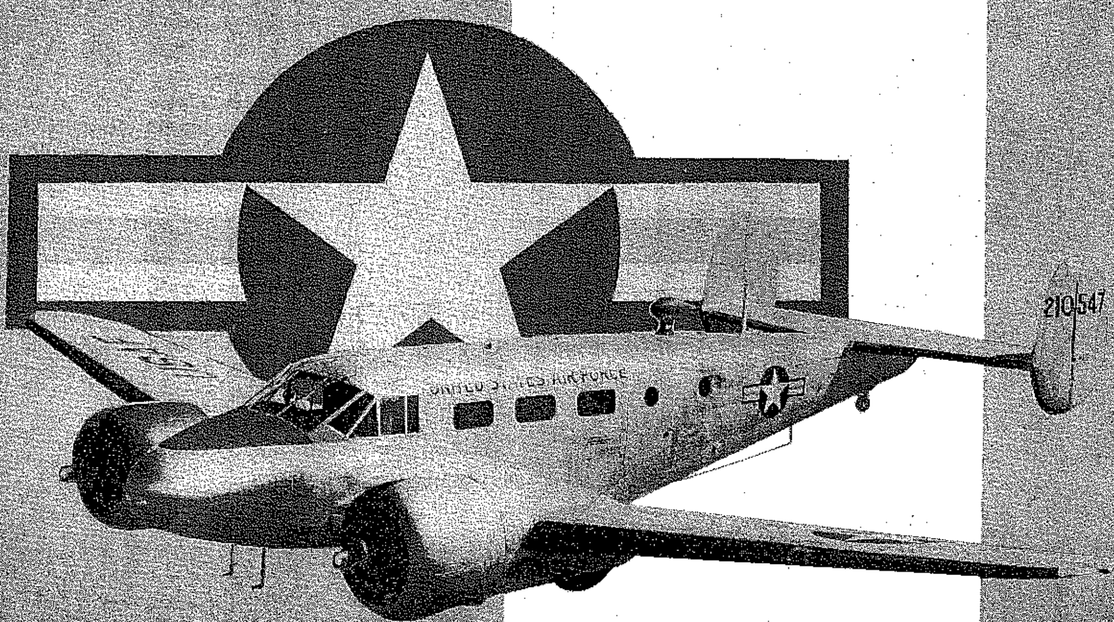
T.O. 1C-45H-1
(FORMERLY AN 01-90 CDC-1)

FLIGHT HANDBOOK

USAF SERIES
C45H
AIRCRAFT



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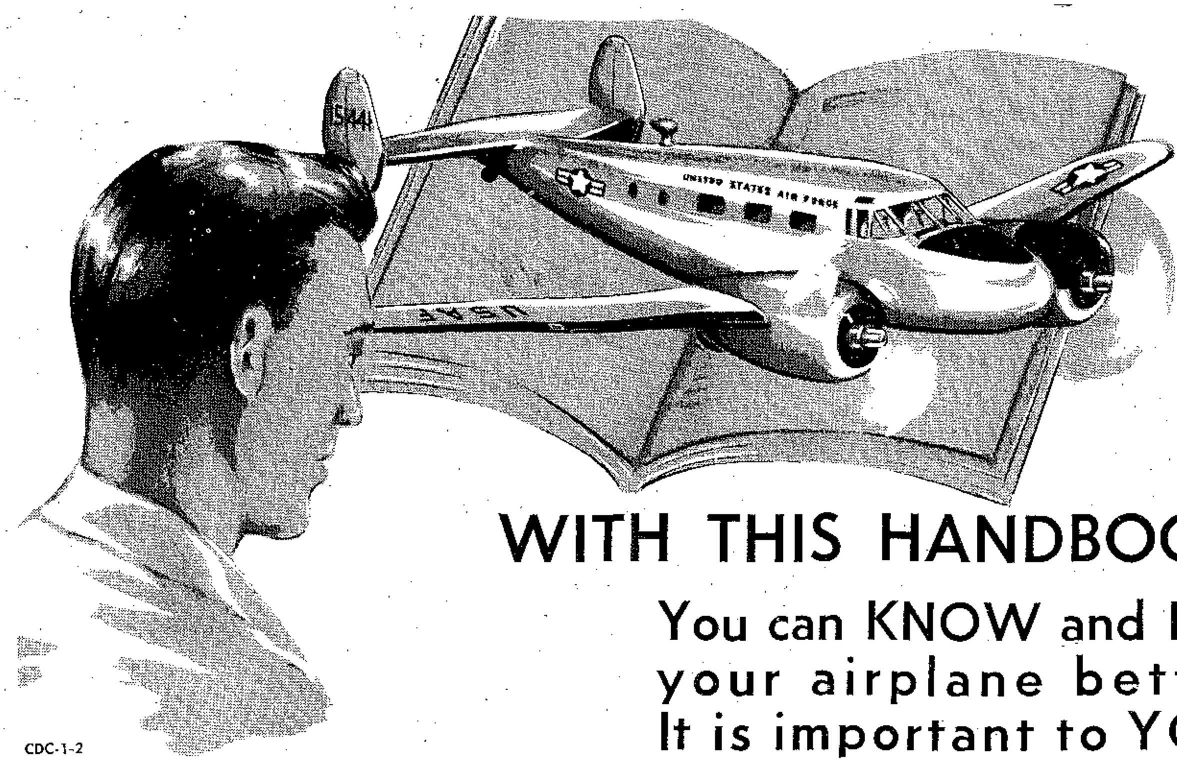

CDC-1-2

WITH THIS HANDBOOK···

You can KNOW and FLY your airplane better. It is important to YOU

This handbook contains all the information necessary for safe and efficient operation of the C-45H. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

'he instructions in this handbook are designed to pro- · for the needs of a crew inexperienced in the ation of this aircraft. This book provides the possible operating instructions under most cir- stances, but it is a poor substitute for sound judg- t. Multiple emergencies, adverse weather, ter- , etc., may require modification of the procedures .tained herein.

.ice you have learned to use one Flight Handbook, ›u will know how to use them all — closely guarded ›tandardization assures that the scope and arrangement of all Flight Handbooks are identical.

These Flight Handbooks 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 handbooks. 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. Each flight crew member, EXCEPT THOSE ATTACHED TO AN ADMINISTRATIVE BASE, is entitled to have a personal copy of the Flight Handbook. *Air Force Regulation* 5-13 specifically makes that provision. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Handbook. These good-looking, simulated-leather binders will make it much easier for you to revise your handbook as well as to keep it in good shape. These tabs and binders are secured through your local contracting officer.

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TECHNICAL ORDER 0-5-2 explains how to order Flight Handbooks so that you automatically will get all revisions, reissues, and Safety of Flight Supplements. Basically, all you have to do is order the required quantities in the PUBLICATION REQUIREMENTS TABLE (T. O. 0-3-1). Talk to your base supply officer — it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the books to the flight crews once they are received on the base.

For your information, the warnings, cautions, and notes found throughout the handbook bear the following connotation:

WARNING — Injury to personnel

CAUTION — Damage to equipment

NOTE — Information requiring

Comments and questions regarding any phase of the Flight Handbook program are invited and should be addressed to the Directorate of Systems Management, Headquarters Air Research and Development Command, Attention RDZSTH; Detachment #1, Wright-Patterson Air Force Base, Ohio.

Section I. DESCRIPTION. Here is described the aircraft and the location and function of those controls and systems which are essential to flight. Also discussed in this section are the locations and descriptions of all items of emergency equipment which are not part of an auxiliary system.

Section II. NORMAL PROCEDURES. This section contains operating instructions arranged in proper sequence to be followed from the time the flight crew approaches the airplane until it is left parked on the ramp after the completion of a normal flight.

Section III. EMERGENCY PROCEDURES. This section contains concise instructions to be followed in meeting any emergency (except those involving operational equipment) that can reasonably be expected.

Section IV. DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT. This section contains a description, plus all normal and emergency operating instructions for equipment and systems not actually essential to the flight of the airplane.

Section V. OPERATING LIMITATIONS. This section includes operating limitations of the aircraft that must be observed during all operating conditions.

Section VI. FLIGHT CHARACTERISTICS. This section describes the general flight characteristics of the airplane.

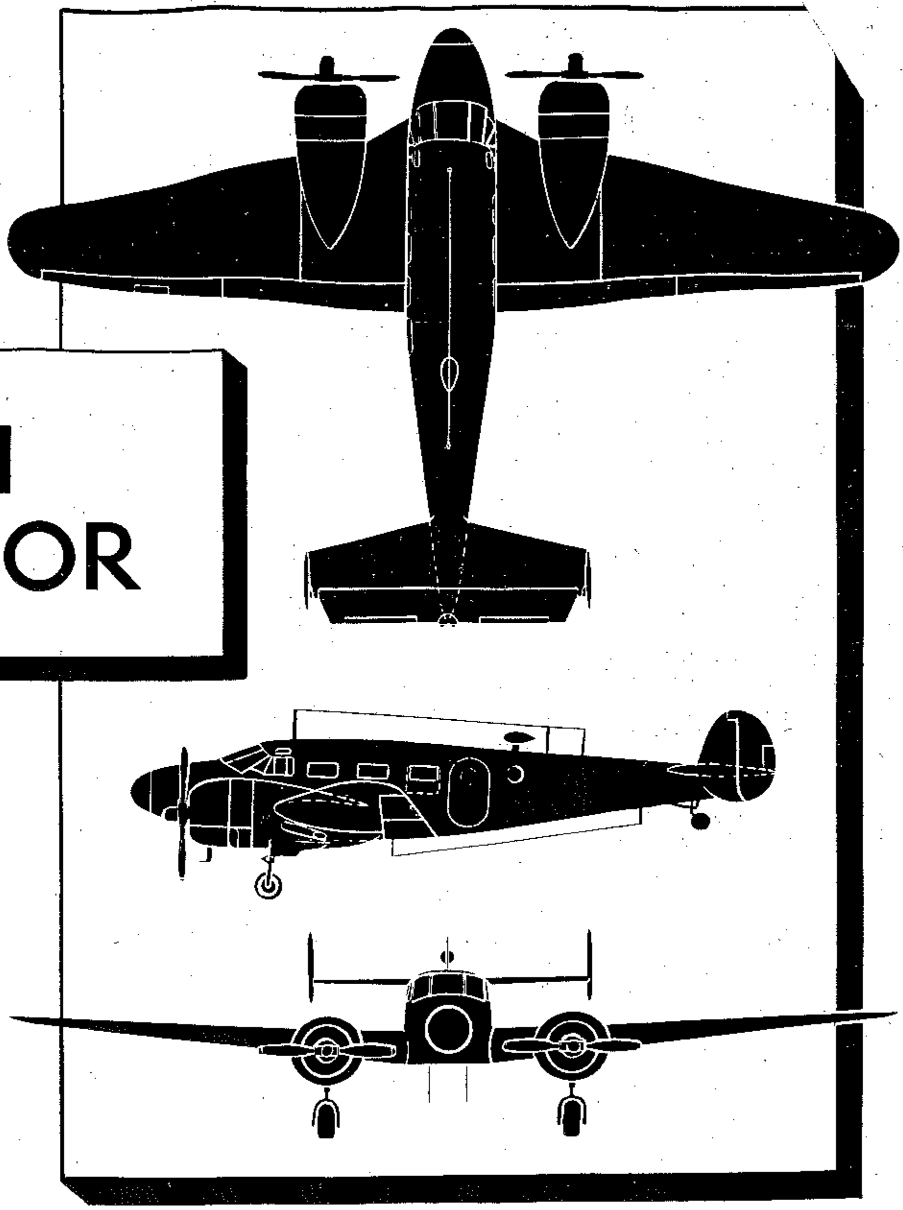
Section VII. SYSTEMS OPERATION. This section discusses the operation and characteristics of specific aircraft systems under various conditions of aircraft operation.

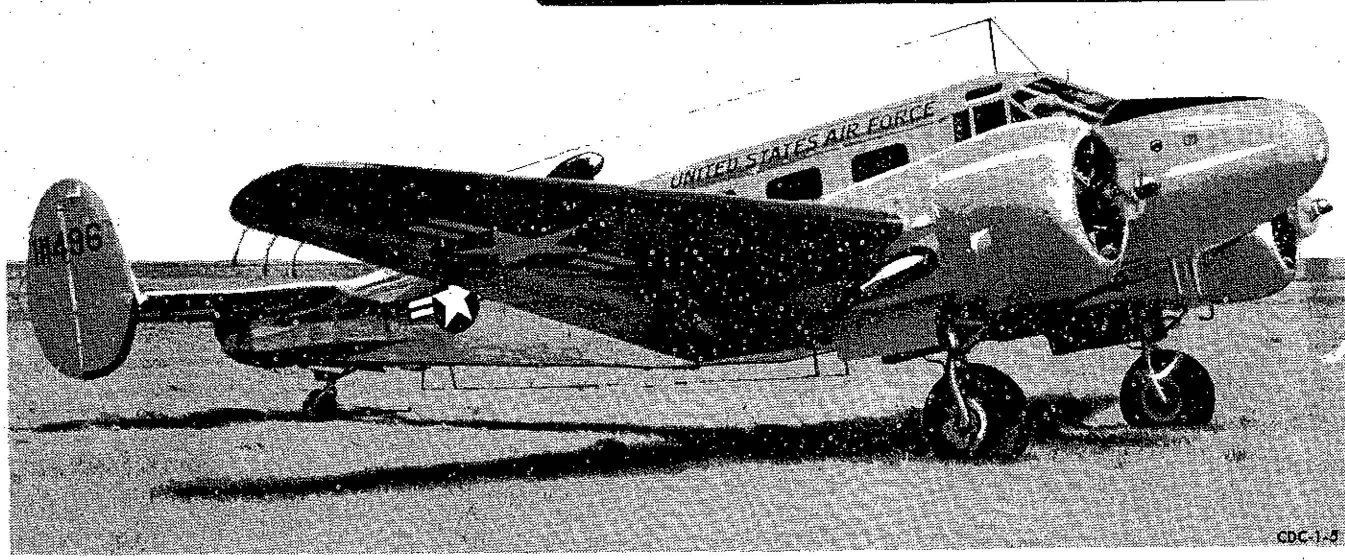
Section VIII. CREW DUTIES. Since the Model C-45H airplane may be flown by one pilot, this section is not applicable.

Section IX. ALL-WEATHER OPERATION. This section covers the proper procedures and techniques to be employed during night flight, instrument flight, turbulent air flight and extreme cold and hot weather operation.

APPENDIX I. PERFORMANCE DATA. This appendix contains all operating data graphs necessary for pre-flight and in-flight mission planning and includes explanatory text and sample problems for the data presented.

C45H EXPEDITOR





CDC-1-5

Figure 1-1

section I DESCRIPTION

THE AIRCRAFT.

The C-45H is a twin engine, low wing, land monoplane manufactured by the Beech Aircraft Corporation. This aircraft, as modified, differs only slightly from the C-45G; however, it is greatly improved, structurally and aerodynamically, where compared with the earlier C-45B and C-45F models.

Basic design and configuration remains unchanged except as noted in the Main Differences Tables, figure 1-2.

The primary mission of the aircraft is personnel transportation and four seats for passengers are provided in the cabin.

Although dual controls and dual flight instrumentation are provided, the aircraft can be safely and efficiently operated by one pilot from the left pilot seat.

Dual flight instrumentation, plus interior and exterior lighting are provided for safe and efficient operation at night or under instrument conditions.

DIMENSIONS.

The following are approximate dimensions of the aircraft:

Wing Span	47 ft. 8 in.
Length	34 ft. 2 in.
Height	9 ft. 2 in.
Tread (Main Wheels)	12 ft. 10 in.

GROSS WEIGHT.

The approximate gross take-off weight of the aircraft is 9300 pounds. Reference should be made to Section V for a complete discussion of conditions created by various loadings.

ENGINES.

The aircraft is powered by two R-985-AN-14B, 9-cylinder, single row, radial, air cooled engines. The engines have direct propeller drive and incorporate a noncontrollable, single speed, single stage blower which operates whenever the engine is running. Engine controls are mounted on the control pedestal (figure 1-5) and are easily accessible to either pilot.

THROTTLES.

The throttles (figure 1-5), mounted on the pedestal, are mechanically linked to the carburetors. The throttle friction lock (figure 1-5), between the throttles, prevents creeping from any desired position by increasing friction on the levers. Upward movement of the lock handle increases, while downward movement decreases, the friction. Switches which close the circuit to the landing gear warning horn and the landing gear malfunction light, are actuated by the throttles when they are retarded to a position which corresponds to approximately 12 inches of manifold pressure.

MIXTURE LEVERS.

The mixture levers (figure 1-5), located on the pedestal, are mechanically linked to the mixture control valves in the carburetor. They are used for manually changing the fuel-air mixture to the engine to obtain efficient engine operation and maximum fuel economy. The fully advanced position is FULL RICH, while the fully retarded position is the IDLE-CUT-OFF position. The FULL RICH position provides the high fuel air ratios needed for high power operation such as take-off and landing (in the case of a go-around). The IDLE-CUT-OFF position shuts off all fuel flow to the engine except through the priming system.

The mixture lever friction lock (figure 1-5) on the right side of the pedestal is the same in operation as the throttle lock; it also applies friction to the oil shutter levers.

MANIFOLD HEAT LEVERS.

The manifold heat levers (figure 1-5), located on the

MAIN DIFFERENCES TABLE

ITEM	C-45B, F	C-45G	C-45H	TC-45G
Nacelle	Short Upper Section	Upper Section Extender	Upper Section Extender	Upper Section Extender
Center Section Leading Edge		Leading Edge Extended Between Fuselage and Nacelles	Leading Edge Extended Between Fuselage and Nacelles	Leading Edge Extended Between Fuselage and Nacelles
Cabin Interior	5 Passenger Seats	4 Passenger Seats	4 Passenger Seats	3 Navigation Positions
Oxygen Equipment	2 Type G-1 Cylinders on Some Aircraft	3 Type G-1 Cylinders	None	3 Type G-1 Cylinders
Propeller	Hamilton Standard Constant Speed (Aeroproducts Full Feathering on Some Aircraft)	Aeroproducts Full Feathering	Hamilton Standard Hydramatic Full Feathering	Aeroproducts Full Feathering
Emergency Fuel Pump	Hand Operated Wobble Pump	Electric Fuel Booster Pumps (Front Wing Tanks Only)	Electric Fuel Booster Pumps (Front Wing Tanks Only)	Electric Fuel Booster Pumps (Front Wing Tanks Only)
Landing Gear	Welded Steel Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel
Brakes	Bendix Internal	Goodyear External Single Disc Key or Gear Type	Goodyear External Single Disc Key or Gear Type	Goodyear External Single Disc Gear Type
Auto Pilot	A3 Sperry or A-3A Jack & Heintz on Most Aircraft	A-3A Jack & Heintz	None	A-3A Jack & Heintz
Upper Exterior Fuselage	No Astrodome	No Astrodome	No Astrodome	Astrodome
Engine Fire Extinguisher	CO_2	CO_2	CB	CO_2
Ignition Switches	Off in Vertical Position	Off in Horizontal Position	Off in Horizontal Position	Off in Horizontal Position

CDC-1-7A

Figure 1-2

pedestal, employ mechanical linkage to the manifold heat valves at the base of the carburetor throats. The full up position of the levers is the COLD position and full down is the HOT position, with intermediate positions delivering mixed hot and cold air. Air for carburetor anti-icing is ducted from inlets between the engine cylinders to muffs around the exhaust collector ring. It is heated and then ducted to the carburetor intake, where it is either dumped overboard or directed into the carburetor, depending on the position of the manifold heat valves. Heat will be used only when the mixture temperature is in the icing range, temperatures below the icing range should not necessarily be avoided.

The manifold heat lever friction lock (figure 1-5), on the left side of the pedestal, is the same in operation as the throttle friction lock. It is also used to apply friction to the propeller levers.

COWL FLAP HANDLES.

The cowl flap handles (figure 1-6), on the left side of the pedestal, are mechanically linked to the cowl flaps on the lower portion of the engine cowling. The handles have a lock incorporated in their housings, which lock the handles, and also the cowl flaps in the desired position. Turning the handles one quarter turn clockwise will disengage the lock, allowing the handles to be repositioned. The full out position of the handles is the FULL OPEN, or maximum engine cooling, position of the cowl flaps; and full in on the handle is the FULL CLOSED position. There is also a slightly open, or "TRAIL" position, which allows sufficient air flow for adequate cooling at reduced airspeeds.

IGNITION SWITCHES.

The ignition switches (figure 1-7) on the left subpanel are the conventional individual engine ignition switches which incorporate a master on-off switch.

STARTING SYSTEM.

The starting system employs a direct drive electric starter, an ignition booster coil and an electric primer for each engine. One set of controls operates both systems and is routed through the engine selector switch to the units of the engine being started.

ENGINE SELECTOR SWITCH.

The engine selector switch (figure 1-7) on the left subpanel, used to select the engine for starting, has LEFT ENGINE-OFF-RIGHT ENGINE positions. When moved to either engine position, it completes the electrical circuits between the starter, primer and ignition booster switches and their respective units on the engine selected. When the engine selector switch is in the OFF position, the control switches are inoperative.

STARTER SWITCH.

The starter switch (figure 1-7) under the safety cover on the left subpanel is a push-button switch which energizes the starter as selected by the engine selector switch.

PRIMER SWITCH.

The primer switch (figure 1-7) located under the safety cover on the left subpanel, is a push-button switch electrically connected to the priming solenoid through the engine selector switch. When the primer switch is depressed, it opens the priming valve, allowing raw fuel under boost pump pressure to enter the top five cylinders of the engine selected. The primer switch is also electrically connected to the fuel booster pumps through the engine selector switch and will activate both booster pumps regardless of the position of the fuel booster pump switch. However, fuel will be delivered only to the engine selected since only that primer solenoid valve will be open.

IGNITION BOOSTER SWITCH.

The ignition booster switch (figure 1-7), under the safety cover on the left subpanel, is a push-button switch which, through the engine selector switch, activates the ignition booster coil of the engine selected. Since output of the magnetos is very low at the slow speeds encountered in starting, the induction vibrator has been incorporated in the ignition system to boost the voltage for easier starting.

ENGINE INSTRUMENTS.

ENGINE GAGE UNITS.

An engine gage unit for each engine is mounted on the instrument panel. These instruments utilize direct pressure lines to indicate fuel and oil pressure in pounds per square inch; and a temperature bulb, dependent on the aircraft electrical system, to indicate oil temperature in degrees centigrade.

MANIFOLD PRESSURE GAGE.

This instrument, mounted on the instrument panel, is a dual gage furnishing, in inches Hg, an indication of the pressure within the intake manifold of each engine. A direct pressure line connects the gage to each engine.

TACHOMETER.

The tachometer, also on the instrument panel, is a dual instrument using self generated current, completely independent of the aircraft electrical system, to indicate the speed of each engine.

CARBURETOR MIXTURE TEMPERATURE GAGE.

Aircraft electrical power is utilized to transmit an indication of the temperature of the fuel-air mixture in each engine's induction system to a dual gage on the instrument panel. The indication is in degrees centigrade.

CYLINDER HEAD TEMPERATURE GAGE.

The temperature of cylinder heads on each engine is indicated on a dual gage on the instrument panel. The units operate on current generated by thermocouples and so are independent of the aircraft electrical system.

PROPELLERS.

This aircraft is equipped with Hydromatic, two blade, constant speed, full feathering propellers. These propellers utilize engine oil under engine pump pressure, and engine oil under governor boost pump pressure, to hydraulically change propeller pitch so that a given engine speed, as determined by governor setting, remains constant.

PROPELLER FEATHERING.

Engine oil is also used for the feathering and unfeathering functions of the propeller. In these instances, however, both the pressure and quantity of oil delivered to the propeller is increased by an electrically operated feathering pump. This pump makes possible a much more rapid feathering operation.

PROPELLER LEVERS.

The propeller levers, located on the left side of the pedestal (figure 1-5), control the governor setting and thus engine speed. They are so adjusted that the full forward, or TAKE-OFF RPM, position positions the governor so that the proper rpm for maximum power is the result. Moving the propeller levers aft results in progressively reduced engine speed. These levers are mechanically linked to their respective propeller governors.

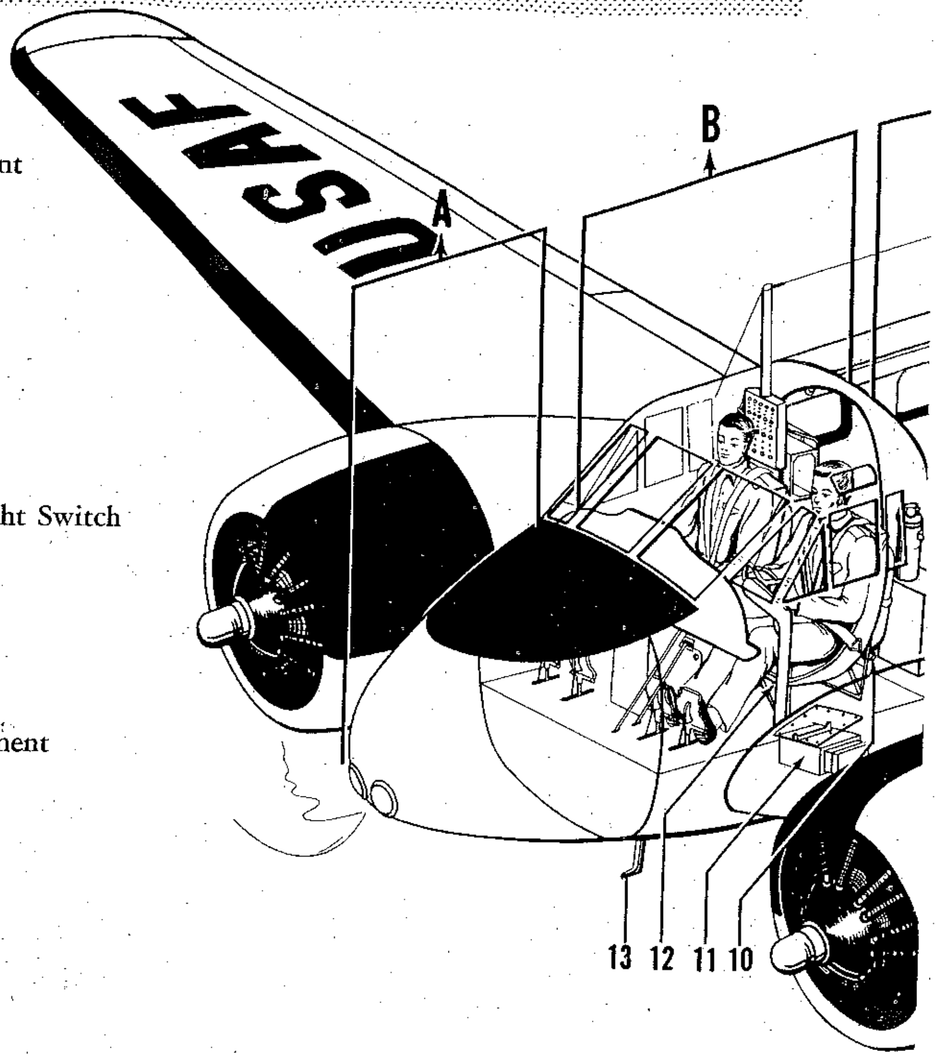
PROPELLER FEATHERING BUTTONS.

Two propeller feathering buttons, one for each propeller, are located on a small panel in the cutout for the automatic pilot (figure 1-10). These buttons operate the feathering pump motor and are so designed that to feather the propeller it is necessary only to "push" the button. The button remains in until feathering is complete and then automatically "pops out". To unfeather, the same button is again depressed, but in this case it is necessary to hold the button in until the engine is turning approximately 1000 rpm.

OIL SYSTEM.

The oil system in this airplane is a simple system used for engine lubrication and propeller operation. Oil is supplied to the oil pressure pump from the oil supply tank and returns to the tank through the oil cooler radiator. The oil supply tank filler openings are located on the inboard upper portion of the nacelles. Each tank has a capacity of 8 gallons, of which 6½ gallons are usable, and an expansion space of 3 gallons. Within the tank, approximately 6 quarts of oil are

GENERAL ARRANGEMENT DIAGRAM



A. Nose Baggage Compartment
B. Pilot's Compartment
C. Cabin
D. Radio and Toilet
E. Tail Section
1. Emergency Escape Hatch
2. Rear Cabin Red Dome Light Switch
3. Static Source
4. Rear Radio Junction Box
5. Chemical Toilet
6. Tool Kit and Misc. Equipment
7. Parachute Stowage
8. Generator Control Box
9. External Power
10. Pilot's Inertia Reel
11. Battery (typical both sides)
12. Relief Tube
13. Pitot Mast

Figure 1-3. (Sheet 1 of 2)

held in reserve so the propeller can be feathered even though the engine oil is depleted. Oil grade and specification will be found in the Servicing Diagram, Section I.

OIL COOLERS.

The oil coolers, located in the firewall in each nacelle, are radiators for cooling the returning engine oil. The volume of air allowed to pass through the coolers is controlled by the oil cooler shutters located in the air duct on the air inlet side of the radiators.

OIL SHUTTER LEVERS.

The oil shutter levers (figure 1-5), located on the

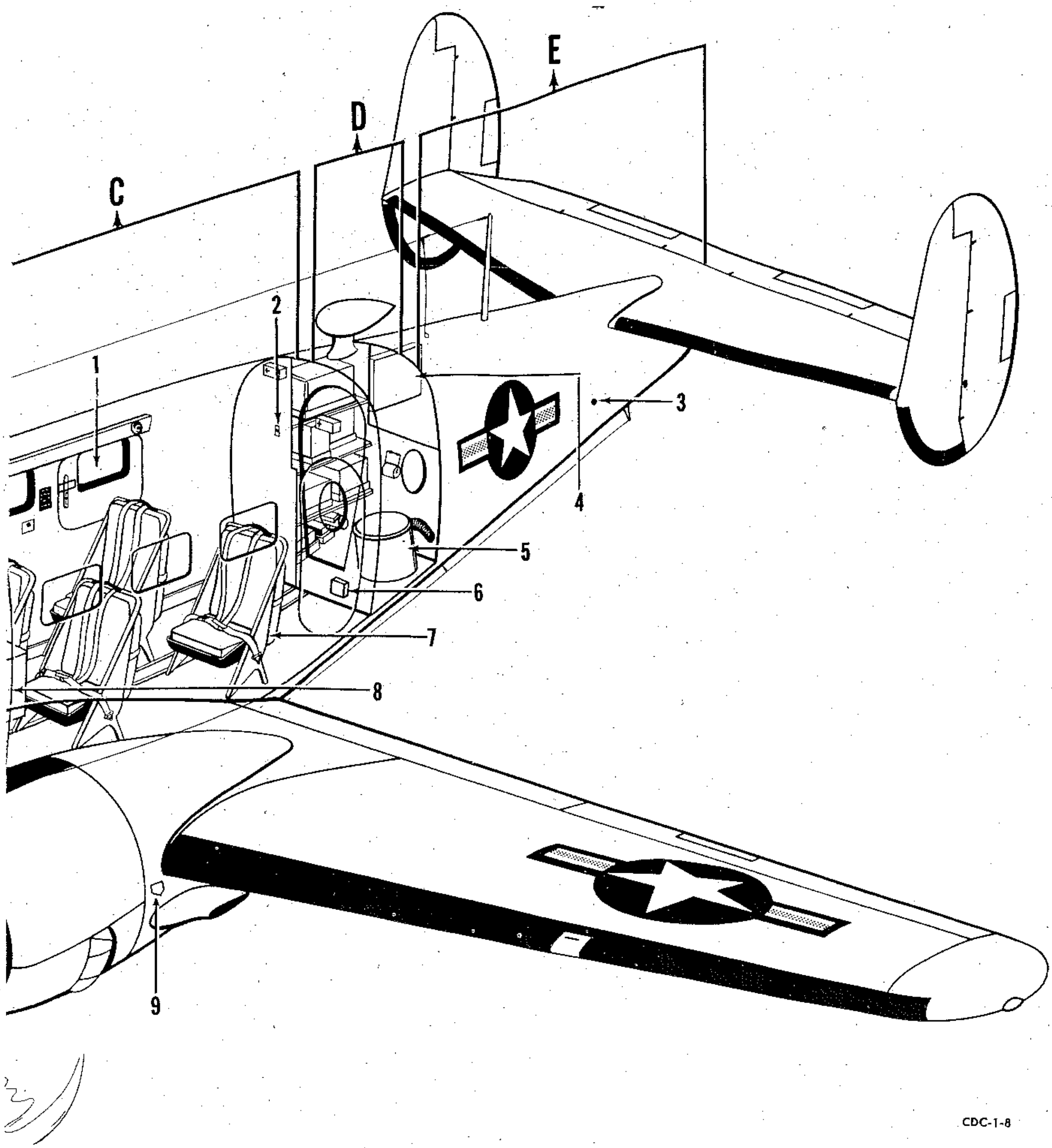


Figure 1-3. (Sheet 2 of 2)

pedestal, are mechanically linked to the shutters, which regulate the volume of air allowed to pass through the coolers. The full up position of the levers is the COLD (shutters opened) position; full down is the HOT (shutters closed) position. The shutters may be set in any desired position through their full travel, as conditions require.

The oil shutter levers, and thus the shutters, may be locked in any desired position by the friction lock (figure 1-5) on the right side of the pedestal. The friction lock is the same in operation as the throttle friction lock and also serves the mixture control levers.

PILOTS' COMPARTMENT

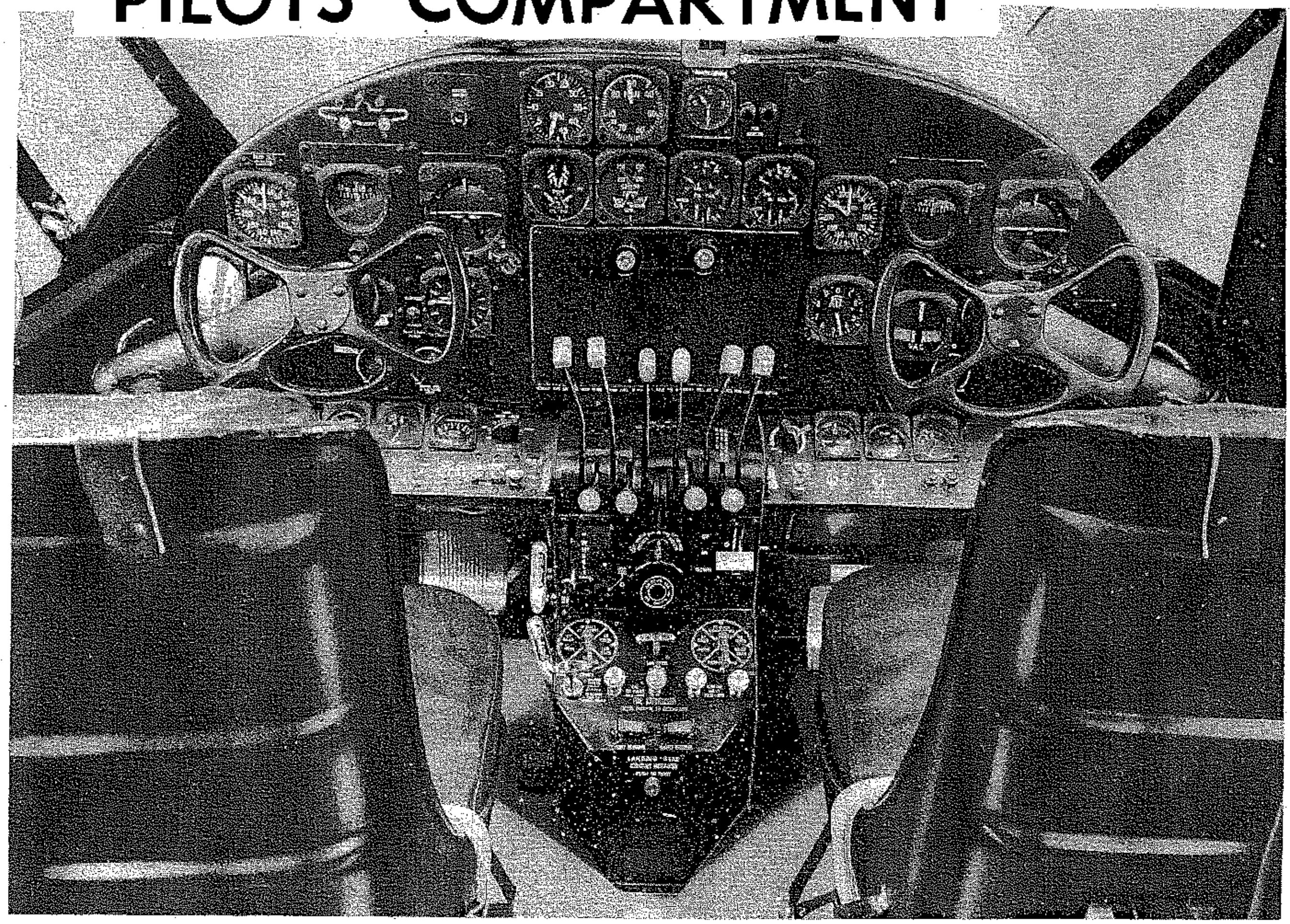


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Figure 1-4

OIL BY-PASS BUTTONS.

The oil by-pass buttons (figure 1-5) on the pedestal are mechanically linked to the oil by-pass valves in the engine compartments. The controls are the push-pull type, incorporating an automatic position lock which should be released by depressing the center plunger when the control is repositioned. Pulling the button all the way out places the valve in the HOT oil (by-pass valve open) position, pushing it all the way in places the valve in the COLD oil (by-pass valve closed) position. The control has only two operating positions, full out or full in. Pulling the control out allows the oil to by-pass the coolers and flow from the engine directly to the oil supply tank for quicker warm-ups in cold weather and to maintain oil temperature during cold weather operation.

The by-pass valves are relief type valves and in the event of a clogged cooler or one in which the oil has congealed, they will automatically by-pass the oil around the cooler to the supply tank, preventing damage to the cooler or loss of oil from ruptured lines.

OIL DILUTION SWITCHES.

The oil dilution switches (figure 1-7) on the left subpanel are momentary toggle switches, which are normally in the OFF position. When the switch is moved to the ON position, it opens the oil dilution solenoid valve allowing fuel, under pressure, from the carburetor to be injected into the "Y" drain of the oil system to facilitate cold weather starting.

FUEL SYSTEM.

The fuel system basically is an individual system for each engine, interconnected by a suction cross-feed

1. Propeller Levers.
2. Throttles.
3. Warning Horn Silencer.
4. Mixture Levers.
5. Mixture and Oil Shutter Levers Lock.
6. Oil Shutter Levers.
7. Aileron Trim Tab Wheel.
8. Flap Lever.
9. Right Engine Fuel Selector Handle.
10. Cabin Heat Buttons.
11. Left and Right Engine Fire Extinguisher Switches.
12. Landing Gear Motor Circuit Breaker.
13. Oil By-Pass Buttons.
14. Parking Brake Handle.
15. Right Engine Cowl Flap Handle.
16. Left Engine Fuel Selector Handle.
17. Tail Wheel Lock Handle.
18. Landing Gear Lever.
19. Landing Gear Malfunction Light Test Switch.
20. Left Engine Cowl Flap Handle.
21. Aileron Trim Tab Position Indicator.
22. Throttle Lock.
23. Manifold Heat Levers.
24. Propeller and Manifold Heat Levers Lock.

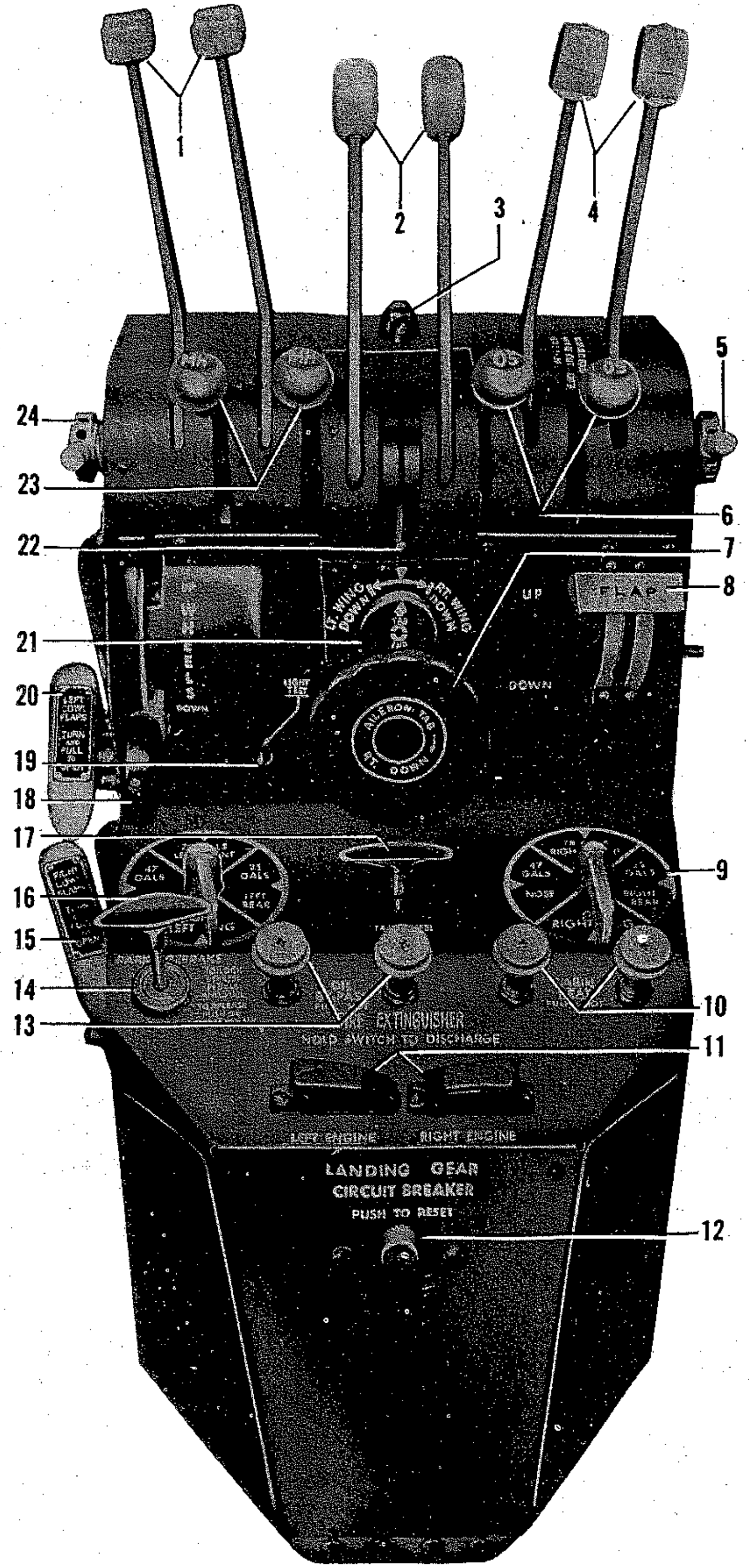

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Figure 1–5. Control Pedestal

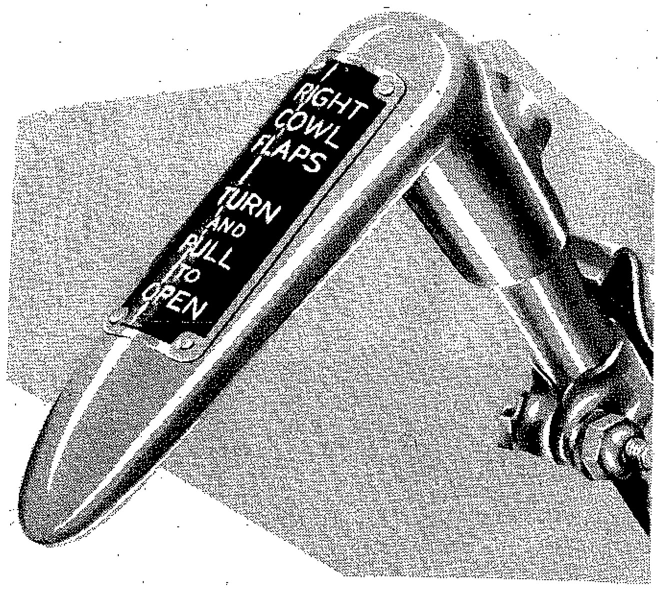

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Figure 1-6. Cowl Flap Handle

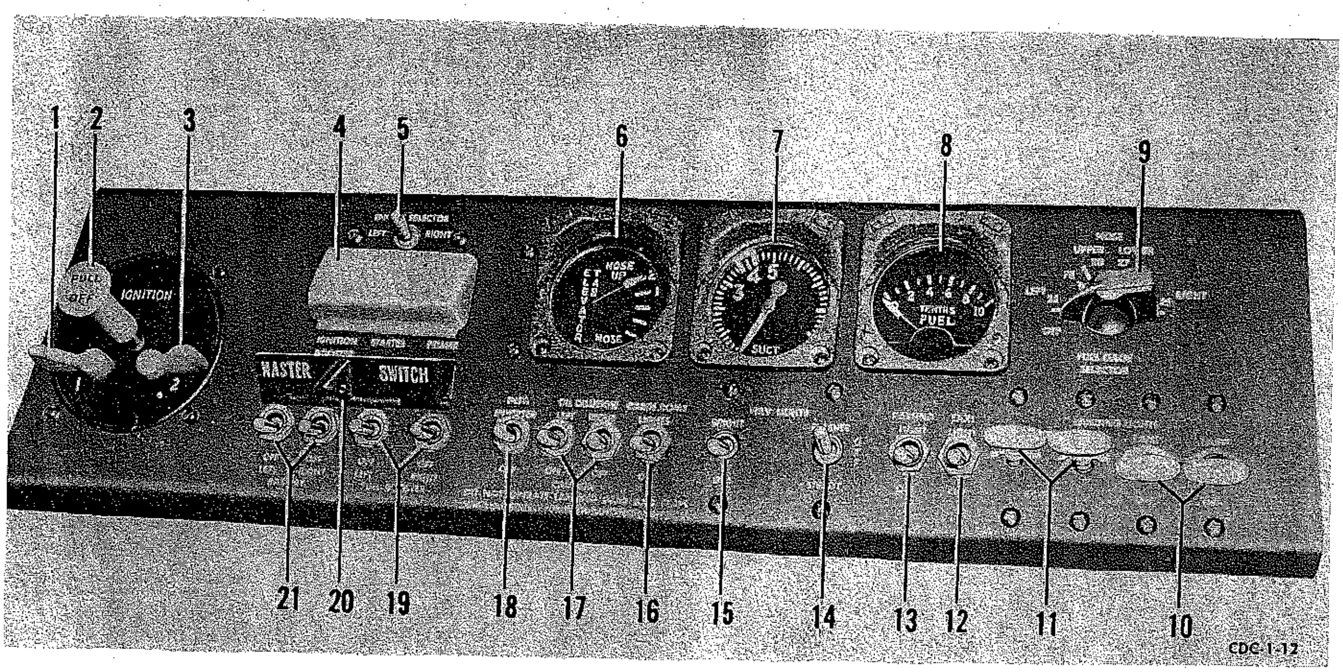
valve. In each system there is a front fuel tank, which has a submerged electric fuel booster pump; and a rear fuel tank, both located in the wing root. In the nose is a tank comprised of two fuel cells (upper and lower) which is a part of both systems. The nose cells are separated for ease of installation, but are interconnected and drain through a common sump. Fuel quantities for each tank and cell are read on a single instrument.

NOTE

The engines will not operate on gravity pressure alone if both engine and boost pumps fail, since the tanks are so near the same level as the carburetors.

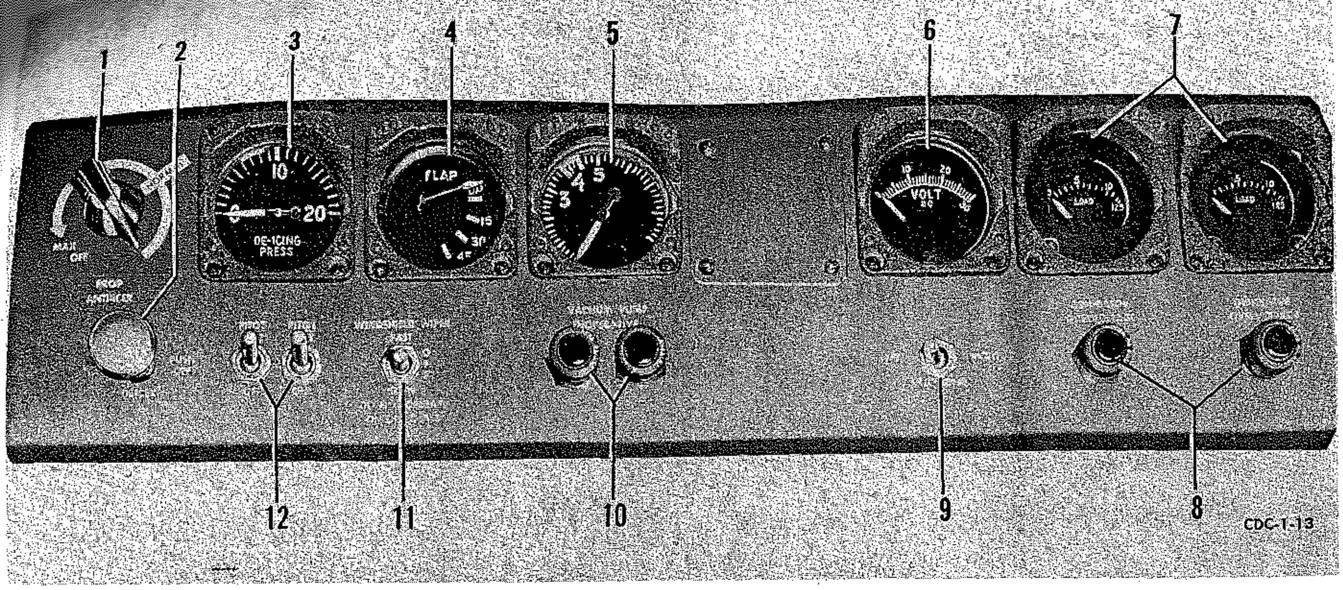
ENGINE FUEL SELECTOR HANDLES.

The fuel selector handles (figure 1-12) on the pedestal are used, one for each engine, to select the tank from which you wish to operate the engine. The left handle is placarded LEFT ENGINE OFF - NOSE - LEFT FRONT - LEFT REAR. The right handle is similarly placarded for the right tanks and engine. Each selector will allow fuel to flow from only one tank at a time.



1. Left Engine Ignition Switch.
2. Master Engine Ignition Switch.
3. Right Engine Ignition Switch.
4. Ignition Booster, Starter and Primer Switches Cover.
5. Engine Selector (Starting System).
6. Elevator Tab Position Indicator.
7. Pilot's Suction (Vacuum) Gage.
8. Fuel Gage.
9. Fuel Gage Tank Selector Switch.
10. Landing Light Lamp Switches.
11. Landing Light EXTEND-RETRACT Switches.
12. Taxi Light Switch.
13. Passing Light Switch.
14. Navigation Lights Switch.
15. Navigation Lights Dimmer Switch.
16. Cabin Dome Lights Switch (White Lights).
17. Engine Oil Dilution Switches.
18. Instrument Inverter Switch.
19. Fuel Booster Pump Switches.
20. Master Switch Bar.
21. Battery Switches.

Figure 1-7. Left Subpanel



1. Prop Anti-Icer Pump Knob.
2. Wing and Tail Deicer Button.
3. Wing and Tail Deicer Pressure Gage.
4. Flap Position Indicator.
5. Copilot's Suction (Vacuum) Gage.
6. Voltmeter.
7. Generator Load Meters.
8. Generator Inoperative Lights.
9. Voltmeter Switch.
10. Vacuum Pump Warning Lights.
11. Windshield Wiper Switch.
12. Pitot Heater Switches.

Figure 1-8. Right Subpanel

SUCTION CROSS-FEED HANDLE.

The suction cross-feed handle (figure 1-13), located under the copilot's seat, is for use in those emergencies where it is necessary to operate both engines from the same tank or where it is necessary to operate one engine from the tanks in the other engine's fuel system. This cross-feed connects the two fuel supply systems up stream of the engine driven pumps.

FUEL BOOSTER PUMPS SWITCHES.

Two electric fuel booster pumps are provided in the aircraft, one in each front (main) wing fuel tank. Individual booster pump switches (figure 1-7) on the left subpanel activate the electric fuel booster pumps. The pumps are provided to supply fuel under pressure to the carburetors for priming and starting, to supplement the engine driven pumps in an emergency and as a safety feature for take-offs and landings. The engine driven pump has a by-pass valve incorporated in it through which the fuel from the booster pump passes.

NOTE

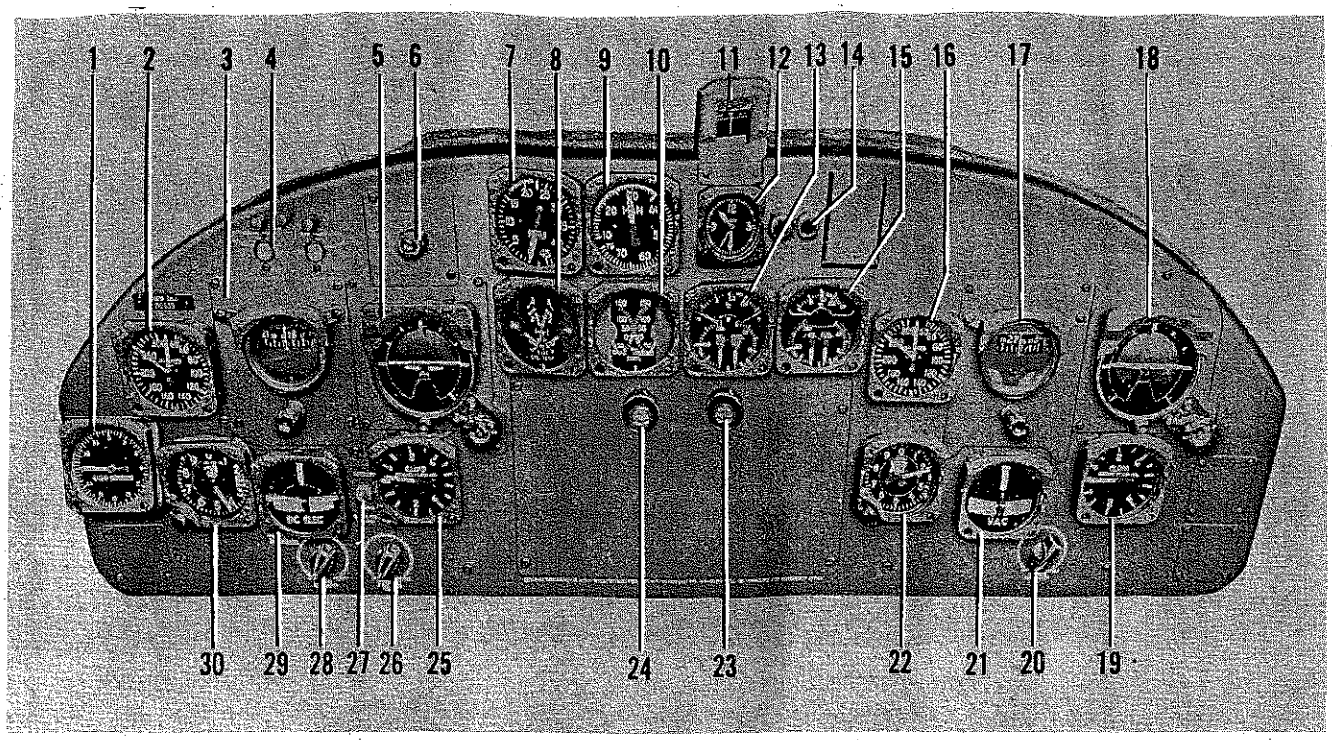
The primer switch will momentarily activate the fuel booster pumps, so that pressure is available for priming even though the booster pump switch may not have been turned ON.

FUEL SYSTEM INDICATORS.

The fuel gage and the fuel gage tank selector switch (figure 1-7) on the left subpanel are used to determine the quantity of fuel in each individual tank. The gage is calibrated in tenths of tank capacity, not in gallons.

The selector switch has seven positions, one for each tank and an OFF position. The selector switch completes the electrical connection between the gage and the liquidometers in the individual fuel tanks, eliminating the necessity for multiple gages. Each engine system has a pressure warning light (figure 1-9), mounted on the instrument panel, which will light whenever the pressure drops to 3 psi or less.

Two fuel pressure gages, one for each engine, are provided in the engine gages units on the instrument panel.



CDC-1-14 A

1. Radio Compass Indicator.
2. Pilot's Airspeed Indicator.
3. Pilot's Directional Gyro.
4. Landing Gear Position Indicator.
5. Pilot's Gyro Horizon.
6. Marker Beacon Light.
7. Dual Tachometer.
8. Dual Cylinder Head Temperature Gage.
9. Dual Manifold Pressure Gage.
10. Dual Carburetor Mixture Temperature Gage.
11. Standby Magnetic Compass.
12. Clock.
13. Left Engine Gage Unit.
14. Fuel Pressure Warning Lights.
15. Right Engine Gage Unit.
16. Copilot's Airspeed Indicator.
17. Copilot's Directional Gyro.
18. Copilot's Gyro Horizon.
19. Copilot's Rate-of-Climb Indicator.
20. Copilot's Flight Instruments Lights Rheostat Switch.
21. Copilot's Turn-and-Bank Indicator.
22. Copilot's Altimeter.
23. Right Propeller Feathering Button.
24. Left Propeller Feathering Button.
25. Pilot's Rate-of-Climb Indicator.
26. Engine Instruments and Subpanel Lights Rheostat.
27. Pilot's Turn-and-Bank Power Selector Switch.
28. Pilot's Flight Instruments Lights Rheostat Switch.
29. Pilot's Turn-and-Bank Indicator (dc electric).
30. Pilot's Altimeter.

Figure 1-9. Instrument Panel

ELECTRICAL POWER SUPPLY SYSTEM.

The electrical power supply system as provided in this aircraft is a 24 volt, direct current, single wire system, utilizing the airframe as a common ground return. Power is supplied to the system by two 28 volt, engine driven generators, one on each engine; and supplemented by two 24 volt batteries, one on each side of the fuselage, mounted in the leading edge of the center section wing between the fuselage and the engine nacelle. An external power supply receptacle is provided on the outboard side of the left engine nacelle for starting and for ground operation of electrical equipment. Refer to electrical system diagram (figure 1-15) for ac and dc operated equipment.

WARNING

DELETED

MASTER SWITCH BAR.

The master switch bar (figure 1-7), on the left subpanel, is provided so that both booster pump switches and both battery switches may be turned OFF simultaneously in event of an emergency. The bar is spring-loaded to hold it away from the switches so that it will not interfere with their normal operation.

BATTERY SWITCHES.

The battery switches (figure 1-7) on the left subpanel connect both batteries to the electrical system.

GENERATOR SWITCHES.

The generator switches (figure 1-16), one on top of each generator control box at either side of the entrance to the pilots' compartment, are toggle switches having three positions: ON - OFF - RESET. ON and OFF are fixed positions, while RESET is a momentary position. Each switch is covered by a plastic guard to prevent its being inadvertently moved to the OFF position. With the guard closed, the switch can be only in the ON position. The RESET position is provided so that in the event the overvoltage relay should trip off, disconnecting the generator, the circuit may be reclosed. For all normal operations, these switches are in the ON position, being turned OFF only in emergencies.

OVERVOLTAGE RELAY.

An overvoltage relay is provided in each generator control box to protect the system from excessive voltages. The relay is adjusted to trip off whenever the generator output voltage rises to between 31 and 33 volts, with additional safety provisions for disconnecting at a maximum high voltage of 35. When the overvoltage relay trips off, the pilot is warned of the condition by the automatic lighting of the generator inoperative light for that particular generator.

GENERATOR INOPERATIVE LIGHTS.

The generator inoperative lights (figure 1-8) on the right subpanel are so connected to the overvoltage relay that they are turned on whenever the overvoltage relay trips off. Resetting the overvoltage relay automatically turns these lights off.

VOLTMETER SWITCH.

The voltmeter switch (9, figure 1-8) is located on the right subpanel and is used for the selection of the desired generator voltage to be indicated on the voltmeter. The switch is a two-position toggle type, moving from right to left to select the desired generator voltage reading. When the switch is moved to the right the voltage of the right generator is read on the voltmeter. When moved to the left the left generator's voltage may be read on the same voltmeter. The switch may be left in either position upon completion of the check.

LOADMETERS.

Two electric loadmeters (figure 1-8) are mounted on the right subpanel. These meters show what percentage of the total potential of the generators is being used. Thus, 100 percent indication shows that full generator capacity is utilized. The loadmeters are protected by circuit breakers (figure 1-16) located on the inboard side of each generator control box.

PILOTS' TURN-AND-BANK POWER SELECTOR SWITCH.

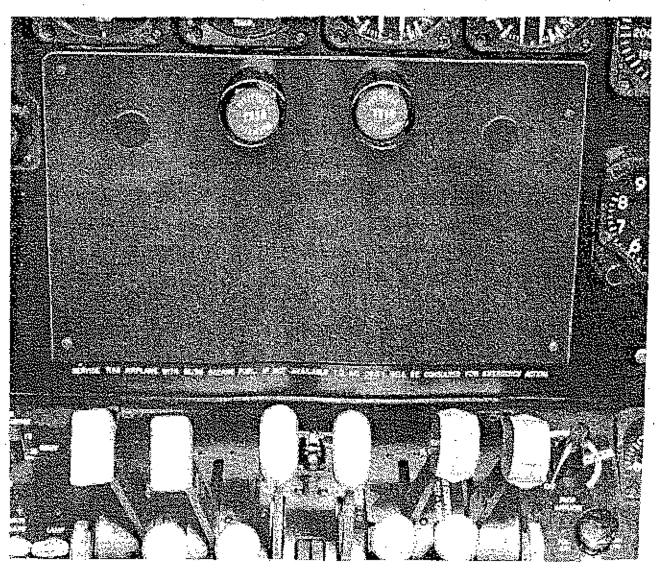
The pilots' turn-and-bank power selector (figure 1-9), on the instrument panel adjacent to the indicator, permits the use of this instrument even though the battery switches may be turned off. The switch has two positions, NORMAL and ALTERNATE, and is a fixed position toggle switch with no off position. When the switch is in the NORMAL position, it connects the indicator to the secondary bus for its power source; when in the ALTERNATE position, it connects the indicator directly to the right battery. The switch should be placed in the ALTERNATE position only in such emergencies as require battery switches to be turned off when the instrument is required. At all other times it will remain in the NORMAL position. The switch should never be left in the ALTERNATE position when the airplane is parked since it will continue to operate on the direct line from the battery.

CIRCUIT BREAKERS.

All circuit breakers with the exception of the landing gear motor, loadmeter and propeller feathering circuit breakers are located in the circuit breaker boxes (figure 1-17) on the bulkhead behind the copilot's head. The landing gear motor circuit breaker is located on the control pedestal (figure 1-5), the loadmeter circuit breakers (figure 1-16) on the generator control boxes and the propeller feathering circuit breakers are located on the windshield cowl. The landing gear motor circuit breaker is of the push-to-reset type, the propeller feathering circuit breakers are switch type, all others are of the trip-free, push-to-reset type that can be pulled out (tripped) manually. The landing gear circuit breaker cannot be pulled out (tripped) manually.

INSTRUMENT INVERTER.

An inverter is installed to convert dc current to the 400 cycle ac current required by the gyrosyn compass system.



CDC-1-79

Figure 1-10. Propeller Feathering Buttons

FUEL SYSTEM DIAGRAM

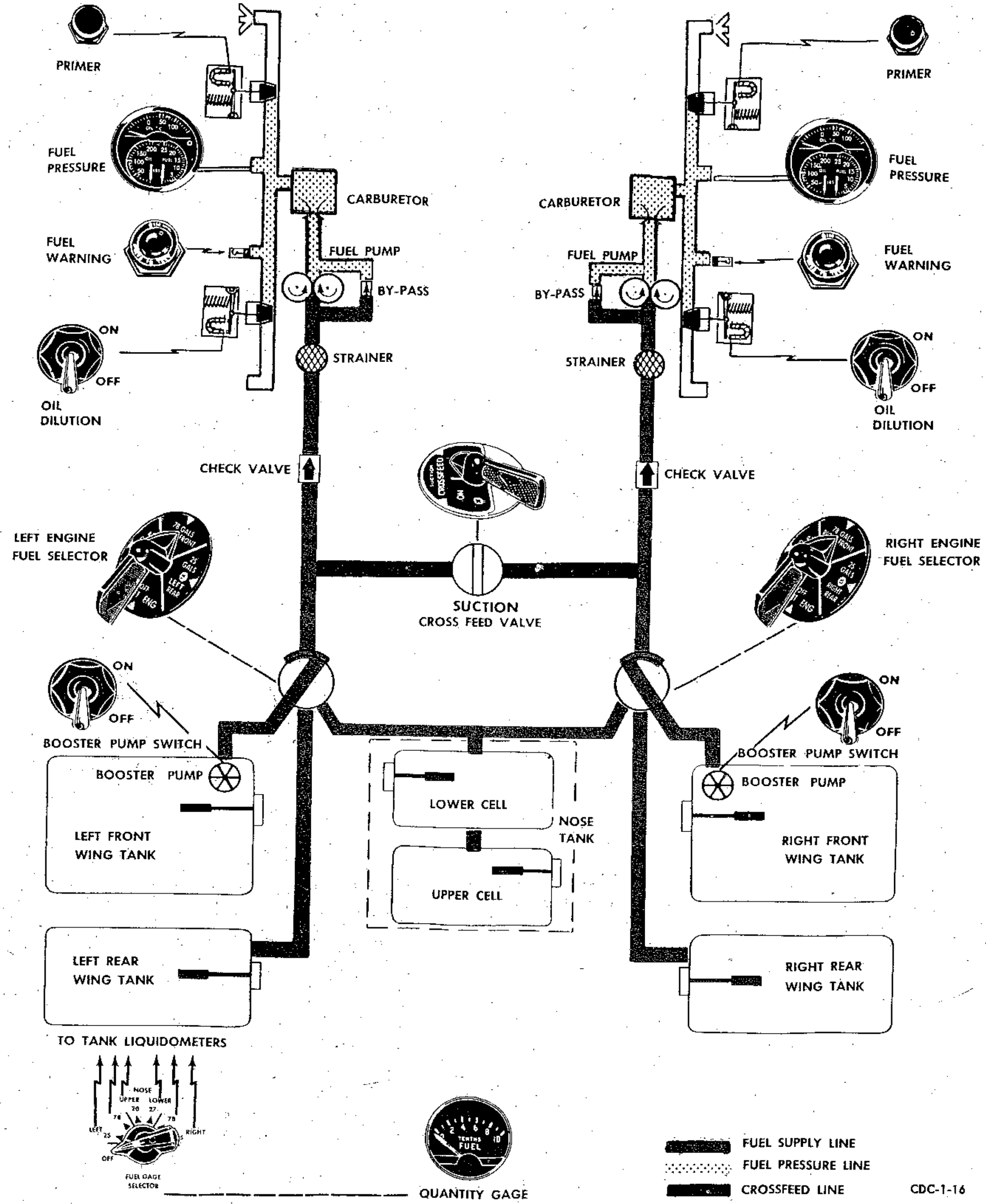
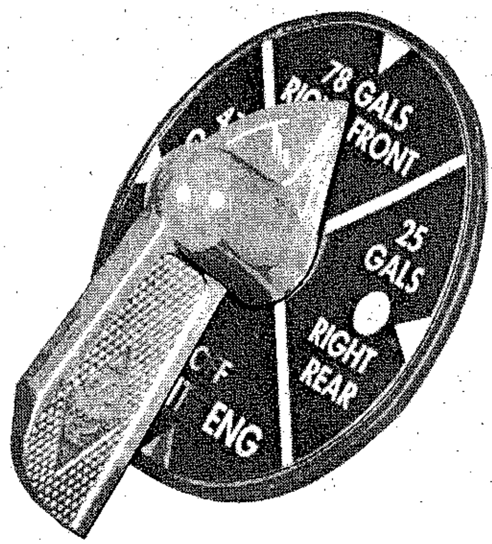


Figure 1-11

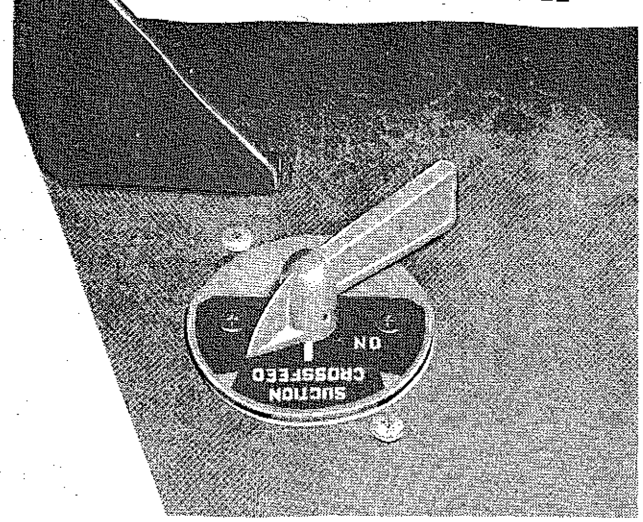


ENGINE FUEL SELECTOR HANDLE

CDC-1-17

Figure 1-12

FUEL CROSSFEED HANDLE



CDC-1-18

Figure 1-13

INSTRUMENT INVERTER SWITCH.

The instrument inverter switch (figure 1-7) on the left subpanel is a toggle switch having ON and OFF positions. This switch opens and closes the dc circuit to the inverter.

FUEL QUANTITY DATA

(U. S. GALLONS)

TOTAL USABLE FUEL 252.0 GALLONS

TANKS	NO.	USABLE FUEL (EACH)	FULLY SERVICED	EXPANSION SPACE (EACH)	TOTAL VOLUME (EACH)
Front Wing	2	77.7	78.0	2.3	80.3
Rear Wing	2	24.8	25.0	0.8	25.8
Nose	1				
Upper Nose Cell	1	20.0	20.0	0.0	20.0
Lower Nose Cell	1	27.0	27.0	0.0	27.0

NOTE The outlets are designed for level flight. The above figures will vary slightly with changes in attitude.

CDC-1-19

77.7
24.8
20.0
23.5
126.0
252.0

Figure 1-14

ELECTRICAL SYSTEM

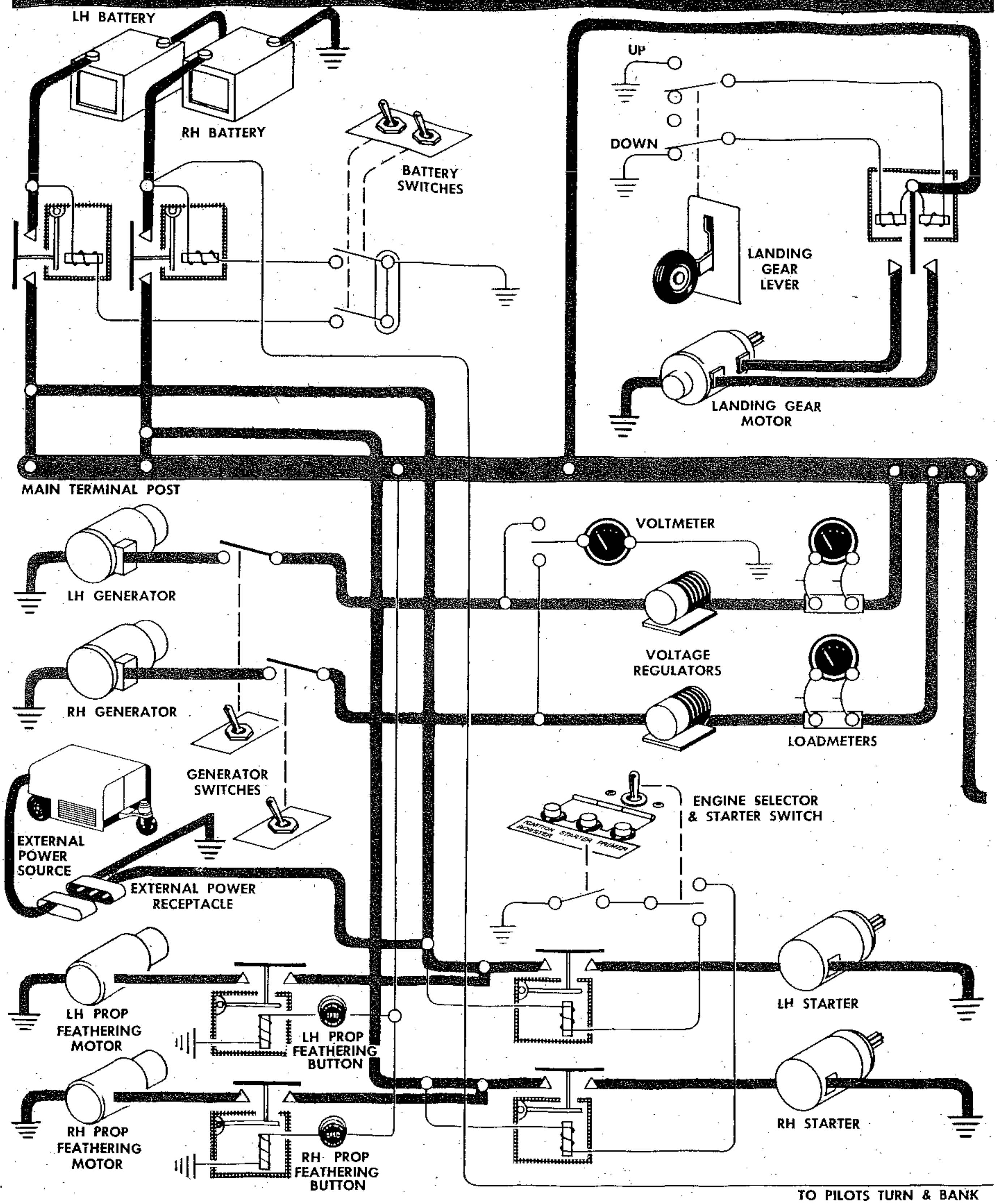


Figure 1-15. (Sheet 1 of 2)

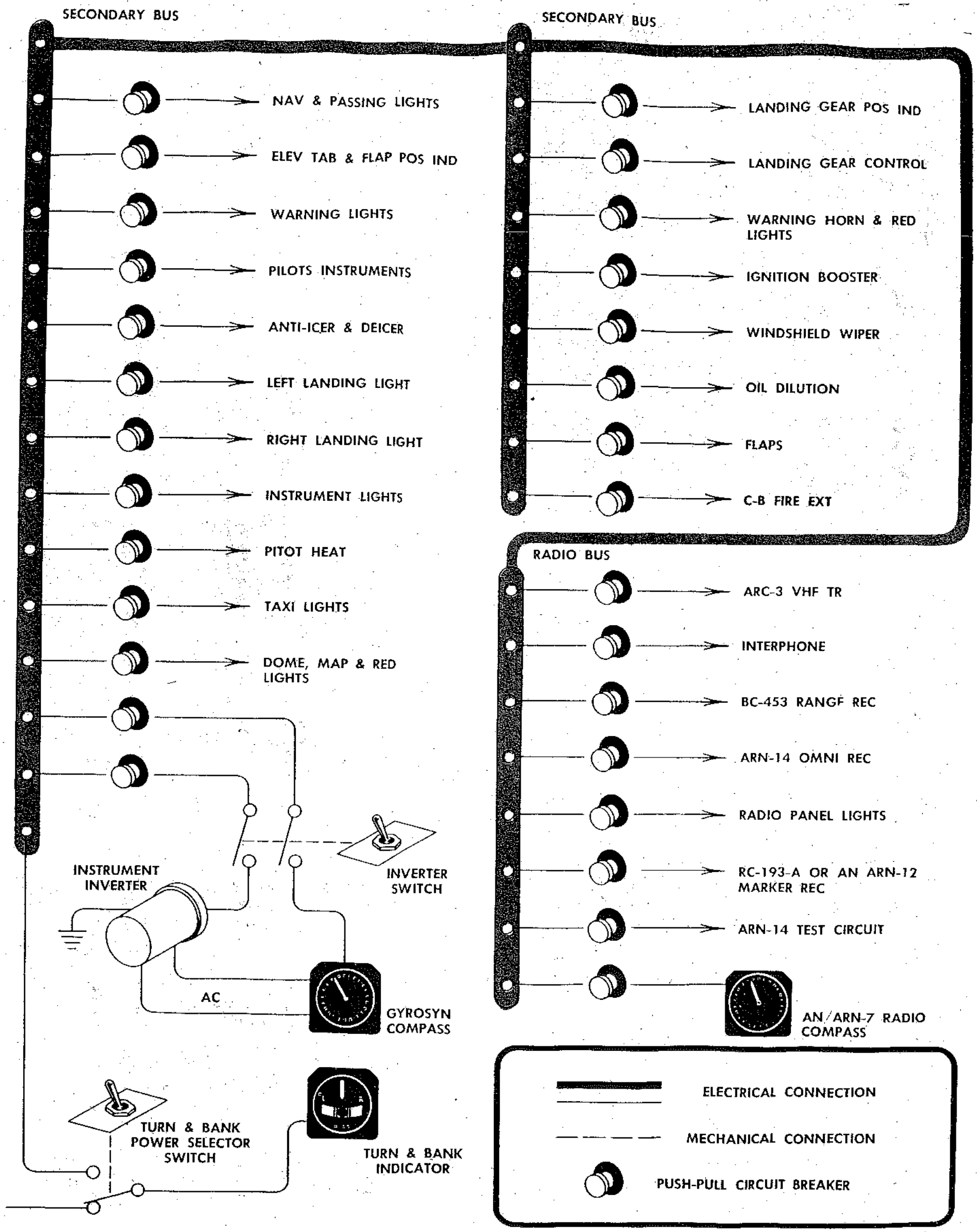
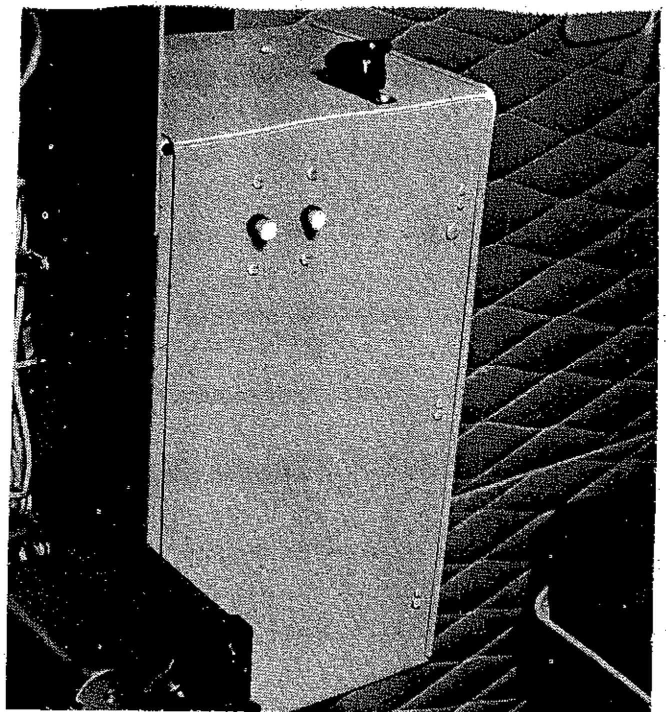


Figure 1-15. (Sheet 2 of 2)



CDC-1-21

Figure 1-16. Generator Control Box

VACUUM SYSTEM.

Pumps, one on each engine, supply vacuum for those flight instruments which require vacuum for operation. The exhaust from these pumps is utilized to supply pressure for the wing and tail deicing system. Both pumps are integrated into a single system which uses check valves in such a manner that failure of a single pump results only in decreased capacity, rather than failure of the entire system.

VACUUM CONTROL

The pilot has no operating controls for the system. The vacuum pumps operate whenever the engine on which it is installed is operating. Relief valves are preset to maintain proper operating pressures.

VACUUM INDICATORS.

A warning light (figure 1-8), for each pump, is mounted on the right subpanel. These lights are operated by pressure switches and when lighted indicate failure of the corresponding pump.

Suction (vacuum) gages (figures 1-7 and 1-8) are mounted on the right and left subpanels for indication of the exact value of the vacuum being delivered.

FLIGHT CONTROL SYSTEM.

The flight control system in this aircraft is a conventional wheel, column and rudder pedal combination, mechanically linked to the control surfaces. The rudder pedals are not adjustable; however, a comfortable pedal position may be obtained by adjusting the seat fore and aft. The upper portion of the rudder pedals are the toe brake pedals.

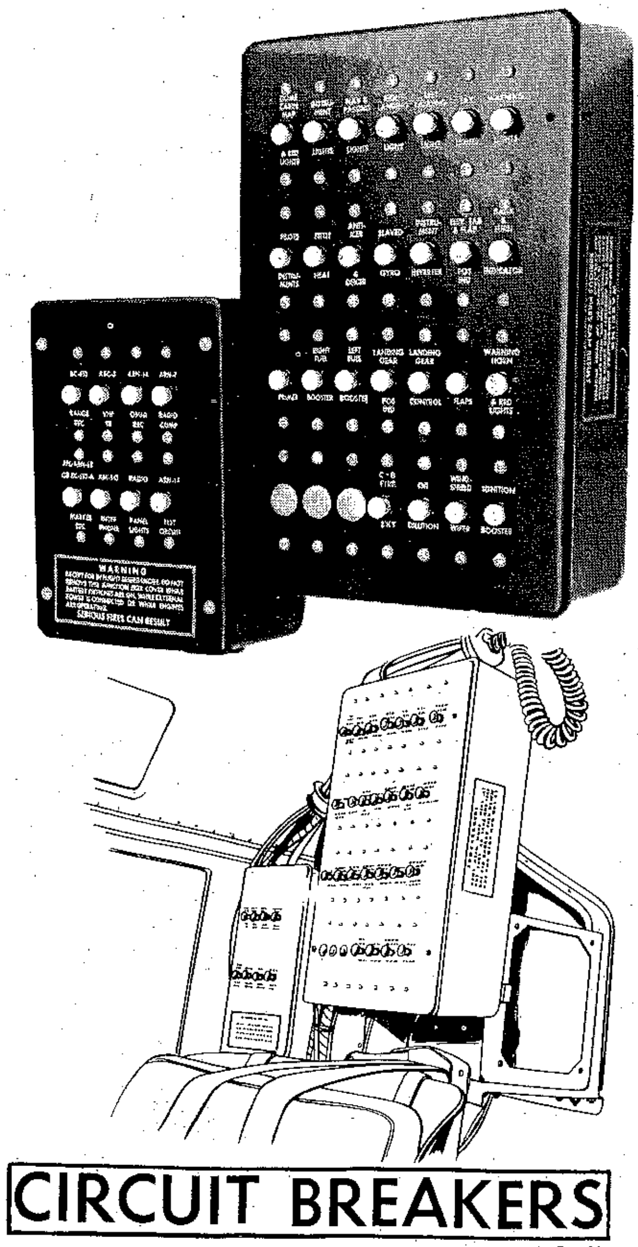
All primary flight controls and trim tab controls are closed systems of cables or chains and cables.

FLIGHT TAB CONTROLS.

The three mechanically operated tab controls (figure 1-18) will trim the aircraft in the same direction as control movement.

FLIGHT CONTROLS LOCK.

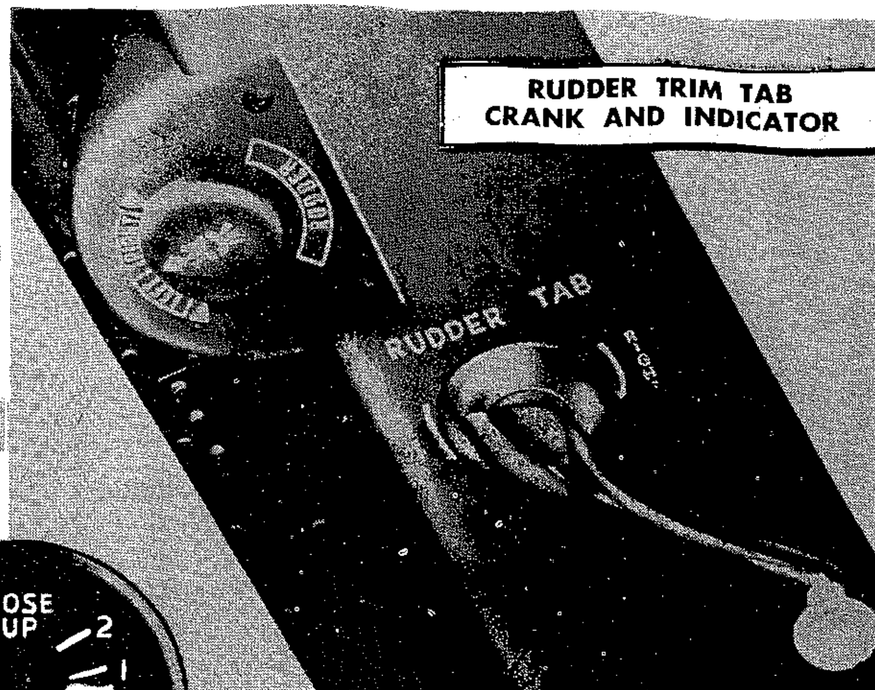
The lock assembly for the flight controls (figure 1-20) is a loose item which, when not in use, is stowed on the pilots' compartment floor. It consists of steel tubing with pins for locking the rudder pedals, a clamp for the control column (elevators) and a thumb screw which locks the control wheel sprocket for the ailerons.



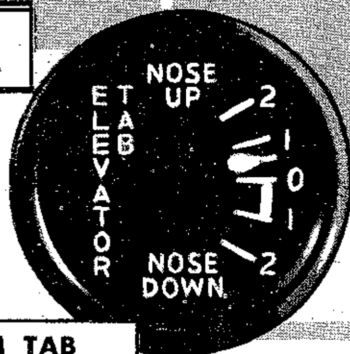
CDC-1-22

Figure 1-17

AILERON TRIM TAB WHEEL



RUDDER TRIM TAB CRANK AND INDICATOR



FLIGHT TAB CONTROLS

ELEVATOR TRIM TAB WHEEL AND INDICATOR

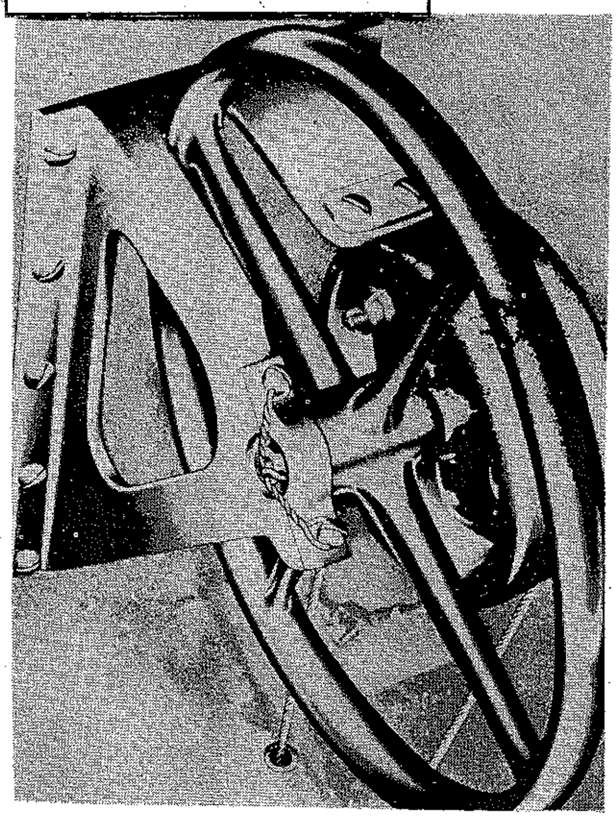


Figure 1-18

CDC-1-23

When put in the locking position, the required operations are:

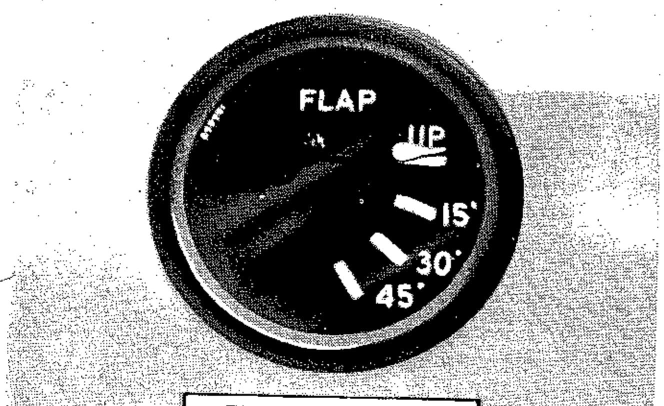
- Unfasten strap at aft end of the stowed lock.
- Raise forward end of lock assembly.
- Pinch pins on rudder pedal lock assembly together.
- Place lock between rudder pedals and allow pins to enter end of rudder cross bars.
- Raise aft end of assembly.
- Position column latch, on the aft end of the assembly, around vertical portion of column (do not tighten clamp).
- Insert wheel lock assembly into inboard end of the control column.
- Tighten column latch.

The column latch should not be tightened until thumb screw on the wheel lock assembly is installed, as it may be necessary to move the clamp either up or down to align thumb screw. The thumb screw goes all the way through the column, passing between the teeth of the control wheel sprocket; it is usually necessary to wiggle the wheel a little to properly align the sprocket and thumb screw.

FLIGHT TAB POSITION INDICATORS.

AILERON AND RUDDER. The relative position of the aileron and rudder trim tabs is indicated by the small discs (figure 1-18), adjacent to the respective tab controls. These indicators are not calibrated in degrees, but simply indicate the relative effect the tab will produce.

ELEVATOR. The elevator tab position indicator (figure 1-7) on the left subpanel is an electric, dial indicator, graduated from "2" (nose up) to "0" (neutral) to "2" (nose down). The graduations have no significance other than reference to relative position of the tab. The "2" nose up and nose down are simply the extreme positions of the tab. The normal flight position is between "0" and "1" nose down. The indicator is controlled by a rheostat located in the horizontal stabilizer; the rheostat is mechanically linked to the left trim tab actuator rod.



FLAP POSITION INDICATOR

CDC-1-23-1

Figure 1-19

WING FLAPS.

The aircraft is equipped with trailing edge flaps for use primarily as a landing aid; however, they may also be used for short field and emergency take-offs. The flaps are actuated normally by an electric motor, but they may be operated manually by the emergency hand crank. They are held in any preset position by the mechanical advantage of the system.

WING FLAP LEVER.

The position of the wing flaps is selected by the flap lever (figure 1-5), on the pedestal, which closes the dc circuit to the flap motor. The lever has two positions: UP — DOWN. The lever is placed in the UP position to raise the flaps, and in the DOWN position to lower the flaps. Before the switch lever can be moved, it is first necessary to move it to the right since it is spring loaded to hold in the detents of a lock plate.

There is incorporated in the system a dynamic brake relay which will stop the movement of the flap motor instantaneously when the flap limit switches are tripped.

EMERGENCY HAND CRANK.

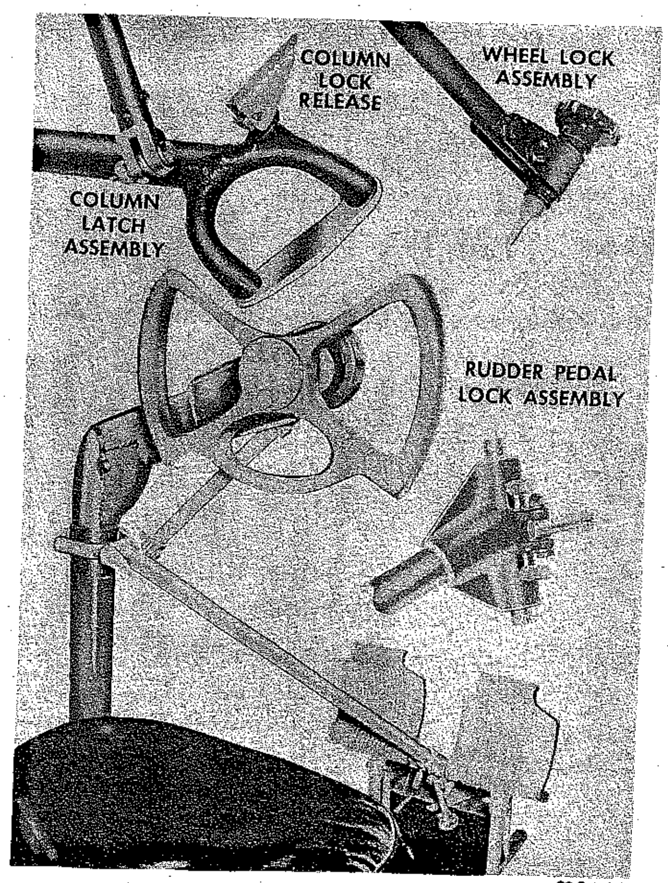
The landing gear and flaps may be raised or lowered by means of the emergency hand crank (figure 1-21) located to the right of the pilot's seat. The crank is pushed in (toward the pilot) for flap operation and pulled out (away from the pilot) for landing gear operation.

FLAP POSITION INDICATOR.

The flap position indicator (figures 1-8 and 1-19), on the right subpanel, is an electrical indicator controlled by a rheostat located in the wing. The indicator shows the flap position in 15 degree increments ranging from 0 (full up) to 45 degrees, which is the full travel of the flaps.

LANDING GEAR SYSTEM.

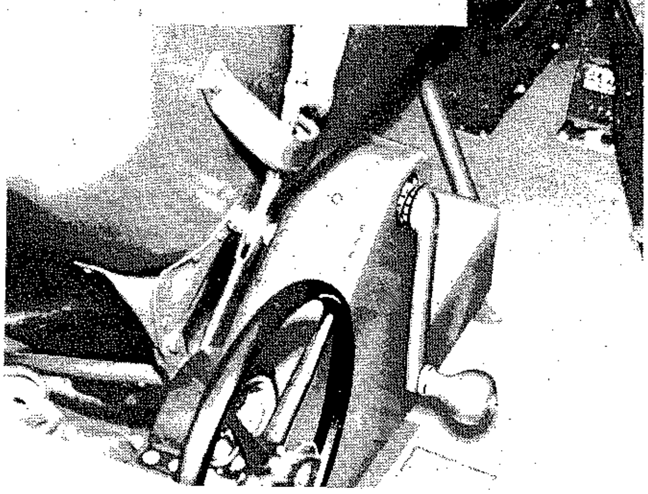
The landing gear actuating mechanism is electrical, the main wheels retracting into the engine nacelles. The tail wheel, which is full swiveling but lockable, has been permanently fixed in the down position and does not retract. The landing gear doors remain open when the gear is in any position other than retracted. When the gear is retracted, there is approximately



CDC-1-24

Figure 1-20. Flight Control Lock

EMERGENCY HAND CRANK



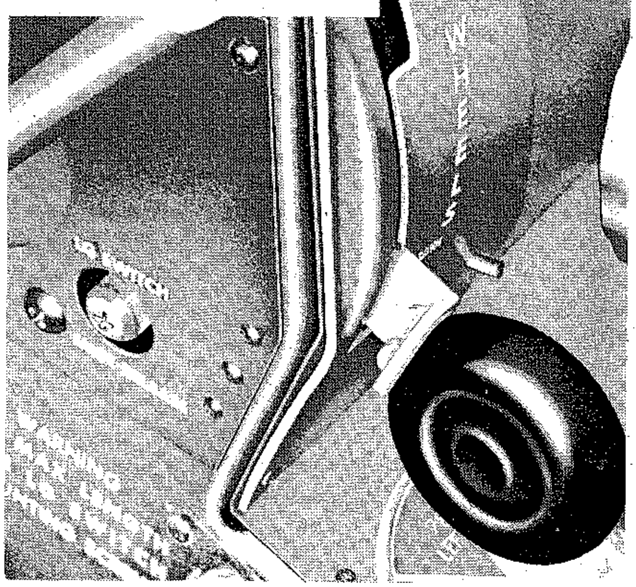
CDC-1-25

Figure 1-21

one-third of the main landing gear wheels exposed with the doors cut out for the exposed portion.

No manual up or down lock is provided since the motor and worm drive gear will lock the gear in place. The gear may be raised or lowered manually in emergency by means of the emergency hand crank.

LANDING GEAR SWITCH EMERGENCY RELEASE



CDC-1-26

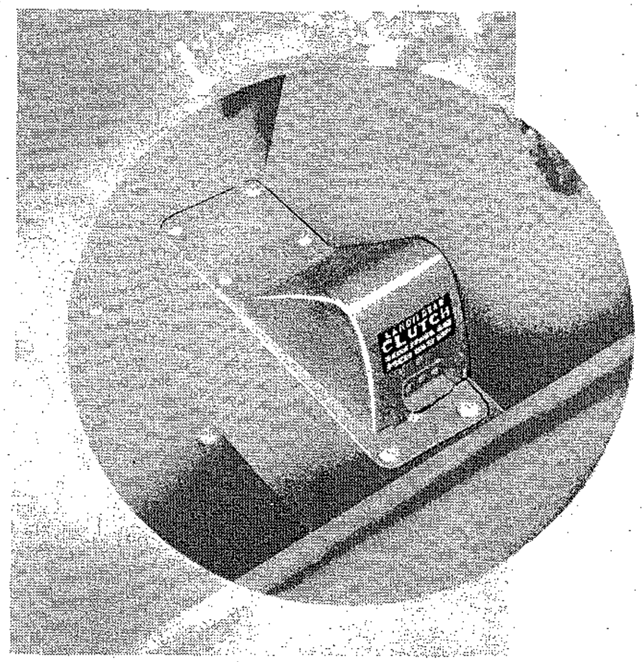
Figure 1-22

LANDING GEAR LEVER.

The position of the landing gear is selected by the two-position landing gear lever (figure 1-5) on the control pedestal. When the lever is moved to UP, the motor is energized and the landing gear retracts. It extends when the lever is moved to DOWN.

LANDING GEAR LEVER EMERGENCY RELEASE.

Within the pedestal is a latching solenoid which prevents the landing gear lever from being moved to the UP position while the aircraft is on the ground. This solenoid is controlled by safety switches, one on each main landing gear strut, which open the circuit to the solenoid when the strut is compressed ½ inch or more and close the circuit when the strut is fully extended. When the circuit is closed, it activates the solenoid, pulling the latching bar away from the switch lever so that it can be moved to the UP position. Should the solenoid fail to function properly, the latching bar may be moved manually to release the landing gear lever by pushing the button on the left side of the pedestal, marked LG SWITCH EMER RELEASE (figure 1-22).



LANDING GEAR EMERGENCY CLUTCH

Figure 1-23 CDC-1-27

LANDING GEAR MALFUNCTION LIGHT.

The landing gear lever has a small red plastic wheel-shaped knob in which there is a light. This light illuminates the knob any time the position of the landing gear does not correspond to the position of the lever. Also, the knob will be illuminated when the throttles are retarded to a point which corresponds to approximately 12 in. Hg. provided the landing gear is not fully extended. This light can be tested by pushing the button below the landing gear lever. See figure 1-5.

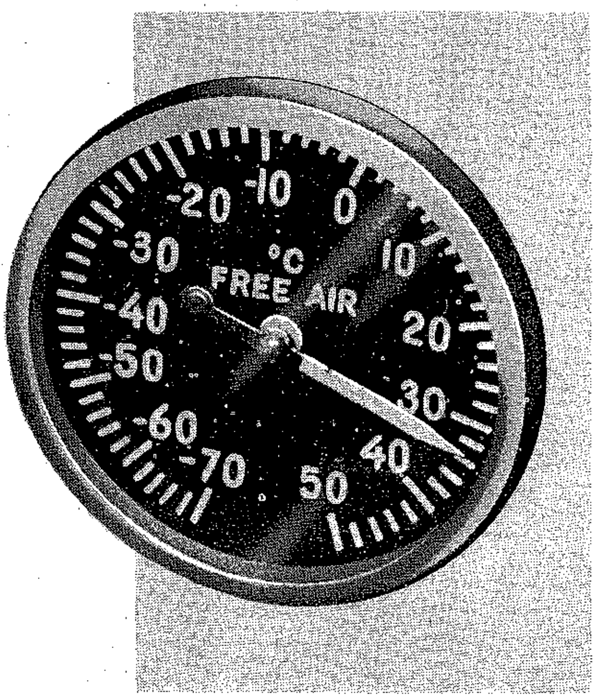
LANDING GEAR WARNING HORN.

When the throttles are retarded to a position on the quadrant equivalent to approximately 12 inches Hg, they close the ground circuit to the landing gear warning horn, located on the floor board under the copilot's seat. The positive circuit of the horn is broken by the landing gear lower (down) limit switch so the horn will not operate when the gear is in the full down position.

WARNING HORN SILENCER. A spring loaded, self centering landing gear warning horn silencer knob (figure 1-5) is located ahead of and between the throttles. Rotating the knob toward the throttle which is actuating the horn will silence the horn until the throttle is advanced and then retarded.

LANDING GEAR POSITION INDICATORS.

The position of the landing gear is illustrated by the electrically operated position indicators (figure 1-9) on the upper left portion of the instrument panel. The indicators are in the outline of an airplane, with a small window at each landing gear position. When the gear is fully extended, a picture of a wheel and strut appears in each window; when the gear is retracted, the word UP appears in each of the windows. A set of diagonal lines appears in each window when the gear is in any position other than full up or full down, or when the electrical power is off.



CDC-1-28

Figure 1-24. Free Air Temperature Gage

LANDING GEAR EMERGENCY CLUTCH.

A clutch pedal (figure 1-23), on the floor to the left of the pedestal, is provided to disengage the electric drive so the landing gear may be operated with the emergency hand crank. By pushing forward on the pedal, the electric drive mechanism is disengaged; however, the clutch must be released and the electric drive re-engaged to lock the gear after it has been repositioned.

EMERGENCY HAND CRANK.

The landing gear and flaps may be operated manually by using the emergency hand crank (figure 1-21) located to the right of the pilot's seat. Pulling the crank out (away from the pilot) engages it to the landing gear mechanism, pushing it in engages it to the flap mechanism. In either case, extension is accomplished by turning the crank forward at the top of the stroke; retraction by turning aft.

The position of the landing gear lever has no effect on the emergency operation of the landing gear if the gear fails to operate normally. This is because the entire control system is electrical, while the emergency operation is entirely mechanical. However, as a safety precaution, since failure of the normal control system might well be the severance of an electrical circuit which could reconnect, the landing gear lever should be positioned at DOWN and the landing gear control circuit breaker pulled off before use of the emergency mechanism.

TAIL WHEEL LOCK SYSTEM.

The tail wheel locking system is a mechanical linkage from the tail wheel lock handle, on the pedestal, to a locking pin at the tail wheel. When engaged, the lock will hold the tail wheel in a straight fore and aft position which will aid in preventing the aircraft from turning in either direction.

TAIL WHEEL LOCK SYSTEM CONTROL.

The tail wheel lock handle (figure 1-5) is a "T" handle located on the control pedestal. It is a push-pull control equipped with a position lock, which is locked by turning the handle clockwise and unlocked by turning counterclockwise.

Pulling the handle out unlocks the tail wheel, pushing the handle in causes the tail wheel to be locked. However, the lock will not engage until the tail wheel is in its centered position. The tail wheel is locked for take-off and landing and unlocked for ground operation to facilitate maneuvering.

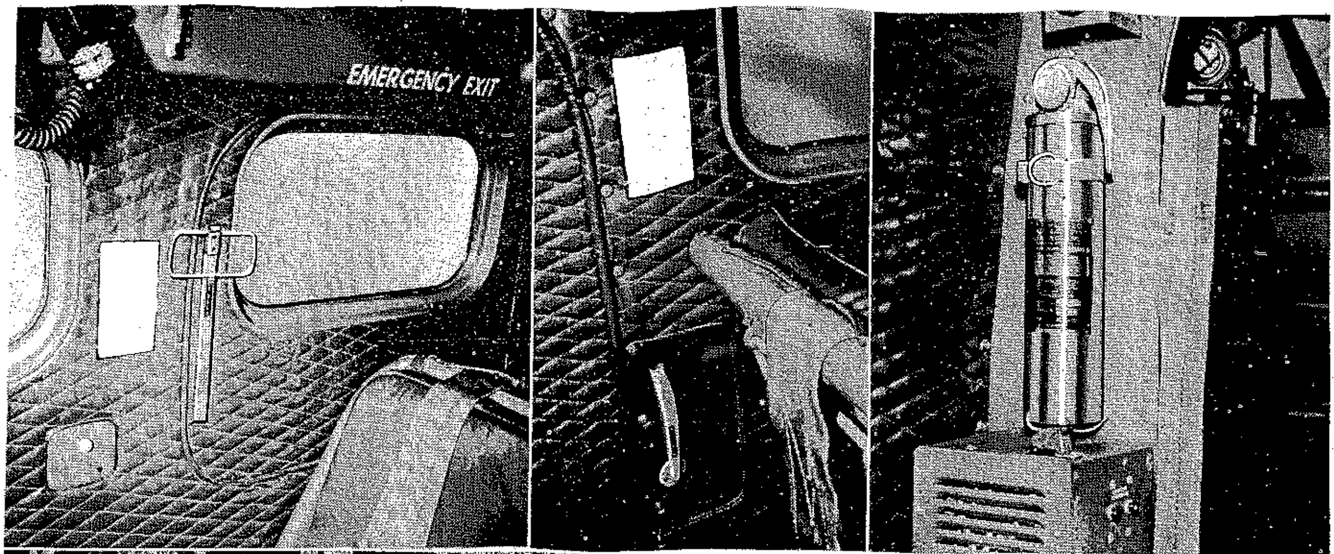
While spring tension will hold the entire mechanism in the locked position, it is necessary to lock the control out when it is desired the wheel swivel freely.

CAUTION

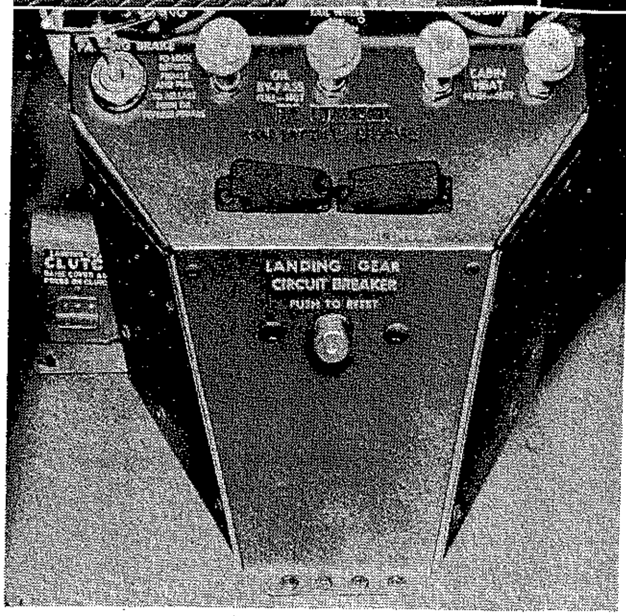
When locked, the tail wheel lock mechanism may be damaged by any extreme forces which tend to turn the aircraft.

BRAKE SYSTEM.

The hydraulic pressure required for braking action is created entirely by toe pressure. The aircraft, being provided with two individual brake systems, has one system actuated by toe pressure on the pilot's rudder



EMERGENCY EQUIPMENT



CDC-1-29

Figure 1-25

pedals and the other by the copilot's. These separate systems join at shuttle valves on each main wheel brake housing. By means of these shuttle valves, either system is closed off when the other is being used. The system having the greater pressure applied is the one which will be effective in braking the airplane, the other will be completely ineffective. The additional safety provided by separate systems eliminates the necessity for a separate emergency brake system.

PARKING BRAKE HANDLE.

The parking brake handle (figure 1-5), on the pedestal, is mechanically linked to parking brake valves which are incorporated only in the pilot's brake system.

When the handle is pulled out, the valves are closed thus maintaining, on the brake, whatever pressure has been applied by the pilot's pedals. Pushing the handle in opens the valves, releasing the trapped fluid.

To set the parking brake, it is necessary to apply pressure to the brakes with the pilot's pedals; then pull the parking brake handle out.

The parking brakes can be released by either pushing the parking brake handle in or depressing the pilot's brake pedals.

NOTE

The copilot's brake pedals are isolated from the parking brake action. All operation must be with the pilot's pedals.

INSTRUMENTS.

In addition to those instruments discussed as indicators for specific systems, the aircraft instrumentation includes the following, all of which are located on the instrument panel (figure 1-9):

Gyro flight instruments for both pilot and copilot which, with the exception of the pilot's turn-and-bank indicator, are vacuum operated. The pilot's turn-and-bank requires dc power and a switch, adjacent to the instrument, provides for the sources of power. This switch is completely discussed under the electrical system in this section.

Two altimeters and two rate-of-climb indicators, all of which rely on static pressure for their operation.

Two airspeed indicators which require both pitot and static pressure.

One 8 day clock.

A gyrosyn compass system, requiring both dc and ac current for operation.

A direct reading outside air temperature gage (figure 1-24), mounted at the top of the windshield.

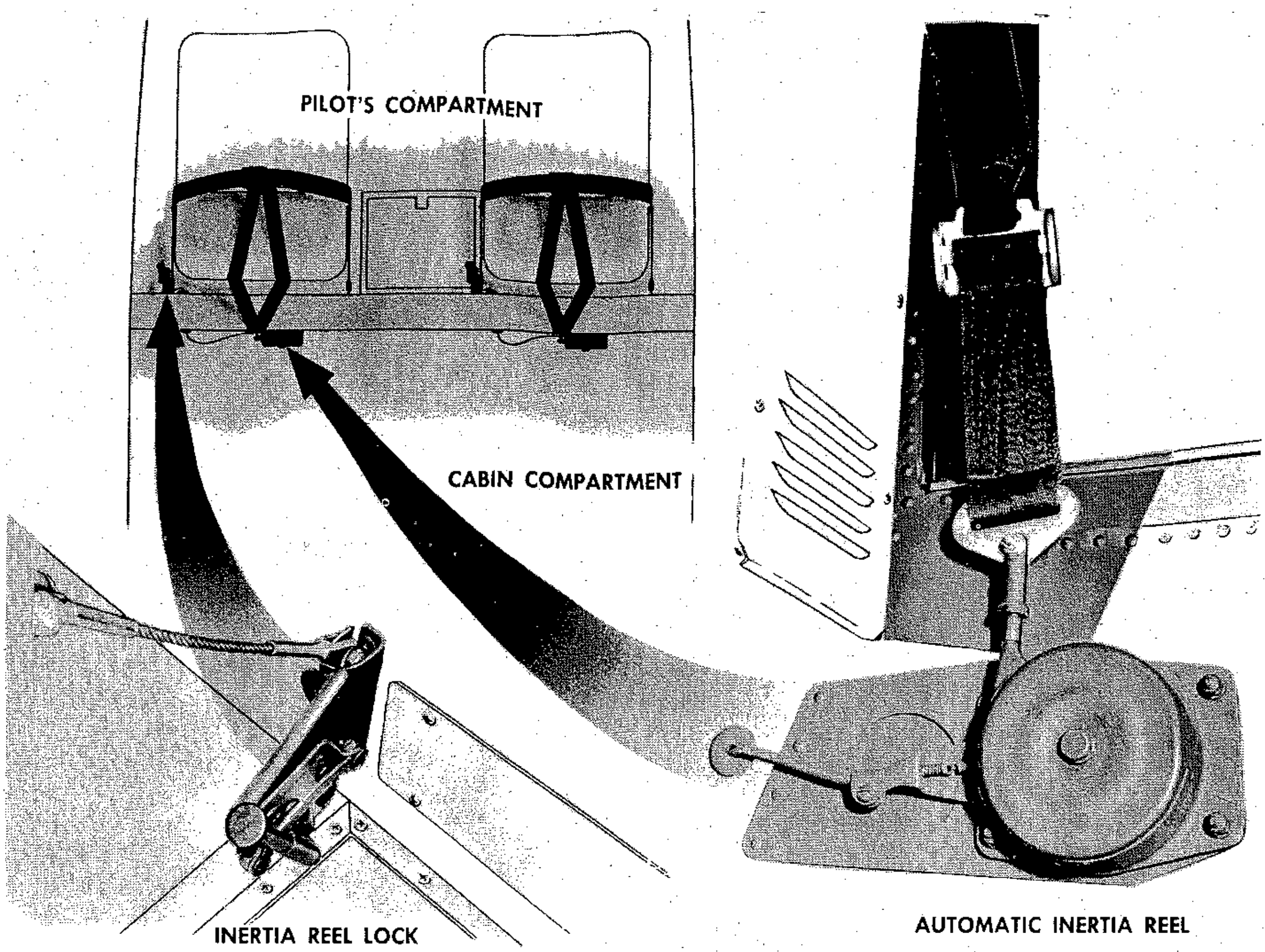


Figure 1-26. Automatic Inertia Reel

PITOT AND STATIC PRESSURE SOURCE.

The aircraft is equipped with two pitot masts, located on the underside of the aircraft, which deliver impact pressure only. The static source is two static buttons, one on each side of the rear portion of the fuselage, ahead of and below the leading edge of the horizontal stabilizer. There is no alternate static source.

EMERGENCY EQUIPMENT.

HAND FIRE EXTINGUISHER.

A type A-20 hand fire extinguisher is installed on the aft side of the front cabin bulkhead, to the left of the pilots' compartment door. The extinguisher contains bromochloromethane which is charged with dry air to a pressure of 150 to 175 psi. A pressure gage is installed on the top of the extinguisher, providing a visual check of the condition of the extinguisher.

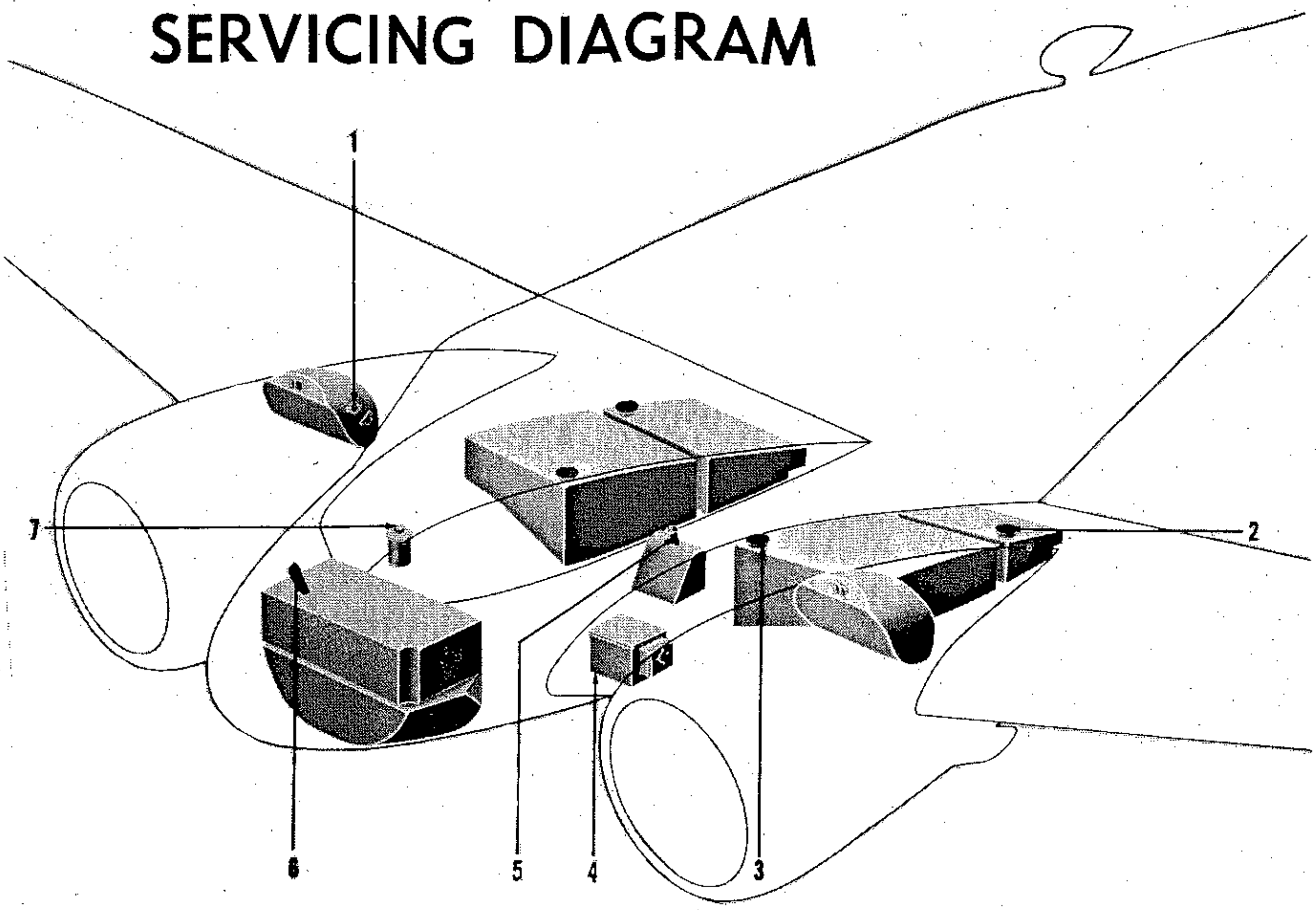
ENGINE FIRE EXTINGUISHER.

The engine fire extinguishing system is a single shot CB system with the sphere (bottle) located under the pilot compartment. The sphere is accessible for replacement or inspection through a large door on the underside of the airplane.

ENGINE FIRE EXTINGUISHER CONTROLS. On the lower portion of the pedestal, under safetied plastic guards, are two momentary toggle switches; the left switch for the left engine, the right switch for the right. By holding either switch in the ON position, a solenoid valve directs flow to the engine selected and then discharges the CB. This is the only operation necessary to discharge the system with this particular installation.

ENGINE FIRE EXTINGUISHER INDICATORS. The engine fire extinguisher system is not provided with an indicator which is visible in flight. A pressure gage is mounted on the sphere to indicate, on inspection, the system has not been discharged.

SERVICING DIAGRAM



*1. Oil Supply Tank Filler (RH).
*2. Left Rear Fuel Tank Filler.
*3. Left Front Fuel Tank Filler.
*4. Battery (LH).
5. Anti-Icer Fluid Tank Filler.
6. Nose Tank Filler.
7. Brake Fluid Reservoir Filler.

*Asterisk indicates typical of both sides.
Fuel: Specification MIL-F-5572
Grade 91/96
Oil: Specification MIL-L-6082A
Grade 1100
Hydraulic Fluid: Specification MIL-O-5606
Anti-Icer Fluid: Specification MIL-F-5566

Figure 1-27

WARNING

CB is toxic, particularly when used to fight a fire in a closed area where various kinds of materials are burning. It is important to use as little CB as possible and to avoid inhaling CB fumes as much as possible. Dizziness and nausea are symtoms of CB poisoning sufficient to require medical treatment.

EMERGENCY CABIN DOOR RELEASE HANDLE.

The cabin door is provided with a mechanism for releasing the hinge pins so that the door may be jettisoned for emergency exit. The release handle (figure 1-25) is located in the cabin wall at the forward edge of the door.

EMERGENCY ESCAPE HATCH RELEASE HANDLE.

The emergency escape hatch, in the right cabin wall, is designed primarily for escape when the cabin door is jammed or blocked and should not be opened except in an emergency. The release handle (figure 1-25) is at the front edge of the hatch.

FIRST AID KITS.

Two first aid kits are provided, one on the front side of the lavatory door and one on the forward side of the rear cabin bulkhead.

SEATS.

Both pilots' seats are adjustable by a crank located just below the front edge and in the center of each seat. The construction of the seat legs is such that the seat rises as it moves forward and lowers as it moves back.

SHOULDER HARNESS LOCKING LEVER.

A two position (locked-unlocked) shoulder harness inertia reel lock control (figure 1-26) is located on the left side of both pilots' seats. A latch is provided for positively retaining the control handle in either position on its quadrant. By pressing down on the top of the control handle, the latch is released and the handle may then be freely repositioned.

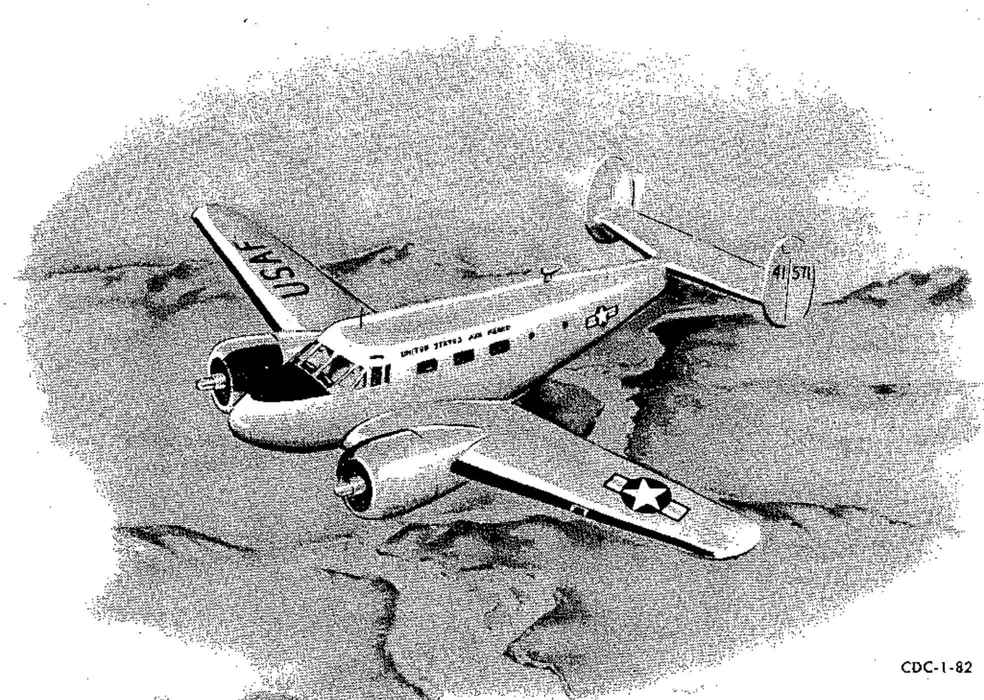
When the control is in the unlocked position (full back), the reel harness cable will extend, allowing the occupant to lean forward in the seat; however, the reel harness cable will automatically lock when an impact force of two to three g's is encountered on the aircraft. When the reel is locked in this manner, it will remain locked until the control handle is moved to the locked and then to the unlocked position.

When the control is in the locked position (full forward), the reel harness cable is manually locked so that the user is prevented from bending forward. The locked position is used when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock.

AUXILIARY EQUIPMENT.

The following auxiliary equipment is fully described in Section IV:

- Heating and Ventilating System
- Windshield Defrosting System
- Propeller Anti-Icing System
- Wing and Tail Deicing System
- Lighting Equipment
- Radio Equipment
- Miscellaneous Equipment.



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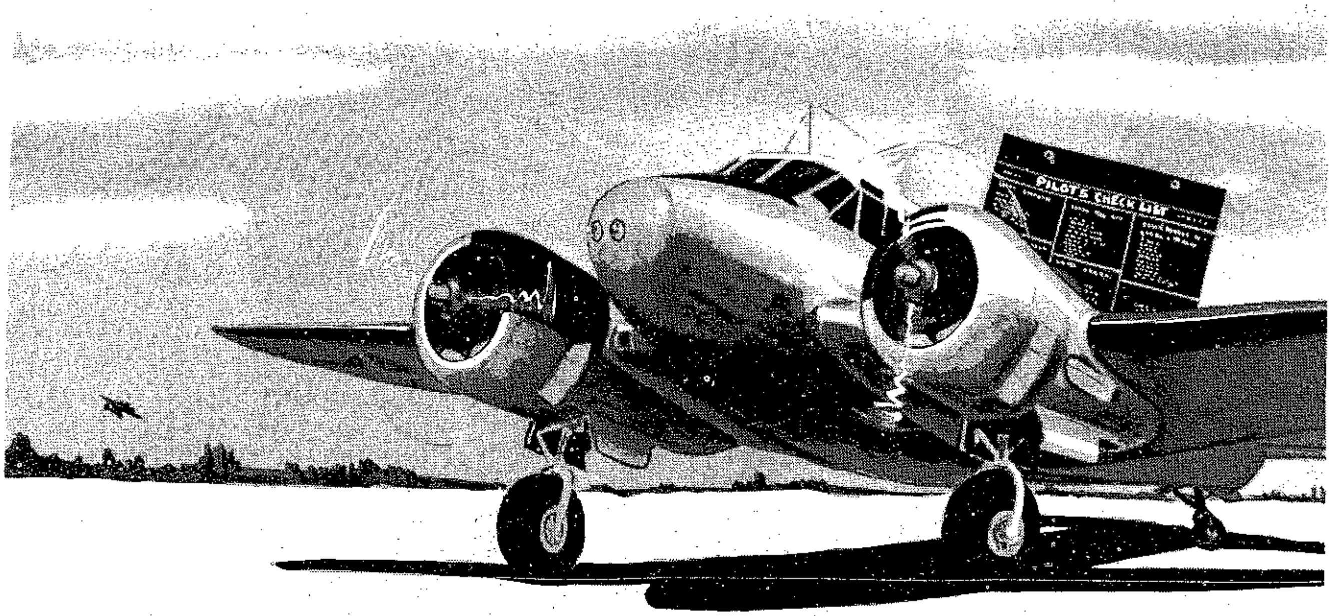

section II NORMAL PROCEDURES

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STATUS OF AIRCRAFT.

FLIGHT RESTRICTIONS.

Refer to Section V for limitations on the aircraft.

CRUISE CONTROL.

Refer to Appendix I to determine fuel, airspeeds and power settings required for safe and efficient completion of the proposed mission.

WEIGHT AND BALANCE.

Know the take-off and anticipated landing gross weight and balance. Refer to weight limitations specified in Section V; Handbook of Weight and Balance, T. O. 1-1B-40; and Basic Weight Check List, T. O. 1C-45G-5. Refer also to Form F to ascertain loading is within weight and balance limits.

BEFORE EXTERIOR INSPECTION.

Personal gear should be stowed aboard and the following safety check completed:

Ignition Switches - OFF.

Battery Switches - OFF.

Landing Gear Lever - DOWN.

Flight Controls - Unlocked.

Check engineering status on USAF Form I.

EXTERIOR INSPECTION.

The exterior check will begin at the cabin door and proceed clockwise around the aircraft (figure 2-1) ending at the cabin door. The following inspection will be accomplished:

1.—Fuselage — Skin and windows for damage.
Top antennas—Taut and securely mounted.

2.—Left fuel access doors — Closed and secured.
Left wing, top surface — No skin damage or leakage from the nacelle.
Left flap — Top and bottom surfaces undamaged and hinges secure.

3.—Left Aileron — Top and bottom surfaces undamaged, no play in hinges and unobstructed full travel. Bonding intact.
Aileron trim tab — Securely hinged and in a neutral setting.

4.—Left wing tip — Undamaged with the left position light securely installed.

5.—Deicer boot — Securely attached and undamaged.
Passing light — Unbroken and securely in place.
Left wing, bottom surface — Skin surface undamaged and free of any accumulation of mud or dirt. Landing light fully retracted, clean and unbroken, wing tie-down removed.

6.—Left engine cowling — Securely fastened.
Left cowl flaps — Mechanical linkage secure.
External power — Connected.

CAUTION

External power should be used for starting the aircraft to relieve the batteries of the extra load. Starting by use of the aircraft batteries is emergency procedure.

Left landing gear doors — Linkage and hinge secure; and the structure undamaged.
Left landing gear shock strut — 2½ inches of extension.

EXTERIOR INSPECTION

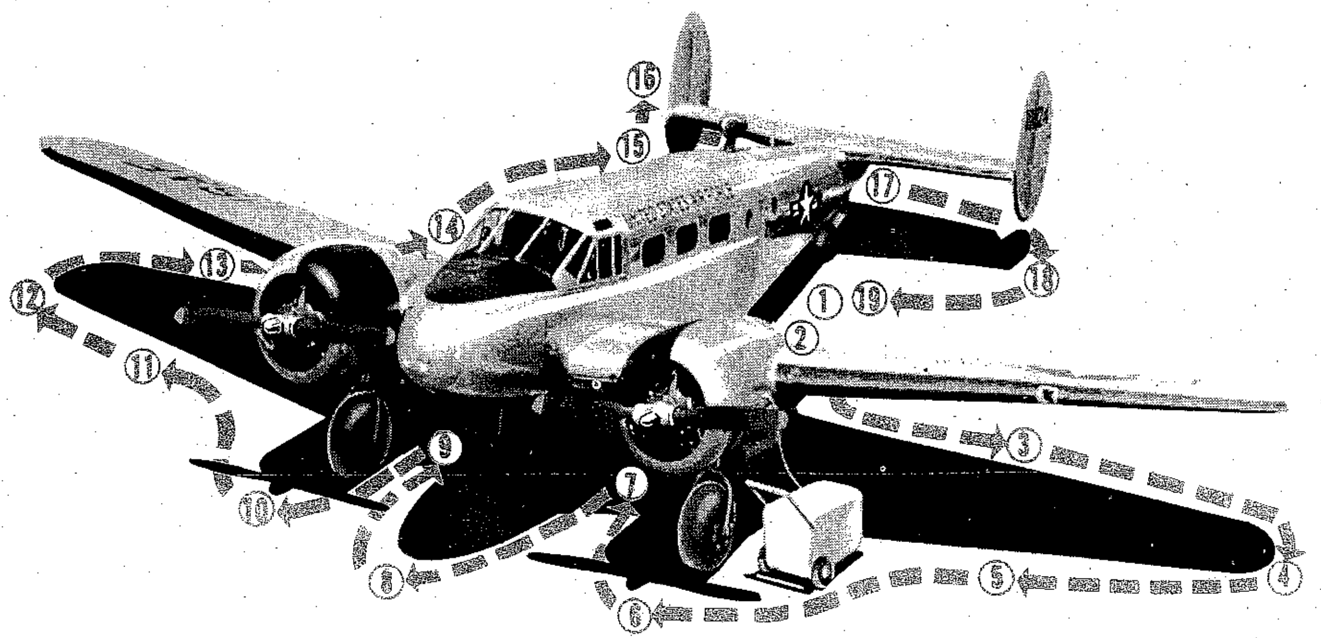

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Figure 2-1

CAUTION

Damage to the landing gear may result if the aircraft is operated when there is less than 1½ inches of shock strut extension after the aircraft is loaded. Below this minimum, shock absorbing action is insufficient for landing.

Left brake actuators — No leakage.

Left tire — Properly inflated and without cuts, cracks or badly worn areas.

Wheel chocks — In place.

Left propeller blades and hubs — No cracks, nicks or deep scratches. No apparent leakage.

Left engine — No crankcase leakage. Air scoops unobstructed.

Landing gear wheel well — No apparent engine or hydraulic oil leakage. No ruptured tubing, broken wiring or damaged equipment. Entire compartment free of any accumulation of oil. Landing gear slide tube free of dust or dirt.

WARNING

The area surrounding the aircraft will be inspected for evidence of leakage or spillage of inflammable liquids which might be ignited during the starting operation.

7.—Aircraft belly — Antennas taut and forward mounts secure. All access doors secure. Belly skin and structure undamaged.

8.—Pitot tubes — Uncovered and unobstructed.

Nose compartment — Door closed and securely latched.

Taxi lights — Lens clean and unbroken. Retaining rings secure.

9. through 13.—The right engine, engine cowling, propeller, landing gear, tire, wing, deicer, aileron, flap, lights and fuel access doors will be inspected in the manner prescribed for the corresponding left-hand components.

14.—Fuselage — Skin and windows for damage.

15.—Aft belly antenna mount — Secure.

Right static port — Unobstructed.

Horizontal stabilizer — Top and bottom surfaces of the left side undamaged. Deicer boot undamaged and secure.

16.—Right vertical stabilizer — Securely attached and undamaged.

Right rudder — Undamaged, bonding intact, no hinge play and unobstructed through its full range of travel.

17.—Elevator — Top and bottom surfaces undamaged. Unobstructed through the full range of travel. Hinges secure with no apparent play. Bonding intact.

Top of aircraft fuselage — Undamaged.

Tail position light — Securely attached and undamaged.

Elevator tab — Undamaged with hinges and linkage secure. Note position.

Tail cone drain — Unobstructed.

18.—Left rudder — Unobstructed through the full range of travel, undamaged, securely hinged, no hinge play and bonding intact.

Rudder trim tab — Set in neutral and undamaged. Hinges and linkage secure.

Vertical stabilizer — Undamaged and securely mounted.

Horizontal stabilizer — Top and bottom surfaces of the left-hand side undamaged. Deicer boot undamaged and secure.

19.—Tail wheel assembly — Structure undamaged and free of an accumulation of mud, rust or dirt which would restrict operation.

Left static port — Unobstructed.

Aft belly antenna mount — Secure.

Fuselage — Portion aft of the cabin door undamaged.

Tail tie-down — Removed.

ON ENTERING AIRCRAFT.

CABIN COMPARTMENT.

After entering the aircraft, the main cabin door should be checked, noting the security of the latch. The lavatory compartment should be inspected. Weight and balance limitations do not permit stowage of gear in this compartment. First aid kits in place. Proceeding forward through cabin, check as follows:

There should be no loose gear in the cabin area.

There are to be seat belts available to all passengers.

Emergency escape hatch — Secure.

Fire extinguisher — In place and secure.

BEFORE ENTERING PILOT COMPARTMENT.

Generators — Check ON.

Anti-icer tank gage — Full.

PILOT COMPARTMENT.

Loose gear — Stowed or removed.

Control lock — Stowed.

Seat, safety belt and shoulder harness — Adjusted.

All control tab indicators — Coincide with the actual positions.

(Battery switches — ON for this check, then — OFF.)

All ignition switches — OFF.

Engine selector — OFF.

Ignition booster, starter and primer switches — Cover down.

Battery switches — OFF. (Do not use ship's batteries for starting except in emergencies.)

Fuel booster switches — OFF.

Instrument inverter switch — OFF.

All light switches — OFF.

Fuel quantity gage — Check all tanks.

Propeller levers — TAKE-OFF RPM.

Manifold heat levers — COLD.

Throttles — CLOSED.

Mixture levers — IDLE CUT OFF.

Oil shutter levers — COLD.

Cowl flap handles — OPEN.

Landing gear lever — DOWN.

Flap lever — UP (Flaps retracted).

NOTE

If flaps are not fully retracted, retract them to prevent damage from objects which may be thrown against their lower surface.

Left engine fuel selector handle — OFF.

Tail wheel handle — LOCKED.

Right engine fuel selector handle — OFF.

Parking brake handle — ON.

Oil by-pass button — COLD.

Landing gear circuit breaker — Check. (Push to reset.)

Engine fire extinguisher switches — Check safetied.

NOTE

If the safety wire is broken on the guards for the extinguisher switches, it may be the system has been discharged. The pressure gage should be checked.

Fuel cross-feed handle — OFF.

Propeller anti-icer — Place knob at NORMAL. Allow to remain a few seconds and check for alcohol flow at the propeller. Return knob to OFF.

NOTE

If there is no indication of alcohol flow within a few seconds with the knob at NORMAL, the knob should be slowly turned toward MAX and the position at which flow begins noted.

Deicer button — OFF.

Pitot heat switches — OFF.

Windshield wiper switch — OFF.

All indicator lights — Push to test.

Pilot's instruments lights knob — OFF.

Engine and subpanel instruments lights knob — OFF.

Pilot's turn-and-bank power selector switch — NORMAL.

Propeller feathering circuit breaker — Check ON.

Manifold pressure gage — Check (Note indication for power check).

NOTE

Manifold pressure gages should indicate the current barometric pressure. Any variation should be noted.

Copilot's instruments lights knob — OFF.

ADDITIONAL CHECK (NIGHT FLIGHT).

If operation during the hours of darkness is initiated or anticipated, the following additional checks will be completed:

All interior and exterior lights — Check for proper operation.

Flashlight — In operating condition and accessible to the pilot.

STARTING ENGINES.

As a precaution against liquid lock, each engine should be pulled through 4 blades. This may be accomplished with the starter when external power is utilized. The starter should be used intermittently in such a manner that rotation will be in approximately 90-degree increments.

NOTE

A liquid lock will be recognized by the resistance it offers to rotation. When liquid lock is detected, it is not to be relieved by turning the engine in either direction. The spark plugs for those cylinders affected are to be removed and all fluid drained.

Determine that the area to the rear of the aircraft is clear and that no damage will result from the propeller air stream.

The fire guard, who is to stand by for all starts, should be in such position that he is visible to the pilot to indicate the area is "clear." No start should be attempted until the "clear" signal is received. The left engine should not be started with the cabin door open.

RIGHT ENGINE.

Right Engine Fuel Selector Handle — RIGHT FRONT.

Right Cowl Flap Handle — Check OPEN.

Right Throttle — 1/8 OPEN.

Right Mixture Lever — FULL RICH.

Right Fuel Booster Switch — ON.

Master Ignition Switch — ON.

Engine Selector Switch — RIGHT.

Starter Switch — ON.

Allow engine to turn two revolutions, then:

Right Ignition Switch — BOTH.

Ignition Booster Switch — ON.

Primer Switch — Use until the engine fires and is operating smoothly.

Starter Switch — Release.

Ignition Booster Switch — Release.

NOTE

If engine ceases to fire after starting, move the Mixture Lever to IDLE CUT OFF until it again begins to fire. Then return the Mixture Lever to FULL RICH.

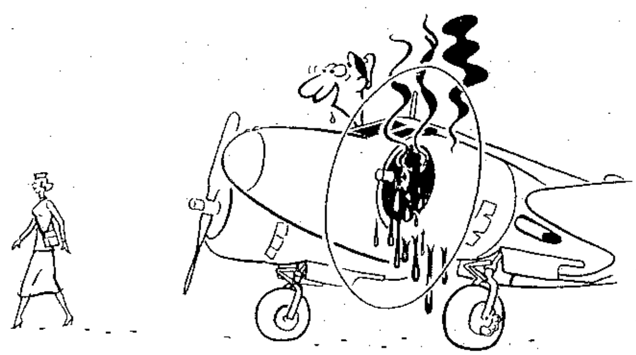
CAUTION

Overheating of the starter motor will occur with prolonged operation. Thirty seconds should be considered as the maximum period of continuous operation without a cooling period.

Adjust engine speed to 1000 rpm.

Fuel Booster Switch — OFF.

Engine Selector Switch — OFF.



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CAUTION

If oil pressure is not indicated within 30 seconds after starting, shut down engine and investigate.

Refer to Section III for the procedure to be followed in the event of engine fire.

Position controls and start the left engine in the manner prescribed for the right engine.

Instrument Inverter — ON.

All components of the radio system should be individually checked for proper operation.

Receivers should be checked in each tuning range, if multiple and on a known frequency for proper calibration.

Direction finding equipment is to be operated both manually and automatically and checked visually and aurally. The visual indicator should be checked on a know station for proper indication.

Each transmitter should be checked on more than one frequency to determine proper operation of the remote tuners.

NOTE

Since the marker beacon receiver cannot usually be adequately checked on the ground, it should be both visually and aurally noted at the first opportunity in flight. During the radio check, local altimeter setting and correct time should be obtained and the instruments correctly set.

CAUTION

Since the generators are not operative at warm-up rpm, the radio check is to be accomplished on external power. If engines are warm and there is a possibility of overheating, this check may be made prior to starting.

External Power — Disconnect.

Battery Switches — ON.

ENGINE GROUND OPERATION.

When oil pressure has stabilized within limits, engine speed should be increased to the smoothest operating speed between 1200 rpm and 1600 rpm for the remainder of the warm-up period.

Avoid prolonged ground operation because of the high cylinder head temperatures that may result.

NOTE

For any given throttle setting, maximum cooling will result from maximum rpm. Therefore, for all ground operation the propeller control lever should be positioned for TAKE-OFF RPM.

GROUND TESTS.

For the ground testing of systems and accessories the aircraft should be headed into the wind, the tail wheel locked and the parking brake set. Checks of the generator, flap and propeller systems are combined.

1. Engine Speed — 1600 rpm.
2. Right propeller feathering button — PUSH until drop of approximately 200 rpm then pull out.

NOTE

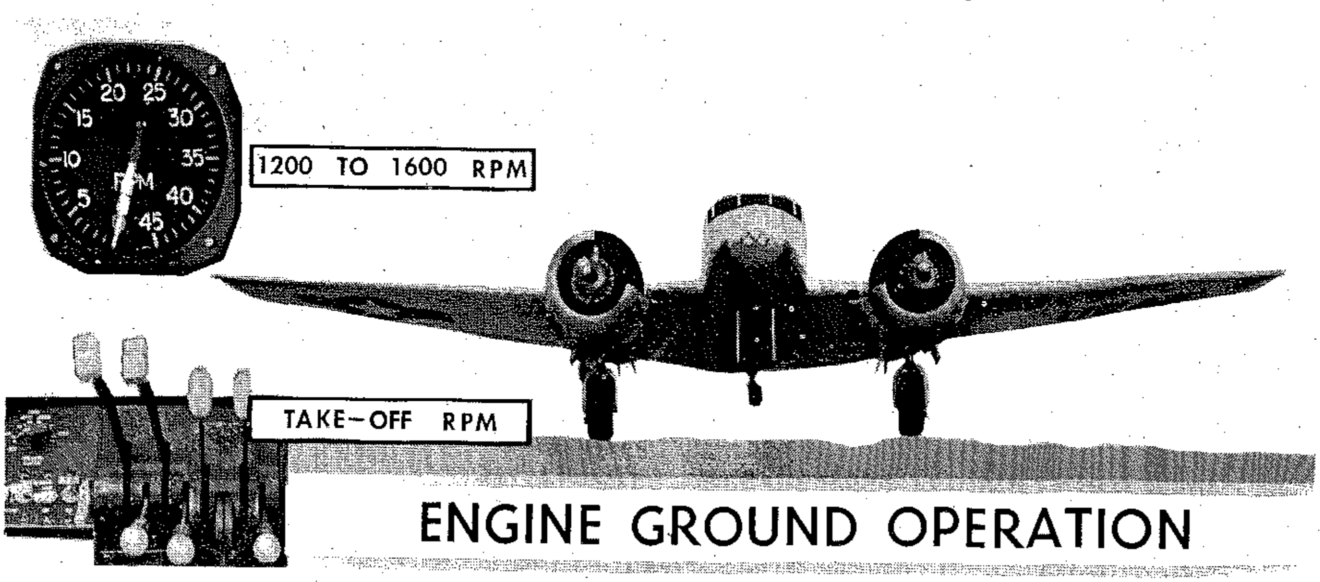
If the engine is operating at approximately 1500 rpm before feathering, it will continue to run fully feathered at about 450 rpm. Under these conditions, once the propeller is feathered, it will tend to slowly and steadily come out of the feathered position. This should not be considered abnormal since it is caused by the engine oil remaining under pressure.

3. Right propeller — UNFEATHER (Pull feathering button).

NOTE

(Deleted)

4. Repeat for the left propeller.
5. Left battery and generator switches — OFF.
6. Voltmeter selector switch — RIGHT.
7. Retard throttle to 900 rpm.
8. As engine speed decreases, the generator control circuit should disconnect the generator. This should occur at approximately 1000 rpm and will be indicated by a sudden "drop-off" of the volt and loadmeters.
9. Advance throttle on the right engine to 1900 rpm.
10. Observe volt and loadmeters — generators should reconnect at approximately 1200 rpm.
11. Lower flaps approximately 25 degrees. While the flaps are operating, observe the load and volt-



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meter readings. The flap motor should draw approximately .3 load and the voltage should not exceed 29 volts.

12. Check if flaps are in the indicated position.

13. Pull the right propeller lever back to the LOW RPM (high pitch) position. Engine speed should stabilize at approximately 1200 rpm.

14. Return the right propeller lever to TAKE-OFF RPM position. Engine should again stabilize at 1900 rpm.

15. Lower flaps full down. Operation of the flap limit switches can be checked by noting the generator load drop-off as the flaps reach the FULL DOWN position.

16. Retard the right engine to warm-up rpm.

17. Left battery and generator switches — ON.

18. Right battery and generator switches — OFF.

19. Voltmeter selector switch — LEFT.

20. The left propeller and generator systems are checked in the same manner as the right (steps 7 through 17), with the exception that flaps are raised instead of being lowered.

21. Voltmeter selector switch — LEFT.

22. If icing is anticipated, check boots for proper operation by pulling the deicer button out and watching the boots go through several complete cycles.

23. Set and uncage gyros.

24. Instrument vacuum — Check.

25. Pitot heat — Check. (Increase on the loadmeter indicates operation.) Each engine, having been operated on their respective main tanks, should now be checked on other tanks in the following manner:

26. Fuel cross-feed — On.
    Right engine fuel selector handle — NOSE.
    Left engine fuel selector handle — OFF. Leave in this position 15 seconds.

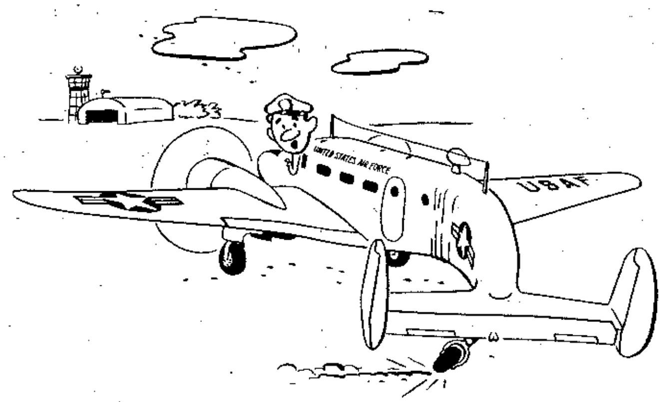
27. Left engine fuel selector handle — NOSE.
    Right engine fuel selector handle — OFF. Leave in this position 15 seconds.

28. Left engine fuel selector handle — LEFT REAR.
    Right engine fuel selector handle — RIGHT REAR.
    Fuel cross-feed handle — OFF. Leave in this position 15 seconds.

29. Left engine fuel selector handle — LEFT FRONT.
    Right engine fuel selector handle — RIGHT FRONT.

TAXIING INSTRUCTIONS.

Have chocks pulled and release the parking brake. As the aircraft first begins to move, brakes should be applied to determine that adequate brake is available for stopping. It can also be noted if there is grab, drag or other malfunction of either brake.



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The tail wheel must be unlocked before attempting any turn.

In taxiing, pilot visibility is restricted by the nose, in an area to the right and forward of the aircraft. To determine adequate clearance in this area will require an occasional S-turn.

Insofar as is possible, directional control should be maintained and turns executed by varying the power of the engines. This will permit minimum use of brakes.

The tendency for this aircraft to nose-over is not critical; however, brake application should be made with caution when the aircraft is empty or lightly loaded.

During taxiing turns, the gyro instruments should be checked for proper operation.

BEFORE TAKE-OFF.

PREFLIGHT ENGINE CHECK.

1. Both engines idle speed — Check (500 rpm).
2. Advance both engines to 700 rpm.
3. Ignition Switch — Check.
   Turn right ignition switch to OFF. As soon as it is determined that the engine ceases to fire, return the switch to BOTH. Repeat for the left engine. Any delay in returning the switch to BOTH after the engine has stopped may result in backfire.
4. Advance both throttles to Field Barometric pressure.
5. Check RPM. The engine speed should be approximately 1950 ± 50 rpm.
6. Left Engine — Warm-up rpm.
7. Right Engine Ignition — Check.
   Advance the throttle to field barometric pressure. Switch from BOTH to R, observe rpm, return to BOTH and allow rpm to stabilize. Switch from BOTH to L, observe rpm, return to BOTH. The maximum allowable drop is 65 rpm in either the R or L switch position.

CAUTION

To avoid detonation, a period of 1 minute will be considered maximum for operating the engine on single ignition at this speed.

8. Right Engine — 1700 rpm.
9. Cruising Fuel Air Mixture — Check.
   Move mixture control into the MANUAL LEANING RANGE until an approximate 100 rpm drop is noted; then return to RICH. During this operation the engine speed should increase very slightly before decreasing. An immediate decrease indicates the mixture is set too lean; a momentary increase in excess of 25 rpm indicates the mixture is set too rich.
10. Right Engine Oil Temperature — Check.
11. Right Engine Oil Pressure — Check.
12. Right Fuel Pressure — Check.
13. Right Cylinder Head Temperature — Check.
14. Right Manifold Heat — HOT and check for carburetor mixture temperature rise.
15. Right Manifold Heat — COLD.
16. Right Engine — Warm-up rpm.
17. Left Engine — 1950 rpm.
18. Check left engine in the same manner as steps 7 through 16 for the right engine.

NOTE

Throughout the engine check, with the mixture RICH, acceleration or deceleration should be both smooth and rapid with no tendency to miss or backfire.

19. Batery Switches — ON.
20. Fuel Booster Switches — ON.
21. Propeller Levers — TAKE-OFF RPM.
22. Manifold Heat Levers — COLD.
23. Mixture Levers — RICH.
24. Oil Shutter Levers — As required.
25. Pedestal Levers Friction Locks — Tighten to prevent creeping.
26. Right Engine Fuel Selector — RIGHT FRONT.
27. Left Engine Fuel Selector — LEFT FRONT.

PREFLIGHT AIRCRAFT CHECK.

Elevator Tab Wheel — Set for take-off.
Rudder Tab Crank — NEUTRAL.
Aileron Tab Wheel — NEUTRAL.
Flaps — Retracted.
Deicer Button — OFF.
Pitot Heat Switches — As required.
Gyro Instruments — Set and uncaged.
Instrument Inverter Switch — ON.
Safety Belt and Shoulder Harness — Check. (Shoulder harness unlocked.)
Flight Controls — Check for free and correct movement.

WARNING

If atmospheric conditions are conducive to the formation of carburetor ice, the induction system should be cleared, immediately before take-off, with manifold heat. Take-off, however, is to be made with the manifold heat levers in the COLD position to obtain maximum power. Heat may be re-applied when maximum power is no longer required.

TAKE-OFF.

The following techniques, when employed, will produce the results set forth in the Take-Off Curve, Appendix I.

WARNING

Do not take-off or land with the lavatory compartment occupied. The occupying of this compartment exceeds weight and balance limitations.

NOTE

Cylinder head temperature will increase 25° C to 50° C (45° F to 90° F) during the take-off run. Prior to take-off, temperatures should be sufficiently low that this increase will not cause the maximum allowable temperatures to be exceeded.

Tail Wheel Handle — LOCKED.
Cowl Flap Handles — TRAILED.
Apply take-off power with a slow, easy throttle movement.

NORMAL TAKE-OFF.

Take-off power is to be used for all take-offs. It is to be maintained until all obstacles have been cleared and the "Best Rate-of-Climb" speed is reached.

Directional control by use of the rudder is ineffective at airspeeds of less than 35 mph (30 knots) IAS. No attempt to raise the tail on take-off run below these minimums should be made.

There will be a tendency for the aircraft to "lift off" at 85 to 90 mph (74 to 78 knots) IAS and very little control pressure will be necessary at this speed to become airborne. This characteristic makes it possible for the aircraft to be "flown off" the ground, as compared to the more definite and abrupt "pull-off".

CROSS-WIND TAKE-OFF.

The only particular problem encountered making cross-wind take-offs with this aircraft is directional control at slow speeds. During the take-off runs, control can be facilitated by the application of power with the up-wind engine slightly in advance and in excess of power supplied by the down-wind engine, holding the tail down a little longer than for a normal take-off to minimize the weather-vaning tendency and by use of up-wind aileron. When enough speed for directional control by rudder has been attained, the power output of the engines should be equalized. At approximately 60 mph the tail should be lifted and the aircraft flown off as soon as practicable.

NIGHT TAKE-OFF.

Normal take-off technique can be employed for night take-offs with the exception that acceleration after take-off should be accomplished in a climbing attitude. No level-off to attain "Best Rate-of-Climb" speed should be made under the reduced visibility conditions encountered at night.

MINIMUM RUN TAKE-OFF.

The following procedure for take-off is to attain a minimum take-off run.

Flaps — 15-degrees down.
Take position on the runway.
While holding the toe brakes, apply take-off power.
Release brakes.
Raise the tail in a normal manner.

NOTE

Hold control column in full aft position until brakes are released and aircraft begins to roll.

At an IAS of approximately 70 mph (60 knots), apply elevator pressure to pull the aircraft off the ground.
When the aircraft is airborne, level off to accelerate.
Landing gear — UP.
Flaps — UP.

TAKE-OFF TO CLIMB OVER OBSTRUCTIONS.

For maximum performance when take-off with a climb-out over obstructions is required, the procedure for "minimum take-off run" is employed up to the stage where the aircraft becomes airborne. From that point it varies as follows:

When airborne, Landing Gear — UP.
Maintain a climbing attitude, but allow acceleration to 100 mph (86 knots) IAS as rapidly as possible.
Maintain this airspeed in climb until all obstructions are cleared.
Level off to accelerate, retracting flap when maximum flap speed is reached.
Re-establish a climbing attitude after attaining "Best Rate-of-Climb" speed.

AFTER TAKE-OFF.

Immediately after take-off, climb to a safe altitude, level off and maintain level flight until "Best Rate-of-Climb" speed is attained. Retract landing gear. (Gear retraction required 4 seconds.) Retract as soon as practicable since single-engine performance is greatly improved with the gear in the UP position.

WARNING

Before raising the landing gear, be certain that the aircraft is not only airborne but sufficient control can be exercised to maintain flight. Any settling back to the runway with the landing gear unlocked and in an intermediate position will result in structural damage or complete collapse of the landing gear assembly.

CAUTION

Except under conditions of emergency and to prevent damage to the retracting mechanism, landing gear operation should never be reversed. That is, the lever should not be placed in the DOWN position while the gear is retracting or in the UP position while the gear is extending.

WARNING

At no time should the landing gear be retracted when sufficient runway for landing, in an emergency, remains ahead of the aircraft.

When the aircraft has reached its cruising altitude, trim for level flight and maintain climb power until cruising airspeed is attained. Accomplish the following:

Establish cruise power.
Fuel Booster Switches — OFF.
Mixture Levers — Adjust.
Manifold Heat Levers — As required.
Oil Shutter Levers — As required.
Right and Left Engine Fuel Selector Handles — REAR Tanks.
Cowl Flap Handles — CLOSED.

CLIMB.

See Take-off, Climb and Landing Curves in Appendix I. For climb performance, as specified in Appendix I, set up power for climb and establish an attitude which will produce the best rate-of-climb for your particular altitude.

FLIGHT CHARACTERISTICS.

Refer to Section VI for information regarding flight characteristics.

SYSTEMS OF OPERATION.

For information regarding the operation of the various systems, refer to Section VII.

DESCENT.

Preparatory to starting normal descent, accomplish the following:

Left Engine Fuel Selector Handle — LEFT FRONT.
Right Engine Fuel Selector Handle — RIGHT FRONT.
Fuel Cross-Feed Handle — OFF.
Mixture Lever — RICH.

NOTE

The Mixture Lever should be positioned in RICH for all descents since the correct mixture at cruising altitude will be excessively lean as more dense atmosphere is encountered at lower altitudes.

Manifold Heat Lever — As required.

Reduce power to establish the desired rate of descent and trim the aircraft. Maintain constant airspeed throughout. Use power variations to increase or decrease the rate of descent as desired. Frequently note that cylinder head temperatures are within operating limits.

CAUTION

In determining the necessity of manifold heat, it should be remembered the fuel air ratios and power settings normally used during descent offer those conditions which are most conducive to the formation of ice in the induction system.

PRE-TRAFFIC PATTERN CHECK.

The purpose of the Pre-Traffic Pattern Check is to prepare the aircraft for landing, insofar as is practicable, well in advance of the period when the pilot's full attention is required in observing other traffic and landing. In this check, proceed as follows:

Altimeters — Set (Local altimeter setting).

Gyros — Set and uncaged.

Fuel Booster Switches — ON.

Fuel Quantity — Check.

Mixture Lever — FULL RICH.

Left Engine Fuel Selector Handle — LEFT FRONT.

Tail Wheel Handle — LOCKED.

Right Engine Fuel Selector Handle — RIGHT FRONT.

Brakes — Check.

Parking Brake Handle — OFF.

Fuel Cross-Feed Handle — OFF.

Landing Weight — Check.

Seat belts and shoulder harness, crew and passengers — Secure.

Enter the traffic pattern at 120 mph (105 knots) IAS at an altitude of 1000 feet.

TRAFFIC PATTERN CHECK LIST.

Propeller Levers — Set for 2000 rpm.

Manifold Heat Levers — As required.

Oil Shutter Levers — As required.

Deicer Button — OFF.

Landing Gear Lever — DOWN.

Recheck landing gear for down and locked position by use of all indicators and by visual check.

NOTE

(Deleted)

Decrease IAS to 115 mph (100 knots).

Cowl Flap Handles — As required.

Flap Lever — DOWN.

Immediately prior to flare out:

Propeller Levers — TAKE-OFF RPM.

NOTE

If it is necessary to use manifold heat during the approach to landing, the manifold heat levers should be placed COLD prior to landing. This should be accomplished at the time propeller levers are positioned for TAKE-OFF RPM. Manifold heat levers are managed in this fashion so that full power will be available for go-around if the landing cannot be completed.

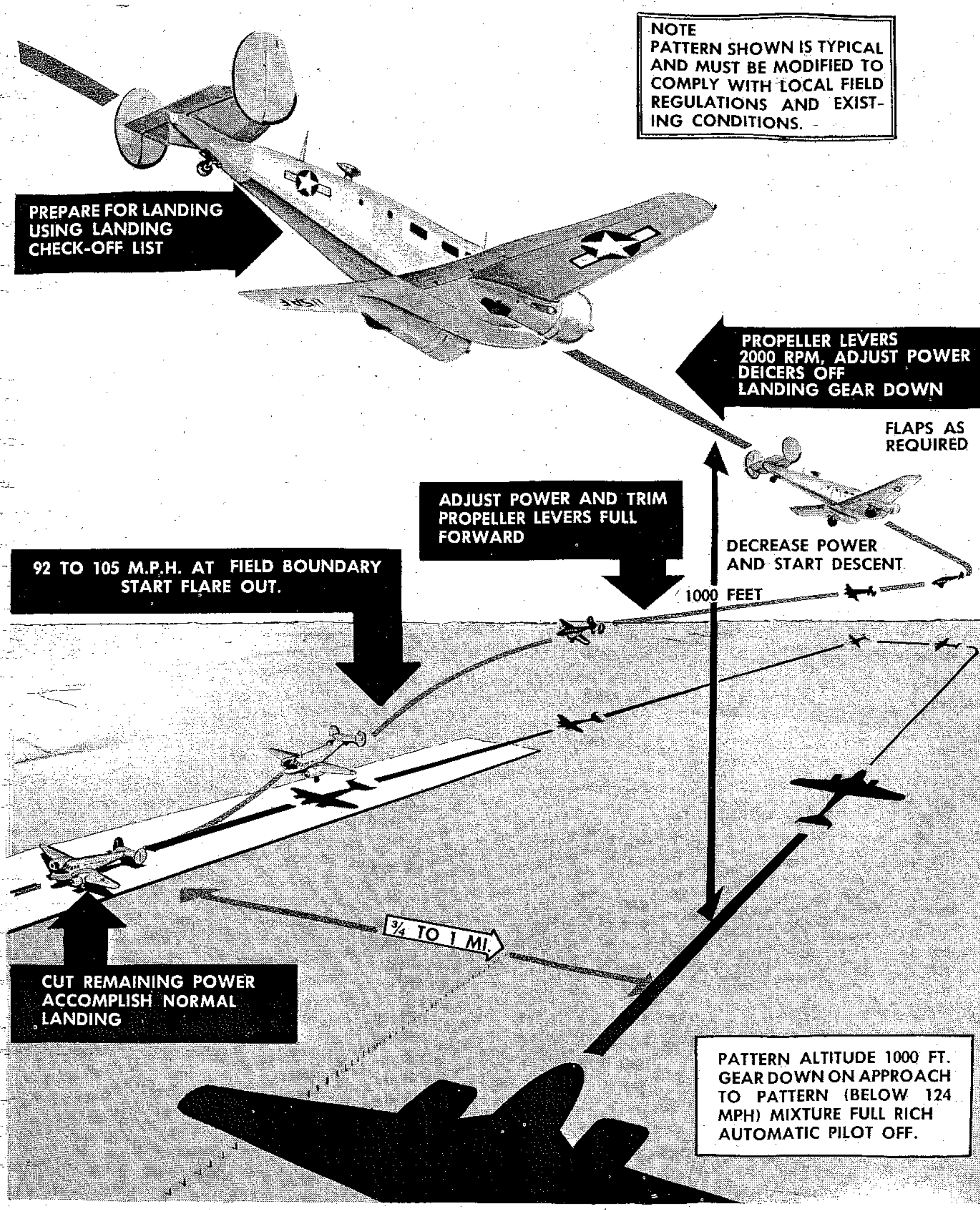
LANDING.

NORMAL LANDING.

There are no outstanding characteristics peculiar to this particular aircraft in landing. The effectiveness of control remains positive throughout the range of decreasing speed and in none of the various operations are control pressures excessive. The procedure outlined in this section will produce the results shown on the landing chart in Appendix I. As with all aircraft, a number of checks and operations must be accomplished in a relatively short period of time. Unless routine checks are accomplished prior to beginning the actual approach to landing, your technique will suffer. On a downwind leg, all checks should be completed, the landing gear extended and speed reduced to 115 mph (100 knots) IAS.

Flaps may be used, on the approach, at the discretion of the pilot. On final approach, speed should have been reduced to 105 mph to 92 mph (90 knots to 80 knots) IAS and full flap applied. Over the end of the runway close the throttle and complete the portion of the check list that is required before flare-out. Through the steady application of back pressure, flare-out the glide angle and establish a slight tail low attitude.

Thoughout the approach, trim the aircraft to relieve elevator pressure as more control is applied to reduce airspeed. Maintain the desired rate-of-descent with power variation rather than causing airspeed fluctuation by using elevators. When the aircraft main wheels have settled firmly on the ground, apply sufficient forward pressure to keep the aircraft in a level attitude and firmly on the runway. At approximately 60 mph the tail should be lowered in one smooth continuous motion. Maintain directional control with rudder as long as possible, using brakes only when necessary. Utilize the full landing area, permitting



LANDING PATTERN DIAGRAM

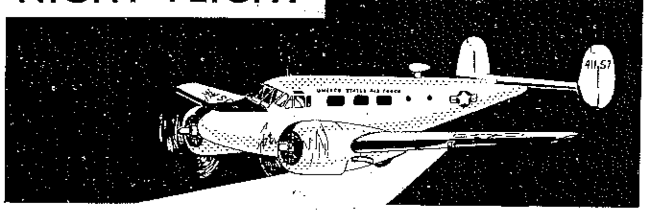
Figure 2-2

the aircraft to roll to a stop, rather than using the brakes unnecessarily.

CROSS-WIND LANDING.

When landing in a cross-wind, normal landing procedure can be employed; however, landing in a more level attitude will make directional control easier after the aircraft is on the ground. On final approach, the up-wind wing should be lowered enough to counteract drift, while the line of flight is maintained by the application of opposite rudder. The result is a slip, equal to and opposite the effect of drift, with the longitudinal axis of the airplane in line with the runway. The slip should be held until touch-down. If it is relaxed prior to the time when the aircraft is on the runway, the purpose is defeated and the aircraft will land drifting. During the ground roll, when airspeed has decreased to approximately 60 mph (50 knots), the tail should be lowered and full back pressure applied in one smooth continuous motion. This technique provides adequate rudder control until the tail wheel is firmly on the ground. Upwind aileron will aid in maintaining directional control on the runway. That period when the tail is lowered is the most critical and it is here that your greatest attention is required.

NIGHT FLIGHT



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NIGHT LANDING.

For night landings, power approaches should be employed. The procedure for accomplishing routine checks is the same as that for a normal landing; however, by utilizing power for the entire approach, the rate-of-descent will be less, permitting an extended landing pattern. The larger approach pattern, at night, makes more apparent the position of the landing area relative to the aircraft. This aids appreciably in planning a constant rate-of-descent. It also permits "lining-up" with the runway a greater distance from the landing area where drift is more apparent and obstructions on the final approach can be more carefully scrutinized. By using power throughout the approach and into the flare-out for landings, rate-of-descent can, at any time, be sharply reduced by increasing power. This decreased rate-of-descent gives more time for accurate appraisal of distance from the ground during the flare-out and touch-down portions of the landing. Landing lights may be used at the discretion of the pilot with the following limitations:

1. Due to the initial surge of electrical current the switches controlling the wing flaps, landing lights and landing gear, should not be turned on simultaneously.

2. Do not exceed specified maximum speed for flight with landing lights extended.

MINIMUM RUN LANDING.

In the execution of a minimum run landing, a power approach should be made to assure minimum safe clearance over obstructions. The approach end of the runway should be crossed with the aircraft in a slightly nose high attitude at 72 mph (63 knots) IAS. In this attitude and with the proper IAS, rate-of-descent is very rapid unless considerable power is used to retard it. Therefore, with power variation the remaining altitude, after obstructions are crossed, can be dissipated with a minimum forward motion. Some power will be required until the aircraft has been flared and landed in a three point attitude. As touch-down is made, the power should be "cut" and the control column pulled full back. This procedure produces a minimum touch-down speed and the aircraft can be braked to a full stop in a very short distance.

HIGH GROSS WEIGHT LANDING.

In the event of a landing at or near the maximum gross weight, you will find that characteristically the aircraft can be flown in the same manner as for a normal landing. As shown on the landing curve Appendix I, speeds are greater with the increased weight. Technique for specific results, however, remains the same.

GO-AROUND.

If at any time during the approach it becomes necessary to abandon the landing, the paramount factor is the regaining of speed for the necessary climb out. If this should occur with any appreciable amount of altitude, the procedure is simply to apply "Climb Power," establish a climbing attitude, retract the landing gear and then the flaps.

NOTE

Keep in mind that the landing gear control circuit breaker must be reset before the landing gear can be retracted.

If proximity to the ground or other object necessitates immediate pull-up, the following procedure will produce the maximum climb in the minimum period of time.

Apply Take-Off power.

Establish a climbing attitude.

Retract Landing Gear.

At a speed of 117 mph (102 knots) IAS — Retract Flaps.

In either case after climb is established, cowl flaps should be positioned for "Trail."

For procedures required in landing emergencies, refer to Section III.

AFTER LANDING.

When the landing roll has been completed, accomplish the following:

Cowl Flap Handle — OPEN.

Wing Flap Lever — UP.

Manifold Heat — As required.

Oil Shutter Levers — As required.

NOTE

If landing is made on a surface such as stone or gravel, wing flaps may be damaged when such material is thrown by the main landing wheels. For this reason, the flaps should be retracted immediately after landing.

Fuel Booster Switches — OFF.

Tail Wheel Handle — UNLOCKED before turning.

Pitot Heat Switches — OFF.

POST FLIGHT ENGINE CHECK.

Complete this check prior to stopping engines.

Ignition Switch — Check ground at 700 rpm. Turn momentarily to OFF. Engine should stop firing.

Idle Speed and Mixture — Check (500 rpm). With engines at idle, slowly move the mixture levers toward Idle Cut-Off and throughout the operation watch the Manifold Pressure Gage. A decrease of more than ¼-inch manifold pressure indicates an excessively rich mixture. An immediate increase in manifold pressure, not preceded by a decrease, indicates the idle mixture is too lean.

Engine power, ignition and the cruising fuel air mixture are to be checked as prescribed in the preflight engine check.

NOTE

If engine operation is found to be rough on one magneto, operate the engine on this magneto alone just prior to shut-down. This procedure will aid in isolating a cylinder which is not firing if maintenance personnel are immediately advised.

All malfunctioning controls or components should be reported on the appropriate form.

BEFORE STOPPING ENGINES.

For cold weather operation, refer to Section IX, Oil Dilution Procedure. Engines should be operated at 1200 rpm until temperatures have stabilized at their lowest reading. If it is not necessary to cool engines, they should be operated a minimum of 1 minute to scavenge the oil system.

STOPPING ENGINES.

Mixture Levers — IDLE CUT-OFF.

After engines have stopped firing:

Throttles — Slowly to FULL OPEN.

After engines have stopped:

All ignition switches — OFF.

BEFORE LEAVING THE AIRCRAFT.

Wheels chocked or Parking Brake — ON.

NOTE

Brake disc warpage may occur if the parking brake is left "Locked" when hot from excessive braking.

Battery Switches — OFF.

Instrument Inverter Switch — OFF.

All Light Switches — OFF.

Flap Lever — UP (Flaps retracted)

Left Engine Fuel Selector Handle — OFF.

Tail Wheel Handle — LOCKED.

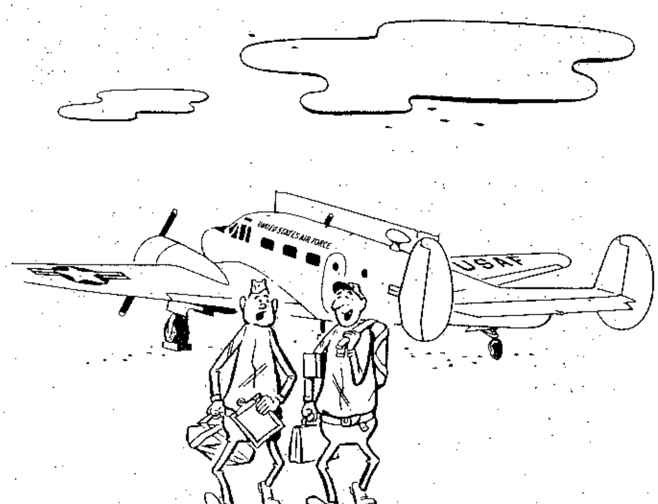
Right Engine Fuel Selector Handle — OFF.

Gyro Instruments — Caged.

Turn-and-Bank Power Selector Switch — NORMAL.

Flight Controls — Locked.

Form 1 complete.



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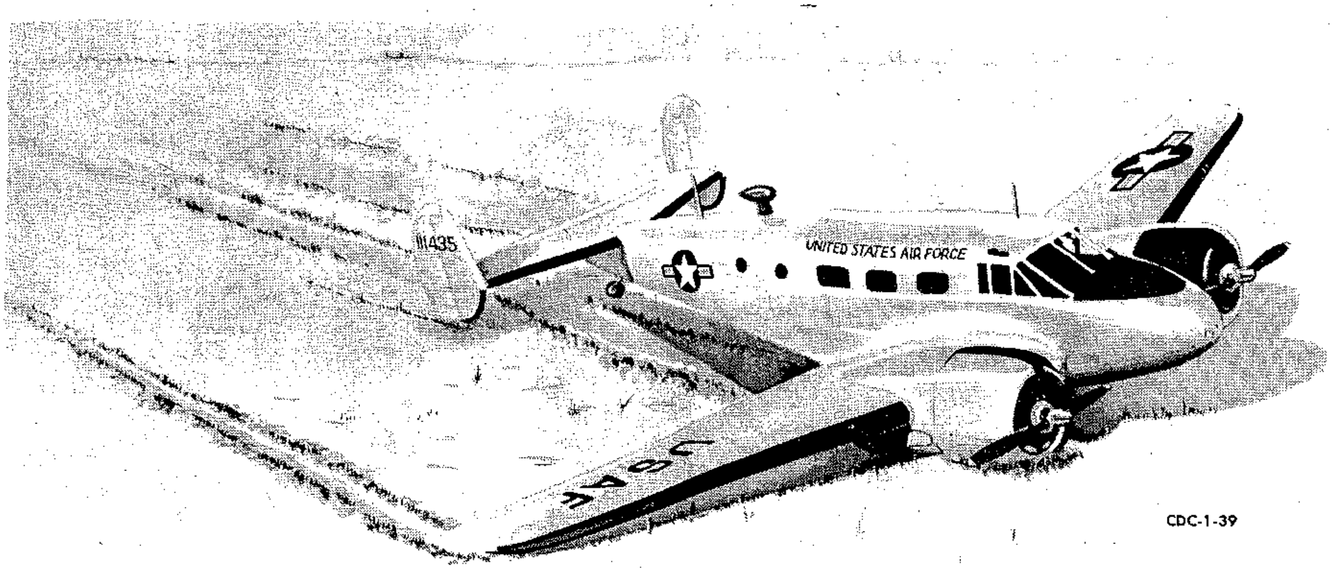

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section III EMERGENCY PROCEDURES

INTRODUCTION.

The degree of emergencies, created by the failure or malfunctioning of one or more components or accessories, will be minimized by a complete understanding of the factors involved and by immediate initiation of the proper procedures as discussed in this section. Description of emergency systems and equipment will be found in Sections I and IV.

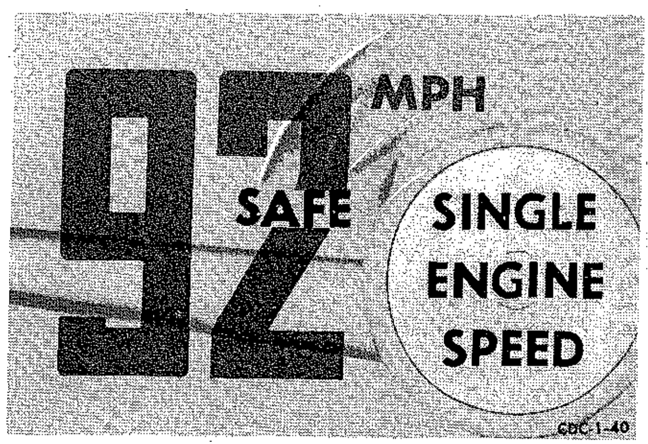
ENGINE FAILURE.

The loss of power from one engine, with this aircraft, creates no radical or unconventional tendencies. It does present the problems of diminished and unbalanced power. Diminished power will be noticed in decreased performance, either lost airspeed or altitude, or both. The unbalanced power will be evident in the yawing toward the dead engine. These immediate effects of engine failure are the factors that require immediate attention and compensation. Your primary concern is the maintenance of altitude, airspeed and directional control. YOU MUST FLY THE AIRCRAFT.

In maintaining altitude and airspeed, maximum power from the operating engine can be used.

Directional control can be effected by the flight controls. The amount of rudder required to maintain straight flight depends on two variables; the effect of control, that is, the amount of air flowing past the rudder, and the amount of yaw caused by the unbalanced power. It can be readily appreciated that the more power applied by the operating engine, the more yaw; and the more yaw, the more control effect required to offset it. From this comes the one most important single point to be remembered: THE MINIMUM SINGLE ENGINE CONTROL SPEED IS 92 MPH (80 KNOTS) IAS. This is the speed necessary to produce the required effect of rudder to control the aircraft under conditions of single engine operation at TAKE-OFF power.

The electrical system is so designed that when a generator becomes inoperative, it automatically becomes disconnected from the circuit. However, as discussed later in this section, loss of one generator has far-reaching results.



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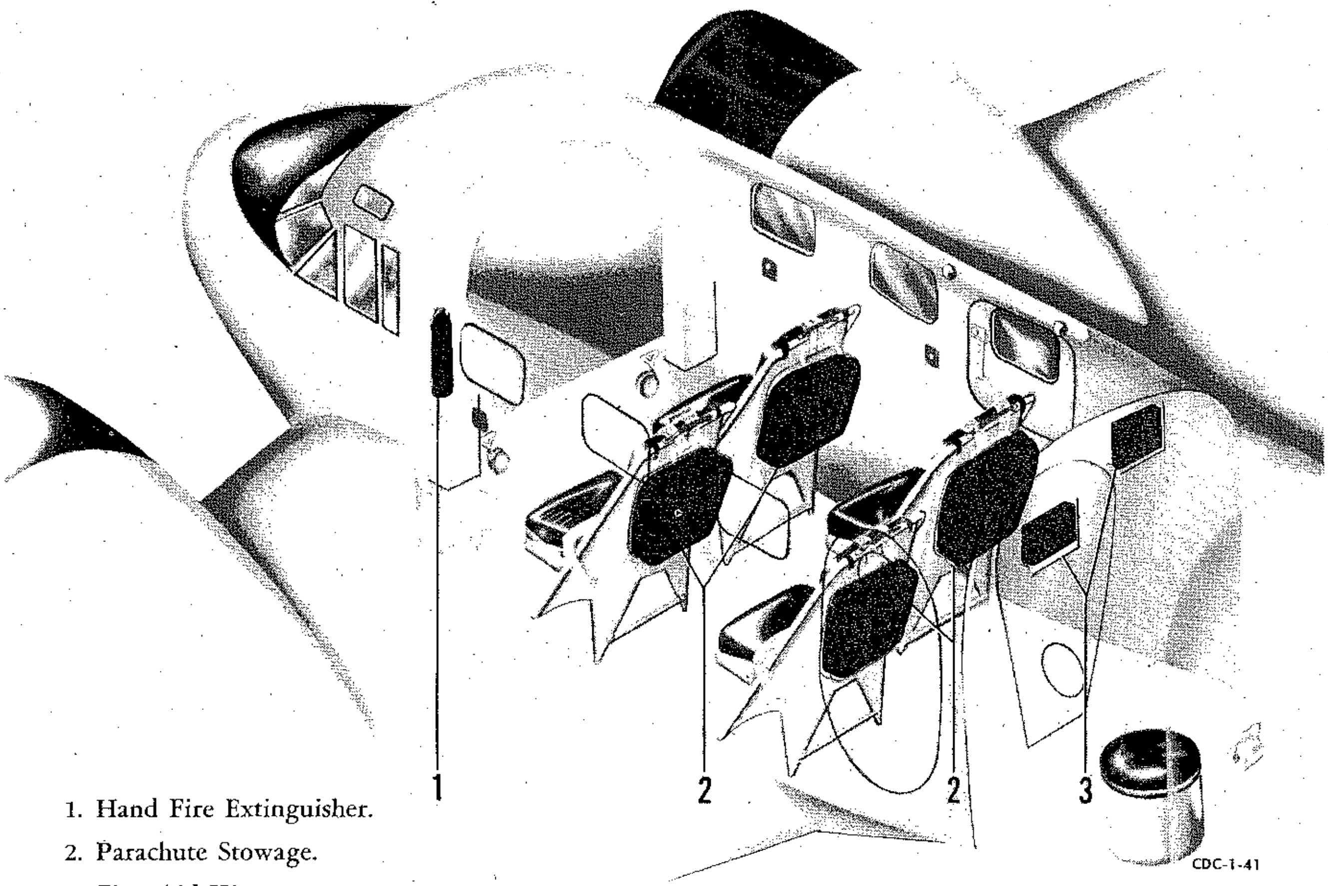
SINGLE ENGINE PROCEDURE.

The procedure to be followed in preparing for single engine flight is divided into two categories. First, the preliminary, including those steps necessary to get the engine stopped and to prepare to fight possible engine fire. Second, those steps necessary to completely shut down the engine for continued single engine operation. Keep in mind that this procedure is for engine malfunction and you are preparing for a possible resulting fire. The procedure in the case of actual engine fire is slightly different, as discussed later in this section.

EMERGENCY EQUIPMENT



1. Hand Fire Extinguisher.
2. Parachute Stowage.
3. First Aid Kits.

Figure 3-1

SINGLE ENGINE PROCEDURE.

NOTE

On encountering engine failure it is necessary to maintain altitude, airspeed and directional control. It may be necessary to advance the power on the good engine to assist in maintaining airspeed and altitude.

Throttle — CLOSED (inoperative engine).

Propeller Feathering Button — PUSH (inoperative engine).

Mixture Lever — IDLE CUT-OFF (inoperative engine).

Engine Fuel Selector Handle — OFF (inoperative engine).

Cowl Flaps — TRAIL (inoperative engine).

Ignition — OFF (inoperative engine).

The steps to this point are the preliminary steps. The following steps are those required for continued single engine operation.

Boost Pump — Check OFF (inoperative engine).
Mixture Lever — RICH (operating engine).
Adjust power on the operating engine.

NOTE

Varying situations require different power adjustment on the remaining engine. These are brought out later in this section.

Landing Gear Lever — UP.

Flap Lever — UP.

Operating Engine Fuel Selector Handle — FRONT TANK.

Fuel Cross-Feed Handle — OFF.

NOTE

When the inoperative engine is sufficiently cool, cowl flaps may be closed to reduce drag.

Oil Shutter Button — CLOSED (inoperative engine).

Generator Switch — OFF (inoperative engine).
Remove all non-essential electrical loads from the aircraft electrical system.
Trim aircraft for single-engine flight.

NOTE

In all single engine operation, the temperatures of the operating engine will rise. Temperatures will require frequent checking to assure that they are maintained within the operating limits.

RESTARTING ENGINE IN FLIGHT.

The following procedure should be followed in restarting an engine in flight and for resumption of normal flight.

NOTE

An engine should not be restarted unless the condition which required the feathering has been alleviated and it can be determined it will be safe to do so.

Engine Fuel Selector Handle — FRONT TANK.
Ignition Switch — BOTH.
Throttle — 1/8 open.
Fuel Booster Switch — ON.
Propeller — Unfeather.
Mixture Lever — RICH (after engine is turning).
Throttles — Adjust for warm-up (15 to 18 inches Hg.).

NOTE

When temperatures are such that little warm-up is required, 15 inches Hg. manifold pressure will suffice. Under colder conditions 18 inches Hg. may be required.

Fuel Booster Switch — OFF.

Generator Switch — ON.

Oil Shutter Button — Closed until oil temperature is above operating minimums. Then as required.

Cowl Flap Handle — Closed until cylinder head temperatures are above operating minimums. Then as required.

When all temperatures are above the operating minimums, equalize the power settings for the engines.

Retrim the aircraft.

Mixture Lever — Adjust.

Engine Fuel Selector Handle — Check.

ENGINE FAILURE DURING TAKE-OFF.

If engine failure occurs on take-off and sufficient runway remains ahead of the aircraft, cut power on the remaining engine and land. Order all occupants to abandon the aircraft and assign one to the engine that failed with the portable fire extinguisher. Stand by to fight possible engine fire.

If engine failure occurs during take-off and sufficient runway to land does not remain ahead of the aircraft, but airspeed is above "Minimum Single Engine Control Speed," complete the "Single Engine Procedure." Utilize Take-Off Power until all obstructions are cleared and the climb is established, then reduce to a climb power, climbing at 110 mph (95 knots) IAS. A landing should be made as soon as practicable. After landing, secure the aircraft and stand by to fight possible engine fire as previously discussed.

If engine failure occurs during take-off at an airspeed below "Minimum Single Engine Control Speed," reduce power on the remaining engine sufficiently to maintain directional control. Prepare to crash-land straight ahead, turning no more than necessary to avoid obstructions. Accomplish as much of the Single Engine Procedure as possible. To minimize the hazard of fire after landing, the Engine Fuel Selectors and Ignition Switches should be placed OFF prior to touch-down. Also lock shoulder harness before landing. After landing, determine that all occupants have escaped, then abandon the aircraft.

If engine failure occurs during take-off run when there is not sufficient distance ahead for stopping with the use of brakes and ground looping is not feasible, the landing gear should be retracted by using the Landing Gear Switch Emergency Release to avoid the danger of cartwheeling when reaching the end of the runway.

ENGINE FAILURE DURING FLIGHT.

If engine failure should occur during flight, accomplish the Single Engine Procedure, adjusting power on the remaining engine as required to maintain altitude and safe airspeed.

Refer to the performance graphs in Appendix I for information regarding airspeed, power settings and fuel consumption for single engine operation. In any event, a landing is to be made as soon as practicable.

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 as follows:

1. CUT THE ENGINE IMMEDIATELY—Do this if the power is not necessary to sustain flight or to reach a safe destination.

2. CONTINUE OPERATING THE ENGINE NORMALLY—This may be done if it can be unques-

tionably determined that the indicated fuel pressure drop has not resulted from a fuel leak.

3. KEEP THE AFFECTED ENGINE IN OPERATION AT OR ABOVE CRUISING SPEED WHILE MAINTAINING WATCH FOR FIRE—This can be done if it cannot be determined 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 (by means of the mixture control—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. Too many lives and aircraft have already been lost when the pilot gained a false sense of security as a result of several hours of flight under these circumstances without any indication of fire—then when he reduced power for a landing, an engine fire developed and it became too late to take any corrective action. This required procedure is based on the fact that air flow over the engine and nacelle, due to its cooling and dispersing effect, will frequently serve to keep a fire from breaking out, even though an actual fuel leak exists—that is until the speed of the airplane is reduced sufficiently, as during landing.

NOTE

All other factors being equal, course "1" 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, stage and requirements of the mission, and power requirements of the aircraft should be considered.

SINGLE ENGINE LANDING.

Complete the "Pre-Traffic Pattern Check" for the aircraft, as applicable for the operating engine.

Enter the traffic pattern at a minimum of 105 mph (90 knots) IAS. The "Traffic Pattern Check" should be completed and will be the same as for normal landing except that the propellers should be advanced to 2200 rpm and specific airspeeds do not apply.

Since control is more positive and greater control can be exercised when turning toward the operating engine, the pattern should be such that all turns will be, whenever possible, in this direction. The landing gear will normally be lowered early on the final approach. The traffic pattern usually will be larger, with a single engine, because of more shallow turns. This will make lowering the gear after the final turn

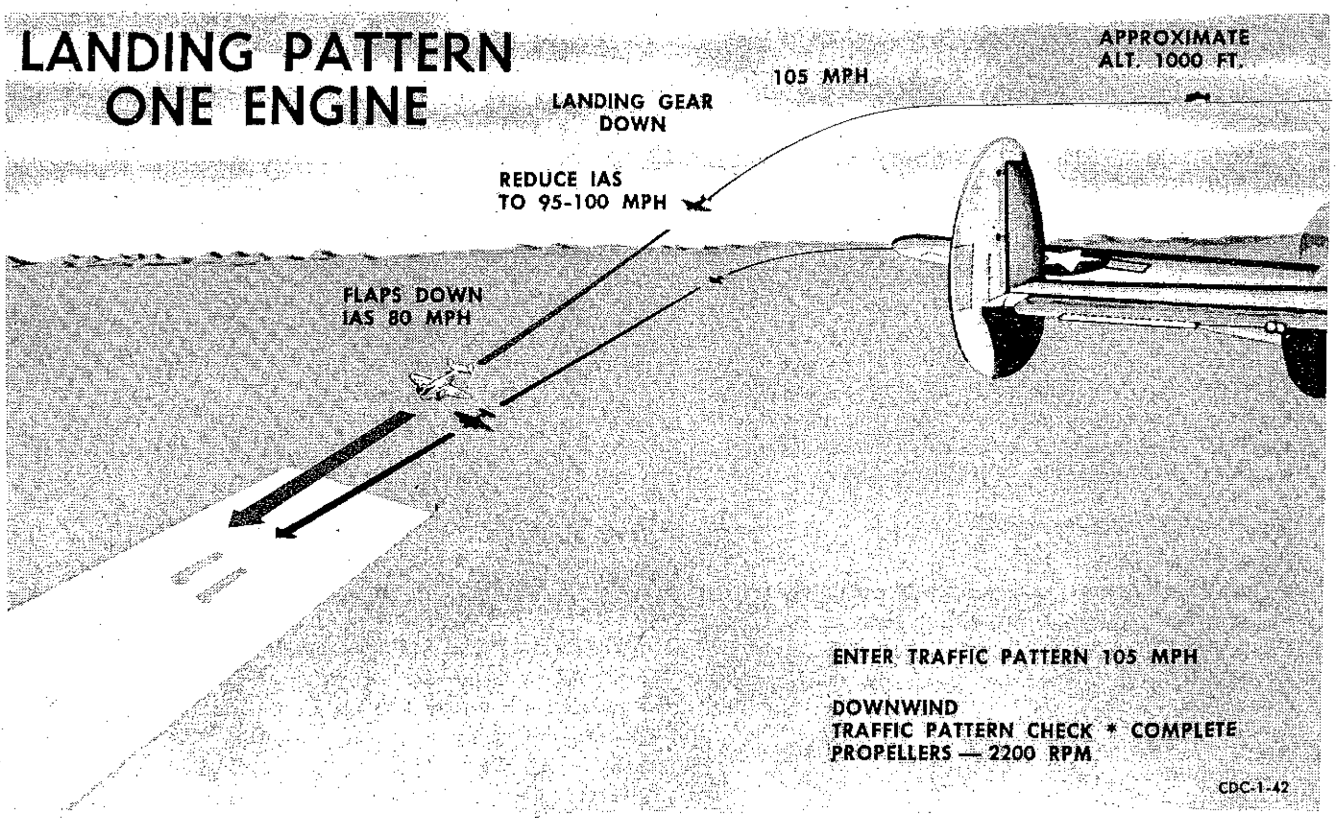


Figure 3-2

quite practical. Should circumstances make lowering the landing gear earlier in that pattern feasible, there is no reason why it may not be lowered; however, keep in mind the effect on altitude and airspeed of the added drag. It will not only require more power to maintain altitude and airspeed, but it will also make the regaining of lost altitude and airspeed more difficult.

Flaps may be used as required during the approach, but since all added drag will reduce performance in the event of a "go around", it is good practice to plan the approach so that no great amount of flap is required until the final stage of the final approach.

Maintain 105 mph (90 knots) IAS in the approach until after the final turn, then reduce power and retrim. Reduce airspeed to not less than "Minimum Single Engine Control Speed." When landing is assured, lower flaps to Full Down and reduce airspeed to 80 mph (70 knots) IAS.

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CAUTION

With landing gear and flaps down and airspeed reduced below the "Minimum Single Engine Control Speed" you are committed to land. Do not attempt a "go around."

If circumstances require a shorter approach, speed may be reduced earlier in the approach. (Never less than Minimum Single Engine Control Speed.) In an approach of this type, speed control in the final turn is very important. If speed is allowed to diminish, control may be lost; if speed is allowed to build up, it may be difficult to slow the aircraft for landing. Once committed to landing, the remaining rudder trim, which was used to compensate for unbalanced power, may be neutralized.

Keep in mind that the power-off glide of the aircraft will be appreciably greater because of the reduced drag with one propeller feathered. Flare out the glide and make a normal landing with added caution against stalling too high since controllable power is not available for recovery.

LANDING WITH NO POWER AVAILABLE.

If it becomes necessary to land the aircraft with no power available, the following procedure should be followed. Complete the Single Engine Procedure as applicable in shutting down both engines with the exception that batteries should be ON.

Warn all occupants.

Utilize the engine starters to position the feathered propellers in a horizontal position.

WARNING

Propellers in a vertical position will dig into the ground on a "wheels-up" landing, greatly increasing the initial shock and also increasing the possibility of fire since wing fuel tanks may be ruptured.

Unbuckle parachute, tighten seat belt and shoulder harness.

Jettison emergency escape doors prior to landing since impact could jam them.

Lower landing gear only when you are certain terrain is suitable and only to conserve battery power, by means of the emergency system.

Make a normal approach. Use flaps as required in the approach and full flap for landing.

NOTE

Keep in mind the variation in glide if the landing gear is not lowered.

After flaps are lowered turn batteries — OFF.

Lock shoulder harness reel.

Execute a nose-high landing, maintaining ample airspeed throughout approach, avoiding a stall condition. After the aircraft has stopped, make certain all occupants have escaped, then abandon the aircraft.

SINGLE ENGINE GO-AROUND.

The procedure for single engine go-around is as follows:

1. Apply full power.
2. Landing Gear — UP.
3. Flaps — UP.
4. Cowl Flap — TRAIL.

As power is applied and the gear raised, establish a climbing attitude and raise the flaps. Normally a go-around will not be attempted from that portion of an approach where full flap is extended, however, if such is the case maintain Minimum Single Engine Control Speed and raise the flaps. If speed has been reduced below Minimum Single Engine Control Speed, or if the landing gear is extended and flaps fully extended, a go-around cannot be accomplished unless sufficient altitude is available to retract the landing gear and flaps, and/or increase speed to that for single engine control.

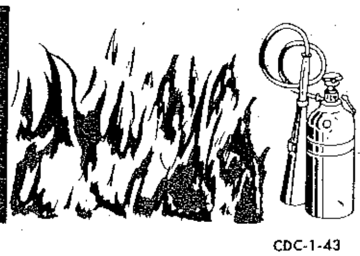
PROPELLER FAILURE.

If a propeller governor should fail, as indicated by uncontrollable engine speed, complete the Single Engine Procedure, shutting down the engine.

Should a feathering button "pop out" before feathering is complete, the button should be repeatedly pushed in, but not held in, until feathering is complete.

If a propeller fails to completely stop rotating, engine rotation can sometimes be stopped by slightly decreasing airspeed.

When a feathering button fails to "pop out" after feathering is complete, the propeller will begin unfeathering. In this case the propeller should be refeathered and the button pulled out as soon as rotation stops.



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FIRE.

ENGINE FIRE ON THE GROUND.

Engine fire on the ground is usually an induction system fire which occurs during the starting operation. For this type of fire, proceed as follows:

If the engine has started, keep it running.

Most fires can be pulled through the induction system.

If the engine has not started, place mixture control in IDLE CUT-OFF, the throttle OPEN and continue to turn the engine with the starter in an attempt to extinguish by drawing fire into the engine.

If in either case fire does not extinguish, stop the engine and order ground crew to extinguish with hand extinguishers. If ground crew does not immediately extinguish the fire, discharge the engine extinguishing system.

NOTE

If either or both engines are running when it becomes necessary to combat fire with extinguishers, they should be stopped.

ENGINE FIRE DURING FLIGHT.

Propeller Buttons — PUSH (Inoperative engine).
Mixture Lever — IDLE CUT-OFF (Inoperative engine).
Engine Fuel Selector Handle — OFF (Inoperative engine).
Oil Shutter Lever — CLOSED (Inoperative engine).
Fire Extinguisher Switch — Hold ON.
Cowl Flap Handle — TRAIL.
Ignition Switch — OFF (Inoperative engine).
Landing Gear Lever — DOWN.
Shut down inoperative engine completely.
Do not restart engine.
Land as soon as practicable.

CAUTION

The landing gear actuation system may have been damaged by the fire; therefore, do not retract the gear unless it is absolutely necessary.

NOTE

This procedure is general. The necessity of stopping the engine and extinguishing the fire is paramount and the establishing of adequate power from the remaining engine was intentionally omitted because of greatly varied situations. Where a loss of altitude is not important neither is the immediate application of additional power. In other instances, such as an approach, loss of a few hundred feet may be as hazardous as fire. You must appraise each emergency situation and act accordingly. REMEMBER — NOTHING IN THIS HANDBOOK CAN REPLACE GOOD JUDGMENT.

FUSELAGE FIRE DURING FLIGHT.

Batteries — OFF.
Generators — OFF.

NOTE

If it is determined the fire is not electrical, batteries and generators may be turned ON.

Close all windows and ventilating ducts.
Combat fire with portable extinguisher.

WARNING

CB is toxic, particularly when used to fight a fire in a closed area where various kinds of materials are burning. It is important to use as little CB as possible and to avoid inhaling any more fumes than necessary. Dizziness and Nausea are symptoms of CB poisoning sufficient to require medical attention.

That crew member not combating fire — Stand by to aid others in distress.
Make preparation for emergency landing.

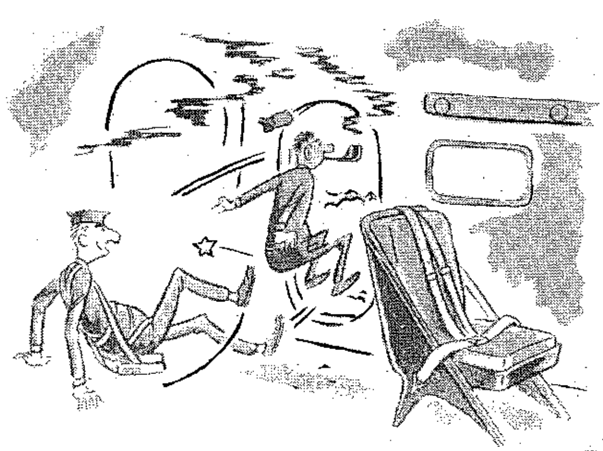
WING FIRE.

1. All electrical circuits into the wing — OFF.
2. Attempt to extinguish the flames by slipping the aircraft (away from the wing on fire).
3. Prepare for an emergency landing and land as rapidly as practicable.

ELECTRICAL FIRE.

1. Follow procedure for fuselage fire.
2. Position all individual electrical switches OFF.
3. Batteries and Generators — ON.
4. Check by switching on individual circuits, one by one, in an attempt to identify which is malfunctioning. When the faulty circuit is determined, all switches and circuit breakers in that circuit must be turned off. The remaining circuits and equipment may then be operated normally.

SMOKE ELIMINATION.



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After an interior fire has been extinguished, smoke and/or fumes should be eliminated in the following manner:

1. With all other vents and windows closed, open

SMOKE & FLAME IDENTIFICATION

TYPE OF FIRE OR SMOKE	VISUAL INDICATION	POSSIBLE INSTRUMENT INDICATION	POSSIBLE CAUSE	DANGER	REMEDY
Black smoke	Puffs from exhaust and rough engine	High CHT and CAT, fluctuating MP, RPM and F/F	Detonation, afterfire or backfire from lean mix. and/or carb. failure	Loss of power, engine failure	Enrich mixture, reduce power and temperature and monitor engine instruments
Bluish-grey smoke	Thin wisps of smoke from cowl flaps and exhaust areas	Drop in oil quantity	Slight oil leak	Slight possibility of fire	Watch closely and feather if volume of smoke indicates necessity
Grey smoke and possible light flame	Variable quantity from cowl flaps and exhaust areas — rough engine	High CHT, fluctuating MP and RPM and low oil pressure	Cylinder head or exhaust stack failure	Engine failure and fire	Feather procedure and alert crew
Black smoke	Heavy — From exhaust	Sudden drop in MP and RPM, high CHT	Initial induction fire from burning fuel	Uncontrolled fire	Fire and feather procedure and alert crew
White smoke	Dense — From exhaust and/or cowl flap areas	Very high CHT and CAT and fluctuating engine instruments	Induction casting burning and/or burned through	Uncontrolled fire	Fire and feather procedure and alert crew
Black smoke	From accessory section	Variable oil pressure, high CAT and fire lights	Oil leak and oil fire	Uncontrolled fire	Fire and feather procedure and alert crew
Black smoke and orange flame	From accessory section	Variable fuel pressure, high CAT and fire lights	Gasoline leak and fire	Uncontrolled fire	Fire and feather procedure and alert crew

Figure 3-2A

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main cabin door. Leave open until smoke and/or fumes are eliminated.

2. If a trace of smoke and/or fumes remain in the cockpit area after the cabin is apparently clear, open the copilot's sliding window for final elimination.

NOTE

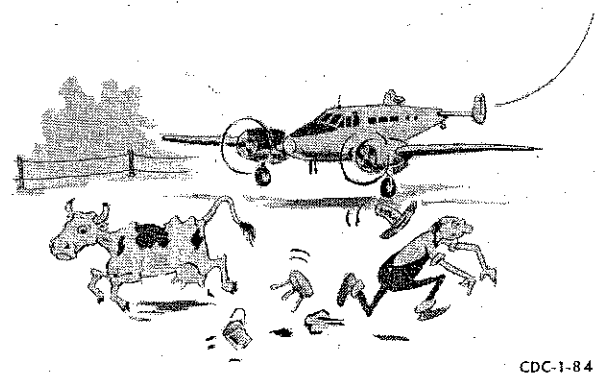
When the cabin door is unlatched, it will open approximately 2 inches. This is sufficient for average elimination of smoke and/or fumes. If more rapid elimination is required, the door may readily be held open (up to 6 inches) with the foot.

WARNING

If it is necessary to hold the cabin door open for smoke elimination, extreme caution should be exercised to avoid accidental falling from the aircraft. A parachute should be worn and the door pushed, with the foot, from a sitting position on the cabin floor.

LANDING EMERGENCIES.

Landing emergencies, generally, can be placed in two categories: minor, those which require only a slight change in the technique used for a normal landing with little possibility of more than minor damage to the aircraft; and major, those which require special technique and procedure with major damage to the



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aircraft possible if not probable.

LANDING WITH DEFLATED TIRES (MAIN GEAR).

If landing with both main landing gear tires flat is required, execute a minimum roll landing as outlined in Section II. After touch-down, allow the aircraft to roll to a stop without use of brakes if possible since brake application will tend to tear the tires from the wheels. Employ the same type of landing when one tire only is flat except that the initial touch-down should be made with the inflated tire. Also, touch-down should be on the edge of the runway near the inflated tire since, after both wheels are on the runway, the aircraft will tend to veer toward the side with the flat tire. Use brake on the inflated tire as necessary for directional control and to stop the landing roll as soon as possible.

LANDING WITH TAIL WHEEL TIRE DEFLATED.

When landing with the tail wheel tire flat, appproach for a normal landing. Touch-down on the main gear only and utilize slight forward elevator pressure to hold the tail off the runway as long as possible.

When the tail can no longer be kept up, brake the aircraft to a stop as rapidly as possible.

CAUTION

With the aircraft on the ground in a tail-high attitude and with forward elevator pressure applied, the tendency to nose over with a sudden application of brakes is greatly increased. Positive braking action is possible if application is smooth and gradual.

LANDING ON UNPREPARED RUNWAYS.

Landing on an unprepared runway can be made with a normal approach and landing if the surface is hard. If the surface is soft, there will be a tendency for the aircraft to nose over as the landing wheels sink into the surface and deceleration becomes rapid. Make an approach for a minimum roll landing. Land with power on and the aircraft in a tail-low attitude. As touch-down is made, apply full back pressure to the control column. Use no brakes. Air stream from the power that was being utilized at the time the landing was made will aid in keeping the tail down. Therefore,

EMERGENCY ENTRANCE

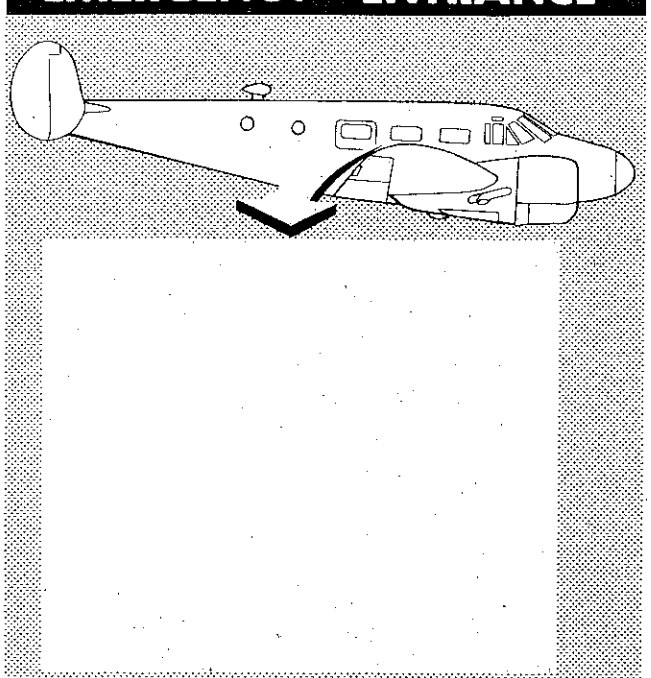

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Figure 3-3

this power should be continued on the landing roll and slowly decreased as the aircraft slows.

WHEELS UP LANDING.

In landing with both main wheels retracted, power should be utilized throughout the approach to assure landing on a suitable area. Proceed as follows:

In the traffic pattern
Generators — OFF.

Immediately before touch-down
Mixture levers — IDLE CUT-OFF.
Propellers — Feather.

All Ignition Switches — OFF.

Batteries — OFF.

Land with flaps full down in a slight nose high attitude but not fully stalled. With the landing gear retracted, the main landing gear wheels extend far enough out of the nacelles that they will support the aircraft. Brakes may be used for directional control or stopping. If only one landing gear extends, retract it and make a landing with both wheels up. If this cannot be done and it is necessary to land with only one extended, make an approach for a normal landing. Land with the wing on the side with the faulty landing gear slightly higher and utilize full aileron to hold it up as long as possible. As the wing finally touches, relax aileron, apply full back pressure and brake to a stop as rapidly as possible.

NOTE

On any landing where sufficient braking action is not available and ground-looping is not feasible, the aircraft may be stopped by retracting the landing gear during the landing roll.

EMERGENCY ENTRANCE.

If entrance to the aircraft through the cabin door is impossible or impractical, entrance may be gained through the "Emergency Rescue" area on the right side of the fuselage. The area to be broken through is indicated with yellow markings.

DITCHING.

In the event a forced landing on water becomes necessary, the following general instructions will apply; however, each organization will draw up a "Ditching Bill," giving ditching stations for crew and passengers and listing crew duties:

Send distress signal including time, position, altitude, ground speed, course and estimated position of landing.

Prepare the life raft which, if carried, is stowed in the lavatory compartment. It should be brought into the cabin near the exit and prepared for use. Do not inflate until the raft is outside the aircraft.

Safety belts should be secure but ready for instant removal.

Parachute harness should be removed.

In landing, the gear must be retracted and the flaps fully extended. The landing itself should be made with the aircraft in a nose-high attitude so that the tail strikes the water slightly first. If there is little or no wind, ditching will be made with as low IAS as possible. Waves are created and maintained by wind; consequently, landing should be made across the waves into the wind.

If a swell system is evident, the landing should be made parallel to the swells along a crest and, since swells do not necessarily run with the wind, as nearly into the wind as possible. If wind velocity is so great as to make this procedure impractical, landing may be made into the wind across the swells. If so, the touch-down should be made on the upslope of a swell near the top.

NOTE

Use of power is advisable. Even one engine will aid greatly in flattening the approach. For this reason, if it is certain land cannot be reached, land before fuel is exhausted.

BAIL OUT.

Decrease IAS to 100 mph (87 knots).

Jettison cabin door.

Maintain level flight until all occupants have left aircraft.

Head the aircraft toward the least inhabited area available.

Trim aircraft slightly nose down for straight flight.

Abandon the aircraft.

NOTE

For the purposes of mutual aid and survival, it is advisable to plan the bail out pattern so that after all passengers have bailed out, a 180 degree turn can be made permitting the pilot to abandon the aircraft in the same general area.

The safest procedure for leaving the aircraft is as follows:

Adjust parachute.
Kneel on the cabin floor facing the door.
Fall forward, head first, out the cabin door (in the same manner as turning a somersault).

WARNING

Do not jump from the cabin door. Leaving the aircraft in this manner, you may strike the tail surfaces.

FUEL SYSTEM.

If fuel pressure is lost, refer to Fuel Pressure Drop — Engine Operating Normally. To restart use the following procedure:

1. Throttle — 1/8 OPEN (on engine with no pressure) to prevent surging when the engine again begins to fire.

2. Engine Fuel Selector — FRONT TANK.
3. Fuel Booster — ON.
4. After pressure is regained, readjust power.
5. Fuel Booster — OFF. (If pressure fails with the fuel booster OFF, operate the engine with it on.)

If engine pressure cannot be regained, assume a broken line and complete the single engine procedure.

NOTE

After the engine is secure, check cross-feeding to determine that fuel can be utilized from the inoperative side. If the remaining engine stops when the cross-feed is turned ON, it would indicate the operating pump is sucking air and no fuel can be cross-fed in any manner.

FLAP SYSTEM.

In the event the electrical system fails to actuate the flaps, check the circuit breaker. If it is tripped, it should be reset and the electrical actuation attempted again. If the circuit breaker again trips, or if it was not tripped on the initial check, flaps should be operated by the emergency hand crank in the following manner:

Place flap switch in OFF position so that if the electrical circuit should become operative the flaps will not move from a set position.

NOTE

Prior to compliance with T. O. 1C-45H-203, the flap switch has three positions, "UP", "OFF" and "DOWN". After compliance with above T. O., the "OFF" position is removed.

Engage emergency hand crank (push in, toward pilot).

Turn crank (forward at top of stroke) to lower flaps; the opposite to raise flaps.

Approximately 30 turns are required for full flap travel. The flaps will lock in whatever position they are cranked to.

LANDING GEAR SYSTEM.

If the electrical system fails to operate the landing gear, BOTH the landing gear control circuit breaker on the circuit breaker panel and the landing gear circuit breaker on the pedestal should be checked. The landing gear may be extended manually; however, due to the weight of the gear and the inaccessibility of the hand crank, it is not recommended that you attempt to retract the gear manually unless there is someone available who can use both hands on the hand crank. Weight of the gear requires considerable force and is difficult to manage with one hand.

To extend the landing gear manually:

Pull out Landing Gear Control circuit breaker.

Place switch in DOWN position.

Raise landing gear clutch cover on floor board to the left of the pedestal.

Depress clutch pedal with toe and hold.

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Allow gear to fall to trail position.

Engage emergency hand crank (move crank away from pilot) and turn (forward at top of stroke) until considerable resistance is encountered.

WARNING

The hand crank may cause serious injury to the operator if it is engaged, on gear extension, before the clutch has been released and the gear allowed to reach the limit of its free fall. The gear ratio in the emergency mechanism is such that during this period the crank spins quite rapidly and is all but impossible to hold.

Release clutch.

Since electrical power may be OFF, check gear down visually. (A small portion of each wheel is visible through the pilots' compartment windows by leaning well forward.)

Rock hand crank back and forth slightly until clutch pedal is all the way back against the floor boards.

The landing gear switch circuit breaker should be pulled out and the switch placed in the DOWN position as a safety measure. Be certain the clutch is full back against the floor board to insure locking the gear in position. If the electrical system has been turned off, be sure the landing gear switch is left in the DOWN position so the gear will not accidentally retract if the electrical system is turned ON.

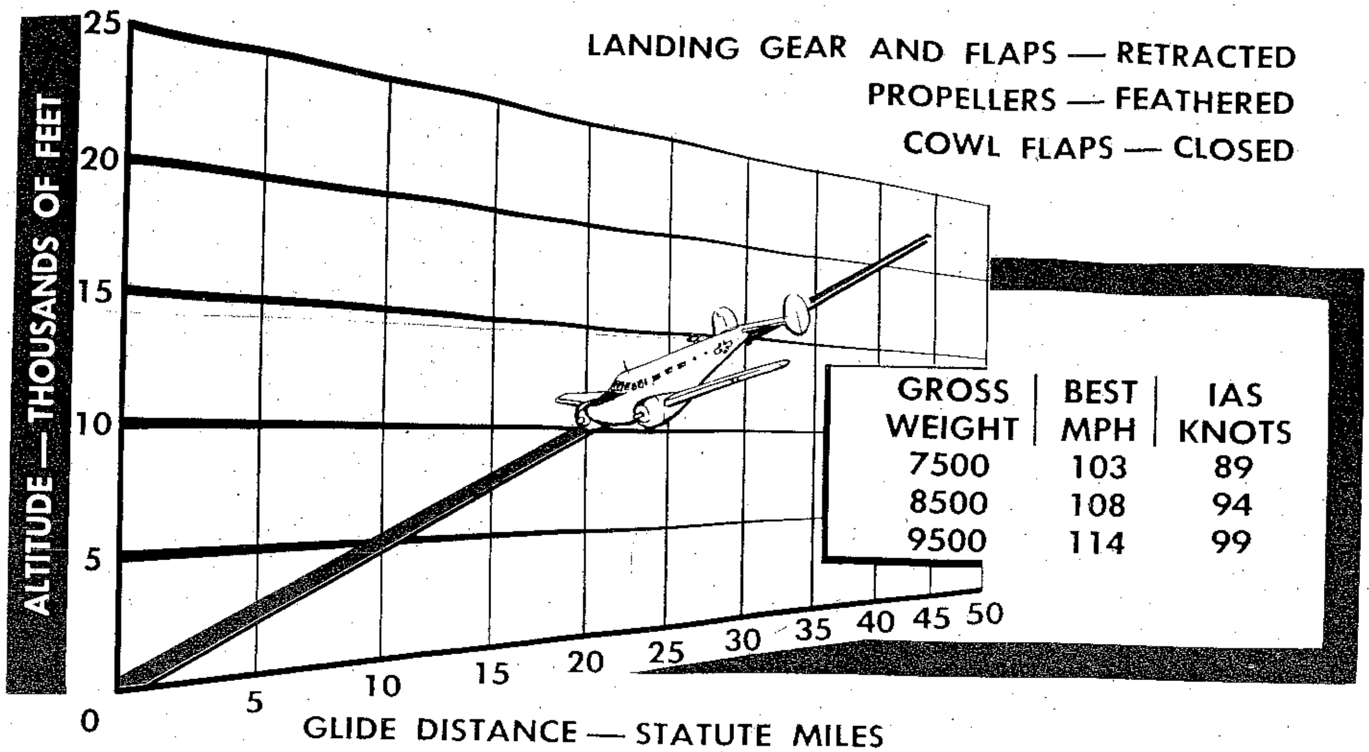
ELECTRICAL POWER SYSTEM.

In the event a generator becomes inoperative:

Reset circuit breakers and overvoltage relay.

Check voltmeter and loadmeter for output.

MAXIMUM GLIDE — NO POWER AVAILABLE



GROSS WEIGHT	BEST MPH	IAS KNOTS
7500	103	89
8500	108	94
9500	114	99

Figure 3-4

If generator fails to become operative, or again becomes inoperative, disconnect from the system.

On this aircraft, with all electrical equipment operating, (with the exception of the landing gear) when the landing gear system is operated, the load momentarily exceeds the capacity of one generator. Therefore, the loss of one generator, either through malfunction or as a result of single engine operation, does not present a problem.

The system is so designed that as a generator becomes inoperative it is automatically disconnected from the system, but as an added precaution the switch for that generator should be turned OFF.

All electrically powered equipment, not required for safe flight under the existing conditions, should be off.

NOTE

DELETED

A study of the Electrical Load Analysis in Section VII will show the load requirements of all operational and navigational equipment.

ELECTRICAL SYSTEM TROUBLE SHOOTING TABLE.

The majority of electrical system failures which occur, or which may occur in flight, can in some instances be corrected and the system involved be brought back into operation. The following table (figure 3-4A Sheets 1 and 2) was prepared with that thought in mind. The data which is included and the manner in which it is presented is intended to furnish flight crews the necessary information which will be needed to detect a system malfunction, correct it before major damage to the system wiring or components has occurred and then, if possible, bring the system back into operation. The following table is provided for C-45H aircraft which use two type M-3 generators with rated output of 50 amperes or C-45H aircraft which are equipped with two type 30E16-1-A generators with rated output of 100 amperes after compliance with T. O. 1C-45H-201. This table lists the most common causes of electrical system malfunction, two visual indication columns are provided: one with generator switches "ON" and the other with generator switches "OFF". Two "action columns" are provided; one "Immediate Action," stipulates procedures to be followed immediately upon noting a system malfunction. The "Corrective Action" column outlines the procedure to be followed in flight to bring the system back into operation so that the mission may be continued or specifies the corrective action limits. In come cases no corrective action can be taken until ground facilities are available.

CAUSES OF DC ELECTRICAL SYSTEMS FAILURE		VISUAL INDICATION OF ELECTRICAL SYSTEMS MALFUNCTION WITH GENERATOR SWITCHES "ON"				VISUAL INDICATION GENERATOR	
Item No.		Generator Voltmeter Failure	Generator Ammeter Failure	Other Voltmeter	Other Ammeter	Generator Voltmeter Failure	Generator Ammeter Failure
1.	OPEN GENERATOR ARM WINDINGS, BROKEN BRUSHES, GENERATOR SHAFT SHEAR OR BEARING FAILURE.	Zero Reading On Failed Generator	Zero Reading	Normal Bus Voltage (28.5) On Good Generator	Above Normal	Zero Reading	Zero Reading
2.	OPEN GENERATOR FIELD CIRCUIT, OPEN VOLTAGE REGULATOR.	Zero Reading	Zero Reading	Normal Bus Voltage (28.5)	Above Normal	Zero Reading	Zero Reading
3.	OVERVOLTAGE.	High Momentarily Then Zero Reading	High Momentarily Then Zero Reading	High Momentarily Then Normal	High Above Normal	Zero Reading	Zero Reading
4.	IMPROPER PARALLELING DUE TO OVERVOLTAGE.	Normal or Above (28.5)	Above Normal	Normal or Above (28.5)	Below Normal	Normal or Above (28.5)	Zero Reading
5.	LOW VOLTAGE, IMPROPER PARALLELING, HIGH RESISTANCE FIELD CIRCUIT FAULT. OPEN REVERSE CURRENT COIL CIRCUIT.	Normal or Below (28.5)	Low or Zero Reading	Normal or Below	Above Normal	Normal or Below (28.5)	Zero Reading
6.	ELECTRICAL SYSTEM IS NOT WARMED UP.	Below Normal	Below Normal	Below Normal	Above Normal	Below Normal	Zero Reading
7.	GROUND FAULT ON GENERATOR LEADS.	Below Normal	Zero Reading	Normal	High Above Normal	Below Normal	Zero Reading
8.	GROUND FAULT ON GENERATOR LEADS WITH WELDED REVERSE CURRENT RELAY.	Below Normal	Zero Reading	Low	High Above Normal	Below Normal	Low Off Scale
9.	GROUND FAULT ON MAIN BUS.	Low	High Above Normal	Below Normal	High Above Normal	Normal	Zero Reading

NOTES: (1) Generator Switch Controls, 3 components; Reverse Current Relay, Overvoltage Relay, and Generator Field Relay Re-Set Coil.
a. Generator switch in "ON" position closes circuit to reverse current relay.
b. Generator switch in "OFF" position disconnects circuit to reverse current relay.
c. Overvoltage light — Generator light will come on only when overvoltage condition occurs. Light will turn off when generator switch is placed in "re-set" position, provided generator field relay closes.

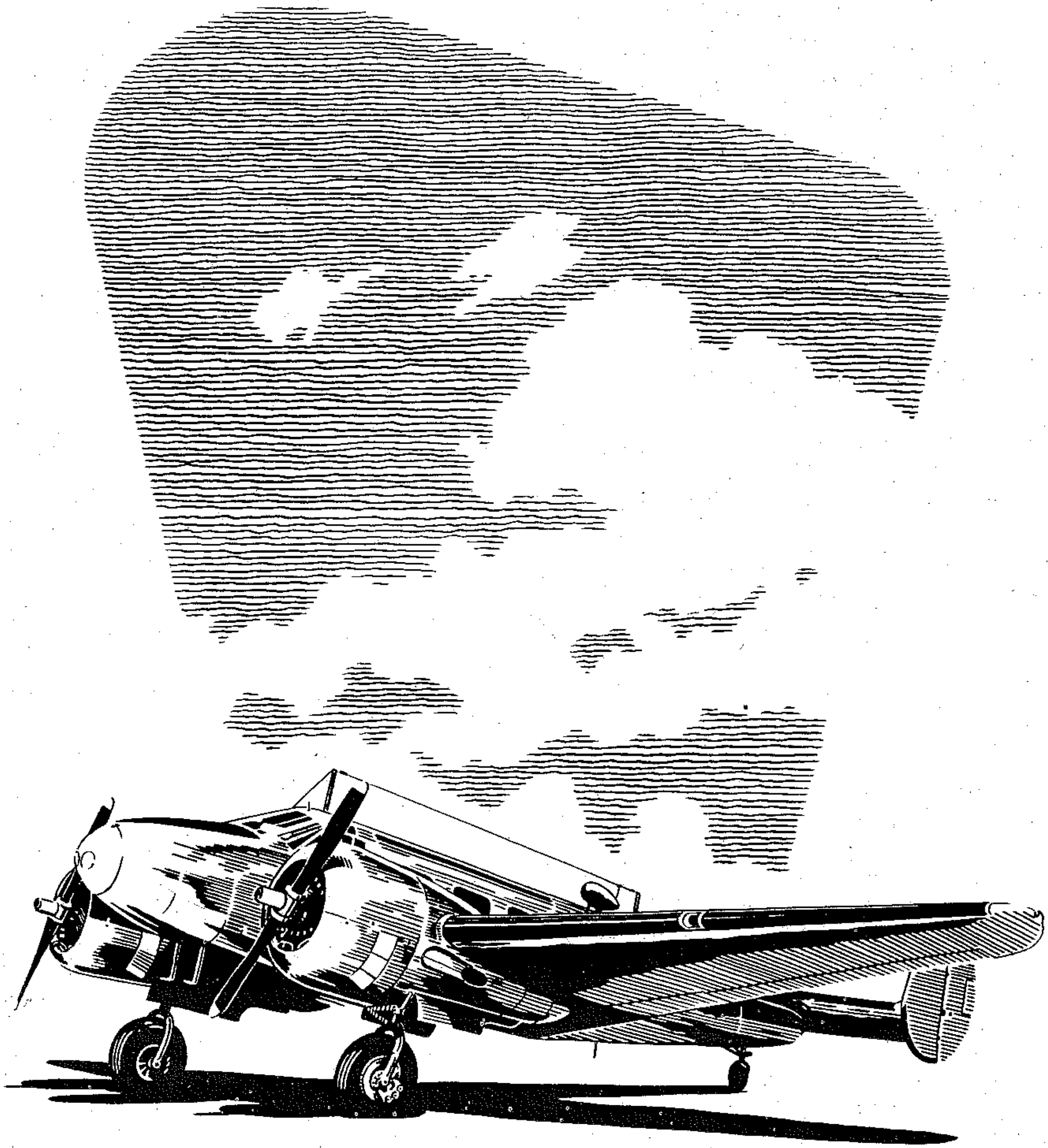
(2) SAFETY MEASURES IN CONNECTION WITH ELECTRICAL SYSTEM.
a. In event open circuit breaker is found in any generator leads, do not reset prior to determining cause of failure. For example, a ground fault which, if re-energized, could cause a serious fire.
b. Make certain electrical system (reverse current relay, voltage regulator and generator) is functional after any inspection or overhaul which may affect the electrical system.

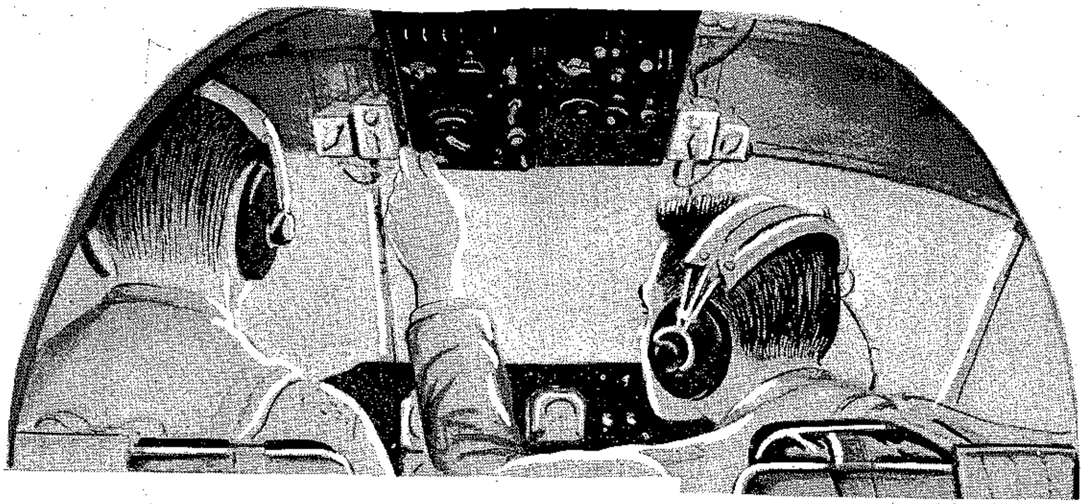
Figure 3-4A. (Sheet 1 of 2)

WITH FAILED SWITCH "OFF"		Immediate Action	Corrective Action
Other Voltmeter	Other Ammeter		
Normal Bus Voltage (28.5)	Above Normal	Leave failed generator switch in "OFF" position. If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and nonessential equipment turned "OFF."	Leave good generator on system, turn off all nonessential loads to reduce load to below the 50 ampere rating. Fire, if going to occur, will normally be in evidence 1 to 10 minutes after generator failure. It should be noted that fire is a rare occurrence.
Normal Bus Voltage (28.5)	Above Normal	Leave generator switch in "OFF" position. If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and nonessential equipment turned off.	Inspect for open generator field or defective voltage regulator. If defect can be corrected, reclose generator switch to "ON." Never remove voltage regulator except in emergency without shutting down engine, and do not interchange a voltage regulator from a faulty generator with a regulator of a good generator in flight.
Normal	Above Normal	Leave generator switch in "OFF" position. If any generator failures occur, the ammeter of the generators remaining on the bus should be immediately checked for overload and nonessential equipment turned off, if necessary.	Leave generator switch off. Inspect voltage regulator for loose or shorted wiring. Attempt to clear fault and return generator switch to ON position. Watch closely for evidence of further overvoltage indication. If overvoltage still prevails, return generator switch to OFF position.
Normal	Above Normal	Leave generator switch "OFF." Check other generator ammeter to see that load is approximately twice normal indicated output or total load of system. When faulty generator is taken off circuit system will become stable.	If possible, check voltage regulator bases for short circuit on equalizer leads (d and k terminals). If equalizer leads can be cleared, reclose generator switches to "ON" position. If equalizer lead fault cannot be located or cleared, do not make more than one attempt to place generator on bus unless additional electrical power is absolutely needed.
Normal	Above Normal	Leave generator switch "OFF." If any generator failures occur, the ammeter of the generator remaining on the bus should be immediately checked for overload and non-essential equipment turned off, if necessary.	Increase voltage of failed generator to normal by turning the voltage regulator rheostat clockwise. Reclose generator switch to "ON" position. If generator takes load and is absolutely needed, leave switch "ON." Do not, under any circumstances, interchange a voltage regulator from a faulty generator with a regulator of a good generator in flight. Also, do not attempt to rebalance electrical loads by ammeter indicator unless electrical system has been in operation for over 15 minutes (for warm-up).
Above Normal	Above Normal	None	System is not warmed up. Do not attempt to rebalance electrical loads by ammeter indicator unless electrical system has been in operation for over 15 minutes.
Normal	Above Normal	Leave generator switch "OFF."	Inspect generator leads at control box. If leads can be cleared and are serviceable, generator switch may be reclosed to "ON" position.
Below Normal	High Above Normal	Turn battery and generator switches "OFF." Remove voltage regulator. Generator with faulted leads will have a lower voltage than other generator.	If ground fault on main bus can be closed, generator leads from bus or circuit breaker. Reclose good generator and battery switches to "ON" position, if fault is cleared or circuit breaker is open.
Low	High Above Normal	Turn "OFF" all battery and generator switches. Inspect available sections of main bus for ground fault.	If ground fault on main bus can be cleared, reclose generator and battery switches to "ON" position.

c. When checking electrical system, turn off all electrical equipment (battery, radio, etc.) which would be affected by overvoltage. Inverters will not be adversely affected if over-voltage periods are short and kept as low as possible during checkout. Every effort should be made to not exceed 30 volts.
d. In event an electrical malfunction trips more than one, or all generators, turn off bus, turn off battery switch immediately, and all nonessential electrical loads. Reclose battery switch, 're-set' generator circuit breakers, check voltages, place one good generator only on bus, turn 'OFF' battery switch. Then check other generator and attempt to return electrical system to normal. Reclose battery switch.
e. When checking electrical system, turn off all electrical equipment (battery, radio, etc.) which would be affected by overvoltage. Inverters will not be adversely affected if overvoltage periods are short and kept as low as possible during checkout. (Every effort should be made to not exceed 30 volts). Check should also be made to assure overvoltage relay does not trip below 31 volts.

Figure 3-4A. (Sheet 2 of 2)





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section IV DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

INTERIOR HEATING AND WINDSHIELD DEFROSTING SYSTEM.

GENERAL

Heated air is furnished the aircraft interior by two identical systems, each with its own control. One system supplies air to all outlets on one side of the aircraft, the other system to the other side. Each engine is the source of heat for the corresponding system. There are no means for providing heat to either the cabin area or the pilot's compartment separately.

With the understanding that both heating systems are identical, the operation of only one side will be discussed in detail.

HEATING AND DUCTING. Outside air enters the system through an air intake which is located in the nacelle in such position that will pick up clean outside air. It is then heated by the engine exhaust, utilizing a heat exchanger. Two ducts lead from the nacelle; one to a cabin outlet which is located near the floor between the seats, the other to the pilot compartment. Two outlets are provided in the pilot's compartment, one on the side of the aircraft forward of the seat; the other, for defrosting, at the base of the windshield.

NOTE

> With propeller anti-ice operating, alcohol fumes will be picked up by the heating system and will become quite noticeable in the cabin.

CABIN HEAT BUTTONS.

Control valves, located in the nacelles are operated by push-pull buttons (figure 1-5) on the pedestal. This button incorporates a locking device, for maintaining the desired setting, which should be released by depressing the center plunger before repositioning.

With the pedestal button full out all of the heated air is dumped overboard; full in, all the heated air is directed into the cabin and pilots' compartment. Any intermediate position will direct a proportional amount of heated air to the aircraft interior.

For that portion of the air which flows to the cabin, there is no further control.

PILOT COMPARTMENT OUTLET SHUT-OFF.

The outlet forward of the pilot's seat is equipped with a combined deflector and shut-off valve. The outlet is in the OFF position when the opening is pointed aft. Turning counterclockwise it begins opening, reaching a full open position after approximately 90 degrees and remaining full open until the forward position where it begins to close. All air which does not pass through this outlet will be directed to the windshield defrost outlet. So remember, MAXIMUM DEFROSTING HEAT IS OBTAINED WITH THE PILOTS' COMPARTMENT OUTLETS CLOSED.

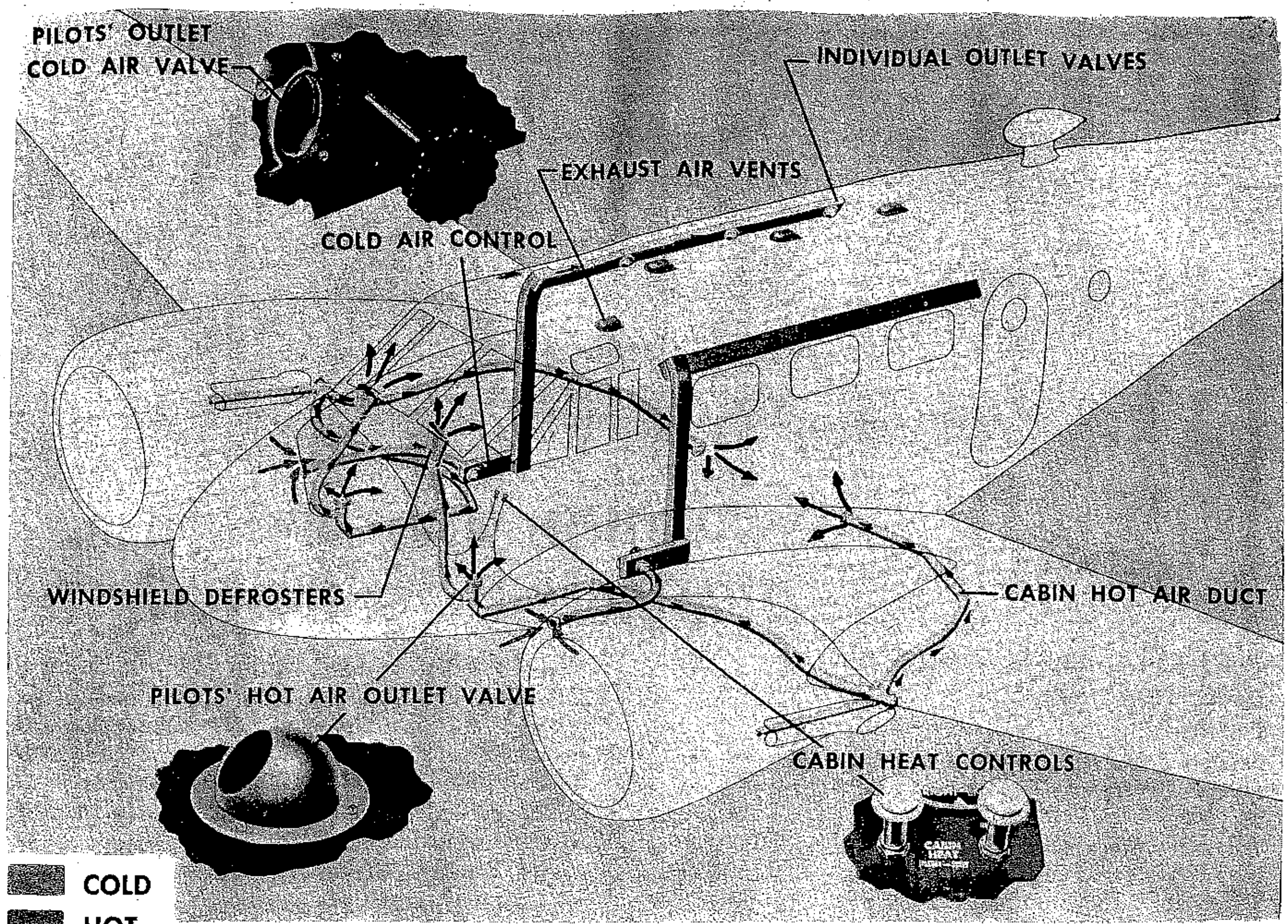
VENTILATION SYSTEM.

Cold air for ventilation enters the leading edge of the wing between the nacelle and the fuselage and passes through a duct to the cold air control valve in the wall of the pilots' compartment. From here it is ducted to the individual outlets in the cabin and to the pilot's and co-pilot's outlets. Individual and identical systems are provided on each side of the fuselage and are individually controlled.

Overhead exhaust vents are provided in the pilots' compartment and in the cabin section to permit the escape of air from the aircraft.

COLD AIR CONTROLS.

The cold air control valve (figure 4-1) is a screw-type valve located to the rear of each pilot's seat on the cabin wall. Turning the valve clockwise closes



HEATING AND VENTILATING SYSTEM

Figure 4-1

off the air flow and counterclockwise increases flow. The individual outlets located by each pilot's seat just ahead of the control valve and one above and ahead of each passenger seat are the same in operation as the pilot's and copilot's individual hot air outlets, in that they may be used for deflecting or shutting off air flow.

ANTI-ICING AND DEICING SYSTEMS.

PROPELLER ANTI-ICING.

The propellers are equipped with a liquid type anti-ice system. Both propellers are anti-iced simultaneously from a single supply tank through a single pump. The flow is from the 3 gallon tank, located on the floor boards behind the pilot's seat, through check valves in the nacelles and into the slinger rings on the propeller hubs.

PROPELLER ANTI-ICE CONTROL. The propeller anti-icing fluid pump, and thus the rate of flow, is controlled by the rheostat (figure 1-8) on the right subpanel. As the knob is turned in a clockwise direction from the OFF position, the maximum rate of flow (approximately 35 minutes' supply) is obtained as the pump starts to operate. Continued turning of the rheostat in a clockwise direction decreases the rate of flow to a minimum (approximately 3½ hours' supply). The maximum travel of the rheostat is approximately 270 degrees.

PROPELLER ANTI-ICE OPERATION. The normal operating position is indicated by a rectangular block with the word NORMAL on it across the placarded arrow. This setting affords approximately 3 hours' supply of fluid. The propeller anti-icing system is designed to prevent the formation of ice, not to remove it after it has formed.

Refer to Servicing Diagram for fluid specifications.

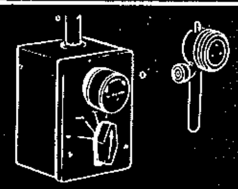
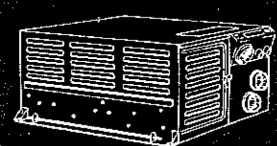
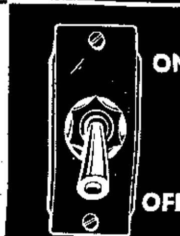
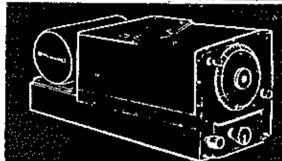
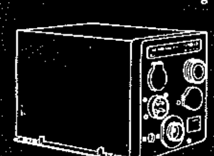
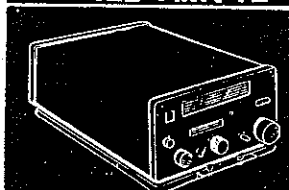
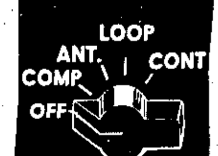
DESIGNATION	TYPE	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS	ON-OFF PROCEDURE
 RC-36 INTERPHONE	Interphone Equipment	Intercommunication Between Pilots and Passengers	Crew Members	Stations Within The Airplane	Jack Box Installation Near Each Pilot's Seat and on the Right Hand Cabin Wall.	BATTERY  SWITCHES
 AN ARC-27	VHF Command Set	Short Range Two-Way Voice and Code Communication	Pilot and Copilot	Line of Sight	Radio Control Panel Overhead Between Pilot and Copilot	
 BC 453-B	Low Frequency Receiver	Radio Navigation	Pilot and Copilot	20-200 Miles, Depending on Frequency Used and Time of Day	Radio Control Panel Overhead Between Pilot and Copilot	
 BC 1333 OR R 122 ARN-12	Marker-Beacon Receiver	Receives Location Marker Signal on Navigational Beam	Pilot and Copilot	Airplane to Ground		BATTERY  SWITCHES
 R 122 ARN-12	Radio Compass	Receive Voice and Code Signals for Homing and Direction Finding	Pilot and Copilot	20-200 Miles, Depending on Frequency Used and Time of Day	Radio Control Panel Overhead Between Pilot and Copilot	

Figure 4-2. Communications Equipment Table

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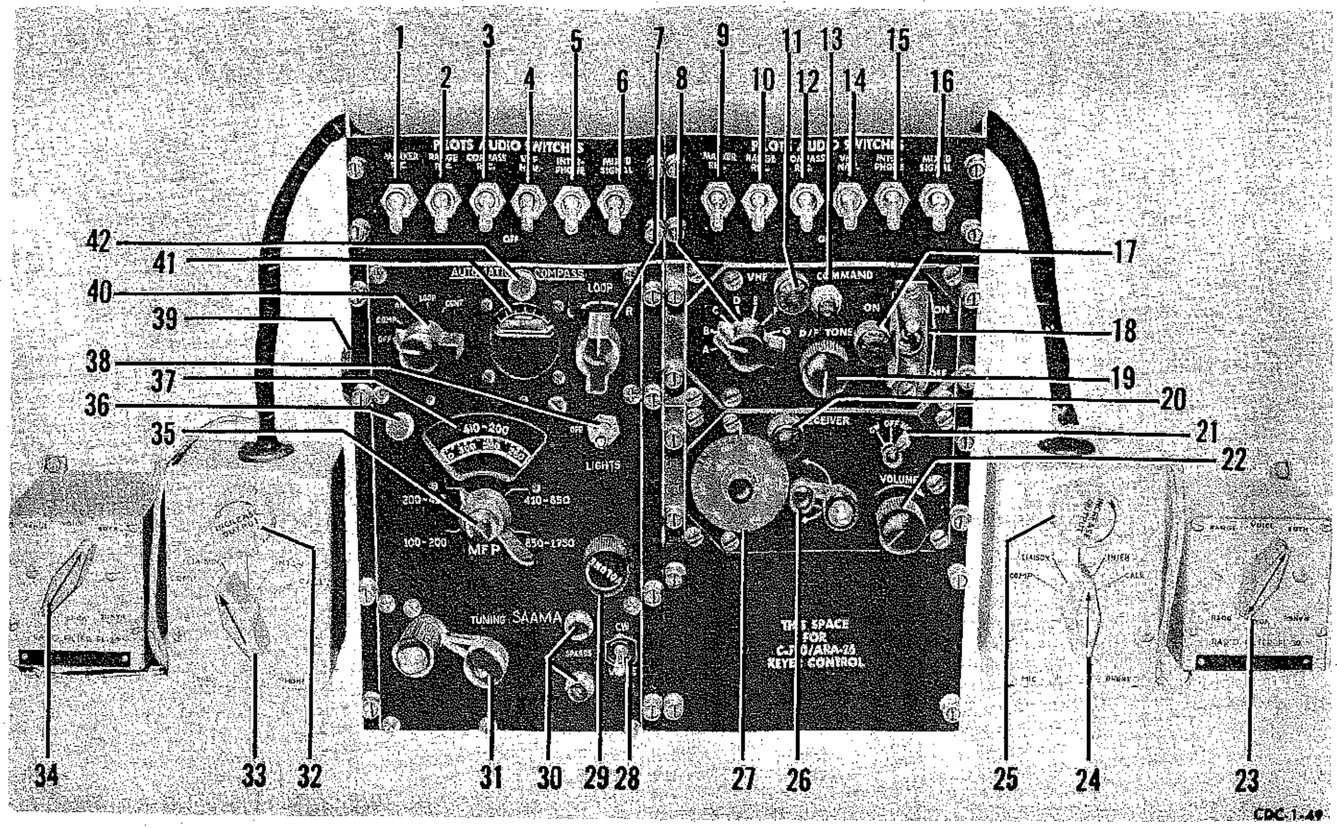
COMMUNICATION EQUIPMENT



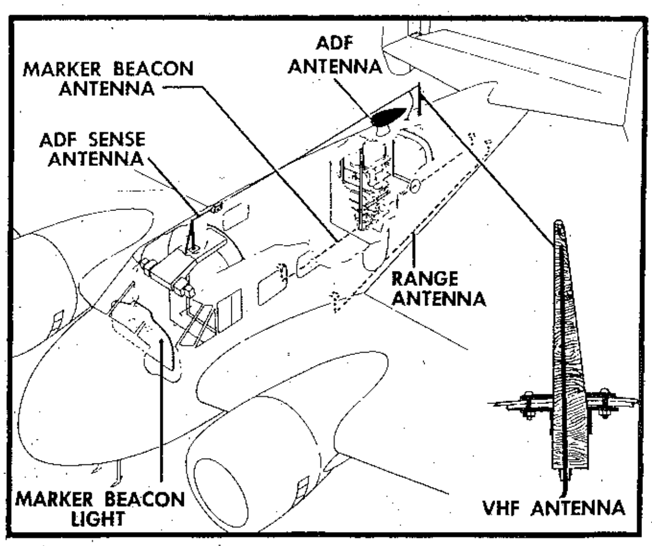


Figure 4-3. Communications Equipment

NOTE

With the heating system in operation, alcohol fumes will be noticeable in the cabin.

WING AND TAIL DEICER.

The leading edges of the wings and the horizontal tail surfaces are equipped with pneumatic deicer boots. Pressure for operation is taken from the exhaust side of the engine driven vacuum pumps.

WING AND TAIL DEICER CONTROL. A push-pull button (figure 1-8) for the control of the wing and tail deicers is mounted on the right subpanel. The button is self locking so the center plunger should be depressed when the control is repositioned. There are two operating positions; full OUT directs pressure into the deicing system and also actuates an electrically driven cycling valve which further directs the pressure to the various cells within the deicer boots. With the button full IN, the cycling operation is stopped and the air is dumped overboard.

CAUTION

If at any time in flight with the deicer system not in operation a rippling of the boots is noticed, they should be inspected upon landing and replaced if necessary. A rippling or loose boot is a flight hazard and may cause failure of the skin.

WARNING

Do not attempt to land or take-off with deicer in operation. The boot changes the shape of the airfoil as it inflates and deflates. If the airplane is flown near stalling speed with the boot in operation, a stall may result.

PITOT HEATER.

A conventional electrically heated head is used on the pitot tubes.

PITOT HEATER SWITCHES.

Two toggle switches (figure 1-7) on the left subpanel complete the circuits to the heating elements in the pitot heads; the left switch for the left pitot tube and the right switch for the right tube.

PITOT HEAT OPERATION.

Whenever possible, conditions which may cause ice to form in the pitot tubes should be anticipated so that the heater may be turned on in advance, to preclude even temporary instrument failure.

CAUTION

Prolonged ground operation of the pitot heaters will result in excessive pitot head temperatures with possible failure of the heating elements.

COMMUNICATION AND ASSOCIATED RADIO EQUIPMENT.

GENERAL.

Equipment for radio navigation as well as communication is provided in the aircraft. The various items which comprise this equipment are located in the lavatory compartment, but all controls are grouped in the overhead control panel in the pilots' compartment.

AUDIO SWITCH PANELS. Each pilot station is equipped with audio switch panel for the purpose of selecting those particular receivers to which he wishes to listen. Any number of switches may be placed ON for simultaneous reception if desired. All switches are clearly placarded as to the equipment they serve with the exception of that marked MIXED SIGNAL which serves to connect all receivers to the headset simultaneously.

FILTER SWITCHES. Each pilot station has installed conventional range filter switches.

COMP - LIAISON - COMM AND INTER - CALL SWITCH AND VOLUME CONTROL. This unit is installed for each pilot to have supplemental individual control of volume and as an interphone selector and call switch.

RC-36 INTERPHONE.

This unit is installed to provide interphone communication throughout the aircraft. It has no separate controls of its own and is on whenever the battery switches are on.

BC 1333 or R-122/ARN-12 MARKER BEACON RECEIVER. This receiver covers a range of 62 to 78 megacycles with a preset circuit for reception of the 75 megacycle fan marker, "Z" marker and ILS localizer marker signals.

BC 1333 or R-122/ARN-12 RECEIVER INDICATORS. An indicator light (figure 1-8) on the instrument panel will light in response to signal reception. This is in addition to the aural signal which may or may not be selected.

BC 1333 or R-122/ARN-12 OPERATION. No separate and individual controls are provided for this equipment since it is in operation whenever battery power is available to the bus.

AN/ARC-27 COMMAND.

This equipment provides VHF Communication from aircraft to aircraft or aircraft to ground through a frequency range of 100 to 156 megacycles. The set has line of sight range, with eight preset channels.

AN/ARC-27 OPERATION.

VHF Master Switch — ON.

VHF Channel Selector Switch — Desired frequency.

Allow 45 seconds for warm-up.

Adjust volume.

To transmit — Press microphone button and speak.

To receive — Release microphone button.

To transmit code — Use D/F TONE button on the VHF panel as a key. (Limit your speed.)

To turn off set — Move Master Switch to — OFF.

AN/ARN-7 RADIO COMPASS.

The AN/ARN-7 radio compass provides for visual and aural radio navigation as well as ordinary radio reception through a frequency range of 100 to 1750 kcs. At your discretion either automatic or manual direction finding procedures may be followed.

AN/ARN-7 RADIO COMPASS OPERATION.

To operate as an ordinary receiver:

Function switch on ANT.

Frequency Selector Switch to desired band.

Volume Control — Adjust.

Tuning Crank — Tune to maximum audio level on the chosen station.

To operate as direction finding or homing equipment manually:

Function switch — ANT.

Frequency Selector Switch — Desired Band.

Volume Control — Adjust.

Tuning Crank — Tune to the maximum audio level and identify the desired stations.

CW Switch on CW.

Retune the receiver for maximum audio level.

Function Switch — LOOP.

Retune for maximum audio level.

Proceed with desired loop operation.

To operate as automatic direction finding equipment:

Function Switch — ANT.

Select the desired frequency band.

Tune to and identify the desired station.

Adjust volume.

CW Switch — CW.

Retune to greatest deflection of the tuning indicator needle.

Function Switch — COMP.

Proceed with automatic DF navigation.

BC 453-B RECEIVER.

This receiver provides for voice and code reception through a frequency range of 190 to 550 kilocycles.

BC 453-B OPERATION.

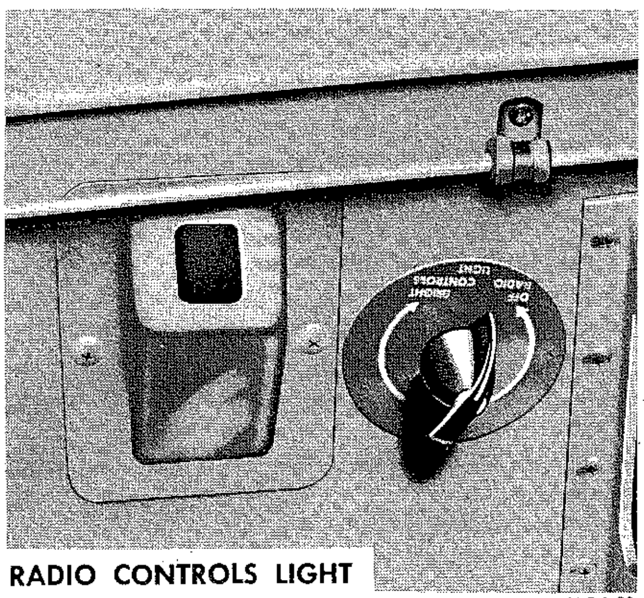
Range Receiver Switch — MCW.

Adjust volume.

Tune and identify the desired station.

NOTE

For code reception, place the Range Receiver Switch in the CW position, then tune for the highest audio level. This position may also aid in tuning stations, that are very weak, for voice reception. After attaining maximum audio level, if the switch is returned to MCW, it should be the best tuning for voice reception.



RADIO CONTROLS LIGHT

CDC-1-50

Figure 4-4

RADIO CONTROL PANEL LIGHTING.

On the left side of the radio control panel, a rheostat (figure 4-3) is provided for the control of edge lighting in the VHF and range receiver control panels. The AN/ARN-7 control panel incorporates its own lighting control, with a HI-OFF-LO toggle switch.

In addition to the lighting provided within the panels, a spotlight (figure 4-4) is located on the bulkhead below the threshold of the pilots' compartment. This light illuminates all the radio controls with any intensity of light desired. Mounted adjacent to the light is a rheostat for its control.

LIGHTING EQUIPMENT.

INTERIOR LIGHTING.

In addition to those radio panels which have interior panel lights, the following lighting is provided in the aircraft:

CABIN, LAVATORY AND BAGGAGE COMPARTMENT LIGHTS.

Dome lights are provided in the cabin, lavatory and baggage compartments. The three overhead lights in the cabin will furnish either white or red lighting, while the single fixtures in the lavatory and nose baggage compartment are white only.

LAVATORY AND BAGGAGE COMPARTMENT LIGHT SWITCHES. The overhead lights in the lavatory and baggage compartment are operated by toggle switches adjacent to the lights.

CABIN DOME LIGHT SWITCHES. The white lamps in all three cabin dome lights are controlled by a single two position switch (figure 1-7) on the left subpanel. The red lamp in each dome light is controlled by a two position toggle switch. The switch for the forward light is on the right hand cabin wall, above the window and forward of the front seat. The middle light switch is similarly located above the rear seat while the rear switch is on the rear cabin bulkhead.

PILOT COMPARTMENT LIGHTING.

A utility light is mounted above each seat to serve as a reading light. For greater utility, these lights are on six foot extension cords and may be pulled from their mounting brackets when advantageous. The utility lights have a clear lamp but are furnished with an attached red filter which may be clipped over the lens when necessary.

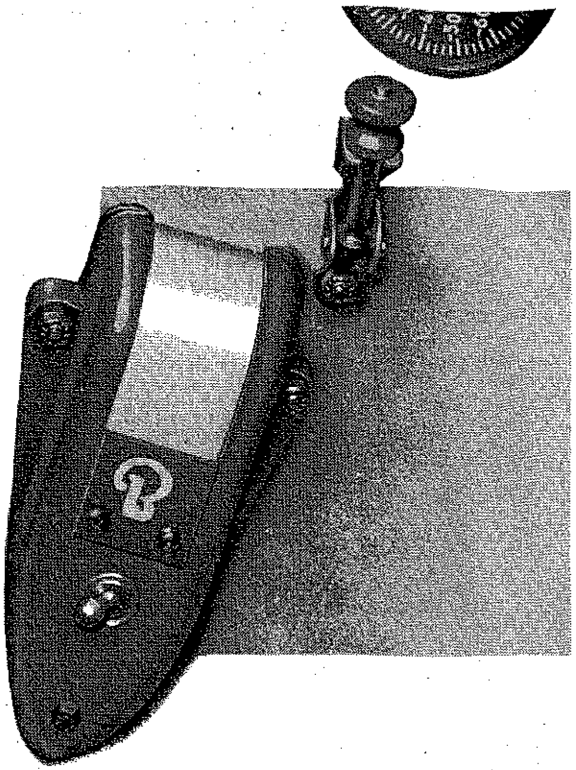
White map reading lights (figure 4-5) are mounted overhead on each side of the pilot compartment and provide illumination of the entire area.

A spotlight (figure 4-4) is located on the bulkhead below the threshold of the pilot's compartment for lighting all the radio controls with any intensity of light desired.

All instruments are individually lighted with shaded red lamps and are arranged on three separate circuits so the desired intensity of each group may be obtained. The pilot's flight instrument lights are on one circuit, the engine instruments and subpanel lights are on a separate circuit and the copilot's flight instruments on a third circuit.

UTILITY LIGHT SWITCHES. Snap switches for control of the utility lights are provided within the light housing and operated by a knob on the side.

MAP READING LIGHTS SWITCHES. Two position toggle switches are provided on the map reading light fixtures for individual control.



PILOT'S MAP READING LIGHT CDC-1-51

Figure 4-5

RADIO CONTROLS SPOTLIGHT RHEOSTAT. Adjacent to the radio controls spotlight, on the bulkhead, is a rheostat which serves not only to control the intensity of the light but also to turn it off and on.

INSTRUMENT LIGHTING CONTROL. Each of the three groups of instrument lights are provided with its own rheostat which not only controls intensity but also serves as an on-off switch. The rheostat for the pilot's flight instruments is located on the left side of the instrument panel; the rheostat for the engine instruments and the subpanels is adjacent to the one for the pilot's flight instruments; and the one for the copilot's flight instruments is on the right side of the instrument panel. All of these knobs can be located on figure 1-9.

EXTERIOR LIGHTING.

Exterior lighting consists of conventional navigation lights, a passing light, two taxi lights, fuselage clearance lights and two landing lights. The passing light is mounted in the leading edge of the left wing, the taxi lights in the nose and the landing lights are retractable into the lower surface of each wing. The clearance lights are mounted one on the top and one on the bottom of the fuselage.

NAVIGATION LIGHTS SWITCH. Both the navigation and the clearance lights are operated by the navigation lights switch (figure 1-7) on the left subpanel. The switch, a three position toggle, is placarded FLASHER-OFF-STEADY and when in the STEADY position, all lights burn continuously. In the FLASHER position, operation of the clearance lights remains continuous but the navigation lights are alternately on and off.

NOTE

If the automatic flashing device should fail while in operation, it is designed to fail safe and the lights will automatically revert to steady operation.

PASSING LIGHT SWITCH. The passing light is operated by a two position toggle switch (figure 1-7) on the left subpanel.

TAXI LIGHTS SWITCH. A two position toggle switch (figure 1-7) on the left subpanel operates the taxi lights.

LANDING LIGHTS SWITCHES. Each landing light is operated by two toggle switches. One, a three position switch, is placarded RETRACT-OFF-EXTEND; its purpose is obvious. During extension or retraction, the light may be stopped in any position by moving the switch to OFF. The other, a two position switch, is for turning the lamp off and on. The lamp may be turned on at any time except when the light is fully retracted. All four switches are together, on the left subpanel, as seen in figure 1-7.

CAUTION

Only in case of extreme emergency should the landing lights be used for ground operation. Due to the slow speed of the aircraft during ground operation, the flow of cooling air is insufficient to provide adequate cooling of the landing lights; thus overheating of the lamp filament will result in its burning out.

MISCELLANEOUS EQUIPMENT.

WINDSHIELD WIPERS.

The electrically operated windshield wipers are designed and installed for use during take-off and landing. They should not be turned on in flight, except in an emergency, since they are relatively ineffective at cruising speed and the air loads imposed on them could cause damage to the operating mechanism.

They are controlled by the windshield wiper switch (figure 1-8) on the right subpanel which is a fixed position toggle switch having FAST-OFF-SLOW, position, the center position being OFF.

CAUTION

Do not operate windshield wipers on dry glass. Such action can severely damage the linkage as well as scratching the windshield.

DATA CASE.

A data case is provided on the lavatory door.

FLIGHT REPORT CASE.

An airplane flight report case is mounted on the back of the copilot's seat.

MAP CASE.

A map case is located on the wall to the left of the pilot's seat. The case rests on the floor.

PASSENGER SEATS.

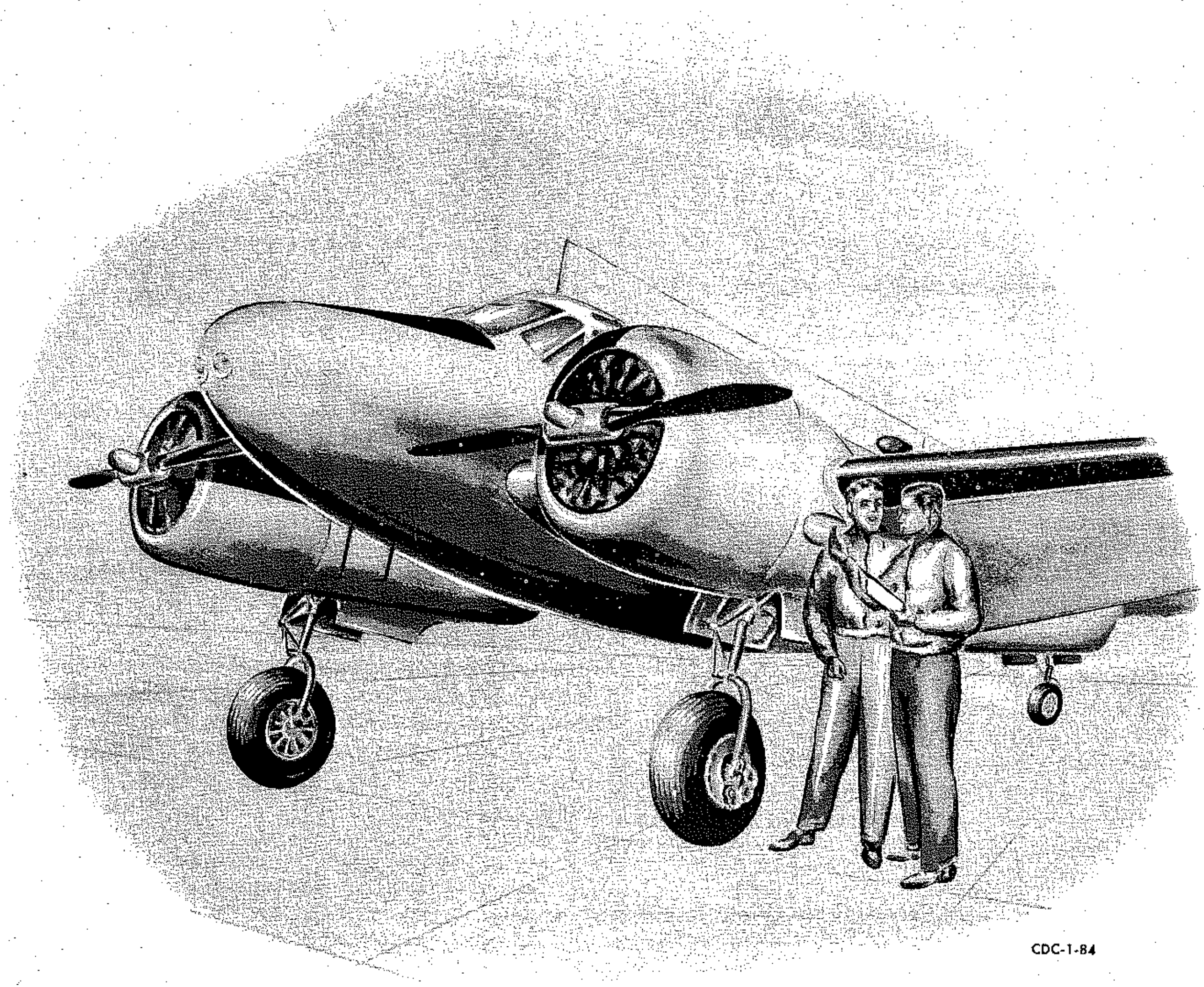
Four bucket type seats are provided in the cabin section. The seats are provided with foam rubber cushions, safety belts and fixed type G-1 shoulder straps.

MOORING KIT.

A mooring kit is stowed on the floor of the lavatory compartment.

RELIEF EQUIPMENT.

A relief tube is provided for the pilot's comfort. When not in use, it is stowed in a clip under the pilot's seat. For the passengers, there is provided in the lavatory compartment, a chemical-type toilet and relief tube.



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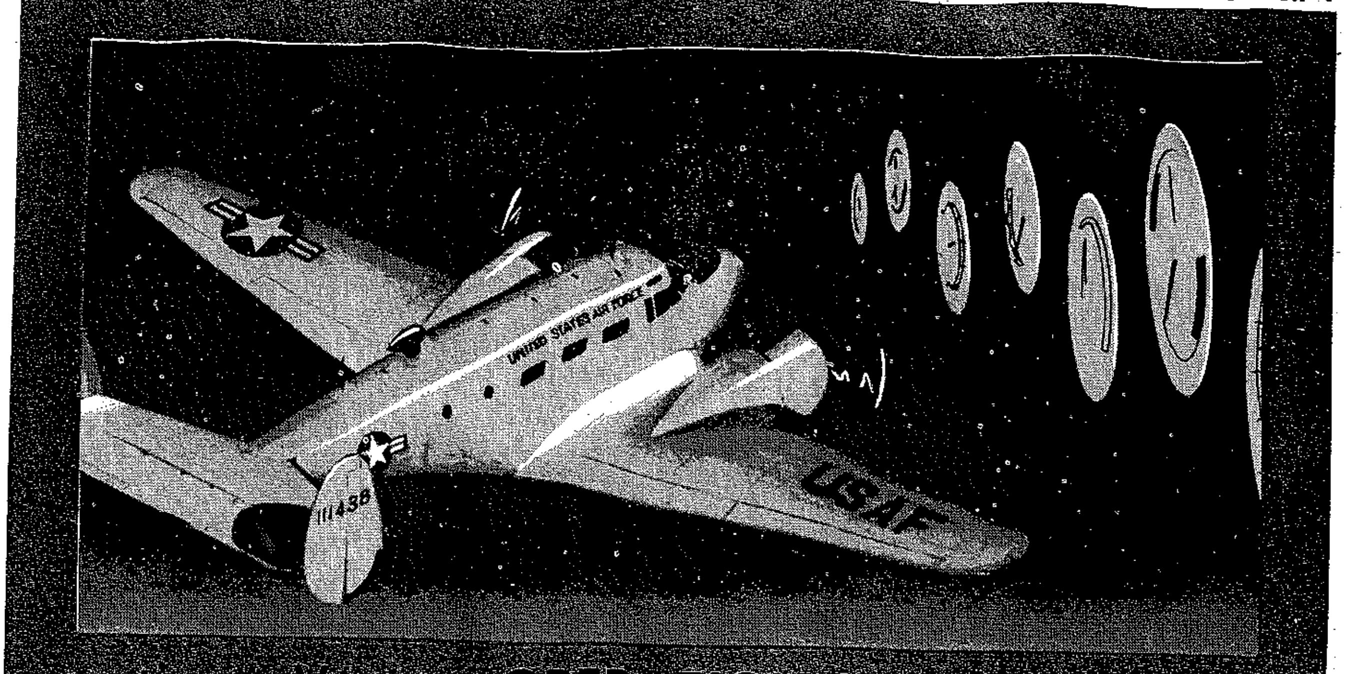


Section V OPERATION LIMITATIONS

PURPOSE.

This section includes limitations for the aircraft, engine and auxiliary flight equipment for normal operation. These limitations must be observed at all times to prevent possible damage to equipment through excessive loads. Particular attention must be given to the instrument marking pages in this section, as this data is not repeated elsewhere in the text. For complete restrictions, carefully read this entire section including the instrument marking page.

You would do well to study this section until it is memorized; however, it is not recommended that you rely on memory alone for the limitations of the aircraft.

MINIMUM CREW.

While there is a provision for both a pilot and copilot, the airplane may be flown easily and safely by one pilot under any conditions. The minimum crew, therefore, will be a pilot in the left seat. Additional crew members as required will be added at the direction of the Commanding Officer.

ENGINE LIMITATIONS.

The engine limitations as set up by the instrument markings are based on grade 91/96 fuel. Should grade 91/96 fuel not be available, the next higher grade may be used with the same limitations. Grade 87 fuel may be used if no other is available.

In the event an engine overspeeds, any speed in excess of 2900 rpm requires that the engine be inspected. A speed of 3000 rpm necessitates removal of the engine. In either event, the degree of overspeed, the length of time the engine operated at that speed and, if possible, the cause, should be noted and reported.

ELECTRICAL SYSTEM.

Do not operate landing gear and flaps simultaneously, or with landing lights on. Such operations will considerably overload the electrical system. Refer to Section VII for power requirements.

LANDING LIGHTS.

The landing lights shall not be extended at speeds in excess of 110 mph IAS (95 knots). Extension at greater speeds can cause structural failure in the light mechanism.

PROHIBITED MANEUVERS.

All acrobatic maneuvers, including spins, are prohibited. However, should an accidental spin occur, follow normal spin recovery procedure, detailed in Section VI.

WEIGHT AND BALANCE LIMITATIONS.

The lavatory compartment is restricted against occupancy during take-off and landing.

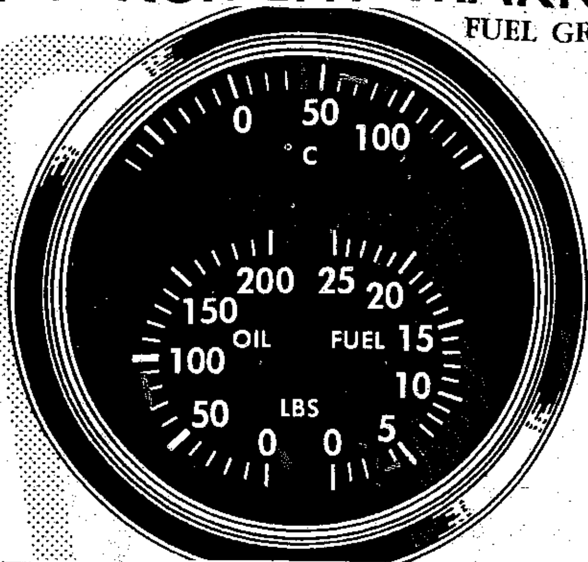
The forward CG limit of the aircraft is 107 inches, the rear limit 118.8 inches.

OPERATING WEIGHT LIMITATIONS.

In flight planning, the pilot is often confronted with this question: "What is the maximum weight at which this aircraft may be operated?" Due to certain weight controlling criteria, there is no single answer to this question. Since these criteria can be set at various optimums to accommodate varying conditions, it becomes apparent that the maximum weight of an aircraft is a varying quantity. Following are some of the controlling criteria with illustrations of how they can vary.

INSTRUMENT MARKINGS

FUEL GRADE 91/96

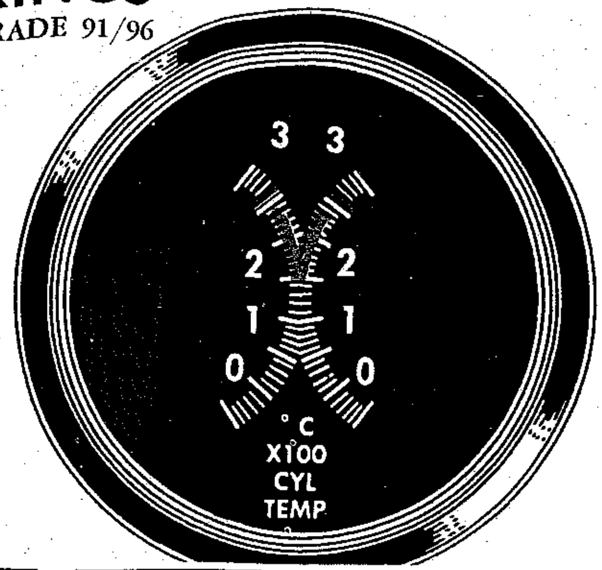


ENGINE GAGE UNIT

	OIL TEMP	OIL PRESS	
	40° C	50 PSI	MINIMUM
	60° TO 75° C	70 TO 90 PSI	NORMAL
	85° C	100 PSI	MAXIMUM

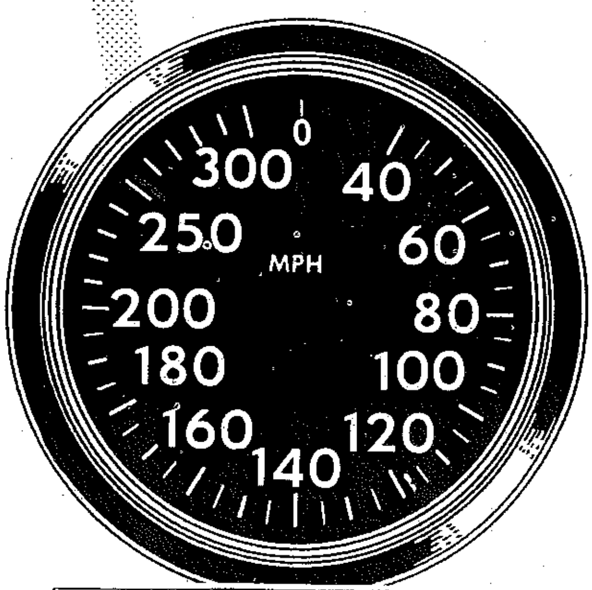
FUEL PRESS

- 3 PSI MIN FOR FLIGHT
- 3 TO 4 PSI NORMAL
- 6 PSI MAXIMUM



CYLINDER HEAD TEMP

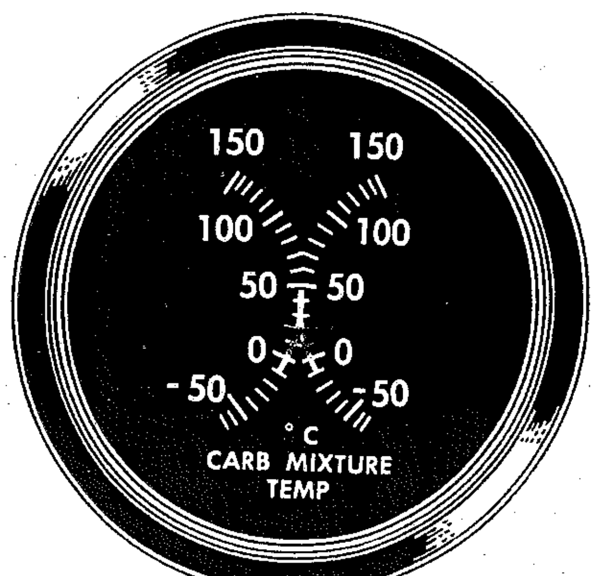
- 150° TO 232° C NORMAL
- 260° C MAXIMUM DURING TAKE-OFF



AIRSPEED INDICATOR

MPH

- 117 MAXIMUM FOR FLAPS (LANDING GEAR 125)
- 253 MAXIMUM ALLOWABLE (STILL AIR)



CARB MIXTURE TEMP

- − 10° TO + 3° C ICING ZONE
- 3° TO 20° C NORMAL
- 20° C DANGER OF DETONATION

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Figure 5-1. (Sheet 1 of 2)

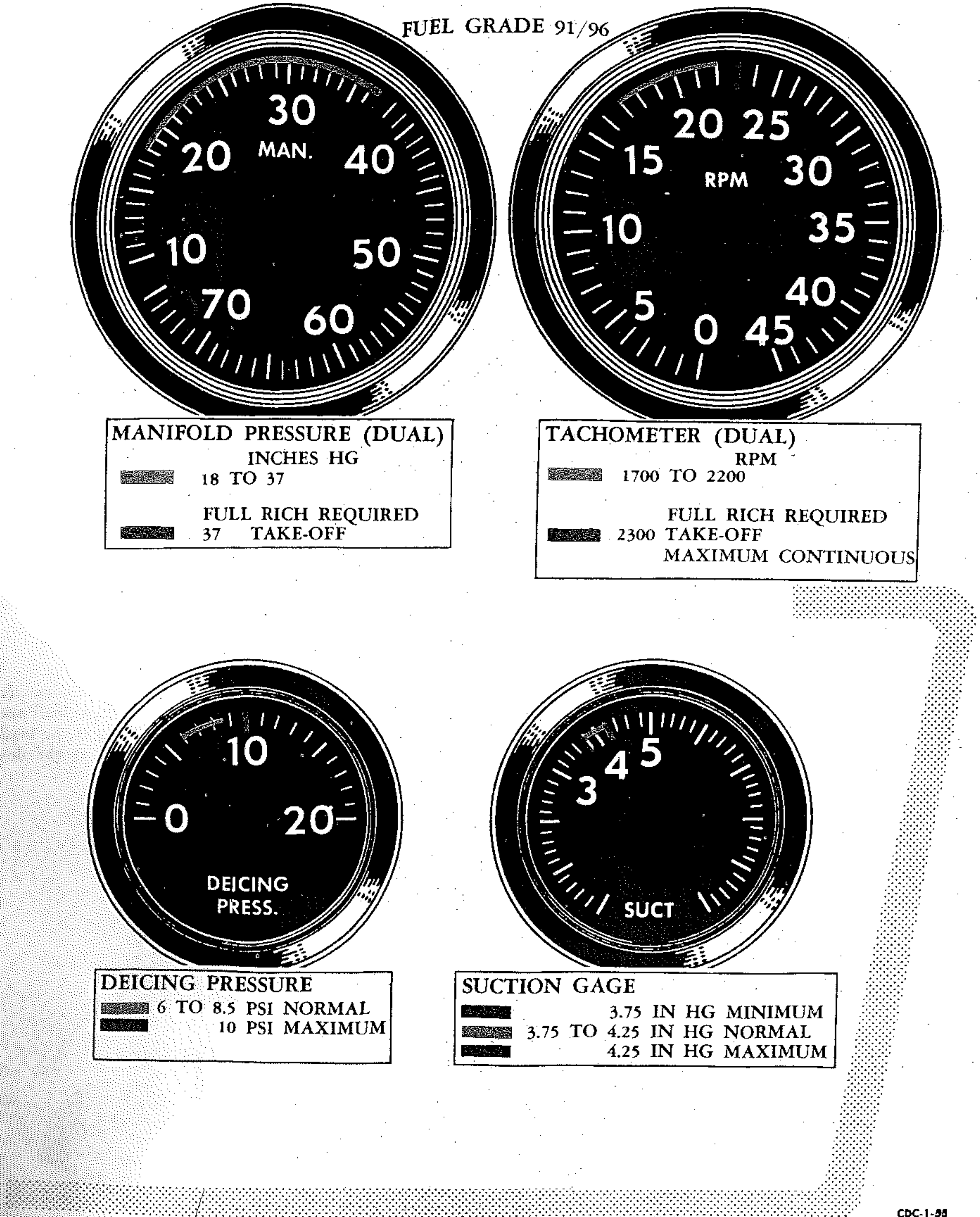


Figure 1-5. (Sheet 2 of 2)

OPERATING WEIGHT.

The weight limitations chart for the aircraft is based on an operating weight of 6520 pounds. This is an approximate weight including the aircraft (basic weight) with standard crew and full oil. Since individual airplane basic weights vary, it will be necessary to adjust the chart for specific aircraft. The intersection of the cargo (ordinate) with wing fuel (abscissa) at "0" represents the airplane operating weight of 6520 pounds.

GROSS WEIGHT.

Diagonal lines on the chart indicate the gross weights of the loaded aircraft.

DISTRIBUTION OF LOAD.

The maximum load that an aircraft can carry is dependent on the way that load is distributed throughout the aircraft. Since the wings support the weight of an aircraft in flight, the greater the load carried in the fuselage, the greater will be the bending moment on the wings. This means that an aircraft might safely carry 10,000 pounds if 6000 pounds were carried in the fuselage and 4000 pounds were in the wings. The same 10,000 pounds might become an unsafe load if 8000 pounds were carried in the fuselage and 2000 pounds in the wings. The unsafe condition would result from the excessive bending moment imposed on the wings by the 8000 pounds in the fuselage. It is to be noted that this is merely an example and does not apply to this aircraft.

SPACE CAPACITY.

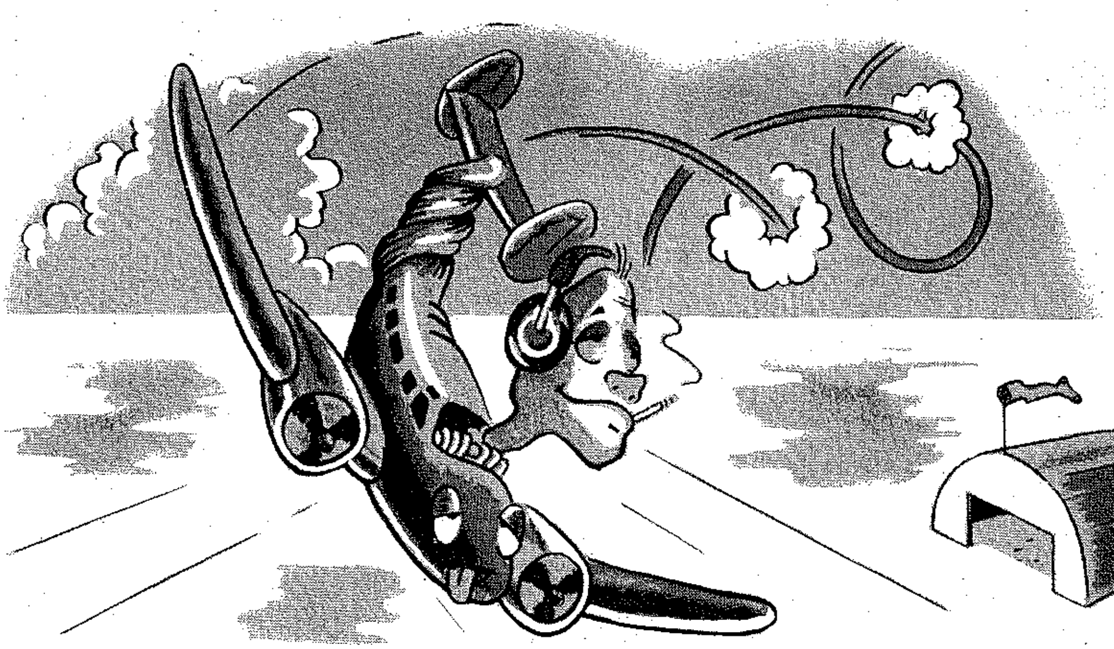
The space available may limit the load that can be carried in an aircraft. This does not normally apply to cargo aircraft.

MARGIN OF SAFETY AND LOAD FACTORS.

Ability to withstand shocks or additional loads resulting from maneuvers becomes increasingly less, as the aircraft structure is loaded to higher weights. The amount of shock or additional load that the structure will sustain before failure occurs is the margin of safety. In planning a mission, it must be understood that the "maximum" permissible weight may depend on the margin of safety desired for the various supporting structures (wings, landing gear, etc.). Should the mission require excessive maneuvering or flight through turbulent air, it would be advisable to maintain a greater margin of safety for the wing structure and, as pointed out, the greater the margin of safety, the lower the "maximum" permissible weight. Regarding aircraft, load factors are used as an indication of the margin of safety available. The structural margin of safety of the wing, for example, will be equal to the difference between the load factor the wing is capable of making good and the load factor the wing is sustaining at that moment. Example: Should the aircraft be loaded so that the wing is capable of making good a load factor of 2.6 and during the flight, load factors of 2.0, 2.3 and 1.5 are imposed on the wing, the margins of safety during these phases of flight will be 0.6, 0.3 and 1.1 load factors, respectively. The above shows how important it is to anticipate the maximum load factors that will be encountered during a mission, so that the aircraft will be loaded such that the load factors it can make good will never be exceeded during any part of the flight. Experience has shown that it is difficult to accomplish a mission, even under ideal conditions, during which the aircraft will not be subjected to load factors of at least 2.0.

WING LIMITATIONS.

Lines showing wing strength in terms of aircraft load factors for combinations of fuel and payload are shown for 2.0g, 2.5g and 3.36g. The 3.36g is the load which the aircraft structure will sustain at the de-



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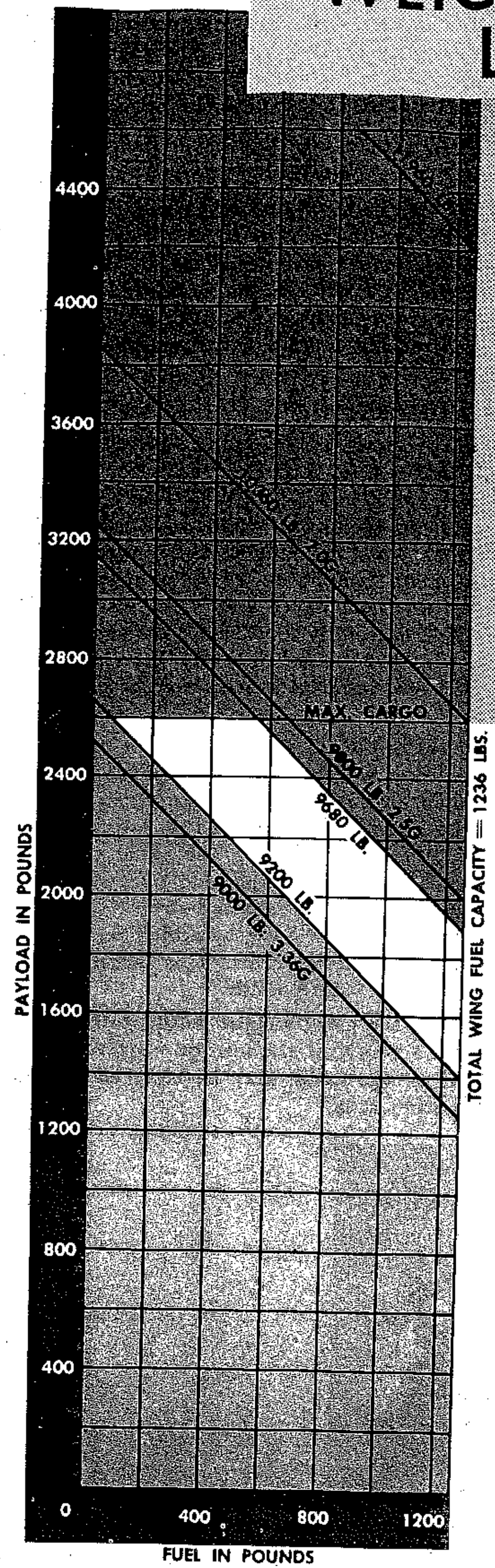
WEIGHT LIMITATIONS



WEIGHT LIMITATIONS CHART

6520 LB	Operating Weight
9000 LB	Design Landing Gross Weight at 10 FPS Contact Sinking Speed — Landing Load Factor = 3.0 Flight Load Factor 3.36
9200 LB	100 FPM Rate of Climb — Sea Level — Hot Day One Engine Inoperative — Prop Feathered Take-Off Power 450 BHP — Gear and Flaps Up
9680 LB	100 FPM Rate of Climb — Sea Level — Standard Day One Engine Inoperative — Prop Feathered Take-Off Power 450 BHP — Gear and Flaps Up
9800 LB	Design Gross Weight for Take Off, Landing, and Flight for 2.5 g's Maneuver Load Factor. Tail Wheel and Tire become Critical above this Weight because there is a possibility of the Tire and Tube blowing out upon Rough Landings, or Taxiing over Extremely Rough Ground.
10360 LB	Maximum Fuel and Maximum Body Weight Based on Compartment Loading Limitations — See Chart "E" T.O. 01-90CDB-5 Flight Load Factor = 2.0
11960 LB	Maximum Landing Gross Weight at 8 FPS Sinking Speed

Max. Cargo is the maximum load for compartments in accordance with Chart "E" of T.O. 01-90CDB-5.

NOTE: Fuel located in the fuselage is considered as cargo.

RED — NOT RECOMMENDED
YELLOW — CAUTIONARY
GREEN — RECOMMENDED

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sign gross weight of 9000 pounds. Combinations of payload and fuel, for which the aircraft structure is good for less than 3.36g's, should be flown with caution, especially when making turns and pullouts. THE AIRCRAFT WILL NOT BE LOADED WITH ANY COMBINATION OF PAYLOAD AND FUEL WHICH EXTENDS BEYOND THE 2.0g LINE BECAUSE STRUCTURAL DAMAGE TO THE WING MAY OCCUR.

The wing structure is designed for landing during routine operation at a gross weight of 9000 pounds at a maximum contact sinking speed of 10 feet per second limit. Based on stress of the landing gear carry-through structures located in the wings of the aircraft, the maximum recommended landing weight is 9,800 pounds.

Figure 5-2

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routing operation at a gross weight of 9000 pounds at a maximum contact sinking speed of 10 feet per second limit. This is the maximum recommended landing weight for normal operation. The maximum recommended landing weight under emergency conditions is 9800 pounds at a landing load factor of 2.5. This weight is based upon the fact that the tail wheel and tire become critical above this weight, because there is a possibility of the tire and tube blowing out during a rough landing or when taxiing over extremely rough ground. Therefore, when landing at weights in excess of 9000 pounds, the tail down attitude should be avoided if at all possible. The maximum permissible landing gross weight is 11,960 pounds based upon a sinking speed of 8 feet per second limit.

PERFORMANCE LIMITATIONS.

Unsatisfactory performance at higher weights may limit the maximum permissible weight of the aircraft. Maximum take-off weight must necessarily be limited by the ability of the aircraft to take-off within the available runway length, its ability to clear any obstacles and its ability to fly with partial power failure. Two performance limitations lines are shown. The explanation of the performance limits is stated in the notes which appear on the chart.

EXPLANATION OF THE CHART.

The red area represents loadings which are not recommended. Under conditions of extreme emergency when safety of flight is of secondary importance, the Commanding Officer will determine whether the degree of risk warrants operation of the aircraft in the red zone.

The yellow area represents loadings of progressively increasing risk as the red area is approached. The structural strength becomes marginal in the landing configuration and the performance becomes marginal depending upon aircraft configuration, take-off altitude and ambient air temperature. Therefore, adequate care must be exercised when operating in the yellow area.

The green area represents the loading conditions that present no particular problem in regard to strength or preformance of the aircraft. This weight should not be exceeded unless dictated by the requirements of the mission.

NOTE

Operating weight should never exceed that required by the mission, since unnecessary risk and equipment wear will result. The take-off weight must also be considered in light of available runways and their altitude, surrounding terrain and atmospheric temperatures.

USE OF THE CHART.

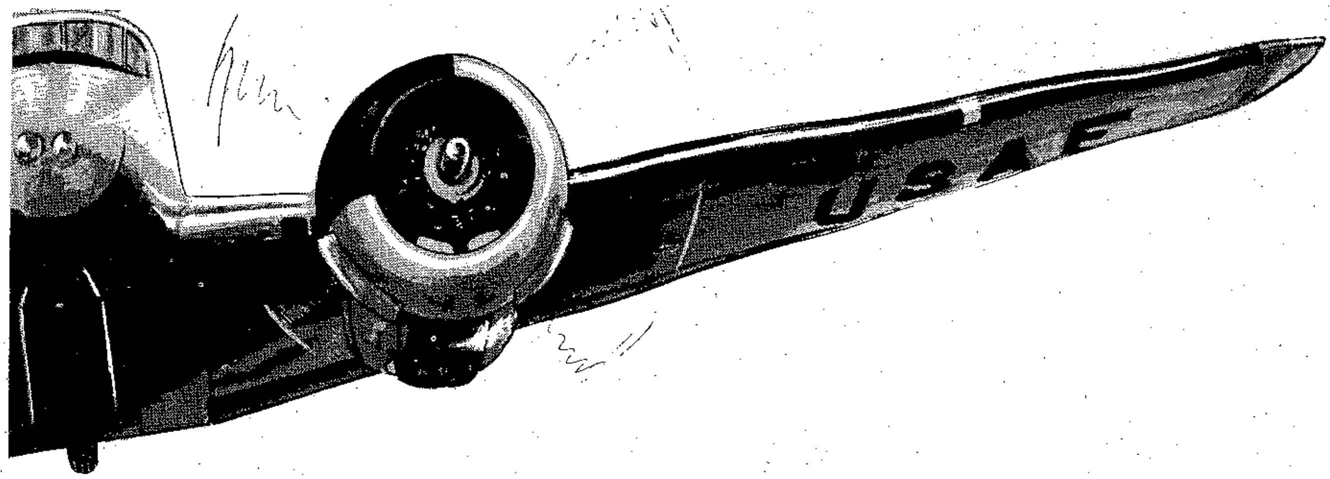
For illustration purposes, two sample problems follow:

1. Assume that a C-45H aircraft calls for an 800 pound payload and 1000 pounds of fuel. Starting with the operating weight of 6520 pounds at "0", proceed along the vertical axis to 800 pounds; this increases the gross weight to 7320 pounds. Next proceed along the horizontal axis to 1000 pounds and project a line vertically to intersect the horizontal projection of the 800 pound line. By interpolation, the intersection will indicate a gross weight of 8,320 pounds.

2. Another example to demonstrate a problem where the operating weight of the aircraft is greater than that shown on the chart: assume an operating weight of 6720 pounds instead of 6520 pounds, or a difference of 200 pounds. Using the same requirements as in the previous example and proceeding as before, the gross weight will be found at 8320 pounds. To this value, 200 pounds must be added to correct the chart for the heavier aircraft. This increases the total gross weight to 8520 pounds.

In the event that the gross weight would fall within the red area as a result of the mission requirements, either the fuel or the cargo may be reduced to fall within the caution area.

CDC-1-58



section VI FLIGHT CHARACTERISTICS

CDC-1-59

STABILITY.

Characteristically this is a stable aircraft. Once trimmed for a specific flight condition, it requires a minimum of pilot attention The trim tabs, provided on all controls, have sufficient effect for all conditions you may encounter.

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CONTROL PRESSURE.

The pressures required in manipulating the flight controls are best described as light. Extreme tab settings can readily be overridden. Aileron and elevator pressures can be applied individually or together with one hand. In fact, a very common error is over controlling.

LANDINGS.

The effect of flight controls remains positive throughout a landing. After you are on the ground, however, and the aircraft is slowing down, remain alert to the effectiveness of your rudder and be prepared to supplement it with power and/or brakes for directional control.

STALLS.

In either power on or power off stalls, the aircraft gives ample warning before the actual stall. There is considerable tail buffeting which is very apparent. During this period of approach to a stall, recovery is possible with no loss of altitude. Even when the aircraft is completely stalled, no extreme changes of attitude are necessary to recover. If the aircraft is stalled in a near level attitude, the tendency will be for it to "mush" without the nose dropping any great amount. If stalled in a nose high attitude, the aircraft will "mush" for a period, then the nose will drop. In either case, although the left wing may drop first, there is no great tendency for the stall to develop into a spin. Recovery can be effected by a relaxing of back pressure and an addition of power. It is not necessary to dive the aircraft.

SPINS.

Although intentional spins are prohibited, you may at some time find it necessary to recover from one. If so, the proper procedure is as follows:

Throttles — CLOSED.

Apply opposite rudder to stop rotation.

Apply enough forward pressure to relieve the stall.

Recover from the resulting dive as rapidly as possible without imposing excessive wing loads.

NOTE

Power should not be used in spin recovery. Power will be of no advantage in your recovery and it will increase diving speeds.

STALL CHART

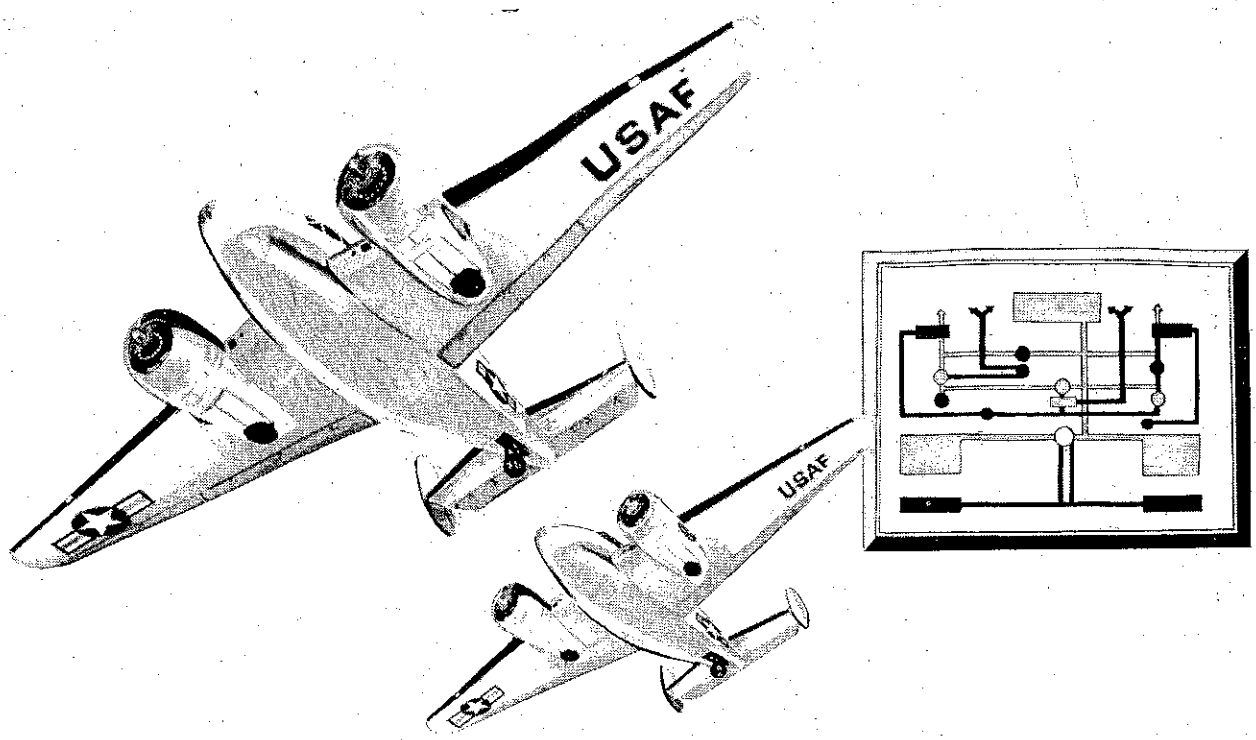
GEAR AND FLAPS UP									
GROSS WEIGHT (LB.)	C. G. (POS)	POWER ON (MAX. CONTINUOUS POWER)				POWER OFF (WINDMILLING PROP)			
		LEVEL	15°	30°	45°	LEVEL	15°	30°	45°
7500	FWD.	69	70	73	82	77	78	82	90
	REAR	66	67	70	78	73	74	78	86
8500	FWD.	73	76	80	88	81	82	87	97
	REAR	70	72	76	84	77	78	83	92
9500	FWD.	78	79	84	92	86	87	92	102
	REAR	74	75	80	88	82	83	88	97
10500	FWD.	82	84	88	98	90	92	98	108
	REAR	78	80	84	93	86	88	93	103

GEAR AND FLAPS DOWN (45°)									
GROSS WEIGHT (LB.)	C. G. (POS)	POWER ON (APPROACH POWER)*				POWER OFF (WINDMILLING PROP)			
		LEVEL	15°	30°	45°	LEVEL	15°	30°	45°
7500	FWD.	60	61	64	70	71	72	78	85
	REAR	57	58	61	67	68	69	74	81
8500	FWD.	63	64	68	76	77	78	82	90
	REAR	60	61	65	72	73	74	78	86
9500	FWD.	67	68	71	80	81	82	87	97
	REAR	64	65	68	76	77	78	83	92
10500	FWD.	70	71	76	84	85	86	103	108
	REAR	67	68	72	80	81	82	98	103

*POWER APPROACH 2000 RPM, 20 INCHES HG.

GEAR AND FLAPS UP — SINGLE ENGINE					
GROSS WEIGHT (LB.)	C. G. (POS)	POWER ON (MAX. CONTINUOUS POWER)			
		LEVEL	15°	30°	45°
7500	FWD.	77	78	82	90
	REAR	73	74	78	86
8500	FWD.	81	82	87	97
	REAR	77	78	83	92
9500	FWD.	86	87	92	102
	REAR	82	83	88	97
10500	FWD.	90	92	98	108
	REAR	86	88	93	103

Figure 6-1



section VII SYSTEMS OPERATION

CDC-1-62

POWER CHANGE.

The pressures developed within the cylinders of any engine are a prime limiting factor. These brake mean effective pressures (B.M.E.P.) can be built up to a point where they become excessive by improper co-ordination of propeller levers and throttles. For this reason, the throttles should be retarded before decreasing engine rpm and inversely the rpm should be increased before the throttles are advanced.

MANUAL LEANING.

Since no exhaust gas analyzer is provided in the aircraft, the mixture must be leaned by procedure as outlined below. Manual leaning should only be accomplished for the purpose of preventing engine roughness caused by an excessively rich mixture.

Establish the desired rpm and manifold pressure.

Retard the mixture lever in small increments until an instantaneous drop of 25 rpm is noted. Advance the mixture lever to its last position prior to the sudden drop.

Under normal operating conditions, at altitudes of less than 5,000 feet, the mixture will not be leaned.

FUEL SYSTEM.

BOOSTER PUMPS.

The fuel booster pumps, in the front wing tanks, are used for varied purposes under different conditions. They serve to furnish pressure for starting, but the safety factor they add to the fuel system should not be neglected. The operation of the fuel booster pumps during take-off and landing precludes the possibility of loss of fuel pressure, at a critical altitude, since they will furnish adequate fuel under all conditions of operation. In the event of engine pump failure, booster pumps should be used to maintain pressure.

FUEL TANK SEQUENCE.

The front wing tanks, since they are equipped with booster pumps, shall be used for starting, ground operation, take-off and landing.

For cruising, the rear wing tanks should be used first, the nose tanks next and lastly the front tanks. Using the rear wing tanks prior to the nose tanks will result in a lesser shift in the center of gravity. C. G. limits will not be exceeded regardless of the sequence in which fuel tanks are used, nor will there be any effect on operation; however, the front tanks should be last in order since they are the only tanks from which the booster pumps can draw fuel.

When changing from one tank to another, it is usually possible, by reference to the fuel gage, to make the change before a tank runs dry. This should be considered normal procedure.

At such times as maximum utilization of fuel is necessary, the tanks may be used until exhausted. In doing this, your first indication of fuel depletion is an indication by the fuel pressure warning lights, so watch them closely when your fuel is low.

If the fuel selector is turned to another tank and the fuel booster turned on at the first indication by the warning lights, pressure can be re-established before any interruption in engine operation occurs.

The fuel system is such that neither the engine driven fuel pumps, the fuel booster pumps, nor the cross-

EQUIPMENT	Number of Units	Amps. per Unit	Operating Time-Min	OPERATING: Start & Warm-Up									
					Average Amp				Taxi	Average Amp			
				Amp	0.5 Min	2.0 Min	15.0 Min	Min	Amp	0.5 Min	2.0 Min	15.0 Min	Min
C - Control Surface													
Motor, Wing Flap	1	11.80	0.16										
E - Engine Instruments													
Indicator, Carb Mixture Temp.	2	0.07	60.0										
Indicator, Fuel Quantity	1	0.18	60.0 0.358	0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	
Indicator, Oil Temperature	2	0.02	60.0										
F - Flight Instruments													
Pitot Heater	2	3.30	60.0	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	
Indicator, Vac Pres Warning	2	0.17	Neg										
G - Landing Gear													
Indicator Ldg Gr Position	2	0.17	5.0	0.2	0.2	0.2	Neg		0.2	0.2	0.2	Neg	
Motor, Ldg Gr	1	70.00	0.16										
Light, Ldg Gr Warning	1	1.00	Neg										
Solenoid, Ldg Gr Latch	1	1.00	0.16										
H - Heating, Ventilating & Deicing													
Motor, Propeller Anti-icer	2	2.00	60.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	
Motor, Wing Deicer Valve	1	1.00	60.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
J - Ignition													
Coil, Booster	1												
K - Engine Control													
Motor, Engine Starter	2	75.0	2.0	75.0	75.0	75.0	10.0						
Relay, Engine Starter	2	0.80	2.0	0.8	0.8	0.8	0.1						
L - Lighting													
Baggage Lights - Nose & Rear	2	0.80	2.0	1.6	1.6	1.6	0.2		0.8	0.8	0.8	0.1	
Compass Light	1	0.19	60.0	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	
Dome Lights, Clear	3	0.80	2.0	2.4	2.4	2.4	0.3		2.4	2.4	2.4	0.3	
Dome Lights, Red	3	1.50	2.0	4.5	4.5	4.5	0.6		4.5	4.5	4.5	0.6	
Extension Light, B-7	1	0.30	2.0	0.3	0.3	0.3	Neg		0.3	0.3	0.3	Neg	
SUBTOTALS				97.0	97.0	97.0	23.4		20.4	20.4	20.4	13.2	

Figure 7-1. Electrical Load Analysis (Sheet 1 of 4)

CDC-1-63

CONDITIONS														
Take-Off & Climb					Cruise					Landing				
	Average Amp					Average Amp					Average Amp			
Amp	0.5 Min	2.0 Min	15.0 Min	Min	Amp	0.5 Min	2.0 Min	30.0 Min	60.0 Min	Amp	0.5 Min	2.0 Min	5.0 Min	15.0 Min
11.8	3.8	Neg	Neg											
0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		0.4
6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6		6.6
										0.2	0.2	0.2		Neg
70.0	22.4	5.6	0.7							70.0	22.4	5.6		0.7
1.0	0.3	Neg	Neg							1.0	0.3	Neg		Neg
4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0
1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0
0.8	0.8	0.8	0.1		0.8	0.8	0.8	Neg	Neg	0.8	0.8	0.8		0.1
0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2
2.4	2.4	2.4	0.3		2.4	2.4	2.4	0.2	Neg	2.4	2.4	2.4		0.3
4.5	4.5	4.5	0.6		4.5	4.5	4.5	0.3	0.1	4.5	4.5	4.5		0.6
0.3	0.3	0.3	Neg		0.3	0.3	0.3	Neg	Neg	0.3	0.3	0.3		Neg
103.0	46.7	25.8	13.9		20.2	20.2	20.2	12.7	12.3	103.2	26.9	26.0		13.9

Figure 7-1. Electrical Load Analysis (Sheet 2 of 4)

CDC-1-64

EQUIPMENT	Number of Units	Amps. per Unit	Opera-ting Time-Min	OPERATING Start & Warm-Up Amp	Start & Warm-Up Average Amp 0.5 Min	Start & Warm-Up Average Amp 2.0 Min	Start & Warm-Up Average Amp 15.0 Min	Start & Warm-Up Min	Taxi Amp	Taxi Average Amp 0.5 Min	Taxi Average Amp 2.0 Min	Taxi Average Amp 15.0 Min	Taxi Min
L - Lighting (Continued)													
Flasher, C-2	1	0.90	60.0	0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	
Instrument Light Shield, Red	66	0.048	60.0	3.1	3.1	3.1	3.1		3.1	3.1	3.1	3.1	
Landing Lights	2	21.4	1.5										
Map Light	2	0.30	2.0	0.6	0.6	0.6	Neg		0.6	0.6	0.6	Neg	
Passing Light	1	1.50	60.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Radio Controls Light	1	0.80	60.0	0.8	0.8	0.8	0.8		0.8	0.8	0.8	0.8	
Relay, Landing Light	2	0.35	1.5										
Utility Light	6	0.17	2.0	1.0	1.0	1.0	0.1		1.0	1.0	1.0	0.1	
Tail Lights	2	0.80	60.0	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
Taxi Lights	2	5.36	5.0						10.7	10.7	10.7	3.5	
Wing Position Lights	2	0.75	60.0	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
M - Miscellaneous													
Motor - Windshield Wiper	1	7.63	60.0	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	
P - D. C. Power													
Battery Charging			60.0										
Battery Relay	2	0.80	60.0	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
Indicator, Generator Failure	2	1.17	Neg										
Inverter, AN/ARN-7 Radio	1	15.0	60.0	15.0	15.0	15.0	15.0		15.0	15.0	15.0	15.0	
Inverter, Instrument	1	6.0	60.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	
Propeller Feathering Motor	2	80	0.1										
Propeller Feathering Relay	2	2.4	0.1										
Q - Fuel & Oil													
Motor, Booster Pump	2	2.00	15.0	4.0	4.0	4.0	4.0						
Primer Solenoid	2	0.33	Neg										
Indicator, Low Fuel Pressure	2	0.17	Neg										
R - Radio													
Interphone	1	2.20	60.0	2.2	2.2	2.2	2.2		2.2	2.2	2.2	2.2	
Marker-Beacon Receiver	1	0.65	60.0	0.6	0.6	0.6	0.6		0.6	0.6	0.6	0.6	
Radio Compass Receiver	1	1.95	60.0	1.9	1.9	1.9	1.9		1.9	1.9	1.9	1.9	
Range Receiver	1	1.60	60.0	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
VHF Radio Receiver	1	5.50	60.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	
VHF Radio Transmitter	1	7.50	0.5	7.5	7.5	1.9	0.2		7.5	7.5	1.9	0.2	
TOTALS				164	164	158	81		93	93	88	70	

Figure 7-1. Electrical Load Analysis (Sheet 3 of 4)

CDC-1-65

CONDITIONS																		
	Take-Off & Climb					Cruise					Landing							
	Average Amp					Average Amp					Average Amp							
Amp	0.5 Min	2.0 Min	15.0 Min	Min	Amp	0.5 Min	2.0 Min	30.0 Min	60.0 Min	Amp	0.5 Min	2.0 Min	5.0 Min	15.0 Min				
0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		0.9				
3.1	3.1	3.1	3.1		3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1		3.1				
0.6	0.6	0.6	Neg		0.6	0.6	0.6	Neg	Neg	0.6	0.6	0.6		Neg				
3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0				
0.8	0.8	0.8	0.8		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		0.8				
										0.3	0.3	0.2		Neg				
1.0	1.0	1.0	0.1		1.0	1.0	1.0	Neg	Neg	1.0	1.0	1.0		0.1				
1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6				
										10.7	10.7	10.7		3.5				
1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5				
7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6				
81.6	81.6	51.0	30.6		61.2	61.2	38.1	16.5	11.4	20.4	20.4	12.7		7.6				
1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6				
15.0	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0		15.0				
6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0				
4.0	4.0	4.0	4.0							4.0	4.0	4.0		4.0				
2.2	2.2	2.2	2.2		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2		2.2				
0.6	0.6	0.6	0.6		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		0.6				
1.9	1.9	1.9	1.9		1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9		1.9				
1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6				
5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5		5.5				
7.5	7.5	1.9	0.2		7.5	7.5	1.9	0.1	Neg	7.5	7.5	1.9		0.2				
251	195	138	102		144	144	115	83	77	244	188	143		87				

Figure 7-1. Electrical Load Analysis (Sheet 4 of 4)

CDC-1-66

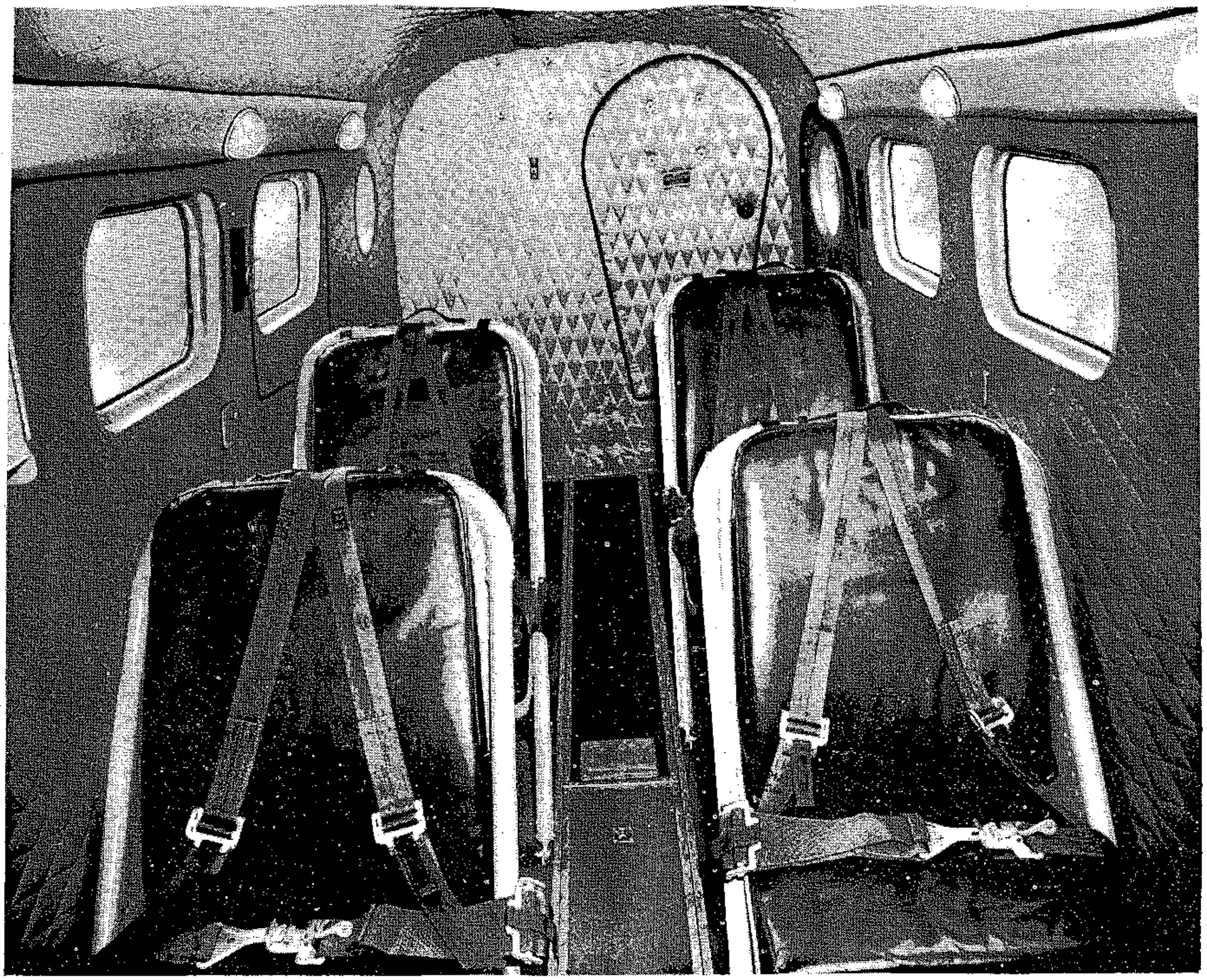


Figure 7-2. Cabin Compartment

CDC-1-67

feed system can provide for the transfer of fuel from one tank to another.

When it is necessary to operate both engines from the same tank, the other fuel selector handle should be placed in the "OFF" position. If the suction cross-feed is used the fuel selector handle should be positioned "OFF" after the suction cross-feed handle is placed "ON".

SUCTION CROSS-FEED.

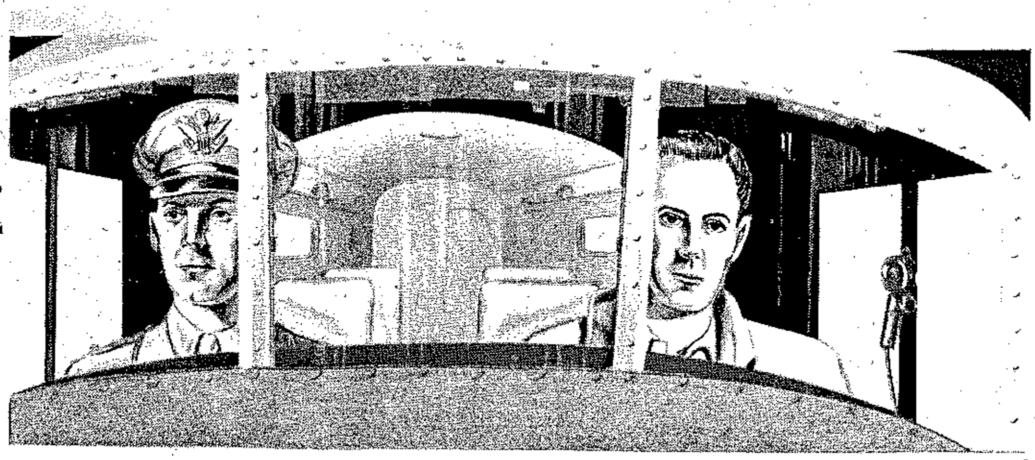
The suction cross-feed is just that, a SUCTION cross-feed which will permit either or both engines to draw fuel from any tank in the aircraft. It will not provide for one engine-driven pump supplying fuel, under pressure, to both engines.

ELECTRICAL SYSTEM.

The progression of aircraft equipment, especially navigational equipment, has imposed on this aircraft an electrical load which can, under emergency conditions, become critical. With both engines and generators operating, sufficient current is supplied for all equipment; with one generator inoperative the amount of electrically operated equipment which can be used is limited.

It is impossible to set down a definite procedure to be followed if all, or a portion, of your electrical power is lost; but, an appreciation of what each item of equipment requires as compared to the power available will make apparent what action must be taken in each situation. Appraise the requirements for each situation, and then turn off all electrical equipment which is not absolutely essential. Keep in mind your generators, at rated output, supply 50 amperes each. With the 100 ampere generator installed, enough current is produced to supply the electrical system while on single engine operation. Figure 7-1, sheets 1 through 4, will show what each item of electrical equipment requires; a thorough study of these charts is very advisable.

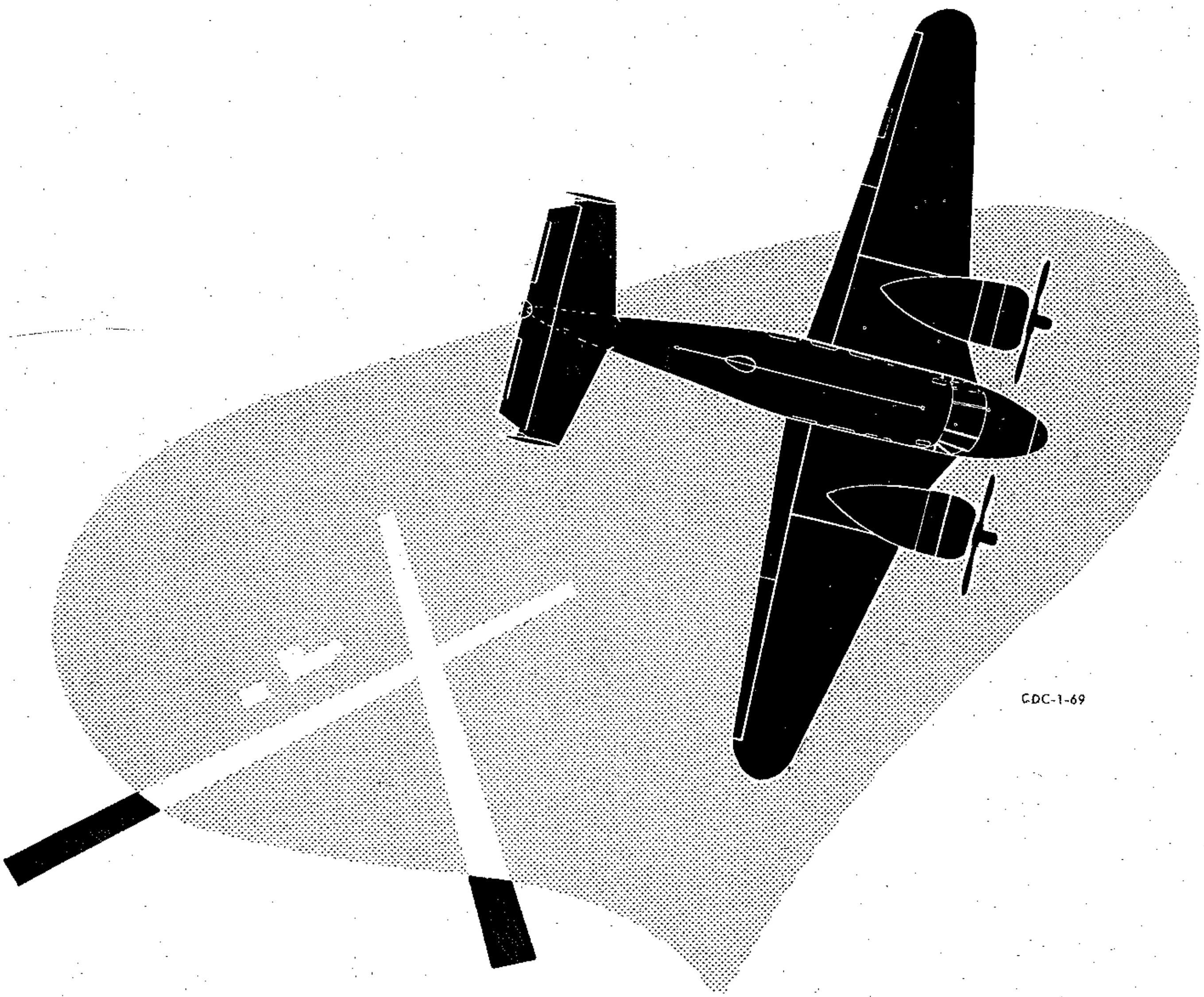
In any event, for ground operation, when generator output is not up to rated capacity, use as little electrically powered equipment as possible.



section VIII CREW DUTIES

NOT APPLICABLE TO THIS AIRPLANE

CDC-1-68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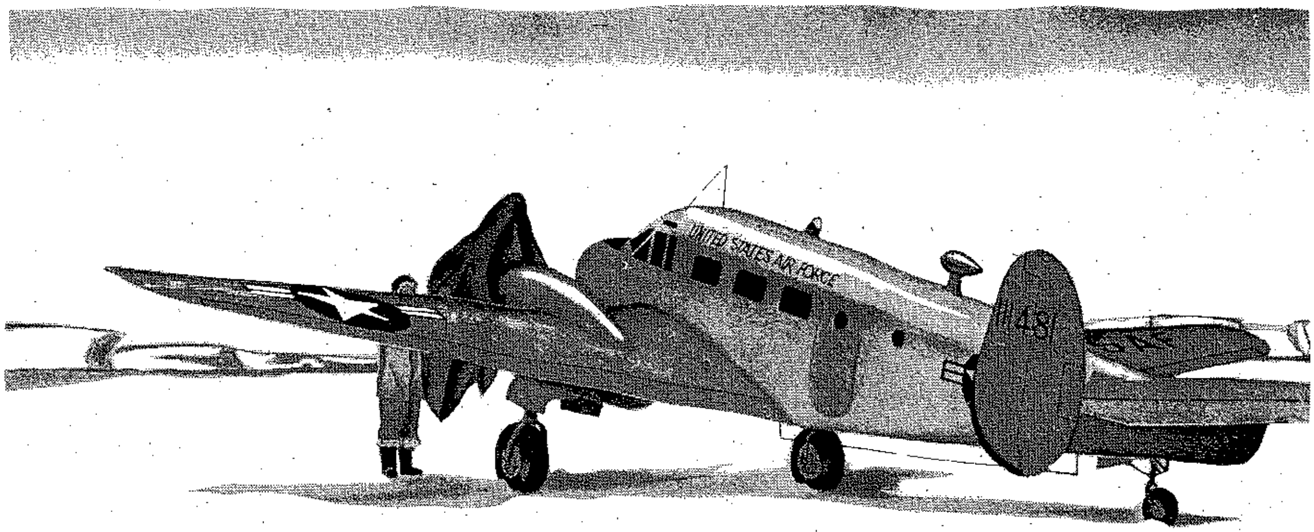


section IX ALL WEATHER OPERATION

CDC-1-70

INTRODUCTION.

Except for some repetition necessary for emphasis, clarity or continuity of thought, this section contains only those procedures that differ or are in addition to the normal operating instructions covered in Section II. Any discussions relative to operation are covered in Section VII.

OPERATION UNDER INSTRUMENT FLIGHT CONDITIONS.

INSTRUMENT FLIGHT.

Due to low stalling speeds and ease of control, the aircraft is very capable of instrument flight. Equipment on the aircraft that will aid in instrument flight are two sets of blind flying instruments, VHF command radio set which includes the normal channels including all GCA channels, low frequency receiver for range reception, marker beacon receiver and radio compass. With this equipment, it is possible to accomplish any phase of instrument flight including take-off, approach and landing.

NOTE

Due to critical electrical power it is necessary, under instrument conditions, to maintain constant check on generator operation during flight. In the event of one generator failure or single engine operation, monitor the electrical output of the remaining generator. The electrical load should not exceed 0.8 on the loadmeter of the remaining generator. Do not rely on the generator overvoltage light as sole indication of generator failure. This light comes on only after an overvoltage condition. The loadmeter and voltmeter are the only reliable indications of generator operation.

The electrical load is especially critical during night-weather conditions on one-generator operation. Under these conditions, it will be necessary to turn off the MG149F inverter and radio compass to decrease the electrical load to 0.8 or less on the remaining generator. The MG149F inverter is operated by the radio compass switch.

INSTRUMENT TAKE-OFF.

Due to the conventional type landing gear and somewhat restricted forward visibility, when poor visibility conditions exist, the pilot must depend on his instruments for take-off. The take-off and climb will not be difficult if the proper technique is used.

CAUTION

Check the electrical equipment on external power to avoid imposing an unnecessary load on the batteries. During taxiing the rpm is too low for generator output.

Add special emphasis on the following checks:

- Radio facility chart and appropriate handbooks aboard.
- Altimeters — Set on station altimeter setting. (The elevation indicated should be within 75 feet of actual field elevation.)
- Clocks — Set on time given by the tower.
- Gyros — Checked for precision while taxiing, reset and uncaged for take-off.
- Rate of climb — Check for zero setting.
- Vacuum Gage — Check at 4 inches hg.
- Generators — Check operation.
- Pitot Heat — Check operation with crew chief, then use as desired.

Propeller Anti-Icing — Check fluid quantity and operation and turn OFF.

De-icing Boots — Check operation and turn OFF.

Windshield Wipers — Check and use as desired.

Cabin Heat — Check Windshield Defrosting and use as desired.

Manifold Heat — Check operation, for a temperature rise and place in cold position.

Radio Compass — Set on station to be used and the pointer checked for movement while taxiing.

VHF — GCA channels checked and the operator standing by.

Inverter — ON.

Instruments — Warmed up and operating properly.

if necessary to maintain direction control until complete control is possible through use of the rudders. On reaching an airspeed that the empennage rises off the runway without applying pressure to the elevator control, establish a slightly nose high attitude by holding the aircraft so the attitude indicator in the gyro horizon will be level and approximately 1/4 inch above the horizontal bar. Maintain this attitude until the aircraft gains flying airspeed and clears the runway.

INSTRUMENT CLIMB.

As the aircraft clears the runway, adjust the attitude as needed to establish a definite climb: Gyro horizon indicating plane approximately 1/4 inch above the horizontal bar, airspeed increasing toward minimum safe single engine airspeed, rate of climb indicating approximately 500 feet per minute climb, directional gyro steady on the runway heading and the altimeter indicating an increase in altitude. Retract the landing gear and on reaching minimum safe single engine airspeed reduce to climb power. During normal climb, hold 120 mph indicated airspeed. For ease of control, avoid a degree of bank in excess of 20 degrees during climb.

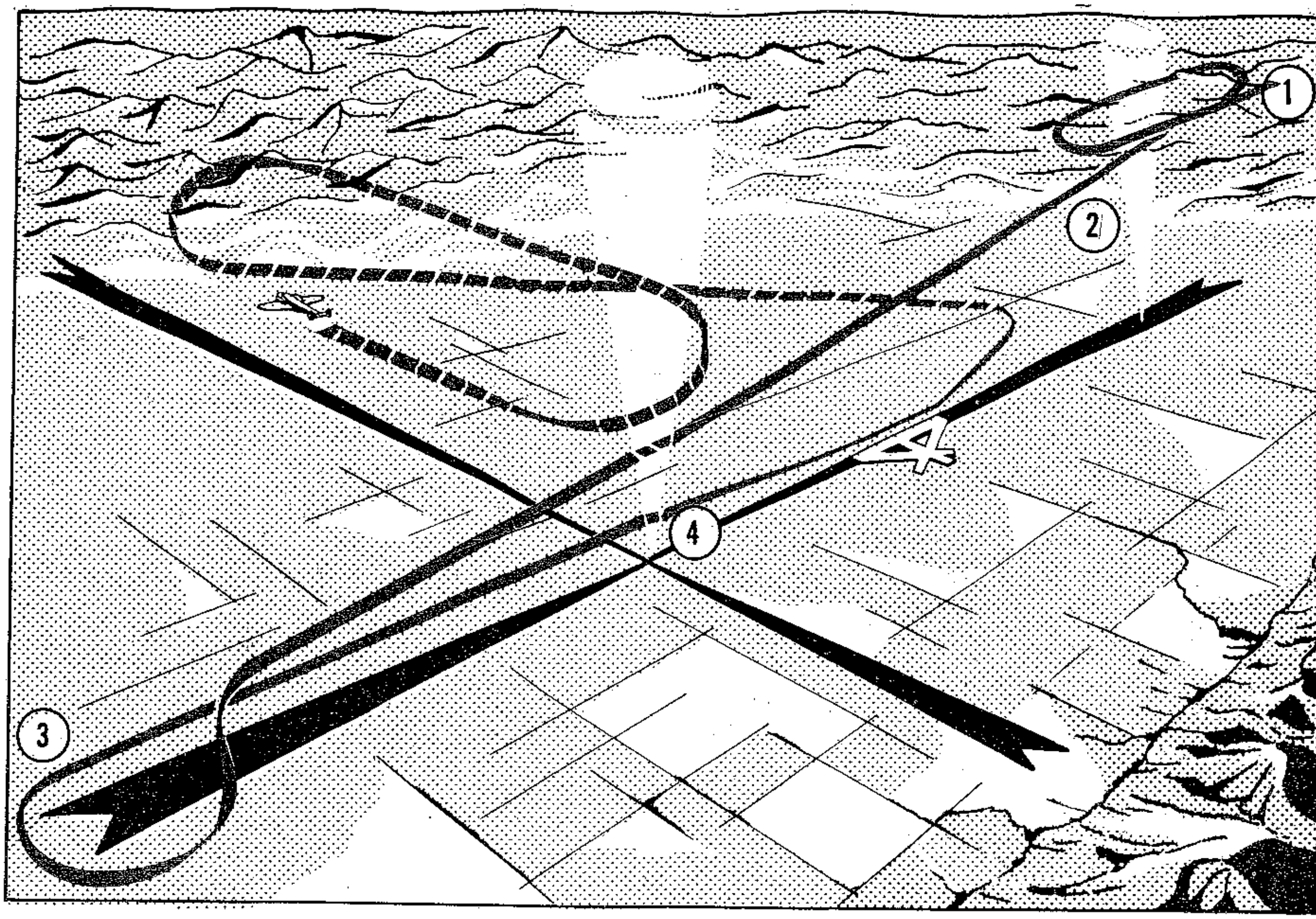
TURBULENT AIR PENETRATION

"THE HEAVIEST TURBULENCE NORMALLY OCCURS BETWEEN 10,000 AND 20,000 FEET. IF A PENETRATION MUST BE MADE, A SAFE, MORE COMFORTABLE AIRSPEED CAN BE FOUND BY ADDING 60 KNOTS (70 MPH) TO THE POWER-ON STALL SPEED FOR THE WEIGHT AND CONFIGURATION BEING FLOWN."

CDC-1-71A

Figure 9-1

Normal take-off power settings will be used. After the proper checks have been completed, obtain tower approval and line up in take-off position. Reset the directional gyro to the runway heading apply power evenly, and at approximately 25 inches manifold pressure release the brakes and continue the addition of power to full take-off power. Watch the directional gyro to maintain runway heading and use asymmetrical power with the rudders and individual braking



CDC-1-77

Figure 9-2. Radio Range Letdown

DURING INSTRUMENT CRUISING FLIGHT

NOTE

> As a precaution against clogged pitot lines, pitot heat should be used at all times when instrument conditions are encountered and icing is possible.

Keep the aircraft trimmed by use of tabs on all control surfaces.

RADIO AND NAVIGATION EQUIPMENT.

The radio equipment on the aircraft is normally reliable, however, cross check on all the radio and navigation equipment in flight and never depend entirely on any one unit.

DESCENT.

All descents should be made with the mixture levers in the Full Rich position. When a lower than cruising airspeed is desired for descent, slow the aircraft to the desired airspeed before starting the descent.

NOTE

> Cruising at a constant airspeed a reduction of 5 inches Hg will result in approximately a 500 fpm rate of descent if IAS is maintained.

HOLDING.

Recommended airspeed for holding is 120 mph. Any maneuver prior to a possible approach and landing should be accomplished at 120 mph with the pre-traffic pattern check completed. Make all turns standard rate. Because of its low stalling speed, the aircraft should handle well during holding procedures.

NOTE

(Deleted)

INSTRUMENT APPROACHES.

Again, due to low stalling speeds, instrument approaches should be easily accomplished in the aircraft. Complete the pre-traffic pattern check before the approach is actually started. This gives the pilot more time to concentrate on headings and altitudes, range or GCA procedures, etc. ILS equipment is not installed in the aircraft.

NOTE

> 21 inches Hg and 2000 rpm with the flaps up and gear extended should give approxi-

mately 120 IAS. To descend at 500 fpm, retard the throttles to 17 inches Hg. To descend on final approach at 500 fpm let throttles remain at 21 inches Hg and drop 30 degrees of flaps.

RADIO RANGE LETDOWN. The following procedure is recommended and includes holding, see figure 9-2.

1. Going into the holding pattern or nearing the range for an approach, lower the airspeed to 120 mph and complete the pre-traffic pattern check list as outlined in Section II.

2. When the aircraft is cleared by the tower to descend for an approach, start the descent by lowering the landing gear and increasing the rpm to 2000.

3. On completing the procedure turn, set the flaps at 15 degrees.

4. After passing the low cone, use the flaps as needed. Full flaps are recommended for landing.

GCA LETDOWN. The following procedure is recommended along with the GCA operators instructions. Refer to figure 9-3.

1. Estimate when two to three minutes of holding or the GCA identification point; lower the airspeed to 120 mph and complete the pre-traffic pattern check list as outlined in Section II.

2. Lower the landing gear and increase the rpm to 2000 at point of starting descent on reaching the base leg of the GCA pattern.

3. Lower the flaps as needed on reaching the glide path of the GCA approach. Full flaps are recommended for landing.

ICE, SNOW AND RAIN

Ice, snow and rain may affect the operation of the engines, weight of the aircraft, airflow over the lifting surfaces and the pilots' visibility. The aircraft employs wing and empennage deicing boots, propeller anti-icing fluid, windshield and carburetor hot air and pitot heat. It is best to operate all ice combating equipment on the aircraft, excepting the deicing boots, when known icing conditions exist and before it has started to collect on the aircraft.

PROPELLER ICING.

In preparing for propeller ice:

Propeller anti-ice knob — MAX (for a period of 1 minute).

Propeller anti-ice knob — As required.

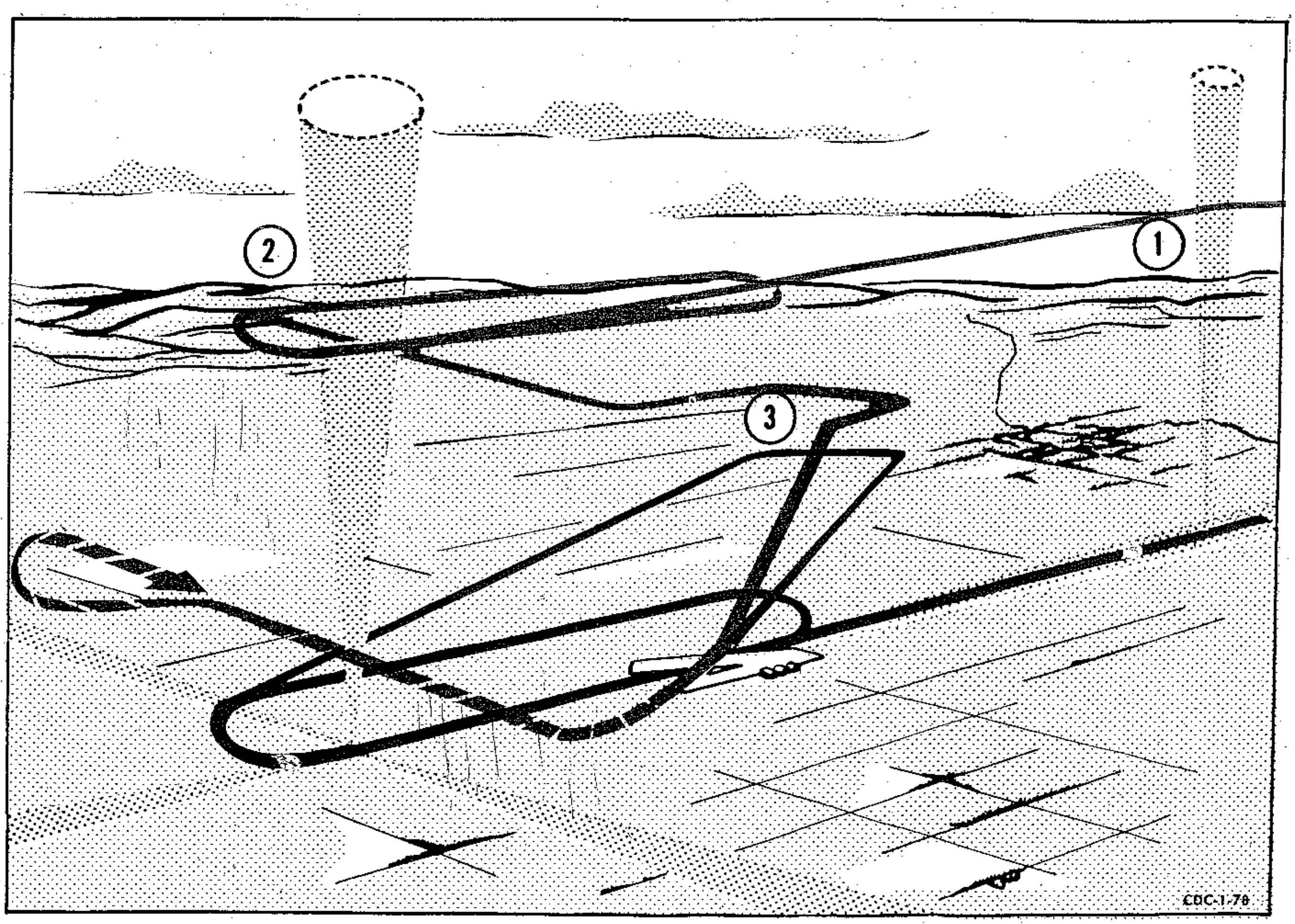
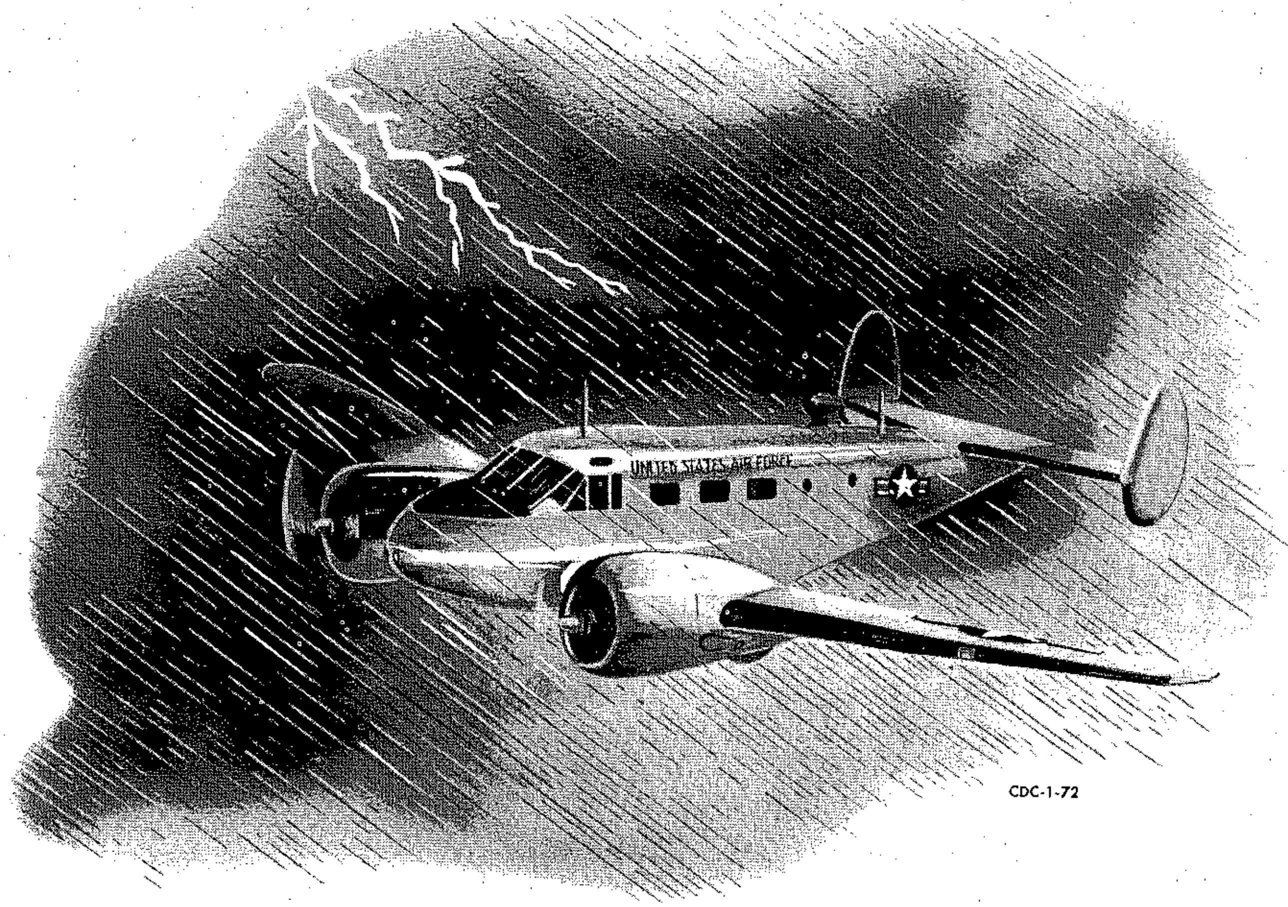


Figure 9-3. GCA Letdown



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NOTE

The rate of flow of anti-icing fluid necessary to prevent the formation of ice on the propeller will vary greatly with varying conditions; however, if the severity of conditions is unknown, attempt to maintain prevention with NORMAL flow, increasing if necessary. The knob is positioned for MAX flow for the period of one minute to thoroughly lubricate the propeller blades.

CARBURETOR ANTI-ICER.

Manifold heat on the aircraft will, to a degree, eliminate ice which has already formed in the carburetor throat; but it should be used as a preventive measure, rather than a corrective measure.

Take-off and landing should be made without using carburetor heat, but watch for a decrease in manifold pressure indicating carburetor ice and be prepared to use carburetor heat any time full power is not needed. Any use of carburetor heat will decrease the available horsepower.

While in icing conditions, operate the carburetor air doors frequently enough to keep ice broken off so they may be used as needed.

WING AND TAIL DEICER

In the use of this deicing system, the control will be left on continuously in cases of severe icing conditions. Normally, ice will be allowed to build up a slight amount (approximately 1/4 inch) before any attempt is made to deice the wing. Let the ice build up, eliminate it and then turn deicers off.

CAUTION

Under conditions of light to moderate icing, with the deicer operating continuously, ice may form as a shell over the entire deicer area; for this reason, intermittent operation is preferable.

FLIGHT IN TURBULENCE AND THUNDERSTORMS.

Flight through a highly turbulent or thunderstorm area is to be avoided whenever possible.

Under certain conditions, such as at night or where flying on instruments, avoiding these turbulent areas can well be impossible, and so those procedures which result in the safest and easiest operation should be well understood. Utilization of the equipment provided, with ordinary instrument proficiency and normal good judgment, makes turbulent air flying not only possible but safe.

Your most reliable instrument in turbulence will be your attitude indicator (gyro horizon). If the proper attitude for penetration airspeed is established and power adjusted for level flight at this attitude, most difficulties are minimized. This should be accomplished prior to entering the turbulent area whenever possible.

NOTE

If you cannot see a storm area, the intensity of radio static is usually an indication of your approach and distance away.

In flying through turbulent air, you know, or will discover, the most difficult single factor is the maintaining of constant airspeed. By establishing an attitude and power setting for your penetration IAS, your TAS will vary only slightly if this attitude and power setting is maintained. Often the IAS and other pressure instrument readings will give a very false indication of actual conditions, because of the great pressure variation within a storm area and are thus unreliable.

Remember: ESTABLISH THE PROPER ATTITUDE, and then MAINTAIN IT.

For preparing to enter a turbulent area, proceed as follows:

Secure loose equipment.

No smoking.

All seat belts and shoulder harness snug and secure.

Manifold Heat — Hot.

Engine Fuel selectors — FRONT tanks.

Establish penetration speed and note power requirements.

Check all pilot compartment lighting.

Navigation lights — ON.

Automatic pilot — OFF.

Check instruments and align gyros.

Trim aircraft for the selected speed.

Pitot Heaters — ON.

Propeller anti-icers — ON.

Cowl Flaps — Closed.

If lightning is expected, turn all pilot compartment lights to full brilliance.

This will aid in preventing lightning flashes from blinding you.

Turn off all radio equipment rendered useless by storm interference.

Pull circuit breakers for the range and VHF receivers.

When operating in turbulent air, make no turns that are not necessary. When making changes in attitude, use the least control pressure necessary for the required change, thus avoiding unusual loads on the aircraft structure.

COLD WEATHER OPERATION.

Preflight Check.

Have snow, ice and frost removed from wings, tail control surfaces and hinges, propellers, pitot tubes and fuel and oil tank caps and vents.

Test to see that oil Y-drains and oil tank sumps will allow a free flow of oil. Have heat applied if unsatisfactory.

NOTE

Prior to attempting a start at temperatures below 0° F, the engine should be heated sufficiently to obtain fuel vaporization and permit proper engine valve clearances and valve seating.

Thoroughly check controls for free movement.

See that drain hole in bottom of tail cone is open. If this drain is stopped up, water may collect inside cone and freeze, restricting or even blocking elevator travel. Also, see that the felt strip between the movable and fixed parts of the tail cone has been lubricated with grease. When felt strip gets wet and then freezes, it tends to hold the elevator in one position. This situation is not dangerous but the elevator will "stick" and smoothness of control is lost.

Have propeller pulled through at least one blade before engaging starter.

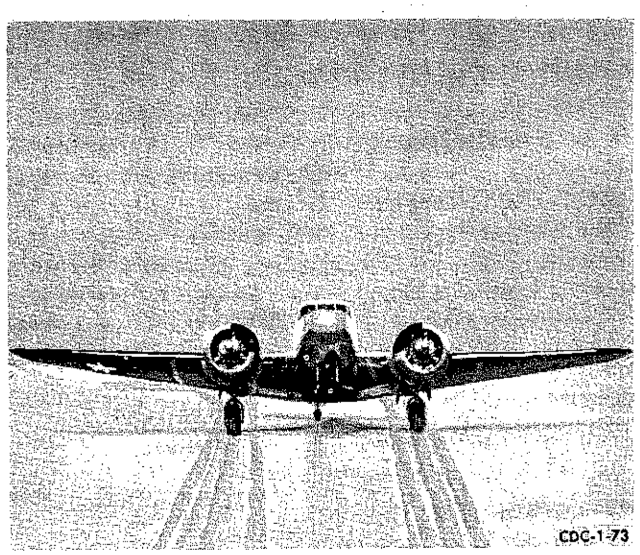
Remove all covers and heaters.

STARTING.

Cold weather starts will be made the same as normal weather starts, with the exception that the throttle opening used for the start should be decreased to a position which will be equivalent to approximately 800 rpm.

NOTE

Moisture forms quickly on spark plug electrodes during cold starts. After three or four unsuccessful attempts, have at least one plug from each cylinder removed and heated to dry the electrodes. Attempt to start immediately after plugs have been replaced.



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Have cowl flaps at least one-half open during all ground operations. Otherwise the engine accessory section will overheat.

Starts should be made with the oil by-pass lever in hot position.

If there is no oil pressure after 30 seconds running or if pressure drops after a few minutes of ground operation, shut-down and check for blown oil lines or radiators and for congealed oil or ice at Y-drain or in oil tank sump drain.

WARM-UP.

When the outside air-temperatures are low, the general procedure for warm-up will be followed, with the exception that operation at approximately 800 to 1000 rpm will be required until oil pressure is steady and within limits.

Close oil cooler shutters.

If outside air is below -20° C (-4° F) use sufficient manifold heat to improve vaporization and prevent backfiring.

When subjected to excessive drain, storage batteries deteriorate rapidly in cold weather; therefore, none but essential electrical equipment should be used until generators are supplying current. (See Electrical System, Section VII).

Operate propeller through four or five complete cycles from maximum to minimum to replace the oil in the propeller dome with warm engine oil.

When oil temperature reaches 20° C (68° F), move oil by-pass valve to cold position: the by-pass valve will be warmed sufficiently to allow oil to automatically by-pass the radiator if the radiator is blocked by congealed oil.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

TAXIING.

Do not taxi through puddles of water or slush if they can be avoided. Water splashed onto the wing and tail surfaces will freeze, increasing weight and drag and perhaps limiting control surface movement.

TAKE-OFF.

When operating in slush, be sure tail wheel is locked before take-off since slush may have frozen in locking pin hole, preventing locking and requiring added caution on the take-off run.

If a deep or heavy snow interferes with take-off run but permits taxiing, move slowly up and down the take-off course several times to pack down the runway before attempting actual take-off.

Run up engine prior to take-off, using manifold heat to eliminate carburetor ice.

IN FLIGHT.

Use sufficient manifold heat to prevent rough operation and backfiring.

The propeller should be cycled periodically to keep the propeller dome supplied with warm engine oil so it will be possible to maintain proper propeller operation.

NOTE

If the feathering button pops out before the propeller is feathered, do not hold the button in. Excess pressure due to viscous oil may be causing this premature release of the feathering button; followed in turn by a tendency for the propeller to unfeather. Depress the switch and let it release by internal pressure and then depress it again. Continue this operation until propeller is completely feathered.

LANDING.

Turn off all nonessential electrical equipment at least one minute before final approach to save batteries when rpm is reduced and generators cut out. (See Electrical System, Section VII).

When letting down, watch engine temperatures closely. Keep cylinder head temperature above operating minimums by maintaining sufficient power and regulating cowl flaps. Manifold heat may be used to assure good fuel vaporization, thus minimizing the danger of backfiring and cutting out.

NOTE

Do not fail to use sufficient manifold heat during approach and landing. Be prepared to change manifold heat to cold (UP) position to obtain maximum power if go-around is necessary.

When landing on runways covered with slush or large puddles, avoid leaving wing flaps down after the aircraft is on the ground since heavy sprays of slush kicked up during landing may cause damage. Use brakes sparingly and not until absolutely necessary during landing roll. Keep manifold heat in the hot position while taxiing.

STOPPING ENGINES.

Before stopping the engine, when a cold weather start is anticipated, set the throttle to 800 to 1200 rpm and hold the oil dilution control in the ON position for a period of time as indicated in the table below.

During engine oil dilution, close the propeller feathering switch long enough to produce a drop of 400 rpm. Pull the switch out to release and allow the rpm to return to normal. Repeat this operation three times for each propeller.

4° C to -12° C (40° F to 10° F)	1½ minutes
-12° C to -29° C (10° F to -20° F)	3 minutes
-29° C to -46° C (-20° F to -50° F)	5 minutes

Add one minute dilution time for each additional 5° C (9° F) below -46° C (50°.F).

NOTE

When the dilution time required is in excess of 5 minutes, make certain that the oil tanks do not contain more than 7 gallons each.

If an oil temperature of 50° C (120° F) or less cannot be obtained with the engine running, the engine should be shut off and restarted after the oil has cooled to below 40° C (104° F), after which the engine will be started and dilution of the oil accomplished as previously outlined.

At any time when a long dilution period is required and the oil temperatures exceed 50° C (120° F), it will be necessary to dilute the oil in two or more short periods in order to maintain oil temperatures below 50° C (120° F). On such occasions, the engine will be stopped when the oil temperature reaches 50° C (120° F), allowed to cool until the oil temperature is well below 40° C (104° F), then it will be restarted and the dilution continued. The total of the two or more dilution periods will be that specified in the table.

CAUTION

Dilution of the engine oil when the oil temperatures are above 50° C (120° F) should not be accomplished since the heat of the oil will evaporate the fuel with subsequent lack of proper dilution.

NOTE

When 50 hours engine time have elapsed since the last dilution was accomplished, two dilutions will be used instead of one. On these occasions, the engine will be given the full dilution period and after dilution, the engine will be shut down and the oil pressure screens will be removed and cleaned. This is necessary because the fuel in the oil tends to wash down any accumulated sludge within the engine. After reinstallation of the oil screens, the engine will be started and run for at least 20 minutes at 1000 to 1200 rpm to evaporate any fuel in the oil. After each oil screen cleaning, drain approximately 1 gallon of oil from the "Y" drain to eliminate any sludge which may have collected at this point. The engine will then be again diluted for the specified period of time.

If it is necessary at any time to service the oil tank, the oil dilution procedure must be divided so that some dilution is accomplished before servicing the oil tank and the remainder is accomplished after the oil tank is serviced. It is unwise to service with undiluated oil without additional dilution, as this heavy oil collects and may congeal on the tank bottom blocking the oil flow.

After dilution has been accomplished, shut off the engine by moving mixture control to the IDLE CUT-OFF position, continuing to hold the dilution switch on until the engine stops.

PARKING.

When the aircraft is parked for a period of time, leave some aperture, such as a window, partly open. Otherwise, lack of air circulation within the aircraft will cause windows to frost.

Batteries are easily accessible and should be removed to a warm place for storage.

Cover wings, tail and windshield with tarpaulins, if possible, to prevent frost formation.

FUEL SUMP DRAINAGE.

Have fuel and oil tank sumps drained frequently to remove ice and water which may have collected. Water gets into fuel and oil systems in the form of ice and snow when the tanks are serviced and additional moisture accumulates from condensation. If this is allowed to remain, a drop in temperature may freeze this water, reducing the flow of fuel and oil. Have Y-drain (oil system) drained to eliminate additional water in the oil system.

DESERT PROCEDURES.

Take-Off.

Under extremely hot conditions, aircraft require a longer take-off run. Consider this in loading and use all the available runway.

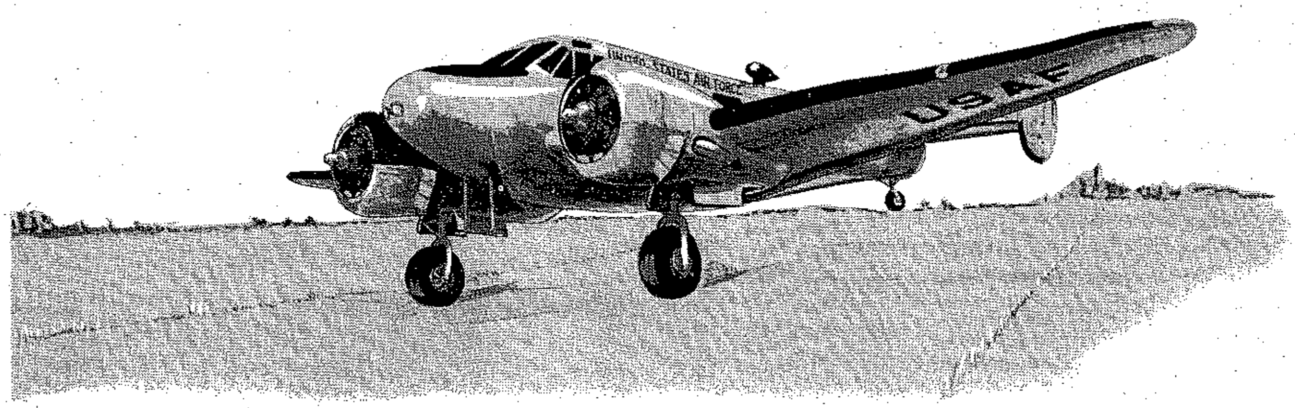
Loss of power from detonation probably will occur if carburetor mixture temperature exceeds 15° C (59° F).

PARKING.

Leave at least one aperture open when parking in sun so that temperature inside will not be excessive. High temperatures can cause fluid in compass to boil away, dry out electrical insulation and cause inside paint to pull away from skin.

WARNING

All air scoops or vents should be protected, whenever possible, from blowing dust or sand which might restrict air flow during subsequent operation.



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appendix I PERFORMANCE DATA

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INTRODUCTION.

This appendix is prepared, and included, to facilitate preflight and in-flight planning. The information has been prepared from actual flight test information and is based on normal technique as set forth in Section II. If utilized it will afford accurate information on the aircraft performance.

AIRSPEED POSITION CORRECTION.

This graph (figure A-1) is provided for computing calibrated airspeed (CAS) from indicated airspeed (IAS). The chart form is self-explanatory.

POWER SCHEDULE.

The power schedule table (figure A-2) and power schedule graphs (figures A-3 thru A-6) presents the power settings for the normal operating schedule from sea level to 13,000 feet. The power curves provide a power range from minimum power to take-off power. Data shown on the power schedule graphs and power schedule table represent performance to be expected of average engines in good mechanical condition.

NAUTICAL MILES PER POUND OF FUEL.

The nautical miles per pound of fuel curves (figures A-7 through A-10) have been prepared for altitudes from sea level to 13,000 feet. The gross weight parameters range from 7,500 to 10,500 pounds. Power settings shown will result in maximum over-all operating efficiencies under standard day conditions.

FUEL FLOW PER ENGINE.

The fuel flow per engine curves (figures A-11 through A-14) are plotted to show fuel flow per engine versus brake horsepower and are based on altitudes ranging from sea level to 13,000 feet.

TAKE-OFF CURVE.

The take-off curve (figure A-15) presents the ground run distance using a hard surface run-way and no flaps. The graph consists of an altitude-temperature curve, a ground roll distance curve, and parameters of gross weight. A correction plot for various head winds and conversion information required to obtain the take-off distance is also included. From this graph it is possible to predict the required ground roll if the runway altitude, temperature, aircraft gross weight, and head winds are known. The total take-off distance to clear a 50-foot obstacle is approximately 115% of the ground run distance.

CLIMB CURVE.

From the climb curve (figure A-16), distance versus weight, fuel consumed in climb, and service ceiling may be determined.

SINGLE ENGINE CLIMB.

The single engine climb graph (figure A-17) is plotted to furnish the single engine rate-of-climb at various weights and altitudes.

LANDING CURVE.

The landing curve (figure A-18) provides the lengths of landing roll on a runway with a hard, dry surface at various weights, altitudes, temperatures and head winds. The total landing distance required to clear a 50-foot obstacle is approximately 200 percent of the ground roll distance.

MAXIMUM ENDURANCE.

The maximum endurance graph (figure A-19) outlines the power settings for minimum fuel consumption in level flight for various altitudes.

LONG RANGE PREDICTION GRAPHS.

These graphs (figures A-20 through A-23) are plotted to furnish the maximum aircraft range and time to cruise for a given amount of fuel used at a constant altitude. The graphs are plotted on the basis of nautical miles versus gross weight and time versus gross weight and are provided for either single or twin engine operation.

EMERGENCY CLIMB.

The emergency climb graphs (figures A-24 and A-25) are furnished to provide the rate of climb for both single and twin engine operation in the clean configuration at sea level.

EMERGENCY SERVICE CEILING.

The emergency service ceiling graph (figure A-26) is furnished to provide the maximum altitudes at which rate-of-climb is 100 feet-per-minute at momentary weight. The graph is a plot of altitude versus gross weight and is furnished for both twin and single engine operation.

USE OF GRAPHS.

The following sample problems, based on a typical mission and employing actual graphic values, demonstrates the proper use of the graphs.

PROBLEM: It is required that you fly four passengers to a base 625 statute miles away. The first 200 miles must be flown above 3000 feet altitude and the remainder above 8000 feet altitude due to terrain.

KNOWN FACTORS:

Required Range	625 Statute Miles (543 Nautical Miles)
Weather	CAVU
Basic Weight	6350 Pounds
Personnel Weight	1200 Pounds (6 Men at 200 Pounds Per Man)
Fuel Weight	1512 Pounds (252 Gallons at 6 Pounds Per Gallon)
Oil Weight	120 Pounds (16 Gallons at 7.5 Pounds Per Gallon)
Total Weight	9182 Pounds

In completing the actual flight plan, each separate flight condition should be treated as a separate problem. In this particular case, we will have four basic steps.

With the weight determined at start of cruise from the climb graph (Figure A-16) and the distance to be covered, the fuel used during mission may be found by using long-range prediction-distance graph (Figure A-20). With this information, the time and power setting can be found from long-range prediction-time (Figure A-21) and maximum endurance (Figure A-19).

From the Climb Curve (Figure A-16).

LEG 1	CLIMB
Initial weight	9182 lb.
Warm-up (5 gal.)	30 lb.
Climb	48 lb.
Take-off weight	9152 lb.
Fuel (1512 lb.)	252 gal.
Altitude	SL to 5000 ft.
Fuel used (78 lb.)	13 gal.

From the Power Schedule Chart (Figure A-2).

Power setting	2300 rpm
	38 in. Hg at SL
	33 in. Hg at 5000 ft.
	full rich

NOTE: RPM, MP, and Mixture:

These items are read directly from the power schedule chart. The fuel used in climb was read directly from climb curve (Figure A-16). This value plus five gallons for warm-up and take-off is equal to 13 gallons. Climb distance equals 6.5 miles (7.5 statute miles) in 4.2 minutes (.07 hours).

LEG 2	CRUISE
Aircraft weight	9104
Fuel in gallons	239
Distance to travel	200 statute miles
	174 nautical miles

From long-range prediction-distance—5000 ft. (Figure A-20).

Fuel used	224 lb.
	37 gal.

From nautical miles per pound of fuel—5000 ft. (Figure A-8).

True air speed	126 kts.
Power setting	1600 rpm
	24.5 in Hg
	Manual lean
Time (Distance ÷ Air Speed)	1.38 hr.

NOTE

Weight:
13 (Gal. of fuel used in Leg 1) × 6 (Lb./Gal.) = 78 lb. 9182 — 78 = 9104 lb. at the start of Leg 2.

The cruise speed power settings were based on 99-percent maximum miles per pound calculations.

LEG 3	CLIMB
Aircraft weight	8880
Fuel in gallons	202
Altitude	5000 to 10000 ft.

From the Power Schedule (Figure A-2).

Power setting	2300 rpm
	33 in. Hg at 5000 ft.
	27.5 in. Hg at 10000 ft.
	full rich

From the Climb Curve (Figure A-16).

Fuel used (90 lb.)	15 gal.
Climb distance from Figure	15 nautical miles
	(17.2 statute miles)
Climb time	5.2 min.
	(.09 hr.)

NOTE

Fuel Used:

Change of weight from 5000 to 10000 feet on climb curve is fuel consumed.

Weight: Weight at start of second climb (Leg 3) is initial weight minus weight of fuel used in Legs 1 and 2. 9182 — (78 + 224) = 8880 pounds at start of Leg 3.

Fuel:

Original fuel minus fuel used in Legs 1 and 2 gives 252 — (13 + 37) = 202 gallons at the beginning of Leg 3.

LEG 4	CRUISE
Aircraft weight	8790 lb.
Fuel in gallons	187
Distance	400 statute miles
	347 nautical miles

From long-range prediction-distance 10000 ft. (Figure A-20).

Fuel used	440 lb.
	73 gal.

From nautical miles per pound—10000 ft. (Figure A-9).

True air speed	134 kts.
	1600 rpm
	22.5 in. Hg
	manual lean
Time	2.6 hr.

NOTE

Weight:

Weight at start of Leg 4 is initial weight less fuel used in Legs 1, 2 and 3. 9182 — (78 + 224 + 90) = 8790 pounds.

Fuel:

Original fuel minus that used in Legs 1, 2, and 3 gives 252 — (13 + 37 + 15) = 187 gallons.

Fuel Used:

Fuel used was the change in weight starting at 8790 pounds and traveling 347 nautical miles as determined by the use of the long-range prediction-distance curve.

Fuel Remaining at End of Mission:

Initial fuel minus fuel used in Legs 1, 2, 3, and 4 gives 252 — (13 + 37 + 15 + 73) = 114 gallons.

Mission time includes the time used in Legs 1, 2, 3, and 4 = .07 + 1.38 + .09 + 2.60 = 4.14 hr.

TOTAL MISSION

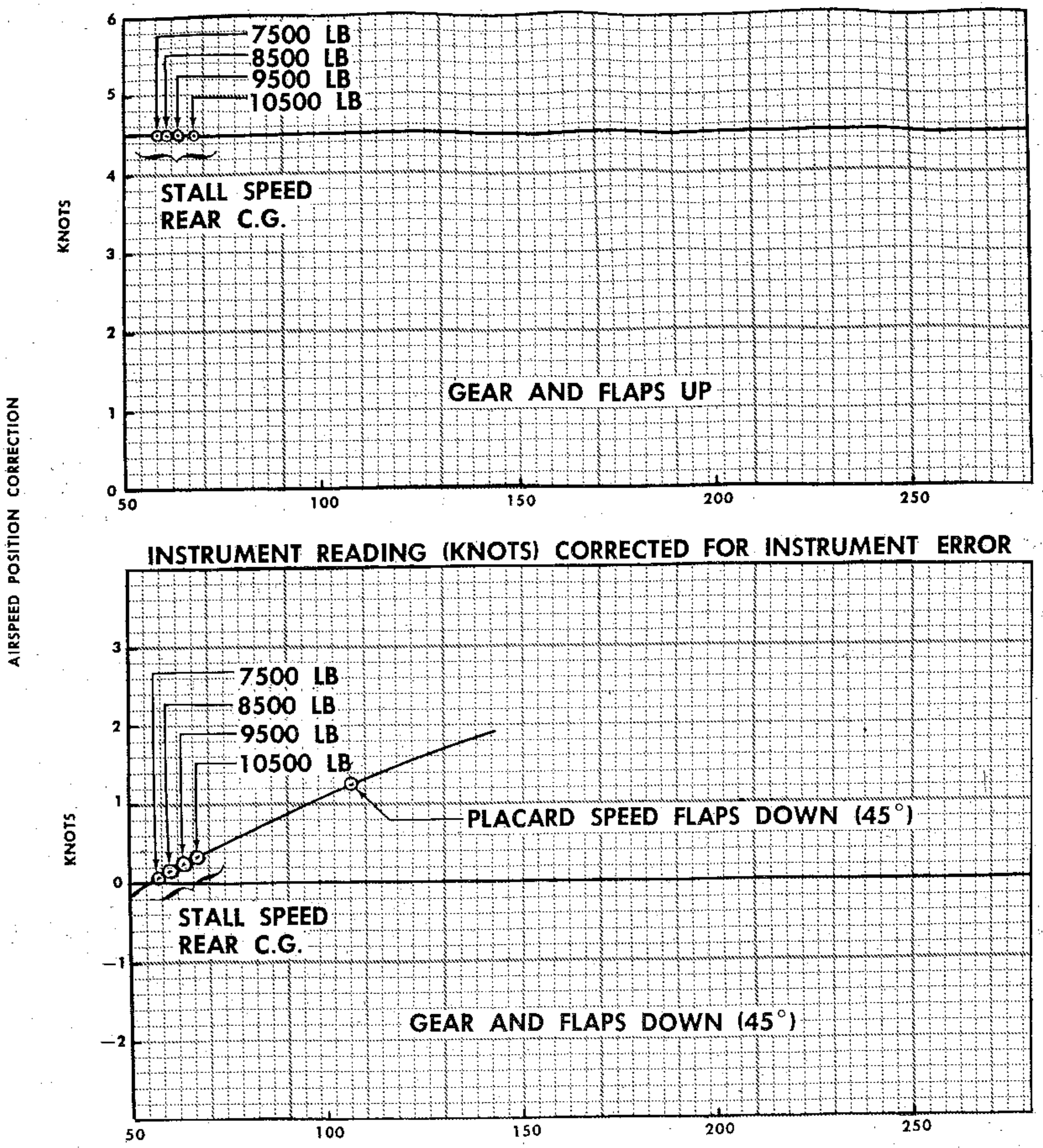
Distance to climb 5000 ft.	8 mi.
Cruise at 5000 ft.	200 mi.
Distance to climb from 5000 ft. to 10000 ft.	17 mi.
Cruise at 10000 ft.	400 mi.
TOTAL	625 mi.

AIRSPEED POSITION CORRECTION

STANDARD DAY

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

Figure A-1

POWER SCHEDULE

APPROXIMATE MANIFOLD PRESSURE REQUIRED

MODEL C-45G

ENGINE(S): (2)R985-AN-1,3 14B

MIXTURE	RPM	BHP	SEA LEVEL	5000 FT	10000 FT	13000 FT
MANUAL LEAN	2300	276				24.7
	2200	264				24.5
	2100	360		32.5		
	2100	285			27.0	
	2100	250				24.3
	2000	309	33.5			
	2000	312		30.7		
	2000	270			26.7	
	2000	236				24.0
	1900	285	33.0	30.0		
	1900	254			26.2	
	1900	220				23.7
	1800	270	33.0	30.0		
	1800	236			25.7	
	1800	203				23.2
	1700	255	32.8	29.9		
	1700	217			25.2	
	1700	186				22.5
	1600	240	32.7	29.7		
	1600	220	31.0	28.3		
	1600	200	29.5	26.9	24.8	
	1600	160	26.4	24.0	21.5	21.6
	1600	140	24.7	22.5	19.7	20.5
	1600	100	21.6	19.7		
FULL RICH	2300	450	38.0			
	2300	398		33.5		
	2300	313			27.4	
	2200	406	36.0			
	2200	383		33.2		
	2200	300			27.2	
	2100	357	34.0			
BEST POWER	2300	408		33.3		
	2300	330			27.5	
	2300	296				24.8
	2200	388		33.0		
	2200	316			27.0	
	2200	284				24.5
	2100	360		32.0		
	2100	300			26.8	
	2100	270				24.2
	2000	311		29.5		
	2000	284			26.5	
	2000	256				24.0
	1900	286		28.8		
	1900	266			26.0	
	1900	242				23.5
	1800	270		28.7		
	1800	250			25.5	
	1800	225				23.0
	1700	255		28.5		
	1700	232			25.3	
	1700	206				22.4
	1600	240		28.5		
	1600	200		25.8	24.0	
	1600	160		23.0	21.0	20.0
	1600	140		21.5	19.5	18.5
	1600	120		20.3	18.2	17.0
	1600	100		18.8	16.8	15.5
	1600	80		17.5		

DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

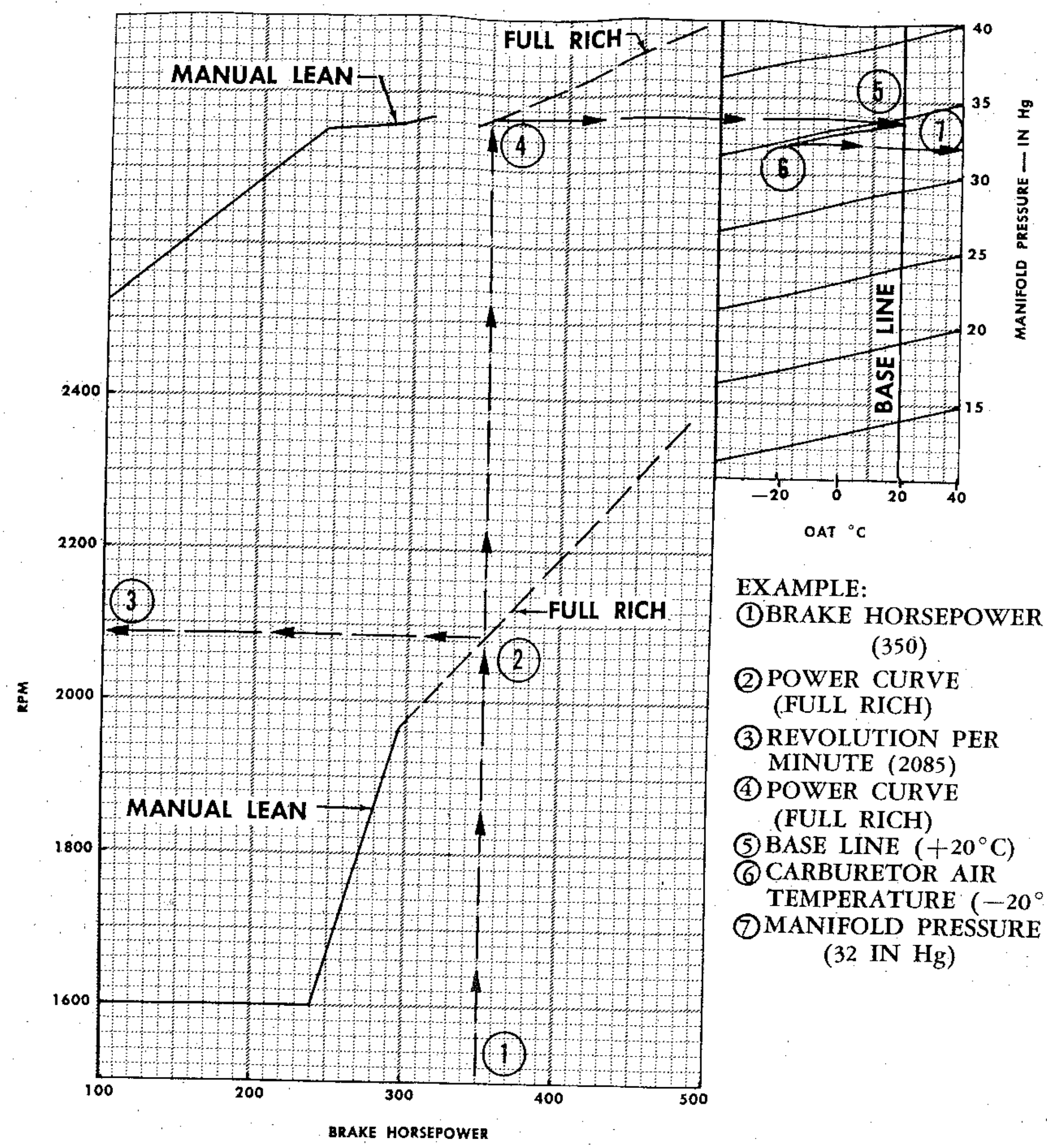
Figure A-2

POWER SCHEDULE

SEA LEVEL

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



EXAMPLE:
① BRAKE HORSEPOWER (350)
② POWER CURVE (FULL RICH)
③ REVOLUTION PER MINUTE (2085)
④ POWER CURVE (FULL RICH)
⑤ BASE LINE (+20°C)
⑥ CARBURETOR AIR TEMPERATURE (−20°C)
⑦ MANIFOLD PRESSURE (32 IN Hg)

DATA AS OF: JULY, 1952
DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6.0 LB/GAL

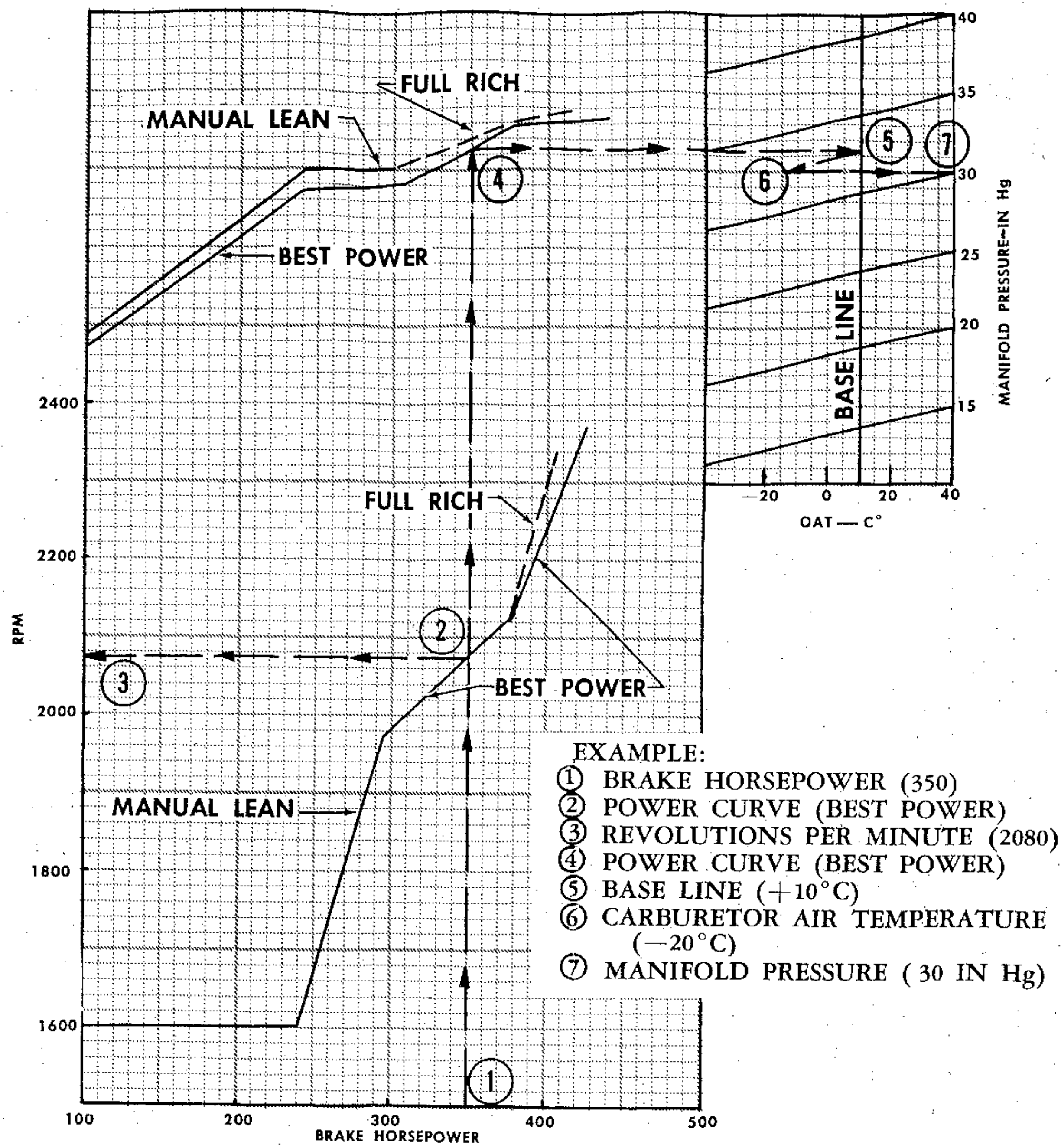
Figure A-3

POWER SCHEDULE

5000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

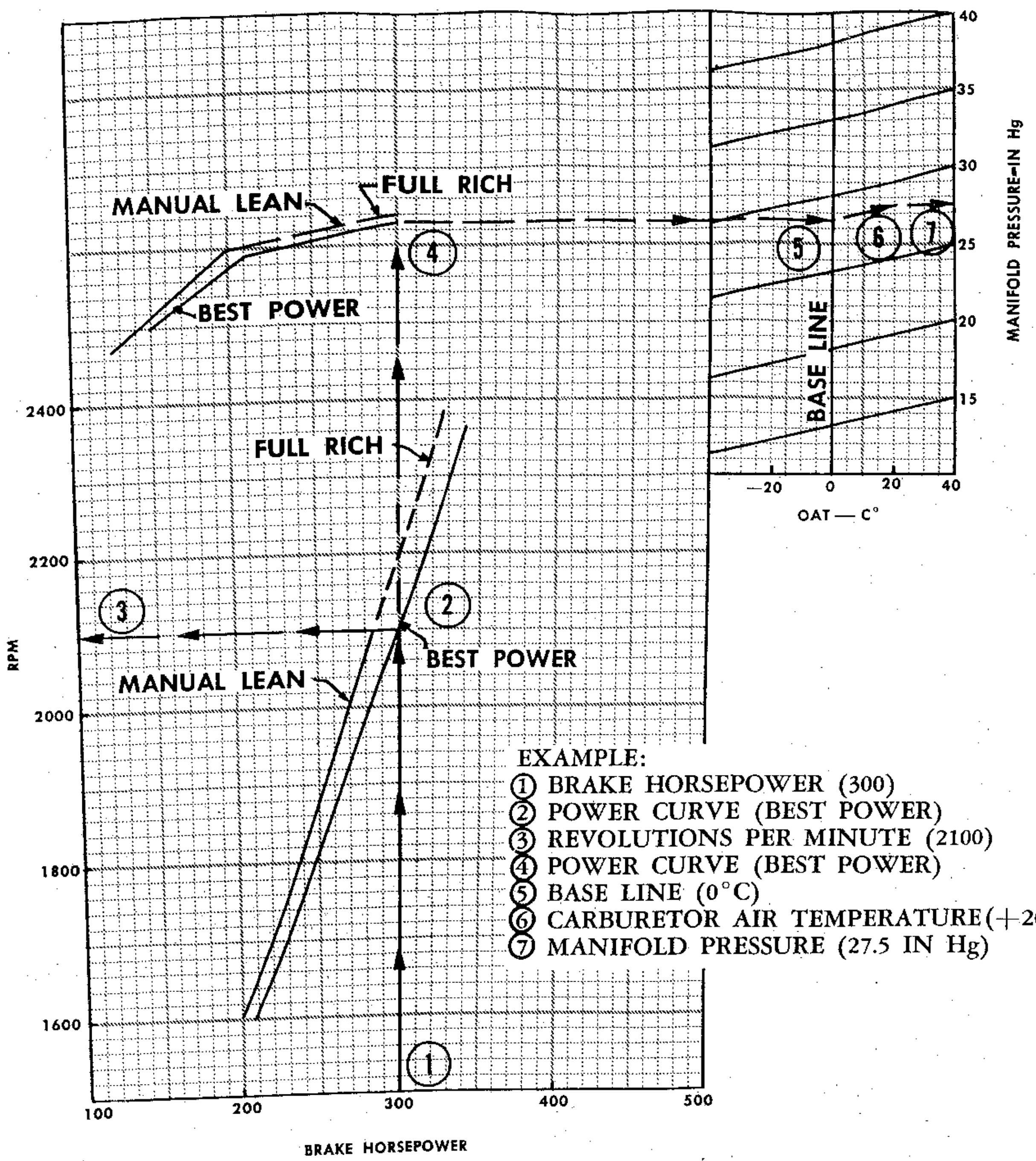
FUEL DENSITY: 6.0 LB/GAL

Figure A-4

POWER SCHEDULE
10000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



EXAMPLE:
1. BRAKE HORSEPOWER (300)
2. POWER CURVE (BEST POWER)
3. REVOLUTIONS PER MINUTE (2100)
4. POWER CURVE (BEST POWER)
5. BASE LINE (0°C)
6. CARBURETOR AIR TEMPERATURE (+20°C)
7. MANIFOLD PRESSURE (27.5 IN Hg)

DATA AS OF: JULY, 1952
DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6.0 LB/GAL

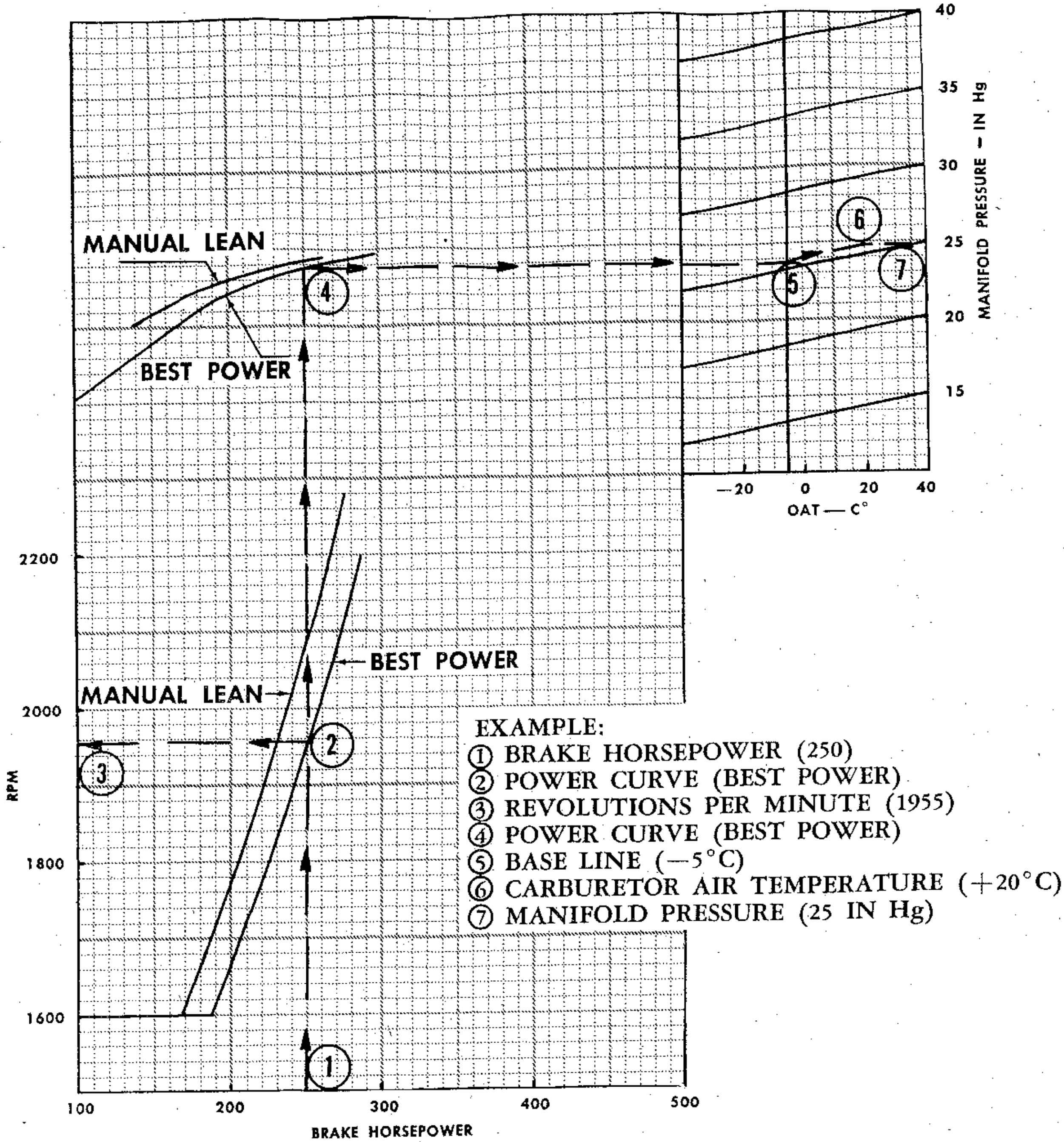
Figure A-5

POWER SCHEDULE

13000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA BASED ON: FLIGHT TEST

DATA AS OF: JULY, 1952

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

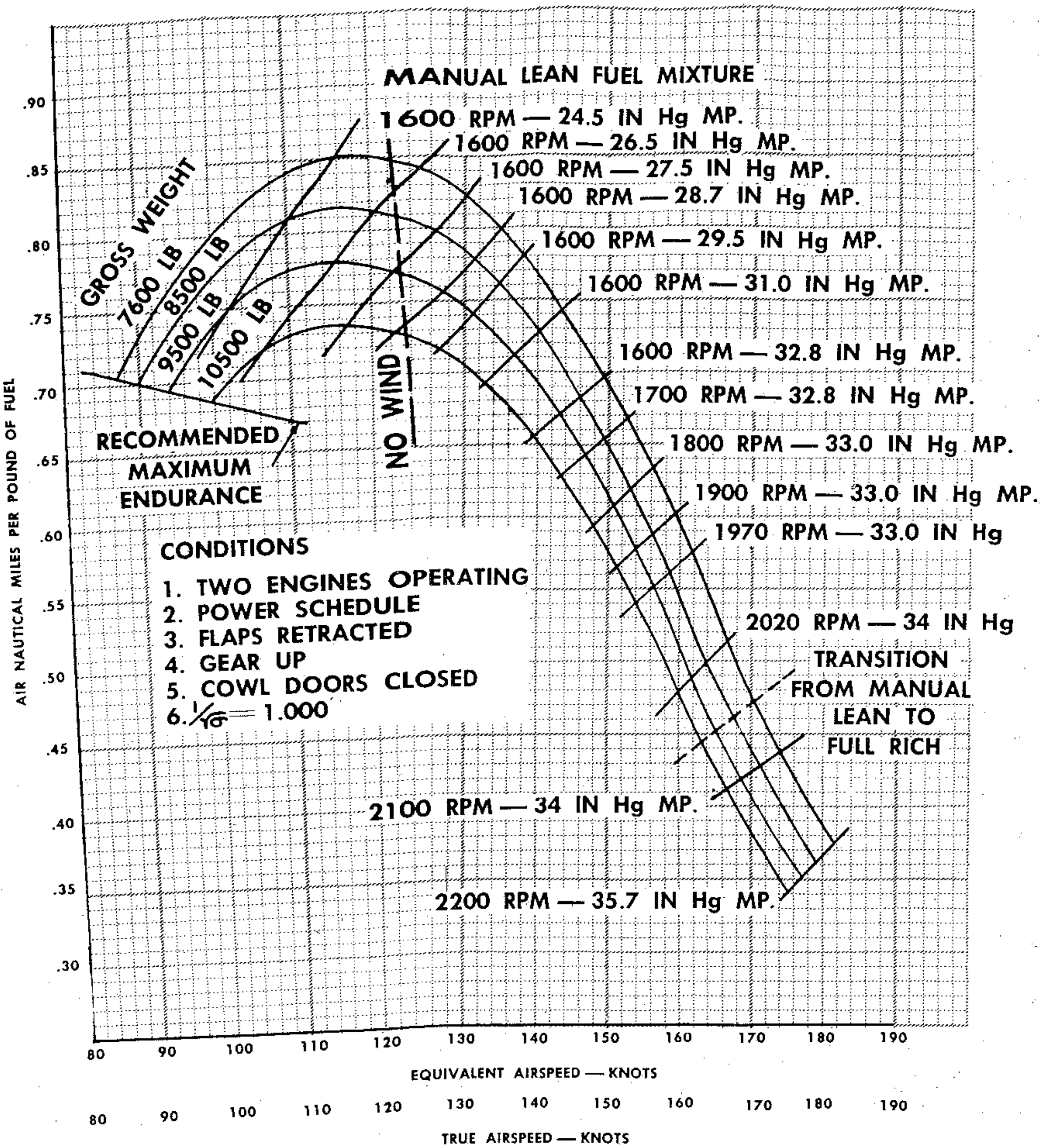
Figure A-6

NAUTICAL MILES PER POUND OF FUEL

STANDARD DAY — SEA LEVEL

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

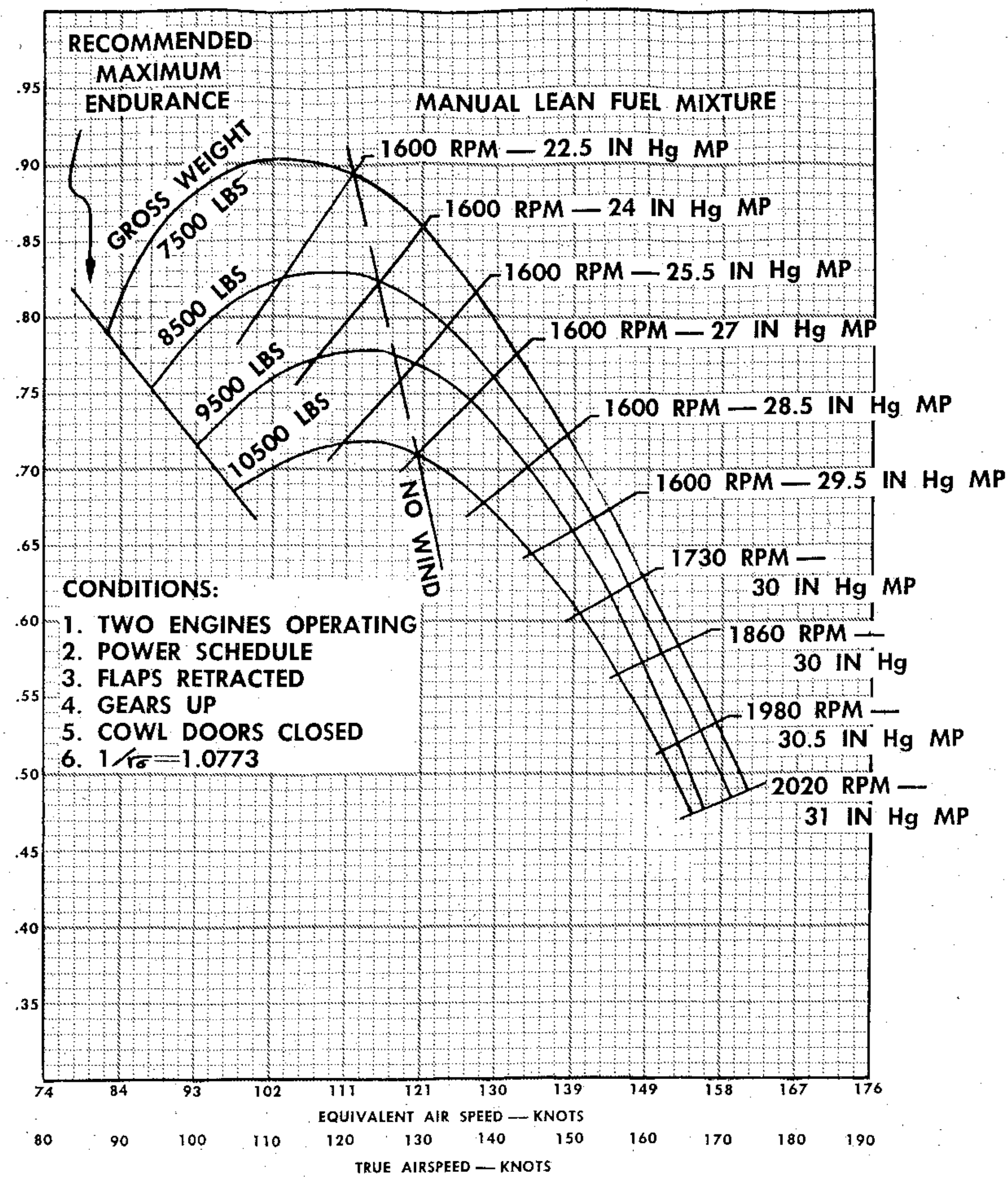
Figure A-7

NAUTICAL MILES PER POUND OF FUEL

STANDARD DAY — 5000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

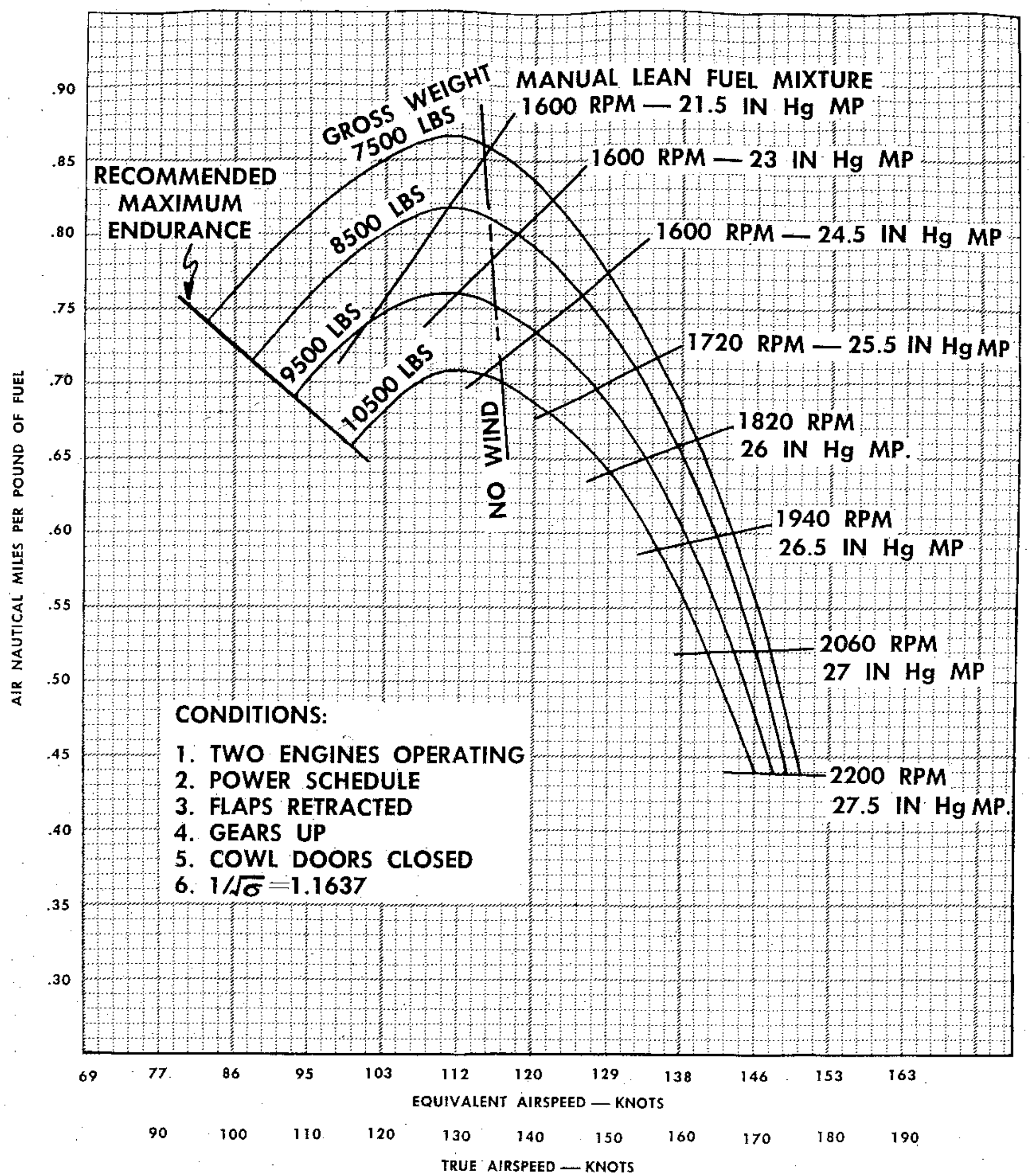
Figure A-8

NAUTICAL MILES PER POUND OF FUEL

STANDARD DAY — 10000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

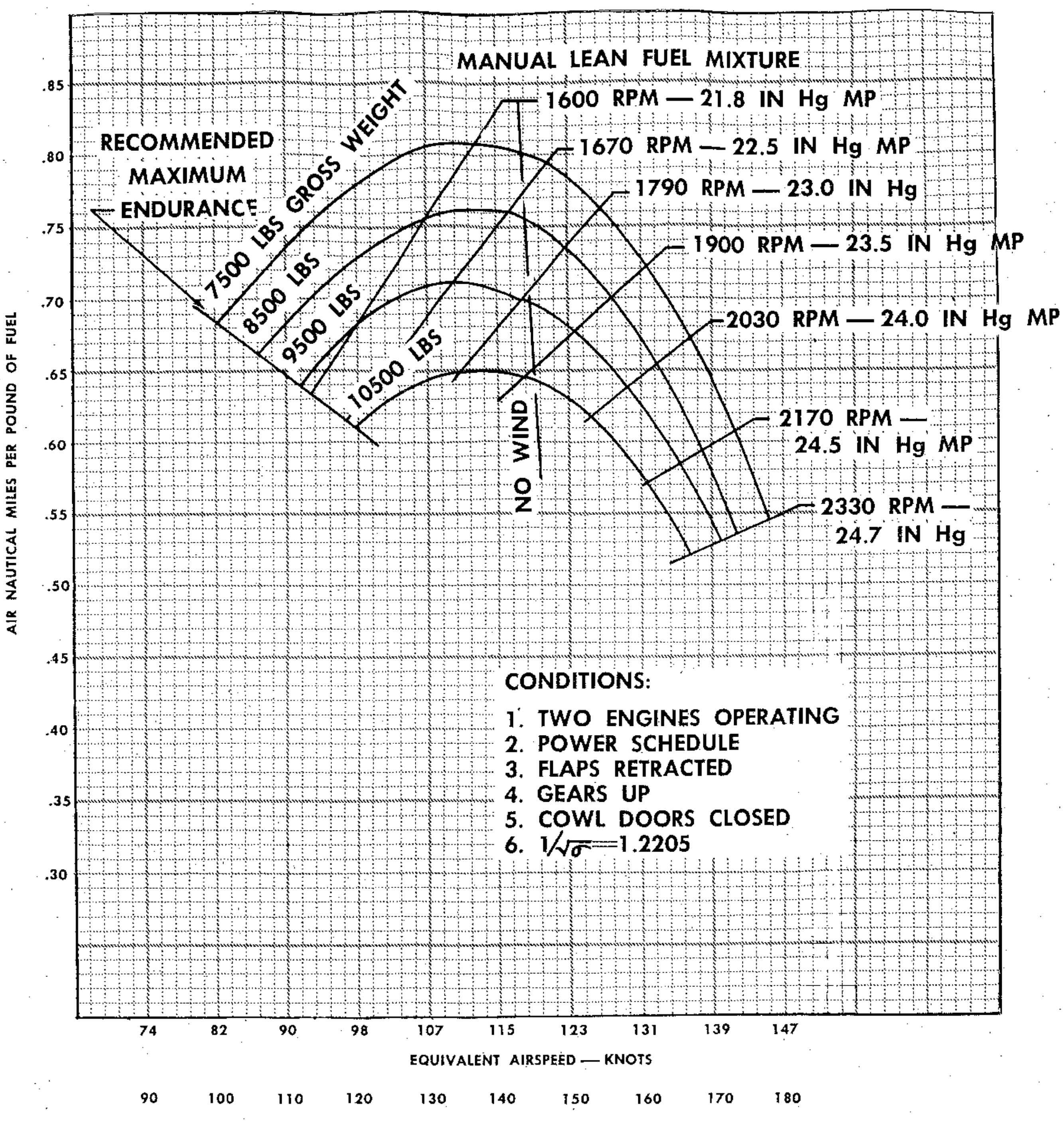
Figure A-9

NAUTICAL MILES PER POUND OF FUEL

STANDARD DAY —— 13000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

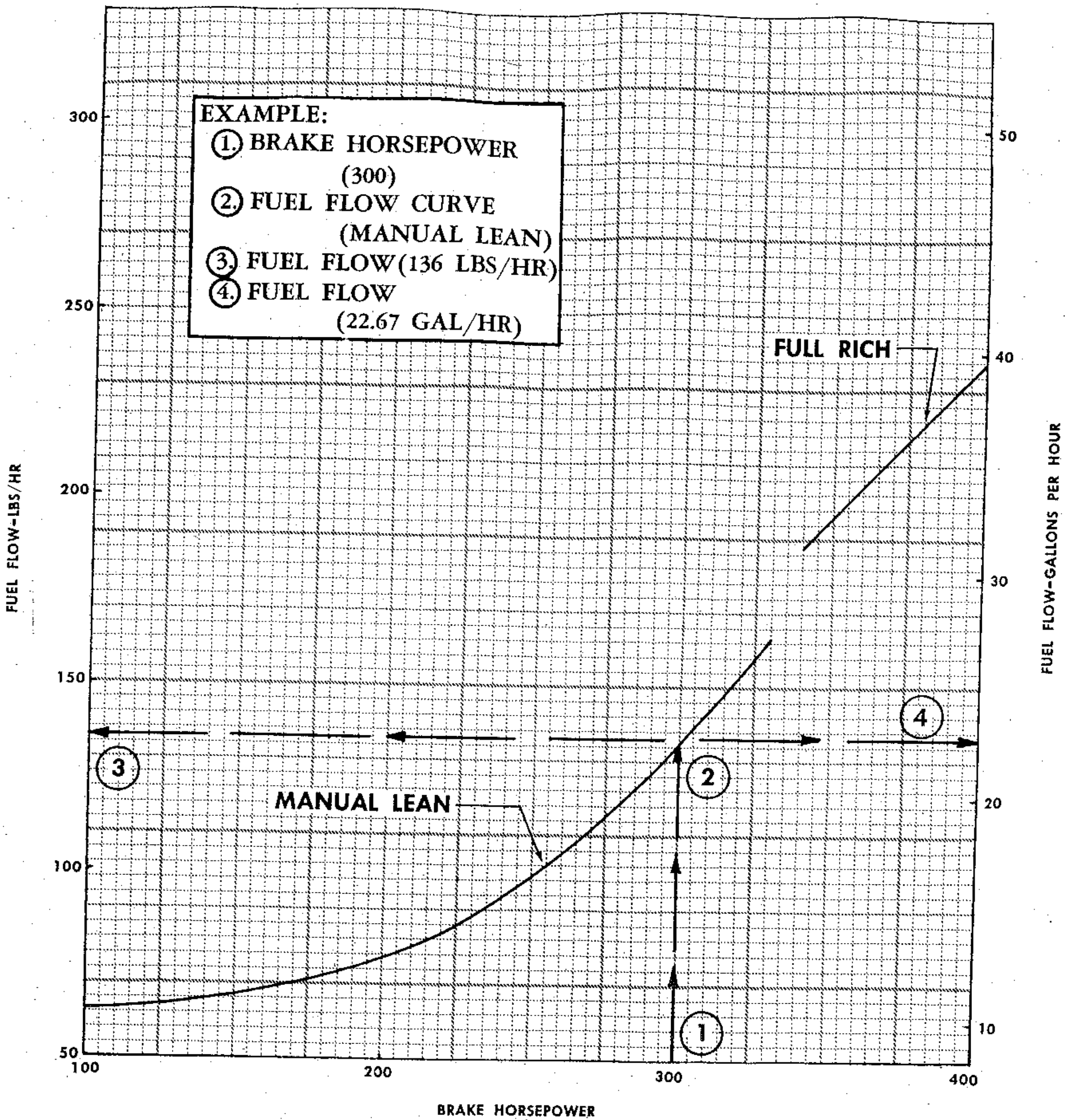
Figure A-10

FUEL FLOW PER ENGINE

STANDARD DAY — SEA LEVEL

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

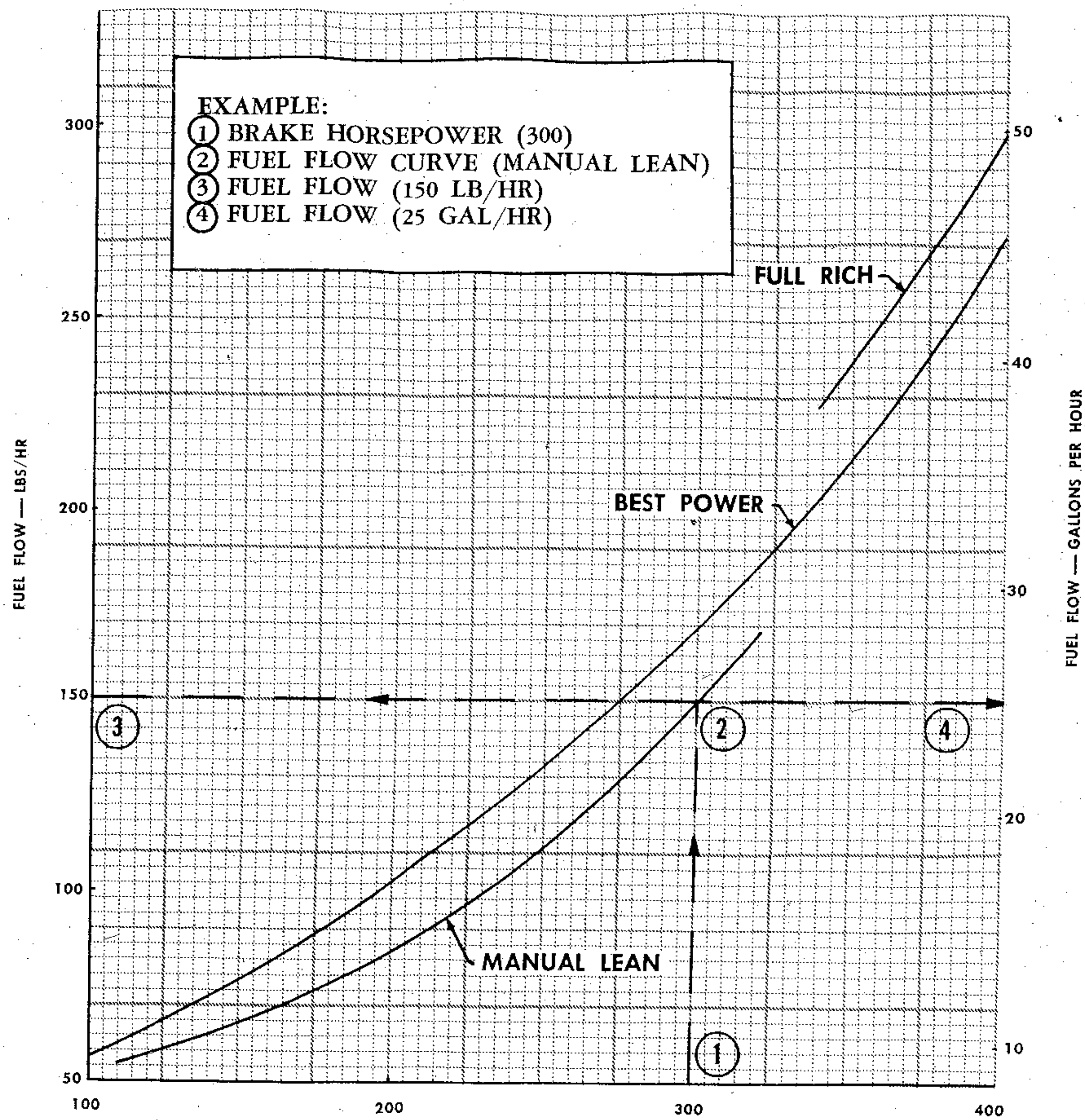
Figure A-11

FUEL FLOW PER ENGINE

STANDARD DAY — 5000 FEET

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

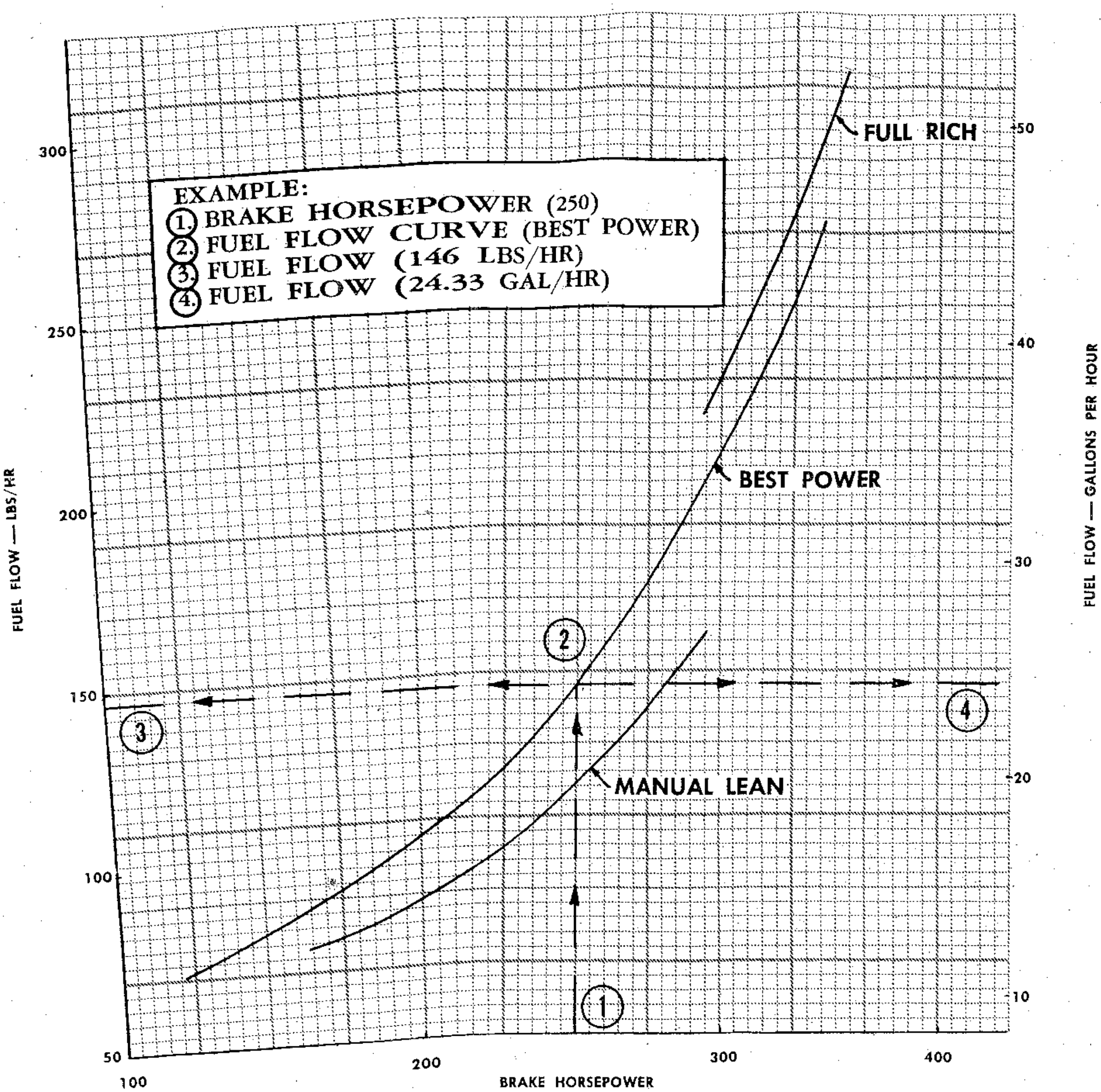
Figure A-12

FUEL FLOW PER ENGINE

10000 FEET
STANDARD DAY

EL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

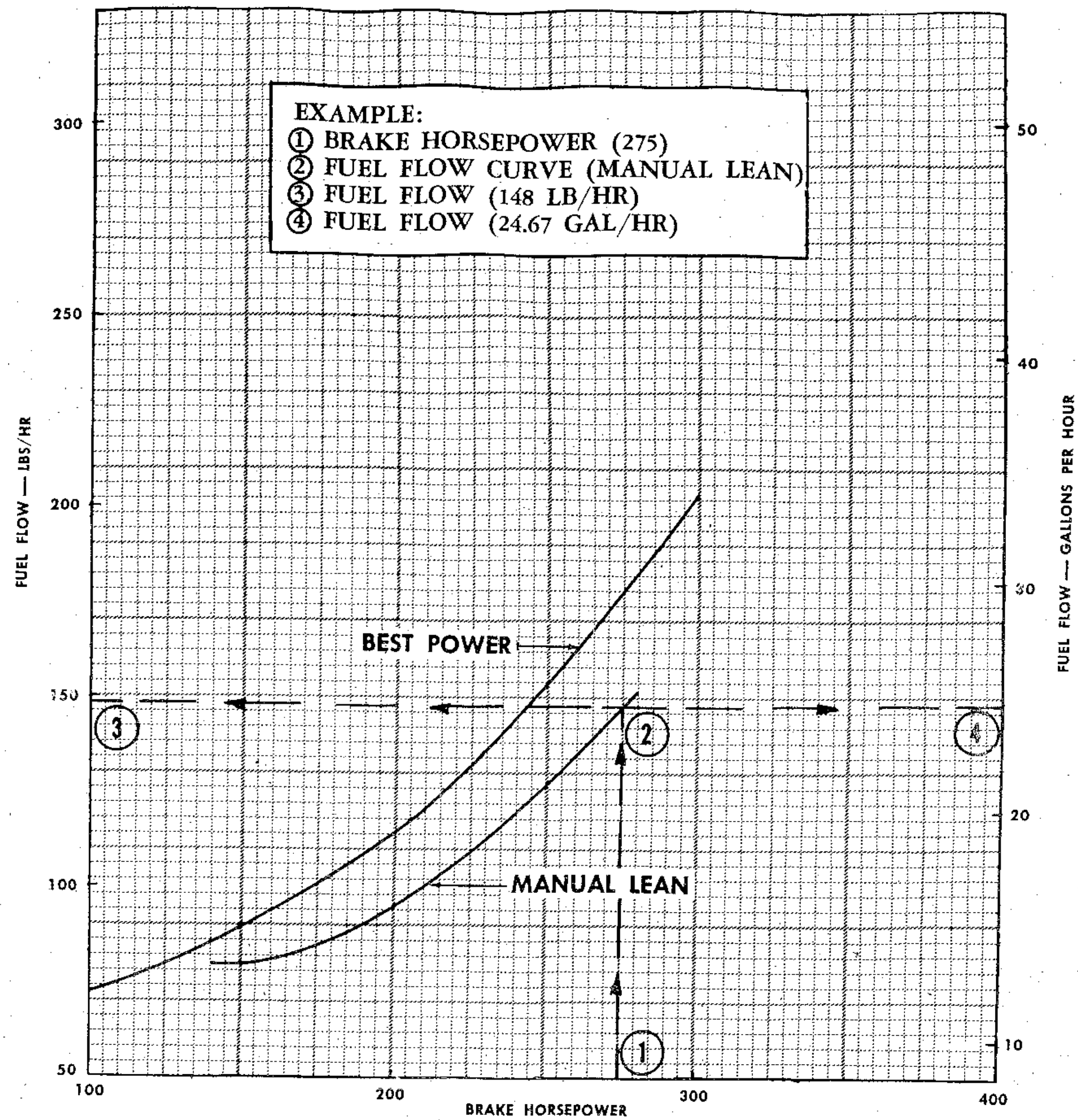
Figure A-13

Revised 30 August 1956

FUEL FLOW PER ENGINE

STANDARD DAY —— 13000 FEET

MODEL C-45 ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952 FUEL GRADE: 91/96

DATA BASED ON: FLIGHT TEST FUEL DENSITY: 6.0 LB/GAL

Figure A-14

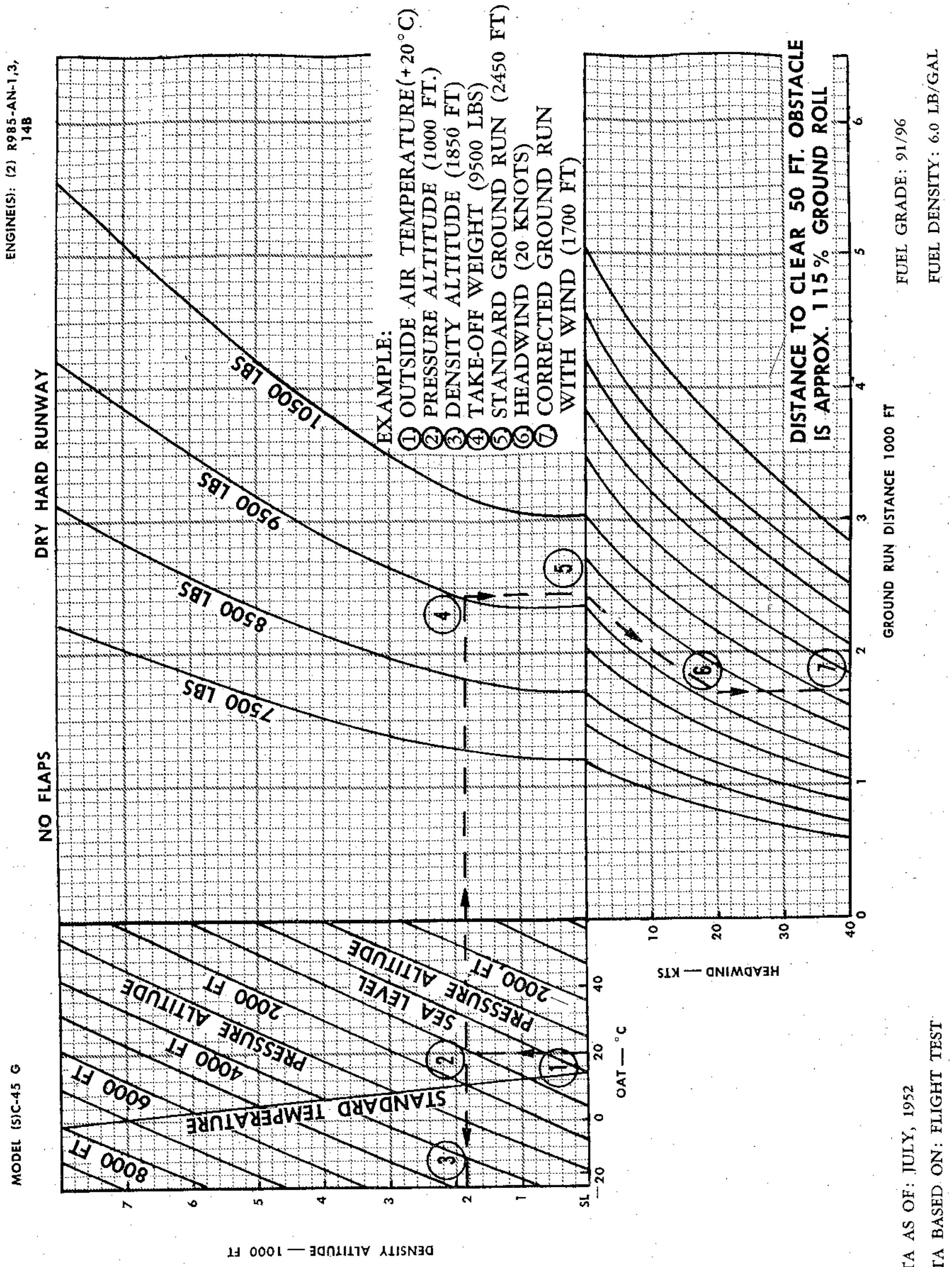

TAKE-OFF CURVE
NO FLAPS
DRY HARD RUNWAY
MODEL (S)C-45 G
ENGINE(S): (2) R985-AN-1,3, 14B
EXAMPLE:
① OUTSIDE AIR TEMPERATURE (+20°C)
② PRESSURE ALTITUDE (1000 FT.)
③ DENSITY ALTITUDE (1850 FT)
④ TAKE-OFF WEIGHT (9500 LBS)
⑤ STANDARD GROUND RUN (2450 FT)
⑥ HEADWIND (20 KNOTS)
⑦ CORRECTED GROUND RUN WITH WIND (1700 FT)
DISTANCE TO CLEAR 50 FT. OBSTACLE IS APPROX. 115% GROUND ROLL
10500 LBS
9500 LBS
8500 LBS
7500 LBS
8000 FT
6000 FT
4000 FT
2000 FT
PRESSURE ALTITUDE
SEA LEVEL
PRESSURE ALTITUDE 2000 FT
STANDARD TEMPERATURE
DENSITY ALTITUDE — 1000 FT
OAT — °C
HEADWIND — KTS
GROUND RUN DISTANCE 1000 FT
FUEL GRADE: 91/96
FUEL DENSITY: 6.0 LB/GAL
DATA AS OF: JULY, 1952
DATA BASED ON: FLIGHT TEST

Figure A-15

CLIMB CURVE

STANDARD DAY

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B

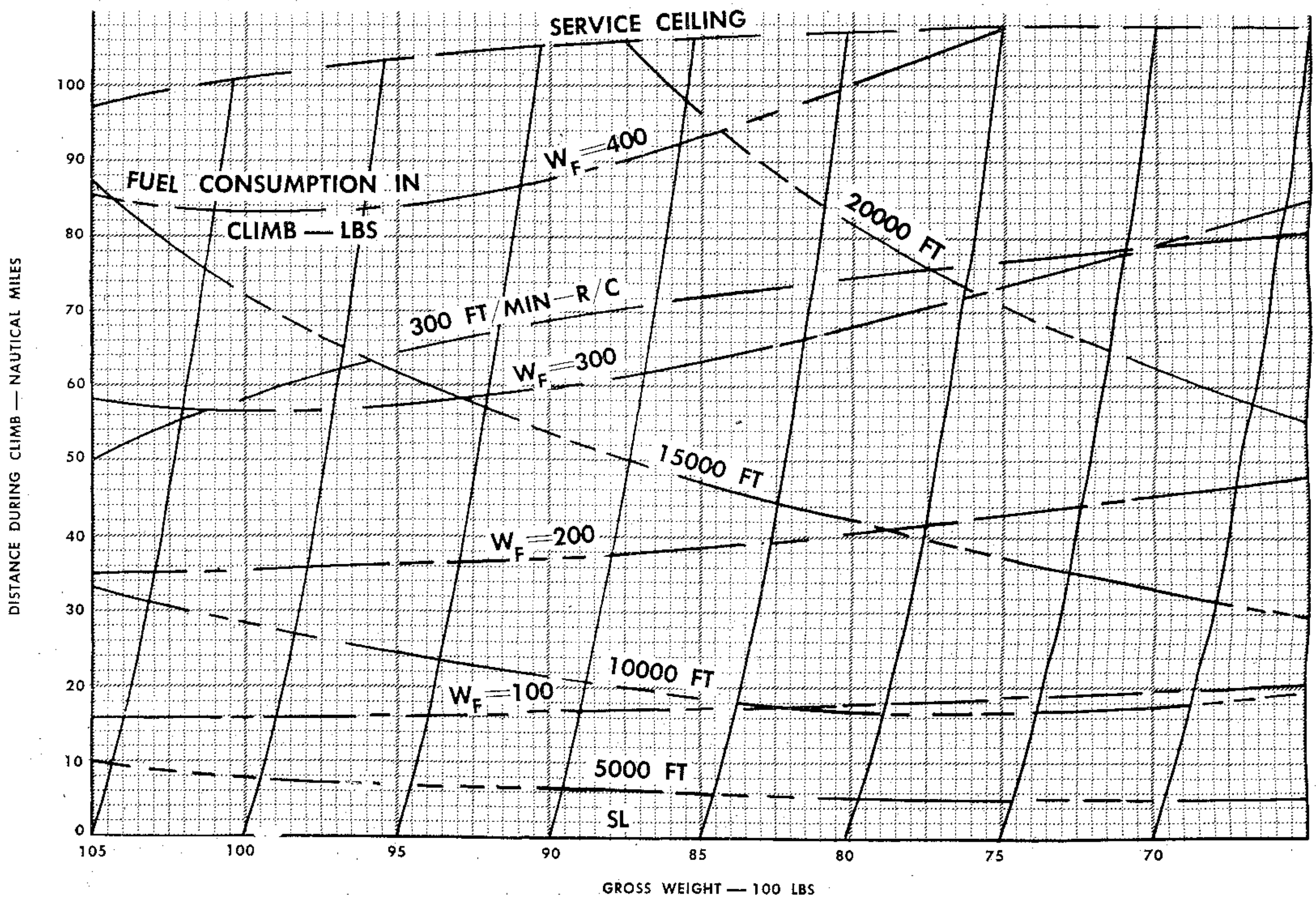


Figure A-16

DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

SINGLE ENGINE CLIMB
MAXIMUM CONTINUOUS POWER

MODEL C-45

ENGINE(S): (1) R985-AN-1,3, 14B

CONDITIONS: 1. PROPELLER ON INOPERATIVE ENGINE FEATHERED 2. FLAPS UP AND GEAR UP

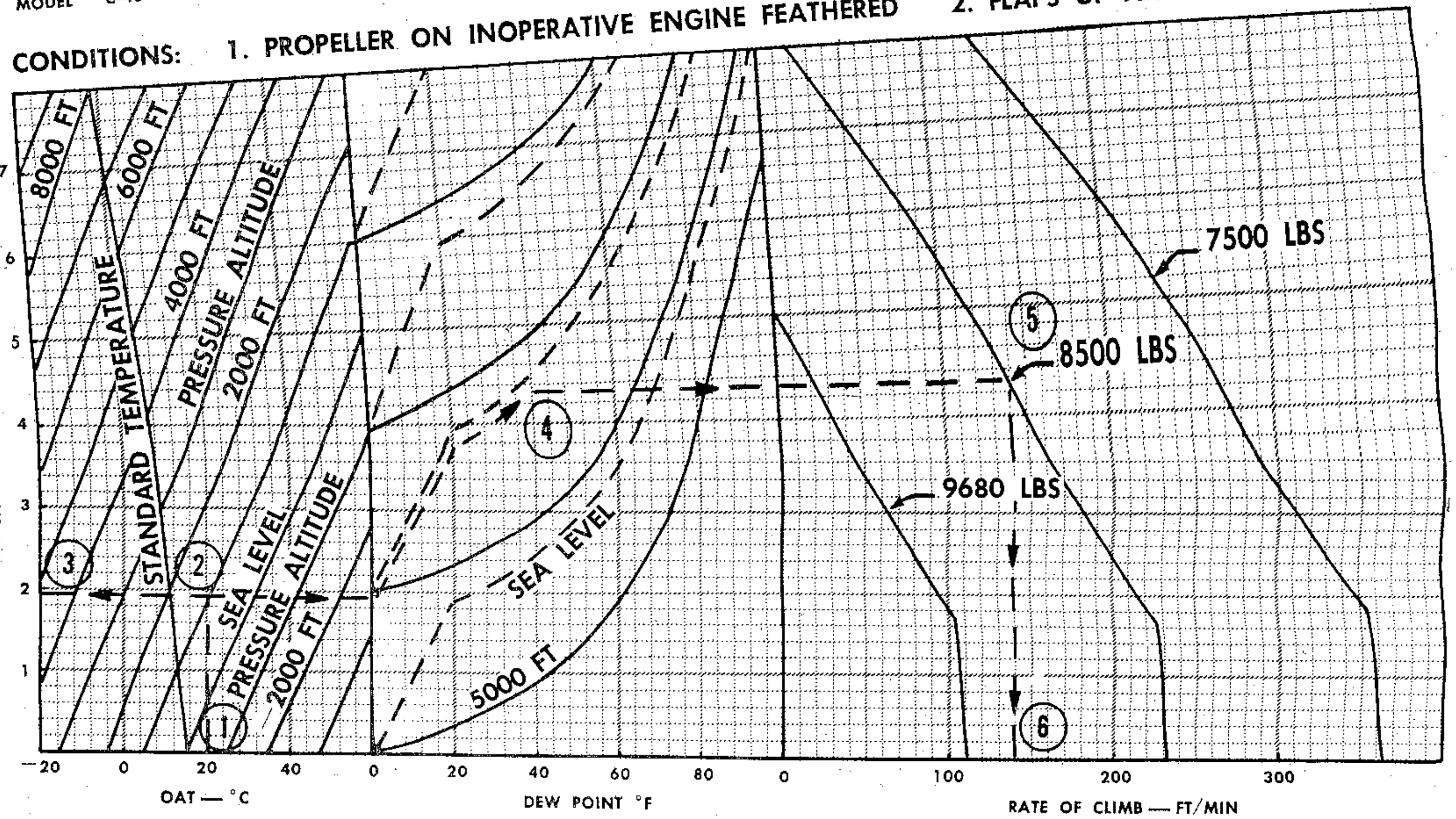


Figure A-17

EXAMPLE:

1. OUTSIDE AIR TEMPERATURE (+20°C)
2. PRESSURE ALTITUDE (1000 FT)
3. DENSITY ALTITUDE (1850 FT)
4. DEW POINT TEMPERATURE (+40°F)
5. GROSS WEIGHT (8500 LBS)
6. RATE OF CLIMB (137 FT/MIN)

DATA BASED ON: FLIGHT TEST

DATA AS OF: JULY, 1952

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

LANDING CURVE

MODEL C-45 45 DEGREE FLAPS HARD DRY RUNWAY ENGINE(S): (2) R985-AN-1,3, 14B

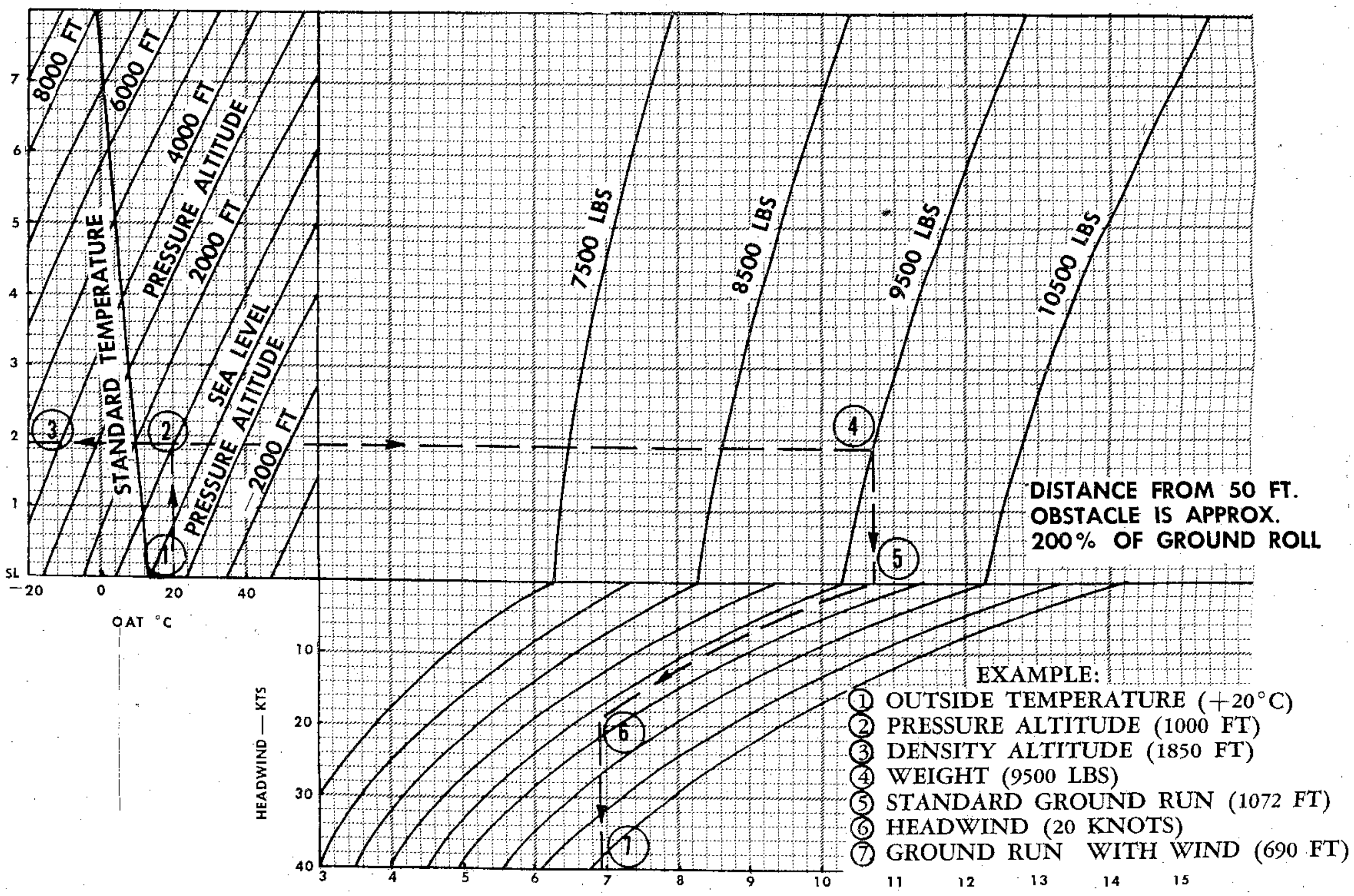


Figure A-18

DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

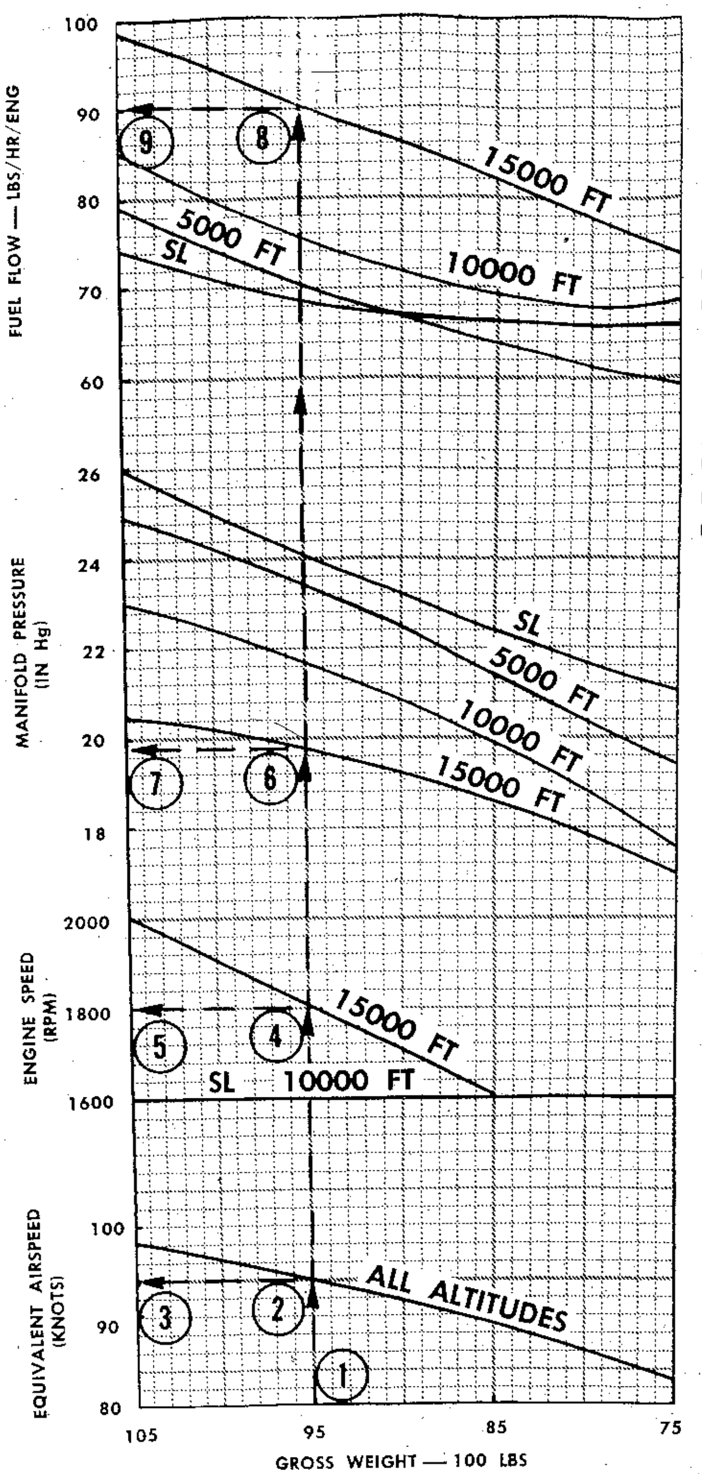
FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

MAXIMUM ENDURANCE

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



EXAMPLE:
1. GROSS WEIGHT (9500 LBS)
2. ALL ALTITUDES
3. EQUIVALENT AIRSPEED (94 KNOTS)
4. ALTITUDE (15000 FT)
5. ENGINE SPEED (1800 RPM)
6. ALTITUDE (15000 FT)
7. MANIFOLD PRESSURE (19.8 IN Hg)
8. ALTITUDE (15000 FT)
9. FUEL FLOW (90 LB/HR/ENG)

DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

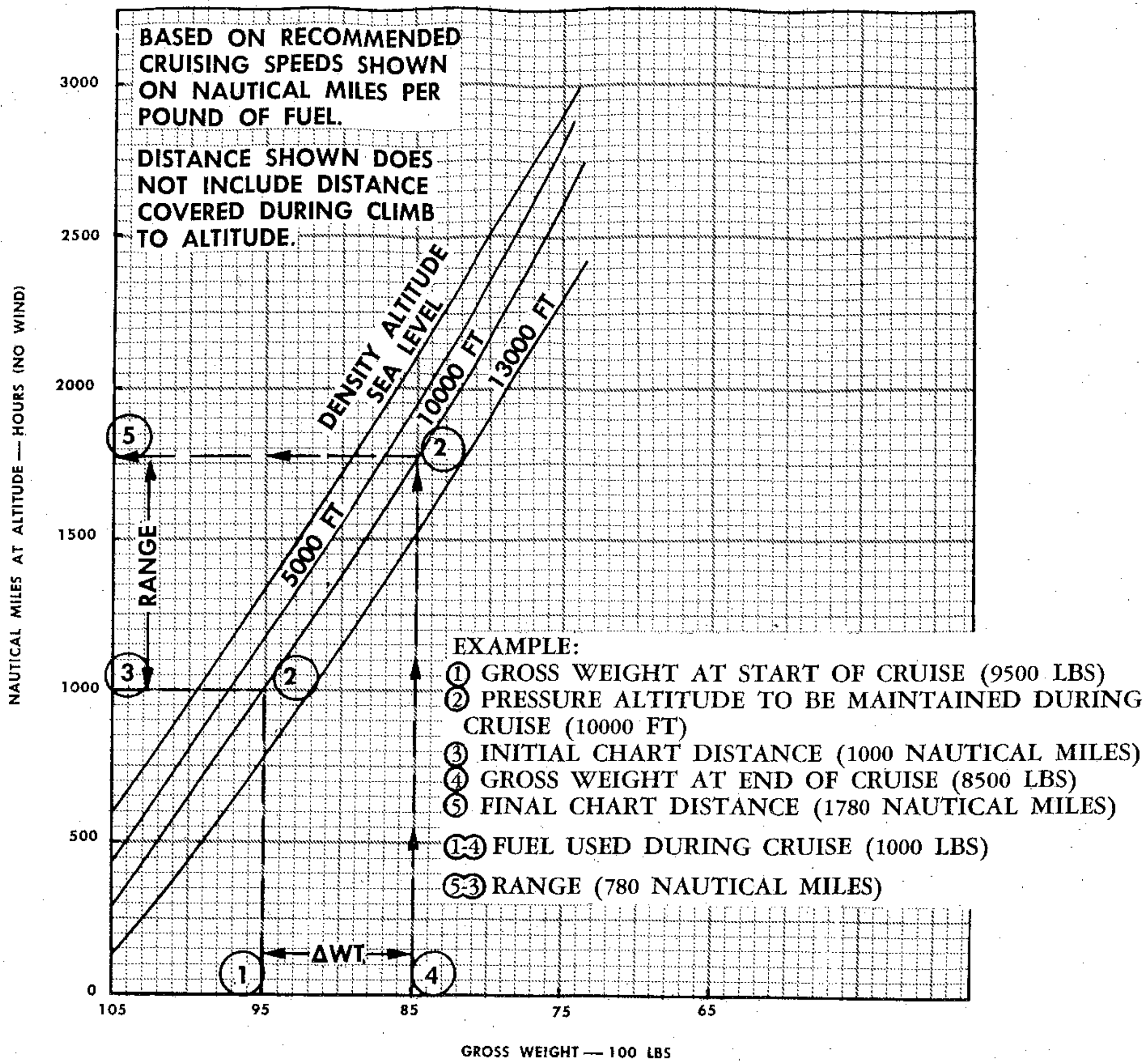
Figure A-19

LONG-RANGE PREDICTION — DISTANCE

STANDARD DAY

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

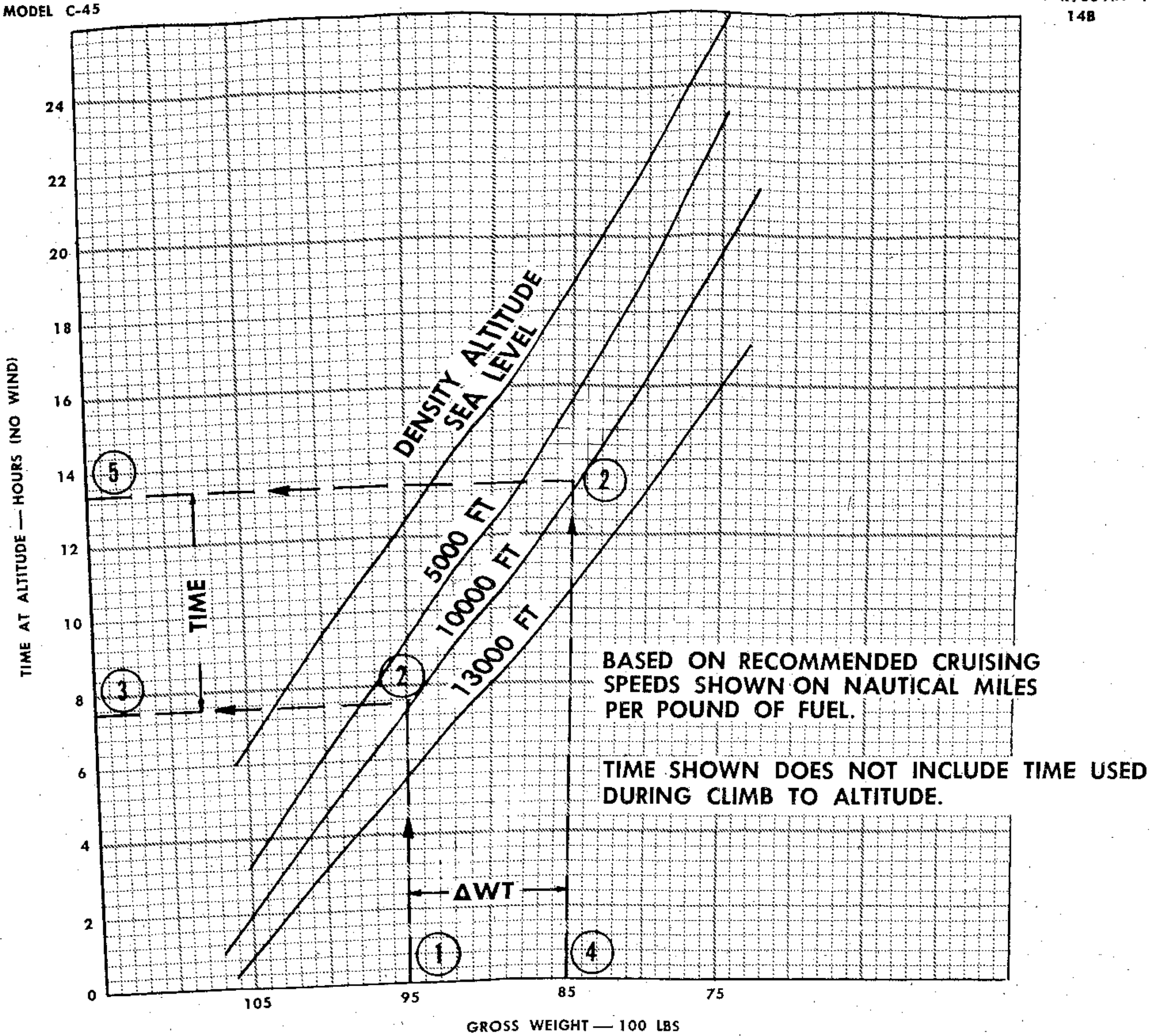
Figure A-20

LONG-RANGE PREDICTION — TIME

STANDARD DAY

MODEL C-45

ENGINE(S): (2) R985-AN-1,3, 14B



EXAMPLE:
① GROSS WEIGHT AT START OF CRUISE (9500 LBS)
② PRESSURE ALTITUDE TO BE MAINTAINED DURING CRUISE (10000 FT)
③ INITIAL CHART TIME (7.45 HRS)
④ GROSS WEIGHT AT END OF CRUISE (8500 LBS)
⑤ FINAL CHART TIME (13.34 HRS)
①-④ FUEL USED DURING CRUISE (1000 LBS)
⑤-③ TIME TO CRUISE (5.89 HRS)

DATA BASED ON: FLIGHT TEST

DATA AS OF: JULY, 1952

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

Figure A-21

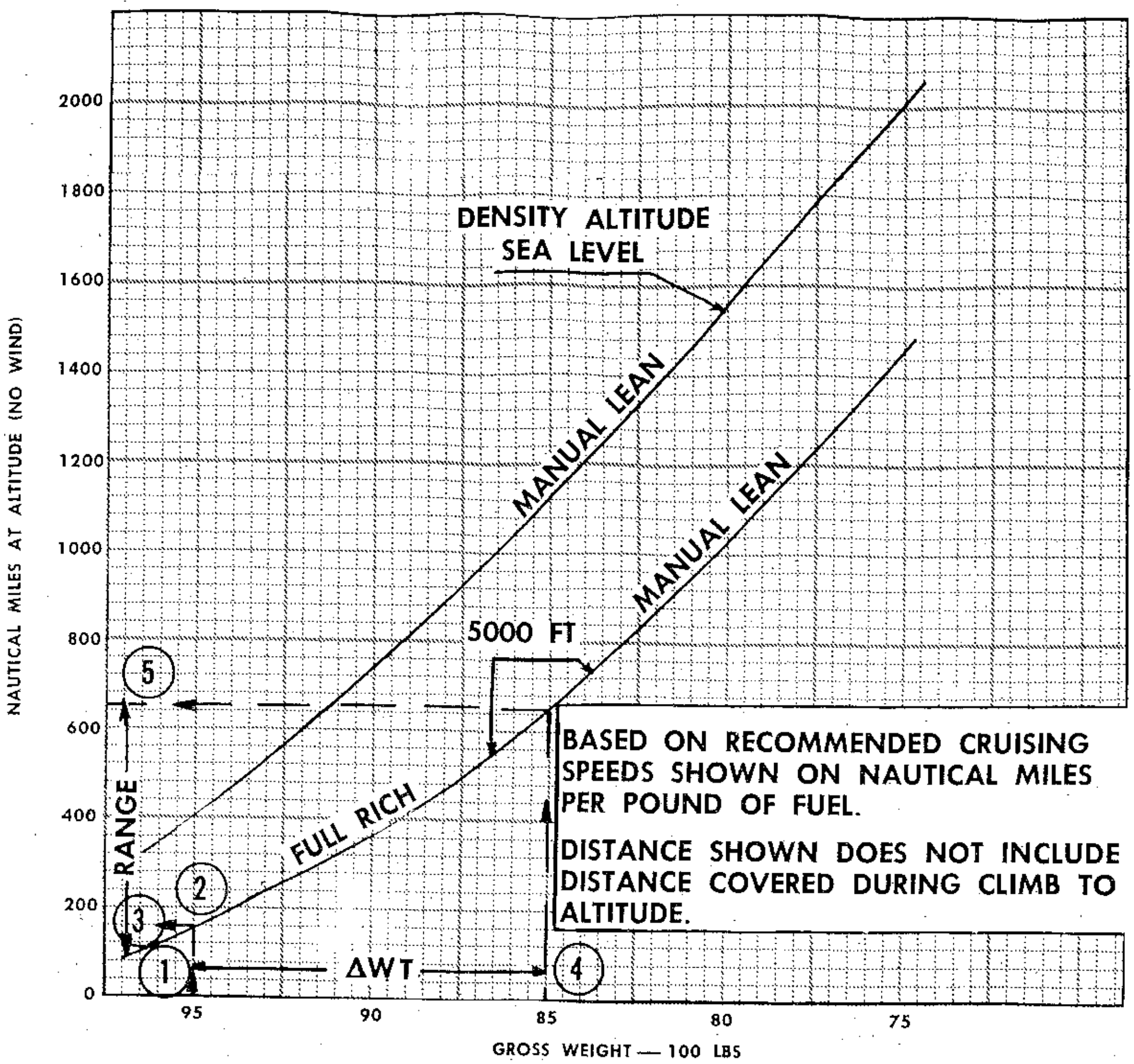
LONG-RANGE PREDICTION — DISTANCE

SINGLE ENGINE

STANDARD DAY

MODEL C-45

ENGINE(S): (1) R985-AN-1,3, 14B



EXAMPLE:

1. GROSS WEIGHT AT START OF CRUISE (9500 LBS)
2. PRESSURE ALTITUDE TO BE MAINTAINED DURING CRUISE (5000 FT)
3. INITIAL CHART DISTANCE (160 NAUTICAL MI.)
4. GROSS WEIGHT AT END OF CRUISE (8500 LBS)
5. FINAL CHART DISTANCE (650 NAUTICAL MI.)

(1-4) FUEL USED DURING CRUISE (1000 LBS)

(5-3) RANGE (490 NAUTICAL MI.)

DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

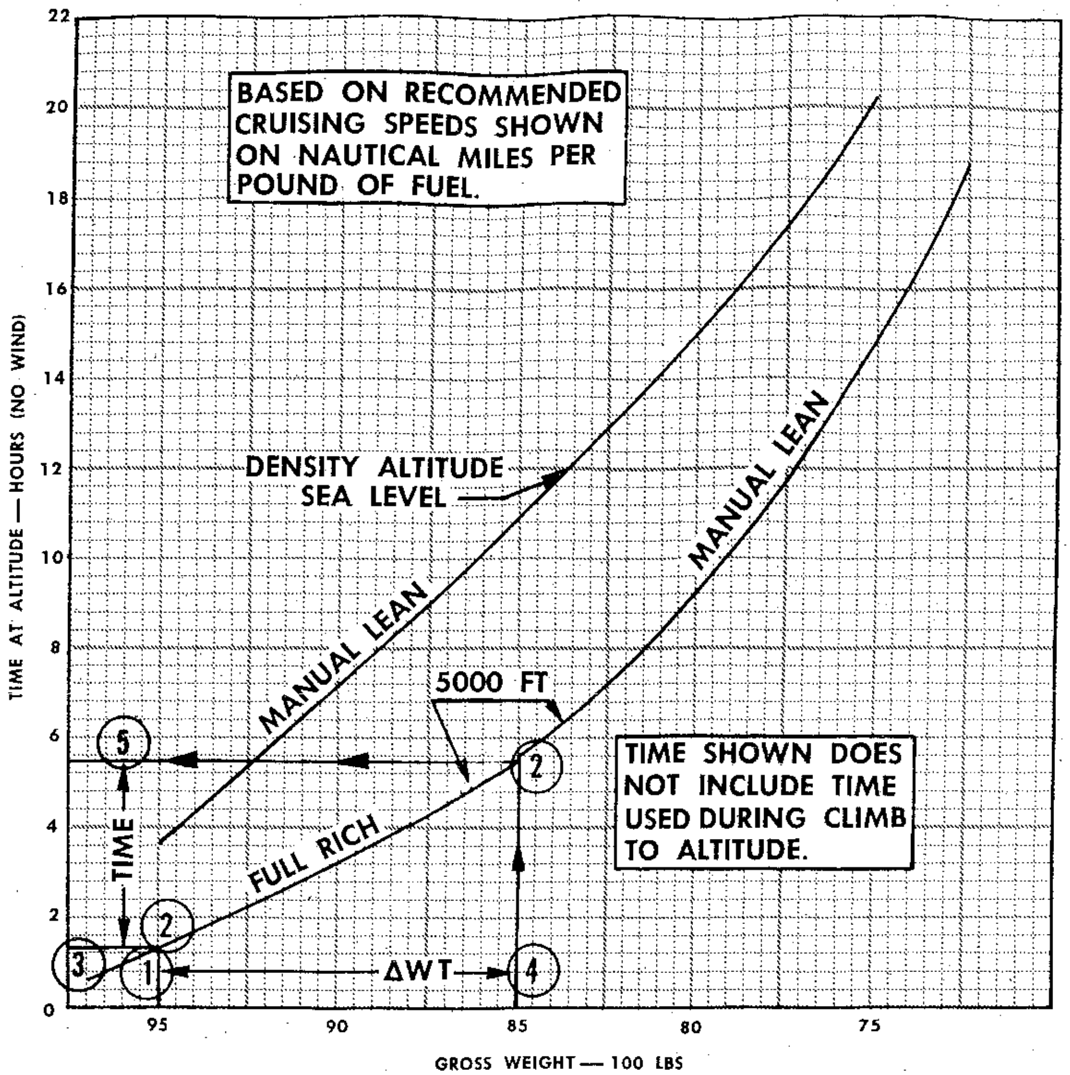
Figure A-22

LONG-RANGE PREDICTION — TIME

SINGLE ENGINE —— STANDARD DAY

MODEL C-45

ENGINE(S): (1) R985-AN-1,3, 14B



EXAMPLE:

1. GROSS WEIGHT AT START OF CRUISE (9500 LBS)
2. PRESSURE ALTITUDE TO BE MAINTAINED DURING CRUISE (5000 FEET)
3. INITIAL CHART TIME (1.30 HR)
4. GROSS WEIGHT AT END OF CRUISE (8500 LBS)
5. FINAL CHART TIME (5.42 HRS)

(1-4) FUEL USED DURING CRUISE (1000 LBS)

(5-3) TIME OF CRUISE (4.12 HRS)

DATA AS OF: JULY, 1952

FUEL GRADE: 91/96

Figure A-23

EMERGENCY CLIMB

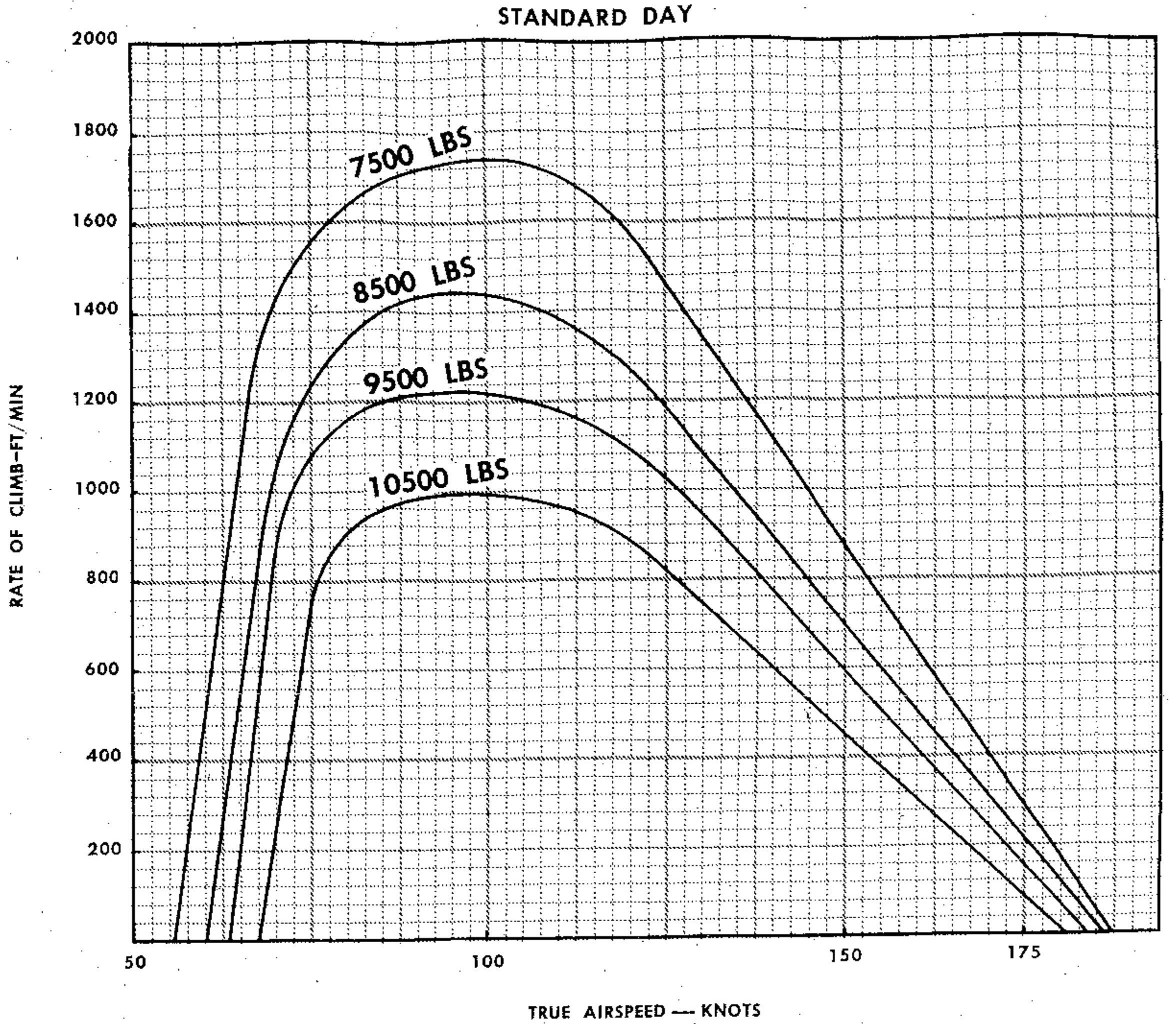
MODEL C-45G

CLEAN CONFIGURATION

SEA LEVEL

STANDARD DAY

ENGINE(S): (2) R985-AN-1,3 14B



DATA BASED ON: FLIGHT TEST

DATA AS OF: JULY, 1952

FUEL GRADE: 91/9

FUEL DENSITY: 6.0 LB/GA

Figure A-24

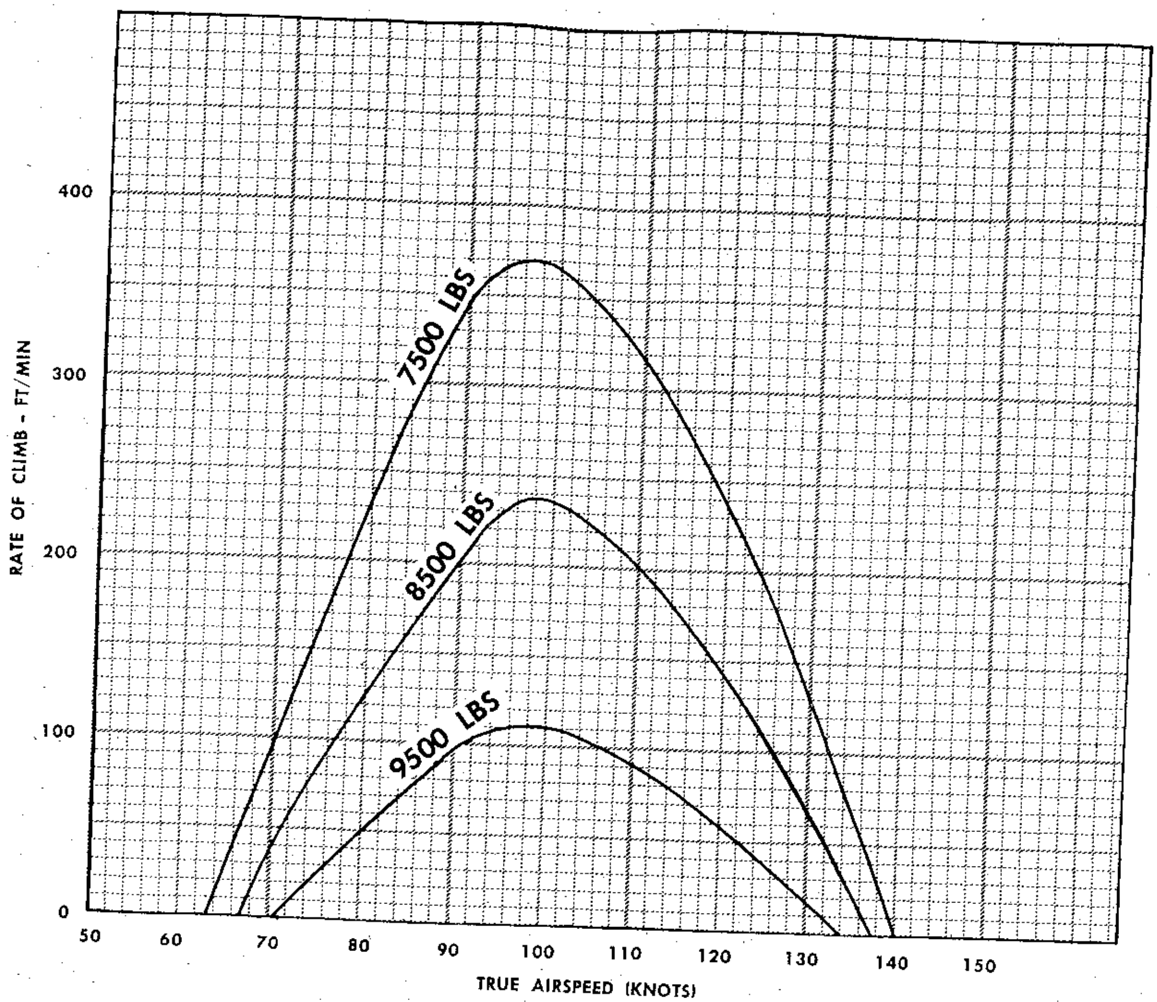
SINGLE ENGINE EMERGENCY CLIMB

STANDARD DAY CLEAN CONFIGURATION

MODEL C-45

SEA LEVEL

ENGINE(S): (1) R985-AN-1,3, 14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

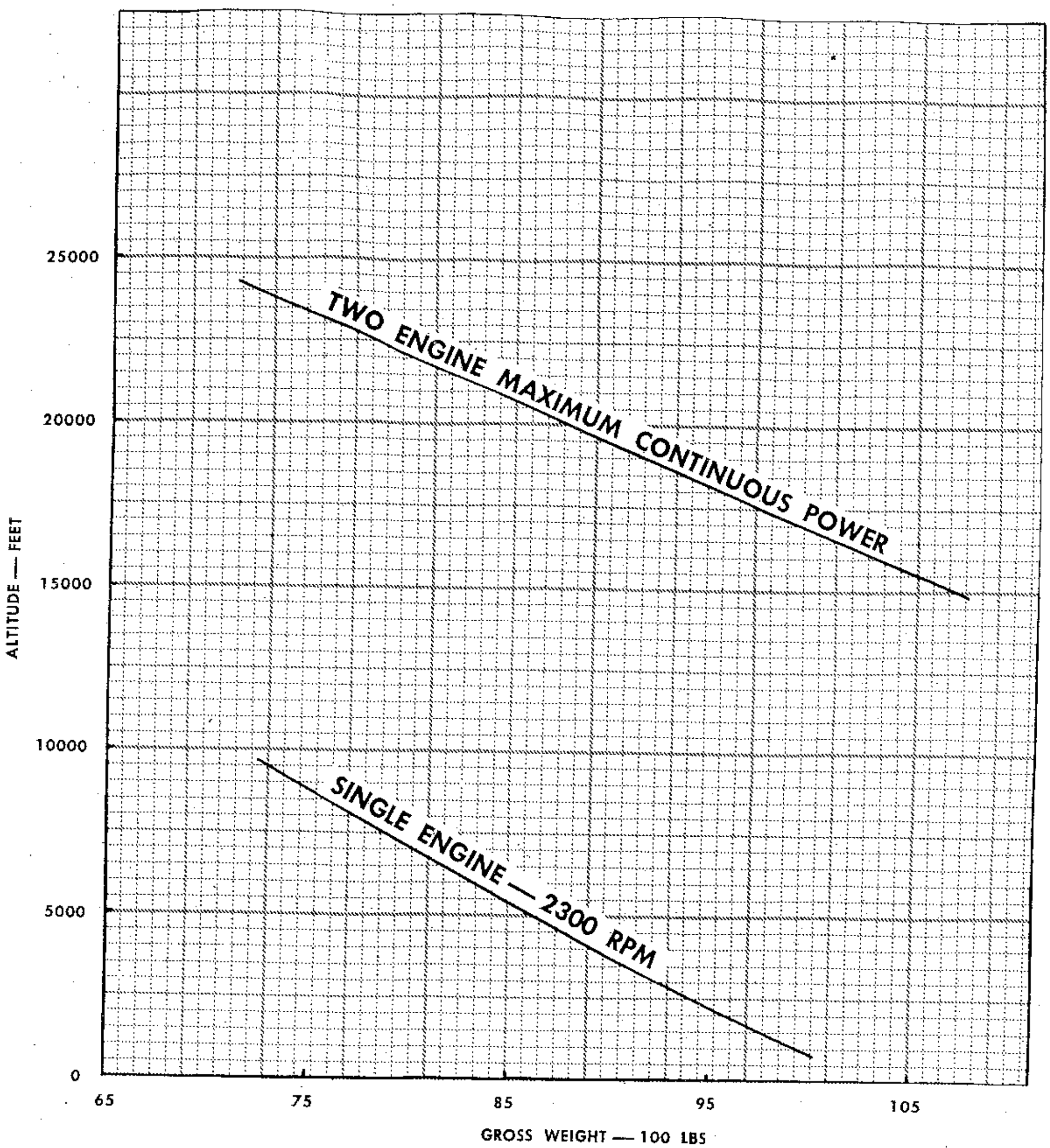
Figure A-25

EMERGENCY SERVICE CEILING

MODEL C-45

STANDARD DAY

ENGINE(S): (2) R985-AN-1,3,14B



DATA AS OF: JULY, 1952

DATA BASED ON: FLIGHT TEST

FUEL GRADE: 91/96

FUEL DENSITY: 6.0 LB/GAL

Figure A-26

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