T.O.1L-1A-1

USAF SERIES

O-1A E, F and G AIRCRAFT FLIGHT MANUAL

EACH TRANSMITTAL OF THIS DOCUMENT OUTSIDE OF THE DEPARTMENT OF DEFENSE MUST HAVE APPROVAL OF THE TECHNICAL ORDER DISTRIBUTION CONTROL ACTIVITY. REFER TO T.O. 00-5-2.

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

Commanders are responsible for bringing this technical publication to the attention of all Air Force personnel cleared for operation of affected aircraft.

THIS PUBLICATION SUPERSEDES SAFETY SUPPLEMENT T.O. 1L-1A-1SS-6.

REFER TO BASIC INDEX T.O. 0-1-1-5 AND SUPPLEMENTS THERETO, FOR THE CURRENT STATUS OF FLIGHT MANUALS, SAFETY/OPERATIONAL SUPPLEMENTS AND FLIGHT CREW CHECKLISTS.

Published under authority of the Secretary of the Air Force

1 MARCH 1969

CHANGE 4 - 1 MAY 1970

Technical Orders are normally distributed promptly after printing. Date(s) shown on the title page (lower right) are for identification only. This is not a distribution date. Processing time sometimes causes distribution to only appear to have been delayed.

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LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

Original .... 0 .... 1 Mar 69
Change ..... 1 .... 15 Sep 69
Change ..... 2 .... 24 Nov 69
Change ..... 3 .... 16 Dec 69
Change ..... 4 .... 1 May 70

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 170, CONSISTING OF THE FOLLOWING:

Page No.	Change No.	Page No.	Change No.	Page No.	Change No.
*Title	4	2-1 thru 2-2	0	A3-1 thru A3-4	0
*A	4	2-3	3	A4-1 thru A4-3	0
*Flyleaf-1	4	2-4	0	A4-4 Blank	0
*Flyleaf-2 Blank	4	*2-5 thru 2-6	4	A5-1 thru A5-7	0
i	0	2-7	0	A5-8 Blank	0
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*1-3	4	3-5	0	A8-4 Blank	0
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*1-5 thru 1-6	4	3-7 thru 3-8	0	B1-4 Blank	0
1-7	0	4-1 thru 4-18	0	B2-1 thru B2-3	0
1-8	1	4-19 thru 4-22	3	B2-4 Blank	0
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1-10	0	5-2 thru 5-4	0	B4-1 thru B4-3	0
*1-11	4	6-1 thru 6-2	0	B4-4 Blank	0
1-12	0	7-1 thru 7-2	0	B5-1 thru B5-7	0
*1-13	4	8-1	0	B5-8 Blank	0
1-14	1	8-2 Blank	0	B6-1	0
1-15	0	9-1 thru 9-6	0	B6-2 Blank	0
*1-16	4	A-1	0	B7-1 thru B7-5	0
1-17 thru 1-18	0	A-2 Blank	0	B7-6 Blank	0
*1-19	4	A1-1 thru A1-3	0	B8-1 thru B8-4	0
1-20 thru 1-25	0	A1-4 Blank	0	Index 1 thru Index 6	0
1-26 Blank	0	A2-1 thru A2-2	0		

CURRENT FLIGHT CREW CHECKLIST

T.O. 1L-1A-1CL-1
1 MARCH 1969
Changed 16 Dec 69

Upon receipt of the second and subsequent changes to this technical order, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete.

* The asterisk indicates pages changed, added, or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

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

NAVY ACTIVITIES.--Use Publications and Forms Order Blank (NAVAIR 140) and submit in accordance with instructions thereon. For listing of available material and details of distribution see Naval Air Systems Command Publications Index NAVAIR 00-500.

USAF

OS OS OS OS OS OS OS OS OS OS OS OS

T.O. 1L-1A-1S-12

OPERATIONAL SUPPLEMENT
FLIGHT MANUAL

USAF SERIES

O-1A, O-1E, O-1F AND O-1G

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1L-1A-1 DATED 1 MARCH 1969.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

27 APRIL 1970

1. PURPOSE. To advise aircrews of added braking capability on aircraft modified in accordance with T.O. 1L-1-528.

2. INSTRUCTIONS.

NOTE

A reference to this supplement shall be entered opposite each paragraph in the basic manual affected by this supplement.

Page 2-8, Landing, Normal Landing, add CAUTION to read:

CAUTION

Aircraft modified in accordance with T.O. 1L-1-528 has approximately twice the effective braking capacity of the original brakes. Due to the added braking efficiency, cautious application of braking is required upon landing. Heavy braking and improper stick control can cause loss of aircraft control and/or nose over.

THE END

AFLC RAFB, GA

CURRENT FLIGHT MANUAL AND SAFETY AND OPERATIONAL SUPPLEMENT STATUS

This page will be published with each Safety and Operational Supplement, Flight Manual Change, and Flight Manual Revision. It provides a comprepensive listing of the current flight manual, flight crew checklist, and safety and operational supplements. The supplements you receive should follow in sequence and if you are missing one listed on this page, see your publications distribution officer and get your copy. In accordance with T.O. 00-5-1, Safety and Operational Supplements will be filed in reverse numerical sequence in front of basic manual, with Safety Supplements filed in front of Operational Supplements. The appropriate index should be checked periodically to make sure you have the latest publications.

FLIGHT MANUAL	DATE	CHANGED
1L-1A-1	1 March 1969	16 Dec 1969

CHECKLIST	DATE	CHANGED
1L-1A-1CL-1	1 March 1969	16 Dec 1969

SAFETY SUPPLEMENTS	DATE	SHORT TITLE	PAGES AFFECTED
1L-1A-1SS-18	30 Jan 1970	Wake Turbulence	2-6, 2-8

OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE	PAGES AFFECTED
1L-1A-1SS-12	27 Apr 1970	Brakes	2-8

SUPPLEMENTS INCORPORATED, RESCINDED OR REPLACED.

CURRENT FLIGHT MANUAL AND SAFETY AND OPERATIONAL SUPPLEMENT STATUS

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FLIGHT MANUAL	DATE	CHANGED
1L-1A-1	1 Mar 69	1 May 70

CHECKLIST	DATE	CHANGED
1L-1A-1CL-1	1 Mar 69	16 Dec 69

SAFETY SUPPLEMENTS	DATE	SHORT TITLE	PAGES AFFECTED

OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE	PAGES AFFECTED

SUPPLEMENTS INCORPORATED, RESCINDED OR REPLACED

1L-1A-1SS-6	30 Jan 70	Incorporated in Change 4

Table of Contents

SCOPE

This manual contains the necessary information for safe and efficient operation of the O-1 aircraft. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided. This manual provides the best possible operating instructions under most circumstances; however, multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS

The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from WRNEO before any questionable operation is attempted which is not specifically permitted in this manual.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to Basic Index T.O. 0-1-1-5 and supplements thereto for current status of Flight Manuals, Safety/Operational Supplements, and Checklists. Their frequency of issue and brevity assures an accurate up-to-date listing of these publications.

STANDARDIZATION AND ARRANGEMENT

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

SAFETY AND OPERATIONAL SUPPLEMENTS

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

CHECKLISTS

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

HOW TO GET PERSONAL COPIES

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

FLIGHT MANUAL AND CHECKLIST BINDERS

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

WARNINGS, CAUTIONS, AND NOTES

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

WARNING

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

CAUTION

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

NOTE

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

YOUR RESPONSIBILITY - TO LET US KNOW

Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be addressed to Command Headquarters to WRAMA, Robins Air Force Base, Georgia; Attention: WRNEA.

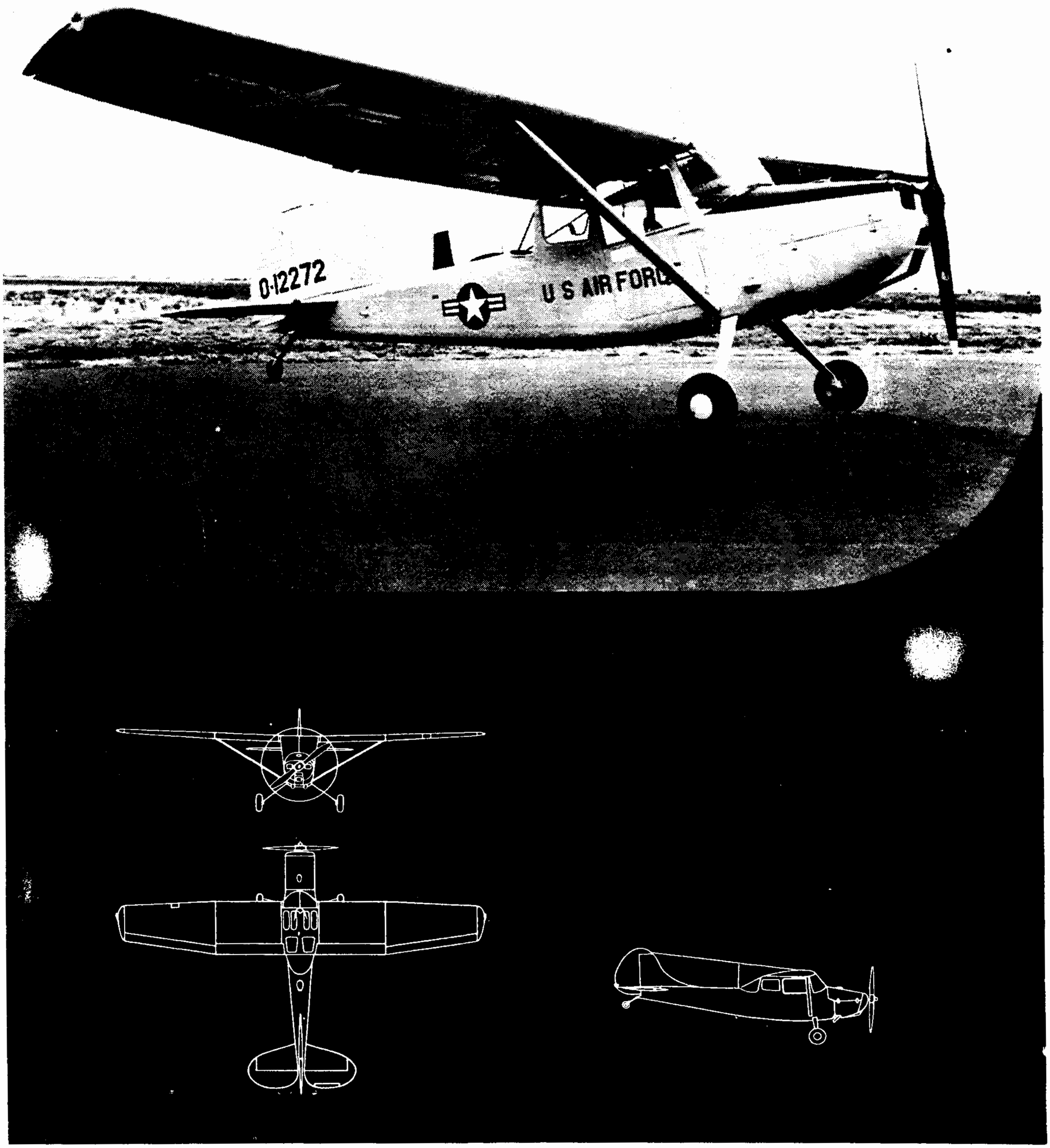

Figure 1-1. The Aircraft (Without Pylons Installed)

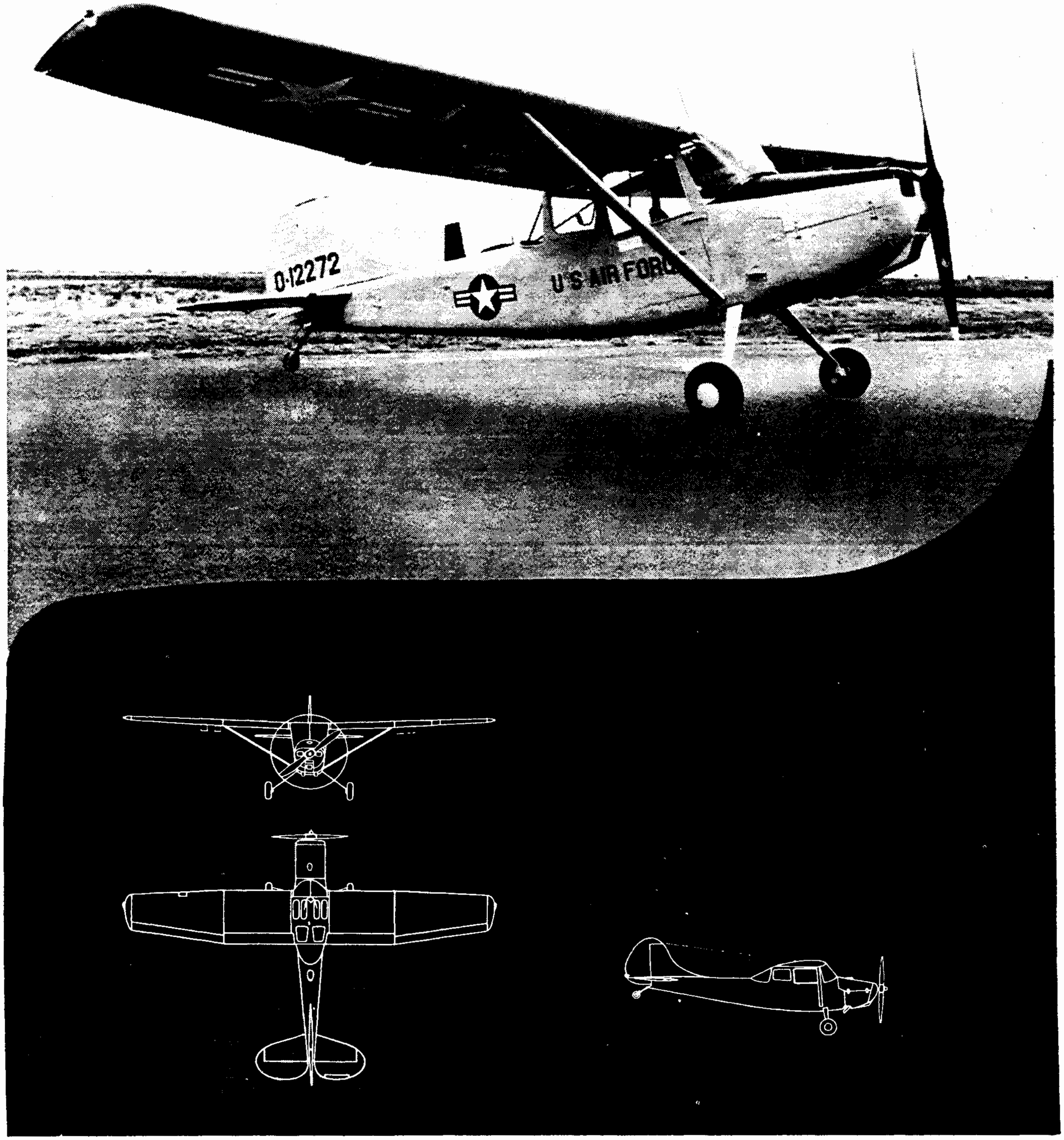

Figure 1-2. The Aircraft (With Pylons Installed)

SECTION I

DESCRIPTION

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THE AIRCRAFT

The O-1 aircraft is an all-metal, high-wing, two place (tandem) monoplane. It is a multi-purpose aircraft used for reconnaissance observation. Although basically designed as a landplane, the aircraft can be converted to a seaplane with the installation of floats and seaplane fins.

DIMENSIONS

The over-all dimensions of the aircraft under normal conditions of gross weight and tire inflation are as follows:

Wing Span	36 feet
Over-all Length	25 feet $9\frac{1}{2}$ inches
Height to Top of Cabin	7 feet 6 inches
Weight	2000 pound class (See Section V for Weight Limitations)

Refer to Section II for turning radius and ground clearance.

(A) Aircraft Modified by T.O. 1L-19A-247.
(A) Aircraft Not Modified by T.O. 1L-19A-247.

SPECIAL FEATURES

The special features of this aircraft are: One piece spring steel landing gear struts, a simple control lock that locks the rudder, elevators and ailerons in neutral and applies the parking brake, and flush retracting lift handles (figure 1-20), in the tailcone that can be extended for hoisting or retracted flush with the fuselage skin when not in use. The rear rudder pedals are hinged and can be folded flat against the cabin floor when not in use. Brake action on these pedals is transmitted mechanically to the forward brake pedals and thereby down to the main wheel brakes.

ENGINE

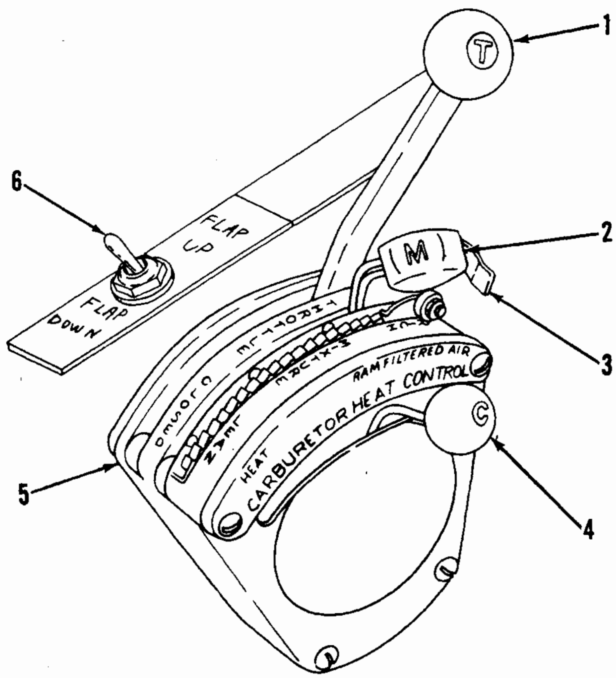
The aircraft is powered by a Continental six cylinder, horizontally opposed, air-cooled engine. The engine model designation is O-470-11A or B on the O-1A, E and G aircraft and O-470-15 on the O-1F aircraft. Approximate standard day sea level maximum horsepower rating is 213 horsepower. The engine controls, consisting of a throttle, mixture control lever, carburetor air control lever, and propeller control lever (O-1F), are mounted on two quadrants (figure 1-3). The front quadrant is located on the left side of the fuselage slightly forward of the front seat. The rear quadrant is located in a like position just forward of the rear seat. These quadrants are mechanically interconnected between the front and rear stations to provide simultaneous movement of the engine controls.

CARBURETOR

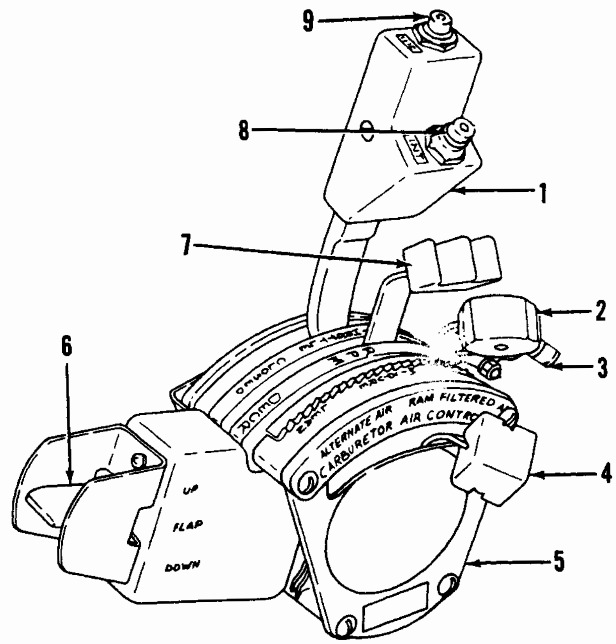
The aircraft is equipped with an updraft, single barrel, pressure injection-type carburetor mounted on the intake manifold on the underside of the engine. The carburetor incorporates a manually operated mixture valve. The basic purpose of the carburetor is to meter fuel accurately in proportion to the amount of air being consumed by the engine.

THROTTLE

The throttle (figure 1-3), is the outboard lever in each quadrant and is mechanically connected to the carburetor by a flexible push-pull type control. The full forward position of the throttle is open and the full aft position is closed.



O-1A, E AND G



O-1F ONLY

▲ Aircraft Modified by T.O. 1L-19A-247.

1. Throttle
2. Mixture Control Lever
3. Mixture Control Lever Lock (Front Quadrant Only)
4. Carburetor Air Control Lever
5. Engine Control Quadrant
6. Wing Flap Switch (Front Quadrant Only, O-1A ▲, E and G Aircraft)
7. Propeller Control Lever
8. Interphone Switch
9. Microphone Switch

Figure 1-3. Engine Control Quadrant

MIXTURE CONTROL

The inboard center lever on each quadrant is the mixture control (figure 1-3). This control enables the pilot, or rear seat occupant, to regulate the fuel-air mixture to the engine to obtain efficient engine operation and maximum fuel economy. Positions for each mixture control lever are rich and lean. The rich position is full forward, full aft is idle cutoff and manual leaning is accomplished by placing the control between the rich and lean positions. The front mixture control lever is equipped with a spring loaded lock. When either the front or rear mixture control lever is moved forward, the lock is automatically released. However, before the mixture control lever can be moved aft toward lean, the lock must be released by pressing forward on the lock lever of the front mixture control. The mixture control lever, when pulled full aft, shuts off fuel flow at the carburetor to stop the engine.

CARBURETOR AIR CONTROL LEVER

The inboard lever on each engine control quadrant is the carburetor air control lever (figure 1-3). The carburetor air control lever positions are marked RAM FILTERED AIR (forward position) and ALTERNATE AIR (HEAT O-1A, E, and G) aft position. The lever enables either the pilot or the rear seat occupant to control the temperature of air entering the carburetor thereby maintaining efficient engine operation under all flying conditions. When the lever is in the RAM FILTERED AIR position, ram air is admitted to the carburetor through the air intake scoop on the front lower side of the cowl. When the lever is moved to the alternate air position, a gate valve closes off the ram-air intake opening from the carburetor. With the gate valve closed, the hot air surrounding the engine cylinders passes through the filtered alternate air ducting to the carburetor. In event the alternate air filter becomes clogged and with the gate valve closed, a partial vacuum is

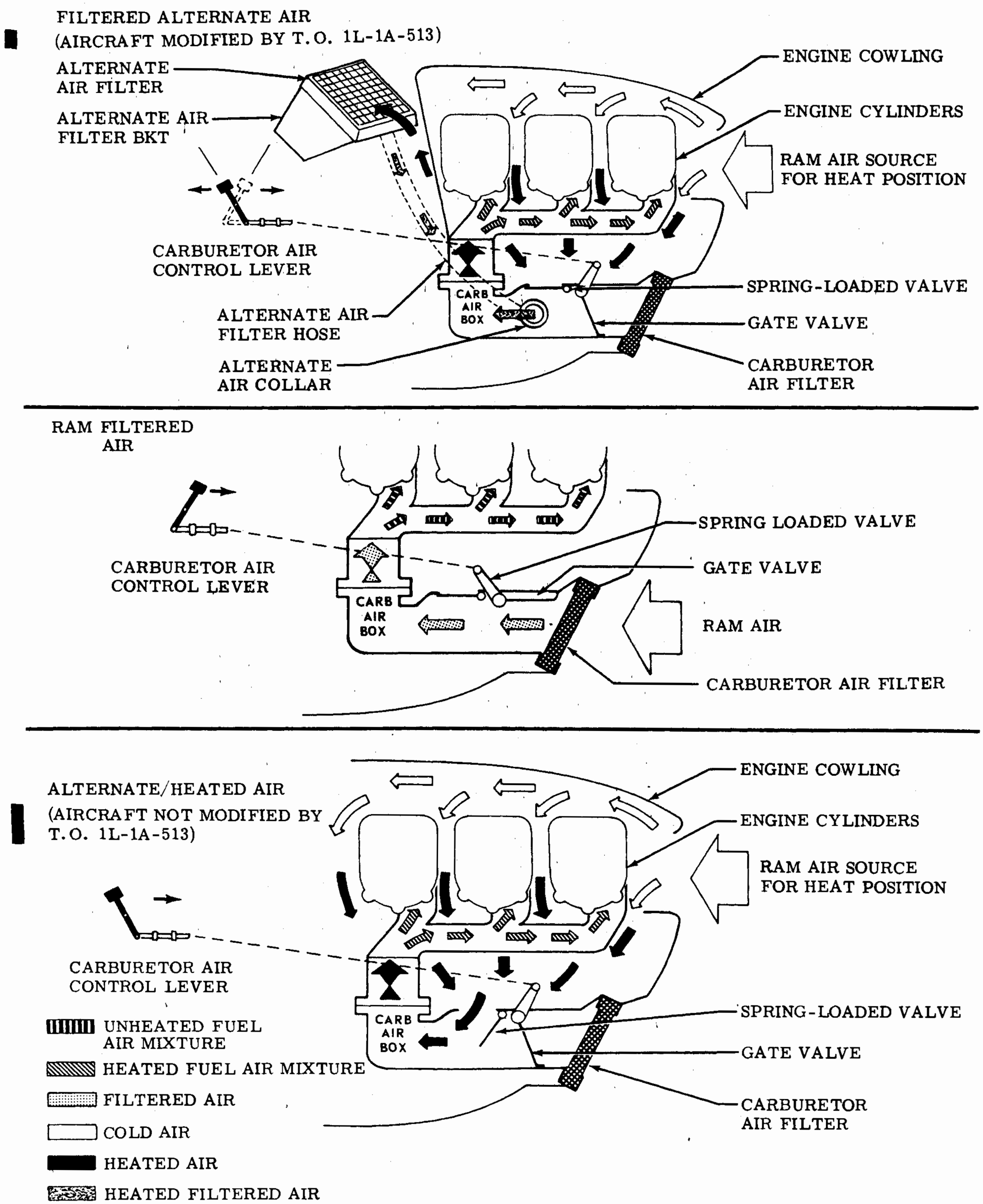
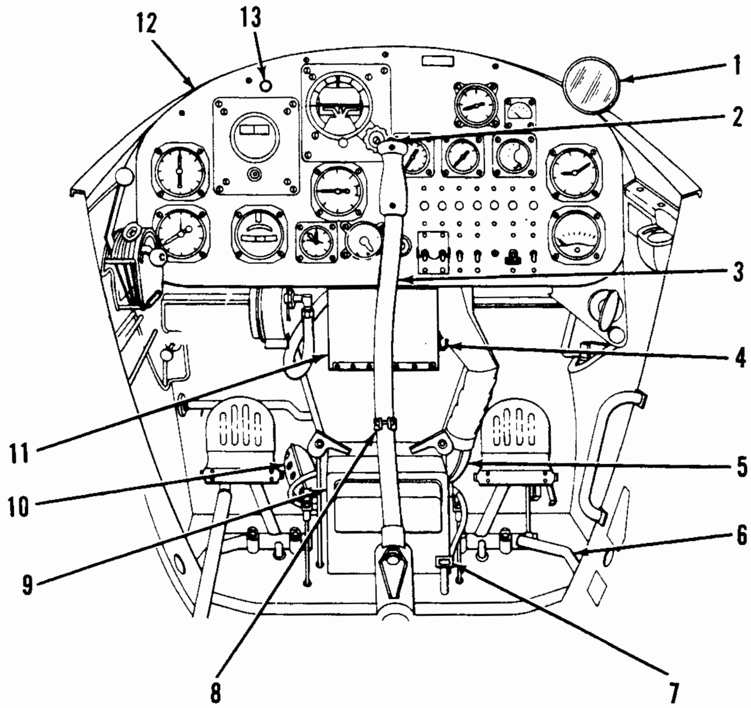
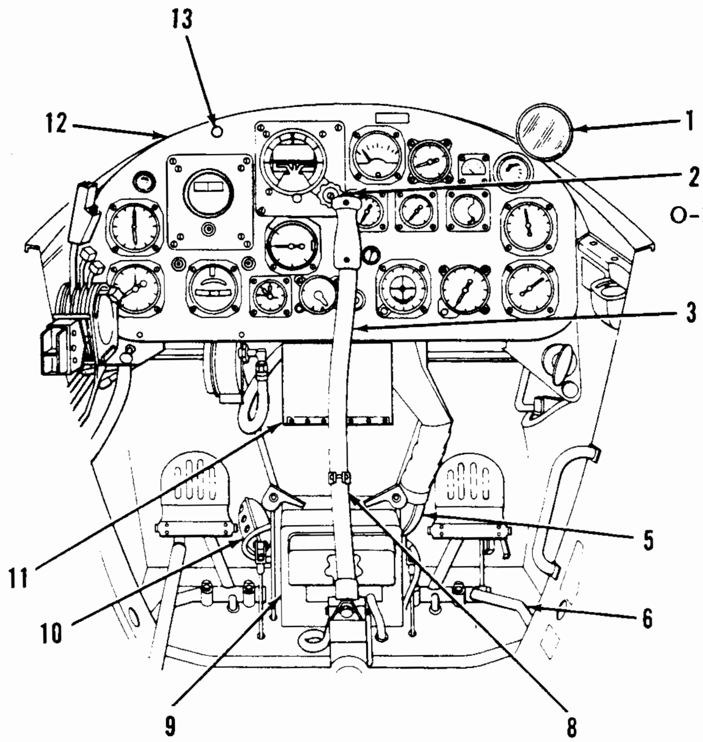


Figure 1-4. Engine Air Induction System

O-1A TYPICAL

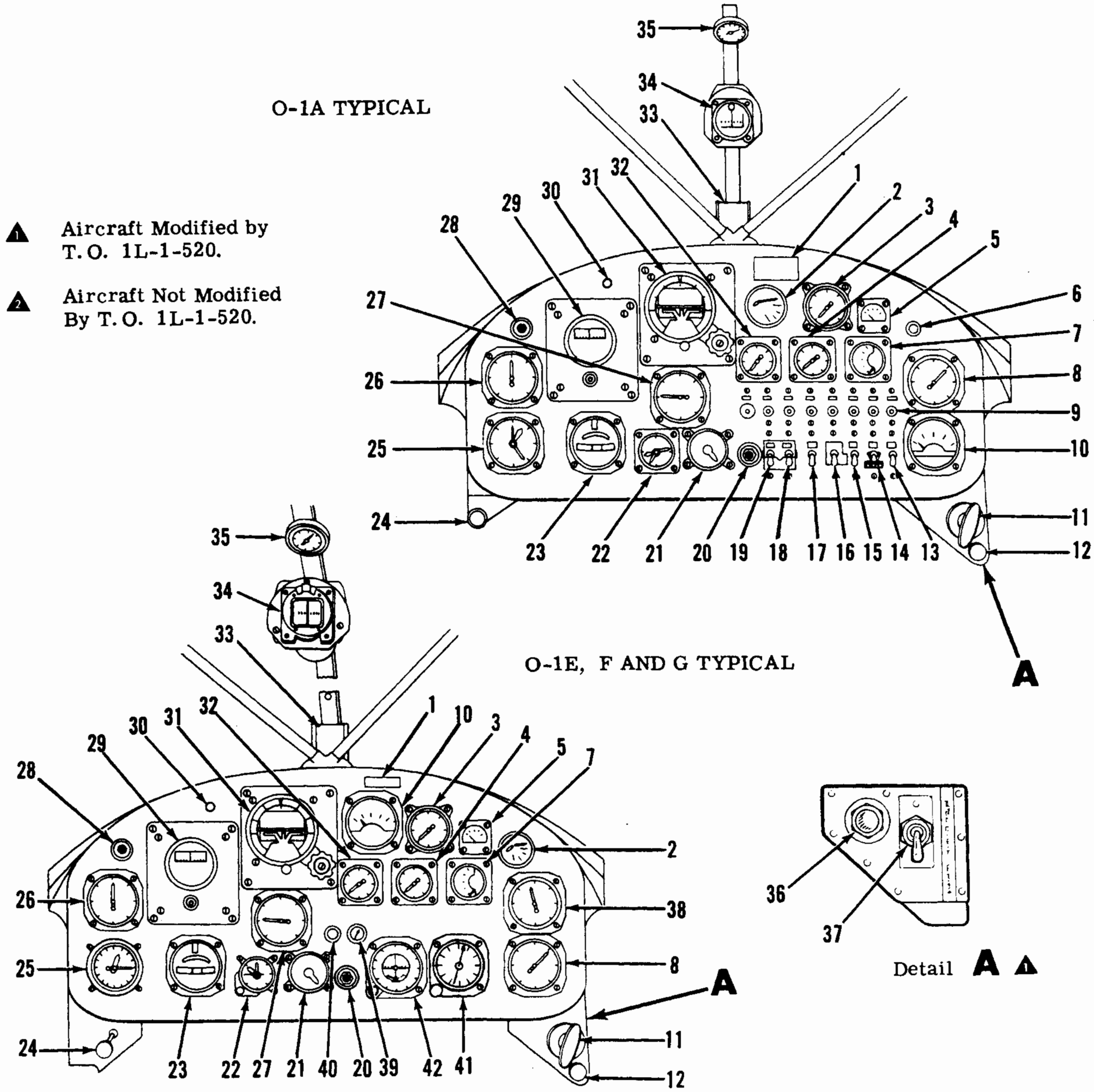


O-1E, F AND G TYPICAL



1. Rear View Mirror
2. Microphone Switch
3. Control Stick
4. Water Rudder Retraction Handle Hook (Seaplanes Only)
5. Right Cabin Heater Outlet
6. Controls Lock
7. Water Rudder Retraction Handle (Seaplanes Only)
8. Controls Lock Engaging Pin
9. Battery
10. Left Cabin Heater Outlet
11. Voltage Regulator Rheostat (Behind Checklist)
12. Instrument Panel
13. Chip Detector Light

Figure 1-5. Front Cockpit Forward View



1. Radio Call Plate
2. Wing Flap Position Indicator
3. Fuel Pressure Gage
4. Oil Pressure Gage
5. Loadmeter
6. Compass Light Rheostat Knob
7. Oil Temperature Gage
8. Tachometer
9. Circuit Breakers
10. Cylinder Head Temperature Gage
11. Engine Primer Handle ▲2
12. Defroster & Pilot Heat Knob ▲2
13. Fuel Pump Switch
14. Landing Light Switch
15. Navigation Light Flasher Switch
16. Rotating Beacon
17. Pitot Heat Switch
18. Battery Switch
19. Generator Switch
20. Starter Button
21. Ignition Switch
22. Clock
23. Turn and Slip Indicator
24. Cabin Heat Knob
25. Altimeter
26. Airspeed Indicator
27. Vertical Velocity Indicator
28. Emergency/Salvo Switch
29. Directional Indicator
30. Chip Detector Light
31. Attitude Indicator
32. Suction Gage
33. Compass Card Holder
34. Compass
35. Free Air Temperature Gage
36. Engine Primer Switch ▲1
37. Emergency Fuel Switch ▲1
38. Manifold Pressure Gage (O-1F)
39. Marker Beacon Power Switch (If Installed)
40. Marker Beacon Indicator Light
41. ADF Compass Indicator
42. Homing Indicator (ID 48/ARN)

Figure 1-6. Instrument Panel

created in the carburetor air box, causing a spring loaded valve to open automatically, thereby allowing unfiltered hot air surrounding the engine cylinders to enter the carburetor.

With the lever in any intermediate position, the gate valve in the carburetor air box is partially closed, restricting the entrance of ram filtered air into the carburetor. However, unless the gate valve is completely closed, the partial vacuum produced in the carburetor air box is not adequate to open the spring loaded valve which permits the entrance of heated air into the induction system. This results in the engine putting out less power because it is not getting its normal air supply.

ENGINE COOLING

Air for engine cooling enters through an opening located in the upper parts of the nose cowling. The cooling air passes over the engine and exists through an opening in the aft portion of the lower cowling. The vented areas are always open and cannot be controlled from the cabin.

IGNITION SYSTEM

The engine is equipped with a high-tension dual ignition system firing two spark plugs in each cylinder. The high voltage required to ignite the fuel-air mixture is supplied by two engine-driven magnetos. Control of the magneto circuit is obtained by use of a conventional rotary-type magneto switch mounted on the front instrument panel.

IGNITION SWITCH

The ignition switch (figure 1-6) controls the ignition system. There are four switch positions designated counterclockwise: BOTH, L, R, and OFF. The engine is started and operated in the BOTH position. The L and R positions are for checking purposes only.

ENGINE PRIMER SYSTEM ▲2

The engine primer system consists of a manual plunger-type primer. A fore and aft movement of the engine primer handle (figure 1-6) pumps raw fuel into the six cylinders to aid in engine starting. The handle is normally full in and locked. The handle is turned counterclockwise to unlock or clockwise to lock.

ENGINE PRIMER SYSTEM (ELECTRIC OPERATED) ▲1

The electric operated engine primer system consists of a solenoid operated fuel valve assembly, and a push-button type primer switch (figure 1-6). Fuel for the primer system operation is supplied by the auxiliary fuel pump. Pressing the push button primer switch energizes the solenoid valve assembly allowing raw fuel, under pressure, to enter the six engine cylinders. The fuel is injected into the intake port just forward of the intake valve. When the primer switch is not energized, the solenoid valve is in the closed position, providing a positive shutoff to prevent fuel passage into the priming system.

EMERGENCY FUEL SWITCH ▲1

An emergency fuel switch (figure 1-6) is provided adjacent to the engine primer switch. This switch energizes the fuel priming solenoid valve assembly, which provides fuel to sustain flight (approximately 2000 RPM) in event of carburetor malfunction due to mechanical failure or icing conditions. Fuel is supplied, under pressure, by the auxiliary fuel pump (figure 1-9).

STARTER SYSTEM

A starter system, operating on 28 volt dc from the bus, consists of a starter button and direct-drive starter motor located on the accessory section of the engine.

STARTER BUTTON

A press-type starter button (figure 1-6) energizes the electrical starter motor. The starter button, mounted on the lower center portion of the instrument panel, is housed within a circular recessed cup to prevent inadvertent operation. When the starter button is pressed, a solenoid connects the starter to the 28 volt dc bus. Electrical power for energizing the starter is supplied by the battery, or from an external power source which may be connected to conserve battery life. The starter button is protected by a circuit breaker (figure 1-7).

ENGINE INSTRUMENTS

TACHOMETER

An electric tachometer (figure 1-6) showing the engine RPM, is provided on the instrument panel. The tachometer circuit is self-generating and the instrument requires no power from the electrical system.

CYLINDER HEAD TEMPERATURE GAGE

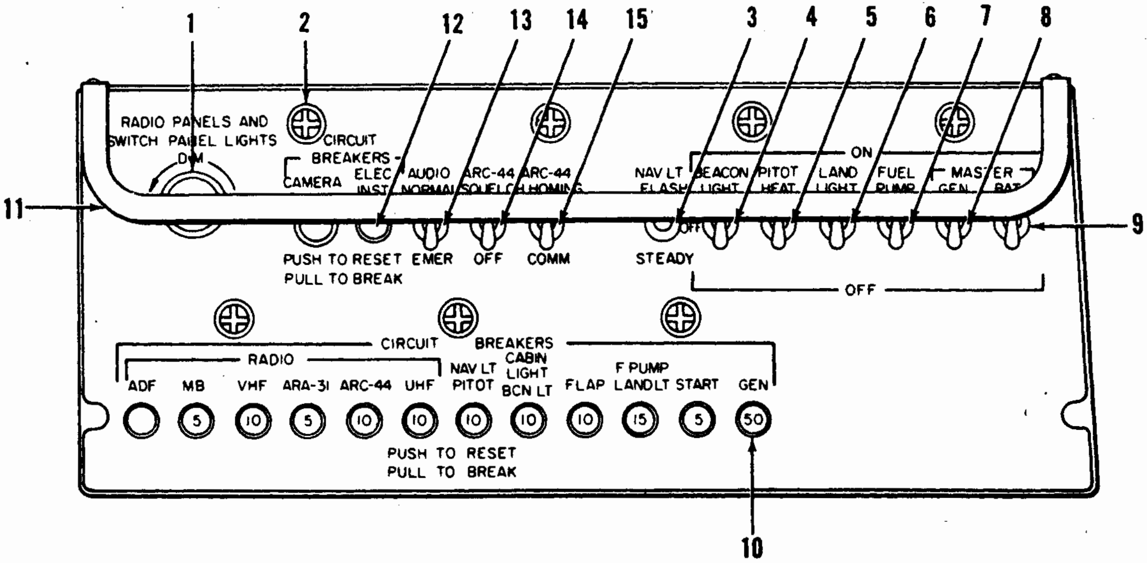
The cylinder head temperature gage (figure 1-6), located on the instrument panel, is calibrated in degrees C, with a range of 0° to 350°C in 50° increments. It is an electrical instrument; however, the sole source of power is generated by a thermocouple mounted on the number three cylinder and thus requires no power from the electrical system.

MANIFOLD PRESSURE GAGE (O-1F)

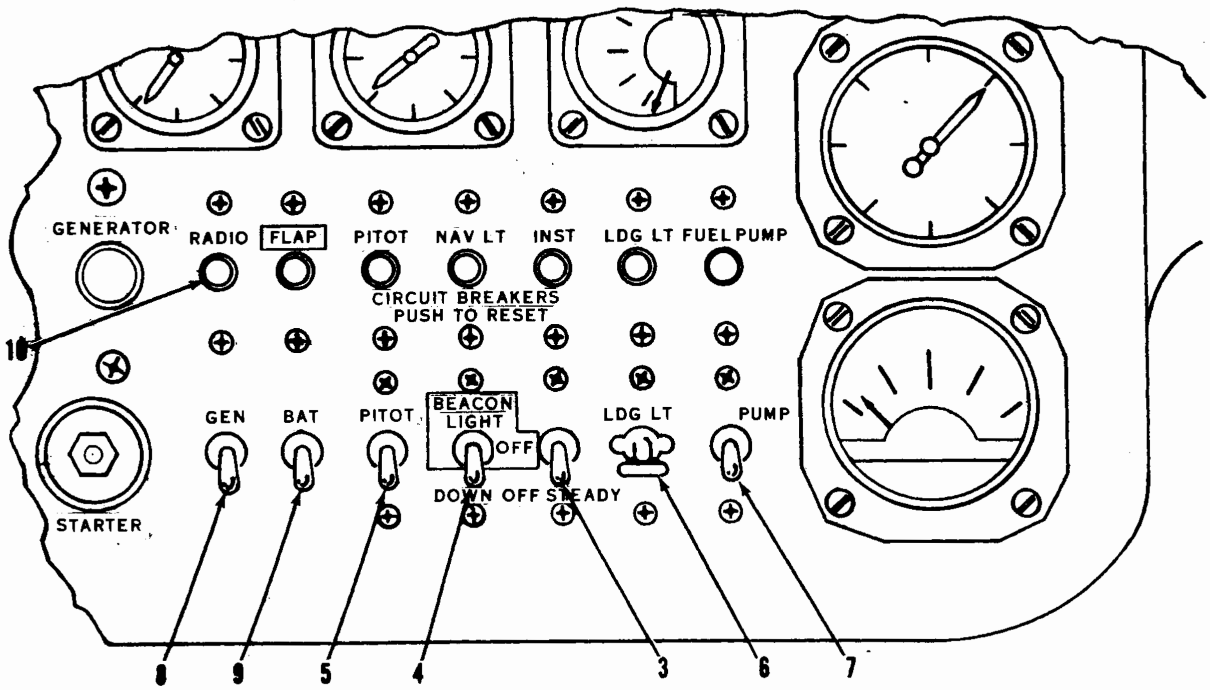
The manifold pressure gage (figure 1-6) is located on the right-hand side of the instrument panel and is calibrated in inches of mercury.

▲1 Aircraft Modified by T.O. 1L-1-520.
▲2 Aircraft Not Modified by T.O. 1L-1-520.

O-1E, F AND G TYPICAL



O-1A TYPICAL (Refer to figure 1-6 for complete instrument panel)



1. Compass, Switch and Circuit Breaker Panel, and Radio Panels Light Switch
2. Panel Edge Light
3. Navigation Lights Switch
4. Rotating Beacon Light Switch
5. Pitot Heat Switch
6. Landing Light Switch
7. Auxiliary Fuel Pump Switch
8. Generator Switch
9. Battery Switch
10. Circuit Breakers
11. Switch Guard
12. Electrical Instruments Circuit Breaker
13. Audio Control Switch
14. Squelch Switch
15. Homing Communications Switch

Figure 1-7. Switch and Circuit Breaker Panel

IL TEMPERATURE INDICATOR

n electrical resistance-type oil temperature indica- or (figure 1-6), mounted on the instrument panel, is alibrated in degrees C and ranges in increments of 0°, from -70° to +150°C. The indicator receives ower from the 28 volt dc bus and is protected by a ircuit breaker (figure 1-7).

IL PRESSURE GAGE

n oil pressure gage (figure 1-6) is installed in the istrument panel and indicates oil pressure to the ngine in pounds per square inch and is a direct ressure operated gage.

HIP DETECTOR WARNING LIGHT

n amber, press-to-test, engine chip detector warn- g light (figure 1-6) is located on the top left side of e front instrument panel. The warning light is arked CHIP DETECTOR and is wired to a chip de- ector installed in the engine oil sump. When a large etal chip or sufficient smaller particles bridge the lectrically insulated air gap between the magnet and ody of the chip detector, the electrical circuit will e complete and the engine chip detector warning ght will come on. The chip detector warning light ircuit is protected by a chip detector warning light ircuit breaker, marked CHIP DETECTOR.

UEL PRESSURE GAGE

fuel pressure gage (figure 1-6) for the engine is cated on the instrument panel and indicates fuel ressure to the engine in pounds per square inch.

ROPELLER

he O-1A, E and G aircraft are equipped with a two ade, all-metal, fixed pitch propeller. On the O-1F rcraft, the engine drives a two blade, constant- eed, controllable pitch, all-metal propeller. A opeller governor, controlled from either cockpit, aintains a selected RPM, regardless of varying rloads or flight attitude. The governor increases e propeller blade angle by directing pressurized gine oil to a piston in the propeller hub. The rodynamic force on the propeller blades is utilized pull the blades into low pitch. The governor as- embly, containing a gear-driven oil pump, is ounted on the rear section of the engine. With a ked throttle setting, the propeller has a govern- g range (full increase to full decrease) of from proximately 2600 to 1800 RPM.

ROPELLER CONTROL LEVER (O-1F)

gine RPM is determined by the setting of the pro- ller control lever (figure 1-3) on the throttle quad- nt in each cockpit. The quadrant is marked RPM th marked positions DECR (aft position) and INCR orward position). The position of the propeller ontrol lever determines the setting of the propeller overnor by mechanical linkage.

OIL SUPPLY SYSTEM

Oil for engine lubrication and on O-1F aircraft propeller governor operation is supplied from a sump mounted on the bottom of the engine. Oil is picked up by the engine-driven pressure pump, forced through the oil thermostat, oil cooler, and then through the engine and on O-1F aircraft the engine-driven propeller governor. When the oil temperature is below 72°C, the thermostat will cause the oil to bypass the oil cooler. Oil from the engine and on O-1F aircraft propeller governor returns to the sump by gravity flow. The oil filler neck is located on the rear side of the engine (figure 1-20). Ten U. S. quarts are required to fill the sump and an additional $\frac{1}{2}$ quart is required for the oil cooler and connecting lines. The oil supply is measured by a dipstick (figure 1-20) located just forward of the oil filler neck on the left side of the engine.

FUEL SUPPLY SYSTEM

Fuel is supplied to the engine from two aluminum or self-sealing fuel tanks, a main fuel tank located in the inboard end of the left wing and an auxiliary fuel tank similarly located in the right wing (figure 1-20). From these tanks, fuel flows through a fuel selector valve, an auxiliary fuel pump, a fuel strainer, and an engine-driven fuel pump to the carburetor. A vapor return line from the carburetor carries excess fuel and vapor back through the rear half of the fuel selector valve to the tank being used. A drain valve is incorporated in the fuel strainer and each fuel tank to drain any water or sediment that may collect in the system. The auxiliary fuel pump is provided with a drain which opens the outside surface of the aircraft just forward of the auxiliary fuel pump. In the event of pump seal failure, any fuel escaping through the seal will flow overboard instead of entering the pump motor where it would create a fire hazard.

NOTE

On aircraft modified by T. O. 1L-1-522, polyurethane foam baffles have been added to the fuel tanks to act as an explosion suppressant.

FUEL SELECTOR VALVE

A rotary-type fuel selector valve is incorporated in the fuel system. The selector valve handle (figure 1-9), which controls the fuel selector valve (through mechanical linkage, has three positions: MAIN TANK, AUX TANK, and FUEL OFF. The MAIN TANK and AUX TANK positions allow fuel to flow from the main tank and auxiliary tank respectively to the engine. The OFF position seals off both tanks from the rest of the fuel system and allows no fuel to pass beyond the selector valve. The valve is designed so that the fuel flowing through the vapor return line is routed back into the fuel tank from which fuel is being used. The fuel selector valve is located on the left side of the fuselage at the wing root and is accessible from either the front or rear seat.

TANKS	NO.	USABLE FUEL—EACH	FULLY SERVICED—EACH
MAIN	1	20.5 GALLONS	21.0 GALLONS
AUX.	1	20.5 GALLONS	21.0 GALLONS
TOTAL	2	41 GALLONS	42 GALLONS

NOTE

- Usable and total capacities of regular and self-sealing tanks are essentially the same.
- Due to variations in aircraft attitude during refueling and variations in fuel density, the total usable fuel may be as low as 38.0 gallons.
- Usable fuel capacity is reduced approximately 5 percent on aircraft modified by T.O. 1L-1-522.

Figure 1-8. Fuel Quantity Data (U.S. Gallons)

AUXILIARY FUEL PUMP SWITCH

The auxiliary fuel pump switch (figure 1-7) is located on the switch panel below the left front window on O-1E, F and G aircraft or on the lower right-hand corner of the instrument panel on O-1A aircraft. The switch is marked FUEL PUMP and has two positions: ON (up position) and OFF (down position). The auxiliary fuel pump is used to build up pressure in the carburetor before starting the engine and during takeoff and landing. It is also used as an emergency source of fuel pressure if the engine-driven fuel pump fails. When the auxiliary fuel pump is not in operation, fuel is by-passed around the pump through a by-pass valve located in its base. The switch receives power from the 28 volt electric bus and is protected by a circuit breaker (figure 1-10).

FUEL DRAIN VALVES

Three self-locking drain valves are provided in the fuel system. A valve is located in the bottom of each wing tank and marked FUEL TANK DRAIN. One valve is incorporated in the fuel filter and is marked FUEL FILTER DRAIN. These valves are used to drain water and sediment from the fuel system.

FUEL QUANTITY INDICATORS

A direct reading, mechanically actuated, float-type fuel quantity indicator (figure 1-9) is mounted in each fuel tank at the wing root. Each indicator shows, in relation to a full tank, the amount of fuel remaining in its respective fuel tank. The indicator is marked: E, 1/4, 1/2, 3/4, and F. A red arc is painted on the face of each indicator and is marked NO TAKEOFF.

NOTE

Fuel quantity checks during flight should be accomplished in level flight.

ELECTRICAL POWER SUPPLY SYSTEM

The aircraft is equipped with a 28 volt dc electrical power supply system (figure 1-10). The dc system is powered by a 50-ampere engine-driven generator. A 24 volt, 11 ampere hour storage battery serves as a standby power source to supply current to the dc system when the generator is inoperative or when generator voltage is insufficient to close the reverse current relay.

AUXILIARY POWER RECEPTACLE

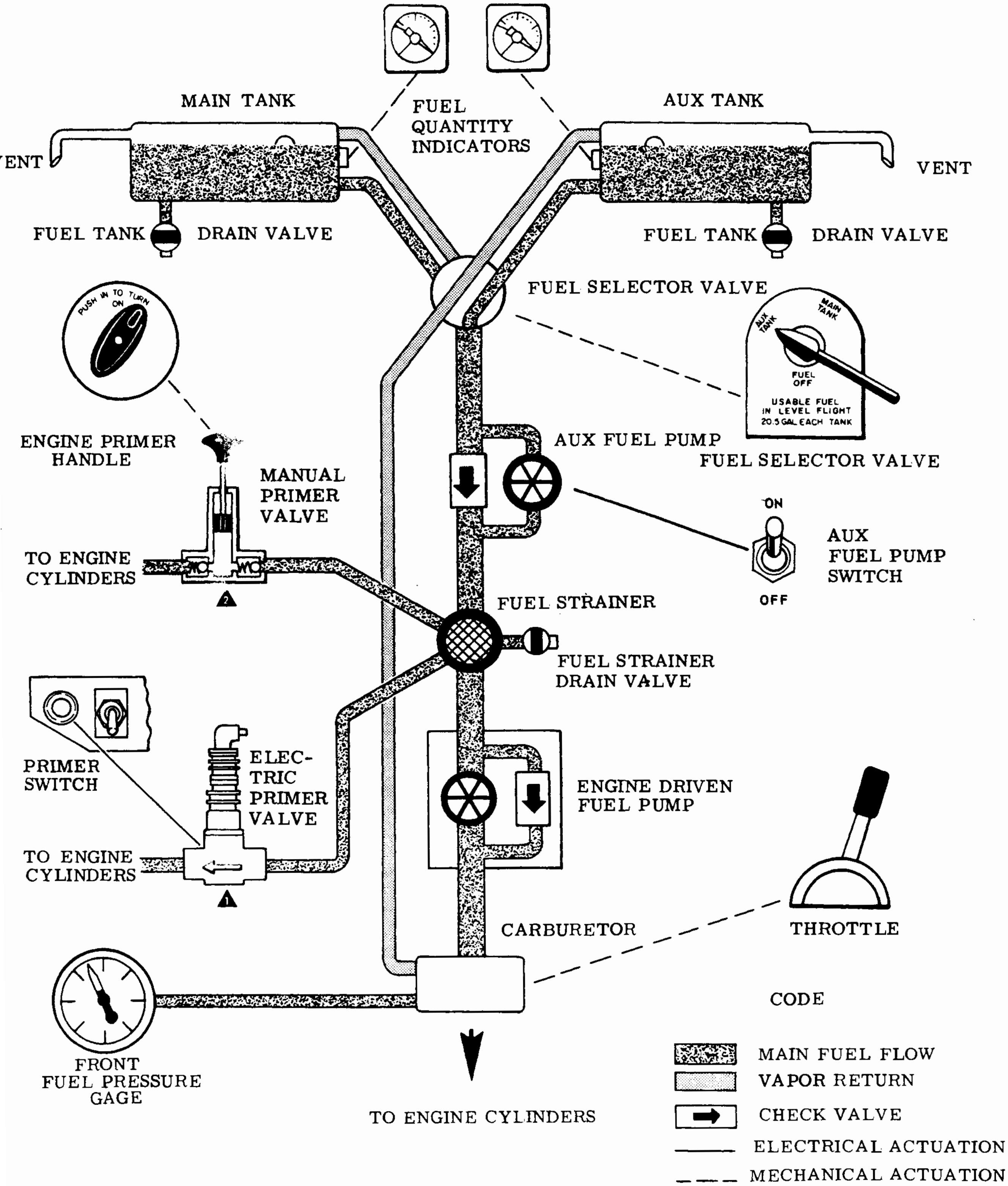
The dc power supply system can be connected to an external power source for engine starting, or for ground checking the electrical system, through the auxiliary power receptacle located on the right side of the fuselage aft of the firewall. This receptacle is protected by a spring-loaded door.

CIRCUIT BREAKERS

The circuit breakers (figure 1-7) are located on the switch and circuit breaker panel. The circuit breakers are PUSH to RESET TYPE. Should an overload occur, circuit breaker will pop out, breaking the circuit. The circuit breaker may be pushed in to RE-ENERGIZE the circuit; however, if it pops out a second time, the circuit should not be ENERGIZED again.

NOTE

Automatic reset circuit breakers are provided on the O-1A aircraft for starter and oil temperature circuits. On all aircraft an automatic reset circuit breaker is installed in the external drop load circuit.



1 Aircraft Modified by T. O. 1L-1-520.
2 Aircraft Not Modified by T. O. 1L-1-520.

Figure 1-9. Aircraft Fuel Supply System

CAUTION

Circuit breakers should not be pulled or reset without a thorough understanding of all the effects and results. Use of the circuit breakers can eliminate from the system some related warning system or interlocking circuit. A circuit breaker that continues to pop out after being reset could result in an electrical fire and further attempts to reset it should be discontinued.

THE BATTERY SWITCH

The battery switch (figure 1-10) is located on the switch and circuit breaker panel. The switch is used to disconnect the battery from the aircraft electrical supply system. The switch is marked BAT and has two positions: ON and OFF. When the switch is in the ON position, the battery is connected directly to the 28 volt dc bus.

GENERATOR SWITCH

The generator switch (figure 1-10) is mounted beside the battery switch on the switch and circuit breaker panel. Switch positions are ON and OFF. With the switch in the ON position, engine RPM at 1200-1250 or above, insures electrical power to the bus bar, thus relieving the drain on the battery. The generator circuit is protected by a circuit breaker on the circuit breaker panel.

VOLTAGE REGULATOR

The voltage regulator, preset by the ground crew, is located behind the lower center portion of the instrument panel. The voltage regulator maintains a generator voltage of approximately 28 volts dc.

WARNING

Improper regulation of the voltage regulator may cause battery to overheat or explode.

LOADMETER

A loadmeter (figure 1-6) is located within the upper row of instruments on the right-hand side of the pilot instrument panel. The instrument indicates the percentage of a generator output being utilized.

FLIGHT CONTROL SYSTEM

Conventional stick and rudder pedal controls are provided in both the front and rear cockpits. The primary flight control surfaces (ailerons, rudder and elevators) are operated by mechanical linkage. The flight-adjustable trim tab on the right elevator is mechanically actuated by manual operation of the elevator trim tab control wheels located on the left wall; an additional control wheel is located in the rear cockpit of the O-1F aircraft. The rudder and aileron trim tabs are adjustable on the ground only.

CONTROL STICKS

The elevator and aileron surfaces are operated by conventional movement of either one of dual control sticks. The forward control stick is located just forward of the pilots seat. The aft control stick is quickly removable by pulling on the control stick release knob and lifting the control stick from its socket. Mounting straps for storage of the aft control stick are provided in the rear cockpit.

RUDDER PEDALS

Two sets of rudder pedals are provided to mechanically operate the rudder. The front pedals are located just aft of the firewall and adjacent to the cabin floor. The rear pedals, located just aft of the pilots seat, can be folded flat against the floor by pulling up on the locking pin of each pedal, and pushing the pedal down and aft (figure 1-12). The pedals in this position do not interfere with the normal operation of the front rudder pedals. The rear pedals can be raised to the operating position by pulling them up and forward. The rudder pedals also mechanically operate the steerable tail wheel and the brake system master cylinders.

ELEVATOR TRIM TAB CONTROL WHEEL

An elevator trim tab control wheel is located on the left cabin wall in all aircraft and is accessible from the front seat; an additional trim tab control wheel (figure 1-15) is located on the left wall of the rear cockpit on O-1F aircraft. The rear cockpit trim tab control wheel is mechanically interconnected with the forward trim tab control wheel and operates in exactly the same manner. The trim tab control wheel is mechanically connected to the elevator trim tab by chains, cables, and a screw-jack tab actuator. A trim tab position indicator is in each trim tab control wheel mechanism indicating the nose attitude of the aircraft. The marked indicator positions are NOSE UP, NOSE DOWN, and TAKEOFF.

CONTROL LOCK

A simple positive control lock (figure 1-12) for rudder pedals, elevators and ailerons, and parking brakes is located on the floor in front of the forward control stick. The lock is a welded U-shaped tube that pivots inside the front rudder pedal torque tubes. Locking and unlocking of the controls is accomplished by a single operation. The controls can be locked by lifting the lock from the floor and engaging it with the steel pin attached to the forward control stick. The controls can be unlocked by disengaging the control lock from the pin and lowering the lock to the floor.

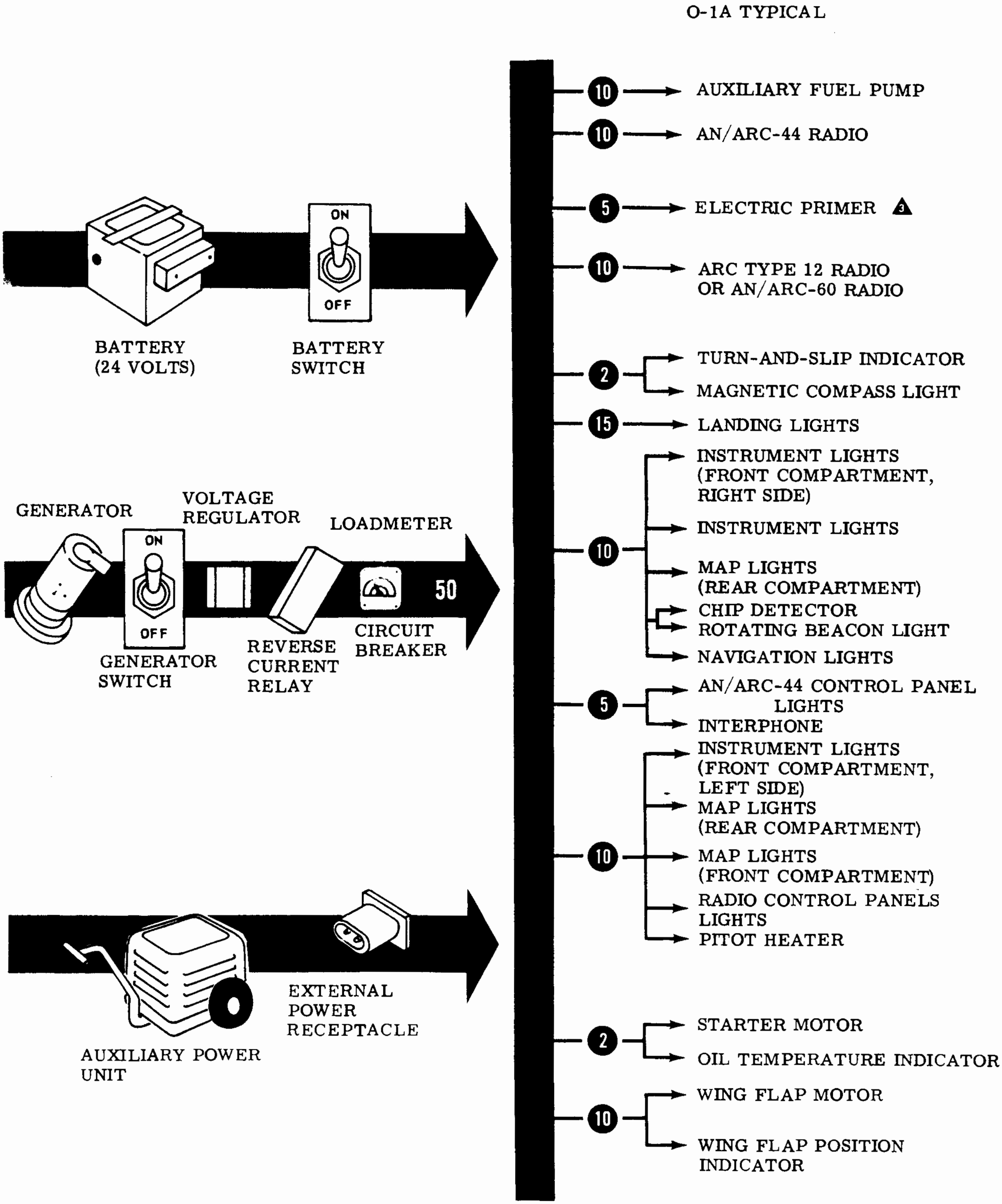
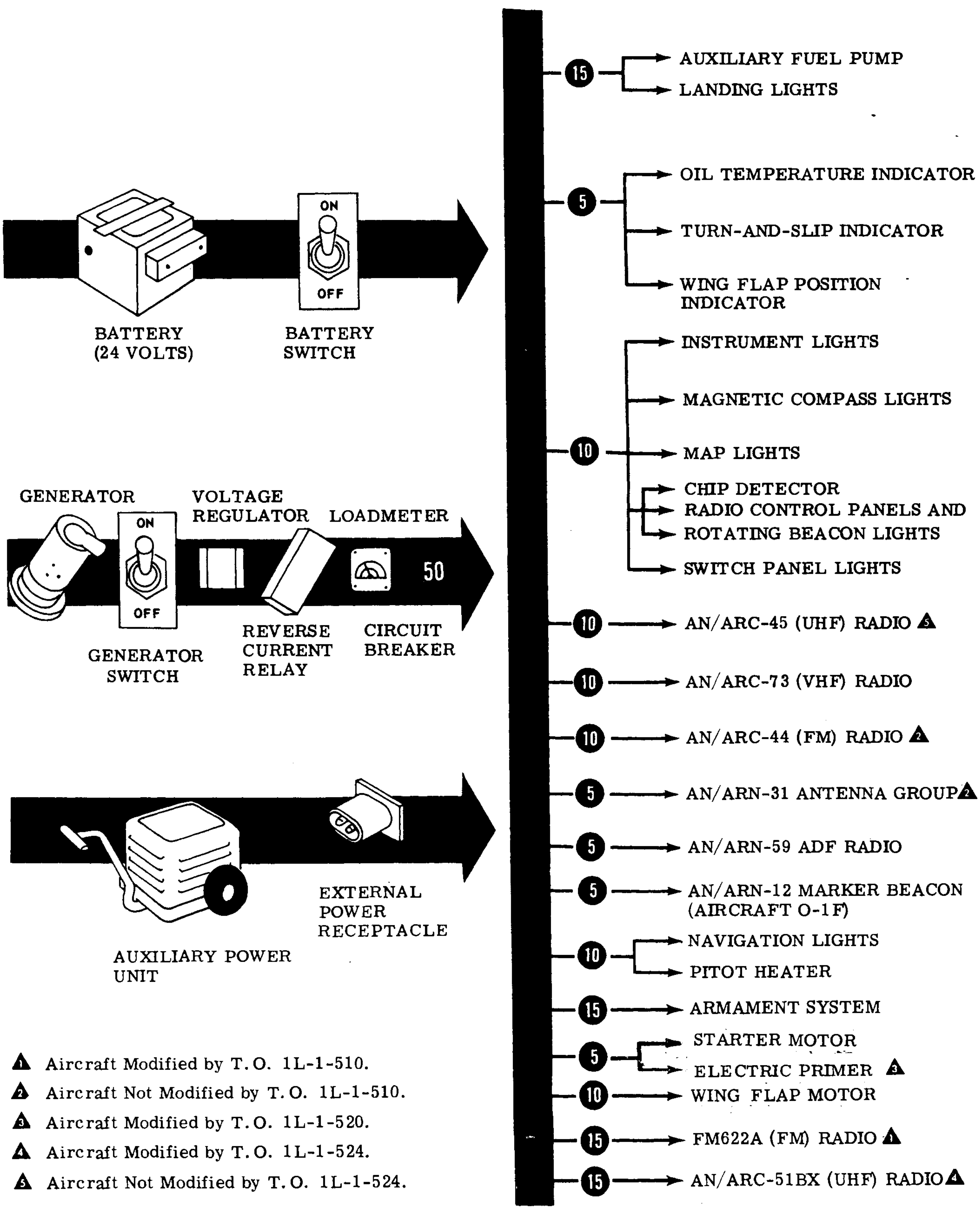


Figure 1-10. Electrical Power Supply System (Sheet 1 of 2)



▲1 Aircraft Modified by T.O. 1L-1-510.

▲2 Aircraft Not Modified by T.O. 1L-1-510.

▲3 Aircraft Modified by T.O. 1L-1-520.

▲4 Aircraft Modified by T.O. 1L-1-524.

▲5 Aircraft Not Modified by T.O. 1L-1-524.

Figure 1-10. Electrical Power Supply System (Sheet 2 of 2)

WING FLAP SYSTEM ▲2

The wing flaps are partial-span, single-slotted, trailing-edge type and extend from the aileron to the fuselage on each wing. The wing flaps are manually operated by a wing flap lever mounted on the cabin floor adjacent to the left cabin wall. The lever is operated by depressing a thumb button on the lever and moving the lever to the desired flap setting. By releasing the thumb button, the flap lever can be locked to provide 0-, 30-, 45-, and 60-degree flap positions.

WING FLAP SYSTEM ▲1

The wing flaps are partial-span, single-slotted, trailing-edge type and extend from the aileron to the fuselage on each wing. The wing flaps are electrically operated by a wing flap switch to any setting between zero and 60 degrees. A flap position indicator on the instrument panel shows the position of the wing flaps at all times. No emergency system is provided for operating the flaps. The wing flaps receive electrical power from the 28 volt dc bus, and the system is protected by a circuit breaker (figure 1-10).

WING FLAP SWITCHES ▲1

On modified O-1A aircraft and all O-1E and G aircraft, the wing flaps are electrically operated by means of a three-position, spring-loaded wing flap switch (figure 1-13), mounted on the window sill adjacent to the front engine control quadrant. The switch has two marked positions: FLAPS UP and FLAPS DOWN. The center position of the switch is the off position. The wing flaps can be lowered electrically to any setting between zero and 60 degrees and locked at that position by releasing the switch and allowing it to return to the center off position. When either the up or down flap limit is reached, the electrical actuator motor is automatically turned off by a limit switch. On O-1F aircraft, the wing flaps are electrically operated by either of two spring-loaded three-position switches. One switch (figure 1-3) is mounted on the aft side of the front engine control quadrant for use by the front occupant. The switch is labeled FLAP and has two marked positions: UP and DOWN. The center position of the switch is off. On O-1F aircraft, the rear cockpit flap switch (figure 1-15) is mounted on the left side of the rear engine control quadrant. The switch is spring-loaded and is marked FLAP with two marked positions, UP and DOWN, with the center position being off. On O-1F aircraft, the front and rear flap switches are identical in operation, being momentarily on in both the UP and DOWN positions; however, the front wing flap switch will override the rear flap switch. The time required to lower the wing flaps from zero to 60 degrees is approximately 7½ seconds. The wing flap switches receive electrical power from the 28 volt dc bus and are protected by a circuit breaker (figure 1-10).

▲1 Aircraft Modified by T. O. 1L-19A-247.
▲2 Aircraft Not Modified by T. O. 1L-19A-247.

WING FLAP POSITION INDICATOR ▲1

An electrically operated wing flap position indicator (figure 1-6) is provided on the front instrument panel. The indicators are calibrated in degrees and show the position of the wing flaps at all times. The indicators receive electrical power from the 28 volt dc bus and are protected by a circuit breaker (figure 1-10).

LANDING GEAR SYSTEM (LANDPLANE)

The landing gear system consists of a fixed main landing gear and a steerable tailwheel. The main landing gear incorporates a single-tapered spring-steel leaf supporting each main wheel. The tailwheel is supported by a multileaf spring. The tailwheel steering arms are connected to the rudder by flexible cables and springs, and steering is controlled through normal operation of the rudder pedals.

CASTORING GEAR

The castoring gear permits the main wheel on the downwind side of the aircraft to momentarily swivel outboard to align with the drifting ground track of the aircraft. However, the opposite (upwind) wheel is incapable of swiveling inboard and it will scrub lightly until the drifting motion has ceased. The castoring gear is essentially a spring-loaded, fluid filled, orifice-dampened cylinder.

LANDING GEAR SYSTEM (SEAPLANE)

When the aircraft is used as a seaplane, floats are attached to fittings on the fuselage, and seaplane fins are installed at the tips of the horizontal stabilizer. Retractable water rudders on the floats are connected to the rudder bellcrank to permit steering during taxiing.

STEERING SYSTEM (LANDPLANE)

Steering is made possible by operation of the rudder pedals. The tailwheel steering arms are connected to the rudder by flexible cables and springs. The tailwheel is steerable through an arc of 16 degrees each side of neutral. Beyond this travel, the tailwheel becomes free-swiveling.

STEERING SYSTEM (SEAPLANE)

WATER RUDDERS

Retractable water rudders are mounted at the aft end of each float to provide steering during seaplane taxiing. The water rudders are connected by a system of cables to the rudder bellcrank; thus, normal operation of the rudder pedals operates the water rudders.

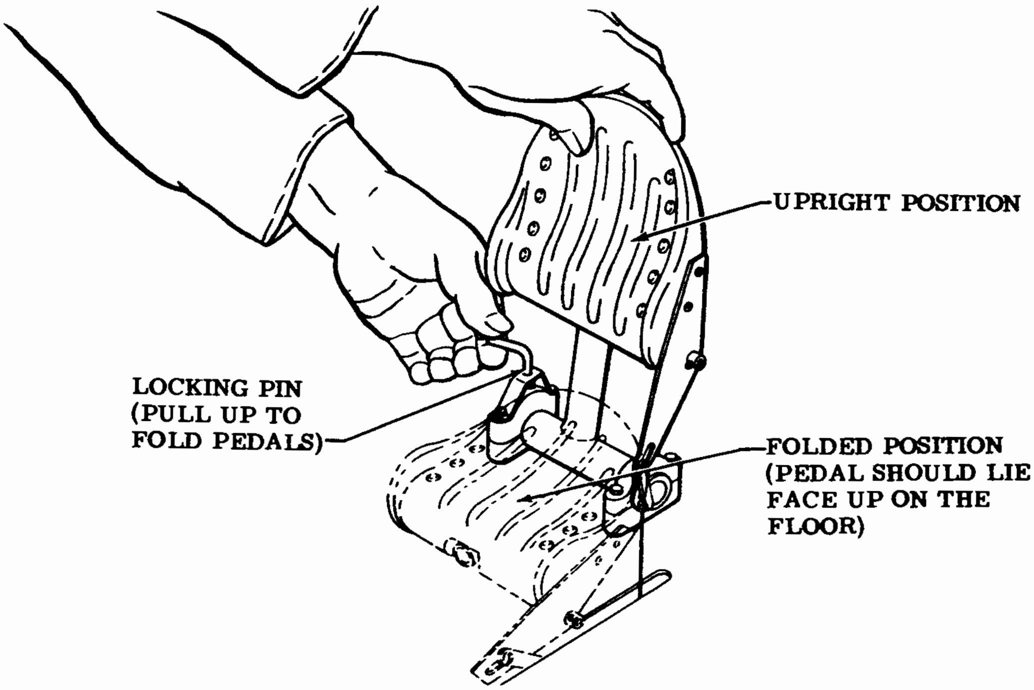


Figure 1-11. Rear Rudder Pedal Positions

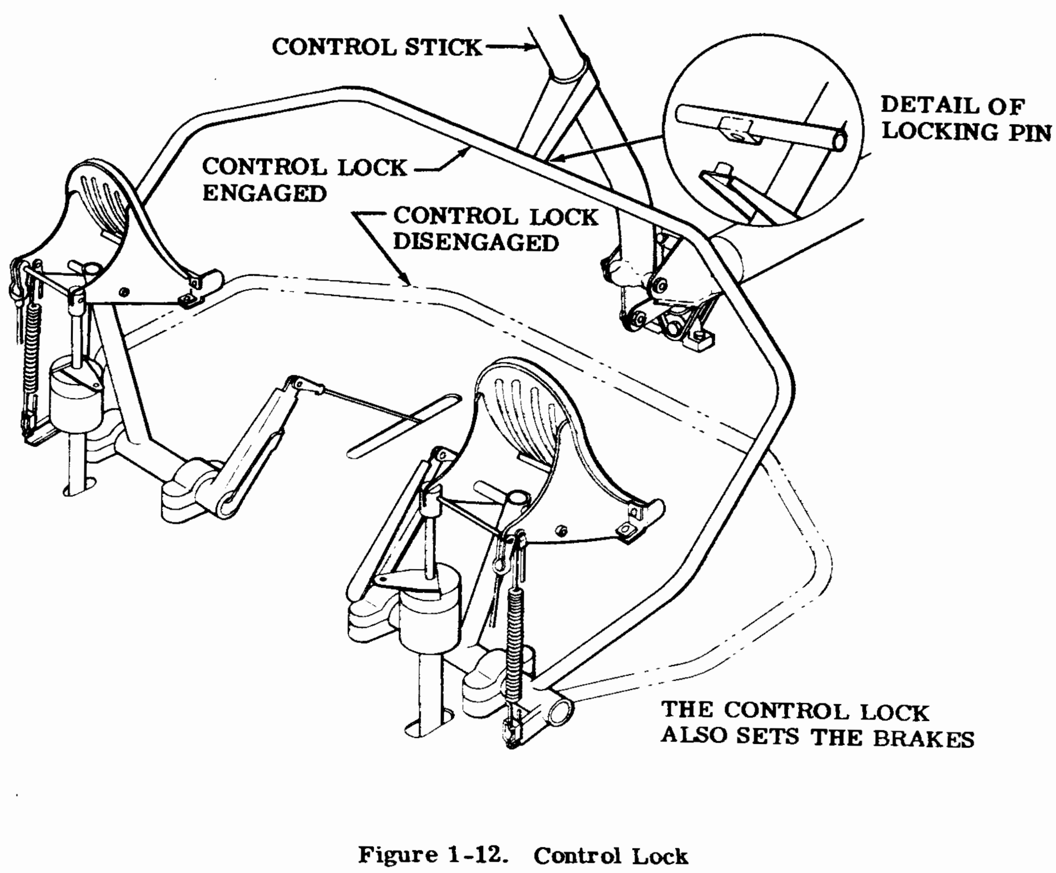
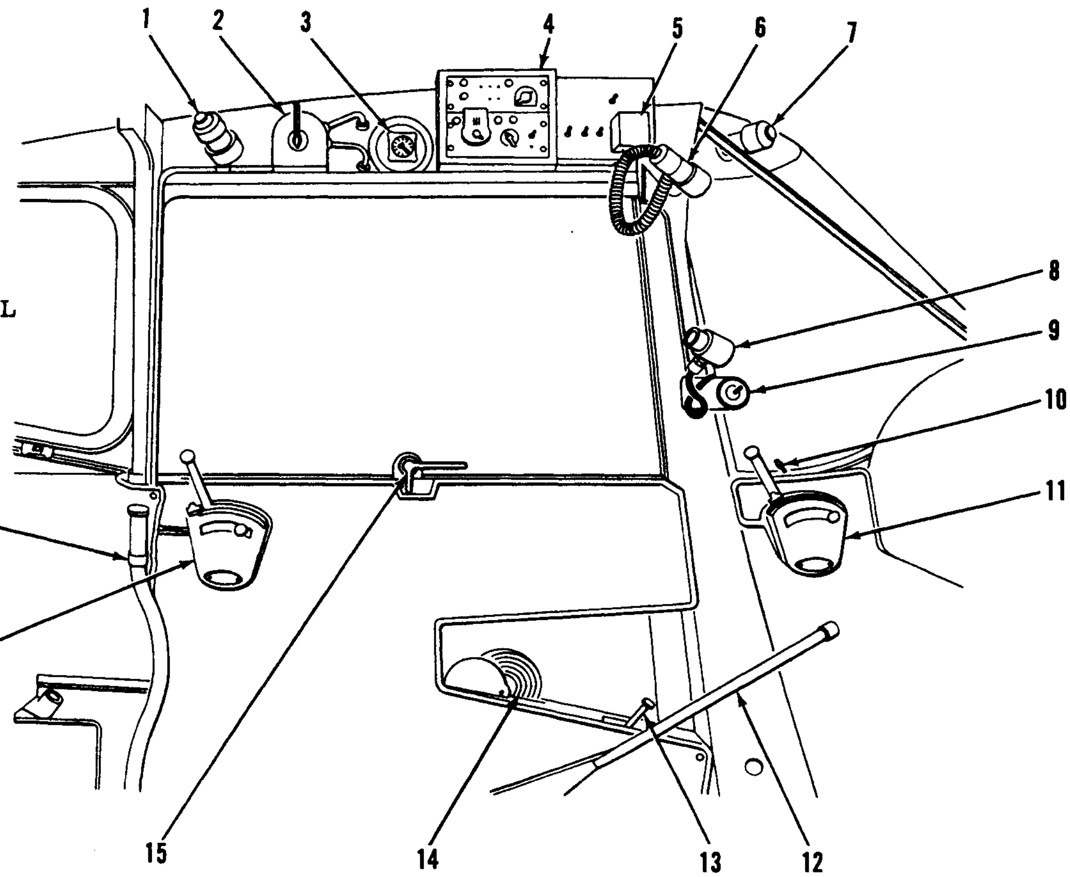


Figure 1-12. Control Lock



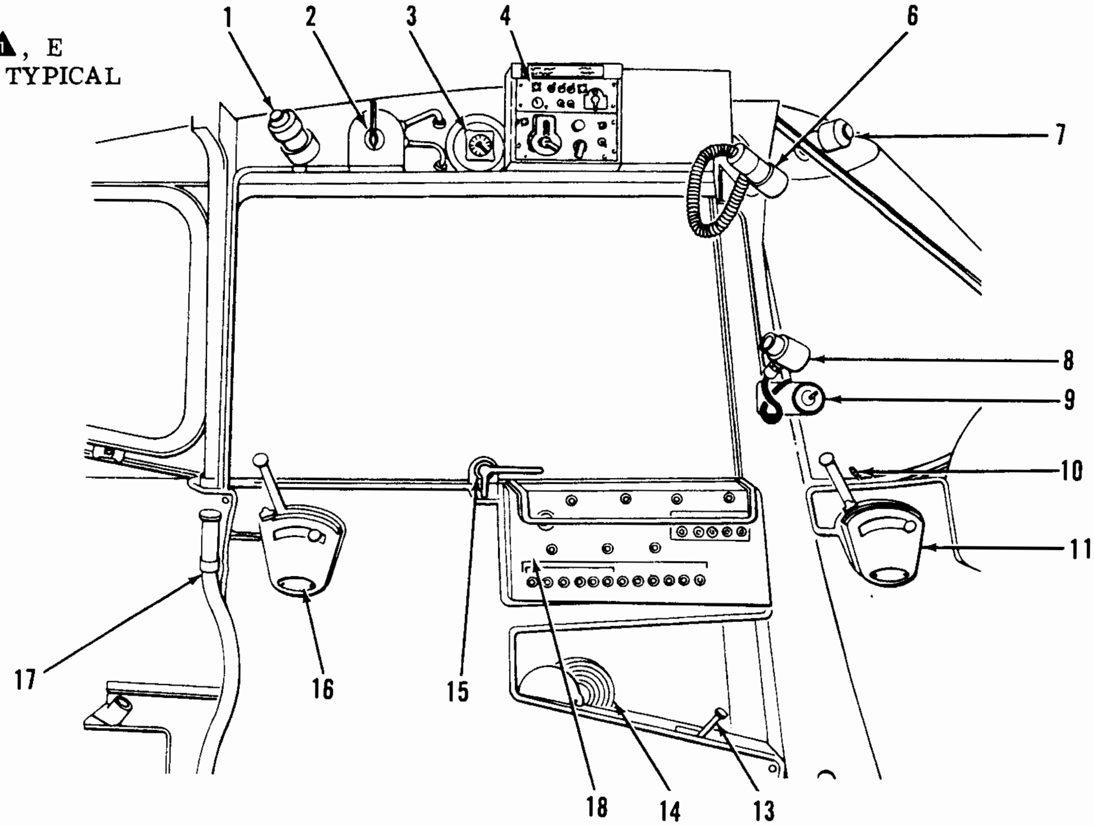
1. Rear Cockpit Ventilator
2. Fuel Selector Valve Handle
3. Main Fuel Tank Quantity Indicator
4. Radio Control Panel
5. Radio Jack Box
6. Map Light
7. Front Cockpit Ventilator
8. Instrument Light
9. Instrument Light Rheostat Switch
10. Wing Flap Switch ⚠1
11. Front Engine Control Quadrant
12. Wing Flap Lever ⚠2.
13. Shoulder Harness Inertia Reel Lock Lever
14. Elevator Trim Tab Control Wheel
15. Window Handle
16. Rear Engine Control Quadrant
17. Control Stick Stowage Strap
18. Switch and Circuit Breaker Panel

⚠1 Aircraft Modified by T.O. 1L-19A-247.

⚠2 Aircraft Not Modified by T.O. 1L-19A-247.

Figure 1-13. Front Cockpit (Left Side) (Sheet 1 of 2)

O-1A ⚠1, E
AND G TYPICAL



O-1F TYPICAL

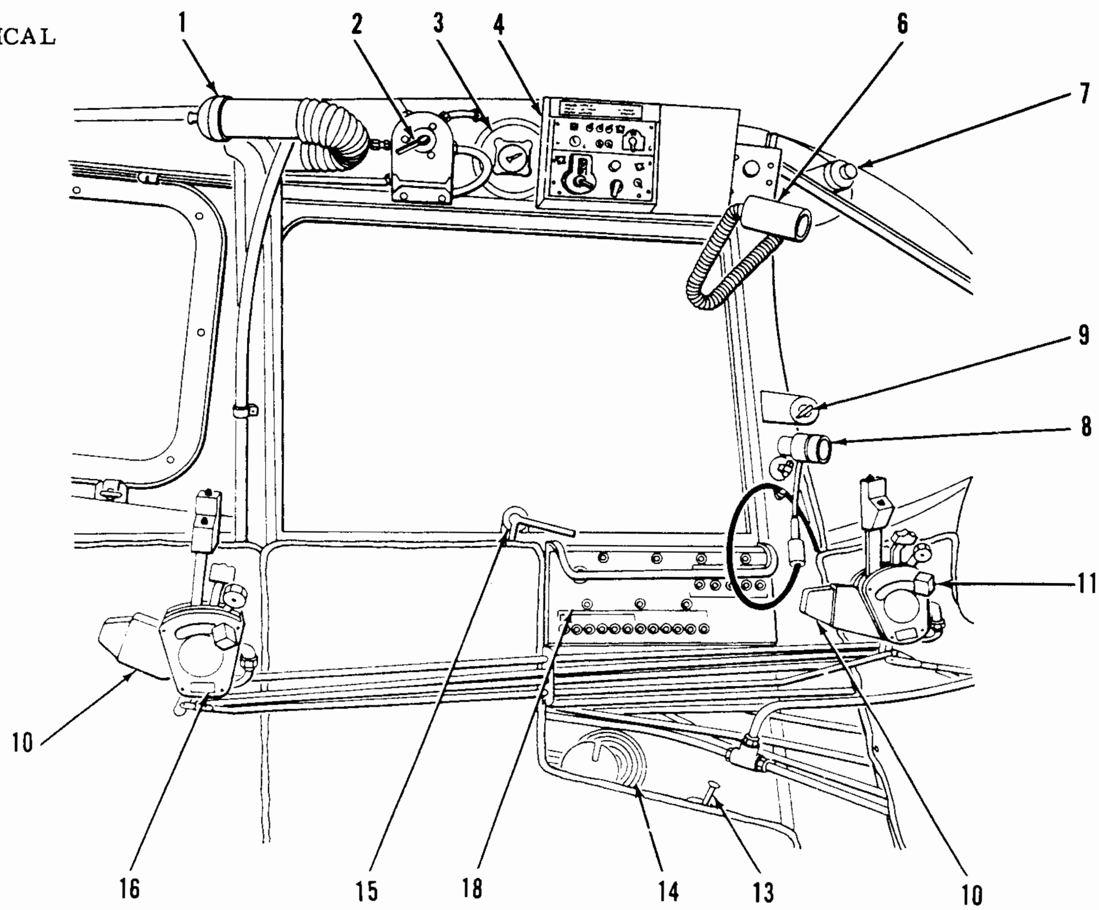
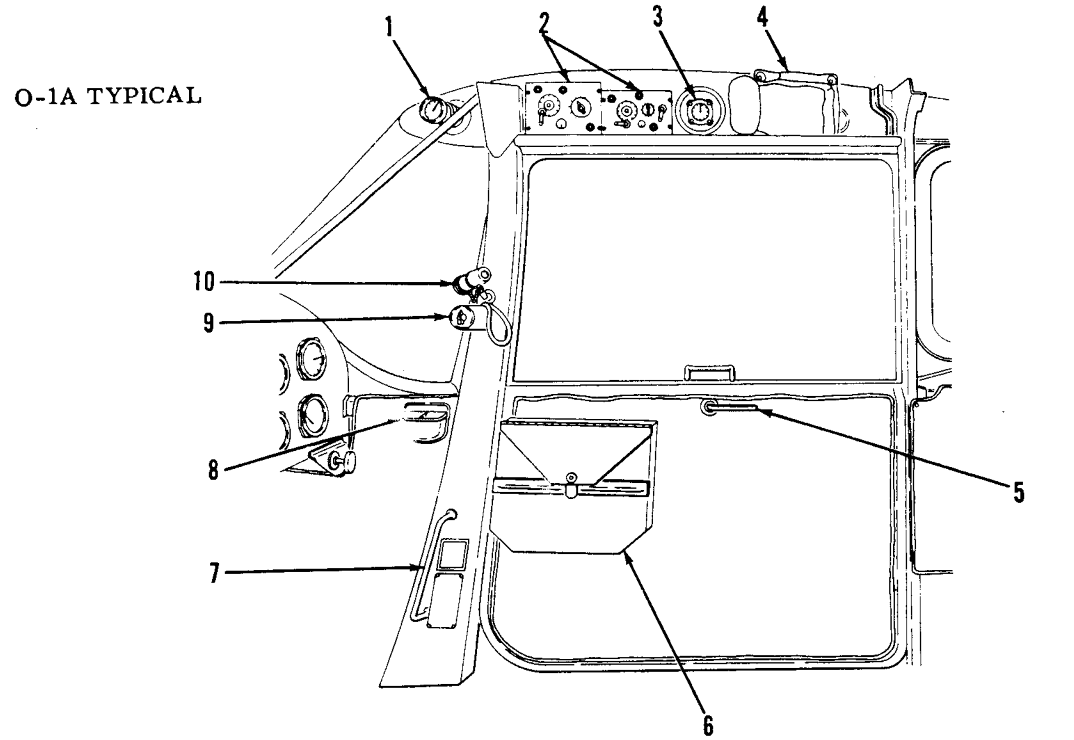
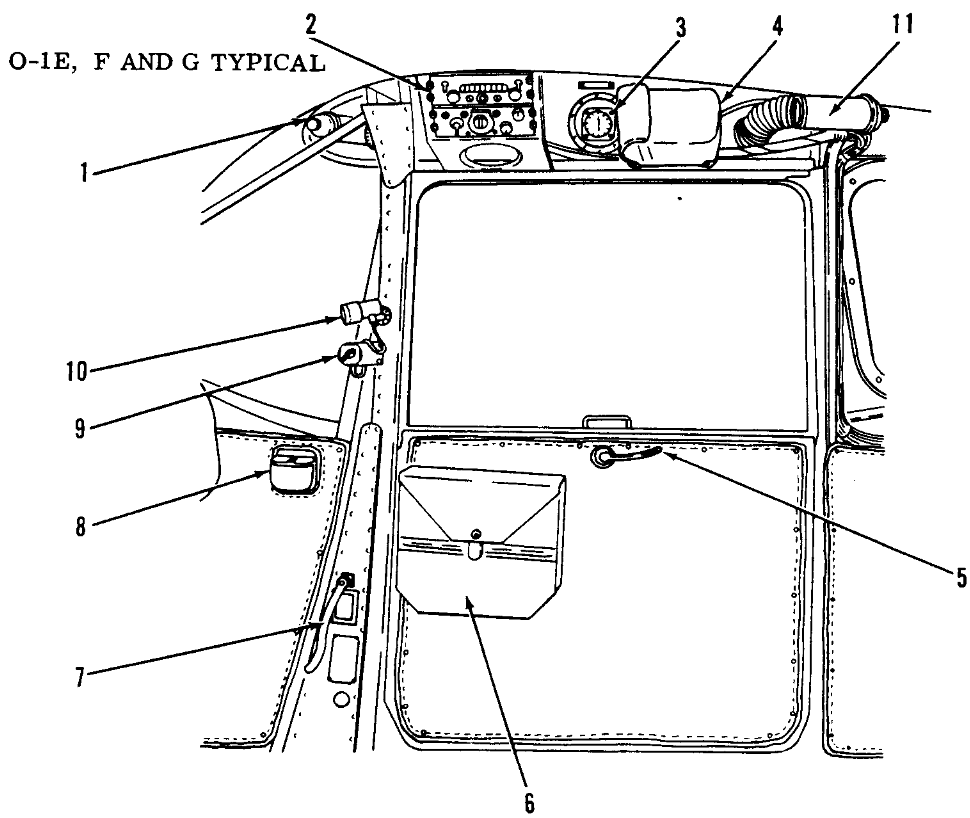


Figure 1-13. Front Cockpit (Left Side) (Sheet 2 of 2)

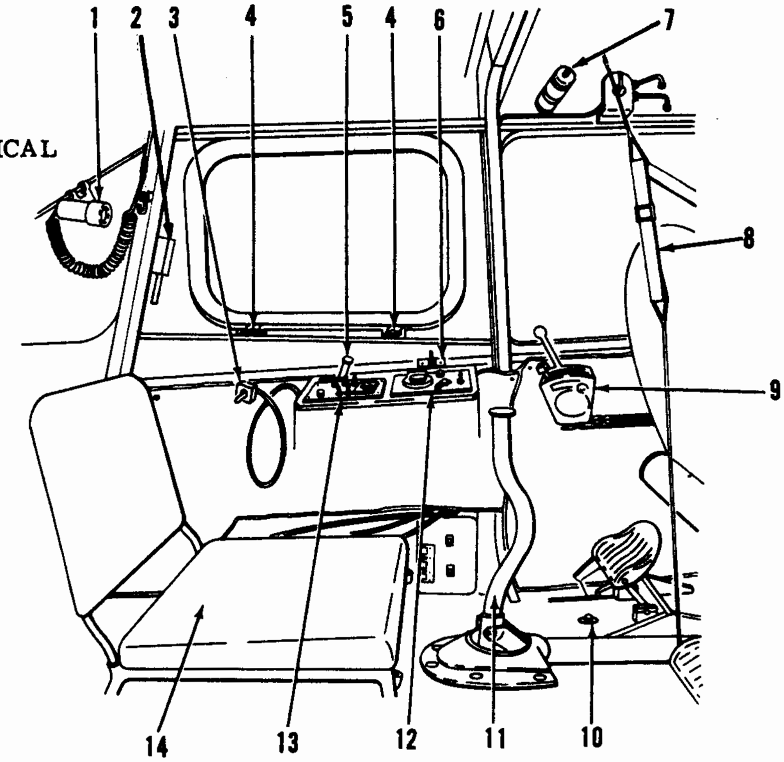




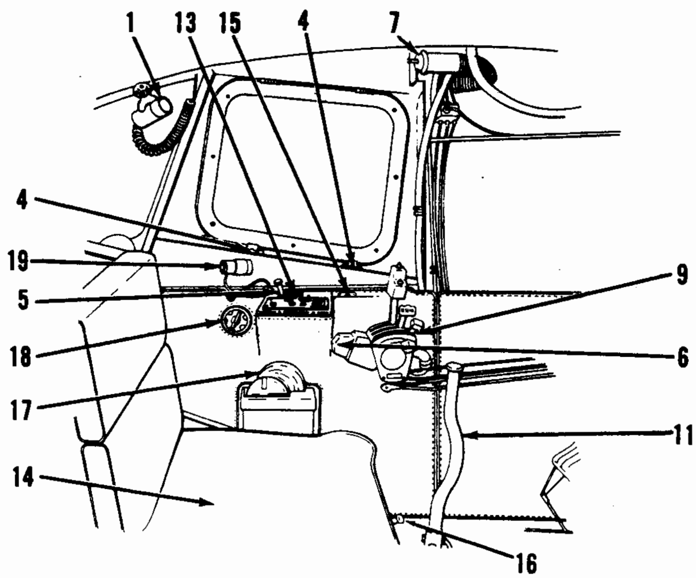
1. Front Cockpit Ventilator
2. Radio Control Panels
3. Auxiliary Fuel Tank Quantity Indicator
4. First Aid Kit
5. Door Handle
6. Map and Flight Report Case
7. Door Emergency Release Handle
8. Ash Tray
9. Instrument Light Rheostat Switch
10. Instrument Light
11. Rear Cockpit Ventilator

Figure 1-14. Front Cockpit (Right Side)

O-1A, E AND G TYPICAL



O-1F TYPICAL



1. Map Light
2. Radio Jack Box (O-1A)
3. Portable Microphone Switch
4. Side Window Latch
5. Shoulder Harness Inertia Reel Lock Lever
6. Wing Flap Switch
7. Rear Cockpit Ventilator
8. Front Shoulder Harness
9. Engine Control Quadrant
10. Foot-operated Microphone Switch
11. Control Stick
12. AN/ARC-44 Radio Control Panel O-1A
13. Interphone Control Panel
14. Rear Seat
15. Auxiliary Fuel Pump Switch
16. Seat Adjustment Lever
17. Elevator Trim Tab Control Wheel
18. Instrument Light Rheostat Switch
19. Instrument Light

Figure 1-15. Rear Cockpit (Left Side)

WATER RUDDER RETRACTION HANDLE

A water rudder retraction handle (figure 1-5) located slightly to the right and in front of the forward control stick, is provided to manually raise and lower the water rudders. Flexible steel cables connect the water rudders to the water rudder retraction handle. The retraction handle is normally hooked to the water rudder retraction handle hook (figure 1-5) during flight. The water rudders are up when the retraction handle is in the up position. By manually lowering the retraction handle to the cabin floor the water rudders are lowered to their operating position.

BRAKE SYSTEM

Single-disc hydraulic brakes on the main wheels are operated by applying toe pressure to either the front or rear rudder pedals. Rotation of the pedals actuates the hydraulic brake cylinders. The parking brake is set by engagement of the control lock.

BRAKE PEDALS

Conventional toe-type pedals make up the upper part of the front and rear rudder pedals. A hydraulic brake master cylinder is mounted directly on each of the front brake pedals. The rear brake pedals are connected by flexible steel cables to the front brake pedals; thus, pressure applied to the rear pedals is mechanically transmitted to the master cylinders on the front pedals, and pressure is applied to the wheel brakes.

INSTRUMENTS

This paragraph covers only those instruments which cannot be considered to be part of complete systems, such as fuel systems, engine, etc. For information regarding instruments that are an integral part of a particular system, refer to applicable paragraph in this section. The flight and engine instruments are mounted on a shock-mounted instrument panel in the front cockpit with the exception of a free air temperature gage and a magnetic compass. The free air temperature gage is mounted on the windshield center-strip. The magnetic compass is mounted on a bracket attached to the windshield centerstrip just below the free air temperature gage.

ELECTRICALLY OPERATED INSTRUMENTS (O-1A AIRCRAFT)

Instruments operating on power from the aircraft 28 volt dc electrical system includes the turn-and-slip indicator, wing flaps position indicator, and the oil temperature indicator. These instruments (figure 1-6) will operate when the battery switch is ON or when generator output is sufficient when the generator switch is ON. The tachometer and cylinder head temperature gage systems are self-generating types and do not require power from the aircraft electrical power supply system.

ELECTRICALLY OPERATED INSTRUMENTS (O-1E, F AND G AIRCRAFT)

Instruments operating on power from the 28 volt dc electrical system includes the turn-and-slip indicator, wing flaps position indicator, marker beacon indicator light (O-1F), radio compass azimuth indicator, and course indicator. The oil temperature gage will operate when the battery switch is ON, or with the generator charging, when the generator switch is ON. With the battery switch ON, the marker beacon indicator lights may be tested for continuity of their circuits by pressing the lights in. The radio compass azimuth indicators are operative after turning on the battery switch and the ON-OFF volume control knob located on the ADF control panel. The tachometer and cylinder head temperature gage systems are self-generating types and do not require power from the aircraft electrical power supply system.

VACUUM OPERATED INSTRUMENTS

Vacuum operated instruments are an attitude indicator and directional indicator. The attitude indicator (figure 1-6) and directional indicator (figure 1-6) are mounted on the panel. A suction gage (figure 1-6) is provided on the instrument panel to indicate the amount of vacuum being developed by the engine-driven vacuum pump.

PITOT STATIC SYSTEM

The airspeed indicator (figure 1-6) utilizes the difference between impact and static air pressure. The altimeter (figure 1-6) is calibrated in feet and incorporates a barometric scale. A vertical velocity indicator (figure 1-6) is calibrated in feet per minute. These instruments are located on the instrument panel and utilize static air pressure obtained from static ports mounted on each side of the fuselage aft section. The pitot tube is mounted on the under side of the left wing.

EMERGENCY EQUIPMENT

DOOR EMERGENCY RELEASE HANDLE

A door emergency release handle (figure 1-14) is located just forward of the door on the right side. The entire section of the door can be jettisoned by disengaging the bottom end of the door emergency release handle and turning it 90 degrees.

HAND-OPERATED FIRE EXTINGUISHER

A hand-operated fire extinguisher (figure 1-17) is secured within a bracket on the back of the lower frame of the front seat.

FIRST AID KIT

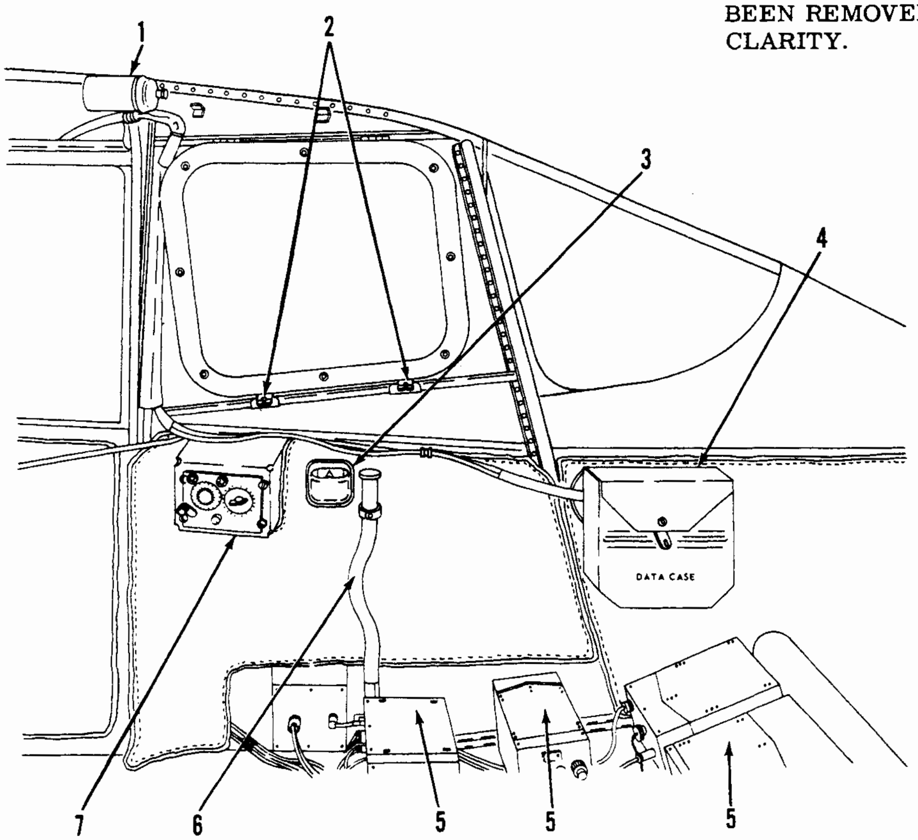
A first aid kit (figure 1-14) is located on the fuselage right root rib aft of the auxiliary fuel tank quantity indicator.

ENTRANCE DOOR

A door is provided on the right side of the aircraft. The door is composed of two sections, the lower door section which is jettisonable in flight, and the upper door section which is window hinged on the top edge and opens out and up. The lower section is hinged along the forward edge. Handles are provided on both the inside and outside of the lower door section. To open the window section of the door, rotate the handle down approximately 60 degrees until the window swings free. The window can be held open by swinging it up until it engages a spring clip located on the under surface of the wing. To open the door lower section, continue rotating the handle down until the door is unlatched.

NOTE

THE REAR SEAT HAS BEEN REMOVED FOR CLARITY.



1. Rear Cockpit Ventilator
2. Side Window Latches
3. Ash Tray
4. Data Case
5. Electronic Equipment
6. Rear Control Stick (Stowed)
7. Radio Control Panel (O-1A)

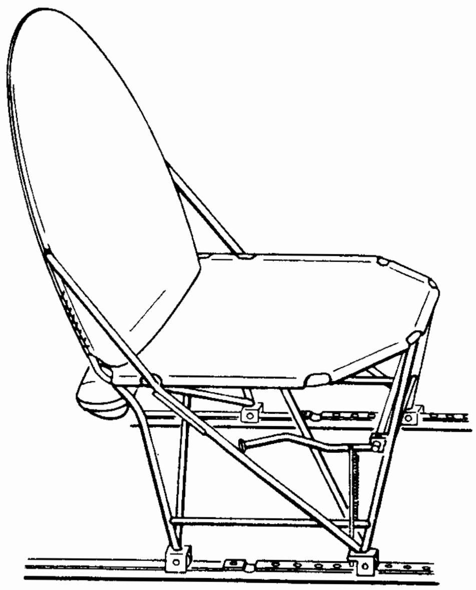
Figure 1-16. Rear Cockpit (Typical Right Side)

SEATS

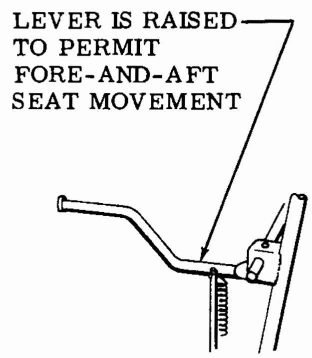
FRONT SEAT

The front seat (figure 1-17) is mounted on two rails in the front part of the cabin. A seat adjustment lever is provided on the right side of the seat. The front seat may be adjusted fore and aft by raising the lever and sliding the seat to the desired position.

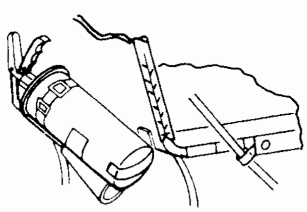
The front seat framework is constructed of welded steel tubing and an aluminum seat pan. Moisture resistant cloth material covers the seat back. A sponge rubber seat pad is attached to the seat with snap fasteners. Some front seats have armor plating installed to provide protection for the pilot. This armor plating is attached to the bottom, back, and sides of the seat. The right side plate is hinged to permit access to the seat.



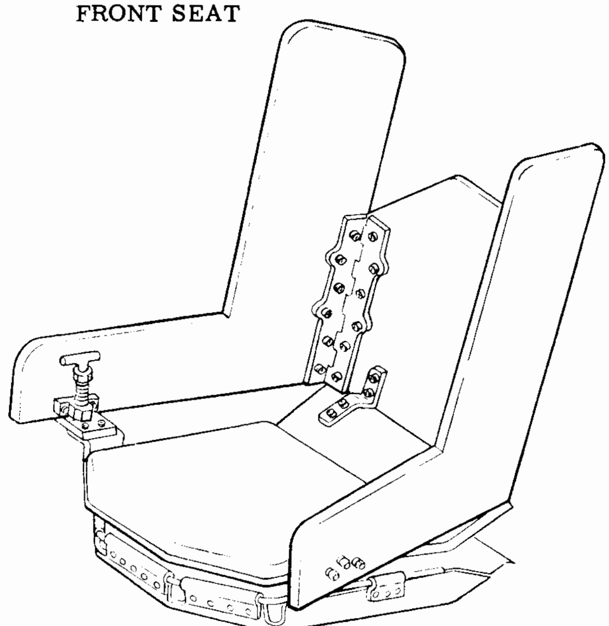
FRONT SEAT



PILOT'S SEAT ADJUSTMENT LEVER



HAND FIRE EXTINGUISHER



FRONT SEAT WITH ARMOR ⚠1

⚠1 Aircraft Modified by T.O. 1L-1-521.

Figure 1-17. Front Seat

SURVIVAL KIT SEAT (AIRCRAFT O-1A AND O-1F)

The regular front seat may be replaced with a seat using the same general framework, but equipped to accommodate a survival kit in the seat bottom.

REAR SEAT (AIRCRAFT O-1F)

The rear seat (figure 1-18), mounted on two rails to permit seat adjustment, is located in the rear compartment. A seat adjustment lever (figure 1-15) is located centrally along the front of the seat framework. The rear seat may be adjusted fore and aft by pushing the adjustment lever to the left and sliding the seat to the desired position. The seat framework is constructed of welded steel tubing and aluminum seat pan. The seat back is covered with moisture-resistant cloth material. Sponge rubber filled pads cushion the seat back and seat pan.

REAR SEAT (AIRCRAFT O-1A, E AND G)

The rear seat (figure 1-19), is not adjustable. Sockets for installing the seat back are provided at each corner of the seat bottom frame. The seat back can be lifted from the rear retaining sockets and installed in the front sockets if the rear seat occupant desires to sit facing aft. The seat may be replaced with a survival kit seat (figure 1-19) which is similar to the regular rear seat, except that a sheet-metal pan to hold a survival kit replaces the regular seat bottom.

SAFETY BELTS AND SHOULDER HARNESS

A safety belt and shoulder harness, with associated inertia reel, is provided for each crew member. The safety belts are bolted to brackets on the fuselage structure. The inertia reels are mounted under the floor aft of each seat. A two-position LOCK and UNLOCK shoulder harness inertia reel lock lever (figure 1-13 and figure 1-15) is located on the left wall adjacent to each seat. A positive latch is provided for retaining the lever at either position of the quadrant. By pressing down on the top of the lever, the latch is released and the lever may be moved from one position to another. The inertial reel will not lock the shoulder harness automatically. Therefore, it is necessary to lock the shoulder harness manually before takeoff and landing, during maneuvers, flight in rough air, or in the event of a forced landing.

O-1F TYPICAL

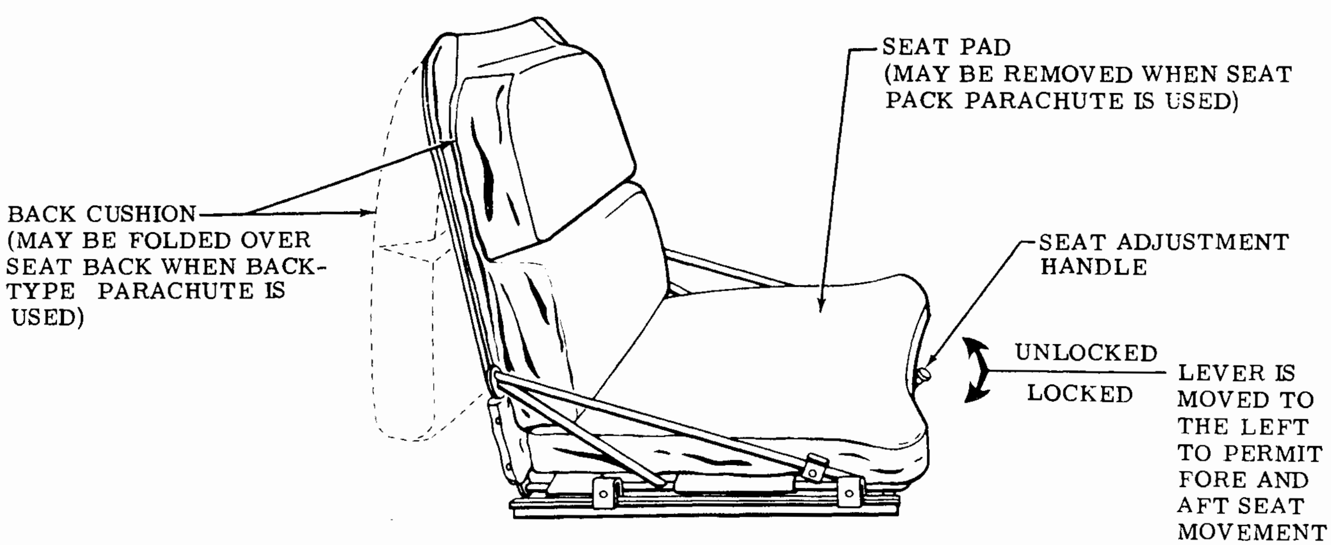


Figure 1-18. Rear Seat

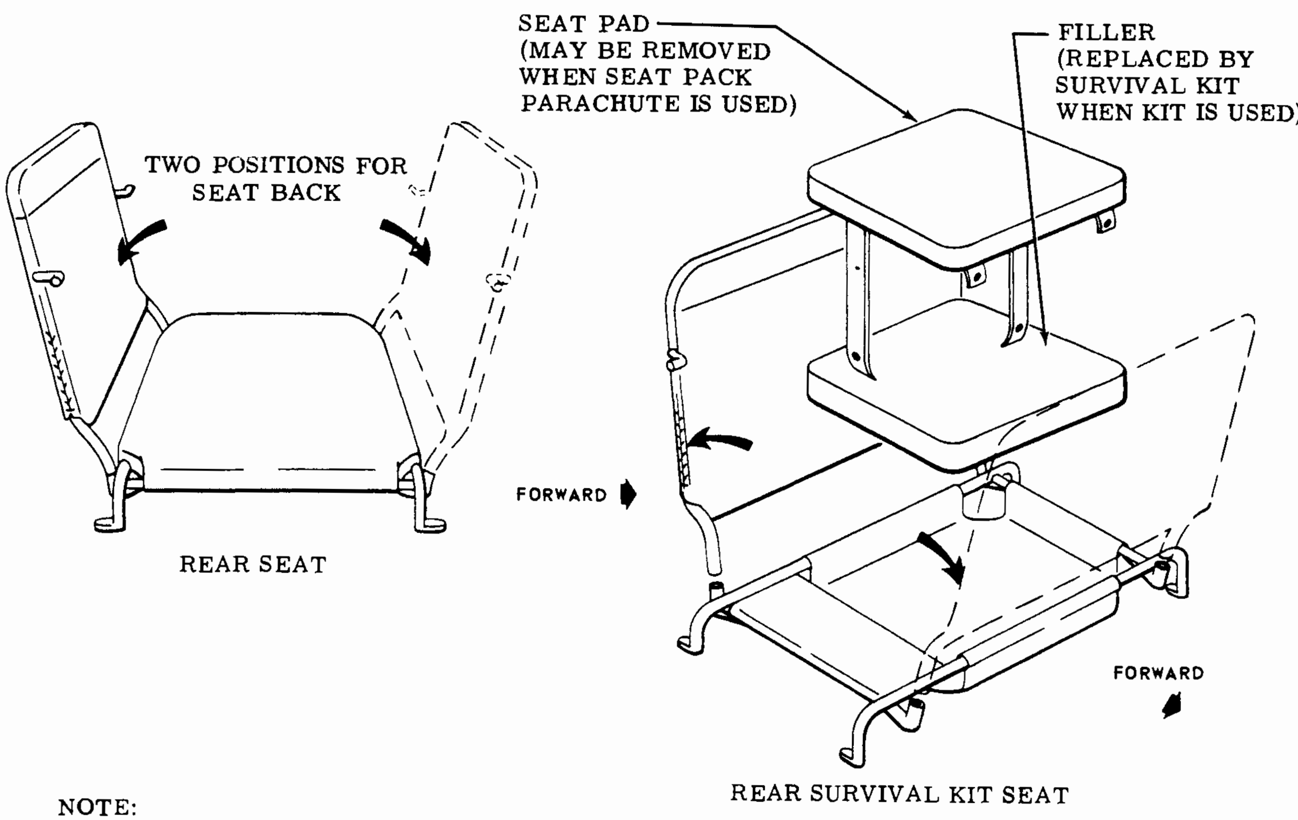
If the harness is locked while the pilot is leaning forward, as he straightens up, the harness will retract with him, moving into successive locked positions as he moves back against his seat. To unlock the harness, the pilot must be able to lean back enough to relieve the tension on the lock. Therefore, if the harness is locked while the pilot is leaning back hard against the seat he may not be able to unlock the harness without first releasing it momentarily at the safety belt (or by releasing the harness buckles, if desired).

AUXILIARY EQUIPMENT

The following items are covered in Section IV, Description and Operation of Auxiliary Equipment.

a. Heating and Defrosting System.
b. Ventilation System.
c. Pitot Heater.
d. Lighting Equipment.
e. Armament System.
f. Miscellaneous Equipment.

O-1A, E AND G



NOTE:
THE SURVIVAL KIT SEAT MAY BE INSTALLED IN LIEU OF THE STANDARD REAR SEAT

Figure 1-19. Rear Seat

RECOMMENDED FUEL
SPEC. NO. MIL-G-5572 (NATO F-22)
GRADE: 115/145 (PURPLE)

ALTERNATE FUEL
SPEC. NO. MIL-G-5572 (NATO F-12)
GRADE: 80/87 (RED)

OIL
SPEC. NO. MIL-L-22851 (NATO O-128)

HYDRAULIC FLUID
SPEC. NO. MIL-H-5606 (NATO H-515)

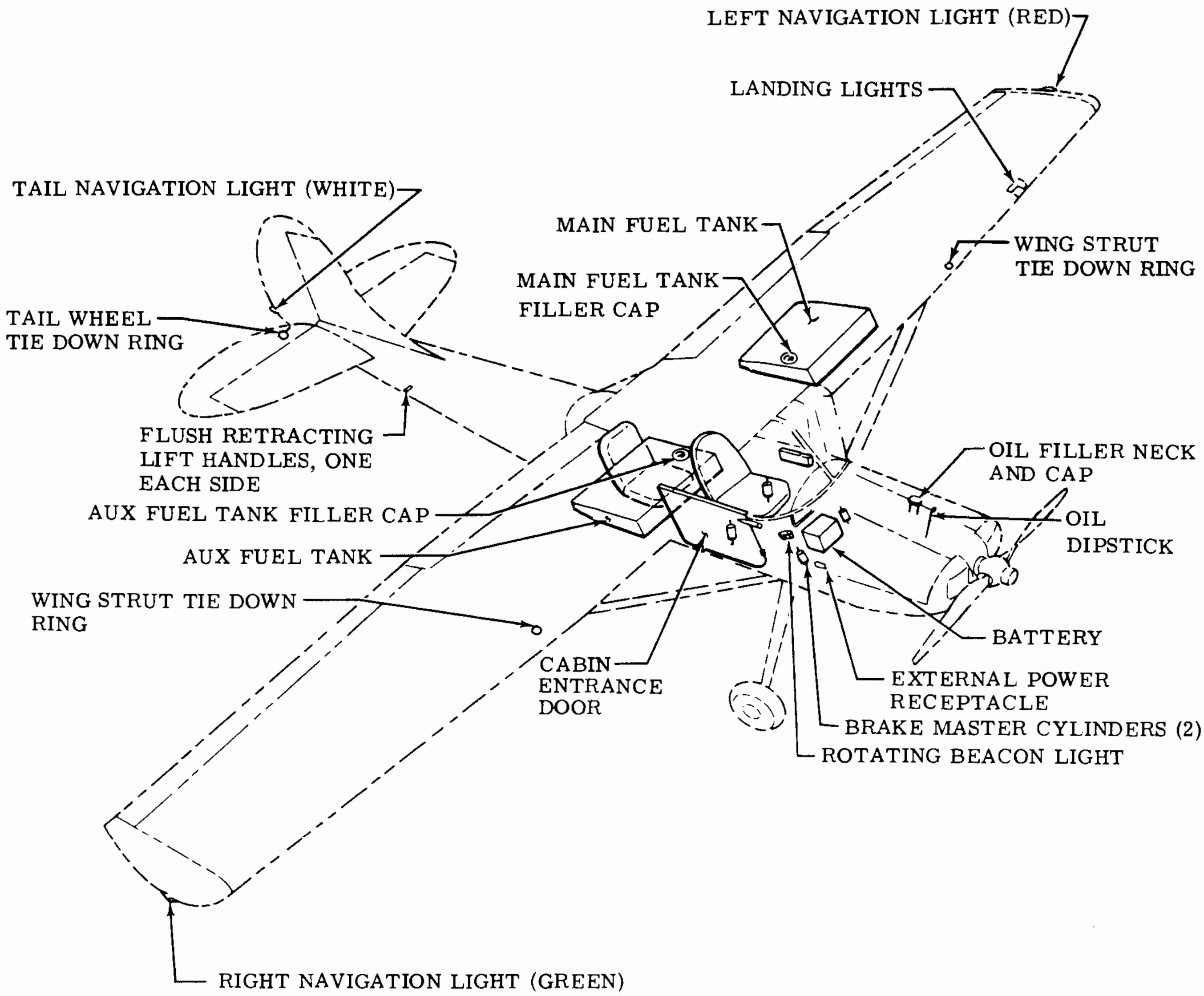


Figure 1-20. General Arrangement and Servicing Diagram

SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

Prior to flight, the pilot should assure that all information in this manual, that is applicable to the proposed mission, is complied with.

FLIGHT RESTRICTIONS

For limitations imposed on the aircraft, refer to Section V.

FLIGHT PLANNING

The required fuel, airspeed and power settings for takeoff, climb, cruising and landing may be determined by reference to performance data in the Appendix.

TAKEOFF AND LANDING DATA CARD

Complete the takeoff and landing data cards, contained in the Pilot's Abbreviated Flight Crew Checklist, T.O. 1L-1A-1CL-1. Refer to the Appendix for detail instructions.

WEIGHT AND BALANCE

Takeoff and landing gross weight should be limited as recommended in Section V.

CHECKLISTS

The checklists in this section provide a chronological listing of the steps of procedure used throughout the normal operation of the aircraft. This section contains only amplified checklists; the abbreviated checklist has been eliminated from the Flight Manual and is issued as a separate technical order. It is intended that, insofar as possible, the flight crew will perform each phase of action in conjunction with direct reference to the checklist. At times however, it is both impractical and unsafe to refer to a checklist during actual landing, takeoff, touch-and-go landing, taxiing or certain emergency situations. For this reason, procedures in the checklists fall into two categories, mandatory checklists and non-mandatory checklists, which are defined as follows:

a. Mandatory Checklists - These cover phases of action that shall be performed in conjunction with direct reference to the appropriate checklist.

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

PREFLIGHT CHECK

The pilot is responsible for insuring that the maintenance personnel have performed the required inspections in accordance with the applicable directives. The visual inspections requirements of this manual are predicated upon this assumption. However, checks of any equipment involving safety are duplicated in the preflight checks.

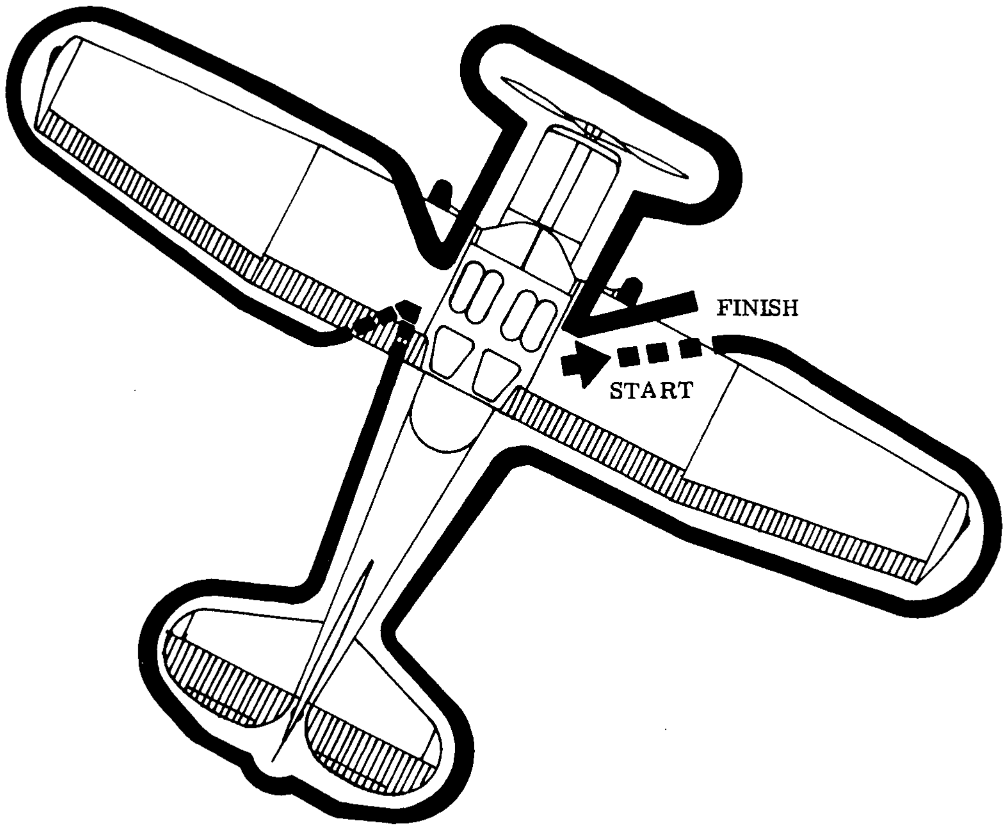


Figure 2-1. Exterior Inspection

BEFORE EXTERIOR CHECK

1. Form 781 - CHECKED.
   Check Form 781 for status of aircraft, servicing, loading, etc.
2. All Switches - OFF.
3. Armament System - CHECKED.
   Check in accordance with Armament Procedures - Before Exterior Check.
4. Controls - UNLOCKED.

CAUTION

If gusty wind conditions exist, do not unlock controls until ready for the Interior Inspection, as control surfaces may be damaged by buffeting.

5. Fuel Selector - AUX TANK.
   Lowest tank if not fully serviced.
6. Trim Tab - SET.
   Set trim tab for takeoff.
7. Emergency Equipment - CHECKED.
8. Loose Objects - REMOVED OR SECURED.
9. Emergency Door Release - CHECKED.
   a. Handle in detent.
   b. Hinge pins secure.

EXTERIOR CHECK

Make an exterior check as shown in Figure 2-1.

1. Right fuel tank drain cock - DRAINED.
   Drain small amount of fuel and inspect for water or sediment.
2. Right Wing - CHECKED.
   a. Check wing for general condition.
   b. Tie-down removed.
   c. Check aileron and wing flap hinges for security.

NOTE

If ice or frost has formed on the wing surface, remove all traces before attempting flight.

3. External Stores - CHECKED.
   Check external stores in accordance with Armament Procedures - Exterior Check.
4. Right Static Source - CHECKED.
5. Tail Assembly - CHECKED.
   a. Check general condition of horizontal and vertical stabilizer, control surfaces, tail wheel and tire.
   b. Tie-down removed.

6. Left Static Source - CHECKED.
7. Left Fuel Tank Drain Cock - DRAINED.
   Drain small quantity of fuel and inspect for water or sediment.
8. External Stores - CHECKED.
   Check external stores in accordance with Armament Procedures - Exterior Check.
9. Left Wing - CHECKED.
   a. Check wing for general condition.
   b. Tie-down removed.
   c. Check aileron and wing flap hinges for security.

NOTE

If ice or frost has formed on the wing surface, remove all traces before attempting flight.

10. Landing Light - CHECKED.
11. Pitot Tube - CHECKED.
    a. Cover removed.
    b. Check for obstructions and security.

NOTE

If the possibility of icing exists, check pitot heater for operation.

12. Main Fuel Tank - CHECKED.
    a. Check fuel level.
    b. Check seal installed and cap secure.
13. Upper Wing and Fuselage Surfaces - CHECKED.
    Check antennas for security.
14. Left Landing Gear and Tire - CHECKED.
    Check general condition of strut, brake lines, brake clips, castoring assembly, wheel and tire.
15. Auxiliary Fuel Pump Drain Opening - CHECKED.
    Check for obstructions or fuel stains.
16. Inside Left Cowl - CHECKED.
    a. Check condition and security of all assemblies and exhaust stacks.
    b. Check alternate air filter for cleanliness and security.
17. Engine Oil - CHECKED.
    Check oil level, oil filler cap and safety pin secure. 10 Quarts minimum for a four hour flight.
18. Propeller - CHECKED.
    Check propeller for condition, security and leaks.
19. Carburetor Air Filter - CHECKED.
    Check filter for cleanliness and security.
20. Inside Right Cowl - CHECKED.
    Check all assemblies for condition and security.
21. Windshield and Cockpit Windows - CHECKED.
22. Auxiliary Fuel Tank - CHECKED.
    a. Check Fuel Level.
    b. Check seal installed and cap secure.
23. Right Landing Gear and Tire - CHECKED.
    Check general condition of strut, brake lines, brake clips, castoring assembly, wheel and tire.
24. Battery Cable - CONNECTED.

WARNING

Assure that propeller area is clear before applying power to the aircraft.

25. Rotating Beacon - CHECKED.
    Check condition and operation.
26. Chip Detector Light - CHECKED

INTERIOR CHECK (NIGHT FLIGHTS)

1. Interior and Exterior Lights - CHECKED.
2. Flashlight - CHECKED.

BEFORE STARTING ENGINE

1. Front Seat - ADJUSTED.
2. Safety Belt and Shoulder Harness - FASTENED.
   Check locking mechanism.

NOTE

It is the responsibility of the pilot to ascertain that a satisfactory safety belt and shoulder harness are available to his passenger and that the passenger employs them in a satisfactory manner. If no passenger is to occupy the rear seat, the safety belt and shoulder harness must be placed in a secure position so as not to interfere with any control movement. Insure that rear cockpit control stick is properly installed and secured.

3. Flight Controls - CHECKED.
   Visually check that control surface movement corresponds to stick and rudder pedal movement.
4. All Switches and Circuit Breakers - SET.
   a. Normal/Emergency Switch - NORMAL.
   b. ARC-44 Homing Com Switch - COM.
   c. ARC-44 Squelch Switch - ON.
   d. Navigation lights - AS REQUIRED.
5. Throttle Quadrant - SET.
   a. Throttle - Check through full operating range and set approximately 1/4 inch open.
   b. Propeller - INCREASE RPM (O-1F).
   c. Mixture - RICH.
   d. Carburetor Air - RAM FILTERED AIR.
6. Altimeter - SET.
7. Airspeed Indicator - CHECKED.
8. Gyros - UNCAGED.
9. Magnetic Compass - CHECKED.
10. Clock - SET.
11. Engine Instruments - CHECKED.
12. Manual Primer - CLOSED AND LOCKED▲.

▲▲ Aircraft Not Modified by T.O. 1L-1-520.

STARTING ENGINE

1. Pilot Calls Out - "SWITCHES ON."
   Pilot will ensure that all personnel are clear of propeller.
2. Generator and Battery - ON.
   If external power source is used, battery switch should be off until external power source has been disconnected.
3. Auxiliary Fuel Pump - ON.
   Turn off after pressure gage shows a rise within limits, unless electrical primer is to be used.
4. Ignition - BOTH.
   Pilot call out - "CLEAR" and hold brakes on and stick back.
5. Starter Button - PRESS.
   Press until engine starts and set throttle at 800 RPM. Use priming as required.

CAUTION

Continuous cranking should not exceed 30 seconds. If engine fails to start, release starter button and allow starter to cool for 30 seconds before attempting another start.

NOTE

If engine runs rough, indicating too rich a mixture, briskly move mixture control lever through its full range of travel several times. This should cause the engine to run smoothly. Occasionally dirt may become lodged under the mixture control poppet valve in the carburetor causing an excessively rich mixture.

6. Auxiliary Power - DISCONNECTED.
   (Battery Switch ON.)
7. Oil Pressure - CHECKED.

CAUTION

If oil pressure gage fails to show rise in 30 seconds, in warm weather, or 60 seconds in cold weather, shutdown engine and investigate.

BEFORE TAXIING

1. Throttle - 700 RPM.
   Warm-up engine for at least 1 minute.
2. Magneto Grounding - CHECKED.
   At 700 RPM turn ignition switch to left, right, off, then back to both. Perform rapidly as possible, remaining in OFF position momentarily to ensure engine ceases firing.
3. Loadmeter - CHECKED.
   Advance throttle to 1500 RPM, generator should cut in at 1200 to 1250 RPM, check loadmeter for reading of 0.5 or less.
4. Vacuum Gage - CHECKED.
5. Throttle - REDUCE TO 1300 RPM.

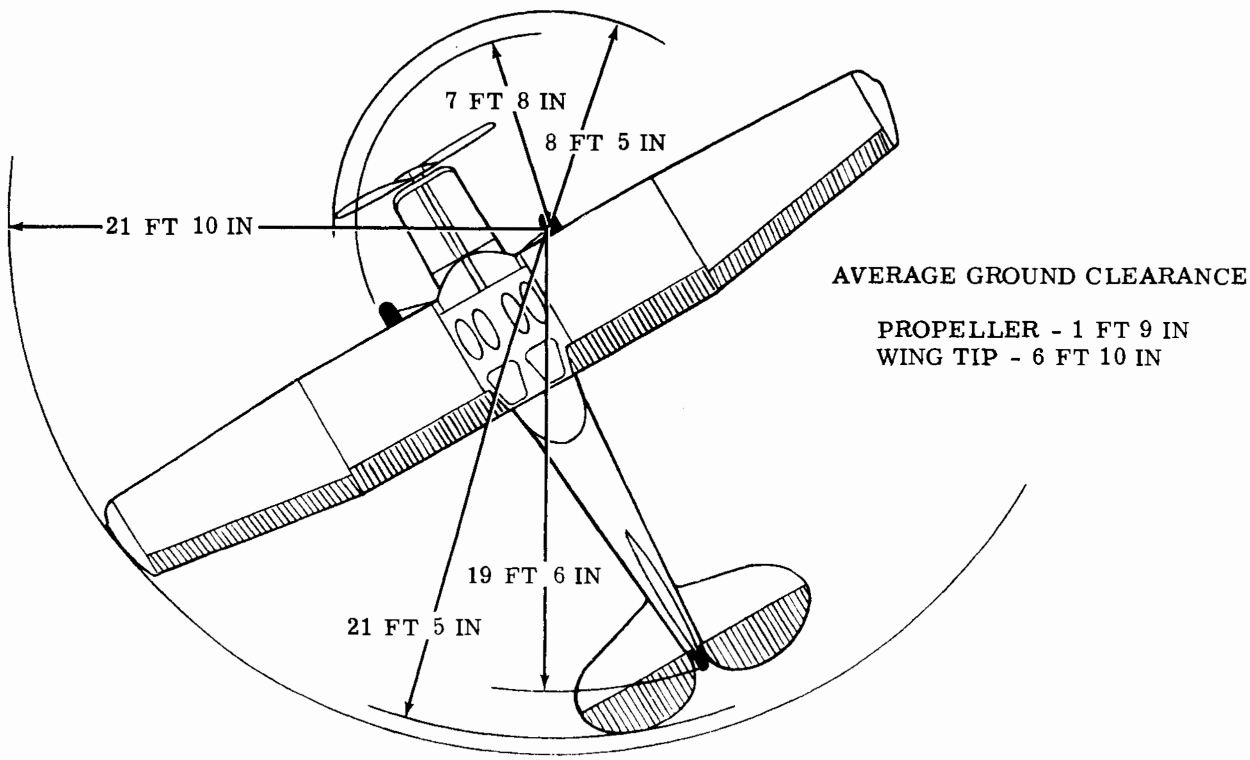


Figure 2-2. Minimum Turning Radius

CAUTION

Do not operate the engine any longer than necessary before takeoff. The engine system is designed for optimum efficiency under flight conditions. Lengthy ground operations may result in overheating and subsequent engine damage.

6. Communications and Navigation Equipment - ON.
7. Flaps - CHECKED.
   Extend and retract. Check for symmetrical operation.
8. Radio Communications - CHECKED.
   Obtain taxi clearance.
9. Chocks - REMOVED.

NOTE

Reduce throttle to idle when personnel approach the aircraft to preclude injury from debris kicked up by propeller blast.

TAXIING

Refer to figure 2-2 for Minimum Turn Radius.

When taxiing with a headwind component, hold the control stick full aft with aileron into the wind. When taxiing with a tailwind component, hold the control stick forward with aileron into the wind.

CAUTION

Caution must be exercised at all times while the aircraft is in motion on the ground. Unless the pilot maintains positive directional control through the use of tailwheel steering/differential braking, a ground loop could result.

CAUTION

When taxiing through snow, tall grass, sand, mud, over loose objects, or through anything that may seize the wheels, extreme caution must be used to prevent nosing over.

1. Brakes - CHECKED.
   a. Test brakes on initial roll when starting to taxi.

CAUTION

Steer aircraft with rudder pedals, using brakes only for sharp turns. Riding the brakes causes unnecessary brake wear and engine overheating. Do not use more power than is necessary to keep aircraft rolling.

NOTE

In extremely cold weather, place carburetor air control to ALTERNATE AIR (HEAT) as required for smooth engine operation.

CAUTION

On aircraft not modified by T. O. 1L-1A-513, if carburetor air control lever is placed in Alternate air (Heat) position, air entering the carburetor is unfiltered and under dusty conditions, dust may enter the engine cylinders.

2. Mixture - AS REQUIRED.
   Mixture should be leaned during prolonged ground operations to prevent spark plug fouling.
3. Flight Instruments - CHECKED.

ENGINE RUNUP

CAUTION

Stick should be fully back and brakes held securely during runup. Do not let aircraft roll forward.

1. Fuel Selector - FULLEST TANK.
2. Mixture - RICH.
3. Throttle - 1700 RPM.
   Check engine instruments within limits.
4. Mixture - CHECKED.
   Manually lean mixture by pulling mixture control lever slowly toward IDLE CUT-OFF position, observing tachometer for maximum momentary RPM rise. Indicated RPM rise will occur immediately before engine operation falters due to excessively lean mixture. Return lever to FULL RICH before engine cuts out.

NOTE

A rise not to exceed 40 RPM is satisfactory. A rise of approximately 100 RPM indicates an excessively rich mixture; no rise, or a premature drop in engine RPM, indicates an excessively lean mixture. These departures from a desired rise of 40 RPM are to account for extreme variations in elevation, temperature, humidity, etc., from average home station conditions. Repeat mixture check several times, running engine up to cruise RPM each time to clear spark plugs. A gust of wind may give an erroneous indication.

5. Carburetor Air - CHECKED.
   Move carburetor air control to ALTERNATE AIR (HEAT). Normally a slight RPM drop will be noted. Return carburetor air control to RAM FILTERED AIR position.

WARNING

Takeoff will not be attempted with carburetor air control in ALTERNATE AIR (HEAT) position.

WARNING

The carburetor air control should be set only in the RAM FILTERED AIR or ALTERNATE AIR (HEAT) position. Do not use any intermediate positions.

NOTE

Under icing conditions, a slight rise in RPM may be noted.

6. Ignition System - CHECKED.
   Move ignition switch from BOTH to L, and observe drop in RPM. Move switch back to BOTH until RPM returns to 1700, then move switch to R, and observe drop in RPM. Return switch to BOTH. Maximum allowable RPM drop is 100 RPM.
7. Generator - CHECKED.
   Turn generator OFF, then ON while observing Loadmeter indication as generator may fail to cut in at 1200 - 1250 RPM.
8. Auxiliary Fuel Pump - CHECKED.
   Turn pump ON. Check for no change in engine RPM, then turn pump OFF. A slight increase in fuel pressure is normal.
9. Throttle - IDLE - 550 ±50 RPM.
   Close throttle, check idle speed 550 ±50 RPM.

NOTE

Idle speed will be altered by changes in elevation, temperature, humidity, etc. Therefore, the idle speed need not be adjusted to accomodate these variations except when aircraft is operated at another location for a prolonged period.

10. Throttle - 1300 RPM.

CAUTION

On O-1F aircraft, do not exercise propeller control prior to takeoff, as excessive time and power are required to return the propeller to low pitch which is necessary to develop takeoff power.

NOTE

On O-1F aircraft, a propeller governor check is not required as failure of the propeller governing system will cause the propeller to revert to low pitch, thus allowing maximum power to develop for takeoff.

BEFORE TAKEOFF

1. Fuel Selector - FULLEST TANK.

WARNING

Do not switch fuel tanks within 30 seconds prior to takeoff.

2. Rotating Beacon and Navigation Lights - AS REQUIRED.
3. Pitot Heat - AS REQUIRED.
4. Auxiliary Fuel Pump - ON.
5. Shoulder Harness - LOCKED.
6. Trim Tab - SET.
7. Flaps - SET.
8. Throttle Quadrant - SET.
   a. Propeller - FULL INCREASE (O-1F aircraft).
   b. Mixture - RICH.
   c. Carburetor Air - RAM FILTERED AIR.
9. Engine Instruments - CHECKED.
   Check within operating limits.
10. Directional Indicator - SET.
11. Flight Controls - RECHECKED.
    Check control stick and rudder pedals for freedom of movement and full travel.
12. Armament Checklist - COMPLETED.

TAKEOFF

NORMAL TAKEOFF

In order to achieve the performance shown in the Appendix, the following takeoff technique is recommended. A normal takeoff is conducted with zero degrees flaps. The takeoff will always be conducted with full power regardless of gross weight. After aligning the aircraft with the runway, smoothly and rapidly advance the throttle to full power for static power check (2200 RPM O-1A, E and G or 2500 RPM O-1F) while holding the brakes. The engine should accelerate smoothly. Release the brakes, maintaining directional control with rudder and tail wheel steering. Use brakes for directional control only when necessary early in the takeoff roll, and avoid dragging the brakes. As airspeed increases and elevator becomes effective, the tail wheel should be raised slightly to avoid premature lift off. At the computed lift off speed (see Appendix) allow the aircraft to fly off the ground.

WARNING

Avoid wake turbulence. Allow a minimum of three to five (3 to 5) minutes before takeoff behind a heavy aircraft or helicopter. This will permit the lateral displacement of wing tip vortices. When necessary to takeoff behind a heavy aircraft or helicopter, and conditions permit, takeoff well before the lift off point of the departing aircraft and climb above its flight path.

MINIMUM RUN/OBSTACLE CLEARANCE TAKEOFF

The technique used during a minimum run or obstacle clearance takeoff is essentially the same as that for a normal takeoff except that the flaps are set at 30°, and lift off speed is reduced (see Appendix). After lift off, or after obstacles have been cleared, allow the aircraft to accelerate to the best rate-of-climb speed.

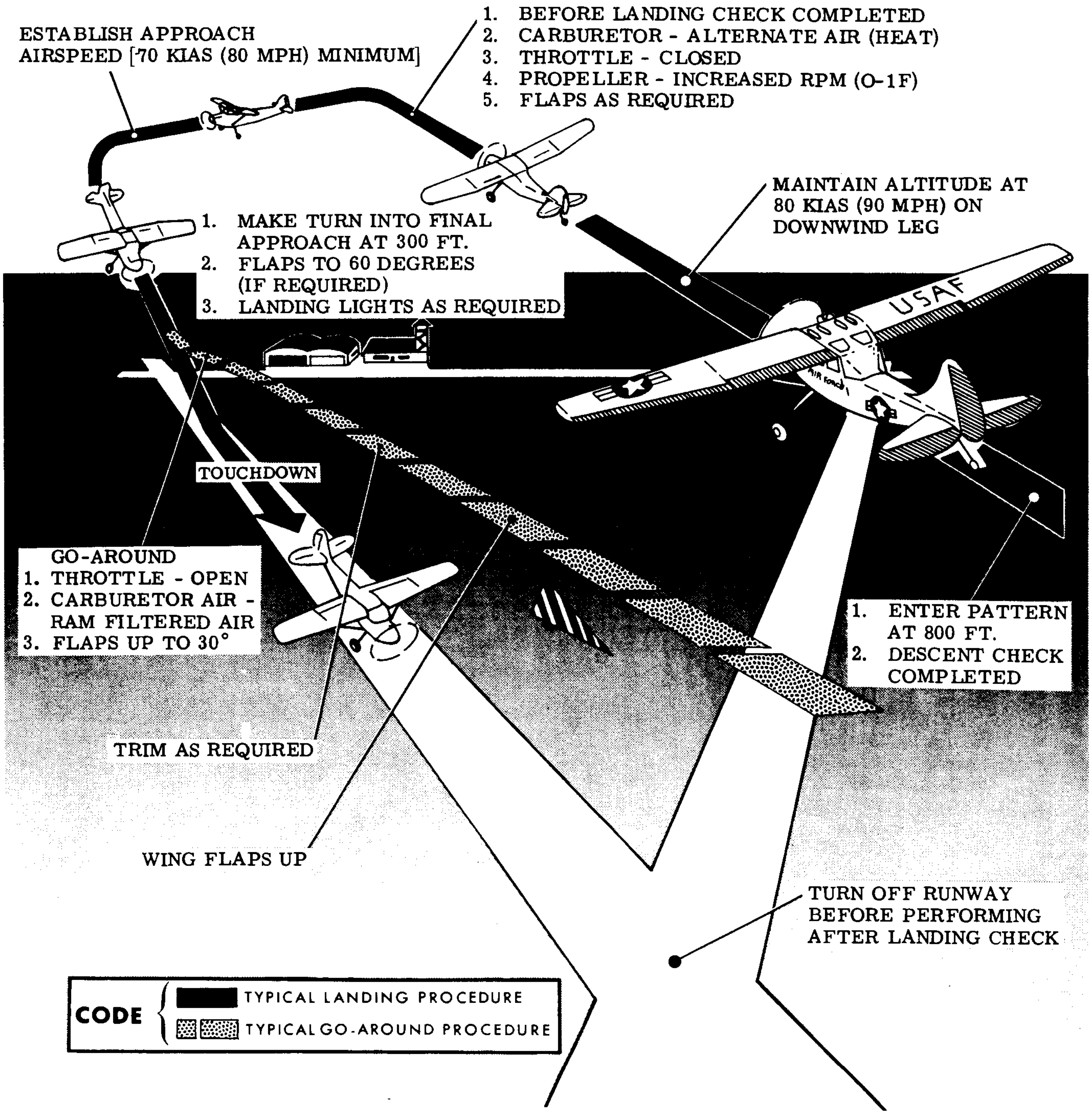


Figure 2-3. Typical Landing and Go-Around Pattern

WARNING

- The minimum run/obstacle clearance takeoff speeds are based on maximum aircraft performance, and are considerably below power off stall speed. Therefore, wings level flight must be maintained and airspeed increased to at least best rate-of-climb speed as soon as possible after lift off or after obstacles have been cleared.
- In no case will takeoff be attempted with more than 30° flaps.
- When extending or retracting the wing flaps, visually observe the flaps for symmetrical operation.

CROSSWIND TAKEOFF

Refer to Takeoff and Landing Crosswind Charts, in Appendix. Do not use wing flaps unless minimum flap setting is necessary for critical field length. Maintain a tail-high attitude to keep the aircraft on the ground until an airspeed well above takeoff airspeed is reached. Use positive control pressure to pull the aircraft off to avoid settling to the ground while drifting.

NIGHT TAKEOFF

Night takeoff is conducted essentially the same as day takeoff using flight instruments to assist in establishing the proper attitudes. Be alert for possible spatial disorientation.

AFTER TAKEOFF

First power reduction should not be initiated until well clear of all obstructions or until a reasonable altitude (200 feet) has been attained. To reduce drag, retract flaps at a safe airspeed and altitude before reducing power.

1. Flaps - UP.
   Retract wing flaps after safe altitude and airspeed have been reached.
2. Throttle - RETARD.
   Retard throttle to 2300 RPM or less (O-1A, E and G aircraft) 24 inches Hg. manifold pressure or less (O-1F aircraft).
3. Propeller - DECREASE.
   Decrease to 2300 RPM or less (O-1F aircraft).
4. Auxiliary Fuel Pump - OFF.
   Turn switch off at or above 500 feet altitude.

CLIMB

The speed for best rate-of-climb is 56 KIAS (65 MPH) (O-1A, E and G aircraft). Best rate-of-climb speed for O-1F aircraft is determined from the appendix using 2300 RPM and 24 inches Hg. Normal climbs at 70 KIAS (80 MPH) (O-1A, E and G aircraft), 80 KIAS (90 MPH) and 2300 RPM and 24 inches Hg (O-1F aircraft) are recommended for best engine cooling. For additional speed climb data, refer to the Appendix.

CRUISE

Refer to Appendix for power setting. Lean mixture in accordance with procedure in Section VII.

FLIGHT CHARACTERISTICS

Refer to Section VI for information on aircraft flight characteristics.

DESCENT

1. Mixture - RICH.
2. Propeller - INCREASE (2300 RPM O-1F aircraft).
3. Carburetor Air - ALTERNATE AIR (HEAT) position.
4. Throttle - CLOSED.

NOTE

Clear the engine at least every 30 seconds by opening and closing the throttle. Refer to Section VII for additional information.

BEFORE LANDING

1. Armament Checklist - COMPLETED.
2. Fuel Selector - FULLEST TANK.
3. Auxiliary Fuel Pump - ON.
4. Shoulder Harness - LOCKED.
5. Mixture - RICH.
6. Manual Primer - CHECKED.
7. Landing Light - AS REQUIRED.

LANDING

NORMAL LANDING

Refer to Landing Charts in Appendix for landing data. Sideslips can be safely accomplished during approach with the wing flaps down and either a wheel or three-point landing may be accomplished. A wheel landing is recommended when wind velocity approaches or exceeds stalling speed. See figure 2-3 for typical landing pattern and recommended procedures. Refer to Section III for emergency landing procedures.

WARNING

- Cross-control flight with fuel selector on low wing tank can cause fuel starvation. During cross-control flight, particularly slips on final approach, fuel selector will be placed on the high wing tank, if fuel is available, to insure positive fuel supply at this critical point.
- Avoid wake turbulence. Allow a minimum of three to five (3 to 5) minutes before landing behind a heavy aircraft or helicopter. This will permit the lateral displacement of wing tip vortices. When necessary to land behind a heavy aircraft or helicopter, and conditions permit, keep above the approach path of the landing aircraft and touchdown past its point of touchdown.

1. Carburetor Air - ALTERNATE AIR (HEAT).
2. Throttle - RETARDED.
   On downwind, opposite the point of intended touchdown, smoothly retard the throttle and establish a normal glide.

NOTE

- Clear engine at least every 30 seconds during approach.
- Maintain RPM above idle until landing is assured.

3. Propeller - FULL INCREASE (O-1F aircraft).
4. Flaps - AS REQUIRED.

WARNING

When extending or retracting the wing flaps, visually observe the flaps for symmetrical operation.

TOUCH-AND-GO LANDINGS

Touch-and-go landings should be made only when authorized or directed by the major command concerned. Touch-and-go landings are performed in accordance with the following procedures:

1. Throttle - OPEN.
2. Carburetor Air - RAM FILTERED AIR.
3. Flaps - UP (Until Flaps are Extended only 30°).
4. Elevator Trim - ADJUSTED.
5. Flaps - UP after climb established.

CROSSWIND LANDING

Use minimum flap setting for field length. The wing-low method of drift correction is recommended. Either a three-point or wheel landing may be used. Maintain a slightly higher airspeed than for normal landing to counter assymmetrical flight condition.

MINIMUM RUN LANDING

Extend 30 to 60 degrees flaps and maintain approach speed. Execute a three-point landing and apply brakes as required. Refer to Appendix for landing data.

CAUTION

The control stick should be held full back at all times when using brakes to avoid nosing over.

GO-AROUND

1. Throttle - OPEN.
2. Carburetor Air - RAM FILTERED AIR.

WARNING

Failure to place the carburetor air control lever in the ram filtered air position will result in a power loss, and will reduce the possibility of a successful go-around.

3. Flaps - UP (Until Flaps are Extended Only 30°).
4. Elevator Trim - ADJUSTED.
5. Flaps - UP after climb established.

NIGHT LANDING

Night landing will be performed using normal landing procedures.

AFTER LANDING

NOTE

After landing checks should be performed immediately after turning off the active runway. Priority during the after landing roll should be placed on directional control.

1. Flaps - UP.
2. Carburetor Air - RAM FILTERED AIR.
3. Auxiliary Fuel Pump - OFF.
4. Rotating Beacon - OFF.
5. Navigational Lights - AS REQUIRED.
6. Armament Checklist - COMPLETED.

POST FLIGHT

1. Brakes - HOLD.
2. Magneto Grounding - CHECKED.
3. Ignition System - CHECKED.
4. All Unnecessary Electrical Equipment - OFF.

ENGINE SHUTDOWN

1. Throttle - 900 RPM.
   For one to three minutes to cool engine.
2. Radio Switches - AS REQUIRED.
3. Throttle - 1300 RPM.
4. Mixture - IDLE CUT-OFF.
5. All Switches - OFF (AFTER ENGINE STOPS).
6. Fuel Selector - OFF.

BEFORE LEAVING THE AIRCRAFT

1. Battery Cable - DISCONNECTED.
2. Controls and Parking Brake - LOCKED.
   The controls lock will lock the rudder, aileron, and elevator in neutral position and also applies the parking brake.
3. Forms - COMPLETE.

NOTE

Make appropriate entries covering any limits that have been exceeded during the flight. Entries must also be made when in the pilot's judgement the aircraft has been exposed to unusual or excessive operations such as hard landings, excessive braking action during aborted take-offs, long and fast landings, long taxi runs at high speed, etc.

4. Windows and Door - CLOSED.
5. Pitot Tube Cover - INSTALLED.
6. Wheels - CHOCKED.
   Tie-down aircraft if necessary.

TURN-AROUND CHECKLIST

In many instances, it may be desirable to accomplish a rapid turn-around flight when time is a critical factor in relation to successful mission accomplishment. The following procedure sh[illegible]t be considered a normal procedure, but ra[illegible] procedure to be used only when a rapid turn-ar[illegible] flight is a necessary and critical requirement. This procedure includes those items considered minimum essential to flight and in the interest of flight safety.

EXTERIOR CHECK

1. Form 781 - COMPLETED.
2. Aircraft General Condition - CHECKED.
3. Fuel - CHECKED.
4. Oil - CHECKED.
5. Armament Checklist - COMPLETED.

BEFORE STARTING ENGINE

1. Safety Belt and Shoulder Harness - FASTENED.
2. Fuel Selector Valve Handle - ON LOWEST TANK.
3. Mixture - RICH.
4. Navigation Lights - AS REQUIRED.

STARTING ENGINE

1. Pilot Calls Out - "SWITCHES ON."
2. Generator and Battery - ON.
3. Auxiliary Fuel Pump - ON, then OFF.
4. Ignition - BOTH.
   Pilot Calls Out - "CLEAR" and holds brakes on and stick back.
5. Starter - PRESS.
6. Throttle - 800 RPM.
7. Oil Pressure - CHECKED.

BEFORE TAXI AND TAXIING

1. Radios - CHECKED.
2. Brakes - CHECKED.

ENGINE RUNUP

1. Fuel Selector - FULLEST TANK.
2. Throttle - 1700 RPM.
3. Ignition System - CHECKED.

BEFORE TAKEOFF

1. Rotating Beacon - ON.
2. Pitot Heater - AS REQUIRED.
3. Auxiliary Fuel Pump - ON.
4. Shoulder Harness - LOCKED.
5. Trim Tab - SET.
6. Flaps - SET.
7. Throttle Quadrant - SET.
8. Engine Instruments - CHECKED.
9. Directional Indicator - SET.
10. Manual Primer - CHECKED.
11. Controls - CHECKED.
12. Armament Checklist - COMPLETED.

ARMAMENT PROCEDURES

This section contains the amplified procedures for the performance of non-nuclear combat or training missions, procedures for weapon preflight, firing/release, prior-to-landing, and after landing.

PREFLIGHT

BEFORE EXTERIOR CHECK.

1. Aircraft - POSITIONED, CHOCKED AND GROUNDED
2. Battery - OFF.
3. Armament/Camera Circuit Breaker - PULLED.
4. Shackle Arm and Release Switches - SAFE, guards CLOSED AND SAFETIED.
5. Rocket Arming Switches - SAFE, guards CLOSED.
6. Trigger Safety Pin - INSTALLED.
7. Armament Master Switch (Rear Cockpit) - SAFE.
8. Flare Arm Switches (If Installed) - SAFE, guards CLOSED.

EXTERIOR CHECK - ROCKET.

1. Launcher Safety Pins - INSTALLED.
2. Bomb Racks - PROPERLY INSTALLED.
   a. Check sear for proper engagement.
   b. Electrical Connections secure.
3. Sway Brace Pads - SECURE.
4. Rockets - ENGAGED IN DETENT LATCH.
5. Arming Wire (3.5" warhead) - SECURE.

EXTERIOR CHECK - FLARE

1. Safety Pins - INSTALLED.
2. Flare Lanyard - LOOP INSTALLED IN ARMING SOLENOID.
3. Ignition and Ejection Dials - SET.

BEFORE TAKEOFF

1. Rocket and Flare Safety Pins - REMOVED.
2. Armament/Camera Circuit Breaker - RESET (If applicable).

CAUTION

Aircraft with up-loaded rockets will not be taxied toward or through congested or populated areas with rocket launcher safety pins removed. Pilot will have rocket launcher safety pins removed as the last step before takeoff; he will place his hands where the armament personnel, removing the pins, can see them and be assured the rocket firing switch cannot be inadvertently actuated during removal of the safety pins. When firing rockets to mark targets, remove safety pin from the trigger switch, and when aircraft is pointed at the target, arm appropriate switch. After firing rockets, place Arming Switches in OFF position. Before landing, install safety pin in trigger switch and check Arming Switches OFF. After landing, have rocket launcher safety pins installed in all rockets not fired.

DELIVERY PROCEDURE - ROCKET

FIRING

1. Trigger Safety Pin - REMOVED.
2. Armament Master Switch - ARM.
3. Rocket Selector Switch - ARM.
4. Trigger - DEPRESSED.

AFTER FIRING

1. Rocket Selector Switch - SAFE.
2. Armament Master Switch - SAFE.

DELIVERY PROCEDURES - FLARE

RELEASE

1. Trigger Safety Pin - REMOVED.
2. Armament Master Switch - ARM.
3. Rack Jettison Switch - ARM.
4. Arm and Rocket Select Switches - ARM
   The outboard pair of Arm and Rocket Select Switches corresponding with the Rack Jettison Switch selected must be placed in the ARM position to insure arming of the flare.

NOTE

Both switches must be on in order to assure arming of the flare.

5. Trigger - DEPRESSED.
   Hold trigger depressed for approximately three seconds to insure flare arming. The flare lanyard will be released and fall free of the aircraft when the trigger is released.

AFTER RELEASE

1. All Armament Switches - SAFE.
2. Trigger Safety Pin - INSTALLED.

WARNING

Following an attempted release or jettison, any munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing impact. If visual examination cannot positively affirm a safe condition, either jettison or land following locally established procedures.

BEFORE LANDING

1. Trigger Safety Pin - INSTALLED.
2. All Armament Switches - SAFE.

AFTER LANDING (UNEXPENDED OR HUNG ORDNANCE)

Rocket and Flare Safety Pins - INSTALLED.

Install safety pins in all rockets and flares not expended.

CAUTION

Pilot will place his hands where armament personnel, installing the pins, can see them and be assured the armament switches cannot be inadvertently actuated during installation of the safety pins.

SECTION III

EMERGENCY PROCEDURES

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INTRODUCTION

This section contains procedures to be followed to correct an emergency condition. These procedures will insure maximum safety for the crew and/or aircraft until a safe landing or other appropriate action is accomplished. Multiple emergencies, adverse weather, and other peculiar conditions may require modification of these procedures. The mandatory items (BOLD FACE CAPITAL LETTERS) contained in the various emergency procedures cover the most adverse conditions and must be committed to memory. The nature and severity of the encountered emergency will dictate the necessity for complying with the mandatory items in their entirety. It is essential, therefore, that aircrews determine the correct course of action by use of common sense and sound judgement. As soon as possible, the pilot should notify the tower of any existing emergency and of the intended action. When an emergency occurs, three basic rules are established which apply to airborne emergencies. They should be thoroughly understood by all aircrews:

1. MAINTAIN AIRCRAFT CONTROL.
2. ANALYZE THE SITUATION AND TAKE PROPER ACTION.
3. LAND AS SOON AS PRACTICABLE.

ENGINE FAILURE

Engine failures fall into two main categories; those occuring instantly, and those with ample indication prior to failure. The instant failure usually occurs only if ignition or fuel flow fails completely. Some engine failures are gradual and afford the pilot ample indication that he may expect a failure. An extremely rough-running engine, loss of oil pressure, excessive cylinder head temperature under normal flight conditions, and fluctuating rpm are indications that a failure is imminent. When indications point to an engine failure, the pilot should land as soon as practicable.

ENGINE FAILURE DURING TAKEOFF

If malfunction occurs when the remaining runway is insufficient for stopping, and the nature of malfunction will permit flight, continue takeoff, circle field, and land immediately. If malfunction occurs when there is sufficient runway for stopping or is of such a nature as to make flight impossible, follow ABORT procedures.

NOTE

Ground loop to avoid obstacles. Get clear immediately when aircraft has come to a stop.

TAKEOFF EMERGENCIES

ABORT

1. THROTTLE - CLOSE.
2. BRAKES - APPLY.
   If fire is suspected or exists, proceed as follows.
3. MIXTURE - IDLE CUTOFF.
4. BATTERY - OFF.
5. FUEL SELECTOR - OFF.

▲ Aircraft Modified by T.O. 1L-1-520.

ENGINE FAILURE AFTER TAKEOFF

If engine fails immediately after takeoff, proceed as follows:

1. EXTERNAL STORES - JETTISONED (AS REQUIRED).
2. ESTABLISH GLIDE.
3. MIXTURE - IDLE CUTOFF.
4. BATTERY - OFF.
   Unless wing flaps, lights, or radio is required.

WARNING

Land straight ahead, changing direction only enough to miss obstacles. Do not try to turn back to the field. Making a crash landing is much better than turning back and taking a chance of an uncontrolled roll into the ground.

ENGINE FAILURE DURING FLIGHT

1. ESTABLISH GLIDE.
2. FUEL SELECTOR - CHANGE TANKS UNLESS OPPOSITE TANK IS EMPTY.
3. AUXILIARY FUEL PUMP - ON.
4. MIXTURE - RICH.
5. PROPELLER - INCREASE RPM (O-1F AIRCRAFT).

NOTE

If engine fails to start after the above procedure has been completed, attempt to restart the engine by accomplishing the Engine Restart During Flight procedures as long as position and altitude permit. If this cannot be accomplished, or if restart attempts fail, bail out or accomplish Engine Shutdown In Flight procedure, jettison external stores, and make a forced landing.

ENGINE SHUTDOWN IN FLIGHT

1. Mixture - IDLE CUTOFF.
2. Propeller - DECREASE RPM (O-1F AIRCRAFT).
3. Ignition - OFF.
4. Generator - OFF.
5. Fuel selector - OFF.
6. Battery - OFF unless required for radios, flaps, or lights.

ENGINE RESTART DURING FLIGHT

If the source of trouble has been determined and corrective action has been taken, and there is still sufficient altitude to restart the engine, proceed as follows:

CAUTION

The engine should not be restarted unless it can be determined that it will be reasonably safe to do so.

1. Fuel Selector - FULLEST TANK.
2. Mixture - IDLE CUTOFF.
3. Throttle - OPEN for a few seconds to clear engine.
4. Throttle - OPEN (1/4 inch).
5. Propeller - INCREASE RPM (O-1F AIRCRAFT).
6. Ignition - BOTH.
7. Mixture - RICH.
8. Battery - ON.
9. Auxiliary fuel pump - ON.

NOTE

If propeller is not windmilling, attempt restart by engaging starter. Engine restart should not be continued below a safe bailout altitude.

MAXIMUM GLIDE

If engine fails during flight, maximum gliding distance can be obtained by maintaining the airspeed shown on figure 3-1. To establish maximum glide, proceed as follows:

1. External Stores - JETTISON.
2. Flaps - UP.
3. Propeller - Decrease RPM (O-1F aircraft).

WARNING

Do not attempt to stop propeller from windmilling. The altitude lost trying to stop the propeller more than offsets the additional performance gained with the propeller stopped. Trim aircraft to maintain optimum glide speed.

LANDING WITH ENGINE INOPERATIVE

A full flap three-point landing is recommended on rough ground when landing with engine inoperative.

PROPELLER FAILURE (O-1A, E AND G AIRCRAFT)

1. Throttle - CLOSE.
2. Mixture - IDLE CUTOFF.

NOTE

At a safe altitude, nose up to decrease speed quickly, thereby stopping propeller rotation and vibration. Establish normal glide and follow instructions for engine shutdown procedure.

PROPELLER FAILURE (O-1F AIRCRAFT)

OVERSPEED

If the linkage of the propeller governor fails, a spring on the governor automatically sets the governor to control the propeller in full increase RPM (2600 RPM). If failure of the propeller governor occurs and the propeller goes into low pitch (high RPM), resulting in a runaway propeller, proceed as follows:

CAUTION

Prompt corrective action is essential to prevent engine failure due to excessive RPM.

1. ESTABLISH CLIMB.
   To decrease airspeed and increase load on propeller.
2. THROTTLE - RETARDED.
   Maintain RPM within limits - 2600 RPM.
3. PROPELLER - MANIPULATE.
   Attempt to restore governing.

NOTE

If after moving propeller lever through full range of travel, control is not regained, adjust throttle to maintain RPM within limits and land as soon as practicable. Propeller failure resulting in high pitch (low RPM) is rare; however, if this type of failure occurs, use minimum power required to maintain flight. Sufficient power is available at low altitudes to maintain flight with flaps retracted.

UNDERSPEED

Propeller governor failure resulting in the propeller going into high pitch (low RPM) is rare; however, if this type of failure occurs, proceed as follows:

1. Throttle - CLOSED.
   Adjust to the lowest manifold pressure which will sustain flight.
2. Flaps - UP.

NOTE

Sufficient power is available at low altitudes to maintain flight with wing flaps retracted. Land as soon as possible.

FIRE

ENGINE FIRE ON GROUND

If fire is located in the air induction system during ground operation, proceed as follows:

1. THROTTLE - OPEN.
2. MIXTURE - IDLE CUTOFF.
3. STARTER - PRESS.
   Continue cranking engine; the fire may be sucked through the engine and extinguished.
4. FUEL SELECTOR - OFF.
5. Battery - OFF.
6. Ignition - OFF.
7. Fire extinguisher - USE.

WARNING

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor. During operation of the hand fire extinguisher, ventilate personnel areas with fresh air. The nontoxic liquid should not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns.

ENGINE FIRE DURING FLIGHT

1. MIXTURE - IDLE CUTOFF.
2. FUEL SELECTOR - OFF.
3. Cabin Heat - IN.
   To prevent smoke from entering cabin.
4. Battery - OFF.
5. Ignition - OFF.

NOTE

Do not attempt to restart engine after fire goes out.

FUSELAGE FIRE

1. Battery - Off.
2. All ventilators - Closed.
3. Fire extinguisher - Use if possible.

NOTE

If fire cannot be extinguished land as soon as possible or bail out.

WING FIRE

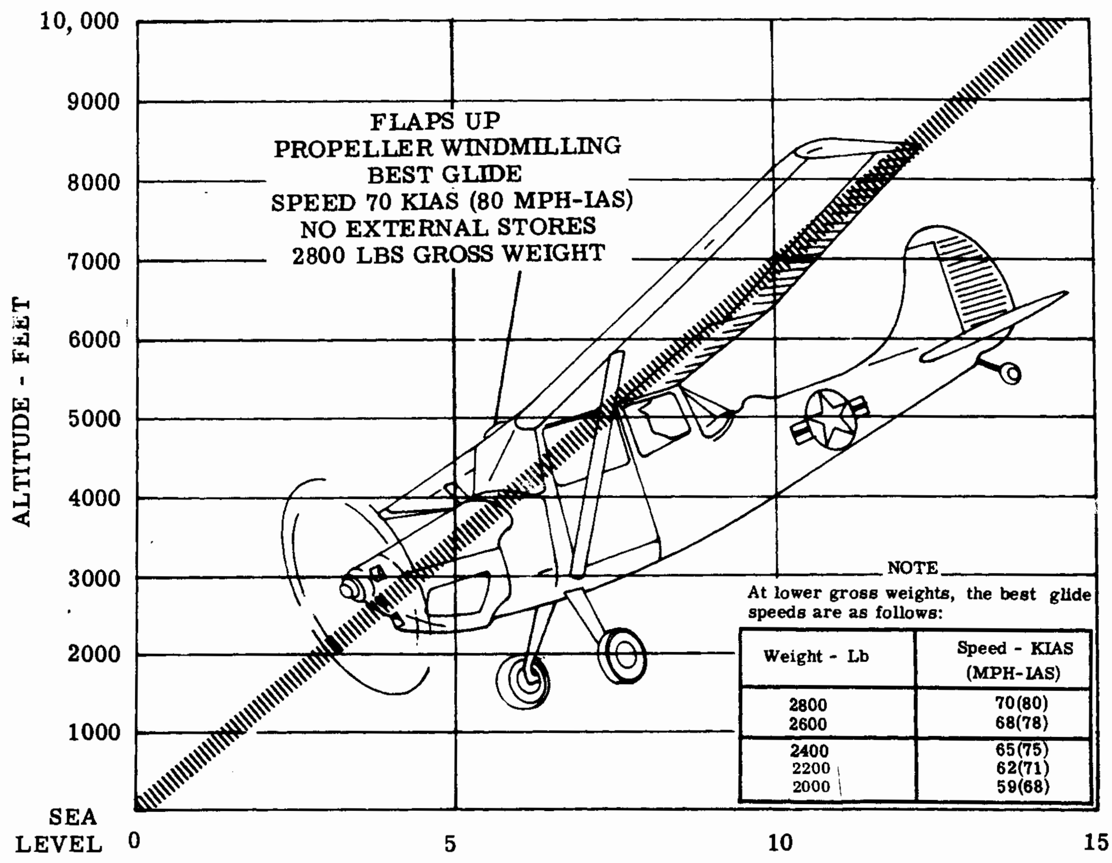
1. Landing lights - Off.
2. Navigation lights - Off.
3. Pitot heat - Off.

NOTE

Slip aircraft away from burning wing in effort to extinguish flames. Land as soon as possible or bail out.

ELECTRICAL FIRE

Circuit breakers isolate most electrical circuits and automatically interrupt power to prevent a fire when



Weight - Lb	Speed - KIAS (MPH-IAS)
2800	70(80)
2600	68(78)
2400	65(75)
2200	62(71)
2000	59(68)

Figure 3-1. Maximum Glide Distance

a short circuit occurs. If necessary, however, turn generator and battery switches off to remove power from all electrical equipment and land as soon as possible. If electrical power is essential, as during instrument flight, an attempt to identify and isolate the shorted circuit may be feasible. This can be accomplished as follows:

1. BATTERY - OFF.
2. GENERATOR - OFF.
   Turn off all remaining switches except ignition switch.
3. Generator - ON.
   If generator circuit is shorted, return switch to OFF.
4. Battery - ON.

NOTE

Individually restore each circuit, allowing a short period of time before proceeding to the next, until the shorted circuit is identified.

SMOKE AND FUME ELIMINATION

1. Cabin heat - IN.
2. Defroster and pilot heat - IN.
3. Open pilot's window.

CHIP DETECTOR LIGHT ILLUMINATED

Land as soon as practicable, keeping power changes to a minimum. Maintain sufficient power for an approach until landing is assured.

FUEL SYSTEM FAILURE

In event of engine fuel pump failure, turn auxiliary fuel pump switch ON. The pump will develop normal fuel pressure. A landing should be made at the nearest suitable airfield.

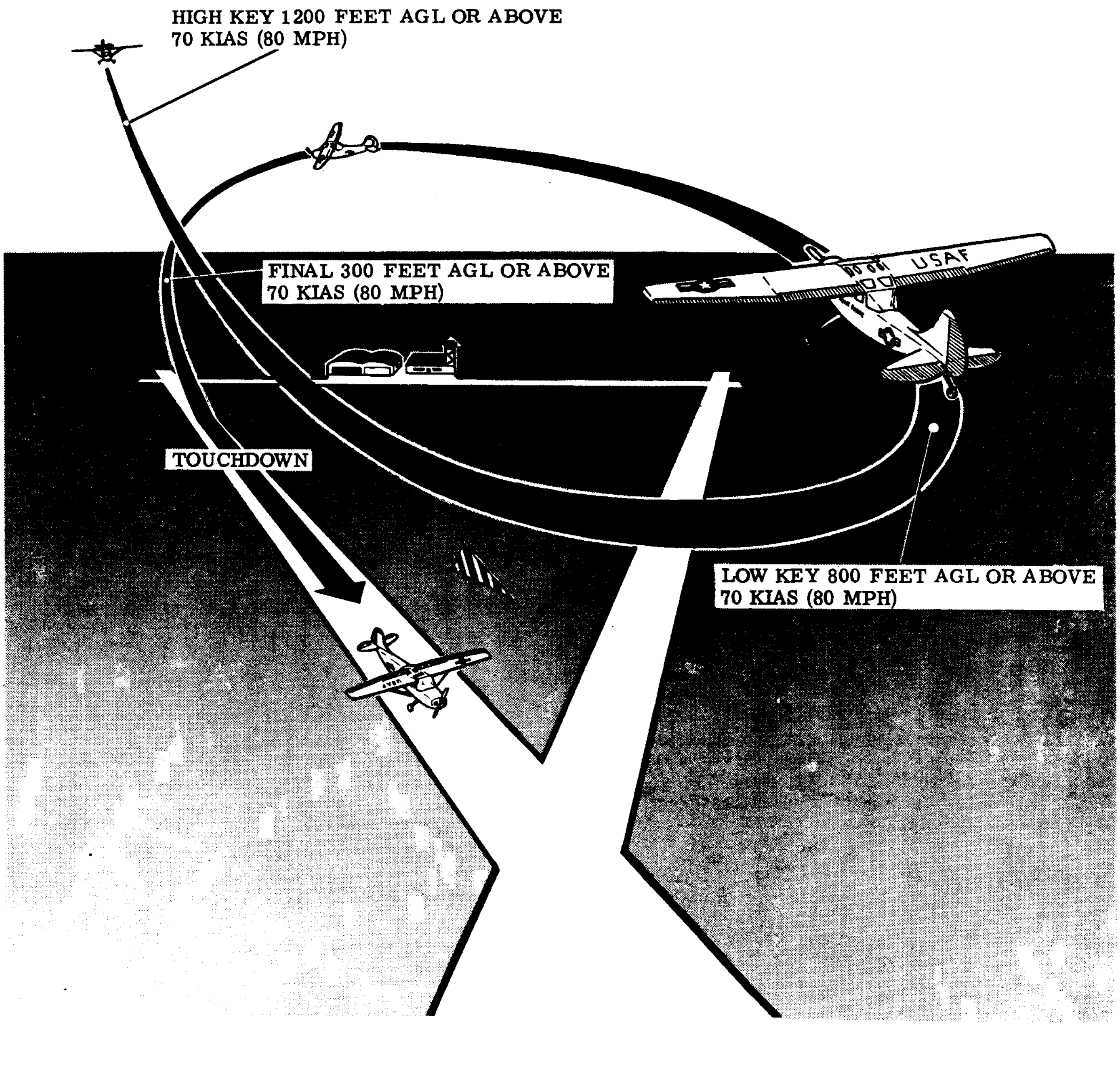


Figure 3-2. Typical Forced Landing

CARBURETOR FAILURE ▲

If carburetor malfunction due to mechanical failure causes fuel system failure, trim the aircraft for level flight immediately. Set the throttle at the Cruise (2000 RPM) position on the quadrant, then proceed as follows:

1. Auxiliary Fuel Pump - ON.
   Observe fuel pressure gage. A slight fluctuation will indicate proper functioning of the auxiliary fuel pump.
2. Fuel Selector - FULLEST TANK.
3. Mixture - IDLE CUTOFF, Emergency Fuel ON.
   Simultaneously move mixture control to IDLE CUTOFF position and turn emergency fuel system switch to the ON position.

NOTE

Rough engine operation can be expected because of incorrect fuel-air ratio. If rough engine operation is encountered, adjust the throttle to provide the correct air flow for best engine operation. Advancing the throttle will lean the fuel-air ratio. Retarding the throttle will enrich the fuel-air ratio. Once the proper fuel-air ratio is selected, the engine will operate normally. Further movement of the throttle will result in a power loss because the engine is operating on a fixed fuel flow that cannot be altered. All flight maneuvers must be compatible with the fixed power obtained from the engine while operating on the emergency fuel system.

ELECTRICAL POWER FAILURE

If a complete electrical failure occurs, or if it becomes necessary to turn the battery and generator off, a landing should be made as soon as possible. The auxiliary fuel pump, wing flaps and oil temperature gage will be inoperative. Instrument flying will be dangerous, as all radio communication equipment will be inoperative.

GENERATOR FAILURE

If the generator is inoperative, the battery is supplying all the current to the electrical system. Conserve the battery by immediately turning off all nonessential equipment and check generator circuit breaker.

ASYMMETRICAL FLAPS

If other than normal wing flap operation is noticed during operation of flaps, immediately release the wing flap switch, which is spring-loaded to the NEUTRAL or OFF position. Attempt to equalize the flap setting.

LANDING EMERGENCIES

FORCED LANDING

Landing with no engine power available is recommended only under ideal weather and terrain conditions. If weather, terrain, or altitude are such that a forced landing pattern cannot be safely accomplished, bailout is recommended.

FORCED LANDING PATTERN

The forced landing pattern is basically a 360 degree overhead approach, modified as required to compensate for variances in high key altitude and wind drift. A typical pattern is depicted in Figure 3-2. Establish a glide and attempt to arrive at the high key point at or above 1200 feet AGL. Maintain 70 KIAS (80 MPH) minimum throughout the pattern. Plan the pattern so as to roll out on the final approach approximately 300 feet AGL, 1/4 mile from the end of the runway. Plan to touchdown 1/3 of the way down the runway. The touchdown point may be readjusted after landing is assured, by use of flaps and/or sideslip. Land fully stalled, tail low.

1. External Stores - JETTISONED.
2. Door - OPEN SLIGHTLY.
3. Windows - OPEN.
4. Safety belt and shoulder harness - FASTENED AND LOCKED.

WARNING

Shoulder harness must be locked manually.

NOTE

Before locking shoulder harness, turn off all switches not readily accessible with harness locked.

5. Flaps - AS REQUIRED.
6. Throttle - CLOSE.
7. Mixture - IDLE CUTOFF.
8. Fuel selector - OFF.
9. Battery - OFF on approach.

NOTE

Rear seat occupant should exit through the door first or use side window. It is easier to exit out the door from the rear compartment with the front seat forward. After the rear seat occupant exits, the front occupant can slide his seat aft to exit. If door is jammed shut, turn emergency door release handle clockwise and push door outward. If this is impracticable, exit through a side window.

▲ Aircraft Modified by T.O. 1L-1-520.

LANDING WITH FLAT TIRE

If a tire is flat at the time of landing, or if a blowout occurs during the landing roll, be alert for possible ground loop toward side having flat tire. Fully extend wing flaps and land slowly keeping the wing high on the side of the flat tire as long as possible. Maintain directional control with steerable tailwheel and braking action on good wheel. Shut down engine as a fire precaution in case of ground loop.

EMERGENCY ENTRANCE

To gain emergency entrance into the cabin, turn emergency release handle to release door and window. If unsuccessful, entrance can also be gained by kicking in any of the cabin windows. (See figure 3-3.)

DITCHING

The aircraft should be ditched only as a last resort. Since all emergency equipment is carried by the crew members, there is no advantage in riding the aircraft down. However, if ditching is unavoidable, proceed as follows:

1. Follow radio distress procedures.
2. Insure equipment will not foul when you leave the aircraft.
3. Unbuckle parachute.
4. Seat belt and shoulder harness - SECURED.

NOTE

Before locking shoulder harness, turn off all switches not readily accessible with harness locked.

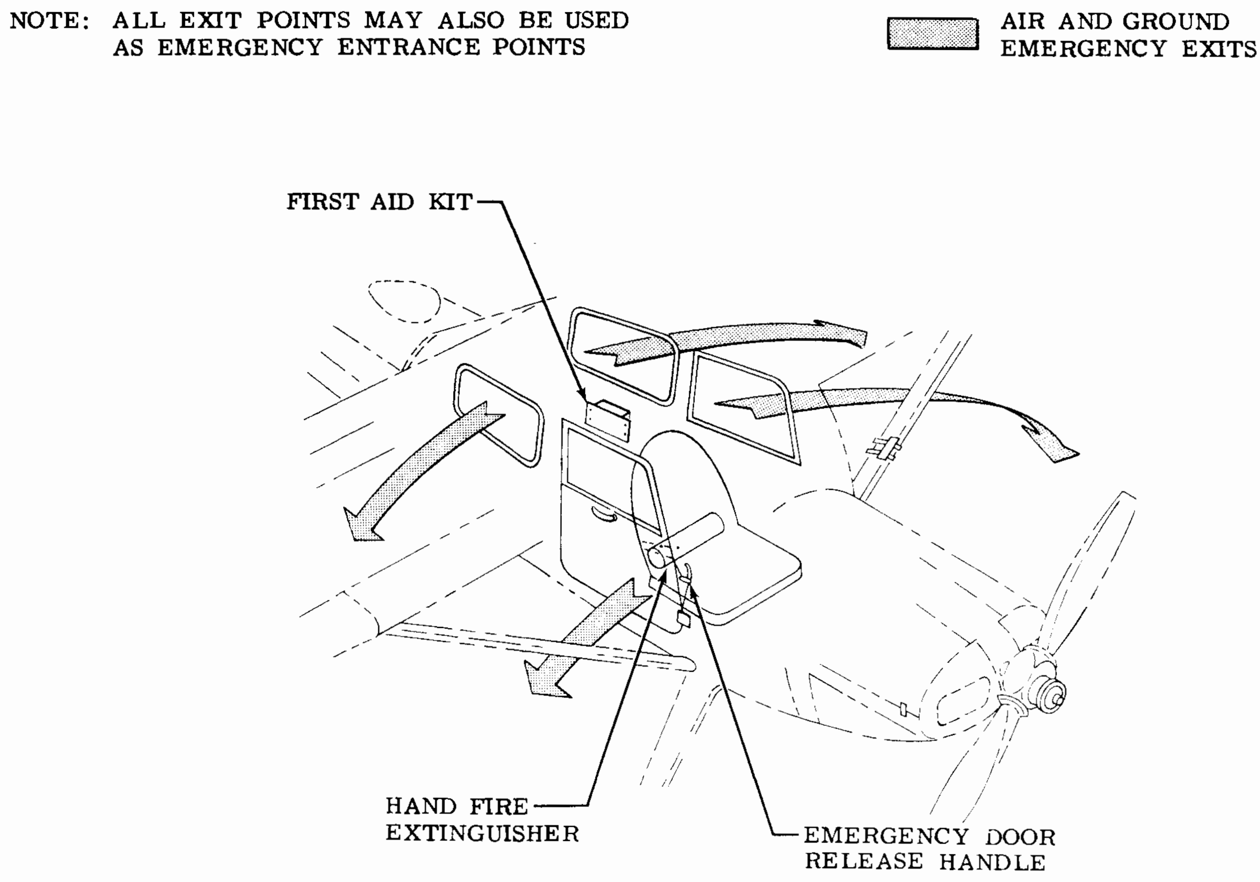


Figure 3-3. Emergency Exits, Entrances, and Equipment

5. Front side window - OPEN.
   Engage windows in spring clips on under side of wing.
6. Aft side windows - OPEN (IF REAR COCKPIT IS OCCUPIED).
7. Flaps - DOWN.
8. Battery - OFF.

NOTE

If possible make normal approach with power, and flare out to normal landing altitude. Touchdown just above stalling speed with tail slightly low. Unless wind is high or sea is rough, plan approach heading parallel to any uniform swell pattern and try touchdown along wave crest or just after crest passes. If wind is as high as 25 knots or surface is irregular, the best procedure is to approach into the wind and touchdown on the receding side of wave.

9. Ignition - OFF.
   Just before impact.
10. Exit - IMMEDIATELY.

BAIL OUT

NOTE

Reduce speed as much as possible and trim aircraft to fly hands off toward unhabited areas.

1. Safety belts and shoulder harness - UNFASTENED.
2. Helmet - DISCONNECTED.
3. Door window - OPEN.
   Engage window in spring clip or under side of wing.
4. Emergency door release handle - TURN CLOCKWISE.
   Kick door out.

WARNING

Bailout must be accomplished at a minimum altitude of 750 ft. above the terrain.

5. Rear seat occupant exit by diving out and down through door opening.
6. Front seat occupant exits.
   Front seat occupant will slide seat back and exit by diving out and down.

NOTE

It is easier to exit out the door from the rear compartment with the front seat forward. After the rear seat occupant exits, the front seat occupant can slide his seat aft.

SECTION IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

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HEATING, VENTILATING, AND WINDSHIELD DEFROSTING SYSTEM

Ram air picked up from the front openings of the engine cowling is heated in shrouds around the exhaust stacks, and is ducted into the front and rear cabin compartments. (See figure 4-1.) Heated air enters the front cabin compartment through three outlets; two aluminum elbows mounted just inboard and forward of the front rudder pedals, and a defroster duct located at the base of the windshield. The rear cabin compartment is heated through a register mounted on the aft cabin floor. Two push-pull type controls are provided to regulate the flow of heated air into the cabin.

CABIN HEAT KNOB

The cabin heat is controlled by operating a flexible push-pull type cabin heat knob (figure 1-6) located on a bracket just beneath the front instrument panel on the left side of the cabin. The knob is marked CABIN HEAT - PULL. As the knob is pulled to the full aft position, hot air is admitted to both cabin compartments.

DEFROSTER AND PILOT HEAT KNOB

The windshield defrosting and front compartment heat is controlled by operating a flexible push-pull type knob (figure 1-6) located on a bracket just beneath the front instrument panel on the right side of the cabin. The control knob is marked DEFROSTER AND PILOT HEAT - PULL. As the knob is pulled, hot air is admitted to the defroster and front compartment.

EMERGENCY OPERATION OF HEATING AND DEFROSTING SYSTEM

Should fumes or smoke from the heating system enter the cabin or should the air become excessively hot, push both heater control knobs to their off position.

VENTILATION SYSTEM

Cabin ventilation is provided by ram air ducted from two intake ports in the leading edge of each wing. Air is ducted to four individually adjustable, ram-type tubular air vents on O-1F aircraft and to three air vents on O-1A, E and G aircraft. These ventilators are manually operated by moving them in or out and can be rotated 360 degrees. This feature enables the front or rear occupant to divert the flow of air in any direction. Air from the front ventilators can be directed forward and used to defog the windshield.

PITOT HEATER

An electrical pitot heater is provided in the pitot tube to prevent the formation of ice in the pitot head. The heater receives its power from the 28 volt dc bus and is protected by a circuit breaker (figure 1-10).

PITOT HEAT SWITCH

The pitot heater is controlled by a two-position switch. On O-1A aircraft, the switch (figure 1-6) is located on the lower center portion of the instrument panel. On O-1E, G and F aircraft, the switch (figure 1-7) is located on the switch and circuit breaker panel on the left forward cabin wall. The switch is marked PITOT HEAT and has two positions; ON and OFF. On O-1A aircraft; the switch is marked PITOT HEATER. The switch receives its power from the 28 volt dc bus and is protected by a circuit breaker (figure 1-10).

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

POWER SUPPLY

Electrical power is supplied to the electronic equipment from the aircraft 28 volt dc bus. On O-1A, E and G aircraft, the electronic equipment may be

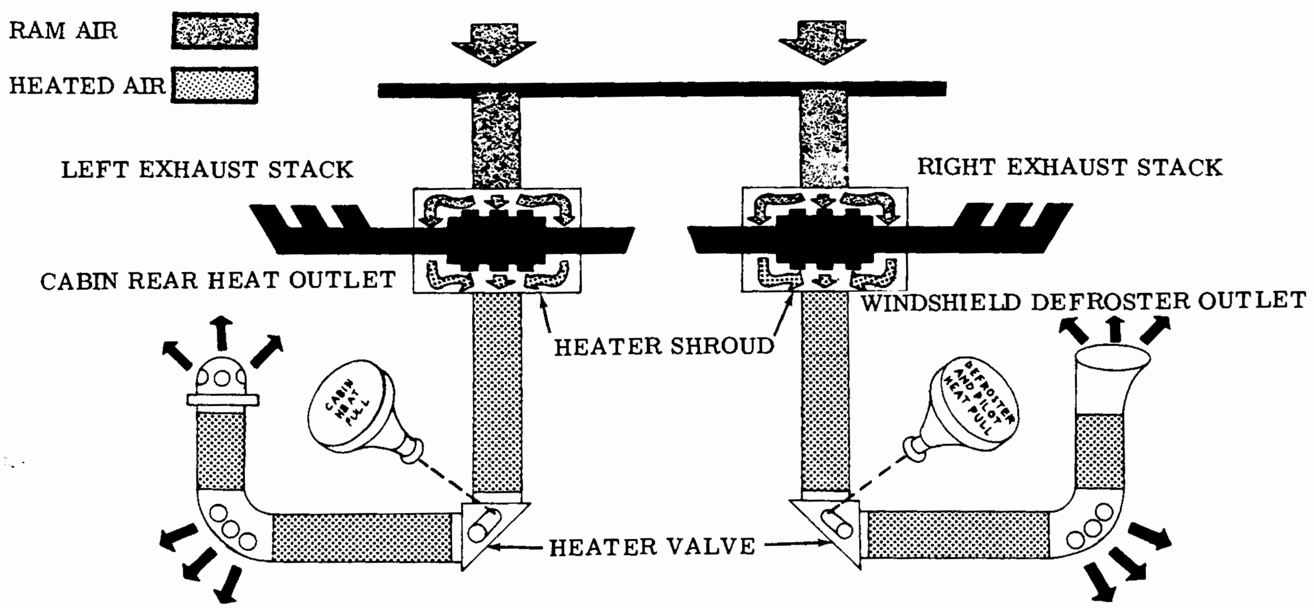


Figure 4-1. Heating and Windshield Defrosting System

energized by placing the generator switch, battery switch, power switch (radio switch panel) and the switch on the individual equipment in the ON position. On O-1F aircraft, the electronic equipment will be energized when the generator switch, battery switch, and the switch on the individual equipment are in the ON position.

CAUTION

Prolonged operation of electronic equipment on battery only should be avoided to prevent excessive battery power drainage.

ELECTRONIC EQUIPMENT

Radio Circuit Breakers

Circuit breakers for the electronic equipment are located on the switch and circuit breaker panel (figure 1-7). The circuit breakers may be pulled out to completely disable any set or may be reset by pushing them in.

Microphone Switches (Front Cockpit)

The microphone switches for the front cockpit are located on either the control stick or the throttle. (See figure 1-3.) The microphone switch, marked MIC, on the control stick controls the microphone for interphone and communication. Two separate microp..one switches are installed on the throttle, one, ma..ked INT, is used for interphone, and one, marked MIC, used for communication.

Microphone Switches (Rear Cockpit)

The microphone switches for the rear cockpit are located on either the portable microphone switch, thrott.. or floor. The portable microphone switch and th.. .witch on the floor controls the microphone for interphone and communication.

COMMUNICATION EQUIPMENT

Refer to figure 4-2.

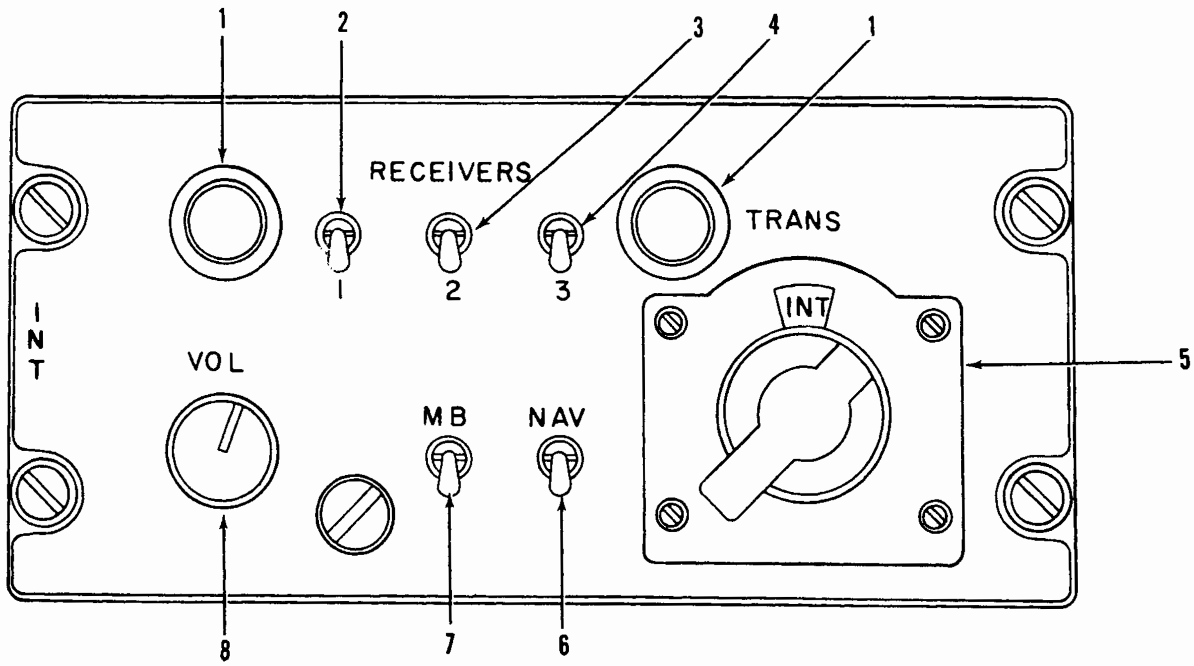
Interphone Control Panel SB-329

The audio channels of all radio sets and the interphone system are tied together for simplified control and simultaneous operation at two identical interphone control panels (see figure 4-3). The interphone control panel for the front cockpit is located on the left root rib. On aircraft with AN/ARC-45 installed, the interphone control panel is located on the r.. side of the rear cockpit. The controls on each ..phone control panel consists of five receiv.. ..tches, marked RECEIVERS, a volume

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	USE	RANGE	LOCATION OF CONTROLS	REMARKS
Interphone	ARC Type 12 or AN/ARC-60	Intercommunications	Interior of Aircraft	Front Cockpit	O-1A Aircraft
	AN/AIC-10	Intercommunications	Interior of Aircraft	Front and rear cockpit	O-1E, F, G Aircraft
	SB-329	Intercommunications	Interior of Aircraft	Front and rear cockpit	O-1A, E, F, G Aircraft
FM Liaison Set	AN/ARC-44	Two-Way Voice communications	Line of sight	Front and rear cockpit	REM-LOC switch inoperative on aircraft O-1F and should remain in LOC position. O-1A, E, F, G Aircraft
	FM 622A	Two-way voice communications	Line of sight	Front cockpit	O-1E, F, G Aircraft
VHF Command Set	ARC Type 12	Two-way Voice communications	Short range	Front cockpit	O-1A Aircraft
	AN/ARC-73	Two-way Voice communications	Short range	Front cockpit	O-1E, F, G Aircraft
UHF Command Set	AN/ARC-45	Two-way Voice communications	Line of sight	Front cockpit	O-1A, E, F, G Aircraft
	AN/ARC-51BX	Two-way Voice communications	Line of sight	Front cockpit	O-1E, F, G Aircraft
	AN/ARC-60	Two-way Voice communications	Short range	Front cockpit	O-1A Aircraft
Antenna Group	AN/ARA-31	Homing			O-1A, E, F, G Aircraft
	AN/ARA-56	Homing			O-1E, F, G Aircraft
DF (LF) NAV	R-511	Navigation	Long range	Front cockpit	O-1A Aircraft
Automatic Direction Finder Set	AN/ARN-59	Navigation and direction finding	Long range	Front cockpit	O-1A, E, F, G Aircraft
Marker Beacon	AN/ARN-12	Navigation	Vertical to 50, 000 feet	Front cockpit	Provide positive position indication O-1F Aircraft

Figure 4-2. Communication and Associated Electronic Equipment



1. Panel Light
2. Receiver 1 Switch
3. Receiver 2 Switch
4. Receiver 3 Switch
5. Transmitter Interphone Selector Switch
6. NAV Switch
7. Marker Beacon Switch
8. Volume Control

Figure 4-3. Interphone Control (SB-329)

control marked VOL and a transmitter selector switch marked TRANS. The FM liaison set is connected to receiver switch No. 1 and the No. 1 position of the transmitter selector switch. The UHF command set is connected to the No. 2 receiver switch. The VHF command set is connected to the No. 3 receiver switch. On aircraft with the AN/ARC-45 installed, the Marker Beacon AN/ARN-12 is connected to the MB switch. The Automatic Direction Finder Set AN/ARN-59 is connected to the NAV switch. For interphone operation the transmitter selector switch must be in the INT position. Interphone will break in regardless of which, if any, radio sets are in use. Two different radio sets may be operated simultaneously without crosstalk by proper setting of the receiver switches and the transmitter selector switches on the interphone control panels. The volume control on the interphone control panel may be set at a medium position and the volume control of the individual sets adjusted to give equal volume in the headsets. Subsequent adjustment of the volume control on the interphone control panel will vary the volume of any set in operation uniformly.

SB-329 Operation

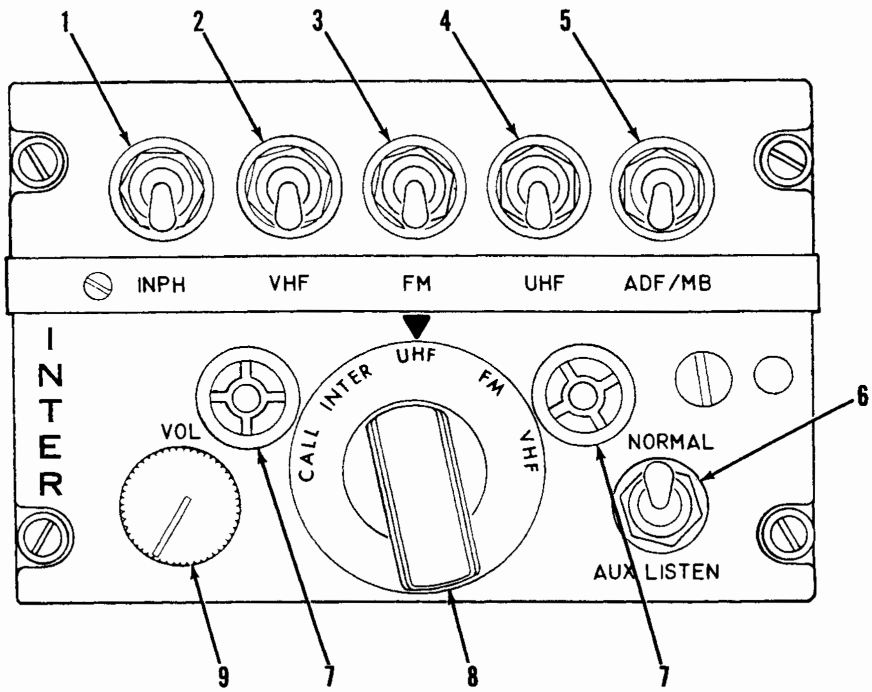
1. Electrical power - ON.
2. Power switch (radio switch panel) - ON (O-1A aircraft).
3. VOL control (interphone control panel) - AS DESIRED.
4. Transmitter selector switch (interphone control panel) - INT POSITION.
5. Microphone switch - DEPRESS.
6. Power switch (radio switch panel) - OFF (O-1A aircraft).

NOTE

Placing the power switch in the OFF position will render all headsets and microphones inoperative.

Interphone Operation (Aircraft Without Interphone Control Panel Installed)

1. Electrical power - ON.
2. OFF-VOL control (ARC Type 12 or AN/ARC-60 control panel) - ON.
   Rotate clockwise.
3. OFF-VOL control (ARC Type 12 or AN/ARC-60 control panel - ADJUST VOLUME AS DESIRED.
4. Transmitter channel selector switch - INT POSITION.
5. Microphone switch - DEPRESS.
6. OFF-VOL control (ARC Type 12 or AN/ARC-60 control panel) - OFF.
   Rotate counterclockwise.



1. INTERPHONE MIXER SWITCH
2. VHF MIXER SWITCH
3. FM MIXER SWITCH
4. UHF MIXER SWITCH
5. ADF/MB MIXER SWITCH
6. NORMAL-AUXILIARY LISTEN SWITCH
7. CONTROL PANEL LIGHTS
8. CHANNEL SELECTOR SWITCH
9. VOLUME CONTROL KNOB

Figure 4-4. Control Panel (AN/AIC-10)

Interphone (AN/AIC-10)

The audio channels and the transmitter key and mic circuits of all radio sets are tied into the AN/AIC-10 control panels for control by the pilot or observer. The pilot's AN/AIC-10 control panel is located on the left root rib; the observer's AN/AIC-10 control panel is located on the left side console. Each control panel (see figure 4-4) provides five audio mixer (monitoring) switches, a volume control, a channel selector switch, and a "NORMAL-AUX LISTEN" switch. When the applicable radio equipment is on and operating, the control panel allows the operator to operate the UHF, FM, or VHF (AM) transmitter according to placement of the channel selector switch; the corresponding sidetone and receiver audio will be heard in the headset. Any combination of audio channels may be monitored by upward placement of the mixer switches. The "NORMAL-AUX LISTEN" switch is wired in the "NORMAL" position. If the internal amplifier in the control unit fails, the wire may be broken to place the switch in "AUX LISTEN;" this will allow audio monitoring to be restored. The volume control should be used in conjunction with the volume controls on the separate radio control panels to provide a comfortable audio level. Careful adjustment of the volume controls on the separate radio controls will allow a fairly stable level on each monitoring position (and thus little needed adjustment of the AN/AIC-10 volume control when switching from one audio to another). With the channel selector on "INTER" (PHONE), no transmitter will be keyed and crew members may converse. The "CALL" position is used to inject the calling crew members voice, via interphone, into the other control panel. The other crew member will hear the "caller's" voice regardless of switch positions on the other crew member's control panel. The other crew member may then switch (channel selector) to "INTER" (PHONE).

NOTE

To "CALL," it is necessary to restrain the channel selector switch in "CALL" position. When released, the channel selector returns to "INTER" (PHONE).

AN/AIC-10 Operation

(Same as SB-329 Operation.)

FM Liaison Set AN/ARC-44

The AN/ARC-44 provides two-way communications, air-to-air or air-to-ground. A second function of this radio set when used in conjunction with the Antenna Group AN/ARA-31, is to provide facilities for homing on any signal within the frequency range of 24.0 to 49.0 megahertz. Principal components of the FM liaison set are a receiver-transmitter, two interphone control panels, two control panels and an antenna. The receiver is a double-conversion type including homing circuits for the D-U signals which are coded in the Antenna Group AN/ARA-31. The FM Homer incorporates two dipole antennas mounted on the horizontal stabilizer leading edge. The squelch switch which is used to minimize the static and background noise of the FM liaison set is located on the radio switch panel (figure 4-8). The AN/ARC-44 Antenna (figure 4-6) is a whip-type antenna, located above the front cockpit.

AN/ARC-44 Control Panel

The AN/ARC-44 Control Panels (figure 4-8) marked FM, are located on the radio control panel on the left-hand side of the front cockpit and on the radio control panel (in some aircraft), on the left-hand side of the rear cockpit. The controls consist of a switch marked ON-OFF, a frequency selector with a frequency indicating window marked FREQ, a volume control marked VOL and a two-position switch marked REM-LOCAL. The FM liaison set is connected to the interphone control panels at receiver switch No. 1 and the No. 1 position of the transmitter selector switch. The ON-OFF switch turns the FM liaison set on or off as desired. Frequency selection is accomplished by the frequency selector and is indicated in the FREQ window. The volume control, marked VOL, is used for adjusting the audio level of the FM liaison set. The squelch circuit is controlled from the squelch switch, marked SQUELCH-ON-OFF located on the radio switch panel on O-1A, E and G aircraft. The squelch switch, marked ARC-44 SQUELCH-OFF, is located on the switch and circuit breaker panel for O-1F aircraft. The REM-LOCAL switch is provided to transfer control of the FM liaison set between the front and rear cockpit. When the REM-LOCAL switch on either control panel is placed in the LOCAL position, it automatically positions the REM-LOCAL switch on the opposite control panel to the REM position. The control panel which has the REM-LOCAL switch in the LOCAL position will have control of the FM liaison set.

AN/ARC-44 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. Power switch (O-1A aircraft) - ON.
4. HOMING-COMM switch (radio switch panel or switch and circuit breaker panel) - COMM.
5. SQUELCH switch (radio switch panel or switch and circuit breaker panel) - AS DESIRED.
6. Receiver switch No. 1 (interphone control panel) - ON.
7. REM-LOCAL switch (control panel) - LOCAL.
8. ON-OFF switch - ON.
9. VOL control - AS DESIRED.
10. Frequency selector - AS DESIRED.
11. Transmitter selector switch (interphone control panel) - NO. 1.
12. Frequency selector (control panel) - AS DESIRED.
13. Microphone switch - DEPRESS.
14. ON-OFF switch (control panels) - OFF. The ON-OFF switch on both control panels must be in the OFF position before the FM liaison set is off.

Antenna Group AN/ARA-31

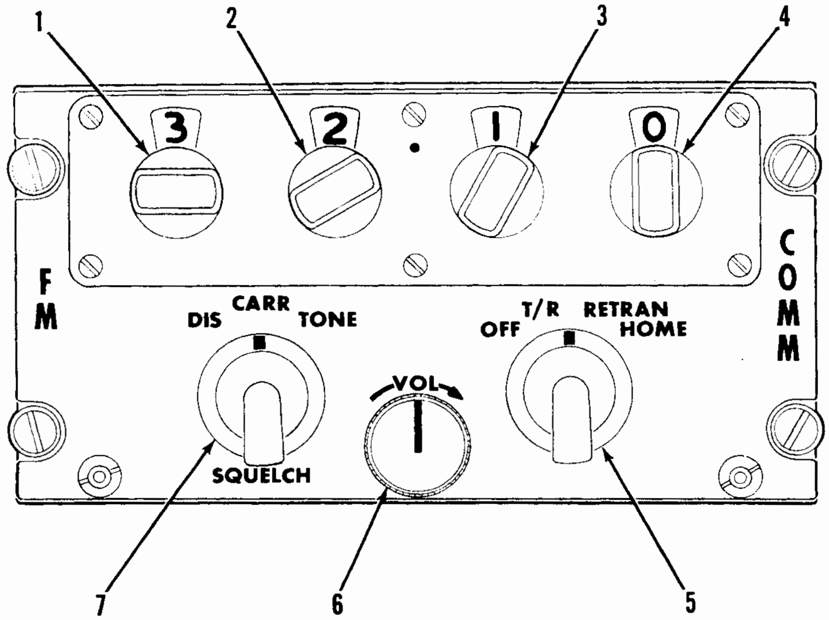
The Antenna Group AN/ARA-31 (figure 4-6) is installed in conjunction with the AN/ARC-44 system. The antenna group receives homing signals in the high frequency band of 24.0 to 49.0 megahertz. The function of this antenna group is to provide navigational facilities by homing on any signal within the frequency range of 24.0 to 49.0 megahertz.

Antenna Group AN/ARA-31 Controls

The antenna group will be energized when the homing-communication switch (figure 4-8), marked HOMING-COMM, is placed in the HOMING position. The volume control on the interphone control panel will vary the audio level of the homing signal.

FM Homer Operation (AN/ARA-31) (See figure 4-8.)

1. Electrical power - ON.
2. Circuit breakers - CHECK.
3. Turn on the FM radio (ARC-44) and set desired frequency.
4. Contact the ground station or aircraft that you wish to locate. Request a thirty second tone for homing.
5. Place ARC-44 homing switch (on switch and circuit breaker panel) in the HOMING position. Either a steady tone, a U (..-), or a D (-..) will be heard.
6. A steady tone indicates the aircraft is heading either directly toward or from the transmitter. Initiate a turn in either direction until a U or D is received.
7. If a U is received, start a right turn. If a D is received, start a left turn. Continue turn until a steady tone is heard. The aircraft will now be heading toward the transmitter.
8. Turn ARC-44 homing switch back to COMM position for normal transmissions.
9. Subsequent checks may be necessary to determine wind effect and keep the aircraft heading toward the transmitter.
10. It should be noted that procedures for operation of the FM homer resemble DF procedures. The uses of the FM homer are also similar to DF. It can be used for general orientation, to locate a ground station, or to locate another aircraft transmitting on FM. However, it is inferior to ADF for use as a normal navigational aid.
11. Turn set OFF, turn homing switch to COMM.



1. TENS MEGAHERTZ FREQUENCY SELECTOR KNOB
2. UNITS MEGAHERTZ FREQUENCY SELECTOR KNOB
3. TENTHS MEGAHERTZ FREQUENCY SELECTOR KNOB
4. HUNDREDTHS MEGAHERTZ FREQUENCY SELECTOR KNOB
5. MODE CONTROL KNOB
6. VOLUME CONTROL KNOB
7. SQUELCH CONTROL KNOB

Figure 4-5. FM-622A Control Panel

VHF/FM Communication Set FM-622A

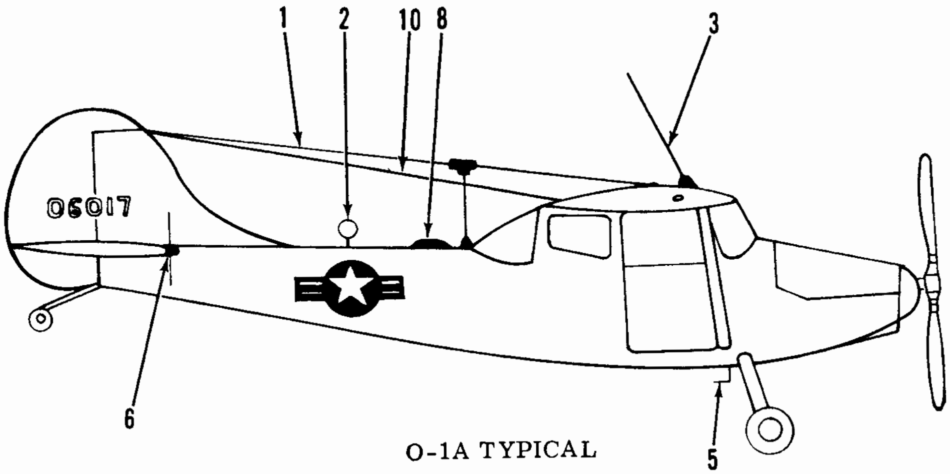
The FM-622A provides 920 channels of two way voice communications, air-to-air or air-to-ground, in the VHF frequency range of 30. 00 - 75. 95 megahertz. With the AN/ARA-56 homing equipment, the FM-622A also permits "homing" on any signal within its frequency range. Principal components of the FM-622A are the transceiver, the control panel, and the antenna. The transceiver has no controls or adjustments normally subject to operation in flight. The antenna is a whip located on top of the cockpit.

FM-622A Control Panel

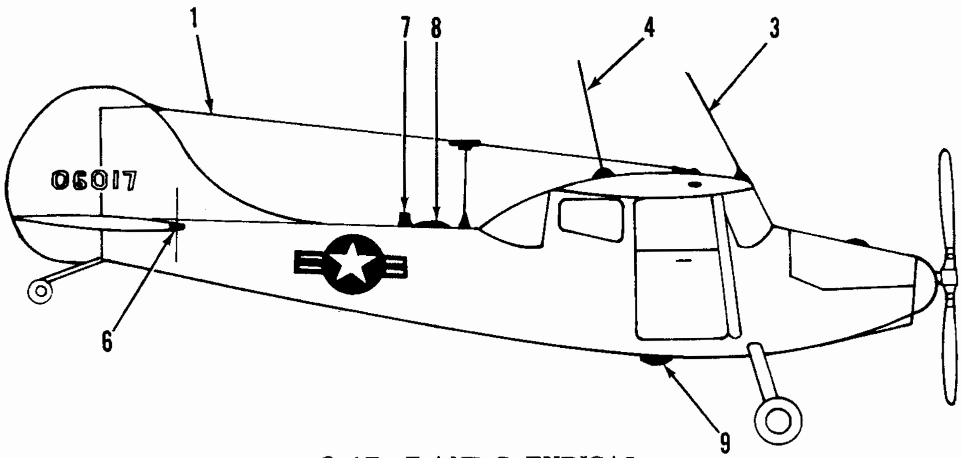
The FM-622A Control Panel (figure 4-5) is marked "FM" (left side) and "COMM" (right side) and is located on the root rib above the pilot's left side. The panel includes a volume control, squelch control, four frequency selector knobs and a mode control. Selected frequency is displayed in four digit windows above the frequency selector knobs. The mode control knob, labeled "OFF-T/R-RETRAN-HOME", applies power to the FM-622A VHF/FM equipment when placed in a mode other than "OFF." The "T/R" position is normal (Transmit/Receive) for communicating. The "HOME" position allows homing (with the AN/ARA-56 equipment) on any signal within the frequency range of the FM-622A. The "RETRAN" position is not operative on the O-1 aircraft. The volume control knob, labeled "VOL", provides adjustment of the receiver audio level. The frequency selector knobs permit selection of any one of the 920 channels between 30. 00 and 75. 95 megahertz. From the left, the knobs set "tens of megahertz," units of megahertz," "tenths of megahertz" and "hundredths of megahertz." As each knob is turned, the selected digit appears above the knob. The squelch control knob, labeled "DIS-CARR-TONE" provides control of the squelch threshold. In the "DIS" position, squelch is DISabled. The "CARR" position, normal except for weak signals, suppresses the characteristic FM hiss which otherwise is heard when no signal is being received. The "TONE" position is used when homing on a 150 hertz tone modulated signal.

FM-622A Operation

1. Electrical Power - ON.
2. Circuit Breaker - CHECKED.



O-1A TYPICAL



O-1E, F AND G TYPICAL

1. Type 12 DF Sense Antenna or AN/ARN-59 DF Sense Antenna
2. Type 12 DF Manual Loop Antenna
3. AN/ARC-44 Antenna
4. FM-622A Antenna
5. AN/ARC-60 Antenna or Type 12 VHF Antenna
6. AN/ARA-31 Antenna or AN/ARA-56 Antenna
7. AN/ARC-73 and AN/ARC-45 Antenna or AN/ARC-73 and AN/ARC-51BX Antenna
8. AN/ARN-59 Loop Antenna
9. AN/ARN-12 Antenna
10. Type 12 Range Antenna

Figure 4-6. Antenna Location

3. Channel Selector Switch (AN/AIC-10 CONTROL) - FM.
4. Mode Control Knob - T/R.
5. Squelch Control Knob - CARR or DIS.
6. Frequency selector Knobs - TO DESIRED FREQUENCY.
7. Microphone Switch - DEPRESS and talk (to transmit).
8. Microphone Switch - RELEASE (to receive).
9. Volume control (FM-622A and AN/AIC-10 Control Panels) - AS REQUIRED.
10. To turn the equipment off, return mode control knob to "OFF."

FM Homing Equipment AN/ARA-56.

The AN/ARA-56 consists of two dipoles and impedance networks on the horizontal stabilizer. These are coaxially connected to the FM-622A VHF/FM transceiver which is internally equipped to interpret homing signals for display on the homing indicator (ID-48/ARN) mounted in the lower right side of the instrument panel. Homing control is provided by the FM-622A control panel.

AN/ARA-56 Operation.

1. Place the FM-622A in operation as described above, selecting desired homing frequency.
2. Mode control knob (FM-622A Control Panel) - HOME.
3. Squelch Control - CARR ("TONE" if the homing station is transmitting a 150 hertz modulated signal).
4. Observe homing indicator (ID-48/ARN). Adequate homing signals will cause the vertical pointer flag to disappear. If vertical needle is left of center, perform a gentle left turn. This maneuver should cause needle to swing toward centered position. (IF NEEDLE DEFLECTS FURTHER LEFT, AIRCRAFT HEADING IS OFF BY NEARLY 180°). Correct aircraft heading until vertical needle reaches center. Maintain needle-centered heading. Drift is not compensated.
5. The horizontal needle provides a relative indication of received signal strength. The greater the upward deflection, the stronger the received signal.

UHF Command Set AN/ARC-60

The AN/ARC-60 provides two way voice communication, air-to-air or air-to-ground, within the frequency range of 228. 0 to 258. 0 megahertz. Principal components of the UHF command set are a receiver, two transmitters, a control panel, and an antenna. The receiver is a continuously tunable superheterodyne-type receiver. The transmitters are five-tube, amplitude-modulated transmitters providing eight crystal-controlled channels each. The control panel provides the means of turning the UHF command set on or off, selecting the desired receiver and transmitter frequency and adjusting the volume to the desired level. The antenna (figure 4-6) is an L-type antenna mounted under the forward portion of the fuselage.

AN/ARC-60 Control Panel

An AN/ARC-60 Control Panel (figure 4-8) marked UHF COMM, is located in the front cockpit on the right root rib. The controls consist of an off-volume control marked OFF-VOL, a receiver tuning crank marked PRESS TO WHISTLE, a receiver frequency indicating dial marked REC and a 17-position channel selector switch marked TRANS. The OFF-VOL control turns the UHF command set on or off and adjusts the volume as desired. The tuning crank tunes the receiver to the desired frequency. The receiver is tuned to the frequency of the transmitter by depressing the tuning crank and tuning for maximum whistle. The transmitter channel selector switch is used to select the desired frequency on which to transmit. The No. 17 position of this switch is not used.

AN/ARC-60 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. Power switch - ON.
4. Receiver switch No. 2 or UHF - ON.
5. OFF-VOL control (control panel) - ON. Rotate clockwise.
6. Tuning crank - AS DESIRED. To fine tune the receiver to the transmitter frequency, depress the tuning crank and tune for maximum whistle.
7. OFF-VOL control - AS DESIRED.
8. Transmitter selector switch - NO. 2 POSITION.
9. Transmitter channel selector switch - AS DESIRED.
10. Microphone switch - DEPRESS.
11. OFF-VOL control - OFF. Rotate counterclockwise.

UHF Command Set AN/ARC-45

The AN/ARC-45 is an airborne radio communication set which provides two-way voice communication, air-to-air or air-to-ground, within the frequency range of 225. 0 to 399. 9 megahertz. Principal components of the UHF command set are a receiver-transmitter, a control panel and an antenna. The receiver-transmitter operates on any one of 12 preset channels of the 1750 available channels. The control panel provides the means of turning the UHF command set on or off, adjusting the volume, channel selection, remote-local selection, and tone transmission. The remote-local switch on O-1F aircraft is inoperative and should remain in the LOCAL position. The antenna is located on top of the fuselage aft of the rear cockpit.

AN/ARC-45 Control Panel

The AN/ARC-45 Control Panel (figure 4-8) marked UHF, is located on the right root rib. The controls consist of a power switch marked ON-OFF, a volume control marked VOL, a channel selector switch marked CHANNEL, a remote-local switch marked REM-LOC and a tone button marked TONE. The ON-OFF switch turns the UHF command set on or off as desired. The VOL control is provided for adjusting the vol... f the UHF command set to the desired level. ...tion of the desired channel is accomplished by rotating the CHANNEL switch. The REM-LOC switch is inoperative on O-1F aircraft and should remain in the LOC position.

AN/ARC-45 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. Receiver switch No. 2 or UHF (interphone control panel) - ON POSITION.
4. ON-OFF switch (control panel) - ON.
5. REM-LOC switch - LOC.
6. Channel selector switch - AS DESIRED.
7. VOL control - ADJUST VOLUME TO DESIRED LEVEL.
8. Transmitter selector switch (interphone control) - NO. 2 POSITION.
9. Channel selector switch (control panel) - AS DESIRED.
10. Microphone switch - DEPRESS.
11. Tone button - DEPRESS.

CAUTION

Do not depress TONE button for more than 15 seconds; allow 45-second intervals between tone transmissions to prevent damage to equipment.

12. ON-OFF switch (control panel) - OFF.

UHF Communication Set AN/ARC-51BX

The AN/ARC-51BX is an airborne radio set which provides two-way voice communication, air-to-air and air-to-ground, on 3500 crystal-controlled channels in the frequency range of 225.00 to 399.95 megahertz. Principle components of the AN/ARC-51BX are a receiver-transmitter, a control panel and an antenna. The receiver-transmitter has no controls or adjustments normally subject to operation in flight. The antenna is a stub located aft of the cabin on top of the fuselage.

AN/ARC-51BX Control Panel

The AN/ARC-51BX Control Panel (figure 4-7) is marked "UHF" on its left side and is located on the root rib above the pilot's left side. The controls include a preset channel selector, squelch switch, volume control, function selector, three frequency selector knobs ("first two digits," "third digit," and "last two digits"), and an operation mode selector. The control panel allows selection of any one of 20 preset channels as well as manual selection of any one of the 3500 channels on which the equipment can operate. Manual selection does not disrupt the 20 preset channels. The UHF guard (emergency) channel frequency (usually 243.00 megahertz) may be monitored simultaneously with the equipment operating on any other selected operating frequency. Control switches and knobs are discussed individually:

a. PRESET CHANNEL SELECTOR. This switch (knob) identified "PRESET CHAN," selects any one of the 20 preset channels. The selected channel number is displayed in the channel indicator window above and left of the preset channel selector knob. The frequency of this channel is also displayed in the 5-digit window labeled "MC" for megacycles (megahertz). A card at the top of the panel identifies the frequency preset on each of the 20 channels.

b. SQUELCH SWITCH. This switch (toggle), identified "SQ DISABLE," has two positions identified "ON and "OFF." In the OFF position, the squelch is operating (i.e., is NOT disabled) and background receiver noise cannot be heard at normal volume control settings; only received signals of sufficient signal strength will override the squelch and be heard. In the "ON" position, the squelch is inoperative (i.e., DISABLED) and both background noise and signals will be heard. The "OFF" position allows monitoring without causing aural fatigue due to constant presence of background noise; however, with the squelch operating, weak signals may not be heard due to inability to override the squelch.

c. VOLUME CONTROL. This small knob, identified "VOL," allows adjustment of the receiver audio level as heard in the headset. Volume is increased in the direction of the arrow (clockwise). The volume control should be set in conjunction with the AN/AIC-10 interphone volume control and as warranted by the placement of the squelch switch.

d. FUNCTION SELECTOR. This switch (knob), identified by positions "OFF-T/R-T/R + G - ADF," applies power to the equipment and turns the equipment off. Either the "T/R" or T/R +G" position is normal for operation; on both positions, the equipment will Transmit and Receive. On the "T/R + G" position, the Guard channel is simultaneously monitored while the equipment is operating on any other frequency. The "ADF" position is inoperative on O-1 aircraft.

e. FREQUENCY SELECTOR. These three knobs are in line across the lower quarter of the control panel. Each is related by a scribed line, to one or two of the digits in the 5-digit frequency indicator window. Rotation of each knob changes the corresponding digits in the frequency window.

f. OPERATION MODE SELECTOR. This switch identified by positions "MAN" and "GD-XMIT" is actually a three-position control. In the extreme counterclockwise position, the knob refers, by a scribed line, to the preset channel selector, indicating that the equipment will operate in the "preset channel selection" mode (i.e., will operate on one of the 20 preset channels). In the center position "MAN" (for manual), the equipment is prepared for manual selection of any one of the 3500 available channels. The "GD-XMIT" position automatically and immediately selects the guard frequency for transmission and reception.

AN/ARC-51BX Operation

The operating procedure depends on whether or not the desired operating frequency has been previously set up on one of the 20 preset channels. Check the frequency card at the top of the control panel.

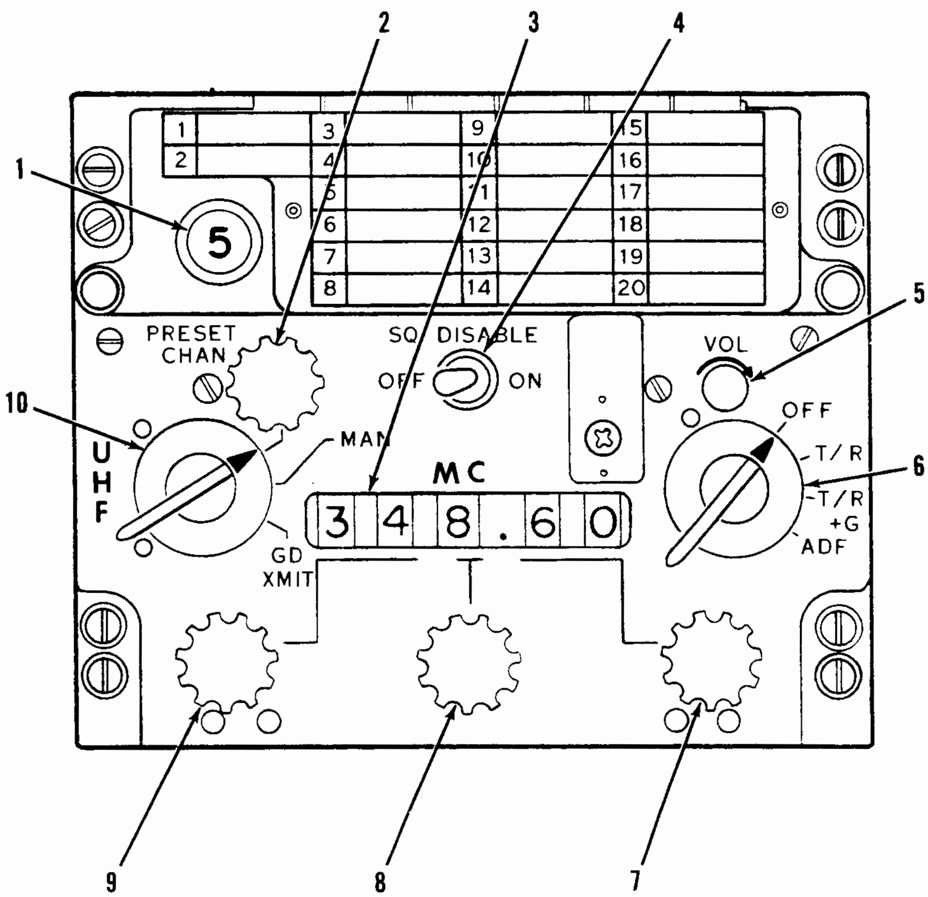
Desired frequency NOT preset:

1. Electrical Power - ON.
2. Channel Selector Switch (AN/AIC-10) - UHF.
3. Circuit Breaker - CHECK.
4. Function Selector Switch - T/R or T/R + G.
5. Operation Mode Selector - MAN.
6. Allow five minute warm-up.
7. Turn the "first two digits" (left) frequency selector knob until the first two digits of the desired frequency appear in the "MC" window.

NOTE

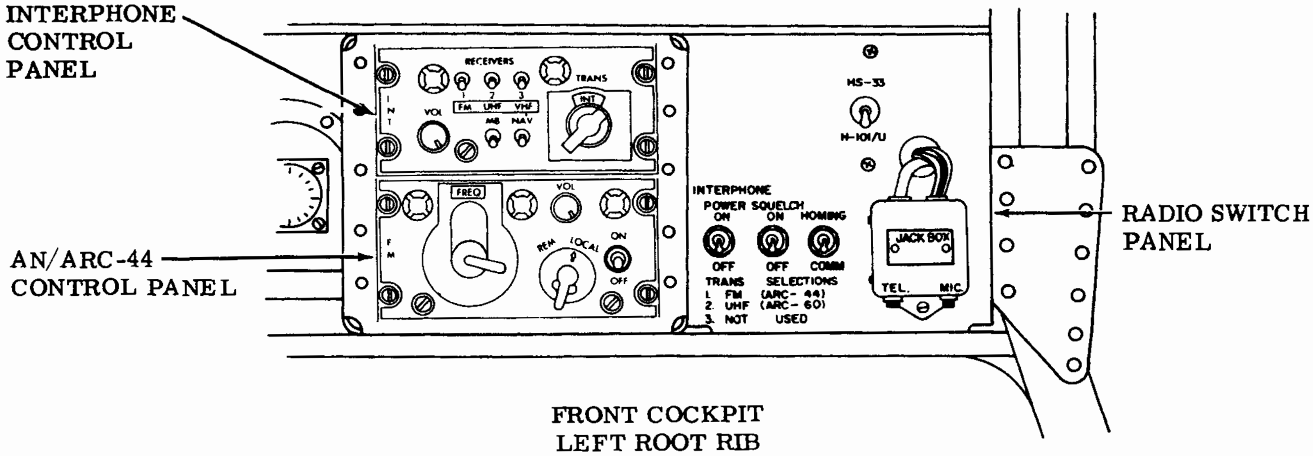
During the equipment tuning cycle an audio tone (800 hz) should be heard in the headset.

8. Turn the "third digit" (center) frequency selector knob until the third digit of the desired frequency appears in the "MC" window.
9. Turn the "last two digit" (right) frequency selector knob until the fourth and fifth digits of the desired operating frequency appear in the "MC" window.

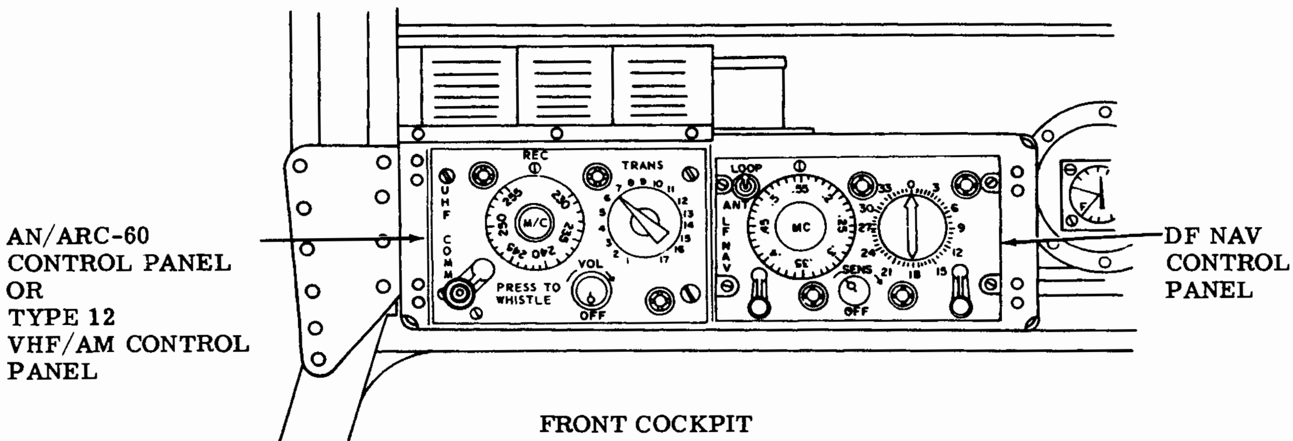


1. CHANNEL INDICATOR WINDOW
2. PRESET CHANNEL SELECTOR KNOB
3. FREQUENCY INDICATOR WINDOW
4. SQUELCH SWITCH
5. VOLUME CONTROL KNOB
6. FUNCTION SELECTOR KNOB
7. LAST TWO DIGIT FREQUENCY SELECTOR KNOB
8. THIRD DIGIT FREQUENCY SELECTOR KNOB
9. FIRST TWO DIGIT FREQUENCY SELECTOR KNOB
10. OPERATION MODE SELECTOR KNOB

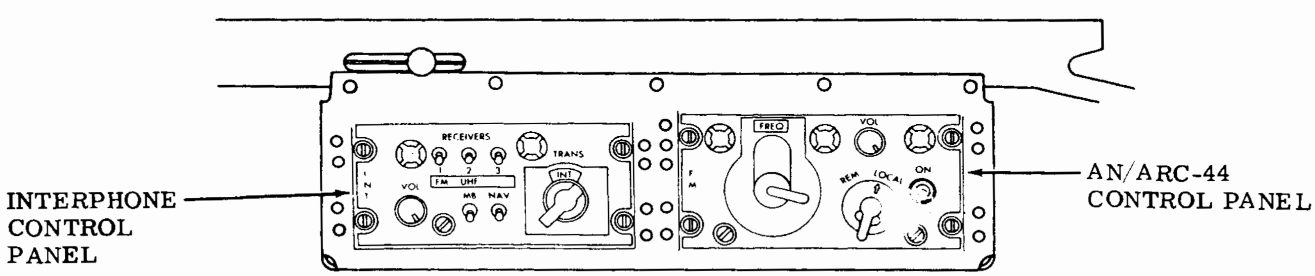
Figure 4-7. AN/ARC-51BX Control Panel



FRONT COCKPIT
LEFT ROOT RIB

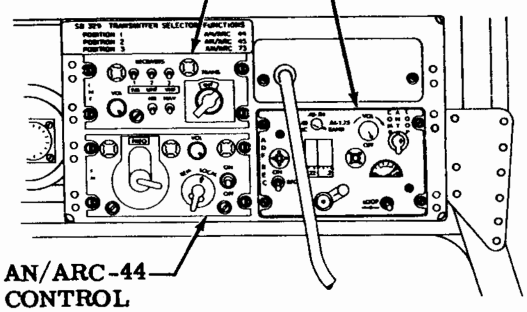


FRONT COCKPIT
RIGHT ROOT RIB

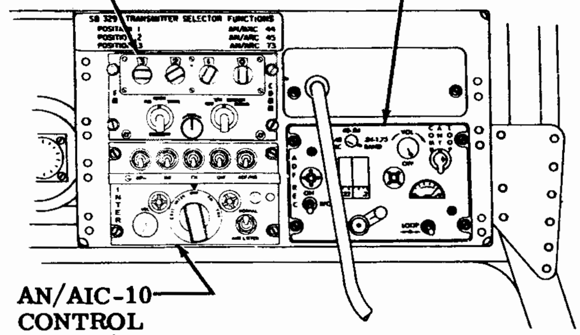


REAR COCKPIT
LEFT SIDE

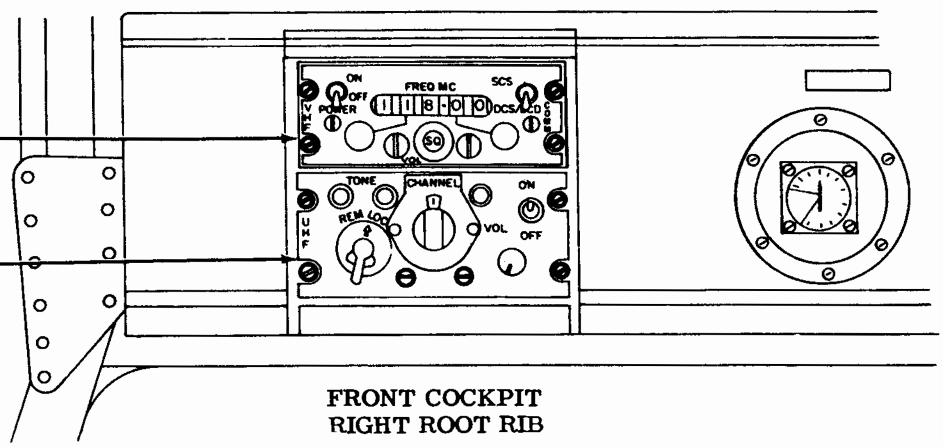
Figure 4-8. Radio Control Panels (O-1A) (Sheet 1 of 2)



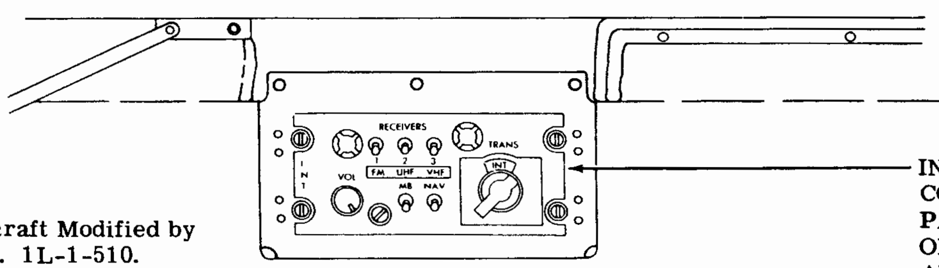
FRONT COCKPIT
LEFT ROOT RIB



FRONT COCKPIT
LEFT ROOT RIB



FRONT COCKPIT
RIGHT ROOT RIB



REAR COCKPIT
LEFT SIDE

▲3 Aircraft Modified by T.O. 1L-1-510.

▲4 Aircraft Modified by T.O. 1L-1-524.

Figure 4-8. Radio Control Panels (O-1E, F and G) (Sheet 2 of 2)

CAUTION

Once a frequency is set, allow at least 12 seconds before any re-setting.

10. Squelch switch - AS REQUIRED.
11. Volume Control - AS REQUIRED.
12. Microphone switch - DEPRESS (to transmit).
13. Speak into microphone and listen for sidetone in headset.
14. To shut down the equipment, turn the function selector switch to OFF.

Desired frequency is preset:

1. Same steps as 1 through 4 above.
2. Operation mode selector - FULL CCW to preset channel position.
3. Preset channel selector - Turn knob until required preset channel appears in the channel indicator window. (The frequency will also appear in the "MC" window).
4. Proceed from step 10 of Not Preset Procedures.

To transmit and receive on guard channel:

1. With the equipment ON, and regardless of existing operating frequency, function, or mode, switch the operation mode selector switch to "GD-XMIT." The equipment is automatically set up for transmission and reception on the guard channel.

VHF Command Set ARC Type 12

The ARC Type 12 provides two-way voice communications, air-to-air or air-to-ground, within the frequency range of 118. 0 to 148. 0 megahertz. Principal components of the VHF command set are a receiver, two transmitters, two control panels, and an antenna. The receiver is a continuously tunable type receiver with a frequency range of 118. 0 to 148. 0 megahertz. The transmitters are five channel, crystal-control transmitters. The selection of transmitters is automatic when the transmitter channel selector switch is placed on the desired channel. The control panels provide the means of turning the set on or off, adjusting the volume, selecting the transmitting channel, and tuning the receiver. The antenna (figure 4-6) is either a whip-type or an L-type, located on the bottom of the fuselage.

ARC Type 12 Control Panel

The ARC Type 12 Control Panel (figure 4-8) is located in the front cockpit on the left-hand side. The controls consist of a volume on-off control marked OFF, a sensitivity switch marked LO-HI, a tuning crank, a receiver frequency indicating dial marked VHF and an 11-position transmitter channel selector switch, marked TRANS. The remaining controls on this control panel are used for the LF range receiver. Rotating the volume on-off control clockwise turns the VHF command set on and increases the volume. Rotating the control counterclockwise decreases the volume and turns the set off. Placing the sensitivity switch in the LO position cuts down static and background noise allowing strong signals to come through. Placing this switch in the HI position allows weaker signals along with static and background noise to be heard. Selection of the desired receiver frequency is accomplished by rotating the tuning crank left or right. The selected frequency will be shown on the frequency indicating dial. The transmitter channel selector switch selects any one of the 10 frequencies provided. The center position of the transmitter channel selector switch is used for interphone.

ARC Type 12 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. Volume on-off control - ON. Rotate clockwise.
4. PUSH FOR CONTROL switch - DEPRESS.
5. Volume on-off control - ADJUST VOLUME AS DESIRED.
6. Tuning crank - ROTATE TO DESIRED FREQUENCY.
7. LO-HI switch (O-1A aircraft) - AS DESIRED.
8. Transmitter channel selector switch - AS DESIRED.
9. Microphone switch - DEPRESS.
10. Volume on-off control - OFF. Rotate counterclockwise.

VHF Command Set AN/ARC-73

The AN/ARC-73 is an airborne radio communication set which provides air-to-air or air-to-ground communications within the frequency range of 116. 0 to 151. 95 megahertz. Principal components of the VHF command set are a receiver, a transmitter, a control panel, and an antenna. The receiver may be detent tuned to any one of 720 available channels. The transmitter may be detent tuned to any one of 680 available channels within the frequency range of 116. 0 to 149. 95 megahertz. The control panel provides the means of turning the power on or off, adjusting the volume, adjusting the squelch, selecting the desired receiver and transmitter frequency and selecting the mode of operation. The antenna (figure 4-6) is airfoil-shaped and is mounted on the top of the fuselage aft of the rear cockpit.

AN/ARC-73 Control Panel

The AN/ARC-73 Control Panel (figure 4-8), marked VHF COMM, is located in the front cockpit on the right root rib. The controls consist of a power switch marked POWER-OFF-ON, a volume control marked VOL, a squelch control marked SQ, a mode selector switch marked SCS-DCS/DCD, two frequency selector controls and a frequency indicating window marked FREQ MC. Placing the POWER-OFF-ON switch in the ON position turns the VHF command set on. Volume may be adjusted to the desired level by rotating the VOL control. The SQ control may be adjusted to minimize static and background noise. Frequency selection is accomplished by rotating the two frequency selector controls to any one of 720 available channels. The selected frequency will be indicated in the frequency indicator window. The SCS-DCS/DCD switch is inoperative in this installation and should remain in the SCS position. The VHF command set is connected to the interphone control at receiver switch No. 3 and the No. 3 position of the transmitter selector switch.

AN/ARC-73 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. Receiver switch No. 3 (interphone control panel) - ON.
4. POWER-OFF-ON switch - ON.
5. Frequency selector controls - AS DESIRED.
6. VOL control - AS DESIRED.
7. SQ control - AS DESIRED.
8. Transmitter selector switch (interphone control panel) - No. 3 POSITION.
9. Frequency selector controls - AS DESIRED.
10. Microphone switch - DEPRESS.
11. POWER-OFF-ON switch - OFF.

NAVIGATION EQUIPMENT

The navigation equipment for the aircraft consists of Automatic Direction Finder Set AN/ARN-59, LF Range Receiver, and Marker Beacon AN/ARN-12.

Automatic Direction Finder Set (ADF) AN/ARN-59

The AN/ARN-59 is an airborne navigation set which operates in the frequency range of 190. 0 to 1750. 0 kilohertz. The function of the ADF set is to automatically provide visual indication of the direction from which an incoming signal is received and to aurally indicate amplitude-modulated signals. This ADF set may also be used for homing and position fixing. Principal components of the ADF set are a receiver, control panel, azimuth indicator, a loop antenna and a sense antenna. The receiver is a three-band type receiver. The control panel provides the means of turning the ADF set on or off, adjusting the volume, selecting the desired function, rotating the loop antenna, tuning the receiver, turning the BFO on or off and selecting the desired band. The azimuth indicator, located on the instrument panel provides either true, magnetic or relative bearing indication of the received signal. The loop antenna (figure 4-6) may be rotated to give bearing indications on the azimuth indicator. The sense antenna (figure 4-6) is used to tune the receiver to the desired frequency. Both antennas are located on top of the fuselage aft of the rear cockpit.

ADF Control Panel

The ADF control panel (figure 4-8), marked ADF REC, is located in the front cockpit on the left root rib. The controls consist of a volume control and power switch marked OFF-VOL, a function switch marked COMP-ANT-LOOP, a loop rotating switch marked LOOP, a tuning crank, a beat frequency oscillator switch marked BFO-ON, a three-position band selector switch marked MC BAND, a frequency indicating window and a tuning meter. Rotating the OFF-VOL control clockwise turns the ADF set on and adjusts the volume or sensitivity to the desired level. The function switch, when placed in the ANT position, allows the receiver to be tuned to the desired frequency using the sense antenna. When the function switch is placed in the LOOP position, the loop antenna is operational and may be rotated by the LOOP switch. When the function switch is placed in the COMP position, the ADF set is used as a radio compass using both the loop and sense antenna. The loop antenna may be rotated clockwise or counterclockwise by positioning the LOOP switch either left or right. Rotating the tuning crank tunes the receiver to the desired frequency. This selected frequency will be indicated in the frequency indicating window. The BFO-ON switch, when placed in the ON position, turns the beat frequency oscillator on to permit identification of cw transmissions as well as an aid in the determination of aural nulls when the function switch is in the LOOP position. The three-position band selector switch provides the means of selecting any one of three available bands. The tuning meter provides an indication when the receiver is accurately tuned to the desired frequency. The receiver is tuned until maximum deflection on the tuning meter is indicated. When maximum deflection is indicated, the receiver is accurately tuned.

AN/ARN-59 Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. NAV switch (interphone control panel) - ON.
4. OFF-VOL control (control panel) - ON. Rotate clockwise.
5. Function switch - ANT POSITION.
6. MC BAND switch - AS DESIRED.

CAUTION

When tuning be sure function switch is in ANT position to prevent damage to equipment.

7. BFO-ON switch - OFF (ON FOR CW RECEPTION).
8. Tuning crank - ROTATE TO DESIRED FREQUENCY. Tune for maximum deflection on tuning meter.
9. OFF-VOL control - AS DESIRED.
10. E-W-VAR control (azimuth indicator) - ADJUST FOR AIRCRAFT'S MAGNETIC HEADING AT INDEX. Pointer will indicate magnetic bearing of transmitting station.
11. Function switch - LOOP POSITION.
12. BFO-ON switch - AS DESIRED.
13. OFF-VOL control - AS DESIRED.
14. LOOP switch - SWITCH LEFT OR RIGHT FOR MINIMUM HEADSET VOLUME.
15. E-W-VAR control (azimuth indicator) - MAGNETIC HEADING FOR ADF OPERATION. ZERO AT INDEX FOR RADIO COMPASS.
16. Function switch - COMP POSITION.
17. OFF-VOL control - AS DESIRED.

18. Tuning crank - ROTATE TO DESIRED FREQUENCY. Tune for maximum deflection on tuning meter.
19. OFF-VOL control - OFF. Rotate counterclockwise.

LF Range Receiver (R-511)

The R-511 receiver is a navigation receiver which is continuously tunable in the frequency range of 190.0 to 550.0 kilohertz. The function of this receiver is to provide homing or manual direction finding facilities. Principal components of the LF range receiver are a range receiver, a control panel, a loop antenna control panel on O-1A aircraft, a loop antenna and a sense antenna. The loop antenna (figure 4-6) is located on top of the fuselage aft of the rear cockpit. The sense antenna (figure 4-6) is located on top of the fuselage from the top of the front cockpit to the top of the vertical stabilizer.

R-511 LF Control Panel

The LF control panel (figure 4-8) marked LF NAV or RANGE, is located in the front cockpit. The control panel controls consist of a power switch and sensitivity control marked OFF-SENS, a tuning crank, a frequency indicating dial marked MC, an antenna selector switch marked ANT-LOOP, a loop position indicating dial and a loop position crank. Rotating the OFF-SENS control clockwise turns the LF range receiver on and adjusts the sensitivity. Selection of the desired frequency is accomplished by rotating the tuning crank. This frequency will be indicated on the frequency indicating dial. Antenna selection is accomplished by positioning the ANT-LOOP switch as desired. Rotation of the loop antenna is accomplished by turning the loop position crank. Relative bearing of the transmitting station will be indicated on the loop position dial.

Operation

1. Electrical power - ON.
2. Circuit breaker - CHECK.
3. NAV switch - ON.
4. Power switch - ON (O-1A aircraft).
5. SENS-OFF control - ON. Rotate clockwise.
6. Antenna selector switch - ANT POSITION.
7. Tuning crank - ROTATE TO DESIRED FREQUENCY.
8. SENS-OFF control - ADJUST VOLUME TO DESIRED LEVEL.
9. Antenna selector switch - ANT POSITION.
10. Tuning crank - ROTATE TO DESIRED FREQUENCY.
11. SENS-OFF control - ADJUST VOLUME TO DESIRED LEVEL.
12. Antenna selector switch - LOOP POSITION.
13. Loop position crank - ROTATE. Rotate loop antenna for minimum signal.
14. Loop position indicator - READ RELATIVE BEARING OF TRANSMITTING STATION.
15. SENS-OFF control - OFF. Rotate counterclockwise.

Marker Beacon AN/ARN-12

The AN/ARN-12 is an airborne, pretuned, radio navigation aid receiver which receives an amplitude-modulated signal of 75.0 megahertz. The function of this receiver is to receive signals transmitted by a ground beacon transmitter and deliver an aural and visual indication of the receiver signal. Principal components of the marker beacon are a receiver, a volume control, an indicator light and an antenna. The receiver is a superheterodyne-type receiver. The antenna (figure 4-6) is located under the fuselage.

Marker Beacon Indicator Light and Volume Control

The indicator light and volume control (figure 1-6), marked MARKER BEACON, is located on the instrument panel. The indicator light is an amber, push-to-test type light which gives a visual indication of the received signal. The volume control, when rotated clockwise turns the set on and adjusts the volume to the desired level.

LIGHTING EQUIPMENT

All exterior and interior lights can be controlled from within the cockpit. All interior lights and the rotating beacon light are fed through a common push-to-reset circuit breaker (figure 1-7). The navigation and landing light circuits are fed through separate push-to-reset circuit breakers (figure 1-7). All lights in the aircraft draw their power from aircraft bus.

EXTERIOR LIGHTS

The exterior lights consist of two landing lights, three navigation lights and a rotating beacon. The landing lights are mounted in the leading edge of the left wing. The navigation lights consist of a red light on the left wing tip, a green light on the right wing tip and a white light on the lower trailing edge of the rudder. The rotating beacon, containing a large red lens, is mounted on the bottom of the fuselage slightly aft of the main landing gear.

INTERIOR LIGHTS

The interior lights consist of three ultraviolet fluorescent instrument lights, two map lights, a compass light, switch panel lights and radio control panel lights. The two forward instrument lights (figure 1-13) are mounted on the fuselage structure between the windshield and the pilot's windows, one on each side of the cabin directly below the student's window. These instrument lights are mounted on swivel-type brackets and may be turned to illuminate any area of the instrument panel. The front map light (figure 1-13) is located directly above and forward of the pilot's left window. The rear map light (figure 1-15) is located on the left rear window brace, over the seat. The map lights are equipped with red plastic filters and are mounted on swivel-type mounting brackets. The lights can be adjusted to shine in any direction or can be pulled from their stowage brackets and used as hand lights. The compass dial is illuminated by a compass light mounted in the compass (figure 1-6). Switch panel and radio control panel lights (figure 1-7) are mounted on the face of the panel.

LANDING LIGHT SWITCH

The landing light switch (figure 1-7) on O-1A aircraft, is located on the instrument panel. On O-1E, G and O-1F aircraft, the landing light switch (figure 1-7) is located on the switch and circuit breaker panel. The switch is marked LAND LIGHT and has two positions: ON and OFF. On O-1A aircraft, the switch is marked LAND LT. The switch receives power from the 28-volt dc bus and is protected by a circuit breaker (figure 1-7).

NAVIGATION LIGHTS SWITCH

The navigation lights switch (figure 1-7) is marked NAV LT and is located on the instrument panel on O-1A aircraft. On O-1E, G and F aircraft, the switch (figure 1-7) is marked NAV LIGHT and is located on the switch and circuit breaker panel. It has three positions: FLASH, OFF, and STEADY. The switch receives power from the 28 volt dc bus and is protected by a circuit breaker (figure 1-7).

ROTATING BEACON LIGHT SWITCH

The rotating beacon light switch (figure 1-7) on O-1A aircraft, is located on the instrument panel. On O-1E, G and F aircraft, the rotating beacon light switch (figure 1-7) is located on the switch and circuit breaker panel on the forward left side of the cabin. The switch is marked BEACON LIGHT and has two marked positions: ON and OFF. The switch receives power from the 28 volt dc bus and is protected by a circuit breaker (figure 1-7).

WARNING

The rotating beacon light should be turned off during flight through actual instrument conditions. With the light on during instrument conditions, the pilot could experience spatial disorientation as a result of the rotating reflections of the light against the clouds. In addition, the light would be ineffective as an anti-collision light during instrument conditions since it could not be observed by pilots of other aircraft.

INSTRUMENT LIGHT SWITCH

Rheostat switches (figure 1-13) are mounted directly below the light they control. The switch positions are (clockwise) OFF, DIM, ON and START. To turn an instrument light ON, turn the switch clockwise to START, then turn the switch counterclockwise to ON, or DIM, depending on the amount of illumination desired. To turn light off, move switch counterclockwise to OFF.

MAP LIGHT SWITCH

An integral, knob type switch is contained in each map light.

COMPASS, SWITCH PANEL, AND RADIO EDGE PANEL LIGHTS SWITCH

A rheostat switch (figure 1-7) is mounted on the switch panel and controls the compass light, switch panel lights and radio edge panel lights simultaneously. Clockwise rotation of the rheostat increases the intensity of the lights while counterclockwise rotation dims them. Rotating the rheostat to the full counterclockwise position turns the lights off.

COMPASS LIGHT RHEOSTAT SWITCH (O-1A AIRCRAFT)

A compass light rheostat switch (figure 1-7) is installed in the instrument panel to control the compass light. To turn the compass light on, rotate the switch clockwise until the desired illumination is attained. The switch receives power from the 28 volt dc bus and is protected by a circuit breaker (figure 1-7).

MISCELLANEOUS EQUIPMENT

ARMAMENT SYSTEM

The armament system incorporated on this aircraft is capable of delivering rockets and flares in various combinations. All rockets and flares are carried externally on two MA-4A bomb racks hung beneath each wing. The drag increase caused by this installation has a negligible effect on performance.

ARMAMENT CONTROLS TRIGGER SWITCH

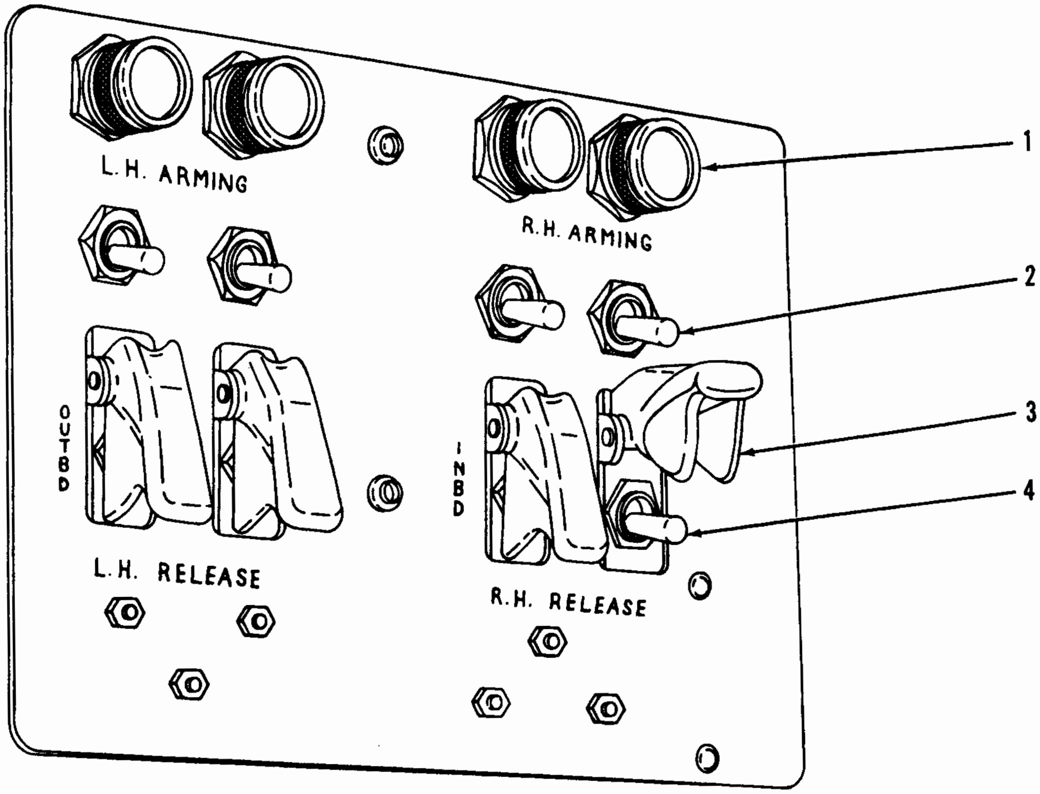
The control stick (front cockpit only) incorporates a trigger switch for firing rockets, and on aircraft not equipped with individual flare drop switches, dropping flares. Ordnance released is determined by placement of the armament selector switches. Use of the trigger switch in conjunction with the shackel arming switches also enables selective jettisoning of external stores. A trigger safety pin prevents travel of the switch in case it is depressed inadvertently.

MASTER ARMAMENT SWITCH (Some Aircraft)

A master armament switch, installed on the left side of the rear seat outboard of the throttle quadrant, controls the operation of all armament equipment. Unless this switch is on, no armament circuits can be energized except the emergency salvo circuit.

EMERGENCY SALVO BUTTON

The emergency salvo button is located on the instrument panel and is housed in a recessed mounting to prevent accidental release of external stores. Pressing the emergency salvo button causes all drop-load shackles to open simultaneously. The salvo circuit is wired directly to the battery, making



1. Shackle Indicator Lights
2. Shackle Arming Switches
3. Switch Guards
4. Shackle Selector Switch

Figure 4-9. Armament Switch Panel, Four-Shackle System (O-1A)

it possible to jettison all external stores by the use of the emergency salvo button at any time, regardless of the position of the battery and shackle selector switches. The emergency salvo button will jettison unarmed stores only.

ARMAMENT SYSTEM CIRCUIT BREAKER

A fifteen ampere circuit breaker located on the switch and circuit breaker panel protects the armament system from electrical overload. The position of this circuit breaker does not affect the operation of the Emergency Salvo circuit.

ARMAMENT SYSTEM (O-1A)

Switches mounted on the armament switch panel (figure 4-9) permits the selection and arming of any combination of loads to be dropped. This switch panel is mounted in the cabin ceiling adjacent to the left wing root. The selected loads are dropped when the control stick trigger switch is depressed. For emergency use, an emergency salvo button on the instrument panel jettisons all external stores simultaneously. The battery switch must be ON for normal operation of the armament system but the emergency salvo button is operative regardless of the battery switch position. The emergency salvo button will jettison unarmed stores only.

SHACKLE ARMING SWITCHES

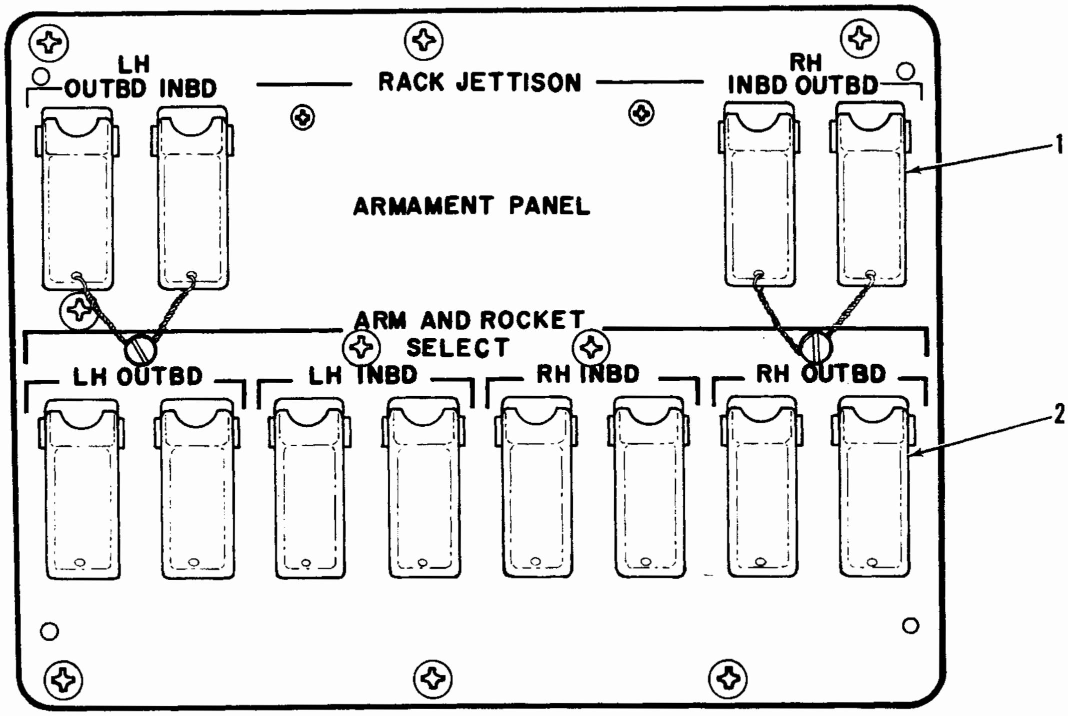
The four shackle arming switches, located just below the indicator lights on the armament switch panel, have two positions; ARM and SAFE. The ARM position operates the arming mechanism of the corresponding drop shackle.

SHACKLE SELECTOR SWITCHES

The shackle selector switches, located on the armament switch panel, are equipped with guards which make it impossible for the switches to be in the ON position with the guards closed. Placing the individual shackle selector switches in the ON position causes the shackles to release when the control stick trigger switch is depressed. With all shackle selector switches in the OFF position, the shackle releasing mechanism will not operate except through the use of the emergency salvo button.

SHACKLE INDICATOR LIGHTS

Four shackle indicator lights are located in a row at the top of the armament switch panel. These lights are wired in series with the individual shackles and illuminate when the shackles are loaded. When external stores are dropped, the lights go out.



1. Rack Jettison Switches
2. Shackle Selector Switch

Figure 4-10. Armament Switch Panel (O-1E, F and G)

NORMAL OPERATION OF THE ARMAMENT SYSTEM (O-1A)

1. Battery Switch - On.
2. If external stores are to be armed prior to release, place the respective shackle arming switches in the ARM position.
3. Select combination of loads to be dropped by placing respective shackle switches ON.
4. Depress control stick trigger switch to drop selected stores.

NOTE

Return the shackle selector and arming switches to the SAFE position after the stores are released to prevent useless operation of the release circuits in the event the trigger switch is depressed inadvertently in flight.

ARMAMENT SYSTEM (O-1E, F, G)

The Armament Switch Panel (figure 4-10) contains the Jettison, Selector, and Arming switches necessary to operate the MA-4A Bomb Rack, MA-2A Rocket Launcher, MK-24 Parachute Flare and MK-6 Target Flare Marker. The Armament Switch Panel operates in an "arming and selection" capacity only, with the desired armament function executed by depressing Control Stick Trigger Switch.

The two pair of red-guarded switches at the aft end of the panel are the "Rack Jettison" switches and are labeled "LH OUTBD, INBD and RH OUTBD, INBD." When the switch is placed in the "ON" position electrical power is routed to the appropriate bomb rack and to the Trigger Switch. Depressing the Trigger Switch provides power to open the bomb rack latches, releasing the rack loads. Four pair of red-guarded switches at the front of the panel correspond to the four Bomb Rack assemblies and are labeled as such. These are ARM & ROCKET SELECT switches and will be used for rocket firing and flare dropping. Specific procedures for each operation are as follows:

ROCKET FIRING

Since the inboard bomb racks are normally used to carry the rocket launchers, the four inboard ARM & ROCKET SELECT switches will be wired to their respective rocket launcher tubes. Placing the desired switch in the ON position selects the correct electrical circuit and provides power to the Trigger Switch. Depressing this switch provides electrical power to the correct rocket launcher tube to ignite the rocket motor.

CAUTION

Do not fire more than one rocket from the same wing simultaneously. Failure of the rocket motor folding fin assembly could cause the rockets to collide in dangerous proximity to the aircraft.

MK-24 OR MK-6 FLARE DROPS.

For flare drop operations, the MK-24 Parachute Flares or the MK-6 Target Marker Flares are singly installed on the outboard bomb rack assemblies (wing stations 1 and 4). A flare lanyard (arming) wire connects to the nose-arming solenoid of the bomb rack assembly, and provides the means for arming the flare after it is released from the bomb rack shackles. To drop & arm the flare proceed as follows: Place the appropriate RACK JETTISON switch ON, the corresponding outboard pair of ARM & ROCKET SELECT switches ON, and depress the Trigger Switch. With the switches positioned as described above, and the trigger switch depressed, two actions occur in the MA-4A Bomb Rack Assembly: The bomb rack shackles OPEN, allowing the flare to fall free and the nose arming solenoid engages, locking the arming wire to the bomb rack. The flare weight on the lanyard wire arms the flare, and the flare separates from the lanyard wire. When the ARMAMENT TRIGGER Switch is released the nose-arming solenoid dis-engages, allowing the lanyard wire to fall free of the aircraft. (Refer to Figure 4-11 for MK-24 flare drop and burn profile or Figure 4-12 for MK- flare release tables).

NOTE

To insure proper flare arming hold the trigger switch depressed approximately three seconds. An immediate trigger release could allow the flare to drop un-armed since the lanyard wire would not be locked to the bomb rack.

FUELING STEPS AND ASSIST HANDLE

To facilitate fueling, steps are provided on each wing strut and on each side of the fuselage front section. An assist handle is mounted at the lower juncture of the windshield center strip and the fuselage.

MOORING PROVISIONS

Three tie-down rings (figure 1-20) are provided, one on each wing strut and one on the tail wheel.

RETRACTABLE LIFT HANDLES

Two retractable lift handles (figure 1-20) are incorporated in the fuselage, one on each side just forward of the stabilizer, and are very useful for pushing the aircraft around on the ground. Each handle can be extended to a useable position by inserting a finger into the handle and pulling it outward as far as it will go. When not in use, the handles can be retracted flush with the fuselage by pushing them in.

MOVABLE WINDOW

Excluding the door, there are three movable windows in the cabin area. The window adjacent to the pilot on the left side of the aircraft is hinged at the top and opens out and up. To open this window, turn handle (figure 1-15) down until the window swings free. A retaining stud is mounted on the lower surface of the wing for securing the window in the open position. The rear side windows open in and up. To open the rear windows, turn the Dzus fastener in each window frame a half-turn counterclockwise. Two canvas straps hang from the cabin ceiling to hold these windows open. Both the rear windows may be open at the same time.

CAUTION

Do not exceed the maximum allowable speed when the rear windows are open. (See Section V.)

DATA CASE

A data case (figure 1-16) is installed on the right cabin wall immediately aft of the rear seat.

MAP AND FLIGHT REPORT CASE

A map case (figure 1-14) is located on the cabin door adjacent to the pilot.

STOWAGE COMPARTMENT

A stowage compartment is provided aft of the rear seat, measuring approximately 23 x 24 x 29 inches. If increased space is required, the rear seat, radio sets, and rear control stick are easily removed, and the rudder pedals can be folded flat on the floor. This provides a cargo compartment approximately 59 inches long.

WARNING

Improper loading of the stowage compartment may cause aft CG limit to be exceeded.

MINIMUM LAUNCHING HEIGHT (IN FT.) FOR FLARE BURN OUT AT 1000 FT.

EJECTION FUZE SETTING (SEC)	IGNITION FUZE SETTING (SEC)					
	0	10	15	20	25	30
	5	2550	2625	2700	2775	2850
	10	3275	3350	3425	3500	3575
	15	4175	4250	4325	4400	4475
	20	5175	5250	5325	5400	5475
	25	6175	6250	6325	6400	6475
	30	7175	7250	7325	7400	7475

DISTANCE OF FALL FOR FUZE SETTINGS PRIOR TO FLARE IGNITION (IN FT.)

EJECTION FUZE SETTING (SEC)	IGNITION FUZE SETTING (SEC)					
	0	10	15	20	25	30
	5	425	500	575	650	725
	10	1150	1225	1300	1375	1450
	15	2050	2125	2200	2275	2350
	20	3050	3125	3200	3275	3350
	25	4050	4125	4200	4275	4350
	30	5050	5125	5200	5275	5350

The following values were used in the preparation of this table:

1. Flare descent prior to suspension (5 sec. - 275 ft., 10 sec. - 1000 ft., 15 sec. - 1900 ft., 20 sec. - 2900 ft., 25 sec. - 3900 ft., 30 sec. - 4900 ft.)
2. Average values of fuze settings - (5, 10, 15, 20, 25, 30 sec)
3. Suspended flare descent, prior to ignition - 15 ft. per sec.
4. Average rate of flare descent, after ignition - 7.5 ft. per sec.
5. Flare burning time - 180 sec.
6. Burnout altitude - 1000 ft.

Figure 4-11. MK-24 Flare Drop and Burn Profile

DIVE ANGLE	ALT ABOVE TGT	TAS	BOMB RANGE	TIME OF FLIGHT	SLANT RANGE FROM REL	IMPACT ANGLE	WIND CORRECTION FACTORS		
							RANGE	CROSS DRIFT	CRAB
DEG	FT	KTS	FT	SEC	FT	DEG	FT/KNOT	FT/KNOT	
0	500	60	529	5.79	728	64	9.8	9.8	1.0
		80	694	5.83	856	58	9.8	9.8	1.2
		100	854	5.87	989	58	9.9	9.9	1.4
		120	1008	5.90	1125	48	10.0	10.0	1.6
0	1000	60	7.24	8.40	1234	73	14.2	14.2	2.1
		80	945	8.46	1376	68	14.3	14.3	2.5
		100	1156	8.52	1529	64	14.4	14.4	2.8
		120	1358	8.58	1686	61	14.5	14.5	3.2
0	1500	60	860	10.54	1729	77	17.8	17.8	3.4
		80	1120	10.61	1872	73	17.9	17.9	3.9
		100	1367	10.69	2029	70	18.0	18.0	4.4
		120	1601	10.77	2194	68	18.2	18.2	4.8
0	2000	60	967	12.45	2221	79	21.0	21.0	4.9
		80	1256	12.54	2362	77	21.2	21.2	5.5
		100	1530	12.63	2518	74	21.3	21.3	6.0
		120	1788	12.72	2683	72	21.5	21.5	6.6
0	2500	60	1053	14.23	2713	81	24.0	24.0	6.5
		80	1367	14.32	2849	79	24.2	24.2	7.1
		100	1662	14.43	3002	77	24.3	24.3	7.7
		120	1940	14.53	3165	75	24.5	24.5	8.4
0	3000	60	1126	15.92	3204	83	26.9	26.9	8.1
		80	1460	16.02	3336	81	27.0	27.0	8.8
		100	1773	16.13	3485	79	27.2	27.2	9.5
		120	2068	16.24	3644	78	27.4	27.4	10.2
0	3500	60	1188	17.55	3696	84	29.6	29.6	9.8
		80	1539	17.66	3823	82	29.8	29.8	10.6
		100	1868	17.77	3967	81	30.0	30.0	11.3
		120	2177	17.89	4122	80	30.2	30.2	12.1
0	4000	60	1241	19.13	4188	85	32.3	32.3	11.6
		80	1608	19.25	4311	83	32.5	32.5	12.4
		100	1951	19.37	4450	82	32.7	32.7	13.2
		120	2272	19.49	4600	81	32.9	32.9	14.0

Figure 4-12. Level Release Tables for MK-6 MOD 3 Flare Marker

SECTION V

OPERATING LIMITATIONS

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Aircraft not modified by T.O. 1L-1-525 are restricted to 2400 pounds maximum gross weight.

INTRODUCTION

Operating limitations are derived from extensive flight testing and operational experience. These limitations insure your safety and help to obtain maximum utility from the aircraft and its equipment. The instruments are marked as shown in figure 5-1 as a constant reminder of airspeed and engine limitations; however, additional limitations on operational procedures, acrobatics, and loading are given in the following paragraphs.

MINIMUM CREW REQUIREMENTS

The minimum crew required for this aircraft is one pilot in the front seat. An additional crew member, as required, will be added at the discretion of the Commander.

INSTRUMENT MARKINGS

Refer to figure 5-1 for details of instrument markings.

ENGINE LIMITATIONS

All normal engine limitations are shown in figure 5-1. The maximum allowable engine speed is 2600 RPM. When engine speed exceeds the operating limits, the reason for the overspeed (if known), the maximum RPM, and duration will be entered in Form 781. Overspeed between 3400 and 3600 RPM will necessitate an inspection of the engine before further flight. If engine speed exceeds 3600 RPM, the engine must be removed for overhaul.

PROPELLER LIMITATIONS

The maximum propeller speed is 2600 RPM.

AIRSPEED LIMITATIONS

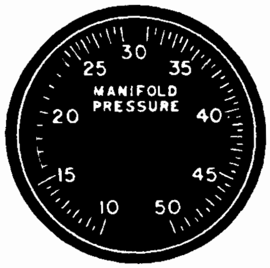
The indicated airspeed limitations listed below are based on the maximum gross weight of the aircraft.

Flaps up	
O-1A	155 KIAS (180 MPH)
O-1E and G	166 KIAS (192 MPH)
O-1F	166 KIAS (192 MPH)
Flaps down	
O-1A, E, F and G	88 KIAS (102 MPH)
Front side window open	
O-1A, E and G	105 KIAS (120 MPH)
O-1F	100 KIAS (115 MPH)
Rear side window open	
O-1A, E and G	125 KIAS (145 MPH)
O-1F	125 KIAS (145 MPH)
Maneuvering speed	
O-1A	103 KIAS (119 MPH)
Gross weights less than 2400 pounds:	
O-1E and G	116 KIAS (134 MPH)
O-1F	114 KIAS (131 MPH)
Gross weights between 2400 and 2800 pounds:	
O-1E, F and G	111 KIAS (128 MPH)

PROHIBITED MANEUVERS

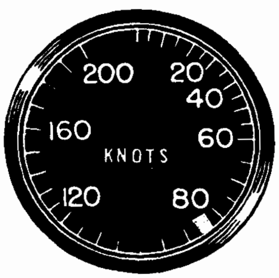
1. Intentional spins and over the top maneuvers are prohibited.
2. When gross weight exceeds 2100 pounds on O-1A aircraft, 2165 pounds on O-1E and G aircraft, and 2400 pounds on O-1F aircraft, all acrobatics are prohibited.

OPERATING LIMITATIONS BASED ON USE OF FUEL GRADE 115/145



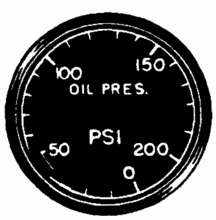
MANIFOLD PRESSURE O-1F AIRCRAFT

- 15 - 24 IN. HG CONTINUOUS OPERATION
- 24 IN. HG MAXIMUM CONTINUOUS (OPERATION ABOVE THIS PRESSURE LIMITED TO 5 MINUTES)
- 30 IN. MAXIMUM (LIMITED TO 5 MINUTES)



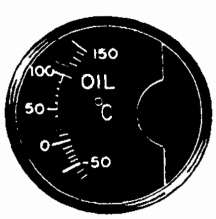
AIRSPEED INDICATOR

- 88 KN (102 MPH) FULL FLAPS
- 166 KN (192 MPH) MAXIMUM DIVING O-1E, F, AND G
- 155 KN (180 MPH) MAXIMUM DIVING O-1A



OIL PRESSURE

30 PSI	MINIMUM FOR FLIGHT
40-60 PSI	NORMAL
95 PSI	MAXIMUM

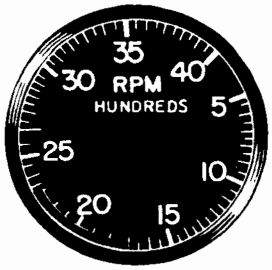


OIL TEMPERATURES

24°C	MINIMUM FOR FLIGHT
38° - 108°C	CONTINUOUS OPERATION
108°C	MAXIMUM

Figure 5-1. Instrument Markings (Sheet 1 of 2)

OPERATING LIMITATIONS BASED ON USE OF FUEL GRADE 115/145



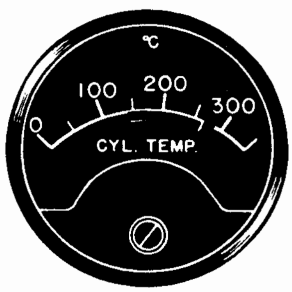
TACHOMETER

1600 - 2300 RPM CONTINUOUS OPERATION O-1A, E AND G

1800 - 2300 RPM CONTINUOUS OPERATION O-1F

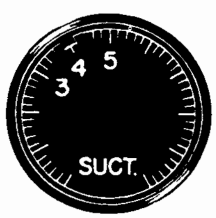
2300 RPM MAXIMUM CONTINUOUS (OPERATION ABOVE THIS RPM LIMITED TO 5 MINUTES)

2600 RPM MAXIMUM FOR TAKEOFF, O-1A, E, F AND G



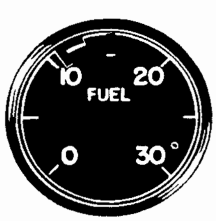
CYLINDER HEAD TEMPERATURE

149° - 274°C	CONTINUOUS OPERATION
274°C	MAXIMUM



SUCTION

3.75 IN. HG	MINIMUM FOR FLIGHT
3.75 - 4.25 IN. HG	CONTINUOUS OPERATION
4.25 IN. HG	MAXIMUM



FUEL PRESSURE

11 PSI	MINIMUM FOR FLIGHT
11-13 PSI	NORMAL
15 PSI	MAXIMUM

Figure 5-1. Instrument Markings (Sheet 2 of 2)

ACCELERATION LIMITATIONS

The maximum maneuvering load factors are as follows:

	Gross Weights Less than 2400 Pounds	Gross Weights Between 2400 and 2800 Pounds
Flaps up	4.4 G's	3.8 G's
Flaps down	3.5 G's	3.5 G's

CENTER-OF-GRAVITY LIMITATIONS

The aircraft recommended weight or cg limits can be exceeded by loading arrangements. Refer to Weight and Balance Data for weight control data.

WEIGHT LIMITATIONS (O-1A AIRCRAFT)

The maximum recommended gross weight of this aircraft is 2100 pounds. This weight consists of an aircraft fully serviced with fuel and oil and loaded with full crew and baggage or miscellaneous equipment necessary to bring the aircraft up to gross weight. At 2100 pounds gross weight, the aircraft is approved for flight load factors up to 4.4G's and landing load factors up to 4.0G's. The maximum gross weight for the seaplane configuration is 2400 pounds.

WEIGHT LIMITATIONS (O-1E AND G AIRCRAFT)

The maximum recommended gross weight of this aircraft for combat missions is 2165 pounds. This weight consists of an aircraft fully serviced with fuel and oil and loaded with full crew and no baggage. The maximum mission gross weight is 2400 pounds. This weight consists of an aircraft fully serviced with fuel and oil and loaded with full crew and baggage or miscellaneous equipment necessary to bring the aircraft up to gross weight. At 2400 pounds gross weight, the aircraft may be operated for flight load factors up to 4.4G's and landing load factors up to 4.0G's. The maximum gross weight for the seaplane configuration is also 2400 pounds.

WEIGHT LIMITATIONS (O-1F AIRCRAFT)

The maximum gross weight of this aircraft is 2400 pounds. This weight consists of an aircraft fully serviced with fuel and oil and loaded with full crew. At 2400 pounds gross weight, the aircraft is approved for load factors up to 4.4G's.

WEIGHT LIMITATIONS (O-1E, F AND G AIRCRAFT MODIFIED BY T.O. 1L-1-525.

The maximum gross weight of these modified aircraft is 2800 pounds. This weight consists of an aircraft fully serviced with fuel and oil and loaded with full crew and baggage or miscellaneous equipment necessary to bring the aircraft up to gross weight. At gross weights between 2400 and 2800 pounds, the aircraft may be operated at flight load factors up to 3.8G's. At gross weights below 2400 pounds, the flight load factor will be 4.4G's. During two point or three point landings, the maximum load factors are 3.5 and 4.2G's resepctively. When any of the modified aircraft are operated between 2400 and 2800 pounds gross weight, they will be normal category aircraft.

SECTION VI

FLIGHT CHARACTERISTICS

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MANEUVERING FLIGHT

All control forces are normal, requiring only gentle pressure to execute any maneuver. Stability around all axis is excellent. Control is positive down to a very low speed.

STALLS

NORMAL STALL CHARACTERISTICS

The normal stall characteristics of the aircraft are conventional and very mild. Stall warning is characterized by loss in effectiveness of the controls (large increases in control movements required) and increasing elevator stick force. The aircraft pitch is very gentle when stall occurs, with very little tendency to roll providing the wings are level upon entry. Slight elevator buffeting may occur just before and after the stall with flaps down.

NOTE

Wing flaps have little effect on stall characteristics.

ACCELERATED STALL CHARACTERISTICS

Stalls in accelerated flight are characterized by heavy, low frequency, longitudinal buffeting that provides unmistakable warning to the pilot. Structural limitations of the aircraft will be exceeded if accelerated stalls are performed above the maneuvering speed, see Section V, Operating Limitations.

PRACTICE STALLS

Practice stalls should include power-on and power-off stalls in straight and turning flight with recovery initiated both prior to and following the downward pitch of the nose. Retard throttle smoothly for power-off stalls; use low cruise power settings for power-on stalls. With power off, the aircraft may be stalled in an approximate landing attitude with no roll or yaw tendency, providing the wings are level upon entry. With power on, the aircraft is normally stalled with the nose about 40 degrees above the horizon. Characteristics of the power-on stall are identical with those of the power-off stall, except for an increase in pitching motion and yaw.

NOTE

Practice stalls will be accomplished at an altitude that will permit recovery no lower than 1500 ft. above terrain.

STALL SPEEDS

See figure 6-1 for stall speeds.

STALL RECOVERY

The intended mission of this aircraft dictates slow flight, approach, and climb-out speeds that are very close to actual stalling speeds and for these reasons the stall recovery should be made with a minimum loss in altitude. The aircraft can readily be flown out of the stall in nearly the same attitude as that at stall by using a slight amount of forward stick with throttle required to accelerate the aircraft in level flight. Raise wing flaps slowly as aircraft accelerates. An excessive amount of altitude will be lost if the stick is moved quickly forward in an attempt to dive the aircraft to regain flying speed.

WARNING

Back pressure on the control stick must be released before applying full throttle to prevent the aircraft rolling violently to the left. The higher the degree of flap setting the more violent the roll.

SPINS

1. Intentional spins are prohibited. However, in the event an unintentional spin is entered, the aircraft will not exhibit any dangerous spin characteristics when spun in the clean, power-off configuration. The spins are very mild, except for the rapid rate of rotation. Altitude lost per turn is approximately 200 to 300 feet. The rate of descent is approximately 125 feet per second.

SPIN RECOVERY

Spin recovery is accomplished by reversing the rudder immediately; after one-half turn, return elevator briskly to approximately neutral; hold ailerons neutral throughout the entire recovery procedure. After rotation ceases, return rudder to neutral. All control forces are light to moderate during recovery. The aircraft recovers rapidly and shows no tendency to spin in the opposite direction. Altitude required for pullout after rotation is approximately 300 to 400 feet.

FLIGHT CONTROL FORCES

Aileron, rudder, and elevator control forces are moderately light in all configurations. Elevator stick forces are somewhat less for the 60 degrees flap deflection and rear center of gravity loading combination. Elevator trim is effective throughout the range of flight speeds. With full flaps, nosedown trim may be used in gliding flight to increase elevator effectiveness for the landing flareout. The rate of retraction of the wing flaps with the electric motor provides smooth transition from the takeoff to the climb configuration.

DIVING

Dives shall be limited to the maximum diving airspeed marked on the airspeed indicator. Recovery from any dive should be made gradually, since the structural load on the aircraft increases in direct relation to abruptness of pullout.

FLIGHT WITH EXTERNAL LOADS

No special technique is required for flying the aircraft with external loads.

KIAS
(MPH - IAS)

CONFIGURATION	0 DEGREES FLAPS - POWER OFF										
GROSS WEIGHT (LBS)	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800
LEVEL FLIGHT	44.8 (51.6)	46.1 (53.1)	47.0 (54.1)	47.6 (54.8)	48.0 (55.2)	48.3 (55.6)	49.1 (56.5)	50.1 (57.7)	51.0 (58.7)	51.8 (59.6)	52.2 (60.1)
20 DEGREE BANK	46.8 (53.9)	48.2 (55.5)	49.4 (56.9)	50.0 (57.6)	50.4 (58.0)	51.1 (58.8)	51.6 (59.4)	52.4 (60.3)	53.1 (61.1)	54.1 (62.3)	54.7 (63.0)
40 DEGREE BANK	54.0 (62.2)	55.1 (63.4)	56.2 (64.7)	57.0 (65.6)	57.7 (66.4)	59.0 (67.9)	59.2 (68.1)	60.1 (69.2)	61.1 (70.3)	62.0 (71.4)	63.0 (72.5)
60 DEGREE BANK	68.3 (78.6)	69.5 (78.0)	70.7 (81.4)	72.0 (80.0)	73.3 (84.4)	74.6 (85.9)	75.8 (87.2)	76.7 (88.3)	78.0 (89.8)	79.1 (91.0)	80.0 (92.1)

CONFIGURATION	30 AND 60 DEGREES FLAPS - POWER OFF										
GROSS WEIGHT (LBS)	1800	1900	2000	2100	[illegible]00	2300	2400	2500	2600	2700	2800
LEVEL FLIGHT	40.6 (46.7)	41.5 (47.8)	42.6 (49.0)	42.8 (49.3)	43.1 (49.6)	44.0 (50.6)	44.6 (51.3)	45.3 (52.1)	46.3 (53.3)	47.1 (54.2)	47.5 (54.7)
20 DEGREE BANK	42.6 (49.0)	43.5 (50.1)	44.6 (51.3)	45.0 (51.8)	45.2 (52.0)	46.0 (52.9)	47.2 (54.3)	47.7 (54.9)	48.5 (55.8)	49.4 (56.9)	49.8 (57.3)
40 DEGREE BANK	49.2 (56.6)	50.0 (57.6)	51.2 (58.9)	51.6 (59.4)	52.4 (60.3)	53.4 (61.5)	54.1 (62.3)	54.9 (63.2)	55.8 (64.2)	56.5 (65.0)	57.1 (65.7)
60 DEGREE BANK	62.3 (72.3)	63.6 (73.2)	64.9 (74.7)	65.9 (75.9)	66.8 (76.9)	67.8 (78.0)	69.0 (79.4)	70.3 (80.9)	71.5 (82.3)	72.6 (83.6)	73.5 (84.6)

Figure 6-1. Stall Speeds (All O-1 Aircraft)

SECTION VII

SYSTEMS OPERATION

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INTRODUCTION

This section presents additional material on the operation of various aircraft systems to supplement or amplify information given in Section II.

ENGINES

The carburetor is not equipped with an automatic mixture control to lean the mixture as altitude is changed. To achieve the level of flight performance shown in the range charts in the Appendix, the mixture must be leaned. DO NOT lean mixture above 2300 RPM for the O-1A, E and G aircraft and DO NOT lean mixture above 24 inches of manifold pressure, 2300 RPM for the O-1F aircraft.

The procedure for leaning the mixture on O-1A, E and G aircraft is to retard the mixture control lever until there is a slight drop in RPM. Normally a slight rise will register just prior to the decrease. Enrich the mixture back to the point where the RPM stabilizes. Any change in power or altitude will require a change in the lean mixture setting.

The procedure for leaning the mixture on O-1F aircraft is to retard the mixture control lever until a slight engine roughness is detected. Enrich the mixture until smooth engine operation is restored; this is approximately the best power mixture setting.

WARNING

If the engine should suddenly start running rough, indicating too rich a mixture, rapidly move the mixture control through its full range of travel several times. Occasionally, dirt may become lodged under the mixture control poppet valve in the carburetor causing an excessively rich mixture to result. Fore and aft movement of the mixture control should dislodge this dirt and restore normal engine operation.

SPARK PLUG FOULING

Spark plug fouling is a principle cause of ignition trouble. Fouling is an accumulation of deposits which cause misfiring or shorting across the spark plug electrodes. The most common types of fouling are lead and carbon fouling with lead fouling the main problem. Prevention is the best method of resolving the problem.

SPARK PLUG FOULING DUE TO GROUND OPERATION

Lead fouling may be residual from a previous flight. Carbon fouling is usually due to prolonged ground operation at idle, particularly when the idle mixture is excessively rich. Excess carbon from the rich mixture plus engine oil in the combustion tends to build up as fouling deposits. The symptoms of such fouling usually include excessive RPM drop during ignition check.

PREVENTION OF SPARK PLUG FOULING DURING GROUND OPERATION

Whenever possible, avoid prolonged or unnecessary ground operation. The idle mixture should be adjusted to the best power mixture at the idle speed commonly used for ground operation. There is a tendency for the mixture to enrich as the RPM increases and excessively rich idling mixture is the most common cause of carbon fouling.

NOTE

After each 10 minutes of ground operation the engine should be runup to full throttle for one minute.

IN FLIGHT SPARK PLUG FOULING

Cruise conditions usually generate lead fouling rather than carbon fouling. Conditions favorable to lead fouling include: long continued engine operation during certain conditions typical of cruise flight, such as lean mixture, cool cylinder head temperature, and low power.

PREVENTION OF SPARK PLUG FOULING DURING FLIGHT

A periodic change in engine conditions will usually prevent lead fouling. To prevent fouling of spark plugs in flight, the engine should be cleared every hour of cruise flight by increasing the cruise setting 200 to 300 RPM for 1 to 2 minutes with full rich mixture.

NOTE

During power-off descents where the engine is subjected to closed throttle operation and low temperatures, spark plug fouling and induction system fuel loading are possible. To clear the engine, apply carburetor heat and advance the throttle to 3/4 open position every 30 seconds (for 10 to 15 seconds) during descent.

SPARK PLUG DEFOULING PROCEDURE FOR GROUND OPERATION

The following procedure is to be utilized if suspected spark plug fouling occurs during ground operation.

1. RPM - 2000.
2. Mixture - Lean for a 100 RPM Drop.
3. Operate the engine in this manner for a minimum of one minute.
4. Mixture - Rich.
5. RPM - 1700.
6. Ignition System - Check.

SECTION VIII

CREW DUTIES

SECTION VIII, CREW DUTIES, IS NOT APPLICABLE
TO THE O-1 AIRCRAFT.

SECTION IX

ALL WEATHER OPERATIONS

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INTRODUCTION

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather and climatic conditions that may be encountered in flight. With the exception of some possible repetition of text necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ from, or are in addition to, the normal operating procedures found in Section II.

NIGHT FLYING

Be thoroughly familiar with the lighting equipment of the aircraft, know the location of all switches in the cockpit. Before a night takeoff, check all lights for proper operation. Leave the navigation and required cockpit lights on. During night weather flight, place the navigation lights switch in the STEADY position and place the rotating beacon light switch in the OFF position to prevent any distraction created by cloud reflections. To penetrate an electrical storm by night, turn the cabin lights on to full bright after removing the red filters. This will prevent a momentary blindness from lightning. During normal VFR flight, unfiltered lights should be used sparingly.

WARNING

When making VFR takeoffs in areas of limited horizon references, reference to the flight instruments is recommended to avoid flying back to the ground after takeoff.

INSTRUMENT FLIGHT PROCEDURES

Although this aircraft is adequately equipped for instrument flight, it is not designed for complete all weather operation. The lack of de-icing equipment imposes a serious handicap when flying in precipitation. Other limitations are the light wing loading which makes control more difficult in severe turbulence, a lack of alternate sources of vacuum and electrical power for gyro instruments and radio equipment, and insufficient radio frequencies for safe operation in dense traffic areas. Sustained operation under instrument flight conditions is not recommended since the aircraft is equipped with limited navigation facilities. If flight under instrument conditions is required, the weather should be free of precipitation, heavy turbulence, and thunderstorm activity.

WARNING

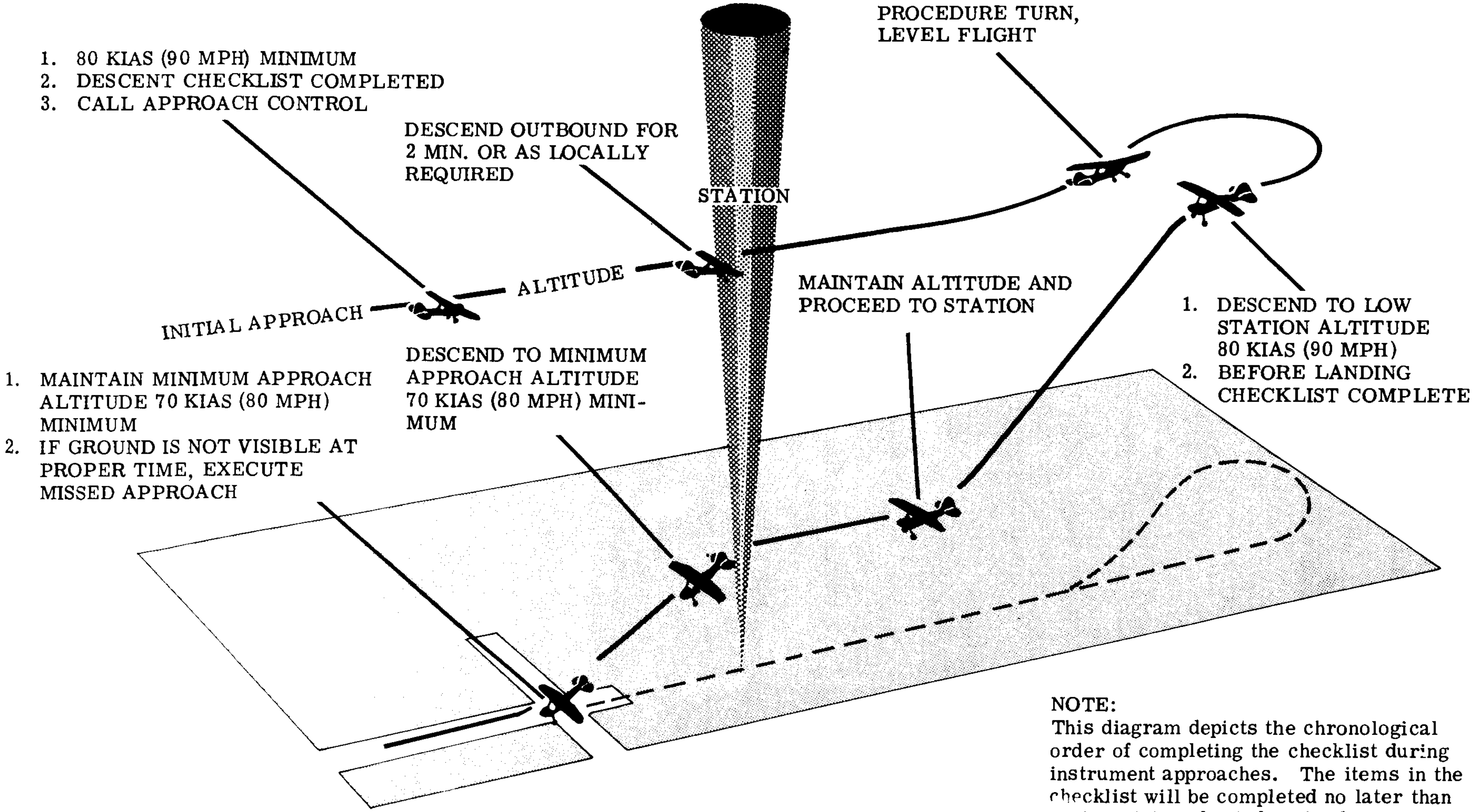
Rotating beacon light should be turned off during flight through actual instrument conditions. With light on during instrument conditions, pilot could experience spatial disorientation as a result of rotating reflections of light against clouds. In addition, the light would be ineffective as an anti-collision light, since it could not be observed by pilots of other aircraft.

INSTRUMENT TAKEOFF

Maintain directional control by visual reference as long as possible. Gradually bring the heading indicator into the crosscheck as visual references are lost. As the elevators become effective, relax back pressure on the control stick and maintain a constant attitude on the attitude indicator until lift-off. Maintain a positive rate of climb and accelerate to normal climb speed.

INSTRUMENT CLIMB

Normal climb procedures and power settings are given in Section II. Climbing turns may be safely executed with as much as 30 degrees bank angle above 1000 feet.



NOTE:
This diagram depicts the chronological order of completing the checklist during instrument approaches. The items in the checklist will be completed no later than the points indicated in the diagram but does not preclude a pilot from accomplishing them at an earlier time.

Figure 9-1. Typical ADF Approach

INSTRUMENT CRUISING FLIGHT

The aircraft has satisfactory instrument characteristics at normal cruising speed. Fatigue can be decreased during long flights in smooth air by maintaining headings through rudder action alone. The excellent longitudinal and lateral stability of the aircraft make control stick attention unnecessary unless the air is turbulent.

RADIO AND NAVIGATION EQUIPMENT

The radio equipment in the aircraft is normally reliable; however, a continuous cross check of all radio and navigational equipment in flight will insure safe operation in the event of failure of one piece of equipment.

DESCENT

Normal enroute descents or radar controlled descents to traffic pattern altitude are made with wing flaps up at 80 KIAS (90 MPH) minimum using 1800 RPM and manifold pressure as required to maintain the desired rate of descent. A maximum rate of descent of 1000 feet per minute is obtained at 80 KIAS (90 MPH) with wing flaps up and power off. Flight characteristics are conventional in descents with any combination of power and airspeed in the normal operating range. Limit banks to 15 degrees if rate of descent is more than 500 feet per minute.

HOLDING

Holding in this aircraft normally presents no problem concerning fuel consumption regardless of altitude; however, holding at low airspeeds may present a problem if the winds are strong at holding altitude. Enter the holding pattern and maintain recommended instrument cruising airspeed of 80 KIAS (90 MPH) minimum unless there is considerable delay or the fuel reserve is low, then reduce power to maximum range.

INSTRUMENT APPROACHES

Preparations for instrument approaches should include a thorough study of approach charts and obstacles in the letdown area; determination of the rate of descent required at 80 KIAS (90 MPH); follow the prescribed glide path into the field; selection of a minimum altitude; and a study of the go-around procedure. In addition, all instruments and radio equipment should be carefully checked for proper operation. Accomplish Before Landing Checklist.

COLD WEATHER PROCEDURES

The success of low temperature operation depends primarily upon the preparations made during the post flight inspection in anticipation of the requirements for operation on the following day. In order to expedite preflight inspection and insure satisfactory operation for the next flight, normal operating procedures outlined in Section II should be adhered to with the following additions and exceptions.

BEFORE ENTERING THE AIRCRAFT

1. Remove protective cover from cabin and pitot head.
2. Remove snow and ice from control surfaces, wings, control hinges, fuel tank vents, pitot static sources, and auxiliary fuel pump drain opening.
3. Perform exterior inspection outlined in Section II.
4. Preheat engine compartment by using portable ground heater with engine cover in place.
5. Fill oil tank with preheated oil to which 1 quart of gasoline has been added.
6. Remove engine cover.
7. With ignition switch OFF, pull propeller through several revolutions by hand.

ON ENTERING THE AIRCRAFT

Actuate controls through a complete cycle of movement to ascertain that there are no obstructions and particularly to find if any controls are frozen. To conserve the battery, use external power to operate all electrical and radio equipment and perform interior inspection. Refer to Section II.

BEFORE STARTING ENGINE

Refer to Section V for normal engine operating limitations.

STARTING ENGINE

1. Set all controls as for normal start.
2. Battery switch - OFF.

CAUTION

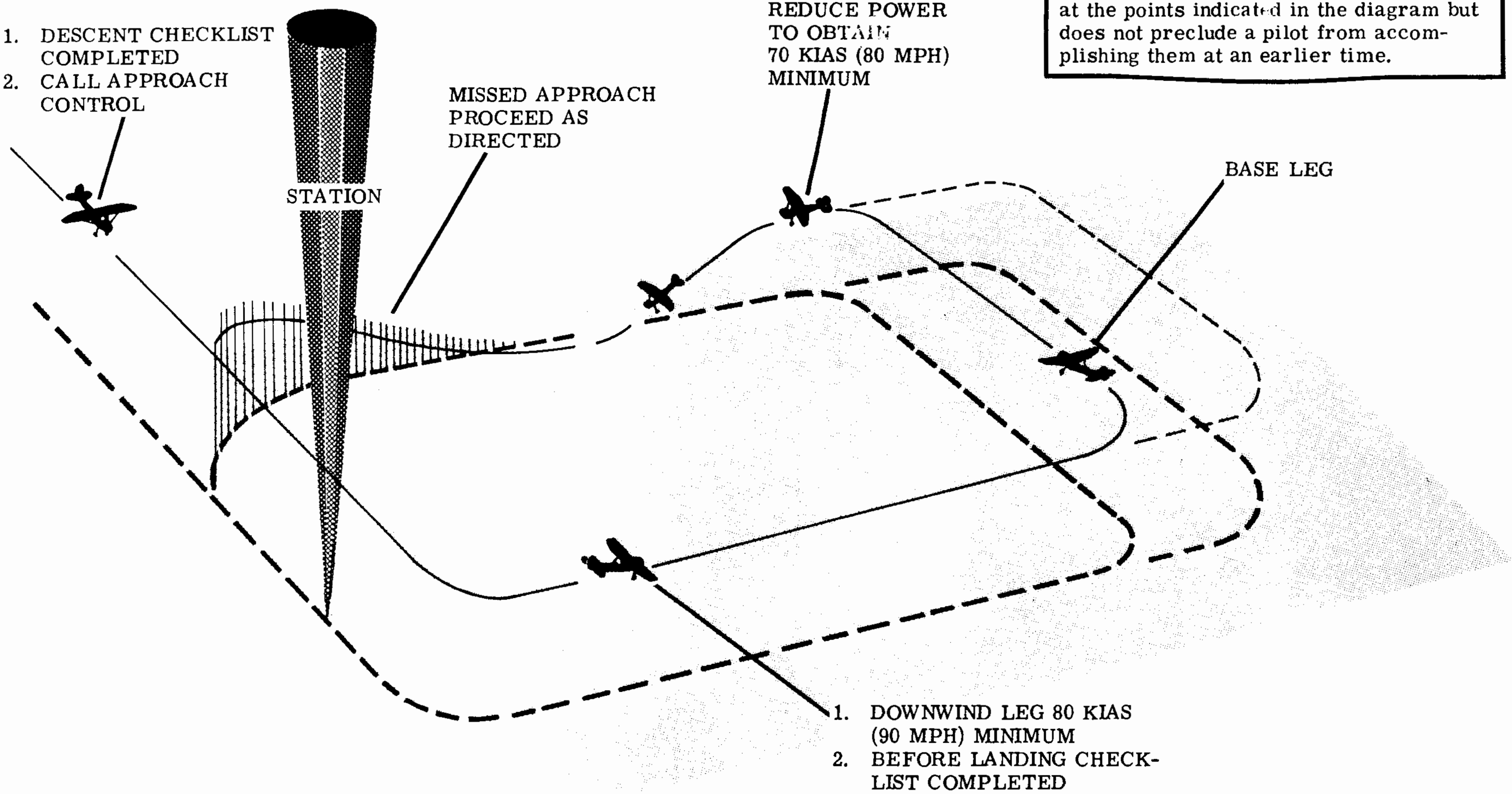
Battery switch must be OFF when using external power as damage to the battery will result.

3. External power source - CONNECTED.
4. Mixture control lever - RICH.
5. Auxiliary fuel pump switch - ON.
6. Ignition switch - BOTH.
7. Prime as required.
8. Starter button - PRESS.
9. Continue to prime until engine runs smoothly.
10. Auxiliary fuel pump switch - OFF (WHEN ENGINE RUNS SMOOTHLY).
11. Carburetor air control lever - ALTERNATE AIR (HEAT) position. Leave in this position for warm-up period.
12. After engine is running, cabin heater may be used for cabin heating and windshield defrosting as required.
13. Auxiliary power source - DISCONNECT.
14. Battery switch - ON.

NOTE

Use utmost care to avoid engine stoppage as this will cause moisture to condense on spark plug points, making a restart difficult.

NOTE:
This diagram depicts the chronological order of completing the checklist during instrument approaches. The items in the checklist will be completed no later than at the points indicated in the diagram but does not preclude a pilot from accomplishing them at an earlier time.



NOTE

RADAR APPROACHES DURING HEAVY PRECIPITATION PRESENT SOME DIFFICULTY FOR RADAR OPERATORS TO KEEP THE AIRCRAFT VISIBLE BECAUSE OF THE PRECIPITATION CLUTTER ON THE RADAR SCOPE. THIS MAY REQUIRE THE EXECUTION OF A MISSED APPROACH.

Figure 9-2. Typical Radar Approach

WARM-UP AND GROUND TESTS

Maintain engine RPM between 800 and 1000 RPM until engine accelerates smoothly and oil pressure remains steady as throttle is advanced.

TAXIING INSTRUCTIONS

Avoid taxiing in deep snow, as taxiing and steering are extremely difficult and frozen brakes are likely to result. The wheels should be visually checked to make sure they are turning. Use only essential electrical equipment to preserve battery life while taxiing at low engine speeds. Increase space between aircraft while taxiing to provide safe stopping distance. Taxi speed should be reduced when taxiing on slippery surfaces to avoid skidding. Keep control stick back when taxiing through snow. Taxiing in a strong crosswind on ice is not recommended.

WARNING

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

BEFORE TAKEOFF

Refer to the Before Takeoff Procedure in Section II.

TAKEOFF

Carburetor heat may be used as required during takeoff.

WARNING

Do not take off if there is any frost on the wings, because this condition reduces the wing lift and affects the stalling characteristics of the aircraft.

AFTER TAKEOFF

If takeoff from a snow- or slush-covered field is made, the brakes should be operated several times to expel wet snow or slush and during VFR conditions the wing flaps should be operated through several cycles to prevent their freezing in the retracted position. If takeoff is made under IFR conditions, delay raising the wing flaps to allow as much slush and water to drain off as possible.

CAUTION

Do not exceed the wing flaps-down limit airspeed during this operation.

CLIMB

Climb performance will be improved during cold weather operation at low altitude.

DURING FLIGHT

Under extreme conditions, carburetor icing might occur. This will be indicated by an unaccountable drop in RPM on the O-1A, E and G aircraft, and a drop in manifold pressure on the O-1F aircraft. Operation of the carburetor air control lever provides a heated air source.

CAUTION

The carburetor air control lever should not be positioned to any intermediate position.

On O-1F aircraft, under extreme conditions, exercise the propeller control lever between INCREASE RPM and DECREASE RPM positions periodically to cycle the oil in the propeller housing. This will prevent the propeller from becoming inoperative due to oil congealing in the propeller housing.

DESCENT

Use power in letdowns to maintain proper engine temperatures. Alternate air may be used if engine roughness develops during the letdown, and the mixture control lever should be in the RICH position.

LANDING

Avoid landing in snow unless the depth and conditions of the snow are known. After landing, apply brakes intermittently and carefully.

ENGINE SHUTDOWN

Refer to Section II for engine shutdown procedures.

BEFORE LEAVING THE AIRCRAFT

1. Carburetor air control lever - RAM FILTERED AIR.
2. When parking aircraft on snow or ice, always place a layer of fabric, straw, or other insulation under the wheels to keep them from freezing to the surface.
3. Control lock - UNLOCKED. (This keeps brakes from freezing.)
4. Chock wheels and secure aileron, elevators, and rudder with external locks.
5. Drain fuel drains of condensate.
6. Inspect fuel and oil vents and remove ice.
7. Clean dirt and ice from brake discs.
8. Drain oil.
9. Fill fuel tanks to avoid condensation in tanks.
10. If the engine is expected to be idle for several days, the battery should be removed.

CAUTION

Battery should be kept fully charged at all times in cold climates.

11. Install protective covers.

CAUTION

When installing cabin cover, avoid scratching the plexiglas with metal fasteners on the cover or with other hard objects.

ICE, SNOW AND RAIN

A takeoff shall not be attempted if the aircraft is covered with frost, sleet, or snow because the takeoff distance would be greatly increased. Because of the lack of anti- or deicing equipment, ice will normally adhere to the leading edge of wings, empennage, struts, propeller, antennas, and the windshield; however, the windshield defrosters will partially remove windshield ice during light icing conditions. Flight controls become sluggish, and the cruising speed is decreased as ice is accumulated. If icing conditions cannot be avoided, turn the pitot heat switch ON and move the carburetor air control lever to ALTERNATE AIR (HEAT) position.

NOTE

Icing within the carburetor might occur. If so, it will be indicated by an unaccountable drop in RPM on O-1A, E and G aircraft and a drop in manifold pressure on O-1F aircraft. Placing the carburetor air control lever in the ALTERNATE AIR (HEAT) position provides filtered warm air from the engine compartment. If use of carburetor heat does not have desired effect, refer to Carburetor Failure, Section III.

If rough engine operation persists due to propeller ice, increase and decrease engine RPM to attempt to remove some of the ice. During flight, ice may accumulate between the outboard portion of the stabilizer and the overhanging aerodynamic balance of the elevator. This accumulation will restrict normal elevator operation if left undisturbed; therefore, occasional abrupt fore and aft movements of the elevator control should be made. Descend or climb to a warmer altitude if possible. If a landing is to be made with ice on the aircraft, make a power on approach at a higher than normal airspeed.

WARNING

The stalling speed will be increased due to frost or icing.

No special precautions are required during flight in rain or snow other than keeping constantly alert for icing conditions and remembering that visibility is reduced considerable. If a landing is to be made on a field covered in spots by water, or if soft sod is suspected, a full stall tail-low landing should be made to preclude the possibility of nosing over. A tail-low takeoff should also be made when these conditions exist.

DESERT AND HOT WEATHER PROCEDURES

Hot weather and desert procedures differ from normal procedures mainly in that added precautions must be taken to protect the aircraft from damage due to high temperature and dust. Particular care should be taken to prevent the entrance of sand into the various aircraft parts and systems (engine, fuel system, pitot-static system, etc). All filters should be checked more frequently than under normal conditions. Units incorporating plastic or rubber parts should be protected as much as possible from windblown sand and excessive temperatures. Tires should be checked frequently for blistering, cracking, and proper inflation.

TURBULENCE AND THUNDERSTORMS

Flight in thunderstorms or areas of known heavy turbulence will be avoided. If significant turbulence is unavoidable recommended IAS is 1.5 x power off stall speed. Proximity to thunderstorm activity is evidenced by intensity of radio crash static and presence of advanced cumulus buildups and lightning. If a landing must be made in an area of thunderstorm activity, high gusty surface winds should be anticipated.

HEAVY PRECIPITATION/TURBULENT AREA PENETRATION

1. Mixture control lever - RICH.
2. Pitot heat switch - ON.
3. Carburetor air control lever - AS REQUIRED.
4. Throttle - ADJUST. Adjust as necessary to obtain penetration speed.
5. Directional and attitude indicators - SET.
6. All loose equipment - SECURED.
7. Safety belt - TIGHTENED.
8. Shoulder harness inertia reel lock lever - LOCKED.
9. Turn off any radio equipment rendered useless by static.
10. At night, turn cabin lights full bright after removing red filters to minimize blinding if lightning is present.

APPENDIX

I AND II

Performance Data

The appendix is divided into two Sections, Appendix I covering the O-1A, E and G aircraft and Appendix II covering the O-1F aircraft. Each appendix is divided into eight parts to present performance data in proper sequence for preflight planning. Sample problems and discussions are given in Appendix I and Appendix II. Reduction in performance due to installation of external stores described in Section IV is negligible.

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APPENDIX I

Performance Data
O-1A, E, and G Aircraft

The appendix is divided into eight parts which are presented in proper sequence for preflight planning. Discussions and sample problems are given in each part.

PART I INTRODUCTION

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INTRODUCTION

The information in this appendix provides the pilot with performance data for all flight conditions and shows how to obtain the maximum performance from the aircraft. By utilizing the data in this appendix, each mission can be flown in an efficient manner with ample margin of safety. By using the recommended powers and airspeeds a greater distance can be covered at better cruising speed and with more reserve fuel at the destination. A careful study of each part will show the extensive range of operating conditions included and the potential usefulness of the charts. Power is the same for the aircraft using the 115/145 grade fuel as it is using 80/87 grade.

DENSITY ALTITUDE CHART

The Density Altitude Chart (figure A1-1) expresses density altitude in terms of pressure altitude and temperature. A conversion factor is provided to obtain true airspeed from calibrated airspeed by correcting for density altitude.

SAMPLE PROBLEM (figure A1-1)

Pressure altitude 5000 feet, air temperature -5°C.

A. Enter chart at -5°C.
B. Proceed vertically to 5000 pressure altitude.
C. Proceed horizontally right to read $\frac{1}{\sqrt{\sigma}}$, 1.06.
D. Proceed horizontally left to read density altitude; 4000 feet.

AIRSPEED POSITION CORRECTION

An airspeed position correction chart (figure A1-2) shows position error as a function of airspeed for flap configurations of 0° and 30-60°. In using the chart, the position error is added to the indicated airspeed (corrected for instrument error) to obtain calibrated airspeed (CAS). With this value of CAS and the free air temperature at a given pressure altitude, the true airspeed (TAS) can be found by means of an airspeed computer, dead reckoning computer or by multiplying the CAS by the factor found from the Density Altitude Chart.

SAMPLE PROBLEM (figure A1-2)

Gross weight 2800 pounds flaps up and indicated airspeed 72 knots (IAS corrected for instrument error).

A. Enter chart at 72 knots.
B. Proceed vertically up to gross weight reference line.
C. Proceed horizontally left to airspeed correction; +2.7 knots.

Calibrated airspeed = 72 knots +2.7 knots = 74.7 KCAS.

DENSITY ALTITUDE

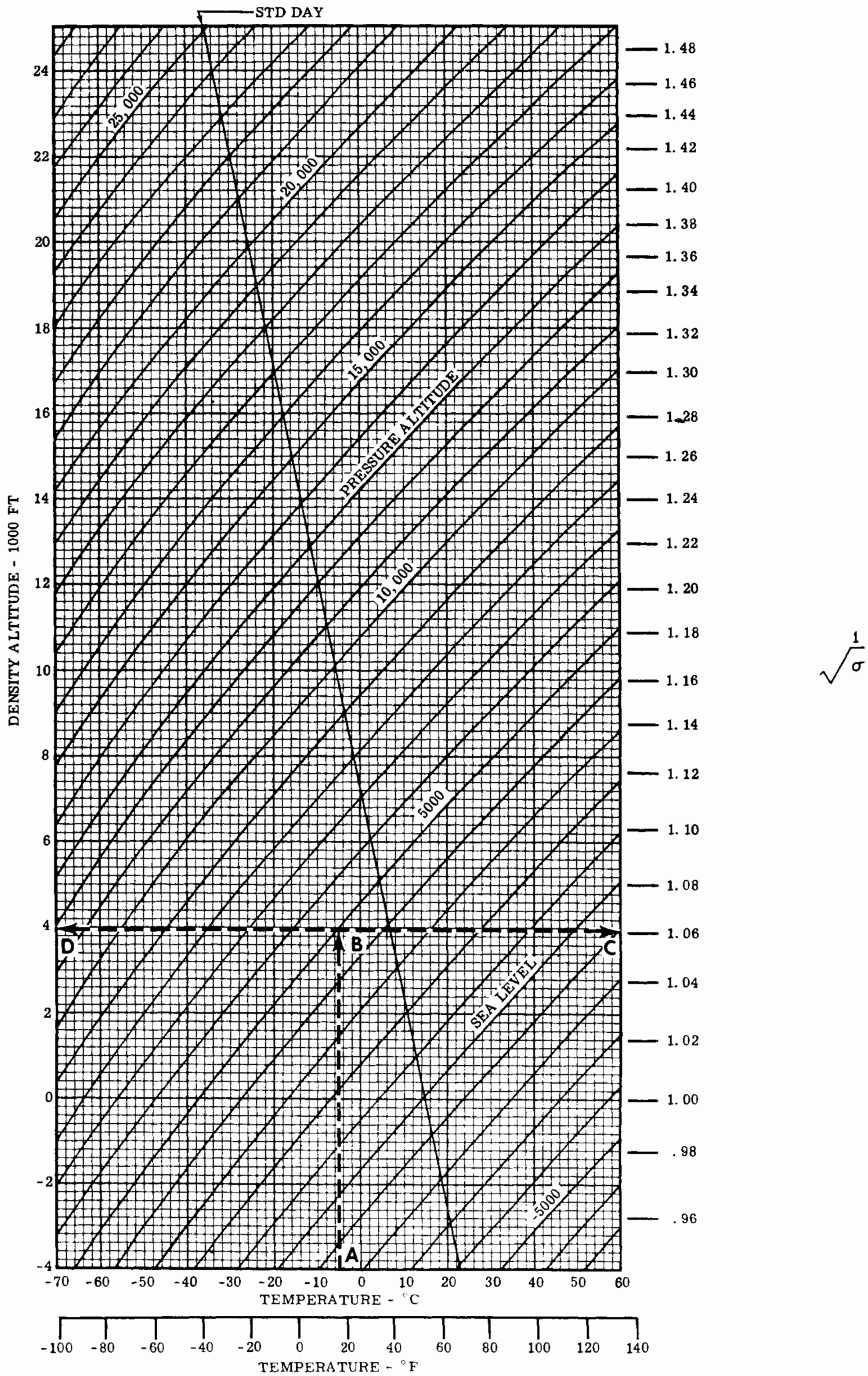


Figure A1-1.

AIRSPEED POSITION CORRECTION

MODEL: O-1A,E AND G

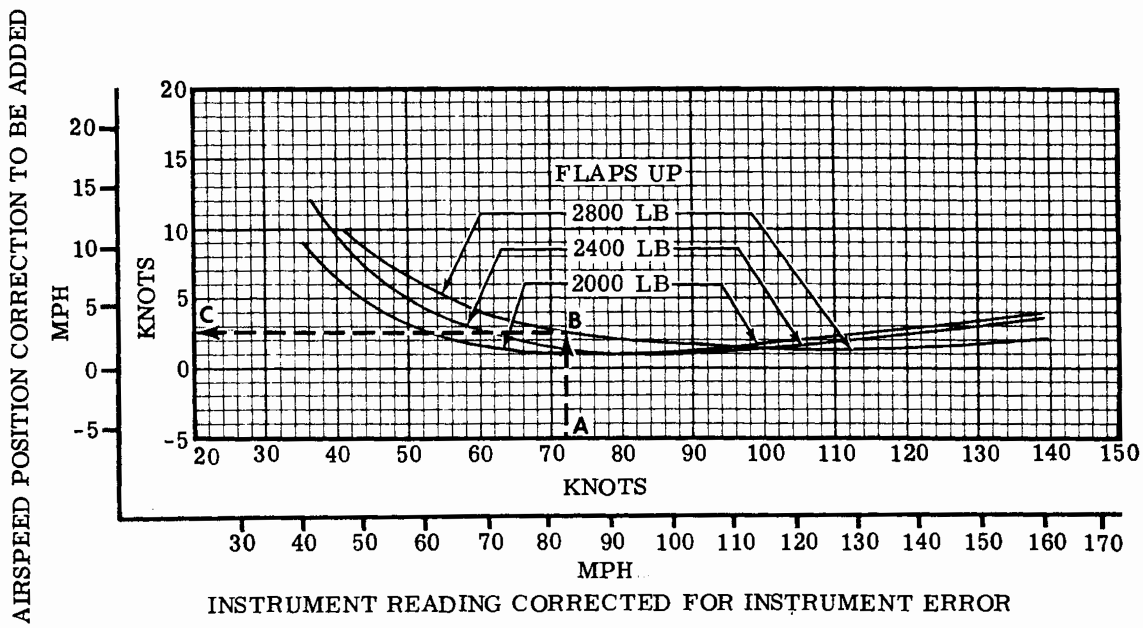
ENGINE: (1) O-470-11A or B

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

NOTE:

ADD CORRECTION TO IAS (INSTRUMENT READING CORRECTED FOR INSTRUMENT ERROR) TO OBTAIN CAS.



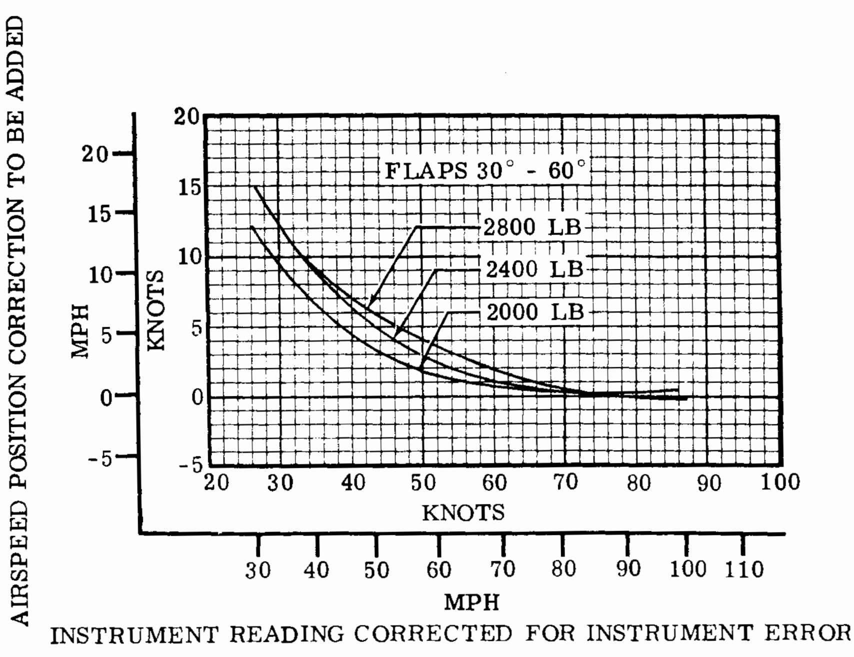


Figure A1-2.

PART II POWER INFORMATION

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FUEL FLOW

The fuel flow curve (figure A2-1) shows fuel flow for stabilized level flight versus engine RPM with parameters of altitude. The fuel flow is based on a lean mixture and corresponds to the range performance shown on the nautical miles per gallon of fuel curves. The engine performance with 115/145 grade fuel is no different than with 80/87 grade fuel.

SAMPLE PROBLEM (figure A2-1)

A. Enter chart at 1900 RPM.
B. Proceed vertically up to 5000 feet reference line.
C. Proceed horizontally left to read fuel flow; 5.92 gallons per hour.

FUEL FLOW

MODEL: O-1A, E AND G

DATA BASIS: FLIGHT TEST
DATE: 15 APRIL 1957

CONDITIONS:
1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

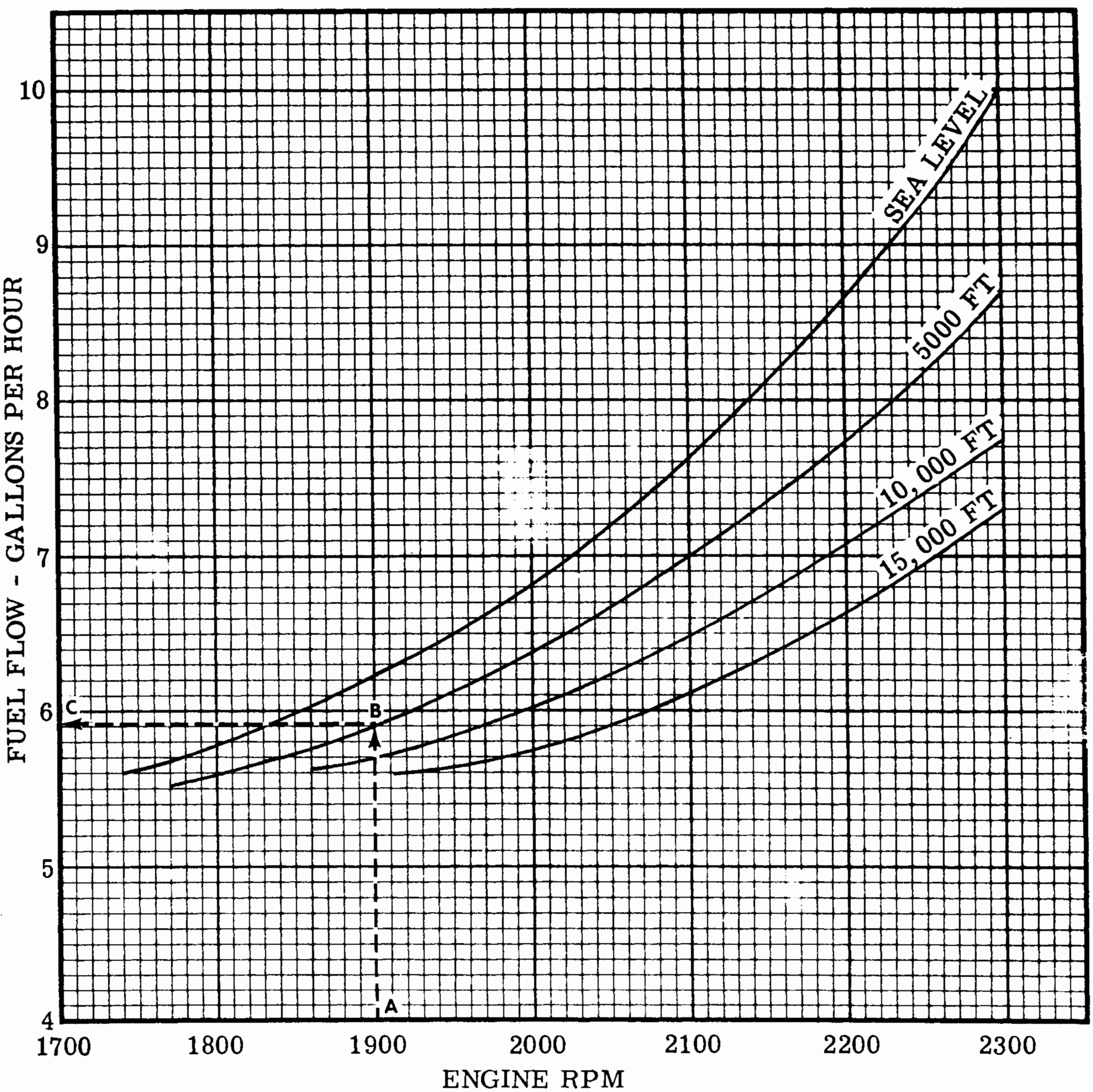

Figure A2-1.

PART III TAKEOFF

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TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

The Takeoff and Landing Crosswind Component Chart (figure A3-1) provides a means of determining whether the crosswind velocity exceeds the recommended maximum for the aircraft. Crosswind direction and velocity are presented by a series of arcs and radials emanating from the lower left-hand corner of the chart. By selecting a point on the chart at the intersection of a velocity arc and a direction radial, a known crosswind can be resolved into a headwind component and crosswind component on the scales at the left and bottom edges of the chart. Crosswind direction is the relative angle between the runway heading and the wind direction, measured either to the right or left.

SAMPLE PROBLEM (figure A3-1)

Takeoff on runway 32, wind from 360° at 15 knots.

A. Since the wind is at an angle of 40° to the runway, start at the intersection of the 40° radial and the 15 knot wind arc.
B. Read headwind component of 11.5 knots.
C. Read 90° crosswind component of 9.5. Both components are in the recommended zone of the chart.

TAKEOFF DISTANCE CHARTS

Takeoff distance charts are presented for minimum takeoff with 30° flaps and normal takeoff with 0° flaps. These charts show takeoff ground run and total distance to clear a 50 foot obstacle for various pressure altitudes and air temperatures. Takeoff distances are shown for hard surface runways using full throttle and takeoff RPM. A correction plot for winds and runway slope and a correction factor for sod runways are included. The distances shown are based on use of the recommended airspeeds shown on the charts for takeoff and climb speeds at 50 foot height. The problems for all landing distance charts are worked in a manner similar to the sample problem shown below.

SAMPLE PROBLEM (figure A3-2)

Hard surface runway, sea level pressure altitude 25°C temperature, 2600 pounds gross weight, 10 knot headwind, and 1% runway downhill slope.

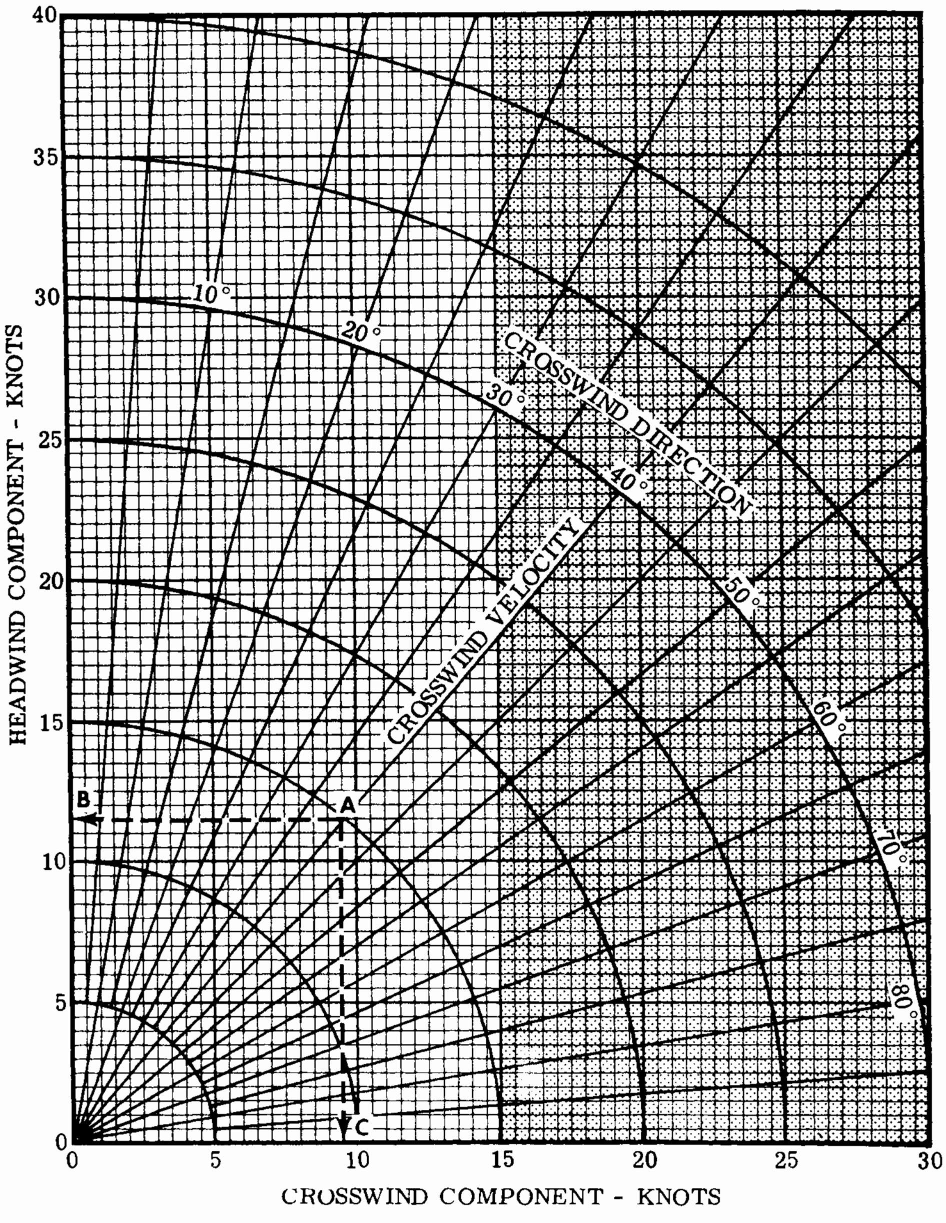
A. Enter chart at 25°C.
B. Proceed vertically up to sea level pressure altitude.
C. Proceed horizontally right to gross weight guide line 2600 pounds.
D. Proceed vertically down to wind component base line.
E. Proceed parallel to headwind component guide lines to 10 knots.
F. Proceed vertically down to runway slope guide line.
G. Proceed parallel to down hill slope guide line to 1%.
H. Proceed vertically down to read ground roll; 500 feet.
J. Proceed vertically down to wind guide line.
K. Proceed horizontally left to find total distance required to clear a 50 foot obstacle; 980 feet.

TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

MODEL: O-1A,E AND G | **ENGINE: (1) O-470-11A or B**

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



RECOMMENDED

NOT RECOMMENDED

GROUND OPERATION IS NOT RECOMMENDED WHEN WIND EXCEEDS 25 KNOTS FROM ANY DIRECTION.

Figure A3-1.

MINIMUM TAKEOFF DISTANCE

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST

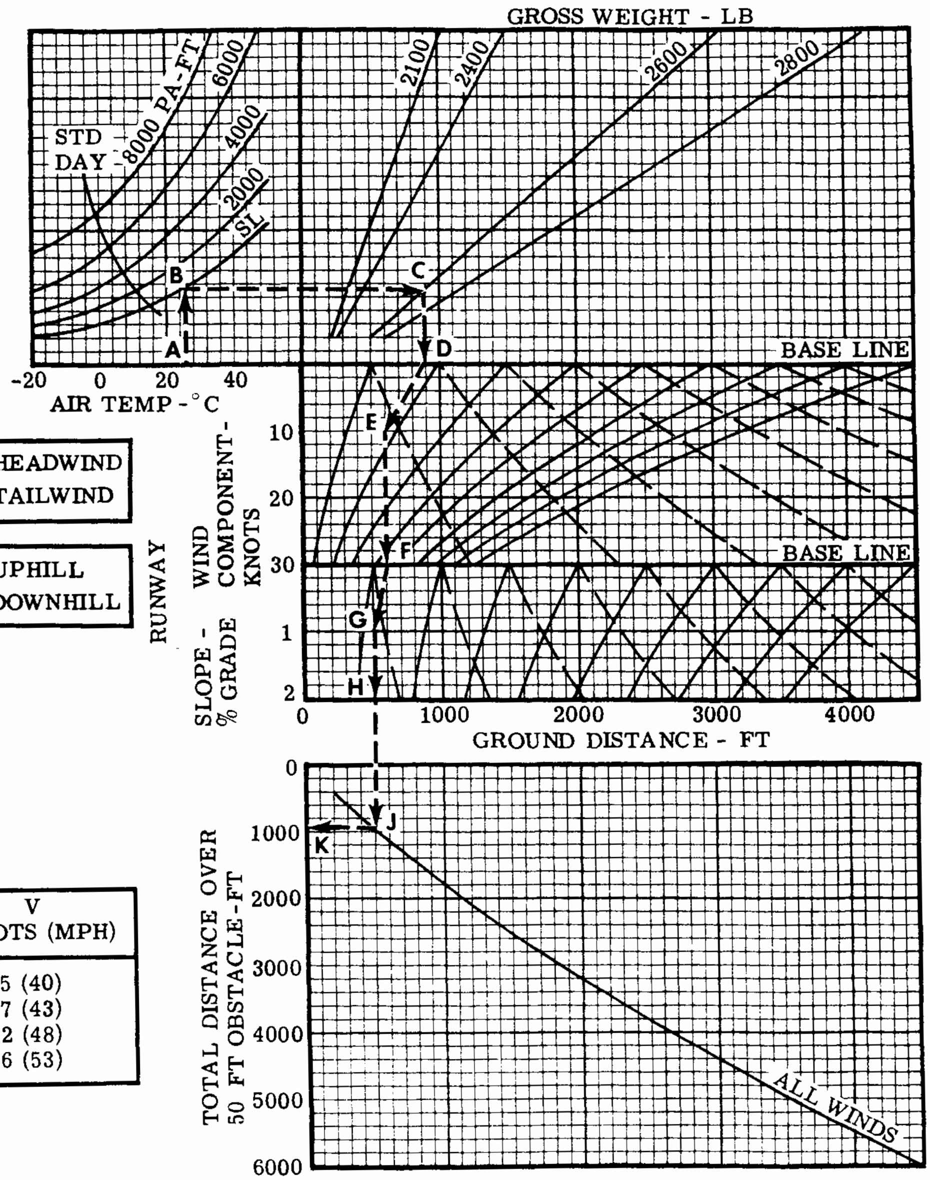
DATE: 3 MAY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 30°
3. FULL THROTTLE

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL



———— HEADWIND

— — — — TAILWIND

— — — — UPHILL

———— DOWNHILL

IAS
$V = V_{T.O.} = V_{50}$

WEIGHT LB	V KNOTS (MPH)
2100	35 (40)
2400	37 (43)
2600	42 (48)
2800	46 (53)

NOTE: FOR TAKEOFF DISTANCE UTILIZING SOD RUNWAY, INCREASE DISTANCE SHOWN BY APPROXIMATELY 8%.

Figure A3-2.

NORMAL TAKEOFF DISTANCE

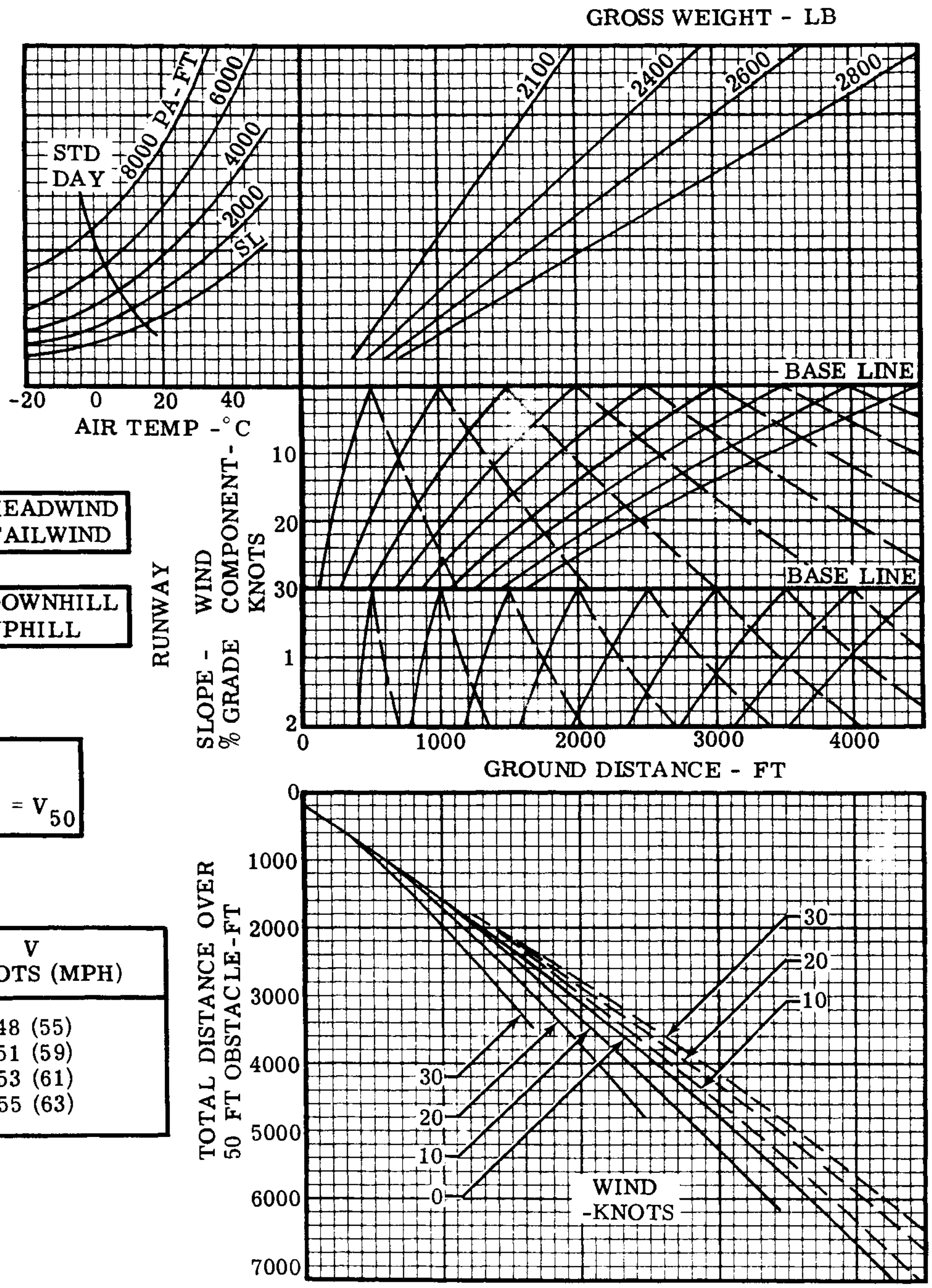
MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. **HARD SURFACE RUNWAY**
2. **FLAPS 0°**
3. **FULL THROTTLE**

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



——— HEADWIND
– – – – TAILWIND

——— DOWNHILL
– – – – UPHILL

IAS

$V = V_{T.O.} = V_{50}$

WEIGHT LB	V KNOTS (MPH)
2100	48 (55)
2400	51 (59)
2600	53 (61)
2800	55 (63)

NOTE: FOR TAKEOFF DISTANCE UTILIZING SOD RUNWAY, INCREASE DISTANCE SHOWN BY APPROXIMATELY 8%.

Figure A3-3.

PART IV CLIMB

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BEST RATE-OF-CLIMB CURVE

Distance during climb, time to climb, and fuel used in the climb can be determined from the climb curve (figure A4-1). Best rate-of-climb performance can be obtained for climbs from sea level and in-flight climbs between any altitudes. The data shown is based on normal power (full throttle), flaps up, and 56 KIAS (65 MPH). A correction factor is provided to correct performance for nonstandard day temperatures. In addition, the chart shows the service ceiling attainable at various gross weights.

When the chart is to be used to determine fuel, distance, and time starting at altitudes above sea level, it is necessary to determine values from sea level to the desired cruise altitude and values from sea level to the initial climb altitude. The fuel, distance and time values for the in-flight climb are the differences between the cruise altitude and the initial climb altitude values.

SAMPLE PROBLEM (figure A4-1)

Climb from sea level to 5000 feet at temperature 10°C above standard day. Initial weight 2610 pounds +40 pounds (temperature correction) = 2650 pounds.

A. Enter chart at gross weight 2650 pounds.
B. Proceed parallel to weight guide lines to altitude of 5000 feet.
   Interpolate between 1 gallon and 2 gallon fuel guide lines to determine fuel used in climb; 1.7 gallons.
C. Proceed horizontally left to determine distance traveled during climb; 7.0 nautical miles.
D. Proceed left, parallel to guide lines to determine time in climb; 6.9 minutes.

NORMAL CLIMB CURVE

Distance during climb, time to climb, and fuel used in the climb can be determined from the climb curve (figure A4-2). Normal climb performance can be obtained for climbs from sea level and in-flight climbs between any altitudes. The data shown is based on normal power (full throttle), flaps up and 70 KIAS (80 MPH). A correction factor is provided to correct performance for nonstandard day temperatures. In addition, the chart shows the service ceiling attainable at various gross weights.

When the chart is to be used to determine fuel, distance, and time required starting at altitude above sea level, it is necessary to determine values from sea level to the desired cruise altitude and values from sea level to the initial climb altitude. The fuel, distance and time values for the in-flight climb are the differences between the desired cruise altitude and the initial climb altitude values. Refer to sample problem for figure A4-2.

SAMPLE PROBLEM (figure A4-2)

Climb from 5000 feet to 10,000 feet. Initial weight 2610 pounds.

A. Enter chart at gross weight 2610 pounds.
B. Proceed parallel to weight guide lines to altitude of 10,000 feet.
   Interpolate between 4 gallon and 5 gallon fuel guide lines to determine fuel used in climb; 4.6 gallons.
C. Proceed horizontally left to determine distance traveled during climb; 25.4 nautical miles.
D. Proceed left, parallel to guide lines to determine time in climb; 18.9 minutes.
E. Enter chart at gross weight 2610 pounds.
F. Proceed parallel to weight guide lines to altitude of 5000 feet.
   Interpolate between 1 gallon and 2 gallon fuel guide lines to determine fuel used in climb; 1.9 gallons.
G. Proceed horizontally left to determine distance traveled during climb; 9.4 nautical miles.
H. Proceed left, parallel to guide lines to determine time in climb; 7.2 minutes.

To determine fuel, distance, and time for the climb, subtract the 5000 feet values from the 10,000 feet values.

Fuel consumed = 4.6 gallons -1.9 gallons = 2.7 gallons.
Distance traveled = 25.4 nautical miles -9.4 nautical miles = 16.0 nautical miles.
Time required = 18.9 minutes -7.2 minutes = 11.7 minutes.

BEST RATE-OF-CLIMB CURVE

DISTANCE, TIME & FUEL
2300 RPM
56 KIAS (65 MPH)

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

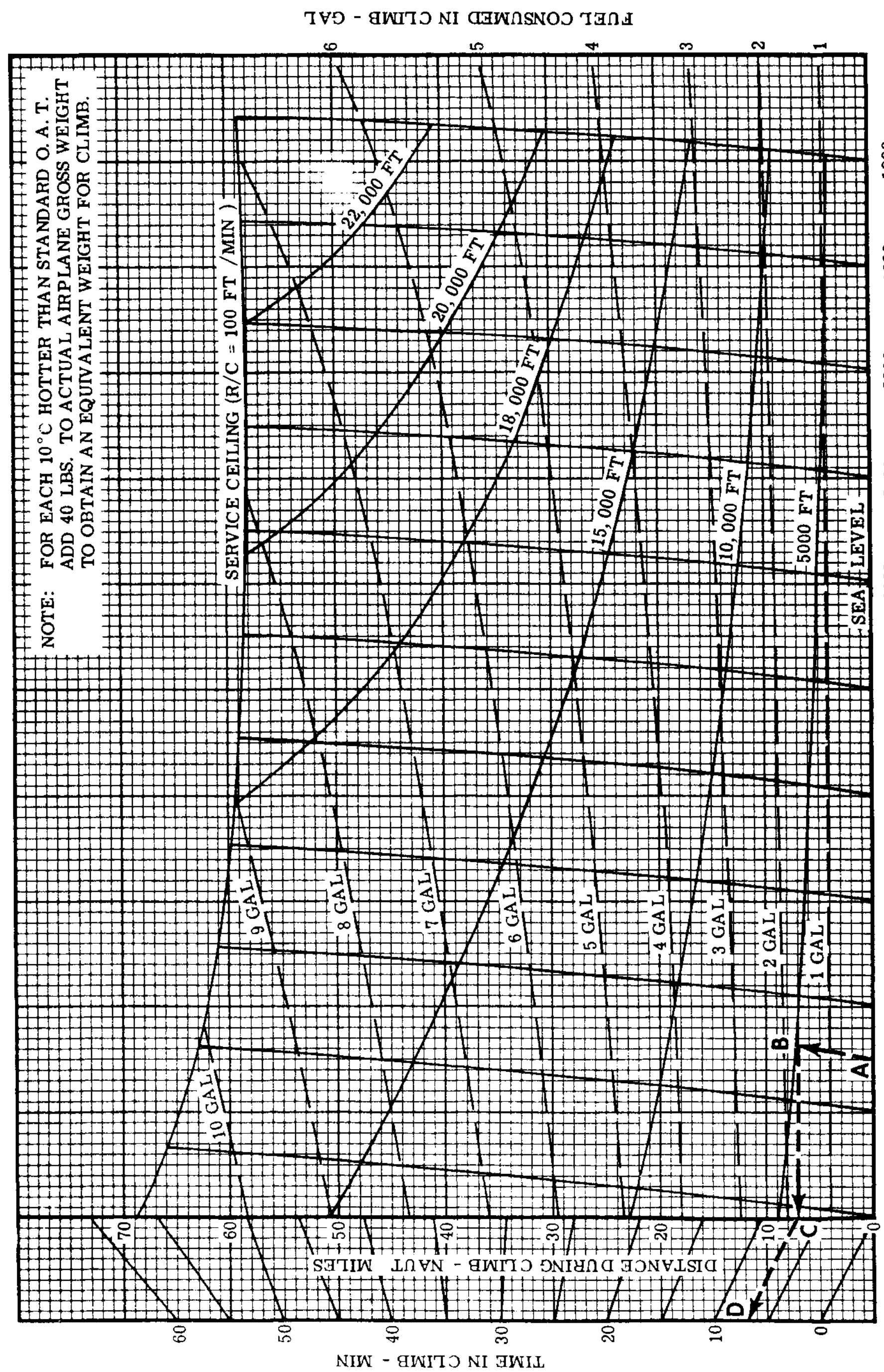

Figure A4-1.

NORMAL CLIMB CURVE

DISTANCE, TIME, & FUEL
2300 RPM
70 KIAS (80 MPH)

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

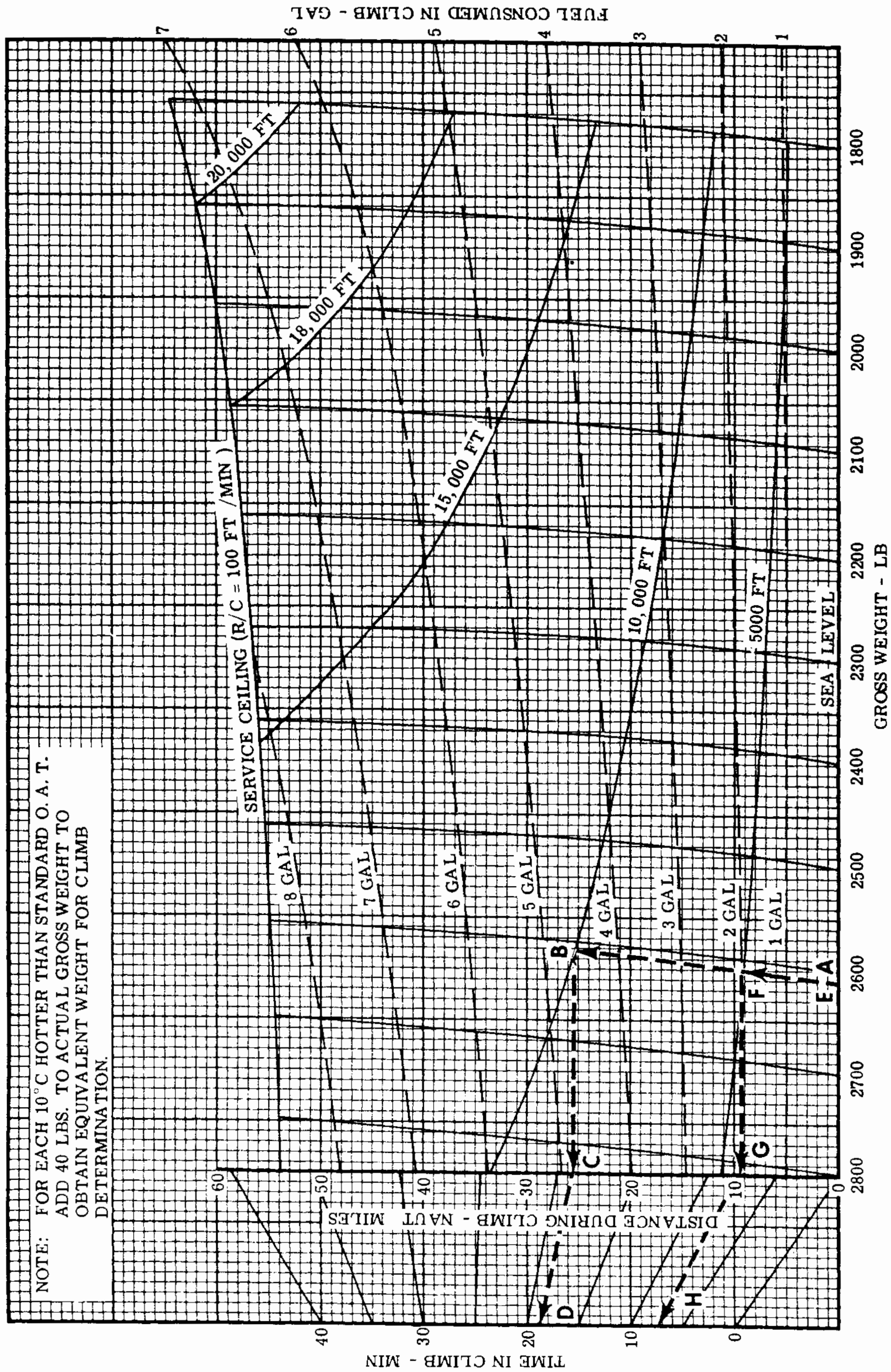

Figure A4-2.

PART V CRUISE

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NAUTICAL MILES PER GALLON OF FUEL CURVES

Cruise performance is presented in the form of nautical miles per gallon of fuel (figure A5-1 through A5-4) as a function of calibrated airspeed in knots (or MPH) with a subscale of true airspeed in knots. Nautical miles per gallon of fuel curves (figure A5-1 through A5-4) are presented for altitudes of sea level, 5000, 10, 000 and 15, 000 feet for gross weights from maximum to minimum probable flight weights. The performance shown is based on the use of lean mixture. The curves show the complete speed range of the aircraft from maximum speed with normal power down to the speed recommended for maximum endurance. A line of recommended airspeed is shown for both a zero knot wind and 50 knot headwind and is based on the highest speed possible which gives long range performance. A note is included on the charts showing how gallons per hour can be obtained.

SAMPLE PROBLEM (figure A5-2)

Altitude 5000 feet, 2500 pounds gross weight, and zero wind.

A. Enter chart at 2500 pounds gross weight on the no wind reference line.
B. Proceed vertically down to read calibrated airspeed; 84. 1 knots.
C. Proceed horizontally left from point A to read nautical miles per gallon of fuel; 12. 34.
D. Interpolate point A between RPM reference lines; 2150 RPM.

LONG RANGE PREDICTION - DISTANCE

The Long Range Distance Prediction Chart (figure A5-5) can be used to determine the maximum distance possible at altitude for a given fuel load or to find fuel used to cover a given distance at altitude. Data shown on this chart is based on the long range cruising speeds shown on the Nautical Miles Per Gallon of Fuel Charts.

SAMPLE PROBLEM (figure A5-5)

Altitude 10, 000 feet, required distance 140 nautical miles, and initial gross weight 2620 pounds.

A. Enter chart at 2620 pounds gross weight.
B. Proceed vertically up to 10, 000 feet reference line.
C. Proceed horizontally left and read air distance; 560 nautical miles.
D. Enter chart with final chart distance; 140 nautical miles +560 nautical miles = 700 nautical miles.
E. Proceed horizontally right to 10, 000 feet reference line.
F. Proceed vertically down to read final gross weight; 2557 pounds.

Fuel required = initial gross weight - final gross weight = 2620 - 2557 = 63 pounds = 10. 5 gallons.

LONG RANGE PREDICTION - TIME

The Long Range Time Prediction Chart (figure A5-6) shows the time expended in cruising if the fuel available for cruising is known. The data shown on this chart is based on the long range cruising speeds and should be used in connection with the Distance Prediction Chart.

SAMPLE PROBLEM (figure A5-6)

Initial gross weight 2620 pounds, final gross weight 2557 pounds, and cruise altitude 10,000 feet.

A. Enter chart at 2620 pounds gross weight.
B. Proceed vertically up to 10, 000 feet reference line.
C. Proceed horizontally left to read initial time; 5. 74 hours.
D. Enter chart at 2557 pounds gross weight.
E. Proceed vertically up to 10, 000 feet reference line.
F. Proceed horizontally left to read final time; 7. 15 hours.

Time at altitude = final time-initial time = 7. 15-5. 74 = 1. 41 hours.

NAUTICAL MILES PER GALLON OF FUEL

SEA LEVEL

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

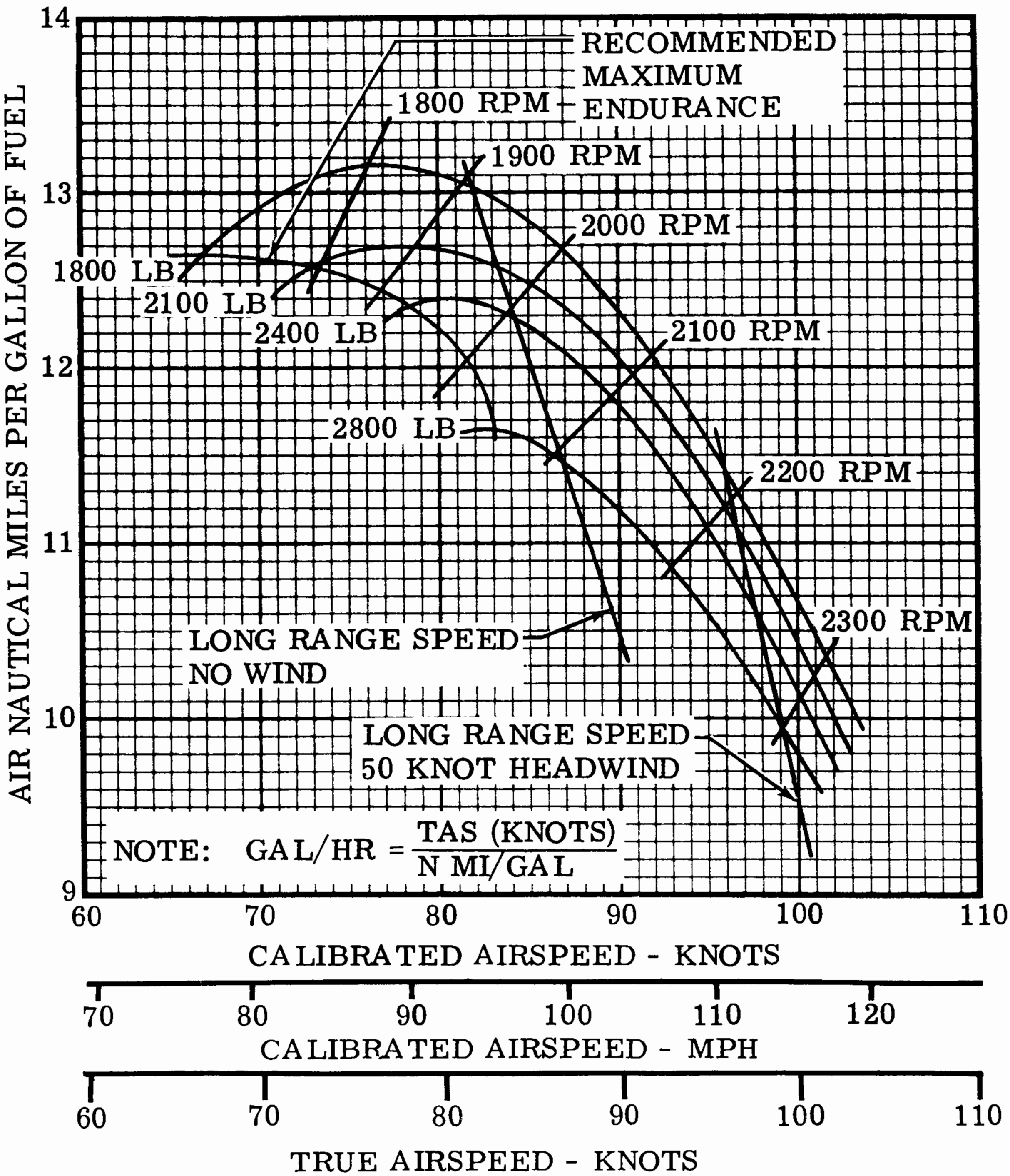


Figure A5-1.

NAUTICAL MILES PER GALLON OF FUEL

5000 FEET

MODEL: O-1A,E AND G	CONDITIONS:	ENGINE: (1) O-470-11A or B
DATA BASIS: FLIGHT TEST	1. LEAN MIXTURE	FUEL GRADE: 80/87
DATE: 3 MAY 1967	2. STANDARD DAY	FUEL DENSITY: 6LB/GAL

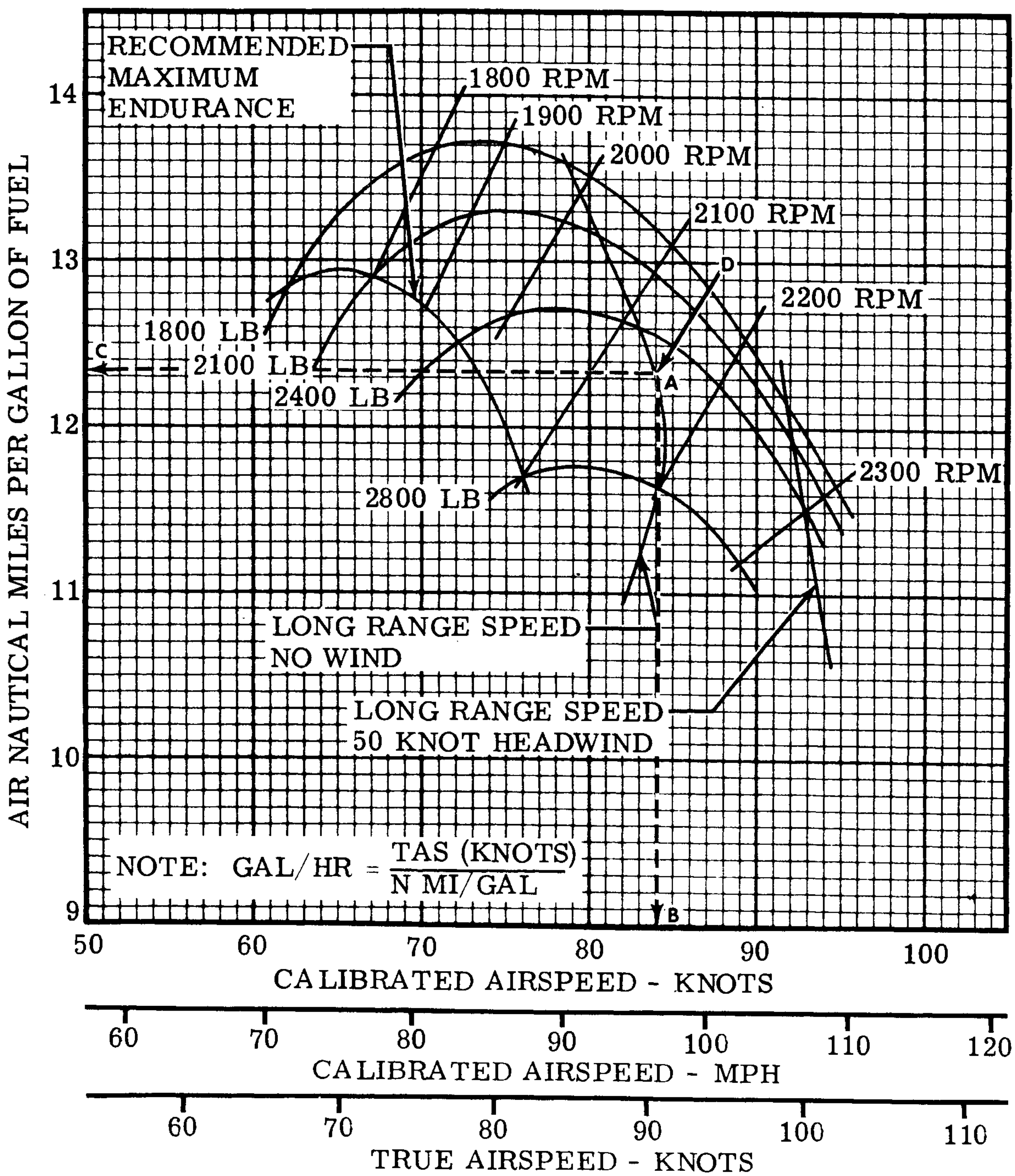


Figure A5-2.

NAUTICAL MILES PER GALLON OF FUEL

10,000 FEET

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST

DATE: 3 MAY 1967

CONDITIONS:

1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL

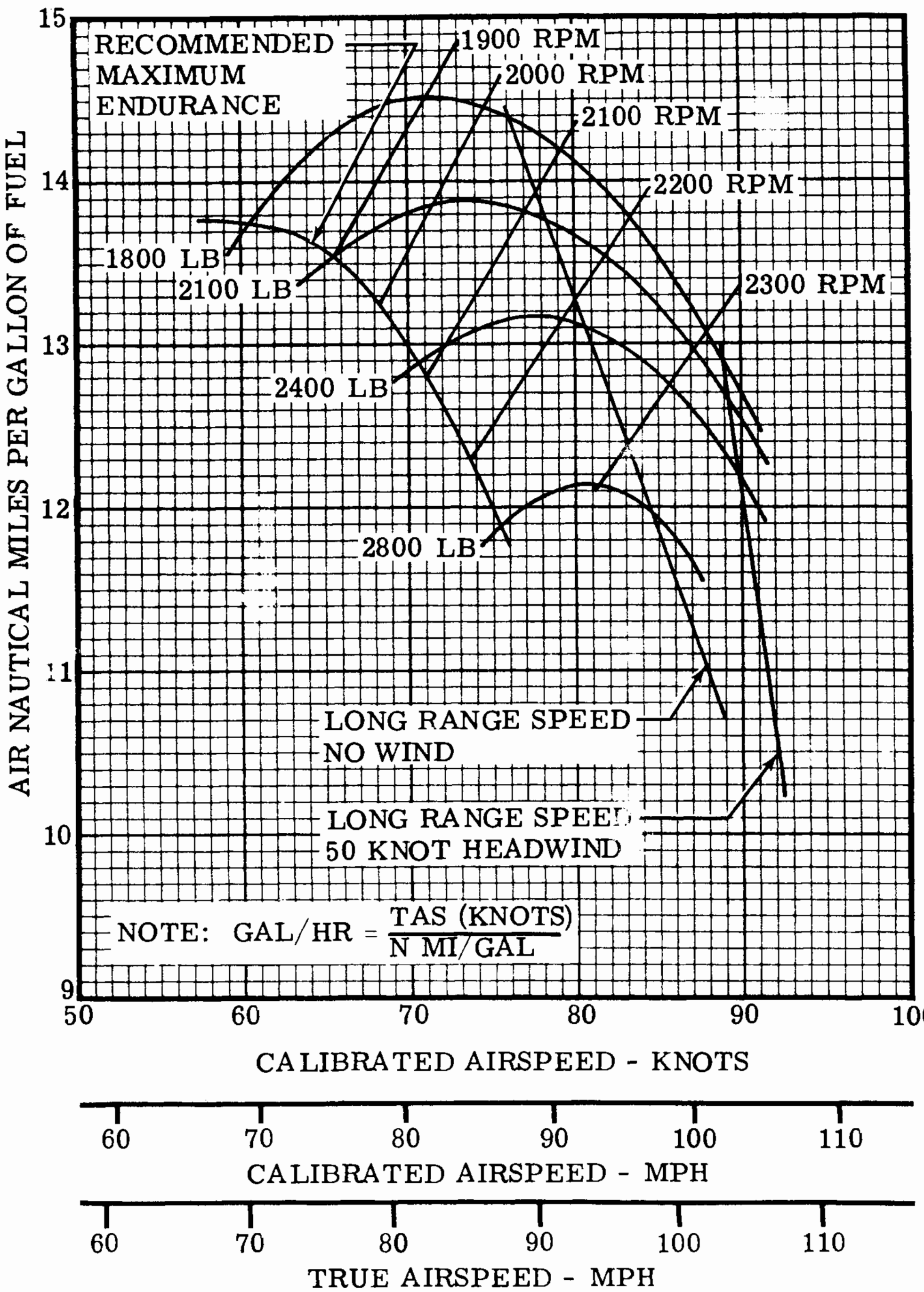


Figure A5-3.

NAUTICAL MILES PER GALLON OF FUEL

15,000 FEET

MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 15 APRIL 1957

CONDITIONS:

1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

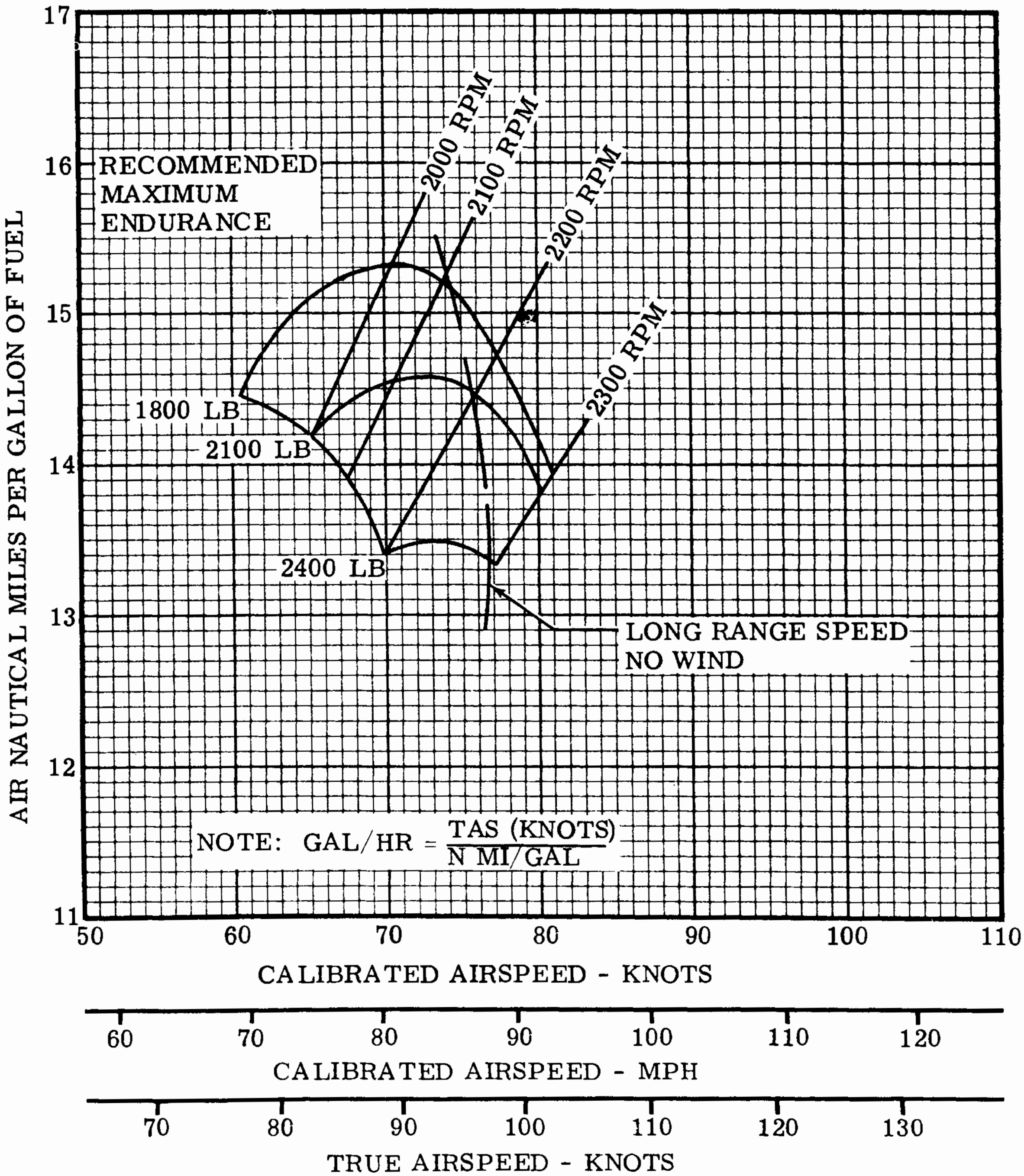


Figure A5-4.

LONG RANGE PREDICTION-DISTANCE

MODEL: O-1A,E AND G

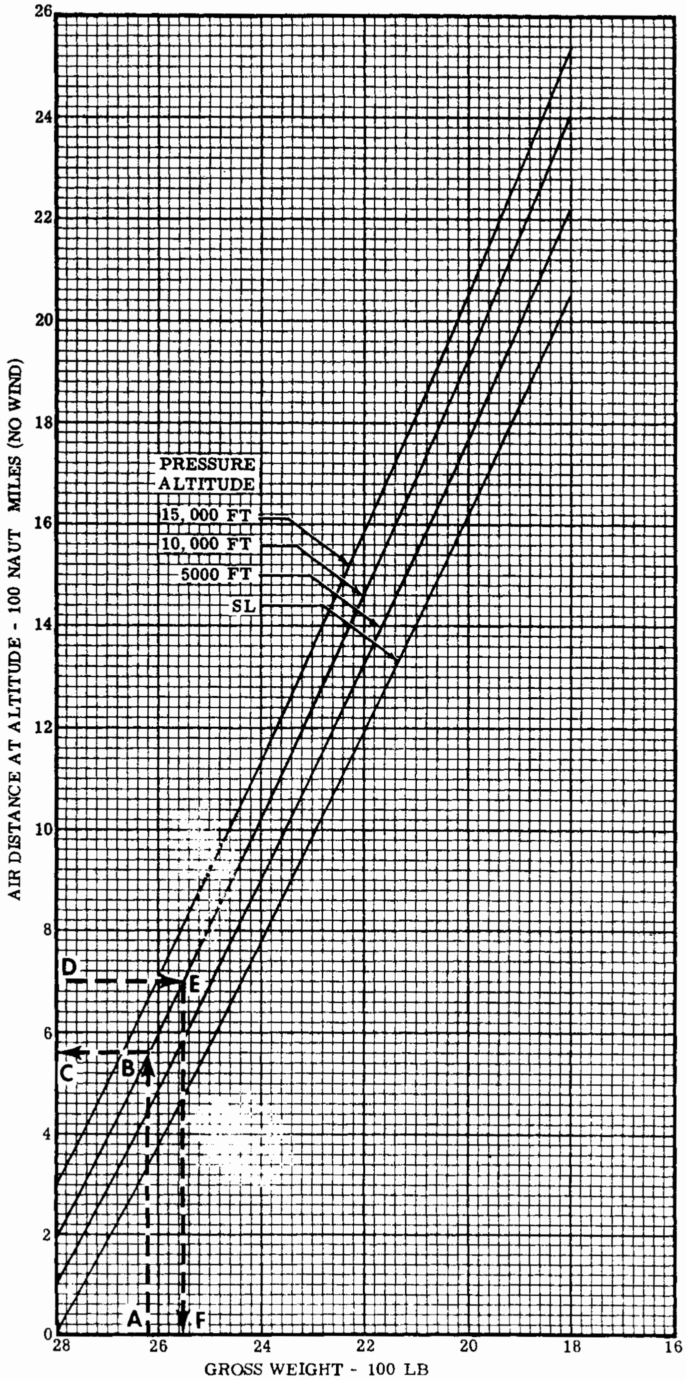
DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:

1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



NOTES:

(1) DATA BASED ON LONG RANGE CRUISE SPEEDS.
(2) DISTANCE COVERED DURING CLIMB TO ALTITUDE IS NOT INCLUDED ON THIS CHART.

Figure A5-5.

LONG RANGE PREDICTION-TIME

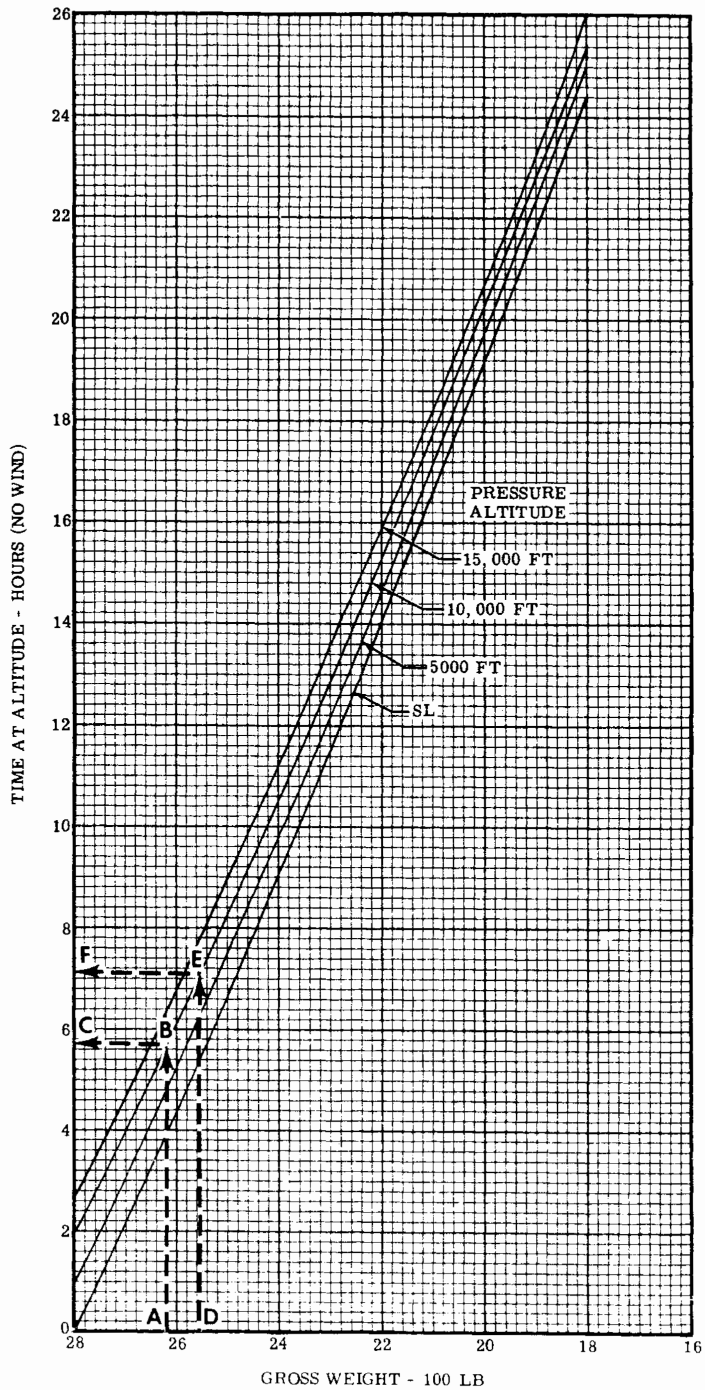
MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



NOTES:

(1) DATA BASED ON LONG RANGE CRUISE SPEEDS
(2) TIME TO CLIMB TO ALTITUDE IS NOT INCLUDED ON THIS CHART

Figure A5-6.

PART VI DESCENT DATA

No specific curves for descent data are required. Check Section II for proper descent procedure.

PART VII LANDING

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TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

The Takeoff and Landing Crosswind Component Chart (figure A3-1) provides a means of determining whether the crosswind velocity exceeds the recommended maximum for the aircraft. Crosswind direction and velocity are represented by a series of arcs and radials emanating from the lower left-hand corner of the chart.

By selecting a point on the chart at the intersection of a velocity arc and a direction radial, a known crosswind can be resolved into a headwind component and tailwind component on the scales at the left and bottom edges of the chart. Crosswind direction is the relative angle between the runway heading and wind direction, measured either to the left or to the right.

LANDING DISTANCE CHARTS

Landing performance charts are presented for minimum landing distances with 60° flaps and normal landing distances with 0° and 30° flaps. The charts show landing ground rolls and total distances over a 50 foot obstacle for various pressure altitudes and air temperatures. Correction plots for wind and runway slope are included on all charts. In addition, each chart presents approach and landing speed information for particular gross weights. The problems for all landing distance charts are worked in a manner similar to the sample problem shown below.

SAMPLE PROBLEM (figure A7-3)

Hard surface runway, 25°C temperature, 2600 pounds gross weight, 1000 feet pressure altitude, 10 knot headwind, and 1% downhill slope.

A. Enter chart at 25°C.
B. Proceed vertically up to 1000 feet pressure altitude.
C. Proceed horizontally right to gross weight line 2600 pounds.
D. Proceed vertically down to wind component base line.
E. Proceed parallel to headwind component guide line to 10 knots.
F. Proceed vertically down to runway slope base line.
G. Proceed parallel to downhill slope guide line to 1%.
H. Proceed vertically down to read ground roll; 225 feet.
J. Proceed vertically down to wind guide line.
K. Proceed horizontally left to find landing distance from 50 feet; 972 feet.

CORRECTION TO LANDING GROUND ROLL FOR RUNWAY CONDITION READING

The correction to landing ground roll (figure A7-4) for Runway Condition Reading (R.C.R.) Chart is to be used with the Minimum Landing Distances Chart and Normal Landing Distances Charts to correct for runway surface material and condition. The chart is based on dry hard surface runways and includes corrections for dry pavement to ice-covered runways.

SAMPLE PROBLEM (figure A7-4)

For a hard surface ground run of 300 feet, find sod surface distance.

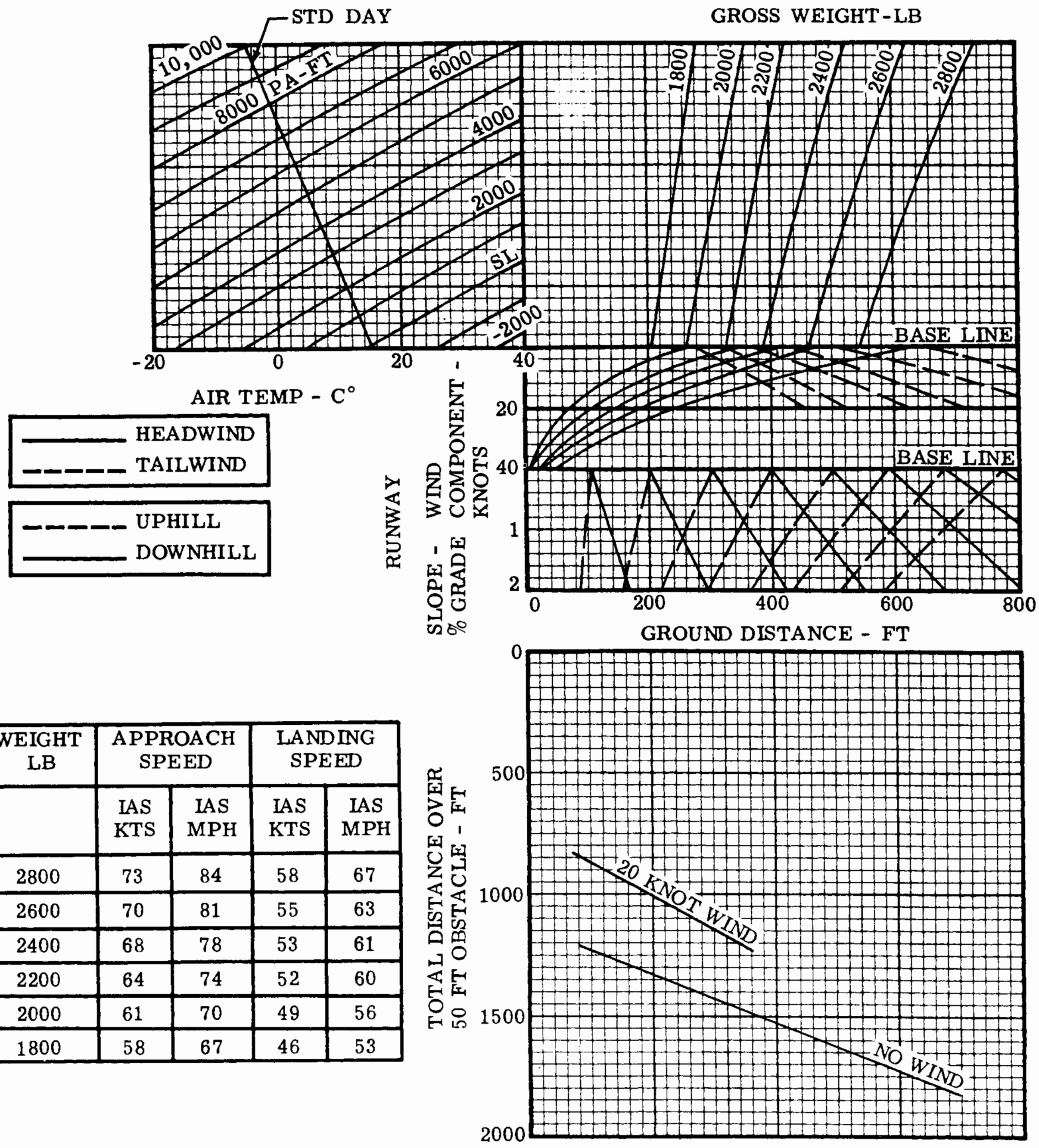
A. Enter chart at 300 feet.
B. Proceed vertically up to sod surface reference line.
C. Proceed horizontally left and read corrected ground roll; 345 feet.

NORMAL LANDING DISTANCE

MODEL: O-1A,E AND G
DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 0°
3. POWER OFF

ENGINE: (1) O-470-11A or B
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



WEIGHT LB	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	73	84	58	67
2600	70	81	55	63
2400	68	78	53	61
2200	64	74	52	60
2000	61	70	49	56
1800	58	67	46	53

Figure A7-1.

NORMAL LANDING DISTANCE

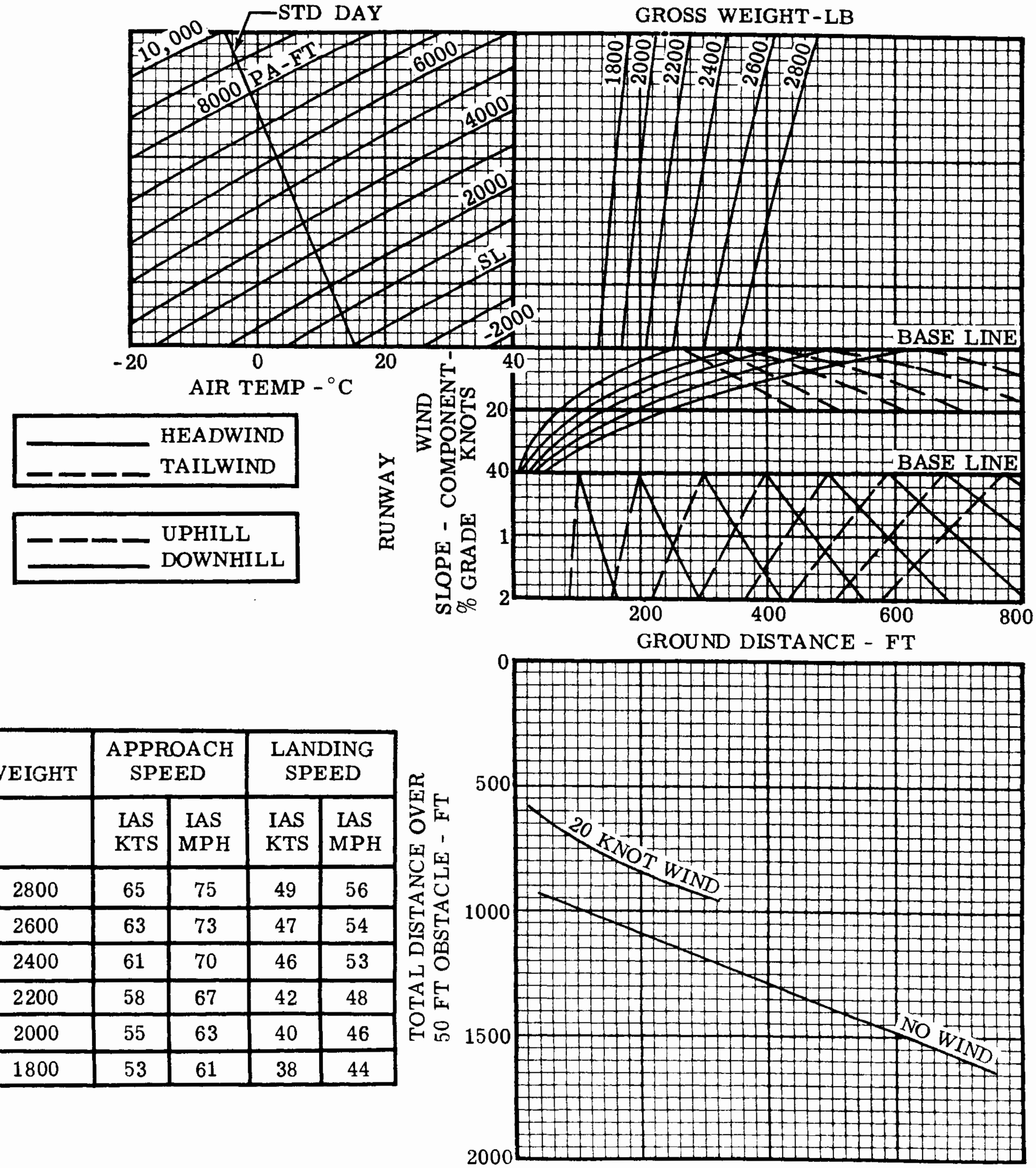
MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 30°
3. POWER OFF

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



WEIGHT	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	65	75	49	56
2600	63	73	47	54
2400	61	70	46	53
2200	58	67	42	48
2000	55	63	40	46
1800	53	61	38	44

Figure A7-2.

MINIMUM LANDING DISTANCE

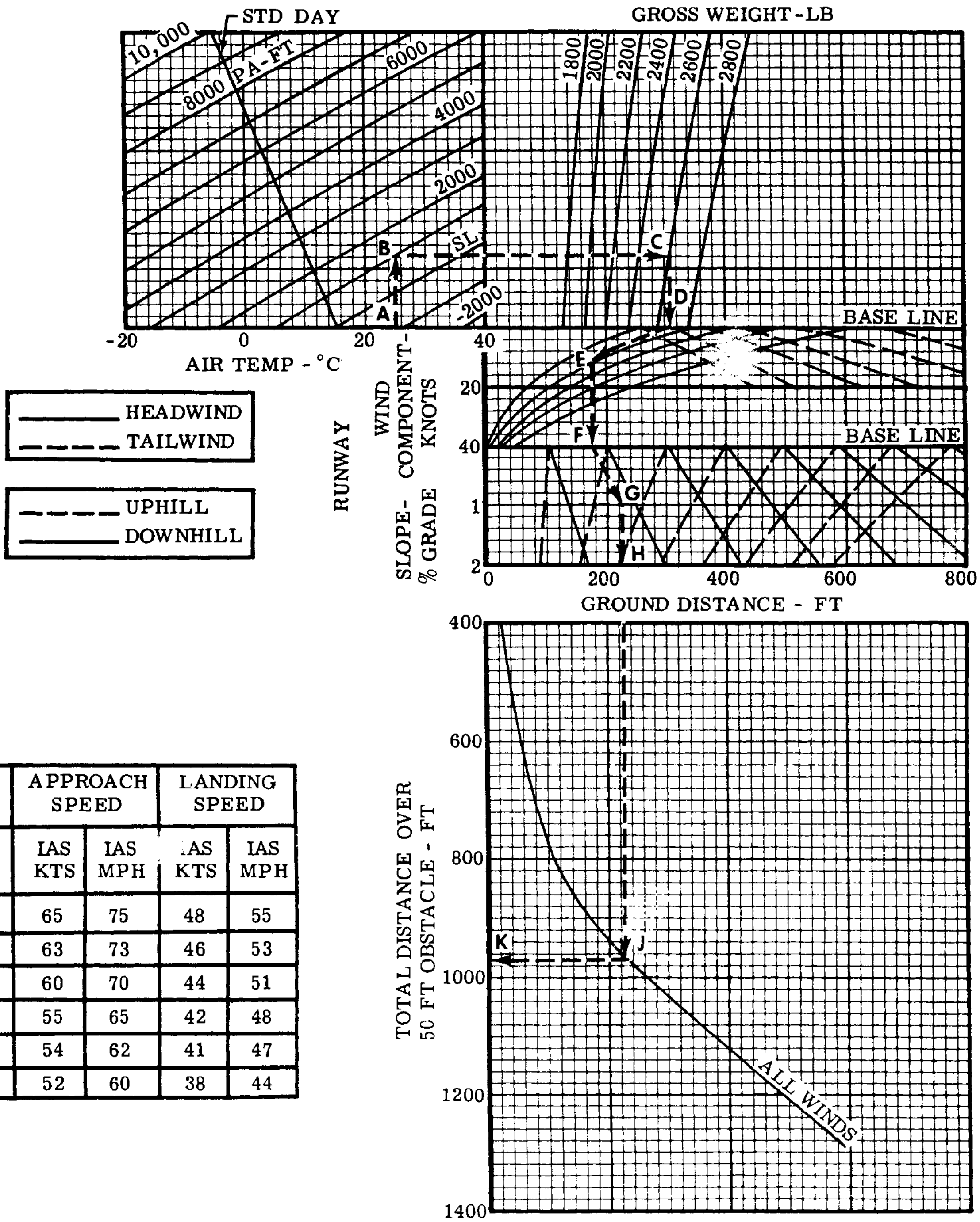
MODEL: O-1A,E AND G

DATA BASIS: FLIGHT TEST
DATE: 3 MAY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 60°
3. POWER OFF

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	65	75	48	55
2600	63	73	46	53
2400	60	70	44	51
2200	55	65	42	48
2000	54	62	41	47
1800	52	60	38	44

Figure A7-3.

CORRECTION TO LANDING GROUND ROLL FOR RUNWAY CONDITION READING (R C R)

MODEL: O-1A,E AND G

ENGINE: (1) O-470-11A or B

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

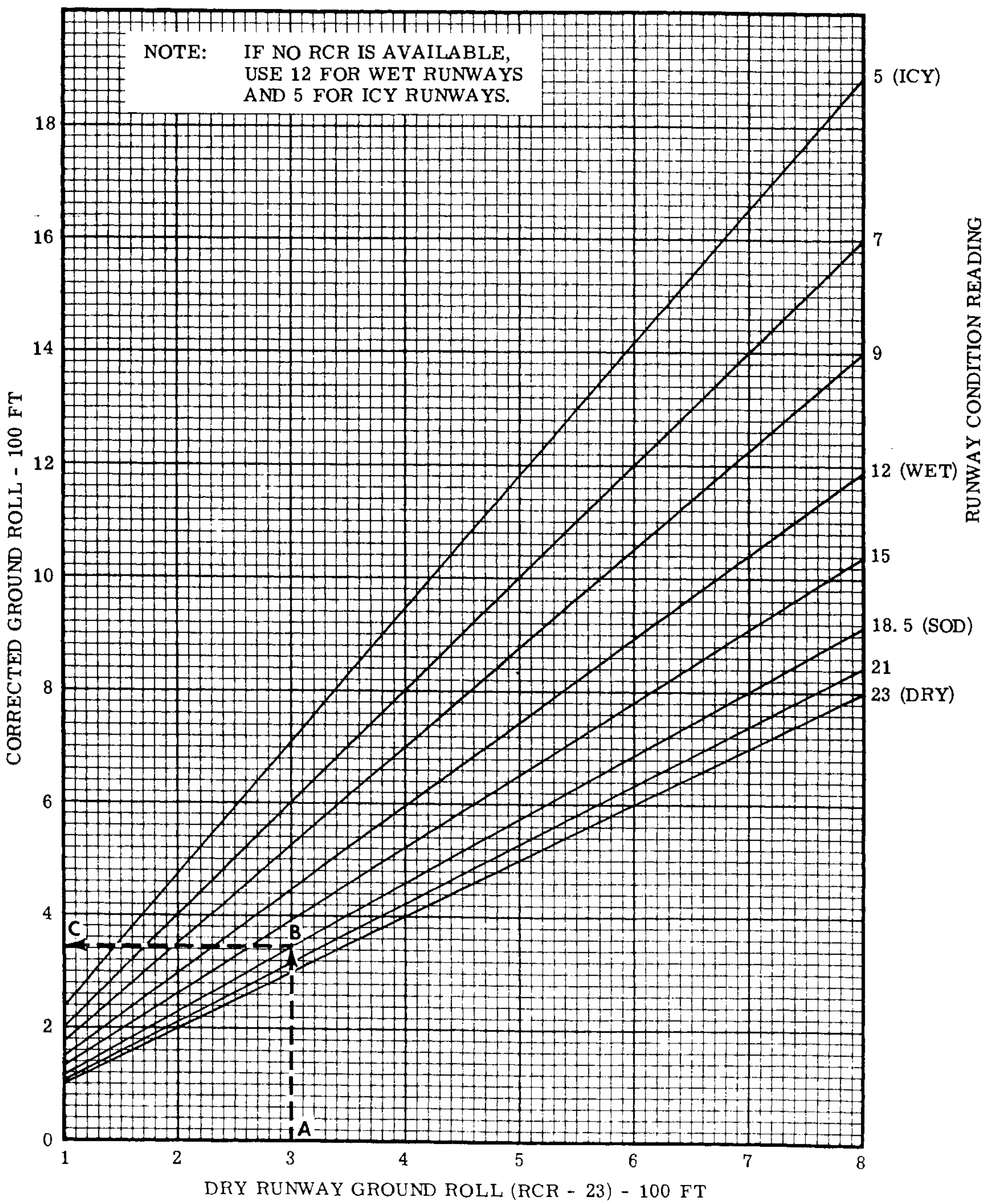


Figure A7-4.

PART VIII MISSION PLANNING

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TAKEOFF AND LANDING DATA CARD

The takeoff and landing data card included in T. O. 1L-1A-1CL-1, "Pilot's Abbreviated Flight Crew Checklist," is placed in a binder with a plastic envelope so it can be filled out with a wax pencil for each mission. The takeoff and landing information for the planned mission shall be entered on the data card and used as a ready reference for review prior to takeoff and landing. A complete sample problem of mission, to familiarize the pilot with the use of the charts and procedures to fill out the takeoff and landing data card, is shown at the end of this Section.

SYMBOLS AND DEFINITIONS

SYMBOLS	DEFINITIONS
CAS	Calibrated airspeed, indicated airspeed corrected for position error. CAS = IAS + V_i.
GS	Ground speed, true airspeed corrected for the wind component velocity. GS = TAS + V_W.
H_d	Density altitude, that value obtained from the density altitude chart, figure A1-1, at which air density at the observed pressure altitude equals air density as defined by the International Civil Aviation Organization.
IAS	Indicated airspeed, airspeed indicator uncorrected. Where this symbol (IAS) is used on the performance charts, mechanical error in the instrument is assumed to be zero.
Kn or Kts	Knots, nautical miles per hour.
OAT	Outside air temperature.
TAS	True airspeed, calibrated airspeed corrected for atmospheric density. TAS = CAS x $\frac{1}{\sqrt{\sigma}}$
V_{APP}	Approach speed.
V_i	Airspeed position error correction.
V_{TD}	Touchdown speed.
V_{TO}	Takeoff speed.
V_{50}	Speed at the 50 foot obstacle.

TAKEOFF AND LANDING DATA CARD

TAKEOFF DATA

CONDITIONS (Base Airfield)

Gross Weight	2600	LB
Field Length	3100	FT
Outside Air Temperature	10	°C
Pressure Altitude	2500	FT
Effective Wind 360° Dir	15	KN

TAKEOFF

Takeoff Ground Roll (no obstacle)	550	FT
Takeoff Over 50 FT Obstacle	1050	FT
Obstacle Clearance Speed	42	KIAS

LANDING IMMEDIATELY AFTER TAKEOFF

Approach Speed at 50 FT	63	KIAS
Landing Distance Over 50 FT	905	FT

LANDING DATA

CONDITIONS (Remote Airfield)

Gross Weight	2500	LB
Field Length	1800	FT
Outside Air Temperature	15	°C
Pressure Altitude	0	FT
Effective Wind 350° Dir	10	KN

LANDING

Landing Distance Over 50 FT	1179	FT
Approach Speed at 50 FT	62	KIAS

SAMPLE PROBLEM

The following sample problem employs actual graph values demonstrating how the graphs should be used. It is required that the aircraft be flown 175 nautical miles to a remote airfield, land and return without refueling. Base airfield is at 2500 feet and the remote airfield is at sea level.

Write down condition of problem:

1. Required range .... 350 nautical miles plus reserve.
2. Base airfield (runway 32, 3100 feet long, dry pavement, level surface).
   Elevation .... 2500 feet
   Surface winds .... 360°, 15 knots
   Outside air temp .... 10°C
3. Winds aloft (at airfield).
   Tailwind at 5000 feet .... 15 knots
   Tailwind at 8000 feet .... 35 knots
4. Remote airfield (runway 33, 1800 feet long, wet pavement, 1% down slope, landing over a 50-foot obstacle).
   Elevation .... Sea level
   Surface winds .. .. 350°, 10 knots
   Outside air temp .... 15°C
5. Aircraft gross weight.
   Aircraft basic weight (includes trapped fuel and oil) .... 1716 LBS
   Crew (2) .... 400 LBS
   Oil weight (10 qt) .... 19 LBS
   Misc. - Flight equipment .... 100 LBS
   Fuel Load (38 gal) .... 228 LBS
   External stores .... 137 LBS

   Takeoff gross weight 2600 LBS

The flight out will be flown at 8000 feet for most favorable tailwinds. A landing will be made at the remote base and no fuel will be taken aboard. The return trip will be made at 5000 feet where winds are more favorable.

The flight is divided into four segments as follows:

Segment 1 - Warmup, takeoff and climb to 8000 feet
Segment 2 - Flight to remote airfield
Segment 3 - Warmup, takeoff and climb to 5000 feet
Segment 4 - Return flight

TAKEOFF AND CLIMB

1. Refer to the Takeoff and Landing Crosswind Component Chart (figure A3-1) for headwind and crosswind components at takeoff. Headwind is $11\frac{1}{2}$ knots, crosswind is $9\frac{1}{2}$ knots for the wind conditions of 40° to the runway at 15 knots. This is within the recommended takeoff area of the chart.

2. Use the Minimum Takeoff Distance Chart (figure A3-2) to find runway length required for takeoff. Enter the chart with the air temperature at the field. For 10°C, 2500 feet pressure altitude, 2600 pounds gross weight, $11\frac{1}{2}$ knot headwind, hard level surface, ground run required is 550 feet. From the Minimum Takeoff Distance Chart, the takeoff IAS is 42 knots. Total distance over 50 foot obstacle 1050 feet.

3. Assume fuel allowance of 1.5 gallons (9 lbs) for warmup and takeoff.

4. Refer to the best rate of climb curve (figure A4-1) to climb from 2500 feet to 8000 feet at best rate of climb speed. Time required is 9.8 minutes, covering 10.0 nautical miles, and consuming 2.20 gallons of fuel. These values are found by taking the difference of a sea level climb to 2500 feet and a sea level climb to 8000 feet.

5. The power setting for climb is 2300 RPM, part throttle, and rich mixture.

6. Gross weight at end of takeoff and climb is 2578 pounds.

CRUISE TO REMOTE AIRFIELD

The flight to the remote airfield will be flown at 8000 feet for most favorable tailwinds. Normally, tailwinds are treated as a no wind condition and; therefore, the fuel and time required for this Segment can be determined from the long range prediction charts. The required cruise distance is 175 - 10 = 165 nautical miles.

1. Fuel -
   a. From the Long Range Prediction - Distance Chart (figure A5-5) the initial chart distance at an initial gross weight of 2578 pounds is 600 n. mi.
   b. The final chart distance is initial chart distance plus required distance: 600 + 165 = 765 n. mi.
   c. At final chart distance of 765 n. mi., final weight at end of cruise is 2500.
   d. Fuel required is 2578 - 2500 = 78 pounds or 13.0 gallons.

2. Time
   a. From the Long Range Prediction - Time Chart, (figure A5-6) the initial time at an initial gross weight of 2578 pounds is 6.3 hours.
   b. At final gross weight of 2500 pounds, final chart time is 8.0 hours.
   c. Time required for the flight out is 8.00 - 6.3 = 1.7 hours.

3. The power setting is determined from the Nautical Miles per Gallon graphs for 5000 and 10,000 feet (figures A5-2, A5-3) and then interpolating for 8000 feet. Use average gross weight of 2539 pounds. The power setting is then 2205 RPM.
4. Check the Takeoff and Landing Crosswind Component Chart (figure A3-1) to determine

winds at remote airfield where the wind is 20° to the runway at 10 knots. This gives a headwind of $9\frac{1}{2}$ knots and a crosswind of $3\frac{1}{2}$ knots.

5. Use the Minimum Landing Distance Chart (figure A7-1) to find runway length for an air temperature of 15°, sea level pressure altitude, 2500 pounds, $9\frac{1}{2}$ knot headwind, 1% down slope, 50-foot obstacle to land over. The total distance over the 50-foot obstacle is 935 feet. Ground run is 192 feet for dry pavement. Correct for wet pavement using the Correction for Runway Condition Chart (figure A7-4). Ground roll is now 436 feet and corrected total distance is 1179 feet.

REMOTE TAKEOFF AND CLIMB

This Leg consists of a warmup, takeoff, and climb to 5000 feet with a takeoff gross weight of 2500 pounds.

1. Using the Minimum Takeoff Distance Chart (figure A3-2) and considering the wind conditions, determine the runway length to clear the 50-foot obstacle. From the chart this distance is 700 feet.

2. Assume a fuel allowance of 1.5 gallons (9 pounds) for warmup and takeoff.

3. Reference to the best rate of climb (figure A4-1) shows that to climb to 5000 feet at best rate-of-climb speed requires 6.1 minutes and covers 6.2 nautical miles while consuming 1.5 gallons of fuel. Final gross weight at end of climb is 2482 pounds.

4. The power setting for climb is 2300 RPM, part throttle and rich mixture.

RETURN CRUISE

The flight from remote airfield will be flown at 5000 feet with a 15 knot tailwind. The fuel and time required for this segment can be determined from the Nautical Miles Per Gallon of Fuel Chart (figure A5-2). If a calibrated airspeed of 83.3 knots is desired (TAS = 90 knots, the power setting is 2125 RPM. Fuel consumption is then found to be 12.5 nautical miles per gallon. These values are obtained from the 5000-foot chart. The time to complete this segment is the distance divided by the ground speed - headwind component if any. Ground speed = 90 - 0 = 90 knots.

1. $\text{Time} = \dfrac{\text{Distance}}{\text{Ground speed}} = \dfrac{169}{90} = 1.88 \text{ hours}$

To find the fuel consumed, gallons per hour must be first determined.

$$\text{Gal/Hr} = \frac{\text{TAS (knots)}}{\text{N. Mi./Gal}} = 7.2 \text{ gallons per hour}$$

Fuel consumed = (Gal/Hr) hours = 7.2 x 1.88 = 13.5 gallons or 81 pounds.
Final gross weight is now 2482 - 81 = 2401 pounds.

2. To find the minimum required landing distance at the home base, the Minimum Landing Distance Chart (figure A7-1) should be consulted. For a gross weight of 2401 pounds, 2500 feet pressure altitude, 10°C temperature, level surface, $11\frac{1}{2}$ knot headwind, and landing over a 50 foot obstacle, the minimum landing distance is 485 feet from 50 feet with 210 feet of ground run.

SUMMARY

The total time and fuel for the mission is summarized as follows:

	TIME HOURS	FUEL GALLONS
Segment 1	.16	3.7
Segment 2	1.70	13.0
Segment 3	.10	3.0
Segment 4	1.88	13.5
TOTAL	3.84	33.2

Fuel remaining at the end of flight is 38.0 - 33.2 = 4.8 gallons. Since one gallon of fuel is unusable, the usable reserve fuel is 3.8 gallons and is ample for this mission. From the Nautical Miles per Gallon of Fuel Chart at 5000 feet (figure A5-2) maximum endurance is at 1960 RPM. From the fuel flow curve (figure A2-1) the fuel consumption is 5.76 gal/hr therefore, this reserve fuel is equivalent to 39 minutes of flight time at maximum endurance speed.

Once the plan is satisfactorily computed, it should be assembled into one master chart to facilitate the use of the data in flight. On completion of the flight, a comparison should be made between the actual and computed data. This will give the pilot a better idea of the margin of safety afforded by the charts. He should then be able to plan succeeding missions with increasing accuracy. It should be noted that a similar mission but of greater range, can be accomplished by carrying extra fuel in suitable small containers and by refueling at the return point.

APPENDIX II

Performance Data O-1F Aircraft

The appendix is divided into eight parts which are presented in proper sequence for preflight planning. Discussions and sample problems are given in each part.

PART I INTRODUCTION

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INTRODUCTION

The information in this appendix provides the pilot with performance data for all flight conditions and shows how to obtain the maximum performance from the aircraft. By utilizing the data in this appendix, each mission can be flown in an efficient manner with ample margin of safety. By using the recommended powers and airspeeds a greater distance can be covered at better cruising speed and with more reserve fuel at the destination. A careful study of each part will show the extensive range of operating conditions included and the potential usefulness of the charts. Power is the same for the aircraft using the 115/145 grade fuel as it is using 80/87 grade.

DENSITY ALTITUDE CHART

The Density Altitude Chart (figure B1-1) expresses density altitude in terms of pressure altitude and temperature. A conversion factor is provided to obtain true airspeed from calibrated airspeed by correcting for density altitude.

SAMPLE PROBLEM (figure B1-1)

Pressure altitude sea level, air temperature 25°C.

A. Enter chart at 25°C.
B. Proceed vertically to sea level pressure altitude.
C. Proceed horizontally right to read $\frac{1}{\sqrt{\sigma}}$, 1.018.
D. Proceed horizontally left to read density altitude; 1220 feet.

AIRSPEED POSITION CORRECTION

An airspeed position correction chart (figure B1-2) shows position error as a function of airspeed for flap configurations of 0° and 30-60°. In using the chart, the position error is added to the indicated airspeed (corrected for instrument error) to obtain calibrated airspeed (CAS). With this value of CAS and the free air temperature at a given pressure altitude, the true airspeed (TAS) can be found by means of an airspeed computer, dead reckoning computer, or by multiplying the CAS by the factor found from the Density Altitude Chart.

SAMPLE PROBLEM (figure B1-2)

Gross weight 2800 pounds flaps up, and indicated airspeed 72 knots (IAS corrected for instrument error).

A. Enter chart at 72 knots.
B. Proceed vertically up to gross weight reference line.
C. Proceed horizontally left to airspeed correction; +2.7 knots.

Calibrated airspeed = 72 knots +2.7 knots = 74.7 KCAS.

DENSITY ALTITUDE CHART

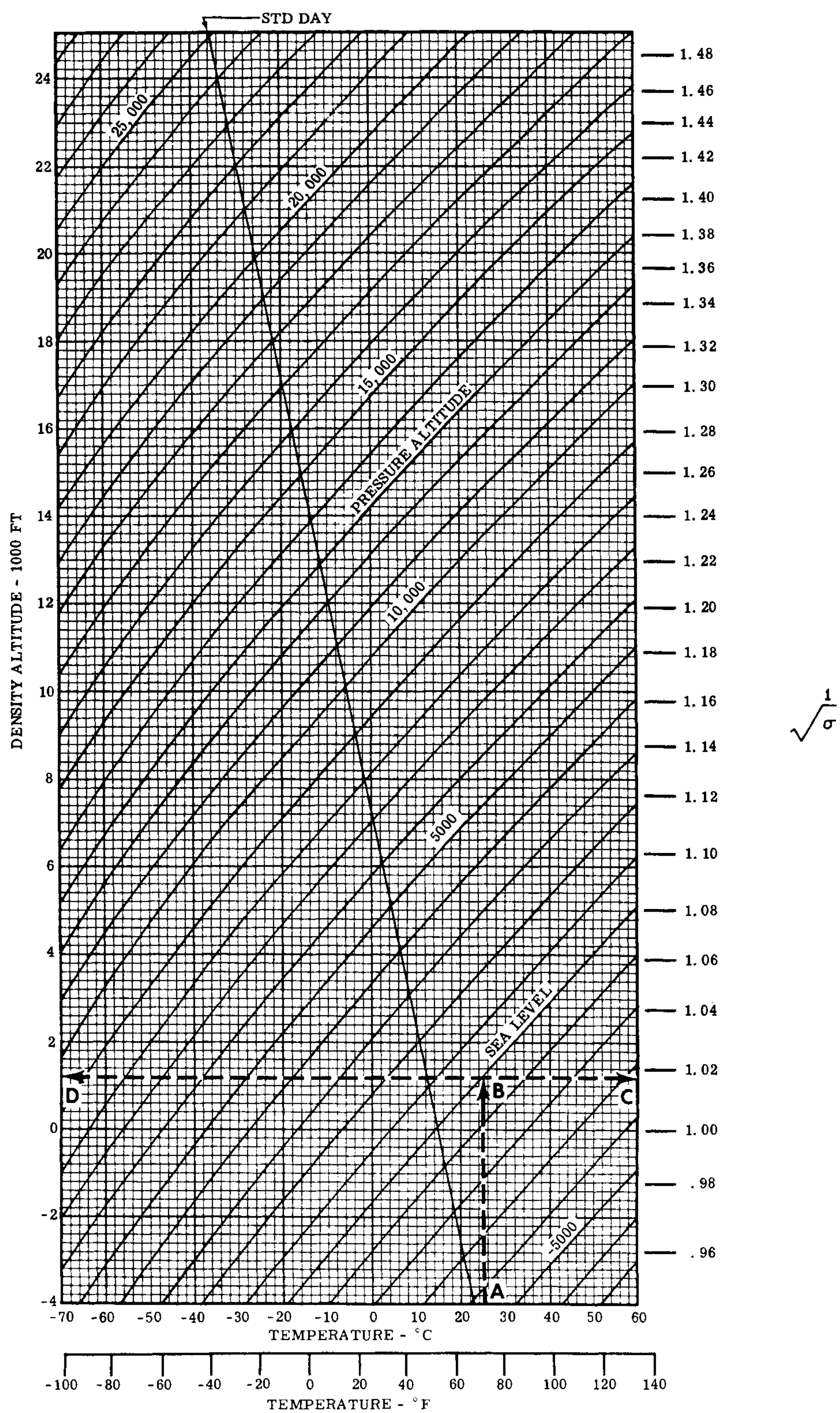


Figure B1-1.

AIRSPEED POSITION CORRECTION

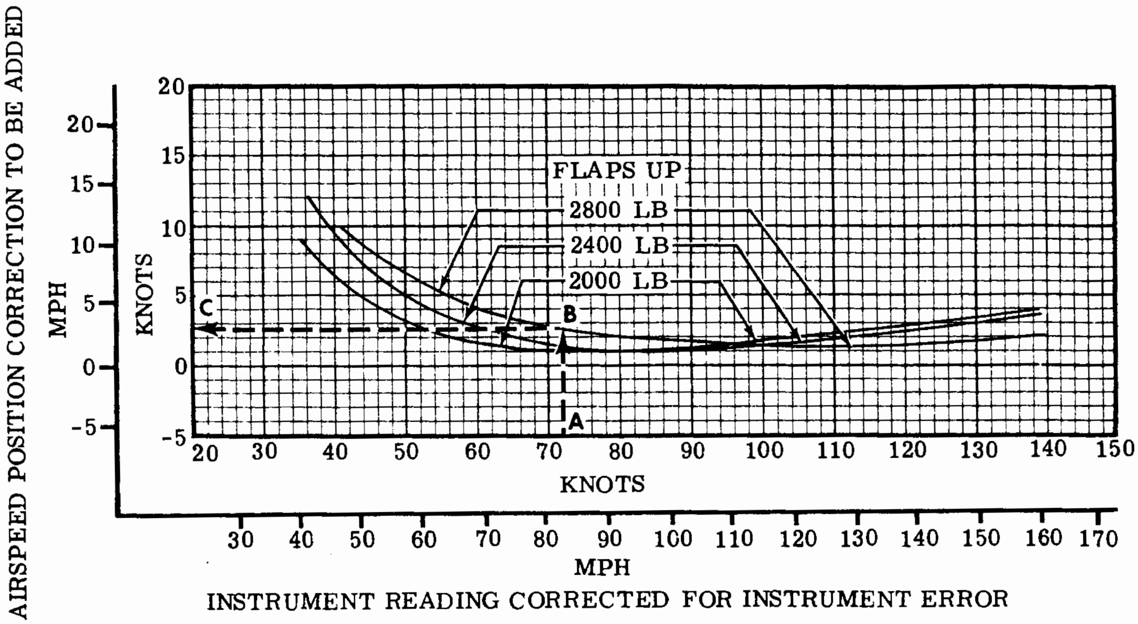
MODEL: O-1F | **ENGINE: (1) O-470-15**

DATA BASIS: FLIGHT TEST | **FUEL GRADE: 80/87**

DATE: 27 FEBRUARY 1967 | **FUEL DENSITY: 6LB/GAl**

NOTE:

ADD CORRECTION TO IAS (INSTRUMENT READING CORRECTED FOR INSTRUMENT ERROR) TO OBTAIN CAS.



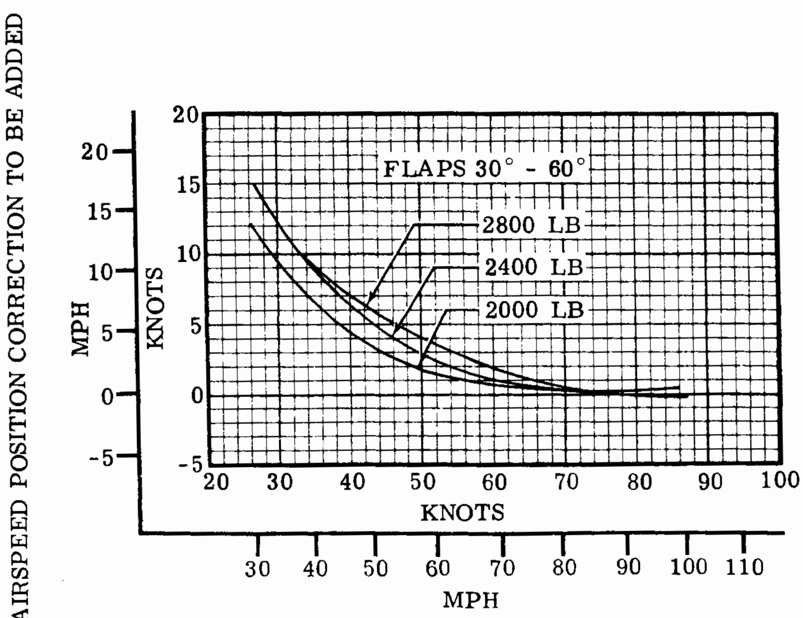


Figure B1-2.

PART II POWER INFORMATION

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ENGINE POWER CHART

The Engine Power Chart (figure B2-1) shows full throttle brake horsepower versus altitude for various engine speeds with lines of full throttle manifold pressure superimposed. Guide lines are included showing the variation of engine power with altitude for constant power setting. These guide lines may be used to determine the engine power for part throttle operation at any altitude. The engine performance with 115/145 grade fuel is identical to the performance with 80/87 grade fuel.

SAMPLE PROBLEM (figure B2-1)

Power setting 1950 RPM, 24 inch manifold pressure, and 5000 feet pressure altitude.

A. Enter chart on the 24 inch Hg. manifold pressure dotted line.
B. Proceed down to intersection of 24 inch Hg. and 1950 RPM.
C. Proceed parallel to guide lines to intersection of 5000 feet pressure altitude line.
D. Proceed horizontally left to read brake horsepower; 130 horsepower.

FUEL FLOW CHART

A fuel flow curve (figure B2-2) shows fuel flow versus brake horsepower with parameters of engine RPM. This data is based on a lean mixture and corresponds to the range shown on the nautical miles per gallon curves.

SAMPLE PROBLEM (figure B2-2)

Brake horsepower 130, 1950 RPM, 24 inch manifold pressure, and lean mixture.

A. Enter chart at 130 horsepower.
B. Proceed vertically up to intersection of 1950 RPM line.
C. Proceed horizontally left and read fuel flow; 10 gallons per hour.

ENGINE POWER CHART

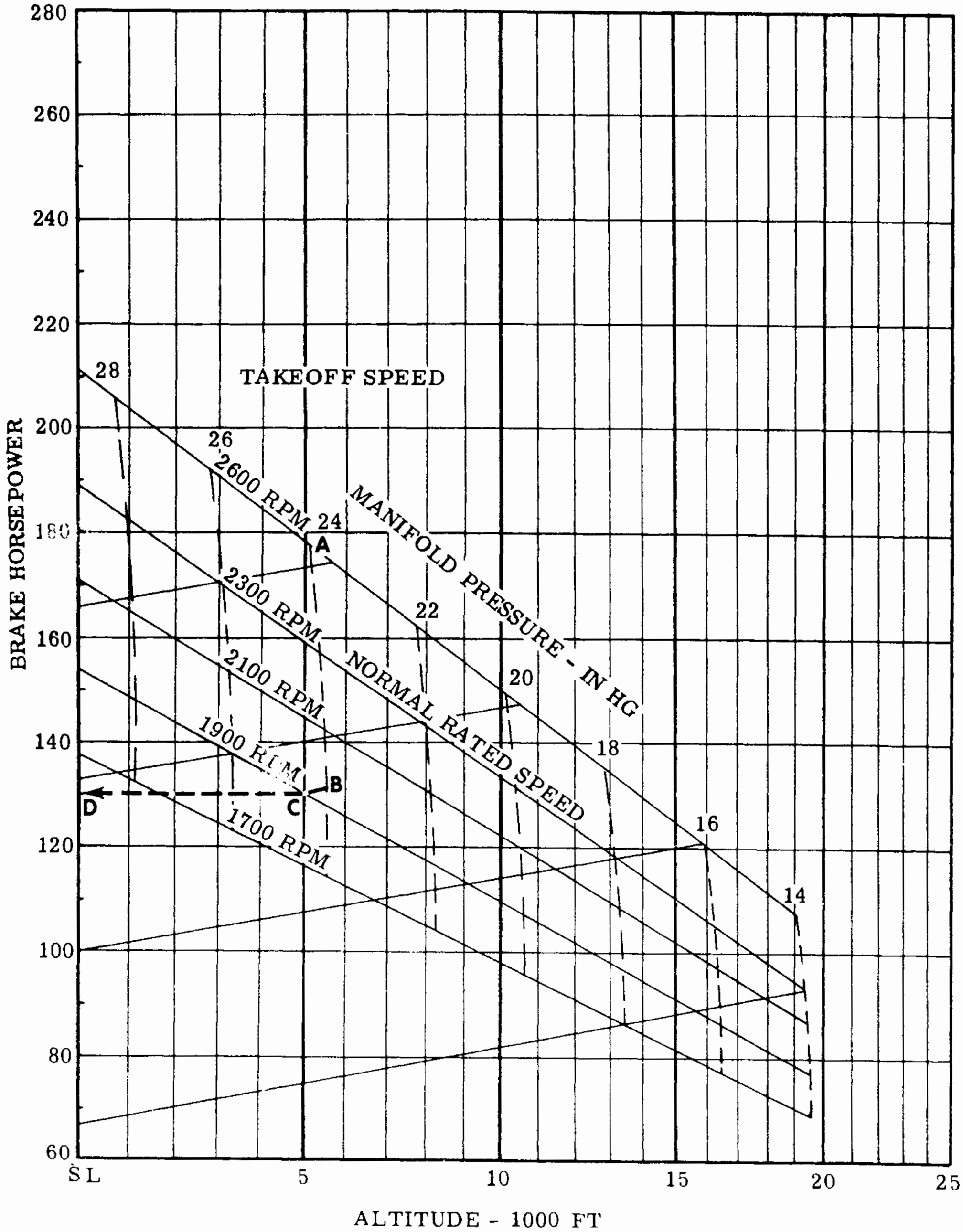
MODEL: O-1F

DATA BASIS: FLIGHT TEST
DATE: 15 APRIL 1957

CONDITIONS:
1. RICH MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6 LB/GAL



NOTE: CORRECT BHP IN ACCORDANCE WITH CARBURETOR AIR TEMP. BY APPLYING THE FOLLOWING
A - ADD 1% FOR EACH 6°C DECREASE FROM STANDARD TEMP.
B - SUBTRACT 1% FOR EACH 6°C INCREASE FROM STANDARD TEMP.

Figure B2-1.

FUEL FLOW

MODEL: O-1F

DATA BASIS: FLIGHT TEST
DATE: 15 APRIL 1957

CONDITIONS:
1. **LEAN MIXTURE**
2. **STANDARD DAY**

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6 LB/GAL

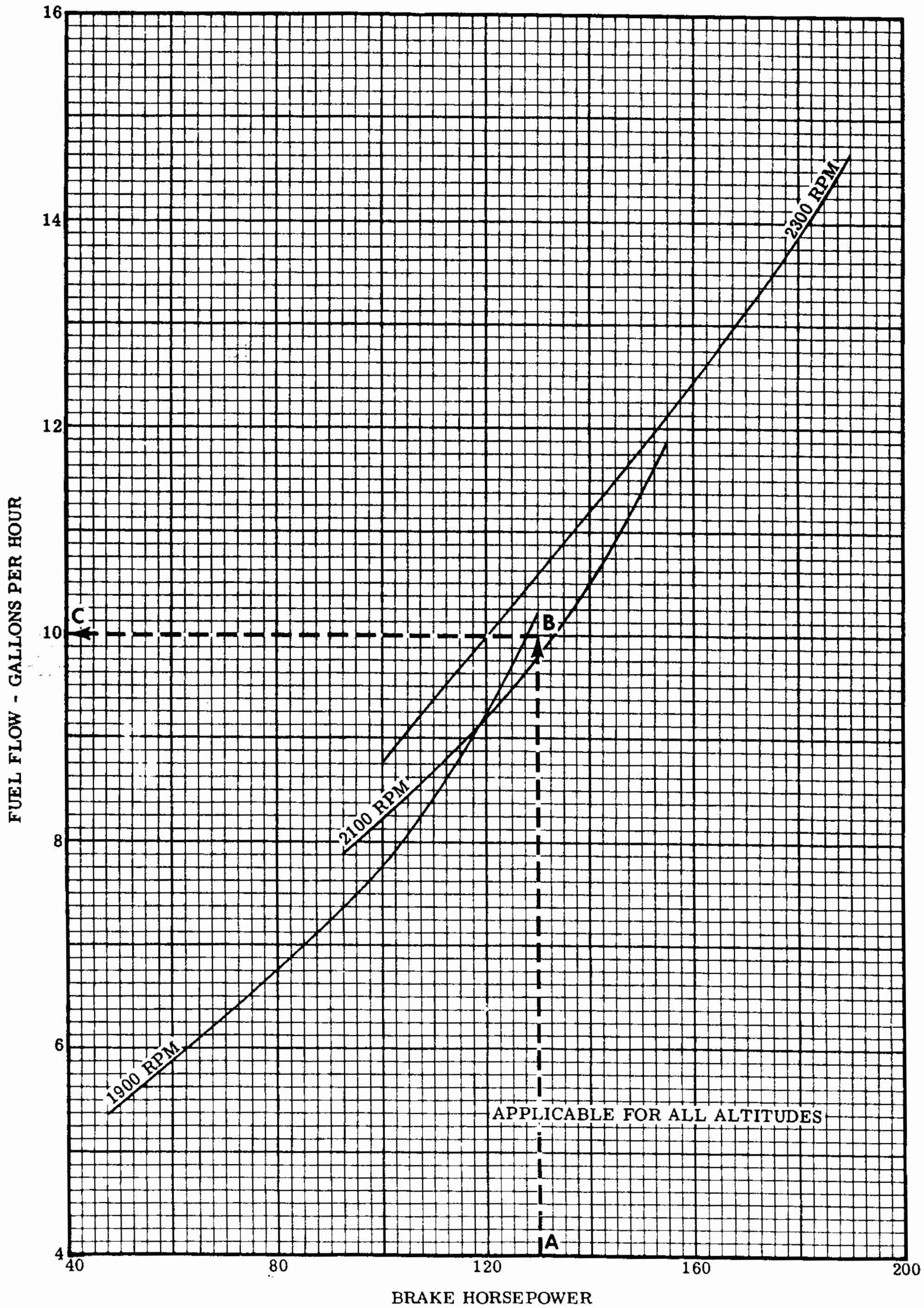


Figure B2-2.

PART III TAKEOFF

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TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

The Takeoff and Landing Crosswind Component Chart (figure B3-1) provides a means of determining whether the crosswind velocity exceeds the recommended maximum for the aircraft. Crosswind direction and velocity are presented by a series of arcs and radials emanating from the lower left-hand corner of the chart. By selecting a point on the chart at the intersection of a velocity arc and a direction radial, a known crosswind can be resolved into a headwind component and crosswind component on the scales at the left and bottom edges of the chart. Crosswind direction is the relative angle between the runway heading and the wind direction, measured either to the right or left.

SAMPLE PROBLEM (figure B3-1)

Takeoff on runway 32, wind from 360° at 15 knots.

A. Since the wind is at an angle of 40° to the runway, start at the intersection of the 40° radial and the 15 knot wind arc.
B. Read headwind component of 11.5 knots.
C. Read 90° crosswind component of 9.5 knots. Both components are in the recommended zone of the chart.

TAKEOFF DISTANCE CHARTS

Takeoff distance charts are presented for minimum takeoff with 30° flaps and normal takeoff with 0° flaps. These charts show takeoff ground run and total distance to clear a 50 foot obstacle for various pressure altitudes and air temperatures. Takeoff distances are shown for hard surface runways using full throttle and takeoff RPM. A correction plot for winds and runway slope and a correction factor for sod runways are included. The distances shown are based on use of the recommended airspeeds shown on the charts for takeoff and climb speeds at 50 foot height. The problems for all landing distance charts are worked in a manner similar to the sample problem shown below.

SAMPLE PROBLEM (figure B3-2)

Hard surface runway, sea level pressure altitude 25°C temperature, 2600 pounds gross weight, 10 knot headwind, and 1% runway downhill slope.

A. Enter chart at 25°C.
B. Proceed vertically up to sea level pressure altitude.
C. Proceed horizontally right to gross weight guide line 2600 pounds.
D. Proceed vertically down to wind component base line.
E. Proceed parallel to headwind component guide lines to 10 knots.
F. Proceed vertically down to runway slope guide line.
G. Proceed parallel to down hill slope guide line to 1%.
H. Proceed vertically down to read ground roll; 285 feet.
J. Proceed vertically down to wind guide line.
K. Proceed horizontally left to find total distance required to clear a 50 foot obstacle; 650 feet.

TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

MODEL: O-1F

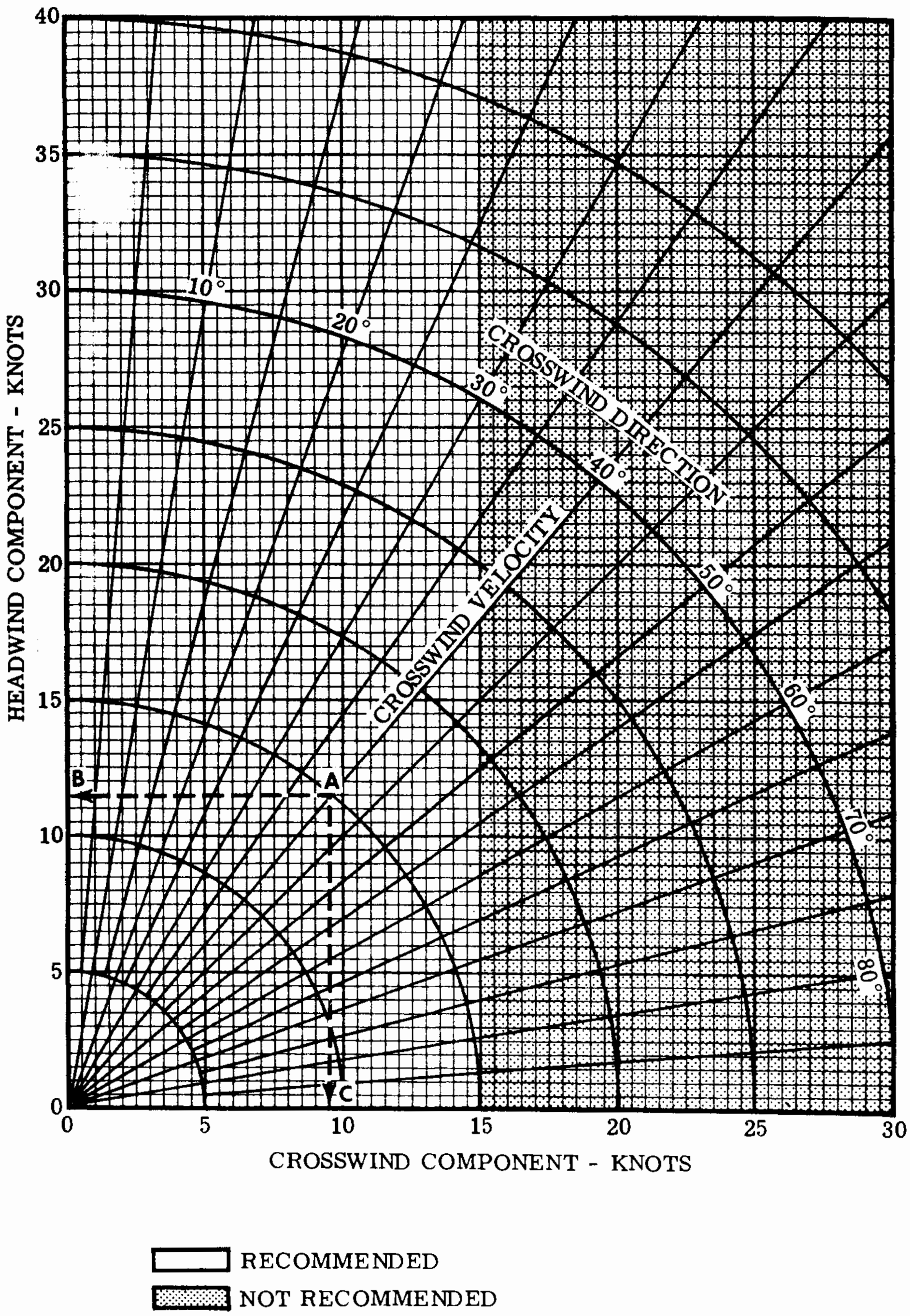
ENGINE: (1) O-470-15

DATA BASIS: FLIGHT TEST

DATE: 27 FEBRUARY 1967

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL



GROUND OPERATION IS NOT RECOMMENDED WHEN WIND EXCEEDS 25 KNOTS FROM ANY DIRECTION.

Figure B3-1.

MINIMUM TAKEOFF DISTANCE

MODEL: O-1F

DATA BASIS: FLIGHT TEST

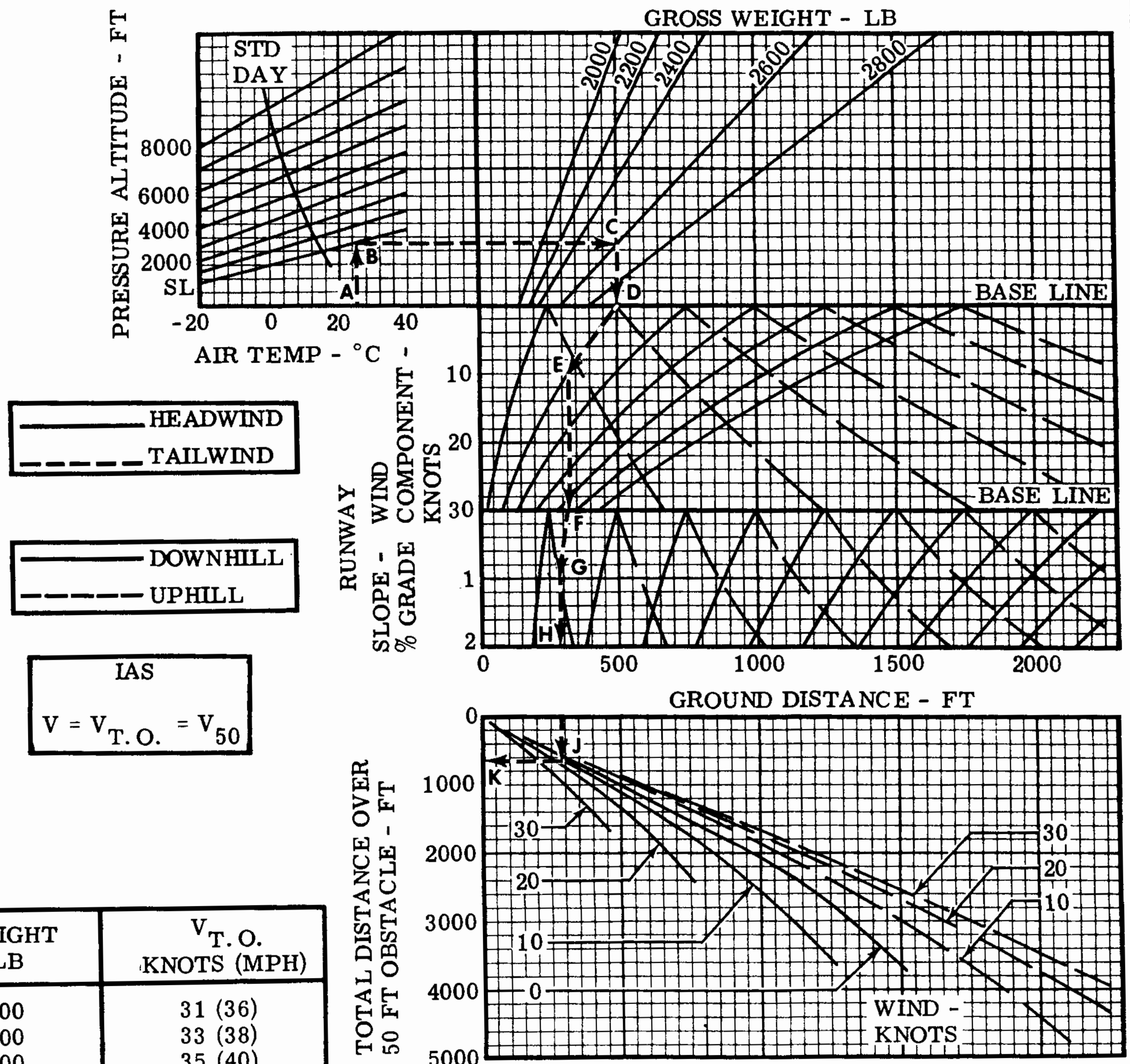
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 30°
3. MAXIMUM POWER

ENGINE: (1) O-470-15

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL



WEIGHT LB	$V_{T.O.}$ KNOTS (MPH)
2000	31 (36)
2200	33 (38)
2400	35 (40)
2600	37 (43)
2800	39 (45)

NOTE: FOR TAKEOFF DISTANCE UTILIZING SOD RUNWAY, INCREASE DISTANCE SHOWN BY APPROXIMATELY 8%.

Figure B3-2.

NORMAL TAKEOFF DISTANCE

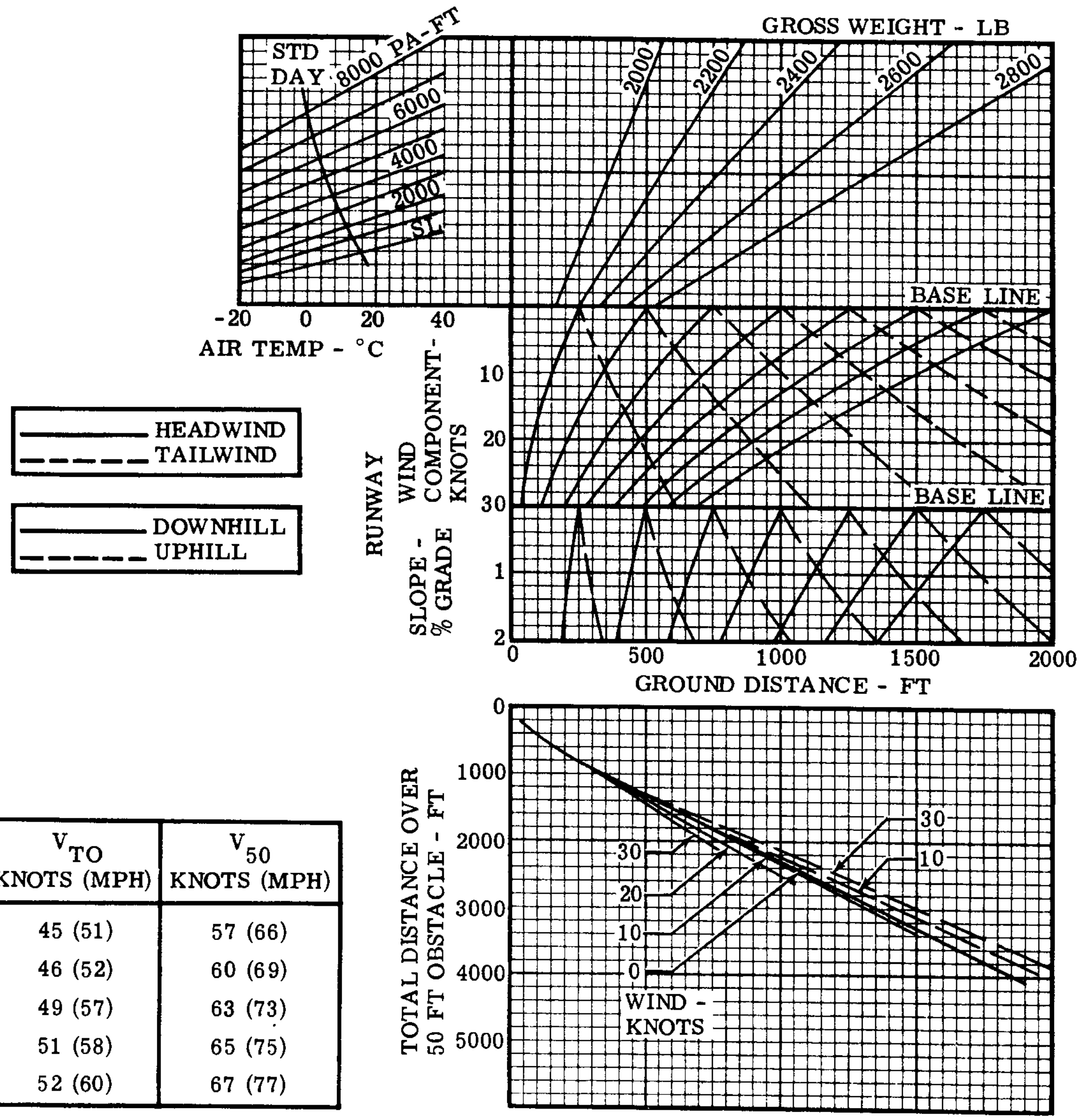
MODEL: O-1F

DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 0°
3. MAXIMUM POWER

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



WEIGHT LB	V_{TO} KNOTS (MPH)	V_{50} KNOTS (MPH)
2000	45 (51)	57 (66)
2200	46 (52)	60 (69)
2400	49 (57)	63 (73)
2600	51 (58)	65 (75)
2800	52 (60)	67 (77)

Figure B3-3.

PART IV CLIMB

BEST RATE-OF-CLIMB CURVE

Distance during climb, time to climb, and fuel used in the climb can be determined from the climb curve (figure B4-1). Best rate-of-climb performance can be obtained for climbs from sea level and in-flight climbs between any altitudes. The data shown is based on 2300 RPM, 24 in. Hg, flaps up, and airspeed for maximum rate of climb as noted in the chart. A correction factor is provided to correct performance for nonstandard day temperatures. In addition, the chart shows the service ceiling attainable at various gross weights.

When the chart is to be used to determine fuel, distance, and time starting at altitudes above sea level, it is necessary to determine values from sea level to the desired cruise altitude and values from sea level to the initial climb altitude. The fuel, distance and time values for the in-flight climb are the differences between the cruise altitude and the initial climb altitude values.

SAMPLE PROBLEM (figure B4-1)

Climb from sea level to 5000 feet at temperature 10°C above standard day. Initial weight 2588 pounds +40 pounds (temperature correction) = 2628 pounds.

A. Enter chart at gross weight 2628 pounds.
B. Proceed parallel to weight guide lines to altitude of 5000 feet.
   Interpolate between 1 gallon and 2 gallon fuel guide lines to determine fuel used in climb; 1. 65 gallons.
C. Proceed horizontally left to determine distance traveled during climb; 7. 9 nautical miles.
D. Proceed left, parallel to guide lines to determine time in climb; 6. 4 minutes.

NORMAL CLIMB CURVE

Distance during climb, time to climb, and fuel used in the climb can be determined from the climb curve (figure B4-2). Normal climb performance can be obtained for climbs from sea level and in-flight climbs between any altitudes. The data shown is based on normal power (full throttle), flaps up and 80 KIAS (90 MPH). A correction factor is provided to correct performance for nonstandard day temperatures. In addition, the chart shows the service ceiling attainable at various gross weights.

When the chart is to be used to determine fuel, distance, and time required starting at altitude above sea level, it is necessary to determine values from sea level to the desired cruise altitude and values from sea level to the initial climb altitude. The fuel, distance and time values for the in-flight climb are the differences between the desired cruise altitude and the initial climb altitude values. Refer to sample problem for figure B4-2.

SAMPLE PROBLEM (figure B4-2)

Climb from 5000 feet to 10, 000 feet. Initial weight 2610 pounds.

A. Enter chart at gross weight 2610 pounds.
B. Proceed parallel to weight guide lines to altitude of 10, 000 feet.
   Interpolate between 3 gallon and 4 gallon fuel guide lines to determine fuel used in climb; 3. 8 gallons.
C. Proceed horizontally left to determine distance traveled during climb; 24. 0 nautical miles.
D. Proceed left, parallel to guide lines to determine time in climb; 15. 3 minutes.
E. Enter chart at gross weight 2610 pounds.
F. Proceed parallel to weight guide lines to altitude of 5000 feet.
   Interpolate between 1 gallon and 2 gallon fuel guide lines to determine fuel used in climb; 1. 65 gallons.
G. Proceed horizontally left to determine distance traveled during climb; 9. 2 nautical miles.
H. Proceed left, parallel to guide lines to determine time in climb; 6. 1 minutes.

To determine fuel, distance, and time for the climb, subtract the 5000 feet values from the 10, 000 feet values.

Fuel consumed = 3. 80 gallons -1. 65 gallons = 2. 15 gallons.
Distance traveled = 24. 0 nautical miles -9. 2 nautical miles = 14. 8 nautical miles.
Time required = 15. 3 minutes -6. 1 minutes = 9. 2 minutes

BEST RATE-OF-CLIMB CURVE

DISTANCE, TIME, & FUEL

2300 RPM

24 IN HG

MODEL: O-1F

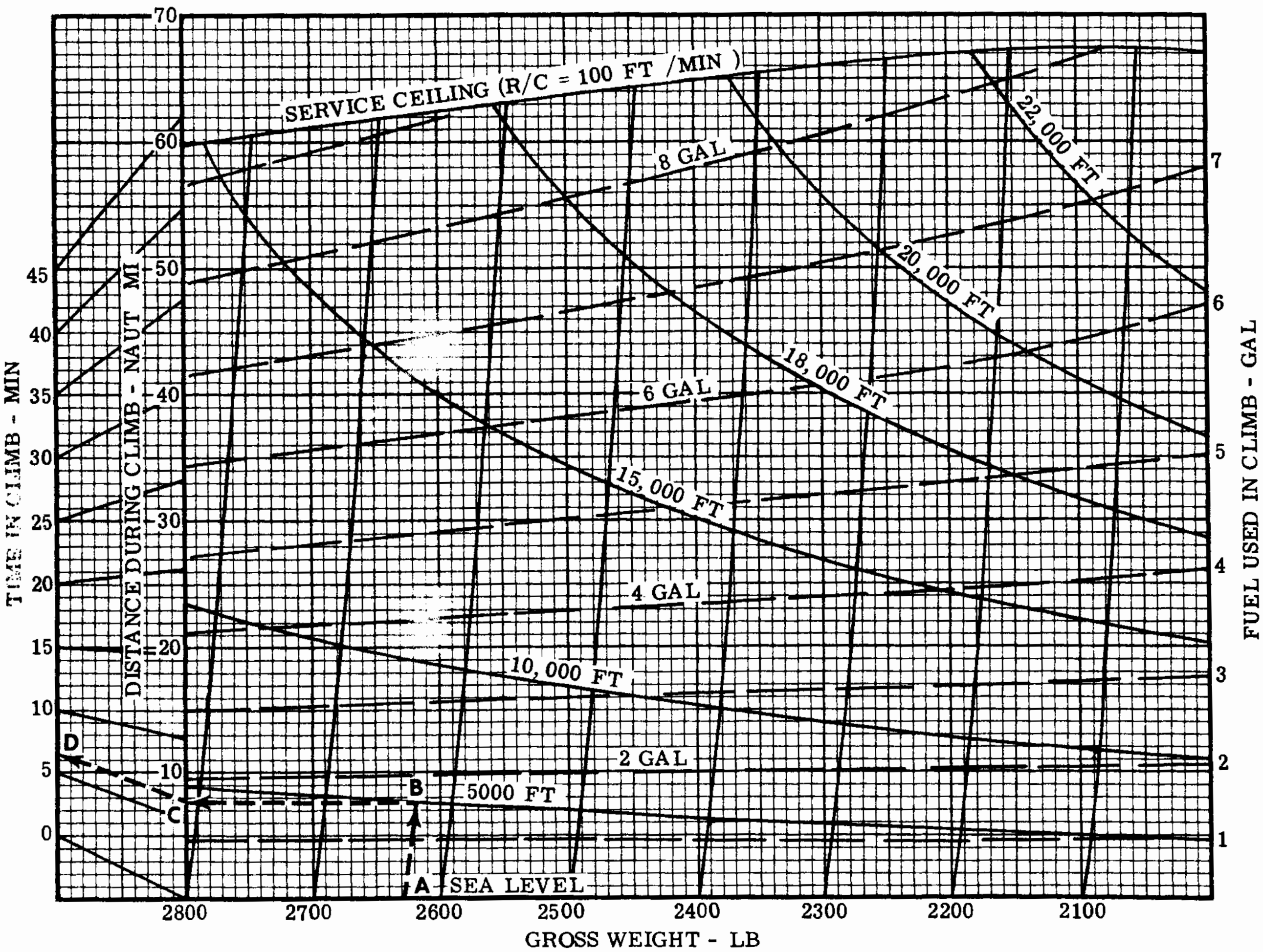
ENGINE: (1) O-470-15

DATA BASIS: FLIGHT TEST

DATE: 27 FEBRUARY 1967

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL



CLIMB SPEEDS

ALT	SL	5000	10,000	15,000	20,000
IAS MPH	83	80	77	74	70
IAS KNOTS	72	69	67	64	61

NOTE: FOR EACH 10°C HOTTER THAN STANDARD O. A. T. ADD 40 LBS TO ACTUAL GROSS WEIGHT TO OBTAIN EQUIVALENT WEIGHT FOR CLIMB.

Figure B4-1.

NORMAL CLIMB CURVE

DISTANCE, TIME & FUEL
2300 RPM 24 IN. HG.
80 KIAS (90 MPH)

MODEL: O-1F
DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

ENGINE: (1) O-470-15
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

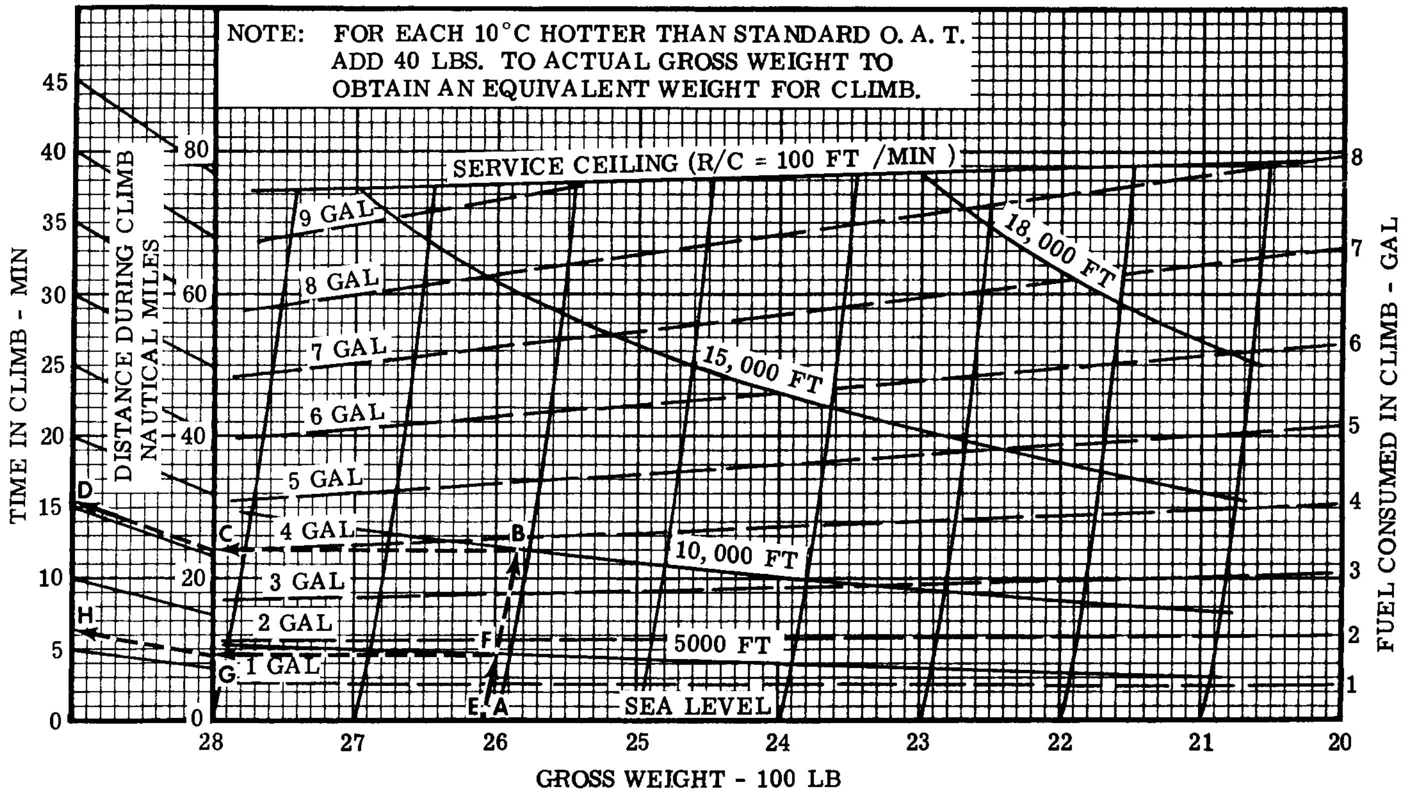


Figure B4-2.

PART V CRUISE

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NAUTICAL MILES PER GALLON OF FUEL CURVES

Cruise performance is presented in the form of nautical miles per gallon of fuel (figure B5-1 through B5-4) as a function of calibrated airspeed in knots (or MPH) with a subscale of true airspeed in knots. Nautical miles per gallon of fuel curves (figure B5-1 through B5-4) are presented for altitudes of sea level, 5000, 10,000 and 15,000 feet for gross weights from maximum to minimum probable flight weights. The performance shown is based on the use of lean mixture. The curves show the complete speed range of the aircraft from maximum speed with normal power down to the speed recommended for maximum endurance. A line of recommended airspeed is shown for both a zero knot wind and 50 knot headwind and is based on the highest speed possible which gives long range performance. A note is included on the charts showing how gallons per hour can be obtained.

SAMPLE PROBLEM (figure B5-2)

Altitude 5000 feet, 2500 pounds gross weight, and zero wind.

A. Enter chart at 2500 pounds gross weight on the no wind reference line.
B. Proceed vertically down to read calibrated airspeed; 94 knots.
C. Proceed horizontally left from point A to read nautical miles per gallon of fuel; 14.30.
D. Interpolate point A between RPM/MP reference lines; 1900 RPM, 18.50 in. Hg.

LONG RANGE PREDICTION - DISTANCE

The Long Range Distance Prediction Chart (figure B5-5) can be used to determine the maximum distance possible at altitude for a given fuel load or to find fuel used to cover a given distance at altitude. Data shown on this chart is based on the long range cruising speeds shown on the Nautical Miles Per Gallon of Fuel Charts.

SAMPLE PROBLEM (figure B5-5)

Altitude 10,000 feet, required distance 140 nautical miles, and initial gross weight 2620 pounds.

A. Enter chart at 2620 pounds gross weight.
B. Proceed vertically up to 10,000 feet reference line.
C. Proceed horizontally left and read air distance; 627 nautical miles.
D. Enter chart with final chart distance; 140 nautical miles +627 nautical miles = 767 nautical miles.
E. Proceed horizontally right to 10,000 feet reference line.
F. Proceed vertically down to read final gross weight; 2560 pounds.

Fuel required = initial gross weight - final gross weight = 2620 - 2560 = 60 pounds = 10.0 gallons.

LONG RANGE PREDICTION - TIME

The Long Range Time Prediction Chart (figure B5-6) shows the time expended in cruising if the fuel available for cruising is known. The data shown on this chart is based on the long range cruising speeds and should be used in connection with the Distance Prediction Chart.

SAMPLE PROBLEM (figure B5-6)

Initial gross weight 2620 pounds, final gross weight 2560 pounds, and cruise altitude 10,000 feet.

A. Enter chart at 2620 pounds gross weight.
B. Proceed vertically up to 10,000 feet reference line.
C. Proceed horizontally left to read initial time; 6.0 hours.
D. Enter chart at 2560 pounds gross weight.
E. Proceed vertically up to 10,000 feet reference line.
F. Proceed horizontally left to read final time, 7.3 hours.

Time at altitude = final time-initial time = 7.3 - 6.0 = 1.3 hours.

NAUTICAL MILES PER GALLON OF FUEL

SEA LEVEL

MODEL: O-1F

DATA BASIS: FLIGHT TEST

DATE: 27 FEBRUARY 1967

CONDITIONS:
1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-15

FUEL GRADE: 80/87

FUEL DENSITY: 6LB/GAL

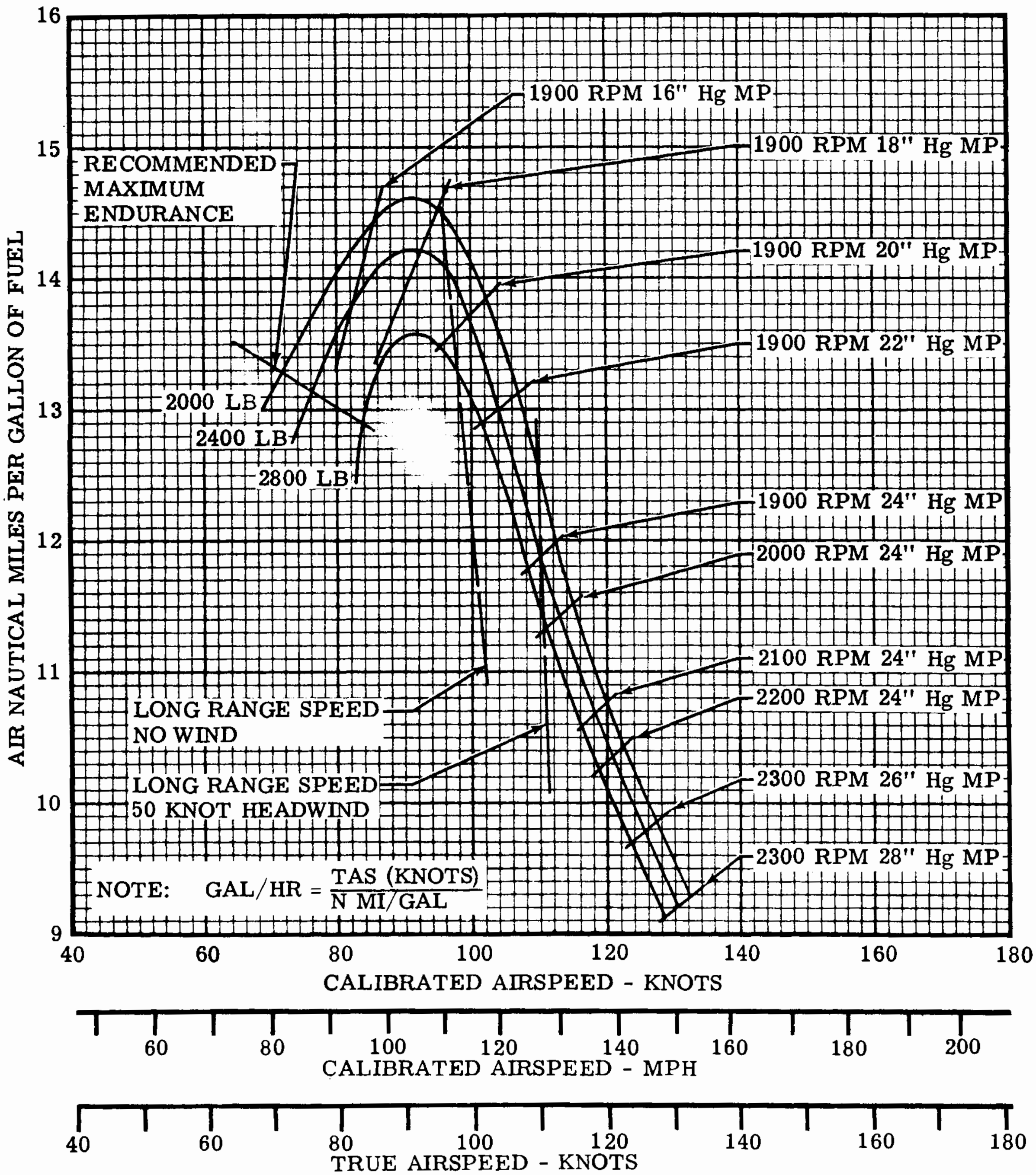


Figure B5-1.

NAUTICAL MILES PER GALLON OF FUEL

5000 FEET

MODEL: O-1F

CONDITIONS:

ENGINE: (1) O-470-15

DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

1. LEAN MIXTURE
2. STANDARD DAY

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

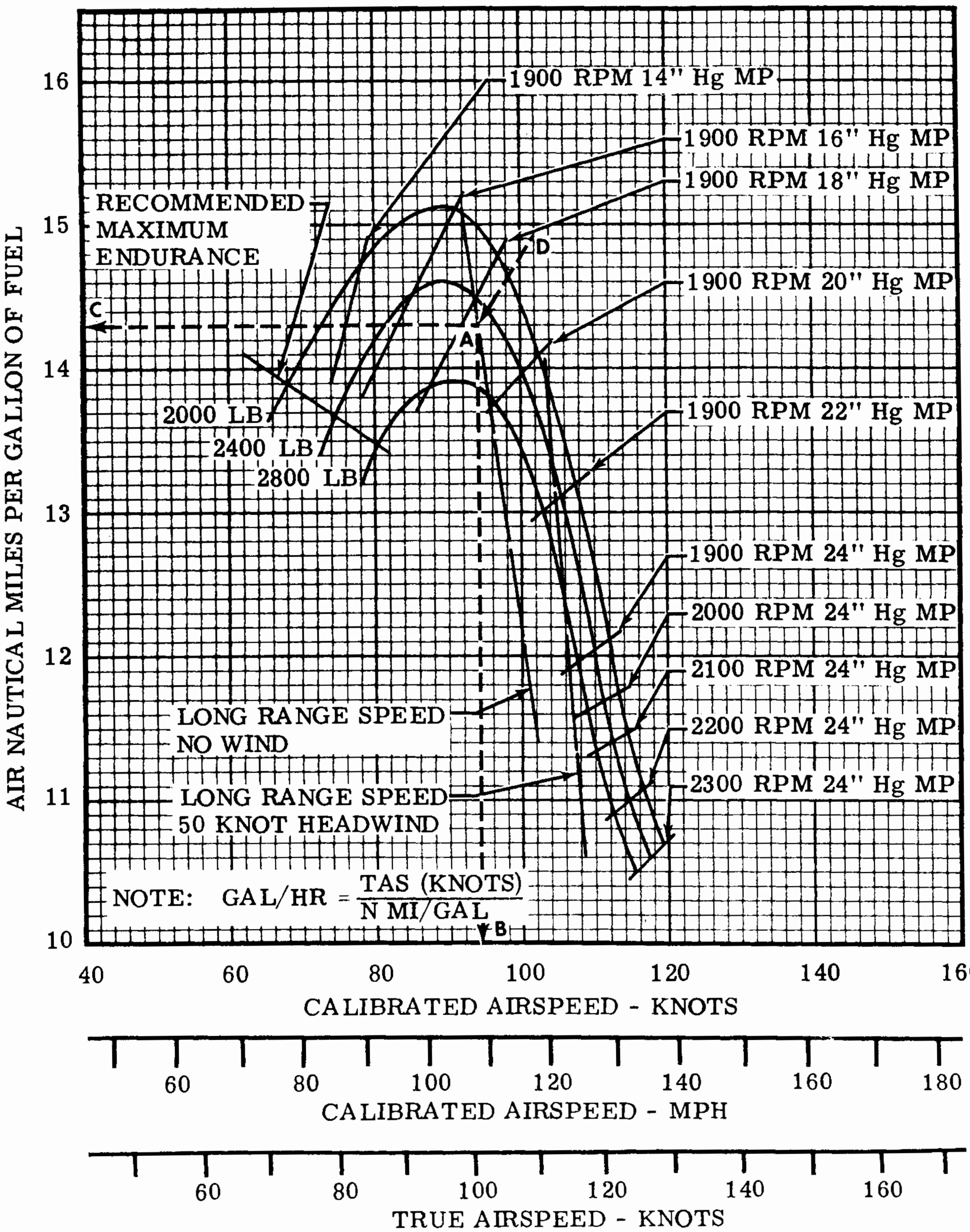


Figure B5-2

NAUTICAL MILES PER GALLON OF FUEL

10,000 FEET

MODEL: O-1F	CONDITIONS:	ENGINE: (1) O-470-15
DATA BASIS: FLIGHT TEST	1. LEAN MIXTURE	FUEL GRADE: 80/87
DATE: 27 FEBRUARY 1967	2. STANDARD DAY	FUEL DENSITY: 6LB/GAL

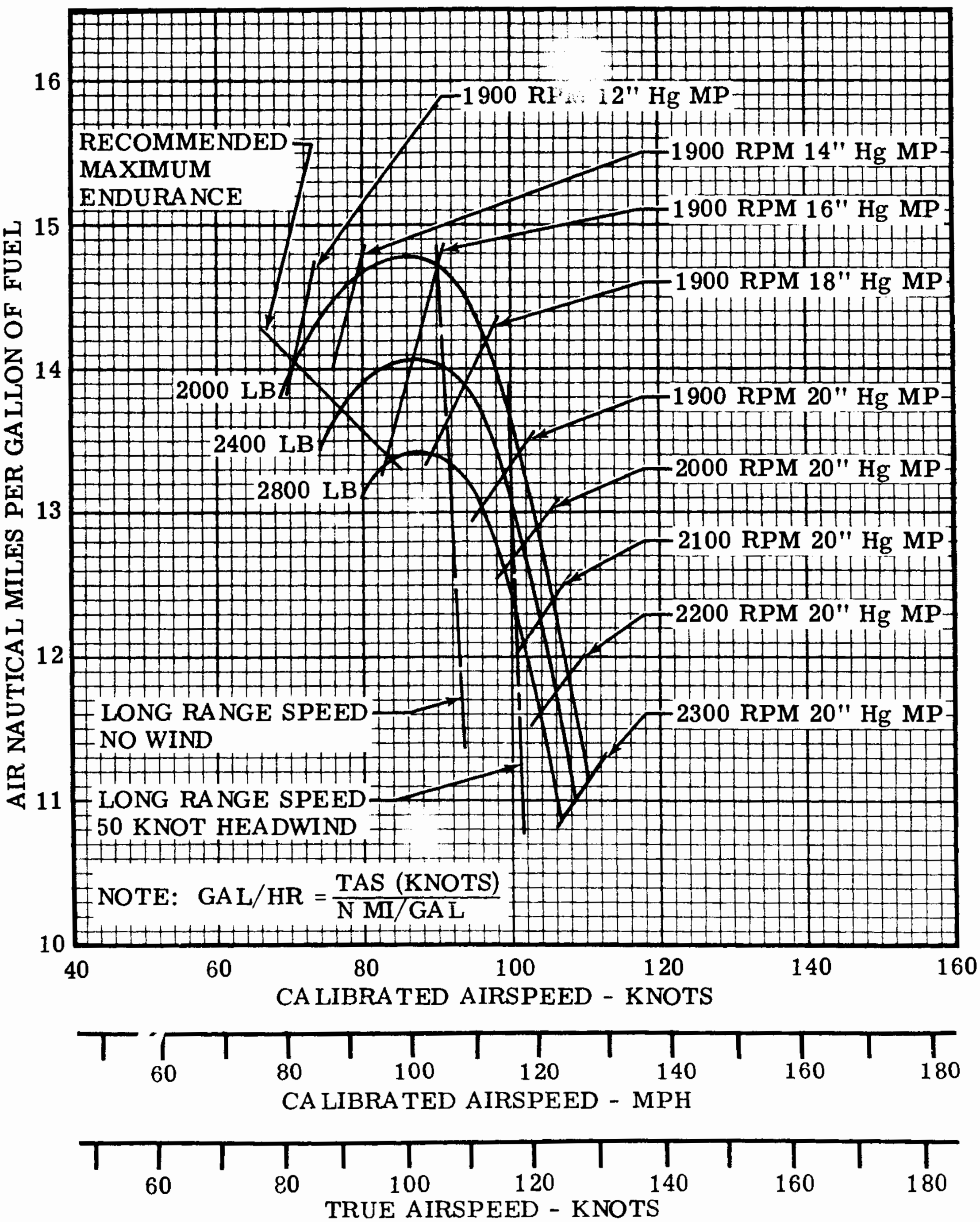


Figure B5-3.

NAUTICAL MILES PER GALLON OF FUEL

15,000 FEET

MODEL: O-1F

DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:

1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

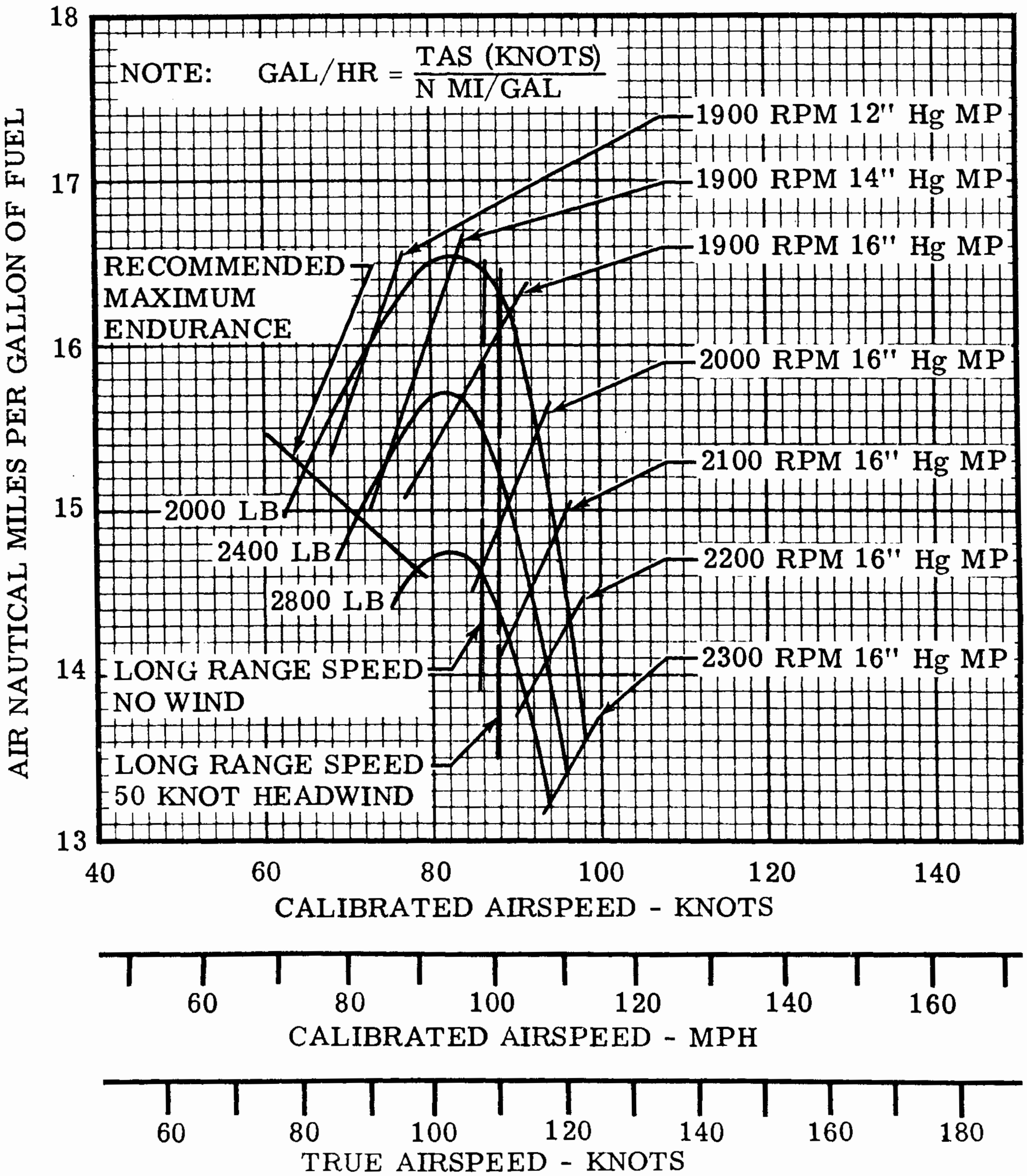


Figure B5-4.

LONG RANGE PREDICTION-DISTANCE

MODEL: O-1F

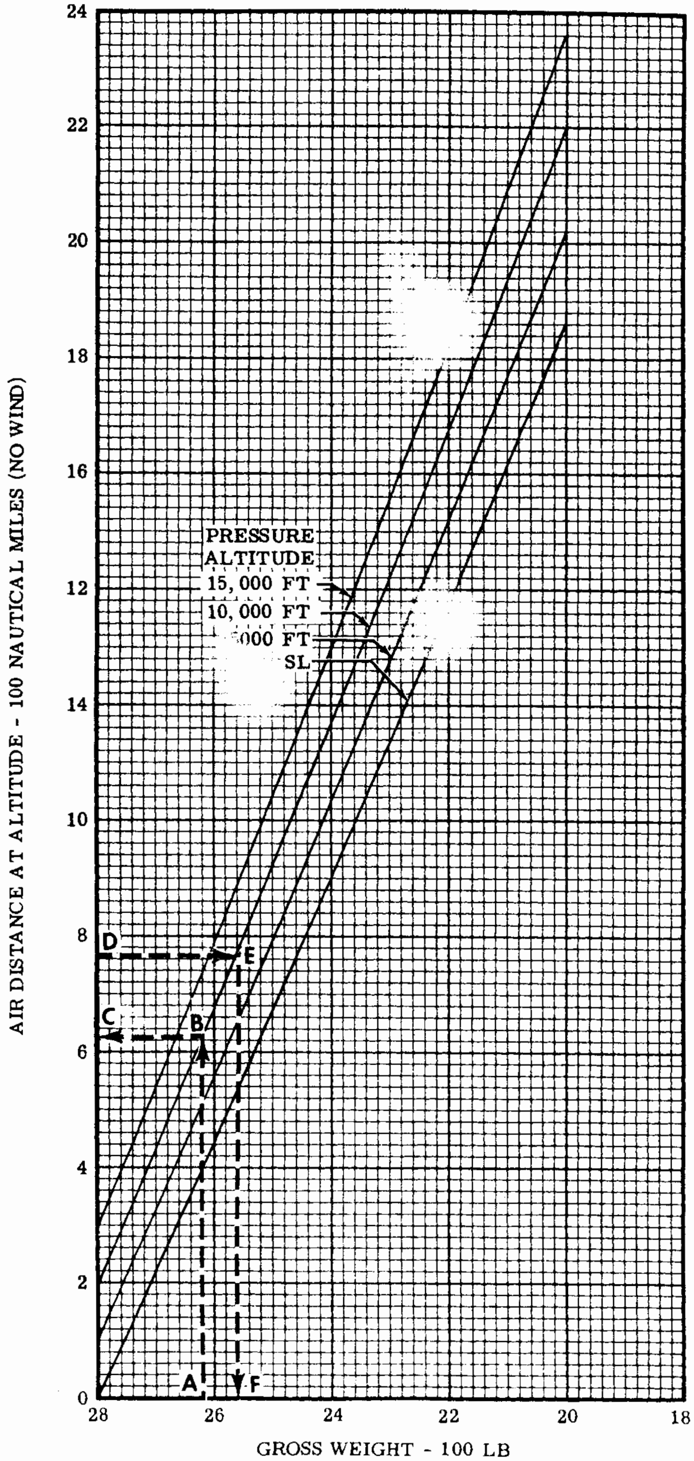
DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:

1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



NOTES:

(1) DATA BASED ON LONG RANGE CRUISE SPEEDS.
(2) DISTANCE COVERED DURING CLIMB TO ALTITUDE IS NOT INCLUDED ON THIS CHART.

Figure B5-5.

LONG RANGE PREDICTION-TIME

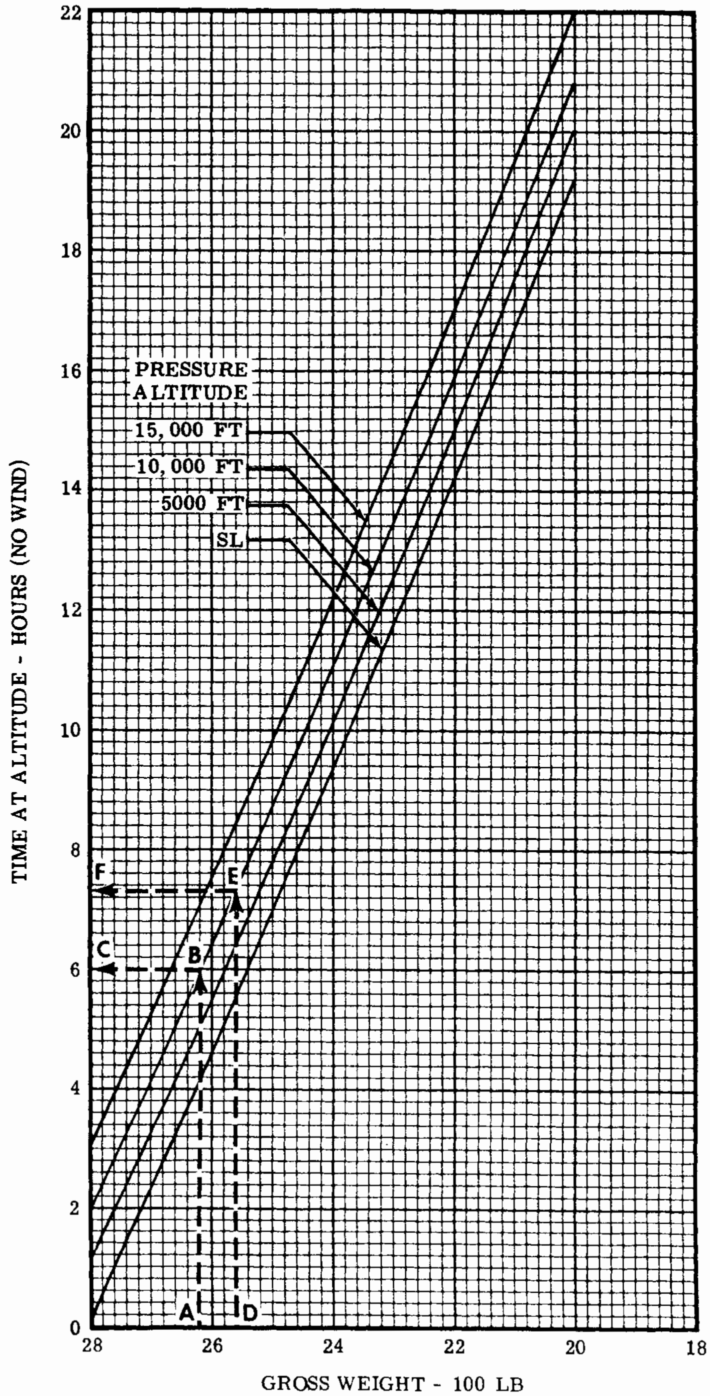
MODEL: O-1F

DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. LEAN MIXTURE
2. STANDARD DAY

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



NOTES:

(1) DATA BASED ON LONG RANGE CRUISE SPEEDS.
(2) TIME TO CLIMB TO ALTITUDE IS NOT INCLUDED ON THIS CHART.

Figure B5-6.

PART VI DESCENT DATA

No specific curves for descent data are required. Check Section II for proper descent procedure.

PART VII LANDING

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TAKEOFF AND LANDING CROSSWIND COMPONENT CHART

The Takeoff and Landing Crosswind Component Chart (figure B3-1) provides a means of determing whether the crosswind velocity exceeds the recommended maximum for the aircraft. Crosswind direction and velocity are represented by a series of arcs and radials emanating from the lower left-hand corner of the chart.

By selecting a point on the chart at the intersection of a velocity arc and a direction radial, a known crosswind can be resolved into a headwind component and tailwind component on the scales at the left and bottom edges of the chart. Crosswind direction is the relative angle between the runway heading and wind direction, measured either to the left or to the right.

LANDING DISTANCE CHARTS

Landing performance charts are presented for minimum landing distances with 60° flaps and normal landing distances with 0° and 30° flaps. The charts show landing ground rolls and total distances over a 50 foot obstacle for various pressure altitudes and air temperatures. Correction plots for wind and runway slope are included on all charts. In addition, each chart presents approach and landing speed information for particular gross weights. The problems for all landing distance charts are worked in a manner similar to the sample problem shown below.

SAMPLE PROBLEM (figure B7-3)

Hard surface runway, 22°C temperature, 2600 pounds gross weight, 2000 feet pressure altitude, 10 knot headwind, and 1% downhill slope.

A. Enter chart at 22°C.
B. Proceed vertically up to 2000 feet pressure altitude.
C. Proceed horizontally right to gross weight line 2600 pounds.
D. Proceed vertically down to wind component base line.
E. Proceed parallel to headwind component guide line to 10 knots.
F. Proceed vertically down to runway slope base line.
G. Proceed parallel to down hill slope guide line to 1%.
H. Proceed vertically down to read ground roll; 230 feet.
J. Proceed vertically down to wind guide line.
K. Proceed horizontally left to find landing distance from 50 feet; 975 feet.

CORRECTION TO LANDING GROUND ROLL FOR RUNWAY CONDITION READING

The correction to landing ground roll (figure B7-4) for Runway Condition Reading (R.C.R.) Chart is to be used with the Minimum Landing Distances Chart and Normal Landing Distances Charts to correct for runway surface material and condition. The chart is based on dry hard surface runways and includes corrections for dry pavement to ice-covered runways.

SAMPLE PROBLEM (figure B7-4)

For a hard surface ground run of 300 feet, find sod surface distance.

A. Enter chart at 300 feet.
B. Proceed vertically up to sod reference line.
C. Proceed horizontally left and read corrected ground roll; 345 feet.

NORMAL LANDING DISTANCE

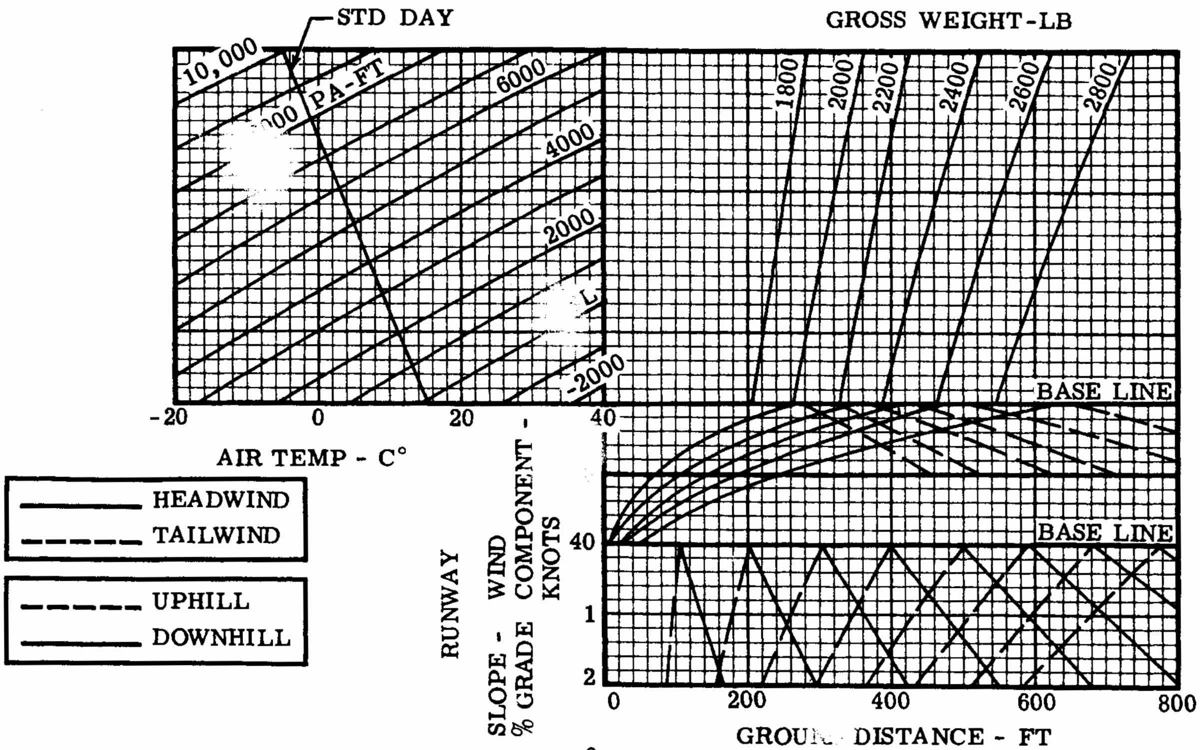
MODEL: O-1F

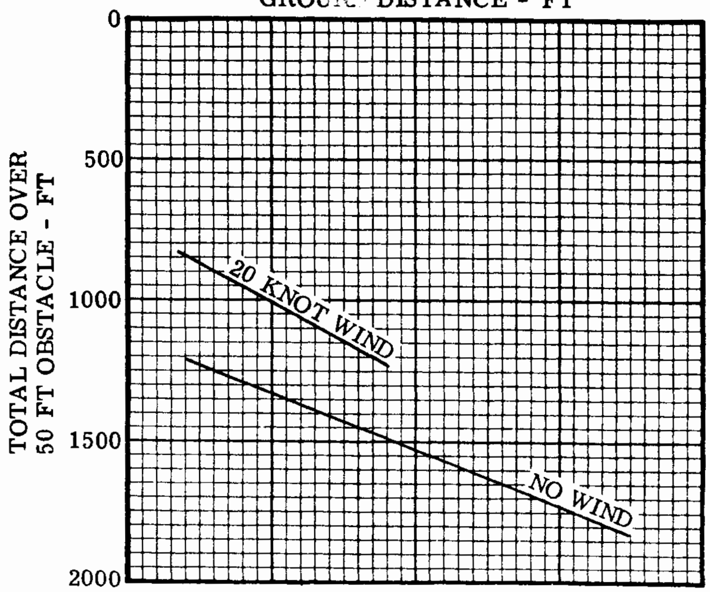
DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. **HARD SURFACE RUNWAY**
2. **FLAPS -0°**
3. **POWER-OFF**

ENGINE: (1) O-470-15

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL





WEIGHT LB	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	73	84	58	67
2600	70	81	55	63
2400	68	78	53	61
2200	64	74	52	60
2000	61	70	49	56
1800	58	67	46	53

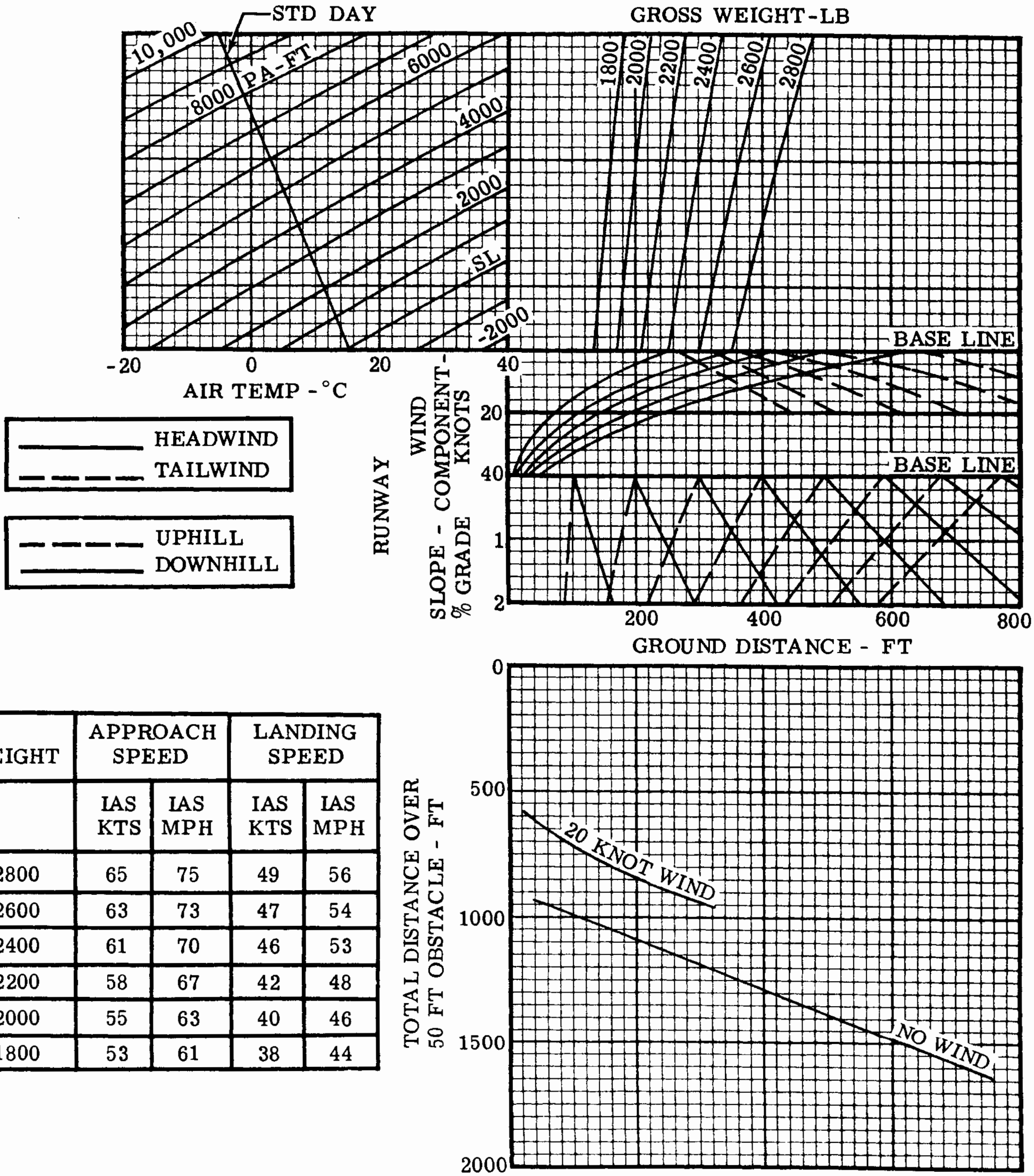
Figure B7-1.

NORMAL LANDING DISTANCE

MODEL: O-1F
DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 30°
3. POWER OFF

ENGINE: (1) O-470-15
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



WEIGHT	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	65	75	49	56
2600	63	73	47	54
2400	61	70	46	53
2200	58	67	42	48
2000	55	63	40	46
1800	53	61	38	44

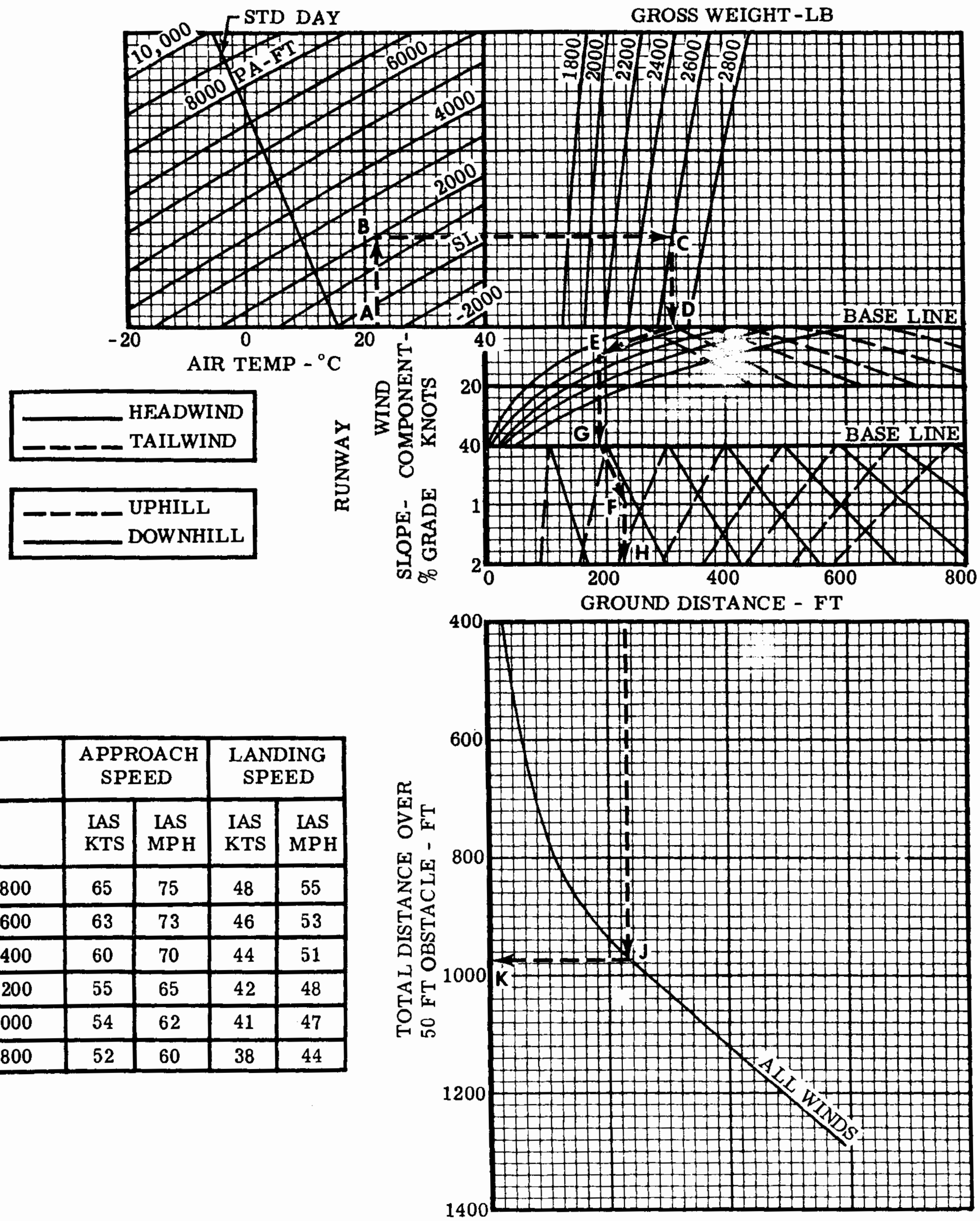
Figure B7-2.

MINIMUM LANDING DISTANCE

MODEL: O-1F
DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

CONDITIONS:
1. HARD SURFACE RUNWAY
2. FLAPS 60°
3. POWER OFF

ENGINE: (1) O-470-15
FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL



	APPROACH SPEED		LANDING SPEED	
	IAS KTS	IAS MPH	IAS KTS	IAS MPH
2800	65	75	48	55
2600	63	73	46	53
2400	60	70	44	51
2200	55	65	42	48
2000	54	62	41	47
1800	52	60	38	44

Figure B7-3.

CORRECTION TO LANDING GROUND ROLL FOR RUNWAY CONDITION READING (R C R)

MODEL: O-1F

ENGINE: (1) O-470-15

DATA BASIS: FLIGHT TEST
DATE: 27 FEBRUARY 1967

FUEL GRADE: 80/87
FUEL DENSITY: 6LB/GAL

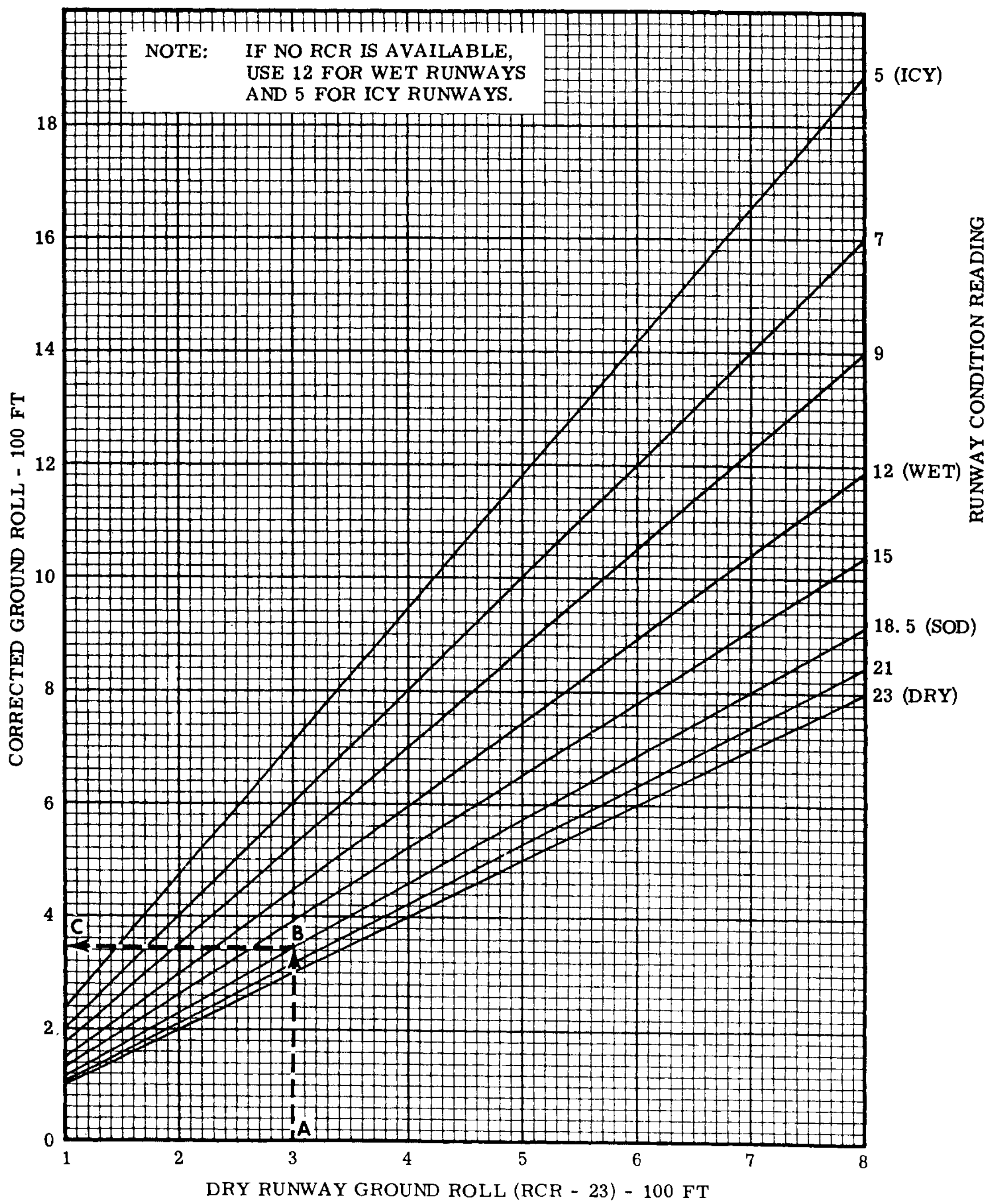


Figure B7-4.

PART VIII MISSION PLANNING

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TAKEOFF AND LANDING DATA CARD

The takeoff and landing data card included in T. O. 1L-1A-1CL-1, "Pilot's Abbreviated Flight Crew Checklist," is placed in a binder with a plastic envelope so it can be filled out with a wax pencil for each mission. The takeoff and landing information for the planned mission shall be entered on the data card and used as a ready reference for review prior to takeoff and landing. A complete sample problem of mission, to familiarize the pilot with the use of the charts and procedures to fill out the takeoff and landing data card, is shown at the end of this Section.

SYMBOLS AND DEFINITIONS

SYMBOLS	DEFINITIONS
CAS	Calibrated airspeed, indicated airspeed corrected for position error. $CAS = IAS + V_i$.
GS	Ground speed, true airspeed corrected for the wind component velocity. $GS = TAS + V_w$.
H_d	Density altitude, that value obtained from the density altitude chart, figure B1-1, at which air density at the observed pressure altitude equals air density as defined by the International Civil Aviation Organization.
IAS	Indicated airspeed, airspeed indicator uncorrected. Where this symbol (IAS) is used on the performance charts, mechanical error in the instrument is assumed to be zero.
Kn or Kts	Knots, nautical miles per hour.
OAT	Outside air temperature.
TAS	True airspeed, calibrated airspeed corrected for atmospheric density. $TAS = CAS \times \frac{1}{\sqrt{\sigma}}$.
V_{APP}	Approach speed.
V_i	Airspeed position error correction.
V_{TD}	Touchdown speed.
V_{TO}	Takeoff speed.
V_{50}	Speed at the 50 foot obstacle.

SUMMARY

Check your flight plan during the actual flight to determine whatever deviations exist. These deviations may be applied to the reserve expected at the destination. The most important factors to consider are:

Fuel used during start, taxi, and takeoff.

Wind effect.

Deviations from the recommended climb schedule.

Deviations from the recommended cruise setting.

Navigational errors and fuel actually on board at takeoff.

TAKEOFF AND LANDING DATA CARD

TAKEOFF DATA

CONDITIONS (Base Airfield)

Gross Weight	2400	LB
Field Length	7500	FT
Outside Air Temperature	11	°C
Pressure Altitude	2000	FT
Effective Wind 30° Dir	10	KN

TAKEOFF

Takeoff Ground Roll (no obstacle)	300	FT
Takeoff Over 50 FT Obstacle	630	FT
Obstacle Clearance Speed	35	KIAS

LANDING IMMEDIATELY AFTER TAKEOFF

Approach Speed at 50 FT	60	KIAS
Landing Distance Over 50 FT	910	FT

LANDING DATA

CONDITIONS (Remote Airfield)

Gross Weight	2333	LB
Field Length	1800	FT
Outside Air Temperature	14	°C
Pressure Altitude	500	FT
Effective Wind 0° Dir	0	KN

LANDING

Landing Distance Over 50 FT	940	FT
Approach Speed at 50 FT	59	KIAS

SAMPLE PROBLEM

The following sample problem employs actual graph values demostrating how the graphs should be used. It is required that the aircraft be flown 100 nautical miles to a remote airfield, land and return without refueling. Base airfield is at 2000 feet and the remote airfield is at 500 feet.

Write down condition of problem:

1. Required range .... 200 nautical miles plus reserve.
2. Base airfield (runway 7, 7500 feet long, dry hard, level surface).
   - Elevation .... 2000 feet
   - Surface winds .... 30°, 10 knots
   - Outside air temp .... 11°C
3. Winds aloft (at airfield).
   - Headwind at 5000 feet .... 10 knots
   - Headwind at 10, 000 feet .... 20 knots
4. Remote airfield (runway 24, 1800 feet long, sod surface, 2% up slope, landing over a 50-foot obstacle).
   - Elevation .... 500 feet
   - Surface winds .... 0°, 0 knots
   - Outside air temp .... 14°C
5. Aircraft gross weight.

Aircraft basic weight (includes trapped fuel and oil)	1707 LBS
Crew (2)	400 LBS
Oil weight (10 qt)	19 LBS
Misc. - Flight equipment	46 LBS
Fuel Load (38 gal)	228 LBS
Takeoff gross weight	2400 LBS

The flight out will be flown at 5000 feet for most favorable headwinds. A landing will be made at the remote base and no fuel will be taken aboard. The return trip will be made at 10, 000 feet where tailwinds are more favorable.

The flight is divided into four segments as follows:

- Segment 1 - Warmup, takeoff and climb to 5000 feet
- Segment 2 - Flight to remote airfield
- Segment 3 - Warmup, takeoff and climb to 10, 000 feet
- Segment 4 - Return flight

TAKEOFF AND CLIMB

1. Refer to the Takeoff and Landing Crosswind Component Chart (figure B3-1) for headwind and crosswind components at takeoff. Headwind is $7\frac{1}{2}$ knots. crosswind is $6\frac{1}{2}$ knots for the wind conditions of 40° to the runway at 10 knots. This is within the recommended takeoff area of the chart.

2. Use the Minimum Takeoff Distance Chart (figure B3-2) to find runway length required for takeoff. Enter the chart with the air temperature at the field. For 11°C, 2000 feet pressure altitude, 2400 pounds gross weight, $7\frac{1}{2}$ knot headwind, hard level surface, ground run required is 300 feet. From the Minimum Takeoff Distance Chart, the takeoff IAS is 35 knots. Total distance over 50 foot obstacle is 630 feet.

3. Assume fuel allowance of 1.5 gallons (9 lbs) for warmup and takeoff.

4. Refer to the Best Rate-of-Climb Curve (figure B4-1) to climb from 2000 feet to 5000 feet at best rate-of-climb speed. Time required is 3.0 minutes, covering 3.6 nautical miles, and consuming 0.8 gallons of fuel. These values are found by taking the difference of a sea level climb to 5000 feet and a sea level climb to 2000 feet.

5. The power setting for climb is 2300 RPM, 24 In. Hg., and rich mixture.

6. Gross weight at end of takeoff and climb is 2386 pounds with a remaining distance of 96 nautical miles.

CRUISE TO REMOTE AIRFIELD

The flight to the remote base will be flown at 5000 feet. The fuel and time required for this segment can be determined from the Nautical Miles per Gallon of Fuel Chart (figure B5-2). If a calibrated airspeed of 111 knots is desired (TAS = 120 knots), the power setting is 1980 RPM and 24 inches of manifold pressure. Fuel consumption is then found to be 11.75 nautical miles per gallon. These values are obtained from the 5000 foot chart. The time to complete this segment is the distance divided by the ground speed where ground speed equals true airspeed-headwind component. Ground speed = 120 - 10 = 110 knots.

1. Time $= \frac{\text{Distance}}{\text{Ground speed}} = \frac{96}{110} = .87$ hours.

   To find the fuel consumed, gallons per hour must first be determined.

   Gal/Hr $= \frac{\text{TAS (knots)}}{\text{N. mi/gal}} = \frac{120}{11.75} = 10.2$ gallons per hour.

   Fuel consumed = (gal/hr) x time = 10.2 x .87 hours = 8.9 gallons or 53 pounds.

   Final gross weight is now 2386 - 53 = 2333 pounds.

2. At this cruise configuration the brake horsepower output of the engine can be determined from the Engine Power Chart (figure B2-1). For 1980 RPM and 24 inches of manifold pressure at 5000 feet, the engine is developing 135 horsepower for standard carburetor air temperature.

3. To find the landing distance required, the Minimum Landing Distance Chart (figure B7-1) is used. With a gross weight of 2333 pounds, 500 feet pressure altitude, 14°C, no wind and 2% upslope sod runway, the minimum landing distance is 915 feet over a 50 foot obstacle with 175 feet of ground run. It should be noted that the remote airfield is sod; however, the charts are based on hard surface runways. Refer to the Runway Condition Reading Chart (figure B7-4) for the applicable corrections. The corrected total distance over a 50 foot obstacle and the corrected ground run are 915 + 25 = 940 feet and 175 + 25 = 200 feet respectively.

REMOTE TAKEOFF AND CLIMB

This segment consists of warmup, takeoff and climb to 10,000 feet with a takeoff gross weight of 2333 pounds.

1. The minimum takeoff distance can be found from the Minimum Takeoff Distance Chart (figure B3-2) for a gross weight of 2333 pounds, 2% upslope sod runway, no wind, 14°C temperature and 500 feet pressure altitude. The Minimum Takeoff Distance Chart is predicated on hard surface runway conditions, therefore a correction of 8% must be added to the takeoff ground roll. The minimum corrected takeoff distance over a 50 foot obstacle is 910 + 36 = 946 feet with a corrected ground roll of 450 + 36 = 486 feet.

2. Assume a fuel allowance of 1.5 gallons (9 pounds) for warmup and takeoff. Gross weight for climb is now 2333 - 9 = 2324 pounds.

3. Refer to the Best Rate of Climb Curve (figure B4-1) to determine the climb to 10,000 feet from 500 feet at the best rate of climb speed. The climb requires 2.45 gallons of fuel, 10.5 minutes and covers 13.3 nautical miles. The gross weight at the end of climb is 2309 pounds.

RETURN CRUISE

The flight to the home airfield will be flown at 10,000 feet altitude with a 20 knot tailwind. Normally, tailwinds are treated as a no wind condition; therefore the fuel and time required for this segment can be determined from the Long Range Prediction Charts (figure B5-5 and B5-6).

1. Since 13.3 nautical miles were covered in the climb, the remaining distance is 100 - 13.3 = 86.7 nautical miles.
   a. From the Long Range Prediction - Distance Chart (figure B5-5) the initial chart distance at an initial gross weight of 2309 pounds is 1420 miles.
   b. The final chart distance is the initial chart distance plus the required distance = 1420 + 86.7 = 1506.7 nautical miles.
   c. At the final chart distance of 1506.7 nautical miles, final weight at the end of cruise is 2274 pounds.
   d. Fuel required = 2309 - 2274 = 35 pounds or 5.8 gallons.

2. Time
   a. From the Long Range Prediction - Time Chart (figure B5-6) the initial time at a gross weight of 2309 pounds is 13.45 hours.
   b. At the final gross weight of 2274 pounds the final chart time is 14.30 hours.
   c. The time in flight is the final time - initial time = 14.30 - 13.45 = .85 hours.

3. To determine the power setting for this leg, the Nautical Miles per Gallon of Fuel Chart (figure B5-3) is used. Nautical miles per gallon of fuel $= \frac{\text{n. mi.}}{\text{fuel}} = \frac{86.7}{5.8} = 14.95.$

   The average gross weight during cruise = $\frac{2309 + 2274}{2} = 2292$ pounds. At the average gross weight of 2292 pounds, the power setting is 1900 RPM and 16.6 inches of manifold pressure at a CAS of 90.5 knots (TAS of 105 knots).

4. To find the landing distance required, the Minimum Landing Distance Chart (figure B7-1) is used. For the conditions of 2292 pounds gross weight, 11°C temperature, dry concrete runway, pressure altitude of 2000 feet, and $7\frac{1}{2}$ knot headwind, the total distance, over a 50 foot obstacle is 895 feet with a ground run of 160 feet.

FINAL SUMMARY

The total time and fuel for the mission is summarized as follows:

	TIME HOURS	FUEL GALLONS
Segment 1	.05	2.30
Segment 2	.87	8.90
Segment 3	.18	3.95
Segment 4	.85	5.80
TOTAL	1.95	20.95

Total fuel reserves = 38.00 - 20.95 = 17.05 gallons.
Usable fuel reserves = 17.05 - 1.00 = 16.05 gallons.

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ALPHABETICAL

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