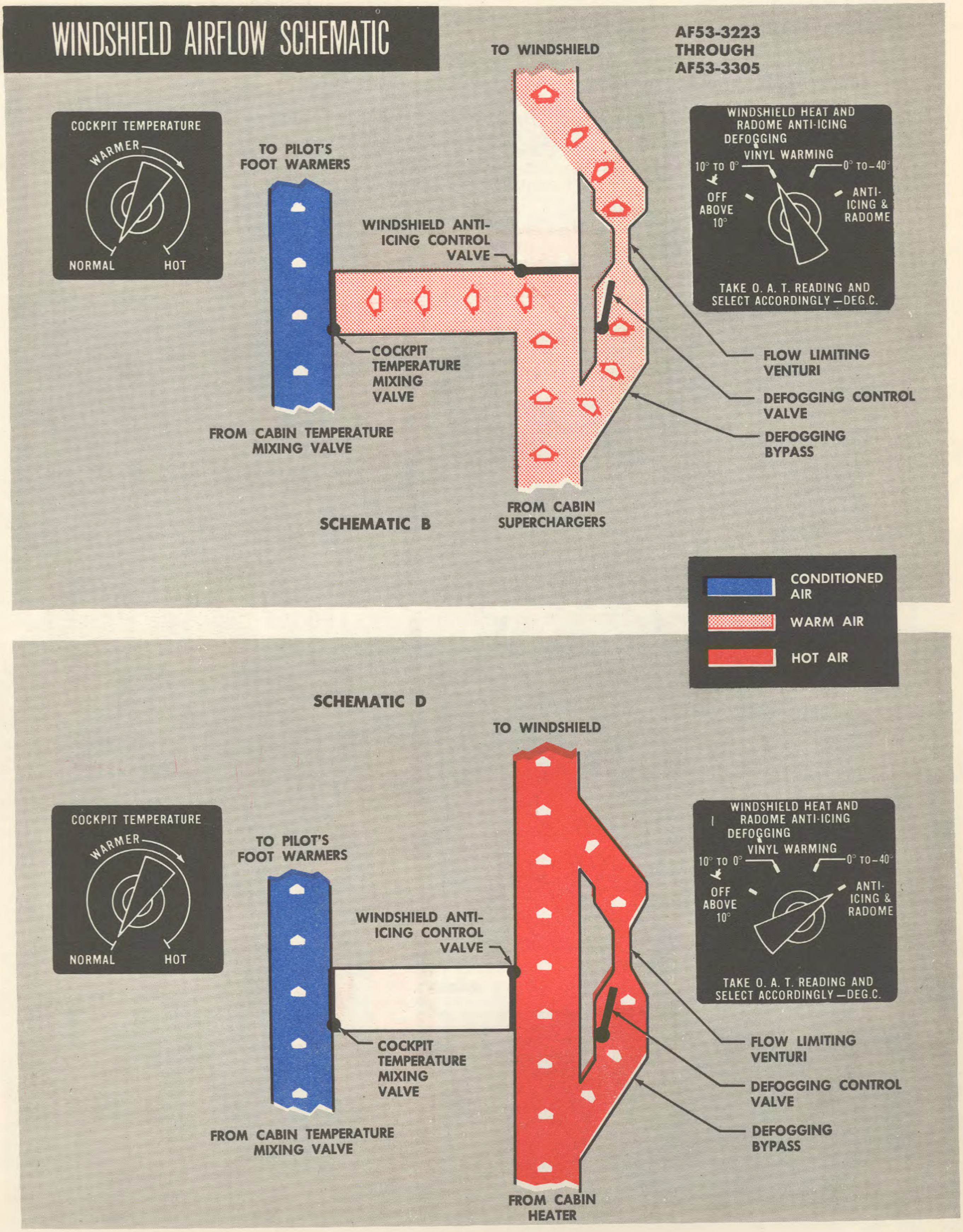


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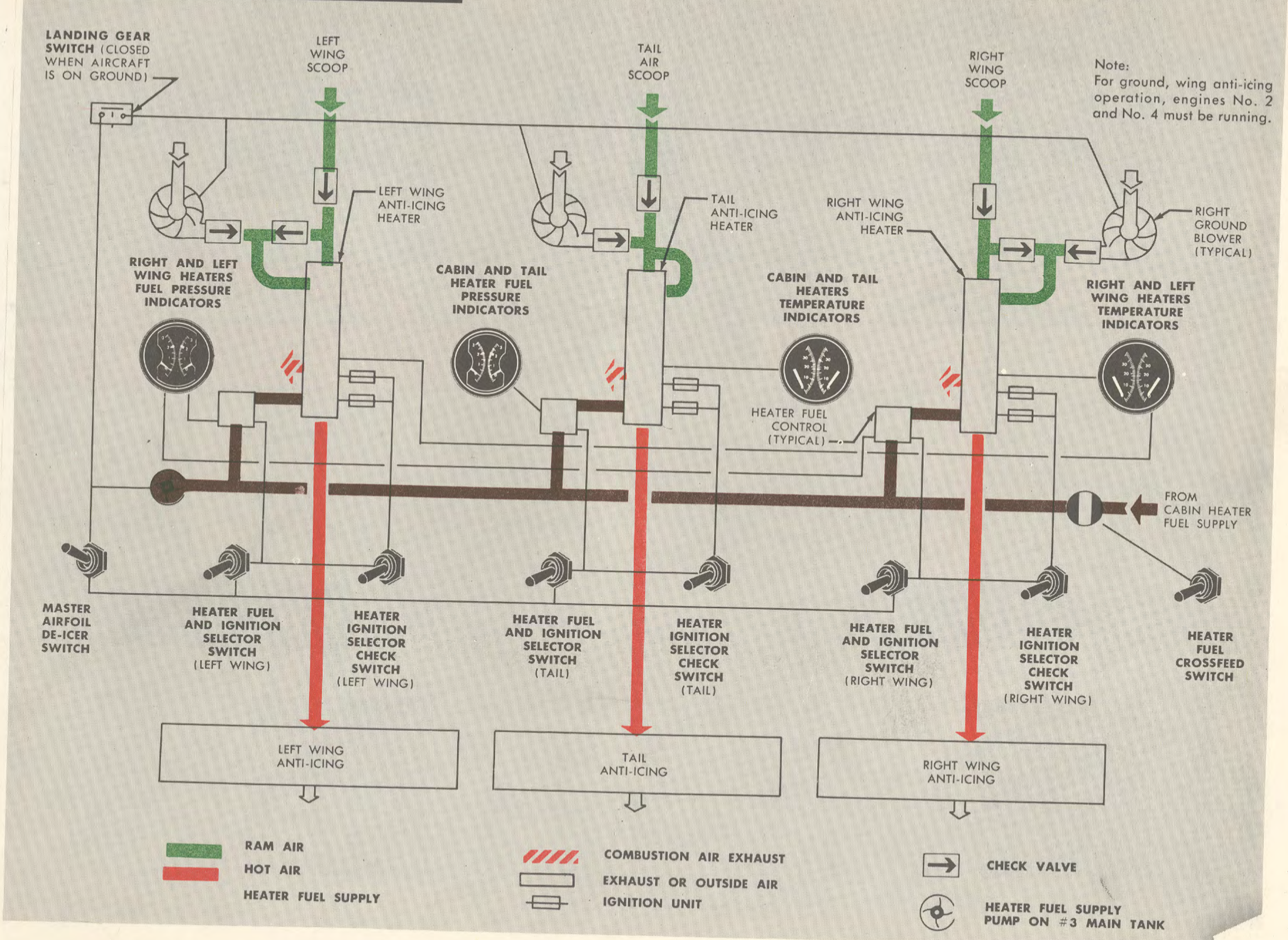
Figure 4-11 (Sheet 4 of 4)

AIRFOIL ANTI-ICING SYSTEM



AA1-138

Figure 4-12

AIRFOIL ANTI-ICING SYSTEM — NORMAL OPERATION.

A. Heater fuel switch — NORMAL SYSTEM.

B. Airfoil deicer switch — ON.

C. Heater ignition selector check switches — NORM (DUAL IGN.).

D. Heater fuel and ignition selector switches — #1 FUEL.

AIRFOIL ANTI-ICING SYSTEM — EMERGENCY OPERATION.

Excessive Airfoil Heater Temperature.

The maximum airfoil heater temperature is 210°C (410°F) with tubular-type thermocouples. If an airfoil heater air temperature indicator exceeds the above temperature, proceed as follows:

A. Turn the airfoil deicer switch OFF. The temperature should drop immediately.

B. If airfoil anti-icing heater operation is required, position the respective heater fuel selector switch to the opposite fuel system and turn the airfoil deicer switch ON.

C. Watch the airfoil heater air temperature indicator to make certain that it does not rise excessively.

D. If the temperature continues to rise, turn the airfoil deicer switch OFF. If it is necessary to operate the heaters, airfoil anti-icing can be maintained by manually turning the airfoil deicer switch ON and OFF as required to maintain the temperature within limits.

E. In flight, heater output in relation to ram airflow through the heater and ducting, or to OAT., is such that at some airspeeds the heaters may not cycle. Therefore, continuous fuel pressure with normal temperature indication does not indicate malfunctioning of the system.

Insufficient Airfoil Heater Temperature.

If the indicated temperature for the airfoil anti-icing heaters in inadequate (see figures 4-13 and 4-14 for minimum indicator temperatures), turn the airfoil deicer switch OFF, position the respective heater fuel selector switch to the opposite system, and turn the airfoil deicer switch back ON.

Airfoil Heater Fuel Pressure.

If there is temperature indication but no fuel pressure indication for any one airfoil heater the fuel pressure indicator has probably failed; no action is necessary since fuel pressure indication is not required for operation of the heaters. With the airfoil deicer switch ON, the fuel pressure indicators should indicate between the following limits.

Operation	*IAS*	*Wing and Tail Heater Fuel Pressure (Psi)*
Ground	0	3 to 7
Flight	230	20 to 26

If there is fuel pressure but heat output is not indicated, proceed as follows:

A. Turn the airfoil deicer switch OFF, wait 30 seconds, then turn switch ON.

B. If the heater fails to operate, turn the airfoil deicer switch OFF and wait 30 seconds, then select the opposite heater ignition system and turn the airfoil deicer switch ON.

C. If the heater still fails to operate, turn the airfoil deicer switch OFF and wait 30 seconds; then select the opposite heated fuel system and turn the airfoil de-icer switch ON.

If no pressure or temperature is indicated on any one of the airfoil indicators, switch to the opposite systems being used. If no pressure or temperature is yet indicated on any of the indicators, perform the following steps:

A. Check the following circuit breakers on the main circuit breaker panel to make certain they are positioned to SET:

MAIN, TAIL, L & R WING AIRFOIL HEATERS

MAIN AND AIRFOIL HEATER FUEL PUMPS

CABIN HEATER FUEL PUMP

If operating on the ground, also check generators No. 2 and 4 above cut-in speed and the AIRFOIL HEATER GROUND BLOWER circuit breaker.

B. Check inverter power, which should be 26 volts a-c.

C. If adequate pressure or temperature is still not available for any of the airfoil heaters, position the heater fuel switch to CROSSFEED.

D. If there is neither fuel pressure nor temperature indication on any of the airfoil heater indicators, the lack of fuel pressure may indicate a failure of the fuel system. Position the airfoil deicer switch to OFF and the heater fuel switch to NORMAL.

E. If malfunctioning of either the left or the right wing anti-icing heater, or both, is indicated by their respective fuel pressure and temperature indicators, the wing heaters circuit breaker on the main circuit breaker panel may be tripped. This will deenergize both wing heaters, leaving the tail heater in operation.

F. If malfunctioning of the tail anti-icing heater is indicated by its fuel pressure or temperature indicator, the circuit breaker on the main circuit breaker panel may be tripped, thus leaving only the two wing anti-icing heaters in operation.

G. In flight, if no fuel pressure or temperature is indicated on any heater after loss of #2 generator, (cabin heater is inoperative after loss of #3 generator), or no fuel pressure or temperature on airfoil heaters after loss of #4 generator, trip the landing gear ground control relay circuit breaker located on the main circuit breaker panel. Turn heater master switch on and if heaters operate, the left landing gear microswitch is stuck closed and heaters should be turned off just prior to touchdown.

CAUTION

The warning placard on the circuit breaker panel under the landing gear ground control relay circuit breaker will be strictly complied with any time this circuit breaker is tripped during ground operation.

RADOME ANTI-ICING SYSTEM.

The radome is anti-iced by hot air supplied from the windshield anti-icing duct *(figure 4-1)*. A supply of hot air is available to the radome when the windshield heat selector switch is in the ANTI-ICING & RADOME position and when the control valve in the radome duct is opened by means of a switch located in the cockpit.

RADOME ANTI-ICING SWITCH.

A 2-position radome anti-icing switch is located on the heater fire control panel *(figure 4-10)*. This switch should be placed in the ON position to automatically provide radome anti-icing when the windshield heat selector switch is positioned to ANTI-ICING & RADOME. Placing the switch in the OFF position closes the control valve in the radome duct to shut off the supply of hot air to the radome. Normal cabin pressure cannot be maintained with single supercharger operation unless the radome anti-icing switch is in the OFF position.

DEICING SYSTEMS.

The propeller, pitot heads, main static vents, wing scoops, belly scoop, and cabin heater combustion airscoop are protected against ice accretion by electrical heating elements. Ice is removed from the carburetor by heat from the engine and by an alcohol deicing system. Windshield ice is removed by heat from the cabin heater, or by an emergency standby alcohol system.

PROPELLER DEICING SYSTEM.

Ice is prevented from forming on the propeller blades by electrical heating elements installed in each blade leading edge. Takeoffs and landings can be made with the system in operation, and short periods of operation are permitted on the ground with the engines inoperative.

Note

The lack of a cooling airstream over the blade surfaces when the engines are inoperative is the limiting factor for ground operation. One complete cycle should be sufficient for ground check. The deicing circuit is deenergized while the feathering or reversing motor is in operation.

Propeller Deicing Controls.

Propeller deicing is controlled by a single ON-OFF master switch on the heater control panel Four 2-position selector switches, mounted on the aft overhead panel *(figure 1-12)*, are provided to select MANUAL operation when the timer system is inoperative. The switches are normally guarded to the TIMER position.

Propeller Deicing Indicators.

An ammeter with a selector switch is mounted on the aft overhead panel *(figure 1-12)*. Positioning the switch to the desired propeller will indicate the current load for the propeller when the timer cycles the selected propeller ON. For manual operation, position the individual propeller selector switches to MANUAL and rotate the ammeter selector switch in sequence to the four ON positions. When all four propellers are being manually deiced, it is recommended that the deicing time period for each propeller should not exceed 60 seconds ON and 180

WING ANTI-ICING SYSTEM MINIMUM INDICATOR TEMPERATURE CHART

Notes:

1. Temperatures based on use of 8T31B82 tubular thermocouple placed in center of cycling switch plate.
2. Curves based on low tolerance fuel nozzle 28 pounds per hour at 22.5 PSI.

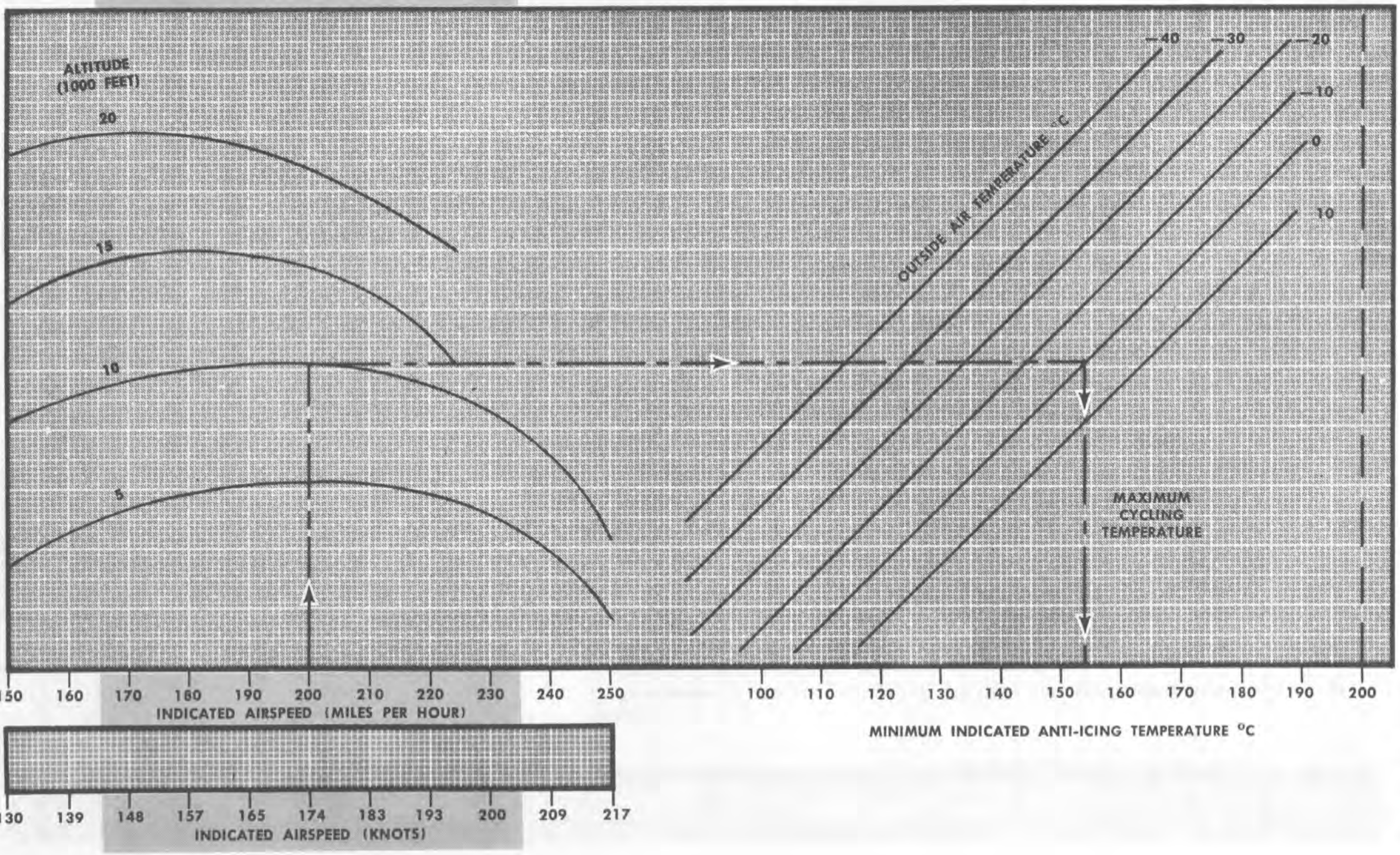


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Figure 4-13

TAIL ANTI-ICING SYSTEM MINIMUM INDICATOR TEMPERATURE CHART

Notes:
1. Temperatures based on use of 8T31B82 tubular thermocouple placed in center of cycling switch plate.
2. Curves based on low tolerance fuel nozzle 28 pounds per hour at 22.5 PSI.

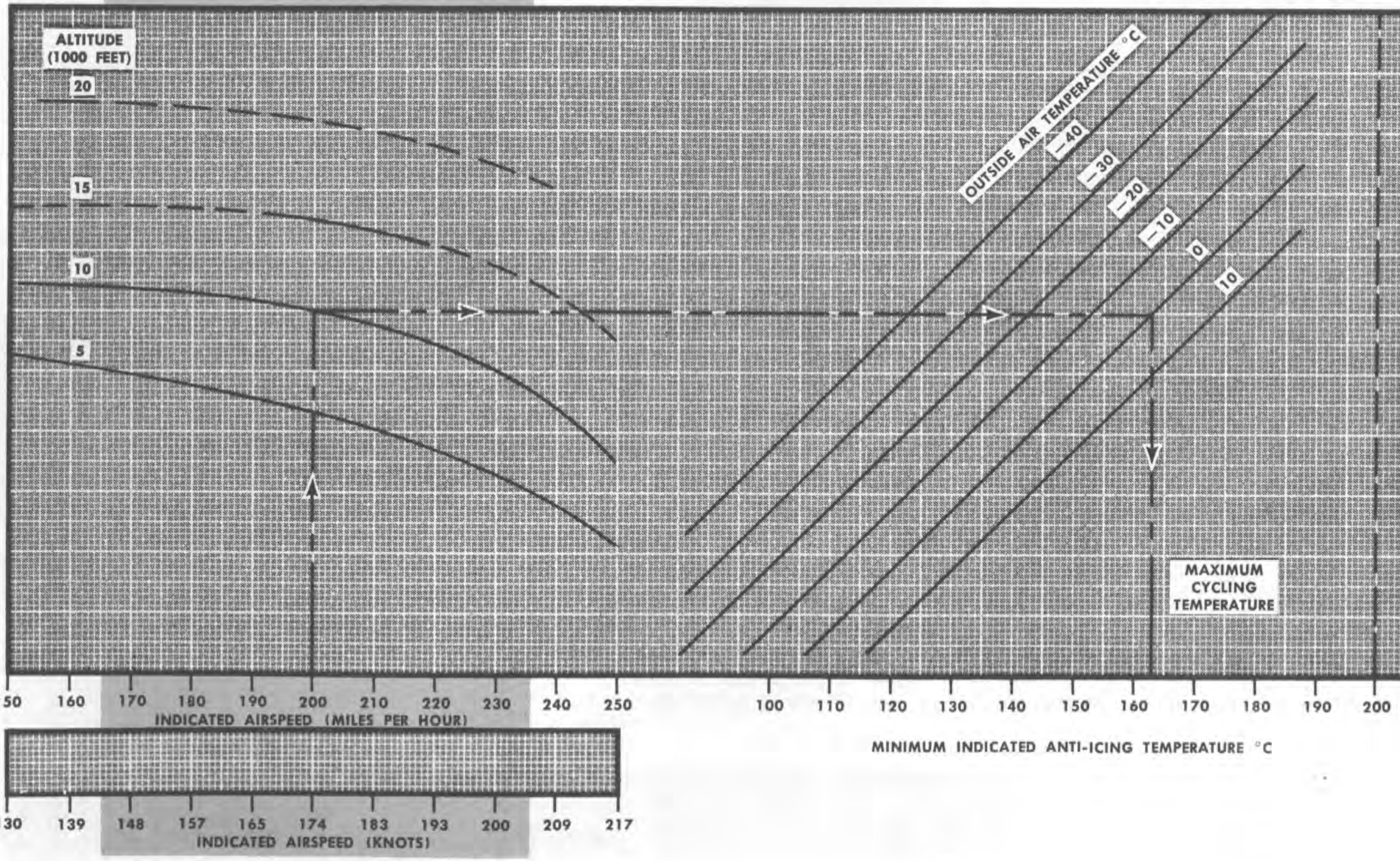

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Figure 4-14

seconds OFF. Partial timer and manual deicing operation is not recommended since it is possible to have a manually selected propeller and a timer selected propeller on at the same time, which may overload the generators. (Approximately a 200-ampere load per propeller is required for propeller deicing.)

PROPELLER DEICING SYSTEM — NORMAL OPERATION.

The propeller deicing system is placed in operation as follows:

A. Individual propeller deicing switches — TIMER.

B. Propeller deicing master switch — ON. PROPELLER DEICING SYSTEM — EMERGENCY OPERATION.

If the propeller deicing system automatic timer fails, perform the following to place the system in operation:

A. Master propeller deicing switch — OFF.

B. Individual propeller deicing switches — MANUAL.

C. Propeller deicing system ammeter selector switch — Alternate selector switch to the required propellers to simulate the normal cycling of the timer.

PITOT, STATIC, AND AIRSCOOP DEICING SYSTEMS.

The pitot heads, static vents, and airscoops incorporate electrical heating elements to prevent the accumulation of ice.

Pitot, Static, and Airscoop Deicing Control.

An ON-OFF pitot and scoop heaters switch is mounted on the upper instrument panel *(figure 1-11)* and is placarded MAX GROUND OPERATION 1 MINUTE.

CAUTION

Do not operate the pitot heaters for extended periods on the ground; the lack of a cooling airstream will result in damage to pitot heads.

Pitot, Static, and Airscoop Deicing Indicator.

A single ammeter and selector switch, mounted on the upper instrument panel *(figure 1-11)*, indicates through use of the selector switch the operation of the pitot, static, and airscoop deicing systems.

CARBURETOR DEICING SYSTEM.

The carburetor is protected against ice accretion by carburetor preheat and the alcohol deicing system. The alcohol deicing system consists of a 16-gallon alcohol supply tank *(17, figure 1-3)* and an electric pump which furnishes alcohol for both the carburetor and the windshield. In continuous operation, the carburetor alcohol deicing system provides for a 17-minute supply of fluid to the four carburetors, provided alcohol is not used for the windshield deicing system.

Carburetor Alcohol Deicing Switches.

Four spring-loaded ON-OFF switches, one for each carburetor, are mounted on the heater control panel When placed ON, each switch will energize the alcohol pump and direct flow to the desired carburetor.

WINDSHIELD DEICING SYSTEM.

The windshield is protected against ice accretion by the alcohol deicing system. The system can be operated without functional restriction. In continuous operation, the alcohol deicing system provides for a 48-minute supply of fluid, provided no alcohol is being used for the carburetor deicing system. The windshield is also protected by an anti-icing system (see Air Conditioning System, this section).

Windshield Alcohol Deicing Switch.

An on-off switch, mounted adjacent to the battery master switch on the forward overhead panel *(figure 1-13)*, energizes the alcohol pump and directs fluid flow through a needle valve to the windshield. The needle valve control knob is located on the side panel to the right of the copilot's seat, close to the decking.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

The equipment listed in the figure 4-15 is typical for C-118A aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

OPERATION OF COMMUNICATION AND ELECTRONIC EQUIPMENT.

AN/AIC-5B, AN/AIC-8, AND AN/AIC-10 INTERPHONE SYSTEMS.

Multiple interphone control panels are located in the flight compartment *(figure 1-7)*, adjacent to each flight crew member's station. The interphone equipment provides communication between all crew members and enables them to use or isolate VHF, UHF, HF, ADF, VOR, and marker beacon *(figure 4-16)*. The interphone equipment may be checked as follows:

A. Power supply – ON.

B. Make certain that the ON-OFF switch on the interphone amplifier is in the ON position. (Normally, the switch is safetywired ON.)

C. Set the volume control on the interphone control panel for maximum output; then set the filter switch on BOTH. The microphone selector switch can be in any position. Plug the microphone and headset into the control panel jacks provided at the crew stations (the pilot's and copilot's stations have microphones and headsets installed).

D. Listen for a signal in the headset when each of the receiver toggle switches on the interphone control panel is thrown to the receiver position. Check operation of the volume control on any one receiver input circuit.

E. Select the automatic compass receiver, tune in a low frequency range station, and listen for proper filtering of the signals when the range filter switch is turned to filter.

F. On aircraft AF51-3818 through AF51-3835, hold the microphone selector switch in the CALL position.

G. Press the microphone press-to-talk hutton and talk into the microphone.

H. A signal should be heard in the headset. Adjusting the volume should have no effect on the signal.

I. Turn the microphone selector switch to INTER.

J. Press the microphone press-to-talk button and talk into the microphone. A signal should be heard in the headset.

K. Turn the microphone selector switch to HF COMMAND.

L. Press the microphone press-to-talk button and talk into the microphone. The transmitter dynamotor should start running immediately, and a side tone should be heard in the headset.

Note

When testing transmitter circuits, operate units for as brief an interval as possible to avoid unnecessary transmissions and possible radio frequency channel jamming.

M. Turn the microphone selector switch to VHF and repeat step 12.

N. With the microphone selector switch in any position except INTER, position the INTER-OFF receiver toggle switch to INTER.

O. Press the microphone press-to-talk button and talk into the microphone. A signal should be heard in the headset.

P. Check each of the other interphone control panels by repeating steps C through O.

Q. Turn off all receivers and the power supply.

On AF53-3223 through AF53-3305, the interphone system is controlled from the pilot's, copilot's, and navigator's stations as follows *(figures 1-7 and 4-19)*.

A. On the C-824/AIC-10 interphone control panel, the VOL. knoh controls audio output to headphones when the NORMAL/AUX LISTEN switch is on the NORMAL position only. The monitoring switches, placarded INTER. UHF COMM, HF-1, ADF-1, and VHF COMM, provide simultaneous monitoring of any number of channels when the NORMAL/AUX LISTEN switch is on the NORMAL position. The AUX LISTEN position hypasses the internal amplifier in case of failure and connectts the headphones directly to the interphone line. The microphone cannot be used in this position, and only one of the channels may be monitored at a time. The switches preceding the one for the desired line must be off. The channel selector provides talk and listen facilities on five channels (INTER, COMM UHF, HF-1, COMM VHF, and HF-2), and a spring-loaded CALL position is provided in the extreme counterclockwise position. This energizes CALL relays in all C-824/AIC-10 control panels, placing them on the interphone line and interrupting any other communications.

B. Control panel C-826/AIC-10 contains five switches (blank not used, HF-2, MARKER, ADF-2, and VHF-NAV) which are used to extend the monitoring facilities of control panel C-824/AIC-10 to ten channels. Under emergency conditions when the station is on AUX LISTEN, the switches preceding the desired channel must be off and all monitoring switches on the corresponding C-824/AIC-10 control panel must be off (down).

C. The microphone feeds audio to the circuit selected by the channel selector switch when the control circuit is actuated by the microphone switch or CALL position on control panel C-824/AIC-10.

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

Type	*Designation*	*Use*	*Operator*
Public address	MI/36A (1, 2, 3, 4)	Loading ground crew and passenger announcements	Pilot (1, 2, 3, 4) Copilot (1, 2, 3, 4) Cabin attendant (1, 3)
Flight interphone	AN/AIC-5B (2) AN/AIC-8 (1) AN/AIC-10 (3) AN/AIC-10(4)	Intercrew communication (1, 2, 3) Maintenance communication (3) Intercrew communication (4)	All flight crew members Cabin stations (1, 3) Maintenance personnel (3) All flight crew members
Service interphone	LA-17 (1, 2)	Intercrew and maintenance communication	Pilot Copilot Cabin attendant Maintenance personnel
VHF	AN/ARC-1 (2)	Two-way communication	Pilot Copilot
VHF	51X-1(4)	Two-way communication	Pilot Copilot
VHF	17L4(4)	Two-way communication	Pilot Copilot
VHF	AN/ARC-49 (1, 3)	Two-way communication	Pilot Copilot
VHF	AN/ARC-3	Two-way communication	Pilot Copilot
VHF	Collins VHF-101	Two-way communication	Pilot Copilot
HF transmitter	AN/ART-13 (2)	One-way voice and code communication	Pilot Copilot Radio Operator
HF receiver	AN/ARR-15 (2) BC-454-B (1)	Receiver only	Pilot Copilot Radio Operator
HF transmitter receiver	618S-1 (1, 3, 4)	Two-way communication	Pilot (1, 3) Copilot (1, 3) Radio Operator (4)
HF transmitter receiver	ARC-58(4)	Two-way communication	Radio Operator
HF transmitter receiver	BC-348(4)	Voice reception	Radio Operator
A/N range receiver	R-23A/ARC-5 (2)	Navigation	Radio Operator (2)
VOR and localizer	AN/ARN-14(1, 2, 3, 4)	Omni-range navigation	Pilot Copilot
Steering Computer	562A-2(4)		Automatic
Glide slope receiver	AN/ARN-18 (1, 2, 3, 4) 51V-1 (1)	Glide slope landing approach	Pilot Copilot

Figure 4-15 (Sheet 1 of 2)

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT *(Continued)*

Type	*Designation*	*Use*	*Operator*
UHF homing adapter	AN/ARA-25 (3,4)	Homing	Pilot Copilot
Emergency keyer	AN/ARA-26 (1, 3, 4)	Distress signals	Radio operator (1,4) Navigator (3)
ADF	AN/ARN-6 (1, 2, 3, 4)	Direction finder and communication receiver	Pilot Copilot Navigator
IFF	AN/APX-25A(1, 2, 3, 4)	Indentification transmitter-receiver	Pilot (2) Radio operator (1) Navigator (3,4)
LORAN	AN/APN-9 (1) AN/APN-70 (2, 3, 4)	Long-range navigation	Navigator
Radio altimeter	SCR-718 (1, 2, 3, 4)	Radar altimeter (high range)	Navigator
Radio altimeter	AN/APN-1 (1, 2)	Radar altimeter (low range)	Pilot Copilot
Radio altimeter	AN/APN-22 (3, 4)	Radar altimeter (low range)	Pilot Copilot
TACAN	AN/ARN-21	Navigation	Pilot (1, 3, 4) Copilot (1, 3, 4)
Marker beacon	AN/ARN-12 (1, 2, 3, 4)	Location marker beacon	Pilot Copilot
Search radar	AN/APS-42 (1, 2) AN/APS-42A (3, 4) AN/APS-42B (2)	Search and weather radar	Pilot (2) Copilot (2) Navigator (1, 2, 3, 4) Radio operator (2)
Radar pressurizing kit	MK-59/AP (1, 2, 3, 4)	Pressurize radar system	Navigator (1, 2, 3, 4) Radio operator (2)
UHF	AN/ARC-27 (1, 2, 3, 4)	Two-way communication	Pilot (1, 2, 3, 4) Copilot (1, 2, 3, 4) Radio operator (1, 2)
Emergency transmitters and receivers	AN/CRT-3 (1, 2, 3) URC-4 (1, 2, 3)	Rescue	All flight crew members
Entertainment Radio	SX-62(4)	1 On AF53-3229 2 On AF53-3240	Passengers
Static Dischargers	AN/ASA-3		No Controls

Code: (1) AF51-3818 through AF51-3835.
(2) AF51-17626 through AF51-17661, AF51-17667, and AF51-17668.
(3) AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, AND AF53-3241 through AF53-3305.
(4) AF53-3229 and AF53-3240.

Figure 4-15 (Sheet 2 of 2)

D. The F-90/AIC filter assemblies at the pilot's and copilot's stations permit insertion of a filter for reception of voice, range signals, or both (no filter) from the ADF-1 and ADF-2 systems. The interphone control C-823/AIC-10 is controlled from the nosewheel well (1) and the cabin stations (7) in the same manner as the above set except that the headset microphone is connected to the system through the telephone jack and the microphone control circuit is actuated by the button on the telephone jack, or the CALL button.

Note

> The normal position for the interphone volume control knob is in the straight up (12 o'clock) position. This is the position for maximum undistorted volume for normal signals. Increased rotation will increase by only a small amount the normal audio level, but will greatly increase dynamotor whine, crosstalk, etc. To reduce the possibility of undesirable background interference when it is necessary to rotate the volume control beyond the normal position, the volume controls for the unmonitored receivers should be checked to determine that they are not higher than their normal listening level.

Cabin Interphone — VC-118A.

An interphone control panel with 10 monitor switches, a microphone selector switch, a volume control, and a two-position toggle switch placarded NORMAL and AUX. LISTEN, is located at the radio operator's station *(figure 4-19)*. . This interphone control panel also incorporates the HF-3 position for control of the auxiliary HF communication receiver. Interphone control boxes incorporating a call button, a volume control, and a two-position toggle switch placarded NORMAL and AUX. LISTEN are located in the cockpit, radio operator's station, galley, and passenger entrance. Telephone-type handsets are furnished at these locations and an additional handset is installed in the aft stateroom. All cabin area interphone stations are equipped with individual call buttons for calling any of the other stations, with the exception that the galley cannot call the aft stateroom. Call lights at the radio operator's station, passenger entrance, and galley are turned off by a reset button on the call panel. The pilot's call light is turned off automatically when the push-to-talk button on the handset is depressed. The aft stateroom has no call lights, and calls are indicated by a chime in the stateroom. The radio operator is furnished with a switch which controls a light in the aft stateroom to notify the occupant that a radio call has been placed, and that the radio operator is ready to go on the air.

INTERPHONE SYSTEM OPERATION.

Flight Interphone System Operation.

The flight interphone system is operated as follows:

A. Master battery switch — BATT & GND PWR.

B. Battery selector switch — PLANE BATTERY or GROUND POWER, as required.

C. Master radio power switches (two) — ON.

D. Turn on the radio receivers on the pilot's control pedestal and radio operator's station, and tune as desired.

E. NORMAL and AUX. LISTEN switch — NORMAL.

F. When any of the monitor switches on the interphone control panel are placed in the UP position, the respective radio receiver will be monitored at that interphone station.

G. Placing the microphone selector switch on INTER, and depressing the push-to-talk button on the microphone energizes the dynamotor and permits the initiating interphone station to talk to any of the other interphone control stations and the nosewheel well.

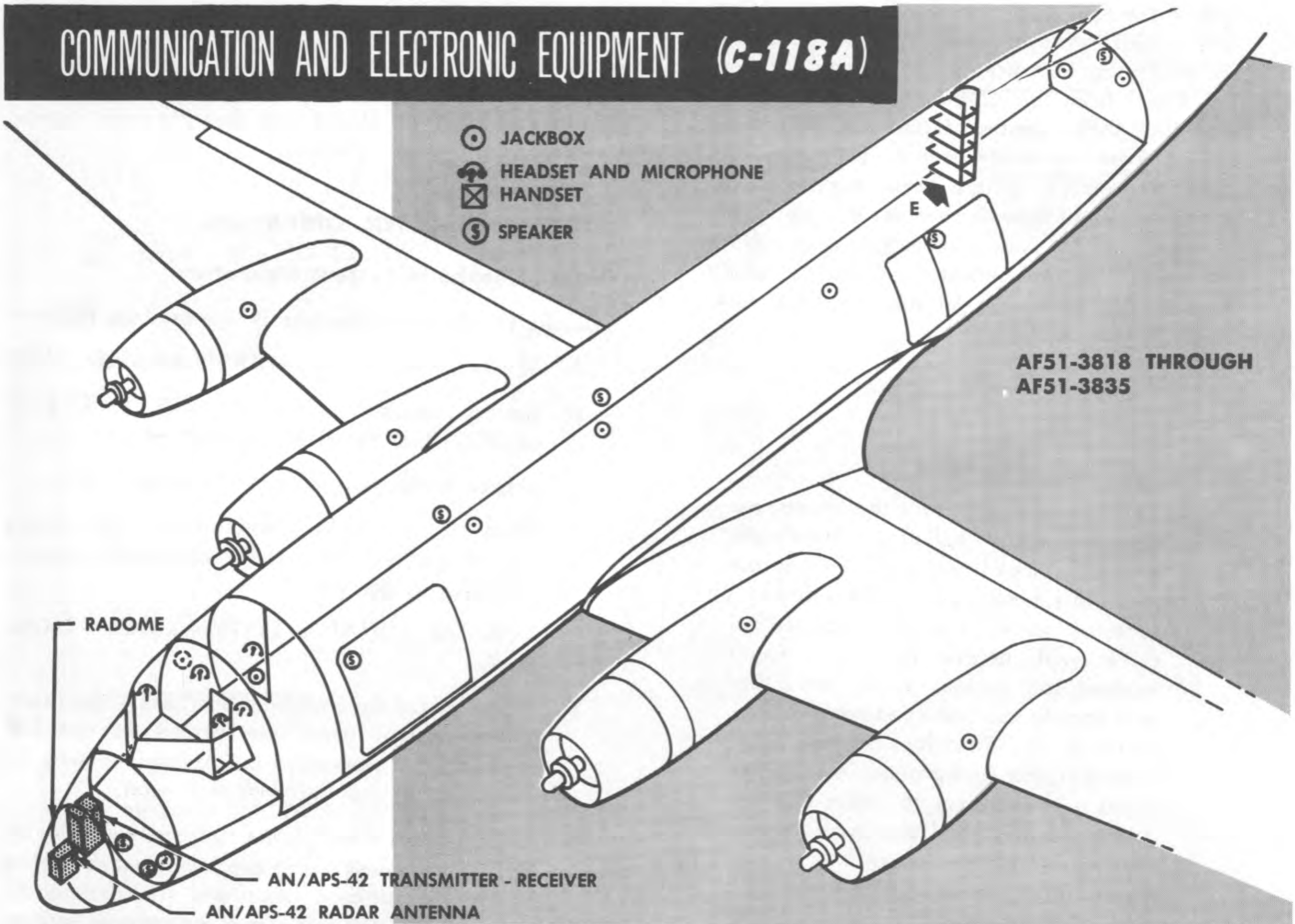
H. Placing the microphone selector switch in the momentary CALL position interrupts transmission at all other stations and places them on interphone.

I. When the NORMAL and AUX. LISTEN switch is in the AUX. LISTEN position, the internal amplifier is bypassed and the headphones at that station are connected directly to the interphone line. Only one radio receiver can be monitored and all receiver monitor switches except the one being monitored must be OFF. No transmission can be made in the AUX. LISTEN position.

J. Voice transmissions can be made on the HF-2, COMM VHF, HF-1, or the COMM UHF by placing the microphone selector switch in the appropriate position and depressing the push-to-talk button.

K. Volume control — Set as desired. Normal output is obtained when the knob is rotated to the 12-o'clock position.

COMMUNICATION AND ELECTRONIC EQUIPMENT (C-118A)



1. RADIO CIRCUIT BREAKERS
2. G-2 COMPASS AMPLIFIER
3. CABIN PRESSURE AMPLIFIER
4. AUTOPILOT REPEATER AMPLIFIER
5. FIRE DETECTOR RELAYS
6. RADIO A-C FUSE PANEL
7. EMERGENCY KEYER
8. HF COMMAND TRANSMITTER
9. SPARE FUSES
10. HF COMMAND RECEIVER
11. VHF POWER JUNCTION BOX
*12. RADIO ALTIMETER INDICATOR
13. SEARCH RADAR SYNCHRONIZER
*14. RADAR BEACON RECEIVER
*15. RADAR BEACON DYNAMOTOR
16. INTERPHONE MIXER AMPLIFIER (RADIO OPERATOR AND NAVIGATOR)
17. INTERPHONE MIXER AMPLIFIER (PILOT AND COPILOT)
18. AUXILIARY OIL AND FUEL QUANTITY TOTALIZER AMPLIFIERS
19. OIL QUANTITY AMPLIFIERS
20. FUEL QUANTITY AMPLIFIERS
21. VHF TRANSMITTER
22. VHF RECEIVER
23. AUTOPILOT AMPLIFIER
24. AUTOPILOT APPROACH AMPLIFIER
25. GLIDE SLOPE RECEIVER
26. PUBLIC ADDRESS AMPLIFIER
27. ADF RECEIVER
28. COMPASS SIGNAL POWER AMPLIFIER
29. MARKER BEACON RECEIVER
30. AF INTERPHONE AMPLIFIER
31. TACAN TRANSMITTER-RECEIVER
32. LORAN INDICATOR
33. SEARCH RADAR INDICATOR
34. HF LIAISON TRANSMITTER
35. HF LIAISON LOAD COIL
36. SEARCH RADAR CONTROL
37. INTERPHONE FILTER
38. INTERPHONE CONTROL
39. IFF CONTROL
40. EMERGENCY KEYER CONTROL
41. MONITOR-NORMAL AND KEY TRANSFER SWITCH
42. AZIMUTH INDICATOR
43. PHASE DETECTING NETWORK
44. HF LIAISON DYNAMOTOR
45. HF COMMAND DYNAMOTOR
46. INTERPHONE FOOT SWITCH
47. VOR AND GLIDE SLOPE CONTROLS
48. VHF COMMAND CONTROLS
49. UHF-VHF TRANSFER SWITCH
50. UHF COMMAND CONTROLS
51. ADF CONTROLS
52. VOR-TACAN TRANSFER SWITCH
53. TACAN CONTROL
54. PEDESTAL RADIO PANEL LIGHT RHEOSTAT
55. PUBLIC ADDRESS CONTROL
56. HF COMMAND CONTROL
57. AUTOMATIC APPROACH CONTROL
58. VHF COMMAND TRANSMITTER CONTROLS
59. HIGH-RANGE ALTIMETER TRANSMITTER-RECEIVER
60. ALTIMETER ANTENNA SWITCHING RELAY
61. LOW-RANGE ALTIMETER TRANSMITTER-RECEIVER
62. UHF TRANSMITTER-RECEIVER
63. VOR RECEIVER
64. VOR DYNAMOTOR
65. IFF INDICATOR LIGHT
66. IFF TRANSMITTER-RECEIVER
67. IFF IMPACT SWITCH
68. IGNITION ANALYZER RECEPTACLES
69. SEARCH RADAR PRESSURE CONTROLS
70. BLANK PANEL
71. INTERPHONE FILTER
72. INTERPHONE CONTROLS
73. ADF CONTROLS
74. CONSOLE PANEL LIGHT RHEOSTAT
75. RADIO MAGNETIC INDICATOR
76. OMNI BEARING INDICATOR
77. INSTRUMENT PANEL
78. HIGH-RANGE ALTIMETER INDICATOR
79. LORAN RECEIVER INDICATOR
80. SEARCH RADAR PRESSURE SWITCH
81. SEARCH RADAR DEHYDRATOR
82. SEARCH RADAR COMPRESSOR
83. INTERPHONE FOOT SWITCH

*SPACE PROVISIONS ONLY

Figure 4-16 (Sheet 1 of 6)

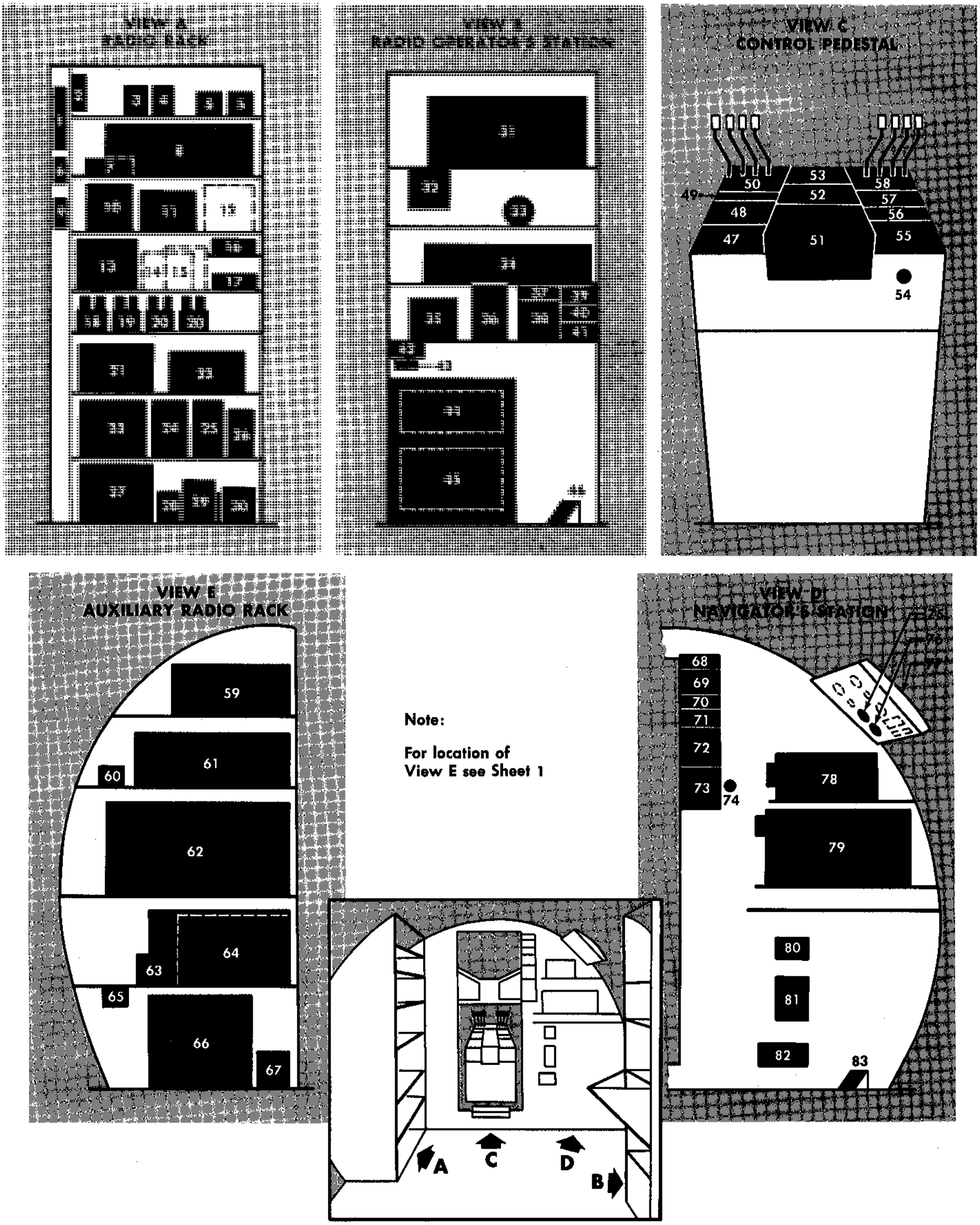


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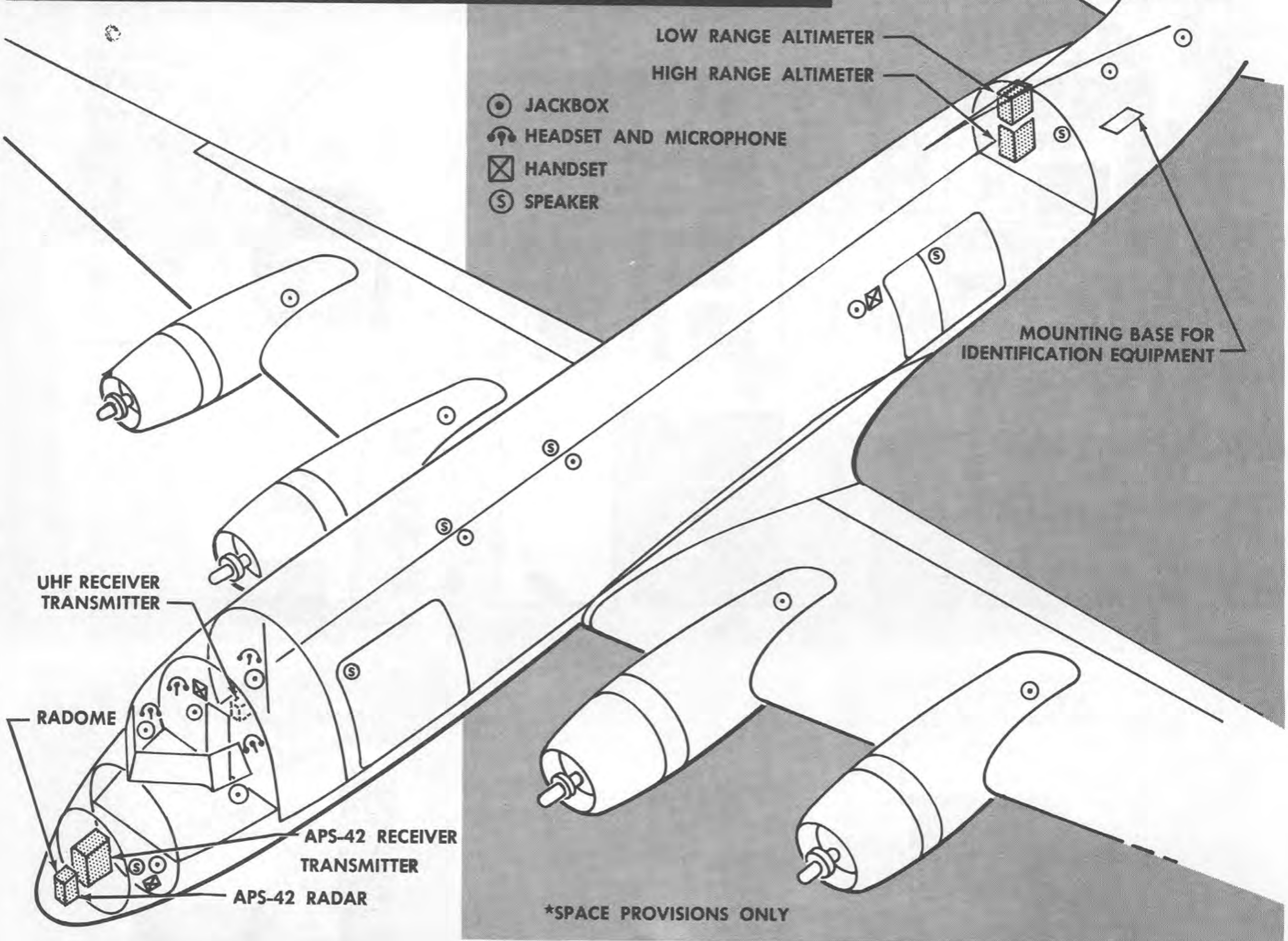
Figure 4-16 (Sheet 2 of 6)

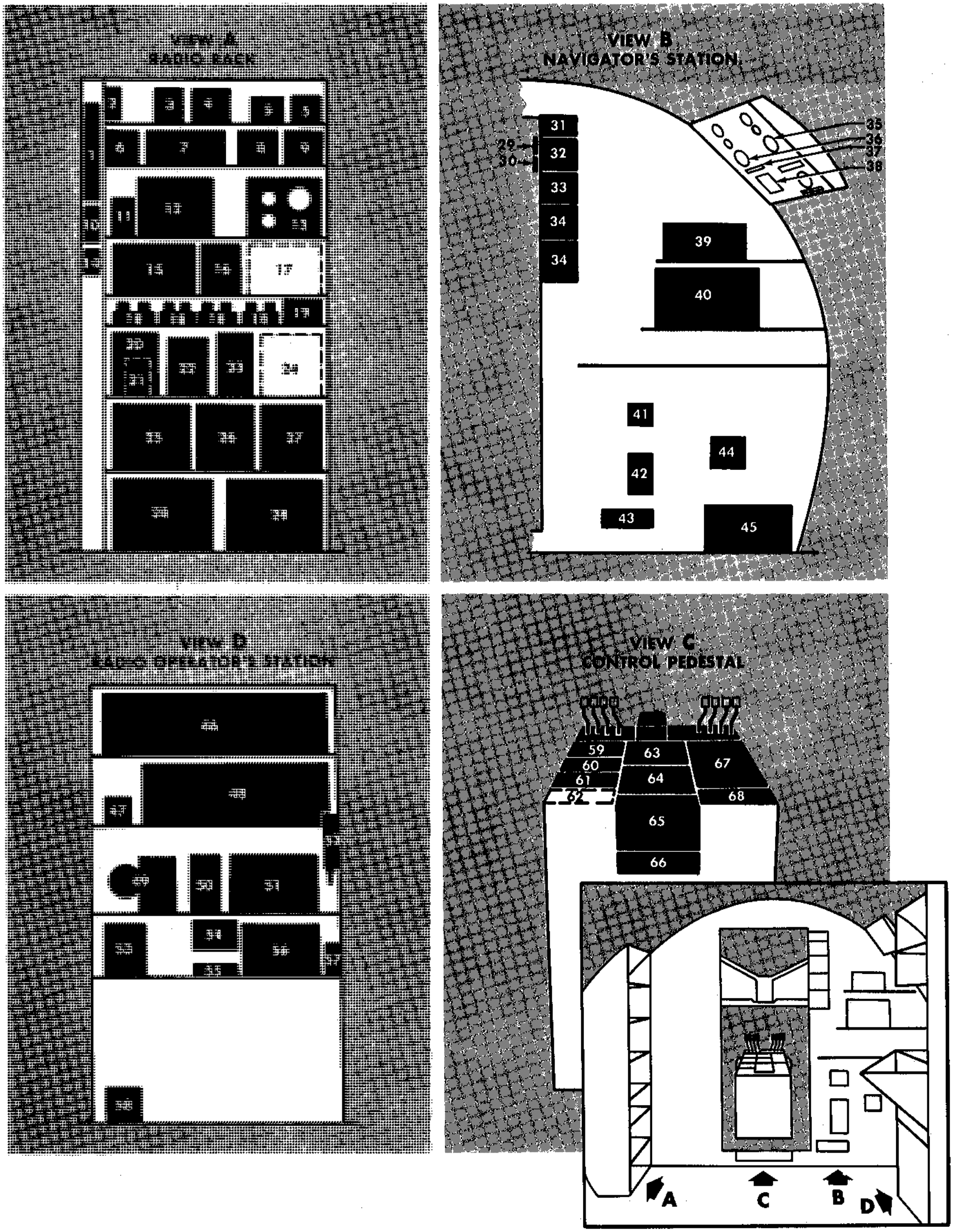
COMMUNICATION AND ELECTRONIC EQUIPMENT (C-118A)

AF51-17626 THROUGH AF51-17661
AF51-17667 AND AF51-17668



1. RADIO CIRCUIT BREAKERS
2. G-2 COMPASS AMPLIFIER
3. CABIN PRESSURE AMPLIFIER
4. AUTOPILOT REPEATER AMPLIFIER
5. FIRE DETECTOR RELAYS
6. INTERPHONE AMPLIFIER
7. INTERPHONE OPERATING ASSEMBLY
8. VOR RECEIVER
9. VOR DYNAMOTOR
10. RADIO A-C FUSE PANEL
11. COMPASS POWER AMPLIFIER
12. IGNITION ANALYZER AMPLIFIER
13. IGNITION ANALYZER CONTROLS
14. SPARE FUSES
15. SEARCH RADAR SYNCHRONIZER
16. SEARCH RADAR TRANSFER CONTROL RELAY
*17. DISTANCE MEASURING EQUIPMENT
18. FUEL AND OIL QUANTITY AMPLIFIERS
19. ADF TUNING DRIVE AMPLIFIER (TWO)
20. MARKER BEACON RECEIVER
21. SERVICE INTERPHONE AMPLIFIER
22. PUBLIC ADDRESS AMPLIFIER
23. GLIDE SLOPE RECEIVER
*24. VHF TRANSMITTER
25. AUTOPILOT AMPLIFIER
26. AUTOPILOT APPROACH AMPLIFIER
27. VHF RECEIVER/TRANSMITTER
28. ADF RECEIVER
29. FLIGHT ENGINEER'S INTERPHONE CONTROLS
30. FLIGHT ENGINEER'S AUDIO SELECTOR CONTROLS
31. PRESSURIZING KIT CONTROLS
32. BLANK PANEL
33. INTERPHONE CONTROLS
34. ADF CONTROLS
35. G-2 COMPASS REPEATER INDICATOR
36. RADIO MAGNETIC INDICATOR
37. VOR/ADF TRANSFER SWITCH
38. OMNI BEARING INDICATOR
39. RADAR ALTIMETER INDICATOR
40. LORAN INDICATOR
41. SEARCH RADAR PRESSURE SWITCH
42. SEARCH RADAR DEHYDRATOR
43. SEARCH RADAR COMPRESSOR
44. IFF IMPACT SWITCH
45. LORAN RECEIVER
46. LORAN ANTENNA MATCHING UNIT
47. HF TRANSMITTER
48. SEARCH RADAR INDICATOR AND CONTROL
49. INTERPHONE CONTROL
50. NO. 2 HF RECEIVER
51. UHF MASTER CONTROL
52. LF RECEIVER
53. LM FREQUENCY METER
54. MONITOR-NORMAL SWITCH
55. NO. 1 HF RECEIVER
56. INTERPHONE JACKBOX
57. VOLTMETER STOWAGE
58. UHF COMMAND CONTROLS
59. VHF COMMAND CONTROLS
60. VOR/GLIDE SLOPE CONTROL
*61. VOR
62. RADIO ALTIMETER LIMIT SWITCH
63. AUTOMATIC APPROACH CONTROLS
64. AUTOPILOT CONTROLLER
65. C-26/ARC-5 REMOTE CONTROL
66. SEARCH RADAR CONTROLS
67. SEARCH RADAR MASTER SWITCH
68. PUBLIC ADDRESS

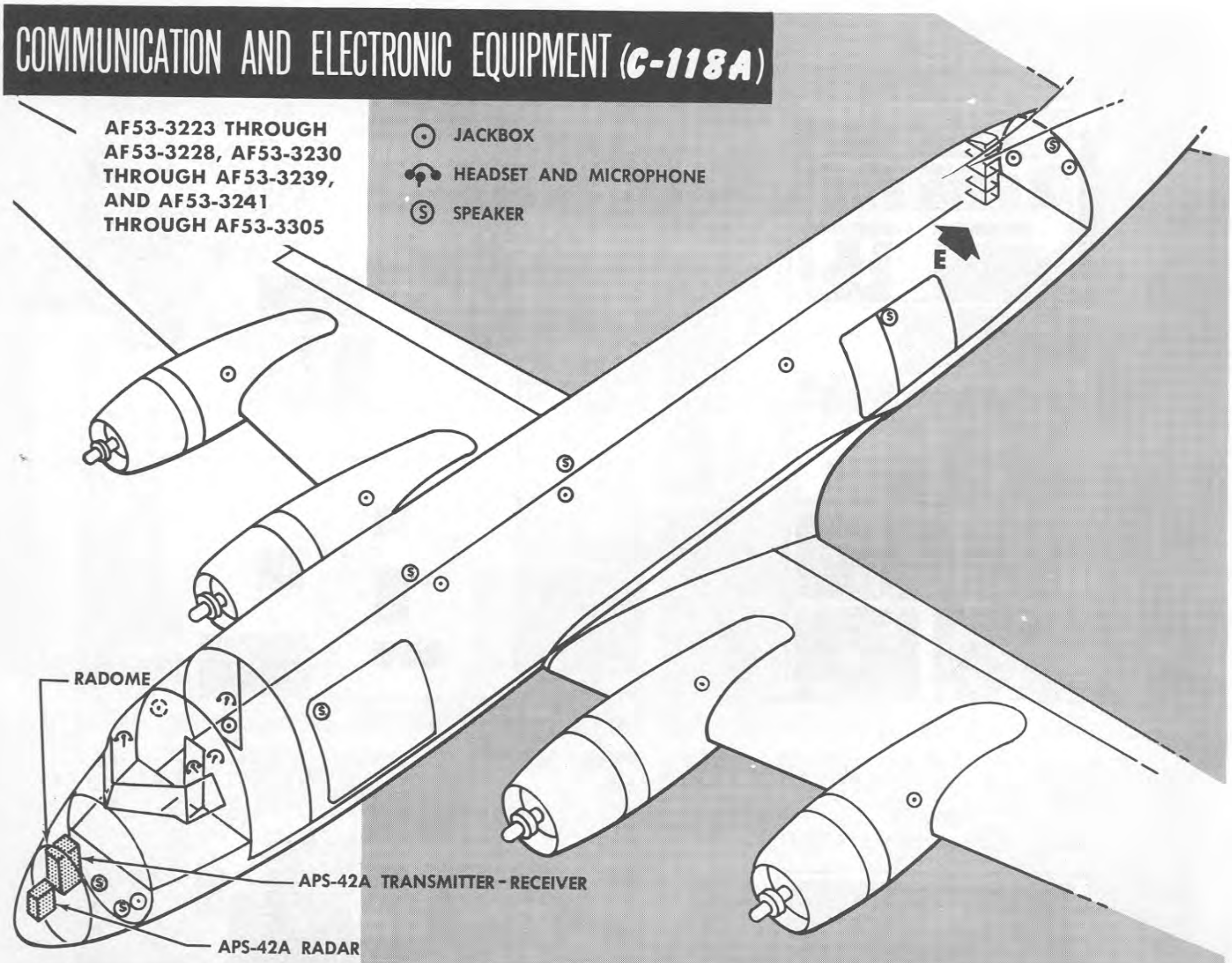
Figure 4-16 (Sheet 3 of 6)



AA1-155

Figure 4-16 (Sheet 4 of 6)

COMMUNICATION AND ELECTRONIC EQUIPMENT (C-118A)



1. S-2 COMPASS AMPLIFIER
2. CABIN PRESSURE AMPLIFIER
3. REPEATER AMPLIFIER
4. FIRE DETECTOR RELAYS
5. FIRE DETECTOR RELAYS
6. HF-1 LOAD COIL
7. EMERGENCY KEYER
8. HF-1 TRANSMITTER-RECEIVER
9. RADIO CIRCUIT BREAKERS
10. HF-2 TRANSMITTER-RECEIVER
11. HF-2 POWER SUPPLY
12. HF-1 POWER SUPPLY
13. SEARCH RADAR SYNCHRONIZER
14. MARKER BEACON RECEIVER
15. COMPASS SIGNAL POWER AMPLIFIER
16. UHF HOMING AMPLIFIER
17. RADIO FUSE PANEL
18. OIL QUANTITY AMPLIFIERS
19. OIL QUANTITY AMPLIFIERS
20. FUEL QUANTITY AMPLIFIERS
21. FUEL QUANTITY AMPLIFIERS
22. ADF TUNING AMPLIFIER (TWO)
23. EMERGENCY TRANSMITTER
24. VHF TRANSMITTER
25. VHF RECEIVER
26. AUTOPILOT AMPLIFIER
27. AUTOPILOT APPROACH AMPLIFIER
28. GLIDE SLOPE RECEIVER
29. PUBLIC ADDRESS AMPLIFIER
30. ADF-2 RECEIVER
31. ADF-1 RECEIVER
32. NAVIGATOR CHART STOWAGE
33. STANDARD POWER TEST RECEPTACLE
34. EMERGENCY KEYER TEST
35. INTERPHONE CONTROLS
36. BLANK PANEL
37. KEYER CONTROL
38. ADF-1 CONTROL PANEL
39. IFF CONTROL PANEL
40. INTERPHONE CONTROLS
41. ADF-2 CONTROL PANEL
42. NAVIGATOR'S INSTRUMENT PANEL
43. ALTIMETER INDICATOR
44. LORAN RECEIVER
45. RADAR CONTROLS
46. RADAR INDICATOR
47. LORAN INDICATOR
48. PHASE DETECTING NETWORK
49. AZIMUTH INDICATOR
50. TACAN TRANSMITTER-RECEIVER
51. ADF-1 CONTROL PANEL
52. UHF CONTROL PANEL
53. ADF-2 CONTROL PANEL
54. HF-1 CONTROL PANEL
55. VOR CONTROL PANEL
56. HF-2 CONTROL PANEL
57. VHF CONTROL PANEL
58. AUTOPILOT CONTROLLER
59. TACAN CONTROL
60. ADF TUNING METER
61. VOR-TACAN TRANSFER SWITCH
62. PEDESTAL RADIO PANEL LIGHT RHEOSTAT
63. CIRCUIT BREAKERS
64. IFF AND VOR TEST RECEPTACLE
65. HIGH-RANGE ALTIMETER TRANSMITTER-RECEIVER
66. VOR OBI
67. VOR DYNAMOTOR
68. VOR RECEIVER
69. UHF TRANSMITTER-RECEIVER
*70. IFF TRANSMITTER-RECEIVER
*71. LOW-RANGE ALTIMETER AMPLIFIER
72. HF-2 LOAD COIL
73. ANTENNA RELAY
74. ENGINE ANALYZER CONTROLS
75. LORAN COUPLER
76. PRESSURIZING KIT CONTROLS
77. ENGINE ANALYZER POWER SUPPLY
78. PRESSURIZATION PUMP
79. DEHYDRATOR
80. SWITCH
81. DYNAMOTOR COMPARTMENT

*SPACE PROVISIONS ONLY

Figure 4-16 (Sheet 5 of 6)

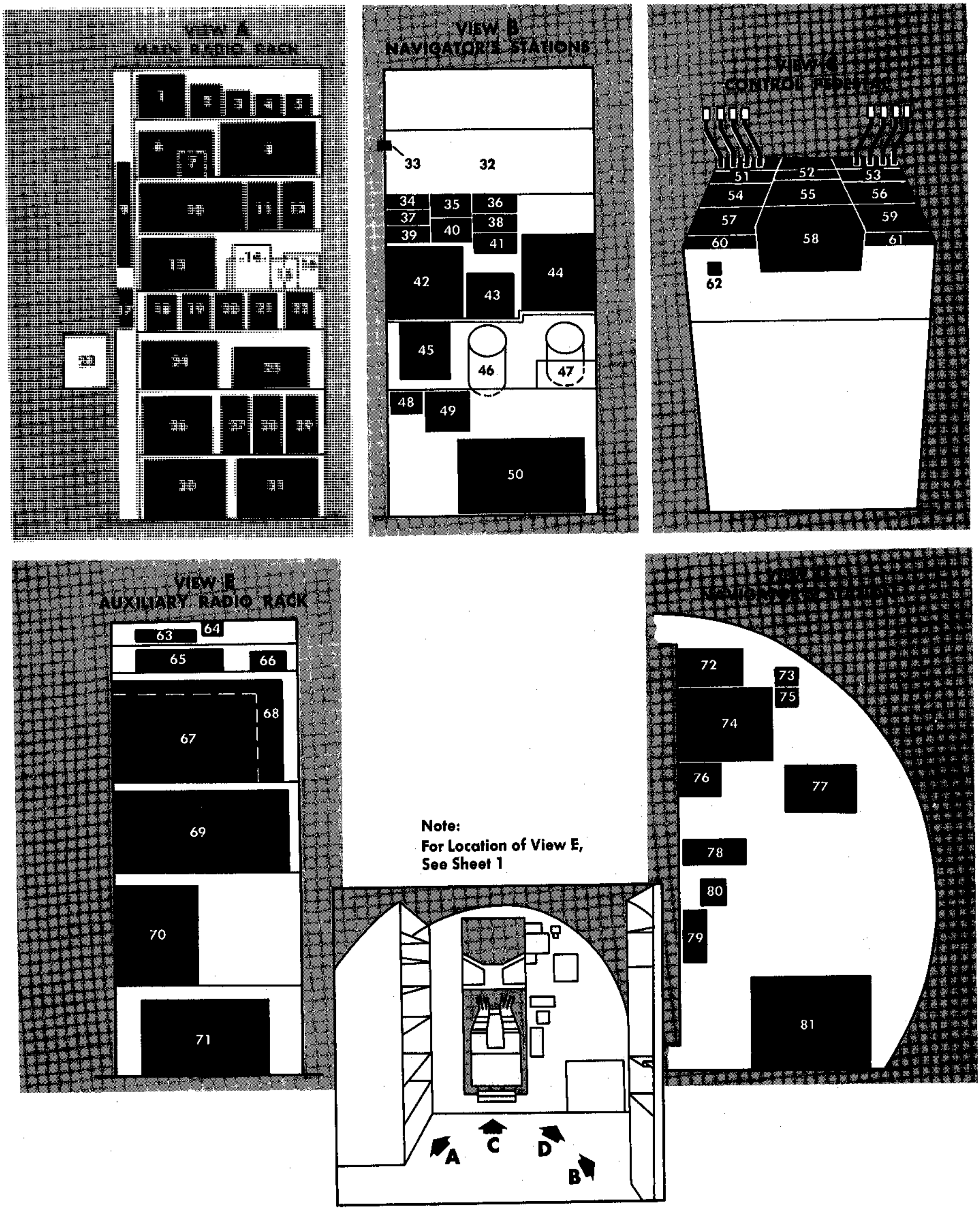


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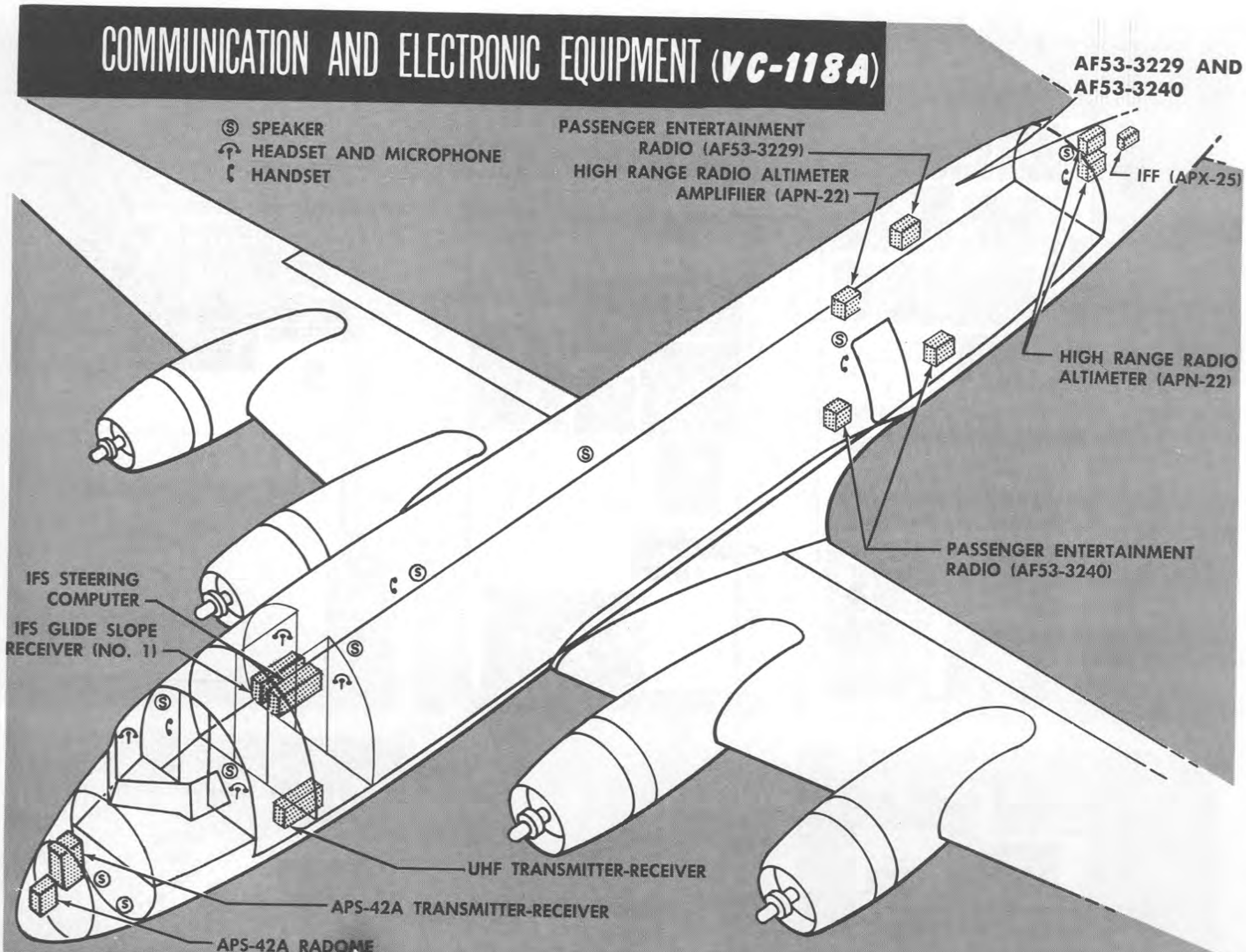
Figure 4-16 (Sheet 6 of 6)

COMMUNICATION AND ELECTRONIC EQUIPMENT (VC-118A)



1. S-2 COMPASS AMPLIFIER
2. CABIN PRESSURE AMPLIFIER
3. HF GROUND RELAY
4. FIRE DETECTOR RELAY (ZONES 2 AND 3)
5. FIRE DETECTOR RELAY (ZONE 1)
6. HF-1 LOAD COIL
7. HF-1 TRANSMITTER-RECEIVER
8. ARC-58 RECEIVER EXCITER
9. ARC-58 TRANSMITTER
10. HF-1 POWER UNIT
11. SEARCH RADAR SYNCHRONIZER
12. MARKER BEACON RECEIVER
13. ARC-58 ANTENNA RELAY ASSEMBLY
14. UHF-DF HOMING AMPLIFIER
15. C-1 COMPASS AMPLIFIER
16. OIL AND FUEL QUANTITY AMPLIFIER
17. ADF TUNING AMPLIFIER (TWO)
18. VHF COMMAND TRANSMITTER (17L4)
19. VHF COMMAND RECEIVER (51-X1)
20. VOR-1 RECEIVER (ARN-14)
21. VOR-1 DYNAMOTOR
22. VOR-2 RECEIVER (ARN-14)
23. A-12 AUTOPILOT AMPLIFIER
24. RADIO BEAM COUPLER AMPLIFIER
25. IFS GLIDE SLOPE RECEIVER (NO. 2)
26. PUBLIC ADDRESS AMPLIFIER
27. ADF-1 RECEIVER
28. ADF-2 RECEIVER
29. ADF SERVO AMPLIFIER (ARA-19) (TWO)
30. RADIO CIRCUIT BREAKERS
31. RADIO FUSE PANEL
32. IFS-TACAN CIRCUIT BREAKERS
33. ARC-58 CIRCUIT BREAKERS
34. SPARE FUSE BOX
35. ARC-58 ANTENNA COUPLER
36. ARC-58 ANTENNA COUPLER CONTROL
37. LORAN ANTENNA COUPLER
38. RADAR PRESSURE KIT (MK-59/AP)
39. ARC-58 ANTENNA RELAY ASSEMBLY
40. INTERPHONE DYNAMOTOR
41. IFS VERTICAL GYRO
42. VOR-2 DYNAMOTOR (DY-66)
43. RADIO ALTIMETER INDICATOR
44. LORAN RECEIVER (APN-70)
45. IFF CONTROL
46. INTERPHONE CONTROL PANEL
47. ADF-1 CONTROL PANEL
48. ADF-2 CONTROL PANEL
49. SIF CONTROL PANEL
50. LORAN INDICATOR (APN-70)
51. RADAR CONTROLS
52. RADAR INDICATOR
53. TACAN TANSMITTER-RECEIVER
54. NAVIGATORS INSTRUMENT PANEL
55. NAVIGATORS GYROSYN COMPASS
56. INVERTER VOLTMETER
57. OMNI BEARING INDICATOR VOR-1
58. OMNI BEARING INDICATOR VOR-2
59. STATEROOM HANDSET SELECTOR SWITCH
60. PA SPEAKER SELECTOR SWITCH
61. HF-1 CONTROL PANEL (618S-1)
62. RADIO OPERATOR'S INTERPHONE CONTROL PANEL
63. ARC-58 INVERTER SWITCH
64. ARC-58 CONTROL PANEL
65. STATEROOM INTERPHONE CONTROL PANEL
66. HF-3 RECEIVER (BC-348)
67. 60-CYCLE INVERTER CONTROL PANEL AND FUSE BOX
68. C-1 AMPLIFIER (A-12 SYSTEM)
69. 60-CYCLE INVERTER
70. INVERTER FREQUENCY METER
71. CALL BUTTONS
72. RADIO OPERATOR'S LIGHT SWITCHES
73. ADF-1 CONTROL PANEL
74. UHF CONTROL PANEL
75. ADF-2 CONTROL PANEL
76. VOR-1 CONTROL PANEL
77. VHF CONTROL PANEL (17L4)
78. VOR-2 CONTROL PANEL
79. ADF TUNING METER
80. TACAN-VOR-2 TRANSFER SWITCH
81. AUTOPILOT CONTROLLER
82. TACAN CONTROL PANEL
83. PEDESTAL RADIO PANEL LIGHT RHEOSTAT

Figure 4-17 (Sheet 1 of 2)

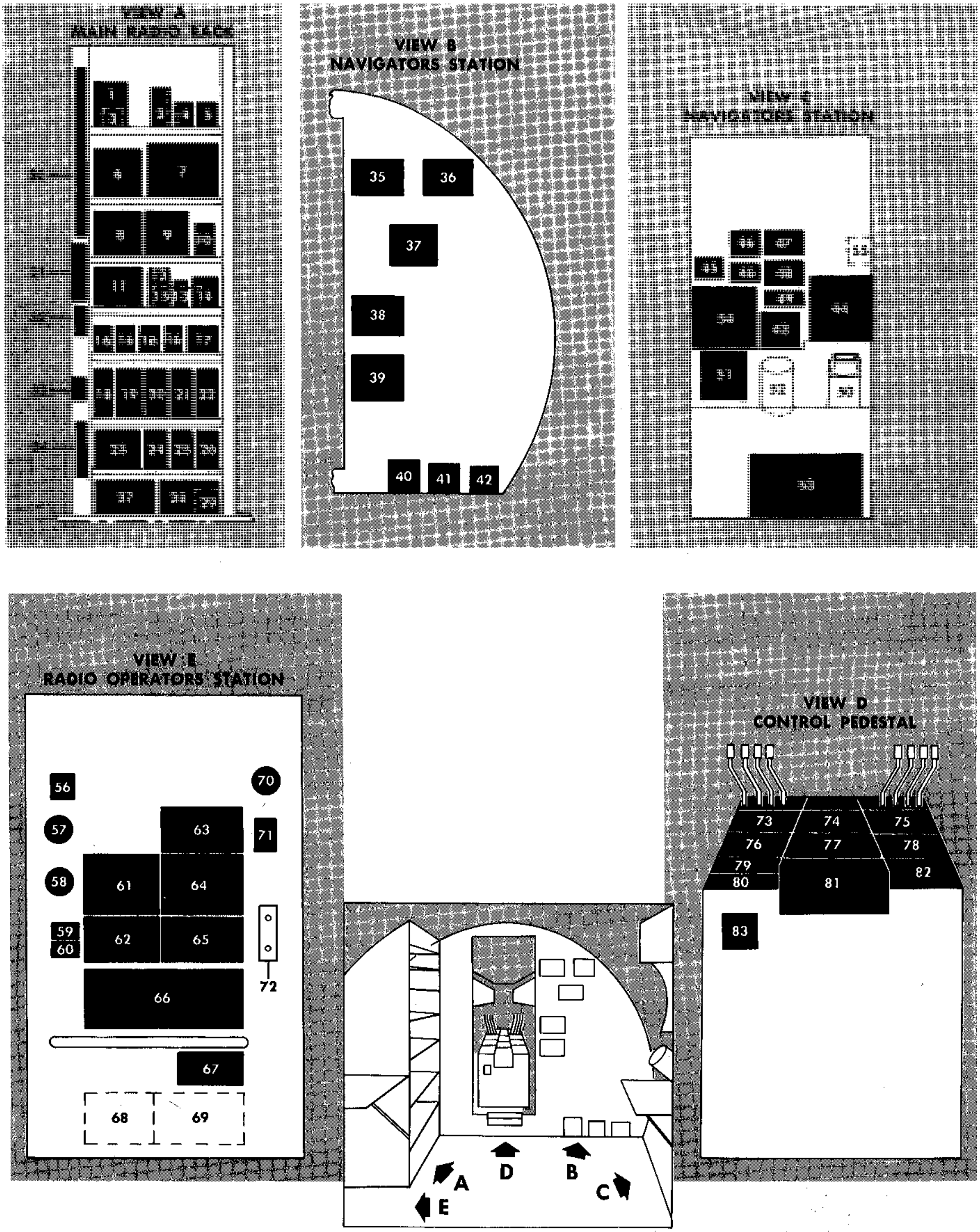


Figure 4-17 (Sheet 2 of 2)

Cabin Interphone System Operation — VC-118A.

A. Repeat steps A through D under Flight Interphone System Operation.

B. Positioning the INTER toggle switch up or the microphone selector switch on the radio operator's interphone control panel to the INTER position will energize the cabin interphone system.

C. NORMAL and AUX. LISTEN switch — NORMAL (all cabin interphone control panels).

D. The radio operator and the galley, cabin, or stateroom occupant may call any other station by depressing the selected button on the call panel and depressing the push-to-talk lever on the interphone handset. No call lights are installed in the stateroom, but calls to that area are indicated by a chime in the stateroom. The radio operator, galley, and cabin attendant annunciator panels are equipped with a reset switch to turn off the call lights when calls are completed or acknowledged. The pilots' handsets automatically reset the call light in the cockpit when the push-to-talk lever on the handset is depressed.

E. When the NORMAL and AUX. LISTEN switch is placed in the AUX. LISTEN position, the related handset is placed directly on the interphone line and the internal amplifier is bypassed. No transmission from the related handset is possible until the switch is returned to the NORMAL position.

F. Each cabin interphone control panel is equipped with a CALL button located under a plastic screw cap. Removing the cap and depressing the button interrupts all transmission on the cabin interphone system and places all cabin interphone control panels on interphone.

Public Address System Operation — VC-118A.

A. Repeat steps A through C under Flight Interphone System Operation.

B. Placing the toggle switch on the public address system control panel in the STANDBY position applies power to the filament of the amplifier.

C. Placing the switch in the LOUDSPEAKER position applies high voltage to the amplifier.

D. Rotary switch NOSE or CABIN — As desired.

E. Transmission can now be made through the cockpit handset by placing the toggle switch on the handset hanger in the up position and depressing the push-to-talk lever on the handset. Replacing the handset on the hanger automatically returns the handset to the interphone circuit.

F. When the CABIN SPEAKER RECVR AUDIO switch, on the radio operator's interphone control panel, is placed in the ON position, any audio output selected on the interphone control panel may be transmitted over the public address system. Closing the push-to-talk lever on the handset in the stateroom disconnects these audio signals from the public address system.

TAPE RECORDER JACKS — VC-118A.

Two tape recorder jacks are installed at the radio operator's station. They are placarded INPUT and OUTPUT.

LA-17 SERVICE INTERPHONE — C-118A.

The service interphone system consists of an amplifier (separate from the interphone amplifier) and jackboxes located throughout the aircraft *(figure 4-16)*. The installations at the main cabin door, in the nosewheel well, and in the cockpit are equipped with telephone-type receivers and employ a pushbutton call system which sounds bells at the main cabin door, and in the pilot's compartment, and a horn in the nosewheel well. The nosewheel well jackbox incorporates a plug for connecting an external power supply.

INTERPHONE PROCEDURES AND PHRASEOLOGY.

To implement standard interphone procedures and phraseology, the following will be used during all ground and air operations.

Nomenclature: For purposes of identification of crew members, the following list is submitted:

A. Pilot: The occupant of the left seat in the cockpit regardless of his position on the crew.

B. Copilot: The occupant of the right seat in the cockpit regardless of his position on the crew. Frequently, during training, the instructor pilot or the student pilot will occupy the right seat; nevertheless, he will be referred to as copilot.

C. Crew engineer: The crew member seated aft of the control pedestal and between the pilots.

Identification: The crew member who is being called will be identified first, followed by the identification of the transmitter, for example, engineer from pilot.

Sequence: Pilots will always state the unit they desire to be actuated first, and then state what is to be done second, for example, gear up, flaps 20 degrees, rpm 2300, manifold two five, etc.

Terminology: The following will be stated as indicated to prevent ambiguous, confusing. or incomprehensive terminologies:

A. Rpm: Twenty-three fifty or two thousand.

B. Throttle setting: Manifold two two or manifold four five.

C. Flaps: Twenty degrees or full up.

Acknowledgement: Prior to execution, every command will be repeated by the receiver to insure proper understanding of the transmission. An exception to the above rule may be made during the final approach on a GCA letdown. Here, the pilot may direct the copilot not to acknowledge his commands to prevent interphone transmission from interfering with the controller's instructions. In this situation, if it is not certain what the command was, the copilot will momentarily press his mike button and state, "Say again." The pilot will then repeat his original transmission. After the original contact has been established, it is not necessary during subsequent transmissions to identify the crew member being called.

AN/ARC-1 VHF COMMAND AND AN/ARC-3 VHF COMMAND TRANSMITTER-RECEIVER — C-118A.

This equipment is operated from the VHF command radio control panel on the control pedestal *(figure 1-8)*, as follows:

A. VHF power switch — ON.

B. Receiver toggle switch on interphone control panel — VHF. Microphone selector switch — VHF.

C. Rotate the channel selector switch on the VHF control panel to the desired channel and allow at least 30 seconds for the radio to warm up. When the audio tone heard in the headset stops, the radio is ready for operation.

D. Adjust the volume control knob on the VHF control panel and the interphone control panel for the desired output.

E. To transmit, press the press-to-talk button on the microphone.

F. To shut down the set, turn the VHF power switch to OFF.

Note

D/F tone is used during an emergency to transmit steady tone to permit locating the aircraft from other stations (AN/ARC-3 only).

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.

VHF COMMAND TRANSMITTER-RECEIVER (COLLINS VHF-101).

The Collins VHF-101 command communications system is a remotely-controlled transmitting and receiving set. The set has 680 crystal-controlled channels in the frequency range of 116.0 to 149.95 megacycles in 50 kilocycle steps. The equipment operates over line-of-sight distances and provides air-to-air and air-to-ground communications. This set is transistorized and replaces sets ARC-3, ARC-36, or ARC-49, where installed.

VHF COMMAND RADIO — VC-118A.

The VHF command radio is a short range VHF air-to-air or air-to-ground communication system. The receiver unit and the transmitter unit are located on the radio rack and the controls are located on the VHF command radio control panel on the control pedestal. The system provides selection of crystal controlled frequencies ranging from 118.0 to 135.95 mc. Placing the ON-OFF toggle switch on the control panel in the ON position supplies 28-volt d-c power to the filaments of the audio system and energizes the dynamotor. Placing the microphone selector switch on the interphone control panel in the VHF COMM position and depressing the push-to-talk button on the microphone energizes the 115-volt a-c dynamotor circuit for transmission. When the ON-OFF switch is placed in the OFF position, all circuits are deenergized.

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.

AN/ART-13 AND AN/ART-13A TRANSMITTERS — C-118A.

This equipment is operated from the controls on the equipment at the radio operator's station *(figure 4-18)*, as follows:

A. LOCAL — REMOTE switch must always be in LOCAL position.

B. Calibrate-tune — Place switch in OPERATE positions.

C. OFF-VOICE-CW-MCW emission switch in VOICE position.

D. Receiver toggle switch on interphone control panel on HF; microphone selector on HF.

E. Rotate channel selector switch to the desired channel.

F. Adjust the volume control on the interphone control panel and on the receiver.

G. To transmit, press the press-to-talk button on the microphone.

H. Emission switch in CW or MCW position.

I. Receiver toggle switch on interphone box on HF; microphone selector on HF.

J. Rotate channel selector switch to the desired channel.

K. Adjust the volume control knob on the interphone control panel.

L. To transmit, press transmitting key.

M. On AF51-3818 through AF51-3835, this equipment may be controlled, by controls on the pedestal with the LOCAL-REMOTE switch in the REMOTE position.

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.

AN/ARR-15A AND BC-454-B RECEIVERS — C-118A.

The AN/ARR-15A is operated from the controls on the equipment at the radio operator's station *(figure 4-18)* and the BC-454-B is operated from the controls at the control pedestal *(11, figure 1-8)* and on the equipment as follows:

A. Power switch — ON.

B. Select frequency with selector control.

C. To shut-down, turn power switch — OFF.

Note

On the AN/ARR-15A, do not manually turn the power switch. Pushing the switch in toward the panel will automatically release the switch and turn it to the OFF position.

R-23A/ARC-5 LF RANGE RECEIVER — C-118A.

This equipment is operated by controls on the equipment at the radio operator's station *(figure 4-18)*, as follows:

A. Turn the tuning knob on the ARC-5 receiver control panel to the desired frequency.

B. Adjust the sensitivity control for normal operation.

AN/ARN-14, AN/ARN-18, AND 51V-1 RECEIVERS — C-118A.

This equipment is operated from the AN/ARN-14 radio control panel on the control pedestal *(figure 1-8)*, as follows:

A. Equipment is turned on automatically when power is supplied to the bus and the appropriate circuit breakers are closed.

B. Frequencies are selected by a control on the radio control panel.

C. Omni-range courses are selected on the combination cross-pointer and course selector instrument located on the main instrument panel *(figure 1-9)*.

D. Glide slope frequencies are automatically selected with the paired localizer frequencies.

VHF NAVIGATION (VOR-1)—VC-118A.

The VOR-1 receiver (R540/ARN-14) and dynamotor are located on the radio rack. Controls for the system are located on the VHF NAV-I radio control panel on the control pedestal. Radio magnetic indicators (RMI's) are located on the main instrument panel *(26, figure 1-10)* and the navigator's instrument panel *(figure 4-21)*, and an omni-bearing indicator is located on the radio operator's panel *(figure 4-19)*. The system provides reception of any of 280 crystal-tuned channels in the 108.0 to 135.9 frequency range. The set will also receive VHF communications in certain frequency ranges within the band-spread covered by these transmissions. This audio signal can be received at any interphone control station by placing the VHF NAV-1 monitor switch in the ON position. Tuning the receiver to receive VOR or localizer signals feeds directional signals to the pilot's, copilot's, and navigator's VOR-1 pointers through the navigator's VOR-1 omni-bearing indicator. It also provides deviation signals for the course bar on the pilot's course line indicator and to the steering computer. The S-2 compass and the C-1 compass amplifier direct signals to the azimuth ring on the pilot's course line indicator and to the pilot's compass repeater. The C-1 amplifier also directs the signals from the S-2 compass to the copilot's ADF and VOR radio magnetic indicator (RMI) cards and to the navigator's ADF

RADIO OPERATOR'S STATION—Typical (C-118A)

AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668

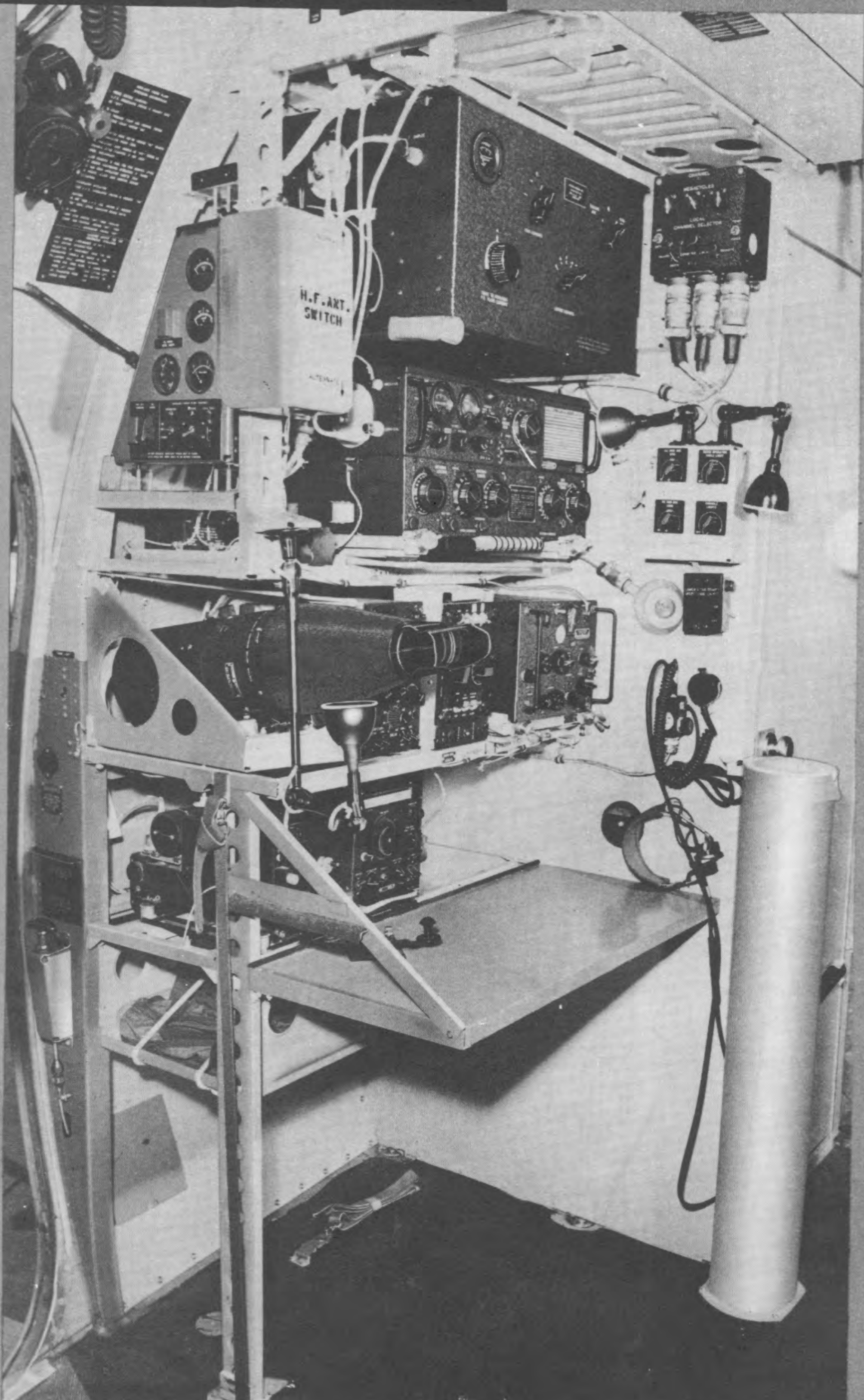
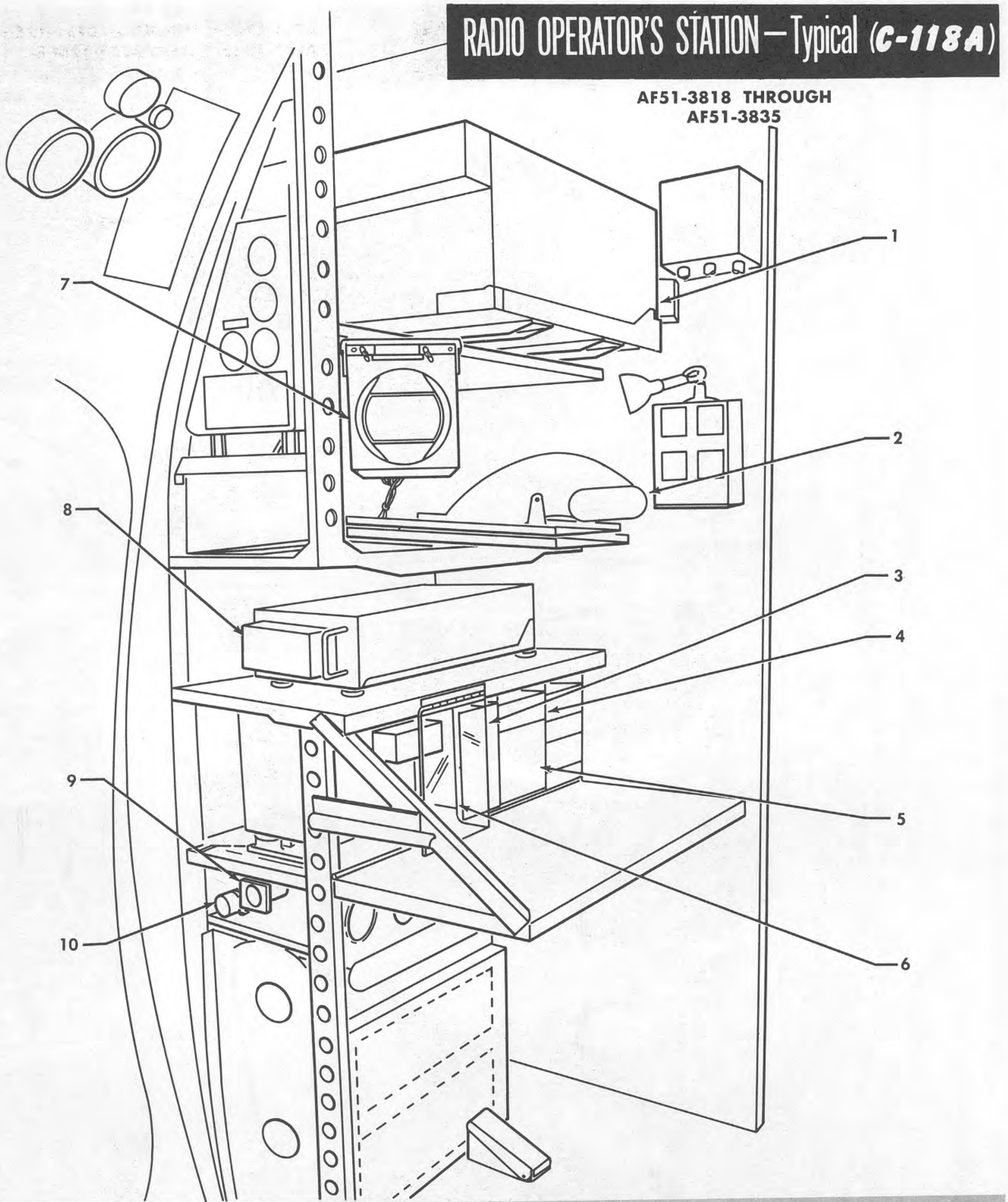


Figure 4-18 (Sheet 1 of 2)



1. TACAN Receiver Transmitter
2. Search Radar Indicator
3. Search Radar Control
4. Interphone Filter
5. Interphone Control
6. HF Load Coil
7. LORAN Indicator
8. HF Transmitter
9. Azimuth Indicator
10. Phase Detecting Network

Figure 4-18 (Sheet 2 of 2)

RADIO OPERATOR'S STATION—Typical (VC-118A)

Figure 4-19

radio magnetic indicator (RMI) card. When the control is tuned to a localizer frequency, the glide slope receiver (R322/ARN-18) is automatically energized. Turning the OFF-ON switch on the control pedestal to the ON position supplies 28-volt d-c power to the receiver filaments and dynamotor.

VHF NAVIGATION (VOR-2)—VC-118A.

The VOR-2 receive (R540/ARN-14) is located on the radio rack and the dynamotor is located in the dynamotor compartment adjacent to the radio rack. The C-1 compass amplifier is located at the radio operator's station. Radio magnetic indicators (RMI's) for the VOR-2 system are located as follows: two on the main instrument panel *(26, figure 1-10)*, one in front of each pilot, and one on the instrument panel at the navigator's station *(figure 4-21)*. An omni-bearing indicator placarded VOR-2 is installed at the radio operator's station *(figure 4-19)*. The VOR-2 system is operated from the VHF NAV radio control panel on the control pedestal. The VOR-2 system incorporates the same frequency range as the VOR-1 system and is tuned in the same way. The audio signals tuned on the control panel may be monitored at any interphone control panel by placing the VHF NAV-2 monitor switch in the ON position. Tuning the receiver to a VOR or localizer frequency feeds directional signals to the navigator's VOR-2 omni-bearing indicator (OBI) and to the VOR-2 pointers on the pilot's, copilot's, and navigator's RMI's. The VOR-2 system provides directional signals to the copilot's course indicator to indicate the direction the aircraft must be flown for the preselected course. When the system is tuned to localizer frequency, the copilot's course indicator is inoperative. The A-12 compass headings are fed to the copilot's course indicator synchro and to the RMI cards at the pilot's ADF and VOR indicators. When the system is used for VHF NAV, the signals from the copilot's deviation synchro are fed to the radio beam coupler for use by the autopilot. To operate the system, 28-volt d-c power is supplied to the filament and dynamotor by placing the ON-OFF switch on the control panel in the ON position.

STEERING COMPUTER—VC-118A.

The steering computer is installed on the floor on the forward right side of the crew compartment. The steering computer consists of a veritcal gyro, a computer, and a gyro monitor indicator. The gyro monitor indicator is installed on the main instrument panel *(2, figure 1-10)*. The instrument is placarded SLO and OFF. When the pointer is in the SLO position, the steering computer vertical gyro is in the erection cycle; when the pointer is in the OFF position, the gyro is deenergized. Normal operation of the gyro is indicated when the pointer is in the midposition. Deviation signals are received from the VOR-1 radio equipment, and magnetic heading signals are received from the S-2 compass system through the pilot's course indicator. These signals are combined with pitch and roll signals from the steering computer vertical gyro to operate the steering pointer on the approach horizon instrument.

GLIDE SLOPE RECEIVER -1—VC-118A.

The glide slope system (AN/ARN-18) consists of a receiver located on the radio rack and controls that are an integral part of the VOR-1 tuning system. Turning the ON-OFF switch on the pilot's VHF NAV-1 radio control panel to the ON position, and tuning the selector to a localizer frequency energizes the glide slope power relay switch and supplies 28-volt d-c power to the glide slope receiver. The output of the receiver is connected directly to the horizon bar of the approach horizon indicator *(4, figure 1-10)*. When sufficient signal strength is available, the OFF flag on the face of the instrument will disappear.

GLIDE SLOPE RECEIVER -2—VC-118A.

The glide slope system (AN/ARN-18) consists of a receiver located on the radio rack and controls that are an integral part of the VOR-2 tuning system. Placing the ON-OFF switch on the VHF NAV-2 radio control panel in the ON position, and tuning the selector to a localizer frequency energizes the glide slope power relay and supplies 28-volt d-c power to the receiver. The output of the receiver is shown on the face of the copilot's course indicator. When sufficient signal strength is available, the OFF flag on the face of the instrument will disappear.

ENTERTAINMENT RADIOS—VC-118A.

Aircraft AF53-3240 is equipped with two entertainment radios, one located in the aft stateroom, and one located in the conference compartment. Aircraft AF53-3229 has one radio installed in the aft stateroom Power for the entertainment radios is supplied by a 60-cycle, 115-volt a-c inverter located in the radio operator's compartment. The radio ON-OFF switches, located on the control consoles of the individual receiver, energize the inverter when the switch is placed in the ON position.

AN/ARN-6 AUTOMATIC RADIO COMPASSES.

This equipment is operated from the pilot's station *(figure 1-8)* and the navigator's station *(figures 4-20 and 4-21)* as follows:

A. Receiver toggle switch or filter selector switch on interphone control panel—ADF-1 or ADF-2.

B. Function switch on automatic compass control panel—COMP, ANT, or LOOP, as desired.

C. Select frequency by use of frequency selector control.

AN/APX-25A IFF.

The IFF radar set provides automatic radar identification of the aircraft in which it is installed when challenged by surface or airborne radar sets using coded pulse transmission. Three modes of interrogation are used in the IFF system and the set will reply to any or all of these modes, depending on the setting of the mode switches. Mode 1 is known as SI (Security Identification), Mode 2 as PI (Personal Identification), and Mode 3 as TI (Traffic Identification). The IFF radar set can also be used to send distress signals or prearranged intelligence messages. The set incorporates an auxiliary coder group control panel which provides a more reliable identification through selectable pulse trains, the interval and number of which permit more coding combinations in the reply. The IFF radar set uses d-c and a-c power.

IFF Master Selector Switch.

A rotary IFF master selector switch, on the IFF control panel, has OFF, STBY, LOW, NORM, and EMERGENCY positions. When the switch is placed to the STBY position: all primary power is turned on; the tubes will be heated and ready for operation; but the receiver will be inoperative. In the LOW position, the receiver is partially sensitive and responds only to strong interrogations. In the NORM position, the receiver provides maximum performance. When the switch is placed to EMERGENCY, the receiver operates at full sensitivity and four pulse replies are transmitted regardless of the mode of interrogation received or the setting of the mode switches.

Detent Button. A detent button dial stop is located to the left of the IFF master selector switch. The detent button must be depressed before the IFF master selector switch can be placed in the EMERGENCY position.

Mode Switches.

Two mode switches, on the IFF control panel, have the positions MODE 2, and OUT, and MODE 3, and OUT respectively. The mode switches are operative only when the IFF master selector switch is in either the LOW or NORM position. Placing the mode 2 switch to the MODE 2 position and the mode 3 switch to the MODE 3 position allows the IFF set to reply to mode 2 or mode 3 interrogations respectively. When either switch is in the OUT position, the IFF will not reply in that mode.

Note

The IFF set will reply to mode 1 interrogations at any time the IFF master selector switch is in either LOW or NORM position regardless of the setting of the mode switches.

I/P-MIC Switch.

The I/P-MIC switch, on the IFF control panel, has I/P, MIC, and OUT positions, and is spring-loaded from the I/P position to the OUT position. The I/-MIC switch is operative only when the IFF master selector switch is in either the LOW or NORM position. I/P (Identification of Position) is a special reply feature that is a temporary change to mode 2. When the switch is held in the I/P position, the IFF responds to mode 1 replies. When the switch is placed to the MIC position, I/P replies are transmitted while the pilot's interphone button is depressed. The mode change remains in effect for 30 seconds after the switch is released or returned to OUT, or after the microphone button is released when the switch is in the OUT position, the IFF replies to the mode originally selected.

AN/APN-4, AN/APN-9, AND AN/APN-70 (LORAN) NAVIGATION EQUIPMENT.

This equipment is operated from the navigator's station *(figures 4-20 and 4-21)* as follows:

A. Power switch — ON.

B. Set sweep speed to position 1.

C. Center the amplifiier balance control.

D. Select desired station with station selector switch.

E. Adjust intensity control until a brilliant trace pattern appears on the indicator; then adjust focus to provide clear pattern.

F. To shut down, turn power switch — OFF.

AN/APN-1 AND APN-22 RADIO ALTIMETER.

WARNING

Do not rely on your AN/APN-1 or APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

This equipment is operated from the main instrument panel *(figures 1-9 and 1-10)*, as follows:

A. Radio altitude indicator power switch — ON.

NAVIGATOR'S STATION—Typical (C-118A)

AF51-3818 THROUGH
AF51-3835

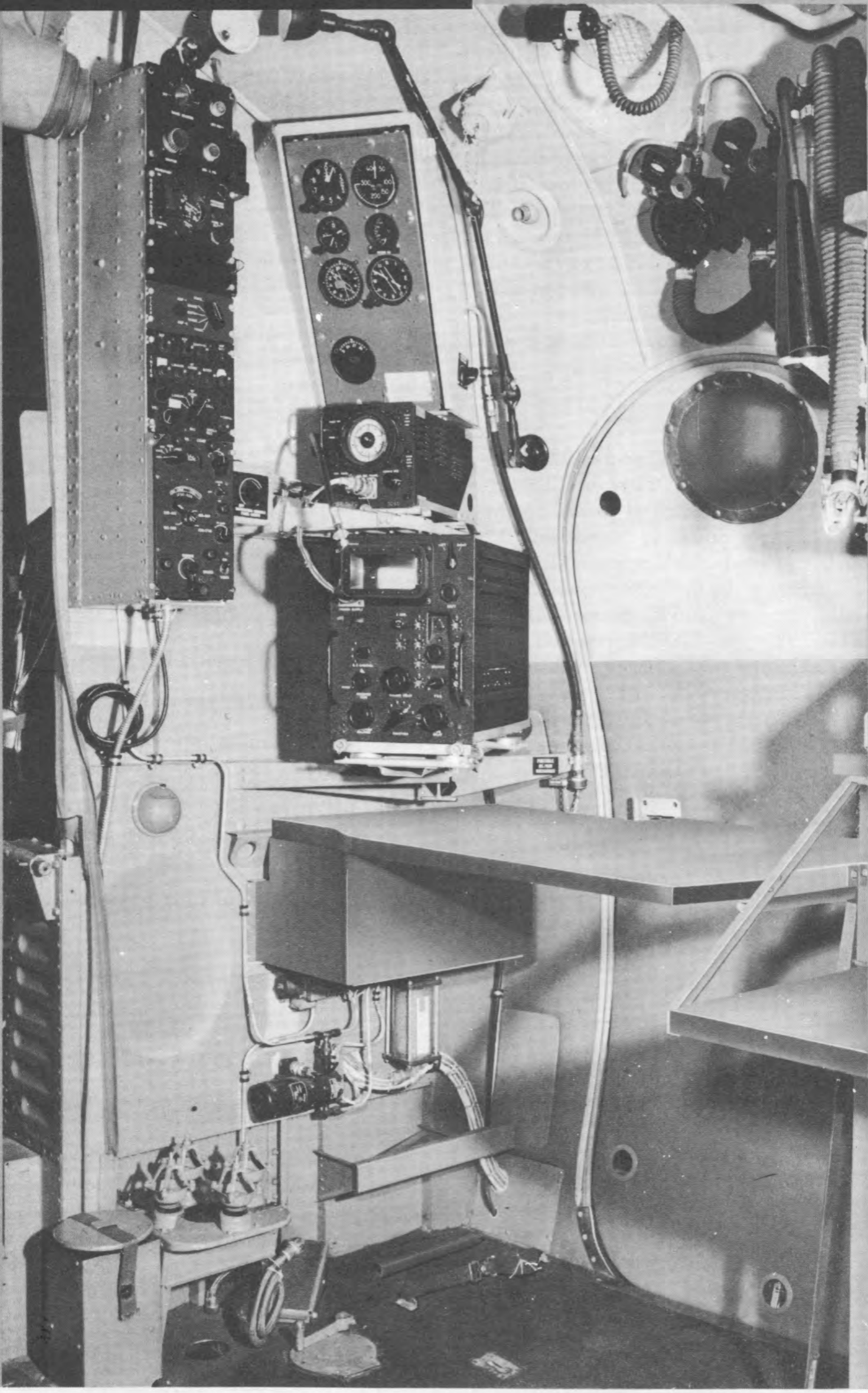


Figure 4-20 (Sheet 1 of 3)

NAVIGATOR'S STATION—Typical (C-118A)

AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668

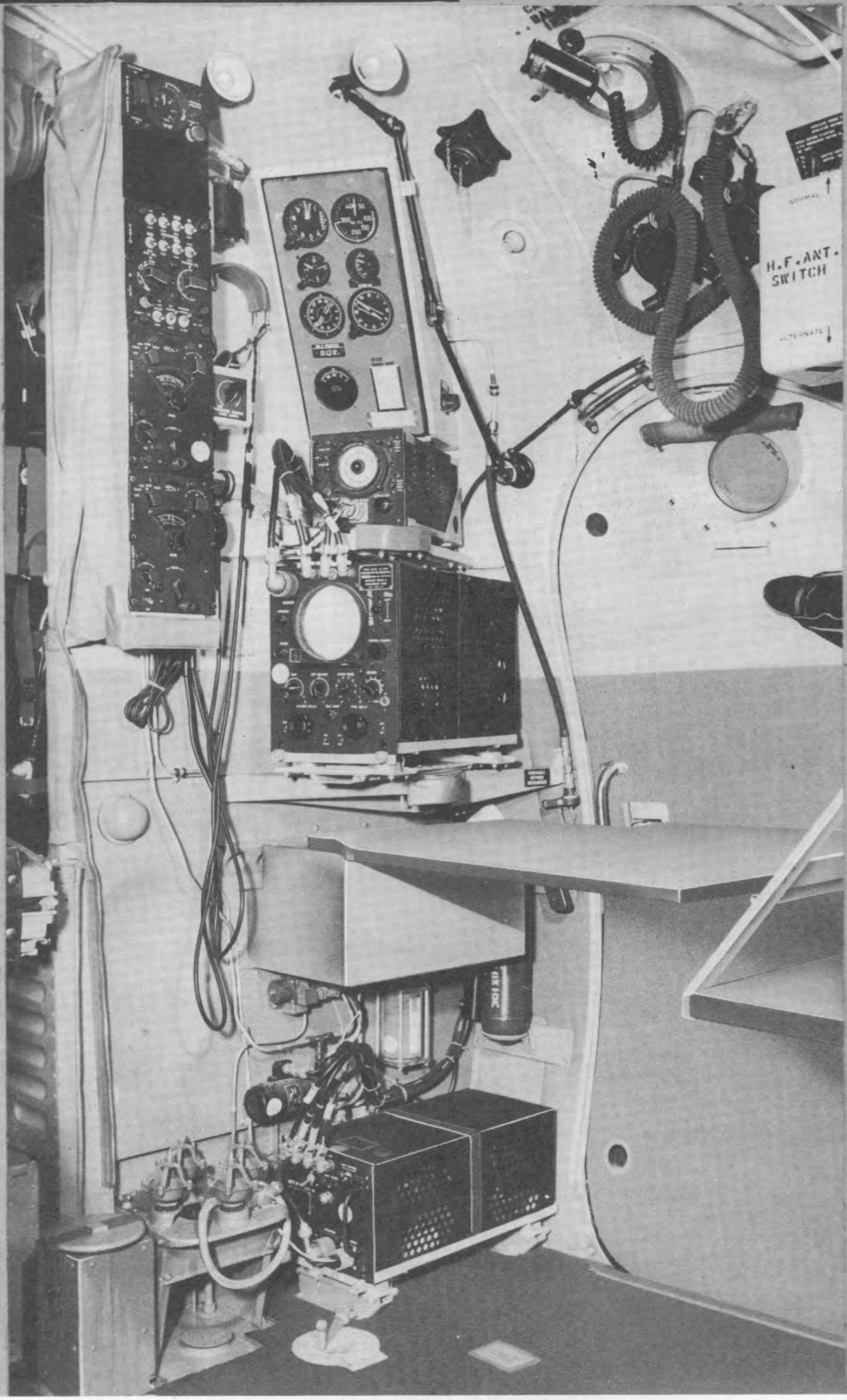


Figure 4-20 (Sheet 2 of 3)

Figure 4-20 (Sheet 3 of 3)

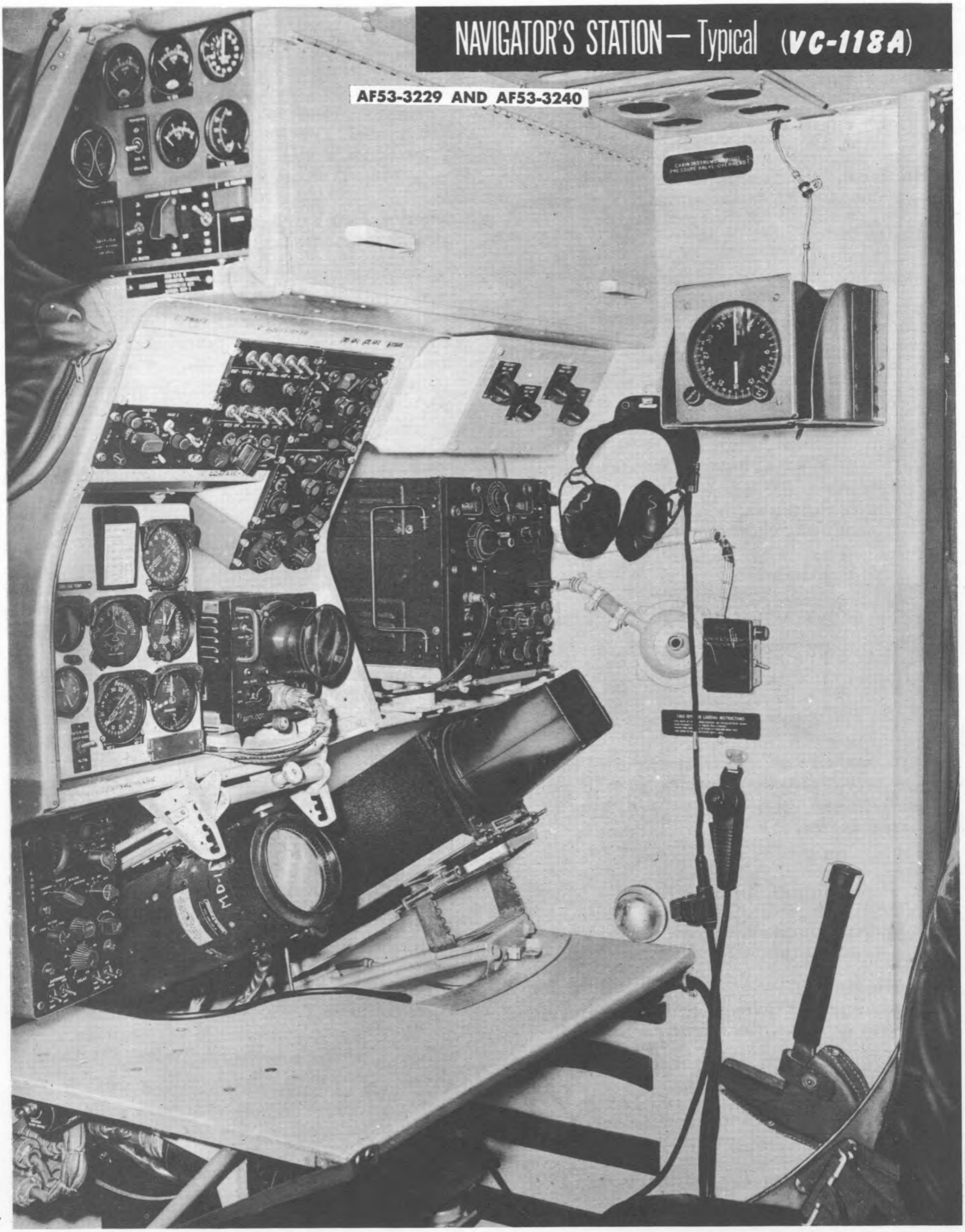


Figure 4-21

B. Allow 1 minute for the tubes to heat up, and observe that the indicator has moved from its stopped position, thus indicating the equipment is ready for operation.

C. Set the range switch to desired altitude range (AN/APN-1 only).

D. Set the limit switch for the desired minimum altitude.

E. To turn off the equipment — Turn the power switch to OFF.

CAUTION

The high range of the AN/APN-1 altimeter cannot be relied upon below 500 feet over water and 600 feet over land. Below these altitudes, when on the high range, the indicator will usually read high and may fail to read below 400 feet no matter how close to the terrain the aircraft may actually be flying under conditions of poor visibility, the AN/APN-1 indicator should always be on the low range.

SCR-718 RADIO ALTIMETER.

WARNING

Do not rely on your SCR-718 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

This equipment is operated from the navigator's station *(figures 4-20 and 4-21)*, as follows:

A. To start the set — Turn REC. GAIN control knob on the indicator approximately one-half turn in a clockwise direction.

B. Adjust the circle to the size required for normal operation.

C. To shut down — Turn the REC. GAIN control knob counterclockwise to OFF.

AN/ARN-12 MARKER BEACON RECEIVER.

The marker beacon receiver *(figures 4-16 and 4-17)* has no controls but is energized automatically when power is supplied to the d-c bus and the marker beacon circuit breaker is on.

A marker beacon indicator light is located on the course indicators. When the aircraft is within the radiation pattern of a 75-megacycle marker beacon transmitter, the beacon will give an audio signal in the interphone system and the indicator will illuminate. On AF53-3223 through AF53-3305, sensitivity may be controlled by a HIGH-LOW switch on the main instrument panel in front of the pilot's seat.

PILOT'S AND COPILOT'S RADIO MAGNETIC INDICATORS—AF51-3818 THROUGH AF51-3835.

A visual indication of the magnetic bearing of a station from the aircraft is given on each ID-250/ARN radio magnetic indicator (RMI). The No. 1 pointer on each RMI is connected to the ADF system. When a station is tuned in and the function selector is placed in the COMP position, the ADF pointer on each RMI will point in the direction of the station. A compass heading signal from the A-12 autopilot system rotates the card of each RMI so that the card shows the aircraft's magnetic heading. The reading of the ADF pointer against the card will then show the no wind heading to fly to reach the station.

The A-12 autopilot system feeds a compass heading signal into each RMI card. As the card rotates, the aircraft's heading in degrees appears under the lubber line at the top of the RMI. This should correspond to the heading on the magnetic compass, the A-12 heading selector, and the G-2 or S-2 compass repeater. When the frequency of the VOR station is selected on the control panel, the No. 2 pointers will point toward the station. The reading indicated by the pointer is the bearing of the station from magnetic north. The angle between the tip of the No. 2 pointer and the lubber line of the instrument is the track of the aircraft from the VOR station.

PILOT'S AND COPILOT'S RADIO MAGNETIC INDICATORS—AF53-3223 THROUGH AF53-3305.

On AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, and AF53-3241 through AF53-3305, the radio magnetic indicators (RMI's) are installed in pairs. The pilot's panel has one RMI which has the No. 1 pointer connected to ADF No. 1, and No. 2 pointer connected to ADF No. 2. The second RMI indicator has No. 1 pointer connected to UHF homing adapter and No. 2 pointer connected to VOR — TACAN.

On VC-118A aircraft AF53-3229 and AF53-3240 the radio magnetic indicators (RMI's) are installed in pairs. The pilot's panel has one RMI which has the No. 1 pointer connected to ADF No. 1, and the No. 2 pointer connected to ADF No. 2. The second RMI has the No. 1 pointer connected to VOR-1 and the No. 2 pointer connected to VOR-2 — TACAN. A separate RMI mounted above the glare shield in front of the magnetic compass has a pointer connected to the UHF homing adapter.

AN/ARN-21 TACTICAL AIR NAVIGATION SYSTEM (TACAN)—AF51-3818 THROUGH AF51-3835 AND AF53-3223 THROUGH AF53-3305.

This equipment provides continuous indications of the aircraft's bearing and distance from any surface beacon within a range of 195 nautical miles. It is operated from the control panel located in the control pedestal in the cockpit. The system receives power from the 28-volt d-c power source and the 115-volt single-phase a-c power source. The receiver operates in the frequency range of 962 to 1024 and 1151 to 1207 megacycles. The transmitter operates in the frequency range of 1025 to 1144 megacycles. Any one of 120 preset channels can be selected by the channel selector knobs on the control panel. TACAN courses are selected on the radio magnetic indicator (RMI). The distance to the TACAN beacon station is indicated on the range indicator, located on the main instrument panel *(figures 1-9 and 1-10)*. After turning the NAV switch to the REC position, allow at least 90 seconds for the unit to warm up. Place the channel selector in the desired position and adjusr the volume. Turn off by placing the NAV switch in the OFF position.

HF COMMUNICATION (HF-1 AND HF-2) 618S-1 TRANSMITTER-RECEIVER—C-118A.

The system is controlled from the pilot's HF panel by means of the following controls:

A. The OFF-PHONE-CW switch turns on the system and selects either voice or CW operation. Since no key is provided, normal operation is on PHONE. For CW operation, a portable key is plugged directly into the receiver-transmitter.

B. FREQUENCY — The outer dial is calibrated in 24 steps, numbered 1 through 24; the inner dial is calibrated in 24 steps, lettered A through Z (except O and Q). Reference to a frequency card permits tuning to any frequency in the range of 2.0 megacycles through 25.0 megacycles.

C. BFO — Controls frequency of beat oscillator on CW reception.

D. THRESHOLD SENSITIVITY — Controls RF gain on PHONE; ineffective on CW.

E. RF GAIN — Controls output of audio amplifier on PHONE, and RF gain on CW.

F. Indicator Lamp — Operates when antenna tuner is cycling. The antenna tuner automatically tunes the antenna circuit to properly load the transmitter output. The audio signal is available at the pilot's, copilot's, and navigator's stations by closing the applicable HF switch on control panel C-824/AIC-10 or by placing the selector in the applicable HF position. The transmitter is energized by placing the microphone selector in the applicable HF position and operating the push-to-talk switch at the pilot's, copilot's, or navigator's station. This applies high voltage to the transmitter circuits and replaces receiver audio with transmitter sidetone.

The HF-2 is not operable when the HF-1 system is on CW or transmitting on PHONE, and the HF-1 system is not operable when the HF-2 system is on CW or transmitting on PHONE, except when using the emergency keyer. Operation of the emergency keyer on HF-1 will disable the HF-2 system.

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.

HF COMMUNICATION TRANSMITTER-RECEIVER (HF-1)—VC-118A.

The HF-1 communication transceiver provides long range two-way voice and key communication on 2.0 to 25.0 mc frequencies. The transceiver, power supply, and associated equipment are installed on the radio rack and the controls are located at the radio operator's station *(figure 4-19)*. Twenty-eight-volt d-c and 115-volt a-c are supplied by the appropriate buses for radio reception. High voltage for transmission is supplied by the dynamotor which operates when the push-to-talk lever on the microphone is depressed and the interphone control panel microphone selector switch is in the HF-1 position. Receiving and transmission may be monitored at any interphone station by placing the HF-1 monitor switch in the ON position. Normal operation of the unit is voice transmission and the OFF-PHONE-CW switch should be in the PHONE position. A manual key may be plugged into the radio operator's set for key transmission, if desired. To transmit on key, turn the OFF-PHONE-CW switch to CW. Turning the OFF-PHONE-CW switch to either PHONE or CW turns the system ON, and rotating the switch to the OFF position turns the set OFF.

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.

HF COMMUNICATION TRANSMITTER-RECEIVER (HF-2)—VC-118A.

The HF-2 communication transmitter-receiver (AN/ARC-58) provides two-way voice communication on 28,000 separate frequencies from 2.0 to 29.999 mc for air to ground and air to air communication. The transmitter and receiver are located in the radio rack and are controlled from the radio operator's station *(figure 4-19)*. Four modes of operation are provided: amplitude modulation (AM), upper (U), lower (L), and twin sideband (TWIN), selected by a rotary switch on the control panel. An OFF-ON switch, a volume control, and 4 frequency selector knobs are also provided on the control panel. Power is supplied by an independent 115-volt, three-phase, 400-cycle inverter.

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.

AUXILIARY HF RECEIVER (HF-3)—VC-118A.

The auxiliary HF receiver (BC-348) is located at the radio operator's station *(figure 4-19)*. Controls are on the front of the unit and no remote control provisions are made. The unit provides medium-range voice reception in the 200 to 500 kc and 1.5 to 18.0 mc range. Audio output of this unit is available only at the radio operator's station and in the stateroom. Control of the audio output is selected by placing the HF-3 monitor switch on the interphone panel in the ON position. One-hundred-fifteen-volt a-c power is supplied by the radio bus, and the circuit is controlled by the MVC-OFF-AVC switch located on the face of the receiver. The set may be turned on by rotating the MVC-OFF-AVC knob to the desired position. Returning the knob to OFF deenergizes the circuit.

AN/ARA-26 EMERGENCY KEYER EQUIPMENT.

The emergency keyer equipment is utilized to transmit aircraft identification, SOS, and a modulated homing signal on the HF radio. On AF51-3818 through AF51-3835, the emergency keyer is used in conjuction with the HF liaison AN/ART-13 transmitter; on AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, and AF53-3241 through AF53-3305, the emergency keyer is used in conjunction with the Collins 618S-1 HF-1 transmitter. When the ON-OFF switch on the emergency keyer control panel is positioned to ON, 28 volts d-c is supplied to the system and the distress signals are automatically transmitted over the HF radio.

On AF51-3818 through AF51-3835, the LOCAL-REMOTE switch on the AN/ART-13 transmitter must also be in the REMOTE position to operate the system.

On AF51-3818 through AF51-3835, the emergency keyer system is operated from the radio operator's station *(figure 4-18, sheet 1)*; on AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, and AF53-3241 through AF53-3305, the system is operated from the navigator's station *(figure 4-20, sheet 3)*.

On AF53-3223 through AF53-3228, AF53-3230 through AF53-3239, and AF53-3241 through AF53-3305, an emergency keyer test panel is provided at the navigator's station *(figure 4-20, sheet 3)*. With the test switch in the TEST position, the light on the test panel will emit the code signals and the transmitter will not be keyed.

CAUTION

When testing the emergency keyer system, make certain that the test switch is in the TEST position, or distress signals will be transmitted.

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.

AN/ARC-27 UHF COMMAND TRANSMITTER-RECEIVER.

On AF51-3818 through AF51-3835, AF51-17626 through AF51-17661, AF51-17667, and AF51-17668, the equipment is operated from either the UHF command radio control panel on the control pedestal *(30, figure 1-7, sheet 1; and 26, sheet 2)*, or the UHF command radio control panel, located on the aft bulkhead above the table lights at the radio operator's station *(figure 4-18)*. To operate the UHF equipment from the radio operator's station, proceed as follows:

A. LOCAL-REMOTE switch — LOCAL.

B. ON-OFF power switch — ON.

C. Set function switch on one of the following positions, as required:
MAIN — main transmitter-receiver.
BOTH — main transmitter and guard receiver.
GUARD — main transmitter-receiver on guard frequency.

CAUTION

To prevent damage to the equipment, allow at least one minute for warm-up before actuating channel selector switch or microphone switch.

D. Channel selector switch — Select the desired frequency (as preset on the radio operator's UHF control panel).

E. TONE-VOICE switch — VOICE (TONE position may be used for D/F tone).

F. To turn off the equipment, move the ON-OFF power switch to OFF.

To operate the equipment from the UHF command radio control panel on the control pedestal *(30, figure 1-7, sheet 1; and 26, sheet 2)*, proceed as follows:

A. LOCAL-REMOTE switch (at radio operator's station) — REMOTE.

B. Receiver toggle switch on interphone control panel — UHF.

C. Microphone selector switch (if installed) — UHF.

D. Function selector switch — Rotate clockwise from the OFF position to either T/R (main transmitter-receiver), or T/R + G (main transmitter-receiver and guard receiver), as required.

CAUTION

To prevent damage to the equipment, allow at least one minute for warm-up before actuating channel selector switch or microphone switch.

E. Channel selector switch - SELECT THE DESIRED FREQUENCY (AS PRESET ON THE RADIO OPERATOR'S UHF CONTROL PANEL).

F. Adjust volume control knob on interphone control panel for desired volume level.

G. To transmit, depress the press-to-talk button on the microphone.

H. To turn off the equipment, rotate the function selector switch counterclockwise to the OFF position.

On AF53-3223 through AF53-3305, the equipment is operated entirely from the UHF radio control panel located on the control pedestal *(5, figure 1-7, sheet 3)*. A master channel selector switch provides manual frequency selection when the channel selector switch is in the M position, and also permits pre-selection of any of the 20 channels by pushing the SET CHAIN button. The channel selector switch permits selection of any of the 20 preset channels, guard channel (G) or manual frequency selection (M). To operate the equipment, proceed as follows:

A. Function switch — TURN CLOCKWISE FROM THE OFF POSITION TO ONE OF THE FOLLOWING POSITIONS AS REQUIRED:

T/R — Main transmitter-receiver.

T/R + G — Main transmitter-receiver and guard receiver.

ADF — Automatic direction finding (actuates UHF homing AN/ARA-25).

B. Receiver toggle switch on interphone control panel — UHF.

CAUTION

To prevent damage to the equipment, allow at least one minute for warm-up before actuating channel selector switch or microphone switch.

C. Channel selector switch — SELECT DESIRED FREQUENCY (AS PRESET BY THE MASTER CHANNEL SELECTOR SWITCH).

D. Adjust volume control knob on interphone control panel for desired volume level.

E. To transmit, press the press-to-talk button on the microphone.

F. To turn off the equipment, rotate the function selector switch counterclockwise to the OFF position.

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.

UHF HOMING AN/ARA-25—C-118A.

The UHF homing system adapts the UHF command radio transmitter-receiver and control to homing use; the indication is read on the pilot's and copilot's RMI's, located to the right of the course indicator on the main instrument panel. Rotating the function switch on the UHF pedestal panel from the OFF position applies 27.5 volts d-c to the filaments of the homing system. Rotating this switch to the ADF position applies high voltage to the electronic control amplifier, and applies 27.5 volts d-c to the antenna drive motor and solenoid relay. This relay transfers the antenna terminal of the receiver-transmitter from the UHF command antenna to the homing antenna. Tuning a station on the control panel FREQUENCY selector causes the UHF homing antenna to align its null point in the direction of the received signal. The antenna synchro feeds directional signals to the single pointers of the pilot's and copilot's right-hand RMI's, and the C-1 compass signal power amplifier (fed by the A-12 autopilot compass) feeds heading signals to the above RMI cards. The RMI cards, the number 1 pointers, and the antenna synchro are fed 26 volts a-c from a transformer in the C-1 amplifier.

UHF HOMING AN/ARA-25—VC-118A.

The UHF homing adapter (AN/ARA-25) operates in conjunction with the UHF command radio system. The electronic and compass signal amplifiers are located on the radio rack and the solenoid relay in the forward baggage compartment. The unit is controlled by the ADF position on the UHF command function switch. The unit supplies static-free air-to-air or air-to-ground homing signals. Homing bearings are shown on an indicator mounted on the top of the instrument panel glareshield (*figure 4-27*). Power is supplied to the circuits from the main radio 28-volt d-c and 115-volt a-c buses. The unit is placed in operation by turning the UHF command funtion switch to the ADF position. Turning the switch to OFF deengerizes the system.

PUBLIC ADDRESS SYSTEM—VC-118A.

The public address system consists of an amplifier mounted on the radio rack, a control panel located on the pilot's interphone control panel, and seven loudspeakers. Two speakers are located in the nose wheel well, five in the cabin area, and one in the aft stateroom. A telephone-type handset is located on the bulkhead aft of the copilot's seat. The bracket for the handset is equipped with a toggle switch, which, if placed in the UP position, connects the handset to the public address system. Replacing the handset on the hanger automatically trips the switch to the down position and returns the handset to the interphone circuit. The public address control panel incorporates a three-position toggle switch placarded LOUDSPEAKER, OFF, and STANDBY, and a rotary selector with NOSE and CABIN positions.

PUBLIC ADDRESS SYSTEM—C-118A.

The public address system consists of loudspeakers located throughout the aircraft (*figure 4-16*) and is operated from the public address system control panel. The public address system is controlled from the public address panel on the control pedestal by means of the following switches:

A. Toggle switch – 3 POSITION (OFF, STANDBY, and LOUDSPEAKER).

B. Rotary switch – 3-POSITION (NOSE, DOOR, and CABIN).

NOSE – Operates the loudspeakers (2) in the nosewheel well.

DOOR – Operates the loudspeakers at the forward and aft cargo doors.

CABIN – Operates the loudspeakers (3) in the cabin and both cargo doors.

The public address system receives its audio signal from the interphone system; therefore, the interphone system is operated as for normal interphone function.

AN/APS-42, AN/APS-42A, AND AN/APS-42B SEARCH RADAR.

This equipment is installed in the radome nose, in the radio rack, and at the pilot's and navigator's stations (*figure 4-17*), and is operated from the navigator's station. On some aircraft, the pilot also may operate this equipment from his station. On some aircraft, the ISO-Echo feature is installed. See Radome Anti-Icing System, this section. The components of this equipment are located as follows:

Component	*Location*
Radar receiver-transmitter	Nosewheel well
Synchronizer	Radio rack
Range-azimuth indicator (2)	Pilot's (or copilot's in AF51-17626 through AF51-17661, AF51-17667, and AF51-17668) and navigator's stations.
Control panel	Navigator's station (and pilot's station in AF51-17626 through AF51-17661, AF51-17667, and AF51-17668).
Antenna	Radome

The AN/APS-42 equipment is operated as follows:

Pre-Operation Check.

A. Function switch – OFF.

B. Intensity (pilot's and navigator's scopes) – FULL COUNTERCLOCKWISE (low).

C. Scan switch – STOP.

D. Gain control – FULL COUNTERCLOCKWISE.

E. Tune control AFC – FULL COUNTERCLOCKWISE.

F. STAB switch — OUT.

G. Heater switch — OUT.

H. Check radar circuit breakers and fuses —BOTH INSTALLED AND SPARES.

Operation.

A. Turn on radar inverter and check frequency (380 to 420 cycles per second) and voltage (115 $\pm$3 volts).

B. Place function switch to STANDBY and wait at least 3 minutes. This is an added precaution, for there is an automatic 3-minute delay any time the function switch is switched from the OFF position, or if the heater switch is switched from HTR to OUT. However, much damage could result should the automatic delay be inoperative.

Note

The antenna will respond to the tilt meter control as soon as the power is turned on; however, the tilt meter indicator will not register antenna position until the set has warmed up completely. The tilt control should not be deflected for more than 4 seconds prior to complete warm-up to avoid damaging the antenna tilt stops.

C. Adjust FOCUS control on scope for a sharp and clear sweep.

D. Set function switch to SEARCH.

E. Place scan switch to FULL.

Note

If extremely low ambient temperature exists (below —30°C), and the antenna and the sweep trace will not turn, place heater switch to HTR position for 1 or 2 minutes, depending on the temperature, then switch to OUT. If antenna and sweep on the indicator will not rotate after the 3-minute delay, return heater switch to HTR position for a short period. Repeat until equipment operates. Always use heater switch with function switch in the STANDBY position. If the transmitter has been operating previously, turn the function switch to OFF first, then to STANDBY.

F. Place STAB switch to STAB position. This gyro-stabilizes the antenna. In case the sweep turn is anticipated, switch it to OUT.

Operation of the Gain Control.

A. Rotate the gain control clockwise, until the target appears, then turn intensity down so that the sweep trace is just barely visible again. There is an optimum position for the clearest viewing and the highest degree of definition.

Note

This set has much more signal amplification than is normally needed in the event some tubes become weak during flight. Still further increases in GAIN may be obtained by rotating the VIDEO adjustment screw on the indicator housing.

B. If no signal appears after turning up the GAIN a reasonable amount, or in the event that the sweep starts spoking, move the tune control from the AFC position and attempt to tune the set manually. This is a critical adjustment requiring extreme care. Use the MANUAL tuning only when absolutely necessary. The AFC position is more advantageous.

C. When it is desired to materially reduce the returns from heavy masses of targets, better definition may be had by setting the A-J switch to the FTC position. Further sharpening may be obtained by placing the A-J switch in the IAGC position. Use the setting that gives the clearest results and readjust GAIN if necessary.

CAUTION

The A-J switch should not be used unless definite improvements are noted. The overall sensitivity is reduced, making small targets more difficult to detect on the longer range.

D. At times, the returns from large cities or a rough sea may appear too bright on the scope. Setting the STC switch to STC position will reduce the return from targets up to 10 miles. Increase the GAIN to compensate for the reduction in intensity.

E. Use the MAP position on the OBS-MAP switch for low ranges (5, 10, and 30) with the antenna tilt meter at approximately zero. In this position, the radiation pattern of the antenna is such that the distant targets will return as much energy as nearby targets; hence, a good mapping presentation. In the OBS position, all of the energy is concentrated into a narrow beam of approximately 5 degrees. Operate antenna TILT switch to experiment for the best results. With zero tilt and OBS position employed, one can observe objects at approximately the same altitude for collision prevention.

F. On the first five positions of the range switch, the scope represents the number of nautical miles, as indicated by the range switch. Range marks will appear on the scope with intervals corresponding to the number illuminated at the top of the scope (the 5- and 10-mile range will have 2-mile intervals, the 30-mile range will have 5-mile intervals, and the 100- and 200-mile range will have 25-mile intervals). The sixth position of the range switch, TD (target discrimination), enables the operator to pick out any 30-mile sector within the range of the set and use the entire scope to present it. This is accomplished with the use of the DELAY control.

G. On the TD position of the range switch, the start of the sweep is delayed from 5 to 175 miles as indicated by the DELAY control. On any other position of the range switch, a variable delay marker will appear on the scope a distance from the start of the sweep as indicated by the DELAY control setting. The following is an example of TD operation:

Assume the target to be scrutinized is 150 miles out. First, place the range switch on 200 and observe the target just about on the sixth range mark (25-mile interval range marks at this setting). Next, rotate the DELAY control until the variable delay marker is between the fifth and sixth range markers (approximately 135 miles from the start of the sweep). Now when the range switch is turned to the TD position, the target will appear enlarged and approximately halfway from the start of sweep to the edge of scope. The exact distance will be the number of miles as indicated by the DELAY control plus the distance from the start of the sweep to the target.

Note

There are two screwdriver adjustment screws on the front of the synchronizer SN-59/APS-42 for adjusting the intensity of the fixed range marks and the variable delay marker.

H. Use sector scan any time it is desired. Observation of specific targets in the direction of the aircraft heading is slightly improved by using sector scan.

I. The control on the top of the indicator housing varies the brightness of illuminating lights for observing cursor line and azimuth scale. It also varies the brightness of the range marker indicator lights on the upper rim of the indicator.

J. The knurled knob on the lower edge of the indicator housing rotates cursor lines to the desired azimuth position.

K. For beacon operation, place the functions switch on BEACON, and the A-J and STC switches in the OUT position. In beacon operation, the MAP beam is automatically selected; therefore, operate antenna TILT switch to zero tilt as indicated on the antenna tilt meter, then proceed as for SEARCH operation.

Note

There are no ground returns when utilizing BEACON. The exact range of the station will be ½ mile less than the distance to the first arc line from the start of the sweep. The bearing may be obtained by placing the cursor line through the center of the arcs and reading the bearing from the azimuth scale. To read the beacon station code, interpret the long intervals between arcs as dashes and the short intervals as dots. Read identification of radar station from start of sweep outward.

L. When it is desired to view the surrounding weather conditions, place the function switch in the WEATHER position and proceed as in search. Energy returns from clouds are proportional to the amount of precipitation contained in them. Hence, the denser the cloud formation, the brighter the return will appear on the scope. Use OBS and operate TILT switch to zero for best indications.

Note

Place function on STANDBY, scan switch on STOP, and STAB switch on OUT every time set is not being used. Then there will be no delay when set is used again.

Turn-Off Procedure.

A. Place the STAB switch in the OUT position.

B. Place the scan switch in the STOP position.

C. Rotate the INTENSITY (on both scopes) full counterclockwise.

D. Turn GAIN control full counterclockwise.

E. Move the function switch to OFF position.

Note

If spoking is noticed on the scopes during weather operation or long-range search operation, pulse transformer T-404 is probably burning out. Use set on low-range search operation only.

Terms and Abbreviations.

AFC — Automatic Frequency Control.

A-J — Anti-Jamming Operation.

FTC — Fast Time Constant.

HTR — Antenna Heater.

IAGC — Instantaneous Automatic Gain Control.

MAN — Manual Frequency Control.

MAP — Equal Energy Return Beam.

OBS — Pencil Beam.

STAB — Antenna Stabilizer.

STC — Sensitive Time Control.

TD — Target Discriminator.

RADAR PRESSURIZING KIT MK-59 AP.

The components of the radar pressurizing kit are pump, switch, and control, and are located on the aft side of the bulkhead immediately behind the copilot's seat.

The system is controlled from the RADAR PRESS panel by means of the following controls:

A. Blower switch — Two-position with guard (NORMAL ON position).

MOMENTARY ON — USED for test purposes. Pump operates continuously in this position.

NORMAL ON — Used for normal operation.

Pump controlled automatically by pressure switch.

B. PRESSURE INDICATOR (push-to-test light)— Lights when pump is operating.

C. PUSH-TO-BLEED — Releases pressure from system.

D. Pressure meter (marked in increments of one, 15 through 45) — Registers pressure in the system.

ANTENNAS.

Antenna locations are shown in figure 4-22.

LIGHTING EQUIPMENT.

All lights are wired to the 28-volt d-c supply through their respective circuit breakers and switches.

EXTERIOR LIGHTING.

Taxi Light.

A sealed beam taxi light is installed on the nose gear shock strut and is controlled by an ON-OFF switch mounted on the forward overhead panel *(figures 1-13 and 1-14)*.

Wing Leading Edge Lights.

Two lights are installed, one on each side of the fuselage, to illuminate the leading edges of the wing so that ice formation can be detected. The lights are controlled by an ON-OFF switch which is mounted on the forward overhead panel *(figures 1-13 and 1-14)*.

Landing Lights.

A sealed beam, electrically actuated landing light is installed on the underside of each middle wing panel. Each light is controlled by a 3-position switch marked EXTEND, OFF, and RETRACT, and an ON-OFF switch located on the upper instrument panel *(figure 1-11)*. The EXTEND-OFF-RETRACT switch actuates the landing light mechanism and provides for intermediate positioning. The ON-OFF switch controls illumination of the landing lights.

Navigation Position Lights.

The navigation position lights consist of a green light on the right wing tip, a red light on the left wing tip, red and white lights on the tail cone tip and a white light on the top and bottom of the fuselage. The wing tip and tail cone lights are controlled by a 3-position switch placarded STEADY, OFF and FLASH. A separate ON-OFF switch controls the upper and lower white fuselage lights. These switches are located on the forward overhead panel *(figure 1-14)*. Placing the 3-position switch in the STEADY position will illuminate the wing tip lights and the white tail cone light. When the switch is placed in the FLASH position, the wing tip lights and the white tail cone light will flash alternately to the red tail cone light. When the fuselage light switch is placed in the ON position, the upper and lower, white fuselage lights will flash with the red tail cone light.

Note

Should the flasher fail, place the switch in the STEADY position.

Anticollision Light.

A red streamlined rotating anticollision light is installed on the top of the vertical stabilizer and is normally controlled by the navigation position lights switch on the forward overhead panel. (On some aircraft, a separate ON-OFF switch controls the anticollision light.) On some aircraft, the circuit is interlocked through a ground control relay to prevent burning the light lens when there is no cooling airstream.

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 anticollision light during these conditions since it could not be observed by pilots of other aircraft.

Wheel Well Lights.

A light is provided in each landing gear wheel well and is controlled by either a switch located on the forward overhead panel *(figures 1-13 and 1-14)* or by a switch located in the nosewheel well. The wheel well lights should be focused on the wheel-down locks.

Lower Baggage Compartment Lights.

Dome lights are installed in the lower baggage compartments, hydraulic accessories compartment, heater compartment, and in the spar area. The lower baggage compartment lights are controlled by a switch located on the bulkhead of the crew's lavatory, aft of the navigator's station. The dome lights in the four lower compartments are individually controlled by a switch installed beside the compartment's respective access door. In addition, a switch and an amber indicator light, located in the flight compartment immediately aft of the crew's entrance door, are provided to illuminate the compartments from within the aircraft. This switch controls all underfloor compartment and tail heater compartment dome lights. Illumination of the amber indicator light indicates that the dome lights are illuminated when the switch is on.

Aldis Lamp (If Installed).

An Aldis lamp is provided in a holder located on the bulkhead aft of the copilot's seat. The lamp cord may be plugged into a receptacle located on the aft overhead panel *(figure 1-12)* when the lamp is required.

INTERIOR LIGHTING.

Cockpit Overhead Lights (Floodlights).

Two adjustable overhead lights *(figure 1-7)*, one white and one red, are installed in the cockpit. The lights provide floodlighting for the cockpit area and are individually controlled by dimming rheostats located on the lower section of the forward overhead panel *(figure 1-13)*. On AF51-3818 through AF51-3835 and AF53-3223 through AF53-3305, both overhead lights are white and the intensity of the lights is controlled by a single dimming rheostat located adjacent to the ammeter-voltmeter panel *(figure 1-22)*; however, the lights may also be turned on to full intensity by an override switch located above the pilot on the forward overhead panel *(figure 1-14)*. The switch is placarded OVERHEAD WHITE LIGHT with the positions ON and OFF and may be used by the pilot to floodlight the cockpit for general illumination or during flight through thunderstorm areas, as required.

Instrument Lighting.

The red lights for the flight instrument panels are controlled by rheostats on the cold air orifice panels *(13, figure 1-6)*.

The red lights for the engine instrument panel, the forward top face of the control pedestal, the fuel dump valve control handles, and the overhead panels are controlled by rheostats on the forward overhead panel *(figures 1-13 and 1-14)*. Twelve white lights on the main instrument panel also are controlled by rheostats on the forward overhead panel.

Radio Operator's Table Lights and Instrument Lights—C-118A.

Three adjustable table lights are installed at the radio operator's station *(figure 4-18)*. The lights are controlled by three dimming rheostats located on the aft bulkhead at the radio operator's station. The instrument rim red lighting and the radio equipment red and white lights are controlled by two rheostats located on the aft bulkhead at the radio operator's station. An adjustable red instrument panel light, located above the flight compartment dome light provides illumination for the navigator's instrument panel and is controlled by a dimming rheostat on the light.

Radio Operator's Station Lighting—VC-118A.

The radio operator's station is equipped with a flexible work table light with a rheostat control mounted on the radio panel. General illumination for the area is furnished by a dome light in the upper aft corner of the compartment. The dome light switch is located on the dome light support bracket. The main junction box exterior panel is illuminated by a floodlight mounted above the radio operator's seat. The control switch for the junction box floodlight is located on the forward overhead panel *(figure 1-14)*. The integral radio panel lights are controlled by a rheostat located on the radio control panel.

Navigator's Table Lights and Instrument Lights.

Two adjustable table lights are installed at the navigator's station *(figure 4-20)*. The two lights are controlled by separate dimming rheostats, one located on the wall adjacent to the base of the outboard light and the other located on the forward bulkhead beside the radio control panels. On AF53-3223 through AF53-3305, the navigator's white console lights are concealed. Red rim lighting is provided for the instrument panel. Red and white work table lights contained in a single, adjustable fixture are installed on the wall forward of the flight compartment entrance door. The lights are controlled by dimming rheostats located on the navigator's light control panel, overhead.

Dome Lights—C-118A.

Flight Compartment Dome Light. A flight compartment dome light, located above the flight compartment entrance door, can be turned on or off from either the ENTRANCE LIGHT switch on the forward overhead panel *(figures 1-13 and 1-14)* or from the DOME LIGHT switch on the aft side of the entrance door.

Cabin Dome Lights. Seven dome lights, installed down the center of the cabin ceiling, are controlled by an ON-OFF switch located on the forward side of each cargo door *(figure 4-23)*. The main cabin switch panel *(figure 4-23)* also has a BRT-DIM switch for the dome lights.

Emergency Cabin Dome Lights. Five of the dome lights in the cabin ceiling have additional 6-volt bulbs. These bulbs are controlled by an impact switch on the aft right side of the flight compartment partition. A drycell battery to supply the 6 volts is located in the right main junction box annex, and a test switch is located on the main cabin switch panel *(figure 4-23)*.

Lavatory Dome Light. A light is installed in the lavatory and is controlled by an ON-OFF switch on the lavatory partition.

Map Reading Lights. Three white map reading lights are installed in the cockpit, and are controlled by individual rheostats. The pilot's map reading light is located on the heater fire control panel *(figure 4-10)*, the copilot's on the ammeter-voltmeter panel, and the crew engineer's on the aft overhead panel *(figure 1-12)*.

On AF53-3223 through AF53-3305, the pilot's map reading light is located immediately above the heater fire control panel and the copilot's is located above the ammeter-voltmeter panel.

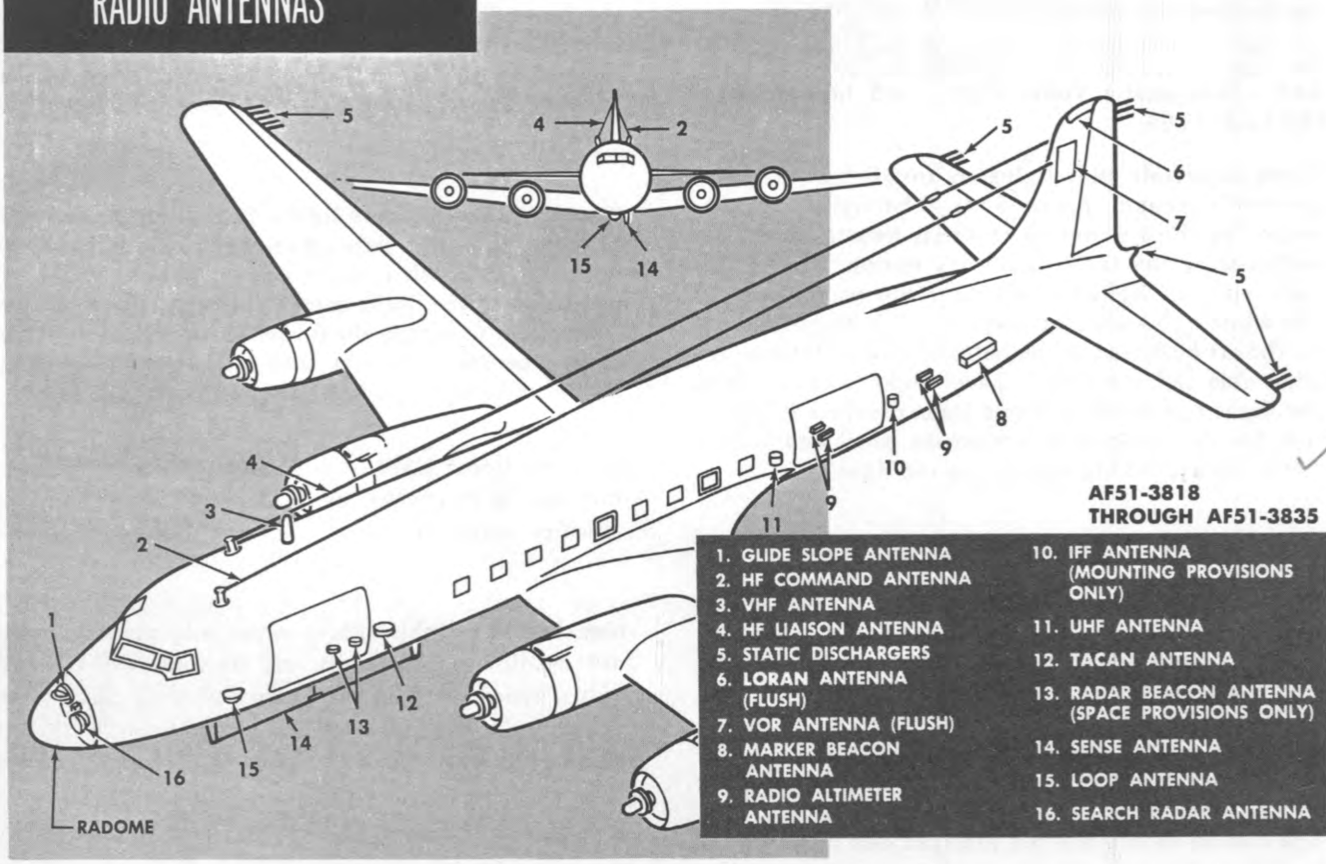
Upper Instrument and Forward Overhead Panel Lighting. A white and red light assembly is located on the bulkhead above each pilot *(figure 1-7)*. Individual dimming rheostats to control light intensity are located on the forward overhead panel *(figures 1-13 and 1-14)*.

On some aircraft, the lights are controlled by a single rheostat located on the right side of the forward overhead panel.

Main Cabin Lights—VC-118A.

The main cabin area is illuminated by nine combination dome and aisle lights. One in the crew compartment, 2 in the galley, 1 in the passenger compartment, 2 in the conference room, and 3 in the stateroom. A double ON-OFF switch, with one toggle for the dome light and the other toggle for the aisle light, is located beside each compartment door to control the lights for the particular compartment. Seats and divans have individual reading lights which are controlled by ON-OFF switches located on the individual fixtures.

RADIO ANTENNAS



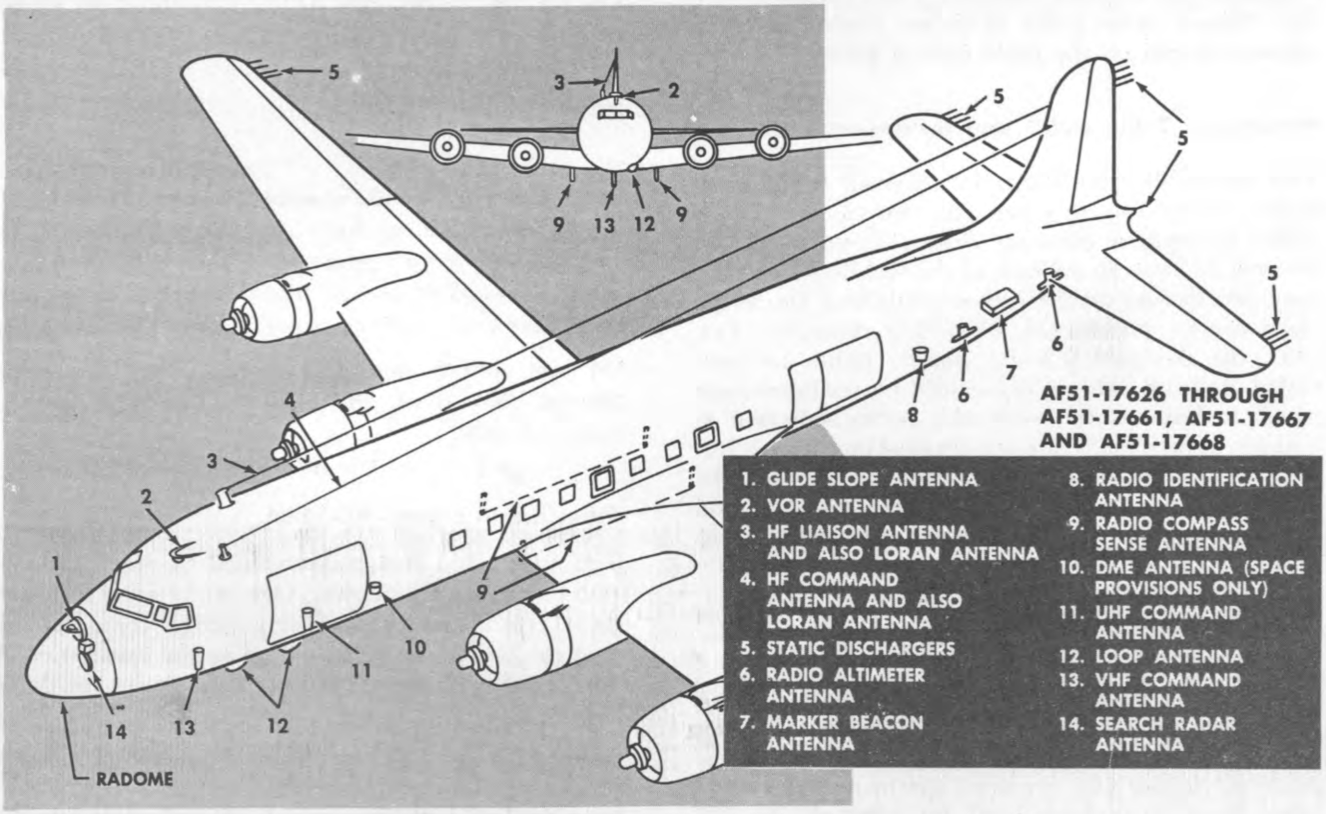


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Figure 4-22 (Sheet 1 of 2)

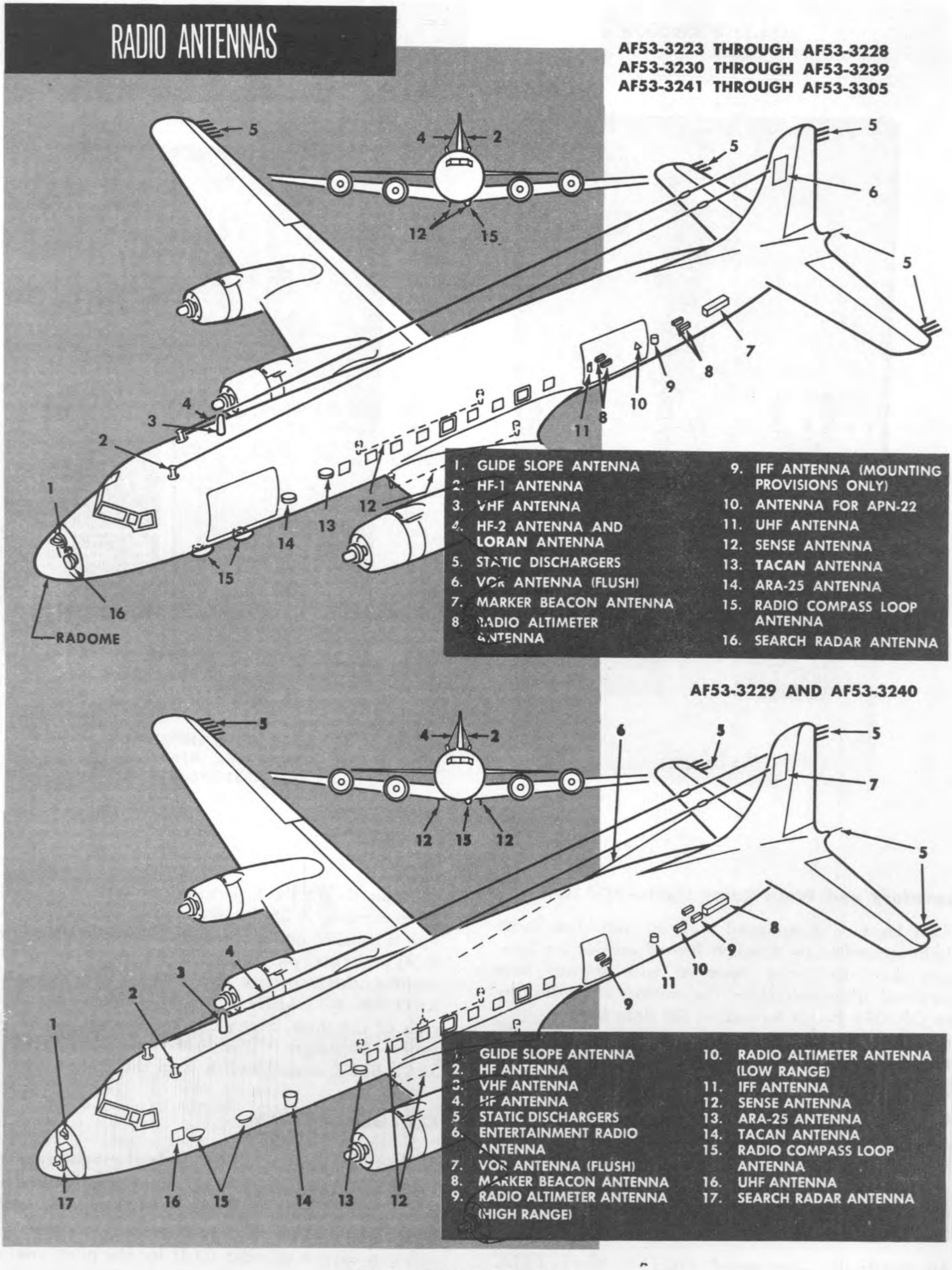
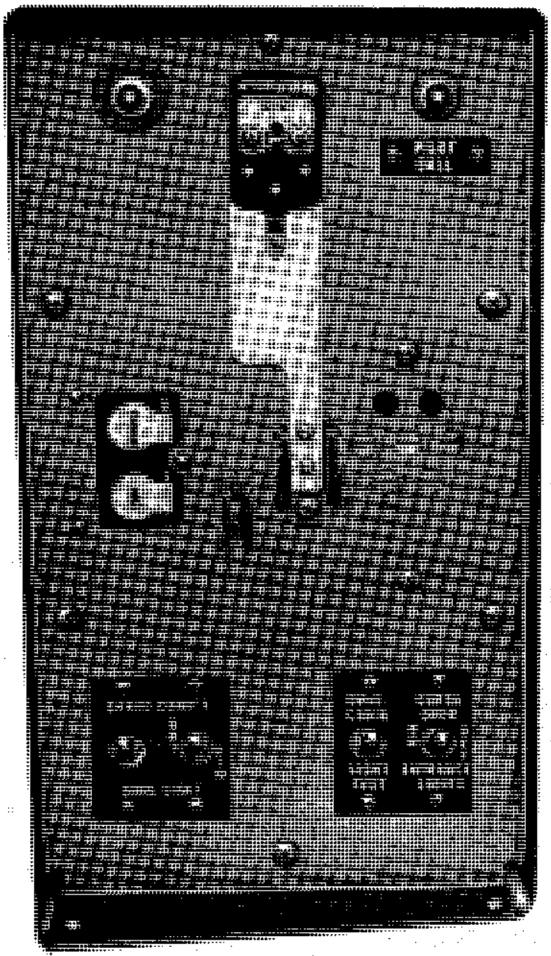
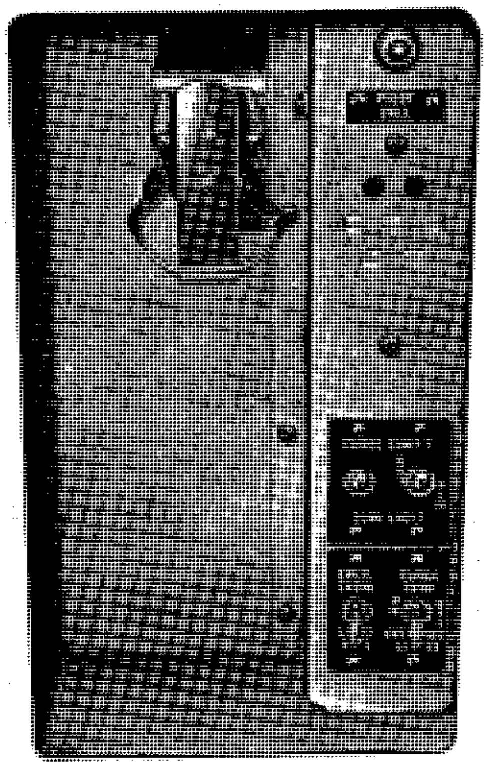


Figure 4-22 (Sheet 2 of 2)

MAIN CABIN SWITCH PANEL

AF51-3818 THROUGH
AF51-3835





AF51-17626 THROUGH
AF51-17661, AF51-17667
AND AF51-17668

AA1-151

Figure 4-23

Lavatory and Wash Room Lights—VC-118A.

Each lavatory is equipped with an individual dome light controlled by a switch located outside the lavatory door. Lavatories equipped with mirrors have localized illumination for the mirrors controlled by an ON-OFF switch located on the light fixture.

Passenger Entrance Lights—VC-118A.

The passenger entrance is illuminated by one dome light for general lighting and two spotlights focused on the threshold. These lights are controlled by two ON-OFF switches located beside the passenger door.

Fasten Seat Belt, No Smoking, and Return to Cabin Signs—VC-118A.

An electrically illuminated FASTEN SEAT BELT sign and a NO SMOKING sign are located above the door on the forward partition of each main cabin compartment. A 28-volt d-c control switch for each sign is installed on the forward overhead panel *(figure 1-14)* in the cockpit. When either switch is in the ON position, the respective sign will be illuminated. A RETURN TO CABIN sign is located on the wall of each of the three lavatories, the aft lounge, and the galley. Each sign is illuminated when the FASTEN SEAT BELT control switch is in the ON position.

OXYGEN SYSTEM.

A fixed low-pressure, diluter-demand oxygen system is installed on the aircraft for the flight crew to use either in the event of cabin supercharger failure or in case of smoke or fire. The standard fixed oxygen system provides an oxygen cylinder (D-2) for the pilot, and one (G-1) for use of the copilot and other flight crew members. In addition to the fixed system, three low-pressure portable oxygen cylinders are installed to supplement the fixed system and to provide oxygen at locations other than at the established crew positions. Four recharger fittings are installed in the flight compartment to replenish the portable cylinders. When the aircraft is used to transport litter patients, a rack containing six portable high-pressure oxygen cylinders is installed in the main cabin.

OXYGEN SYSTEM CONTROLS.

Diluter-Demand Regulators.

Five diluter-demand regulators (four on AF53-3223 through AF53-3305) are installed, one at each crew station. On some aircraft, two regulators are also installed in the aft cabin compartment.

Oxygen System Indicators.

Flow Indicators. Oxygen flow indicators (blinker-type) are installed on each regulator.

Pressure Gages.

Two pressure gages, one for each system, are provided. The pilot's system pressure gage is installed on the left side of the cockpit *(figure 1-7)*; the copilot's and crew's pressure gage is installed on the hydraulic and oxygen instrument panel *(figure 1-29)*.

OXYGEN SYSTEM—NORMAL OPERATION.

Normal operation of the oxygen system is as follows:

A. Diluter-demand regulator control—NORMAL OXYGEN.

B. If pure oxygen is required—Diluter-demand regulator control—100% OXYGEN.

OXYGEN SYSTEM—EMERGENCY OPERATION.

In an emergency, the diluter-demand system is controlled by the safetywired red knob on the diluter-demand regulator. To operate the system, break the safetywire and turn the red knob to the open position. This will supply a continuous flow of 100 percent oxygen.

OXYGEN SYSTEM DURATION.

The oxygen duration table *(figure 4-24)* shows a greater oxygen duration at higher altitudes using 100% oxygen. This is due to the oxygen expansion to a greater volume at altitude than at sea level.

AUTOPILOT.

The A-12 autopilot is designed to enable the pilot to operate the equipment with an absolute minimum of effort and attention. The electrical and mechanical releases and interlocks simplify operation and prevent an improper operating procedure. The following data pertains to the flight operation of the autopilot:

WHEN TO ENGAGE.

The autopilot can be engaged with complete safety when the aircraft is in any of the following attitudes.

A. Normal straight and level flight.

B. Any normal climb or descent, including just after takeoff.

Note

> If the autopilot is turned on and engaged in a climb or descent, the aircraft will continue to fly in that attitude until the pitch control knob switch is operated or the altitude control switch is turned on.

AIRCRAFT TRIM PRIOR TO AND DURING AUTOPILOT OPERATION.

A. Trim the aircraft manually by adjusting the aircraft's trim tabs for "hands off" flight.

B. The autopilot automatically synchronizes itself to the aircraft's attitude at all times when disengaged and may be engaged while the aircraft is in an out-of-trim condition. In this case, however, an untrimmed condition is immediately reflected on one of the three trim meters on the autopilot controller *(figure 4-25)* by a constant signal indication.

C. Trim in the elevator channel is automatic within limits which are set on installation. Aileron and rudder trim can only be obtained by manually applying trim tab.

D. In order not to impose an unnecessary load on the autopilot, it is recommended that the aircraft be manually trimmed before engaging.

ENGAGING AUTOPILOT.

A. Automatic approach selector switch—AUTO-PILOT.

B. Turn knob—DETENT (centered).

C. Aileron knob—CENTERED.

D. Autopilot engaging levers *(figure 4-24)*—DISENGAGE (down).

E. Pilot switch—ON (allow 2 minutes for warm-up).

OXYGEN DURATION CHART

OXYGEN DURATION, HOURS (UNPRESSURIZED)

CREW MEMBER (PILOT)

ONE TYPE D-2 CYLINDER

ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
25,000	1.0 / .7	.8 / .6	.7 / .5	.5 / .4	.3 / .3	.28 / .2	.14 / .1	EMERGENCY Descend to Altitude not requiring Oxygen
20,000	1.1 / .6	.9 / .5	.8 / .4	.6 / .34	.47 / .25	.3 / .17	.15 / .08	
15,000	1.4 / .5	1.2 / .4	1.0 / .35	.8 / .28	.6 / .21	.4 / .14	.2 / .07	
10,000	1.8 / .4	1.5 / .3	1.3 / .3	1.0 / .22	.77 / .17	.5 / .11	.25 / .05	

BLACK FIGURES—INDICATE DILUTER DEMAND USAGE
RED FIGURES—INDICATE 100% OXYGEN USAGE

OXYGEN DURATION, HOURS (UNPRESSURIZED)

CREW MEMBER (OTHER THAN PILOT)

BASED ON FOUR CREW MEMBERS, ONE TYPE G-I

ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
25,000	1.0 / .8	.8 / .68	.7 / .57	.5 / .45	.4 / .34	.28 / .22	.14 / .11	EMERGENCY Descend to Altitude not requiring Oxygen
20,000	1.1 / .6	.93 / .5	.79 / .43	.62 / .34	.47 / .25	.31 / .17	.15 / .08	
15,000	1.4 / .5	1.2 / .4	1.0 / .35	.8 / .28	.6 / .21	.4 / .14	.2 / .07	
10,000	1.9 / .4	1.6 / .34	1.3 / .28	1.1 / .22	.8 / .17	.54 / .11	.27 / .05	

BLACK FIGURES—INDICATE DILUTER DEMAND USAGE
RED FIGURES—INDICATE 100% OXYGEN USAGE

AA1-149

Figure 4-24

F. Aircraft wings – LEVEL WITH HORIZON.

G. Manually trim aircraft.

H. Autopilot trim indicators – CHECK TRIM INDICATORS ON AUTOPILOT CONTROLLER FOR SYNCHRONIZATION.

I. Autopilot engaging levers – ENGAGE (up).

J. Aircraft trim – RECHECK THAT TRIM INDICATORS ON AUTOPILOT CONTROLLER ARE CENTERED.

USE OF ALTITUDE CONTROL.

To maintain specific pressure altitude while operating on autopilot, move the altitude control switch to the ON position. The following will occur:

A. If in level flight, the aircraft will continue to fly at the pressure altitude at which the aircraft was flying when the altitude control was turned ON.

B. If climbing or descending when the switch is turned ON, the aircraft will level off and hold a constant altitude. Later, however, when the altitude control switch is turned OFF, the aircraft will return to the climbing or descending attitude effective at the time the switch was turned ON.

AUTOPILOT CONTROLLER

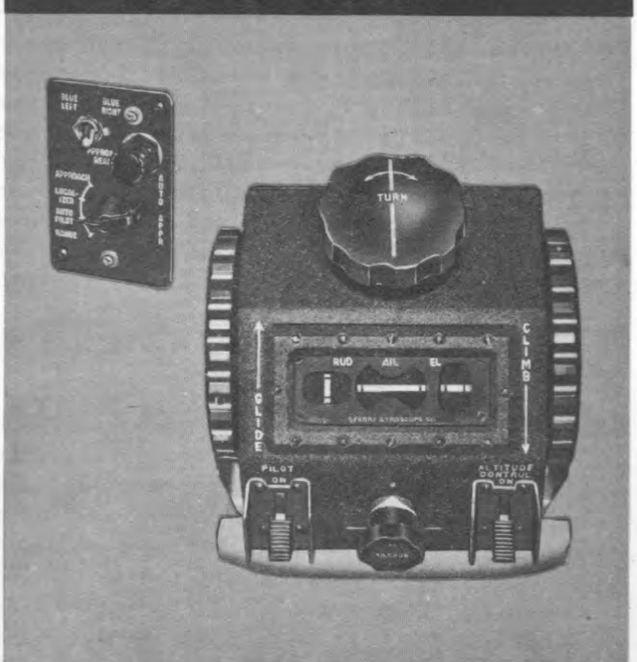


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Figure 4-25

AUTOPILOT MECHANICAL ENGAGING LEVERS

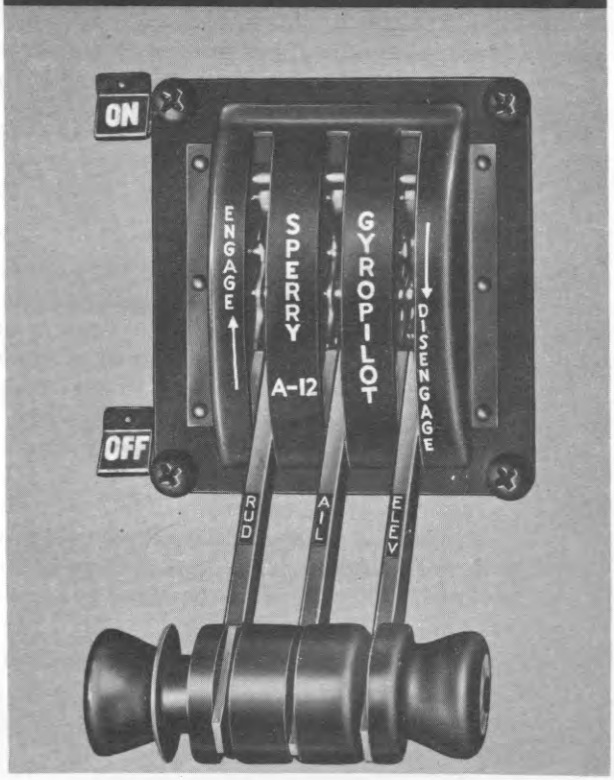

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Figure 4-26

C. Pitch attitude change through the use of the altitude control is limited to plus or minus 6 degrees of level flight attitude. If the altitude control is engaged while the aircraft is climbing or descending at greater than this limit, the altitude control will compensate for 6 degrees, and the aircraft will continue to climb or desecend at a pitch attitude 6 degrees less than the original attitude. In this case, if the aircraft continues to climb or descend, the altitude control may become damaged.

D. It is recommended that the aircraft be leveled off at the cruising altitude before engaging the altitude control.

E. During the time the altitude control switch is ON, the pitch knob will be inoperative.

CAUTION

The altitude control switch must be turned OFF prior to changing the static source selector valve switch to the alternate position. Failure to do so will result in an abrupt change of attitude up to the limit of 6 degrees.

TO CHANGE ATTITUDE OF AIRCRAFT.

The autopilot controller reduces the task of maneuvering the aircraft to the manipulation of two knobs (a pitch knob for climbing and descending and a turn knob for left and right turns).

A. The pitch knob is so placed on the autopilot controller that rotating it forward will produce nosedown control and rotating it aft will produce nose up control.

B. The turn knob is so placed on the autopilot controller that if rotated to the right or left it will produce right or left turns respectively. Operation of the turn knob in either direction, besides establishing a bank, simultaneously applies automatic rudder correction which is simply a means for correcting or preventing any slip or skid of the aircraft. In this way the aircraft will fly a perfectly coordinated turn at any airspeed, without the necessity of making manual adjustments. The smooth turn control permits minute and exact change of course and simplifies aircraft maneuvers.

C. Climbing or descending turns can be made by proper coordination of the pitch knob and the turn knob.

D. Straight and level flight may be resumed after turns by returning the turn knob to the DETENT position and rotating the pitch knob for level flight. When the turn knob is returned to the DETENT position, the aircraft will roll out of the turn and hold the new heading.

AUTOMATIC APPROACH EQUIPMENT.

Automatic approach and range flying equipment is installed and is used with the autopilot. The equipment provides instrument guidance through which the autopilot responds to radio signals and maintains an "on-course" flight path through interpretation of VOR, VAR, and TACAN radio range beam signals, and ILS localizer and glide slope radio beam signals. The automatic approach and range flying equipment consists of an automatic approach control, an automatic approach control selector switch *(figure 1-8)* and a heading selector, installed in the main instrument panel *figure 1-9)*.

The heading selector is a part of the automatic range flying system. Automatic range flight requires that the pilot preset the desired course on the heading selector. The angular error between the aircraft heading and the desired course is measured by a synchro in the heading selector which furnishes a proportional signal to the automatic pilot. This signal is mixed with beam error data derived from the course indicator signal. The automatic pilot, therefore, senses a signal which is proportional to the angular heading error as well as the magnitude and rate change of beam error signal. The heading selector contains two synchros. One serves as an A-12 heading repeater, operating a pointer which continuously indicates the magnetic heading of the aircraft. The second synchro is connected to the settable pointer and is used to define the desired heading. The output of the heading selector (a signal proportional to the angular difference between the two pointers) enters the automatic pilot system only when the selector switch is in RANGE position.

AUTOMATIC RANGE AND AUTOMATIC APPROACH FEATURES.

During automatic range flying (omni, VAR), use range position with track heading on the heading selector and course selector. Use BLUE RIGHT for omni-range and BLUE LEFT or BLUE RIGHT for VAR, depending upon direction of flight. The blue left, blue right switch *(figure 4-25)* is in the circuit only in the range position. For best results, do not use the range position for ILS approach due to the 10-degree bank limitation that is imposed.

Holding.

There are times when traffic control conditions will require the pilot to maintain a constant altitude for a period during the descent for landing. For example, a letdown rate of 500 feet per minute may have been set in when traffic control directs the pilot to proceed to 2000 feet and hold that altitude until instructed further. Turning the altitude control switch ON and increasing power to maintain airspeed will automatically level off the aircraft and hold that altitude. When instructions are received to descend, the altitude control switch may be turned OFF and power returned to letdown condition; and the aircraft will return to the original 500-feet-per-minute descent.

Automatic Approach.

Because of the ease in maneuvering and because of the stabilizing effect, the autopilot should be kept engaged and should be used during the letdown and approach when an automatic instrument approach is planned. However, the autopilot should be disengaged before landing (in line with runway and descending). The automatic approach system is more than just another piece of accessory equipment. Its use must be studied and thoroughly understood by the pilot and all others concerned. An automatic approach should be considered as a flight operation technique which must he

AUTOPILOT CONTROLS (VC-118A)

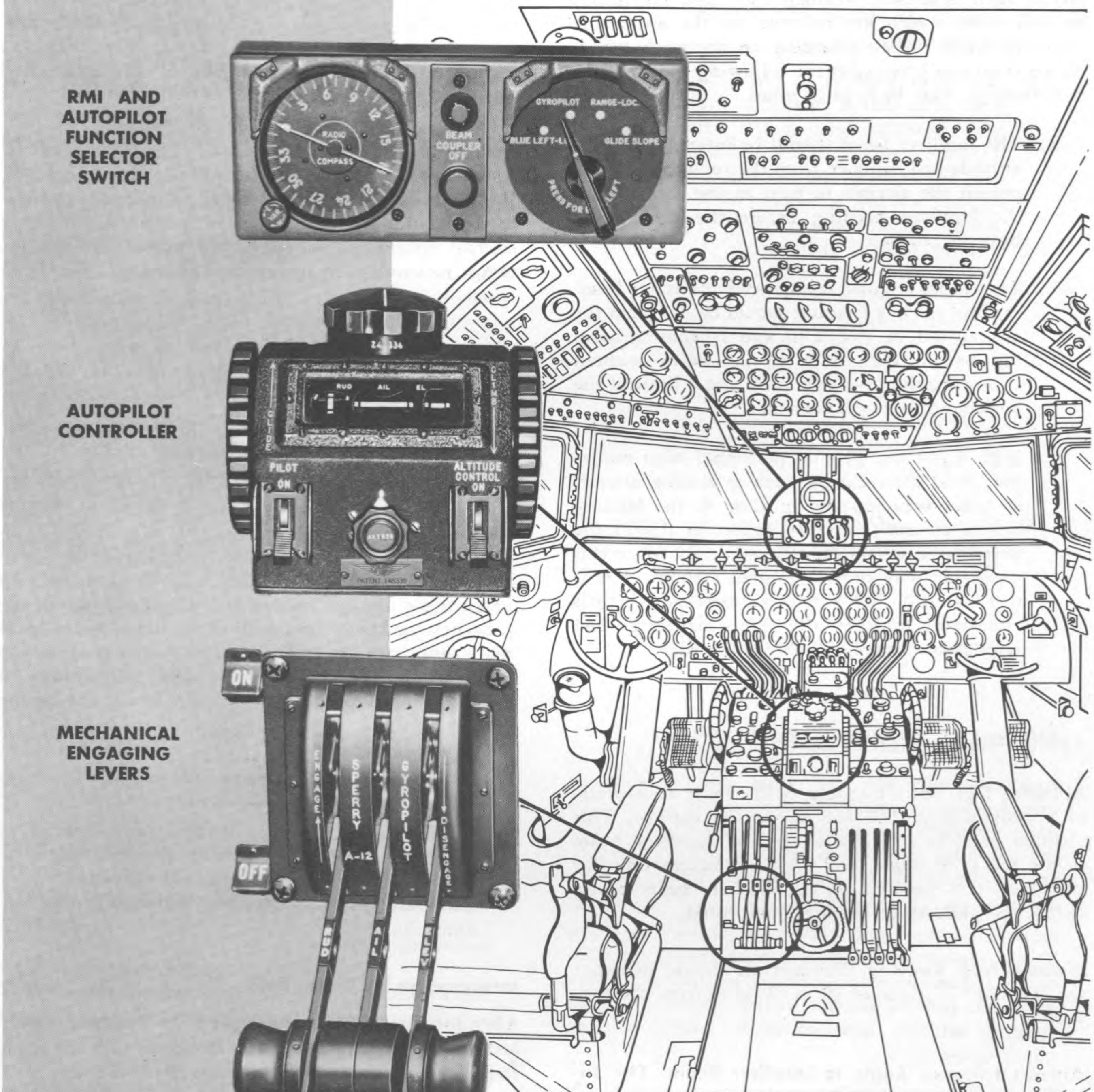


Figure 4-27

carefully planned, developed, and practiced. The cockpit procedures must be definitely established and rigidly followed. It should also be remembered that the automatic approach equipment is quite flexible with regard to the geometry of the approach pattern. The altitude, distance from runway, and angle of interception which are set forth in the procedure outlined below may be varied to meet varying external conditions such as terrain, weather, and traffic conditions or differences which are reflected on the applicable approach plate. When planning an approach which differs from this procedure, the following fundamental relationships must be kept in mind.

A. The localizer beam should be intercepted at an altitude and distance from the runway that will permit the aircraft to turn to and stabilize on the localizer heading before the glide slope beam is reached.

B. The initial angular error between aircraft heading and runway heading should be such that the aircraft will be able to turn to the runway heading within the width of the beam without exceeding the 25-degree bank angle limit of the automatic approach control.

C. Both flight and ground personnel must realize that local disturbances, such as taxiing aircraft or other vehicles passing close to the landing system transmitters, may deflect or distort the beams sent out by these transmitters. Since this distortion may cause a limited amount of control action on the part of an airplane which is attempting to follow the beams, airport ground regulations must be strictly enforced.

Approaching Localizer Beam.

Altitude. The aircraft should be flown at an altitude of approximately 1500 feet above the runway. This altitude permits interception of the localizer beam below the glide slope, and allows sufficient time for the aircraft to stabilize on the localizer beam course before the glide slope beam is intercepted.

Distance from Runway. The aircraft should intercept the beam at a distance of 10 to 12 miles from the runway.

Aircraft Entrance Angle to Localizer Beam. The aircraft may approach the localizer beam at any angle up to 90 degrees from the landing heading.

Altitude Control. The altitude control switch should be turned ON unless particular conditions dictate otherwise.

Note

The use of altitude control in the procedure described represents one recommended method of executing an automatic approach. However, its use is optional and an automatic approach may be made satisfactorily without it. In such a case, tbe instructions relative to the altitude control may be omitted.

Instrument Landing Receivers. The instrument landing receivers should be turned ON.

Automatic Approach Controller. The selector switch should be in the AUTOPILOT position. The APPROACH READY ligbt must be illuminated to indicate that the autopilot and the automatic approach control equipment are receiving power. Do not attempt to execute an automatic approach if the light is out.

Airspeed. The power settings should be the same as set up for a normal approach pattern.

Course Indicator. When the aircraft intercepts the localizer beam (course), the localizer needle on the course indicator will leave its stop and move towards the center.

Automatic Approach Controller. As soon as the localizer needle on the course indicator leaves its stop, turn the selector switch to the LOCALIZER position (the green light should remain on). As the aircraft approaches the center of the localizer beam under automatic approach control, the needle will continue to move to the center, overshoot, and then return to center. When the aircraft is on the beam, the needle will be centered.

CAUTION

Attempting to put in a manual turn signal by rotating the turn knob on the autopilot controller during the approach procedure will result in electrically disengaging the autopilot.

Interception of Glide Path.

After the aircraft has intercepted the localizer track and is approaching the glide slope, extend the wing flaps and landing gear and establish the approach airspeed. When the glide slope is intercepted turn OFF the automatic altitude control, adjust the pitch knob to effect the approximate rate of descent and turn the automatic approach selector switch to the APPROACH position. If the altitude control switch is not turned OFF manually it will automatically return to the OFF position when the selector switch is turned to APPROACH.

Airspeed. Power settings should be reduced to maintain constant airspeed as the aircraft flies down the glide slope. Thus, the aircraft is brought over the edge of the field and down the center of the runway on the correct flight slope for a normal landing. The difficulties of manually lining up with the runway under bad visibility conditions and the possibility of over or undershooting are eliminated.

Turning Off Automatic Approach.

The automatic approach system is not an automatic landing system. Under all conditions, the automatic approach equipment must be turned OFF at a safe predetermined minimum altitude. The pilot must assume control of the aircraft from the autopilot and complete the landing.

The recommended way to turn off the automatic approach equipment is to push the electric release switch and disengage the autopilot servo controls. (The elevator trim tab wheels cannot be moved while the servos are engaged.)

Note

During the entire automatic approach procedure, the elevator trim tab servo of the autopilot automatically keeps the aircraft in trim about the pitch axis. This is important to the pilot in that it insures proper pitch trim for the aircraft when the autopilot is turned OFF.

Automatic Range and Automatic Approach Operation Checklist.

Inbound on Front Beam or Outbound on Back Beam of Localizer — Flag Down.

A. Auto approach selector switch..............RANGE.

B. Blue left/right selector switch....BLUE RIGHT.

C. Heading selector......................SET ON INBOUND LOCALIZER HEADING.

Inbound on Back Beam or Outbound on Front Beam of Localizer — Flag Down.

A. Auto approach selector switch..............RANGE.

B. Blue left/right selector switch........BLUE LEFT.

C. Heading selector................SET ON OUTBOUND LOCALIZER HEADING.

Localizer Inbound for Landing on Front Beam — 15 to 20 Miles from Transmitter.

A. Auto approach switch...................... SWITCH FROM LOCALIZER TO APPROACH WHEN CENTER OF GLIDE SLOPE BEAM IS INTERCEPTED, I.E., WHEN CROSS-POINTER METER IS CENTERED.

B. Blue left/right selector switch...............OUT OF CIRCUIT; HAS NO EFEFCT ON OPERATION OF AUTOPILOT.

C. Heading selector.....OUT OF CIRCUIT; HAS NO EFFECT ON OPERATION OF AUTOPILOT.

Note

If bracketing the localizer beam, do not turn the auto approach switch to the LOCALIZER position until the needle on the cross-pointer meter leaves its stop.

Omni-Range Inbound.

A. Auto approach selector switch..............RANGE.

B. Blue left/right selector switch....BLUE RIGHT.

C. Heading selector.................... SET ON HEADING TO OMNI STATION.

D. Course selector........................ SET ON HEADING TO OMNI STATION.

Omni-Range Outbound.

A. Auto approach selector switch..............RANGE.

B. Blue left/right selector switch....BLUE RIGHT.

C. Heading selector.........SET ON HEADING FROM OMNI STATION.

D. Course selector.............SET ON HEADING FROM OMNI STATION.

VAR Inbound.

A. Auto approach selector switch..............RANGE.

B. Blue left/right selector switch.......... POSITIONED ACCORDING TO WHETHER BLUE IS ON LEFT OR RIGHT ACCORDING TO VAR CHART.

C. Heading selector..... SET ON HEADING TO VAR STATION (BEAM HEADING).

VAR Outbound.

A. Automatic range selector switch............RANGE

B. Blue left/right selector switch.......... POSITIONED ACCORDING TO VAR CHART.

C. Heading selector.................... SET ON HEADING FROM VAR STATION.

Note

Under crosswind conditions, the crab angle necessary to maintain flight along the center of the radio beam can result in the autopilot affecting a hunting reaction from side to side of the course to the omni station. This reaction is caused by feedback of correcting signals from the heading selector synchro and the automatic approach control amplifier synchro to the autopilot. To eliminate the hunting reaction, the correct crab angle should be determined and maintained by aligning the heading selector (double needle or settable pointer) with the average heading indicated by the compass repeater pointer.

The operation of the directional switch is such that when the blue area of the VAR station is on the right of the aircraft heading, the direction switch must be positioned at BLUE RIGHT in making the approach to the station. If it is positioned at BLUE LEFT, the automatic approach equipment will turn the aircraft away from the station rather than towards it. When tracking with the blue area on the left, the switch must be positioned on BLUE LEFT. The direction switch does not cause reversed course indicator indication. For omni-range operation, the switch is normally in the BLUE RIGHT position.

During cross-wind condition, the crab angle will show up as the difference between the heading selector and the omni bearing selector settings after stabilization of the autopilot is obtained.

The autopilot information during omni-range operation is dependent upon the aircraft's heading, the setting of the heading selector, and the omni bearing selector settings. The omni bearing selector is not connected in the circuit during VAR operation. It is difficult to obtain intelligent indication from the autopilot when the auto approach selector switch is in RANGE position while the aircraft is on the ground unless the aircraft heading, heading selector, and the omni needle are approximately the same.

Operating Limits.

All specifications given are maximum and are measured from the normal level flight reference position.

On Autopilot.

Bank...45 DEGREES.

Climb and descent...........................18 DEGREES.

Altitude control........
6 DEGREES (APPROXIMATELY). CAN BE REDUCED TO MEET ANY AIRCRAFT CHARACTERISTICS.

Aileron trim......................8 DEGREES BANK IN EITHER DIRECTION.

On Manual Control.

GYRO TILT...............85 DEGREES IN EITHER DIRECTION FROM OPERATING LEVEL POSITION BEFORE HITTING STOPS.

Automatic Range.

Bank...10 DEGREES.

Automatic Approach — Localizer.

Bank...25 DEGREES.

Automatic Approach — Approach.

Bank...10 DEGREES.

Climb and descent........................... 5 DEGREES.

NAVIGATION EQUIPMENT.

Periscopic sextants are installed on all aircraft. The following procedure includes only the information that is pertinent to this particular aircraft. For more complete information on the alignment of the periscopic sextant mount, see the applicable equipment handbook.

A. Select the point of antenna connection at the top center portion of the leading edge of the vertical stabilizer, and crank the azimuth counter to read 180.4 degrees.

B. When sighting on the object described above, the vertical reticle, target, and 0 degrees (or N) on the azimuth scale should coincide within ¼ degree, and the azimuth counter should have the reading of 180.4 degrees previously set in.

Driftmeters are installed on AF51-3818 through AF51-3835, AF51-17626 through AF51-17661, AF51-17667, and AF51-17668 in the navigator's compartment aft of the copilot's bulkhead. The driftmeter is used by the navigator while the aircraft is in flight, to measure both drift and azimuth. The instrument makes it possible to obtain direct indications of drift or the angle between the actual direction of motion of the aircraft and its heading, the relative bearing angle of a fixed object on the earth, and data for calculating ground speed.

DRIFTMETER ALIGNMENT.

The driftmeter is aligned as follows:

A. With the caging knob in the CAGED position, apply 115 volts a-c to the driftmeter, and place the toggle switch in the ON position.

B. Depress the starting button and hold it in for approximately 1 minute.

C. Allow at least 5 minutes for the gyro to erect.

D. By rotating the tangent screw and sight control handle, sight on the UHF antenna on AF51-3818 through AF51-3835, AF51-17626 through AF51-17661, AF51-17667, and AF51-17668.

E. Uncage the gyro by pulling out the caging knob and moving it as far as it will go toward UNCAGED.

F. With the target centered on the grid lines, tighten the driftmeter to the mount.

G. Again sight the target and note that the driftmeter azimuth scale reads 182 ($\pm\frac{1}{2}$) degrees on AF51-3818 through AF51-3835, and 190 ($\pm\frac{1}{2}$) degrees on AF51-17626 through AF51-17661, AF51-17667, and AF51-17668.

H. When the target and grid lines are aligned as described above, and the driftmeter azimuth scale does not read the correct azimuth, proceed as follows:

I. Make certain that the driftmeter is tightened on the mount and again sight through the driftmeter to assure that the target and grid lines are properly aligned.

J. Loosen the screws securing the index pointer to the rotating tube.

K. Set the lubber line of the index pointer to read the proper azimuth reading as outlined in step G.

L. Retighten the index pointer screws, cage the gyro, and move the toggle switch to the OFF position.

AUXILIARY POWER UNIT (D-2).

On some aircraft, an auxiliary power unit is installed in the lower forward cargo compartment *(28, figure 1-3)* to provide a source of additional electrical power independent of a ground power supply. The auxiliary power unit is provided primarily for ground operation only, and is a 2-cylinder, 4-cycle, V-type gasoline engine with a muffler and a self-contained oil supply system which has a capacity of 3 quarts. Fuel is supplied from the No. 2 main fuel tank. The engine will supply, at constant speed, an electrical output of 0 to 5 kilowatts (0 to 175 amperes at 28.5 volts).

AUXILIARY POWER UNIT CONTROLS (D-2).

Auxiliary Power Unit Throttle Control (D-2).

The auxiliary power unit carburetor is controlled by a mechanical 3-position control located below the auxiliary power unit control panel *(figure 4-28, sheet 1)*. The positions are CHOKE, IDLE, and RUN. The CHOKE position is used as the starting position. The IDLE position is used after the power plant has started to provide a slower warmup rpm. The RUN position is used after the engine has warmed up thoroughly (approximately 5 minutes) to provide maximum power output.

Note

Operation of the CHOKE can best be determined by experience. Little or no choke will be necessary above 10°C.

Auxiliary Power Unit Ignition Switch (D-2).

A 2-position ignition switch is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1)*. The switch positions are ON and OFF and are conventional in operation.

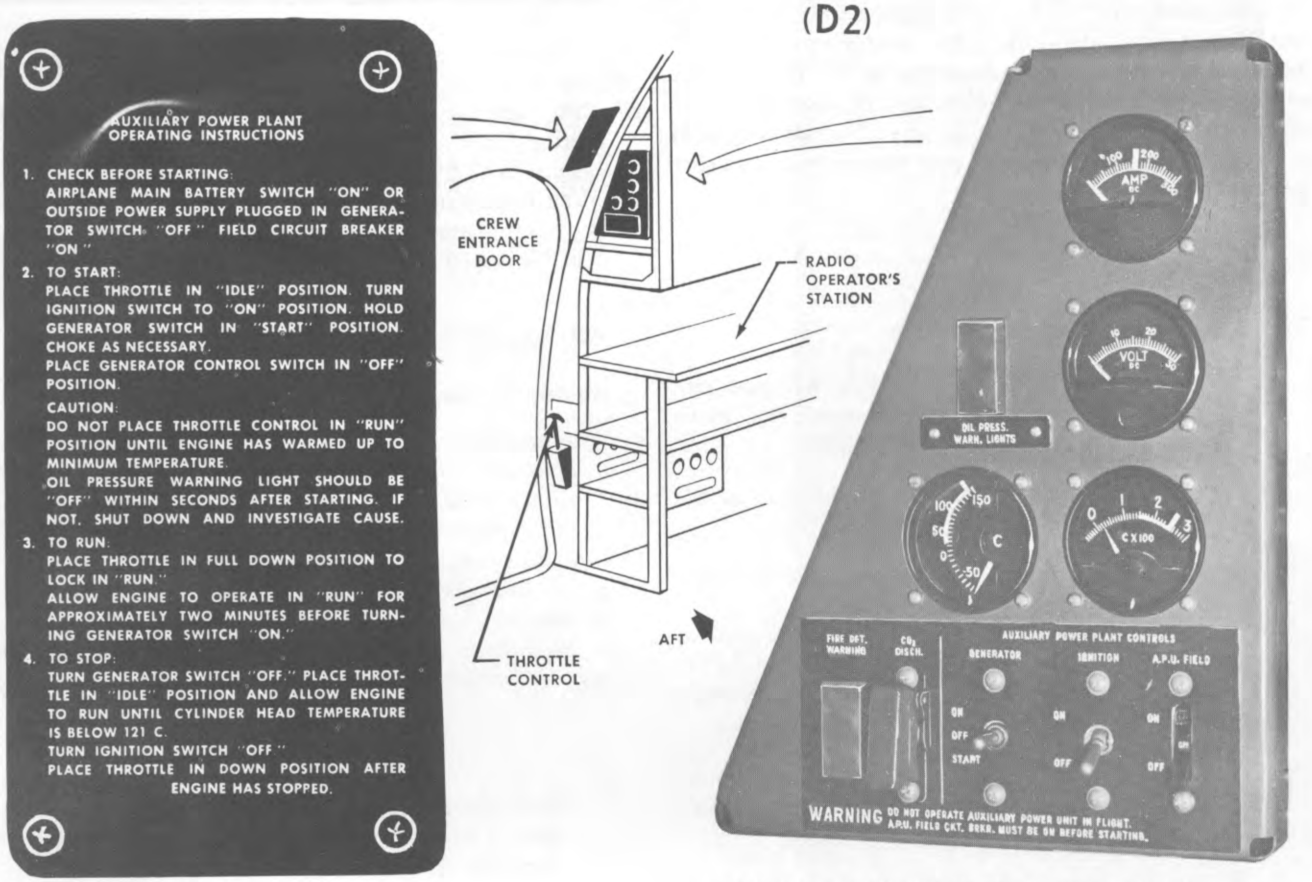
Auxiliary Power Unit Starter and Generator Switch (D-2).

A 3-position combination starter and generator switch is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1)*. The generator serves the dual purpose of starter and generator. The spring-loaded START position causes the generator to function as a starter. The ON position produces generator functioning. The center position is the OFF position. The auxiliary power unit may be started by power supplied from the aircraft batteries.

Auxiliary Power Unit Circuit Breaker (D-2).

A generator field circuit breaker is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1)*, and must be set to ON before starting the auxiliary power unit.

AUXILIARY POWER UNIT CONTROL PANEL



PLACARD

AUXILIARY POWER UNIT PLANT PANEL

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Figure 4-28 (Sheet 1 of 4)

Auxiliary Power Unit Hand Cranking (D-2).

The auxiliary power unit can be hand cranked with a pull cord that fits into a notched and grooved pulley on the engine flywheel. Operation of the auxiliary power unit controls is identical for both electrical and manual starting. The pull cord is stowed on the auxiliary power unit mounting platform *(28, figure 1-3).*

Auxiliary Power Unit Oil Temperature Gage (D-2).

An oil temperature gage is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1).*

Auxiliary Power Unit Cylinder Head Temperature Gage (D-2).

A cylinder head temperature gage is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1).*

Auxiliary Power Unit Oil Pressure Warning Light (D-2).

An oil pressure warning light is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1).* If the light does not go out a few seconds after the auxiliary power unit has started, shut down and investigate.

Auxiliary Power Unit Ammeter (D-2).

A d-c ammeter is mounted on the auxiliary power unit panel *(figure 4-28, sheet 1).*

Auxiliary Power Unit Voltmeter (D-2).

A d-c voltmeter is mounted on the auxiliary power unit control panel *(figure 4-28, sheet 1).*

Starting Auxiliary Power Unit (D-2).

Before starting the auxiliary power unit, make certain that either the main battery switch is ON or external power is plugged in, that the APU generator switch is OFF, and that the APU field circuit breaker is ON.

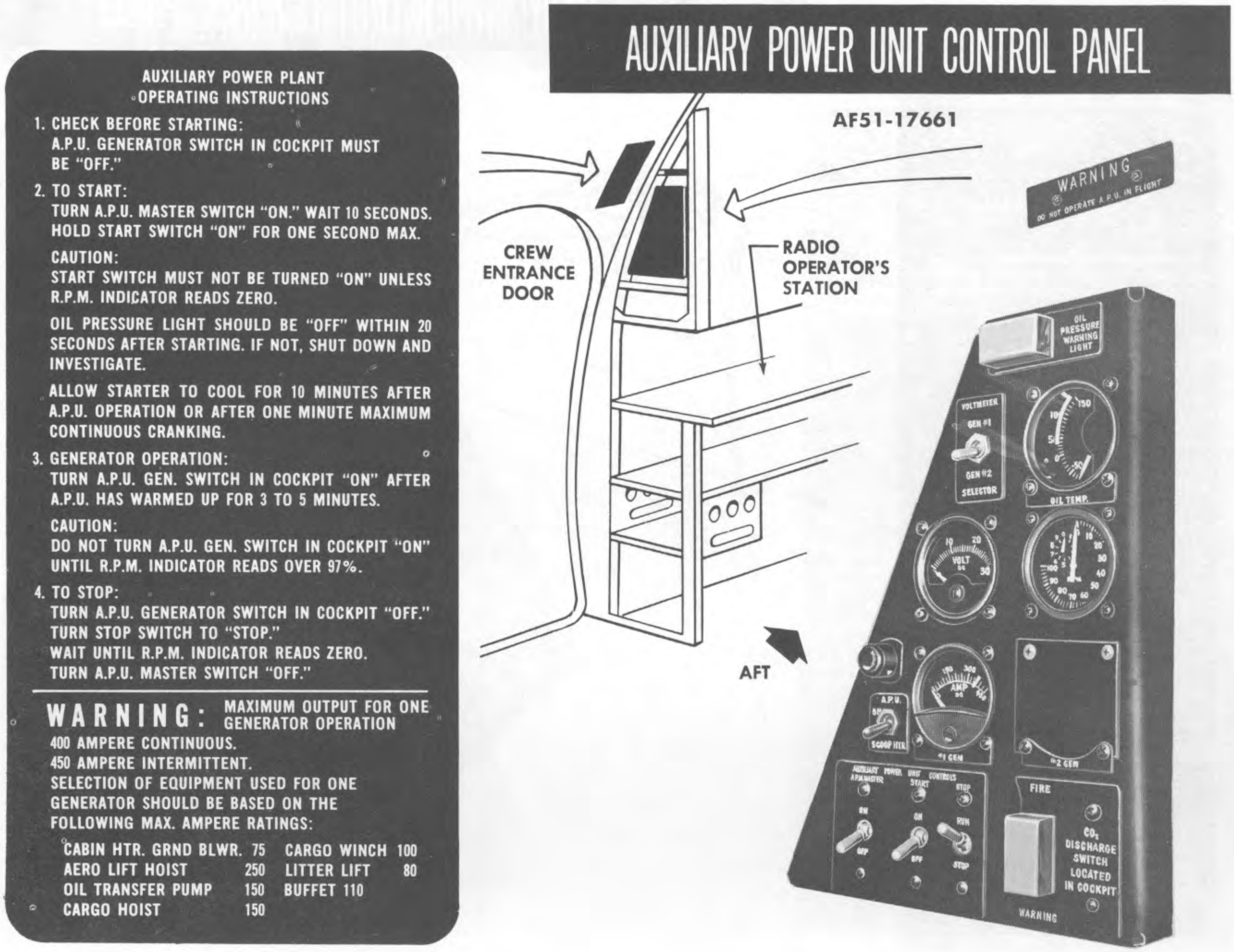

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Figure 4-28 (Sheet 2 of 4)

Use the following procedure to start the APU.

A. APU throttle – CHOKE.

B. APU ignition switch – ON.

C. APU generator switch – HOLD IN START.

D. APU generator control switch – OFF.

Note

Operation of the CHOKE can best be determined by experience. Little or no choke will be necessary above 10°C.

E. APU throttle – IDLE AFTER ENGINE STARTS, EXCEPT FOR STARTS AT ALTITUDE, WHEN THROTTLE SHOULD BE PLACED IN THE RUN POSITION. CONSISTENT STARTS UNDER LOAD CANNOT BE MADE AT ALTITUDES OVER 5500 FEET.

CAUTION

Do not place the throttle in Run position except for altitude starts, until the engine has warmed up to minimum temperature. The oil pressure warning light should be OFF within seconds after starting; if not, shut down and investigate.

TO OPERATE AUXILIARY POWER UNIT (D-2).

Use the following procedure to operate the APU:

A. Place APU throttle in the full down position to lock in the RUN position.

B. Allow APU to operate in RUN position for approximately 2 minutes before turning the generator switch ON.

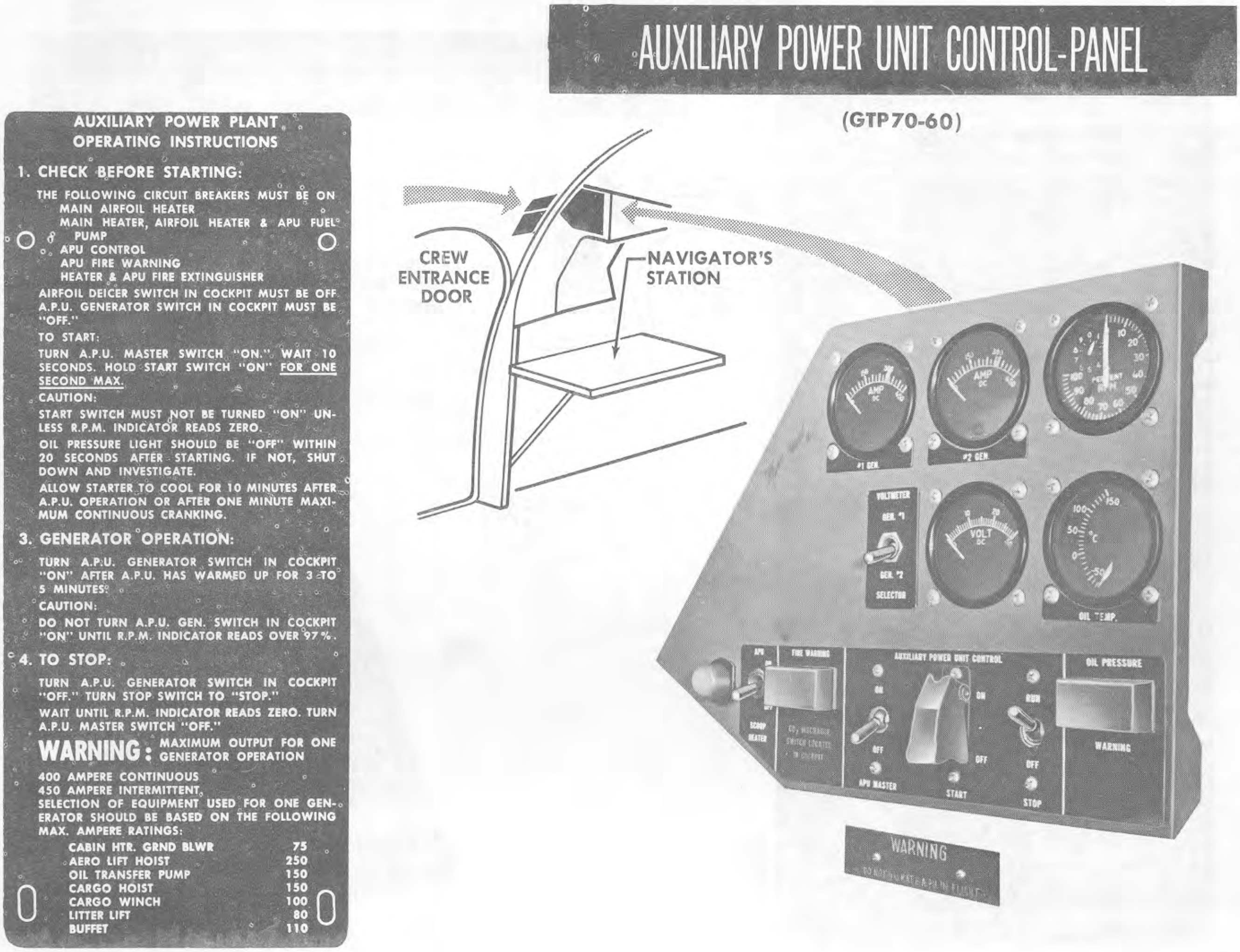

Figure 4-28 (Sheet 3 of 4)

TO STOP AUXILIARY POWER UNIT (D-2).

Use the following procedure to stop the APU:

A. APU generator switch – OFF.

B. Place the throttle in the IDLE position and allow engine to run until the cylinder head temperature is below 121°C.

C. APU ignition switch – OFF.

D. Place the throttle in the DOWN position after the engine has stopped.

MANUAL STARTING OF AUXILIARY POWER UNIT (D-2).

The auxiliary power unit can be started by hand by means of a pull cord if electrical power is not available to make a normal start.

AUXILIARY POWER UNIT (GTP70)

On some aircraft, an auxiliary power unit is installed in the fuselage tail section, aft of the pressure dome *(19, figure 1-3)* to provide a source of electrical power on the ground. The auxiliary power unit is an automatically controlled, gas turbine-powered source of constant speed power, used to drive and cool two aircraft-type generators. Fuel is supplied from the No. 3 main fuel tank; fuel consumption at normal rated power (70 horsepower) is approximately 97.5 pounds per hour. The maximum output for each generator is 350 amperes at 28 volts.

AUXILIARY POWER UNIT CONTROLS (GTP70).

Auxiliary Power Unit Master Switch (GTP70).

An ON-OFF auxiliary power unit master switch is mounted on the auxiliary power unit control panel and is placarded APU MASTER *(figure 4-28, sheets 2, 3, and 4)*.

AUXILIARY POWER UNIT CONTROL PANEL

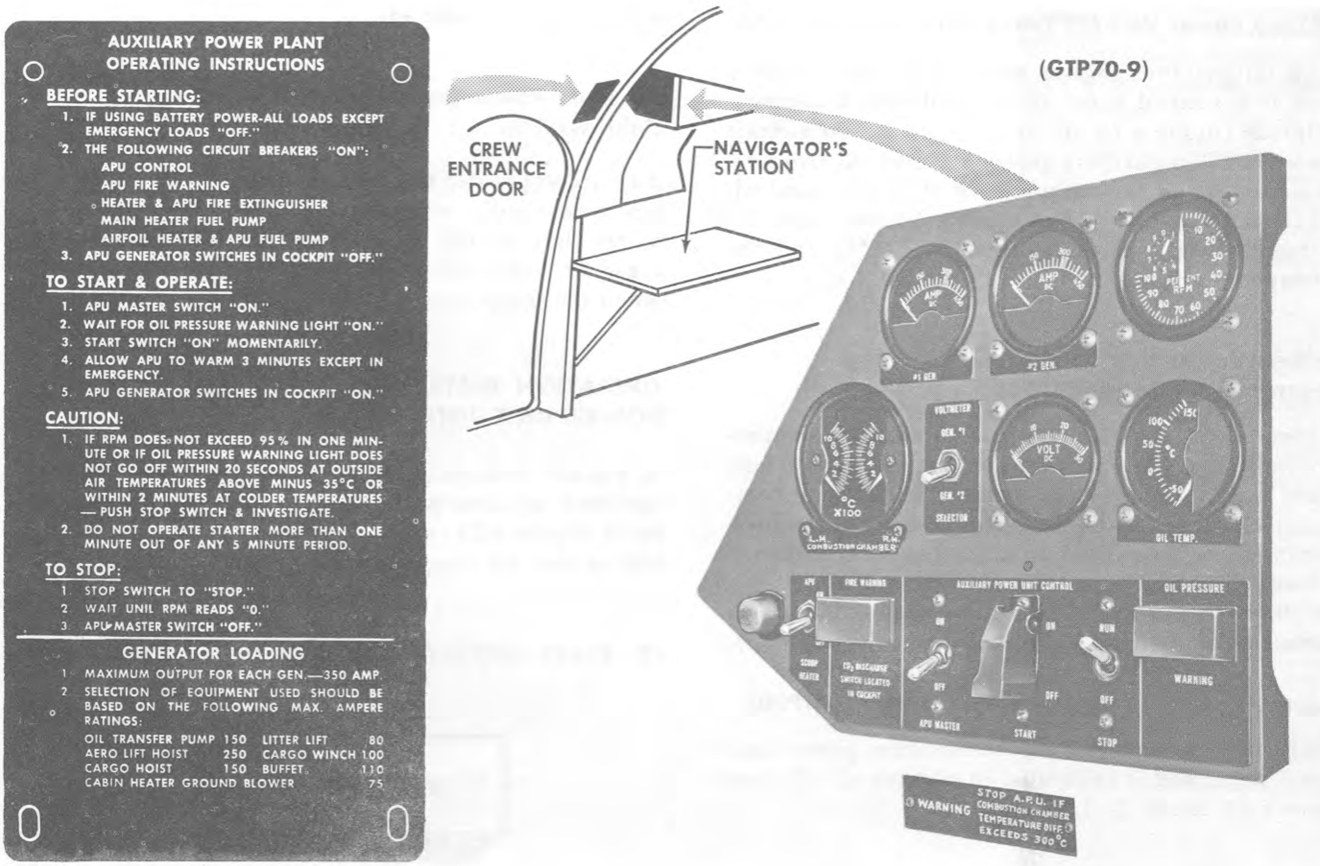

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Figure 4-28 (Sheet 4 of 4)

Auxiliary Power Unit Start Switch (GTP70).

A guarded ON-OFF auxiliary power unit START switch is mounted on the auxiliary power unit control panel. It is spring loaded to the OFF position *(figure 4-28, sheets 2, 3, and 4)*.

Auxiliary Power Unit Stop Switch (GTP70).

An auxiliary power unit STOP switch is mounted on the auxiliary power unit control panel. It is spring loaded to the RUN position *(figure 4-28, sheets 2, 3, and 4)*.

Auxiliary Power Unit Scoop Heater Switch (GTP70).

An ON-OFF auxiliary power unit scoop heater switch is mounted on the auxiliary power unit control panel, and is placarded APU SCOOP HTR *(figure 4-28, sheets 2, 3, and 4)*.

Auxiliary Power Unit Voltmeter Selector Switch (GTP70).

A 2-position VOLTMETER SELECTOR switch is mounted on the auxiliary power unit control panel, and has the positions GEN #1 and GEN #2. On some aircraft, provisions for only the GEN #2 position are installed.

Auxiliary Power Unit Generator Switch (GTP70).

On some aircraft, an ON-OFF auxiliary power unit generator switch is mounted on the aft right corner of the forward overhead panel, and is placarded GEN #1. Provisions are made for a GEN #2 switch, and an APU GENERATOR CUTOFF bar is installed so the two switches may be cut off simultaneously.

On some aircraft, two generator ON-OFF switches for the auxiliary power unit are mounted on the forward overhead panel adjacent to the four generator control switches. A gang bar is installed to cut off the four generator control switches, the two auxiliary power unit generator switches, and the battery master switch, simultaneously.

Auxiliary Power Unit Oil Temperature Gage (GTP70).

An oil temperature gage is mounted on the auxiliary power unit control panel and is calibrated in degrees centigrade *(figure 4-28, sheets 2, 3, and 4)*. On aircraft with a GTP70-6 auxiliary power unit, an oil temperature limit card for various grades of oil is also installed. On aircraft with a GTP70-9 auxiliary power unit, the oil temperature gage is red-lined at 124°C, and the oil temperature limit card is not installed.

Auxiliary Power Unit Combustion Chamber Temperature Indicator (GTP70).

On some aircraft, a dual combustion chamber temperature indicator is mounted on the auxiliary power unit control panel and gives the temperature of each combustion chamber in degrees centigrade. The temperature indicator provides indication that both chambers are firing. If at any time after start there is a temperature difference of over 300°C between combustion chambers, the APU must be shut down immediately.

Auxiliary Power Unit Tachometer Indicator (GTP70).

A tachometer is mounted on the auxiliary power unit control panel and is calibrated in percent of full rpm *(figure 4-28, sheets 2, 3, and 4)*.

Auxiliary Power Unit Voltmeter (GTP70).

On some aircraft, a d-c voltmeter is mounted on the auxiliary power unit control panel to indicate the voltage output when the voltmeter selector switch is in the GEN #1 position only. On some aircraft, the d-c voltmeter indicates the voltage output of either generator when the voltmeter selector switch is positioned to the respective generator.

Auxiliary Power Unit Ammeter (GTP70).

On some aircraft, a d-c ammeter is mounted on the auxiliary power unit control panel to indicate the amperage output of the generator. On some aircraft, two d-c ammeters are mounted on the control panel to indicate the amperage output of the two generators *(figure 4-28, sheets 3 and 4)*.

Auxiliary Power Unit Oil Pressure Warning Light (GTP70).

An oil pressure warning light is mounted on the auxiliary power unit control panel *(figure 4-28, sheets 2, 3, and 4)*. The light should go out within 20 seconds after the START switch is energized.

Auxiliary Power Unit Fire Warning Light (GTP70).

A fire warning light is mounted on the auxiliary power unit control panel and is wired in parallel, with a warning light on the heater fire control panel *(figure 4-28, sheets 2, 3, and 4)*.

Auxiliary Power Unit Airscoop Heater on Light (GTP70).

An airscoop heater ON light is mounted on the auxiliary power unit control panel immediately above or to the left of the APU SCOOP HTR switch *(figure 4-28, sheets 2, 3, and 4)*. This light illuminates when the scoop heater is ON.

OPERATION INSTRUCTIONS FOR AUXILIARY POWER UNIT (GTP70).

A placard containing brief operation instructions is mounted adjacent to the auxiliary power unit control panel *(figure 4-28, sheets 2, 3, and 4)*. The following instructions are supplementary to those on the placard.

TO START AUXILIARY POWER UNIT (GTP70-6).

WARNING

If aircraft APU is equipped with GE2CM82D4 generators, emergency operation only of the GTP70-6 APU is authorized provided an observer is stationed near the APU. If vibration is observed to the extent that visible vibration is being transmitted to the APU support structure and aircraft structure, the unit must be turned OFF immediately.

A. Check that the APU generator switches (located on the forward overhead panel) and the airfoil de-icer switch (located on the heater control panel) are OFF. Position the battery switch to PLANE BATTERY, or to GROUND POWER if the external power source is plugged in.

B. Check that the following circuit heaters are ON:
Main airfoil heater.
Main heater, airfoil heater, and APU fuel pump.

APU control.

APU fire warning.

Heater and APU fire extinguisher.

C. Test the fire warning lights on the heater fire control panel and the auxiliary power unit control panel by pressing the auxiliary power unit test button on the heater fire control panel.

D. APU scoop heater – ON, IF REQUIRED (BELOW FREEZING).

E. Turn ON the APU MASTER switch. Allow 10 seconds for the intake duct door to open.

F. Push the START switch momentarily (not over 1 second) to the ON position. The unit should start and show a constant increase in rpm. Do not turn the START switch ON unless the percent rpm indicator reads zero. Do not hold the START switch ON longer than 1 second. The duty cycle of the starter is 35 seconds ON, 10 minutes OFF. In case of malfunction, or an aborted start, do not exceed these requirements because the starting motor will be damaged. If the duration of the starter operation exceeds 35 seconds, the stop switch should be actuated and the unit allowed to stop; however, if the unit has not been in operation previously for at least 1 hour, three consecutive starts may be made. If additional starts are made, the starter duty cycle must be observed.

G. Note that the oil pressure warning light on the auxiliary power unit control panel goes out within 20 seconds after the START switch is energized.

CAUTION

If the light does not go out within 20 seconds, shut down the unit and investigate.

If the APU does not come up to full speed or slows down when a load is applied, the cause may be that a single combustion chamber is inoperative. The APU should be shut down immediately and the cause investigated.

H. After 3 to 5 minutes of warmup time, turn ON the APU generator switches on the forward overhead panel. In an emergency, it is not necessary to warmup the unit, but do not turn the APU generator switch ON unless the percent rpm indicator shows 97 percent rpm, or more.

TO STOP AUXILIARY POWER UNIT (GTP70-6).

A. Turn the APU generator switches OFF.

B. Momentarily place the STOP switch in the STOP position.

C. Wait until the percent rpm indicator indicates 0.

D. Place the APU MASTER switch in the OFF position.

Note

To facilitate cooling after shutdown, the intake duct door should be kept open for a short period of time. This can be accomplished by waiting for approximately 5 minutes after the speed of the unit reaches zero before turning the APU master switch OFF. This should not be interpreted to mean that such a procedure is necessary in case of a fire. When the auxiliary power unit is selected for fire extinguishing on the heater fire control panel, the intake door is closed simultaneously with shutting down of the unit.

E. If the auxiliary power unit circuit breakers are to be opened, wait approximately 10 seconds in order to insure that the air intake duct door has had time to close.

TO START AUXILIARY POWER UNIT (GTP70-9).

Use the following procedure to start the APU:

A. Check that the APU generator switches (located on the forward overhead panel) and the airfoil deicer switch (located on the heater control panel) are OFF. Position the battery switch to PLANE BATTERY, or to GROUND POWER if external power source is plugged in.

Note

If using PLANE BATTERY, all loads except emergency loads shall be OFF.

B. Check that the following circuit breakers are ON:
APU control.
APU fire warning.
Heater and APU fire extinguisher.
Main heater fuel pump.
Airfoil heater and APU fuel pump.

C. Test the fire warning lights on the heater fire control panel and the auxiliary power unit control panel by pressing in the auxiliary power unit test button located on the heater fire control panel.

D. APU scoop heater – ON, IF REQUIRED (BELOW FREEZING).

E. Turn ON the APU Master switch.

F. Wait until the oil pressure warning light illuminates. This indicates that the air intake door is open.

G. Press the START switch momentarily to the ON position. The unit should start and show a constant increase in rpm. The duty cycle of the generator acting as a starter is 1 minute out of any 5-minute period.

NOTE

Aircraft that have been modified by T.O. 1C-118A-626, the oil pressure warning light will not illuminate until start switch is pressed, and air intake door is open. The start switch must be held on until oil pressure warning light goes off. Do not exceed starter operating limitations.

CAUTION

If rpm does not exceed 95 percent in 1 minute, or if oil pressure warning light does not go off within 20 seconds at outside air temperatures above −35°C (−31°F) or within 2 minutes at colder temperatures, push stop switch and investigate. Do not operate starter more than 1 minute out of any 5-minute period.

WARNING

Stop APU if combustion chamber temperature difference exceeds 300°C.

H. After 3 to 5 minutes of warmup time, turn the generator switches on the forward overhead switch panel to ON.

TO STOP AUXILIARY POWER UNIT (GTP70-9).

Use the following procedure to stop the APU:

A. Generator — OFF.

B. Momentarily place the STOP switch in the STOP position.

C. Wait until the percent rpm indicator reads zero.

D. Place the APU MASTER switch in the OFF position.

Note

To facilitate cooling after shutdown, wait until the speed of the unit reaches zero as indicated on the percent rpm indicator, and, if practical, wait 5 minutes before turning the APU MASTER switch OFF (which closes the air intake door). This should not be interpreted to mean that such a procedure is necessary in case of a fire. When the auxiliary power unit is selected for fire extinguishing on the heater control panel, the intake door is closed simultaneously with shut down of the unit.

E. If the auxiliary power unit circuit breakers are to be opened, wait approximately 10 seconds in order to insure that the air intake door has had time to close.

ENGINE ANALYZER.

On some aircraft, a fixed engine analyzer is installed, while certain other aircraft contain provisions for the use of a portable engine analyzer. The engine analyzer, which permits continuous visual analysis of the power plant during either flight or ground operation, isolates and identifies malfunctions and imminent failures by projecting a series of patterns *(figure 4-29)* on the phosphorescent screen of a cathode ray tube.

ENGINE ANALYZER CONTROLS.

Engine Analyzer Power Switch.

The engine analyzer is controlled by an ON-OFF toggle-type power switch located on the engine analyzer panel when a fixed engine analyzer is provided. When a portable engine analyzer is employed, the power switch is located on the face of the analyzer.

Condition Selector Switch.

The condition selector switch, mounted on the engine analyzer panel (fixed analyzer), and on the face of the analyzer (portable analyzer), chooses an engine and magneto and the kind of pattern (ignition, synchronization, or vibration) to be analyzed.

Cycle Selector Switch.

The cycle selector switch, mounted on the engine analyzer panel (fixed analyzer), and on the face of the analyzer (portable analyzer) chooses the individual spark plug and portion of the complete engine cycle. The push-button at the center of the cycle selector switch, when pulled out, simultaneously displays patterns of all spark plugs in a row on the indicator, starting with any single cylinder selected by the rotary position of the switch. Numbers on the switch dial identify the particular spark plug and positively show the location of any detected trouble in the engine. For vibration analysis, the cycle switch can select only the No. 5 cylinder (all engines) since a vibration pick-up has been installed only on the No. 5 cylinder for all engines.

Engine Analyzer Indicator.

The engine analyzer indicator, mounted on the engine analyzer panel (fixed analyzer), and on the face of the engine analyzer (portable analyzer), shows the exact characteristic patterns of engine operation on a phosphorescent screen, as selected by the condition selector switch.

ENGINE ANALYZER OPERATION.

See figure 4-29.

IGNITION ANALYSIS.

For ignition analysis, the engine analyzer is operated as follows:

Note

Allow approximately 1 minute for the power supply amplifier and the indicator tube to warm up.

A. Engine analyzer power switch — ON.
B. Condition selector switch — PLACE INDEX LINE ON L, R, OR B WITHIN THE IGNITION SECTOR ON THE ENGINE TO BE CHECKED. INDEXING THE DIAL DETERMINES WHETHER THE PATTERN WILL BE FOR THE LEFT, RIGHT, OR BOTH DISTRIBUTORS.

C. Cycle selector switch — ALIGN THE IGN INDEX LINE WITH THE NUMBER OF THE CYLINDER TO BE SHOWN FIRST IN THE SERIES OF PATTERNS FOR ONE DISTRIBUTOR.

D. Cycle switch knob — PULL OUT TO OBTAIN A SLOW SWEEP (720 DEGREES OF CRANKSHAFT ROTATION) COVERING THE IGNITION PATTERNS FOR ALL OF THE CYLINDERS. THE CYLINDER SELECTED BY THE CYCLE SWITCH WILL APPEAR TO THE LEFT ON THE INDICATOR, FOLLOWED BY THE OTHER 17 IN THE ORDER OF FIRING OF THAT DISTRIBUTOR.

E. If all 18 patterns are abnormal during the slow sweep, the malfunction is associated with that portion of the magneto circuit that is common to all 18 ignition circuits. This would indicate magneto or distributor difficulty.

F. If part of the series is abnormal, position the cycle selector switch to bring one of the abnormal patterns to the left side of the screen.
G. Cycle switch knob — PUSH IN FOR A MORE THOROUGH EXAMINATION OF THE EXAMINATION OF THE EXPANDED PATTERN OF ANY ABNORMAL CYLINDER.
H. Repeat the above steps for left and right sides of both distributors for all engines. It is suggested that at slack work periods all ignition patterns be investigated on the fast sweep for malfunctions that may not be observed on the slow sweep.

DISTRIBUTOR SYNCHRONIZATION CHECK.

The distributor synchronization check is made to determine that both distributors simultaneously fire the two plugs in a cylinder. The distributor points are timed to the No. 1 cylinder, and therefore should be checked on the No. 1 reference cylinder. For this check, proceed as follows:

A. Engine analyzer power switch — ON.

B. Condition selector switch — INDEX LINE ON B UNDER THE ENGINE NUMBER TO BE CHECKED.

C. Cycle selector switch knob — PUSH IN FOR FAST SWEEP.

D. Cycle switch — ALIGN THE IGN INDEX LINE WITH THE NO. 1 REFERENCE CYLINDER. THIS SUPERIMPOSES THE IGNITION PATTERN OF THE LEFT AND RIGHT DISTRIBUTORS. IF THE DISTRIBUTORS ARE SYNCHRONIZED, THE PATTERNS COINCIDE AND APPEAR AS ONE; OTHERWISE, THEY OVERLAY AND THE ONE APPEARING TO THE LEFT IS ADVANCED IN RELATION TO THE OTHER. BY MEASURING THE DISTANCE ON THE SCOPE BETWEEN THE POINTS OF BREAKER POINT OPENING, AND ALLOWING 1/32 INCH TO EQUAL 1 DEGREE OF CRANKSHAFT TRAVEL, THE AMOUNT OF SYNCHRONIZATION ERROR MAY BE DETERMINED.

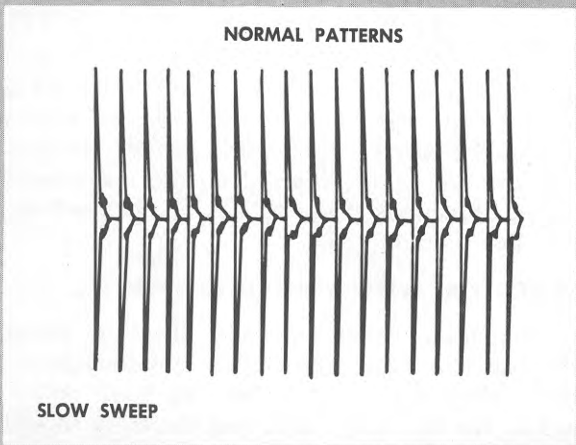
E. Repeat the above procedure for both distributors on each engine.

Two methods are available for determining which distributor, right or left is out of synchronization. The first is as follows:

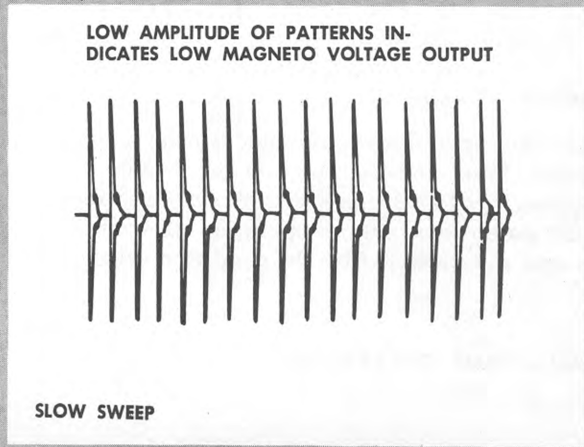
A. Condition selector switch — SET TO R UNDER THE ENGINE NUMBER TO BE CHECKED.

B. Cycle switch knob — IN.

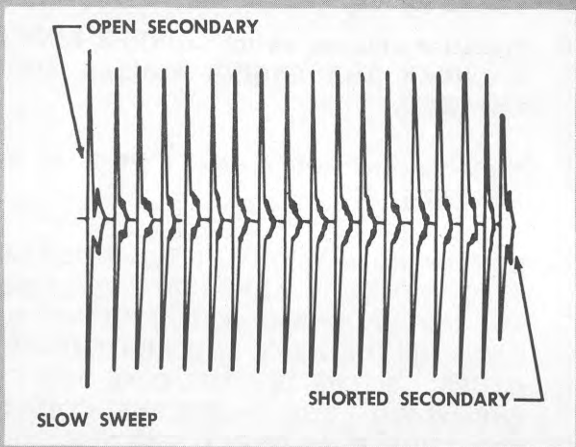
ENGINE ANALYZER



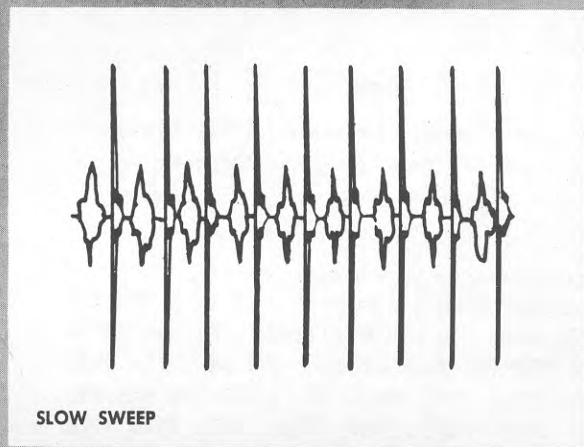
NORMAL PATTERN



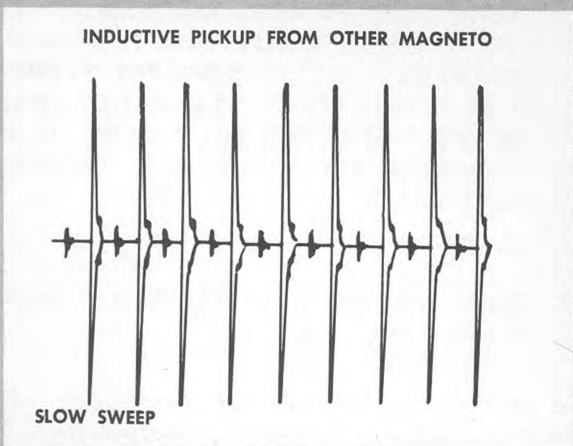
LOW MAGNETO VOLTAGE OUTPUT



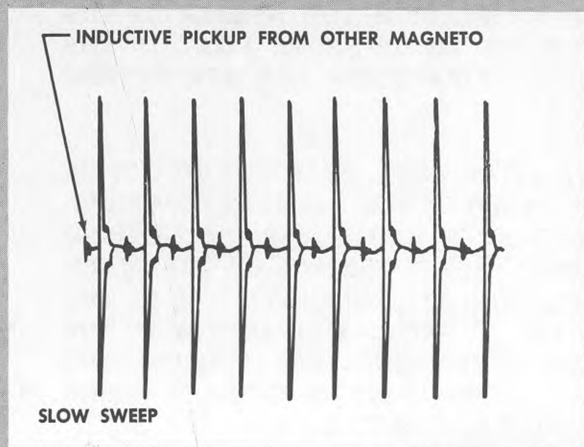
RESULT OF OPEN SECONDARY OF ONE CYLINDER AND SHORTED SECONDARY ON ANOTHER



OPEN PRIMARY IN ONE MAGNETO CIRCUIT



SHORTED PRIMARY IN ONE MAGNETO CIRCUIT



OPEN "P" LEAD, ONE PRIMARY, ONE MAGNETO (L^1 OR L^2 OR R^1 OR R^2)

AA1-163

Figure 4-29 (Sheet 1 of 4)

PATTERNS

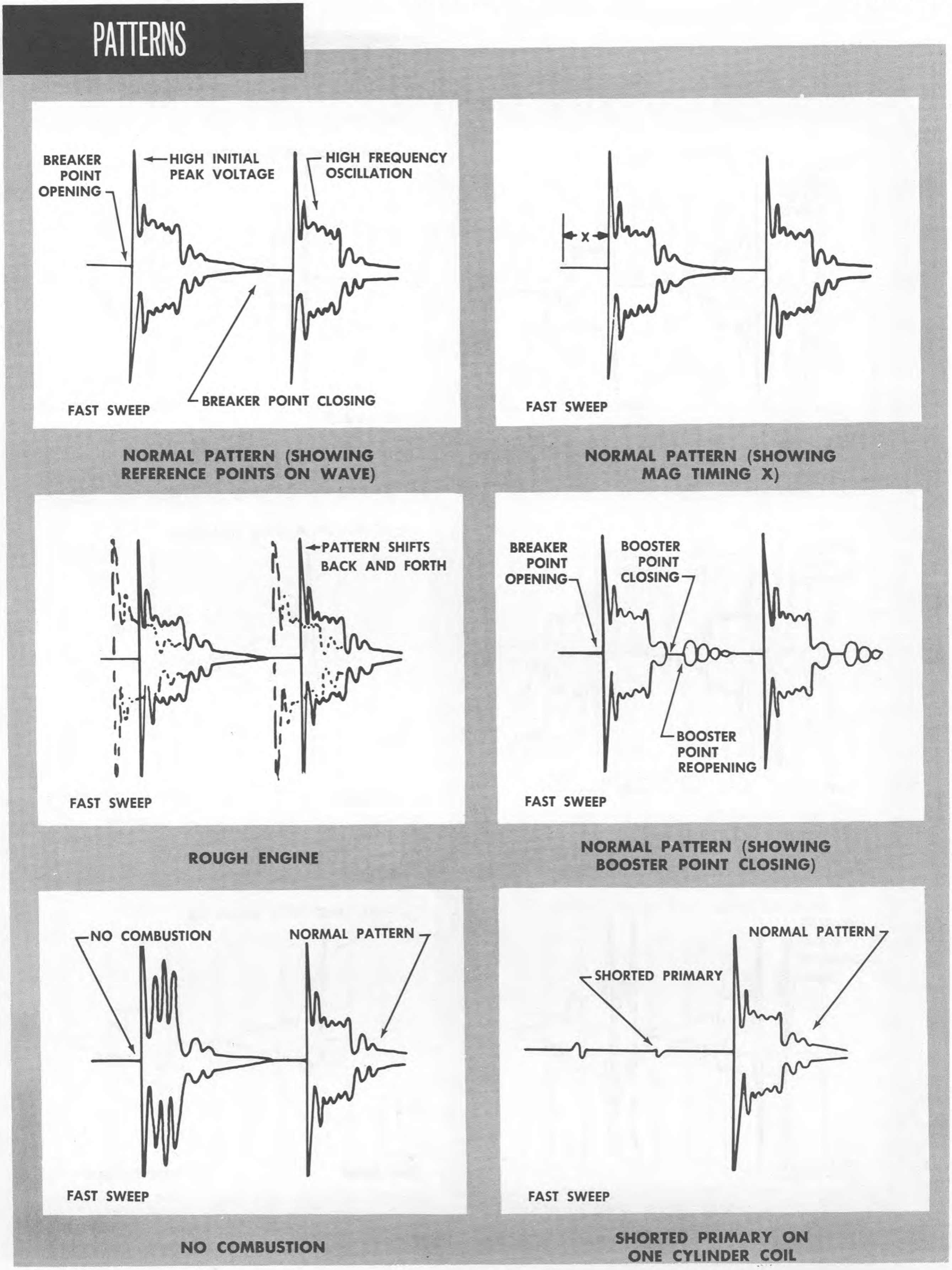
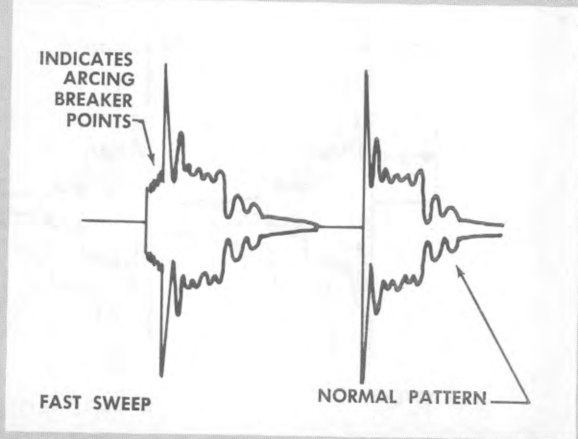
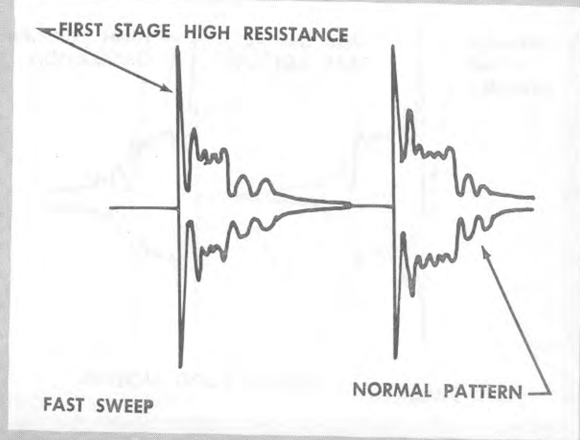


Figure 4-29 (Sheet 2 of 4)

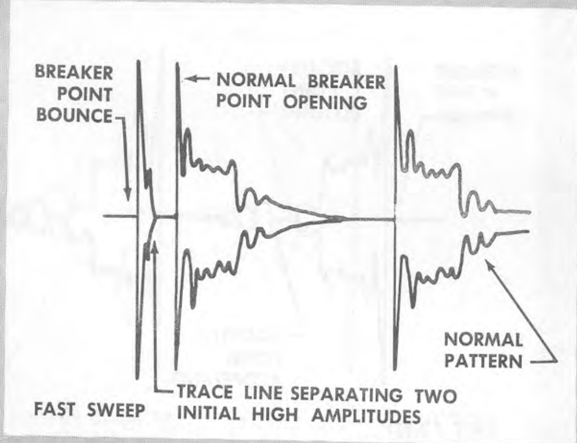
ENGINE ANALYZER



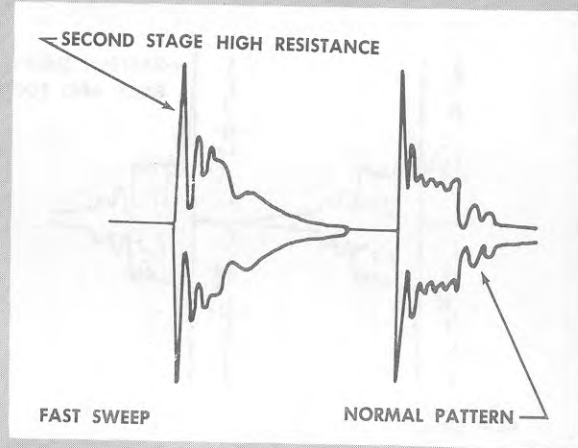
ARCING BREAKER POINTS



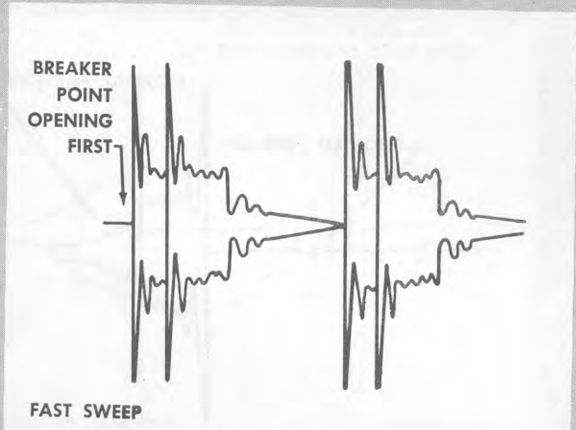
FIRST STAGE HIGH RESISTANCE



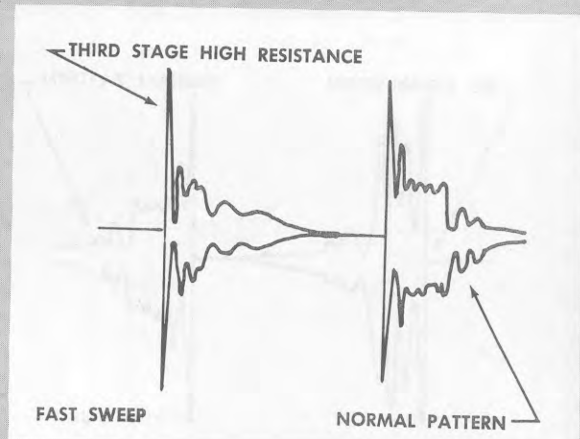
BOUNCING BREAKER POINTS



SECOND STAGE HIGH REISTANCE



INCORRECT BREAKER POINT SYNCHRONIZATION



THIRD STAGE HIGH RESISTANCE

AA1-164

Figure 4-29 (Sheet 3 of 4)

PATTERNS

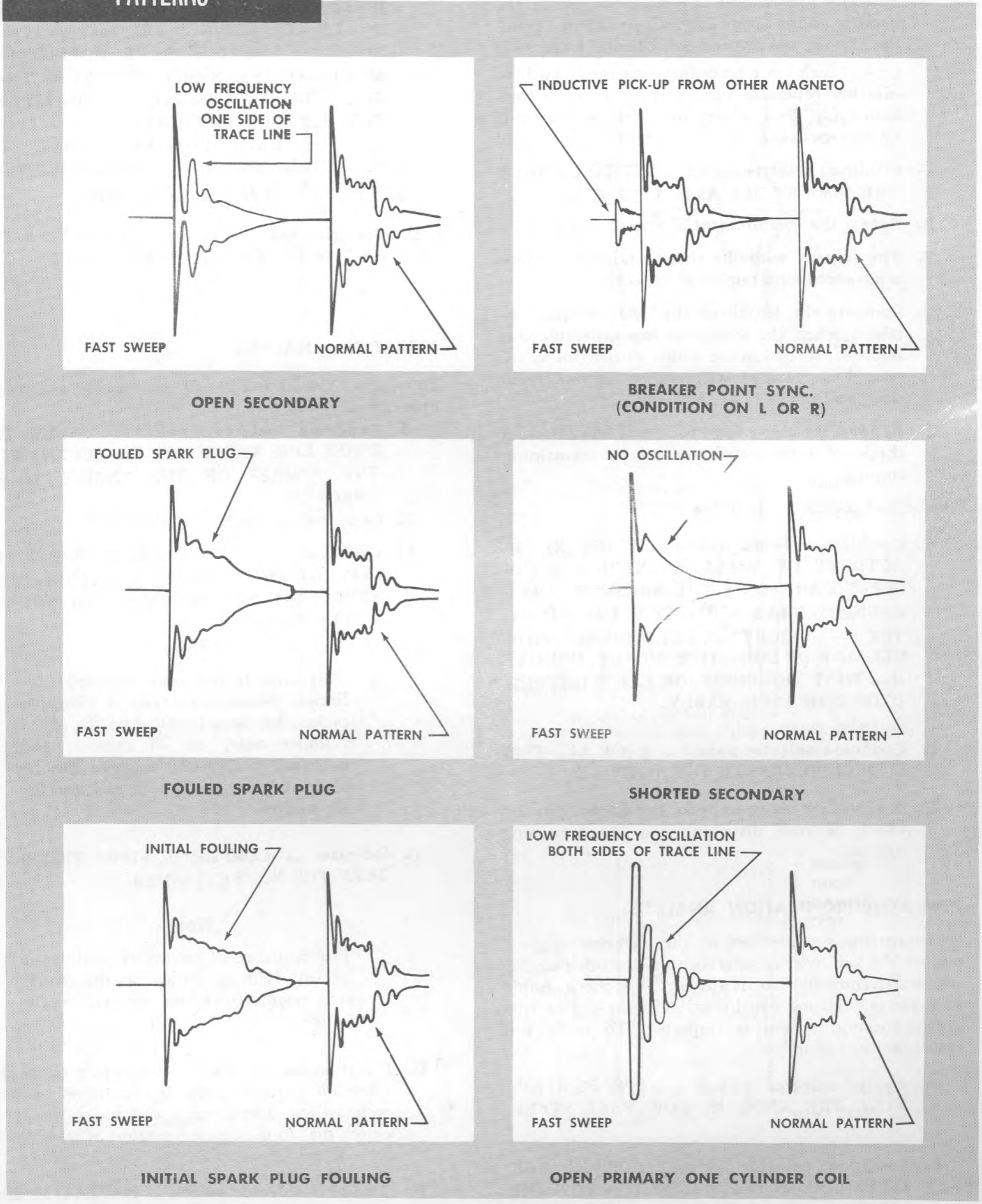


Figure 4-29 (Sheet 4 of 4)

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C. Measure the exact distance between the start of the horizontal trace at the left edge of the indicator screen and the point at which the breaker points open. The No. 1 reference cylinder, being uncompensated, should leave $15/32$ ($\pm 1/32$)-inch trace preceding first pip. (Synchronization generator timing is 34 or 35 degrees before top dead center, and ignition timing is 19 degrees before top dead center.)

D. Condition selector switch — SET TO L UNDER THE SAME ENGINE AS IN STEP A.

E. Repeat the measurement of step C.

F. The pattern with the shorter horizontal trace is advanced with respect to the other.

G. Compare the length of the traces to that obtained when the synchronizing generator was installed, to determine which distributor is advanced or retarded with respect to the crankshaft position.

H. Perform the above steps for the synchronization check of each distributor on the remaining engines.

The second method is as follows:

A. Condition selector switch — L (OR R). IF ACTIVITY OF SMALL MAGNITUDE IS OBSERVED AHEAD OF THE BREAKER POINT OPENING, THAT ACTIVITY IS CAUSED BY THE RIGHT (OR LEFT) DISTRIBUTOR BECAUSE OF INDUCTIVE PICKUP, INDICATING THAT THE RIGHT (OR LEFT) DISTRIBUTOR IS OPENING EARLY.

B. Condition selector switch — R (OR L). THIS SHOULD ELIMINATE THE ACTIVITY.

C. Perform the above steps for the synchronization check of each distributor on the remaining engines.

RPM SYNCHRONIZATION ANALYSIS.

In comparing engine rpm of the different engines, engine No. 1 is used as a reference and the other engine speeds are compared to its speeds. This check should be made at any time a malfunction of the engine rpm synchronization system is suspected. To make this check, proceed as follows:

A. Cycle selector switch — ANY POSITION, WITH THE KNOB IN FOR FAST SWEEP.

B. Condition selector switch — ALIGN THE INDEX LINE IN THE SYN SECTOR WITH THE NUMBER OF THE ENGINE TO BE COMPARED WITH ENGINE NO. 1.

C. Indicator — THE IGNITION PATTERN WILL BE STATIONARY ON THE SCREEN IF THE ENGINES ARE SYNCHRONIZED, AND MOVING IF THE ENGINES ARE NOT SYNCHRONIZED. A PROGRESSIVE HORIZONTAL SHIFT TO THE RIGHT INDICATES THAT THE SELECTED ENGINE IS UNDERSPEED WITH RESPECT TO ENGINE NO. 1; A SHIFT TO THE LEFT INDICATES THAT THE SELECTED ENGINE IS OVERSPEED WITH RESPECT TO THE NO. 1 ENGINE.

D. Condition selector switch — INDEX TO EACH OF THE REMAINING SYN POSITIONS.

VIBRATION ANALYSIS.

For engine vibration analysis, the engine analyzer is operated as follows:

A. Condition selector switch — ALIGN THE INDEX LINE WITHIN THE VIB SECTOR WITH THE NUMBER OF THE ENGINE TO BE CHECKED.

B. Cycle switch knob — PULL OUT.

C. Cycle switch — PLACE THE CYCLE SWITCH DIAL SO THAT THE DESIGNATION EC IS APPROXIMATELY ALIGNED WITH THE NO. 5 CYLINDER.

Note

This aircraft has been equipped for limited vibration analysis. A vibration pickup has been installed on the No. 5 cylinder only, for all engines, and therefore a vibration analysis can be made only on the No. 5 cylinder for all engines.

D. Indicator — COMPLETE VIBRATION PATTERN FOR NO. 5 CYLINDER.

Note

The sequence of events is read from left to right, as shown on the scope, and counterclockwise on the cycle switch.

E. For an expanded pattern of any portion of the vibration pattern, push in the knob on the cycle switch (fast sweep), and index the cycle switch dial to the desired portion of the engine cycle to be inspected for the No. 5 cylinder.

F. Condition selector switch — REPEAT STEPS B THROUGH D FOR THE REMAINING VIB POSITIONS.

FORWARD CARGO DOOR CONTROL PANEL

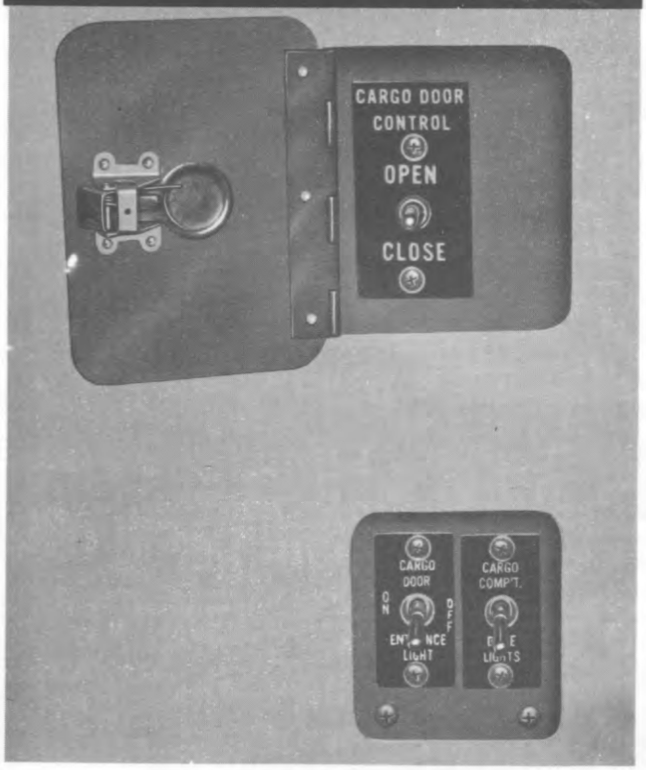

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Figure 4-30

Note

On the assumption that the portable engine analyzer will be used primarily on the ground and for a group of engines having the same number of cylinders, the engine switch and the cylinders-per-engine switch, which require only initial settings, are mounted in a compartment that is shielded by a spring-tensioned door.

SYNCHRONIZATION TIMING CHECK.

Synchronization generator timing should be checked once during each flight. If a spark plug malfunction is discovered on the same engine with a mistimed synchronization generator, it is recommended that this be noted on Form 781. The procedure for checking synchronization generator timing is as follows:

A. Set the condition switch for the desired engine to VIB.

B. Select slow sweep with the cycle switch.

C. Position the EC event opposite cylinder No. 5 with the cycle switch.

D. If the EC event is approximately 1/8 inch from the start of the trace line, the synchronizing generator is properly timed to the engine crankshaft; thus, when ignition analysis is performed, the correct cylinder will appear on the screen in the proper position.

E. Adjust the gain control for pattern height as necessary.

CARGO LOADING EQUIPMENT.

Most aircraft are equipped with hydraulically actuated, electrically operated forward and aft cargo loading doors. The forward cargo loading door is hinged at the top and opens outward. The aft loading door is divided into two sections. The forward section swings outward and forward, providing normal entry into the aircraft, and may be jettisoned. The aft section of the loading door is hinged at the top and opens outward. A hold-open rod is provided for auxiliary support when the aft section of the door is in the loading position. A downward swinging access door is provided on the right side of the aircraft for each lower cargo compartment, and may be opened or closed by external handles installed flush with the outside of each door. Hatches are installed in the fuselage floor to provide internal access to the underfloor compartments.

(For detailed information on cargo loading procedures for this aircraft, see the applicable handbook of cargo loading instructions.)

AFT CARGO DOOR CONTROL PANEL

AA1-147

Figure 4-31

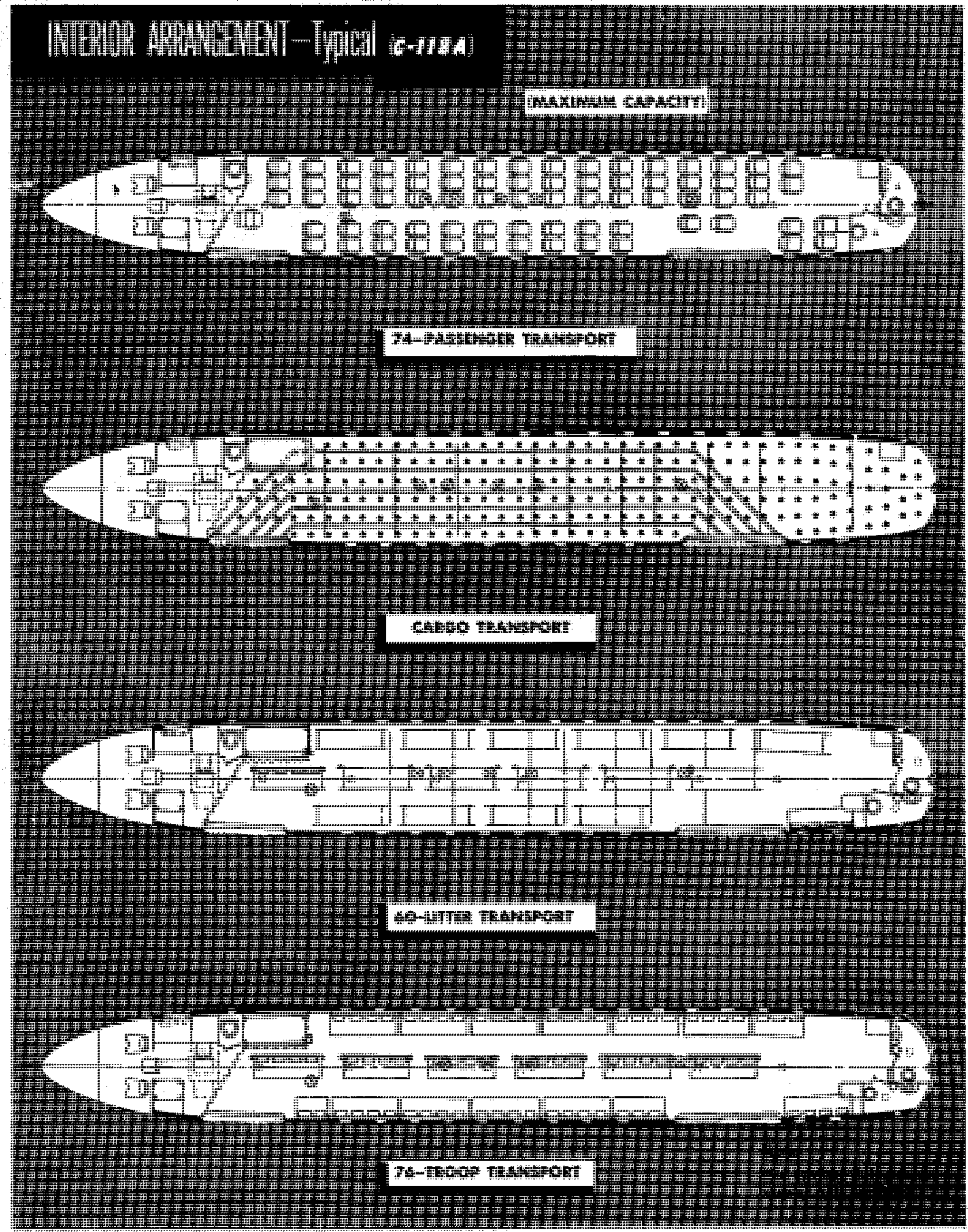

INTERIOR ARRANGEMENT—Typical (C-118A)
(MAXIMUM CAPACITY)
74—PASSENGER TRANSPORT
CARGO TRANSPORT
60—LITTER TRANSPORT
76—TROOP TRANSPORT

Figure 4-32

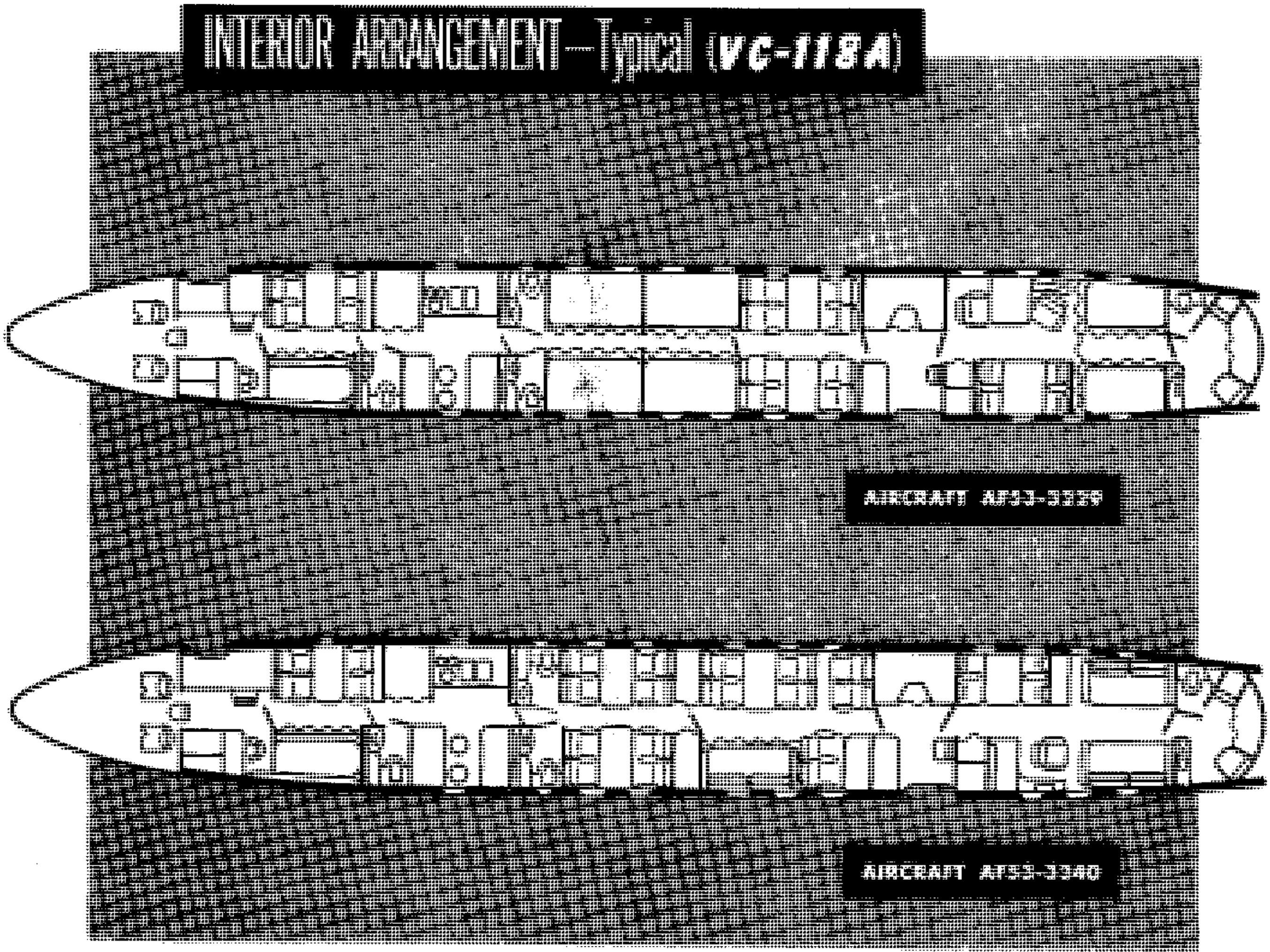


Figure 4-33

CARGO DOOR CONTROLS.

Forward Cargo Door Control.

The hydraulically actuated forward cargo door is controlled by a spring-loaded 2-position switch located on the fuselage wall forward of the door *(figure 4-30)*. The switch positions are OPEN and CLOSE.

Aft Cargo Door Control.

The hydraulically actuated aft loading door (aft section of divided door) is controlled by a spring-loaded 2-position switch located on the fuselage wall forward of the door *(figure 4-31)*. The switch positions are OPEN and CLOSE. The forward section of the door must be in the full OPEN position and latched before the aft section will operate.

TROOP CARRYING EQUIPMENT.

The aircraft may be utilized as a high density personnel transport, and is designed for cargo carrying and troop and ambulance transport *(figure 4-32)*. High-strength floors, and high-strength tiedown fittings in the floor and side walls are installed. Provisions for cargo lifts are installed at both the forward and aft cargo doors. Troop transport and litter fittings are supplied in kit form and stowed in the baggage compartment.

PASSENGER CARRYING EQUIPMENT.

Some aircraft are designed as staff transports and differ from the standard cargo version in the main cabin interior only.

INTERIOR ARRANGEMENT—VC-118A.

Aircraft AF53-3240 is arranged as a staff transport and is provided with a combination day-plane and sleeping compartment, a conference compartment, an aft stateroom, and a galley. Aircraft AF53-3229 is arranged as a staff transport and is equipped with fixed seating for eight passengers, fixed berths for eight passengers, an aft stateroom, and a galley *(figure 4-33)*.

MISCELLANEOUS EQUIPMENT.

CREW'S QUARTERS, FORWARD RIGHT SIDE—Typical

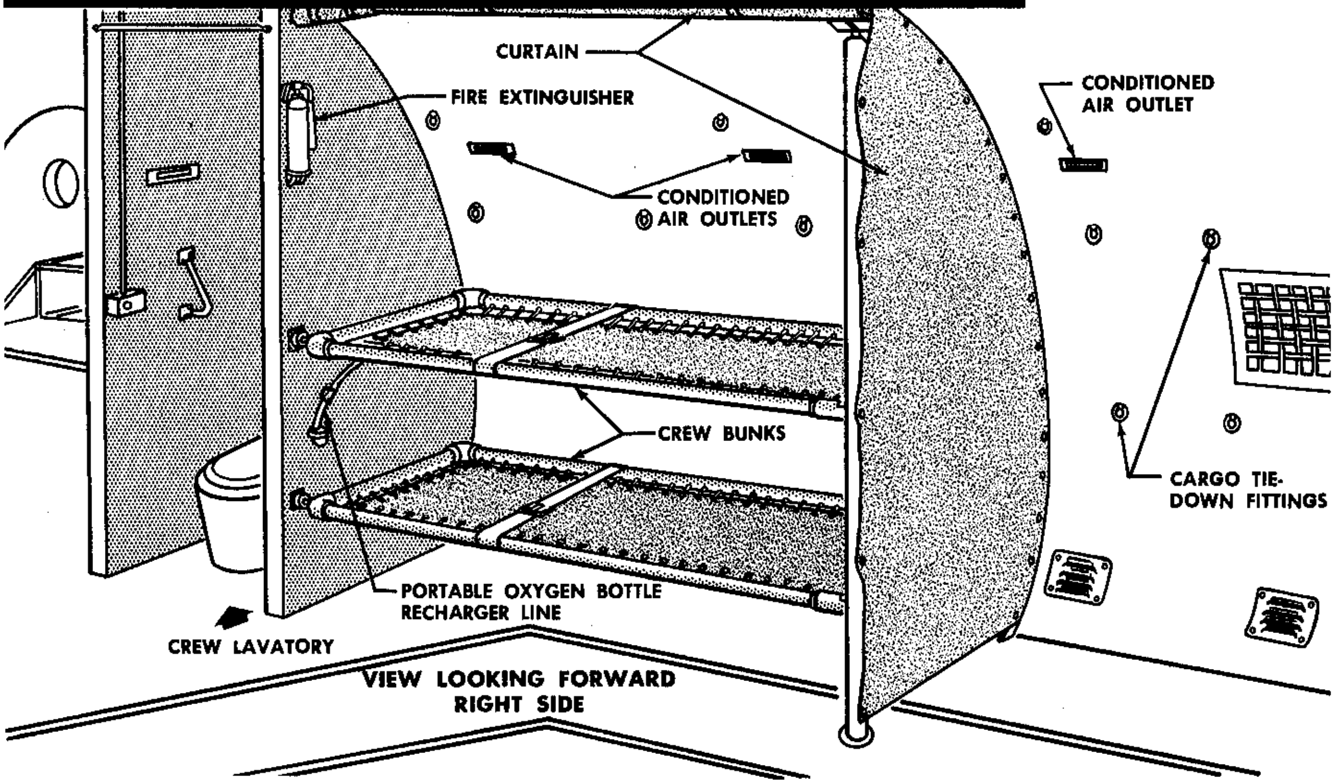


Figure 4-34

CREW'S QUARTERS.

Quarters for the accommodation of the relief crew are provided forward of the main cabin *(figures 4-33, 4-34 and 4-35)*.

Navigator's Seat.

The navigator's seat incorporates a backrest, an upholstered seat cushion, a safety belt, and an adjustable platform for use with the periscopic sextant.

Radio Operator's Seat (If Installed).

The radio operator's seat is the full-swivel type, incorporating a backrest, armrests, a lever to lock the seat and prevent swiveling, and a safety belt.

Briefcase Rack.

Two briefcase racks are installed, one on each outboard side of the pilot's seats.

Pre-Takeoff Warning Systems.

Door-Open Warning Lights. Red warning lights are installed on the cabin pressure control panel *(figure 4-2)* and remain illuminated when any pressurized door is not closed and locked. Each warning light has dual bulbs to provide light in case one bulb goes out.

Ladder.

A folding ladder is provided *(31 figure 1-3)* for entering or leaving the aircraft. This ladder should be used only in case of emergency.

Windshield Wipers.

Two hydraulically actuated windshield wiper units are installed, one on each windshield, and are operated in a synchronized movement. Full or partial stoppage of one windshield wiper blade will not interfere with complete operation of the other. Both blades are controlled by a single-speed control knob mounted to the left of the pilot *(31, figure 1-6)*.

Note

To avoid scratching the windshield, the blades should not be operated when the windshield is dry.

Protective Covers.

Protective covers for the pitot tubes are stowed just inside the rear cargo door *(27, figure 1-3)*.

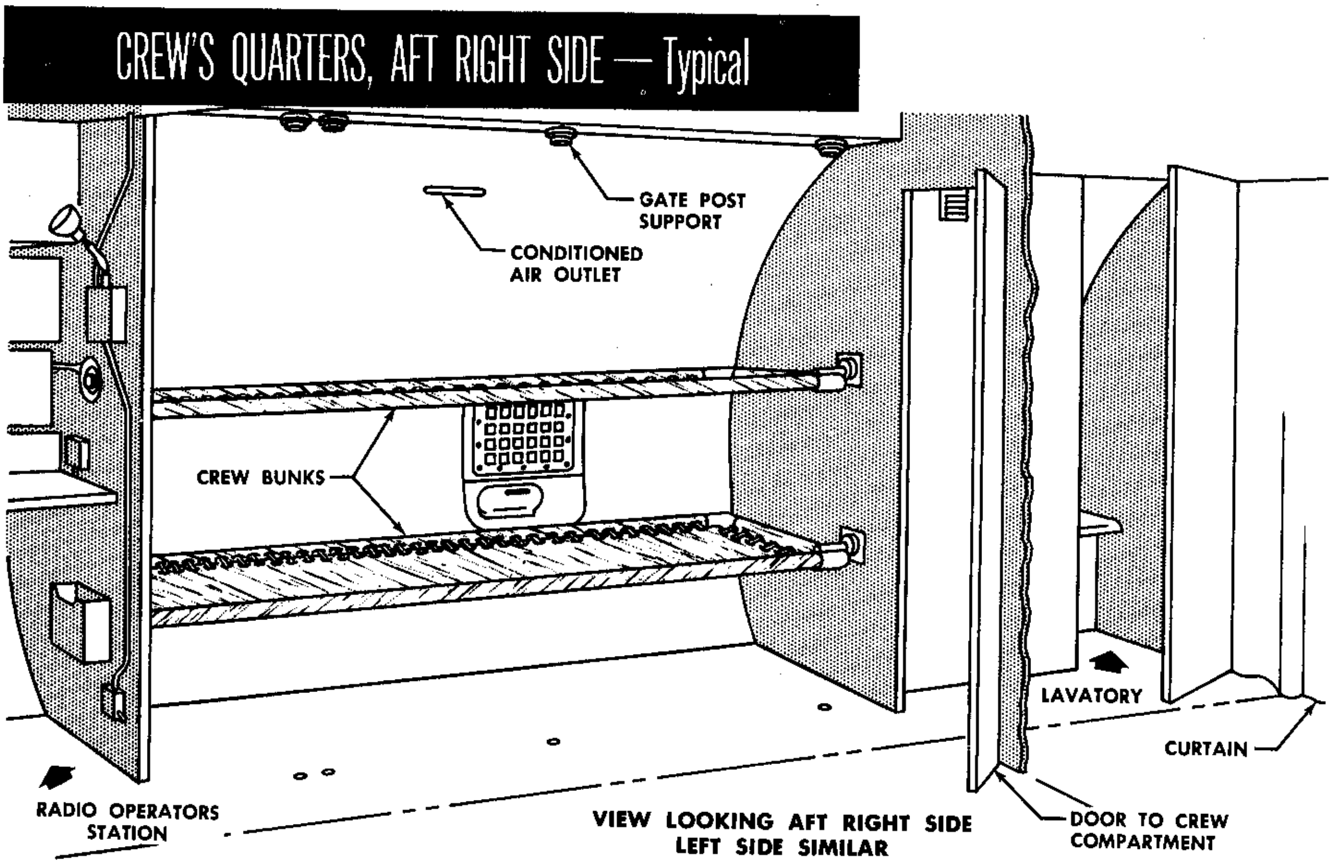


Figure 4-35

WATER SUPPLY.

Main Cabin Water Supply and Disposal System—C-118A.

A 26-gallon water supply tank is installed for washing purposes. *See 15, figure 1-36,* for filler location.

WARNING

Do not dump wash water during flight in below freezing temperatures, as the overflow water could freeze over the auxiliary power unit exhaust.

Wash Water Supply—VC-118A.

Fifty-five gallons of fresh water are supplied for washing and galley sanitary use. The water is heated by thermostatically controlled immersion heaters. Three tanks are furnished; one 15-gallon tank to supply the galley, one 25-gallon tank to supply the lavatories and wash room, and one 15-gallon tank to supply the aft lounge *(8, and 12, figure 1-4)*. A single-point pressure-type filler for the wash water supply system is located inside an access door located on the bottom of the aft edge of the left wing fillet.

Drinking Water Supply—VC-118A.

Each lavatory and washroom is equipped with a 2-quart thermos bottle and paper cup dispenser. Drinking water for the aft lounge and stateroom is provided in a 1-gallon thermos located in the aft lounge.

GALLEY—VC-118A.

Both aircraft are equipped with a galley for the storage and preparation of food. The galley is furnished with a 28-volt d-c stove and oven, an electric refrigerator, an electric toaster, and two outlets for electric hot cups. Dishes and utensils are stowed in the galley cabinets. Circuit breakers placarded for the applicable galley power sources are located on a breaker panel above the stove.

Galley Power Switch—VC-118A.

A galley power switch is installed in the cockpit to deenergize all galley power. The switch is located on the cabin temperature control panel *(figure 4-9)*.

ATTENDANT'S SEAT—VC-118A.

A cabin attendant's seat and stowable table for secretarial use are installed against the aft bulkhead in the passenger entry area. When not in use, the seat folds against the aft bulkhead and the table is stowed in a slot outboard of the folding seat.

UTILITY OUTLETS—VC-118A.

Sixty-cycle, 115-volt a-c outlets are provided for electric shavers in each lavatory and washroom. In addition, there is an outlet in the stateroom and at the radio operator's station for the use of a tape recorder. All 60-cycle outlets are placarded to indicate restrictions as to voltage and use. Power for the 60-cycle circuits is provided by the 60-cycle inverter located in the radio operator's compartment.

60-CYCLE INVERTER—VC-118A.

A 60-cycle, 115-volt a-c inverter is installed at the radio operator's station. The inverter is supplied with 28-volt d-c power from the main bus. A control panel with a three-position rotary switch placarded PASS. COMP., CONF., and STATERM., and a two-position toggle switch placarded NORMAL AND SELECTIVE, is provided to control the output of the inverter. The inverter is automatically energized when the entertainment radio switch is turned ON.

CABIN INSTRUMENTS—VC-118A.

An altimeter, an airspeed indicator, an OAT indicator, and an eight-day clock are installed on the forward left bulkhead of the aft stateroom.

PASSENGER ENTRANCE LADDER—VC-118A.

A folding ladder, operated by a 28-volt d-c motor, is provided at the passenger entrance door. A switch at the aft edge of the door operates the motor. The ladder is stowed on rails in a slot along the inside of the fuselage aft of the door.

SECTION V
operating limitations

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION.

This section includes the engine and aircraft limitations which must be observed during normal operation. Cognizance must be taken of instrument markings, since the limitations stated thereon are not repeated in the text *(figure 5-1)*.

MINIMUM CREW REQUIREMENT.

The minimum crew consists of a pilot and a copilot. Additional crew members, as required, will be added at the discretion of the commander.

INSTRUMENT MARKINGS.

ENGINE POWER INSTRUMENTS.

Refer to figure 5-1 for engine power limitations.

ENGINE LIMITATIONS.

If an engine overspeed condition occurs and the engine exceeds 2950 rpm the engine must be inspected upon landing. If overspeed is in excess of 3400 rpm, the engine must be replaced.

ENGINE OVERBOOST OR EXCESSIVE MANIFOLD PRESSURE.

Overboost above the maximum manifold pressures specified under normal and alternate fuel grade operating limits, this section, is not permitted; however, should overboost occur due to control malfunction, the following limits will apply:

From 5 to 10 inches Hg overboost for 5 to 15 seconds — inspection of engine.

Ten or more inches Hg for any period of time — removal of engine.

Overboost of any magnitude, at or above normal rated power, for periods in excess of 15 seconds — removal of engine.

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 time limitation in the use of METO power.

CARBURETOR AIR TEMPERATURE LIMITATIONS.

LOW BLOWER — Max allowable CAT. (without preheat) 55°C.

LOW BLOWER — Max allowable CAT. (preheat applied) 38°C.

HIGH BLOWER Maximum allowable CAT. 15°C.

Note

When preventive preheat is applied, the maximum carburetor air temperature limit in low blower is 38°C. In high blower the maximum CAT is 15°C; however, this limit has been extended to 30°C for cruise up to 1200 brake horsepower at mixture settings of 12 BMEP drop from best power mixture. It is mandatory that these higher CAT limits in high blower, along with the specified BHP, BMEP and CHT (204°C) limits, not be exceeded. If any of these limits are exceeded, the maximum CAT limit reverts to 15°C.

PROPELLER LIMITATIONS.

Refer to figure 5-1 for normal propeller limitations.

AIRSPEED LIMITATIONS.

Note

Limit markings on the airspeed indicator vary with different C-118A aircraft. On some the limits are for indicated airspeed (IAS), while on others the limits are for equivalent airspeed (EAS), which is also referred to sometimes as true indicated airspeed (TIAS).

The maximum permissible indicated airspeeds (IAS) for AF51-3818 through AF51-3835, AF51-17616 through AF51-17661, AF51-17667, AF51-17668, and AF53-3223 through AF53-3234 are as follows:

Maximum dive speed (V_{ne}) — sea level to 12,000 feet .... 329 knots; above 12,000 feet, reduce speed 5 knots per 1000 feet

Maximum speed for normal operation (V_{no}) — sea level to 17,000 feet .... 246 knots; above 17,000 feet, reduce speed 5 knots per 1000 feet

NORMAL FUEL GRADE OPERATING LIMITS.

The normal operating limits on grade 108/135 or 115/145 fuel are as follows:

Condition	*Rpm*	*Bhp*	*MAX MP (In. Hg)*	**Critical Altitude*	*Bmep*	*MAX CHT.*	*MAX *CAT.*	*Mixture*
Wet Takeoff (5 Minutes) Low Blower	2800 (±25)	2500	62.0 at SL 61.5 at 3800 feet	2600 feet (MP-61.0)	253	260°C	38°C	AUTO RICH
Dry Takeoff (5 Minutes) Low Blower	2800 (±25)	2200	60.0 at SL 59.0 at 5200 feet	4400 feet (MP-57.2)	222	260°C	38°C	AUTO RICH
METO Low Blower	2600	1900	51.5 at SL 50.0 at 7200 feet	7000 feet (MP-48.0)	207	260°C	38°C	AUTO RICH
METO High Blower	2600	1700	50.0 at 10,000 feet 47.5 at 15,900 feet	15,400 feet (MP-46.7)	185	260°C	15°C	AUTO RICH
Maximum Cruise Low Blower	2300	1240	37.3 at SL 33.3 at 15,500 feet	†	153	232°C	38°C	12 Bmep Drop‡
Maximum Cruise High Blower	2300	1200	35.1 at 10,000 feet 34.6 at 22,000 feet	†	147	232°C	15°C	12 Bmep Drop‡

* Critical altitude in climb as determined by flight test.

† Function of gross weight.

‡ With reference to "Best Power" mixtures.
Maximum cruise low blower — 155 bmep (except when at 1240 bhp and 2300 rpm — 153 bmep).

CAUTION

The requirement for 2800 (±25) rpm applies during the takeoff roll only and not during preflight runup or block test.

ALTERNATE FUEL GRADE OPERATING LIMITS.

The operating limits on grade 100/130 fuel are as follows:

Condition	*Rpm*	*Bhp*	*MAX MP (In. Hg)*	**Critical Altitude*	*Bmep*	*MAX CHT.*	*MAX CAT.*	*Mixture*
Wet Takeoff (5 Minutes) Low Blower	2800 (±25)	2400	59.5 at SL 58:5 at 5000 feet	3500 feet (MP-59.0)	242	260°C	38°C	AUTO RICH
Dry Takeoff (5 Minutes) Low Blower	2800 (±25)	1950	53.0 at SL 51.0 at 9800 feet	8200 feet (MP-50.1)	197	260°C	38°C	AUTO RICH
METO Low Blower	2600	1800	48.5 at SL 46.5 at 9200 feet	8700 feet (MP-45.2)	196	260°C	38°C	AUTO RICH
METO High Blower	2600	1700	49.0 at 10,000 feet 47.5 at 15,900 feet	15,400 feet (MP-46.7)	185	260°C	15°C	AUTO RICH
Maximum Cruise Low Blower	2300	1240	37.3 at SL 33.3 at 15,500 feet	†	153	232°C	38°C	12 Bmep Drop‡
Maximum Cruise High Blower	2300	1200	35.1 at 10,000 feet 34.6 at 22,000 feet	†	147	232°C	15°C	12 Bmep Drop‡

* Critical altitude in climb as determined by flight test.

† Function of gross weight.

‡ With reference to "Best Power" mixtures.
Maximum cruise high blower — 150 bmep (except when at 1200 bhp and 2300 rpm — 147 bmep)

CAUTION

The requirement for 2800 (±25) rpm applies during the takeoff roll only and not during preflight runup or block test.

INSTRUMENT LIMIT

HYDRAULIC PRESSURE GAGE

- (red) 3200 PSI MAXIMUM ALLOWABLE
- (green) 2650 TO 3100 PSI NORMAL OPERATING RANGE

FUEL PRESSURE INDICATOR

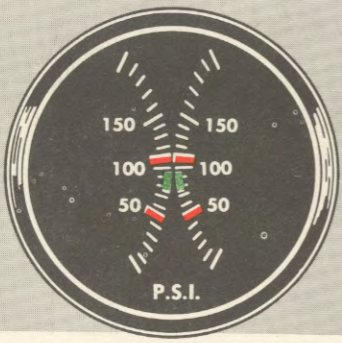
- (red) 25 1/2 PSI MAXIMUM ALLOWABLE
- (green) 22 TO 24 PSI NORMAL OPERATING RANGE
- (red) 14 PSI MINIMUM ALLOWABLE, IDLING

WATER PRESSURE INDICATOR

- (green) 22 TO 24 PSI NORMAL OPERATING RANGE
- (red) 19 PSI MINIMUM ALLOWABLE

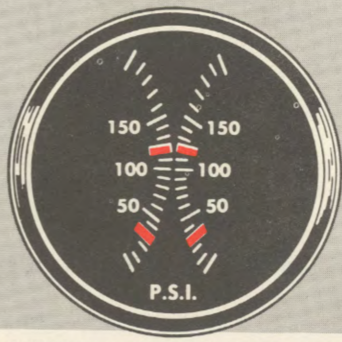
FUEL GRADE

115/145



OIL PRESSURE INDICATOR

- (red) 110 PSI MAXIMUM ALLOWABLE
- (green) 75 TO 95 PSI NORMAL OPERATING RANGE
- (red) 50 PSI MINIMUM ALLOWABLE (FOR 1400 RPM ONLY)



SUPERCHARGER OIL PRESSURE

- (red) 120 PSI MAXIMUM ALLOWABLE
- (red) 30 PSI MINIMUM ALLOWABLE

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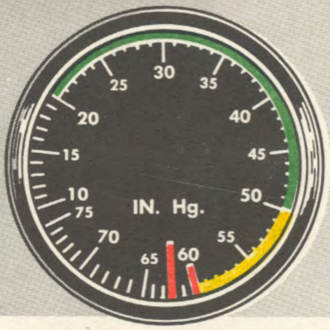
Figure 5-1 (Sheet 1 of 6)

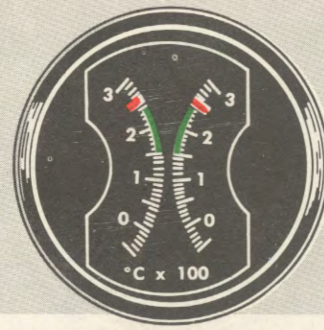
MARKINGS

AF51-3818 THROUGH AF51-3835
AF53-3223 THROUGH AF53-3305



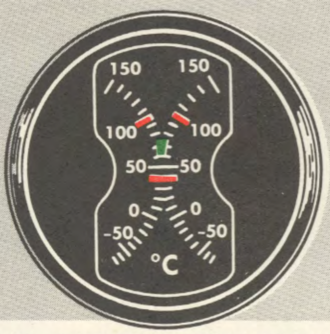
MANIFOLD PRESSURE GAGE

LONG 62 IN. HG. MAXIMUM OPERATING LIMIT (WET)
SHORT 60 IN. HG. MAXIMUM OPERATING LIMIT (DRY)
50 TO 60 IN. HG. LIMITED OPERATION (CAUTION RANGE)
20 TO 50 IN. HG. NORMAL CONTINUOUS OPERATION



CYLINDER HEAD TEMPERATURE INDICATOR

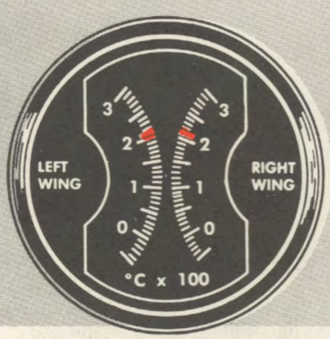
260°C MAXIMUM OPERATING LIMIT
150°C TO 232°C CONTINUOUS OPERATION
190°C TO 200°C DESIRED FOR CRUISE



OIL TEMPERATURE INDICATOR

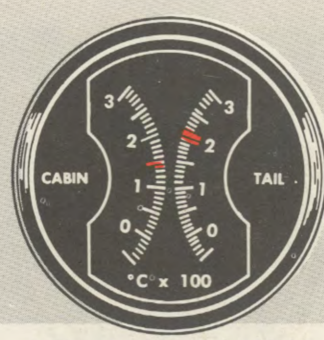
100°C MAXIMUM OPERATING LIMIT
60°C TO 75°C NORMAL CONTINUOUS OPERATION
40°C MINIMUM OPERATING LIMIT

FUEL GRADE
115/145



WING HEATERS TEMPERATURE INDICATOR

210°C MAXIMUM OPERATING LIMIT

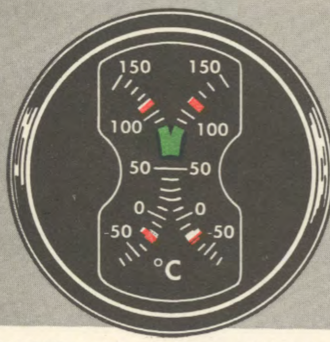


CABIN AND TAIL HEATERS TEMPERATURE INDICATOR

CABIN HEATER 150°C MAXIMUM OPERATING LIMIT
115°C TO 145°C NORMAL
TAIL HEATER 210°C MAXIMUM OPERATING LIMIT

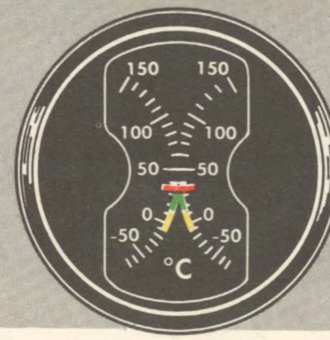
Figure 5-1 (Sheet 2 of 6)

INSTRUMENT LIMIT



SUPERCHARGER OIL TEMPERATURE INDICATOR

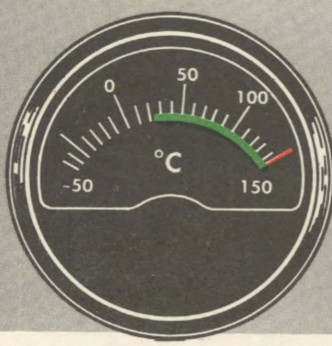
- 110°C MAXIMUM OPERATING LIMIT
- −23°C MINIMUM OPERATING LIMIT
- 60°C TO 80°C NORMAL CONTINUOUS OPERATION



CARBURETOR AIR TEMPERATURE INDICATOR

- +38°C MAXIMUM OPERATING LIMIT
- −10°C TO +15°C LIMITED OPERATION (CAUTIONARY RANGE; DANGER OF ICING)
- NORMAL CONTINUOUS OPERATION

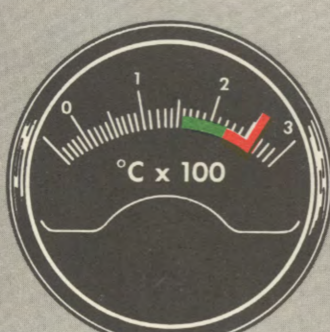
Note:
55°C maximum with low blower and no carburetor heat.



AUXILIARY POWER UNIT OIL TEMPERATURE GAGE

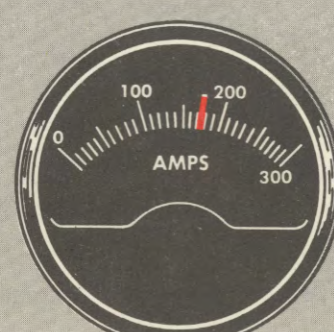
- 146°C MAXIMUM OPERATING RANGE
- 21°C TO 146°C NORMAL CONTINUOUS OPERATING RANGE

FUEL GRADE
115/145



AUXILIARY POWER UNIT CYLINDER HEAD TEMPERATURE GAGE

- 255°C MAXIMUM OPERATING LIMIT
- 220°C TO 255° LIMITED OPERATION (CAUTIONARY RANGE)
- 160°C TO 220°C NORMAL CONTINUOUS OPERATION



AUXILIARY POWER PLANT AMMETER

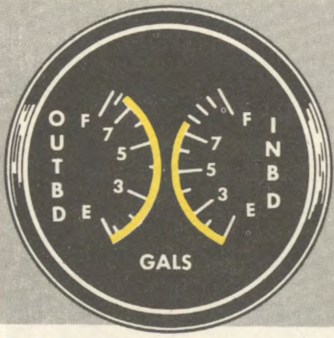
- 175 AMPS MAXIMUM OPERATING LIMIT

AA1-180

Figure 5-1 (Sheet 3 of 6)

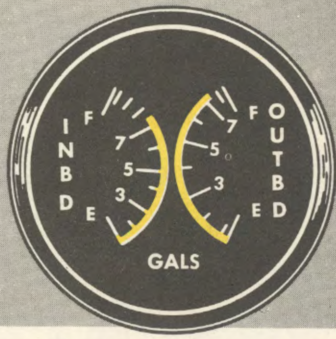
MARKINGS

AF51-3818 THROUGH AF51-3835
AND AF53-3223 THROUGH AF53-3305



**WATER QUANTITY INDICATOR
ENGINES 1 AND 2**

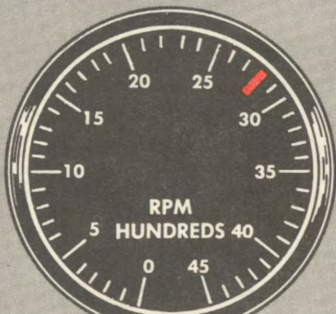
- (yellow) OUTBOARD 0 TO 7.5
- (yellow) INBOARD 0 TO 7.5



**WATER QUANTITY INDICATOR
ENGINES 3 AND 4**

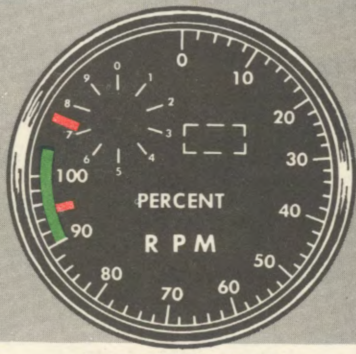
- (yellow) INBOARD 0 TO 7.5
- (yellow) OUTBOARD 0 TO 7.5

**FUEL GRADE
115/145**



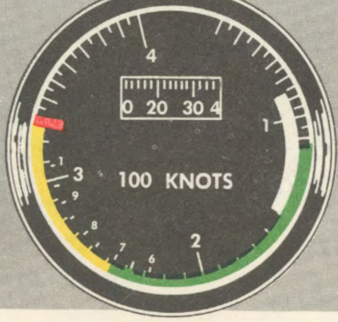
TACHOMETER

- (red) 2800 (±25) RPM MAXIMUM TAKEOFF LIMIT
- 2600 TO 2800 RPM LIMITED OPERATION
- 1400 TO 2600 RPM NORMAL CONTINUOUS OPERATION



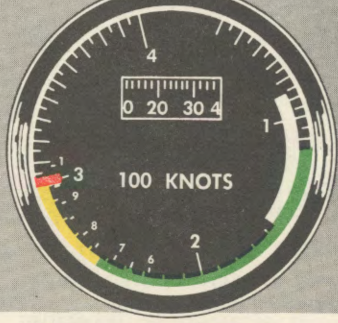
**APU TACHOMETER
(FOR AIRCRAFT WITH GTP70 APU)**

- (green) 90 TO 105% OF RATED RPM
- (red) 95 AND 110% MOMENTARY MAXIMUM



**AIRSPEED INDICATOR
(AF53-3223 THROUGH AF53-3234)**

- (red) 329 KNOTS (IAS) — MAXIMUM PERMISSIBLE INDICATED AIRSPEED
- (yellow) 246 TO 329 KNOTS (IAS) — CAUTION RANGE
- (green) 115 TO 246 KNOTS (IAS) — NORMAL OPERATING RANGE
- (white) 150 KNOTS (IAS) — MAXIMUM PERMISSIBLE INDICATED AIRSPEED WITH FLAPS EXTENDED MORE THAN 30 DEGREES



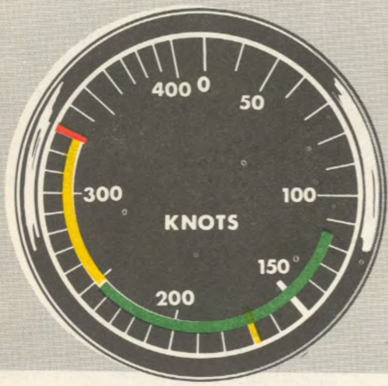
**AIRSPEED INDICATOR
(AF53-3235 THROUGH AF53-3305)**

- (red) 300 KNOTS (EAS) — MAXIMUM PERMISSIBLE EQUIVALENT AIRSPEED
- (yellow) 251 TO 300 KNOTS (EAS) — CAUTION RANGE
- (green) 115 TO 251 KNOTS (EAS) — NORMAL OPERATING RANGE
- (white) 152 KNOTS (EAS) — MAXIMUM PERMISSIBLE EQUIVALENT AIRSPEED WITH FLAPS EXTENDED MORE THAN 30 DEGREES

AA1-176

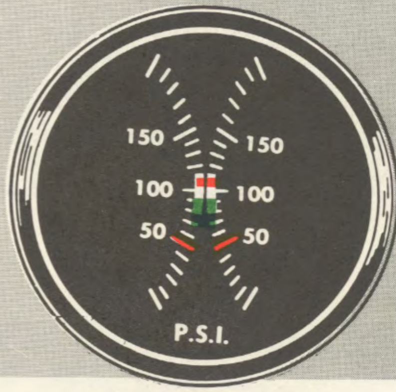
Figure 5-1 (Sheet 4 of 6)

INSTRUMENT LIMIT



AIRSPEED INDICATOR

- (red) 329 KNOTS MAXIMUM PERMISSIBLE INDICATED AIRSPEED
- (yellow) 246 TO 329 KNOTS CAUTION RANGE
- (green) 115 TO 246 KNOTS NORMAL OPERATING RANGE
- (white) 150 KNOTS — MAXIMUM PERMISSIBLE INDICATED AIRSPEED WITH FLAPS EXTENDED MORE THAN 30 DEGREES

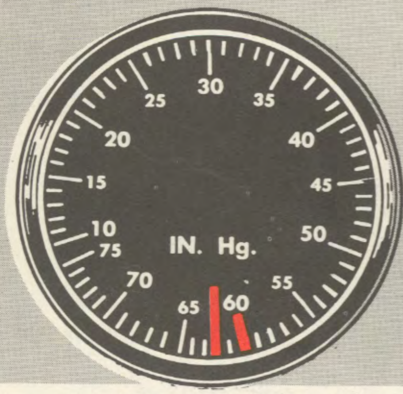


OIL PRESSURE GAGE

- (red) 110 PSI MAXIMUM ALLOWABLE
- (green) 75 TO 95 PSI NORMAL OPERATING RANGE
- (red) 50 PSI MINIMUM ALLOWABLE (FOR 1400 RPM ONLY)

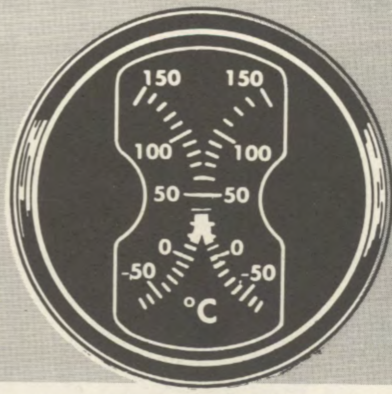
AF 51-3818 THROUGH AF 51-3835
AF 51-17626 THROUGH AF 51-17661
AF 51-17667 THROUGH AF 51-17668

FUEL GRADE 115/145



MANIFOLD PRESSURE GAGE

- (red, long) LONG 62 INCHES HG MAXIMUM TAKEOFF PRESSURE (WET)
- (red, short) SHORT 60 INCHES HG MAXIMUM TAKEOFF PRESSURE (DRY)



CARBURETOR AIR TEMPERATURE INDICATOR

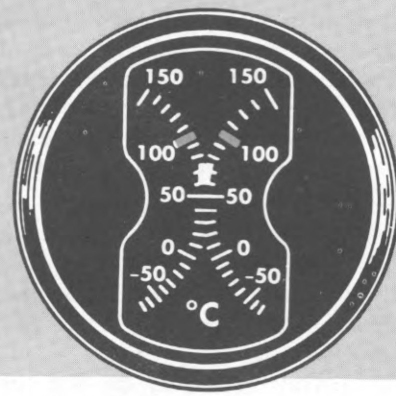
- (white) +15° TO +38°C NORMAL OPERATION RANGE

AA1-193

Figure 5-1 (Sheet 5 of 6)

MARKINGS

AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668



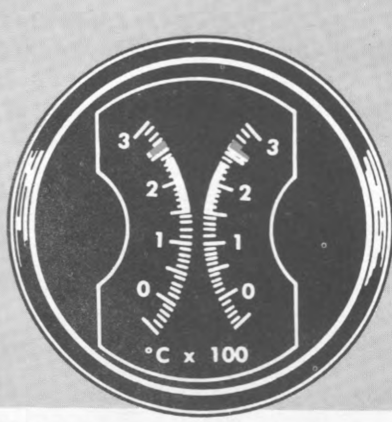
OIL TEMPERATURE INDICATOR

- 100°C MAXIMUM ALLOWABLE
- 60°C TO 75°C DESIRED RANGE

TACHOMETER

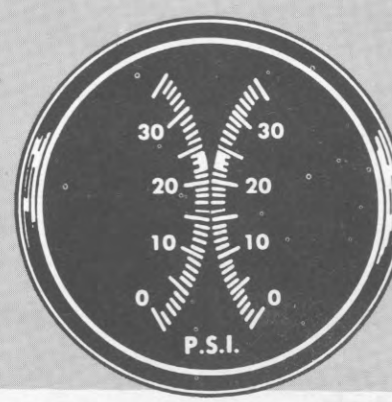
- 2800 (±25) RPM MAXIMUM TAKEOFF LIMIT
- 2600 TO 2800 RPM LIMITED OPERATION
- 1400 TO 2600 RPM NORMAL CONTINUOUS OPERATION

FUEL GRADE
115/145



CYLINDER HEAD TEMPERATURE INDICATOR

- 260°C MAXIMUM ALLOWABLE
- 150°C TO 232°C CONTINUOUS OPERATION
- 190°C TO 200°C DESIRED CRUISE



FUEL PRESSURE INDICATOR

- 22 TO 24 PSI NORMAL OPERATING RANGE

AA1-175

Figure 5-1 (Sheet 6 of 6)

Landing gear extended	170 knots
Flaps extended 30 degrees or less	170 knots
Flaps extended more than 30 degrees	150 knots
Landing light extended	152 knots
Propeller unfeathering	135 knots
Fuel dumping	185 knots
Hardover signal for autopilot	210 knots
Propeller Feathering	190 knots
Max Fire Notation Speed	139 knots

For flight in severe turbulence, indicated speeds of 165 knots are recommended for weights under 100,000 pounds and speeds of 175 knots for weights above 100,000 pounds.

The maximum permissible equivalent airspeeds (EAS) for AF53-3235 through AF53-3305 are as follows:

Maximum dive speed (V_{ne}) — sea level to 12,000 feet ..... 300 knots; above 12,000 feet, reduce speed 5 knots per 1000 feet

Maximum speed for normal operation (V_{no}) — sea level to 17,000 feet .... 251 knots; above 17,000 feet, reduce speed 5 knots per 1000 feet

Landing gear extended	174 knots
Flaps extended 30 degrees or less	174 knots
Flaps extended more than 30 degrees	152 knots

MANEUVERS.

The following maneuvers are permitted:

Bank angles up to but not in excess of 60 degrees. Slipping or skidding as required for asymmetric power conditions or for landing approaches, at indicated airspeeds up to but not in excess of 225 knots.

CENTER OF GRAVITY (CG) LIMITATIONS.

Aft limit	33 percent MAC
Forward limits (landing gear up)	
Up to 83,200 pounds	9 percent MAC
83,200 to 103,000 pounds	13 percent MAC
103,000 to 107,000 pounds	13.8 percent MAC
Forward limits (gear down)	
Up to 85,600 pounds	11 percent MAC
85,600 to 102,200 pounds	14.1 percent MAC
102,200 to 103,000 pounds	14.6 percent MAC
103,000 to 107,000 pounds	16.9 percent MAC

Note

MAC limits given may be computed linearly in order to determine the correct limit for a specific gross weight.

Refer to Handbook of Weight and Balance, T.O. 1-1B-40.

OPERATIONAL WEIGHT LIMITATIONS.

Weight has an important effect on the capability and performance of the aircraft. In designing aircraft, weight has always been a primary restrictive factor. 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 unneccessary weight; however, the weight penalty for making an aircraft foolproof is prohibitive. Weight limitations, therefore, are necessarily involved in operation of the aircraft. If these limitations are exceeded, a loss in performance is inevitable and structural failure is quite probable. When the aircraft is loaded beyond the established limits, the 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 takeoff and landing rolls increase appreciably with an increase in gross weight. Likewise, the brakes may become insufficient to brake the forward momentum of the aircraft, and the wings will become more vulnerable to airloads during maneuvers or flight through turbulent air. These resultant effects can reach serious proportions when the weight limitations are disregarded. In cargo aircraft, the effect produced by weight is much greater than that encountered in aircraft of other types because the cargo itself adds a considerable amount to the weight at which the aircraft is operated. In order that cargo of various sizes may be accommodated, the cargo hold is of such proportions that space is not a restrictive factor; consequently, overloading is entirely possible. Weight limitations must be complied with if the aircraft is to be operated efficiently, economically, and safely. The maximum recommended gross weights for normal operation are as follows:

Takeoff	107,000 pounds
Landing	88,200 pounds
Zero wing fuel	83,200 pounds

War emergency gross weights are as follows:

Takeoff	112,000 pounds
Landing	107,000 pounds
Zero wing fuel	89,900 pounds

The zero wing fuel weight is the gross weight minus the weight of the fuel, oil, and water-alcohol carried in the wings and nacelles. The zero wing fuel determines the maximum weight which can be carried in the fuselage in order to have strength available for the corresponding permissible accelerations. *Since the permissible accelerations are a function of the weight and distribution of fuel, the fuel must be loaded and used as described in figure* 7-2. There are no structural minimum fuel requirements for this aircraft.

WEIGHT AND LOADS.

Due to the effect of gravity on its mass, 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 it 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 called 1 g. As fuel, cargo, crew members, and additional equipment are added in order that the aircraft may accomplish a specific mission, the weight of the aircraft correspondingly increases and the additional weight constitutes a force acting on the aircraft structure. The weight of the aircraft, or the force which gravity imposes on it, 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, takeoff, 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. 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 these forces 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. 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.

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 by gravity in any condition of static equilibrium. The load factor denotes the strength of the forces acting on the aircraft because 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 1 g 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 0.5 g, 2.0 g, 3.0 g, etc, which means that the forces exerted on the wing structure and its members are ½, 2, or 3 times the force exerted by gravity. For example, if the normal weight of the aircraft is 60,000 pounds and the load factor at some given moment of accelerated flight is 3.0 g's, the total force which the wings must sustain is 180,000 pounds, or 3 times the normal weight of the aircraft in straight and level flight. See Distribution of Load, this section.

CAUTION

The aircraft must have the load distributed so that the wings can safely withstand a load factor of at least 2.0 g's, as structural damage to the wings may result if the aircraft encounters a situation whereby more than 2.0 g's are imposed. Aircraft with combinations of payload and fuel which limit the load factor capability to 2.5 g's must be flown with caution, especially in turbulent air or during turns and pullouts.

MARGIN OF SAFETY.

The margin of safety is the range of forces which exist between two points, one of which is the load factor the aircraft is sustaining at any given moment, and the other the load factor at which structural damage will occur. If, for example, the aircraft is incapable of sustaining a load factor greater than 2.5 g's and during flight through turbulent air is subjected to a force of 1.5 g's, the margin of safety at this particular moment is 1.0 g. 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 aircraft to maintain a margin of safety which 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 2.5 g's, turns and pullouts should be made with caution to minimize the resulting airloads.

EXPLANATION OF CHART.

The Weight Limitations Chart *(figure 5-2)* shows graphically the weight-carrying capabilities of the aircraft as defined by the various criteria which provide limits for safe and efficient operation. Through the use of these charts, the flight planner is aided in recognizing the weight limitations which will restrict operation on a specific mission and in determining 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 it at a given gross weight remains the responsibility of the local authority.

GROSS WEIGHTS.

The data in the chart *(figure 5-2)* 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 loads axes represents an operating weight of 60,000 pounds. As individual operating weights may vary, it is necessary to adjust the chart for the specific aircraft involved. The operating weight plus the fuel and cargo as required in a mission can be shown by gross weight lines which 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 which 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. Takeoff gross weights must also be considered with respect to available runways, surrounding terrain, altitude, atmospheric conditions, mission requirements, and the urgency of the mission.

DISTRIBUTION OF LOAD.

The maximum load that the aircraft can carry is dependent on the way the load is distributed. The weight of an aircraft in flight is supported by the wings; therefore, the more load that is carried in the fuselage, the greater will be the bending moment on the wings. This means that an aircraft might safely carry 30,000 pounds if 12,000 pounds were carried in the fuselage and 18,000 pounds were in the wings. But the same 30,000 pounds might become an unsafe load if the weight distribution were 25,000 pounds in the fuselage and 5000 pounds in the wings, the unsafe condition resulting from the excessive bending moment imposed on the wings by the 25,000 pounds in the fuselage. When carrying cargo, load factor capabilities below 2.5 g's are not considered desirable because the cargo distribution may be critical enough to overload the floor and/or the fuselage shell.

CARGO LOAD.

In any mission, range and fuel consumption directly determine the fuel which must be carried and indirectly the cargo which 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 fuselage fuel is utilized to increase the range of the aircraft, the combined weight of the fuel and tanks is computed as cargo load.

WING FLIGHT LOAD FACTORS.

Wing flight load factors of 2.0, 2.25, and 2.5 g's are represented. The load factor 2.0 line represents an absolute minimum which should never be violated because of the dangerously small margin of safety; the load factors of 2.25 and 2.5 g's are included for comparative purposes. Notice that the effect of weight distribution is clearly illustrated by the shape of these lines. If the aircraft bas a basic operating weight of 60,000 pounds, a load factor in excess of 2.0 g's may result in structural damage in each of the following instances:

At 100,000 pounds, when no load is carried in the wings.

At 107,000 pounds, when 7000 pounds of fuel is carried in the wings.

At 123,800 pounds, when 23,800 pounds of fuel is carried in the wings.

The airplane will safely withstand a load factor of 2.5 g's in each of the following instances:

At 83,200 pounds, when no load is carried in the wings.

At 88,200 pounds, when 5000 pounds of fuel is carried in the wings.

At 107,000 pounds, when 23,800 pounds of fuel or above is carried in the wings.

See Cautionary Loading Area, this section.

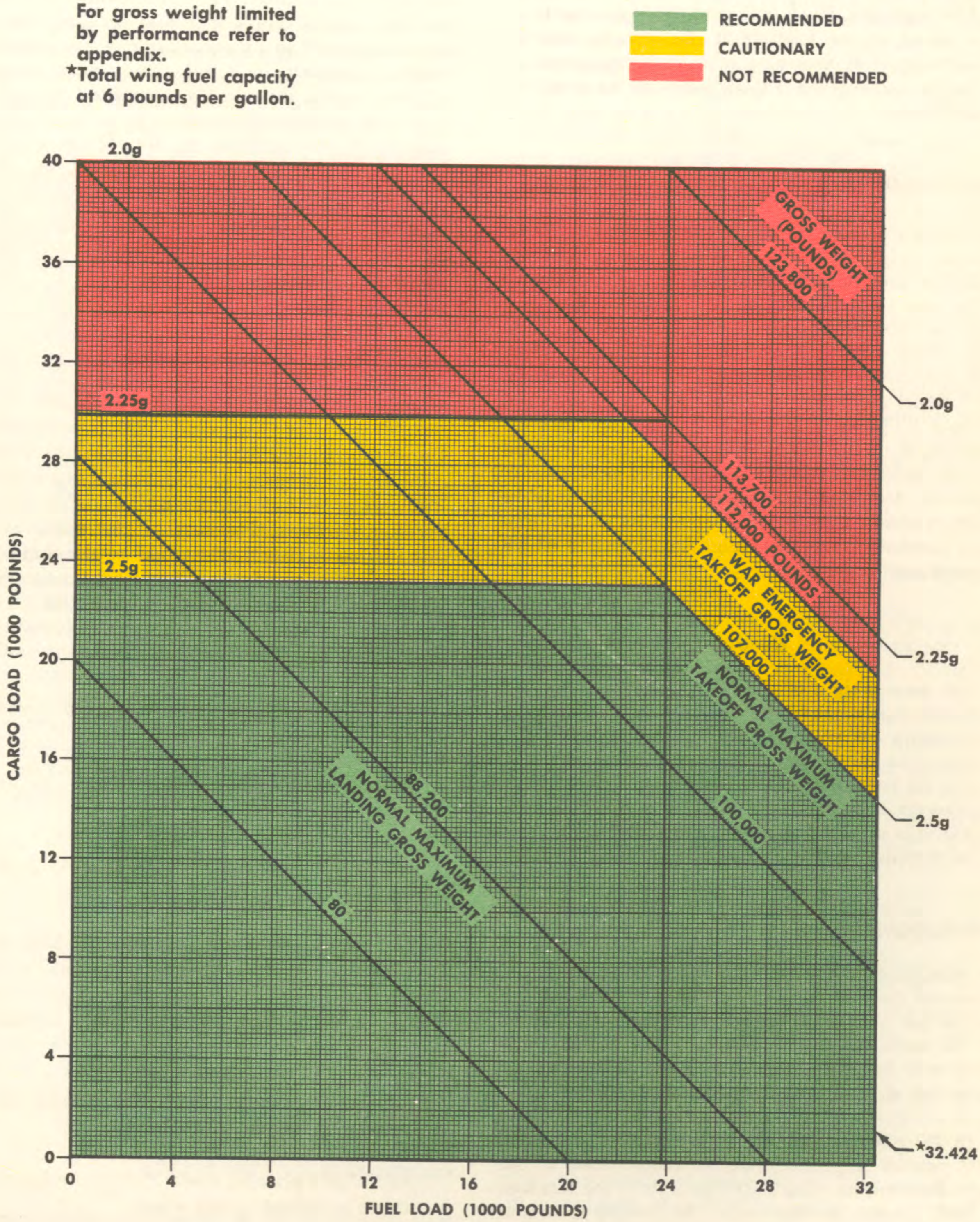
WEIGHT LIMITATIONS CHART

BASED UPON 60,000 POUNDS
BASIC OPERATING WEIGHT
(INCLUDES OIL)

MODEL: C-118A

ENGINES: R2800-52W
FUEL GRADE 115/145
ALTERNATE FUEL GRADE 100/130

Note:
For gross weight limited by performance refer to appendix.
*Total wing fuel capacity at 6 pounds per gallon.



AA1-213

Figure 5-2

CRUISE SPEEDS.

Caution must also be exercised in selecting the cruise speeds for operation. Load factors result not only from maneuvers instituted by the pilot, but also by encountering atmospheric gusts. At any given speed and gross weight, the larger the gust the higher the load factor. Similarly, at any given gross weight and stated gust intensity, the higher the speed the larger the load factor. The aircraft is basically designed to be able to safely withstand the load factors resulting from a gust of 30 feet per second at 251 knots per hour with 23,200 pounds of cargo. From the chart, it can be seen that, as the cargo weight is increased, the load factor made good is decreased. If a gust of 30 feet per second is also to be made good, then the speed likewise must be decreased.

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routine operation at a gross weight of 88,200 pounds at a maximum contact sinking speed of 10 feet per second *(figure 5-3)*. This is the maximum recommended landing weight for normal operation. In case of emergency, landings may be made up to 107,000 pounds at a maximum contact sinking speed of 5 feet per second.

PERFORMANCE LIMITATIONS.

In the case of four-engine aircraft, it is generally inherent that structural rather than performance limitations restrict 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. Performance with one engine out is not generally a restrictive factor in the normal 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 performance limitations, but the gross weights are sufficiently high for normal operation. 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.

The loss of one engine results in an asymmetric power condition and a decrease in the rate of climb. However, a rate of climb of 50 feet per minute with three engines operating can be maintained with gross weights up to 113,900 pounds on a standard day at sea level with maximum power, wing flaps at the takeoff position, gear down, and inoperative engine windmilling. Power losses due to temperature, humidity, and engine deficiency exert a considerable influence on the rate of climb even when all the 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 marked difference in aircraft performance resulting from a rise in temperature and a corresponding fall in air density. The gross weight difference to provide a rate of climb of 50 feet per minute on a hot day as compared to a standard day at sea level is 6,600 pounds, resulting in a maximum gross weight of 107,300 pounds, in order to maintain a rate of climb of 50 feet per minute at sea level on a hot day. For purpose of standardization, the temperature of a standard day is 15°C and that of a hot day, 38°C 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 the gross weight at which the aircraft may be operated, has not been included in the weight limitations chart because of the extreme number of variable conditions involved. However, the effect of humidity on brake horsepower is shown in the Appendix, part 2.

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 takeoff 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 takeoff roll is such that no attempt to take off should be made unless the critical engine failure airspeed for the gross weight of the aircraft has been attained or exceeded.

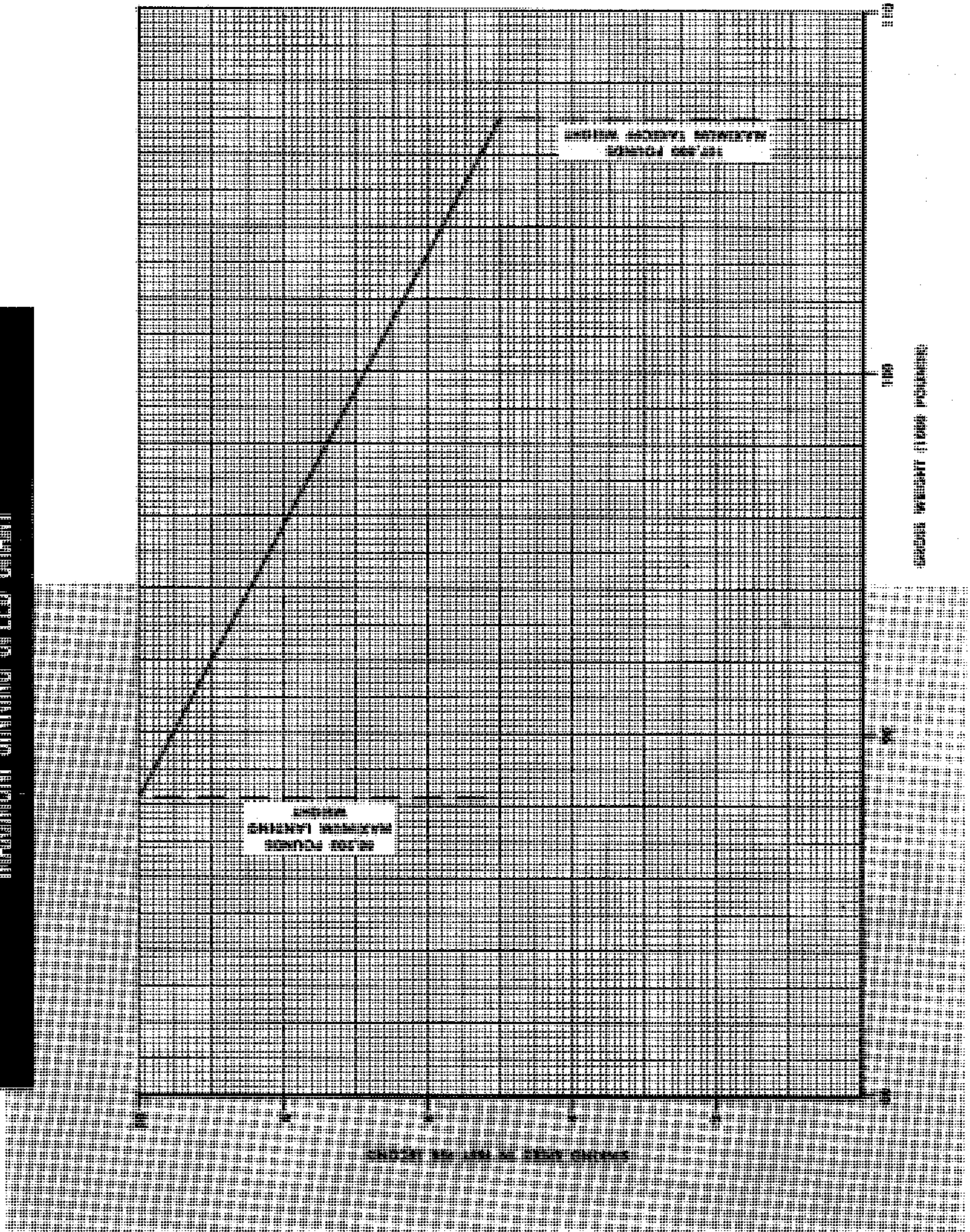
RECOMMENDED LOADING AREA.

The green area on the charts represents the loading conditions that present no particular problem in regard to strength or performance of the aircraft. Operation of the aircraft at weights outside this recommended loading area should be avoided unless the mission requires it. The green area is bounded by the 2.5 g's wingload factor line and the landing gear limitation.

CAUTIONARY LOADING AREA.

The yellow area on the charts represents loadings of progressively increasing risk as the red area is approached. Caution must be exercised because (1) per-

MAXIMUM SINKING SPEED CHART



AA1-214

Figure 5-3

formance with one engine out at these gross weights is marginal depending upon configuration, altitude, and ambient air temperature and (2) the maximum safe load factor is decreased.

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 of loss of the margin of safety from the standpoint of both performance and structural limitations. Under conditions of extreme emergency when safety of flight is of secondary importance, the commanding officer will determine if the degree of risk warrants operation of the aircraft at gross weights appearing in the red zone.

USE OF WEIGHT LIMITATIONS CHART.

The sample problems shown below may be used to determine the exact position of a loaded aircraft on the Weight Limitation Chart *(figure 5-2)*.

Problem:

Requiring 2000 gallons of fuel to reach a base, what is the maximum cargo that can be carried?

Solution:

Presume that the aircraft weighs 65,000 pounds hefore the fuel and cargo are added. Enter the chart at a fuel weight of 12,000 pounds (based on fuel weight of 6 pounds per gallon). By moving vertically up the chart to the maximum loading (limit of the yellow area), it is determined that a maximum cargo of 35,000 pounds may be carried. This limitation dictates that the gross weight of the aircraft cannot exceed 107,000 pounds. By adding the operating, fuel, and cargo weights, it is found that the aircraft would weigh 65,000 + 12,000 + 35,000 or 112,000 pounds, which exceeds the permissible limit by 5000 pounds (112,000 — 107,000 = 5000). This weight must be removed, and since the operating and fuel weights are not to be reduced, it becomes necessary to reduce the cargo weight to 35,000 — 5000, or 30,000 pounds. The additional operating weight of 5000 pounds (65,000 — 60,000 = 5000) is simply considered as added alternate cargo, which reduces the maximum cargo first determined. If, for instance, the aircraft weighed 58,000 pounds rather than the 65,000 pounds presumed above, the alternate cargo would be 60,000 — 58,000, or 2000 pounds, and would allow a 2000 pound increase in the maximum cargo first determined.

Problem:

Requiring a 22,000 pound cargo load, what is the maximum amount of fuel that can be carried?

Solution:

Presume that the aircraft weighs 60,000 pounds before the fuel and cargo are added. Since the basic operating weight is 60,000 pounds, the chart can be entered at a cargo weight of 22,000 pounds and the maximum amount of fuel can be read directly from the chart. By moving horizontally across the chart to the maximum fuel load (limit of the green area), it is determined that the maximum fuel that can be carried is 25,000 pounds, or, 25,000 ÷ 6 = 4167 gallons.

TABLE OF TOLERANCES

ADI (Water-Alcohol Inspection) – 27 to 32 psi.
Antiskid brake accumulator pressure – 325 (±25) psi.
Snubbing pressure – 150 $\left(\begin{smallmatrix}+20\\-0\end{smallmatrix}\right)$ psi.
Oxygen systems pressure – 400 $\left(\begin{smallmatrix}+25\\-0\end{smallmatrix}\right)$ psi.
D-C Generator Voltage – 27.5 to 28.5 V d-c.
Landing gear operating time –

Down (free fall) 20 seconds
Up 7 to 10 seconds

Wing flaps –

Low Fuel Boost Pressure – 12 to 18 psi
High Fuel Boost Pressure – 21 to 33 psi

Oil Cooler Air Exit Doors – approximately 20 seconds for full range travel.
Emergency air pressure – 1000 (±50) psi.

SECTION VI

flight characteristics

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GENERAL FLIGHT CHARACTERISTICS.

The general flight characteristics are excellent for a cargo-type aircraft. Maneuvering and control of the aircraft does not require undue force by the pilot. The aircraft is very stable and trims out easily. Very little change in trim is required to maintain the desired aircraft attitude. Rudder and aileron control is excellent. Elevator forces are normal at both low and high speeds.

AERODYNAMIC CHARACTERISTICS.

The aircraft is dynamically stable about all axes; that is, if an oscillation is induced about the roll, pitch, or yaw axis of the airplane, it will damp out. Static stability is the tendency of the aircraft to return to its original trimmed condition following a displacement from that condition. From the point of view of control forces, an aircraft is statically stable in pitch (longitudinally) if a push force is required to maintain a speed above trim speed, and a pull force is required to maintain a speed below trim speed. Spiral stability is approximately neutral. As an example, when the aircraft is properly trimmed for a standard rate turn in the instrument approach configuration (gear up, flaps 20 degrees), it will tend to remain in that attitude. Dihedral effect will cause the aircraft to bank automatically into the turn as rudder is applied. This effect is helpful in obtaining maximum maneuverability.

CONTROL FORCE AND EFFECTIVENESS.

Due to the characteristics of the aerodynamic boost system, the control forces and movements required vary throughout the speed range of the aircraft. At high speed, a given rate of roll can be developed with a small force applied to the controls and with a small control movement. To develop the same rate of roll at low speed, both a greater force and movement must be applied to the controls.

The ratio of rudder to aileron displacement required to accomplish a coordinated turn varies with speed. At high speeds, turns may be made primarily with the ailerons, very little rudder being required. As speed decreases, and/or gear and flaps are extended, a greater portion of rudder to aileron displacement is required. This should be taken into consideration when making approaches in gusty air conditions, or with one or more engines inoperative.

At high speed, the elevator is extremely effective and, therefore, requires a small amount of force and movement to maneuver the aircraft. At low speed, such as during the landing approach, elevator effectiveness decreases, requiring a greater movement to maneuver the aircraft. Control force increases with elevator displacement; therefore, both a greater movement and a greater force are required at low speed, as compared to cruising flight.

During landing, the center of gravity position greatly affects the amount of elevator required. The further aft the cg, the less elevator required; the further forward the cg, the more elevator required. If the aircraft is loaded aft of the aft cg limit, it will be unstable; if loaded forward of the forward limit, the amount of elevator control available will probably be insufficient to properly flare the aircraft.

Elevator requirements vary with power. As an example, as power is applied during an overshoot, down elevator is required to counteract for nose-up pitching; conversely, as power is cut during the landing flare, up elevator is required.

EQUIVALENT PARASITE DRAG AREAS.

The following table of drag items is given in square feet of equivalent flat plate area:

Item	*Drag of Item (Square Feet)*
Basic Aircraft	27.3
Landing Gear	38.6
20-Degree Wing Flaps	26.8
30-Degree Wing Flaps	46.3
50-Degree Wing Flaps	83.6
Windmilling Propeller	13.6
+4-Degree Cowl Flaps	5.4
+2-Degree Cowl Flaps	3.5
+-Degree Cowl Flaps	1.7

WING FLAP CHARACTERISTICS.

Wing flaps of the double-slotted type provide the additional lift required for takeoff, and both extra lift and drag for approach and landing. At small angles (20 to 25 degrees), the flaps act primarily as an added lift device, and at large angles (40 to 50 degrees), as both an added lift and drag device. High drag at maximum flap extension is obtained primarily from the amount of extra surface exposed to the airstream. In effect, as the flaps are extended the camber of the wing is increased, giving it a higher lift at any given angle of att. ck. This explains the ballooning of the aircraft as the flaps are extended. Conversely, the opposite occurs as flaps are retracted and the aircraft setttles. Extension of the flaps also reduces the stalling speed of the aircraft. Changes resulting from flap extension are included in the following table:

Flap Position (Degrees)	*Wing Flap Drag Area (Square Feet)*	*Lift Increase (Percent)*	*Equivalent Stall Speed at 88,200 lb (Knots)*
0	0	0	106
10	12.8	7.5	102
20	26.8	26.7	94
30	46.3	46.1	88
40	58.7	56.5	85
45	66.8	60.5	84
50	83.6	64.5	83

Two-speed flap retraction is provided. The faster retraction rate from 50 to 20 degrees (9 seconds) is provided for rapid elimination of high drag present at high flap angles. The slower retraction rate from 20 degrees to up (13 seconds) is provided so that the flight path during takeoff can remain relatively constant as flaps are retracted. This is the result of lift increase due to increasing airspeed balancing lift loss due to flap retraction. At a given speed, the flight path can remain constant during flap extension or retraction, provided the angle of attack is changed to counteract for the lift changes which are taking place in the wing-flap combination, or the speed is changed to compensate for the change in lift at a constant angle of attack.

STALLS.

Stall characteristics of the aircraft are excellent. The aircraft is fully controllable up to the stall, and the pre-stall warning buffet is of sufficient magnitude that it is easily perceptible to the pilot. At the stall, the nose of the aircraft pitches down gently without rolling, allowing stall recovery to be effected with a minimum manipulation of the controls and loss of altitude. Acceleration increases stalling speed. A 15-foot-per-second gust encountered in level flight will raise the stalling speed from 117 to 132 knots EAS. This gust is equivalent to an acceleration of 1.30 g's which can be developed in a coordinated turn at a bank angle of 41 degrees. Figure 6-1 is based on the effect of acceleration and gives the change in stalling speed for gross weight, gear and flap positions, and for all bank angles up to 60 degrees. The use of this chart is illustrated by the dashed lines drawn on its face. Due to the slipstream effect over the wing, power-on stalling speeds are lower than zero thrust stalling speeds by approximately 5 to 10 knots at approach power, and 10 to 15 knots at maximum power. This difference is not taken into consideration in calculating performance speeds based on stalling speeds, but instead is available as an extra margin of safety.

RECOVERY FROM STALL.

When the aircraft is stalled, recovery should always be made by nosing the aircraft slightly down, and applying power as required. At all times, abrupt pullouts should be avoided so as to eliminate the possibility of excessive g forces and a resultant secondary stall.

SPINS.

Spins are one of the prohibited maneuvers and must never be done intentionally. However, if a spin is entered accidentally, use normal recovery procedure to regain level flight; that is, nose down and apply corrective control to stop the spin.

FLIGHT CONTROLS.

The flight controls are very effective under all conditions of flight, and there is no unusual reaction of the flight controls under any flight condition.

LEVEL FLIGHT CHARACTERISTICS.

The level flight characteristics of the aircraft are excellent under the various speed conditions of slow flight, cruising flight and high speed flight.

MANEUVERING FLIGHT.

The characteristics of the aircraft during acceleration on takeoff and in flight are excellent and do not require undue force on the part of the pilot.

DIVING.

Diving speed is limited as mentioned in Section V. Avoid abrupt pullouts at any time. Do not allow the IAS pointer to exceed the limit marking on the airspeed indicator (*figure 5-1*).

LIMITING DESIGN SPEEDS.

The criteria for establishing the limiting speeds of the aircraft from a structural standpoint may be explained as follows:

A. The load exerted on a body in a moving stream of air depends on the density of the air and on the speed of the air with respect to that body.

B. Mach number effect is caused by changes in airflow around an aircraft which may result in control force, control effectiveness and stability irregularities. For this reason, a maximum Mach number limitation is established.

The maximum speed demonstrated is based on two design limits of the aircraft: first, the ability to withstand a 15-foot-per-second gust at the maximum permissible indicated airspeed with no permanent deformation; and, second, no control force, control effectiveness, or stability abnormalities. The aircraft has been demonstrated to a maximum Mach number of 0.65. At Mach numbers at or below the maximum demonstrated value, no undesirable flight characteristics occur.

At the maximum normal operating speed (V_{no}) and at any combination of gross weight and fuel weight within the stated limitations, the aircraft is designed to withstand the gust load factors resulting from at least a 30-foot-per-second gust with no permanent deformations.

Note

The aircraft is capable of withstanding higher accelerations (gusts) with the wing flaps retracted; therefore, it is necessary that all cruising and descent operation be with the flaps retracted during flight in turbulent air conditions.

SECTION VII
systems operation

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LIST OF ILLUSTRATIONS

FUEL SYSTEM MANAGEMENT.

All takeoffs, landings, and ground operations should be made with each engine receiving fuel from its respective main tank. A vapor vent return line connected to each carburetor returns all vapor plus fuel to the No. 2 main tank for engines No. 1 and 2, and to the No. 3 main tank for engines No. 3 and 4. The normal return flow is less than 2 gallons per engine per hour; however, if the vent float sticks or is damaged, it is possible to obtain a maximum flow of 20 to 30 gallons per engine per hour. For this reason, the fuel levels of No. 2 and 3 main tanks must be checked periodically to avoid overflowing. When selecting a new fuel supply for an engine, the new supply should be selected before shutting off the old supply or before the old supply is depleted, in order to minimize fuel surge to the carburetor (which can result in ruptured diaphragms or collapsed vapor vent floats), and the fuel booster pump should be turned to LOW. If a fuel supply is completely depleted before selecting a new source, *retard the throttle* of the affected engine before selecting a new supply to prevent fuel surge to the carburetor, and also to prevent the possibility of overspeeding, which can result from the sudden resumption of power following a momentary power loss. Figures 7-1 and 7-2 graphically show the fuel flow and the control lever positions for various combinations of fuel system management. See figure 7-3 for fuel quantity data.

CAUTION

Maximum wing strength must be maintained by using fuel as recommended in the Fuel System Management Table (*figure 7-1*). After selecting alternate fuel tanks, the main fuel tank fuel quantity indicator should be monitored to prevent possible overfilling of the main tanks through the vapor vent return system in case of malfunctioning carburetors. The maximum unbalanced fuel load permissable, without restriction on speed or gross weight, is 1050 lbs between inner wing tanks. These cross ship fuel unbalances must not occur simultaneously.

RECOMMENDED USE OF FUEL BOOSTER PUMPS.

It is recommended that the electric fuel booster pumps be operated in LOW boost under the following conditions:

A. For engine start.

B. For takeoff.

C. When climbing.

D. When selecting a new fuel supply source.

E. For fuel conditioning.

F. When fuel pressure drops below 22 psi or fluctuates.

G. For oil dilution.

WARNING

Always shut booster pumps off one at a time, and make certain that pressure is maintained by the engine-driven pumps.

Since the boiling point characteristics of fuel vary with each production run, and each run varies with age and the conditioning the fuel receives, it is difficult to predict the exact moment and condition under which booster pumps should be applied. Conditioning the fuel for 1½ hours by booster pump agitation covers most of the critical fuel conditions that may occur in the fuel system. It is realized that this 1½-hour period will be extremely liberal in a great many instances. With OAT. below 24°C (75°F), it should be remembered that, with high altitudes and/or high OAT., it will be necessary to condition the fuel for longer periods. Therefore, make the following test for fuel stability:

A. After the aircraft has been stabilized at the cruise altitude, momentarily turn one of the selected booster pumps off and at the same time watch the fuel pressure.

B. If the fuel pressure drops or fluctuates, leave the booster pump in operation for a longer period.

C. If the pressure remains steady, the booster pump may be turned off.

D. Repeat this procedure for the remaining booster pumps.

USE OF HIGH BOOST PUMP PRESSURE.

In the event of engine fuel pump failure or an extreme cold weather start, where LOW boost does not supply sufficient pressure, HIGH boost may be used, provided LOW boost is first used to pressurize the system up to the carburetor. When shifting from LOW boost to HIGH boost, make the switch as rapidly as possible.

PRECAUTIONS.

A. Crossfeed and selector valves should be in their OFF positions unless flow of fuel is expected through them.

B. No tank will be run dry.

C. Apply boost pump pressure before opening the valves to a new source.

FUEL SYSTEM MANAGEMENT TABLE
8-TANK SYSTEM
TOTAL USABLE FUEL — 5404 GALLONS

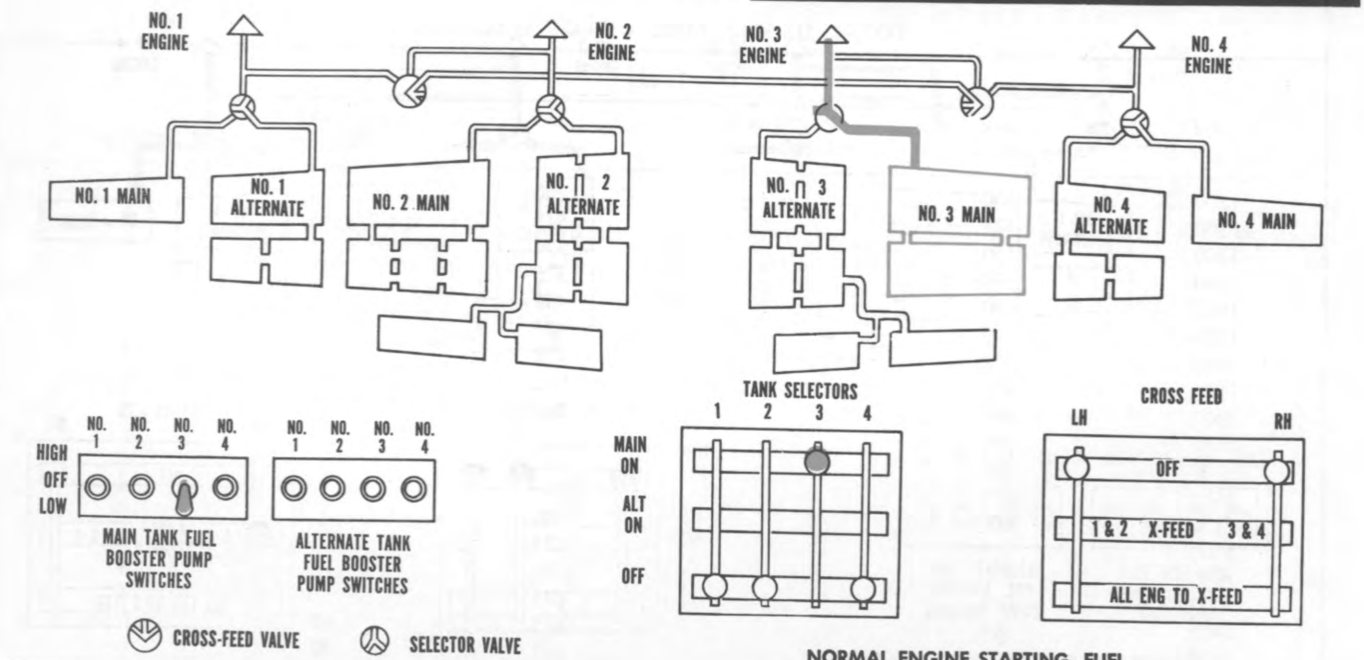
	Tanks				
Fuel Load	*1 and 4 Main*	*1 and 4 Alternate*	*2 and 3 Main*	*2 and 3 Alternate*	**Usage*
1200	300		300		4
1300	325		325		4
1400	350		350		4
1500	375		375		4
1600	400		400		4
1700	425		425		4
1800	450		450		4
1900	475		475		4
2000	500		500		4
2100	525		525		4
2200	550		550		4
2300	575		575		4
2400	600		600		4
2500	625		625		4
2600	650		650		4
2700	675		675		4
2800	695		625	80	1-3-4
2900	695		675	80	1-3-4
3000	695		675	130	1-3-4
3100	695		675	180	1-3-4
3200	695		675	230	1-3-4
3300	695		675	280	1-3-4
3400	695		719	286	1-3-4
3500	695		719	336	1-3-4
3600	695	200	719	186	1-2-4
3700	695	218	719	218	1-2-4
3800	695	243	719	243	1-2-4
3900	695	268	719	268	1-2-4
4000	695	293	719	293	1-2-4
4100	695	318	719	318	1-2-4
4200	695	343	719	343	1-2-4
4300	695	368	719	368	1-2-4
4400	695	393	719	393	1-2-4
4500	695	418	719	418	1-2-4
4600	695	443	719	443	1-2-4
4700	695	468	719	468	1-2-4
4800	695	493	719	493	1-2-4
4900	695	526	719	510	1-2-4
5000	695	526	719	560	1-2-3-4
5100	695	526	719	610	1-2-3-4
5200	695	526	719	660	1-2-3-4
5300	695	526	719	710	1-2-3-4
5404	[illegible]	526	719	762	1-2-3-4
Undumpable	116	0	108	54	
Unstickable	140	160	140	80	

*Usage:

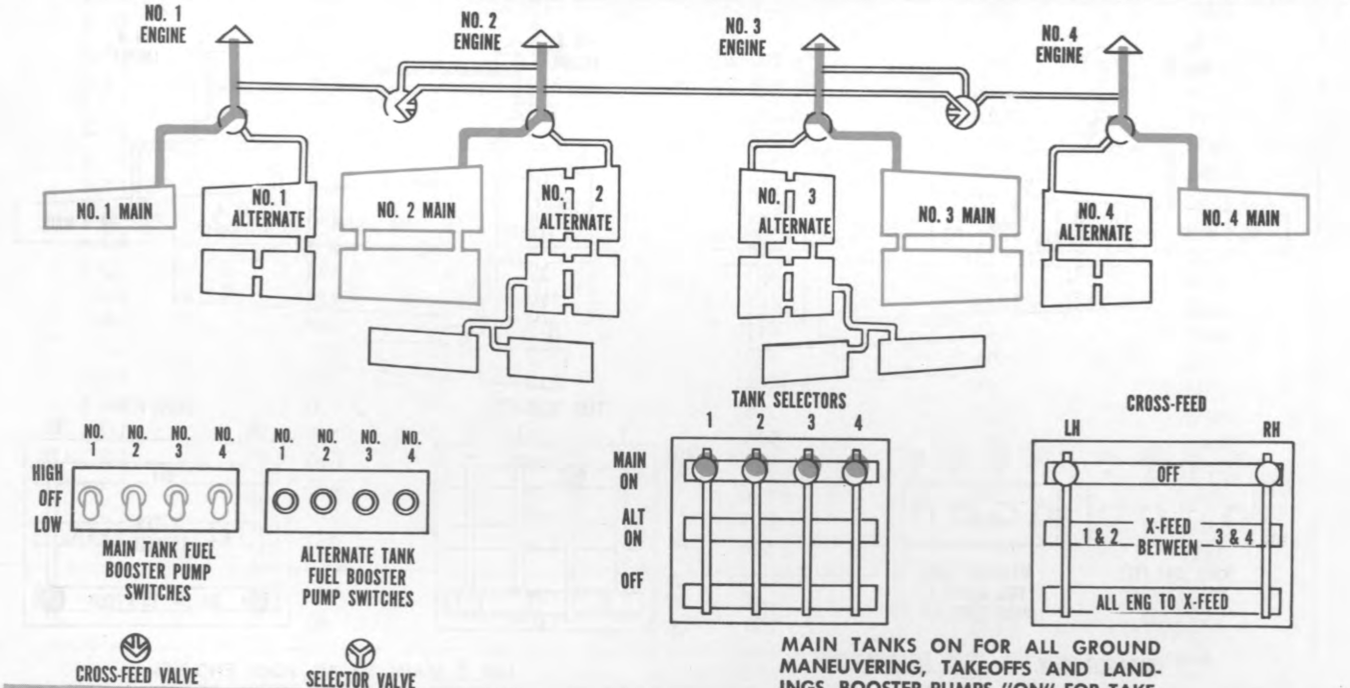
1. Main tanks to respective engines (switch to next step after 75 gallons [450 pounds] are used from each main tank or at completion of initial climb).
2. Alternate tanks to respective engines until 100 pounds remain.
3. No. 2 and 3 alternate tanks to respective sides (crossfeed) until 100 pounds remain.
4. Main tanks to respective engines.

Figure 7-1

FUEL SYSTEM



NORMAL ENGINE STARTING, FUEL FLOW "OFF" TO INOPERATIVE ENGINES, BOOSTER PUMP "LOW" TO ENGINE NO. 3

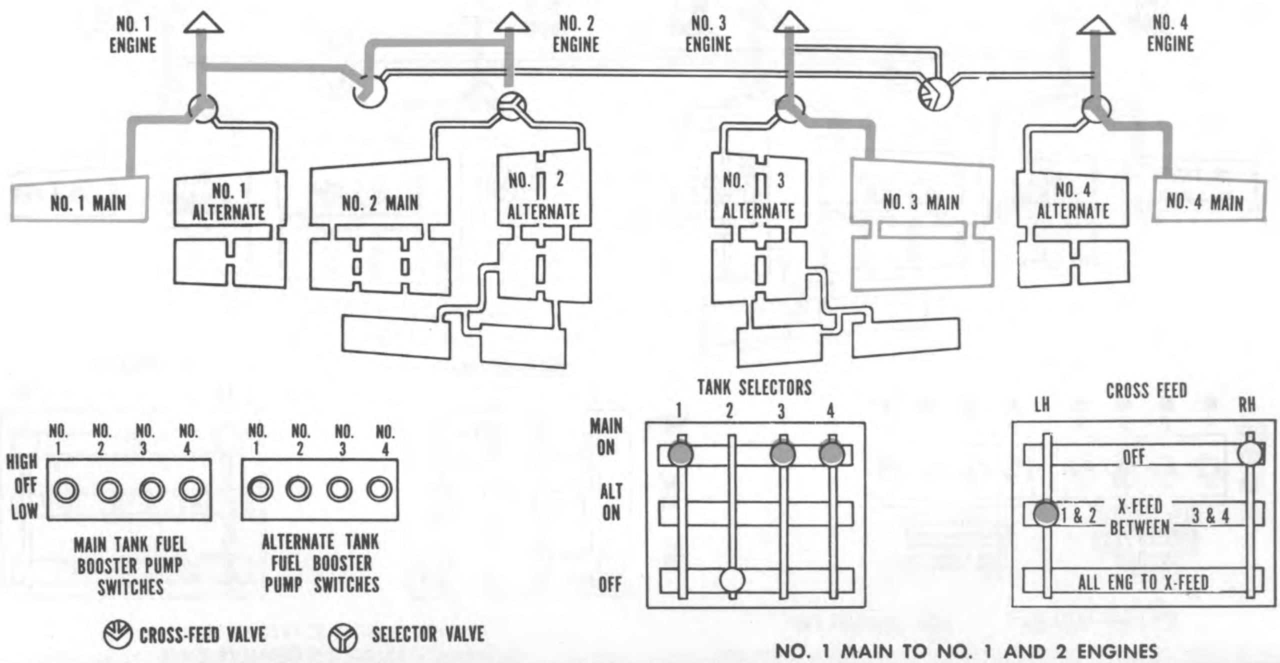


MAIN TANKS ON FOR ALL GROUND MANEUVERING, TAKEOFFS AND LANDINGS. BOOSTER PUMPS "ON" FOR TAKEOFFS AND LANDINGS AND WHENEVER NECESSARY TO MAINTAIN PRESSURE.

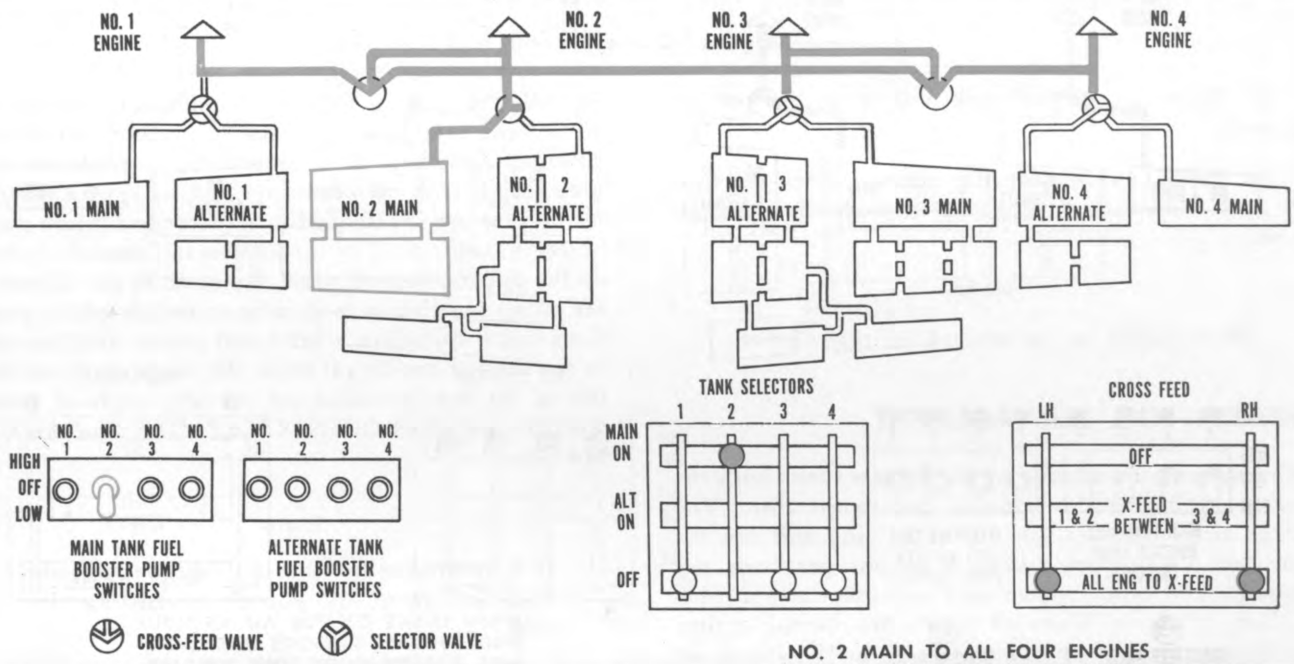
AA1-16B

Figure 7-2 (Sheet 1 of 3)

MANAGEMENT



NO. 1 MAIN TO NO. 1 AND 2 ENGINES NO. 3 AND NO. 4 MAIN TO RESPECTIVE ENGINES, BOOSTER PUMPS "OFF" UNLESS NECESSARY TO MAINTAIN PRESSURE



NO. 2 MAIN TO ALL FOUR ENGINES THROUGH CROSS FEED SYSTEM BOOSTER PUMP "ON" TO MAINTAIN PRESSURE

AA1-169

Figure 7-2 (Sheet 2 of 3)

FUEL SYSTEM MANAGEMENT

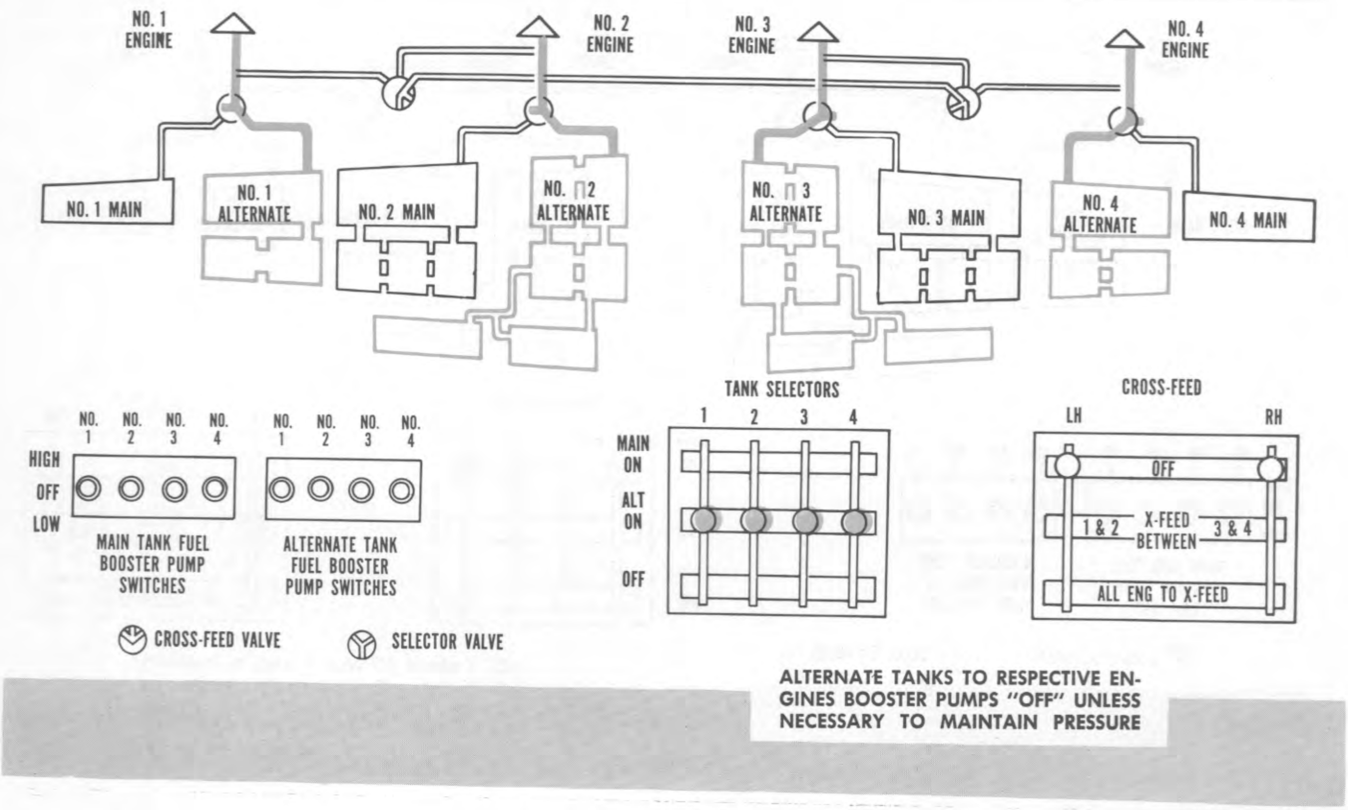


Figure 7-2 (Sheet 3 of 3)

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D. Normally, no fuel tank will be used below 100 pounds.

E. Prior to runup, during taxiing, check the flow of fuel from each source and through the crossfeed system.

Note

Fuel cannot be transferred in this aircraft.

HEATER FUEL MANAGEMENT.

The amount of fuel used by the heaters varies with the heater cycling due to altitude and temperature. The three airfoil heaters, one for each wing and one for the tail, use approximately 5 gallons per hour per heater. The cabin heater uses approximately 2 to 4 gallons per hour. When all heaters are operating, they will use a total of approximately 17 to 19 gallons per hour.

OIL SYSTEM MANAGEMENT.

The capacity of each nacelle oil tank is 35 usable gallons plus 2.5 gallons in reserve for propeller feathering. In addition, the auxiliary oil tank located in the left fillet provides a total of 26 gallons consisting of 50 percent 1100 grade oil and 50 percent 100 octane gasoline. Auxiliary oil is transferred to a selected engine nacelle tank by means of a transfer system. Transfer oil pressure is provided by a motor and pump combination, controlled by a momentary contact switch on the upper overhead panel. Adjacent to the oil transfer pump switch is a tank selector switch which positions the 4-way selector valve and directs auxiliary oil to the desired nacelle oil tank. Oil temperature is controlled by four switches on the aft overhead panel with the positions OPEN, CLOSE, OFF, and AUTOMATIC.

Note

It is recommended that no takeoff be made with less than 110 pounds in any nacelle tank.

It is desirable but not necessary that auxiliary oil be transferred to a nacelle tank when the level of oil drops to 110 pounds. The procedure should be as follows:

A. Position the tank selector switch to the required nacelle tank.

FUEL QUANTITY DATA TABLE

FUEL AT 6 POUNDS PER GALLON (BASED ON STANDARD DAY CONDITIONS)

TANK	NO.	USABLE FUEL LEVEL FLIGHT (EACH TANK)		TOTAL FUEL GROUND ATTITUDE (EACH TANK)	
		GALLONS	POUNDS	GALLONS	POUNDS
1 AND 4 MAIN	2	695	4170	700.3	4201.8
2 AND 3 MAIN	2	719	4314	722.6	4335.6
1 AND 4 ALTERNATE	2	526	3156	531.0	3186.0
2 AND 3 ALTERNATE	2	762	4572	773.7	4642.2
TOTAL		5404	32,424	5455.2	32,731.2

Figure 7-3

B. Depress the auxiliary oil tank pump switch. Release the switch when the desired amount of oil has been transferred, as indicated by the oil tank quantity indicator.

C. After oil has been transferred, the transfer system lines should be evacuated by reversing the pump actuating switch (approximately 1 minute) to avoid the possibility of oil congealing in the transfer line.

Note

Nacelle oil tanks must not be filled above the 150-pound level by use of the oil transfer system due to excessive foaming when the diluted oil enters the tank. In the event of an emergency condition, the engine can be continuously operated down to 35 pounds of oil (15 percent of normal quantity). When operating with a low oil quantity, the oil temperature and oil pressure should be monitored closely.

D. The oil temperature normally is regulated automatically. However, if automatic oil temperature control becomes inoperative, the oil cooler door can be positioned manually by using the oil cooler door air exit switch on the aft overhead panel in either the OPEN or CLOSE positions, as required. These are momentary positions. When the switch is centered, a brake keeps the door locked in position. Refer to Section V for Operation Limits.

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 115/145 or 100/130 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 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 FACTORS.

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 type of ignition system, spark plug characteristics and age, water injection operation (dry or wet takeoffs), 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 operating 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, upset 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 postflight check, the flight engineer 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 engineer 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. It must be remembered that cylinder head temperature has a direct bearing upon the results obtained; therefore, the engineer 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 flight engineer 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 flight engineer 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-2800 engine is between 900 and 1100 rpm.

SPARK PLUG CLEANOUT FOR GROUND OPERATION.

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, with a concurrent scan of combustion patterns on the ignition analyzer. This power shall be held for one minute; however, maximum ground operating cylinder head temperature will not be exceeded. If a fouled pattern appears on the engine analyzer, the operator must decrease power to a manifold pressure one inch below the power at which the spark plug resumes firing and operate for at least 10 seconds; then, resume the cleanout procedure. Repeat the gradual increase and reduction of power in this maneuver until reaching 35″ MAP, checking all analyzer patterns for satisfactory combustion.

Note

If an engine analyzer is not available to scan spark plug patterns during the preceeding procedures, another ignition check will be performed just prior to takeoff, when time since the last engine runup ignition check exceeds 10 minutes.

GROUND DEFOULING PROCEDURES.

Whenever low BMEP is noted and the analyzer indicates low resistance patterns (fouled spark plugs), proceed as follows:

A. Props — Full Increase RPM.

B. ADI — OFF.

C. Mixture — AS REQUIRED.

NOTE

In colder temperatures it is permissable to place mixture control in auto lean until desired CHT is reached, then return to auto rich.

D. Operate Engine (or engines) at field barometric pressure until cylinder head temperature reaches 180° to 190°.

E. Using the same technique described under Spark Plug Cleanout for Ground Operation, this section, advance power slowly to 40 inches Hg while noting analyzer patterns and BMEP output. If analyzer patterns indicate some degree of combustion in all cylinders, power may be further advanced 45" MAP for a maximum of 30 seconds in order to compare actual BMEP against that which a normal engine should produce under existing conditions of temperature, humidity and altitude. Do not exceed maximum ground operating cylinder head temperatures.

F. If spark plugs are still not cleared after using the ground defouling procedures twice, the necessary corrective maintenance must be performed.

INFLIGHT PREVENTION.

A periodic change in engine conditions will usually prevent lead fouling during cruise. The engine analyzer should be used to check ignition patterns at least once each hour and, after each hour at cruise settings, one of the following procedures should be used to prevent fouling:

A. The use of auto-rich mixture for a two-minute period.

B. Engine blower shift.

C. 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 be 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, while scanning analyzer and repeating the previous process until all plugs have resumed firing and manifold pressure has been increased to the desired cruise setting. Plugs which cannot be cleared should be recorded for corrective maintenance after landing.

DESCENT.

Best power mixture is favorable to clean ignition and provides minimum tendency for plug fouling. Therefore, it is recommended that best power mixture setting be maintained during descent.

CAUTION

When flying conditions require a large reduction in power, reduce rpm as well as manifold pressure. 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.

USE OF LANDING WHEEL BRAKES

To reduce maintenance difficulties and accidents due to wheel brake failure, the importance of properly using aircraft landing wheel brakes should be emphasized.

It is absolutely necessary that aircraft brakes be treated with respect. Consideration must also be given to the wheel brake antiskid system. Although the antiskid system will give consistently shorter landing distances on dry runways, it would not be used to its maximum potential to purposely make all landing rolls as short as possible.

It is generally known that operating personnel stop the aircraft as quickly as possible regardless of the length of the runway, use the brakes consistently for speeding up turns, and drag the brakes while taxiing. To minimize brake wear, the following precautions should be observed insofar as is practicable.

A. When the antiskid system is inoperative use extreme care when applying brakes immediately after touchdown or at any time there is considerable lift on the wings, to prevent skidding the tires and causing flat spots. A heavy brake pressure can result in locking the wheel more easily if brakes are applied immediately after touchdown, than if the same pressure is applied after the full weight of the aircraft is on the wheels. A wheel once locked in this manner, immediately after touchdown, will not become unlocked as the load is increased as long as brake pressure is maintained. Proper braking action cannot be expected until the tires are carrying heavy loads.

a. Brakes themselves can merely stop the wheel from turning, but 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 friction which is equal to the frictional force divided by the load on the wheel. It has been found that optimum braking occurs with approximately a 15 to 20 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 full skid, becomes even lower.

b. There are two reasons for this loss in braking effectiveness with skidding. First, the immediate action is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant.

c. NACA figures have shown that for an incipient skid with an approximate load of 10,000 pounds per wheel, the coefficient of friction on dry concrete is as high as .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.

B. Antiskid systems are intended to prevent skids at high speed under light wheel loads. Therefore, brakes equipped with an antiskid system may be applied immediately after touchdown, but this should be done only when definitely necessary. The antiskid system will function to prevent tire skidding if it is operating properly, however, it is not designed to **perform as an automatic braking system. Continuous braking from the point of touchdown will result in considerable overworking of the antiskid system beyond design limits in addition to causing excessive wear and extreme heating of the brakes.**

C. If maximum braking is required after touchdown and the antiskid system is inoperative, lift should first be decreased as much as possible by raising the flaps and dropping the nose before applying brakes. This procedure will improve braking action by increasing the frictional forces between the tires and the runway. Propeller reversal should be used whenever possible to reduce braking action required.

D. For short landing rolls, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable. This procedure applies equally well for operation of emeregency braking system.

E. With or without use of the antiskid system 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.

F. On all landings, 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.

G. 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.

H. The brakes should not be dragged when taxiing, and should be used as little as possible for turning the aircraft on the ground.

SECTION VIII

crew duties

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INTRODUCTION.

This section contains those functions of the crew which are in addition to the primary responsibilities of a crew member. It is assumed that each individual crew member is fully aware of the primary responsibilities of his job.

PILOT.

It will be the responsibility of the pilot to insure that a thorough inspection of the aircraft and all equipment is properly conducted in sufficient time prior to departure to permit correction of discrepancies without incurring delays. The inspection checklists are covered in detail in Sections II and III.

VISUAL INSPECTION.

The responsibility of conducting the visual inspection may be assigned by the pilot to the copilot, navigator, crew engineer, or radio operator. When conducting these visual inspections, each item of the checklist will be inspected for the condition and/or the position described thereon. The radio operator will, upon completion of the inspection, report to the copilot that everything is in order, or state any discrepancies. The copilot will then report completion of all checklists to the pilot.

RADIO OPERATOR (AF51-17626 THROUGH AF51-17661, AF51-17667, AND AF51-17668).

The radio operator, in addition to checking out the equipment described in Section IV, will also assume the following responsibilities:

A. Have a thorough knowledge of the emergency equipment.

B. Inspect the emergency radio (AN/CRT-3) for correct stowage and current inspection dates.

C. Be familiar with cabin fire procedure.

D. Be able to give passenger briefing on bail-out and ditching procedures.

RADIO OPERATOR'S PREFLIGHT CHECKLIST.

Note

On aircraft without the services of a radio operator, these items will be checked by a pilot crew member.

EXTERIOR INSPECTION.

Nose to Belly Scoop.

A. VHF and/or UHF antennas – CHECK SECURENESS AND GENERAL CONDITION.

B. ADF loop housings – CHECK SECURENESS AND GENERAL CONDITION.

C. ADF sensing antennas – CHECK SECURENESS AND GENERAL CONDITION.

Right Wing Fillet and Root-to-Tail Right Side Check.

A. H/F antenna (liaison) – GENERAL CONDITION AND SECURENESS.

B. Antennas - CHECK ALL ANTENNAS FOR TAUTNESS AND SECURENESS (IFF, RADIO ALTIMETER, FLAT TOP ANTENNA). CHECK COVER OVER MARKER BEACON ANTENNA FOR CRACKS AND MAKE SURE IT IS NOT PAINTED.

INTERIOR INSPECTION.

Main Cargo Compartment.

A. Interphone and public address system – CHECK TELEPHONE, AND INTERPHONE AND PUBLIC ADDRESS SYSTEM FOR OPERATION.

B. Emergency radio – CHECK THAT THE EMERGENCY RADIOS ARE PROPERLY SECURED. TYPE, NUMBER, AND LOCATION WILL VARY WITH CONFIGURATION AND MISSION.

C. IFF (if installed) – CHECK AND SET.

Crew Compartment Check.

A. Emergency transmitter – CHECK THAT THE URC-4 EMERGENCY TRANSMITTER (S) ARE INSTALLED AND PROPERLY SECURED, (IF APPLICABLE).

NAVIGATOR.

The navigator will aid the pilot in all matters pertaining to flight planning and will perform any other duties assigned.

NAVIGATOR'S PREFLIGHT CHECKLIST.

EXTERIOR INSPECTION.

Nose to Belly Scoop.

A. Driftmeter (if installed) – CHECK LENS AND LENS HOUSING FOR CLEANLINESS, GENERAL CONDITION, AND HOUSING SECURED.

B. Flare chute – CHECK FOR GENERAL CONDITION.

INTERIOR INSPECTION.

Crew Compartment Check.

A. Navigator's equipment – CHECK THAT NAVIGATOR TABLE IS IN STOWED POSITION; DRIFTMETER IS CAGED AND OFF; LORAN, RADIO ALTIMETER, AND RADAR OFF; DRIFT FLARES STOWED; VERY PISTOL EMPTY, IN PLACE, AND SECURED; PISTOL SIGNALS ABOARD AND SECURED; DRIFT FLARE CHUTE CLOSED; STAR SIGHTING WINDOW CLEAN; NAVIGATOR'S STOOL SECURED; PERISCOPIC SEXTANT ABOARD; AND NAVIGATION PUBLICATIONS, KITS, AND FLASHLIGHTS ABOARD.

B. Magnetic compass – REMOVE ANY METAL OBJECTS FROM IMMEDIATE VICINITY OF MAGNETIC COMPASS. SHAKE BOWL AND CHECK FLUID LEVEL AND FREEDOM OF CARD.

FLIGHT ATTENDANT.

FLIGHT ATTENDANT'S PREFLIGHT CHECKLIST.

INTERIOR INSPECTION.

Main Cargo Compartment.

A. Lavatories – INSPECT BOTH LAVATORIES FOR NEATNESS AND CLEANLINESS. CHECK INSPECTION WINDOW ON PRESSURE BULKHEAD FOR SECURENESS. (SCREWDRIVER INSTALLED FOR EMERGENCY USE.) CHECK WATER FLOW FROM LAVATORY FAUCETS.

B. Wash water tank valve – CHECK THAT VALVE IS ON NORMAL POSITION.

C. First aid kits – CHECK THAT FIRST AID KITS ARE INSTALLED AND THAT SEALS ARE UNBROKEN.

D. Buffet – INSPECT BUFFET FOR CLEANLINESS. CHECK THAT ELECTRICAL CONNECTOR BEHIND BUFFET IS PLUGGED IN AND SECURED. CHECK OPERATION OF HOT CUP RECEPTACLE BY OPERATION OF SWITCHES ON BUFFET PANEL. AMBER LIGHTS ON PANEL INDICATE POWER TO RECEPTACLE. CHECK WATER HEATER AND TOILET LIGHTS. BUFFET CEILING LIGHT WILL DIM NOTICEABLY WHEN WATER HEATER IS TURNED ON. CHECK THAT RELEASE PINS ON BUFFET ARE INSTALLED AND SECURED.

E. Water tanks – CHECK THAT THE AFT 10-GALLON WATER TANK IS PROPERLY SECURED.

F. Liferafts and vests – CHECK FOR SUFFICIENT RAFTS AND LIFE VESTS TO ACCOMODATE ALL PERSONNEL ABOARD AIRCRAFT. CHECK CONDITION OF ALL RAFTS AND MAKE SURE THEY ARE SECURED. NUMBER OF RAFTS WILL VARY WITH CONFIGURATION.

G. Emergency slide – CHECK FOR INSTALLATION, STOWAGE, AND GENERAL CONDITION.

H. Ditching rope – CHECK THAT DITCHING ROPE AT MAIN CABIN DOOR HAS RED RIBBON SECURELY ATTACHED, AND IS FASTENED TO SNAP SECURELY.

I. Safety belts, oxygen masks, and smoke masks – ONE SAFETY BELT FOR EACH PERSON, EITHER PASSENGER OR CREW, AND ONE OXYGEN MASK FOR EACH CREW MEMBER. AIR EVACUATION PATIENTS WITH LUNG OR RESPIRATORY AILMENTS WHO ARE TO BE CARRIED SHALL BE PROVIDED WITH AN OXYGEN MASK (NORMALLY SUPPLIED BY AIR EVACUATION MEDICAL TEAM).

J. Distribution and secureness of cargo – IF CARGO IS LOADED, CHECK DISTRIBUTION AND SECURENESS. PASSENGERS SHALL NOT BE SEATED FORWARD OF CARGO. ADEQUATE SAFETY SHALL BE PROVIDED AND CARGO SHALL BE LOADED TO PROVIDE UNOBSTRUCTED AND OPERABLE EMERGENCY EXITS IN ACCORDANCE WITH LOCAL DIRECTIVES. ALSO CHECK THAT LOWER COMPARTMENT VIEWER ACCESS DOORS ARE CLEAR OF CARGO OR BAGGAGE, IF POSSIBLE.

K. General condition of cabin – CHECK CLEANLINESS, SECURENESS, AND THAT DITCHING PLACARDS ARE INSTALLED.

L. Nameplates (if required) – INSTALL CREW NAMEPLATES.

Crew Compartment Check.

A. First aid kits – CHECK THAT FIRST AID KITS ARE MOUNTED ON THE AFT SIDE OF VOLTAGE REGULATOR PANEL AND THAT SEALS ARE UNBROKEN.

SECTION IX

all weather operation

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LIST OF ILLUSTRATIONS

INTRODUCTION.

This section contains only those procedures which differ from, or are in addition to, the normal operating instructions covered in Section II, except where repetition is necessary for emphasis, clarity, or continuity of thought. Operation of the various aircraft systems is described in Section VII.

NIGHT FLYING.

Night flying procedure is conventional and there is no special technique required in the use of any of the aircraft equipment. However, it is recommended that landing lights be turned off prior to retraction.

OPERATION UNDER INSTRUMENT FLIGHT CONDITIONS.

The aircraft has excellent qualities in regard to instrument flying. Stability in all axes is excellent, and the aircraft can be trimmed to fly "hands off." Takeoff characteristics are satisfactory. Maneuverability on GCA and ILS is excellent. Before attempting an instrument flight, check that all radios and flight instruments are operating properly.

INSTRUMENT TAKEOFF.

Use the following procedure when making an instrument takeoff:

A. Check all radios and flight instruments for proper operation.

B. Make certain the control-surface lock is off and that the controls are free.

C. Set the altimeters for correct barometric pressure.

D. When takeoff clearance is received, align the aircraft on the centerline of the runway and proceed with the specified takeoff.

E. Raise the landing gear as soon as positive climb is established.

F. Climb until clear of obstacles and accelerate to en route climb speed. (See Appendix for climb speeds.)

INSTRUMENT CLIMB.

Climbing airspeed and attitude are easily maintained and the aircraft handles satisfactorily up to and during maximum rate of climb. Climbing turns should be limited to bank angles of 30 degrees.

CRUISING UNDER INSTRUMENT CONDITIONS.

The aircraft should be handled in the same manner as during VFR flight. (See the Appendix for cruising speeds.) In addition, the following checks should be made periodically:

A. Check directional indicators and attitude indicators for proper indication, cross-checking all flight instruments.

B. Check pitot heaters and surface deicing equipment for proper operation during icing conditions.

SNOW, RAIN, ICE CRYSTAL, OR CORONA RADIO STATIC.

When radio static is encountered en route, turn the radio volume down until conditions improve. When nearing the destination, the following may improve reception:

Reduced airspeed.

Lowered radio volume.

Keying the transmitter.

Radio compass in LOOP (wing tip position).

Changing rpm.

DESCENT.

To descend from altitude, use the same procedure as during VFR flight down to the minimum safe altitude for the range being used and in accordance with instructions received from the airway traffic controller.

HOLDING PROCEDURE.

Holding is normally accomplished by using the traffic pattern configuration (rpm 2100, flaps 20 degrees, 140 knots). However, if prolonged holding is expected or fuel is considered critical, fly the aircraft clean in accordance with Maximum Endurance Power Charts.

INSTRUMENT APPROACHES.

The general qualities and capabilities of the aircraft on instrument approaches are excellent and there is no special technique required in the handling of the aircraft.

AUTOMATIC APPROACH.

The procedure to be used when flying an automatic approach is as follows:

A. Automatic approach selector switch — AUTOPILOT.

B. Autopilot — ENGAGED.

C. Altitude control switch — ON.

D. Prior to or when over outer marker outbound, reduce airspeed to 140 knots (161 mph) and call for the maneuvering descent checklist.

One minute after crossing the outer marker outbound, execute a standard procedure turn by using the autopilot turn control knob.

E. On the inbound heading, which in most cases will be 45 degrees from the localizer heading, turn the automatic approach selector switch to LOCALIZER when the vertical needle of the course indicator just leaves the stops.

F. When steady on the localizer, the glide slope should be monitored by means of the cross pointer indicator. Just prior to glide path interception (approximately 30 seconds or one mile) extend wing flaps to 30 degrees and allow airspeed to taper to the approach airspeed. Set rpm at 2400. When the cross pointer indicator shows one-half to one dot above center, extend the landing gear and complete the Before Landing checklist.

G. When the cross pointer indicator centers, turn OFF the automatic altitude control, adjust the pitch knob to effect the approximate rate of descent, and then turn the automatic approach selector switch to APPROACH position. (Check to see that approach-ready light is illuminated.)

H. Check cross pointer indicator to be sure that the correct glide slope is being held. Adjust power as necessary to maintain 120 knots. Just prior to reaching minimum approach altitude, the pilot depresses autopilot release switch on his control wheel, states "Servos out", and assumes control of the aircraft to complete the landing or missed approach as applicable. Crew engineer disengages autopilot servos on pilot's command.

CIRCLING APPROACHES.

It must be remembered, that a circling approach is not an IFR maneuver, and visual contact with the runway and/or terrain should be maintained throughout. The minimum circling altitude guarantees a clearance of only 300 feet above obstacles within 1.7 nautical miles from the airfield boundaries.

Note

Circling approaches should be conducted in strict observance of circling approach minimums. A circling approach in the maneuvering configuration takes a radius of turn of approximately 1.5 miles.

MANEUVERING CONFIGURATION.

The maneuvering configuration for four-engine circling approaches will normally be rpm 2100, flaps 20 degrees, and airspeed 140 knots.

VOR, ADF, AND RANGE APPROACH PROCEDURE — FOUR-ENGINE (STRAIGHT-IN FINAL).

A. Just prior to high station, pilot reduces airspeed and calls for rpm 2100, flaps 20 degrees, and the maneuvering Descent checklist.

B. Maintains 140 knots and flaps 20 degrees from high station throughout procedure turn. If necessary, 2400 rpm may be used.

C. Just prior to low station, pilot may extend flaps to 30 degrees. At low station rpm 2400, gear down, flaps 30 degrees and complete Before Landing checklist. Maintain 120 knots until runway is in sight.

VOR, ADF, AND RANGE APPROACH PROCEDURE — THREE-ENGINE (STRAIGHT-IN FINAL).

A. Just prior to high station, pilot reduces speed and calls for rpm 2400, flaps 20 degrees, and the maneuvering Descent checklist.

B. Rpm 2600 may be used if necessary.

C. Just prior to low station, pilot may extend flaps to 30 degrees. At low station, rpm 2600, gear down, flaps 30 degrees, ADI-ON, and complete Before Landing checklist. Maintain 120 knots until runway is in sight.

VOR, ADF, AND RANGE APPROACH PROCEDURE — TWO-ENGINE (STRAIGHT-IN FINAL).

A. Just prior to the high station, pilot reduces airspeed and calls for rpm 2600 and the maneuvering Descent checklist.

B. Rpm 2800 may be used if necessary.

C. Over low station, rpm 2800, flaps 20 degrees. Maintain 140% Vs.

Note

When the distance from the low station to the airfield prohibits immediate descent, the flaps should remain UP until starting descent. This will prevent using prolonged high power when the station is a considerable distance from the airfield.

LOW FREQUENCY RANGE, OMNI AND ADF PROCEDURES (STRAIGHT-IN)

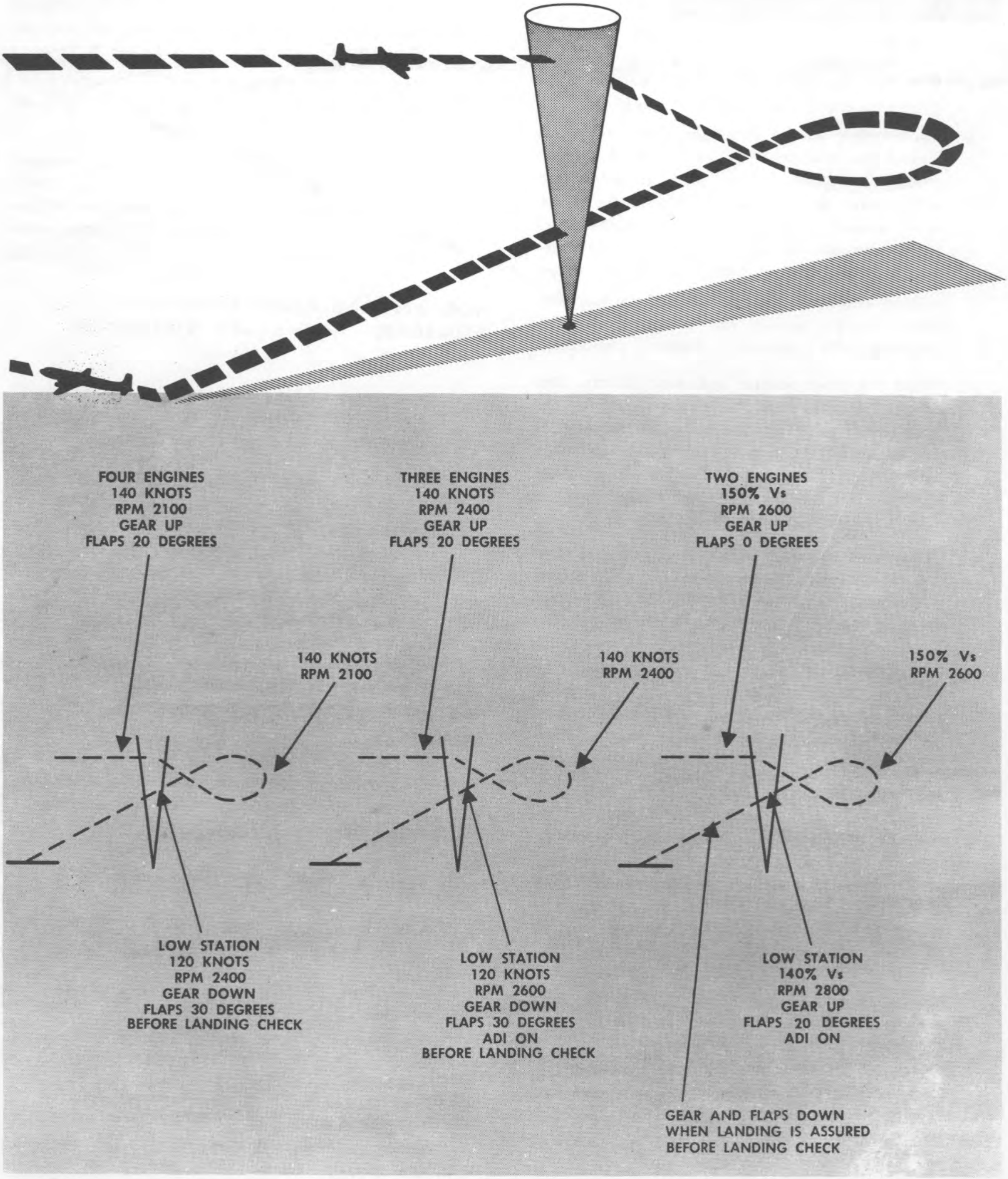
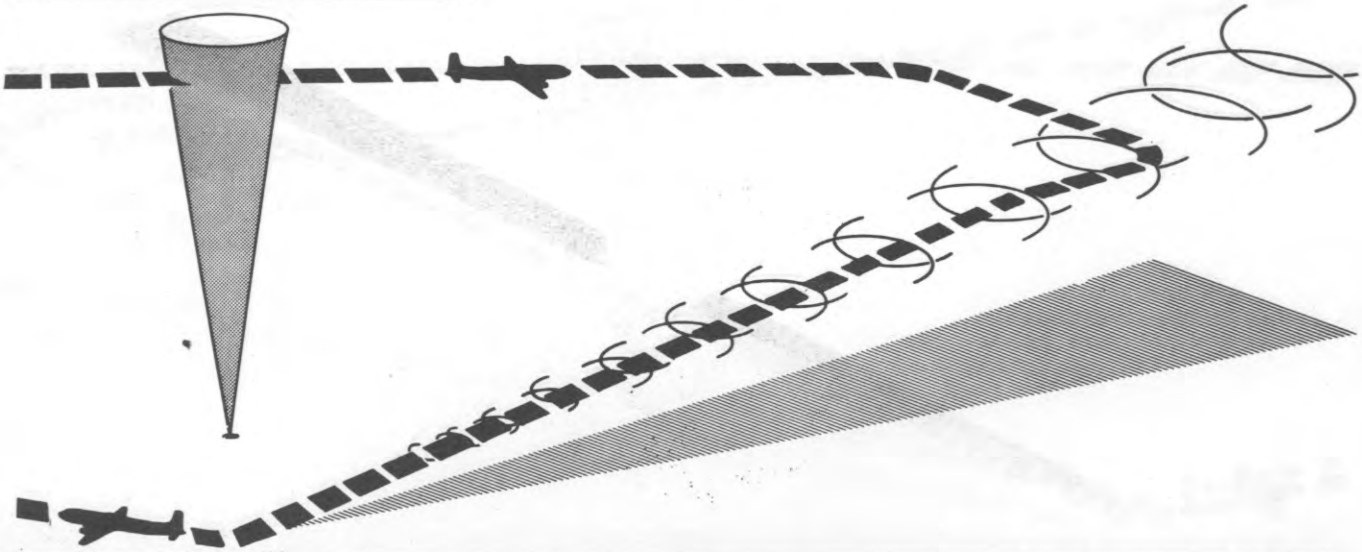
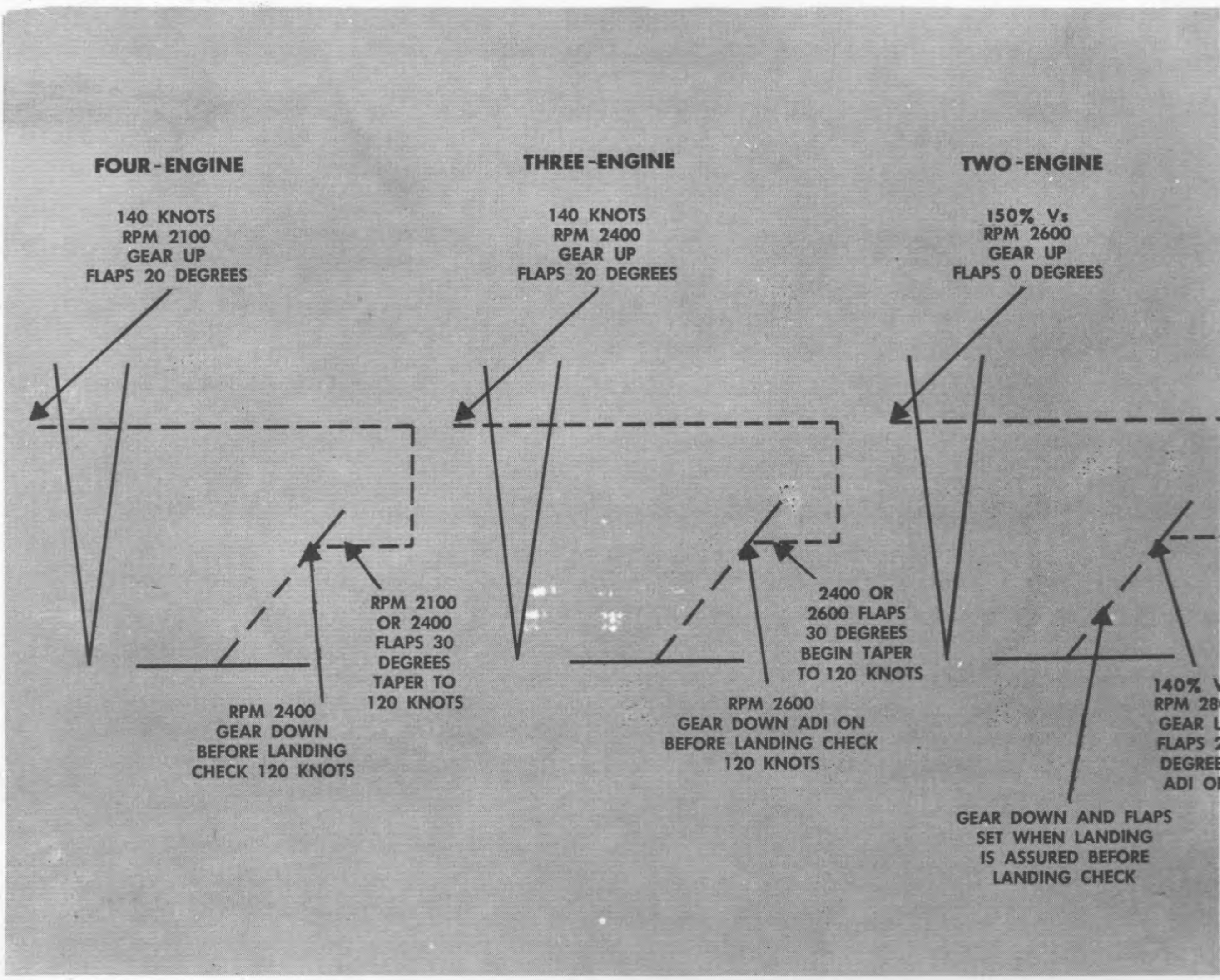


Figure 9-1

GCA PROCEDURE

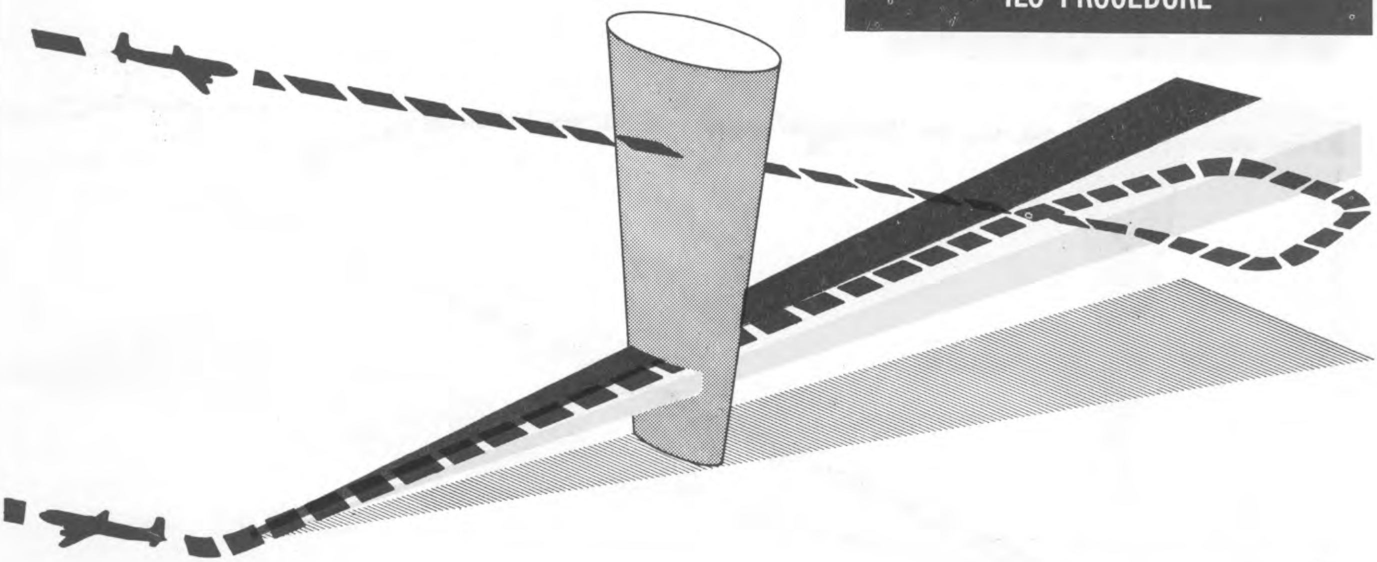




AA1-172

Figure 9-2

ILS PROCEDURE



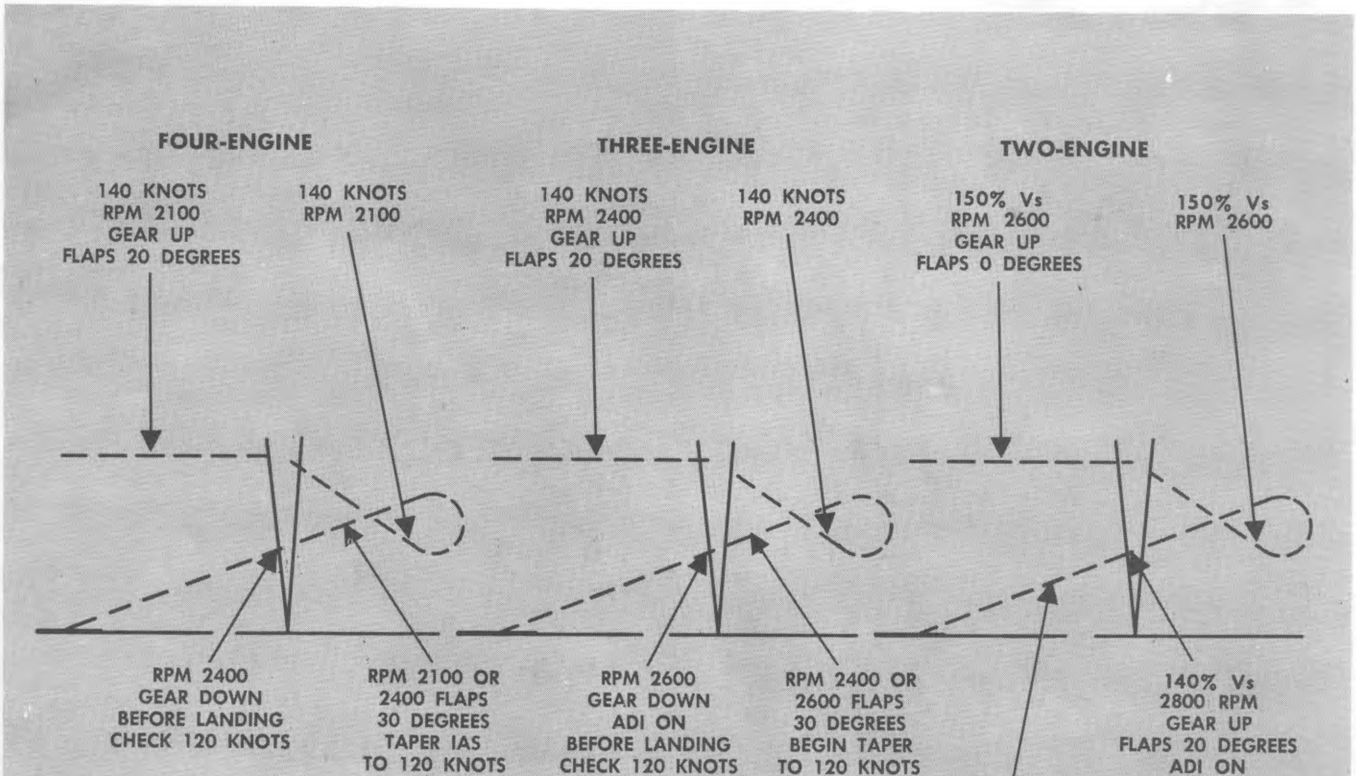


Figure 9-3

TACAN PROCEDURE -Typical

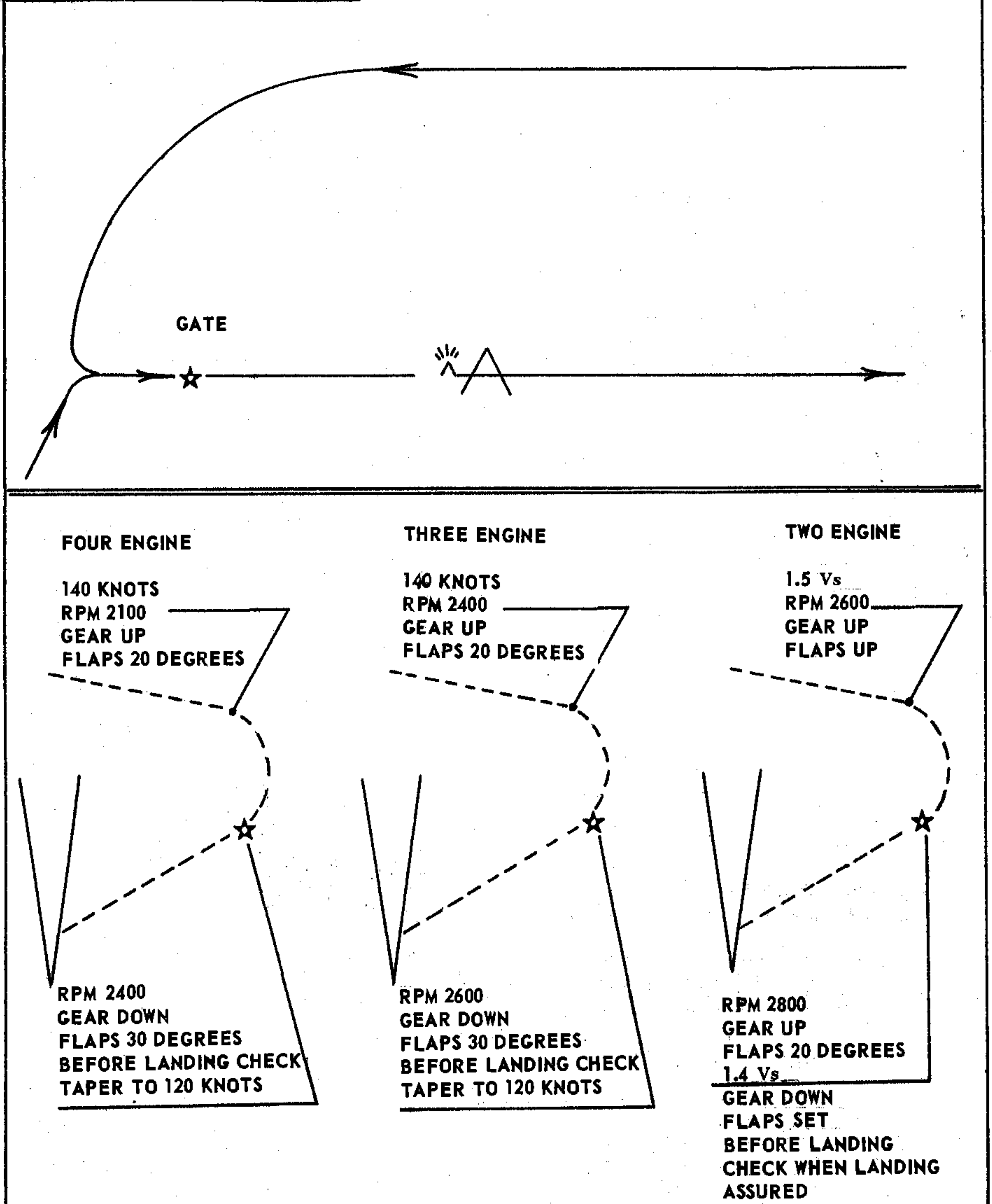


Figure 9-4

D. Maintains an airspeed of at least 140% Vs.

E. Do not extend gear or wing flaps beyond 20 degrees until certain that landing will be completed. Complete Before Landing checklist and ADI-ON.

Note

At normal landing gross weights, it is impossible to maintain altitude even with maximum power on two engines with either the gear down and zero flaps or the flaps down and gear up. Maintain a speed of 140 knots IAS during approach until certain that a landing will be accomplished (see the paragraph, Go-Around With Two Engines Inoperative, Section III). The pilot must remember that considerably more power will be required on the good engines during the two-engine approach. It is important to remember that normal relationships of power, trim, and control do not apply with two engines out on one side. During approach with two engines inoperative on one side, it is better to control manually, at least in part, the directional and lateral attitudes of the aircraft, rather than to apply full trim tab to rudder and aileron. This will obviate a drastic trim change and/or reduce the forces necessary to maintain control when power is reduced for landing.

VOR, ADF, AND RANGE APPROACH PROCEDURE – FOUR-ENGINE (CIRCLING FINAL).

A. Just prior to the high station, pilot reduces airspeed and calls for rpm 2100, flaps 20 degrees, and the maneuvering Descent checklist.

B. Rpm 2400 may be used if necessary.

C. After turning base leg, pilot calls for rpm 2400 gear down, flaps 30 degrees and the Before Landing checklist. (Refer to Circling Approaches, this section, for additional information.)

VOR, ADF, AND RANGE APPROACH PROCEDURE – THREE-ENGINE (CIRCING FINAL).

A. Just prior to the high station, pilot reduces airspeed and calls for rpm 2400, flaps 20 degrees and the maneuvering Descent checklist.

B. Rpm 2600 may be used if necessary.

C. After turning base leg, pilot calls for rpm 2600, gear down, flaps 30 degrees, and the Before Landing checklist (water-alcohol – ON).

VOR, ADF, AND RANGE APPROACH PROCEDURE – TWO-ENGINE (CIRCLING FINAL).

A. Just prior to the high station, pilot reduces airspeed and calls for rpm 2600 and maneuvering Descent checklist.

B. Rpm 2800 may be used if necessary.

C. When certain that landing can be completed, pilot calls for rpm 2800, gear down, flaps set, and the Before Landing checklist (water-alcohol – ON).

GCA AND ILS APPROACH PROCEDURE – FOUR-ENGINE.

NOTE

When necessary to make a circling approach, maintain maneuvering configuration and airspeed (140 knots) on glide path and until after turning on base leg.

A. Just prior to reaching the radio fix used in conjunction with GCA or ILS, the pilot reduces airspeed and calls for rpm 2100, flaps 20 degrees, and the maneuvering Descent checklist.

B. Maintains 140 knots, flaps 20 degrees, and rpm 2100 on GCA downwind leg or outbound on ILS.

C. Just prior to glide path interception (approximately 30 seconds or 1 mile) extend flaps to 30 degrees, allowing airspeed to taper to approximately 120 knots at glide path interception. When flaps are set 30 degrees, rpm may be advanced to 2400 for stabilization, if desired. Upon glide path interception, rpm 2400, gear down, Before Landing checklist. Maintain 120 knots.

GCA AND ILS APPROACH PROCEDURE — THREE-ENGINE.

NOTE

When necessary to make a circling approach, maintain maneuvering configuration and airspeed (140 knots) on glide path and until after turning on base leg.

A. Just prior to reaching the radio fix used in conjunction with GCA or ILS, the pilot reduces airspeed and calls for rpm 2400, flaps 20 degrees, and the maneuvering Descent checklist.

B. Maintain 140 knots, flaps 20 degress, and rpm 2400 on GCA downwind leg or outbound on ILS.

C. Just prior to glide path interception (approximately 30 seconds or 1 mile) extend flaps to 30 degrees, allowing airspeed to taper to 120 knots at glide path interception. When flaps are set 30 degrees, rpm may be advanced to 2600 for stabilization if desired. Upon glide path interception, rpm 2600, gear down, ADI-ON, and complete Before Landing checklist. Maintain 120 knots.

TWO-ENGINE GCA AND ILS APPROACH PROCEDURE.

A. Just prior to reaching the radio fix used in conjunction with GCA or ILS, the pilot reduces airspeed and calls for rpm 2600 and the maneuvering Descent checklist.

B. Maintain 150% Vs (minimum), flaps UP, and rpm 2600 on GCA downwind leg or outbound on ILS.

C. When intercepting the glide path on GCA or ILS, pilot calls for rpm 2800 and flaps 20 degrees, and maintains 140% Vs.

D. When certain that the landing can be completed, pilot calls for gear down, flaps set, and the Before Landing checklist (ADI-ON).

TACAN APPROACH PROCEDURE

FOUR ENGINE

A. Just prior to reaching the inbound TACAN Gate, the pilot reduces airspeed to 140 knots, calls for RPM 2100, flaps 20 degrees and maneuvering descent checklist.

B. Maintains 140 knots, maneuvering configuration until reaching TACAN Gate. RPM may be increased to 2400 RPM for stabilization, if desired.

C. Upon interception of the TACAN Gate, pilot calls for RPM 2400, gear down, flaps 30 degrees and before landing check. Tapers airspeed to and maintains 120 knots.

THREE ENGINE _ TACAN APPROACH

A. Just prior to reaching the inbound TACAN Gate, the pilot reduces airspeed to 140 knots, calls for RPM 2400, flaps 20 degrees and maneuvering descent checklist.

B. Maintains 140 knots, maneuvering configuration until reaching TACAN Gate. RPM may be increased to 2600 RPM for stabilization, if desired.

C. Upon interception of the TACAN Gate, pilot calls for RPM 2600, gear down, flaps 30 degrees and before landing check. Tapers airspeed to and maintains 120 knots.

TWO ENGINE – TACAN APPROACH

A. Just prior to reaching the inbound TACAN Gate, the pilot reduces airspeed to 1.5 Vs, calls for RPM 2600 and maneuvering descent checklist.

B. Maintains 1.5 Vs, flaps UP, and RPM 2600 to the TACAN Gate.

C. Upon interception of the TACAN Gate, pilot calls for RPM 2800, 20 degrees flaps and decreases airspeed to 1.4 Vs. Maintain 1.4 Vs until certain a landing can be completed. Pilot will call for gear down, flaps set and before landing check at this time. (ADI—ON)

Note

Maneuvering descent configuration may be maintained beyond the TACAN GATE if the distance from this point to the airfield missed approach point is considered excessive.

FLIGHT IN THUNDERSTORMS.

Note

Should circumstances force a flight into a zone of severe turbulence, the following recommended techniques aid in reducing structural strain on the aircraft.

For flight in severe turbulence, see Section V for the recommended range of airspeeds. If possible, do not operate on fuel tanks that have less than 1000 pounds; return each engine to its own fuel supply. Place the mixture in AUTO RICH and turn the booster pumps on low. When operating in icing or severe cold, mixtures may be adjusted to *best power* to maintain cylinder head temperatures within limits. When slowing to penetration speed to reduce the effect of turbulence, it is desirable to reduce power and wait for the speed to drop without simultaneously pulling up the aircraft. The reason for this is to avoid combining the acceleration due to the pull-up with those accelerations resulting from the turbulence. It is imperative that the aircraft be prepared as follows prior to entering severe turbulence:

A. Autopilot altitude control switch — OFF.

B. Power — REDUCE TO OBTAIN PENETRATION SPEED.

Note

For flight in severe turbulence, speeds of 165 knots under 100,000 pounds, and 175 knots over 100,000 pounds are recommended.

C. Hydraulic bypass lever — DOWN.

D. Gear lever — UP.

E. Mixture controls — AUTO RICH.

F. Booster pumps — LOW.

G. Carburetor heat — SET.

H. Heater and de-icers or anti-icers — ON.

I. Gyro instruments — CHECKED.

J. Safety belts — TIGHTENED.

K. Cockpit lights — SET.

L. Seat belt light — ON.

Note

For night operations, the cockpit lights may be turned to full bright to minimize the blinding effects of lightning.

WARNING

Do not lower the wing flaps. Refer to wing flap stresses, Section VI.

PENETRATING STORM.

Penetrate the storm as follows:

A. Establish power to provide recommended penetration speed before entering the storm.

B. Devote all attention to flying the aircraft. Concentrate principally on holding a level attitude by reference to the artificial horizon and maintaining as constant an altitude and airspeed as possible.

Note

Normally, the least turbulent area in a thunderstorm will be an altitude of 6000 feet above the terrain. Altitudes between 10,000 and 20,000 feet are usually the most turbulent.

C. Use as little elevator control as possible in maintaining altitude in order to minimize the stresses imposed on the aircraft.

COLD WEATHER PROCEDURES.

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 arctic operation. The following actions should be taken when temperatures reach 0°F and lower.

BEFORE ENTERING AIRCRAFT.

A. Apply external heat to the engines and accessory sections. An extra heater duct should be directed to the auxiliary power unit if the unit is to be used. The following list of time requirements for engine heating at various temperatures gives rough estimates which will vary with wind velocities and percentage of engine oil dilution. The tabulation is based on an oil dilution of approximately 25 percent and no wind.

—6° to —18°C (20° to 0°F) .... ½ hour (approximately)

—18° to —32°C (0° to —25°F) ...... ½ to 1 hour

—32° to —40°C (—25° to —40°F) .. 1 to 2 hours

—40° to —54°C (—40° to —65°F) .... 1½ to 2½ hours

B. Check the oil drains for oil flow. If no oil flow is obtainable, apply external heat to the drains and oil tanks. In addition to external heating, oil immersion heaters may be used. 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 engine shutdown.

C. Start the cabin heater as soon as possible to heat the flight instruments, defrost the windshields, and warm the radios, dynamotors, inverters, and other equipment within the aircraft. At −54°C (−65°F), the cabin heater may not operate unless radome heat is turned ON first. If the cabin heater still fails to operate, check for a frozen fuel solenoid in the landing gear well. Cabin superchargers should be preheated at temperatures below −40°C (−40°F).

D. Remove all covers from the aircraft, including the pitot covers, and inspect for ice.

E. Clean the shock struts and landing gear actuating cylinders of ice and dirt. Check inflation of the landing gear struts, and, if necessary, service with *dry* air.

F. 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.

G. Check for operation of cowl flaps. If the cowl flaps to not operate, apply heat as necessary.

H. Check for proper flow of windshield deicing fluid and for quantity of fluid in tanks.

I. If oxygen is to be used, check the system and portable oxygen bottles for proper operating pressure.

J. Check the emergency airbrake pressure for normal operating pressure, which should be 1000 (±50) psi.

K. Check all accumulators for proper operating pressure. The nosewheel steering accumulator air pressure should be 50 (+5,—0) psi. The hydraulic accumulator air pressure should be 1000 (+200, —0) psi.

L. Check the operation of the main cargo door. If it operates sluggishly at −29°C (−20°F) and lower, apply heat to the actuating cylinders.

M. Check the operation of the hydraulic accessories compartment door. If it fails to close, apply heat to the door seals.

BEFORE STARTING ENGINES.

Before starting the engines, perform the following:

A. Remove the oil immersion heaters, if used.

B. Remove the ground heater ducts.

C. Remove all covers.

STARTING ENGINES.

Start the engine by the normal procedure (Section II), except for the following variations:

A. Rather than short, rapid actuation of the primer switch, hold the switch in the PRIME position for a longer period to provide effective priming.

Note

High boost may be used if necessary, provided low boost is used first.

B. Oil may be diluted slightly if pressure is too high for a prolonged period.

C. Carburetor heat should be applied immediately after starting, in order to assist vaporization and combustion. Do not exceed a carburetor air temperature of 38°C (100°F).

D. Check all instruments for proper operation.

E. If the oil pressure gage does not indicate minimum pressure within 30 seconds, shut down the engine and check for a frozen oil pressure transmitter. If the transmitter is frozen, apply heat as necessary.

F. Operate wing flaps through at least one cycle.

G. Check the movement of the control surfaces.

WARMUP AND GROUND TESTS.

Use the procedure outlined in Section II.

TAXIING INSTRUCTIONS.

Use the same procedure outlined in Section II, only taxi more slowly and use more caution when applying brakes.

BEFORE TAKEOFF.

Make a thorough check for ease and proper operation of all controls important to a cold weather takeoff. These controls include carburetor heat, cowl flaps, oil cooler, cabin heater, and trim tabs.

WARNING

Remove all frost, snow, and ice accumulations before flight.

TAKEOFF.

A. The cabin heating system should be operating, and the windshield anti-icing system should be utilized during takeoff.

B. Pitot heaters and propeller and airfoil de-icers should be ON if precipitation is encountered or if icing conditions are anticipated immediately after takeoff.

C. The pilot should be cognizant of the fact that the flight indicators are not very reliable at temperatures below —20°C (—4°F). Also, all flight instruments should be cross-checked.

Note

At temperatures below —7°C (+20°F) the landing gear lever should remain in the UP position until a safe altitude has been attained, because there is danger of the landing gear extending due to uplatches not engaging when gear lever is placed in NEUT position. The gear lever may be moved to NEUT position after climbing to a safe altitude; however, the pilot should be aware that the gear may free fall.

DURING FLIGHT.

Adjust the cowl flaps as required in order to maintain proper cylinder head temperatures. Cross-check all flight instruments and be alert for any erroneous indication.

PREPARATION FOR ICING.

Icing conditions may be anticipated by a close study of the weather map, weather forecasts, and indications en route. Prepare the aircraft for icing prior to entering any possible icing zone.

CARBURETOR PREHEAT.

When icing conditions are anticipated, carburetor preheat should be used. A carburetor air temperature of 15°C will prevent severe power loss when entering heavy precipitation if preheat is applied several minutes in advance. The automatic mixture control requires up to 5 minutes to adjust to large changes in temperature, and may tend to overcompensate for temperatures appreciably above standard. It is therefore desirable to richen mixtures prior to the application of carburetor preheat, and then delay resetting the chart brake mean effective pressure (bmep) drop until 5 minutes after the throttles have been opened or rpm has increased to the new chart value. At any fixed position of the carburetor preheat control carburetor air temperature (CAT.) will fluctuate with power, airspeed, cowl flap opening, and air moisture content. It will be necessary to monitor the CAT. in order that sufficient heat for ice prevention be maintained, and that the maximum temperature limits of 38°C in low ratio and 15°C in high ratio not be exceeded, except as noted in the following paragraph.

Should carburetor icing occur, it is usually first indicated by a loss of bmep and fuel flow, not necessarily accompanied by engine instability or loss of manifold pressure. The indication is the same as would be obtained by moving the mixture control toward IDLE CUTOFF. Corrective action for this most common type of icing (the presence of which is confirmed by loss of both bmep and fuel flow) consists of AUTO RICH mixture, full carburetor heat for 30 seconds, and then slowly reduced heat to 15°C when it is established that cooler CAT. increases fuel flow and bmep, thus indicating that ice has been eliminated. When advanced stages of leanness have occurred, full prime may be of assistance in restoring power. The addition of carburetor preheat reduces bmep, and this is not to be contsructed as further icing. When ice has been thoroughly eliminated and the CAT. stabilized for 5 minutes, the mixture may be reset to chart bmep drop. It is possible in some circumstances for ice to form in the airscoop, on the carburetor upper deck screen, or in the supercharger intake throat in such a manner as to restrict airflow and therefore cause a loss of manifold pressure, as well as fuel flow and bmep. Corrective action is the same as above, with the addition of rpm and/or high blower ratio, if necessary to generate the required heat.

Another less common type of carburetor icing may be encountered when descending through warm moist air with cold fuel in the tanks. The fuel, acting as a refrigerant, may cause ice to form and create a restriction between the air chambers of the carburetor, thus inducing excessive fuel flow, with resultant bmep loss. Full carburetor preheat should be applied, but the mixtures in this case should be leaned to best power as indicated by bmep. Monitor both bmep and fuel flow in this condition, since mixtures will lean out rapidly as ice is dispelled. Restore normal CAT. and mixture as before. With the — 16 carburetor, this type of icing is more likely to occur under other conditions, but it can be dispelled much more readily. Carburetor de-icing alcohol has been helpful in ice elimination, particularly ice of the latter type; however, preheat is a more effective remedy.

Because of the reaction time required by the automatic mixture control to large temperature changes, the sudden removal of carburetor heat will cause mixture to lean severely. For this reason, the mixture controls should be placed in AUTO RICH and CAT. reduced in increments. Allow temperatures to stabilize for 5 minutes before adjusting mixtures to desired value.

CARBURETOR ALCOHOL DEICING.

If the presence of ice is still suspected after applying carburetor preheat or if the carburetor preheat is inoperative, return the carburetor air temperature controls to full COLD position, and operate the carburetor alcohol deicing system for a period of 1 minute.

Note

> As a last resort, backfire the engine by manually leaning.

PROPELLER DEICING.

Ice is prevented from forming on the propeller blades by electrical heating elements mounted on the blade leading edge. The propeller deicing system is controlled by a single ON-OFF master switch on the heater control panel. Operation of the system is either automatic or manual. When the system is operated automatically, each propeller, one at a time, receives electrical current for a period of 20 seconds. Each propeller is heated once every 80 seconds. For manual operation, position the individual propeller selector switches to MANUAL and rotate the ammeter selector switch in sequence to the four ON positions. When manually deicing, it is recommended that the time period for each propeller not exceed 60 seconds ON and 180 seconds OFF.

Before entering any possible icing conditions, turn the propeller deicing system ON. Generally, automatic operation will be sufficient to keep the propeller blades free of ice.

Note

- The lack of cooling airstream over the propeller blade surfaces, when the engines are inoperative, is the limiting factor for ground operation. One complete cycle should be sufficient for ground checks. Any one propeller may be isolated from the automatic system by turning its manual switch ON and keeping the selector switch OFF. This may be desirable if any one propeller vibrates, because one blade is not receiving proper heating. Electric heating is available when any propeller is in the feathered position.
- When making a ground check, the propeller deicing switch should be turned ON and the propeller deicing ammeter checked for a 20-second cycle for each propeller. The switch should then be placed in the OFF position. The desired amperage during this check is 150-225 amperes. A reading below 150 amperes may indicate a malfunction and should be thoroughly checked by maintenance.

PITOT, STATIC, AND AIRSCOOP DEICING.

The pitot heads, static vents, and the airscoops incorporate electrical heating elements to prevent the accumulation of ice. An ON-OFF switch, which operates the system, is mounted on the upper instrument panel.

Note

> Do not operate the pitot heaters for extended periods on the ground, as the lack of cooling airstream will result in damage to the pitot heads. The pitot heater should be turned ON when icing conditions prevail and when flying through rain or clouds.

WINDSHIELD HEAT.

By setting the windshield heat selector switch to the temperature range in which the aircraft is flying, the windshield will remain at a temperature which will probably melt any ice that is encountered. In the event of severe icing, the windshield heat selector can be turned to the ANTI-ICING position to supply the maximum amount of heat from the cabin heater directly to the windshield.

WINDSHIELD ALCOHOL DEICING.

If the windshield heat does not keep the windshield clear, apply windshield de-icing fluid. Normally, this can be delayed until the aircraft is out of the icing zone, since the ice will usually evaporate or melt during descent.

AIRFOIL ANTI-ICING.

Turn ON the airfoil anti-icing heater switch 3 to 5 minutes prior to entering icing conditions to allow time for the airfoil leading edges to heat to maximum temperature. If unable to anticipate icing, turn system ON when first accumulation of ice is noted. Accumulated ice should melt and blow off. Leave the airfoil anti-icing heaters ON continuously when flying in and out of intermittent icing conditions.

It is permissible to operate the airfoil anti-icing heaters on the ground prior to and during takeoff, when climbing into known icing conditions. The heaters should be manually turned OFF after landing, rather than depending upon the automatic controls. If one wing airfoil heater fails to operate, turn both heaters OFF, in order to maintain wing symmetry. If the tail airfoil heater is inoperative, it is permissible to continue operation of the wing airfoil heaters for anti-icing. Normal cruising speed is permissible in light icing conditions, provided that long duration in the icing does not result in accumulations in excess of 1 inch on the engine cowling, propeller domes, and antennas. Fragments of ice, 1 inch or more in thickness, may cause appreciable damage to the horizontal stabilizer after breaking loose from the inboard engine cowling at high speeds.

If severe icing conditions are encountered, a percentage of the water striking the leading edge will not evaporate because of insufficient heat and will run back along the airfoil a few inches and refreeze over the fuel tank area where the local temperature is below 0°C. Runback will usually be observed first in the nacelle-to-nacelle wing sections and the horizontal stabilizers, in the wing sections outboard of the outer-engines, and progressively approaching the wing tips as the severity of the icing increases.

TRUE ALTITUDE.

When flying in subzero temperatures, constantly refer to the temperature correction chart and determine the true altitude, since the actual altitude will always be considerably less than the indicated altitude. This is especially important when flying over rough terrain, such as the Greenland Ice Cap, and when making instrument approaches.

ALTIMETER ERROR.

There has been considerable discussion regarding the altimeter error due to mountain top vortices, caused by winds of high velocity over mountain ranges or other rough terrain. There are several different lines of thought as to the magnitude of this error. It is known that altimeter errors do exist from this source, and there is enough evidence to justify maintenance of altitudes of not less than 2000 feet above the highest terrain during periods of high wind velocities and turbulence.

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 in the altimeter setting window from the opposite side, thus indicating a 10,000-foot error.

ST. ELMO'S FIRE.

St. Elmo's Fire is static electricity of pale blue color, which appears on propeller hubs and blades and around the cockpit. It is recommended that all radios be turned off except VHF and UHF (conditions permitting) to prevent a discharge through the set; otherwise, it is usually harmless. St. Elmo's Fire does not affect the VHF or UHF equipment.

APPROACH AND LANDING.

During descent for landing, monitor engine temperatures closely. Temperature inversions are common in winter, and ground temperature may be 15° to 30°C colder than at altitude. Therefore, keep cylinder head temperatures above 150°C by maintaining sufficient power and closing cowl flaps to assure good fuel vaporization, thus minimizing the danger of backfiring and cutting out. The oil temperature should be maintained over 50°C. Monitor airspeed. The stalling speed of the aircraft increases when ice has formed on the wings. Maintain shallow angles of bank when making an approach with an iced-up aircraft.

Note

At low temperatures, inadvertent asymmetrical propeller reversing is possible, and an alternate procedure must be used if the propellers do not reverse or will not reverse together.

A. Upon completion of landing roll, the oil cooler doors should be opened so that the oil will cool sufficiently while taxiing to the ramp and permit oil dilution.

B. Emergency airbrake pressure should be visually checked in order to ascertain whether or not the system will function, if needed.

CLEARVIEW WINDOW.

In the event that windshield hear has been inoperative and alcohol supply exhausted, it may be necessary to open the clearview window in order to provide adequate visibility for landing. Proceed as follows:

A. Depressurize.

B. Compute a minimum final approach speed in accordance with the degree of icing on airfoils and aircraft surface.

C. Make all turns shallow.

D. Commands will not be audible in the cockpit after the clearview window has been opened. Therefore, plan to give and receive all instructions by use of the interphone system.

E. Perform a thorough crew briefing before opening the window. The briefing should include the copilot calling airspeeds and altitude over the interphone during final approach, leaving enough interval to allow the pilot to interpose commands for manifold pressure adjustments.

F. Accurate depth perception will be more difficult than normal. Therefore, do not attempt to touch down in a nose-high attitude.

G. The tendency will be to land in a slight crab to the right due to having to lean the body slightly to the left in order to look through the window opening.

STOPPING OF ENGINES.

Oil dilution is required if the expected minimum temperature is below 2°C (35°F).

OIL DILUTION PROCEDURE.

The aircraft is equipped with a system of oil dilution to facilitate cold weather starting. When a cold weather start is anticipated, the engine oil should be diluted with fuel before stopping the engines, provided that the engine oil temperature is maintained below 50°C (122°F). Above this temperature, dilution may not be 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. 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. In order to allow for addition of the fuel, the oil tanks should not be completely filled.

Perform the oil dilution operation as follows (operation of the oil dilution system is indicated by a slow drop in oil pressure):

Note

For operating temperatures above 1.7°C (35°F), use 1100 engine oil; for temperatures below 1.7°C (35°F), use grade 1065 engine oil. If grade 1065 is not available, preheat must be used and if preheat is not available, dilute oil as outlined in item 3 of paragraph 4, following. When using grade 1065 oil and temperatures below −17.8°C (0°F) are predicted, use preheat; if preheat is not available, dilute oil as outlined in item 3 in the following.

A. Turn the fuel booster pump switches to LOW to supply adequate fuel pressure.

B. Operate each engine at 1000 to 1200 rpm.

C. Maintain oil temperature below 50°C (122°F), stopping any engine for a short period if the temperature exceeds this limit.

D. Operate the oil dilution switches for the following periods and temperatures:

Temperature	*Time*
2° to −12°C (35° to 10°F)	3 minutes
−12° to −29°C (10° to −20°F)	6 minutes
−29° to −40°C (−20° to −40°F)	9 minutes
−40° to −54°C (−40° to −65°F)	12 minutes

E. When the dilution is complete, shut the engine down in a normal manner, continuing to hold the oil dilution switch ON until the engine has stopped. Exercise the propellers at 1500 rpm from low to high pitch three times to dilute the oil in the propeller system. Reverse the propellers at least once during oil dilution.

F. When warming up an engine after oil dilution, 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 dilutant fuel as possible and allow the oil to return to its normal viscosity. Below this temperature, and at low engine speeds, very little gasoline will be driven out of the oil. It is also good practice to run the propellers to full increase and decrease at least three times to heat the oil in the propeller domes. It is advisable to reverse the propellers at least once during the warmup period. Recheck the engine section oil tanks for proper quantity.

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 because of 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.

GROUND OPERATION.

The aircraft must be given special treatment when based in the desert if the operation is to be successful. In order to minimize costly maintenance, adhere to the following instructions:

A. Hold ground operation of the aircraft to a minimum.

B. Cover all air intakes and ducts as soon as possible after landing to prevent entrance of blowing sand.

C. Keep all equipment free of sand, dirt, or moisture.

D. Keep the aircraft dispersed as much as possible. The engines of one aircraft can add hours to maintenance problems of another when proper precautions during taxiing or ground operation are not followed.

FLIGHT OPERATIONS.

Hot weather operation requires that you be more cautious of stalling speeds and temperature limitations. Also, keep the following in mind when operating in hot weather.

Note

If CAT. limit must be exceeded, reduce manifold pressure limit 1 inch Hg for each 6° above normal CAT. limit.

A. Keep cylinder head temperatures as low as possible before takeoff.

B. Longer takeoff distances are required.

C. Use the brakes sparingly.

D. Climb at not less than the speed shown in the climb charts (see the Appendix).

performance data

APPENDIX I

AA1-215

TABLE OF CONTENTS

Note

The illustrations in this appendix are applicable to both the C-118A and the VC-118A.

part 1 introduction

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ABBREVIATIONS.

Abbreviation	*Definition*
ADI	Anti-detonation injection
Alt.	Altitude
BHP	Brake horsepower
BMEP	Brake mean effective pressure
°C	Degrees Centigrade
CAS	Calibrated airspeed
CAT	Carburetor air temperature
CHT	Cylinder head temperature
Comp.	Component
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
MAP	Manifold absolute pressure
METO	Maximum except takeoff
Min.	Minute
OAT	Outside air temperature

Abbreviation	*Definition*
PSI	Pounds per square inch
Pt.	Point
RPM	Revolutions per minute
S.L.	Sea level
Std.	Standard
T	Absolute temperature
TAS	True airspeed
V_A	Acceleration check speed
V_{CO}	Climbout speed
V_{CRIT}	Critical engine failure speed
V_D	Decision 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

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.

BEST ECONOMY MIXTURE – the fuel-air mixture which results in the most power for a given fuel flow.

BEST POWER MIXTURE – the fuel-air mixture which results in the most power for a given manifold pressure.

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.

CLIMBOUT FACTOR – a factor used to detremine the maximum gross weight allowable for climbout over a given obstacle on three engines, based on the height of the obstacle and distance of the obstacle from brake release.

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.

CRITICAL ENGINE FAILURE SPEED – the speed at which engine failure permits acceleration to takeoff speed in the same distance that the aircraft may be decelerated to a stop.

CRITICAL FIELD LENGTH – the total length of runway required to accelerate on all engines to the critical engine failure speed, experience an engine failure, then continue to takeoff or stop.

DENSITY ALTITUDE – the altitude obtained from a standard density altitude chart (such as figure A1-12) for any given pressure altitude and temperature or for any density ratio factor ($1/\sqrt{\sigma}$).

DEW POINT – the temperature at which condensation occurs in a cooling mass of air.

DRY BULB TEMPERATURE – the air tmeperature as indicated by a thermometer with a dry bulb (true air temperature).

DRY POWER – engine power being developed without the aid of water injection (ADI switch OFF).

EFFECTIVE WIND (HEADWIND 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 takeoff and landing crosswind chart.

EQUIVALENT AIRSPEED – calibrated airspeed corrected for compressibility.

ACCELERATION CHECK POINT – a predetermined point, based on time/distance, at which the acceleration check speed should be attained.

ACCELERATION SPEED – the minimum acceptable speed at the acceleration checkpoint.

GROUND EFFECT – the reduction in induced drag when the aircraft is near the ground.

HIGH BLOWER – the engine supercharger in high gear ratio.

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.

MANUAL LEAN – fuel-air mixture on the lean side of best power mixture, adjusted manually to give a prescribed BMEP drop from best power mixture.

MANUAL RICH – fuel-air mixture on the rich side of best power mixture, adjusted manually to reduce fuel flow to the prescribed minimum shown on figure A2-13.

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 loaded 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, such as figure A1-13, 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 tbe barometric setting is at 29.92.

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. For the C-118A recommended long range cruise speed is the same at 110 percent of the speed of maximum lift to drag ratio.

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 tbe 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.

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.

TAKEOFF FACTOR – a factor used to determine takeoff performance, based on available BMEP corrected for pressure altitude and temperature.

THRESHOLD SPEED – the speed at which the aircraft crosses the end of the runway during a normal landing (130 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 (120 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 times $1/\sqrt{\sigma}$).

TRUE ALTITUDE – altitude above sea level.

VAPOR PRESSURE – the partial pressure of water vapor existing in the air.

V_D – DESCISION SPEED; the highest speed at which the pilot may elect either to continue takeoff or to stop should an engine fail. At higher speeds the aircraft is committed to takeoff.

$V_{L/D}$ – 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 (115 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.

WET POWER – the power developed by an engine with the aid of water injection (ADI fluid).

WIND GRADIENT – the change in wind speed with altitude. Because of friction between the air and the ground surface, the wind speed generally diminishes as one nears the ground.

INTRODUCTION.

The data shown in this Appendix are provided to aid the flight crews in achieving maximum utilization of the aircraft consistent with safety. In most cases data are included to permit missions to be planned with allowances for more than one degree of safety. This is done so that the importance of the mission may be weighed against safety requirements. For example, the charts in Part 3 allow takeoff distance to be determined based on the engines developing 100% of the predicted power or 95% of the predicted power, or even less, if desired. Furthermore, this takeoff distance may be based on all four engines operating all the way, or may allow for an engine failure at the most critical time. Similarly, rates of climb and cruise performance are shown for two, three or four engines operating, and landing distances are provided for brakes only or for either two engines or four engines operating at full reverse thrust.

It should be stressed that these charts show the optimum performance expected from the aircraft when flown with careful pilot technique under stable atmospheric conditions. There are several factors (mechanical imperfections, improper pilot technique, turbulent air, etc.) which adversely affect performance, whereas very few factors can improve performance. This is one of the reasons for allowing performance margins when planning a mission.

FUEL GRADES.

The standard fuel grade for the C-118A and VC-118A is 115/145. The alternate fuel grade is 100/130. Takeoff and climb data may be determined for both standard and alternate fuel grades. Cruise data is applicable to either fuel grade, except as noted.

Note

The P&W R2800-52W engine used on C-118A aircraft was certificated using 108/135 grade fuel. It is permissible to substitute 108/135 grade fuel for 115/145 grade fuel without any loss in engine performance.

INSTRUMENT ERRORS.

All instruments have some degree of mechanical error. Ordinarily this may be assumed to be negligible since the instruments are maintained within specified tolerances. However, the airspeed indicator, altimeter and outside air temperature indicator have other sources of error which, under certain circumstances, are great enough to require corrections to be made to the instrument readings. One of these errors, known as the position error, arises from the requirement that the airspeed indicator and altimeter must measure the ambient air pressure. This is done through the static orifices on the side of the fuselage for the pilot's and copilot's normal systems and through a duct ending in the tailcone for the alternate systems. Because of the rapid motion of the airplane through the air neither of these locations transmit the true ambient pressure at all speeds and angles of attack. The correction for this error is included in the Airspeed Position Error Correction charts *(figures A1-1 through A1-4)* and the Altimeter Position Error Correction charts *(figures A1-6 through A1-9)*. The Airspeed Position Error Correction charts also include a correction for a smaller error due to the position of the pitot tubes which measure the impact pressure.

Another error in the airspeed system is due to the behavior of air striking the pitot tubes at high velocities. This is called the compressibility error. The markings on the airspeed indicator have been spaced so that this error is automatically accounted for at sea level. At higher altitudes, however, corrections for this error should be applied to the instrument reading. These corrections appear on the Calibrated Airspeed Correction for Compressibility chart *(figure A1-5)*.

The outside air temperature indicator also has an error known as the compressibility error. This error arises from the fact that the outside air passes the temperature sensing element at a speed approximately equal to the speed of the aircraft. However, the very thin layer of air in immediate contact with the sensing element has been brought almost to rest (relative to the element). In doing this its temperature has risen due to a combination of compression and friction. The correction for this error appears on the Temperature Correction for Compressibility chart *(figure A1-10)*.

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	$TAS = EAS \times 1/\sqrt{\sigma}$

*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).

PROCEDURE TO CONVERT INDICATED AIRSPEED (IAS) TO TRUE AIRSPEED (TAS).

Charts and tables are provided to convert indicated airspeed to true airspeed. This is done in three steps as follows:

Sample Problem.

GIVEN:	Indicated Airspeed	= 185 knots
	Pressure Altitude	= 15,000 feet
	Outside Air Temperature	= −30°C
FIND:	True Airspeed	

INDICATED AIRSPEED (IAS) TO CALIBRATED AIRSPEED (CAS).

1. Find applicable position error correction chart, noting static source reference. For example, Figure A1-1, Airspeed Position Error Correction Chart — Pilot's Normal Static Source.
2. Enter chart at 185 knots IAS and project vertically to curve.
3. Project horizontally left to correction scale. Read 3.5 knots. Round off to 4 knots.
4. To obtain calibrated airspeed, add correction.

   185 knots IAS + 4 knots = 189 knots CAS.

CALIBRATED AIRSPEED (CAS) TO EQUIVALENT AIRSPEED (EAS).

1. To obtain equivalent airspeed, correct calibrated airspeed for compressibility error, which varies with airspeed and pressure altitude.
2. Use chart Figure A1-5, Calibrated Airspeed Correction for Compressibility Chart.
3. Enter chart on calibrated airspeed scale at 189 knots (CAS). Project vertically to intersection with 15,000 feet pressure altitude curve.
4. Project horizontally to scale on left edge of chart. Read correction 1.5 knots. Round off to 2 knots.
5. Subtract correction from calibrated airspeed to obtain equivalent airspeed.

   189 knots CAS − 2 knots = 187 knots EAS.

EQUIVALENT AIRSPEED (EAS) TO TRUE AIRSPEED (TAS).

True airspeed may be found by multiplying the equivalent airspeed by the quantity $1/\sqrt{\sigma}$, where σ (sigma) is the density ratio of ambient air to standard sea level air. The quantity $1/\sqrt{\sigma}$ is sometimes referred to as the "Smoe factor."

1. Correct OAT for compressibility by use of Figure A1-10. For 15,000 feet pressure altitude and 189 knots CAS, read 3.6°C correction. Round off to 4°C.

   −30°C OAT −4°C correction = −34°C OAT.
2. Enter Density Altitude chart, Figure A1-11, with −34°C and project vertically to 15,000 feet pressure altitude line.
3. Project horizontally to right edge of chart. Read $1/\sqrt{\sigma} = 1.213$.
4. Another method of obtaining $1/\sqrt{\sigma}$ is to project horizontally to the density altitude scale at the left. Read 12,600 feet density altitude. Then, by using the ICAO Standard Atmosphere Table (*Figure A1-12,* sheet two), read $1/\sqrt{\sigma} = 1.2127$ opposite 12,600 feet.
5. EAS x $1/\sqrt{\sigma}$ = TAS.

   189 knots EAS x 1.213 = 229 knots TAS.

DISCUSSION OF CHARTS.

AIRSPEED POSITION ERROR CORRECTION CHARTS.

These charts (*figures A1-1 through A1-4*) show the correction that must be applied to the indicated airspeed to determine the calibrated airspeed. Corrections are shown for the pilot's normal static source, the copilot's normal static source, and the pilot's and copilot's alternate static source. It will be seen on the chart for the pilot's and copilot's alternate static source that one curve is provided for airplanes with sealed tailcone and another for airplanes with unsealed tailcone. The choice between using one curve or the other depends upon the configuration of the particular aircraft.

Three of the charts are for in-flight use, while the fourth is for use during the takeoff ground run.

CALIBRATED AIRSPEED CORRECTION FOR COMPRESSIBILITY CHART.

This chart *(figure A1-5)* shows the correction that must he subtracted from calibrated airspeed to determinę equivalent airspeed. It will be noted that there is no correction at sea level and that the amount of the correction increases with increasing altitude.

ALTIMETER POSITION ERROR CORRECTION CHARTS.

These charts *(figures A1-6 through A1-9)* show the corrections that must be applied to the altimeter reading to obtain the true altitude. If the barometric setting is at 29.92 the result will be true pressure altitude. If, instead, the barometric setting is at the local sea level value the result will be approximate true altitude.

Corrections are shown for the pilot's normal static source, the copilot's normal static source, and the pilot's and copilot's alternate static source. It will be seen that there are two charts for the alternate static source. One is for airplanes with sealed tailcone and the other is for airplanes with unsealed tailcone. The choice between using one curve or the other depends upon the configuration of the particular aircraft.

On figures A1-6 through A1-9 chase-around lines illustrate the following sample problem.

GIVEN: Airspeed = 185 knots IAS.
Altimeter reading =

14,940 feet, pilot's normal static source;

14,890 feet, copilot's normal static source;

14,950 feet, pilot's and copilot's alternate static source, tailcone sealed;

15,150 feet, pilot's and copilot's alternate static source, tailcone unsealed.

FIND: True altitude

1. Enter the indicated airspeed scale at 185 knots.
2. Proceed vertically to appropriate altimeter reading.
3. Go horizontally to the left hand scale and read the correction:

60 feet, pilot's normal static source *(figure A1-6);*

110 feet, copilot's normal static source *(figure A1-7);*

50 feet, pilot's and copilot's alternate static source, tailcone sealed *(figure A1-8);*

−150 feet, pilot's and copilot's alternate static source, tailcone unsealed *(figure A1-9).*

In each case when the correction is added to the appropriate altimeter reading the true altitude becomes 15,000 feet.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY CHART.

This chart *(figure A1-10)* shows the correction that must be subtracted from the outside air temperature indicator reading to determine the true outside air temperature (see next under "INSTRUMENT ERRORS"). For example, assume that the airplane is cruising at 185 knots CAS (point A) at an altitude of 15,000 feet (point B). The chart shows that the correction is 3.5°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 −3.5, or 2.5°C. If the instrument read −12°C, then the outside air temperature would be −12 −3.5, or −15.5°C.

DENSITY ALTITUDE CHART.

A Density Altitude Chart *(figure A1-11)* has been included so that the density altitude and the reciprocal of the square root of the density ratio ($1/\sqrt{\sigma}$) may be determined for any pressure altitude under nonstandard conditions. Sheet one covers a range of density altitudes from −8,000 feet to 18,000 feet, and sheet two extends from 14,000 feet to 40,000 feet.

ICAO STANDARD ATMOSPHERE TABLE.

The ICAO Standard Atmosphere Table *(figure A1-12)* shows values of the various atmospheric properties for a standard day as defined by the International Civil Aviation Organization. Sheet one lists the density ratio (σ), the reciprocal of the square root of the density ratio ($1/\sqrt{\sigma}$), the temperature, speed of sound, pressure and pressure ratio (δ) for every thousand feet of altitude from sea level to 45,000 feet. Sheet two lists only the reciprocal of the square root of the density ratio ($1/\sqrt{\sigma}$) for every 100 feet of altitude from 100 feet to 30,000 feet.

The standard atmosphere defined by ICAO represents an approximation to the average atmosphere of the world. It is based on a temperature of 15°C (59°F) and a pressure of 29.92 inches Hg for sea level conditions. The temperature variation with height is uniform from 15°C (59°F) at sea level to −56.5°C (−69.7°F) at 36,089 feet. This altitude is assumed to be the beginning of the isothermal region or stratosphere. For all practical purposes, the temperature will remain constant as altitude is increased above 36,089 feet. ICAO standard atmosphere values have been used in preparation of all performance charts in this Appendix.

PSYCHROMETRIC CHART.

The Psychrometric Chart (*figure A1-13*) 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 to 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).

TEMPERATURE CONVERSION CHART.

A Temperature Conversion chart is provided *(figure A1-14)* to facilitate the conversion of either Fahrenheit temperatures to Centigrade or Centigrade temperatures to Fahrenheit. The appropriate scale is entered at the known temperature. The corresponding value may then be read from the other scale as indicated by the oblique line. For example, the chart shows that 50° Fahrenheit is the same temperature as 10° Centigrade.

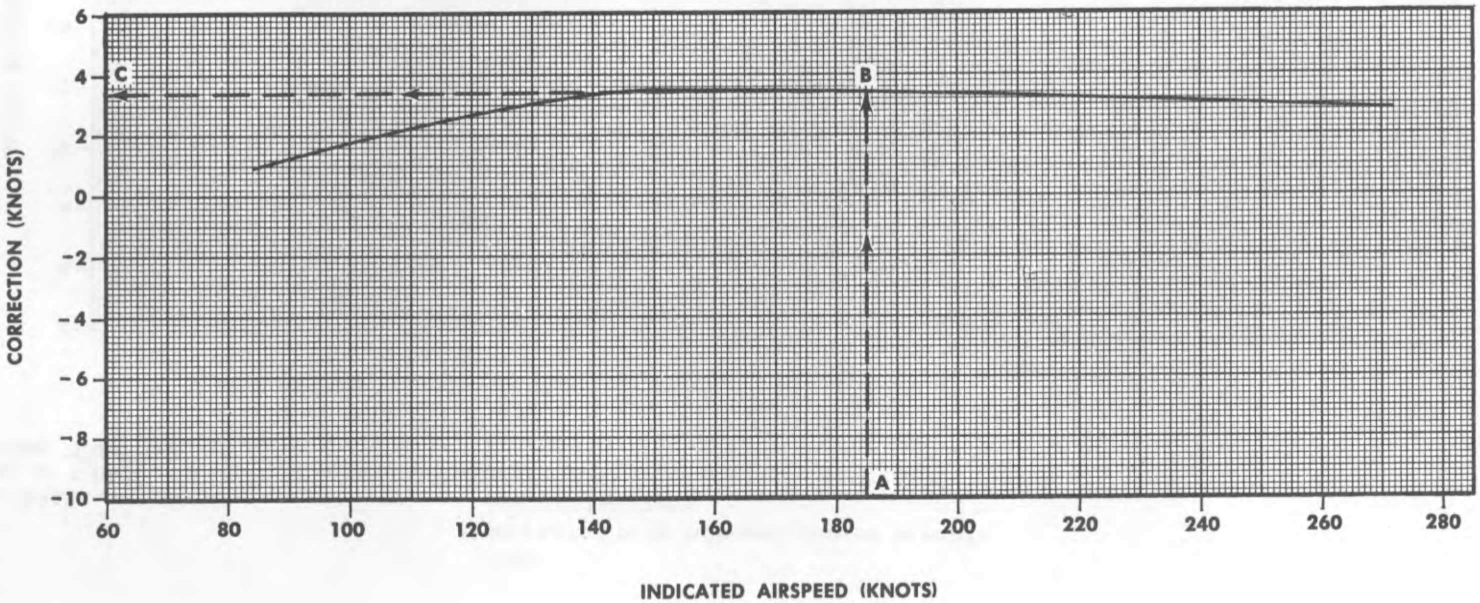
AIRSPEED POSITION ERROR CORRECTION - FLIGHT

PILOT'S NORMAL STATIC SOURCE

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

Note:
Add correction to indicated airspeed to obtain calibrated airspeed.

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST



AA1-4

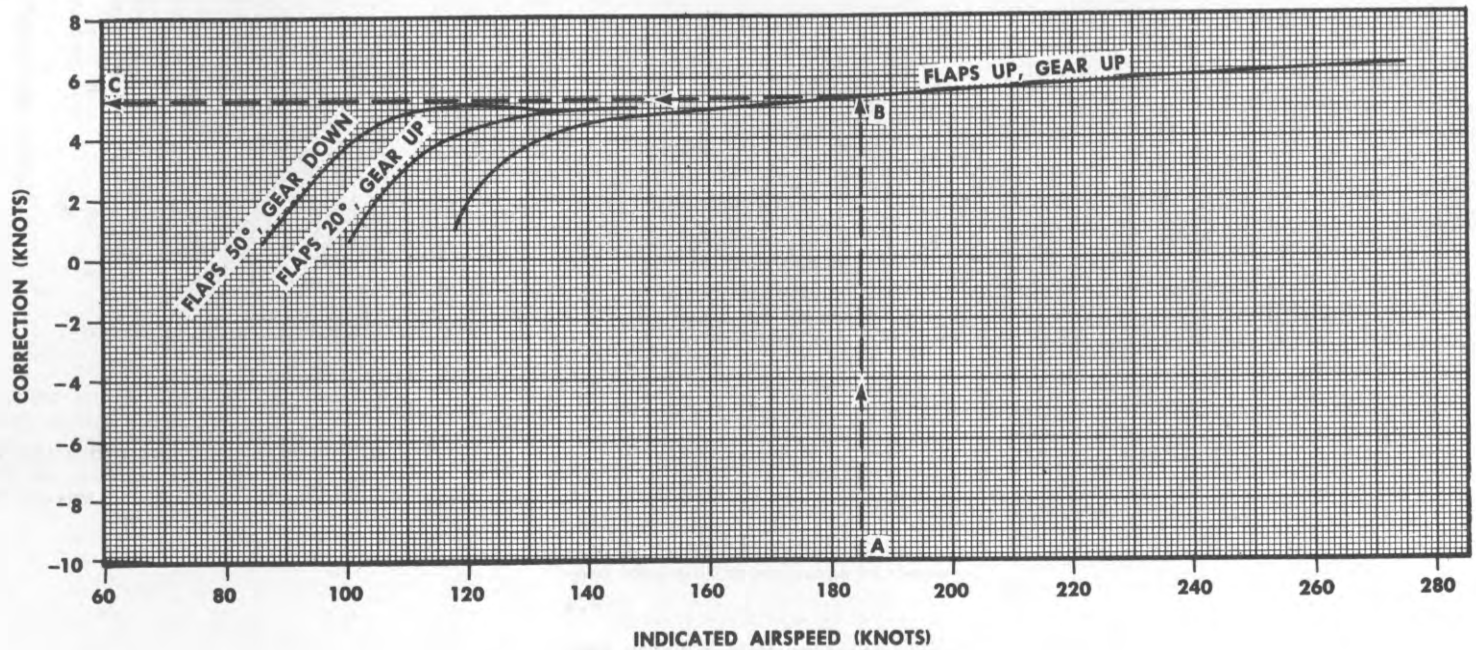
Figure A1-1. Airspeed Position Error Correction — Flight — Pilot's Normal Static Source

AIRSPEED POSITION ERROR CORRECTION — FLIGHT

COPILOT'S NORMAL STATIC SOURCE

MODEL: C-118A
DATA AS OF 2-15-59
DATA BASIS: FLIGHT TEST

Note:
Add correction to indicated airspeed to obtain calibrated airspeed.



AA1-3

Figure A1-2. Airspeed Position Error Correction — Flight — Copilot's Normal Static Source

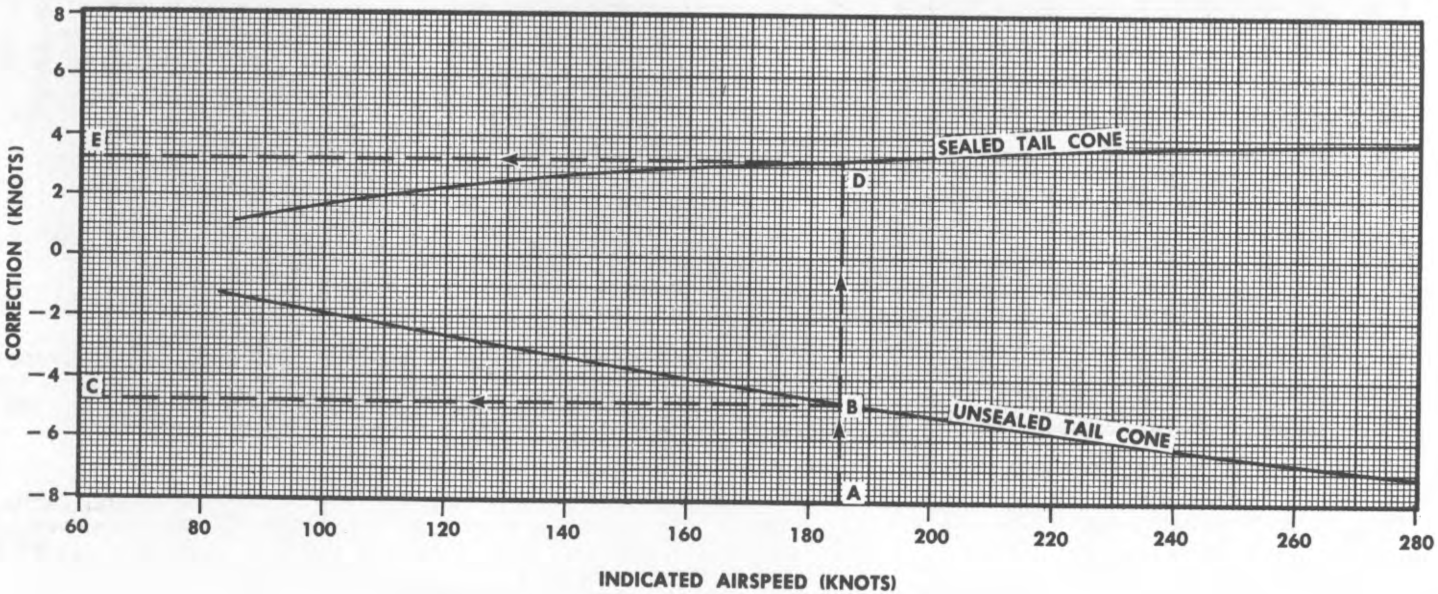
AIRSPEED POSITION ERROR CORRECTION — FLIGHT

PILOT'S AND COPILOT'S ALTERNATE STATIC SOURCE

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

Note:
Add correction to indicated airspeed to obtain calibrated airspeed.

MODEL: C-118A
DATA AS OF 2-15-59
DATA BASIS: FLIGHT TEST



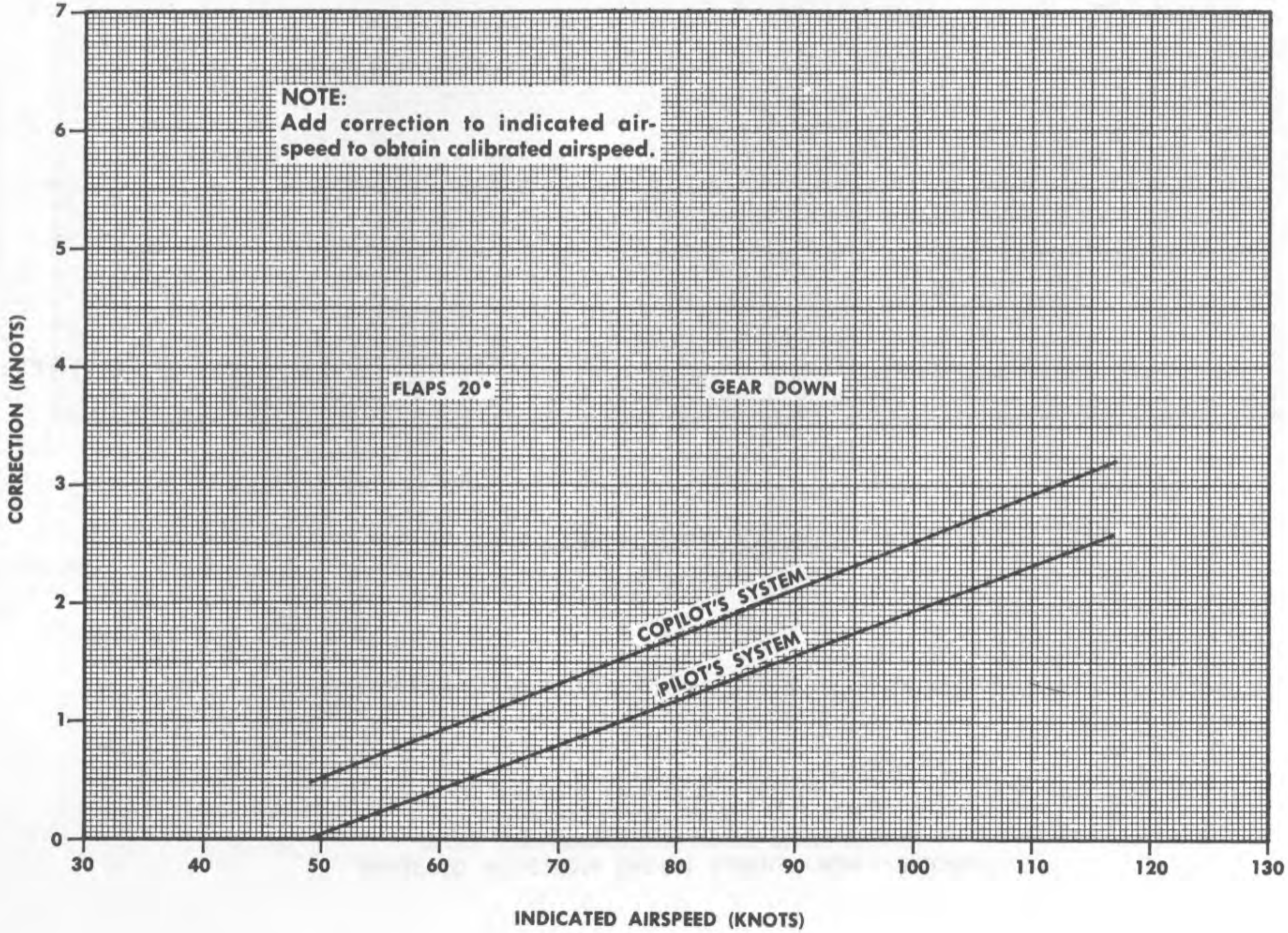
AA1-206

Figure A1-3. Airspeed Position Error Correction — Flight — Pilot's and Copilot's Alternate Static Source

AIRSPEED POSITION ERROR CORRECTION FOR THE GROUND RUN

PILOT'S AND COPILOT'S NORMAL STATIC SOURCE

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: FLIGHT TEST



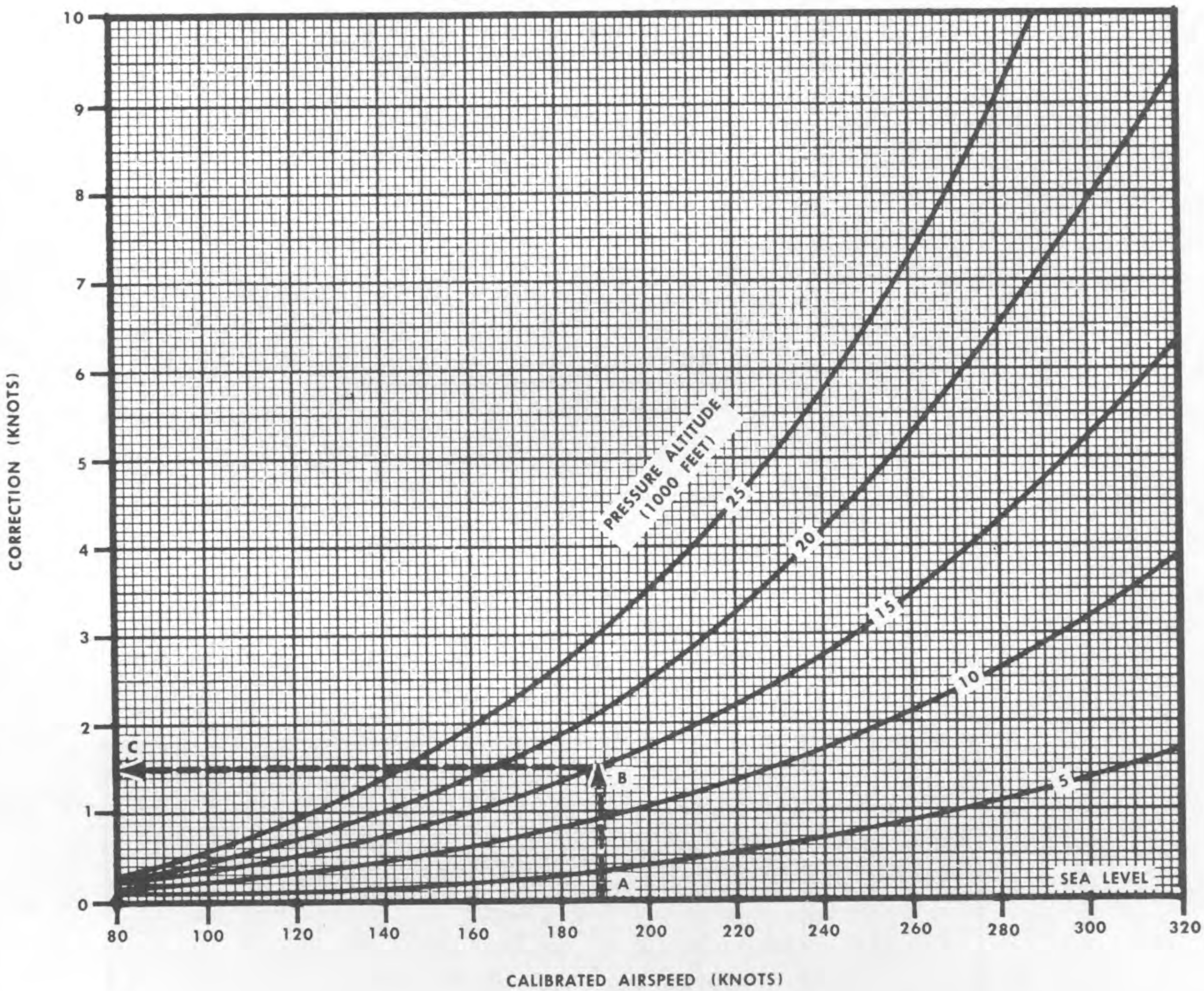
AA1-1

Figure A1-4. Airspeed Position Error Correction for the Ground Run

CALIBRATED AIRSPEED CORRECTION FOR COMPRESSIBILITY

MODEL: C-118A
DATA AS OF: 2-15-59

Note:
Subtract correction from calibrated airspeed to obtain equivalent airspeed.



SAMPLE PROBLEM:
Given: Pressure altitude = 15,000 feet
calibrated airspeed = 189 knots

A. Enter graph at 189 knots CAS
B. At 15,000 feet read correction
C. Correction = 1.5 knots (round off to 2 knots).
D. 189 knots CAS — 2 knots = 187 knots EAS.

AA1-B

Figure A1-5. Calibrated Airspeed Correction for Compressibility

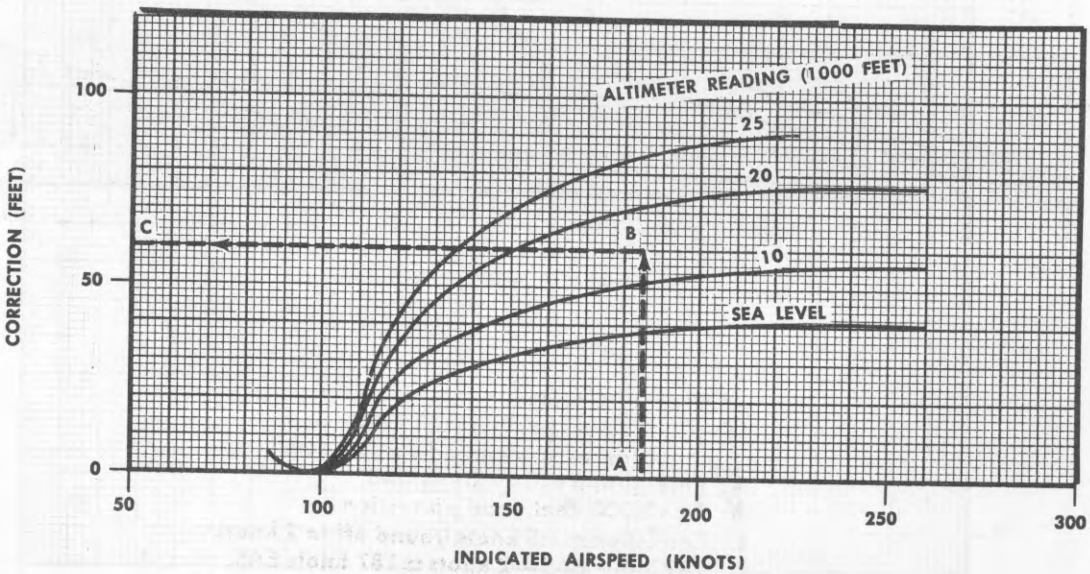
ALTIMETER POSITION ERROR CORRECTION

PILOT'S NORMAL STATIC SOURCE

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST

Note:
Add correction to altimeter reading to obtain altitude.



AA1-207

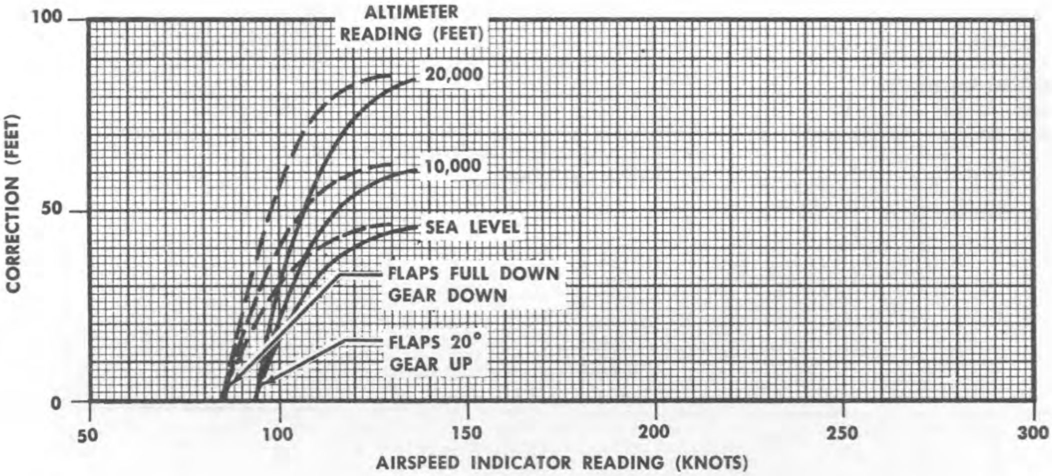
Figure A1-6. Altimeter Position Error Correction — Pilot's Normal Static Source

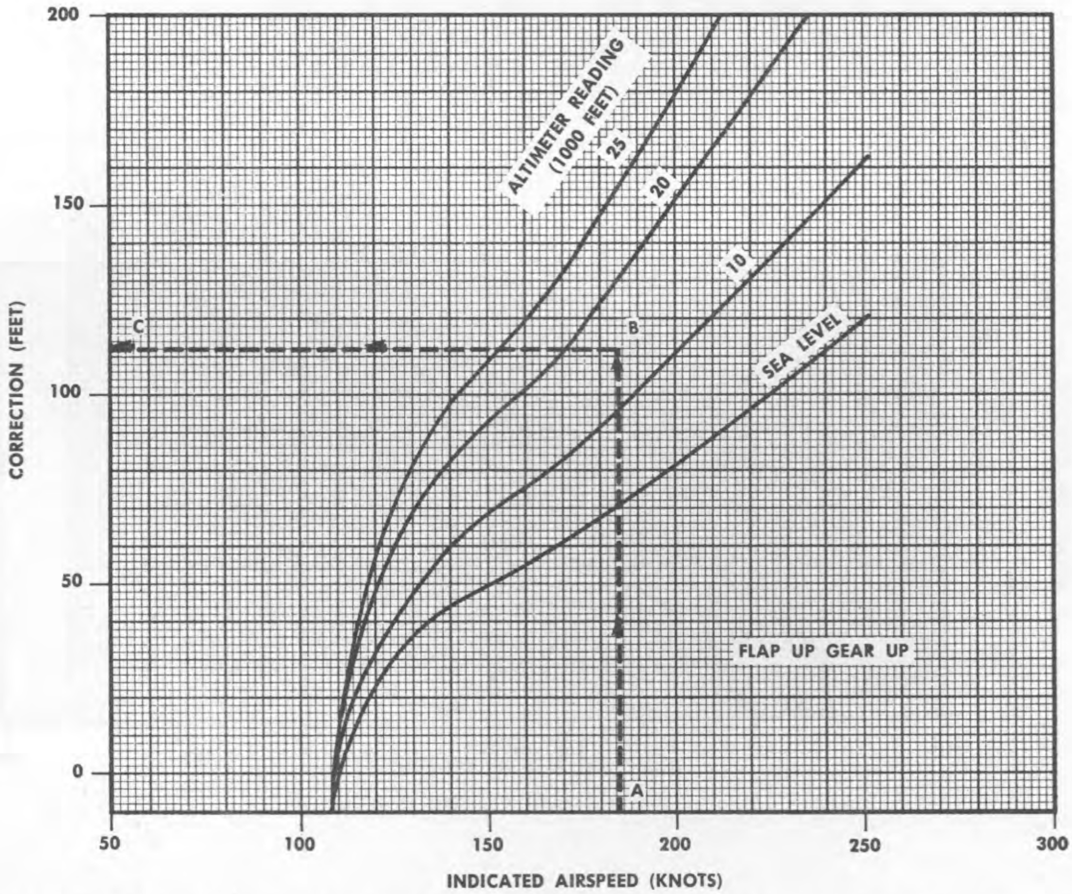
ALTIMETER POSITION ERROR CORRECTION

COPILOT'S NORMAL STATIC SOURCE

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST

Note:
Add correction to altimeter reading to obtain altitude.





AA1-204

Figure A1-7. Altimeter Position Error Correction — Copilot's Normal Static Source

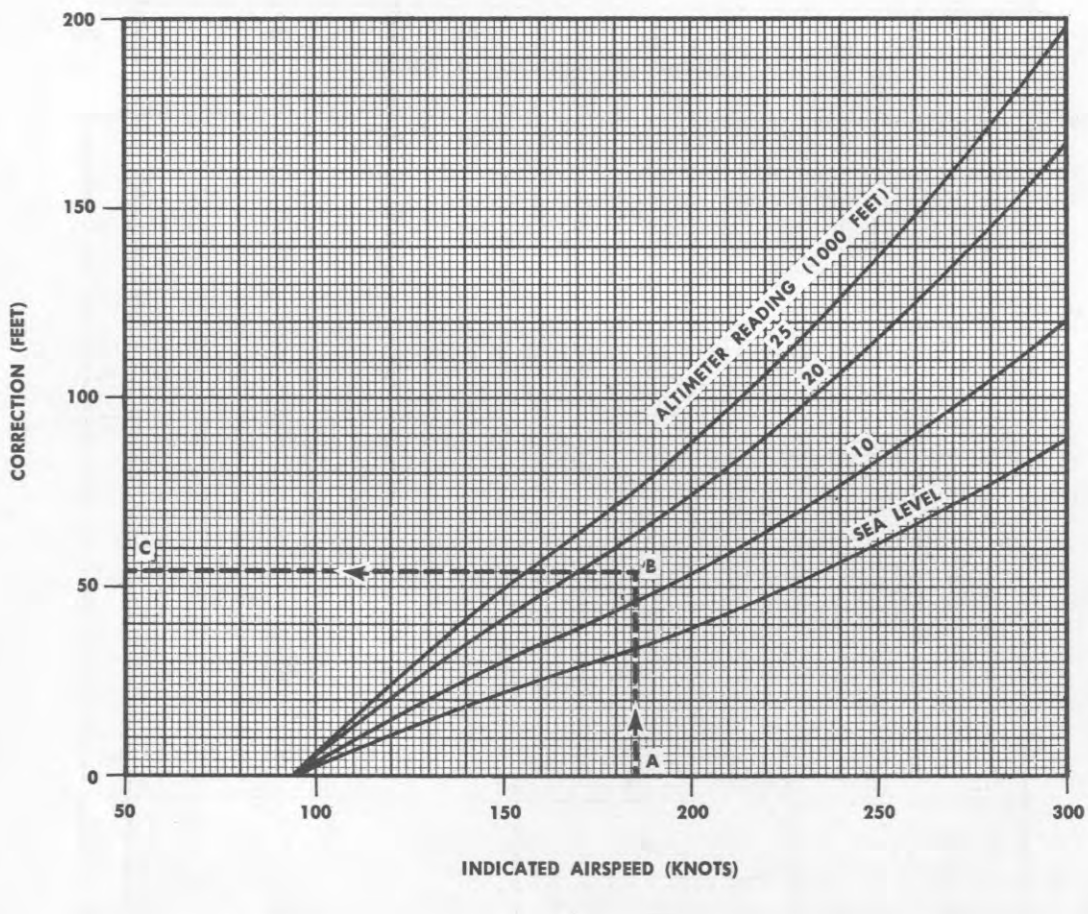
ALTIMETER POSITION ERROR CORRECTION

PILOT'S AND COPILOT'S ALTERNATE STATIC SOURCE
TAIL CONE SEALED

THIS CHART APPLIES TO ALL FLAP
AND LANDING GEAR CONFIGURATIONS

MODEL: C-118A
DATA AS OF 2-15-59
DATA BASIS: FLIGHT TEST

Note:
Add correction to altimeter reading to obtain altitude.



AA1-205

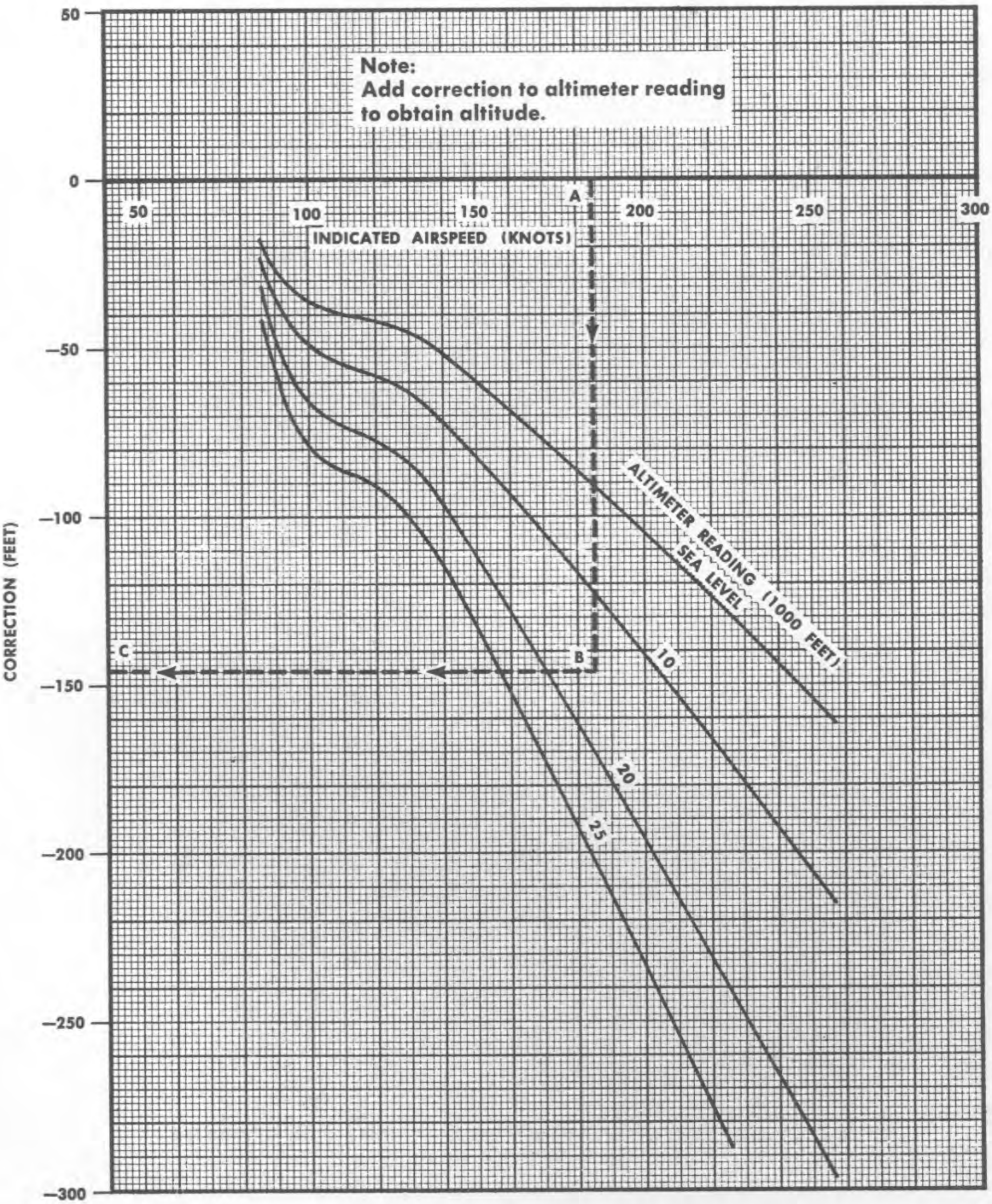
Figure A1-8. Altimeter Position Error Correction — Pilot's and Copilot's Alternate Static Source — Tailcone Sealed

ALTIMETER POSITION ERROR CORRECTION

PILOT'S AND COPILOT'S ALTERNATE STATIC SOURCE
TAILCONE UNSEALED

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

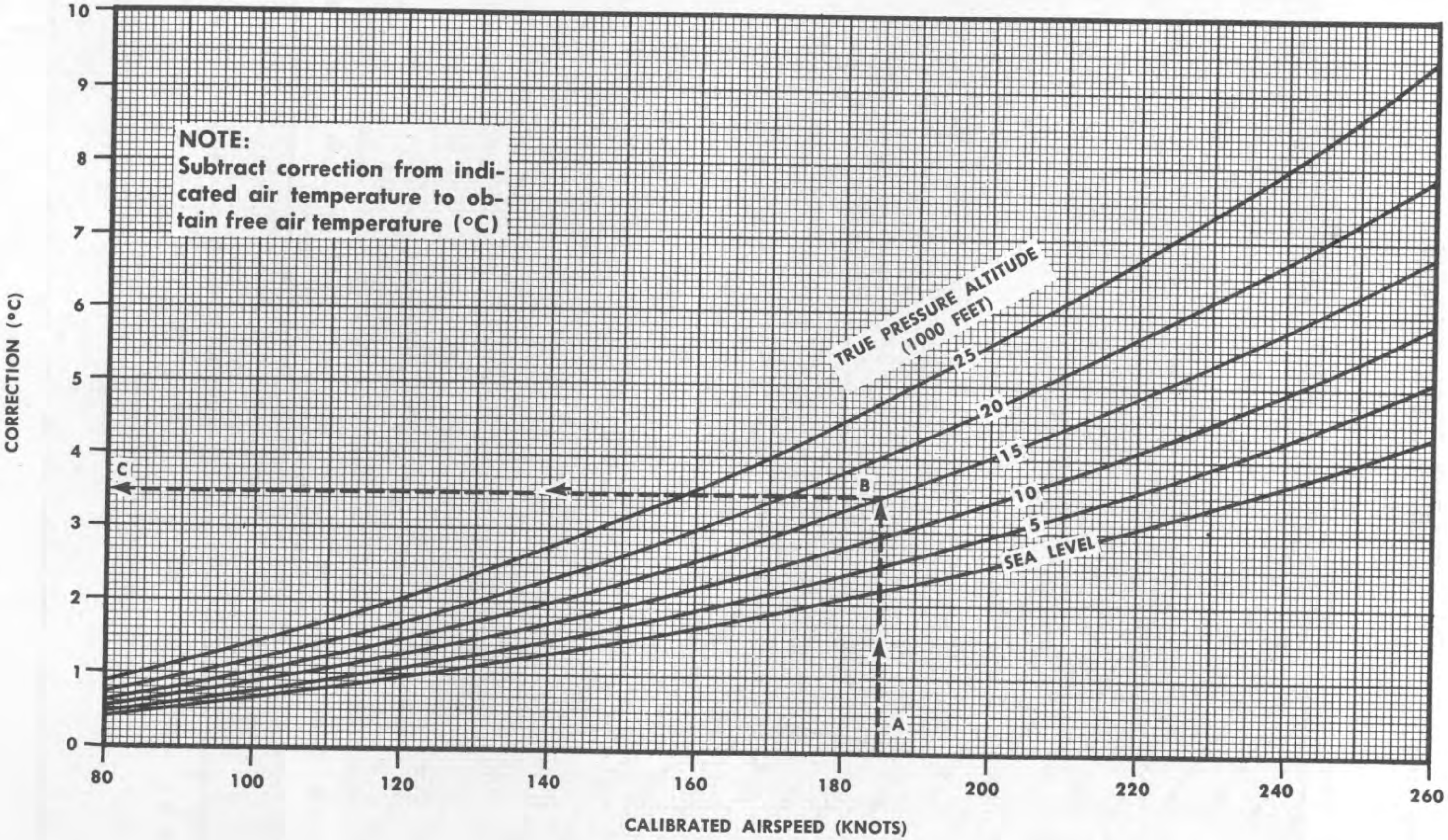


AA1-208

Figure A1-9. Altimeter Position Error Correction — Pilot's and Copilot's Alternate Static Source — Tailcone Unsealed

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST



AA1-9

Figure A1-10. Temperature Correction for Compressibility

DENSITY ALTITUDE CHART

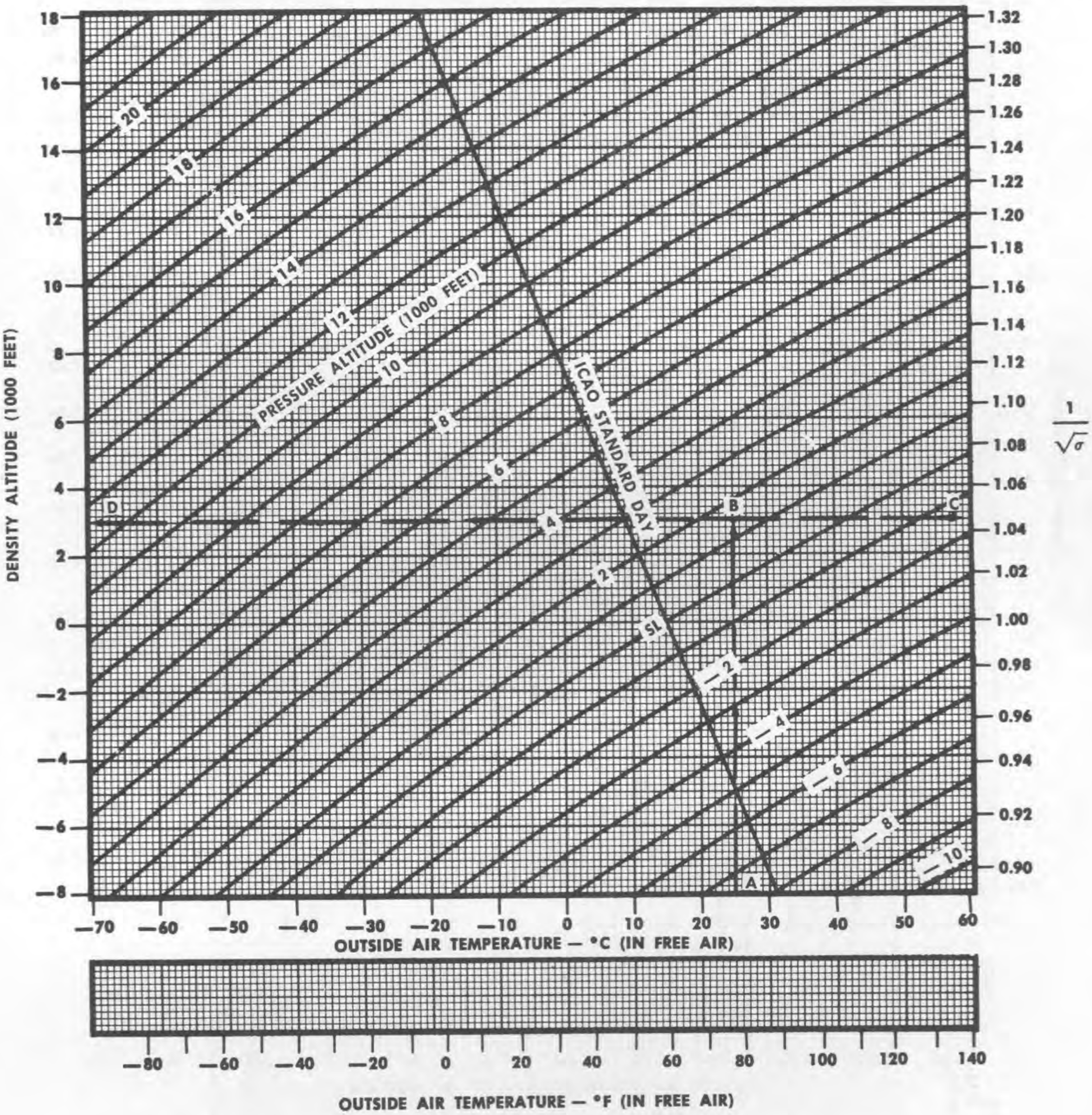
SAMPLE PROBLEM:

A. OUTSIDE AIR TEMPERATURE = 25°

B. PRESSURE ALTITUDE = 1500 FEET

C. $\frac{1}{\sqrt{\sigma}} = 1.045$

D. DENSITY ALTITUDE = 3000 FEET



AA1-5

Figure A1-11. Density Altitude Chart (Sheet 1 of 2)

DENSITY ALTITUDE CHART

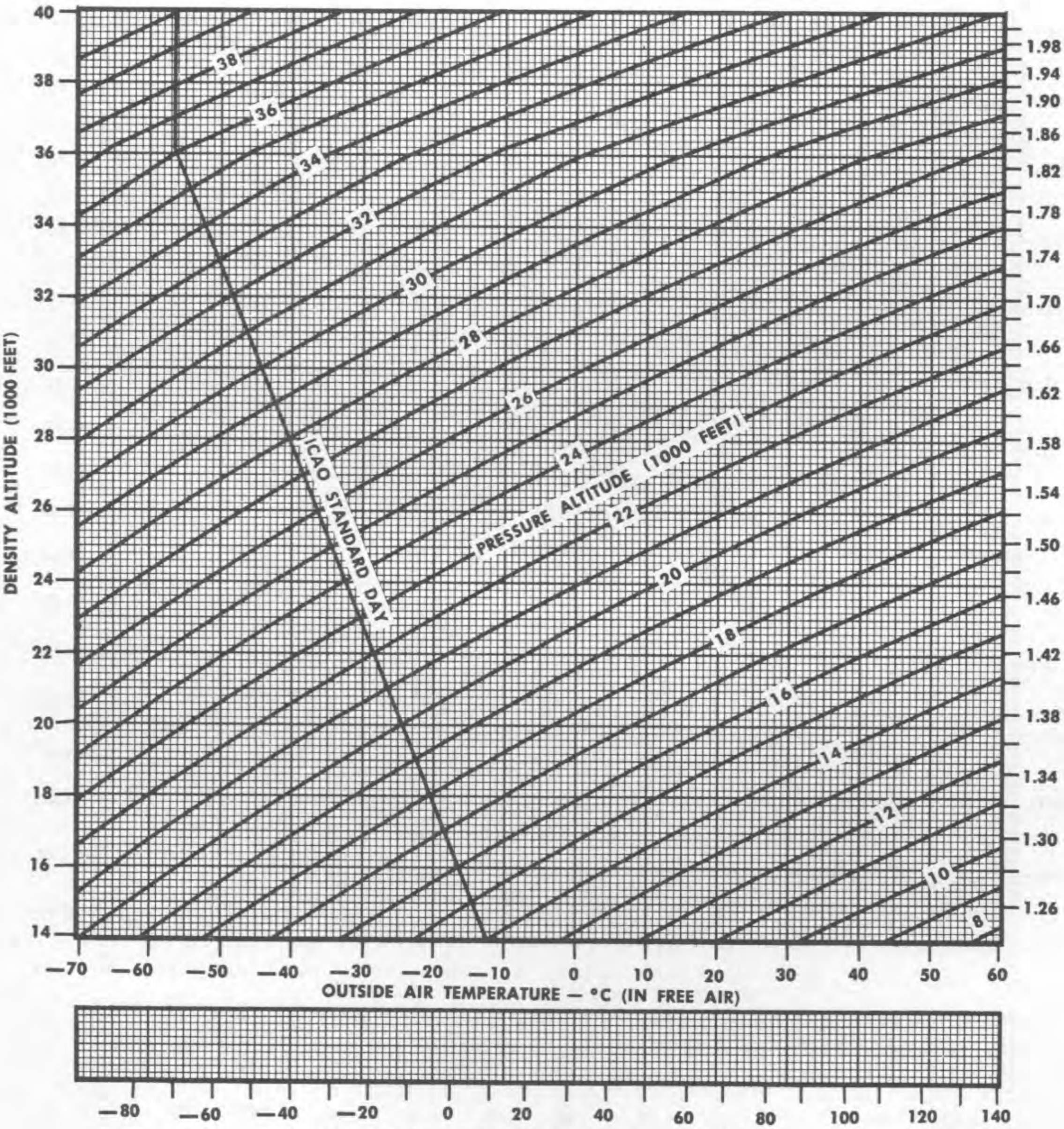


Figure A1-11. Density Altitude Chart (Sheet 2 of 2)

ICAO STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL CONDITIONS:

Temperature = 15°C (59°F)
Pressure = 29.921 in. Hg (2116.216 lb/sq. ft.)
Density = .0023769 slugs/cu. ft.
Speed of sound = 1116.89 ft/sec. (661.7 knots)

CONVERSION FACTORS:

1 in. Hg = 70.727 lb/sq. ft.
1 in. Hg = 0.49116 lb/sq. in.
1 Knot = 1.151 mph
1 Knot = 1.688 ft./sec.

Altitude (Feet)	*Density Ratio* σ	$\frac{1}{\sqrt{\sigma}}$	*Temperature* °C	°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 A1-12. 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	12100	1.2030	18100	1.3269	24100	1.4704
200	1.0029	6200	1.0971	12200	1.2049	18200	1.3291	24200	1.4729
300	1.0044	6300	1.0988	12300	1.2069	18300	1.3313	24300	1.4755
400	1.0059	6400	1.1005	12400	1.2088	18400	1.3335	24400	1.4781
500	1.0074	6500	1.1022	12500	1.2107	18500	1.3358	24500	1.4807
600	1.0088	6600	1.1039	12600	1.2127	18600	1.3380	24600	1.4833
700	1.0103	6700	1.1056	12700	1.2146	18700	1.3403	24700	1.4860
800	1.0118	6800	1.1073	12800	1.2166	18800	1.3425	24800	1.4886
900	1.0133	6900	1.1090	12900	1.2185	18900	1.3448	24900	1.4912
1000	1.0148	7000	1.1107	13000	1.2205	19000	1.3470	25000	1.4938
1100	1.0163	7100	1.1124	13100	1.2224	19100	1.3493	25100	1.4965
1200	1.0178	7200	1.1141	13200	1.2244	19200	1.3516	25200	1.4991
1300	1.0193	7300	1.1158	13300	1.2264	19300	1.3539	25300	1.5018
1400	1.0208	7400	1.1175	13400	1.2284	19400	1.3561	25400	1.5045
1500	1.0223	7500	1.1193	13500	1.2303	19500	1.3584	25500	1.5071
1600	1.0238	7600	1.1210	13600	1.2323	19600	1.3607	25600	1.5098
1700	1.0253	7700	1.1127	13700	1.2343	19700	1.3630	25700	1.5125
1800	1.0269	7800	1.1245	13800	1.2363	19800	1.3653	25800	1.5152
1900	1.0284	7900	1.1262	13900	1.2383	19900	1.3677	25900	1.5179
2000	1.0299	8000	1.1279	14000	1.2403	20000	1.3700	26000	1.5206
2100	1.0314	8100	1.1297	14100	1.2423	20100	1.3723	26100	1.5233
2200	1.0330	8200	1.1314	14200	1.2444	20200	1.3746	26200	1.5260
2300	1.0345	8300	1.1332	14300	1.2464	20300	1.3770	26300	1.5287
2400	1.0360	8400	1.1350	14400	1.2484	20400	1.3793	26400	1.5315
2500	1.0376	8500	1.1367	14500	1.2504	20500	1.3817	26500	1.5342
2600	1.0391	8600	1.1385	14600	1.2525	20600	1.3840	26600	1.5370
2700	1.0407	8700	1.1403	14700	1.2545	20700	1.3864	26700	1.5397
2800	1.0422	8800	1.1420	14800	1.2565	20800	1.3888	26800	1.5425
2900	1.0438	8900	1.1438	14900	1.2586	20900	1.3911	26900	1.5453
3000	1.0454	9000	1.1456	15000	1.2606	21000	1.3935	27000	1.5480
3100	1.0469	9100	1.1474	15100	1.2627	21100	1.3959	27100	1.5508
3200	1.0485	9200	1.1492	15200	1.2648	21200	1.3983	27200	1.5536
3300	1.0501	9300	1.1510	15300	1.2668	21300	1.4007	27300	1.5564
3400	1.0516	9400	1.1528	15400	1.2689	21400	1.4031	27400	1.5592
3500	1.0532	9500	1.1546	15500	1.2710	21500	1.4055	27500	1.5620
3600	1.0548	9600	1.1564	15600	1.2731	21600	1.4079	27600	1.5649
3700	1.0564	9700	1.1582	15700	1.2752	21700	1.4103	27700	1.5677
3800	1.0580	9800	1.1600	15800	1.2773	21800	1.4128	27800	1.5705
3900	1.0595	9900	1.1618	15900	1.2794	21900	1.4152	27900	1.5734
4000	1.0611	10000	1.1637	16000	1.2815	22000	1.4176	28000	1.5762
4100	1.0627	10100	1.1655	16100	1.2836	22100	1.4201	28100	1.5791
4200	1.0643	10200	1.1673	16200	1.2857	22200	1.4225	28200	1.5819
4300	1.0659	10300	1.1692	16300	1.2878	22300	1.4250	28300	1.5848
4400	1.0676	10400	1.1710	16400	1.2899	22400	1.4275	28400	1.5877
4500	1.0692	10500	1.1729	16500	1.2921	22500	1.4299	28500	1.5906
4600	1.0708	10600	1.1747	16600	1.2942	22600	1.4324	28600	1.5935
4700	1.0724	10700	1.1766	16700	1.2963	22700	1.4349	28700	1.5964
4800	1.0740	10800	1.1784	16800	1.2985	22800	1.4374	28800	1.5993
4900	1.0757	10900	1.1803	16900	1.3006	22900	1.4399	28900	1.6022
5000	1.0773	11000	1.1822	17000	1.3028	23000	1.4424	29000	1.6052
5100	1.0789	11100	1.1840	17100	1.3049	23100	1.4449	29100	1.6081
5200	1.0806	11200	1.1859	17200	1.3071	23200	1.4474	29200	1.6110
5300	1.0822	11300	1.1878	17300	1.3093	23300	1.4499	29300	1.6140
5400	1.0838	11400	1.1897	17400	1.3115	23400	1.4525	29400	1.6170
5500	1.0855	11500	1.1916	17500	1.3136	23500	1.4550	29500	1.6199
5600	1.0871	11600	1.1935	17600	1.3158	23600	1.4576	29600	1.6229
5700	1.0888	11700	1.1954	17700	1.3180	23700	1.4601	29700	1.6259
5800	1.0905	11800	1.1973	17800	1.3202	23800	1.4627	29800	1.6289
5900	1.0921	11900	1.1992	17900	1.3224	23900	1.4652	29900	1.6319
6000	1.0938	12000	1.2011	18000	1.3246	24000	1.4678	30000	1.6349

Figure A1-12. ICAO Standard Atmosphere Table (Sheet 2 of 2)

PSYCHROMETRIC CHART

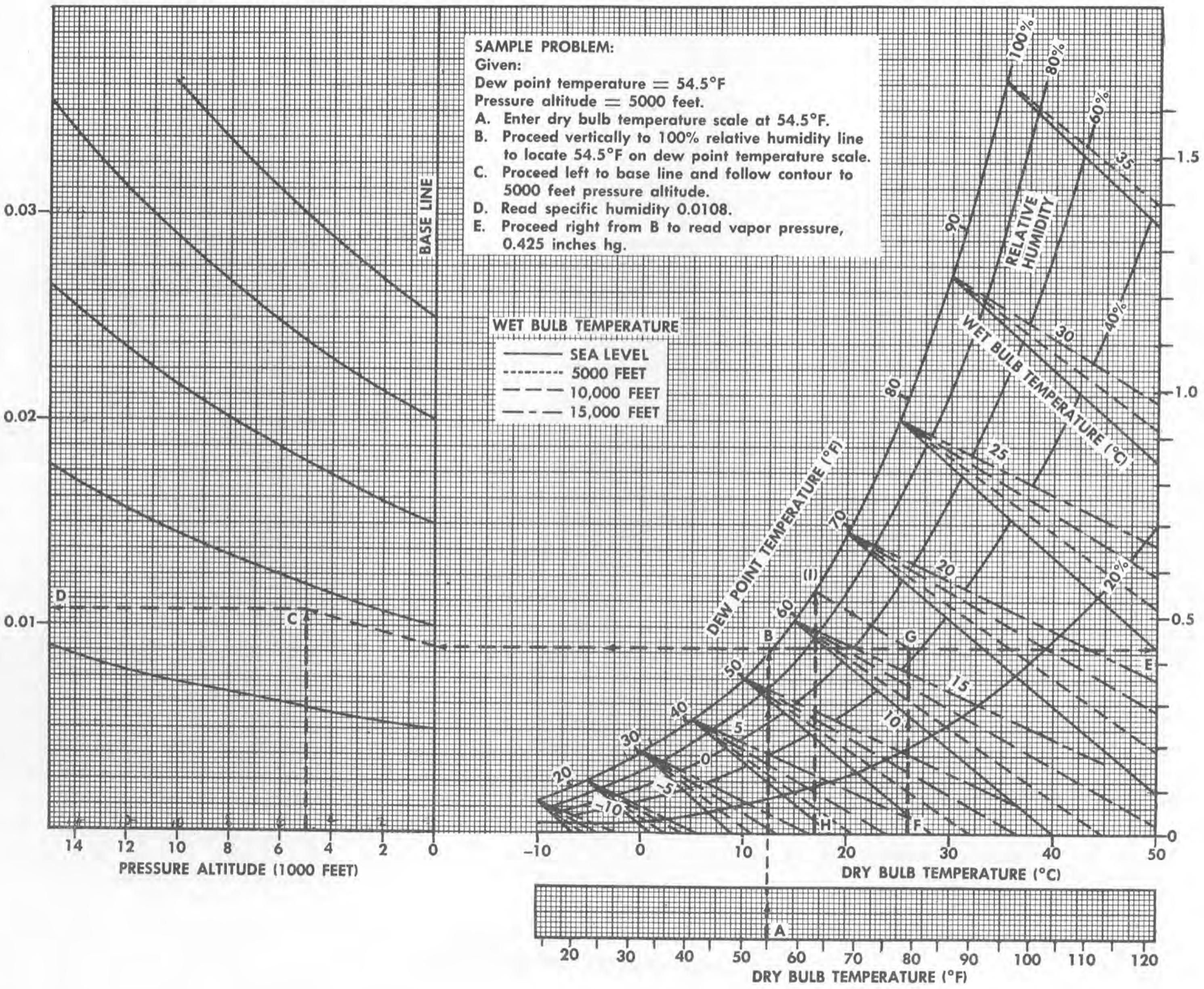


Figure A1-13. Psychrometric Chart

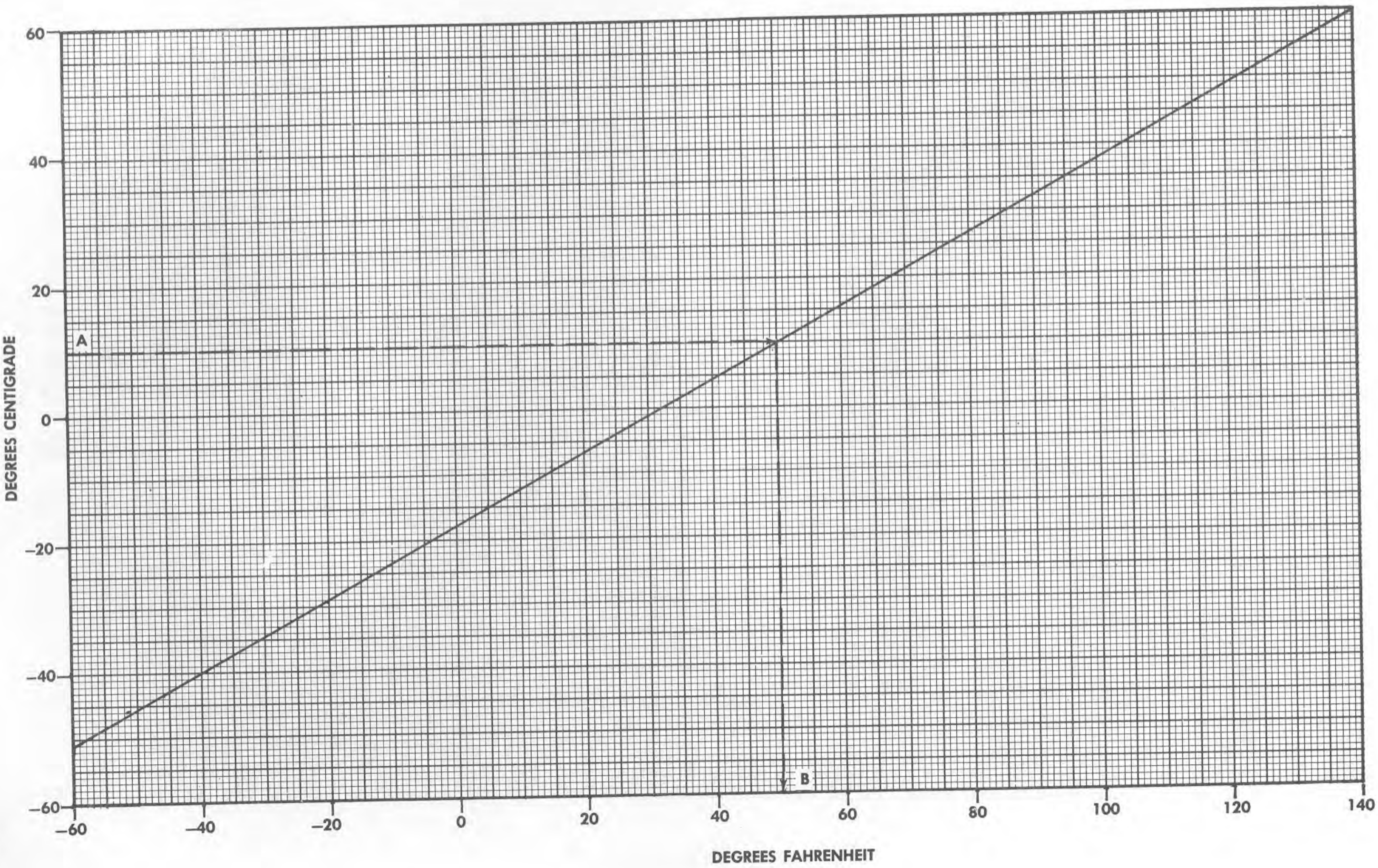
AA1-543

TEMPERATURE CONVERSION CHART

CENTIGRADE VS FAHRENHEIT

TEMPERATURE CONVERSION:
Centigrade = 5/9 (F — 32)
Fahrenheit = 9/5 C + 32

SAMPLE PROBLEM:
A. Centigrade = 10°
B. Fahrenheit = 50°



AA1-541

Figure A1-14. Temperature Conversion Chart

part 2
engine data

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LIST OF ILLUSTRATIONS

INTRODUCTION.

The engine data shown in this part are provided to aid the prediction of takeoff, climb and cruise performance and to supply the information necessary for maximum and safe utilization of the engine. The individual charts are described in detail below.

The words "wet" or "dry" describing the power used for takeoff refer to whether or not water injection (ADI fluid) is used.

The engine torquemeters are connected to gauges which are calibrated in terms of BMEP (brake mean effective pressure). If the BMEP and RPM are known it is possible to determine the brake horsepower by the following equation:

$$BHP = (BMEP \times RPM)/283$$

THE EFFECT OF TEMPERATURE ON ENGINE POWER.

The effect of temperature on engine power is accounted for by correction grids on many of the charts. If it is desirable to determine this effect for conditions not shown it may be approximated by the following equations:

$$BHP = BHP_{std}\sqrt{T_{std}/T}$$ For part throttle, constant manifold pressure operation,

$$BHP = BHP_{std}(T_{std}/T)$$ For full throttle operation,

where T and T_{std} are absolute temperature. Absolute temperature is equal to the temperature in degrees Centigrade plus 273. A 10°C temperature increase above standard results in approximately 1.7 percent power loss for part throttle, constant manifold pressure operation, and approximately 3.5 percent power loss for full throttle operation.

THE EFFECT OF HUMIDITY ON ENGINE POWER.

The effect of humidity on engine power is accounted for by correction grids on many of the charts. In addition, a chart labeled "Effect of Humidity on Power Output" *(figure A2-3)* is included to show this effect separately. This chart is discussed under "Discussion of Charts."

THE BMEP DROP METHOD OF SETTING CRUISE MIXTURES.

Considerable experience with the R-2800 engines indicate that the most efficient method of setting cruise mixtures is the BMEP drop method. With this method it is possible to operate the engine much closer to the optimum fuel to air ratio than would result from the use of auto-lean. This, in turn, permits more range for a given amount of fuel.

The BHP-RPM Schedules and BHP-MAP Schedules *(figures A2-16 through A2-19)* and the Power Settings for Cruise Charts (the even numbered figures from A5-28 through A5-50) are based on a given BMEP drop (usually 12 PSI) from best power mixture.

Upon reaching cruise altitude, climb power should be maintained until the indicated airspeed slightly exceeds that anticipated for the particular altitude, gross weight and cruise power to be used. This higher airspeed will afford a cushion so that the airspeed dissipation incurred during trim and power adjustments will not result in an airspeed at the start of cruise less than that anticipated for cruise.

From the charts referenced above for the selected brake horsepower determine the appropriate manifold pressure, RPM, blower ratio and BMEP drop. Cruise power will then be set in this sequence:

1. Set cruise RPM. (Mixture rich)
2. Shift blower, if required.

3. Set cowl flaps to the angle anticipated to yield 190° to 200°C cylinder head temperature when stabilized.

4. Adjust throttle to selected manifold pressure, allowing for any known gage error.

Note

For initial cruise setting after climb, maintain rich mixture setting for 5 minutes to allow stabilization prior to manual adjustment.

5. Manually lean the mixture for each engine individually as follows:

   a. Determine best power mixture by slowly leaning the mixture while carefully observing the BMEP until maximum BMEP is reached. Since the transport carburetor has been specifically designed to facilitate manual leaning, a rise of BMEP should be noted during the initial leaning process, indicating that the mixture is providing the maximum power output for the MAP and RPM setting used. If the initial rise is not observed, but instead an immediate drop of BMEP is noted, the carburetor is at or slightly on the lean side of best power even though the mixture is in the auto-rich position. If the carburetor is lean, return the mixture control to auto-rich and determine best power by applying intermittant prime and observing the BMEP. If a drop in BMEP is noted when using prime, the mixture is at best power. If a rise in BMEP is noted when using prime, the mixture is leaner than best power and should not be leaned beyond the auto-lean position when manually leaning to the prescribed BMEP drop in the following procedure.

   b. When the BMEP is stabilized with the mixture at best power setting (maximum BMEP), manually lean the mixture to the prescribed BMEP drop. Since the BMEP drop setting is based on a constant manifold pressure, it is essential that airspeed and altitude be held constant during this step. A change in airspeed at constant throttle affects ram and therefore manifold pressure and BMEP to the extent that an airspeed change of ten knots can result in as much as a five BMEP change. If loss of manifold pressure is experienced due to loss of ram, reset manifold pressure to original value.

6. Readjust cowl flaps to provide the desired CHT, 190° to 200°C. When stabilized, cross check engine instruments. With equal manifold pressure, RPM, carburetor air and cylinder head temperatures, equal engine airflow is normally obtained. With identical BMEP drop settings, fuel/air ratio and therefore fuel flows will also be equal, regardless of the condition of the ignition system. Any difference in fuel flow under these conditions must be due to instrument inaccuracy, either flowmeter or manifold pressure, or to a mechanical malfunction, such as a stuck valve or broken pushrod, which affects mixture flow. BMEP differences will be due entirely to unequal accessory loads, instrument inaccuracy and/or mechanical discrepancies.

7. Once cruise power has been set and stabilized, the maximum difference in indicated BMEP, after allowing for that due to unequal accessory loading, should not exceed 10 BMEP. If a greater discrepancy is noted, it should be recorded in the log with as complete a description as possible to assist in troubleshooting.

Mixtures adjusted in this manner should remain substantially the same regardless of small throttle adjustments necessary to counteract small changes in airspeed, altitude and/or CAT. Mixtures, however, should be periodically checked during cruise and adjusted as required. Power should be reset after appreciable change in CAT or altitude. If power change is excess of 50 BHP from original power setting, reset mixtures as outlined in step 5. Mixture strength or BMEP drop can be quickly checked by applying prime in varying amounts to determine best power or peak BMEP.

This procedure affords the simplest and quickest adjustment to cruise power since it involves the fewest control movements. Another advantage is that by setting equal airflow (RPM, MAP, CAT and CHT) and fuel/air ratio (BMEP drop) on all engines, any discrepancies are in greater evidence and in-flight troubleshooting is facilitated.

SETTING MANUAL RICH MIXTURES.

When operating in the power ranges where the cruise performance charts require manual rich mixture settings, set the cruise mixture as follows:

1. From the appropriate charts determine manifold pressure, rpm and blower ratio for the selected power.

2. Set RPM, blower ratio (if required), cowl flaps, and manifold pressure as outlined in steps 1 through 4 for manual lean adjustment.

Note

For initial cruise setting after climb maintain rich mixture setting for 5 minutes to allow stabilization prior to manual adjustment.

3. Determine the desired fuel flow from the Minimum Fuel Flow chart *(figure A2-13).*
4. If fuel flows exceeds chart values manually lean the mixture to charted fuel flow.
5. Readjust cowl flaps to provide the desired CHT, 190° to 200°C. When stabilized cross check engine instruments (see step 6, manual lean adjustment).
6. Check mixture periodically during cruise and adjust as required, particularly after appreciable changes in CAT, power or altitude.

DISCUSSION OF CHARTS.

ENGINE MANIFOLD PRESSURE AND POWER LIMITS CHART.

A chart has been included *(figure A2-1)* tabulating the engine manifold pressure and power limits for takeoff, METO and maximum cruise powers. These limits have been established by the engine manufacturer to permit maximum utilization of the engine consistent with a reasonably long engine life. If any of these limits are exceeded, excessive engine wear, and even engine failure, may result.

It will be noted that for several power conditions both a MAP limit and a BMEP limit are shown. In these cases observe whichever limit is reached first. On cold days the BMEP limit will be most restrictive, while on warm days the MAP limit will be most restrictive.

For takeoff power with alternate fuel grade, dry, only a MAP limit need be observed since there is no BMEP limit. For maximum cruise powers there are no MAP limits as such; however, the Power Settings for Cruise charts in Part 5 (the even numbered figures from A5-28 through A5-50) or the BHP-RPM Schedules and BHP-MAP Schedules *(figures A2-16 through A2-19)* list the RPM and MAP required to develop a given brake horsepower at a given altitude and temperature. Each MAP listed is to be considered as the MAP limit for that particular set of conditions. *(See Section D, Engine Overboost Limits.)*

In order to partially offset the loss of power due to humidity the MAP limits for the takeoff powers may be increased by the existing water vapor pressure up to a maximum of 1.5 inches Hg.

WET TAKEOFF BMEP AT VARIOUS CONDITIONS OF TEMPERATURE AND HUMIDITY CHART.

A chart is provided *(figure A2-2)* tabulating the allowable takeoff manifold pressure and the corresponding BMEP for a range of dewpoint temperatures and carburetor air tmeperatures. Although it is based only on sea level with standard fuel grade, wet, it illustrates the use of the increase in MAP by the existing water vapor pressure. It may be noted that even when the MAP is increased by the full amount permitted there is still a loss in power due to humidity. The information supplied by this chart plus the corresponding information for other altitudes and for the other power configurations (standard fuel grade, dry, and alternate fuel grade, wet and dry) may be determined from graphs on figures A2-4 through A2-7.

EFFECT OF HUMIDITY ON POWER OUTPUT CHART.

A chart is provided *(figure A2-3)* to show the effect of humidity on power output. This chart applies only to maximum power (takeoff power) engine settings. It will be noted that the degree of the effect of humidity depends upon whether or not water injection is used. The power loss determined from this chart should not be applied to the predicted power obtained from the Brake Horsepower Available for Takeoff charts *(figure A2-4 through A2-7)* because this humidity correction is built into those charts.

Humidity corrections for climb and cruise powers are not shown because at the higher altitudes the amount of water vapor that the air can hold is much less than at sea level.

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF CHARTS.

Four charts are provided showing the power available for takeoff with standard fuel grade, wet *(figure A2-4),* standard fuel grade, dry *(figure A2-5),* alternate fuel grade, wet *(figure A2-6),* and alternate fuel grade, dry *(figure A2-7).* The powers determined from these charts are used to determine takeoff performance in Part 3. Results may be read in the form of predicted brake horsepower, predicted BMEP (corresponding to the predicted brake horsepower) or 95% of predicted BMEP. Generally, 95% of predicted BMEP is used to determine takeoff performance.

These charts allow corrections to be made for altitude, carburetor air temperature and humidity. Because the carburetor air temperature is seldom known at the time these charts are used, assume that it is 5 degrees Centigrade above the outside air temperature. To prevent overboosting the engines when the carburetor air temperature is below standard a correction scale, showing the amount by which the MAP limit should be reduced, is included on the applicable charts (the chart for alternate fuel grade, dry, figure A2-7, does not need this correction).

In allowing for the effect of humidity one scale corrects the power downward for the effect of humidity alone. Another scale corrects the power upwards to account for the allowable increase in MAP equal to the existing water vapor pressure up to 1.5 inches Hg. This later correction may only be made when the combination of pressure altitude and carburetor air temperature indicate that takeoff power may be developed with less than full throttle setting.

For takeoff ground run, with full throttle operation, the chart values for BMEP are based on ram available at approximately 70 knots IAS. At the start of the ground run, with no ram air, manifold pressures approximately 1 in. Hg below charted values may be expected. In part throttle operation, when manifold pressures are set at the start of ground run, an overboost of approximately 1 in. Hg MAP may be expected at climbout speeds unless the throttles are adjusted during the ground run.

When planning a takeoff with ADI inoperative on one or more engines, determine the reject BMEP of 95 percent BMEP for both wet and dry power for the given conditions. Compute BMEP for determining takeoff factor, gross weight limited by three-engine climb performance, and emergency climb performance as follows: With ADI inoperative on one engine, take the average of the BMEP for two wet and one dry engine; for example, for given conditions producing a wet BMEP of 240, the dry BMEP will be 211, the average will be (240 + 240 + 211) ÷ 3 = 230 BMEP. Use 230 BMEP for computing performance from the charts. This method allows sufficient margin of safety in the event that engine failure occurs on an engine with ADI operating, leaving only two wet engines. To compute the average BMEP with ADI inoperative on two engines, take the average of one wet and two dry engines. If ADI is inoperative on three engines, compute performance for dry power on all engines.

A different example has been included on each chart to illustrate a range of possible operating conditions.

ENGINE CALIBRATION — LOW BLOWER — BRAKE HORSEPOWER VS MANIFOLD PRESSURE CHART.

This chart *(figure A2-8)* shows the relationship between brake horsepower, manifold pressure and RPM with auto-lean mixture control at sea level on a standard day. From this chart it may easily be determined how a given change in manifold pressure or RPM will affect brake horsepower. Although the actual values on the chart apply only to sea level, standard day, the relative picture remains approximately the same at higher altitudes and other atmospheric conditions. For example, the chart shows that for a given manifold pressure, decreasing the RPM from 1500 to 1400 decreases the power output by 60 brake horsepower. This approximate loss in power will occur regardless of altitude or temperature.

This chart may also be used with the Brake Horsepower vs Altitude chart on the facing page to determine the engine settings required to develop a given power at higher altitudes (see text under Engine Calibration — Low Blower, Brake Horsepower vs Altitude Chart).

ENGINE CALIBRATION — LOW BLOWER — BRAKE HORSEPOWER VS ALTITUDE CHART.

This chart *(figure A2-9)* shows the relationship between brake horsepower, RPM and altitude for low blower operation with standard atmospheric conditions. Each curve is for a single RPM and shows how engine power decreases with increasing altitude when operating at full throttle. The curves for takeoff RPM, wet and dry, and for METO RPM are for auto-rich operation with ram available as noted. The curves for 1400 RPM to 2300 RPM are for auto-lean operation with ram available in level flight at long range cruise speeds.

A line labeled "Limited by Maximum Recommended Cruise BMEP" has been drawn across the auto-lean curves to show the maximum power which may be developed at any given RPM during normal cruise operation. The same line also shows the maximum altitude at which that power may be obtained with that RPM (in lower blower). For example, the chart shows that the maximum cruise power for 2000 RPM is 1100 brake horsepower. Furthermore, the maximum altitude at which 1100 brake horsepower may be obtained with 2000 RPM is 11,600 feet. 1100 brake horsepower may be obtained at lower altitudes by using 2000 RPM and varying degrees of throttle. In order to obtain 1100 brake horsepower at altitudes above 11,600 feet it is necessary to increase the RPM. Once 2300 RPM has been reached, with full throttle, it will be necessary to use high blower to gain more altitude.

The manifold pressures shown on the chart are for full throttle only (with the exception of the sea level values indicated on the takeoff and METO RPM lines). However, manifold pressures for part throttle operation may be determined by use of the guide lines as illustrated in the following example.

Sample Problem.

GIVEN: Cruise altitude = 10,000 feet.
Cruise power = 1240 brake horsepower per engine.

FIND: RPM and manifold pressure.

1. Enter brake horsepower scale at selected power, 1240 BHP.
2. Enter pressure altitude scale at cruise altitude, 10,000 feet.
3. Locate BHP-altitude point.
4. Find intersection of 1240 BHP and the line limited by maximum recommended cruise BMEP. This determines the minimum RPM at which 1240 BHP may be obtained for cruise operation, 2300 RPM.
5. Extend a line parallel to the guide lines from point C to the 2300 RPM line. Read the MAP required to develop 1240 BHP at 10,000 feet with 2300 RPM, 33 inches Hg.
6. As an alternate step to 5, extend a line parallel to the guide lines from point C to the left hand scale. Read the power, 1100 BHP, with which to enter the BHP vs MAP chart *(figure A2-8)* for determining the required MAP.

ENGINE CALIBRATION — HIGH BLOWER — BRAKE HORSEPOWER VS MANIFOLD PRESSURE CHART.

This chart *(figure A2-10)* is similar to the low blower brake horsepower vs manifold pressure chart described above. It differs in that it is based on high blower operation at an altitude of 10,000 feet. It is used in the same manner as described for the low blower chart.

ENGINE CALIBRATION — HIGH BLOWER — BRAKE HORSEPOWER VS ALTITUDE CHART.

This chart *(figure A2-11)* shows data for high blower operation corresponding to the low blower brake horsepower vs altitude chart described above. It differs in that there are no takeoff RPM's shown, and the chart starts at 10,000 feet (to correspond to the facing high blower brake horsepower vs manifold pressure chart) rather than sea level. In other respects the chart may be used in the same manner as described for the low blower chart.

ENGINE CALIBRATION — ALTERNATE FUEL GRADE CHART.

This chart *(figure A2-12)* shows the brake horsepower vs altitude calibration for takeoff RPM, wet and dry, in low blower and for METO RPM in both low blower and high blower with alternate fuel grade. For cruise power calibrations the auto-lean curves on figures A2-8 through A2-11 may be used; however, never exceed the power limited by maximum recommended cruise BMEP for any given RPM.

MINIMUM FUEL FLOW CHART — AUTO RICH OPERATION.

The Minimum Fuel Flow chart *(figure A2-13)* shows the expected fuel flow for auto rich operation in both low blower ratio and high blower ratio. If fuel flows substantially exceed those shown on the chart a loss in power may result. In such a case it is permissible to manually lean the mixture to the fuel flow determined from the chart. In no case should the mixture be leaned to less than the chart fuel flows.

It is important that fuel flow be monitored throughout the climb to ascertain that it is within prescribed limits. The minimum fuel flow limit is not an engine limit at normal climb power. It is, however, a carburetor limit designed to obviate damage which might otherwise result at higher power, where margin between a safe fuel flow and engine detonation is diminishing. At climb power, therefore, it is considered safe to continue operation when the fuel flow is at or 50 pounds per hour below the minimum fuel flow shown on figure A2-13, providing CHT and CAT limits are observed. If the climb fuel flow falls more than 50 pounds per hour below published minimum, power should be reduced by increments of 100 BHP until the fuel flow is not more than 50 pounds per hour below the limit for that particular reduced power. CHT and CAT limits must still be monitored. For a carburetor whose fuel flow is below published minimums, a complete write-up should be made in the log and corrective maintenance accomplished at the next landing.

The chase-around lines on the chart illustrate the example.

Sample Problem.

GIVEN: Engine power = 1300 BHP.
RPM = 2300.

FIND: Minimum fuel flow (low blower).

1. Enter the brake horsepower scale at 1300 BHP and proceed vertically upwards.
2. Enter the left hand scale at 2300 RPM and continue to the right to 1300 BHP.
3. At the intersection of 2300 RPM and 1300 BHP read the minimum fuel flow per engine, 810 pounds per hour.

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS CHARTS.

These two charts show the estimated fuel flows for cruise operation in low blower *(figure A2-14)* and high blower *(figure A2-15)* when using the BMEP drop method of cruise control. The charts are based on best economy mixture setting; however, an auxiliary graph is included so that the fuel flow may be determined when operating at any given BMEP drop from best power mixture setting.

Sample Problem:

GIVEN: Engine power = 1150 BHP.

RPM = 2200.

BMEP Drop = 12.

Blower Range = Low blower.

FIND: Estimated fuel consumption.

1. Enter the chart *(figure A2-14)* at 1150 BHP (A).
2. Read vertically to the 2200 RPM curve (B).
3. Read across to find fuel flow of 557 pounds per hour per engine (C).
4. To find fuel flow increment for BMEP drop, enter the auxiliary graph at 12 BMEP (D) and read up to 2200 RPM (E).
5. Read across to find fuel flow increment of 2 pounds per hour (F).
6. Fuel flow for each engine is 557 + 2 = 559 pounds per hour per engine. Total fuel flow for all four engines is 559 × 4 = 2236 pounds per hour.

BHP-RPM SCHEDULE CHARTS.

These two charts show the RPM necessary to develop a given brake horsepower when cruising either in low blower *(figure A2-16)* or high blower *(figure A2-18)*. The charts are based on operating at 12 BMEP drop from best power mixture. Corrections are provided for carburetor air temperature and pressure altitude.

Within a certain range of conditions part throttle operation is indicated on each chart. In such cases the manifold pressure required to develop the given brake horsepower may be determined from the facing BHP-MAP Schedule chart. When full throttle operation is indicated it is not necessary to know the manifold pressure. Correction for ram effect is included in the chart so that no correction for airspeed is required.

It may also be noted that carburetor air temperature only affects RPM when operating at full throttle. For example, figure A2-16 shows that at 6,000 feet pressure altitude the RPM required to develop 1000 BHP is 1855 for any carburetor air temperature from 20°C to minus 60°C. This is because part throttle operation is indicated. However, at 14,000 feet pressure altitude any change in carburetor air temperature affects tbe RPM required to developed 1000 BHP because, for these conditions, full throttle operation is required. The chart shows that an increase in carburetor air temperature increases the RPM required.

Sample Problem:

GIVEN: Carburetor air temperature = −10°C.

Blower operation = Low blower.

Pressure altitude = 10,000 feet.

Desired power = 1050 BHP.

FIND: RPM required to produce 1050 BHP.

1. Enter the low blower chart *(figure A2-16)* at carburetor air temperature of −10°C (A) and read across to pressure altitude of 10,000 feet (C).
2. Read up to desired power of 1050 BHP (C).
3. Read across to find required RPM of 1945 (D). Since power setting is in the part throttle range at this altitude, the manifold pressure for this power setting must be obtained from the BHP-MAP Schedule chart *(figure A2-17)*.

BHP-MAP SCHEDULE CHARTS.

These two charts show the manifold pressure required to develop a given brake horsepower when cruising in either low blower *(figure A2-17)* or high blower *(figure A2-19)*. They are to be used with the RPM's determined from the facing BHP-RPM Schedule charts, and are based on 12 BMEP drop from best power mixture. The corrections shown for carburetor air temperature are applicable only for part throttle operation. Although manifold pressures are also shown for full throttle operation they are approximately correct only for standard atmospheric conditions and are not required for setting up engine powers.

Sample problems are included on both charts to illustrate the method of computing for temperatures below standard *(figure A2-17)* and for temperatures above standard *(figure A2-19)*.

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ENGINE MANIFOLD PRESSURE AND POWER LIMITS

MODEL: C-118A AND VC-118A — **ENGINES: R2800-52W**
DATA AS OF: 2-15-59 — **FUEL GRADE: 115/145**
BASED ON: Estimated data — **ALTERNATE FUEL GRADE: 100/130**

FUEL GRADE: 115/145

Power Condition	*RPM*	*Blower*	*Mixture*	*MAP Limit (In. Hg)*	*BMEP Limit (psi)*	*BHP*
Takeoff (Wet)	2800	Low	Rich	*62.0 at S.L. *61.5 at 3800 feet	253 253	2500 2500
Takeoff (Dry)	2800	Low	Rich	*60.0 at S.L. *58.5 at 5300 feet	222 222	2200 2200
METO	2600	Low	Rich	51.5 at S.L. 50.0 at 7000 feet	207 207	1900 1900
METO	2600	High	Rich	50.0 at 10,000 feet 47.5 at 16,000 feet	190 190	1750 1750
Maximum Cruise	2300	Low	Lean		153	1240
Maximum Cruise	2300	High	Lean		147	1200

FUEL GRADE: 100/130

Power Condition	*RPM*	*Blower*	*Mixture*	*MAP Limit (In. Hg)*	*BMEP Limit (psi)*	*BHP*
Takeoff (Wet)	2800	Low	Rich	*59.5 at S.L. *58.5 at 5000 feet	243 243	2400 2400
Takeoff (Dry)	2800	Low	Rich	*53.0 at S.L. *51.0 at 9900 feet		
METO	2600	Low	Rich	49.0 at S.L. 47.0 at 9300 feet	196 196	1800 1800
METO	2600	High	Rich	47.5 at 10,000 feet 45.5 at 16,000 feet	185 185	1700 1700
Maximum Cruise	2300	Low	Lean		153	1240
Maximum Cruise	2300	High	Lean		147	1200

Note
1. Observe MAP limit of BMEP limit, whichever is reached first.
2. For maximum cruise MAP see the Power Settings for Cruise charts, Part 5.
   Maximum cruise low blower – 155 bmep (except when at 1240 bhp and 2300 rpm – 153 bmep)
   Maximum cruise high blower – 150 bmep (except when at 1200 bhp and 2300 rpm – 147 bmep)

* Takeoff MAP may be increased by existing vapor pressure up to 1.5 in. Hg.

Figure A2-1. Engine Manifold Pressure and Power Limits

WET TAKEOFF BMEP AT VARIOUS CONDITIONS OF TEMPERATURE AND HUMIDITY

2800 RPM
SEA LEVEL
ADI ON
NO INSTALLATION EFFECTS

DATA AS OF: 2-15-59
BASED ON: Pratt & Whitney Table, ALT120

Carburetor Air Temperature			°C: 10	15	20	25	30	35	40	45
			°F: 50	59	68	77	86	95	104	113
**Manifold Pressure (In. Hg)*	*Dewpoint Temperature °C*	*°F*	*BMEP (psi)*							
62.1	—4	25	253	252	250	248	245	243	241	239
62.2	—1	30	253	252	249	248	245	243	241	239
62.2	2	35	253	251	249	247	244	242	240	238
62.2	4	40	252	250	248	246	244	242	240	237
62.3	7	45	252	250	248	246	243	241	239	237
62.3	10	50	251	249	247	245	243	241	238	236
62.4	13	55		248	246	244	242	240	238	236
62.5	16	60		248	245	244	241	239	237	235
62.6	18	65			244	243	240	238	236	234
62.7	21	70			243	242	239	237	235	233
62.9	24	75				240	238	236	234	231
63.0	27	80				238	236	234	232	230
63.2	29	85					234	232	230	228
63.4	32	90						230	228	226

*62.0 inches plus existing vapor pressure up to 1.5 inches

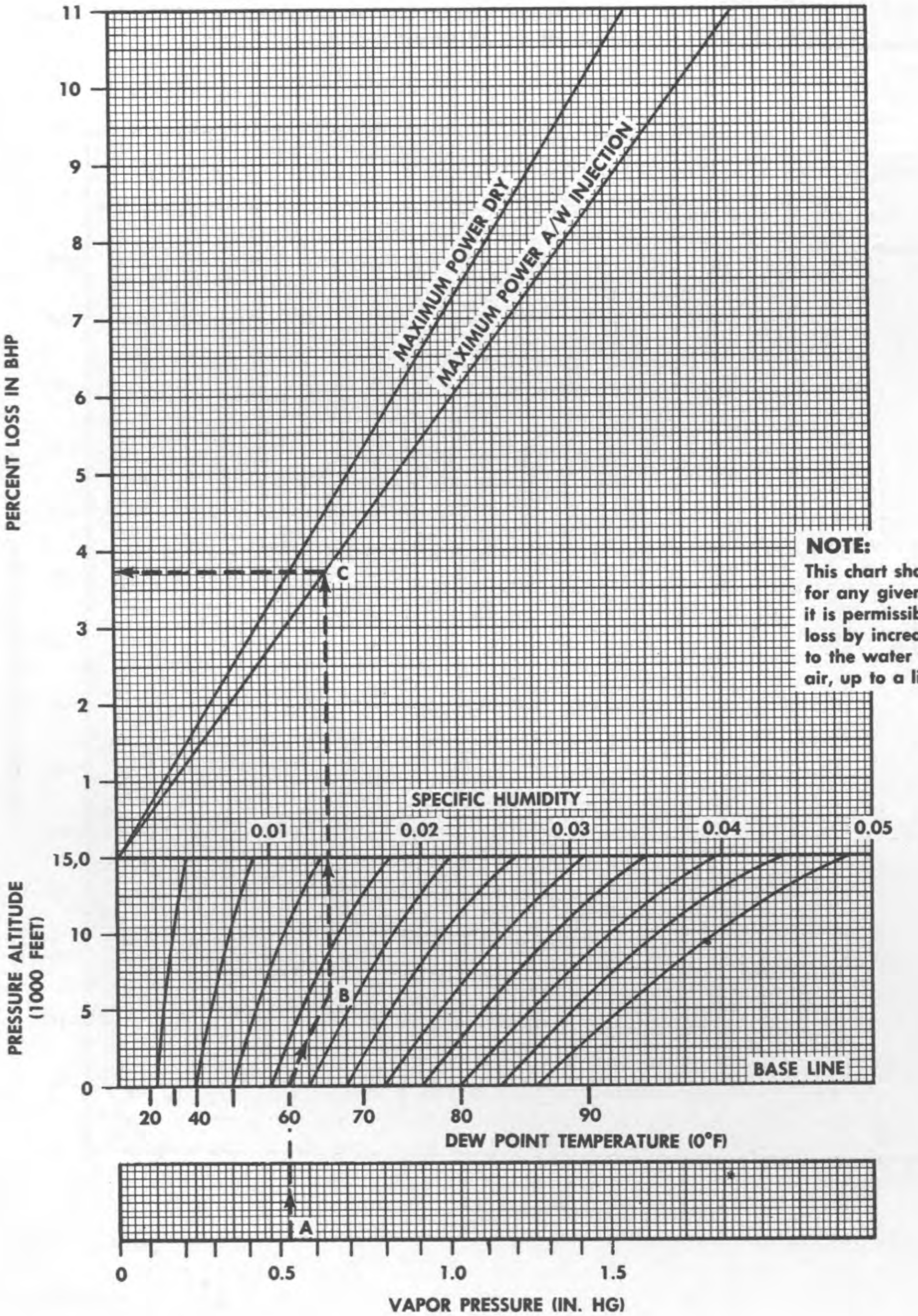
Figure A2-2. Wet Takeoff BMEP at Various Conditions of Temperature and Humidity

EFFECT OF HUMIDITY ON POWER OUTPUT

MODEL: C-118A AND VC-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

SAMPLE PROBLEM:
A. Vapor pressure = 0.53 In. Hg (Dew point temperature = 60°F).
B. Pressure altitude = 6000 feet.
C. Effect of humidity on maximum power, wet, is a 3.7% loss in power.

ENGINES: (4) R2800-52W



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 MAP by an amount equal to the water vapor pressure present in the air, up to a limit of 1.5 inches HG.

AA1-542

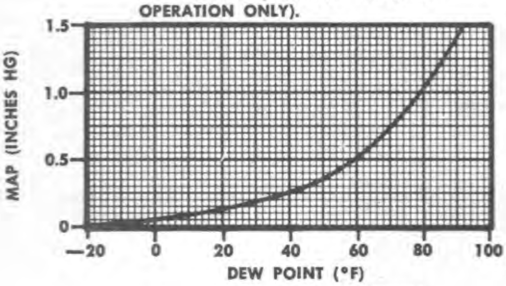
Figure A2-3. Effect of Humidity on Power Output

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — WET

2800 RPM

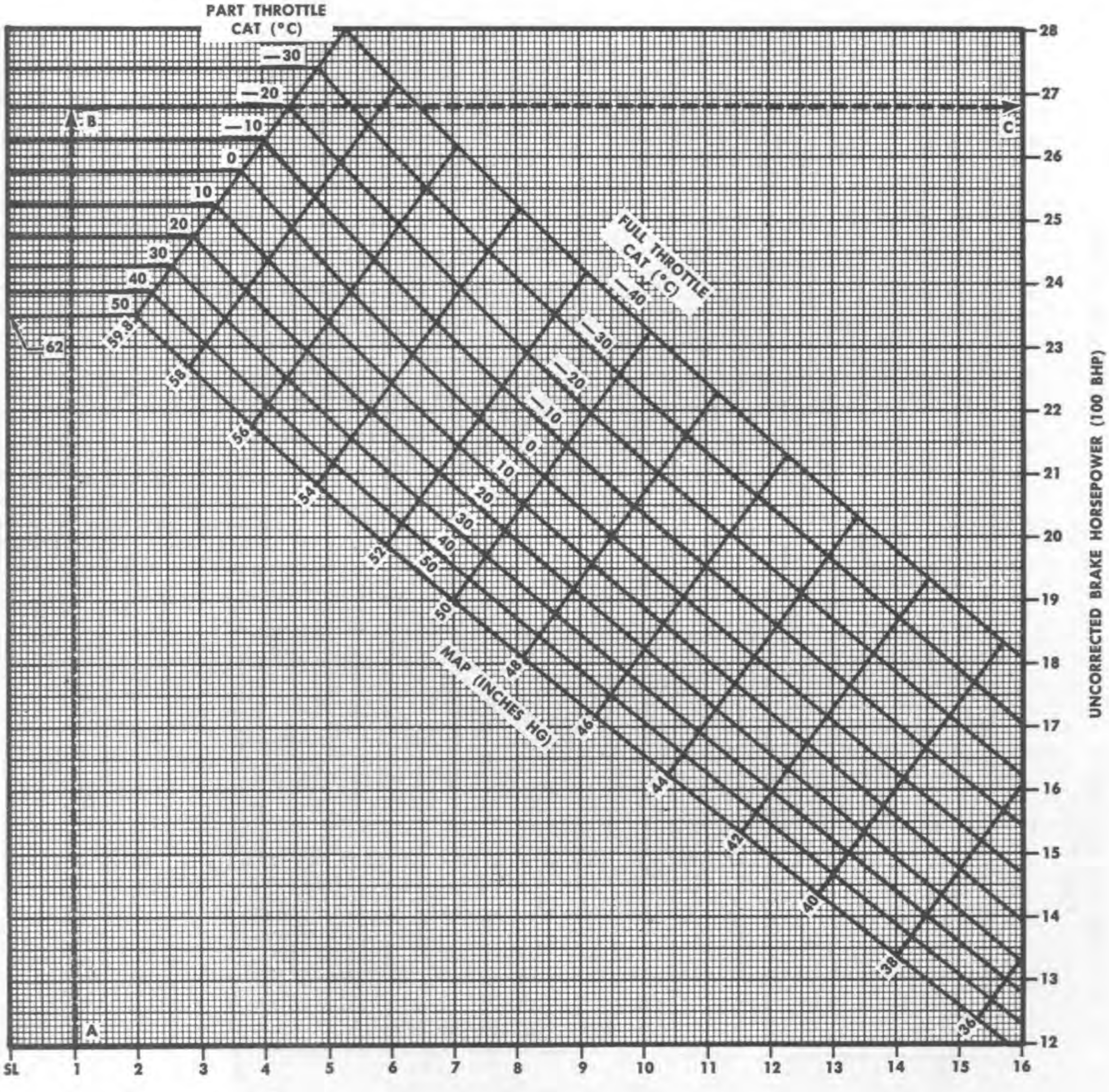
MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145



NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).



AA1-532

Figure A2-4. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Wet (Sheet 1 of 2)

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — WET

2800 RPM

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM:

A. Pressure altitude = 1000 feet.
B. CAT = −20°C (5° above OAT of −25°C).
C. Uncorrected brake horsepower = 2680.
D. No correction for humidity because dew point is −20°C.
E. Predicted power per engine = 2500 BHP.
F. Map reduction for low CAT = 3.6 inch. HG. (MAP for takeoff = 62 inch. HG −3.6 inch. HG, or 58.4 inch. HG).
G. Predicted BMEP = 253 PSI.
H. 95 percent predicted BMEP = 240 PSI.

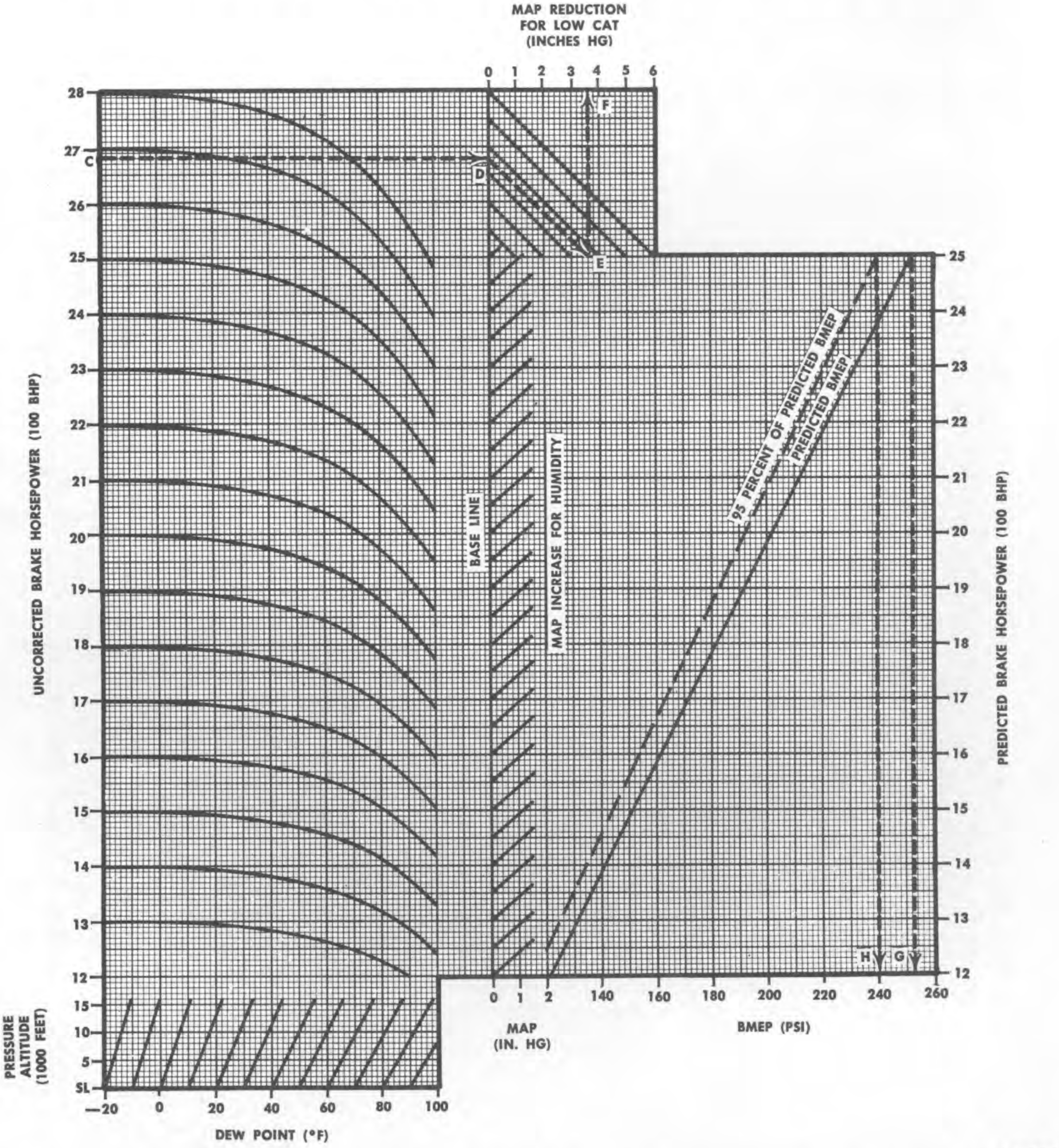


Figure A2-4. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Wet (Sheet 2 of 2)

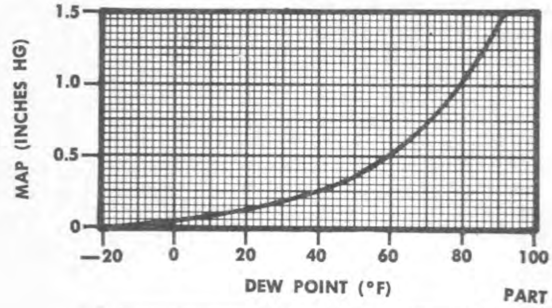
BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — DRY

2800 RPM

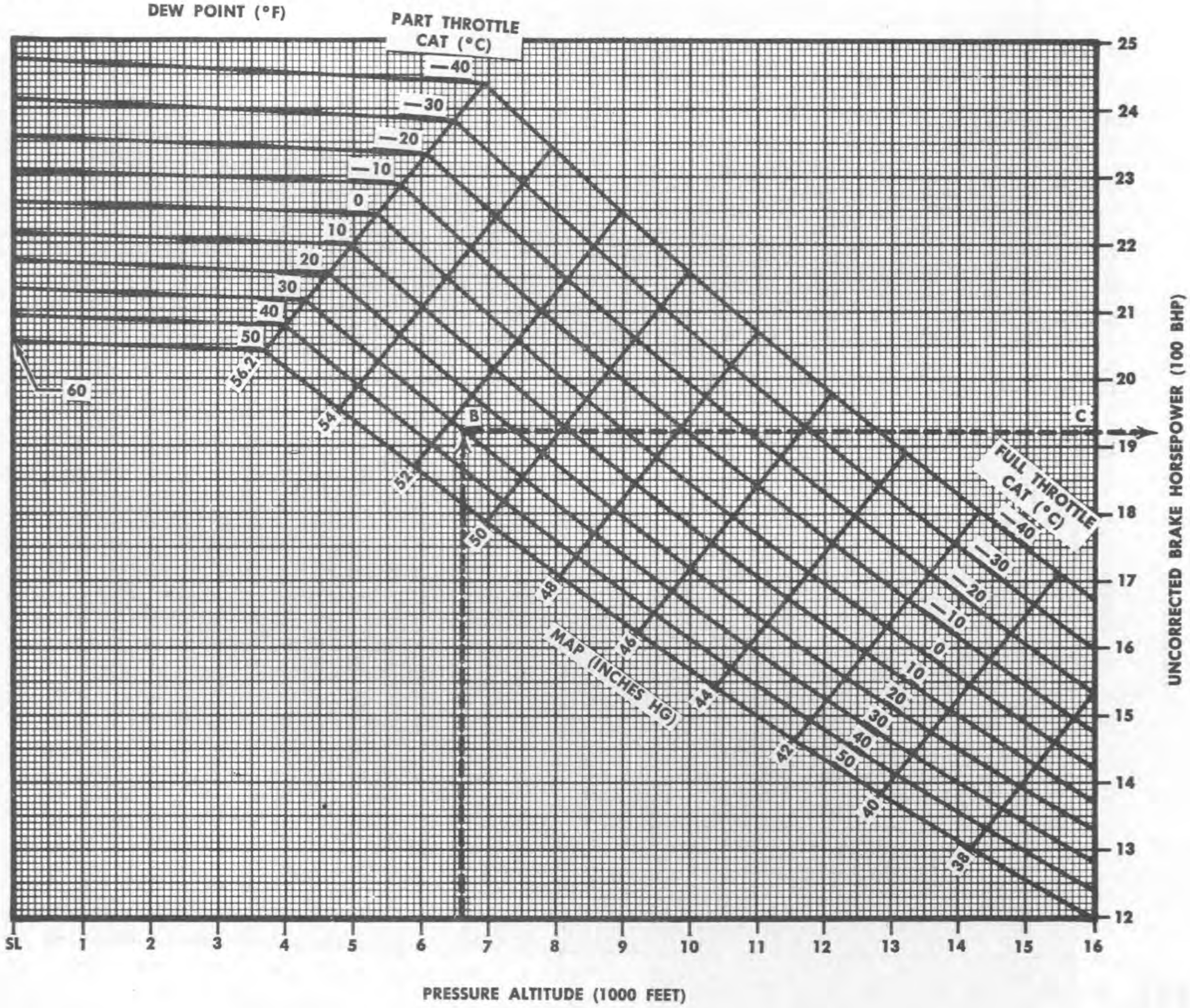
MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

ALLOWABLE INCREASE IN MAP DUE TO HUMIDITY (FOR PART THROTTLE OPERATION ONLY).



NOTE:
1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).



AA1-534

Figure A2-5. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Dry (Sheet 1 of 2)

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — DRY

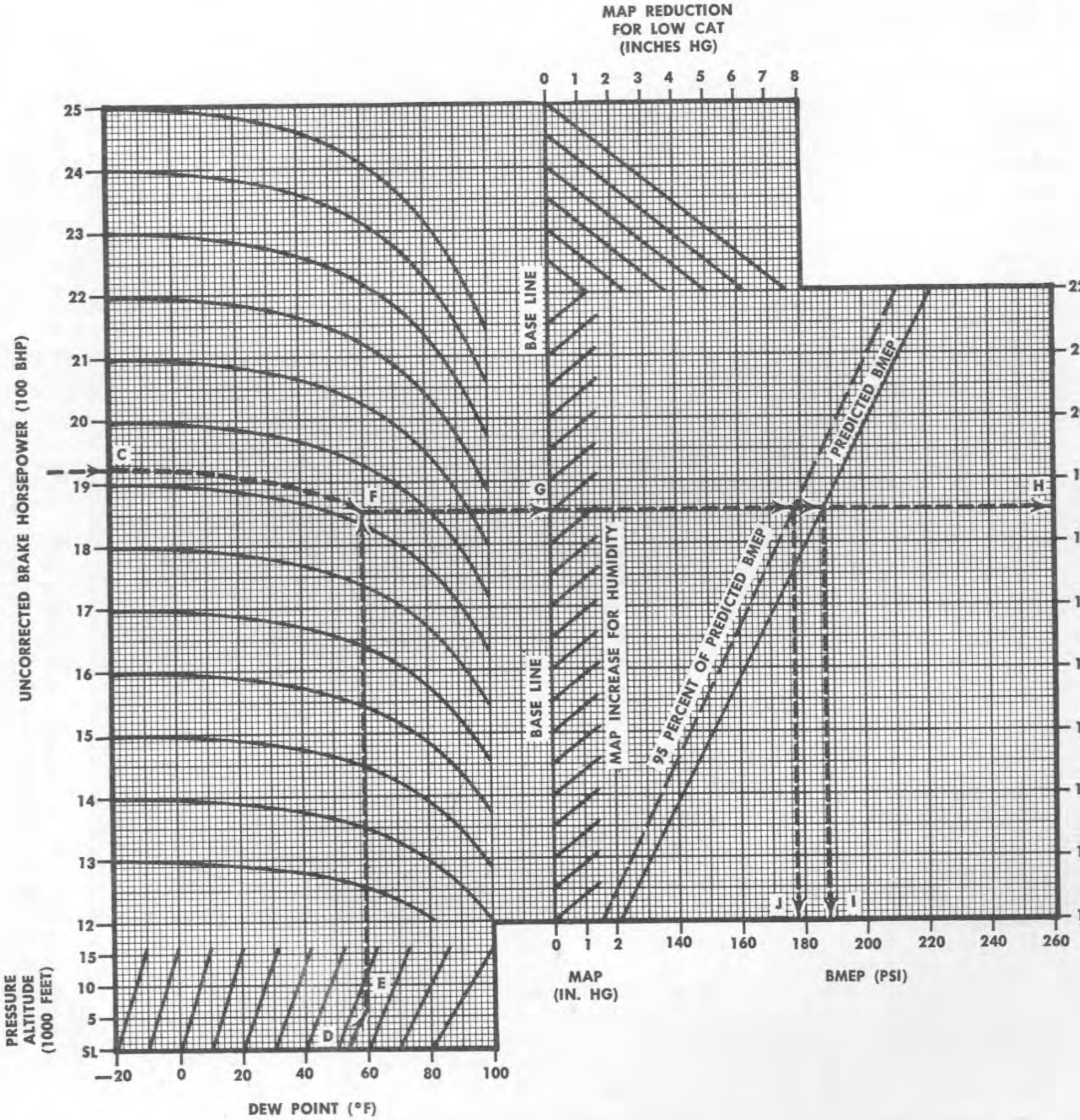
2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM:

A. Pressure altitude = 6600 feet.
B. CAT = 30°C.
C. Uncorrected brake horsepower = 1922 BHP.
D. Dew point = 54°F.
E. Pressure altitude = 6600 feet.
F. Power corrected for humidity.
G. No increase in MAP for humidity because full throttle operation is required (see point B).
H. Predicted power per engine = 1854 BHP.
I. Predicted BMEP = 187.5 PSI.
J. 95 percent of predicted BMEP = 178 PSI



AA1-535

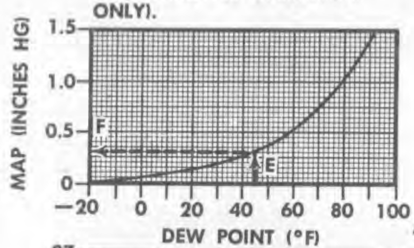
Figure A2-5. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Dry (Sheet 2 of 2)

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON FLIGHT TEST DATA

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — ALTERNATE FUEL GRADE — WET

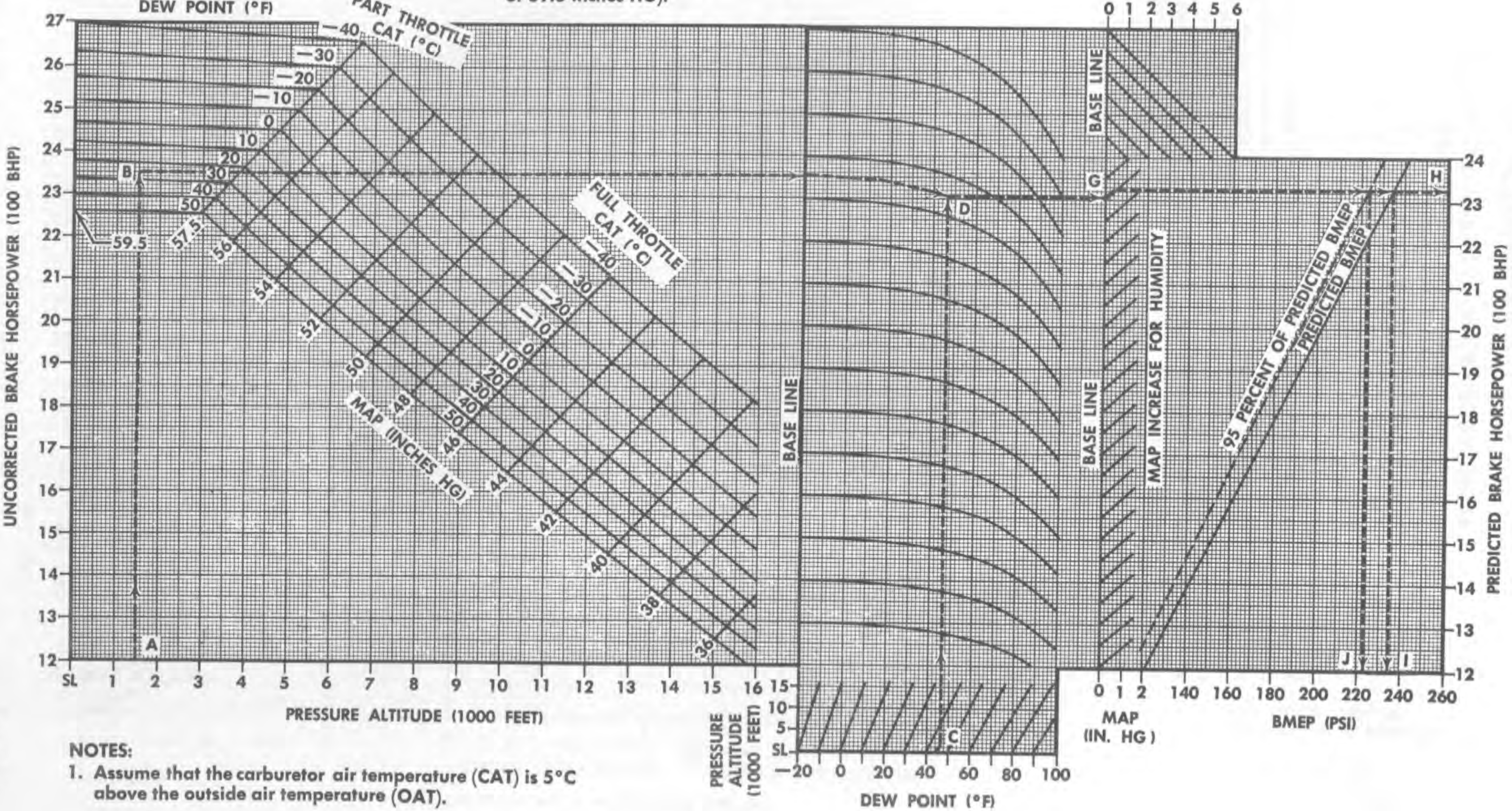
2800 RPM

ENGINES: (4) R2800-52W
FUEL GRADE: 100/130



SAMPLE PROBLEM:

A. Pressure altitude = 1500 feet.
B. CAT = 25°C (5° above OAT of 20°C).
C. Dew point = 45°F at 1500 feet altitude.
D. Power correction for humidity.
E. Enter auxiliary graph at the dew point of 45°F.
F. Read the allowable increase in MAP due to humidity, 0.3 inches of HG (MAP for takeoff will be 59.5 + 0.3 or 59.8 inches HG).
G. Correct power for 0.3 inch HG increase in MAP.
H. Predicted power per engine = 2322 BHP.
I. Predicted BMEP = 234 PSI.
J. 95 percent of predicted BMEP = 222.3 PSI.



NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).

AA1-251

Figure A2-6. Brake Horsepower Available for Takeoff — Alternate Fuel Grade — Wet

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — ALTERNATE FUEL GRADE — DRY

2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON FLIGHT TEST DATA

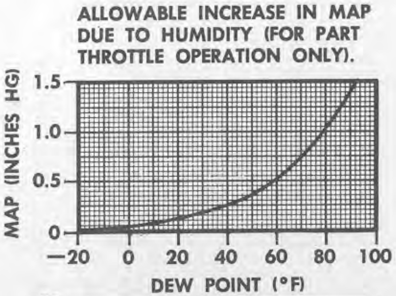
ENGINES: (4) R1800-52W
FUEL GRADE: 100/130

NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).

SAMPLE PROBLEM

A. Pressure altitude = 4000 feet.
B. CAT = −25°C (5°C above OAT of −30°C).
C. There is no correction for humidity because the dew point is less than −20°C.
D. There is no increase in MAP because the dew point is less than −20°.
E. Predicted power per engine = 2105 BHP.
F. Predicted BMEP = 212 PSI.
G. 95 percent of predicted BMEP = 201.5 PSI.



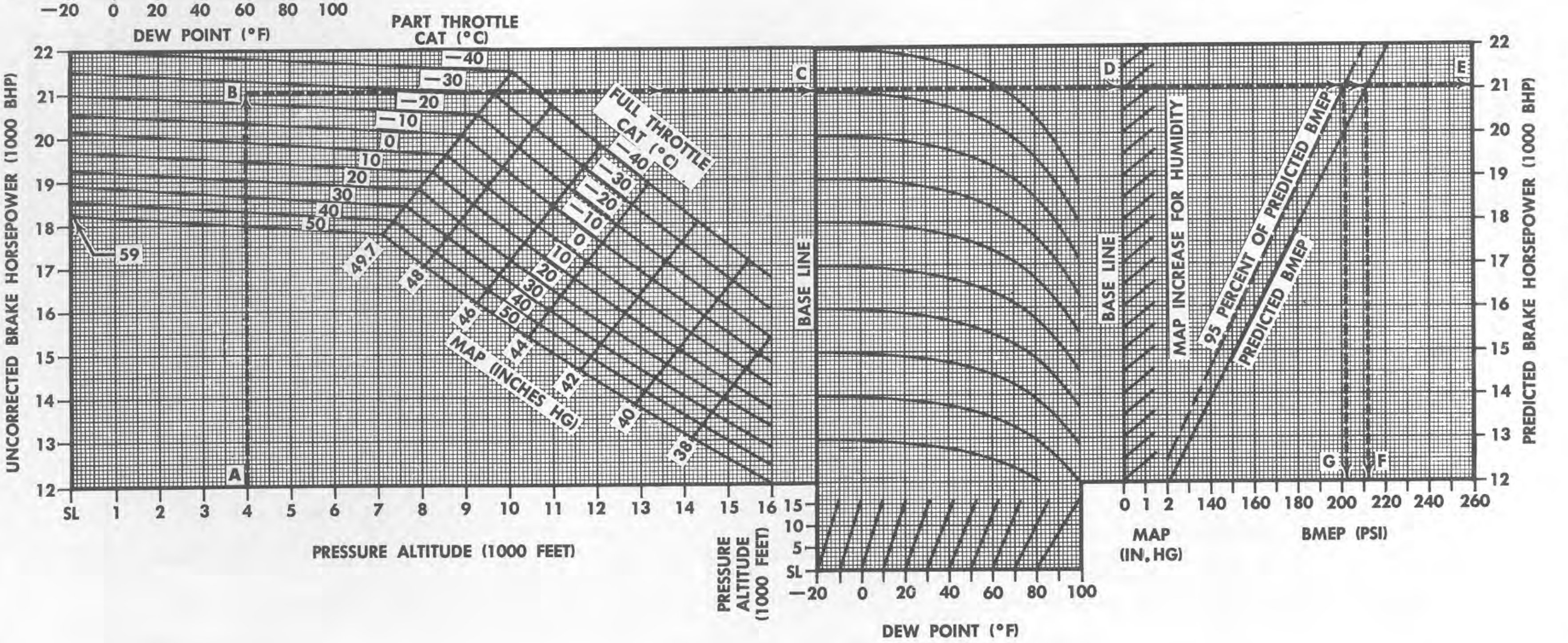


Figure A2-7. Brake Horsepower Available for Takeoff — Alternate Fuel Grade — Dry

AA1-24B

ENGINE CALIBRATION — LOW BLOWER

BRAKE HORSEPOWER Vs MANIFOLD PRESSURE
SEA LEVEL — STANDARD DAY
AUTO — LEAN MIXTURE

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASED ON: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

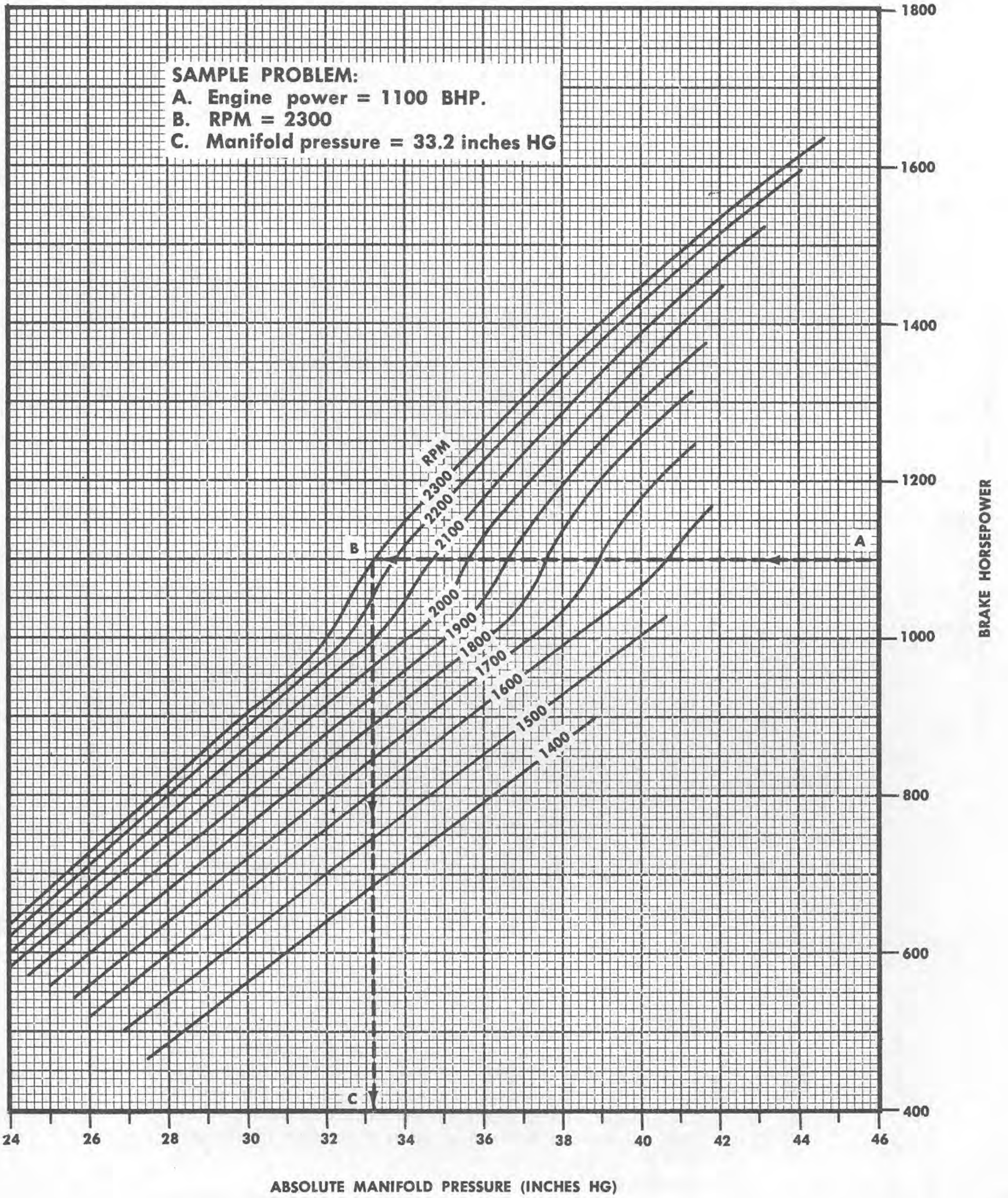


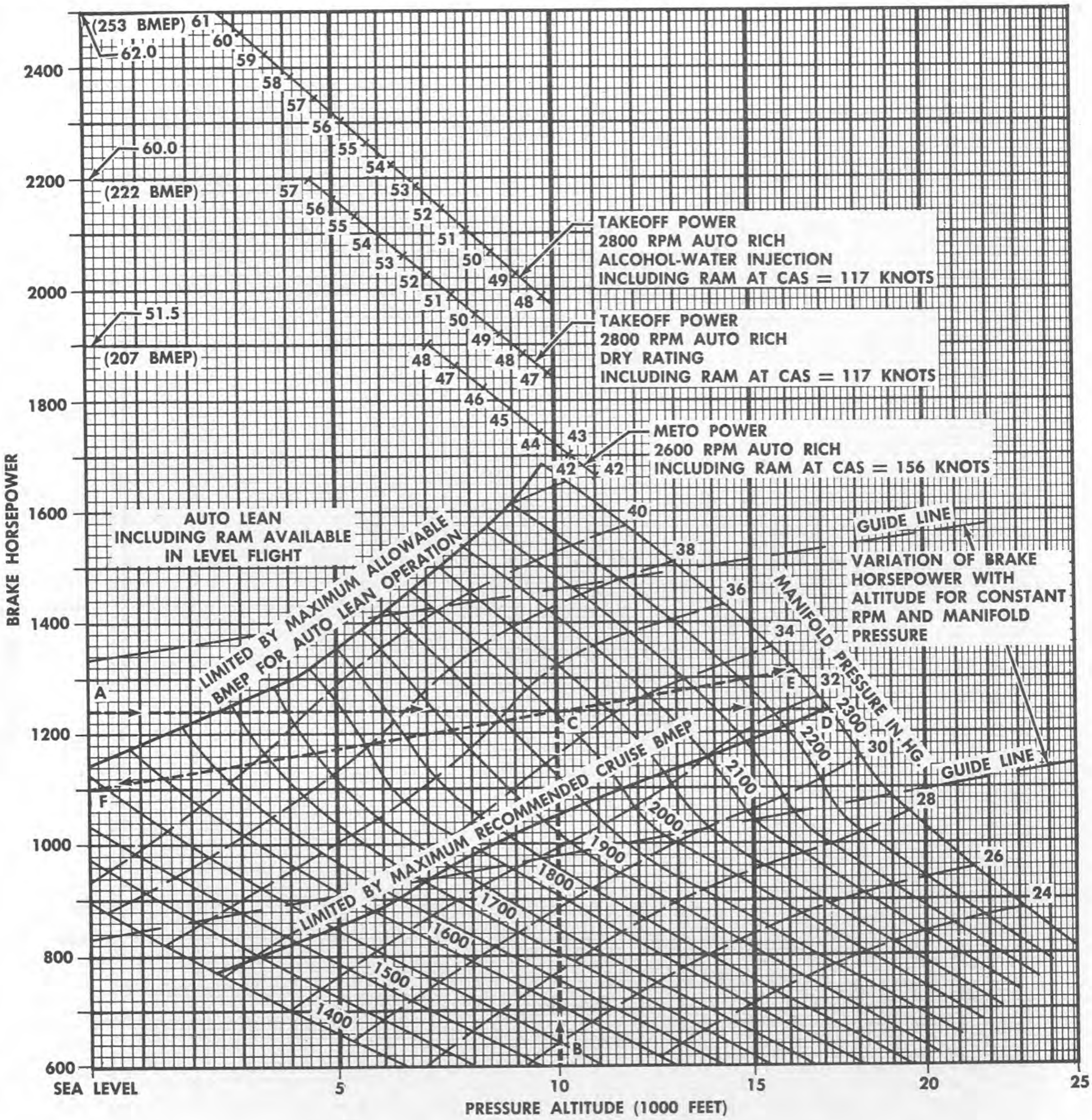
Figure A2-8. Engine Calibration—Low Blower—Brake Horsepower Vs Manifold Pressure

ENGINE CALIBRATION — LOW BLOWER

BRAKE HORSEPOWER Vs ALTITUDE
NACA STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145



NOTE:
Values given in this chart are based on flight test engine calibration data where available and on engine calibration curve No. Inst. 16472-1 in Pratt and Whitney Special Operating Instructions No. 01.115 dated April 1951, revised June 15, 1951 (modified to agree with existing flight test results). All values include RAM. All predicted BHP values are available from the Altitude, RPM intersection, back to sea level, at that RPM, by maintaining constant BMEP.

AA1-14

Figure A2-9. Engine Calibration Chart—Low Blower—Brake Horsepower Vs Altitude

ENGINE CALIBRATION — HIGH BLOWER

BRAKE HORSEPOWER VS MANIFOLD PRESSURE
10,000 FEET — STANDARD DAY
AUTO — LEAN MIXTURE

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALIBRATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145

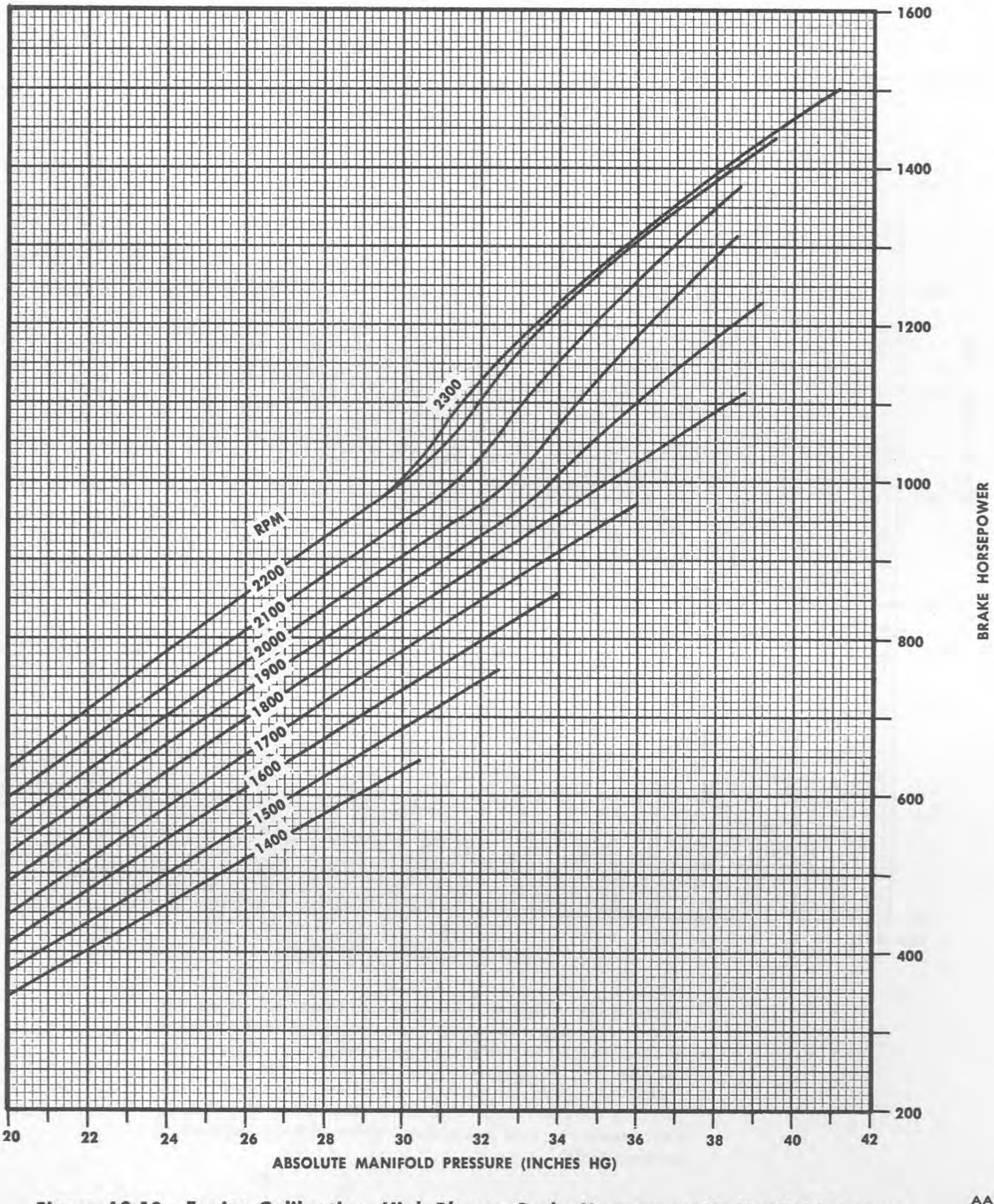


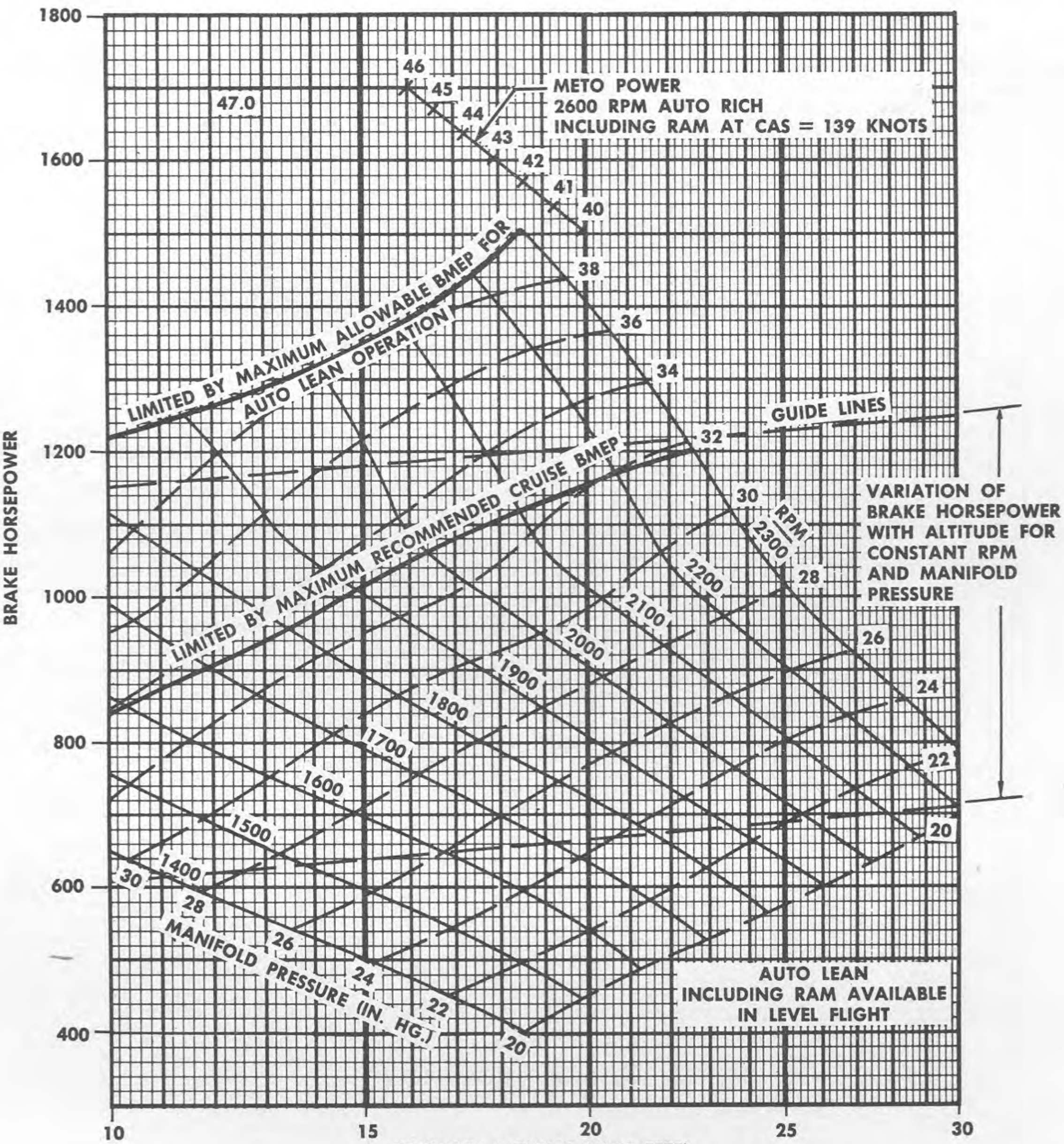
Figure A2-10. Engine Calibration—High Blower—Brake Horsepower Vs Manifold Pressure

ENGINE CALIBRATION — HIGH BLOWER

BRAKE HORSEPOWER VS ALTITUDE
STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145



NOTES:

1. Values given in this chart are based on flight test engine calibration data where available and on engine calibration curve No. Inst. 16472-3 in Pratt and Whitney Special Operating Instructions No. 01-115 dated April 1951, revised June 15, 1951, (modified to agree with existing flight test results). All values include RAM available at the speeds noted.
2. Do not use high blower if carburetor air temperature exceeds 15°C (approximately 60°F).

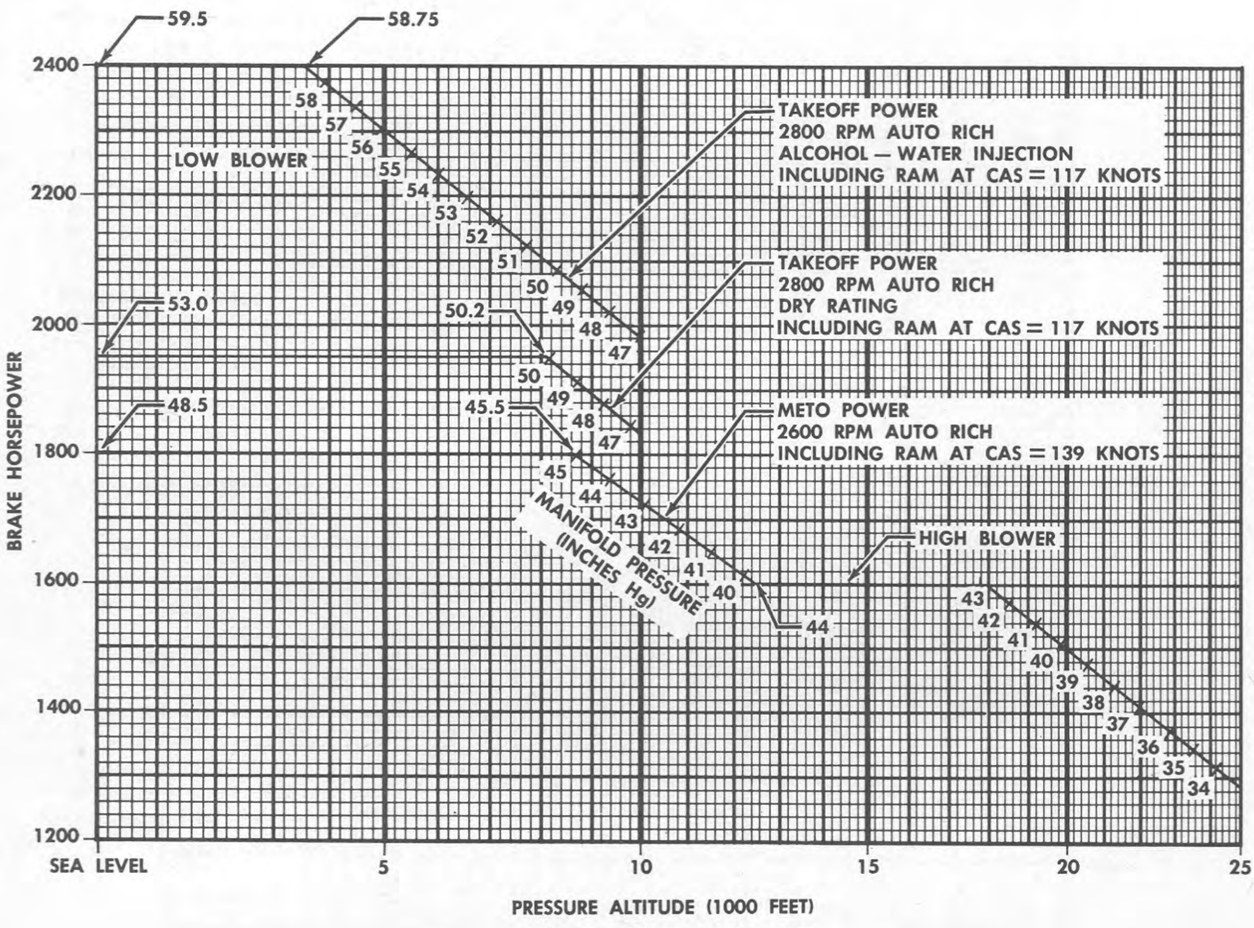
AA1-16

Figure A2-11. Engine Calibration Chart — High Blower — Brake Horsepower Vs Altitude

ENGINE CALIBRATION CURVE — ALTERNATE FUEL GRADE
NACA STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST

ENGINE(S): R2800-52W
FUEL GRADE: 100/130



NOTES:
1. Do not use high blower if carburetor air temperature exceeds 15°C (approximately 60°F).
2. Cruise powers are the same as for 115/145 grade fuel.

CAUTION

Use of this alternate grade fuel for takeoff is not desired for normal operation.

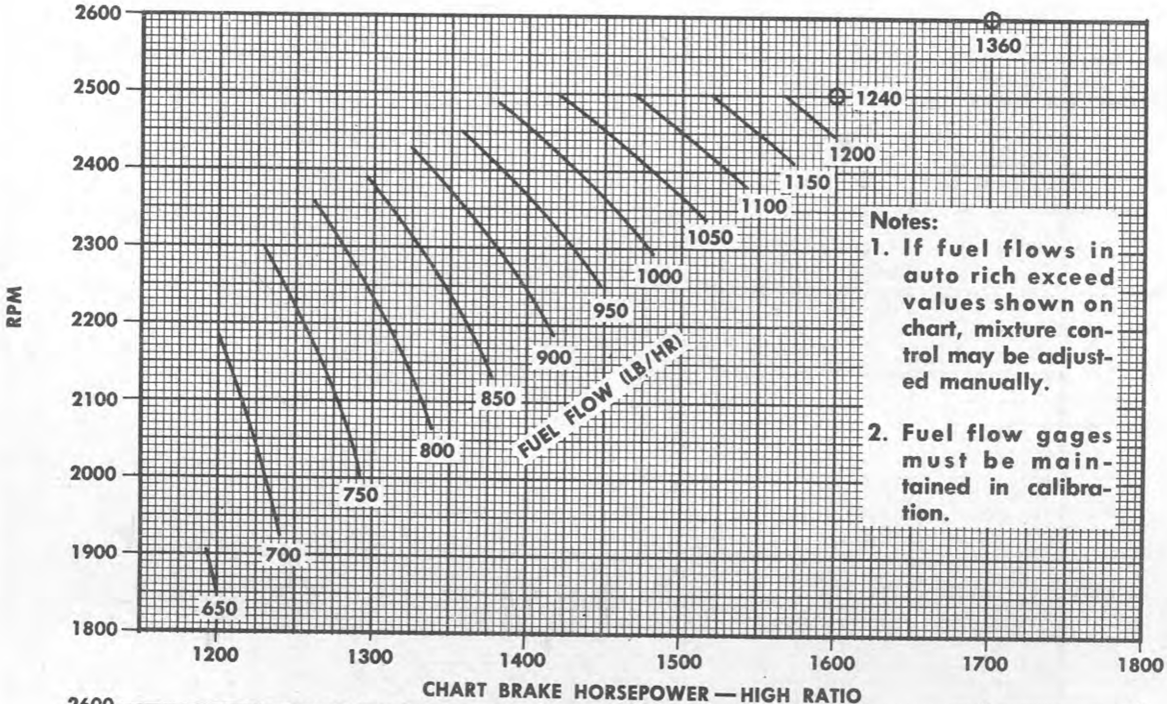
AA1-15

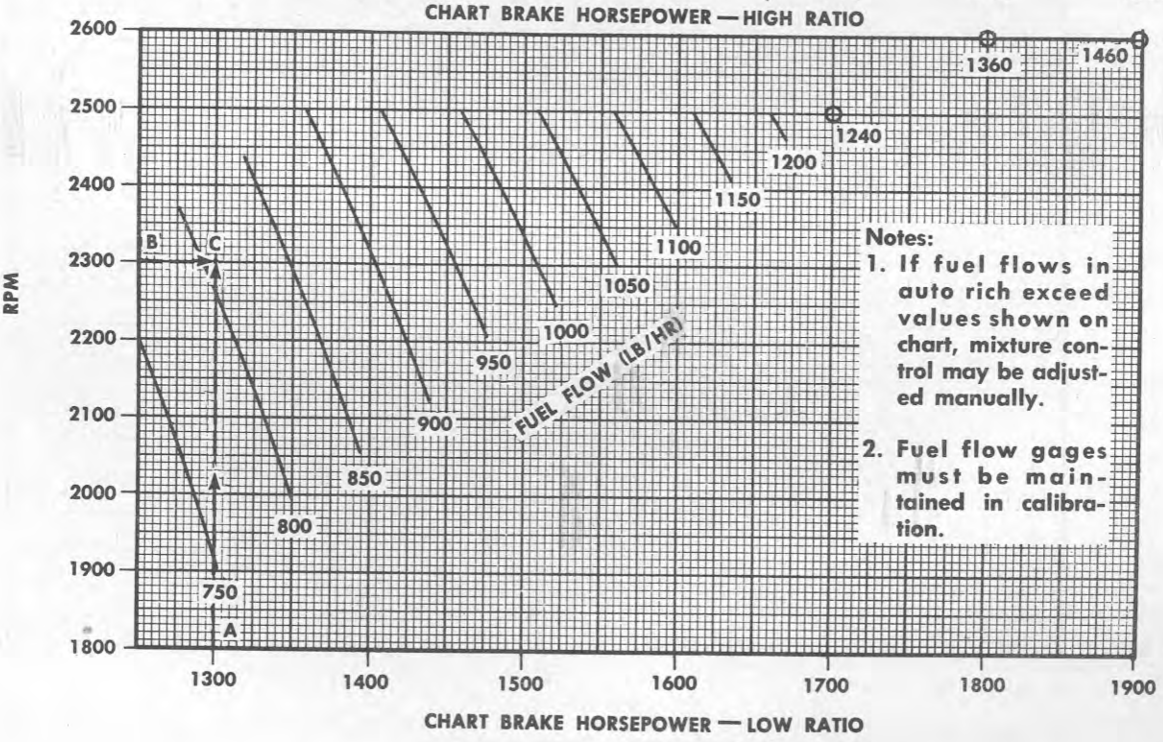
Figure A2-12. Engine Calibration Curve — Alternate Fuel Grade

MINIMUM FUEL FLOW — AUTO RICH OPERATION

MODEL: C-118A
DATA BASIS: P & W SPECIFIC OPERATING INSTRUCTION AS OF 6-15-62

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130





AA1-11

Figure A2-13. Minimum Fuel Flow — Auto Rich Operation

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS — LOW BLOWER

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
Fuel flow increments to be added to fuel flow for best economy, when operating at a given BMEP drop.

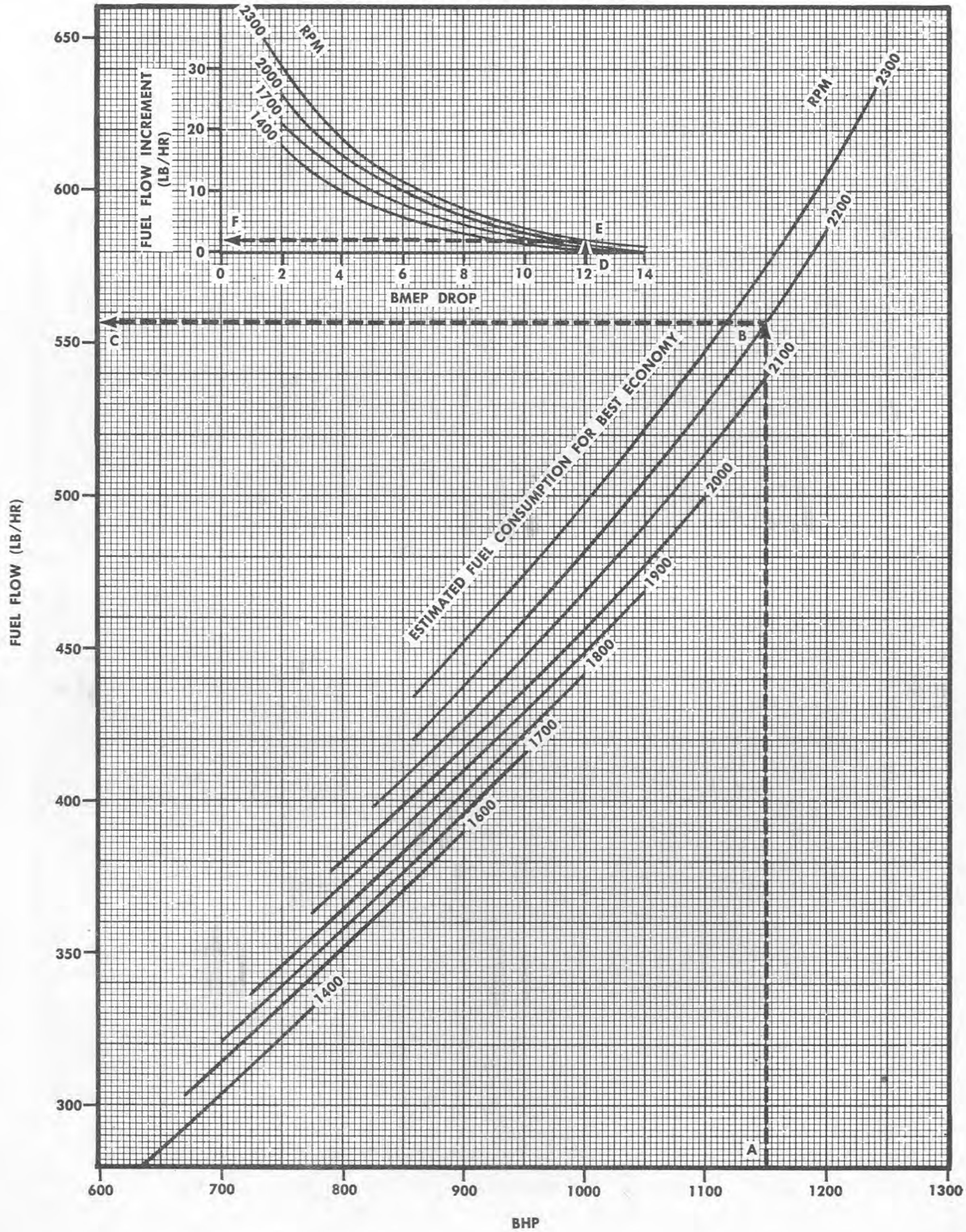


Figure A2-14. Estimated Fuel Consumption for Cruise Powers — Low Blower

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS — HIGH BLOWER

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
Fuel flow increment to be added to fuel flow for best economy, when operating at a given BMEP drop.

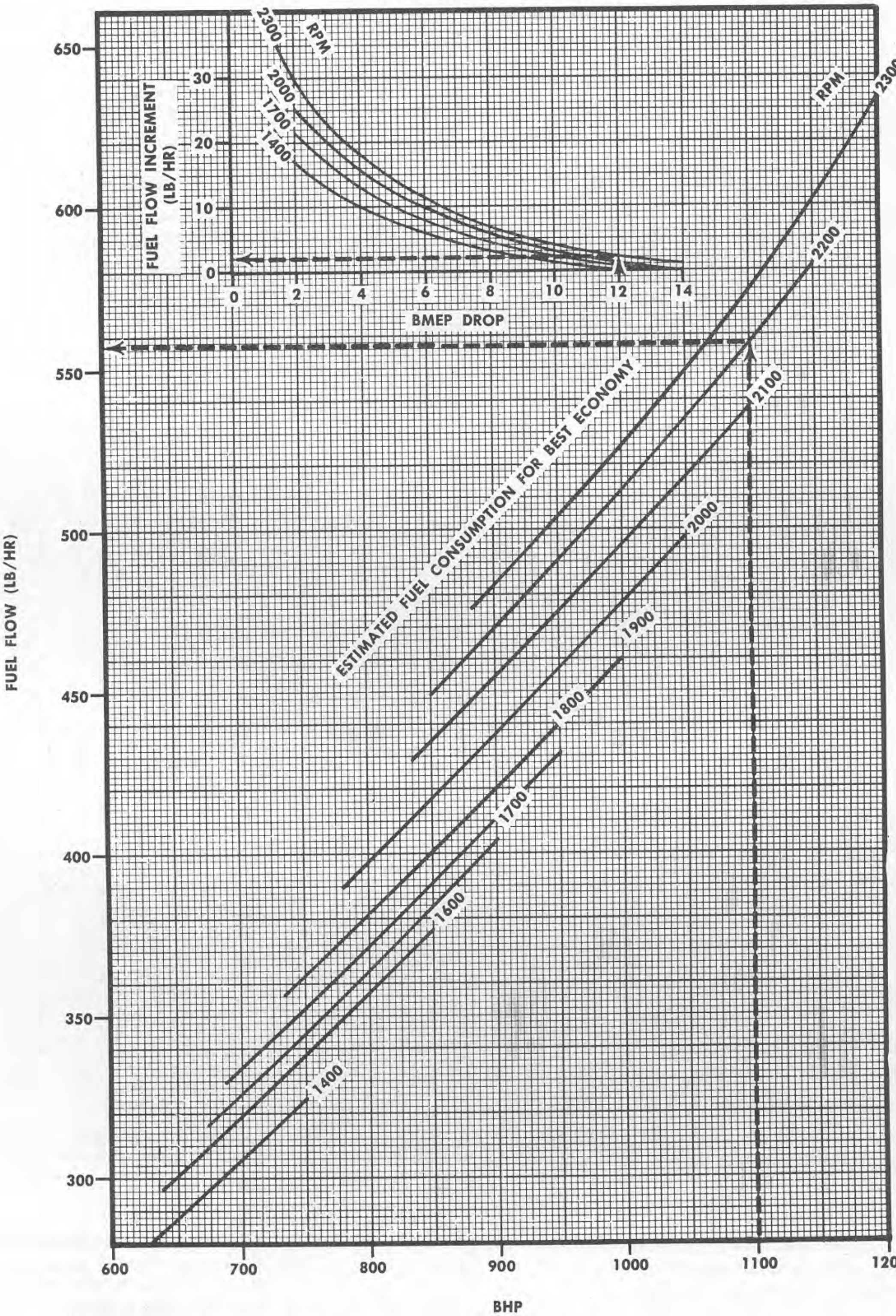


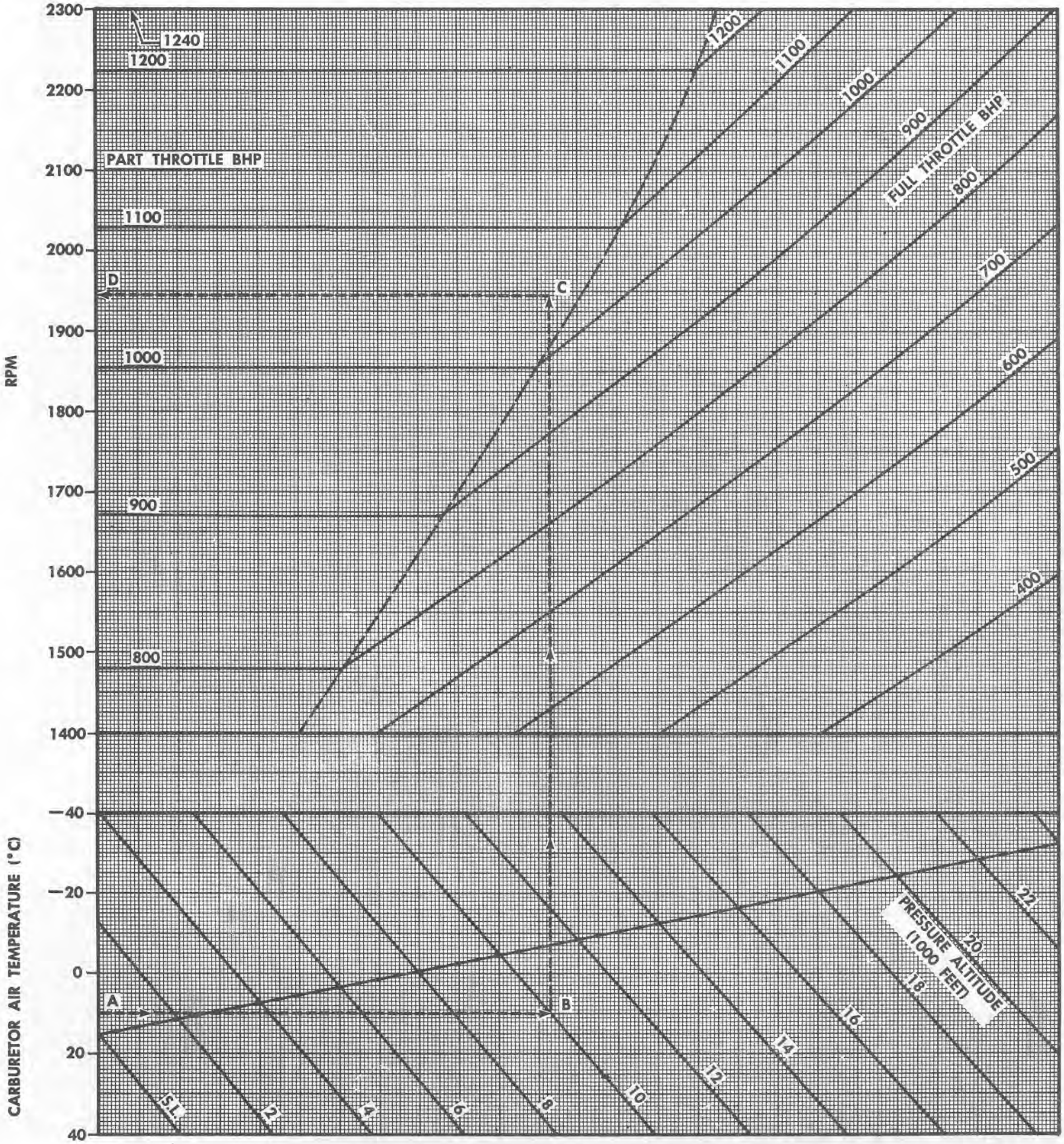
Figure A2-15. Estimated Fuel Consumption for Cruise Powers — High Blower

BHP-RPM SCHEDULE — LOW BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTE:
For part throttle BHP's the manifold pressure must be obtained from the BHP-manifold pressure schedule.

SAMPLE PROBLEM:
A. Carburetor air temperature = 10°C.
B. Pressure altitude = 10,000 feet.
C. Desired power = 1050 BHP.
E. Required RPM = 1945.

AA1-245

Figure A2-16. BHP — RPM Schedule — Low Blower

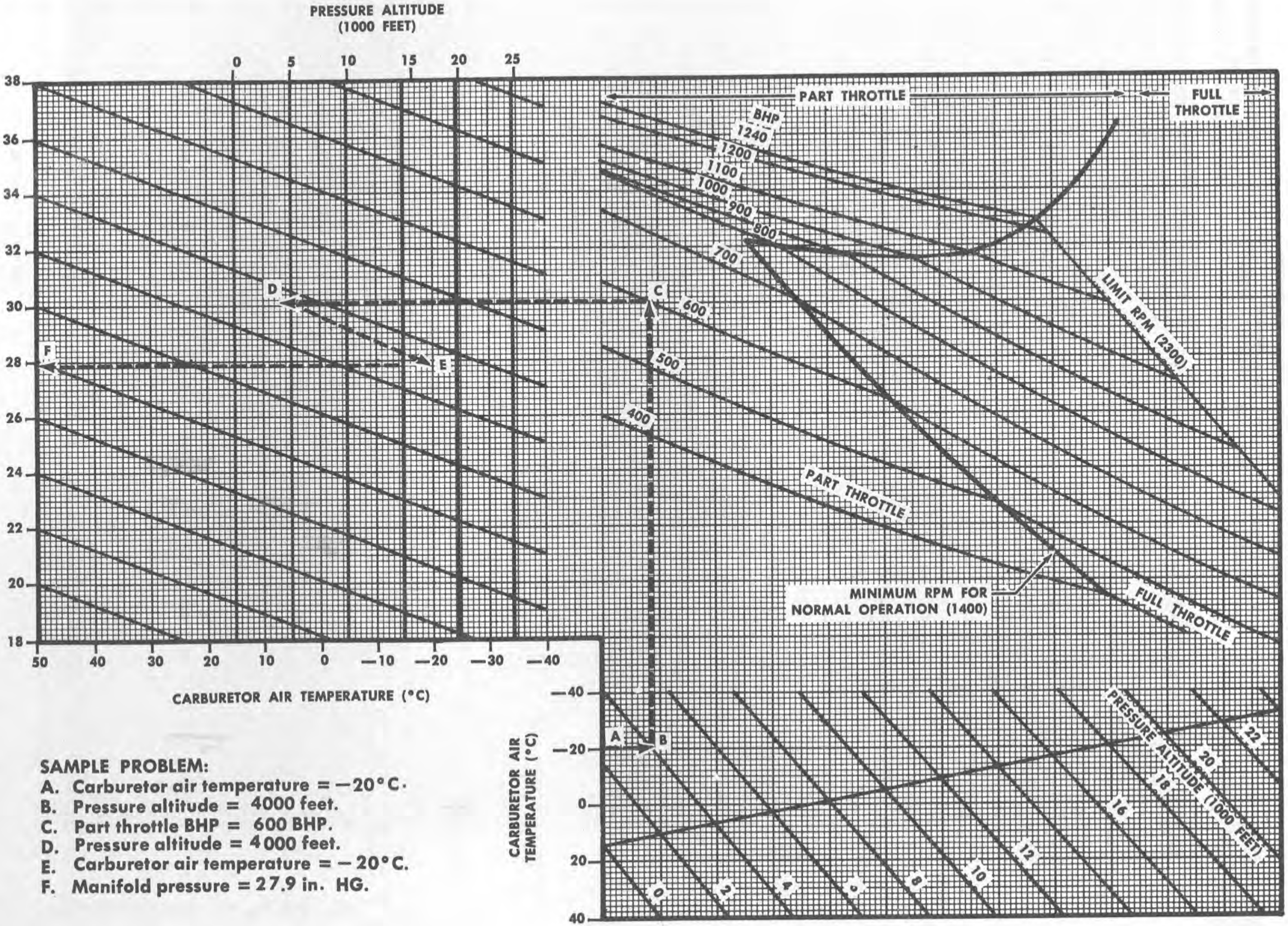
Changed 16 July 1962

BHP-MAP SCHEDULE — LOW BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM:

A. Carburetor air temperature = —20°C.
B. Pressure altitude = 4000 feet.
C. Part throttle BHP = 600 BHP.
D. Pressure altitude = 4000 feet.
E. Carburetor air temperature = —20°C.
F. Manifold pressure = 27.9 in. HG.

Figure A2-17. BHP — MAP Schedule — Low Blower

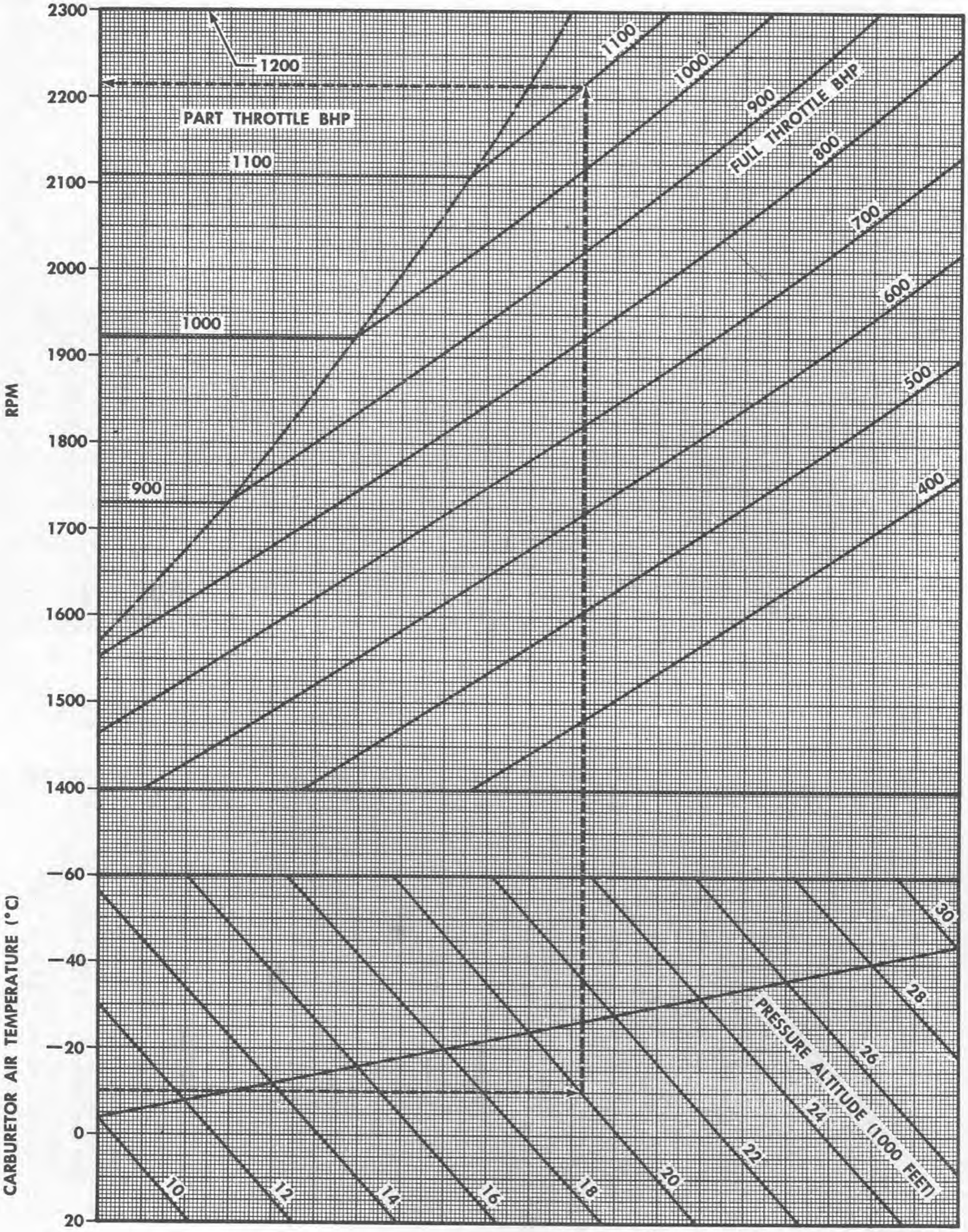
AA1-247

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

BHP-RPM SCHEDULE — HIGH BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTE:
For part throttle BHP's the manifold pressure must be obtained from the BHP-manifold pressure schedule.

AA1-244

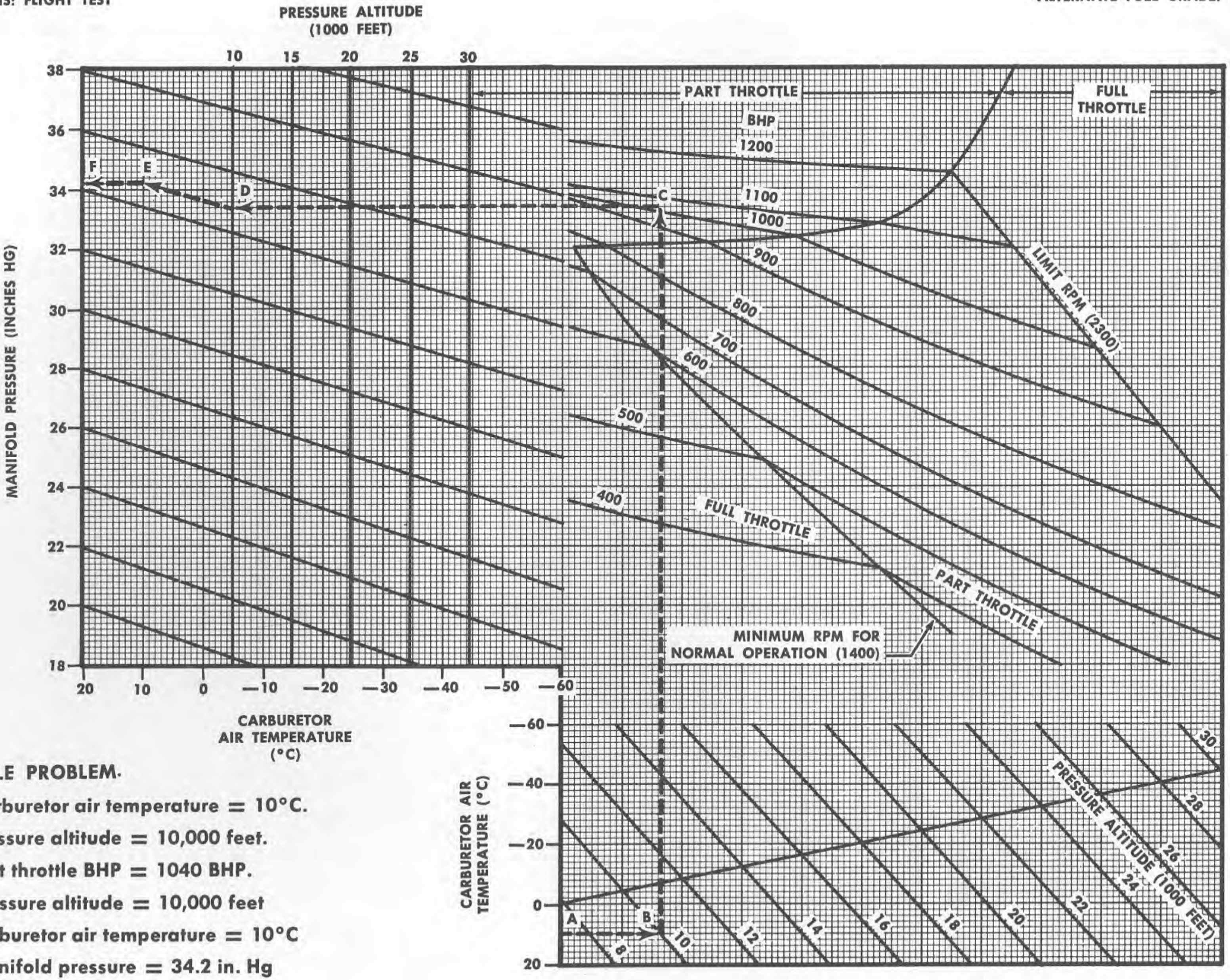
Figure A2-18. BHP — RPM Schedule — High Blower

BHP-MAP SCHEDULE — HIGH BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM.

A. Carburetor air temperature = 10°C.

B. Pressure altitude = 10,000 feet.

C. Part throttle BHP = 1040 BHP.

D. Pressure altitude = 10,000 feet

E. Carburetor air temperature = 10°C

F. Manifold pressure = 34.2 in. Hg

AA1-246

Figure A2-19. BHP — MAP Schedule — High Blower

part 3 takeoff

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INTRODUCTION.

The takeoff and climbout performance charts are presented in a form which allows corrections to be made for the several factors which affect performance. Some of the charts may be used only when the engine power is known. In these cases the brake horsepower, or BMEP, may be determined from the Brake Horsepower Available For Takeoff charts in Part 2. Generally, only 95% of the predicted power is used to determine takeoff performance.

On those charts where wind corrections are provided, the user shall apply 50% of the reported headwind and 150% of the reported tailwind. This is the recommended procedure, which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

All the takeoff charts are based on a wing flap setting of 20 degrees. Each type of chart is discussed in detail below. Sample problems with chase-around lines are also provided on the individual charts to aid in their use.

Indicated takeoff speeds based on the copilot's airspeed system, to be used for determining lift-off speed when on the ground, are shown on the Ground Run chart *(figure A3-3)*. Indicated takeoff speeds based on the pilot's airspeed system, to be used in flight when it is necessary to clear obstacles immediately after takeoff, are shown on the Liftoff, Landing, and Stall Speeds chart *(figure 2-5)*.

MAXIMUM TAKEOFF GROSS WEIGHT.

Safe operation of the aircraft requires that takeoffs 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 takeoff gross weight.

1. The ability of the structure to withstand taxiing loads and inflight maneuvering loads is shown as design takeoff gross weights on the Gross Weight Limitation Chart in Section V.
2. The ability to take off or stop within the available runway is shown on the Critical Field Length charts *(figures A3-6 and A3-7)*.
3. The ability to have adequate rate of climb when airborne is shown on the Gross Weight Limited by Three-Engine Climb Performance chart *(figure A3-2)*.
4. The ability to clear obstacles within the takeoff corridor is determined by the Climbout Factor charts *(figures A3-12 through A3-14)* and the Gross Weight Limited By Climbout Over Obstacle chart *(figure A3-15)*.

For a given set of takeoff 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 takeoff, 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 takeoff gross weight.

TAKEOFF WITHOUT ALLOWANCE FOR ENGINE FAILURE.

Charts are provided to show the takeoff performance of the aircraft without allowance for engine failure. They are intended as a guide to show the ultimate performance of the aircraft. Ordinarily, takeoff performance should be determined by allowing for the possibility of an engine failure.

The takeoff of the airplane is made with a wing flap deflection of 20 degrees and with four engines operating at maximum power. Performance for this configuration is illustrated by the Takeoff Factor chart *(figure A3-1)*, the Takeoff Performance — Ground Run chart *(figure A3-3)*, the Effect of Runway Slope on Ground Run chart *(figure A3-4)*, the Effect of Runway Surface Conditions On Ground Run chart *(figure A3-5)*, the Climbout Factor — Four-Engine — Ground Effect Not Included chart *(figure A3-12)* and the Gross Weight Limited By Climbout Over Obstacle chart *(figure A3-15)*. An acceleration check may be determined from the Takeoff Performance — Distance and Time Vs Speed chart *(figure A3-10)* or the Takeoff Performance — Acceleration Increment Time Check chart *(figure A3-11)*. These charts are based on lifting off at the takeoff speed shown on the Takeoff Performance — Ground Run chart *(figure A3-3)* and maintaining that speed until the immediate obstacles are cleared.

TAKEOFF WITH ALLOWANCE FOR ENGINE FAILURE.

Normal takeoff planning procedure allows for the possibility of an engine failure during the takeoff. There are two methods for which data are provided herein.

CRITICAL FIELD LENGTH METHOD.

The critical field length method utilizes data from the Takeoff Performance — Critical Field Length charts *(figures A3-6 and A3-7)*. When using this method, if an engine fails before the critical engine failure speed is reached, the aircraft is stopped. If an engine fails after the critical engine failure speed is reached, the takeoff is continued. Takeoff speeds are the same as those shown on the Takeoff Performance — Ground Run chart *(figure A3-3)*. Climbout flight path data are determined from the Climbout Factor — Three-Engine charts *(figures A3-13 and A3-14)*, and from the Gross Weight Limited By Climbout Over Obstacle chart *(figure A3-15)*.

REFUSAL SPEED METHOD.

The refusal speed method will be used when the available runway is longer than the critical field length. This method utilizes data from the Takeoff Performance — Ground Run chart *(figure A3-3)*, the Takeoff Performance — Refusal Speed charts *(figures A3-8 and A3-9)*, and the Takeoff Performance — Distance and Time Versus Speed chart *(figure A3-10)*. When using the method above, an acceleration check point (time and/or distance) and an acceleration speed will be determined to validate proper acceleration prior to reaching the refusal speed. The acceleration check may be accomplished by checking the time to accelerate between two predetermined speeds from the Takeoff Performance — Acceleration Increment Time Check chart *(figure A3-11)* rather than checking airspeed at a given check point. If an engine fails, or the acceleration speed is below designated acceleration check point, the aircraft is stopped. If an engine fails between the acceleration check point and refusal speed, the aircraft is also stopped. If an engine fails after reaching refusal speed, the takeoff should be continued.

However, it is possible for the aircraft performance to be better than predicted. This will generally be the case when 95% of the predicted BMEP is used to determine takeoff performance. The result can be acceleration to a higher speed than expected at the acceleration check point, from which the aircraft might not be stopped within the remaining length of runway. To avoid an attempt to stop from too high a speed, the takeoff should be continued if an engine fails after the aircraft has attained the acceleration check speed even though the acceleration check point has not been reached.

The following steps summarize what action should be taken when using the refusal speed method.

1. Stop (abort takeoff):
   a. If acceleration check speed is not attained by the time the acceleration check point, either time or distance, is reached.
   b. If engine failure occurs before acceleration check speed is attained.
   c. If an engine failure occurs between the acceleration check point and refusal speed.
2. Go (continue takeoff): If an engine failure occurs after reaching refusal speed.

If the acceleration check speed is less than the critical engine failure speed, it may not be possible to accelerate the aircraft to takeoff speed if an engine should fail shortly after attaining the acceleration check speed. In such cases the critical engine failure speed should be the abort criterion rather than the acceleration check point.

DISCUSSION OF CHARTS.

TAKEOFF PERFORMANCE — TAKEOFF FACTOR.

The Takeoff Performance — Takeoff Factor chart *(figure A3-1)* is used to provide a common factor for computing takeoff performance on the ground run, critical field length, and refusal speed charts, and for determining a climbout factor for the climbout flight path charts.

The chart uses BMEP corrected for OAT and pressure altitude to provide a common factor based on sea level standard day wet power with standard grade fuel as a zero factor. A sample problem to illustrate the method of using the chart is included on the chart.

GROSS WEIGHT LIMITED BY THREE-ENGINE CLIMB PERFORMANCE CHART.

The effect of pressure altitude and engine power on climb performance cannot be shown accurately as limit lines on the critical field length charts. For this reason, the Takeoff Gross Weight Limited By Three-Engine Climb Performance chart *(figure A3-2)* is provided to indicate the gross weight limit required to achieve the desired rate of climb. Curves are provided to indicate the gross weight for zero and 50 feet per minute rate of climb at lift-off with gear down and inoperative propeller windmilling, and for 50 and 100 feet per minute rate of climb with the gear up and the inoperative propeller feathered. The rate of climb in each case is based on climb at takeoff speed with the wing flaps set for takeoff and no ground effect.

The curves for lift-off with the gear down and inoperative propeller windmilling are for informational purposes only and are not to be used as a limiting factor in establishing the permissible takeoff gross weight. In no case should the gross weight for 50 feet per minute rate of climb with the gear up be exceeded.

The design takeoff gross weights of 107,000 pounds for normal operation and 112,000 pounds for war emergency are also indicated on the chart. These limits should not be exceeded even though the rate of climb may be adequate.

The use of this chart requires that the engine power and density altitude be known. The engine power may be determined from the Brake Horsepower Available For Takeoff Charts in Part 2. Generally, 95 percent of the predicted BMEP is used to enter this chart. The density altitude may be obtained from the density altitude curve of the Takeoff Performance — Takeoff Factor chart *(figure A3-1)*.

Sample Problem:

GIVEN: Density altitude = 2100 feet.
BMEP = 230 psi.

FIND: Gross weight for zero rate of climb at lift-off with gear down and inoperative propeller windmilling and for 50 feet per minute rate of climb with gear up and inoperative propeller feathered.

1. Enter the chart with density altitude of 2100 feet (A).
2. Read up to BMEP of 230 psi (B), and across to the zero rate of climb for lift-off (C).
3. Read down to find gross weight of 104,700 pounds (D). This gross weight is for information only.
4. Continue across the chart to the 50 feet per minute rate of climb line for gear up (E).
5. Read down to find the maximum gross weight at which 50 feet per minute rate of climb can be maintained of 125,500 pounds (F). See note on chart for structural limitations.

GROUND RUN CHART.

The ground run chart *(figure A3-3)* shows the distance required to accelerate from a standstill to takeoff speed on a dry, hard-surface, level runway with all four engines operating. Indicated takeoff speeds are shown based on the copilot's ground run airspeed calibration. The takeoff factor needed for the use of this chart may be obtained from the Takeoff Performance — Takeoff Factor chart *(figure A3-1)*.

Sample Problem:

GIVEN: Takeoff factor = 8.5.
Gross weight = 95,000 pounds.
Wind = 20 knots headwind 50 percent of reported headwind).

FIND: Takeoff ground run corrected for wind.

1. Enter the chart with takeoff factor of 8.5 (A) and read across to gross weight of 95,000 pounds (B).
2. Read down to find uncorrected ground run of 4375 feet (C).
3. Correct for wind by following headwind curve to 20 knots (D) and reading down to find corrected ground run of 3170 feet (E).

RUNWAY SLOPE CORRECTION CHART.

This chart *(figure A3-4)* is to be used to correct data obtained from the Ground Run chart *(figure A3-3)* when runways have slopes other than zero.

EFFECT OF RUNWAY SURFACE CONDITIONS ON GROUND RUN.

The Effect of Runway Surface Conditions on Ground Run chart *(figure A3-5)* is used to correct the takeoff ground run for various runway conditions affecting the coefficient of rolling friction. The coefficient of rolling friction values given on this chart are approximate since numerous factors, such as condition of the tires or the amount of water on a wet runway can result in a slight change from the values shown.

A sample problem to illustrate the use of the chart is included on the chart.

CRITICAL FIELD LENGTH CHART.

The critical field length as shown on *figure A3-6 and A3-7* is defined as the distance required to accelerate with four engines from a standstill to the critical engine failure speed, experience an engine failure, and then either come to a stop or continue accelerating with three engines to the takeoff speed in the same distance.

The stopping distance has been determined by the use of brakes only, and by the use of brakes plus two engines reverse thrust. Since, in most cases, reverse thrust may be used, it should not be difficult to duplicate this stopping distance even though runway conditions may not be so favorable. As an added safety margin, these data are based on a three second time delay after reaching the critical engine failure speed before the engines are cut and the brakes applied.

The three-engine acceleration part of the critical field length is based on the inoperative propeller windmilling. The indicated takeoff speeds may be obtained from the Ground Run chart *(figure A3-3)* for ground run calibration (copilot's system), or from the Liftoff, Landing, and Stall Speeds charts *(figure 2-5 in Section II)* for in-flight calibration (pilot's system).

A sample problem illustrating the use of the chart is included on the chart for brakes only *(figure A3-6)*.

REFUSAL SPEED CHART.

The usual situation during operation of the C-118A aircraft is to have an actual runway length greater than the critical field length for the given conditions. Since it is always desirable to safely stop an airplane within the limits of the runway in the event of an engine failure rather than risk a three-engine takeoff and go-around, the refusal speed charts *(figure A3-8 and A3-9)* are presented to allow the decision to stop to be made at the highest speed possible.

The refusal speed as shown on these charts is refined as the maximum speed which may be reached, accelerating from a standstill with four engines operating, and from which a stop may be made within a given runway length. If the critical field length and runway length are the same, then refusal speed and critical engine failure speed are identical. If, however, the runway length is greater than critical field length, then the refusal speed may be considerably higher than the critical engine failure speed. For this reason, the refusal speed is of primary importance during take off operation. It must be remembered that the validity of refusal speed is dependent upon a normal four-engine acceleration of the aircraft. If the acceleration is low, the aircraft will have used more runway than predicted in reaching the refusal speed, and insufficient runway will remain in which to stop the airplane. For this reason, use of acceleration check speeds or times is necessary to insure safe takeoff.

DISTANCE AND TIME VS SPEED CHART.

This chart *(figure A3-10)* shows the relationship between distance, time and speed during the takeoff acceleration. It is based on acceleration from a standstill on a dry, hard surface runway with four engines operating. It will also apply, approximately, to less favorable runway conditions if the ground run, which is used in entering the graph, has been corrected for such conditions. Wind corrections used with this chart are based on 50 percent of the reported headwinds. If actual winds during the takeoff run exceed 50 percent of the reported winds, the time to accelerate to a given check point, and the speed at the check point will be higher than computed.

The acceleration check speed and check point may be determined from this chart. To do this it is necessary first to obtain the ground run and indicated takeoff speed from the Ground Run chart *(figure A3-3)*. The ground run should be corrected for wind, runway slope and runway condition. A wind correction grid is provided on the chart to correct the takeoff speed. By entering the chart with takeoff speed and takeoff ground run corrected for wind, a contour line is established which is then used to determine the acceleration check speed and distance.

From the Refusal Speed chart for brakes only *(figure A3-8)*, determine the indicated refusal speed corrected for wind and slope for the available runway and correct for wind when entering the chart. Following the corrected refusal speed to the contour line previously established will determine the refusal distance. The acceleration check point is then determined, preferably at the next 1000 foot runway marker below refusal distance. Acceleration check speed (go-no-go speed) is then determined at the intersection of the contour line and the acceleration check point (go-no-go distance). This speed is then corrected for wind velocity. The following example illustrates the method of using the chart.

Sample Problem:

GIVEN: Wind = 15 knots headwind (50 percent of reported headwind).

Ground run (corrected for headwind and slope) = 3500 feet.

Takeoff speed = 111 knots IAS.

Refusal speed (corrected for headwind and slope = 104 knots IAS.

Density altitude = 2000 feet.

FIND: Acceleration check point and speed.

1. Enter the wind correction grid at the top of the chart with takeoff speed of 111 knots IAS (A) and follow the headwind guide lines to 15 knots (B) to obtain corrected takeoff speed of 96 knots IAS.
2. Read down to ground run (corrected for headwind) of 3500 feet (C) and establish a contour line by following the guide lines.
3. Enter the chart with a refusal speed of 104 knots IAS (D) and correct for headwind as in step 1, to find corrected refusal speed of 89 knots IAS (E).
4. Read down to the intersection of the contour line to find refusal distance of 2900 feet (F), continue following the contour line to the nearest 1000 foot marker below the refusal distance to determine the acceleration check distance (go-no-go distance) of 2000 feet (G).
5. The intersection of the contour line and the acceleration check distance of 2000 feet gives an acceleration check speed minus wind correction of 77 knots IAS, and a time to accelerate of 29 seconds. To correct for wind read up to wind velocity of 15 knots (H) and follow the headwind guide lines to find corrected acceleration check speed of 91 knots IAS (I).
6. Determine $1/\sqrt{\sigma}$ for 2000 feet density altitude from the ICAO Standard Atmosphere Table *(figure A1-12)* of 1.0299. Correct time to accelerate by dividing by this figure. Actual time at the marker will be $29 \div 1.0299 = 28$ seconds.

ACCELERATION INCREMENT TIME CHECK.

The Takeoff Performance — Acceleration Increment Time Check chart *(figure A3-11)* provides a means of checking the time to accelerate from 60 knots to 100 knots, or to refusal speed minus 10 knots, whichever is lower. The four-engine ground run, takeoff gross weight, and density altitude determine a total acceleration time line (the four-engine ground run used in entering this chart is actual ground run for the given conditions but without wind correction).

Following the speed-time line on the chart, the times are read at 100 knots, or refusal speed minus 10 knots, and at 60 knots. The difference between these times is the acceleration check time. Althrough wind has a large effect on the total time from brake release to takeoff speed, it does not appreciably affect the shape of the speed-time curve, therefore, no wind correction is necessary in determining the net time to accelerate from one indicated airspeed to another. However, runway slope will affect acceleration, for this reason the ground run is corrected for slope before entering the chart.

Sample Problem:

GIVEN: Four-Engine ground run (corrected for slope but without wind correction) = 4250 feet.
Gross weight = 90,000 pounds.
Density Altitude = 5000 feet.

FIND: Acceleration time from 60 knots to 100 knots.

1. Enter the chart with ground run corrected for slope but with no wind correction, of 4250 feet (A) and read across to gross weight of 90,000 pounds (B).
2. Correct for density altitude by reading down to the baseline in the altitude graph (C) and following the guide lines to density altitude of 5000 feet (D).
3. Read down to an airspeed of 100 knots (E) for a time of 36 seconds.
4. Follow guide lines to 60 knots (F) to find a time of 18.5 seconds.
5. Subtract the time at 60 knots (18.5 seconds) from time at 100 knots (36 seconds) to find acceleration time between these speeds. $36 - 18.5 = 17.5$ seconds.

CLIMBOUT FACTOR CHARTS.

The Climbout Factor charts *(figures A3-12 through A3-14)* are used to compute climbout data in conjunction with the Gross Weight Limited By Climbout Over Obstacle chart *(figure A3-15)*. Charts are provided for four-engine operation without ground effect and for three-engine operation with and without ground effect. The charts are plotted so that at zero height, the climbout factor given conditions will represent four-engine ground run (uncorrected for slope) on the four-engine charts, and critical field length on the three-engine charts, for the same given conditions.

The two methods of using the charts are illustrated on figure A3-13. Sheet 1 shows method of determining a climbout factor which is then used to determine the maximum gross weight allowable for clearance of an obstacle, on the Gross Weight Limited By Climbout Over Obstacle chart (figure A3-15). Sheet 2 illustrates the method of determining the height over a given point using a climbout factor determined from figure A3-15, based on a given gross weight and takeoff factor.

Climbout and Ground Effect.

Ground effect, in general, refers to a reduction in the overall drag of an aircraft when operated in close poximity to the ground. The degree of drag reduction will vary with distance of the wing from the ground, being greatest when the wing is at ground level. Ground effect will, for all practical purposes, disappear when the wing is greater than one half the wing span above the ground. Ground effect is greatest at low airspeeds and becomes a lesser drag reduction as airspeed increases.

Climbout data is provided for three-engine operation both with and without ground effect. Four-Engine operation is based on no ground effect since the normal climbout flight path is steep enough that the aircfrat will climb above the altitude where ground effect is noticable shortly after liftoff.

For three-engine operation, on a takeoff over level terrain or with only a slight downhill slope the flight path will be such that the aircraft performance will be influenced by ground effect for a longer period of time, which will result in a more rapid acceleration to climb speed than would be possible where takeoff is over terrain which slopes sharply downhill after the point of liftoff.

1. Ground Effect Included chart — Use this chart when the terrain does not slope downhill more than 5% from point of liftoff to the point where aircraft will have reached an altitude equal to one half the wing span.
2. Ground Effect Not Included chart — Use this chart when the applicable slope is greater than 15%.
3. Both Charts — If the applicable slope is between 5 and 15%, assume a climbout factor half way between the two charts.

GROSS WEIGHT LIMITED BY CLIMBOUT OVER OBSTACLE CHART.

The Gross Weight Limited By Climbout Over Obstacle chart *(figure A3-15)* is used to compute climbout data in conjunction with the Climbout Factor charts *(figure A3-12 through A3-14)*, and the Takeoff Factor chart *(figure A3-1)*. The chart may be used to determine the maximum allowable gross weight for clearance of an obstacle, using a takeoff factor and climbout factor obtained from the appropriate charts, or to determine a climbout factor for a given gross weight, which is then used to compute the altitude which may be expected over an obstacle. The following sample problems illustrate both methods of using the chart.

Sample Problem (1):

GIVEN: Climbout factor = 10.8.
Takeoff factor = 3.0.

FIND: Maximum gross weight for climbout over an obstacle.

1. Enter chart with climbout factor of 10.8 (A) and takeoff factor of 3.0 (B), obtained from figures A3-13 and A3-1.
2. At the intersection of climbout and takeoff factor lines read maximum allowable gross weight of 102,250 pounds (C).

Sample Problem (2):

GIVEN. Takeoff factor = −0.1.
Gross Weight = 100,000 pounds.

FIND: Climbout factor for use in determining altitude over an obstacle.

1. Enter chart with takeoff factor of −0.1 (D).
2. Read across to a gross weight of 100,000 pounds (E) and down to find a climbout factor of 10 (F).
3. Use this factor to determine height over a given obstacle on the appropriate climbout factor chart.

TAKEOFF DISTANCE TO 50-FT HEIGHT, THREE-ENGINE FERRY CONFIGURATION CHART.

The 3-engine ferry takeoff performance *(figure A3-16)* is based on starting the ground roll with maximum power on only the two symmetrical engines. The odd engine begins with idle power and increases to maximum power as rapidly as the rudder effectiveness permits control of the asymmetrical power. The takeoff speeds noted on the chart are 130% of the stalling speeds instead of the usual 115% for normal takeoffs. The inoperative propeller is considered either feathered or removed, and there is no allowance for engine failure during the takeoff. The ground run is approximately 87% of the takeoff distance to a 50 foot height.

DISTANCE TO STOP CHARTS.

The Distance To Stop charts *(figures A3-17 and A3-18)* are provided for stopping with brakes only and with brake plus two-engine reverse thrust. The charts show the distance required to stop from a given indicated airspeed for various runway surface conditions and density altitudes. Both charts are based on wing flaps in the takeoff configuration.

Sample Problem:

GIVEN: Airspeed at which brakes are applied = 83.5 knots.
Runway condition = Dry.
Density altitude = Sea level.

FIND: Required stopping distance with brakes only.

1. Enter the brakes only chart *(figure A3-17)* at an airspeed of 83.5 knots (A) and read up to the baseline (B).

2. From the legend on the chart determine the coefficient of friction for dry runway surface as 0.3. Read across from the baseline to this value (C).
3. Read up to density altitude of sea level (D) and across to find the required stopping distance of 2500 feet (E).

TAKEOFF AND LANDING CROSSWIND CHART.

The Takeoff and Landing Crosswind chart *(figure A3-19)* presents headwind (or tailwind) and crosswind components in knots for crosswind angles of zero to 90 degrees for headwinds and 90 to 180 degrees for tailwinds for wind speeds up to 50 knots. These components are used to obtain a correction factor to be applied to the minimum liftoff or nosewheel touchdown speeds which have been determined by reference to the liftoff or touchdown gross weight and selected wing flap settings.

To insure greater lateral stability, runway directional control, and to compensate for maneuver leads imposed upon the aircraft under varying or gusty wind conditions, a correction factor will be added to the liftoff or approach and touchdown speeds. The correction factor will be 50 percent of the crosswind component or one half of the reported differences between constant and peak wind velocities, whichever is greater. In no case will the correction factor exceed 10 knots.

To compute headwind, tailwind and crosswind components a wind angle relative to the takeoff or landing runway must first be determined from the existing surface wind conditions as follows:

1. Subtract the runway heading angle from the magnetic wind direction.
2. If the resultant angle is greater than 180 degrees (regardless of sign, + or −), it should be subtracted from 360 degrees. This result is the crosswind angle.
3. When the crosswind angle is less than 90 degrees the resultant component is a headwind. When the angle is greater than 90 degrees the resultant component is a tailwind.
4. The Takeoff and Landing Crosswind chart may then be entered to obtained the headwind and crosswind components.

Sample Problem:

GIVEN. Runway heading = 030.
Wind velocity and direction = 31 knots at 075.

FIND: Headwind and crosswind components.

1. Determine crosswind angle = 075 − 030 = 045.
2. Enter the chart at zero headwind and zero crosswind components and proceed along the crosswind angle of 45 degrees to the wind velocity arc of 31 knots (A).
3. Read down to find a crosswind component of 22 knots (B), and across to find headwind component of 22 knots (C).
4. Correction factor to be added to liftoff or touchdown speed of one half of the crosswind component (11 knots), exceeds the maximum allowable correction of 10 knots so in this case 10 knots would be used.

If the crosswind comonent falls within the CAUTION ZONE, a landing may dictate the utilization of thirty degrees flaps with a proportionate increase in approach and touchdown speeds. Whenever a correction factor is applied to a liftoff or touchdown speed, the pilot must be prepared to accept a correspondingly longer ground roll.

MINIMUM CONTROL SPEED VS BANK ANGLE.

The Minimum Control Speed Vs Bank Angle chart *(figure A3-20)* is provided to show the effect of bank angle on minimum control speed. The chart is based on one outboard engine inoperative with the propeller windmilling and the remaining engine operating at 2500 BHP. The minimum control speed will be lower with an inboard engine inoperative, with the propeller on the inoperative engine feathered, or with the engines operating at a lower BHP. The chart shows only the decrease in minimum control speed as the aircraft is banked away from the inoperative engine. If the bank angle is toward the inoperative engine, the minimum control speed will increase at approximately the same rate as it decreases when banking in the opposite direction. The relationship between minimum control speed and bank angle as shown on the chart illustrates the importance of initiating a bank into the inoperative engine as soon as possible after engine failure.

TAKEOFF PERFORMANCE — TAKEOFF FACTOR

2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

SAMPLE PROBLEM:

A. Outside air temperature = 10°C.
B. Pressure altitude = 6000 feet.
C. Density altitude = 6800 feet.
D. BMEP = 205.
E. Takeoff factor = 10.2.

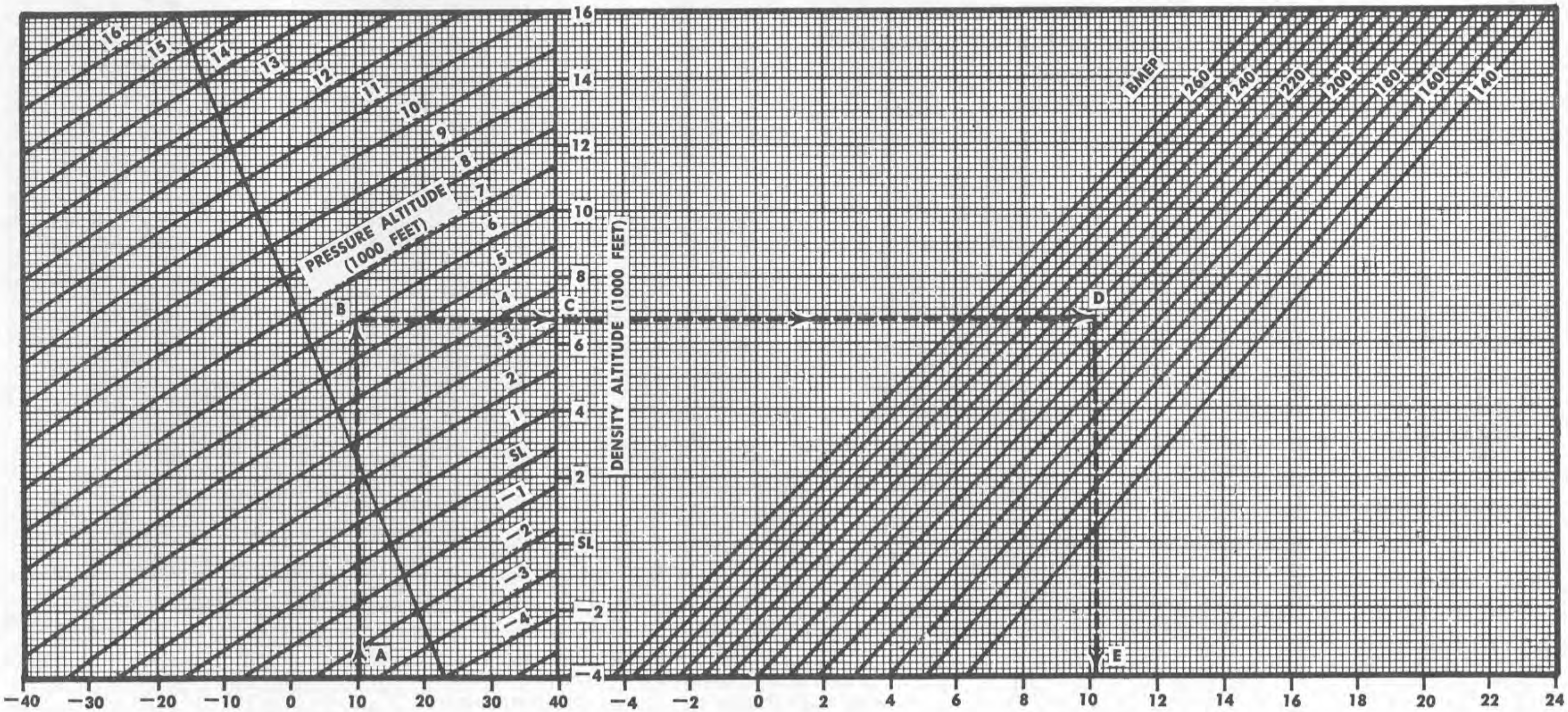


Figure A3-1. Takeoff Performance — Takeoff Factor

AA1-513

TAKEOFF GROSS WEIGHT LIMITED BY THREE-ENGINE CLIMB PERFORMANCE

THREE ENGINES OPERATING 2800 RPM
WING FLAPS 20 DEGREES CLIMB AT TAKEOFF SPEED — NO GROUND EFFECT

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
The structural limit of 107,000 pounds must not be exceeded for normal operation nor 112,000 pounds for emergency.

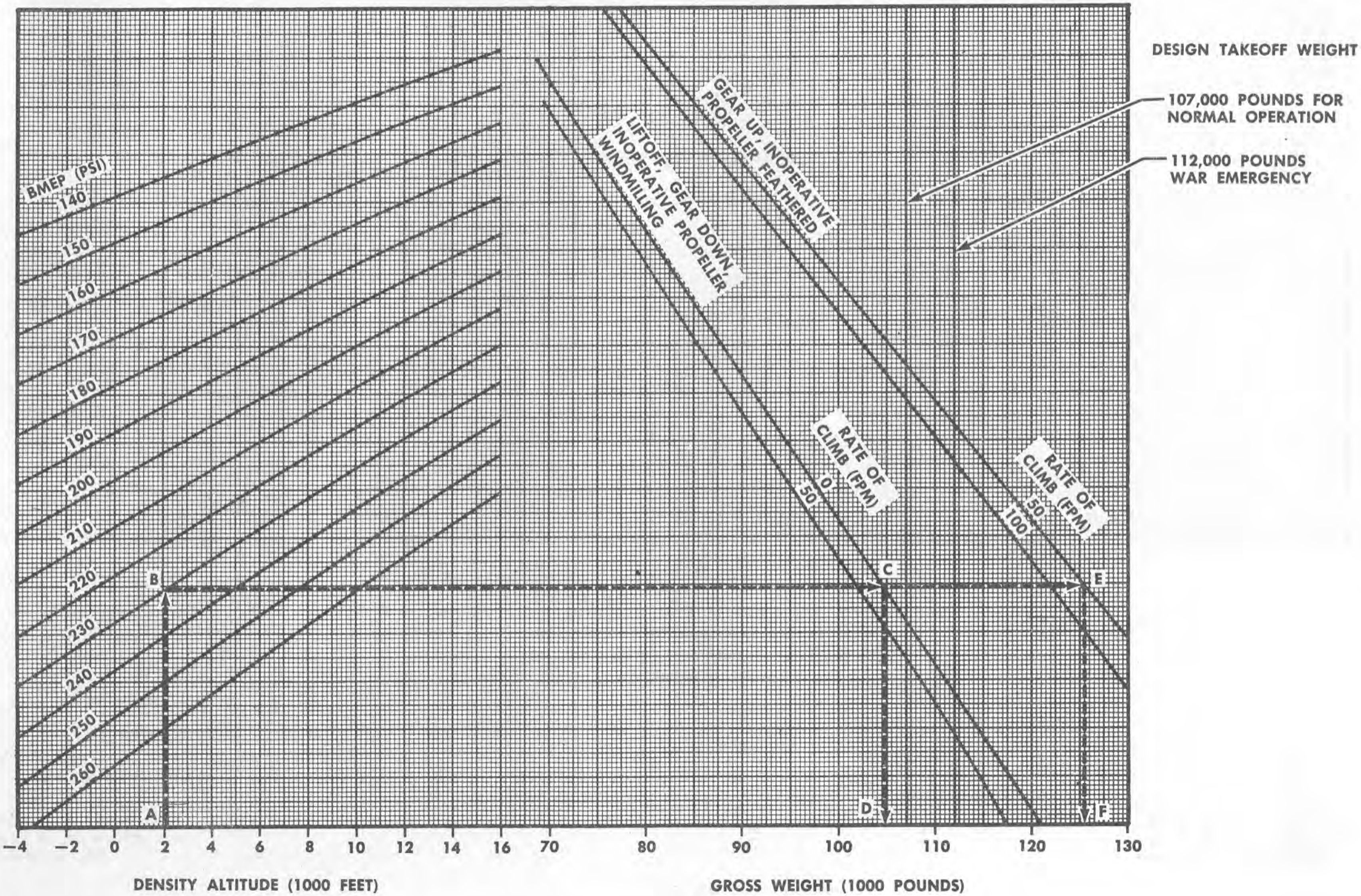


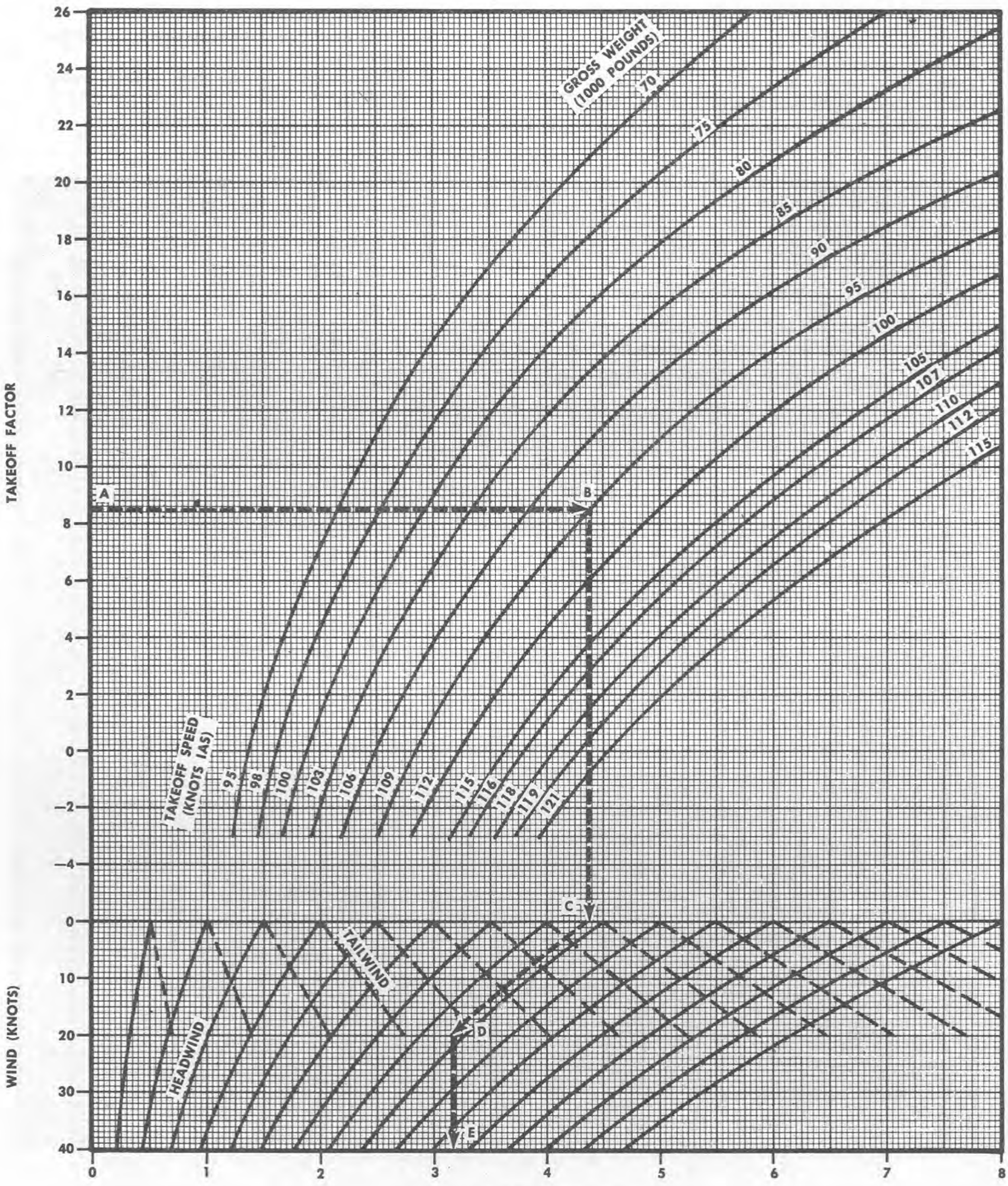
Figure A3-2. Takeoff Gross Weight Limited By Three-Engine Climb Performance

TAKEOFF PERFORMANCE — GROUND RUN

ALL ENGINES OPERATING 2800 RPM
WING FLAPS 20 DEGREES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-507

Figure A3-3. Takeoff Performance — Ground Run

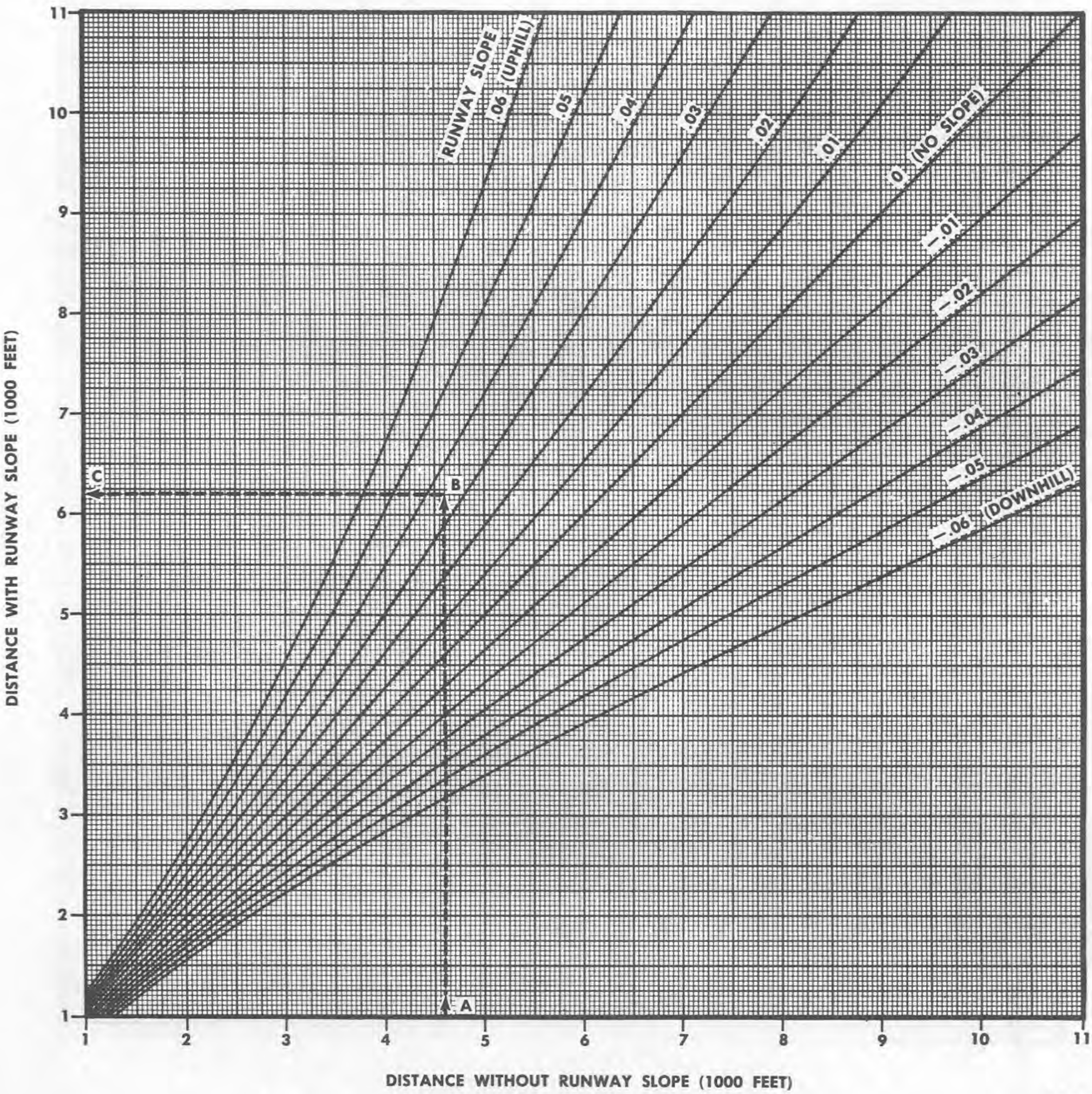
TAKEOFF PERFORMANCE — RUNWAY SLOPE CORRECTION

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
This chart applicable to:
4 engine ground run,
Critical field length, brakes only.
Critical field length, and brakes plus two engine reverse.

SAMPLE PROBLEM:
A. Distance without runway slope = 4600 feet.
B. Runway slope = .035.
C. Distance with runway slope = 6200 feet.



AAT-24

Figure A3-4. Takeoff Performance – Runway Slope Correction

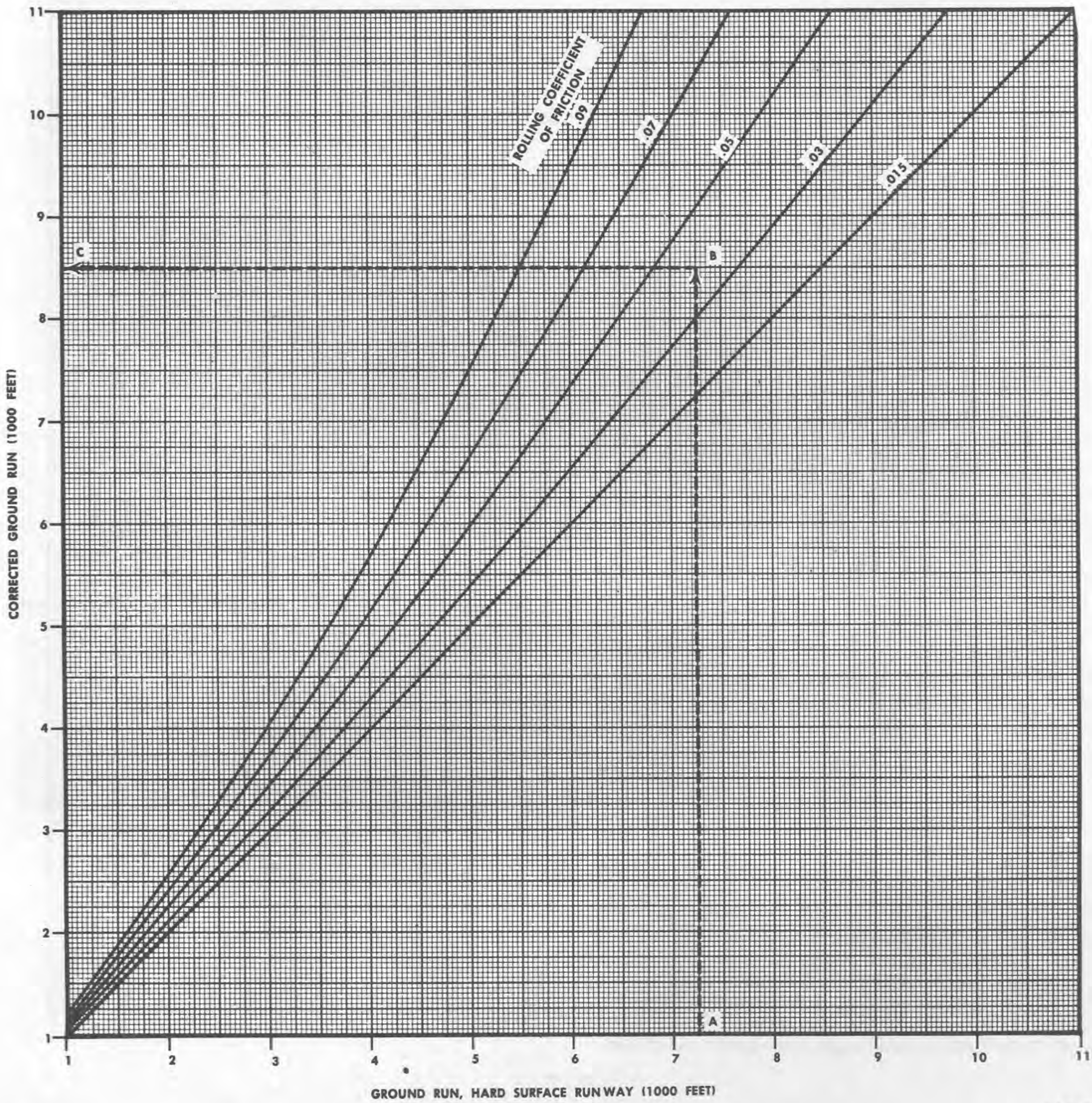
EFFECT OF RUNWAY SURFACE CONDITIONS ON GROUND RUN

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

RUNWAY SURFACE CONDITION	APPROXIMATE COEFFICIENT OF ROLLING FRICTION
HARD DRY	.015
DRY SOD TURF	.05
WET SOD TURF	.09

SAMPLE PROBLEM:
A. Ground run, hard surface runway = 7250 feet.
B. Rolling coefficient of friction = .04.
C. Corrected ground run = 8500 feet.



AA1-537

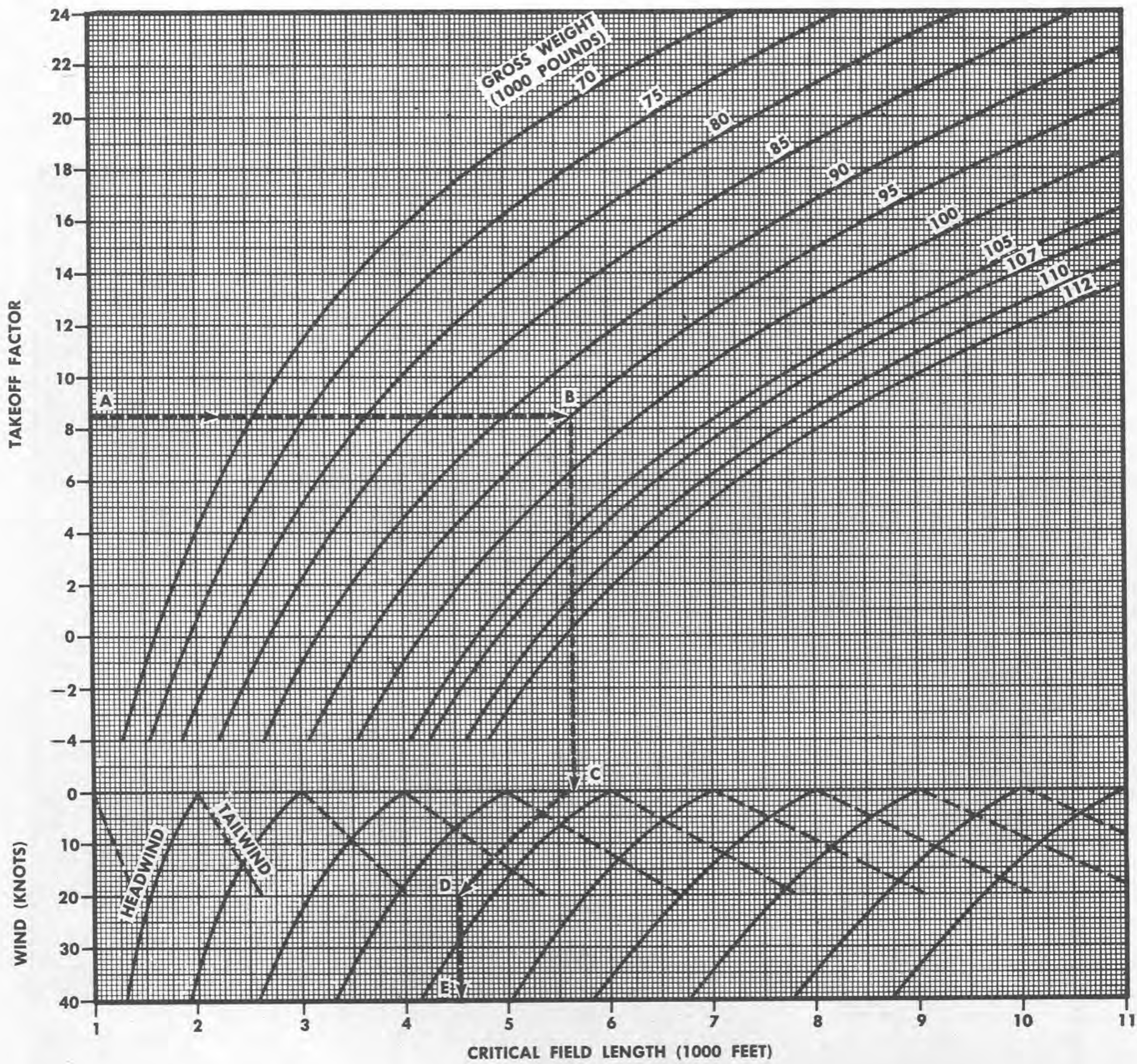
Figure A3-5. Effect of Runway Surface Conditions on Ground Run

TAKEOFF PERFORMANCE — CRITICAL FIELD LENGTH — BRAKES ONLY

2800 RPM
WING FLAPS 20°

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM:

A. Takeoff factor = 8.5.
B. Gross weight = 95,000 pounds.
C. Critical field length, no wind = 5650 feet.
D. Wind = 20 knots,headwind.
E. Critical field length with wind = 4525 feet.

AA1-509

Figure A3-6. Takeoff Performance — Critical Field Length — Brakes Only

TAKEOFF PERFORMANCE — CRITICAL FIELD LENGTH — BRAKES PLUS TWO-ENGINE REVERSE THRUST

2800 RPM
WING FLAPS 20°

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

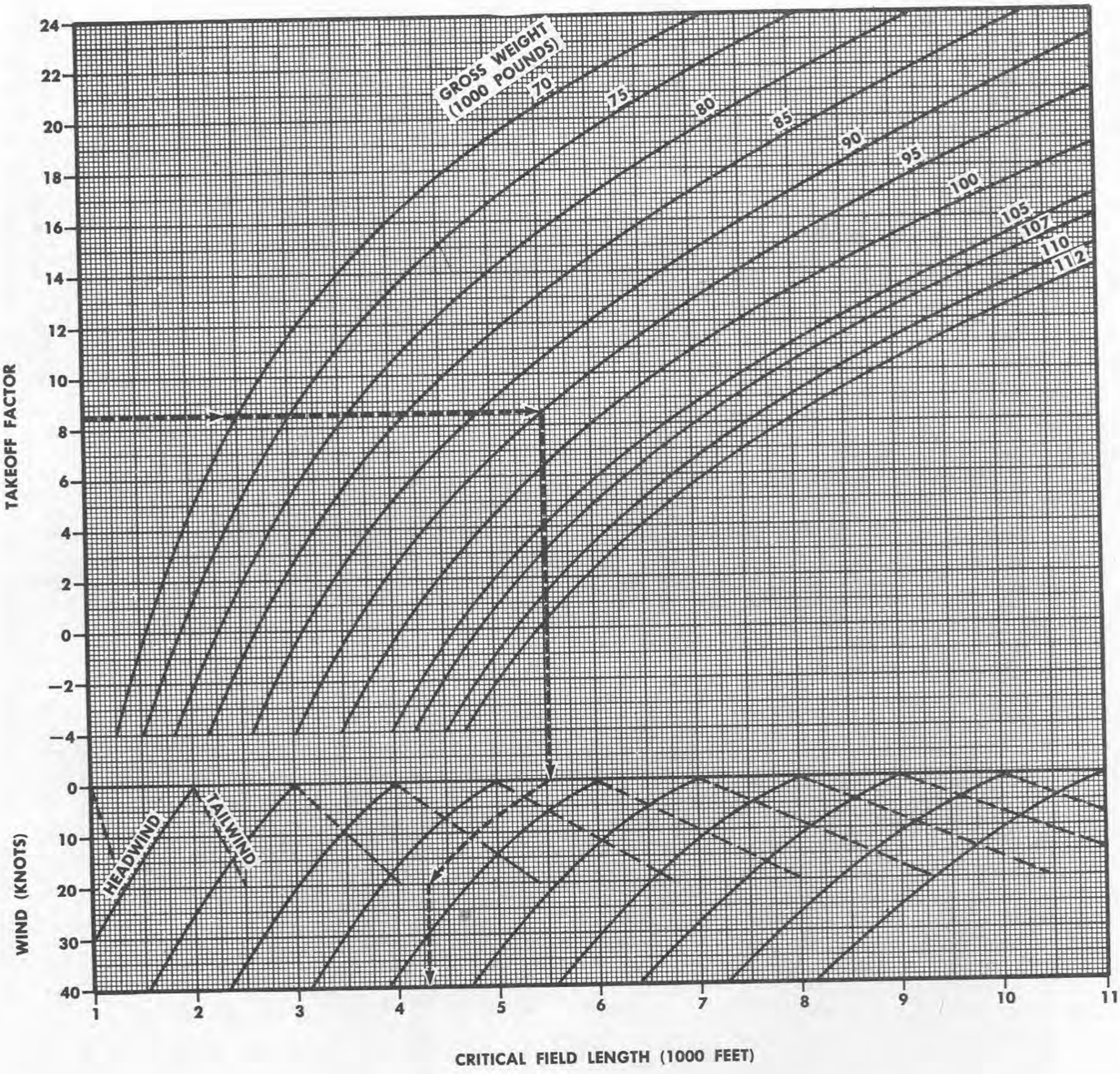


Figure A3-7. Takeoff Performance — Critical Field Length — Brakes Plus Two-Engine Reverse Thrust

TAKEOFF PERFORMANCE — REFUSAL SPEED — BRAKES ONLY

2800 RPM
WING FLAPS 20°

MODEL C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST

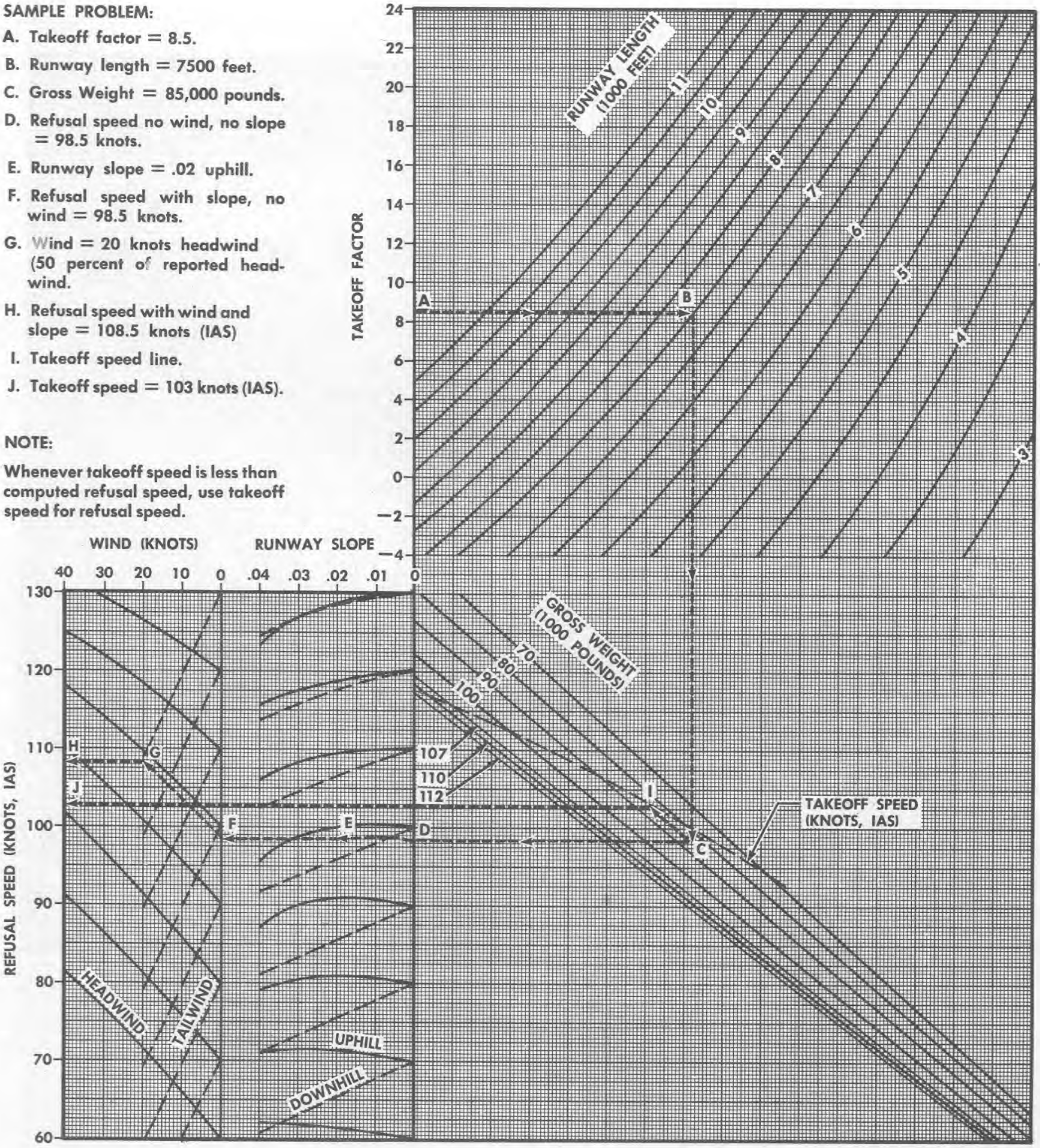
ENGINES: (4)R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

SAMPLE PROBLEM:

A. Takeoff factor = 8.5.
B. Runway length = 7500 feet.
C. Gross Weight = 85,000 pounds.
D. Refusal speed no wind, no slope = 98.5 knots.
E. Runway slope = .02 uphill.
F. Refusal speed with slope, no wind = 98.5 knots.
G. Wind = 20 knots headwind (50 percent of reported headwind.
H. Refusal speed with wind and slope = 108.5 knots (IAS)
I. Takeoff speed line.
J. Takeoff speed = 103 knots (IAS).

NOTE:

Whenever takeoff speed is less than computed refusal speed, use takeoff speed for refusal speed.



AA1-511

Figure A3-8. Takeoff Performance — Refusal Speed — Brakes Only

TAKEOFF PERFORMANCE — REFUSAL SPEED — BRAKES PLUS TWO-ENGINE REVERSE THRUST

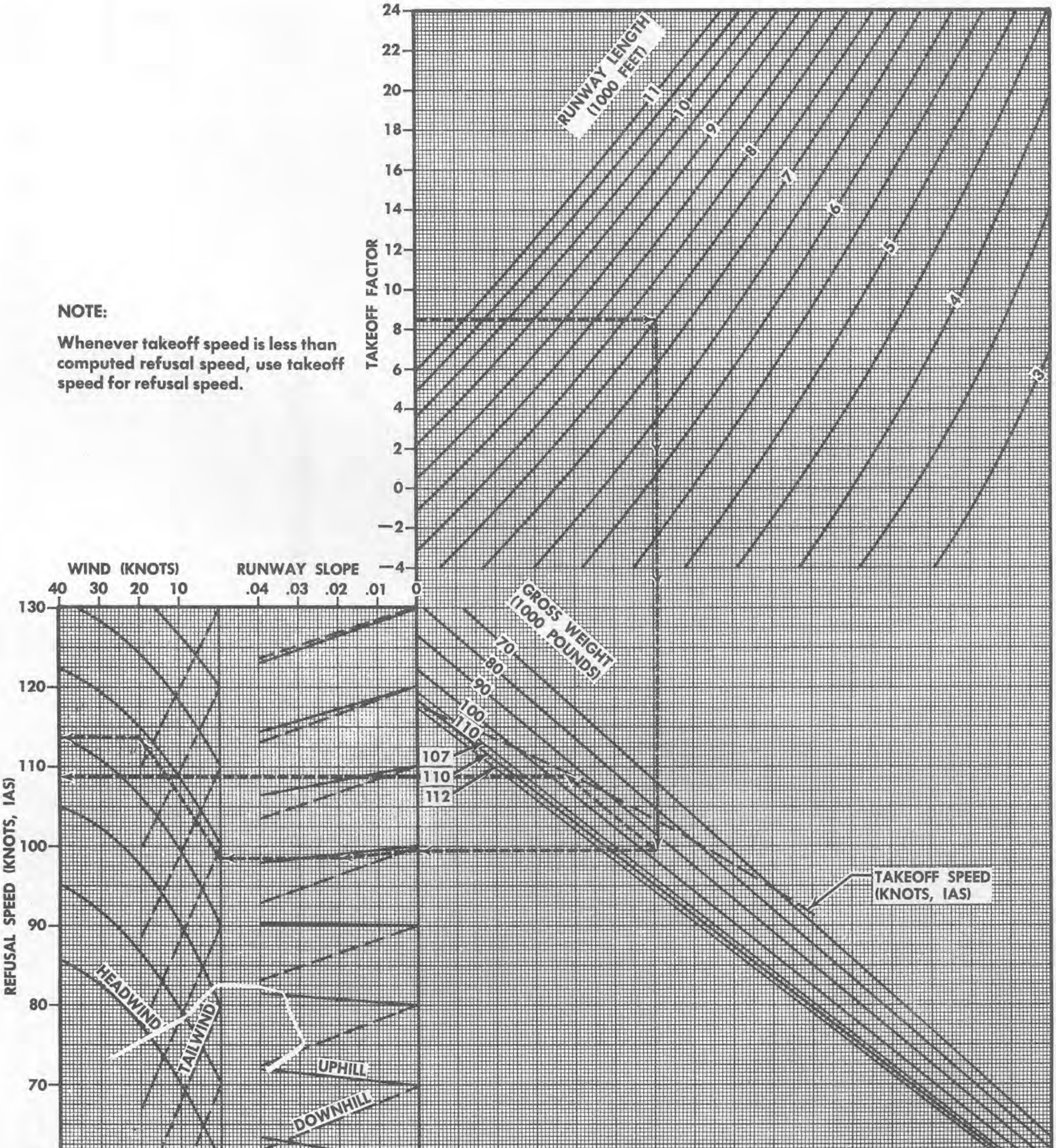
2800 RPM
WING FLAPS 20°

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:

Whenever takeoff speed is less than computed refusal speed, use takeoff speed for refusal speed.



AA1-512

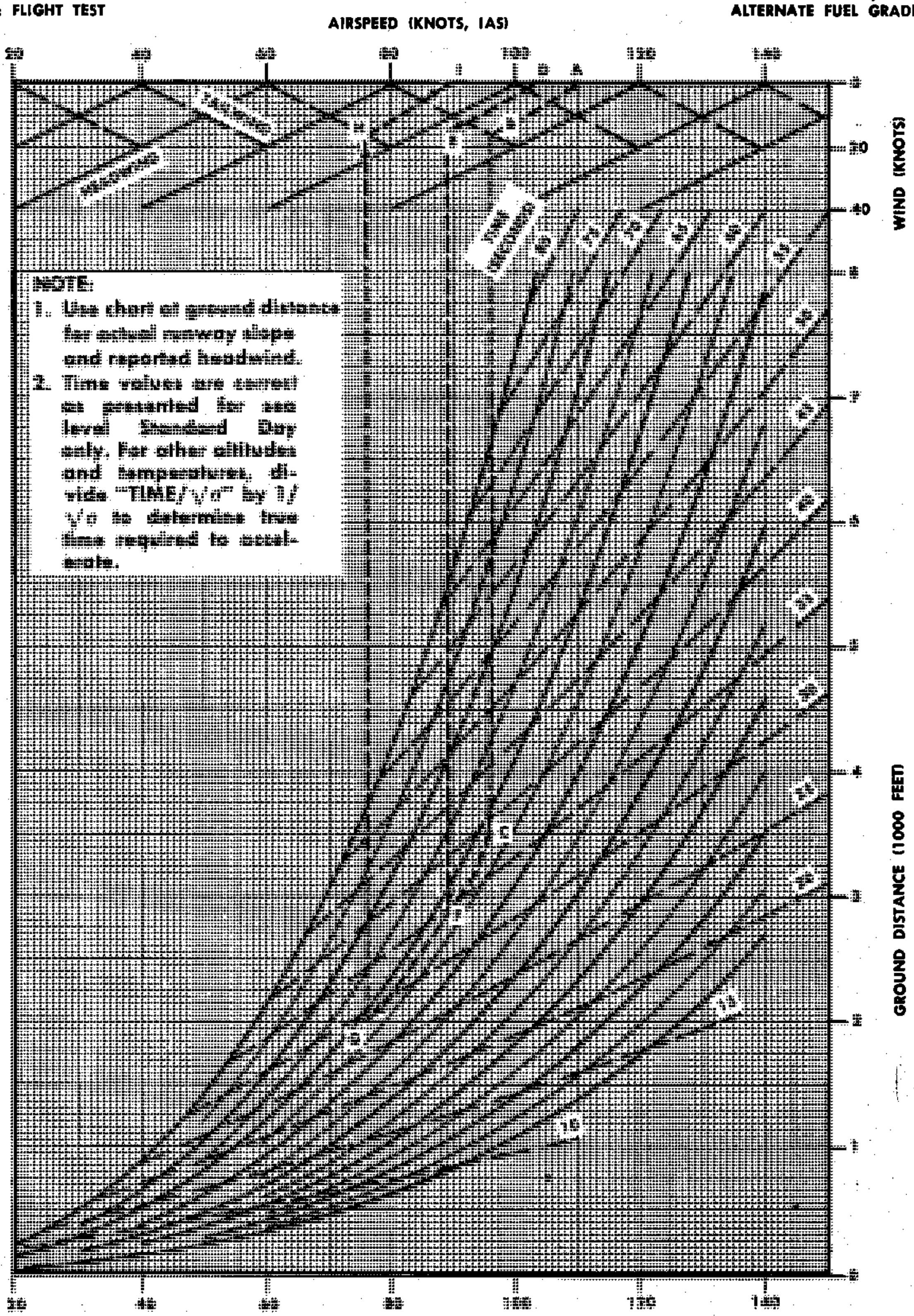
Figure A3-9. Takeoff Performance — Refusal Speed — Brakes Plus Two-Engine Reverse Thrust

TAKEOFF PERFORMANCE — DISTANCE AND TIME VERSUS SPEED

FOUR-ENGINE GROUND RUN

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-538

Figure A3-10. Takeoff Performance — Distance and Time Versus Speed

TAKEOFF PERFORMANCE— ACCELERATION INCREMENT TIME CHECK

FOUR-ENGINE GROUND RUN

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST DATA

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
Use this chart only for determining time increment between two indicated airspeeds.

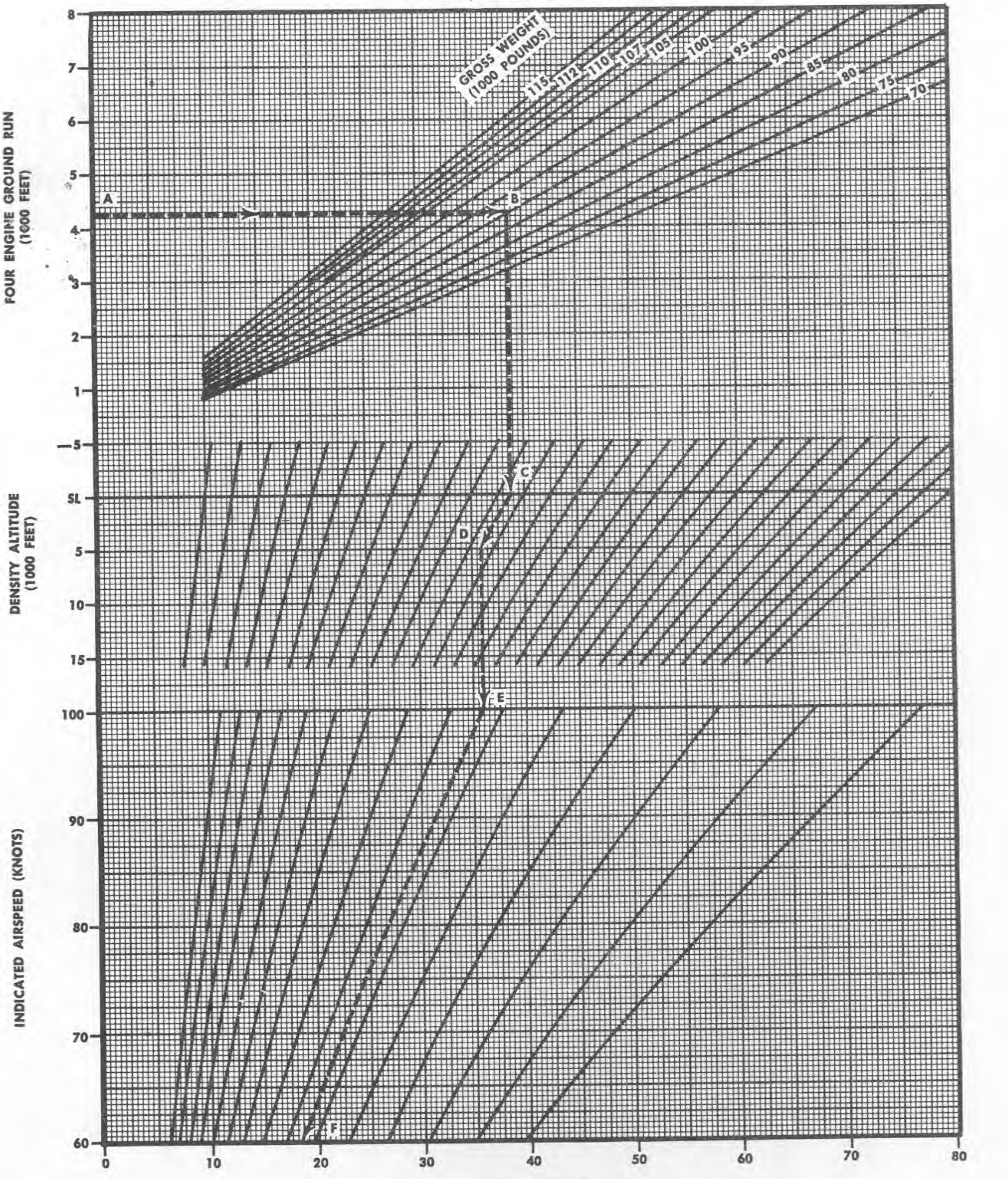


Figure A3-11. Takeoff Performance — Acceleration Increment Time Check

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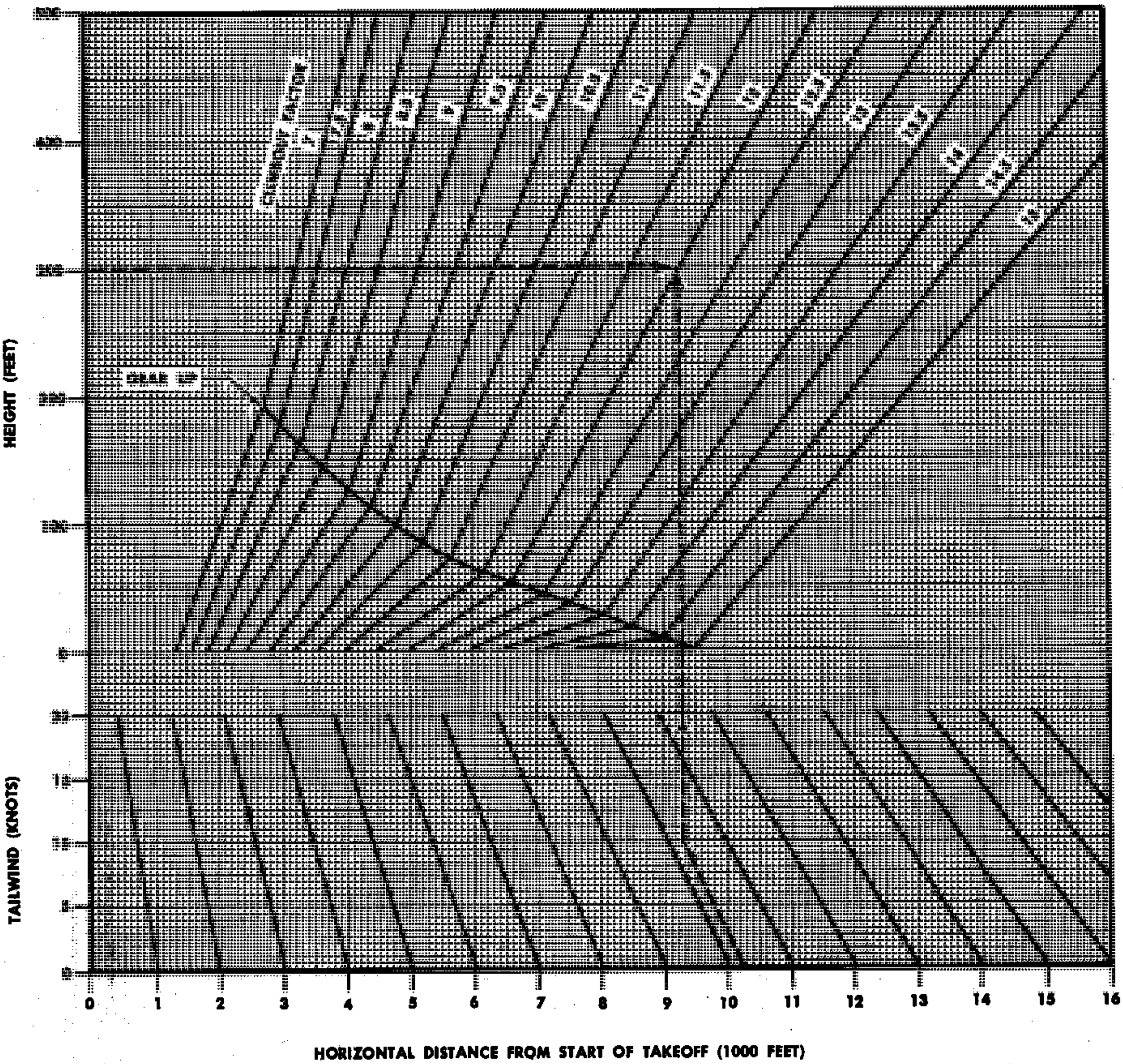
CLIMBOUT FACTOR — FOUR-ENGINE — GROUND EFFECT NOT INCLUDED

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-536

Figure A3-12. Climbout Factor — Four-Engine — Ground Effect Not Included

CLIMBOUT FACTOR — THREE-ENGINE — GROUND EFFECT NOT INCLUDED

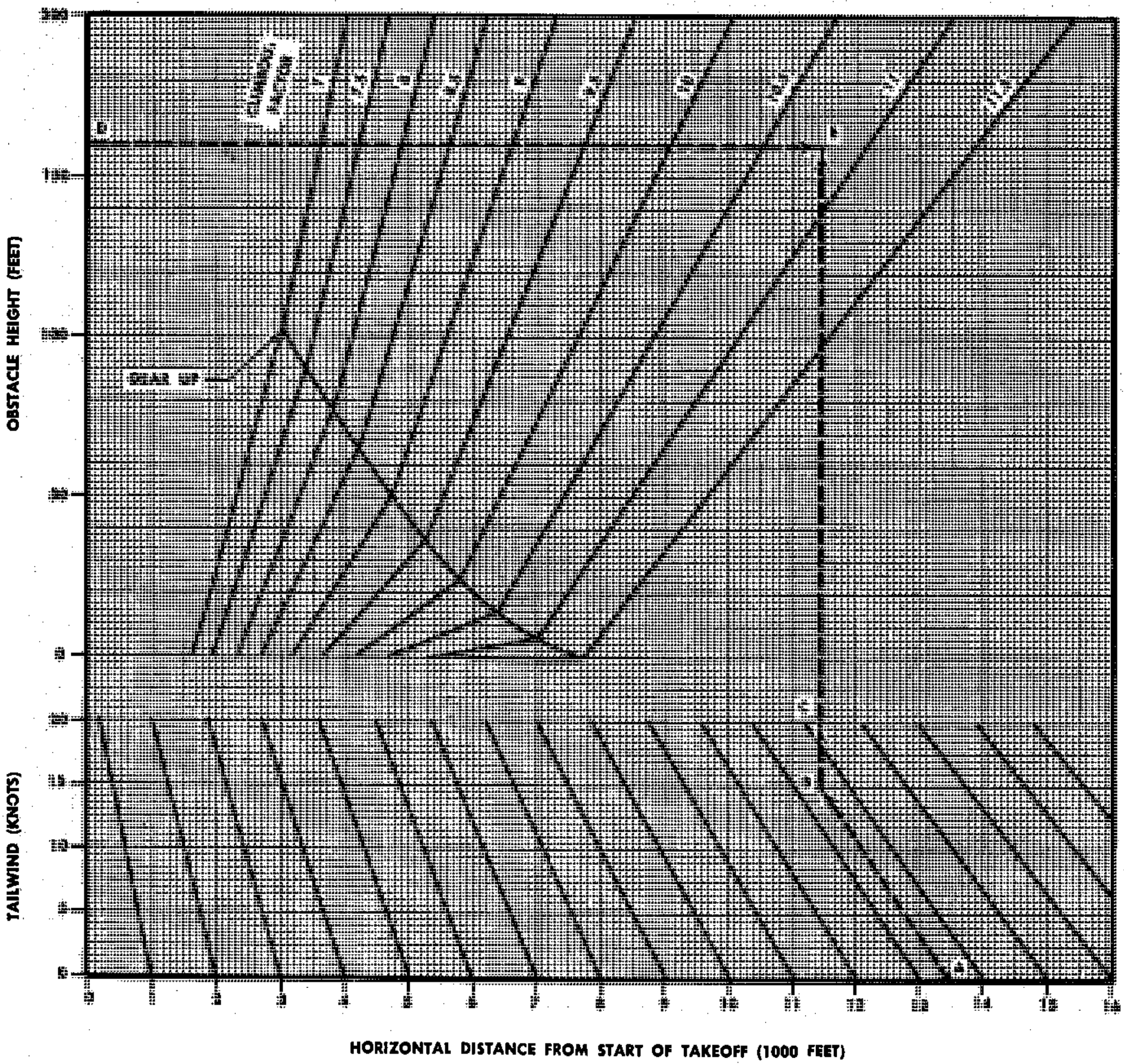
ZERO TO 200 FEET

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

SAMPLE PROBLEM:

A. Obstacle distance from start of takeoff = 13500 ft.
B. Tailwind = 15 knots
C. Obstacle distance corrected for wind = 11450 ft.
D. Obstacle height above runway = 160 ft.
E. Climbout factor to clear obstacle = 10.8



AA1-527

Figure A3-13. Climbout Factor — Three-Engine — Ground Effect Not Included (Sheet 1 of 2)

CLIMBOUT FACTOR — THREE-ENGINE — GROUND EFFECT NOT INCLUDED

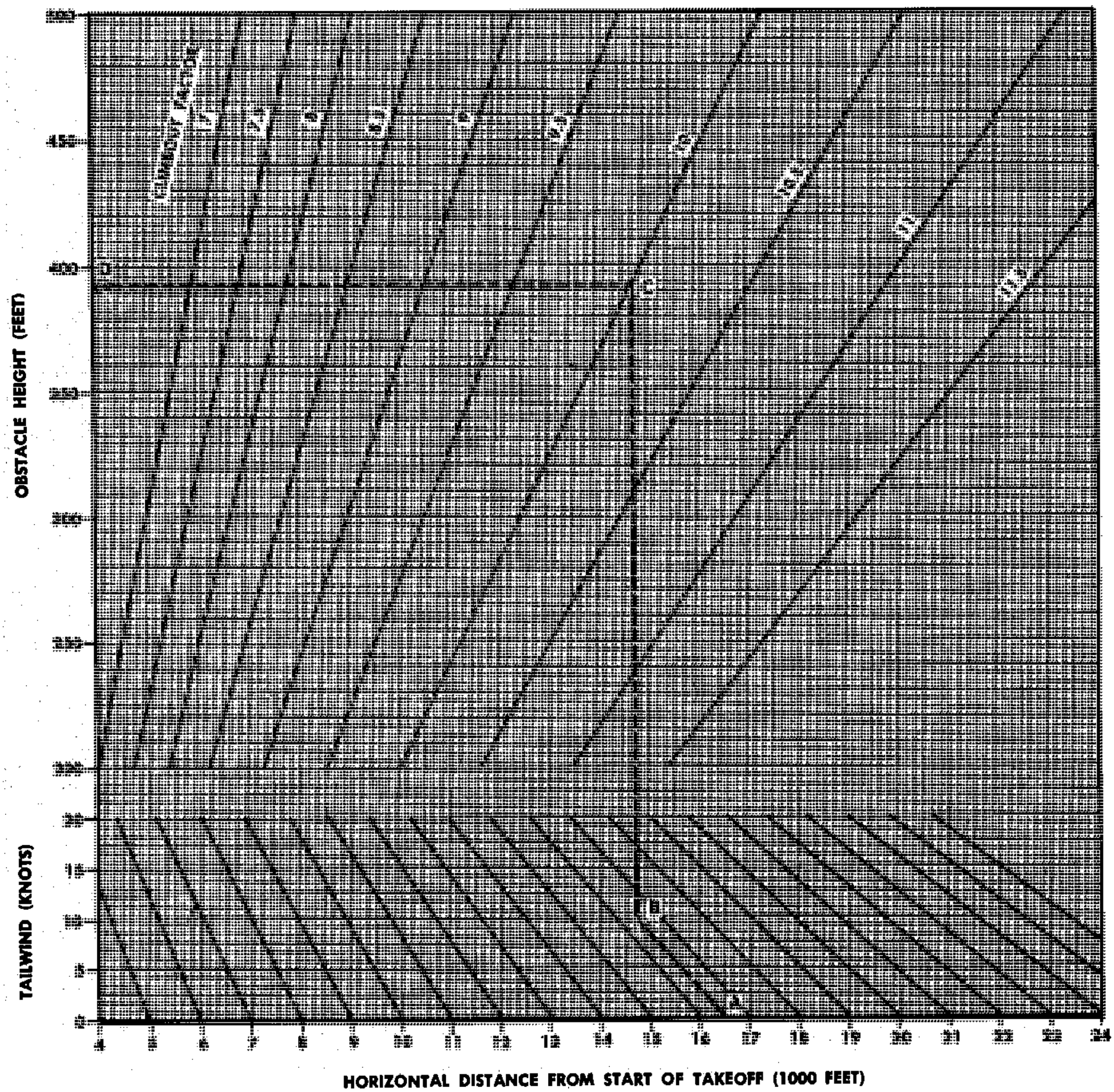
200 TO 500 FEET

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

SAMPLE PROBLEM:

A. Obstacle distance = 16,500 feet
B. Wind = 10 knots (tailwind)
C. Climbout factor = 10
D. Altitude over obstacle = 393 feet



AA1-528

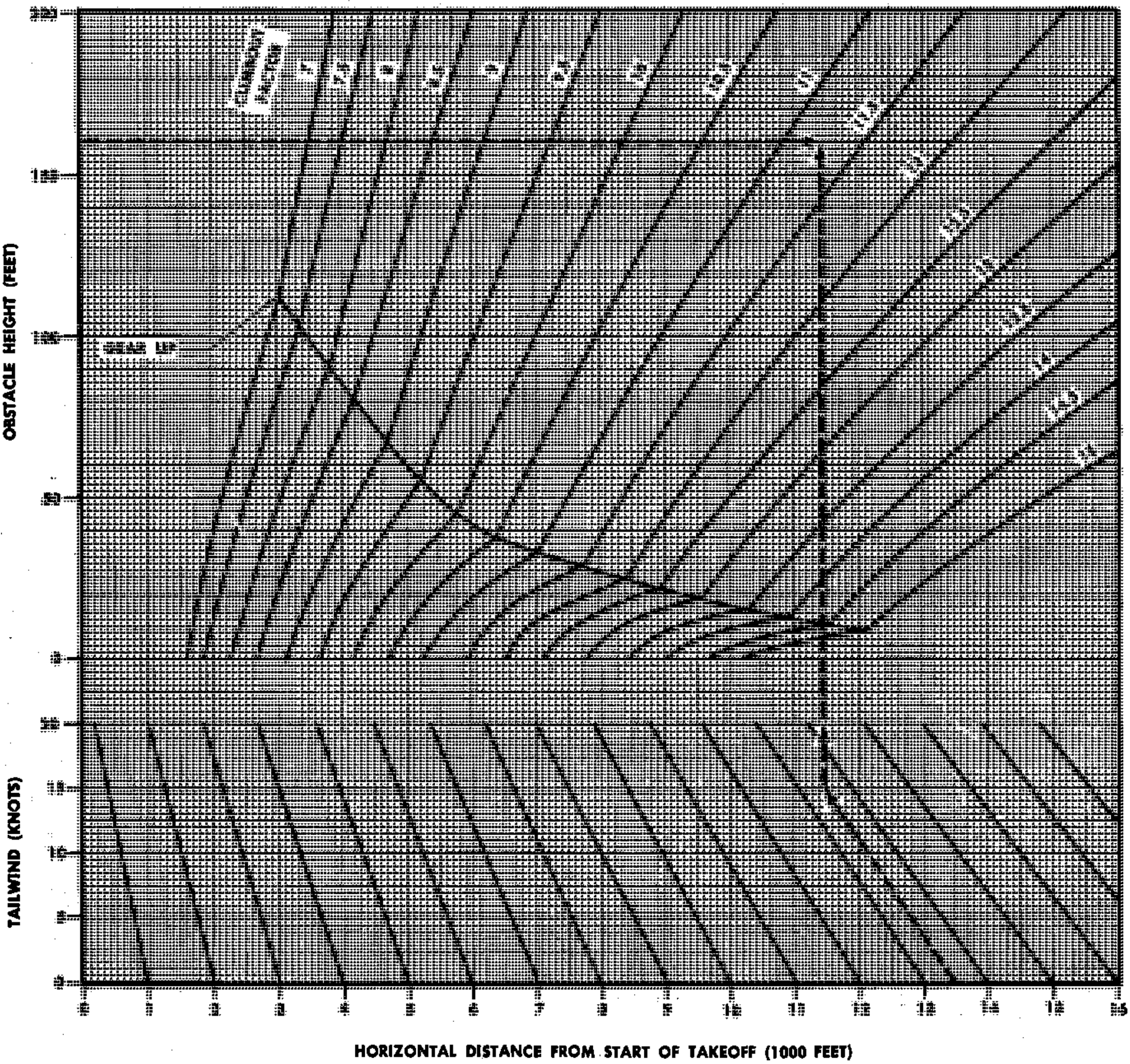
Figure A3-13. Climbout Factor — Three-Engine — Ground Effect Not Included (Sheet 2 of 2)

CLIMBOUT FACTOR — THREE-ENGINE — GROUND EFFECT INCLUDED

ZERO TO 200 FEET

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



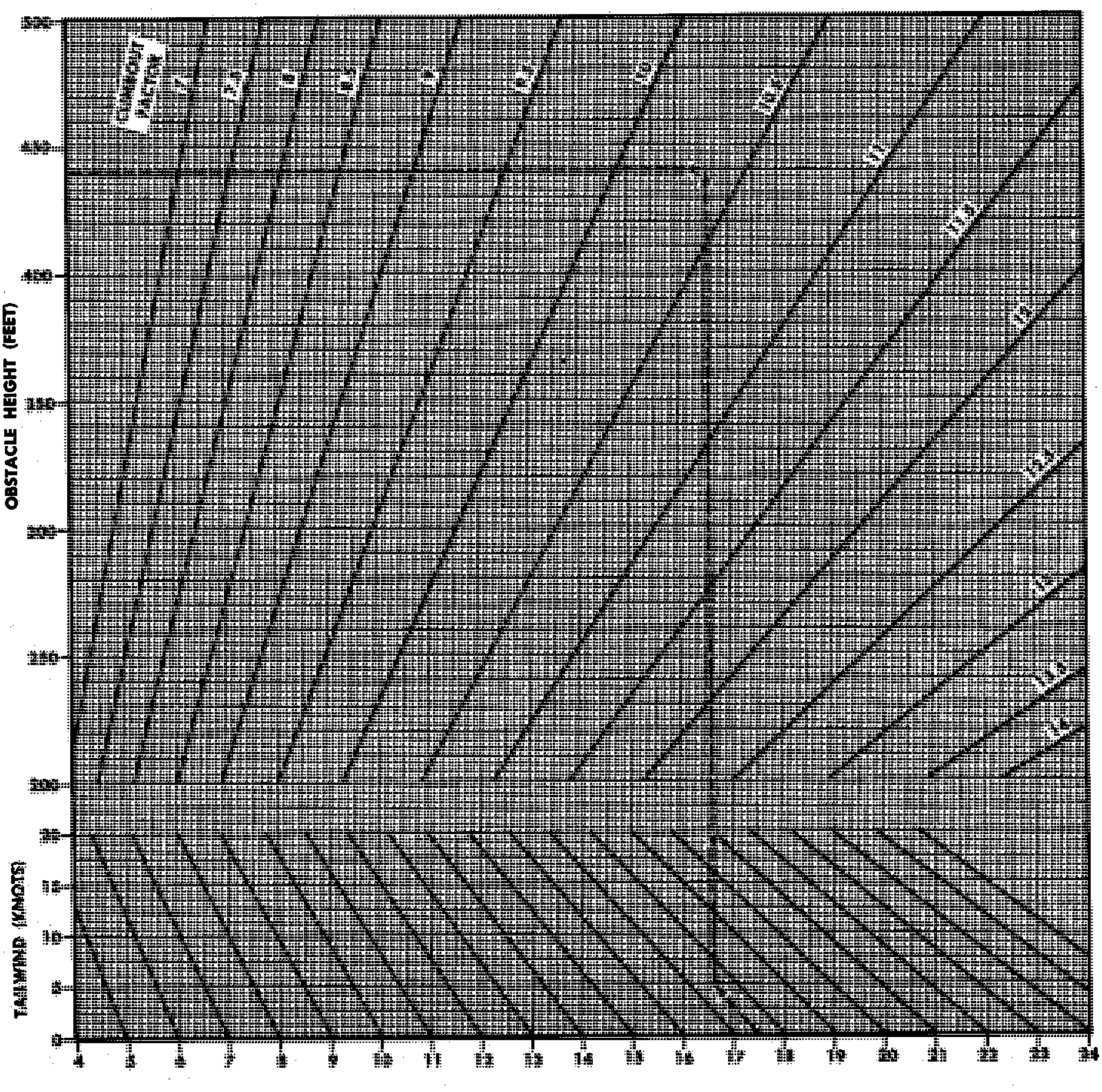
AA1-529

Figure A3-14. Climbout Factor — Three Engine — Ground Effect Included (Sheet 1 of 2)

CLIMBOUT FACTOR — THREE-ENGINE — GROUND EFFECT INCLUDED
200 TO 500 FEET

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



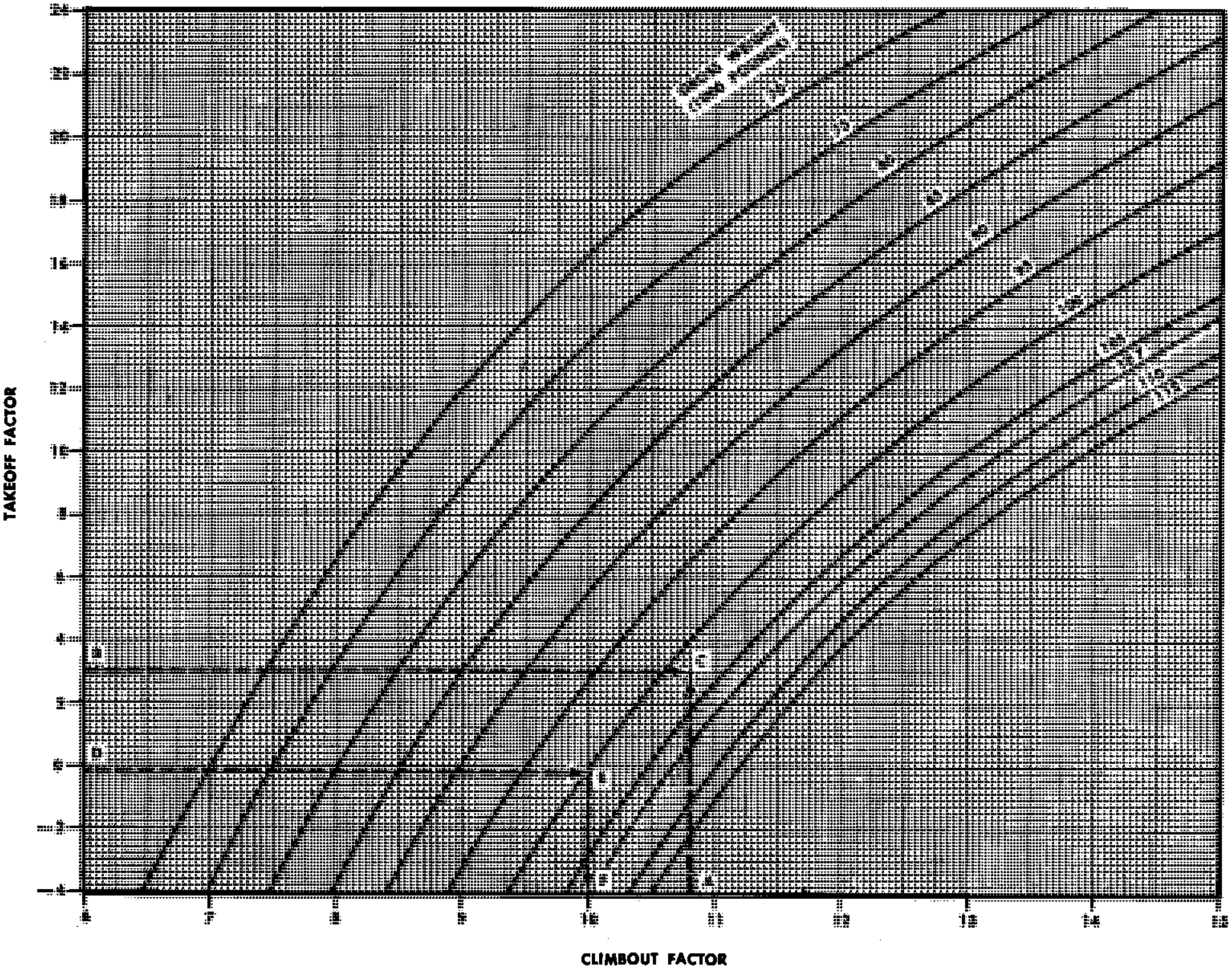
AA1-530

Figure A3-14. Climbout Factor — Three-Engine — Ground Effect Included (Sheet 2 of 2)

GROSS WEIGHT LIMITED BY CLIMBOUT OVER OBSTACLE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-531

Figure A3-15. Gross Weight Limited By Climbout Over Obstacle

TAKEOFF DISTANCE TO A 50-FOOT HEIGHT
THREE-ENGINE FERRY CONFIGURATION

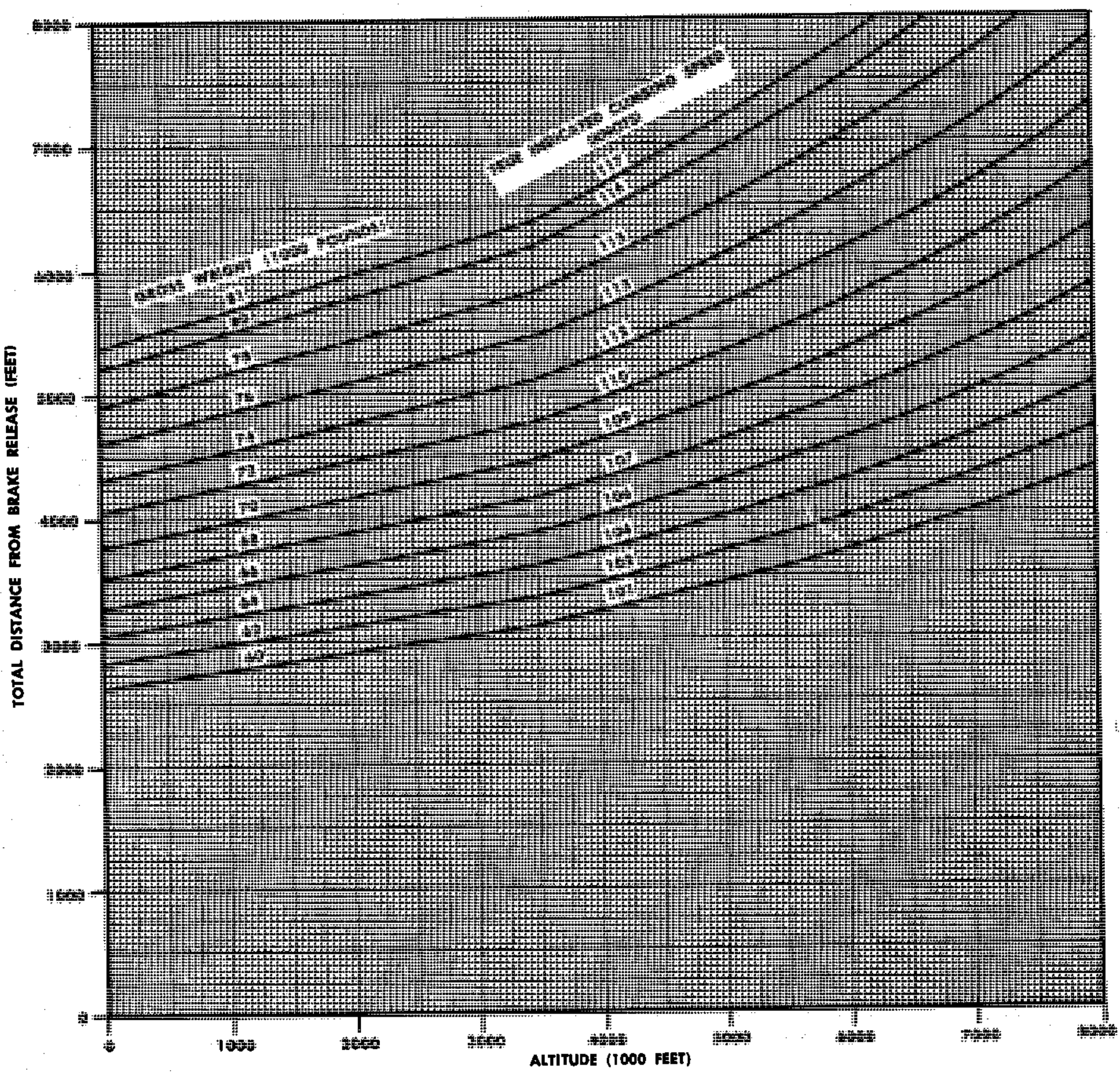
ONE ENGINE INOPERATIVE, PROPELLER FEATHERED OR REMOVED

HARD SURFACE RUNWAY   NO WIND
WING FLAPS 20 DEGREES
STANDARD ATMOSPHERIC CONDITIONS
NO OBSTACLE AT END OF RUNWAY

NO RUNWAY SLOPE
COWL FLAPS =
INOPERATIVE ENGINE, CLOSED (—4 DEGREES)
OPERATIVE ENGINE, OPEN (+3 DEGREES)

ENGINE(S): (4) R2800-52W

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA



AA1-253

Figure A3-16. Takeoff Distance to a 50-Foot Height, Three-Engine Ferry Configuration

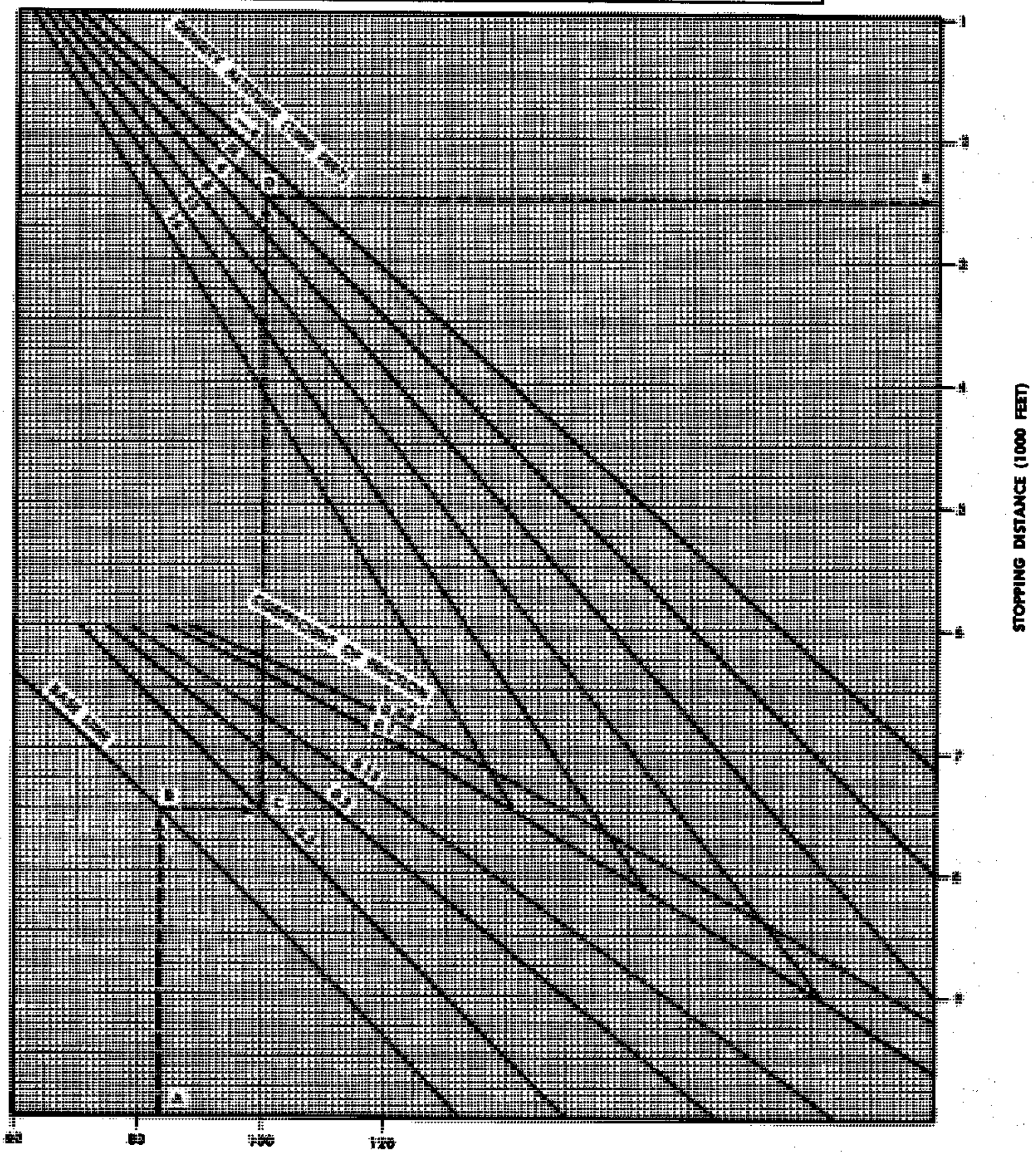
MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

DISTANCE TO STOP — BRAKES ONLY — PROPELLERS WINDMILLING

TAKEOFF FLAP ANGLE = 20 DEGREES

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

RUNWAY SURFACE CONDITION	AVERAGE COEFFICIENT OF FRICTION (μ)
DRY CONCRETE OR MACADAM	0.3
DRY TURF	0.2
WET CONCRETE OR MACADAM	0.15
SNOW OR WET GRASS	0.10
ICE	0.08



AA1-72

Figure A3-17. Distance to Stop — Brakes Only — Propellers Windmilling

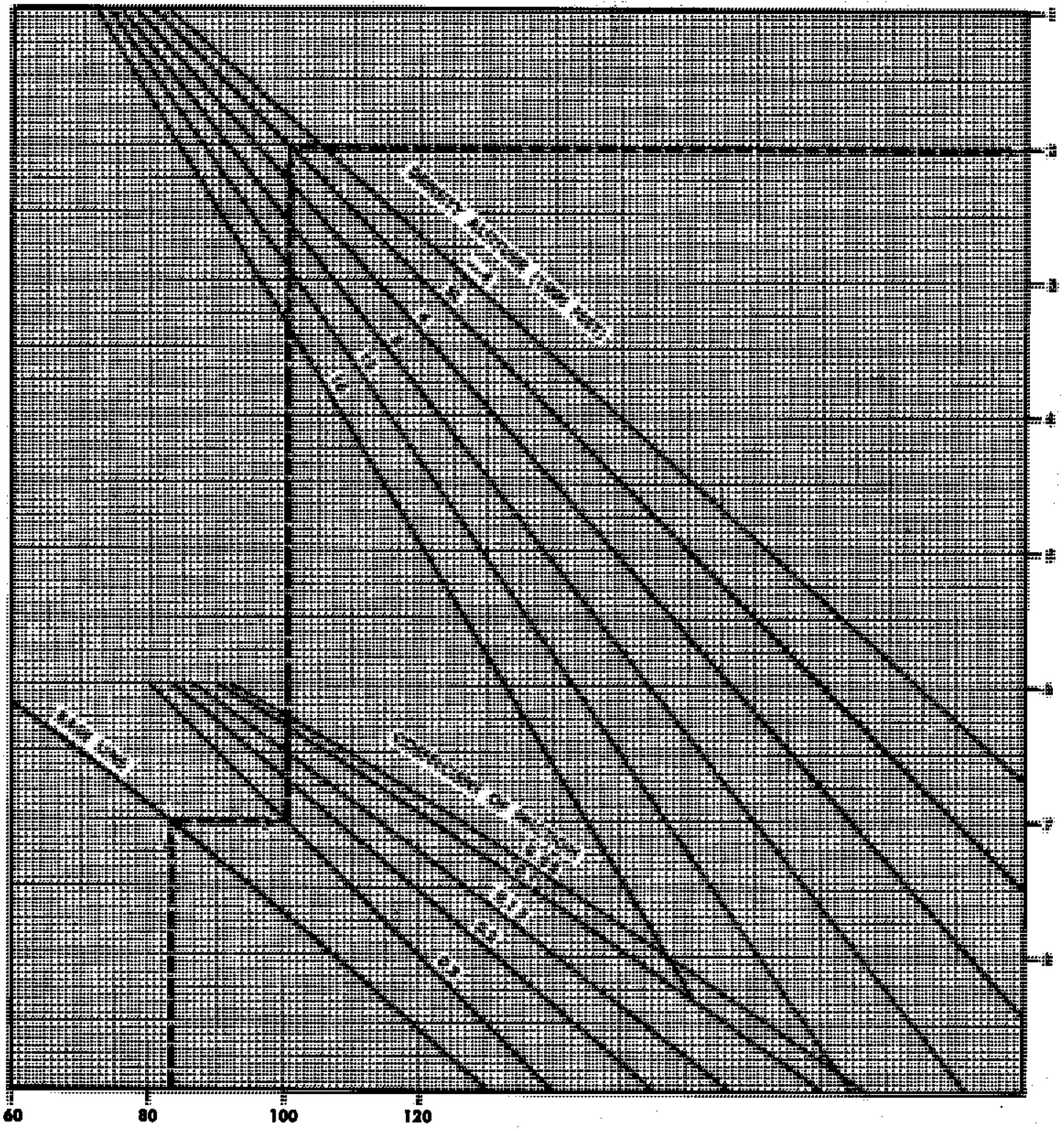
DISTANCE TO STOP — BRAKES PLUS TWO-ENGINE REVERSE THRUST

TAKEOFF FLAP ANGLE = 20 DEGREES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

RUNWAY SURFACE CONDITION	AVERAGE COEFFICIENT OF FRICTION (μ)
DRY CONCRETE OR MACADAM	0.3
DRY TURF	[illegible]
WET CONCRETE OR MACADAM	0.15
SNOW OR WET GRASS	[illegible]
ICE	[illegible]



AA1-94

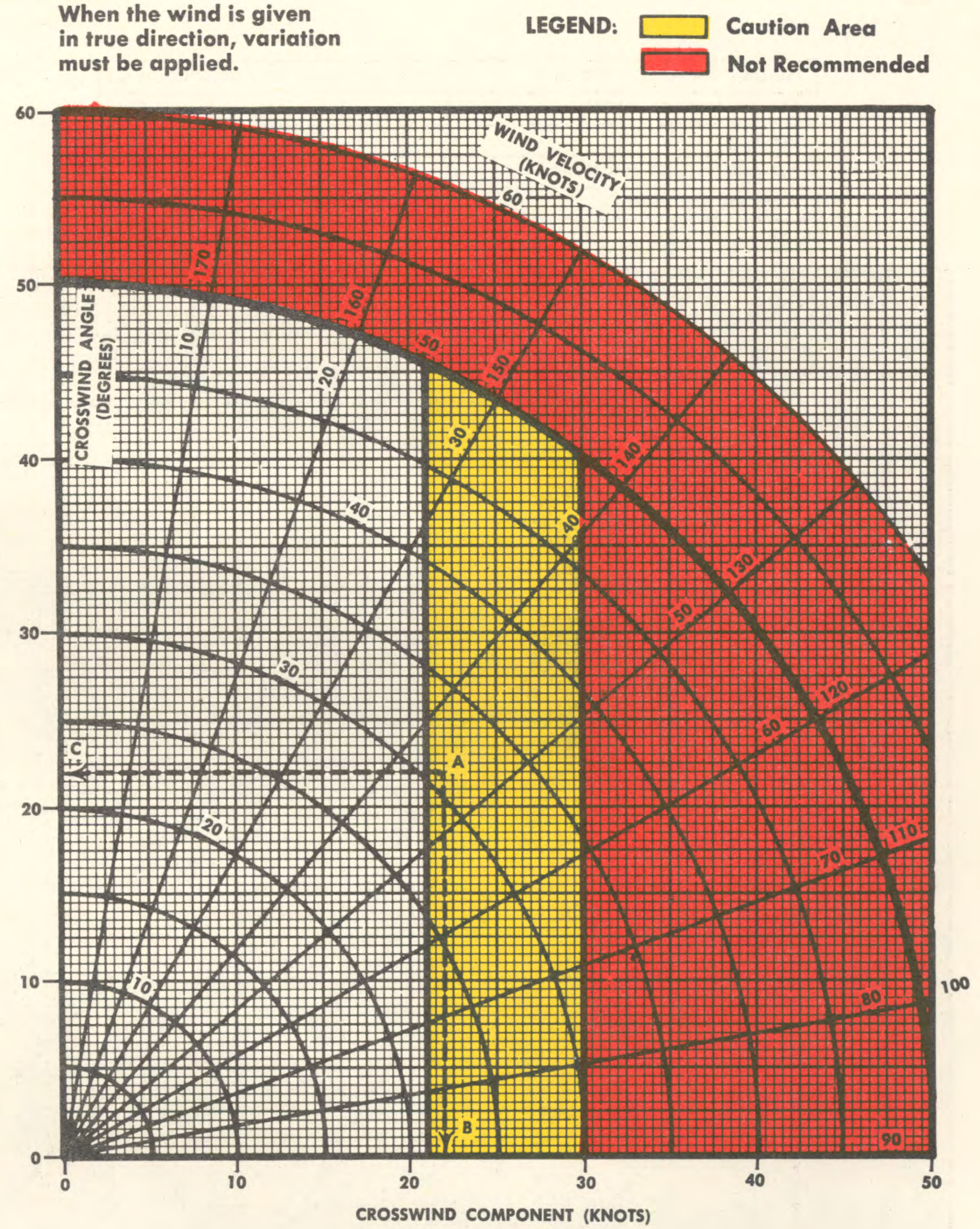
Figure A3-18. Distance to Stop — Brakes Plus Two-Engine Reverse Thrust

TAKEOFF AND LANDING CROSSWIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
When the wind is given in true direction, variation must be applied.



NOTE:
Maximum allowable nosewheel liftoff or touchdown speed is 139 knots due to tire structure limitations.

SAMPLE PROBLEM:
GIVEN:
Takeoff runway .030.
Wind: = 31 knots at .075.
Crosswind angle = .075 — .030 = .045.

A. Wind = 31 knots at 45 degrees crosswind angle.
B. Crosswind component = 22 knots.
C. Headwind component = 22 knots.

AA1-515

Figure A3-19. Takeoff and Landing Crosswind

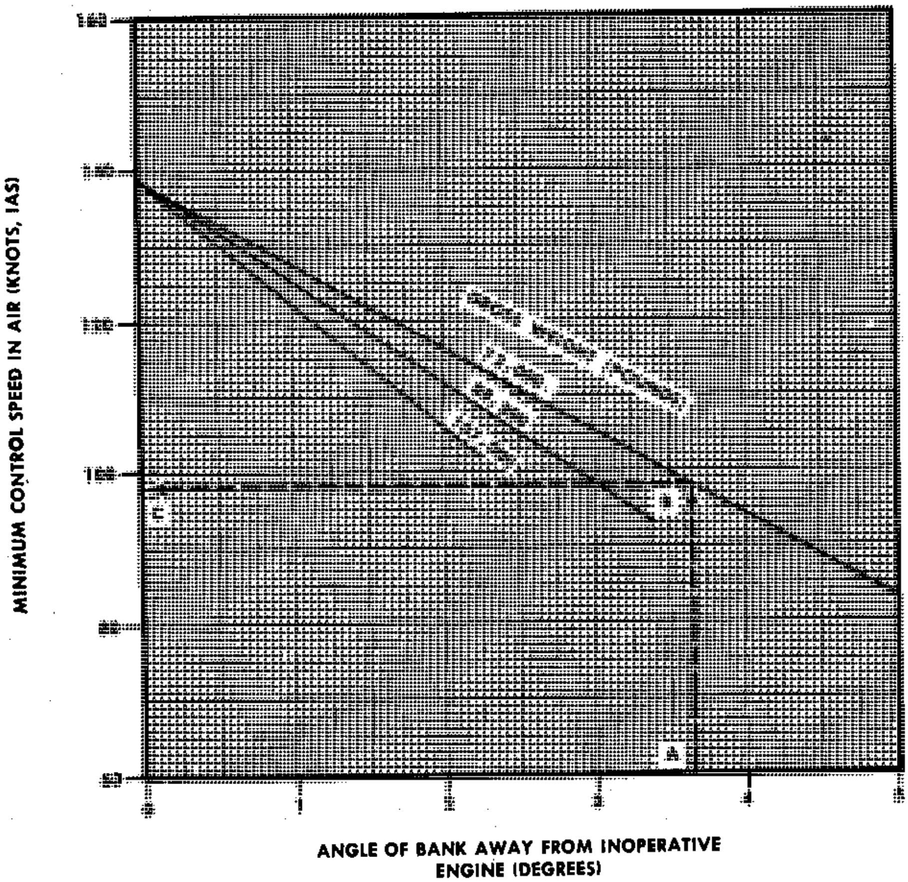
MINIMUM CONTROL SPEED VS BANK ANGLE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
1. Based on one outboard engine inoperative, propeller windmilling.
2. Three engines operating at 2500 BHP/ENG.
3. Wing flaps 20 degrees.

SAMPLE PROBLEM:
A. Bank angle = 3.65 degrees.
B. Gross weight = 173,000 pounds.
C. Minimum control speed = 98 knots IAS.



AA1-540

Figure A3-20. Minimum Control Speed Vs Bank Angle

part 4 climb

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

DISCUSSION OF CHARTS.

TIME, DISTANCE AND FUEL TO CLIMB CHARTS.

Two charts are provided *(figures A4-1 and A4-2)* from which may be determined the time elapsed, distance travelled and fuel consumed during an operational climb from sea level to cruise altitude. One chart is for 1400 brake horsepower per engine and the other is for 1500. In both cases the power is assumed to be constant from sea level up to the altitude at which that power may only be obtained with full throttle and 2600 RPM. Above that altitude power is assumed to decrease as the engine settings remain at full throttle and 2600 RPM.

The charts were prepared for standard atmospheric conditions. However, they may be used for conditions hotter than standard if the pressure altitude is increased by 0.7% for each degree Centigrade that the outside air temperature is above standard. This temperature difference should be the average temperature difference throughout the climb. For example, if, at the initial climb altitude, the outside air temperature is 15 degrees Centigrade above standard and it is determined that at the cruise altitude it will only be 5 degrees Centigrade above standard (for that altitude) then, in using these charts, it may be assumed that the average temperature difference is 10 degrees above standard. In this case the altitude correction for temperature will be 10 degrees times 0.7% per degree, or 7%. This means that if the cruise altitude were 20,000 feet the altitude correction would be 7% of 20,000 feet, or 1,400 feet. The charts would be read at 20,000 feet plus 1,400 feet, or 21,400 feet.

Although the charts are based on sea level as the initial climb altitude they may be used when the initial climb altitude is above sea level. For example, in the problem discussed above assume that the initial climb altitude is 6,000 feet, the initial climb gross weight is 98,000 pounds and 1400 BHP is to be used. Enter the chart on figure A4-1 at 98,000 pounds and proceed vertically upward to 6,000 feet altitude plus 7% of 6,000 feet. This would be 6,000 feet plus 420 feet, or 6,420 feet. Note that at this point the distance is 30 nautical miles and the time is 11 minutes. Now proceed upwards parallel to the guide lines to 21,400 feet altitude (determined above). At this point note that the distance is 156 nautical miles, the time is 49 minutes and the gross weight is 95,400 pounds. By subtracting these two sets of values we determine that in climbing from 6,000 to 20,000 feet the distance travelled will be 156 nautical miles minus 30 nautical miles, or 126 nautical miles. The time required will be 49 minutes minus 11 minutes, or 38 minutes and the fuel consumed will be 98,000 pounds minus 95,400 pounds, or 2,600 pounds.

No correction has been established for colder than standard conditions. In such cases read the charts at the actual pressure altitude.

EMERGENCY CEILING CHARTS.

Two charts are provided *(figures A4-3 and A4-4)* showing the altitude at which 100 feet per minute rate of climb may be maintained with METO power at any given gross weight. One chart is for standard fuel grade and the other is for alternate fuel grade. On both charts there are curves for four engines, three engines and two engines operating. Grids are included to allow corrections to be made for hotter than standard temperatures. The charts are based on a clean configuration and a climbing airspeed of 136 knots IAS.

EMERGENCY CLIMB CHARTS.

The Emergency Climb charts *(figures A4-5 through A4-13)* indicate the rate of climb at various combinations of power, indicated airspeed, gross weight and density altitudes. Charts are provided for both four- and three-engine operation in the takeoff configuration with the gear up and with the gear down, enroute configuration (flaps and gear up), and in the landing configuration (flaps full down and gear down). A chart is also provided for two-engine operation in the enroute configuration. No chart is provided for two-engine operation in the landing configuration since a negative rate of climb exists during two-engine operation with both flaps and gear down.

All charts are based on the cowl flaps at +3 degrees on the operative engines. Thre three- and two-engine charts are based on the cowl flaps at −4 degrees and the propellers feathered on the inoperative engines.

The speeds for best rate of climb and the power off stall speeds for various gross weights are indicated on each chart. A sample problem to illustrate the method of using the charts is included on figure A4-5.

PERFORMANCE CLIMBS CHART.

This chart *(figure A4-14)* shows the variation of rate of climb vs gross weight for several three-engine configurations. Four of these configurations may occur during the climbout after a takeoff with engine failure and the fifth is the three-engine enroute configuration. They are all based on sea level standard atmospheric conditions. A scale is included to show the takeoff speed vs gross weight.

POWER SETTINGS FOR CLIMB TABLES.

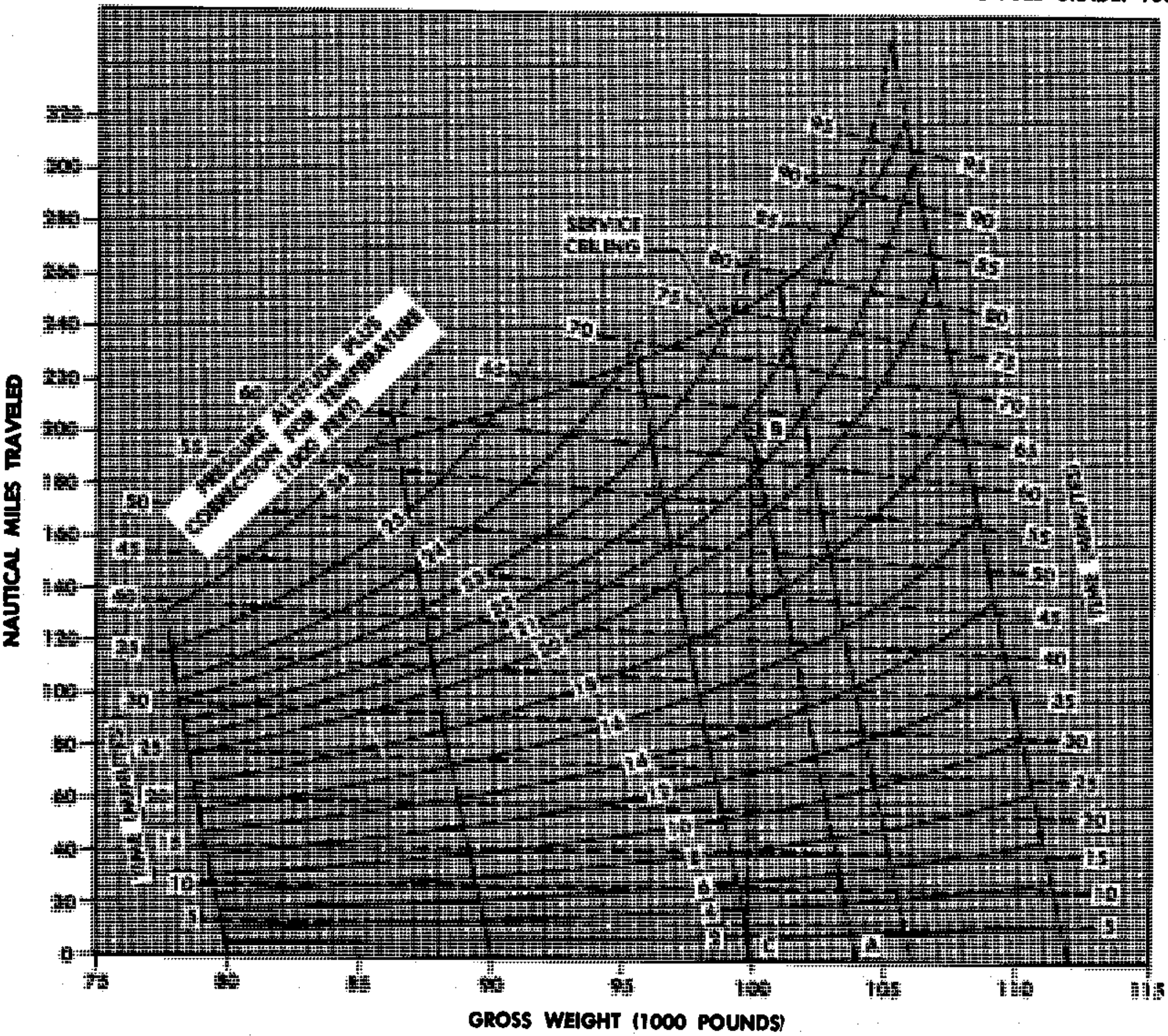
Four tables are provided, tabulating the power settings necessary to maintain climb power for various altitude and carburetor air temperature combinations. The tables are based on a constant RPM and BMEP for a given brake horsepower and show the manifold pressures necessary to maintain the required brake horsepower at a given altitude and carburetor air temperature. The range of fuel flow for these power settings is shown on each table. Tables are provided for four-engine climb at 1400 BHP/engine *(figure A4-15)* and 1500 BHP/engine *(figure A4-16),* and for three- and two-engine climb at 1600 BHP/engine *(figure A4-17)* and 1700 BHP/engine *(figure A4-18).*

TIME, DISTANCE AND FUEL TO CLIMB—1400 BHP

ALL ENGINES OPERATING—AUTO RICH MIXTURE
CLIMBING AIRSPEED=156 KNOTS CAS

MODEL: C-118A
DATA AS OF: 2-16-59
DATA BASED ON FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTES:

1. For standard atmospheric conditions and for colder than standard atmospheric conditions use no correction for temperature.
2. For hot day the correction for temperature is equal to 0.7% of the pressure altitude for each °C above standard (for example when climbing from sea level to 15,000 feet the correction is 0.7% of 15,000 feet, or 105 feet for each °C above standard. If the temperature were 6°C above standard the correction would be 105 x 6, or 630 feet. Add 630 feet to 15,000 feet and read time, distance and fuel to climb to 15,630 feet.
3. Based on 1400 BHP from sea level up to altitude at which full throttle is reached with 2600 RPM in high blower. Based on full throttle and 2600 RPM above that altitude.

SAMPLE PROBLEM

GIVEN:

1. Gross weight at start of climb = 104,000 pounds.
2. Climb from sea level to 20,000 feet pressure altitude.
3. Average temperature deviation = 12°C above standard.
   (Correction for temperature = 0.7% of 20,000 x 12, or 1680 feet).

A. Enter chart at 104,000 pounds gross weight.

B. Follow contour to 20,000 feet pressure altitude plus 1680 feet correction for temperature, or 21,680 feet. Read time to climb, 63 minutes, and distance travelled, 202 nautical miles.

C. Weight at end of climb = 99,800 pounds. Fuel consumed during climb = 104,000 − 99,800, or 4200 pounds.

Figure A4-1. Time, Distance and Fuel to Climb — 1400 BHP

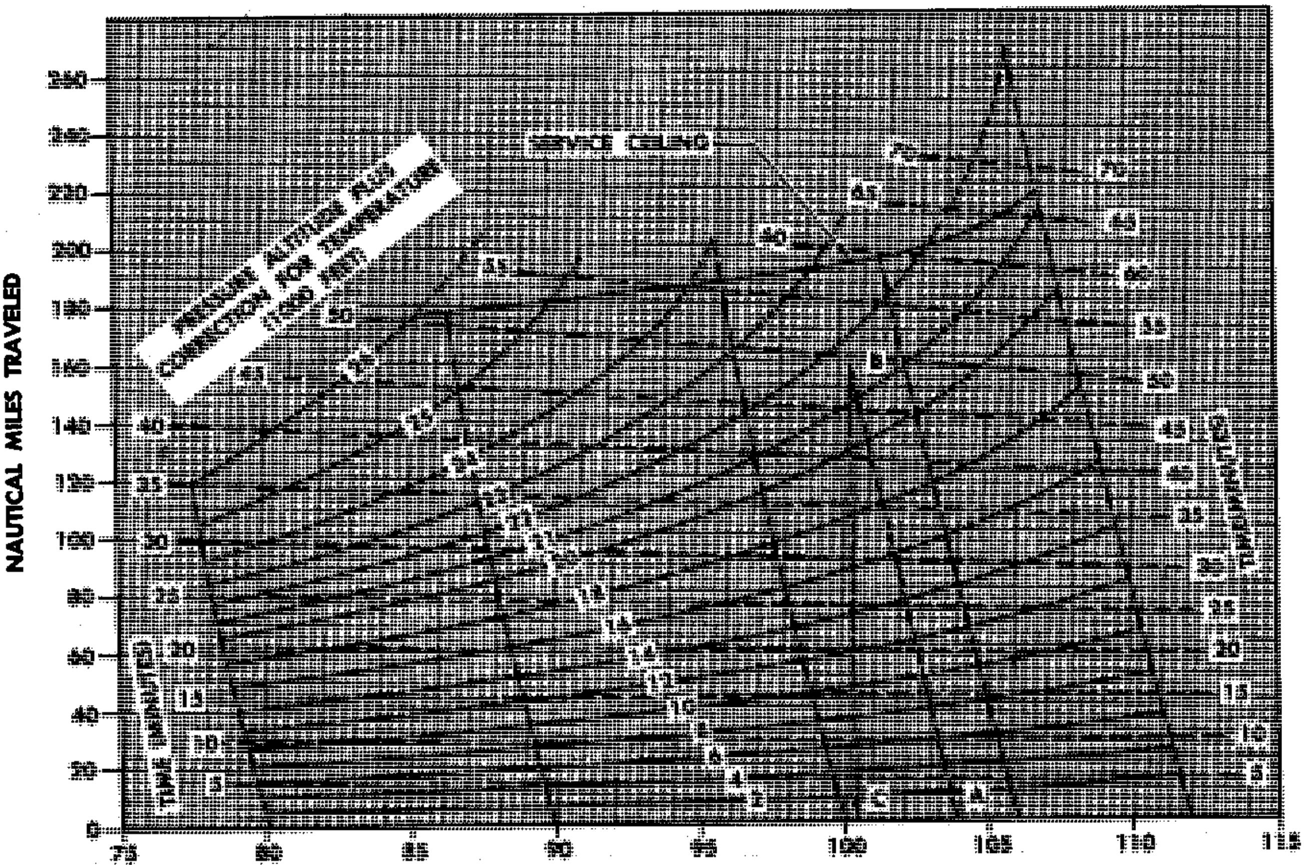
AA1-243

TIME DISTANCE AND FUEL TO CLIMB—1500 BHP

ALL ENGINES OPERATING—AUTO RICH MIXTURE
CLIMBING AIRSPEED=156 KNOTS CAS

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASED ON: FLIGHT TEST

ENGINES: (4) R 2800-52 W
FUEL GRADE 115/145
ALTERNATE FUEL GRADE: 100/130



NOTES:

1. For standard atmospheric conditions and colder than standard atmospheric conditions use no correction for temperature.
2. For hot days the correction for temperature is equal to 0.7% of the pressure altitude for each °C above standard (for example when climbing from sea level to 15,000 feet the correction is 0.7% of 15,000 feet, or 105 feet, for each °C above standard. If the temperature were 6 °C above standard the correction would be 105 x 6, or 630 feet. Add 630 feet to 15,000 feet and read time distance and fuel to climb to 15,630 feet.
3. Based on 1500 BHP from sea level up to altitude at which full throttle is reached with 2600 RPM in high blower. Based on full throttle and 2600 RPM above that altitude.

SAMPLE PROBLEM

GIVEN:

1. Gross weight at start of climb = 104,000 pounds.
2. Average temperature deviation = 12°C above standard.
   (Correction for temperature = 0.7% of 20,000 x 12, or 1680 feet.)

A. Enter chart at 104,000 pounds gross weight.

B. Follow contour to 20,000 feet pressure altitude plus 1680 feet correction for temperature or 21,680 feet. Read time to climb 49 minutes, and distance travelled, 158 nautical miles.

C. Weight at end of climb = 100,350 pounds. Fuel consumed during climb = 104,000 — 100,350 or 3650 pounds.

AA1-242

Figure A4-2. Time, Distance and Fuel to Climb — 1500 BHP

EMERGENCY CEILING

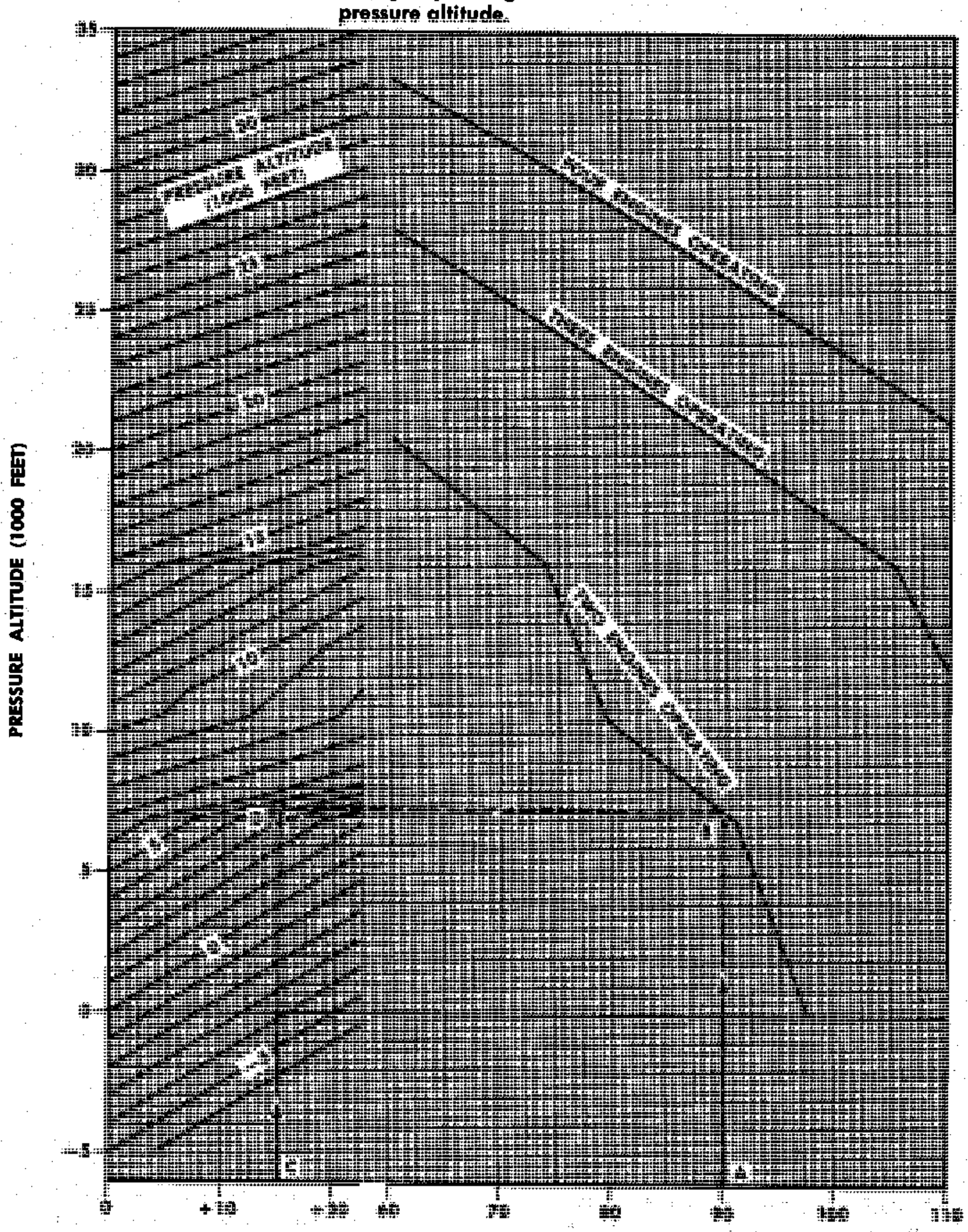
100 FEET PER MINUTE RATE OF CLIMB AT METO POWER
CLIMBING SPEED — 136 KNOTS, PILOT'S IAS

MODEL: C-118A
DATA AS OF 2-15-59
BASED ON FLIGHT TEST

ENGINE(S): R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM:

- A. Gross weight = 90,000 pounds.
- B. Two engines operating.
- C. Temperature = 15°C above standard.
- D. Emergency ceiling = 4300 feet pressure altitude.



AA1-227

Figure A4-3. Emergency Ceiling — Standard Fuel Grade

EMERGENCY CEILING

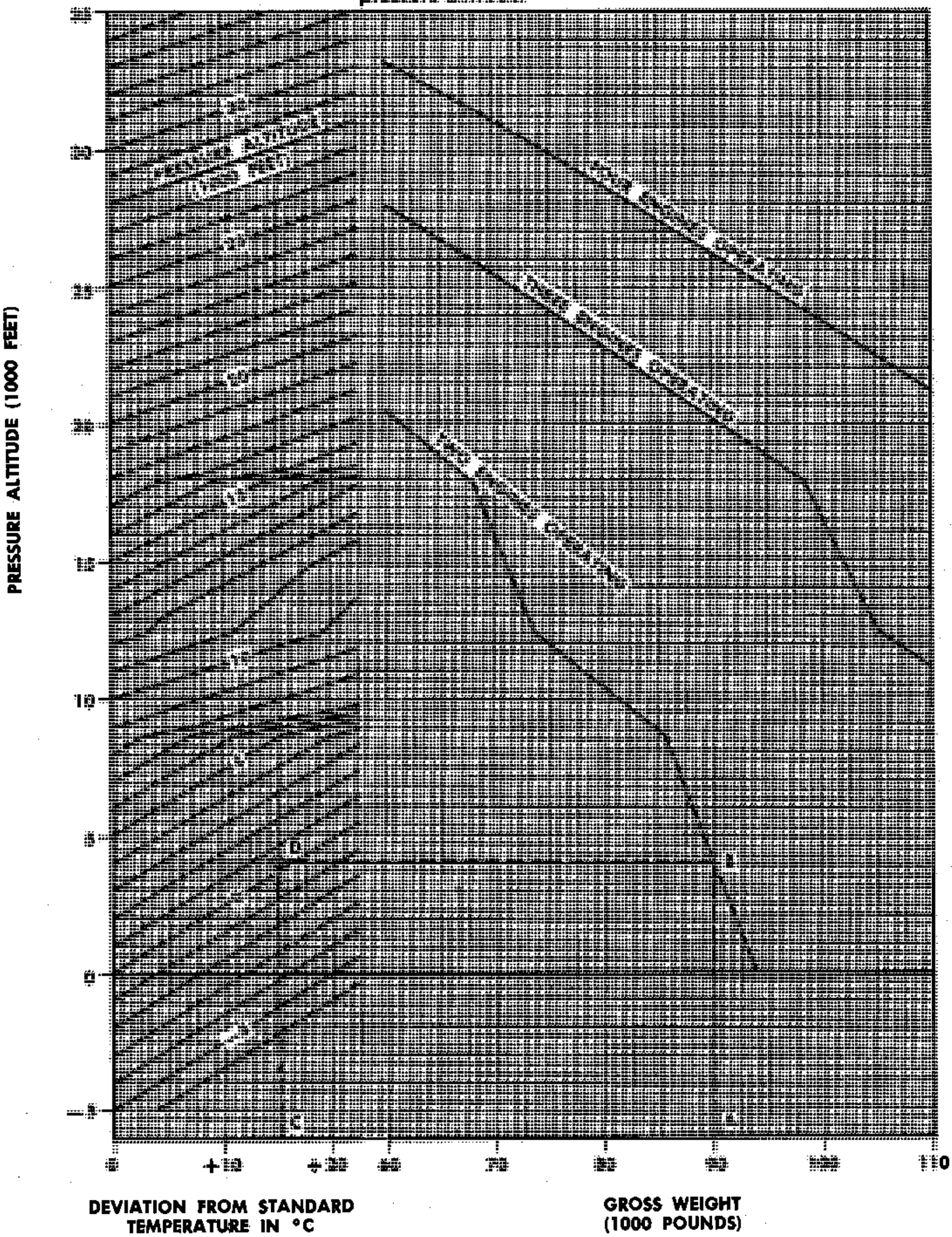
100 FEET PER MINUTE RATE OF CLIMB AT
METO POWER
CLIMBING SPEED — 136 KNOTS, PILOT'S IAS

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: FLIGHT TEST

SAMPLE PROBLEM:

A. Gross weight = 90,000 pounds.
B. Two engines operating.
C. Temperature = 15°C above standard.
D. Emergency ceiling = 400 feet pressure altitude.

ENGINE(S): R2800-52W
FUEL GRADE: 100/130



AA1-226

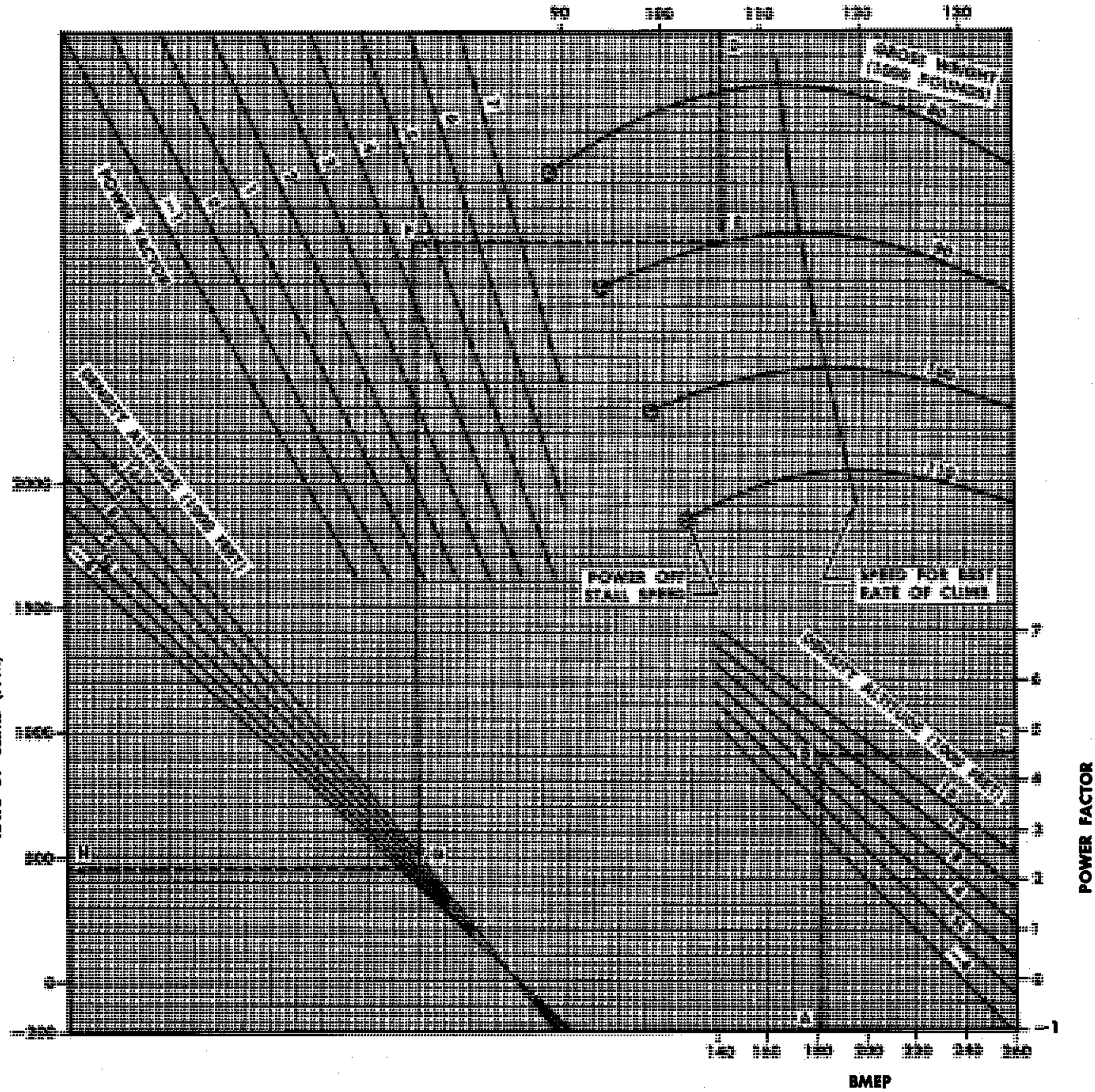
Figure A4-4. Emergency Ceiling — Alternate Fuel Grade

FOUR-ENGINE EMERGENCY CLIMB — TAKEOFF CONFIGURATION — FLAPS 20 DEGREES, GEAR DOWN

COWL FLAP SETTING: +3 DEGREES ON ALL ENGINES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM:
A. BMEP = 182 PSI.
B. Density altitude = 8,000 feet.
C. Power factor = 4.5.
D. Indicated airspeed = 106 knots.
E. Gross weight = 90,000 pounds.
F. Power factor = 4.5.
G. Density altitude = 8,000 feet.
H. Rate of climb = 450 FPM.

AA1-42

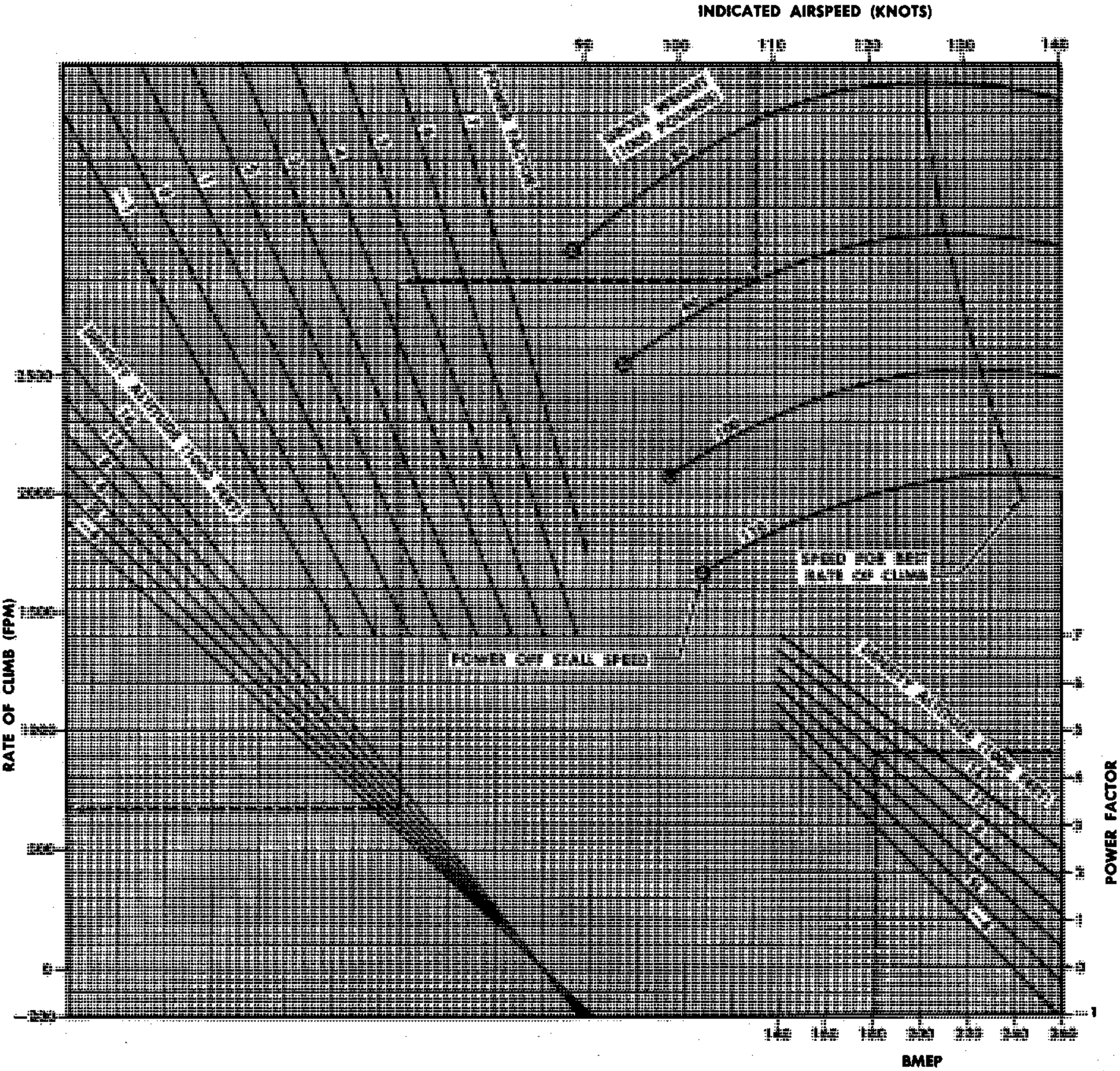
Figure A4-5. Four-Engine Emergency Climb—Takeoff Configuration—Flaps 20 Degrees, Gear Down

FOUR-ENGINE EMERGENCY CLIMB — TAKEOFF CONFIGURATION — FLAPS 20 DEGREES, GEAR UP

COWL FLAP SETTING: +3 DEGREES ON ALL ENGINES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



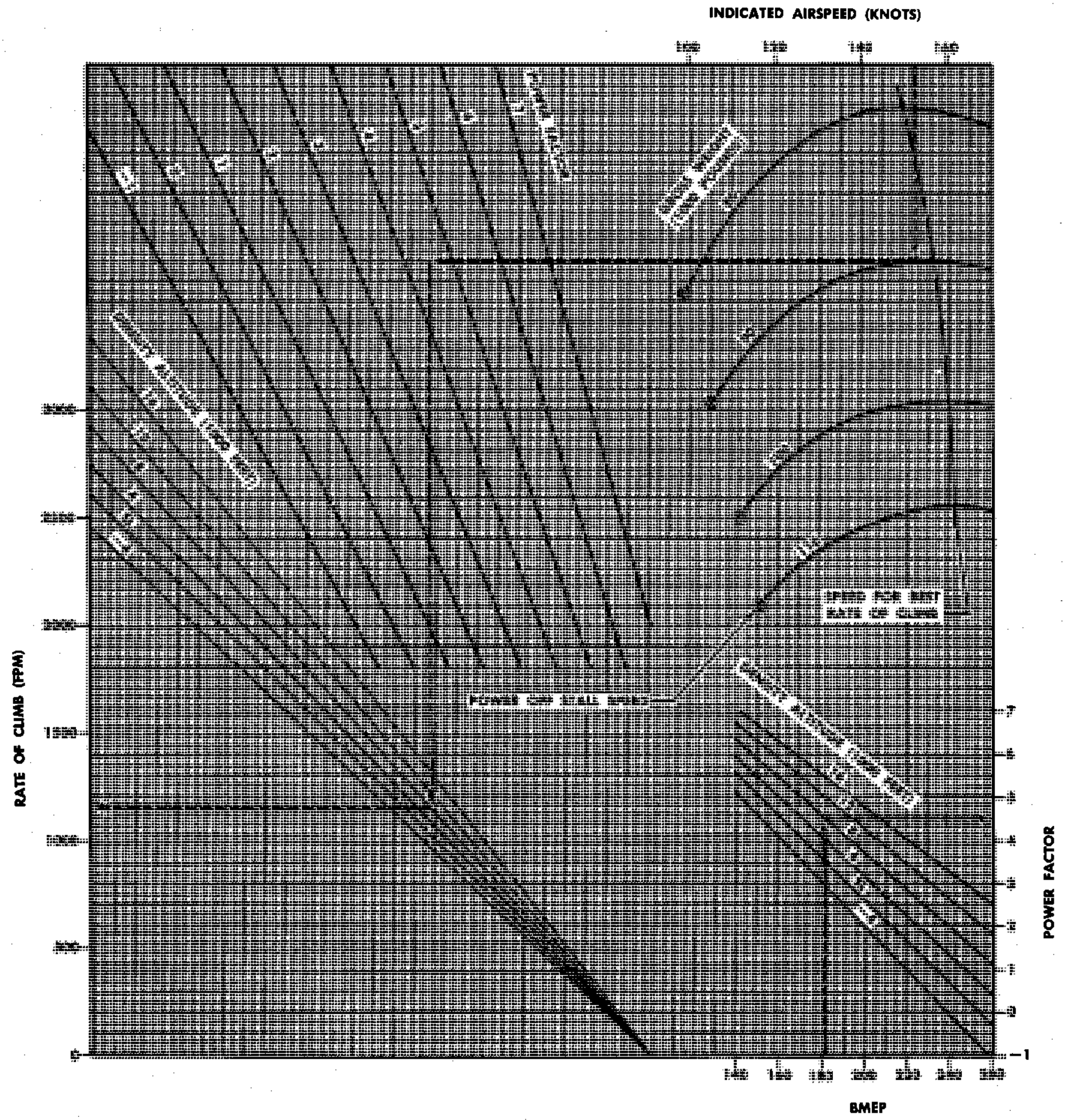
AA1-516

Figure A4-6. Four-Engine Emergency Climb — Takeoff Configuration — Flaps 20 Degrees, Gear Up

FOUR ENGINE EMERGENCY CLIMB — ENROUTE
CONFIGURATION — FLAPS UP, GEAR UP
COWL FLAP SETTING: +3 DEGREES ON ALL ENGINES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-517

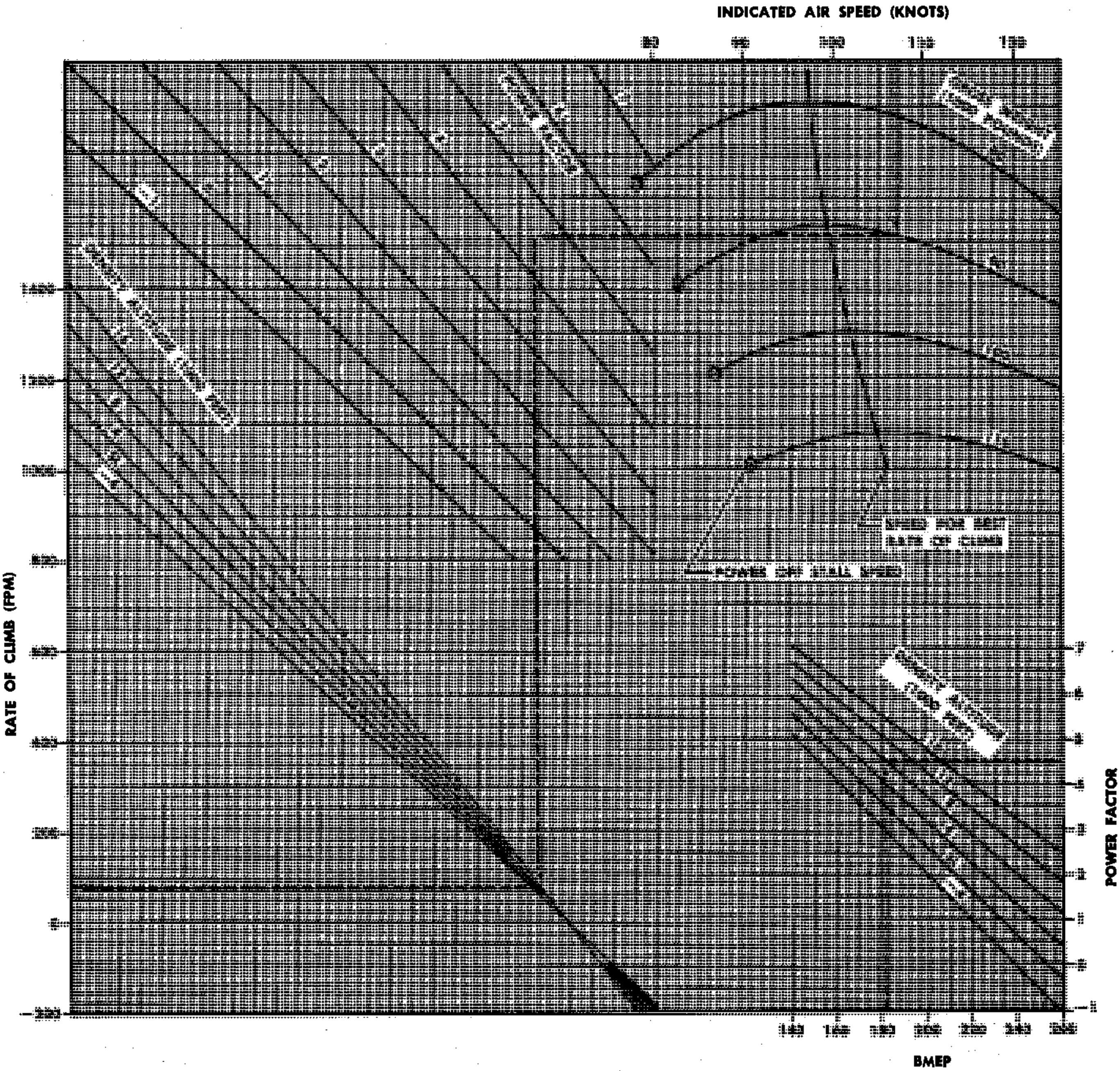
Figure A4-7. Four-Engine Emergency Climb — Enroute Configuration — Flaps Up, Gear Up

FOUR ENGINE EMERGENCY CLIMB — LANDING CONFIGURATION — FLAPS FULL DOWN, GEAR DOWN

COWL FLAP SETTING: +3 DEGREES ON ALL ENGINES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-51B

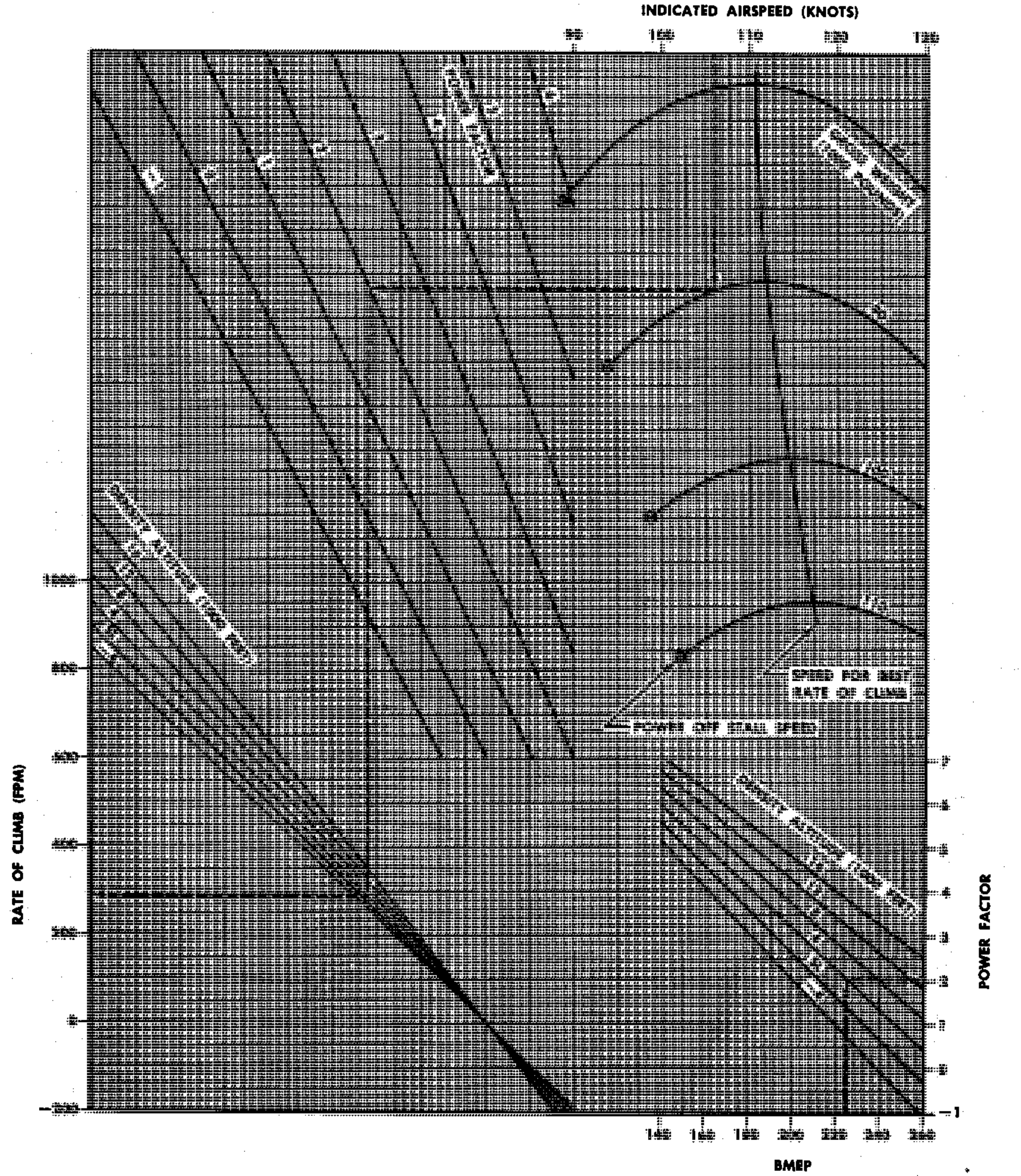
Figure A4-8. Four-Engine Emergency Climb — Landing Configuration — Flaps Full Down, Gear Down

THREE-ENGINE EMERGENCY CLIMB — TAKEOFF CONFIGURATION — FLAPS 20 DEGREES, GEAR DOWN

COWL FLAP SETTING: +3 DEGREES ON OPERATING ENGINES
−4 DEGREES ON OPERATIVE ENGINE
PROPELLER FEATHERED ON INOPERATIVE ENGINE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-223

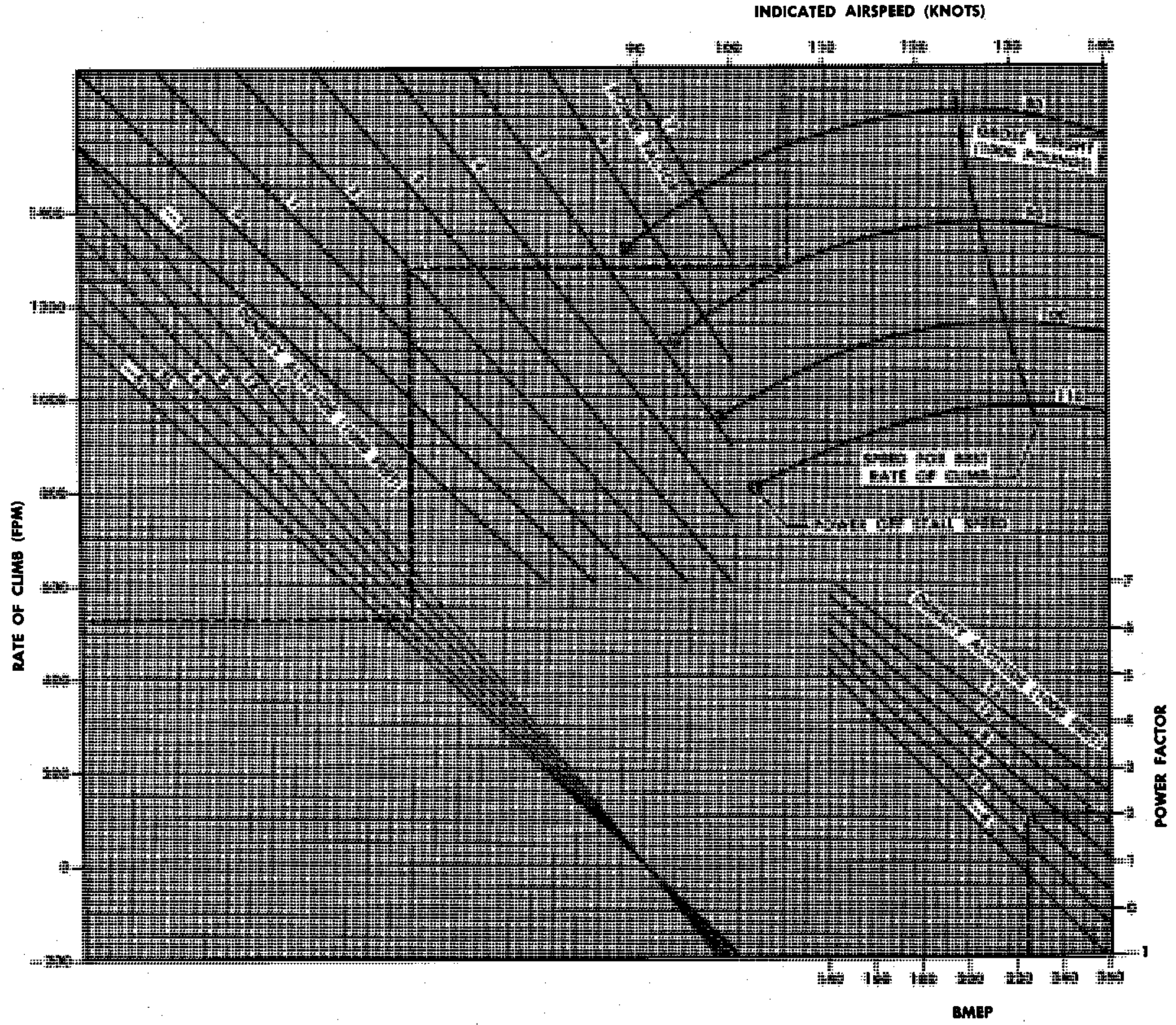
Figure A4-9. Three-Engine Emergency Climb — Takeoff Configuration — Flaps 20 Degrees, Gear Down

THREE-ENGINE EMERGENCY CLIMB — TAKEOFF CONFIGURATION — FLAPS 20 DEGREES, GEAR UP

COWL FLAP SETTING: +3 DEGREES ON OPERATING ENGINES
−4 DEGREES ON INOPERATIVE ENGINE
PROPELLER FEATHERED ON INOPERATIVE ENGINE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-519

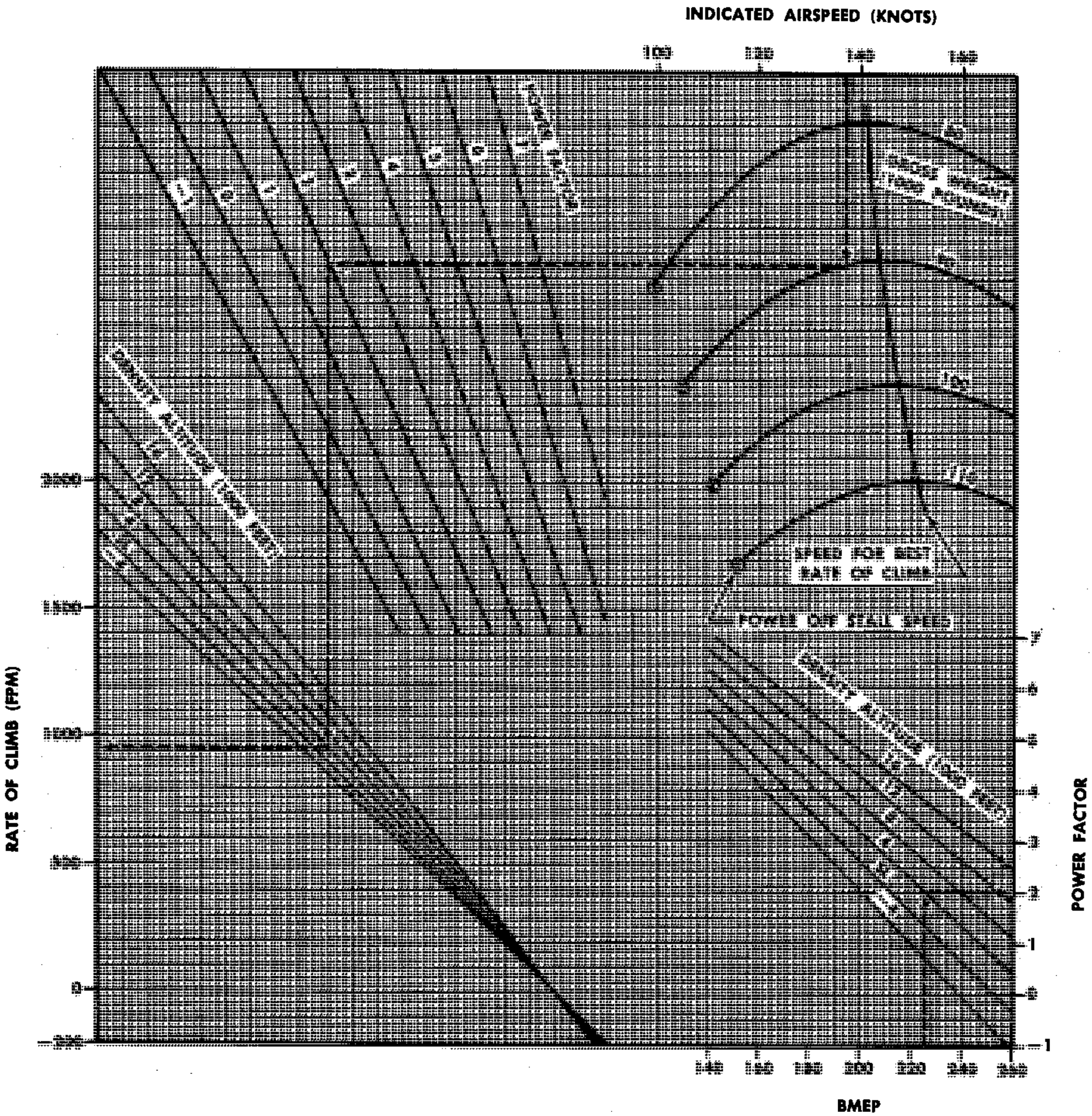
Figure A4-10. Three-Engine Emergency Climb — Takeoff Configuration — Flaps 20 Degrees, Gear Up

THREE-ENGINE EMERGENCY CLIMB — ENROUTE CONFIGURATION — FLAPS UP, GEAR UP

COWL FLAP SETTING: +3 DEGREES ON OPERATING ENGINES
−4 DEGREES ON INOPERATIVE ENGINE
PROPELLER FEATHERED ON INOPERATIVE ENGINE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-520

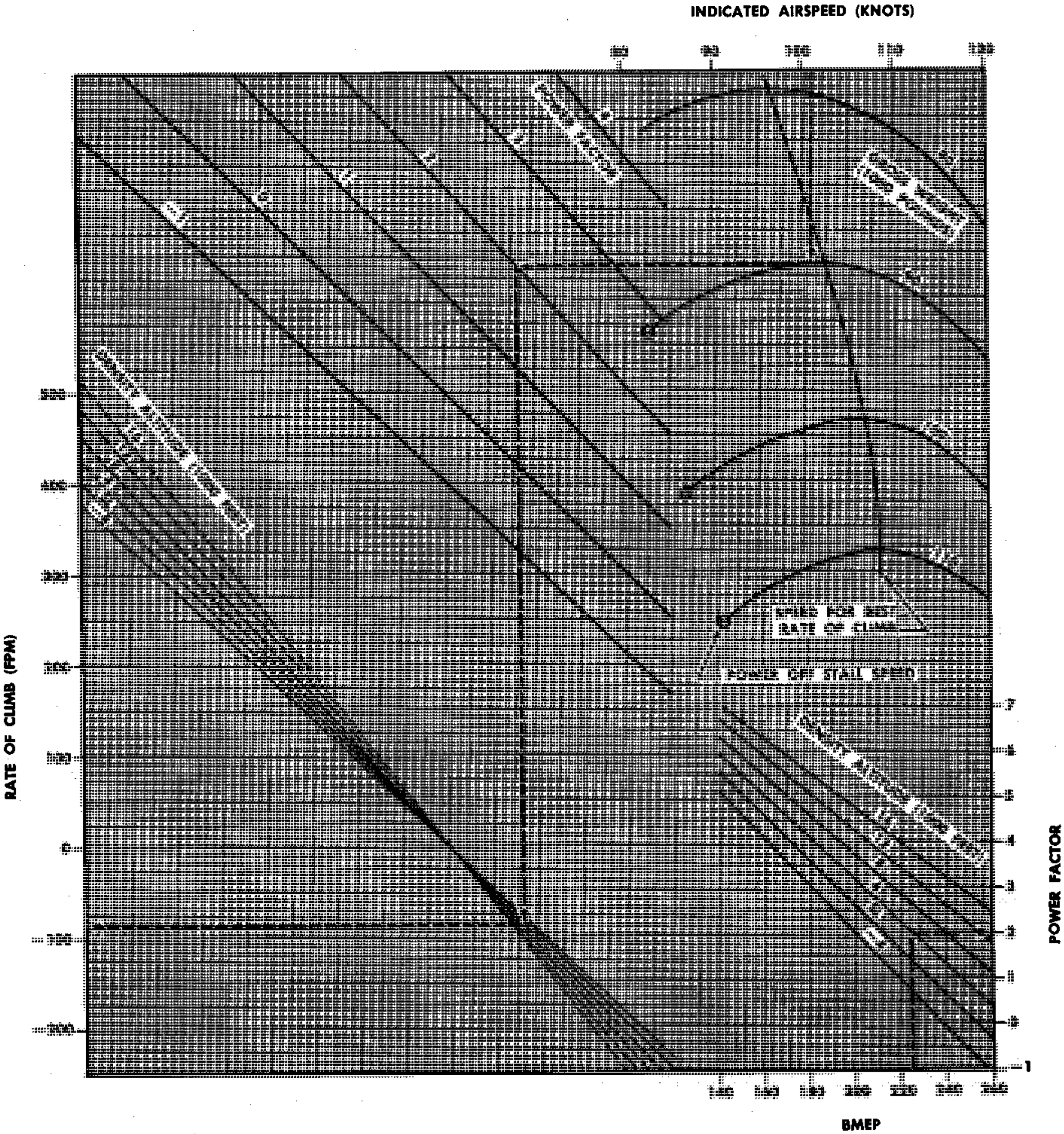
Figure A4-11. Three-Engine Emergency Climb — Enroute Configuration — Flaps Up, Gear Up

THREE-ENGINE EMERGENCY CLIMB — LANDING CONFIGURATION — FLAPS FULL DOWN, GEAR DOWN

COWL FLAP SETTING: +3 DEGREES ON OPERATING ENGINES
−4 DEGREES ON INOPERATIVE ENGINE
PROPELLER FEATHERED ON INOPERATIVE ENGINE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-521

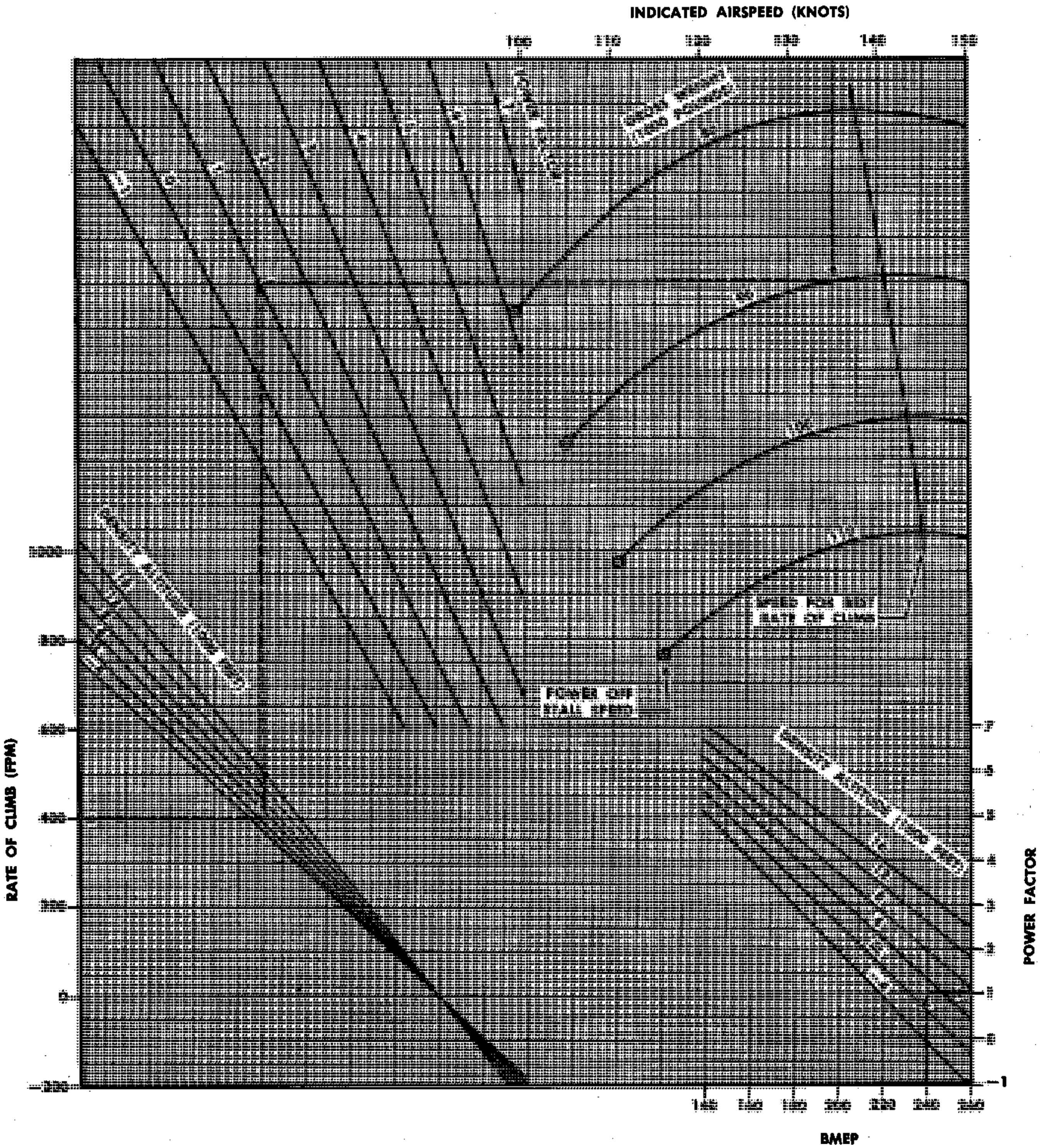
Figure A4-12. Three-Engine Emergency Climb — Landing Configuration — Flaps Full Down, Gear Down

TWO-ENGINE EMERGENCY CLIMB — ENROUTE
CONFIGURATION — FLAPS UP, GEAR UP

COWL FLAP SETTING: +3 DEGREES ON OPERATING ENGINES
−4 DEGREES ON INOPERATIVE ENGINES
PROPELLERS FEATHERED ON INOPERATIVE ENGINES

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-43

Figure A4-13. Two-Engine Emergency Climb—Enroute Configuration— Flaps Up, Gear Up

Changed 16 July 1962

PERFORMANCE CLIMBS

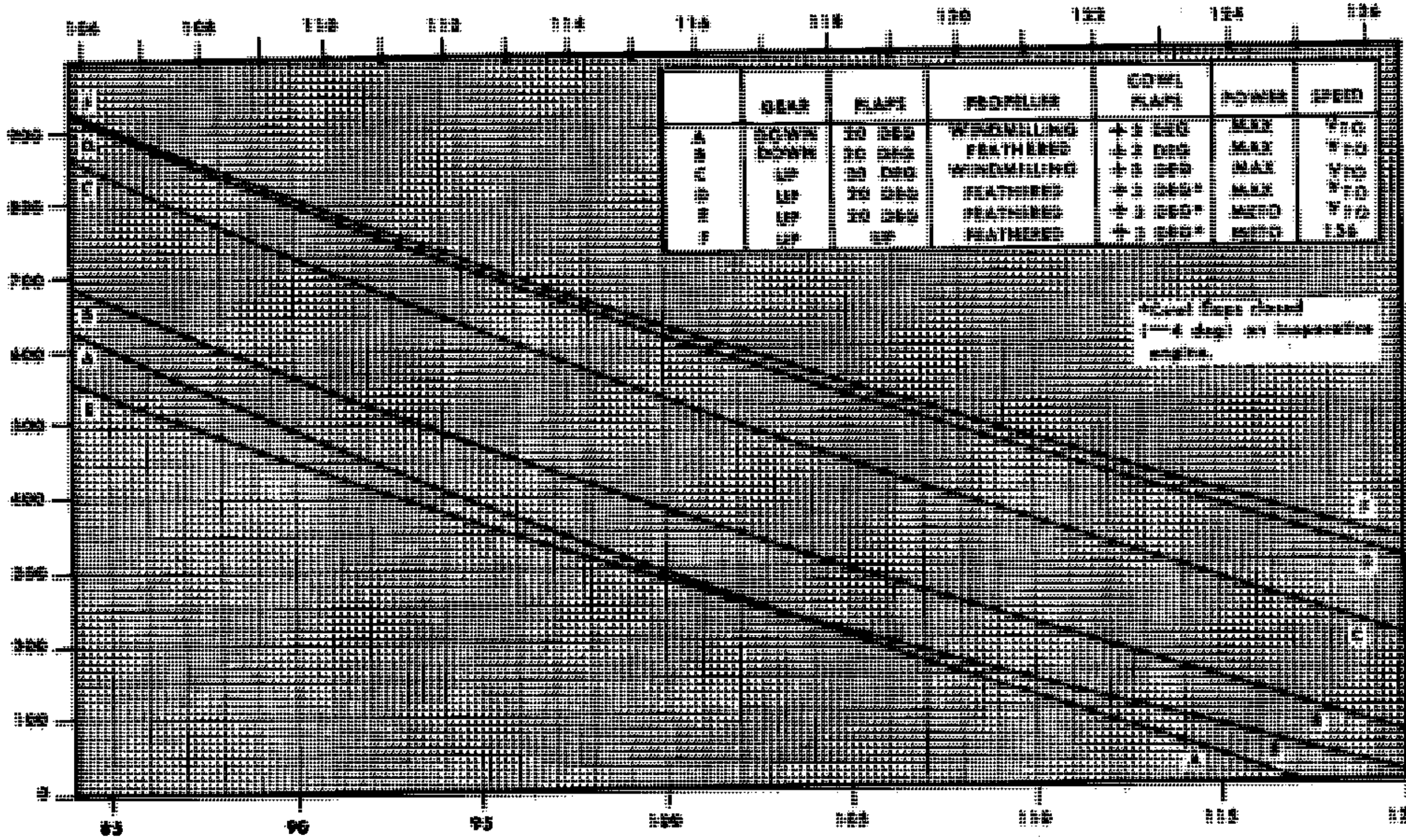
SEA LEVEL

STANDARD ATMOSPHERIC CONDITIONS

MODEL: C-118A
BASED ON: FLIGHT TEST
DATA BASIS: 6-15-62

ENGINE(S): (4) R2800-52W
WITH W/A INJECTION

TAKEOFF SPEED V_{TO} (KNOTS EAS)



	GEAR	FLAPS	PROPELLER	COWL FLAPS	POWER	SPEED
A	DOWN	30 DEG	WINDMILLING	+3 DEG	MAX	V_{TO}
B	DOWN	30 DEG	FEATHERED	+3 DEG	MAX	V_{TO}
C	UP	30 DEG	WINDMILLING	+3 DEG	MAX	V_{TO}
D	UP	30 DEG	FEATHERED	+3 DEG*	MAX	V_{TO}
E	UP	30 DEG	FEATHERED	+3 DEG*	METO	V_{TO}
F	UP	UP	FEATHERED	+3 DEG*	METO	136

*Cowl flaps closed (~4 deg) on inoperative engine.

RATE OF CLIMB (FEET PER MINUTE)

GROSS WEIGHT (1000 POUNDS)

Figure A4-14. Performance Climbs

AA1-52

POWER SETTINGS FOR CLIMB AT 1400 BHP/ENGINE
2300 RPM*
172 BMEP* (NOMINAL)
150 TO 160 KNOTS IAS
200* CHT OR LESS DESIRED

Fuel Flow per Engine	*Low Blower*	*High Blower**
Normal Auto Rich	980 (lb/hr)	1000 (lb/hr)
Minimum	900 (lb/hr)	920 (lb/hr)

Pressure Altitude	*Manifold Pressure (In. Hg) at Carburetor Air Temp. °C*							
	−30°	−20°	−10°	0°	+10°	+20°	+30°	
18,000	38	*	*	*	*			HIGH BLOWER
16,000	37½	38	39	40	40¼			HIGH BLOWER
14,000	34½	38	39	39¾	40¼			HIGH BLOWER
12,000	34¾	35½	36	36½	37½			HIGH BLOWER
10,000	35	35¾	36¼	37	37¾	38½	39	LOW BLOWER
8000	35¼	36	36½	37¼	38	38½	39	LOW BLOWER
6000	35½	36¼	36¾	37½	38	39	39½	LOW BLOWER
4000	35¾	36½	37	37¾	38½	39	40	LOW BLOWER
2000	36	36¾	37½	38	39	39½	40	LOW BLOWER
S. L.	36¼	37	38	38½	39	40	40½	LOW BLOWER

*Above full throttle altitude, increase RPM to maintain highest M.P. shown under appropriate CAT. For each 100 RPM increase, fuel flow must increase 60 lb/hr and BMEP decrease 7. Do not exceed 2500 RPM except in emergency.

Figure A4-15. Power Settings for Climb at 1400 BHP/Engine

POWER SETTINGS FOR CLIMB AT 1500 BHP/ENGINE
2400 RPM*
177 BMEP* (NOMINAL)
150-160 KNOTS IAS

Fuel Flow per Engine	*Low Blower*	*High Blower**
Normal Auto Rich	1100 (lb/hr)	1150 (lb/hr)
Minimum	1020 (lb/hr)	1070 (lb/hr)

Pressure Altitude	*Manifold Pressure (In. Hg) at Carburetor Air Temp. °C*							
	−30°	−20°	−10°	0°	+10°	+20°	+30°	
18,000	40	*	*	*	*			HIGH BLOWER
16,000	40	40¾	41½	42¼	43	*	*	
14,000	36¼	40¾	41½	42¼	43	43¾		
12,000	36½	37¼	38	38¾	43	43¾		
10,000	36¾	37½	38¼	39	39¾	40½	41	LOW BLOWER
8000	37	37¾	38½	39¼	40	40¾	41¼	
6000	37¼	38	38¾	39½	40¼	41	41½	
4000	37½	38½	39	39¾	40½	41¼	41¾	
2000	38	38¾	39¼	40	40¾	41½	42¼	
S. L.	38½	39¼	39¾	40½	41¼	42	42¾	

*Above full throttle altitude, increase RPM to maintain highest M.P. shown under appropriate CAT. For a 100 RPM increase, fuel flow must increase 60 lb/hr and BMEP must decrease 7. Do not exceed 2500 RPM except in emergency.

Figure A4-16. Power Settings for Climb at 1500 BHP/Engine

POWER SETTING FOR CLIMB AT 1600 BHP/ENGINE
2500 RPM — THREE AND TWO-ENGINE OPERATION
181 BMEP* (NOMINAL)
150-160 KNOTS IAS

Fuel Flow Per Engine	*Low Blower*	*High Blower*
Normal Auto Rich	1220	1320
Minimum	1140	1240

Pressure Altitude (Ft)	*Manifold Pressure (In. Hg.) at Carburetor Air Temp. (°C)*							
	−30°	−20°	−10°	0°	+10°	+20°	+30°	
18000	43							HIGH BLOWER
16000	43	43¾	44½	45¼	46			
14000	38½	43¾	44½	45¼	46	46¾		
12000	38¾	39½	40¼	41	46	46¾		
10000	39	39¾	40½	41¼	42	42¾	43¼	LOW BLOWER
8000	39¼	40	40¾	41½	42¼	43	43½	
6000	39½	40¼	41	41¾	42½	43¼	43¾	
4000	39¾	40¾	41¼	42	42¾	43½	44¼	
2000	40¼	41	41¾	42½	43¼	44	44¾	
S.L.	40¾	41½	42¼	43	43¾	44½	45¼	

Figure A4-17. Power Settings for Climb at 1600 BHP/Engine

POWER SETTING FOR CLIMB AT 1700 BHP/ENGINE
2500 RPM — THREE- AND TWO-ENGINE OPERATION
192 BMEP (NOMINAL)
150-160 KNOTS IAS

Fuel Flow Per Engine	*Low Blower*
Normal Auto Rich	1320
Minimum	1240

Pressure Altitude (Ft.)	*Manifold Pressure (In. Hg.) at Carburetor Air Temp. (°C)*							
	−30°	*−20°*	*−10°*	*0°*	*+10°*	*+20°*	*+30°*	
18000								*HIGH BLOWER*
16000								
14000								
12000	41¼							
10000	41½	42½	43¼	44				
8000	41¾	42¾	43½	44¼	45	45¾	46¼	*LOW BLOWER*
6000	42	43¼	43¾	44½	45¼	46	46½	
4000	42½	43½	44	44¾	45½	46¼	47	
2000	43	43¾	44½	45¼	46	46¾	47½	
S.L.	43½	44¼	45	45¾	46½	47¼	48	

Figure A4-18. Power Settings for Climb at 1700 BHP/Engine

part 5 cruise

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION.

The information provided in this part is for cruising in level flight. The charts are based on standard atmospheric conditions. However, they are applicable to non-standard conditions at the same density altitude if allowance is made for the change in cowl flap setting required to maintain proper engine cooling. The cruise charts for four engines operating are based on a cowl flap setting of -2 degrees. For each degree that the cowl flaps are opened beyond -2 degrees, the aircraft will lose approximately 3 knots EAS. Or, if the power is increased to maintain a constant speed, each degree that the cowl flaps are opened beyond -2 degrees will require approximately 15 additional brake horsepower per engine at sea level. To obtain true brake horsepower at altitude, multiply the sea level brake horsepower by $1/\sqrt{\sigma}$.

MAXIMUM RANGE OPERATION.

The amount of range that may be obtained from a given amount of fuel will vary considerably, depending on the cruise technique used. Unless high speed is the primary consideration, it is generally desirable to cruise in such a manner that maximum range may be obtained from a given amount of fuel (or a minimum of fuel will be required to fly a given distance). In doing this there are two techniques that must be used. The first is to set engine powers so that a minimum fuel flow results from a given brake horsepower. The second technique is to cruise at the speed which results in the most miles per pound of fuel.

In setting up engine powers for minimum fuel flow, the first step is to use the lowest RPM allowable for a given brake horsepower. This minimum RPM may be obtained from the Power Settings for Cruise Tables (the even numbered figures from A5-28 through A5-52) or from the BHP-RPM Schedules *(figures A2-16 and A2-18)*. The power setting tables show only the even 100 RPM's, while the BHP-RPM Schedules show a continuous variation of RPM. The second step is to adjust the mixture to obtain the minimum fuel flow for a given brake horsepower. The fuel flow curves on the Estimated Fuel Consumption for Cruise Power charts *(figures A2-14 and A2-15)* indicate the fuel flows which will result in best economy mixture settings. However, it is difficult to obtain best economy mixture settings and any error on the lean side may result in unstable operation. In addition, operation at lean mixture settings is restricted to brake horsepowers of 1240 BHP or less in low blower and 1200 BHP or less in high blower. Manual lean mixture settings using a 12 BMEP drop from best power mixture, or manual rich mixture settings are used, depending on the requirements of the cruise performance charts. A description of the method used in settings cruise mixtures for both 12 BMEP drop and manual rich is included in Part 2 of this Appendix.

On the Nautical Miles per Pound of Fuel Charts *(figures A5-1 through A5-12)* the highest point on any gross weight curve shows the speed (and brake horsepower) for obtaining the maximum range per pound of fuel. Generally, however, to obtain better handling characteristics, and to obtain a substantial increase in speed for only a slight loss in miles per pound of fuel, aircraft are flown at a higher speed which still results in 99% of the maximum miles per pound of fuel. For the C-118A this speed for 99% of maximum range is very near to 110% of the speed for maximum ratio of lift to drag (110% of $V_{L/D}$). For this reason 110% of $V_{L/D}$ is also referred to as long range cruise speed. This speed varies with gross weight and is shown on the Nautical Miles per Pound of Fuel Charts *(figures A5-1 through A5-12)*, Long Range Summary Charts *(figures A5-13 through A5-15)* and the Level Flight Performance Charts *(figures A5-19 and A5-20)*.

As fuel is consumed the gross weight decreases and, hence, the power required and the speed for long range cruise both decrease also. If the power is not adjusted periodically the aircraft will increase in speed as the gross weight decreases. For this reason it is recommended that at least once an hour the gross weight be computed and the power reduced to the appropriate value.

DISCUSSION OF CHARTS.

NAUTICAL MILES PER POUND OF FUEL CHARTS.

The Nautical Miles per Pound of Fuel Charts *(figures A5-1 through A5-12)* indicate the nautical miles that can be travelled for each pound of fuel consumed and the airspeeds that can be expected for various altitudes, gross weights and brake horsepowers. Both calibrated airspeed and true airspeed can be read. Graphs are included at 1000-foot intervals for four-engine operation, and at 5000-foot intervals for three-engine and two-engine operation.

Each graph consists of a set of curves for constant gross weights intersected by a set of straight lines for constant values of brake horsepower per engine. Any given combination of gross weight and brake horsepower determines a point on the graph. From this point one projects horizontally to the left to read nautical miles per pound of fuel and vertically downward to read calibrated and true airspeeds.

In addition, two curves are shown on each graph to indicate values for long range operation. One of these curves is identified as "Recommended Long Range Cruise Speed (110% of $V_{L/D}$)" and the other as "110% of the Speed for Maximum Range."

The recommended long range cruise speed curve (110% of $V_{L/D}$) provides a type of operation which is practical for long flights. Furthermore, the recommended long range cruise speed is in the vicinity of the speed for maximum miles per pound (which would be drawn through the peaks of the gross weight curves), and has the advantage of being generally on the fast side of this speed. The result is to reduce the flight time as compared to that for maximum miles per pound at only a very slight sacrifice in range. It is therefore recommended that long range flights be conducted at "Recommended Long Range Cruise Speed (110% of $V_{L/D}$)." It may be noted that operation at 110% of $V_{L/D}$ results in maintaining a constant angle of attack throughout the flight.

The 110% of speed for Maximum Range curve provides a type of operation which is practical when operating with headwinds over 50 knots. The speeds obtained by the use of this curve result in a decreased mission time, thereby offsetting the increased fuel flow required. It must be remembered, however, that use of this curve is recommended only when operating under headwind conditions.

In this appendix, the Long Range Summary Graphs *(figures A5-13 through A5-15)* and the Range Prediction Charts *(figures A5-22 through A5-29)* are based on operation at the "Recommended Long Range Cruise Speed (110% of $V_{L/D}$)." The brake horsepower required to fly at the recommended long range cruise speed is read (by interpolation if necessary) on each chart of nautical miles per pound of fuel. Since these charts are furnished only for altitudes in 1000-foot steps, the brake horsepower for four-engine operation at intermediate altitudes can be obtained from the Power Required to Maintain 1.1 $V_{L/D}$ Chart *(figure A5-21)*.

It will be observed in the nautical miles per pound of fuel charts that both manual lean and manual rich mixture settings are used, depending upon the brake horsepower. The use of low blower or high blower is also indicated. In some charts a note should be observed requiring the use of 115/145 grade fuel when the brake horsepower exceeds specified values.

Sample Problem:

GIVEN: Cruise altitude = 20,000 feet density altitude.

Gross weight = 90,000 pounds.

Four engines operating.

FIND: Power required to cruise at long range cruise speed.

Nautical miles per pound of fuel.

1. Enter the chart *(figure A5-5)* at the intersection of 90,000 pounds and the curve labeled "Recommended Long Range Cruise Speed."
2. By interpolation, read the power required, 1075 BHP/engine, high blower, manual lean.
3. Go horizontally to the left hand scale and read the nautical miles per pound of fuel, 0.1145.
4. From the point described in step A, drop straight down to the scale at the bottom of the chart and read the calibrated airspeed, 183 knots.
5. Continue down to the next scale and read the true airspeed, 248 knots.

LONG RANGE SUMMARY CHARTS.

These charts show the nautical miles per pound of fuel, fuel flow, calibrated airspeed and engine settings for maintaining long range cruise speed with either four engines operating *(figure A5-13)*, three engines operating *(figure A5-14)*, or two engines operating *(figure A5-15)*. For this aircraft, long range cruise speed is 110% of the speed for maximum lift to drag ratio (110% of $V_{L/D}$).

These charts are based on standard atmospheric conditions. However, the calibrated airspeed and BHP/engine will remain unchanged for non-standard conditions at the same density altitude. The RPM and fuel flow will increase slightly as temperature increases, while the BMEP and nautical miles per pound of fuel will decrease slightly.

Sample Problem:

GIVEN: Engines operating = Four.

Cruise altitude = 15,000 feet.

Gross weight = 100,000 pounds.

FIND: CAS, BHP/Engine, RPM, BMEP, fuel flow for four-engine operation, and nautical miles per pound of fuel.

1. Enter the Four-Engine Long Range Summary chart *(figure A5-13)* at a gross weight of 100,000 pounds (A) and procede vertically through the chart.
2. At the intersection of the 100,000 gross weight line and the 15,000 foot altitude curves, read across to the appropriate scale at the side of the chart to find: CAS of 193 knots (B), BHP/engine of 1160 (C), RPM 2150 (D), BMEP 153 (E), fuel flow of 2250 pounds per hour (F), and nautical miles per pound of fuel of 0.108 (G).
3. Since the gross weight line intersects the altitude curve in the solid portion of the curves, operation would be in low blower with mixture set for manual lean.

MAXIMUM ENDURANCE POWER CONDITIONS CHARTS.

These charts show the calibrated airspeed, engine settings and fuel flow for maintaining maximum endurance speed with either four engines operating *(figure A5-16)*, three engines operating *(figure A5-17)* or two engines operating *(figure A5-18)*. Maximum endurance speed is slower than long range cruise speed, and is the speed which requires the minimum power to maintain level flight.

The charts are based on standard atmospheric conditions. However, the calibrated airspeed and BHP/engine will remain unchanged for non-standard conditions at the same density altitude. The RPM and fuel flow will increase slightly as temperature increases, while the BMEP will decrease slightly.

Sample Problem:

GIVEN: Engines operating = Four.

Gross weight = 100,000 pounds.

Cruise altitude = 15,000 feet.

FIND: CAS, BHP/engine, RPM, BMEP, and fuel flow for four engines.

1. Enter the Four-Engine Maximum Endurance Power Conditions chart *(figure A5-16)* at a gross weight of 100,000 pounds (A) and read vertically through the chart.
2. At the intersection of the 100,000 pound line and the 15,000 foot altitude curves read across to the appropriate scale to find: CAS of 144 knots (B), BHP/engine of 965 BHP (B), RPM of 2040 (D), BMEP of 134 (E), and Fuel flow of 1750 pounds per hour (F).
3. The gross weight curve intersects the altitudé curves in the solid portion of the curve, therefore, all operation would be in low blower with the mixture set for manual lean.

LEVEL FLIGHT PERFORMANCE CHARTS.

These charts show the power required to maintain level flight at any given airspeed and altitude with four engines operating *(figure A5-19)*, three engines operating *(figure A5-19)* and two engines operating *(figure A5-20)*. The charts are based on a clean configuration with cowl flaps set for adequate engine cooling on a standard day. They are applicable to nonstandard conditions if allowance is made for the small effect of a change in cowl flap setting on speed. On figure A5-19 chase-around lines illustrate the example.

Sample Problem:

GIVEN: Gross weight = 94,000 pounds.

Density altitude = 20,000 feet.

FIND: Power required to maintain long range cruise speed (110% of $V_{L/D}$) with four engines operating.

1. Near center of chart locate intersection of 94,000 pounds and the curve labeled "110% Speed For Maximum L/D."
2. Proceed horizontally to the left to 20,000 feet density altitude and read the power required to maintain level flight, 1140 BHP per engine.
3. On the scale directly below point A, read the equivalent airspeed, 185 knots.
4. Continue straight down to 20,000 feet density altitude and read the true airspeed, 253 knots.

POWER REQUIRED TO MAINTAIN 1.1 $V_{L/D}$ CHART.

A chart is provided *(figure A5-21)* to show the power required to maintain 110% of $V_{L/D}$ (long range cruise speed) in level flight at any given temperature, pressure altitude and gross weight. The chart is based on all engines operating. A chase-around line on the chart illustrates the example.

Sample Problem:

GIVEN: Outside air temperature = −16°C.

Pressure altitude = 15,000 feet.

Gross weight = 100,000 pounds.

FIND: Power required to maintain 1.1 $V_{L/D}$.

1. Enter air temperature scale at −16°C.
2. Proceed vertically upwards to 15,000 feet pressure altitude.
3. Turn horizontally to the right to the density altitude scale and note density altitude, 14,900 feet.
4. Enter gross weight scale at 100,000 pounds.
5. At intersection of 14,900 feet density altitude and 100,000 pounds gross weight, read the power required to maintain 1.1 $V_{L/D}$, 1160 brake horsepower per engine.

RANGE PREDICTION CHARTS.

The range prediction charts *(figures A5-22 through A5-27)* are provided to determine the amount of fuel and the time required to cruise a given distance at various gross weights and cruise altitudes. The charts are based on cruise at the recommended long range cruise speeds and are not corrected for wind. Figures A5-22 and A5-23 are based on four engines operating at density altitudes of 5,000 to 20,000 feet. Figures A5-24 and A5-25 are based on three engines operating at density altitudes of 5,000 to 15,000 feet. Figures A5-26 and A5-27 are based on two engines operating and density altitudes of sea level to 10,000 feet.

The charts may also be used to determine the range that may be obtained from a given amount of fuel. The following example illustrates the use of the chart to determine cruise fuel and cruise time for initial flight planning.

Sample Problem:

GIVEN: Final cruise weight at destination = 72,500 pounds.

Cruise altitude = 10,000 feet.

Cruise distance = 1500 nautical miles.

FIND: Fuel and time required to cruise 1500 nautical miles.

1. Enter the distance chart *(figure A5-22)* at final cruise weight of 72,500 pounds (A).
2. Read up to cruise altitude of 10,000 feet (B).
3. Read across to range scale for range at final cruise weight of 6780 nautical miles (C).
4. Subtract cruise distance of 1500 nautical miles (D) from (C) to obtain range at initial cruise weight of 5280 nautical miles (E).
5. Read across from (E) to cruise altitude of 10,000 feet (F), and down to find initial gross weight of 82,500 pounds (G).
6. Fuel required is the final cruise weight (A) subtracted from the initial cruise weight (G), or 82,500 −72,500 = 10,000 pounds of fuel required.
7. To find the time required for cruise, enter the time chart *(figure A5-23)* with the final cruise weight of 72,500 pounds (A) and read up to the cruise altitude of 10,000 feet (B).
8. Read across to the time scale to time at final cruise weight of 28.5 hours (C).
9. Enter with the initial cruise weight obtained from the distance chart of 82,500 pounds (D).
10. Read up to cruise altitude of 10,000 feet (E) and across to the time at initial cruise weight of 20.7 hours (F).
11. Cruise time is initial time (F) subtracted from the final time (C) or 28.5 − 20.7 = 7.8 hours (G).

POWER SETTINGS FOR CRUISE TABLES.

The even numbered tables *(figures A5-28 through A5-52)* show the engine settings necessary to develop a given brake horsepower for various pressure altitudes and carburetor air temperatures. Power settings shown above the heavy line on the table are for operation in high blower and those below the heavy line are for operation in low blower.

Each table is for a single brake horsepower. Tables are provided for each 50 brake horsepower from 700 to 1200 based on a 12 BMEP drop from best power mixture setting. Two additional tables are provided for 1240 BHP (maximum cruise power in low blower), one based on 12 BMEP drop, and one based on 2 BMEP drop from best power mixture. Fuel flows are lower on the 12 BMEP table than on the 2 BMEP table, however, the use of the 2 BMEP drop permits operation at higher altitudes. Facing each power setting table is a table showing the cruise speeds for that brake horsepower.

The following example illustrates the method of using the table and the different power settings that may be expected due to a difference in carburetor air temperature.

Sample Problem:

GIVEN: Desired cruise power = 950 BHP/Engine.

Cruise pressure altitude = 17,000 feet.

Carburetor air temperature = 0° C.

FIND: Power settings necessary to maintain 950 BHP.

1. Select table for 950 BHP/Engine *(figure A5-38).*
2. Enter the table at 17,000 ft. pressure altitude (A) and carburetor air temperature of 0° C (B).
3. Read across and down, disregarding the guide lines on the table, to the intersection of altitude and temperature, to find the manifold pressure for these conditions of 27.9 in. Hg (C).
4. Follow between the guide lines, reading to the right, to find RPM of 2200 in LOW blower, BMEP drop of 12 psi, fuel flow of 461 lb/hr/eng, and a nominal BMEP of 122 psi at (D).

Note

To illustrate power settings changes necessary for a change in CAT, assume a carburetor air temperature of +20° C for the same conditions.

5. Entering the table with the same altitude, but with a CAT of +20° C (E), find manifold pressure of 31.2 in. Hg (F) as in steps 2 and 3.
6. Follow between the guide lines to find RPM of 2100 in HIGH blower, BMEP drop of 12 psi, fuel flow of 476 lb/hr/eng, and nominal BMEP of 128 psi at (G).

From these examples it is noted that the guide lines are used only after manifold pressure has been determined from the altitude and CAT.

CRUISE SPEED TABLES.

The odd numbered tables *(figures A5-29 through A5-51)* show the indicated airspeed and the true airspeed resulting from any given cruise power at any given density altitude and gross weight. Each chart is for a single brake horsepower. There is a chart for each 50 brake horsepower from 700 to 1200. An additional chart for 1240 BHP (maximum cruise power in low blower) is included. Cruise speeds for 1240 BHP are the same for both 12 BMEP and 2 BMEP drop. Facing each cruise speed table is a table showing the engine settings necessary to develop that brake horsepower.

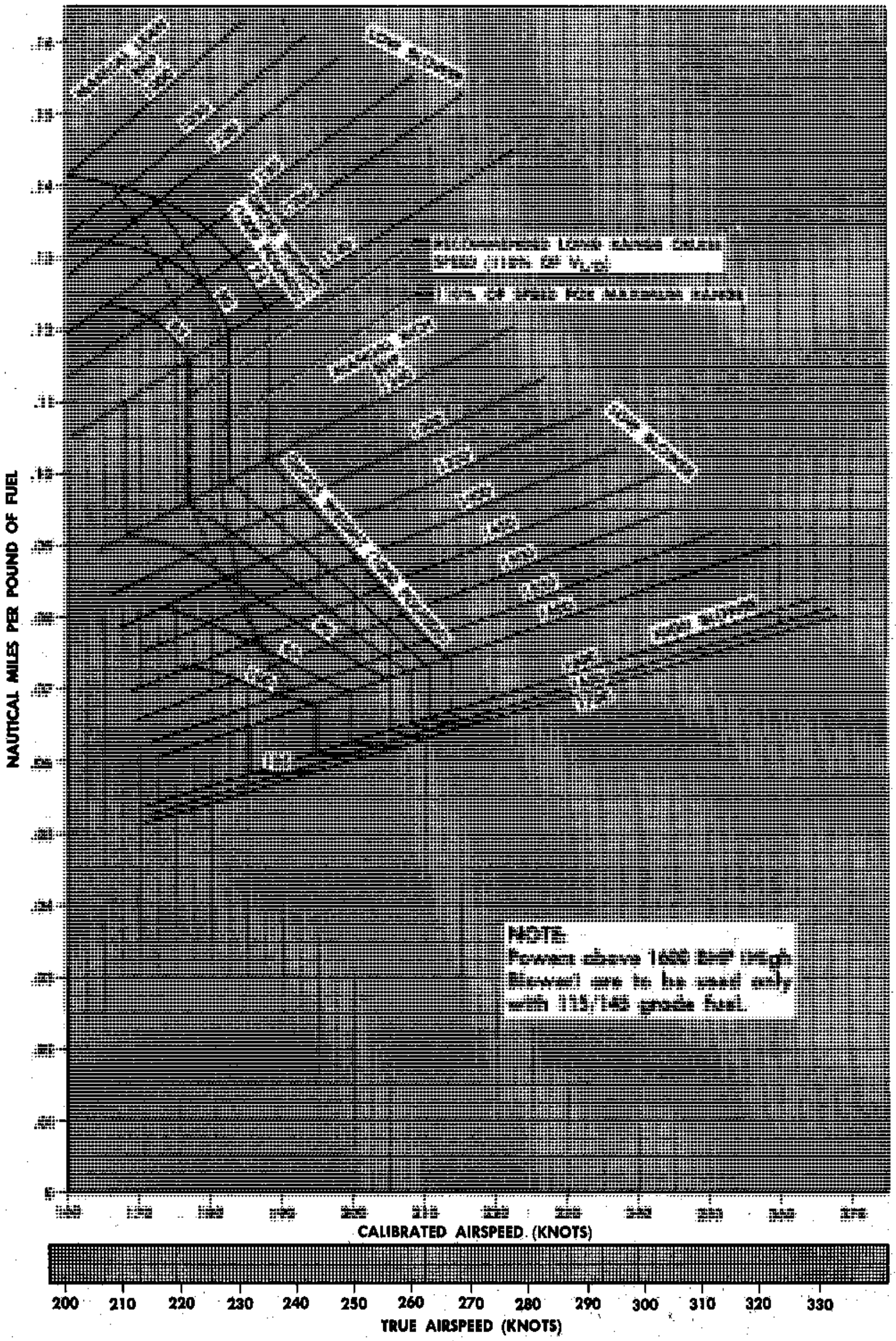
NAUTICAL MILES PER POUND OF FUEL — THREE-ENGINE

15,000 FEET — STANDARD DAY

$1/\sqrt{\sigma} = 1.2608$

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: LEAN-FLIGHT TEST
RICH-CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-68

Figure A5-9. Nautical Miles Per Pound of Fuel — Three-Engine — 15,000 Feet

NAUTICAL MILES PER POUND OF FUEL — TWO-ENGINE

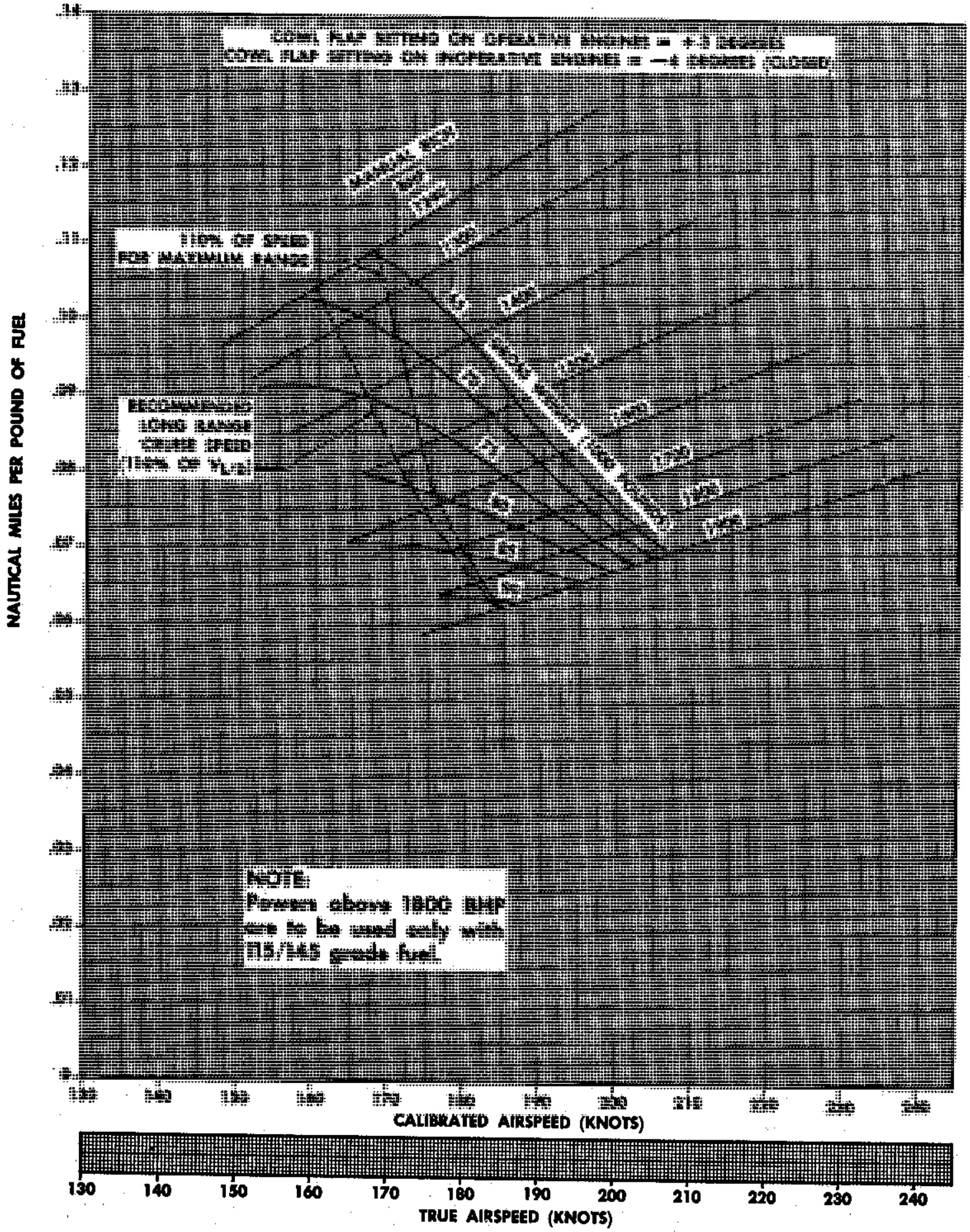
SEA LEVEL — STANDARD DAY

LOW BLOWER

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

$$\frac{1}{\sqrt{\sigma}} = 1.0000$$

ENGINES: R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-67

Figure A5-10. Nautical Miles Per Pound of Fuel — Two-Engine — Sea Level

NAUTICAL MILES PER POUND OF FUEL — TWO-ENGINE

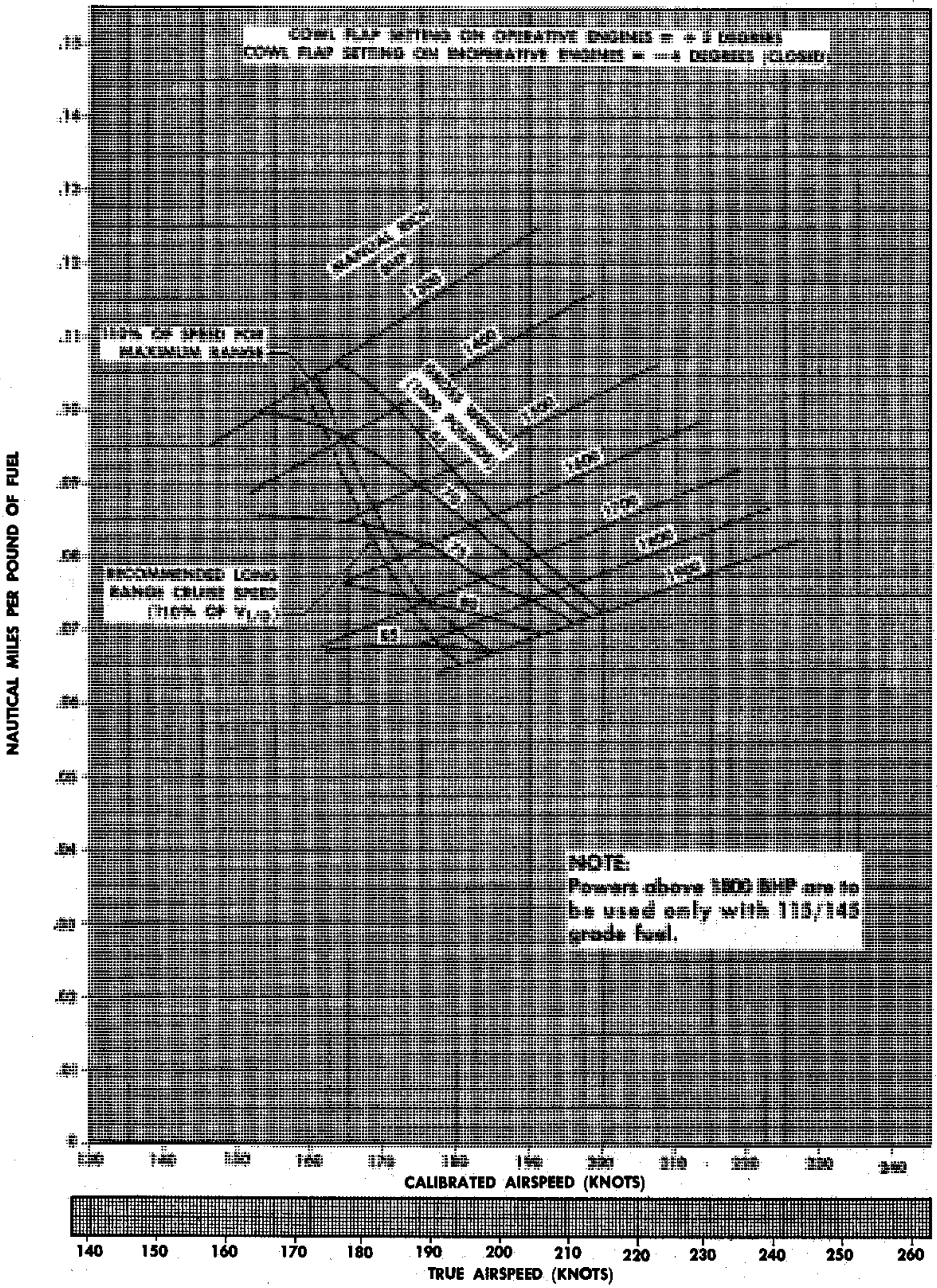
5000 FEET — STANDARD DAY

LOW BLOWER

$1/\sqrt{\sigma} = 1.0773$

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-66

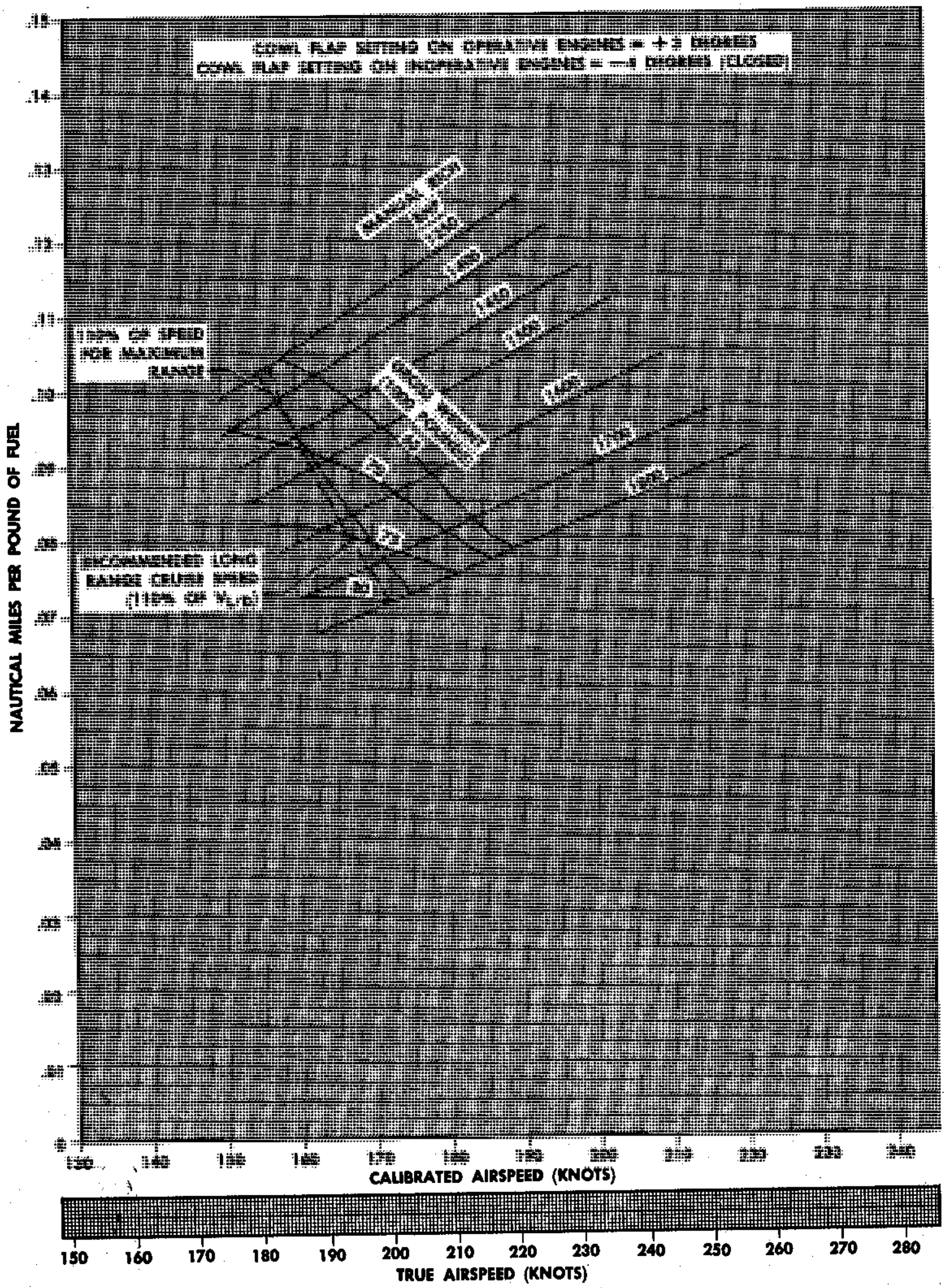
Figure A5-11. Nautical Miles Per Pound of Fuel — Two-Engine — 5000 Feet

NAUTICAL MILES PER POUND OF FUEL — TWO-ENGINE

10,000 FEET — STANDARD DAY
LOW BLOWER
$1/\sqrt{\sigma} = 1.1637$

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-65

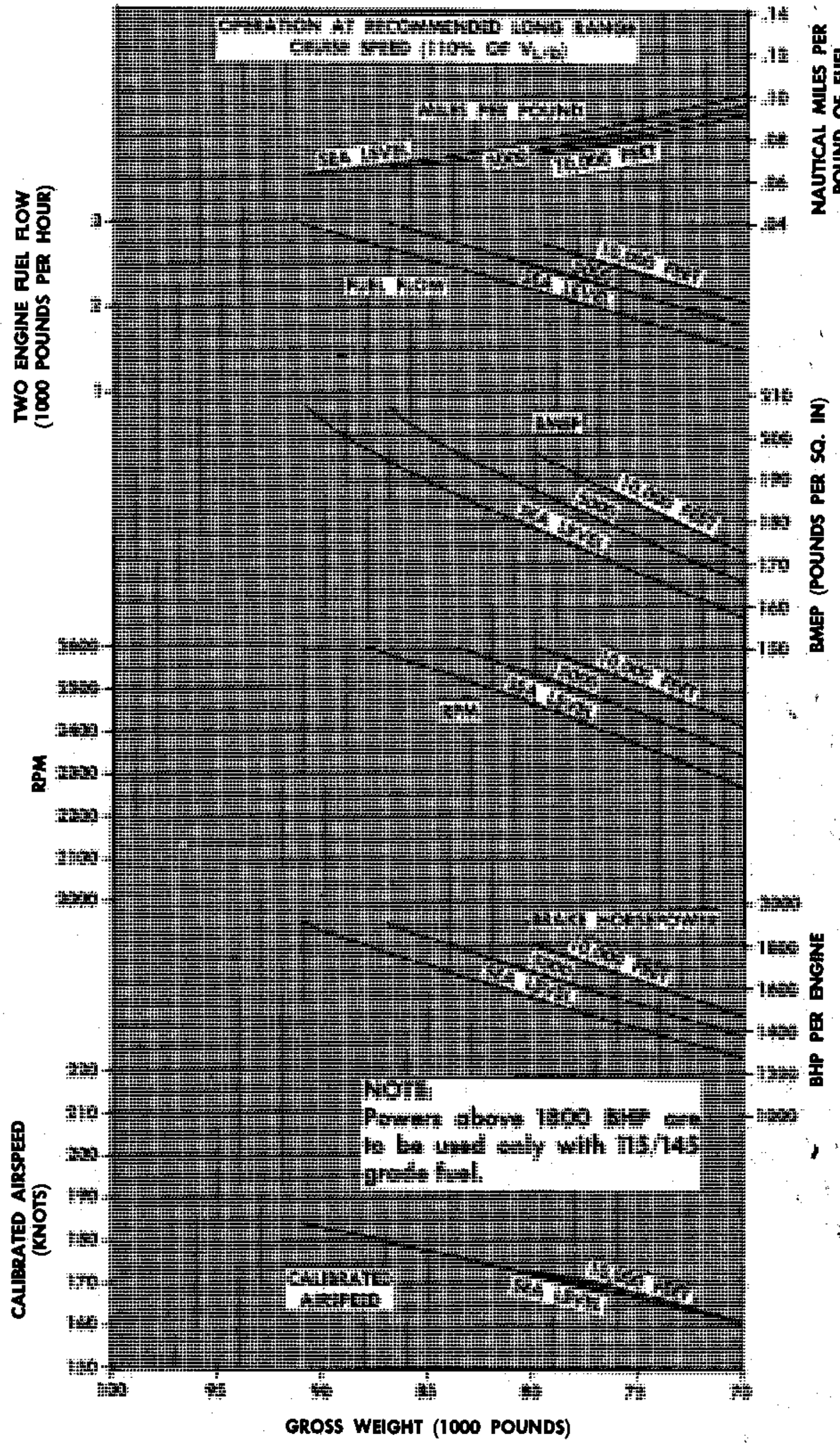
Figure A5-12. Nautical Miles Per Pound of Fuel — Two-Engine — 10,000 Feet

TWO ENGINE LONG RANGE SUMMARY

STANDARD DAY
LOW BLOWER MANUAL RICH

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-191

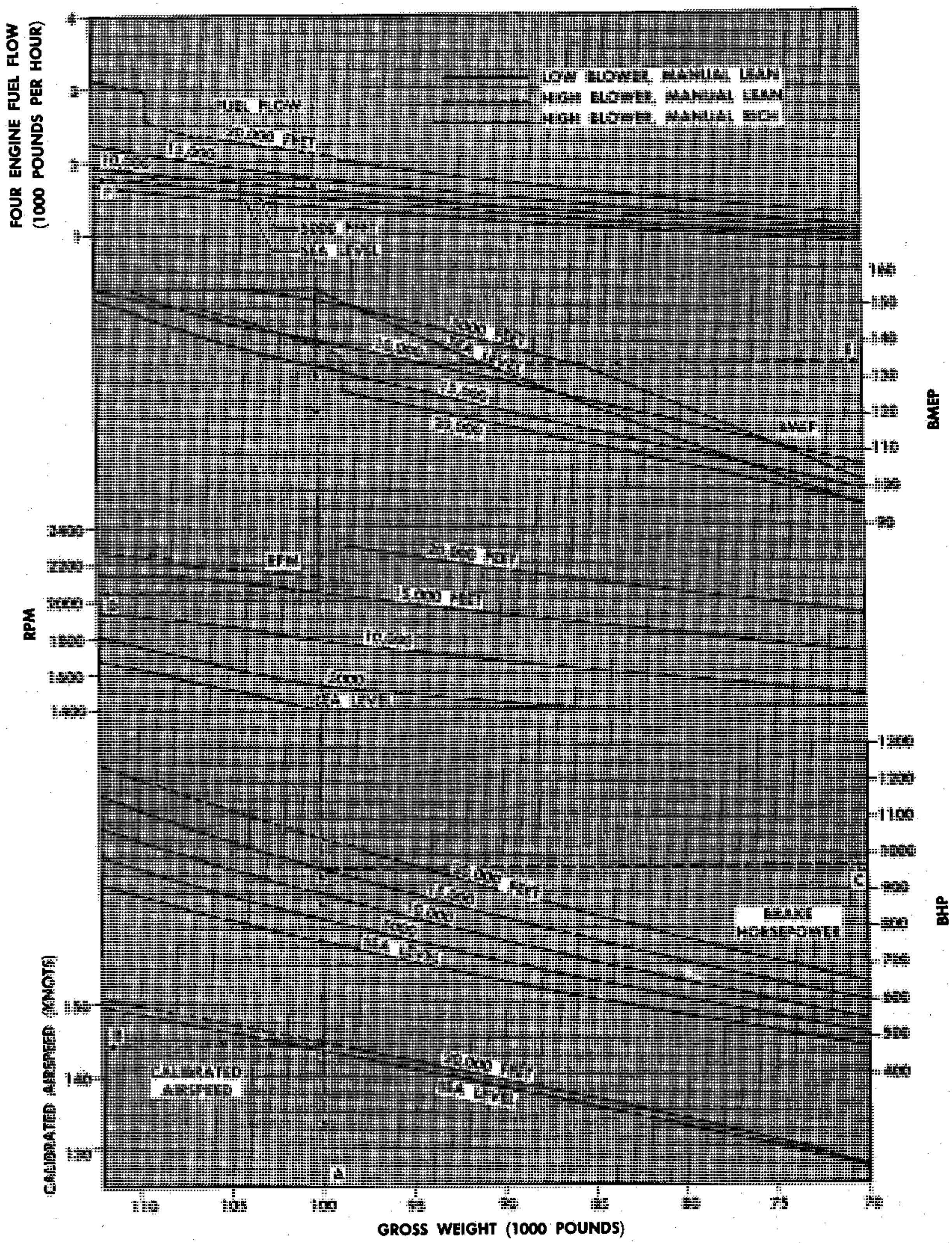
Figure A5-15. Two Engine Long Range Summary

FOUR ENGINE MAXIMUM ENDURANCE POWER CONDITIONS

STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: LEAN — FLIGHT TEST
RICH — CALCULATED DATA

ENGINE(S): R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-79

Figure A5-16. Four Engine Maximum Endurance Power Conditions

MODEL: C-118A
BASED ON: FLIGHT TEST DATA
DATA AS OF: 2-15-59

ENGINE(S): (4)R2800-52W

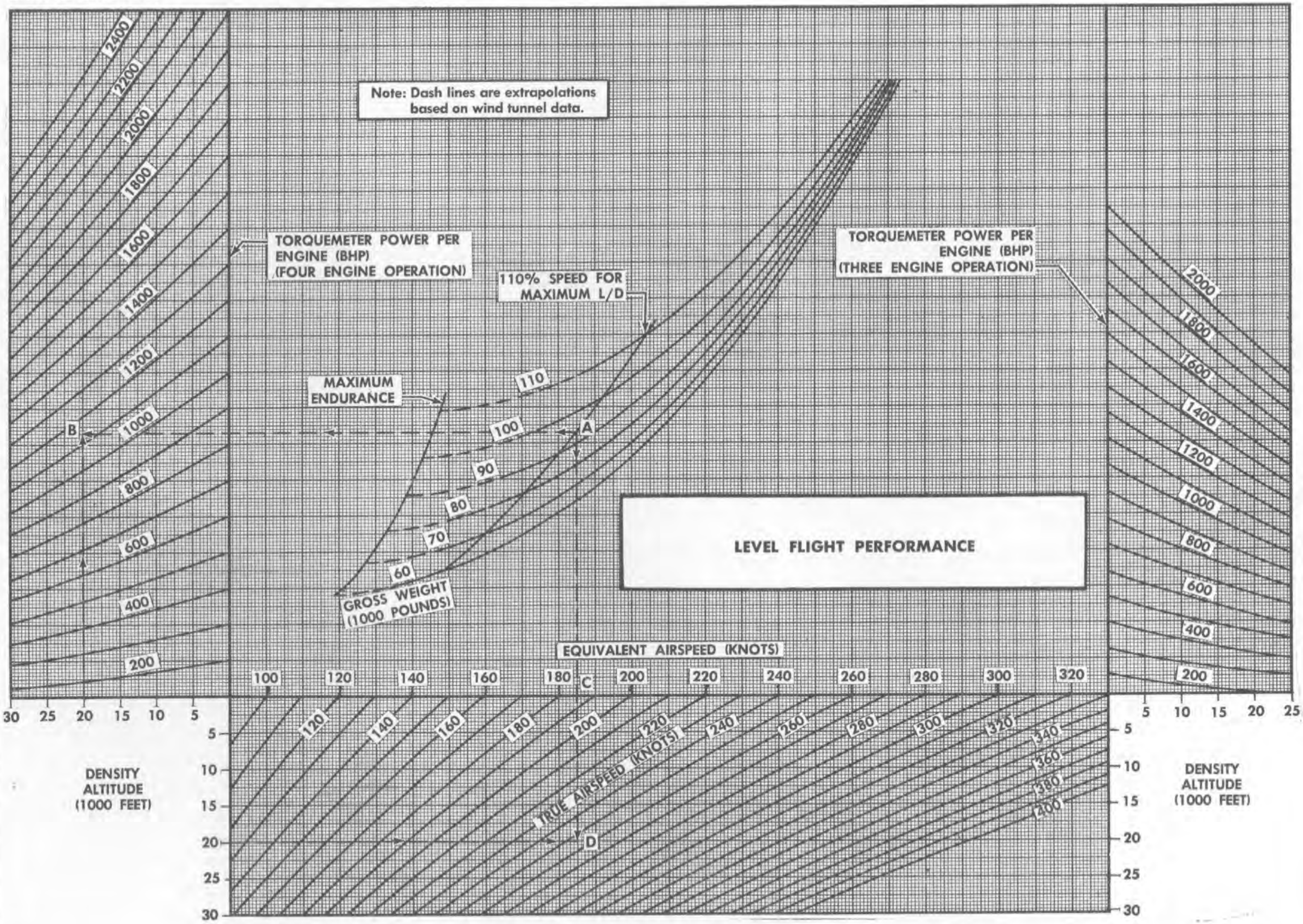


Figure A5-19. Level Flight Performance — Four-Engine and Three-Engine Operation

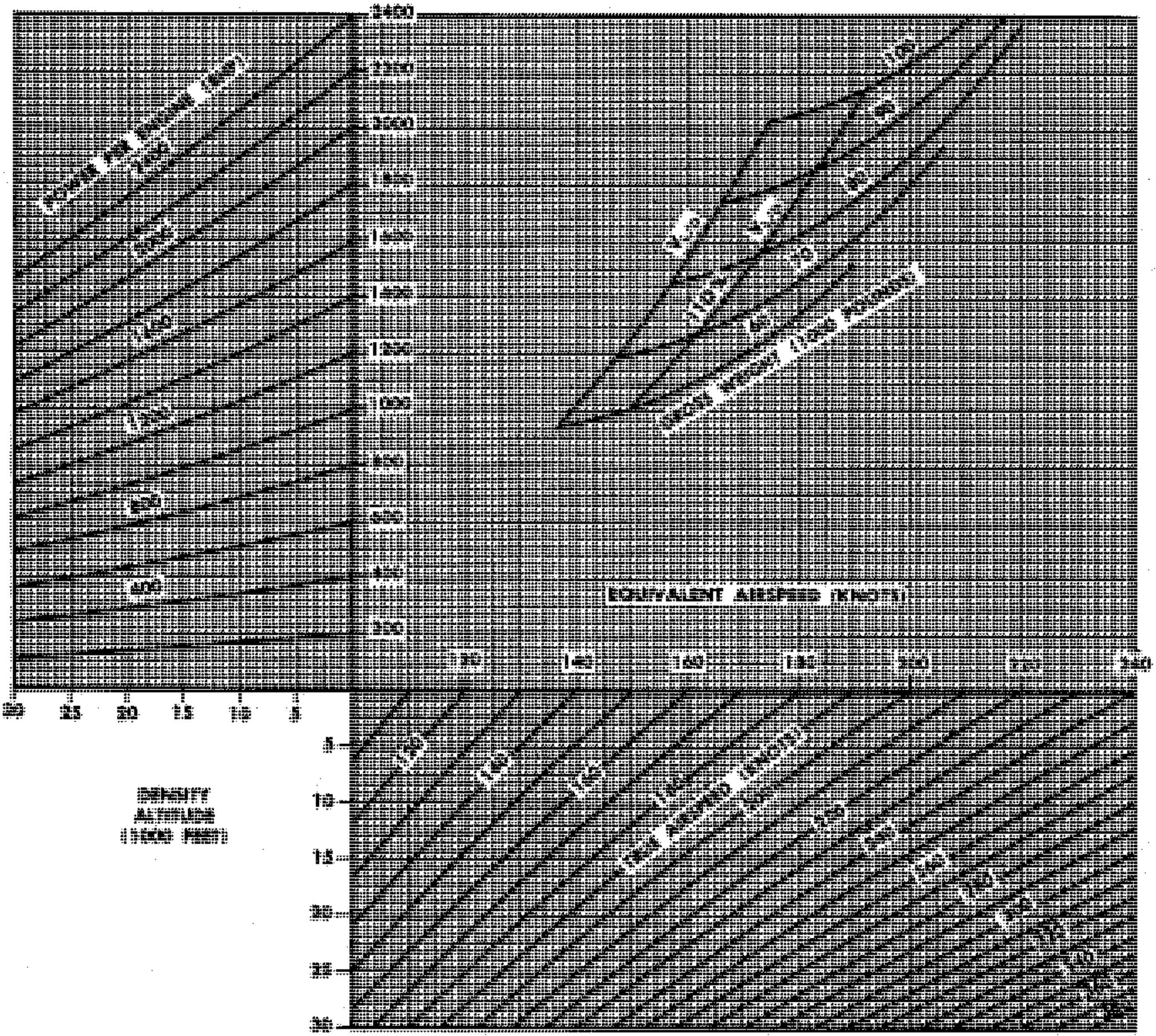
AA1-62

APPROXIMATE TWO ENGINE LEVEL FLIGHT PERFORMANCE
TWO ENGINES INOPERATIVE ON ONE SIDE

INOPERATIVE PROPELLER FEATHERED
COWL FLAPS ON OPERATING ENGINES OPEN (+ 3 DEGREES)
COWL FLAPS ON INOPERATIVE ENGINES CLOSED (− 4 DEGREES)

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: FLIGHT TEST DATA

ENGINE(S): (4) R2800-52W



Note: When using chart brake horsepower the torquemeter brake horsepower per engine should be taken as the chart brake horsepower per engine minus power required for cabin supercharging which is an average of 17.5 BHP per engine for this two engine operation.

AA1-74

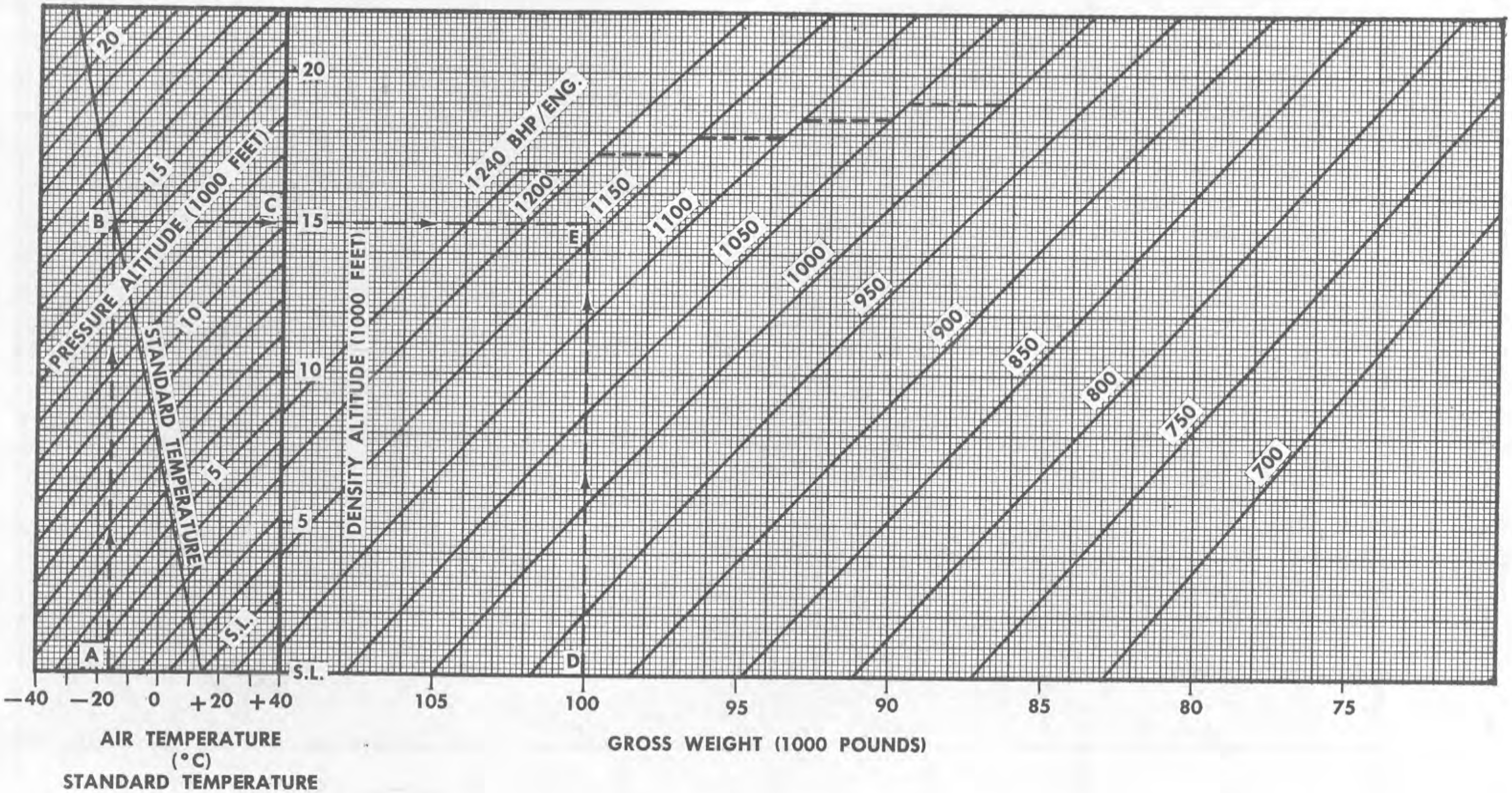
Figure A5-20. Approximate Two Engine Level Flight Performance

POWER REQUIRED TO MAINTAIN 1.1V L/D

ALL ENGINES OPERATING

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: FLIGHT TEST DATA

ENGINES: (4) R2800-52W



NOTE:
Flight at altitudes above dotted lines require the use of high blowers.

AA1-75

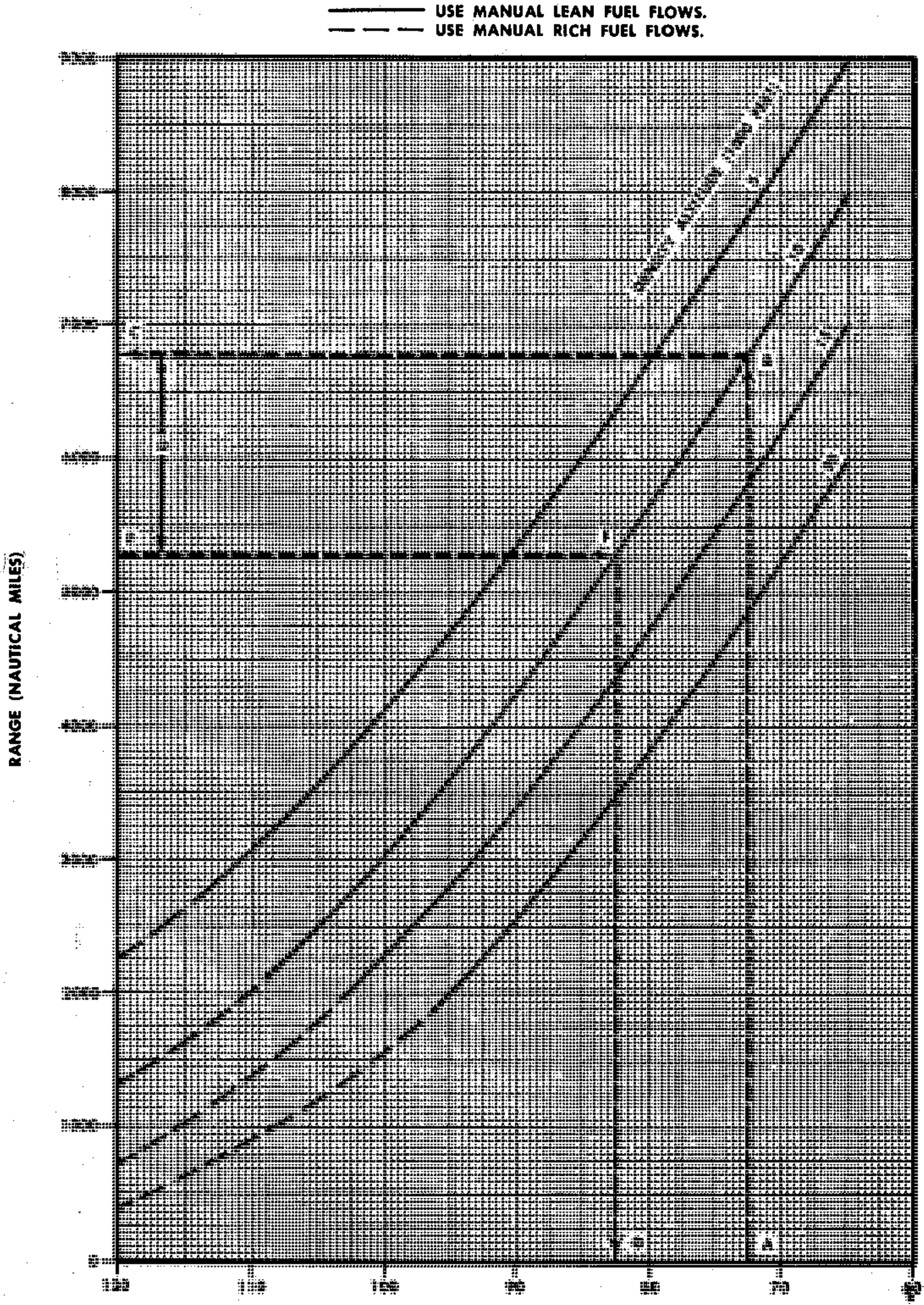
Figure A5-21. Power Required to Maintain 1.1V L/D

FOUR-ENGINE RANGE PREDICTION — DISTANCE

RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-218

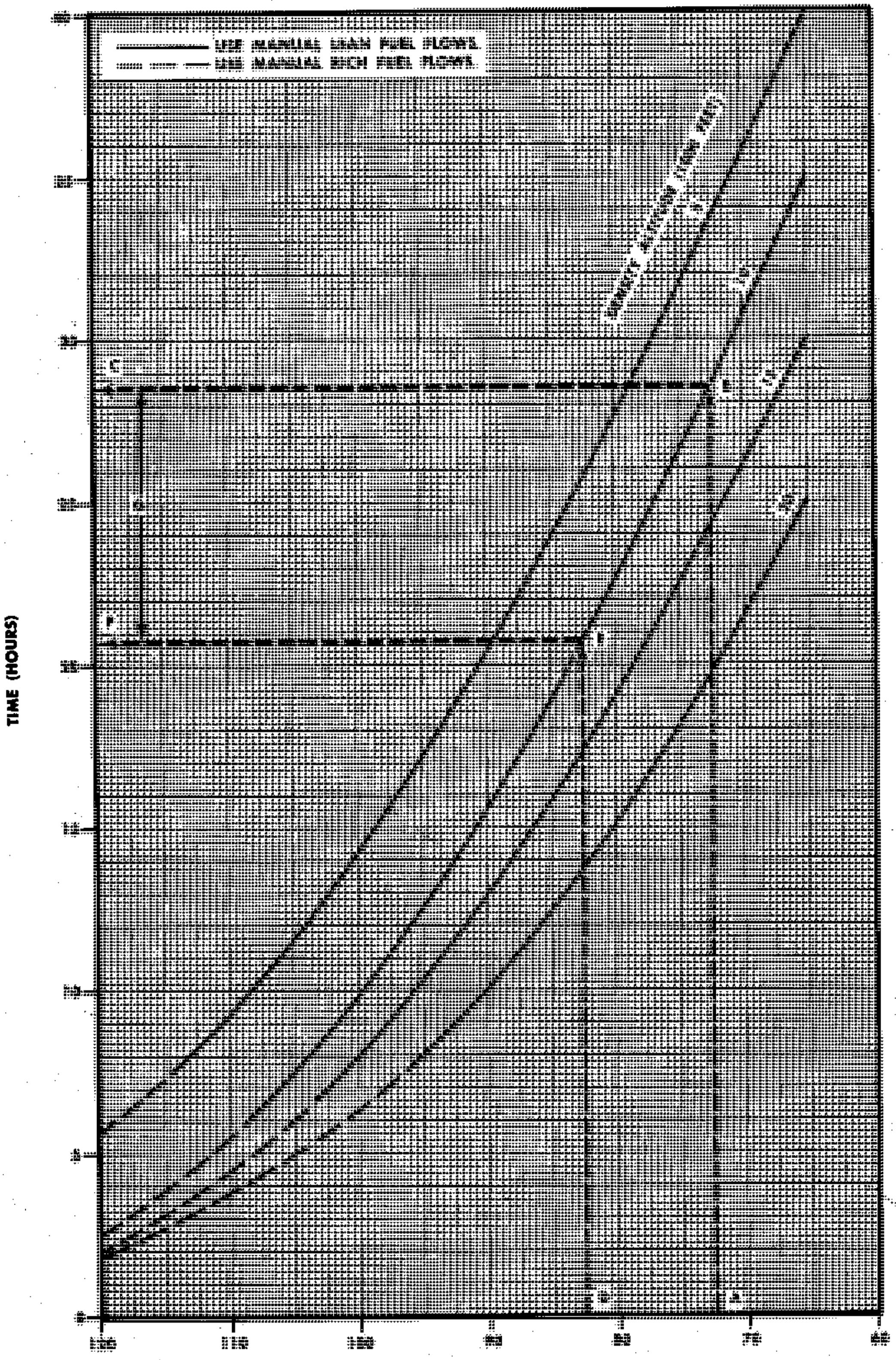
Figure A5-22. Four-Engine Range Prediction—Distance

FOUR-ENGINE RANGE PREDICTION — TIME

RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-188

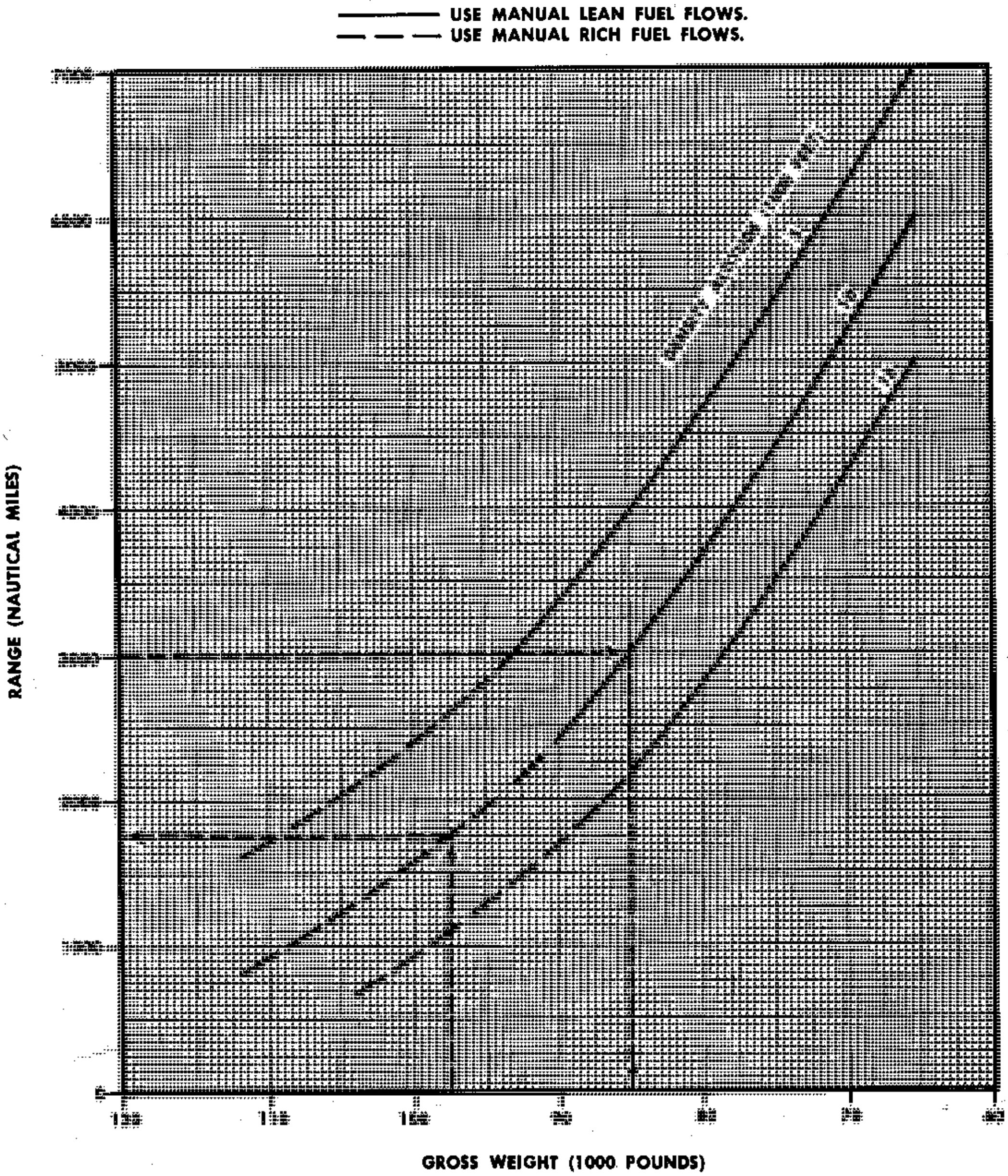
Figure A5-23. Four-Engine Range Prediction—Time

THREE-ENGINE RANGE PREDICTION — DISTANCE

RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-217

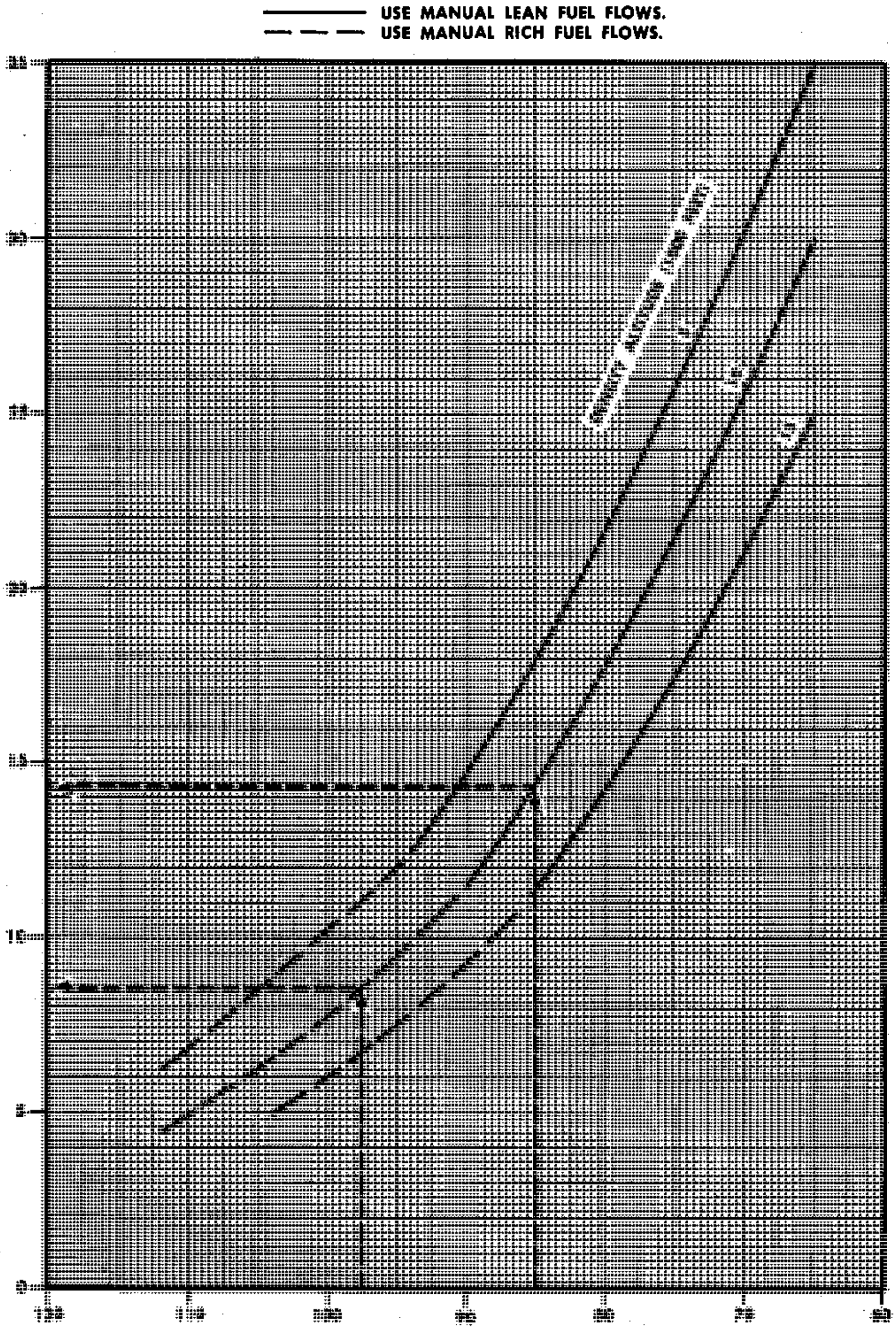
Figure A5-24. ***Three-Engine Range Prediction—Distance***

THREE-ENGINE RANGE PREDICTION — TIME

RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-76

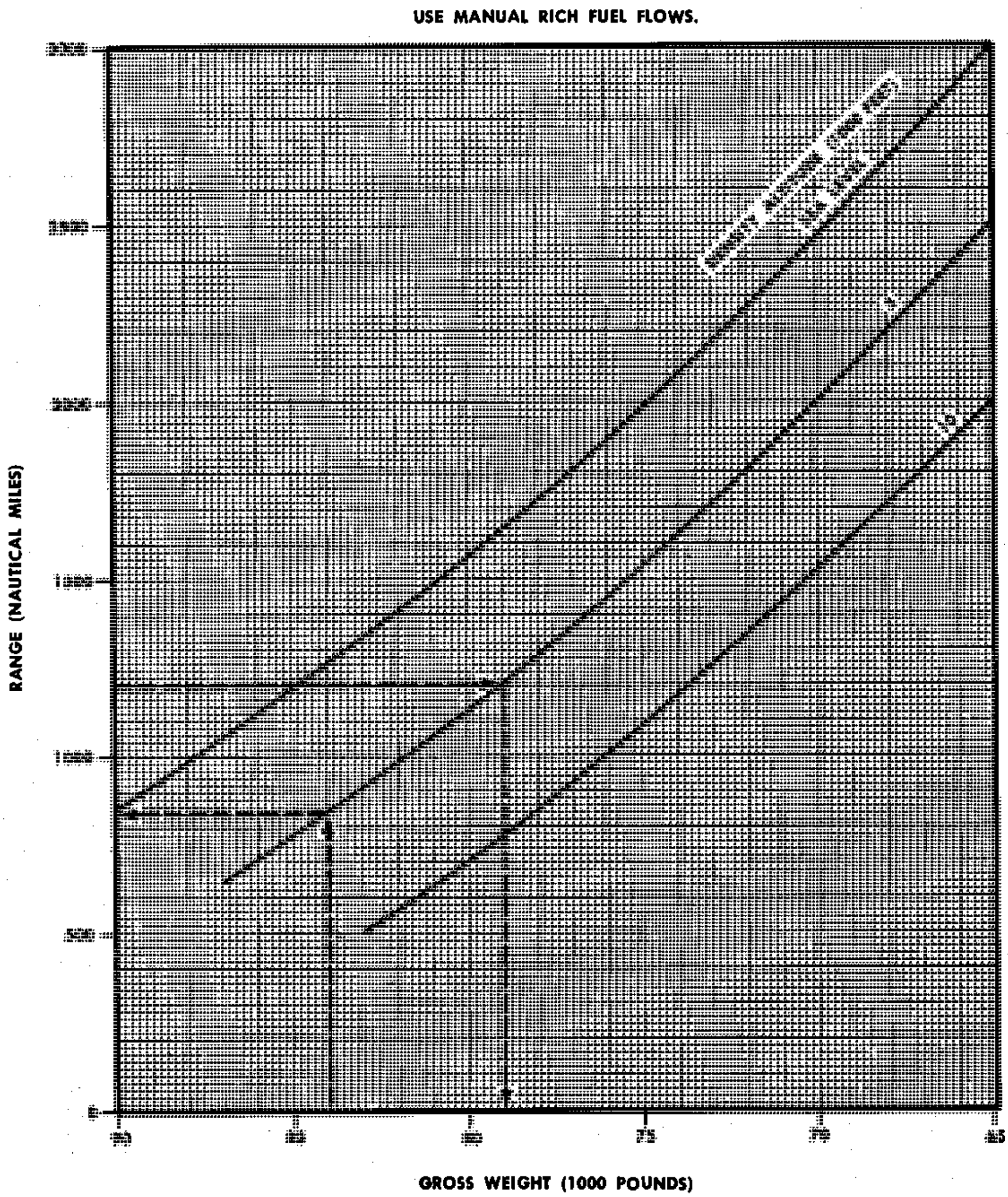
Figure A5-25. Three-Engine Range Prediction — Time

TWO-ENGINE RANGE PREDICTION — DISTANCE

RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



AA1-64

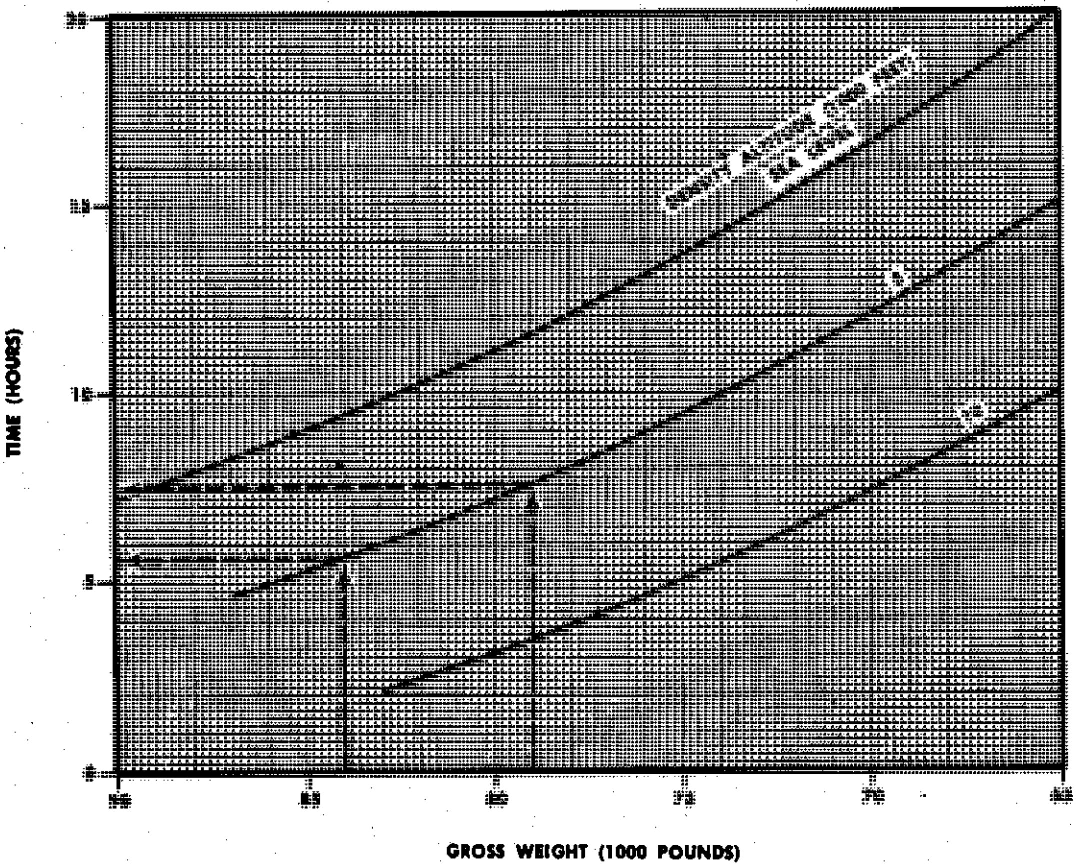
Figure A5-26. Two-Engine Range Prediction — Distance

TWO-ENGINE RANGE PREDICTION — TIME
RECOMMENDED LONG RANGE CRUISE SPEED
NO WIND

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

USE MANUAL RICH FUEL FLOWS.



AA1-63

Figure A5-27. Two-Engine Range Prediction — Time

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
700 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000	21.9	22.4	22.8	23.3	23.1	23.5	23.9	DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
24,000	22.9	23.3	22.8	23.2	23.7	23.6	24.0					
23,000	22.9	23.3	23.8	23.3	23.7	24.1	24.0		HIGH 2200	12	389	90
22,000	23.0	23.4	23.9	24.3	24.8	24.2	24.6					
21,000	23.8	24.3	24.7	24.4	24.8	25.3	24.6		HIGH 2100	12	377	94
20,000	23.9	24.4	24.8	24.5	24.9	25.4	25.8					
19,000	24.8	25.3	24.9	25.4	25.9	26.3	25.8					
18,000	24.9	25.4	26.0	25.5	26.0	26.4	25.9		HIGH 2000	12	360	99
17,000	23.2	25.5	26.1	26.5	27.0	26.5	27.0					
16,000	23.5	23.9	26.2	26.7	27.1	27.6	27.1		HIGH 1900	12	344	104
15,000	23.7	24.1	24.5	25.0	27.3	27.7	28.2					
14,000	24.6	25.0	24.7	25.1	25.6	26.0	28.3					
13,000	24.8	25.3	25.8	26.3	25.9	26.3	26.8		HIGH 1800	12	334	110
12,000	25.6	26.1	26.5	26.5	27.0	26.7	27.2	27.5				
11,000	25.8	26.3	26.9	27.4	27.2	27.7	28.2	27.8	LOW 1800	12	328	110
10,000	26.8	26.6	27.1	27.6	28.2	28.0	28.5	28.9				
9,000	27.1	27.6	27.3	27.8	28.4	28.8	28.7	29.1				
8,000	27.3	27.9	28.4	28.9	28.6	29.0	29.5	29.4	LOW 1700	12	321	117
7,000	28.4	28.9	28.7	29.3	29.8	30.3	29.7	30.1				
6,000	28.6	29.2	29.8	30.3	30.0	30.5	31.0	30.3	LOW 1600	12	314	124
5,000	29.0	29.6	30.2	30.7	31.3	30.8	31.3	31.7				
4,000	29.3	29.9	30.5	31.1	31.7	32.2	31.7	32.1	LOW 1500	12	309	132
3,000	29.7	30.3	30.9	31.5	32.1	32.7	33.3	33.7				
2,000	30.0	30.7	31.3	31.9	32.4	33.0	33.6	34.0				
1,000	30.4	31.0	31.7	32.3	32.8	33.4	34.0	34.4	LOW 1400	12	304	141

Figure A5-28. Power Settings for Cruise — 700 BHP/Engine

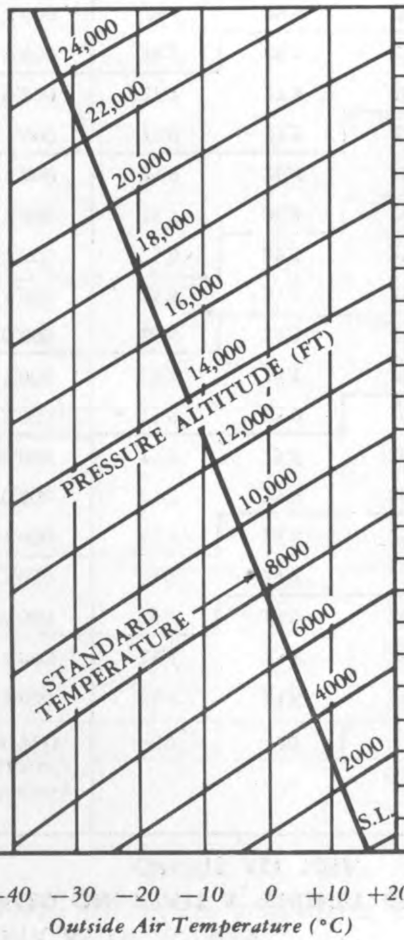
OPERATION BELOW $1.1V_{L/D}$

OPERATION BELOW $V_{L/D}$

CRUISE SPEEDS FOR 700 BHP/ENGINE MANUAL LEAN OPERATION

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Density Altitude (Ft)	110,000 Pounds		105,000 Pounds		100,000 Pounds		95,000 Pounds		90,000 Pounds		85,000 Pounds		80,000 Pounds		75,000 Pounds	
	IAS	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*
25,000																
24,000																
23,000																
22,000																
21,000																
20,000																
19,000																
18,000																
17,000																
16,000																
15,000															152	193
14,000															155	193
13,000															157	193
12,000															159	192
11,000															161	192
10,000													155	182	164	192
9000													158	182	166	191
8000													160	182	168	191
7000													162	182	170	190
6000													164	181	172	189
5000													167	181	173	189
4000											161	172	170	181	175	188
3000											164	172	171	180	177	187
2000											166	172	173	180	178	186
1000											168	172	175	180	180	185
S.L.											171	172	177	179	182	184

Airspeed in Knots for Different Gross Weights

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-500

Figure A5-29. Cruise Speeds for 700 BHP/Engine

POWER SETTINGS FOR CRUISE
750 BHP/ENGINE
MANUAL LEAN OPERATION

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

Note:
Do not operate in high blower above 30°C CAT.

R-2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	Manifold Pressure At Carburetor Air Temperature °C (In. Hg)								RPM and Blower	BMEP Drop (psi)	Fuel Flow Per Eng. (Lb./Hr.)	Nominal BMEP (psi)
	−30	−20	−10	0	+10	+20	+30	+38				
25,000	23.4	23.8	24.2	24.3	24.7	25.1		DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
24,000	23.4	23.8	24.3	24.3	24.8	25.2	25.6					
23,000	24.1	23.9	24.4	24.8	25.2	25.3	25.7					
22,000	24.2	24.7	25.1	24.9	25.3	25.7	25.8		HIGH 2200	12	410	96
21,000	24.9	24.8	25.3	25.7	25.3	25.8	26.2					
20,000	25.0	25.5	26.0	25.8	26.2	26.6	26.2		HIGH 2100	12	399	101
19,000	25.1	25.6	26.1	26.3	26.3	26.7	27.1					
18,000	23.5	23.9	26.2	26.5	27.1	27.5	27.2		HIGH 2000	12	380	106
17,000	23.7	24.1	24.6	26.7	27.1	27.6	28.1					
16,000	24.6	24.3	24.8	25.2	27.2	27.7	28.2					
15,000	24.8	25.3	25.7	25.4	25.9	27.7	28.3					
14,000	25.6	25.5	25.9	26.4	26.1	26.5	27.0		HIGH 1900	12	364	112
13,000	25.7	26.2	26.1	26.6	27.1	26.6	27.1	27.4				
12,000	25.9	26.4	26.9	27.5	27.2	27.7	28.1	27.5	LOW 1900	12	355	112
11,000	27.0	27.5	27.3	27.8	28.3	28.0	28.4	28.8				
10,000	27.2	27.8	28.3	28.0	28.5	29.0	28.5	28.9				
9,000	28.2	28.1	28.5	29.1	28.7	29.2	29.6	29.0	LOW 1800	12	347	118
8,000	28.4	28.9	29.5	29.3	29.9	30.4	29.7	30.1				
7,000	28.6	29.1	29.7	30.2	30.1	30.6	31.0	30.2	LOW 1700	12	340	125
6,000	29.8	30.3	30.0	30.5	31.1	31.7	31.1	31.5				
5,000	30.0	30.5	31.2	30.8	31.4	31.9	32.3	31.6	LOW 1600	12	333	133
4,000	30.3	30.9	31.5	32.1	31.7	32.2	32.6	33.0				
3,000	30.7	31.2	31.9	32.5	33.0	33.7	32.7	33.1	LOW 1500	12	327	141
2,000	31.0	31.6	32.3	32.9	33.4	34.0	34.4	34.8				
1,000	31.4	32.0	32.7	33.3	33.9	34.4	34.8	35.2	LOW 1400	12	322	152

Figure A5-30. Power Settings for Cruise — 750 BHP/Engine

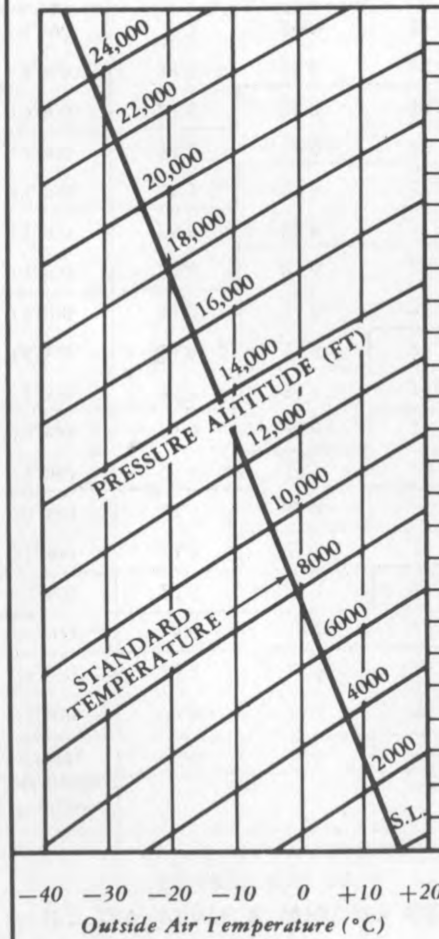
OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 750 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
25,000																
24,000																
23,000																
22,000																
21,000																
20,000																
19,000															153	207
18,000															155	207
17,000															158	207
16,000															160	206
15,000															163	206
14,000													156	195	165	205
13,000													159	195	167	205
12,000													162	195	169	204
11,000													165	195	171	203
10,000													167	195	172	202
9000											160	184	169	194	174	201
8000											163	184	171	194	176	200
7000											165	184	172	193	178	199
6000											168	184	174	193	180	198
5000											170	184	176	192	181	197
4000									163	175	172	184	178	191	183	196
3000									166	175	174	183	180	190	185	195
2000									169	175	176	183	182	189	186	194
1000									172	175	178	183	183	188	187	192
S.L.									174	175	180	182	185	187	189	191

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-522

Figure A5-31. Cruise Speeds for 750 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
800 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000	23.9	24.4	24.9	25.2	25.6	26.1	F.T.	DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.	HIGH 2300	12	442	98
24,000	23.9	24.5	24.9	25.5	25.8	26.2	26.7					
23,000	24.6	25.1	25.6	25.5	25.8	26.3	26.7					
22,000	22.6	23.1	25.7	26.2	25.9	26.3	26.8					
21,000	23.2	23.3	23.7	26.4	26.8	27.3	26.8		HIGH 2200	12	429	103
20,000	23.3	23.6	23.8	24.3	24.7	27.4	27.9					
19,000	23.9	23.7	24.1	24.6	24.9	25.3	27.9		HIGH 2100	12	415	108
18,000	24.0	24.4	24.3	24.8	25.2	25.5	26.0					
17,000	24.7	24.5	25.0	25.5	25.3	25.8	26.2	26.5	LOW 2200	12	396	103
16,000	24.8	25.3	25.2	25.6	26.1	26.0	26.5	26.9	LOW 2100	12	388	108
15,000	25.0	25.5	26.0	26.5	26.3	26.7	26.7	27.1				
14,000	26.1	25.6	26.1	26.7	27.1	26.9	27.4	27.8	LOW 2000	12	381	114
13,000	26.3	26.8	27.3	26.9	27.4	27.8	27.5	27.9				
12,000	27.2	27.0	27.5	28.0	28.6	28.0	28.5	28.9	LOW 1900	12	372	119
11,000	27.4	28.0	28.5	28.2	28.8	29.2	28.7	29.1				
10,000	28.1	28.2	28.7	29.2	29.0	29.5	30.0	30.4	LOW 1800	12	364	128
9,000	28.3	28.8	29.4	29.4	30.0	30.5	30.0	30.0				
8,000	28.7	29.2	29.8	30.3	30.2	30.7	31.2	30.8				
7,000	29.6	30.2	30.1	30.6	31.2	30.9	31.5	31.9	LOW 1700	12	358	132
6,000	29.9	30.5	31.1	31.0	31.5	32.0	32.6	32.1				
5,000	30.1	30.7	31.3	31.9	31.7	32.2	32.8	33.2				
4,000	30.4	31.0	31.6	32.2	32.8	33.4	32.9	33.3	LOW 1600	12	351	141
3,000	30.7	31.2	31.9	32.5	33.1	33.7	34.3	34.7				
2,000	31.0	31.6	32.3	32.9	33.5	34.0	34.6	35.0	LOW 1500	12	346	151
1,000	31.4	32.0	32.7	33.3	33.9	34.4	35.0	35.4				

Figure A5-32. Power Settings for Cruise — 800 BHP/Engine

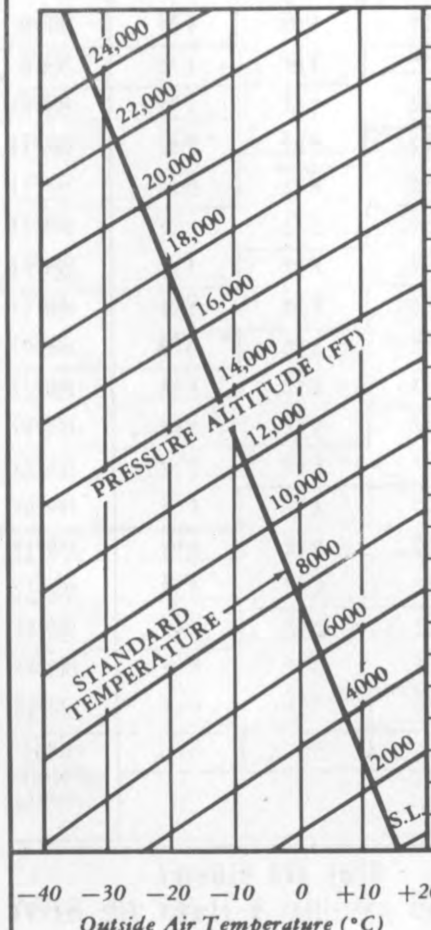
OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 800 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Density Altitude (Ft)	110,000 Pounds		105,000 Pounds		100,000 Pounds		95,000 Pounds		90,000 Pounds		85,000 Pounds		80,000 Pounds		75,000 Pounds	
	IAS	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*
25,000																
24,000																
23,000															152	220
22,000															155	220
21,000															157	220
20,000															160	220
19,000															162	219
18,000													156	208	164	219
17,000													159	208	167	219
16,000													162	208	169	218
15,000													164	208	171	217
14,000													166	207	172	216
13,000											161	197	169	207	174	215
12,000											164	197	171	207	176	214
11,000											166	197	173	206	178	213
10,000											168	196	175	205	180	211
9000											170	196	177	204	182	210
8000									165	187	173	196	178	203	183	209
7000									167	187	175	195	180	202	185	208
6000									170	187	177	195	182	201	186	206
5000									172	186	179	194	184	200	188	205
4000									175	186	181	194	186	199	189	203
3000									177	186	183	193	187	198	191	202
2000							170	177	179	185	184	192	188	196	192	200
1000							173	177	181	185	186	191	190	195	194	199
S.L.							176	177	183	185	187	190	192	194	195	198

Airspeed in Knots for Different Gross Weights

NOTES:

(1) Airspeeds based upon pilot's instrument, nose radar installed.

(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.

(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-501

Figure A5-33. Cruise Speeds for 800 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
850 BHP/ENGINE
MANUAL LEAN OPERATION

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Note:
Do not operate in high blower above 30°C CAT.

Pressure Altitude (Feet)	*Carburetor Air Temperature °C (In. Hg) Manifold Pressure At*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000	25.4	F.T.	26.3	26.9	F.T.			DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
24,000	25.5	26.0	26.5	26.9	27.4	F.T.						
23,000	25.8	26.1	26.6	27.1	27.5	27.8						
22,000	25.9	26.3	26.8	27.2	27.6	27.9	28.4					
21,000	26.0	26.4	26.9	27.5	27.7	28.0	28.4		HIGH 2300	12	365	105
20,000	24.3	26.5	27.0	27.5	28.0	28.1	28.6					
19,000	24.5	24.9	25.4	27.6	28.0	28.4	28.6		HIGH 2200	12	351	109
18,000	25.1	25.5	25.5	26.0	28.1	28.4	28.9					
17,000	25.3	25.7	26.2	26.1	26.6	28.5	29.0					
16,000	26.0	25.9	26.4	26.9	26.7	27.2	29.1					
15,000	26.1	26.6	26.5	27.0	27.4	27.4	27.9		HIGH 2100	12	437	115
14,000	27.1	26.8	27.4	27.9	27.6	28.1	28.1	28.5	LOW 2100	12	409	115
13,000	27.2	27.7	27.6	28.1	28.6	28.3	28.8	29.3				
12,000	28.0	27.9	28.4	28.2	28.7	29.2	29.0	29.5	LOW 2000	12	401	120
11,000	28.2	28.8	28.7	29.3	28.9	29.4	29.9	30.4				
10,000	28.5	29.1	29.6	29.5	30.0	30.5	30.0	30.5	LOW 1900	12	392	127
9,000	29.5	30.1	29.9	30.4	30.2	30.7	31.2	31.7				
8,000	30.3	30.3	30.9	30.6	31.2	31.7	31.4	31.9	LOW 1800	12	384	134
7,000	30.5	31.1	31.1	31.7	31.4	32.0	32.5	32.9				
6,000	30.8	31.4	32.0	31.9	32.5	32.2	32.7	33.1	LOW 1700	12	377	141
5,000	31.0	31.7	32.3	32.9	32.8	33.4	33.9	34.3				
4,000	31.2	31.8	32.5	33.1	33.7	34.3	34.0	34.4	LOW 1600	12	370	150
3,000	31.5	32.1	32.7	33.4	34.0	34.6	35.2	35.6				
2,000	31.7	32.4	33.0	33.6	34.2	34.8	35.4	35.8				
1,000	32.0	32.6	33.3	33.9	34.5	35.1	35.7	36.1	LOW 1550	12	368	155

Figure A5-34. Power Settings for Cruise — 850 BHP/Engine

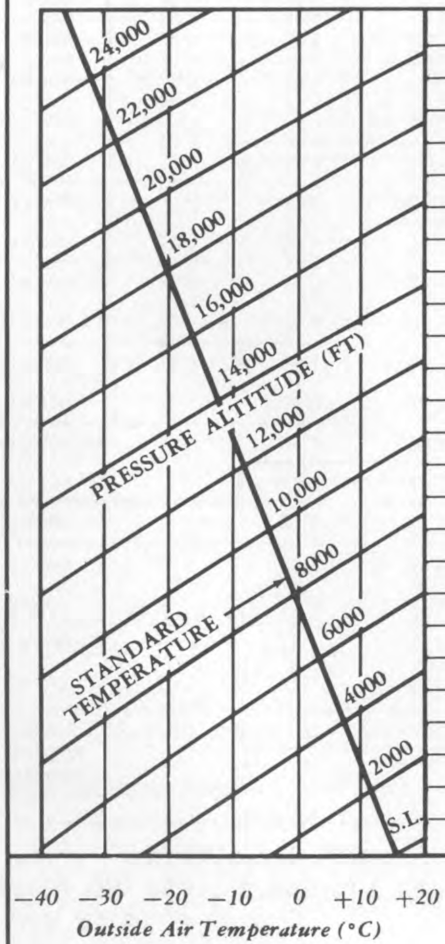
OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 850 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	*110,000 Pounds*		*105,000 Pounds*		*100,000 Pounds*		*95,000 Pounds*		*90,000 Pounds*		*85,000 Pounds*		*80,000 Pounds*		*75,000 Pounds*	
	IAS	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*	*IAS*	*TAS*
25,000															156	234
24,000															159	234
23,000															162	234
22,000													154	222	164	233
21,000													158	222	166	233
20,000													161	222	168	232
19,000													163	222	170	231
18,000													166	222	172	230
17,000											159	209	168	221	174	229
16,000											163	209	170	220	176	227
15,000											165	209	172	219	178	226
14,000											168	209	174	218	180	225
13,000											170	209	176	217	181	223
12,000									164	198	173	208	178	216	183	222
11,000									167	198	175	208	180	215	185	220
10,000									170	198	176	207	182	214	186	219
9000									172	198	178	206	184	213	188	218
8000									175	198	180	205	186	212	189	216
7000									177	197	182	204	187	210	191	214
6000							170	188	179	197	184	203	188	208	192	213
5000							173	188	181	197	186	202	190	207	194	211
4000							176	188	183	196	188	201	192	206	195	210
3000							178	188	185	195	189	200	193	204	197	208
2000							180	188	186	194	191	199	195	203	198	206
1000					175	178	183	187	188	193	193	198	197	202	200	205
S.L.					177	178	185	187	190	192	194	197	198	200	201	203

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-523

Figure A5-35. Cruise Speeds for 850 BHP/Engine

POWER SETTINGS FOR CRUISE
900 BHP/ENGINE
MANUAL LEAN OPERATION

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000	26.7	27.2	F.T.									
24,000	26.6	27.2	27.7	28.2	F.T.							
23,000	26.7	27.3	27.8	28.2	28.8	29.3	F.T.					
22,000	26.7	27.3	27.8	28.3	28.8	29.2	29.7					
21,000	27.2	27.8	27.9	28.4	28.9	29.3	29.7					
20,000	25.0	27.8	28.3	28.9	28.9	29.4	29.9	DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.	HIGH 2300	12	483	111
19,000	25.0	25.5	26.1	28.8	29.4	29.9	29.9					
18,000	25.5	26.0	26.2	26.7	27.1	30.0	30.5		HIGH 2200	12	470	116
17,000	25.6	26.1	26.7	27.2	27.2	27.7	30.6					
16,000	26.3	26.8	26.8	27.3	27.7	27.8	28.3		HIGH 2100	12	455	122
15,000	26.4	26.9	27.5	27.4	27.9	28.3	28.5	28.9				
14,000	27.3	27.8	27.6	28.2	28.7	28.5	29.0	29.0	LOW 2200	12	436	116
13,000	27.4	28.0	28.5	28.3	28.8	29.3	29.2	29.6				
12,000	28.5	28.2	28.7	29.3	28.9	29.5	30.0	29.7	LOW 2100	12	426	122
11,000	28.7	29.3	29.8	29.6	30.1	29.7	30.2	30.6				
10,000	28.9	29.5	30.0	30.6	30.2	30.7	30.3	30.7	LOW 2000	12	417	128
9,000	29.9	30.5	31.1	30.7	31.3	30.9	31.5	31.9				
8,000	30.4	31.1	31.3	31.8	31.5	32.0	31.6	32.0	LOW 1900	12	410	134
7,000	30.6	31.2	31.9	32.1	32.7	32.3	32.9	33.3				
6,000	31.0	31.6	32.2	32.9	32.9	33.5	34.1	33.5	LOW 1800	12	403	142
5,000	31.1	31.8	32.4	33.0	33.6	34.2	34.3	34.7				
4,000	31.3	31.9	32.5	33.2	33.8	34.4	35.0	35.4	LOW 1700	12	396	150
3,000	31.5	32.1	32.7	33.4	34.0	34.6	35.2	35.6				
2,000	31.7	32.4	33.0	33.7	34.2	34.8	35.4	35.8				
1,000	32.0	32.6	33.3	33.9	34.5	35.1	35.7	36.1	LOW 1650	12	392	154

Figure A5-36. Power Settings for Cruise — 900 BHP/Engine

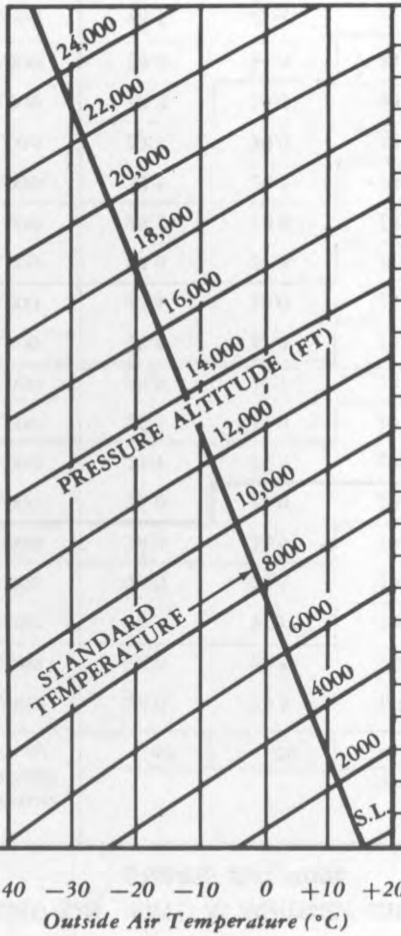
OPERATION BELOW $1.1V_{L/D}$

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

CRUISE SPEEDS FOR 900 BHP/ENGINE MANUAL LEAN OPERATION

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
25,000													155	234	164	246
24,000													158	234	166	246
23,000													161	234	169	245
22,000													164	234	171	245
21,000													167	234	173	243
20,000											160	222	169	233	175	242
19,000											163	222	172	233	177	240
18,000											166	222	173	232	179	239
17,000											169	222	175	231	181	238
16,000									162	210	171	221	177	229	183	236
15,000									165	210	173	221	179	228	185	234
14,000									168	210	176	220	181	227	187	233
13,000									171	210	178	219	184	226	188	231
12,000									173	210	180	218	186	224	190	229
11,000									175	209	182	217	187	223	191	228
10,000							169	199	178	209	185	216	189	221	193	226
9000							172	199	180	209	186	215	191	220	195	224
8000							175	199	182	208	188	214	192	218	196	222
7000							177	199	184	207	189	212	193	216	197	220
6000							180	199	186	206	191	211	195	215	198	219
5000					174	189	182	198	188	205	192	210	196	214	199	217
4000					177	189	184	198	189	203	194	209	198	212	200	215
3000					179	189	186	197	191	202	196	207	199	211	202	214
2000					182	189	188	196	193	201	197	205	200	209	203	212
1000					184	189	190	195	195	200	199	204	202	208	204	210
S.L.					186	188	192	194	197	199	200	203	203	206	206	209

Airspeed in Knots for Different Gross Weights

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-502

Figure A5-37. Cruise Speeds for 900 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
950 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0 B	+10	+20 E	+30	+38				
25,000	28.0	28.5	F.T.									
24,000	28.0	28.5	29.0	F.T.				DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
23,000	28.1	28.6	29.1	29.4	F.T.							
22,000	28.0	28.6	29.1	29.7	30.2	30.7	F.T.					
21,000	28.3	28.9	29.2	29.8	30.2	30.7	31.2					
20,000	26.0	29.0	29.5	30.1	30.3	30.8	31.2					
19,000	26.1	26.6	27.2	30.2	30.6	30.8	31.3		HIGH 2300	12	506	117
18,000	26.5	27.0	27.3	27.8	30.6	31.1	31.3					
17,000 A	26.6	27.1	27.7	27.9 C	28.3	31.2 F	31.7		HIGH 2200	12	492	122
16,000	27.3	27.8	27.9	28.4	28.5	29.0	31.8					
15,000	27.5	28.0	28.6	28.5	29.0	29.1	29.6		HIGH G 2100	12	476	128
14,000	28.0	28.6	28.7	29.3	29.3	29.7	29.7	30.1				
13,000	28.2	28.8	29.3	29.5	30.1	29.8	30.4	30.2	LOW D 2200	12	461	122
12,000	29.1	29.7	29.5	30.1	30.3	30.8	30.5	30.9				
11,000	29.3	29.9	30.4	30.2	30.8	31.0	31.6	31.0	LOW 2100	12	447	128
10,000	30.2	30.0	30.6	31.2	31.0	31.6	31.7	32.1				
9,000	30.4	31.0	30.8	31.3	32.0	31.8	32.4	32.2	LOW 2000	12	436	135
8,000	30.7	31.3	32.0	31.5	32.1	32.7	32.5	32.9	LOW 1950	12	433	138
7,000	30.9	31.5	32.2	32.7	33.3	32.9	33.5	33.9	LOW 1856	12	425	145
6,000	31.2	31.8	32.4	33.0	33.6	34.2	34.8	35.2				
5,000	31.3	31.9	32.6	33.2	33.8	34.4	35.0	35.4				
4,000	31.4	32.0	32.7	33.3	33.9	34.5	35.1	35.5				
3,000	31.6	32.2	32.9	33.5	34.1	34.7	35.3	35.7				
2,000	31.8	32.5	33.1	33.7	34.3	34.9	35.5	35.9				
1,000	32.0	32.6	33.3	33.9	34.5	35.1	35.7	36.1	LOW 1750	12	418	154

Figure A5-38. Power Settings for Cruise — 950 BHP/Engine

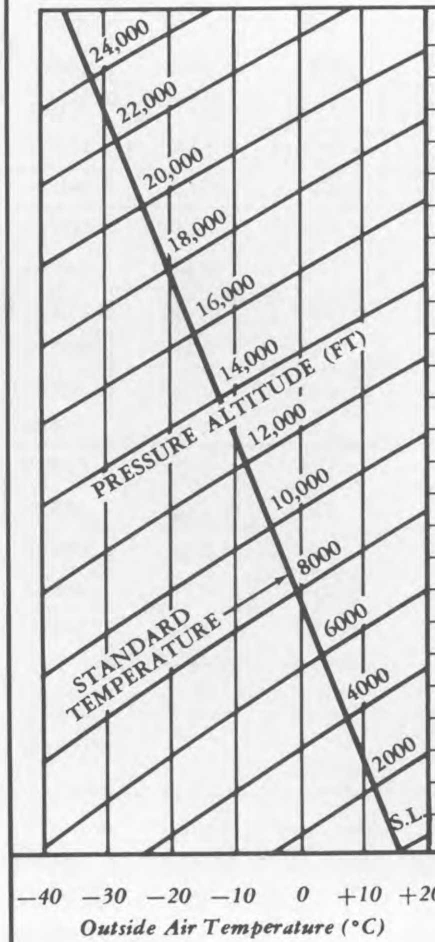
OPERATION BELOW 1.1$V_{L/D}$

CRUISE SPEEDS FOR 950 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds		105,000 Pounds		100,000 Pounds		95,000 Pounds		90,000 Pounds		85,000 Pounds		80,000 Pounds		75,000 Pounds	
	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
25,000													165	248	171	258
24,000											158	234	167	247	173	257
23,000											161	234	170	246	175	255
22,000											164	234	172	246	177	254
21,000											167	234	174	245	179	252
20,000											170	234	176	243	181	250
19,000											172	233	178	242	184	249
18,000									166	221	174	233	180	240	186	247
17,000									169	221	176	232	182	239	187	245
16,000									172	221	178	231	185	238	188	242
15,000									174	221	181	230	186	236	190	241
14,000									177	220	184	229	188	234	192	240
13,000							171	210	179	220	186	228	190	233	194	238
12,000							174	210	181	220	187	226	191	231	195	236
11,000							177	210	184	219	189	225	193	230	197	234
10,000							179	209	186	218	191	223	195	228	198	232
9000							181	209	188	217	193	222	196	226	199	230
8000					175	199	184	208	190	215	194	221	198	224	200	228
7000					178	199	185	208	191	214	195	219	199	223	201	226
6000					181	199	187	207	192	213	197	218	200	221	202	224
5000					183	198	189	206	194	212	198	216	201	220	204	222
4000					186	198	191	205	196	210	200	214	203	218	205	221
3000			178	188	188	197	193	204	198	209	201	213	204	216	207	219
2000			181	188	189	197	195	203	199	208	202	211	206	215	208	217
1000			184	188	191	196	197	202	201	207	204	210	207	213	209	215
S.L.			186	188	193	195	199	201	202	205	205	208	208	211	210	213

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-524

Figure A5-39. Cruise Speeds for 950 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
1000 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
23,000	29.1	29.7	F.T.									
22,000	29.1	29.7	30.3	30.9	F.T.							
21,000	29.2	29.7	30.3	30.9	31.4							
20,000	29.5	29.8	30.3	30.9	31.4	32.0	F.T.					
19,000	29.6	30.2	30.7	30.9	31.4	32.0	32.6					
18,000	27.0	27.5	30.8	31.3	31.5	32.0	32.6	DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.	HIGH 2300	12	526	123
17,000	27.2	27.7	28.3	31.4	31.8	32.0	32.6					
16,000	27.8	28.3	28.4	28.9	31.9	32.4	32.6		HIGH 2200	12	512	128
15,000	27.9	28.5	29.1	29.0	29.6	32.5	33.0					
14,000	28.8	29.4	29.2	29.7	29.7	30.1	33.0		HIGH 2100	12	495	135
13,000	28.9	29.5	30.1	29.8	30.4	30.2	30.8	31.2				
12,000	29.8	30.3	30.2	30.7	30.5	31.1	31.7	31.4	LOW 2200	12	481	128
11,000	30.4	30.6	31.2	30.9	31.4	31.3	31.9	32.3				
10,000	30.5	31.1	31.3	31.9	31.5	32.1	32.7	32.4	LOW 2100	12	469	135
9,000	30.7	31.3	32.0	32.1	32.6	32.2	32.8	33.2				
8,000	30.9	31.5	32.1	32.6	32.8	33.4	34.0	33.4	LOW 2200	12	456	141
7,000	31.1	31.7	32.3	32.9	33.5	34.2	34.2	34.6	LOW 1900	12	449	149
6,000	31.3	31.9	32.5	33.1	33.7	34.3	34.9	35.3				
5,000	31.4	32.1	32.7	33.3	33.9	34.5	35.1	35.5				
4,000	31.6	32.3	32.9	33.6	34.2	34.8	35.4	35.8				
3,000	31.9	32.5	33.1	33.8	34.3	35.0	35.6	36.0				
2,000	32.0	32.7	33.3	33.9	34.5	35.1	35.7	36.1				
1,000	32.3	32.9	33.6	34.2	34.8	35.4	36.0	36.4	LOW 1850	12	444	153

Figure A5-40. Power Settings for Cruise — 1000 BHP/Engine

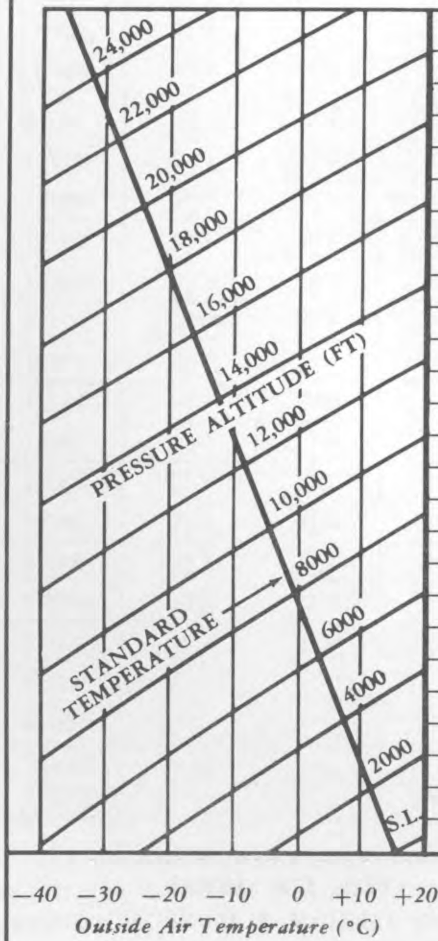
OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 1000 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
25,000																
24,000																
23,000											170	246	177	256	183	264
22,000											173	246	179	254	185	262
21,000									167	233	175	245	181	253	187	260
20,000									170	233	177	244	183	252	188	258
19,000									173	233	180	243	186	250	190	256
18,000									175	233	182	242	188	248	191	254
17,000									178	232	185	241	189	247	193	252
16,000							172	221	180	232	187	239	191	245	195	250
15,000							175	221	183	231	188	238	193	243	196	248
14,000							178	221	186	230	190	236	195	242	198	246
13,000							180	221	188	229	192	235	196	240	199	244
12,000							183	220	189	228	194	234	198	238	201	241
11,000					177	210	185	219	191	226	196	232	200	236	202	239
10,000					180	210	188	219	193	225	197	230	201	234	203	237
9000					183	210	190	218	195	223	199	229	202	233	205	235
8000					185	209	192	217	197	222	201	229	203	231	206	233
7000					187	209	193	216	198	221	202	225	204	229	207	231
6000			179	199	188	208	194	215	199	219	203	224	205	227	207	229
5000			183	199	190	207	196	214	200	218	204	222	206	225	208	227
4000			185	199	192	206	198	212	201	216	205	220	208	223	209	225
3000			188	198	194	205	200	211	203	215	206	218	209	221	211	224
2000			190	198	196	204	201	210	205	214	208	217	210	219	212	222
1000	184	188	192	197	198	203	203	209	206	212	209	215	211	217	213	220
S.L.	187	188	195	197	200	202	205	208	208	211	210	214	213	216	215	218

NOTES:

(1) Airspeeds based upon pilot's instrument, nose radar installed.

(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.

(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-503

Figure A5-41. Cruise Speeds for 1000 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
1050 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000												
24,000												
23,000	30.7	31.3	F.T.									
22,000	30.7	31.3	32.0									
21,000	30.8	31.3	32.0	32.6	F.T.							
20,000	31.2	31.4	32.0	32.6	33.2							
19,000	31.3	31.7	32.1	32.6	33.2	33.8	34.3		HIGH 2300	12	551	129
18,000	28.2	31.8	32.4	32.7	33.2	33.8	34.3					
17,000	28.3	28.9	32.5	33.0	33.3	33.8	34.3	DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
16,000	28.8	29.0	29.6	33.1	33.5	33.9	34.4		HIGH 2200	12	537	135
15,000	28.9	29.5	29.7	30.2	33.6	34.1	34.6					
14,000	29.8	29.7	30.3	30.3	30.9	31.4	34.7		HIGH 2100	12	518	141
13,000	29.9	30.5	30.5	31.0	31.0	31.5	32.1	32.5				
12,000	30.4	30.7	31.2	31.1	31.7	32.2	32.8	32.6	LOW 2200	12	507	135
11,000	30.6	31.2	31.3	32.0	32.0	32.5	33.1	33.5				
10,000	30.7	31.3	31.9	32.1	32.8	33.2	33.8	33.7	LOW 2100	12	492	141
9,000	30.8	31.5	32.1	32.7	33.3	33.8	33.9	34.3	LOW 2000	12	478	148
8,000	31.0	31.6	32.3	32.8	33.5	34.0						
7,000	31.2	31.8	32.4	33.0	33.7	34.2	34.8	35.2				
6,000	31.3	32.0	32.6	33.2	33.8	34.4	35.0	35.4				
5,000	31.5	32.1	32.8	33.4	34.0	34.6	35.2	35.6				
4,000	31.7	32.3	32.9	33.6	34.2	34.8	35.4	35.8				
3,000	31.9	32.5	33.2	33.8	34.4	35.0	35.6	36.0				
2,000	32.1	32.7	33.4	34.0	34.6	35.2	35.8	36.2				
1,000	32.3	32.9	33.6	34.2	34.8	35.4	36.0	36.4	LOW 1950	12	474	153

Figure A5-42. Power Settings for Cruise — 1050 BHP/Engine

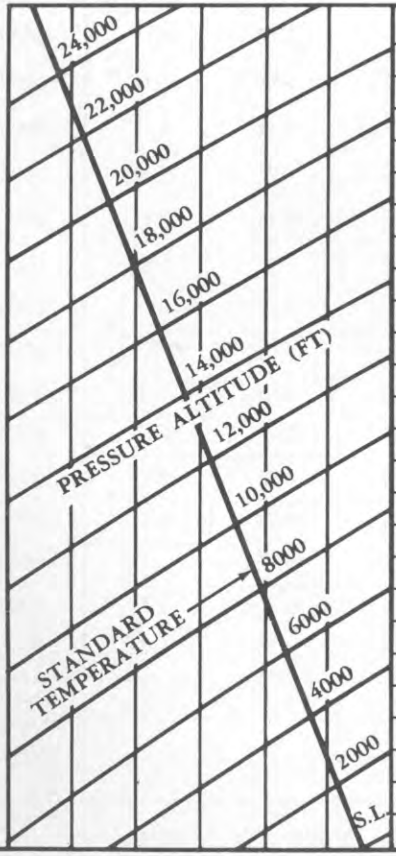
MODEL: C-118A
BASED ON: FLIGHT TEST

OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 1050 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
25,000																
24,000									167	245	175	257	181	267	185	273
23,000									170	245	177	256	183	265	187	276
22,000									173	245	179	255	185	263	189	269
21,000									175	244	182	254	187	261	190	267
20,000									178	244	184	253	188	259	192	264
19,000							172	232	180	243	186	251	190	257	194	262
18,000							175	232	182	242	187	250	191	255	195	260
17,000							178	232	184	241	189	248	193	253	197	258
16,000							180	232	186	240	191	247	195	252	198	256
15,000							183	231	188	239	193	245	197	250	200	254
14,000					177	220	185	230	190	238	195	244	199	248	201	252
13,000					180	220	187	229	192	236	197	242	200	246	202	249
12,000					182	220	189	229	194	235	198	240	202	244	204	247
11,000					185	219	192	228	196	234	200	238	203	242	206	245
10,000					187	219	194	227	198	232	202	236	204	240	207	243
9000			181	208	190	218	196	226	200	230	203	234	206	238	208	241
8000			184	208	192	218	198	224	201	228	204	232	208	236	209	239
7000			187	208	194	217	199	223	202	227	206	231	209	234	211	237
6000			189	208	195	216	200	221	203	225	207	229	210	232	212	234
5000			191	207	197	215	202	220	205	224	208	227	211	230	213	232
4000	185	198	193	207	199	214	204	219	207	222	209	225	212	228	214	230
3000	188	198	195	206	201	213	205	217	208	221	211	224	213	226	215	228
2000	190	198	197	205	203	212	207	216	209	219	212	222	215	224	216	226
1000	193	197	199	205	204	210	208	215	211	217	214	220	216	222	218	224
S.L.	195	197	201	204	206	209	210	213	212	216	215	219	217	221	219	222

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-525

Figure A5-43. Cruise Speeds for 1050 BHP/Engine

POWER SETTINGS FOR CRUISE
1100 BHP/ENGINE
MANUAL LEAN OPERATION

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	Manifold Pressure At Carburetor Air Temperature °C (In. Hg)								RPM and Blower	BMEP Drop (psi)	Fuel Flow Per Eng. (Lb./Hr.)	Nominal BMEP (psi)
	−30	−20	−10	0	+10	+20	+30	+38				
21,000	31.6	32.1	F.T.					DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.	HIGH 2300	12	573	135
20,000	31.6	32.1	32.8	33.4	F.T.							
19,000	31.7	32.1	32.8	33.5	34.0	F.T.						
18,000	31.9	32.2	32.9	33.4	34.1	34.6	F.T.					
17,000	32.0	32.4	33.1	33.5	34.0	34.6	35.1					
16,000	29.3	29.9	33.2	33.7	34.1	34.6	35.1					
15,000	30.1	30.1	30.6	33.8	34.3	34.6	35.1		HIGH 2200	12	557	141
14,000	30.2	30.7	30.7	31.3	34.4	35.1	35.1					
13,000	31.0	30.9	31.5	31.4	32.0	35.2	35.7		HIGH 2100	12	538	148
12,000	31.1	31.7	31.7	32.2	32.2	32.8	35.7					
11,000	31.2	31.9	32.5	32.3	32.9	33.0	33.6	34.0	LOW 2200	12	530	141
10,000	31.3	32.0	32.6	33.2	33.0	33.6	34.2	34.1				
9,000	31.5	32.1	32.8	33.4	34.0	33.7	34.3	34.7	LOW 2100	12	512	148
8,000	31.7	32.3	33.0	33.5	34.2	34.8	35.4	34.9				
7,000	31.9	32.5	33.1	33.7	34.3	35.0	35.6	36.0				
6,000	32.1	32.7	33.4	34.0	34.6	35.2	35.8	36.2				
5,000	32.2	32.8	33.5	34.1	34.7	35.3	35.9	36.3				
4,000	32.3	33.0	33.7	34.3	34.9	35.5	36.1	36.5				
3,000	32.6	33.3	34.0	34.6	35.2	35.8	36.4	36.8				
2,000	32.7	33.4	34.1	34.7	35.3	35.9	36.5	37.0				
1,000	32.8	33.5	34.2	34.8	35.4	36.0	36.7	37.2	LOW 2000	12	500	155

Figure A5-44. Power Settings for Cruise — 1100 BHP/Engine

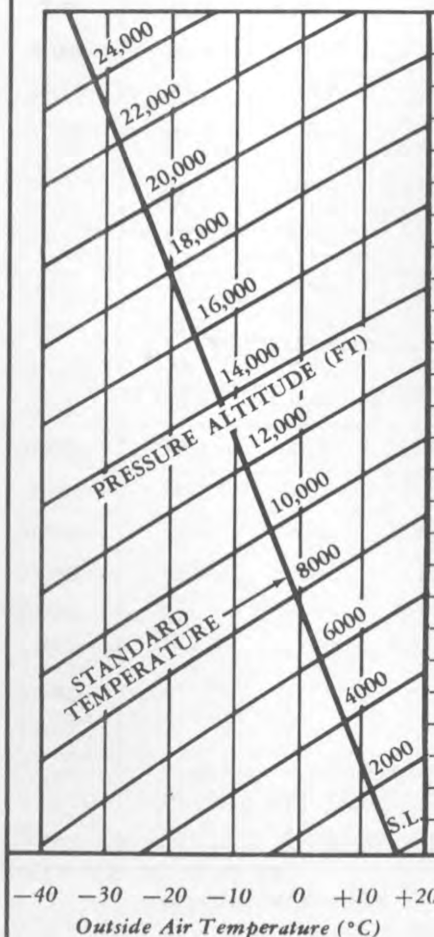
MODEL: C-118A
BASED ON: FLIGHT TEST

OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 1100 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds		105,000 Pounds		100,000 Pounds		95,000 Pounds		90,000 Pounds		85,000 Pounds		80,000 Pounds		75,000 Pounds	
	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
25,000																
24,000																
23,000																
22,000																
21,000							173	243	181	254	187	262	191	268	196	273
20,000							176	243	184	253	189	260	193	266	198	271
19,000							179	243	186	252	191	259	195	264	199	269
18,000							182	242	188	250	193	257	197	262	200	266
17,000					176	230	184	242	190	249	195	255	198	260	201	264
16,000					179	230	187	241	192	247	196	253	200	258	202	261
15,000					182	230	189	240	194	246	198	252	202	256	204	259
14,000					185	230	191	239	196	244	200	249	203	254	205	257
13,000					187	229	193	237	198	243	202	248	204	252	207	254
12,000			180	218	189	229	195	236	200	241	203	246	206	250	208	252
11,000			184	218	191	228	197	235	201	239	204	244	207	248	209	250
10,000			187	218	194	227	199	233	203	238	206	242	209	246	211	248
9000			189	217	196	226	201	232	204	236	208	240	210	243	212	245
8000			192	217	198	225	203	231	206	235	209	238	211	241	213	243
7000	185	207	194	216	199	224	204	229	207	233	210	236	212	239	214	241
6000	188	207	195	216	201	223	205	228	208	231	211	234	213	237	215	239
5000	190	207	198	215	203	221	207	226	210	229	212	232	215	235	216	236
4000	193	207	200	215	205	220	208	224	211	228	214	230	216	233	218	234
3000	195	206	202	214	206	218	210	223	213	226	215	228	217	231	219	232
2000	198	206	204	213	208	217	212	221	214	224	217	227	219	229	220	230
1000	200	205	206	212	210	216	213	220	216	222	218	225	220	227	222	228
S.L.	202	204	207	211	211	215	215	218	217	221	220	223	221	225	223	226

NOTES:

(1) Airspeeds based upon pilot's instrument, nose radar installed.

(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.

(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-504

Figure A5-45. Cruise Speeds for 1100 BHP/Engine

POWER SETTINGS FOR CRUISE
1150 BHP/ENGINE
MANUAL LEAN OPERATION

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*								*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20	+30	+38				
25,000												
24,000												
23,000												
22,000												
21,000	32.2	32.7	F.T.									
20,000	32.2	32.7	33.5	33.9	F.T.							
19,000	32.3	32.7	33.5	34.0	34.5	F.T.						
18,000	32.5	32.8	33.5	34.0	34.6	35.2	F.T.					
17,000	32.7	33.2	33.6	34.1	34.6	35.2	35.8					
16,000	29.5	33.3	33.9	34.6	34.7	35.2	35.8		HIGH 2300	12	604	141
15,000	29.6	30.2	30.7	34.7	35.2	35.3	35.8	DO NO OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
14,000	30.4	30.9	30.8	31.3	35.3	36.0	35.9		HIGH 2200	12	585	148
13,000	30.5	31.0	31.5	31.4	32.0	36.1	36.6					
12,000	31.3	31.9	31.6	32.1	32.1	32.7	36.6		HIGH 2100	12	561	155
11,000	31.4	32.1	32.7	32.3	32.9	32.8	33.4	33.8				
10,000	31.5	32.2	32.8	33.4	33.0	33.6	34.2	33.9	LOW 2200	12	559	148
9,000	31.7	32.3	33.0	33.6	34.2	33.7	34.3	34.7				
8,000	31.9	32.5	33.2	33.7	34.4	35.0	35.6	34.8	LOW 2100	12	541	155
7,000	32.1	32.7	33.3	33.9	34.5	35.2	35.8	36.2				
6,000	32.3	33.0	33.7	34.3	34.9	35.5	36.1	36.6				
5,000	32.5	33.2	33.9	34.5	35.1	35.7	36.3	36.7				
4,000	32.7	33.4	34.1	34.7	35.3	35.9	36.5	36.9				
3,000	32.9	33.6	34.3	34.9	35.5	36.1	36.8	37.3				
2,000	33.1	33.8	34.5	35.1	35.7	36.3	37.0	37.5				
1,000	33.3	34.0	34.7	35.3	35.9	36.5	37.2	37.7	LOW 2000	12	525	163

Figure A5-46. Power Settings for Cruise — 1150 BHP/Engine

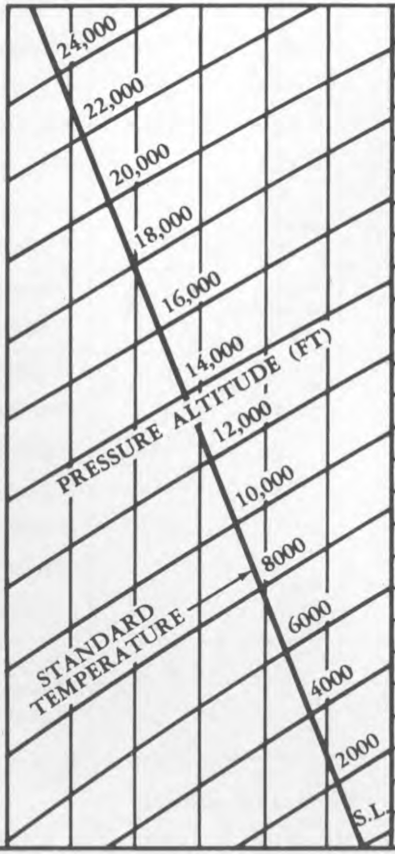
MODEL: C-118A
BASED ON: FLIGHT TEST

OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 1150 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
25,000																
24,000																
23,000																
22,000							178	254	185	264	190	271	195	277	199	282
21,000							181	253	187	263	192	269	197	275	200	279
20,000					175	241	183	253	189	261	195	267	199	273	202	277
19,000					178	241	185	252	191	259	197	265	200	270	203	274
18,000					181	241	187	251	193	258	198	264	201	268	204	272
17,000					184	241	191	250	195	256	200	262	202	266	205	269
16,000					187	240	193	249	197	254	201	260	204	263	206	267
15,000			180	228	188	239	195	247	199	253	202	258	206	262	208	264
14,000			183	228	190	238	197	246	201	251	204	256	207	259	209	262
13,000			186	228	193	237	199	244	202	249	206	253	208	257	210	259
12,000			188	228	195	236	201	243	204	247	207	251	210	255	212	257
11,000			191	227	198	235	202	241	206	245	209	249	211	252	213	255
10,000	185	216	194	227	200	234	204	240	207	243	210	247	213	250	214	252
9000	188	216	196	226	202	233	206	238	209	242	212	245	214	248	216	250
8000	190	216	198	225	203	231	208	236	210	240	213	243	215	245	217	248
7000	193	216	200	224	204	230	209	235	211	238	214	241	216	243	218	245
6000	195	216	202	223	206	229	210	233	212	236	215	239	217	241	219	243
5000	198	216	204	222	208	227	212	232	214	234	217	237	219	239	220	241
4000	200	215	206	221	210	226	213	230	216	232	218	235	220	237	222	239
3000	202	214	208	220	211	224	215	228	217	231	220	233	221	235	223	236
2000	205	213	210	219	213	223	217	227	219	229	221	231	223	233	224	234
1000	207	212	212	218	215	222	219	225	221	227	223	229	224	231	225	232
S.L.	209	211	213	217	217	220	220	223	222	225	224	227	225	229	226	230

Airspeed in Knots for Different Gross Weights

NOTES:
(1) Airspeeds based upon pilot's instrument, nose radar installed.
(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.
(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-526

Figure A5-47. Cruise Speeds for 1150 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
1200 BHP/ENGINE
MANUAL LEAN OPERATION

Note:
Do not operate in high blower above 30°C CAT.

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	Manifold Pressure At Carburetor Air Temperature °C (In. Hg) −30	−20	−10	0	+10	+20	+30	+38	RPM and Blower	BMEP Drop (psi)	Fuel Flow Per Eng. (Lb./Hr.)	Nominal BMEP (psi)
23,000								DO NOT OPERATE IN HIGH BLOWER ABOVE 30°C CAT.				
22,000												
21,000												
20,000												
19,000	34.1	F.T.										
18,000	33.9	34.6	F.T.									
17,000	33.9	34.6	35.3	36.0	F.T.							
16,000	31.3	34.5	35.2	35.8	36.5	F.T.						
15,000	31.3	31.9	35.2	35.8	36.4	37.1	37.7					
14,000	31.7	32.1	32.7	33.3	36.4	37.0	37.6					
13,000	31.8	32.4	32.8	33.4	34.0	37.0	37.6		HIGH 2300	12	633	147
12,000	31.9	32.5	33.1	33.7	34.0	34.6	37.6					
11,000	32.0	32.7	33.3	34.0	34.6	34.8	35.4	35.8				
10,000	32.2	32.8	33.5	34.1	34.7	35.3	35.4	35.8	LOW 2300	12	605	147
9,000	32.3	33.0	33.7	34.3	34.9	35.5	36.1	36.5				
8,000	32.6	33.2	33.8	34.4	35.1	35.7	36.3	36.7				
7,000	32.7	33.3	34.0	34.6	35.2	35.9	36.5	37.0				
6,000	32.8	33.5	34.2	34.8	35.5	36.1	36.6	37.1				
5,000	33.0	33.7	34.4	35.0	35.6	36.3	36.9	37.3				
4,000	33.2	33.9	34.6	35.3	35.9	36.5	37.1	37.6				
3,000	33.4	34.0	34.7	35.4	36.0	36.6	37.2	37.7				
2,000	33.6	34.3	35.0	35.6	36.2	36.8	37.5	38.0				
1,000	33.8	34.5	35.2	35.8	36.4	37.0	37.7	38.2	LOW 2200	12	587	155

Figure A5-48. Power Settings for Cruise — 1200 BHP/Engine

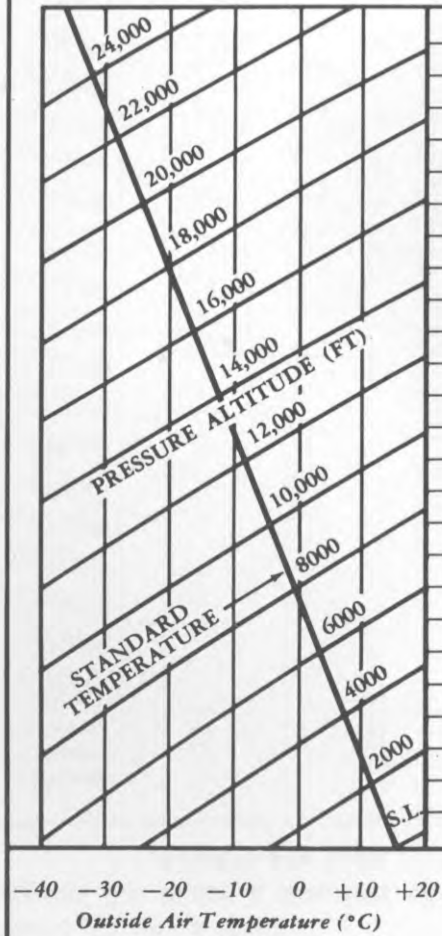
OPERATION BELOW $1.1V_{L/D}$

OPERATION BELOW $V_{L/D}$

CRUISE SPEEDS FOR 1200 BHP/ENGINE MANUAL LEAN OPERATION

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



Airspeed in Knots for Different Gross Weights

Density Altitude (Ft)	110,000 Pounds		105,000 Pounds		100,000 Pounds		95,000 Pounds		90,000 Pounds		85,000 Pounds		80,000 Pounds		75,000 Pounds	
	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
25,000																
24,000																
23,000																
22,000					177	251	185	264	190	272	196	278	199	283	203	288
21,000					180	251	187	263	192	270	198	276	201	281	204	285
20,000					182	250	189	261	194	268	200	274	203	279	205	282
19,000					184	250	192	260	197	266	201	272	204	276	207	280
18,000					187	249	195	258	199	264	203	270	206	274	208	277
17,000			183	238	190	249	197	257	200	263	204	267	207	272	209	274
16,000			185	238	192	248	198	256	202	261	205	265	208	269	210	272
15,000			187	238	195	247	200	254	203	259	207	263	209	267	211	269
14,000			190	237	197	246	202	252	205	257	208	260	211	264	213	267
13,000	184	226	193	237	199	245	204	251	207	255	210	258	212	262	214	264
12,000	186	226	196	237	201	243	206	249	209	253	211	256	214	259	216	262
11,000	189	226	198	235	203	242	207	247	210	251	213	254	215	257	217	259
10,000	192	226	200	234	205	240	208	245	211	248	214	252	216	254	218	256
9000	194	225	202	233	207	239	210	243	213	246	216	250	218	252	219	254
8000	197	225	204	232	209	237	212	242	215	245	217	248	219	250	221	252
7000	199	224	206	231	210	236	214	240	216	243	219	245	220	248	222	249
6000	202	224	207	230	211	235	215	238	217	241	220	243	221	246	223	247
5000	204	223	209	228	213	233	216	236	219	239	221	241	223	243	224	245
4000	206	222	211	227	215	231	218	234	221	237	222	239	224	241	225	242
3000	209	221	213	226	217	230	220	233	222	235	224	237	225	239	226	240
2000	211	219	215	225	218	228	221	231	223	233	225	235	226	237	227	238
1000	213	218	216	223	220	226	223	229	225	231	226	233	227	235	229	236
S.L.	214	217	218	222	222	225	224	228	226	230	227	231	229	233	230	234

NOTES:

(1) Airspeeds based upon pilot's instrument, nose radar installed.

(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.

(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-505

Figure A5-49. Cruise Speeds for 1200 BHP/Engine

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: PRATT & WHITNEY CRUISE CHARTS ALT 102A

POWER SETTINGS FOR CRUISE
1240 BHP/ENGINE
MANUAL LEAN OPERATION
12 BMEP DROP

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*						*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30	−20	−10	0	+10	+20				
25,000										
24,000										
23,000										
22,000										
21,000										
20,000										
19,000										
18,000										
17,000										
16,000										
15,000	31.9									
14,000	32.0	32.7					2300 LOW	12	634	153
13,000	32.1	32.8	33.5							
12,000	32.2	33.0	33.6	34.2	34.8					
11,000	32.3	33.1	33.7	34.3	34.9	35.5				
10,000	32.5	33.2	33.8	34.4	35.0	35.6				
9,000	32.7	33.3	33.9	34.5	35.1	35.7				
8,000	32.8	33.4	34.0	34.6	35.2	35.9				
7,000	32.9	33.5	34.1	34.7	35.3	36.0				
6,000	33.0	33.7	34.3	34.9	35.5	36.1				
5,000	33.1	33.8	34.4	35.0	35.6	36.3				
4,000	33.2	33.9	34.5	35.1	35.7	36.4				
3,000	33.3	34.0	34.7	35.3	35.9	36.5				
2,000	33.5	34.1	34.8	35.4	36.0	36.6				
1,000	33.6	34.2	34.9	35.5	36.1	36.7				

Figure A5-50. Power Settings for Cruise — 1240 BHP/Engine — 12 BMEP Drop

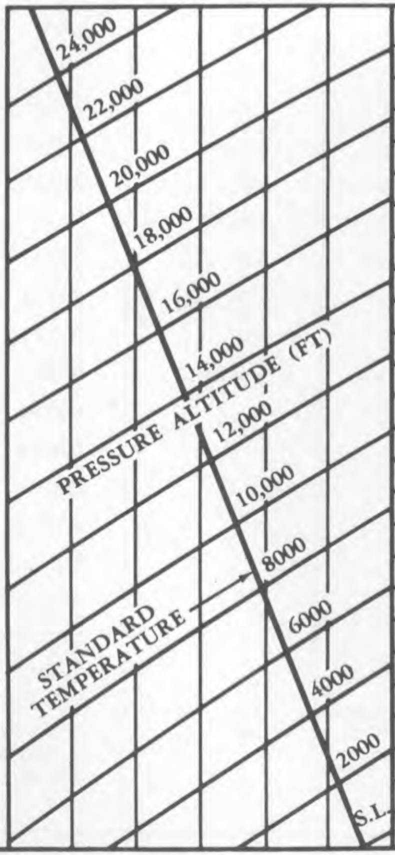
OPERATION BELOW $1.1V_{L/D}$

CRUISE SPEEDS FOR 1240 BHP/ENGINE MANUAL LEAN OPERATION

OPERATION BELOW $V_{L/D}$

MODEL: C-118A
BASED ON: FLIGHT TEST

R2800-52W ENGINES
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



−40 −30 −20 −10 0 +10 +20
Outside Air Temperature (°C)

Density Altitude (Ft)	110,000 Pounds IAS	110,000 Pounds TAS	105,000 Pounds IAS	105,000 Pounds TAS	100,000 Pounds IAS	100,000 Pounds TAS	95,000 Pounds IAS	95,000 Pounds TAS	90,000 Pounds IAS	90,000 Pounds TAS	85,000 Pounds IAS	85,000 Pounds TAS	80,000 Pounds IAS	80,000 Pounds TAS	75,000 Pounds IAS	75,000 Pounds TAS
	Airspeed in Knots for Different Gross Weights															
25,000																
24,000																
23,000																
22,000																
21,000																
20,000																
19,000																
18,000																
17,000			187	244	195	255	200	263	203	267	207	272	209	276	211	278
16,000			190	244	197	254	202	261	205	265	208	269	211	273	213	276
15,000	184	234	193	244	199	253	204	259	207	263	210	267	212	270	215	273
14,000	187	234	196	244	201	252	206	257	209	261	211	265	215	268	216	270
13,000	190	234	198	244	203	251	208	256	210	259	213	263	216	265	217	268
12,000	192	234	201	243	205	249	209	254	212	257	215	261	217	263	218	265
11,000	195	233	203	241	207	247	211	252	213	255	216	258	218	261	220	262
10,000	198	233	205	240	209	246	213	250	215	253	218	256	220	258	221	260
9000	200	232	207	239	211	244	214	248	217	251	219	254	221	256	223	258
8000	202	231	208	237	212	242	216	246	218	249	221	252	222	253	224	255
7000	205	230	210	236	214	240	218	244	220	247	222	249	223	251	225	253
6000	207	229	212	235	215	239	219	243	221	245	223	247	224	249	226	250
5000	209	228	213	233	217	237	220	241	222	243	224	245	225	247	227	248
4000	211	227	215	232	219	236	222	239	224	241	225	243	227	245	228	246
3000	213	225	217	230	220	234	223	237	225	239	226	240	228	242	229	243
2000	215	224	219	229	222	232	225	235	226	237	227	238	229	240	230	241
1000	217	223	221	227	224	230	226	233	227	235	229	236	230	238	232	239
S.L.	219	222	222	226	225	229	227	231	229	233	231	235	232	236	233	237

NOTES:

(1) Airspeeds based upon pilot's instrument, nose radar installed.

(2) Airspeeds based on −2 degrees cowl flap setting. Decrease airspeeds 3 knots per degree of opening from −2 degrees.

(3) Without nose radome decrease IAS approximately 3 knots. TAS is unaffected.

AA1-506

Figure A5-51. Cruise Speeds for 1240 BHP/Engine

MODEL: C-118A
DATA AS OF: 6/15/62

BASED ON: PRATT & WHITNEY CRUISE CHARTS

POWER SETTINGS FOR CRUISE
1240 BHP/ENGINE
MANUAL LEAN OPERATION — 2 BMEP DROP

R2800-52W ENGINES
FUEL GRADE: 115-145
ALTERNATE FUEL GRADE: 100/130

Pressure Altitude (Feet)	*Manifold Pressure At Carburetor Air Temperature °C (In. Hg)*						*RPM and Blower*	*BMEP Drop (psi)*	*Fuel Flow Per Eng. (Lb./Hr.)*	*Nominal BMEP (psi)*
	−30°	−20°	−10°	0°	+ 10°	+ 20°				
25,000										
24,000										
23,000										
22,000										
21,000										
20,000										
19,000										
18,000										
17,000	29.3	30.0	F.T.							
16,000	30.4	30.0	30.6	F.T.			2300	2	663	153
15,000	30.5	31.1	31.7	31.4			LOW			
14,000	30.6	31.2	31.9	32.5	32.1					
13,000	30.7	31.3	32.0	32.6	33.2	32.8				
12,000	30.8	31.5	32.1	32.7	33.3	33.8				
11,000	30.9	31.6	32.2	32.8	33.4	33.9				
10,000	31.0	31.7	32.3	32.9	33.5	34.1				
9000	31.2	31.8	32.4	33.0	33.6	34.2				
8000	31.3	31.9	32.5	33.1	33.7	34.4				
7000	31.4	32.0	32.6	33.2	33.8	34.5				
6000	31.5	32.2	32.8	33.4	34.0	34.6				
5000	31.6	32.3	32.9	33.5	34.1	34.8				
4000	31.7	32.4	33.0	33.6	34.2	34.9				
3000	31.8	32.5	33.2	33.8	34.4	35.0				
2000	32.0	32.6	33.3	33.9	34.5	35.1				
1000	32.1	32.7	33.4	34.0	34.6	35.2				
S.L.										

Figure A5-52. Power Settings for Cruise—1240 BHP/Engine—2 BMEP Drop

part 6 landing

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LIST OF ILLUSTRATIONS

DISCUSSION OF CHARTS.

LANDING GROUND ROLL CHARTS.

Charts are provided *(figures A6-2 through A6-4)* showing the landing ground roll for three configurations; brakes only, brakes plus two engines with full reverse thrust and brakes plus four engines with full reverse thrust. Allowances are shown for density altitude, gross weight and headwind. Curve distances corrected for wind account for 100 percent of wind values shown. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid. 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. This allows a safety margin for fluctuation of wind velocity.

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL CHART.

The Effect of Unusual Runway Conditions on Landing Ground Roll chart *(figure A6-5)* is used to determine the effect of various runway conditions on the landing ground roll. Curves are presented to give corrected ground roll distances for landings made on dry turf, wet concrete, snow, and ice covered runways as compared to landing ground roll distances on dry concrete. The coefficient of friction values given on the chart are approximate since other factors such as the condition of the tires or the amount of water on the runway may affect the coefficient of friction. The corrected landing ground roll distance is determined by entering the chart with the landing ground roll obtained from the Landing Ground Roll charts *(figures A6-2 through A6-4)*.

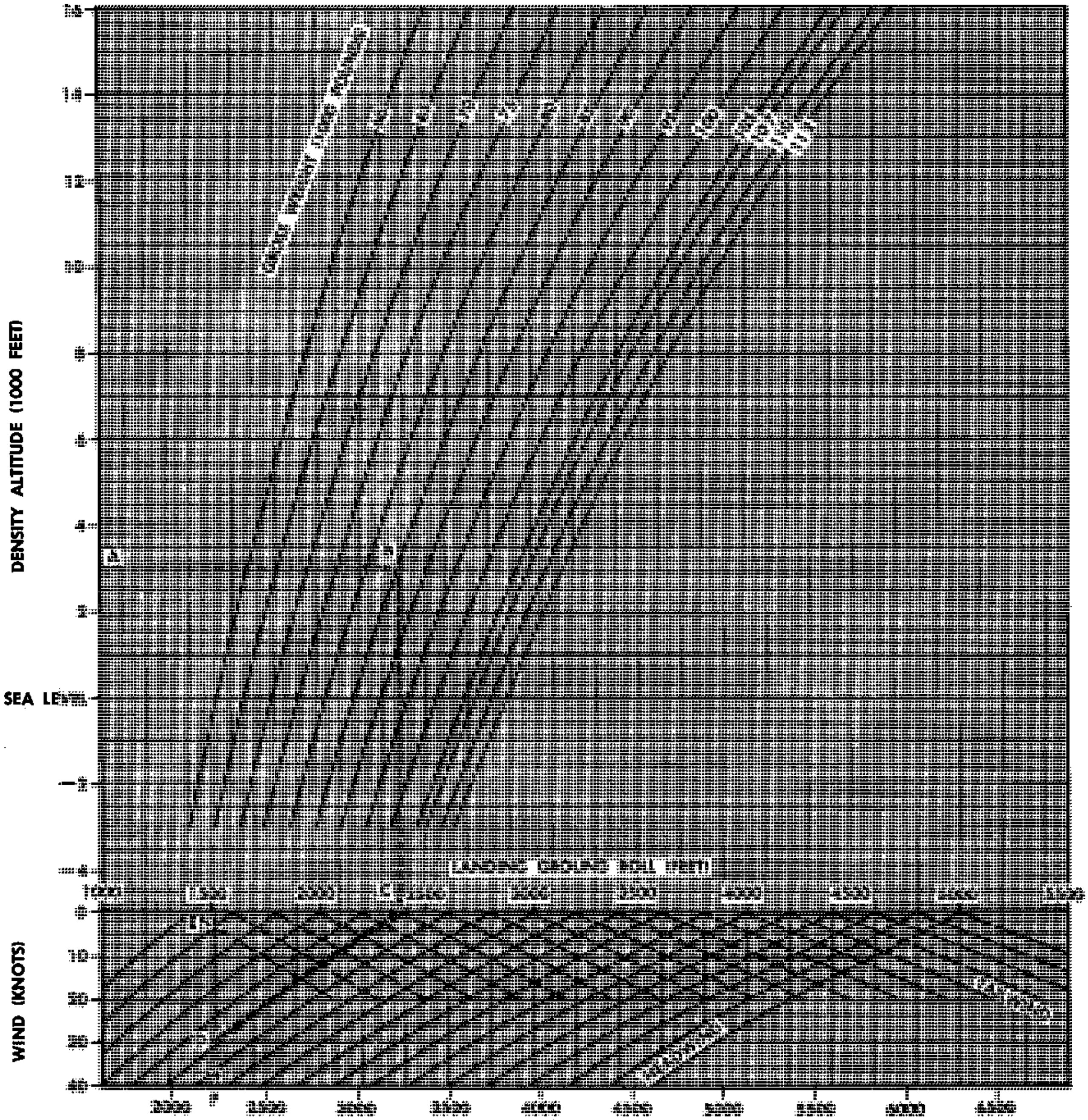
TO BE ADDED WHEN AVAILABLE

Figure A6-1. Takeoff, Landing, and Stall Speeds

LANDING GROUND ROLL — BRAKES ONLY

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTES:

1. Based on dry, hard surface runway.
2. Wing flaps full down.
3. Threshold speed = 130 percent of stall speed.
4. Touchdown speed = 120 percent of stall speed.
5. Ground roll for 30 degree flaps is approximately 115 percent of ground roll for flaps full down.

SAMPLE PROBLEM:

A. Density altitude = 3000 feet.
B. Gross weight = 85,000 pounds.
C. Landing ground roll no wind = 2370 feet.
D. Headwind = 30 knots.
E. Landing ground roll with wind = 1520 feet.
F. Landing distance from 50 feet height = 2200 feet.

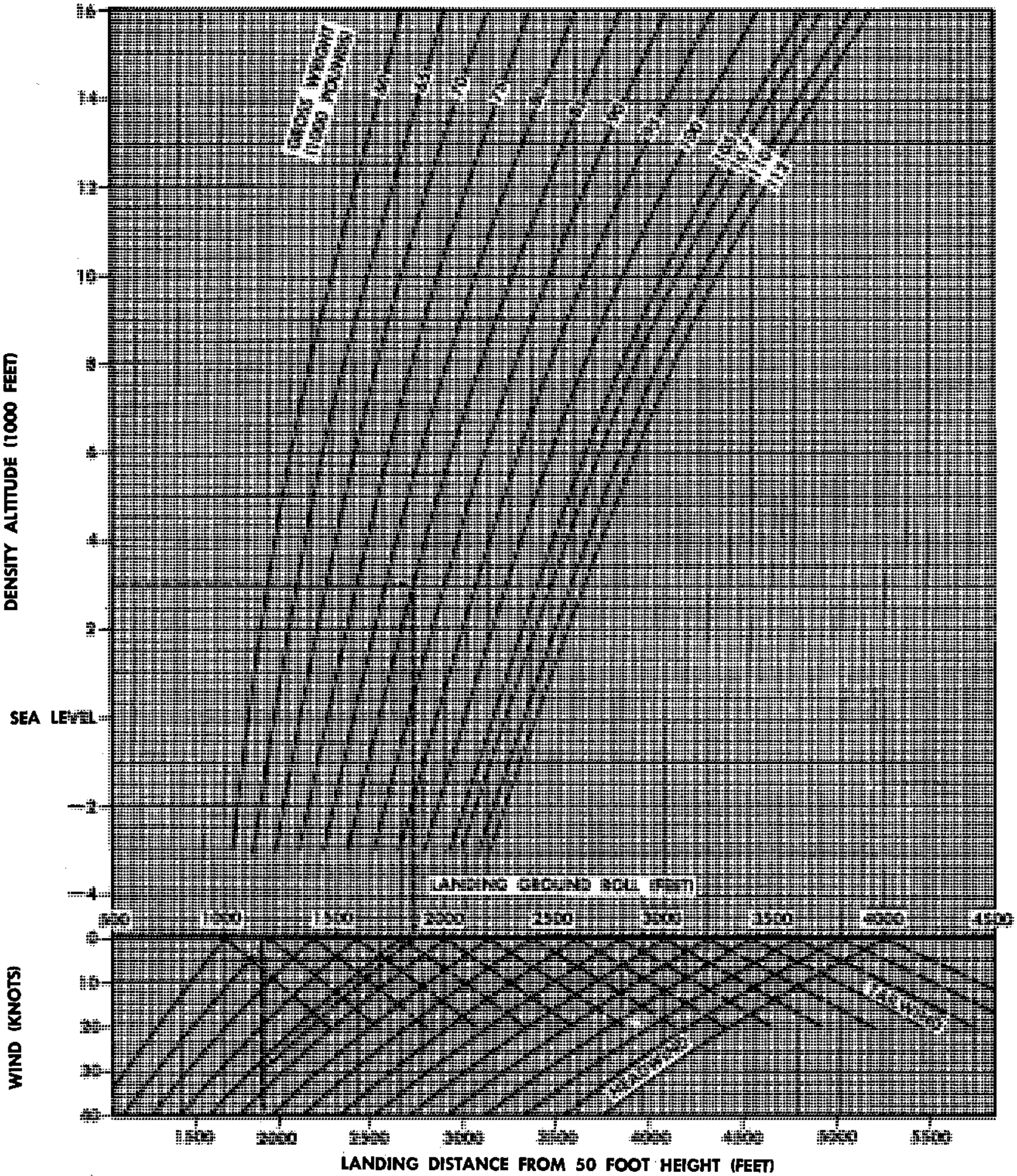
AA1-239

Figure A6-2. Landing Ground Roll — Brakes Only

LANDING GROUND ROLL — BRAKES PLUS TWO-ENGINE REVERSE THRUST

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTES:

1. Based on dry, hard surface runway.
2. Wing flaps full down.
3. Threshold speed = 130 percent of stall speed.
4. Touchdown speed = 120 percent of stall speed.
5. Ground roll for 30 degree flaps is approximately 115 percent of ground roll for flaps full down.

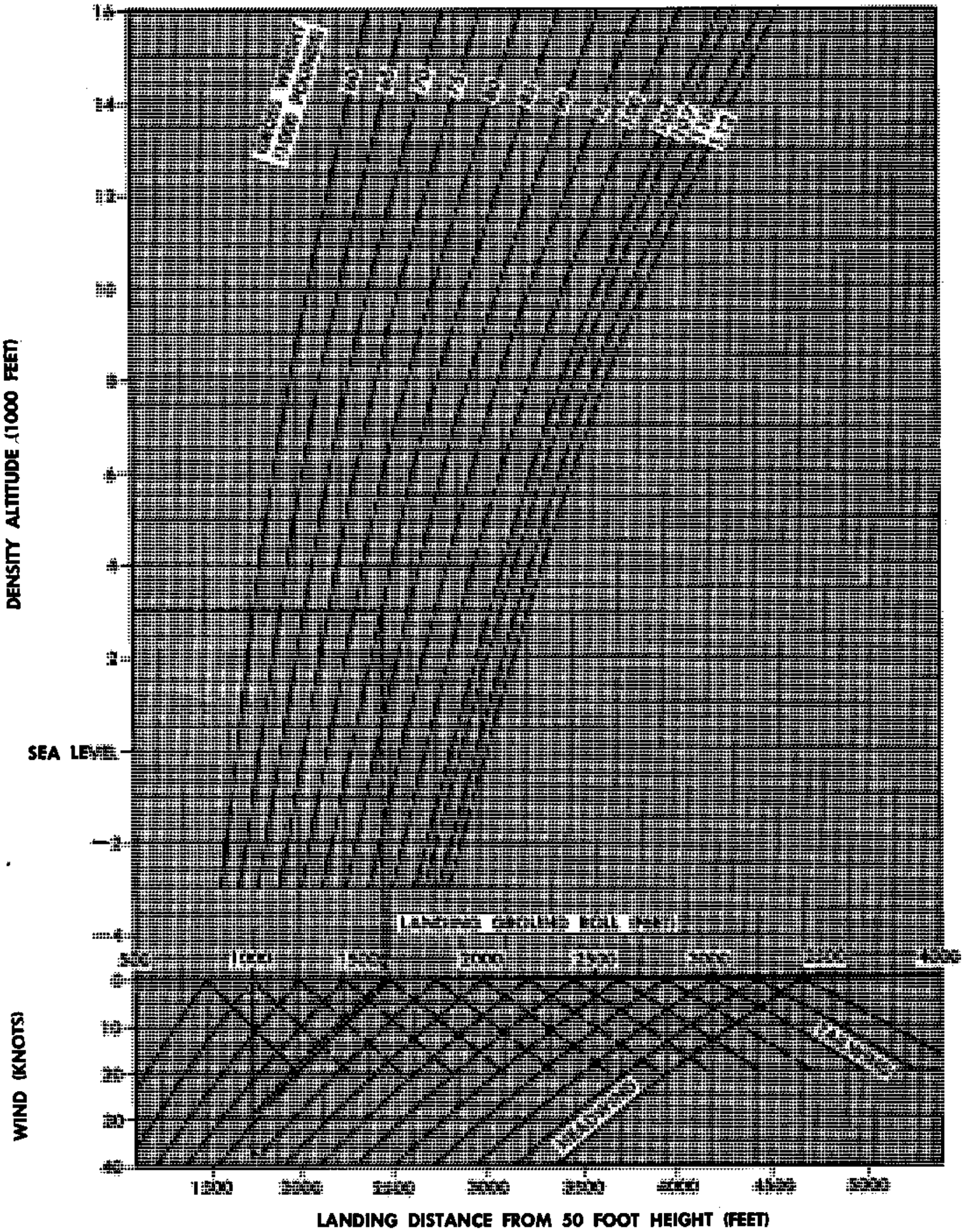
AA1-240

Figure A6-3. Landing Ground Roll—Brakes Plus Two-Engine Reverse Thrust

LANDING GROUND ROLL — BRAKES PLUS FOUR-ENGINE REVERSE THRUST

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTES:

1. Based on dry, hard surface runway.
2. Wing flaps full down.
3. Threshold speed = 130 percent of stall speed.
4. Touchdown speed = 120 percent of stall speed.
5. Ground roll for 30 degree flaps is approximately 115 percent of ground roll for flaps full down.

AA1-23B

Figure A6-4. Landing Ground Roll—Brakes Plus Four-Engine Reverse Thrust

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: CALCULATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

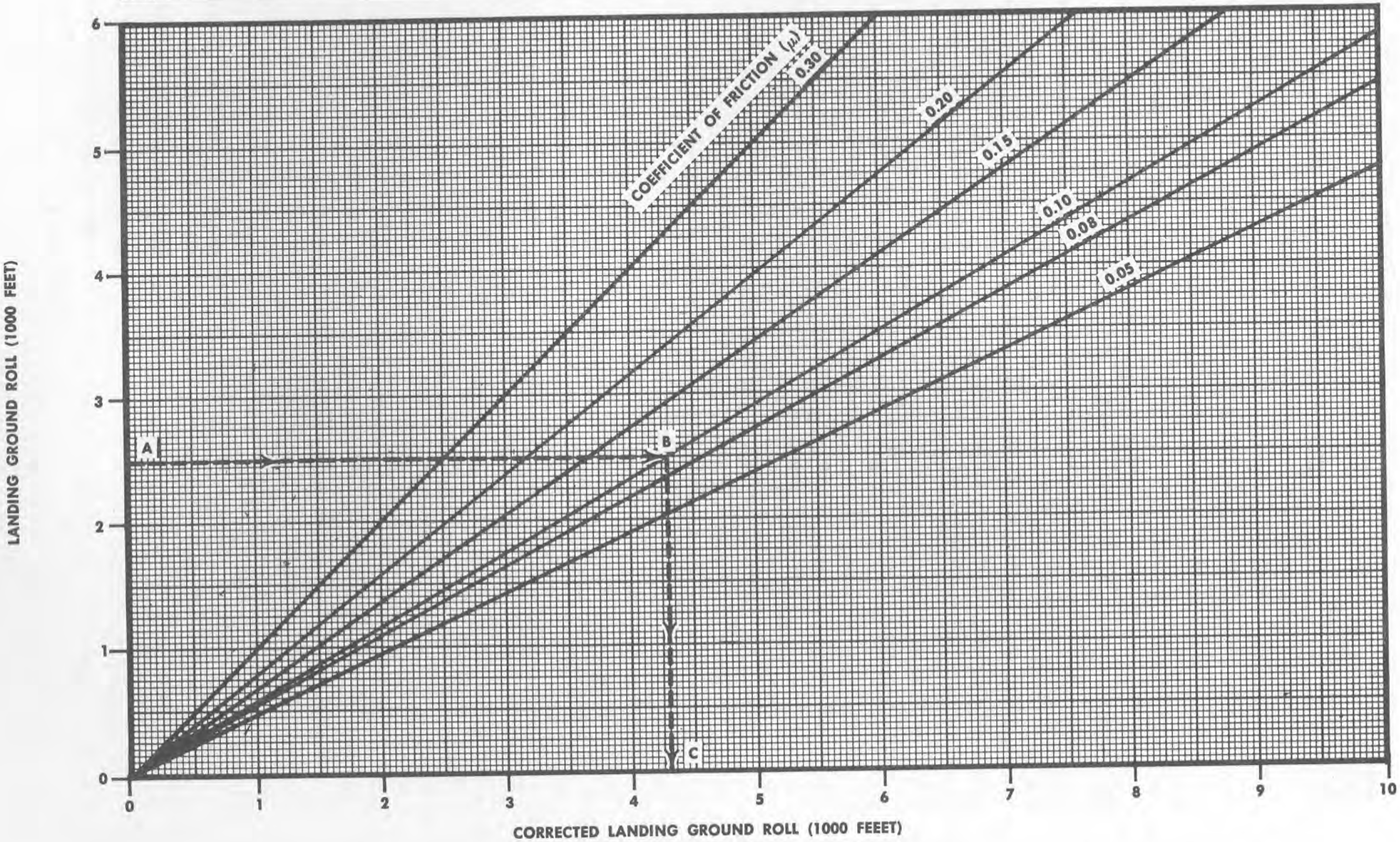
RUNWAY SURFACE CONDITION	AVERAGE COEFFICIENT OF FRICTION (μ)
DRY CONCRETE OR MACADAM	0.3
DRY TURF	0.2
WET CONCRETE OR MACADAM	0.15
SNOW OR WET GRASS	0.10
ICE	0.08

SAMPLE PROBLEM:

A. Landing ground roll = 2500 feet.

B. Coefficient of friction = 0.10.

C. Corrected landing ground roll = 4300 feet.



AA1-539

Figure A6-5. Effect of Unusual Runway Conditions on Landing Ground Roll

LIFTOFF, LANDING, AND STALL SPEEDS
PILOT'S INDICATED AIRSPEED — KNOTS (IAS)

	Dump Time	Liftoff Speed	V_s for Zero Angle of Bank				Threshold Airspeeds 130% V_{so}				
Wing Flap Setting		20°	0°	20°	30°	Full Down	0°	20°	30°	Full Down	Wing Flap Setting
Gross Weight Pounds		115% V_s									Gross Weight Pounds
112,000	9.0	120	118	105	97	92	153	136	127	120	112,000
110,000	8.2	118	116	103	96	91	151	134	125	119	110,000
107,000	7.0	117	114	102	95	90	148	133	124	117	107,000
105,000	6.2	116	113	101	94	89	147	131	122	116	105,000
100,000	4.2	113	111	99	92	87	144	129	120	113	100,000
95,000	2.5	110	108	96	90	85	140	125	117	111	95,000
92,610	1.7	109	107	95	89	84	139	124	116	109	92,610
90,000	.6	107	105	94	88	83	137	122	114	108	90,000
88,200	0	106	104	93	87	82*	135	121	113	107	88,200
85,000	0	104	102	91	85	81*	133	118	111	105	85,000
80,000	0	101	99	89	83	78*	129	116	108	101	80,000
75,000	0	98	96	86	80*	76*	125	112	104	99	75,000
70,000	0	95	93	83	78*	73*	121	108	101	95	70,000
65,000	0	92	90	80*	75*	71*	117	104	98	92	65,000
60,000	0	91**	86	77*	72*	68*	112	100	94	88	60,000

Note: Stall speed at zero thrust (V_s).

*Less than minimum control speed (V_{mc}) with one engine out in the air (83 knots IAS).

**110 percent of minimum control speed (91 knots IAS).

BASED ON: FLIGHT TEST DATA

DATA AS OF 2-15-59

Figure A6-6

part 7
mission planning

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LIST OF ILLUSTRATIONS

INTRODUCTION.

Sample problems have been included on the charts in this Appendix to illustrate the use of each type of chart. In addition, two mission planning sample problems are included herein to illustrate how several of the charts are used to plan typical missions.

Sample Problem 1 illustrates a typical medium range mission which does not require the use of capacity fuel. For this type of mission it is necessary to carry adequate reserve fuel to meet certain adverse conditions. (In Sample Problems 1 and 2 the reserve fuel allowance is based on holding for three hours at 10,000 feet altitude at long range cruise speed. However, the various commands may require reserve fuel to be determined differently, depending upon the availability of alternate airfields.) Another important consideration is that large amounts of excess fuel should not be carried without a reason. This is because the fuel consumption increases when the gross weight increases. For the conditions described in Sample Problem 1, the fuel consumed in completing the mission would increase by approximately 200 pounds for each 1,000 pounds of additional fuel carried.

Sample Problem 2 illustrates a long range mission which cannot be completed with capacity payload. For this type of mission it is important that the fuel requirement be determined carefully, because each pound of additional fuel carried means that one pound less payload may be carried.

FUEL DUMP TIME.

The following shows the time required to dump fuel from any given gross weight down to the design landing weight for normal operation of 88,200 pounds.

Gross Weight (pounds)	*Dump Time (minutes)*
107,000	7.0
106,000	6.5
104,600	6.0
103,300	5.5
101,900	5.0
100,500	4.5
99,200	4.0
97,800	3.5
96,400	3.0
95,000	2.5
93,700	2.0
92,300	1.5
91,000	1.0
89,600	0.5

SAMPLE PROBLEM 1—MEDIUM RANGE MISSION.

Object of Mission:

To transport 18,500 pounds of cargo a distance of 1600 nautical miles.

GIVEN:

1. Miscellaneous conditions:

   Operating weight empty = 59,000 pounds.

   Fuel grade = standard (115/145), with water injection (ADI) used for takeoff.

   Oil carried = 1050 pounds (140 gallons).

   Fuel allowance for warm-up, taxi and takeoff = 625 pounds.

   Reserve fuel requirement = fuel for 3 hours holding at long range cruise speed at 10,000 feet altitude.

2. Takeoff conditions:

   Runway length = 8,000 feet.

   Runway slope = — 0.015 (downhill).

   Pressure altitude = 1500 feet.

   Temperature = 22°C.

   Dew point = 60°F.

   Wind = 20 knots headwind (runway component).

3. Cruise conditions:

   Cruise altitude = 14,000 feet pressure altitude.

   Temperature = — 6°C.

   Cruise at long range cruise speed.

   Wind = 40 knots headwind.

4. Landing conditions:

   Runway length = 7500 feet.

   Pressure altitude = 2000 feet.

   Temperature = 20°C.

   Wind = 30 knots headwind (runway component).

Estimate of Fuel Required.

For this type of mission the easiest way to determine the minimum fuel requirement is to first establish the landing weight and then the initial cruise weight, the initial climb weight and, finally, the takeoff weight. The fuel required is found by subtracting the zero fuel weight and the oil weight from the takeoff weight.

1. Add the payload to the operating weight empty to determine the zero fuel weight, 18,500 + 59,000 = 77,500 pounds.

2. Add the oil weight to the zero fuel weight to determine the zero fuel plus oil weight, 1050 +77,500 = 78,550 pounds.

3. The reserve fuel allowance may now be determined from the Four-Engine Range Prediction —Time chart (*figure A5-23*). Enter the gross weight scale at the zero fuel plus oil weight of 78,550 pounds and read up to the 10,000 foot altitude line and across to the time scale at 23.6 hours. Subtract the holding time of 3 hours (23.6 − 3 = 20.6 hours). Re-enter the time scale at 20.6 hours and read across to the 10,000 foot curve and down to find the gross weight at start of holding of 82,700 pounds. The reserve fuel allowance is equal to the weight at the start of hold minus the weight at the end of hold (zero fuel plus oil weight), 82,700 − 78,550 = 4,150 pounds. (The weight at the start of hold is the same as the final cruise weight, and may also be considered as the landing weight since the fuel saved during the descent to the airfield is approximately offset by the fuel used during the landing and taxiing.)

4. The next step is to establish the cruising density altitude. This may be done with the aid of the Density Altitude Chart (*figure A1-11*). Enter the temperature scale at the expected cruise temperature, −6°C, and proceed vertically upward to cruising pressure altitude, 14,000 feet. The density altitude may then be read at the left hand scale, 14,800 feet. Use 15,000 feet for planning cruise data since the 200 foot difference is negligible.

5. The cruise fuel may now be determined from the Four-Engine Range Prediction — Distance chart (*figure A5-22*). Enter the gross weight scale at the final cruise weight of 82,700 pounds and read up to the 15,000 foot curve and across to the distance scale at 4340 nautical miles for the range at final cruise weight. To determine the cruise fuel accurately it is necessary to know the climb distance. Then the climb distance may be subtracted from the mission distance to establish the cruise distance. Since the climb distance will be small compared to the cruise distance an approximation will suffice. To obtain this approximation subtract the mission distance from the range at final cruise weight (4340 − 1600 = 2740 nautical miles). Re-enter the range scale at 2740 nautical miles and read across to the 15,000 foot curve and down to find approximate initial cruise weight of 95,600 pounds. To correct the initial cruise weight for headwind enter the Range Prediction — Time chart (*figure A5-23*) at the initial and final gross weights of 95,600 and 82,700 pounds. Read up to the 15,000 foot curve and across to the time scale to read the times of 10.2 and 17.2 hours. The difference between these times, 7.2 hours, is the cruise time. Multiply the cruise time by the average predicted headwind of 40 knots to determine the decrease in range due to headwind in nautical miles (7.2 × 40 = 288 nautical miles). Correct for this decrease in range by subtracting 288 nautical miles from the range at initial cruise weight (2740 − 288 = 2452 nautical miles). Re-enter the range scale of the Distance chart (*figure A5-22*) and read across to 15,000 foot and down to obtain the approximate initial cruise weight, corrected for headwind of 98,200 pounds. Assume that this is the initial climb weight and determine the approximate distance to climb from the Time, Distance and Fuel to Climb Chart (*figure A4-1*, assuming 1400 BHP/eng.). Since this is only an approximation it is not necessary to correct for temperature or headwind. Enter the gross weight scale at 98,200 pounds and proceed vertically upwards to 1500 feet altitude and note the distance (read at the left hand scale), 7 nautical miles. Now follow the contour upwards to 14,000 feet and also note the distance, 78 nautical miles. The approximate climb distance is the difference between the two, 78 − 7 = 71 nautical miles. The cruise distance is the mission distance, minus the climb distance, plus headwind correction (1600 − 71 + 288 = 1817 nautical miles). Subtract this cruise distance from the range at end of cruise determined above (4340 − 1817 = 2523 nautical miles). Re-enter the range scale on the Range Prediction — Distance chart (*figure A5-22*) at 2523 nautical miles and proceed horizontally to the 15,000 foot curve. The initial cruise weight may be read at the gross weight scale directly below, 97,500 pounds. The cruise fuel is equal to the initial cruise weight minus the final cruise weight, 97,500 − 82,700 = 14,800 pounds.

6. The time, distance and fuel to climb may now be estimated more accurately. First, determine the average number of degrees above standard for the climbing altitudes. Standard temperature at the initial climb altitude, 1500 feet, is 12°C (from the ICAO Standard Atmosphere Table, figure A1-12, sheet one). Subtract this from the ambient temperature to obtain the number of degrees above standard at the initial climb altitude, 22 − 12 = 10°C. Similarly, standard temperature at the final cruise altitude, 14,000 feet, is − 13°C. The ambient temperature of − 6°C is thus 7°C above standard. The average between these two is (10 + 7)/2, or 8.5°C, which may be rounded off to 9°C. In using the Time, Distance and Fuel to Climb Chart (*fig-*

ure A4-1) the altitude correction for temperature will be 9°C times 0.7% of the altitude per °C, or 6.3% of the altitude. For the initial climb altitude this correction is 6.3% of 1500 feet, or 90 feet. At the final climb altitude it is 6.3% of 14,000 feet, or 880 feet. Enter the gross weight scale at the final climb weight of 97,500 pounds and proceed vertically upwards to 14,000 feet pressure altitude plus 880 feet correction for temperature, or 14,880 feet. At this point read the nautical miles travelled, 88, and the time, 29 minutes. Now follow down the contour to 1500 feet pressure altitude plus 88 feet correction for temperature, or 1590 feet. At this point read the nautical miles travelled, 7, the time, 3 minutes, and the gross weight at start of climb, 99,200 pounds. The difference between these two sets of values will be the distance to climb (88 − 7 = 81 nautical miles), the time to climb (29 − 3 = 26 minutes) and the fuel required (99,200 − 97,500 = 1,700 pounds). If necessary, the effect of wind on the distance to climb may be determined by multiplying the effective wind times the time to climb. Assuming that the average headwind during the climb is 75% of the headwind at the cruising altitude, this wind effect is 75% of 40 knots times 26/60 hour, or 13 nautical miles. Thus the distance to climb is 81 − 13, or 68 nautical miles.

7. The takeoff gross weight may now be determined by adding the fuel allowance for warm-up, taxi and takeoff to the initial climb weight, 625 + 99,200 = 99,825 pounds.

8. The fuel requirement is equal to the takeoff weight minus the zero fuel weight minus the oil weight, 99,825 − 77,500 − 1050 = 21,275 pounds. This is also the sum of the reserve fuel, cruise fuel, climb fuel and warm-up, taxi and takeoff fuel, 4,150 + 14,800 + 1,700 + 625 = 21,275 pounds.

Filling out the Takeoff Data Card.

Now that the takeoff gross weight has been estimated, data may be entered on the takeoff data card. The first step is to find out what power will be available for takeoff. Then the takeoff performance may be determined based on this power.

1. Turn to the applicable Brake Horsepower Available for Takeoff Chart for standard fuel grade, wet *(figure A2-4)*. Enter the pressure altitude scale at 1500 feet and proceed vertically upwards to 27°C CAT (22°C OAT plus 5°C ram rise). At this point note that the brake horsepower, read at the left hand scale, is 2425. Proceed horizontally to the right to the base line and draw a contour parallel to the guide lines. Enter the dew point scale below at 60°F, follow the guide lines to 1500 feet pressure altitude and then go vertically upwards to the contour line just drawn. At this point the power is approximately 2365 BHP. Since the first pressure altitude-CAT point indicates that the power will be obtained with part throttle setting, it is permissible to regain some of this power loss due to humidity by increasing the manifold pressure above the standard day limits (shown on figure A2-1). Enter the dew point scale on the auxiliary graph at 60°F and read the allowable increase in manifold pressure, 0.5 inches Hg. Re-enter the main graph where we left off (2365 BHP), continue to the right to the next base line and follow the guide lines as far as 0.5 inches Hg. Continue horizontally to the right hand scale and read the predicted brake horsepower, 2385. From the intersection of the 95% of predicted BMEP curve and 2385 BHP, drop straight down to the scale below and read 95% of the predicted BMEP, 229 PSI. Use this power for determining takeoff performance.

2. The next step is to find out if the estimated takeoff weight will meet all takeoff requirements. Turn to the Takeoff Gross Weight Limited by Three-Engine Climb Performance Chart *(figure A3-2)*. Enter the chart at a density altitude of 2600 feet, as determined from the Density Altitude chart *(figure A1-11)* at 22°C and 1500 feet pressure altitude, and proceed vertically to 229 BMEP. Proceed horizontally to the right to the first bold line which shows the maximum allowable takeoff gross weight for normal operation, 107,000 pounds. This is well in excess of the estimated takeoff gross weight of 99,825 pounds. By continuing to the right to the next bold line it may be seen that the maximum allowable takeoff gross weight for an emergency is 112,000 pounds. By continuing even farther it may be seen that the 50 feet per minute rate of climb requirement for the configuration noted on the chart is met at approximately 124,500 pounds.)

3. Determine the takeoff factor by entering the Takeoff Performance — Takeoff Factor chart *figure A3-1)* at an OAT of 22°C and proceeding vertically to a pressure altitude of 1500 feet. Read across to a BMEP of 229 psi and down to find a takeoff factor of 4.3.

4. The critical field length may be determined from the Critical Field Length — Brakes Only chart *(figure A3-6)*. Enter the chart with a take-

off factor of 4.3 and read across to a gross weight of 99,825 pounds. Read down to find zero wind/zero slope critical field length of 5070 feet. Correct for a 10 knot headwind (50 percent of reported headwind) by following the guide line to 10 knots and reading down to find corrected field length of 4400 feet. To correct for slope enter the Effect of Runway Slope on Ground Run chart *(figure A3-4)* with a distance without runway slope of 4400 feet. Read up to the −0.015 (downhill) slope correction curve and across to find corrected critical field length of 3980 feet.

5. The refusal speed may be determined from the Takeoff Performance—Refusal Speed—Brakes Only chart *(figure A3-8)*. Enter the chart with a takeoff factor of 4.3 and proceed horizontally to the available runway length of 8000 feet. Read down to a gross weight of 99,825 pounds and across to find the zero wind/zero slope refusal speed of 104.2 knots IAS. Correcting for runway slope of 0.015 downhill and for 10 knots headwind results in a corrected refusal speed of 106.5 knots IAS.

6. The ground run is determined from the Takeoff Performance—Ground Run chart *(figure A3-3)*. Follow the same method described for the other takeoff performance charts using a takeoff factor of 4.3 and the takeoff gross weight of 99,825 pounds. For the given conditions the ground run without wind or slope correction is 3980 feet. Correct for headwind by following the guide lines to 10 knots and reading down for corrected ground run of 3380 feet. Correct for runway slope by entering the Effect of Runway Slope on Ground Run chart *(figure A3-4)* with a distance without runway slope of 3380 feet. Read up to the slope correction curve for −0.015 downhill and across to find corrected distance of 3090 feet. The takeoff speed corresponding to the ground run is read from the gross weight curves on the ground run chart as 112 knots IAS.

7. The acceleration check point and speed may now be determined from the Takeoff Performance — Distance and Time Versus Speed chart *(figure A3-10)*. Enter the scale at the top of the chart with the takeoff speed of 112 knots IAS. Follow the headwind guide lines to 10 knots for a corrected takeoff speed of 102 knots IAS. Read down to the ground run (corrected for wind and slope) of 3090 feet and establish a contour line by following the guide lines. Enter the chart with the refusal speed, corrected for wind and slope of 106.5 knots IAS and correct for a 10 knot headwind to obtain a corrected speed of 96.5 knots IAS. Read down to the previously established contour line and across to find the refusal distance of 2700 feet. Follow the contour line to the first thousand foot marker below refusal distance or 2000 feet. This marker represents the acceleration check point. At the intersection of the checkpoint distance and the contour line read the acceleration check speed, minus wind correction, of 85 knots. Correct the check speed for wind by reading up to the wind correction grid to 10 knots and following the headwind guide line to zero wind for a corrected acceleration check speed of 95 knots IAS.

8. An acceleration increment time check may be preferred to the acceleration speed and distance check. To determine the acceleration increment time check enter the Takeoff Performance — Acceleration Increment Time Check chart *(figure A3-11)* with the takeoff ground run for zero wind but corrected for slope of 3610 feet. Read across to a gross weight of 99,825 pounds and down to the Sea Level altitude line. Follow the guide lines to a density altitude of 2600 feet and read down to the 100 knot line, read the time of 27.5 seconds at the time scale at the bottom of the chart. Follow the guide lines from 100 knots to 60 knots and read the time of 14 seconds. The difference between the two times (27.5 − 14 = 13.5 seconds) is the time required to accelerate from 60 to 100 knots IAS.

The values obtained above for 95% of predicted BMEP critical field length, refusal speed, accleration check point, acceleration check speed, and liftoff speed may be entered in the appropriate places on the Takeoff and Landing Data Card under the Takeoff Data column labeled "Wet" (meaning all four ADI units operative). In a similar manner takeoff data for standard fuel grade, dry, may be obtained and entered on the card. The liftoff speed and dump time are the same for either wet or dry power. The charts used in determining takeoff data for the dry power are the same as those used for the wet power except for 95% of the predicted BMEP which is obtained from figure A2-5. It will be seen when determining the dry power takeoff data that the takeoff requirements are still met at 99,825 pounds gross weight.

1. The items under "LANDING DATA (TAKEOFF WEIGHT)" are for landing shortly after takeoff, if some emergency demands it. The atmospheric and runway conditions are the same as those listed under "TAKEOFF CONDITIONS." The threshold speed may be obtained from the Liftoff, Landing, and Stalling Speeds chart (*figure 2-5* in Section II). For 99,825 pounds gross weight the threshold speed is approximately 112 knots IAS (130% of stalling speed with flaps full down). The landing distance from a 50 foot height may be determined

from the Landing Ground Roll — Brakes Only chart *(figure A6-7)*. Enter the chart with a density altitude of 2600 feet and read across to a gross weight of 99,825 pounds. On the scale directly below read the landing ground roll with no wind, 2750 feet. Follow parallel to the guide lines to a 10 knot headwind. On the scale directly above read the ground roll corrected for wind, 2420 feet. Obtain the total landing distance from a 50 foot height on the scale directly below of 3470 feet.

Filling out the Landing Data Card.

The information on the Landing Data Card is for landing at the intended destination at the predicted landing gross weight. The threshold speed may be obtained from the Takeoff, Landing and Stalling Speeds Chart (*figure* 2-7 in Section II). At 82,700 pounds gross weight this is approximately 103 knots (130% of the stalling speed with flaps full down). The landing distance from a 50 foot height may be determined from the Landing Ground Roll — Brakes Only Chart *(figure A6-2)*. Determine the density altitude at destination for 2000 feet pressure altitude and 20°C from the Density Altitude chart *(figure A1-11)* as 3000 feet. Enter the Landing Ground Roll — Brakes Only chart at a density altitude of 3000 feet and read across to the gross weight at destination of 82,700 pounds. Read down to find the landing ground roll of 2310 without wind correction. Correct for a 15 knot headwind (50 percent of reported wind) by following the guide line to 15 knots and reading up for a corrected ground roll of 1860 feet. Obtain the total landing distance from a height of 50 feet from the scale directly below, of 2620 feet.

SAMPLE PROBLEM 2 — LONG RANGE MISSION.

Object of Mission:

To transport as much cargo as possible a distance of 3100 nautical miles.

GIVEN:

1. Miscellaneous conditions:

   Operating weight empty = 60,000 pounds.

   Fuel grade = standard (115/145), with water injection (ADI) used for takeoff.

   Oil carried = 1050 pounds (140 gallons).

   Fuel allowance for warm-up, taxi and takeoff = 625 pounds.

   Reserve fuel requirement = fuel for 3 hours holding at long range cruise speed at 10,000 feet altitude.

2. Takeoff conditions:

   Runway length = 9,000 feet.

   Runway slope = none.

   Pressure altitude = 500 feet.

   Temperature = 14°C.

   Dew point = 10°F.

   Wind = none.

3. Cruise conditions:

   Cruise altitude = 10,000 feet pressure altitude.

   Temperature = −5°C.

   Cruise at long range cruise speed.

   Wind = none.

4. Landing conditions:

   Runway length = 7,000 feet.

   Pressure altitude = 1,000 feet.

   Temperature = 5°C.

   Wind = none.

This type of mission differs from that discussed in sample problem 1. For long range missions it is very likely that it will not be possible to load the aircraft with capacity payload and still carry enough fuel to reach the destination without exceeding the maximum permissible takeoff gross weight. For this reason the maximum permissible takeoff gross weight is determined first, then the fuel required for the mission is estimated, and, finally, the maximum payload is solved for.

1. An examination of the takeoff conditions indicates that a takeoff is permitted at the maximum structural limit for normal operation, 107,000 pounds gross weight.

2. The initial climb weight is obtained by subtracting the fuel allowance for warm-up, taxi and takeoff from the takeoff gross weight, 107,000 − 625 = 106,375 pounds.

3. The initial cruise weight may be determined from the Time, Distance and Fuel to Climb Chart *(figure A4-2*, assuming 1500 BHP/eng). Since the temperature conditions are standard there will be no altitude correction for temperature. Enter the gross weight scale at 106,375 pounds and proceed vertically upwards to 500 feet pressure altitude and note the distance, 2 nautical miles. Continue upwards, following parallel to the guide lines, to 10,000 feet pressure altitude and note the distance, 53 nautical miles. The difference between these two values is the distance travelled during the climb, 53

$- 2 = 51$ nautical miles. From this last point drop straight down to the scale below and read the final climb weight, 105,000 pounds. This is also the initial cruise gross weight.

4. The final cruise weight may be determined from the Four-Engine Range Prediction — Distance chart *(figure A5-22)*. The cruise distance is equal to 3100 nautical miles minus the climb distance of 51 nautical miles, or 3049 nautical miles. The pressure altitude at 10,000 feet with a temperature of $-5°C$ is approximately equal to a density altitude of 10,000 feet so no correction for density altitude is necessary. Enter the gross weight scale at 105,000 pounds and proceed vertically upwards to 10,000 feet density altitude and across to the range scale at 2500 nautical miles. Add 2500 to the desired cruise distance ($3049 + 2500 = 5549$ nautical miles) and re-enter the range scale at 5549 nautical miles. Read across to an altitude of 10,000 feet and down for a final cruise gross weight of 80,700 pounds. This is also the estimated landing gross weight.

5. Determine the reserve fuel from the Four-Engine Range Prediction — Time chart *(figure A5-23)*. Enter the gross weight scale at the final cruise weight of 80,700 pounds and read up to the density altitude of 10,000 feet. Read across to the time scale at 22.0 hours. Add the holding time of 3 hours ($22.0 + 3.0 = 25.0$ hours) and re-enter the time scale at 25.0 hours. Read across to the 10,000 feet altitude curve and down for a gross weight at end of hold of 76,800 pounds. This is also the zero fuel plus oil weight.

6. To obtain the zero fuel weight subtract the oil weight from the zero fuel plus oil weight, $76,800 - 1050 = 75,750$ pounds.

7. To determine the allowable payload subtract the operating weight empty from the zero fuel weight, $75,750 - 60,000 = 15,750$ pounds.

Information for the Takeoff and Landing Data Card may be determined in the same manner as described in detail in Sample Problem 1.

C-118A AND VC-118A TAKEOFF AND LANDING DATA CARD

TAKEOFF CONDITIONS

DENSITY ALT 2600 FT.

PRESSURE ALT 1500 FT DEW PT 60 °F

OAT 22 °C + 5°C = 27 °C CAT

WIND COMP 20 (headwind) KTS GROSS WT 99.825 LBS

RUNWAY LENGTH 8000 FT SLOPE 0.015 (downhill)

SIGNIFICANT OBSTACLE HEIGHT 0

DIST FROM END OF RUNWAY —

GROSS WT. LIMITED BY CLIMBOUT OVER OBSTACLE —

GROSS WT LIMITED BY 3-ENG. RATE OF CLIMB 124,500

TAKEOFF DATA

	WET	DRY
95% PREDICTED BMEP	229	
TAKEOFF FACTOR	4.3	
CRITICAL FLD LENGTH	3980 FT	FT
GROUND RUN	3090 FT	FT
REFUSAL SPEED	106.5 KTS	KTS
ACCELERATION CHECK POINT DISTANCE/TIME	2000 ft.	
ACCELERATION CHECK SPEED	95 KTS	KTS

LIFTOFF SPEED 112 KTS

DUMP TIME 4.25 MIN

LANDING DATA (TAKEOFF WEIGHT)

LANDING GROUND ROLL 2420

THRESHOLD SPEED (130% V_{so}) 112 KTS

LANDING DISTANCE FROM 50 FT HEIGHT 3470 FT

Figure A7-1. Takeoff and Landing Data Card

C-118A AND VC-118A LANDING DATA CARD

LANDING CONDITIONS

PRESSURE ALT 2000 FT

OAT 20 °C

WIND COMP 30 (headwind) KTS GROSS WT 82,700 LBS

RUNWAY LENGTH 7500 FT SLOPE 0

DENSITY ALT 3000 FT

LANDING DATA

THRESHOLD SPEED (130% V_{so}) 103 KTS

LANDING DISTANCE FROM 50 FT HEIGHT 2620 FT

LANDING GROUND ROLL 1860

Figure A7-2. Landing Data Card

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