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Flight Handbook

NAVY MODEL
AU-1
AIRCRAFT

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

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INTRODUCTION

IMPORTANT

To gain the maximum benefit from this handbook, you should read this page carefully.

This handbook describes the airplane, its equipment, its operation and its characteristics in enough detail so that a pilot of minimum experience may safely accomplish a complete flight.

Section I describes the airplane and those systems and controls which contribute to the actual flight. Section II describes the normal flight operations from the time of preflight inspection to the time the airplane is left parked on the ramp. Section III describes the procedures to be followed in meeting flight emergencies. Section IV describes the auxiliary equipment and gives procedures for normal and emergency operations. Section V describes all important limitations to be observed during normal flight. Section VI describes the flight characteristics of the airplane. Section VII describes the operation of the various airplane systems. Section VIII is omitted because it pertains only to airplanes having crews. Section IX describes the operation of the airplane under instrument flight conditions and under extreme heat and cold. All operating charts necessary for preflight and inflight planning are included in appendix I.

Capitalized nomenclature used in this book is actual nameplate nomenclature, for example, GEN WARNING light. Positions of controls or switches appearing on nameplates in the airplane are capitalized within quotation marks, for example, "BATT ONLY."

Frequent revisions of the handbook will be made, but because of the time necessary to incorporate such revisions it is important that the pilot keep abreast of all technical directives affecting this airplane.

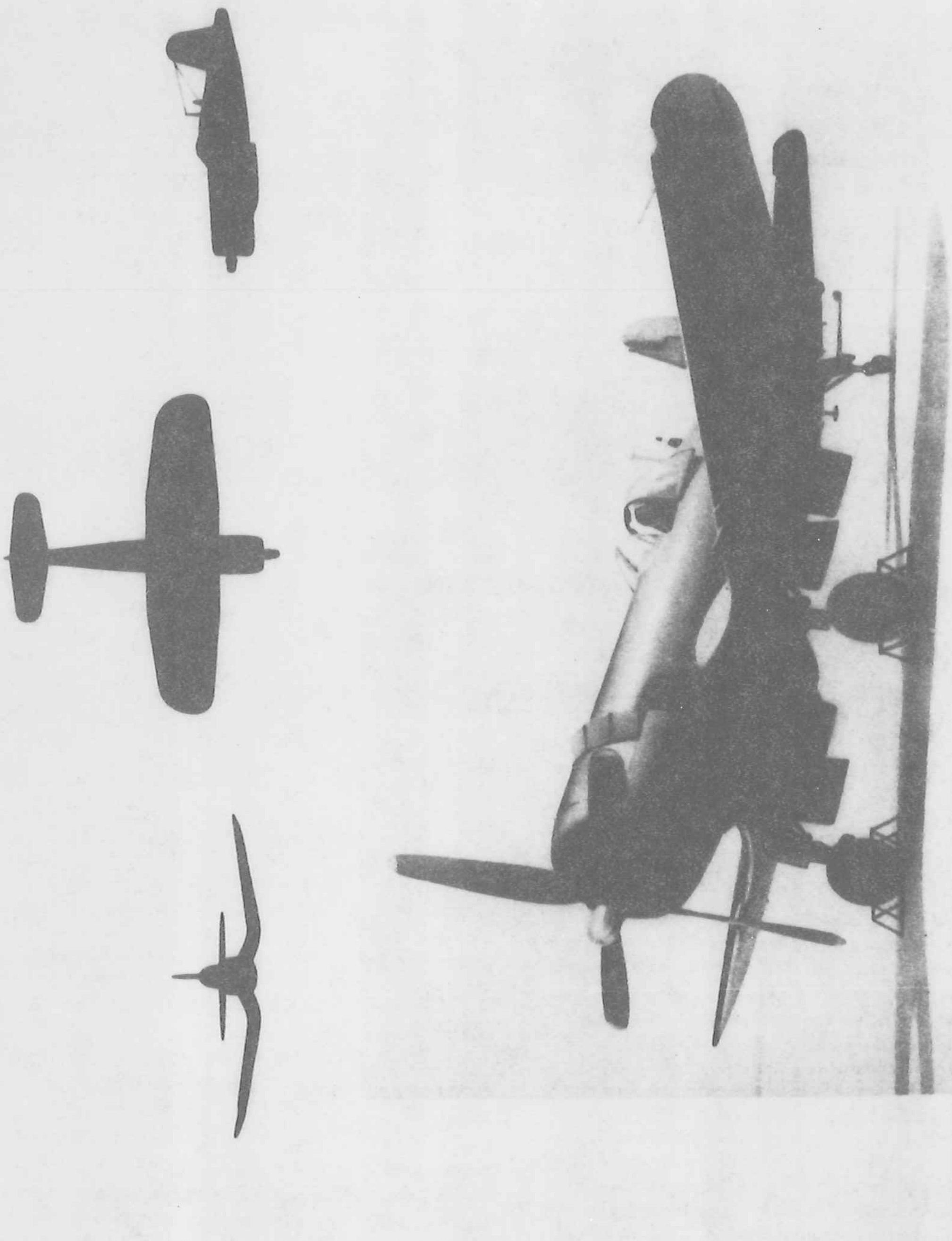
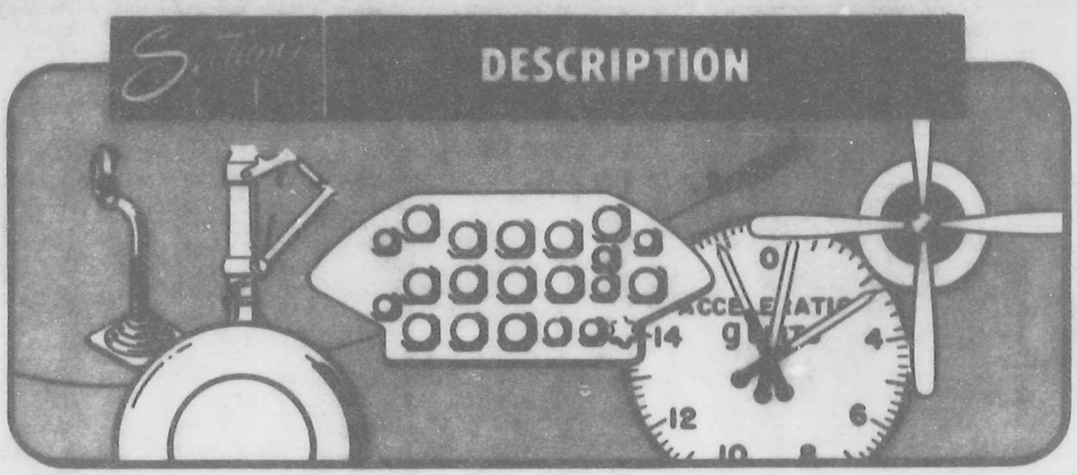


Figure 1-1. AU-1 Airplane



THE AIRPLANE.

The airplane is a single-engine single-seat low-wing monoplane of the F4U "Corsair" series, designed as a carrier-based attack landplane. Over-all approximate dimensions are as follows:

Length .... 34½ feet
Width (wings spread) .... 41 feet
Height .... 13 feet
Height (wings folded) .... 16¼ feet

F4U-1	F4U-4	F4U-5	AU-1
Three-bladed propeller. Circular engine cowl with no air ducts.	Four-bladed propeller. Air duct in lower edge of engine cowl.	Four-bladed propeller. Air ducts in lower half of each side of engine cowl.	Four-bladed propeller. Noncircular engine cowl with no air ducts.
R-2800-8W engine	R-2800-18W or R-2800-42W engine.	R-2800-32W engine.	R-2800-83WA engine.
Six 50 cal machine guns, 2,400 rounds of ammunition. Eight 5-inch rockets. Two 1000-lb bombs.	Six 50 cal machine guns, 2,400 rounds of ammunition. Eight 5-inch rockets. Two 11.75-inch rockets or two 1000-lb bombs.	Four 20-mm cannons, 924 rounds of ammunition. Eight 5-inch rockets. One 2000-lb bomb (centerline pylon). Two 1000-lb bombs or two 11.75-inch rockets.	Four 20-mm cannons, 924 rounds of ammunition. Ten 5-inch rockets, six 500-lb bombs, or ten 250-lb bombs. One 2000-lb bomb (centerline pylon). Two 1000-lb bombs or two 11.75-inch rockets.
Main tank — 237 gal max capacity. Three drop tanks — 510 gal max capacity	Main tank — 233 gal max capacity. Two drop tanks — 300 gal max capacity.	Main tank — 234 gal max capacity. Two drop tanks — 300 gal max capacity.	Main tank — 234 gal max capacity. Two drop tanks — 300 gal max capacity.
12,000 lb normal gross weight.	12,500 lb normal gross weight.	12,900 lb normal gross weight.	12,950 lb normal gross weight.

Figure 1-2. Main Differences — F4U Series Airplanes

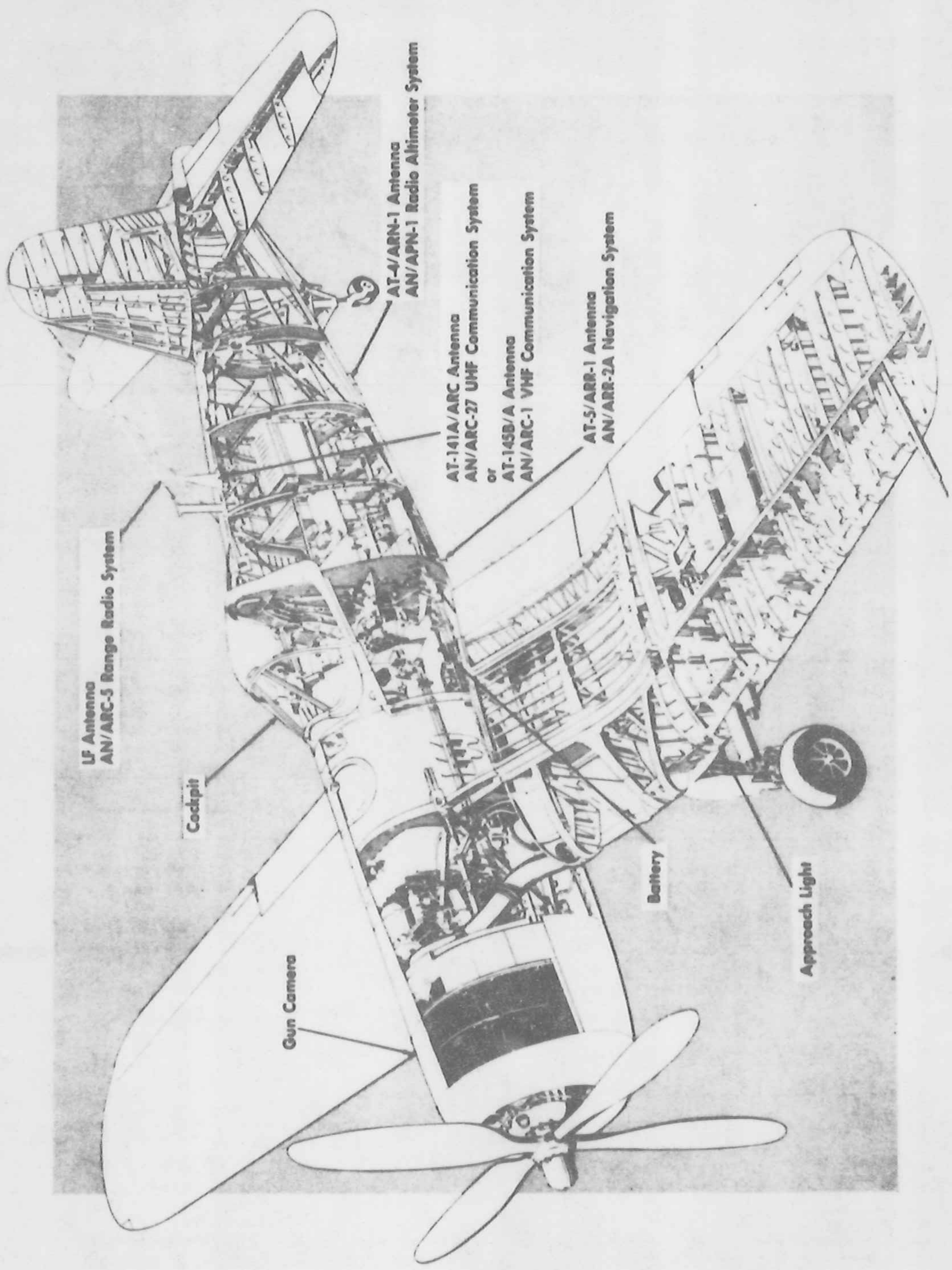


Figure 1–3. General Arrangements Diagram

ENGINE.

GENERAL. The airplane is powered by a Pratt and Whitney model R-2800-83WA double-Wasp C-series 18-cylinder engine, which is equipped with a single-stage two-speed manually controlled supercharger and provisions for water injection.

THROTTLE. The THROTTLE control (11, figure 1–6), located on the left-hand control shelf, is equipped with a fire control system ranging grip and a microphone switch button. The THROTTLE control actuates the manifold pressure regulator, which is mounted on the rear of the engine. The regulator adjusts the carburetor throttle opening as selected by the pilot with the cockpit throttle to obtain the desired manifold pressure indication on the manifold pressure gage (26, figure 1–8). The manifold pressure setting is maintained regardless of changes in engine speed, airspeed, and altitude below the critical altitude for the power setting. The regulator also provides manual control for starting, idling, and taxiing. It will limit manifold pressures for combat power, and high- and low-blower operation. Failure of the pressure regulator will ordinarily leave the pilot with enough power to maintain cruising flight. Indirectly, the THROTTLE control affects the propeller, which must change pitch to absorb the engine power output without changing rpm. When placed in combat position, the THROTTLE control actuates a water injection microswitch. The tachometer (25, figure 1–8), located in the bottom row of the instrument panel, indicates the engine rpm. The manifold pressure gage (26, figure 1–8), located in the middle row of the instrument panel, indicates the pressure at the intake manifold.

CARBURETOR. The carburetor meters fuel in proportion to the air flow. The MIXTURE control (27, figure 1–6) inboard of the THROTTLE and PROPELLER controls, adjusts the ratio of fuel to air. The MIXTURE control may be positioned in "IDLE CUT-OFF" to stop fuel flow to the carburetor, in "AUTO-LEAN" for normal flight operations, or in "AUTO-RICH" for ground, take-off, landing, and combat operations. Intermediate positions provide proportional mixture control. Normal air flow to the carburetor is through the center section ducts, the carburetor ducts, and the air box into the carburetor. When the CARBURETOR ALTERNATE AIR switch (32, figure 1–6) is turned "ON," the air is closed off and engine accessory compartment air is let into the carburetor through the air box blow-in doors. The CARB AIR TEMP gage (27, figure 1–8), located on the left-hand side of the instrument panel, indicates the temperature of the induction air at the carburetor air box.

FRICTION ADJUSTMENT CONTROL. *(See figure 1–6.)* A friction adjustment control (26) is located inboard of the MIXTURE control on the left-hand control shelf. The control adjusts the friction of the PROPELLER and THROTTLE controls. Rotating the control forward increases friction and rotating it aft decreases friction.

SUPERCHARGER. The integral single-stage two-speed supercharger is controlled from the cockpit by the SUPERCHARGER control (14, figure 1–6) outboard of the THROTTLE control. "LOW" position is used for normal operation. For increased manifold pressure at high altitudes, the SUPERCHARGER control handle is shifted to the "HIGH" position.

WATER INJECTION SYSTEM. *(See figure 1–9.)* The water injection system allows the normally limited manifold pressure to be exceeded in emergencies. A water-alcohol mixture is injected into the blower throat whenever the MASTER WATER INJECTION switch (13, figure 1–6), located on the left-hand control shelf, is turned "ON" and the THROTTLE control is pushed beyond the military power stop to the combat power position. The 14 gallons of water-injection fluid will last a total of approximately 7½ minutes, and then the manifold pressure regulator will automatically readjust the manifold pressure back to military power.

Note

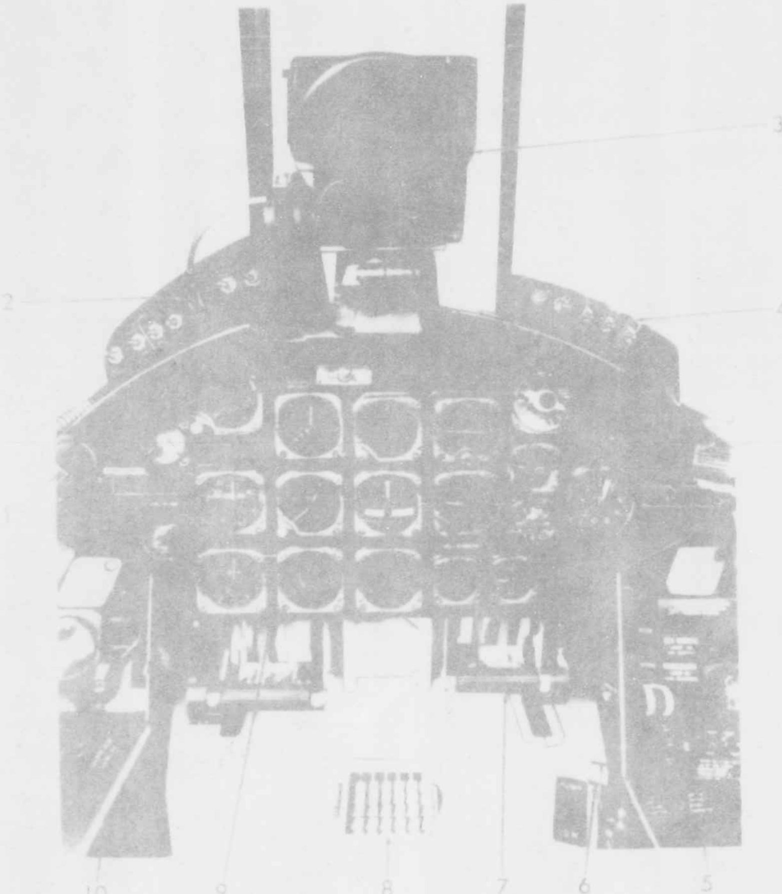
Engine operation in combat power shall be limited to 5 minutes at any one time.

ENGINE COOLING. The engine is cooled externally by air flow through the nose cowl around the cylinders and internally by cooled lubricating oil. Cooling is regulated by controlling the air exhaust flow through the cowl flaps and the oil cooler door. The cowl flaps are controlled by the COWL FLAPS switch (29, figure 1–6) on the left-hand control shelf, below the MIXTURE control. On the ground, the cowl flaps are automatically opened by a microswitch on the landing gear, allowing maximum air flow. A COWL FLAPS OVERRIDE switch (21, figure 1–7) is provided on the aft end of the right-hand control shelf to allow closing of the cowl flaps on the ground after the engine has cooled. The oil cooler door is automatically adjusted, but has an emergency OIL COOLER DOOR override switch (28, figure 1–6) located adjacent to the COWL FLAP switch. Engine temperatures are indicated by the cylinder temperature gage (23, figure 1–8) located in the bottom row of instruments on the instrument panel.

IGNITION SYSTEM. The ignition system is the conventional dual type. The ignition switch (2, figure 1–8), located on the left-hand side of the instrument panel, has "BOTH," "L," "R," and "OFF" positions.

PRIMER SYSTEM. The primer system injects fuel into the top eight cylinders to aid in starting the engine. The PRIME switch (5, figure 1–7) is located inboard of the START switch on the right-hand control shelf.

STARTER. The electric starter accelerates the engine to sufficient rpm to sustain engine operation. The START switch (5, figure 1–7) is located on the forward inclined portion of the right-hand control shelf.



1 Floodlamps
2 Gunnery Switch Box
3 Sight Unit
4 Bomb and Rocket Switch Box
5 Right-hand Control Shelf
6 Fuel Tank Pressure Dump Control
7 Brake and Rudder Pedals
8 Ventilator
9 Instrument Board
10 Left-hand Control Shelf

Figure 1–4. Cockpit Arrangement

PROPELLER.

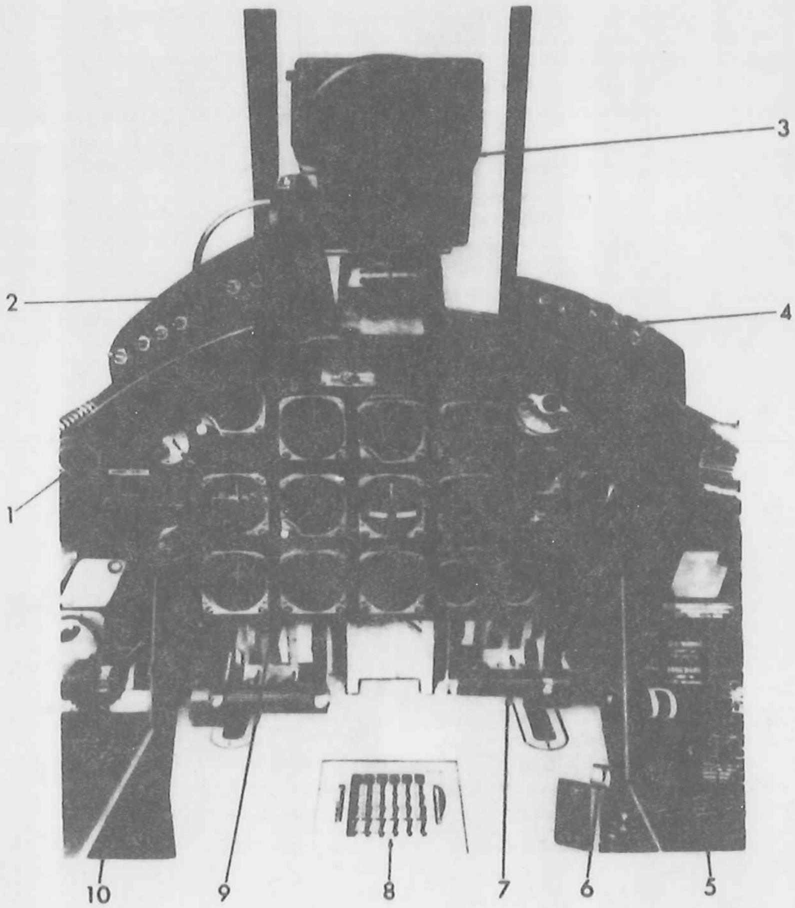
GENERAL. The airplane is equipped with a four-bladed Hamilton Standard Hydromatic propeller.

GOVERNOR. The blade pitch angle is automatically controlled by the propeller governor to maintain a constant engine speed as selected by the pilot. The PROPELLER control (12, figure 1–6) is located inboard of the THROTTLE control on the left-hand control shelf. Moving the control forward increases rpm and moving it aft decreases rpm.

OIL SYSTEM.

GENERAL. *(See figure 1–10.)* The oil system stores, supplies, and cools oil for the lubrication of the engine and accessories, for operation of the supercharger clutches, and for operation of the propeller pitch. The system provides for warm-up and dilution of oil for cold weather operation. The oil tank, located on the forward side of the fire wall, has a capacity of 2[illegible] gallons with an expansion space of 8.[illegible] gallons. Two oil coolers located in the engine accessory compartment provide oil cooling from air which flows in through the center section air ducts and exhausts through the oil cooler door. Oil grade and specification are given in the servicing diagram (figure 1–14).

OIL COOLER DOOR SWITCH. The OIL COOLER DOOR switch (28, figure 1–6) is located below the THROTTLE control on the left-hand control shelf. When the switch is in either the "OFF" or "AUTOMATIC" position, the oil cooler door is operated auto-



1. Floodlamps
2. Gunnery Switch Box
3. Sight Unit
4. Bomb and Rocket Switch Box
5. Right-hand Control Shelf
6. Fuel Tank Pressure Dump Control
7. Brake and Rudder Pedals
8. Ventilator
9. Instrument Board
10. Left-hand Control Shelf

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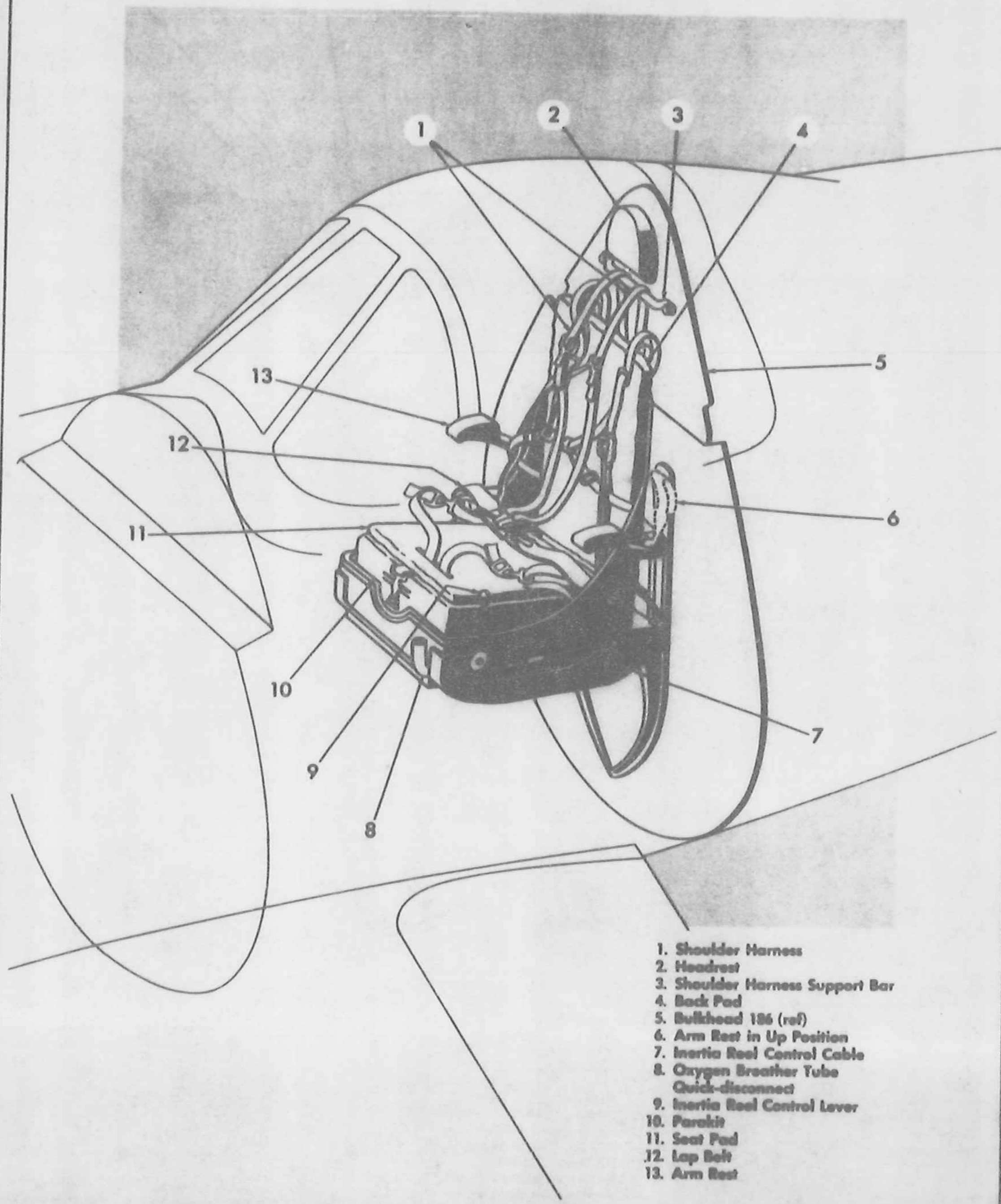
OIL SYSTEM.

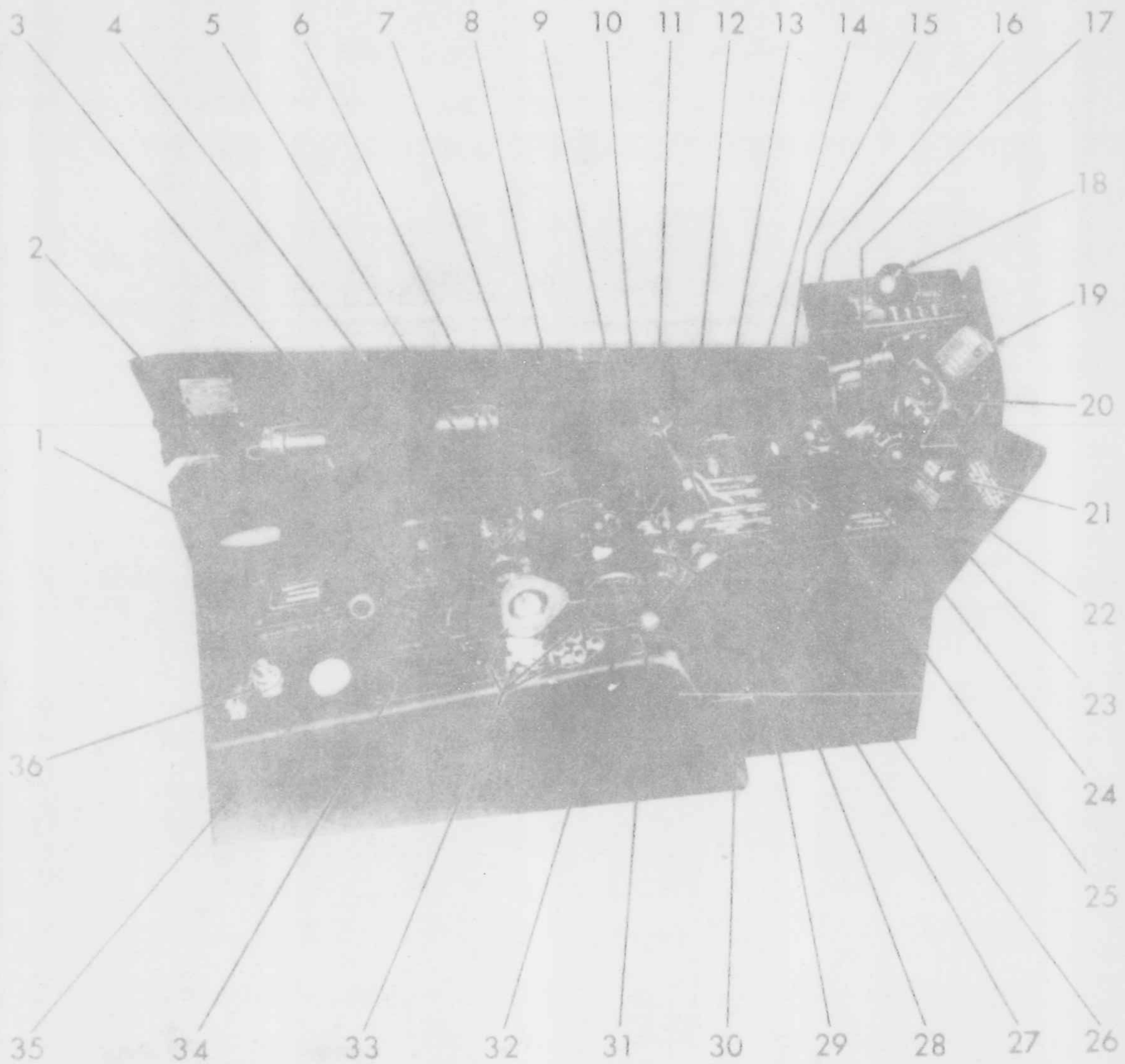
GENERAL. *(See figure 1–10.)* The oil system stores, supplies, and cools oil for the lubrication of the engine and accessories, for operation of the supercharger clutches, and for operation of the propeller pitch. The system provides for warm-up and dilution of oil for cold weather operation. The oil tank, located on the forward side of the fire wall, has a capacity of 27.5 gallons with an expansion space of 8.4 gallons. Two oil coolers located in the engine accessory compartment provide oil cooling from air which flows in through the center section air ducts and exhausts through the oil cooler door. Oil grade and specification are given in the servicing diagram (figure 1–14).

OIL COOLER DOOR SWITCH. The OIL COOLER DOOR switch (28, figure 1–6) is located below the THROTTLE control on the left-hand control shelf. When the switch is in either the "OFF" or "AUTOMATIC" position, the oil cooler door is operated auto-



1. Shoulder Harness
2. Headrest
3. Shoulder Harness Support Bar
4. Back Pad
5. Bulkhead 186 (ref)
6. Arm Rest in Up Position
7. Inertia Reel Control Cable
8. Oxygen Breather Tube Quick-disconnect
9. Inertia Reel Control Lever
10. Parakit
11. Seat Pad
12. Lap Belt
13. Arm Rest

Figure 1-5. Pilot's Seat

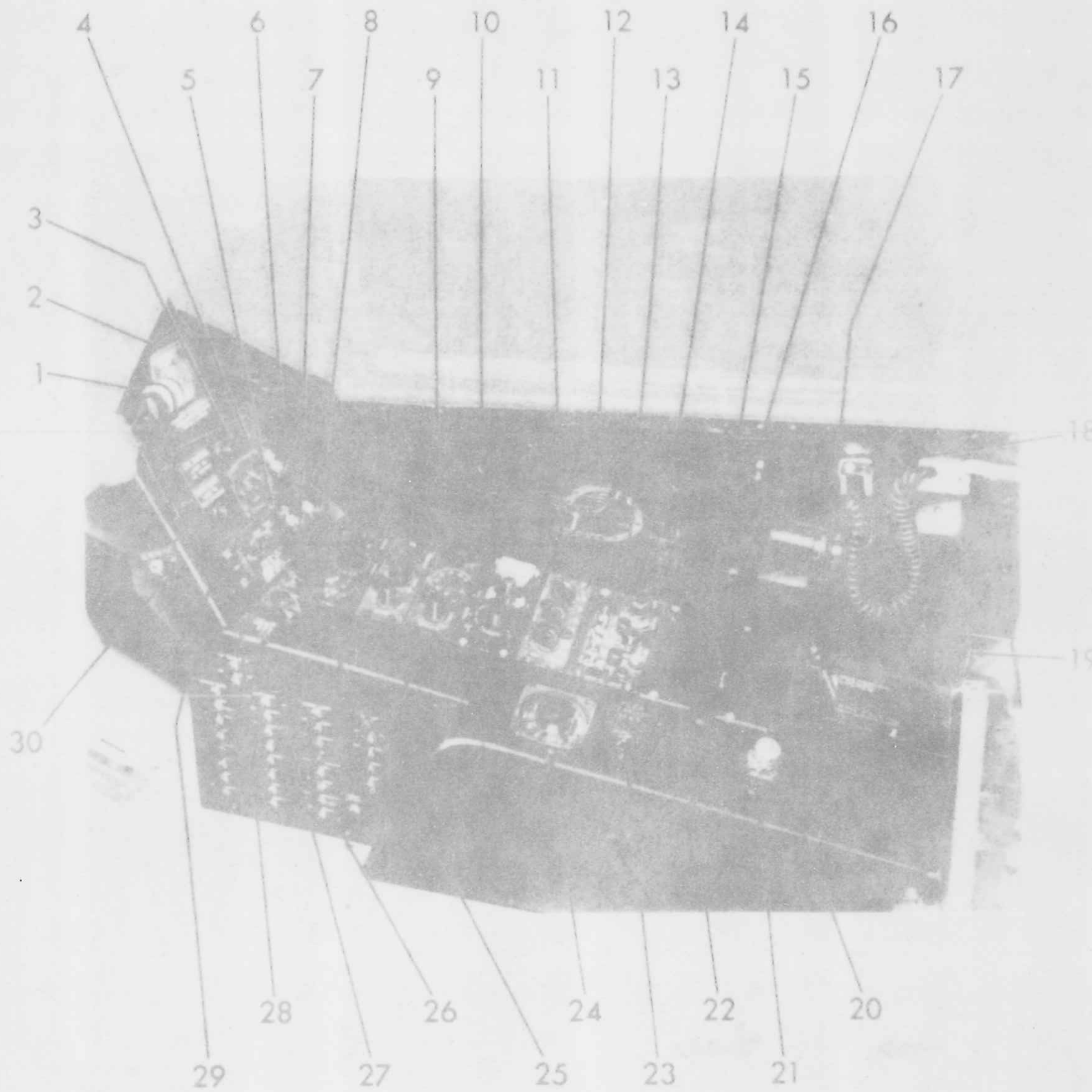


1. Emergency Bomb or Drop Tank Release
2. Tail Wheel Lock Control
3. Fuel Selector Valve Control
4. Fuel Transfer Switch
5. Fuel Transfer Warning Light
6. Auxiliary Fuel Pump Switch
7. Ash Tray
8. Oxygen Regulator
9. Wing Flap Control
10. Emergency-Down Latch, Wing Flap
11. Throttle Control
12. Propeller Control
13. Master Water Injection Switch
14. Supercharger Control
15. Oxygen Repeater Indicators
16. Catapult Handgrip Flap
17. Oil Cooler By-pass Switch
18. Cabin Control
19. Landing Check-off List
20. Wheel and Flaps Position Indicator
21. Emergency-Down Latch Landing Gear
22. Landing Gear Control Lever
23. Oil Low-level Warning Light
24. Landing Gear Warning Light
25. Oil Cooler Indicator
26. Friction Adjustment Control
27. Mixture Control
28. Oil Cooler Door Switch
29. Cowl Flaps Switch
30. Tow Target Release
31. Shoulder Harness Lock
32. Carburetor Alternate Air Switch
33. Trim Tab Switches and Indicators (See Note)
34. Gunsight Selector and Dimming Controls
35. Anti-G Suit Valve
36. Anti-G Suit Quick-Disconnect

NOTE

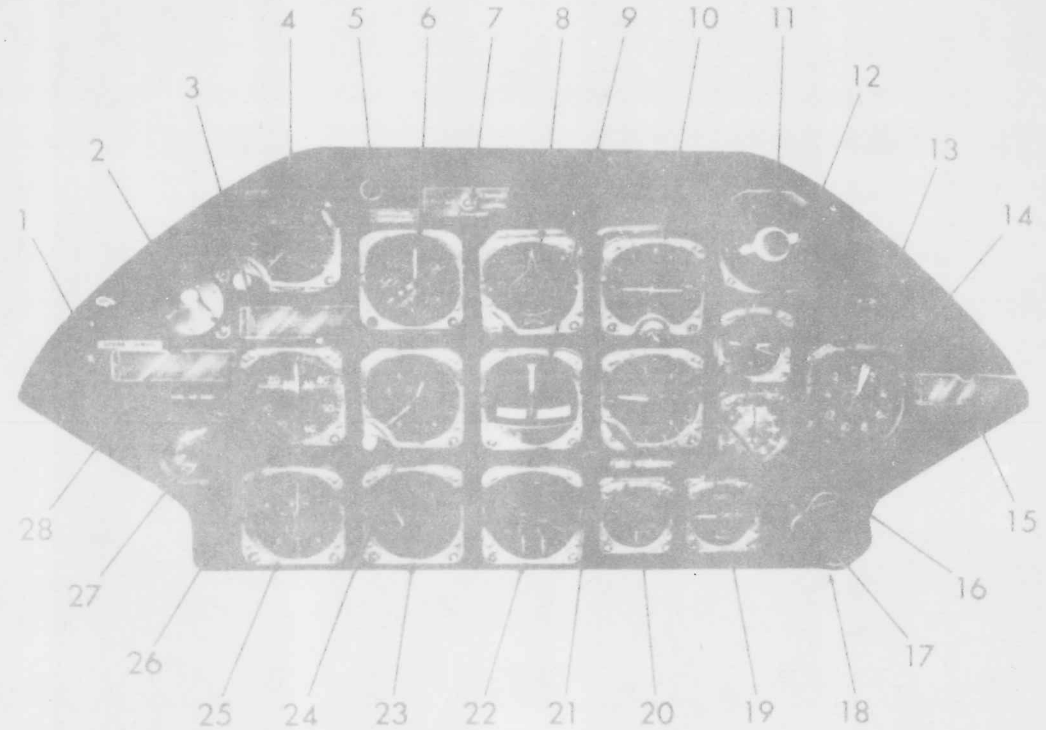
In Airplanes Bureau Serial No. 129318 through 129394, the trim tab indicators are combined in one instrument.

Figure 1–6. Left-Hand Controls



1. Arresting Hook Control
2. Take-off Check List
3. Generator Warning Light
4. Voltammeter
5. Prime and Start Switches
6. Auxiliary Hydraulic Pump Switch
7. Oil Dilution Switch
8. Pitot Heat Switch
9. Radio Controls
10. Spare Lamps
11. Interior Lighting Controls
12. Air Distributor Control
13. Exterior Lighting Controls
14. Defogger Air Control
15. Blank Panel and Radio Card
16. Cabin Safety Control
17. Wing-Folding Control
18. Microphone and Headphone Receptacle
19. Map Case
20. Portable Equipment Receptacle
21. Cowl Flaps Override Switch
22. Oxygen Shut-off Valve Access Door
23. Seat Adjustment Control
24. Altitude Limit Switch
25. Inverter Warning Light
26. Circuit Breaker Panel
27. A-C Instr Trans Switch
28. Gen and Batt Switch
29. Arresting Hook Warning Light
30. Voltmeter Test Jacks

Figure 1–7. Right-Hand Controls



1. Spare Lamps Container
2. Ignition Switch
3. Compass Correction Card
4. Radio Altitude Indicator
5. Altitude Low-limit Warning Light
6. Airspeed Indicator
7. G-2 Compass Switch
8. G-2 Compass Indicator
9. Turn-and-Bank Indicator
10. Gyro Horizon Indicator
11. Rocket Selector Switch
12. Standard Clock
13. Stand-by Compass
14. Accelerometer
15. Compass Correction Card
16. Elapsed-time Clock
17. Climb Indicator
18. Pedal Adjustment Knob
19. Hydraulic Pressure Gage
20. Fuel Quantity Gage
21. Fuel Reserve Warning Light
22. Engine Gage Unit
23. Engine Cylinder Temperature Gage
24. Altimeter
25. Tachometer Indicator
26. Manifold Pressure Gage
27. Carb Air Temp Gage
28. Airspeed Correction Card

Figure 1–8. Instrument Panel

matically. The "OPEN" and "CLOSE" positions are for emergency operation when the automatic adjustment fails. The oil cooler door position indicator (25, figure 1–6) is located forward of the throttle on the left-hand control shelf, and shows the position of the door. When the centerline pylon is installed in airplanes Bureau Serial No. 129318 through 129341, the oil cooler door opening is restricted. This may necessitate some reduction in power and/or an increase in airspeed during climbs.

OIL COOLER BY-PASS SWITCH. The OIL COOLER by-pass switch (17, figure 1–6) is a guard-covered switch located on the left-hand control shelf below the wheel-and-flap position indicator. The switch is normally in the "NORMAL" position. In emergencies, when the oil low-level warning light (23, figure 1–6) adjacent to the by-pass switch goes on, the switch should be placed in the "BY-PASS" position to by-pass the oil coolers, in case they have been damaged and are leaking oil.

OIL DILUTION SWITCH. The OIL DILUTION switch (7, figure 1–7), located on the forward inclined panel of the right-hand control panel, energizes the oil dilution system when it is placed in the "ON" position.

OIL DILUTION MANUAL SHUT-OFF VALVE. A manual valve, located adjacent to the fuel strainer in the engine accessory compartment, must be opened before oil dilution can take place. Access to the valve is through the oil cooler door.

OIL PRESSURE GAGE. The oil pressure gage is part of the engine gage unit (22, figure 1–8) and indicates the pressure of the oil entering the engine.

OIL TEMPERATURE GAGE. The oil temperature gage is part of the engine gage unit (22, figure 1–8) and indicates the temperature of the oil entering the engine.

OIL LOW-LEVEL WARNING LIGHT. The oil low-level warning light (23, figure 1–6) is located on the left-hand control shelf and lights up when the oil level has dropped to approximately 9½ gallons with the airplane level, or approximately 11 gallons with the airplane in the three-point position. The lamp bulb may be tested by pressing on the lamp housing.

Note

> The oil low-level warning light may go on during engine warm-up in cold weather. This does not necessarily indicate that the oil level is low; it will usually indicate that the oil warm-up system is in operation.

ENGINE CYLINDER TEMPERATURE GAGE. The engine cylinder temperature gage (23, figure 1–8) is located in the row of instruments on the bottom of the instrument panel. It indicates the engine cylinder head temperatures, which are affected by the air and oil cooling systems.

FUEL SYSTEM.

GENERAL. *(See figure 1–11.)* The fuel system consists of a primary fuel supply system, a transfer system, a venting and pressurizing system, and an emergency stand-by fuel selection system. The cockpit heater is also fed by the fuel system. The 234-gallon self-sealing main fuel cell is pressurized above 18,000 feet by the vapor pressure of the fuel. Three external drop tanks may be carried on the centerline and center section pylons, but the left-hand and centerline tanks cannot be used simultaneously. The drop tanks are pressurized at all altitudes by the positive pressure of the vacuum pump. A valve is incorporated to vent the main fuel cell in a dive. Fuel grades and specifications are given in the servicing diagram (figure 1–14).

FUEL SELECTION. The fuel selector valve control (3, figure 1–6) is located on the left-hand control shelf outboard of the sight unit control panel. The selector control has four positions: "OFF," "LEFT OR CENTER DROP TANK STAND-BY," "ON," and "RIGHT DROP TANK STAND-BY." The two stand-by positions are emergency positions, used if the fuel transfer system fails.

Fuel Quantity Data

*Configuration	Tank Selection	Volume	Total Volume
Main Cell	ON	234 gallons	234 gallons
Main Cell plus	ON	234 gallons	
Right Drop Tank	RIGHT DROP TANK STAND-BY	150 gallons	384 gallons
Main Cell plus	ON	234 gallons	
*Left or Centerline Drop Tank	LEFT OR CENTER-LINE DROP TANK STAND-BY	150 gallons	384 gallons
Main Cell plus	ON	234 gallons	
Right Drop Tank plus	RIGHT DROP TANK STAND-BY	150 gallons	534 gallons
*Left or Centerline Drop Tank	LEFT OR CENTER-LINE DROP TANK STAND-BY	150 gallons	

*It is not possible to connect the left drop tank and the centerline tank to the fuel system simultaneously.

FUEL TRANSFER SYSTEM. Transfer of fuel from the external tanks to the main cell is accomplished when the FUEL TRANSFER switch (4, figure 1–6), located forward of the fuel selector control, is placed in either "LEFT TANK" or "RIGHT TANK" position. A float valve located in the main fuel cell controls transfer fuel flow.

AUXILIARY FUEL PUMP. The auxiliary submerged fuel boost pump, located in the main fuel cell, furnishes fuel to the engine-driven main fuel pump and may be used to supply fuel to the engine if the main fuel pump fails. The AUXILIARY FUEL PUMP switch (6, figure 1–6), located on the left-hand control shelf below the SUPERCHARGER control, has three positions: "OFF," "HIGH," and "LOW."

FUEL TANK PRESSURE DUMP CONTROL. The fuel TANK PRESSURE control (6, figure 1–4), located under the right-hand rudder pedal, is actuated by the pilot's foot. The control releases main fuel cell pressure for crash landings or when going into combat.

DROP TANK RELEASE. A manual EMERGENCY BOMB OR DROP TANK RELEASE (1, figure 1–6) is located on the left-hand control shelf aft of the fuel selector control. Pushing the release forward in the left-hand, center, or right-hand slot will release the respective external tank. When one external tank is dropped, pressurization is lost at the remaining tank.

FUEL QUANTITY GAGE. The fuel quantity gage (20, figure 1–8), located in the bottom row of instruments on the right-hand side of the instrument panel, indicates the number of gallons of fuel remaining in the main fuel cell.

FUEL RESERVE WARNING LIGHT. The FUEL WARNING light (21, figure 1–8) located adjacent to the fuel quantity gage, goes on when the fuel remaining in the main cell drops to 50 gallons or less. The lamp may be tested by pressing in on the lamp cover.

FUEL PRESSURE GAGE. The fuel pressure gage (22, figure 1–8) is part of the engine gage unit and indicates the pressure of the fuel entering the carburetor.

FUEL TRANSFER WARNING LIGHT. The FUEL TRANSFER warning light (5, figure 1–6), adjacent to the FUEL TRANSFER switch, goes on when an external tank from which fuel is being transferred is empty. When the FUEL TRANSFER warning light comes on, the FUEL TRANSFER switch should be placed in the other transfer position or in the "OFF" position. The lamp may be tested by pressing in on the lamp cover with the FUEL TRANSFER switch in either transfer position.

ELECTRICAL POWER SUPPLY SYSTEM.

D-C POWER SUPPLY. *(See figure 1–12.)* Direct current is supplied by a 30-volt 200-ampere generator and a 24-volt 17-, 24-, or 36-ampere-hour battery, or by external power supplied through the external power receptacle. The GEN & BATT switch (28, figure 1–7), located on the right-hand control shelf inboard of the PRIME and START switches, has three positions: "OFF," "BATT ONLY," and "GEN & BATT." A GEN WARNING light (3, figure 1–7), adjacent to the GEN & BATT switch, goes on when the generator is not operating at a charging potential. The lamp may be tested by pressing in on the lamp cover. All circuit breakers accessible during flight (26, figure 1–7) are located on the forward vertical panel of the right-hand control shelf and are the manual-reset push-pull type. They may be manually pulled out to shut off power to a particular item or system. A voltammeter (4, figure 1–7), located above the starting switch, indicates the bus voltage and generator output. When the GEN WARNING light is on, the voltammeter shows battery current only. All electrical equipment, except the G-2 compass, gyro horizon, IFF radar, and most of the interior lights are supplied with direct current.

A-C POWER SUPPLY. *(See figure 1–12.)* Alternating current is supplied by the main inverter which normally supplies the G-2 compass, the gyro horizon, and the interior lighting (excepting the utility floodlamps, which are d-c powered). The stand-by inverter supplies a-c power to the IFF system. The inverters are controlled by the AC INSTR TRANS switch (27, figure 1–7), located on the inclined panel of the right-hand control shelf. If the main inverter fails, the inverter warning light (25, figure 1–7), adjacent to the AC INSTR TRANS switch, goes on. The G-2 compass and gyro horizon power load is transferred to the stand-by inverter by changing the AC INSTR TRANS switch from "MAIN" to "STBY" position. The instrument lights and IFF become inoperative and the inverter warning light will indicate the failure of the stand-by inverter when the AC INSTR TRANS switch is in the "STBY" position.

EXTERNAL POWER SUPPLY. An external power receptacle is located on the right-hand side of the fuselage, forward and above the trailing edge of the wing. It is recommended that the GEN & BATT switch be placed in the "OFF" position before connecting external power and that it be left in the "OFF" position until external power is turned off.

HYDRAULIC POWER SUPPLY SYSTEM.

GENERAL. *(See figure 1–13.)* The 1,500-psi main hydraulic system is normally supplied by an engine-driven pump which takes fluid from a standpipe in the hydraulic reservoir. The system may also be supplied by the electrically operated auxiliary pump which takes fluid from the bottom of the reservoir, or by an external pump using either the airplane's reservoir or an external reservoir. The auxiliary hydraulic pump supplies fluid at 1,750 (±100) psi. The main hydraulic system supplies the following subsystems: wing flap, wing fold, oil cooler door, landing gear, canopy, carburetor alternate air, and gun charging. The capacity of the entire system including the reservoir is 7.7 US gallons. Refer to the servicing diagram (figure 1–14) for the hydraulic fluid specification.

AUXILIARY HYDRAULIC PUMP SWITCH. The AUX HYDRAUL PUMP switch (6, figure 1–7) is located outboard of the voltammeter on the right-hand control shelf. The switch turns on the auxiliary pump when it is placed in the "AUX HYDRAUL PUMP" position and automatically returns to the "OFF" position if the switch becomes electrically overloaded.

HYDRAULIC PRESSURE GAGE. The hydraulic pressure gage (19, figure 1–8) is located in the bottom row of instruments on the instrument panel. The gage indicates the pressure in the main system.

FLIGHT CONTROL SYSTEM.

GENERAL. The flight controls are the conventional stick and pedal type with cable and push rod linkage. The rudder and elevators have electrically and mechanically actuated combination spring-tabs that serve to lighten the control forces as well as to provide directional and longitudinal trim. The ailerons have mechanically actuated automatic balance tabs to lighten control forces and an electrically actuated trim tab to provide lateral trim.

RUDDER PEDALS. The hanging-type rudder pedals (7, figure 1–4) have a 6-inch fore and aft adjustment controlled by a PEDAL ADJUSTMENT knob (18, figure 1–8) located on the right-hand side of the instrument panel. The pedals may be folded aft to provide a padded leg rest. Pushing forward on the toe of a pedal actuates the brakes on that side of the airplane.

CONTROL STICK. The control stick is equipped with a conventional pistol grip which contains three armament trigger switches.

TRIM TAB SWITCHES. The tabs are electrically controlled from the composite switch unit (33, figure 1–6), located on the left-hand control shelf forward of the gun sight control panel. The forward "LEFT-NOSE-RIGHT" toggle controls the rudder tab. The top toggle controls the elevator and aileron tabs. If the elevator and aileron switches become inoperative, the guarded TRIM TABS OVERRIDE switch (33, figure 1-6) inboard of the housing may be placed in the "OVERRIDE" position, and the four push-button switches (33, figure 1-6) may be used to actuate the aileron and elevator tabs. A tab position indicator (33, figure 1-6), located forward of the composite switch unit, shows the degree of trim being used. In airplanes Bureau Serial No. 129395 and subsequent, three separate trim tab indicators replace the single indicator. The indicator will not be accurate while the GEN WARNING light is on.

TURN-AND-BANK INDICATOR. The turn-and-bank indicator (9, figure 1-8), located in the middle row of instruments on the instrument panel, is the conventional needle-ball type. It is vacuum-powered by the engine-driven vacuum pump. The indicator shows the direction, rate, and coordination of turns.

CLIMB INDICATOR. The climb indicator (17, figure 1-8), located in the middle row of instruments on the instrument panel, shows the rate of ascent and descent.

AIRSPEED INDICATOR. The airspeed indicator (6, figure 1-8), located in the top row of instruments on the instrument panel, indicates the speed of the airplane through the air. The striped hand indicates the maximum allowable airspeed at any altitude at which the airplane is flying. An airspeed correction card (28, figure 1-8) on the left-hand side of the instrument panel gives the calibrated airspeeds for various indicated airspeeds.

ACCELEROMETER. The accelerometer (14, figure 1-8), located in the middle row of instruments on the instrument panel, provides visual indication of positive or negative stresses along the normal axis of the airplane.

LANDING GEAR SYSTEM.

GENERAL. The landing gear is normally actuated by hydraulic pressure, but in the event of hydraulic failure compressed air may be used. A mechanical ground lock prevents retraction of wheels while the airplane is on the ground. Six position-indicating microswitches, four on the main landing gear and two on the tail wheel gear, are actuated when the gear is up and locked, and when it is down and locked. A seventh microswitch, located on the left-hand landing gear scissors, overrides the cockpit COWL FLAPS switch and opens the cowl flaps when the airplane is on the ground. The tail wheel gear mechanically actuates the lower cockpit access step.

CAUTION

Do not attempt to retract the landing gear after use of the air system, as damage to the hydraulic reservoir will result.

LANDING GEAR CONTROL. The WHEELS control lever (22, figure 1-6) is located on the forward end of the left-hand control shelf. The control may be placed in three positions: "UP," "DOWN," and "EMERGENCY DOWN." A latch (21, figure 1-6) must be displaced before the WHEELS control can enter the "EMERGENCY DOWN" position. The control actuates a microswitch which is connected to the landing gear warning light and the secondary bus relay.

TAIL WHEEL LOCK CONTROL. The TAIL WHEEL lock control (2, figure 1-6) is located on the aft end of the left-hand control shelf. The "LOCK" position is forward and the "UNLOCK" position is aft.

LANDING GEAR POSITION INDICATOR. The landing gear position indicator (20, figure 1-6) shows the position of each main gear wheel and the tail wheel and, combined with the flap position indicator, is located on the left-hand control shelf outboard of the landing gear control.

LANDING GEAR WARNING LIGHT. The landing gear warning light (24, figure 1-6) is located on the left-hand control shelf aft of the landing gear control. The light goes on when the WHEELS control is moved and stays on until the landing gear is locked in the position selected by the control. The lamp may be tested by pressing in on the lamp cover.

ARRESTING HOOK SYSTEM.

GENERAL. The arresting hook is retracted and extended with the tail wheel when the HOOK control is in the "DOWN" position. On the deck, after the HOOK control is placed in the "UP" position the hook may be manually raised to the "parked" position by the deck crew. It will then be retracted with the tail wheel after take-off. Avoid dropping the hook after the landing gear is extended to prevent excessive jarring.

ARRESTING HOOK CONTROL. The HOOK control (1, figure 1-7) is located on the right-hand control shelf, inboard of the voltammeter. The control has two positions: "UP" and "DOWN." When the control is in the "DOWN" position, the MASTER ARMT switch breaker is opened and the guns are automatically safetied. When the exterior lights are on, and the landing gear is down, the approach light will blink until the arresting hook is lowered. For field-carrier landing practice, a hook by-pass switch in the radio compartment may be closed to energize a holding relay which will allow the approach light to operate and keep the approach light from blinking with the hook up. The holding relay will operate until the hook is lowered or until the exterior lights circuit breaker is opened (pulled out).

ARRESTING HOOK WARNING LIGHT. The HOOK WARN light (29, figure 1-7), adjacent to the HOOK control, goes on when the control is placed in the "DOWN" position and stays on until the hook is down and locked. The lamp may be tested by pressing in on the lamp cover.

WING FLAPS.

GENERAL. The wing flaps are conventional hydraulically actuated flaps that may be positioned in 10-degree increments from 0 to 50 degrees down. The flap hydraulic system has a by-pass valve which allows the flaps to "blow-up" when the air loads on the flaps become excessive.

WING FLAPS CONTROL. The WING FLAPS control (9, figure 1–6) is located on the left-hand control shelf outboard and aft of the throttle. The control positions are marked in 10-degree increments from 0 to 50 degrees. The "EMERG DOWN" position has a latch (10, figure 1–6) which must be displaced before the control lever can enter this position.

WING FLAPS POSITION INDICATOR. The flaps position indicator (20, figure 1–6) is combined with the wheel position indicator located on the left-hand control shelf outboard of the landing gear control. The indicator shows the position of the wheels and wing flaps.

CAUTION

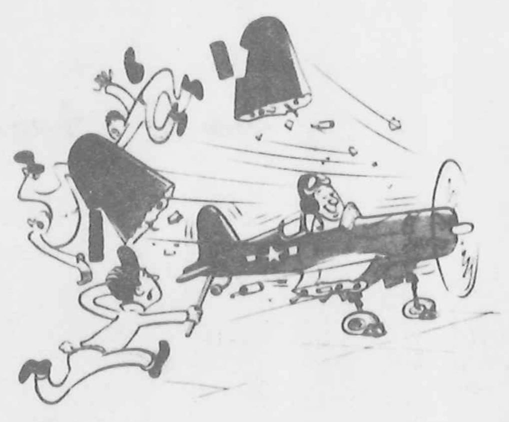
The wing flaps are limited to a 30-degree deflection when 11.75-inch rockets are carried on the center section pylons.

BRAKE SYSTEM.

The multiple-disk wheel brakes are actuated by independent left- and right-hand hydraulic systems. Master hydraulic cylinders are connected to the rudder pedals so that pressing forward on the upper part of the pedal actuates the cylinder, and the resulting hydraulic pressure compresses the disk brakes.

WING-FOLDING SYSTEM.

The wings are hydraulically folded and spread, and the hinge pin is locked by the WING FOLDING control (17, figure 1–7), located on the aft end of the right-hand control shelf. The control has four positions in an L-shaped slot, marked "FOLD," "PARK," "SPREAD," and "WING HINGE PIN LOCKED." A red warning flag at each wing-folding joint is raised until the wing hinge pin is locked. Jury struts are furnished with each airplane for holding the folded wing securely. The jury struts must be installed on a parked airplane when the wings are folded and there is any possibility of the airplane being exposed to wind or propeller blast. Failure of the wing-folding system may result from stresses being imposed on an unsupported folded wing.



CAUTION
Do Not Run-up the Engine Past 1,500 RPM Unless the Jury Struts Are Installed!

CANOPY SLIDING SECTION.

GENERAL. The canopy sliding section is normally operated manually or by hydraulic power. In emergencies it may be operated by compressed air.

WARNING

Under no conditions shall personnel outside the cockpit reach into the cockpit and actuate the sliding section by means of hydraulic power. A slip, loss of balance, or poor timing may result in serious injury or death.

INTERNAL CONTROL. The canopy sliding section CABIN CONTROL (18, figure 1–6) is located on the forward left-hand side of the cockpit, above the flap and wheel indicator. The control has five positions: "CLOSE," "STOP," "OPEN," "MANUAL," and "EMERGENCY." Placing the control in either "OPEN" or "CLOSE" hydraulically moves the canopy sliding section toward the selected position. Placing the control in "STOP" holds the canopy sliding section in intermediate positions. Placing the control in the "MANUAL" position frees the canopy sliding section so that it can be opened by pushing on it. If the sliding section is opened fully in "MANUAL," a CABIN SAFETY control (16, figure 1–7), located on the right-hand side of the cockpit above the wing-fold control, must be moved from the "BLOCKED" position to "CLEAR" before the sliding section can be pushed forward. Pulling the spring guard inboard and placing the CABIN CONTROL in the "EMERGENCY" position opens the sliding section with compressed air.

EXTERNAL MANUAL RELEASE. The external manual release is a pull ring stowed behind a small door on the right-hand side of the fuselage above the wing root. This control is used only in the case of a crash landing when the CABIN CONTROL has been left in the "CLOSE" position. Pulling the external control places the CABIN CONTROL in the "MANUAL" position and the sliding section can then be opened by pushing aft on the external actuating handle. Do not use the actuating handle for a handhold when entering the cockpit.

PILOT'S SEAT.

GENERAL. The pilot's seat (figure 1–5) is an adjustable bucket seat and back. A ferrying bucket is furnished as loose equipment to be placed in the seat when the parakit is not being used. The seat is equipped with arm rests which may be folded out of the way when not in use.

CONTROL. A PUSH-TO-ADJUST-SEAT control (23, figure 1–7), located on the right-hand control shelf forward of the oxygen access door, frees the seat for height adjustment when depressed. The seat may be raised or lowered in increments of 1 inch through a range of 7 inches vertical travel and 1 inch forward travel.

SAFETY BELT. The seat is equipped with a conventional lap safety belt.

SHOULDER HARNESS. The pilot's seat is equipped with a shoulder harness attached to an inertia reel behind the seat. The inertia reel may be locked by moving the control (31, figure 1–6), located on the left-hand control shelf inboard of the trim tab indicator, forward and down. When the control is in the "UNLOCK" position, the shoulder harness restricts sudden forward movements in excess of 2.5g acceleration, thus protecting the pilot but still allowing free movement. When the control is in the "LOCK" position, the shoulder harness is locked in the position it was in at the time the control was moved to that position; therefore, to obtain maximum protection, the harness should be locked while the pilot is leaning back against the seat.

INSTRUMENTS.

GENERAL. Information on instruments associated with a particular system will be found with the text pertaining to that system.

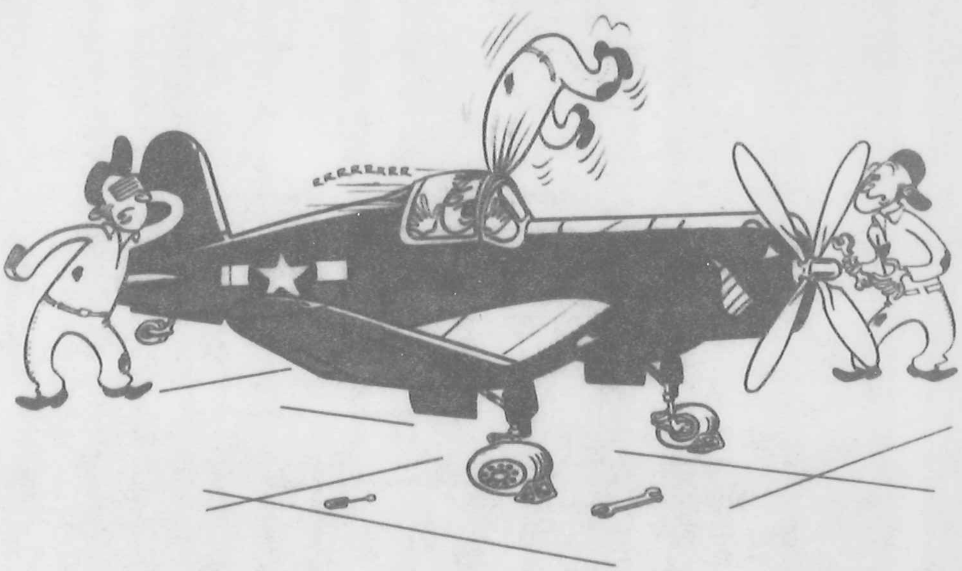
GYRO HORIZON. A gyro horizon indicator (10, figure 1–8) is located in the upper row of instruments on the instrument panel. The electrically driven gyro horizon reflects the flight attitude of the plane. The knob below the face of the indicator permits adjustment of the airplane image for load conditions of the airplane. The gyro horizon power is supplied by the a-c electrical system.

ALTIMETER. A sensitive barometric altimeter (24, figure 1–8) is located in the middle row of instruments on the instrument panel. The altimeter indicates the barometric altitude of the airplane. The knob below the face of the indicator permits adjustment for barometric pressures.

CLOCKS. Two clocks are located on the right-hand side of the instrument panel. The standard 8-day clock (12, figure 1–8) is set and wound by means of the projecting knob. The elapsed-time clock (16, figure 1–8) is wound, set, started, and stopped by means of the projecting knob.

AUXILIARY SYSTEMS.

The following auxiliary equipment is covered in section IV: heating and ventilating, pitot heat, communications and associated electronics, lighting, oxygen, navigation, armament, and miscellaneous equipment.



WARNING Do Not Work Through the Cockpit Canopy Opening!

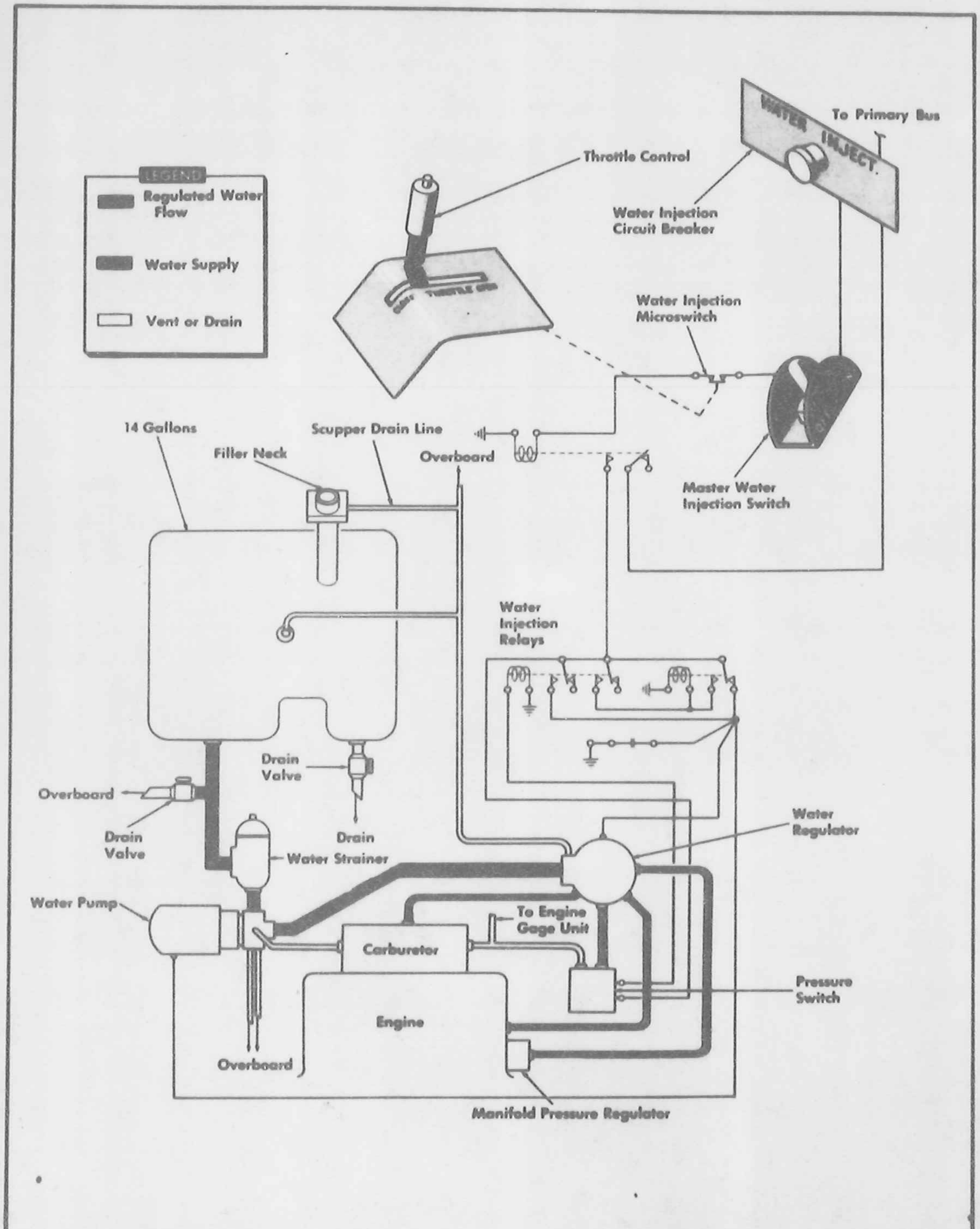


Figure 1-9. Water Injection System Schematic Diagram

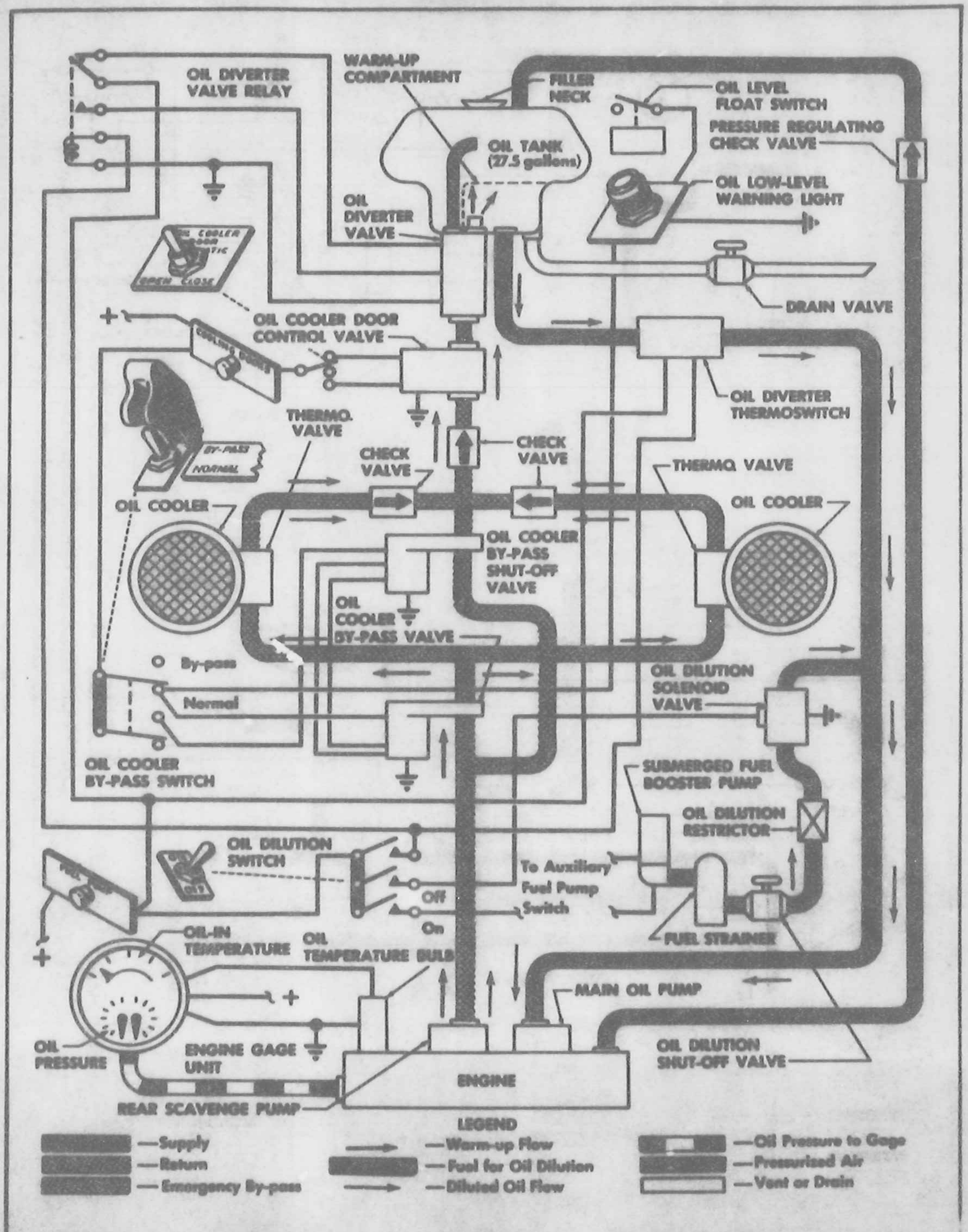


Figure 1-10. Oil System Schematic Diagram

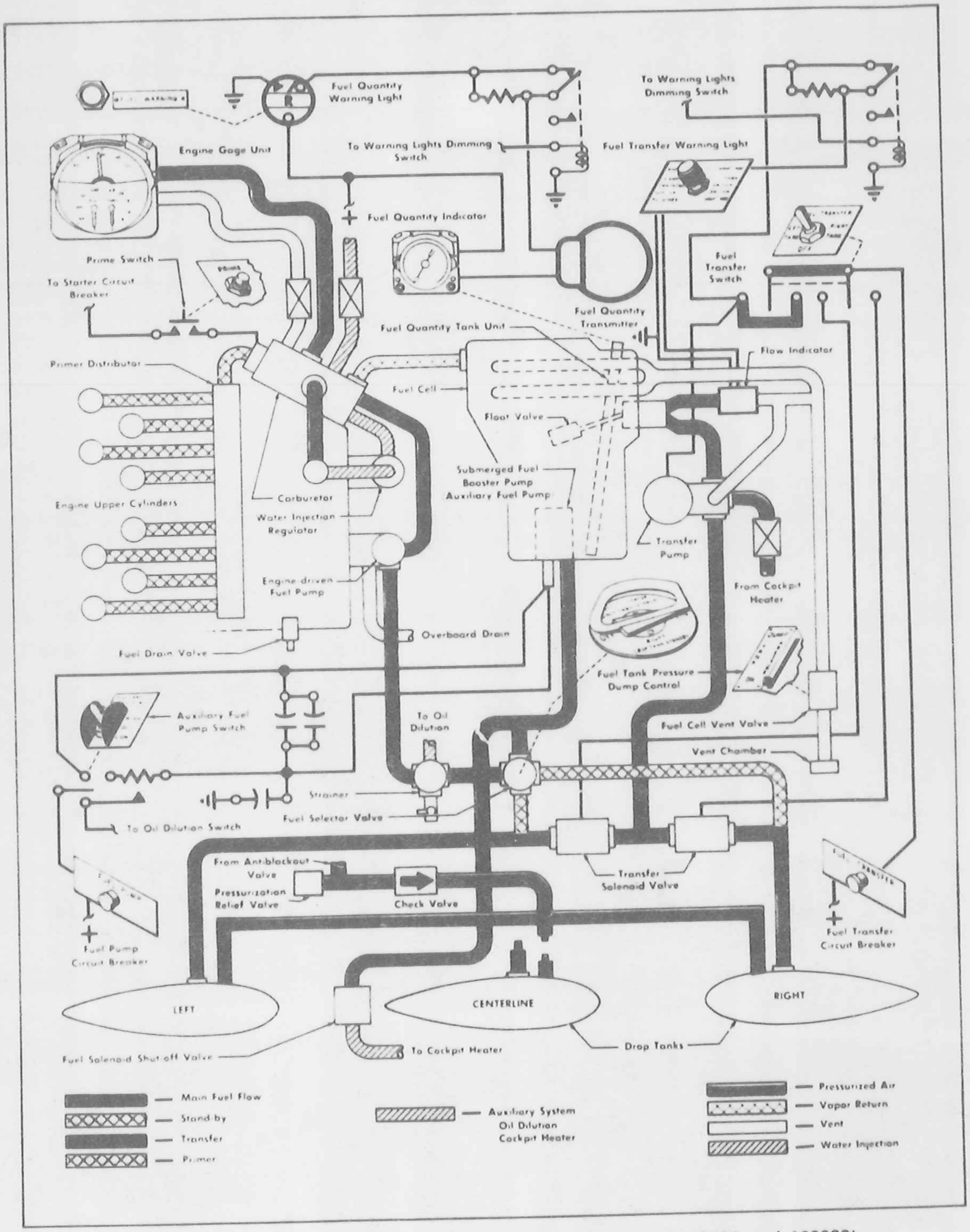


Figure 1–11. Fuel System Schematic Diagram (Bureau Serial No. 129380 and 129382)

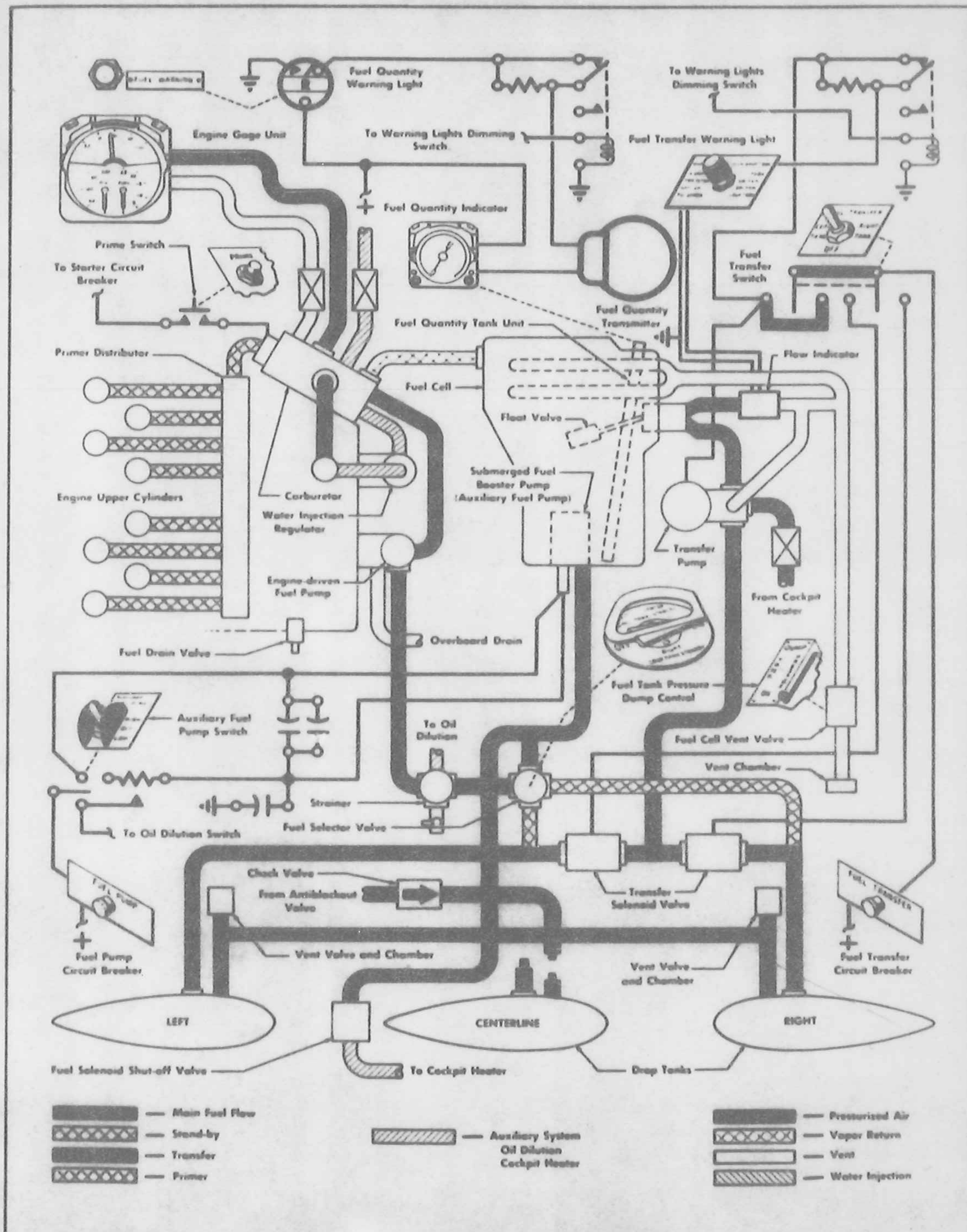


Figure 1-11A. Fuel System Schematic Diagram (Bureau Serial No. 129318–129379, 129381, 129383–129417, 133833–133843)

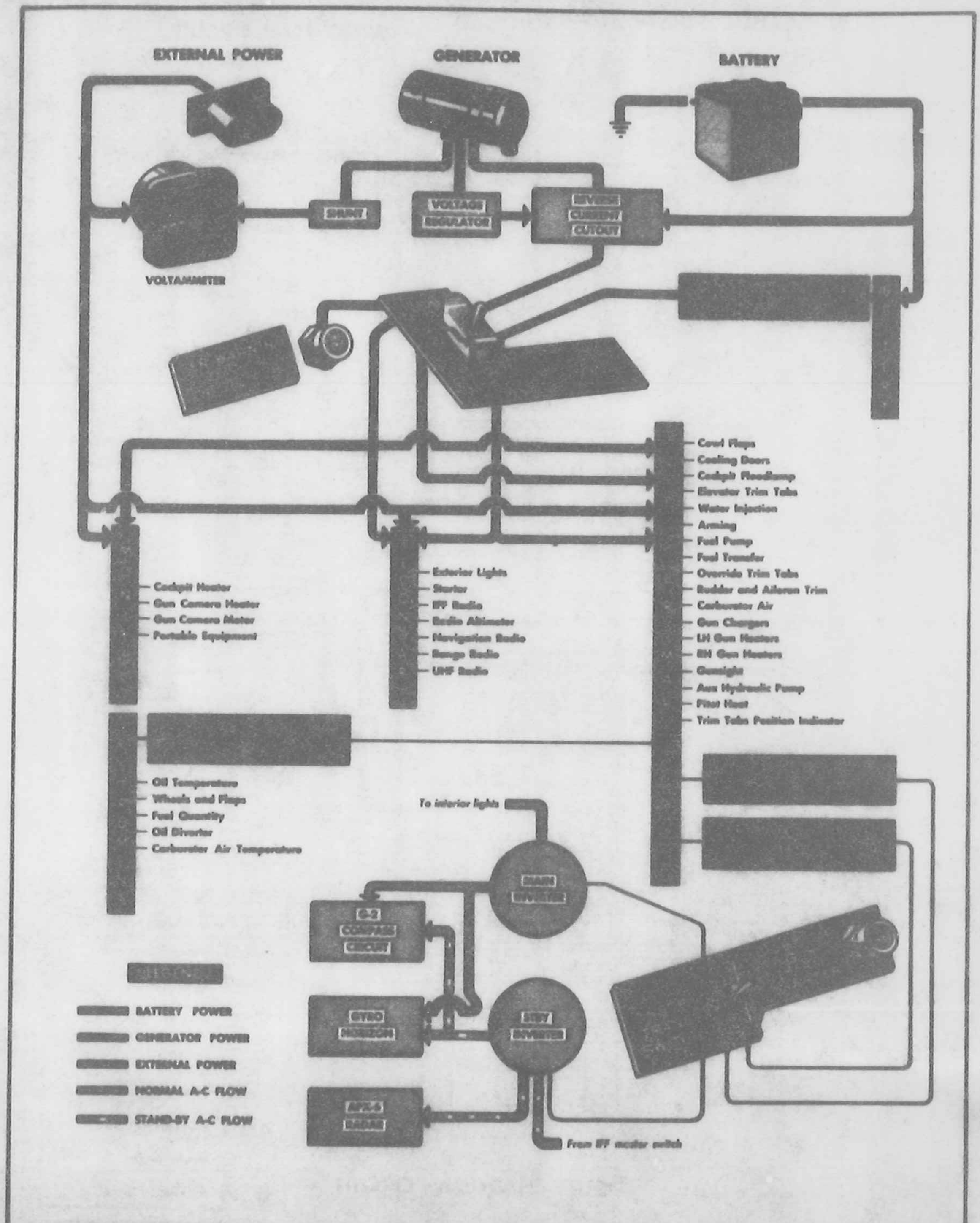


Figure 1–12. Electrical System Schematic Diagram

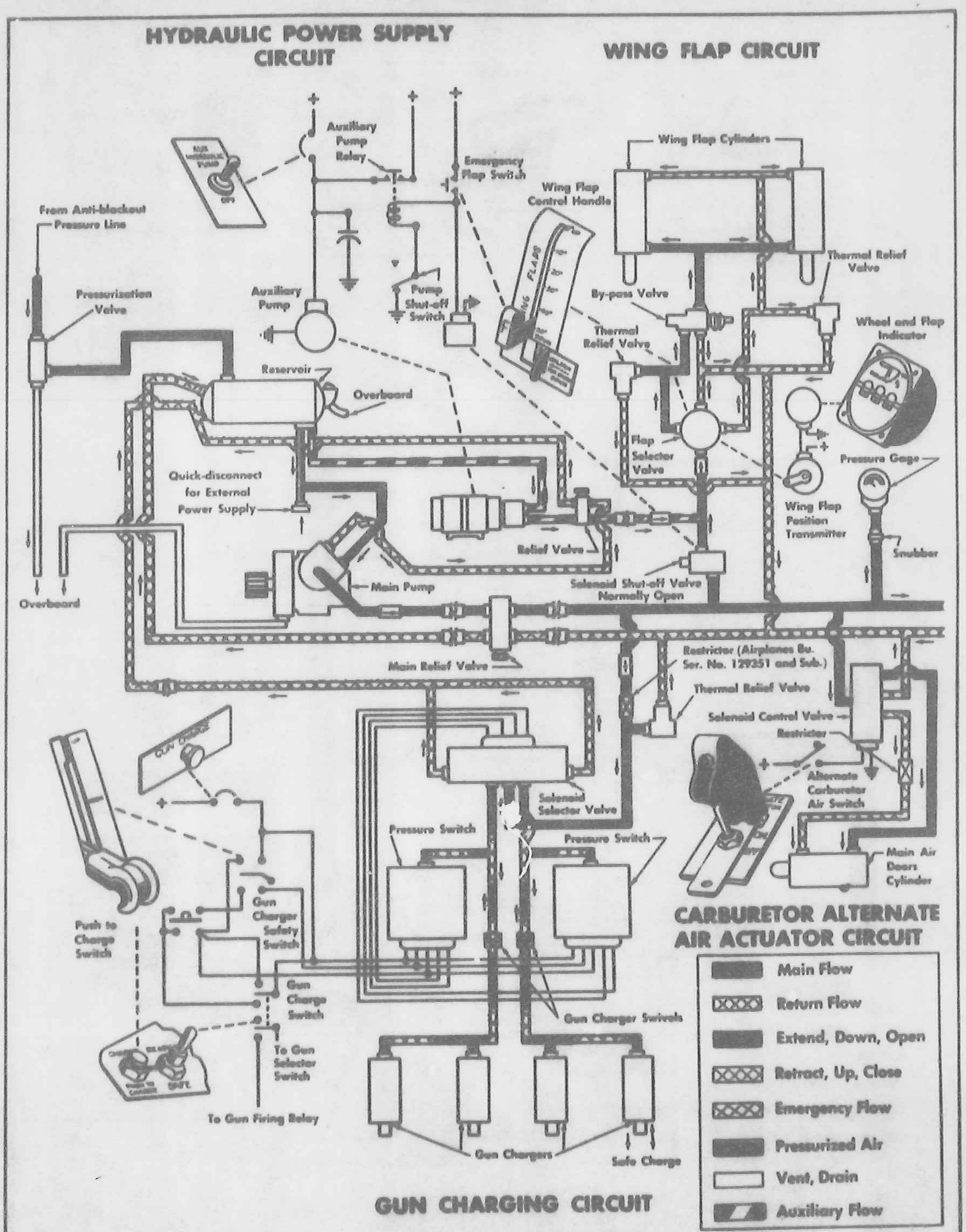


Figure 1–13. Hydraulic System Schematic Diagram (Sheet 1 of 2)

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80

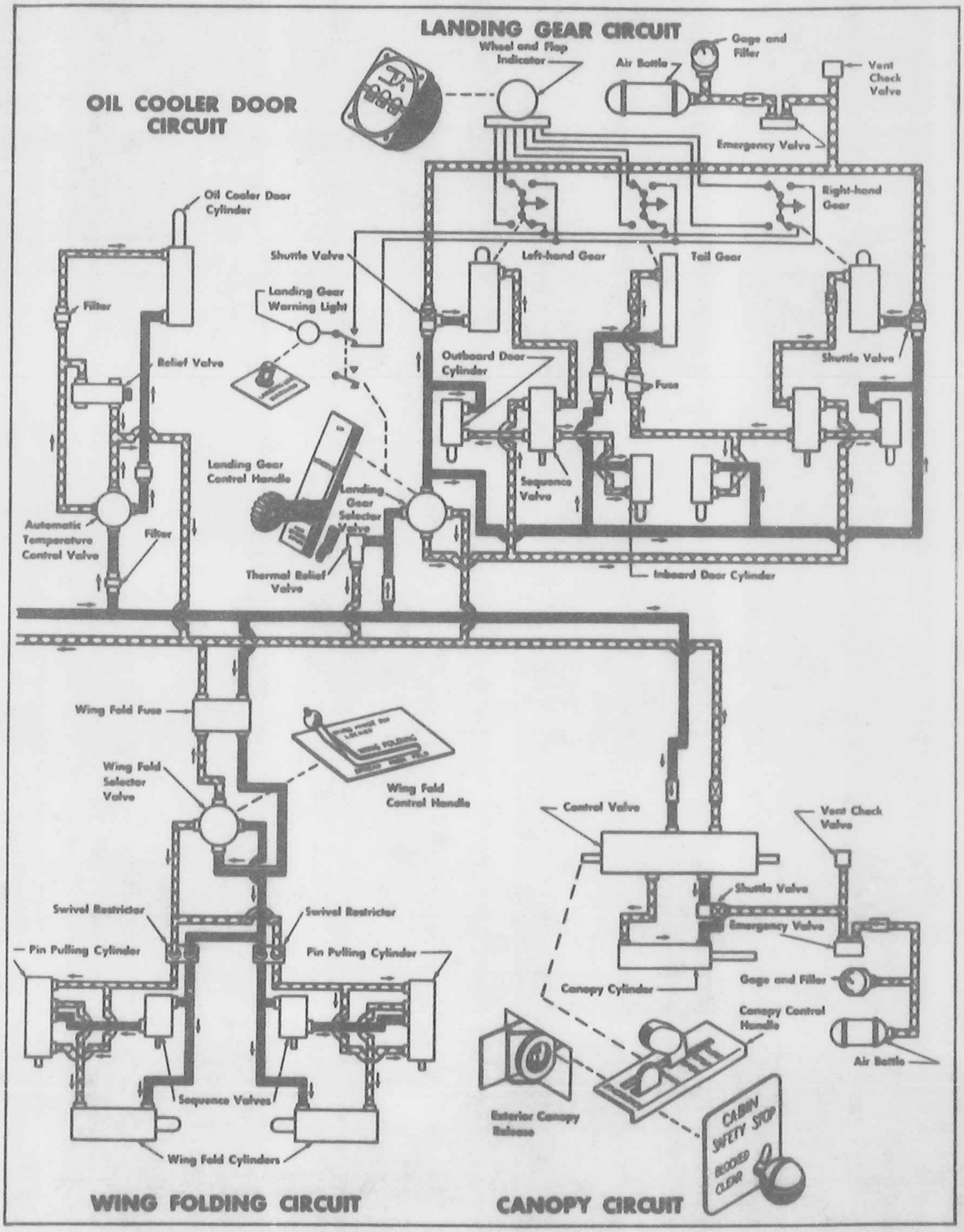


Figure 1–13. Hydraulic System Schematic Diagram (Sheet 2 of 2)

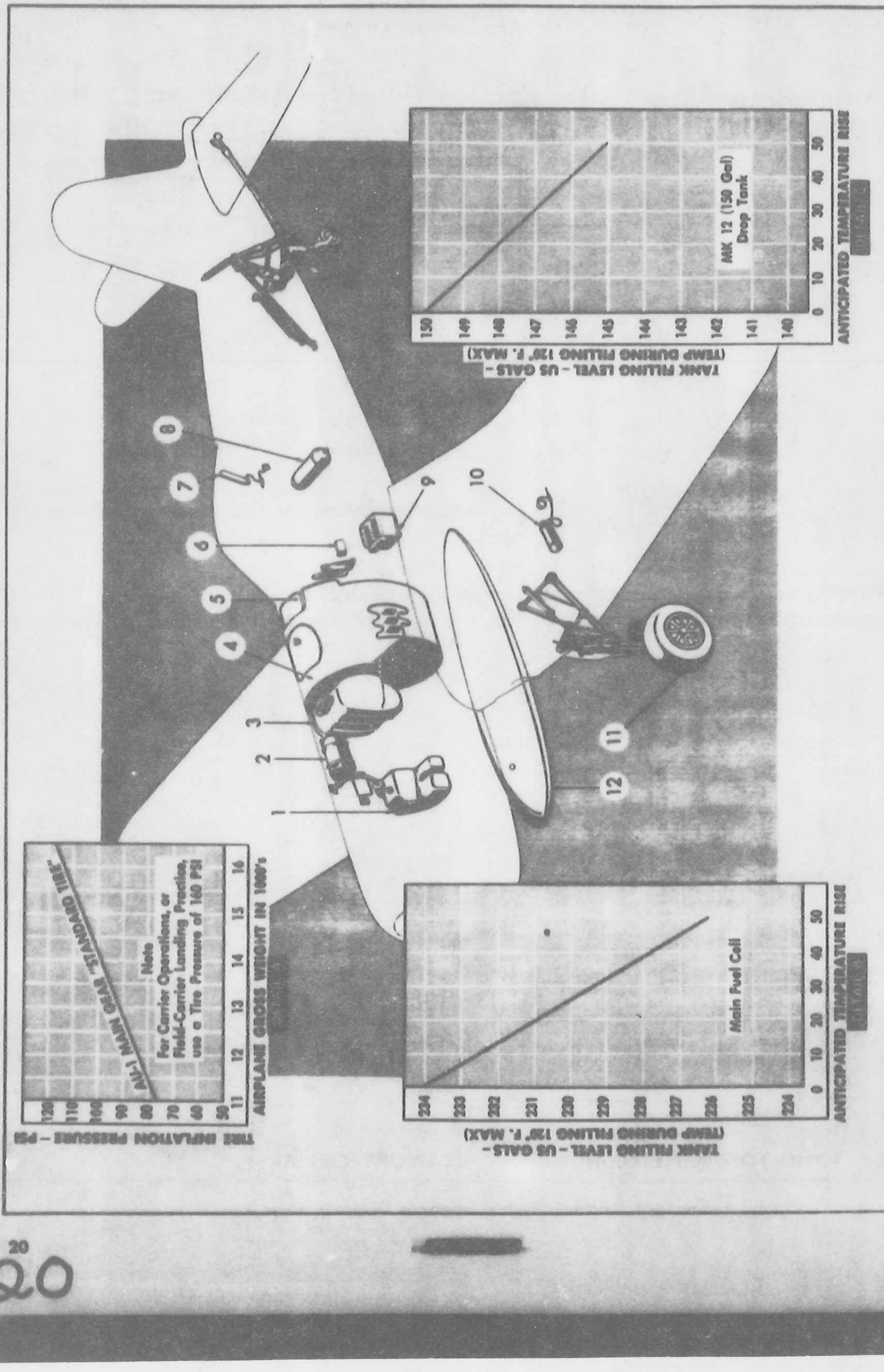
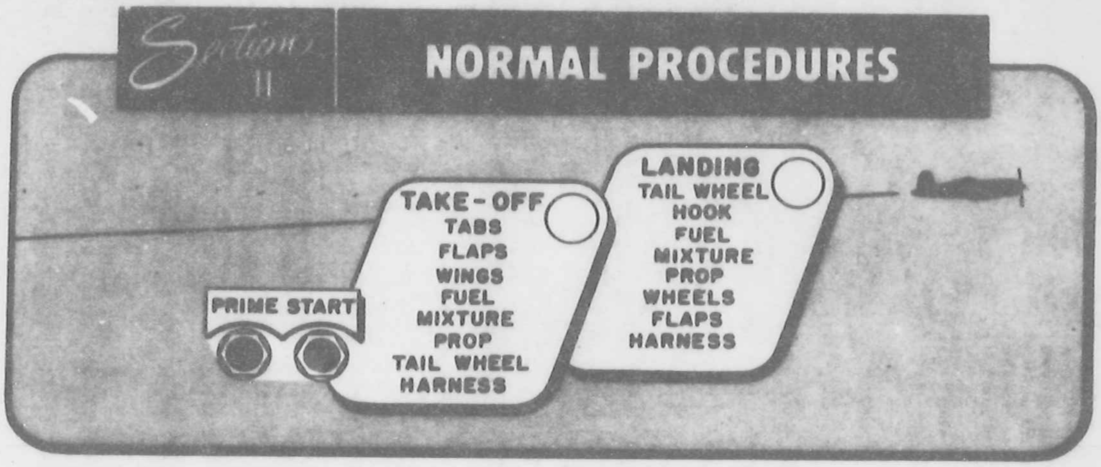


Figure 1-14. Servicing Diagram (Sheet 1 of 2)

ITEM	NAME	OPERATION
1	Water Tank	Fill water tank with 14 US gallons (11.65 Imperial or 52.99 liters) of MIL-A-6091 or AN-M-32 water injection fluid.
2	Hydraulic Reservoir	Fill hydraulic reservoir with 7.7 US gallons (6.4 Imperial gallons or 29.14 liters) of H-2 hydraulic fluid (MIL-F-7083).
3	Oil Tank	Fill oil tank with 27.5 US gallons (22.62 Imperial gallons or 104.09 liters) of MIL-L-6082A grade 1100 oil when average ambient temperature is above 50°F; grade 1065 oil when average ambient temperature is below 50°F.
4	Fuel Cell	Fill fuel cell with 234 US gallons (193.9 Imperial gallons or 885.8 liters) of MIL-F-5572 grade 115/145 fuel. Grade 100/130 fuel may be used as an alternate.
5	Grounding Jack	Connect fueling system ground line to jack or insert fuel nozzle into filler so that it makes good contact with airplane.
6	External Power Receptacle	Use external power for ground operation of electrical equipment. Power supply should be 2 KW, 28.5V direct current using an AN2551 plug.
7	Canopy Compressed Air Bottle	Replace emptied bottle and valve (CV4-601165) with bottle filled to capacity (30.6 cubic inches).
8	Oxygen Cylinder	Replace emptied cylinder (BuAer SK-1084-514) and valve (BuAer 9606) with cylinder filled to capacity (514 cubic inches).
9	Battery	Check specific gravity and water level. For normal operation, use one 24-amphhr battery (AN3151-2) or one 36-amphhr battery (AN3150-2). For cold weather operation, use two 24-amphhr batteries (AN3151-2) or one 36-amphhr battery (AN3150-2).
10	Landing Gear Compressed Air Bottle	Replace emptied bottle and valve (CV4-601162) with bottle filled to capacity (96 cubic inches).
11	Tires	Check and inflate tires to correct pressure. See Detail A.
12	External Fuel Tanks	Fill external fuel tank with 150 US gallons (124.85 Imperial gallons or 567.8 liters) of MIL-F-5572 grade 115/145 fuel. Grade 100/130 fuel may be used as an alternate.

Figure 1–14. Servicing Diagram (Sheet 2 of 2)



BEFORE ENTERING AIRPLANE.

FLIGHT RESTRICTIONS. Refer to section V for flight restrictions.

CRUISE CONTROL. Refer to the tables in the appendix for the data needed for flight planning.

WEIGHT AND BALANCE. Obtain the take-off and the anticipated landing weights. See that the required fuel, ammunition, bombs, and rockets have been loaded. Refer to the Handbook of Weight and Balance, AN 01-1B-40, for general information on loading; for specific information on tactical loading, refer to Form F.

EXTERIOR INSPECTION. Consult the yellow sheet for the status of the airplane. Refer to the inspection diagram (figure 2–1) for the exterior inspection procedure.

ENTRANCE. Two steps are provided on the right-hand side of the fuselage for entrance to the cockpit. The steps are extended with the landing gear but may be manually retracted by pushing up on the bottom step. If the steps are retracted, open the upper step with the hand; the bottom step will drop into place. The canopy is opened by pushing aft with the external handle. Do not use the external handle as a hand-grip when entering the cockpit.

ON ENTERING AIRPLANE.

On entering the airplane make the following checks:

Cockpit	Clean — no loose dirt, rags or tools
Windshield	Clean
Control lock	Removed
Parachute	Complete with parakit if over-water flight is anticipated
Parachute harness	On and fastened
Seat	Normal flight position
Shoulder harness	Fastened with lap belt
Microphone and head set	Connected to airplane receptacle
Rudder pedals	Adjusted to comfortable length
Controls	Free and correct movement
FUEL TRANSFER switch	"OFF"
AUXILIARY FUEL PUMP switch	"OFF"
OIL COOLER DOOR switch	"AUTOMATIC"
MASTER WATER INJECTION switch	"OFF"
Ignition switch	"OFF"
Armament switches	"OFF" or "SAFE"
GEN & BATT switch	"OFF"
Oxygen	Checked. (Refer to Oxygen System, Section IV.)

Note the manifold pressure gage reading for use in the engine test.

BEFORE STARTING ENGINE.

Have the propeller turned through 5 revolutions (20 blades). If external power is being used, it is recommended that this be done with the starter. The recommended fuel for this airplane is grade 115/145. Grade 100/130 may be used, subject to the limitations given in section V.

STARTING ENGINE.

The recommended procedure for starting the engine is with external power. In emergencies, the airplane bat-

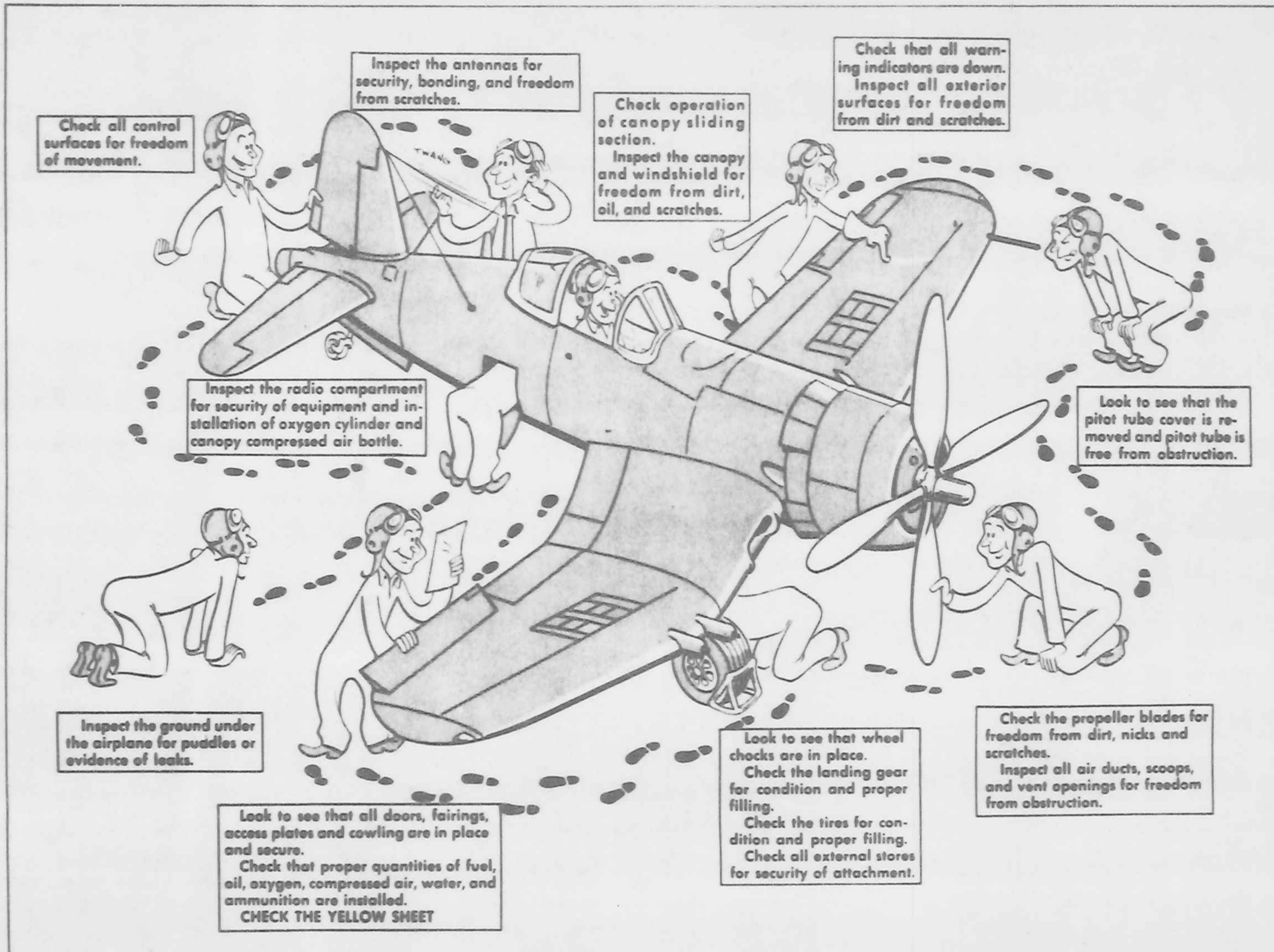


Figure 2–1. Exterior Inspection Diagram

tery may be used. To start the engine, proceed as follows:

PROPELLER control	Full "INCREASE"
MIXTURE control	"IDLE CUT-OFF"
THROTTLE control	Set to give 800 to 1,000 rpm
GEN & BATT switch	"OFF" if external power is to be used, "GEN & BATT" if battery is to be used
Fuel selector control	"ON"
AUXILIARY FUEL PUMP switch	"LOW" (Fuel pressure 10 to 12 psi)
Ignition switch	"OFF"

Energize the starter and after 2 revolutions (8 blades) turn the ignition switch "ON" and prime the engine. When the engine begins to fire regularly on prime, move the MIXTURE control *SLOWLY* to "AUTO-RICH." *Do not pump or move the throttle abruptly.* There will be a lapse of time, after moving the MIXTURE control to "AUTO-RICH," until the fuel feeds from the discharge nozzle; therefore, it is important to keep the engine firing steadily (at least 350 to 400 rpm) by using the prime switch until normal carburetion is established. If the engine stops firing, move the MIXTURE control to "IDLE CUT-OFF" and continue cranking and priming until the engine starts. Refer to section III for the procedure to follow in case of a fire. Idle the engine at 600 to 800 rpm until the oil pressure reaches a minimum of 25 psi. If the oil pressure does not register almost immediately, stop the engine. Normally, the engine should start in about 30 seconds. If the START switch is held on for 1 minute and the engine does not start, wait 3 to 5 minutes to allow the starter to cool and the excess fuel to drain from the intermediate rear section fuel drain before making a second attempt. After the second and successive starting failures, allow 5 minutes for starter cooling. The ground crew should check for fire in the exhaust pipe outlets. No trace of smoke from the upper exhaust pipe outlets indicates underpriming. Excessive black smoke from the exhaust pipe outlets indicates overpriming. If the engine is overprimed, clear the cylinders as follows:

MIXTURE control	"IDLE CUT-OFF"
AUXILIARY FUEL PUMP switch	"OFF"
Ignition switch	"OFF"
THROTTLE control	Full "OPEN"

Clear the engine by turning it through 4 revolutions with starter.

WARNING

Never allow a hot engine to be pulled through by hand.

ENGINE GROUND OPERATION.

Do not run the engine past 1,500 rpm with the wings folded and the jury struts removed. To warm up the engine, proceed as follows:

WARNING
Never Allow a Hot Engine to Be Pulled Through by Hand!

PROPELLER control	Full INCREASE
THROTTLE control	1,000 rpm minimum to prevent fouling plugs
AUXILIARY FUEL PUMP switch	"OFF" after the engine is turning over satisfactorily
MIXTURE control	"AUTO-RICH"
External power	Disconnected
GEN & BATT switch	"GEN & BATT"

Warm up the engine until the oil temperature reaches 40°C.

Note

When oil temperature is below 40°C, the OIL LOW-LEVEL warning light may be on. It should go off as soon as normal operating oil temperature is reached.

GROUND TESTS.

To test the airplane for satisfactory performance, proceed as follows:

Fuel selector control	"ON"
Radio altimeter	On, low-range
Hydraulic pressure gage	1,500 (±50) psi
Circuit breakers	In
UHF or VHF radio	On
IFF	On
WING FOLDING control	"WING HINGE PIN LOCKED"
Both wing-folding warning flags	Down

Check the GEN WARNING light while advancing the THROTTLE control. The warning light should go out above 1,400 rpm. As the throttle is advanced farther, the voltammeter should stabilize at approximately 27.5 volts. Reduce the THROTTLE control to 1,200 rpm. To check the stand-by inverter, turn off the AN/APX-6 IFF and place the AC INSTR TRANS switch in the "STBY" position. The INVERTER WARNING light should light up and remain on until the stand-by inverter picks up speed. Return the AC INSTR TRANS switch to "MAIN." Without stopping between positions, smoothly shift the supercharger to high ratio and after 2 minutes return the supercharger to low ratio to desludge the clutches. Close and open the canopy sliding section hydraulically and manually. Actuate the flaps through the normal positions, checking the flaps and indicator. If security permits, check the communication radio. If a night flight is anticipated, check the interior and exterior lights.

TAXIING.

Use S-turns while taxiing to gain forward vision. Use the brakes as sparingly as possible and reduce power when necessary to avoid taxiing too fast. Use the tail wheel lock when taxiing cross wind or behind other idling airplanes. Do not taxi behind an airplane whose engine is turning up any faster than idling speed.

WARNING

Before take-off, make sure that both wing-folding warning flags are down.

BEFORE TAKE-OFF.

IDLE MIXTURE CHECK.

THROTTLE control	400 to 550 rpm
PROPELLER control	Full "INCREASE"
MIXTURE control	"AUTO-RICH"
AUXILIARY FUEL PUMP switch	"LOW"

While observing the tachometer, place the MIXTURE control handle in the "IDLE CUT-OFF" position and back into "AUTO-RICH" before the engine dies. If a momentary rise of not more than 20 rpm is observed before normal drop-off, the mixture strength is correct. If a greater rise in rpm is noted, the mixture is too rich. If there is no rise in rpm, the mixture is too lean. A momentary drop in manifold pressure of 1/4 of an inch will indicate a momentary rise of 10 rpm. If the mixture indicated is not correct, combat or carrier operations should be prohibited until the trouble is remedied.

MAGNETO CHECK. To check the magnetos, set the THROTTLE control to give 2,200 rpm with the PROPELLER control in the full "INCREASE" position and the MIXTURE control in "AUTO-RICH." While watching the tachometer, move the ignition switch from "BOTH" to "R" and back to "BOTH." Move the ignition switch from "BOTH" to "L" and back to "BOTH." Normal drop-off in either the "R" or "L" position is 50 to 75 rpm and should not exceed 100 rpm. Difference in drop-off between "R" and "L" should not exceed 30 to 40 rpm. If the above conditions cannot be met, the ignition system is defective and the airplane should be grounded until the trouble is remedied.

WARNING
Before Take-off Make Sure Both Wing Fold Warning Flags Are Down!

IGNITION SAFETY CHECK. To check the ignition, set the THROTTLE control to give 1,000 rpm with the PROPELLER control in the full "INCREASE" position and the MIXTURE control in "AUTO-RICH" position. Move the ignition switch from "BOTH" to "OFF" and immediately back to "BOTH." The engine should cut out while the switch is in the "OFF" position. If engine does not cut out, the ignition system is defective and airplane should be grounded.

PROPELLER CHECK. To check the propeller governor, set the THROTTLE control to give 2,000 rpm with the PROPELLER control in the full "INCREASE" position and MIXTURE control in "AUTO-RICH." Move the propeller control to the full "DECREASE" position. The engine speed should drop to 1,200 rpm. Return the PROPELLER control to full "INCREASE." Engine speed should return to 2,000 rpm. If these rpm are not obtained, the propeller governor is defective and the airplane should be grounded until the trouble is remedied.

ENGINE CHECK.

THROTTLE control	Set to give manifold pressure equal to local barometric pressure (manifold pressure before starting engine)
PROPELLER control	Full "INCREASE"
Fuel pressure gage	21 to 23 psi
Oil pressure	85 psi
Oil temperature	40°C to 85°C
Cylinder temperature	150°C
Tachometer	2,000 to 2,200 rpm

If the above conditions are not met, the engine is not delivering full power and the airplane should be grounded until the trouble is remedied.

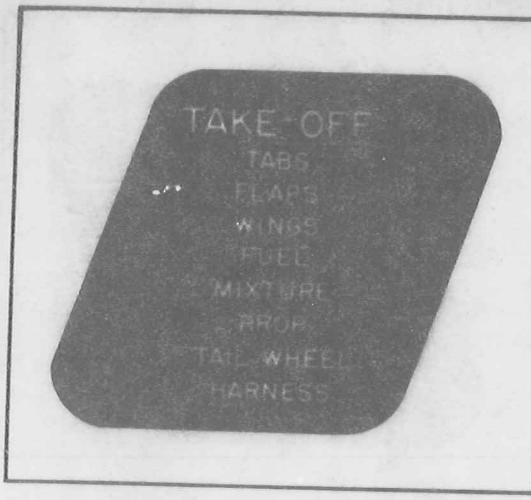


Figure 2-2. Take-off Check List

COCKPIT CHECK.

- TAIL WHEEL control .... "LOCK"
- Fuel selector .... "ON"
- FUEL TRANSFER SWITCH .... "OFF"
- AUXILIARY FUEL PUMP switch .... "HIGH"
- Rudder tab .... 6 degrees "NOSE RIGHT"
- Elevator tab .... 2 degrees "NOSE UP" with no flap; 3 to 4 degrees "NOSE UP" with full flap
- Aileron tab .... 4 degrees "RIGHT WING DOWN"

Note

To obtain accurate readings on the tab position indicator, the GEN WARNING light must be off.

- OIL COOLER DOOR switch .... "AUTOMATIC"
- WING FLAPS control .... As desired
- SUPERCHARGER control .... "LOW"
- MIXTURE control .... "AUTO-RICH"
- PROPELLER control .... Full "INCREASE"
- Friction adjustment control .... Set to prevent the THROTTLE control from creeping back
- MASTER WATER INJECTION switch .... "OFF"
- AC INSTR TRANSFER switch .... "MAIN"
- G-2 compass .... Set to magnetic heading of airplane
- HOOK control .... "UP"
- GEN & BATT switch .... "GEN & BATT"
- WING FOLDING control .... "WING HINGE PIN LOCKED"
- TAKE-OFF check list .... All items checked
- Shoulder harness control .... "LOCKED"
- Cabin control handle .... "OPEN"

TAKE-OFF.

NORMAL. With the brakes held and the control stick full back, advance the THROTTLE control to give approximately 2,400 rpm. Release the brakes and advance the THROTTLE control to take-off power as the airplane starts to roll. As the speed increases, use forward control stick pressure to raise the tail. At about 80 knots, start easing back on the control stick.

Note

Take-off power is the same as military power. See figure A-19 for engine operation information.

MINIMUM RUN. For a minimum run take-off, use a full 50 degrees of flap. Start the control stick back at approximately 75 knots.

OBSTACLE CLEARANCE. If an obstacle is to be cleared after a take-off, use 30 degrees of flap and retract the landing gear as soon as airborne.

AFTER TAKE-OFF.

LANDING GEAR. After the airplane is airborne and insufficient runway remains for an emergency landing, apply the brakes to stop wheel spin, and retract the landing gear. Braking the wheels prevents damage to the scuff plate in the wheel wells.

THROTTLE AND PROPELLER. When all obstacles have been cleared, reduce the THROTTLE control to the normal rated power position (figure A-5) and reduce engine rpm to 2,600 rpm.

NOTE
When the Flaps Are Used on Take-off They Should Be Raised As Soon As a Safe Altitude and Speed Are Reached!

FLAPS. Raising the flaps with the airplane at too slow an airspeed will cause dangerous settling of the airplane; however, the best rate of climb is with the flaps up. When the flaps are used on the take-off, they should therefore be raised as soon as a safe altitude and speed are reached.

MIXTURE. After the wheels and flaps are raised, place the MIXTURE control in the "AUTO-LEAN" position.

FUEL SYSTEM. After a take-off, if external tanks are carried, the FUEL TRANSFER switch should be placed in either the "LEFT TANK" or "RIGHT TANK" position and the AUXILIARY FUEL PUMP switch should be placed in the "LOW" position.

CLIMB.

After a take-off at normal gross weight, trim the airplane for best climb at 150 knots with 41.5-inch manifold pressure and 2,600 rpm for normal rated power or 58-inch manifold pressure and 2,800 rpm for military rated power. Refer to figures A-8, A-9, A-10, and A-11 for reductions in airspeed for best climb as altitude increases. Watch cylinder head and oil temperatures for overheating, particularly when centerline pylon is installed. Refer to section V for temperature limitations.

FLIGHT CHARACTERISTICS.

Refer to section VI for the flight characteristics of this airplane.

SYSTEMS OPERATION.

Refer to section VII for operation of the systems while in flight.

DESCENT.

Before a prolonged descent at reduced power (20-inch manifold pressure, minimum), place the MIXTURE control in the "AUTO-RICH" position. During the descent, advance the THROTTLE control occasionally to clear the engine. Watch the cylinder head temperature for overcooling. To prevent the engine cutting out at the end of a descent, advance the THROTTLE control slowly, well in advance of need.

TRAFFIC PATTERN CHECK.

See figure 2–3 for landing check list and figure 2–4 for typical landing pattern diagram.

On entering the traffic pattern, make the following checks:

TAIL WHEEL control	"LOCK" for field, "UNLOCK" for carrier
Fuel selector control	"ON" (main tank)
AUXILIARY FUEL PUMP switch	"HIGH"
FUEL TRANSFER switch	"OFF"
Cowl flaps	Open for field, closed for carrier
MASTER WATER INJECTION switch	"OFF"
Armament switches	"OFF" or "SAFE"
Shoulder harness control	"LOCKED"

Figure 2–3. Landing Check List

Seat	Normal flight position
WING FLAPS control	As required
SUPERCHARGER control	"LOW"
PROPELLER control	Full "INCREASE"
MIXTURE control	"AUTO-RICH"
WHEELS control	"DOWN"
Wheel position indicator	Down
CABIN CONTROL (canopy)	"OPEN"
Arresting HOOK control	"UP" for field, "DOWN" for carrier

At night the following additional checks should be made:

Exterior lights	All BRIGHT
Interior lights	FLT and NON-FLT on

WAVE-OFF.

In the event of a wave-off, advance the THROTTLE control promptly but smoothly. Raise the wheels and open the cowl flaps at once. Raise the wing flaps as soon as a safe speed and altitude have been reached. Retrim the airplane.

LANDING.

FIELD. The airplane will make either wheel or three-point landings. Care must be exercised to avoid over-correcting, since the controls remain effective through the early part of the landing run.

CROSS-WIND LANDING. When a cross-wind landing must be made, use not more than 30 degrees of wing flap and make a wheel landing. Avoid weather cocking by use of the rudder and brakes.

MINIMUM RUN LANDING. To make a minimum run landing, use full-flap, nose-high power approach. Bring the airplane in over the runway at a minimum safe altitude, close the throttle, and land. Use the brakes as necessary. Refer to figure A-20 for the landing distances for various conditions.

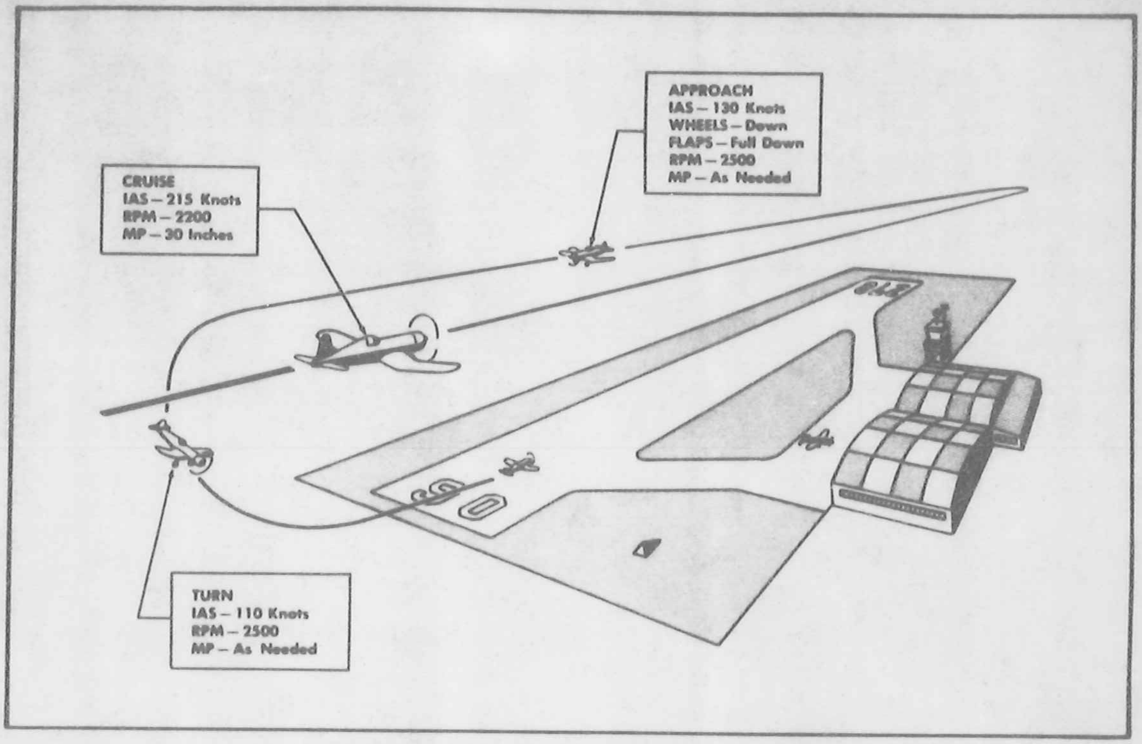


Figure 2–4. Typical Landing Pattern Diagram

AFTER LANDING.

After the landing run has slowed, raise the flaps and unlock the tail wheel.

STOPPING ENGINE.

AUXILIARY FUEL PUMP switch...................."OFF"
OIL COOLER DOOR switch............"AUTOMATIC"
WING FLAPS control ...."UP"
PROPELLER control ....Full "INCREASE"
MIXTURE control ...."IDLE CUT-OFF"
Ignition switch...................."OFF" after engine stops turning over
THROTTLE control................................."CLOSED"

CAUTION

Leaving the THROTTLE control in "OPEN," particularly in cold weather, may cause the manifold pressure regulator to stick in the increase position, and may cause an engine runaway at next start.

BEFORE LEAVING AIRPLANE.

Fuel selector control..................................."OFF"
FUEL TRANSFER switch................................"OFF"
GEN & BATT switch......................................"OFF"
Auxiliary switches (radio, lights, etc.)............"OFF"
Oxygen air control valve............."100% OXYGEN"
Control lock ....Installed if the airplane is to be parked for an extended period
Jury struts..................In place if the airplane is to be parked with wings folded where exposed to wind or propeller blast
Canopy sliding section.............................Partially open
Yellow sheet ....Filled out and signed

After the engine has cooled, the cowl flaps may be closed by the following procedure:

GEN & BATT switch........................."GEN & BATT"
COWL FLAPS OVERRIDE switch......"OVERRIDE"
COWL FLAP switch..............."CLOSED" until flaps are closed
GEN & BATT switch............"OFF" before releasing the COWL FLAPS OVERRIDE switch

The flaps will open again when the GEN & BATT switch is placed in the "GEN & BATT" position. If the engine cover is to be installed, pull out COWL FLAPS circuit breaker to prevent opening of cowl flaps before covers are removed.

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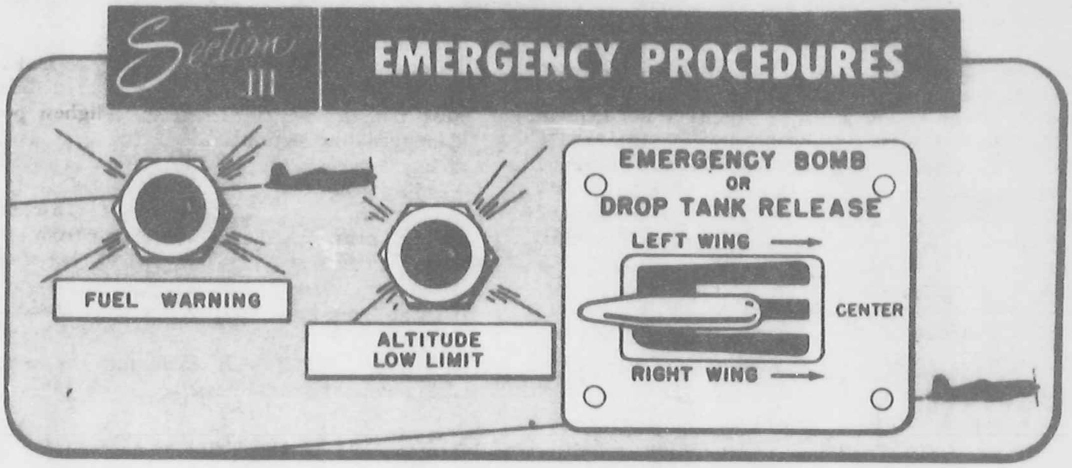
Section III EMERGENCY PROCEDURES



ENGINE FAILURE.

DURING TAKE-OFF. If the engine fails during a take-off before leaving the ground, close the THROTTLE and use the brakes as required. If the engine fails immediately after clearing the runway, drop the nose to hold flying speed, close the THROTTLE, and land straight ahead, turning only enough to avoid obstacles. As many as possible of the following operations should be completed before landing.

External tanks or bombs	Manually released
Landing gear	Up
Flaps	Full down
Seat	Lowered
GEN & BATT switch	"OFF"
Ignition switch	"OFF"
Fuel selector	"OFF"

SEIZURE DURING FLIGHT. If the engine seizes during flight and the propeller stops, turn on the auxiliary hydraulic pump to gain hydraulic pressure for operating the flaps and the landing gear.

POWER LOSS DURING FLIGHT. If there is a loss of power with the propeller turning, check the fuel pressure. If the fuel pressure has dropped considerably below normal and external tanks are carried, switch the fuel selector valve to another tank and proceed as follows:

AUXILIARY FUEL PUMP switch	"HIGH"
THROTTLE control	¼ "OPEN"
MIXTURE control	IDLE CUT-OFF until fuel pressure is built up
PRIME switch	Depress, if necessary

If external tanks are not carried and the fuel pressure drops, causing loss of power, place the AUXILIARY FUEL PUMP switch in the "HIGH" position.

MAXIMUM GLIDE. For maximum glide, drop any external load and hold an airspeed of 140 knots with the landing gear and flaps up, which will give a gliding ratio of approximately 14 to 1. With the landing gear and flaps down, hold an airspeed of 85 knots, which will give a gliding ratio of approximately 5 to 1.

PROPELLER FAILURE.

The only anticipated propeller malfunction is that due to a propeller governor failure. If there is governor failure resulting in overspeeding, retard the THROTTLE and PROPELLER controls. If there is a loss of rpm, try to increase rpm by advancing the PROPELLER and the THROTTLE controls. In cases of propeller governor failure where sustained flight is possible, treat the landing as an emergency, as power may not be available to take a wave-off.

FIRE.

ENGINE. If an induction system fire should break out while starting the airplane, keep the engine running. The fire will probably be drawn into the cylinders. If this should fail, have the ground crew apply carbon dioxide and stop the engine. If an engine fire breaks out in flight, the pilot must decide from the intensity of the fire, the altitude, and the terrain below, whether he will bail out or stay with the airplane. If it is decided to try to stay with the airplane and put out the fire, stop the engine using the following procedure:

Fuel selector control	"OFF"
AUXILIARY FUEL PUMP switch	"OFF"
MIXTURE control	"IDLE CUT-OFF"
THROTTLE control	Full "CLOSED"
Ignition switch	"OFF"
COWL FLAP switch	"OPEN" until flaps are full open
IFF MASTER switch	"EMERGENCY"

If the fire goes out, do not attempt to restart the engine.

FUSELAGE OR WING. In case of a fire in the aft fuselage or a wing, prepare to abandon the airplane.

ELECTRICAL. In case of an electrical fire, which usually can be recognized by a characteristic acrid odor and white smoke, place the GEN & BATT switch in the "OFF" position and pull out all the circuit breaker buttons, starting with BATTERY CONTROL. After all circuit breakers are opened, place the GEN & BATT switch in the "GEN & BATT" position and depress IFF RADIO, IFF OR STANDBY INVERTER, MAIN INVERTER, and UHF RADIO circuit breaker buttons. Place the IFF MASTER switch in the "EMERGENCY" position. If the fire diminishes, other circuit breaker buttons may be depressed as the equipment is needed.

Note

If a circuit breaker button does not stay in, do not hold it in.

SMOKE ELIMINATION. If smoke fills the cockpit, reduce speed below 260 knots and open the canopy sliding section. Use oxygen mask with "100% OXYGEN."

LANDING EMERGENCIES.

GEAR RETRACTED. If a landing is to be made with the landing gear retracted, the following procedure should be observed:

External tanks or bombs	Released
Landing flaps	Down as needed
Shoulder harness	Locked
Seat	Normal flight position
Canopy	Full open
Fuel TANK PRESSURE release	"DUMP"

If power is available, make a power-on approach and land in a normal landing attitude.

GEAR PARTIALLY RETRACTED. If the landing gear cannot be raised or extended from a partially retracted position, make a power-on approach and land in a normal landing attitude.

FLAT TIRE. If there is a possibility that a tire is flat, a one-wheel landing should be made on the good tire. Hold the flat tire off of the ground as long as possible. Do not use the brakes until the flat tire touches, then balance the drag of the flat tire with the brake of the opposite wheel.

SOFT GROUND. When a landing must be made where there is a possibility of the ground being soft enough to cause a nose-over, make a gear-retracted landing.

EMERGENCY ENTRANCE. When the canopy sliding section has been left closed with the CABIN CONTROL in the "CLOSE" position, entrance from the outside may be gained by opening the small emergency door located forward of the handgrip on the right-hand side of the fuselage, pulling the emergency release ring and pushing the canopy aft by means of the external handle.

DITCHING.

GENERAL. The decision whether to ditch the airplane or to bail out must be left to the pilot. The airplane may be ditched satisfactorily; therefore, the altitude and location of the airplane, and the other circumstances of the emergency will be the deciding factors.

PREPARATION.

External bombs or tanks	Released
Parachute	Unbuckled
Shoulder harness	Locked
Seat	Highest position
Canopy sliding section	Open
Wing flaps	Down
Landing gear	Up
Anti-g suit	Disconnected
Oxygen mask	Disconnected from airplane breather tube
Head set	Disconnected
Heated flying suit	Disconnected
IFF MASTER switch	"EMERGENCY"

LANDING TECHNIQUE. Head into the wind and make a normal attitude landing, with power on if power is available.

EXIT. Leave the airplane immediately, taking the parakit.

BAIL-OUT.

Bail-out procedures for this airplane are similar to those for any low-wing propeller-driven airplane; the pilot may either dive out over the trailing edge of the wing, or roll the airplane over and drop out. If a bail-out is to be made at an oxygen altitude, place the air valve control in the "100% OXYGEN" position and inhale deeply several times before leaving the airplane. To bail out, proceed as follows:

Parachute	Buckled securely
Anti-g suit	Disconnected
Oxygen mask	Disconnected from airplane breather tube
Head set	Disconnected
Heated flying suit	Disconnected
IFF MASTER switch	"EMERGENCY"
Canopy sliding section	Open
Seat	Highest position
Shoulder harness and lap belt	Released

Slow the airplane as much as possible and then leave promptly. If the roll-over technique is used, trim the airplane "NOSE DOWN" before roll to help hold the airplane in inverted flight.

OXYGEN SYSTEM EMERGENCY OPERATION.

If symptoms occur which suggest the onset of anoxia, immediately depress the SAFETY PRESS button. If for any reason the regulator becomes inoperative and a constant pressure or flow of oxygen is not obtained by use of safety pressure, disconnect the breathing tube, use the oxygen bail-out equipment, and descend below 10,000 feet.

Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, regardless of the altitude, the air valve should be set at "100% OXYGEN" position and undiluted oxygen should be used until danger is passed or the flight is completed.

If it is necessary to remove the mask from the face for a short time 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.

Do not exhaust oxygen supply below 300 psi except in an emergency.

FUEL SYSTEM EMERGENCY OPERATION.

TRANSFER FAILURE. If there is a failure of the fuel transfer system, proceed as follows:

FUEL TRANSFER switch........"OFF"
Fuel selector control........Desired stand-by position

Do not take off with the fuel control in either stand-by position. While operating with the fuel selector control in either stand-by position, operation will probably be unsatisfactory above 12,000 feet. Keep an accurate mental check on the amount of fuel remaining. If there is sufficient altitude available, use a tank until the fuel pressure starts to fluctuate. DO NOT run a tank dry below 3,000 feet because fuel pressure will be lost and there will not be sufficient time to restart engine.

FUEL PRESSURE LOSS. If an auxiliary tank runs dry with the fuel control handle in a stand-by position, the fuel pressure may be regained by proceeding as follows:

Fuel selector control........"ON" (main tank)
Auxiliary fuel pump........"HIGH"
Throttle........¼ Open
Mixture control........"IDLE CUT-OFF until approximately 6-psi fuel pressure is built up
Airplane........Steep glide
PRIME switch........Depress, if necessary

FUEL PUMP FAILURE. If the engine-driven fuel pump fails, proceed as follows:

Auxiliary fuel pump........"HIGH"
Fuel selector control........"ON" (main tank)

ELECTRICAL SYSTEM EMERGENCY OPERATION.

If there is a generator failure, as indicated by the GEN WARNING light, all nonessential electrical equipment should be turned off before placing the GEN & BATT switch in the "BATT ONLY" position. Any piece of equipment which does not have an off-on switch may be turned off by pulling out its circuit breaker button. If there is a main inverter failure, as indicated by the inverter warning light and by failure of the G-2 compass and gyro horizon, place AC INSTR TRANS switch in the "STBY" position.

Note

The IFF radar system will not operate when the AC INSTR TRANS switch is in the "STBY" position.

HYDRAULIC SYSTEM EMERGENCY OPERATION.

The auxiliary hydraulic pump may be used to build up hydraulic pressure if the main system pressure drops. The primary use of the emergency hydraulic system is to operate the wing flaps in case of a main hydraulic failure. If the main system failure is due to a loss of fluid, there will be enough fluid available for one emergency operation only; therefore, if the emergency hydraulic system is used to actuate some other component, there will be no fluid left to lower the flaps.

FLIGHT CONTROL EMERGENCY OPERATION.

If there is a loss of flight control, it may be possible to keep the airplane in the air by using the trim tabs. Before deciding to attempt a landing after an indication of even slight damage to a control system, make a simulated landing, at an altitude permitting bail-out, to test control response. Do not try landing the airplane with tabs alone.

LANDING GEAR SYSTEM EMERGENCY OPERATION.

RETRACTION. Mechanical down locks prevent the retraction of the landing gear as long as the weight of the airplane is on the gear. If the landing gear control is inadvertently placed in the "UP" position before a take-off, the gear will not retract after take-off until the control is first placed in the "DOWN" position and then moved back to the "UP" position.

EXTENSION. To extend the landing gear when normal procedure fails, proceed as follows:

Speed........110 knots
WHEELS control........"EMERGENCY DOWN"

CAUTION

Do not attempt to retract the landing gear after use of the emergency air system because damage to the hydraulic reservoir will result.

If the landing gear will not extend with compressed air, reset the WHEELS control to the "DOWN" position and turn on the auxiliary hydraulic pump.

CAUTION

If the failure is due to a lack of hydraulic fluid, extending the landing gear with the emergency pump will use the emergency fluid, and there will be none left to lower the wing flaps.

WING FLAP EMERGENCY OPERATION.

When there is insufficient hydraulic pressure to operate the wing flaps, proceed as follows:

Airspeed........100 knots
WING FLAPS control........"EMERG DOWN"

The flap extension will be a full 50 degrees. If the loss of hydraulic pressure is caused by a loss of fluid, there will be only enough fluid available for one emergency extension of the wing flaps. The wing flaps are designed to start "blowing up" at 100 to 115 knots. If the "blow-up" feature is inoperative, restrict airspeed to 130 knots with the flaps fully extended.

CANOPY SLIDING SECTION EMERGENCY OPERATION.

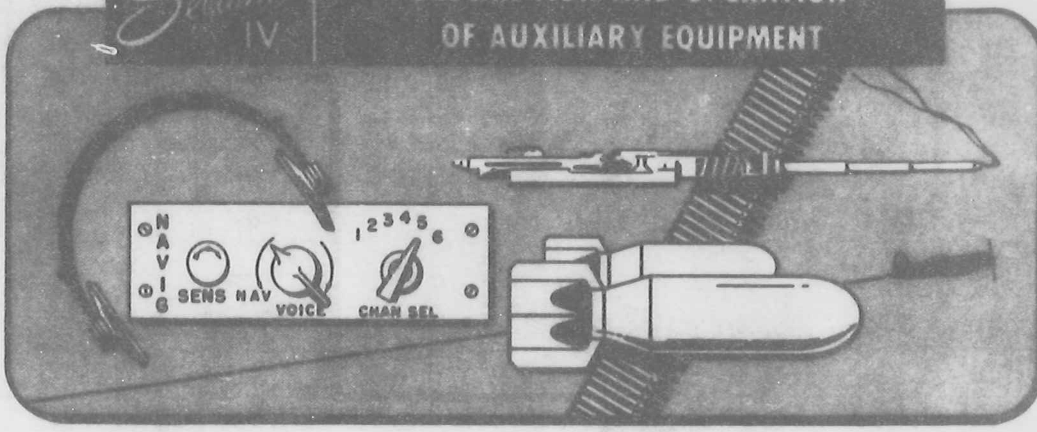
INTERIOR. To open the sliding section from the cockpit in an emergency, move the cabin control latch inboard and pull the CABIN CONTROL aft into the "EMERGENCY" position.

EXTERIOR. To open the sliding section from the outside when the control handle is in the "CLOSE" or "STOP" position, open the emergency panel below the cockpit on the right-hand side of the fuselage, and pull the ring. The canopy sliding section can then be opened by pushing it aft.

OIL SYSTEM EMERGENCY OPERATION.

A loss of engine oil will be signalled by the oil low-level warning light. When the light goes on, place the guard-covered OIL COOLER by-pass switch in the "BY-PASS" position and prepare to make an emergency landing. If the leakage is in the oil coolers, no more oil will be lost and the airplane can be kept in the air if power is reduced to prevent exceeding the temperature limits. If oil is being lost at another point, the oil level will continue to drop and engine failure will result.

Section IV — DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT



HEATING AND VENTILATING.

Fresh air for ventilation is taken through an inlet in the left-hand wing root and is passed through a fuel-fed heater (figure 4–1) to the cockpit. The distribution of fresh air in the cockpit is controlled by an AIR DISTRIBUTOR control (12, figure 1–7) and a DEFOGGER AIR control (14, figure 1–7) located above the right-hand control shelf. The AIR DISTRIBUTOR control has four positions: "VENT" for ventilator flow only, "W'DSH'LD" for windshield flow only, "W'DSH'LD & VENT" for both, and "OFF." The DEFOGGER AIR control has maximum and minimum air flow positions marked "MAX" and "MIN." The ventilator (8, figure 1–4), located below the rudder pedals, has two foot-operated controls. The right-hand foot control adjusts the amount of air flow. Rotating the control forward opens the ventilator and rotating the control aft closes it. The left-hand foot control adjusts the direction of the air flow forward and aft. When heating is desired, the HEATER switch adjacent to the AIR DISTRIBUTOR control is placed in the "ON" position. The heater will not operate until the air-speed of the airplane reaches 120 knots. Two thermal switches are incorporated in the heater circuit. One thermal switch controls ignition and fuel cycling to maintain heater outlet temperature below 250°F. The other thermal switch shuts off heater operation if a heater malfunction permits the outlet temperature to reach 350°F.

PITOT TUBE HEAT.

The pitot tube heat is used to prevent the forming of ice on the pitot tube head. The PITOT HEAT switch (8, figure 1–7) is located on the right-hand control shelf outboard of the OIL DILUTION switch.

Table I. Communication and Associated Electronic Equipment

Type	*Designation*	*Function*	*Range*	*Location of Controls*
UHF Communication	AN/ARC-27	Two-way voice communication	Line of sight	RH control shelf
VHF Communication (may be substituted for AN/ARC-27)	AN/ARC-1	Two-way voice communication	Line of sight	RH control shelf
Low-frequency Navigation	AN/ARC-5	Receives radio range signals	20 to 200 miles	RH control shelf
Homing Navigation	AN/ARR-2A	Receives homing signals	Line of sight	RH control shelf
Radio Altimeter	AN/APN-1	Indicates altitude from ground to airplane	0 to 4,000 feet	RH control shelf and instrument panel
IFF Identification	AN/APX-6	Identifies airplane for interrogating stations	Line of sight	RH control shelf

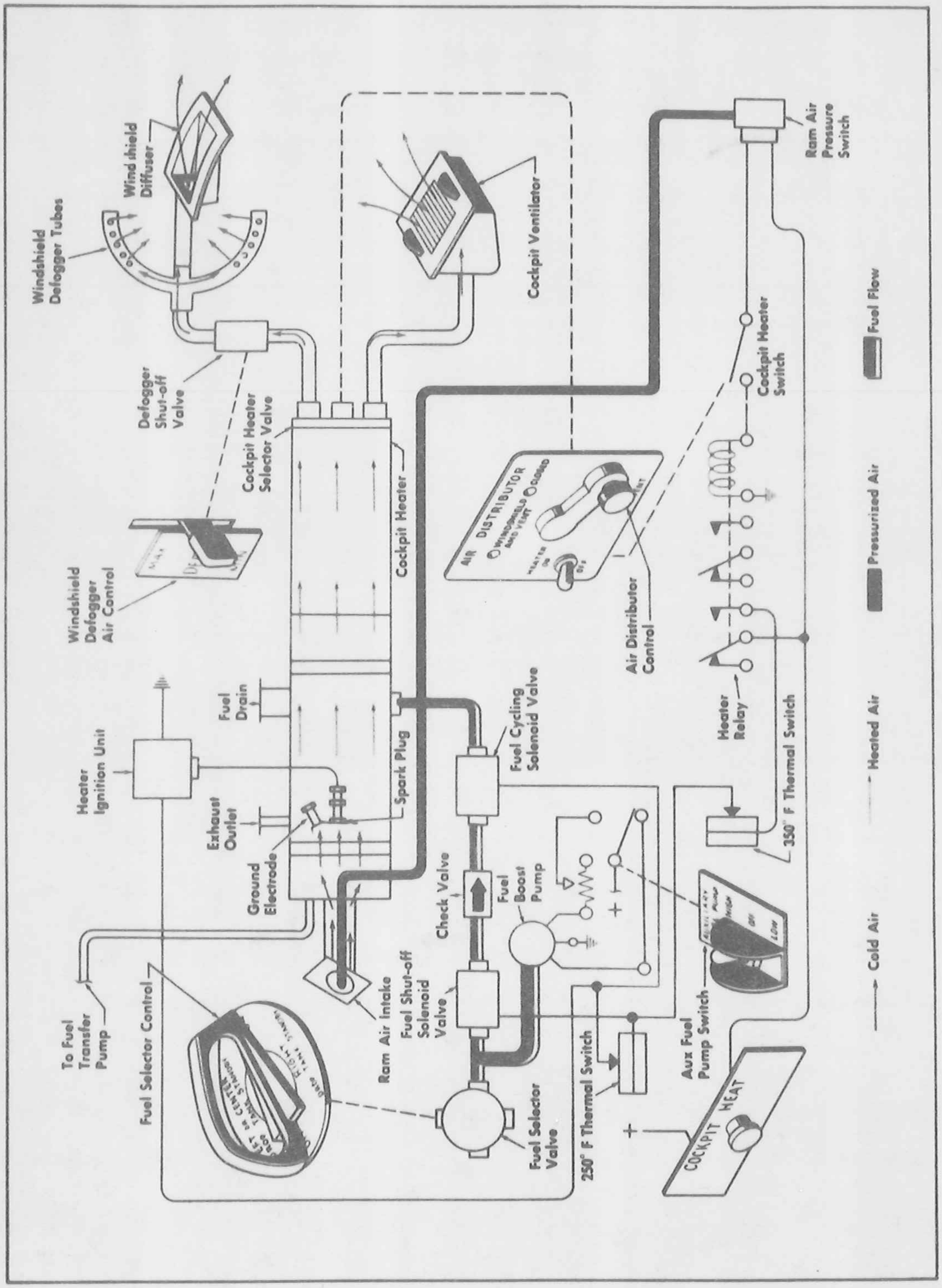


Figure 4-1. Heating and Ventilating System Diagram

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

GENERAL. *(See figure 4–2.)* Either AN/ARC-1 vhf or AN/ARC-27 uhf equipment may be installed in the airplane. When the AN/ARC-1 equipment is installed, a master radio control panel is added to the right-hand control shelf. The master radio control must be turned on before the communication, radio range, and navigation equipment can be operated. The GEN & BATT switch on the right-hand control shelf inboard of the starter switch must be in the "GEN & BATT" or "BATT ONLY" position to operate any of the electronic equipment in flight or in taxiing. With external power connected, the electronic equipment may be operated with the GEN & BATT switch in the "OFF" position. The microphone and headphone receptacle (18, figure 1–7) is clipped to the right-hand side of the cockpit. The microphone switch is on the top of the THROTTLE control ranging grip.

AN/ARC-27 UHF COMMUNICATION RADIO SYSTEM. *(See figure 4–2.)* The controls for the uhf system are located on the right-hand control shelf. To operate the uhf system, place the T/R control in the "T/R" or "T/R + G REC" position, and turn the CHANNEL control to the desired channel. Adjust the VOLUME control for a comfortable volume level. If reception or transmission on a particular channel fails, try other channels. A list of uhf channel frequencies is located forward of the WING FOLDING control.

AN/ARC-1 VHF COMMUNICATION RADIO SYSTEM. *(See figure 4–2.)* The controls for the vhf system are located on the right-hand control shelf. To operate the set, place the MASTER radio control toggle switch in the "ON" position, turn the CHAN SEL switch to the desired channel and the GUARD-MAIN T/R switch to "GUARD," "BOTH," or "MAIN T/R." Adjust the volume with the COMM VOLUME control on the MASTER radio control panel. If reception or transmission fails on a particular channel, try other channels.

AN/ARR-2A NAVIGATION RADIO SYSTEM. *(See figure 4–2.)* The navigation receiver controls are located on the right-hand control shelf. To operate, set the CHAN SEL switch to the desired channel, place the PITCH control in the "NAV" position, and turn the VOL control to a comfortable volume level.

AN/ARC-5 RANGE RADIO SYSTEM. *(See figure 4–2.)* The range receiver controls are located on the right-hand control shelf. To operate the system, turn the SENS control to a comfortable level and set the frequency dial to the desired frequency.

AN/APN-1 RADIO ALTIMETER SYSTEM. The radio altitude indicator (4, figure 1–8) is located in the top row of instruments on the instrument panel. To operate the radio altimeter system, turn the lower control on the face of the indicator in the direction indicated. Turn the upper control to the desired range.

CAUTION

Do not use the 0-to-4,000-foot range of the radio altimeter when flying below 600 feet. The system is not calibrated for such use and inaccuracies would result. The radio altimeter is also inaccurate during AN/ARC-27 UHF transmission.

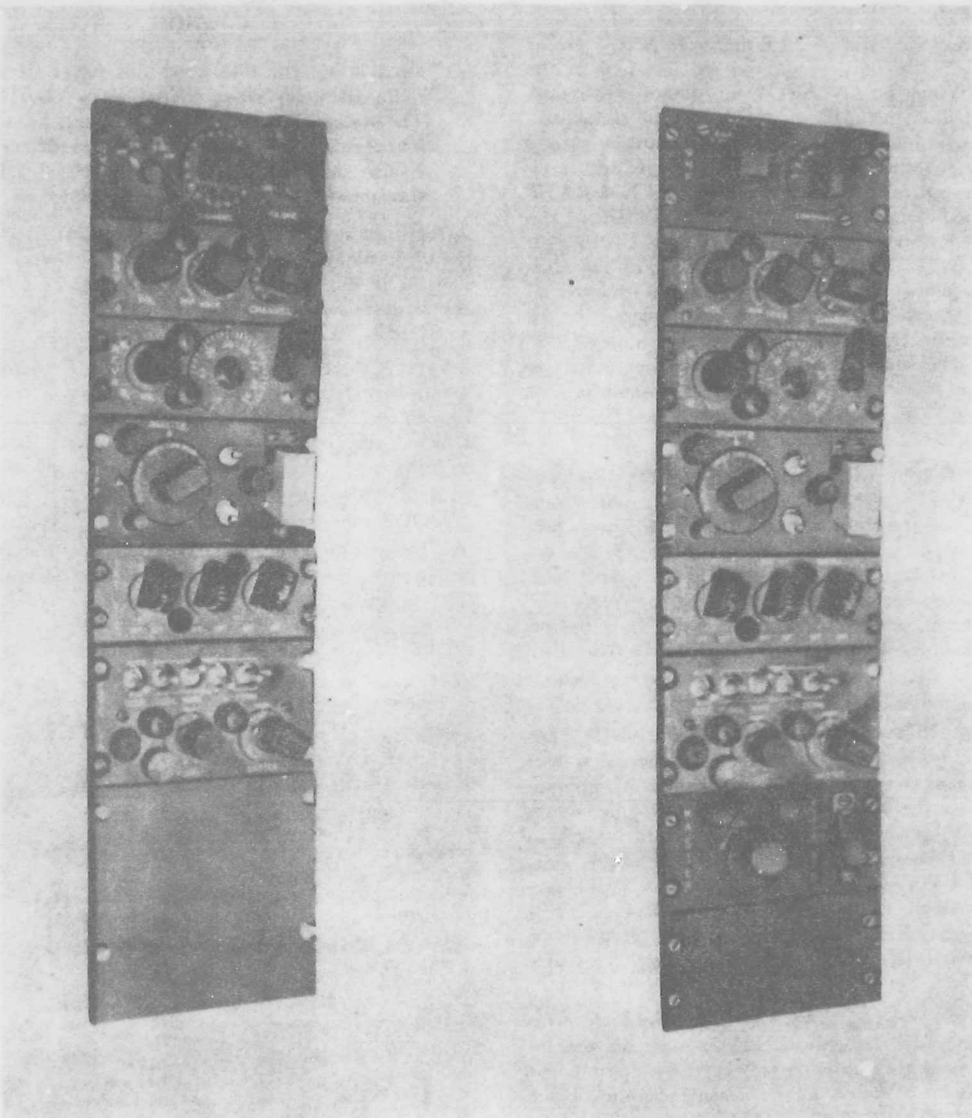
An altitude limit switch (24, figure 1–7) is located on the right-hand control shelf inboard of the radio controls. The limit switch sets the altitude below which the altitude warning light, located on the instrument panel adjacent to the indicator, will go on.

AN/APX-6 IFF IDENTIFICATION RADAR SYSTEM. *(See figure 4–2.)* The IFF system controls are located on the right-hand control shelf. Unless instructed otherwise by local authority, turn the IFF on as follows:

MASTER control .... "NORM"
MODE switches .... "OUT"

To transmit an emergency signal, depress the dial stop and rotate the MASTER control to the "EMERGENCY" position.

CAUTION
Do Not Use the 0-4,000 Foot Range of the Radio Altimeter When Flying Below 600 Feet!



WITH AN/ARC-27 INSTALLED WITH AN/ARC-1 INSTALLED

Figure 4-2. Radio Controls

PAGES 39 and 40

MISSING

with the quick-disconnect fitting projecting from a horn on the front of the seat pan. A repeater flow indicator and pressure gage (15, figure 1–6) are located forward of the MASTER WATER INJECTION switch on the left-hand control shelf. The oxygen bottle is located in the radio compartment on the forward bulkhead. A filler check valve is located in the oxygen line near the centerline of the same bulkhead.

PREFLIGHT CHECK. Be sure that the oxygen shutoff valve is open and that the pressure gages read 1,800 (±50) psi at 70°F(21°C), indicating a full bottle. Test the oxygen regulator for leakage by obstructing the outlet of the breather tube. If the flow indicators open in less than 30 seconds, excessive leakage exists and the regulator should be replaced. 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 depress the SAFETY PRESS button. Take a deep breath and hold. If flow indicator opens (all black showing) a leak is indicated. Tighten mask straps until flow indicator closes (white face showing). Release SAFETY PRESS button. *Do not use a mask that leaks.* Fully engage mask and breather tube couplings and check force required to disconnect. Force should not be less than 10 pounds.

OPERATING INSTRUCTIONS. Oxygen shall be used constantly while above 5,000 feet at night and above 10,000 feet during the day. During all flights the air valve shall be set to the "NORMAL OXYGEN" position except during flights above 30,000 feet and under emergency conditions, as directed in section III. When flights above 30,000 feet are planned, the use of 100 percent oxygen from the ground up is recommended. The SAFETY PRESS button should be depressed at all times when flying above 35,000 feet, or at any time anoxia is suspected. Routine use of the safety pressure at lower altitudes is not recommended because of the high oxygen consumption.

CAUTION

If the SAFETY PRESS button is depressed when the mask is not securely on the face, oxygen will be rapidly exhausted.

During a flight requiring oxygen, frequently check oxygen flow and pressure indicators. At altitudes above approximately 41,000 feet the flow indicator will not blink, but the positive pressure in the mask is an unmistakable indication that oxygen is being delivered. While on oxygen, occasionally check mask for leakage by use of the SAFETY PRESS button, as described for a preflight check. On completion of flight, place air valve control in the "100% OXYGEN" position, and turn off the shutoff valve below the right-hand control shelf.

NAVIGATION EQUIPMENT.

G-2 COMPASS. The G-2 compass indicator (8, figure 1–8), located in the top row of instruments on the instrument panel, gives the pilot the gyro-stabilized magnetic heading of the airplane. The center dial gives an unstabilized magnetic heading. The indicator may be operated as a free-directional gyro by placing the G-2 COMPASS switch (7, figure 1–8), located above the indicator, in the "FREE DG" position. While the indicator is being operated as a directional gyro, precession errors must be corrected from time to time. To operate the system under compass control, place the G-2 COMPASS switch in the "COMPASS CONTROL" position. Allow 3 minutes after power is turned on for the gyro to reach full speed. Depress the resetting knob and set the direction indicator dial to the heading of the airplane as given by the center dial. Hold for 2 seconds and release straight out. The direction indicator dial will align itself correctly in about 2 minutes. The G-2 compass power is supplied by the a-c electrical system.

STAND-BY COMPASS. The stand-by compass (13, figure 1–8), located in the top row of instruments on the instrument panel, is a direct-reading magnetic compass. The stand-by compass is used if the G-2 system fails.

COMPASS CORRECTION CARDS. Two compass correction cards (3, 15, figure 1–8) are located on the right- and left-hand sides of the instrument panel to give magnetic deviations for various magnetic headings.

ARMAMENT.

GENERAL. All armament circuits except the gun charging, gun heating, and gun camera heating circuits are supplied with electrical power through the master armament circuit. The MASTER ARMT switch breaker, located in the gun switch box (2, figure 1–4) on the left-hand side of the cockpit cowl, controls the master armament circuit. The MASTER ARMT switch breaker is opened when the arresting hook control is placed in the "DOWN" position, and it must be manually reset if the armament system is to be used.

FIRE CONTROL. The airplane is equipped with a MK 6, Mod 0, fire control system, which incorporates a MK 8 lead-computing sight (3, figure 1–4). The system is controlled by the MASTER ARMT switch breaker, the ranging throttle grip (11, figure 1–6), the span lever on the face of the sight, the SELECTOR and DIMMING switches (34, figure 1–6) on the left-hand control shelf, and the DIVE ANGLE switches in the gun switch box on the cockpit cowl. To operate the fire control system as a gun sight, proceed as follows:

- MASTER ARMT switch breaker .... "ON"
- Span lever .... Span of expected target
- DIVE ANGLE switches .... "GUNS"
- SELECTOR switch "FIXED & GYRO" or "GYRO"
- DIMMER switch .... As desired
- Ranging throttle grip .... Rotate as needed to keep gyro image diameter equal to target span

To operate the fire control system as a rocket sight, proceed as follows:

- MASTER ARMT switch breaker .... "ON"
- DIVE ANGLE switches .... "ROCKETS" and "ABOVE 35°" or "BELOW 35°," depending on expected dive angle
- SELECTOR switch "FIXED & GYRO" or "GYRO"
- DIMMER switch .... As desired

Light for the computing sight reticle images is provided by two lamp bulbs in the base of the sight. To replace a burned-out lamp bulb, open the lamp cover below the crash pad and remove the defective lamp bulb. Insert one of the replacement lamp bulbs provided, with the frosted spot toward the interior of the sight, and close the cover.

GUNNERY EQUIPMENT. The four M-3 20-mm wing guns are hydraulically charged and electrically fired. A maximum total of 924 rounds of ammunition may be provided. A gun camera, enclosed in the right-hand wing leading edge, is actuated when the guns or rockets are fired. The guns and gun camera are electrically heated. The gunnery switches are located in the armament switch box on the left-hand side of the cockpit cowl, except for the trigger switch, which is located on the control stick. To charge the guns, proceed as follows:

- GUNS READY-SAFE switch .... "READY"
- PUSH-TO-CHARGE button .... Depress

The guns may also be charged by placing the GUNS READY-SAFE switch in the "SAFE" position for 1 second and then in the "READY" position.

To fire all the guns after charging, proceed as follows:

- MASTER ARMT switch breaker .... "ON"
- GUNS READY-SAFE switch .... "READY"
- FIRING switches .... "ON"
- Trigger switch .... Depress

To secure the guns, proceed as follows:

- MASTER ARMT switch breaker .... "OFF"
- GUNS READY-SAFE .... "SAFE"
- FIRING switches .... "OFF"

If the trigger should stick, causing uncontrolled firing, place the MASTER ARMT switch breaker in the "OFF" position. To stop a runaway gun, place the GUNS READY-SAFE switch in the "SAFE" position. To clear a stoppage, charge the guns.

CAUTION

If a stoppage occurs during use of high-explosive incendiary ammunition, do not cycle the gun chargers more than twice.

BOMBING EQUIPMENT. Bombs, 11.75-inch rockets, or MK 12 droppable fuel tanks may be carried on the two center section pylons and on the centerline pylon.

CAUTION

When 11.75-inch rockets are carried on the center section pylons, the flaps are limited to a 30-degree deflection.

The center section pylons can carry bombs weighing as much as 1,600 pounds. The centerline pylon can carry bombs weighing as much as 2,000 pounds. The BOMB AND ROCKET arming switch and BOMB RACKS switches are located in the bomb and rocket switch box (4, figure 1–4) on the right-hand side of the cockpit cowl. The bomb, 11.75-inch rocket, and fuel tank release button is located on the upper left-hand side of the control stick grip. To drop the bombs, 11.75-inch rockets, or fuel tanks, proceed as follows:

- MASTER ARMT switch breaker .... "ON"
- BOMBS OR ROCKETS arming switch .... "NOSE AND TAIL ARM" or "TAIL ARM" as desired; "SAFE" for drop tank
- BOMB RACKS switches .... "ON" as desired
- Release button .... Depress

To drop the bombs, 11.75-inch rockets, or fuel tanks when the electrical release system is inoperative or in an emergency when speed is essential, the manual EMERGENCY BOMB OR DROP TANK RELEASE (1, figure 1–6), located on the left-hand control shelf, may be used. Push the manual EMERGENCY BOMB OR DROP TANK RELEASE forward into the center right- or left-hand slot to release the pylon stores. If the arming circuits are inoperative, the bombs or 11.75-inch rockets will be dropped unarmed. To secure the centerline and center section pylons, proceed as follows:

- MASTER ARMT switch breaker .... "OFF"
- BOMBS OR ROCKETS arming switch .... "SAFE"
- BOMB RACKS switches .... "OFF"

ROCKET EQUIPMENT. Ten 3.5- or 5-inch HPAG or HVAR rockets, ten 250-pound bombs, or six 500-pound bombs may be carried below the wing outer panels. The rocket system is controlled by the MASTER ARMT switch breaker, the ROCKET READY-SAFE switch and the BOMBS OR ROCKETS arming switch in the bomb and rocket switch box, the rocket selector switch (11, figure 1–8) in the top row right-hand side of the instrument panel, and the rocket firing button on the lower left-hand side of the control stick grip.

Salvo firing is not possible. To fire rockets or release bombs from the outer panel launchers, proceed as follows:

MASTER ARMT switch breaker........"ON"
ROCKETS READY-SAFE switch........"READY"
or
WING O. P. BOMB-ROCKET switch (BuNo. 129318 only)........"BOMBS" or "ROCKETS"
BOMBS OR ROCKETS arming switch........"NOSE AND TAIL ARM" or "TAIL ARM"
Rocket selector switch........No. "1" for singles, No. "6" for pairs
Rocket firing button........Depress

To secure the outer panel rockets or bombs, proceed as follows:

MASTER ARMT switch breaker........"OFF"
ROCKETS READY-SAFE switch........"SAFE"
or
WING O.P. BOMB-ROCKET switch (BuNo. 129318 only)........"SAFE"
BOMBS OR ROCKETS arming switch........"SAFE"

Table III. Rocket Firing Sequence

Note

Rocket stations are consecutively numbered from the left-hand outboard station to the right-hand outboard station.

Rocket Selector Switch Position	*Energized Rocket Station(s)*
1, *Start Singles*	1
2	9
3	3
4	7
5	5
6, *Start Pairs*	1, 10
7	2, 9
8	3, 8
9	4, 7
10	5, 6

TOW TARGET EQUIPMENT. The tow target equipment is furnished as loose equipment to be installed as needed. When installed, the latch projects from the bottom of the fuselage aft of the cockpit. The release control (30, figure 1–6) is below the shoulder harness lock control on the side of the left-hand control shelf. Pulling up the release handle mechanically releases the tow target line.

MISCELLANEOUS EQUIPMENT.

ANTI-G SUIT SYSTEM. The anti-g suit quick-disconnect fitting (36, figure 1–6) is located on the left-hand control shelf, inboard of the tail wheel lock. The fitting is covered with a cap when not in use. Compressed air for operating the system is supplied from the positive pressure of the engine-driven vacuum pump. The system operates automatically after the suit is connected.

CAUTION

When you are using an anti-g suit you will have an increased resistance to the effects of high acceleration. If you have previously depended on "greying out" to judge the severity of a maneuver, you must develop a new sense of feel to avoid structural failure of the airplane. Combat maneuvers should be practiced with the aid of the accelerometer until you can accurately judge accelerations while wearing an anti-g suit.

UTILITY RECEPTACLE. A utility receptacle marked "PORT EQUIP" (20, figure 1–7) is located on the right-hand control shelf. The receptacle supplies electrical power to the pilot's heated flying suit.

MAP CASE. The map case (19, figure 1–7), for holding maps and flight data, is mounted aft of the right-hand control shelf.

BAGGAGE COMPARTMENT. A baggage compartment for stowage of 100 pounds of nonmagnetic gear is located in the radio compartment. The radio compartment access door is below and aft of the cockpit on the right-hand side of the fuselage. It is opened with four flush latches. The zipper fasteners on the canvas baggage cover must be safety wired together after stowing gear.

HEADREST. A fixed headrest is bolted to the pilot's seat bulkhead for catapulting operations.

RELIEF TUBE. The relief tube horn is secured in a cup on the forward side of the control stick base. The slack in the hose is taken up by an elastic cord below the cockpit floor.

CHECK LISTS. An edge-lighted check list (19, figure 1–6 and 2, figure 1–7) is mounted on the forward inclined end of each control shelf. One lists the operations for landing, the other for take-off.

CATAPULT HANDGRIP. A handgrip is located behind a flap (16, figure 1–6) in the side of the cockpit ahead of the throttle. The handgrip may be extended to give the pilot a fixed grip against which the throttle control lever may be steadied during catapulting.

REAR-VISION MIRRORS. Three rear-vision mirrors are mounted on the forward frame of the canopy.

ASH TRAY. An ash tray (7, figure 1–6) is installed in the cockpit lining above the left-hand control shelf.

CONTROL LOCK. A control lock is provided for use when the airplane is to be parked for an extended period. To install the lock, set the rudder pedals in the full aft position and insert the forward tubes of the lock into the bottom tubes of the rudder pedals. Position the control stick in the retaining clamps of the lock, and rotate the spring-loaded pins into the locking position.

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Section V OPERATING LIMITATIONS

GENERAL.

Notice must be taken of the cockpit instrument markings since they represent limitations that are not necessarily repeated in the text. Where necessary, a further explanation of an instrument's markings will be found under the heading dealing with its limitation.

INSTRUMENT MARKINGS.

See figure 5-1 for instrument markings. All instruments are marked for 115/145 fuel.

ENGINE LIMITATIONS.

Cylinder temperatures — maximum
- Take-off and military power .... 241°C
- Normal rated in "AUTO-RICH" .... 241°C
- Normal rated in "AUTO-LEAN" .... 222°C

Maximum continuous in any power except above .... 222°C

Desired for continuous operation .... Below 200°C

Oil pressures — minimum
- 2,600 rpm at 85°C .... 75 psi
- 2,250 rpm at 85°C .... 60 psi
- 1,200 rpm at 85°C .... 50 psi
- Idling .... 25 psi
- Desired at 2,200 rpm and 60°C .... 85-90 psi

Oil temperatures
- Minimum for take-off and flight .... 40°C
- Desired .... 60°C-75°C
- Maximum, level flight .... 85°C
- Maximum, climb .... 98°C

Carburetor air temperatures — maximum
- Low supercharger ratio .... 38°C
- High supercharger ratio .... 16°C

Engine rpm
- Maximum during dive .... 3,120 rpm (30 sec)
- Minimum for sustained cruise .... 1,400 rpm (minimum for generator cut-in, 1,400 rpm)

Manifold pressures — maximum*
- Combat power (limited to 5 min)
  - High blower .... 66 in.
  - Low blower .... 70 in.
  - (Full throttle and airspeed will determine maximum manifold pressure for combat power in low blower).
- Take-off and military power (limited to 5 min)
  - High blower .... 49.5 in.
  - Low blower .... 58 in.
- Grade 100/130 fuel — military rated power (2,800 rpm) — low blower .... 53 in. (sea level) to 52 in. (4,000 ft.)

Mixture control
- Position for all engine speeds above normal rated power (2,600 rpm) .. "AUTO-RICH"

AIRSPEED LIMITATIONS.

The maximum permissible indicated airspeeds in smooth or moderately turbulent air are as follows:

- With flaps and landing gear retracted and canopy closed .... As shown in fig. 5-2
- For extending the landing gear .... 270 knots
- With the landing gear down and locked .... 350 knots
- With canopy open .... 300 knots
- For actuating the flaps (with the relief mechanism in operation) .... 200 knots
- For actuating the flaps (with the relief mechanism inoperative)

Flap Setting	*Speed*
20°	200 knots
30°	170 knots
40°	145 knots
50°	130 knots

Note

To minimize the possibility of malfunctioning of the main landing gear during retraction or extension, use of the landing gear as a dive brake is permitted only in the full down and locked position.

*Manifold pressure limits listed are for use with grade 115/145 fuel except as specified. For rpm's below 2,600, limits for manifold pressure are the same when using grade 115/145 fuel or grade 100/130 fuel.

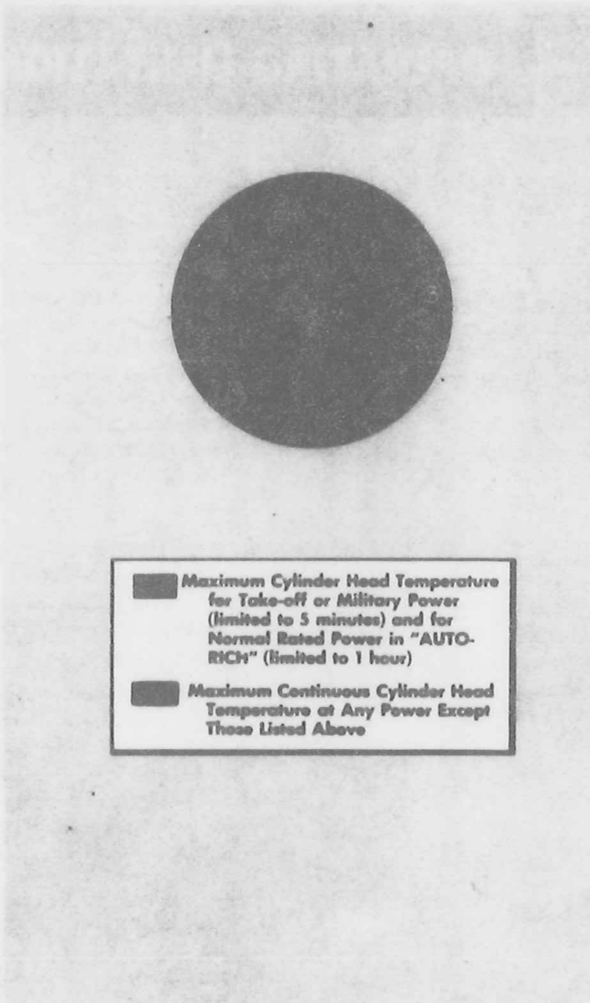


Figure 5–1. Instrument Markings Diagram (Sheet 1 of 2)

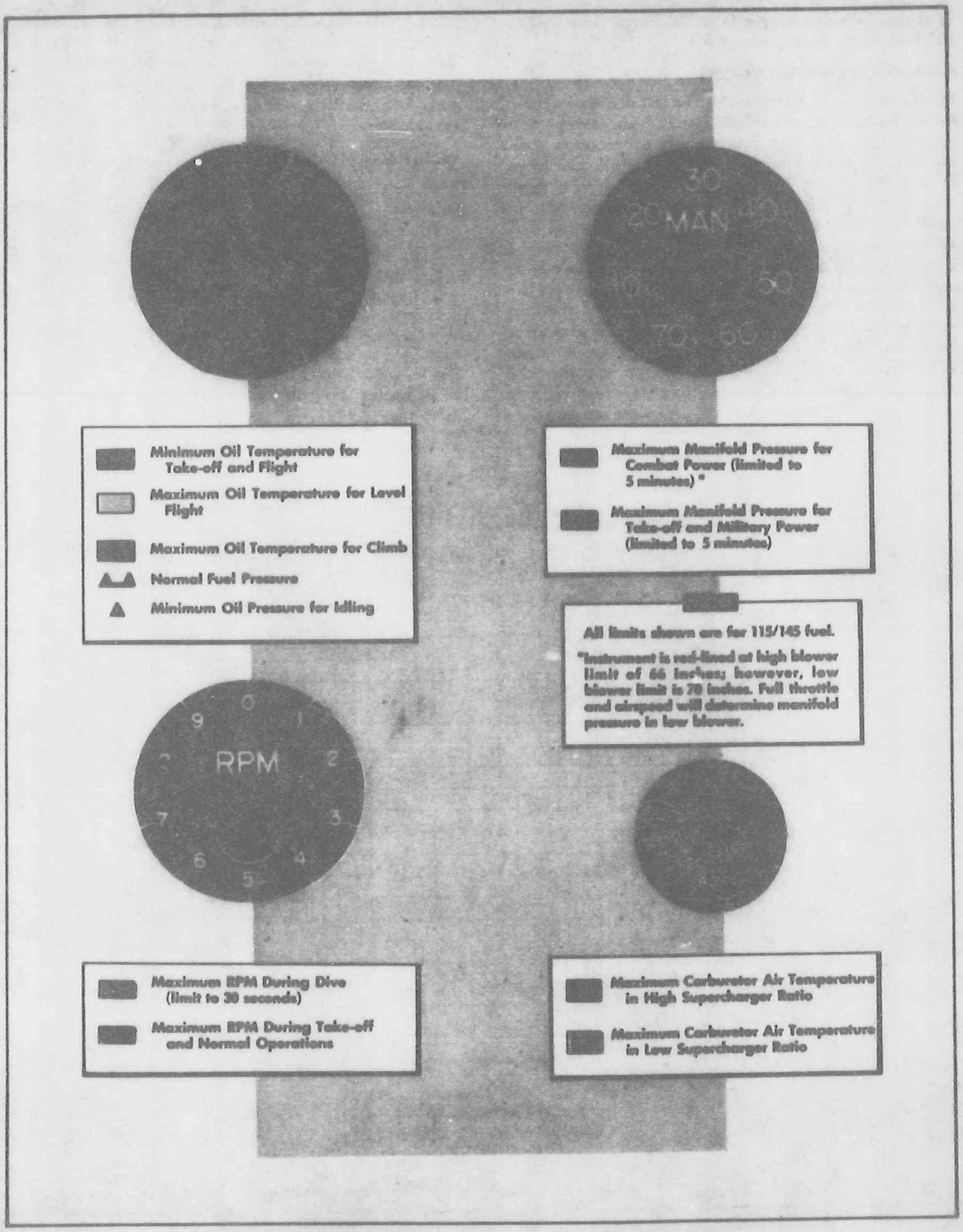


Figure 5–1. Instrument Markings Diagram (Sheet 2 of 2)

In severe turbulence, speeds in the range from 150 to 300 knots IAS are recommended.

ACCELERATION LIMITATIONS.

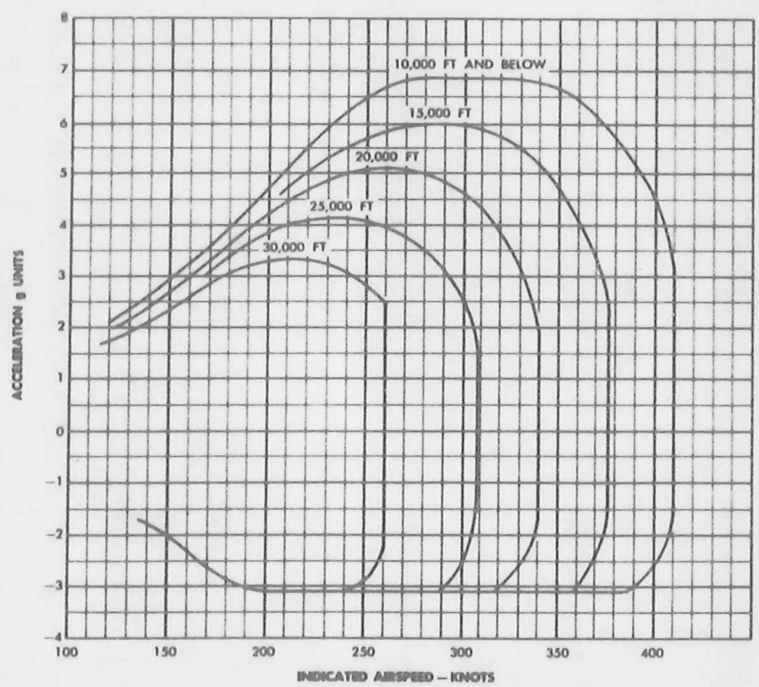
Except as otherwise limited by the restrictions imposed in the paragraph entitled "STORES" and except that accelerations at which buffeting is encountered shall not be exceeded, the maximum permissible accelerations in smooth air for airplanes of 13,200 pounds gross weight are as shown in figure 5–2. When flying in conditions of moderate turbulence, it is essential that accelerations resulting from deliberate maneuvers be limited to 5.0g for gross weights of 13,200 pounds in order to minimize the possibility of overstressing the airplane as a result of the combined effects of the gust and maneuvering loads. If the gross weight is greater or less than 13,200 pounds, the perm' ̇ible accelerations will decrease or increase respectively. To determine the maximum permissible accelerations at gross weights other than 13,200 pounds, multiply the appropriate acceleration from figure 5–2 or that given above for moderate turbulence by the ratio of 13,200 pounds to the new gross weight, except that 7.5g positive and 3.4g negative shall never be exceeded in smooth air and 5.0g shall never be exceeded in moderate turbulence.

WEIGHT LIMITATIONS.

The maximum recommended gross weights are as follows:

Field take-off	19,400 lb
Field landing	15,000 lb
Catapulting	18,500 lb
Arrested landing	13,000 lb

Whenever it is operationally practicable, arrested landings shall be made at gross weights of 12,500 pounds or less in order to increase the service life of the airplanes by reducing the number of high loads applied to the airframes.



OPERATING FLIGHT STRENGTH DIAGRAM
FOR SYMMETRICAL FLIGHT
GROSS WEIGHT 13,200 POUNDS

Figure 5–2. Operating Flight Strength Diagram

PROHIBITED MANEUVERS.

The following maneuvers are permitted when not carrying external stores:

Loops
Immelmann turns
Aileron rolls
Inverted flight (Not to exceed 10 seconds)
Wingovers
Chandelles

The following maneuvers are permitted when carrying stores:

Inverted flight (Not to exceed 10 seconds)
Aileron rolls
Wingovers

AILERONS.

Full-stick throw of the ailerons shall not be used at speeds in excess of 300 knots IAS. At higher speeds the use of ailerons shall be limited to the same stick force as is required for full throw at 300 knots, but shall not exceed ½ throw at 350 knots IAS and ¼ throw at 400 knots IAS. Large or abrupt aileron deflections shall be avoided when flying in turbulent air.

STORES.

External stores of weights not exceeding those shown in figure 5–3 may be carried, singly or in combination, under the same restrictions of flight, catapulting, and arresting that apply without such stores, except as noted hereinafter.

(1) Arrested landings are not permitted with fuel in the external tanks, with a 2,000-lb bomb, or with rockets installed, except under emergency conditions.

(2) When carrying a 2,000-lb bomb, the maximum permissible positive acceleration is 5.0g.

(3) Catapulting, deck takeoffs, and landings with combinations of stores which result in unsymmetrical weight to the left shall be avoided because of insufficient rudder and aileron control at speeds near the stall.

(4) Sway braces shall not be carried on wing center section pylons when the airplane is catapulted without stores on these pylons.

ARRESTING DECELERATIONS.

The maximum permissible arresting hook load is 46,800 pounds and the maximum permissible longitudinal deceleration for arrested landing is 3.6g. The ultimate barrier engagement force is 58,500 pounds, and the ultimate-strength longitudinal deceleration for barrier engagement is 4.5g.

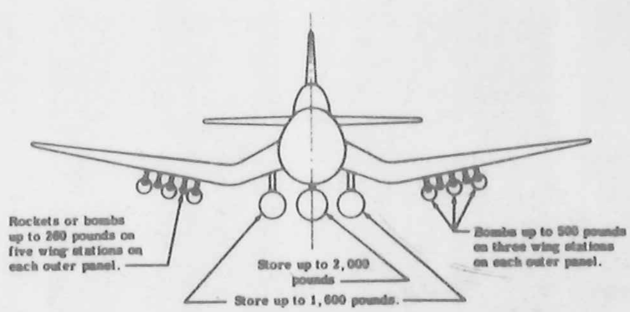


Figure 5–3. Stores Loading Diagram

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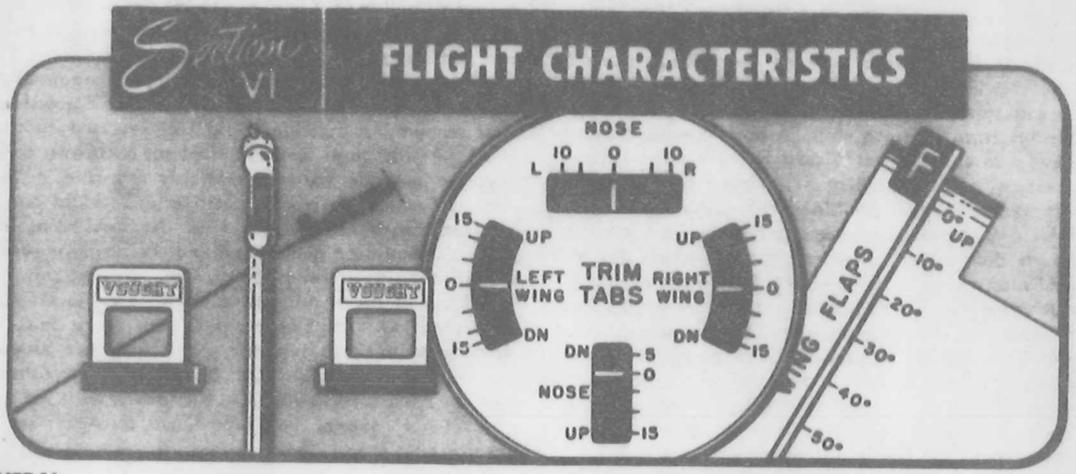


GENERAL.

The flight characteristics of this airplane are those that would normally be expected of a propeller-driven high-performance fighter. Extension of the landing gear, cowl flaps, and wing flaps changes the trim only slightly.

STALLS.

The stalling characteristics of this airplane are consistent with those experienced on earlier model F4U-type airplanes and are not considered abnormal. Stall warning, as indicated by slight airframe buffeting, occurs at speeds very close to the actual stall and therefore will not provide a positive and early indication to the pilot. With power on, the variation of elevator control force and/or position in approaching the stall is very slight and therefore does not provided a large degree of feel or a change in angle of attack or airspeed. For these reasons, FLIGHT IN CLOSE PROXIMITY TO THE STALL AT LOW ALTITUDES SHOULD BE AVOIDED OR APPROACHED WITH CAUTION.

CAUTION

Pilots should thoroughly familiarize themselves with the stall characteristics of this airplane in both clean and landing configurations in straight and level flight and in turns of various banks, as well as stalls in the landing configuration, using various flap positions and power settings while simulating approach and landing conditions.

At the stall with power off, the airplane exhibits a moderate nose-down pitch and roll-off in either direction. With power on and flaps down, a roll-off to the left at the stall is violent and is accompanied by a loss in altitude of 600 to 900 feet.

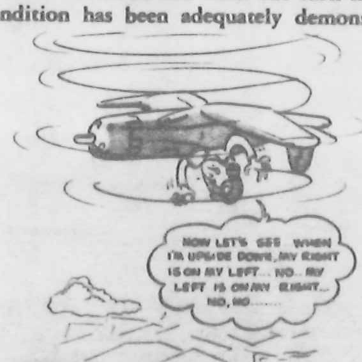
On the basis of flight test information obtained on the F4U-4 airplanes, it is anticipated that the AU-1 airplanes, when equipped with the Aero 14A rocket launchers with or without external stores, will not have sufficient right rudder control to avoid spins during accelerated stalls in left turns. Because of these rudder control characteristics and because of inadequate stall warning in these configurations, pilots are cautioned to exercise care in low-speed steady and maneuvering flight.

SPINS.

WARNING

No intentional spinning of this airplane is permitted.

GENERAL. The spinning and spin recovery characteristics of this airplane are somewhat more severe than those of the earlier F4U-type airplanes. Satisfactory recovery from spins of five turns in each direction in the clean condition and from one turn in the landing condition has been adequately demonstrated for



WARNING
Check the Turn-and-Bank Indicator for Direction of Spin Before Applying Corrective Controls!

all presently required spin entry conditions. The number of turns required for recovery from 5-turn spins in each direction varies between 1½ and 3½ turns in the clean condition depending upon the type of entry and number of turns in the spin. In the landing condition from a 1-turn spin, in both directions, the average recovery requires ¼ turn. Spins in either direction are, in general, oscillatory in character. A lateral-directional oscillation combines with the initial longitudinal oscillation if the airplane is held in the spin for more than 2 turns. However, the oscillation should not be interpreted to mean that a flat spin is developing. Recovery should be normal with forces within the capabilities of the average pilot. Tabs, especially the elevator tab, should be used if the recovery forces are too high. Inverted spins will probably be to the right. Recovery from an inverted spin requires the application of full controls, but the control forces will be about one-half of those required for a normal spin.

NORMAL SPIN RECOVERY TECHNIQUE. To recover from a normal spin, proceed as follows:

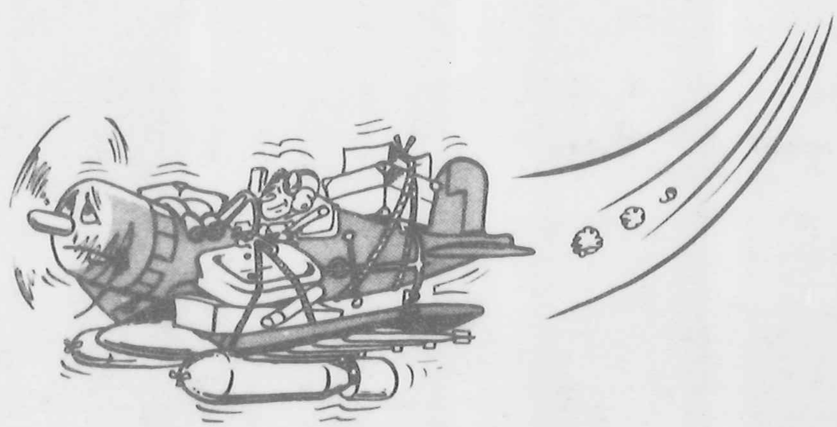
THROTTLE control	*Full* "CLOSED"
PROPELLER control	*Full* "DECREASE"
Rudder control (pedals)	*Full* opposite to direction of turn
Elevator control (stick)	*Full* forward
Aileron control (stick)	Neutral

Apply opposite controls sharply, leading with *full* opposite rudder followed ½ turn later by *full* forward movement of the control stick. An increase in the rudder pedal force will be noted when the stick is moved forward but full rudder pedal throw should be reapplied and held if any movement has occurred. The aileron position during recovery is not considered critical and, in general, should be retained in neutral. The rate of rotation will increase significantly upon application of controls for recovery, which is a good sign that recovery is starting. Hold full reversed controls until rotating stops and the airplane is thrown to an inverted attitude with considerable negative g. This recovery condition is very positive and should not be confused with an inverted spin. At this point, the controls should be neutralized and the airplane pulled out in a symmetrical pull-out. The airplane must be eased out of the ensuing dive. Avoid a rapid aft stick movement as a high-speed stall may result with an accompanying spin re-entry requiring more altitude for recovery. If unable to hold full opposite controls and the stick walks back, return controls with the spin for a brief interval, and repeat full recovery control motion.

Note

> Full forward stick (against the stops) must be applied and held for spin recovery. It is further recommended that the airplane in a well-developed spin should be abandoned only if the recovery controls cannot be applied and held, and/or the airplane reaches an altitude below 5,000 feet.

INVERTED SPIN RECOVERY TECHNIQUE. Inverted spins will probably be to the right. The needle of the turn-and-bank indicator will show the direction of the spin. *Check the direction of the needle of the turn-and-bank indicator before applying corrective*



"... with loads on all three pylons, buffeting will probably occur ..."

STALL CHART

STANDARD DAY

MODEL: AU-1 ENGINE: R-2800-83WA

TAKE-OFF CONFIGURATION

Weight — 11,000 Pounds		Weight — 13,000 Pounds		Weight — 15,000 Pounds	
Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots
0°	66	0°	72	0°	77
10°	67	10°	73	10°	79
20°	71	20°	76	20°	82
30°	77	30°	83	30°	89

LANDING CONFIGURATION

Weight — 11,000 Pounds		Weight — 13,000 Pounds		Weight — 15,000 Pounds	
Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots
0°	76	0°	82	0°	89
10°	77	10°	83	10°	90
20°	81	20°	89	20°	94
30°	88	30°	96	30°	102

CLEAN CONFIGURATION

Weight — 11,000 Pounds		Weight — 13,000 Pounds		Weight — 15,000 Pounds	
Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots	Angle of Bank	Stalling Speed — Knots
0°	86	0°	93	0°	100
10°	87	10°	95	10°	102
20°	91	20°	99	20°	107
30°	99	30°	108	30°	116

REMARKS:

1. Take-off configuration is wheels down, flaps 50 degrees down, take-off power.
2. Landing configuration is wheels down, flaps 50 degrees down, power off.
3. Clean configuration is wheels and flaps up, power off.

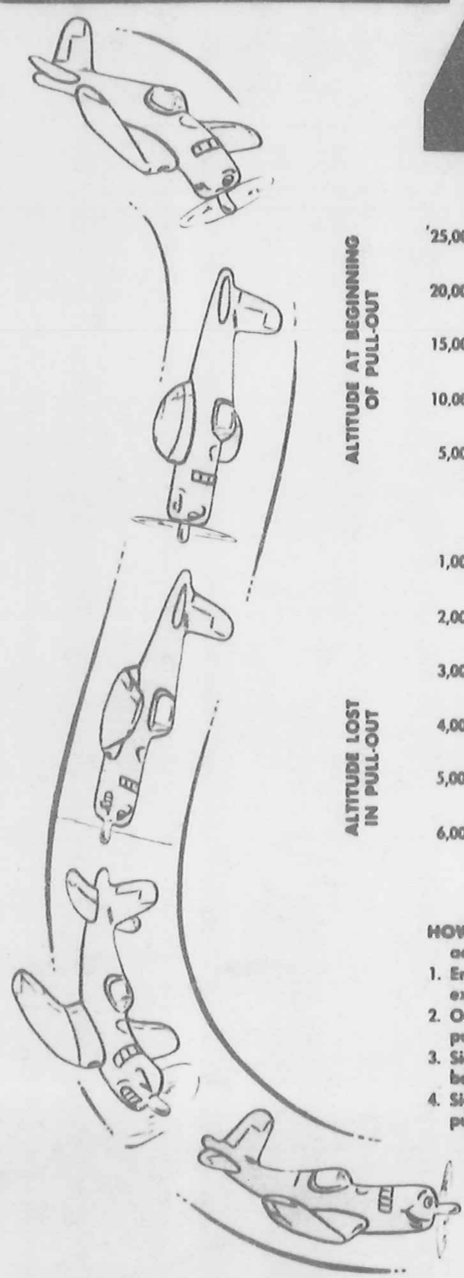
DATA AS OF: 15 November 1951.

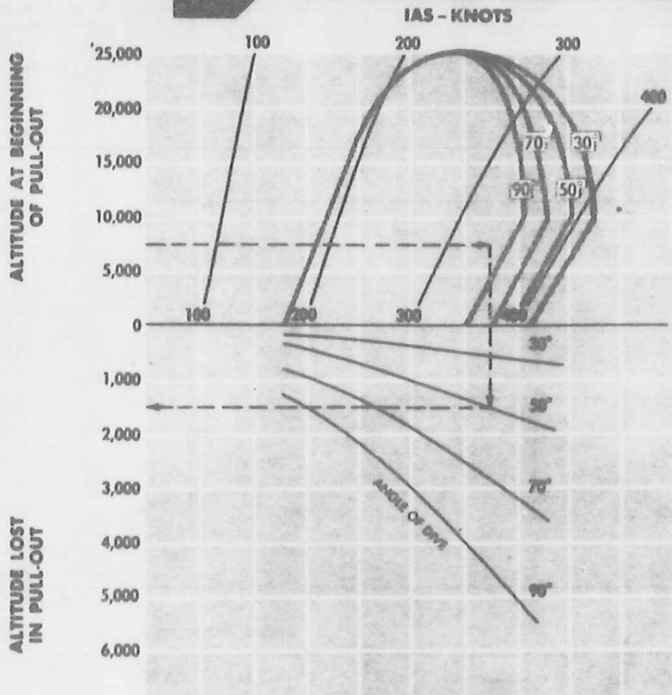
DATA BASIS: Estimate, based on Project TED No. BIS 21102, NATC "Service Acceptance Trials (Performance Phase and Carbon Monoxide Survey) for the F4U-5 Airplane" Dated 29 September 1950.

Figure 6–1. Stall Chart

CONSTANT 4g PULL-OUT

ABOVE 25,000 FT AIRPLANE STALLS BEFORE REACHING 4g's





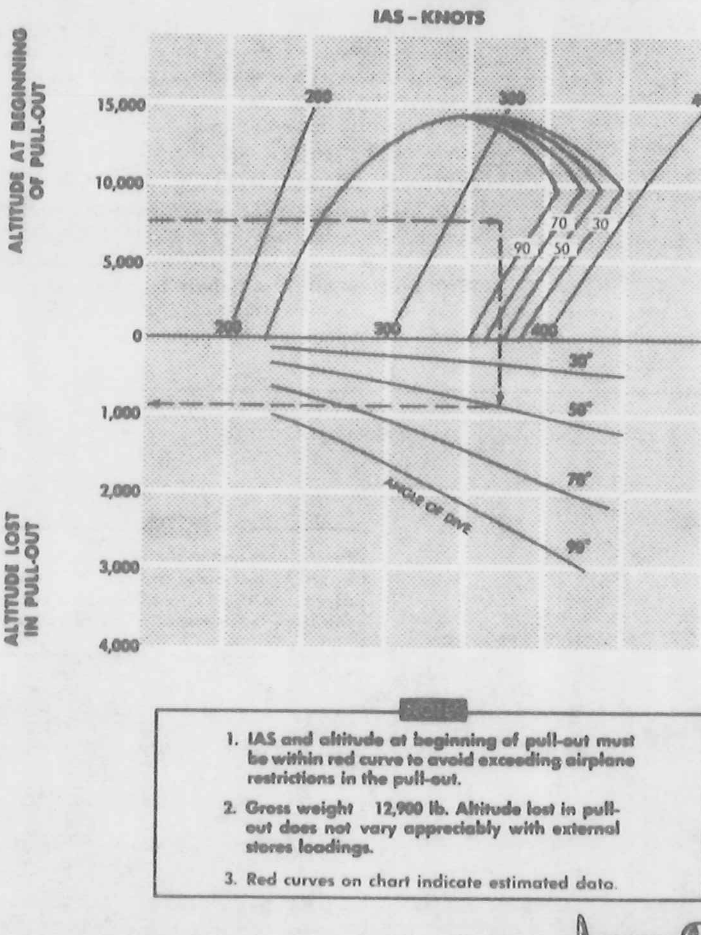
HOW TO USE CHARTS: Select appropriate chart, depending upon acceleration (4g or 6g) to be held in pull-out; then –

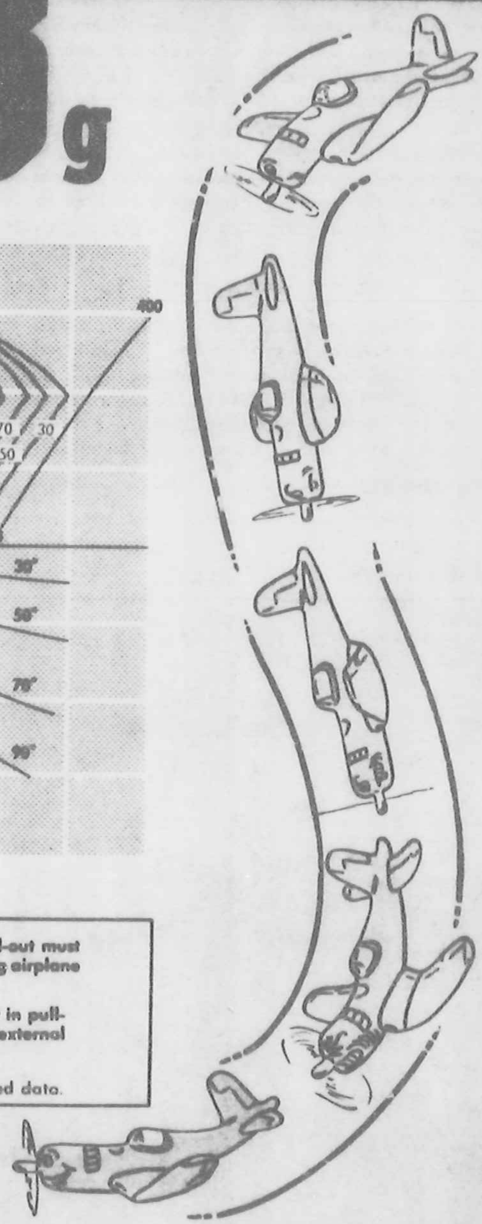
1. Enter chart at line nearest actual altitude at start of pull-out (for example 7,500 feet).
2. On scale along altitude line, select point nearest the IAS at which pull-out is started (330 knots IAS).
3. Sight vertically down to point on curve of dive angle (50°) directly below airspeed.
4. Sight back horizontally to scale at left to read altitude lost during pull-out (constant 4g pull-out, 1500 ft; constant 6g pull-out, 900 ft).

Figure 6–2. Dive Recovery Chart (Sheet 1 of 2)

ABOVE 15,000 FT AIRPLANE STALLS BEFORE REACHING 6g's

CONSTANT 6g PULL-OUT





NOTES

1. IAS and altitude at beginning of pull-out must be within red curve to avoid exceeding airplane restrictions in the pull-out.
2. Gross weight 12,900 lb. Altitude lost in pull-out does not vary appreciably with external stores loadings.
3. Red curves on chart indicate estimated data.

Figure 6–2. Dive Recovery Chart (Sheet 2 of 2) *controls*. Recovery from a well-developed inverted spin requires the application of full controls, but the control forces will be about one-half of those required for a normal spin. To recover from an inverted spin, proceed as follows:

THROTTLE control	Full "CLOSE"
PROPELLER control	Full "DECREASE"
Turn-and-bank indicator	Check for direction of spin
Elevator control (stick)	Full aft
Rudder control (pedals)	*Full* opposite to direction of turn
Aileron control (stick)	Neutral

Neutralize the controls immediately after the rotation stops to prevent entering a normal spin. Ease the airplane out of the ensuing dive to avoid an accelerated stall.

Note

If an attempted maneuver results in an inverted nose-high attitude with insufficient speed and a high power setting, pull the THROTTLE and PROPELLER controls full aft and allow the airplane to fall out of the maneuver. Avoid excessive use of controls.

LEVEL FLIGHT.

Stability is good during level flight at all speeds within the limits of the airplane. Moderate trim changes are needed to adjust for changes in speed.

FLIGHT CONTROLS.

There are no unusual control reactions in this airplane. Flight test data on the F4U-5 airplane indicate that stick force versus acceleration does not vary appreciably with Mach number within the airplane restrictions (figure 5–2). Stick force per g increases with forward movement of the center of gravity.

MANEUVERING FLIGHT CHARACTERISTICS.

Flight characteristics during maneuvers are normal. To reduce turn radii, use 20 degrees of wing flap at 200 knots or less. Pilots unfamiliar with this airplane should enter slow rolls at 180 knots and loops or Immelmanns at 280 knots.

DIVES.

Flight characteristics are normal and control forces are not excessive during dives. Use of the landing gear as a speed brake within the airspeed limit requires some nose-up trim adjustment and is permissible only with the gear fully extended and locked except in emergency. See figures 6–2 and 6–3 for dive recovery data.

EXTERNAL LOADS EFFECTS.

With loads on either the centerline pylon or the center section pylons no buffeting is likely to occur at speeds and accelerations within the limits of the airplane. With loads on all three pylons, buffeting will probably occur at speeds between 300 to 350 knots. When buffeting occurs, reduce speed to prevent damage to the wing flaps.

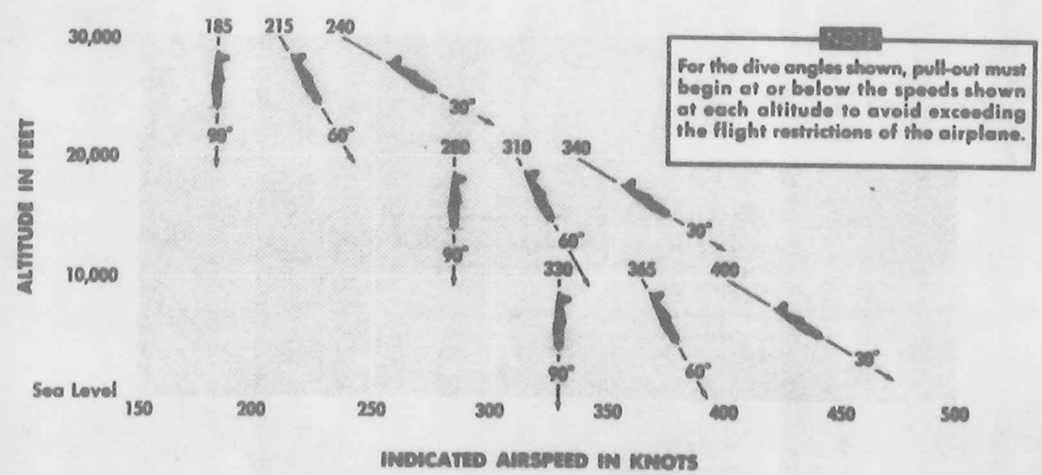
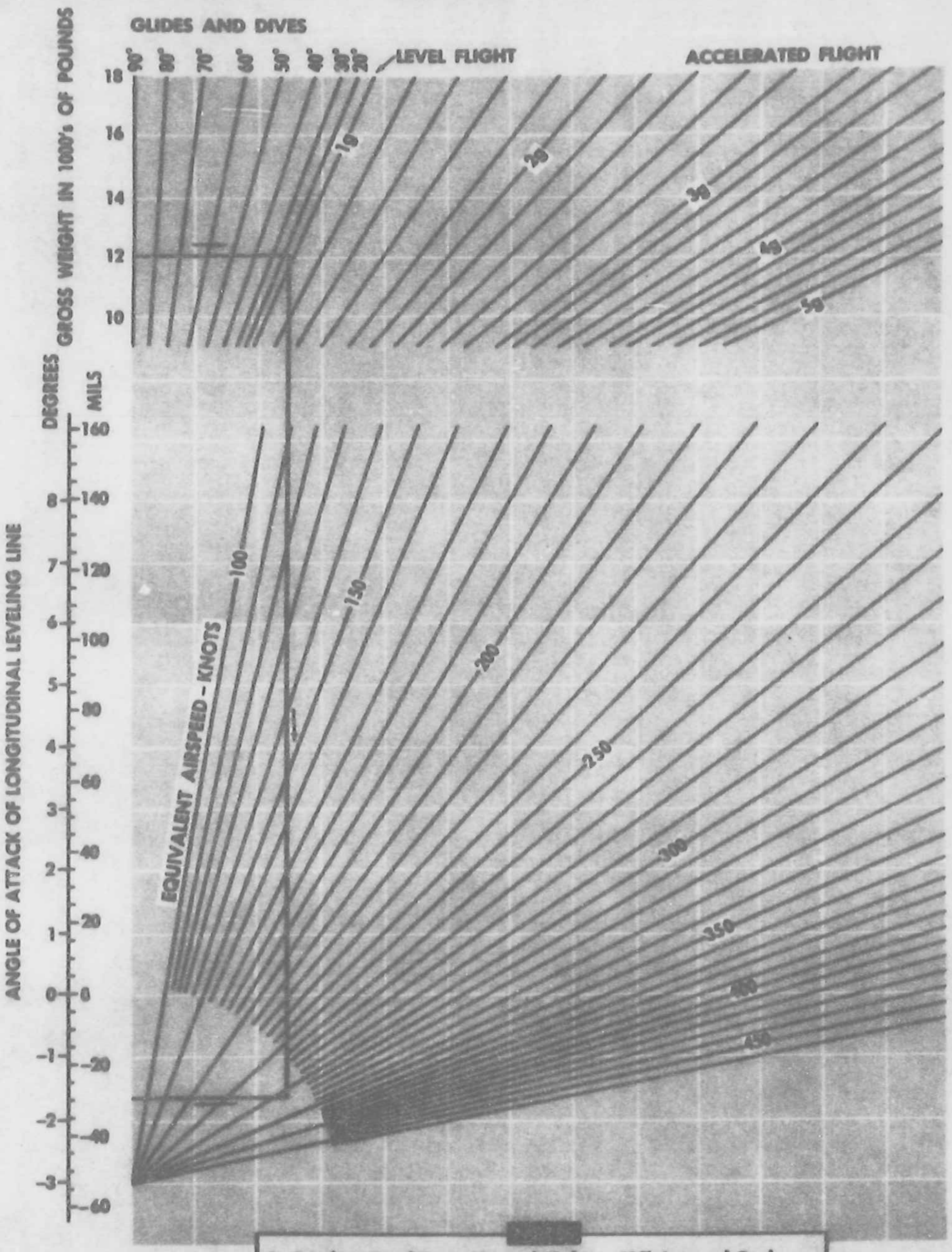


Figure 6–3. Limit Speeds for Various Dive Angles

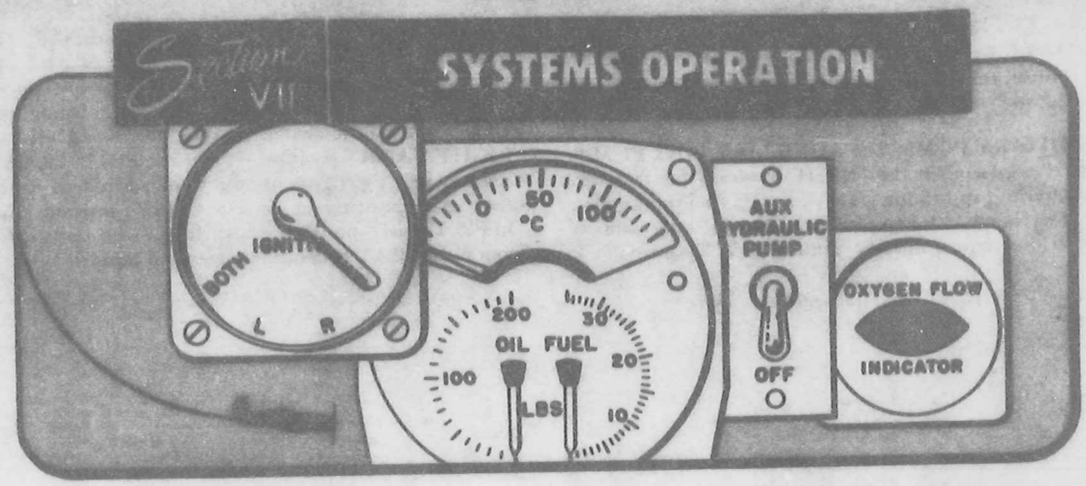


[redacted]

1. Combat Condition — Normal Fighter, 60% Internal Fuel + 10 — 5-inch Rockets. Gross Weight — 13,926 Pounds.
2. Subtract 0.23° (4 MILS) to Obtain Armament Datum Line.
3. Add 8.27 Degrees (144.3 MILS) to Obtain Rocket Datum Line.

Figure 6—4. Angle-of-Attack Chart

56(Blank)



ENGINE.

MANUAL LEANING. Manual leaning is possible, but is not recommended because there is no way to judge the effect on engine output and fuel consumption.

SUPERCHARGER SHIFT CONSIDERATIONS. See figures A-5, A-6, and A-19 for altitudes and manifold pressures that will require supercharger shifting. To shift the supercharger from low to high ratio, proceed as follows:

THROTTLE control........Reduce setting to avoid exceeding manifold pressure limits

PROPELLER control........Reduce to approximately 1,700 rpm

SUPERCHARGER control........Shift smoothly from "LOW" to "HIGH" without stopping between positions

In shifting from high to low ratios, the THROTTLE control setting does not have to be reduced. When under combat power or in an emergency, the shift may be made without changing the THROTTLE and PROPELLER controls. To allow clutch heat to dissipate, a second shift should not be made for 2 minutes after the first shift. To prevent sludging and the resultant damage to the supercharger, the supercharger clutches must be exercised before each flight and every 3 hours in the air during long flights when operating in one supercharger ratio.

CARBURETOR ICING. In the presence of high humidity, when the carburetor air temperature drops to 5°C, there is a possibility of ice forming in the air metering passages and bleeds of the carburetor. The alternate air supply from the engine accessory section is warm enough to prevent the formation of ice.

BACKFIRING. Backfiring is most likely to occur during a let-down at reduced power and may result in considerable damage to the engine air induction system. Operation with a rich mixture is the best way to prevent backfiring.

CYLINDER HEAD TEMPERATURE CONSIDERATIONS. Cylinder head temperatures are normally controlled by regulating the air flow by adjusting the position of the cowl flaps. Under abnormal conditions such as a descent with reduced power during cold weather, the cowl flaps may not keep the cylinder head temperatures within the recommended limits. Cylinder head temperatures may be increased by (1) making sure the cowl flaps are closed, (2) increasing the drag by lowering the landing gear and/or flaps, (3) increasing power, or (4) using a mixture leaner than "AUTO-RICH."

Note

The engine may tend to run rough at low power settings in "AUTO-LEAN" if cylinder head temperature falls below 170°C. To restore smooth operation, move the control slightly toward the "AUTO-RICH" position.

DETONATION. Detonation is indicated by a rapid rise in cylinder head temperatures and a loss of power. Operation with a richer mixture will help prevent detonation. To stop detonation, open the cowl flaps and reduce power.

SPARK PLUG FOULING. Fouling of the spark plugs usually results from operation with reduced power and a rich mixture. Increasing power and leaning the mixture will help to remove the carbon from the spark plugs.

GROUND OPERATIONS. To prevent fouling the spark plugs, the engine should not be operated for prolonged periods at less than 1,000 rpm. When possible, the rpm should be increased to 1,400 (or until the GEN WARNING LIGHT goes out) to allow the generator to reach a charging potential.

FUEL SYSTEM.

TANK SELECTION. Except in the event of a transfer system failure, the fuel selector control is normally left in the "ON" position for all flight operations. For the procedures to be followed in the event of a fuel transfer failure, refer to section III, Emergency Fuel System Operation.

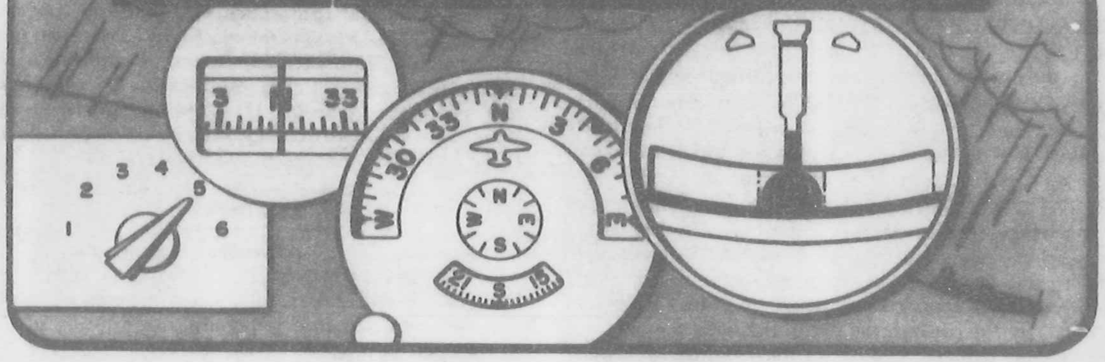
AUXILIARY PUMP. The AUXILIARY FUEL PUMP switch is placed in the "HIGH" position for take-off and landing, and in the event of a main fuel pump failure (section III, Pump Failure). Normal and combat operations require the use of the "LOW" position.

TRANSFER. When external tanks are carried, the transfer system is put into operation after take-off and kept in operation until the external tanks are empty or until landing. Fuel is transferred by placing the FUEL TRANSFER switch in the "LEFT TANK" or "RIGHT TANK" position. When the FUEL TRANSFER warning light goes on, the switch is placed in the other tank position or in the "OFF" position. The "LEFT TANK" position causes fuel to be transferred from either the left-hand or centerline tank.

Section VIII CREW DUTIES

(Not Applicable)

Section IX — ALL WEATHER OPERATION



GENERAL.

No provisions have been made in this airplane for flight operations under extreme weather conditions.

NIGHT FLYING.

Although not designed as a night fighter, this airplane has all the stability and cockpit lighting necessary to permit successful tactical flights at night.

INSTRUMENT FLIGHT PROCEDURES.

The instrument flight procedures for this airplane are similar to those for any single-engine airplane. See figure 9–2 for suggested instrument approach pattern.

FLIGHT IN THUNDERSTORMS AND TURBULENCE.

Flight through thunderstorms should never be regarded lightly. However, when required, even violent thunderstorms may be traversed safely by (1) preparing the airplane and yourself before entering the storm, (2) staying within the penetration speeds given in figure 9–1, and (3) concentrating on maintaining attitude. To prepare the airplane, proceed as follows:

- MIXTURE control .... "AUTO-RICH"
- PROPELLER control .... Adjusted to 2,600 rpm
- CARBURETOR ALTERNATE AIR switch—"ON"
- G-2 Compass switch .... "COMPASS CONTROL"
- PITOT HEAT switch .... "ON"
- Radio .... Reduce volume to a minimum and turn off radios made unusable by static
- Flight lights .... On bright
- Safety belt .... Tight
- Oxygen mask .... Connected and used

Flying on instruments, enter the storm at a minimum safe altitude above terrain obstacles and prepare for a rough ride. Rely primarily on the gyro instruments and the airspeed indicator. *Concentrate on flying attitude.* Allow the airplane to ride the gusts, using the throttle only when high- or low-altitude limits are exceeded. The greatest danger from lightning lies in the possibility of a flash briefly blinding the pilot.

COLD WEATHER PROCEDURES.

GENERAL. This airplane is not equipped for flight operations during extreme cold or icing conditions. During moderate cold spells operations may be carried on successfully.

EXTERIOR CHECK. In addition to normal checks (section II, Exterior Inspection), be sure that all covers have been removed and that all exterior surfaces, intake openings, and vent holes are free of ice and frost.

INTERIOR CHECK. Make a normal cockpit check (section II, On Entering Airplane).

PRESTART PROCEDURES. Heat engine with portable heater to aid in starting, and have propeller turned through (section II, Before Starting Engine).

STARTING. It is important that external power be used for starting in cold weather. Use normal starting procedure (section II, Starting Engine); bear in mind that diluted oil increases fire hazard during starting.

WARM-UP AND GROUND TESTS. Warm up the engine thoroughly. Leaning the mixture to slightly less than "AUTO-LEAN" will aid in warming the engine. Do not close the cowl flaps for ground operation. Use the same ground tests as would be used for normal operation (section II, Ground Tests).

Altitude (feet)	V (Knots) IAS			
	Severe Turbulence		Moderate Turbulence	
	Minimum Airspeed	Maximum Airspeed	Minimum Airspeed	Maximum Airspeed
0	150	300	110	400
10,000	150	300	110	400
15,000	150	300	110	370
20,000	155	270	115	335
25,000	160	250	125	295
30,000	165	220	130	255

Figure 9–1. Turbulent Air Penetration Chart

TAXIING. Use extreme caution if taxiing on ice or packed snow. If temperatures are near freezing, avoid taxiing through water or slush. Wet brakes may freeze in the air, and water thrown by the propeller may freeze on intakes, vent holes, and control surfaces.

BEFORE TAKE-OFF CHECK. In addition to the normal check (section II, Before Take-Off), make sure that the surface control and tab movements are free.

TAKE-OFF. If take-off is to be made from ice or packed snow, apply throttle slowly and do not hold brakes. Use 50 degrees of flap. When airborne, work the tabs, if wet, to prevent their freezing.

FLIGHT. No difficulties other than icing should be experienced in cold weather flight. Avoid severe icing conditions. Moderate icing conditions can be combated with pitot tube heat and alternate carburetor air. During let-downs, cylinder head temperature may be maintained by increasing the drag through the use of wheel and or flaps. The engine may tend to run rough at low power settings in "AUTO-LEAN" if cylinder head temperature falls below 170°C. To restore smooth operation, move the control slightly toward the "AUTO-RICH" position.

LANDING. The approach and landing must be smooth if a slippery runway is to be used. Use brakes sparingly.

STOPPING ENGINE. If temperatures below 2°C (35°F) are expected, dilute engine oil as follows:

Manual shut-off valve	Open
THROTTLE control	1,000 rpm
AUXILIARY FUEL PUMP switch	"LOW"
OIL DILUTION switch	"ON" for period determined from figure 9–3.

If oil tank is to be serviced, divide dilution time into one-half before and one-half after servicing. During last minute of dilution, advance the THROTTLE control to give 1,600 rpm. Then with throttle constant, move PROPELLER control to obtain 1,200 rpm, then back to full "INCREASE." Repeat, and throttle the engine back to 1,000 rpm. Stop engine by using normal procedure (section II, Stopping Engine), and leave oil dilution switch on until engine stops turning. Close and safety manual shut-off valve.

CAUTION

Dilution will considerably increase the inflammability of vapors issuing from crankcase breather. At an ambient temperature of 60°F, the oil itself will burn at a dilution of 20 percent. Make sure that personnel with fire extinguishers are standing by in vicinity of airplane during dilution operation.

BEFORE LEAVING AIRPLANE. Leave the canopy slightly open to prevent moisture condensation and the subsequent formation of ice and frost. After the engine has cooled, close the cowl flaps and the canopy sliding section and install covers. Covering the control and wing surfaces will speed up preparation for flight by preventing formation of ice and frost on surfaces.

HOT WEATHER PROCEDURES.

Follow the same procedures for operations in hot weather as for operations in moderate weather.

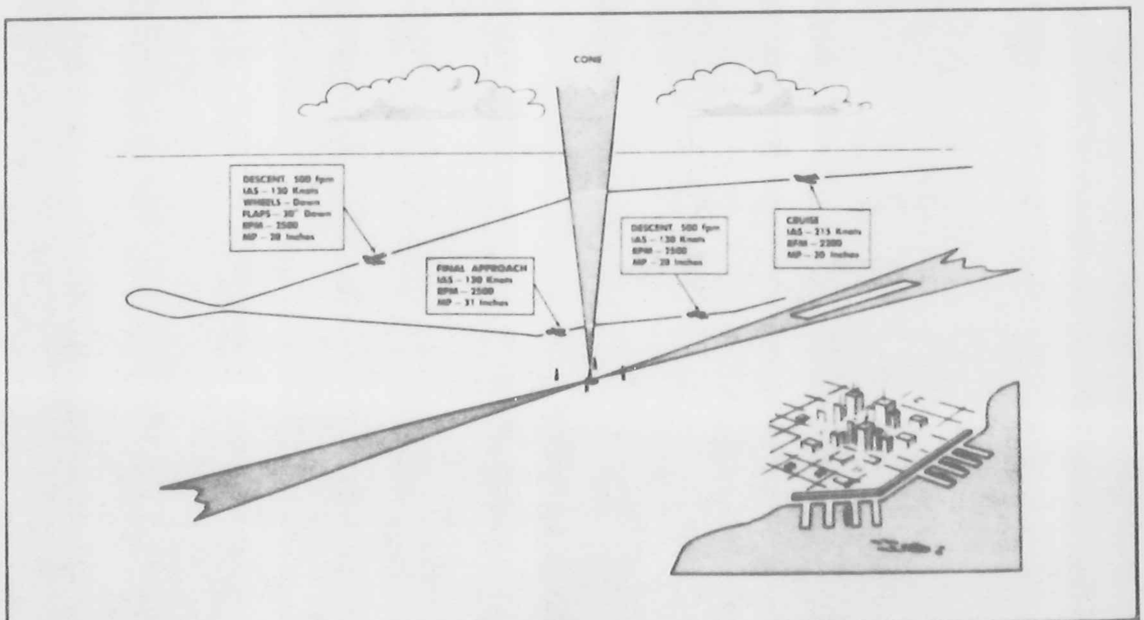


Figure 9–2. Suggested Instrument Approach Diagram

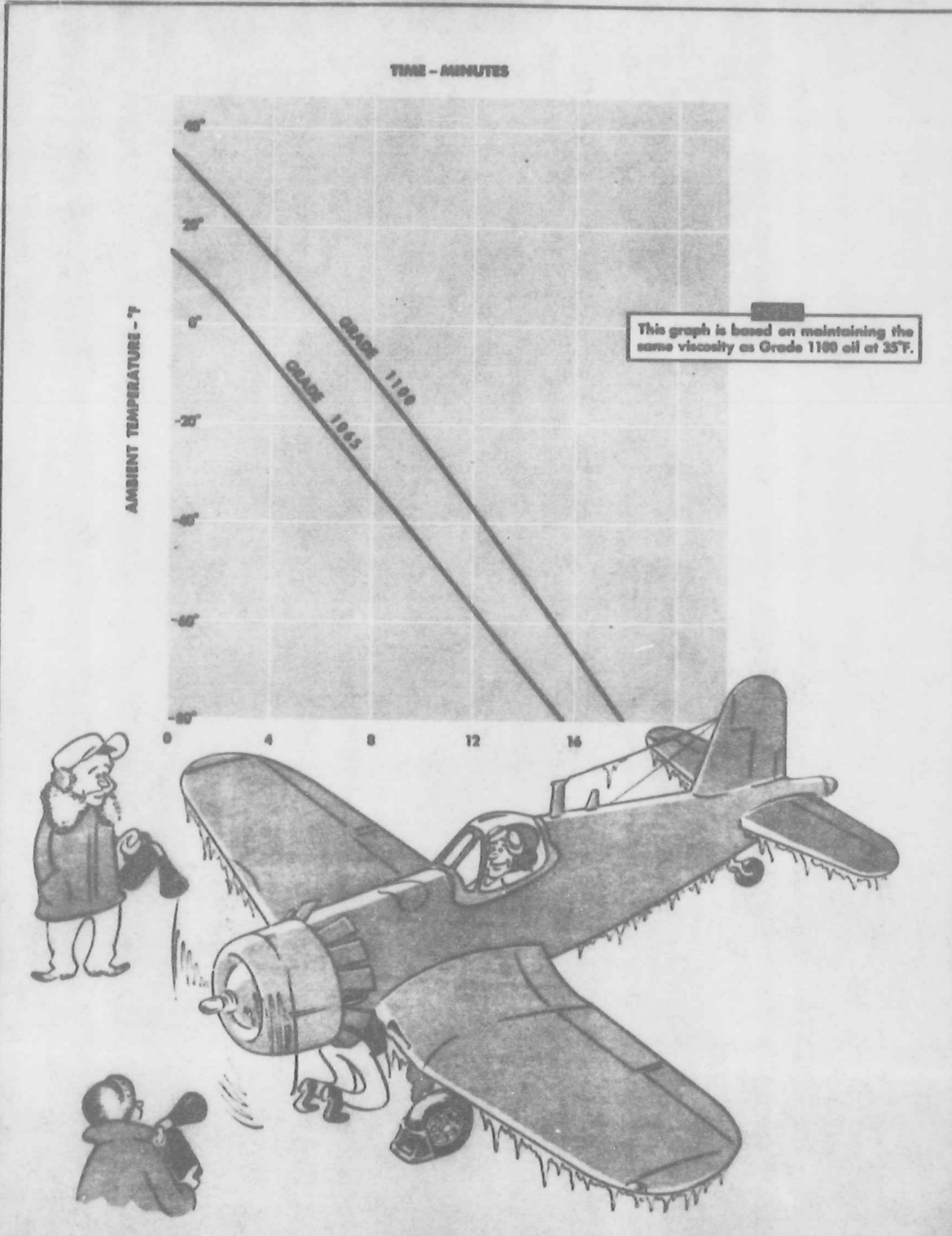


Figure 9–3. Oil Dilution Time Chart

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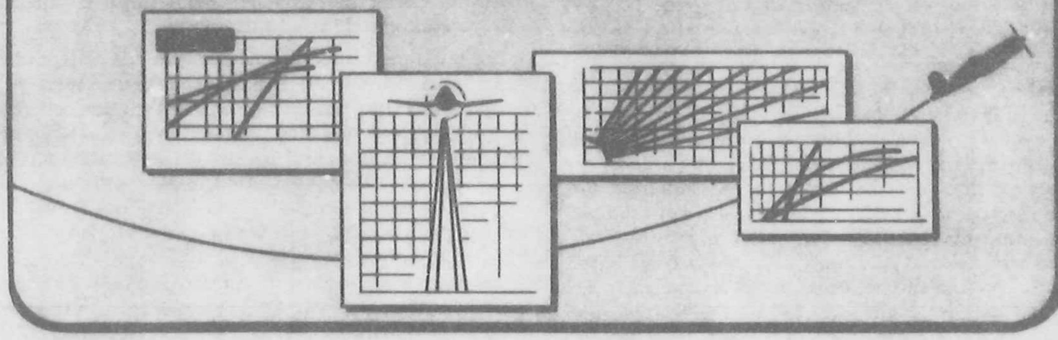
Appendix I OPERATING CHARTS



INTRODUCTION.

GENERAL. Appendix I contains the data from which the performance of the airplane can be predicted. This information is needed both for the planning of flights and for an understanding of the factors affecting the airplane's performance. A sample problem which has been devised to illustrate the use of the charts is located following the explanations of the charts. Notations on the charts are keyed to the discussions in the text to show the sequence of operations used. Where applicable, figures from the problem are used in the discussions of the charts; table IV, Abbreviations and Symbols, and table V, External Stores Weights, are given to aid in the use of the charts.

POWER AND FUEL CONSIDERATIONS. A number of variable factors affect the power output and fuel consumption of the engine as follows:

a. Ram effect, which increases with forward velocity, increases the altitude at which the engine can maintain rated power and manifold pressure.

b. In general, at a given manifold pressure, a higher rpm will give higher fuel consumption because of the increased volume of fuel flowing through the engine. Reducing the rpm necessitates an increase in the brake mean effective pressure (BMEP) which may lead to exceeding the BMEP limits of the engine if too low an rpm is used. The desirable operation point for minimum fuel consumption would be at minimum rpm, within the BMEP and manifold pressure limits of the engine, to maintain the best-range speed.

c. More engine power is required to drive the supercharger in high ratio than in low ratio. Therefore, in general, a higher power setting of both manifold pressure and rpm will be necessary to maintain the same speed in high ratio as in low ratio.

d. The position of the MIXTURE control affects fuel consumption and engine cooling. Minimum fuel will be used by the engine when the MIXTURE control is in the "AUTO-LEAN" position. With the MIXTURE control in "AUTO-LEAN," the engine operating temperature normally will be higher than when in "AUTO-RICH."

CAUTION

Do not exceed normal rated power engine speed (2,600 rpm) with MIXTURE control in "AUTO-LEAN" position.

e. Humidity affects power as follows: At constant total air flow through the carburetor (full throttle), a portion of the induction air is replaced by water vapor which decreases the total dry air flow. This decrease in dry air flow results in: (1) A reduction in horsepower output since dry air flow into the engine is a direct measure of horsepower, and (2) fuel-air ratio enriched above normal dry air mixtures since the carburetor meters to total flow of air and water vapor. The presence of excessive water vapor in the combustion process affects combustion efficiency, resulting in a loss in power (drowning). Under very humid conditions, total power loss from all of these conditions can be as great as 7 percent.

f. Carburetor air temperature (CAT) affects air flow into the engine, and it affects the temperature of the mixture entering the cylinders. At constant manifold pressure, rpm, and pressure altitude, air flow into the engine varies only with the temperature of air entering the carburetor. Increase in CAT causes a decrease in weight flow of air into the engine and a reduction in power output (since weight flow of air into the engine is a direct measure of horsepower output). At constant manifold pressure, rpm, and pressure altitude, induction air pressure and temperature rise across the supercharger are nearly constant. If CAT is lower than limit CAT, the temperature of the mixture entering the cylinder is lower than the detonation limit temperature.

Therefore, the manifold pressure can be increased slightly to attain the limit BMEP conditions.

ALTERNATE FUEL. The use of grade 100/130 fuel imposes a manifold pressure limit of 53 inches (sea level) to 52 inches (4,000 feet) in low blower operation only. In those charts where curves are not based on military power, the substitution of grade 100/130 fuel for grade 115/145 fuel will have no effect on performance data.

CHARTS.

AIRSPEED POSITION ERROR CORRECTION. *(See figure A-1.)* To obtain calibrated airspeed, use the Airspeed Position Error Correction chart which gives the correction that is to be added to the indicated airspeed for various attitudes of the airplane. For example, the sample problem calls for a return cruising calibrated airspeed of 225 knots at a weight of 12,937 pounds. To find the indicated airspeed that gives the required calibrated airspeed, follow the weight lines to a point where a projection to the left (A to B) and a projection down (A to C) give a total of 225 knots. This point A gives an indicated airspeed of approximately 224 knots.

AIRSPEED COMPRESSIBILITY CORRECTION. *(See figure A-2.)* To obtain equivalent airspeed from calibrated airspeed, use the Compressibility Correction chart which gives the necessary corrections for pressure altitude and temperature. For example, the sample problem calls for the return from the target at a 225-knot calibrated airspeed at an altitude of 15,000 feet. To find the equivalent airspeed, enter the chart at 225 knots on the calibrated airspeed scale and project vertically to 15,000 feet (A to B), then horizontally to the correction scale (B to C). Subtract the correction of 2.3 knots from the calibrated airspeed to obtain an equivalent airspeed of 222.7 knots.

DENSITY ALTITUDE. *(See figure A-3.)* To convert equivalent airspeed to true airspeed, use the Density Altitude chart which gives the necessary correction for temperature and pressure altitude. The correction is a factor ($1/\sqrt{\sigma}$) by which the equivalent airspeed is multiplied to get true airspeed. For example, using the data given in the problem, assume a normal temperature of −15°C at a pressure altitude of 15,000 feet. Enter the chart at −15 on the temperature scale and project vertically to 15,000 feet (A to B) then horizontally to the right (B to C) to the ($1/\sqrt{\sigma}$) scale, which gives a correction factor of 1.26. Projection horizontally to the left (B to D) gives the density altitude. Multiply the equivalent airspeed of 222.7 knots by 1.26, giving a true airspeed of 281 knots for the return from the target.

STANDARD ALTITUDE TABLE. *(See figure A-4.)* The Standard Altitude table gives various physical properties of the standard atmosphere. For example, the standard temperature at 1,000 feet is 13.019°C. Standard temperature lapse rate is 2°C per 1,000 feet up to 35,332 feet (isothermal level); altitudes above this maintain −55°C.

ENGINE OPERATING LIMITS. *(See figures A-5 and A-6.)* The Engine Operating Limits charts present (1) the power provided by the engine for any possible combination of control settings, and (2) the approved engine control setting limits. The curves are based on no ram and operation under NACA standard day conditions. Corrections as stated below must be made for other atmospheric conditions.

The horizontal lines of constant rpm and BHP indicate maximum allowed BHP permitted for the corresponding rpm. Interpolation between these lines is permitted. Manifold pressure values shown are limiting values for sea level and critical (full throttle) altitudes respectively. These manifold pressure values corresponding to the applicable rpm's may not be exceeded except as described below for carburetor air temperature (CAT) deviations. Interpolation between these limiting values is permitted to accompany the interpolation between rpm lines. The limit manifold pressure values for altitudes between sea level and critical altitudes will constantly decrease as altitude increases. Specific values may be determined as in the following example: If 35 inches manifold pressure and 2,300 rpm are chosen, extend the 2,300 rpm full throttle line until it intersects the 35 inches manifold pressure line extended. Through this intersection, which occurs at 1,340 BHP and 9,500 feet altitude, draw a slope line parallel to the constant manifold pressure-rpm line. This slope line will then represent constant 35 inches manifold pressure and 2,300 rpm operation, intersecting the sea-level line at 1,180 BHP. The slope line also intersects the 1,220 BHP and 2,300 rpm limit line at 2,000 feet and thus defines the manifold pressure limit of 35 inches at 2,000 feet, and 2,000 feet as the highest altitude at which 2,300 rpm and 35 inches manifold pressure may safely be used. Interpolation between these limiting manifold pressure values may also be made along the constant BHP and rpm lines.

The effect of ram is to increase the altitude at which full throttle occurs at a particular rpm setting. The manifold pressure limit for these higher critical altitudes may be obtained by the method described above. For example, if ram permits 1,220 BHP to be obtained with 2,300 rpm at 14,000 feet altitude under standard CAT conditions, the manifold pressure limit of 31.7 inches is determined by passing a slope line parallel to the constant manifold pressure-rpm line through the 14,000 feet altitude and 1,220 BHP point and reading the manifold pressure (31.7 inches) at the intersection of the slope line and the no ram full throttle 2,300 rpm line.

In the power range below 2,500 rpm, manifold pressure limits are reduced ¼ inch for each 6°C decrease in CAT below standard temperature, and are increased ¼ inch for each 6°C increase in CAT above standard temperature up to 38°C in "LOW" and 15°C in "HIGH" supercharger ratios. At this point, manifold pressure limits are decreased 1 inch for each 6°C increase in CAT above this temperature limit. At 2,500 rpm and above, manifold pressure limits are reduced ¼ inch for each 6°C decrease in CAT below standard temperature. In this power range, manifold pressure limits are not increased to compensate for power losses due to above-standard temperatures, and are reduced ¼ inch for each 6°C increase in CAT above 38°C in "LOW" and 15°C in "HIGH."

Standard temperature (15°C at sea level) decreases 2°C per 1,000 feet altitude. Standard temperature at 5,000 feet is 5°C.

TAKE-OFF. *(See figure A-7.)* The Take-off chart gives the ground roll distance for take-off, incorporating the factors of temperature, altitude, gross weight, deviation from standard temperature, humidity, and headwind. A specific humidity nomograph and specific humidity corrections for altitude are given on a separate part of the chart. Factors are also given at the bottom of the chart for obtaining distance needed to clear a 50-foot obstacle. For example, use the sample problem and assume an air temperature of 20°C (A), an altitude at the field of 1,000 feet (A to B), and gross weight of 17,169 pounds (B to C). Deviation from standard air temperature is obtained by subtracting the standard temperature, which is given at the intersection of the standard temperature line and the given altitude line, from the observed air temperature (20°C−13°C=7°C, D to E). Note that in going from gross weight to deviation from standard temperature, the projection goes to the 0°C line (C to D) and then to the deviation (D to E). (If the deviation were negative, the projection from point D would be upward and to the left.) From the temperature deviation, the projection drops to the specific humidity curves (E to F), then along the curves to the specific humidity value of 0.01 (F to G). The projection then drops to the headwind curves (G to H), along the curve to the assumed headwind value of 15 knots (H to I), and down to the ground roll distance of 1,475 feet (I to J). By interpolation, take-off equivalent airspeed is found to be 89 knots. To clear a 50-foot obstacle at 17,000 pounds, multiply the ground roll distance by the factor given at the bottom of the chart (2 × 1,475 ft=2,950 ft).

For an example of the use of the nomograph, assume a dry bulb temperature of 30°C, and wet bulb temperature of 20°C. Project a straight line through the two temperatures to the specific humidity scale (A to B to C); this gives a value of 0.011.

To obtain the specific humidity at a take-off altitude higher than sea level, enter the specific humidity chart at an assumed sea level specific humidity of 0.010 and project horizontally to an assumed altitude of 10,000 feet (A to B). From the altitude line, project vertically downward to the specific humidity at altitude scale (B to C); this gives a value of 0.0145.

CLIMB. *(See figures A-8 through A-11.)* The four Climb charts give either distance and fuel or time and fuel needed for climbing with normal rated power and military rated power. For example, using the values from the sample problem, enter both the normal rated power climb charts at 16,870 pounds and project upward along curves to 10,000 feet (A to B), then project horizontally to the distance or time scale (B to C), which gives approximately 22 miles or 9 minutes to climb to 10,000 feet. A vertical projection dropped to the weight scale (B to D) gives the weight reduction due to fuel being used in the climb. Since the problem starts the climb at 1,000 feet, subtract the time and distance to climb 1,000 feet from the above values, giving approximately 8½ minutes and 21 miles.

EMERGENCY CLIMB. *(See figure A-12.)* The Emergency Climb chart shows rate of climb immediately after take-off, using take-off power. Three configurations and three weights are considered. Curves terminate at the approximate stalling speed for the configuration. The effect of external stores is included where applicable. For example, using the unadjusted take-off weight of 17,169 pounds from the sample problem and assuming flaps and gear up, find the best climbing speed and rate of climb by interpolating between the values taken from the chart. Maximum rate of climb at 16,000 pounds is 2,450 feet per minute, and at 19,300 pounds is 1,700 feet per minute. By interpolation, the effect of weight is approximately 0.227 feet per minute per pound. For 17,169 pounds, the expected rate of climb is 2,285 feet per minute. The best speed at 16,000 pounds is 124 knots, and at 19,300 pounds is 135 knots. By interpolation, the best speed at 17,169 pounds is approximately 128 knots.

EMERGENCY CEILING. *(See figure A-13.)* The Emergency Ceiling chart shows the service ceiling at various weights for normal and military rated powers. Assuming a gross weight of 16,500 pounds, enter the chart from the weight scale and project vertically to the normal or military curves (A to B) then horizontally to the altitude scale (B to C) which reads 24,600 feet for normal power.

NAUTICAL MILES PER GALLON OF FUEL. *(See figure A-14.)* The Nautical Miles per Gallon of Fuel charts give the nautical miles obtained per gallon of fuel for various altitudes, airspeeds, weights and power settings, or the power settings necessary to make good a desired airspeed for a given weight. There are six charts which separate the data by altitude. The gross weights include the effect of drag of typical external stores carried. Using data from the sample problem to find the maximum range conditions at 10,000 feet, find the adjusted weight by adding weight adjustment factors (3,200 pounds for six 500-pound bombs and 1,150 pounds for one 150-gallon drop tank) from the Drag Conversion Table (figure A-22) to the normal gross weight (12,900 pounds), and subtract the fuel (378 pounds) previously used for take-off and climb. Enter the chart at the adjusted weight of 16,872 pounds and move along the weight curves to the maximum range curve. Projecting vertically downward gives the true airspeed (A to B) and the calibrated (A to C). By interpolating between the given power setting lines, the power settings that will give the maximum range are found to be approximately 34 inches and

2,200 rpm. By projecting from point A to the specific range scale, the specific range is found to be 2.1 nautical miles per gallon.

When the calibrated airspeed is not near the maximum range or maximum endurance lines, as during the return from the target in the sample problem, use the normal gross weight (12,900 pounds) of the airplane with the adjusted calibrated airspeed to find the required power settings. Using data from the sample problem, it is desired to make good 225 knots at 15,000 feet with one centerline pylon and ten rocket launchers. The Δ EAS adjustment from the Drag Conversion chart is 10 knots, giving an adjusted calibrated airspeed of 235 knots which is used to enter the 15,000-foot altitude Nautical Miles per Gallon of Fuel chart at point A. Projecting vertically upward to 12,900 pounds (A to C) gives a power setting of approximately 2,600 rpm and 34 inches. Projecting downward along the power setting line to its intersection with the indicated airspeed (225 knots) at point D, then projecting horizontally to the specific range scale (D to E) gives 2.45 nautical miles per gallon of fuel.

In a case where a specified power setting is used which intersects the weight line away from the maximum range or endurance lines, ΔEAS adjustment is used with the normal gross weight of 12,900 pounds. To find the resulting airspeed, enter the chart along the power setting line and move to the normal weight curve position. A vertical projection downward to the calibrated airspeed scale gives the unadjusted airspeed. To obtain the actual calibrated airspeed, subtract ΔEAS from the unadjusted calibrated airspeed. To obtain specific range, project up from actual calibrated airspeed to power setting line, then horizontally to specific range scale.

The effects of wind on speed and range for maximum range are considered as follows: In selecting maximum range speed for wind conditions, increase or decrease true airspeed for maximum range by 1/4 of head or tail wind. To determine the effect of wind on specific range for any predetermined power setting, subtract or add head or tail winds respectively to true airspeed along power setting (fuel flow line) and read correct nautical miles per gallon and ground speed.

MAXIMUM RANGE. *(See figure A-15.)* The Maximum Range chart gives miles per gallon, gallons per hour, power settings, and calibrated airspeed for obtaining maximum range. Using a gross weight of 16,872 pounds and an altitude of 10,000 feet, enter the chart at the gross weight and project a vertical line upward (A to J). At the intersection of the 10,000-foot curves and the projected line (B, D, F, H, J), project lines horizontally to obtain the necessary information. Weights used in this chart are obtained from the Drag Conversion table.

MAXIMUM ENDURANCE. *(See figure A-16.)* The Maximum Endurance chart gives gallons per hour, power settings, and calibrated airspeed for obtaining maximum endurance. The gross weights include the effect of drag of typical external stores carried, making it necessary to consult the Drag Conversion Table (figure A-22) for the weights to be used. To use the chart, project a vertical line up from the gross weight and at the point of intersection with the desired altitude curves, project horizontal lines to obtain the necessary information, as in the Maximum Range chart.

LONG RANGE PREDICTION. *(See figures A-17 and A-18.)* The two Long Range Prediction charts give the range and time for maximum range flight with a given amount of fuel. These charts are based on the recommended cruising speeds from the Nautical Miles per Gallon charts (figure A-14). For example, assume a starting gross weight of 15,000 pounds and 133 1/3 gallons of fuel available. The weight change due to fuel used in flight is 6 x 133 1/3, or 800 pounds, which is subtracted from the starting gross weight. Assuming a cruising altitude of 15,000 feet, project lines upward from 15,000 and 14,200 pounds to intersect the altitude curve for 15,000 feet, then project horizontally to the miles scale (A to B to C, and D to E to F). The difference in value between F and C gives the range (350 miles) or time (1 hour 42 minutes).

COMBAT ALLOWANCE. *(See figure A-19.)* The Combat Allowance charts are summaries of the military and combat power conditions. An example of use of the charts is as follows: At 5,000 feet the military power conditions are 2,800 rpm, full throttle, low blower, and auto-rich. A time limit of 5 minutes and cylinder head temperature limit of 241 C must be observed. The last column shows a fuel consumption of 239 gallons per hour.

LANDING GROUND ROLL. *(See figure A-20.)* The Landing Ground Roll chart gives the ground distance used in landing roll-out for various gross weights, altitudes, temperatures, and headwinds. For example, using data from the sample problem, the landing weight is 12,517 pounds; wind, 15 knots; temperature 7 C above standard (refer to discussion of TAKE-OFF chart); and altitude of field, 1,000 feet. Enter the chart at an altitude of 1,000 feet and project horizontally to gross weight (A to B); drop a projection to the headwind curves (B to C), and move along the headwind curves to the wind velocity (C to D) and down to the ground roll scale (D to E). To obtain the distance necessary to clear a 50-foot object, the ground roll of 1,120 feet must be multiplied by 1.5, which will give 1,680 feet. The effect of temperature increases distance by 7/20 of 10 percent, which is 39 feet added to 1,120 feet or 59 feet added to 1,680 feet.

STOPPING DISTANCE. *(See figure A-21.)* The Stopping Distance chart gives the distance needed to stop for various indicated airspeeds and the minimum and maximum take-off weights. Distances for other weights may be obtained by straight-line interpolation or extrapolation. Assuming a landing weight of 12,200 pounds and a touch-down indicated airspeed of 85 knots (no wind), find the stopping distance by extrapolating from the values obtained from the charts. Projecting from the IAS scale to the curves (A to B) and down to the distance scale (B to C) gives stopping distances of 1,550 feet for 12,900 pounds and 2,200 feet for 19,300 pounds. Dividing the difference in distance by the difference in weight gives an effect of weight on landing distance of 0.102 feet per pound. When this effect is multiplied by the difference in actual landing weight (12,200 pounds) and the smaller gross weight (12,900 pounds), a distance of 71 feet is obtained, which is subtracted from the smaller gross weight distance, giving a stopping distance of 1,479 feet.

DRAG CONVERSION. *(See figure A-22.)* The Drag Conversion table presents the weight and airspeed adjustment factors required to use the climb and cruise charts for any combination of external stores. The weight adjustment factors are added to the weight of the normal attack airplane (12,900 pounds), which carries no external stores, pylons, or launchers. (Actual airplane weight is used for charts other than climb and cruise charts.) The ΔEAS adjustment factor is used when the calibrated airspeed is not near the maximum range or maximum endurance lines on the Nautical Miles per Gallon of Fuel charts (figure A-14). For example, using data from the sample problem, it is necessary to obtain the weight adjustment factors from the drag conversion data in order to use the Climb chart (figures A-8 through A-11). Add to the weight of the normal attack airplane the weight adjustment factors given in the climb column for six 500-pound bombs (3,000 pounds) and one 150-gallon drop tank (1,150 pounds), which gives an adjusted weight of 17,050 pounds. To obtain weight for entering the Nautical Miles per Gallon of Fuel charts near maximum range or endurance settings, add to the weight of 12,900 pounds the weight adjustment factors in the long-range cruise column for six 500-pound bombs (3,200 pounds) and one 150-gallon drop tank (1,150 pounds), giving 17,250 pounds.

To use the Nautical Miles per Gallon of Fuel charts when the desired airspeed is not near the maximum range or maximum endurance settings, add to the desired calibrated airspeed the ΔEAS values to obtain the calibrated airspeed that must be used to enter the chart to obtain the power settings. From the sample problem, the desired calibrated airspeed is 225 knots. Because this airspeed is not near the maximum range or endurance lines, a correction must be applied. Assuming that ten rocket launchers and one centerline pylon are carried, the calibrated airspeed is 225 knots plus 5 knots for the pylon and 5 knots for the launchers, giving 235 knots. This is the calibrated airspeed value used to enter the Nautical Miles per Gallon of Fuel chart to find the power settings required to make good 225 knots. On this chart, the power settings are found at the intersection of 235 knots and 12,900 pounds. To determine the specific range, project downward from this point along the power setting line to its intersection with the indicated airspeed (225 knots), then project horizontally to the specific range scale.

Table IV. Abbreviations and Symbols

BMEP	Brake mean effective pressure
CAS	Calibrated airspeed
CAT	Carburetor air temperature
EAS	Equivalent airspeed
FAT	Free air temperature
F.T.	Full throttle
GPH	Gallons per hour
IAS	Indicated airspeed (instrument reading corrected for instrument error)
IN.	Inches of Hg (manifold pressure)
M	Mach number
MP (MAP)	Manifold pressure (manifold absolute pressure)
RPM	Revolutions per minute
SL	Sea level
STD	Standard
TEMP	Temperature
A - - - - B	Sample problem data
ΔEAS	Correction for equivalent airspeed (drag conversion)
ΔW	Change in weight
$1/\sqrt{\sigma}$	Reciprocal of the square root of the density ratio

68B (Blank)

SAMPLE PROBLEM.

GENERAL. This sample problem is presented only as an aid in explaining the use of the charts. The problem does not consider possible distance gained during let-downs, nor the effect of wind except in taking off and landing. The problem is to fly to a target 200 miles away, drop bombs, and return. The altitude going out is 10,000 feet, and back is 15,000 feet. Stores carried are one 150-gallon tank on the centerline pylon and six 500-pound bombs on the outer panel launchers. A reserve fuel allowance of 20 percent is held for possible combat or emergency use, giving a total of 384 gallons minus 77 gallons (reserve) or 307 gallons net. Fuel is grade 115/145.

TAKE-OFF.

Fuel available (less reserve)	307 gal
Take-off weight (no adjustment)	17,169 lb
Altitude of field	1,000 ft
Air temperature	20 C
Specific humidity	0.01
Wind	15 knots
Distance (ground roll)	1,475 ft
Distance (to clear 50-ft obstacle)	2,950 ft
EAS at take-off	89 knots
Fuel used (warm-up and take-off)	30 gal
Fuel remaining (less reserve)	277 gal

CLIMB — NORMAL RATED POWER.

Fuel available (less reserve)	277 gal
Climb weight—adjusted: 12,900 lb normal gross weight plus weight adjustment factors (3,000 lb for six 500-lb bombs and 1,150 lb for one 150-gal drop tank) minus 180 lb fuel used for take-off	16,870 lb
Time to climb (10,000 ft minus 1,000 ft)	8½ min
Distance to climb (10,000 ft minus 1,000 ft)	21 mi
Fuel used for climb	33 gal
Fuel remaining (less reserve)	244 gal

CRUISE OUT — MAXIMUM RANGE.

Fuel available (less reserve)	244 gal
Distance (200 mi minus 20 mi)	180 miles
Cruise weight—adjusted: 12,900 lb normal gross weight plus weight adjustment factors (3,200 lb for six 500-lb bombs and 1,150 lb for one 150-gal drop tank) minus 378 lb fuel used previously	16,872 lb
FAT (standard), determined from lapse rate; same as CAT (standard).	
CAT (indicated)	7°C
Throttle (plus CAT correction)	33.5 in.
RPM	2,200
Naut mi/gal	2.08
CAS	166 knots
TAS	191 knots
Fuel used for cruise	87 gal
Fuel remaining (less reserve)	157 gal

AT TARGET. Assume the bombs and fuel tank are dropped at 2,000 feet in one pass.

CLIMB — NORMAL RATED POWER.

Fuel available (less reserve)	157 gal
Weight — adjusted: 12,900 lb normal gross weight plus weight adjustment factors (150 lb for centerline pylon and 250 lb for 10 Aero 14A launchers)	13,300 lb
Time to climb (15,000 ft minus 2,000 ft)	7 min
Distance to climb (15,000 ft minus 2,000 ft)	19 mi
CAS	149 to 142.5 knots
Fuel used for climb	33 gal
Fuel remaining (less reserve)	124 gal

CRUISE BACK — FAST CRUISE.*

Fuel available (less reserve)	124 gal
Distance (200 mi minus 19 mi)	181 miles
Cruise weight (no adjustment)	12,937 lb
Weight for use with Δ EAS adjustment	12,900 lb
FAT (standard)	−15 C
CAT (indicated)	−15 C
Throttle (low blower)	34 in.
RPM	2,600
Naut mi/gal	2.45
CAS*	225 knots
TAS	281 knots
Fuel used for cruise	74 gal
Fuel remaining (less reserve)	50 gal

*Since there is sufficient fuel, a cruising speed faster than that for maximum cruise is chosen to show the use of Δ EAS correction with the Nautical Miles per Gallon of Fuel chart.

LANDING.

Fuel available (including reserve)	127 gal
Landing weight (no adjustment)	12,493 lb
Altitude of field	1,000 ft
Air temperature	20 C
Wind	15 knots
Distance (ground roll)	1,159 ft
Distance (to clear 50-ft obstacle)	1,739 ft

Table V. External Stores Weights

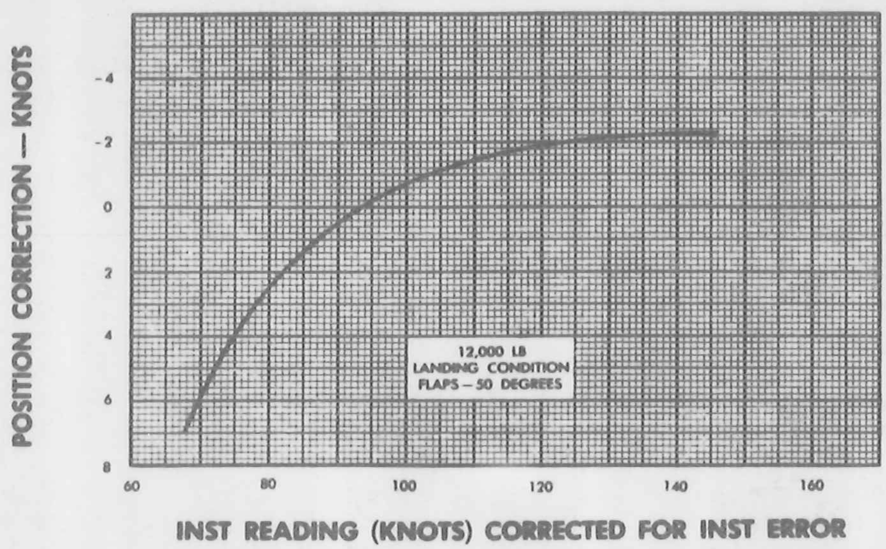
Qty	*External Stores*	*Weight (Pounds)*
1	Center section pylon, bomb rack, and sway brace assembly	71.5
1	Centerline pylon, bomb rack, and sway brace assembly	89.5
10	Aero 14A launchers	145
10	3.5-inch rockets	550
10	5-inch rockets with 3¼-inch motors	995
10	5-inch rockets with 5-inch motors	1,545
1	11.75-inch rocket (Tiny Tim)	1,280
1	MK 12 aux fuel tank (empty)	134

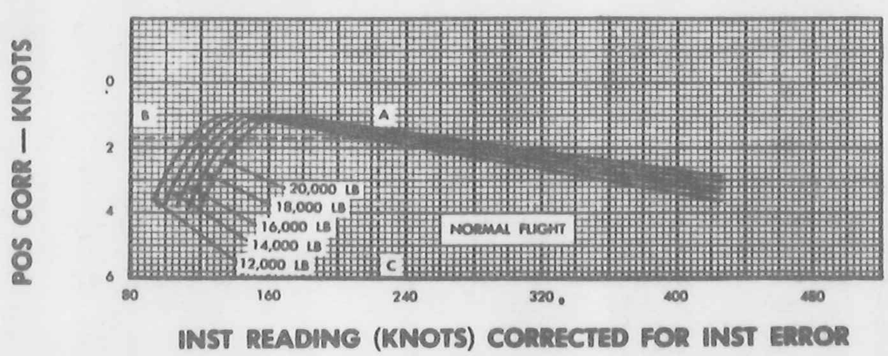
AIRSPFED POSITION ERROR CORRECTION

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0

MODEL: AU-1





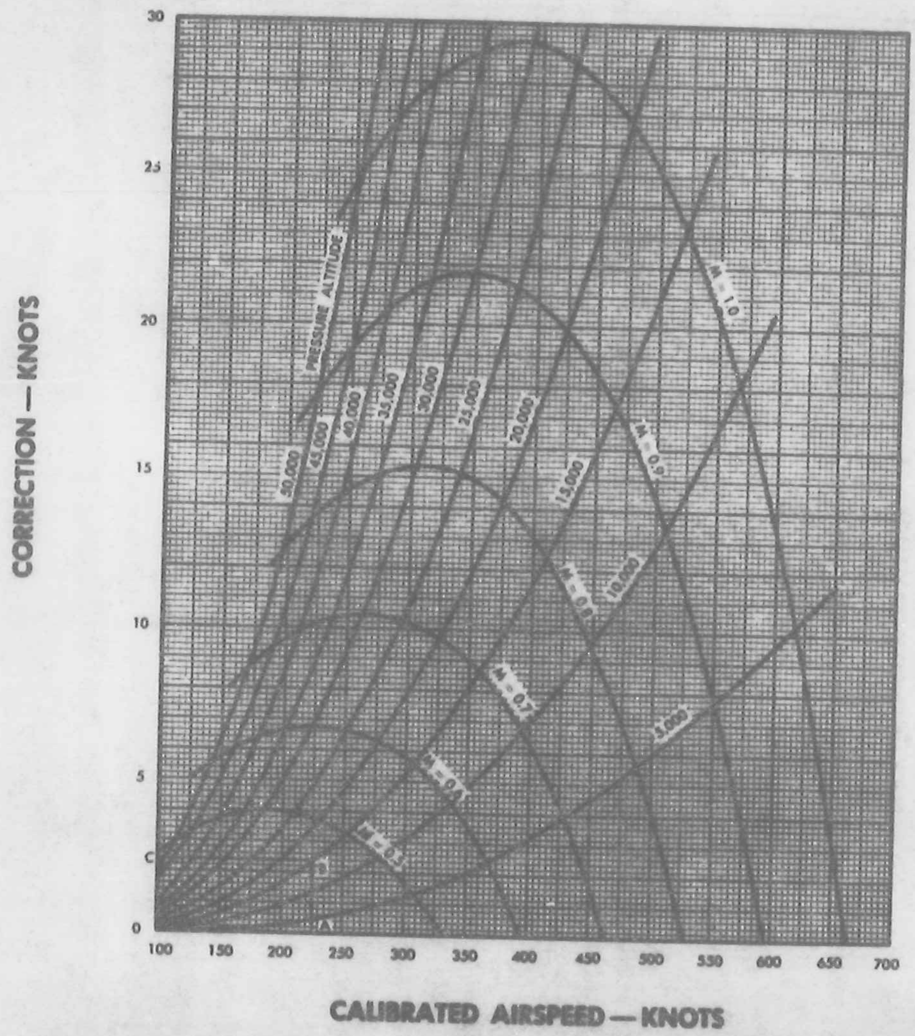
REMARKS: 1. Add correction to indicated airspeed (instrument reading corrected for instrument error) to obtain calibrated airspeed.

DATA BASED ON: Flight Test.

DATA AS OF: 1 May 1952

Figure A–1. Airspeed Position Error Correction

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

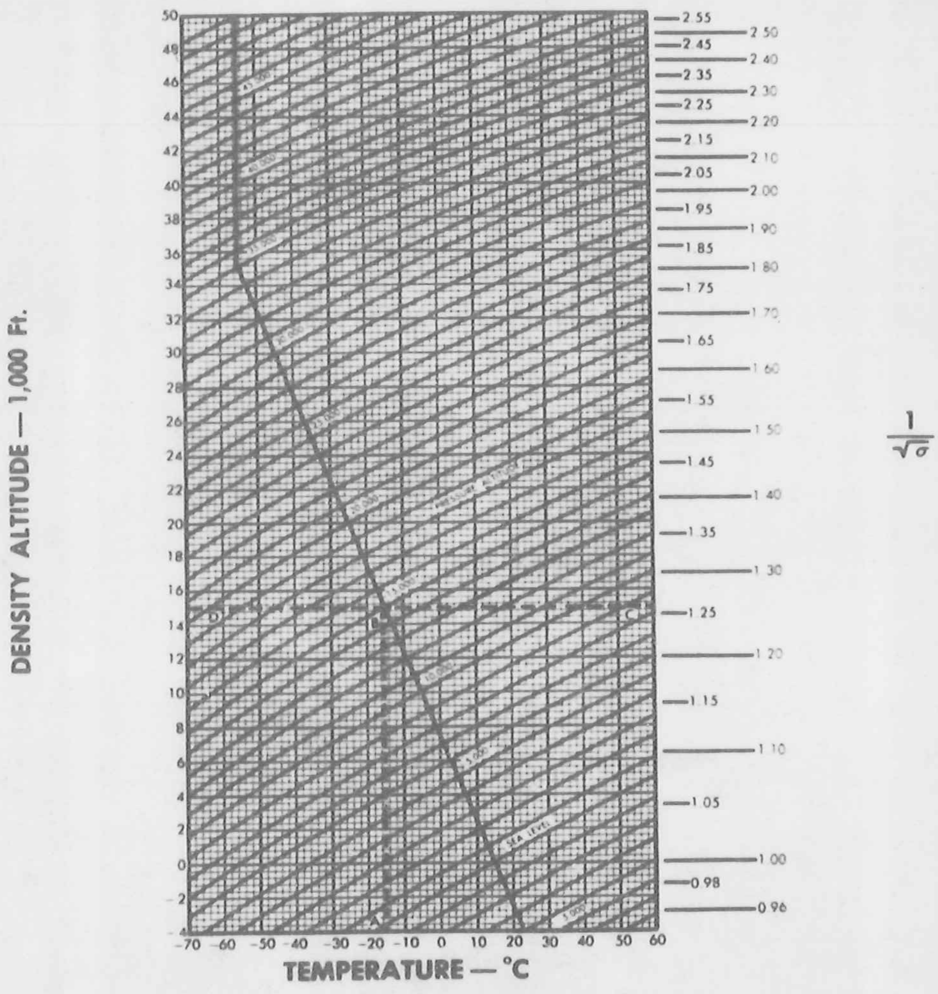


REMARKS: 1. EAS = CAS – Correction

Figure A-2. Airspeed Compressibility Correction

[redacted]

DENSITY ALTITUDE CHART



REMARKS: 1. TAS = $(1/\sqrt{\sigma})$ (EAS)

Figure A-3. Density Altitude

[redacted]

STANDARD ALTITUDE TABLE

STANDARD SEA LEVEL AIR:
$T = 15° C$
$P = 29.921$ in. of Hg
$W = .07651$ lb/cu ft

$\rho_o = .002378$ slugs/cu ft
1 in. of Hg = 70.732 lb/sq ft = 0.4912 lb/sq in.
$a_o = 1116$ ft/sec

ALTITUDE (FEET)	DENSITY RATIO ρ/ρ_o	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE DEG C	TEMPERATURE DEG F	SPEED OF SOUND RATIO a/a_o	PRESSURE IN. OF HG	PRESSURE 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	16.205	.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

REMARKS:

1/ This table is based on NACA Technical Report No. 218

[redacted]

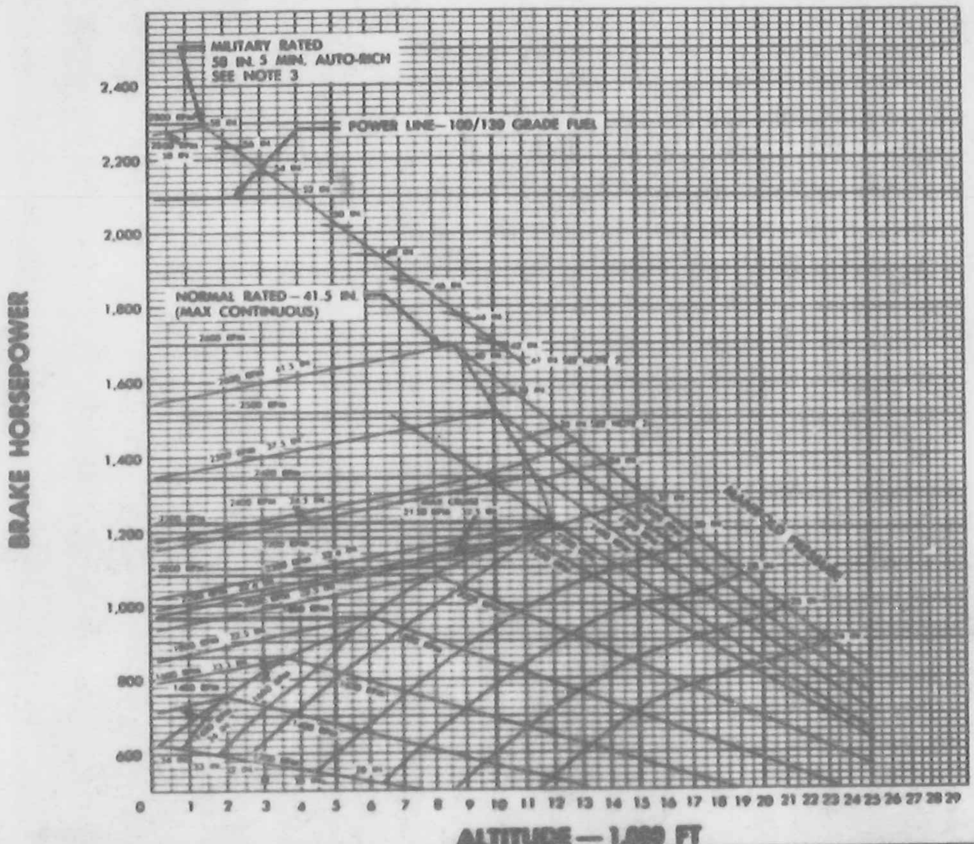
ENGINE OPERATING LIMITS

LOW BLOWER — NO RAM

STANDARD DAY

ENGINE: R2800-83WA

MODEL: AU-1 PROPELLER: 24E60/6837A-0



REMARKS:

1. Use "AUTO-RICH" for all operations above 2,400 rpm. Cylinder head temperature limits must be observed and "AUTO-RICH" used when cooling is inadequate in "AUTO-LEAN."
2. For maximum performance, shift to high blower when manifold pressure drops to 36 inches with 2,600 rpm or 41 inches with 2,800 rpm.
3. When grade 100/130 fuel is used, the brake horsepower obtainable under military power in low blower (2,800 rpm and manifold pressure of 53 inches at sea level to 52 inches at 4,000 ft) is limited to 2,100 horsepower.
4. To correct MAP for carburetor air temperature, increase or decrease standard-day manifold pressure ½ inch for each 6°C increase or decrease in carburetor air temperature, respectively, up to 38°C in low blower for power settings below 2,500 rpm.

DATA BASED ON: Estimates from PWA-OI-52A

DATE AS OF: 5 March 1945

FUEL GRADE: 115/145. See Note 3.

FUEL DENSITY: 6 Lb/Gal

[redacted]

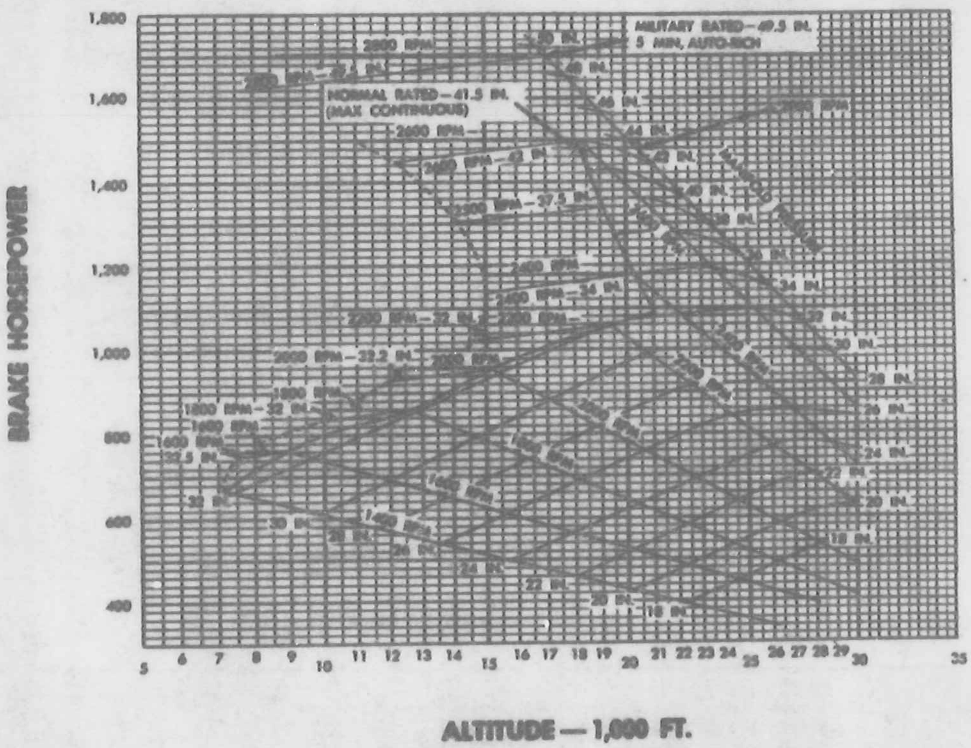
ENGINE OPERATING LIMITS

HIGH BLOWER — NO RAM

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:

1. Use "AUTO-RICH" for all operations above 2,600 rpm. Cylinder head temperature limits must be observed and "AUTO-RICH" used when cooling is inadequate in "AUTO-LEAN."
2. To correct MAP for carburetor air temperature, increase or decrease standard day manifold pressure 1/4 inch for each 6°C increase or decrease in carburetor air temperature respectively up to 15°C in high blower for power settings below 2,500 rpm.

DATA BASED ON: Estimates from PWA-OI-52A
DATE AS OF: 5 March 1945

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

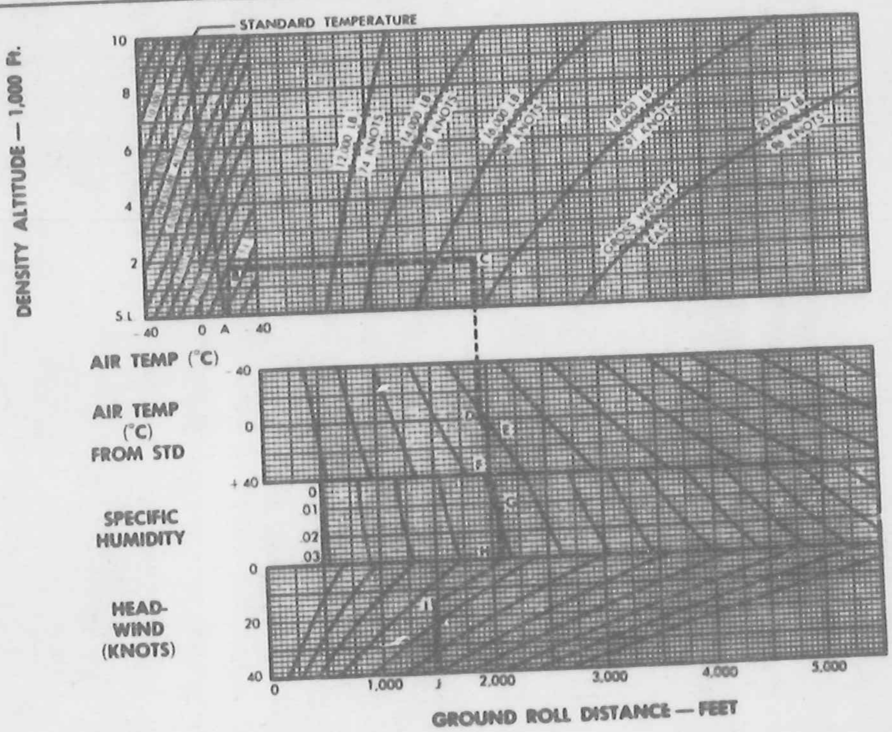
Figure A-6. Engine Operating Limits — High Blower

TAKE-OFF

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0

MODEL: AU-1



REMARKS:

1. Distance over 50-foot obstacle using flap deflection of 50 degrees
   12,000 lb to 16,000 lb ----- 2 times ground run
   18,000 lb, S.L. to 10,000 ft -- 2 to 2.5 times ground run
   20,000 lb, S.L. to 10,000 ft -- 2.2 to 3 times ground run
2. Take-off distances shown are airplane requirements during normal service operations.
3. When using 100/130 grade fuel, multiply the distances obtained from curve by 1.15.
4. These distances include the effect of the drag of the stores included in the gross weight.
5. Flap deflection is 50 degrees for ground roll distance.
6. Take-off power:
   a. For 115/145 fuel, low blower limiting manifold pressure is 58 in. at 2,800 rpm.
   b. For 100/130 fuel, low blower limiting manifold pressure is 53 in. (sea level) to 52 in. (4,000 feet) at 2,800 rpm.

DATA BASED ON: Estimates

DATA AS OF: 1 May 1952

FUEL GRADE: 115/145. See Note 3.

FUEL DENSITY: 6 Lb/Gal

Figure A-7. Take-off (Sheet 1 of 2)

HUMIDITY CHART

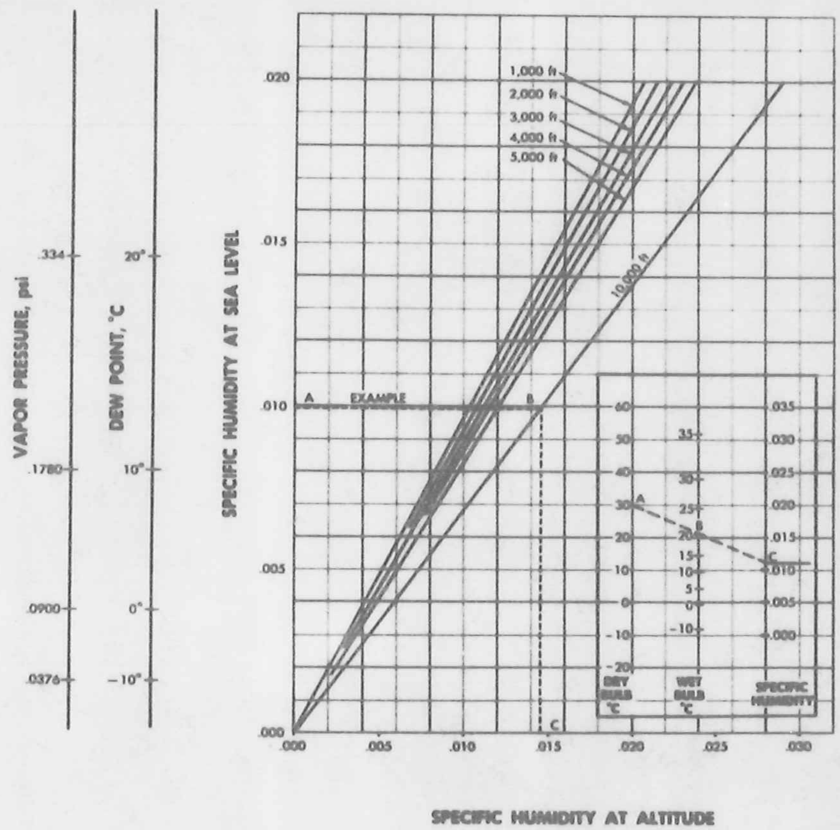


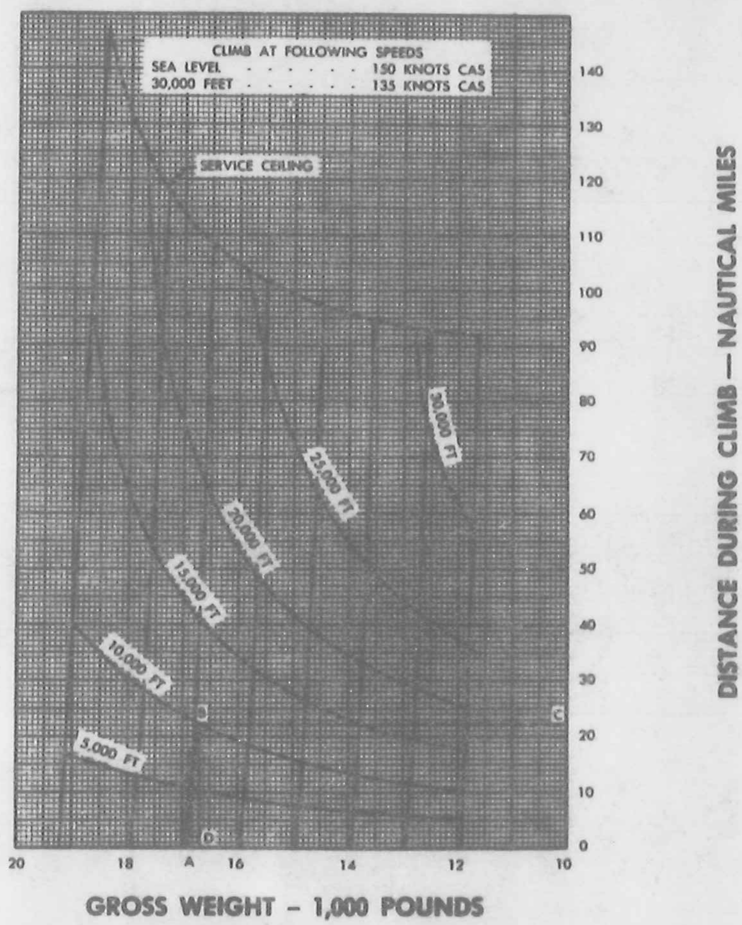
Figure A–7. Take-off (Sheet 2 of 2)

CLIMB — DISTANCE AND FUEL

NORMAL POWER
STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:
1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. Multiply distance by 1.1 for each 20°C above standard temperature.

DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

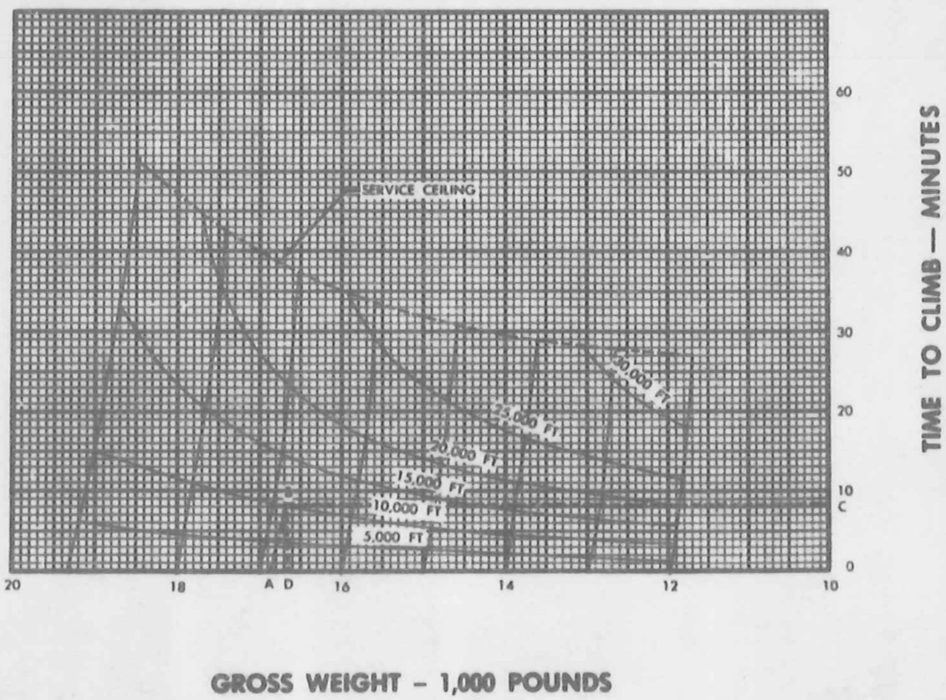
FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

Figure A-8. Climb, Normal Rated Power — Distance and Fuel

CLIMB – TIME AND FUEL
NORMAL POWER
STANDARD DAY

ENGINE: R2800-83WA

MODEL: AU-1 PROPELLER: 24E60/6837A-0



REMARKS: 1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.

2. Multiply distance by 1.1 for each 20°C above standard temperature.

DATA BASED ON: Estimates

DATA AS OF: 1 May 1952

FUEL GRADE: 100/130 or 115/145

FUEL DENSITY: 6 Lb/Gal

Figure A-9. Climb, Normal Rated Power – Time and Fuel

CLIMB — DISTANCE AND FUEL

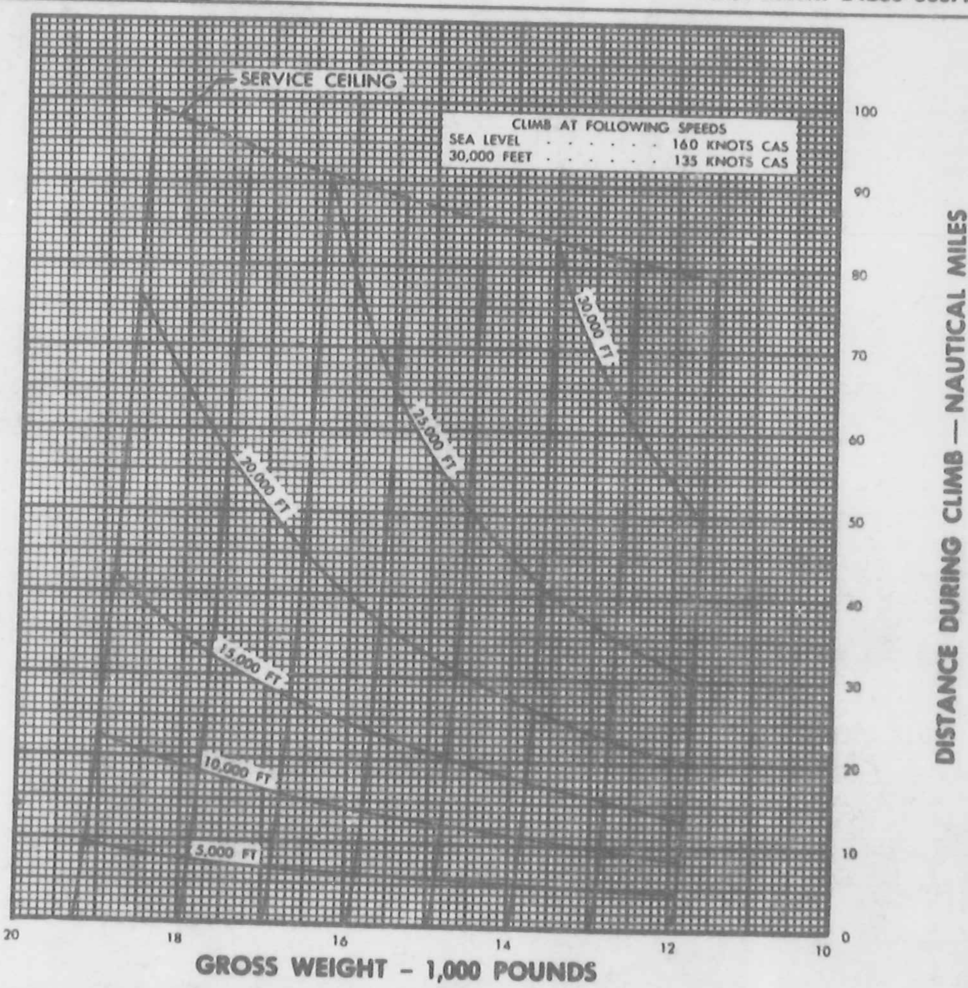
MILITARY POWER

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0



REMARKS:

1. Multiply distance by 1.1 for each 20°C above standard temperature.
2. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
3. Chart is also applicable to fuel grade 100/130 above 5,000 feet; when using fuel grade 100/130 below 5,000 feet, multiply distance during climb by 1.15.

DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

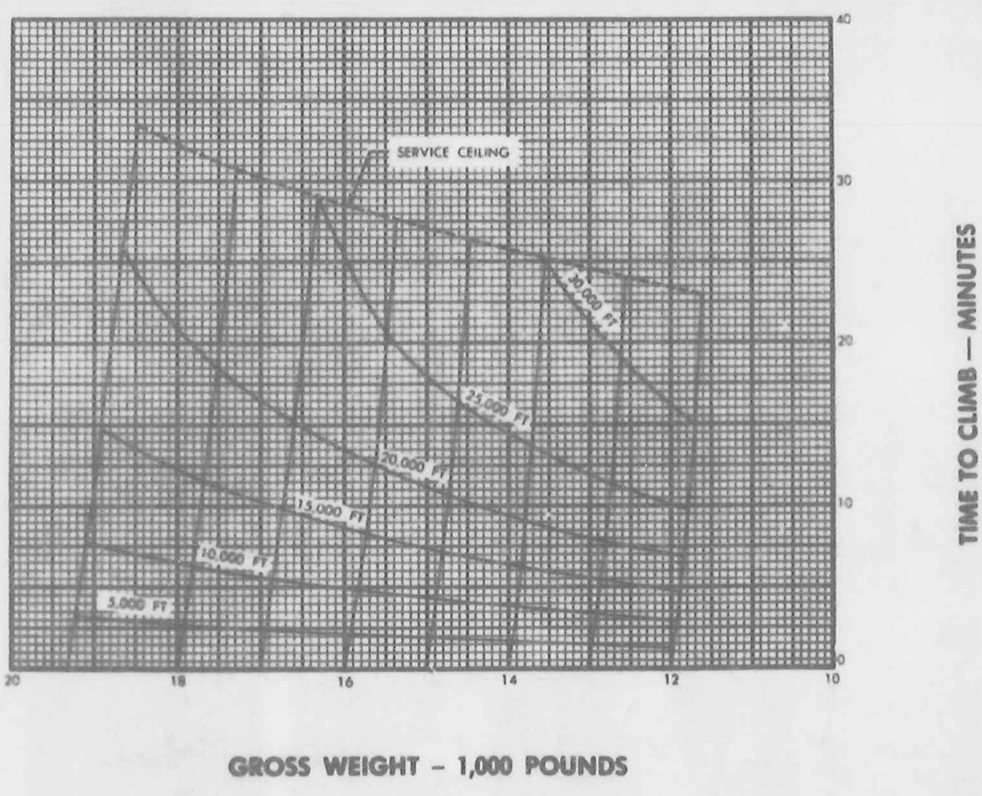
FUEL GRADE: 115/145 — see Note 3
FUEL DENSITY: 6 Lb/Gal

Figure A-10. Climb, Military Rated Power — Distance and Fuel

CLIMB — TIME AND FUEL
MILITARY POWER
STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:
1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. Multiply distance by 1.1 for each 20°C above standard temperature.
3. Chart is also applicable to fuel grade 100/130 above 5,000 feet; when using fuel grade 100/130 below 5,000 feet, multiply time to climb by 1.15.

DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

FUEL GRADE: 115/145 – see Note 3
FUEL DENSITY: 6 Lb/Gal

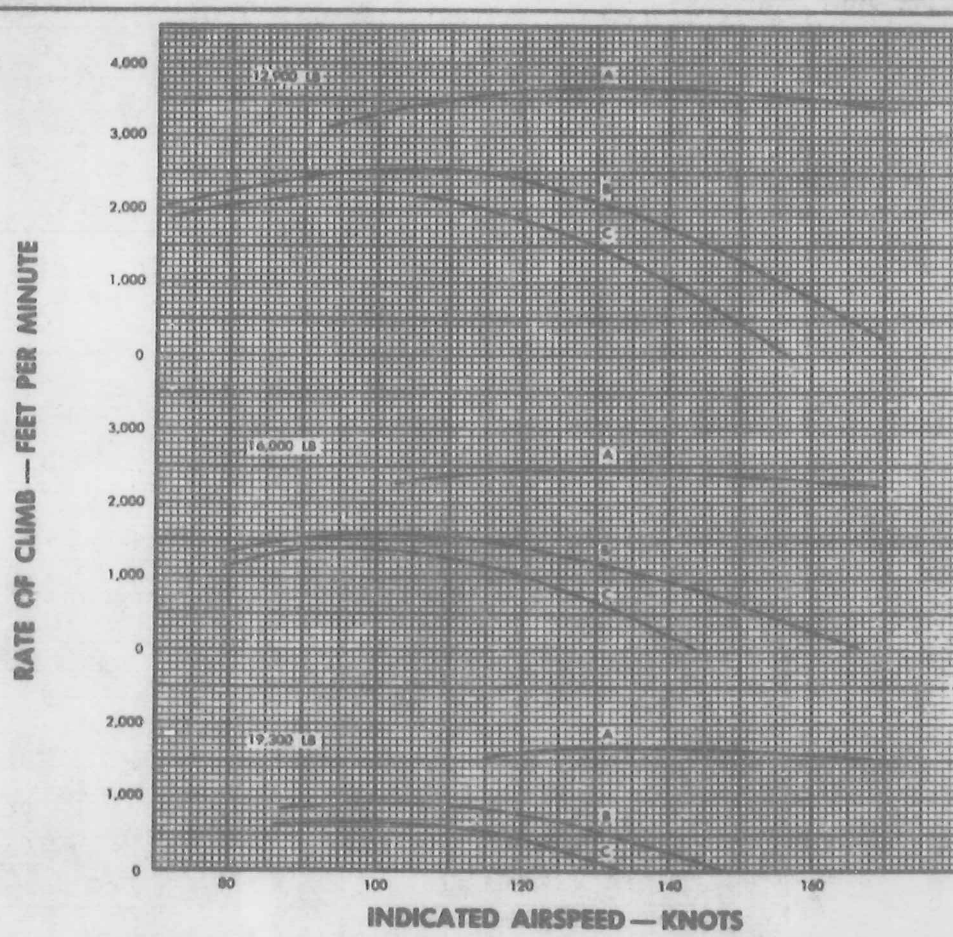
Figure A-11. Climb, Military Rated Power — Time and Fuel

EMERGENCY CLIMB

SEA LEVEL — TAKE-OFF POWER
STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS: 1. Configuration
A–Flaps and landing gear up.
B–Flaps 50 degrees down, landing gear up.
C–Flaps 50 degrees down, landing gear down.
2. Decrease rate of climb by 10 percent for each 20°C above standard temperature.
3. When using fuel grade 100/130, note the following:
a. For 12,900 lb, decrease rate of climb by 450 ft/min.
b. For 19,300 lb, decrease rate of climb by 300 ft/min.

DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

FUEL GRADE: 115/145 – see Note 3
FUEL DENSITY: 6 Lb/Gal

Figure A–12. Emergency Climb

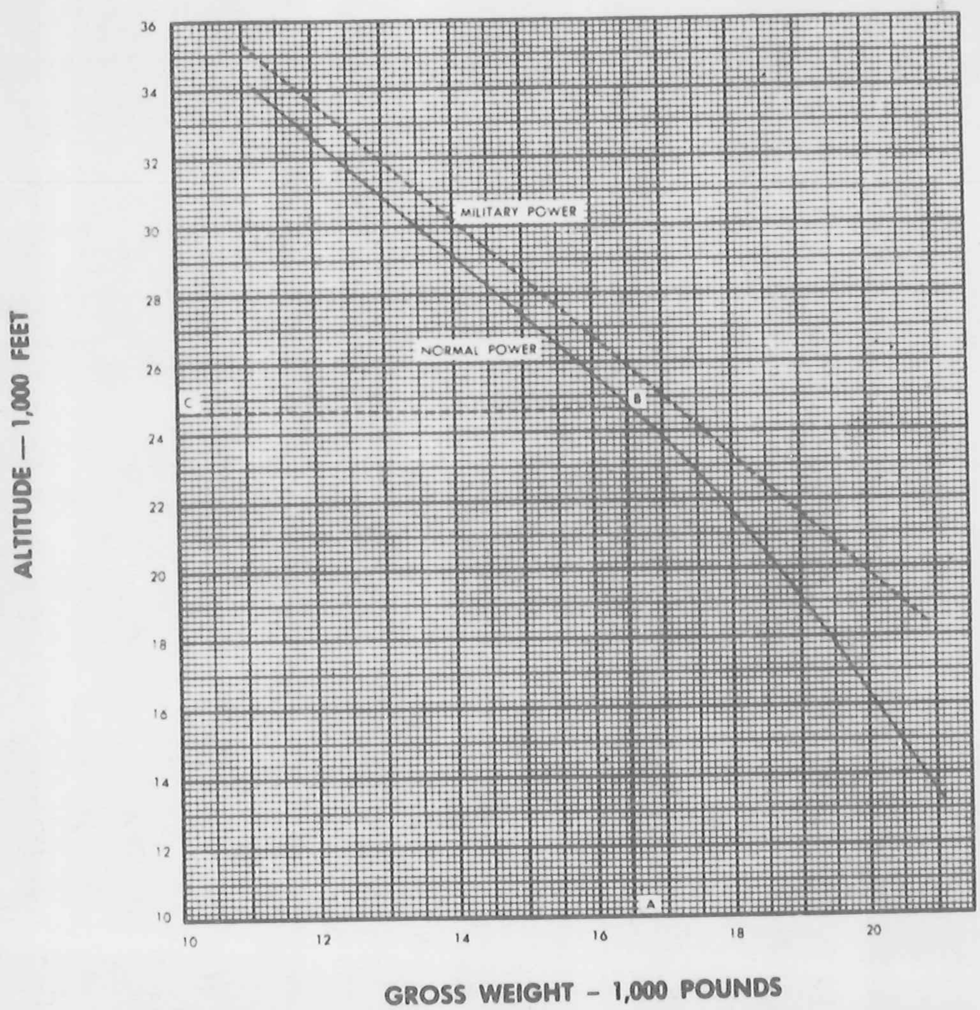
EMERGENCY CEILING

(100 FT/MIN RATE OF CLIMB)

MODEL: AU-1

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0



DATA BASED ON: Estimates

DATA AS OF: 1 May 1952

FUEL GRADE: 100/130 or 115/145

FUEL DENSITY: 6 Lb/Gal

Figure A–13. Emergency Ceiling

NAUTICAL MILES PER GALLON OF FUEL

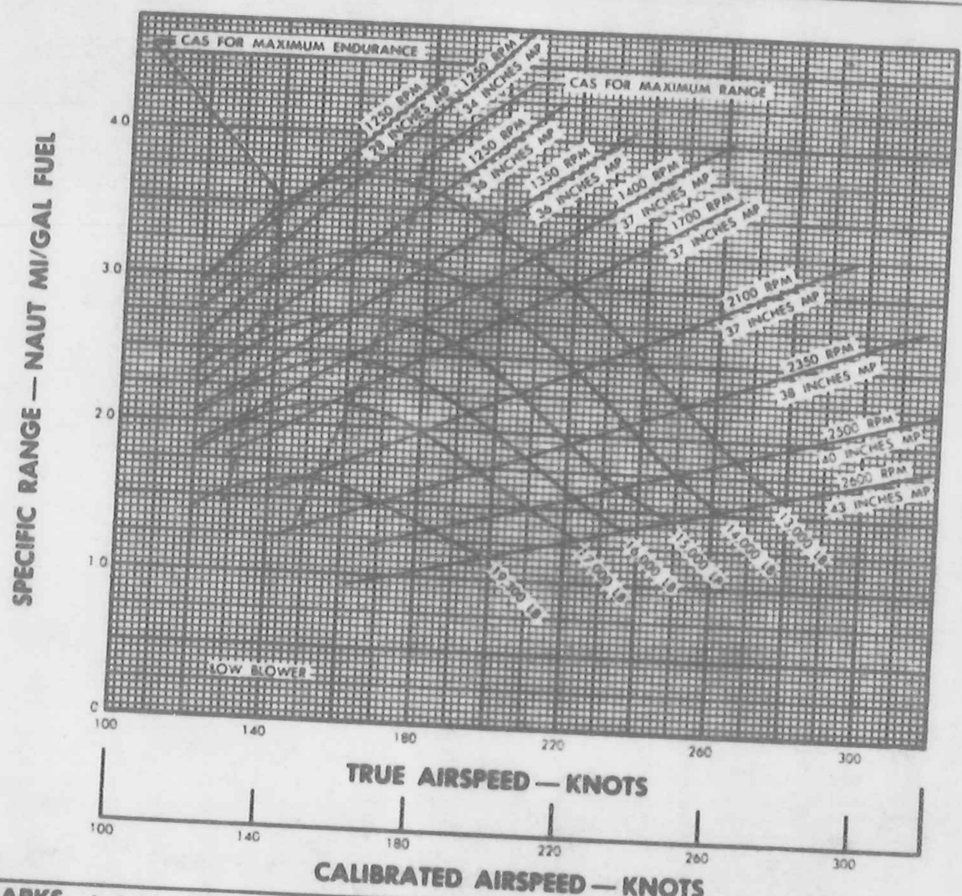
SEA LEVEL

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

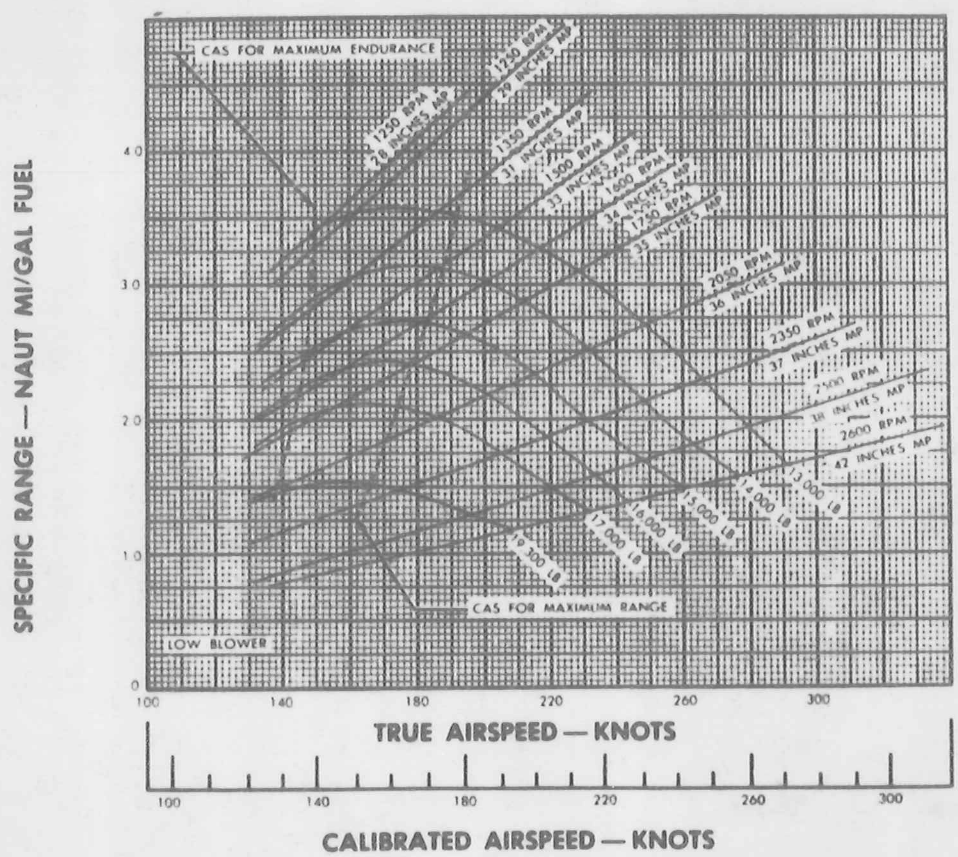
FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

Figure A-14. Nautical Miles per Gallon of Fuel (Sheet 1 of 6)

NAUTICAL MILES PER GALLON OF FUEL
5,000 FT ALT
STANDARD DAY

ENGINE: R2800-83WA

MODEL: AU-1 **PROPELLER: 24E60/6837A-0**



REMARKS:
1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

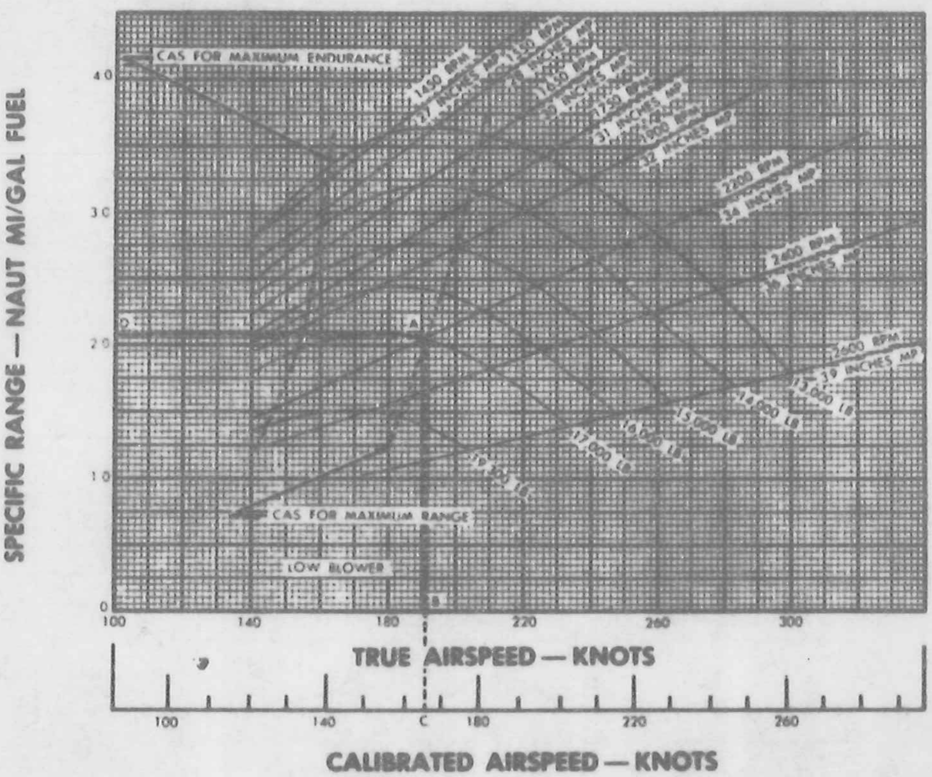
Figure A-14. Nautical Miles per Gallon of Fuel (Sheet 2 of 6)

NAUTICAL MILES PER GALLON OF FUEL

10,000 FT ALT
STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:
1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

Figure A–14. Nautical Miles per Gallon of Fuel (Sheet 3 of 6)

NAUTICAL MILES PER GALLON OF FUEL

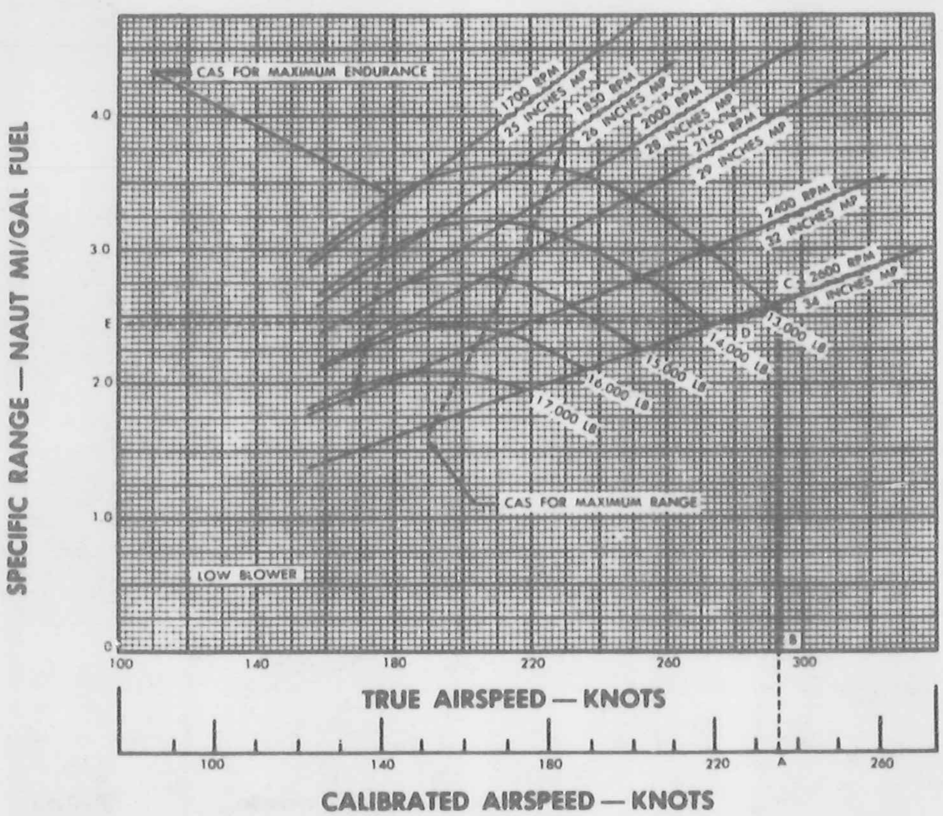
15,000 FT ALT

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates

DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145

FUEL DENSITY: 6 Lb/Gal

Figure A-14. Nautical Miles per Gallon of Fuel (Sheet 4 of 6)

NAUTICAL MILES PER GALLON OF FUEL

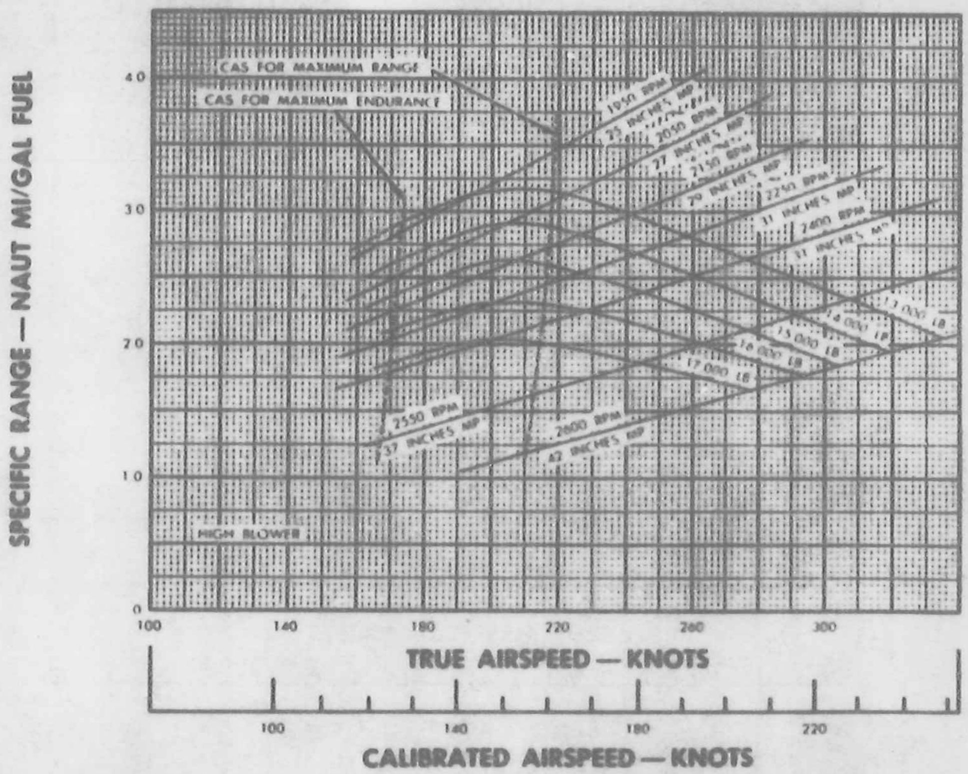
20,000 FT ALT

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA

PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates

DATA AS OF: 1 May 1952

FUEL GRADE: 100/130 or 115/145

FUEL DENSITY: 6 Lb/Gal

Figure A–14. Nautical Miles per Gallon of Fuel (Sheet 5 of 6)

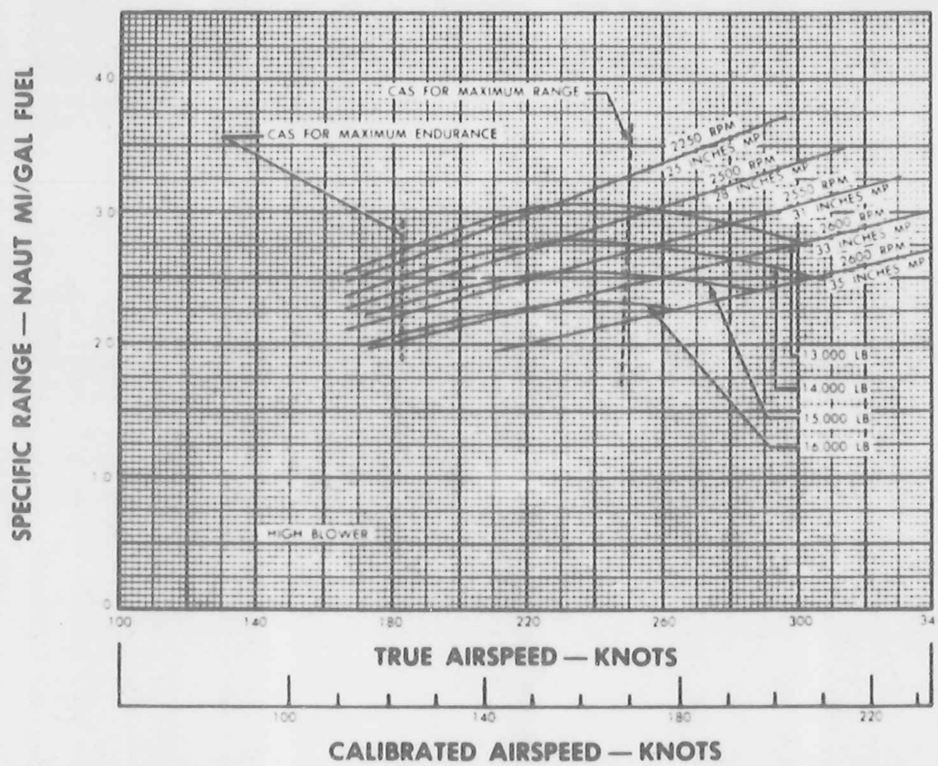
NAUTICAL MILES PER GALLON OF FUEL

25,000 FT ALT

STANDARD DAY

ENGINE: R2800-83WA

MODEL: AU-1 **PROPELLER: 24E60/6837A-0**



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and air-speed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.

DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

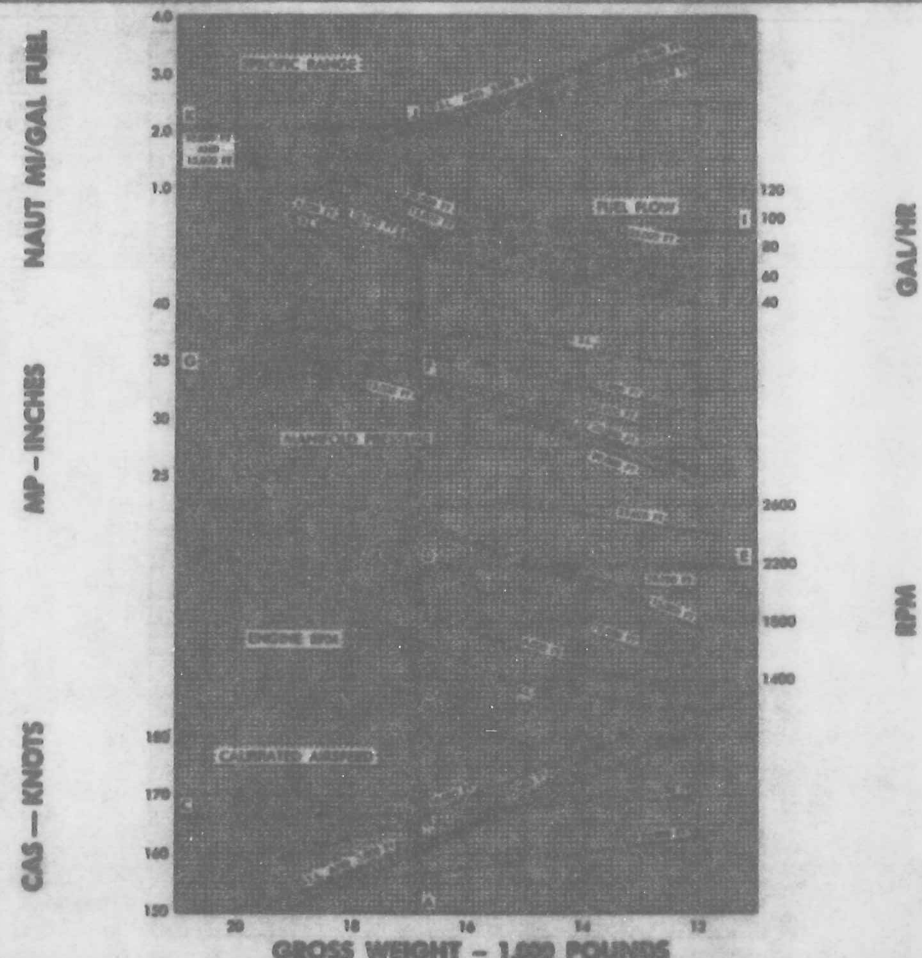
Figure A-14. Nautical Miles per Gallon of Fuel (Sheet 6 of 6)

MAXIMUM RANGE POWER CONDITIONS VS GROSS WEIGHT

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.
3. Curves for 20,000 feet and 25,000 feet indicate operation with high blower.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

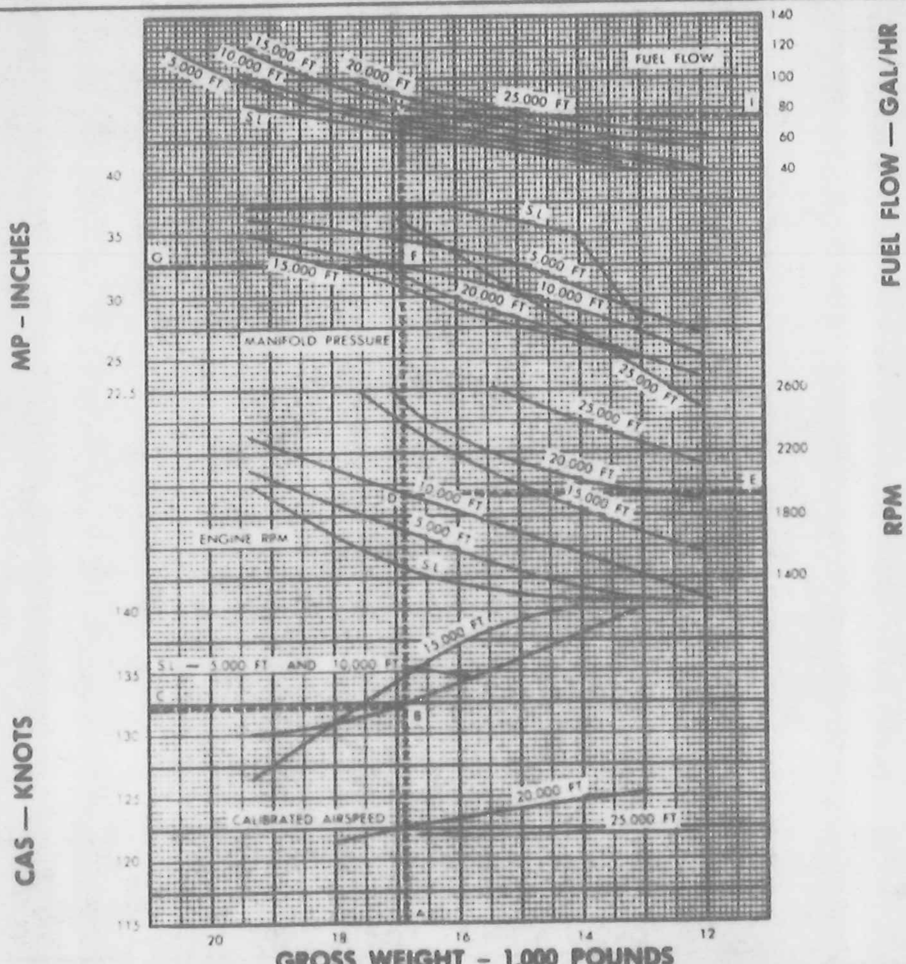
Figure A–15. Maximum Range

MAXIMUM ENDURANCE

MODEL: AU-1

STANDARD DAY

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. For non-standard atmosphere, use chart for density altitude and correct MAP as stated under paragraph on ENGINE OPERATING LIMITS. The specific range and airspeed values will then be applicable for part throttle operation. For full throttle operation, reduction will be 10 knots calibrated airspeed and 6 percent range when temperature is 20°C above standard.
3. Curves for 20,000 feet and 25,000 feet indicate operation with high blower.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

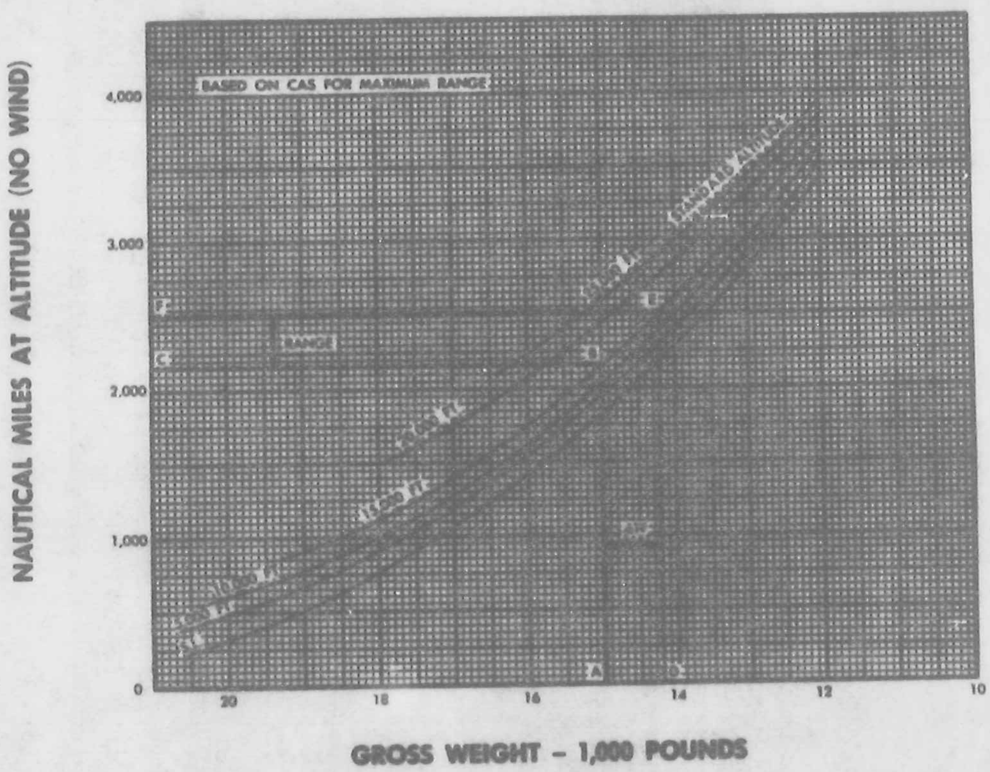
Figure A–16. Maximum Endurance

LONG RANGE PREDICTION — DISTANCE

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:

1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. A temperature 20°C above standard will reduce range 4 percent if engine is at part throttle. With engine at full throttle, reduction will be 6 percent.
3. Curves for 20,000 feet and 25,000 feet indicate operation with high blower.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

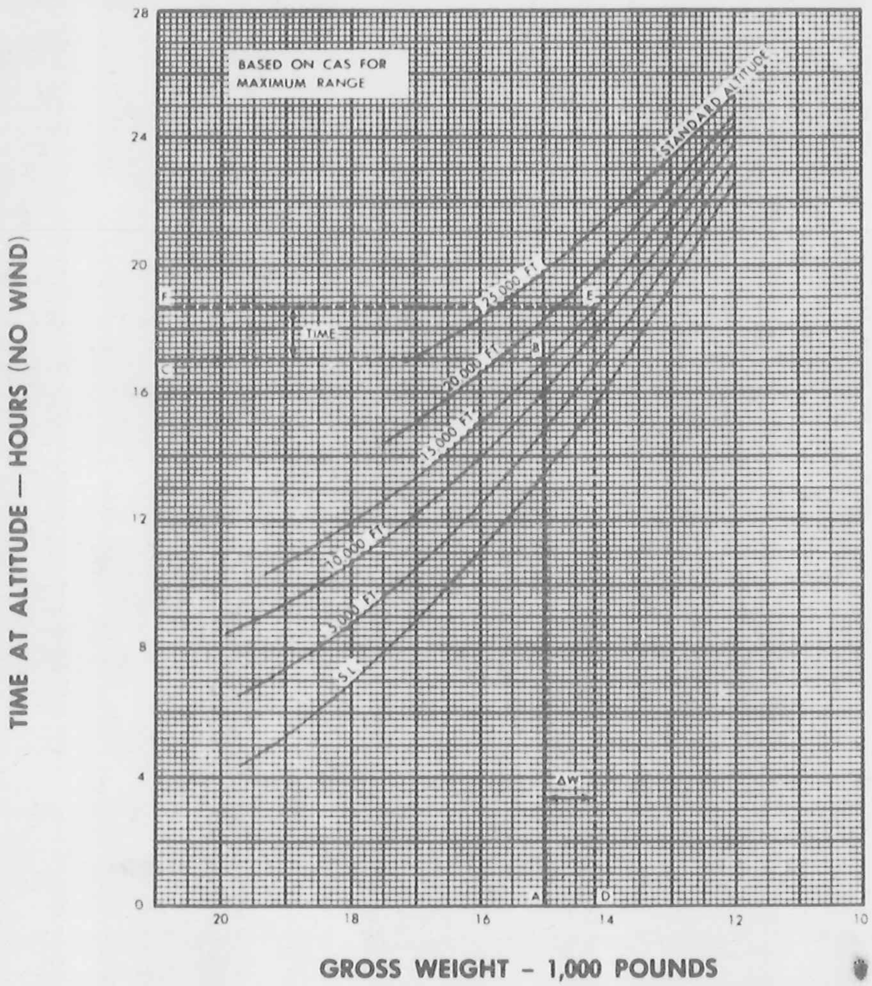
Figure A-17. Long Range Prediction — Distance

LONG RANGE PREDICTION — TIME

STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS:
1. Refer to Drag Conversion Table (Fig. A-22) to determine weight to be used in chart for a particular external stores loading.
2. Time remains approximately constant as temperature changes.
3. Curves for 20,000 feet and 25,000 feet indicate operation with high blower.

DATA BASED ON: Estimates
DATA AS OF: 1 JANUARY 1953

FUEL GRADE: 100/130 or 115/145
FUEL DENSITY: 6 Lb/Gal

Figure A-18. Long Range Prediction — Time

COMBAT ALLOWANCE CHART

STANDARD DAY

MODEL: AU-1

ENGINE: R-2800-83WA
PROPELLER: 24E60/6837A-0

MILITARY RATED POWER

PRESSURE ALTITUDE FEET	RPM	MP IN. HG	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT MIN	LIMIT CYLINDER TEMP (°C)	FUEL FLOW GPH
SL	2800	58	LOW	AUTO-RICH	5	241	283
5,000	2800	F.T.	LOW	AUTO-RICH	5	241	239
10,000	2800	49.5	HIGH	AUTO-RICH	5	241	205
15,000	2800	49.5	HIGH	AUTO-RICH	5	241	200
20,000	2800	F.T.	HIGH	AUTO-RICH	5	241	181
25,000	2800	F.T.	HIGH	AUTO-RICH	5	241	164
30,000	2800	F.T.	HIGH	AUTO-RICH	5	241	132

COMBAT RATED POWER

PRESSURE ALTITUDE FEET	RPM	MP IN. HG	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT MIN	LIMIT CYLINDER TEMP (°C)	FUEL FLOW GPH
SL	2800	70	LOW	AUTO-RICH	5	241	263
5,000	2800	66	HIGH	AUTO-RICH	5	241	270
10,000	2800	66	HIGH	AUTO-RICH	5	241	270
15,000	2800	F.T.	HIGH	AUTO-RICH	5	241	232
20,000	2800	F.T.	HIGH	AUTO-RICH	5	241	190
25,000	2800	F.T.	HIGH	AUTO-RICH	5	241	153
30,000	2800	F.T.	HIGH	AUTO-RICH	5	241	133

DATA AS OF: 1 January 1953
DATA BASED ON: Estimated

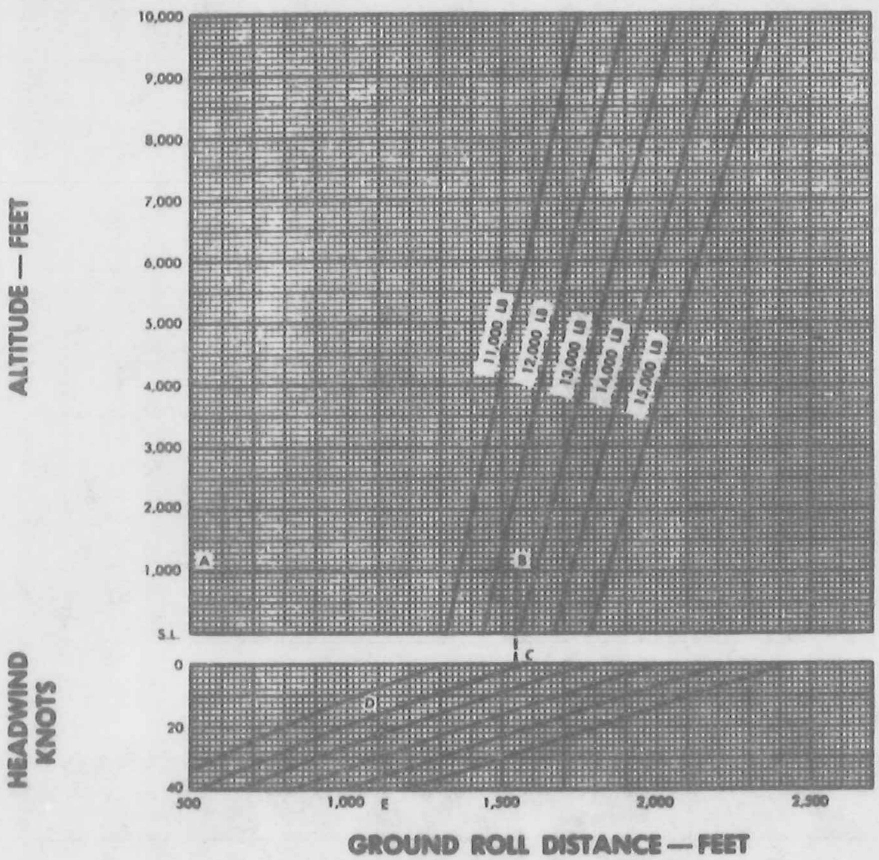
FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/GAL

Figure A-19. Combat Allowance

LANDING GROUND ROLL
HARD SURFACE RUNWAY
STANDARD DAY

ENGINE: R2800-83WA

MODEL: AU-1 PROPELLER: 24E60/6837A-0



REMARKS:
1. Flap deflection is 50 degrees.
2. To clear 50-foot obstacle, multiply ground roll by 1.5.
3. Multiply distance by 1.1 for each 20°C above standard temperature.

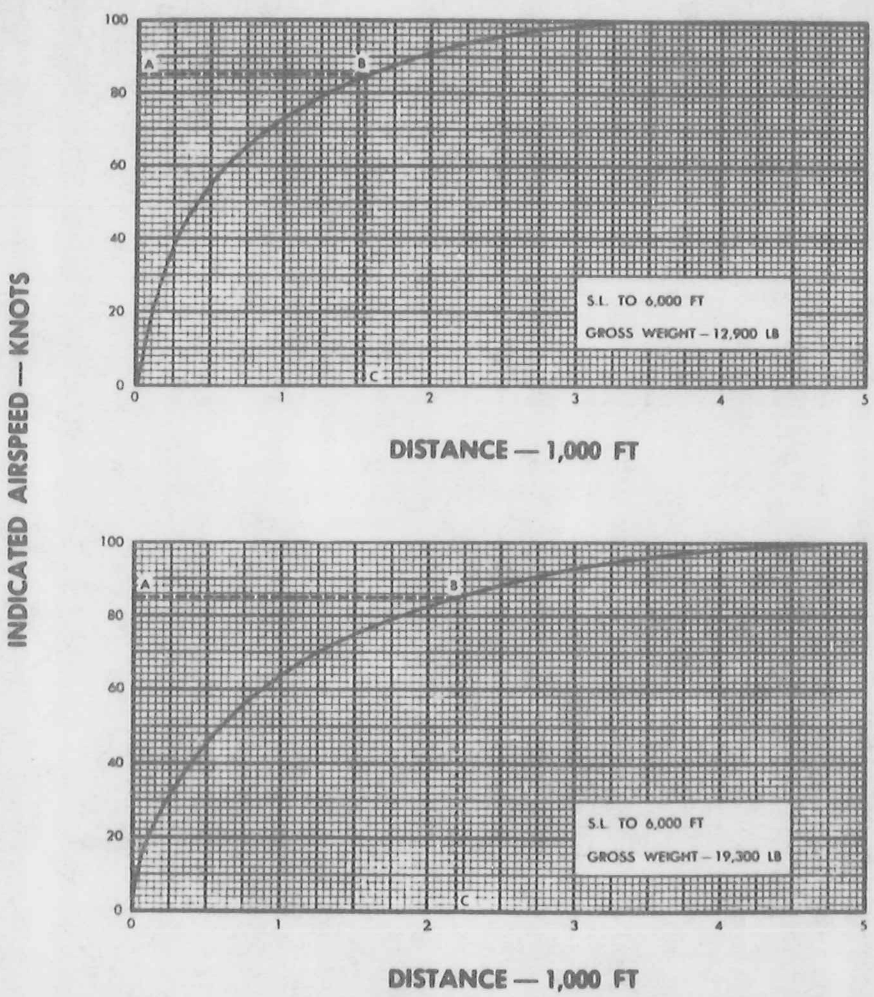
DATA BASED ON: Estimates
DATA AS OF: 1 May 1952

Figure A-20. Landing Ground Roll

STOPPING DISTANCE
NO WIND
STANDARD DAY

MODEL: AU-1

ENGINE: R2800-83WA
PROPELLER: 24E60/6837A-0



REMARKS: 1. Brakes should be inspected after stops from high speeds at high gross weights.

DATA BASED ON: Estimates

DATA AS OF: 1 May 1952

Figure A-21. Stopping Distance

DRAG CONVERSION TABLE

MODEL: AU-1

ENGINE: R-2800-83WA
PROPELLER: 24E60/6837A-0

CHANGE IN AIRPLANE CONFIGURATION	EFFECT ON PERFORMANCE: CRUISE Δ EAS FOR CONSTANT POWER (KNOTS)	WT ADJUSTMENT FACTOR — LB: CLIMB	WT ADJUSTMENT FACTOR — LB: LONG RANGE CRUISE
Add one centerline pylon with sway braces	5	150	150
Add two center section pylons with sway braces	8	250	300
Add ten AERO 14A launchers	5	250	150
Add one 150-gallon drop tank	14	1150	1150
Add one 1000-lb bomb	20	1150	1450
Add one 2000-lb bomb	27	2000	2300
Add ten 5-in. HVAR	19	1450	1600
Add one 11.75-in. aircraft rocket	10	1400	1250
*Add six 500-lb bombs (See Note 2)	50	3000	3200
Add ten 250-lb bombs (See Note 2)	75	3000	4400

REMARKS:

1. Weight adjustment factor for long range cruise is applicable only in the region of recommended EAS and maximum endurance lines. Δ EAS should be used for all other power regions.
2. The effect of the applicable pylons and launchers is included in the effect of the external stores.

DATA AS OF: 1 January 1953
DATA BASED ON: Estimated

Figure A–22. Drag Conversion

[redacted]

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