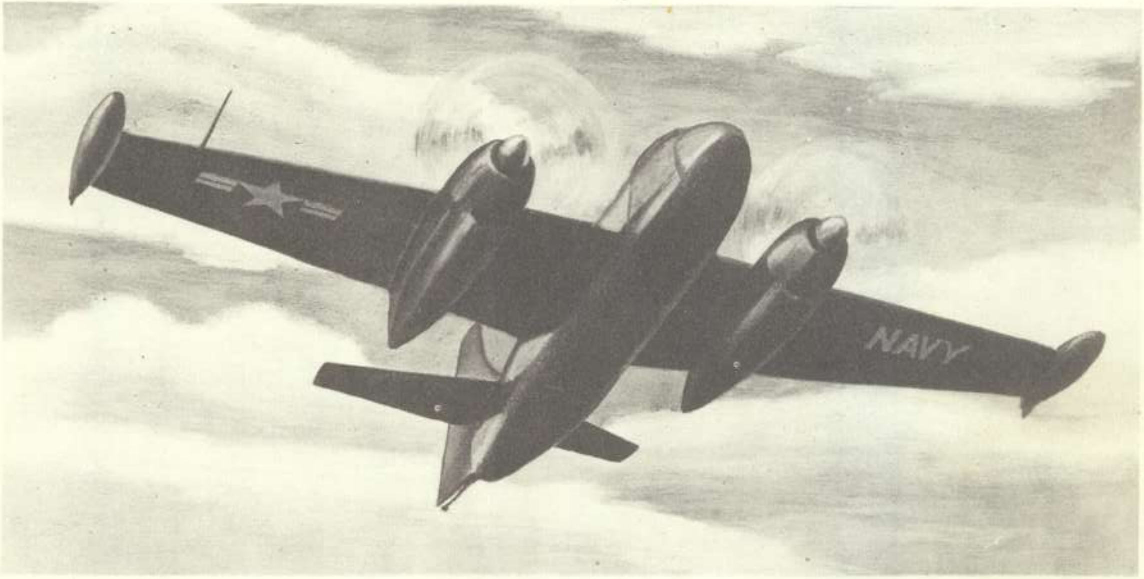
RESTRICTED AN 01-60AAA-1
SECURITY INFORMATION

Flight Handbook

NAVY MODEL
AJ-1
AIRCRAFT



THIS PUBLICATION SUPERSEDES AN 01-60AAA-1
DATED 15 SEPTEMBER 1952 REVISED 1 APRIL 1953

This publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of an unfriendly nation unless authorized by the Operational Commander.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS

NOTICE—This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U. S. C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

RESTRICTED *15 July 1953*

Reproduction for non-military use of the information or illustrations contained in this publication is not permitted without specific approval of the issuing service (BuAer or AMC). The policy for use of Classified Publications is established for the Air Force in AFR 205-1 and for the Navy in Navy Regulations, Article 1509.

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

*The asterisk indicates pages revised, added or deleted by the current revision.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS: BuAer

USAF ACTIVITIES.—In accordance with Technical Order No. 00-5-2.

NAVY ACTIVITIES.—Submit request to nearest supply point listed below, using form NavAer-140; NASD, Philadelphia, Pa.; NAS, Alameda, Calif.; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NAS, San Diego, Calif.; NAS, Seattle, Wash.; ASD, NSC, Guam.

For listing of available material and details of distribution see Naval Aeronautics Publications Index NavAer 00-500.

TABLE OF CONTENTS

IMPORTANT

In order for you to gain the maximum benefits from this handbook, it is imperative that you read this page carefully.

FOREWORD

This handbook contains all information necessary for safe and efficient operation of the AJ-1 Airplane. These instructions are designed to introduce the airplane, its handling characteristics, and specific normal and emergency procedures for operation of the airplane and related equipment to the crew members who fly it. The flying experience of crew members is recognized, and elementary instructions have been avoided.

The instructions are based on engineering reports and flight observations by Naval and manufacturer's test pilots. Every effort has been made to produce a handbook easy to read and practical to apply. Read the entire handbook for an over-all perspective of the airplane; use it as a reference manual to answer specific questions.

The handbook is divided into nine sections, an appendix, and an alphabetical index as follows:

Section I, DESCRIPTION — a detailed and comprehensive description of the airplane and all its systems and controls which contribute to the physical act of flying the airplane. Also included is a description of all emergency and miscellaneous equipment which is not part of an auxiliary system.

Section II, NORMAL PROCEDURES — procedural steps to be accomplished by the flight crew from the time the airplane is approached until it is left parked after the completion of one nontactical flight under normal conditions.

Section III, EMERGENCY PROCEDURES — clear and concise procedures to be followed in coping with any emergency (not connected with the auxiliary equipment) that could reasonably be expected.

Section IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT — description, normal operation, and emergency operation of all equipment not essential for flying the airplane, but which contributes directly to the use of the airplane for certain specialized functions, such as cabin air conditioning and pressurization, communication, oxygen, armament, lighting, and tow-target equipment. Emphasis has been placed on auxiliary equipment peculiar to this airplane.

Section V, OPERATING LIMITATIONS — contains all airplane and engine operating limitations that must be observed during normal operation of the airplane.

Section VI, FLIGHT CHARACTERISTICS — description of unique flight characteristics of this airplane, whether or not advantageous in nature.

Section VII, SYSTEMS OPERATION — operation of certain airplane systems described, with primary attention given to special problems of each system.

Section VIII, CREW DUTIES — discussion of the primary and collateral functions and responsibilities of each crew member.

Section IX, ALL-WEATHER OPERATION — proper technique and procedure to be followed, as a supplement to normal procedures in Section II, for satisfactory flight performance under abnormal weather conditions, such as thunderstorm flying, cold-weather operation, etc.

Appendix I, OPERATING DATA — all operating data charts necessary for preflight and in-flight mission planning. Explanatory text is included in this section to illustrate proper use of the data presented.

INDEX — a complete listing of material in this handbook, including illustrations, arranged alphabetically for ease in reference.

Note

Changes are made on the airplane from time to time, and it is therefore necessary to revise the Flight Handbook frequently to reflect changes affecting operating procedures. Consult your base Technical Order index to be sure you have the latest issue of the Flight Handbook.

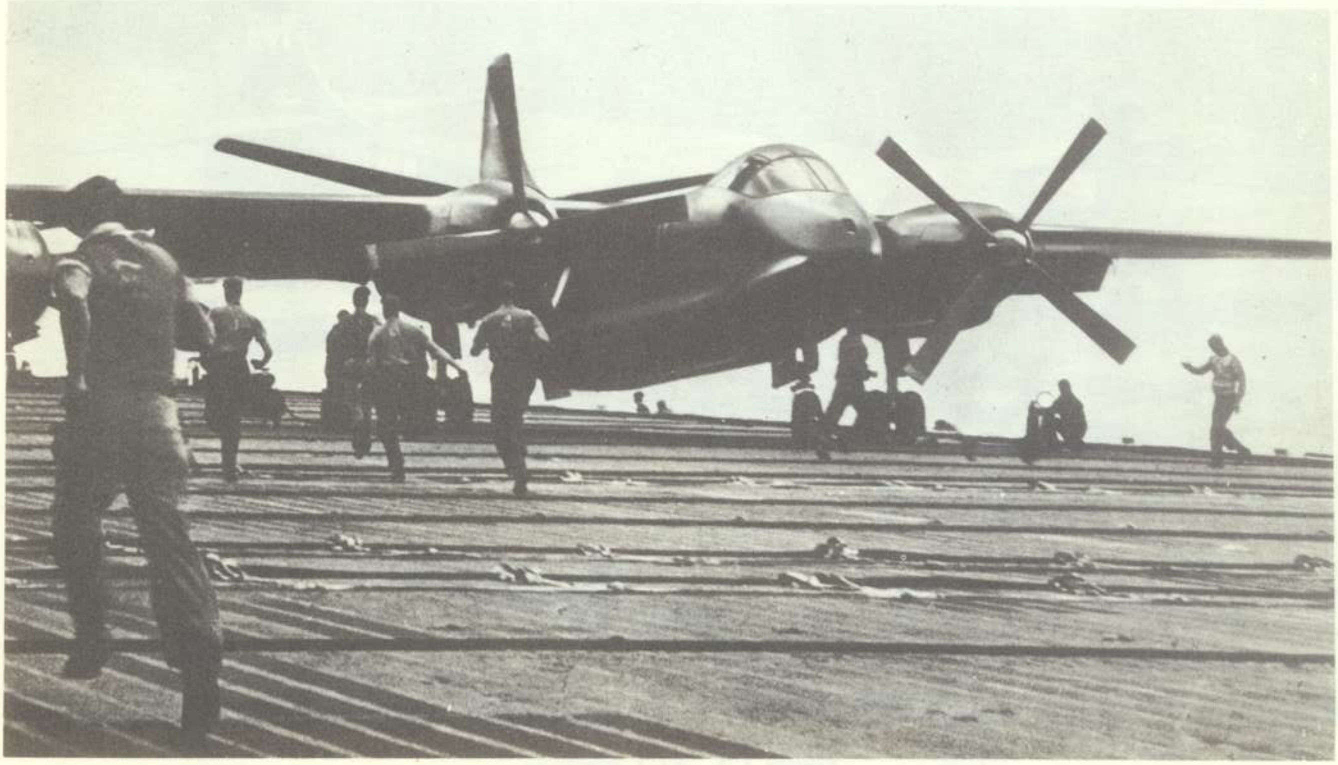


Figure 1-1. AJ-1 Airplane

Description

SECTION I

THE AIRPLANE.

The North American AJ-1 is a three-place, high-wing airplane (figure 1-1), powered by two reciprocating engines and one turbojet engine. The airplane is an attack bomber designed for day or night operation from a land base or from CVB or CV34 class carrier, with or without catapult. For carrier stowage, the outer wing panels and vertical fin can be folded. The basic flight crew consists of a pilot, a bomber-navigator, and a third crewman who acts as a radioman, tow-target reel operator, or inflight refueling operator depending upon the configuration of the airplane. A 10,500-pound load of effective armament can be carried in the bomb bay, the primary mission of the airplane being the execution of a horizontal bombing attack from high altitude. No defensive armament is provided. A tow-target package with an operator's seat and controls may be installed in the bomb bay with provisions for towing sleeve-, banner-, or winged-type targets. Provisions are also incorporated for the installation of an in-flight refueling tanker package with a capacity of approximately 1300 gallons.

AIRPLANE DIMENSIONS AND GROSS WEIGHT.

See figure 1-2.

AIRPLANE INTERIOR.

The fuselage is divided into seven compartments: a nose equipment compartment, a crew entry compartment, a pilot's compartment, a bomb bay, a forward equipment compartment, an aft equipment compartment, and a jet-engine compartment. The jet engine is visible from the

DIMENSION AND GROSS WEIGHT TABLE

AIRPLANE DIMENSIONS

LENGTH	64.1 FEET
WING SPAN	71.4 FEET
WING SPAN (WITH TIP TANKS)	75.0 FEET
WING SPAN (FOLDED)	49.3 FEET
HEIGHT	21.4 FEET
HEIGHT (FOLDED)	16.2 FEET
HEIGHT (FOLDED WITH TIP TANKS)	17.3 FEET

GROSS WEIGHTS

BASIC EMPTY	30,751 POUNDS
NORMAL (INTERNAL FUEL AND BOMB LOAD)	49,772 POUNDS
NORMAL (INTERNAL FUEL, BOMB LOAD, AND TIP TANKS)	53,772 POUNDS
NORMAL (INTERNAL FUEL, TIP TANKS, AND FERRY TANK)	49,730 POUNDS
TANKER PACKAGE INSTALLED (APPROXIMATELY)	52,877 POUNDS
TOW TARGET PACKAGE INSTALLED (APPROXIMATELY)	41,378 POUNDS

NOTE: Since airplane empty weight will vary, all above weights are approximate.

H-9634-00-20

Figure 1-2.

crew entry compartment through windows in the bulkheads. (See figure 1-3.) The pilot's compartment provides side-by-side seating for the pilot and the bomber-navigator. The crew entry compartment provides a seat for the radio operator. Hatches at each end of the bomb bay permit crew access to the aft equipment compartment during flight. The forward equipment compartment, below the left side of the pilot's compartment, provides access in flight to electrical and radio equipment located beneath the flight deck. Care should be used when entering the forward equipment compartment in flight to prevent damage to equipment.

MAIN DIFFERENCES.

The principal differences between the AJ series airplanes are shown in figure 1-4.

MOVEMENT OF FLIGHT PERSONNEL.

Provisions are made for passage in flight from the crew entry compartment to the aft equipment compartment when the ferrying tank or tanker package is not installed. The bomb bay doors serve as a walkway.

Note

> Prior to walking through bomb bay in flight, be sure all bomb control switches are off and bomb bay door close lockpin is installed.

RECIPROCATING ENGINES.

The airplane is powered by two R-2800-44W, 18-cylinder, twin-row, radial, air-cooled engines. Each engine is equipped with a manifold pressure regulator, a pressure-type injection carburetor, an exhaust-driven turbosupercharger, an internal single-stage, engine-driven supercharger, and a torquemeter.

HORSEPOWER RATING.

The military power rating of each reciprocating engine is 2300 brake horsepower at sea level.

THROTTLES.

Dual throttle levers are located on a quadrant on the left console. (See 9, figure 1-6.) The throttle positions are marked OPEN and CLOSED. A friction lock (18, figure 1-6), located on the inboard side of the quadrant, controls throttle friction. As a safety measure, neither throttle can be advanced while the surface controls are locked. A push-to-talk microphone switch is mounted on the right engine throttle lever. A throttle catapult handle, located forward of the quadrant, is provided to assist the pilot in holding throttles open during catapult take-off. Each throttle is mechanically connected to a manifold pressure regulator, which automatically maintains the manifold pressure setting selected by the pilot, below engine critical altitude. The regulator operates to hold the manifold pressure setting selected by regulating the engine carburetor throttle valve. To ensure sufficient carburetor inlet pressure for manifold pressures higher than those obtainable with wide open throttle and an inlet pressure equal to atmospheric pressure, turbosupercharging is necessary.

GENERAL ARRANGEMENT

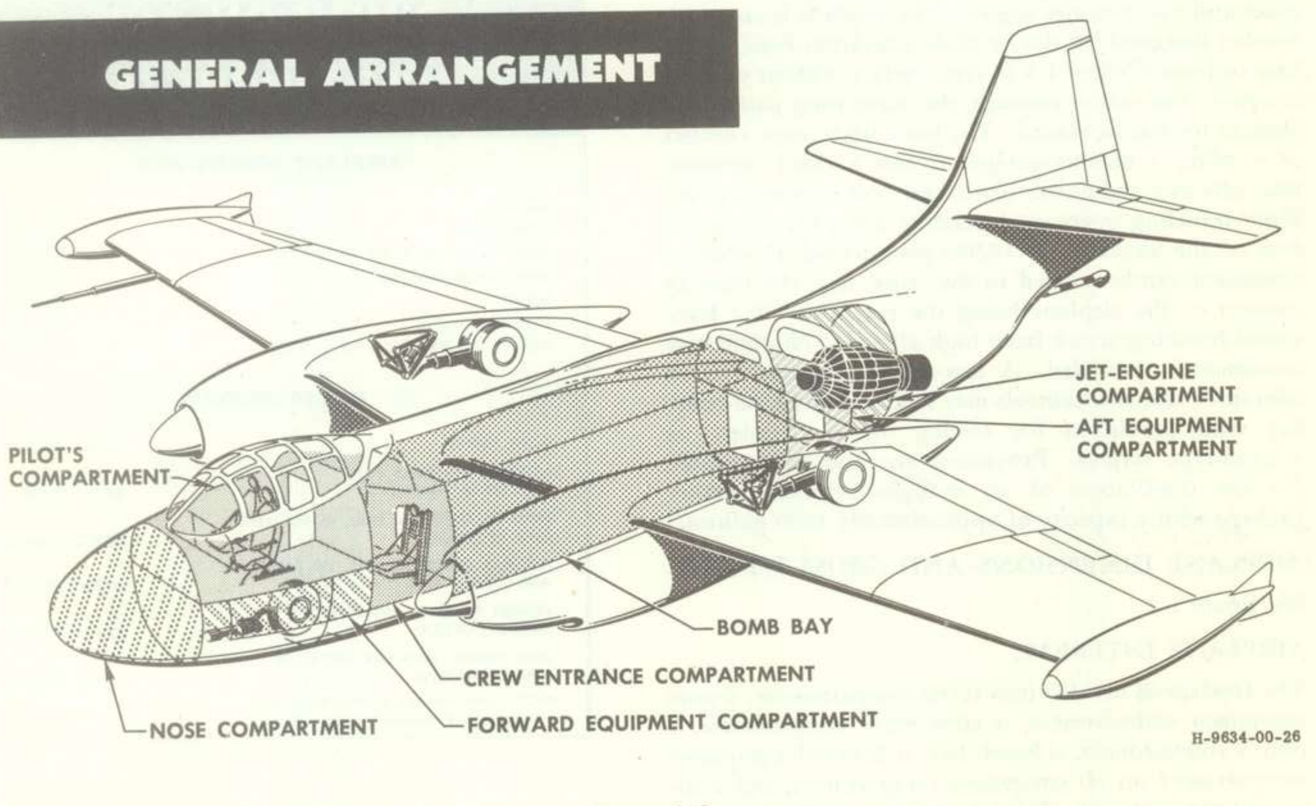
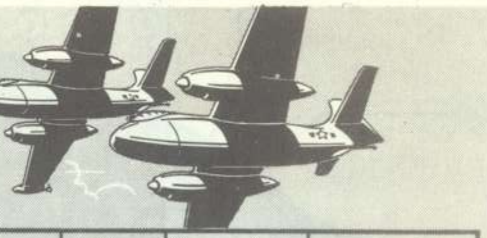


Figure 1-3.

MAIN *Differences* TABLE



CONFIGURATION	NOSE	TAIL	COMPARTMENTS	AILERON AND ELEVATOR CONTROLS	ELECTRICAL	FUEL	HYDRAULIC	ARMAMENT	MISSION	CREW ARRANGEMENT
AJ-1 	RADOME	DIHEDRAL IN HORIZONTAL STABILIZER SMALL VERTICAL FIN	FIVE LARGE BOMB BAY	STICK	TWO GENERATORS	THREE TANKS PLUS FERRY AND TIP TANKS	FOUR SYSTEMS BOOST SYSTEMS (3) UTILITY SYSTEM (EMERGENCY SYSTEM INTEGRATED)	BOMBS	ATTACK BOMBER	THIRD CREW MEMBER ON LOWER FLOOR LEVEL
AJ-1 **MODIFIED** 	RADOME	NO DIHEDRAL IN HORIZONTAL STABILIZER LARGE VERTICAL FIN	FIVE LARGE BOMB BAY	WHEEL	TWO GENERATORS	THREE TANKS PLUS FERRY AND TIP TANKS	FOUR SYSTEMS BOOST SYSTEM ALTERNATE RUDDER SYSTEM UTILITY SYSTEM EMERGENCY SYSTEM	BOMBS	ATTACK BOMBER TOW-TARGET AND TANKER	THIRD CREW MEMBER ON LOWER FLOOR LEVEL
AJ-2 	RADOME	NO DIHEDRAL IN HORIZONTAL STABILIZER LARGE VERTICAL FIN	FIVE LARGE BOMB BAY	WHEEL	TWO GENERATORS	THREE TANKS PLUS FERRY AND TIP TANKS	FOUR SYSTEMS BOOST SYSTEM ALTERNATE RUDDER SYSTEM UTILITY SYSTEM EMERGENCY SYSTEM	BOMBS	ATTACK BOMBER TANKER	ALL CREW MEMBERS ON UPPER FLOOR LEVEL
AJ-2P 	RADOME AND CAMERA	NO DIHEDRAL IN HORIZONTAL STABILIZER LARGE VERTICAL FIN	NINE SMALL BOMB BAY	WHEEL	THREE GENERATORS	FOUR TANKS PLUS LOWER BOMB BAY AND TIP TANKS	FOUR SYSTEMS BOOST SYSTEM ALTERNATE RUDDER SYSTEM UTILITY SYSTEM EMERGENCY SYSTEM	PHOTOFLASH BOMBS	PHOTO-RECONNAISSANCE	THIRD CREW MEMBER ON LOWER FLOOR LEVEL. (THIRD CREW MEMBER ELEVATED TO PILOT'S FLOOR LEVEL AIRPLANE NO. 129190 AND SUBS)

H-9634-93-7

Figure 1-4.

CARBURETORS.

The pressure-type injection carburetor on each reciprocating engine employs an air-measuring, fuel-metering principle of operation. Airflow into the carburetor is controlled by conventional butterfly-type throttle valves. An automatic mixture control compensates for altitude changes. A manual mixture control is available for varying operational conditions, such as climbing, economic cruise, etc.

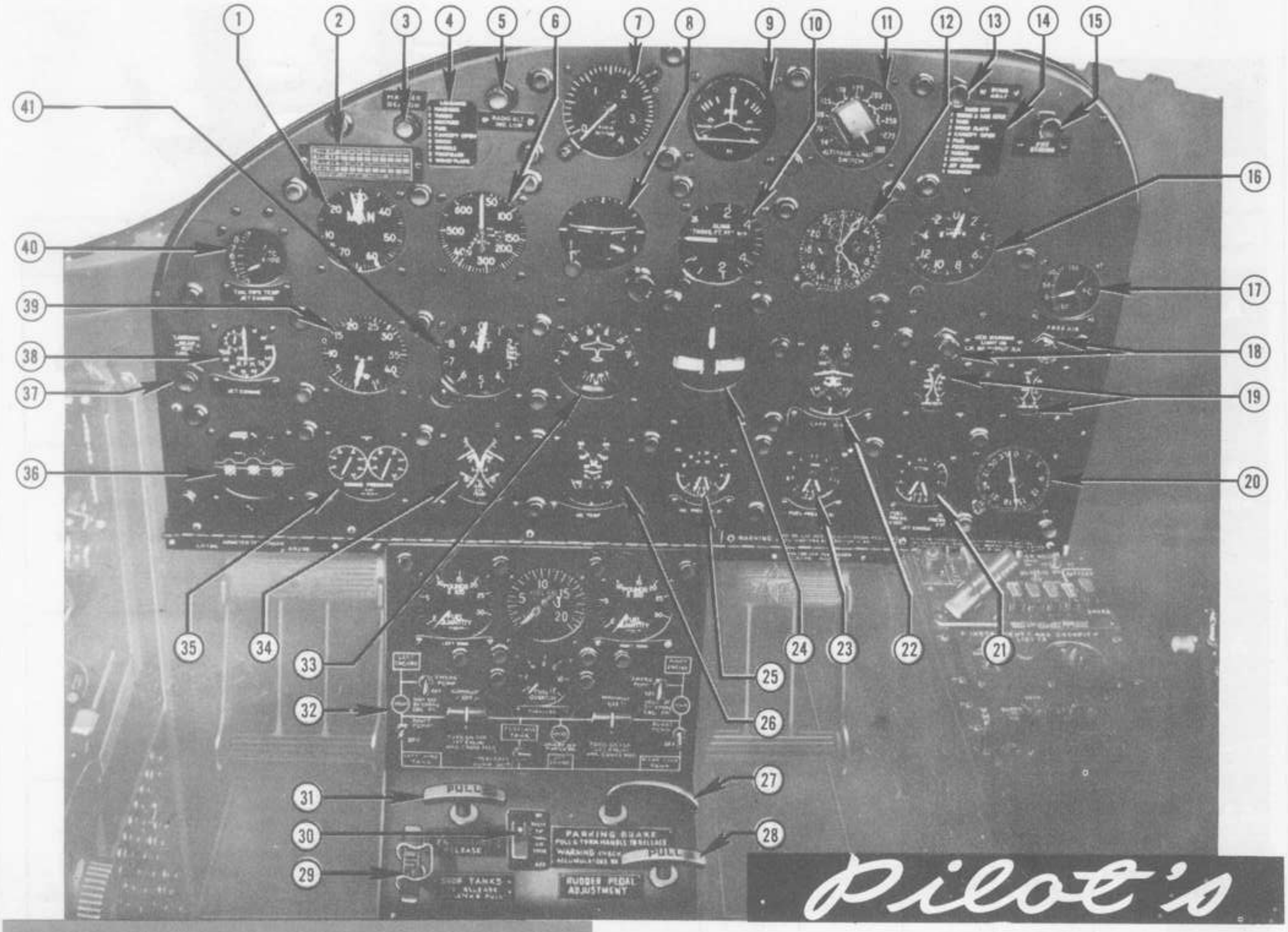
MIXTURE CONTROL LEVERS. Mixture control levers (22, figure 1-6), located on the throttle quadrant, have three positions: IDLE CUT-OFF, NORMAL, and RICH. Controls can be held in the selected position by adjustment of throttle friction lock.

EMERGENCY ENGINE CONTROL SWITCHES.

Emergency engine control switches control the shutoff valves for the fuel and oil supply to the engines. These two switches (figure 1-7) are located on the left console, aft of the throttle quadrant, and are guarded in the NORMAL ON position for all normal operation. When either switch is moved to FUEL & OIL SHUT-OFF, the supply of fuel to the related engine is immediately shut off in the bomb bay; however, oil supply is not shut off until the propeller feathering button is depressed. Moving an emergency engine control switch to FUEL & OIL SHUT-OFF automatically opens oil cooler, cowl, and intercooler flaps of the related engine. To close the flaps after this automatic operation, the emergency engine control switch must be moved to a third position, CONTROL OFF, to restore automatic temperature control to oil cooler, cowl, and intercooler flaps, or before manual movement of the flap control switch will be effective. When the emergency engine control switches are moved to CONTROL OFF, the shutoff valves will remain in the position to which they were last energized.

INTERCOOLERS.

Two intercoolers in each nacelle cool the air compressed by the turbosuperchargers before it enters the carburetors. Cooling the supercharged air lowers carburetor air temperature to avoid detonation. Flow of cooling air



Pilot's

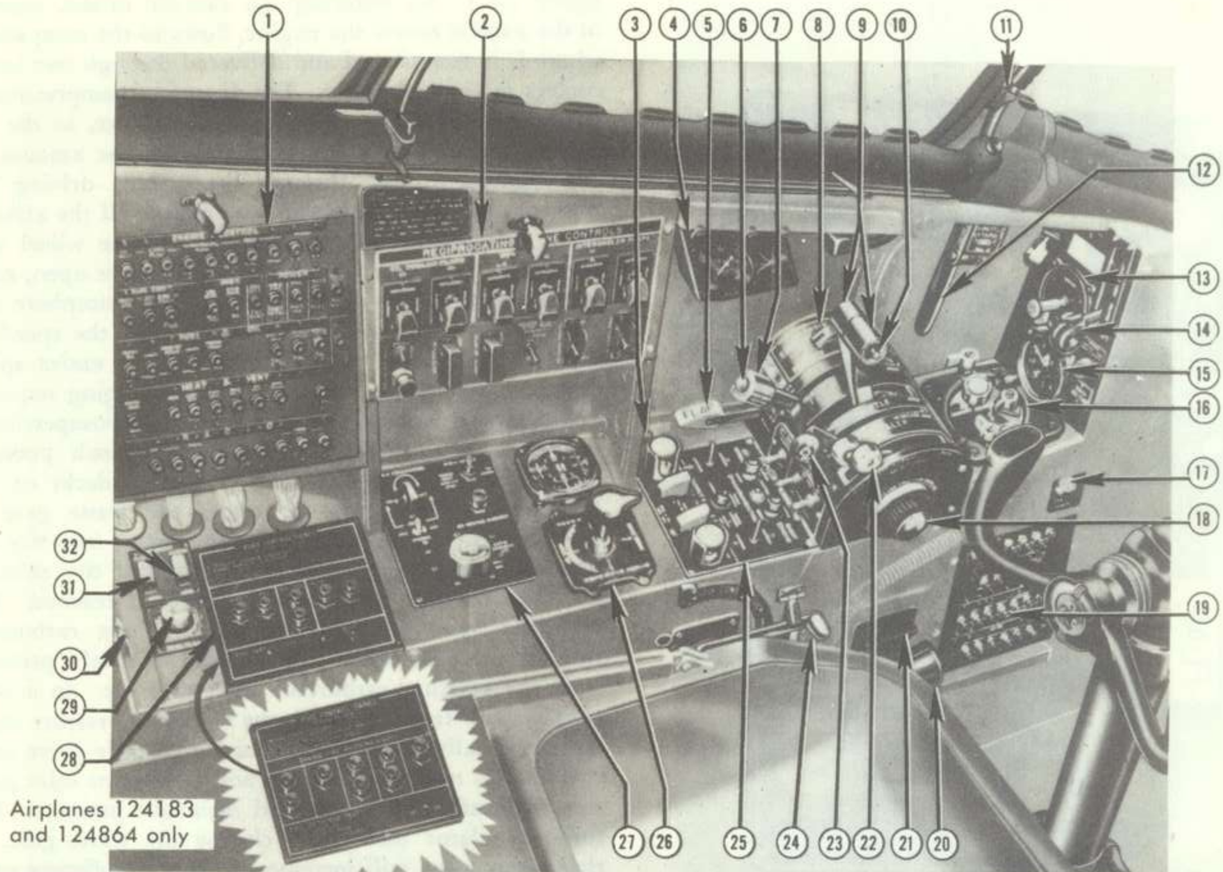
FORWARD VIEW

1. Manifold Pressure Gage
2. Airspeed Correction Card
3. Marker Beacon Indicator Light (AN/ARN-8)
4. Landing Check List
5. Radio Altimeter Low-level Warning Light (AN/APN-1)
6. Airspeed Indicator
7. Radio Altimeter Indicator (AN/APN-1)
8. Gyro Horizon Indicator
9. Position Deviation Indicator
10. Rate-of-Climb Indicator
11. Radio Altimeter Altitude Limit Switch (AN/APN-1)
12. Clock
13. Bomb-away Indicator Light
14. Take-off Check List
15. Master Fire-warning Light
16. Accelerometer
17. Free Air Temperature Indicator
18. Generator Warning Lights
19. D-C Voltammeters
20. Radio Compass Indicator (AN/ARN-6)
21. Jet-engine Fuel and Oil Pressure Indicator
22. Carburetor Air Temperature Indicator
23. Reciprocating-engine Fuel Pressure Indicator
24. Turn-and-Bank Indicator
25. Reciprocating-engine Oil Pressure Indicator
26. Reciprocating-engine Oil Temperature Indicator
27. Parking Brake Handle
28. Rudder Pedal Adjustment Handle
29. Tip Tank Release Handle
30. Tip Tank Air Pressure Switch
31. Automatic Pilot Emergency Release Handle
32. Fuel Control Panel
33. Master Direction Indicator
34. Cylinder Head Temperature Indicator
35. Torquemeter
36. Landing Gear and Wing Flap Position Indicator
37. Landing Gear Warning Light*
38. Jet-engine Tachometer
39. Reciprocating-engine Tachometer
40. Jet-engine Tail-pipe Temperature Indicator
41. Altimeter

*Airplanes 122590 through 122601 and 124158 through 124184

169-00-1231B

Figure 1-5.



Compartment

LEFT CONSOLE

1. **Aft D-C Circuit-breaker Panel**
2. **Reciprocating-engine Control Panel**
3. **Jet Door Unsafe Light**
4. **Hydraulic Pressure Indicator and Selector**
5. **Wing Flap Control Handle**
6. **Jet-engine Ignition and Fuel Start Switch**
7. **Jet-engine Throttle**
8. **Jet-engine Emergency Shutoff Switch**
9. **Reciprocating-engine Throttles**
10. **Microphone Switch**
11. **Canopy Panel Control Handle**
12. **Throttle Catapult Handle**
13. **Ignition Switch Panel**
14. **Landing Gear Control Handle**
15. **Cabin Altimeter**
16. **Oxygen Regulator Panel**
17. **Windshield Defrost Control**
18. **Throttle Friction Lock**
19. **Forward D-C Circuit-breaker Panel**
20. **Relief Tube**
21. **Ash Tray**
22. **Mixture Control Levers**
23. **Propeller Master Lever**
24. **Surface Control (and Throttle) Lock**
25. **Propeller Synchronization Panel**
26. **Trim Tab Control Panel**
27. **Heat and Vent Control Panel**
28. **Engine Fire Control Panel**
29. **Portable Equipment Outlet**
30. **Turbo Power Switches**
31. **Jet-engine Emergency Fuel System Test Switch**
32. **Jet-engine Starting Selector Switch**

Figure 1-6.

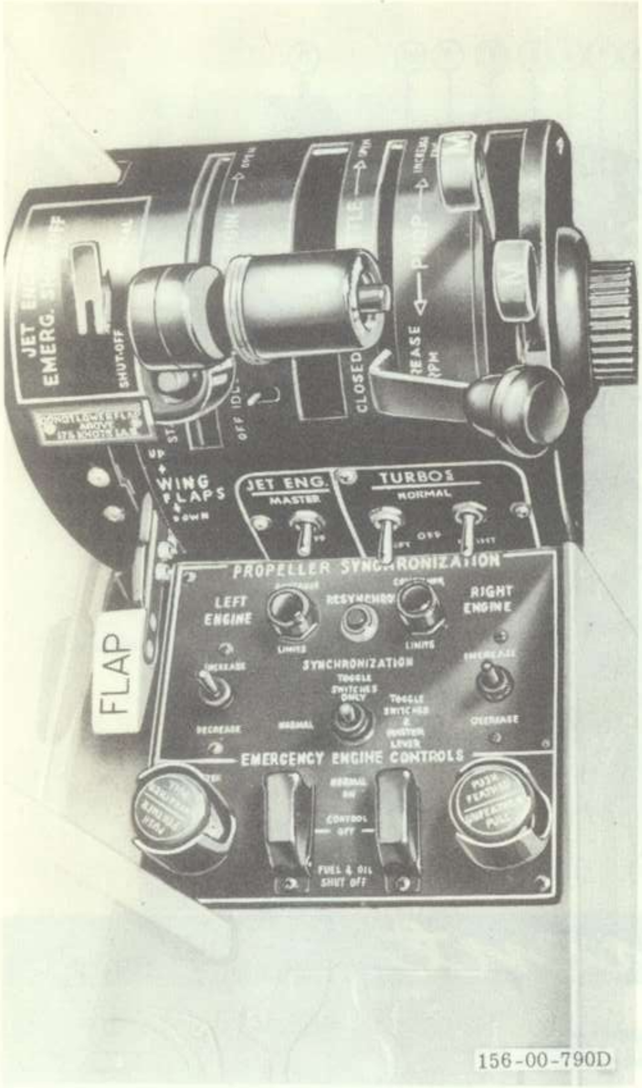


Figure 1-7. Engine Controls

through the intercoolers is regulated by thermostatically controlled intercooler flaps.

INTERCOOLER FLAP SWITCHES. Switches controlling intercooler flaps for both engines are located on the reciprocating-engine control panel above the left console. (See 2, figure 1-6.) Each switch has four positions: AUTOMATIC, OPEN, CLOSED, and a center (OFF) position. Intercooler flap switches are guarded in the AUTOMATIC position for thermostatic control of the flaps, but may be moved to OPEN or CLOSED to override the automatic control system.

TURBOSUPERCHARGERS.

An exhaust-driven turbosupercharger on each engine makes high-altitude operation possible by supplying air to the carburetor at approximately sea level density. The turbosupercharger is essentially a centrifugal air compressor connected directly to a gas turbine, which is driven by waste gases from the engine exhaust. (See figure 1-8.) Air entering the ram-air intake, located in the nacelle below the engine, flows to the compressor where it is compressed and delivered through two intercoolers to the carburetor. The degree of compression is determined by the position of a waste gate, in the exhaust system. The waste gate controls the amount of gas allowed to pass through the turbine driving the compressor. With the waste gate closed, all the exhaust gases will go through the turbine and the wheel will revolve at high speed. With the waste gate open, most of the gases will be discharged into the atmosphere and the turbine wheel will idle. In this way the speed of the turbine can be varied, throughout its entire speed range, to supply the amount of supercharging required by the power demand of the engine. A turbosupercharger regulator automatically senses a $3\frac{1}{2}$-inch pressure differential between the top and bottom decks of the carburetor. This opens or closes the waste gate to provide sufficient pressure at the carburetor inlet for the manifold pressure regulator to maintain the selected manifold pressure until critical altitude is reached. The manifold pressure regulator operates the carburetor throttle valve to obtain the selected manifold pressure with the existing carburetor inlet pressure. In a low-power climb from sea level, the manifold pressure regulator gradually opens the carburetor throttle valve until the valve is nearly wide open and carburetor inlet pressure is insufficient for desired manifold pressure. The turbo-regulator then starts closing the waste gate, so that turbo speed will increase and supply sufficient pressure to the carburetor inlet. Above Normal Rated Power, the waste gate begins to close at sea level. Increasing turbo speed will maintain manifold pressure during the rest of the climb. If maximum turbo speed is reached, the turbo-regulator will control the waste gate to prevent overspeeding of the turbo. A 1.5-gallon oil tank for each exhaust-driven turbosupercharger is installed just aft of the engine oil tank. (See figure 1-27.)

TURBO CONTROL SWITCHES. Turbo control switches (figure 1-7), located on the lower aft part of the throttle quadrant, control the turbo-regulators. The switches have two positions, NORMAL and OFF. With switches at NORMAL, the turbo-regulators operate in conjunction with the manifold pressure regulators to automatically maintain the selected manifold pressure at all powers and altitudes. When the turbo control switches are placed at OFF, the waste gates are held open, making the turbosuperchargers idle. The turbo control switches should be positioned at NORMAL for all normal engine operation. The OFF position can be used for starting and should be used in case of extreme manifold pressure surge due to malfunction of the regulator which cannot be controlled by throttle movement. The OFF position should also be used when the magnetos are being checked to assure a true barometric pressure reading.

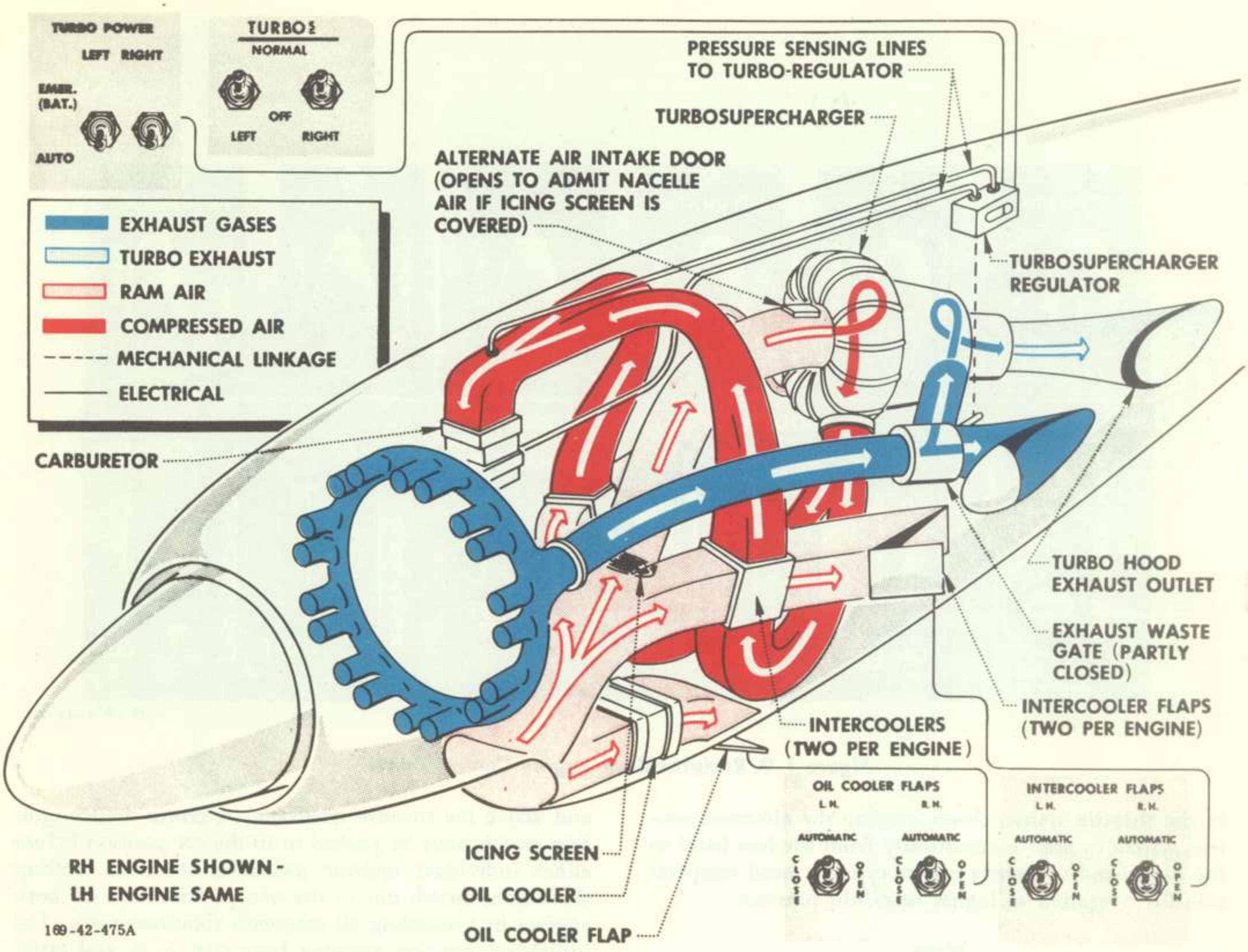


Figure 1-8. Air Induction System—Reciprocating Engines

TURBO POWER SWITCHES. Electrical power to the turbosupercharger regulators is controlled by two turbo power switches (30, figure 1-6), located on a vertical panel above the aft end of the left console. When the switches are in the guarded (AUTO) position, electrical power for automatic control of the waste gate for each turbosupercharger is supplied by the generator on the related engine. If the generator should fail, moving the corresponding switch to EMER. BAT. connects the regulator to the essential bus, so that automatic control of the waste gate is continued. If the switch is left at AUTO after generator failure, the waste gate opens fully and, depending on altitude and power setting, a drop in manifold pressure may occur.

COWL FLAPS.

The cowl flaps are entirely electrical in operation and are powered from the d-c main bus. Either automatic or manual control of the flaps may be used within two operating temperature ranges, a low band for Normal Rated Power and a high band for Military Power. The cowl flaps will remain in the last selected position in case of complete electrical failure.

COWL FLAP SWITCHES. Switches controlling the cowl flaps for both engines are located on the reciprocating-engine control panel above the left console. (See figure 1-9.) Each switch has four positions: AUTOMATIC, OPEN, CLOSE, and a center (OFF) position. When a switch is at the guarded AUTOMATIC position, an electrical control system automatically positions the cowl flaps. Below a power setting of 50 in. Hg, the cowl flaps are automatically positioned to keep the cylinder head temperature in the low temperature range (202°C to 212°C). If temperature exceeds 212°C, the cowl flaps will remain in the full open positions. At power setting above 50 in. Hg, the cowl flaps are automatically positioned to keep the cylinder head temperature in the high temperature range (228°C to 238°C). As the throttle is advanced beyond 50 in. Hg, a microswitch

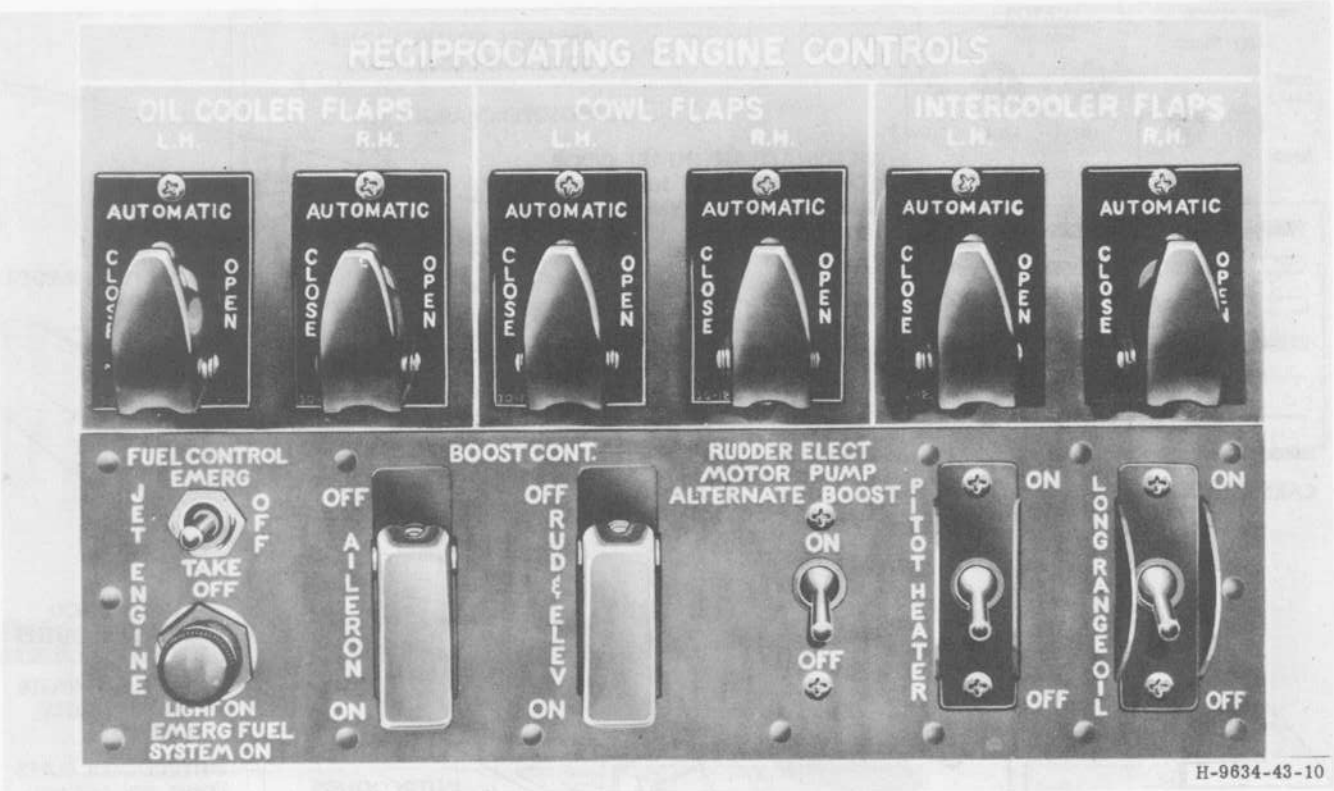


Figure 1-9. Reciprocating-engine Control Panel

in the throttle system closes, causing the electrical control system to shift automatically from the low band to the high band to permit higher cylinder head temperature for operation at higher manifold pressure.

Note

- With the cowl flap switch at AUTOMATIC, cowl flaps automatically go to the full open position whenever the weight of the airplane is on the landing gear. However, flaps can be closed by moving cowl flap switch to CLOSE.
- Cowl flaps automatically go to the full open position when the emergency engine control switch is placed at FUEL & OIL SHUT-OFF. To close the flaps after this automatic operation, the emergency engine control switch must be moved to CONTROL OFF before either automatic or manual control of any cooling flaps will be effective.

IGNITION SYSTEM.

The high-tension ignition system incorporates one pressurized dual magneto and two pressurized distributors on each engine to give satisfactory performance at high altitudes. The magneto on each reciprocating engine operates independently of the airplane's electrical system.

IGNITION SWITCHES. Standard ignition switches (13, figure 1-6) are mounted on a panel forward of and above the throttle quadrant. A center master ignition switch must be pushed in to the ON position before either individual ignition switch is effective. Pulling the master switch out to the OFF position cuts off both engines by grounding all magnetos simultaneously. The individual ignition switches have OFF, L, R, and BOTH positions for the magnetos on each corresponding engine.

PRIMERS.

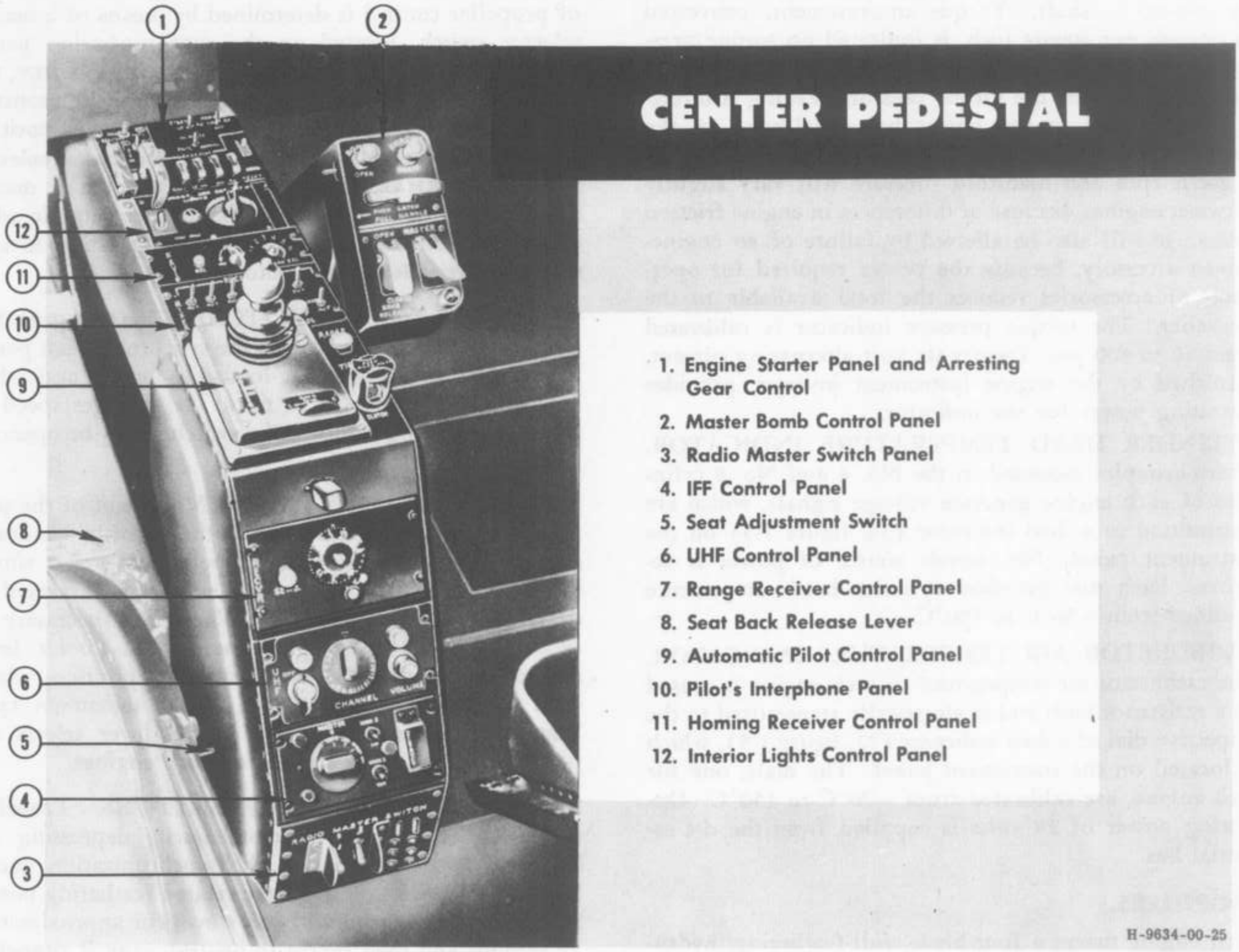
A solenoid-type primer valve is mounted on each carburetor and is electrically operated on d-c main bus power. Normally closed, the valve opens during priming operation to allow unmetered fuel from the carburetors to be distributed to the blower throat of the engine selected.

PRIMER SWITCH. A single toggle switch, located on the center console, controls the priming system for both engines. (See figure 1-11.) The switch is normally OFF, and the primer valve is closed. When the switch is held to either L.H. or R.H., the related primer valve is opened.

STARTERS.

The electrical starters are the direct-cranking type. Power from the d-c main bus is supplied to either the left or the right engine starter through relays controlled by a single switch.

STARTER SWITCH. A single toggle switch on the center pedestal actuates the direct-cranking starters on



CENTER PEDESTAL

1. **Engine Starter Panel and Arresting Gear Control**
2. **Master Bomb Control Panel**
3. **Radio Master Switch Panel**
4. **IFF Control Panel**
5. **Seat Adjustment Switch**
6. **UHF Control Panel**
7. **Range Receiver Control Panel**
8. **Seat Back Release Lever**
9. **Automatic Pilot Control Panel**
10. **Pilot's Interphone Panel**
11. **Homing Receiver Control Panel**
12. **Interior Lights Control Panel**

Figure 1-10. Center Pedestal

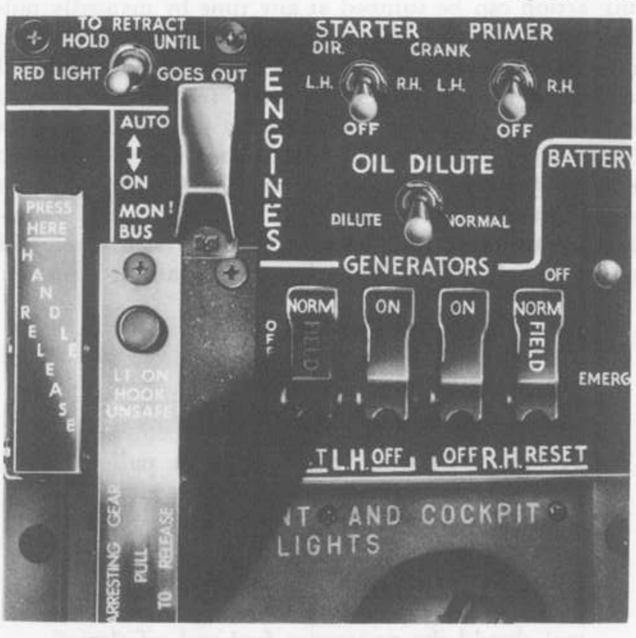


Figure 1-11. Engine Starter Panel and Arresting Gear Control

both engines. (See figure 1-11.) The switch is spring-loaded to the neutral (OFF) position and, when held either to L.H. or R.H., actuates the starter on the corresponding engine.

RECIPROCATING-ENGINE INSTRUMENTS.

MANIFOLD PRESSURE INDICATOR. A manifold pressure indicator (1, figure 1-5), with two pointers, is mounted on the instrument panel. The scale is calibrated from 10 to 75 in. Hg. A pressure transmitter on each engine electrically relays a reading to the respective indicator pointer. The indicator and the transmitters are powered by 26-volt alternating current from the engine instrument inverter.

TACHOMETER. The engine crankshaft speed is transmitted by the tachometer generator to a dual tachometer (39, figure 1-5) located on the instrument panel. The tachometer system generates its own operating power and does not depend on the electrical system of the airplane. The dual-indicating tachometer dial is calibrated from 0 to 4500 rpm.

TORQUE PRESSURE INDICATOR. A torque pressure indicator is installed on each reciprocating engine to measure the torque, or turning moment, delivered by the propeller shaft. Torque measurement, converted to pounds per square inch, is indicated on torque pressure indicators (35, figure 1-5) on the instrument panel. At any given rpm, the torque pressure reading is directly proportional to the power being delivered to the propeller, i.e., brake horsepower. Torque pressure at a given rpm and manifold pressure will vary slightly between engines, because of differences in engine friction losses. It will also be affected by failure of an engine-driven accessory, because the power required for operation of accessories reduces the total available to the propeller. The torque pressure indicator is calibrated from 50 to 400 psi. Twenty-six volt alternating current, furnished by the engine instrument inverter, provides operating power for the indicator.

CYLINDER HEAD TEMPERATURE INDICATOR. Thermocouples mounted in the No. 4 and No. 8 cylinders of each engine generate voltage signals, which are transmitted to a dual indicator (34, figure 1-5) on the instrument panel. No outside source of power is required. Each dial provides cylinder head temperature readings from −50°C to 300°C.

CARBURETOR AIR TEMPERATURE INDICATOR. The carburetor air temperature of each engine is sensed by a resistance bulb and is electrically transmitted to the respective dial of a dual indicator (22, figure 1-5), which is located on the instrument panel. The dials, one for each engine, are calibrated from −70°C to 150°C. Operating power of 28 volts is supplied from the d-c essential bus.

PROPELLERS.

Each engine drives a four-blade, full-feathering, hydromatic propeller. The propellers are automatically controlled through governors to maintain constant speed, between 1200 and 2800 rpm, as selected by the pilot, and to operate at the most efficient blade angle for all airspeeds and rpm settings within the limit of the governing system. An electrical synchronizer provides automatic synchronization of propeller speeds. Propeller feathering or unfeathering is accomplished by supplying additional oil under pressure from an electrical pump to the governor. Oil for feathering is obtained from a reserve supply in the main oil tank. In case of complete electrical failure, the blade angle will remain at the setting at which failure occurs.

PROPELLER CONTROLS.

The propeller controls provide two methods of controlling engine rpm. Propeller toggle switches permit individual adjustment of rpm setting for each engine, and a propeller master lever provides simultaneous control of speed of both engines. Synchronization of propeller speeds by means of the electrical synchronizer is completely automatic. (Refer to SYNCHRONIZATION OF ENGINES, Section VII.) All propeller controls except the propeller master lever are located on a propeller synchronization panel on the left console. (See figure 1-7.)

PROPELLER MASTER SELECTOR SWITCH. Method of propeller control is determined by means of a master selector switch, located on the synchronization panel. With the selector switch at TOGGLE SWITCHES ONLY, the toggle switches are the only effective propeller control. Selecting the TOGGLE SWITCHES & MASTER LEVER position renders both controls effective. With the master selector switch at NORMAL, either the toggle switches or master lever may be used to change propeller speed and, in addition, the electrical synchronizer is in operation to synchronize propeller speeds automatically.

PROPELLER TOGGLE SWITCHES. The two propeller toggle switches are located on the synchronization panel. Each toggle switch is spring-loaded to neutral and, when held at either INCREASE or DECREASE, changes speed of the corresponding engine. The switches may be operated individually or together.

PROPELLER MASTER LEVER. Movement of the propeller master lever, located on the throttle quadrant, changes the setting of both propeller governors simultaneously. The rpm of the two engines is increased or decreased the same amount. When it is necessary to synchronize the two engine speeds, the master lever can be advanced to full INCREASE RPM position, where both propeller governors are set for maximum rpm. Thereafter, movement of the master lever selects approximately the same speeds for both engines.

PROPELLER FEATHERING BUTTONS. Propeller feathering is initiated by momentarily depressing the buttons located just aft of the synchronization panel. Pressing either button starts the related feathering pump. The feathering button will stay down for approximately 12 seconds and then return to neutral, even if propeller has not completely feathered. Normally, feathering action is completed in less than 10 seconds. The feathering action can be stopped at any time by manually pulling the feathering button up to neutral. Unfeathering is accomplished by pulling the button up past neutral and holding it until engine speed reaches 500 to 800 rpm. If the propeller does not start to windmill within 30 seconds, the feathering button should be returned to neutral for one minute to allow the feathering pump motor to cool, before another attempt is made to unfeather the propeller. The feathering button should never be held up for more than 30 seconds at a time.

WARNING

Propeller feathering button must be pulled to the full up (UNFEATHER) position after performing preflight feathering check or after unsuccessful feathering. Failure to do this will leave the oil shutoff valve relay in the armed position, thereby causing loss of governor control should the emergency fuel and oil shutoff switch be moved to OFF.

Note

> An electrical interlock prevents unfeathering the propeller unless the affected emergency engine control switch is in the NORMAL ON position.

PROPELLER GOVERNOR LIMIT INDICATOR LIGHTS.

Two amber governor limit indicator lights, located forward of the propeller toggle switches, illuminate when the governors are in either the full increase or full decrease rpm positions.

TURBOJET ENGINE.

The J33-A-10 centrifugal-type turbojet engine is housed in the aft fuselage. Air is supplied to the jet engine through an intake duct located on the top of the fuselage. When the jet-engine master switch is moved to the on position, a door covering the duct is automatically opened. The door remains open while the engine is operating and closes when the engine is shut down. Opening time for the door is approximately 11 seconds and due to a time delay mechanism, closing time is slightly over 3 minutes. Air from the intake duct is compressed by a centrifugal compressor and passed through air adapters into the combustion chambers. Fuel for the jet engine is pumped by a dual fuel pump to one of three fuel metering units: a starting unit, a main unit, or an emergency unit. The fuel is automatically metered to the combustion chambers, where it is mixed with the compressed air and burned. (See figure 1-12.) The jet engine is provided with a drain line and tank that vents the fuel overboard and normally drains the fuel from the engine during shutdown or false starts. In flight the tank empties automatically at airspeeds above approximately 100 knots IAS. Fuel from the combustion chambers drains directly overboard.

Note

> On the ground, the tank should be drained manually following two shutdowns or false starts to prevent overfilling the tank.

THRUST RATING.

The turbojet engine is rated at 4600 pounds thrust at Military Power, sea level static condition.

AUTOMATIC FUEL METERING.

For automatic starting, fuel under pressure from the dual fuel pump is metered by the starting fuel metering unit to two combustion chambers where ignition occurs. As fuel pressure increases because of increased engine speed, the starting fuel metering unit will meter fuel to the remaining combustion chambers, and the engine will accelerate and stabilize at approximately 36% rpm at sea level. The stabilization speed increases above sea level (approximately 38% rpm at 5000 feet, 42% at 10,000 feet, 50% rpm at 15,000 feet, 60% at 20,000 feet), since the starting fuel metering unit is not compensated for altitude changes. When the jet throttle is advanced from the OFF position, the main fuel metering unit takes over and meters fuel as required to maintain a constant engine speed, which is selected by the pilot, regardless of changes in altitude and airspeed. Idle rpm will increase with altitude, as the altitude compensation device in the main fuel metering unit is ineffective at low power settings. (The starting fuel stabilization speed will be higher than idle rpm above 1500 feet.) The emergency fuel metering unit serves as a stand-by for engine operation in case the main fuel metering unit should fail.

JET-ENGINE CONTROLS.

MASTER SWITCH. A jet-engine master switch, located on the throttle quadrant (figure 1-7), directly controls the jet-engine fuel shutoff valve and the jet-engine air intake door and indirectly controls electrical power for starting and ignition. When the switch is moved to MASTER, the jet air intake door is energized to the open position and the jet-engine fuel shutoff valve opens. Moving the switch to OFF closes the fuel shutoff valve and jet intake door (3 minute delay). Except when the jet engine is in operation, the switch should remain OFF at all times to ensure that the shutoff valves are closed, thus preventing fuel seepage into the combustion chambers.

EMERGENCY SHUTOFF SWITCH. A jet-engine emergency shutoff switch (8, figure 1-6), located on the outboard side of the throttle quadrant, provides emergency control for the jet-engine fuel shutoff valve and the intake door. During normal flight operation, the switch should remain at NORMAL. In an emergency, moving the switch to SHUT-OFF stops fuel supply to the jet engine and keeps the intake door open, regardless of the position of the jet-engine master switch. The intake door will remain open until the emergency shutoff switch is moved to NORMAL and the master switch is positioned OFF.

Note

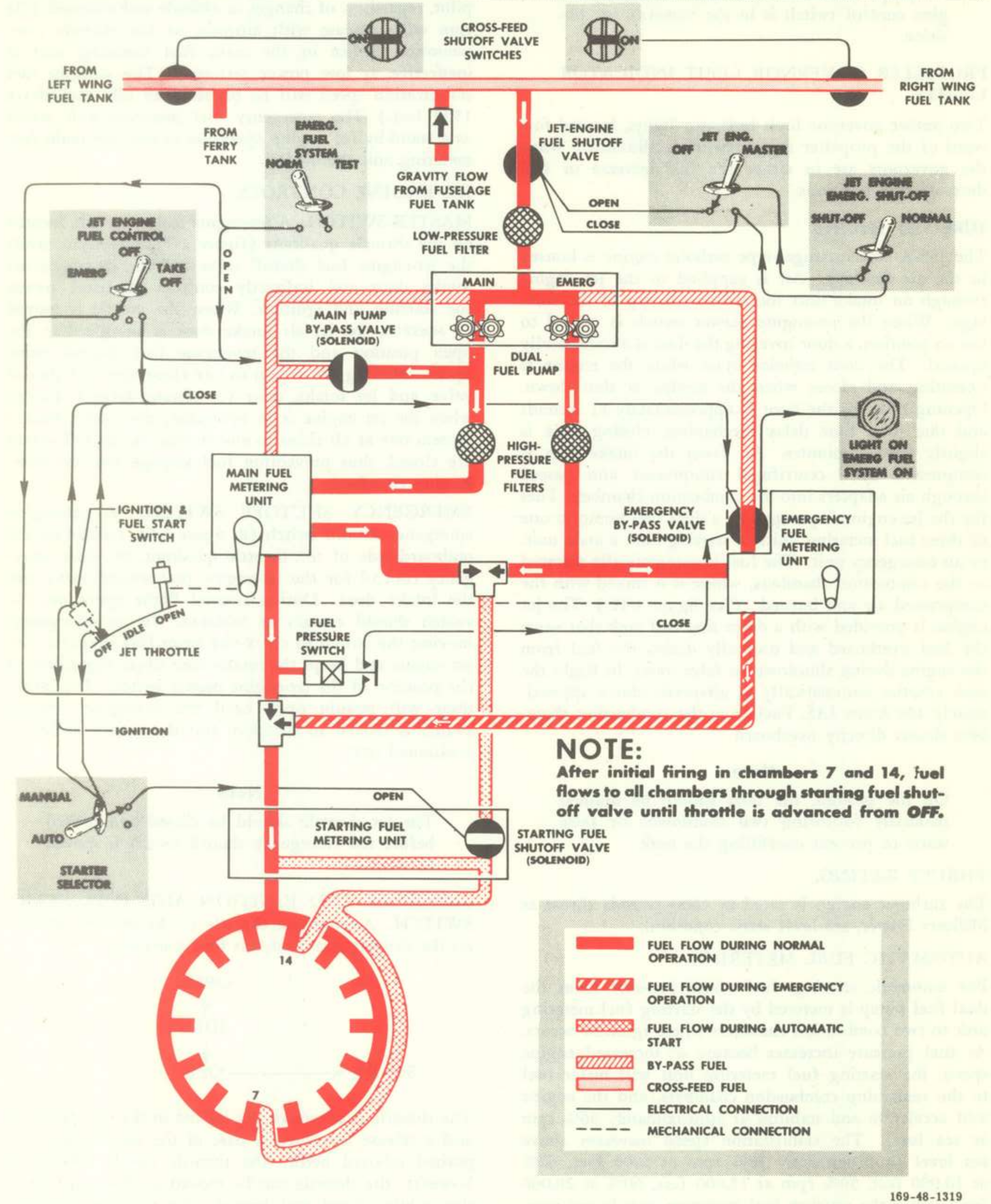
> The jet throttle should be closed and locked before the emergency shutoff switch is moved to SHUT-OFF.

THROTTLE AND IGNITION AND FUEL START SWITCH. A jet-engine throttle (7, figure 1-6), located on the throttle quadrant, has four positions:

OPEN
↑
IDLE
↓
START ← OFF

The throttle is automatically locked in the OFF position, and a release lever at the base of the throttle must be pushed inboard before the throttle can be advanced; however, the throttle can be moved to the START position while closed and locked. An ignition and fuel start switch is mounted on the handle of the jet throttle.

JET-ENGINE FUEL CONTROL



NOTE:

After initial firing in chambers 7 and 14, fuel flows to all chambers through starting fuel shut-off valve until throttle is advanced from *OFF*.

169-48-1319

Figure 1-12.

Moving the throttle momentarily from OFF outboard to START energizes the starter after the door is open. If jet door is not fully open and locked, the JET DOOR UNSAFE light (3, figure 1-6), located on the left console, will illuminate whenever the jet master switch is ON. When engine cranking speed reaches 9% rpm, pressing the ignition and fuel start switch on the throttle handle opens the starting fuel shutoff valve, closes the emergency by-pass valve in the emergency metering unit, and starts ignition. Fuel is pumped to the starting fuel metering unit, which directs fuel to two combustion chambers for ignition, and then meters fuel to the other chambers for acceleraton. The starter and ignition systems are automatically de-energized when the engine reaches a speed of approximately 18% rpm. When engine speed stabilizes at 36% rpm (higher rpm above sea level), the throttle lock should be released and the throttle advanced to IDLE. This closes the starting fuel shutoff valve, opens the emergency by-pass valve, and opens both the main and emergency fuel metering unit shutoff valves for normal operation. Although the shutoff valves for both the main and the emergency fuel metering units open whenever the throttle is advanced from the OFF position, fuel will by-pass the emergency unit if the emergency by-pass valve is open. During a start, the throttle should be OFF and locked when the master switch is moved to MASTER. This will ensure that the shutoff valves for the main and the emergency fuel metering units are closed when the fuel shutoff valve is opened and will prevent accumulation of fuel in the combustion chambers. The starting cycle can be stopped at any time by closing the throttle and turning the jet master switch OFF.

STARTING FUEL SELECTOR SWITCH. Normally, all jet-engine starts should be accomplished by use of the starting fuel metering unit for an automatic start. The starting selector switch (32, figure 1-6), located on the aft portion of the left console, should be placed at AUTO. In emergencies, when the starting fuel metering unit is inoperative, the switch may be positioned at MANUAL for a manual start.

FUEL CONTROL SWITCH. A three-position fuel control switch, (figure 1-13), located above the left console, provides a means of selecting the type of fuel control desired. The jet engine may be operated on the main fuel metering unit, on the emergency unit, or on the main unit with the emergency unit serving as a stand-by. When the fuel control switch is OFF, fuel is directed through the main fuel metering unit and by-passes the emergency unit through the open emergency by-pass valve. In case of main unit failure, the emergency fuel metering unit can be selected by moving the fuel control switch to EMERG. An emergency indicator light adjacent to the fuel control switch will illuminate, indicating that the emergency by-pass valve is closed and the engine is operating on the emergency unit. (See figure 1-13.) The indicator light will also illuminate when the jet engine is started, as fuel will flow to both the main and the emergency fuel metering units until the throttle is advanced from the OFF position during an automatic start, or until the fuel start switch is released during a manual start. The emergency fuel unit does not limit the rate of acceleration and deceleration as does the main unit. Therefore, the throttle should be carefully advanced or retarded, so that extreme tail-pipe temperatures or flameouts will not occur. When the fuel control switch is at TAKE-OFF, the main unit meters fuel to the engine, but if fuel pressure falls below a set value (65 psi), a fuel pressure switch closes, causing the emergency unit to automatically take over fuel control. Although the pressure switch closes at 65 psi, it will not open until pressure is 100 psi. If the fuel control switch is positioned to TAKE-OFF when the fuel pressure is below 100 psi, all subsequent operation will be on the emergency fuel system, with no automatic change-over available.

Emergency fuel system operating; fuel by-passes main fuel system.

Main fuel system operating; fuel by-passes emergency fuel unit.

Main fuel system operating; emergency fuel system on stand-by — automatically takes over if pressure falls below 65 psi.

Emergency fuel system indicator light — on whenever emergency fuel system is operating.

CAUTION

FUEL PRESSURE SHOULD BE ABOVE 100 PSI BEFORE SWITCH IS MOVED TO *TAKE OFF,* TO PREVENT INADVERTENT OPERATION OF EMERGENCY FUEL SYSTEM ON TAKE-OFF.

Figure 1-13. Jet-engine Fuel Control Switch

EMERGENCY FUEL SYSTEM TEST SWITCH. A ground check of the emergency fuel metering unit may be accomplished before take-off by means of an emergency fuel system test switch (31, figure 1-6), located on the aft portion of the left console. When this switch is moved to the spring-loaded TEST position, the output of the main fuel pump is by-passed to simulate failure of the main fuel metering unit. Engine rpm will decrease slightly and the emergency indicator light will illuminate, indicating that the engine is operating on the emergency fuel metering unit. When the switch is at

NORMAL, operation of the emergency unit is determined by the position of the fuel control switch.

CAUTION

- When testing the emergency fuel metering unit, the fuel control switch must be at OFF. If this switch is at TAKE-OFF, the main fuel system does not automatically take over after the test is completed. For a subsequent take-off, fuel metering would be accomplished by the emergency system with no possible automatic emergency control.
- To prevent inadvertent operation of the emergency fuel system on take-off, the fuel control switch should not be moved to TAKE-OFF until the throttle has been advanced to give fuel pressure of 100 psi minimum.

JET-ENGINE INSTRUMENTS.

TAIL-PIPE TEMPERATURE INDICATOR. Voltage, created by three thermocouples in the jet-engine tail pipe, is transmitted to an indicator (40, figure 1-5) on the instrument panel. The average voltage from the three thermocouples indicates the exhaust gas temperature and is shown on a dial calibrated from 0°C to 1000°C. The unit is self-powered.

TACHOMETER. The speed of the jet-engine turbine is shown in percent rpm by an indicator (38, figure 1-5) on the instrument panel. A tachometer generator on the jet engine converts engine speed to voltage, which is transmitted to the indicator. The indicator dial is calibrated from 0 to 100 percent, and a subdial permits a reading of 110 percent. One hundred percent is the equivalent of 11,750 rpm. The tachometer system is completely self-powered.

OIL SYSTEMS.

A separate oil system is provided for each of the three engines and for each turbosupercharger. Each reciprocating engine has a dry-sump, pressure-type lubricating system, with an oil tank and an oil cooler. A propeller feathering pump for each engine receives oil from a reserve supply at the bottom of the related engine oil tank. The jet engine has a wet-sump integral oil system. Oil temperature and pressure indicators for the engines are mounted on the pilot's instrument panel. For oil grades and specifications, see figure 1-27.

RECIPROCATING-ENGINE OIL TANKS.

An oil tank for each reciprocating engine is installed in the engine nacelle, aft of the fire wall. Each oil tank has a capacity of 28.5 gallons of usable engine oil (approximately 1.1 gallons is retained in a hopper) and a reserve of 1.5 gallons for the propeller feathering pump. Each oil tank is equipped with a temperature-sensitive diverter valve which controls oil flow into the tank. When the oil is cold, as during a start, the valve directs the return oil into the hopper and by-passes the main oil supply in the tank. This reduces the quantity of circulating oil and lessens the time required to warm up the oil. When the oil temperature reaches approximately 54°C, the diverter valve directs the return oil into the main compartment of the tank, so that the full oil supply is circulated through the system for normal operation. The diverter valve operation can be overridden by the oil dilution switch.

JET-ENGINE OIL SYSTEM.

The jet engine is lubricated by a wet sump system, utilizing splash oiling for the accessory section and pressure oiling for the rotor shaft bearings and rotor shaft coupling sleeve. The oil system capacity is 12 quarts. Oil quantity can be checked with a bayonet-type oil gage in the oil filler neck. Oil pressure is transmitted to a fuel and oil pressure gage on the instrument panel. Pressure operating limits are noted in Section V. The oil system is an integrated component and no manual control is provided.

OIL SYSTEM CONTROLS.

The reciprocating engines have oil system controls operable by the pilot, but no control is provided for the oil system of the jet engine.

OIL SHUTOFF VALVES. Two electrically operated shutoff valves, one on the fire wall of each reciprocating engine, are controlled by the emergency engine control switches (figure 1-7), located on the left console between the propeller feathering buttons. Normally, the switches are guarded in the NORMAL ON position. To shut off the oil supply to an engine, the related switch must be placed at FUEL & OIL SHUT-OFF and the propeller feathered. When the switches are at CONTROL OFF, the shutoff valves will remain in the position to which they were last energized. (Refer to EMERGENCY ENGINE CONTROL SWITCHES, in this section, for the function of these switches in engine control.)

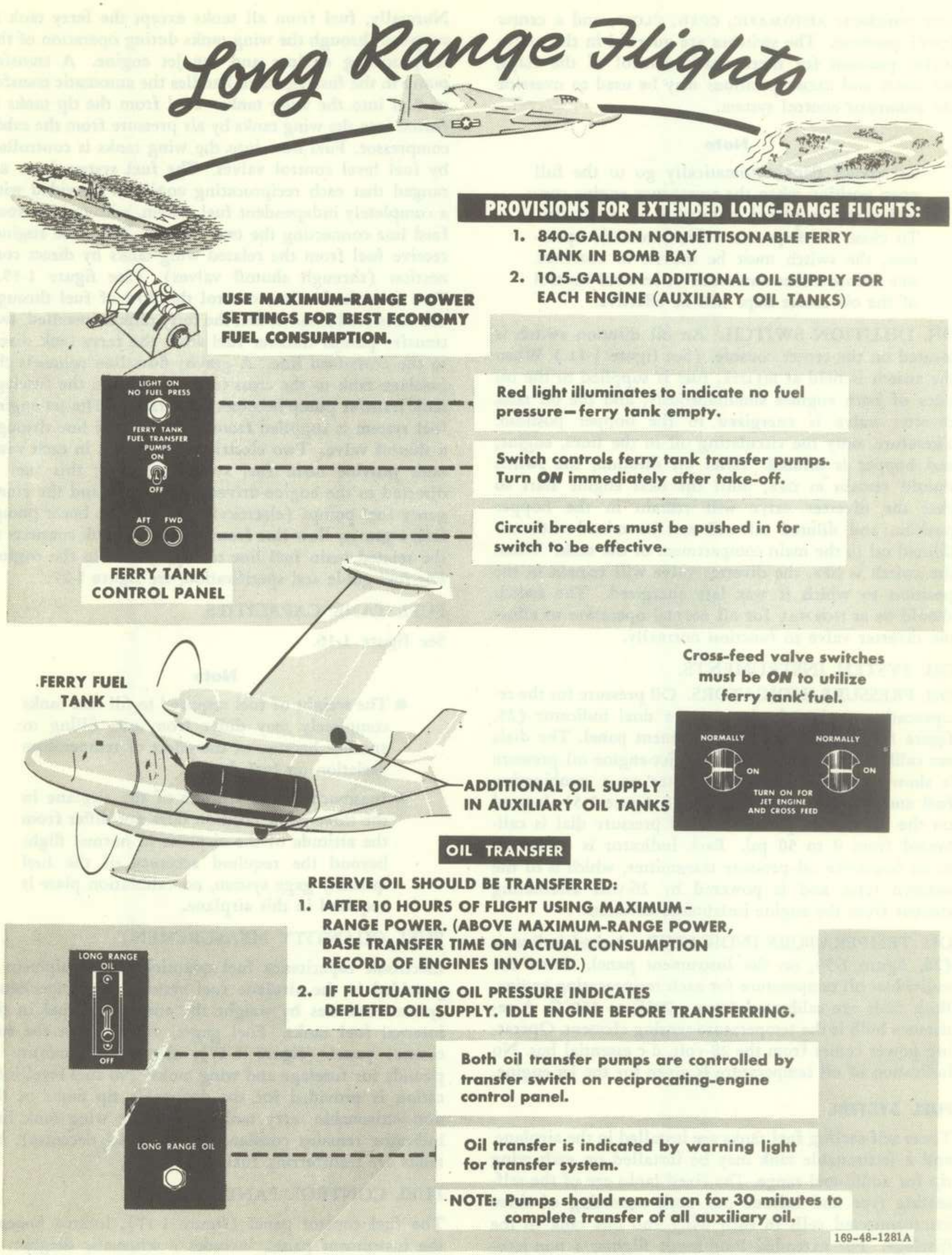
LONG-RANGE OIL SUPPLY.

The long-range oil system consists of a 10.5-gallon oil tank with an integral pump mounted at the aft end of each nacelle. A switch controls both pumps simultaneously and transfers oil into the regular oil tanks. An indicator light, mounted adjacent to the switch, illuminates while pumps are operating. This system should not be used until after 10 hours of maximum range flight time. (See figure 1-14.)

LONG-RANGE OIL SWITCH.

A toggle switch (figure 1-9), located on the left vertical panel, controls the long-range oil pumps for both engines simultaneously.

OIL COOLER FLAP SWITCHES. Oil cooler flaps are controlled by two switches, one for each engine, located above the left console. (See figure 1-9.) Each switch has



PROVISIONS FOR EXTENDED LONG-RANGE FLIGHTS:

1. 840-GALLON NONJETTISONABLE FERRY TANK IN BOMB BAY
2. 10.5-GALLON ADDITIONAL OIL SUPPLY FOR EACH ENGINE (AUXILIARY OIL TANKS)

USE MAXIMUM-RANGE POWER SETTINGS FOR BEST ECONOMY FUEL CONSUMPTION.

Red light illuminates to indicate no fuel pressure—ferry tank empty.

Switch controls ferry tank transfer pumps. Turn *ON* immediately after take-off.

Circuit breakers must be pushed in for switch to be effective.

Cross-feed valve switches must be *ON* to utilize ferry tank fuel.

OIL TRANSFER

RESERVE OIL SHOULD BE TRANSFERRED:

1. AFTER 10 HOURS OF FLIGHT USING MAXIMUM-RANGE POWER. (ABOVE MAXIMUM-RANGE POWER, BASE TRANSFER TIME ON ACTUAL CONSUMPTION RECORD OF ENGINES INVOLVED.)
2. IF FLUCTUATING OIL PRESSURE INDICATES DEPLETED OIL SUPPLY. IDLE ENGINE BEFORE TRANSFERRING.

Both oil transfer pumps are controlled by transfer switch on reciprocating-engine control panel.

Oil transfer is indicated by warning light for transfer system.

NOTE: Pumps should remain on for 30 minutes to complete transfer of all auxiliary oil.

Figure 1-14. Ferry Tank Installation

four positions: AUTOMATIC, OPEN, CLOSE, and a center (OFF) position. The switches are guarded in the AUTOMATIC position for thermostatic control of the flaps, but OPEN and CLOSE positions may be used to override the automatic control system.

Note

> Oil cooler flaps automatically go to the full open position when the emergency engine control switch is placed at FUEL & OIL SHUT-OFF. To close the flaps after this automatic operation, the switch must be moved to CONTROL OFF before either automatic or manual control of the oil cooler flaps will be effective.

OIL DILUTION SWITCH. An oil dilution switch is located on the center console. (See figure 1-11.) When the switch is held at DILUTE, fuel is supplied to the oil lines of both engines simultaneously, and the oil tank diverter valve is energized to the hopper position. Therefore, only the circulating oil in the lines, engine, and hopper is diluted. After oil dilution, the switch should remain at OFF, until the next engine start so that the diverter valve will remain in the hopper position and diluted oil will not be mixed with undiluted oil in the main compartment of the tank. When the switch is OFF, the diverter valve will remain in the position to which it was last energized. The switch should be at NORMAL for all normal operation to allow the diverter valve to function normally.

OIL SYSTEM INSTRUMENTS.

OIL PRESSURE INDICATORS. Oil pressure for the reciprocating engines is shown on a dual indicator (25, figure 1-5), located on the instrument panel. The dials are calibrated from 0 to 200 psi. Jet-engine oil pressure is shown by the right-hand pointer on a combination fuel and oil pressure indicator (21, figure 1-5), located on the instrument panel. The oil pressure dial is calibrated from 0 to 50 psi. Each indicator is connected to its respective oil pressure transmitter, which is of the autosyn type, and is powered by 26-volt alternating current from the engine instrument inverter.

OIL TEMPERATURE INDICATOR. A dual indicator (26, figure 1-5), on the instrument panel, shows the individual oil temperature for each reciprocating engine. Both dials are calibrated from −70°C to 150°C. A resistance bulb is the temperature sensing element. Operating power comes from the 28-volt, d-c essential bus. No indication of oil temperature is given for the jet engine.

FUEL SYSTEM.

Three self-sealing fuel tanks are installed in the airplane, and a jettisonable tank may be installed on each wing tip for additional range. The fixed tanks are of the self-sealing type and include one tank consisting of three interconnected cells in each wing and one tank in the fuselage. For extended long-range flights, a non-jettisonable ferry tank may be installed in the bomb bay. Sequence of fuel tank usage is controlled automatically. Normally, fuel from all tanks except the ferry tank is supplied through the wing tanks during operation of the reciprocating engines and the jet engine. A transfer pump in the fuselage tank handles the automatic transfer of fuel into the wing tanks. Fuel from the tip tanks is forced into the wing tanks by air pressure from the cabin compressor. Fuel flow into the wing tanks is controlled by fuel level control valves. The fuel system is so arranged that each reciprocating engine is provided with a completely independent fuel system, with only a cross-feed line connecting the two systems. Thus, the engines receive fuel from the related wing tanks by direct connection (through shutoff valves). (See figure 1-15.) Two cross-feed valves control the flow of fuel through the cross-feed line. When the ferry tank is installed, two transfer pumps transfer fuel from the ferry tank direct to the cross-feed line. A gravity-flow line connects the fuselage tank to the cross-feed line in case the fuselage tank transfer pump becomes inoperative. The jet-engine fuel system is supplied from the cross-feed line through a shutoff valve. Two electric boost pumps in each wing tank provide main fuel system pressure; this fuel is directed to the engine-driven fuel pumps and the emergency fuel pumps (electrical). In case the boost pumps fail, a gravity-flow line from each wing tank connects to the related main fuel line to supply fuel to the engine. For fuel grade and specification, see figure 1-27.

FUEL TANK CAPACITIES.

See figure 1-16.

Note

> - The weight of fuel required to fill fuel tanks completely may differ from one filling to another because of the effect of temperature variation on fuel density.
> - Inasmuch as the attitude of the airplane in the three-point position does not differ from the attitude of the airplane in normal flight beyond the required accuracy of the fuel quantity gage system, no calibration plate is required in this airplane.

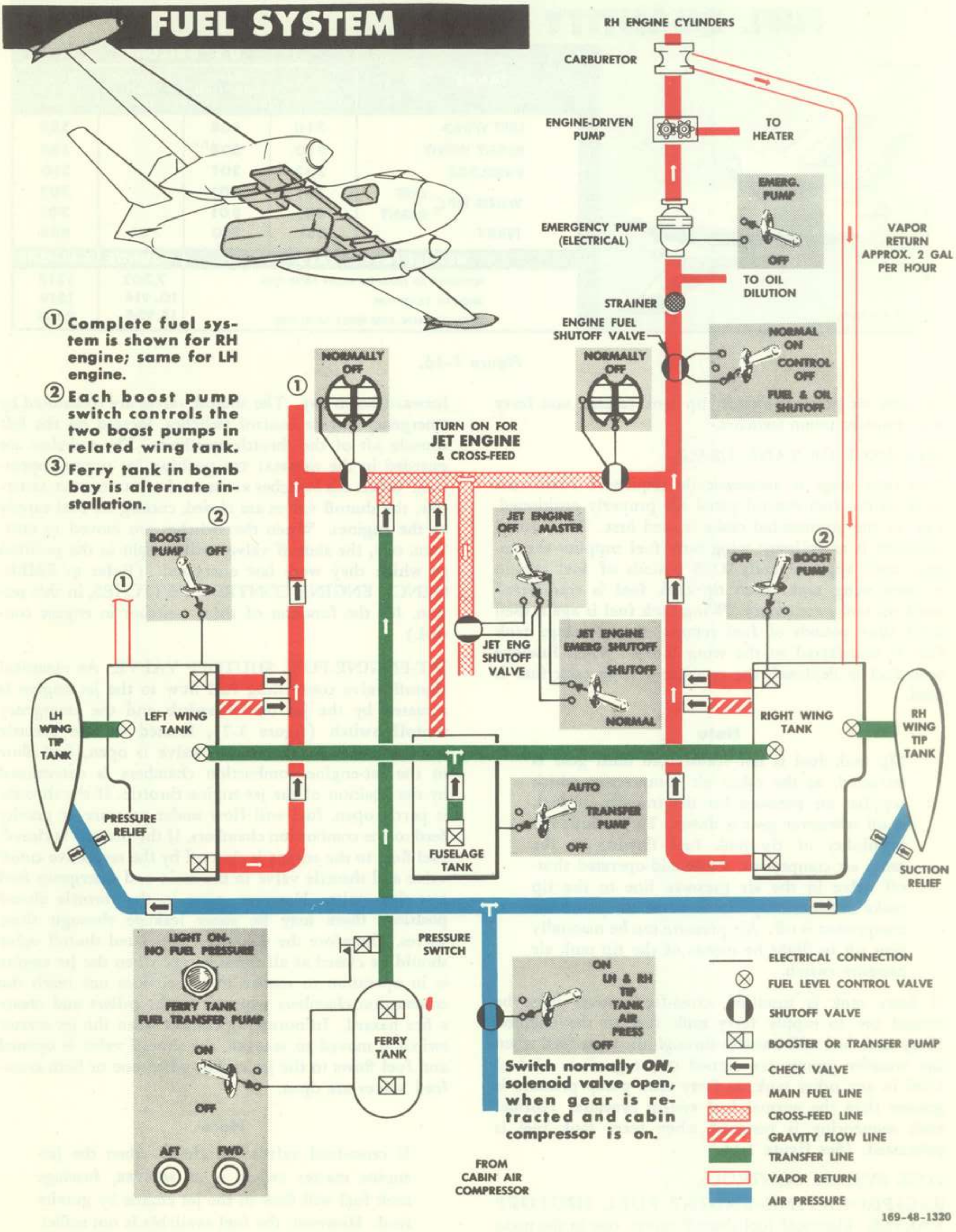
FUEL QUANTITY MEASUREMENT.

Electronic capacitance fuel quantity gage equipment is provided in the airplane fuel system. The capacitance system measures by weight the amount of fuel in the internal fuel tanks. Fuel gages, mounted on the fuel control panel (figure 1-17), show fuel quantity in pounds for fuselage and wing tanks. No fuel level indication is provided for the droppable tip tanks or the non-jettisonable ferry tank. When the wing tank fuel indicator remains constant (after initial decrease), tip tanks are transferring fuel.

FUEL CONTROL PANEL.

The fuel control panel (figure 1-17), located beneath the instrument panel, includes a schematic diagram of the internal fuel system. All fuel system controls are mounted on the panel except for engine fuel shutoff,

FUEL SYSTEM



① **Complete fuel system is shown for RH engine; same for LH engine.**

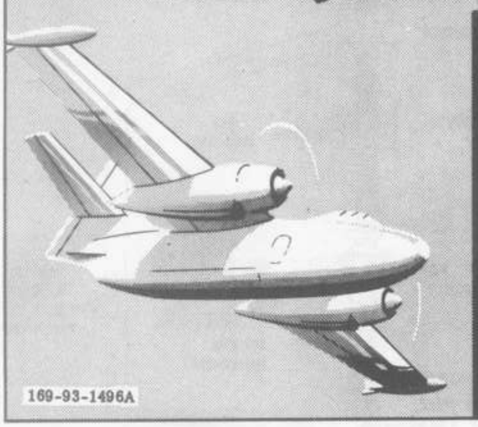
② **Each boost pump switch controls the two boost pumps in related wing tank.**

③ **Ferry tank in bomb bay is alternate installation.**

Switch normally *ON*, solenoid valve open, when gear is retracted and cabin compressor is on.

Figure 1-15.

FUEL QUANTITY DATA



TANKS	U S. GALLONS			
	FULLY SERVICED	USABLE FUEL — LEVEL FLIGHT —(EACH)	EXPANSION SPACE (EACH)	TOTAL VOLUME (EACH)
LEFT WING	510	508		524
RIGHT WING	510	508		524
FUSELAGE	203	201		210
WING TIP LEFT	301	301		301
WING TIP RIGHT	301	301		301
FERRY	851	840	37	888

USABLE FUEL TOTALS	POUNDS	GALLONS
WITHOUT TIP TANK OR FERRY TANK FUEL	7,302	1217
WITH TIP TANK FUEL	10,914	1819
WITH TIP TANK AND FERRY TANK FUEL	15,954	2659

Figure 1-16.

tip tank air pressure switch, tip tank release, and ferry tank transfer pump switches.

SEQUENCE OF TANK USAGE.

Fuel tank usage is automatically sequenced when controls on the fuel control panel are properly positioned. Fuel in the unprotected tanks is used first. The normal sequence is as follows: wing tank fuel supplies the engine until approximately 2778 pounds of fuel remain in each wing tank; then tip tank fuel is transferred until tip tanks are empty. Wing tank fuel is again used until 1044 pounds of fuel remain; then fuselage tank fuel is transferred to the wing tanks. When fuselage tank fuel is depleted, the remaining wing tank fuel is used.

Note

> Tip tank fuel is not transferred until gear is retracted, as the cabin air compressor, which supplies air pressure for the transfer of fuel, is off whenever gear is down. To preclude the possibility of tip tank fuel flowing to the cabin air compressor, a solenoid-operated shutoff valve in the air pressure line to the tip tanks automatically closes when the cabin air compressor is off. Air pressure can be manually shut off in flight by means of the tip tank air pressure switch.

If ferry tank is installed, cross-feed valves must be turned ON to supply ferry tank fuel to the engines. Ferry tank fuel will transfer through the cross-feed when the transfer pumps are turned ON, regardless of fuel level in any other tank, as ferry tank pump pressure is greater than the normal fuel system pressure. Normal tank sequencing is resumed when ferry tank fuel is exhausted. (See figure 1-14.)

FUEL SYSTEM CONTROLS.

RECIPROCATING-ENGINE FUEL SHUTOFF VALVES. Electrical fuel shutoff valves, one in the main fuel line to each reciprocating engine, are located in the forward bomb bay. The shutoff valves are controlled by emergency engine control switches, located on the left console aft of the throttle quadrant. The switches are guarded in the NORMAL ON position for normal operation. When the switches are moved to FUEL & OIL SHUTOFF, the shutoff valves are closed, cutting off fuel supply to the engines. When the switches are moved to CONTROL OFF, the shutoff valves will remain in the position to which they were last energized. (Refer to EMERGENCY ENGINE CONTROL SWITCHES, in this section, for the function of these switches in engine control.)

JET-ENGINE FUEL SHUTOFF VALVE. An electrical shutoff valve controlling fuel flow to the jet engine is actuated by the jet master switch and the emergency shutoff switch (figure 1-7), located on the throttle quadrant. When the shutoff valve is open, fuel flow to the jet-engine combustion chambers is determined by the position of the jet-engine throttle. If the throttle is partly open, fuel will flow under pressure or gravity feed to the combustion chambers. If the throttle is closed, fuel flow to the engine is shut off by the respective cutoff valve and throttle valve to the main and emergency fuel metering units. However, even in the throttle closed position, there may be some leakage through these valves. Therefore the electrically operated shutoff valve should be closed at all times except when the jet engine is in operation to ensure that fuel does not reach the combustion chambers where it might collect and create a fire hazard. In normal operation when the jet master switch is moved to MASTER, the shutoff valve is opened and fuel flows to the jet engine when one or both cross-feed valves are open.

Note

> If cross-feed valves are closed when the jet-engine master switch is at MASTER, fuselage tank fuel will flow to the jet engine by gravity feed. However, the fuel available is not sufficient for satisfactory operation of the jet engine.

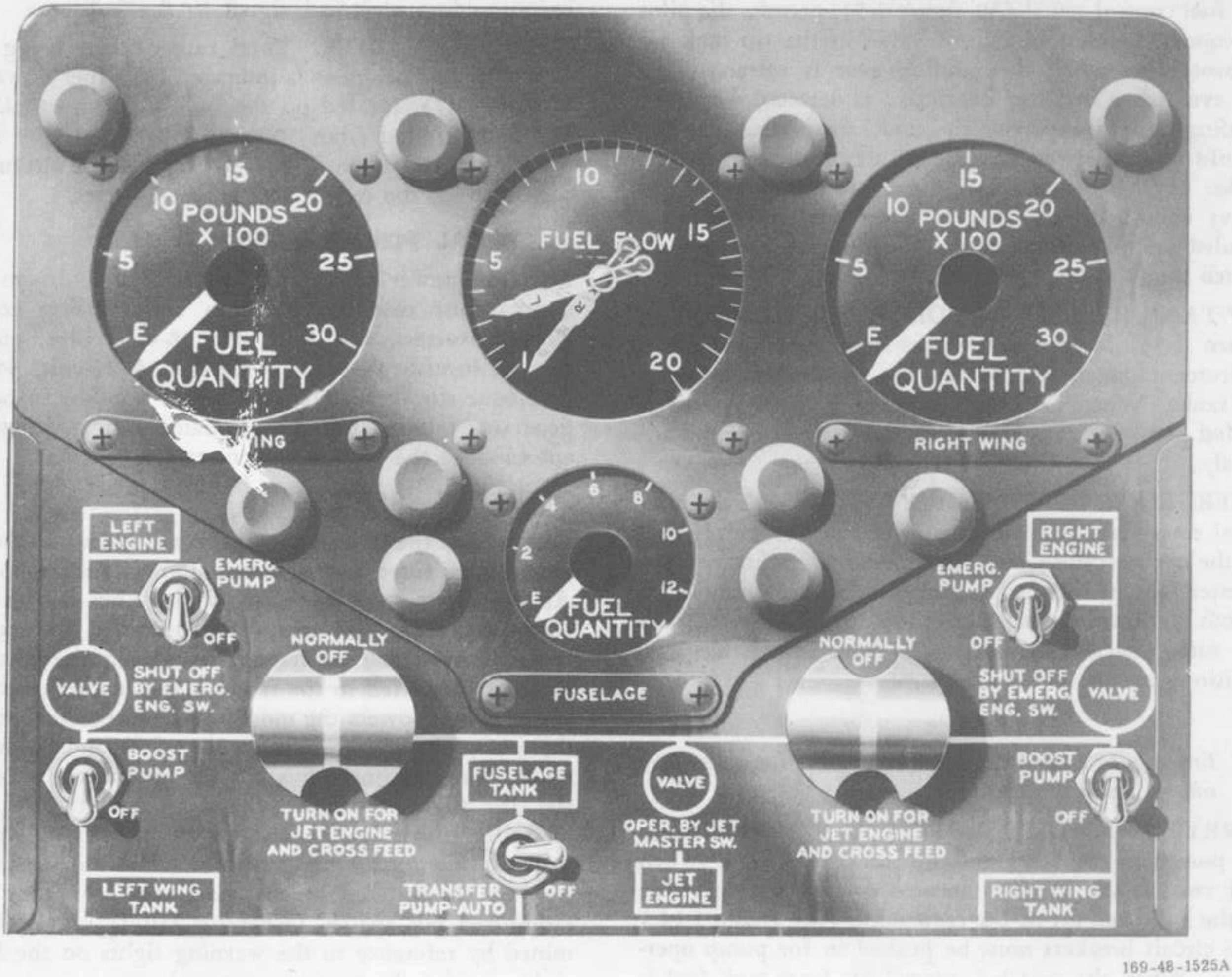


Figure 1-17. Fuel Control Panel

The shutoff valve is normally closed when the jet master switch is moved to OFF. In an emergency, the jet-engine emergency shutoff switch should be moved to SHUT-OFF to close the fuel shutoff valve and open the duct door regardless of the position of the jet master switch. In the event of a fire warning in the jet-engine area during flight, the fuel valve should be closed by means of the emergency shutoff switch.

BOOSTER PUMP SWITCHES. Two booster pumps are installed in each wing tank, one in the forward cell and one in the aft cell. Two switches on the fuel control panel (figure 1-17) control the four pumps, one switch for each wing tank. Wing tank booster pumps should be turned on for all normal flight operation.

TRANSFER PUMP SWITCH. A transfer pump switch on the fuel control panel (figure 1-17) controls the electrical transfer pump in the fuselage tank. The switch has two positions, AUTO and OFF. With the switch in the normal (AUTO) position, a fuel level control valve in each wing tank opens when wing tank fuel level reaches 1044 pounds, and fuselage tank fuel is automatically transferred to the wing tanks. The transfer pump switch should be at AUTO until the fuselage tank is empty to prevent reverse flow from the wing tanks through the fuel level control valve and into the fuselage tank.

CROSS-FEED VALVE SWITCHES. Electric cross-feed valves, one at each end of the cross-feed line, are controlled by two rotary-type switches (figure 1-17) on the fuel control panel. The switches have two positions, ON and NORMALLY OFF. Operation of the cross-feed valves, in conjunction with the fuel shutoff valves and the booster pump switches, makes it possible for one engine to consume all the fuel carried in the airplane, or for both engines to be fed by one fuel system. (However, fuel cannot be transferred from one wing tank to the other.) For jet-engine operation, one or both cross-feed valves should be ON and the jet-engine master switch should be at MASTER.

Note

The cross-feed valve switches should be ON for take-off or landing operations.

TIP TANK AIR PRESSURE SWITCH. A switch below the fuel control panel (30, figure 1-5), permits the pilot to control a solenoid shutoff valve in the tip tank air pressure line when the landing gear is retracted. In the event that fuel loss overboard is detected when the landing gear is up, the tip tank air pressure switch should be turned OFF to shut off air pressure to the tip tanks. If fuel loss continues, usually resulting in a wing-heavy condition, or when sufficient fuel has been expended from the wing tanks, the tip tank air pressure switch should be repositioned ON.

TIP TANK RELEASE HANDLE. A release handle (29, figure 1-5), located below the center of the pilot's instrument panel, is provided for jettisoning the wing tip tanks. When the clip is released and the handle is pulled out, the two tips tanks are released simultaneously.

EMERGENCY FUEL PUMP SWITCHES. Two electrical emergency fuel pumps are provided to supply fuel to the reciprocating engines in case of failure of the booster pumps or the engine-driven fuel pumps. A switch is located on the fuel control panel (figure 1-17) for each emergency fuel pump. Each switch has two positions, EMERG. PUMP and OFF.

Note

Emergency fuel pumps should be on for take-off or landing operations.

FERRY TANK PUMP SWITCH. Two electrical transfer pumps in the ferry tank are controlled by a switch and two circuit breakers located on the forward side of the bulkhead aft of the crew door. (See figure 1-14.) The circuit breakers must be pushed in for pump operation. When the switch is turned ON ferry tank fuel is pumped to the cross-feed line. Cross-feed valves must be turned ON to supply ferry tank fuel to the reciprocating engines. Ferry tank fuel should be used immediately after take-off.

FUEL SYSTEM INDICATORS.

FERRY TANK WARNING LIGHT. A fuel pressure warning light located above the ferry tank switches, illuminates when fuel pressure is below 5 psi. When light illuminates switch should be turned OFF.

FUEL QUANTITY INDICATORS. Fuel quantity indicators for wing tanks and fuselage tank are mounted above the fuel control panel. (See figure 1-17.) The indicators are ratiometer-type and are calibrated in pounds.

FUEL PRESSURE INDICATORS. Fuel pressure for each reciprocating engine is shown individually on a dual indicator (23, figure 1-5), mounted on the instrument panel. Both dials are calibrated from 0 to 50 psi. Jet-engine fuel pressure is indicated on a fuel and oil pressure indicator (21, figure 1-5), located on the instrument panel. The fuel pressure dial is calibrated from 0 to 1000 psi. The indicators register electrically and are powered with 26-volt alternating current from the engine instrument inverter. A diaphragm in the pressure transmitter senses the pressure and transmits a corresponding electrical signal to the indicator.

FUEL FLOWMETER. Total rate of fuel being consumed by both engines is indicated by a fuel flowmeter (figure 1-17), located on the fuel quantity panel. The dial is calibrated from 100 to 2000 pounds per hour. The flowmeter system is powered by 26-volt alternating current from the engine instrument inverter.

ELECTRICAL POWER SUPPLY SYSTEM.

Electrical power is supplied by two engine-driven generators, one mounted on each reciprocating engine. Three inverters, fed from the 28-volt, direct-current supply, furnish alternating current. A 24-volt, 34 ampere-hour storage battery serves as a stand-by in case of generator failure or if the generator output is insufficient to close the reverse current relay.

DIRECT CURRENT.

Power from the 28-volt direct-current system is distributed through three busses: essential, main and monitored. All three busses are energized, through bus tie-in relays, when generators are operating, or when an external source is powering the system. Equipment necessary for flight is connected to the essential and main busses; the essential bus powers the most important equipment, and the main bus powers equipment of secondary importance. The monitored bus powers equipment not essential for flight. Failure of one generator will automatically disconnect the monitored bus to reduce the load on the remaining generator. The monitored bus may be reconnected to the main bus by means of a monitored bus switch. Generator failure can be determined by reference to the warning lights on the lower right part of the instrument panel.

CAUTION

With one generator out, the monitored bus switch should not be used unless the load on the operating generator is less than 400 amperes.

If one or both generators fail, the monitored bus is automatically disconnected. If both generators fail and the battery switch is in the BATTERY position only the essential bus will be energized. Both the main and the essential bus will be energized when the landing gear handle is in the DOWN position. The main bus can also be energized by placing the battery switch in EMERG. Therefore, if generator failure occurs the battery switch should always be placed in EMERG. to ensure electrical power to the main bus after landing gear is lowered.

CAUTION

If both generators fail, the battery switch should not be moved to EMERG. unless *all* non-essential loads are turned off.

CAUTION

Before placing landing gear control handle in DOWN position, with all generators inoperative, *all* nonessential loads should be turned off.

ALTERNATING CURRENT.

Alternating current is supplied by three three-phase inverters: an engine instrument inverter on the essential bus, a main inverter for single-phase power on the main bus, and a flight instrument inverter on the essential bus monitored by the main bus. The engine and flight instrument inverters serve as stand-bys for each other. The flight instrument inverter normally powers the flight instruments and the automatic pilot control equipment. If the flight instrument inverter fails or if both generators fail, the autopilot is disconnected, the flight instruments are automatically powered by the engine instrument inverter, and the stand-by transformer is automatically energized. The engine instrument inverter may be manually selected if auto change-over malfunctions. If the engine instrument inverter fails, the engine instruments may be manually connected to the flight instrument inverter by proper positioning of the inverter switch; however, the autopilot controls are automatically disconnected to prevent overloading the remaining inverter. If the engine instrument inverter fails when only battery power is available, the flight instrument inverter is powered and monitored by the essential bus. The main inverter is automatically turned on whenever the special equipment a-c power switch, ASB-1 power switch, or APX-6 power switch is turned ON. No stand-by provisions are made for the main inverter. Normally, the 115-volt output of the flight instrument inverter is transformed in the autopilot system to 26 volts for operation of the flight instruments. If the autopilot transformer fails, a stand-by flight instrument transformer may be used to supply power to the flight instruments. Normally inoperative, the stand-by flight instrument transformer becomes operative automatically when the flight instrument inverter fails or when manually selected.

POWER RECEPTACLES.

EXTERNAL POWER RECEPTACLE. The external power receptacle is located on the right side of the fuselage, aft of the bomb bay, and is used for starting the engines and ground checking electrical equipment.

INTERNAL POWER RECEPTACLE. An internal power receptacle is located at each crewman's station and is used in conjunction with special equipment.

ELECTRICAL POWER DISTRIBUTION.

For electrical power distribution, see figure 1-18.

ELECTRICAL SYSTEM CONTROLS.

Controls for direct current power are located on a panel on the center pedestal with indicators on the instrument panel. (See figure 1-19.) Controls for alternating current are located on the a-c power control panel on the right console. Circuit breakers and fuses for the entire electrical power supply system are located on six panels: two in the crew entry compartment, two on the left console, one on the center pedestal, and one above the right console. (See figure 1-20.)

BATTERY SWITCH. A battery switch, mounted on the center pedestal has three positions, BATTERY, OFF, and EMERG. (See figure 1-11.) For normal operation, the switch is placed at BATTERY. In case of complete generator failure, the battery switch should be left at BATTERY, since essential flight equipment will automatically remain operative. (See figure 1-18.) If it becomes necessary to use main or monitored bus equipment, the battery switch may be placed at EMERG., but this will seriously reduce flight time because of the limited amount of battery power available. The battery switch is guarded in the BATTERY or OFF positions, but the guard must be raised before the EMERG. position can be used.

CAUTION

In case of complete generator system failure, all nonessential loads should be turned off before the battery switch is placed in the EMERG. position or landing gear is lowered.

GENERATOR CONTROL SWITCHES. Two generator switches, one for each engine-driven generator, are located on the center pedestal adjacent to the battery switch. The switches are guarded in the ON position for all normal operation. When the switches are on, power output of the generator is connected to the system. Placing the switches in OFF disconnects the generators from the system. For normal operation, the generator switches should be ON. (See figure 1-11.)

GENERATOR FIELD SWITCHES AND WARNING LIGHTS. Two generator field switches are mounted on the center pedestal adjacent to the generator switches. Their related warning lights are mounted on the instrument panel. The generator field switches have three positions: NORM, OFF, and RESET. For normal operation the switches should be NORM. When a warning light illuminates, indicating no generator output, the related generator field switch may be moved momentarily to RESET to reclose the generator field disconnect relay in an attempt to re-establish power output. To determine if this procedure is effective, the generator field switch should be repositioned to NORM.

CAUTION

- Generator dimming iris should be kept in the full bright position for all flight operation.
- Whenever a generator warning light flickers intermittently, the related generator switch should be turned OFF to prevent damage to the circuit.

ELECTRICAL POWER

ENGINES OFF—NO EXTERNAL POWER

	BATTERY	LEFT GEN	RIGHT GEN
Battery Switch	OFF		
Generator Control Switches		ON	ON
Generator Field Switches		NORM	NORM
Generator Warning Lights		○	○
Voltammeters		NO VOLTS AMP	NO VOLTS AMP

ENGINES OFF—EXTERNAL POWER

	BATTERY	LEFT GEN	RIGHT GEN
Battery Switch	OFF		
Generator Control Switches		ON	ON
Generator Field Switches		NORM	NORM
Generator Warning Lights		●	●
Voltammeters		NO VOLTS AMP	NO VOLTS AMP

NORMAL OPERATION—GENERATORS CHARGING

	BATTERY	LEFT GEN	RIGHT GEN
Battery Switch	BATTERY		
Generator Control Switches		ON	ON
Generator Field Switches		NORM	NORM
Generator Warning Lights		○	○
Voltammeters		GEN VOLTS LOADS	GEN VOLTS LOADS

ONE GENERATOR INOPERATIVE (FLIGHT)

	BATTERY	LEFT GEN	RIGHT GEN
Battery Switch	BATTERY		
Generator Control Switches		OFF	ON
Generator Field Switches		OFF	NORM
Generator Warning Lights		●	○
Voltammeters		NO VOLTS AMP	GEN VOLTS LOADS

BOTH GENERATORS INOPERATIVE (FLIGHT)

	BATTERY	LEFT GEN	RIGHT GEN
Battery Switch	BATTERY		
Generator Control Switches		OFF	OFF
Generator Field Switches		OFF	OFF
Generator Warning Lights		●	●
Voltammeters		NO VOLTS AMP	NO VOLTS AMP

BATTERY SWITCH	EMERG	
OR		
LANDING GEAR HANDLE ***DOWN***		

WARNING:

Turn off all nonessential equipment before moving battery switch to EMERG.

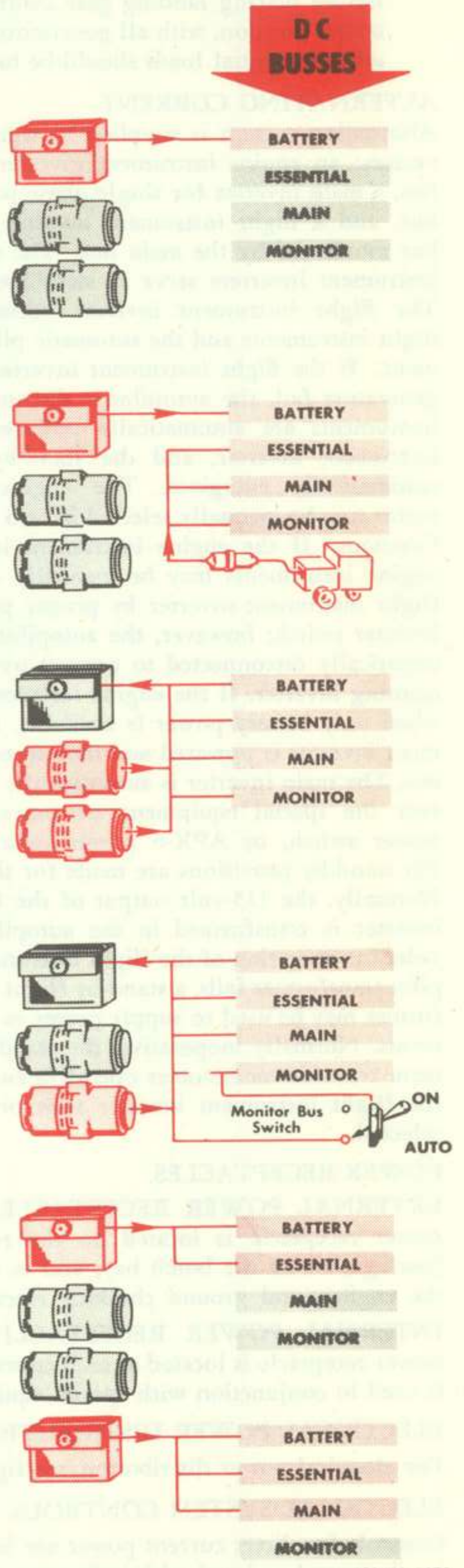


Figure 1-18. (Sheet 1 of 2)

SUPPLY SYSTEM

BATTERY BUS

IFF Destructor
Battery Switch

ESSENTIAL BUS

Monitor Power Control (Generator)
Windshield Wiper
Bombing Controls
Shackle Release Handle
Bomb Salvo
Bomb Doors
Emergency Ram-air Valve
Cabin Compressor
Autopilot Inverter
Engine Temperature Instruments
Emergency Engine Control Switches (Fuel, Oil, and Hydraulic Shutoff)
Fire Detector System
Fuel Transfer Valves
Gear and Flap Position Indicator
Instrument Lights
Interior Lights
Jet-engine Master Switch
Landing Gear Control
Master Fire Warning Light
Propeller Feathering Pump
Propeller Pitch Control
Trim Tab Controls
Turbo Power Switches
Engine Instrument Inverter
Inverter Control
Autopilot DC
Bomb Release

Flight Instrument Inverter (E-1617-1)

Autopilot
Flight Instrument
Fuel Pressure Indicator *
Fuel Quantity Indicator *
Manifold Pressure *
Oil Pressure *
Torquemeter *

Engine Instrument Inverter

Flight Instruments *
Fuel Pressure Indicator
Fuel Quantity Indicator
In-flight Refueling Indicator
Manifold Pressure
Oil Pressure
Torquemeter

*Additional load if either engine instrument or flight instrument inverter is in stand-by condition.

MAIN BUS

Rudder Alternate Boost Pump
Approach Light
Arresting Hook Control
Bomb Sight (2)
Cabin Heater (Emergency)
Cowl, Intercooler, and Oil Cooler Flaps
Emergency Fuel Pump
Emergency Hydraulic Pump
Exterior Lights
Fuel Boost Pumps
Fuel Transfer Pumps
Ignition Induction Vibrator
Interphone
Jet-engine Ignition
Navigation Lights
Oil Diluter
Oil Diverter Valve
Pitot Heater
Primer
Propeller Synchronizer
Radar
Reciprocating-engine Starter
Rudder and Elevator Boost
Vacuum Pumps
Special Armament
Stall Warning Indicator
Main Inverter
Wing Flap Control
Radio Altimeter
ART-13, ARR-15, and VHF
In-flight Refueling System
A-C Control
Essential to Main Control
Bomb Arm and Indicator Lights

Main Inverter (E-1725-1)

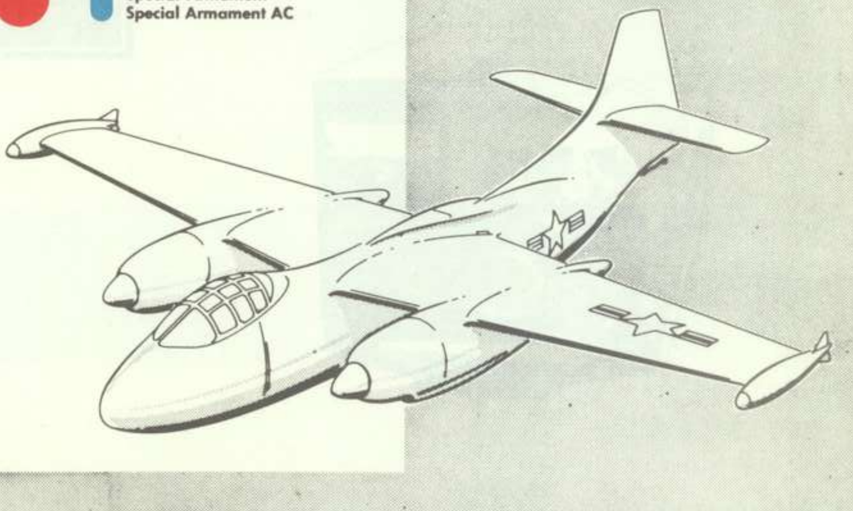
APX-6 (IFF)
Bomb Sight (ASB-1)
Boost Pressure Indicator and Transmitter
Fuel Flowmeter Transformer and Indicator
In-flight Refueling
Special Armament
Special Armament AC

MONITORED BUS

Aileron Boost Cylinder Heater
Bomb Bay and Dome Lights
Bomb Shackle Heater
Cabin Temperature Control
Seat Adjustment Actuator
Suit Heat

WARNING:

Do not turn monitored bus switch *ON* unless load on operating generator is less than 400 amperes.



H-9634-54-96

Figure 1-18. (Sheet 2 of 2)

Figure 1-19. Electrical Power Supply Controls

Note

> In case of generator malfunction, the related generator field switch may be moved to the neutral (OFF) position. This will completely de-energize the affected generator system and its related controls.

GENERATOR EMERGENCY RESET BUTTON. An emergency reset button is mounted in each generator control panel. If the generator cannot be reconnected to the circuit by means of the generator field switch, an attempt may be made to restore generator operation manually by use of the reset button.

MONITORED BUS SWITCH. A monitored bus switch is located on the center pedestal. The switch is guarded in the AUTO position for all normal operation. In case one generator fails, the monitored bus becomes disconnected and related equipment will be inoperative. If it becomes necessary to reconnect the monitored bus to the electrical system, the monitored bus switch can be moved to ON. However, if both generators are inoperative, the monitored bus switch is ineffective.

CAUTION

> In case one generator fails, the monitored bus switch should not be turned ON unless the load on the operating generator is less than 400 amperes.

INVERTER SELECTOR SWITCH. The inverter selector switch is located on the a-c power control panel on the right console. (See figure 1-19.) There are three positions on the switch: FLT. INST. STANDBY, NORMAL, and ENGINE INST. STANDBY. Two red, push to test warning lights (with dimming provisions) are used in connection with and located adjacent to the switch. The selector switch is guarded in the NORMAL position and both warning lights are normally off. The forward light illuminates when the flight instrument inverter is out and the flight instruments are automatically transferred to the engine instrument inverter power and the flight instrument stand-by transformer. Selection of FLT. INST. STANDBY position on the inverter selector switch is normally necessary only for checking operation of the engine instrument inverter. If the aft light illuminates, indicating the engine instrument inverter is inoperative, the engine instruments will be automatically transferred to the flight instrument inverter. Manual selection is also possible by positioning the inverter selector switch to ENGINE INST. STANDBY.

FLIGHT INSTRUMENT TRANSFORMER SWITCH. The flight instrument transformer switch on the a-c power control panel is normally at MAIN position for automatic operation of the transformer circuit. (See figure 1-19.) When malfunction makes it necessary to bypass the autopilot transformer, the flight instrument transformer switch may be positioned to STANDBY to connect the flight instruments to the stand-by transformer.

VOLTAGE REGULATOR RHEOSTATS. The voltage regulators are preset on the ground, but in an *emergency only* may be adjusted in flight by means of two rheostats, one on each generator control panel. (See figure 1-19.) The rheostats are guarded by a fixed cover, held in place by one screw, which must be removed for access to the rheostat.

CIRCUIT BREAKERS AND FUSES. Circuits in the direct-current system are protected by push pull circuit breakers or circuit-breaker switches. Two circuit-breaker panels are located on the left side of the pilot's compartment, one near the left rudder pedal, and the other above the left console. (See figure 1-20.) Two circuit breakers are located on the bomb arming control box above the right console. Alternating-current circuits are protected by replaceable fuses and push-pull circuit breakers, mounted on a panel at the left side of the tunnel forward of third crewman's station. On some airplanes,* additional fuses for interior lighting are mounted on the aft end of the center console.

ELECTRICAL SYSTEM INDICATORS.

D-C VOLTAMMETERS. Two voltammeters are mounted on the lower right side of the instrument panel. (See 19, figure 1-5.) The indicators give direct voltage and current readings for each generator.

A-C VOLTMETER AND SELECTOR SWITCH. A voltmeter and rotary-type selector switch are installed on the a-c power control panel on the right console. The voltmeter adjacent to the selector switch indicates output of the individual inverter or inverter phase selected when the switch is moved from the OFF position. The voltage selector switch may be positioned at FLT. INST. INV. (A or C phase), ENG. INST. INV. (A or C phase), or at MAIN INV.

HYDRAULIC POWER SUPPLY SYSTEMS.

Hydraulic power for the airplane is supplied by two systems, a utility system and an emergency system. (Hydraulic boosts for the flight control system are described in FLIGHT CONTROL SYSTEM in this section.) An automatic cooler installation in each nacelle maintains desired hydraulic fluid temperatures for the utility hydraulic system. For hydraulic fluid specification, see figure 1-27.

UTILITY HYDRAULIC POWER SYSTEM.

The utility hydraulic power system supplies power for normal operation of the main landing gear wheel brakes, which have an automatic priority on available hydraulic pressure, the cabin compressor motor, the jet-engine air intake door, the bomb bay doors, the arresting gear hook, the landing gear, the landing gear fairing doors, and the wing flap motor. Utility operating pressure (3000 psi) is supplied by two variable-volume pumps, one mounted on each reciprocating-engine accessory section. Fluid for

---

*Airplanes 124850 through 124864

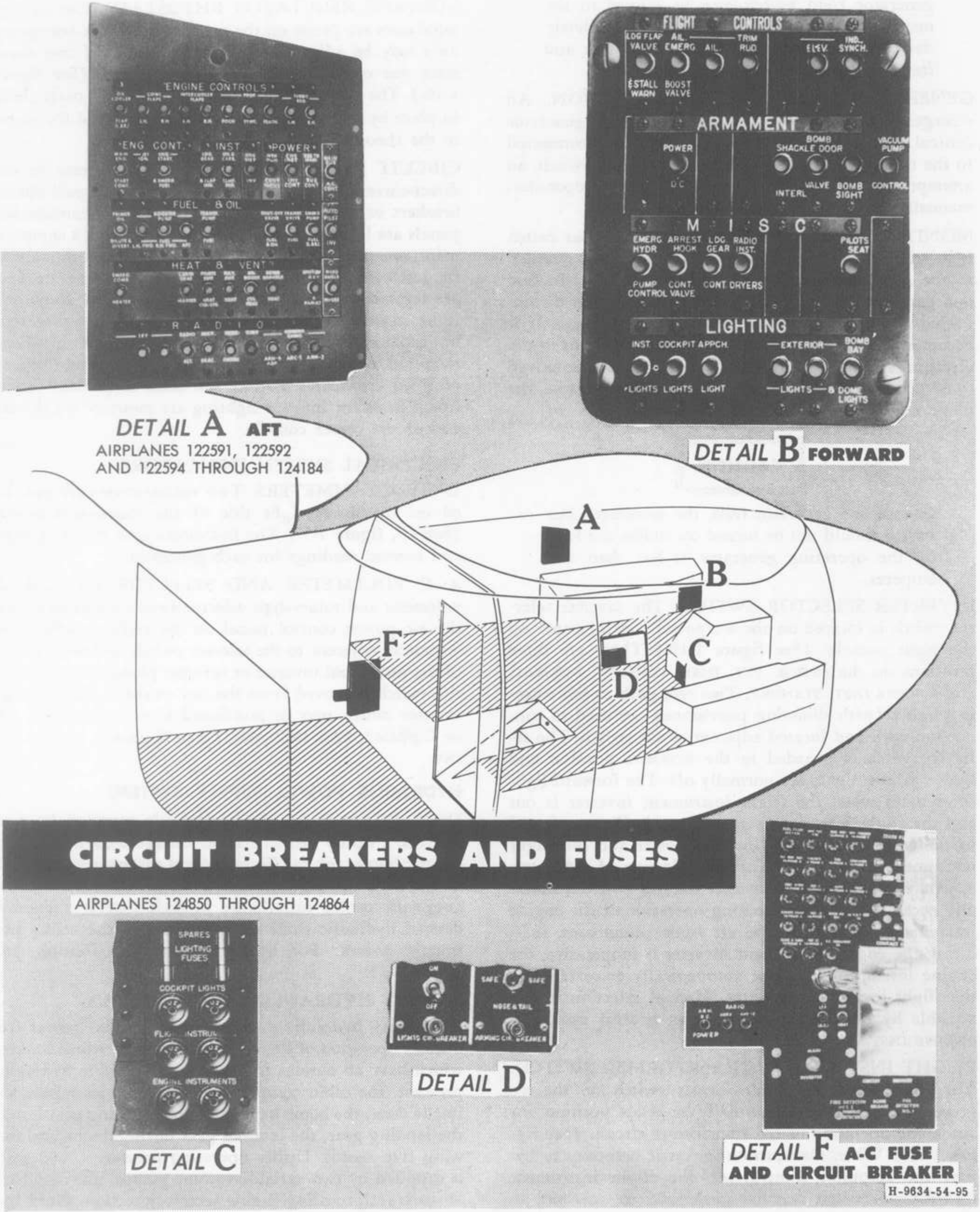

ENGINE CONTROLS
ENG. CONT.
INST.
POWER
FUEL & OIL
HEAT & VENT
RADIO
DETAIL A AFT
AIRPLANES 122591, 122592
AND 122594 THROUGH 124184
FLIGHT CONTROLS
LDG FLAP VALVE
AIL. EMERG.
AIL.
TRIM RUD.
ELEV.
IND. SYNCH.
STALL WARN
BOOST VALVE
ARMAMENT
POWER
DC
BOMB SHACKLE DOOR
INTERL
VALVE
BOMB SIGHT
VACUUM PUMP
CONTROL
MISC
EMERG HYDR
ARREST HOOK
LDG GEAR
RADIO INST.
PUMP CONTROL VALVE
CONT.
CONT.
DRYERS
PILOTS SEAT
LIGHTING
INST. LIGHTS
COCKPIT LIGHTS
APPCH. LIGHT
EXTERIOR LIGHTS
BOMB BAY & DOME LIGHTS
DETAIL B FORWARD
A
B
C
D
F
CIRCUIT BREAKERS AND FUSES
AIRPLANES 124850 THROUGH 124864
SPARES
LIGHTING FUSES
COCKPIT LIGHTS
FLIGHT INSTRU.
ENGINE INSTRUMENTS
DETAIL C
ON
OFF
LIGHTS CIR. BREAKER
SAFE
SAFE
NOSE & TAIL
ARMING CIR. BREAKER
DETAIL D
RADIO
POWER
DETAIL F A-C FUSE AND CIRCUIT BREAKER
H-9634-54-95

Figure 1-20.

the system is stored in a 4.4-gallon reservoir, located in the upper forward section of the bomb bay. Two fluid level indicators, which show full and refill levels, are mounted on the reservoir. A system pressure gage and a remote pressure indicator are provided. In this closed-center pressure system, fluid flows under pump pressure through a selector valve to the cabin compressor motor and to the pressure port of the selector valves, located on the bulkhead forward of the bomb bay returning to the reservoir from the cabin compressor motor if no unit is being operated. (See figure 1-21.) When any unit in the system except the jet duct door is operated, a selector valve controlling flow of fluid to the cabin compressor is automatically energized, turning the compressor motor off and reserving all fluid flow for other units in the utility system. As soon as the operation is completed, except when the landing gear is lowered, fluid is diverted back to the cabin compressor.

HYDRAULIC RESERVOIR FILLING VALVE.

If necessary, the hydraulic reservoirs can be refilled in flight when additional fluid is available. A filling tube is stowed at the side of the emergency hydraulic panel (figure 1-22) to provide for filling reservoirs from a one-gallon container. A filling valve on the panel, when moved from OFF to FILL, allows fluid to be pumped from the container to the reservoirs when the emergency pump switch is held at ON FILLING.

Note

Refer to the filling instructions placard on the emergency hydraulic panel for proper procedures. (See figure 1-22.)

UTILITY HYDRAULIC SYSTEM CONTROLS.

Hydraulic selector valves, which control the various units in the utility system, are located on the aft bulkhead of the crew entry compartment. (See figure 1-22.) Normally, these selector valves are electrically actuated by movement of remote controls. In case of electrical failure, each valve can be manually operated.

Note

To operate any unit, except the jet duct door, in the utility hydraulic power system when no electrical power is available, the valve controlling the unit which is to be operated and the cabin compressor valve must be actuated. Both valves must be actuated and the unit valve held until operation of the unit is completed.

In case of complete failure of the utility hydraulic system, the emergency hydraulic system is available for hydraulic power as long as the electrical system is operating. Emergency hydraulic system controls are located on a panel in the aft section of the crew entry compartment. (See figure 1-22.)

CABIN COMPRESSOR SELECTOR VALVE HANDLE. A handle is provided for manual operation of the cabin compressor selector valve. (See figure 1-22.) To turn the cabin compressor off and supply operating pressure to the utility system, the handle should be rotated forward 90 degrees; the handle will remain forward until manually returned to the original position to restart the cabin compressor.

CABIN AIR COMPRESSOR CIRCUIT GROUND TEST SWITCH. A switch for ground testing the cabin air compressor circuit is located on the aft bulkhead of the crew entry compartment. (See figure 1-22.) Normally, the cabin air compressor is off when the landing gear is extended, ensuring full pressure to the gear. When the switch is moved from NORMAL to TEST, a flight condition is simulated and the cabin compressor valve is de-energized, starting the compressor. The test switch is primarily for maintenance check.

Note

Do not operate cabin compressor longer than 2 minutes on the ground, as ram air is not available to cool the heat exchanger, and damage may result from overtemperatures.

HYDRAULIC FLUID LEVEL INDICATORS.

Each of the three hydraulic reservoirs has a fluid level sighting provision. The utility system and boost system reservoir fluid level is shown for two conditions, FULL and REFILL. The emergency system reservoir fluid level indicator shows FULL, ACCUMULATOR CHARGED, REFILL, and intermediate levels.

UTILITY HYDRAULIC SYSTEM PRESSURE GAGE.

A pressure gage for the utility system is located above the hatch leading to the bomb bay from the crew entry compartment. (See figure 1-22.) Normal operating pressure is 3000 psi. Utility pressure may also be read on an indicator located at the pilot's station.

REMOTE INDICATING HYDRAULIC PRESSURE GAGE.

Readings of individual flight control boost pressures and utility hydraulic power system pressure may be obtained through use of a six-position boost pressure indicator selector switch in conjunction with a single hydraulic pressure indicator. (See 4, figure 1-6.) When the switch is positioned at UTILITY, AIL, ELEV, RUD, or RUD ELECT MOTOR PUMP, the respective pressure readings can be obtained when controls are actuated. The sixth position is OFF. Both the selector switch and the pressure gage are located on a panel above the left console.

EMERGENCY HYDRAULIC POWER SYSTEM.

An electrically driven pump supplies pressure for emergency operation of the landing gear (down), wing flaps (down), jet-engine duct door (close), bomb bay doors (open or close), and parking brakes. Fluid is supplied from a 3.75-gallon capacity reservoir, located in the nose wheel well. A fluid level indicator, mounted on the reservoir, is visible on the bulkhead, forward of the third crewman's seat. The various units operated by the emergency hydraulic system are controlled by manual operation of emergency controls on the emergency hydraulic control panel. The parking brakes are operated

HYDRAULIC SYSTEMS

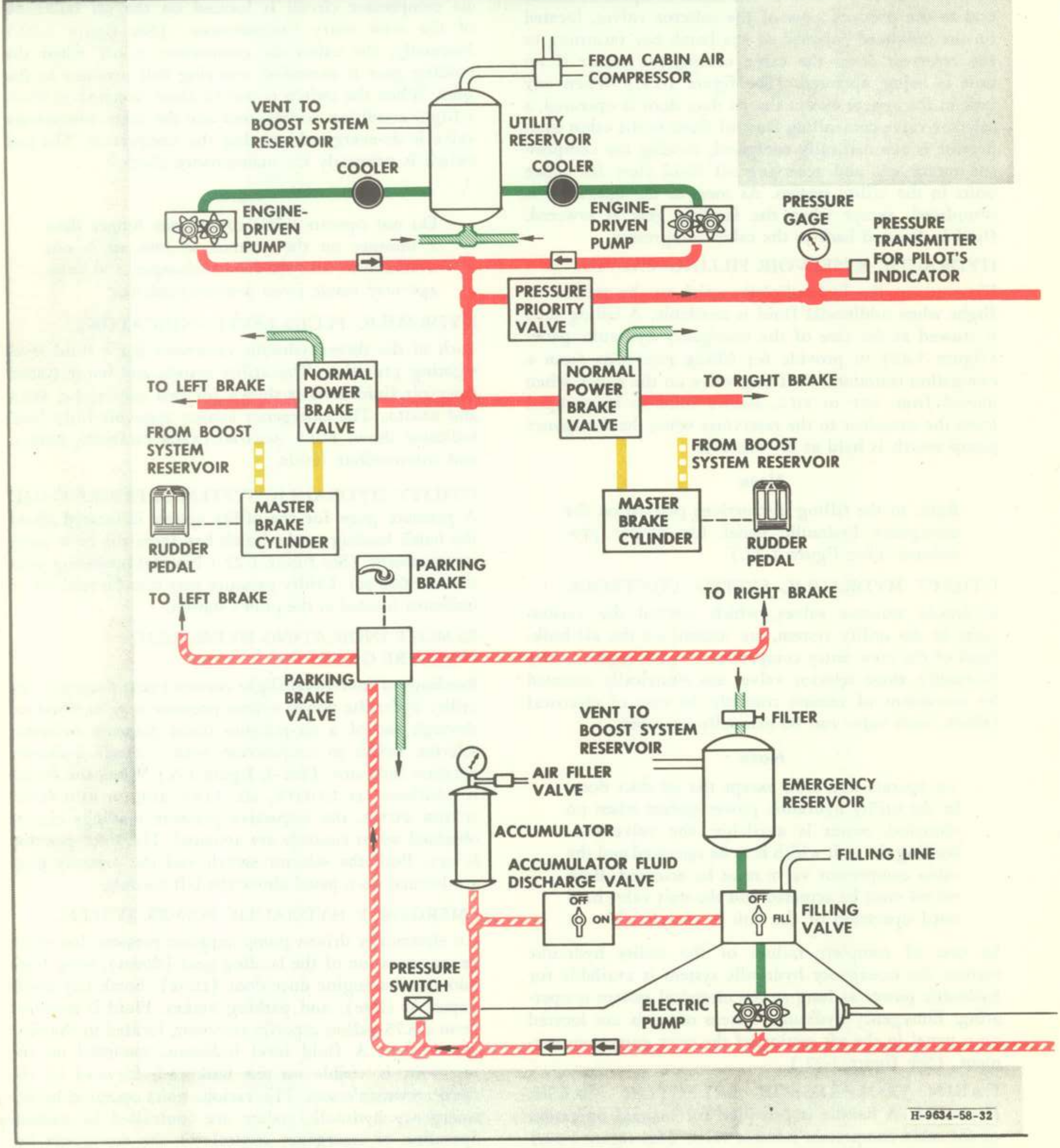
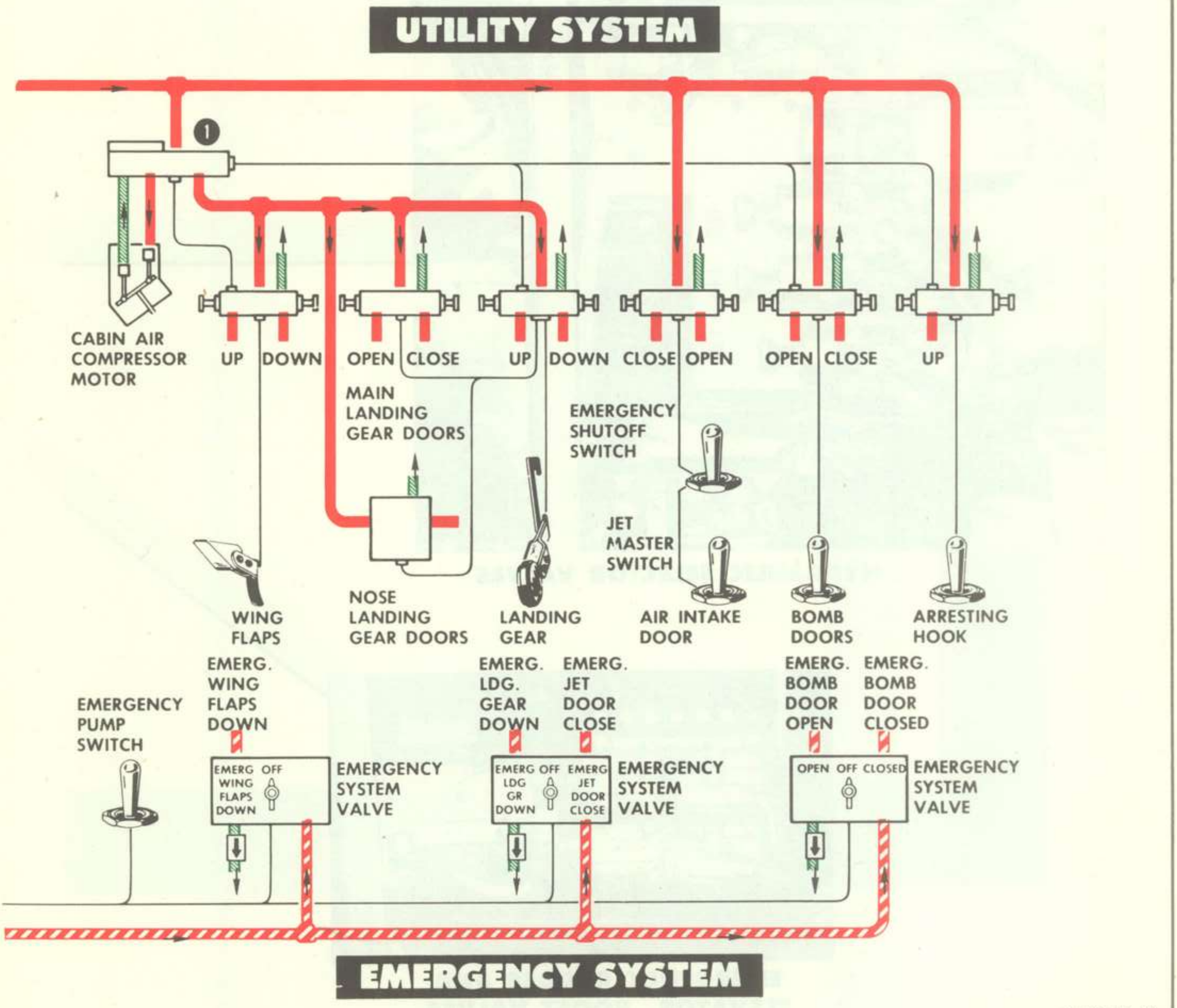


Figure 1-21. (Sheet 1 of 2)

① Normally, the cabin air compressor selector valve is de-energized and utility pressure is directed to the cabin compressor motor and to the wing flap, landing gear doors and landing gear selector valves. Whenever any unit in the utility system, except the jet duct door, is actuated, the cabin air compressor selector valve is automatically energized, cutting off utility pressure to the cabin compressor motor. This is done to ensure full pressure and flow for selected operation. When operation is complete, except when landing gear is DOWN, flow is diverted back to cabin compressor motor.

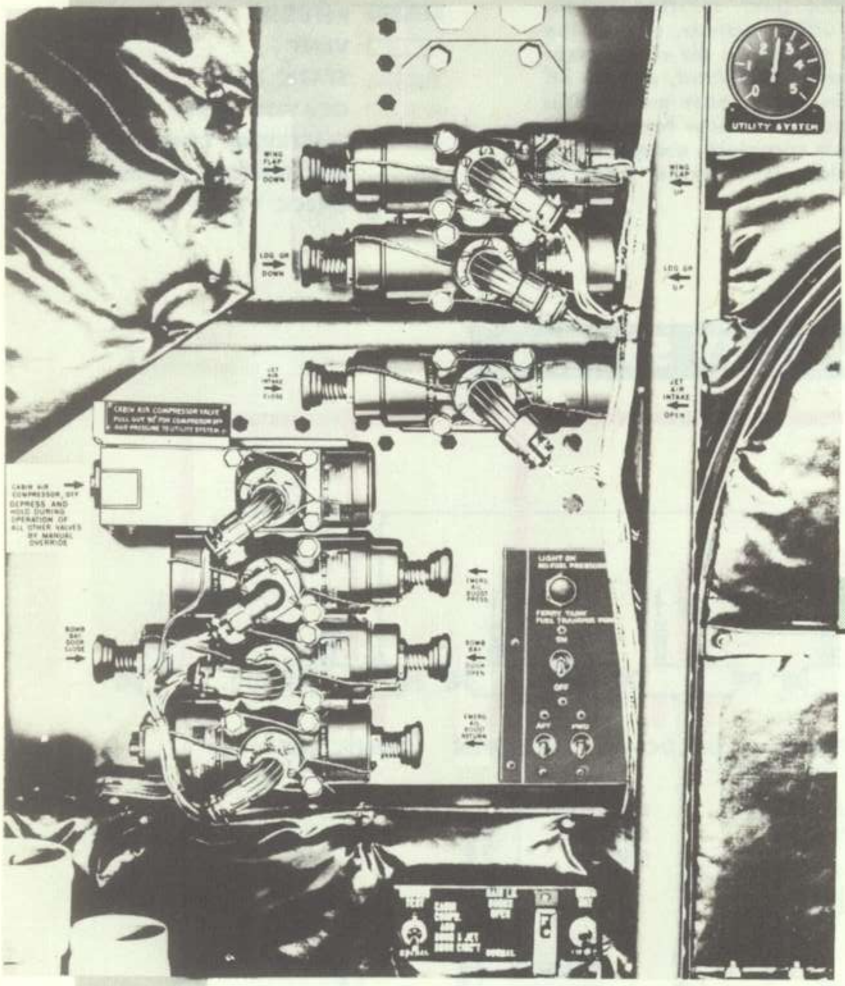
🟩 SUPPLY
🟥 UTILITY PRESSURE
▨ EMERGENCY PRESSURE
▨ RETURN
☐ VENT
🟨 STATIC FLUID
▨ GRAVITY FLOW
— ELECTRICAL CONNECTION
---- MECHANICAL CONNECTION
⇦ CHECK VALVE



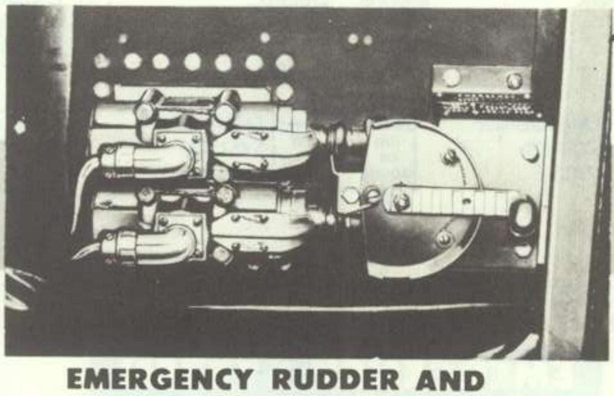
H-9634-58-33

Figure 1-21. (Sheet 2 of 2)

Emergency HYDRAULIC CONTROLS

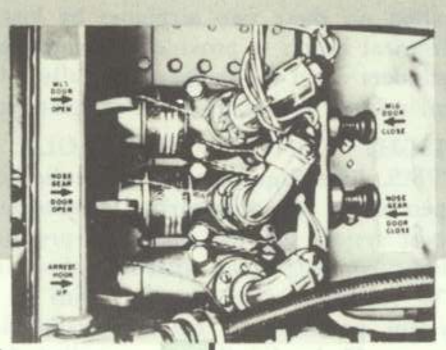


HYDRAULIC SELECTOR VALVES

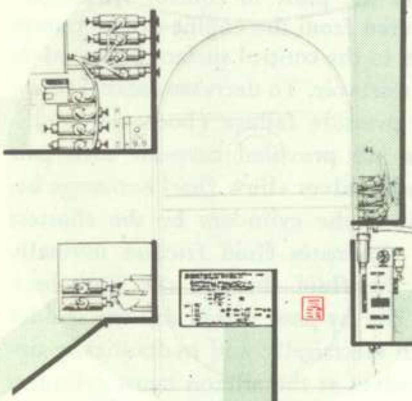


EMERGENCY RUDDER AND ELEVATOR BOOST VALVES

Figure 1-22. (Sheet 1 of 2)



HYDRAULIC SELECTOR VALVES



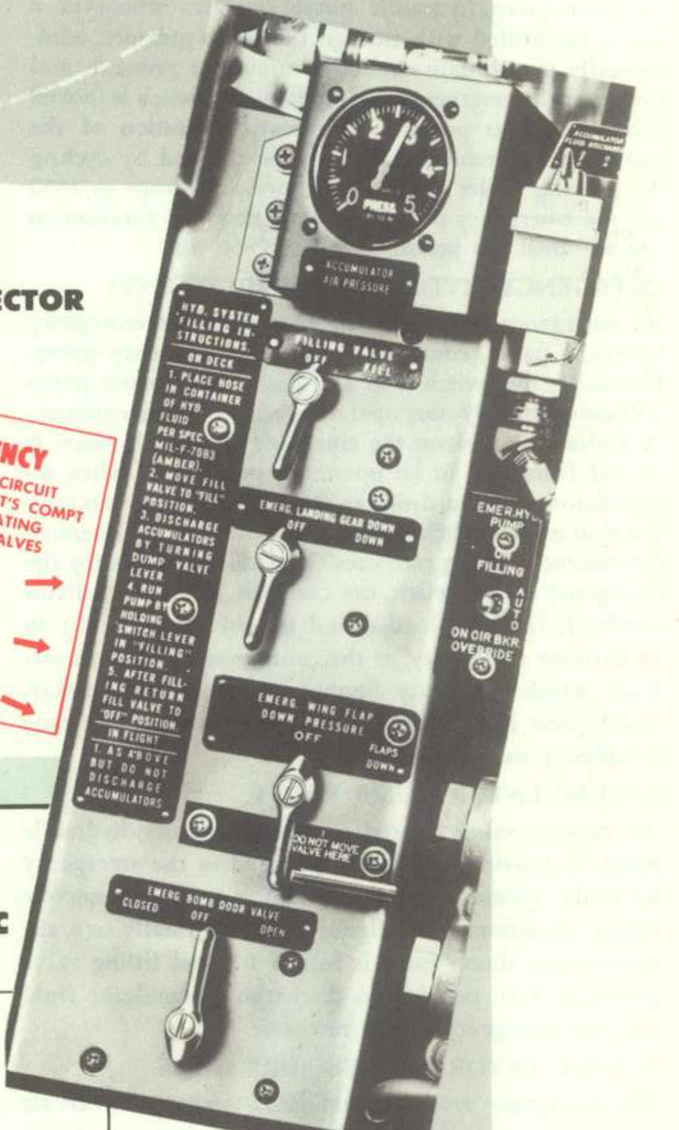
EMERGENCY

PULL PROPER CIRCUIT BREAKERS IN PILOT'S COMPT BEFORE OPERATING EMERGENCY VALVES

LDG GEAR DOWN →

WING FLAP DOWN →

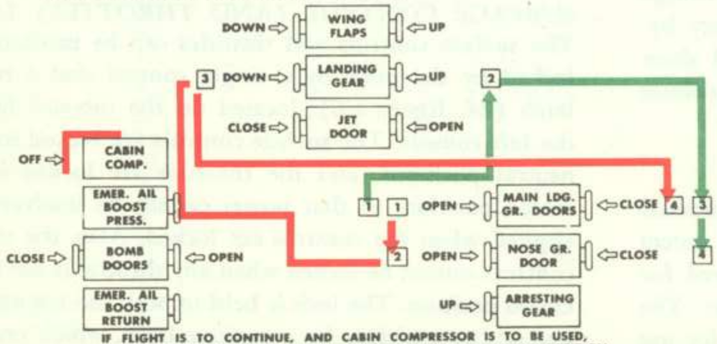
BOMB DOORS OPEN CLOSE →



EMERGENCY HYDRAULIC PANEL

FOR EMERGENCY OPERATION OF LANDING GEAR, WING FLAPS, OR BOMB DOORS, USE EMERGENCY PANEL

IF EMERGENCY PANEL IS INOPERATIVE, UTILITY SYSTEM SELECTOR VALVES MAY BE MANUALLY ACTUATED, PULL PROPER CIRCUIT BREAKERS IN PILOT'S COMPARTMENT. OPERATE CABIN COMPRESSOR MANUAL OVERRIDE HANDLE TO OFF. THIS DIVERTS FULL FLOW TO UTILITY SYSTEM. FOLLOW RED MARKINGS FOR LDG. GEAR DOWN, AND GREEN MARKINGS FOR LDG. GEAR UP. HOLD BUTTON UNTIL OPERATION IS COMPLETED.



IF FLIGHT IS TO CONTINUE, AND CABIN COMPRESSOR IS TO BE USED, RETURN CABIN COMPRESSOR MANUAL OVERRIDE HANDLE TO NORMAL POSITION.

INSTRUCTIONS FOR MANUAL OPERATION OF UTILITY SYSTEM

169-58-2027

Figure 1-22. (Sheet 2 of 2)

by pressure from a hydraulic accumulator, and are operable when neither utility hydraulic system pressure nor electrical power is available. An air pressure gage for the accumulator is located on the emergency hydraulic panel. The emergency hydraulic pump operates whenever a unit is controlled with emergency system pressure, automatically to maintain desired accumulator pressure, and whenever the emergency hydraulic pump switch is moved from the AUTO position. Automatic operation of the emergency hydraulic pump may be checked by cycling the parking brake valve. When pressure drops to 2550 psi, the emergency pump will start and will continue to operate until the pressure reaches 2850 psi.

EMERGENCY HYDRAULIC PUMP SWITCH.

An emergency pump switch, located on the emergency hydraulic panel, controls the electric emergency pump. Normally, the switch is at AUTO, and the electric pump will automatically start operating whenever the emergency hydraulic valve on the emergency hydraulic panel is moved from OFF to an operating position or when accumulator pressure drops to 2550 psi. The ON FILLING position of the switch is used when the pump is operated for reservoir filling purposes. The third position for the emergency pump switch, ON CIR. BKR. OVERRIDE (circuit breaker), is spring-loaded and should be used only in an extreme emergency, as the continuous electrical overload, which originally "popped" the circuit breaker, could cause the emergency hydraulic pump to become completely inoperative.

ACCUMULATOR DUMP VALVE.

An ON-OFF valve located on the emergency hydraulic panel, is provided to dump the fluid in the emergency hydraulic system accumulator and is used in reservoir filling operations. (See figure 1-22.) Normally OFF, the accumulator dump valve is turned ON and filling valve placed to FILL position to discharge accumulator fluid into the emergency system reservoir.

ACCUMULATOR AIR PRESSURE GAGE.

The emergency system accumulator is charged with air pressure to approximately 1200 psi. This pressure charge is indicated on a gage located on the emergency hydraulic panel. (See figure 1-22.) This gage will show accumulator air pressure only when hydraulic pressure has been dumped.

FLIGHT CONTROL SYSTEM.

The primary flight control system is a conventional cable-type system. An open-center boost hydraulic system is incorporated to reduce the pilot forces required for movement of the ailerons, elevators, and rudder. The rudder has an alternate boost hydraulic system for use in case the normal system does not function properly. The control wheel provides adequate control for ailerons in a boost-out condition and aerodynamically balanced elevators provide adequate control in case of elevator boost failure. Airplanes 124161 and 124181 have satisfactory boost out elevator forces by a series of elevator tabs. The aerodynamically balanced elevator will be installed on these two airplanes by kits. An automatic electrical heater is provided to warm the aileron boost cylinders when the temperature falls below 0°F. A control column shaker provides adequate stall warning.

FLIGHT CONTROL HYDRAULIC BOOST SYSTEMS.

The flight control hydraulic boost systems are open-center (nonpressurized) systems. The normal boost system supplies operating pressure for all three flight controls — the ailerons, elevators, and rudder. The rudder is also provided with an alternate boost system powered by an electrically driven hydraulic pump. Hydraulic flow is supplied from a reservoir through two engine-driven, constant-volume pumps to the normal boost system. Deflection of any control surface operates a boost valve, which restricts the open-center hydraulic flow, causing pressure to build up. This pressure is applied to the actuating cylinder at the control surface to aid the pilot in control movement. Normally, flow is routed from the engine-driven pumps through flow dividers to the control surface boost valves and then back to the reservoir. To decrease control forces in case of hydraulic pressure failure (boost-out condition), by-pass valves are provided between each pair of cylinder ports. These valves allow fluid exchange between opposite ends of the cylinders by the shortest possible route. This eliminates fluid friction normally caused by pumping the fluid through the lines back to the boost valve. The by-pass valves for the rudder and elevator are both electrically and hydraulically operated. The by-pass valves at the aileron boost cylinders are solenoid-operated and controlled by the aileron boost switch mounted on the reciprocating-engine control panel above the left console (figure 1-9). The rudder and elevator boost control switch is mounted adjacent to the aileron boost switch. Manual displacement of all flight controls is satisfactory except for the rudder, which has its own alternate boost system to provide it with normal boost.

SURFACE CONTROL (AND THROTTLE) LOCK.

The surface controls and throttles can be mechanically locked by the pilot by a single control and a related latch (24, figure 1-6), located on the inboard face of the left console. The surface controls are locked in their neutral positions, and the throttles are locked in the closed position, so that power cannot be inadvertently applied when the controls are locked. Also, the surface controls cannot be locked when any throttle is out of the closed position. The lock is held in both the LOCKED and UNLOCKED positions by a positive latch, which prevents movement from vibration. When the latch is released and the lock handle is pulled aft, the throttles will automatically be retarded to the CLOSED position. Then the controls can be moved until the locks engage their neutral positions.

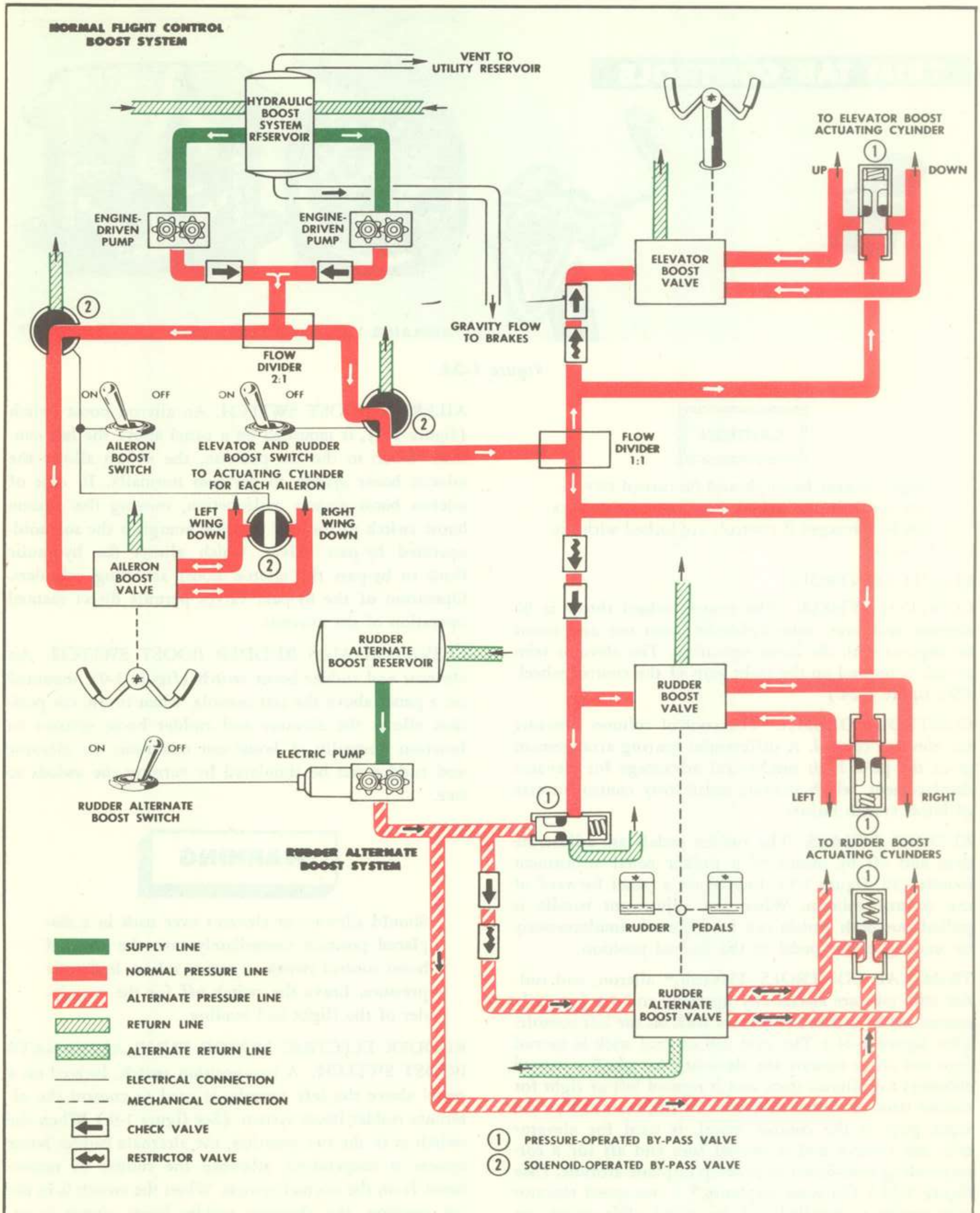


Figure 1-23. Flight Control Boost System

Figure 1-24.

CAUTION

Flight control boost should be turned OFF before controls are locked. Surface control locks may be damaged if controls are locked with the boost on.

FLIGHT CONTROLS.

CONTROL WHEEL. The control wheel throw is 90 degrees each way with hydraulic boost out and about 80 degrees with the boost operating. The elevator trim switch is located on the right grip of the control wheel. (See figure 1-24.)

CONTROL COLUMN. The control column provides for elevator control. A differential gearing arrangement gives the pilot high mechanical advantage for elevator displacement, which permits satisfactory control in case of boost system failure.

RUDDER PEDALS. The rudder pedals are adjustable fore and aft by means of a rudder pedal adjustment handle (28, figure 1-5), located on a panel forward of the control column. When the adjustment handle is pulled out both pedals can be adjusted simultaneously by moving either pedal to the desired position.

TRIM TAB CONTROLS. Elevator,* aileron, and rudder trim tabs are electrically operated and are manually controlled by a trim tab control stick on the left console. (See figure 1-24.) The trim tab control stick is moved fore and aft to operate the elevator trim tabs,* is moved sideways for aileron trim, and is rotated left or right for rudder trim. A thumb-slide trim switch, mounted on the right grip of the control wheel, is used for elevator trim tab control and is moved fore and aft for a corresponding nose-down or nose-up airplane attitude. (See figure 1-24.) On some airplanes,* a two-speed elevator trim system is installed and the thumb slide switch, on the wheel is used for high speed trim.

AILERON BOOST SWITCH. An aileron boost switch (figure 1-9), is mounted on a panel above the left console. When in the ON position, the switch allows the aileron boost system to perform normally. In case of aileron boost system malfunction, moving the aileron boost switch to the OFF position energizes the solenoid-operated by-pass valves, which allows the hydraulic fluid to by-pass the aileron boost actuating cylinders. Operation of the by-pass valves permits direct manual operation of the ailerons.

ELEVATOR AND RUDDER BOOST SWITCH. An elevator and rudder boost switch (figure 1-9), mounted on a panel above the left console, when in the ON position allows the elevator and rudder boost systems to function normally. A boost out condition for elevator and rudder can be simulated by turning the switch to OFF.

WARNING

Should ailerons or elevator ever stick in a displaced position immediately turn the affected boost control switch to OFF to relieve hydraulic pressure. Leave the switch off for the remainder of the flight and landing.

RUDDER ELECTRIC MOTOR PUMP ALTERNATE BOOST SWITCH. A two-position switch, located on a panel above the left console, is used to control the alternate rudder boost system. (See figure 1-9.) When the switch is in the OFF position, the alternate rudder boost system is inoperative, allowing the rudder to receive boost from the normal system. When the switch is in the ON position, the alternate rudder boost system is energized, and the normal boost system is by-passed.

***Airplanes 124161 and 124181 only**

FLIGHT CONTROL SYSTEM INDICATORS.

TRIM TAB POSITION INDICATOR. A trim tab position indicator (26, figure 1-6) is located on the left console, adjacent to the trim tab control stick. (See figure 1-24.) Degrees of displacement from a neutral position are given for each trim tab.

STALL WARNING SYSTEM. A stall warning system consists of a static and an impact pressure vent on the upper surface of the right wing, a pressure switch, and an electrical motor attached to the control stick. When a stall condition is approached, the decrease in pressure differential between the two vents closes the pressure switch, energizing the electrical motor which rotates an eccentric weight and causes the stick to shake. When the weight of the airplane is on the gear, the system is rendered inoperative through connection with a landing gear ground safety switch.

WING FLAPS.

Electrically controlled, hydraulically actuated wing flaps on each wing panel extend from aileron to nacelle and from nacelle to fuselage. The flap system is controlled by a hydraulic selector valve, which determines direction of rotation of the flap hydraulic motor. Each flap is operated by a screwjack actuator mechanically interconnected to torque rods to synchronize flap travel. Flaps are prevented from changing position due to air loads by a non-reversing clutch in the flap gear box. A control handle and position indicator are provided at the pilot's station, and emergency control provisions are located in the crew entry compartment.

WING FLAP CONTROLS.

WING FLAP CONTROL HANDLE. The wing flaps are positioned by means of a control handle (5, figure 1-6), located on the throttle quadrant. Movement of the control handle energizes the selector valve to direct pressure to the hydraulic motor to move the flaps to the desired degree. Position of the flaps roughly approximates the relative position of the control handle. Indentations at the top and bottom of the handle guide are provided to secure the control handle in full UP or DOWN positions. Movement of the flap control handle must be correlated with the flaps position indicator for selection of intermediate flap positions. The flaps remain in the selected position until the flap control handle is repositioned. When the flap handle is in the UP position, the hydraulic selector valve cannot be energized to lower the flaps unless manually operated.

WING FLAP SELECTOR VALVE. If utility hydraulic pressure is available, but electrical power is lost, flaps may be raised or lowered (after the LDG. FLAP circuit breaker has been pulled out) by manual operation of the hydraulic selector valve in the crew entry compartment. The handle on the cabin air compressor selector valve should be rotated out to divert all utility pressure to the utility units and the manual override button on the wing flap selector valve depressed until desired flap position is reached. The cabin air compressor valve handle should then be rotated to its original position to restart the cabin compressor motor.

WING FLAP EMERGENCY CONTROL. Emergency hydraulic pressure may be selected to lower the flaps in the event of utility system failure, providing electrical power is available. The wing flap emergency control is located on the emergency hydraulic panel in the crew entry compartment. (See figure 1-22.) The normal flap control handle should be in the DOWN position when using emergency pressure. When the emergency control is moved from OFF to FLAPS DOWN (after the LDG. FLAP circuit breaker has been pulled out), the emergency hydraulic pump is started and the emergency valve is positioned so that emergency pressure actuates the flaps to the full down position. For intermediate flap positions, the control must be turned OFF when the desired degree of flap is obtained. The emergency control should be turned OFF after completion of flap operation to avoid overheating the emergency system. There are no provisions for raising the flaps by emergency hydraulic pressure.

WING FLAP POSITION INDICATOR.

A flap position indicator (36, figure 1-5), located on the pilot's instrument panel, is marked UP, ½, and DOWN and has lines to designate the ¼ and ¾ positions.

LANDING GEAR SYSTEM.

The landing gear and the fairing doors are hydraulically actuated and electrically controlled. The main gear retracts aft into the nacelles, and the nose gear retracts aft into the fuselage. A safety switch on the left landing gear prevents retraction of the landing gear when the weight of the airplane is on the gear. The nose gear assembly incorporates a conventional shimmy damper and a self-centering device, which is effective within a range of 30 degrees right or left of center. A guard is installed on the nose wheel fork to prevent the nose wheel from twisting upon contact with the barrier actuating strap. The main gear fairing doors close after extension or retraction of the gear, but the nose gear door closes only when the nose gear is retracted. For ground maintenance purposes, the main landing gear doors can be opened with the landing gear extended.

LANDING GEAR CONTROLS.

LANDING GEAR CONTROL HANDLE. The gear is normally operated by the landing gear control handle (14, figure 1-6) located on the forward end of the left console. Indentations are provided to hold the control handle either in UP or DOWN position. To lower the gear, the control handle should be moved to the down position slowly. When the control handle is placed in UP or DOWN position, the hydraulic selector valves are energized, fairing doors open and gear travels to the desired position and locks. If the control handle is moved to UP when the airplane is on the ground, the gear will not retract because of the safety switch. If the weight of the airplane is removed from the wheels while the control handle is in the UP position, the gear will not retract until the handle is moved to DOWN and back to UP. Gear operation can be reversed in either up or down cycle at any time without damage. Reversal in the up cycle causes the gear to return to the down position immediately. If the down cycle is reversed, however, the gear will continue to down-and-locked position before reversing.

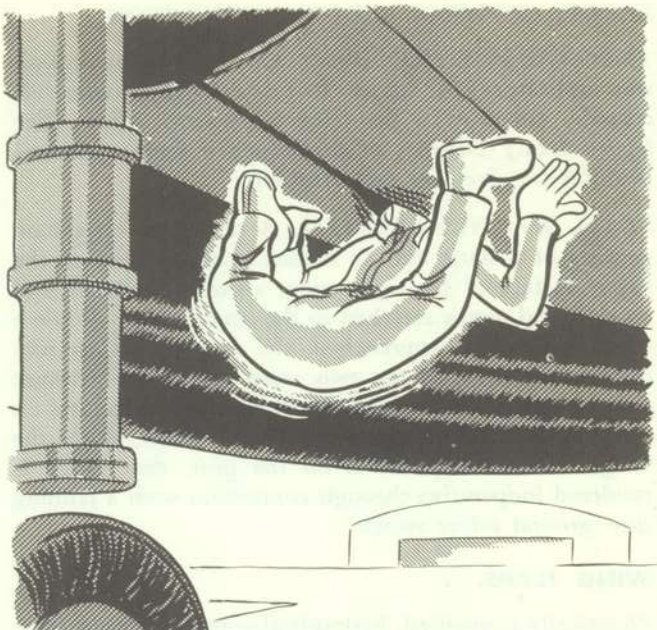
LANDING GEAR AND FAIRING DOOR SELECTOR VALVES. In the event of electrical failure, the landing gear may be lowered by operation of the proper hydraulic selector valves on the emergency hydraulic panel. (See figure 1-22.) Rotate the cabin compressor valve handle out (after pulling out the landing gear control valve circuit breaker), hold the fairing door selector valve at OPEN until doors are fully open, and then press the landing gear selector valve to DOWN until gear has extended and locked. The main fairing doors may be closed afterward by holding the fairing door selector valve at CLOSE while the cabin compressor valve handle is still OUT. Then rotate the cabin compressor valve handle to its original position. The nose gear door has no manual control. The door valve is energized when the main landing gear is selected down and remains energized until the gear is selected up. The door will be held open as long as power is available. Should either electrical or hydraulic failure occur, moving the main gear selector to the down position will release the landing gear uplocks and the weight of the gear will mechanically unlock the door which will then swing free.

CAUTION

> The landing gear selector valve should never be used while the weight of the airplane is on the landing gear.

LANDING GEAR EMERGENCY CONTROL. In the event of utility hydraulic system failure, the landing gear may be lowered, if electrical power is available, by operation of an emergency landing gear valve, located on the emergency hydraulic panel. Moving the valve from OFF to EMERG. LDG. GEAR DOWN, directs emergency hydraulic system pressure to the down side of the landing gear actuating cylinders. The first movement of the gear will unlock the fairing doors and the weight of the gear will open them. No emergency provisions are provided for retracting the landing gear.

MAIN LANDING GEAR DOOR SWITCH. A switch, on the panel below the hydraulic selector valves, is provided for opening the main gear fairing doors while the gear is extended. (See figure 1-22.) With hydraulic and electrical power available, the fairing doors may be opened by moving the switch from the guarded (NORMAL) position to MAIN L. G. DOORS OPEN. Moving the switch back to NORMAL closes the fairing doors. If no hydraulic or electrical power is available, the switch can be left at MAIN L. G. DOORS OPEN position to serve as a safety measure during mechanical operation. When switch is positioned at MAIN L. G. DOORS OPEN, the "close" side of the actuating solenoid is de-energized and the fairing doors can be operated mechanically by a handle located on the left fairing door of each nacelle.



WARNING

Be sure that nacelle areas are clear of personnel before main landing gear switch is returned to normal, after doors have been opened on the ground.

LANDING GEAR INDICATORS.

LANDING GEAR POSITION INDICATORS. The position of the landing gear is shown by a wheel position indicator (36, figure 1-5), mounted on the pilot's instrument panel. When the gear is up and the fairing doors closed, the word "UP" appears in the indicator windows. When the gear is extended and locked, wheels appear in the indicator windows. Any unlocked condition when the gear is extended or failure of the wheel doors to close during the retraction cycle is indicated by yellow and red crossmarks in the indicator windows. When battery switch is OFF, the yellow and red crossmarks appear in the indicator windows, regardless of gear position Nose gear position may be visually checked through a small porthole in the right side of the tunnel.

LANDING GEAR WARNING LIGHT. A red warning light illuminates the knob on the landing gear control handle whenever the gear is unlocked. As soon as the landing gear is locked (either up or down), the light will go out. The light is connected to the interior light rheostat and automatically dims* whenever the interior lights are turned on. On some airplanes† the warning light (37, figure 1-5) is on the instrument panel.

BRAKE SYSTEM.

Brakes on the main wheels are conventionally controlled by toe action on the rudder pedals. Hydraulic pressure for braking is routed from the utility system to a pressure priority valve then through a normal power brake valve for each wheel. Emergency and parking brakes are controlled by a single handle and powered by an accumulator.

EMERGENCY AND PARKING BRAKE CONTROL.

A handle (27, figure 1-5), located on the panel forward of the control column, controls emergency braking and parking brakes. The handle is pulled straight aft to apply braking pressure and will remain in the braked position. To release the brakes, the handle must be pulled and rotated clockwise then released. For emergency braking, the handle should be held in the rotated position and applied as needed.

CAUTION

If electric and hydraulic failures occur, use emergency brake cautiously as accumulator pressure will permit only three full brake applications.

CATAPULT EQUIPMENT.

Provisions for catapulting the airplane from a carrier deck consist of a catapult hook and a holdback fitting. The catapult hook is located just aft of the nose wheel well, and the holdback fitting is aft of the bomb bay. The holdback fitting and the catapult hook are faired by small doors when in the retracted position. The catapult hook can be extended by pulling a manual release handle located to the left of the hook fairing door. When the nose gear is retracted, the catapult hook retracts automatically. The holdback fitting can be extended manually by pushing a handle in the holdback fairing door. After the airplane is released, the holdback fitting retracts automatically. A spring-loaded throttle catapult handle is located forward of the throttle quadrant and swings down to assist the pilot in holding the throttle full OPEN during catapult take-off.

ARRESTING GEAR.

The arresting gear hook, located on the bottom part of the empennage, is lowered by a spring bungee and air pressure. The hook is retracted by a hydraulically operated cylinder.

ARRESTING GEAR CONTROLS.

ARRESTING HOOK RELEASE HANDLE. A handle (figure 1-11), located on the center console, is used to release the arresting hook for automatic lowering. The arresting hook release handle is provided with a ratchet-type lock to hold the handle in extended positions. To unlock the handle, press the handle release lever located adjacent to the arresting hook release handle.

Note

The arresting hook release handle should be pulled full out to ensure proper operation of the arresting gear.

ARRESTING HOOK RETRACT SWITCH. The hydraulic cylinder for retracting the arresting hook can be operated by a spring-loaded toggle switch (figure 1-11) located on the center console. To retract the hook, the release handle must be in hook-up position and the switch held forward until the red warning light goes out. A button-type switch for ground crew use in retracting the arresting hook is located on the aft part of the fuselage on the right side.

ARRESTING HOOK WARNING LIGHT.

A red warning light is located in the arresting hook release handle to indicate when the arresting hook is not safe. Light will illuminate whenever the hook is not locked in either the up or down position. On some airplanes,* the light is connected to the interior light rheostat and automatically dims whenever the interior lights are turned on.

BARRIER GUARD.

A streamlined, fixed barrier guard is mounted on the fuselage forward of the windshield.

WING AND VERTICAL FIN FOLDING.

To facilitate handling of the airplane aboard ship, provisions are made for folding the outboard wing panels and the vertical fin. Portable hydrauically actuated units are furnished and may be bolted to the inboard and outboard wing panels for the wing folding operation. Time for wing folding operation should be approximately 2 minutes for each cycle after hydraulic units are installed and folding preparations completed. For fin folding operation, a hand-operated screw jack is furnished as portable equipment.

CAUTION

Tip tanks must be empty for wing folding. With tip tanks installed, wings cannot be folded safely if wind exceeds 25 knots; without tip tanks, wings cannot be folded safely if wind exceed 45 knots.

---

*Airplanes 124850 through 124864
†Airplanes 122590 through 122601 and 124158 through 124184

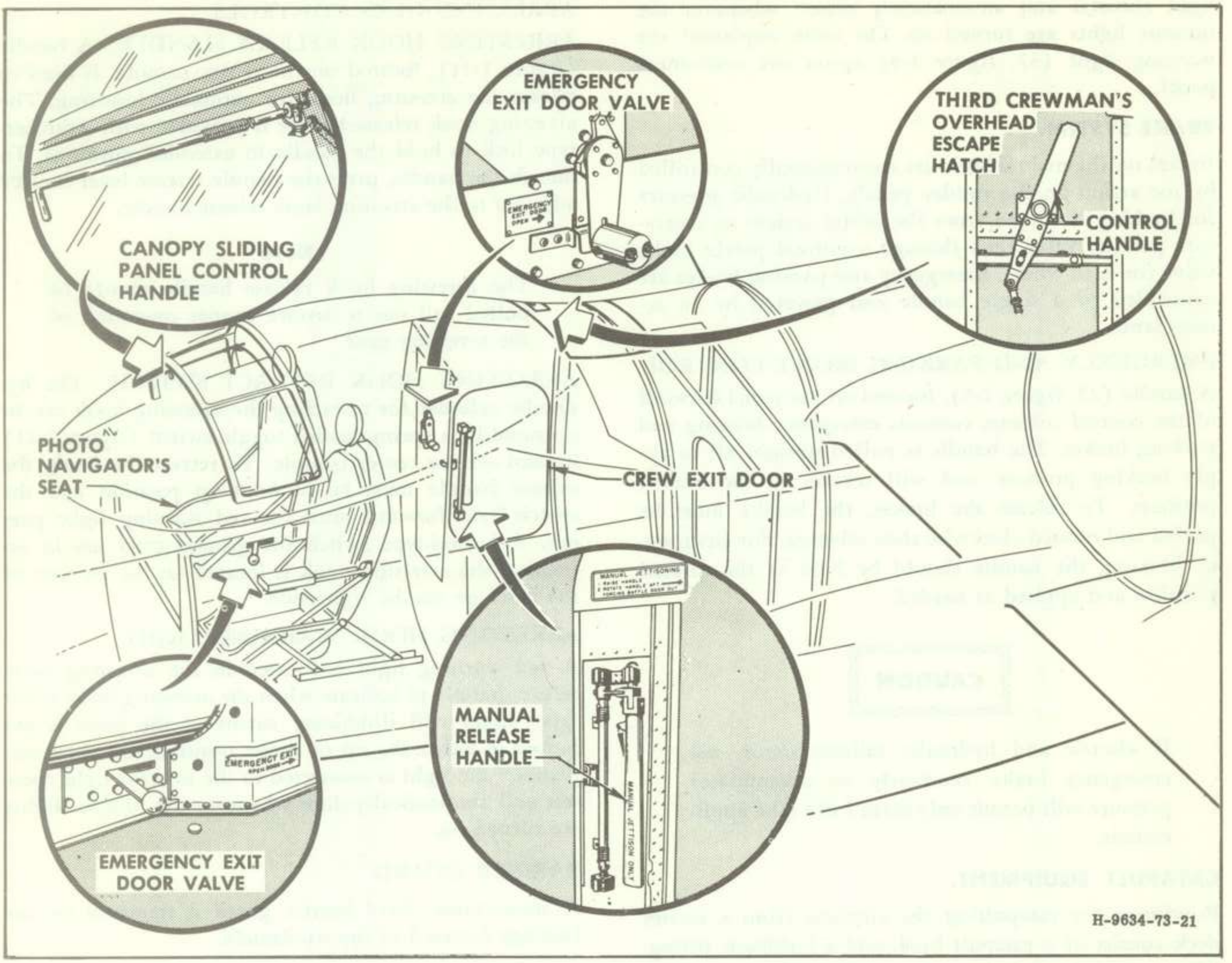


Figure 1-25.

FLIGHT INSTRUMENTS.

The automatic pilot instruments, consisting of master direction indicator, gyro horizon, and turn-and-bank indicator, operate on a-c electrical power supplied by the inverters of the airplane. The airspeed indicator is essentially a conventional airspeed indicator with the addition of a maximum airspeed indicating mechanism, which automatically indicates maximum allowable airspeed for the existing flight altitude. A yellow pointer shows indicated airspeed; a red and black striped pointer, maximum allowable airspeed. The instrument is preset for the limiting Mach number of the airplane, and the maximum airspeed indicating pointer moves to indicate the airspeed corresponding to the limiting Mach number at the existing flight altitude. Clockwise movement of the striped pointer is limited by a preset stop at the limiting structural airspeed of the airplane. When the two pointers meet, the airplane is moving at the maximum allowable speed or the limiting Mach number. At no time should the yellow pointer be allowed to cross over the striped pointer. Other associated flight instruments include a stand-by magnetic compass, a rate-of-climb indicator, a pressure altimeter, two radio altimeters, a cabin altitude indicator, a clock, a self-contained accelerometer, and a free air temperature gage. The tow-target package contains an airspeed indicator and pressure altimeter located on the reel operator's panel.

CREW DOOR.

A crew door is located on the right side of the fuselage just forward of the wing leading edge, and a ladder is stowed in the aft section of the tunnel equipment compartment. The crew door is normally opened by pulling either the inner or the outer handle on the door. The inner handle is recessed in the aft part of the door and is exposed to view. The outer handle is faired into the door skin and has a spring-loaded access cover just forward of the handle. The access cover is pushed in to provide access to the door handle. An integral wind deflector is mounted on the forward side of the door opening to deflect airflow, if the door is jettisoned for emergency exit.

EMERGENCY EXIT PROVISIONS AND CONTROLS.

The crew door may be jettisoned to provide emergency exit from the airplane. An air pressure system is provided to jettison the door and open the integral wind deflector. An air bottle and pressure gage are located forward of the door. The gage should be checked before each flight to ensure availability of sufficient pressure for operation. Two controls are provided for air pressure jettisoning of the door. (See figure 1-25.) One is located in the pilot's compartment on the bomber-navigator's seat and the other is just forward of the door. In addition, a manual release handle can be operated to jettison the door in case of failure of the air pressure system. Bomb bay doors should be closed when the door is being used for bail-out. An alternate means of escape is through the bomb bay doors; however, the cabin must be depressurized before the hatch to the bomb bay can be opened.

COCKPIT DOOR RELEASE HANDLE. An emergency crew exit control located below the bomber-navigator's seat provides means of jettisoning the crew door from the pilot's compartment. (See figure 1-25.) When the control is moved aft to OPEN DOOR, the door is jettisoned and the deflector opens out for a windbreak.

EMERGENCY EXIT DOOR VALVE HANDLE. A handle on the exit door valve, located forward of the door, provides emergency door operation. (See figure 1-25.) When the handle is moved aft to EMERGENCY EXIT DOOR OPEN, the door is jettisoned and the integral wind deflector opens out to serve as a windbreak.

MANUAL JETTISON HANDLE. If the emergency exit door fails to open by means of air bottle pressure, the door can be manually opened by a manual jettison handle on the door. For complete door operation, the handle must be raised and moved *aft* and outboard. When the handle is raised and rotated aft and outboard, the front hinge of the door is unlocked, and the integral wind deflector is forced outward. The outward movement of the wind deflector pushes the leading edge of the door into the slip stream. After the door jettisons or falls free, the wind deflector moves out into the slip stream to serve as a windbreak. (See figure 1-25.)

EMERGENCY EQUIPMENT.

ENGINE FIRE DETECTOR SYSTEM.

An Edison fire detector system is provided for all three engines. The fire control panel (figure 1-26), located on the left console, contains six lights, two for each engine, and a test switch. Illumination of either light indicates fire in the related engine area. A master fire-warning light, mounted on the instrument panel, illuminates in case of fire in any engine. The test switch provides a means of checking the entire fire detector circuit. When the switch is depressed, all detector lights should illuminate within 5 seconds. The lights are the push-to-test type, permitting check of individual bulb condition.

Figure 1-26.

CANOPY DITCHING PANELS.

Two sliding panels are provided in the canopy as a means of escape for the pilot and bomber-navigator in case of ditching or forced-landing emergencies. A single vertical control rod actuates opening, closing and locking of the panel. A short horizontal handle located overhead of each panel, locks or releases panel in the full open or intermediate positions. To open panel, pull the vertical rod inboard and aft. Panel will then open to the first intermediate position. To open panel further the short horizontal handle must be pulled down to release the intermediate latch. This handle is spring-loaded and when released will return to the locked position to engage the next intermediate latch.

OVERHEAD DITCHING HATCH.

A hatch is provided above the third crewman's station for use in ditching or forced landing emergencies. (See figure 1-25.) The hatch can be operated from inside or outside of the airplane by an interconnected handle assembly. Normally, the third crewman stands to the right side of his seat to operate the hatch. The handle is rotated counterclockwise until the hatch unlocks. The hatch is hinged on the left and will fall free after being unlocked; therefore, the operator must be careful to stand clear of the arc of travel and then lower the hatch cautiously. The hatch movement should trip an automatic release on the seat headrest, which is spring-loaded to clear the path. However, it is recommended that the operator release the headrest manually before lowering the hatch. The escape hatch swings fully open to the left side of the seat, where a bracket holds it. A fairing door, located on top of the fuselage aft of the canopy enclosure, can be opened by a spring-loaded release for access to the escape hatch exterior handle, when necessary. If this method of entry is used make sure the seat is not occupied.

SERVICING DIAGRAM

SPECIFICATIONS

FUEL — MIL-F-5572, AV GAS GRADE 115/145

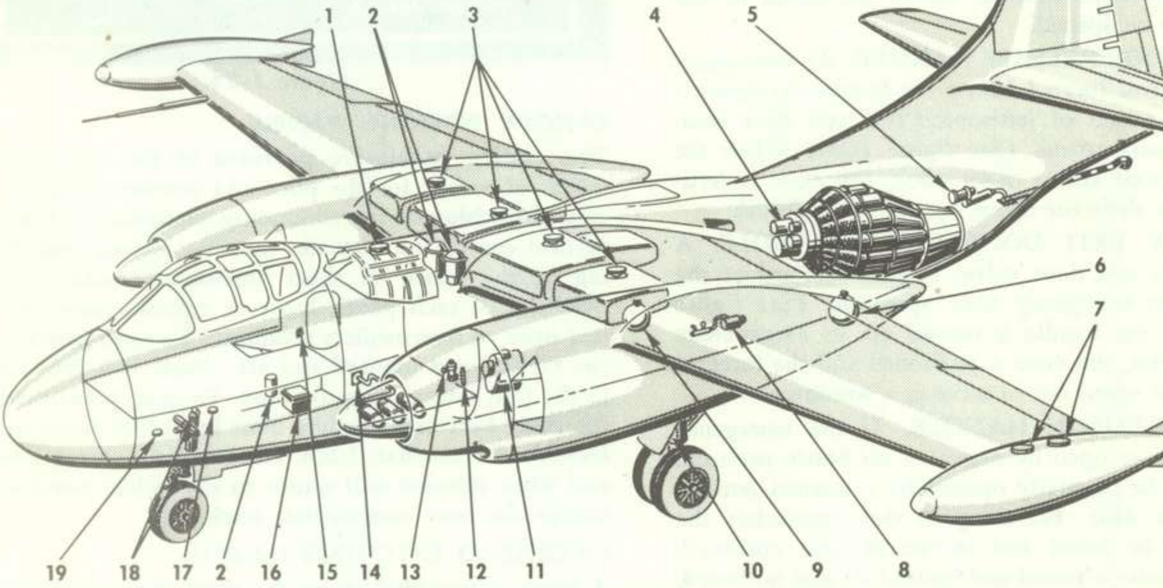
OIL — MIL-O-6082, GRADE 1100
(COLD WEATHER, GRADE 1065)

TURBO OIL — MIL-O-6082, GRADE 1065
[BELOW -9°C (15°F), MIL-O-6081, GRADE 1010]

JET OIL — MIL-O-6081, GRADE 1010

HYDRAULIC FLUID — MIL-F-7083 (AMBER)

AIR COMPRESSOR OIL — MIL-L-7870
(NAVY SYMBOLS 2075 AND 3042)



1 FUSELAGE FUEL TANK FILLER
2 HYDRAULIC SYSTEM RESERVOIRS
3 WING FUEL TANK FILLERS
4 JET-ENGINE OIL SYSTEM FILLER
5 ARRESTING GEAR SNUBBER
6 LONG-RANGE OIL TANK*
7 WING TIP FUEL TANK FILLERS*
8 RUDDER ALTERNATE BOOST RESERVOIR FILLING PUMP
9 TURBOSUPERCHARGER OIL TANK*
10 MAIN GEAR SHOCK STRUT FILLER*
11 RECIPROCATING-ENGINE OIL TANK*
12 HYDRAULIC SYSTEM RESERVOIR FILLING HOSE
13 HYDRAULIC SYSTEM ACCUMULATOR AIR FILLER
14 OXYGEN SYSTEM CHARGING VALVE
15 EMERGENCY EXIT DOOR AIR BOTTLE FILLER
16 BATTERY
17 COOLING PACKAGE OIL SUMP FILLER
18 NOSE GEAR SHOCK STRUT FILLER AND SHIMMY DAMPER FILLER
19 CABIN AIR COMPRESSOR OIL SUMP FILLER

*RIGHT SIDE SIMILAR

H-9634-00-24

Figure 1-27.

WINDSHIELD WIPER.

An electrically powered windshield wiper is mounted on the left windshield panel and controlled by a four position toggle switch located above the landing gear control level. The switch is marked FAST, SLOW, PARK-WIPER, and has a center OFF position. The wiper motor has sufficient power to operate during a normal approach pattern and is guarded against overload by a circuit breaker mounted on the heat and vent circuit-breaker panel on the left vertical console. The wiper should not be operated on dry glass.

FIRST-AID KIT.

A first-aid kit is located in the crew entry compartment at the third crewman's station. The kit should be checked periodically as to the condition of contents.

SEATS.

PILOT'S SEAT.

The pilot's seat is provided with a seat cushion, back cushion, armrests, a headrest, safety belt and shoulder harness with an inertia-lock reel. Seat position may be adjusted electrically. Operation of a toggle switch (5, figure 1-10) on the right side of the seat permits selective adjustment of position. The switch is spring-loaded to neutral. When the switch is held up, the seat adjusts forward and up; when the switch is held down, the seat adjusts aft and down. Provisions for pararaft kits are incorporated in the seat structure. In case of emergency, the seat back can be lowered by operation of the emergency seat-back release lever (8, figure 1-10) located on the forward right side of the seat. The lever is marked PUSH DOWN—ROTATE 90°—PULL UP. The armrests are movable and can be stowed by pulling them up and aft. A shoulder-harness lock control, located on the left side of the seat, is conventionally operated for manually locking and unlocking the shoulder harness.

BOMBER - NAVIGATOR'S SEAT.

The bomber-navigator's seat is equipped with a seat cushion, a back cushion, armrests, a headrest, a safety belt, and shoulder straps with inertia reel. To facilitate escape, the seat back may be lowered like the pilot's seat. When the lowering mechanism is actuated, a pin is pulled from the headrest allowing it to swing down and provide clear escape passage.

THIRD CREWMAN'S SEAT.

The third crewman's seat is provided with a seat filler and provisions for a back type parachute. The seat is provided with safety belt, shoulder harness, inertia reel and headrest. The seat is not adjustable.

SHOULDER-HARNESS LOCK CONTROL.

A shoulder-harness lock control, located on the left side of each seat, is conventionally operated for manually locking and unlocking the shoulder harness. In addition, the shoulder harness inertia reel will automatically lock under a 2 to 3 G load, as in a crash landing.

CAUTION

Shoulder harness should be unfastened before seat back is lowered or occupant may be carried back with seat.

The manual lock is provided for use as an added safety precaution during take-off and landing and in the event of a forced landing.

CAUTION

> Just before a forced landing, all switches not readily accessible with the harness locked should be cut prior to locking shoulder harness.

If the harness is locked while the seat occupant is leaning forward, the harness will retract with him as he straightens up, moving into successive locked positions as he moves back against the seat. To unlock the harness, the seat occupant must be able to lean back enough to relieve the tension on the lock. Therefore, if the harness is locked while the seat occupant is leaning back hard against the seat, he may not be able to unlock the harness without first releasing it momentarily at the safety belt, or releasing the harness buckles if desired. After locking automatically, the harness will remain locked until the lock control is moved to the locked position and then back to unlocked.

AUXILIARY EQUIPMENT.

Section IV of this handbook contains information on the following equipment: cabin air conditioning and pressurization, communication, oxygen, lighting, bombing, tow-target package, and tanker package.

Normal Procedures

SECTION II

NOTE

Complete information on the flight characteristics of the airplane with aerodynamically balanced elevator is not available at this publication. The data pertinent to this configuration, as it affects Section II, will be supplied when available.

INTRODUCTION.

This section covers, essentially, the procedures carried out by the pilot to accomplish a complete non-tactical flight. In carrying out these procedures, the pilot must rely on other members of the crew to accomplish various checks ensuring proper and safe operation of the airplane. These checks, performed by the bomber-navigator and the third crewman, are covered in CREW DUTIES, Section VIII. Instructions as to when these checks should be performed are included as part of the pilot's responsibility in the procedures described in this section.

BEFORE ENTERING THE AIRPLANE.

Instruct the bomber-navigator and the third crewman to perform their exterior and interior checks of the airplane. (Refer to CREW DUTIES, Section VIII.)

FLIGHT RESTRICTIONS.

For flight restrictions and operating limitations, refer to Section V.

FLIGHT PLANNING.

Cruise control information of required fuel, power setting, and airspeed to complete any proposed mission is included in the operating data contained in Appendix I.

WEIGHT AND BALANCE.

1. Ascertain take-off and anticipated landing gross weight and balance. Loading data is furnished in the Handbook of Weight and Balance Data, AN 01-1B-40.
2. Ascertain that the required equipment for the proposed flight has been placed aboard.
3. Consult "yellow sheet" for weight and balance clearance.
4. Check weight limitations covered in Section V.

EXTERIOR INSPECTION.

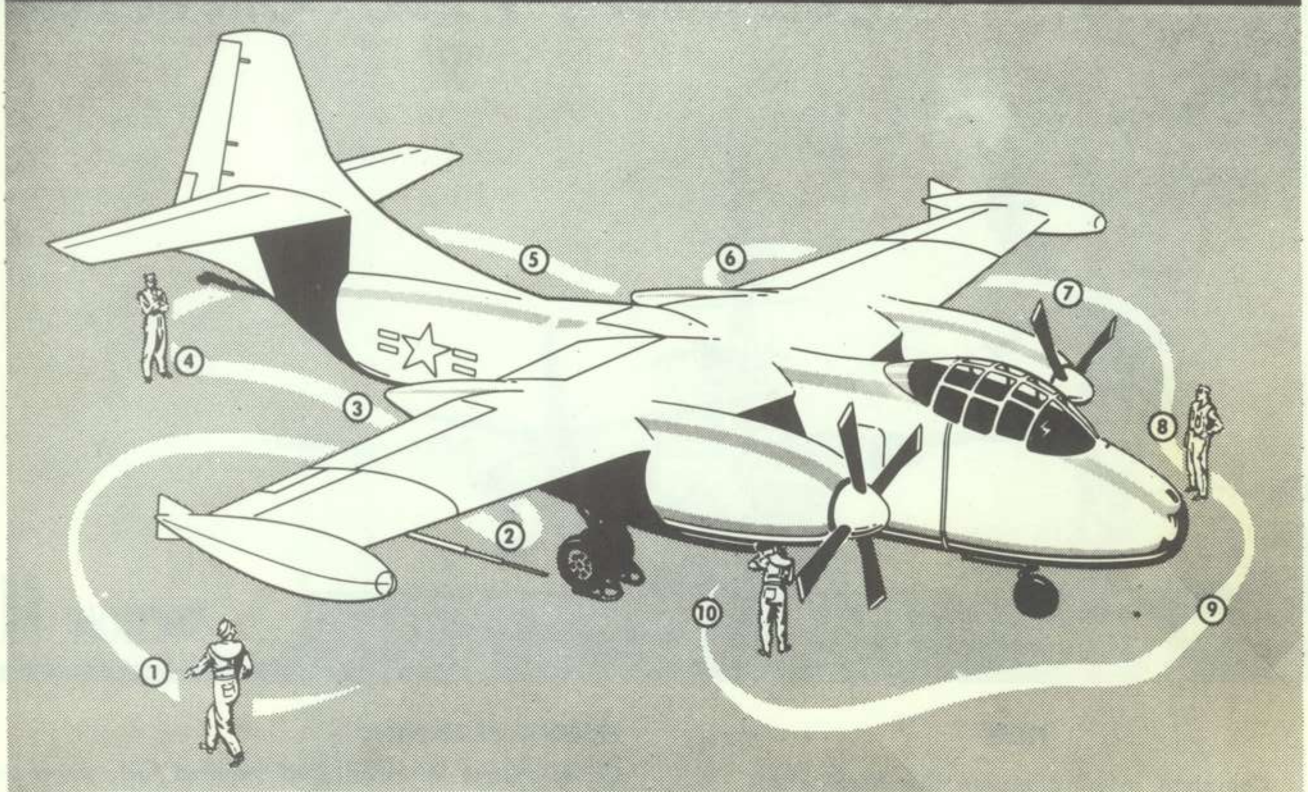
For exterior inspection, see figure 2-1.

1. Ascertain that before first start of each day, residual oil has been drained from the exhaust collector drain, and that the drain plug has been replaced.
2. Ascertain that cabin compressor impeller section has been drained just prior to flight.
3. Consult "yellow sheet" for status of the airplane.

ENTRANCE.

The crew door is located on the starboard side of the fuselage, just forward of the wing leading edge. (See figure 2-2.) A ladder for crew entrance is stowed in the tunnel in the crew entry compartment.

EXTERIOR INSPECTION



1 **RIGHT WING**
Pitot cover removed.
Wing edges undamaged.
Outer panel unfolded and locked.
Inspection doors secure.
Check general exterior condition of wing.

2 **RIGHT ENGINE NACELLE**
Wheels chocked.
Landing gear ground lockpin removed.
Landing gear door ground stops removed.
Landing gear doors secure.
Wheel flanges and hubs not cracked.
No hydraulic leaks.
Tires, strut, and snubber properly inflated.

3 **RIGHT FUSELAGE**
Bomb bay doors ground service lock pins removed and stowed.
Jet-engine exhaust uncovered.
Jet-engine blades and exhaust cone not cracked.
Inspection doors and access covers secure.

4 **EMPENNAGE**
Rudder and vertical fin unfolded and locked.
Arresting gear retracted and secure.
Check general exterior condition of aft portion of airplane.

5 **LEFT FUSELAGE**
same as RIGHT FUSELAGE.

6 **LEFT ENGINE NACELLE**
same as RIGHT ENGINE NACELLE.

7 **LEFT WING**
same as RIGHT WING.

8 **LEFT ENGINE**
Propeller surfaces undamaged and clean.
Cowling secure.
Inspection doors and access covers secure.
Engine cover removed.
Inspect air scoops for cracks and remove any foreign material.

9 **NOSE**
Inspect air scoop and remove any foreign material.
Nose landing gear ground stop removed.
Nose landing gear doors secure.
Check general exterior condition of forward portion of airplane.

10 **RIGHT ENGINE**
same as LEFT ENGINE.

H-9634-00-19

Figure 2-1. Exterior Inspection

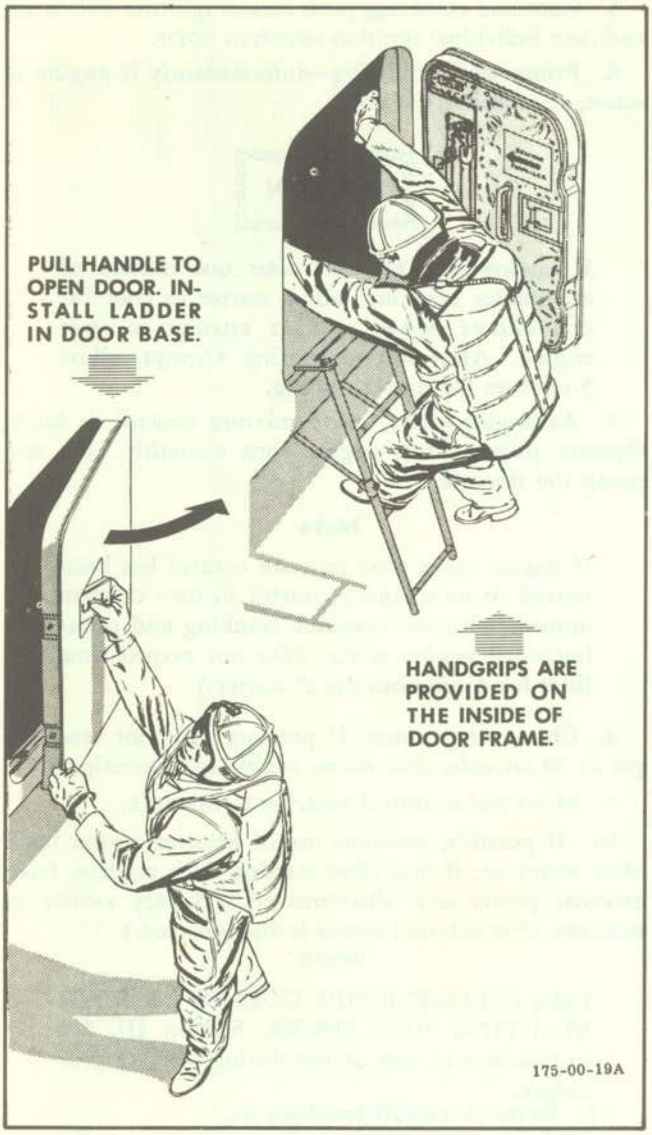


Figure 2-2. Entrance to Airplane

ON ENTERING THE AIRPLANE.

INTERIOR CHECK—ALL FLIGHTS.

1. Emergency air bottle pressure gage for crew exit door 1600 to 1900 psi.

2. Crew door emergency valve handle for crew door in normal vertical position.

3. Crew door manual jettison handle in normal vertical position.

4. Cabin compressor ground test switch NORMAL.

5. Main landing gear door open switch NORMAL.

6. Emergency hydraulic system controls OFF.

7. Check that IFF impact switch is set properly.

8. Safety belt and shoulder harness functioning properly.

9. Parking brakes set.

10. Check drop tank release handle stowed and guard in place.

11. Check autopilot emergency release handle stowed.

12. Surface controls unlocked, lock control latched in UNLOCKED position. Check controls for freedom of movement and proper travel. Make sure control surfaces respond correctly.

13. Turbo power switches AUTO.

14. Jet-engine starting selector switch AUTO.

15. Aft circuit breakers in.

16. Oil cooler flap switches AUTOMATIC.

17. Cowl flap switches AUTOMATIC.

18. Intercooler flap switches AUTOMATIC.

19. Jet-engine fuel control switch OFF.

20. Aileron boost, rudder and elevator boost switches ON.

21. Rudder electric motor pump alternate boost switch OFF.

22. Hydraulic pressure indicator selector switch OFF.

23. Pitot heater switch OFF.

24. Long-range oil switch OFF.

25. Cabin air control NORMAL CONTROL.

26. Cabin temperature control switch AUTO.

27. Cabin temperature control rheostat as desired.

28. Cabin heater switch NORMAL.

29. Emergency engine control switches NORMAL ON.

30. Propeller master selector switch NORMAL.

31. Jet-engine master switch OFF.

32. Turbo control switches OFF.

33. Wing flap control handle UP.

34. Jet-engine emergency shutoff switch NORMAL.

35. Jet-engine throttle OFF and locked.

36. Reciprocating-engine throttles cracked $1\frac{1}{2}$ to 2 inches.

37. Mixture controls IDLE CUTOFF.

38. Propeller master lever full INCREASE RPM.

39. Check friction knob for tightness.

40. Landing gear handle DOWN.

41. Set cabin altimeter to field elevation.

42. Ignition switches OFF.

43. Windshield defrost control as desired.

44. Forward circuit breakers in.

45. Boost pump switches OFF.

46. Transfer pump switch PUMP-AUTO.

47. Cross-feed valve switches NORMALLY OFF.

48. Emergency pump switches OFF.

49. Tip tank air pressure switch ON.

50. Set altimeter, clock, and accelerometer.

51. Arresting gear handle stowed.

52. Oil dilution switch NORMAL.

53. Generator control switches ON.

54. Generator field switches NORM.

55. Radio master switch OFF.

56. Have external power connected after checking with bomber-navigator that switches at his station are positioned properly.

57. Interphone master switch ON.

58. Transmit selector switch ICS.

59. Battery switch OFF.

60. Monitored bus switch AUTO.

61. Push fire detector test switch; check panel warning lights and master warning light (all lights should illuminate within 15 seconds maximum).

62. Check that cowl flaps are open.

63. Check all push-to-test indicator lights.

64. Check operation of trim tabs. Make sure tabs and indicator respond correctly. Set tabs for take-off. (Refer to figure 2-5.)

65. Check fuel quantity.

Note

> If fuel quantity indicators read off scale (below zero or above full mark), check indicator system before flight.

66. Check operation of oxygen equipment. (Refer to OXYGEN SYSTEM PREFLIGHT CHECK, Section IV.)

67. Check for satisfactory interphone contact with each crew member.

68. Adjust seat and rudder pedals.

Note

> If the crew consists of just the pilot and the bomber-navigator, the bomber-navigator should perform the third crewman's checks given in DUTIES OF THE THIRD CREWMAN, Section VIII.

INTERIOR CHECK—NIGHT FLIGHTS.

Before night or instrument flight, check all lights and instruments after completing the normal interior check. Ascertain that a reliable flashlight is on board.

STARTING RECIPROCATING ENGINES.

Start each reciprocating engine as follows:

1. Recheck throttle, propeller, and mixture control positions. Observe manifold pressure gage reading (field barometric pressure) for use during engine warm-up.

2. Fuel boost pumps and transfer pump on. Check fuel pressure 10 to 14 psi.

3. Check propellers clear.

4. With ignition switch OFF, engage starter and turn engine over 12 revolutions (count 17 blades).

Note

> If propeller falters or stops rotating, disengage starter, turn off fuel pumps, and investigate.

5. Continue cranking, push master ignition switch in, and turn individual ignition switch to BOTH.

6. Prime while cranking—intermittently if engine is warm, continuously if cold.

CAUTION

> If engine fails to start after one minute of continuous cranking, allow starter to cool for one minute before another attempt to start engine. After second starting attempt, allow 5 minutes for starter cooling.

7. As engine starts, move mixture control to RICH. Operate primer until engine runs smoothly. Do not pump the throttle.

Note

> If engine stops after mixture control has been moved to RICH, move control to IDLE CUTOFF immediately, and continue cranking and priming until engine starts. (Do not exceed time limit for continuous use of starter.)

8. Check oil pressure. If pressure does not reach 40 psi in 30 seconds, shut down engine and investigate.

9. Move turbo control switches to NORMAL.

10. If possible, continue use of external power until after warm-up; if not, after starting both engines, have external power unit disconnected. (Battery switch to BATTERY after external power is disconnected.)

Note

> Refer to ENGINE FIRE DURING GROUND STARTING PROCEDURE, Section III, for instructions in case of fire during starting procedure.

11. Recheck circuit breakers in.

RECIPROCATING-ENGINE WARM-UP.

1. Warm up engines until oil pressure drops to within operating range.

Note

> If external power unit is connected, warm up engines at 1000 rpm. If no external power is used, warm up at 1200 rpm to provide necessary generator output. Observe that generators cut in at about 1100 rpm.

2. The desired oil temperature should be maintained by having the oil cooler flap controls in AUTOMATIC. If limits are exceeded with the controls in AUTOMATIC, stop engines and investigate. The cowl flaps should be open for all ground operation.

GROUND TESTS.

HYDRAULIC SYSTEM GROUND TEST.

1. Check aileron boost switch ON.

2. Check rudder and elevator boost switch ON.

3. Move hydraulic pressure indicator selector switch to UTILITY; check pressure indicator for 3000 (+250/—0) psi.

Note

> As steps 4. through 8. are accomplished, have observer determine that control surfaces respond correctly.

4. Move indicator selector switch to AIL; move ailerons to full limit of travel and hold against stops; check indicator for 825 (±100) psi.

5. Move selector switch to ELEV; move elevators to full limit of travel and hold against stops; check indicator for 3000 (+100/—200) psi.

6. Move selector switch to RUD; move rudder to full limit of travel and hold against stops; check indicator for 2500 (±100) psi. Leave selector switch at RUD, but release rudder to neutral.

7. Turn rudder alternate boost switch ON; move rudder to full limit of travel and hold against stops; check pressure indicator for a reading less than 200 psi.

8. Move selector switch to RUD ELEC MOTOR PUMP; check indicator for 2500 (±100) psi.

9. Turn rudder alternate boost switch OFF.

10. Return hydraulic pressure indicator selector switch to OFF.

11. Have third crewman check emergency hydraulic system. (Refer to EMERGENCY HYDRAULIC SYSTEM GROUND TEST, Section VIII.)

AUTOMATIC PILOT GROUND TEST.

1. Gyro horizon indicator uncaged.

2. Center all controls on flight controller.

3. Center flight controls.

4. Engage automatic pilot by pushing clutch switch ON.

5. Move control knobs on flight controller to actuate all control surfaces. Make sure control surfaces respond correctly, then re-center the knobs on the flight controller.

6. Move inverter selector switch to ENGINE INST. INV. STANDBY and check that autopilot disengages (the clutch switch will pop up); also check for continued operation of the engine instruments.

7. Return inverter selector switch to NORMAL.

8. Re-engage the automatic pilot by pushing clutch switch ON.

9. Move inverter selector switch to FLT. INST. INV. STANDBY and check that autopilot disengages.

10. Return inverter selector switch to NORMAL.

FUEL SYSTEM GROUND TEST.

If the fuel ferry tank is installed, instruct the third crewman to check operation of the ferry tank system. (Refer to FUEL FERRY TANK GROUND TEST, Section VIII.)

DIRECT-CURRENT SYSTEM GROUND TEST.

1. Battery switch at BATTERY.

2. Test generator warning lights, and make sure they are not dimmed.

3. Check voltmeter; reading should be 28 (±1) volts.

4. Check ammeters; readings should not differ more than 40 amperes and must not exceed 400 amperes per generator.

ALTERNATING-CURRENT SYSTEM GROUND TEST. Instruct bomber-navigator to check the alternating-current system. (Refer to ALTERNATING-CURRENT CHECK, Section VIII.)

TAXIING INSTRUCTIONS.

1. Inform crew, "Ready to taxi."

2. Before starting to taxi, make sure that external power source is disconnected (battery switch BATTERY), and that bomb bay doors and crew door have been closed.

3. Release parking brakes. Check operation of the normal brakes.

4. Check operation of emergency brakes (parking brakes) while taxiing at low speed in a clear area.

5. Avoid overheating and excessive use of brakes while taxiing; recommended taxiing speed can best be controlled at approximately 1000 rpm.

Jet-engine fuel consumption is excessive during taxiing, and since no warm-up is required, it is recommended that the jet engine be started shortly before take-off.

BEFORE STARTING JET ENGINE.

Before starting jet engine, check that area aft of jet engine is cleared of personnel and combustible or inflammable materials. (See figure 2-3.)

Note

> Do not operate jet engine at greater than idle rpm while parked on black top surface. Angle of jet blast will cause damage to black top if high powers are used while remaining in one spot.

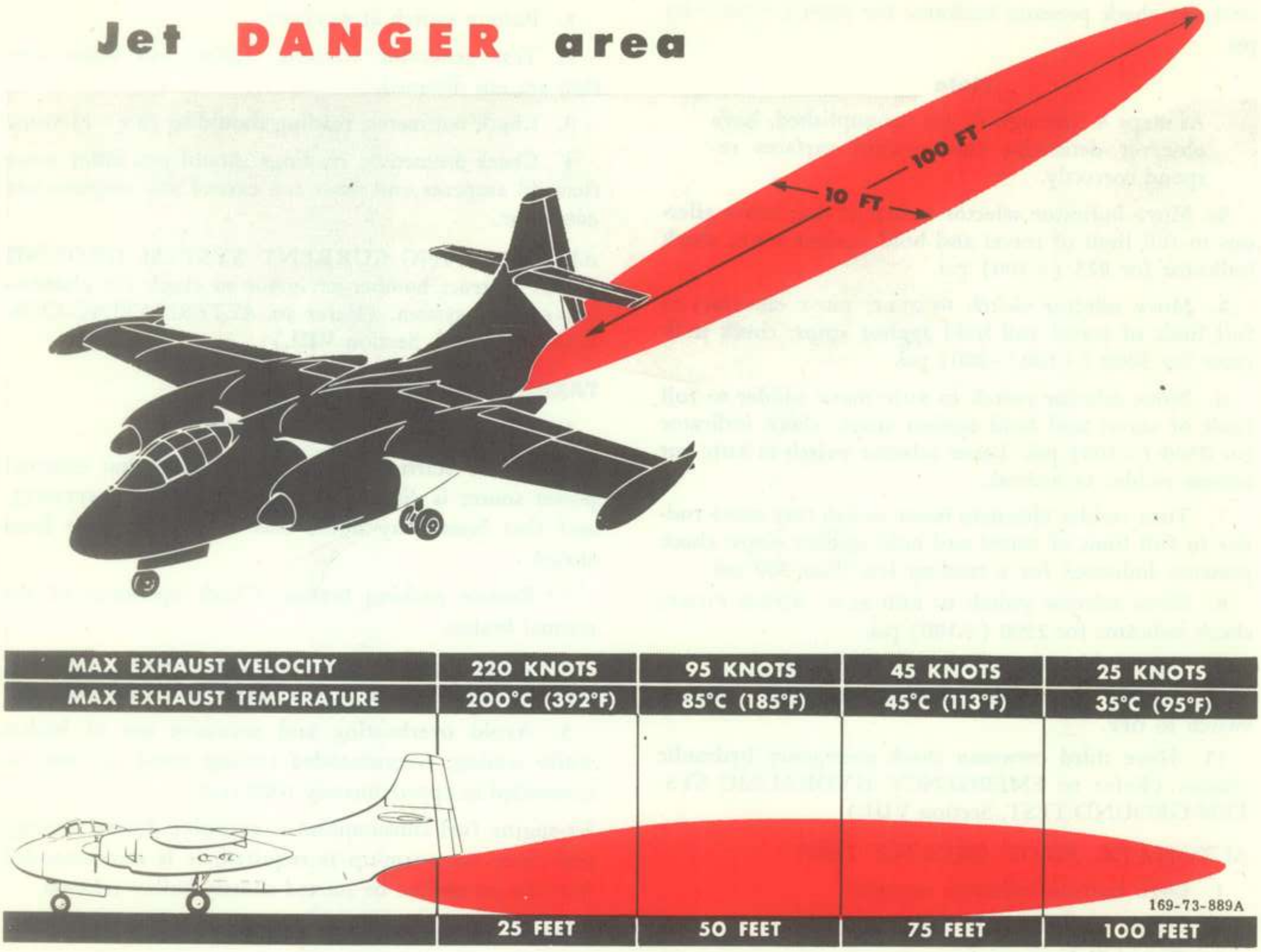
When practicable an external power source shall be used for starting the jet engine. Before starting the jet engine, have the reciprocating engines started and running at 1800 rpm to provide optimum generator performance from both generators. Turn off nonessential electrical loads prior to initiating jet start.

JET-ENGINE AUTOMATIC GROUND START.

1. Fuel cross-feed valves ON.

2. Jet-engine throttle OFF and locked.

3. Jet-engine fuel control switch OFF.



MAX EXHAUST VELOCITY	220 KNOTS	95 KNOTS	45 KNOTS	25 KNOTS
MAX EXHAUST TEMPERATURE	200°C (392°F)	85°C (185°F)	45°C (113°F)	35°C (95°F)
	25 FEET	50 FEET	75 FEET	100 FEET

Figure 2-3.

Note

The emergency fuel indicator light will illuminate during an automatic start until throttle is advanced from the OFF position, as fuel will flow through both main and emergency fuel metering units during the starting procedure.

4. Jet-engine emergency shutoff switch NORMAL.
5. Jet-engine starting fuel selector switch AUTO.
6. Jet-engine master switch MASTER.

WARNING

- Jet-engine throttle should be OFF and locked when master switch is moved to MASTER.
- If the jet duct door unsafe light remains on for more than approximately 3 seconds after moving jet master switch to MASTER, turn jet-engine emergency shutoff switch to SHUT-OFF; then turn jet master switch OFF and investigate.

7. After turning jet-engine master switch to MASTER, hold jet throttle outboard at START until a rise is noted on jet tachometer (3 to 5 seconds).
8. When jet engine reaches a speed of approximately 9% rpm, momentarily depress ignition and fuel start button on top of the jet throttle and watch for an increase in tail-pipe temperature indicating that the engine has started.

CAUTION

- If ignition does not occur within 5 to 10 seconds, be sure throttle is closed, and turn jet master switch OFF. Wait 3 minutes for engine to stop rotating and unburned fuel to drain before another attempt to start.
- After two unsuccessful starting attempts, have ground crew open engine drain-tank valve and drain the tank.

9. After jet-engine speed stabilizes (approximately 30% rpm at sea level), check for positive indication of oil pressure. If oil pressure is not noted within 30 seconds, shut down engine and investigate.

Note

Do not attempt another start until the engine has completely stopped rotating and unburned fuel has drained from the engine.

10. Release lock and advance throttle quickly and smoothly. If at sea level, the throttle should be advanced slightly past idle; then back to idle. At high field elevations, the throttle should be advanced to a position slightly below idle (35 to 38% rpm).

Note

The jet engine will idle at approximately 34 to 41% rpm. At altitude, or high field elevations, the idle speed is higher than at sea level. At 10,000 feet the idle speed is approximately 41% rpm. At 20,000 feet the idle speed is approximately 50% rpm.

CAUTION

If a hot start occurs (tail-pipe temperature above 900°C) enter it on the aircraft forms. After 10 hot starts, the engine must be inspected before flight.

JET-ENGINE MANUAL GROUND START.

The preferred method of starting the jet engine is the automatic start; however, if circumstances demand, the jet engine can be started by a manual procedure.

1. Fuel cross-feed valves ON.
2. Jet-engine throttle OFF and locked.
3. Jet-engine fuel control switch EMERG.
4. Jet-engine emergency shutoff switch NORMAL.
5. Jet-engine starting fuel selector switch MANUAL.

WARNING

- Jet-engine throttle should be OFF and locked when master switch is moved to MASTER.
- If the jet duct door unsafe light remains on for more than approximately 3 seconds after moving jet master switch to MASTER, turn jet-engine emergency shutoff switch to SHUT-OFF; then turn jet master switch OFF and investigate.

6. After turning jet-engine master switch to MASTER, hold jet throttle outboard at START until rise is noted on jet tachometer (3 to 5 seconds).

7. When jet-engine speed reaches approximately 9% rpm, depress and *hold* ignition and fuel start button and then advance throttle rapidly to three-fourths open.

8. At the first indication of fuel pressure, pull throttle back near the OFF position.

9. Release ignition and fuel start button when sure that the jet engine has started.

CAUTION

- If ignition does not occur within 5 to 10 seconds after advancing throttle, be sure throttle is closed, turn jet master switch OFF, and wait 3 minutes before attempting another start.
- After two unsuccessful starting attempts, have ground crew open engine drain-tank valve, and drain the tank.

10. Check for positive indication of oil pressure. If oil pressure is not noted within approximately 30 seconds after jet engine starts, shut down engine and investigate.

Note

Do not attempt another start until the engine has completely stopped rotating and unburned fuel has drained from the engine.

11. Run up engine gradually to 68% to 73% rpm, then retard throttle to IDLE; as engine first begins to decelerate, move jet-engine fuel control switch to OFF.

When the fuel control switch is at emerg., the throttle should be carefully advanced to prevent extreme tail-pipe temperatures or flame-out. The emergency fuel unit does not incorporate the features of the main fuel unit limiting the rate of acceleration or deceleration.

CAUTION

If a hot start occurs (tail-pipe temperature above 900°C) enter it on the aircraft forms. After 10 hot starts, the engine must be inspected before flight.

JET-ENGINE GROUND OPERATION.

No warm-up period is necessary for operation of the jet engine.

BEFORE TAKE-OFF.

PRE-TAKE-OFF RECIPROCATING-ENGINE CHECK.

The following pre-take-off check should be made with the airplane headed into the wind as nearly as possible.

1. Re-check mixture control at RICH.

2. Make ignition safety check at approximately 1000 rpm. Switch ignition to R, back to BOTH, to L, back to BOTH, and then to OFF momentarily. If the ignition leads are connected properly, a slight rpm drop should occur as the switch is moved from BOTH to either L or R, and complete engine cutout should occur when the switch is moved to OFF.

3. At 30 in. Hg, check each magneto for maximum drop of 100 rpm. Normally, differences in drop-off between right or left magneto are 40 rpm or less.

4. Run up each engine until manifold pressure reading is equal to the field barometric pressure (indicated by manifold pressure gage before engine is started). Tachometer should read approximately 2200 rpm, depending on low pitch setting of the propeller.

Note

Variation in field altitude will not change rpm once rpm is established for the installation. If the approximate rpm check is not obtained when throttle is opened to field barometric pressure, the engine is not delivering proper power and should be investigated. However, high surface winds will affect this setting.

5. Check oil pressure 60 psi at 2200 rpm.

6. Test propeller synchronizer with propeller master selector switch at NORMAL. Set both throttles at 35 in. Hg, and then set master lever for 2000 rpm. Push "RESYNCHRONIZE" button momentarily to assure resetting of centering device. Hold left (master) engine toggle switch at DECREASE RPM until rpm decreases to 1800, and check to see that right (slave) engine follows only 50 to 100 rpm. Then hold left engine toggle switch at INCREASE RPM until rpm increases to 2200, and make sure that right engine follows only 100 to 200 rpm. Toggle left engine to 2000 rpm — both engines should synchronize at 2000 rpm. During this test, manifold pressure should remain constant within one in. Hg, indicating proper manifold pressure regulator operation. Hold right engine toggle switch to INCREASE and DECREASE and check that engine responds correctly. Return master lever to full INCREASE RPM, and check that propeller governor lights are on.

7. Check operation of controls for oil cooler flaps, cowl flaps, and intercooler flaps by placing respective switches at OPEN and CLOSE. Return oil cooler, cowl, and intercooler flap controls to AUTOMATIC; check that cowl flaps are full open.

Note

Intercooler flaps will operate only if turbo control switches are at NORMAL. The inboard intercooler flaps can be seen from the pilot's and bomber-navigator's seats. Intercooler flaps on outboard side of nacelle should be checked by ground observer.

PRE-TAKE-OFF JET-ENGINE CHECK.

Check the jet engine prior to take-off as follows:

1. Advance throttle to full open position and make sure that rpm does not exceed 100% rpm. Tail-pipe temperature should be between 700°C and 715°C (700°C maximum in flight). Check to see that all jet-engine instruments are in desired ranges.

2. With the jet engine operating at 55% (6500) rpm, make sure that the jet-engine fuel control switch is OFF, and move the emergency fuel system test switch to TEST. The emergency indicator light should illuminate, and a slight change in rpm should be noted, indicating operation of the emergency system. Return emergency fuel system test switch to NORMAL. In order to prevent high tail-pipe temperature when switching from the emergency fuel system back to the main system, retard the throttle quickly at the instant the test switch is repositioned to NORMAL.

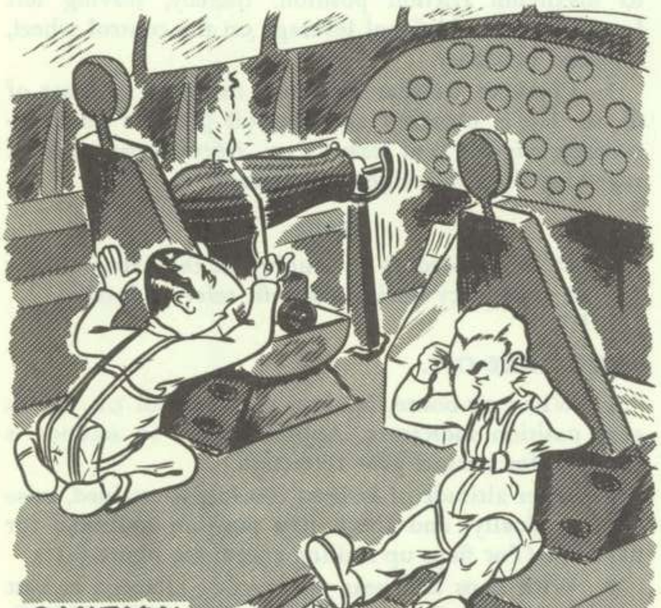
CAUTION

- When changing from main to emergency fuel system, or vice versa, if an excessive drop in rpm occurs, indicating a fuel system not functioning properly, immediately switch back to the other fuel system to prevent possible damage to the engine. Then shut down engine and investigate.
- During test of the emergency fuel system, the jet-engine fuel control switch should be at OFF. If this switch is at TAKE OFF when the test is made, the main fuel system does not automatically take over after the test is completed. For subsequent take-off, fuel metering would be accomplished by the emergency system with no possible automatic emergency control.

PRE-TAKE-OFF AIRPLANE CHECK.

A check list to be accomplished prior to take-off appears on the instrument panel. (See figure 2-4.)

1. Flight controls operating freely.
2. Gyro horizon indicator uncaged.
3. Automatic pilot clutch switch pulled out; disengage switch OFF.
4. Canopy sliding panels open. Ascertain that third crewman's escape hatch is open.
5. Fuel control panel—emergency fuel pump switches at EMERG. PUMP; boost pump switches at BOOST PUMP; fuselage tank transfer pump switch at TRANSFER PUMP—AUTO; cross-feed valves ON.
6. Tip tank air pressure ON.
7. Turbo control switches NORMAL.
8. Mixture controls full RICH.
9. Trim tabs set.
10. Wing flaps as required.
11. Boost switches—aileron boost ON, rudder and elevator boost ON, rudder electric motor pump alternate boost switch OFF.
12. Propeller master lever full INCREASE RPM; propeller master selector switch NORMAL.
13. Ascertain that crew is ready for take-off.
14. Safety belt and shoulder harness tightened and locked.
15. Check instruments for indication in desired ranges and note absence of sluggish operation.



CAUTION

In event of loss of elevator boost during take-off, the pilot should be prepared to counteract a sudden nose-up pitching movement, which will occur at approximately 120 knots with military power, full flaps down.

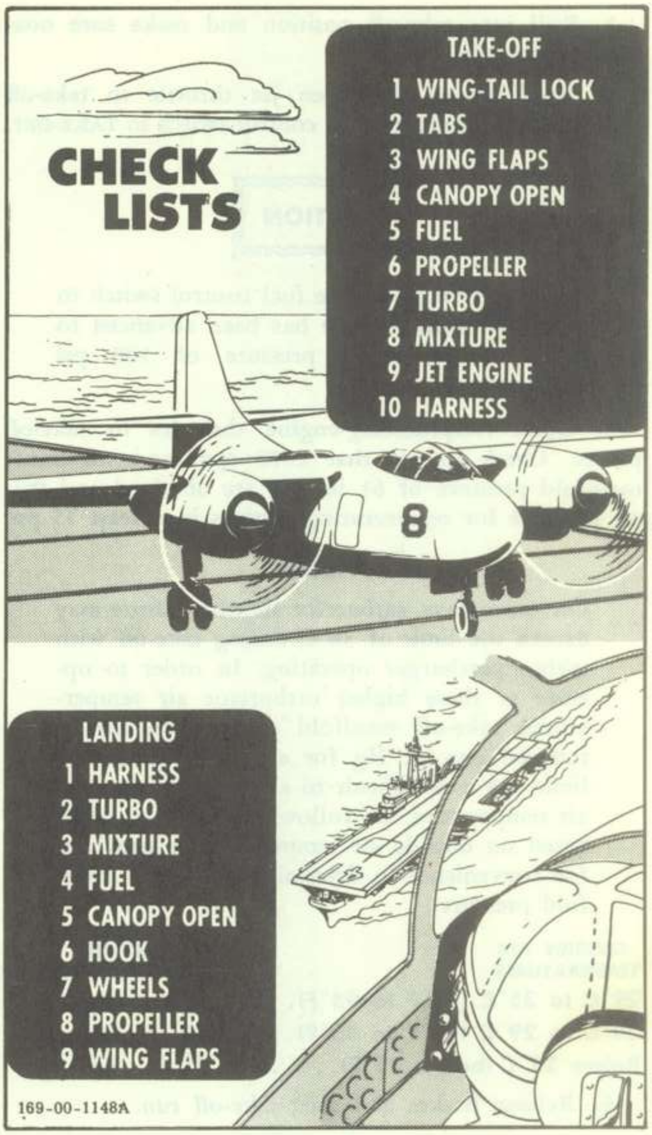


Figure 2-4.

TAKE-OFF.

The jet engine is to be used for all normal take-offs. While the airplane is designed to operate as a two-engine airplane during flight, the jet engine provides the additional thrust necessary for maximum performance when required and is intended to be used at all times for take-off. For take-off trim tab settings, see figure 2-5. The following techniques are required to produce the results stated in figures A-20 through A-24. For information pertaining to emergencies during take-off, refer to Section III.

NORMAL FIELD TAKE-OFF.

1. Complete pre-take-off checks. Use $\frac{1}{2}$ flaps, 5 degrees nose-up elevator trim, and 0 degrees aileron and rudder trim.
2. Check operation of normal and emergency boost system.

3. Roll into take-off position and make sure nose wheel is straight.

4. Hold brakes and open jet throttle to take-off power. Move jet-engine fuel control switch to TAKE-OFF.

CAUTION

Do not move jet-engine fuel control switch to TAKE-OFF until throttle has been advanced to give jet-engine fuel pressure of 100 psi minimum.

5. Open reciprocating-engine throttles to take-off power. Check to see that 2800 rpm and maximum manifold pressure of 61 in. Hg are obtained and that oil pressure for reciprocating engines is at least 75 psi.

Note

On warm days, carburetor air temperature may exceed the limit of 38°C during take-off with turbosupercharger operating. In order to operate at these higher carburetor air temperatures, take-off manifold pressure should be reduced one in. Hg for each 6°C above the limit. As it is difficult to anticipate carburetor air temperature, the following estimated table, based on outside air temperature, is provided for convenience in determining take-off manifold pressure.

OUTSIDE AIR TEMPERATURES	TAKE-OFF MANIFOLD PRESSURE
29°C to 35°C (85°F to 95°F)	59 in. Hg
24°C to 29°C (75°F to 85°F)	60 in. Hg
Below 24°C (below 75°F)	61 in. Hg

6. Release brakes and start take-off run.

Note

Normal take-off speeds at sea level, using ½ flaps, are approximately as follows:

GROSS WEIGHT	INDICATED AIRSPEED
55,000 lbs	110 knots
50,000 lbs	105 knots
45,000 lbs	95 knots
40,000 lbs	85 knots
35,000 lbs	75 knots

7. Immediately after take-off, level off to gain a safe margin above minimum single-engine control speed (115 knots IAS).

CARRIER TAKE-OFF — MINIMUM RUN.

1. Complete pre-take-off checks. Use full flaps, 10 to 12 degrees nose-up elevator trim, and 0 degrees aileron and rudder trim.

2. Hold brakes on and advance jet throttle to full take-off power; move jet-engine fuel control switch to TAKE-OFF. Then open reciprocating-engine throttles rapidly and smoothly to full power.

CAUTION

Do not move jet-engine fuel control switch to TAKE-OFF until jet throttle has been advanced to give jet-engine fuel pressure of 100 psi minimum.

3. Check to see that 2800 rpm and maximum manifold pressure of 61 in. Hg are obtained at full throttle, and that oil pressure on reciprocating engines is at least 75 psi.

4. Release brakes and start take-off run. Approximate take-off speeds with full flaps are as follows:

WEIGHT	INDICATED AIRSPEED
55,000 lbs	85 knots
50,000 lbs	80 knots
45,000 lbs	75 knots
40,000 lbs	65 knots
35,000 lbs	60 knots

5. Immediately after take-off, level off to gain a safe margin above minimum safe single-engine speed (115 knots IAS).

CATAPULT TAKE-OFF.

Prior to catapulting, the pilot should review the latest catapult launching bulletin to check trim tab settings and pilot technique during launching run.

1. Complete pre-take-off checks. Use full flaps and the trim tab settings given in figure 2-5.

2. Open all three throttles (jet-engine fuel control switch at take-off), then turn quadrant friction knob to maximum friction position, thereby, leaving left hand free for additional leverage on the control wheel, if found necessary.

3. Check to see that maximum manifold pressure of 61 in. Hg is obtained and that oil pressure on reciprocating engines is at least 75 psi. Approximate take-off speed for all gross weights is 100 knots.

Note

For the procedure to employ in the event of an emergency during take-off, refer to Section III.

AFTER TAKE-OFF.

1. When air-borne, landing gear control UP. Check gear position indicators. Approximately 10 seconds is required for normal gear retraction.

2. After altitude of at least 200 feet is attained, raise flaps gradually, and check flap position indicator for flaps up. (For flaps up stalling speed, see figure 6-1.)

3. With flaps and gear up, increase airspeed to best climbing speed. (Refer to SPEED FOR BEST CLIMB, Section VI.) If jet-engine operation is not necessary for the climb, shut down jet engine after reaching a safe altitude. (Refer to STOPPING JET ENGINE IN FLIGHT, in this section.)

4. Reduce reciprocating-engine power to Normal Rated Power. Move mixture control to NORMAL.

TRIM TAB SETTINGS FOR TAKE-OFF

TYPE OF TAKE-OFF	LOADING AND GROSS WEIGHT	ELEVATOR TRIM TAB (NOSE-UP)	RUDDER AND AILERON TRIM TABS
CATAPULT (FULL FLAPS)	Qualification shots at 35,500 pounds	17°	0° for all loadings and gross weights
	Full fuel only at 43,800 pounds	16°	
	With 6000 pounds mines at 49,830 pounds	21°	
	With 8000 pounds mines at 51,800 pounds	15°	
MINIMUM RUN OR FREE DECK (FULL FLAPS)	All permissible gross weights	10°-12°	0°
NORMAL FIELD TAKE OFF (½ FLAPS)	All permissible gross weights	5°	0°

*Airplanes 124161 and 124181 only.

Note: Prior to catapulting the pilot should review the latest catapult launching bulletin to check trim tab settings and pilot techniques during launching run.

H-9634-52-23

Figure 2-5. Trim Tab Settings for Take-off

5. Emergency fuel pump switches OFF.

6. Close canopy sliding panels. Ascertain that the third crewman's escape hatch is closed.

CLIMB.

For recommended calibrated airspeeds to be used during climb, and for rate of climb and fuel consumption, see figures A-6 through A-12 and A-29 through A-38. During a Military Power climb at high altitudes on a hot day, the cylinder head temperature limits may be exceeded. If this occurs, increase airspeed slightly or reduce power slightly. The jet engine may be used to increase rate of climb.

RECIPROCATING-ENGINE OPERATION IN FLIGHT.

After climb to cruise altitude:

1. Retard throttles and propeller master lever to desired power setting for cruise.

2. Check boost pumps and transfer pump on for all subsequent operation.

3. Periodically check for desired instrument readings. (See figure 5-1.)

Note

During low-altitude and low-power flight, carburetor icing may occur. If carburetor air temperature is 5°C or less, make sure intercooler flaps are closed. If flaps are closed and carburetor air temperature is still below minimum, operate at a higher power or higher altitude until temperature is within desired range.

For additional information regarding engine operation in flight, refer to SYSTEMS OPERATION, Section VII.

JET-ENGINE OPERATION IN FLIGHT.

The jet engine may be used in flight for conditions requiring maximum speed and climb or evasive action. Approximately 20 to 30 seconds are required to start the jet engine and to obtain full power; therefore, if the need for it can be anticipated, the engine should be started and then idled until full power is desired.

STARTING JET ENGINE IN FLIGHT.

Attempts should not be made to start the jet engine at altitudes above 25,000 feet, unless warranted by operating circumstances. At altitudes exceeding 25,000 feet, poor flame propagation makes air starts very uncertain. Turn off nonessential electrical loads prior to initiating jet start. Jet starts should be made with reciprocating engines at 1800 rpm so as to provide optimum generator performance and protection. Starting the jet engine when only one generator is in operation should be attempted only in an emergency. Upon completion of a flight in which a "single-generator start" was made, the generator should be removed and the brushes and commutator inspected.

JET-ENGINE AUTOMATIC AIR STARTS.

The jet engine is started in flight by following the automatic ground starting procedure and observing the precautions given below. (Refer to JET-ENGINE AUTOMATIC GROUND START, in this section.)

CAUTION

- Engine must be started immediately after jet master switch is moved to MASTER or windmilling will increase rpm above starter engaging speed.
- To prevent high tail-pipe temperature, failure to start, or flame-out during start, do not advance throttle to IDLE until tail-pipe temperature starts to decrease or until initial rpm stabilizes.
- If a flame-out occurs during starting or acceleration, or if the jet engine fails to start for any reason, close throttle to the locked position, move emergency shutoff switch to SHUTOFF, and nose airplane up several times to drain any fuel which may have accumulated in the tail pipe.

At altitude, initial rpm and idle rpm will be considerably higher than at sea level. Under some altitude conditions, initial rpm at which engine stabilizes may be slightly higher than rpm obtained when throttle is advanced to IDLE and engine is operating on the main fuel metering unit. The jet-engine fuel control switch should be OFF for operation of jet engine during flight. If the jet engine starts by use of the automatic starting procedure but will not transfer to the main fuel control when the throttle is advanced, move the throttle to OFF and locked and move the emergency shutoff switch to SHUT-OFF. After nosing airplane up several times, proceed as follows:

1. Move fuel control switch to EMERG.
2. Move emergency shutoff switch to NORMAL and make an automatic start.

CAUTION

- When the fuel control switch is at EMERG, the throttle should be carefully advanced or retarded to prevent extreme tail-pipe temperatures or flame-out. The emergency fuel unit does not incorporate the features of the main fuel unit limiting the rate of acceleration or deceleration.
- To prevent a flame-out when advancing the throttle to IDLE, it will be necessary to advance the throttle slightly beyond IDLE at altitudes between 15,000 and 25,000 feet. If operational circumstances require that a start be made above 25,000 feet, the throttle must be advanced slightly further. A flame-out will occur at any altitude if the throttle is advanced too far. Since there is no governor in the emergency fuel control, care must be exercised to prevent overspeeding during operation on the emergency system.

JET-ENGINE MANUAL AIR START.

If the jet engine fails to start by use of the automatic starting procedure, retard throttle to OFF and locked, and move emergency shutoff switch to SHUT-OFF. After nosing airplane up several times, proceed as follows:

1. Move emergency shutoff switch to NORMAL.
2. Attempt a manual start. (Refer to JET-ENGINE MANUAL GROUND START, in this section.)

CAUTION

Manual air starts differ from manual ground starts in that when an air start is made, the start switch must be energized immediately after the jet master switch is moved to MASTER.

WARNING

If the jet duct door unsafe light illuminates at any time during flight, shut down the jet engine.

STOPPING JET ENGINE IN FLIGHT.

The procedure for stopping the jet engine in flight and on the ground is the same:

1. Jet-engine throttle OFF and locked.
2. Jet master switch OFF immediately.

3. Jet fuel control switch OFF.
4. Cross-feed valve switches NORMALLY OFF.

Note

> The jet-engine master switch must be OFF to close the jet air intake door and to shut off fuel supply to the jet engine.

FLIGHT CHARACTERISTICS.

For information regarding flight characteristics of the airplane, refer to Section VI.

SYSTEMS OPERATION.

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

DESCENT.

Before making a normal descent from altitude, set power at 35 in. Hg and 2000 rpm. Close cowl flaps and intercooler flaps to prevent overcooling of the engine. Leave gear and wing flaps up. Maintain an indicated airspeed of 220 knots. At 40,000 feet, the rate of descent will be approximately 3000 feet per minute; at 10,000 feet, it will be approximately 1300 feet per minute. (Refer to figures A-13 and A-79.) For information regarding emergency descent from altitude, refer to EMERGENCY DESCENT FROM ALTITUDE, Section III.

Note

> During a sustained power-off descent, the cylinders may overcool even with fully closed cowl flaps. Spark plug fouling and inability of the engine to accelerate satisfactorily may result. This may be avoided by intermittent use of power.

PRE-TRAFFIC PATTERN CHECK LIST.

A check list to be accomplished prior to landing appears on the instrument panel. (See figure 2-4.) It may be squadron policy to start the jet engine prior to landing. Refer to STARTING JET ENGINE IN FLIGHT, in this section. During approach to the traffic pattern, prepare for landing as follows:

1. Instruct bomber-navigator and third crewman to prepare for landing.
2. Safety belt and shoulder harness tightened.
3. Master bomb control switch OFF.
4. Emergency fuel pumps ON.
5. Automatic pilot OFF (clutch switch pulled up).
6. Cross-feed valve switches ON.
7. Mixture controls RICH.
8. Check turbo control switches NORMAL.
9. Rudder electric motor pump alternate boost switch OFF.
10. Aileron boost switch ON.
11. Rudder and elevator boost switch ON.
12. Check that utility hydraulic pressure is available.

TRAFFIC PATTERN CHECK LIST.

For information on landing restrictions, refer to Section V.

1. Canopy sliding panels open below 175 knots IAS.
2. Ascertain that third crewman's escape hatch is open.
3. Landing gear down below 175 knots IAS. Check gear position indicator (approximately 10 seconds required for gear extension).
4. Arresting hook down for carrier landing; hook up for field landing.
5. Propeller control 2600 rpm.

Note

> With power off and flaps and gear down, the glide angle of this airplane is very steep.

LANDING—FIELD.

For field landing pattern, see figure 2-6.

NORMAL FIELD LANDING.

In order to obtain the results stated in the landing ground roll chart (figure A-80), observe the following field landing procedures:

1. Lower flaps halfway when abeam end of runway; regulate remaining flaps to control descent from base leg into final approach.
2. Maintain the following applicable approach speeds:

	INDICATED AIRSPEEDS	
GROSS WEIGHT	FINAL	GROOVE
45,000 lbs	135 knots	115 knots
40,000 lbs	125 knots	105 knots
35,000 lbs	115 knots	100 knots

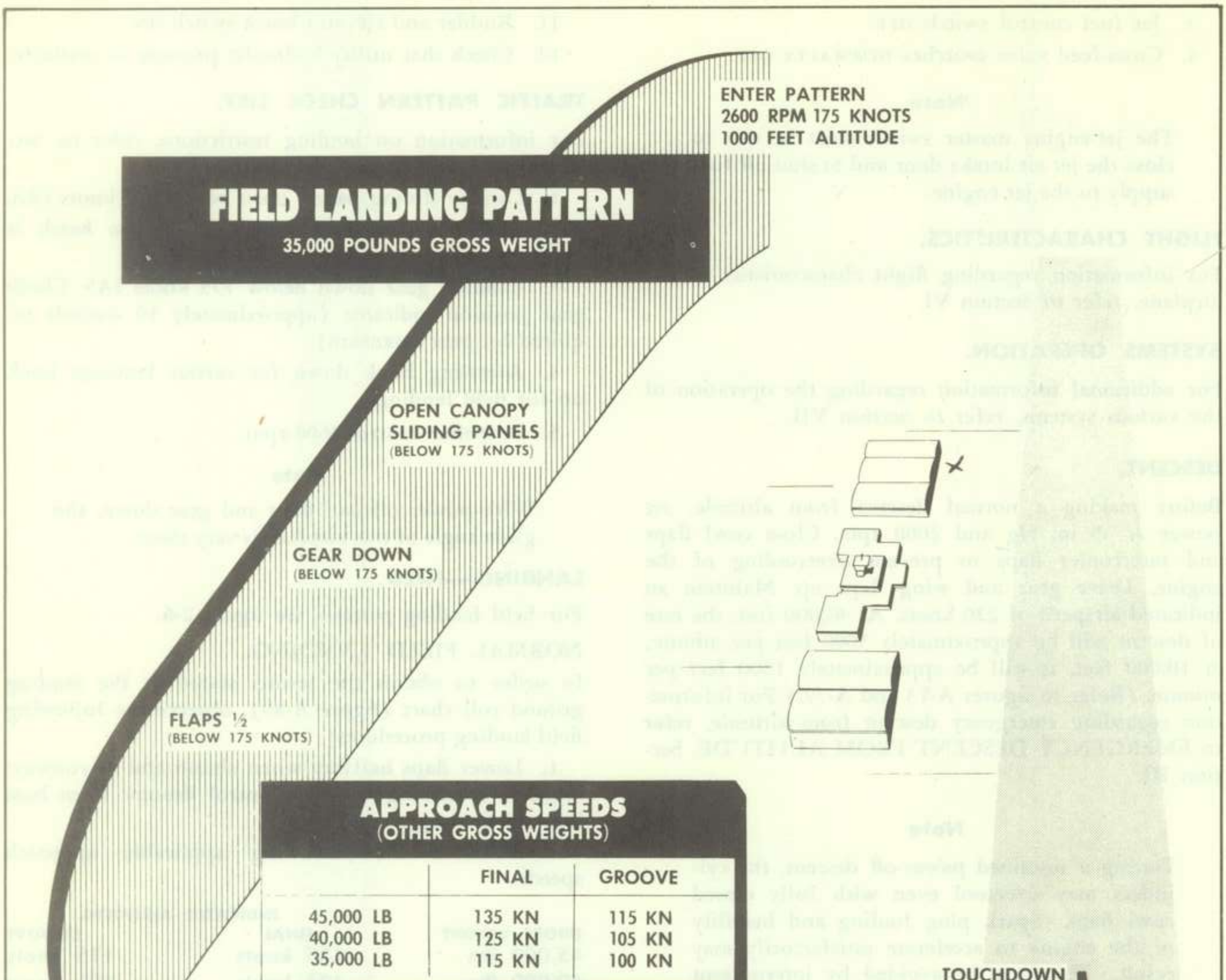
3. Adjust elevator trim constantly throughout landing to afford better control in case of elevator boost failure.
4. Touch main wheels first, tail slightly down; then touch nose wheel.
5. Avoid excessive use of brakes on landing roll.

CAUTION

> Apply brakes gently. Brakes are very powerful and it is easy to skid wheels and damage tires when landing at low gross weights.

HEAVY-WEIGHT FIELD LANDING.

The same technique for a normal field landing applies to heavy-weight landings except the necessary change in power settings. As gross weight increases, approach speeds should be increased accordingly. At the maximum allowable gross landing weight, a final approach speed of 135 knots should be maintained.



APPROACH SPEEDS
(OTHER GROSS WEIGHTS)

	FINAL	GROOVE
45,000 LB	135 KN	115 KN
40,000 LB	125 KN	105 KN
35,000 LB	115 KN	100 KN

Figure 2-6.

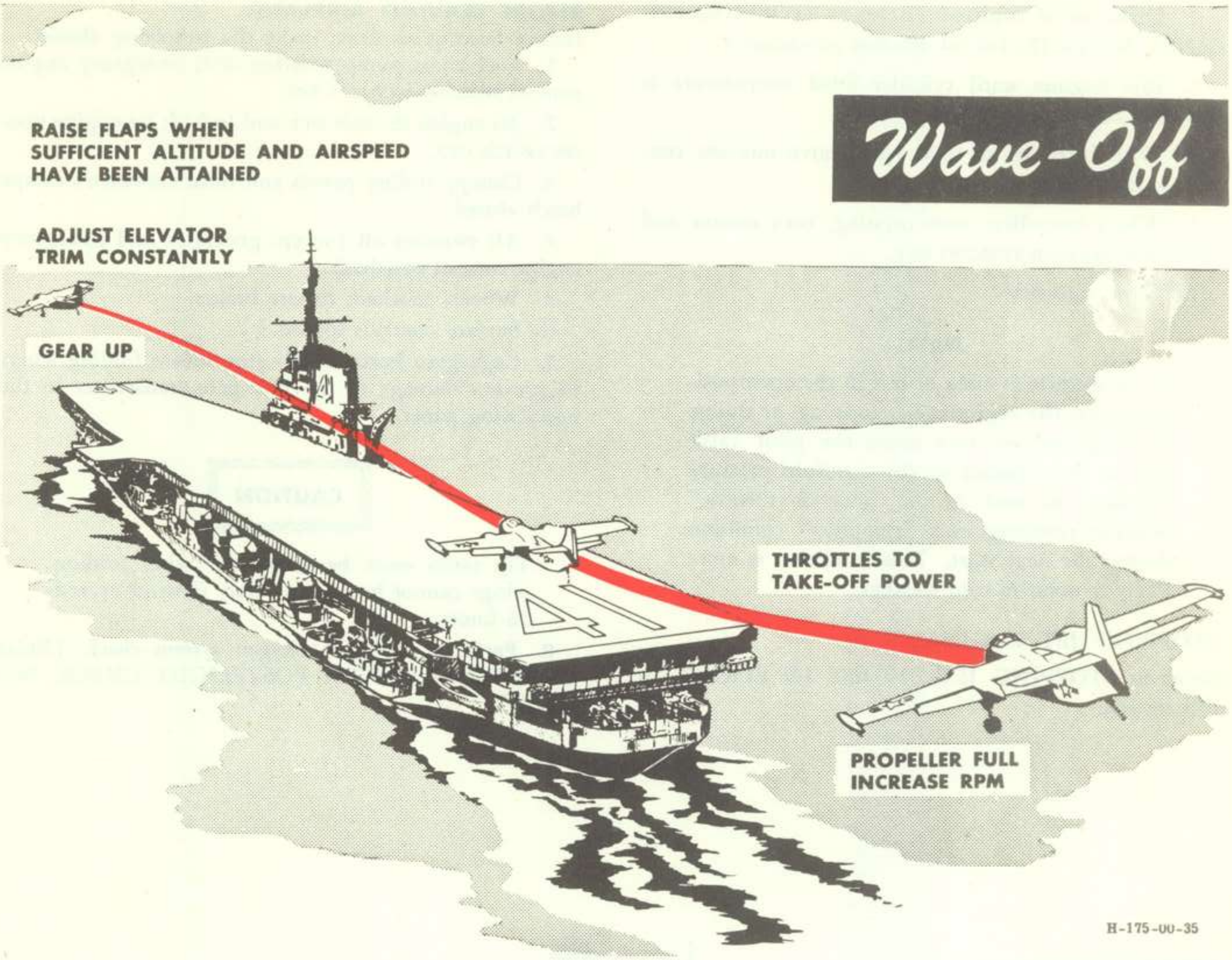


Figure 2-7.

CROSS-WIND FIELD LANDING.

Maintain normal approach speeds on the final approach.

MINIMUM RUN FIELD LANDING.

Maintain 85 to 90 knots IAS on final approach, using 2600 rpm and power to maintain desired attitude. Close throttles just before touch-down. Use brakes intermittently after nose wheel has contacted runway. Avoid skidding wheels.

NIGHT FIELD LANDING.

The same technique and procedure used in a normal field landing apply for a night landing.

Note

> For emergency landing procedures, refer to Section III.

LANDING—CARRIER.

Information will be supplied when available.

WAVE-OFF OR GO-AROUND.

For wave-off or go-around, see figure 2-7.

1. Propeller master lever full INCREASE RPM.
2. Advance throttles to Take-off Power.
3. Adjust elevator trim constantly.
4. Gear up, check gear position indicator.
5. When sufficient airspeed (above flaps-up stalling speed) and altitude are attained, gradually raise wing flaps.
6. Arresting hook up if jet engine is used for wave-off.

AFTER LANDING.

1. Propeller master lever full INCREASE RPM.
2. Arresting hook retracted after carrier landing; check warning light off.
3. Flaps up.
4. Emergency fuel pumps OFF.
5. Turbo control switches OFF.
6. Check cowl flaps fully open.

STOPPING ENGINES.

STOPPING RECIPROCATING ENGINES.

1. When brakes have cooled, set parking brakes.

2. Dilute oil if required. (Refer to STOPPING ENGINES, Section IX, for oil dilution procedure.)

3. Idle engines until cylinder head temperature is less than 200°C.

4. With throttles at 1000 rpm, move mixture controls to IDLE CUTOFF.

5. When propellers stop rotating, turn master and individual ignition switches OFF.

6. Close throttles.

Note

> If the throttle is open or left in the open position while the engine is not running, or sludge or congealed oil may cause the pilot valve and/or servo piston of the manifold pressure regulator to stick in the "increase throttle" position resulting in a "run-away" condition during the next start. This condition is more likely to occur in cold weather.

STOPPING JET ENGINE.

Refer to STOPPING JET ENGINE IN FLIGHT, in this section.

BEFORE LEAVING AIRPLANE.

Before leaving airplane, make the following checks:

1. Fuel boost pump switches OFF; emergency engine control switches NORMAL ON.

2. Jet-engine throttle OFF and locked; jet-engine master switch OFF.

3. Canopy sliding panels and third crewman's escape hatch closed.

4. All switches off (except generator and emergency engine control switches).

5. Wheels chocked; release brakes.

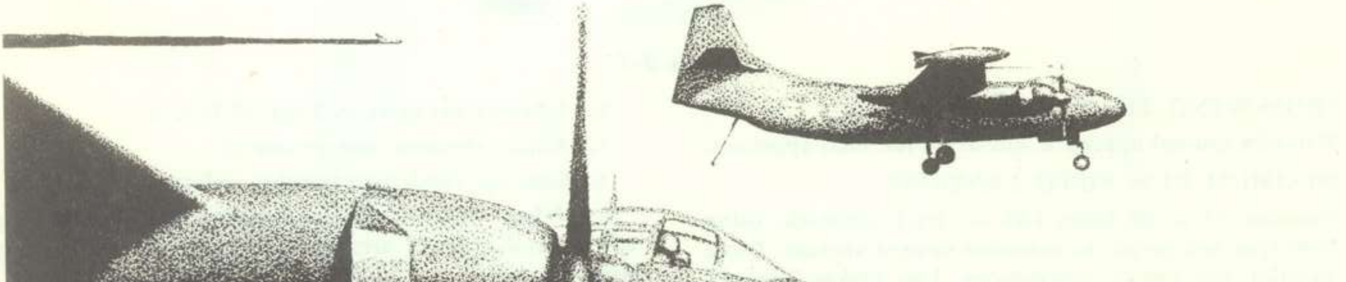
6. Surface controls locked.

7. Cage gyro horizon indicator before folding wings to prevent damage to the flux gate transmitter in the outer wing panel.

CAUTION

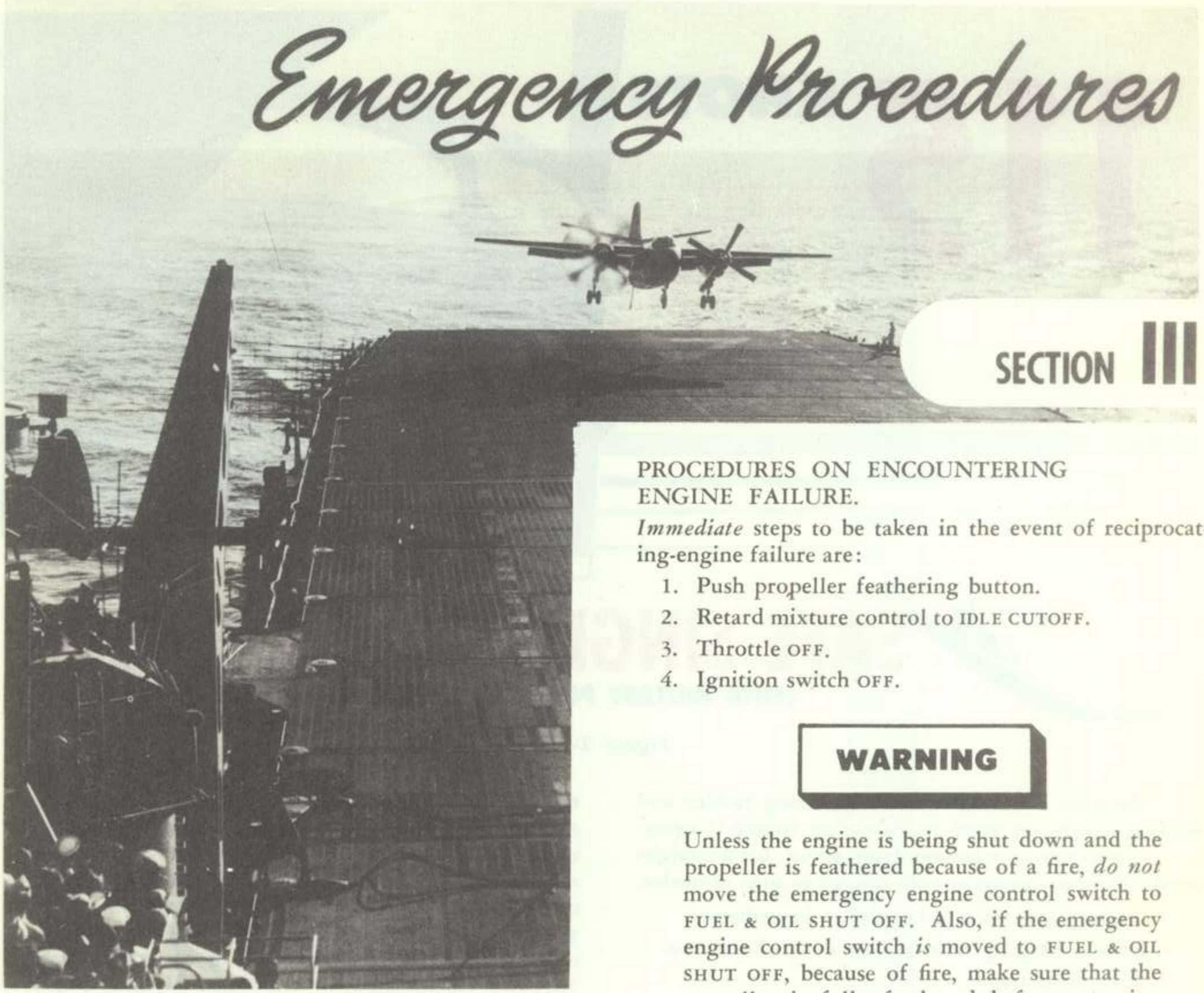
> Tip tanks must be empty for wing folding; wings cannot be folded safely if wind exceeds 26 knots.

8. Perform postflight oxygen system check. (Refer to OXYGEN SYSTEM POSTFLIGHT CHECK, Section IV.)



Emergency Procedures

SECTION III



INTRODUCTION.

Each crew member should be thoroughly familiar with the information presented in this section in order that he may know exactly what his personal action should be when an emergency situation arises.

ENGINE FAILURE.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS.

Torque pressure reading provides an immediate and positive indication of reciprocating-engine failure in flight. Even if windmilling rpm should remain high and manifold pressure decreases slowly, torque pressure drops rapidly, thus identifying the failing engine. When one reciprocating engine fails, directional control is marginal at low airspeeds and becomes critical below 115 knots IAS. Immediate control movements are required for satisfactory recovery. Failure of the jet engine does not materially affect airplane handling characteristics if both reciprocating engines are operating normally.

PROCEDURES ON ENCOUNTERING ENGINE FAILURE.

Immediate steps to be taken in the event of reciprocating-engine failure are:

1. Push propeller feathering button.
2. Retard mixture control to IDLE CUTOFF.
3. Throttle OFF.
4. Ignition switch OFF.

WARNING

> Unless the engine is being shut down and the propeller is feathered because of a fire, *do not* move the emergency engine control switch to FUEL & OIL SHUT OFF. Also, if the emergency engine control switch *is* moved to FUEL & OIL SHUT OFF, because of fire, make sure that the propeller is fully feathered before actuating the switch.

Immediate steps to be taken for jet-engine failure are as follows:

1. Throttle OFF and locked.
2. Jet-engine emergency shutoff switch SHUT-OFF.
3. Jet master switch OFF.

Further steps in shutting down the engines are outlined in the following text. The procedure will vary depending upon the particular conditions necessitating engine shut-down.

RECIPROCATING-ENGINE FAILURE DURING TAKE-OFF.

DURING TAKE-OFF RUN. If one reciprocating engine fails during take-off run, retard all throttles immediately and apply brakes. The landing gear cannot be retracted with the weight of the airplane on the gear.

DURING TAKE-OFF—FORCED LANDING. If flight cannot be continued after engine failure during take-off, prepare for an immediate landing by accomplishing as much of the following as time permits:

Figure 3-1

1. Maintain directional control by using rudder and reducing power on good reciprocating engine if necessary. Lower nose to maintain flying speed. Land straight ahead, changing direction only enough to miss obstacles.

2. Landing gear control handle UP immediately.

3. Jettison wing tip tanks if over uninhabited area.

4. Wing flaps down.

5. Feather propeller on dead engine to stretch glide.

6. Retard throttles; jet-engine emergency shutoff switch SHUT-OFF; ignition master switch OFF; generator switches OFF; battery switch OFF just before ground contact.

DURING TAKE-OFF—CONTINUED FLIGHT. Even if the jet engine is operating when a reciprocating engine fails during take-off, possibility of continued flight is marginal, depending on conditions existing when the engine fails. Adequate directional control is available only if the safe single-engine airspeed has been attained. The lowest airspeed at which you have a safe margin of control over the maximum unbalanced thrust of the good engine is the safe single-engine airspeed. Safe single-engine speed with Military Power on one reciprocating engine and with the dead engine windmilling is 115 knots. With less than Military Power on one reciprocating engine and with the jet engine operating, the airplane is controllable at lower airspeeds. Ability to climb at safe single-engine speed depends on gross weight and other variables tabulated in figure 3-2. If airspeed is higher than minimum for single-engine control, flight can be continued at higher gross weights than those shown in the table or the rate of climb can be increased. Note that the table considers the propeller on the dead engine to be windmilling and the cowl flaps open. When time and altitude are available to raise gear, feather the propeller, close cowl flaps, and reduce other drag items, the possibility of continued flight is increased considerably. If continued flight is possible, take immediate actions as follows:

1. Immediately apply rudder to correct yaw, and depress nose to keep airspeed safely above safe single-engine speed, 115 knots IAS.

2. Landing gear control handle UP immediately.

3. Push feather button on dead engine.

4. Raise wing flaps gradually to full UP as soon as power-off, flaps-up stalling speed is exceeded and safe altitude is reached. (For indicated stalling speeds, see figure 6-1.)

5. Jettison bombs and wing tip tanks if advisable.

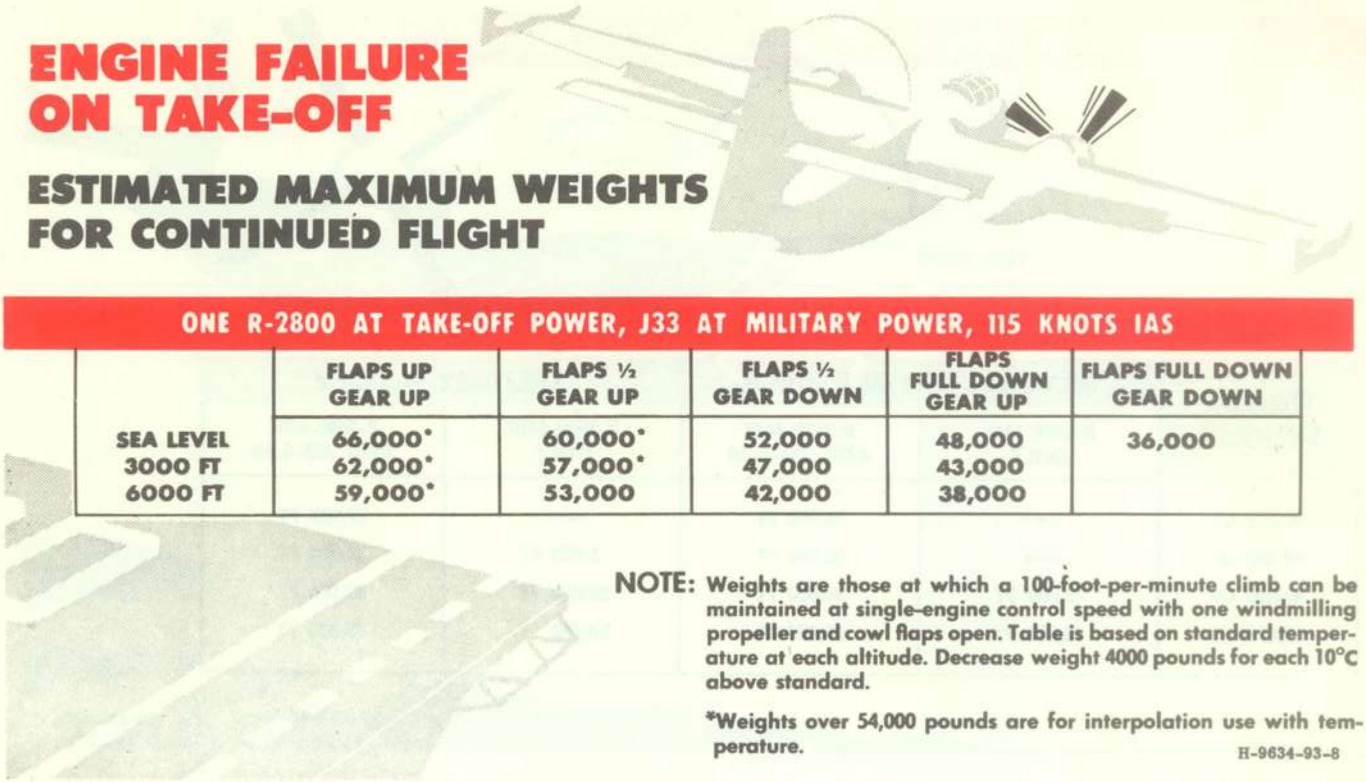
6. Close cowl, intercooler, and oil cooler flaps on dead engine.

7. Trim out rudder force.

8. Gain as much speed as possible before starting climb. Estimated best single-engine climbing speed (sea level), using Military Power with gear and flaps up and propeller on dead engine feathered, is approximately 155 knots IAS (reciprocating engine only) or 195 knots IAS (one reciprocating engine and jet engine). (For data on emergency climb, see figure A-81.)

ENGINE FAILURE ON TAKE-OFF

ESTIMATED MAXIMUM WEIGHTS FOR CONTINUED FLIGHT



ONE R-2800 AT TAKE-OFF POWER, J33 AT MILITARY POWER, 115 KNOTS IAS

	FLAPS UP GEAR UP	FLAPS ½ GEAR UP	FLAPS ½ GEAR DOWN	FLAPS FULL DOWN GEAR UP	FLAPS FULL DOWN GEAR DOWN
SEA LEVEL	66,000*	60,000*	52,000	48,000	36,000
3000 FT	62,000*	57,000*	47,000	43,000	
6000 FT	59,000*	53,000	42,000	38,000	

NOTE: Weights are those at which a 100-foot-per-minute climb can be maintained at single-engine control speed with one windmilling propeller and cowl flaps open. Table is based on standard temperature at each altitude. Decrease weight 4000 pounds for each 10°C above standard.

*Weights over 54,000 pounds are for interpolation use with temperature.

H-9634-93-8

Figure 3-2

WARNING

Unless the jet engine is used for take-off, failure of a reciprocating engine immediately after airplane is air-borne compels a forced landing.

JET-ENGINE FAILURE DURING TAKE-OFF.
If the jet engine fails during take-off, ground run and distance to clear an obstacle are considerably increased. The amount of increase varies with airspeed at the point of engine failure and is naturally greatest when gross weight is high and take-off is made from airfields of high elevation. The table in figure 3-3, based on conditions of Military Power, half flaps, and no wind shows estimated percentage increase over normal take-off distance if jet engine is not operating. For additional information see figure A-83.

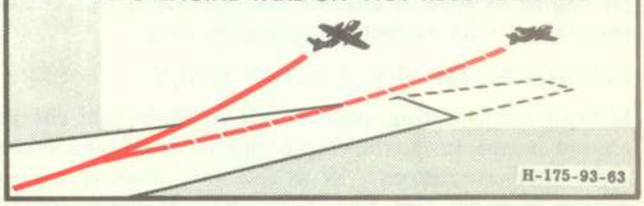
RECIPROCATING-ENGINE FAILURE DURING FLIGHT.
If a reciprocating engine fails during flight, proceed as follows:

1. Hold airplane straight with rudder.
2. Feather propeller on failing engine according to procedure given in figure 3-7.
3. Adjust power settings on good engine.
4. Trim airplane as required. Adequate trim is available for good control on single engine at all normal flight speeds.
5. Cross-feed valves ON.
6. Jettison unnecessary load items if over uninhabited area. Do not drop tip tanks even if they are empty. Less power is required and more range available with tanks installed.

PERCENT INCREASE IN TAKE-OFF DISTANCE WITHOUT JET ENGINE

GROSS WEIGHT	ALTITUDE	INCREASE IN GROUND RUN	INCREASE IN TOTAL TO CLEAR 50-FT OBSTACLE
52,000	SEA LEVEL	75%	80%
	6000 FT	85%	*
45,000	SEA LEVEL	60%	55%
	6000 FT	70%	80%
35,000	SEA LEVEL	45%	40%
	6000 FT	50%	40%

* TWO ENGINE TAKE-OFF NOT RECOMMENDED

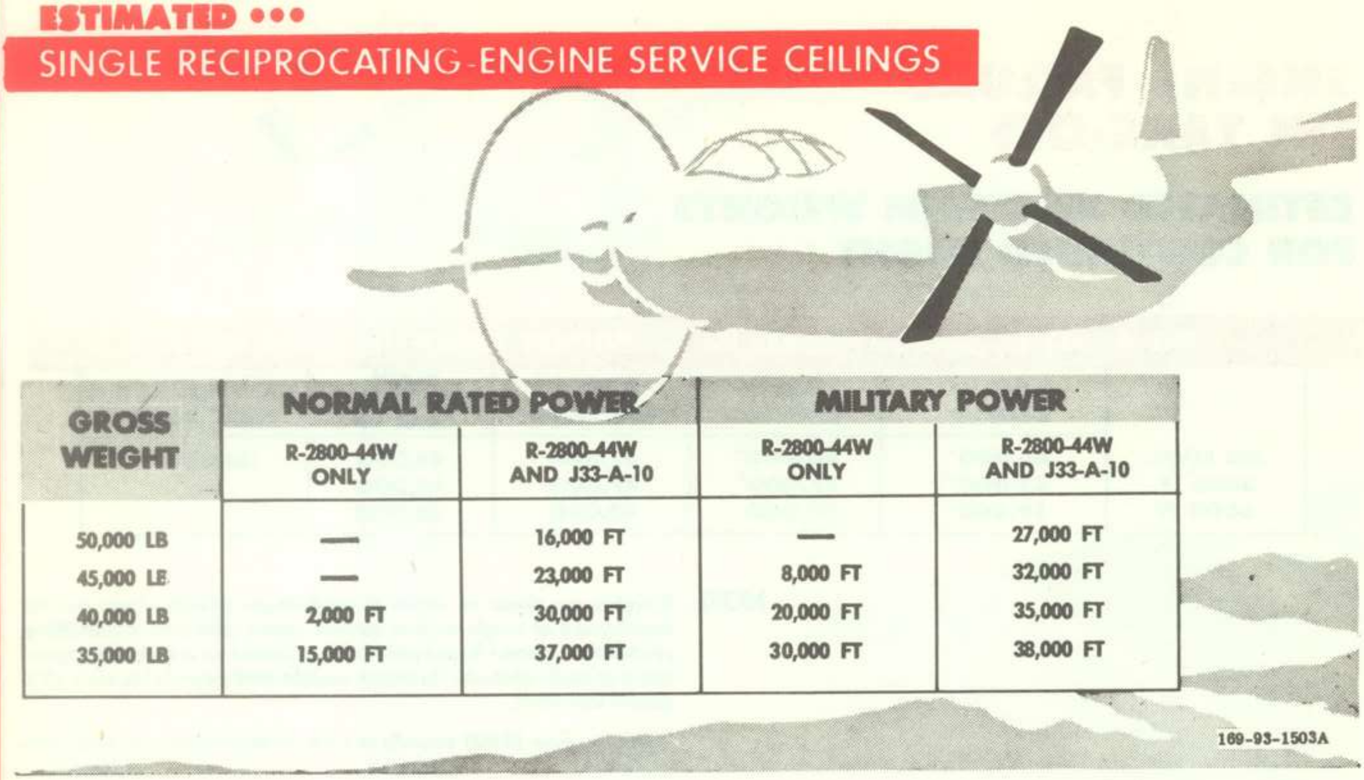


H-175-93-63

Figure 3-3. Percent Increase in Take-off Distances without Jet Engine

ESTIMATED •••

SINGLE RECIPROCATING-ENGINE SERVICE CEILINGS



GROSS WEIGHT	NORMAL RATED POWER		MILITARY POWER	
	R-2800-44W ONLY	R-2800-44W AND J33-A-10	R-2800-44W ONLY	R-2800-44W AND J33-A-10
50,000 LB	—	16,000 FT	—	27,000 FT
45,000 LB	—	23,000 FT	8,000 FT	32,000 FT
40,000 LB	2,000 FT	30,000 FT	20,000 FT	35,000 FT
35,000 LB	15,000 FT	37,000 FT	30,000 FT	38,000 FT

Figure 3-4.

7. For estimated single reciprocating-engine service ceilings, see figure 3-4; for single-engine cruise control data, see figures A-60 through A-64. For emergency cruising ceiling, see figure A-82.

8. Adjust cowl flaps on good engine manually for best engine operating conditions.

MAXIMUM RANGE WITH ONE RECIPROCATING ENGINE. (See figures A-60 through A-64.) For maximum range, proceed as follows:

1. Fly at lowest safe altitude.

2. If gross weight is very high, it may be necessary to exceed Normal Rated Power of the reciprocating engine or to use the jet engine. For maximum range, use reciprocating engine at Military Power in preference to using jet engine. Operation at Military Power is limited to 30 minutes.

3. If jet engine is used, utilize highest practicable power (Normal Rated Power) on reciprocating engine and minimum necessary rpm on jet engine. Shut down jet engine as soon as altitude and 150 knots IAS can be maintained with reciprocating engine only.

FLIGHT WITH JET ENGINE ONLY.

If both reciprocating engines fail in flight and the jet engine is operating, the flight may be continued under light load conditions With Military Power, service ceiling is 6,000 feet for 35,000 pounds gross weight. Feather propellers according to procedure given in figure 3-7, and jettison all unnecessary weight items. All nonessential equipment should be turned off immediately to conserve battery power.

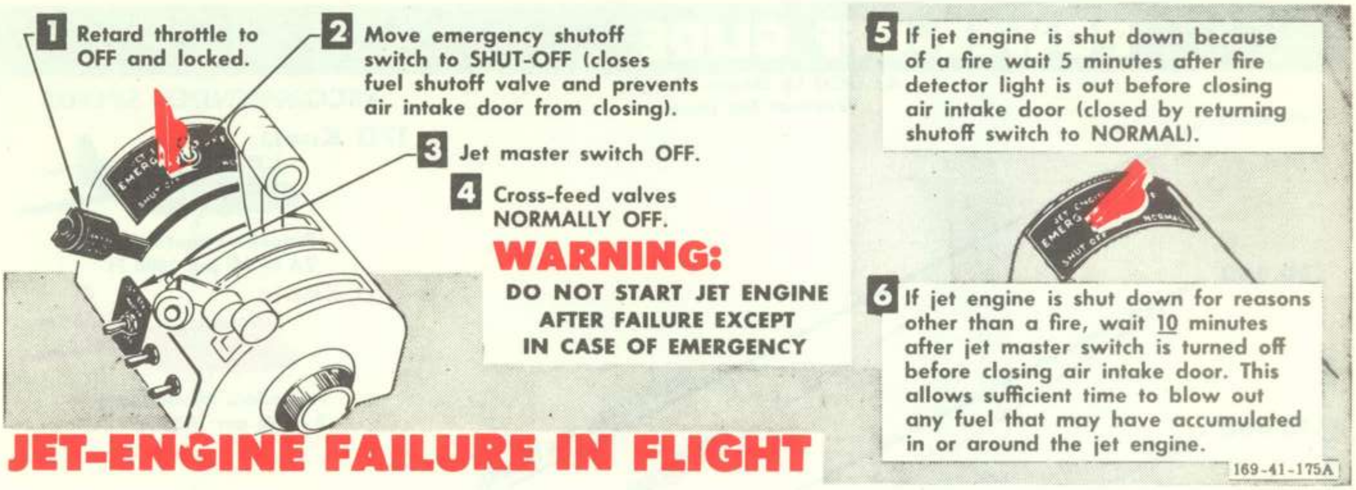
WINDMILLING STARTS OF JET ENGINE.

In the interest of obtaining maximum range, the jet engine may not have been started following failure of a reciprocating engine. This means that if the remaining reciprocating engine fails, or if the remaining generator fails, a normal air start of the jet engine will be impossible. Only the battery remains as a source of electric power. Under these circumstances, a "windmilling" start may be attempted.

Note

- A *true* windmilling start is not possible in this airplane. The starter circuits are wired in such a way that the starter always engages when accomplishing a start. Windmilling merely reduces the torque that must be supplied by the starter to obtain minimum starting rpm.
- The jet duct door cannot be opened unless utility hydraulic pressure is available. If both engines have been shut down, the only method of obtaining utility pressure is to permit one of the dead engines to windmill.

Do not attempt to start the jet engine by windmilling at altitudes above 25,000 feet. At altitudes exceeding 25,000 feet, poor flame propagation makes an air start very uncertain. Accomplish the windmilling start as follows:



1 Retard throttle to OFF and locked.

2 Move emergency shutoff switch to SHUT-OFF (closes fuel shutoff valve and prevents air intake door from closing).

3 Jet master switch OFF.

4 Cross-feed valves NORMALLY OFF.

WARNING:
DO NOT START JET ENGINE AFTER FAILURE EXCEPT IN CASE OF EMERGENCY

5 If jet engine is shut down because of a fire wait 5 minutes after fire detector light is out before closing air intake door (closed by returning shutoff switch to NORMAL).

6 If jet engine is shut down for reasons other than a fire, wait 10 minutes after jet master switch is turned off before closing air intake door. This allows sufficient time to blow out any fuel that may have accumulated in or around the jet engine.

JET-ENGINE FAILURE IN FLIGHT

Figure 3-5.

1. Fuel cross-feed valves ON.
2. Jet-engine throttle OFF and locked.
3. Jet-engine fuel control switch OFF.
4. Jet-engine emergency shutoff switch NORMAL.
5. Jet-engine starting fuel selector switch AUTO.
6. Jet-engine master switch ON.
7. After turning jet master switch ON, increase airspeed sufficiently to obtain the required minimum rpm for starting. The required minimum rpm varies with altitude as shown in the table below:

ALTITUDE	MINIMUM STARTING RPM
10,000 feet	Information will be supplied when available.
15,000 feet	
20,000 feet	
25,000 feet	

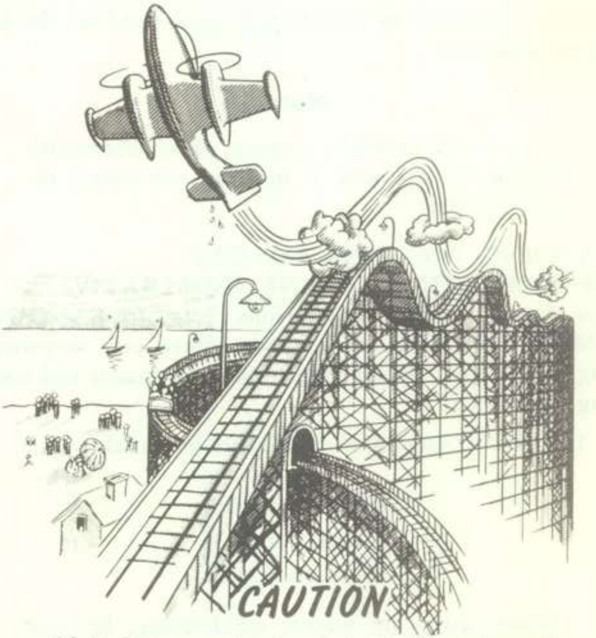
8. When jet engine reaches the proper windmilling rpm, hold jet throttle outboard at start, momentarily depress ignition and fuel start button on top of jet throttle, and watch for an increase in tail-pipe temperature indicating that the engine has started.
9. After jet engine speed stabilizes, release throttle lock and advance throttle smoothly to idle.

JET-ENGINE FAILURE DURING FLIGHT.

For procedure to follow when jet engine fails during flight, see figure 3-5.

MAXIMUM GLIDE.

If all three engines fail (fuel supply exhausted), and a suitable landing area is within reach, reduce airplane drag to a minimum by keeping flaps and gear in the up position and fully feather the propellers. Maintain the proper airspeed. At a gross weight of 35,000 pounds, maintain an indicated airspeed of approximately 150 knots to establish and hold the optimum glide angle at all altitudes. For each increase in weight of 5000 pounds, add 10 knots IAS. (See figure 3-6.) If the propellers cannot be feathered and are left in high rpm (the most critical position), the optimum glide speed is approximately 130 knots at 35,000 pounds. Again, add 10 knots for each 5000 pounds of weight in excess of 35,000. If the propellers are not fully feathered, select an airspeed between 130 and 150 knots according to extent of feathering. When the propellers are fully feathered the airplane is without normal flight control boost, since the engine-driven boost pumps are inoperative. If maximum gliding distance is not a problem, some flight control boost may be obtained if the propellers are permitted to windmill.



If it is necessary to restart the jet engine after a failure, first nose the airplane up sharply several times to drain any fuel which may have accumulated in the tail pipe.

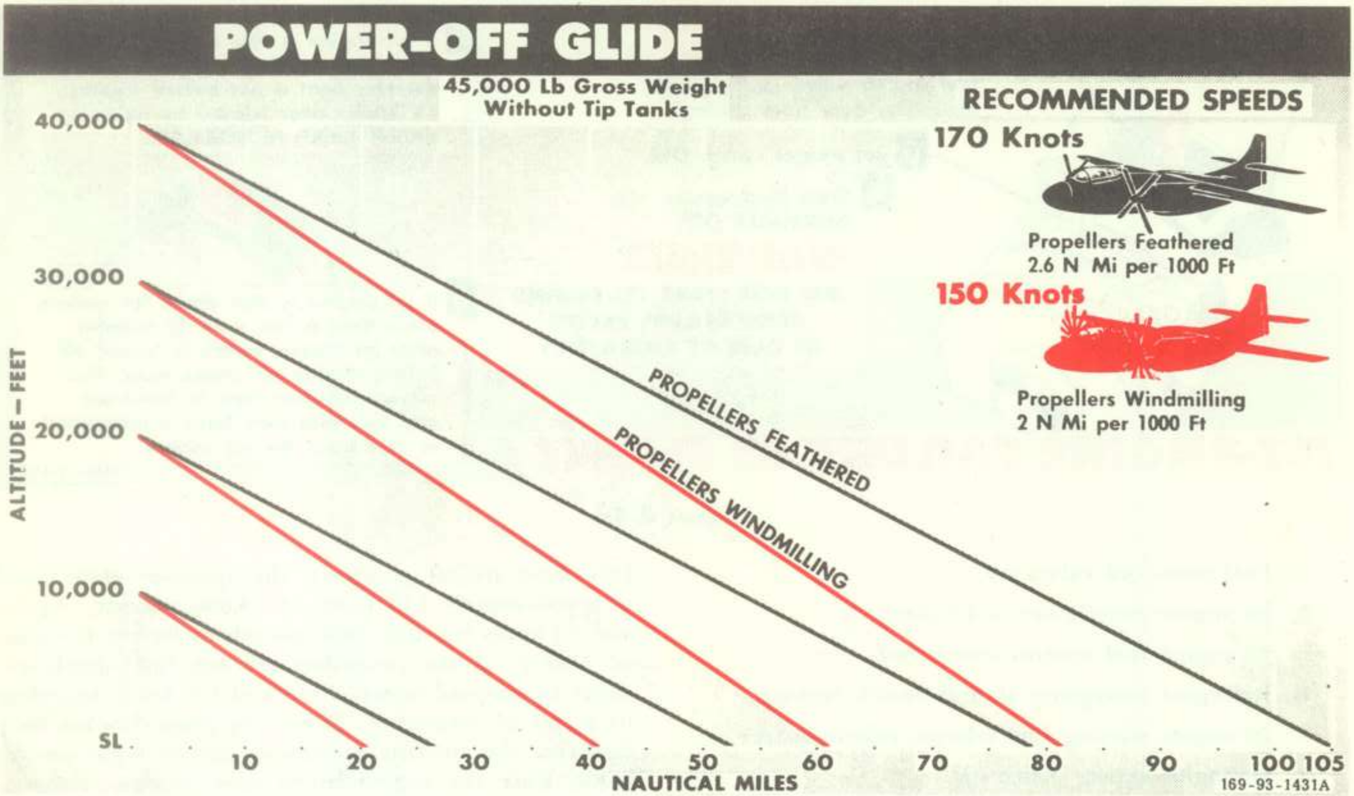


Figure 3-6. Maximum Glide Chart

EMERGENCY DESCENT FROM ALTITUDE.

If it is necessary to make a rapid descent from altitude, turn on windshield defrost and make descent with power off and propellers windmilling. Airspeed during descent should not exceed the maximum permissible Mach number indicated by the striped limit hand on the airspeed indicator.

Note

To prevent excessive cooling, close intercooler and cowl flaps and, if possible, use power intermittently.

LANDING ON RUNWAY—ONE RECIPROCATING ENGINE INOPERATIVE.

For forced landing instructions, refer to LANDING EMERGENCIES in this section. When one reciprocating engine fails during flight, make approach and landing as follows:

1. Start jet engine, if ample fuel is available.

CAUTION

When using jet engine on landing, be sure fuel control switch is OFF to prevent operation on emergency fuel system which may result in extreme tail-pipe temperature or flame-out on acceleration during a wave-off.

CAUTION

If jet engine is started with only one reciprocating engine operating, the generator will probably be damaged. Report the start on aircraft forms so that the generator will be removed and inspected upon completion of the flight.

2. Jettison tip tanks if they contain fuel.

3. When in position for approach and landing, lower gear. Lower flaps to the $1/2$ down position.

4. Establish a final approach speed of 125 knots to maintain constant rate of descent and provide adequate control for landing. Control glide angle with power on single reciprocating engine. Regulate power on jet engine according to airplane weight (bombs, tip tanks, and fuel) to reduce rate of descent. (Maximum landing weight on runway is 45,000 pounds; carrier, 35,500 pounds.)

5. If desired, reduce rudder trim used for single-engine flight to lessen rudder force when power is cut. Using full power on jet and lower power on reciprocating engine will reduce rudder force required to maintain unyawed flight. When landing is assured, lower flaps to full down position.

6. Maintain power down to flare-out, retarding throttle on single reciprocating engine to CLOSED and on jet engine to OFF position during flare.

7. Touch down at relatively high airspeed (100 to 110 knots).

WARNING

During approach, do not allow airspeed to drop below safe single-engine control speed (115 knots IAS) until landing is assured.

WAVE-OFF WITH ONE RECIPROCATING ENGINE INOPERATIVE.

Decision to take a wave-off should be made before flaps are lowered to full down. Wave-off at any practical weight can be taken with Military Power on the good engine and 100% rpm on the jet engine. (See figure 3-2.)

WARNING

Without jet power, a wave-off cannot be taken safely with any flap deflection.

Accomplish wave-off as follows:

1. Advance single reciprocating-engine power to Military Power and jet engine to 100% rpm.

2. Retract landing gear immediately and raise flaps as soon as practicable.

3. Retrim airplane as necessary.

4. Use power necessary to maintain climb or level flight at an indicated airspeed of at least 130 knots during go-around.

PROPELLER FAILURE.

EMERGENCY PROPELLER FEATHERING.

For the emergency propeller feathering procedure, see figure 3-7. If, for any reason, the propeller cannot be feathered in an emergency according to this procedure, minimize drag from the windmilling propeller by putting it in full high pitch. Hold propeller control toggle switch at DECREASE until minimum rpm is obtained.

PRACTICE PROPELLER FEATHERING.

CAUTION

To avoid hydraulic lock, excessive oil cooling, and oil congealing in the propeller and propeller feathering line, minimize the time the propeller is feathered for practice, particularly at high altitude or when outside air temperature is low.

1. Propeller master selector switch in TOGGLE SWITCHES & MASTER LEVER.

2. Throttle CLOSED.

3. Mixture control in IDLE CUTOFF.

4. Depress feathering button.

5. Ignition switch OFF.

WARNING

Propeller feathering button must be pulled to the full up (UNFEATHER) position after performing preflight feathering check or after unsuccessful feathering. Failure to do this will leave the oil shutoff valve relay in the armed position, thereby causing loss of governor control should the emergency fuel and oil shutoff switch be moved to OFF.

PROPELLER UNFEATHERING.

CAUTION

- An electrical interlock prevents unfeathering the propeller unless affected emergency engine control switch is in NORMAL ON position and affected throttle is fully retarded.
- Be sure propeller is in full decrease rpm during unfeathering to avoid overspeeding and engine damage.

1. Pull out feathering button until engine speed reaches 500 to 800 rpm. Under conditions of low outside air temperature when oil in the propeller and engine is sluggish, it is recommended that the feathering button be released as soon as the propeller starts rotating.

CAUTION

If the propeller does not unfeather in 30 seconds, release feathering button and allow feathering pump motor to cool for one minute. If there is no indication of unfeathering after the second attempt, it is possible that the oil in the feathering line has congealed, or the feathering system has not functioned properly. If the outside air temperature is low, descend to a lower altitude in an attempt to find a warmer temperature, and again try the unfeathering operation.

2. After propeller has unfeathered, position ignition switch to BOTH.

3. As propeller starts turning, position mixture control in NORMAL. Check oil pressure for 40 psi minimum.

EMERGENCY PROPELLER FEATHERING PROCEDURE

1 DEPRESS FEATHERING BUTTON.

2 EMERGENCY ENGINE CONTROL SWITCH ***FUEL & OIL SHUTOFF***

3 THROTTLE ***CLOSED***

4 MIXTURE CONTROL ***IDLE CUTOFF***

5 IGNITION SWITCH ***OFF*** AFTER PROPELLER STOPS

6 PROPELLER MASTER SELECTOR SWITCH ***TOGGLE SWITCHES ONLY***

7 FUEL CROSS-FEED VALVE SWITCHES ***ON***

8 MOVE EMERGENCY ENGINE CONTROL SWITCH TO ***CONTROL OFF.***

9 HOLD OIL COOLER, COWL, AND INTERCOOLER FLAP SWITCHES AT ***CLOSE*** TO CLOSE ALL COOLING FLAPS.

NOTE:

If for any reason the propeller cannot be feathered in an emergency according to this procedure, minimize drag from the windmilling propeller by putting it in full high pitch. (Hold propeller control toggle switch at *DECREASE*.)

Figure 3-7.

4. Oil cooler and intercooler flap switches AUTOMATIC. Cowl flaps closed.

5. Advance throttle for warm-up; check torquemeter for indication that the engine is operating. Warm up engine at 1200 rpm until oil temperature indicates a safe operating condition.

6. Cowl flaps in AUTOMATIC.

7. Bring up rpm by propeller control toggle switch; then move propeller master selector switch to NORMAL.

PROPELLER SYNCHRONIZER FAILURE.

Should the propeller synchronizer fail, move propeller master selector switch to TOGGLE SWITCHES ONLY or TOGGLE SWITCHES & MASTER LEVER, and synchronize rpm by operation of individual propeller control toggle switches.

PROPELLER GOVERNOR FAILURE.

Depending upon the cause of malfunction, governor failure may cause a propeller to be held in constant speed as set at the time of failure or to go to full low pitch (runaway propeller). Any kind of electrical failure is most likely to result in the constant-speed condition, and no remedial action is possible other than to check operation of the propeller control toggle switch and the master lever. A runaway propeller may cause the engine speed to exceed allowable limits, but it may be possible to reduce rpm as follows:

1. Retard throttle and reduce airspeed as much as possible.

2. Move propeller master selector switch to TOGGLE SWITCHES & MASTER LEVER and attempt to lower rpm by using both the related propeller control toggle switch and the master lever. (Adjust rpm of good engine as desired by use of related toggle switch.)

3. If this fails, depress feathering button until rpm comes within allowable limits, then pull feathering button up to stop feathering action.

4. If propeller will not feather and rpm cannot be brought within limits by airspeed and throttle reduction, shut down engine completely.

FIRE.

RECIPROCATING-ENGINE FIRE DURING GROUND START.

If fire occurs during engine starting:

1. Keep engine running and open throttle, as fire may be drawn through engine and extinguished. (If engine is not yet running when fire occurs, be sure mixture control is in IDLE CUTOFF, turn fuel boost pump OFF, open throttle, and keep engine turning on starter.)

2. If fire does not go out, move mixture control to IDLE CUTOFF and turn ignition OFF.

3. Turn fuel boost pumps OFF.

4. Move emergency engine control switch to FUEL & OIL SHUT OFF.

5. Battery switch OFF.

6. Shut down other engine.

7. Notify crew to abandon airplane.

JET-ENGINE FIRE DURING GROUND START. If fire occurs during ground start:

1. Jet throttle OFF and locked.

2. Jet master switch OFF to shut off fuel supply to jet engine.

CAUTION

Battery switch must be ON or one reciprocating engine operating to supply power to the jet-engine master switch.

3. Shut down reciprocating engines.

4. Notify crew to abandon airplane.

RECIPROCATING-ENGINE FIRE DURING FLIGHT.

If a fire occurs in a reciprocating engine during flight:

1. Feather propeller according to the procedure given in figure 3-7.

2. Generator field switch OFF.

3. Lower landing gear (below 175 knots) to avoid damaging the gear. After fire-warning light goes out, gear may be retracted.

Note

If gear is not retracted, range will be decreased 20 percent. To maintain flight with single reciprocating engine and with gear down, gross weight must be reduced to 40,000 pounds.

JET-ENGINE FIRE DURING FLIGHT.

If fire occurs in the jet engine during flight:

1. Shut down engine immediately according to the procedure given in figure 3-5.

2. Do not attempt to restart the jet engine.

Note

The jet engine can be viewed from the crew entry compartment. Line-of-sight windows are installed in the bulkhead doors.

FUSELAGE FIRE.

FUSELAGE FIRE IN JET-ENGINE COMPARTMENT. If fire is reported in the jet-engine compartment, position jet-engine emergency shutoff switch at SHUT-OFF to open duct door.

FUSELAGE FIRE IN BOMB BAY. If fire is reported in the bomb bay, proceed as follows:

1. Salvo bombs if loaded and if over clear area.

2. Check that crew hatch to bomb bay is closed.

3. Turn off all switches controlling electrical installations in the bomb bay.

4. Check that bomb bay doors are closed.

5. If fire does not go out immediately, give order to abandon the airplane.

FUSELAGE FIRE IN PRESSURIZED CABIN. If fire is reported in the fuselage cabin, proceed as follows:

1. Turn cabin air control to RAM AIR ON — DUMP VALVE OPEN.

2. Order crew to use oxygen; oxygen regulator at 100% OXYGEN.

3. Turn off cabin heater.

4. Use hand fire extinguishers if available.

5. If fire cannot be controlled, abandon the airplane.

ELECTRICAL FIRE.

Circuit breakers isolate most electrical circuits and automatically interrupt power to prevent a fire when a short occurs. If fire is electrical, try to determine the source, and turn off switches controlling the affected equipment or pull circuit breakers.

ELIMINATION OF SMOKE AND FOG.

If smoke or fumes should enter the cabin, regardless of altitude, proceed as follows:

1. Cabin air control RAM AIR ON — DUMP VALVE OPEN.

2. Oxygen regulator at 100% OXYGEN.

3. Turn cabin heater switch HEATER OFF.

LANDING EMERGENCIES.

FORCED LANDING.

If it is necessary to make a forced landing:

1. Start jet engine if ample fuel is available.

2. Warn crew.

3. Jettison bombs and tip tanks.

4. Jettison crew door to prevent jamming on impact.

5. Open sliding panels and have third crewman open escape hatch.

6. Unbuckle parachute; tighten and lock safety belt.

7. Lower gear only when terrain is suitable for wheels-down landing.

8. Make a normal full-flap approach. (Refer to NORMAL FIELD LANDING, Section II.)

9. If landing is made with wheels up, feather propeller on right engine before contact. With propeller unfeathered, tips may break and pass through the fuselage, endangering personnel.

10. Just before ground contact, warn crew, retard throttles, and cut all switches to reduce possibility of fire.

11. After landing, immediately leave airplane through crew door or sliding panels and make sure that all crew members get out.

ONE GEAR RETRACTED.

If one gear will not extend and it is impossible to retract the other gear, prepare for forced landing. Keep wings level as long as possible.

EMERGENCY ENTRANCE.

Emergency entrance into the airplane may be made through the crew door. An exterior handle is located on the door. If the door is jammed, emergency entrance may be gained if the largest Plexiglas panels on each side of the canopy are knocked out.

DITCHING.

PREPARING FOR DITCHING.

PILOT. When ditching is necessary, ditch airplane while power is still available. Make preparation as follows:

1. Give command, "Prepare for ditching."

2. Jettison tip tanks and bombs. Make sure bomb bay doors are closed after jettisoning.

3. Check landing gear in UP position.

4. Unbuckle parachute. Make sure safety belt and shoulder harness are tightened and locked.

5. Open canopy sliding panel before landing.

BOMBER-NAVIGATOR. Prepare for ditching as follows:

1. Open canopy sliding panel.

2. Unbuckle parachute. Make sure safety belt and shoulder harness are tightened and locked.

3. Notify pilot, "Ready for ditching."

THIRD CREWMAN. Prepare for ditching as follows:

1. Make sure that hatch leading to bomb bay is closed and locked.

2. Crew door securely closed.

3. Start emergency radio procedure immediately.

4. Open escape hatch.

5. Unbuckle parachute. Make sure safety belt and shoulder harness are locked.

6. Notify pilot, "Ready for ditching."

DITCHING TECHNIQUE.

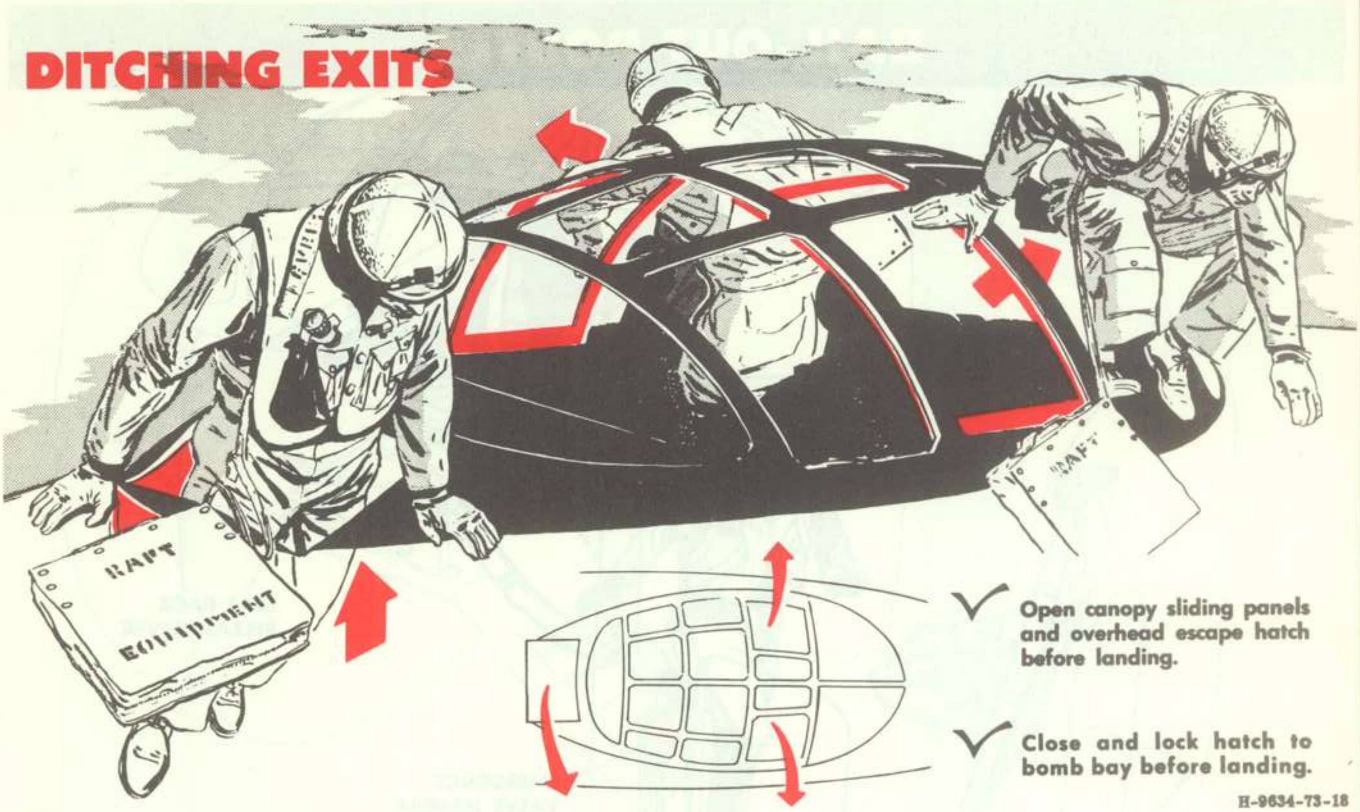
1. Check landing gear up and flaps $1/2$ down.

2. Make normal approach and flare-out to normal landing attitude. Unless wind is high or sea is rough, select approach heading parallel to any uniform swell pattern and try to touch down along the crest of a swell or just after the crest passes. If surface is irregular or wind exceeds 30 knots, ditch into the wind and try to touch down on the falling side of the wave.

3. Warn crew 5 seconds before landing.

ABANDONING THE AIRPLANE.

The crew should hold their stations until the airplane comes to a stop, then proceed as follows: (See figure 3-8.)



✓ Open canopy sliding panels and overhead escape hatch before landing.

✓ Close and lock hatch to bomb bay before landing.

H-9634-73-18

Figure 3-8.

1. Unfasten safety belts and shoulder harnesses.
2. Exit from airplane and inflate pararafts.

BAIL-OUT.

PREPARING FOR BAIL-OUT.

PILOT. When it is necessary to abandon the airplane (figure 3-9), proceed as follows:

1. Warn crew of impending bail-out.
2. Reduce speed as much as possible, and trim airplane "hands off."
3. Make sure that bomb bay doors are closed. There is danger of striking the bomb bay doors if exit is made through the crew door when the bomb bay doors are open.

BOMBER-NAVIGATOR OR THIRD CREWMAN. Open crew door by positioning the emergency exit control in pilot's compartment to OPEN DOOR or by moving the emergency valve handle in crew entry compartment to EMERGENCY EXIT DOOR OPEN. (See figure 3-11.) The main part of the door will be jettisoned and an integral deflector will be held open to serve as a windguard. If door does not open, raise the emergency jettison handle and move it aft and outboard to jettison the main part of the door and open the integral wind deflector.

ALL CREW MEMBERS. Before command to abandon airplane is given by the pilot, crew members should:

1. Unfasten safety belt and shoulder harness.
2. Unfasten oxygen breathing tube clip if fastened to parachute strap.
3. Pilot and bomber-navigator should lower back of seat by operating seat-back release lever to allow exit from pilot's compartment.

If enough time is available before abandoning the airplane, exit may be made through the bomb bay. Open bomb bay doors and hatch leading to bomb bay.

Note

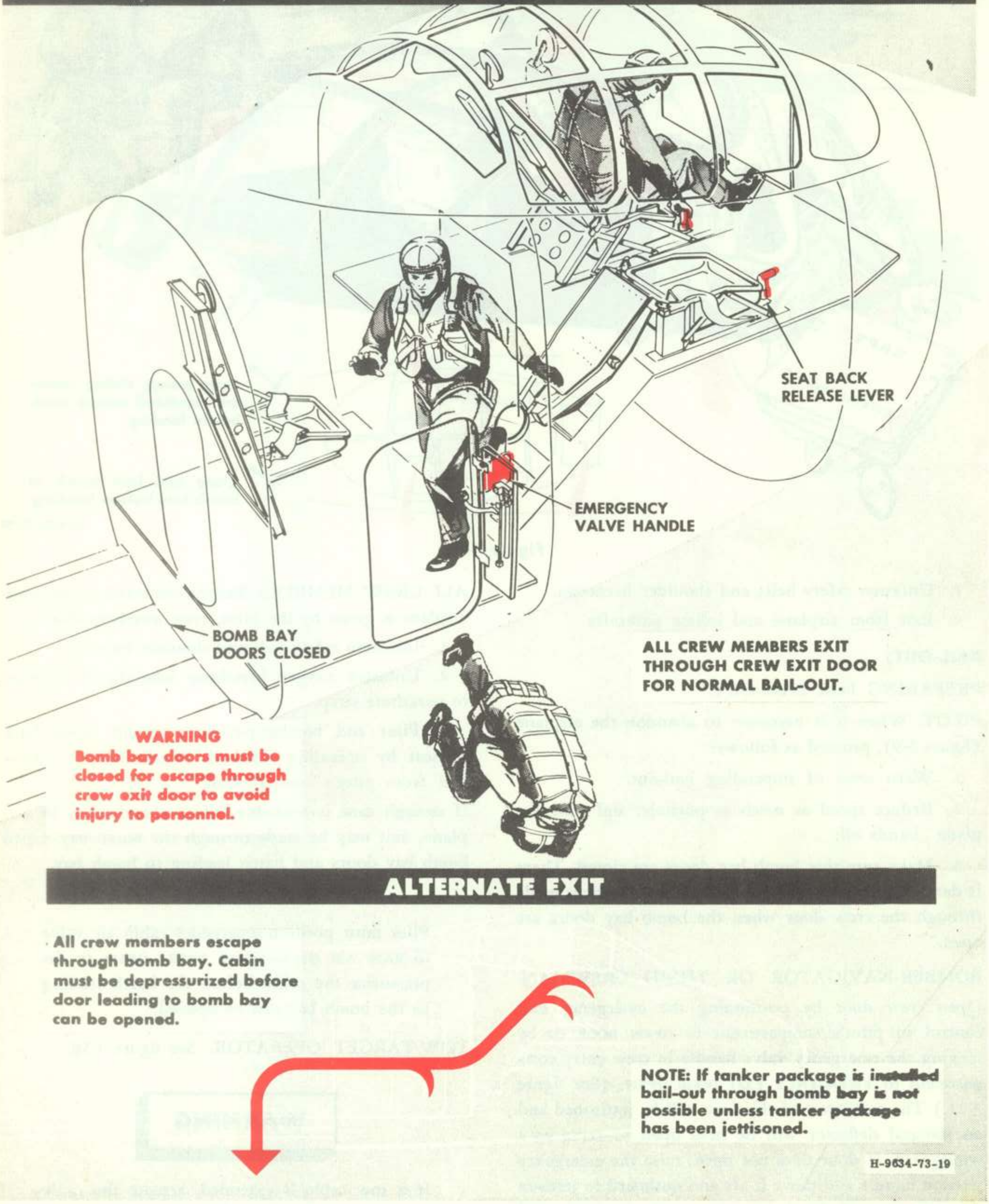
> Pilot must position emergency cabin air valve to RAM AIR ON — DUMP VALVE OPEN to depressurize the cabin before the hatch leading to the bomb bay can be opened.

TOW-TARGET OPERATOR. See figure 3-10.

WARNING

> If a tow cable is extended, actuate the cable-cutter switch on the package console prior to bail-out.

BAIL-OUT ROUTES



ALL CREW MEMBERS EXIT THROUGH CREW EXIT DOOR FOR NORMAL BAIL-OUT.

WARNING

Bomb bay doors must be closed for escape through crew exit door to avoid injury to personnel.

ALTERNATE EXIT

All crew members escape through bomb bay. Cabin must be depressurized before door leading to bomb bay can be opened.

NOTE: If tanker package is installed bail-out through bomb bay is not possible unless tanker package has been jettisoned.

Figure 3-9.

DISCONNECT SAFETY HARNESS; THEN JETTISON HATCH BY ACTUATING HANDLE MARKED **"PULL HANDLE TO JETTISON."**

WARNING

IF TOW CABLE IS EXTENDED, ACTUATE CABLE CUTTER SWITCH ON PACKAGE CONSOLE PRIOR TO BAIL-OUT.

Figure 3-10. Bail-out-Tow-Target Operator

FUEL SYSTEM EMERGENCY OPERATION.

WARNING

Do not attempt to jettison ferry tank under any circumstances, as this will permit fuselage tank fuel to flow into the bomb bay and create a dangerous fire hazard.

FUEL PUMP FAILURE — RECIPROCATING ENGINES.

If drop in fuel pressure indicates failure of an engine-driven pump, turn related emergency fuel pump on. If the pump failure is not detected before the engine cuts out, retard throttle before turning emergency pump on, to prevent possible engine backfire; move related propeller toggle switch to DECREASE to prevent possible overspeeding of propeller when engine cuts in.

FUEL PUMP FAILURE — JET ENGINE.

Sudden drop in fuel pressure and loss of engine rpm on the jet engine usually indicates failure of some part of the fuel system. In case of such failure, turn jet-engine fuel control switch to EMERG. If engine stops, retard throttle OFF and locked and move jet master switch to OFF. Do not attempt a restart except in case of an emergency.

TRANSFER PUMP FAILURE.

If the fuselage tank fuel quantity indicator shows that fuselage tank fuel is not being transferred (by the time wing tanks indicate 400 pounds remaining fuel), fuselage tank fuel can be utilized as follows: At low altitude (10,000 feet or below), where suction feed is sufficient for normal engine operation, open cross-feed valves and turn transfer pump and boost pumps off. Fuselage tank fuel will flow to cross-feed line by suction feed. After fuselage tank fuel has been consumed, turn boost pumps ON.

CROSS-FEED OPERATION IN CASE OF ENGINE FAILURE. In case of engine failure, all fuel in the airplane can be supplied to the operating engine or engines (jet or reciprocating) as follows:

1. Cross-feed valve switches ON.
2. If use of ferry tank fuel is desired, turn ferry tank pumps ON.

DAMAGED TANKS. If one set of wing tanks is damaged or a severe leak is suspected, proceed as follows:

1. If practicable, use fuel from damaged tanks first by turning cross-feed valve switches ON and boost pump switch for good tanks OFF.
2. If leak is believed to be in either wing tank, move fuselage tank transfer switch to OFF so that fuselage tank fuel will not be lost by automatic transfer to the leaking tank.

3. When damaged tanks are nearly empty or if wing heaviness becomes excessive, turn boost pump switch ON for good tanks. Leave cross-feed valves switches ON and leave transfer pump switch OFF. Turn boost pump switch OFF for damaged tanks when tanks indicate empty.

4. If leak is known to be in either wing tank, fuselage tank fuel can be salvaged by the following method: Use wing tank fuel as instructed in steps 2. and 3. When wing tanks are empty, at low altitude (10,000 feet or below) where suction feed is sufficient for normal engine operation, leave cross-feed valve switches ON, turn all boost pump switches OFF, and leave transfer pump switch OFF. Fuel will flow from the fuselage tank to the cross-feed line by suction feed for operation of both engines.

FERRY TANK TRANSFER PUMP FAILURE.

If the ferry tank pressure indicator light illuminates, indicating that ferry tank fuel is no longer being transferred, check that ferry tank pump circuit breakers are in. Circuit breakers will pop out if the pumps are overloaded. If this occurs, turn switch OFF, reset circuit breakers, and return switch to ON; if the overloading was temporary, the cease-flow indicator light will go out. If the overloading continues and the circuit breakers again pop out, turn transfer pump switch OFF. In the event that only one pump is affected by the overload condition, fuel transfer will be satisfactory with the output of the remaining transfer pump. No gravity or suction feed is available for ferry tank fuel.

TIP TANK FAILURE TO TRANSFER FUEL.

If fuel fails to transfer from the tip tanks at low altitude because of cabin compressor failure, increasing altitude to 7500 feet will enable the turbosupercharger to accomplish transfer. Transfer of fuel under these conditions, however, will be slower than normal.

ELECTRICAL SYSTEM EMERGENCY OPERATION.

GENERATOR OVERVOLTAGE.

Should voltage output of either generator become excessive, an overvoltage relay cuts the affected generator out of the electrical circuit. If this condition is indicated by illumination of generator warning light:

1. Hold related generator field switch at RESET momentarily; then return to NORM.

2. If warning light goes out and remains out when the switch is turned to NORM, the overvoltage was temporary.

3. If light illuminates again, push emergency reset button momentarily.

4. If use of the emergency reset button is ineffective, move generator field switch OFF and attempt to reduce voltage by adjusting voltage regulator rheostat in crew entry compartment; then turn generator field switch to NORM and re-check voltage.

5. If voltage cannot be brought within allowable limit (30 volts maximum emergency), move both generator switches for faulty generator to OFF.

Note

Whenever generator warning light flickers intermittently, turn generator control switch OFF to prevent damage to the circuit.

GENERATOR FAILURE.

Failure of one generator automatically disconnects the monitored bus from the remaining generator. (For electrical equipment powered by the monitored bus, see figure 1-18.) When required, the monitored bus can be reconnected to the system by positioning the monitored bus switch to ON.

CAUTION

Do not turn monitored bus switch ON unless the load on the operating generator is less than 400 amperes.

Note

Turbosupercharger for related engine will be inoperative unless turbo power switch is moved to EMERG. (BAT.).

If both generators are inoperative, the length of time that the battery will supply power depends on the electrical load and the condition of the battery. With electrical load reduced to a minimum and the battery fully charged, electrical power will be available for approximately 20 minutes.

CAUTION

Immediately reduce electrical load by turning off all nonessential equipment. (For electrical equipment powered by the essential bus, see figure 1-18.)

INVERTER FAILURE.

Failure of the flight instrument inverter is indicated by illumination of the flight instrument inverter failure warning light on the a-c power panel. As the warning light illuminates, the electrical load on the flight instrument inverter is automatically switched over to the engine instrument inverter. As an added precaution, move the inverter selector switch to FLT. INST. INV. STANDBY, just in case the automatic change-over system has failed to function properly. If the engine instrument inverter fails, the engine instrument inverter failure warning light will illuminate. As this occurs, the electrical load on the engine instrument inverter is automatically switched over to the flight instrument inverter. To ensure that the electrical lead is transferred, move the inverter selector switch to ENGINE INST. INV. STANDBY. A stand-by system is not provided for the main inverter. When the main inverter fails the following equipment, powered by the main inverter, becomes inoperative: all radar equipment, the AN/APX-6 IFF equipment, the fuel flowmeter, and the hydraulic systems pressure gage. When either the flight instrument or engine instrument inverter becomes inoperative the automatic pilot automatically disengages and cannot be re-engaged.

FLIGHT INSTRUMENT TRANSFORMER FAILURE.

If the main instrument transformer fails, indicated by flight instruments becoming inoperative with no illumination of inverter warning lights, move the instrument transformer switch to STANDBY to connect the stand-by transformer into the system.

HYDRAULIC SYSTEM EMERGENCY OPERATION.

If the utility hydraulic system fails and electrical power is still available, the emergency hydraulic system makes it possible to: lower the landing gear and wing flaps; close the jet duct door; and open or close the bomb bay doors. Movement of any of the controls on the emergency hydraulic panel automatically starts the emergency hydraulic pump. The parking brakes are operated by pressure from the hydraulic air accumulator so that they are operable when neither utility hydraulic system pressure nor electrical power is available.

FILLING HYDRAULIC RESERVOIRS IN FLIGHT.

Hydraulic fluid level indicators are located on the utility and boost reservoirs in the bomb bay. To open the hatch leading to the bomb bay, the cabin must first be depressurized. The emergency reservoir, located in the nose wheel well, also has a fluid level indicator; this indicator is visible through a sight window just to the left of the steps in the crew entry compartment. It will be necessary to use a light to read the indicator. Two one-gallon hydraulic fluid containers are stowed in the aft section of the crew entry compartment. If it is necessary to refill hydraulic reservoirs in flight, proceed as follows:

1. Insert hose, stowed on the side of the emergency hydraulic panel, into fluid container.
2. Turn filling valve on emergency hydraulic panel to FILL. (Do not discharge accumulators.)

CAUTION

> Do not allow air to enter the hose during filling operation or air will be pumped into the hydraulic system.

3. Place emergency pump switch at ON FILLING, and hold.
4. When reservoirs are full, release pump switch.
5. Move filling valve to OFF.
6. Stow hose.

Note

> All three reservoirs must be full before utility hydraulic pressure will be available, as the emergency reservoir fills first, then the boost system reservoir and, finally, the utility reservoir.

FLIGHT CONTROL BOOST HYDRAULIC SYSTEM FAILURE.

In case one of the boost system, engine-driven, hydraulic pumps fails, the flight control boost systems will still function normally; however, the rapidity of control surface response may be decreased depending on the rpm of the engine driving the operative pump. If both pumps fail, turn the rudder electric motor pump alternate boost switch ON to furnish alternate rudder boost pressure. The airplane design incorporates sufficient mechanical advantage in the elevator and aileron control systems to permit normal operation of these surfaces without boost pressure. However, increased pilot effort will be required. The elevator boost-out forces will be considerably higher on some airplanes.* The rudder will require very high control forces without boost. Under such circumstances, approach speeds should be high enough to permit adequate aileron control, as rudder control is practically ineffective. In case of aileron boost system failure, the aileron boost control switch should be turned to OFF to open by-pass valves in the aileron boost system. This ensures that the malfunctioning boost system will not interfere with movement of the ailerons.

WARNING

> If, at *any time,* the aileron control sticks in a displaced position, turn the aileron boost switch OFF.

To simulate complete boost-out flight the aileron boost switch and the rudder and elevator boost switch can be positioned to OFF. When this is done the rudder electric motor pump alternate boost switch must also be turned OFF; otherwise, rudder boost will still be available.

LANDING GEAR EMERGENCY OPERATION.

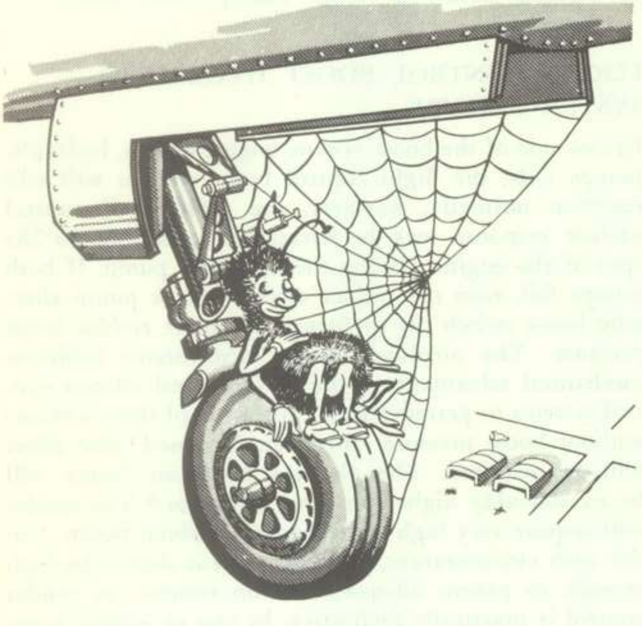
LANDING GEAR EMERGENCY LOWERING.

If normal landing gear operation fails, gear can be lowered as follows:

1. Pull out landing gear control circuit breaker.
2. Place landing gear handle in DOWN position.
3. Position emergency landing gear control, on emergency hydraulic panel, at EMERG. LDG. GEAR DOWN.
4. Check gear position indicator for safe gear condition.

***Airplanes 124161 and 124181 only**

5. Return emergency landing gear control to OFF, so that emergency pressure will be available for other operations.



CAUTION

Time required for gear extension by emergency system is considerably longer than time required for normal operation.

If gear does not operate satisfactorily and utility pressure is available, use the following procedures:

1. Pull out handle of cabin compressor selector valve before operating gear and gear door selector valves in the following steps.

2. Push main landing gear door selector valve to OPEN. Release when doors are fully opened. (Wait at least 10 seconds.)

3. Push landing gear selector valve to DOWN. Hold down until lock engages. Check gear position indicator DOWN.

4. When gear reaches the down position, push main gear door selector valve to CLOSE. (Nose gear doors do not close when gear is lowered.)

5. Return cabin compressor valve handle to original position.

LANDING GEAR EMERGENCY RETRACTION.

If normal landing gear operation fails, gear can be retracted as follows:

1. Pull out landing gear control circuit breaker.

2. Pull out handle of cabin compressor selector valve.

3. Push main landing gear door selector valve to OPEN. Release when doors are fully opened. (Wait at least 10 seconds.)

4. Push landing gear selector valve to UP. Hold up until lock engages. (Wait at least 20 seconds.)

5. When gear reaches the up position, push main gear door selector valve to CLOSE and check position indicators UP.

6. Return cabin compressor selector valve handle to original position.

JET AIR INTAKE DOOR EMERGENCY OPERATION.

The jet door unsafe warning light illuminates whenever the jet duct door is not fully open. The normal opening cycle requires only 2 seconds; however, the normal closing cycle requires approximately 3 minutes, 10 seconds, because of a 3-minute time delay relay incorporated in the jet duct door closed circuit. Allow sufficient time for normal operation before using emergency operation. If jet door fails to open or close normally, proceed as follows:

1. Push duct door selector valve to OPEN or CLOSED, as desired. Wait 2 seconds for door to open, 10 seconds for door to close (time delay relay is by-passed in manual operation of selector valve). Door can be seen from cockpit.

If the jet duct door must be closed after failure of the utility hydraulic system, proceed as follows:

1. Move emergency jet duct door control on emergency hydraulic panel to EMERG. JET DOOR CLOSE. Wait until door is closed; door can be seen from cockpit. (The time delay relay is by-passed when using emergency hydraulic system.)

2. Return emergency jet duct door control to OFF, so that emergency pressure will be available for other operations.

WING FLAP EMERGENCY OPERATION.

WING FLAP EMERGENCY LOWERING.

If normal wing flap operation fails to lower the flaps, they can be lowered as follows:

1. Pull out landing flap control valve circuit breaker.

2. Position emergency wing flap control, on emergency hydraulic panel, at EMERG. WING FLAP DOWN.

3. When flaps reach desired position, return emergency wing flap control to OFF.

If wing flaps do not lower to desired position and utility hydraulic pressure is available, proceed as follows:

1. Pull out handle of cabin compressor selector valve while operating wing flap selector valve.

2. Push wing flap selector valve to DOWN and hold until desired flap position is reached.

3. Return cabin compressor selector valve handle to original position.

WING FLAP EMERGENCY RAISING.

If normal operation fails to raise the wing flaps, they can be raised by the following procedure:

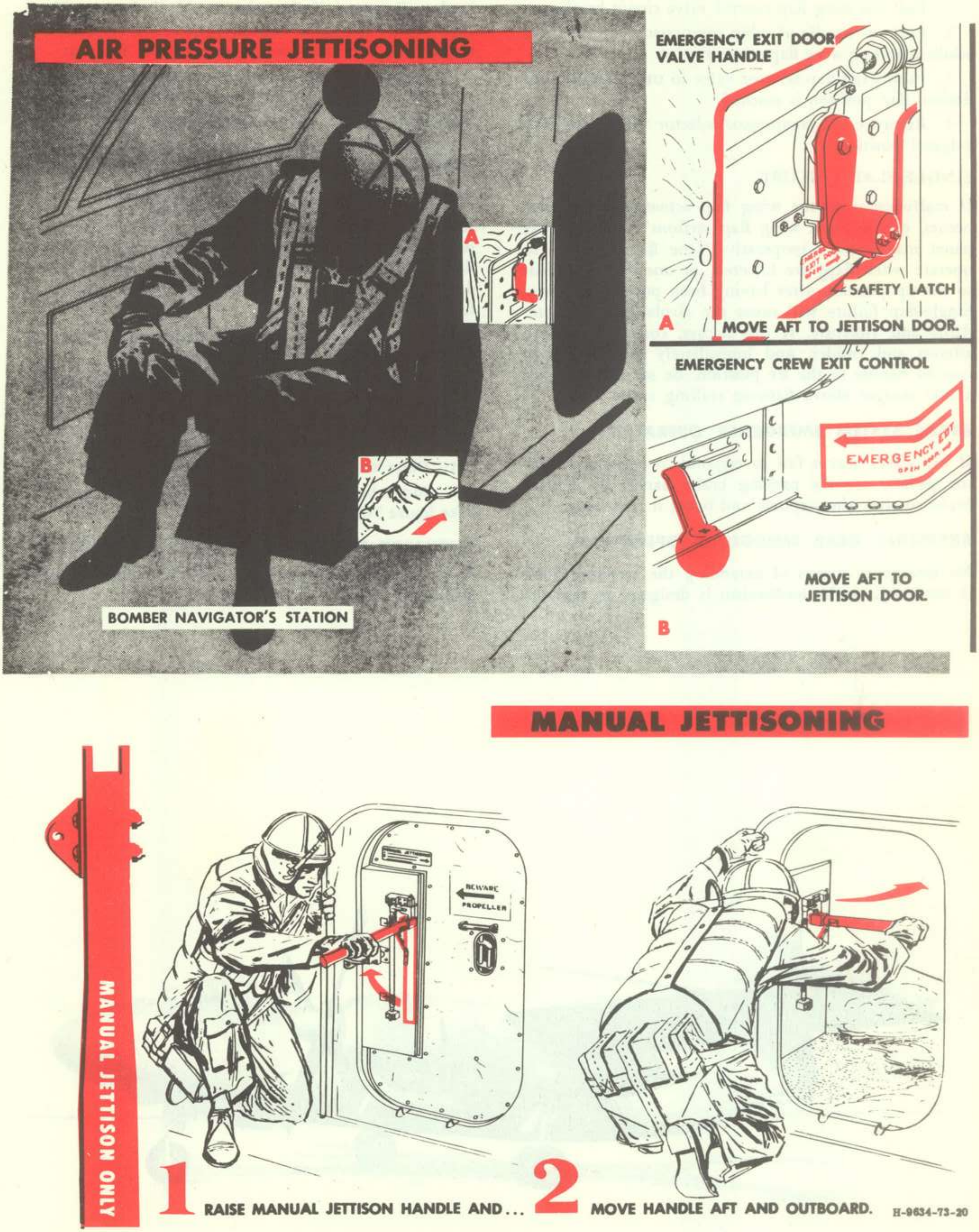


Figure 3-11. Crew Door Emergency Operation

1. Pull out wing flap control valve circuit breaker.

2. Pull out handle of cabin compressor selector valve while operating wing flap selector valve.

3. Push wing flap selector valve to UP and hold until desired flap position is reached.

4. Return cabin compressor selector valve handle to original position.

SINGLE-FLAP FAILURE.

If malfunction of the wing flap actuating mechanism occurs, one or both wing flap sections in either wing panel may become inoperative. One flap may fail to operate when flaps are lowered, or one flap may float to the up position after having been positioned down. Single-flap failure will cause the airplane to roll suddenly and violently. If this occurs, correct with both aileron and rudder, and immediately move the flap control handle to the UP position. Be sure to maintain a safe margin above flaps-up stalling speed.

BRAKE SYSTEM EMERGENCY OPERATION.

If the wheel brakes fail to respond to pressure on the toe pedals, use the parking brake handle as a hand brake to slow the airplane and bring it to a stop.

ARRESTING GEAR EMERGENCY OPERATION.

No emergency means of extending the arresting hook is necessary, as the mechanism is designed so that the hook will extend if the release cable is broken. However, if the electrical control system for retraction is inoperative, the hook can be retracted as follows:

1. Pull out handle of cabin compressor selector valve.

2. Push arresting hook selector valve to UP. Hold until lock engages. (Wait at least 30 seconds.)

3. Return cabin compressor selector valve handle to original position.

CREW DOOR EMERGENCY OPERATION.

An air pressure system is provided to jettison the main part of the door and open an integral air stream deflector which serves as a wind guard. To open the crew door in an emergency, see figure 3-11, and proceed as follows:

1. Position emergency crew exit control, beneath bomber-navigator's seat, to OPEN DOOR.

2. Depress safety latch on emergency valve handle, in crew entry compartment, and move control aft to jettison door.

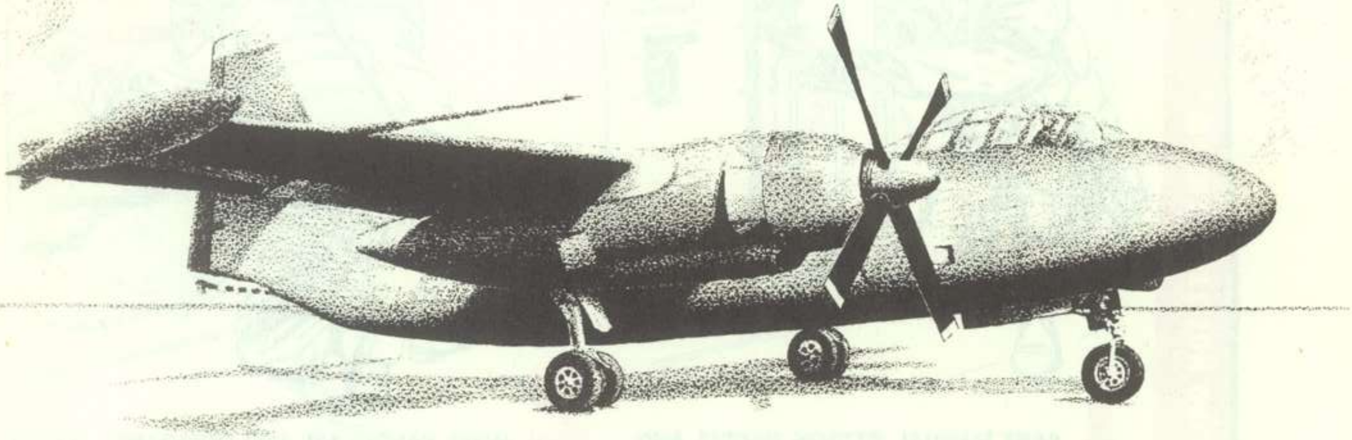
If the door fails to jettison by the penumatic system:

1. Raise manual jettison handle on the door.

2. Move handle aft and outboard as far as possible. (See figure 3-11.)

AUXILIARY EQUIPMENT EMERGENCY OPERATION.

For emergency operation of auxiliary equipment, refer to Section IV.



Description & Operation of Auxiliary Equipment

SECTION IV

CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM.

Air for cabin air conditioning and pressurization is supplied from either a ram-air intake in the nose of the fuselage or from both engine air induction systems, whichever is at the greater pressure. (See figure 4-1.) This air is further compressed by a hydraulically actuated cabin air compressor. Air from the compressor passes through an air mixing valve. The valve is automatically positioned by signals from the cabin temperature control system to direct the pressurized air to either a combustion heater or a cooling unit, or both, depending on preselected temperature requirements. Air is then directed to cabin outlets for ventilation, pressurization, and windshield and canopy defrosting. To improve heating and cooling qualities of the system, the interior of the crew compartments are insulated with a glass-cloth covering. Some panels in the compartments have snap-button fasteners so the panels can be removed for access to equipment.

AIR CONDITIONING SYSTEM.

Cabin air conditioning is normally controlled automatically after a desired temperature is selected on the heat and vent control panel. Pressurized air directed from the air mixing valve is heated by a combustion heater. Fuel for the heater is supplied from each engine fuel pump, and drain lines are provided to drain any accumulation of unburned fuel. Exhaust from the heater is routed overboard. An airflow pressure switch prevents heater operation unless there is sufficient airflow through the heater. For normal operation, the heater discharge temperature is automatically controlled by the cabin temperature control box. A cooling unit, located under the bomber-navigator's floor, cools the cabin air supply as required by the positioning of the air mixing valve. Should the cabin air compressor be inoperative, ventilation air may be selected from the ram-air source. When ram air is selected, the heater can be manually turned on and off to maintain desired temperature.

CABIN PRESSURIZATION.

Cabin air is pressurized by the hydraulically operated single-stage cabin compressor located under the bomber-navigator's floor. The cabin air compressor selector valve (solenoid-operated) directs hydraulic pressure from the utility system to the cabin compressor motor and to the ports of the utility selector valves. However, the compressor is inoperative if a unit in the utility hydraulic system is operated, energizing the selector valve so that all hydraulic pressure is directed to the utility hydraulic system. When the operation is completed, the valve automatically is de-energized and the cabin compressor motor restarted. Whenever the landing gear is down, the compressor will be inoperative to ensure full hydraulic system pressure for gear operation. Should the compressor fail, cabin pressure will depend solely upon the pressure supplied by the turbosuperchargers. However, the ram-air source may be selected for ventilation air. Cabin pressure is regulated by a pressure regulator and is indicated by the cabin altimeter. The

CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM

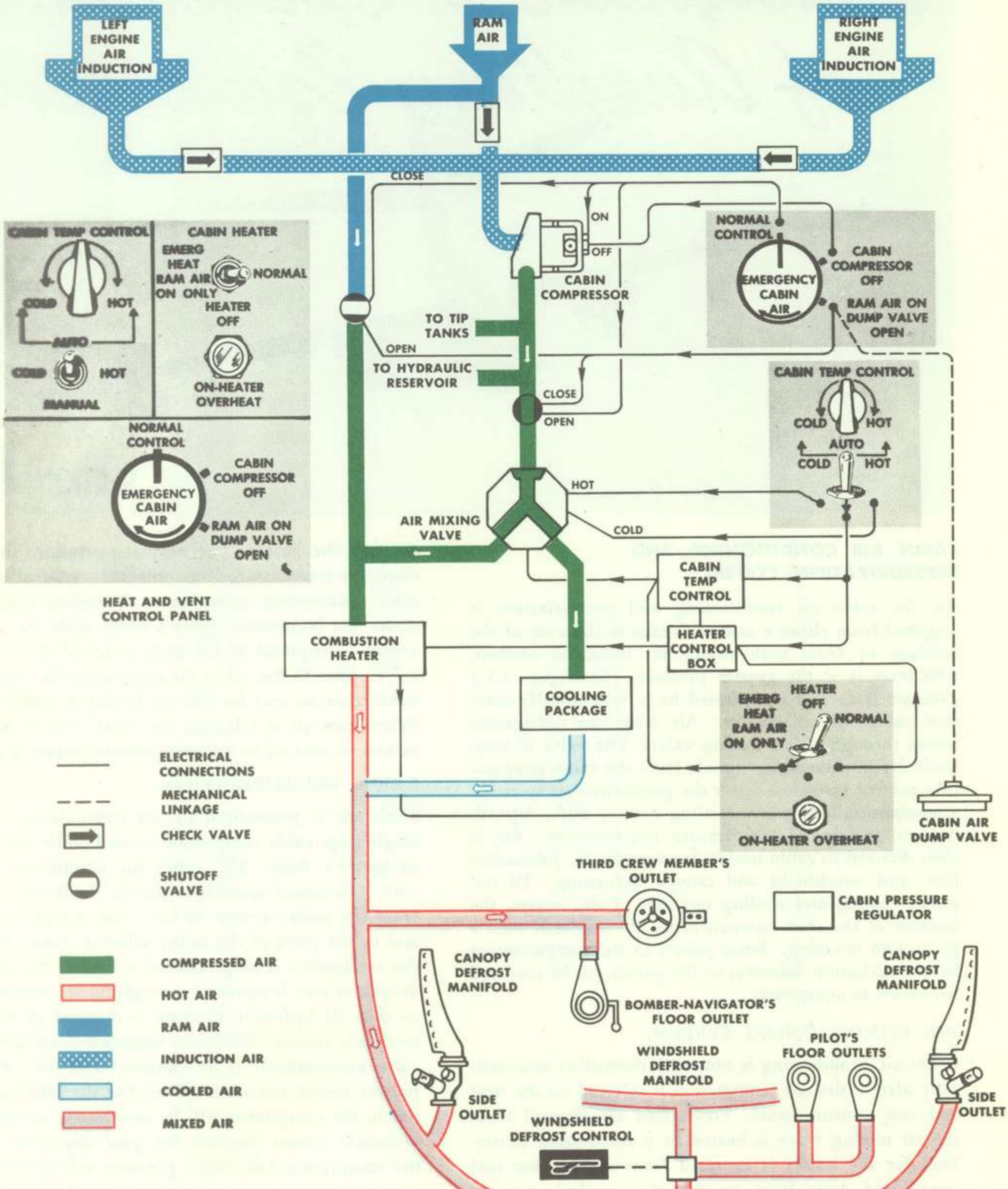


Figure 4-1.

CABIN PRESSURIZATION

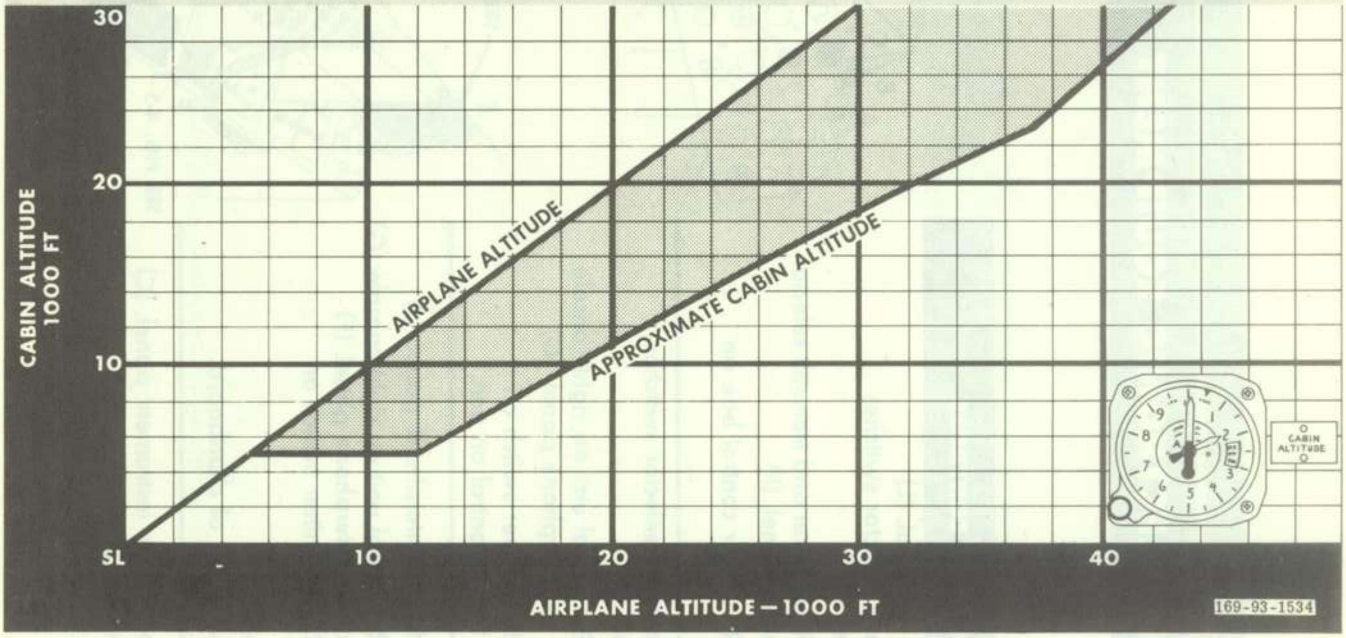


Figure 4-2.

pressure regulator automatically maintains cabin pressure equivalent to a 5000-foot altitude from 5000 to 11,800 feet; above that, up to 37,800 feet, a constant pressure differential of 2.75 psi is maintained between cabin and outside air pressure. (See figure 4-2.) At 37,800 feet, the regulator adjusts to a reduced (or combat) ratio, thereby minimizing the effect of sudden decompression in event of loss of canopy panels or rupture of cabin sealing. A dump valve is provided to dump cabin pressure any time the pressure differential between cabin and atmosphere reaches 3 psi. When the pressure has dropped to normal, the valve will automatically reseat itself. The valve is manually operated to dump cabin pressure when ram air is selected.

DEFROSTING SYSTEM.

Air for windshield and canopy defrosting is obtained from the air conditioning and pressurization system. Defrosting air is always available when the air conditioning and pressurization system is operating. Controls are provided to direct air to defrost outlets as desired.

CABIN AIR CONDITIONING, PRESSURIZATION AND DEFROSTING CONTROLS.

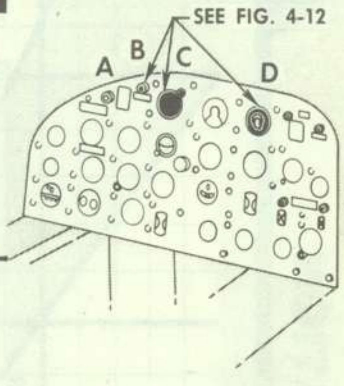
A heat and vent control panel, on the left console aft of the throttle quadrant, contains controls for cabin temperature and pressurization. The defrost controls are located on the inboard side of the left console and near the canopy sill.

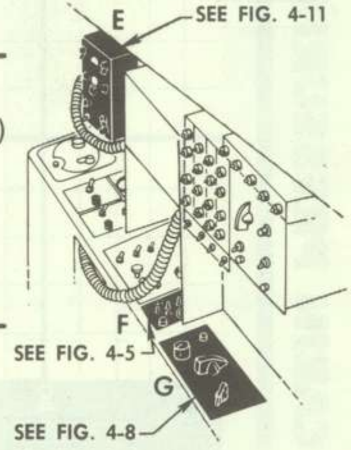
CABIN AIR CONTROL. A cabin air control marked "EMERGENCY CABIN AIR" is provided on the heat and vent panel. (See figure 4-1.) For normal cabin ventilation and pressurization, the control should be positioned at NORMAL CONTROL to open the shutoff valve and turn on cabin compressor. Rotating the control to CABIN COMPRESSOR OFF turns off the cabin compressor by energizing the cabin compressor selector valve, shutting off hydraulic pressure to the compressor motor. When the control is moved to RAM AIR ON DUMP VALVE OPEN, the cabin is immediately depressurized and the system shutoff valve closed, the ram-air shutoff valve is opened and ram air allowed to enter the system, and the cabin air temperature control is inoperative. Ram air is routed through the combustion heater and may be heated by means of the heater control switch.

CABIN TEMPERATURE CONTROLS. Cabin temperature is selected by two controls on the heat and vent panel, a cabin temperature rheostat having a range from HOT to COLD and a cabin temperature control switch with four positions: AUTO, MANUAL, HOT, and COLD. (See figure 4-1.) With the control switch at AUTO, cabin temperature can be controlled when the rheostat is positioned to HOT or COLD or any intermediate position. A thermostatically controlled air-mixing valve will then divert intake air either through a combustion heater, through a cooling unit, or partially through both, as required by the temperature selected by the rheostat. When the control switch is moved to AUTO, a warm-up time of one or two minutes may be required before the

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	USE	OPERATOR AND CONTROLS
UHF Transmitter-Receiver	AN/ARC-27A	Two-way voice communication.	PILOT: Control unit on pedestal. (L) Receiver and transmit selector switches on interphone panel. (J) BOMBER-NAVIGATOR: Receiver and transmit selector switches on interphone panel. (F) THIRD CREW MEMBER: Master control box on canopy deck.
HF Receiver	AN/ARR-15	Reception of voice and code. Long-range communication.	PILOT: Receiver and transmit selector switches on interphone panel. (J) BOMBER-NAVIGATOR: Control unit on right console HF Receiver switch on interphone panel. (G) THIRD CREW MEMBER: Receiver switch on interphone panel. Direct control on unit.
HF Transmitter	AN/ART-13	Transmission of voice and code. Long-range communication	PILOT: Transmitter switch on interphone panel. (J) BOMBER-NAVIGATOR: Control unit on right console. (G) HF Transmitter switch on interphone panel. (F) THIRD CREW MEMBER: Transmitter switch on interphone panel. Direct control on unit. Transmitter key stowed left of chartboard.
Radio Altimeter	AN/APN-1	Indicates vertical distance between airplane and ground (low altitudes).	PILOT: Indicator control unit on instrument panel. (C) Altitude limit switch on instrument panel. (D) Low-level warning light on instrument panel. (B)





H-9634-71-27

Figure 4-3. Table of Communication and Associated Electronic Equipment (Sheet 1 of 2)

Range Receiver	R-23/ARC-5	Reception of radio range signals and voice.	PILOT: Control unit on pedestal. (K) Receiver switch on interphone panel. (J) BOMBER-NAVIGATOR: Control unit on pedestal. (K) Receiver switch on interphone panel. (F)
Homing Receiver	AN/ARR-2A	Reception of navigational signals or voice.	PILOT: Control unit on pedestal. (H) Receiver switch on interphone panel. (J) BOMBER-NAVIGATOR: Control unit on pedestal. (H) Receiver switch on interphone panel. (F)
Marker Beacon	AN/ARN-8	Visual and aural reception of marker beacon signals.	PILOT: Indicator light on instrument panel. (A) Receiver switch on interphone panel (J)
Radio Compass	AN/ARN-6	Visual and aural navigation aid. Aural reception of range and broadcast stations.	PILOT: ADF receiver switch on interphone panel. (J) BOMBER-NAVIGATOR: Control unit above right console. (E) ADF receiver switch on interphone panel. (F)
IFF	AN/APX-6	Automatic identification.	PILOT: Control unit on pedestal. (M) BOMBER-NAVIGATOR: Control unit on pedestal. (M)
Interphone	AN/AIC-4	Intercrew communication.	PILOT: Selector switch on interphone panel. (J) BOMBER-NAVIGATOR: Selector switch on interphone panel. (F) THIRD CREW MEMBER: Selector switch on interphone panel.
Radar	AN/ASB-1	Navigation and bombing equipment.	BOMBER-NAVIGATOR: Control units forward of station. (N)

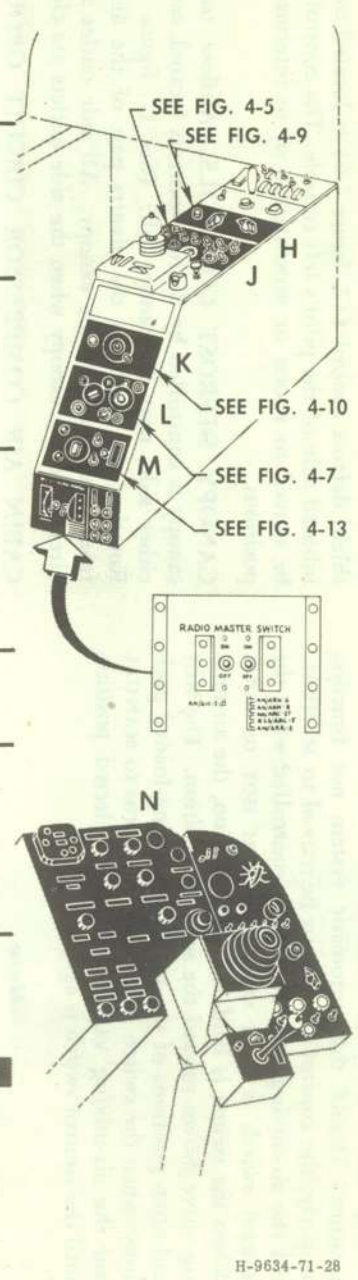


Figure 4-3. Table of Communication and Associated Electronic Equipment (Sheet 2 of 2)

mixing valve will operate to maintain a stabilized temperature. Should this automatic system not function properly, the control switch can be moved to MANUAL, and the air-mixing valve is directly controlled when the control switch is held momentarily at HOT or COLD. When the switch is held at either position, the air-mixing valve moves toward the selected position. The HOT and COLD positions of the switch are spring-loaded positions; when the switch is released, it returns to MANUAL and the air-mixing valve remains in selected position until the control switch is again actuated.

Note

> Time required for the air-mixing valve to move from one extreme position to the other is approximately 15 seconds in manual operation.

CABIN HEATER SWITCH AND OVERHEAT LIGHT. A combustion heater is controlled by a cabin heater switch on the heat and vent panel. (See figure 4-1.) The switch has three positions: NORMAL, EMERG HEAT RAM AIR ON ONLY, and HEATER OFF. For automatic operation, the switch should be placed at NORMAL and the heater will be cycled on and off as required to maintain the selected cabin air temperature. Ram air may be heated if the heater control switch is moved to EMERG HEAT RAM AIR ON ONLY. With the switch in either the NORMAL or EMERG HEAT RAM AIR ON ONLY positions, the heater will be cycled on and off as required to maintain a heater discharge temperature of 225°F. If the heater should overheat (above 350°F), it will be turned off automatically and a heater overheat relay will prevent further operation until it is reset on the ground. A heater overheat indicator light is installed on the heat and vent panel. The light will come on and remain on to inform the pilot that the heater has overheated and has been automatically turned off. The light will go out when the heater control switch is moved to HEATER OFF. If the heater is again turned on before the overheat relay has been reset, the warning light will again illuminate.

CREW STATION OUTLETS. Floor outlets, located forward of the rudder pedals and under the bomber-navigator's seat, provide fixed-direction airflow and may be adjusted for quantity of airflow. The pilot's ventilating air control (17, figure 1-6) is located on the inboard side of the left console and may be moved to FLOOR or WINDSHIELD or to intermediate positions. A separate control under the bomber-navigator's seat controls the amount of air issuing from his floor outlet, regardless of the position of the pilot's control. The side outlets are adjustable for direction and amount of airflow. The third crew member's station is provided with a single, fixed-direction outlet which is adjustable to either a diffused air spray or air-jet flow.

WINDSHIELD DEFROST CONTROL. The windshield defrost control (17, figure 1-6) is located on the inboard side of the pilot's left console. The control may be moved to FLOOR or WINDSHIELD or to intermediate positions.

CANOPY DEFROST CONTROLS. Airflow to the canopy is controlled by defrost controls located, one on either side, near the canopy sill. (See 17, figure 1-6.) Rotating the knobs to ON diverts part of the airflow from side outlets to the canopy. All side outlet air is directed to the canopy when the side outlets are closed.

CABIN AIR COMPRESSOR CIRCUIT GROUND TEST SWITCH. A switch for ground test of the cabin air compressor circuit is located on the aft bulkhead of the crew entry compartment. (See figure 1-22.) When the switch is moved from NORMAL to TEST, a flight condition is simulated and the cabin air compressor valve is de-energized, starting the compressor. The test switch is primarily for maintenance check and should not be used to operate the compressor on the ground for longer than 2 minutes.

NORMAL OPERATION OF CABIN TEMPERATURE CONTROL SYSTEM.

Normal operation of the cabin temperature control system is automatic when the controls are positioned as follows:

1. Cabin air temperature control switch to AUTO.
2. Cabin air temperature control rheostat as desired.
3. Cabin heater switch to NORMAL.
4. Emergency cabin air control to NORMAL CONTROL.

EMERGENCY OPERATION OF CABIN TEMPERATURE CONTROL SYSTEM.

If the automatic temperature control system becomes inoperative and cabin temperature becomes uncomfortable, proceed as follows:

1. Move cabin air temperature control switch from AUTO to MANUAL.

2. Hold temperature control switch momentarily at HOT or COLD until desired temperature is obtained.

3. If insufficient heat is obtained after temperature control switch is held to HOT for 15 seconds, turn cabin heater control switch to EMERG HEAT RAM AIR ON ONLY. (Actuate cabin heater switch to maintain desired cabin temperature.)

EMERGENCY DEPRESSURIZATION OF CABIN.

If the cabin air compressor should fail or if cabin depressurization is necessary proceed as follows:

1. Put on oxygen mask (if at altitude) and adjust regulator. Instruct crew to use oxygen.

2. Turn cabin pressure control to RAM AIR ON DUMP VALVE OPEN.

3. Descend to lower altitude as soon as practicable.

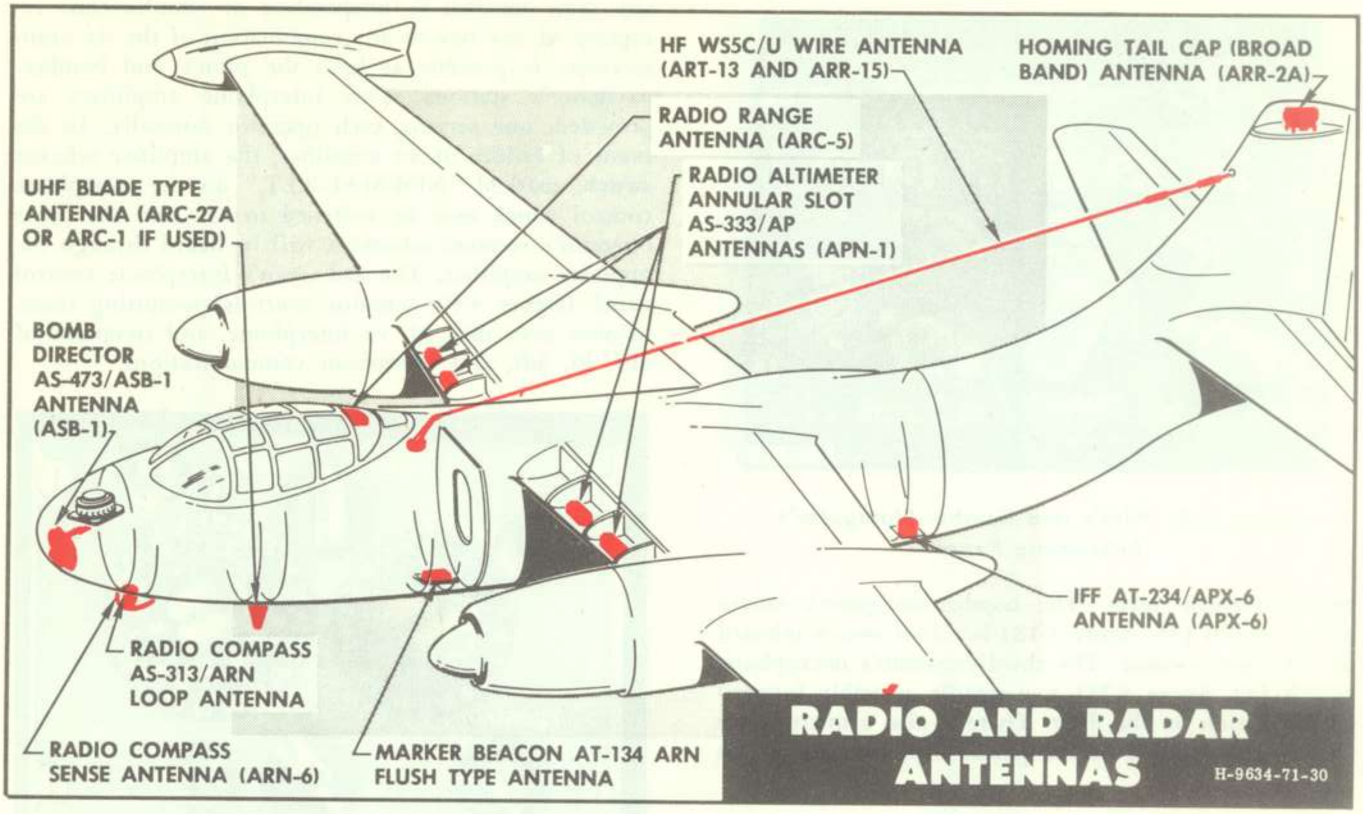


Figure 4-4. Antenna Installations

WARNING

Always have oxygen available for immediate use when flying above 10,000 feet (airplane altitude).

EMERGENCY OPERATION OF CABIN HEATER.

If the cabin becomes depressurized and the automatic temperature control system is inoperative, ram air may be selected and heated.

1. Move emergency cabin air control to RAM AIR ON DUMP VALVE OPEN.
2. Turn heater control switch to EMERG HEAT RAM AIR ON ONLY.
3. Actuate cabin heater switch to maintain desired cabin temperature.

If cabin heater overheat light comes on, turn cabin heater switch to HEATER OFF, as heater is no longer in operation.

ANTI-ICING AND DE-ICING EQUIPMENT.

PITOT HEATER.

A pitot heating element is provided for the pitot tube. The heater is controlled by a pitot heater switch, located on the reciprocating-engine control panel above the left console. (See figure 1-9.) When the switch is moved to ON, sufficient heat is distributed to the pitot tube during icing conditions. The heater switch should remain OFF when the airplane is on the ground or heat is not required.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

For a list of all communication and associated electronic equipment, see figure 4-3.

RADIO AND RADAR ANTENNAS.

For location of antennas, see figure 4-4.

RADIO MASTER SWITCHES.

Two radio master switches, located on the bottom of the pilot's pedestal, control power supply to all radio equipment except the IFF, hf radio, and radio altimeters. (See figure 4-7.) The master switch on the left controls the interphone equipment; the right-hand master switch controls uhf, homing, range, radio compass, and marker beacon. For normal operation, both master switches should be ON. If one generator should fail, radio equipment will still be operative; however, if both generators should fail, all radio equipment will become inoperative. If desired, the electrical load on the battery may be quickly reduced if the right-hand master switch is turned OFF.

MICROPHONE SWITCHES.

The pilot's microphone switch (10, figure 1-6), marked "INTERPHONE," is a push-to-talk button on the right

Figure 4-5. Pilot's and Bomber-Navigator's Interphone Panel

engine throttle lever. The bomber-navigator's microphone switch (15, figure 4-18) is a foot switch inboard of the right console. The third crewman's microphone switch (12, figure 4-23) is a treadle assembly forward of his station on the floor. There is also a microphone switch incorporated in the portable phone jack at his station.

PHONE JACKS.

Phone jacks are located on the right side of the seat back at each station. The third crewman also has a portable phone jack, located forward of his station.

INTERPHONE CONTROL UNITS.

The pilot's and bomber-navigator's interphone control units (figure 4-5) permit a wide latitude in the use of radio equipment. Controls are provided to permit utilization of the uhf and hf transmitters and receivers, plus the marker beacon, range, homing adf receivers, and the interphone system. (Interphone signals will automatically override incoming signals, when used by any crew member.) Independent or simultaneous reception of any one or any combination of the six radio receivers is possible at both the pilot's and bomber-navigator's stations. Two interphone amplifiers are provided, one serving each operator normally. In the event of failure of an amplifier, the amplifier selector switch, marked "NORMAL-ALT," on the interphone control panel, may be switched to ALT and the other operator's receiver selections will be heard through the opposite amplifier. The radioman's interphone control panel (figure 4-6) contains controls permitting transmission over uhf, hf, or interphone, and reception of uhf, hf, adf, and interphone communications.

Figure 4-6. Radioman's Interphone Panel

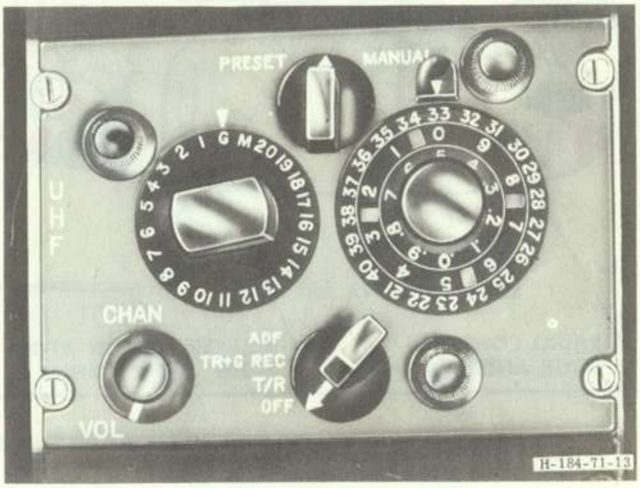


Figure 4-7. UHF Control Panel (C-628/ARC-27)

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

The uhf set provides voice communication between airplanes or between the airplane and ground stations. Reception and transmission are on the same frequency and by the same antenna. A function switch provides primary power control and when in the T/R position, the main receiver is on and the transmitter is on in stand-by. When in T/R + G REC position, the main receiver and guard receiver are on and the transmitter is on in stand-by.

OPERATION OF UHF RECEIVER-TRANSMITTER (AN/ARC-27). For normal operation, proceed as follows: (See figure 4-7.)

1. Radio master switch ON.

2. UHF function switch to desired position (T/R, T/R + G REC, or ADF).

3. Rotate channel selector switch to desired channel.

4. Interphone panel transmit switch to UHF.

5. Interphone panel receiver switch to UHF.

6. Interphone panel volume control to adjust volume as necessary.

7. To transmit, press microphone switch. After each transmission, the switch must be released to hear incoming signals.

8. To turn off equipment turn uhf function switch to OFF.

HF TRANSMITTER AND RECEIVER (AN/ART-13 AND AN/ARR-15).

The hf radio equipment consists of a T-47( )/ART-13 transmitter and an R-105( )/ARR-15 receiver, with a remote-control panel located to the right of the bomber-navigator's station, and provides for long-range communication. Automatic tuning elements permit transmitter and receiver operation on any of 10 pretuned frequencies within a range of 2000 to 18,000 kilocycles; power for the transmitter is supplied by a dynamotor. The control panel (figure 4-8) provides a four-position transmission switch, VOICE, CW, MCW, and OFF, for the transmitter and a two-position, ON-OFF, switch for the receiver. Type of reception is controlled by the switch on receiver unit, in the crew entry compartment, marked "CW," and "MCW-CAL." The switch should be positioned to MCW-CAL for voice or mcw reception with automatic volume control. The channel selector switch selects desired frequency channel for reception and transmission, and a sensitivity control is provided to vary background noise. The third crew member may operate the hf radio locally by similar controls provided on the units and may transmit cw or mcw signals with a key located on the third crewman's right armrest.

OPERATION OF HF TRANSMITTER AND RECEIVER (AN/ART-13 AND AN/ARR-15). The following instructions are subject to local limitations regarding radio silence.

1. Place local-remote switch on the transmitter to REMOTE position.
2. Interphone panel transmitter switch to HF.
3. Interphone panel receiver switch to HF.
4. Rotate receiver power switch on hf control panel to ON, and allow tubes to warm up.
5. Transmitter selector to VOICE, CW, or MCW for type of transmission desired.

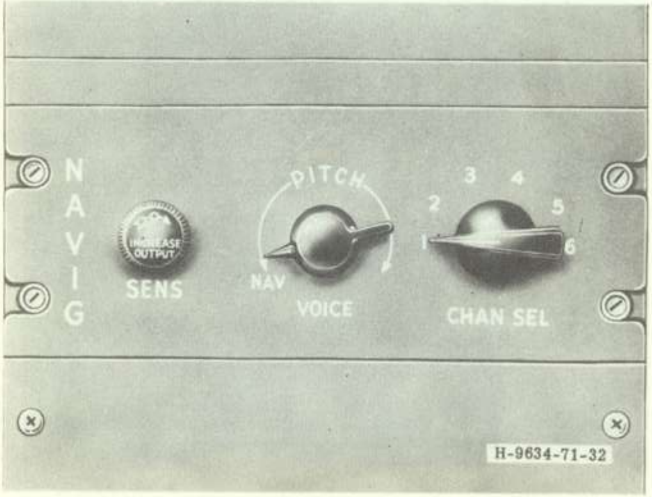


Figure 4-8. HF Control Panel (AN/ART-13 and AN/ARR-15)

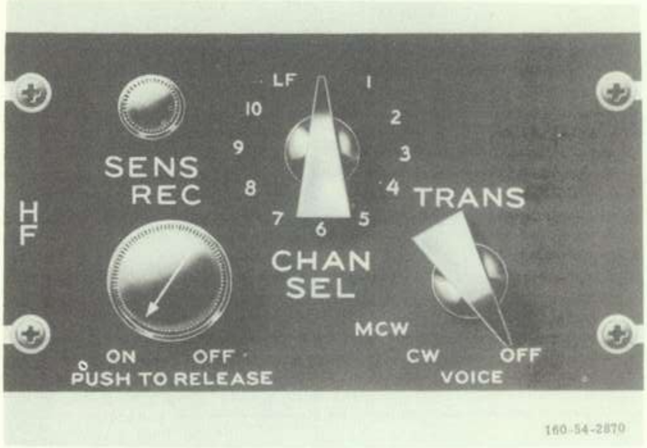


Figure 4-9. Homing Receiver Control Panel (C-116/ARR-2A)

6. Rotate channel selector switch to desired channel for reception and transmission.
7. Adjust sensitivity knob as desired.
8. Regulate volume as necessary with volume control on each interphone panel.
9. To transmit, press microphone switch. After each transmission, the switch must be released so the set can operate for reception of signals.
10. To secure equipment, turn transmitter switch to OFF, and press receiver power switch on both receiver and remote control panel.

HOMING RECEIVER (AN/ARR-2A).

The AN/ARR-2A radio equipment receives navigation or voice signals on any of six preset frequency channels. The control unit (figure 4-9), located on the pilot's pedestal, is marked "NAVIG" and consists of a channel selector to select any of the six frequency channels, a pitch control to vary the tone of the navigation signal received or to select voice reception, and a sensitivity control to adjust gain to the receiver. When the navigation receiver is operated in conjunction with the command set, signals from both receivers are heard in the headphones simultaneously.

OPERATION OF HOMING RECEIVER (AN/ARR-2A). To operate the homing receiver, proceed as follows:

1. Radio master switches ON.
2. Receiver switch on interphone panel at HOM.
3. Channel selector switch to desired channel.
4. Pitch control at NAV or VOICE as required.
5. Adjust navigation receiver sensitivity control to lowest clearly audible signal to obtain greatest accuracy.

RANGE RECEIVER (R-23/ARC-5).

The range receiver provides for reception of voice, weather forecasts, and beacon signals in the range from .19 to .55 megacycles. The control unit (figure 4-10), marked "RECVR," is located on the pilot's pedestal.

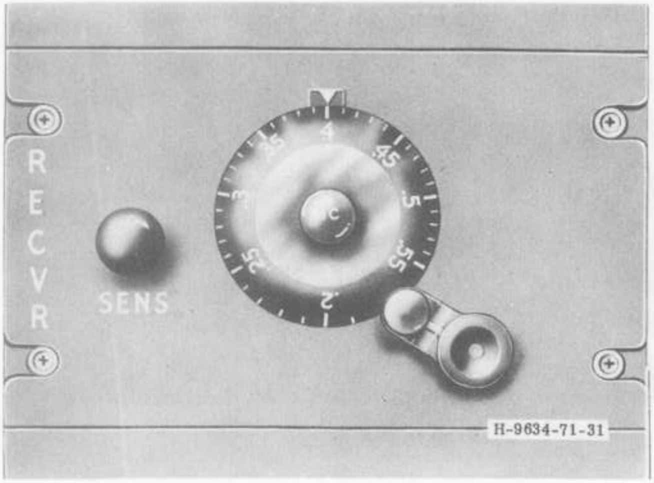


Figure 4-10. Range Receiver Control Panel (C-744/ARC-5)

When the receiver is operated in conjunction with the command set, signals from both receivers are heard simultaneously in either the pilot's or the bomber-navigator's headphones.

OPERATION OF RANGE RECEIVER (R-23/ARC-5). Operate the range receiver as follows:

1. Radio master switches ON.
2. Receiver switch on interphone panel at RANGE.
3. Range receiver selector dial to desired frequency.
4. Adjust sensitivity control to lowest audible signal.

RADIO COMPASS (AN/ARN-6).

The AN/ARN-6 radio compass provides both visual and aural navigational aid. Four frequency bands are available, covering a range of 100 to 1750 kilocycles. The radio compass can be operated in conjunction with the other receivers. The compass loop, located on lower side of fuselage aft of the radome, is automatic in operation. A control box (figure 4-11) is located at the right of the bomber-navigator's station, and an indicator (20, figure 1-5) is mounted on the instrument panel. A receiver switch for selection of the automatic direction finder is located on each interphone panel. (See figure 4-5.)

OPERATION OF RADIO COMPASS (AN/ARN-6). Operate the radio compass as follows:

1. Radio master switches ON; adf receiver switch ADF.
2. Radio compass function switch to ANT or LOOP position, for warm-up.
3. Function switch to COMP., ANT., or LOOP position for operation as desired.
4. CW selector switch VOICE.
5. Frequency band selector on desired frequency band.
6. Tuning crank to desired station.
7. Audio volume control as desired.
8. Visual-aural range control knob marked "VAR," on instrument panel indicator, adjusted as desired.
9. To shut off equipment, turn radio compass function switch to OFF.

MARKER BEACON RADIO (AN/ARN-8).

The marker beacon radio is a navigational aid, providing visual and aural signals. The presence of a signal indicates that the airplane is over a marker beacon, and the nature of the signal indicates the type of beacon. Aural signals can be received simultaneously with signals from other receivers. A red indicator light (3, figure 1-5) on the instrument panel illuminates when the airplane is over a vhf marker beacon station. Marker beacon reception is automatic when radio master switch is turned on.

RADIO ALTIMETER (AN/APN-1).

An altitude indicator for the AN/APN-1 radio altimeter, located on the instrument panel, can be adjusted to indicate absolute altitude within a high or low range. (See figure 4-12.) Low range is 0 to 400 feet, and high range is 400 to 4000 feet. A range switch knob, mounted on the indicator, is used to select the desired altitude range, and a power switch knob on the indicator is rotated from OFF to ON to obtain power for operation of equipment. Low-altitude warning is provided by a low-level indicator light and an altitude limit switch located on the instrument panel. The low-level indicator light will illuminate at or below an altitude preselected by the altitude limit switch.

OPERATION OF RADIO ALTIMETER (AN/APN-1). Operate the radio altimeter as follows:

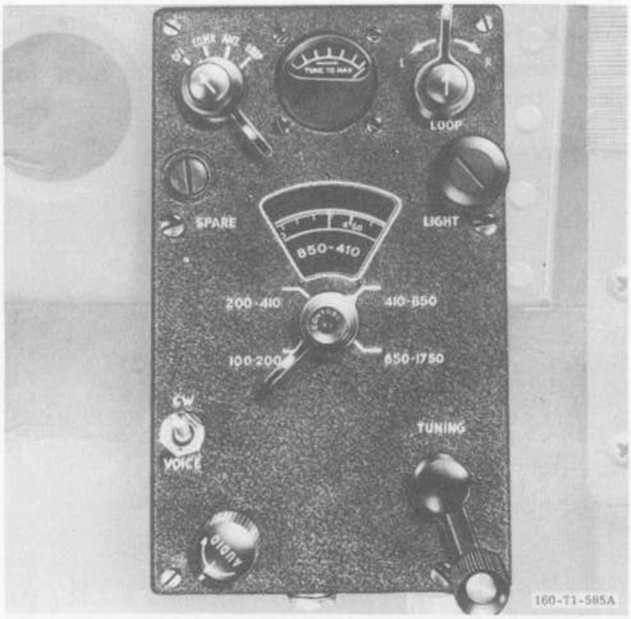


Figure 4-11. Radio Compass Control Box (C-149/ARN-6)

WARNING

The high range of the radio altimeter must not be used at absolute altitudes below 400 feet.

1. Range switch on altitude indicator to low or high range. When on ground or in flight at an altitude below 400 feet, always use low range. When above 400 feet absolute altitude, always use high range.

2. Power switch on the indicator ON. Allow one minute for warm-up.

3. Altitude limit switch for minimum safe operating altitude.

4. Equipment is shut off when power switch on indicator is turned to OFF.

Note

Beam width of APN-1 is extremely sharp. Banks exceeding 12 degrees will cause inaccurate readings and drop out of altimeters.

IFF EQUIPMENT (AN/APX-6).

The IFF equipment consists of an air-borne transpondor, which enables the airplane to identify itself as friendly when challenged by an interrogator-responsor associated with friendly shore, shipboard, or air-borne radars and also permits surface tracking of the airplane by friendly radar. The AN/APX-6 receives challenges initiated by an interrogator-responsor and automatically transmits replies in return which are displayed, along with associated radar targets, on radar indicators. When the radar target is accompanied by proper IFF reply, as transmitted by the AN/APX-6, that target is considered friendly.

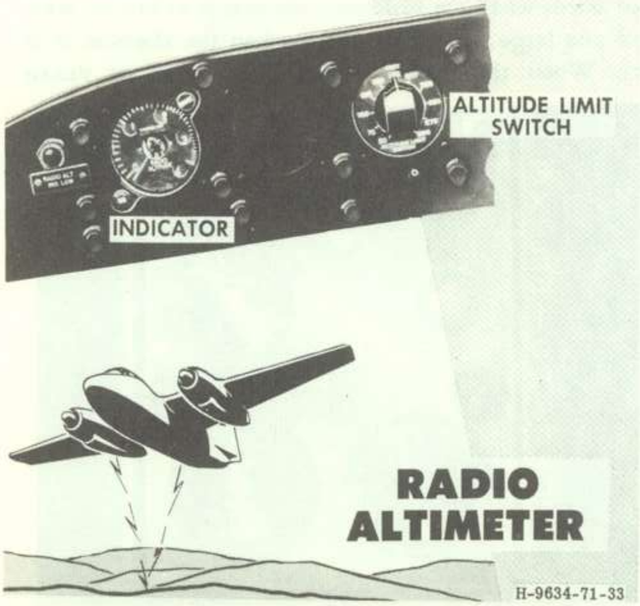


Figure 4-12. Radio Altimeter

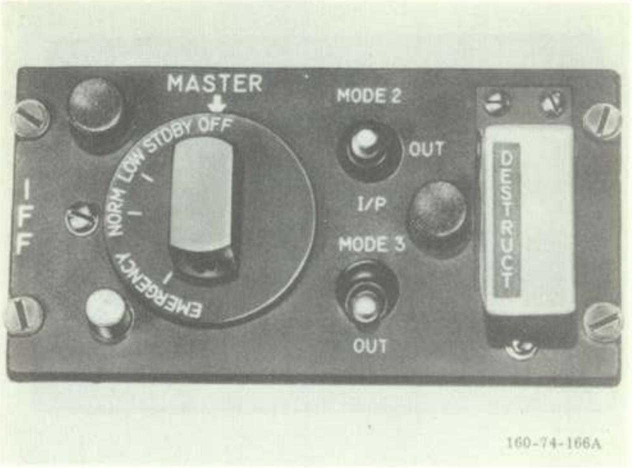


Figure 4-13. IFF Control Panel (C-629/APX-6)

The equipment may also be used to indicate distress. All controls required for operating the AN/APX-6 are contained in the radar control panel marked "IFF" on the pilot's pedestal. (See figure 4-13.) A master selector switch turns the equipment on when rotated from OFF. With the switch at NORM, the transpondor will automatically reply when challenged; with switch at STDBY, the equipment is ready for instant use, but inoperative. The LOW position should not be used unless the pilot is otherwise instructed; EMERGENCY position is provided for extreme distress. Two switches marked "MODE 2" and "MODE 3" provide additional identification on the radar indicator when the master selector switch is at NORM or EMERGENCY. Destructors are provided to prevent equipment from falling into enemy hands.

NORMAL OPERATION OF IFF EQUIPMENT (AN/APX-6). For normal operation of control panel, see figure 4-13.

1. Rotate master selector to NORM.

2. Set mode 2 and mode 3 switches to OUT positions unless otherwise directed by proper authority.

3. To maintain the equipment ready for instant use, but inoperative, rotate master selector to STDBY.

4. Rotate the master selector to OFF to secure the equipment.

EMERGENCY OPERATION OF IFF EQUIPMENT (AN/APX-6). For emergency operation of IFF equipment, proceed as follows:

1. To indicate emergency or distress, press red dial stop and rotate master selector to EMERGENCY and the equipment will automatically transmit a distress signal.

Note

EMERGENCY position is not used except when the airplane, during flight, is in distress. Pilots will be governed by existing regulations dealing with emergency operation of IFF equipment.

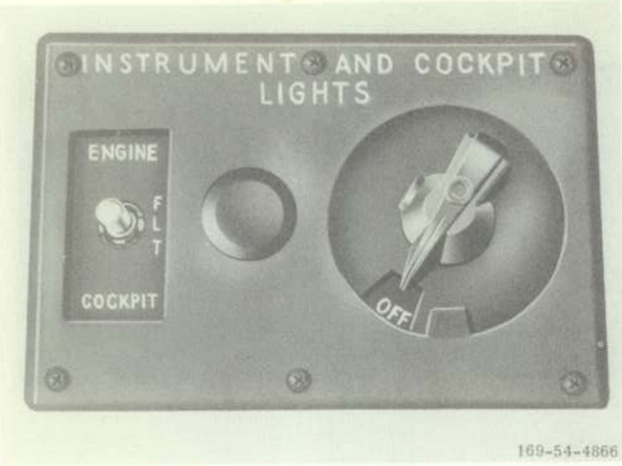


Figure 4-14. Interior Lighting Control Panel

2. To explode the destructors within the equipment, raise the switch guard labeled "DESTRUCT" and move the switch handle to the ON position. An impact switch to fire the destructors and destroy the IFF transpondor is incorporated as a security measure.

RADAR BOMBING EQUIPMENT (AN/ASB-1). The ASB-1 bomb director functions as a combined airborne search and navigation radar system and bomb director set. While in flight, ground position expressed in latitude and longitude will be supplied by a ground position indicator. Electrical power for operation of the ASB-1 is provided from the main bus. Controls for the ASB-1 are located forward of the bomber-navigator and consist of a control unit, a computer, and a tracking lever. The ASB-1 will control the directional path of the airplane during the bombing run when the autopilot radar tie-in switch is engaged. A periscope is installed forward of the bomber-navigator and extends through the lower fuselage. A clamshell-type cover protects the portion of the periscope extending beyond the fuselage.

LIGHTING EQUIPMENT.

INTERIOR LIGHTING.

COCKPIT AND INSTRUMENT LIGHTS. A panel on the pilot's pedestal contains a switch and a brilliancy rheostat for control of the cockpit and instrument lights. (See figure 4-14.) The switch may be positioned at FLIGHT for illumination of flight instruments or at ENGINE for illumination of flight and engine instruments and the fuel quantity indicators. When the switch is moved to COCKPIT, in addition to fuel quantity indicators and flight and engine instruments, the fuel panel schematic diagram and the cockpit lights are illuminated.

DOME LIGHTS. One dome light is provided for the pilot's compartment and one for the crew entry compartment. A switch is mounted on each light assembly. The red dome light in the crew entry compartment may be dimmed by a rheostat control, located to the left of the third crewman's station.

EMERGENCY HYDRAULIC PANEL LIGHT. A light is installed on the back of the third crewman's seat for illumination of the emergency hydraulic panel. A control switch is mounted on the light assembly.

BOMB BAY LIGHTS. Seven dome lights installed in the bomb bay may be turned on or off from three different compartments. In the bomb bay, the light switch is installed left of the hatch leading to the crew entry compartment. In the compartment aft of the bomb bay, a switch is located at the right of the door leading to the bomb bay. In the crew entry compartment, a bomb bay light switch is located to the left of the hatch leading to the bomb bay.

PORTABLE COCKPIT LIGHTS. Portable lights are mounted on clips attached near the bomber-navigator's and third crewman's stations.

EXTERIOR LIGHTING.

EXTERIOR LIGHT PANEL. All exterior lights, except the approach light, are controlled from a panel on the right console. (See figure 4-15.) Formation, fuselage, tail, and wing lights are controlled by four on-off switches at the top of the panel. The control switches are designated "TAIL," "FORM," "FUSEL," and "WING." A switch designated "FLOOD" is provided on the panel, but is inoperative, as no floodlights are installed on the airplane. A master switch on the panel must be positioned at either CODE, FLASH, or STDY before the lights will illuminate (except for keying). A code selector switch is mounted on the panel for selection of the desired signal when the master switch is at CODE. Brilliancy of lights is adjusted when a brilliancy rheostat is turned to either DIM, MED, or BRT.

FUSELAGE LIGHTS. Two fuselage lights are provided, one on top of the fuselage, and one on the bottom. Each light contains two lamps, one small lamp that burns when the brilliancy rheostat is at DIM or MED, and one large lamp that burns when the rheostat is at BRT. When the master switch is at STDY, or FLASH

Figure 4-15. Exterior Lighting Control Panel

(fuselage control switch ON), the fuselage lights burn steadily. With the master switch at CODE, the fuselage lights flash the preselected signal. The lights may be manually flashed by means of a keying switch on the panel. The master switch and fuselage light control switch should be OFF for this operation.

WING LIGHTS AND TAILLIGHTS. The wing lights and white taillight burn steadily when the related control switches are ON and the master switch is at either STEADY or CODE. When the master switch is at FLASH, the wing lights flash on and off and the white taillight and the amber taillight flash alternately.

FORMATION LIGHTS. When the control switch for the formation lights is ON, the lights burn steadily at all master switch positions (except OFF).

APPROACH LIGHT. The approach light, located in the leading edge of the left wing, automatically illuminates when the master light switch is on and the landing gear and arresting gear are down and locked. The light will blink when the arresting hook is up or in an unsafe position. Should a steady approach light be desired for simulated carrier landings (arresting gear up), the blinking relay may be by-passed by the approach light switch (8, figure 4-18), located above the exterior light panel. When the switch is moved to ON, the approach light will become steady, regardless of the position of the arresting gear. When the switch is OFF, the approach light is automatically controlled by the master light switch when the gear is down and locked. The light will flash if the master switch is positioned at FLASH until hook is lowered or approach light by-pass switch is ON.

OXYGEN EQUIPMENT.

Oxygen is supplied from three high-pressure oxygen cylinders installed under the floor of the crew entry compartment. The three cylinders are connected to one main oxygen supply line. Normal full pressure for the system is 1800 psi. All oxygen cylinders can be refilled at a single filler valve, accessible through an access door located on the right side of the fuselage, just aft of the crew door. (See figure 1-27.)

OXYGEN REGULATORS.

Each crew member's station is provided with a positive-pressure, diluter-demand type oxygen regulator for pressure breathing. (See figure 4-16.) Each regulator automatically mixes varying quantities of air and oxygen, the ratio depending on altitude, and delivers the quantity demanded upon inhalation. In addition to a conventional regulator air valve, a safety pressure lever on the regulator (normally OFF) can be turned on to provide oxygen flow under a positive pressure during operation on either NORMAL OXYGEN or 100% OXYGEN. When the safety pressure lever is turned, oxygen flows freely upon inhalation.

Note

Use oxygen on all flights when above 10,000 feet (cabin altitude), on all night flights when above 5000 feet (cabin altitude), and on combat missions and training missions simulating combat.

OXYGEN MASK STOWAGE BAGS.

Stowage bags for pilot's and bomber-navigator's oxygen masks are located in the pilot's compartment, aft of the left console. An oxygen mask stowage bag for a third crewman is located on the bulkhead forward of the third crewman's station.

OXYGEN SYSTEM PREFLIGHT CHECK.

Before each flight requiring use of oxygen, inspect oxygen equipment as follows:

1. Oxygen system leakage shall be determined by comparison of the oxygen cylinder pressure gage readings at the beginning and end of a 24-hour period. A pressure drop of more than 50 psi in a 24-hour period is excessive. Be sure the oxygen regulator shutoff valve is open when these readings are made.
2. Pressure gage should read 1800 (±50) psi at 21°C (70°F) if the cylinders are fully charged.
3. Test the oxygen regulator for leakage by obstructing the outlet of the breathing tube. If the flow indicator face opens in less than 30 seconds, excessive leakage exists and the regulator should be replaced.
4. Test the breathing tube couplings, regulator diaphragm, and the diluter check valve for leakage by inserting a spare mask tube disconnect fitting into the open end of the disconnect. Blow into the end of the disconnect until the flow indicator face opens. Seal the end of the disconnect with the tongue. If the flow indicator does not close within 5 seconds, the leakage is within acceptable limits. If leakage exists, check the couplings, outlet elbow and breathing tube clamps for tightness.
5. Check mask fit by putting on the oxygen mask and attaching to the helmet as in flight. Connect the oxygen mask to regulator couplings and activate the manual safety pressure. Take a deep breath and hold breath. Note the position of the oxygen flow indicator. If flow indicator opens (all black), a leak is indicated. Tighten mask straps until flow indicator closes (white face). Resume breathing and release manual safety pressure.

WARNING

Do not use a mask that leaks.

OXYGEN SYSTEM FLIGHT OPERATION.

Oxygen shall be used constantly during day flights when above 10,000 feet cabin altitude. Oxygen shall be

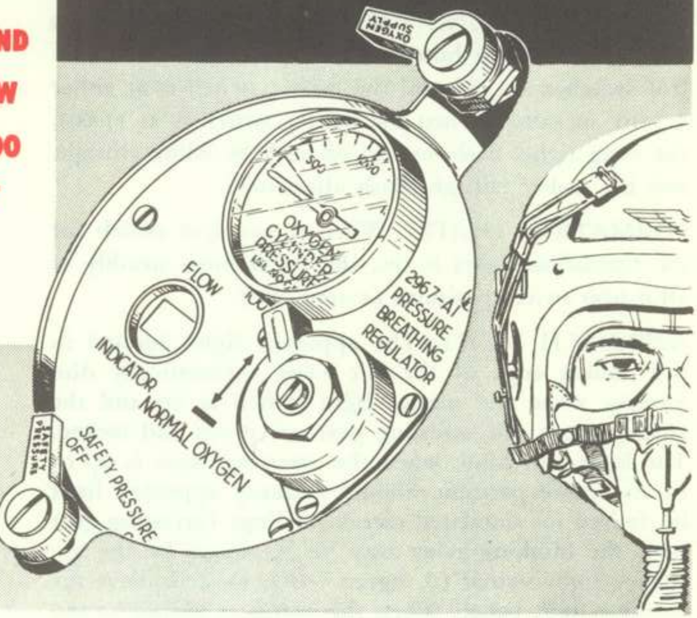
APPROXIMATE OXYGEN DURATION . . . HOURS

CABIN ALTITUDE (Feet)	GAGE PRESSURE					
	1800	1500	1200	900	600	300
40,000	6:50 6:50	5:30 5:30	4:05 4:05	2:45 2:45	1:20 1:20	DESCEND BELOW 10,000 FEET
35,000	4:10 4:10	3:20 3:20	2:30 2:30	1:40 1:40	0:45 0:45	
30,000	3:05 3:05	2:30 2:30	1:50 1:50	1:10 1:10	0:35 0:35	
25,000	2:27 4:05	1:57 3:15	1:24 2:20	0:57 1:35	0:27 0:45	
20,000	2:23 6:50	1:55 5:30	1:26 4:05	0:58 2:45	0:28 1:20	
15,000	1:52 8:30	1:29 6:45	1:07 5:05	0:44 3:20	0:22 1:40	
10,000	1:37 9:00	1:17 7:10	0:58 5:20	0:39 3:35	0:19 1:45	

BLACK FIGURES INDICATE AIR VALVE *NORMAL OXYGEN*

RED FIGURES INDICATE AIR VALVE *100% OXYGEN*

HOURS AVAILABLE FOR THREE-MAN CREW.
INCREASE HOURS 50% WITH TWO-MAN CREW.
CYLINDERS: THREE 514 CU IN.



169-00-1250

Figure 4-16. Oxygen Consumption Table

used constantly during night flights when above 5000 feet cabin altitude when on combat missions. The following procedures shall be observed when oxygen is used:

1. The pressure gage should read 1800 psi if the cylinder is fully charged.

2. Set the air valve to NORMAL OXYGEN for all normal flight conditions.

3. Put mask on. Fully engage the mating portions of the disconnect couplings to connect the mask to the oxygen system. (The force required to disconnect this coupling should not be less than 10 pounds.) Attach the ring to a snap clip sewed to the flight suit sufficiently high on the chest to permit free movement of the head without stretching breathing tube. When using a bail-out connector, the web tab provided with the connector should be attached to the parachute chest buckle or other secure position on the pilot's person.

4. To check the mask fit during flight, turn manual safety pressure lever ON. Take a deep breath, and hold breath. Note position of the oxygen flow indicator. If flow indicator opens (all black), excessive leakage is indicated. Tighten mask straps until flow indicator closes (white face shows). The characteristics of the flow indicator are such that this test cannot be conducted at pressure-breathing altitudes; however, the outward flow of oxygen into the eyes from a leaking mask is readily detectable and is an equally sensitive test.

5. The oxygen flow indicator blinks upon the intermittent application of from 5 to 7 inches of water pressure created by the flow of oxygen. The automatic pressure breathing oxygen regulator delivers a pressure of 5 to 7 inches of water pressure to the mask at approximately 41,000 feet and this pressure is likewise transmitted to the oxygen flow indicator which will remain open as long as this pressure is applied. Accordingly, the flow indicator will not "blink" above this altitude; however, the positive pressure in the mask is an unmistakable indication that oxygen is being delivered to the mask and no apprehension should be felt as long as the flow indicator remains open above 41,000 feet.

The following should be checked frequently while on oxygen:

1. Cylinder pressure gage for oxygen supply.
2. Oxygen flow indicator for flow of oxygen through regulator.
3. Mask fit for leak tightness.
4. Ensure engagement of disconnect couplings.
5. Connection of bail-out fitting to bail-out connector.

OXYGEN SYSTEM POSTFLIGHT CHECK.

Following each flight during which oxygen is used:

1. Turn off oxygen supply.
2. Make sure all oxygen equipment is in proper condition before leaving airplane. Report all difficulties and see that they are corrected.

OXYGEN EMERGENCY CONDITIONS.

1. Should symptoms occur which suggest the onset of anoxia, immediately activate the safety pressure control. If for any reason, the regulator should become inoperative and a constant pressure or flow of oxygen is not obtained by use of the safety pressure, disconnect the breathing tube, activate the oxygen bail-out equipment, and descend below 10,000 feet.

2. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, regardless of the altitude, the air valve should be set to 100% OXYGEN position and undiluted oxygen used until danger is passed or flight is completed.

WARNING

> When the air valve is set to 100% OXYGEN, the oxygen supply is more rapidly depleted. Refer to the oxygen consumption table (figure 4-16) for comparison of time oxygen is available between NORMAL OXYGEN and 100% OXYGEN setting of the air valve.

3. Should brief removal of the mask from the face become necessary at high altitude, use the following procedure: (a.) Take three or four deep breaths of 100 percent oxygen. (b.) Hold breath and remove mask from face. (c.) As soon as practicable, replace mask to face and take three or four deep breaths of 100 percent oxygen. (d.) Reset air valve lever to NORMAL OXYGEN position.

4. Do not exhaust oxygen supply below 300 psi except in an emergency.

Figure 4-17. Automatic Pilot Controls

AUTOMATIC PILOT SYSTEM.

An electrically operated automatic pilot (Type P-1) is installed in the airplane. Electric power is provided from the d-c main bus and from an a-c inverter. Flight instruments (gyro horizon indicator, turn-and-bank indicator, and master direction indicator) are mounted on the pilot's instrument panel. The flight instruments are energized whether the automatic pilot clutch is engaged or not. All controls, except the emergency release handle are located on the center console. (See figure 4-17.)

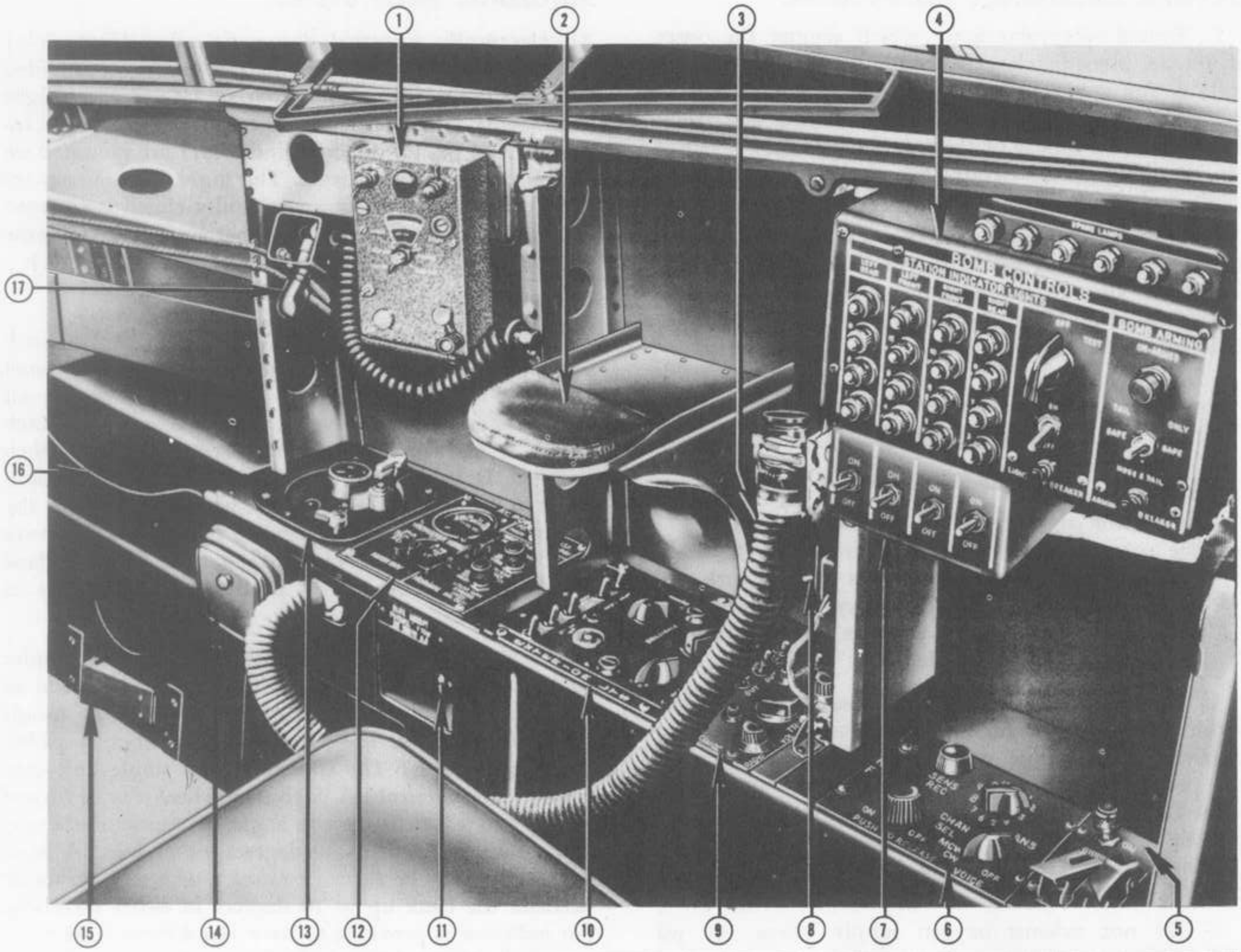
AUTOMATIC PILOT CONTROLS.

AUTOMATIC PILOT CLUTCH SWITCH. A clutch switch, mounted on the automatic pilot control panel (figure 4-17), is provided to engage or disengage all the clutches in the automatic pilot system. The clutch switch is marked "PUSH AUTO-PILOT ON," and, when engaged, is held ON by a holding solenoid. The automatic pilot then takes over in whatever attitude the airplane is when the clutch switch is engaged. However the clutch should not be engaged unless the airplane is trimmed for zero forces on all surface controls in level flight.

AUTOMATIC PILOT CONTROLLER. While under automatic pilot control, the airplane may be made to climb, dive, and execute co-ordinated turns by means of a controller on the automatic pilot control panel. (See figure 4-17.) The controller is a single unit containing three controls. A pitch trim wheel may be turned UP or DOWN to change the angle of attack of the airplane within a limit of 40 degrees either way. A bank trim wheel may be turned toward L or R to increase or decrease the bank up to 10 degrees in either direction. No indicator is provided to show the difference between automatic pilot trim and airplane surface control trim. Periodically the automatic pilot should be turned off and the airplane retrimmed. A small control stick on top of the controller may be moved right or left to produce a co-ordinated turn in the selected direction. Normally, the stick is locked in the neutral position and must be released for movement by means of a release button on top of the stick. As long as the release button is depressed, the stick can be moved freely; when the button is released, the stick is held in the selected position. When the stick is off-center, the lock can be overpowered when necessary if force is exerted on the stick, but when the stick is in neutral, the lock is positive and cannot be overpowered.

AUTOMATIC PILOT-RADAR TIE-IN SWITCH. A push-pull switch on the automatic pilot control panel is provided to tie in the autopilot and radar bombing equipment (AN/ASB-1). The switch is marked "PUSH TO ENGAGE." When the switch is actuated the directional control of the airplane is transferred to the AN/ASB-1 bomb director system.

AUTOMATIC PILOT EMERGENCY RELEASE HANDLE. To disengage the automatic pilot mechanically in



1. Radio Compass Control Box (AN/ARN-6)
2. Armrest
3. Oxygen Tube
4. Adapter Bomb Control Panel
5. Adapter Salvo Control Panel
6. HF Control Panel (AN/ART-13 and AN/ARR-15)
7. Bomb Rack Selector Switches
8. Approach Light Switch
9. Interphone Control Panel
10. Exterior Lights Control Panel
11. Heated Suit Outlet
12. A-C Power Control Panel
13. Oxygen Regulator
14. Ash Tray
15. Microphone Switch
16. Data Case
17. Cockpit Light

BOMBER NAVIGATOR'S STATION

H-9634-00-21

Figure 4-18.

case of electrical failure, pull up the automatic pilot emergency release handle (31, figure 1-5), located on a panel just forward of the control column. When the automatic pilot has been disengaged by the emergency release, it cannot be re-engaged in flight.

OPERATION OF AUTOMATIC PILOT.

1. Trim airplane for straight and level flight.
2. Center all controls on flight controllers.
3. Engage automatic pilot clutches by pushing clutch switch ON.
4. Make necessary trim changes in attitude of airplane with flight controller trim knobs and maneuver airplane by using flight controller stick.
5. Turn automatic pilot OFF at least every hour and retrim airplane.
6. To return to manual flight, pull out clutch switch.

NAVIGATION EQUIPMENT.

STAND-BY COMPASS.

A conventional magnetic compass is mounted on the rearview mirror bracket and can be used for navigation in the event of instrument or electrical failure. The compass is illuminated from a light which is controlled by the internal lighting control panel.

RADIO MAGNETIC INDICATOR.

The radio magnetic indicator is located on the lower right-hand portion of the instrument panel, and is used in conjunction with the radio compass.

BOMBING EQUIPMENT.

The bombing equipment consists of a single-lug shackle, removable bomb adapter rack, AN/ASB-1 or AN/APA-5A bomb director equipment, hydraulically actuated bomb bay doors, the master bomb control panel, and an adapter bomb control panel. The single-lug shackle will accommodate a single store, or the bomb adapter rack. The adapter rack will carry stores from 100-pound to 2000-pound size. Alternate loads may consist of Mark 8 or 24 mines, or Mark 34 torpedoes. Controls for bomb direction, operation of the bomb bay doors, and release of the stores are located at the bomber-navigator's station. Bomb release from the single-lug shackle may be electrical or mechanical. A mechanical device on the shackle indicates whether the shackle is locked. In flight, access to the bomb bay is possible by means of a door in the aft bulkhead of the crew entry compartment. The door can be opened when the cabin is not pressurized, or it can be removed by means of four quick-release type hinges. Two instrument driers are provided to prevent formation of moisture in the AN/ASB-1 computer and periscope.

BOMB BAY DOORS.

The bomb bay doors are hydraulically operated and electrically controlled from the bomber-navigator's station. Each bomb bay door consists of an upper and lower section, with removable panels in the lower section to accommodate the in-flight refueling tanker package. Hydraulic pressure from the utility hydraulic system provides normal operation of the bomb bay doors. Emergency hydraulic pressure is available in the event the utility hydraulic pressure fails. In case of an electrical failure, and if utility hydraulic pressure is available, the doors may be opened or closed by manual operation of the bomb door hydraulic selector valve in the crew entry compartment. For ground maintenance, bomb bay doors may be locked half open or fully open; lockpins are provided to lock the actuator movement. The lockpins are stowed adjacent to the lock points.

Figure 4-19. Master Bomb Control Panel

BOMBING EQUIPMENT CONTROLS AND INDICATORS.

Controls for bomb bay door operation, bomb arming, and bomb release are located on two panels in the bomber-navigator's station. The master bomb control panel (figure 4-19) is attached to the pilot's pedestal, and the adapter bomb control panel is located above the right console (figure 4-20). The control panels for the AN/ASB-1 equipment are located directly in front of the bomber-navigator. A panel with controls for operation of the shackle heater and the adapter salvo is located on the right-hand console (figure 4-21). Bombs may be released automatically through operation of the AN/ASB-1 equipment or by means of the electrical release button on the master bomb control panel. Emergency salvo can be accomplished electrically to drop the

ADAPTER BOMB CONTROL PANEL

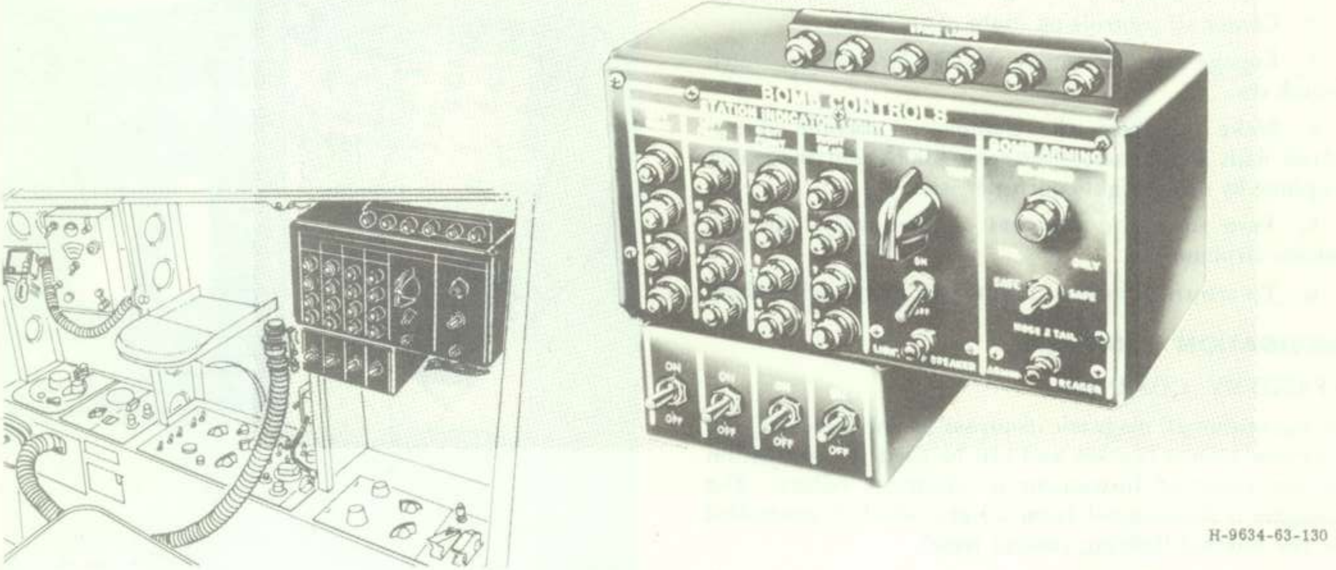


Figure 4-20. Adapter Bomb Control Panel

load of the adapter only. The emergency mechanical salvo will release the single-lug shackle, thus releasing the adapter if it is installed.

BOMB DOOR SWITCH. Bomb bay doors are controlled by a three-position switch on the master bomb control panel. (See figure 4-19.) When the switch is in the guarded OFF position, bomb bay doors are operated automatically through the AN/ASB-1 mechanism. The bomb bay doors are actuated when the switch is held momentarily at OPEN or CLOSE. A green indicator light illuminates when the doors are open. Bomb bay doors should be open immediately prior to bomb release and closed immediately after bomb release.

Note

> Slight buffeting may be encountered while bomb bay doors are open with stores in the bomb bay; severe buffeting develops after bombs are released and doors are open. Therefore, bomb bay doors should be closed immediately after release. When the AN/ASB-1 equipment is used, the bomb bay doors will open automatically and will close automatically after release of the last bomb from the adapter.

BOMB MASTER SWITCH. A bomb master switch is located on the master bomb control panel. When the switch is ON, electrical power is supplied to the bomb release controls, except the emergency bomb salvo switch, which is powered directly from the essential bus.

BOMB ARMING PANEL. A bomb arming section of the adapter bomb control panel (figure 4-20) contains a three-position arming switch, an indicator light, and a circuit breaker. Normally guarded at SAFE, the arming switch may be moved to TAIL ONLY to arm bombs for delayed detonation or to NOSE AND TAIL to arm bombs for instantaneous detonation. An indicator light above the switch is illuminated when bombs are armed. The circuit breaker must be in for bomb arming operation.

BOMB STATION INDICATOR LIGHTS. Sixteen indicator lamps, one for each bomb station on the adapter rack, are located on the adapter panel and are controlled by a toggle switch adjacent to the lights. (See figure 4-20.) When the toggle switch is ON, the indicator lamp for each loaded bomb station is illuminated. When a bomb is released, the related indicator lamp goes out. A rotary-type test switch is provided for testing indicator lamps. A circuit breaker for the lights is mounted on the panel. Spare lamps are located above the panel.

BOMB RACK SELECTOR SWITCHES. Four bomb rack selector switches, located on the adapter bomb control panel (figure 4-20), provide controls for rack selection when less than the entire load of bombs is to be released. The rack selector switches must be ON for either manual or automatic release of bombs. The automatic dropping of bombs will stop after one additional impulse of the automatic bomb director equipment, following the cutting off of all four rack selector switches.

BOMB ADAPTER SALVO CONTROL PANEL

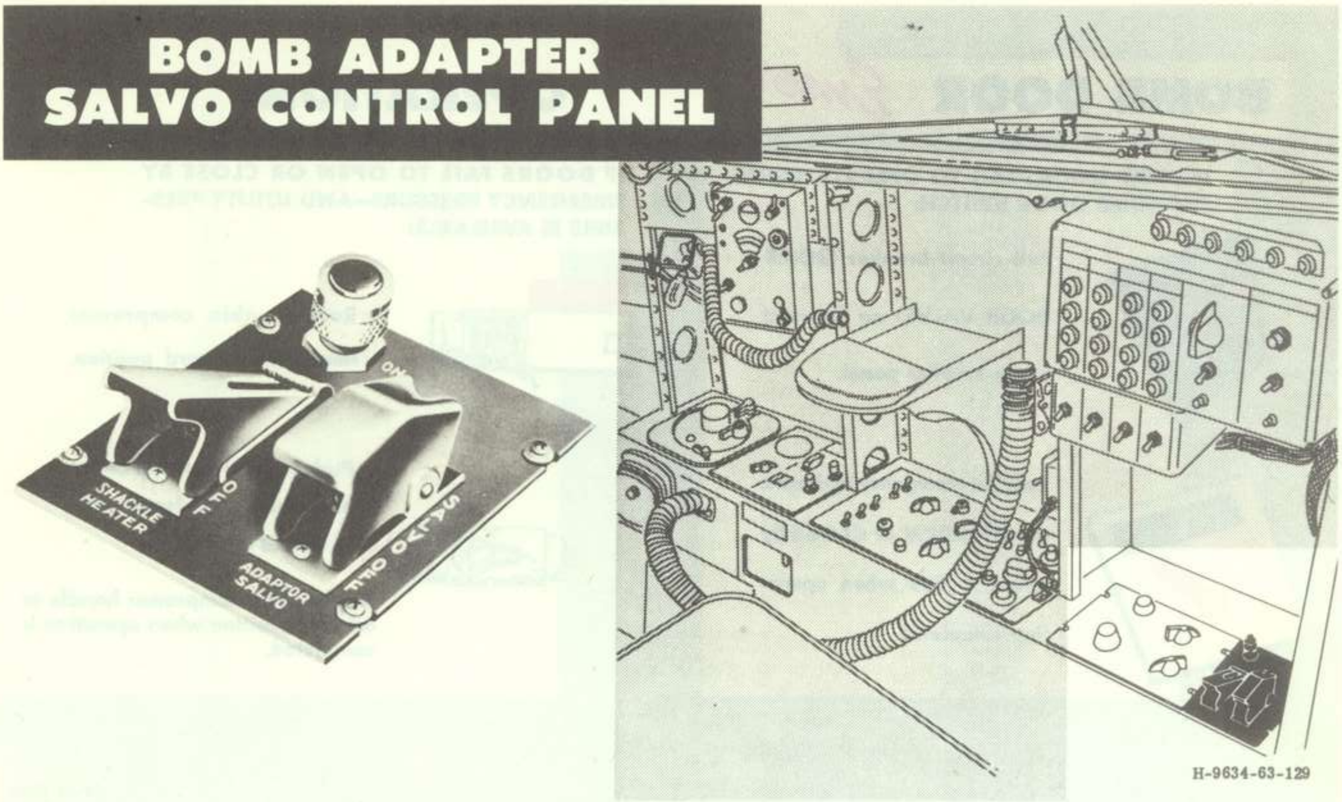


Figure 4-21. Bomb Adapter Salvo Control Panel

BOMB RELEASE BUTTON. A bomb release button is provided for manually actuating the electrical bomb release mechanisms of either the bomb adapter racks or the single-lug shackle. The release button is located on the master bomb control panel.

BOMB ADAPTER SALVO SWITCH. An emergency salvo switch is located on the right console and is guarded in the OFF position. (See figure 4-21.) When the switch is depressed to ON position momentarily, bomb doors open and bombs are salvoed from the adapter unarmed. Bomb doors close automatically after bomb salvo.

SHACKLE HEATER SWITCH. A shackle heater switch is located on the bomb adapter salvo control panel. (See figure 4-21.) When the switch is at NORMAL ON, the electric heater in the single-lug shackle will operate whenever the temperature drops to 40°F. A light above the shackle heater switch illuminates whenever the switch is turned on, but does not necessarily mean that the heater is operating. In freezing weather, the shackle heater should be on after take-off for shackle operation.

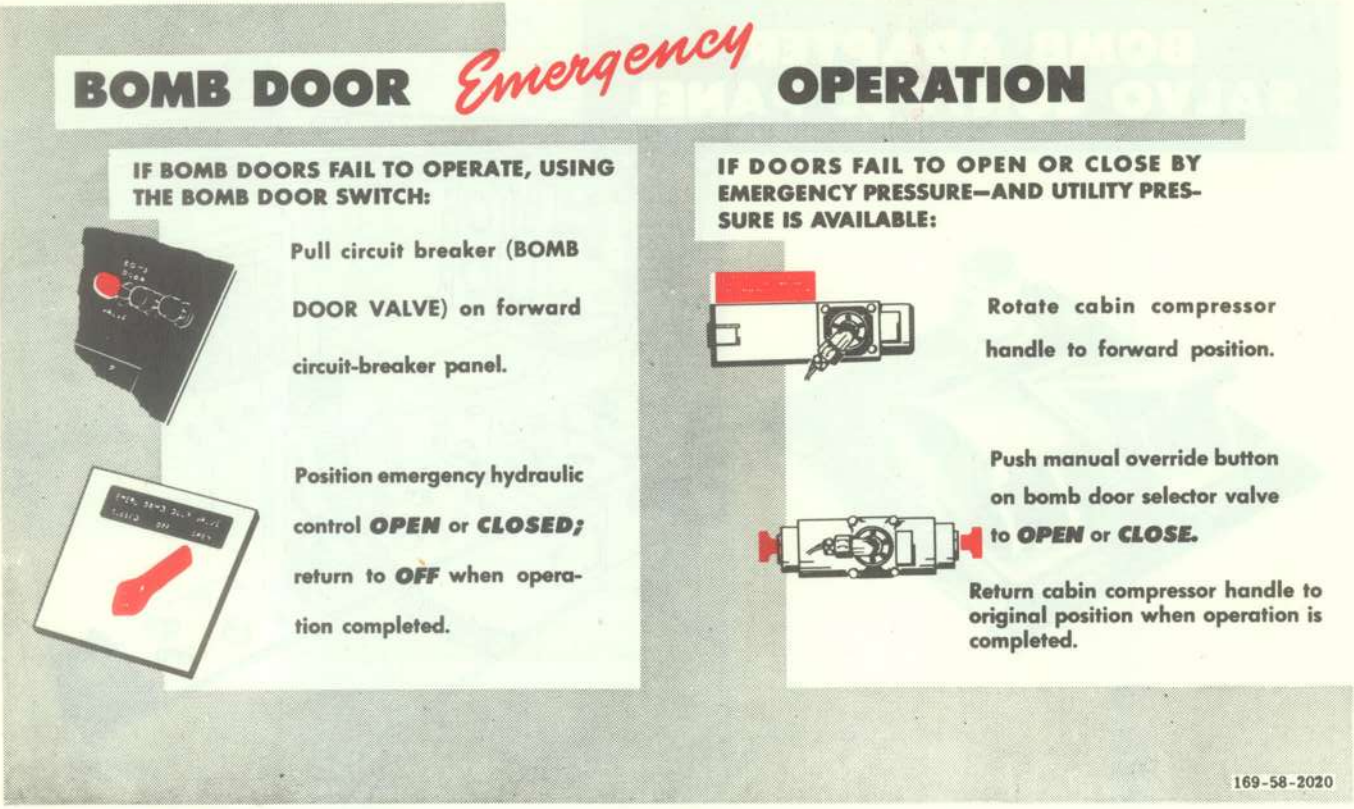
SHACKLE RELEASE HANDLE. To release the load of the single-lug shackle (either the adapter rack or a single store), a shackle release handle is provided on the master bomb control panel. Normally, the shackle release handle is full forward and the shackle is locked. When the handle is pulled, the first portion of travel unlocks the shackle. The shackle must be unlocked for electrical release of a single store. Further extension of the handle is prevented by a catch which must be released by the safety latch mounted adjacent to the handle. An interlock with the bomb bay doors prevents movement of the safety latch unless the bomb bay doors are open. In case of an electrical failure, the complete assembly, bombs, and bomb rack adapter or single store, can be released mechanically by means of the shackle release handle. The safety latch must be pushed forward and the handle then pulled out to release either the adapter and bombs, or a single store.

Note

> Bomb bay doors must be open before the shackle release handle can be pulled full out.

BOMB-AWAY INDICATOR LIGHT. A green indicator light on the pilot's instrument panel illuminates to notify the pilot that the single-lug shackle is in the full release position.

BOMB BAY DOOR EMERGENCY CONTROL. In the event of utility hydraulic system failure, the bomb bay doors may be opened and closed by pressure from the emergency hydraulic system if electrical power is available. (See figure 4-22.) When the emergency bomb door valve control, located on the emergency hydraulic panel, is moved from OFF to OPEN or CLOSED (after the bomb bay door valve circuit breaker has been pulled), the emergency valve is positioned so that emergency hydraulic pressure is directed through shuttle valves to the



BOMB DOOR *Emergency* OPERATION

IF BOMB DOORS FAIL TO OPERATE, USING THE BOMB DOOR SWITCH:

Pull circuit breaker (BOMB DOOR VALVE) on forward circuit-breaker panel.

Position emergency hydraulic control *OPEN* or *CLOSED;* return to *OFF* when operation completed.

IF DOORS FAIL TO OPEN OR CLOSE BY EMERGENCY PRESSURE—AND UTILITY PRESSURE IS AVAILABLE:

Rotate cabin compressor handle to forward position.

Push manual override button on bomb door selector valve to *OPEN* or *CLOSE.*

Return cabin compressor handle to original position when operation is completed.

Figure 4-22.

open or closed side of the bomb bay door actuating cylinders. After operation of the bomb bay doors by emergency pressure, the shuttle valve at the door actuating cylinders must be reset before operation by utility pressure will be normal. If shuttle valves are not reset, time for bomb bay door operation will be increased considerably.

Note

> To reset the shuttle valves, check that emergency control is OFF and operate manual override on selector valve in the *same direction* that bomb doors were last actuated by emergency pressure. Press proper manual override button for 4 seconds to ensure resetting shuttle valve before normal operation is resumed. Hydraulic pressure must flow through the utility system to accomplish the shuttle valve reset.

BOMB BAY DOOR SELECTOR VALVE. If the bomb bay door normal operation fails and utility hydraulic pressure is available, the bomb bay doors may be opened or closed by manual operation of the selector valve in the crew entry compartment. The handle on the cabin air compressor selector valve should be rotated (after the bomb bay door valve circuit breaker has been pulled), and the bomb bay door selector valve pushed to OPEN until the doors are open. After bombs are released, bomb bay door selector valve should be pushed to CLOSED until doors are closed. Then the cabin air compressor valve handle should be returned to original position.

BOMB SHACKLE LOCK INDICATOR. A mechanical indicator for the single-lug bomb shackle lock is provided on the forward side of the shackle. From the outside of the airplane, the indicator can be seen through a small porthole on the right side of the fuselage. Any unlocked condition is indicated by the appearance of a small flag protruding from a housing. When the shackle is locked, the flag is flush with the housing. Condition of the shackle lock can be checked without the bomb doors being opened after the bomb bay is loaded.

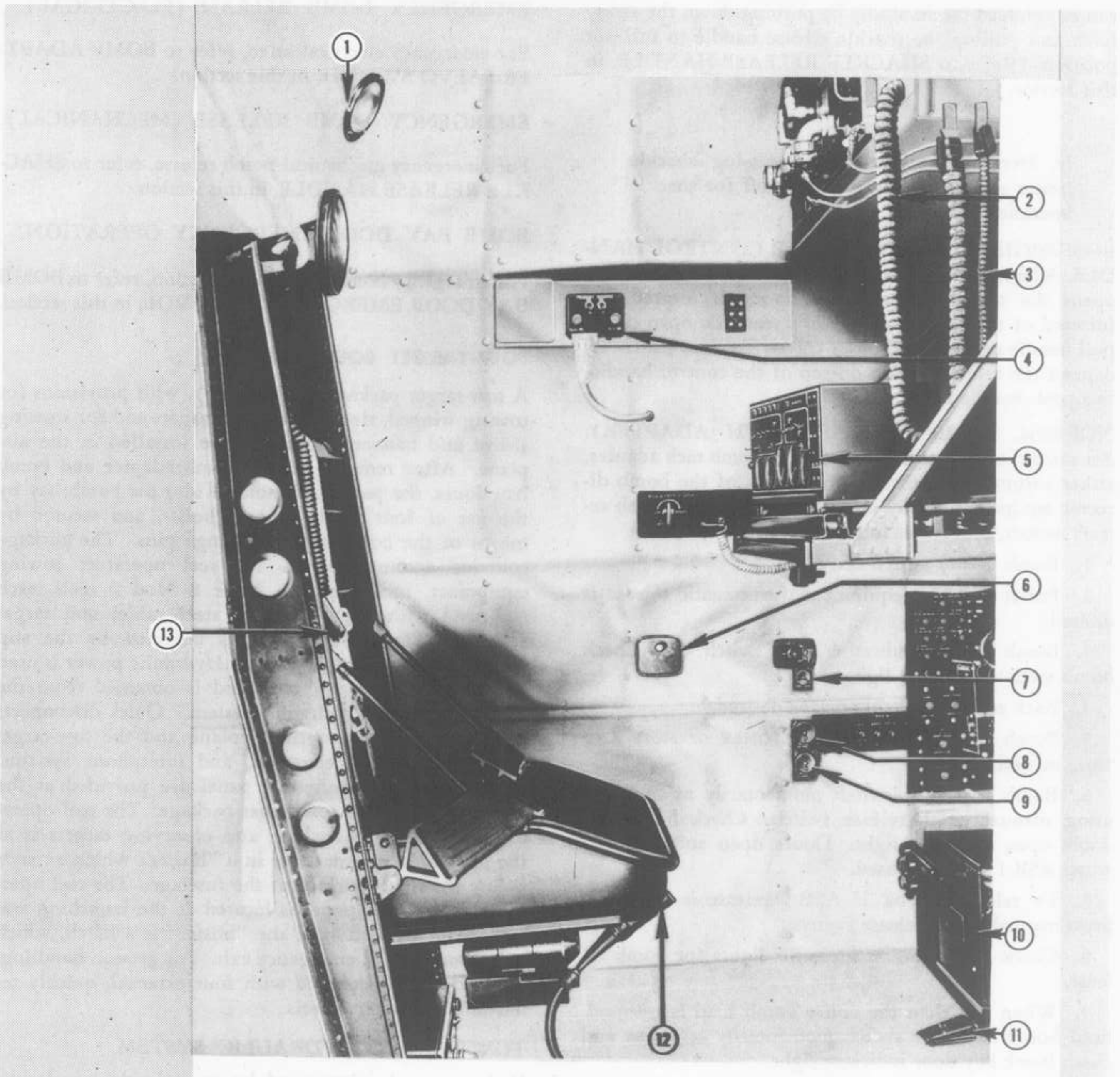
BOMB SHACKLE CONTROLS.

When action is authorized by special Navy instruction, the bomb shackle may be used to carry a single store without use of the bomb rack adapter. The shackle store can be released either automatically through operation of bomb director equipment or by means of the manual bomb release switch. Only the controls on the master bomb control panel are used to release the single store; the adapter panel is ineffective.

Note

> Before release can be accomplished, the shackle release handle must be pulled out to the first position latch stop to unlock the shackle.

When the shackle store is released, a BOMB AWAY lettered indicator light on the pilot's instrument panel (13, figure 1-5) illuminates. In an emergency, the shackle



DOME LIGHT

OXYGEN TUBE

PORTABLE MICROPHONE AND HEADSET EXTENSION

4. INTERPHONE CONTROL PANEL

5. IN-FLIGHT REFUELING OPERATOR'S CONTROL PANEL

6. ASH TRAY

7. PORTABLE EQUIPMENT ELECTRICAL OUTLET

8. DC POWER OUTLET

9. AC POWER OUTLET

10. BATTERY

11. MICROPHONE SWITCH

12. RELIEF TUBE

13. MICROPHONE AND HEADSET JACK

THIRD CREW MEMBER'S STATION

H-9634-00-22

Figure 4-23.

can be released mechanically by pushing down the safety latch and pulling the shackle release handle to full out position. (Refer to SHACKLE RELEASE HANDLE, in this section.)

Note

> In freezing weather, the single-lug shackle heater should be ON after take-off for shackle operation.

BOMBSIGHT PERISCOPE COVER CONTROL HANDLE. A bombsight periscope cover control handle, which opens the clamshell-type cover doors, is located just forward of the bomber-navigator's seat. To open cover, pull handle up the full limit of travel. To close the cover, depress the release button on top of the control handle, and push handle down.

NORMAL BOMB RELEASE (WITH ADAPTER). For normal release of bombs from the bomb rack adapter, either automatically through operation of the bomb director equipment, or by means of the manual bomb release switch, proceed as follows:

1. Bomb master switch ON.
2. Preset bombing equipment if automatic release is desired.
3. Bomb station indicator light switch ON. Check bomb station indicator lights.
4. Rack selector switches ON, as desired.
5. Bomb arming switch at TAIL ONLY or NOSE AND TAIL, as desired.
6. Bomb bay door switch momentarily at OPEN, if using manual bomb release switch. Check bomb bay doors open indicator light. Doors open automatically when ASB-1 release is used.
7. To release bombs, if ASB-1 release is not used, press manual bomb release switch.
8. Check bomb station indicator lights for bomb release.
9. When less than the entire bomb load is released, hold bomb bay door switch momentarily at CLOSE and check bomb bay door indicator light.

NORMAL BOMB RELEASE (SINGLE-LUG SHACKLE).

For release of single stores, use the following procedure:

Note

> In freezing weather, be sure that shackle heater switch is ON after take-off.

1. Master bomb switch ON.
2. For automatic release, preset bomb director; check bomb away indicator light.
3. For manual release, move bomb bay door switch to OPEN and check bomb bay door open indicator light; press manual bomb release switch at release point; position bomb bay door switch to CLOSE after bomb bay is clear.

EMERGENCY BOMB RELEASE (ELECTRICAL).

For emergency electrical salvo, refer to BOMB ADAPTER SALVO SWITCH, in this section.

EMERGENCY BOMB RELEASE (MECHANICAL).

For emergency mechanical bomb release, refer to SHACKLE RELEASE HANDLE, in this section.

BOMB BAY DOOR EMERGENCY OPERATION.

For emergency bomb bay door operation, refer to BOMB BAY DOOR EMERGENCY CONTROL, in this section.

TOW-TARGET EQUIPMENT.

A tow-target package (figure 4-24), with provisions for towing winged, sleeve or banner targets and for stowing sleeve and banner targets, can be installed in the airplane. After removal of the bomb adapter and bomb bay doors, the package is hoisted into the bomb bay by the use of four Mark 8 bomb hoists, and secured by means of the bomb bay door hinge pins. The package contains accommodations for reel operator; towing equipment, including two Mark 8 Mod 0 reels, each equipped with 12,000 feet of steel cable; and target stowage. The towing cable is unreeled by the slip stream force against the target. Hydraulic power is used to rewind the towing reels and is obtained from the airplane's utility hydraulic system. Quick-disconnects are provided between the airplane and the tow-target package hydraulic, electrical, and interphone systems. A rest seat and equipment panel are provided at the forward end of the tow-target package. The reel operator's station for launching and observing targets is at the aft end of the package in a "blister" which extends below the lower surface of the fuselage. The reel operator's instrument panel is located at the launching station. The aft section of the "blister" is a hatch, which is jettisonable for emergency exit. For ground handling, the package is equipped with four external, quickly removable castering wheels.

TOW-TARGET HYDRAULIC SYSTEM.

Each tow reel is rewound by an individual hydraulic motor, driven by pressure supplied from the airplane's utility hydraulic system through the bomb bay door selector valve. (See figure 4-25.) This valve is controlled by the bomb bay door switch, which becomes the winch power switch when the airplane is converted to carry the tow-target package. (See figure 4-30.) The 3000 psi pressure to each tow-reel hydraulic motor is controlled by an individual speed control valve, which is actuated by a related cable return lever. Hydraulic pressure is available for tow-reel operation after the winch power switch (on the master bomb control panel) is ON momentarily. The cabin air compressor is inoperative until the winch power switch is momentarily positioned OFF after reel operation. When reeling-in operations are completed, hydraulic pressure for reel operation should be shut off by positioning the winch power switch OFF

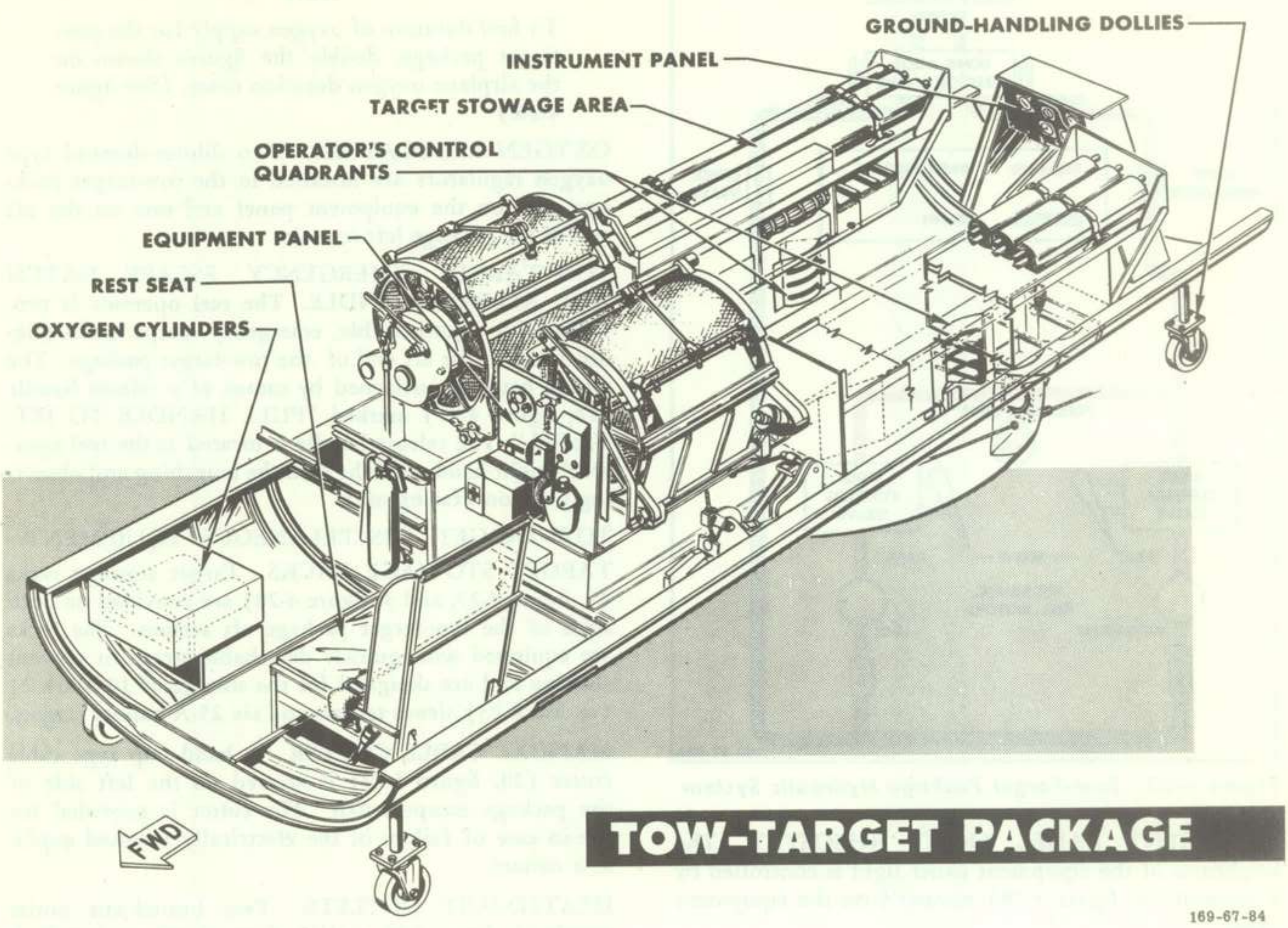


Figure 4-24.

momentarily, and quickly releasing it. If a malfunction of the winch power switch occurs, utility hydraulic pressure can be manually directed through the bomb door selector valve. This is accomplished when the manual override "close" button on the bomb door selector valve is depressed after the handle on the cabin air compressor selector valve is rotated forward and after the bomb door valve circuit breaker is pulled.

TOW-TARGET ELECTRICAL SYSTEM.

Electrical power for the reel operator's heated suit, for lighting and for actuating the explosive cable cutters is obtained from the airplane's electrical system. A disconnect is provided for convenient attachment.

CIRCUIT BREAKERS.

A circuit breaker for the package lights and one for the heated-suit outlets are mounted on a panel (3, figure 4-26) immediately aft of the tow-target equipment panel.

TOW-TARGET LIGHTING SYSTEM.

Two spotlights (18, figure 4-27, and 7, figure 4-28) for target illumination are externally mounted on the outrigger fairings of the tow-target package. Interior lights include two on each of the tow-target consoles (2, figure 4-27, and 10, figure 4-28), one on the equipment panel (figure 4-26), two for the instrument panel (19, figure 4-27, and 6, figure 4-28), and one above each cable holder lever (10, figure 4-27, and 16, figure 4-28).

TOW-TARGET LIGHTING SYSTEM CONTROLS.

TARGET SPOTLIGHT SWITCHES. The target spotlight switches (14, figure 4-27 and 13, figure 4-28), one located on each package console, control the spotlights on the respective sides.

TOW-TARGET INSTRUMENT PANEL LIGHT SWITCHES. Two lights to illuminate the tow-target instrument panel are both controlled either by a switch (2, figure 4-26) on the equipment panel or by a switch (14, figure 4-27) on the tow-target left console.

EQUIPMENT PANEL, CONSOLE, AND COMPARTMENT LIGHT SWITCHES. The light on the equipment panel, both lights on each console, and the light above each cable holder lever are all controlled through either a switch (2, figure 4-26) on the equipment panel or a switch (14, figure 4-27) on the package left console.

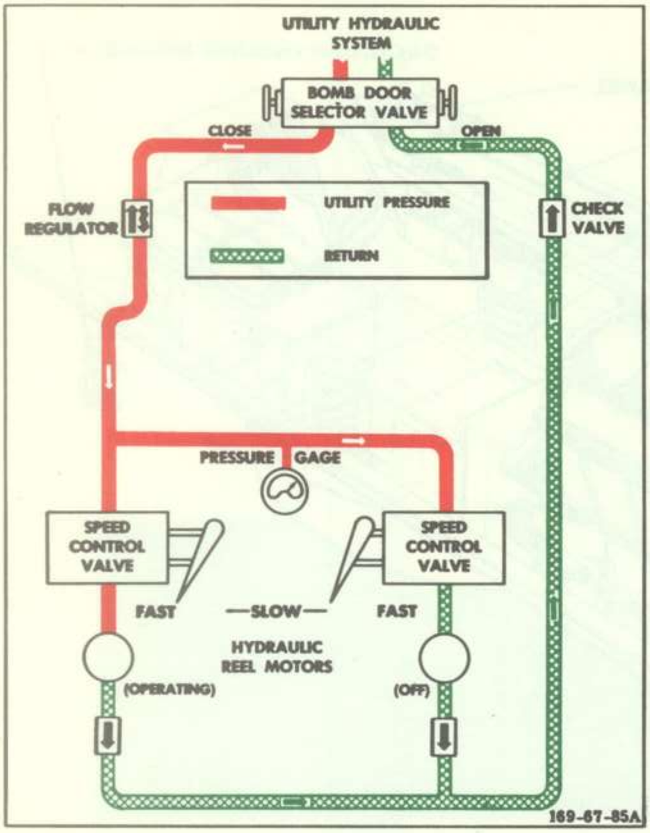


Figure 4-25. Tow-Target Package Hydraulic System

EQUIPMENT PANEL LIGHT RHEOSTAT. The brightness of the equipment panel light is controlled by a rheostat (2, figure 4-26) mounted on the equipment panel.

CONSOLE AND COMPARTMENT LIGHT RHEOSTAT. A rheostat (14, figure 4-27), on the package left console, controls the brilliancy of the lights on both consoles and the compartment light above each cable holder lever.

TOW-TARGET COMMUNICATION EQUIPMENT.

Two portable combination receiver-transmitter jack boxes are provided in the tow-target package, one mounted on the equipment panel (4, figure 4-26) and the other on the right console (11, figure 4-28). The jacks can be removed from their mountings and clipped to the reel operator's clothing, permitting his movement around the fore or aft stations of the package. Both are connected by means of a quick-disconnect plug to the airplane AN/AIC-4 interphone system.

TOW-TARGET OXYGEN SYSTEM.

A separate oxygen system is provided in the tow-target package. Oxygen is supplied from two high-pressure cylinders installed on the forward right side of the package. (See figure 4-24.) The oxygen cylinders may be recharged through the right, forward observation window of the package. Normal pressure for the system is 1800 psi. An oxygen pressure gage is incorporated in each pressure regulator.

Note

> To find duration of oxygen supply for the tow-target package, double the figures shown on the airplane oxygen duration chart. (See figure 4-16.)

OXYGEN REGULATORS. Two diluter-demand type oxygen regulators are installed in the tow-target package, one on the equipment panel and one on the aft end of the package left console.

TOW-TARGET EMERGENCY ESCAPE HATCH AND RELEASE HANDLE. The reel operator is provided with a jettisonable, emergency escape hatch (figure 3-10) at the aft end of the tow-target package. The escape hatch is jettisoned by means of a release handle (16, figure 4-27) marked "PULL HANDLE TO JETTISON." The release handle is located at the reel operator's right hand while he is in the launching and observing position (facing aft).

TOW-TARGET MISCELLANEOUS EQUIPMENT.

TARGET STOWAGE RACKS. Target stowage racks (1, figure 4-27, and 3, figure 4-28) are provided on both sides of the tow-target package aft section. The racks are equipped with quickly detachable straps to prevent shifting and are designed for the storage of 10 Mark 22 (or Mark 23) sleeve targets and six 25-A banner targets.

MANUAL CABLE CUTTER. A hand-snip type cable cutter (20, figure 4-27) is stowed on the left side of the package escape hatch. The cutter is provided for use in case of failure of the electrically actuated explosive cutters.

HEATED-SUIT OUTLETS. Two heated-suit outlet panels (3, figure 4-26, and 12, figure 4-28) are installed, one on the tow-target equipment panel and one on the package right console. A rheostat to control the degree of heat is mounted on both outlet panels.

REST SEAT. A rest seat (7, figure 4-27) is provided for the reel operator at the forward end of the tow-target package.

RELIEF TUBE. A relief tube is stowed in a bracket at the left side of the reel operator's rest seat.

FIRE EXTINGUISHER. A portable fire extinguisher (1, figure 4-28) is mounted aft of the oxygen bottle stowage compartment in the forward section of the tow-target package.

FIRST-AID KIT AND CANTEEN. A first-aid kit (6, figure 4-26) and a water canteen (5, figure 4-26) are stowed on the equipment panel adjacent to the reel operator's rest seat.

SAFETY HARNESS. The reel operator is provided with a safety harness (12, figure 4-27) for use while in position at the launching and observing station.

TOW-TARGET CONTROLS.

Individual controls for the left and right tow reels are installed on each side of the package. The cable return, clutch, and brake levers are contained in two quadrants, one on the left console and one on the right console of the package. A cable holder lever is installed forward of each quadrant. Cable-cutter switches are provided for the reel operator and pilot.

CABLE RETURN LEVER. The cable return lever (figure 4-29) has two extreme positions, FAST and SLOW (off). Operation of the lever actuates a hydraulic valve which governs the rotation speed of the related hydraulic motor for rewinding the tow reel. Intermediate positioning of the lever varies the rewind speed of the tow reel. Placing the lever at SLOW (off) position closes the hydraulic valve.

Note

> Hydraulic pressure to the tow-target package can be obtained by moving this lever from the SLOW position. However, since the cabin compressor is not cut out by this method, operation of the reels will not be satisfactory. Always turn winch power switch ON momentarily to obtain hydraulic pressure.

CLUTCH LEVER. A disk-type clutch on the tow reel is controlled by operation of the clutch lever (figure 4-29). The clutch lever has two positions, OUT (disengaged) and IN (engaged).

BRAKE LEVER. A band-type brake on the tow reel is engaged or released when the brake lever (figure 4-29) is positioned to ON or OFF respectively.

CABLE HOLDER LEVER. A cable holder lever (9, figure 4-27, and 17, figure 4-28) is provided for each towing cable to clamp the cable, when unreeled, to relieve strain on the tow-reel brake and clutch. The cable holder lever has two positions, HOLD and RELEASE.

CAUTION

> Do not place cable holder lever at HOLD when cable is in motion.

CABLE-CUTTER SWITCHES. Two explosive-type cable cutters (11, figure 4-27, and 15, figure 4-28), one located under each console, are actuated by the reel operator through two switches, one on the left console (3, figure 4-27) and one on the right console (14, figure 4-28) of the package. To enable the pilot to sever both tow cables simultaneously in an emergency, a single switch (figure 4-30) is provided on the master bomb control panel.

Note

> To properly sever a cable, the cable holder lever should be at HOLD before cable-cutter switch is actuated.

TOW-TARGET INDICATORS.

The reel operator's instrument panel (figure 4-31), located at the aft end of the tow-target package, incorporates an altimeter, an airspeed indicator, a hydraulic pressure gage, two reel tachometers, and two cable footage counters.

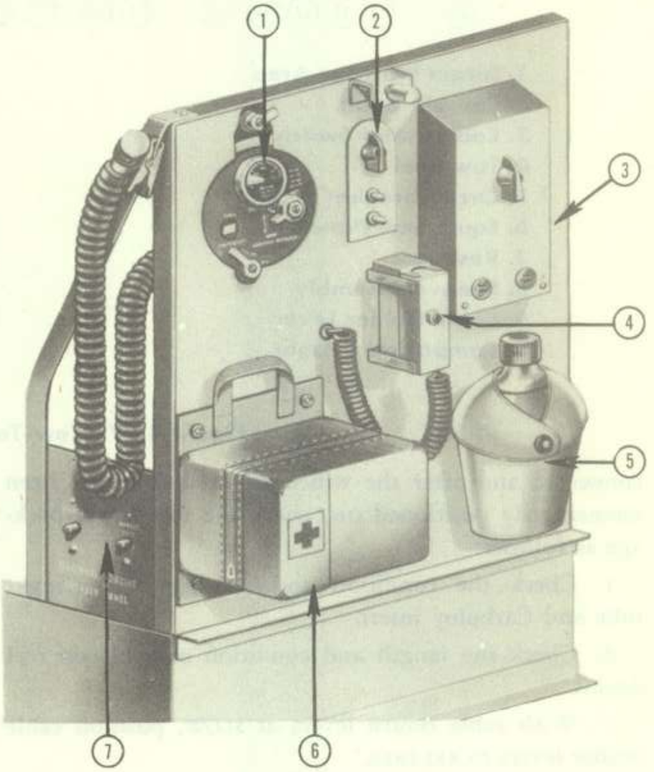
REEL TACHOMETERS. The rate of speed at which cable is being streamed or reeled in is indicated in feet per minute by two reel tachometers (figure 4-31), one for each tow reei, mounted on the reel operator's instrument panel.

CABLE FOOTAGE COUNTERS. The length of cable unwound is registered by a cable footage counter (figure 4-31) for each tow reel. The indicators, mounted on the reel operator's instrument panel, register linear feet from 0 to 99,999. The reading is changed when a reset key on the side of the indicator is pushed in and turned.

REEL OPERATOR'S GROUND CHECK.

This check should be accomplished with the assistance of ground crew members. With a hydraulic test stand

TOW-TARGET PACKAGE EQUIPMENT PANEL

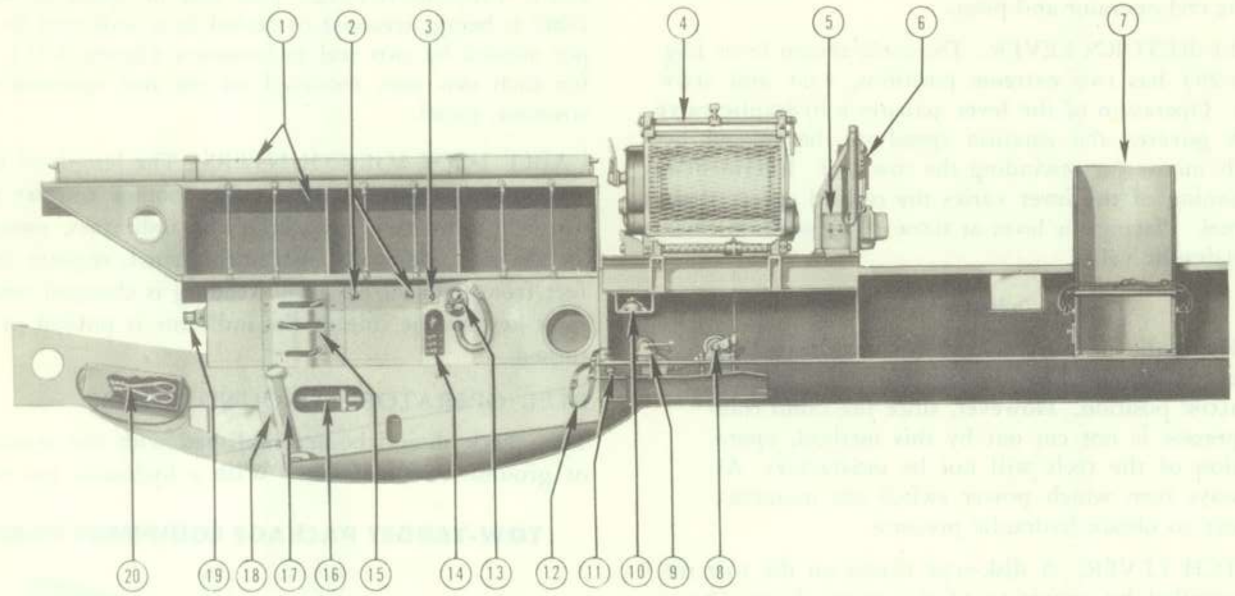


1. Oxygen Regulator
2. Light Switch Panel
3. Heated-suit Outlet Panel
4. Portable Radio Jack
5. Water Canteen
6. First-aid Kit
7. Circuit-breaker Panel

169-67-7?

Figure 4-26. Tow-Target Package Equipment Panel

TOW-TARGET PACKAGE–LEFT SIDE



1. Target Stowage Area
2. Console Lights
3. Cable-cutter Switch
4. Tow Reel
5. Circuit-breaker Panel
6. Equipment Panel
7. Rest Seat
8. Sheave Assembly
9. Cable Holder Lever
10. Compartment Light
11. Cable Cutter
12. Safety Harness
13. Oxygen Regulator
14. Light Switch Panel
15. Control Quadrant
16. Emergency Escape Hatch Release Handle
17. Tow-target Leaders
18. Target Spotlight
19. Instrument Panel Spotlight
20. Manual Cable Cutters

Figure 4-27. Tow-Target Package—Left Side

connected and after the winch power switch has been momentarily positioned ON, check the tow-target package as follows:

1. Check the condition and security of outrigger tube and Carboloy insert.

2. Check the length and condition of cable on reel drums.

3. With cable return levers at SLOW, position cable holder levers to RELEASE.

4. Move clutch levers to OUT position.

5. Move brake levers to OFF.

6. Have ground crew pull 100 to 150 feet of cable from each reel through the outrigger tubes.

7. Return the respective clutch lever to IN position.

8. Move the cable return lever *slowly* from SLOW toward FAST position. This will cause hydraulic pressure to operate the reel motor and rewind the cable. While cable is being rewound, check operation of reel level wind, cable footage counter, and cable tachometer.

9. Return the cable return lever to SLOW (off) position when the cable has been rewound and position the cable holder lever to HOLD, leaving approximately 18 inches of cable projecting beyond the outrigger tube end.

10. Move the brake lever to ON position.

11. Set altimeter; then set cable footage counters at zero.

12. Momentarily position winch power switch OFF.

13. Have hydraulic test stand removed.

PREFLIGHT CHECK.

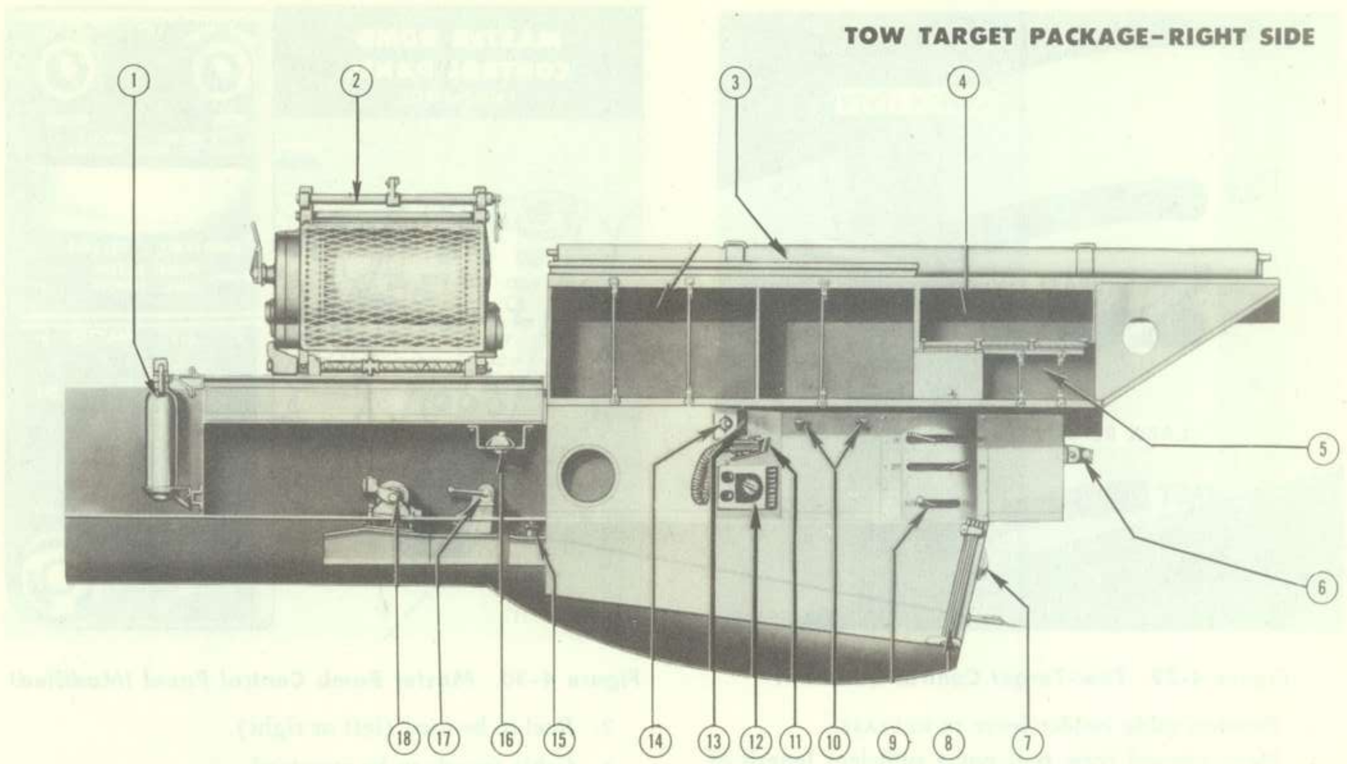
PILOT. Before a target towing mission, the pilot should:

1. Make certain the reel operator has performed his ground check.

2. Winch power switch momentarily OFF.

REEL OPERATOR. In addition to the ground check, the reel operator should perform the following:

1. Check that emergency escape hatch and target streaming hatches are operable and secured.



1. Fire Extinguisher
2. Tow Reel
3. Target Stowage Area
4. Cable-cutting Messenger Stowage
5. Messenger Target Stowage
6. Instrument Panel Spotlight
7. Target Spotlight
8. Tow-target Leaders
9. Control Quadrant
10. Console Lights
11. Portable Radio Jack
12. Heated-suit Outlet Panel
13. Target Spotlight Switch
14. Cable-cutter Switch
15. Cable Cutter
16. Compartment Light
17. Cable Holder Lever
18. Sheave Assembly

169-67-83

Figure 4-28. Tow-Target Package—Right Side

2. Check targets, sleeve messengers, snarl catchers, exchange devices, leaders (in "ready" position on the outrigger with spares), and cable cutting messengers.

3. Check cable cutters to make certain that explosive charge and pellet are properly installed and ready for operation.

4. See that manually operated cutters are readily available for emergency use.

5. Check fire extinguisher for proper condition and security.

6. Check forward observation windows on tow-target package.

7. Check water canteen and first-aid kit on equipment panel.

8. Perform oxygen system preflight check. Refer to OXYGEN SYSTEM PREFLIGHT CHECK, in this section.

9. When power is available, push circuit breakers (aft of equipment panel) in.

10. Ascertain that heated-suit outlets and rheostats are functioning.

11. Check operation of target spotlights and all interior lights.

12. Check communication system for proper operation.

13. Inform pilot when preflight check has been completed.

ATTACHING WINGED TARGET.

PILOT. After preflight checks have been completed, and reel operator has reported his equipment checked, proceed as follows:

1. Taxi to take-off point approximately 150 feet from end of runway.
2. Reduce engine rpm to idle.
3. Notify reel operator to proceed with attaching target.

REEL OPERATOR. When the airplane is in take-off position, and pilot signifies readiness for attaching winged target, proceed as follows:

1. Move clutch lever to OUT position.
2. Move brake lever to OFF.

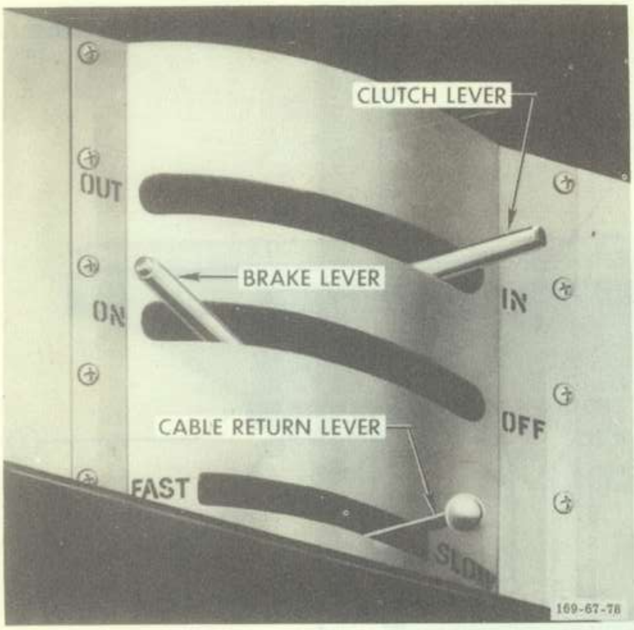


Figure 4-29. Tow-Target Control Quadrant

3. Position cable holder lever to RELEASE.

4. Have ground crew pull out a sufficient length of cable to enable target attachment at distance prescribed by squadron policy.

5. Make sure the cable return lever is at SLOW.

6. Clutch lever IN.

7. Brake lever ON.

8. Cable holder lever HOLD.

9. Notify pilot that the target is attached and ready for take-off.

TAKE-OFF.

PILOT. Make normal take-off except to allow for 10% increase in ground roll when towing winged target.

Note

> Do not use jet engine for take-off when towing a winged target. The exhaust may damage the cable.

REEL OPERATOR. The reel operator should maintain the controls as follows during take-off and climb:

1. Cable return SLOW (off).
2. Clutch lever IN.
3. Brake lever ON.
4. Cable holder lever HOLD.

Note

> The reel operator occupies the third crewman's seat during take-off, landing, or ditching.

AFTER TAKE-OFF.

PILOT. The pilot should inform the reel operator as follows:

1. Type of target to be used.

Figure 4-30. Master Bomb Control Panel (Modified)

2. Reel to be used (left or right).
3. Cable length to be streamed.
4. Type of runs to be executed.

REEL OPERATOR. After take-off, the reel operator proceeds as follows:

Note

> Unless otherwise directed, the reel operator shall wear his earphones, oxygen equipment, and pararaft at all times.

1. Receive instruction from pilot as to type of target, reel to be used, cable length to be streamed, and type of runs to be executed.

2. Secure target to the cable.

Note

> Method of securing the target to the cable depends upon individual squadron policy. Snarl catchers or exchange devices (such as Mark 7 Mod 3 release) are generally used.

3. Inform pilot when equipment is ready for launching and streaming target.

TOW-TARGET NORMAL OPERATION (SLEEVE AND BANNER TARGETS).

LAUNCHING AND STREAMING TARGET.

Preparations for towing should be co-ordinated in such a manner that the airplane will be in the most favorable position for commencing the exercise as the target is streamed. It is recommended that the following procedure be used to launch and stream the target.

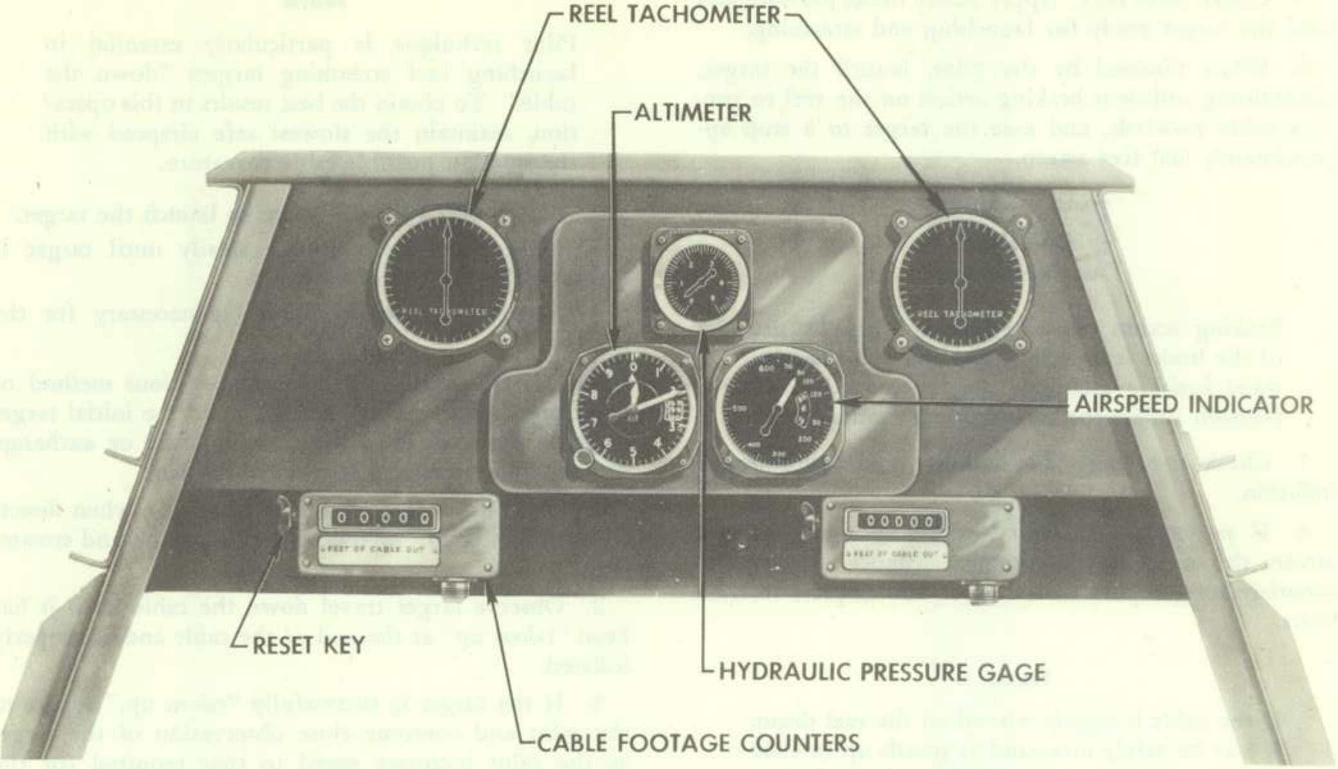


Figure 4-31. Tow-Target Package Instrument Panel

PILOT. The pilot should:

1. Notify reel operator to prepare to launch and stream target.
2. Momentarily position winch power switch ON.
3. Notify reel operator when to launch target.
4. Hold airplane speed and attitude steady until desired length of cable has been streamed and the reel operator reports the reel equipment "secured for towing." If the reel operator reports unsatisfactory inflation or loss of target, it may be necessary to rewind the cable and use a stand-by target.
5. When the reel equipment is secured for towing, slowly increase the speed as necessary for the exercise.

CAUTION

A sudden increase in speed while towing a target will impose excessive loads, which may cause damage or failure of the target, the cable, or related equipment. The following IAS should be observed during towing operations:

Launching—120 knots.

Maximum towing speeds:

A25A target, 210 knots.
A6A target, 180 knots.

6. Momentarily position winch power switch OFF.

REEL OPERATOR. The reel operator should proceed as follows when launching and streaming the target:

Note

If the cable on the reel drum has not been reeled out and rewound in the air, it is extremely desirable to reel out all of the cable on the first flight after ground rewind. Use a sleeve messenger and rewind at an indicated airspeed of 140 knots. This can often be accomplished on the way to the exercise area.

1. Assume prone position at aft station and secure safety harness.
2. Open the target streaming hatch.
3. Cable holder lever RELEASE.
4. Manipulate the cable return lever until all slack between target and reel drum is removed. (Be sure winch power switch has been momentarily positioned ON before operation of the cable return lever.)

Note

It is extremely important that all slack be taken up in the cable before the target is launched. If an exchange device (such as the Mark 7 Mod 3 release) is used, the tip of the device should be carefully snubbed against the outrigger insert, and all precautions should be taken against chipping the insert. The exchange device must be snubbed to prevent its whipping in the slip stream of the airplane.

5. Clutch lever OUT. Apply steady brake pressure and hold the target ready for launching and streaming.

6. When directed by the pilot, launch the target, maintaining sufficient braking action on the reel to prevent cable backlash, and ease the target to a stop approximately 300 feet astern.

CAUTION

Braking action must be accomplished by use of the brake lever only. The clutch is used for static braking and must not be moved to IN position unless the reel drum is motionless.

7. Check the target for stability and condition of inflation.

8. If target is satisfactory, report to the pilot and stream the target to the specified distance. If target is unsatisfactory, report to the pilot and request instructions.

Note

If the cable is tightly wound on the reel drum, it may be safely unwound at speeds up to 4000 feet per minute, as measured by the reel tachometer. However, excellent technique is required to properly control such high speed to prevent backlash and overspeeding and to keep the brake bands from becoming too hot. If the cable is not tightly wound, it should not be allowed to stream faster than 2000 feet per minute.

9. When the target reaches the distance specified by the pilot, bring the reel drum to a smooth stop, using the brake lever only.

10. Position the cable holder lever to HOLD, gradually release the brake, move the clutch lever to IN position, and reapply the brake. This procedure transfers the cable load from the reel to the cable holder and secures the equipment for towing.

11. Report to pilot that tow reel is secured for towing.

12. Fasten a target to the next leader to be used, ready for launching and streaming if the towed target is shot away or damaged beyond use. Be prepared to launch when directed.

13. Make frequent inspections of the tow gear and make an immediate report of any malfunctioning to the pilot.

LAUNCHING AND STREAMING SUBSEQUENT TARGETS "DOWN THE CABLE."

PILOT. Reduce speed immediately when it becomes necessary to replace the target; then proceed as follows:

1. Notify the reel operator to stand by to launch and stream target.

Note

Pilot technique is particularly essential in launching and streaming targets "down the cable." To obtain the best results in this operation, maintain the slowest safe airspeed with the smallest possible cable curvature.

2. Notify reel operator when to launch the target.

3. Hold speed and attitude steady until target is "taken up" at the end of the cable.

4. Slowly increase the speed as necessary for the exercise.

REEL OPERATOR. The most expeditious method of launching and streaming targets, when the initial target must be replaced, is to use snarl catchers or exchange devices (Mark 7 Mod 3 release) as follows:

1. Hold the target ready for launching when directed by the pilot to: "Stand by for launching and streaming."

2. Observe target travel down the cable until it has been "taken up" at the end of the cable and is properly inflated.

3. If the target is successfully "taken up," report to the pilot and continue close observation of the target as the pilot increases speed to that required for the mission.

4. If the target is lost or is not properly inflated, notify the pilot and request instructions.

SECURING THE TOW GEAR.

PILOT. At completion of the towing exercise, reduce airspeed and proceed as follows:

1. Direct the reel operator to release the target, if still in tow, by means of a cable-cutting messenger ("iron horse") or a target release messenger. If a cable cutting messenger is used, best results will be obtained if at least 140 knots airspeed is maintained. If a release messenger is used, airspeed of 110 to 120 knots should be maintained.

2. After being informed by the reel operator that the target has been released, maintain any safe indicated airspeed below 120 knots, momentarily position the winch power switch ON, and direct the reel operator to rewind the cable.

CAUTION

When the winch power switch has been momentarily positioned ON, the cabin compressor is de-activated. To activate the compressor, it is necessary to position the winch power switch OFF. Always make sure the reel operator's cable return lever is in the SLOW position before moving the winch power switch OFF, or a surge in the hydraulic system may damage check valves.

3. Return to desired flight conditions when informed by the reel operator that the towing equipment has been secured.

4. Make certain the operator's cable return lever is in the SLOW position, then momentarily position winch power switch OFF.

REEL OPERATOR. When directed by the pilot to drop the target, proceed as follows:

1. Release a cable cutting messenger ("iron horse") or target release messenger.

2. Notify the pilot when target has been released and request winch power switch be positioned ON.

Note

After winch power switch is positioned ON, hydraulic power is available to the tow-target package. Hydraulic power can be obtained by moving the cable return lever from the SLOW (off) position, without using winch power switch; however, this method does not deactivate the cabin compressor. With the cabin compressor activated, insufficient pressure will be available to provide satisfactory operation of the reels.

3. Check clutch lever IN; then release the cable holder and brake lever.

4. Move the cable return lever *slowly* to the FAST position to rewind cable. Inform the pilot at intervals as to the amount of cable remaining in tow. If the end of the cable is frayed or snarled, stop the reel and cut the frayed end aft of the outrigger with the manual cutters. If an exchange device is attached to the end of the cable, use care to ensure that it does not strike the Carboloy insert.

Note

The cable holder lever should be positioned to HOLD, the clutch lever to IN, and the brake lever ON whenever the cable is in static condition. At least 18 inches of cable should extend from the outrigger tube when the tow gear is secured.

5. Secure the end of the cable and close the streaming hatch.

6. Make certain the cable return lever is in the SLOW position, then report to the pilot that the towing equipment has been secured.

TOW-TARGET NORMAL OPERATION (WINGED TARGETS).

REELING OUT WINGED TARGETS.

PILOT. To allow reeling out of target, follow this procedure:

1. Reduce airspeed.

2. Notify reel operator to unreel cable in order to place target at desired distance.

3. Wait for confirmation from reel operator that target has been reeled out to predetermined distance before increasing airspeed.

REEL OPERATOR. When the pilot requests that cable be unreeled, proceed as follows:

1. With the cable return lever at SLOW (off) and the brake lever at ON, position the clutch lever to OUT.

2. Cable holder lever RELEASE.

3. Maintain sufficient braking pressure to hold cable speed to a maximum of 2000 feet per minute.

WARNING

Never allow cable to unreel freely without brake pressure, as the reel will overspeed and resultant failure may injure reel operator or damage airplane.

4. When cable has unreeled to within 500 feet of desired length, slowly increase brake pressure until the target stops at the desired distance. Use the brake lever only.

5. Engage the cable holder, gradually release the brake, move the clutch lever to IN, and reapply the brake.

6. Advise pilot that target equipment is secured for towing.

CAUTION

Warn pilot to reduce speed if the target shows a tendency to oscillate at high speeds. Oscillation adds stress and may result in failure of the target or towing equipment.

TOWING WINGED TARGET.

The pilot should follow this procedure when towing a winged target:

1. When reel operator reports that target is at desired distance, increase speed as desired for towing.

2. Avoid increased stress on target and towing equipment by performing all maneuvers gently and without steep turns.

REELING IN WINGED TARGET.

PILOT. The pilot should follow this procedure when reeling in the winged target:

1. Reduce airspeed and momentarily position winch power switch ON.

2. Notify reel operator of target distance desired (normally 200 feet) for landing.

3. If possible, fly straight and level until reel operator reports that target is at desired distance.

Note

> If operation of the cabin compressor is desired between time winged target is reeled in to landing distance, and time tow-target equipment is secured for landing, the winch power switch must be momentarily positioned OFF after reel operator notifies pilot that winged target is secured for landing.

REEL OPERATOR. To reel in cable after pilot has reduced airspeed and momentarily positioned winch power to ON, proceed as follows:

1. Check clutch lever IN; then release the cable holder.
2. Slowly release brake lever and make sure clutch is holding reel.
3. Move cable return lever slowly toward FAST. Retard rewinding speed with cable return lever as target approaches desired distance (200 feet of cable normally left extended for landing target).
4. Stop reeling-in by placing cable return at SLOW, brake control full ON, and cable holder lever at HOLD.
5. Gradually release brake, temporarily disengage the clutch and then return it to IN, and finally reapply the brake. This procedure transfers the cable load from the reel to the cable holder.
6. Advise pilot that winged target is reeled in and secured for landing.

LANDING WINGED TARGET.

PILOT. To land the target, a low pass is made over the runway so the target contacts the ground in a normal landing attitude. The target will automatically release upon contact with the ground and the extended cable will be reeled in by the reel operator. Target landing procedure is as follows:

1. Gear up.
2. Flaps partially down.
3. Make a straight-in approach.

WARNING

> Make a higher than normal approach for target to clear any obstacles near the field.

4. Follow instructions by radio from ground observer.
5. Keep sufficient power applied to make safe go-around.
6. When reel operator reports that target is released, apply full power and go around for normal landing.
7. Make certain winch power switch has been momentarily positioned ON.
8. After reel operator reports that towing equipment has been secured, momentarily position winch power switch OFF.
9. Delay landing airplane until reel operator has secured himself in the third crew member's seat.

REEL OPERATOR. During landing of winged target, stand by to:

1. Cut cable in case target does not release automatically or in case of emergency.
2. Notify pilot when target is released, and request that he momentarily position winch power switch ON.
3. Check clutch IN; cable return SLOW.
4. Release brake and cable holder.
5. Move the cable return lever *slowly* to the FAST position to rewind the cable.
6. Retard cable return lever as cable end approaches airplane, so that cable may be stopped with a minimum of 18 inches extending behind the outrigger tube.
7. Stop cable by moving cable return to SLOW and brake to ON. After cable has stopped, place cable holder lever at HOLD.
8. Notify pilot that cable is reeled in and towing equipment is ready for landing.
9. Immediately go to crew entry compartment to prepare for airplane landing and notify pilot when ready.

EMERGENCY RELEASE OF TOW TARGET.

PILOT AND REEL OPERATOR. In an emergency, move cable-cutter switch to ON.

Note

> To properly sever a cable, the cable holder lever should be at HOLD before cable-cutter switch is actuated.

The reel operator is also provided with manual cable cutters, stowed on the left side of the package escape hatch, for use in case of failure of the explosive cable cutters.

BEFORE LEAVING AIRPLANE.

REEL OPERATOR. Check the following:

1. Cable return lever SLOW; clutch lever OUT; brake lever ON; cable holder lever HOLD.
2. Cable footage counter set at zero.
3. Pull circuit breakers (aft of equipment panel) out.
4. Check cable cutters to make certain that explosive charge and pellet are removed.

GENERAL OPERATING INSTRUCTIONS.

1. Exercise caution when cutting cable, releasing targets or messengers, etc, in flight, to avoid damage to personnel or property below.

WARNING

> The reel operator must wear safety harness and parachute whenever working with the streaming hatch open.

2. Tow cable should be free from oil to prevent the formation of an explosive mixture and to prevent spattering equipment when it is moving at high speed.

3. Proper caution should be observed while flying at low altitude to avoid fouling objects with the cable. The cable droop increases with reduction in speed, increase in cable length, increase in bank, or loss of target.

4. If part of the tow cable has been shot off during the exercise, the indication of the amount of cable in tow will, of course, be erroneous. The cable must be reeled in and the cable footage counter reset to "0" to show true subsequent readings.

WARNING

> Only one cable should be streamed at a time. If it is desired to use the alternate tow cable after the first cable has been streamed, the first cable must be completely reeled in or cut off to prevent fouling of the cables or airplane tail surfaces.

5. All loose equipment must be stowed in designated locations.

6. In view of the high speed of this airplane, targets of the closed breech type must remain in a bundle while traveling "down the cable" to result in a successful target exchange or a proper snarl catcher action.

IN-FLIGHT REFUELING TANKER PACKAGE.

Provisions for the installation of an in-flight refueling tanker package (figure 4-32), are incorporated in the airplane. These provisions include removable panels in the aft section of the bomb bay doors, electrical and hydraulic breakaway panels, hoisting provisions for the package, and the necessary controls. The entire refueling operation is accomplished by the controls at the third crewman's station. Fuel pressure, fuel quantity, and fuel flow indicators, as well as a footage indicator and ammeter are also located on the operator's control panel. Fuel transfer is possible from the normal airplane fuel supply to the tanker package, or from the tanker package to the airplane cross-feed system for operation of all three engines. A fuel dumping system is incorporated to dump remaining fuel overboard prior to landing, or in an emergency. The tanker package is inserted in the single-lug bomb shackle, after removing the bomb bay adapter, and connected to the electrical and hydraulic breakaway panels.

TANKER PACKAGE FUEL SYSTEM.

The fuel system of the in-flight refueling tanker package consists of a fuel tank, normal and emergency fuel pumps, fuel transfer and vent systems, hose reel assembly, drogue unit, and a fuel dumping system.

FUEL TANK. The in-flight refueling tank (figure 4-32) has a capacity of approximately 1300 gallons (7800 pounds) and is serviced through an access panel on the left side of the fuselage.

FUEL PUMPS. Under normal refueling operation, a submerged pump (figure 4-32) supplies fuel to the receiver airplane at the rate of 200 gallons per minute, with a discharge pressure of 30 psi. In the event of normal pump failure, fuel transfer at the rate of 50 gallons per minute at a pressure of 5 psi is provided by an emergency pump. Both pumps supply fuel to a common supply line.

FUEL TRANSFER SYSTEM. A manually operated transfer valve, located aft of the third crewman's station (figure 4-35), is used to transfer fuel from the normal airplane fuel supply to the tanker package. A switch on the operator's control panel actuates a valve to transfer fuel from the tanker package to the airplane cross-feed system. Transfer from the airplane to the tanker package is by gravity and the fuel tank booster pumps; and transfer from the tanker package to the airplane supply is accomplished by the emergency pump.

HOSE REEL ASSEMBLY. The hose reel assembly consists of a hose reel, drogue, and drogue extension and retraction mechanism. (See figure 4-32.) The hose extends from the hose reel, around a large pulley mounted on the drogue extension and retraction assembly, to the drogue, which is seated in a fair-lead on the drogue extension and retraction assembly when in the retracted position. When the drogue extension and retraction assembly is lowered by a hydraulic actuator, the drogue is extended by the airplane slip stream. After the refueling mission is completed, power supplied to the fluid coupling rewinds the hose until the drogue is seated in the drogue extension and retraction assembly, which is then raised into the bomb bay. Fluid for the fluid coupling operation is circulated through a cooling unit attached to the drogue extension and retraction assembly.

FUEL DUMPING SYSTEM. Fuel, in excess of 100 gallons, remaining in the tanker package on completion of a refueling mission must be dumped overboard prior to carrier landing. Fuel may also be dumped in an emergency or in the event of an aborted mission. Dumping is accomplished by manually lowering the dumping tube (figure 4-32) into the slip stream, when the bomb bay doors are open, by means of the hand crank on the forward end of the tanker package. The dumping tube lowers through an arc of 105 degrees, with automatic dumping action occurring during the last 15 degrees of travel. The maximum airspeed for fuel dumping is 237 knots.

TANKER PACKAGE ELECTRICAL SYSTEM.

Electrical energy for operation of the tanker package is supplied through the electrical breakaway panels from both the a-c and d-c power systems of the airplane. Electrical control of the tanker package is from the operator's control panel.

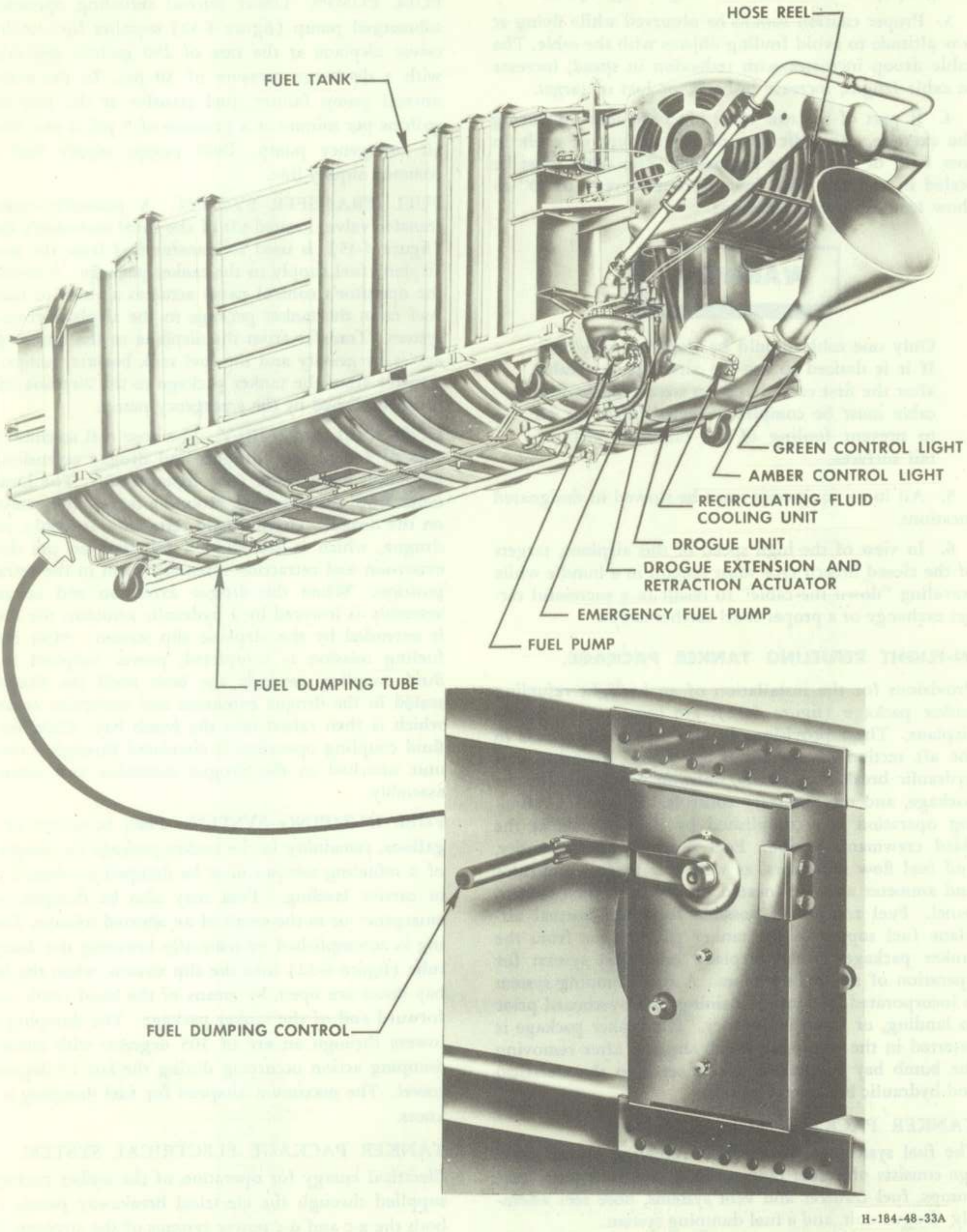


Figure 4-32. In-flight Refueling Tanker Package

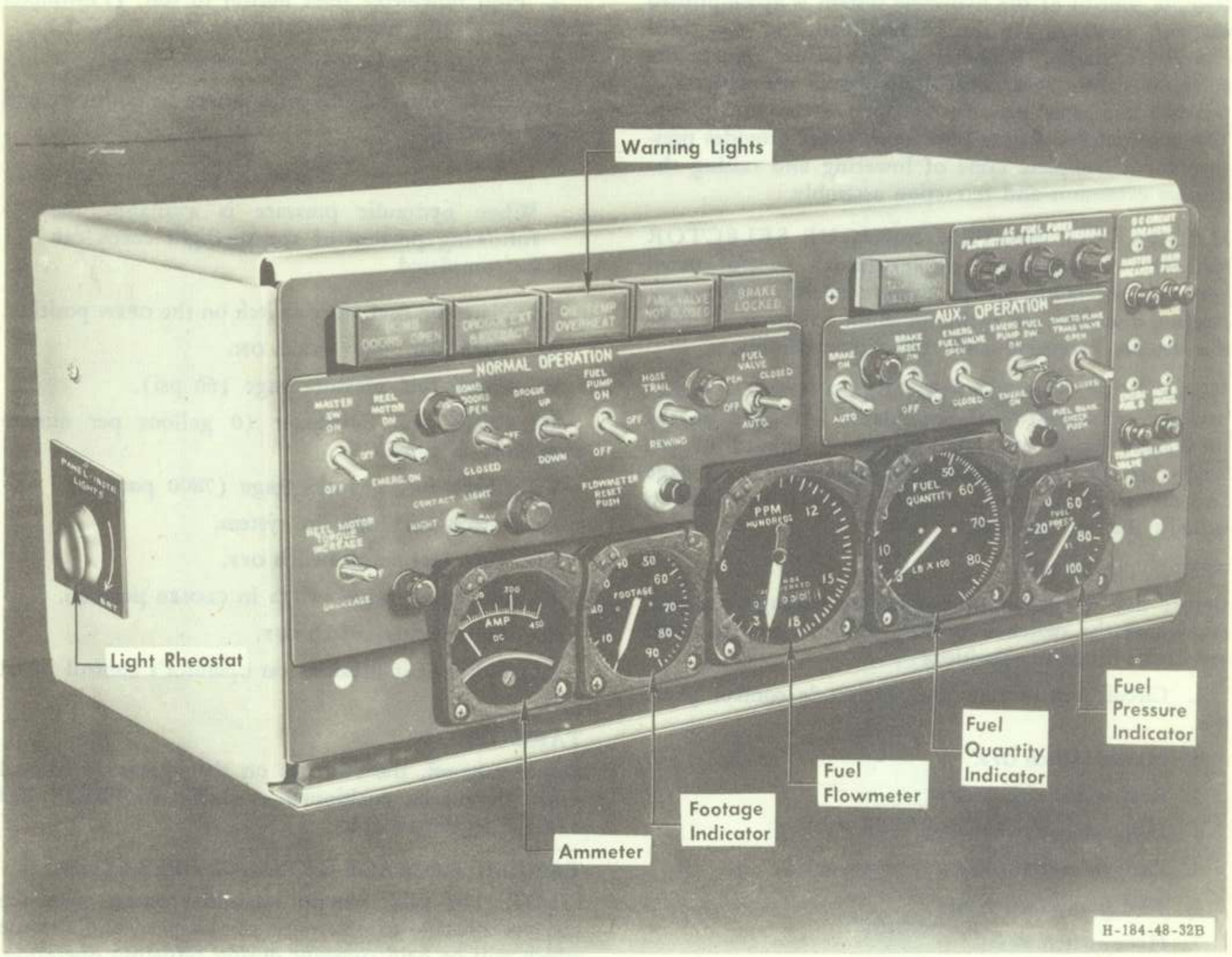


Figure 4-33. In-flight Refueling Operator's Control Panel

OPERATOR'S CONTROL PANEL. The operator's control panel (figure 4-33) is located at the third crewman's station, and incorporates an ammeter to measure the current supply to the electric motor on the fluid coupling, a footage indicator to record the extended length of hose, a fuel flow indicator to show fuel flow in the hose, and pounds of fuel transferred, a fuel quantity indicator to record quantity of fuel in the tank, and a fuel pressure indicator to show delivery pressure in the hose. Instrument panel lights, warning lights, a-c fuses, d-c circuit breakers, and switches for normal and emergency operation of the refueling system are also located on this panel.

ELECTRICAL SYSTEM BREAKAWAY PANELS.

There are two breakaway panels provided to permit the breakaway of the electrical connections to the tanker package if jettisoning of the package becomes necessary. One panel is combined with the hydraulic breakaway panel near the forward bulkhead of the bomb bay (figure 4-34), and the other is located in the aft section of the bomb bay.

TANKER PACKAGE HYDRAULIC SYSTEM.

The tanker package hydraulic units, with the exception of the drogue actuating cylinder and hydraulically driven fuel pump, are located on a breakaway panel which is mounted near the forward bulkhead of the bomb bay (figure 4-34). The units mounted on this panel are the drogue selector valve, a hydraulic shutoff valve, an accumulator, an accumulator dump valve and manual override buttons for the drogue extension and retraction mechanism.

WARNING

The manual override button on the drogue selector valve must be operated rapidly and positively to the extreme position desired to avoid losing accumulator pressure. When selecting drogue position UP or DOWN, hold override button at least 10 seconds to assure complete lowering or retracting.

Remote control of the hydraulic system is accomplished through switches on the control panel at the third crewman's station. Switches on this panel actuate the solenoid valves that control the boom assembly, and provide hydraulic pressure to operate the fuel pump. The accumulator on the breakaway panel provides pressure for a complete cycle of lowering and raising the drogue extension and retraction assembly.

HYDRAULIC SYSTEM DROGUE SELECTOR VALVE. A switch on the operator's control panel energizes solenoids on the drogue selector valve, controlling the flow of hydraulic fluid to lower or raise the drogue extension and retraction assembly.

HYDRAULIC SYSTEM ACCUMULATOR. The tanker package cylindrical-type accumulator is located on the breakaway panel near the forward bulkhead of the bomb bay. The accumulator is connected to an air gage and an air filling valve. A dump valve is provided to exhaust the accumulator.

PRIOR TO START.

Before any operation of the tanker package controls, make sure the switches on the operator's control panel are in the following positions:

1. Circuit breakers on the operator's control panel out.
2. Master switch OFF.
3. Reel motor switch OFF.
4. Bomb doors switch OFF.
5. Drogue switch OFF.
6. Fuel pump switch OFF.
7. Hose switch TRAIL.
8. Fuel valve switch OFF.
9. Brake switch AUTO.
10. Brake reset switch OFF.
11. Emergency fuel valve switch CLOSED.
12. Emergency fuel pump switch OFF.
13. Tank-to-plane transfer valve switch CLOSED.
14. Reel motor torque OFF.

TANKER PACKAGE PREFLIGHT CHECK.

Make certain all switches on the operator's panel are in the PRIOR TO START position before performing the preflight check, then proceed as follows:

1. Circuit breakers on operator's control panel in.
2. Turn master switch ON.
3. Check instrument and panel lights by turning panel light rheostat from OFF to BRIGHT.
4. Check bomb doors switch in OFF position.
5. Be sure drogue switch is in OFF position.
6. See that fuel valve not closed light is not illuminated.
7. Push flowmeter reset button to test. (Flowmeter indicator should return to zero.)
8. Push fuel quantity check button to test.
9. Check contact lights with switch in both DAY and NIGHT positions.

Note

When hydraulic pressure is available, the following portion of the preflight check can be completed.

10. Place the fuel valve switch on the OPEN position.
11. Turn fuel pump switch ON.
12. Check fuel pressure gage (60 psi).
13. Check fuel flowmeter (0 gallons per minute after hose is filled).
14. Check fuel quantity gage (7800 pounds).
15. Check for leaks in system.
16. Turn fuel pump switch OFF.
17. Place fuel valve switch in CLOSED position.
18. Turn master switch OFF.
19. Pull circuit breakers on operator's control panel out.

TAKE-OFF.

Before take-off, the switches on the operator's control panel should be positioned as shown in PRIOR TO START, in this section.

TANKER PACKAGE NORMAL OPERATION.

PILOT. The pilot should establish contact with the receiver airplane to determine the airspeed and altitude which will be held constant during refueling operation. Then notify refueling operator to begin operation.

Note

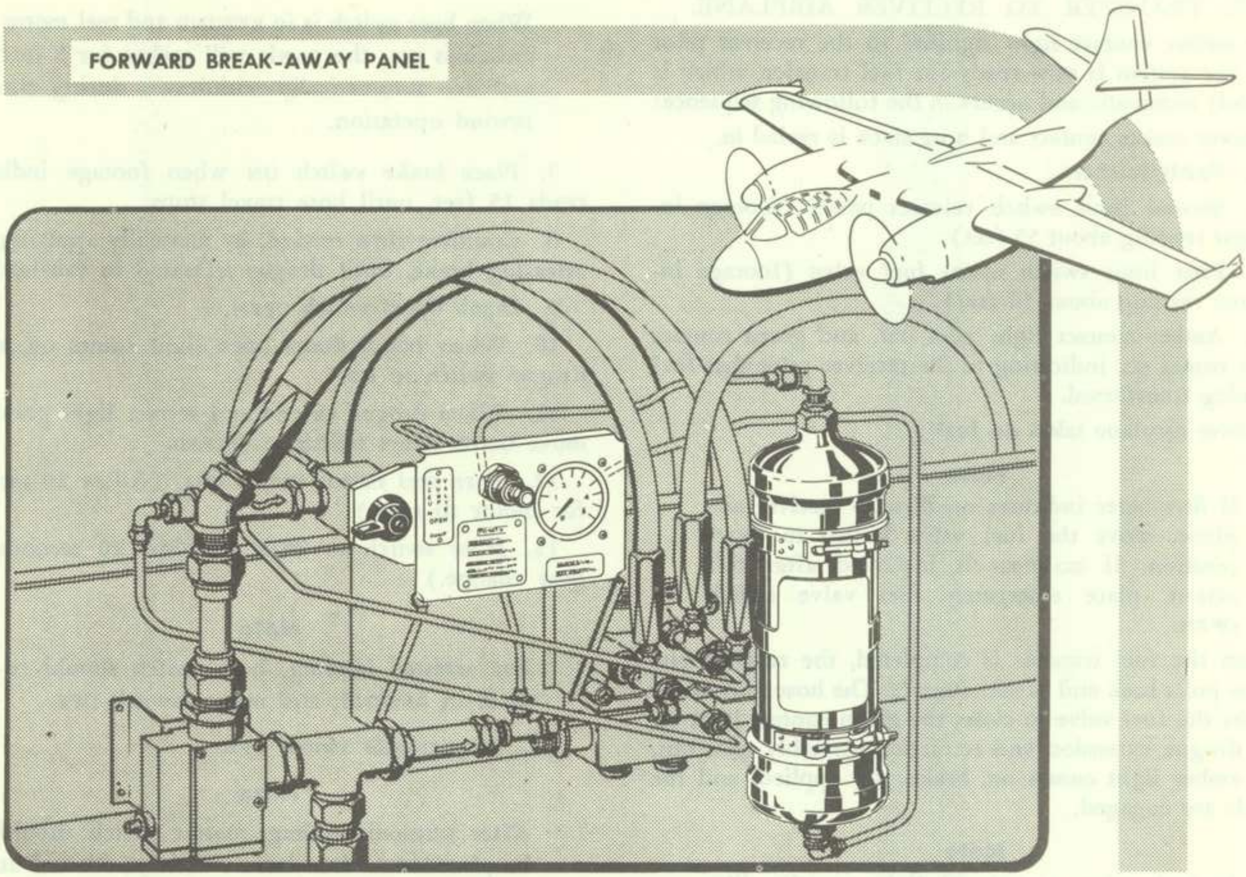
Airspeed should be limited to 230 knots during normal drogue operation, or 150 knots during emergency operation.

REFUELING OPERATOR. Make certain that all switches are in the PRIOR TO START positions, then when the pilot signals readiness for operation, proceed as follows:

1. Circuit breakers in.
2. Turn master switch ON. (Panel lights should be on.)
3. Place reel motor switch ON. (Contact light will come on; color will be determined by position of the fuel valve.)

Note

Allow reel motor to operate for 2 minutes to warm up fluid for operation of fluid coupling. The hose switch should be in the TRAIL position during this warm-up period.



H-184-48-35

Figure 4-34. In-flight Refueling Tanker Breakaway Panel

4. Push fuel quantity check button to check fuel quantity.

5. Push flowmeter reset button to reset totalizer.

6. Move bomb doors switch to OPEN. (Bomb doors open light will illuminate when doors are fully open.)

Note

Bomb shackle interlock circuit breaker must be in before light will illuminate.

7. Fuel valve switch to AUTO.

8. Place drogue switch in DOWN position. (Drogue extend and retract light will stay on until drogue is locked down. The fuel valve opens, and green contact light on the drogue extension and retraction assembly comes on.)

9. When drogue extend and retract light goes out, move bomb doors switch to CLOSED position.

10. Fuel pump switch ON. (If no fuel pressure is indicated, turn emergency fuel pump switch ON.)

Note

Cabin compressor must be OFF to obtain maximum hydraulic pump efficiency.

11. Reel motor switch OFF. (Hose begins to trail. Speed of unwinding is governed automatically by intermittent application of the brake.) (Green contact light goes out when reel motor switch is turned OFF.)

Note

As the hose approaches full extension, two limit switches are actuated. The first limit switch closes the fuel valve, which will cause the amber light to be illuminated when the reel motor switch is turned ON. The second limit switch applies brake, and after a 5-second delay, pawls are engaged, and the brake is released. Footage indicator should show position between 60- to 65-foot trail position.

12. Reel motor switch ON.

13. Reel motor torque switch INCREASE or DECREASE according to airspeed.

FUEL TRANSFER TO RECEIVER AIRPLANE.

The amber contact light signifies to the receiver pilot that the system is now ready for fuel transfer, which is entirely automatic and occurs in the following sequence:

Receiver makes contact and hose slack is reeled in.

1. Pawls ratchet.
2. Second limit switch releases pawls (footage indicator reading about 55 feet).
3. First limit switch opens fuel valve (footage indicator reading about 50 feet).
4. Amber contact light goes out, and green contact light comes on, indicating to the receiver pilot that fuel is being transferred.

Receiver airplane takes on fuel.

Note

> If flowmeter indicates no flow to receiver airplane, move the fuel valve switch to OPEN position. If no flow is indicated after this action, place emergency fuel valve switch OPEN.

When the fuel transfer is completed, the receiver airplane pulls back and breaks contact. The hose movement causes the fuel valve to close, the green contact light on the drogue extension and retraction assembly goes out, the amber light comes on, brakes are applied, and the pawls are engaged.

Note

> If fuel valve not closed light remains illuminated, make sure the emergency fuel valve switch is CLOSED, and actuate the main fuel valve switch to CLOSED. If light still remains illuminated, turn fuel pump switch OFF, and perform any additional refueling transfer by turning switch ON and OFF as needed.

REWIND AND SECURE. The rewind and secure procedure is accomplished by the refueling operator as follows:

1. If hose is not at full trail position, place brake switch ON. If hose is at full trail position, leave brake switch in AUTO.
2. Turn reel motor switch OFF.
3. Turn fuel pump switch OFF.
4. Turn fuel valve switch to CLOSED. Allow 3 seconds for valve actuation, then position the switch OFF.
5. Place hose switch in REWIND position, but not sooner than 20 seconds after switching reel motor to OFF.

Note

> Allow 20 seconds for gear change. If brake switch is ON, after this 20 second delay, position the brake switch to AUTO. With hose switch in REWIND position, and reel motor switch OFF, the brakes are automatically applied.

6. Turn reel motor switch ON.

Note

> When hose switch is in REWIND and reel motor switch is ON, the pawls will rachet for 5 feet and are automatically withdrawn during the rewind operation.

7. Place brake switch ON when footage indicator reads 15 feet, until hose travel stops.
8. Continue slow rewind, by manually applying and releasing brake, until drogue is seated in fair-lead.
9. Bomb doors switch OPEN.
10. When bomb doors open light comes on, move drogue switch to UP.
11. When drogue extend and retract light goes out, move bomb doors switch to CLOSED.
12. Turn reel motor switch OFF. (Allow 20 seconds for motor to stop.)
13. Hose switch to TRAIL. (Allow 20 seconds for gear change.)

Note

> For arrested landing, hose switch should remain in REWIND; and master switch OFF.

14. Turn master switch OFF.

Note

> After arrested landing, master switch should be placed ON, then hose switch positioned at TRAIL, and after 20 seconds master switch returned to OFF.

15. Place all switches in the PRIOR TO START position. (Refer to PRIOR TO START, in this section.)

TANKER PACKAGE FUEL TRANSFER OPERATION.

TRANSFER FUEL FROM TANKER PACKAGE TO AIRPLANE CROSS-FEED SYSTEM. Transfer of fuel for operation of all three engines at Military Power is accomplished as follows:

PILOT. The pilot should:

1. Turn cross-feed valve to OPEN. Notify refueling operator to complete transfer.
2. When transfer is completed, turn cross-feed valve to CLOSED position.

REFUELING OPERATOR. When pilot signifies readiness for fuel transfer:

1. Push emergency fuel and transfer valve, also instrument and panel lights circuit breakers on operator's control panel in.
2. Turn master switch ON.
3. Turn emergency fuel pump switch ON.
4. Move tank-to-plane transfer valve switch to OPEN.
5. Notify pilot when transfer is completed.

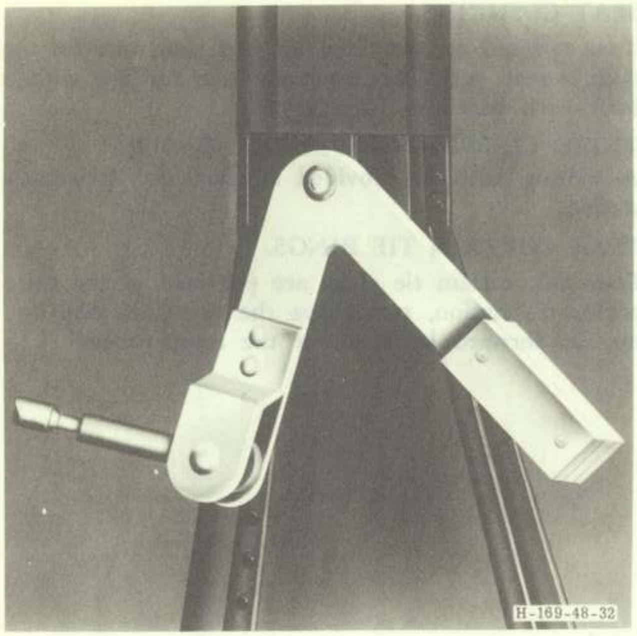


Figure 4-35. In-flight Refueling Transfer Control

6. Move tank-to-plane transfer valve switch to CLOSED.

7. Turn emergency fuel pump switch OFF.

8. Turn master switch OFF.

9. Pull circuit breakers out.

TRANSFER FUEL FROM NORMAL AIRPLANE SUPPLY TO TANKER PACKAGE. Transfer is accomplished as follows:

PILOT. The pilot should:

1. Turn cross-feed valve to OPEN, keep fuel boost pumps operating.

2. Notify refueling operator to complete transfer.

3. When transfer is completed, turn cross-feed valve to CLOSED position.

REFUELING OPERATOR. When pilot signifies readiness for transfer:

1. Pull manual transfer valve handle (figure 4-35) OPEN until transfer is completed.

2. When transfer is completed, push handle to close valve.

Note

> The emergency fuel and transfer valve circuit breaker and master switch must be ON before indicator light on operator's control panel will illuminate.

3. Notify pilot when transfer is completed.

MISCELLANEOUS EQUIPMENT.

BARRIER CRASH GUARD.

A barrier crash guard is mounted on the nose of the airplane, just forward of the windshield.

BARRIER ACTUATING STRAP GUARD.

A barrier actuating strap guard is installed on the nose gear to prevent damage to the gear during barrier crash landing.

BOMB BAY DOOR GROUND LOCKPINS.

Bomb bay doors can be locked in the half-open or fully open position when the airplane is on the ground. At the middle of the hinge point of each bomb bay door, a lockpin is secured by means of a chain and spring clip. A blade at the end of each lockpin can be used to pry out one of two circular skin plugs located in the upper part of each bomb bay door, and the pin can be inserted in the correct safety lock (one for the half-open and one for the fully open position). Whenever bomb bay doors are to be left open while on the ground, the lockpins must be installed.

BOMB BAY WORK PLATFORMS.

A bomb bay work platform is provided to facilitate work in the bomb bay while the airplane is on the ground. It should not be carried aloft, as it may become detached under negative G.

CREW ENTRANCE LADDER.

A ladder for crew entrance is stowed on the right side of the tunnel in the crew entry compartment.

CHECK LISTS.

A take-off check list is located on the right top section of the instrument panel. A landing check list is located on the left top section of the instrument panel. (See figure 2-4.)

DATA CASE.

A data case (16, figure 4-18) is provided forward and to the right of the bomber-navigator's station.

SUNSHADES.

Two sunshades, mounted on roller assemblies, are located on the canopy directly above the pilot's and bomber-navigator's seats.

REARVIEW MIRRORS.

Two rearview mirrors are attached to the top of the windshield bow.

ASH TRAYS.

Three ash trays are provided, one adjacent to each crew member's station. (See 21, figure 1-6; 14, figure 4-18; 6, figure 4-23.)

HEATED-CLOTHING OUTLETS.

Each crew station is provided with an outlet for heated clothing.

RELIEF TUBES.

A relief tube is located under each seat. (See 20, figure 1-6 and 12, figure 4-23.)

WATER CANTEEN.

A water canteen is located on the forward side of the bulkhead aft of the pilot.

ARMRESTS.

The armrests on the pilot's seat are movable and can be stowed when they are pulled up and aft. A fixed armrest (2, figure 4-18) is provided on the right side of the bomber-navigator's seat.

HEADRESTS.

Headrests are provided on the seats for the pilot and bomber-navigator. When the back of the bomber-navigator's seat is lowered, the headrest folds down so that it will not interfere with exit from the compartment.

SEAT CUSHIONS.

Two cushions are provided for each seat, one for use with a seat pack parachute and one for use with a back pack parachute.

THIRD CREWMAN'S WRITING TABLE.

A writing table is provided at the third crewman's station.

FLAK CURTAIN TIE RINGS.

Four flak curtain tie rings are provided at the third crewman's station, two above the seat back and two on the forward bulkhead of the compartment.

SECTION V

Operating Limitations

THE FOLLOWING LIMITATIONS AND RESTRICTIONS ARE SUBJECT TO CHANGE; THEREFORE, LATEST SERVICE DIRECTIVES AND ORDERS MUST BE CONSULTED.

INTRODUCTION.

Operating limits shown as instrument markings are illustrated in figure 5-1. These limits are also presented in tabular form in the patagraphs that follow, together with discussions of all operating limitations and restrictions that do not appear as instrument markings.

MINIMUM CREW REQUIREMENTS.

The minimum crew required to fly the airplane on non-tactical flights consists of the pilot and the bomber-navigator. Depending on the mission to be accomplished, an additional crew member is carried. The third crew member is either the radio operator, the tow-target operator, or the in-flight refueling operator.

RECIPROCATING-ENGINE LIMITATIONS.

The reciprocating-engine limitations are tabulated below:

Oil Pressure	
minimum idling	25 psi
minimum	50 psi
operating range	50-110 psi
maximum	110 psi
Fuel Pressure	
minimum idling	14 psi
minimum	21 psi
operating range	21-23 psi
maximum	23 psi
Manifold Pressure	
minimum	varies with atmospheric conditions
operating range	Refer to RECOMMENDED MANIFOLD PRESSURES in this section.
maximum: take-off (5 minute limit)	
RICH mixture	61 in. Hg* RICH mixture
maximum: Military Power	
normal mixture	60 in. Hg* normal mixture
RPM	
minimum idling	600
operating range	See charts in Appendix I.
maximum cruise	2300
maximum: Military and Take-off Power	2800
Cylinder Head Temperature	
operating range	150°C-212°C
maximum: continuous operating	212°C
maximum: Military and Take-off Power	240°C
Carburetor Air Temperature	
minimum	5°C
operating range	8°C-30°C
maximum	38°C
Oil Temperature	
minimum	30°C
operating range	60°C-80°C
maximum	100°C

*Torque pressure 199 psi

MAXIMUM OVERSPEED.

The maximum permissible overspeed of the R-2800 reciprocating engines is 3120 rpm for 30 seconds duration. Any overspeed between 3100 and 3350 rpm will require that the engine be inspected. An overspeed exceeding 3350 rpm requires removal of the engine.

RECOMMENDED MANIFOLD PRESSURES.

In order to operate the reciprocating engines on the recommended schedule the following manifold pressures should not be exceeded for the corresponding rpm values given.

RECOMMENDED MANIFOLD PRESSURES
NORMAL MIXTURE

IN. HG	RPM	TORQUE PRESSURE (PSI)	BHP
60.0*	2800	199	2300
47.5	2600	168	1800
40.5	2500	158	1630
38.0	2400	147	1460
35.5	2300	136	1280
34.0	2200	130	1173
34.5	2100	130	1120
34.5	2000	130	1065
35.0	1900	130	1010
35.5	1800	130	955
35.5	1700	130	900
35.5	1600	130	850

***61 in. Hg at 2800 rpm RICH mixture for 5 minutes. (Take-off Power)**

MAXIMUM CRUISE RPM.

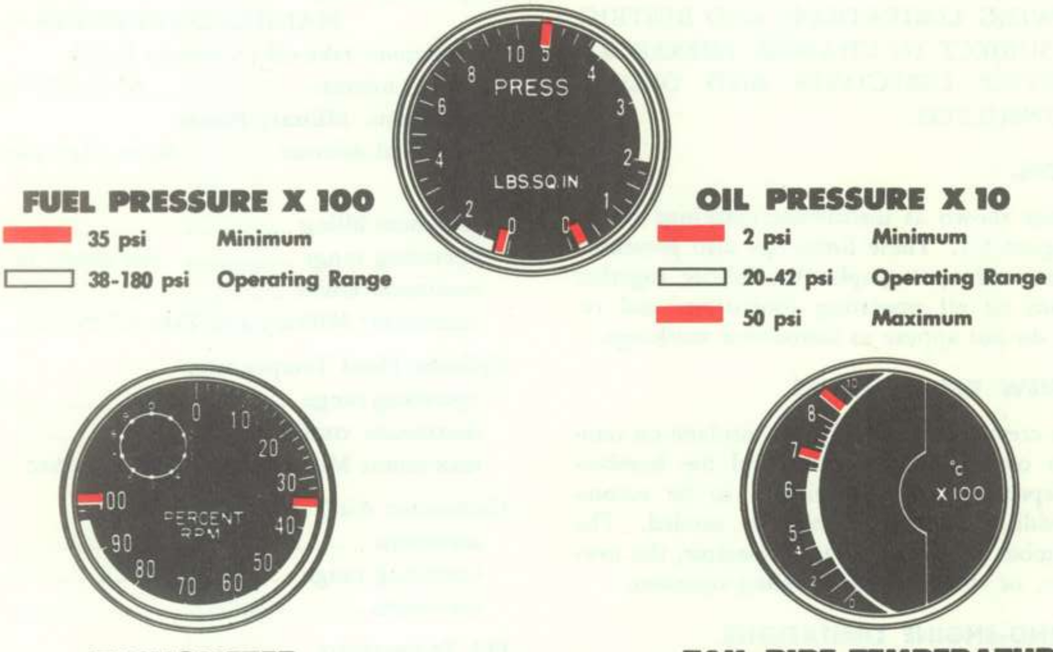
The maximum cruise rpm is 2300. This limit is set to prevent uneconomical use of fuel and results from the characteristics of the carburetor. In the range of 1700 to 2300 rpm, the fuel-air ratio remains relatively constant for the included cruise power settings. At power settings where the rpm value is increased above 2300 rpm, fuel economy drops rapidly because of automatic enrichening of the fuel-air mixture.

IDLE LIMITATIONS.

A minimum of 600 rpm is required for satisfactory idling operation of the reciprocating engines. However, operation below 1000 rpm for extended periods of time will cause carbon deposits to form on the spark plugs

J33-A-10 ENGINE

POWER LIMITS BASED ON FUEL GRADE 115/145



FUEL PRESSURE X 100

🟥	35 psi	Minimum
☐	38-180 psi	Operating Range

OIL PRESSURE X 10

🟥	2 psi	Minimum
☐	20-42 psi	Operating Range
🟥	50 psi	Maximum

TACHOMETER

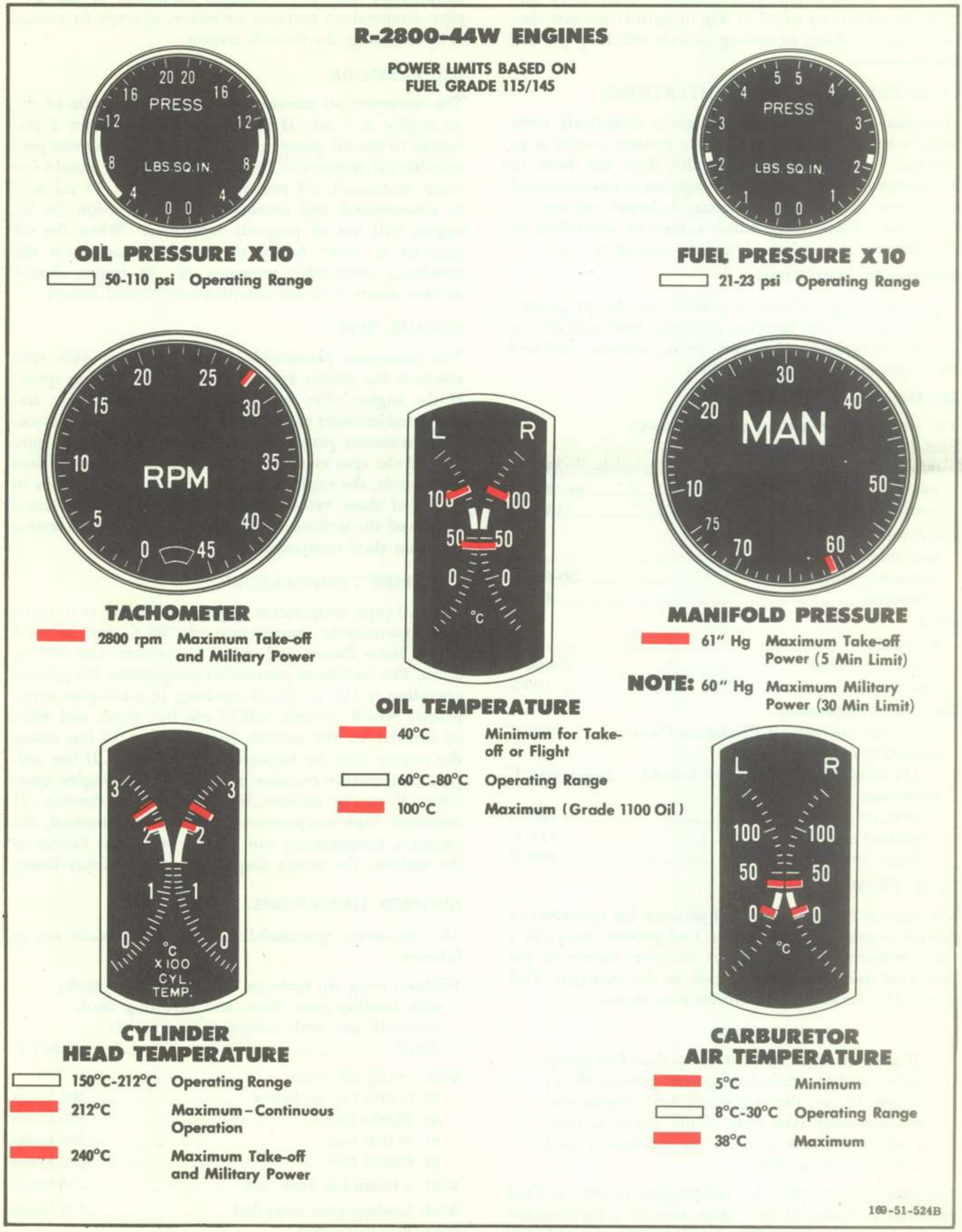
🟥	34% rpm	Minimum
☐	34%-96% rpm	Operating Range
🟥	100% rpm	Maximum

TAIL-PIPE TEMPERATURE

☐	300°C-654°C	Operating Range for Normal Rated Power and Below
🟥	700°C	Maximum Take-off and Military Power
🟥	900°C	Maximum—Start or Acceleration

169-51-525B

Figure 5-1. Instrument Markings (Sheet 1 of 2)



R-2800-44W ENGINES

POWER LIMITS BASED ON FUEL GRADE 115/145

OIL PRESSURE X 10

⬜ **50-110 psi** **Operating Range**

FUEL PRESSURE X10

⬜ **21-23 psi** **Operating Range**

TACHOMETER

🟥 **2800 rpm** **Maximum Take-off and Military Power**

MANIFOLD PRESSURE

🟥 **61" Hg** **Maximum Take-off Power (5 Min Limit)**

NOTE: 60" Hg **Maximum Military Power (30 Min Limit)**

OIL TEMPERATURE

🟥 **40°C** **Minimum for Take-off or Flight**

⬜ **60°C-80°C** **Operating Range**

🟥 **100°C** **Maximum (Grade 1100 Oil)**

CYLINDER HEAD TEMPERATURE

⬜ **150°C-212°C** **Operating Range**

🟥 **212°C** **Maximum-Continuous Operation**

🟥 **240°C** **Maximum Take-off and Military Power**

CARBURETOR AIR TEMPERATURE

🟥 **5°C** **Minimum**

⬜ **8°C-30°C** **Operating Range**

🟥 **38°C** **Maximum**

Figure 5-1. Instrument Markings (Sheet 2 of 2) and thus reduce engine performance. Occasionally running the engine up to 30 in. Hg in normal mixture during extended idling or taxiing periods will help prevent this condition.

TURBOSUPERCHARGER LIMITATIONS.

Operation of the turbosupercharger is completely automatic when the turbosupercharger control switch is in NORMAL. Consequently, the pilot does not have to be concerned with the limits of operation under normal conditions. If the turbosupercharger should malfunction and cause a boost surge which cannot be controlled by the throttle, the switch should be moved to OFF.

PROPELLER LIMITATIONS.

To prevent high vibration stresses on the propellers, avoid engine speeds between 1400 and 1800 rpm during ground operations and engine speeds between 1400 and 1600 rpm during flight operations.

JET-ENGINE LIMITATIONS.

The jet-engine limitations are as follows:

Fuel Pressure	
minimum	35 psi
operating range	38-180 psi
maximum	180 psi
Oil Pressure	
minimum	2 psi
operating range	20-42 psi
maximum	50 psi
RPM	
minimum	34%
operating range	34-96%
maximum	100%
Tail-pipe Temperature	
minimum for take-off (Standard Day)	695°C
operating range (Normal Rated Power and below)	300°C-654°C
maximum	
start or acceleration	900°C
ground operation	715°C
flight operation	700°C

FUEL PRESSURE.

The minimum permissible fuel pressure for operation of the jet engine is 35 psi. When fuel pressure drops to a value below 35 psi it indicates complete failure of the dual fuel pump or a severe leak in the jet-engine fuel lines. The jet engine should be shut down.

Note

> If only the main element of the dual fuel pump fails, or if the main fuel system pressure drops below 65 psi, the emergency fuel system will automatically take over. This action is indicated by illumination of the emergency fuel system warning light.

The maximum permissible fuel pressure is 180 psi. Fuel pressures in excess of this value indicate a malfunction of the by-pass valves. When this occurs the tail-pipe temperature should be watched carefully. If the tail-pipe temperature becomes excessive, attempt to reduce it by adjusting the throttle setting.

OIL PRESSURE.

The minimum oil pressure for proper lubrication of the jet engine is 2 psi. If the pressure drops below 2 psi, failure of the oil pump is indicated. The maximum permissible oil pressure is 50 psi. If an oil line should become obstructed, oil pressures in excess of 50 psi may be encountered, and because of the obstruction the jet engine will not be properly lubricated. When the oil pressure is either below the minimum or above the maximum permissible pressures, the jet engine should be shut down to avoid complete mechanical failure.

ENGINE RPM.

The minimum permissible engine speed is 34% rpm which is the proper approximate sea level idling speed. If the engine idles considerably below this value, improper adjustment of the fuel control system is indicated. The maximum permissible engine speed is 100% rpm. Should the rpm ever exceed 101.5% rpm for more than 30 seconds, the engine should be overhauled. Speeds in excess of these values can lead to, or cause, structural failure of the turbine or compressor because of excessive stress on these components.

TAIL-PIPE TEMPERATURE.

The tail-pipe temperature gage is red-lined at a maximum permissible temperature of 700°C for Take-off and Military Power, and at 900°C for starts and acceleration. The maximum permissible temperature for ground operation is 715°C. Starts resulting in a tail-pipe temperature which exceeds 900°C are hot starts and must be entered on the aircraft forms. After 10 hot starts, the engine must be inspected before flight. If the tail-pipe temperature becomes excessive during engine operation, it can be reduced by retarding the throttle. If sustained high temperature operation is permitted, the excessive temperatures can lead to structural failure of the turbine, the nozzle diaphragms, or the inner liners.

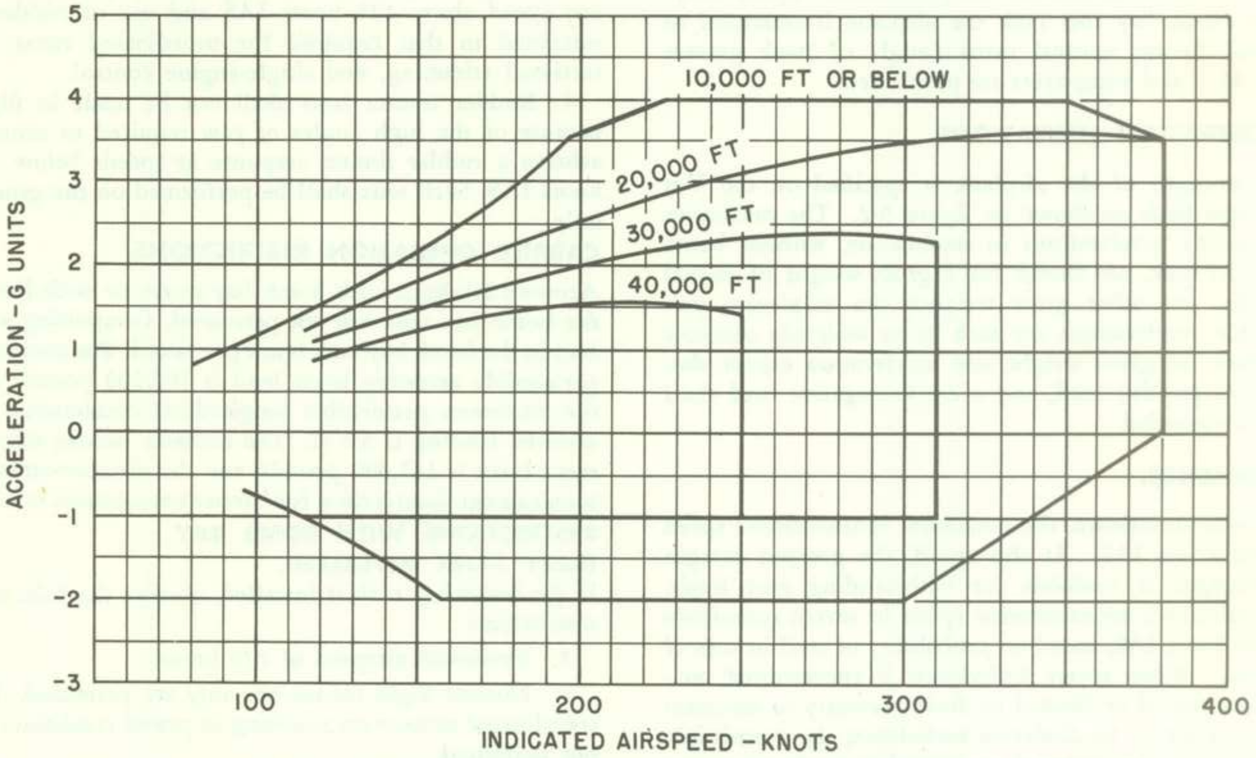
AIRSPEED LIMITATIONS.

The maximum permissible indicated airspeeds are as follows:

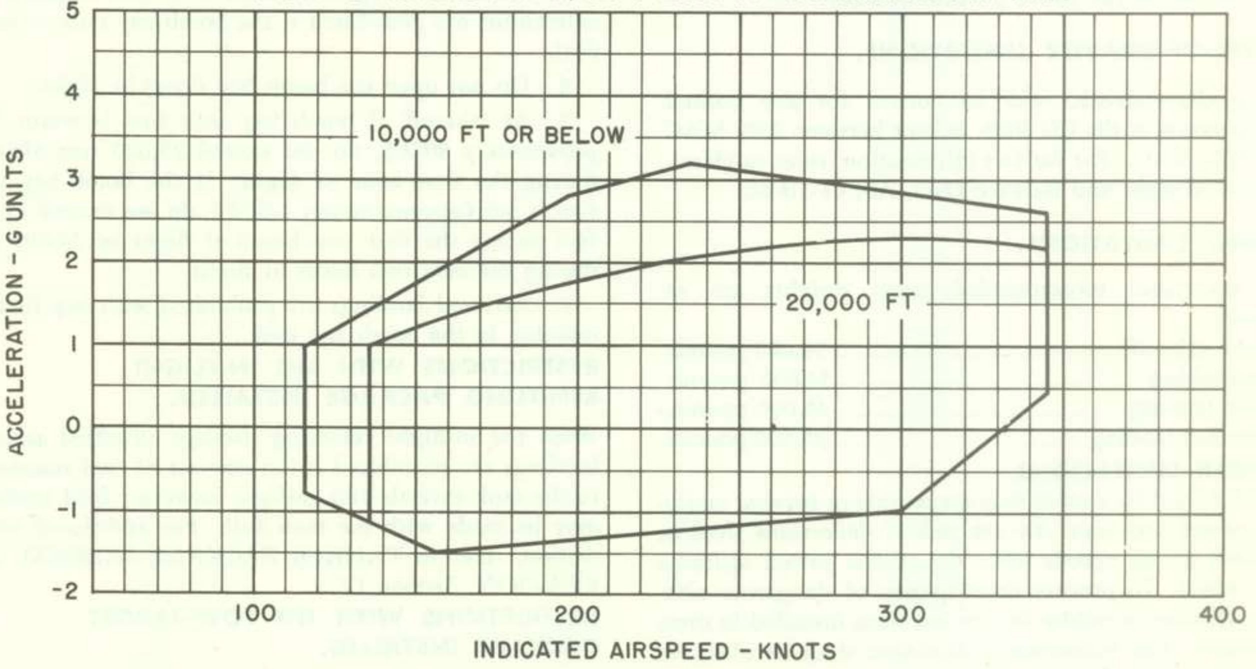
Without wing tip tanks or a bomb bay fuel tank; with landing gear, flaps, and arresting hook retracted; and with canopy sliding panels closed	See figure 5-2.
With wing tip tanks:	
At 17,000 feet or below	380 knots
At 20,000 feet	360 knots
At 30,000 feet	300 knots
At 40,000 feet	240 knots
With a bomb bay fuel tank	270 knots
With landing gear extended	175 knots
With flaps extended	
Service Change 289 incorporated	175 knots
Service Change 289 not incorporated	130 knots

OPERATING FLIGHT STRENGTH DIAGRAM

**GROSS WEIGHT
48,000 LB OR LESS**



FOR SYMMETRICAL FLIGHT IN SMOOTH AIR



FOR SYMMETRICAL FLIGHT IN MODERATE TURBULENCE

H-169-93-6

Figure 5-2. Operating Flight Strength Diagram

With arresting hook extended	175 knots
With canopy sliding panels open	175 knots

PROHIBITED MANEUVERS.

When carrying fuel in the wing tip tanks, large or abrupt aileron deflections are prohibited. When carrying a bomb bay fuel tank the airplane is restricted to normal flying; vertical turns (angle of bank greater than 45°) and wing-overs are prohibited.

ACCELERATION LIMITATIONS.

The strength of the airplane is specified on the V-n envelope basis as shown in figure 5-2. The maximum permissible accelerations in smooth air, without bomb bay fuel tank, are shown for a gross weight of 48,000 pounds. At other gross weights, the maximum permissible accelerations are such as to maintain constant products of gross weight and acceleration except that a 6.0 G positive load, and a 2.0 G negative load shall not be exceeded.

TURBULENCE.

In severe turbulence, the maximum recommended speed is 250 knots IAS. At this speed, the greatest margin of strength is available for withstanding gust loads. The minimum recommended speed in severe turbulence is 140 knots IAS, based on probability of stall or loss of control. When severe turbulence is encountered, maneuvers should be limited to those necessary to maintain a safe attitude. In moderate turbulence, the permissible speeds and pilot imposed maneuvering accelerations are those shown in the lower portion of figure 5-2.

CENTER-OF-GRAVITY LIMITATIONS.

Flying characteristics will be normal for any normal configuration if the CG limit is kept between 23% MAC and 26% MAC. For further information, refer to Handbook of Weight and Balance Data, AN 01-1B-40.

WEIGHT LIMITATIONS.

The maximum recommended gross weights are as follows:

Field take-off	54,000 pounds
Catapulting	54,000 pounds
Field landing	45,000 pounds
Arrested landing	35,500 pounds

RUDDER LIMITATIONS.

Rudder shall be used during maneuvers to prevent attaining yawed attitudes. Abrupt rudder deflections shall be avoided at all speeds since dangerous yawed attitudes may result. To prevent development of dangerous sideslip attitudes, a rudder limiter has been installed in these airplanes. The following instructions shall be observed relative to this device:

1. The rudder limiting control switch shall be kept in the NORMAL position except during take-off and landing.

2. During take-off and landing, the rudder limiting control switch shall be kept in the OFF position to avoid the possibility of lack of rudder control in case of malfunction of the rudder limiting system.

3. With the rudder limiter inoperative (limiter control switch OFF or emergency boost operating), intentional yawing and side slipping are prohibited at any speed above 125 knots IAS and use of rudder is restricted to that required for coordinated turns, directional trimming, and single-engine control.

4. Rudder limiter tests shall not be made in flight because of the high angles of yaw required to actually achieve a rudder limiter response at speeds below 140 knots IAS. Such tests shall be performed on the ground only.

CARRIER OPERATION RESTRICTIONS.

Arrested landings with bomb bay stores or with fuel in the bomb bay tank are not permitted. Catapulting with fuel in the bomb bay tank is not permitted. The maximum permissible arresting hook load is 106,500 pounds and the maximum permissible longitudinal deceleration for arrested landing is 3.3 G. The ultimate barrier engagement force is 142,000 pounds, and the ultimate-strength longitudinal deceleration for barrier engagement is 4.4 G.

RESTRICTIONS WITH BOMB BAY FERRY TANK INSTALLED.

If the bomb bay tank is installed, observe the following restrictions:

1. Maximum airspeed of 270 knots.

2. Normal flight maneuvers only are permitted. Uncoordinated maneuvers resulting in yawed conditions are not permitted.

3. Accelerations greater than 2 G and negative accelerations are prohibited if the bomb bay tank contains fuel.

4. Do not open the bomb bay doors in flight.

5. At take-off, if bomb bay tank fuel is warm (approximately 80°F), do not exceed 25,000 feet altitude during the first hour of flight. If the bomb bay tank fuel is hot (approximately 100°F), do not exceed 15,000 feet during the first two hours of flight or 20,000 feet during the next two hours of flight.

6. Arrested landings are prohibited with any fuel remaining in the bomb bay tank.

RESTRICTIONS WITH THE IN-FLIGHT REFUELING PACKAGE INSTALLED.

With the in-flight refueling package installed arrested landings are prohibited if the amount of fuel remaining in the tank exceeds 100 gallons; however, field landings may be made with the tank full. For additional information, refer to TANKER PACKAGE NORMAL OPERATION, Section IV.

RESTRICTIONS WITH THE TOW-TARGET PACKAGE INSTALLED.

The only restrictions imposed by installation of the tow-target package are those resulting from the strength limitations of the tow-reel assemblies and related equipment. For additional information, refer to TOW-TARGET NORMAL OPERATION, Section IV.

Flight Characteristics

SECTION VI

NOTE

Complete information on Flight Characteristics with the aerodynamically balanced elevator is not available at this publication. The data pertinent to this configuration will be supplied when available.

INTRODUCTION.

The outstanding features of the airplane are its speed, its range, and its low stalling speeds. Control forces are moderate for all flight conditions, and airplane response is adequate at all speeds. The flight control hydraulic boost system supplies boost assistance to all surface controls, reducing the amount of pilot effort required to move them. In the event of complete failure of the boost systems, sufficient mechanical advantage in the elevator and aileron control systems permits normal operation of the surfaces with increased pilot effort. The rudder will require very high control forces. During level flight, take-off, and landing, the airplane should be kept in trim so that it will not be necessary to overcome excessive forces in case of sudden boost loss. The airplane should not be trimmed into high load-factor turns or pull-ups. If this is done, the air loads are no longer reflected as forces at the control wheel and the pilot can easily exceed the G-load limit without realizing it. Since the load factor varies with gross weight and airspeed, caution should be used in turns and pull-ups, so that the limit load factor for the particular flight condition is not exceeded.

STALL CHARACTERISTICS.

APPROACH TO STALL.

Stall warning in the form of light control buffeting starts at 3 to 7 knots above stall speed and increases in intensity during approach to the stall. Stall warning in the form of airframe buffet is not adequate for power approach landings; therefore, a "stick shaker" is provided to warn of impending stall. (For stall speeds, see figure 6-1.)

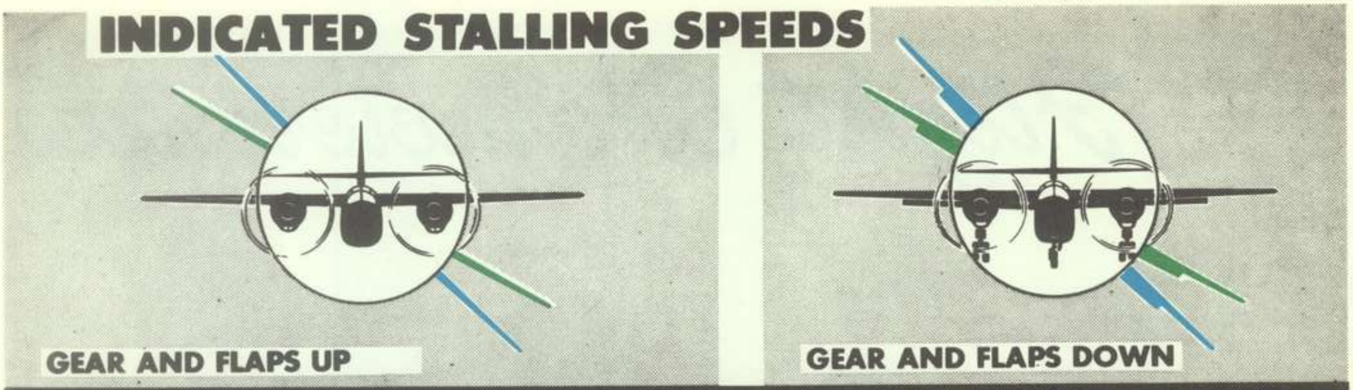
AT THE STALL — POWER OFF.

With power off, flaps and gear up or down, the airplane stalls with a straight-ahead, nose-down pitch and has no tendency to roll or yaw. Relaxing back pressure on the control wheel will result in an immediate recovery.

AT THE STALL — POWER ON.

With power on, extreme nose-high attitudes are reached before the stall. At a cruise power of 2350 rpm and 34 in. Hg, the left wing drops slowly as the nose pitches down in the stall. The left wing drop increases in abruptness as power is increased. With full Military Power, flaps and gear down, the airplane rolls left abruptly, with a tendency to nose up. Aileron and rudder are ineffective against the left roll, but lateral control is regained when normal recovery action is taken. Down elevator must be applied to correct for high angle of attack and as airspeed picks up the ailerons become effective to correct for roll. Approximately 500 feet of altitude will be lost during stall recovery.

INDICATED STALLING SPEEDS



POWER-ON STALL SPEEDS—KNOTS IAS

GROSS WEIGHT—LB	NORMAL RATED			NORMAL RATED		
	LEVEL	30° BANK	45° BANK	LEVEL	30° BANK	45° BANK
55,000	105	116	134	87	97	112
50,000	97	109	126	80	91	105
45,000	90	100	117	74	83	97
40,000	79	90	107	66	75	89
35,000	69	80	96	58	67	80

POWER-OFF STALL SPEEDS—KNOTS IAS

GROSS WEIGHT—LB	WINDMILLING PROPELLERS			WINDMILLING PROPELLERS		
	LEVEL	30° BANK	45° BANK	LEVEL	30° BANK	45° BANK
55,000	124	133	148	105	112	125
50,000	118	127	141	99	107	119
45,000	112	120	133	95	102	112
40,000	105	113	125	89	96	106
35,000	99	106	117	84	90	99

169-93-1575A

Figure 6-1. Indicated Stalling Speeds

ACCELERATED STALLS.

Below 230 knots IAS it is possible to stall the airplane before reaching the limiting structural G. The approach to the stall will be indicated by considerable airframe buffet for stalls at the higher G's (3 to 4 G). At this point, the control wheel should be eased forward to prevent a stall. At speeds greater than 230 knots it will be possible to apply limiting structural G to the airplane before the stall is reached.

SPIN CHARACTERISTICS.

Intentional spins are prohibited. In case a spin is entered accidentally, normal recovery procedure is recommended. The procedure consists of retarding power to idle, applying full opposite rudder, and rapidly pushing the control wheel forward while holding the ailerons in the neutral position.

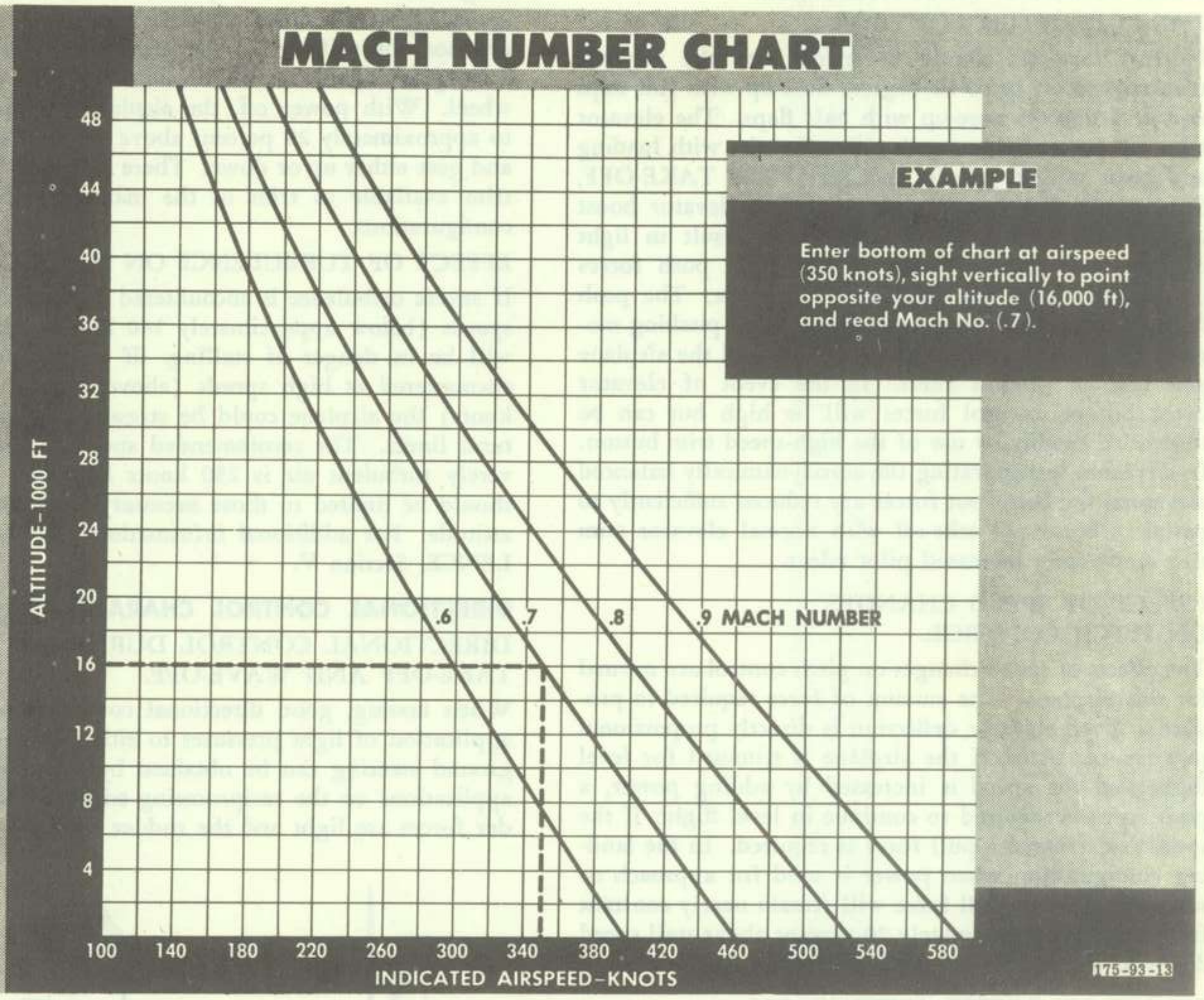
FLIGHT CONTROL CHARACTERISTICS.

Aileron, elevator, and rudder controls are very effective under all flight conditions as are the respective trim tabs. A two-speed elevator trim tab control is installed in some airplanes* for the purpose of enabling the pilot to quickly trim the airplane in pitch at any airspeed. (Refer to ELEVATOR TRIM, in this section.)

MANEUVERABILITY.

Hydraulic boost power to each control surface enables good maneuverability at all airspeeds with moderate pilot effort. The airplane can be easily controlled with one hand during a carrier approach and landing or during a wave-off. Best response for gaining altitude or for accelerating to high speed in level flight will be obtained at best climb speed. If airspeed is much below best climb speed, the excess power for climbing or accelerating to higher speed is low, and airplane response will be slower. If holding altitude is important, the highest operating speed should be maintained, as speed may then be traded for maneuverability to permit tight turning maneuvers or zoom climbs. The airspeed should not be allowed to fall below the best climb value or maneuverability will be decreased.

*Airplanes 124161 and 124181 only


MACH NUMBER CHART

EXAMPLE

Enter bottom of chart at airspeed (350 knots), sight vertically to point opposite your altitude (16,000 ft), and read Mach No. (.7).

Figure 6-2. Mach Number Chart

SPEED FOR BEST CLIMB.

Speeds for best rate of climb are presented in figures A-37 and A-38. You should become familiar with these charts and memorize the approximate best climb speed for each 10,000 feet altitude at combat gross weight. Speed for best climb is important as it represents the approximate speed at which you can get maximum level flight acceleration and turning performance and best rate of climb for altitude advantage.

TURNING PERFORMANCE.

The turning radius of an airplane varies with speed, altitude, and load factor (G). The minimum turning radius, which is most important in defensive maneuvering, is achieved in this airplane at approximately 210 knots IAS at any altitude and at maximum allowable load factor or stall buffet. If necessary, altitude should be sacrificed to maintain airspeed. However, the actual turning radius is not too sensitive to airspeed in this speed range, so a few knots variation in airspeed will not increase the turning radius appreciably. The *maximum rate of turn* of the airplane is obtained at the same conditions of speed, altitude, and load factor as the *minimum radius of turn.*

DIVING CHARACTERISTICS.

For the limits to be observed when diving the airplane, refer to ACCELERATION LIMITATIONS, in Section V. Near the limit dive speeds, (Mach number—approximately .78) the approach to the buffet zone may be noted as light variations in elevator force and by a gentle shuddering of the airplane. (For Mach number—airspeed conversion, see figure 6-2.) This provides you with a good warning of the safe limit for general operation. There is no instability caused by compressibility effects during dives. There is a gradual increase in push forces with increasing airspeed, but the control forces are not excessive. On airplanes with the aerodynamically balanced elevator, a dive above approximately 300 knots IAS will require a lightening in the push force, or a slowly increasing pull force (depending on the elevator trim tab setting) to maintain the dive attitude as speed increases. This change in stick force with increased speed is gradual and can be easily controlled by trimming.

PITCH CONTROL CHARACTERISTICS.

TAKE-OFF PITCH CONTROL.

Normal take-offs should be made with the elevator trim tabs set at 10 to 12 degrees nose-up with full flaps and at 5 degrees nose-up with half flaps. The elevator trim tab setting for catapult take-off varies with loading and gross weight. (Refer to CATAPULT TAKE-OFF, Section II.) For normal take-offs, with elevator boost on, the tab settings given above will result in light elevator pull forces at take-off and light push forces immediately after the airplane is air-borne. The push force is required to counteract the nose-up pitching moment that occurs as the speed increases and the airplane gets free of ground effect. In the event of elevator boost failure, control forces will be high but can be controlled readily by use of the high-speed trim button. In airplanes incorporating the aerodynamically balanced elevators, the boost out forces are reduced sufficiently to permit a boost out take-off with normal elevator trim and moderately increased pilot effort.

EFFECT OF SPEED CHANGES ON PITCH CONTROL.

The effects of speed changes on pitch control are normal for this airplane. The amount of force required to produce a given elevator deflection is directly proportional to airspeed. Also, if the airplane is trimmed for level flight and the speed is increased by adding power, a push force is required to continue in level flight; if the speed is decreased a pull force is required. In the landing configuration when power is used for approach or wave-off, elevator pull force will remain nearly constant from a speed approximately 20 percent above stall speed down to the stall.

EFFECT OF POWER SETTING ON LONGITUDINAL TRIM.

The effect of any possible combination of changes in power setting on longitudinal trim is slight, and in most cases will be practically unnoticed with flight control boost operating.

EFFECT OF FLAP AND GEAR POSITION ON LONGITUDINAL TRIM.

Nose-up trim is required as flaps are extended. The maximum trim change occurs at flap settings between one-half and full flaps. Gear extension causes no appreciable change in trim.

ELEVATOR TRIM.

The longitudinal trimming device on the airplane consists of two electrically actuated trim tabs, one on each elevator. On some airplanes* these trim tabs operate at two speed rates, high speed and normal speed. A switch button located on the control wheel controls high-speed rate and should be used to trim during low-speed flight, including take-offs and landings. A trim tab control stick on the left console controls normal speed rate and should be used when small changes in longitudinal trim are required, such as during high-speed flight. On other airplanes the elevator trim tabs are not controllable at the trim stick. Trimming is accomplished with the thumb slide switch on the control wheel. With power off, the airplane may be trimmed to approximately 20 percent above the stall speed, flaps and gear either up or down. There is enough nose-down trim available to trim to the maximum speed in all configurations.

EFFECT OF TURBULENCE ON PITCH CONTROL.

If severe turbulence is encountered during flight at low speeds (below approximately 140 knots), the airplane will be in danger of stalling. If severe turbulence is encountered at high speeds (above approximately 320 knots) the airplane could be stressed beyond its structural limits. The recommended speed for flight in severely turbulent air is 250 knots IAS, and maneuvers should be limited to those necessary to maintain a safe attitude. For additional information refer to TURBULENCE, Section V.

DIRECTIONAL CONTROL CHARACTERISTICS.

DIRECTIONAL CONTROL DURING TAKE-OFF AND WAVE-OFF.

When taxiing, good directional control is afforded by application of light pressures to either brake, and good ground steering can be obtained by asymmetric power applications on the reciprocating engines. Because rudder forces are light and the rudder becomes effective at

WARNING

At speeds below 115 knots, military power should not be applied to the operating engine, as this will cause the airplane to roll in the direction of the dead engine.

***Airplanes 124161 and 124181 only**

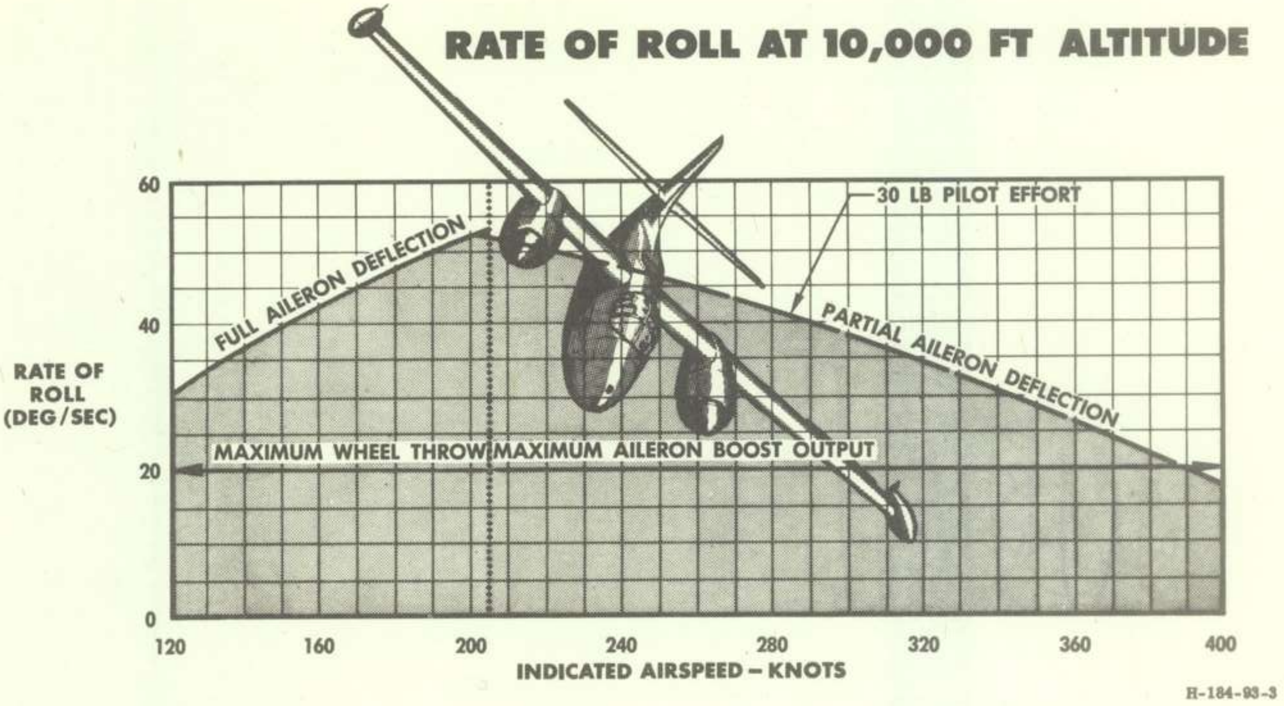


Figure 6-3. Rate-of-Roll Chart

low airspeed (approximately 50 knots), no difficulty will be experienced in controlling the airplane directionally during take-off and wave-off. Skids and sideslips should be held to a minimum.

DIRECTIONAL CONTROL WITH ONE RECIPROCATING ENGINE INOPERATIVE.

Flight with one reciprocating engine inoperative presents a control problem only in the event that the engine fails abruptly during take-off or wave-off with the flaps and gear down and with the propeller windmilling. At speeds below approximately 115 knots, yawed flight is unavoidable with Military Power on the operative engine.

RUDDER TRIM.

During level flight with power on one reciprocating engine, power off and the propeller feathered on the other reciprocating engine, and with the jet engine inoperative it will be necessary to apply rudder pedal force even after full rudder trim is used to maintain unyawed flight at speeds below approximately 140 knots. This will be true with flaps and gear in either the up or down position. If the jet engine is operating, it will be possible to trim out the yaw at speeds lower than 140 knots. Less power is required from the reciprocating engine when the jet is operating and thus the amount of unbalanced thrust is reduced. With both reciprocating engines operating, it is possible to trim to zero rudder force over the entire speed range of the airplane.

ROLL CONTROL CHARACTERISTICS.

ROLL CONTROL DURING TAKE-OFF AND WAVE-OFF.

During take-off and wave-off, aileron forces are very light and stable with boost operating. No difficulty should be experienced in keeping the wings level. With boost off, these forces will be markedly increased.

EFFECT OF SPEED CHANGES ON ROLL CONTROL.

Full aileron deflection is available at all airspeeds below approximately 205 knots. At 205 knots, where a control force of approximately 22 pounds is necessary to obtain full aileron deflection, the aileron boost reaches its maximum output. (See figure 6-3.) Therefore, rate of roll will decrease as speed is increased above 205 knots, since it will be impossible to obtain full aileron deflection because of high control forces. However, sufficient rate of roll is available at all speeds to adequately perform intended maneuvers.

EFFECT OF POWER SETTING OR FLAP AND GEAR POSITION ON ROLL CONTROL.

The effect of power setting or flap and gear position is negligible on the rate of roll of the airplane.

AILERON TRIM.

Trim tabs that are adjustable in flight are provided on both ailerons. These tabs will maintain a given setting indefinitely, unless changed intentionally, and will provide adequate lateral trim throughout the entire speed range of the airplane.

Systems Operation

SECTION VII

RECIPROCATING-ENGINE OPERATION IN FLIGHT. Upon reaching cruising altitude:

1. Maintain climb power until cruising speed is reached then retard the throttles and propeller master lever to desired settings for cruise.

2. Check booster pumps and transfer pump ON for all subsequent operation.

3. Periodically check for desired instrument readings. (See figure 5-1.)

CARBURETOR AIR TEMPERATURE CONTROL.

Carburetor air temperature is normally controlled by the automatic positioning of the intercooler flaps. However, under some flight conditions, it may be advantageous to manually control the intercooler flap position as follows:

1. At *low* altitudes, the change in carburetor air temperature is small in comparison to a corresponding change in intercooler flap angle. When intercooler flaps are automatically controlled, the flap angle may be greater than that necessary to keep carburetor air temperature within the dry limit. Therefore, it is possible to close intercooler flaps manually with little change in carburetor air temperature. In an emergency when maximum range, maximum endurance, or maximum speed is necessary at low altitudes, use the following procedure: (a) If carburetor air temperature is below the dry limit of 38°C, close intercooler flaps manually until temperature reads 38°C, or until full closed position is reached. (b) If carburetor air temperature is at the dry limit of 38°C, close intercooler flaps manually until temperature starts to rise.

Note

Reposition intercooler flap switches to AUTOMATIC when the special low-altitude conditions described are no longer encountered.

2. During normal operation at *low* altitudes on warm days, the induction air temperature may be too high to keep carburetor air temperature below 38°C even with intercooler flaps full open. In this case, increase altitude or reduce power until carburetor air temperature drops to 38° C; then close intercooler flaps manually until carburetor air temperature starts to rise.

3. When Military Power is used at *high* altitudes on warm days, carburetor air temperature may exceed the dry limit of 38°C. If this occurs, reduce manifold pressure one in. Hg for each 6°C above the dry limit. After manifold pressure has been reduced, continued operation with carburetor temperatures above the dry limit is satisfactory.

SELECTION OF POWER SETTINGS AND USE OF TORQUE PRESSURE IN ENGINE CONTROL.

Select power settings by use of the Nautical Miles per Pound Fuel charts in Appendix I. Chart manifold pressures for power settings below 2500 rpm should be increased (or decreased) 1/4 inch for each 6°C CAT above (or below) standard temperature. This adjustment of manifold pressure is not permissible above 2500 rpm.

Use torque pressure as a check that desired power is being obtained. If torque pressure reading is not normal for the manifold pressure and rpm setting selected, consider the following instructions before making any further manifold pressure adjustments:

Note

Decrease MAP one inch for each 6°C CAT above 38°C from MAP allowed at 38°C.

1. Check airspeed against applicable value obtained from nautical miles per pound fuel curve.

2. When torque pressure is low: (a) If airspeed is correct, torque pressure reading is probably inaccurate. (b) If airspeed is low, engine malfunction is probable and manifold pressure should not be increased to raise torque pressure, since such increase may result in damage to the engine.

Note

- Airspeeds may be affected by cowl flap position; therefore, cylinder head temperature and cowl flap position should be checked to assure minimum cowl flap opening.
- For any torque pressure setting, the spread between engines from the lowest to the highest manifold pressure should not exceed 2 inches.

3. When torque pressure is high: (a) If airspeed is correct, torque pressure reading is probably inaccurate. (b) If airspeed is high, reduce manifold pressure until desired torque pressure is obtained. If airspeed is still high, the chart miles per pound are conservative. Torque pressure and rpm should be read simultaneously for accuracy in determining horsepower. To convert torque pressure to brake horsepower, multiply engine rpm × .00412 × torque pressure.

EXAMPLE: For Normal Rated Power at 2600 rpm and torque pressure of 170 psi, find brake horsepower as follows:

RPM × .00412 × torque pressure = BHP
2600 × .00412 = 10.712 × 170 = 1821.04 BHP

Magneto checks can be made in flight by reference to torque pressure reading. Although no rpm drop will occur during operation on a single magneto, torque pressure will decrease. A drop in pressure up to approximately 10 percent of the BOTH value indicates satisfactory ignition condition.

TORQUE PRESSURE AND MANIFOLD PRESSURE RELATIONSHIP.

While torque pressure and rpm together furnish precise data on engine output (and consequently airplane performance), a comparison of torque pressure and manifold pressure furnishes a means of evaluating engine condition. (See figure 7-1.) A damaged or malfunctioning part of the engine will decrease the energy otherwise available to the propeller, requiring increased power input (manifold pressure) to maintain the same power output. For example, if one cylinder were to cut out, the power loss could easily be regained if the throttle is advanced to restore the original torque pressure. However, the increase in manifold pressure would result in an increased load on the remaining good cylinders. Other factors also affect the relationship between torque pressure and manifold pressure. If the engine is held at a given power output (measured by constant rpm and torque pressure), it may be necessary to change manifold pressure with variations in altitude, humidity, amount of supercharging, carburetor air temperature, engine temperature, fuel-air ratio, exhaust back pressure, and accessory load. It is evident, therefore, that the torque pressure indicator and the manifold pressure indicator do not replace each other, but are complementary to each other. Proper engine operating technique is to use manifold pressure (corrected for temperature) and rpm to set power and torque pressure to measure and adjust power output. At all times the pilot should know the correct relationship between the torque pressure indicator, the manifold pressure indicator, the fuel flowmeter, and the airspeed indicator, as well as the meaning of any change in their relationship.

CAUTION

Manifold pressure and rpm must be considered the primary basis for engine operation. Torque pressure is to be used only to adjust power within the manifold pressure limits. Disregarding manifold pressure may lead to incorrect power settings and abuse of the engine.

ENGINE ROUGHNESS.

Engine roughness and "cutting out" might be traced to faulty ignition. Since the airplane is used for operation above 30,000 feet at high powers (up to 2300 bhp), the air in the distributor and magneto is pressurized. At these high altitudes air is a poor insulating medium because of its low density; therefore, pressurizing the magneto and distributor provides sufficient resistance to prevent flashover. Each distributor incorporates an air pump and is provided with a steel tubing system to pressurize the magnetos and distributors. The pressure is controlled by four altitude valves, two located in the magneto and one in each distributor. These valves open at low altitudes to permit venting and close at high altitudes for pressurizing.

IGNITION MALFUNCTION. There are two types of ignition malfunction which can occur. Both types cause rough engine operation and "cutting out." The first type may occur at any altitude and may be caused by any of the common ignition troubles such as fouled spark plugs, burned or pitted breaker points, breakdown of insulation due to accumulation of oil or water in magneto, distributors, harness, etc. The second type will be

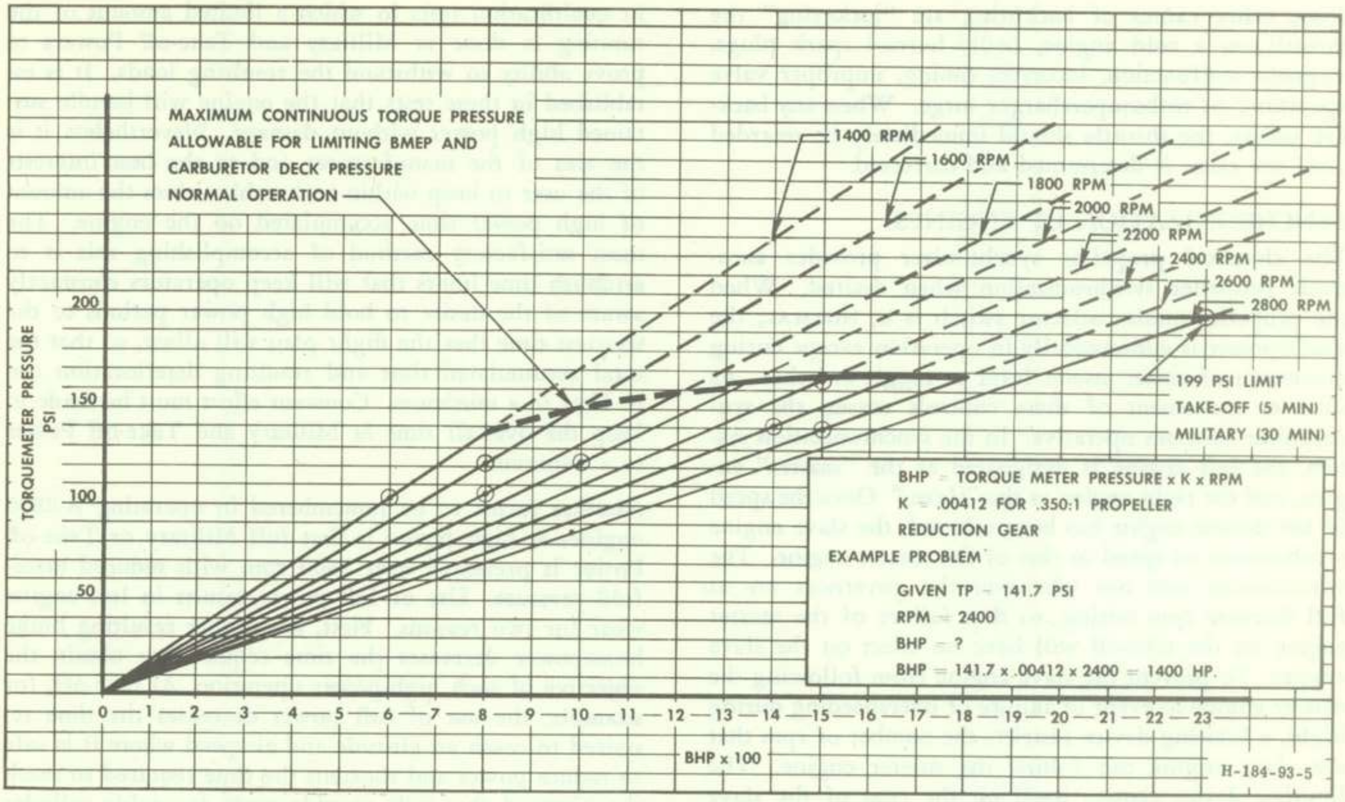


Figure 7-1. Normal Torque Limit Chart

encountered primarily at high altitude and is due to insulation breakdown caused by malfunction of the ignition pressurizing system. Since this type of malfunction is easily confused with turbosupercharger surge, a careful study of the surge curves should be made to eliminate this possibility. If high-altitude ignition trouble is indicated, the ignition pressurizing system should be checked.

Note

> Under some flight conditions, such as a sustained power-off descent, overcooling of the cylinders may occur, even with cowl flaps fully closed. Spark plug fouling and inability of the engine to accelerate satisfactorily may result. This condition may be avoided during prolonged idle periods by intermittent applications of power.

CARBURETOR ICING. The possibility of carburetor ice with impeller-type fuel injection is slight. The induction system on this airplane further lessens the possibility of ice by heating the air before it enters the carburetor, thus vaporizing the moisture in the inducted air. If the air intake screen becomes iced, the alternate air door will automatically open and route warm air from the nacelle into the system. When the ice is melted, the door will automatically close.

Note

> Under flight conditions at low altitude and low power, some icing of the carburetor may occur. If carburetor air temperature is 5°C or less, make sure intercooler flaps are closed. If flaps are closed and carburetor air temperature is still below minimum, operate at a higher power or higher altitude until temperature is within desired range.

DETONATION. Detonation should not occur on the engines if proper operating limits and procedures are observed. If detonation is detected, retard throttle immediately; then use one or both of the following procedures: advance mixture control and/or manually increase the cowl flap opening; then advance throttle to desired position.

BACKFIRING. Backfiring can generally be attributed to an abnormally lean mixture and/or pre-ignition. If the mixture is too lean, the fuel in the firing chamber will not be completely burned before a fresh fuel charge is admitted. Therefore, the burning fuel will ignite the fresh fuel while the intake valve is still open, causing a backfire. Pre-ignition occurs when the engine is too hot, thus igniting the mixture before the spark occurs. When this happens much of the power is wasted pushing the piston downward while it is still rising in the cylinder. This condition causes uneven power impulses, excessive pressures and temperature, and a loss of power.

Some other causes of backfiring are "jockeying" the throttle on a cold engine, badly burned spark plugs, magneto malfunction, incorrect timing, improper valve operation, or turbosupercharger surge. When any backfire occurs, the throttle should immediately be retarded until the cause is determined and corrected.

SYNCHRONIZATION OF ENGINES.

The electrical propeller synchronizer provides automatic propeller synchronization when desired. When the propeller master selector switch is at NORMAL, the synchronizer is automatically in operation except during movement of either master lever or toggle switches. As soon as movement of these controls ceases, the synchronizer becomes operative. In the synchronization system, the left engine is designated as the "master" engine, and the right engine as the "slave." Once the speed of the master engine has been selected, the slave engine synchronizes its speed to that of the master engine. The synchronizer cuts out whenever the governors are at full increase rpm setting, so that failure of the master engine on the take-off will have no effect on the slave engine. To prevent the slave engine from following the master engine in event of failure or overspeeding during flight, a limiting device restricts the number of rpm that the slave engine can follow the master engine. The limiting device centers itself on the rpm of the slave engine (as determined by movement of master lever or right toggle switch) and will allow the slave engine to increase or decrease only 3 percent of its rpm. This gives the slave engine a 6 percent range, but only 3 percent either way of center. If the difference between the rpm of the master engine and slave engine is greater than the limited range of the slave engine, a resynchronize button, located on the synchronization panel, may be used. When the resynchronize button is depressed momentarily and released, it recenters the limiting device, allowing the slave engine rpm to change another 3 percent toward that of the master. This procedure may be repeated until the engines are synchronized.

USE OF MILITARY AND TAKE-OFF POWERS.

It is often asked what the consequences would be if the 30-minute limit at Military Power and the 5-minute limit at Take-off Power were exceeded. Another frequent inquiry is how long a period must be allowed after the specified time limit has elapsed until Military Power can again be used. These questions are difficult to answer, since the specified time limits do not mean that engine damage will occur if the limits are exceeded, but are meant more to keep the operating time at high power to a reasonable minimum in the interest of prolonging engine life.

It is generally accepted that high power operation of an engine results in increased wear and other deterioration and necessitates more frequent overhaul than low power operation. However, it is apparent that a certain percentage of operating time must be at maximum power. The engine manufacturer must prove his engine in qualification tests in which a limited amount of the running is done at Military and Take-off Powers to prove ability to withstand the resulting loads. It is established in these tests that the engine will handle sustained high power without damage. Nevertheless it is the aim of the manufacturer and to the best interests of the user to keep within reasonable values the amount of high power time accumulated on the engine. The most satisfactory method of accomplishing this is to establish time limits that will keep operators constantly aware of the desire to hold high power periods to the shortest time that the flight plan will allow, so that the total accumulated time and resulting deterioration can be kept to a minimum. Constant effort must be made to keep the over-all time at Military and Take-off Power to a minimum.

Another factor to be remembered in operating R-2800 engines at high power is that full Military or Take-off Power is preferred over 2800 rpm with reduced manifold pressure. Use of full power results in less engine wear for two reasons. First, the higher resulting brake horsepower decreases the time required to obtain the objective of such high-power operation. At take-off, for example, the use of full power decreases the time required to reach an altitude and airspeed where it is safe to reduce power and shortens the time required to reach the airspeed that will provide more favorable cylinder cooling. Second, high rpm results in high loads on the reciprocating parts and crankpin bearings because of centrifugal and inertia forces of the rapidly rotating parts. As these loads are partially offset by the gas pressure in the cylinder, pressures resulting from use of full military manifold pressure will give lower net loads and less wear on these parts. Sustained high rpm, not sustained high manifold pressure, is a major factor producing engine wear, and any reduction of "rpm minutes" and "piston ring miles" is advantageous.

The time limits of 30 minutes for Military Power and 5 minutes for Take-off Power were established on the basis of their respective need in actual service operation. The nature of conditions calling for Military Power operation is usually such that periods as long as 30 minutes are required. On the other hand, take-offs rarely last for more than 2 or 3 minutes. Also, conditions preceding and during take-off are more stringent than those accompanying the average application of Military Power. The engine is run up to Take-off Power on the ground at zero or very low airspeed, with a minimum of cooling airflow available, and dusty conditions often prevail. When Military Power is used in flight, the airplane is usually above dusty strata, and better cooling is available.

TURBOSUPERCHARGER SURGE.

Turbosupercharger surge is a particular characteristic of centrifugal compressors and may be encountered at high altitudes with low rpm settings and high manifold pressures. Whenever the airflow of air compressed by the turbocompressor stalls, a surge condition is created. This surge results in cyclic fluctuations of engine speed and torque pressure with lesser variations of manifold pressure and fuel pressure, or in a momentary collapse of engine power similar to "cutting out." Any factor, such as rapid movement of the throttle, which will change the turbosupercharger airflow without changing the turbo pressure, tends to bring the turbocompressor close to the point of surge. The possibility of inducing surge will be reduced by always moving the throttle slowly and smoothly. If surge occurs, it may be stopped by slowly increasing engine rpm, retarding the throttle, or both; the throttle may then be slowly advanced to the desired power. If surge cannot be stopped by this procedure, it may be necessary to reduce altitude. Every effort should be made to avoid surging, as it may induce backfiring of the engine and damage the air induction system.

CYLINDER HEAD TEMPERATURE CONSIDERATIONS.

The airplane has automatic cowl flap control to maintain desired cylinder head temperatures for all normal ground and flight operating conditions. There are two reasons for having this automatic system. First, it is convenient for the pilot in that constant attention to cylinder head temperatures and cowl flap adjustment is unnecessary. Second, the flaps are controlled automatically to the minimum position for satisfactory cooling; therefore, minimum cooling drag is realized at all times and airplane performance is compromised the least amount possible to achieve adequate cooling. "Cooling drag" is the cost to airplane speed and range due to the necessity of cooling the engines. As cowl flaps are opened for this purpose, nacelle frontal area is increased and the negative pressure causes more air to pass through the restrictive passages inside the cowling to cool the cylinders, rather than over the relatively smooth outside of the nacelle. Both of these conditions create increased drag, and result in a lower airspeed at a given power setting. During Military Power climb (best rate-of-climb speed for reciprocating engines only) on an extremely hot day, the cylinder head temperature limit may be exceeded even with cowl flaps wide open. If this occurs, airspeed should be increased as necessary to maintain temperature limits. Very little climb performance loss occurs under these conditions. If the jet engine is also operated at Miltary Power for climbing above 20,000 feet, airspeed for best rate of climb is increased to a point at which cylinders can be cooled at any temperature encountered, and range is not unduly affected. During Normal Rated Power climb at high altitudes on a hot day, cylinder head temperature may be between the maximum continuous limit and the maximum limit on the cockpit gage with mixture control in NORMAL. It is permissible to continue climbing with temperature in this range for 30 minutes, as operation at the maximum cylinder head limit is approved in the engine specification and operating instructions for 30 minutes at Normal Rated Power. It should be kept in mind that the combustion and rpm loads are lower at Normal Rated Power than at Military Power.

The engine is entirely capable of operating without damage at Normal Rated Power for 30 minutes with cylinder head temperature above the continuous limit as long as it is kept under the maximum limit. Rich mixture is available for cooling if temperatures exceed maximum. (Refer to USE OF MILITARY AND TAKE-OFF POWERS, in this section.) However, operating in this manner means increased engine wear. Here, again, it is well to remember that strict adherence to the continuous temperature limit is not so important as keeping the cumulative length of time above the limit to a minimum in the interest of prolonging engine life. Also, as in the case of Military Power usage, operation above the continuous limit should be discouraged for all flight conditions which do not require maximum airplane performance. During routine flights when no specific mission is to be accomplished, cylinder head temperatures should always be kept below the continuous limit when operating at Normal Rated or cruise power. Under these conditions, it may sometimes be desirable to position cowl flaps manually to obtain cylinder head temperatures around 200°C. If this is done, it should be remembered that range data in the flight handbook may not apply, since opening cowl flaps to provide cooler cylinders increases cooling drag, thereby adversely affecting airplane range.

MANUAL LEANING.

In order to conserve fuel on extended flights, yet maintain proper engine operating conditions and temperatures it may be necessary to manually set the reciprocating-engine mixture controls to the desired positions. With normal cruise settings, the procedure for obtaining maximum endurance is as follows: After reaching cruise altitude and leveling off, establish the desired cruise power setting with mixture control in RICH. Allow flying conditions to stabilize for about 5 minutes with the airplane trimmed for cruising flight. Set the mixture for each engine as follows:

1. Note the torque pressure obtained in RICH mixture.

2. Engage the primer and watch the torque pressure indicator for a rise, drop, or steady indication. Note the maximum torque pressure reading then release primer and advance the throttle to 8 percent above the maximum reading obtained.

Note

> If torque pressure drops, RICH position is at or richer than best power. If it is richer than best power, torque pressure will rise as mixture is leaned.

Note

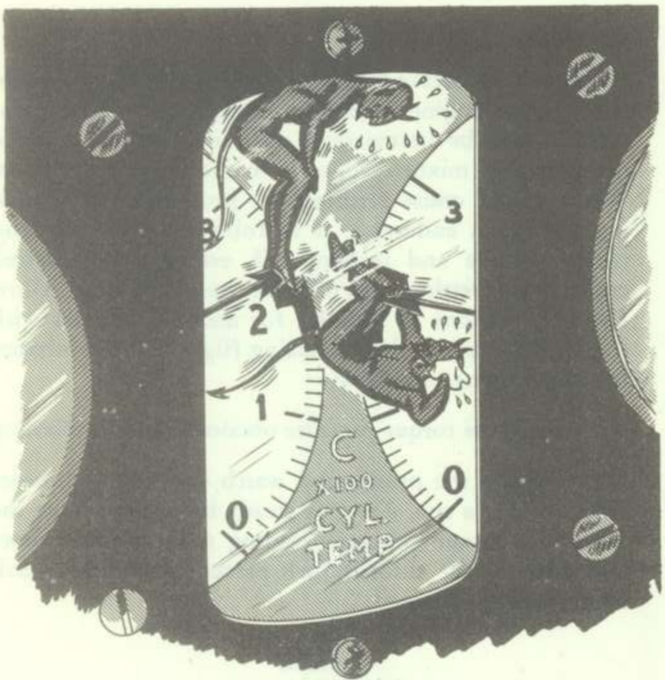
- If torque pressure remains steady, either RICH position is near the lean end of best power mixture range or the primer is inoperative. To check the primer, manually lean the mixture until a definite drop in torque pressure occurs, then apply prime. If primer is working torque pressure will immediately rise.
- If torque pressure rises or rises and falls, RICH position is leaner than best power.

3. Manually lean the mixture until torque pressure drops to the stabilized T.O.P. observed in step 1.

4. After setting mixture, re-check manifold pressure and torque pressure readings and tighten friction lock. Once the mixture is set, the automatic features of the carburetor should maintain the correct fuel-air ratios as power is varied with throttle within a moderate range. However, for any substantial change of power or altitude it is advisable to reset the mixture using the same method.

A sample problem follows, showing how to use the 8 percent torque pressure reduction method of manual leaning. The values shown in the problem will vary with airplane weight and pilot preference.

1. Stabilized T.O.P. (RICH mixture) is 125 psi.
2. Maximum T.O.P. determined by priming is 126 psi.
3. With mixture control at RICH, increase T.O.P. to 136 psi (8% above maximum).



CAUTION

Cylinder head temperatures may become critical with manual leaning. Do not exceed maximum allowable temperature.

4. Lean out final mixture adjustment to give stabilized T.O.P. of 125 psi.

JET-ENGINE OPERATION IN FLIGHT.

The jet engine may be used in flight for conditions requiring maximum speed and climb or evasive maneuvers. Approximately 20 to 30 seconds are required to start the jet engine and obtain full power; therefore, if the need for the use of the jet engine can be anticipated, the engine should be started and idled until full power is desired. For starting procedure, refer to STARTING JET ENGINE IN FLIGHT, Section II.

FUEL SYSTEM MANAGEMENT.

Fuel flow from all tanks except the ferry tank is automatic and no tank selection is necessary. However, the following fuel management is required:

1. Boost pumps on for starting and for all subsequent normal operation.

2. Cross-feed valves normally OFF. Cross-feed valves ON for jet engine or ferry tank operation and take-off.

3. Engine shutoff valve OPEN. (Emergency engine control switches NORMAL ON for all normal operation.)

4. Fuselage tank transfer pump AUTO for all normal operation.

5. Emergency fuel pumps ON for take-off and landing.

6. Tip tank air pressure switch ON for all normal operation.

Note

If cabin compressor fails, tip tank fuel cannot be used.

7. Just before take-off with jet engine operating, check jet-engine emergency fuel system operation. (Refer to EMERGENCY FUEL SYSTEM TEST SWITCH, Section I.)

8. If necessary to jettison wing tip tanks, pull tip tank release handle. (A continued decrease of fuel quantity in wing tanks indicates that tip tanks are empty.)

9. If ferry tank is installed, the fuel will be used whenever the ferry tank pump switch is turned ON (circuit breakers in), the cross-feed valves are turned ON, and the indicator light is out. When the light illuminates, indicating the tank is empty, turn the pump switch and the cross-feed valve OFF. Fuel from the ferry tank should be used immediately after take-off. Normal tank sequencing will automatically begin when ferry tank is empty.

FUEL BALANCE CONTROL.

If fuel consumption is excessive from one tank during normal flight using reciprocating engines, temporarily turn cross-feed valves ON and booster pump for lowest tank OFF to prevent an unbalanced condition. If all three engines are being used, maintain fuel balance by temporarily turning cross-feed valve for tank indicating lowest fuel level to OFF. When approximately 50 gallons of tip tank fuel has been used, fuel will continue to transfer down to approximately 30 gallons, even though air pressure has been shutoff.

Note

> When fuel quanity in either wing tank is low (approximately 400 pounds), cross-feed valve should be turned ON.

FLIGHT CONTROL HYDRAULIC SYSTEM.

CONTROL BOOST CHATTER.

A condition known as boost chatter, a vibration of moderate frequency and small amplitude, may be encountered during operation of any control surface, although more frequently during movement of the ailerons. Appearance of such chatter is very rare and is attributed to the presence of air in boost valve. It should not cause any great concern, as it is merely uncomfortable and does not damage the airplane or cause any appreciable loss of boost. Moving the controls back and forth several times may eliminate boost chatter in flight, and working the controls full throw several times before take-off may lessen the possibility of its occurrence.

Control boost chatter may also occur if a piston in one of the control boost pumps sticks. This can be checked by operating one engine and displacing the chattering control as far as possible. If chatter continues the pump on the operating engine should be checked and/or replaced. If chatter stops when the engine is stopped and starts again when the engine is started the pump on that engine should be replaced. Regardless of the cause, a take-off should never be attempted while boost chatter is present.

Crew Duties

SECTION VIII

INTRODUCTION.

Each crew member has primary duties to perform because of his specialized function in carrying out a tactical mission. In addition to his specialized function he must perform various checks related to safe and efficient operation of the airplane. These latter duties, listed in this section, should be integrated with the specialized duties.

DUTIES OF THE PILOT.

The pilot's duties are fully covered in Sections II, III, and IV. When the tow-target equipment is to be used, the pilot co-ordinates related phases of operation with the reel operator. Similarly, when the in-flight refueling package is installed, the pilot co-ordinates related phases of operation with the refueling operator. These phases of operation are covered in Section IV.

DUTIES OF THE BOMBER-NAVIGATOR.

EXTERIOR CHECK.

1. Check security of exposed radio and radar antennas.
2. On night flights, check exterior lights for proper illumination.

INTERIOR CHECK — ALL FLIGHTS.

1. Bomb bay door switch OFF.
2. Shackle heater switch OFF.
3. Bomb salvo switch guarded OFF.
4. Bomb arming switch SAFE.
5. Bomb station indicator switch OFF.
6. Circuit breakers (bombing controls) in.
7. Inverter stand-by switch NORMAL.
8. Flight instrument transformer stand-by switch MAIN.
9. Exterior light switches OFF.
10. HF control switch OFF.
11. Approach light OFF.
12. Advise pilot when ready for external power to be connected.
13. First-aid kit and water canteen stowed in place and properly stocked.
14. Stowage cases and equipment secure.
15. Seat back release and shoulder harness functioning properly.
16. Sliding canopy panel operating correctly.
17. Rearview mirrors clean.
18. Canopy shade operating properly and not cracked.
19. Check operation of all communication equipment.
20. Check ASB-1 equipment.

WARNING

Radar ground checks must not be made within 50 feet of operations involving fuel. Tests indicate that electrical energy from radar equipment may ground through steel tools, common pencils, etc, causing ignition of fuel vapors.

21. Check oxygen equipment and operation. (Refer to OXYGEN SYSTEM PREFLIGHT CHECK, Section IV.)

INTERIOR CHECK — NIGHT FLIGHTS.

Before night or instrument flight:

1. Check all lights and instruments at your station while accomplishing the normal interior check.
2. Ascertain that a reliable flashlight is on board.

ALTERNATING-CURRENT CHECK.

Make the following check at the pilot's direction:

1. Have the third crewman turn on armament a-c power switch at the third crewman's station.
2. Check the two push-to-test warning lights on the a-c power panel to assure that the lights are not burned out. Make sure that the lights are not dimmed.
3. Check for a voltmeter reading of 115 volts at all positions of the voltmeter switch other than the OFF position.

BEFORE LANDING.

1. Canopy sliding panel open at the same time pilot opens canopy panel.
2. Turn off unnecessary electrical equipment.
3. Safety belt and shoulder harness tightened.

DUTIES OF THE THIRD CREWMAN.

INTERIOR CHECK—ALL FLIGHTS.

1. Crew entrance ladder installed at the crew door.
2. Armament a-c power switch OFF.
3. Inform pilot when ready for external power to be connected.
4. Hatch to bomb bay closed and secure.
5. Escape hatch open and secure.
6. Interphone switch at ICS.
7. Head rest secure and shoulder harness adjusted.
8. Check oxygen equipment and operation. (Refer to OXYGEN SYSTEM PREFLIGHT CHECK, Section IV.)
9. Spare cans of hydraulic fluid on board and filled.

INTERIOR CHECK—NIGHT FLIGHTS.

Before night or instrument flight, check all lights and instruments at your station while accomplishing the normal interior check.

EMERGENCY HYDRAULIC SYSTEM GROUND TEST.

Make ground check of the emergency hydraulic equipment at the pilot's direction:

1. Battery switch ON.
2. Check accumulator pre-charge air pressure by placing the fill valve in the FILL position and then opening the dump valve (fluid discharge valve). Pressure gage reading should stabilize at 1200 psi.
3. Close dump valve; place filling valve at OFF. Emergency hydraulic pump should start and hydraulic pressure should build up to 2850 (± 50) psi. When this pressure has been attained, pump should stop.
4. Check emergency hydraulic system pressure switch by cycling the parking brake valve several times, until the emergency pump cuts in. Pressure reading at the cut-in point should be 2550 (± 50) psi. Pressure should build up to 2850 (± 50) psi and pump should stop.

FUEL FERRY TANK GROUND TEST.

If installed, make ground check of the fuel ferry tank system at the pilot's direction:

1. Push in circuit breakers on ferry tank control panel.
2. Move transfer pump switch to ON, and check for momentary illumination of fuel pressure indicator light.
3. Turn pump switch OFF.

BEFORE TAXIING.

1. Stow crew entrance ladder and close crew door.
2. Check bomb bay doors closed.

AFTER TAKE-OFF.

After an altitude of approximately 200 feet is attained, close escape hatch and check for security.

BEFORE LANDING.

To prepare for landing:

1. Open emergency escape hatch and check for security.
2. Safety belt and shoulder harness tightened.
3. Turn off all unnecessary electrical equipment.

DUTIES OF THE TOW-TARGET OPERATOR.

If the third crewman is the tow-target operator he will have various checks to perform in addition to those listed under DUTIES OF THE THIRD CREWMAN in this section. (Refer to TOW-TARGET EQUIPMENT, Section IV.)

DUTIES OF THE REFUELING OPERATOR.

If the third crewman is the refueling operator, he will also have various checks to perform in addition to those listed under DUTIES OF THE THIRD CREWMAN, in this section. (Refer to IN-FLIGHT REFUELING TANKER PACKAGE, Section IV.)

All-Weather Operation

SECTION IX

INTRODUCTION.

This section contains only those procedures which differ from, or are in addition to, the Normal Procedures outlined in Section II. Repetition has been used, where necessary, for emphasis, clarity, or continuity of thought. Discussion relative to operation of the systems mentioned in this section is included in Section VII.

NIGHT FLYING.

The airplane does not present any unusual characteristics during night flight. It is good policy, however, to familiarize yourself with the location and operation of all switches in the cockpit. Switch locations and lighting equipment differ in various models of this airplane, so be sure you are familiar with the airplane you are going to fly and, as an added precaution, carry a flashlight. It is also advisable to carry a pair of dark glasses, on long cross-country flights, to preclude the possibility of flash blindness should severe thunderstorms be encountered. Instrument lights may be turned to full bright under these conditions and the edge-lighted instruments will present no glare or reflection problem.

INSTRUMENT FLIGHT PROCEDURE.

Instrument flying in this airplane, as in all airplanes, requires constant attention to flight instruments at all times. The airplane has light boost on forces which, along with low stalling speeds, contribute to acceptable characteristics for instrument flying.

INSTRUMENT TAKE-OFF.

After the engine check-out is completed, make usual line up on runway, hold brakes, and advance jet-engine throttle to take-off power:

1. Advance reciprocating-engine throttles and release brakes.
2. Maintain runway heading with directional gyro using light brake applications until rudder becomes effective. (Approximately 50 knots.)
3. Take off at normal airspeed and establish initial climb. Hold wings level with reference to attitude gyro.

INSTRUMENT CLIMB.

1. At approximately 115 knots, retract landing gear and reduce throttles to desired manifold pressure and propellers to desired rpm for climb.
2. Secure jet if it is not needed to maintain desired climb.
3. Retract flaps at 130 knots and 500 feet.
4. Trim airplane for 500 feet per minute climb. (Approximately 170 knots IAS.) Climbing turns should not exceed one needle width.

INSTRUMENT CRUISING FLIGHT.

The airplane has good handling characteristics throughout its normal speed range. When selected cruise altitude and speed are reached, retrim the airplane for level flight and adjust gyro horizon to proper setting.

Note

> Turn indicator should be calibrated in VFR flight to determine needle-width deflection for a standard 3-degree per second rate of turn.

SPEED RANGE. The chart below contains average speed and settings based on 10,000 feet altitude, with

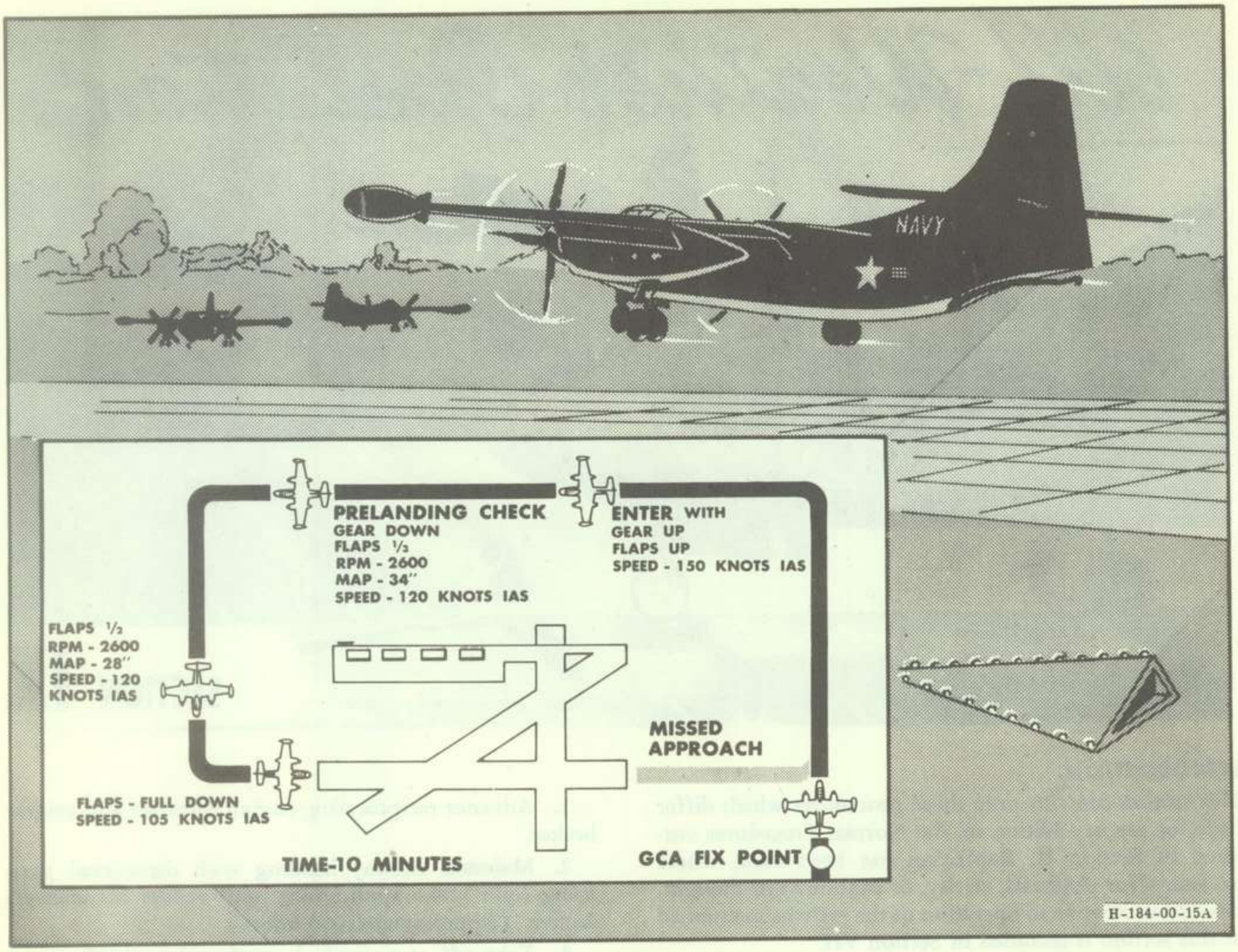


Figure 9-1. Standard GCA Pattern

both reciprocating engines operating and jet engine off at 40,000 pounds gross weight, gear and flaps up.

	KNOTS (IAS)	RPM	MP	MIXTURE
Climb to 10,000 feet from S.L.	145	2600	47.5 In. Hg	NORMAL
Maximum range cruise	179	1980	35.0 In. Hg	NORMAL
Normal rated power cruise	240	2600	47.5 In. Hg	NORMAL

RADIO AND NAVIGATION EQUIPMENT. The radio and navigation equipment is not abnormally affected by static. However, the radio compass may be affected by extreme atmospheric or precipitation static. If the weather is very bad, precipitation static may build up to severe intensity and then suddenly may be discharged from the airplane. Thereafter, range signals may come through very clearly. If signals become inaudible because of precipitation static while using the compass position, switch to LOOP and use aural-null procedures.

DESCENT.

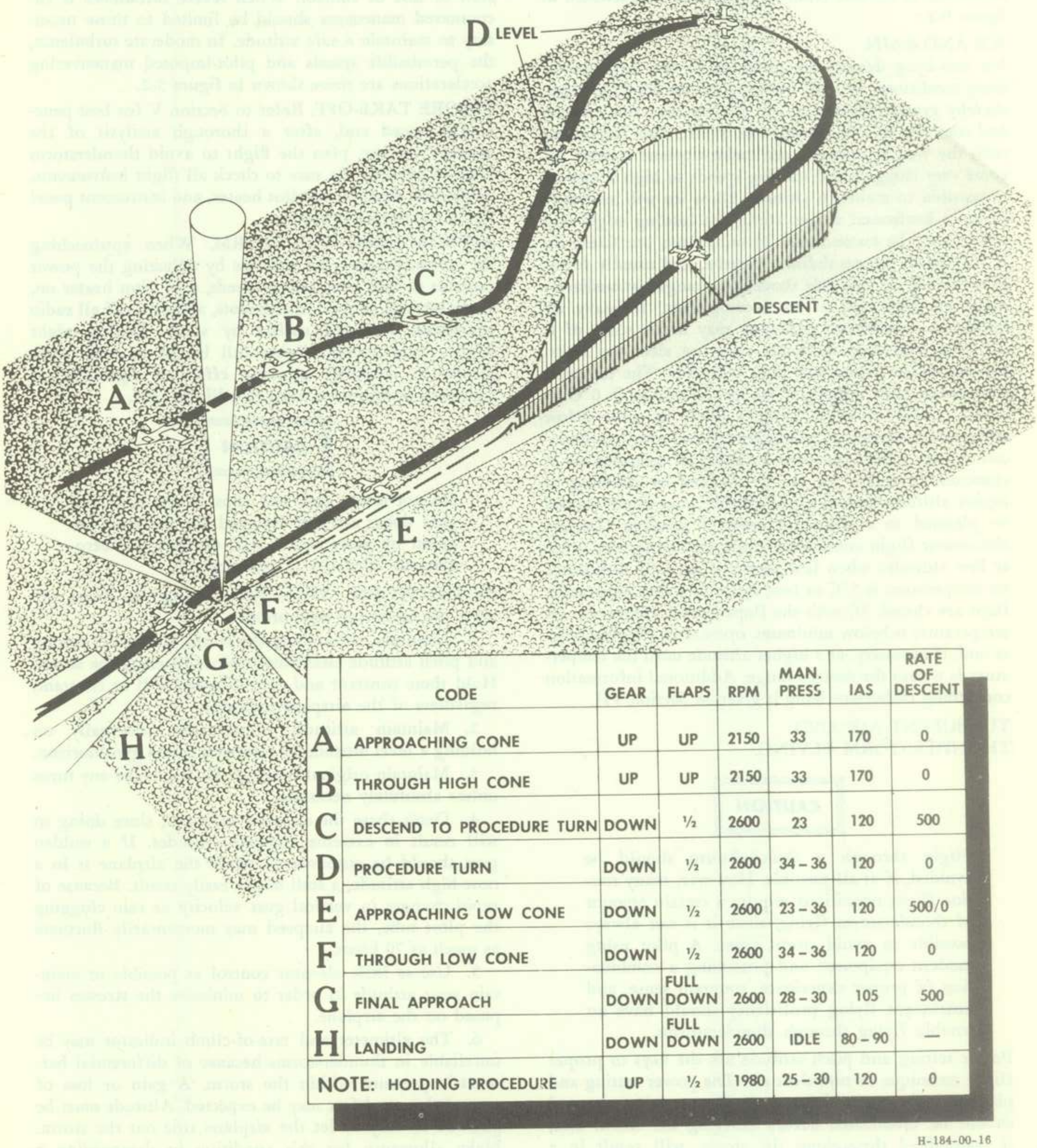
Normal descent procedures are followed. The windshield defroster should be turned on if low temperatures are encountered, and care should be taken to avoid overcooling the engines if descent is made at low or idle power.

HOLDING.

If holding procedure is necessary and the fuel supply is low, fuel consumption can be reduced by using power settings of 1980 rpm and enough manifold pressure to maintain an indicated airspeed of 120 knots.

INSTRUMENT APPROACHES.

Instrument approaches have no unusual characteristics and normal procedures should be used. (Refer to LANDING, Section II.) If conditions warrant the use of a windshield wiper, it should be turned on prior to the approach. With power off and flaps and gear down, the glide angle is quite steep. Rate of descent can, of course, be controlled by use of power. (For standard GCA pattern, see figure 9-1.)



CODE	GEAR	FLAPS	RPM	MAN. PRESS	IAS	RATE OF DESCENT
A APPROACHING CONE	UP	UP	2150	33	170	0
B THROUGH HIGH CONE	UP	UP	2150	33	170	0
C DESCEND TO PROCEDURE TURN	DOWN	½	2600	23	120	500
D PROCEDURE TURN	DOWN	½	2600	34 – 36	120	0
E APPROACHING LOW CONE	DOWN	½	2600	23 – 36	120	500/0
F THROUGH LOW CONE	DOWN	½	2600	34 – 36	120	0
G FINAL APPROACH	DOWN	FULL DOWN	2600	28 – 30	105	500
H LANDING	DOWN	FULL DOWN	2600	IDLE	80 – 90	—
NOTE: HOLDING PROCEDURE	UP	½	1980	25 – 30	120	0

H-184-00-16

Figure 9-2. Instrument Landing Pattern

LETDOWN. Letdowns can be made with landing gear up or down, and gear position will have very little effect on trim. If icing conditions exist, it is best to leave the landing gear up as long as possible, because of the possibility of accumulations of ice creating a heavy drag condition. A normal letdown procedure is illustrated in figure 9-2.

ICE AND RAIN.

No anti-icing devices are provided in this airplane. In icing conditions, ice will build up on the leading edges, thereby greatly disturbing the airflow over the surfaces and resulting in a dangerous loss of lift. This fact, along with the weight increase, can make airplane control become very sluggish and stalling speeds so high it may be impossible to maintain altitude. Rime ice will normally form in horizontal ridges along the leading edges and will mostly be encountered in rain, sleet, etc. Clear ice is very hard, has no definite pattern, and usually forms in turbulent air. Altitude should be changed immediately upon the first sign of ice accumulation. If heavy ice builds up, accelerated pull-outs may break some of it off. Icing may occur in clouds, rain, fog, sleet, wet snow, supersaturated vapor and high humidity. The temperature range most conducive to ice formation is 0°C to −15°C (32°F to 5°F). Icing is likely to occur below temperature inversions, along fronts, and over mountainous terrain where the forced lifting of unstable air is common. Inversion ice can be avoided by climbing to higher altitudes but to avoid trouble, your flight should be planned to avoid these areas if possible. During instrument flight conditions, carburetor icing may occur at low altitudes when low power is used. If carburetor air temperature is 5°C or less, make sure that intercooler flaps are closed. If, with the flaps closed, carburetor air temperature is below minimum, operate at a higher power and, if necessary, at a higher altitude until the temperature is within the desired range. Additional information concerning carburetor icing is given in Section VII.

TURBULENT AIR AND THUNDERSTORM FLYING.

CAUTION

Flight through a thunderstorm should be avoided, if at all possible. However, many routine flight operations require a certain amount of thunderstorm flying, since it is not always possible to avoid storm areas. A pilot using modern equipment and possessing a combination of proper experience, common sense, and instrument flying proficiency should have no trouble flying through thunderstorms.

Power setting and pitch attitude are the keys to proper flight technique in turbulent air. The power setting and pitch attitude required for desired penetration airspeed should be established before entering the storm and, if maintained throughout the storm, will result in a constant airspeed, regardless of any false readings of the airspeed indicator. In severe turbulence the maximum recommended speed is 250 knots IAS. At this speed the greatest margin of strength is available for withstanding gust loads. The minimum recommended speed for severe turbulence is 140 knots IAS, based on the possibility of stall or loss of control. When severe turbulence is encountered maneuvers should be limited to those necessary to maintain a safe attitude. In moderate turbulence, the permissible speeds and pilot-imposed maneuvering accelerations are those shown in figure 5-2.

BEFORE TAKE-OFF. Refer to Section V for best penetration speed and, after a thorough analysis of the general weather, plan the flight to avoid thunderstorm areas if possible. Be sure to check all flight instruments, navigation equipment, pitot heater, and instrument panel lights for proper operation.

APPROACHING THE STORM. When approaching the storm, prepare the airplane by adjusting the power controls to safe penetration speeds, turn pitot heater on, check settings of gyro instruments, and turn off all radio equipment rendered useless by static. During night flights, turn cockpit lights full bright or wear dark glasses to minimize blinding effect of lightning. If lightning is prevalent, turn floodlights ON.

CAUTION

Do not lower gear and flaps, as the flaps and gear doors are not designed for the load imposed by gusts and it will decrease the aerodynamic efficiency of the airplane.

IN THE STORM. While flying through the storm, observe the following precautions:

1. Maintain, throughout the storm, the power setting and pitch attitude established before entering the storm. Hold these constant and your airspeed will be constant, regardless of the airspeed indicator.
2. Maintain attitude. Concentrate principally on holding a level attitude by reference to the gyro horizon.
3. Maintain original heading. Do not make any turns unless absolutely necessary.
4. Don't chase the airspeed indicator, since doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while the airplane is in a nose-high attitude, a stall might easily result. Because of rapid changes in vertical gust velocity or rain clogging the pitot tube, the airspeed may momentarily fluctuate as much as 70 knots.
5. Use as little elevator control as possible to maintain your attitude in order to minimize the stresses imposed on the airplane.
6. The altimeter and rate-of-climb indicator may be unreliable in thunderstorms because of differential barometric pressure within the storm. A gain or loss of several thousand feet may be expected. Altitude must be allowed to vary to let the airplane ride out the storm. Make allowance for this condition in determining a minimum safe altitude.

Note

The most turbulent areas in a thunderstorm are usually between 10,000 and 20,000 feet. The least turbulent areas are usually above 30,000 feet or below 6000 feet. Therefore, altitudes above 30,000 feet or below 6000 feet, are recommended for thunderstorm flying.

WARNING

Thunderstorm flying demands considerable proficiency in instrument flying and should be undertaken only by qualified instrument pilots.

COLD-WEATHER OPERATION.

Successful low temperature operation depends primarily upon the preparations made in postflight inspection and in anticipating the operation requirements of the following day. Ice and frost will normally form on horizontal surfaces first rather than on vertical surfaces and the prevention of such conditions is much easier than the removal. If the airplane cannot be kept on the hangar deck it is best to anticipate snow, icing or heavy frost conditions and use protective covering as necessary. If heat from portable ground heaters is used for removal, make certain that all remaining moisture is wiped off with an absorbent cloth. If ice or frost is removed by this method from the struts or landing gear, the cloth should be soaked in the same type of hydraulic fluid [Specification MIL-F-7083 (AER)] that is used in the struts. The Normal Procedures outlined in Section II should be followed in addition to the steps listed below:

BEFORE ENTERING AIRPLANE.

1. Remove all protective covers from airplane.
2. See that moisture is drained from all fuel tanks and fuel system drains.
3. On each reciprocating engine, check for free flow at drains in main oil supply line and in inlet line of propeller feathering pump. Apply heat if flow is not satisfactory. Engine and accessory sections will require heat at any temperature below – 18°C (0°F).

Note

If oil was drained after previous flight, oil should be heated to at least 65°C (149°F) and engine preheat completed before oil tanks are serviced. For cold weather operation, service tanks with oil (Specification MIL-L-6082A, Grade 1065).

4. On each turbosupercharger, check for free flow at drain in suction line from turbosupercharger oil tank.
5. Have landing gear and shock struts free from dirt and ice; check for proper inflation.

CAUTION

Do not attempt to chip or scrape ice from the airplane, as serious damage to skin may result.

Note

If tires become frozen to the surface it is best to free them by using ground heaters. However, if portable heat is not available, they may be partially released by overinflation. Do not use the combination of heat and overinflation as pressure may be increased beyond the safe limits. When tires are released, reduce the pressure to normal before take-off. When gear is retracted, the nacelles have high enough temperatures to melt any ice which may have accumulated on the gear during take-off.

6. Check the battery to be sure electrolyte is not frozen; if it is frozen replace battery before starting engines.
7. Ensure that snow and ice are removed from surfaces, control hinges, propellers, fuel and oil vents, jet duct door, and pitot tube.
8. Carefully inspect all openings in airplane for accumulated snow or ice.
9. When necessary, preheat reciprocating engines and crew compartments with portable ground heaters. Preheating is adequate only when fluid oil will flow freely from drains and propellers can be pulled through with ease by two men.

Note

Turbojet engine does not require preheat (or oil dilution) unless temperature is below – 54°C (– 65°F).

10. Have external power source connected for starting.

ON ENTERING AIRPLANE.

1. Check flight controls for proper operation.
2. Make sure canopy sliding panels operate normally and will close and lock.
3. Check electrical and radio equipment.
4. Ensure that crew entrance door will close and lock.

BEFORE STARTING ENGINES.

1. Have oil immersion heaters removed.
2. Have engine heater ducts removed and unit pulled clear of airplane and propeller blast.

WARNING

Use firmly anchored wheel chocks for all engine run-ups.

STARTING RECIPROCATING ENGINES.

Prior to starting, make crankability test with ignition OFF by holding starter switch on for 10 to 12 seconds and making sure engine will turn over at least 35 rpm. If 35 rpm cannot be attained, apply more heat to engine.

Note

If propeller turns through eight blades in approximately 10 seconds, 35 rpm will be obtained.

1. Intercooler flap and cowl flap switches AUTOMATIC before starting. Oil cooler flaps closed.
2. Prime by holding priming switch on continuously while engine is being turned over by starter.

CAUTION

If engine fails to start after one minute of continuous cranking, allow starter to cool for one minute before another attempt to start engine. After second starting attempt, allow 5 minutes for starter cooling.

3. If two or three starting attempts have been unsuccessful, remove front spark plugs and inspect for ice. If icing has occurred, front spark plugs should be changed or the engine thoroughly heated before additional attempts to start are made.
4. As engine starts, move mixture control to RICH. Operate primer until engine is running smoothly. Do not pump the throttle.

Note

If engine stops after mixture control has been moved to RICH, move to IDLE CUT-OFF immediately, and continue cranking and priming until engine starts. Do not exceed time limit for continuous use of starter.

5. Check oil pressure. If there is no oil pressure after 30 seconds running, stop engine and investigate.

WARM-UP.

1. Maintain engine rpm at 1200 until oil temperature and pressure and cylinder head temperature are within desired limits.

Note

If oil has been diluted and time permits, run engines at least 30 minutes with oil temperature above 50°C to rid the oil of gasoline. Do not close the cowl flaps for warm-up as it may cause the ignition harness to burn due to lack of circulating air.

2. Inspect all instruments for normal operation.
3. After oil temperatures and pressures are up to normal, advance throttles to 1800 rpm, hold propeller toggle switches at DECREASE, and make sure that governor limit indicator lights come on. Move propeller toggle switches to INCREASE and return to neutral after governor limit lights again come on.
4. Advance throttles to 1800 rpm, with propeller master lever in full INCREASE RPM position. Momentarily depress each feathering button. When engine speed is reduced to 1200 rpm, pull buttons back to unfeather, then return to neutral. (Refer to PROPELLER FEATHERING BUTTONS, Section I.) If rpm drop is very slow or sluggish, the check should be repeated until operation is satisfactory; then move propeller toggle switches to INCREASE and return to neutral after governor limit lights come on.
5. Check rudder alternate boost pump by turning it on and actuating rudder. Check for 2500 psi hydraulic pressure with selector at alternate rudder pressure.
6. Accomplish all normal ground tests; have external power source disconnected.

Note

Because of heavy electrical load imposed by ground operation of electronic equipment, all checks of this equipment should be accomplished before the external power source is disconnected.

TAXIING.

1. If possible, avoid taxiing in deep snow, as taxiing and steering may become difficult and frozen brakes may result.
2. When taxiing at low engine speeds, use only essential electrical equipment to conserve battery power.
3. Taxi at greater than normal distance between airplanes, to ensure safe stopping distances and to avoid low visibility and possible surface ice caused by blast of preceding airplane blowing snow.

STARTING JET ENGINE.

Before turning into take-off position on the runway, start the jet engine, using normal starting procedure outlined in Section II.

BEFORE TAKE-OFF.

1. Check controls carefully for free and proper movement and for proper hydraulic pressure output.

2. Hold brakes and run up each reciprocating engine until spark plugs have burned clean and engine is operating smoothly. Then check magnetos.

3. Turn pitot heater on just prior to rolling into position for take-off.

TAKE-OFF.

Do not take off with overdiluted oil. Never take off unless there has been a rise in oil temperature, oil pressure is steady and the engine is running properly. If an oil discharge is noticed during take off, reduce power as quickly as practicable and run at cruising power for at least 10 minutes. Care must be used when using maximum power for take-off in extremely cold temperatures as it may be possible to exceed the maximum allowable bmep by as much as 25% thereby damaging the engine or causing complete failure.

1. Set brakes and advance jet throttle to 100% rpm.

Note

> If runway is slippery and airplane slides forward from jet-engine thrust, release brakes and advance reciprocating-engine throttles while airplane is moving.

2. At start of take-off run, advance throttles rapidly to take-off setting and ascertain that full power is available. If full power is not obtained, discontinue take-off immediately.

AFTER TAKE-OFF.

1. Follow normal procedures outlined in Section II.

2. After taking off from snow- or slush-covered fields, operate flaps through several cycles to prevent their freezing in the up position.

Note

> All lubricants may become stiff or thick in cold weather; therefore, operating cycles may be slower than normal.

CLIMB.

Climb performance will be improved during cold weather operation at lower altitudes. Check flight instruments perodically as extremely cold temperatures may affect their operation.

DURING FLIGHT.

1. Check that cylinder head temperature, carburetor air temperature, and oil temperature, are in desired ranges and, if required, adjust cowl, intercooler, and oil cooler flaps.

2. Increase propeller speed by approximately 200 rpm every 30 minutes to check continued governing. Return controls to desired cruising rpm as soon as the tachometer shows the governor is functioning.

DESCENT.

Temperature inversions are commonly encountered in the Arctic; therefore, care must be taken to avoid engine overcooling during letdown. Lower gear and flaps to reduce airspeed while descending and use enough power to hold desired engine temperature.

APPROACH.

1. Disconnect heated flying suits and all other electrical equipment not absolutely needed.

2. Pump brake pedals several times on approach to be certain pedals are operating properly and brake fluid is not congealed.

LANDING.

1. If snow and ice tires are installed on the airplane, after touch-down apply brakes intermittently and carefully, to keep treads from filling and glazing over.

2. Check cowl flaps open for all ground operation.

3. Pitot heater OFF.

4. Taxi with sufficient rpm to cut in generators (1000 to 1200) if conditions permit, because low temperatures decrease battery output.

STOPPING ENGINES.

OIL DILUTION PROCEDURE. All precautions against fire should be taken during the dilution process and subsequent starting and warm-up. Dilution will increase the inflammability of the vapors issuing from the crankcase breathers and manned fire extinguishers should always be in the immediate vicinity of the engine during these periods. When a cold weather start is anticipated, proceed as follows:

Note

> - If it is necessary to service oil tanks, service before dilution.
> - The oil dilution switch is located on the center console and dilutes both engines simultaneously.

1. With oil cooler flap switch at AUTOMATIC, run engines at 1200 rpm until cylinder head and oil temperatures stabilize at their lowest reading. Oil temperature should be below 70°C. If this reading cannot be obtained, stop engines until oil has sufficiently cooled, then restart engines.

2. Operate engines at 1800 rpm and hold oil dilution at DILUTE as necessary.

Note

> A dilution time of 1¼ minutes will give approximately 10 percent dilution.

3. Operate propeller pitch control through three complete cycles.

4. Momentarily depress each feathering button to obtain 400 rpm drop; then pull button out to UNFEATHER, then return to neutral.

5. Place dilution switch to OFF to hold oil diverter valve at the hopper position; then stop engines.

BEFORE LEAVING AIRPLANE.

1. Release brakes.
2. Have protective covers installed.
3. Have dirt and ice cleaned from shock struts.
4. Inspect fuel and oil tank vents and breathers and remove ice.
5. Check that oil tank sumps, oil line drains, and fuel drains are drained of condensation approximately 30 minutes after stopping engines. If airplane is to be idle for several days, oil may be drained.

Note

> Engine and manifold pressure regulator oil screens should be checked within one or two hours after initial dilution, since carbon and sludge in the engine will be loosened by dilution and will deposit on the screen.

6. Check specific gravity of battery at least weekly. If it is less than 1.250, have battery removed and serviced. If layover of several days is anticipated or if temperature is below −29°C (−20°F) and airplane will be idle more than 4 hours, have battery removed.

7. Leave some opening to compartments to prevent cracking of transparent areas due to differential contraction. Air circulation also retards formation of frost.

DESERT OR HOT-WEATHER PROCEDURES.

The normal procedures outlined in Section II should be adhered to during hot-weather or desert operation, with the following addition:

When the airplane is on the ground in desert areas, cover all openings to prevent entrance of blowing sand.

APPENDIX I

Operating Data Charts

TABLE OF CONTENTS.

INTRODUCTION.

There are two ways to perform a mission. The *correct* method can be determined from the information presented in the charts on the following pages. If a pilot chooses to ignore the charts, he can fly any mission confident that the airplane is capable of greater performance than he is obtaining from it. The basic idea behind these charts is to enable you to fly a greater distance at better cruising speed and to arrive at your destination with more reserve fuel. The charts in many cases point out the penalty, in fuel consumption, when greater than recommended power settings are used. A description of each chart and a sample problem to illustrate a typical mission are included. The charts contain examples, as necessary, to clarify their use.

DESCRIPTION AND USE OF CHARTS.

AIRSPEED CORRECTION FOR COMPRESSIBILITY. Two charts are provided to correct calibrated airspeed (CAS) for compressibility in order to determine equivalent airspeed (EAS). The tabular chart (figure A-1)

COMPRESSIBILITY CORRECTION TABLE

SUBTRACT CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED

CALIBRATED AIRSPEED (KNOTS)	PRESSURE ALTITUDE						
	5000	10,000	15,000	20,000	25,000	30,000	35,000
150	0	0	1	1	2	2	3
200	0	1	2	3	4	5	7
250	1	2	3	5	7	9	12
300	2	3	5	8	11	15	20
350	2	5	8	12	17		
400	3	7	12	17			

160-93-949A

Figure A-1. Airspeed Correction for Compressibility

shows the correction needed at various calibrated airspeeds, in increments of 50 knots, from 150 to 400 knots, at altitudes from 5000 feet to 35,000 feet in 5000-foot increments. The graphical chart (figure A-14) shows the correction needed for calibrated airspeeds of 100 to 650 knots in 10-knot increments, at altitudes of 1000 feet to 50,000 feet, in 100-foot graduations. The airspeed indicator installation error of this airplane is negligible. For all practical purposes, calibrated airspeed is the same as indicated airspeed. The compressibility correction must be subtracted from CAS to obtain EAS. For instance, figure A-1 shows that at 250 knots CAS (which is equal to indicated airspeed) and a pressure altitude of 15,000 feet, 3 knots must be subtracted from CAS to obtain EAS.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY.

In order to obtain an approximate true free air temperature reading, it is necessary to correct the indicated temperature for compressibility effects. A temperature correction table (figure A-2), and a graphical chart

TEMPERATURE CORRECTION TABLE

APPLY CORRECTION TO INDICATED FREE AIR TEMPERATURE
TO OBTAIN APPROXIMATE TRUE FREE AIR TEMPERATURE

PRESSURE ALTITUDE	CALIBRATED AIRSPEED — KNOTS					
	100	150	200	250	300	350
Sea Level	−1	−1	−3	−4	−6	−8
5,000	−1	−2	−3	−5	−7	−9
10,000	−1	−2	−4	−6	−8	−11
15,000	−1	−2	−4	−7	−9	−12
20,000	−1	−3	−5	−8	−10	
25,000	−1	−3	−6	−9	−12	
30,000	−2	−4	−7	−10	−15	
35,000	−2	−5	−8	−13	−16	
40,000	−3	−6	−10			

DATA AS OF: 12-25-51
BASED ON: Flight Test Data, NAA Report 51-1189

169-93-1485

Figure A-2. Temperature Correction for Compressibility (figure A-15) are provided to show the correction needed. As shown on the table, the required correction increases as airspeed and altitude increase. For example, the correction required at 200 knots (CAS) at sea level is 3°C, while at 250 knots (CAS) at 20,000 feet, an 8°C correction is necessary.

DETERMINATION OF TRUE AIRSPEED.

Certain corrections must be applied to indicated airspeed to determine true airspeed (TAS). These corrections can be set down in steps as follows:

1. IAS corrected for installation error becomes CAS. (Since installation error is negligible, IAS becomes CAS).
2. CAS corrected for compressibility becomes equivalent airspeed (EAS).
3. EAS corrected for atmospheric density becomes TAS ($EAS \times \frac{1}{\sqrt{\sigma}} = TAS$).

These corrections can be applied in several ways with varying speed and accuracy. An example of the method of determining approximate TAS is shown in figure A-15. This method is satisfactory for many instances; however, it is not the most accurate. Type D-4 or G-1 computers or dead-reckoning computer AN5835-1 may also be used. To arrive at an accurate TAS, there are several charts provided to show the necessary corrections. Let us take a typical problem and follow it through. This will show the steps necessary and the charts to be used in determining TAS. What is the true airspeed at 20,000 feet pressure altitude when the outside air temperature indicator reads -20°C and the airspeed indicator reads 200 knots?

1. IAS becomes CAS (since installation error is negligible).
2. Three knots must be subtracted from CAS to obtain EAS as shown in figure A-1 ($200 - 3 = 197$ knots).
3. To correct EAS for atmospheric density, the true free air temperature must be known. Indicated free air temperature must be corrected for compressibility to obtain true free air temperature. Figure A-2 shows a -5°C error, which, when added algebraically to the indicated free air temperature, gives an approximate true free air temperature reading of -25°C. This is a Standard Day condition at the altitude of 20,000 feet as shown in figure A-17.
4. TAS is obtained by multiplying EAS by $\frac{1}{\sqrt{\sigma}}$. Figure A-17 shows $\frac{1}{\sqrt{\sigma}}$ at 20,000 feet to be 1.3701, so TAS is 270 knots. ($197 \times 1.3701 = 270$).

In other than Standard Day conditions, $\frac{1}{\sqrt{\sigma}}$ can be determined by use of the density altitude chart (figure A-16). If the true free air temperature in the preceding problem was -30°C, the chart shows $\frac{1}{\sqrt{\sigma}}$ at 20,000 feet to be 1.36, which means TAS is 268 knots ($197 \times 1.36 = 268$).

POWER PLANT CHART.

Figure A-3 shows fuel consumption under recommended power settings for various operating conditions. The conditions covered are Maximum Cruise, Normal Power, Military Power, and Take-off Power. The chart shows that there is very little difference in fuel consumption at different altitudes. This is true because the turbosupercharger furnishes air to the engine at sea level pressure through all altitudes from sea level to approximately 38,000 feet.

Included in the power plant chart are the desired, the maximum, the minimum, and the idling readings to be expected on the fuel pressure, oil pressure, oil temperature, and carburetor air temperature gages. Maximum and minimum rpm, recommended fuel and oil grades, time limits on operation at Take-off and Military Power, and supercharger and mixture control positions are also given. The chart shows the torque pressure to be expected at different power settings. The torque pressure should be used only as a check on the power output, and never to set power. For discussion of engine operating technique, refer to Section V.

JET-ENGINE POWER CHART.

The decrease in jet-engine fuel consumption with altitude at Military Power and Normal Power is shown in figure A-4. Maximum tail-pipe temperatures, approximate oil consumption, and the effect of temperature on fuel consumption are also shown. To determine fuel consumption on a Standard Day, it is only necessary to read the pounds per minute under the appropriate power setting at the desired altitude. To find fuel consumption in other than Standard Day conditions, a correction must be applied to the figures shown. Assuming that the true free air temperature is 10°C above Standard Day (Standard Day temperature at different altitudes is shown in figure A-17), item 3 under *Remarks* states that fuel flow should be decreased 5%. For example, on Standard Day, fuel consumption of the jet engine being operated at Normal Power at 25,000 feet pressure altitude is 40 pounds per minute. If the temperature is 10°C above Standard Day, the fuel flow is 38 pounds per minute ($40 \times .05 = 2$) ($40 - 2 = 38$). To find gallons per minute, divide pounds per minute by fuel density (6.0 lb/gal).

ALTITUDE CHART AND TABLE.

The density altitude chart (figure A-16) and the standard altitude table (figure A-17) are included to assist in determining true airspeed. Refer to DETERMINATION OF TRUE AIRSPEED, in this section, for the use of these charts. In addition to being used in determining TAS, the standard altitude table shows Standard Day conditions of temperature, density ratio, speed of sound ratio, and pressure for altitudes from sea level through 50,000 feet.

ENGINE OPERATING LIMITS CURVE.

The turbosupercharger maintains a constant carburetor entrance pressure from sea level to approximately 38,000 feet. As a result, there is no power loss when engine is operated at or below Normal Rated Power until this altitude is reached. The engine operating limits curve

POWER PLANT CHART

MODELS: AJ-1
AJ-2
AJ-2P

PROPELLER (S)
HAMILTON STANDARD
HUB: 24260-69
BLADE: 2F17M3-24AC

ENGINE MODEL(S)
R-2800-44W

GAGE READING	FUEL PRESS. PSI	OIL PRESS. PSI	OIL TEMP °C		CARB AIR TEMP °C
DESIRED	22	90	60-80		8-30
MAXIMUM	23	110	102		38 (1)
MINIMUM	21	50 (4)	30		
IDLING	14	25	30		

MAXIMUM PERMISSIBLE DIVING RPM: 3120
MINIMUM RECOMMENDED CRUISE RPM: 1600

OIL: ENGINE - MIL-O-6082, GRADE 1100 OR 1065 FOR EXTREME COLD-WEATHER OPERATION
TURBOSUPERCHARGER - MIL-O-6082, GRADE 1065, OR MIL-O-6081, GRADE 1010 WHEN OUTSIDE AIR TEMPERATURE IS BELOW 15°F (-9°C).

FUEL: GRADE 115/145

TAKE-OFF POWER			MILITARY POWER (NONCOMBAT EMERGENCY)			OPERATING CONDITION			NORMAL POWER (MAXIMUM CONTINUOUS)			MAXIMUM CRUISE (NORMAL OPERATION)		
5 MINUTES			30 MINUTES			TIME LIMIT			UNLIMITED			UNLIMITED		
240° C			240°C			MAX CYL HD TEMP			212°C			212°C		
RICH NORMAL 2800			NORMAL NORMAL 2800			MIXTURE SUPERCHARGER RPM			NORMAL NORMAL 2600			NORMAL NORMAL 2300		
MAN. PRESS.	TORQUE PRESS.	FUEL (2) LB/MIN	MAN. PRESS.	TORQUE PRESS.	FUEL (2) LB/MIN	STD TEMP °C	PRESSURE ALTITUDE	STD TEMP °F	MAN. PRESS.	TORQUE PRESS.	FUEL (3) LB/HR	MAN. PRESS.	TORQUE PRESS.	FUEL (3) LB/HR
			F. T.	150	25	-55.0	40,000 FT	-67.0	F. T.	165	810			
			F. T.	170	27	-55.0	38,000 FT	-67.0	48	170	1200			
			F. T.	195	29	-55.0	36,000 FT	-67.0	48	170	1200			
			60	200	33	-52.4	34,000 FT	-62.3	48	170	1200			
			60	200	33	-48.4	32,000 FT	-55.1	48	170	1190	35.5	135	610
			60	200	33	-44.4	30,000 FT	-48.0	48	170	1180	35.5	135	610
			60	200	33	-40.5	28,000 FT	-40.9	48	170	1170	35.5	135	610
			60	200	33	-36.5	26,000 FT	-33.7	48	170	1160	35.5	135	610
			60	200	33	-32.5	24,000 FT	-26.5	48	170	1160	35.5	135	600
			60	200	33	-28.6	22,000 FT	-19.4	48	170	1150	35.5	135	600
			60	200	33	-24.6	20,000 FT	-12.3	48	170	1140	35.5	135	600
			60	200	33	-20.7	18,000 FT	- 5.2	48	170	1130	35.5	135	600
			60	200	33	-16.7	16,000 FT	2.0	48	170	1130	35.5	135	600
			60	200	33	-12.7	14,000 FT	9.1	48	170	1120	35.5	135	600
			60	200	33	- 8.8	12,000 FT	16.2	48	170	1120	35.5	135	600
			60	200	33	- 4.8	10,000 FT	23.4	48	170	1110	35.5	135	600
			60	200	33	- 0.8	8,000 FT	30.5	48	170	1100	35.5	135	600
61	200	34	60	200	33	3.1	6,000 FT	37.6	48	170	1100	35.5	135	600
61	200	34	60	200	33	7.1	4,000 FT	44.7	48	170	1090	35.5	135	580
61	200	34	60	200	33	11.0	2,000 FT	51.8	48	170	1090	35.5	135	580
61	200	34	60	200	33	15.0	SEA LEVEL	59.0	48	170	1080	35.5	135	580

GENERAL NOTES

(1) Max carb air temp - 38°C
(2) Lb/Min: Approximate pounds per minute per engine.
(3) Lb/Hr. Approximate pounds per hour per engine.
(4) Minimum oil pressure for Take-off, Military, and Normal Rated Power: 75 psi.
(5) Grade 100/130 fuel data will be included when available; until then, use only Grade 115/145 fuel.

FT: Full throttle operation

TAKE-OFF CONDITIONS:

61 in. Hg, 2800 rpm, mixture RICH, supercharger NORMAL (5 min max).

CONDITIONS TO AVOID:

Ground operation between 1400 and 1800 rpm.
Flight operation between 1400 and 1600 rpm.

SPECIAL NOTES

Torque pressure to be used only as a cross-check on manifold pressure and rpm settings.

DATA AS OF: 12-25-51 BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

169-93-1457B

AAFMC-526
4-1-44

Figure A-3. Power Plant Chart—Reciprocating Engines

JET-ENGINE POWER CHART

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (1) J33-A-10

PRESSURE ALTITUDE (FEET)	FUEL CONSUMPTION (POUNDS PER MINUTE)	
	MILITARY POWER 100% RPM (30 MIN LIMIT)	NORMAL POWER 96% RPM (MAXIMUM CONTINUOUS)
SEA LEVEL	92	78
5,000	83	69
10,000	72	60
15,000	63	53
20,000	54	46
25,000	47	40
30,000	40	35
35,000	34	29
40,000	27	23
45,000	21	18

REMARKS:

1. Tail-pipe temperature limits:
   Military Power 700°C
   Normal Power 654°C
2. Oil consumption: approximately one quart per hour.
3. For each 10°C change in air temperature from Standard Day:
   Temp. rise... Decrease Fuel Flow 5%
   Temp. drop .. Increase Fuel Flow 5%

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA,
NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1486C

Figure A-4. Jet-engine Power Chart

(figure A-18) shows the power drop from above 38,000 feet to 48,500 feet. The reason for this operating limitation is the inability of the turbosupercharger to maintain sea level pressure above this altitude. In other words, the reciprocating engines can be expected to operate above approximately 38,000 feet as an unsupercharged engine would operate from sea level. Operation of the reciprocating engines above 38,000 feet must be confined to the limits shown in the Operating Limits Curve. For example, the chart shows that operation at Normal Rated Power (2800 rpm at 48 in. Hg manifold pressure) is not possible above approximately 38,000.

HUMIDITY CORRECTION FOR TAKE-OFF.

Figure A-19 shows the method of determining the specific humidity when wet and dry bulb temperatures are known. To use the chart, find coinciding point of wet and dry bulb temperature (°F), and read the value given in the extreme right column. For instance, if the dry bulb temperature is 80°F and the wet bulb temperature is 65°F, the specific humidity shown directly opposite the coinciding point of the two temperatures is approximately .01. This is the specific humidity to be corrected for to determine take-off ground run. Dew Point and Vapor Pressure can also be determined by following instructions given on the chart.

TAKE-OFF DISTANCES.

For operation from a land base, take-off ground run distances and total distances to clear a 50-foot obstacle are shown in figures A-20 through A-25. The charts cover both normal and maximum performance take-off conditions. To determine the ground run distance, enter the chart at the correct temperature, move vertically to the pressure altitude (this is the altitude of the base from which take-off is to be made), move right horizontally to the take-off gross weight, then read ground distance directly below this point. This will give the ground run distance at zero wind. To correct for specific humidity and wind velocity, continue down to the 0 line of the specific humidity portion of the chart, then follow guide lines to the specific humidity, move down vertically to the 0 wind line, then follow guide lines to the correct wind velocity, and read the ground distance directly above this point. This will show ground run distance necessary for take-off. To determine the additional distance required to clear a 50-foot obstacle, refer to figure A-22 if take-off is to be made with full flaps, or figure A-24 if take-off is to be made with half flaps. To read these charts, enter the chart at the ground run distance (determined from the take-off distances chart for the corresponding configuration), move up to the line designating the wind velocity, and read the figure directly to the left. This figure must be added to the ground run distance to obtain total distance to clear a 50-foot obstacle. Figures A-20 and A-25 have additional air distance shown on the ground run charts.

TAKE-OFF VELOCITIES.

Take-off velocities in knots (IAS) are shown in figures A-26 through A-28. The take-off velocities shown represent the normal IAS at which the airplane becomes airborne. To determine the take-off velocity, enter the chart (as shown in the example in figure A-26) at the correct temperature, move vertically to the pressure altitude of the base from which take-off is to be made, then move horizontally to the gross weight at which take-off is to be made, and read the velocity directly below this point.

CLIMB CHARTS.

Best climb speed, fuel consumed, time to climb, distance covered, and rate of climb can be determined from the climb charts. There are both tabular charts (figures A-6 through A-12) and graphic charts (figures A-29 through A-38) included. All climb conditions are covered, including Normal Power, Military Power, and Maximum Cruise Power climbs, for various configurations and gross weights. These charts include a fuel allowance of 700 pounds for warm-up, taxi, and take-off. To use the tabular charts, locate the chart that covers the expected climb condition and configuration, then read the portion of the chart covering the weight of the airplane at the beginning of climb. For instance, figure A-7, covering Normal Power Climb using reciprocating engines with tip tanks installed, shows under the weight of 50,000 pounds, that a climb from sea level to 20,000 feet will consume 1700 pounds of fuel, will take 26 minutes, the airplane will cover 70 nautical miles, and the best climb speed is 160 knots at beginning of climb and reduced to 155 knots during last portion of climb. To determine an in-flight climb from one altitude to another, subtract the values at the beginning of climb from the values at the completion of climb. From the same chart, a climb from 10,000 feet to 20,000 feet for a gross weight of 50,000 pounds, at beginning of climb, shows: 600 pounds of fuel consumed $(1700 - 1100 = 600)$, 14 minutes required $(26 - 12 = 14)$, and 40 nautical miles covered $(70 - 30 = 40)$. The CAS shown represents the best climb speed. In using the graphical charts, a climb from sea level to 30,000 feet using Normal Rated Power on all three engines, is read as follows (figure A-31): Enter chart at initial gross weight (53,000 pounds) and initial altitude (sea level), follow guide line to final altitude (30,000 feet). This point is shown as "B" on the chart, and all values are read from this point. The final gross weight is shown directly below, the time to climb directly to the right, and the distance covered (in nautical ground miles) is shown directly to the left. The difference between initial and final gross weight represents the fuel consumed (2300 pounds), the time to climb is shown as 23 minutes, and the distance traveled is 84 nautical ground miles. Best climb speeds (CAS) to maintain maximum rate of climb are shown in figures A-37 and A-38. All climb charts (both tabular and graphic) are based on Standard Day conditions, and the correction necessary to compensate for temperature variation is shown on each chart. To convert the pounds of fuel to gallons, divide the pounds by fuel density (6.0 lb/gal).

BOMB RUN PLANNING CHARTS.

The bomb run planning charts (figures A-39 through A-41) are included to enable you to determine approximate fuel consumption for a typical bombing mission. In using these charts, it is necessary to know the radius of the mission, the take-off gross weight, cruise-out altitude, target run-in and run-out distances, and cruise-back altitude. The charts cover a normal mission, a high altitude target run, and a mission where the bomb load is not dropped. To determine fuel required, the example on figure A-39 shows that it is necessary to enter the chart at mission radius (725 nautical miles), move parallel to guide lines to take-off gross weight, then to diagonal base line, then to horizontal base line. From this point, follow guide line to cruise-out altitude (shown as point "E" on the chart), then move vertically to base line. Mark this spot; re-enter the chart at target run-in and run-out distance (shown as "J" on the chart), and follow guide lines to target altitude; then move horizontally to a point where an imaginary line drawn from point "K" would intersect with an imaginary line drawn parallel to the guide lines from the previously marked spot (shown as point "H" on the chart). Move vertically from this intersecting point to target altitude in top portion of the chart, and follow guide lines to cruise-back altitude, then move vertically to top of chart. This point will show fuel required for the mission.

NAUTICAL MILES PER POUND OF FUEL.

These charts (figures A-42 through A-68) show fuel flow, power settings, and airspeeds required to maintain level flight at any specific range for various gross weights. The maximum endurance shown on these charts is based on maximum flying time for a given fuel loading, which would be desirable in the event a fouled deck prevents landing and maximum flight time is desired. The recommended CAS is based on minimum fuel requirements for a flight of a given distance. While the power setting required to maintain the recommended CAS is higher than that required to give maximum range per pound of fuel, the saving in time required to cover a given distance is sufficiently high that less fuel is required to complete the flight than would be required if maximum range were obtained by sacrificing airspeed. Maintaining proper relationship between manifold pressure, torque pressure, fuel flow, and airspeed will provide the most efficient operation possible. The power settings are based on Standard Day conditions, and the manifold pressures shown should be increased or decreased 1/4 inch for each 6°C CAT variation from Standard Day. This adjustment is permissible only at power settings below 2500 rpm. Manifold pressure will not necessarily be identical for both engines; however, the spread between settings should never exceed 2 inches. To use the charts, we will assume that flight at 10,000 feet using reciprocating engines is desired. The configuration is clean (no tip tanks installed) and airplane gross weight is 40,000 pounds. Figure A-44 shows that a power setting of 1800 rpm, 35.5 in. Hg manifold pressure, and torque pressure of 130 psi will give maximum range (.215 nautical miles per pound of fuel). This figure is read directly to the left of the point where the line extending from the power setting and the line representing the gross weight coincide. The airspeed, read directly below this point is shown to be 164 knots. However, by increasing the power setting to 2000 rpm, 35.0 in. Hg manifold pressure, and 130 psi torque pressure, the specific range is decreased to .213; but the airspeed is increased to 180 knots. This is shown as the recommended power setting to cover the maximum distance with the minimum fuel consumption. In addition to normal operation with both reciprocating engines or both reciprocating engines and the jet engine, charts are included to cover emergency operation with one reciprocating engine, and with one reciprocating engine plus jet engine.

DESCENT CHARTS.

The descent charts show rate of descent, distances covered, time to descend, and fuel used during descent from various altitudes to sea level at the recommended descent power setting on the reciprocating engines. The tabular chart (figure A-13) shows that by maintaining 2000 rpm at 35 in. Hg MP and a constant CAS of 220 knots, a descent from 20,000 feet to sea level will consume 250 pounds of fuel, will take 15 minutes to complete, and the airplane will cover 65 nautical ground miles. The rate of descent will be 1600 feet per minute at the start of the descent, and will decrease to 1100 feet per minute at sea level. By entering the graphical chart (figure A-79) at the beginning altitude of 20,000 feet and reading the figures directly below the point each of the lines for the different values cross the altitude line, the same set of figures can be obtained. TAS is also shown on this chart.

FLIGHT MISSION PLANNING.

In addition to those charts already discussed, other charts are included to assist you in flight mission planning.

The maximum range power conditions vs. gross weight charts (figures A-71 and A-72) contain a summary of the maximum range shown on the nautical miles per pound of fuel charts. The maximum endurance charts (figures A-73 and A-74) contain a summary of the maximum endurance information from the same charts. In reading these charts, enter the chart at the correct gross weight, and move up along this line. The values are read to the right or left of the point where this line crosses the lines representing the altitude.

The long-range prediction charts (figures A-75 through A-78) are also based on the nautical miles per pound of fuel charts. An example in each chart shows how to determine the desired information.

The oil consumption chart (figure A-69) is included to show the relation between fuel and oil consumption. The use of this chart is discussed under the sample problem.

The landing ground roll chart (figure A-80) shows the ground roll to be expected when landing at various gross weights with head winds from 0 to 40 knots. The chart also shows additional distance to clear a 50-foot obstacle after the ground roll distance has been determined. An example shown in the chart explains the method of determining these distances.

The emergency climb charts (figure A-81) show the rate of climb that can be attained at various gross weights with the following configurations:

1. Flaps and gear up.
2. Flaps down and gear up.
3. Flaps and gear down.

By showing the rate of climb, these charts also show the airspeed necessary to maintain level flight in the various configurations. The charts cover operation at Military Power on three engines, two reciprocating engines, one reciprocating engine, and one reciprocating engine plus the jet engine. As an example of their use, figure A-81 (sheet 2 of 3) shows that at a gross weight of 40,000 pounds in configuration "2" (flaps down and gear up), level flight cannot be maintained at a CAS greater than 100 knots. Figure A-81 (sheet 3 of 3) also shows the correction that must be made to rate of climb when one propeller is windmilling.

The emergency cruising ceiling chart (figure A-82) shows the ceiling that can be reached at Normal Rated or Military Power on all three engines, two reciprocating engines, one reciprocating engine plus jet engine, and one reciprocating engine only. The chart shows that with Military Power on one reciprocating engine only, and an airplane gross weight of 40,000 pounds, the maximum ceiling that can be attained is 20,000 feet.

Two other charts covering emergency conditions are included, decision speed for emergency take-off after jet-engine failure (figure A-83), and decision speed for stopping (figure A-84). Examples showing the use of these charts are included on each chart.

To use the Appendix charts in flight mission planning, it is necessary to estimate an approximate airplane fuel loading with sufficient allowances for weather conditions, general reserve, type of mission and other factors dictated by local policy. Then a step-by-step analysis of the fuel consumption, speed, distance and time at recommended engine control settings is made for each phase of the intended mission. It may be necessary to revise the original fuel loading estimate if it does not agree with the requirements as determined by the analysis. The following sample problem illustrates the proper use of the charts for an unchanged flight plan, and a flight plan that is changed en route.

SAMPLE PROBLEM.

A typical combat mission is to be flown according to the flight plan illustrated in figure A-5. Three 2000-pound bombs are to be dropped on a target 500 nautical miles from the base. To escape radar detection, the flight going toward the target will be made at sea level. After the bombs are dropped, the return flight will be made at sea level to a point 50 nautical miles from the target. A climb will then be made to 10,000 feet, and the flight will be completed at this altitude.

Normal Power will be used on the reciprocating engines while within 50 nautical miles of the target. Military Power will be used on the jet engine and both reciprocating engines for 5 minutes, while over the target.

Write down the conditions of the problem:

Required range ....1000 nautical miles
Weather ....CAVU
Winds outbound..20-knot effective head wind at sea level
Winds return ......20-knot effective tail wind at sea level
30-knot effective tail wind at 10,000 feet

Airplane basic weight ....32,300 pounds
Tip tank fuel ....3,610 pounds
Maximum internal fuel ....7,302 pounds
Three 2000-pound bombs ....6,000 pounds
Total gross weight ....49,212 pounds

To make sure the mission is flown in an efficient manner, a thorough analysis of the problem must be made. It is necessary to divide the flight into several phases, each phase representing a change in flight conditions.

PHASE 1 — WARM-UP AND TAKE-OFF

FIGURE	INITIAL GROSS WEIGHT	POUNDS FUEL ABOARD	DISTANCE — NAUTICAL MILES	POUNDS FUEL USED
A-7	49,212	10,912	0	700

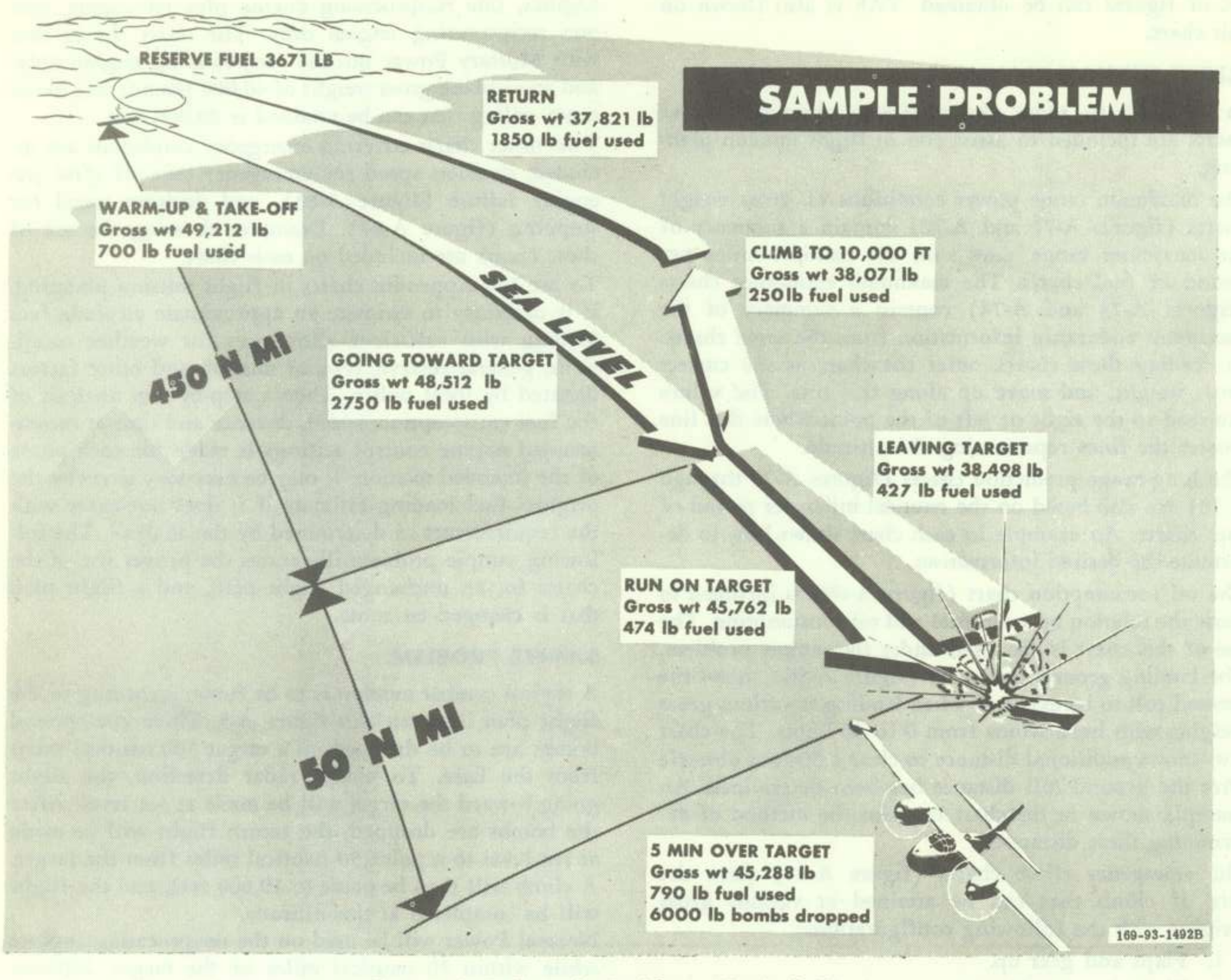


Figure A-5. Sample Problem—Typical Mission

Initial Weight: This item is computed at the beginning of the problem.

Fuel Used: This item is read directly from the sea level column in figure A-7.

PHASE 2 — GOING TOWARD TARGET

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	POWER SETTINGS	LBS/HR	TAS	GROUND SPEED	HOURS	DISTANCE — NAUTICAL GROUND MILES	POUNDS FUEL USED
A-72	48,512	10,212	2100 RPM 34.4 In. Hg 130 PSI Mixture Normal	1025	188	168	2.68	450	2750

Gross Weight and Fuel Remaining: Since 700 pounds of fuel were used in warm-up and take-off, gross weight and fuel remaining are reduced accordingly (49,212 — 700 = 48,512 and 10,912 — 700 = 10,212).

RPM, MP, TP, LBS/HR, and TAS: Read these items from figure A-72 at a gross weight of 48,512 pounds. (It is assumed that this mission is made on a Standard Day, in which case TAS is the same as CAS at sea level.

Ground Speed: Subtract the head wind from the true airspeed (188 − 20 = 168 knots).

Hours: Divide distance by ground speed (450 ÷ 168 = 2.68 hours).

Distance: The distance is to a point 50 nautical miles from the target.

Fuel Used: Multiply pounds per hour by hours (1025 × 2.68 = 2750 pounds).

PHASE 3 — RUN-ON TARGET

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	POWER SETTINGS	LBS/HR	TAS	GROUND SPEED	HOURS	DISTANCE — NAUTICAL GROUND MILES	POUNDS FUEL USED
A-3 A-50	45,762	7462	2600 RPM 48 In. Hg 170 PSI Mixture Normal	2160	248	228	.219	50	474

Gross Weight and Fuel Remaining: Since 2750 pounds of fuel were used to fly Phase 2, the gross weight becomes 45,762 pounds (48,512 − 2750 = 45,762) and the fuel remaining is 7462 (10,212 − 2750 = 7462).

RPM, MP, TP, LBS/HR: Read these items from figure A-3 under Normal Power opposite sea level. Double the fuel flow value, since both reciprocating engines are operating.

TAS: Is obtained from figure A-50 at Normal Rated Power and 45,762 pounds.

Ground Speed: Subtract head wind from true airspeed (248 − 20 = 228 knots).

Hours: Divide distance by ground speed (50 ÷ 228 = .219 hours).

Distance: The distance covered in Phase 3 is 50 nautical miles (distance remaining to the target).

Fuel Used: Multiply pounds per hour by hours (2160 × .219 = 474 pounds).

PHASE 4 — OVER TARGET

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	R-2800 POWER SETTING	R-2800 LBS/MIN	J33 POWER SETTING	J33 LBS/MIN	MINUTES	POUNDS FUEL USED
A-3 A-4	45,288	6988	2800 RPM 60 In. Hg 200 PSI	66	100% RPM	92	5	790

Note

> The conditions of this mission are determined by the problem as 5 minutes over the target at Military Power on all engines.

Gross Weight and Fuel Remaining: Since 474 pounds of fuel were used to fly Phase 3, gross weight becomes 45,288 pounds (45,762 − 474 = 45,288) and fuel is reduced to 6988 pounds (7462 − 474 = 6988).

R-2800 RPM, MP, TP, and LBS/MIN: Read these items (figure A-3) at sea level under Military Power. Double fuel flow value, since both reciprocating engines are operating.

J33 RPM and LBS/MIN: Read these items directly from figure A-4 under Military Power at sea level.

Minutes: Conditions of the problem state that 5 minutes is the time necessary over the target.

Fuel Used: Multiply total pounds per minute by minutes (66 + 92 × 5 = 790 pounds).

PHASE 5 — LEAVING TARGET AREA

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	POWER SETTINGS	LBS/HR	TAS	GROUND SPEED	HOURS	DISTANCE — NAUTICAL GROUND MILES	POUNDS FUEL USED
A-3 A-50	38,498	6198	2600 RPM 48 In. Hg 170 PSI	2160	252	252	.198	50	427

Gross Weight: Bombs were dropped during Phase 4 and 790 pounds of fuel were used, so the weight becomes 38,498 pounds (45,288 − 6000 − 790 = 38,498).

Fuel Remaining: Fuel was reduced by 790 pounds in Phase 4 (6988 − 790 = 6198).

RPM, MP, TP, LBS/HR: Read these items under Normal Power opposite sea level in figure A-3. Double the fuel flow value since both reciprocating engines are operating.

TAS: Is obtained from figure A-50 at Normal Rated Power at 38,498 pounds.

Ground Speed: This figure is the same as true airspeed because the tail wind is considered as zero wind.

Hours: Divide distance by ground speed (50 ÷ 252 = .198 hours).

Distance: The distance covered in this phase is the distance from the target to the point of climb.

Fuel Used: Multiply pounds per hour by hours (2160 × .198 = 427 pounds).

PHASE 6 — CLIMB

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	POWER SETTINGS	CONDITION	HOURS	DISTANCE — NAUTICAL GROUND MILES	POUNDS FUEL USED
A-7	38,071	5771	2600 RPM 48 In. Hg 170 PSI	Climb from Sea Level to 10,000 Feet	.100	15	250

Gross Weight and Fuel Remaining: Since 427 pounds of fuel were consumed during Phase 5, the gross weight becomes 38,071 pounds (38,498 − 427 = 38,071) and the fuel remaining is 5771 pounds (6198 − 427 = 5771).

RPM, MP, TP: The normal power climb chart (figure A-7) is based on climb at Normal Power on two reciprocating engines.

Time and Distance: These values (figure A-7) are for a climb to 10,000 feet.

Fuel Used: This figure is for a climb to 10,000 feet minus the amount shown for sea level (950 − 700 = 250 pounds).

PHASE 7 — RETURN

FIGURE	GROSS WEIGHT	POUNDS FUEL REMAINING	POWER SETTINGS	LBS/HR	TAS	GROUND SPEED	HOURS	DISTANCE — NAUTICAL GROUND MILES	POUNDS FUEL USED
A-52 A-72	37,821	5521	1770 RPM 35.5 In. Hg 130 PSI	860	202	202	2.15	435	1850

Note

> Although the last miles of the flight will be used for descent at lower power than cruising, fuel used is calculated on the basis of cruising at altitude up to the home base. The extra fuel calculated by this method is considered to be used in the approach and landing pattern.

Gross Weight and Fuel Remaining: Since 250 pounds of fuel were used during Phase 6, the gross weight becomes 37, 821 pounds (38,071 − 250 = 37,821) and the fuel remaining is reduced to 5521 pounds (5771 − 250 = 5521).

RPM, MP, LBS/HR, CAS: These items are obtained from figure A-72 at a gross weight of 37,821 pounds.

TAS: Obtain $\Delta Vc = 0.7$ knots from figure A-14 and $\frac{1}{\sqrt{\sigma}} = 1.1637$ from figure A-17 and using CAS = 174 knots compute TAS = (174 − 0.7) × 1.1637 = 202 knots.

Ground Speed: Because the tail wind is considered as no wind, this item is the same as true airspeed.

Hours: Divide distance by ground speed (435 ÷ 202 = 2.15 hours).

Distance: Remaining distance to the home base, or 500 nautical miles for return from target minus 50 nautical miles flown at sea level, minus 15 nautical miles to climb to 10,000 feet (500 − 50 − 15 = 435 nautical miles).

Fuel Used: Multiply pounds per hour by hours (860 × 2.15 = 1850 pounds).

Note

The flight will be completed with a 3671-pound fuel reserve (5521 − 1850 = 3671). A general reserve of 3000 pounds has been allowed for contingencies in the original fuel configuration estimate so that an excess of 671 pounds of fuel is available. This additional fuel permits the flight to be re-planned around higher powers and speeds on certain legs or the original fuel configuration can be reduced by 671 pounds. Otherwise, the mission may be flown as originally planned, with the excess fuel constituting an additional safety factor.

It is evident from the oil consumption chart (figure A-69) that the fuel consumed during the previous typical mission will not exhaust the oil supply; however, the following breakdown of the flight will illustrate the use of the oil consumption chart.

PHASE	RPM	POUNDS FUEL USED	POUNDS OIL USED
1. Warm-up and Take-off	2800	700	30
2. Going Toward Target	2100	2750	70
3. Run-on Target	2600	474	15
4. Over Target	2800	300*	14
5. Leaving Target	2600	427	15
6. Climb	2600	250	11
7. Return	1770	1850	35
TOTAL		6781	190
*Fuel used by reciprocating engines only			

Should an emergency arise during flight, the remainder of the flight would have to be planned in the air. The following problem demonstrates a method of making a quick decision:

Suppose that one of the reciprocating engines fails at 5000 feet during the climb (Phase 6) in the preceding problem. The gross weight and the fuel remaining are reduced 150 pounds, which is the amount of fuel consumed during the climb from sea level to 5000 feet. (Figure A-7 shows 150 pounds difference between the amount of fuel at sea level and at 5000 feet.) The gross weight becomes 37,921 pounds (38,071 − 150 = 37,921). Disregarding the distance covered during the climb before the engine failed, the remaining distance to be covered during the return is 450 nautical miles. Referring to the single-engine cruise charts (figures A-60 through A-64), the amount of fuel needed to return to the home base can be determined. The solution to this emergency requires single-engine operation at 5000 feet (figure A-63). Enter a weight of approximately 38,000 pounds on the recommended CAS line (figure A-63) to obtain a specific range value of .187 nautical miles per pound fuel. By dividing the distance remaining by the specific range, the fuel required to return to the home base is 2410 pounds (450 ÷ .187 = 2410). The remaining 3193 pounds (5603 − 2410 = 3193) of fuel is available to assure the general reserve of 3000 pounds plus an additional reserve of 193 pounds for any further contingencies.

The chart (figure A-63) shows that the required return distance of 450 nautical miles will be made with the remaining reciprocating engine operating at a speed of 2500 rpm, a manifold pressure of 40.5 in. Hg and a torque pressure of 165 psi while maintaining a CAS of 146 knots at 5000 feet. This CAS corresponds to a TAS of 157 knots determined by the use of figures A-14 and A-17, since TAS = 145.7 − 0.2 × 1.0773 = 157 knots.

WADC
Form 2411
(11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY
RECIPROCATING ENGINES

MODELS: AJ-1
AJ-2
AJ-2P

(1) J33-A-10
ENGINE(S): (2) R-2800-44W

CONFIGURATION: CLEAN
GROSS WEIGHT: 50,000 POUNDS

CONFIGURATION: CLEAN
GROSS WEIGHT: 45,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
950	0	0	700(1)	48	160	SEA LEVEL	150	48	700(1)	0	0	1250
850	15	6	950	48	160	5,000	150	48	1000	4	10	1150
750	35	12	1200	48	160	10,000	150	48	1050	10	25	1050
650	55	20	1500	48	160	15,000	150	48	1250	14	40	950
500	85	28	1800	48	155	20,000	150	48	1500	20	60	800
350	135	40	2200	48	155	25,000	145	48	1800	26	85	650
				48	150	30,000	145	48	2150	35	115	450
						35,000	140	48	3000	60	220	150
						40,000						
						45,000						

CONFIGURATION: CLEAN
GROSS WEIGHT: 40,000 POUNDS

CONFIGURATION: CLEAN
GROSS WEIGHT: 35,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
1600	0	0	700(1)	48	145	SEA LEVEL	135	48	700(1)	0	0	2000
1500	10	3	850	48	145	5,000	135	48	800	3	5	1950
1400	20	7	950	48	145	10,000	135	48	900	5	15	1850
1300	30	11	1100	48	140	15,000	130	48	1050	9	20	1750
1150	40	15	1300	48	140	20,000	130	48	1200	11	30	1600
1050	55	20	1500	48	135	25,000	130	48	1300	15	40	1450
850	75	26	1700	48	135	30,000	125	48	1500	18	50	1300
500	105	33	2000	48	130	35,000	125	48	1700	23	70	950
						40,000						
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds
2. Normal climb power - 2600 rpm
   - 48 in. Hg MP
3. For each 10°C rise in air temperature above Standard Day conditions:

Increase	
Time to climb	5 percent
Distance covered	7 percent
Fuel used	3 percent
Decrease	
Rate of climb	5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1447B

Figure A-6. Normal Power Climb—Reciprocating Engines

WADC
Form 2411
(11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY

RECIPROCATING ENGINES

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (1) J33-A-10
(2) R-2800-44W

CONFIGURATION: TWO 300 GAL TIP TANKS							CONFIGURATION: TWO 300 GAL TIP TANKS					
GROSS WEIGHT: 54,000 POUNDS							GROSS WEIGHT: 50,000 POUNDS					
APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
850	0	0	700(1)	48	165	SEA LEVEL	160	48	700(1)	0	0	1000
750	20	7	950	48	165	5,000	160	48	900	5	15	950
650	40	15	1250	48	165	10,000	160	48	1100	12	30	850
500	70	25	1600	48	165	15,000	160	48	1400	19	50	700
400	115	35	2100	48	165	20,000	155	48	1700	26	70	600
200	195	54	3000	48	160	25,000	155	48	2150	36	120	450
						30,000	150	48	3000	54	200	250
						35,000						
						40,000						
						45,000						

CONFIGURATION: TWO 300 GAL TIP TANKS							CONFIGURATION: TWO 300 GAL TIP TANKS					
GROSS WEIGHT: 45,000 POUNDS							GROSS WEIGHT: 40,000 POUNDS					
APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
1300	0	0	700(1)	48	150	SEA LEVEL	145	48	700(1)	0	0	1650
1200	10	4	850	48	150	5,000	145	48	850	3	10	1550
1100	20	9	1050	48	150	10,000	145	48	950	6	15	1450
1000	35	14	1250	48	150	15,000	140	48	1100	11	25	1350
900	55	19	1500	48	150	20,000	140	48	1250	14	35	1250
750	75	25	1700	48	145	25,000	135	48	1450	19	55	1100
550	110	33	2000	48	140	30,000	135	48	1600	24	70	900
200	170	48	2700	48	140	35,000	135	48	2000	31	100	550
						40,000						
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds
2. Normal climb power - 2600 rpm
   - 48 in. Hg MP
3. For each 10°C rise in air temperature above Standard Day conditions:
   Increase
   - Time to climb 5 percent
   - Distance covered 7 percent
   - Fuel used 3 percent

   Decrease
   - Rate of climb 5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1448B

Figure A-7. Normal Power Climb—Reciprocating Engines—with Tip Tanks

WADC
Form 2411
(11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY

TWO RECIPROCATING ENGINES PLUS JET ENGINE

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (2) R-2800-44W
(1) J33-A-10

CONFIGURATION: CLEAN OR TWO 300 GAL TIP TANKS
GROSS WEIGHT: 54,000 POUNDS

CONFIGURATION: CLEAN OR TWO 300 GAL TIP TANKS
GROSS WEIGHT: 50,000 POUNDS

APPROXIMATE RATE OF CLIMB (FPM)	APPROXIMATE FROM SEA LEVEL DISTANCE	APPROXIMATE FROM SEA LEVEL TIME	APPROXIMATE FROM SEA LEVEL FUEL	MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE FROM SEA LEVEL FUEL	APPROXIMATE FROM SEA LEVEL TIME	APPROXIMATE FROM SEA LEVEL DISTANCE	APPROXIMATE RATE OF CLIMB (FPM)
1700	0	0	700(1)	48	180	SEA LEVEL	173	48	700(1)	0	0	1950
1550	10	3	1050	48	179	5,000	172	48	1000	2.5	5	1800
1400	20	6.5	1450	48	178	10,000	171	48	1350	5.5	15	1650
1200	30	10	1800	48	176	15,000	169	48	1650	9	25	1450
1000	50	15	2200	48	174	20,000	167	48	2000	13	40	1250
800	70	20	2700	48	171	25,000	165	48	2400	17	55	1050
500	105	28	3300	48	168	30,000	161	48	2800	22	80	800
150	180	44	4600	48	164	35,000	157	48	3500	31	115	400
						40,000						
						45,000						

CONFIGURATION: CLEAN OR TWO 300 GAL TIP TANKS
GROSS WEIGHT: 45,000 POUNDS

CONFIGURATION: CLEAN OR TWO 300 GAL TIP TANKS
GROSS WEIGHT: 40,000 POUNDS

APPROXIMATE RATE OF CLIMB (FPM)	APPROXIMATE FROM SEA LEVEL DISTANCE	APPROXIMATE FROM SEA LEVEL TIME	APPROXIMATE FROM SEA LEVEL FUEL	MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE FROM SEA LEVEL FUEL	APPROXIMATE FROM SEA LEVEL TIME	APPROXIMATE FROM SEA LEVEL DISTANCE	APPROXIMATE RATE OF CLIMB (FPM)
2300	0	0	700(1)	48	165	SEA LEVEL	155	48	700(1)	0	0	2700
2150	5	2.5	950	48	164	5,000	154	48	950	2	5	2550
2000	10	5	1250	48	162	10,000	153	48	1150	4	10	2400
1800	20	7.5	1500	48	161	15,000	152	48	1400	6	15	2200
1600	30	10	1750	48	159	20,000	150	48	1600	8.5	25	2000
1400	45	14	2100	48	157	25,000	148	48	1800	11	35	1800
1150	60	18	2400	48	153	30,000	146	48	2100	14	45	1550
750	80	23	2800	48	149	35,000	143	48	2400	18	60	1100
						40,000	143	F.T.	2900	26	95	300
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds
2. Normal Power - 2600 rpm
   -48 in. Hg MP
   - 96% rpm (jet engine)
3. For each 10°C rise in air temperature above Standard Day conditions:

Increase	
Time to climb	5 percent
Distance covered	7 percent
Fuel used	3 percent
Decrease	
Rate of climb	5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED
F.T. - FULL THROTTLE

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1449A

Figure A-8. Normal Power Climb—Three Engines

WADC
Form 2411
(11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

TWO RECIPROCATING ENGINES PLUS JET ENGINE

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (1) J33-A-10
(2) R-2800-44W

CONFIGURATION: CLEAN
GROSS WEIGHT: 50,000 POUNDS

CONFIGURATION: CLEAN
GROSS WEIGHT: 45,000 POUNDS

APPROXIMATE									APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL			MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
2950	0	0	700(1)	60	202	SEA LEVEL	192	60	700(1)	0	0	3400
2800	5	2	950	60	201	5,000	191	60	950	1.5	5	3200
2550	10	4	1200	60	199	10,000	190	60	1150	3	10	3000
2350	20	6	1500	60	198	15,000	188	60	1350	5	15	2750
2050	30	8	1750	60	196	20,000	187	60	1600	7	20	2500
1750	40	10.5	2050	60	194	25,000	185	60	1850	9	30	2200
1350	55	14	2400	60	192	30,000	183	60	2100	12	45	1800
550	85	19	2900	F.T.	189	35,000	180	F.T.	2500	15	60	950
						40,000	176	F.T.	3500	29	135	50
						45,000						

CONFIGURATION: CLEAN
GROSS WEIGHT: 40,000 POUNDS

CONFIGURATION:
GROSS WEIGHT:

APPROXIMATE									APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL			MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
3950	0	0	700(1)	60	178	SEA LEVEL						
3750	4	1.5	900	60	177	5,000						
3550	8	3	1100	60	176	10,000						
3300	15	4.5	1300	60	175	15,000						
3050	20	6	1500	60	173	20,000						
2750	25	7.5	1650	60	171	25,000						
2300	35	9.5	1850	60	169	30,000						
1450	45	12.0	2100	F.T.	167	35,000						
500	70	18	2600	F.T.	164	40,000						
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds
2. Military Power - 2800 rpm
   - 60 in. Hg MP
   - 100% rpm (jet engine)
3. Military Power operation limited to 30 minutes
4. For each 10°C rise in air temperature above Standard Day conditions:
   Increase
   Time to climb 5 percent
   Distance covered 7 percent
   Fuel used 3 percent
   Decrease
   Rate of climb 5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED
F.T. - FULL THROTTLE

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1450A

Figure A-9. Military Power Climb—Three Engines

WADC
Form 2411
(11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

TWO RECIPROCATING ENGINES PLUS JET ENGINE

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (2) R-2800-44W
(1) J33-A-10

CONFIGURATION: TWO 300 GAL TIP TANKS
GROSS WEIGHT: 54,000 POUNDS

CONFIGURATION: TWO 300 GAL TIP TANKS
GROSS WEIGHT: 50,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
2650	0	0	700(1)	60	209	SEA LEVEL	202	60	700(1)	0	0	2950
2500	5	2	1000	60	207	5,000	200	60	950	2	5	2800
2250	15	4	1300	60	205	10,000	197	60	1200	3.5	10	2600
2000	25	6.5	1600	60	202	15,000	195	60	1500	5.5	20	2350
1750	35	9	1900	60	200	20,000	192	60	1750	8	30	2050
1400	50	12	2250	60	196	25,000	188	60	2050	11	40	1700
950	70	17	2700	60	192	30,000	185	60	2400	14	55	1300
150	125	27	3700	F.T.	188	35,000	180	F.T.	2900	20	85	500
						40,000						
						45,000						

CONFIGURATION: TWO 300 GAL TIP TANKS
GROSS WEIGHT: 45,000 POUNDS

CONFIGURATION: TWO 300 GAL TIP TANKS
GROSS WEIGHT: 40,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
3400	0	0	700(1)	60	192	SEA LEVEL	178	60	700(1)	0	0	3950
3250	5	1.5	950	60	190	5,000	176	60	900	1.5	4	3800
3050	10	3	1150	60	188	10,000	174	60	1100	2.5	8	3600
2800	15	5	1350	60	185	15,000	172	60	1250	4	13	3350
2500	20	7	1600	60	183	20,000	169	60	1450	6	20	3050
2200	30	9	1850	60	179	25,000	165	60	1650	7.5	25	2750
1800	40	12	2100	60	176	30,000	162	60	1850	9.5	30	2300
950	60	15	2500	F.T.	171	35,000	158	F.T.	2100	12	45	1450
50	140	30	3700	F.T.	165	40,000	153	F.T.	2600	18	70	500
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds
2. Military Power - 2800 rpm
   - 60 in. Hg MP
   - 100% rpm (jet engine)
3. Military Power operation limited to 30 minutes
4. For each 10°C rise in air temperature above Standard Day conditions:
   Increase
   Time to climb 5 percent
   Distance covered 7 percent
   Fuel used 3 percent
   Decrease
   Rate of climb 5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED
F.T. - FULL THROTTLE

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1451A

Figure A-10. Military Power Climb—Three Engines—with Tip Tanks

WADC
Form 2411
(11 Jun 51)

MAXIMUM CRUISE POWER CLIMB CHART

STANDARD DAY

RECIPROCATING ENGINES

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (2) R-2800-44W
(1) J33-A-10

CONFIGURATION: NO EXTERNAL LOAD

GROSS WEIGHT: 54,000 POUNDS

CONFIGURATION: NO EXTERNAL LOAD

GROSS WEIGHT: 50,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
	FROM SEA LEVEL								FROM SEA LEVEL			
RATE OF CLIMB (FPM)	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	RATE OF CLIMB (FPM)
						SEA LEVEL	145	37	700 (1)	0	0	250
						5,000	145	37	1200	27	70	150
						10,000						
						15,000						
						20,000						
						25,000						
						30,000						
						35,000						
						40,000						
						45,000						

CONFIGURATION: NO EXTERNAL LOAD

GROSS WEIGHT: 45,000 POUNDS

CONFIGURATION: NO EXTERNAL LOAD

GROSS WEIGHT: 40,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
	FROM SEA LEVEL								FROM SEA LEVEL			
RATE OF CLIMB (FPM)	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	RATE OF CLIMB (FPM)
450	0	0	700 (1)	37	140	SEA LEVEL	135	37	700	0	0	700 (1)
350	30	13	900	37	140	5,000	135	37	850	7	20	600
300	75	29	1250	37	140	10,000	135	37	1000	17	40	550
200	150	54	1750	37	140	15,000	135	37	1250	28	70	450
						20,000	135	37	1500	42	110	350
						25,000	135	37	1950	64	185	200
						30,000						
						35,000						
						40,000						
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds.
2. Maximum Cruise Power - 2300 rpm.
   - 37 in. Hg MP.
3. For each 10°C rise in air temperature above Standard Day conditions -
   Increase:
   Time to climb 5 percent
   Distance covered 7 percent
   Fuel used 3 percent
   Decrease:
   Rate of climb 5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED
FT - FULL THROTTLE

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/Gal

H-169-93-3A

Figure A-11. Maximum Cruise Power Climb—Reciprocating Engines

WADC
Form 2411
(11 Jun 51)

MAXIMUM CRUISE POWER CLIMB CHART

STANDARD DAY

RECIPROCATING ENGINES

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (1) J33-A-10
(2) R-2800-44W

CONFIGURATION: TWO 300 GAL TIP TANKS — GROSS WEIGHT: 54,000 POUNDS

CONFIGURATION: TWO 300 GAL TIP TANKS — GROSS WEIGHT: 50,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
150	0	0	700(1)	37	145	SEA LEVEL	145	37	(1) 700	0	0	320
90	115	45	1500	37	145	5,000	145	37	1050	18	45	230
						10,000	145	37	1600	45	115	150
						15,000						
						20,000						
						25,000						
						30,000						
						35,000						
						40,000						
						45,000						

CONFIGURATION: TWO 300 GAL TIP TANKS — GROSS WEIGHT: 45,000 POUNDS

CONFIGURATION: TWO 300 GAL TIP TANKS — GROSS WEIGHT: 40,000 POUNDS

APPROXIMATE				MP (IN. Hg)	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MP (IN. Hg)	APPROXIMATE			
RATE OF CLIMB (FPM)	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB (FPM)
	DISTANCE	TIME	FUEL						FUEL	TIME	DISTANCE	
500	0	0	700(1)	37	140	SEA LEVEL	135	37	700(1)	0	0	750
450	25	11	900	37	140	5,000	135	37	850	7	20	650
350	60	24	1200	37	140	10,000	135	37	1000	15	35	600
260	105	42	1500	37	135	15,000	135	37	1200	26	65	500
150	200	73	2100	37	135	20,000	130	37	1400	39	100	400
						25,000	130	37	1700	55	145	300
						30,000						
						35,000						
						40,000						
						45,000						

REMARKS:

1. Warm-up, taxi, and take-off allowance: 700 pounds.
2. Maximum Cruise Power - 2300 rpm.
   - 37 in. Hg MP.
3. For each 10°C rise in air temperature above Standard Day conditions -
   - Increase:
     - Time To Climb 5 percent
     - Distance Covered 7 percent
     - Fuel Used 3 percent
   - Decrease:
     - Rate of Climb 5 percent

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
MP - MANIFOLD PRESSURE
CAS - CALIBRATED AIRSPEED

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/Gal

H-169-93-2A

Figure A-12. Maximum Cruise Power Climb—Reciprocating Engines— with Tip Tanks

WADC
Form 2410
(11 Jun 51)

DESCENT CHART

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINE(S): (2) R-2800-44W
(1) J33-A-10

CONFIGURATION: CLEAN OR TWO 300 GAL TIP TANKS

GROSS WEIGHT: 40,000 POUNDS

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
3000	120	25	420	220	40,000					
2400	110	23	380	220	35,000					
2100	95	21	350	220	30,000					
1800	80	18	300	220	25,000					
1600	65	15	250	220	20,000					
1400	50	12	200	220	15,000					
1300	30	8	140	220	10,000					
1200	15	4	70	220	5,000					
1100	0	0	0	220	SEA LEVEL					

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
					45,000					
					40,000					
					35,000					
					30,000					
					25,000					
					20,000					
					15,000					
					10,000					
					5,000					
					SEA LEVEL					

REMARKS:

1. Recommended descent power - 2000 rpm
 - 35 in. Hg MP

LEGEND

RATE OF DESCENT - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED

DATA AS OF 12-25-51
BASED ON FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 lb/gal

169-93-1452A

Figure A-13. Descent

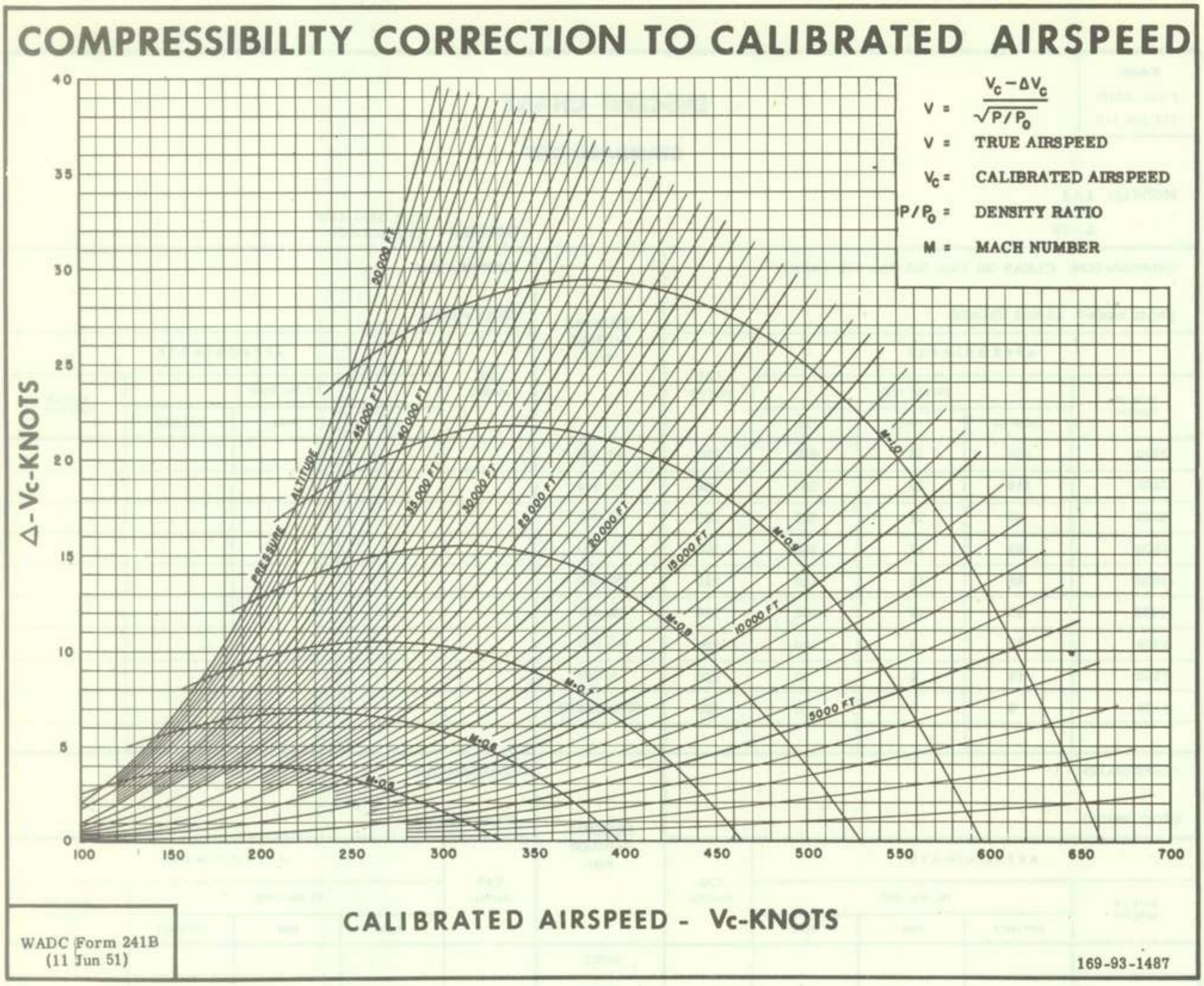
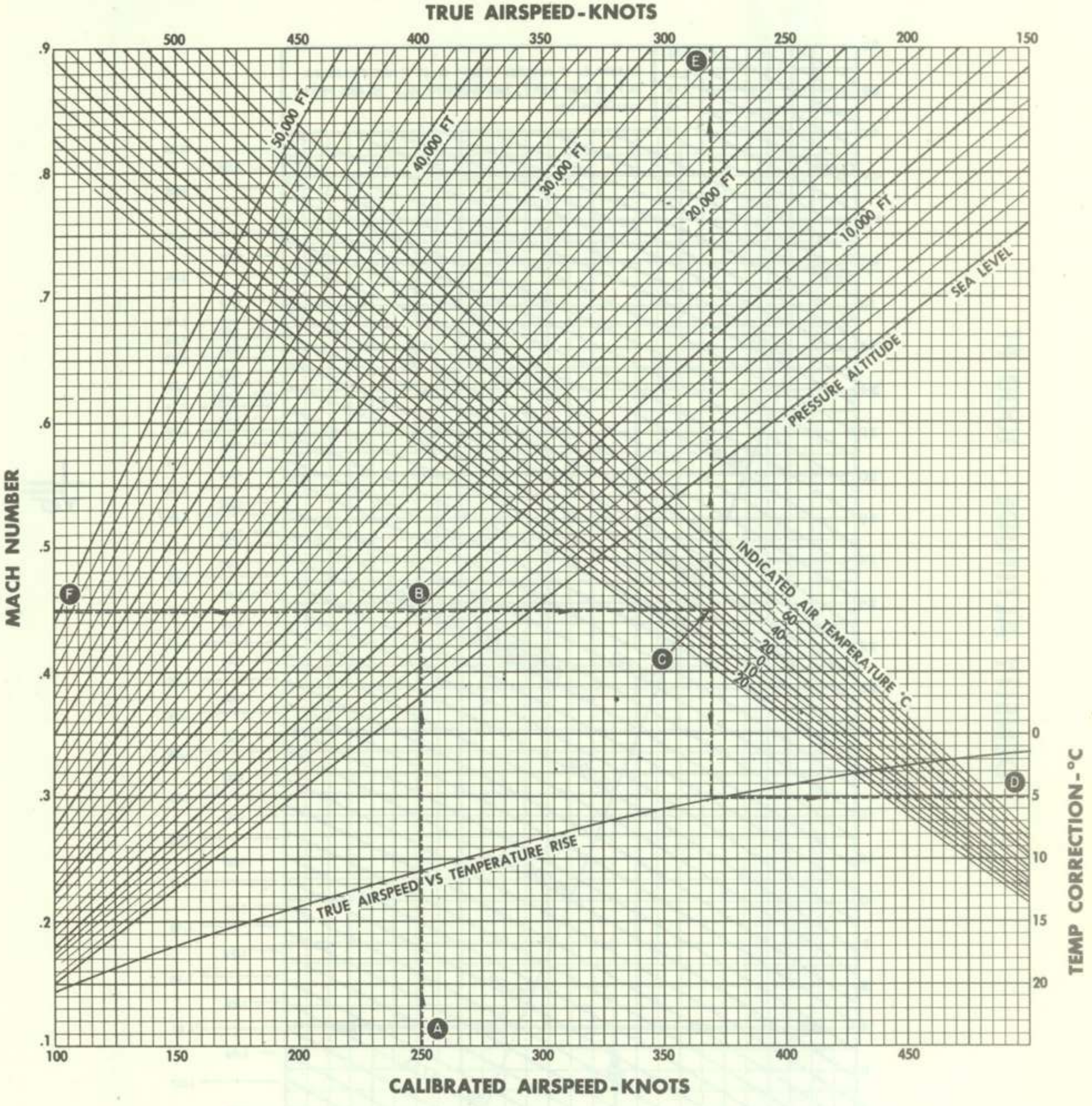


Figure A-14. Compressibility Correction to Calibrated Airspeed

TEMPERATURE CORRECTION FOR COMPRESSIBILITY & AIRSPEED CONVERSION

MODELS: AJ-1
AJ-2
AJ-2P



EXAMPLE:

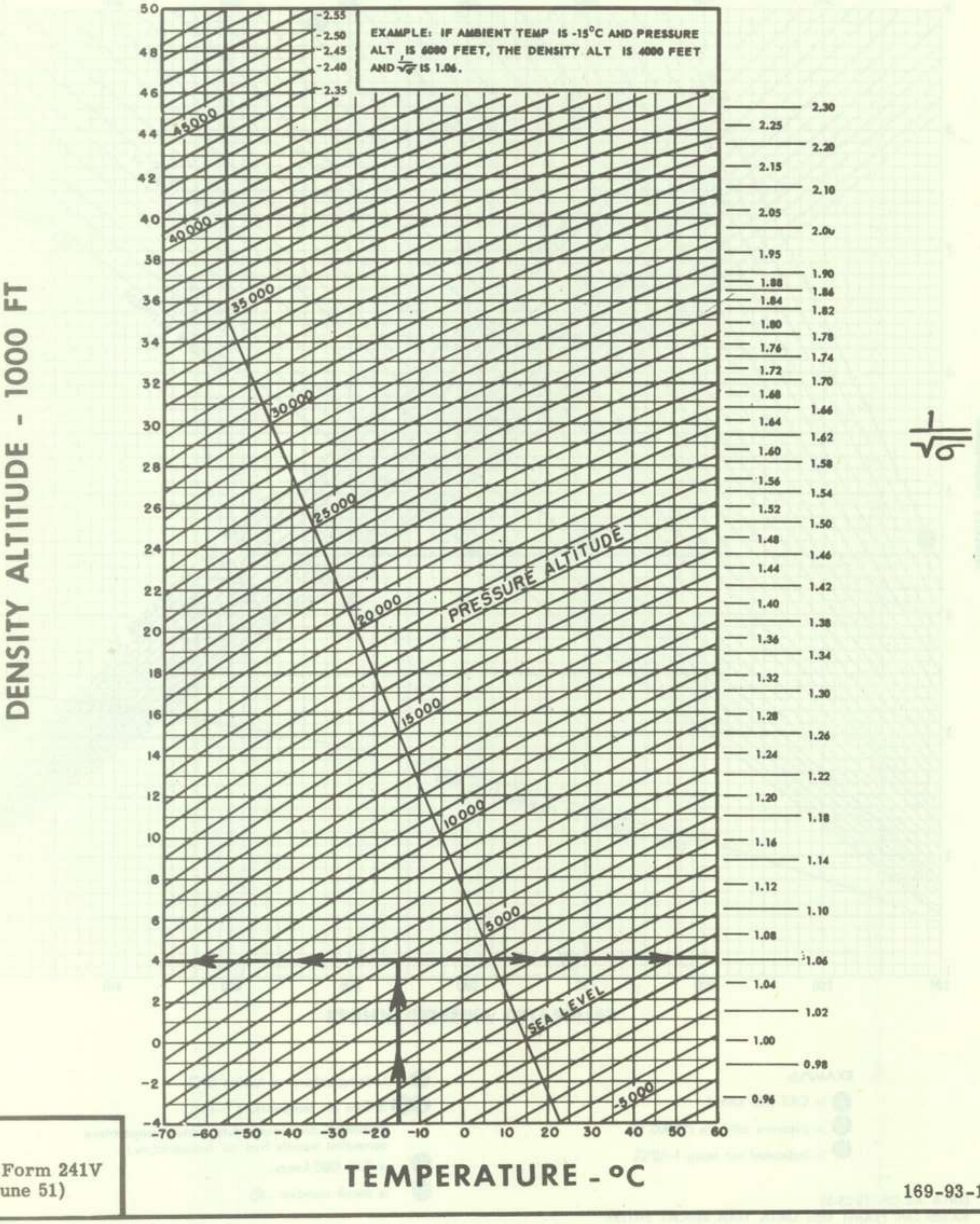
- Ⓐ is CAS (250 knots).
- Ⓑ is pressure altitude (10,000 ft).
- Ⓒ is indicated air temp (−10°C).
- Ⓓ is temperature correction (5°C).
- Ⓒ-Ⓓ is free air temperature (−15°C). (Indicated air temperature minus temperature correction eauals free air temperature.)
- Ⓔ is TAS (280 knots).
- Ⓕ is Mach number (.45).

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

189-93-1488A

Figure A-15. Temperature Correction for Compressibility and Airspeed Conversion

DENSITY ALTITUDE CHART



EXAMPLE: IF AMBIENT TEMP IS -15°C AND PRESSURE ALT IS 6000 FEET, THE DENSITY ALT IS 4000 FEET AND $\frac{1}{\sqrt{\sigma}}$ IS 1.06.

WADC Form 241V
(11 June 51)

169-93-1489

Figure A-16. Density Altitude Chart

Standard Altitude Table

Standard Sea Level Air:
T = 15° C.
P = 29.921 in. of Hg.
1" of Hg. = 70.732 lb/sq. ft. = 0.4912 lb/sq. in.

ρ_0 = .002378 slugs/cu. ft.
W = .07651 lb/cu. ft.
a_0 = 1116 ft./sec.

Altitude feet	Density Ratio ρ/ρ_0	$\frac{1}{\sqrt{\sigma}}$	Temperature		Speed of Sound Ratio a/a_0	Pressure	
			Deg. C	Deg. F		In. of Hg.	Ratio P/Po
0	1.0000	1.0000	15.000	59.000	1.0000	29.92	1.0000
1000	.9710	1.0148	13.019	55.434	.997	28.86	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.82	.9298
3000	.9151	1.0454	9.056	48.301	.990	26.81	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.84	.8636
5000	.8616	1.0773	5.094	41.169	.983	24.89	.8320
6000	.8358	1.0938	3.113	37.603	.979	23.98	.8013
7000	.8106	1.1107	1.132	34.037	.976	23.09	.7716
8000	.7859	1.1280	-0.850	30.471	.972	22.22	.7427
9000	.7619	1.1456	-2.831	26.904	.968	21.38	.7147
10000	.7384	1.1637	-4.812	23.338	.965	20.58	.6876
11000	.7154	1.1822	-6.793	19.772	.962	19.79	.6614
12000	.6931	1.2012	-8.774	16.206	.958	19.03	.6359
13000	.6712	1.2206	-10.756	12.640	.954	18.29	.6112
14000	.6499	1.2404	-12.737	9.074	.950	17.57	.5873
15000	.6291	1.2608	-14.718	5.507	.947	16.88	.5642
16000	.6088	1.2816	-16.699	1.941	.943	16.21	.5418
17000	.5891	1.3029	-18.680	-1.625	.940	15.56	.5202
18000	.5698	1.3247	-20.662	-5.191	.936	14.94	.4992
19000	.5509	1.3473	-22.643	-8.757	.932	14.33	.4790
20000	.5327	1.3701	-24.624	-12.323	.929	13.75	.4594
21000	.5148	1.3937	-26.605	-15.890	.925	13.18	.4405
22000	.4974	1.4179	-28.586	-19.456	.922	12.63	.4222
23000	.4805	1.4426	-30.568	-23.022	.917	12.10	.4045
24000	.4640	1.4681	-32.549	-26.588	.914	11.59	.3874
25000	.4480	1.4940	-34.530	-30.154	.910	11.10	.3709
26000	.4323	1.5209	-36.511	-33.720	.906	10.62	.3550
27000	.4171	1.5484	-38.493	-37.287	.903	10.16	.3397
28000	.4023	1.5768	-40.474	-40.853	.899	9.720	.3248
29000	.3879	1.6056	-42.455	-44.419	.895	9.293	.3106
30000	.3740	1.6352	-44.436	-47.985	.891	8.880	.2968
31000	.3603	1.6659	-46.417	-51.551	.887	8.483	.2834
32000	.3472	1.6971	-48.399	-55.117	.883	8.101	.2707
33000	.3343	1.7295	-50.379	-58.684	.879	7.732	.2583
34000	.3218	1.7628	-52.361	-62.250	.875	7.377	.2465
35000	.3098	1.7966	-54.342	-65.816	.871	7.036	.2352
36000	.2962	1.8374	-55.000	-67.000	.870	6.708	.2242
37000	.2824	1.8818	-55.000	-67.000	.870	6.395	.2137
38000	.2692	1.9273	-55.000	-67.000	.870	6.096	.2037
39000	.2566	1.9738	-55.000	-67.000	.870	5.812	.1943
40000	.2447	2.0215	-55.000	-67.000	.870	5.541	.1852
41000	.2332	2.0707	-55.000	-67.000	.870	5.283	.1765
42000	.2224	2.1207	-55.000	-67.000	.870	5.036	.1683
43000	.2120	2.1719	-55.000	-67.000	.870	4.802	.1605
44000	.2021	2.2244	-55.000	-67.000	.870	4.578	.1530
45000	.1926	2.2785	-55.000	-67.000	.870	4.364	.1458
46000	.1837	2.3332	-55.000	-67.000	.870	4.160	.1391
47000	.1751	2.3893	-55.000	-67.000	.870	3.966	.1325
48000	.1669	2.4478	-55.000	-67.000	.870	3.781	.1264
49000	.1591	2.5071	-55.000	-67.000	.870	3.604	.1205
50000	.1517	2.5675	-55.000	-67.000	.870	3.436	.1149

This table is based on NACA Technical Report No. 218

169-93-1490

WADC Form 241D
(11 Jun 51)

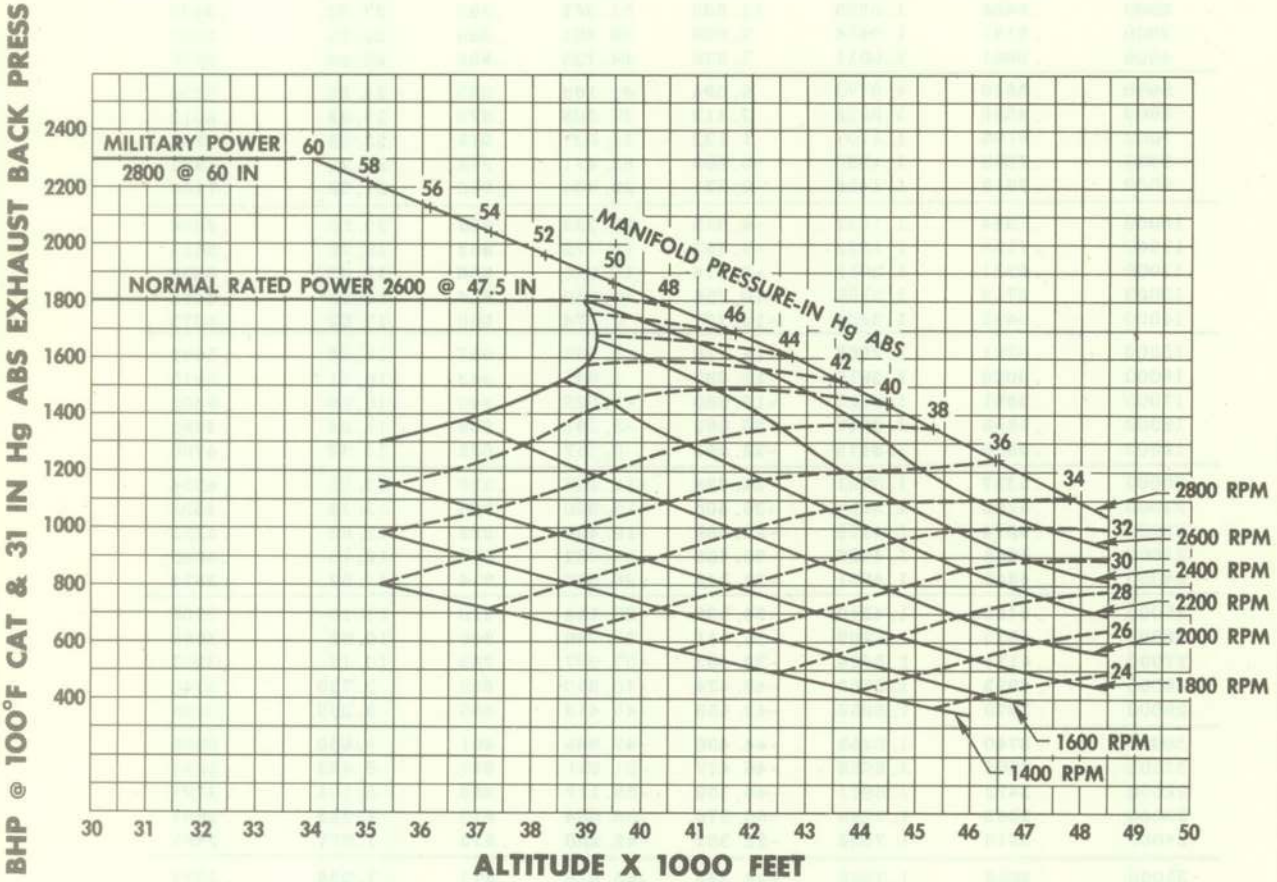
Figure A-17. Standard Altitude Table

MODELS: AJ-1
AJ-2
AJ-2P

OPERATING LIMITS CURVE

R-2800-44 ENGINES

MIXTURE: NORMAL



POWER SCHEDULE:
1. 150 BMEP TO 2250 RPM
2. LINEAR VARIATION ON BMEP
   TO 1800 BHP @ 2600 RPM
3. PROP LOAD VARIATION OF BMEP
   TO 2300 BHP @ 2800 RPM

DATA AS OF: 5-14-53
DATA BASED ON: ESTIMATED PERFORMANCE

FUEL GRADE: MIL-F-5572 AV GAS 115/145
FUEL DENSITY: 6.0 LB/GAL

H-9634-93-14

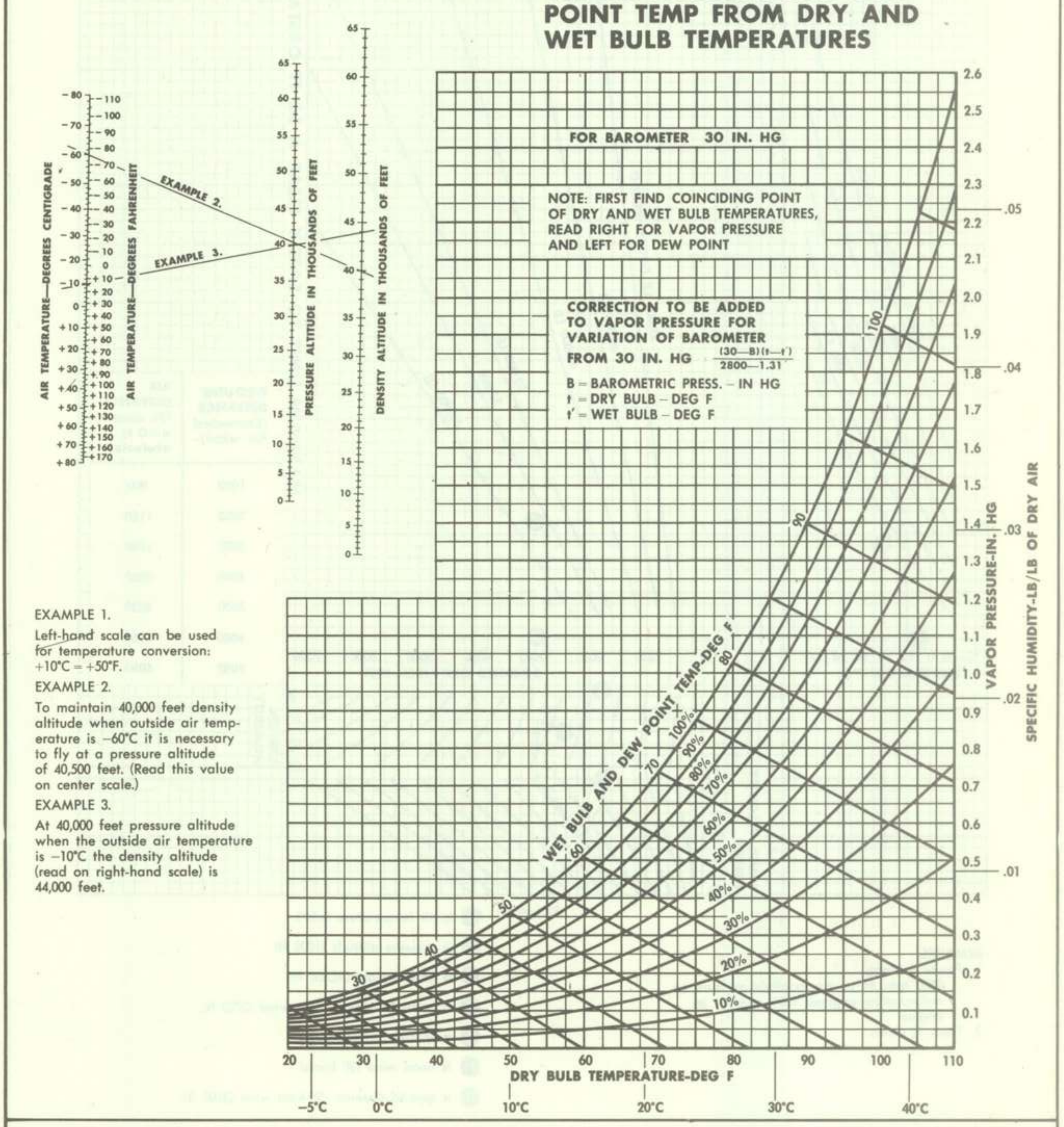
Figure A-18. Engine Operating Limits Curve

MODELS: AJ-1
AJ-2
AJ-2P

HUMIDITY CORRECTION FOR TAKE-OFF

ENGINES:
(1) J33-A-10
(2) R-2800-44W

VAPOR PRESSURE AND DEW POINT TEMP FROM DRY AND WET BULB TEMPERATURES



FOR BAROMETER 30 IN. HG

NOTE: FIRST FIND COINCIDING POINT OF DRY AND WET BULB TEMPERATURES, READ RIGHT FOR VAPOR PRESSURE AND LEFT FOR DEW POINT

CORRECTION TO BE ADDED TO VAPOR PRESSURE FOR VARIATION OF BAROMETER FROM 30 IN. HG $\frac{(30-B)(t-t')}{2800-1.31t'}$

B = BAROMETRIC PRESS. – IN HG
t = DRY BULB – DEG F
t' = WET BULB – DEG F

EXAMPLE 1.

Left-hand scale can be used for temperature conversion: +10°C = +50°F.

EXAMPLE 2.

To maintain 40,000 feet density altitude when outside air temperature is −60°C it is necessary to fly at a pressure altitude of 40,500 feet. (Read this value on center scale.)

EXAMPLE 3.

At 40,000 feet pressure altitude when the outside air temperature is −10°C the density altitude (read on right-hand scale) is 44,000 feet.

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL
H-9634-93-10

Figure A-19. Humidity Correction for Take-off

TAKE-OFF DISTANCES

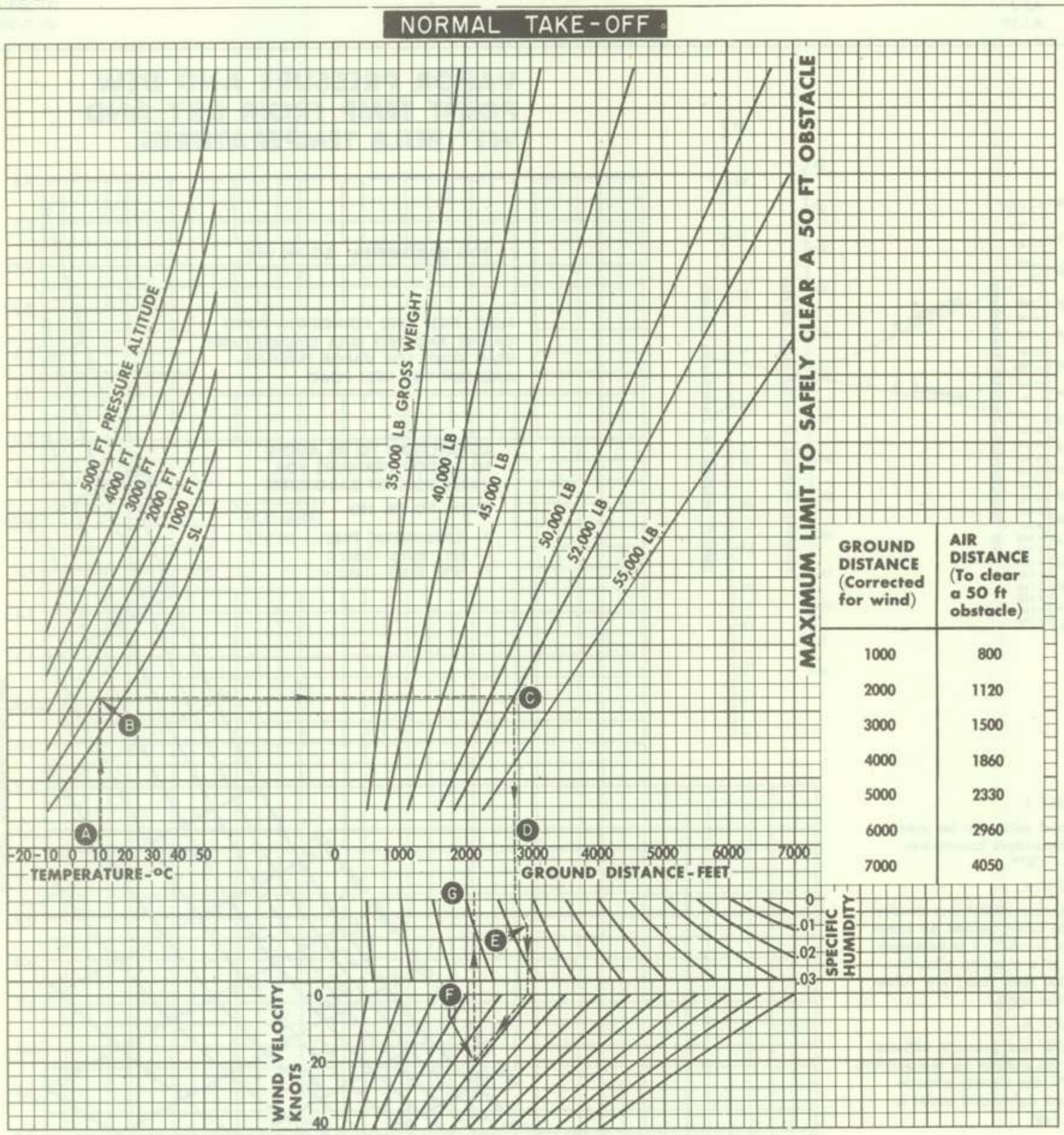
(HARD-SURFACE RUNWAY)

TAKE-OFF POWER—THREE ENGINES

WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



GROUND DISTANCE (Corrected for wind)	AIR DISTANCE (To clear a 50 ft obstacle)
1000	800
2000	1120
3000	1500
4000	1860
5000	2330
6000	2960
7000	4050

EXAMPLE:
- Ⓐ is air temperature (+10°).
- Ⓑ is pressure altitude (1000 ft).
- Ⓒ is gross weight (52,000 lb).
- Ⓓ is ground distance - zero wind (2720 ft).
- Ⓔ is specific humidity (.01).
- Ⓕ is head wind (20 knots).
- Ⓖ is ground distance - 20-knot wind (2100 ft).

REMARKS:
1. Power Settings:
   2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engine.
2. Flaps ½ down.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1436B

Figure A-20. Take-off Distances—Three Engines—Normal Take-off

TAKE-OFF DISTANCES

MAXIMUM PERFORMANCE

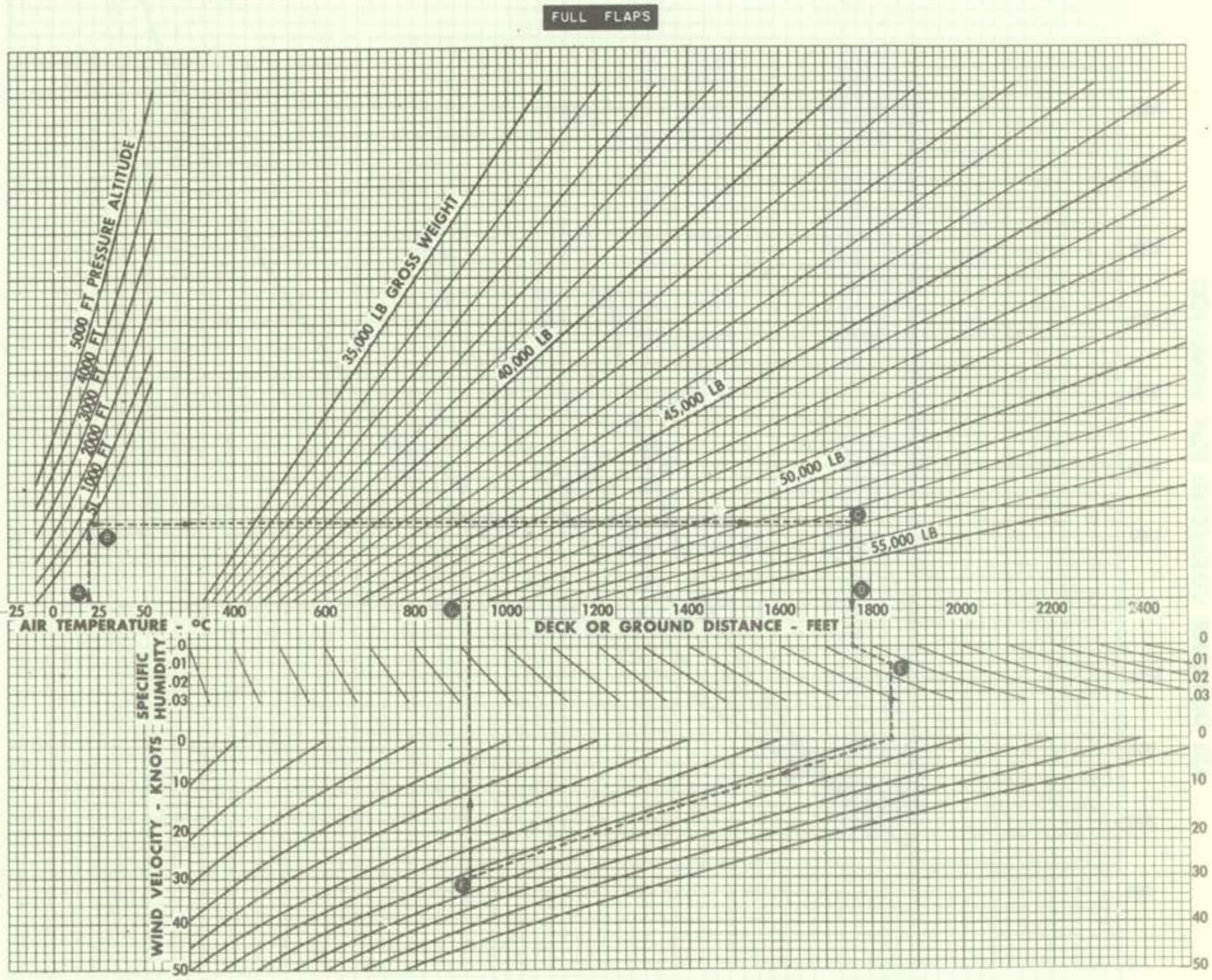
(CARRIER OR HARD-SURFACE RUNWAY)

TAKE-OFF POWER - THREE ENGINES

WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:

1. Power Settings:
2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engine.

EXAMPLE:

Ⓐ is air temperature (+20°C).
Ⓑ is pressure altitude (SL).
Ⓒ is gross weight (52,750 pounds).
Ⓓ is ground distance—zero wind (1760 feet).
Ⓔ is specific humidity (.01).
Ⓕ is head wind (30 knots).
Ⓖ is ground distance 30 knot wind (918 feet).

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1532A

Figure A-21. Take-off Distances—Three Engines—Maximum Performance—Full Flaps

TAKE-OFF AIR DISTANCES

(ADDITIONAL DISTANCE TO CLEAR A 50-FOOT OBSTACLE)

MAXIMUM PERFORMANCE

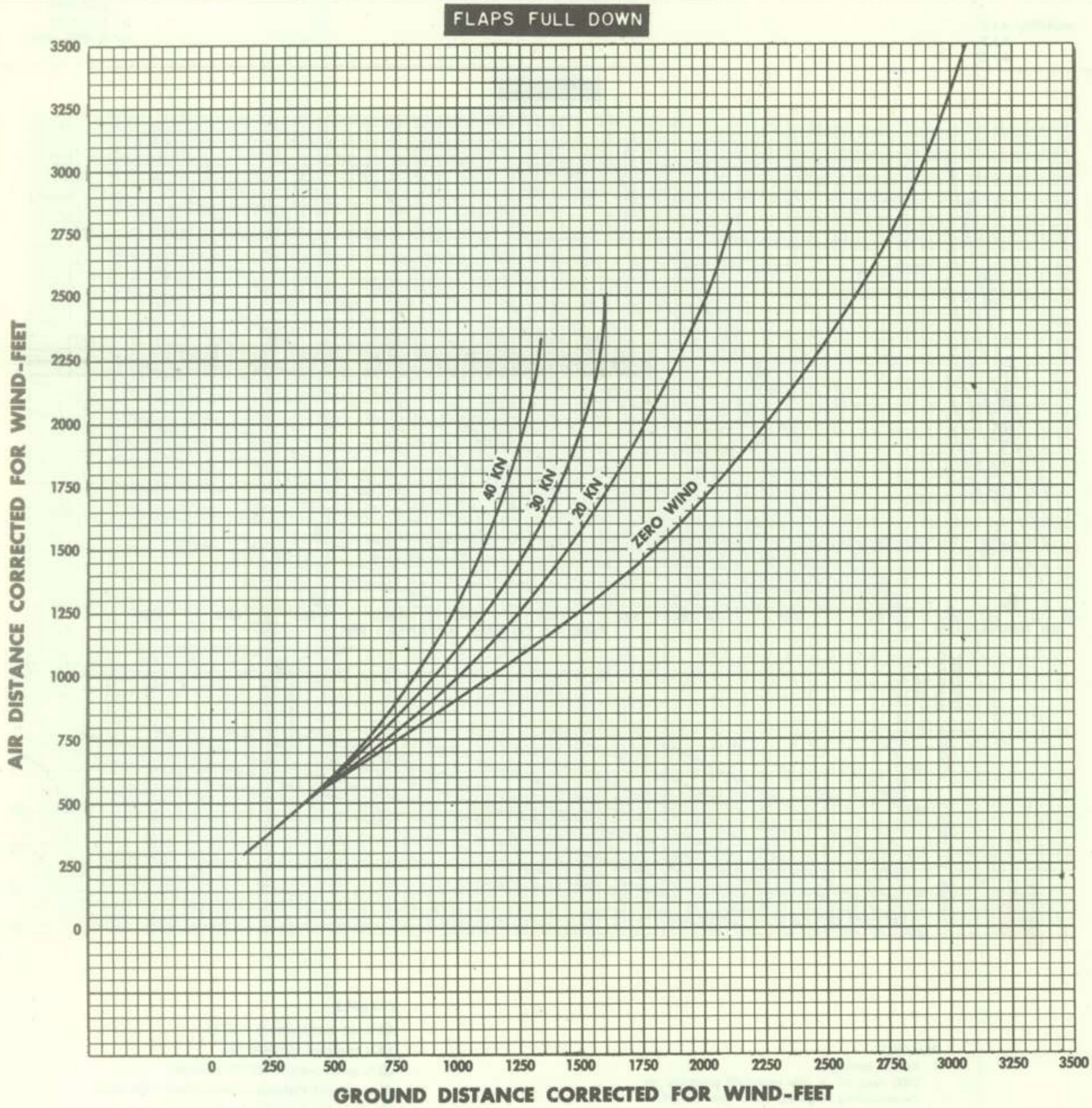
(HARD-SURFACE RUNWAY)

TAKE-OFF POWER-THREE ENGINES

WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:

1. Power Settings:
   2800 rpm, 61 in. Hg manifold pressure reciprocating engines. 100% rpm on jet engine.
2. Take-off distance to clear 50-foot obstacle is ground roll plus air (additional) distance.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

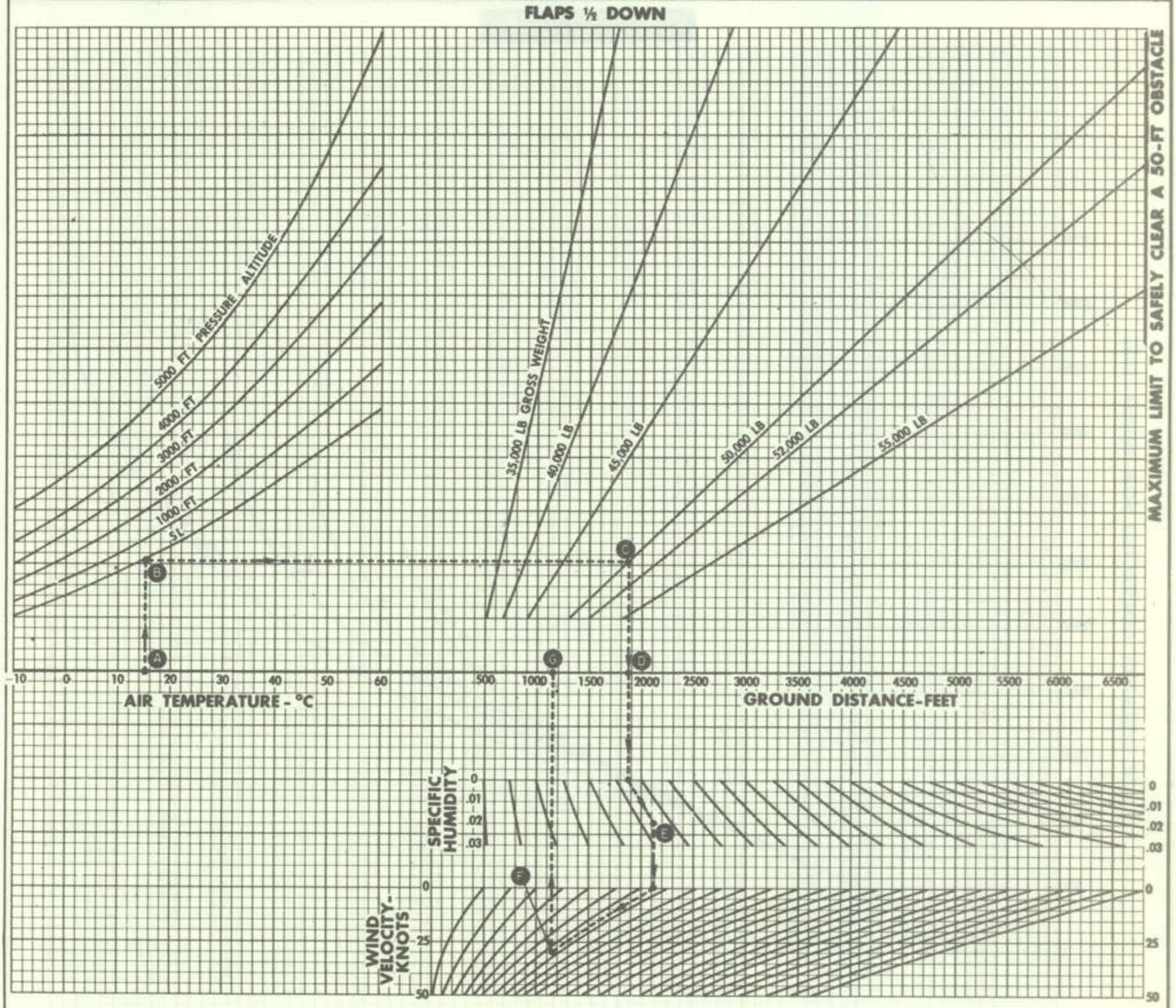
169-93-1581A

Figure A-22. Take-off Air Distances—Three Engines—Maximum Performance—Full Flaps

TAKE-OFF DISTANCES
MAXIMUM PERFORMANCE
(HARD-SURFACE RUNWAY)
TAKE-OFF POWER - THREE ENGINES
WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



EXAMPLE:

Ⓐ is air temperature (+15°C).
Ⓑ is pressure altitude (SL)
Ⓒ is gross weight (50,000 pounds).
Ⓓ is ground distance-zero wind (1875 feet).
Ⓔ is specific humidity (.02).
Ⓕ is head wind (30 knots).
Ⓖ is ground distance-30 knot wind (1140 feet).

REMARKS:
POWER SETTINGS
2800 rpm, 61 in. Hg manifold pressure on reciprocating engines.
100% rpm on jet engine.

DATA: 12-25-51
DATA BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

180-93-1504A

Figure A-23. *Take-off Distances—Maximum Performance—½ Flaps*

TAKE-OFF AIR DISTANCES

(ADDITIONAL DISTANCE TO CLEAR A 50-FOOT OBSTACLE)

MAXIMUM PERFORMANCE

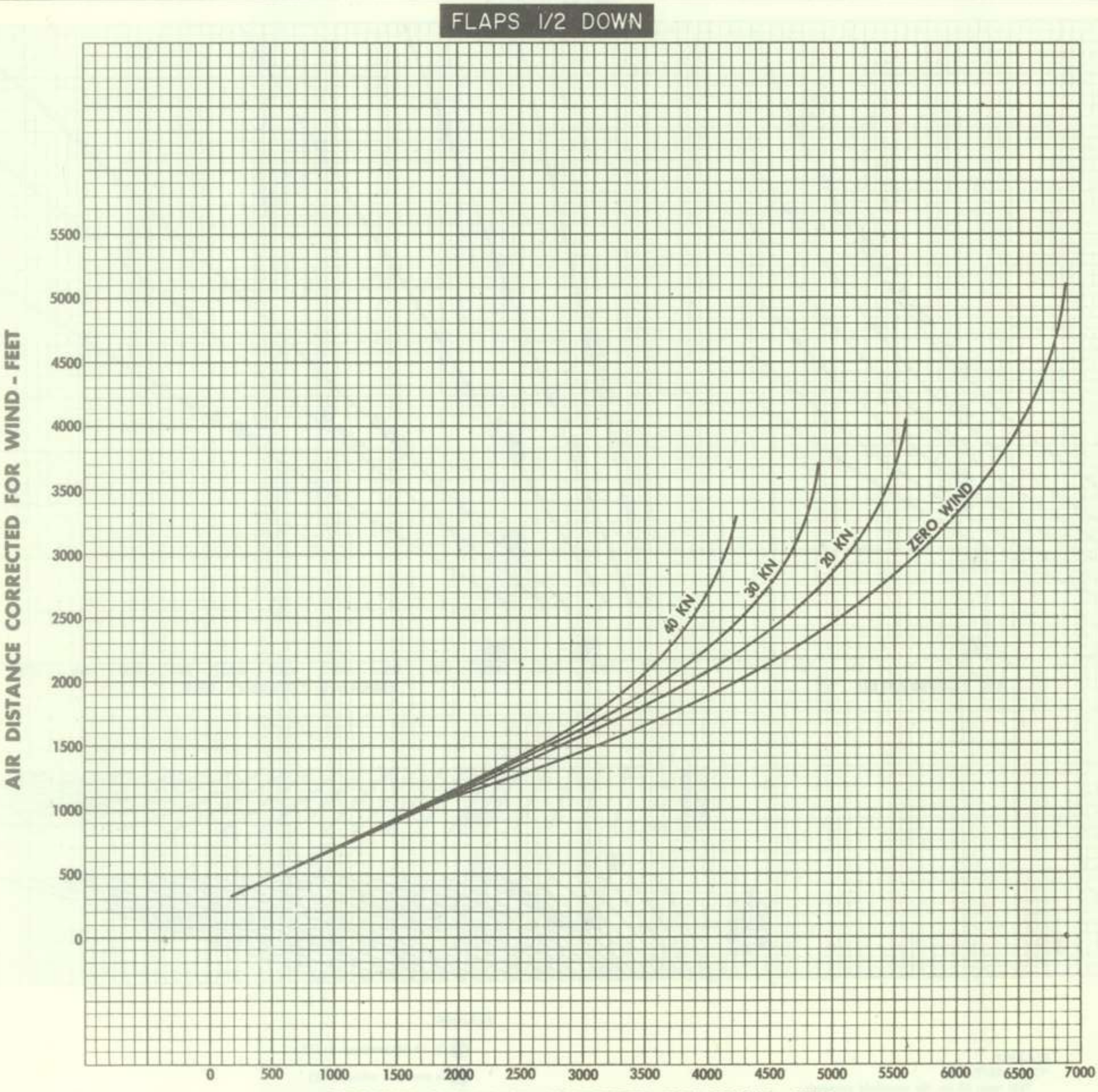
(HARD-SURFACE RUNWAY)

TAKE-OFF POWER—THREE ENGINES

WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:

1. Power settings:
   2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engines.
2. Take-off distance to clear 50-foot obstacle is ground roll plus air (additional) distance.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL
169-93-1582A

Figure A-24. Take-off Air Distances—Maximum Performance—½ Flaps

TAKE-OFF DISTANCES

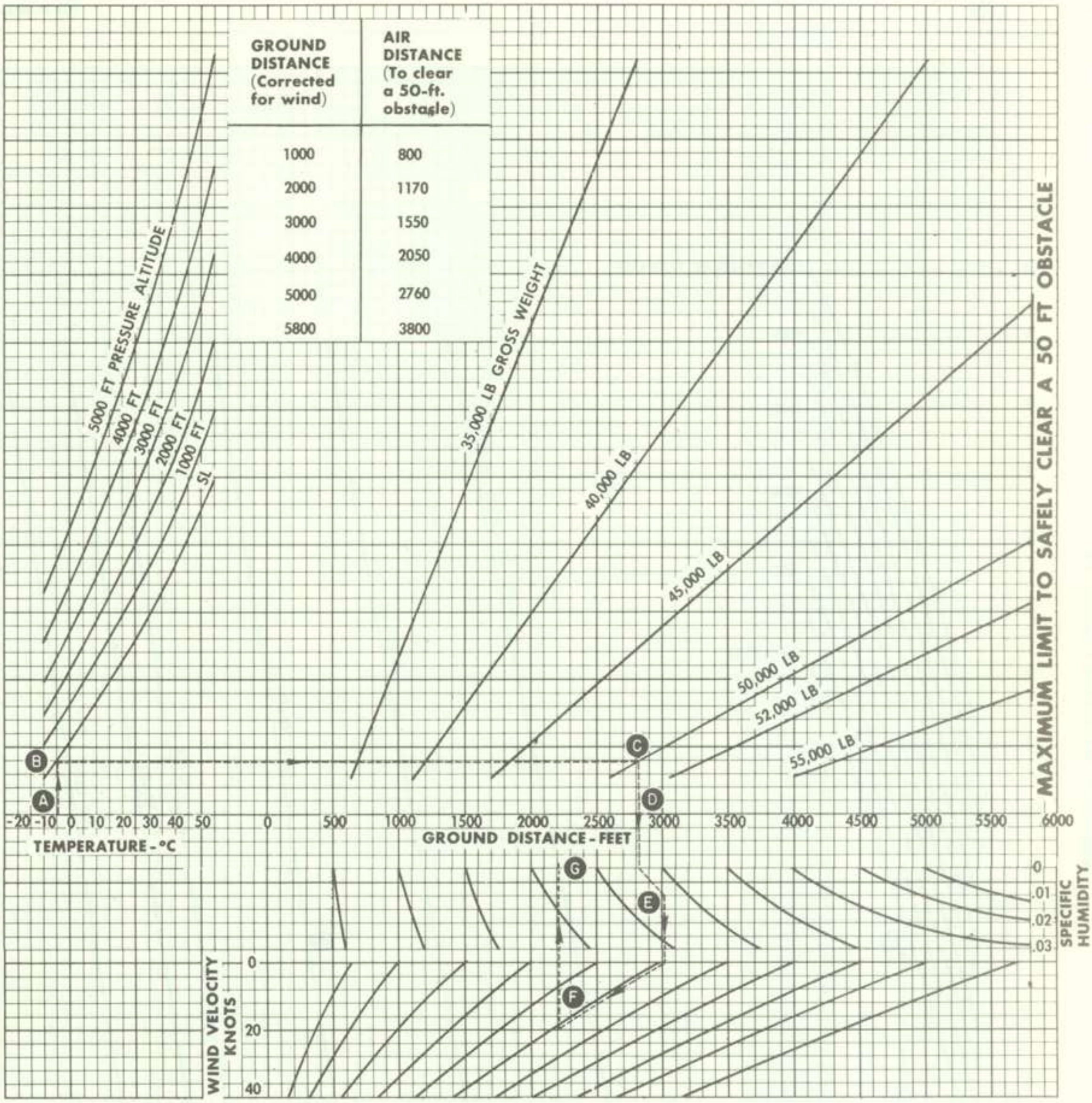
(HARD-SURFACE RUNWAY)

MODELS: AJ-1
AJ-2
AJ-2P

TAKE-OFF POWER—TWO RECIPROCATING ENGINES

WITH OR WITHOUT TIP TANKS

ENGINES:
(1) J33-A-10
(2) R-2800-44W



GROUND DISTANCE (Corrected for wind)	AIR DISTANCE (To clear a 50-ft. obstacle)
1000	800
2000	1170
3000	1550
4000	2050
5000	2760
5800	3800

EXAMPLE:
Ⓐ is air temperature (– 5°C).
Ⓑ is pressure altitude (SL).
Ⓒ is gross weight (50,000 pounds).
Ⓓ is ground distance-zero wind (2810 feet).
Ⓔ is specific humidity (.01).
Ⓕ is head wind (20 knots).
Ⓖ is ground distance-20 knot wind (2200 feet).

REMARKS:

1. Power settings:
   2800 rpm, 61. in Hg manifold pressure.
2. Flaps ½ down.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

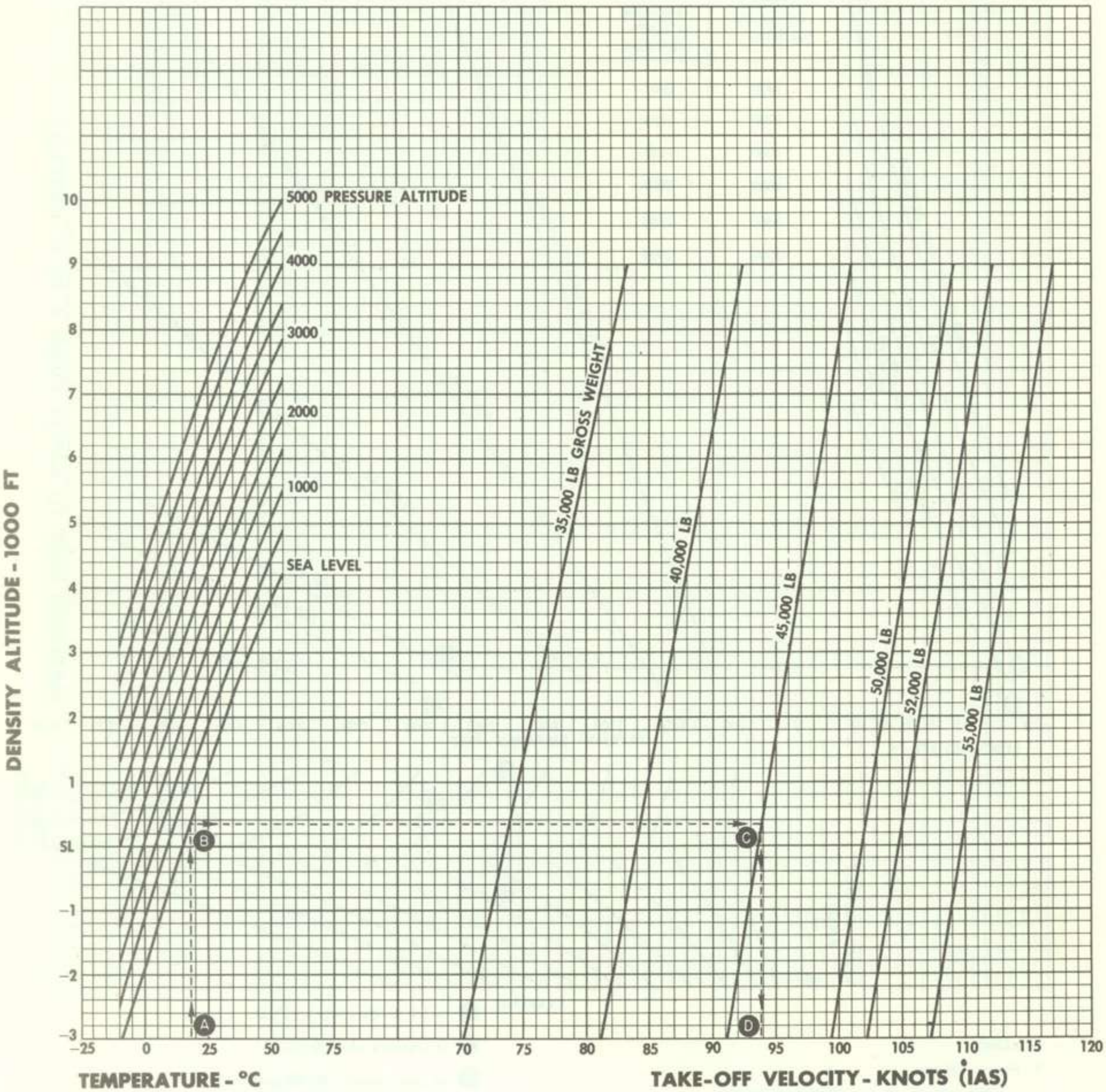
169-93-1435B

Figure A-25. Take-off Distances—Take-off Power—Reciprocating Engines

TAKE-OFF VELOCITIES
(HARD-SURFACE RUNWAY)
TAKE-OFF POWER—THREE ENGINES
NORMAL TAKE-OFF
WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
1. Power settings:
2800 rpm, 61 in. Hg manifold pressure on reciprocating engines.
100% rpm on jet engine.
2. Flaps ½ down.

EXAMPLE:
Ⓐ is air temperature (+18°C).
Ⓑ is pressure altitude (sea level).
Ⓒ is gross weight (45,000 lb).
Ⓓ is take-off velocity (94 knots - IAS).

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1433B

Figure A-26. Take-off Velocities—Normal Take-off

TAKE-OFF VELOCITIES

MAXIMUM PERFORMANCE

(HARD SURFACE RUNWAY)

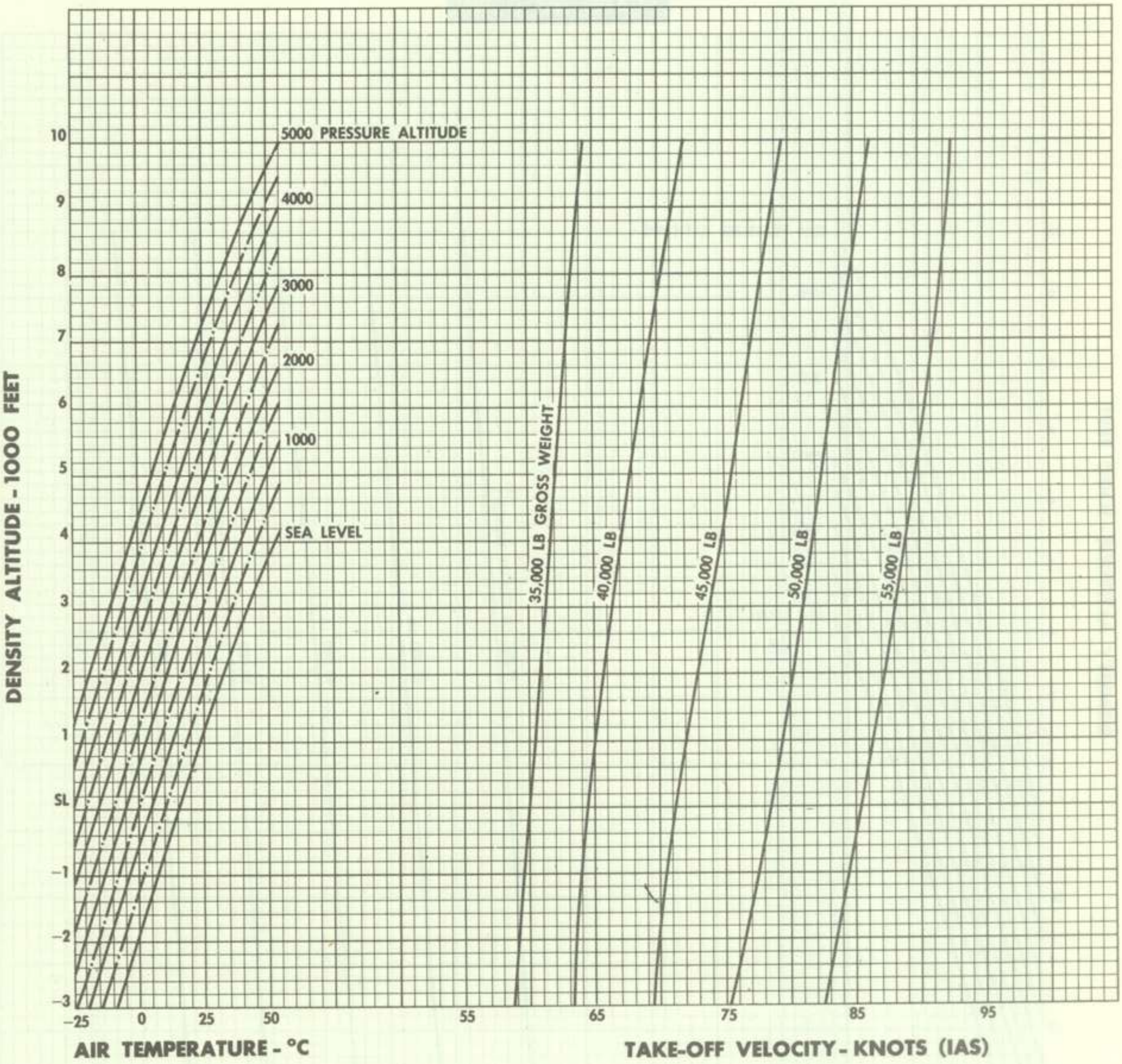
TAKE-OFF POWER—THREE ENGINES

WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W

FLAPS FULL DOWN



REMARKS:
POWER SETTINGS
2800 rpm, 61 in. Hg manifold pressure on reciprocating engines.
100% rpm on jet engine.

FUEL GRADE 115/145
FUEL DENSITY: 6.0 LB/GAL

DATA: 12-25-51
DATA BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

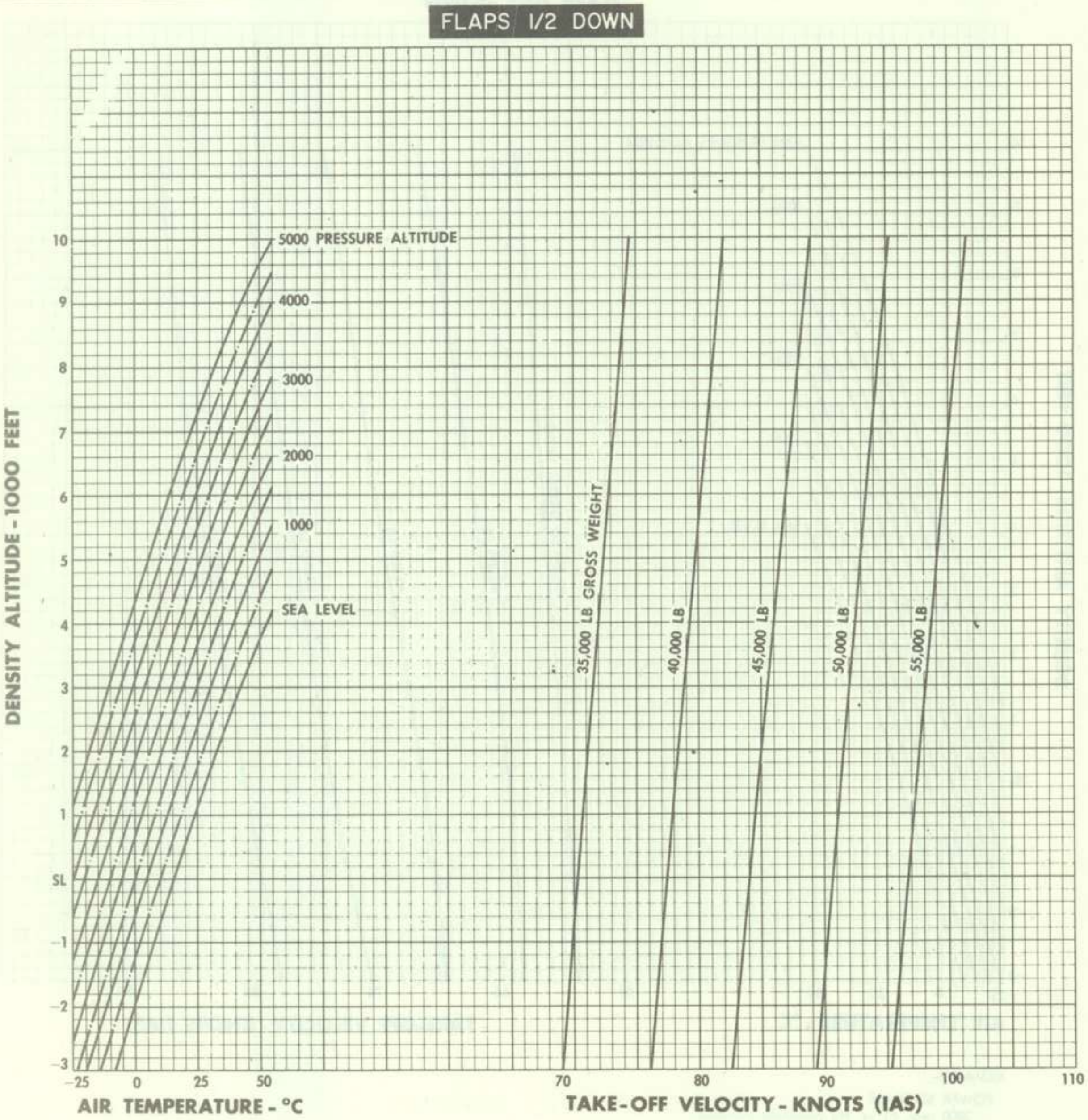
169-93-1533A

Figure A-27. Take-off Velocities—Maximum Performance—Full Flaps

TAKE-OFF VELOCITIES
MAXIMUM PERFORMANCE
(HARD-SURFACE RUNWAY)
TAKE-OFF POWER—THREE ENGINES
WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



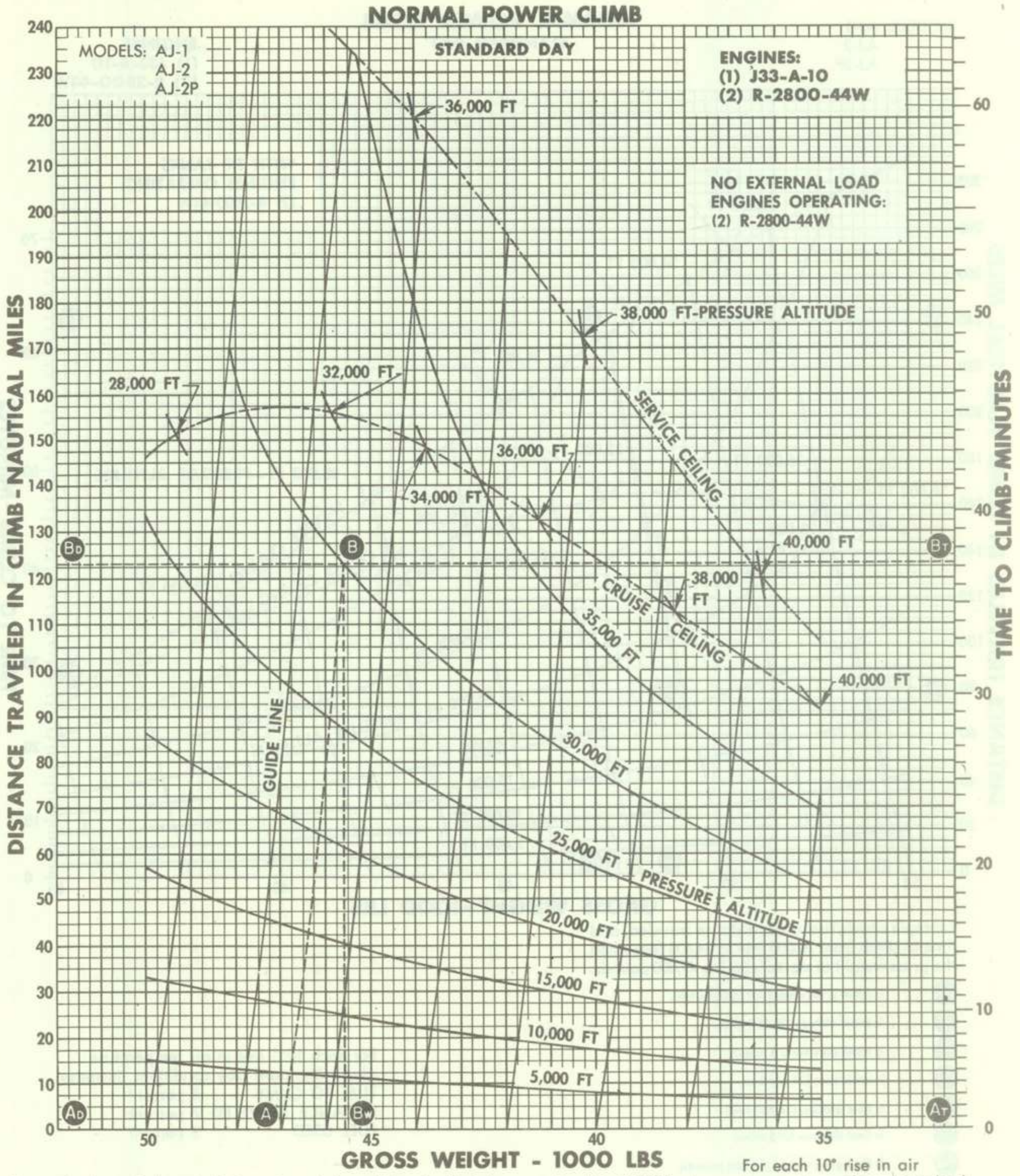
REMARKS:
1. Power settings:
2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engines.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1580A

Figure A-28. Take-off Velocities—Maximum Performance—½ Flaps



Example shows fuel used, distance traveled, and time to climb from sea level to 30,000 feet

Ⓐ is initial gross weight (47,000 pounds).

Ⓑ is final altitude, 30,000 feet.

Ⓑw is final gross weight (45,600 pounds).

Ⓐ—Ⓑw is fuel used (1400 pounds).

Ⓑd—Ⓐd is distance traveled (123 miles).

Ⓑt—Ⓐt is time to climb (37 minutes).

For each 10° rise in air temperature above Standard Day conditions, increase:

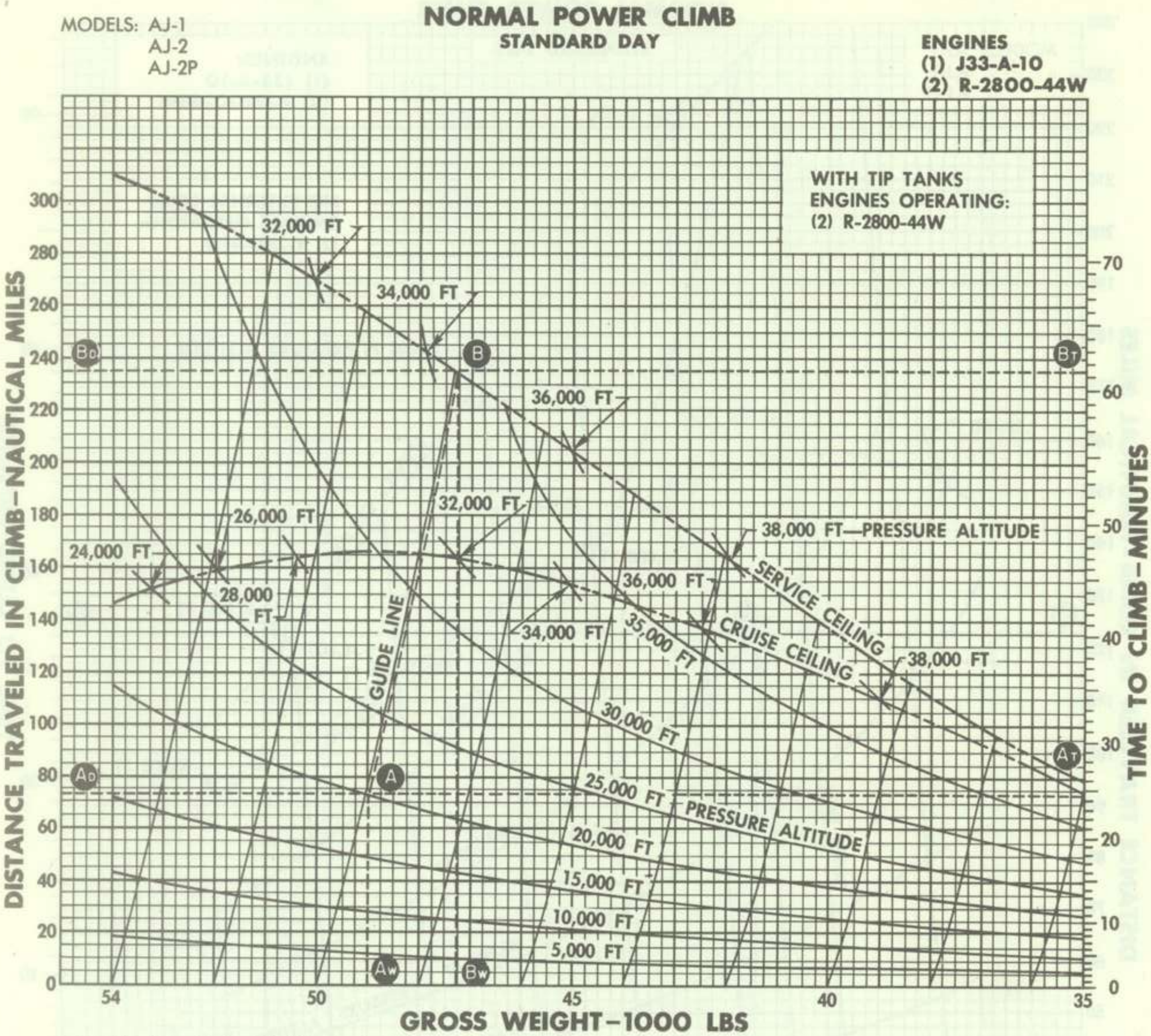
TIME TO CLIMB	5 PERCENT
DISTANCE TRAVELED	7 PERCENT
FUEL USED	3 PERCENT

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1375B

Figure A-29. Normal Power Climb—Reciprocating Engines



Example shows fuel used, distance traveled, and time to climb from 20,000 feet to 34,400 feet when the gross weight at start of climb is 49,000 pounds.

- A_W is initial gross weight (49,000 pounds).
- A is initial altitude (20,000 feet).
- A_D is initial distance (73 miles).
- A_T is initial time (24 minutes).
- B is final altitude (34,400 feet).
- B_D is final distance (235 miles).
- B_W is final gross weight (47,300 pounds).
- B_T is final time (61 minutes).
- A_W – B_W is fuel used (1700 pounds).
- B_D – A_D is distance traveled (162 miles).
- B_T – A_T is time to climb (37 minutes).

For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB	5 percent
DISTANCE TRAVELED	7 percent
FUEL USED	3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1376B

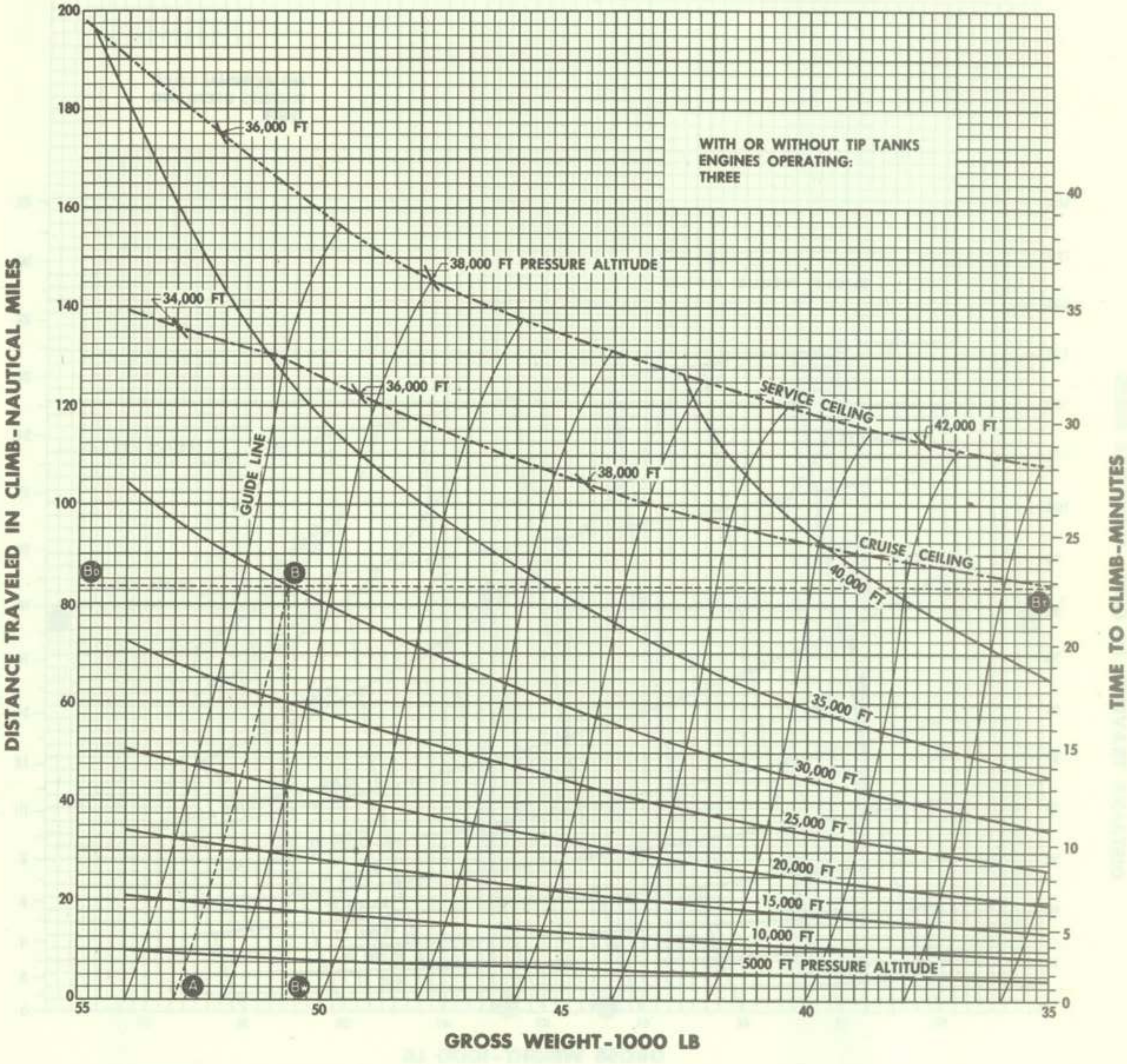
Figure A-30. Normal Power Climb—Reciprocating Engines—with Tip Tanks

NORMAL POWER CLIMB

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



Example shows fuel used, distance traveled, and time to climb from sea level to 30,000 feet.

Ⓐ is initial gross weight (53,000 pounds).
Ⓑ is final altitude. (Follow guide lines to 30,000 feet.)
Ⓑ$_W$ is final gross weight (50,700 pounds).
Ⓐ-Ⓑ$_W$ is fuel used (2300 pounds).
Ⓑ$_D$ is distance traveled (84 miles).
Ⓑ$_T$ is time to climb (23 minutes).

For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB	5 percent
DISTANCE TRAVELED	7 percent
FUEL USED	3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1377A

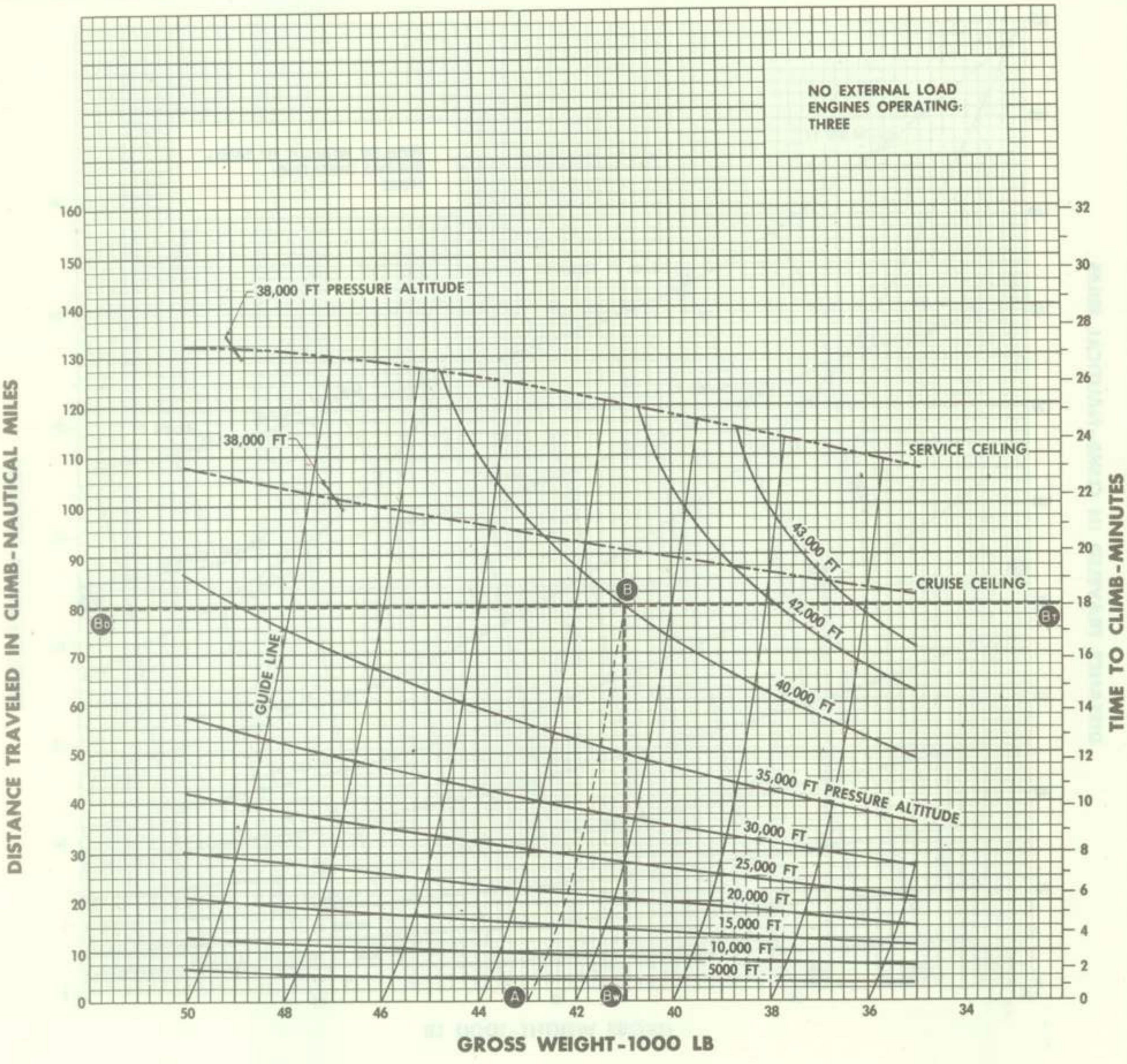
Figure A-31. Normal Power Climb—Three Engines

MILITARY POWER CLIMB

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



Example shows fuel used, distance traveled, and time to climb from sea level to 40,000 feet.

Ⓐ is initial gross weight (43,000 pounds).
Ⓑ is final altitude. (Follow guide lines to 40,000 feet.)
Ⓑw is final gross weight (41,000 pounds).
Ⓐ-Ⓑw is fuel used (2000 pounds).
Ⓑd is distance traveled (80 miles).
Ⓑt is time to climb (18 minutes).

For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB	5 percent
DISTANCE TRAVELED	7 percent
FUEL USED	3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1378A

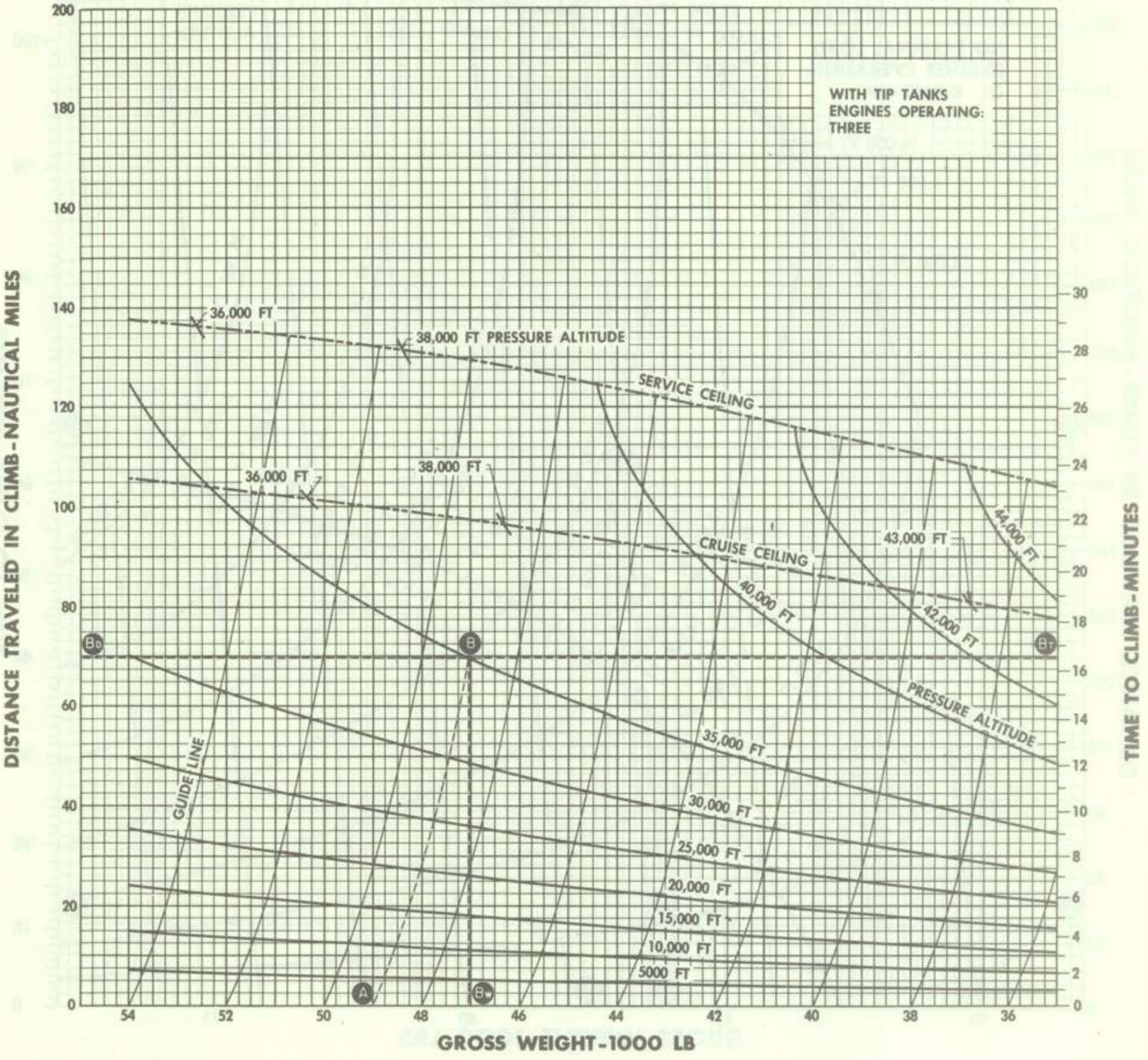
Figure A-32. Military Power Climb—Three Engines

MILITARY POWER CLIMB

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



Example shows fuel used, distance traveled, and time to climb from sea level to 35,000 feet.

Ⓐ is initial gross weight (49,000 pounds).

Ⓑ is final altitude. (Follow guide lines to 35,000 feet.)

Ⓑ$_W$ is final gross weight (47,000 pounds).

Ⓐ—Ⓑ$_W$ is fuel used (2000 pounds).

Ⓑ$_D$ is distance traveled (70 miles).

Ⓑ$_T$ is time to climb (16.5 minutes).

For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB	5 percent
DISTANCE TRAVELED	7 percent
FUEL USED	3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1379A

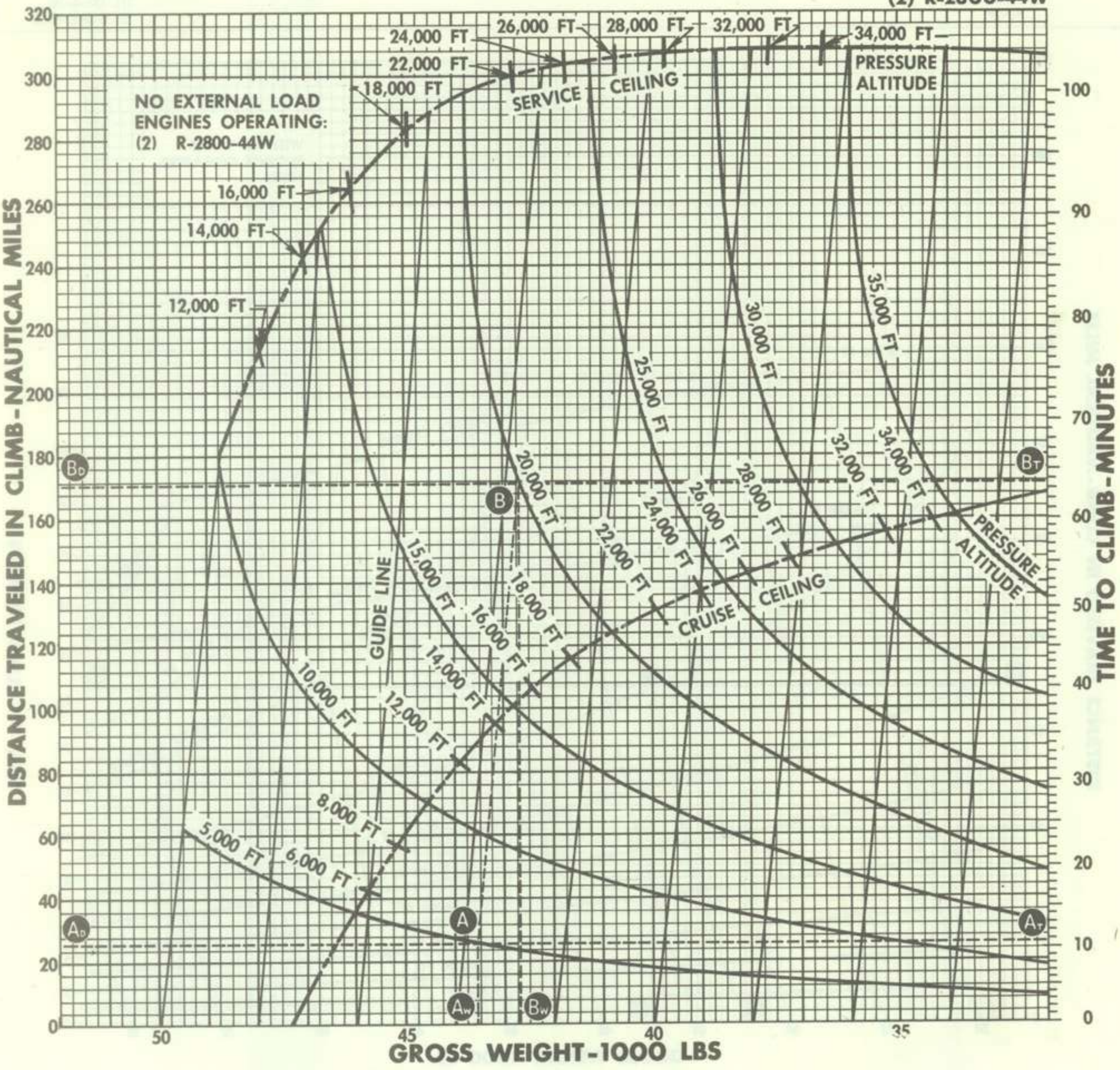
Figure A-33. Military Power Climb—Three Engines—with Tip Tanks

MODELS: AJ-1
AJ-2
AJ-2P

MAXIMUM CRUISE POWER CLIMB

STANDARD DAY

ENGINES
(1) J33-A-10
(2) R-2800-44W



Example shows fuel used, distance traveled, and time to climb from 5000 feet to 20,000 feet.

A	is initial altitude (5000 feet).	A_D	is initial distance (26 miles).
A_W	is initial gross weight (43,550 pounds).	B_D	is final distance (171 miles).
B	is final altitude (20,000 feet).	B_D—A_D	is distance traveled (145 miles).
B_W	is final gross weight (42,650 pounds).	A_T	is initial time (11 minutes).
A_W—B_W	is fuel used (900 pounds).	B_T	is final time (61 minutes).
		A_T—B_T	is time to climb (50 minutes).

For each 10° C rise in air temperature above Standard Day conditions, increase

TIME TO CLIMB	**5 percent**
DISTANCE TRAVELED	**7 percent**
FUEL USED	**3 percent**

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL.

H-169-93-5A

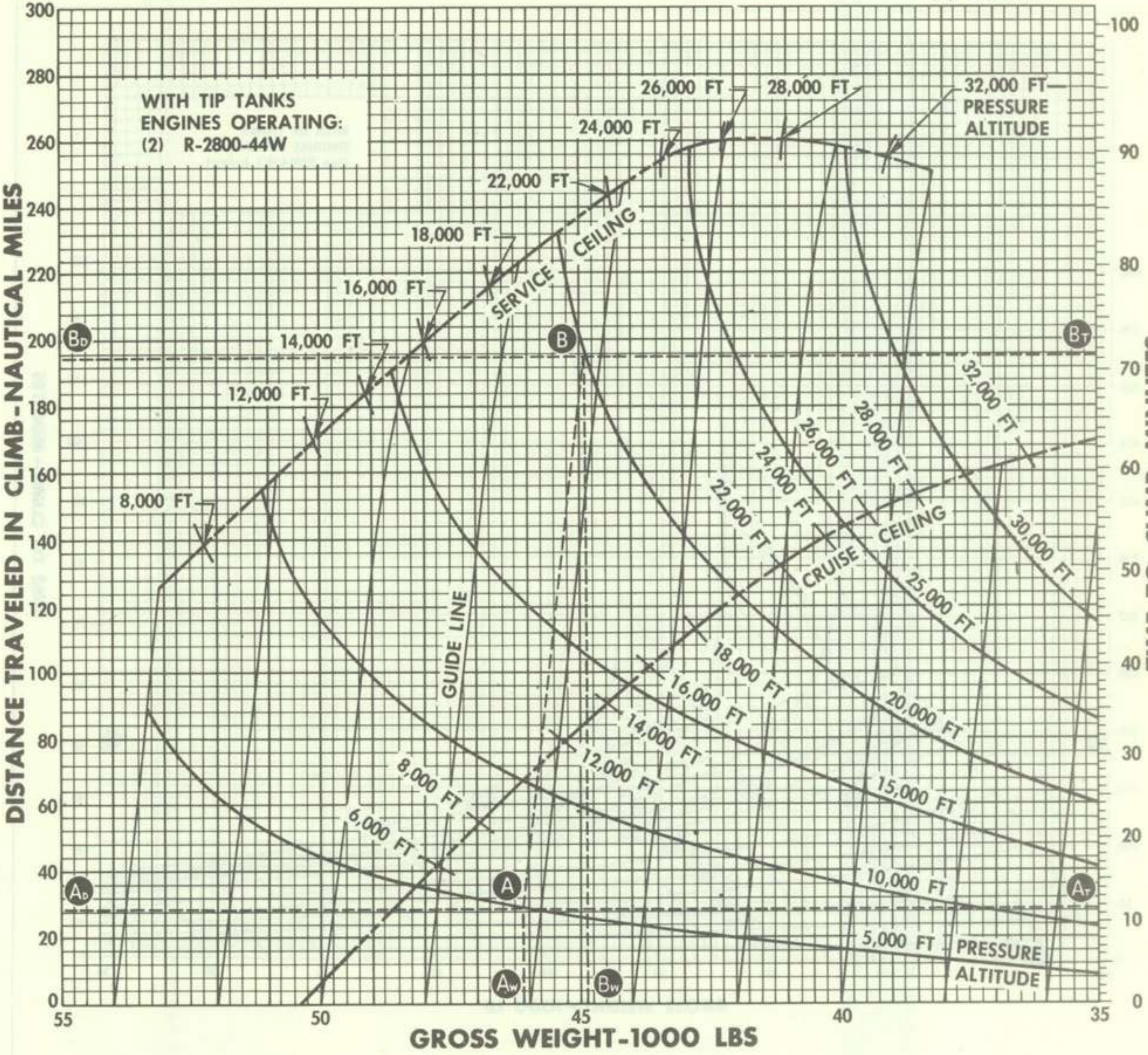
Figure A-34. Maximum Cruise Power Climb—Reciprocating Engines

MODELS: AJ-1
AJ-2
AJ-2P

MAXIMUM CRUISE POWER CLIMB

STANDARD DAY

ENGINES
(1) J33-A-10
(2) R-2800-44W



Example shows fuel used, distance traveled, and time to climb from 5000 feet to 20,000 feet when the gross weight at start of climb is 46,100 pounds.

A$_W$ is initial gross weight (46,100 pounds).
A is initial altitude (5000 feet).
A$_D$ is initial distance (29 miles).
A$_T$ is initial time (12 minutes).
B is final altitude (20,000 feet).

B$_D$ is final distance (195 miles).
B$_W$ is final gross weight (44,900 pounds).
B$_T$ is final time (71 minutes).
A$_W$—B$_W$ is fuel used (1200 pounds).
B$_D$—A$_D$ is distance traveled (166 miles).
B$_T$—A$_T$ is time to climb (59 minutes).

For each 10° C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB	**5 percent**
DISTANCE TRAVELED	**7 percent**
FUEL USED	**3 percent**

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

E-169-93-4A

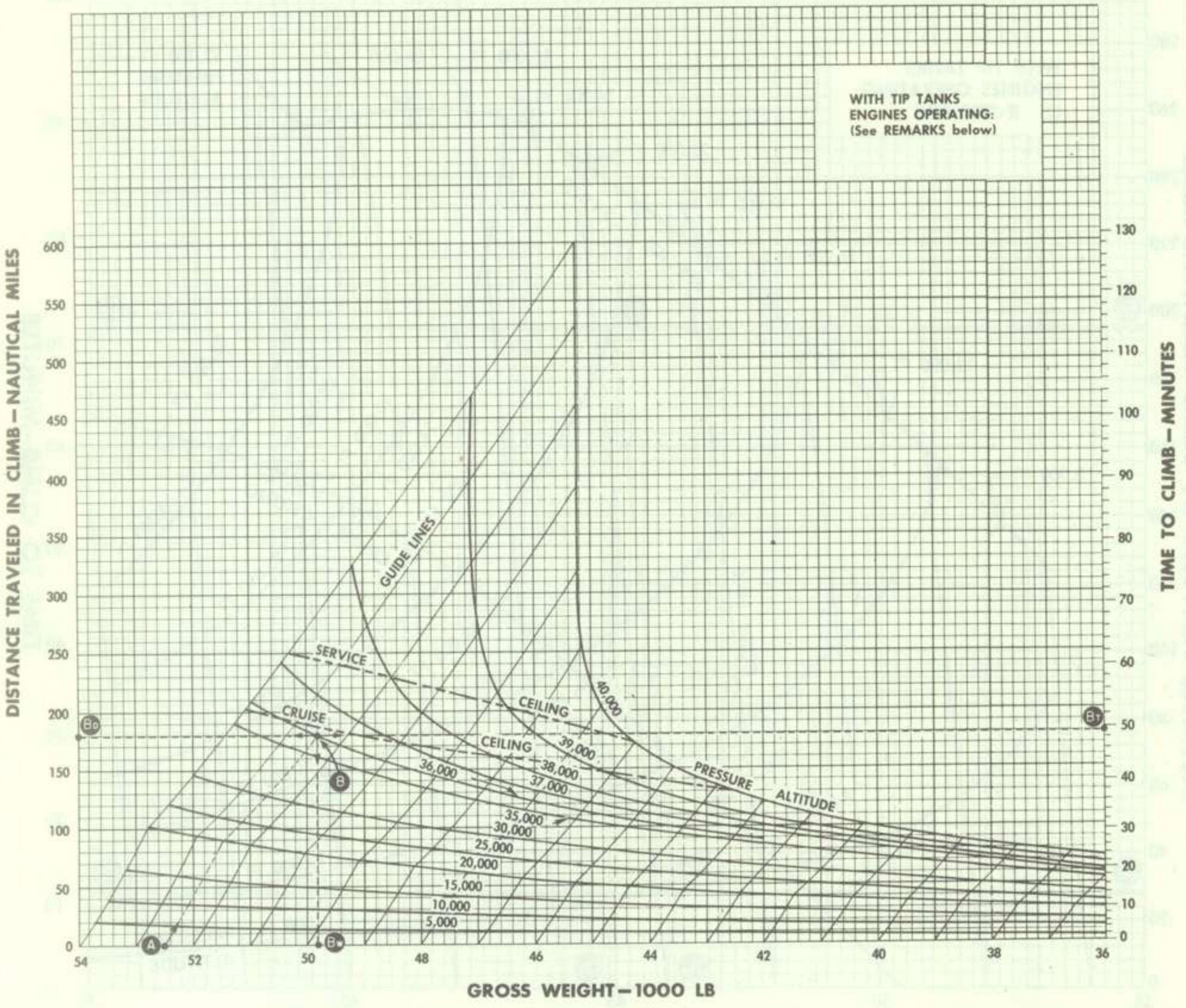
Figure A-35. Maximum Cruise Power Climb—Reciprocating Engines—with Tip Tanks

COMBINATION POWER CLIMB

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800 44W



Example shows fuel used, distance traveled, and time to climb from sea level to 36,000 feet.

Ⓐ is initial gross weight (52,500 pounds).

Ⓑ is final altitude. (Follow guide lines to 36,000 feet.)

Ⓑw is final gross weight (49,800 pounds).

Ⓐ-Ⓑw is fuel used (2700 pounds).

Ⓑd is distance traveled (180 miles).

Ⓑt is time to climb (49 minutes).

REMARKS:
Climb to 20,000 feet using reciprocating engines only (Normal Rated Power).
Climb from 20,000 feet to 35,000 feet using Normal Rated Power on all three engines.
Climb above 35,000 feet using Military Power on all three engines.
For each 10°C rise in air temperature above Standard Day conditions, increase:

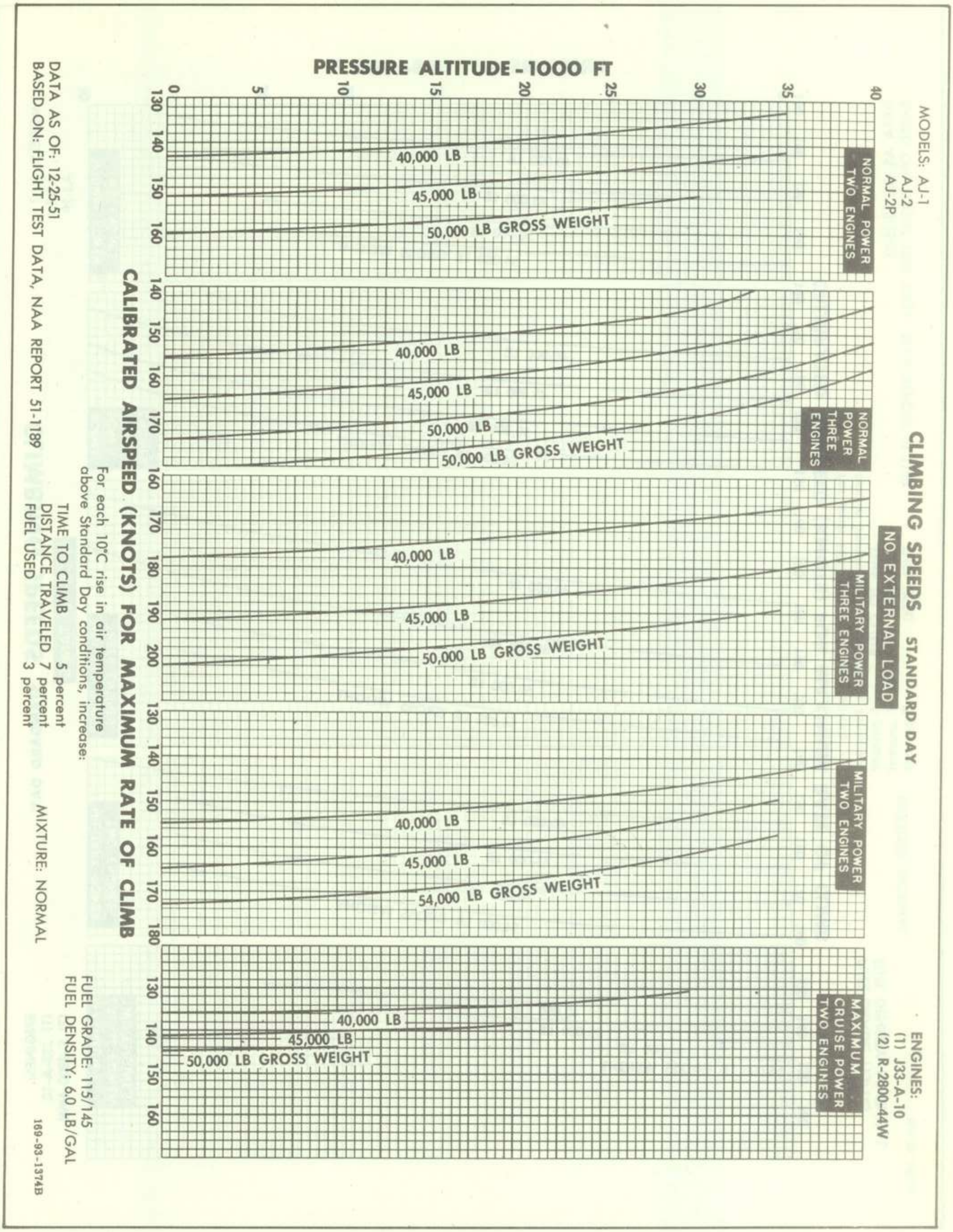
TIME TO CLIMB	5 percent
DISTANCE TRAVELED	7 percent
FUEL USED	3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1577A

Figure A-36. Combination Power Climb—with Tip Tanks



CLIMBING SPEEDS STANDARD DAY

NO EXTERNAL LOAD

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W

For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB 5 percent
DISTANCE TRAVELED 7 percent
FUEL USED 3 percent

MIXTURE: NORMAL

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

169-93-1374B

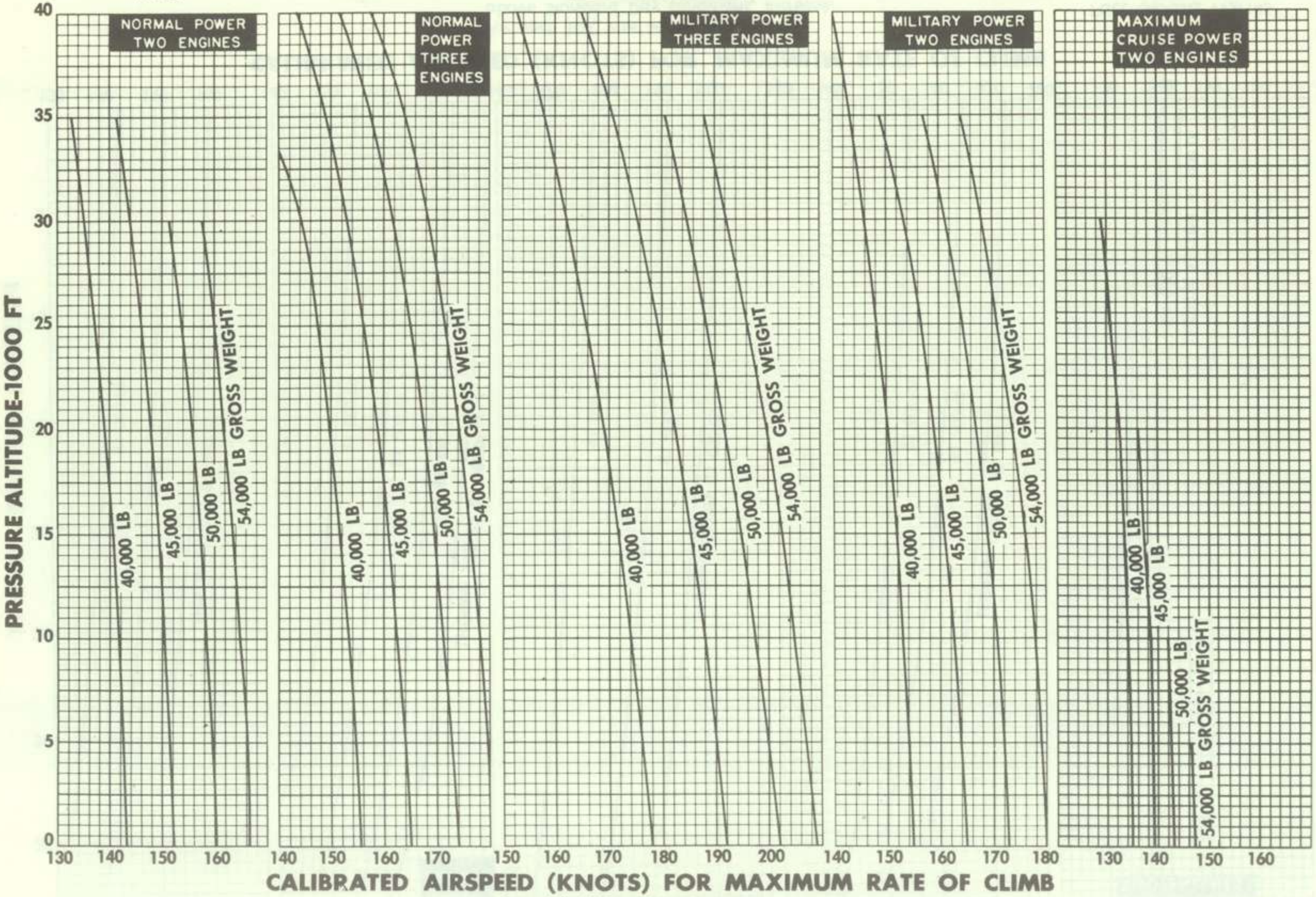
Figure A-37. Climbing Speeds—No External Load

MODELS: AJ-1
AJ-2
AJ-2P

CLIMBING SPEEDS STANDARD DAY

WITH TIP TANKS

ENGINES:
(1) J33-A-10
(2) R-2800-44W



For each 10°C rise in air temperature above Standard Day conditions, increase:

TIME TO CLIMB 5 percent
DISTANCE TRAVELED 7 percent
FUEL USED 3 percent

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

MIXTURE: NORMAL

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1352B

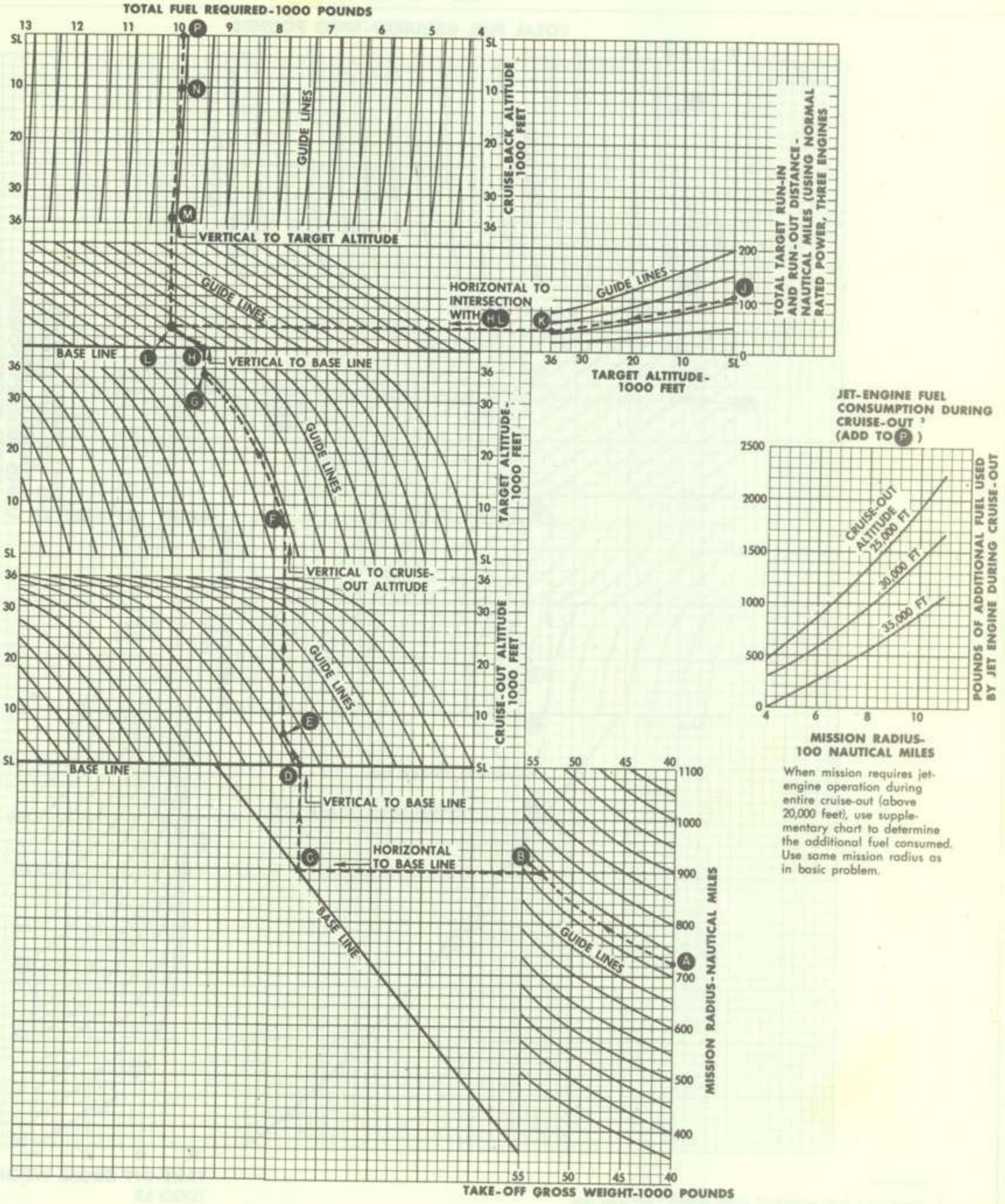
Figure A-38. Climbing Speeds—with Tip Tanks

MODELS: AJ-1
AJ-2

BOMB-RUN PLANNING CHART

WITH TIP TANKS

ENGINES:
(1) J33-A-10
(2) R-2800-44W



When mission requires jet-engine operation during entire cruise-out (above 20,000 feet), use supplementary chart to determine the additional fuel consumed. Use same mission radius as in basic problem.

REMARKS:

1. Based on a basic weight of 43,000 pounds (with crew and fuel but without bomb load).
2. Basic chart is for cruise-out with jet engine inoperative. If initial cruise-out altitude is above 20,000 feet (jet engine inoperative), descend to 20,000 feet just prior to final climb to facilitate jet-engine start.
3. Below 20,000 feet, climb with Normal Rated Power on reciprocating engines only.
   Above 20,000 feet, climb with Normal Rated Power on all three engines.
4. Warm-up and take-off allowance of 440 pounds of fuel included.
5. Chart limited to 36,000 feet because of excessive Jet power necessary at higher altitudes.
6. Assumed bombs dropped at target.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

EXAMPLE:

Ⓐ is mission radius (725 nautical miles).
Ⓑ is take-off gross weight (53,300 pounds).
Ⓔ & Ⓕ is cruise-out altitude (6000 feet).
Ⓖ Ⓚ & Ⓜ is target altitude (35,000 feet).
Ⓙ is total target run-in and run-out distance (110 nautical miles).
Ⓝ is cruise-back altitude (10,000 feet).
Ⓟ is total fuel reauired (9,900 pounds).
AB, DE, FG, HL, JK & MN parallel to guide lines.

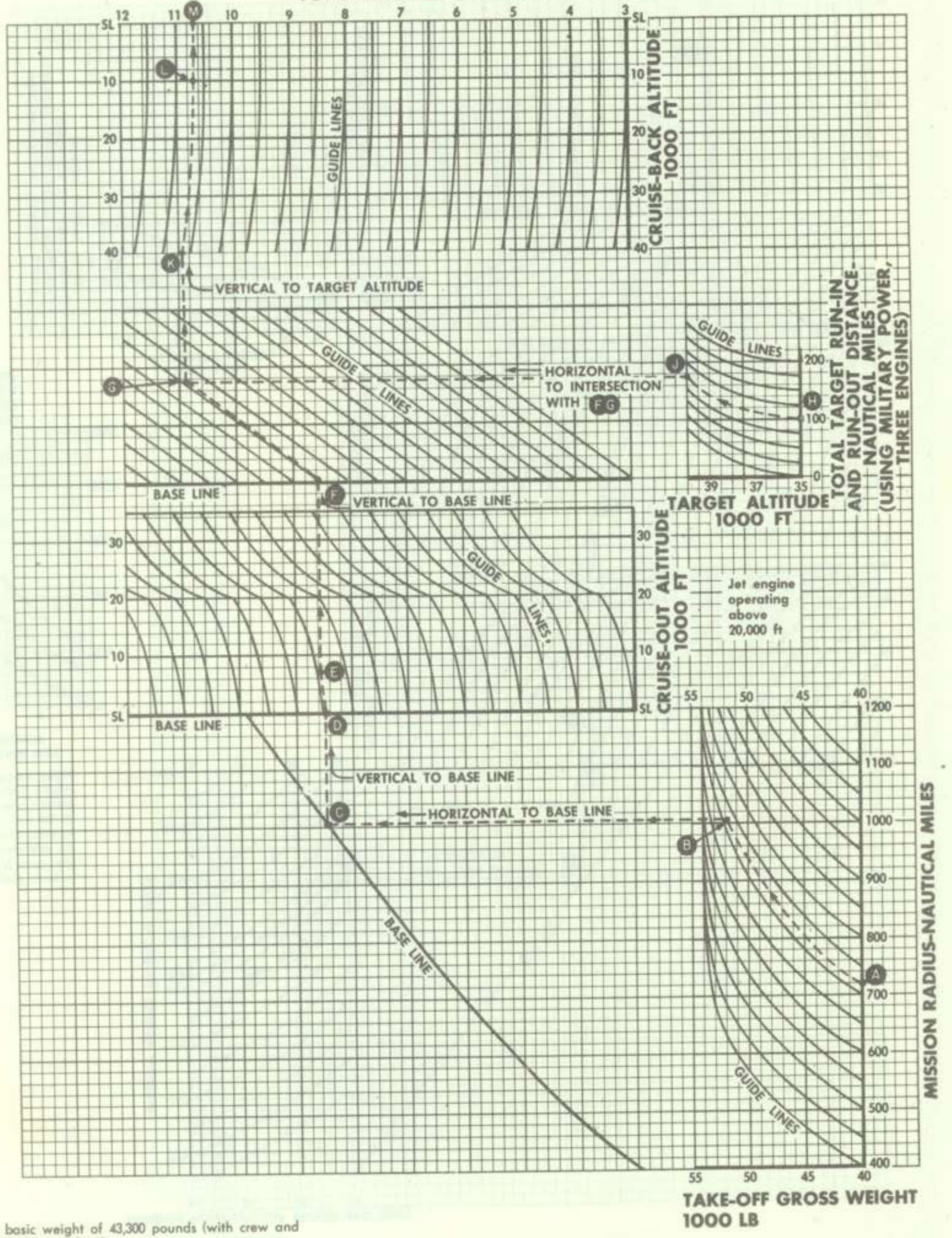
189-93-1579A

Figure A-39. Bomb Run Planning

BOMB-RUN PLANNING CHART
HIGH-ALTITUDE TARGET RUN
WITH TIP TANKS

MODELS: AJ-1
AJ-2

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:

1. Based on a basic weight of 43,300 pounds (with crew and fuel but without bomb load).
2. Jet engine operating above 20,000 feet.
3. Climb to 20,000 feet using reciprocating engine only (Normal Rated Power).
   Climb from 20,000 feet to 35,000 feet using Normal Rated Power on all three engines.
   Climb above 35,000 feet using Military Power on all three engines.
4. Warm-up and take-off allowance of 440 pounds of fuel included.
5. Assumed bombs dropped on target.
6. For take-off weights above 53,000 pounds, a target altitude above 38,000 feet is impractical.

EXAMPLE:

Ⓐ is radius (720 nautical miles).

Ⓑ is take-off gross weight (51,800 pounds).

Ⓔ is cruise-out altitude (7000 feet).

Ⓗ is total target run-in and run-out distance (100 nautical miles).

Ⓙ and Ⓚ are target altitude (40,000 feet).

Ⓛ is. cruise-back altitude (10,000 feet).

Ⓜ is fuel required (10,700 pounds).

ⒶⒷ ⒹⒺ ⒻⒼ ⒽⒿ and ⓀⓁ are parallel to guide lines.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

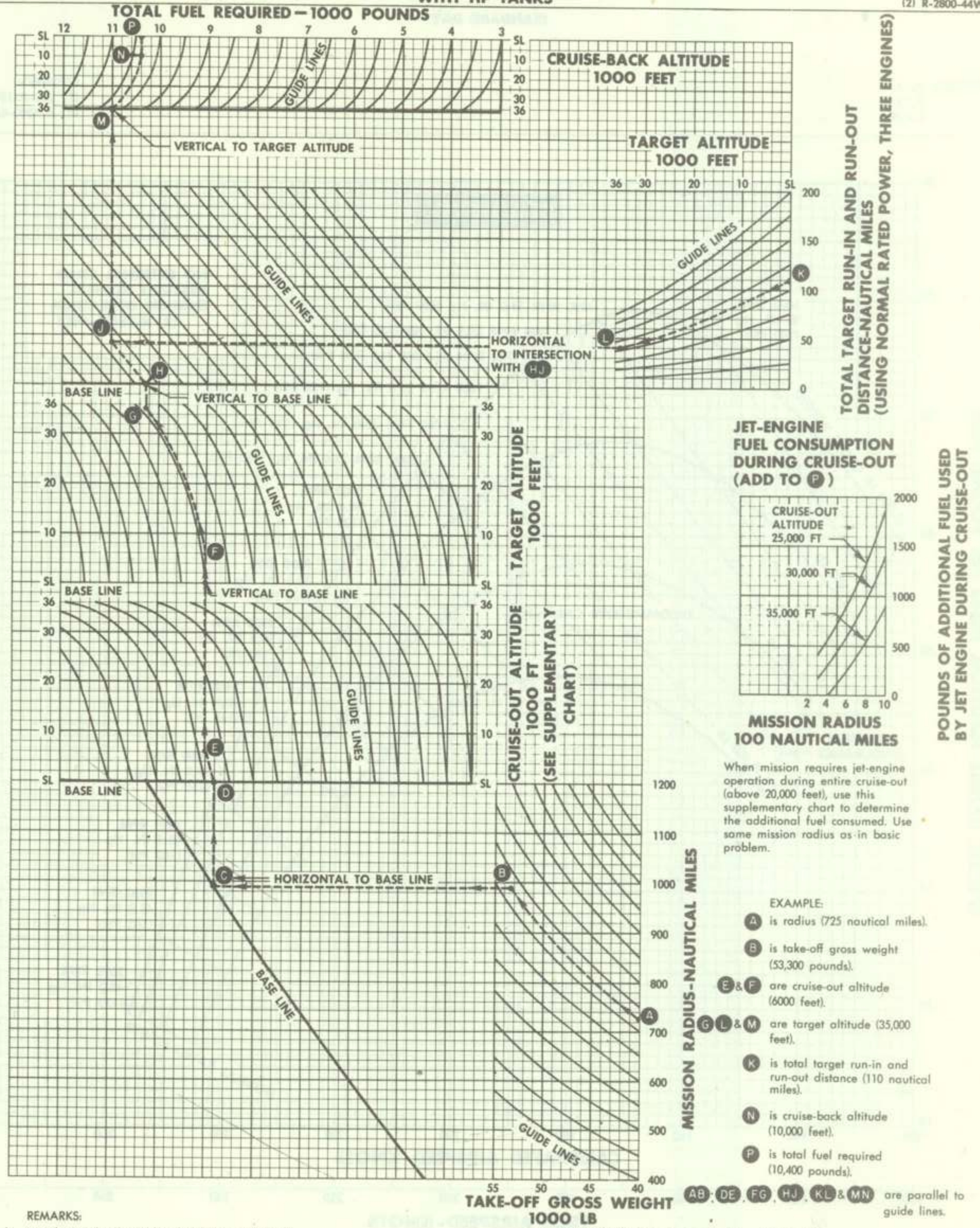
189-93-1578A

Figure A-40. Bomb Run Planning—High Altitude Target Run

MODELS: AJ-1
AJ-2

BOMB-RUN PLANNING CHART
BOMB LOAD NOT DROPPED
WITH TIP TANKS

ENGINES:
(1) J33-A-10
(2) R-2800-44W



When mission requires jet-engine operation during entire cruise-out (above 20,000 feet), use this supplementary chart to determine the additional fuel consumed. Use same mission radius as in basic problem.

EXAMPLE:

- Ⓐ is radius (725 nautical miles).
- Ⓑ is take-off gross weight (53,300 pounds).
- Ⓔ & Ⓕ are cruise-out altitude (6000 feet).
- Ⓖ Ⓛ & Ⓜ are target altitude (35,000 feet).
- Ⓚ is total target run-in and run-out distance (110 nautical miles).
- Ⓝ is cruise-back altitude (10,000 feet).
- Ⓟ is total fuel required (10,400 pounds).

AB, DE, FG, HJ, KL & MN are parallel to guide lines.

REMARKS:

1. Based on a basic weight of 43,300 pounds (with crew and fuel without bomb load).
2. Basic chart is for cruise-out with jet engine inoperative. If initial cruise-out is above 20,000 feet (jet engine inoperative), descend to 20,000 feet just prior to final climb to facilitate jet-engine start.
3. Below 20,000 feet, climb with Normal Rated Power on reciprocating engines only. Above 20,000 feet, climb with Normal Rated Power on all three engines.
4. Warm-up and take-off allowance of 440 pounds of fuel included.
5. Chart limited to 36,000 feet because of excessive jet power necessary at higher altitudes.

DATA AS OF: 12-25-51 BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL DENSITY: 6.0 LB/GAL FUEL GRADE: 115/145 189-93-1578A

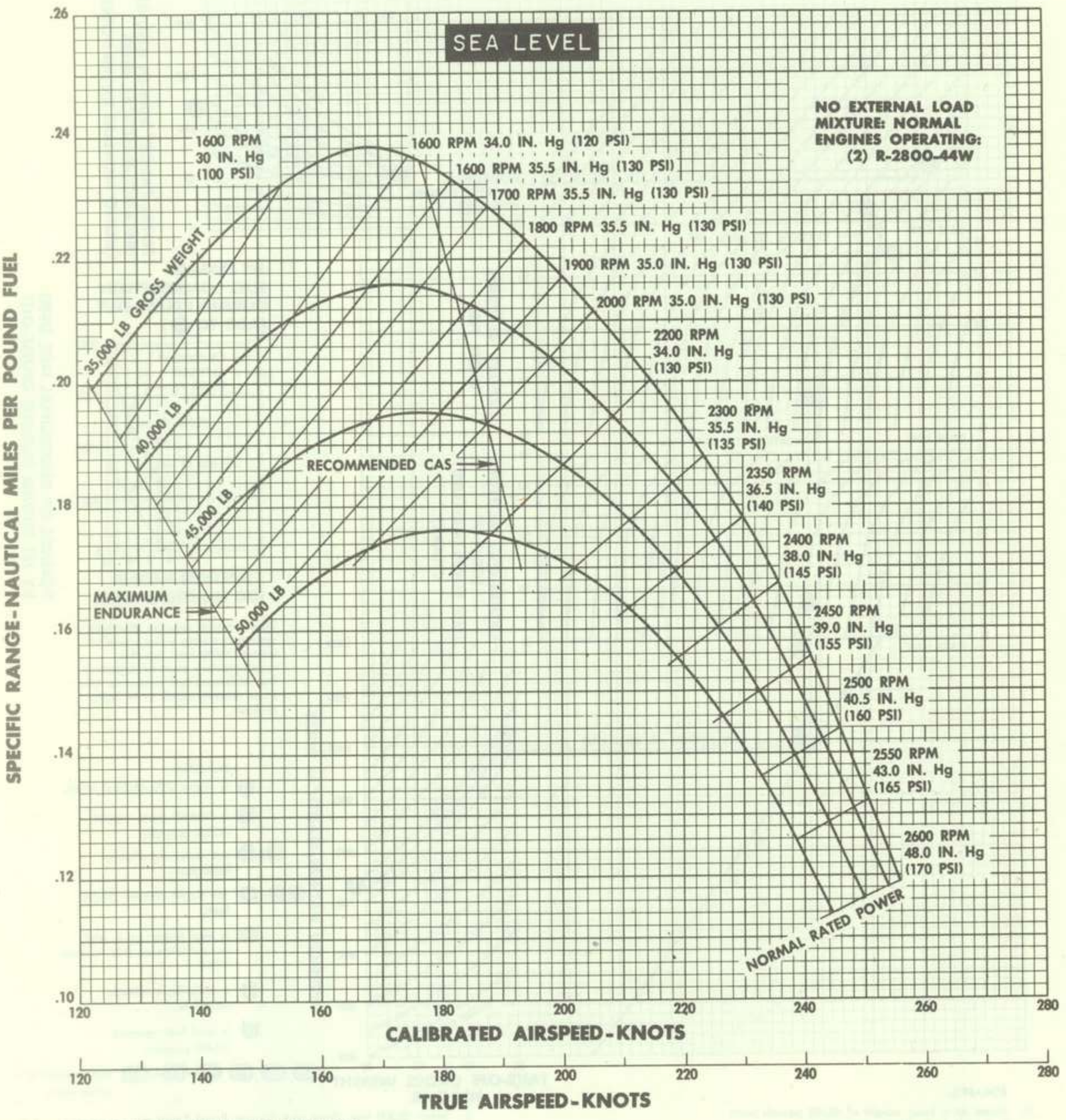
Figure A-41. Bomb Run Planning—Bomb Load Not Dropped

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1373A

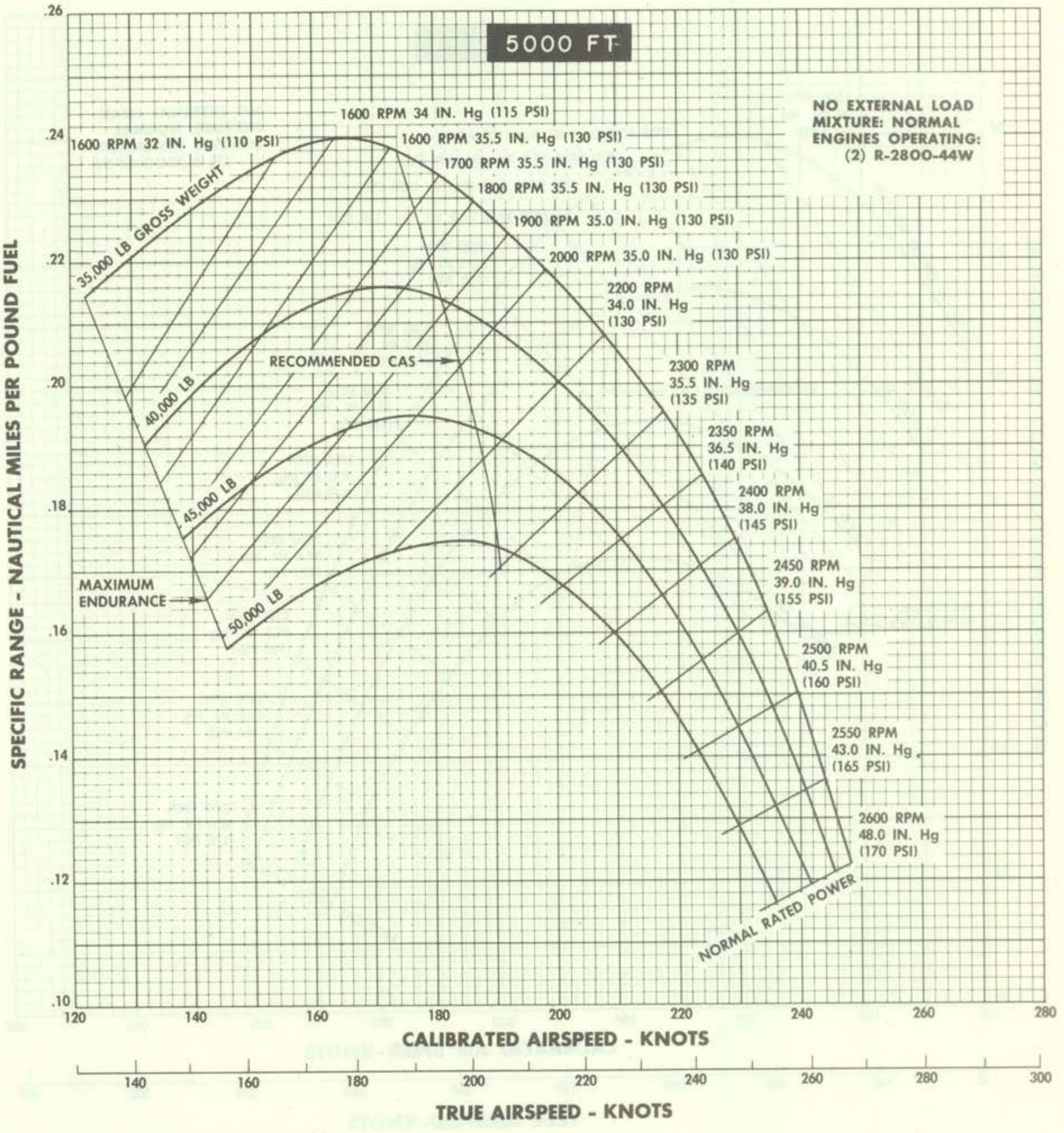
Figure A-42. Nautical Miles per Pound of Fuel—Reciprocating Engines—Sea Level

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1372A

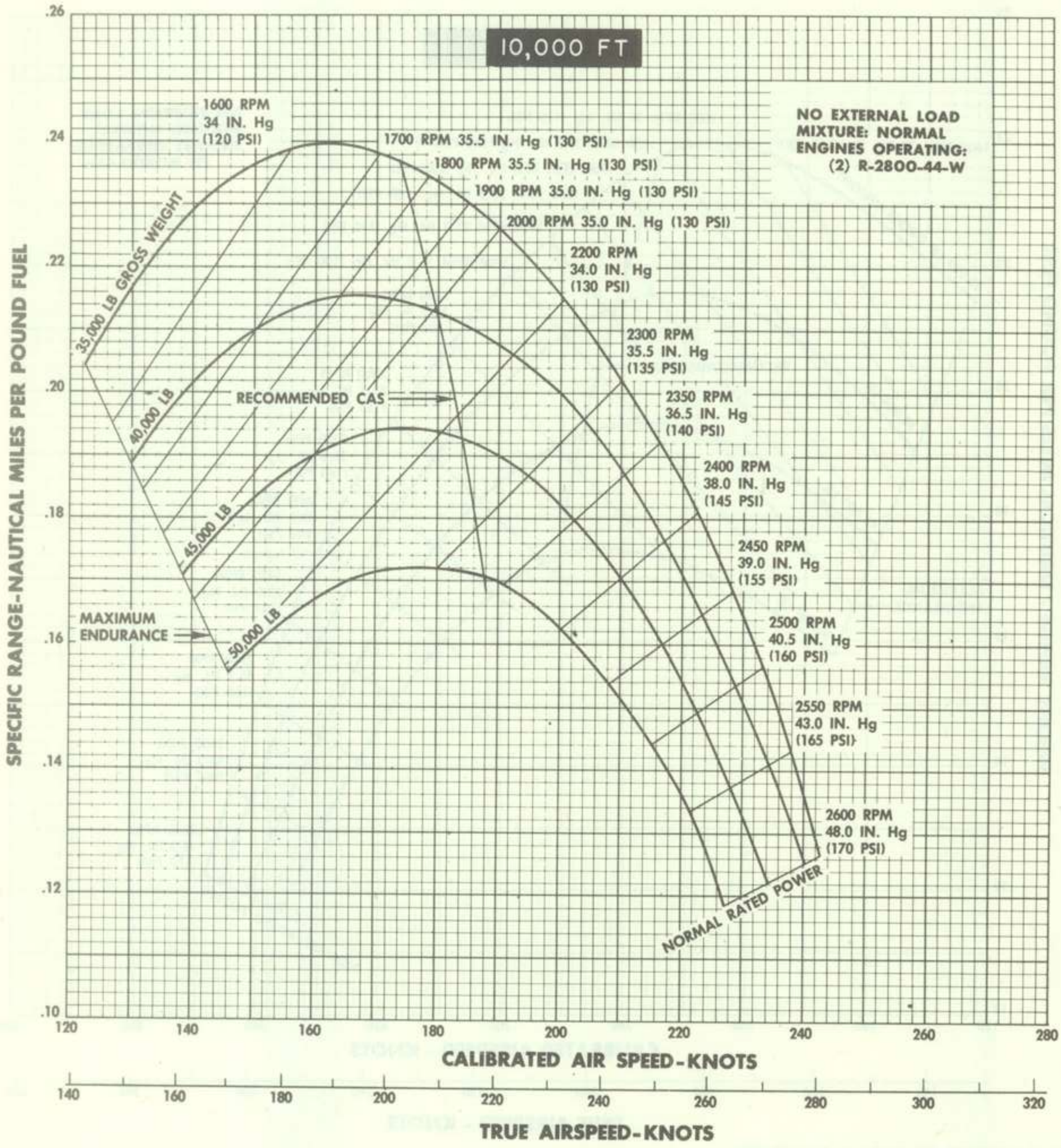
Figure A-43. Nautical Miles per Pound of Fuel—Reciprocating Engines—5000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1371A

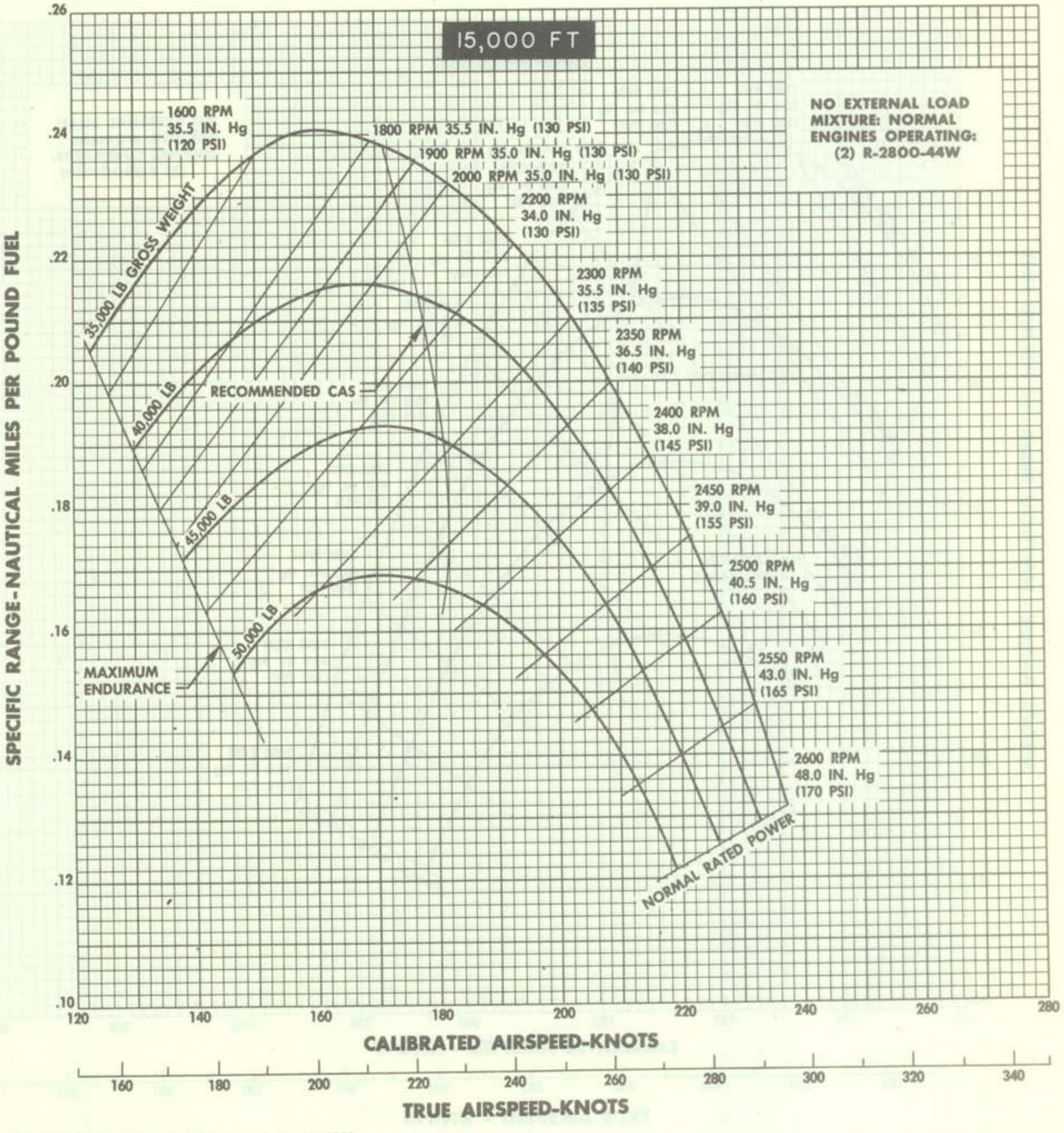
Figure A-44. Nautical Miles per Pound of Fuel—Reciprocating Engines—10,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1370A

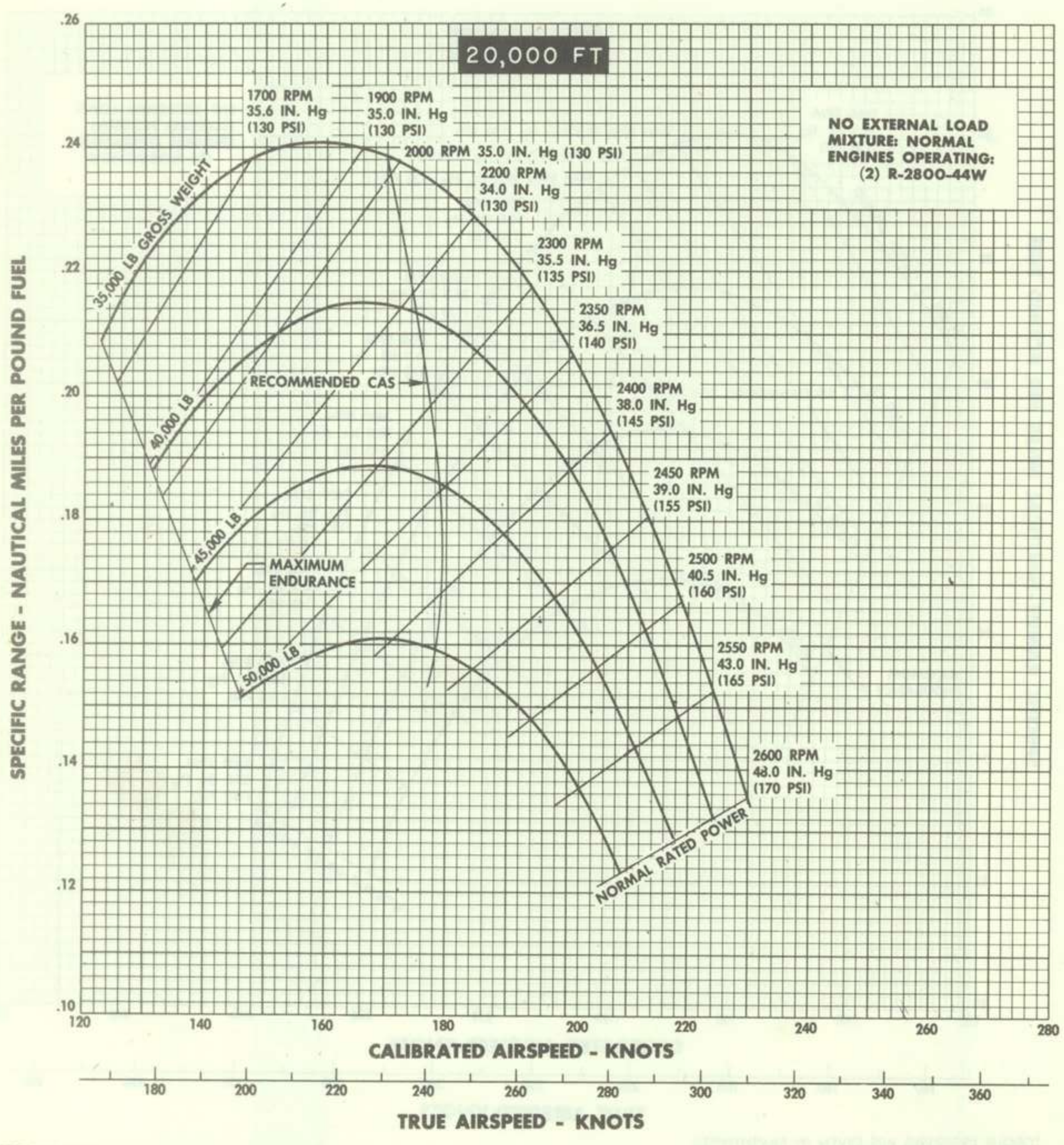
Figure A-45. Nautical Miles per Pound of Fuel—Reciprocating Engines—15,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1369A

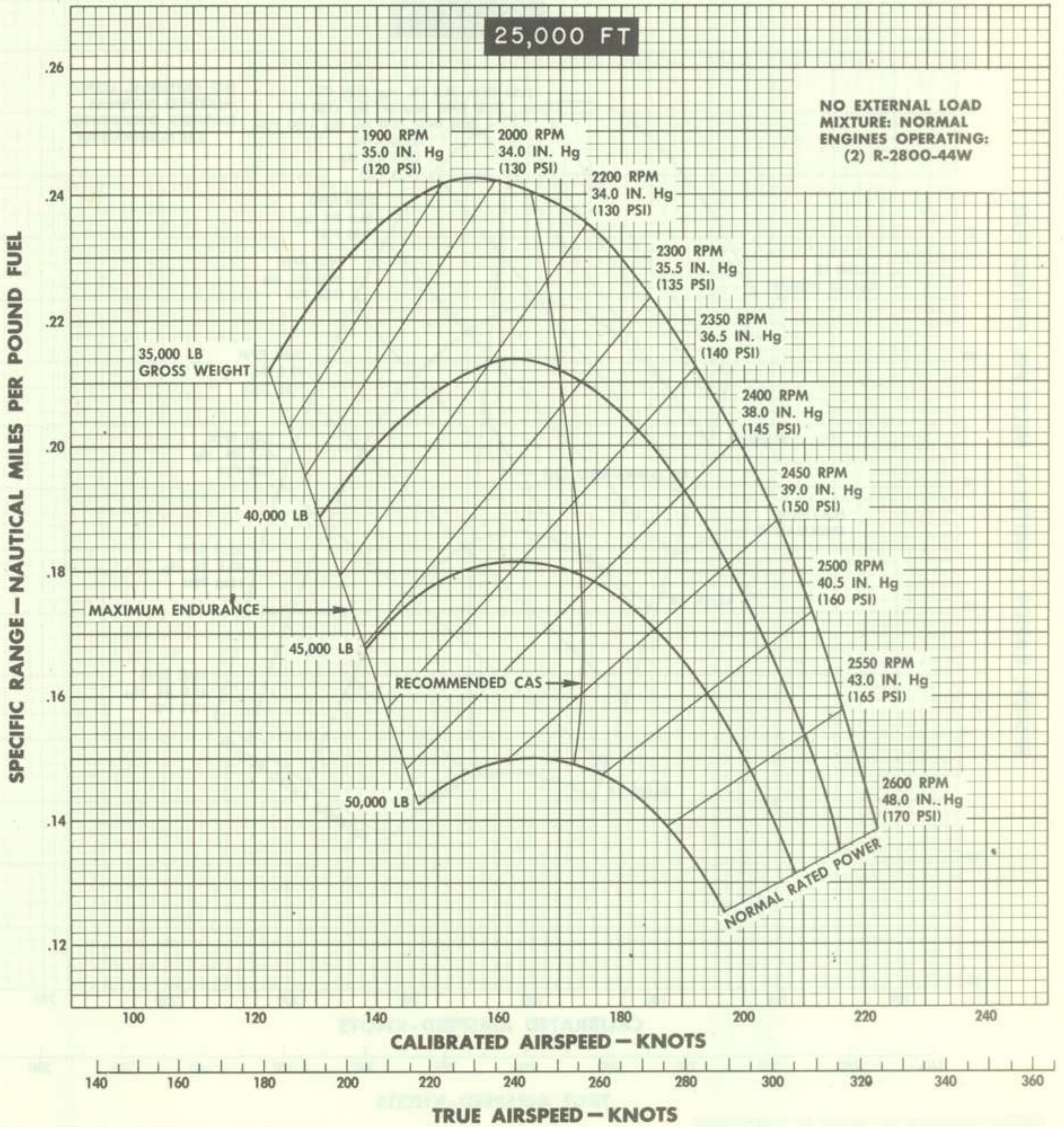
Figure A-46. Nautical Miles per Pound of Fuel—Reciprocating Engines—20,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1368A

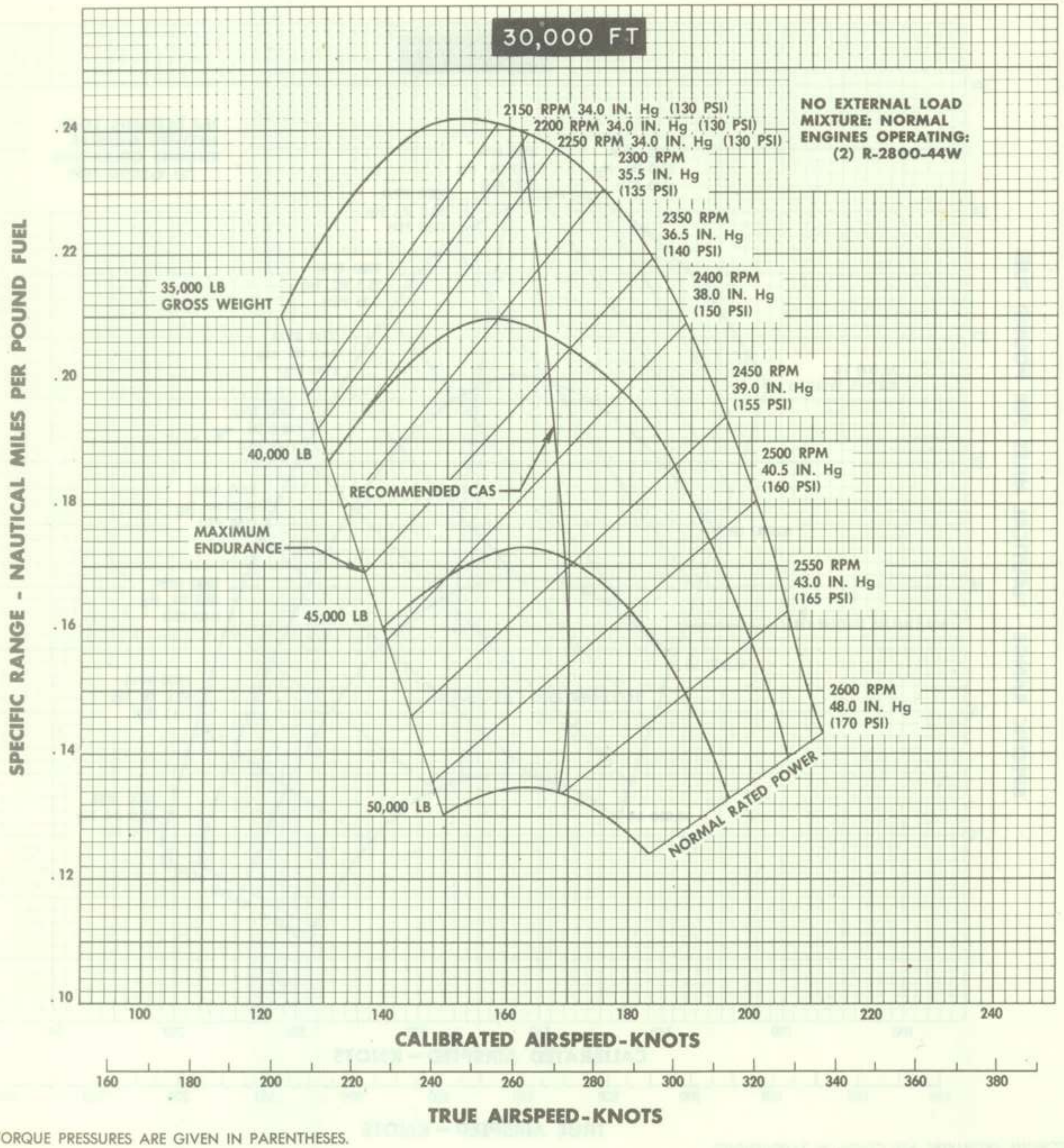
Figure A-47. Nautical Miles per Pound of Fuel—Reciprocating Engines—25,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1367B

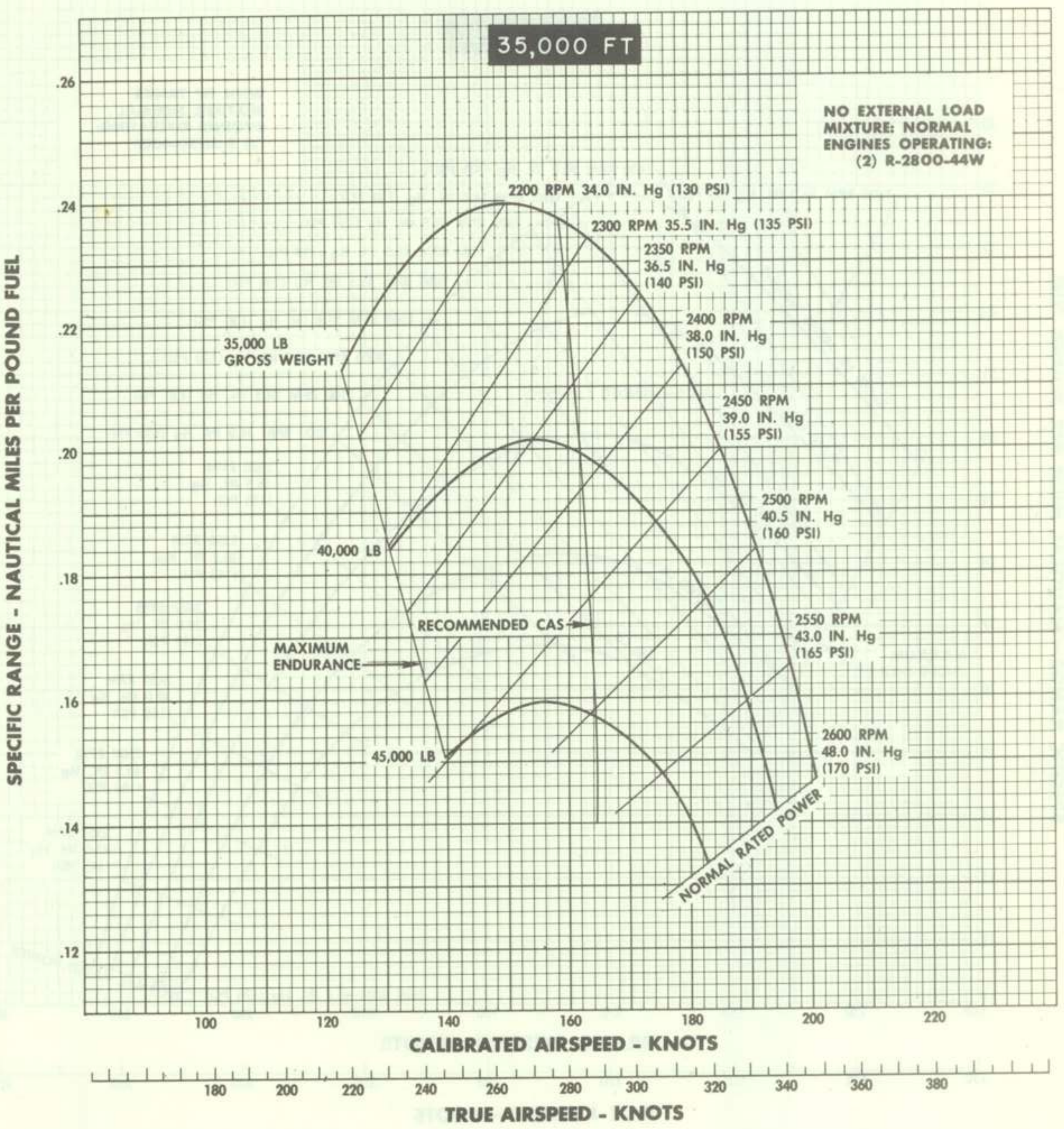
Figure A-48. Nautical Miles per Pound of Fuel—Reciprocating Engines—30,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1366A

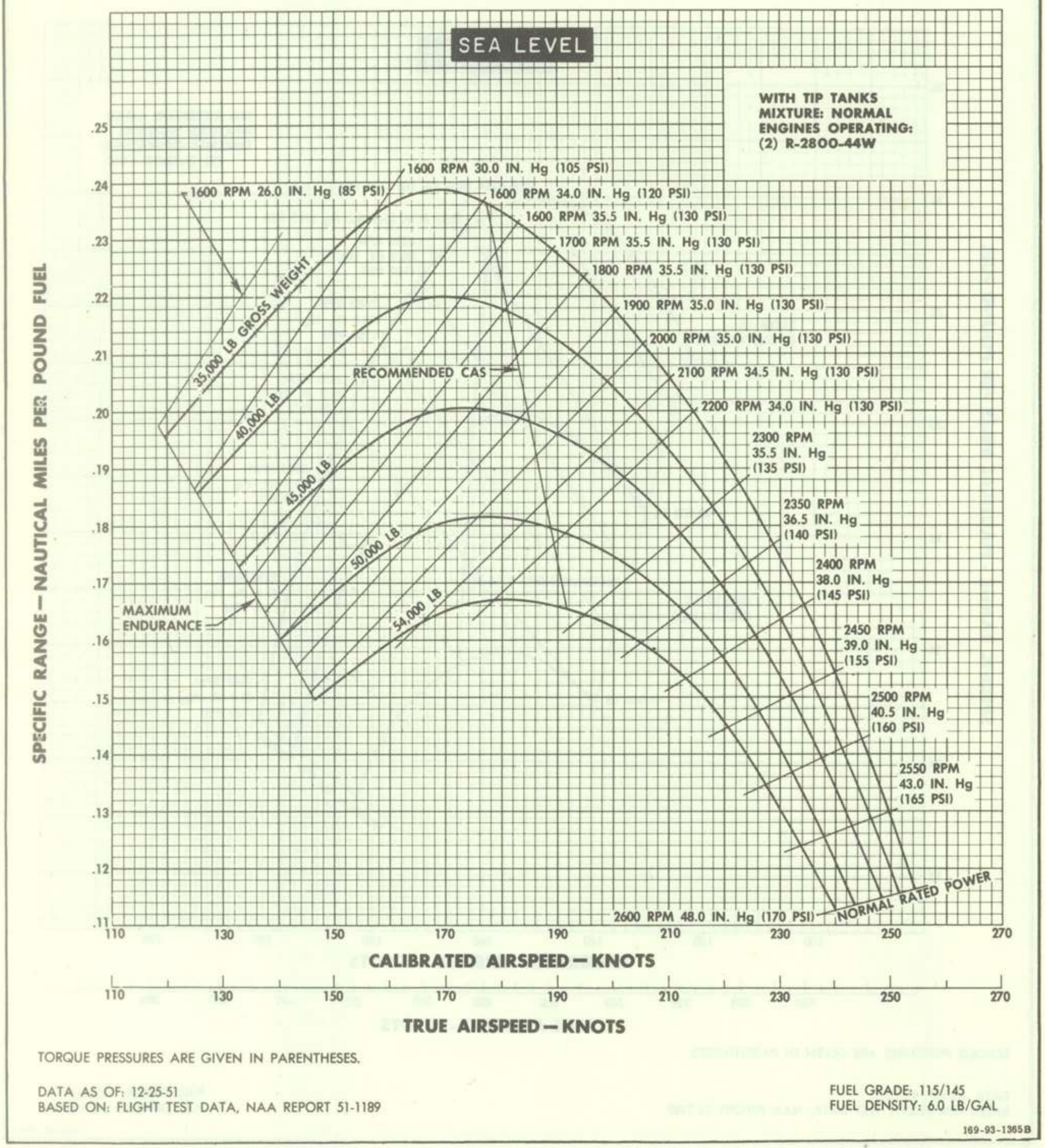
Figure A-49. Nautical Miles per Pound of Fuel—Reciprocating Engines—35,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1365B

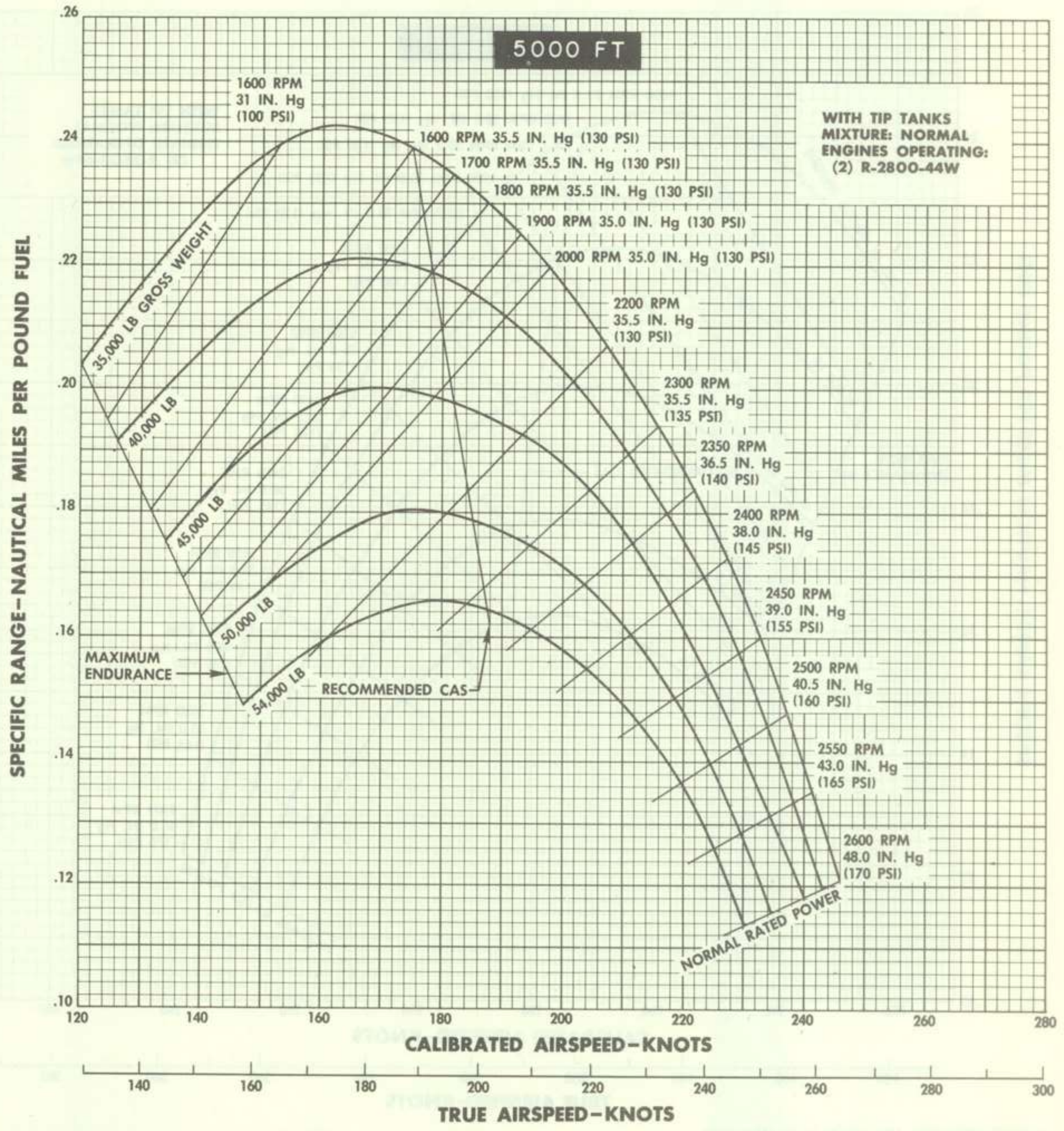
Figure A-50. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—Sea Level

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

189-93-1364A

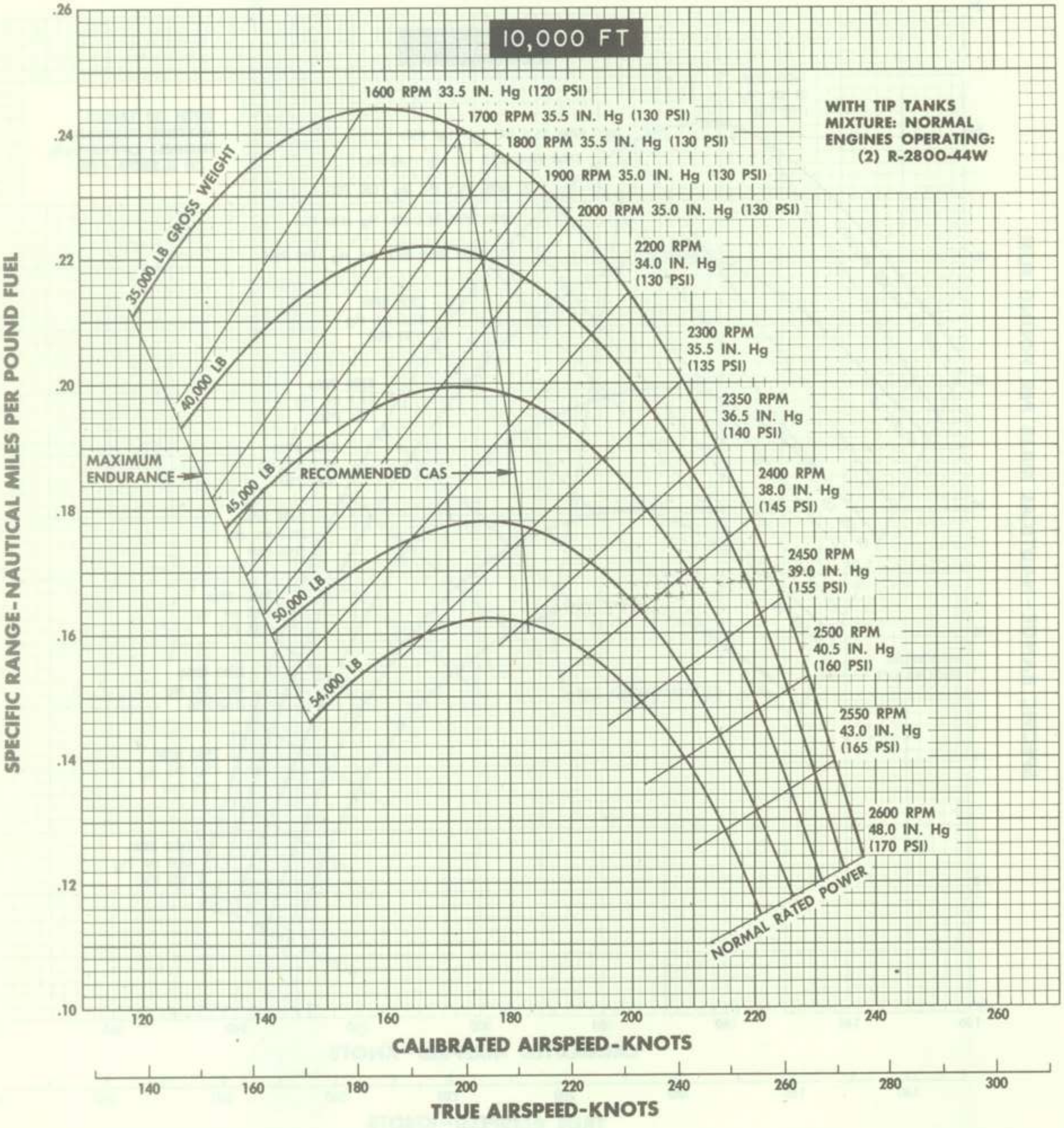
Figure A-51. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—5000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1363A

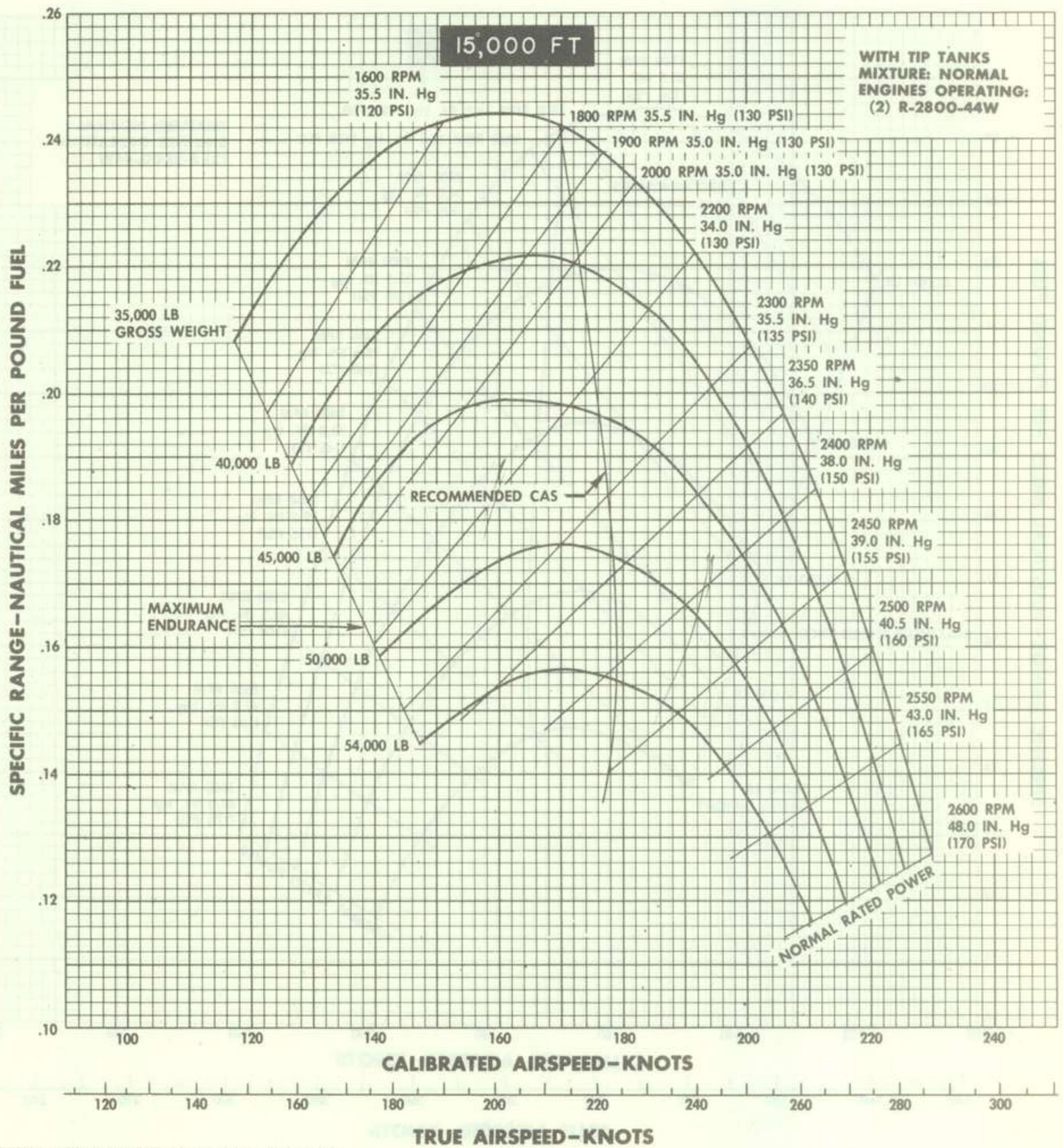
Figure A-52. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—10,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1362A

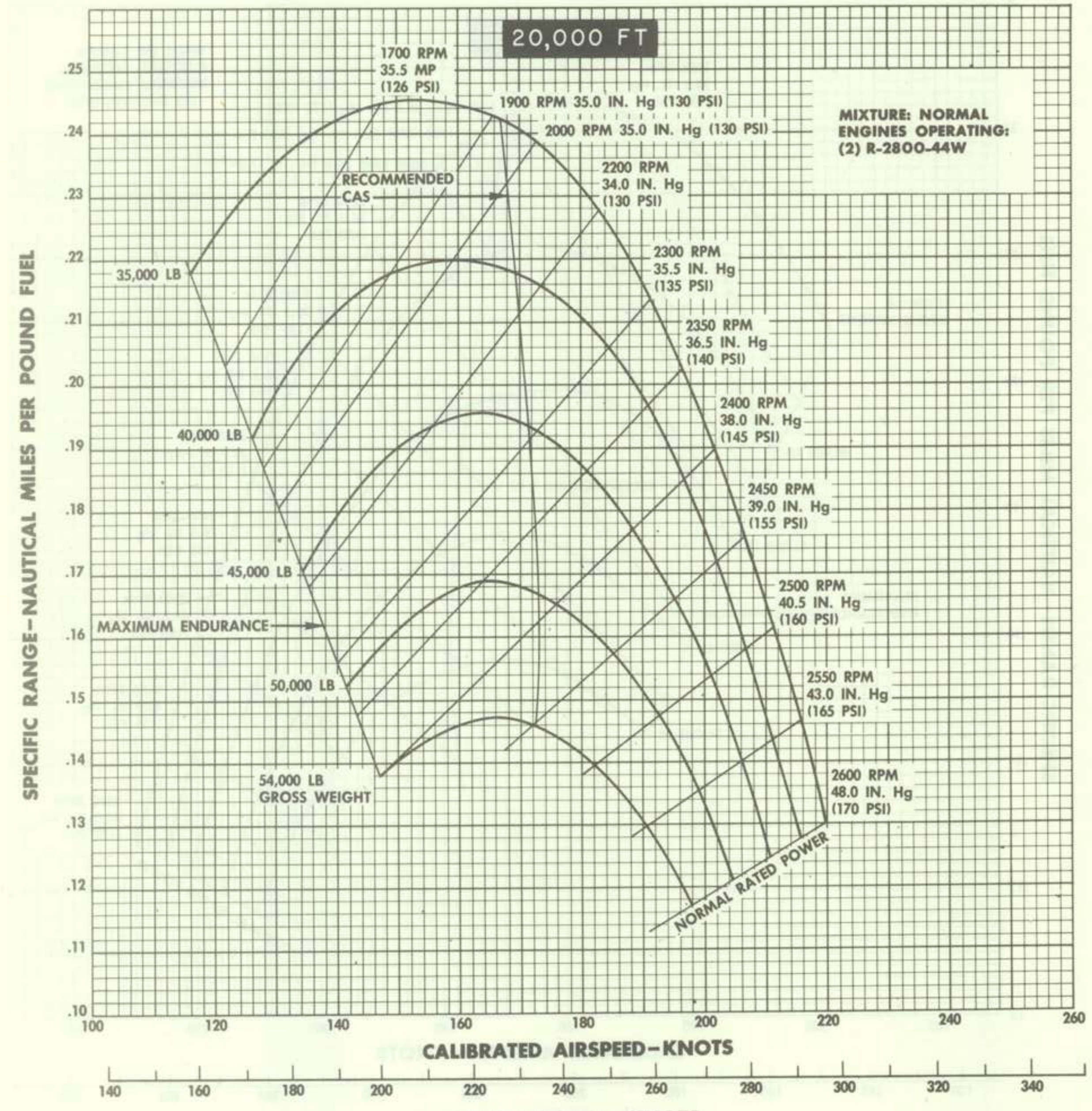
Figure A-53. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—15,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1361A

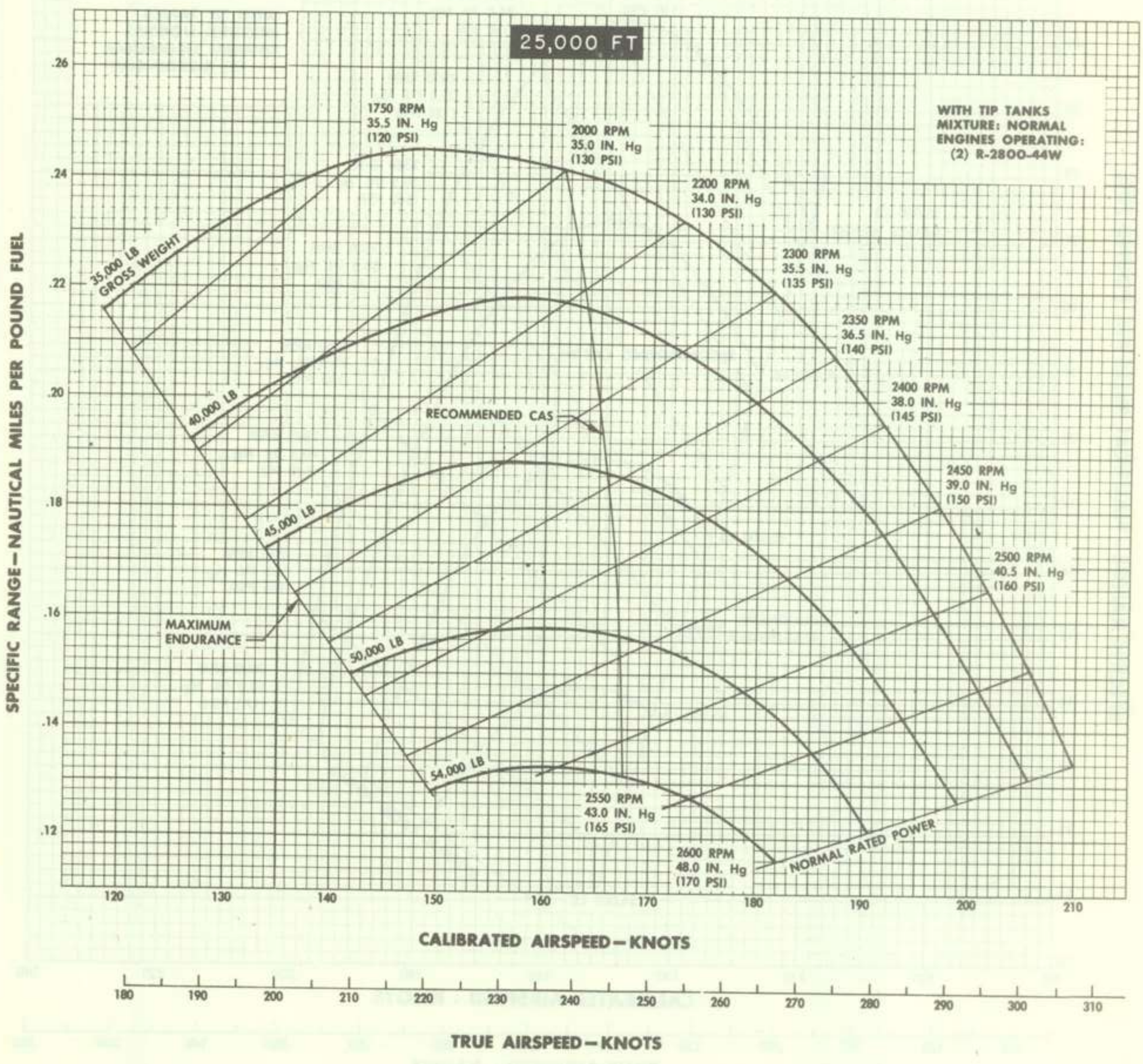
Figure A-54. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—20,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

180-93-1300A

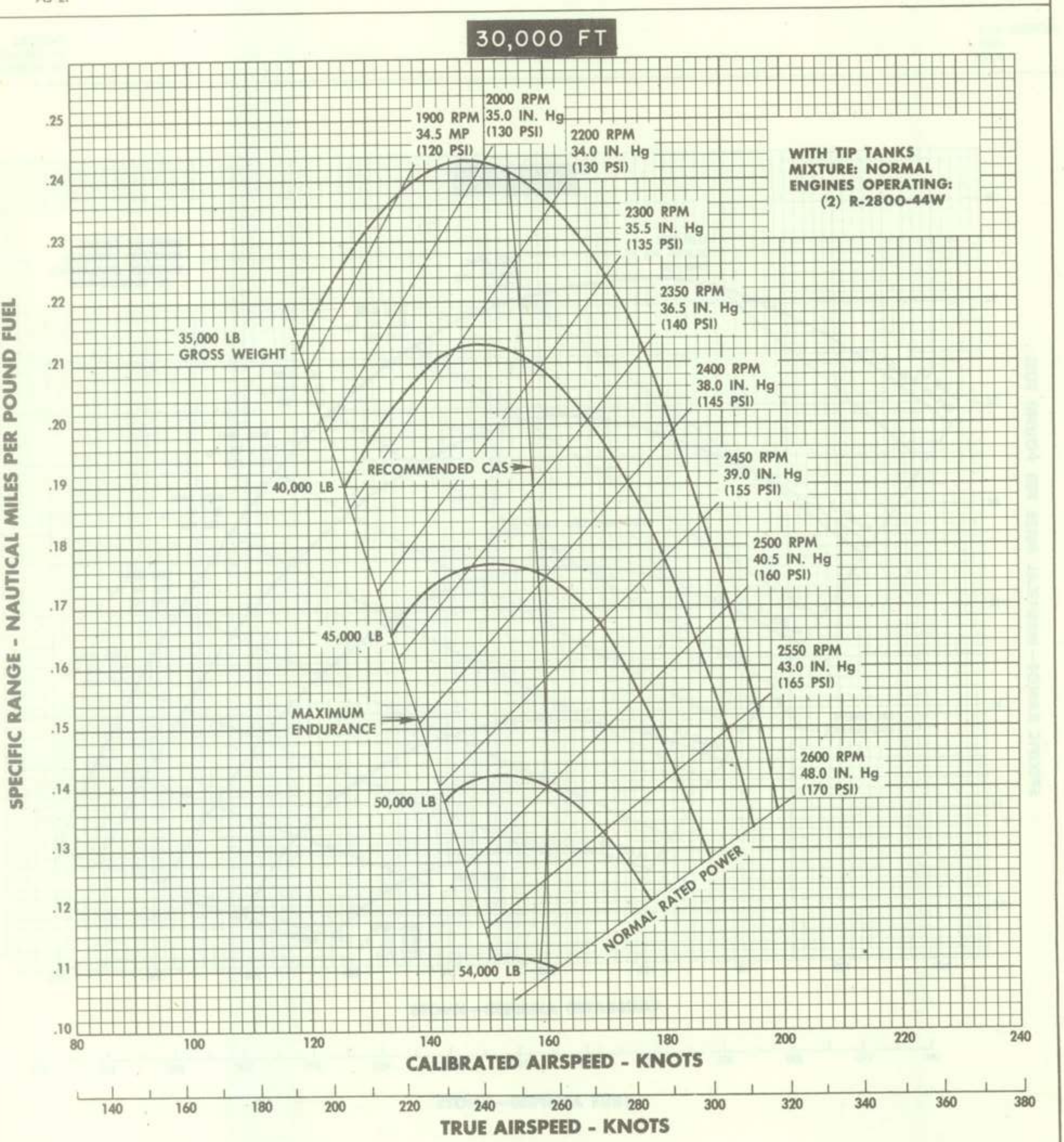
Figure A-55. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—25,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1359A

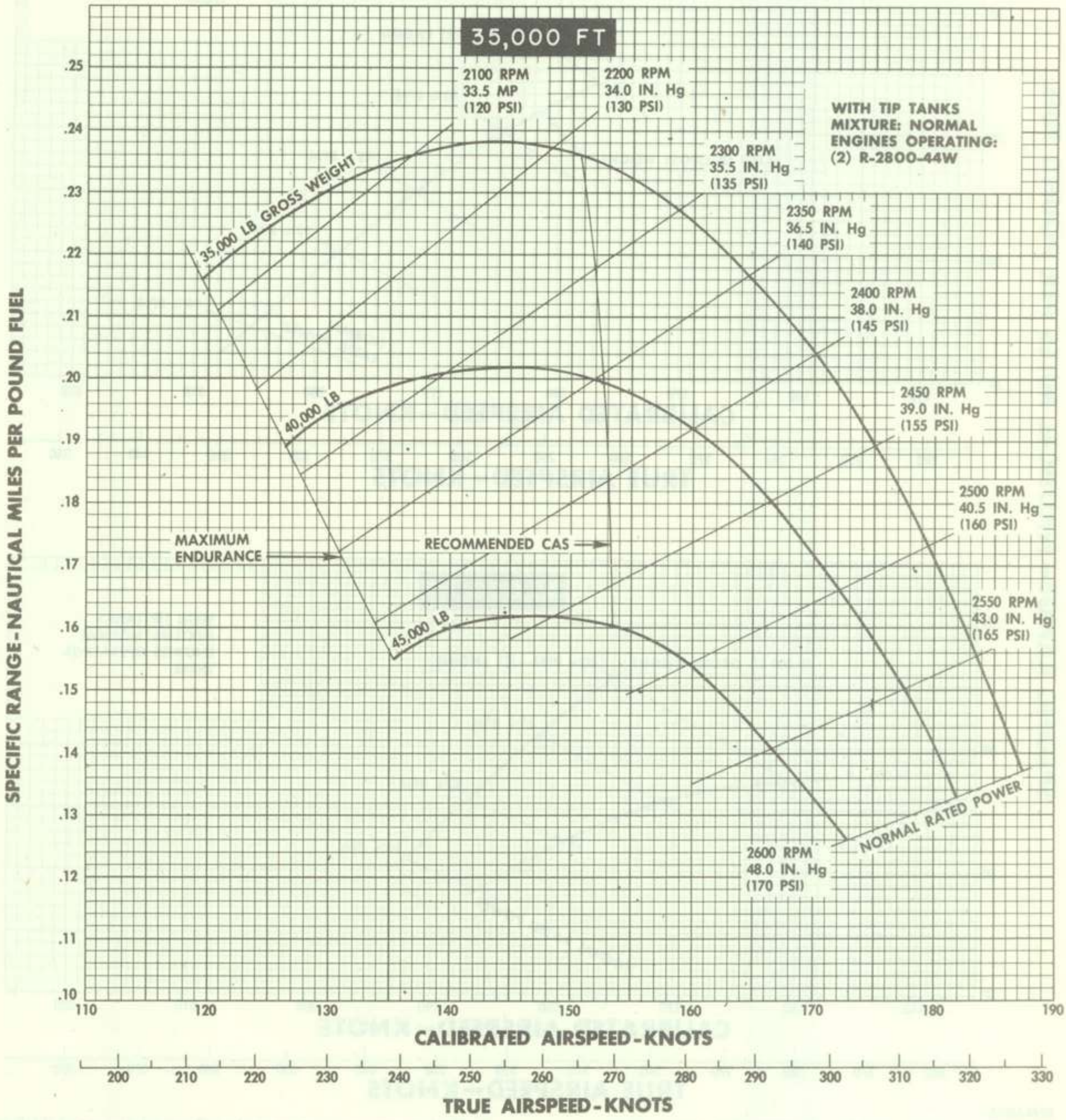
Figure A-56. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—30,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1358A

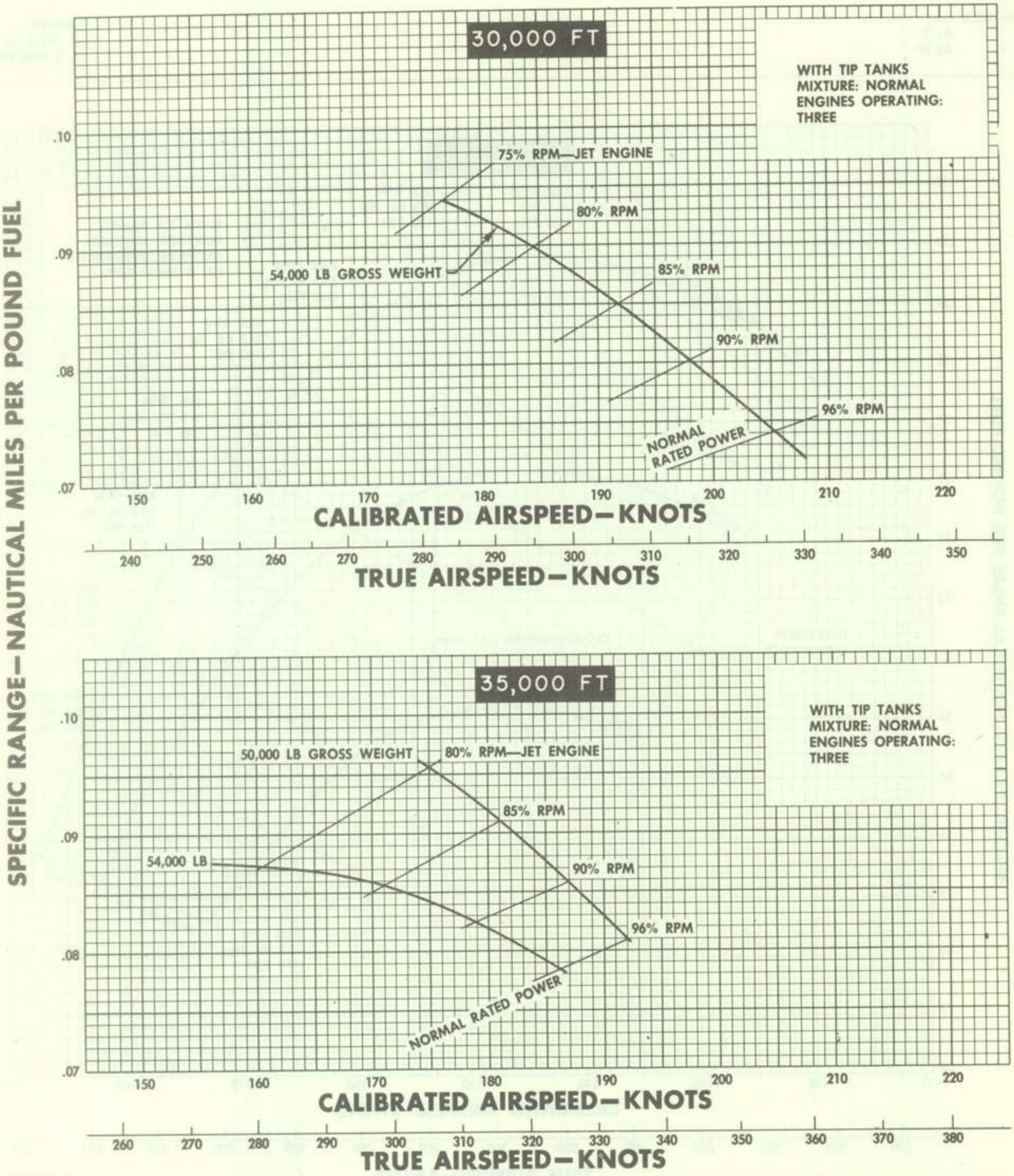
Figure A-57. Nautical Miles per Pound of Fuel—Reciprocating Engines—with Tip Tanks—35,000 Feet

MODELS: AJ-1
AJ-2
AJ-2P

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, 48 in. Hg manifold pressure, 170 psi torque pressure)

To obtain maximum range, use only sufficient jet power to hold CAS.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1531B

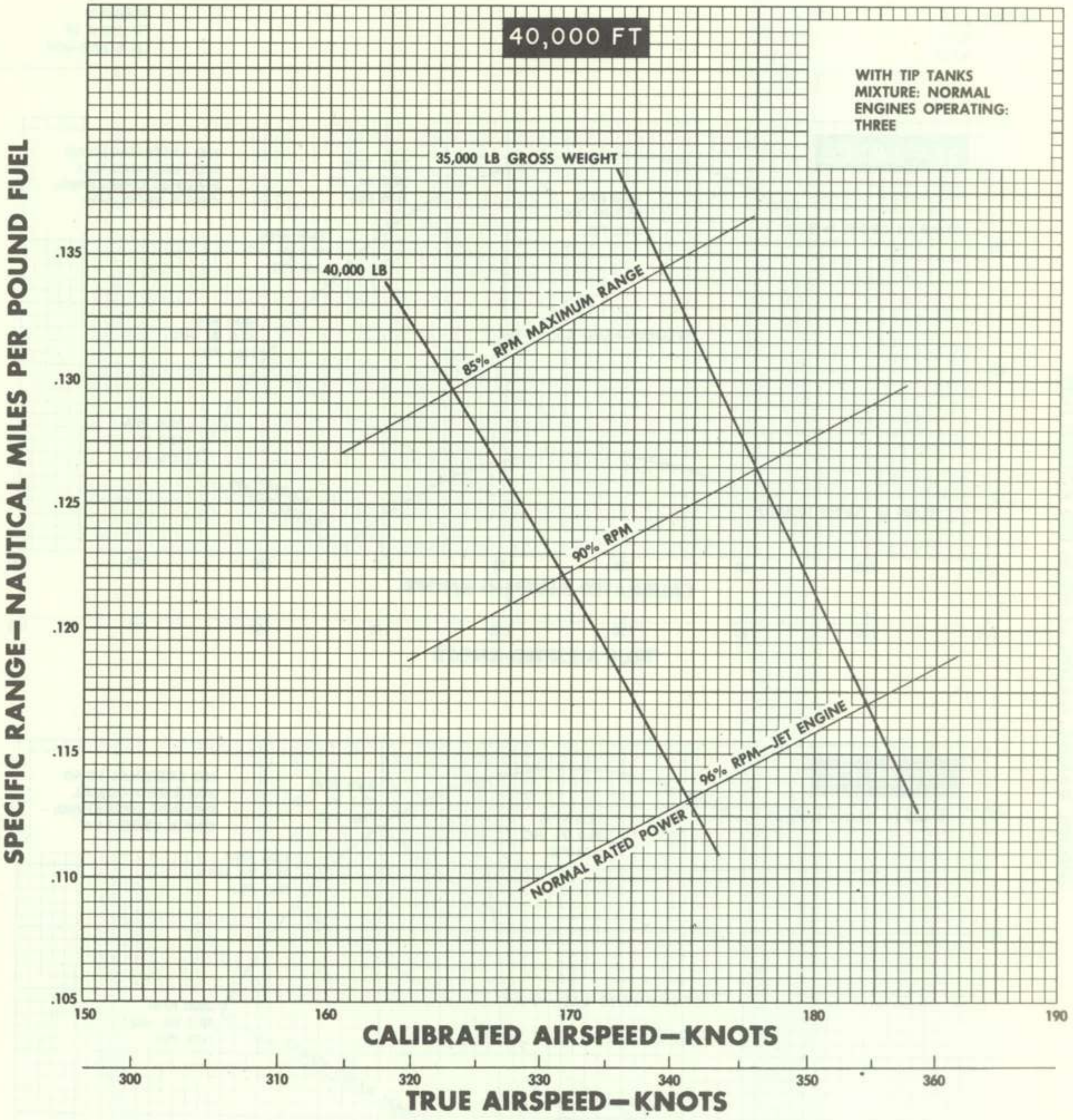
Figure A-58. Nautical Miles per Pound of Fuel—Three Engines—with Tip Tanks—30,000 and 35,000 Feet

MODELS: AJ-1
AJ-2
AJ-2P

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, full throttle, 165 psi torque pressure).

To obtain maximum range, use only sufficient jet power to hold CAS.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

189-93-1530B

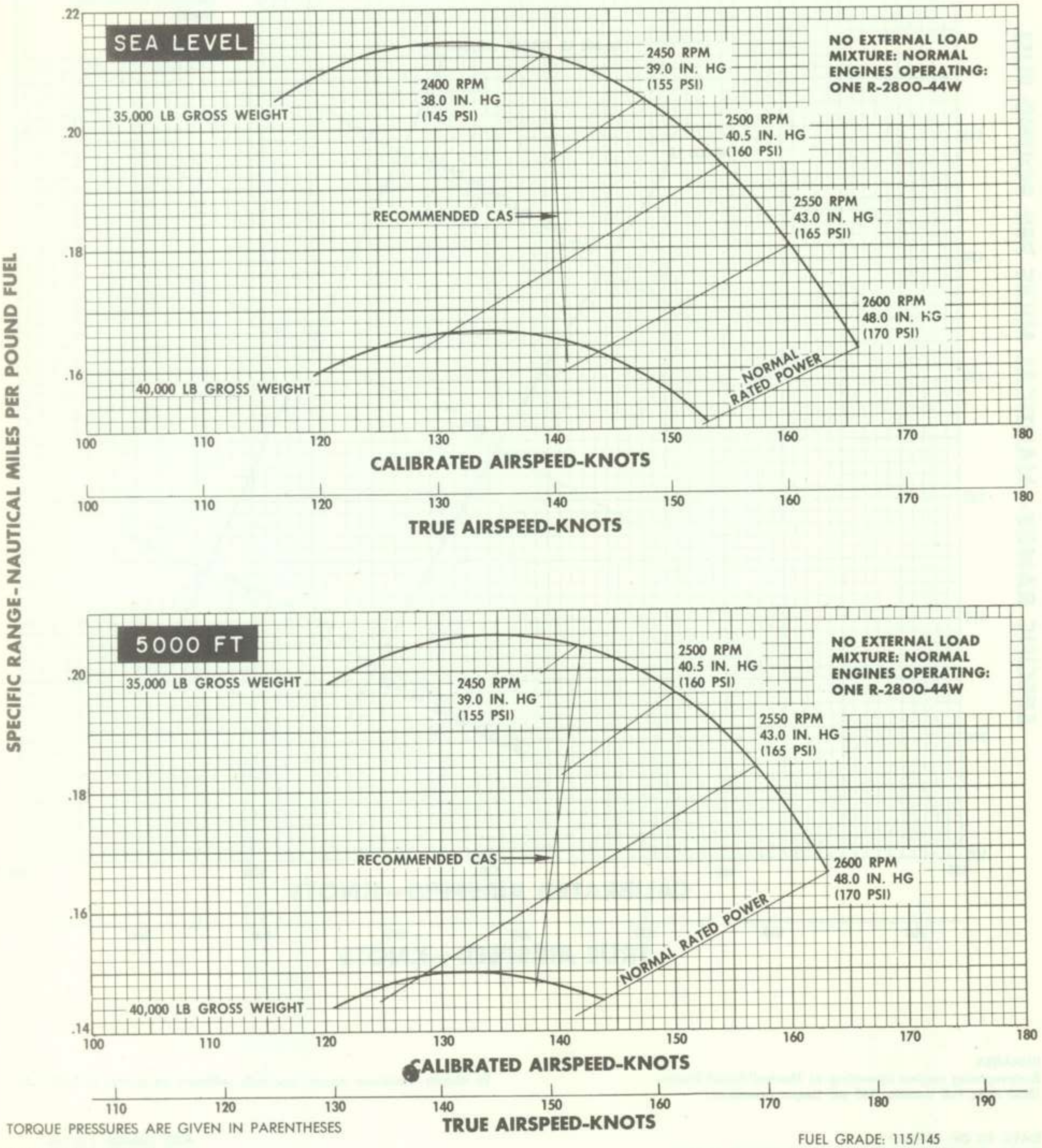
Figure A-59. Nautical Miles per Pound of Fuel—Three Engines—with Tip Tanks—40,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1357A

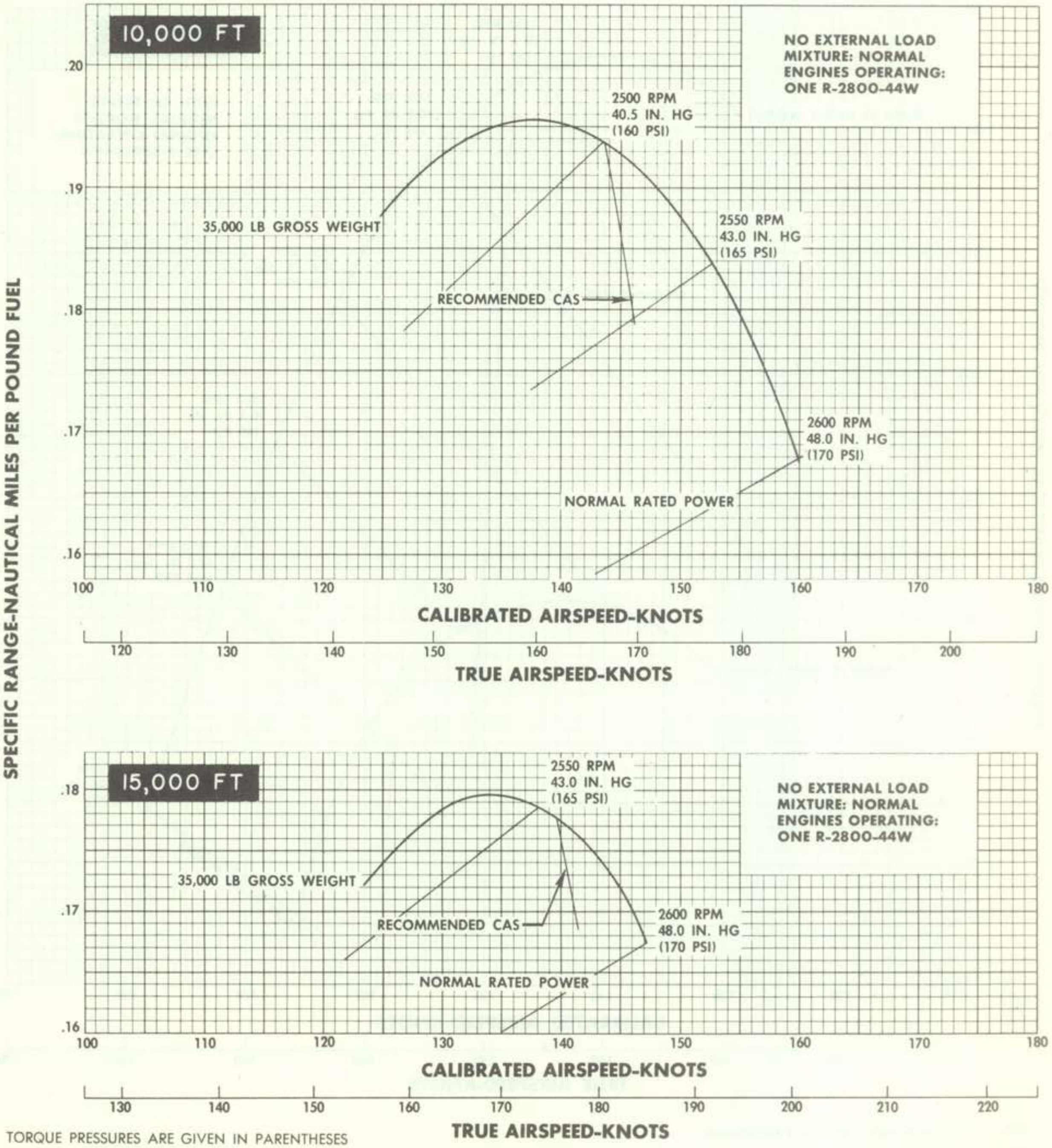
Figure A-60. Nautical Miles per Pound of Fuel—One Reciprocating Engine—Sea Level and 5000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1356A

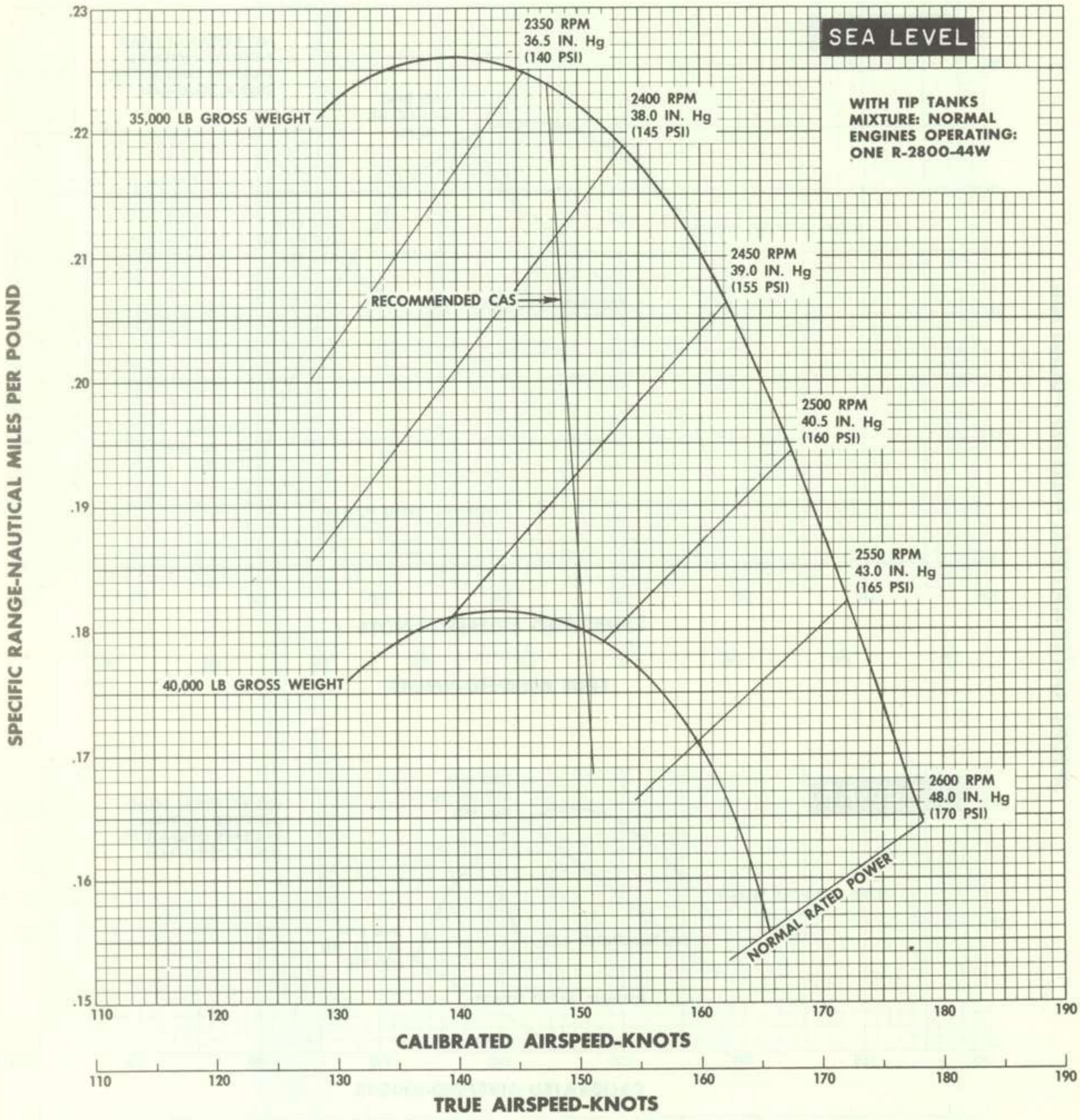
Figure A-61. Nautical Miles per Pound of Fuel—One Reciprocating Engine—10,000 and 15,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1353A

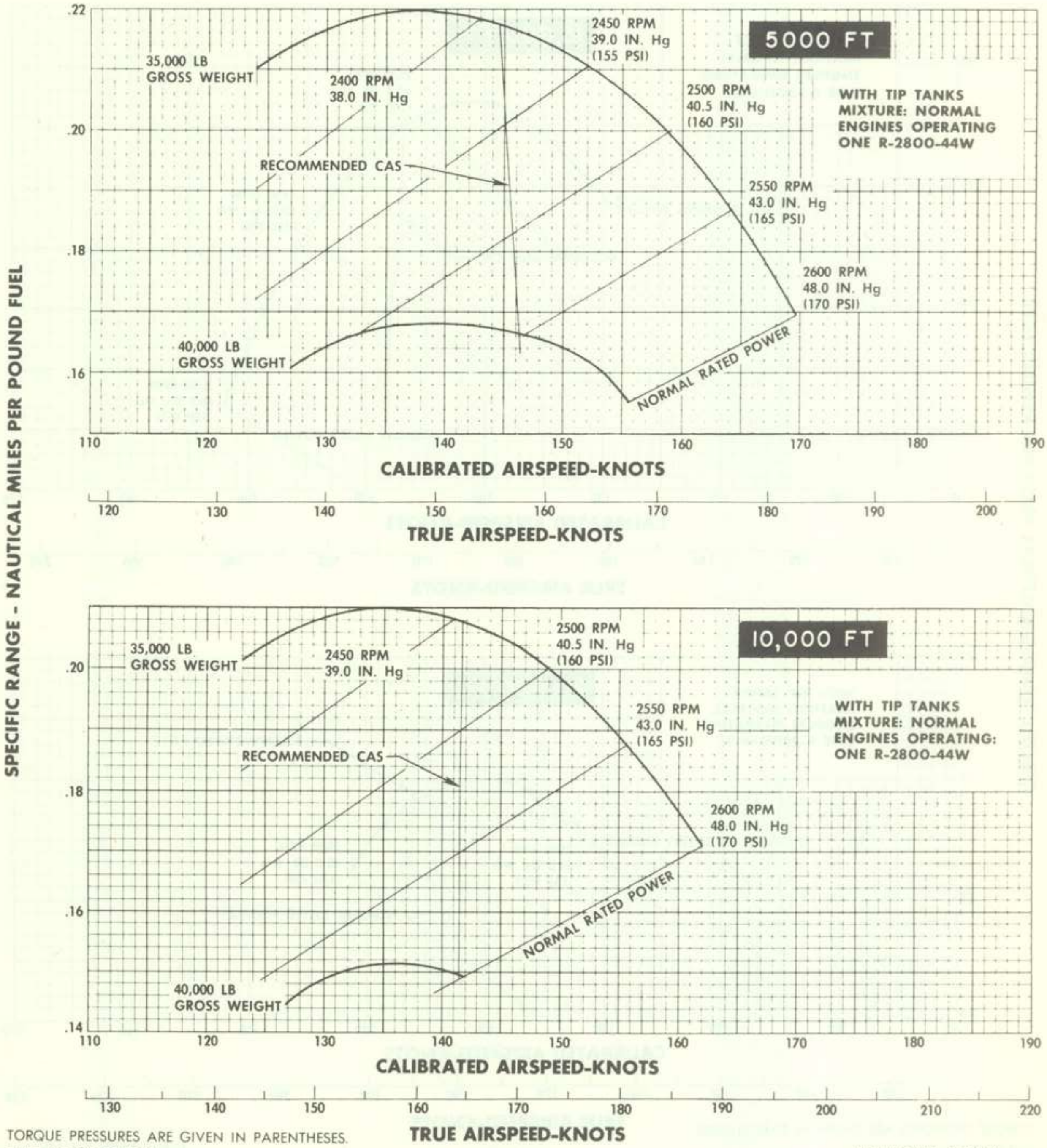
Figure A-62. Nautical Miles per Pound of Fuel—One Reciprocating Engine—with Tip Tanks—Sea Level

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES.
DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1354A

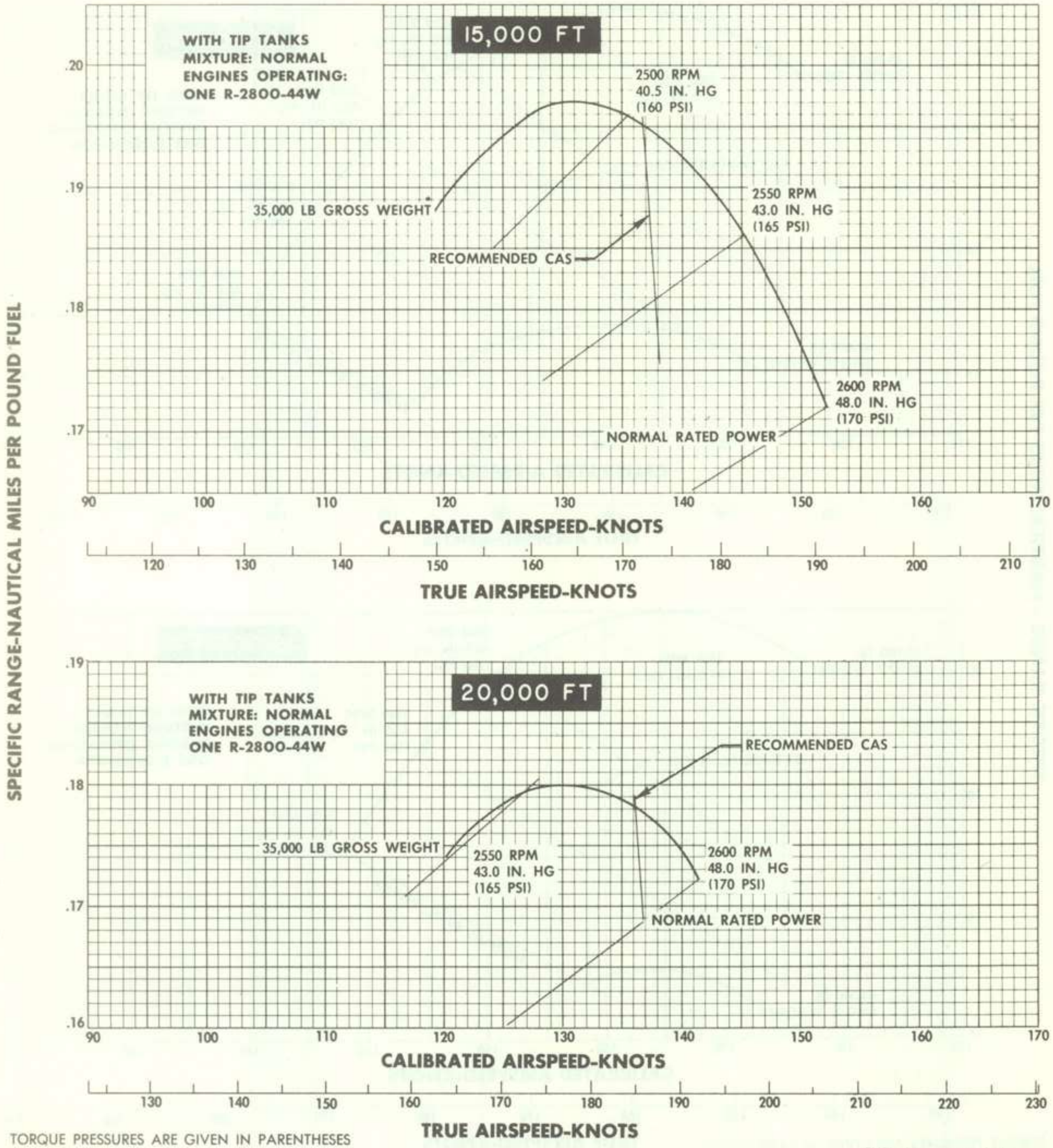
Figure A-63. Nautical Miles per Pound of Fuel—One Reciprocating Engine—with Tip Tanks—5000 and 10,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



TORQUE PRESSURES ARE GIVEN IN PARENTHESES

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1355A

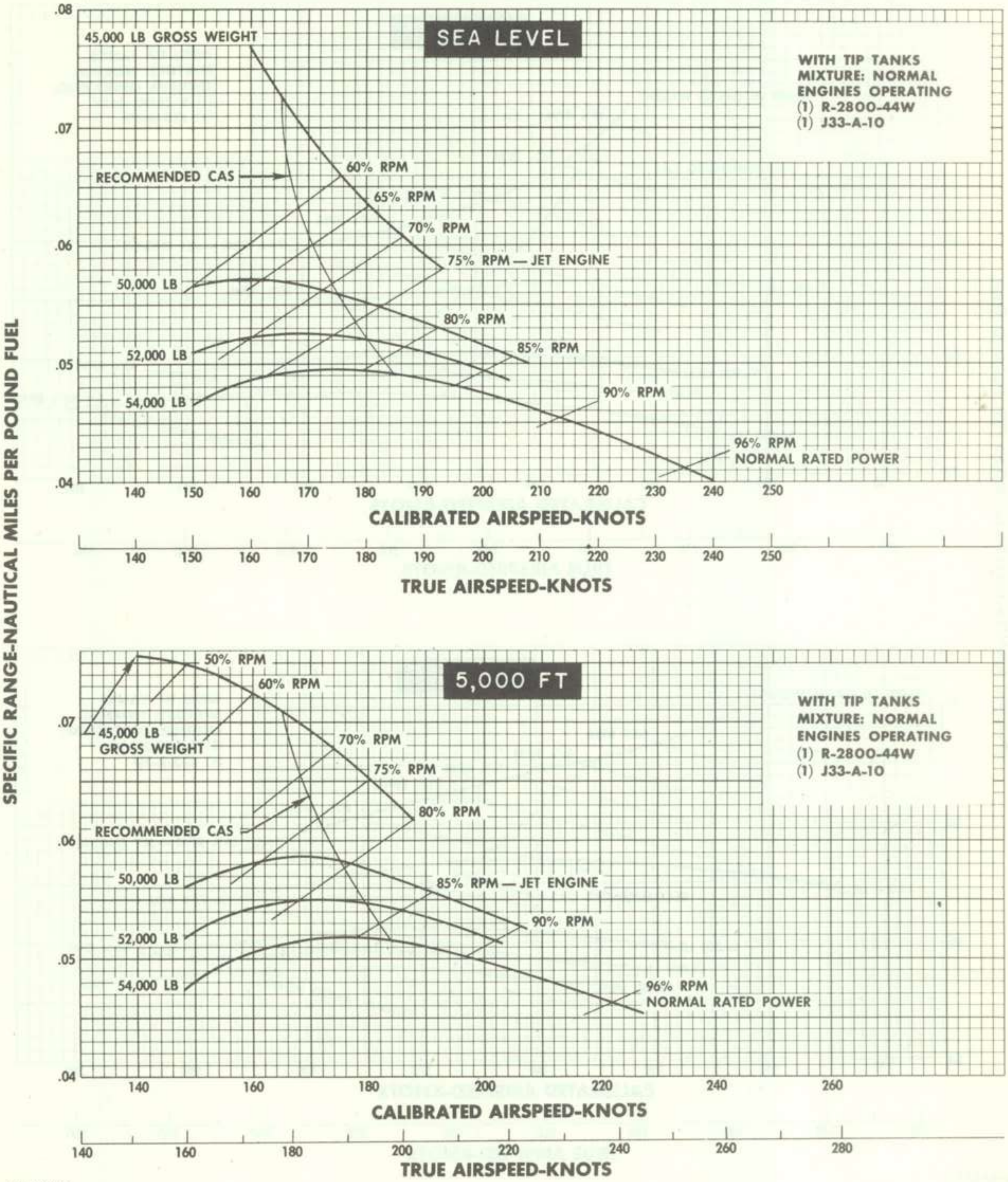
Figure A-64. Nautical Miles per Pound of Fuel—One Reciprocating Engine—with Tip Tanks—15,000 and 20,000 Feet

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W

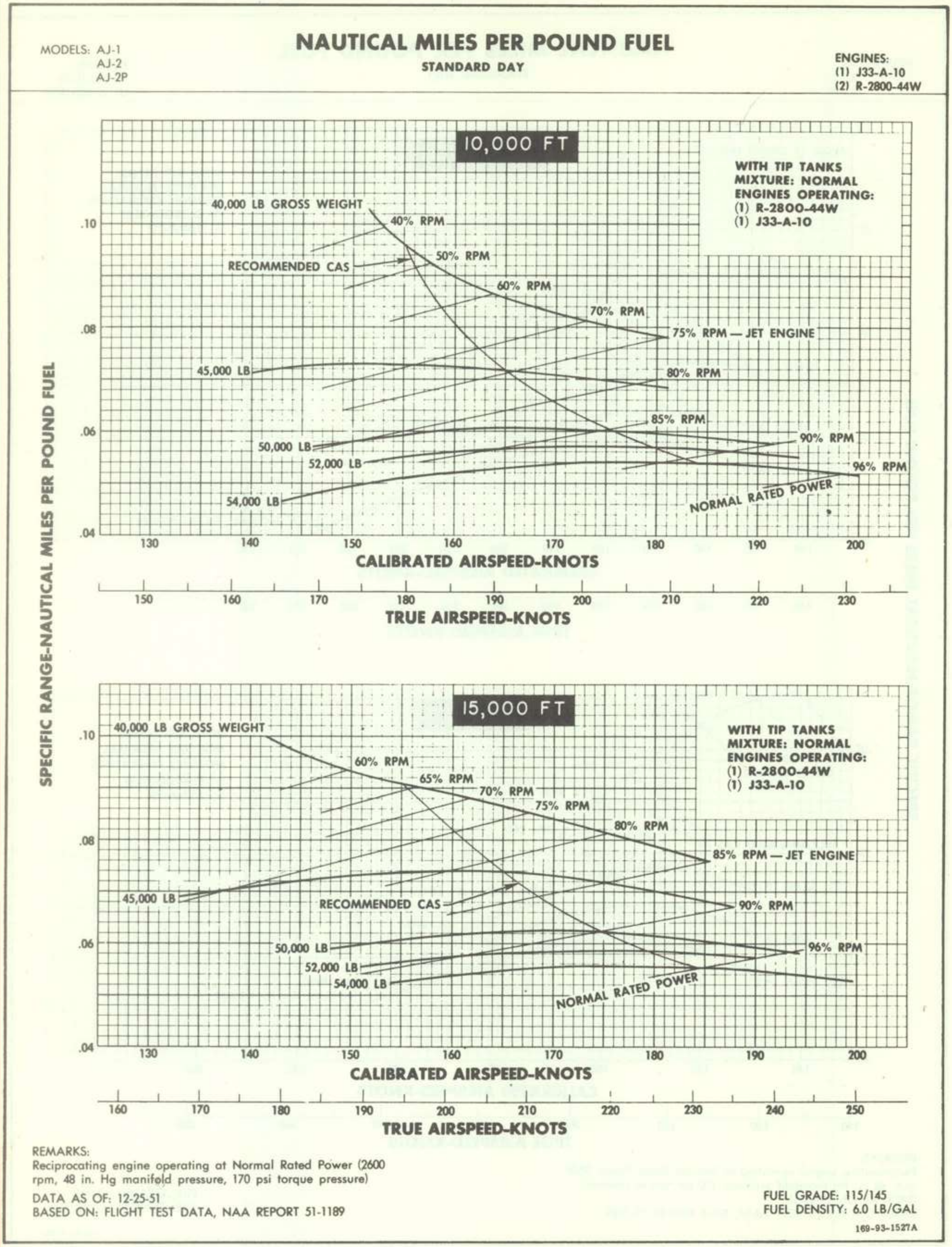


REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, 48 in. Hg manifold pressure, 170 psi torque pressure)
DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1526A

Figure A-65. Nautical Miles per Pound of Fuel—One Reciprocating Engine Plus Jet Engine—with Tip Tanks—Sea Level and 5000 Feet



NAUTICAL MILES PER POUND FUEL

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W

REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, 48 in. Hg manifold pressure, 170 psi torque pressure)

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1527A

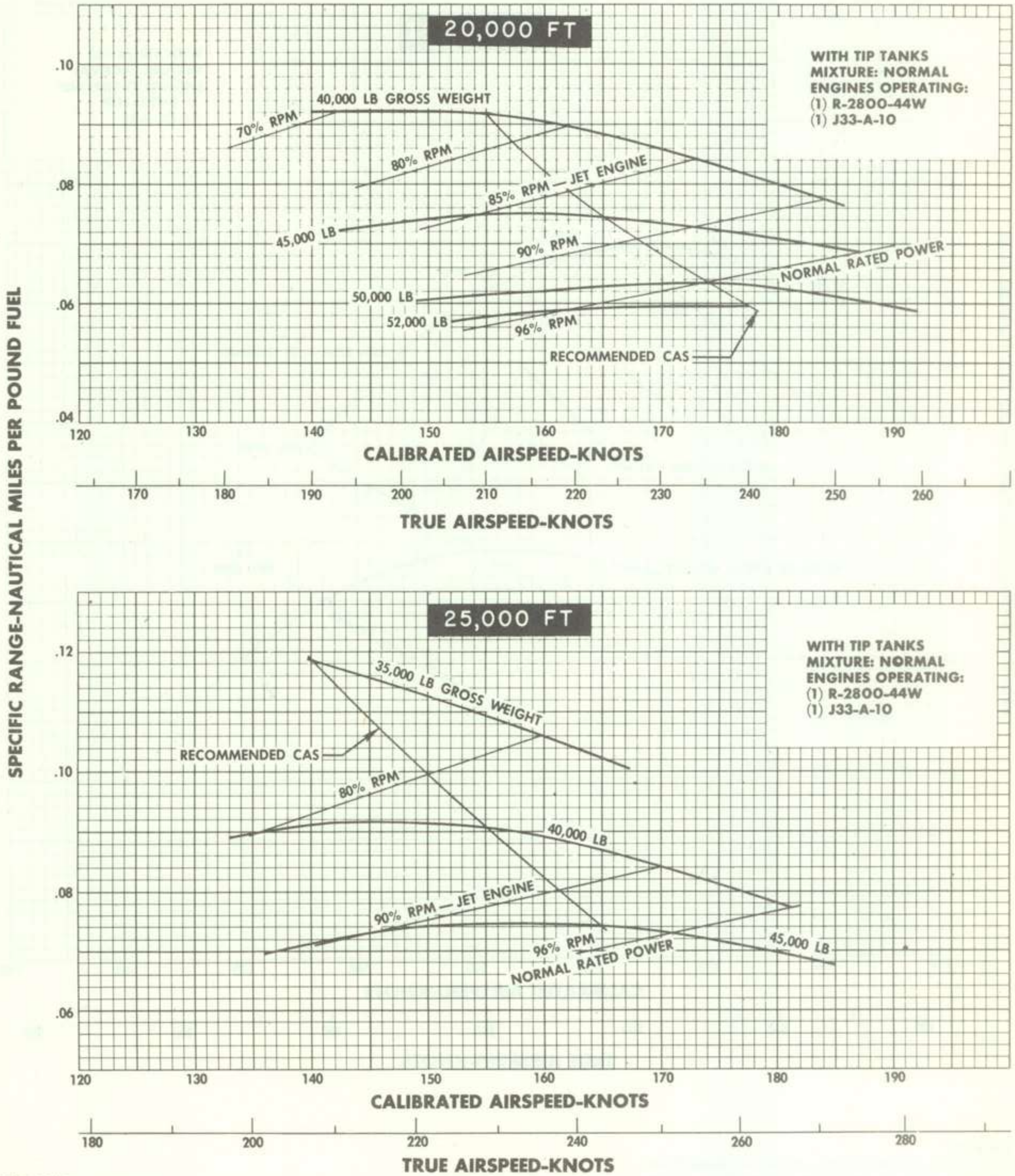
Figure A-66. Nautical Miles per Pound of Fuel—One Reciprocating Engine Plus Jet Engine—with Tip Tanks—10,000 and 15,000 Feet

MODELS: AJ-1
AJ-2
AJ-2P

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, 48 in. Hg manifold pressure, 170 psi torque pressure)

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1528A

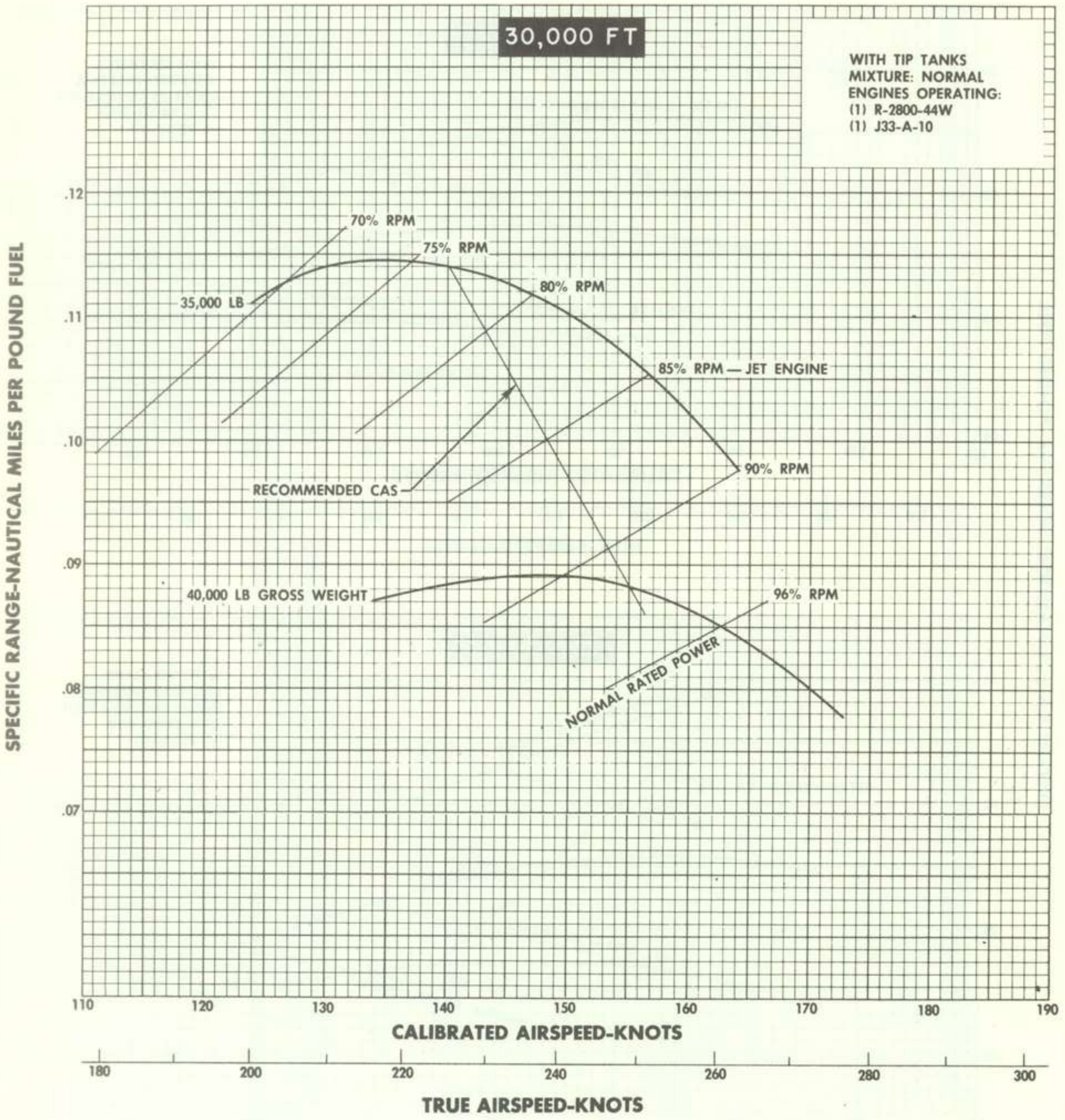
Figure A-67. Nautical Miles per Pound of Fuel—One Reciprocating Engine Plus Jet Engine—with Tip Tanks—20,000 and 25,000 Feet

MODELS: AJ-1
AJ-2
AJ-2P

NAUTICAL MILES PER POUND FUEL

STANDARD DAY

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
Reciprocating engine operating at Normal Rated Power (2600 rpm, 48 in. Hg manifold pressure, 170 psi torque pressure)

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

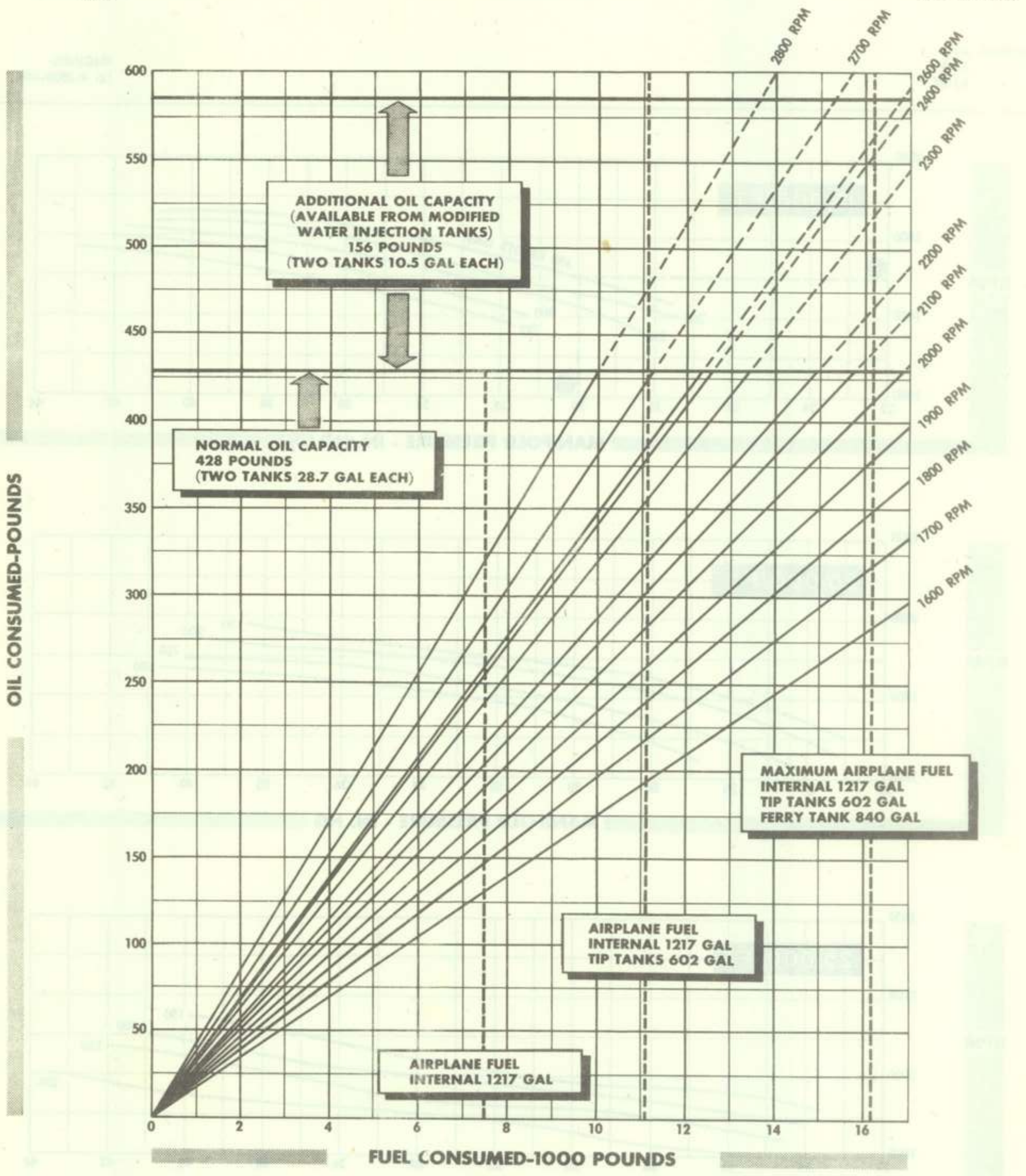
169-93-1529A

Figure A-68. Nautical Miles per Pound of Fuel—One Reciprocating Engine Plus Jet Engine—with Tip Tanks—30,000 Feet

OIL CONSUMPTION-RECIPROCATING ENGINES

MODELS: AJ-1
AJ-2

ENGINES:
(2) R-2800-44W



DATA AS OF: 11-18-49
DATA ESTIMATED AND BASED ON ENGINE MANUFACTURER'S MAXIMUM OIL CONSUMPTION FIGURES.

OIL GRADE: 1100 OR 1065
OIL DENSITY: 7.5 LB/GAL

169-93-1391C

Figure A-69. Oil Consumption—Reciprocating Engines

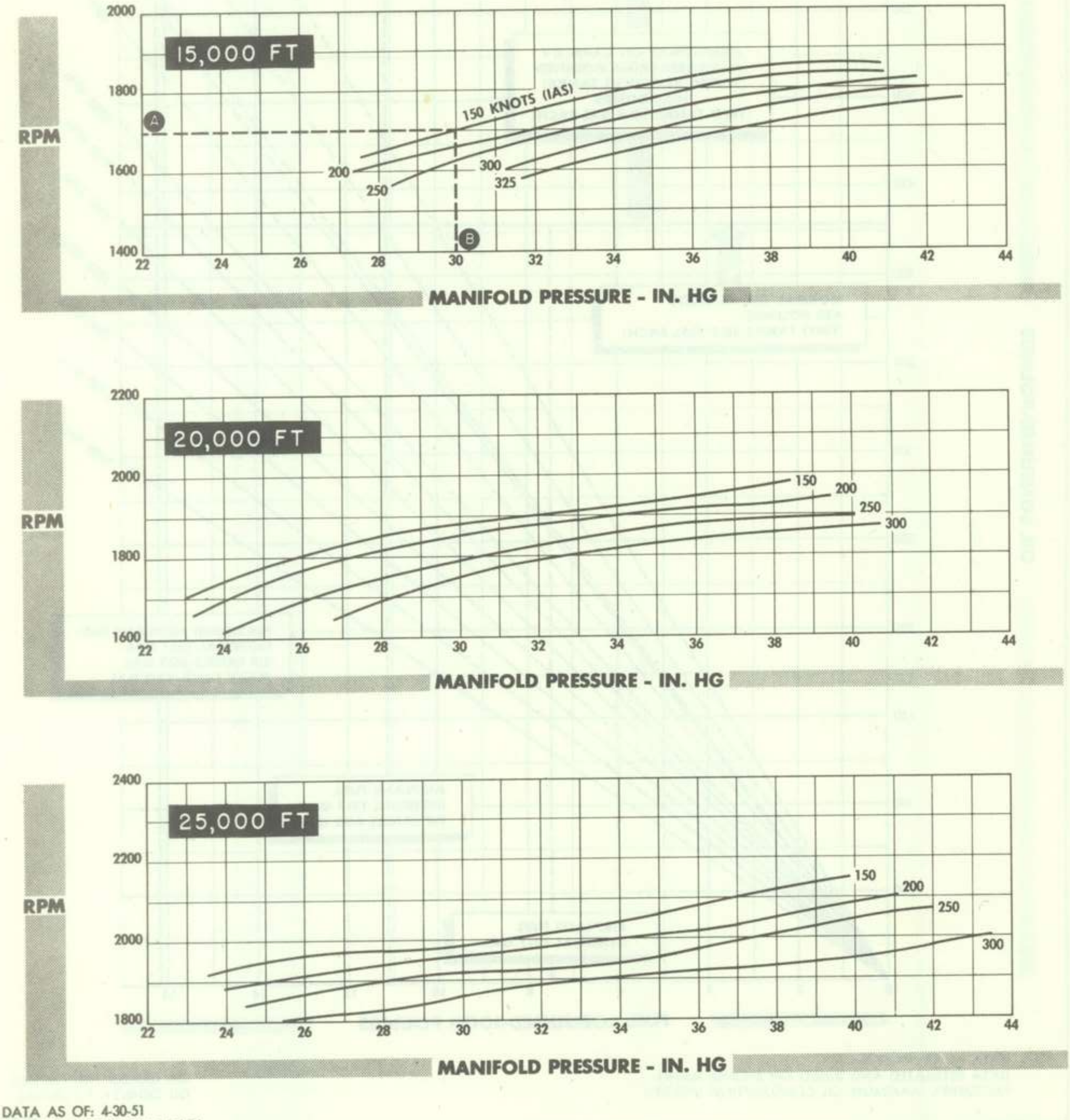
TURBOSUPERCHARGER SURGE LIMITS

TURBOSUPERCHARGER MODEL CH8-F1

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(2) R-2800-44W



DATA AS OF: 4-30-51
BASED ON: ESTIMATED DATA

169-93-1393A

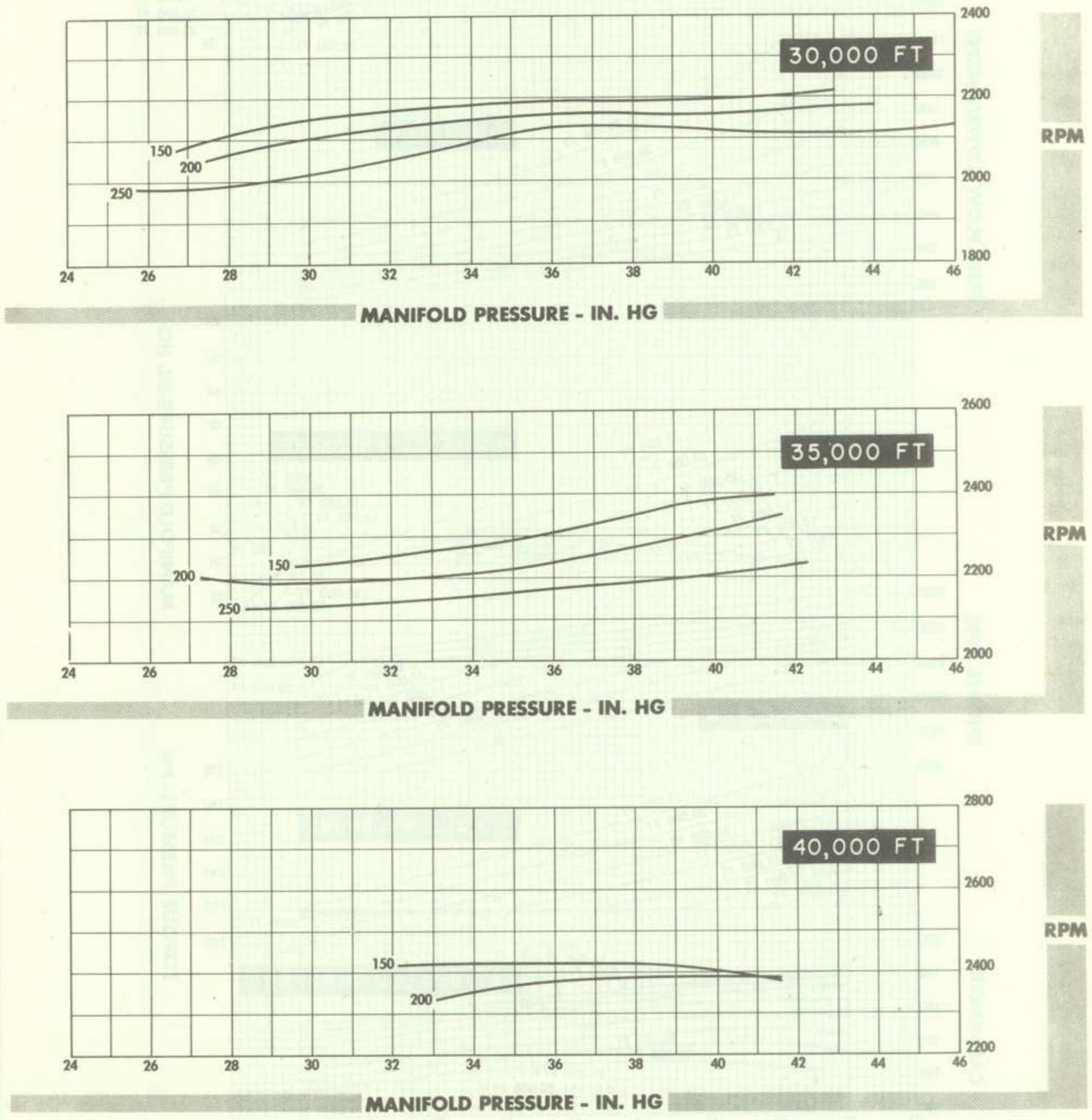
Figure A-70. Turbosupercharger Surge Limits (Sheet 1 of 2)

TO USE CHARTS:

- Ⓐ At given MP and IAS, read minimum rpm for operation above surge region.
- Ⓑ At given rpm and IAS, read maximum MP for operation above surge region.

NOTES:

1. Surge region below curves.
2. Average induction pressures.
3. If surge is encountered, increase rpm or decrease manifold pressure or do both.



169-93-1392A

Figure A-70. Turbosupercharger Surge Limits (Sheet 2 of 2)

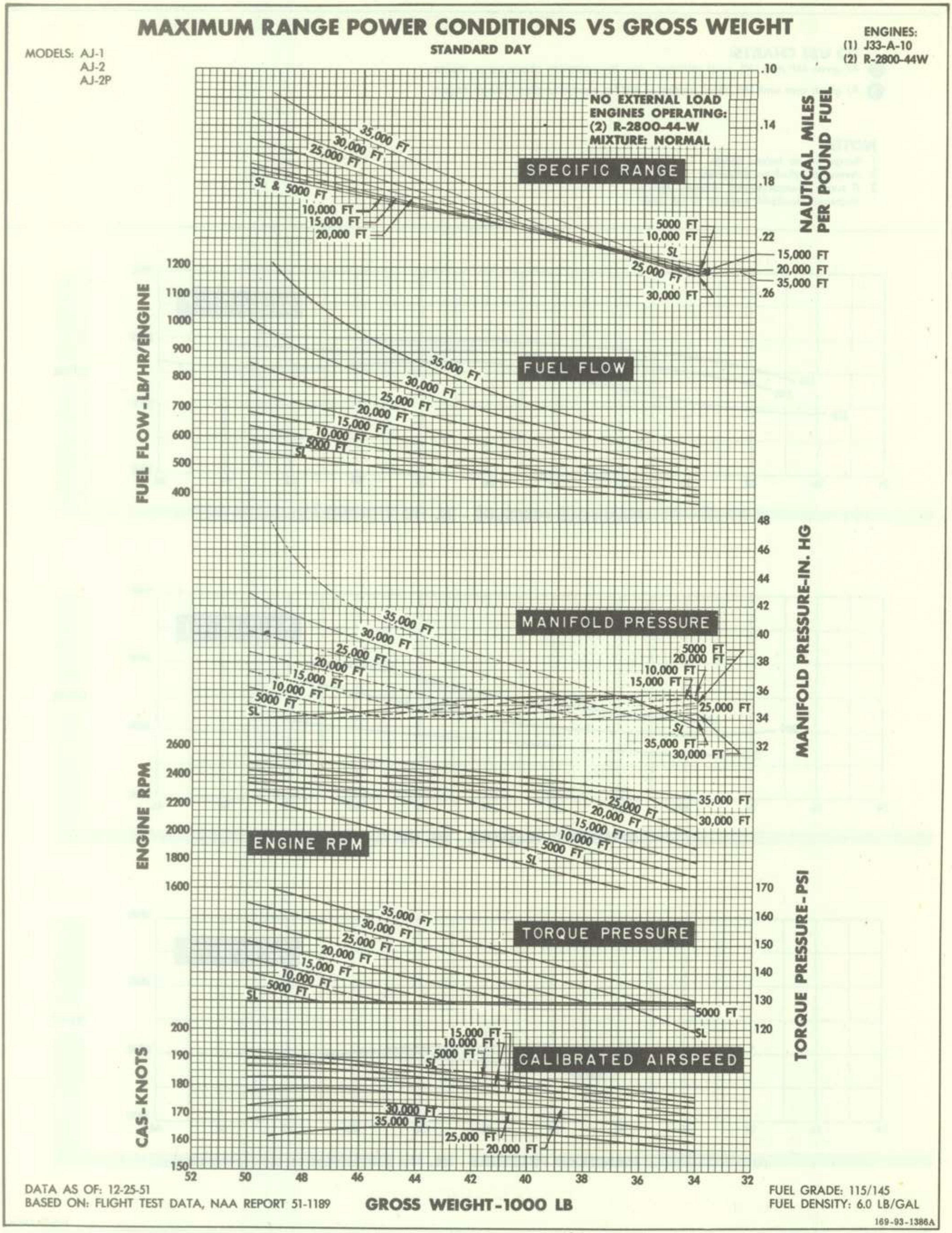
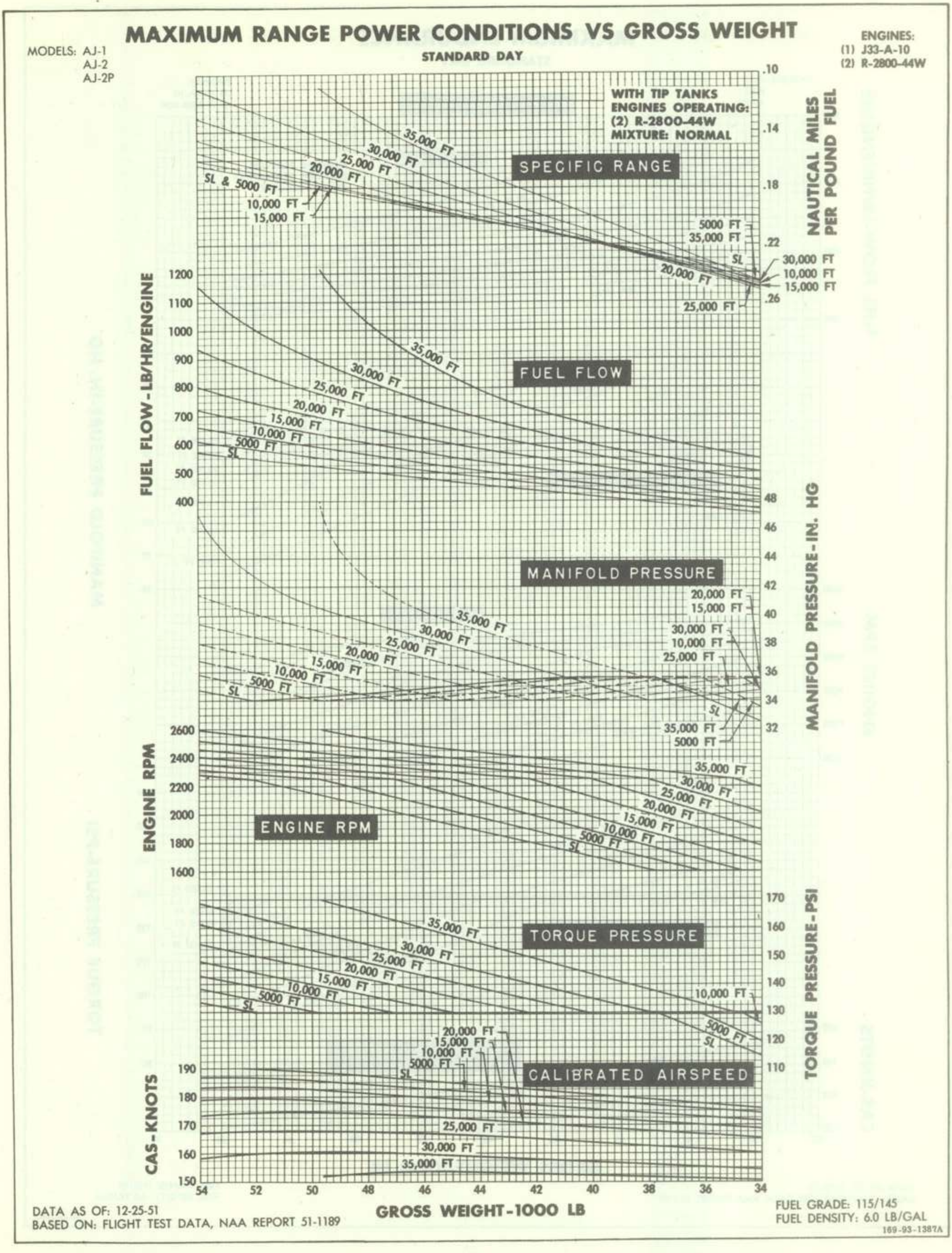


Figure A-71. Maximum Range Power Condition vs. Gross Weight—No External Load



MAXIMUM RANGE POWER CONDITIONS VS GROSS WEIGHT

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W

WITH TIP TANKS
ENGINES OPERATING:
(2) R-2800-44W
MIXTURE: NORMAL

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1387A

Figure A-72. Maximum Range Power Conditions vs. Gross Weight—with Tip Tanks

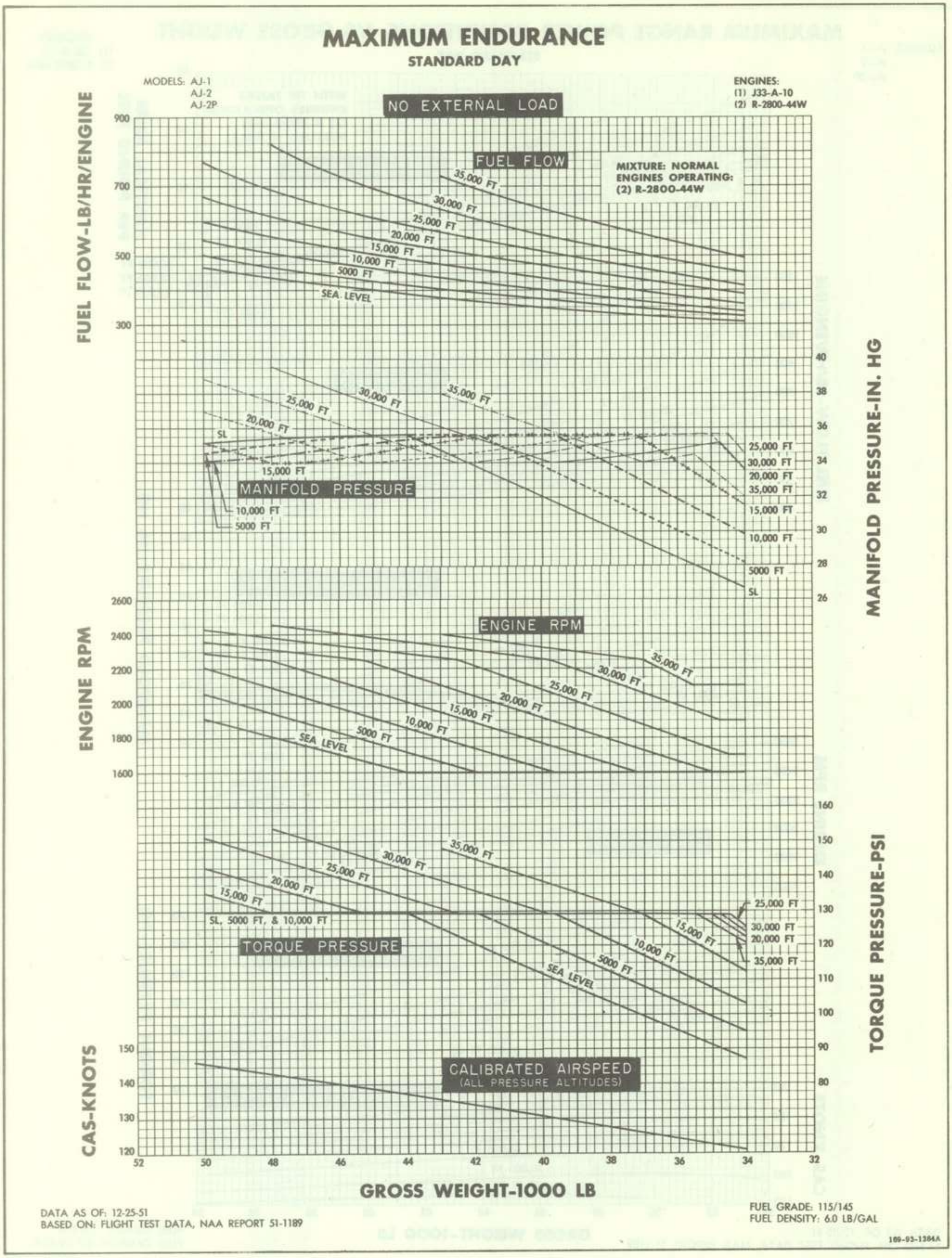
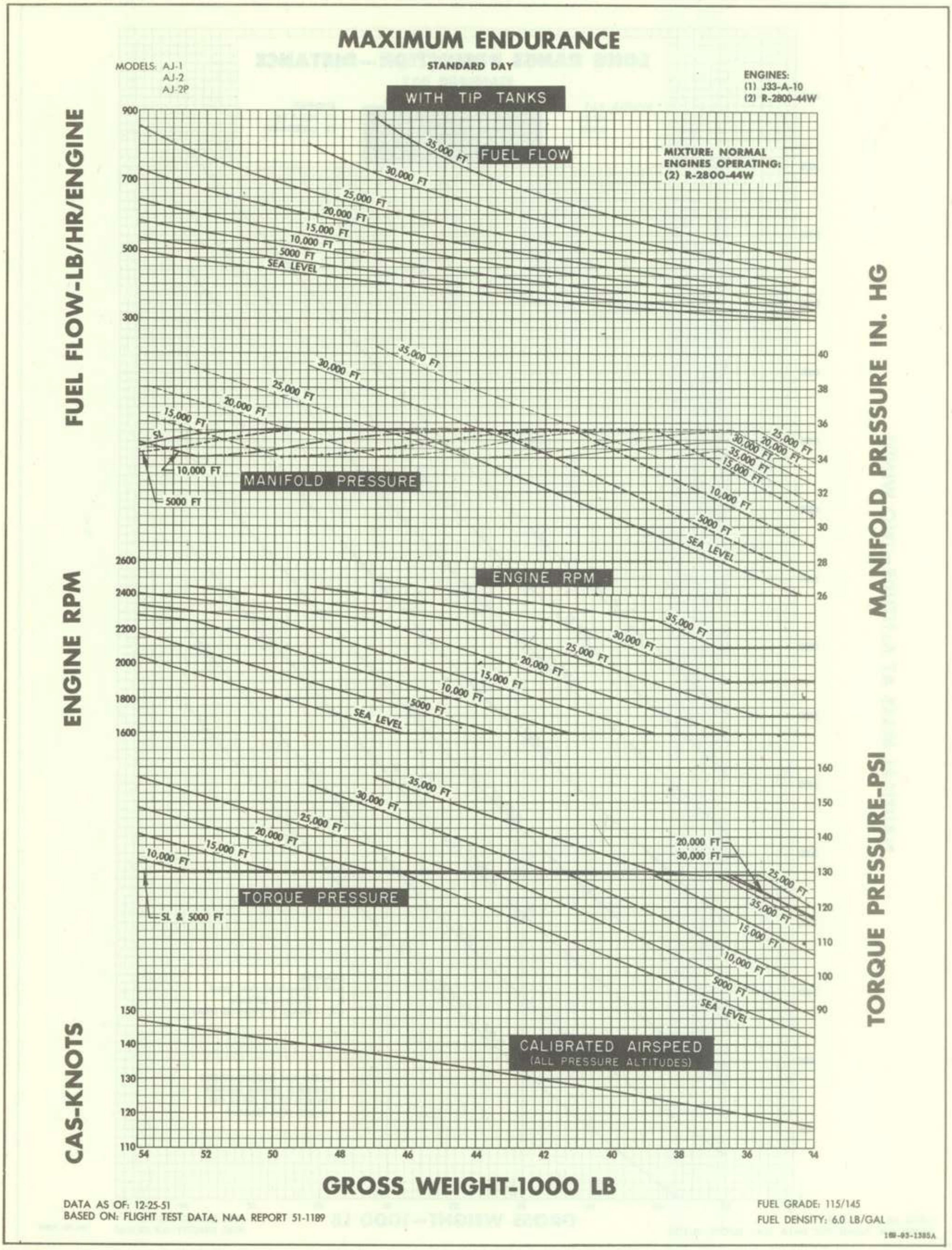


Figure A-73. Maximum Endurance—No External Load

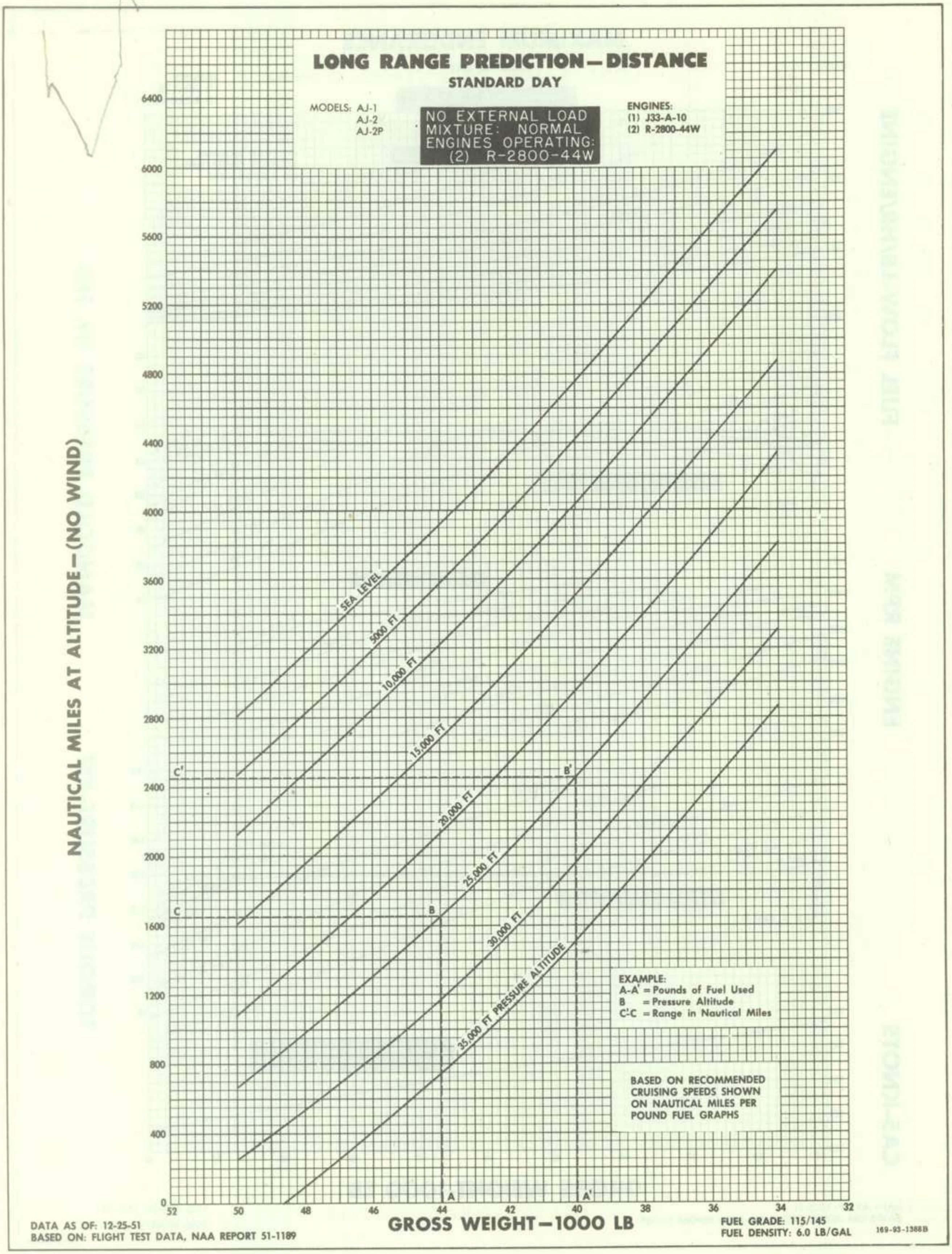


DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

1B-93-1385A

Figure A-74. Maximum Endurance—with Tip Tanks



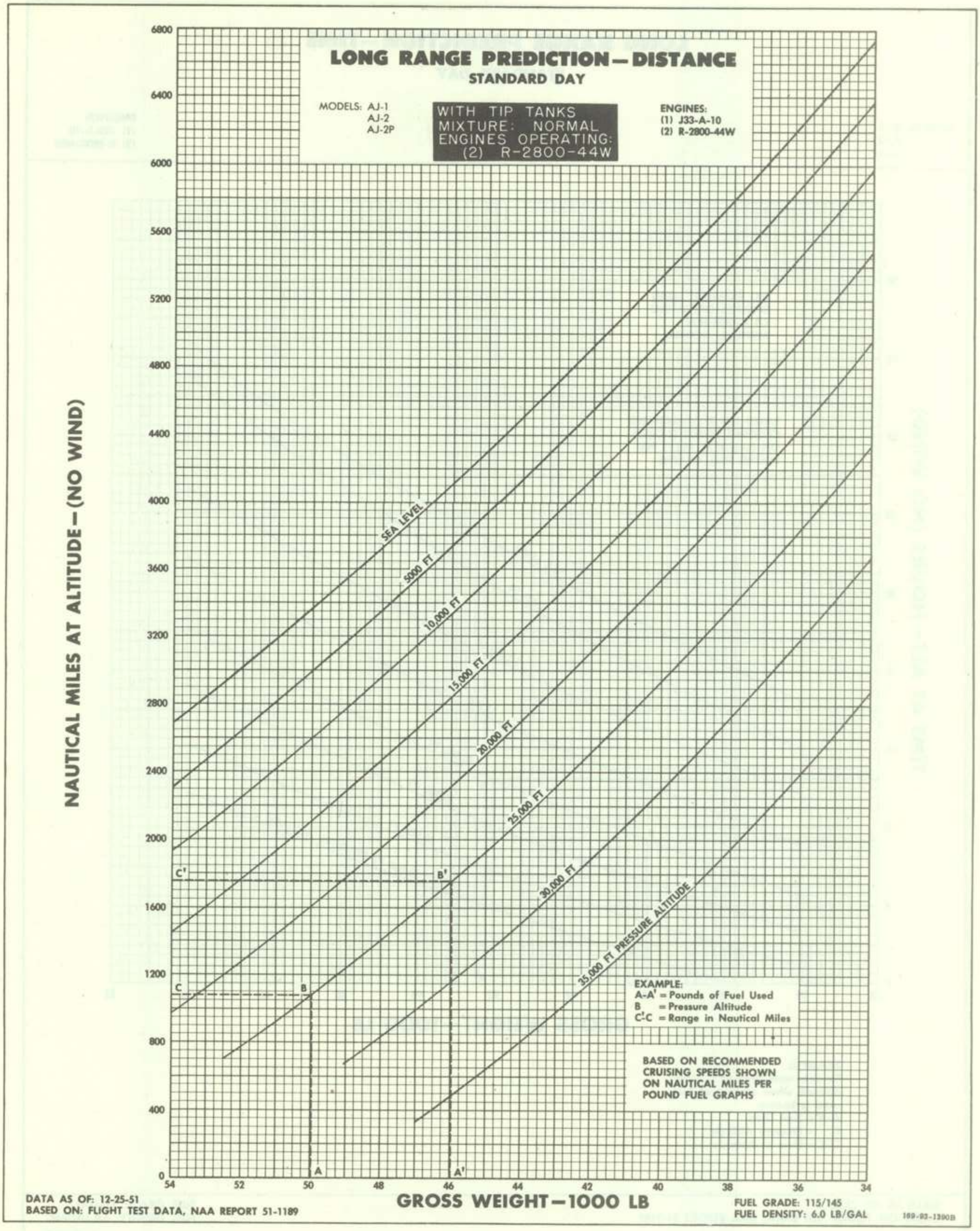
EXAMPLE:
A-A' = Pounds of Fuel Used
B = Pressure Altitude
C'-C = Range in Nautical Miles

BASED ON RECOMMENDED CRUISING SPEEDS SHOWN ON NAUTICAL MILES PER POUND FUEL GRAPHS

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

Figure A-75. Long-range Prediction—Distance—No External Load



DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

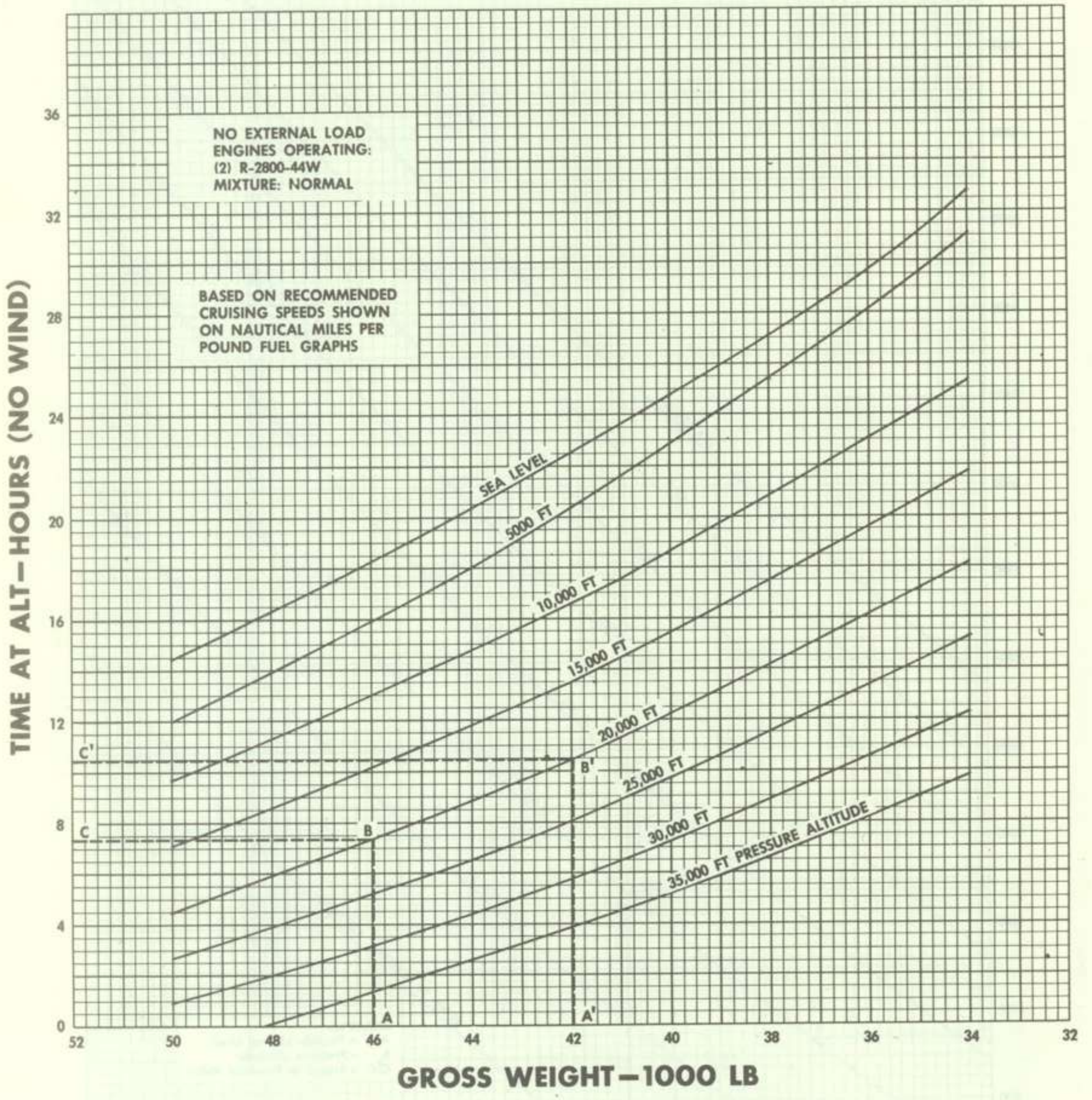
Figure A-76. Long-range Prediction—Distance—with Tip Tanks

LONG RANGE PREDICTION—TIME

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



NO EXTERNAL LOAD
ENGINES OPERATING:
(2) R-2800-44W
MIXTURE: NORMAL

BASED ON RECOMMENDED CRUISING SPEEDS SHOWN ON NAUTICAL MILES PER POUND FUEL GRAPHS

EXAMPLE:
To determine time at a given altitude when amount of fuel used is known:
A-A' = Fuel Used
B- = Pressure Altitude
C'-C = Time at Altitude

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1380B

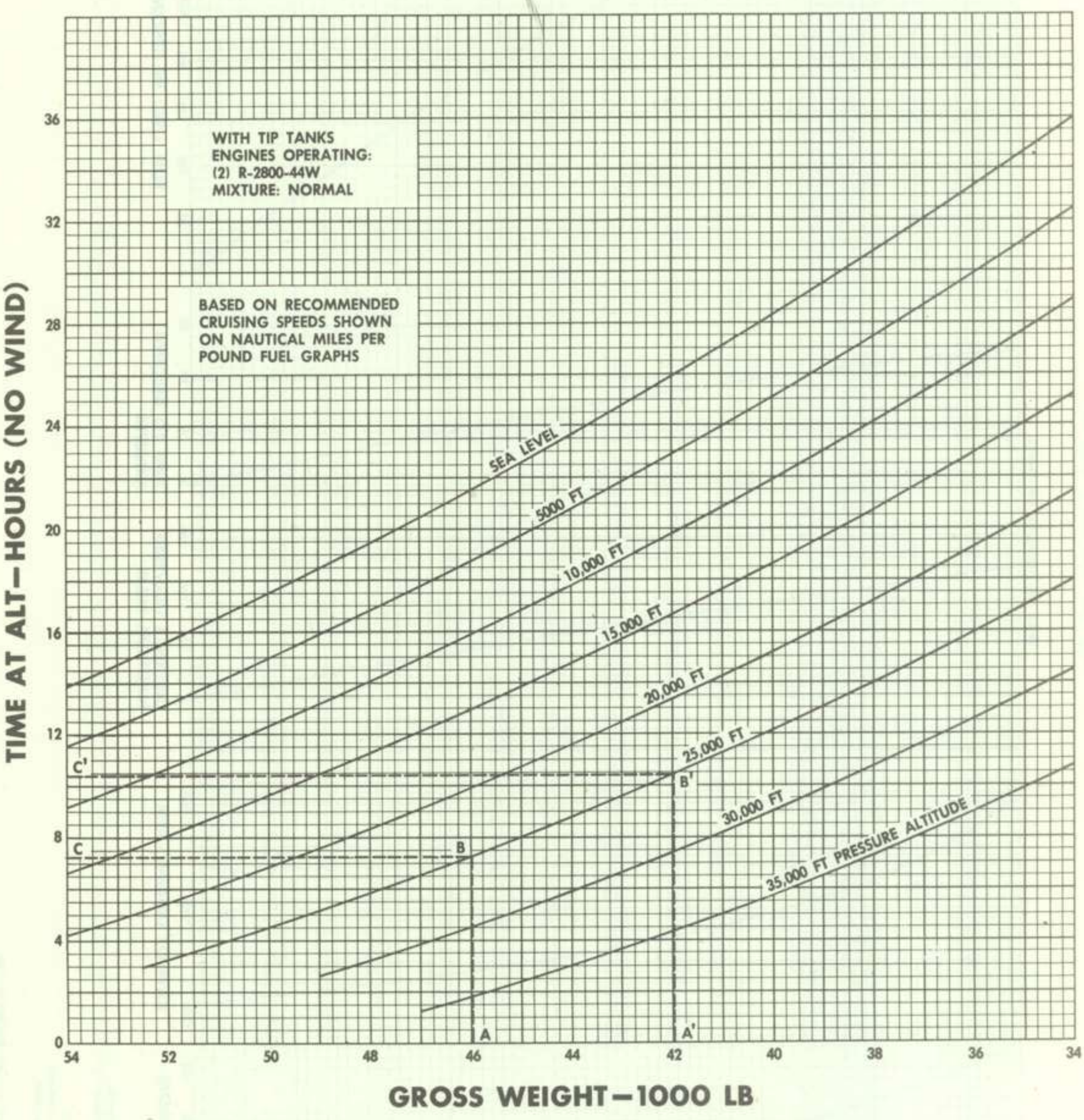
Figure A-77. Long-range Prediction—Time—No External Load

LONG RANGE PREDICTION—TIME

STANDARD DAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



WITH TIP TANKS
ENGINES OPERATING:
(2) R-2800-44W
MIXTURE: NORMAL

BASED ON RECOMMENDED
CRUISING SPEEDS SHOWN
ON NAUTICAL MILES PER
POUND FUEL GRAPHS

EXAMPLE:
A-A' = Pounds of fuel used
B = Pressure altitude
C'-C = Time at altitude

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1381B

Figure A-78. Long-range Prediction—Time—with Tip Tanks

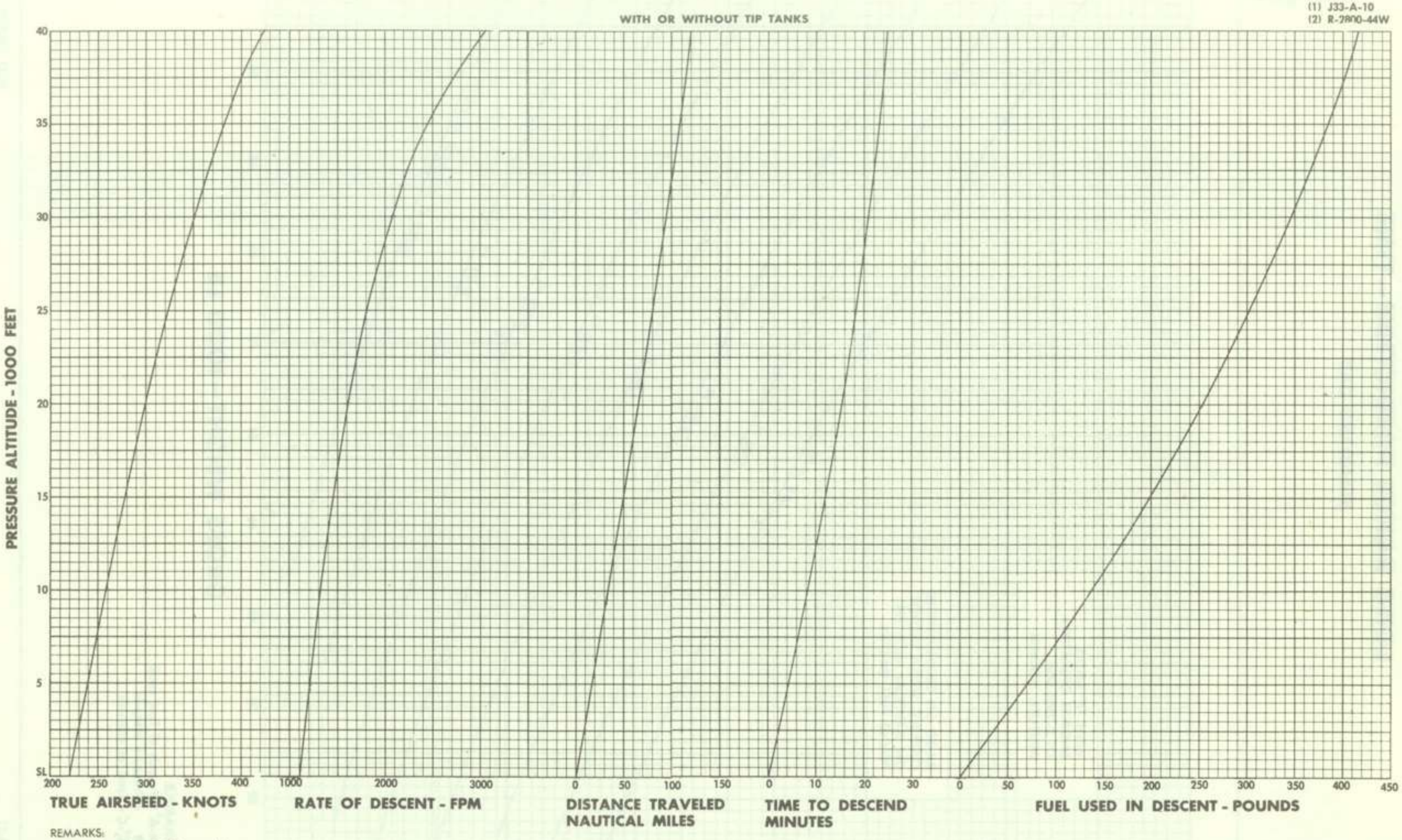
MODELS: AJ-1
AJ-2
AJ-2P

DESCENT

STANDARD DAY
TWO RECIPROCATING ENGINES

ENGINES:
(1) J33-A-10
(2) R-2800-44W

WITH OR WITHOUT TIP TANKS



REMARKS:

1. Data based on 40,000 pounds gross weight with or without tip tanks.
2. Rate of descent based on 2000 rpm, 35 inches Hg manifold pressure and 220 IAS constant.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

189-93-1443A

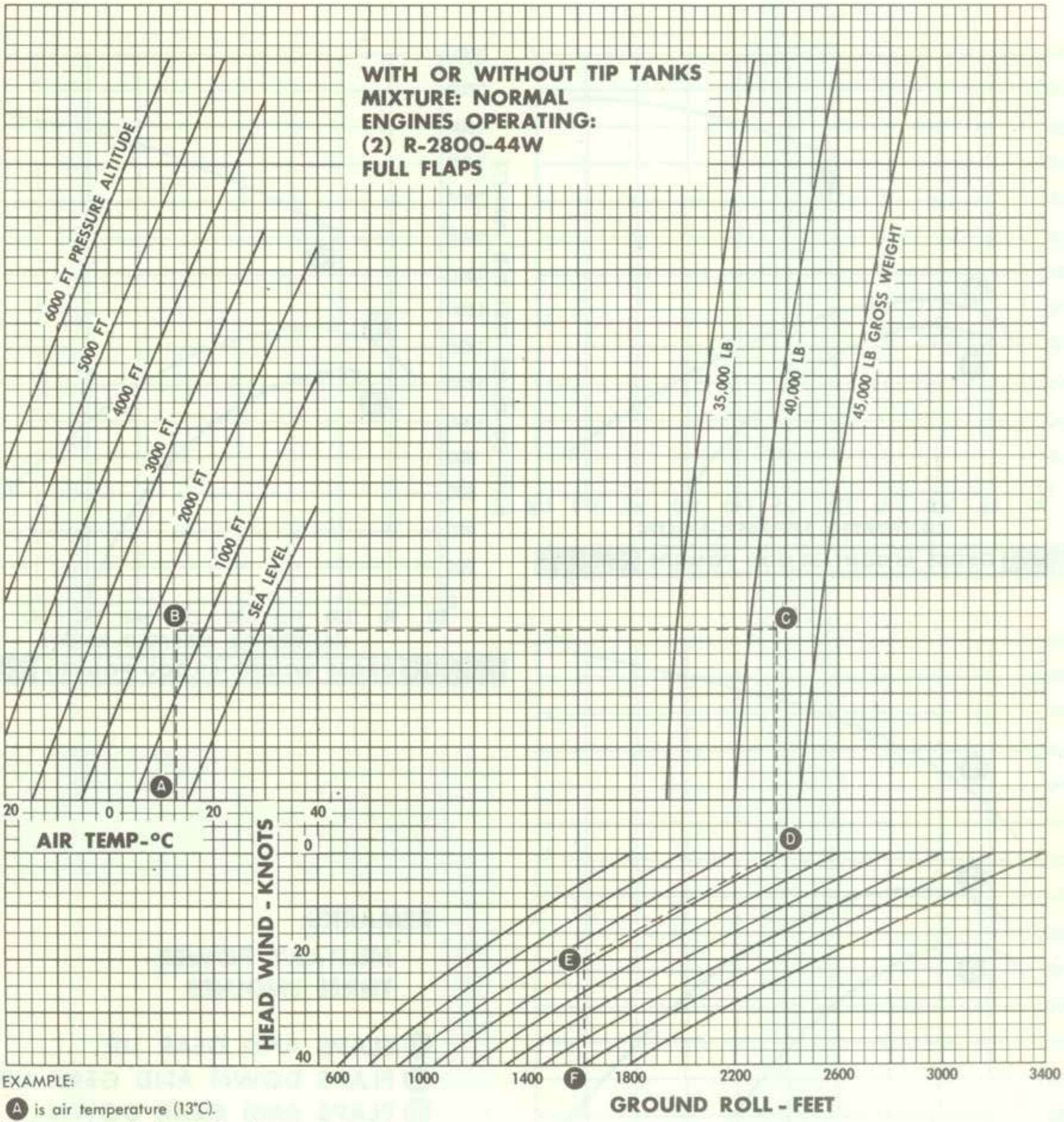
Figure A-79. Descent—Reciprocating Engines

LANDING GROUND ROLL

STANDARD DAY
HARD SURFACE RUNWAY

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES
(1) J33-A-10
(2) R-2800-44W



EXAMPLE:

Ⓐ is air temperature (13°C).
Ⓑ is pressure altitude (1500 feet).
Ⓒ is gross weight (42,000 pounds).
Ⓓ is ground roll with zero wind (2360 feet).
Ⓔ is head wind (20 knots).
Ⓕ is ground roll with wind (1625 feet).
Additional distance to clear a 50-foot obstacle at Ⓓ is 1300 feet (see table). Total distance is 3660 feet.
Additional distance to clear a 50-foot obstacle at Ⓕ is 830 feet (see table). Total distance is 2455 feet.

GROUND ROLL WITH WIND-FT	ADDITIONAL DISTANCE TO CLEAR 50-FT OBSTACLE		
	ZERO WIND	20-KNOT WIND	40-KNOT WIND
1000			450
1500		790	620
2000	1220	950	750
2500	1355	1090	850
3000	1490	1200	
3500	1610		

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-93-1389B

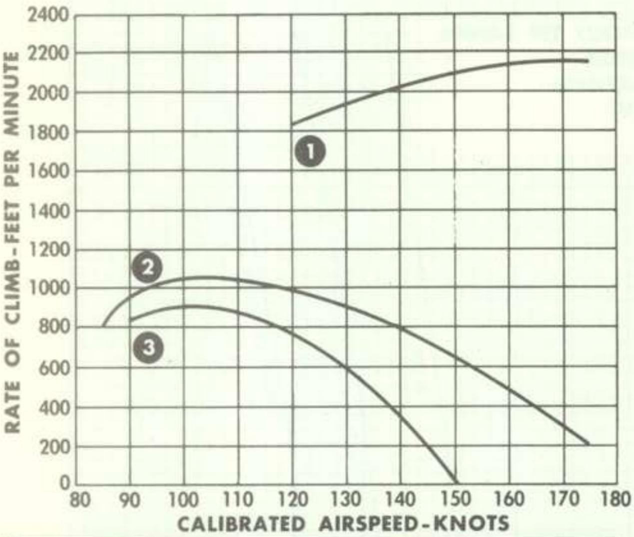
Figure A-80. Landing Ground Roll

EMERGENCY CLIMB

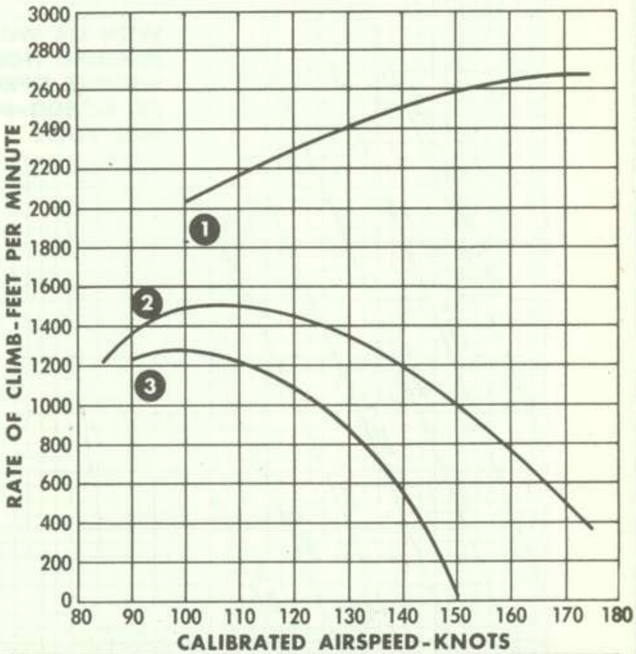
STANDARD DAY
SEA LEVEL

MODELS: AJ-1
AJ-2
AJ-2P

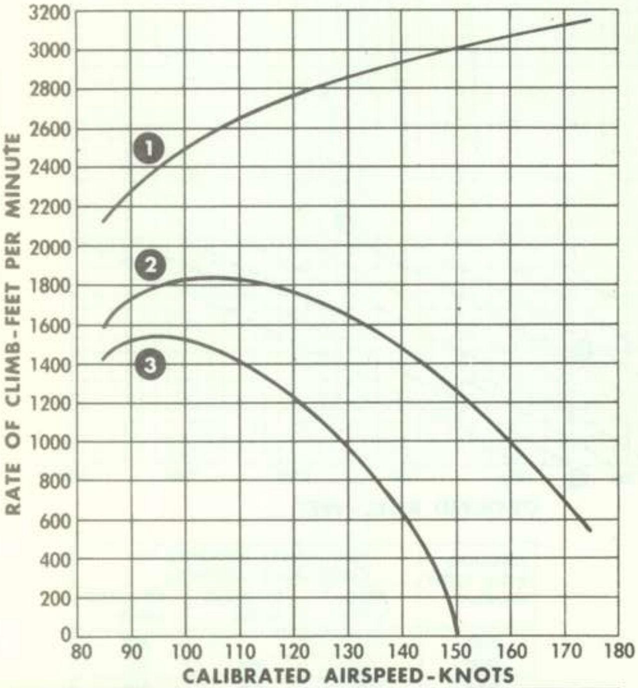
ENGINES:
(1) J33-A-10
(2) R-2800-44W



GROSS WEIGHT-51,000 POUNDS



GROSS WEIGHT-45,000 POUNDS



GROSS WEIGHT-40,000 POUNDS

REMARKS:

**MILITARY POWER-
THREE ENGINES.**

① FLAPS AND GEAR UP
② FLAPS DOWN AND GEAR UP
③ FLAPS AND GEAR DOWN

DATA BASED ON: ESTIMATED PERFORMANCE, NA51-657
DATA AS OF: SEPTEMBER 3, 1951

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

H-175-93-66A

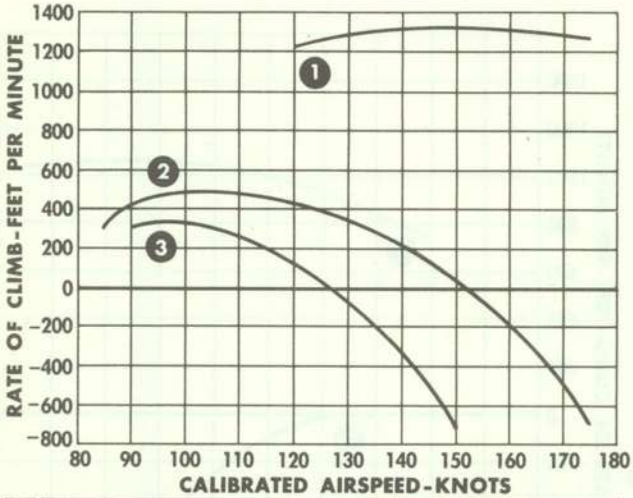
Figure A-81. Emergency Climb (Sheet 1 of 3)

EMERGENCY CLIMB

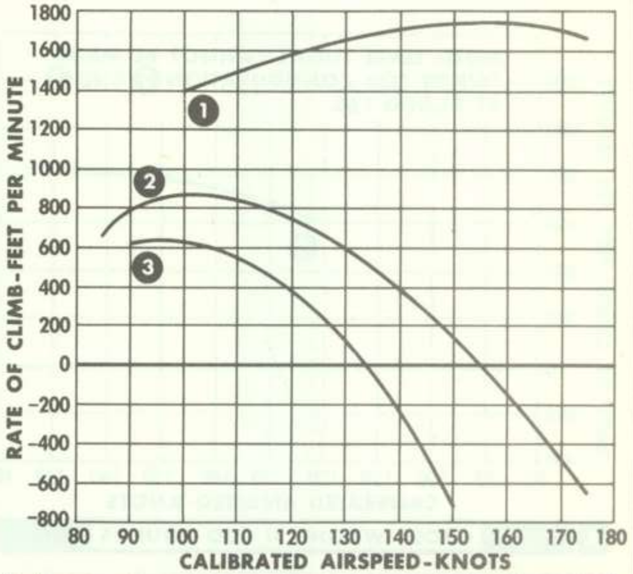
STANDARD DAY
SEA LEVEL

MODELS: AJ-1
AJ-2
AJ-2P

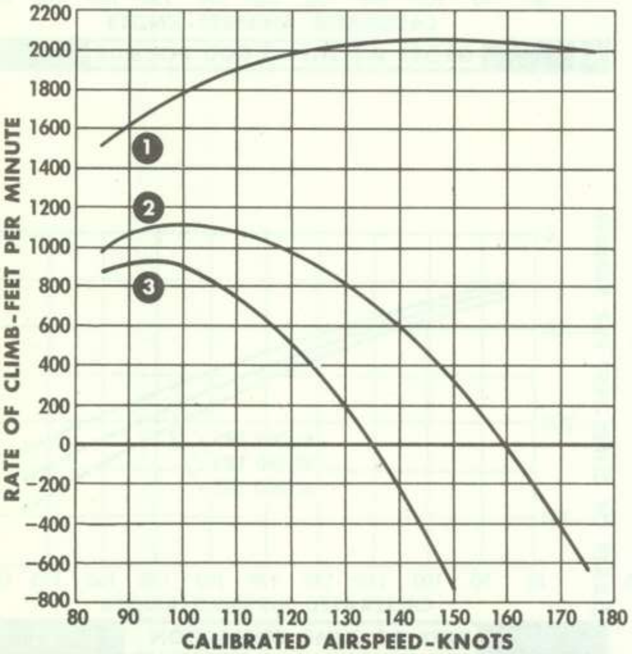
ENGINES:
(1) J33-A-10
(2) R-2800-44W



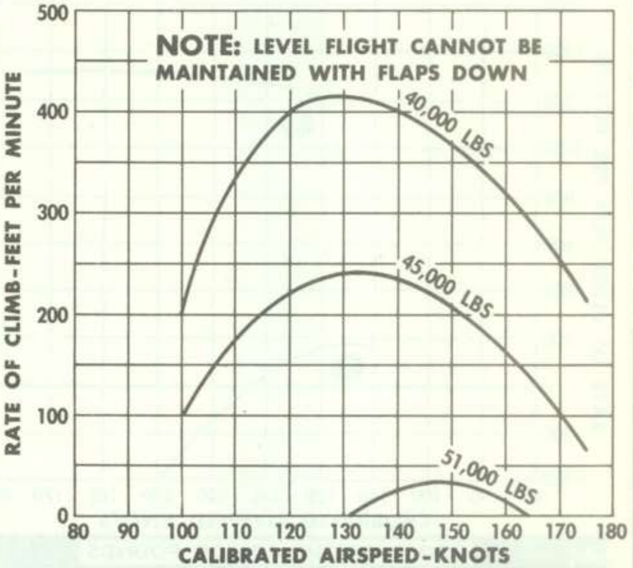
A GROSS WEIGHT-51,000 POUNDS



A GROSS WEIGHT-45,000 POUNDS



A GROSS WEIGHT-40,000 POUNDS



B GROSS WEIGHT-AS NOTED

A REMARKS: MILITARY POWER-
TWO R-2800-44 ENGINES.
① FLAPS AND GEAR UP
② FLAPS DOWN AND GEAR UP
③ FLAPS AND GEAR DOWN

B REMARKS: MILITARY POWER-
ONE R-2800-44 ENGINE
FLAPS AND GEAR UP

DATA BASED ON: ESTIMATED PERFORMANCE, NA51-657
DATA AS OF: SEPTEMBER 3, 1951

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

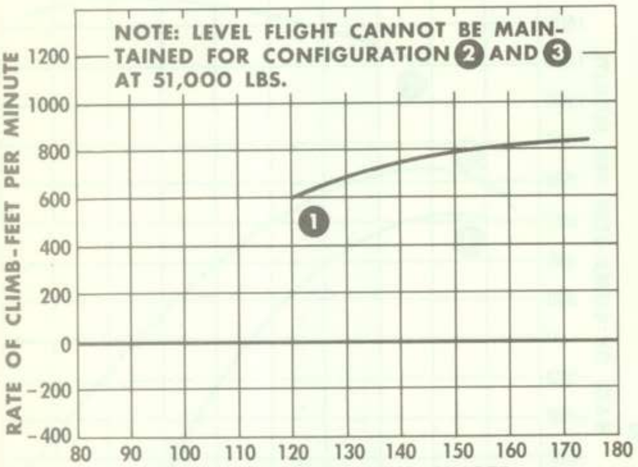
H-175-93-70A

Figure A-81. Emergency Climb (Sheet 2 of 3)

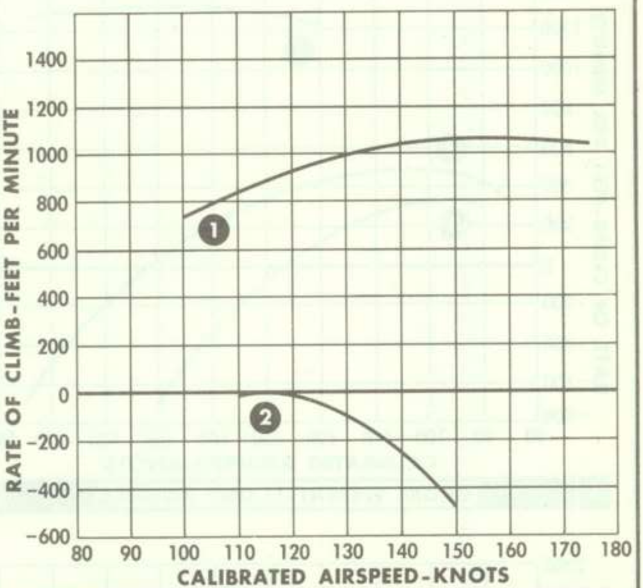
EMERGENCY CLIMB
STANDARD DAY
SEA LEVEL

MODELS: AJ-1
AJ-2
AJ-2P

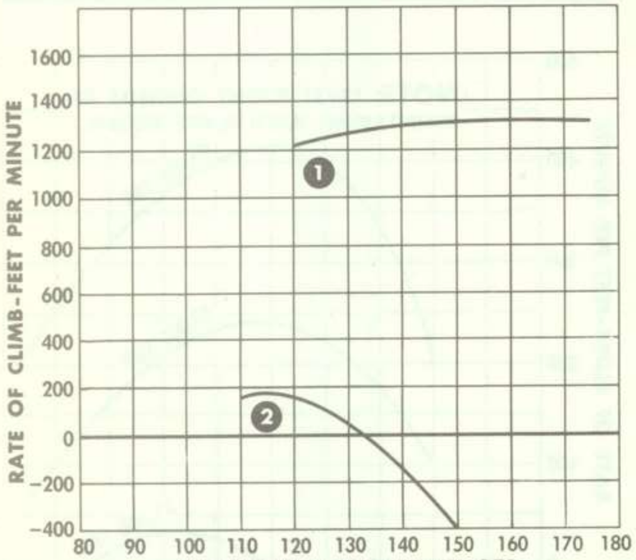
ENGINES:
(1) J33-A-10
(2) R-2800-44W



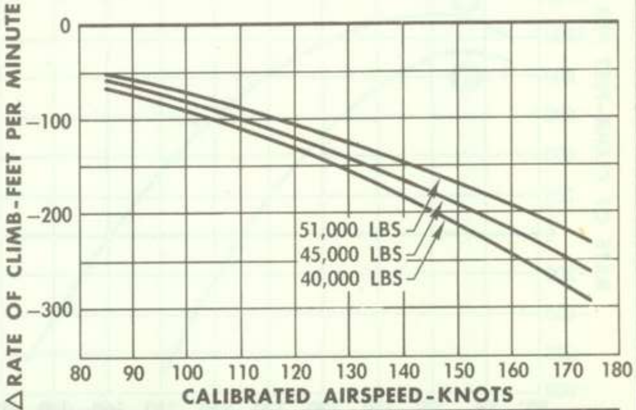
A GROSS WEIGHT-51,000 POUNDS



A GROSS WEIGHT-45,000 POUNDS



A GROSS WEIGHT-40,000 POUNDS



RATE OF CLIMB CORRECTION
FOR WINDMILLING PROPELLER

A REMARKS:
MILITARY POWER-
ONE R-2800-44 ENGINE
ONE J33-A-10 ENGINE

① FLAPS AND GEAR UP
② FLAPS DOWN AND GEAR UP
③ FLAPS AND GEAR DOWN

DATA BASED ON: ESTIMATED PERFORMANCE, NA51-657
DATA AS OF: SEPTEMBER 3, 1951

H-175-93-71A

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

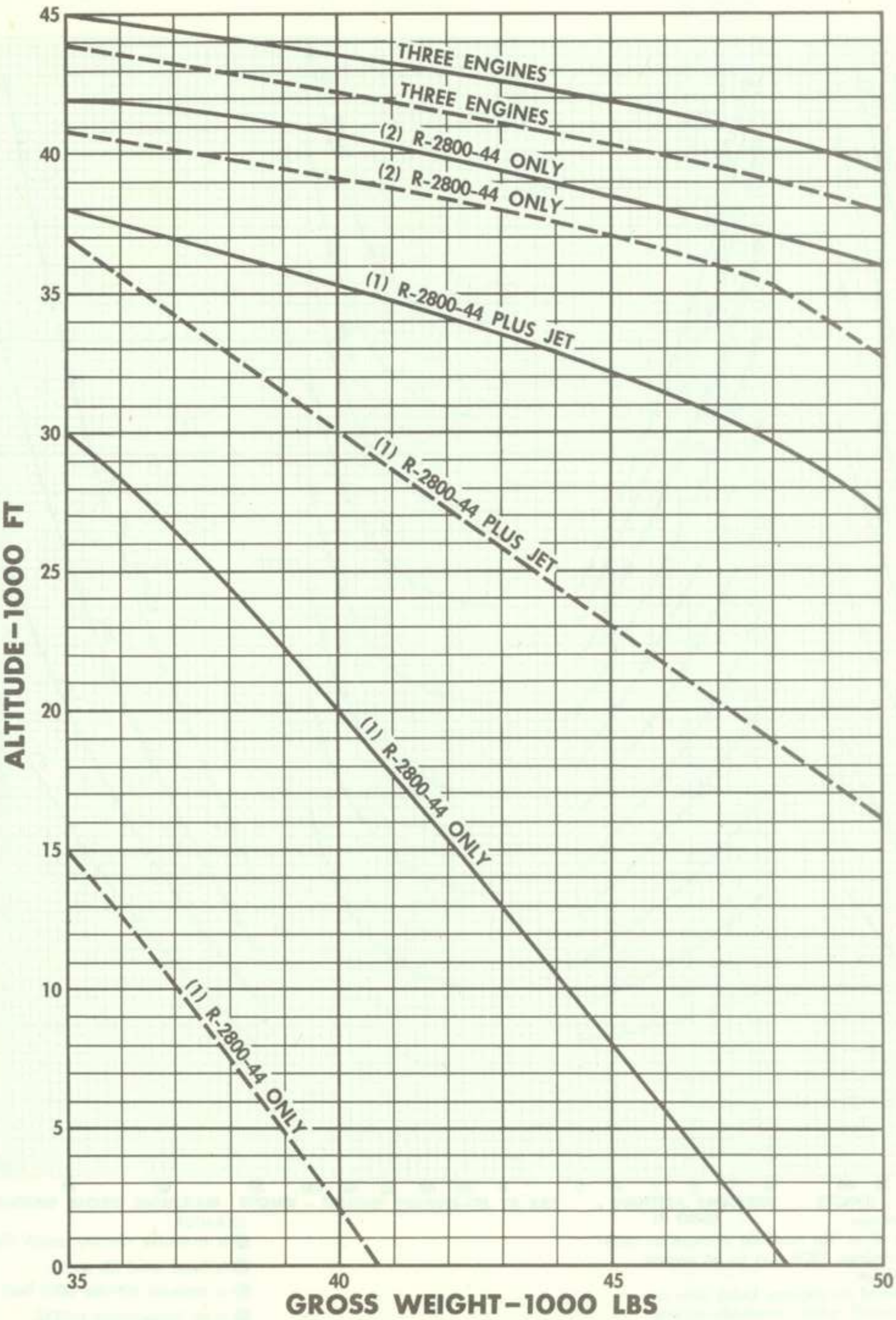
Figure A-81. Emergency Climb (Sheet 3 of 3)

EMERGENCY CEILING

STANDARD DAY
TIP TANKS ON

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES
(1) J-33-A-10
(2) R-2800-44W



REMARKS:

— MILITARY POWER
– – – NORMAL POWER

DATA BASED ON: ESTIMATED DATA
DATA AS OF: 9-3-51

NOTE: Prop feathered on inoperative engine.
SERVICE CEILING (100 fpm R/C)

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

H-175-93-67A

Figure A-82. Emergency Cruising Ceiling

DECISION SPEED FOR EMERGENCY TAKE-OFF AFTER JET-ENGINE FAILURE

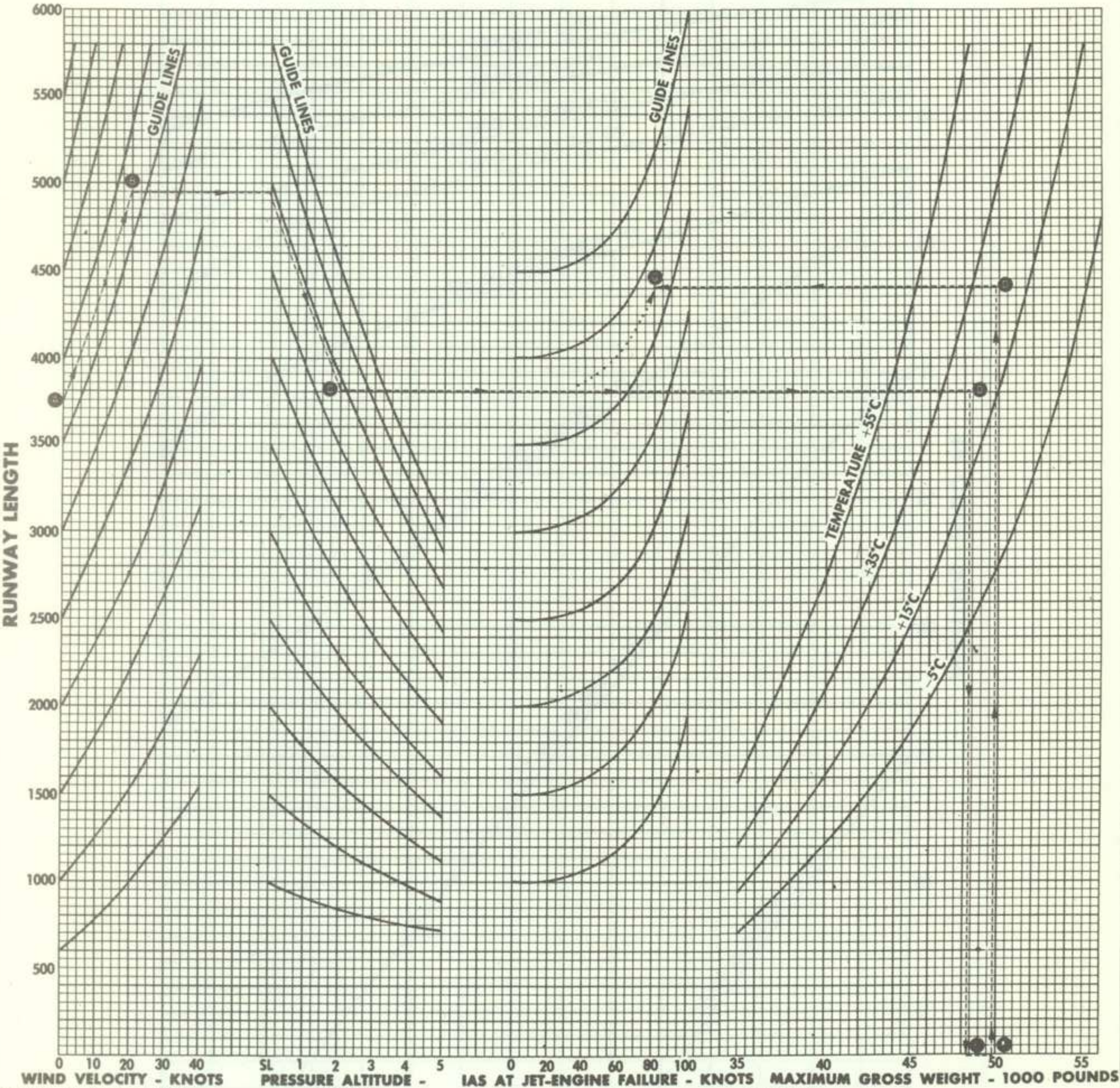
(HARD-SURFACE RUNWAY)

MODELS: AJ-1
AJ-2
AJ-2P

TAKE-OFF POWER - THREE ENGINES

WITH OR WITHOUT TIP TANKS

ENGINES:
(1) J33-A-10
(2) R-2800-44W



REMARKS:
1. Power settings:
   2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engine.
2. Flaps ½ down.
3. Figures based on airplane being able to "break ground" within available runway length at applicable gross weight.
4. Decision speed is minimum speed at which jet engine can fail and take-off can still be accomplished within the runway length available. Jet engine operating from start of take-off to IAS at time of failure.

EXAMPLE:
● is available runway length (3750 feet).
● is head wind (20 knots).
● is pressure altitude (2000 feet).
● is air temperature (+25°C).
● is maximum gross weight to take off without use of jet engine (48,300 lb).
● is actual gross weight of airplane (49,800 lb).
● is decision speed (80 knots - IAS).

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

DATA AS OF: 12-25-51 BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

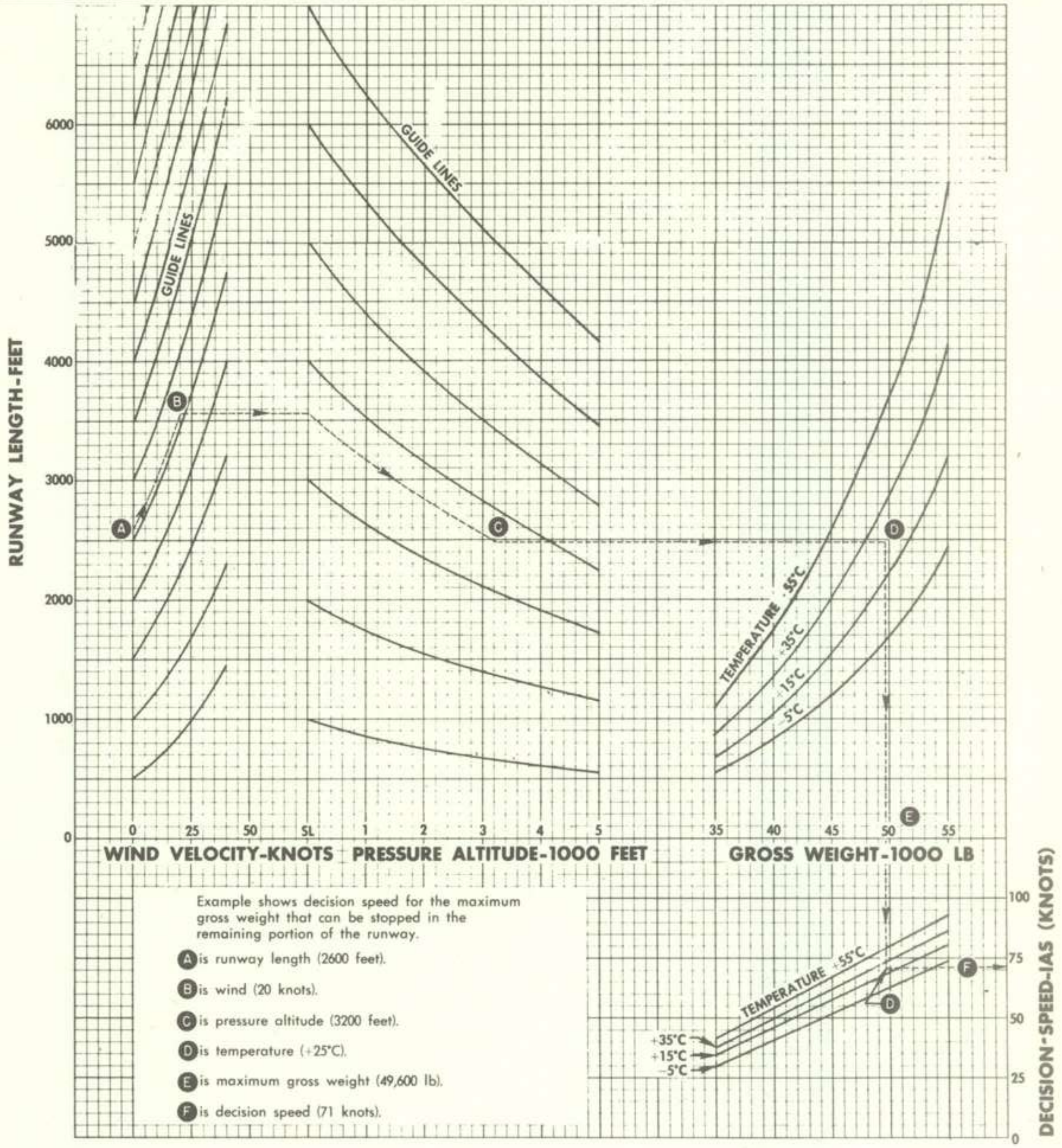
169-93-1432A

Figure A-83. Decision Speed for Emergency Take-off after Jet-engine Failure

DECISION SPEED FOR STOPPING
(HARD-SURFACE RUNWAY)
TAKE-OFF POWER-THREE ENGINES
WITH OR WITHOUT TIP TANKS

MODELS: AJ-1
AJ-2
AJ-2P

ENGINES:
(1) J33-A-10
(2) R-2800-44W



Example shows decision speed for the maximum gross weight that can be stopped in the remaining portion of the runway.

Ⓐ is runway length (2600 feet).

Ⓑ is wind (20 knots).

Ⓒ is pressure altitude (3200 feet).

Ⓓ is temperature (+25°C).

Ⓔ is maximum gross weight (49,600 lb).

Ⓕ is decision speed (71 knots).

REMARKS:

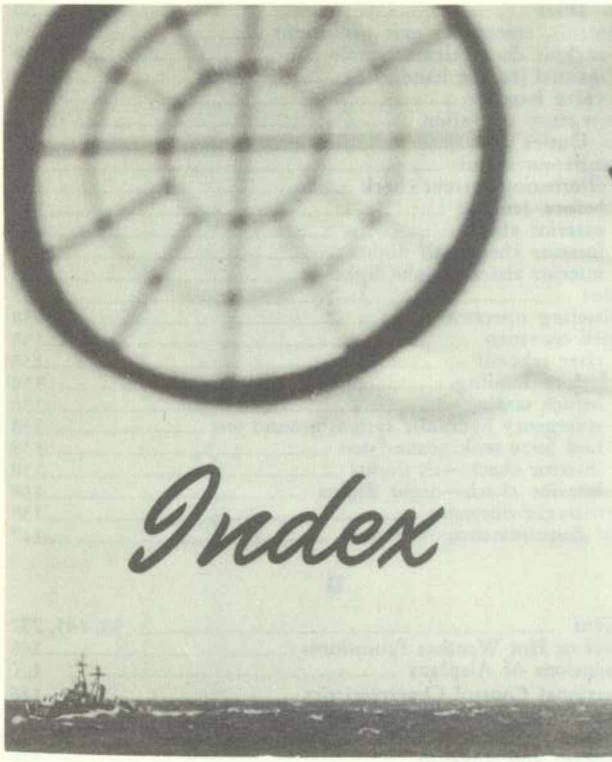
1. Based on normal take-off procedures.
2. Power settings:
   2800 rpm, 61 in. Hg manifold pressure on reciprocating engines. 100% rpm on jet engine.
3. Flaps ½ down.
4. Decision speed is the maximum IAS the airplane can attain and still be stopped in the runway length yet available.
5. The weight determined is the maximum that will allow the airplane to "break ground" in the length of runway available. If the airplane gross weight is less, use the same decision speed, since the actual decision speed would be only slightly higher.
6. Stopping distance is predicted on hard braking, no power.
7. Includes a 6-second delay before applying brakes.

DATA AS OF: 12-25-51
BASED ON: FLIGHT TEST DATA, NAA REPORT 51-1189

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

169-03-1434A

Figure A-84. Decision Speed for Stopping



Index

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS

PAGE NUMBERS IN *ITALICS* DENOTE ILLUSTRATIONS