FLIGHT MANUAL

USAF SERIES

F-89B & C

AIRCRAFT

PUBLISHED UNDER THE AUTHORITY
OF THE SECRETARY OF THE AIR FORCE.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS TECHNICAL PUBLICATION TO THE ATTENTION OF ALL AIR FORCE PERSONNEL CLEARED FOR OPERATION OF AFFECTED AIRCRAFT.

This revision replaces T.O. 1F-89B-1 dated 15 May 1957 and Safety of Flight Supplements 1F-89B-1Y through 1F-89B-1CL. See Basic Index, T.O. 0-1-1, and Weekly Index, T.O. 0-1-1A, for current status of Safety of Flight Supplements.

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12 SEPTEMBER 1958

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LET'S GET BETTER ACQUAINTED

WITH YOUR FLIGHT MANUAL

To gain maximum benefit from this manual, it is important that you thoroughly acquaint yourself with the information contained in these pages.

SCOPE

This manual contains all the information necessary for safe and efficient operation of the F-89B and C airplanes. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT

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

PERMISSIBLE OPERATIONS

The Flight Manual takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Manual. Clearance must be obtained from ARDC before any questionable operation is attempted which is not specifically covered in the Flight Manual.

STANDARDIZATION

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

ARRANGEMENT

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

YOUR RESPONSIBILITY

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

PERSONAL COPIES, TABS AND BINDERS

In accordance with the provisions of AFR 5-13, flight crewmembers are entitled to have personal copies of the Flight Manual.

Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Manual. These good-looking, simulated leather binders will make it much easier for you to revise your manual as well as to keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.

HOW TO GET COPIES

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

SAFETY OF FLIGHT SUPPLEMENTS

Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in ten days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements—you must comply with all existing supplements but there is no point in restricting the operation of your aircraft by complying with a supplement that has been replaced or rescinded. If you have ordered your Flight Manual on the Publications Requirements Table, you automatically will receive all supplements pertaining to your airplane. Technical Order 0-5-1 covers some additional information regarding these supplements.

WARNINGS, CAUTIONS, AND NOTES

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

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

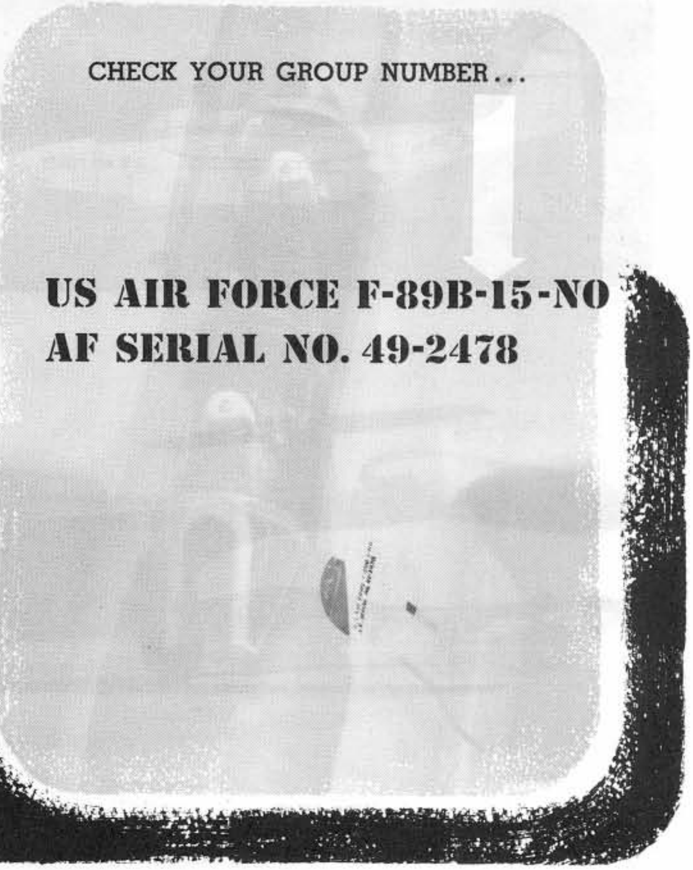
WARNING — **Operating procedures, practices, etc., which will result in personal injury or loss of life if not carefully followed.**

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

GROUP CODING

NOTE: Airplanes having different or additional systems and equipment have been group coded to avoid listing the airplane serial numbers. The groups with the airplanes they include are as follows:

B	Group 1	AF49-2439 THROUGH AF49-2441
B	Group 5	AF49-2442 THROUGH AF49-2448
B	Group 10	AF49-2449 THROUGH AF49-2462
B	Group 15	AF49-2464 THROUGH AF49-2478
C	Group 1	AF50-741 THROUGH AF50-744
C	Group 5	AF50-745 THROUGH AF50-759
C	Group 10	AF50-760 THROUGH AF50-774
C	Group 15	AF50-775 THROUGH AF50-789
C	Group 20	AF50-790 THROUGH AF50-804
C	Group 25	AF51-5757 THROUGH AF51-5771
C	Group 30	AF51-5772 THROUGH AF51-5801
C	Group 35	AF51-5802 THROUGH AF51-5836
C	Group 40	AF51-5837 THROUGH AF51-5856



COMMENTS AND QUESTIONS REGARDING ANY PHASE OF THE FLIGHT MANUAL ARE INVITED AND SHOULD BE FORWARDED THROUGH YOUR COMMAND HEADQUARTERS TO COMMANDER, HEADQUARTERS, OGDEN AIR MATERIEL AREA, HILL AIR FORCE BASE, UTAH, ATTENTION: WCLOD-31D.

BC-3 (2)A

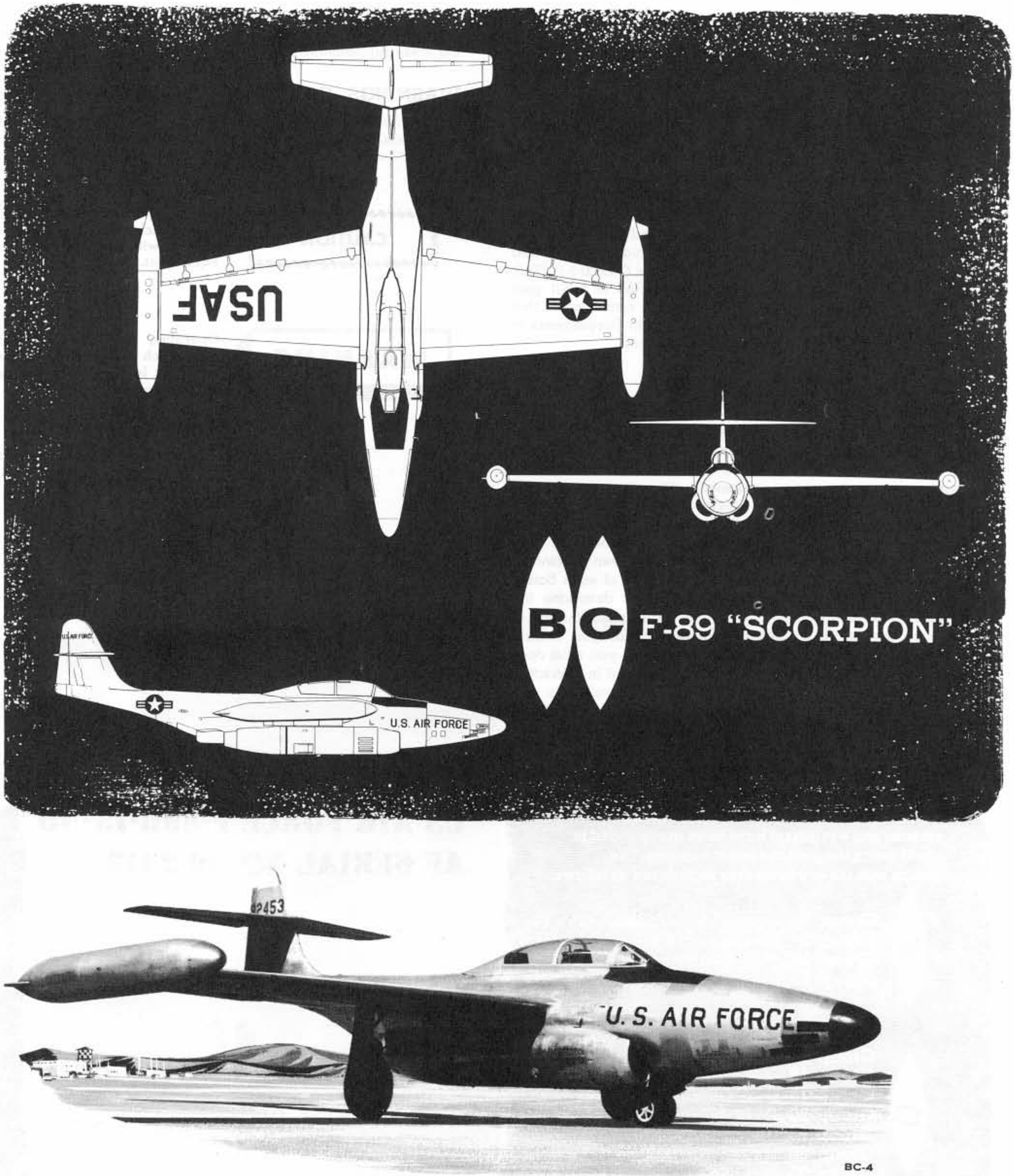


Figure 1-1.

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THE AIRPLANE.

The Northrop F-89B and F-89C airplanes are two-place, midwing, jet-propelled, all-weather fighter-interceptors designed to operate at high speeds and high altitudes. The airplane's function is to locate, intercept, and destroy enemy aircraft by day or night, under all conditions of weather. The crew consists of a pilot and a radar observer. For maximum efficiency, the radar equipment is operated by the radar observer, thus allowing the pilot to devote his full attention to flying. This division of duties results in higher combat effectiveness. The pilot and radar observer have individual cockpits with ejection seats, and automatic heating and pressurizing facilities. The tandem cockpits are enclosed by a single jettisonable canopy. The airplane is powered by two turbojet engines with afterburner systems. The flight control surfaces are fully powered by two independent hydraulic systems. "Feel," which would otherwise be absent in a powered control system, is supplied artificially to the control stick and rudder pedals by springs. Additional elevator "feel" is supplied by a control force bellows system and a "G" operated bobweight. Another unusual feature not found on other combat airplanes is the combination of ailerons and speed brakes. Each aileron is composed of a leading edge section and two movable aft surfaces, one above the other, hinged at their forward edges. These two surfaces can be opened to any desired angle, up to an included angle of 120 degrees, to function as a speed brake. The left and right speed brakes operate simultaneously.

AIRPLANE DIMENSIONS.

Refer to figure 1-2 for airplane dimensions.

AIRPLANE GROSS WEIGHTS.

The design gross weight is approximately 34,000 pounds, and the maximum gross weight is approximately 38,000 pounds (see figure 5-5). Detailed information on weight limitations will be found in Section V.

ARMAMENT.

The airplane is armed with six forward-firing pneumatically-charged 20mm automatic guns, three on each side of the nose section. Twelve hundred rounds of ammunition are carried in nose section compartments.

ENGINES.

The airplane is powered with two J35-47 axial-flow turbojet engines. The engines are equipped with afterburners and retractable air inlet screens. On the front of each engine are mounted all accessories driven by the engine shaft, including engine fuel pump, oil pump, engine fuel control, hydraulic pump, starter-generator, and tachometer generator. Air enters through the engine airscoop and is progressively compressed through 11 stages in the axial-flow compressor. See figure 1-5. A portion of the eleventh stage compressor air is used to pressurize the wing tip fuel tanks and to operate the thermal anti-icing system, the afterburner fuel pump, the air conditioning system, the canopy seal, and the anti "G" suit. The main flow of air from the compressor then enters the eight combustion chambers where fuel is sprayed under pressure and combustion occurs. The hot combustion gases rotate a turbine wheel which drives the compressor, both turbine wheel and compressor being mounted on the same shaft. From the turbine wheel, the gases travel through the exhaust cone and into the afterburner where additional fuel may be injected and burned to create more thrust if desired. The gases are then discharged through the tailpipe. The afterburner tailpipe nozzle is provided with eyelids. During non-afterburning operation the eyelids are closed (minimum tailpipe opening.) During afterburning, the eyelids automatically open to increase the tailpipe nozzle diameter, thus allowing additional thrust without excessive exhaust gas temperatures. Each engine at 100% RPM has a rated thrust of 5600 pounds without afterburning and 7400 pounds with afterburning. For a detailed discussion of eyelid operation, see Section VII.

ENGINE FUEL CONTROL SYSTEM.

Each engine has one gear-type, constant displacement, engine-driven fuel pump and one fuel control installed in the accessory section. The maximum output of each fuel pump is 26 gallons per minute. The fuel control automatically maintains the quantity of fuel supplied to the engine within a range that will prevent "rich blow-out" during engine acceleration and "lean die-out" during deceleration, and bypasses any fuel in excess of that required by throttle setting, engine speed, and altitude. For engine starting and controlled acceleration during starting, the fuel is supplied to the combustion chambers in a wide-angle spray for ignition. This spray narrows its angle to distribute the

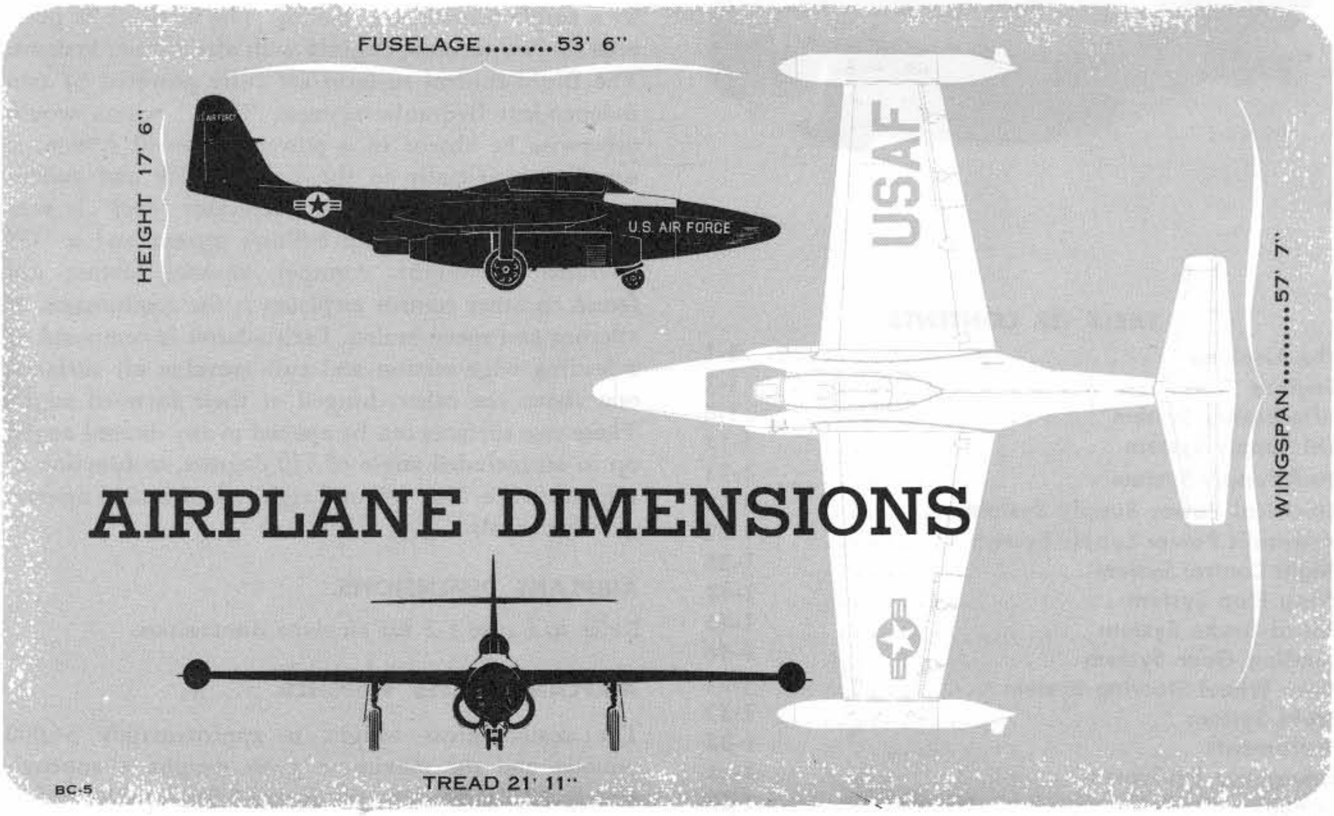


Figure 1-2.

combustion more evenly throughout the chamber as the engine accelerates. This change in spray characteristic is controlled within the nozzle by a spring-loaded valve which opens another set of orifices in the nozzle jet as fuel pressure builds up in the nozzle. The fuel control also prevents the engine from overspeeding for a given throttle setting, and maintains a constant engine speed regardless of changes in temperature and altitude. A centrifugal governor in the fuel control varies the flow of fuel to the nozzles according to engine speed and throttle position. (See figure 1-6.) Refer to Section VII for additional information on engine operation.

Throttles.

Each of the two throttles (figure 1-7) on the pilot's left console regulates an engine fuel control. Markings on the throttle quadrant are CLOSED, IDLE, and OPEN. Mechanical stops at IDLE prevent retarding the throttles below the idle speed (approximately 40% to 45% RPM) of the engine. The throttles can be retarded past the idle stops by raising the fingerlifts under the throttle knobs. This allows the lever to be placed at CLOSED, stopping fuel flow to the fuel nozzles. Each fingerlift is mechanically connected to an afterburner demand switch that will start afterburning on the corresponding engine if the fingerlift is raised when the throttle is in the 90% to 100% RPM range.

Note

The mechanical range on the throttle quadrant is not dependent on engine RPM.

Afterburning is stopped by retarding the throttle below the 90% RPM position, or by depressing the fingerlift when the throttle is in the 90% to 100% RPM range. The right throttle houses a press-to-talk microphone button.

Throttle Friction Lever.

A throttle friction lever (figure 1-7) is provided on the throttle quadrant outboard of the throttles. When the lever is moved toward INCREASE or DECREASE, resistance to throttle movement will increase or decrease accordingly.

ENGINE COOLING AND AIR INDUCTION SYSTEM.

Engine cooling and induction air enters through an air intake at the front of each engine. On the ground and during takeoff, additional induction air is drawn through four intake doors on the outboard side of the engine forward door, and then through a door on the engine transition duct. The combustion sections of the engine compartment and the tailpipe are cooled by ram air supplied through an airscoop on the lower forward section of the engine's NO. 3 door. Retractable screens in the engine air intakes normally extend and retract with the landing gear, but under certain conditions they can be operated during flight.

ENGINE SCREENS.

Two retractable engine screens, one in each engine air intake, provide a means for preventing foreign matter from entering the engine intake ducts. The engine screens normally extend and retract with the landing gear; an engine screen switch, however, provides for screen extension and retraction during flight.

Engine Screen Switch. B, C (Groups 1-30).

An engine screen switch (figure 1-9), located on the pilot's left console, provides a means for overriding the automatic screen retraction feature and extending the engine screens in flight if it is necessary to protect the engines from flying debris. This switch operates on 28-volt DC and has positions marked NORMAL and COMBAT. In flight, when the switch is at normal, the screens will be retracted; if the switch is placed at COMBAT, the screens will extend unless icing conditions are present. If the screen switch is at COMBAT, either the ice-detector probes, when in icing conditions, or the anti-ice master switch, when placed at ENG ONLY or ENG & WING, will override the engine screen switch and retract the screens.

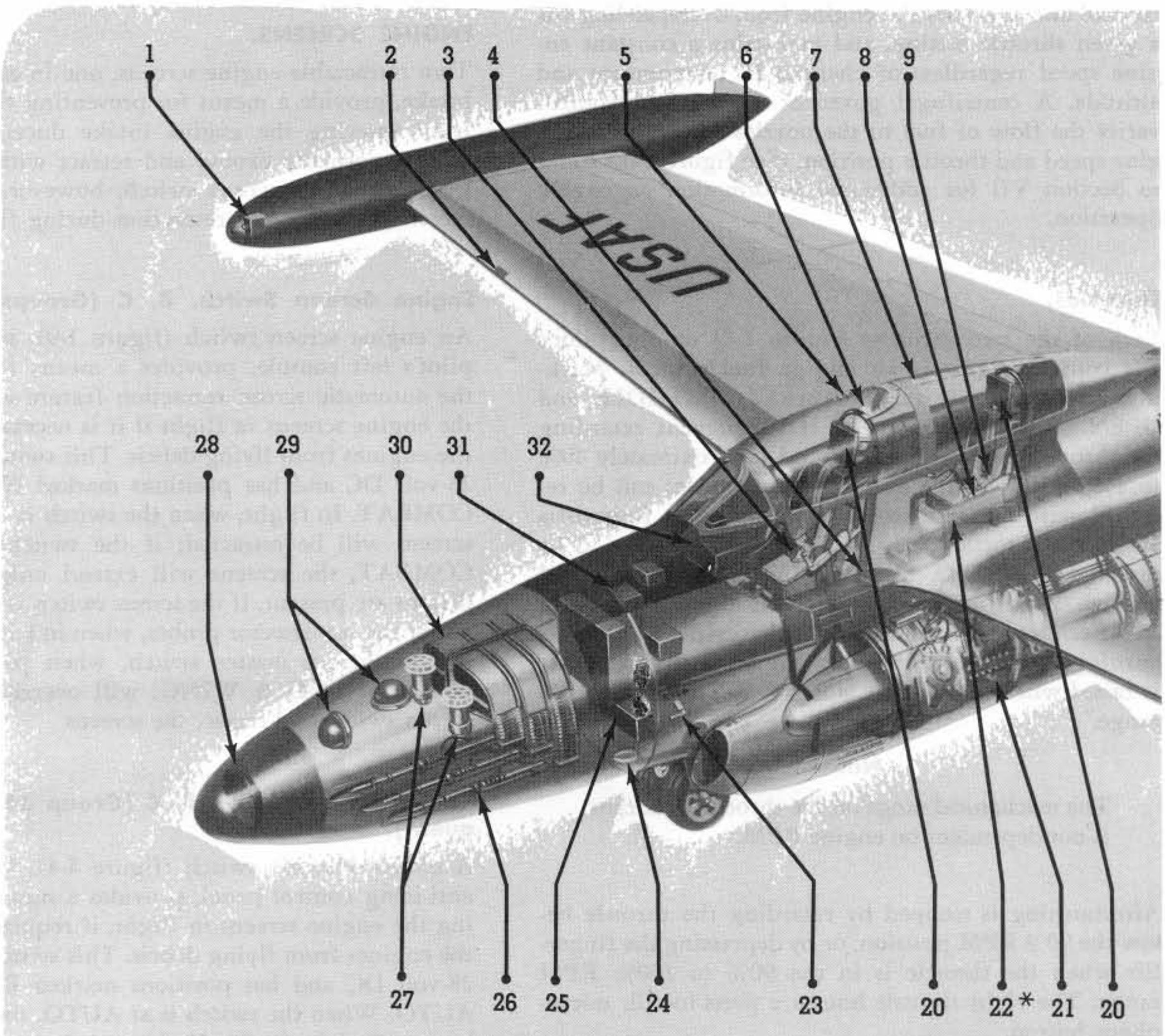
Screen Override Switch. C (Group 35 and Subsequent).

A screen override switch (figure 4-4), located on the anti-icing control panel, provides a means for extending the engine screens in flight, if required, to protect the engines from flying debris. This switch operates on 28-volt DC and has positions marked EXTEND and AUTO. When the switch is at AUTO, the screens will be retracted in flight. If the switch is placed at EXTEND, the screens will extend unless icing conditions are present. If this switch is at EXTEND and icing conditions are encountered, the thermal anti-icing system, if in operation, will override the screen switch and retract the screens as soon as the ice-detector probes pick up ice. When the anti-ice master switch is at ALL EMER the screens will retract if icing conditions are encountered.

STARTING AND IGNITION SYSTEM.

Power for starting is supplied by external power units connected to the power receptacles on the right air intake duct. When external power is not available, the batteries will provide sufficient power for two normal starts. Only one engine can be started at a time, because actuating one starter-generator breaks the 28-volt DC and 115-volt AC circuits to the other engine's starter and ignition system. When a starter switch is

GENERAL ARRANGEMENT



1. GUN CAMERA
2. GLIDE-SLOPE ANTENNA
3. PILOT'S EJECTION SEAT
4. CIRCUIT BREAKER PANELS
5. LOCALIZER ANTENNA
6. RADIO COMPASS LOOP ANTENNA
7. RADIO COMPASS SENSE ANTENNA
8. CIRCUIT BREAKER PANELS
9. RADAR OBSERVER'S EJECTION SEAT
10. RADIO AND ELECTRICAL EQUIPMENT
11. REFRIGERATION UNIT
12. COMMAND RADIO ANTENNA
13. POSITION LIGHTS
14. EXTERNAL POWER RECEPTACLES
15. IFF ANTENNA
16. OXYGEN BOTTLES
17. MARKER BEACON ANTENNA
18. DATA CASE

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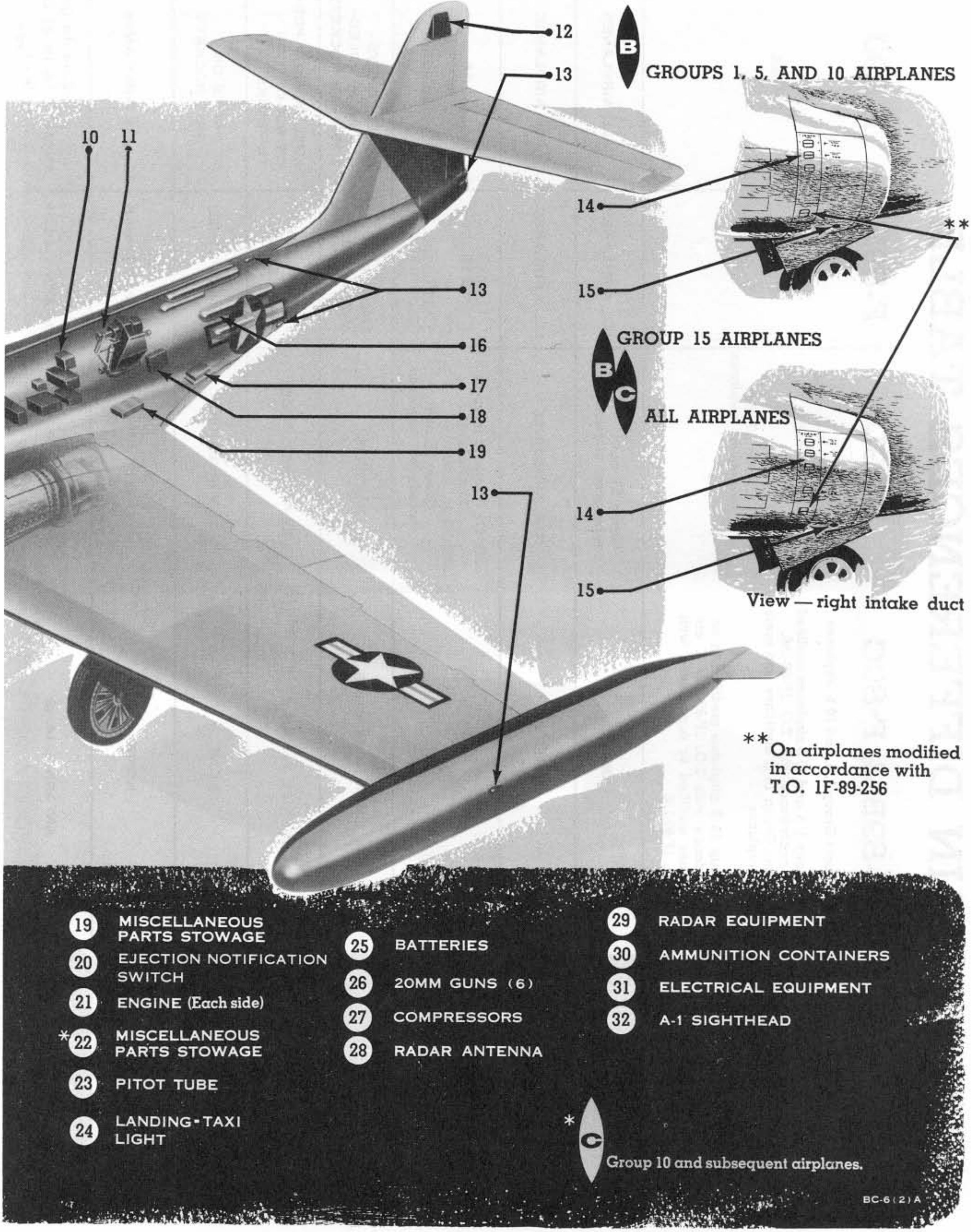
Figure 1-3.


12
13
10
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16
17
18
19
13
B GROUPS 1, 5, AND 10 AIRPLANES
14
15
**
B GROUP 15 AIRPLANES
C ALL AIRPLANES
14
15
View — right intake duct
** On airplanes modified in accordance with T.O. 1F-89-256
19 MISCELLANEOUS PARTS STOWAGE
20 EJECTION NOTIFICATION SWITCH
21 ENGINE (Each side)
*22 MISCELLANEOUS PARTS STOWAGE
23 PITOT TUBE
24 LANDING-TAXI LIGHT
25 BATTERIES
26 20MM GUNS (6)
27 COMPRESSORS
28 RADAR ANTENNA
29 RADAR EQUIPMENT
30 AMMUNITION CONTAINERS
31 ELECTRICAL EQUIPMENT
32 A-1 SIGHTHEAD
* C Group 10 and subsequent airplanes.
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MAIN DIFFERENCES TABLE

ITEM	F-89B & F-89C	F-89D	F-89H	F-89J
EXTERNAL POWER RECEPTACLES	THREE: Some Group 1, 5, and 10 B airplanes FOUR: Group 1, 5, and 10 B airplanes modified in accordance with T.O. 1F-89-256, some Group 15 B airplanes and some C airplanes FIVE: Group 15 B airplanes modified in accordance with T.O. 1F-89-256; C airplanes modified in accordance with T.O. 1F-89-256	FOUR: Groups 1 through 25 airplanes THREE: Group 30 and subsequent airplanes	THREE	THREE
AUTOPILOT	NONE	Group 35 and subsequent airplanes	ALL AIRPLANES	ALL AIRPLANES
SINGLE-POINT FUELING	NONE	ALL AIRPLANES	ALL AIRPLANES	ALL AIRPLANES
ENGINES	J35-47	J35-47: Groups 1 through 20 airplanes J35-35 or J35-35A: Group 25 and subsequent airplanes	J35-35 or J35-35A	J35-35 or J35-35A
ARMAMENT	SIX 20MM NOSE GUNS	ROCKETS	ROCKETS AND MISSILES	MB-1 ROCKETS—GAR-2A MISSILES—2.75 FFAR ROCKETS
WING TIP CONFIGURATION	FUEL TANKS	FUEL-ROCKET PODS	FUEL-ROCKET-MISSILE PODS	FUEL ROCKET PODS OR 600-GALLON TIP TANKS
PYLON TANKS	NONE	ALL AIRPLANES	ALL AIRPLANES	TANKS OR MB-1 ROCKETS
NOSE FUEL TANK	NONE	ALL AIRPLANES	ALL AIRPLANES	ALL AIRPLANES
RADIO NAVIGATION EQUIPMENT	AN/ARN-6,-14,-18	AN/ARN-6,-14,-18	AN/ARN-6,-14,-18	AN/ARN -6,-14,-18 OR -14,-18,-21 OR -6,-21

BC-7A

Figure 1-4.

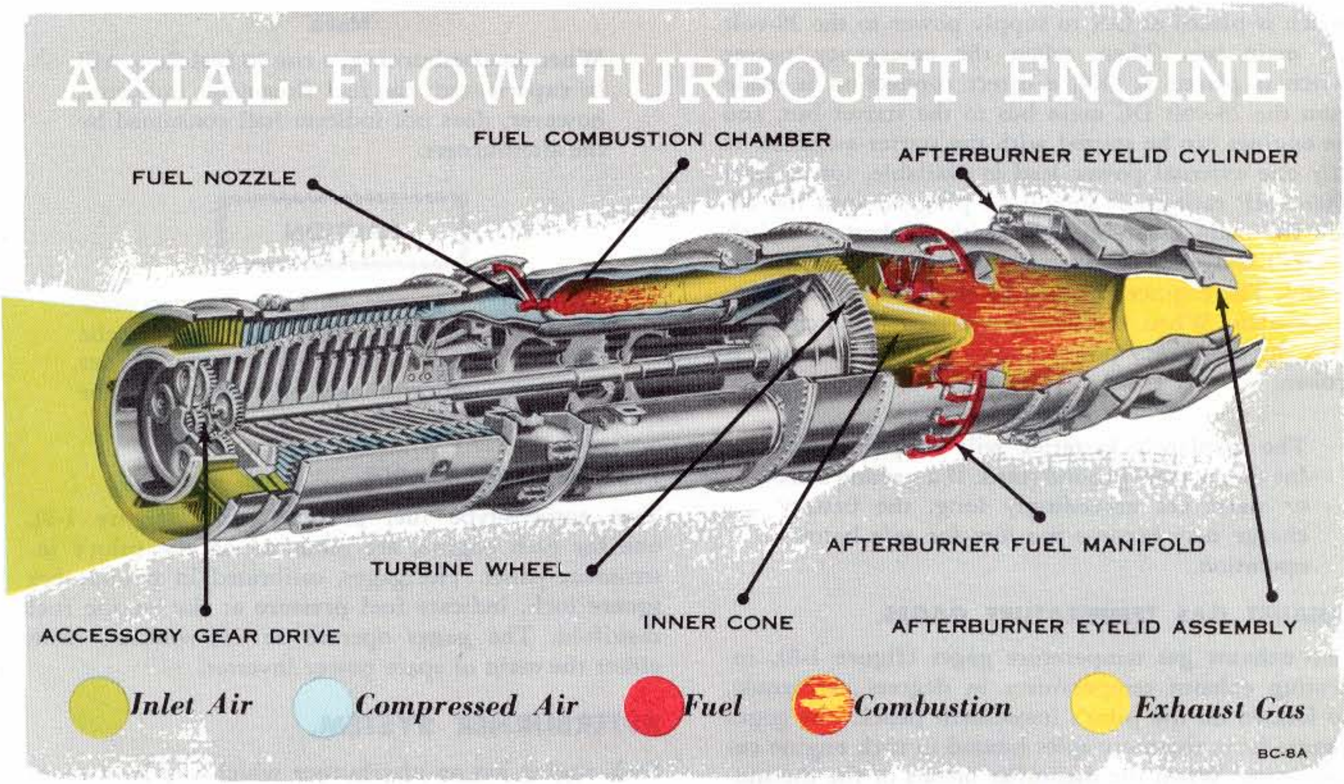


Figure 1-5.

actuated, the ignition system is energized and the starter-generator cranks the engine. After the throttle is opened and combustion is self-sustaining, the starting and ignition circuits automatically disconnect when the electrical load drawn by the starter-generator drops to 200 amperes; this should occur at an engine speed of approximately 26% RPM. Then the starter-generator functions as a 28-volt DC generator. For ground starting, the engine ignition system operates on 115-volt AC. The single-phase, 400-cycle, spare power inverter supplies current to the ignition transformers which, in turn, send high voltage to the two igniter plugs on each engine. Ignition for air starting is supplied to a windmilling engine by either the main or spare power inverter.

Starting and Ignition Switches.

Two starting and ignition switches (figure 1-12), one for each engine, are located on the pilot's right vertical console. These switches have three positions: START, NEUTRAL, and STOP. The switches are spring-loaded to NEUTRAL. The switches, using 28-volt DC, control the electrical circuits to the starter and to the 115-volt AC ignition system. When a switch is at NEUTRAL, starting and ignition circuits are open. Placing a starter switch momentarily at START energizes the starter and completes the circuit to the igniter plugs. When the load drawn by the starter drops to 200 amperes, the starting and ignition circuits automatically disconnect; this should occur at an engine speed of approximately 26% RPM. Placing the switch momentarily at STOP will deenergize the starter and ignition circuits.

Altitude Start and Starter Test Switches.

Two altitude start and starter test switches, one for each engine, are located on a panel outboard of the throttles (C airplanes, figure 1-17), or on the pilot's right vertical console (B airplanes, figure 1-12). These switches are used for supplying ignition during air starts and for turning the engine over with the starter without ignition. The switches have three positions: ALTITUDE START, NEUTRAL, and STARTER TEST; and they are spring-loaded to NEUTRAL. The switches, using 28-volt DC, control separate electrical circuits to the 115-volt AC ignition system and the 28-volt DC starter. When a switch is at NEUTRAL, starting and ignition circuits are open. When an air restart is necessary, placing the switch momentarily at ALTITUDE START will supply ignition to the windmilling engine for 120 seconds through a time-delay unit. When the switch is held at STARTER TEST (for ground operation only), the starter will turn the engine over without ignition.

Emergency Starting Power Switch.

An emergency starting power switch (figure 1-12), with two positions, ON and OFF, is located on the pilot's right vertical console and is used to connect the starter bus to the main 28-volt DC bus so that the engines may be started, in an emergency, by power from the batteries. When external power is not available, the battery switch is placed at ON to supply power to the 28-volt DC main bus. Then, when the emergency power switch is placed at ON, a direct connection is made from the 28-volt DC main bus to the starter bus, and the engines can be started with the starter switches. If only one external power lead is available, (of at least 1000-AMP rating), it should be plugged into the 28-volt DC main bus receptacle (with the battery switch at OFF) and the emergency starting power switch set to ON. The engines can then be started with the starter switches. When the emergency power switch is at OFF, the emergency power circuit to the starter bus is broken.

Note

The airplane's batteries will supply power for two normal ground starts. If a ground start or starts are exceedingly long, the battery charge may become too low for safe battery operation.

EXHAUST GAS TEMPERATURE GAGES.

Two exhaust gas temperature gages (figure 1-8), indicating exhaust temperatures in degrees centigrade, are located on the pilot's instrument panel. The gages operate from thermocouples located in each engine exhaust cone. When the dissimilar metals of the thermocouple in the exhaust cone are heated, an electromotive force (independent of the airplane's electrical system) is created and gives a reading on the gages. The pilot has no direct control for regulating the exhaust temperatures; however, limited control for these temperatures can be indirectly achieved by changing the throttle settings. See Section VII for exhaust gas temperature versus runway temperature discussion.

TACHOMETERS.

Two tachometers (figure 1-8), indicating engine speed in percent of maximum RPM, are located on the pilot's instrument panel. A tachometer generator is installed on the accessory section of each engine. The electrical power it produces for tachometer readings is proportional to engine RPM (100% engine speed is 8000 RPM).

OIL PRESSURE GAGES.

Two oil pressure gages (figure 1-8), one for each engine, are located on the pilot's instrument panel and indicate oil pressure in pounds per square inch. The gages are operated by 115-volt AC from either the main or spare power inverter.

FUEL FLOWMETER INDICATOR.

A single fuel flowmeter indicator (figure 1-8), mounted on the pilot's instrument panel, registers the rate that fuel (any grade or weight) is being consumed by both engines (exclusive of afterburners) in pounds per hour. The fuel flowmeter system is operated by 28-volt DC and 115-volt AC from either the main or spare power inverter.

Note

When in afterburning, a rise in fuel flow will be experienced; the fuel flowmeter indicator, however, does not indicate fuel consumed by the afterburners.

CAUTION

The fuel flowmeter indicator is inaccurate for high rates of fuel flow. However, in the cruising range (3000 to 5000 pounds per hour) the indicator may be relied upon for cruise control.

FUEL PRESSURE GAGES.

Two autosyn-type fuel pressure gages (figure 1-8), one for each engine, are mounted on the pilot's instrument panel. The gages, calibrated in pounds per square inch, indicate fuel pressure at the engine fuel manifold. The gages operate on 115-volt AC from either the main or spare power inverter.

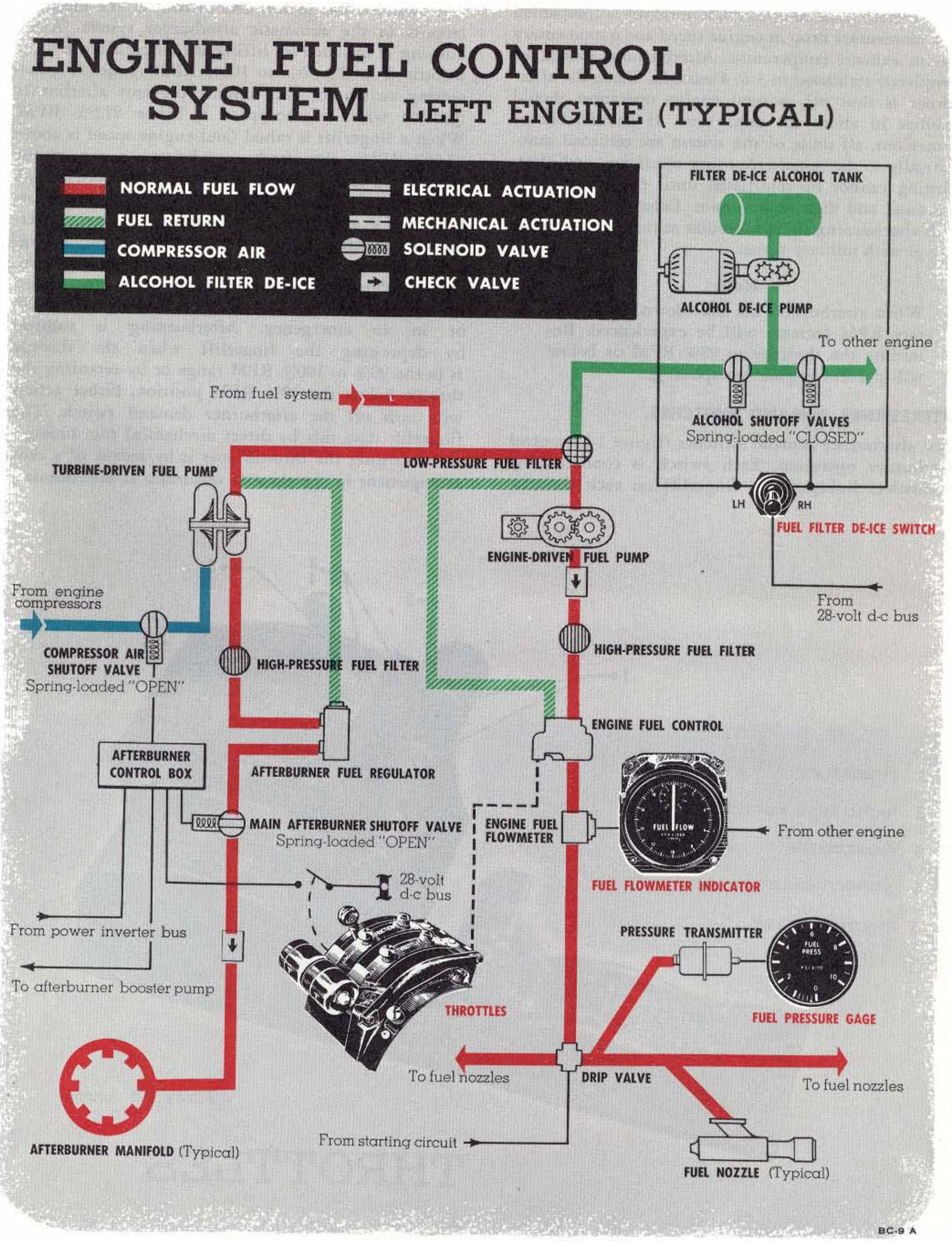
AFTERBURNER SYSTEM.

Each engine has an afterburner which can be used to increase thrust when needed. The afterburner is a part of the tailpipe. As the gases travel through the exhaust cone and into the afterburner section, more fuel can be injected and burned if additional thrust is desired.

Note

Normal fuel sequencing must be used to maintain afterburning. For further explanation, refer to Section VII.

Afterburning is best initiated from a stabilized full-throttle condition. A speed-sensing switch prevents afterburner ignition when engine speed is below 87.5% RPM. The afterburner fuel control system (figure 1-6) consists of a centrifugal-type fuel pump which is driven by an air turbine powered by air bled from the engine compressor. This pump supplies fuel to an afterburner fuel regulator. The fuel regulator, controlled by the difference in pressure between the inlet and the outlet of the engine compressor, automatically meters a continuous flow of fuel to the afterburner. When afterburning is initiated (by lifting the fingerlifts on the throttles), the following operations take place in the automatic control system within approximately 1 second: the afterburner booster pump in the sump tank starts operating; the afterburner booster pump pressure switch closes, causing the valve supplying compressor air to the afterburner fuel pump to open; the main afterburner fuel shutoff valve opens; fuel is then supplied through the afterburner shutoff valve to the afterburner ignition nozzles and into the exhaust gases, causing afterburner ignition. When afterburner fuel ignites, the eyelids open and the afterburner ignition shutoff valve closes, and afterburning continues.



ENGINE FUEL CONTROL SYSTEM LEFT ENGINE (TYPICAL)
NORMAL FUEL FLOW
FUEL RETURN
COMPRESSOR AIR
ALCOHOL FILTER DE-ICE
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
SOLENOID VALVE
CHECK VALVE
FILTER DE-ICE ALCOHOL TANK
ALCOHOL DE-ICE PUMP
To other engine
ALCOHOL SHUTOFF VALVES
Spring-loaded "CLOSED"
LH
RH
FUEL FILTER DE-ICE SWITCH
From 28-volt d-c bus
From fuel system
LOW-PRESSURE FUEL FILTER
TURBINE-DRIVEN FUEL PUMP
ENGINE-DRIVEN FUEL PUMP
From engine compressors
COMPRESSOR AIR SHUTOFF VALVE
Spring-loaded "OPEN"
HIGH-PRESSURE FUEL FILTER
HIGH-PRESSURE FUEL FILTER
ENGINE FUEL CONTROL
AFTERBURNER CONTROL BOX
AFTERBURNER FUEL REGULATOR
MAIN AFTERBURNER SHUTOFF VALVE
Spring-loaded "OPEN"
ENGINE FUEL FLOWMETER
From other engine
FUEL FLOWMETER INDICATOR
28-volt d-c bus
From power inverter bus
PRESSURE TRANSMITTER
FUEL PRESS
FUEL PRESSURE GAGE
To afterburner booster pump
THROTTLES
To fuel nozzles
DRIP VALVE
To fuel nozzles
From starting circuit
AFTERBURNER MANIFOLD (Typical)
FUEL NOZZLE (Typical)
BC-9 A

Figure 1-6.

Initial afterburner combustion is normally accompanied by a momentary drop in engine speed and a momentary rise in exhaust temperature. Afterburning should be completely stabilized in 3 to 4 seconds. When the afterburner is shut off, normal engine operation should stabilize in about the same time. If an afterburner flames out, all units of the system are returned automatically to the nonafterburning condition, and afterburning cannot be reinitiated until the fingerlift is depressed and then raised again. Exhaust temperature with afterburning should stabilize at the same temperature as with military thrust.

Note

When afterburners are shut down, a momentary RPM increase will be experienced. Retarding the throttles to 98% RPM or below will prevent engine overspeeding.

AFTERBURNER DEMAND SWITCHES.

Two afterburner demand switches (figure 1-7) control afterburner operation. Each switch is connected by mechanical linkage to a fingerlift on each throttle. The switches use 28-volt DC to control the electrical circuits in the automatic afterburner system. Afterburning is initiated by lifting the fingerlift when the throttle is in the 90% to 100% RPM range. A speed-sensing switch for each engine prevents afterburner ignition when engine speed is below 87.5% RPM. When a fingerlift is raised (and engine speed is above 87.5% RPM), the afterburner booster pump in the sump tank starts, the booster pump pressure switch opens the valve that supplies compressor air to the turbine-driven afterburner fuel pump, the main afterburner fuel shutoff valve opens, and "hot-streak" ignition occurs. After the fuel ignites, the eyelids open, and afterburning continues. Both afterburners may be ignited at the same time during scrambles or in an emergency. Afterburning is stopped by depressing the fingerlift when the throttle is in the 90% to 100% RPM range or by retarding the throttle below the 90% RPM position. Either action will turn off the afterburner demand switch. The fingerlift does this by direct mechanical cam linkage, and retarding the throttle does it by means of a cam arrangement in the throttle quadrant. If afterburning

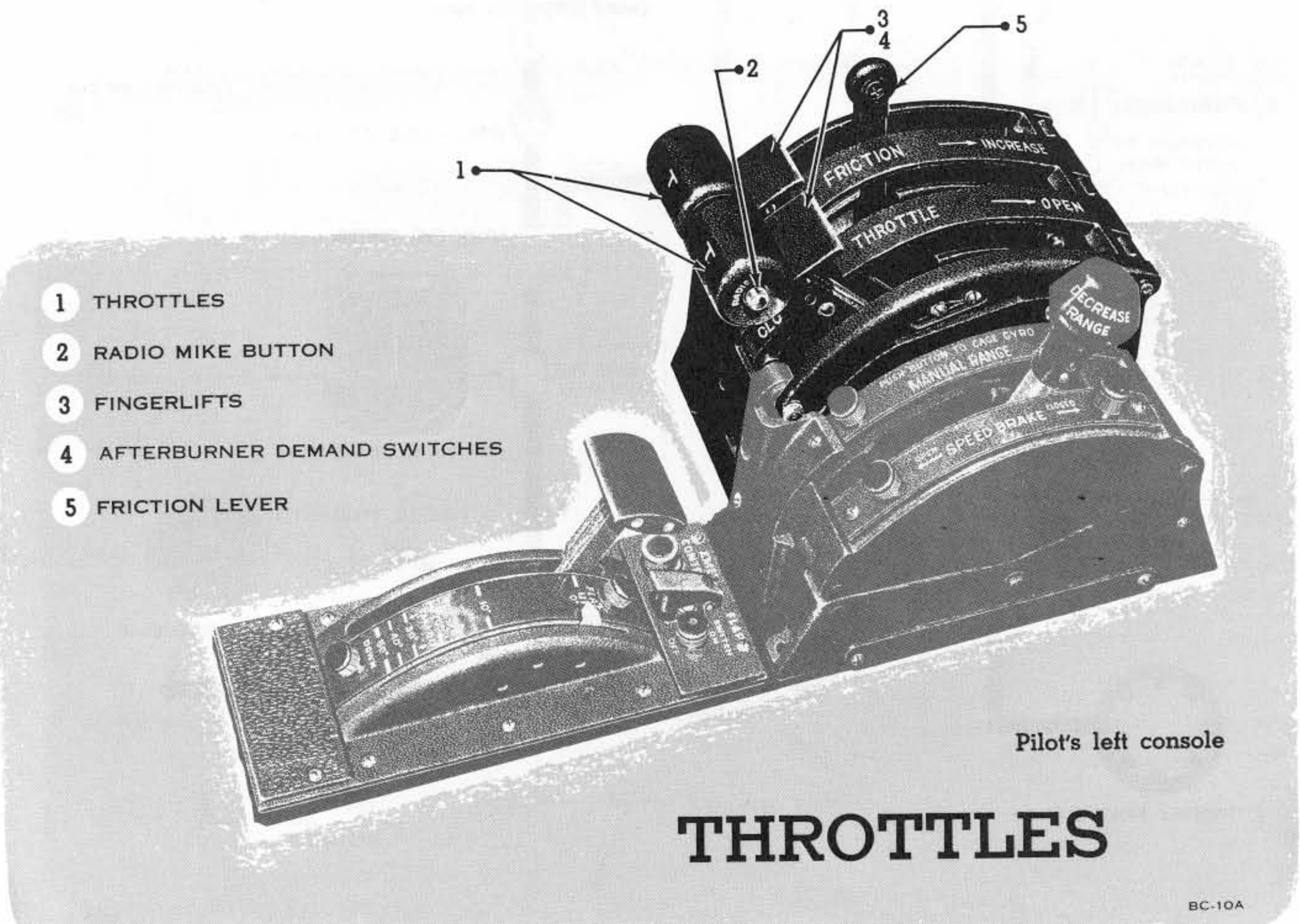


Figure 1-7.

is stopped by retarding the throttle, the fingerlift lowers to the down position. Stopping afterburning by either method returns all units of the automatic control system to a nonafterburning condition and restores normal engine operation. If the afterburner flames out, the automatic control will shut down the afterburner. The afterburner will not reignite until the fingerlift is depressed and then raised again while the throttle is in the 90% to 100% RPM range and engine speed is above 87.5% RPM.

OIL SUPPLY SYSTEM.

Each engine has an independent dry sump, full scavenge oil system. See figure 1-14 for oil quantity data. Oil is gravity fed from the tank, mounted on the outboard side of the engine, to the main engine-driven pump. The main pump distributes the oil under pressure through a filter to the accessory gears and engine bearings. The scavenge side of this same pump returns oil from the accessory and forward engine bearing to the oil tank. A midframe scavenge pump scavenges oil from the mid, damper, and aft bearings, and returns it through a heat exchanger to the oil tank. The heat exchanger uses fuel flow to reduce the temperature of the scavenged oil. This system has no manual controls as its operation is entirely automatic. See figure 1-41 for oil specification and grade.

FUEL SUPPLY SYSTEM.

The airplane has two independent fuel systems, a left and right, with a connecting line and a valve for crossfeeding (see figure 1-16). The tanks in each system include a self-sealing fuselage sump tank; two bladder-type multicelled auxiliary tanks in the wing; and a permanently installed metal tip tank that is automatically pressurized whenever the engines are operating. No tip tank pressurization shutoff is provided. For normal operation, fuel flows to the engine from the sump tank, which is automatically replenished by the tip tank and auxiliary tanks. First, the tip tank fuel flows under air pressure to the sump tank. When the tip tank is empty, a float switch closes the tip tank valve, opens the auxiliary NO. 2 valve to the sump tank, and turns on the booster pump in the auxiliary NO. 2 tank. When the auxiliary NO. 2 tank is empty, a differential pressure switch in the auxiliary NO. 2 line closes, opening the auxiliary NO. 1 valve to the sump tank and turning on the booster pump in the auxiliary NO. 1 tank. Last to empty is the fuselage sump tank. Normally, fuel from the auxiliary tanks flows through the related sump tank to the main fuel line; but in an emergency, auxiliary tank fuel can be manually selected to bypass the sump tank and flow directly to the main fuel line. The crossfeed line allows fuel from both systems to be directed to one main fuel line during single-engine operation; or, fuel from one system can supply both engines if the other system fails. Fuel for afterburner operation is supplied from the sump tank by the afterburner booster pump through an air turbine-driven engine-mounted fuel pump and afterburner fuel regulator to the afterburner manifold.

Note

Normal fuel sequencing must be used to maintain prolonged afterburning, and the sump tanks should be at least two-thirds full. If afterburning is continued after the sump tank fuel drops below the two-thirds full level (as indicated by the sump low level warning light coming on), the pilot will have no indication of the amount of remaining sump fuel and flameout will occur when the tank becomes empty. During afterburning at low altitude, fuel is used from the sump tank faster than it can be replenished. If a sump tank low level warning light comes on, the afterburner should be shut down until the sump tank is replenished (as indicated by the fuel transfer warning light going out).

Dump valves in the wing tip tanks are used for dumping tip tank fuel in an emergency. For fuel quantities see figure 1-15. For fuel specification and grade see figure 1-41.

Booster Pumps.

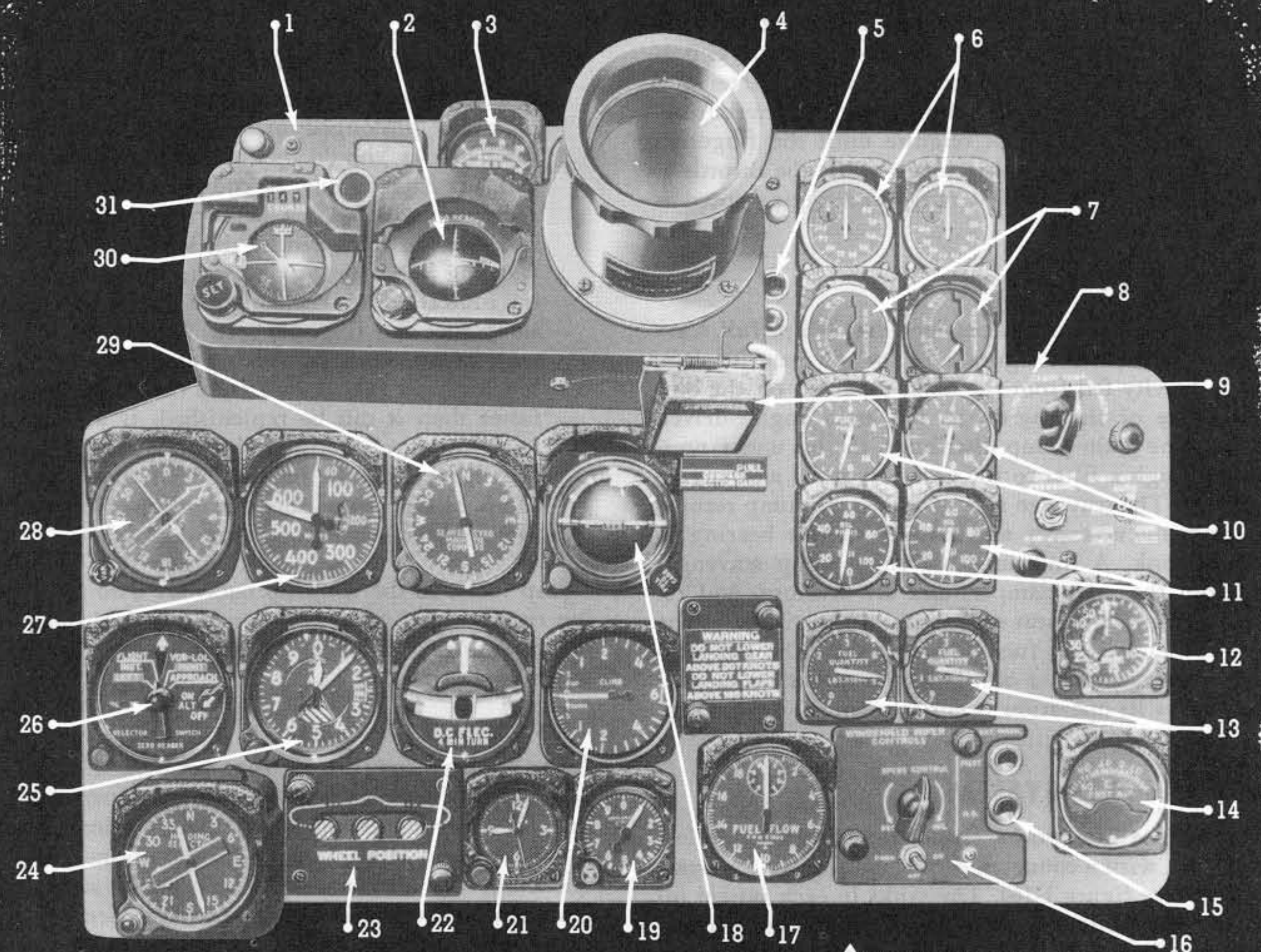
Each fuselage sump tank contains two 28-volt DC booster pumps: one for normal engine operation and one for afterburner operation. The normal booster pump operates continuously during normal fuel sequencing; the afterburner booster pump starts automatically and operates only when afterburning is selected. Each auxiliary tank contains one electric booster pump. The auxiliary NO. 2 tank booster pump is controlled automatically by a float switch in the tip tank, and the auxiliary NO. 1 tank booster pump is controlled by a pressure switch in the auxiliary NO. 2 tank fuel line during automatic sequencing. Automatic sequencing will not take place unless the auxiliary tank switches on the fuel control panel are at ON. If the float switch in the tip tank fails to start fuel transfer from the auxiliary NO. 2 tank, the tip tank switch can be placed at OFF to continue normal fuel sequencing. The auxiliary tank booster pumps are controlled by the fuel selector switch when auxiliary NO. 1 or NO. 2 tank is manually selected.

Low Pressure Fuel Filter De-Icing System.

A de-icing system is provided for the low-pressure fuel filter on each engine. Should water particles in the fuel freeze on the filters and restrict fuel flow, alcohol can be pumped into each filter. See Section IV for complete discussion on this system. Refer to figure 1-41 for alcohol specification.

Tip Tank Fuel Dump System.

Each tip tank has a 28-volt DC motor-driven dump valve in the tip tank tail cone for dumping fuel, under



PILOT'S (TYPICAL) INSTRUMENT PANEL

ALL AIRPLANES

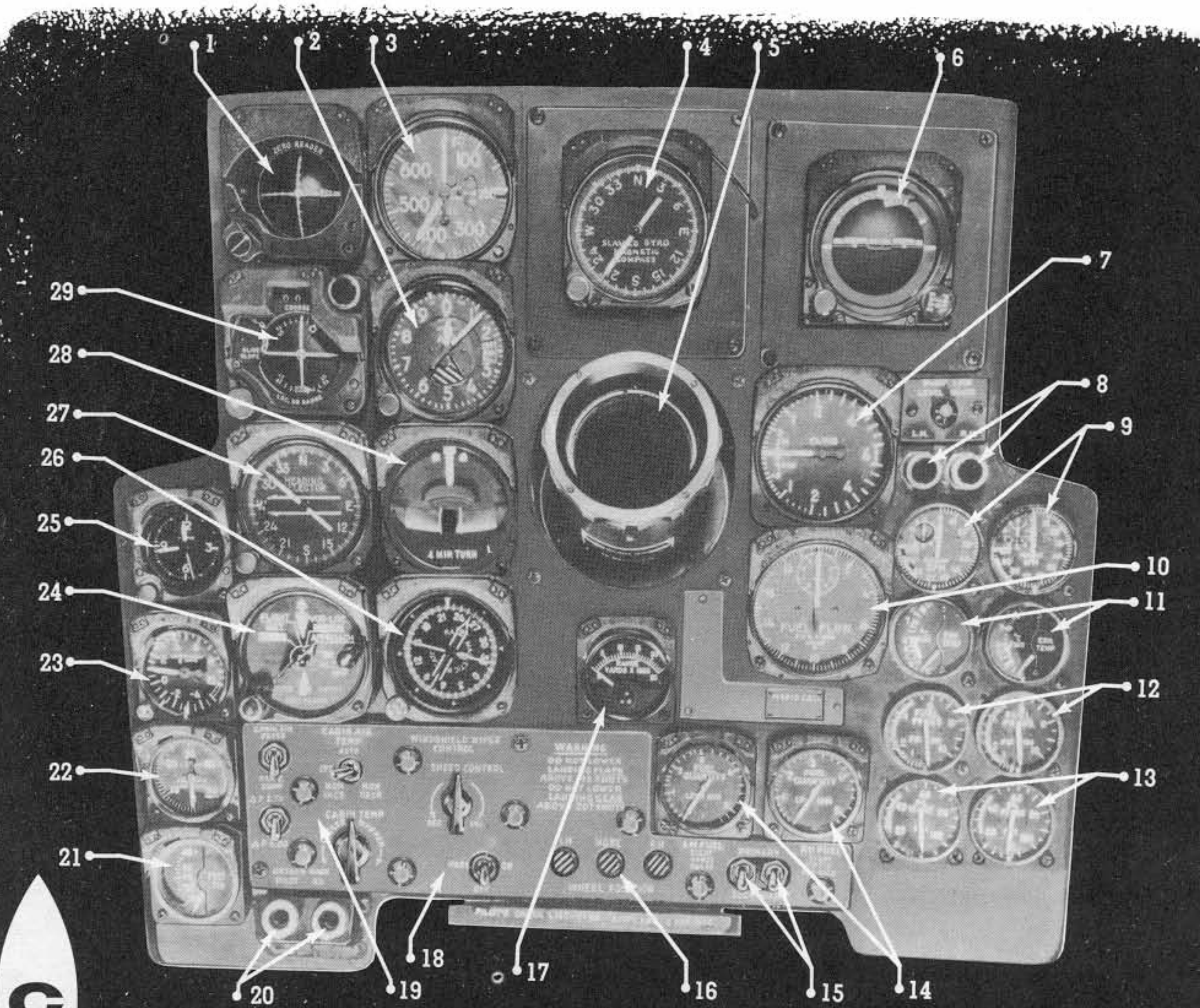
B C GROUPS 1, 5, AND 10 AIRPLANES

Not modified in accordance with T.O. 1F-89C-507

1. SIGHT FILAMENT SELECTOR SWITCHES
2. FLIGHT COMPUTER INDICATOR (ZERO READER)
3. RANGE METER
4. PILOT'S RADAR SCOPE
5. SUMP LOW-LEVEL WARNING LIGHTS
6. TACHOMETERS
7. EXHAUST GAS TEMPERATURE GAGES
8. CABIN AIR CONDITIONING CONTROL PANEL
9. COMPASS CORRECTION CARD HOLDER
10. FUEL PRESSURE GAGES
11. OIL PRESSURE GAGES
12. CABIN PRESSURE ALTITUDE INDICATOR
13. FUEL QUANTITY GAGES
14. FREE AIR TEMPERATURE GAGE
15. OXYGEN WARNING LIGHTS (Inoperative on some airplanes)
16. WINDSHIELD WIPER CONTROL PANEL
17. FUEL FLOWMETER INDICATOR
18. ATTITUDE INDICATOR
19. ACCELEROMETER
20. VERTICAL VELOCITY INDICATOR
21. CLOCK
22. TURN AND SLIP INDICATOR
23. LANDING GEAR POSITION INDICATOR
24. FLIGHT COMPUTER HEADING SELECTOR
25. ALTIMETER
26. FLIGHT COMPUTER SELECTOR SWITCH
27. AIRSPEED INDICATOR
28. RADIO MAGNETIC INDICATOR
29. DIRECTIONAL INDICATOR (SLAVED)
30. COURSE INDICATOR
31. MARKER BEACON INDICATOR LIGHT

BC-11(1) A

Figure 1-8 (Sheet 1 of 4 Sheets).



C

PILOT'S INSTRUMENT PANEL

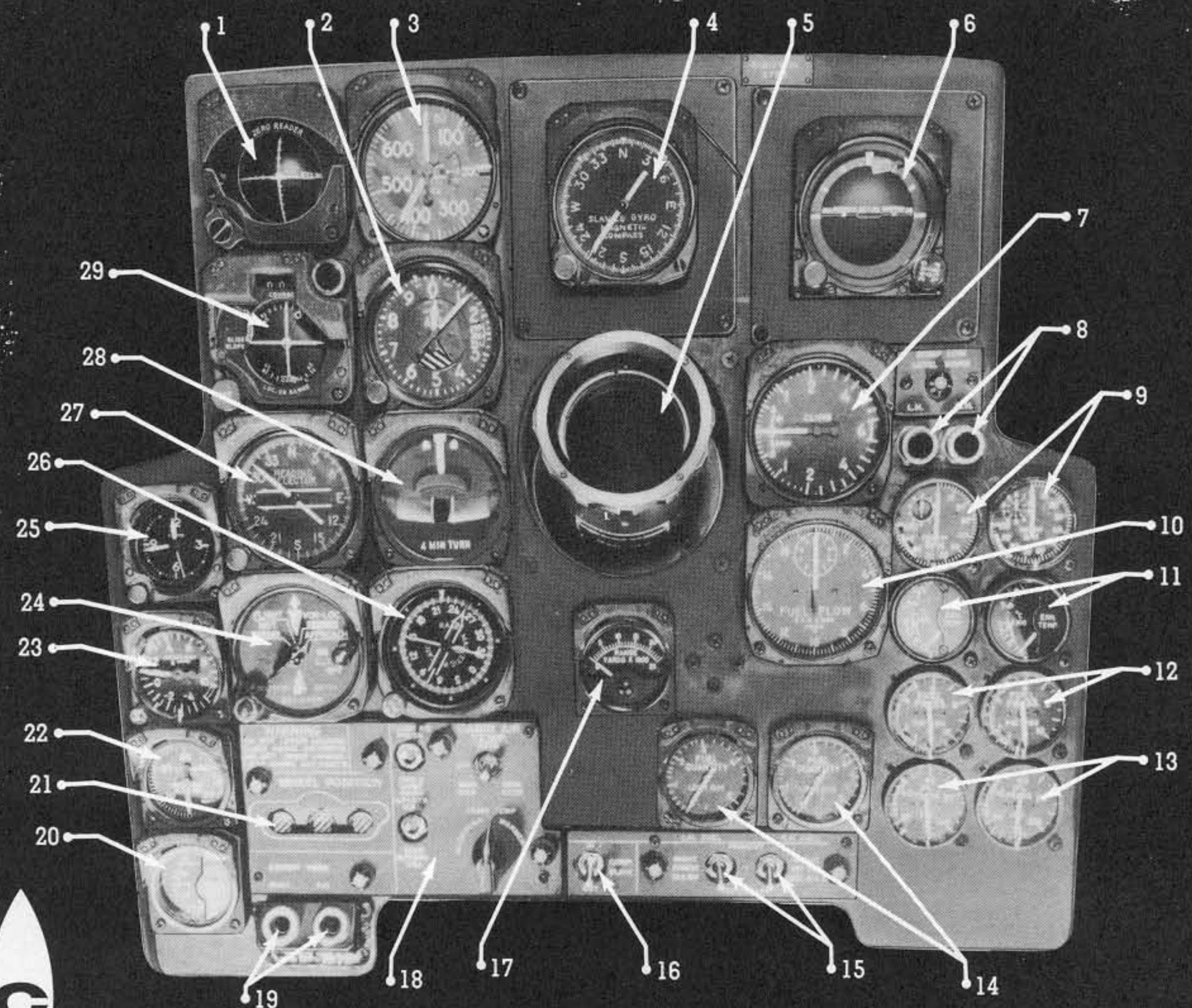
GROUPS 1, 5, AND 10 AIRPLANES

Modified in accordance with T.O. 1F-89C-507

1. FLIGHT COMPUTER INDICATOR (ZERO READER)
2. ALTIMETER
3. AIRSPEED INDICATOR
4. DIRECTIONAL INDICATOR (SLAVED)
5. PILOT'S RADAR SCOPE
6. ATTITUDE INDICATOR
7. VERTICAL VELOCITY INDICATOR
8. SUMP LOW-LEVEL WARNING LIGHTS
9. TACHOMETERS
10. FUEL FLOWMETER INDICATOR
11. EXHAUST GAS TEMPERATURE GAGES
12. FUEL PRESSURE GAGES
13. OIL PRESSURE GAGES
14. FUEL QUANTITY GAGES
15. SIGHT FILAMENT SELECTOR SWITCHES
16. LANDING GEAR POSITION INDICATORS
17. RANGE METER
18. WINDSHIELD WIPER CONTROL PANEL
19. CABIN AIR CONDITIONING CONTROL PANEL
20. OXYGEN WARNING LIGHTS (Inoperative on some airplanes)
21. FREE AIR TEMPERATURE GAGE
22. CABIN PRESSURE ALTITUDE INDICATOR
23. ACCELEROMETER
24. FLIGHT COMPUTER SELECTOR SWITCH
25. CLOCK
26. RADIO MAGNETIC INDICATOR
27. FLIGHT COMPUTER HEADING SELECTOR
28. TURN AND SLIP INDICATOR
29. COURSE INDICATOR

BC-11(4)A

Figure 1-8 (Sheet 2 of 4 Sheets).



C

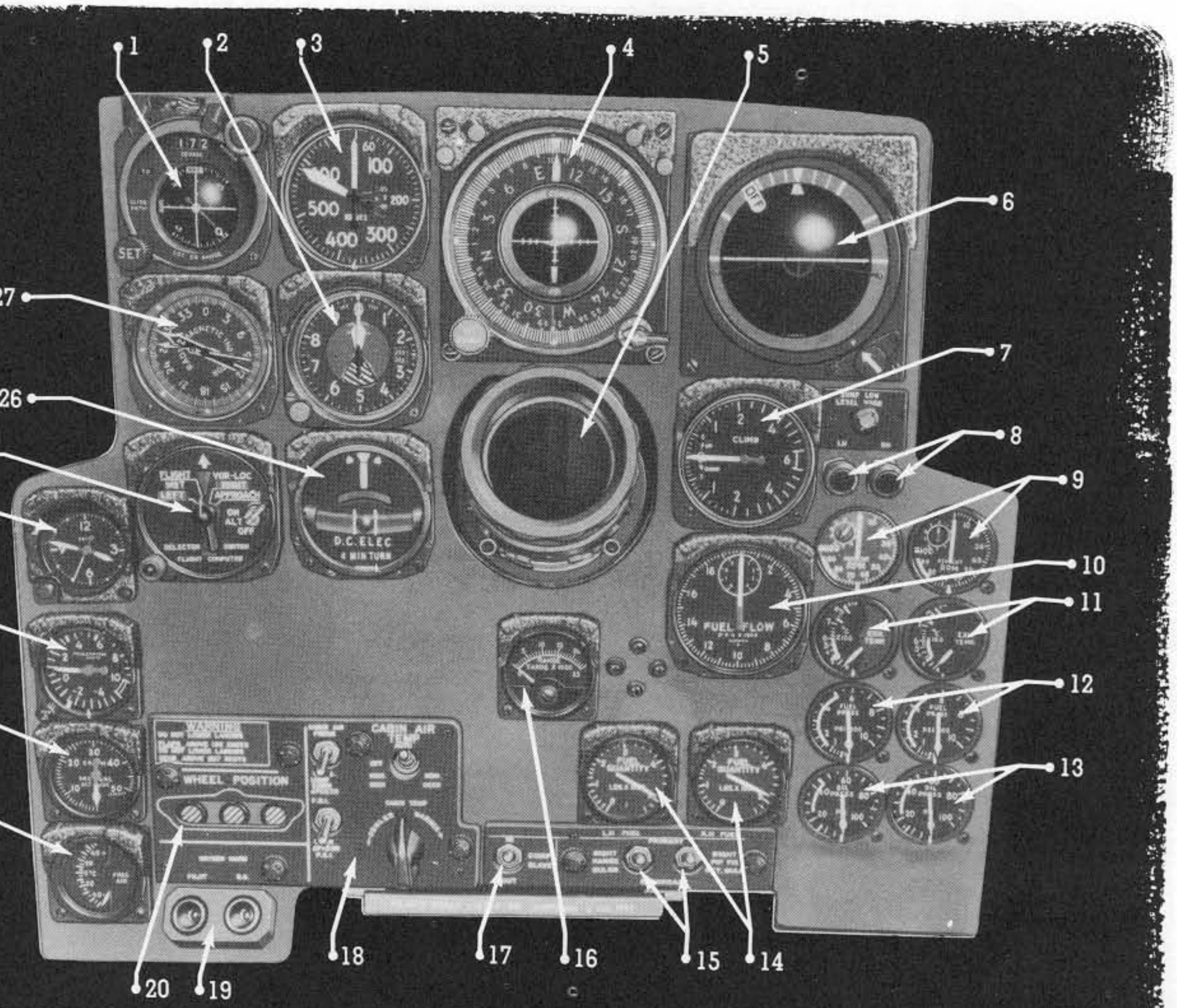
PILOT'S INSTRUMENT PANEL

GROUPS 15 AND 20 AIRPLANES

1. FLIGHT COMPUTER INDICATOR (ZERO READER)
2. ALTIMETER
3. AIRSPEED INDICATOR
4. DIRECTIONAL INDICATOR (SLAVED)
5. PILOTS' RADAR SCOPE
6. ATTITUDE INDICATOR
7. VERTICAL VELOCITY INDICATOR
8. SUMP LOW-LEVEL WARNING LIGHTS
9. TACHOMETERS
10. FUEL FLOWMETER INDICATOR
11. EXHAUST GAS TEMPERATURE GAGES
12. FUEL PRESSURE GAGES
13. OIL PRESSURE GAGES
14. FUEL QUANTITY GAGES
15. SIGHT FILAMENT SELECTOR SWITCHES
16. REMOTE COMPASS SLAVING CUTOUT SWITCH
17. RANGE METER
18. CABIN AIR CONDITIONING CONTROL PANEL
19. OXYGEN WARNING LIGHTS (Inoperative on some airplanes)
20. FREE AIR TEMPERATURE GAGE
21. LANDING GEAR POSITION INDICATOR
22. CABIN PRESSURE ALTITUDE INDICATOR
23. ACCELEROMETER
24. FLIGHT COMPUTER SELECTOR SWITCH
25. CLOCK
26. RADIO MAGNETIC INDICATOR
27. FLIGHT COMPUTER HEADING SELECTOR
28. TURN AND SLIP INDICATOR
29. COURSE INDICATOR

BC-11(2)A

Figure 1-8 (Sheet 3 of 4 Sheets).



PILOT'S INSTRUMENT PANEL

GROUP 25 AND SUBSEQUENT AIRPLANES

1. COURSE INDICATOR
2. ALTIMETER
3. AIRSPEED INDICATOR
4. FLIGHT COMPUTER INDICATOR
5. PILOT'S RADAR SCOPE
6. ATTITUDE INDICATOR
7. VERTICAL VELOCITY INDICATOR
8. SUMP LOW-LEVEL WARNING LIGHTS
9. TACHOMETERS
10. FUEL FLOWMETER INDICATOR
11. EXHAUST GAS TEMPERATURE GAGES
12. FUEL PRESSURE GAGES
13. OIL PRESSURE GAGES
14. FUEL QUANTITY GAGES
15. SIGHT FILAMENT SELECTOR SWITCHES
16. RANGE METER
17. REMOTE COMPASS SLAVING CUTOUT SWITCH
18. CABIN AIR CONDITIONING CONTROL PANEL
19. OXYGEN WARNING LIGHTS (Inoperative on some airplanes)
20. LANDING GEAR POSITION INDICATOR
21. FREE AIR TEMPERATURE GAGE
22. CABIN PRESSURE ALTITUDE INDICATOR
23. ACCELEROMETER
24. CLOCK
25. FLIGHT COMPUTER SELECTOR SWITCH
26. TURN AND SLIP INDICATOR
27. RADIO MAGNETIC INDICATOR

BC-11(3)A

Figure 1-8 (Sheet 4 of 4 Sheets).

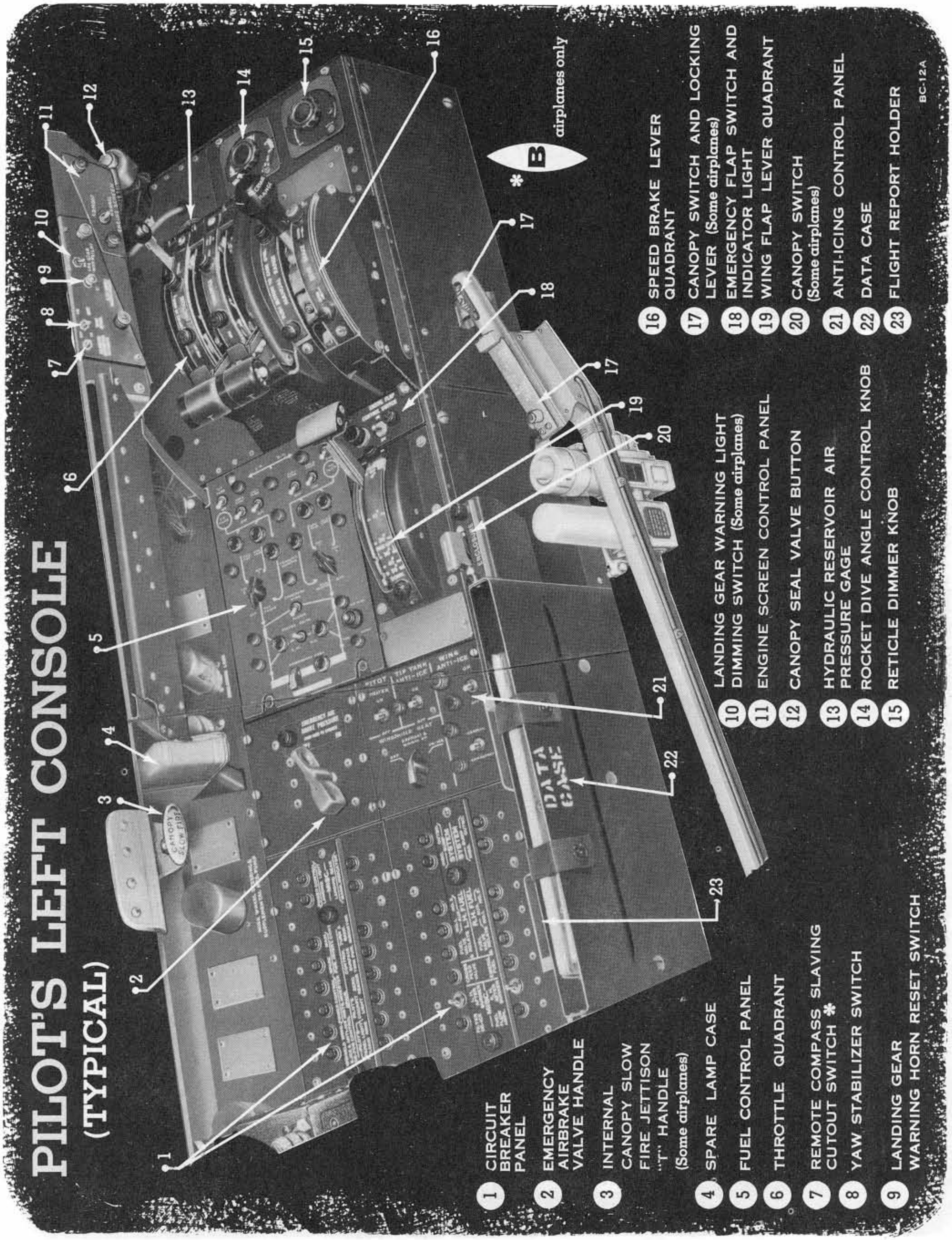

PILOT'S LEFT CONSOLE
(TYPICAL)
1 CIRCUIT BREAKER PANEL
2 EMERGENCY AIRBRAKE VALVE HANDLE
3 INTERNAL CANOPY SLOW FIRE JETTISON "T" HANDLE (Some airplanes)
4 SPARE LAMP CASE
5 FUEL CONTROL PANEL
6 THROTTLE QUADRANT
7 REMOTE COMPASS SLAVING CUTOUT SWITCH *
8 YAW STABILIZER SWITCH
9 LANDING GEAR WARNING HORN RESET SWITCH
10 LANDING GEAR WARNING LIGHT DIMMING SWITCH (Some airplanes)
11 ENGINE SCREEN CONTROL PANEL
12 CANOPY SEAL VALVE BUTTON
13 HYDRAULIC RESERVOIR AIR PRESSURE GAGE
14 ROCKET DIVE ANGLE CONTROL KNOB
15 RETICLE DIMMER KNOB
16 SPEED BRAKE LEVER QUADRANT
17 CANOPY SWITCH AND LOCKING LEVER (Some airplanes)
18 EMERGENCY FLAP SWITCH AND INDICATOR LIGHT
19 WING FLAP LEVER QUADRANT
20 CANOPY SWITCH (Some airplanes)
21 ANTI-ICING CONTROL PANEL
22 DATA CASE
23 FLIGHT REPORT HOLDER
* B airplanes only
CANOPY SLOW FIRE
DATA CASE
BC-12A

Figure 1-9.

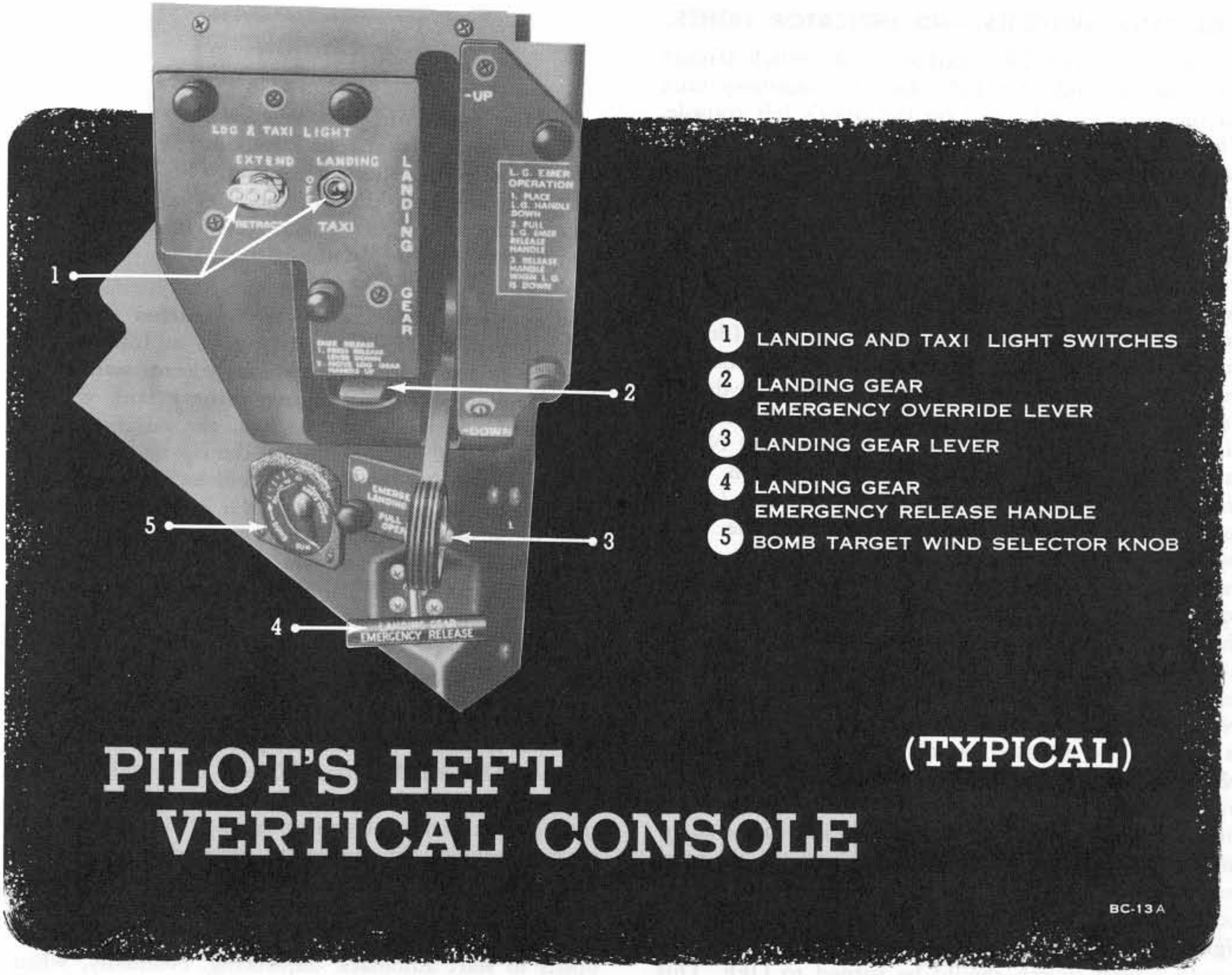


Figure 1-10.

pressure, in an emergency. The tip tank dump pressure is supplied from the engine compressor through the pressure regulator. The fuel is released through an outlet in the tip tank tail cone.

Note

Tip tank fuel cannot be dumped while the weight of the airplane is on the wheels because the oleo strut ground safety switch breaks the tip tank fuel dump electrical circuit.

FUEL SELECTOR SWITCHES.

Two rotary-type, 28-volt DC fuel selector switches (figure 1-18), one for each fuel system, are located on the fuel control panel on the pilot's left console and control the flow of fuel from the tanks to the engines. The switches have ALL TANKS, AUX 1, AUX 2, and OFF positions. When the selector switch is placed at ALL TANKS and the auxiliary and tip tank switches are at ON, the shutoff valve in the main fuel line is opened, the normal booster pump in the sump tank is turned on, the shutoff valve in the tip tank is opened, and automatic sequencing starts. With the selector switch at AUX 1 or AUX 2, the booster pump in the related tank is turned on, the booster pump in the sump tank is turned off, and valves are opened to allow fuel to bypass the sump tank and flow directly from the selected auxiliary tank to the main fuel line. When the selector switch is at OFF, the shutoff valve in the main fuel line is closed and all booster pumps are turned off. For complete fuel system management, refer to Section VII.

CAUTION

After positioning the selector switch at any position, allow at least 3 seconds to elapse before selecting another position. This will preclude any possibility of the affected fuel system motor valves being reversed in midcycle, thus shortening valve life.

FUEL TANK SWITCHES AND INDICATOR LIGHTS.

There is a 28-volt DC auxiliary tank switch (figure 1-18) and an indicator light for each auxiliary tank on the fuel control panel on the pilot's left console. The switches have ON and OFF positions to control booster pump operation during normal sequencing and to energize the auxiliary tank fuel level sensing units of the fuel quantity gage system. To obtain automatic sequencing, the fuel selector switches must be placed at ALL TANKS and the auxiliary and tip tank switches must be placed at ON. When an auxiliary tank switch is placed at ON (during automatic sequencing), the auxiliary tank booster pump, the auxiliary tank to sump tank motor-driven valve, and the indicator light 28-volt DC electrical circuits are armed. In the case of the auxiliary NO. 2 tank, the booster pump and the motor-driven valve circuits are closed by the tip tank float switch (or by turning the tip tank switch to OFF). The float switch (or tip tank switch) closes the tip tank valve, starts the auxiliary NO. 2 booster pump, and opens the auxiliary NO. 2 valve. Fuel then flows from the auxiliary NO. 2 tank to the sump tank. In the case of the auxiliary NO. 1 tank, the booster pump and the motor-driven valve circuits are closed by the auxiliary NO. 2 pressure switch when the auxiliary NO. 2 tank is empty. The pressure switch turns on the auxiliary NO. 2 indicator light, starts the auxiliary NO. 1 booster pump, and opens the auxiliary NO. 1 valve. Fuel then flows from the auxiliary NO. 1 tank to the sump tank. When the auxiliary NO. 1 tank is empty, the pressure switch in the auxiliary NO. 1 line turns on the auxiliary NO. 1 indicator light. When an indicator light comes on to indicate an empty tank, the corresponding tank switch should be turned to OFF. This turns off the booster pump, closes the motor-driven valve, and turns out the indicator light. Since the indicator light is controlled by the pressure switch in the corresponding tank fuel line, the light will come on, provided the tank switch is at ON, in the event of booster pump failure. When the fuel selector switch is at AUX 1 or AUX 2, the tank switch for the selected tank should be turned to ON. In this case the tank switch arms the circuit to the indicator light only. When the selected tank becomes empty, its pressure switch closes the indicator light circuit and the light comes on. The booster pump and motor-driven valve of the manually selected tank are controlled solely by the fuel selector switch.

Note

When an indicator light comes on to indicate an empty tank, a small amount of fuel remains in the tank. This fuel will be pumped at a continually decreasing rate for approximately 5 minutes if the tank switch is left at ON.

CAUTION

After positioning the selector switch at any position, allow at least 3 seconds to elapse before selecting another position. This will preclude any possibility of the affected fuel system motor valves being reversed in midcycle, thus shortening valve life.

The auxiliary tank and tip tank switches affect the operation of the fuel quantity gage as follows: Regardless of the position of the fuel selector switch, the fuel level sensing unit in an auxiliary tank will be energized when, and only when, the auxiliary tank switch is placed at ON. Placing the tip tank switch at ON will energize the tip tank fuel level sensing unit only when the fuel selector switch is placed at either OFF or at ALL TANKS. The sump tank fuel level sensing unit is energized whenever the main or spare power inverter is operating, regardless of the position of any switch on the fuel control panel.

TIP TANK SWITCHES.

A 28-volt DC tip tank switch (figure 1-18) for each tip tank is on the fuel control panel on the pilot's left console. The switches have ON and OFF positions and are used to control tip tank fuel flow and to energize the tip tank fuel level sensing units of the fuel quantity gage system. In automatic sequencing, placing a fuel selector switch at ALL TANKS arms the circuit to the tip tank shutoff valve. Placing a tip tank switch at ON completes the circuit and the shutoff valve opens to start automatic sequencing. Normally, when a tip tank is empty, the float switch completes the circuit that energizes the auxiliary NO. 2 booster pump and opens the motor-driven valve in the auxiliary NO. 2 to sump tank line. If the tip tank float switch fails, turning the tip tank switch to OFF will override the float switch, close the tip tank valve, start the auxiliary NO. 2 booster pump, and open the auxiliary NO. 2 motor-driven valve. Normal sequencing will then follow. The fuel quantity gages are affected by the tip tank switches as follows: When a tip tank switch is at ON, while the fuel selector switch is at either OFF or ALL TANKS, the fuel level sensing unit in the tip tank is energized and the tip tank fuel quantity (plus the sump tank fuel and the fuel in any auxiliary tank whose switch is at ON) will be indicated on the fuel quantity gage.

CROSSFEED SWITCH.

A 28-volt DC crossfeed switch (figure 1-18), located on the fuel control panel on the pilot's left console, opens and closes the 28-volt DC motor-operated valve in the crossfeed line between the main fuel lines of each system. The switch has ON and OFF positions. When the switch is at OFF the crossfeed valve is

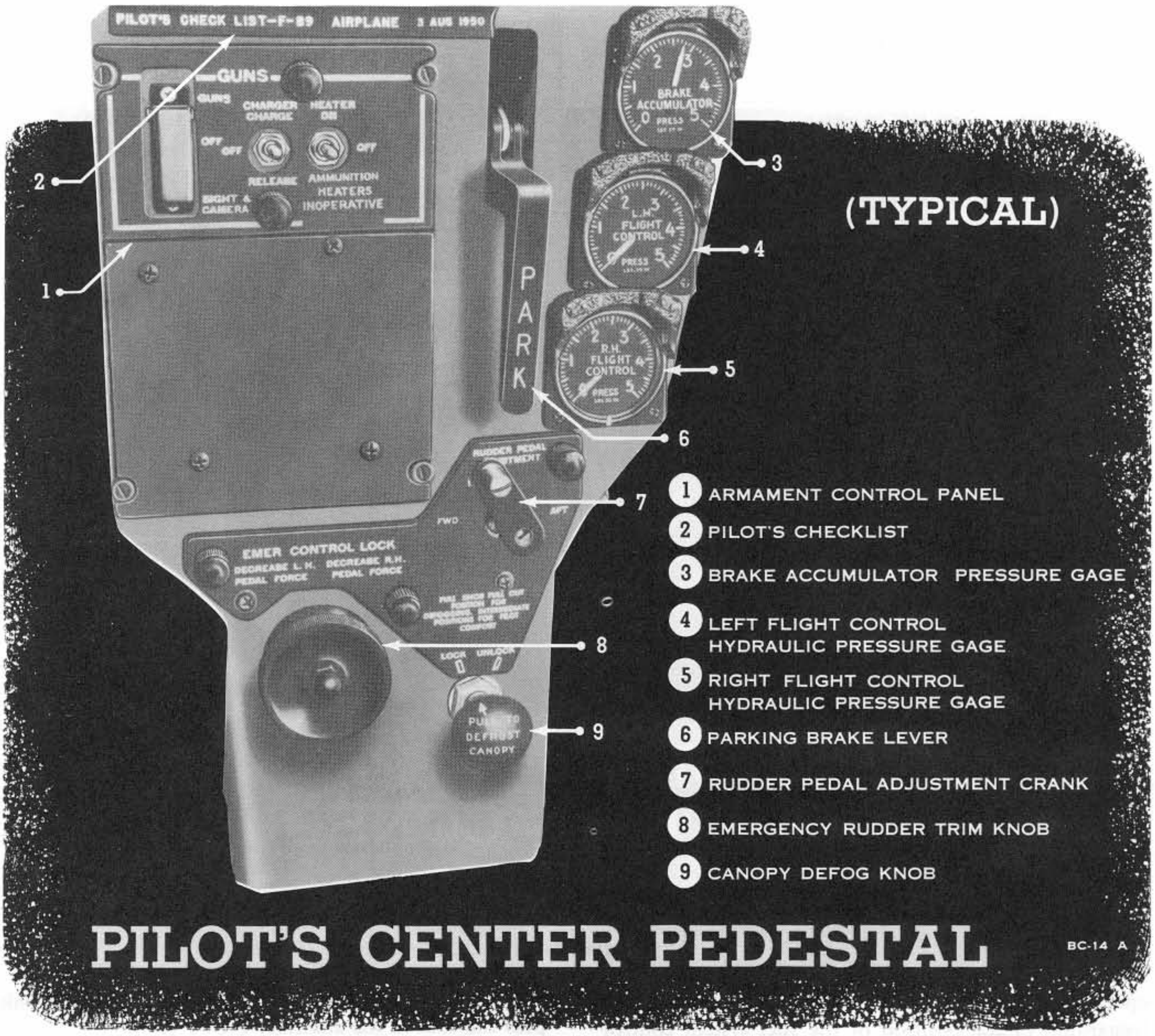


Figure 1-11.

closed. The switch must be placed at ON to open the crossfeed valve when balancing the fuel load, or operating on one engine, or if one fuel system fails.

ENGINE FIRE SELECTOR SWITCHES.

Two guarded 28-volt DC engine fire selector switches (figure 1-36), one for each engine, are located on the pilot's right vertical console. Lifting the guard and placing either switch in the UP position, arms the fire extinguishing agent discharge switch and closes the fuel shutoff valve which isolates the related engine from its fuel supply.

TIP TANK FUEL DUMP BUTTON.

A tip tank fuel dump button (figure 1-18) is located on the fuel control panel. When the button is pressed momentarily, the 28-volt DC fuel dump valve in each tip tank opens and remains open for 75 seconds. A full tip tank is emptied in approximately 60 seconds. Because of the aft location of the dump valves, the tanks cannot be completely drained during decelerations or dives. For complete drainage, the airplane should be in level or climbing flight.

FUEL QUANTITY GAGES.

Two fuel quantity gages (figure 1-8), one for each fuel system, are located on the pilot's instrument panel. The gages are calibrated in pounds and operate on 28-volt DC and 115-volt AC from the main or spare power inverter. Each gage, which is connected through an amplifier to fuel level sensing units (capacitors) in all tanks of its related system, will indicate the fuel in only those tanks in which the sensing units are energized. Whenever the main or spare power inverter is

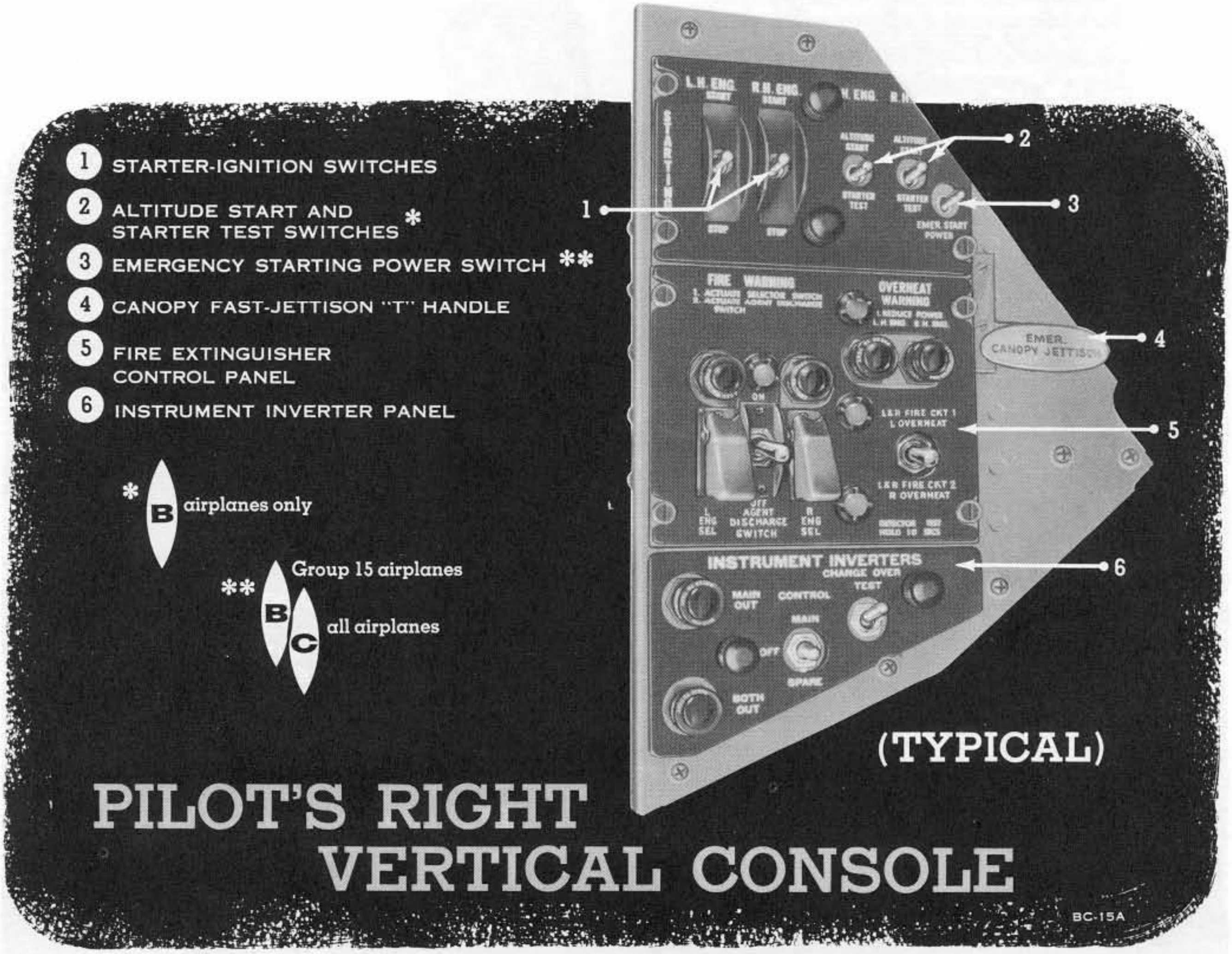


Figure 1-12.

operating, the sump tank sensing unit is energized (regardless of the position of the fuel system control switches), and the sump tank fuel quantity will be registered on the quantity gage. An auxiliary tank sensing unit, however, is energized only when its tank switch is at ON (regardless of the fuel selector switch position), and the tip tank sensing unit is energized only when the tip tank switch is at ON while the fuel selector switch is at either OFF or at ALL TANKS. When the fuel selector switch is at OFF or ALL TANKS, the gage will register the fuel in the sump tank plus the fuel in those tanks whose tank switch is at ON. When the fuel selector switch is at AUX 1 or AUX 2, the tip tank switch is cut out of the fuel quantity gage circuit and the gage will register the fuel in the sump tank plus the fuel in those auxiliary tanks whose tank switch is at ON (regardless of the tank selected by the selector switch). For example, if the selector switch is at AUX 2, the auxiliary NO. 2 tank switch is at OFF, and the auxiliary NO. 1 switch is at ON, the gage will indicate the fuel in the sump tank plus the fuel in the auxiliary NO. 1 tank.

FUEL TRANSFER WARNING LIGHTS.

Two 28-volt DC fuel transfer warning lights (figure 1-18), one for each fuel system, are connected to float switches in the sump tanks. The lights will illuminate during automatic sequencing to indicate when sump tank fuel is being used faster than it is being replenished. When the sump tank fuel falls below the level of the lower sump tank inlet, as may occur during automatic sequencing when the engines are using fuel faster than the sump tanks are being replenished, a float switch closes and the warning light comes on.

SUMP LOW-LEVEL WARNING LIGHTS.

Two 28-volt DC sump low-level warning lights (figure 1-8), located on the pilot's instrument panel, indicate when the sump tank fuel is below the two-thirds full level. Each light is connected to a float switch in the corresponding sump tank. When the fuel in a

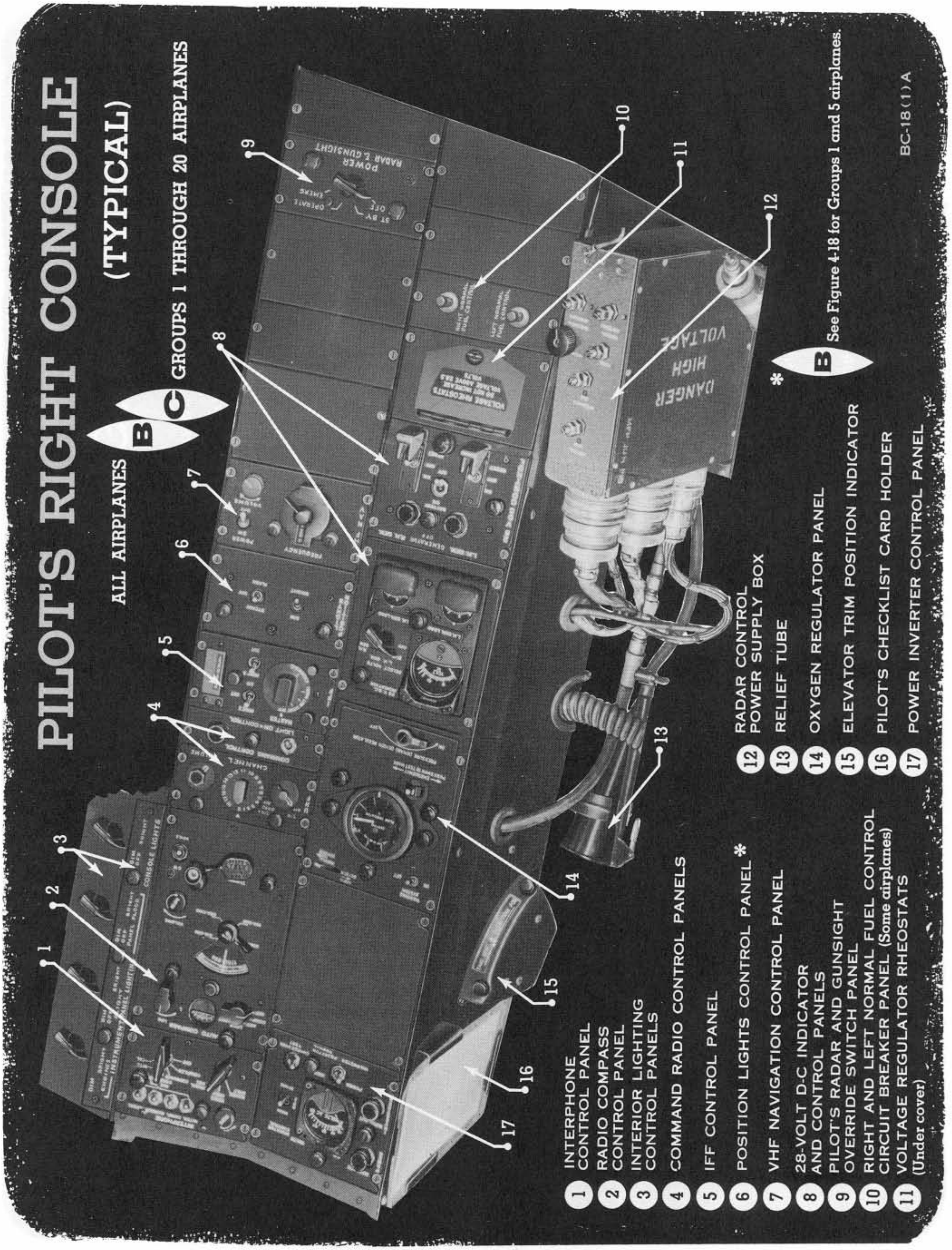


Figure 1-13 (Sheet 1 of 2 Sheets).

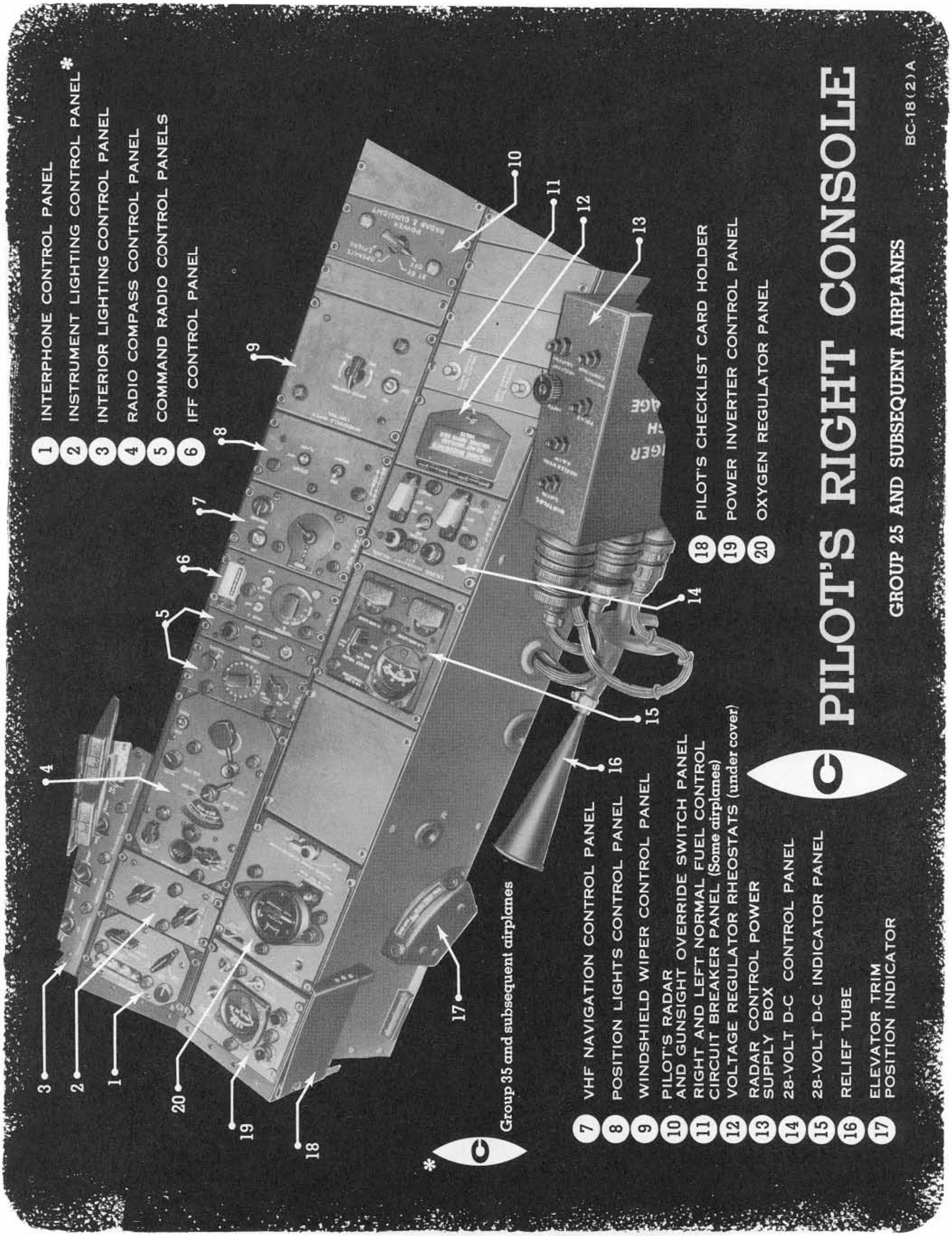


Figure 1-13 (Sheet 2 of 2 Sheets).

sump tank drops to about 450 pounds, the float switch closes and turns on the related warning light. The light will go out when the sump tank has been replenished to the two-thirds full level. If the lights come on during afterburning, the afterburners should be shut down to prevent subsequent flameout (when sump tanks become empty). Afterburning may be reinitiated when sump tanks are again replenished (as indicated by the fuel transfer warning lights going out).

ELECTRICAL POWER SUPPLY SYSTEMS.

Four systems supply electrical power: a 28-volt DC system, a 120-volt DC system, a 115-volt single-phase AC inverter system, and a 115-volt three-phase AC inverter system. The 28-volt and 120-volt DC systems are independent of each other and each has two engine-driven generators; the two 115-volt AC inverter systems, each of which has a main and a spare inverter, are dependent upon the two DC systems for their operating power. The main single-phase power inverter operates on 120-volt DC; the spare single-phase power inverter and the main and spare three-phase instrument inverters operate on 28-volt DC. Both DC systems can be energized for starting and ground operation by external power units. On airplanes modified in accordance with T.O. 1F-89-256, an external AC power receptacle has been added for ground check purposes.

Electrically Operated Equipment.

For complete reference of power distribution to electrically operated equipment, see figure 1-19.

External Power Receptacles. B (Groups 1, 5, and 10).

Two 28-volt DC and one 120-volt DC external power receptacles (figure 1-3) are located on the right engine air intake duct. The 28-volt DC receptacles are wired in parallel to the 28-volt DC main bus through separate relays and the 120-volt DC receptacle (the bottom of the three) is connected to the 120-volt DC bus. All three receptacles should be energized for ground operation when the engine generators are not operating. On airplanes modified in accordance with T.O. 1F-89-256, a lower (fourth) receptacle has been installed and is used for supplying the inverter circuit with an external source of 115-volt 400-cycle AC power. This will increase the serviceability of the aircraft inverters during ground checks.

External Power Receptacles. B (Group 15), C.

One 120-volt DC and three 28-volt DC external power receptacles (figure 1-3) are on the right engine air intake duct. The top two 28-volt DC receptacles are bused together and are connected to the engine starter bus, the third receptacle is connected to the 28-volt DC main bus, and the 120-volt DC receptacle is connected to the 120-volt DC bus. The external power circuit is designed so that only two of the three 28-volt DC receptacles need be energized before current is supplied to the starter bus. When an external power unit having two leads is used, one lead is plugged into the main bus bottom receptacle and the second lead into either one of the starting receptacles. The emergency start switch must be in the NORMAL position when using external power. If two 28-volt DC external power lines are not

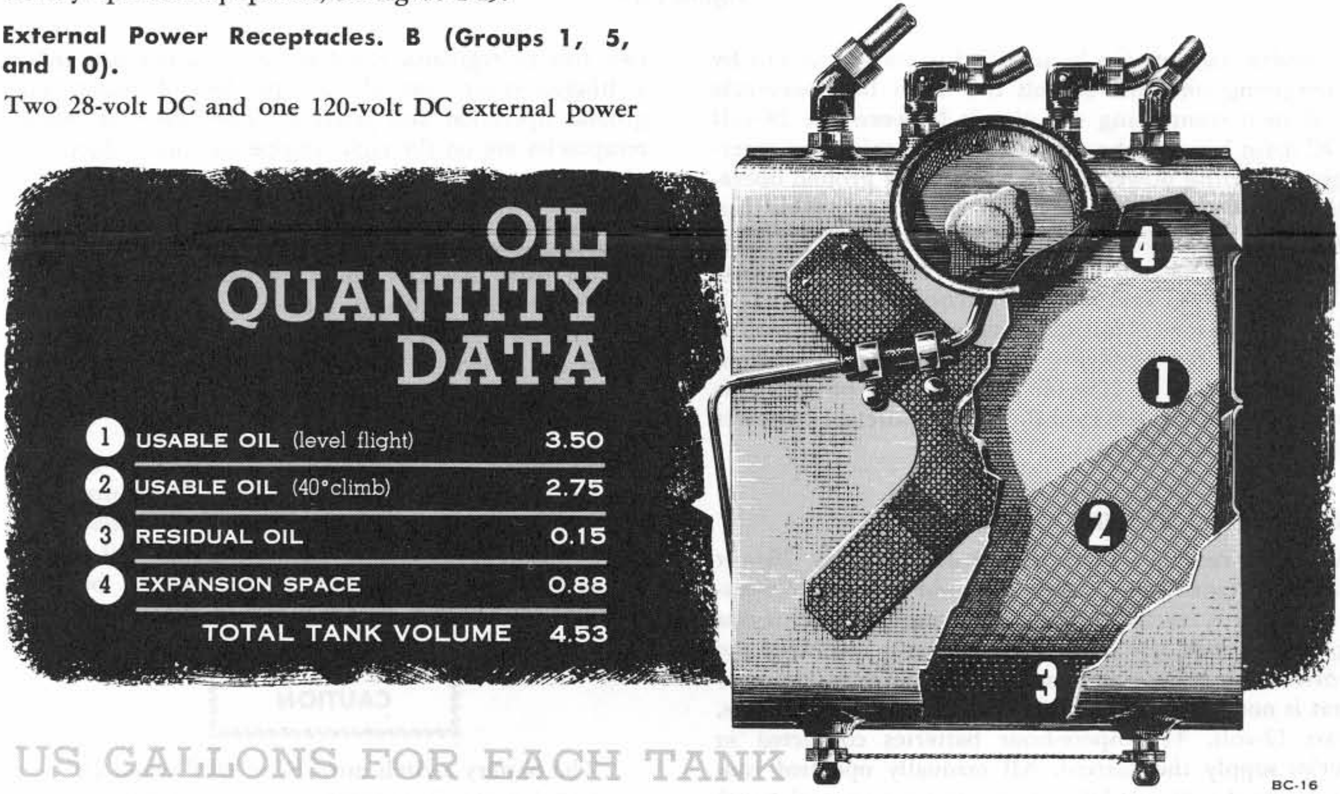
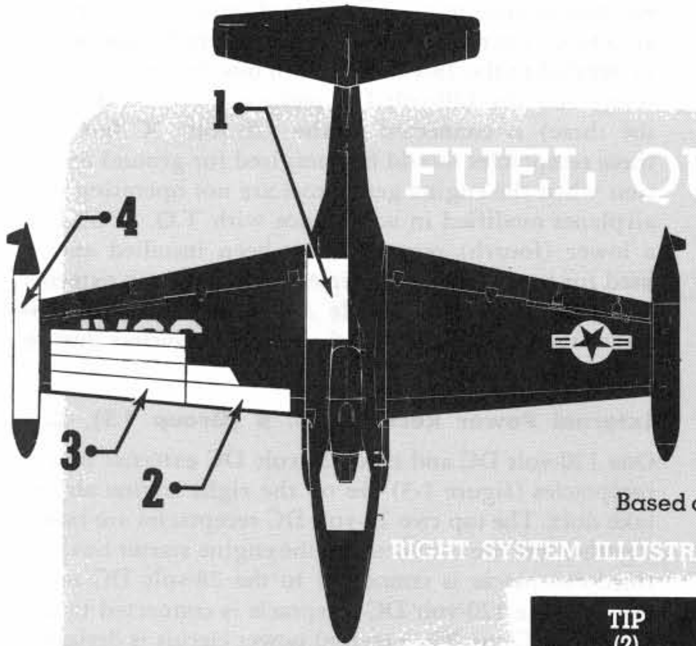


Figure 1-14.

FUEL QUANTITY DATA



US GALLONS AND POUNDS

The weight of fuel required to fill tanks completely may differ from one filling to another because of the effect of temperature variation on fuel density.

Based on 6.5 pounds per US gallon. (STANDARD DAY)

RIGHT SYSTEM ILLUSTRATED

TOTAL USABLE

1559 US GALLONS

(10.133 POUNDS)

		TIP (2)		AUXILIARY 2 (2)		AUXILIARY 1 (2)		FUSELAGE SUMP (2)	
		GAL	LB	GAL	LB	GAL	LB	GAL	LB
USABLE FUEL	EACH	304	1976	267.5	1738.8	107	695.5	101	656.5
	TOTAL	608	3952	535	3477.6	214	1391	202	1313
FULLY SERVICED	EACH	306	1889	274.5	1784.3	110	715	103	669.5
	TOTAL	612	3778	549	3568.6	220	1430	206	1339

DATA AS OF: 1 AUG 1956 DATA BASIS: CALIBRATION

BC-17A

Figure 1-15.

available, current can be supplied to the starter bus by energizing only the 28-volt DC main bus receptacle and then completing the circuit between the 28-volt DC main bus and the starter bus by turning the emergency starting power switch to ON. For ground operation (other than starting), the 28-volt DC main bus and the 120-volt DC bus receptacles should be energized when the engine generators are not operating. On airplanes modified in accordance with T.O. 1F-89-256, a lower (fourth) receptacle has been installed and is used for supplying the inverter circuit with an external source of 115-volt 400-cycle AC power. This will increase the serviceability of the aircraft inverters during ground checks.

28-VOLT DC SYSTEM.

Two engine-driven starter-generators supply 28-volt direct current to the 28-volt DC main bus. Full generator output is reached at about 35% engine RPM. If one generator fails, the remaining generator can carry the entire load. If both generators fail, or if generator output is not sufficient to close the reverse-current relays, two 12-volt, 34 ampere-hour batteries connected in series supply the current. All manually operated controls for the 28-volt DC system are on a control panel on the pilot's right console (figure 1-21) except for two voltage regulator rheostat knobs, which are under a hinged cover just aft of the control panel. For ground operation and starting, three external power receptacles are on the right engine air intake duct.

Battery Switch.

A battery switch (figure 1-21) on the 28-volt DC control panel has ON and OFF positions. When the switch is at ON, a relay is closed to complete a circuit from the two batteries to the 28-volt DC primary bus. When the switch is at OFF, the circuit is broken.

Note

The battery switch relay is energized by the batteries. A minimum of 18 volts is required to energize the relay; therefore, if the battery charge is extremely low the relay may fail to connect the battery bus to the primary bus when the battery switch is moved to ON.

CAUTION

The battery switch must be at OFF when external power is connected to prevent possible damage to the batteries.

28-Volt DC Voltage Regulator Rheostat Knobs.

Two voltage regulator rheostat knobs (figure 1-21) are located under a hinged cover just aft of the 28-volt DC control panel. The 28-volt DC generator voltage output can be increased or decreased by turning the rheostat knobs toward INCR or DEC. The two rheostat knobs are preset on the ground by qualified maintenance personnel, but may be reset in flight when voltage is abnormal.

28-Volt DC Generator Switches.

For each generator there is a guarded generator switch located on the 28-volt DC control panel (figure 1-21). The function of these switches is to connect the corresponding generator to the 28-volt DC primary bus and to reset the overvoltage relay after an overvoltage condition has occurred. The switch positions are ON, OFF, and RESET. The RESET position is spring-loaded to return the switch to OFF when released. Placing the switch at ON connects the generator to the primary bus; at OFF, it disconnects the generator from the bus. The RESET position is used as follows: If the voltage of a generator becomes excessive, an overvoltage relay opens the generator field circuit and causes the generator voltage to drop to zero. As the voltage drops, a reverse-current cutout relay disconnects the generator from the primary bus. To return the generator to service, the switch must be held momentarily to RESET. A circuit is then completed to the generator field and generator voltage builds up to normal. The switch can then be placed at ON to complete the circuit between the generator and the 28-volt DC bus. If the overvoltage condition persists (as indicated by the warning light again coming on), voltage can be reduced to the correct value by first placing the generator switch at OFF, then turning the voltage regulator rheostat knob toward DEC. The generator switch must then be held momentarily to RESET, then returned to OFF. With the switch at OFF, the voltage regulator rheostat knob should be adjusted so that the voltmeter reads 28 volts. Then the generator switch can be placed at ON to put the generator back into service.

28-Volt DC Generator Warning Lights.

For each generator there is a generator-off warning light located on the 28-volt DC control panel (figure 1-21), marked "GENERATOR OFF." The function of the lights is to warn the pilot when the corresponding generator is disconnected from the 28-volt DC primary bus. Each light, powered by 28-volt DC through a connection with the generator reverse-current relay, will come on when the 28-volt DC bus is energized and the generator is out of service (not connected to the primary bus). Specifically, the light will come on under the following conditions: before starting engines when the battery switch is turned on or an external source of 28-volt DC power is applied to the airplane; when the engines are operating but the generator switch is at OFF; or if the generator has been disconnected automatically because of an overvoltage condition.

Note

On some airplanes, the generator warning lights will be marked "Overvoltage Warning." These lights will come on when the generator has been disconnected automatically due to an overvoltage condition, but will not come on when the generator switch is at OFF.

28-Volt DC Circuit Breakers.

All 28-volt DC circuits (except some of the emergency circuits) are protected by push-pull circuit breakers on three circuit breaker panels: one on the pilot's left console (figure 1-24), one on the left side of the radar observer's cockpit (figure 1-24), and one in the forward fuselage section, which is not accessible in flight. When there is an overload in a circuit, the circuit breaker will pop out and the circuit will be opened. The circuit can be closed by pressing in the circuit breaker, or the circuit can be manually opened by pulling out the circuit breaker.

28-Volt DC Loadmeters.

Two loadmeters (figure 1-21), one for each 28-volt generator, are located on the 28-volt DC indicator panel. The loadmeters indicate the percentage of generator rated output being used.

28-Volt DC Voltmeter and Voltmeter Selector Switch.

A voltmeter and a voltmeter selector switch (figure 1-21) on the 28-volt DC indicator panel provide a means of determining generator voltage output. The selector switch has LH GEN, RH GEN, BUS, and OFF positions. When the selector switch is at LH GEN or RH GEN, the circuit is completed from the voltmeter to the corresponding generator and the voltmeter indicates the voltage output. When the switch is at BUS, the voltmeter indicates the voltage of the 28-volt DC bus. When the switch is OFF, the circuits to the voltmeter are open and the voltmeter reads zero.

120-VOLT DC SYSTEM.

The 120-volt direct current is supplied to the 120-volt DC bus by two engine-driven generators, either of which can carry the entire load alone. Circuits operating from the 120-volt bus are protected by fuses in the nose section of the airplane. The 120-volt DC control

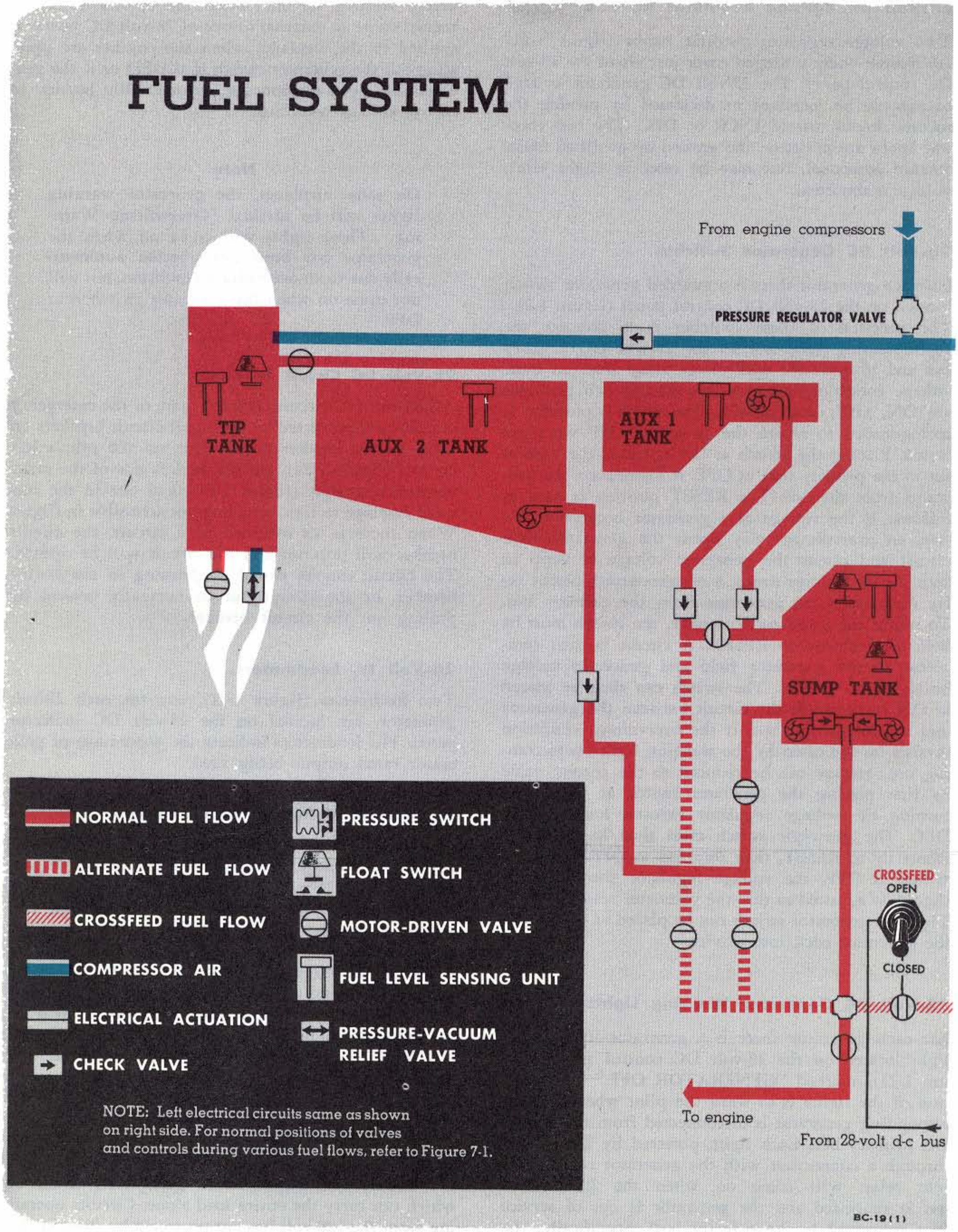


Figure 1-16 (Sheet 1 of 2 Sheets).

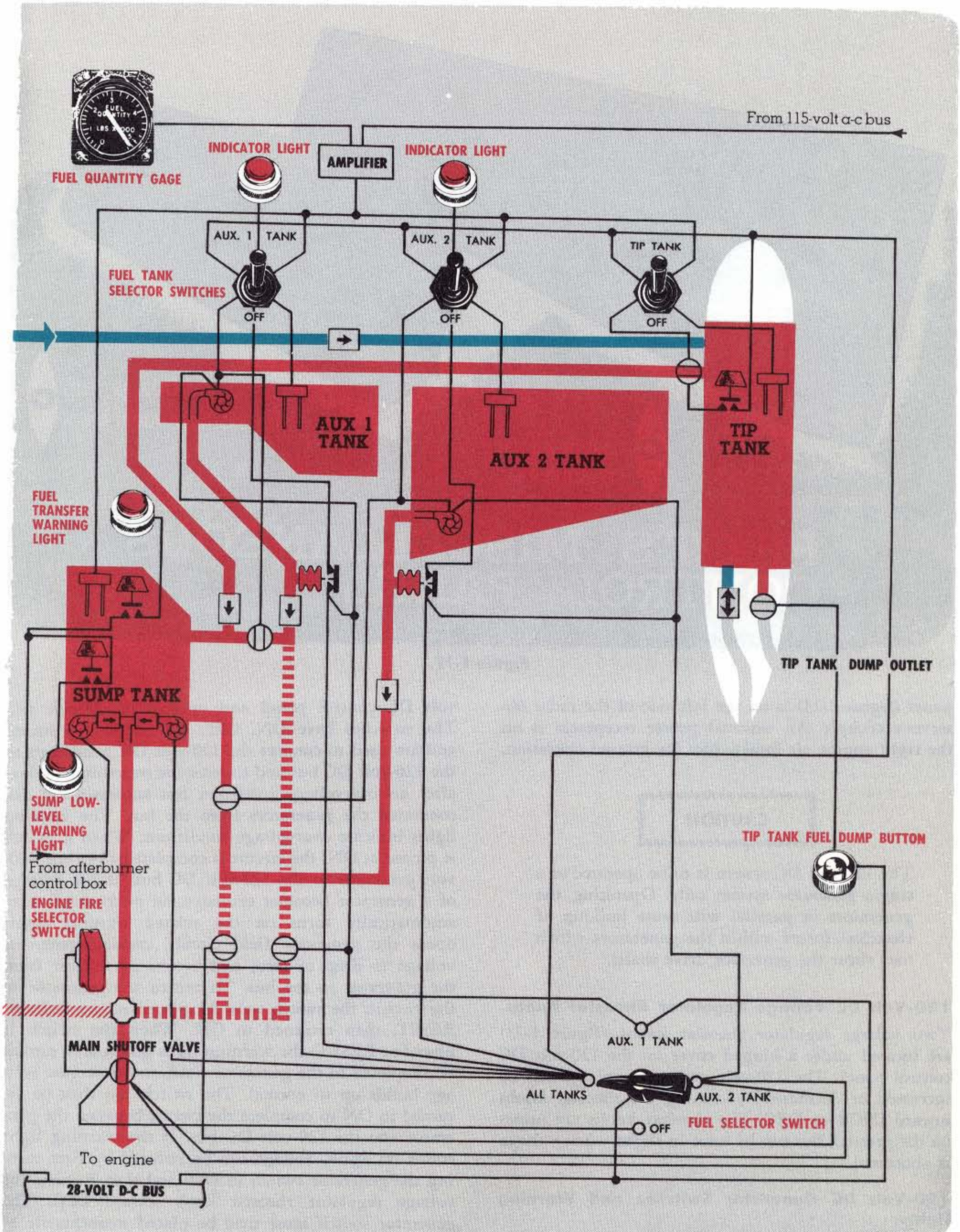


Figure 1-16 (Sheet 2 of 2 Sheets).

Figure 1-17.

panel (figure 1-23) is on the left side of the radar observer's cockpit. An external power receptacle is on the right engine air intake duct for ground operation.

CAUTION

The 120-volt DC system is to be operated as a single generator system only. Operating the generators in parallel will cause buildup of electrical forces within the generators which may shear the generator drive shafts.

120-Volt DC Voltage Regulator Rheostat Knobs.

Two voltage regulator rheostat knobs (figure 1-23) are located under a hinged cover on the 120-volt DC control panel. The 120-volt generator voltage can be increased or decreased by turning the rheostat knobs toward INCR or DEC. The rheostat knobs are preset on the ground, but can be reset in flight when voltage is abnormal.

120-Volt DC Generator Switches and Warning Lights.

Two guarded generator switches and overvoltage warning lights (figure 1-23) are located on the 120-volt DC control panel and operate on 28-volt DC. The switches have ON, OFF, and RESET positions and are used to connect the 120-volt DC generators to the 120-volt DC bus and to reset the overvoltage relays after an overvoltage condition has automatically disconnected the generators from the bus. The warning lights indicate overvoltage conditions. When a switch is placed at ON, the circuit is completed from the 120-volt generator to the 120-volt DC bus. If the voltage of a generator becomes excessive, an overvoltage relay automatically turns on the related warning light; opens the generator field circuit, causing generator voltage to drop to zero; and breaks the circuit from the generator to the bus. To return the generator to the circuit, the switch must be placed momentarily at RESET, then returned to ON. When the switch is placed at RESET, the warning light goes out, a circuit is completed to the generator field, and generator voltage builds up to normal. The switch can then be returned to ON to complete the circuit between the generator and the 120-volt DC bus. If the warning light comes on again, voltage can be reduced by first turning the generator switch to OFF and then turning the voltage regulator rheostat knob toward DEC. The generator switch must then be placed momentarily at RESET, then turned to OFF. With the switch at OFF, the voltage regulator rheostat knob should be adjusted to 115 volts; then the generator switch should be returned to ON. When the switches are at OFF, the generator circuits to the bus are broken.

120-Volt DC Loadmeters.

Two loadmeters (figure 1-23), one for each 120-volt generator, are located on the 120-volt DC control panel. The loadmeters indicate the percentage of generator rated output being used.

120-Volt DC Voltmeter and Voltmeter Selector Switch.

The voltmeter and a voltmeter selector switch (figure 1-23), on the 120-volt DC control panel, provide a means of determining generator voltage output. The switch positions are marked LH GEN and RH GEN. When the selector switch is at LH GEN or RH GEN, the circuit is completed from the voltmeter to the corresponding generator and the voltmeter indicates the voltage output.

AC INVERTER SYSTEMS.

Two systems supply alternating current: a 115-volt single-phase AC power system and a 115-volt three-phase AC instrument system. In each AC system, the current is normally furnished by a 400-cycle main inverter and, for emergency, by a spare inverter. The 5000-V A main power inverter operates on 120-volt direct current. The 1500-VA spare power inverter, the 500-VA main instrument inverter, and the 500-VA spare instrument inverter use 28-volt direct current. The spare inverters can power the equipment essential to flight, but not the total load used for tactical missions. All alternating current circuits are protected by fuses on a fuse panel on the right side of the bulkhead aft of the pilot's seat. All controls for the power inverter system are on the power inverter control panel (figure 1-22) located on the pilot's right console. The instrument inverter system controls are on an instrument inverter panel (figure 1-12) located on the pilot's right vertical panel.

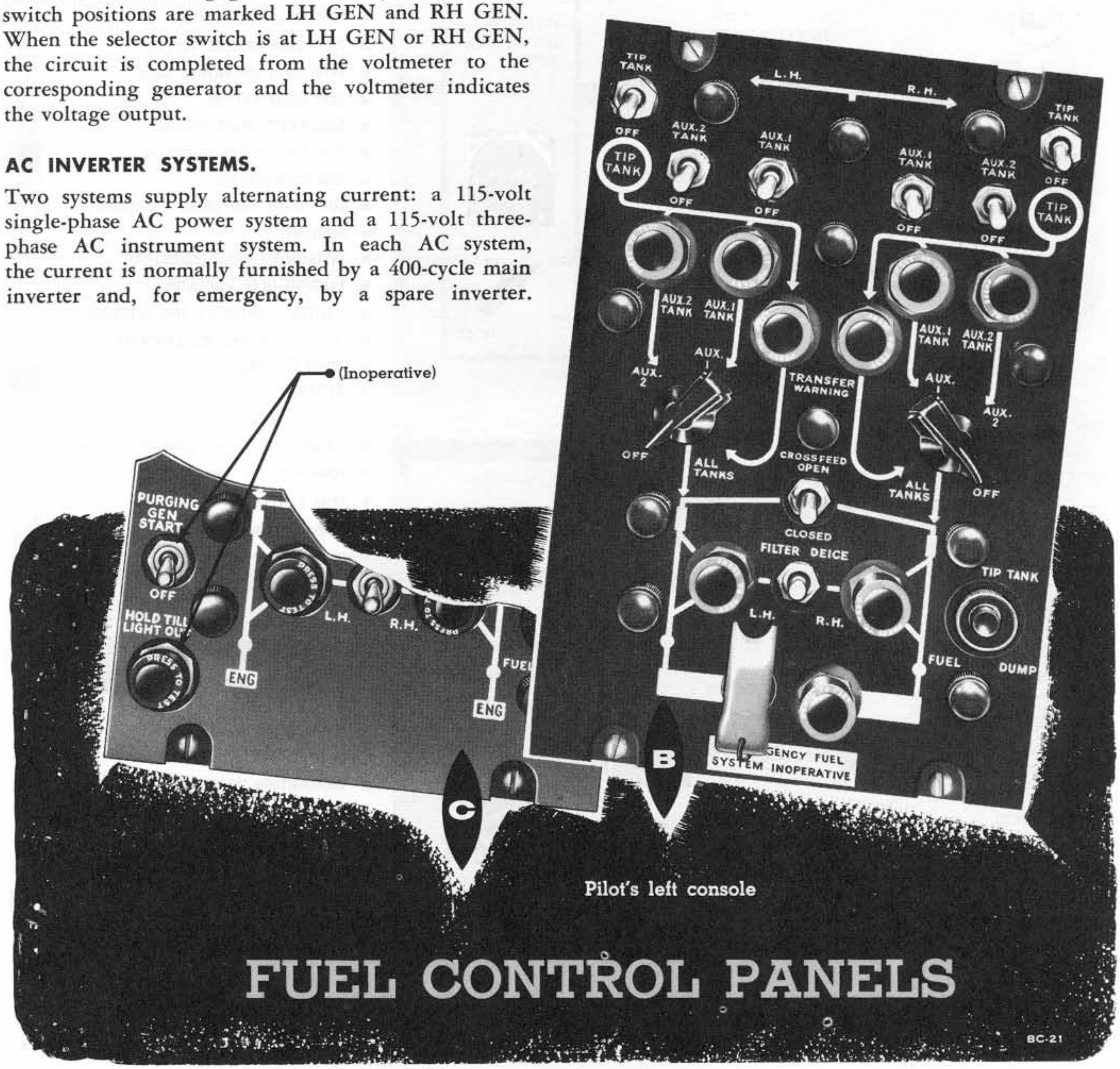


Figure 1-18.

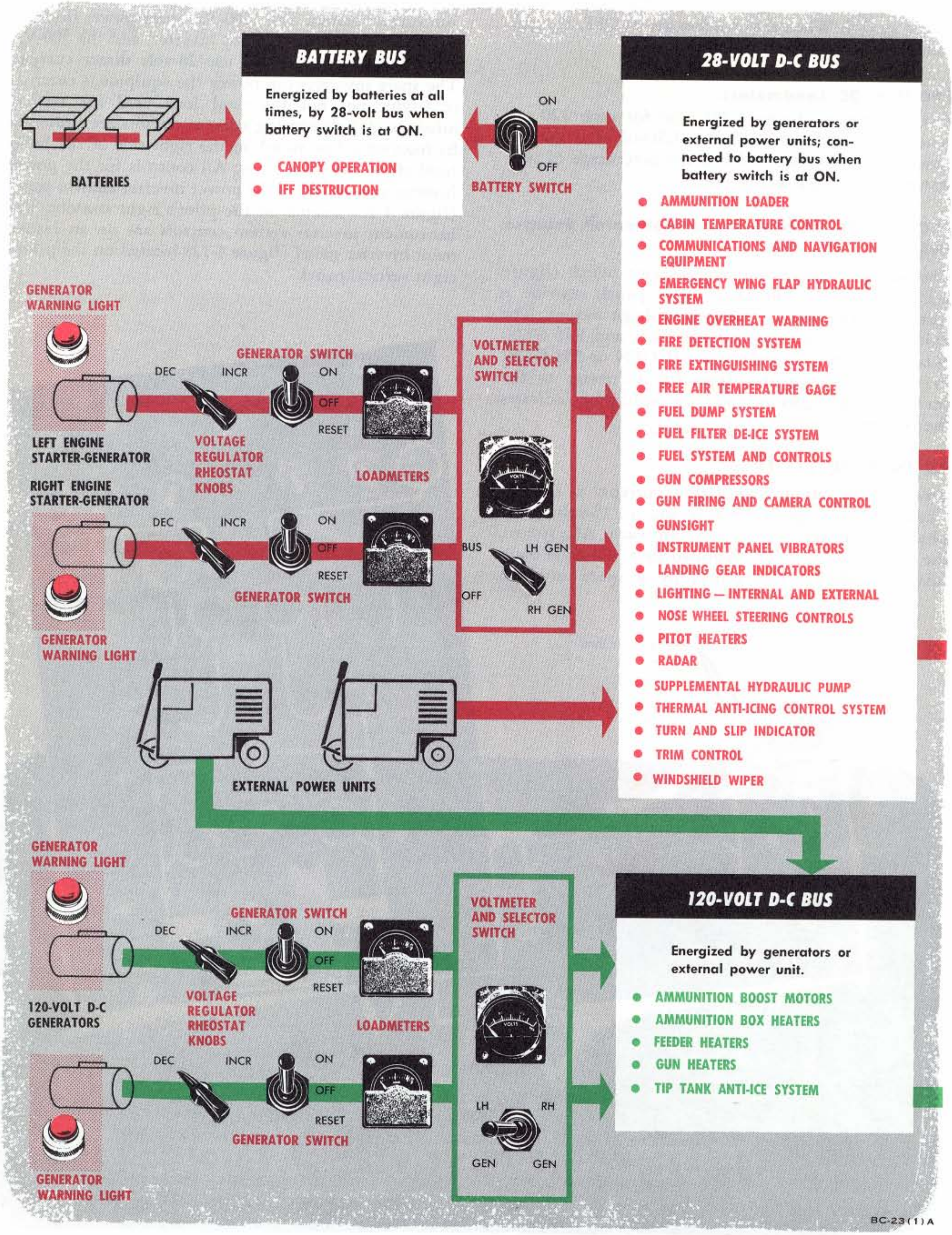


Figure 1-19 (Sheet 1 of 2 Sheets).

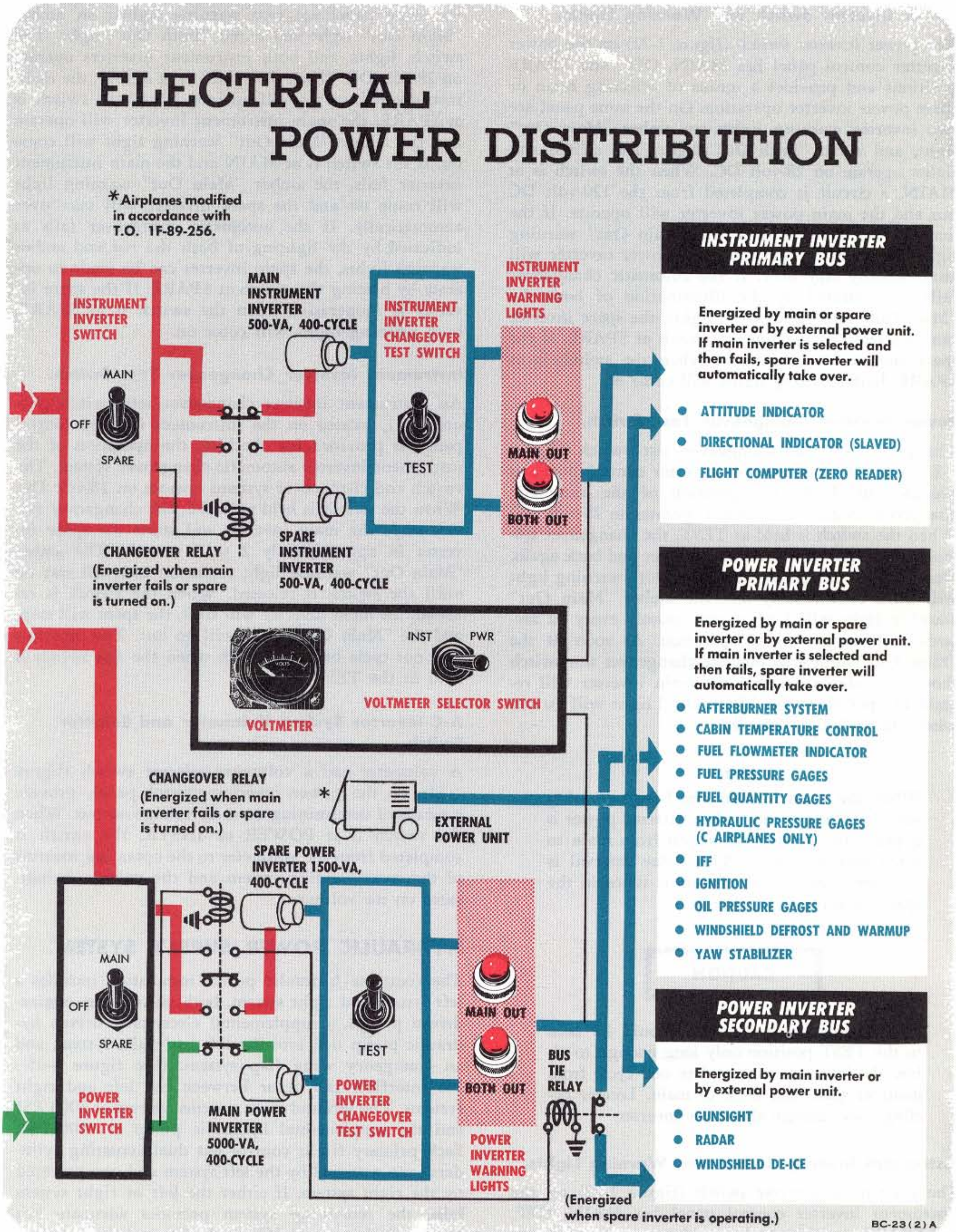


Figure 1-19 (Sheet 2 of 2 Sheets).

Power Inverter Switch and Warning Lights.

The power inverter switch (figure 1-22) on the power inverter control panel has MAIN, OFF, and SPARE positions and provides a means of selecting main or spare power inverter operation. On the same panel are two inverter warning lights, an amber "Main Out" light, and a red "Both Out" light. The switch and lights operate on 28-volt DC. When the switch is at MAIN, a circuit is completed from the 120-volt DC bus and the main power inverter will operate. If the main power inverter fails, the "Main Out" warning light will come on and the spare power inverter will automatically take over. If the automatic changeover fails, as indicated by the illumination of both the "Main Out" and "Both Out" lights, the spare inverter can be started by placing the switch at SPARE. If the spare inverter is inoperative when the switch is at SPARE, both warning lights will come on.

Power Inverter Changeover Test Switch.

The power inverter changeover test switch (figure 1-22), located on the power inverter control panel, is provided to check the operation of the automatic changeover system. The switch operates on 28-volt DC. When the switch is held at TEST, the changeover system cycles from main to spare inverter and back again. During the cycling, the red "Both Out" warning light will burn continuously and the amber "Main Out" warning light will flash approximately every 12 seconds, indicating normal operation. As soon as the "Main Out" light goes out, the changeover test switch should be released so that the main inverter will remain in operation. The "Both Out" light will go out when the switch is released.

Note

When the main inverter has been operating for 70 seconds or more after external power is applied, the changeover action from main to spare may be tested. (This delay interval is to allow time for the electronic tubes in the spare inverter to warm up.)

CAUTION

The changeover test switch should be held in the TEST position only long enough to allow the inverters to complete one cycle from main to spare and back to main. Longer cycling may damage the main inverter.

Instrument Inverter Switch and Warning Lights.

The instrument inverter switch (figure 1-22) on the instrument inverter control panel has MAIN, OFF, and SPARE positions and provides a means of selecting main or spare instrument inverter operation. On the same panel are two warning lights: an amber "Main Out" light and a red "Both Out" light. The switch, lights, and both instrument inverters operate on 28-volt DC. When the switch is at MAIN, the main instrument inverter will operate. When the switch is at SPARE, the spare instrument inverter will operate and the amber "Main Out" warning light will come on. If the switch is at MAIN and the main instrument inverter fails, the amber "Main Out" warning light will come on and the spare inverter will take over automatically. If the automatic changeover fails as indicated by the lighting of both the red and amber warning lights, the spare inverter can be made to operate by placing the switch at SPARE. If the spare inverter is inoperative when the switch is at SPARE, both warning lights will come on.

Instrument Inverter Changeover Test Switch.

An instrument inverter changeover test switch (figure 1-22), located on the instrument inverter control panel, is provided for checking the operation of the instrument inverter automatic changeover system. The switch and changeover systems operate on 28-volt DC. When the switch is held at TEST, the changeover system stops the main inverter and starts the spare inverter in approximately 2 to 8 seconds. The amber "Main Out" warning light comes on and will stay on until the switch is released. When the switch is released, the main inverter will start, the spare will stop, and the "Main Out" light will go out. The inverters will not cycle back and forth when the test switch is held in the TEST position.

A-C Inverter System Voltmeter and Selector Switch.

A voltmeter and a voltmeter selector switch (figure 1-22), on the power inverter control panel, provide a means of determining inverter voltage output. When the switch is at POWER or INSTR, the circuit is completed from the voltmeter to the operating inverter of the corresponding system and the voltage is indicated on the voltmeter.

HYDRAULIC POWER SUPPLY SYSTEM.

The complete hydraulic power installation includes a left system and right system, both powered by engine-driven pumps, a supplemental electrically driven hydraulic pump tied into the left hydraulic system, and an emergency wing flap system. (See figure 1-25.) No interflow can occur between the left and right systems. The left and right systems operate at 3000 PSI and the supplemental hydraulic pump at 2500 PSI. Each primary flight control has dual actuating cylinders: one powered by the left system and one powered by the right system. If either the left or right system fails, the remaining system provides adequate but limited flight control. If both the left and right systems fail, the left hydraulic system supplemental pump

ELECTRICAL SYSTEM LOAD DISTRIBUTION TABLE

POWER SOURCE LOST	EQUIPMENT LOST	EQUIPMENT PICKED UP AUTOMATICALLY	EQUIPMENT PICKED UP MANUALLY	EQUIPMENT LOST PERMANENTLY
INVERTERS:				
1. POWER				
a. 115-volt A-C single-phase 5000-VA (main)	AFTERBURNER SYSTEM CABIN TEMPERATURE CONTROL FUEL FLOW INDICATOR FUEL PRESSURE GAGES FUEL QUANTITY GAGES HYDRAULIC PRESSURE GAGES (C ONLY) IFF IGNITION OIL PRESSURE GAGES WINDSHIELD DEFROST AND WARMUP YAW STABILIZER GUNSIGHT RADAR WINDSHIELD DE-ICE	AFTERBURNER SYSTEM CABIN TEMPERATURE CONTROL FUEL FLOW INDICATOR FUEL PRESSURE GAGES FUEL QUANTITY GAGES HYDRAULIC PRESSURE GAGES (C ONLY) IFF IGNITION OIL PRESSURE GAGES WINDSHIELD DEFROST AND WARMUP YAW STABILIZER	If the automatic change-over fails, placing the power inverter selector switch at SPARE will provide power to the equipment normally picked up automatically.	GUNSIGHT RADAR WINDSHIELD DE-ICE
b. 115-volt A-C single-phase 1500-VA (spare) (If main inverter is inoperative)	AFTERBURNER SYSTEM CABIN TEMPERATURE CONTROL FUEL FLOW INDICATOR FUEL PRESSURE GAGES FUEL QUANTITY GAGES HYDRAULIC PRESSURE GAGES (C ONLY) IFF IGNITION OIL PRESSURE GAGES WINDSHIELD DEFROST AND WARMUP YAW STABILIZER	NONE	NONE	AFTERBURNER SYSTEM CABIN TEMPERATURE CONTROL FUEL FLOW INDICATOR FUEL PRESSURE GAGES FUEL QUANTITY GAGES HYDRAULIC PRESSURE GAGES (C ONLY) IFF IGNITION OIL PRESSURE GAGES WINDSHIELD DEFROST AND WARM UP YAW STABILIZER
2. INSTRUMENT				
a. 115-volt A-C three-phase 500-VA (main)	ATTITUDE INDICATOR DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER (ZERO READER)	ATTITUDE INDICATOR DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER (ZERO READER)	If the automatic change-over fails, placing the instrument inverter selector switch at SPARE will provide power to the equipment normally picked up automatically.	NONE
b. 115-volt A-C three-phase 500-VA (spare) (If main inverter is inoperative)	ATTITUDE INDICATOR DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER (ZERO READER)	NONE	NONE	ATTITUDE INDICATOR DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER (ZERO READER)
GENERATORS:				
1. 28-volt D-C generators (One on each engine)	NONE	The generators operate in parallel; if one generator fails, the other will carry the load.	NONE	NONE
2. 120-volt D-C generators (One on each engine)	AMMUNITION BOOST MOTORS AMMUNITION BOX HEATERS FEEDER HEATERS GUN HEATERS TIP TANK ANTI-ICE SYSTEM MAIN POWER INVERTER	NONE	Only one generator is connected to the bus at a time; if one fails, select the other.	NONE
BATTERIES:				
Two 12-volt, 34 ampere-hour storage batteries connected in series.	NONE (The batteries serve as standby for D-C circuit during flight.)	NONE	NONE	NONE

BC-125

Figure 1-20.

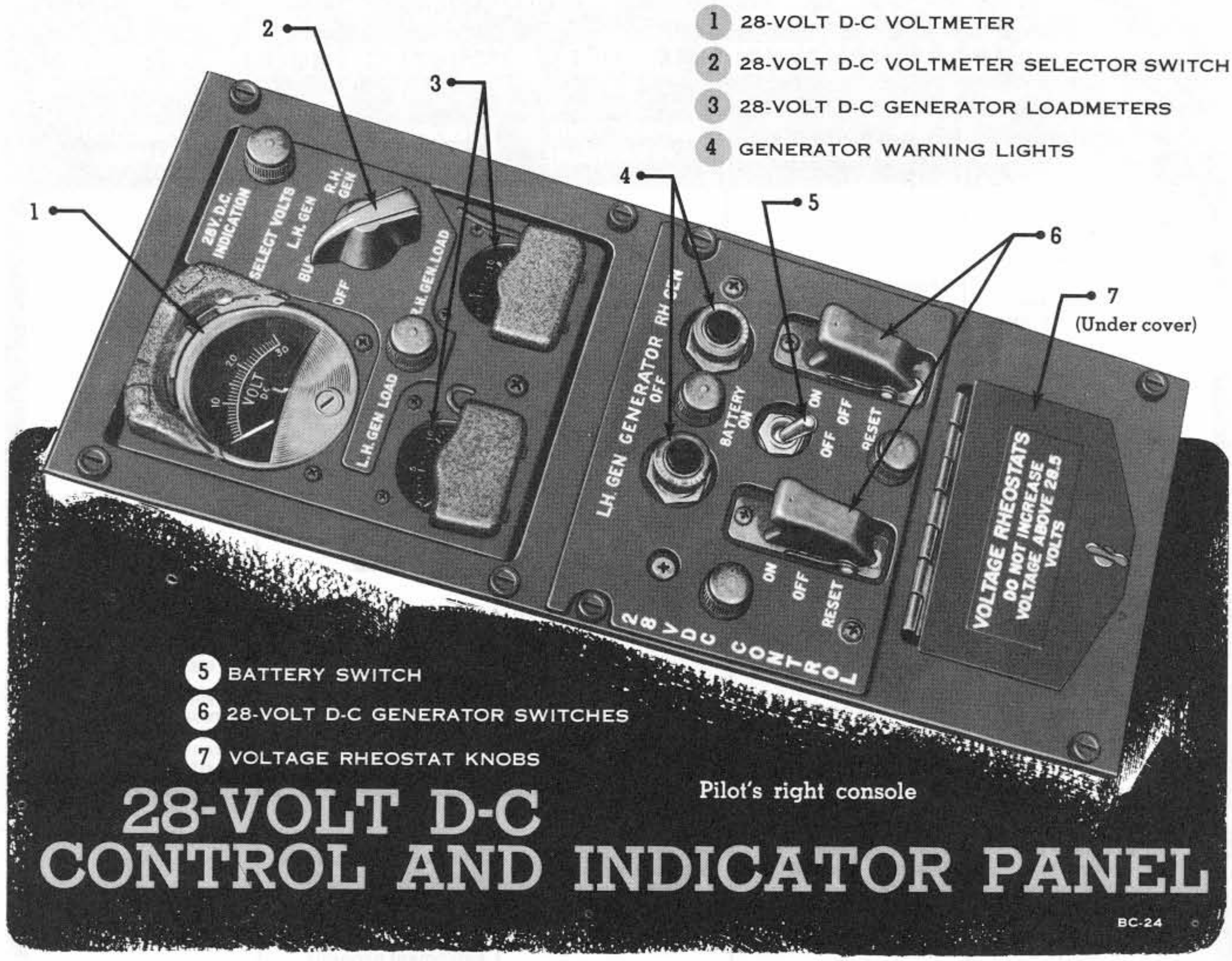


Figure 1-21.

provides further limited flight control if the left hydraulic system has not failed through loss of hydraulic fluid. One pressurized hydraulic reservoir for the left system and one for the right system are in the forward fuselage section. The reservoirs are pressurized to prevent the fluid from foaming at altitude and to maintain a positive pressure on the inlet side of the engine-driven pumps. During engine starts, a purge valve, one in each system, bypasses hydraulic fluid from the pump back to the reservoir to reduce the load on the starter. After the engine starts, the pump puts out more fluid than the purge valve can bypass. The increase of pressure in the valve overcomes a spring tension and forces a piston over the return line to close the valve. System pressure then builds up to 3000 PSI. During cold weather, for ground operation only, the hydraulic fluid in the left and right systems is maintained automatically at operating temperature. The weight of the airplane on the landing gear energizes a circuit to a thermoswitch. When the fluid temperature drops below a predetermined value, the thermoswitch actuates an electric shutoff valve and the fluid is routed through a restrictor which raises the temperature of the fluid until the correct temperature is obtained. See figures 1-26, 1-28, 1-30, 1-33, and 1-34 for hydraulically operated equipment. See figure 1-41 for hydraulic fluid specification.

LEFT HYDRAULIC SYSTEM.

Operating pressure for the left system comes from an engine-driven piston type hydraulic pump on the left engine and an electrically driven supplemental hydraulic pump. This system powers one actuating cylinder on each flight control surface, the landing gear, main gear inboard doors, wheel brakes, wing flaps, speed brakes, and, on some airplanes, the nose wheel steering system. The left system includes a pressurized reservoir in the left side of the forward fuselage section, a brake accumulator in the nose gear wheel well, and a handpump and two selector valves in the radar observer's cockpit. The handpump is ordinarily used to operate the hydraulic engine hoist system. In an emergency the radar observer can recharge the brake hydraulic accumulator by placing the two selector valves at the proper placard positions and then actuating the pump handle. The left hydraulic system supplemental pump is started in three different ways. It starts automatically either in flight or on the ground whenever brake accumulator pressure drops below 1150-800 PSI. A landing gear lever switch also starts the pump automatically, when the landing gear lever is moved to the DOWN position in flight, to supply an additional volume of hydraulic flow to lower the gear. A strut switch cuts out the landing gear lever switch to prevent pump operation while the airplane's weight is on the gear. Normally, in flight and during taxi operations the supplemental pump can be energized by depressing the nose wheel steering button and deenergized by releasing the button. However, if the left hydraulic system pressure switch is automatically actuated, because of excessive use of the wheel brakes during taxiing, the supplemental pump will be automatically energized and continue to operate until the left hydraulic system pressure reaches 2200 to 2350 PSI, regardless of the nose wheel steering button position. While in flight or while taxiing, the pump can be operated whenever additional left hydraulic system flow is desired by depressing the nose wheel steering button. The steering and brake systems have first priority on supplemental pump flow so that only the surplus flow enters the main left hydraulic system. This provides adequate flow on the ground for braking and steering regardless of other hydraulic system functions, even with the left engine inoperative. Since braking and steering are not used in the air, all the flow enters the left main system when the nose wheel steering button is depressed or the gear lowered if the brake accumulator is fully charged.

Note

- The engine hoist system includes two hydraulic cylinders in the aft fuselage section and a selector valve in the radar observer's cockpit. The hoist system is used by ground crew personnel when engine service is required. The handpump will not maintain sufficient hydraulic pressure for operation of the flight controls.

- In the event of a complete 28-volt DC power failure, the battery bus must be ON to operate the supplemental pump.

RIGHT HYDRAULIC SYSTEM.

Operating pressure for the right system is supplied by an engine-driven, piston-type hydraulic pump on the right engine. This system powers one actuating cylinder of each basic flight control surface. The pressurized reservoir for the system is in the right side of the forward fuselage section.

EMERGENCY WING FLAP HYDRAULIC SYSTEM.

The emergency wing flap hydraulic system (figure 1-28) has its own reservoir and 28-volt DC electrically driven, gear-type hydraulic pump just aft of the left main gear wheel well. When the emergency flap switch is placed at ON, a circuit is completed to the wing flap mechanism. Subsequent movement of the wing flap lever starts the emergency flap pump and actuates the flaps. Because of lower pump capacity, flaps operate more slowly in the emergency system than in the normal system.

CAUTION

The emergency wing flap system should not be operated when the left hydraulic system is operating as hydraulic fluid will be dumped overboard.

HYDRAULIC SYSTEM PRESSURE GAGES.

Both left and right hydraulic systems and the brake accumulator system have pressure gages (figure 1-11) on the pilot's center pedestal. On B airplanes, the gages are direct reading, while C airplanes are equipped with autosyn gages. The autosyn gages operate on 115-volt AC from the main or spare power inverter. A pressure gage (figure 1-9) showing the air pressure in both left and right system reservoirs is on the pilot's left console.

FLIGHT CONTROL SYSTEM.

Hydraulic actuating cylinders (figure 1-26) controlled by servo valves operate the control surfaces of the airplane. The servo valves are in turn controlled by push-pull rods and cable linkages from the pilot's stick and rudder pedals. The rudder and elevator have dual sets of control cables, and all control surfaces have two independent sets of hydraulic actuators. One set receives hydraulic power from the right hydraulic system and the other from the left hydraulic system. Either system will give adequate control for safe flight. Surfaces other than the rudder operate on the 3000-PSI system pressure. The rudder actuating cylinders operate on 750 PSI obtained by pressure regulators which reduce the normal 3000-PSI system pressure. On some airplanes, friction dampers for the rudder and ailerons prevent control surface motion through the backlash range when operating on only one hydraulic system. Since the flight control surfaces are fully power-operated, an artificial "feel" to prevent overcontrol has been built into the pilot's controls by attaching springs to the stick and rudder pedal mechanisms. A bobweight on the control stick mechanism and a control force bellows, utilizing ram air pressure, provide additional "feel" for elevator operation. The irreversible surface control hydraulic system prevents the surfaces from moving when the airplane is not in use; however, the control surfaces will eventually droop after the airplane is parked without hydraulic pressure on the system. This is normal and should cause no alarm, as the control surfaces will return to their normal positions when hydraulic power is applied.

CONTROL STICK.

The control stick is conventional, with the following 28-volt DC switches on the grip (figure 1-27): a gun and camera trigger, nose wheel steering and left hydraulic system supplemental pump button, bombs and rockets release buttôn, aileron and elevator trim switch, and radio mike button.

RUDDER PEDALS.

The rudder pedals are the conventional suspended-type with toe-operated brake pedals. The pedals are adjustable for leg length.

Rudder Pedal Adjustment Crank.

A rudder pedal adjustment crank (figure 1-11) is on the pilot's center pedestal panel. Rotation of the crank moves both rudder pedals either forward or aft to the desired leg position.

ELEVATOR FEEL SYSTEM.

A control force bellows in the elevator control mechanism lends "feel" for elevator movement in proportion to airspeed. A diaphragm in the bellows is attached so that a movement of the stick in either direction moves the diaphragm against ram air pressure. In flight, ram air from the right pitot head creates a pressure on the diaphragm which must be overcome to move the stick. This pressure increases with airspeed, increasing the resistance to control stick movement. When the airplane is not moving, there is no differential pressure in the bellows and no bellows resistance to control stick movement; however, elevator "feel" is provided by a spring within the bellows. Additional feel on the control stick comes from a bobweight attached to the stick mechanism. When "G" forces are applied to the airplane, the bobweight tends to move the stick toward neutral. The stick force increases as the "G" force becomes greater.

FLIGHT CONTROL TRIM SYSTEM.

If an unequal load on the airplane requires heavy control stick or pedal force, the trim systems can be utilized to relieve the force. The ailerons and elevator are

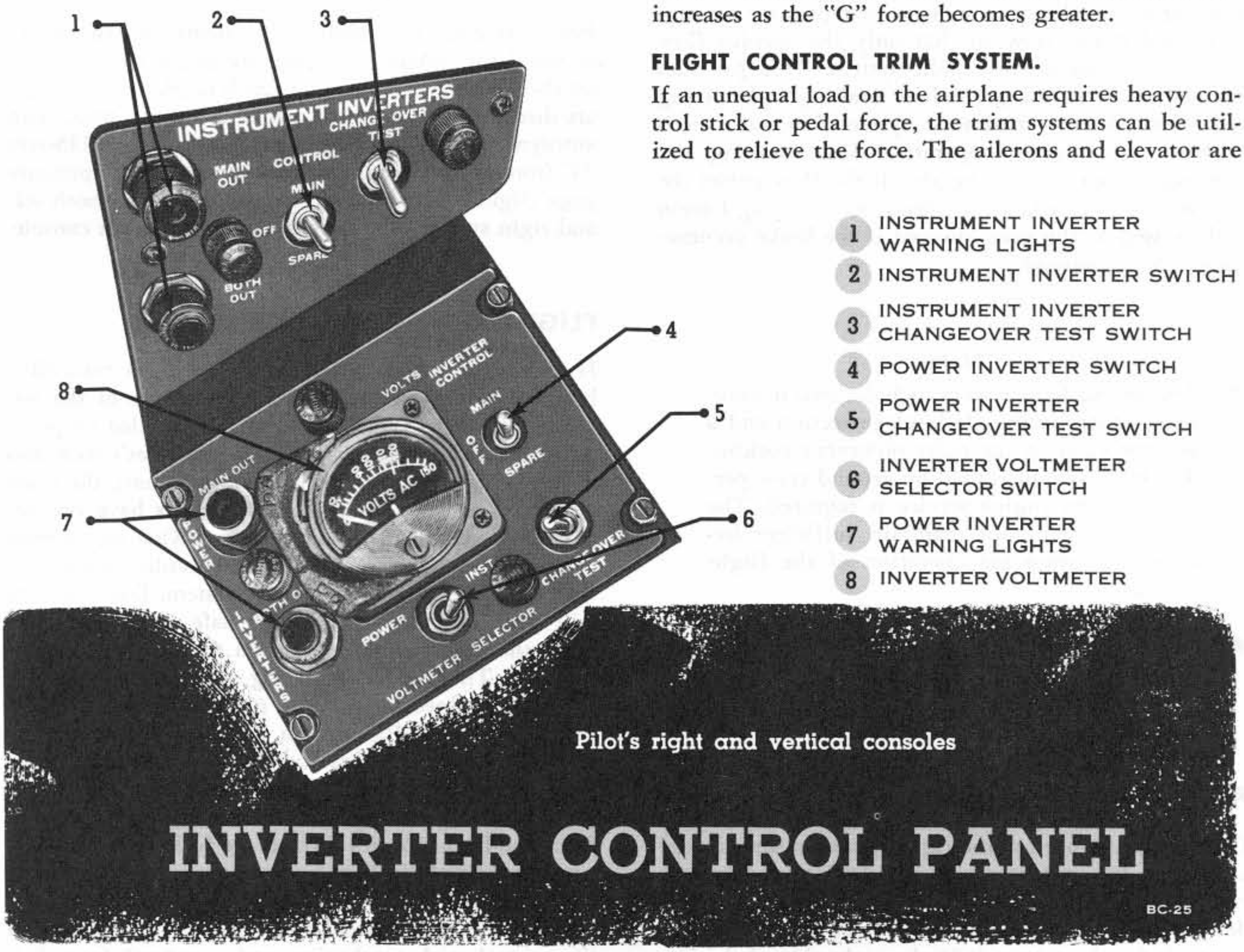


Figure 1-22.

trimmed by electrical motors that mechanically change the relationship between the "feel" mechanism and the control system to reduce the stick force to zero. The trim system on this airplane operates directly on the control force producers and no trim tabs are used on the control surfaces. Aileron and elevator trim is accomplished by moving the aileron and elevator trim switch on the control stick grip. Limit switches are provided on the elevator trim mechanism to prevent serious overtrim if the switch should stick. Rudder trim is accomplished by rotating the emergency rudder trim knob either left or right. Aileron trim travel is 6 degrees each way from neutral. Elevator trim travel is 11 degrees up and 10 degrees down. Rudder trim normally is accomplished through the yaw stabilizer. In an emergency, the rudder can be manually trimmed up to 40 degrees (full travel) each way from neutral. Rudder trim should be used only when the yaw stabilizer is not operating.

Aileron and Elevator Trim Switch.

The aileron and elevator trim switch on the pilot's control stick grip (figure 1-27) can be moved up or down for elevator trim and left or right for aileron trim. This switch, operating on 28-volt DC, controls electrical trim motors that reduce the stick force to zero, within trim limits, at a chosen aileron or elevator position.

WARNING

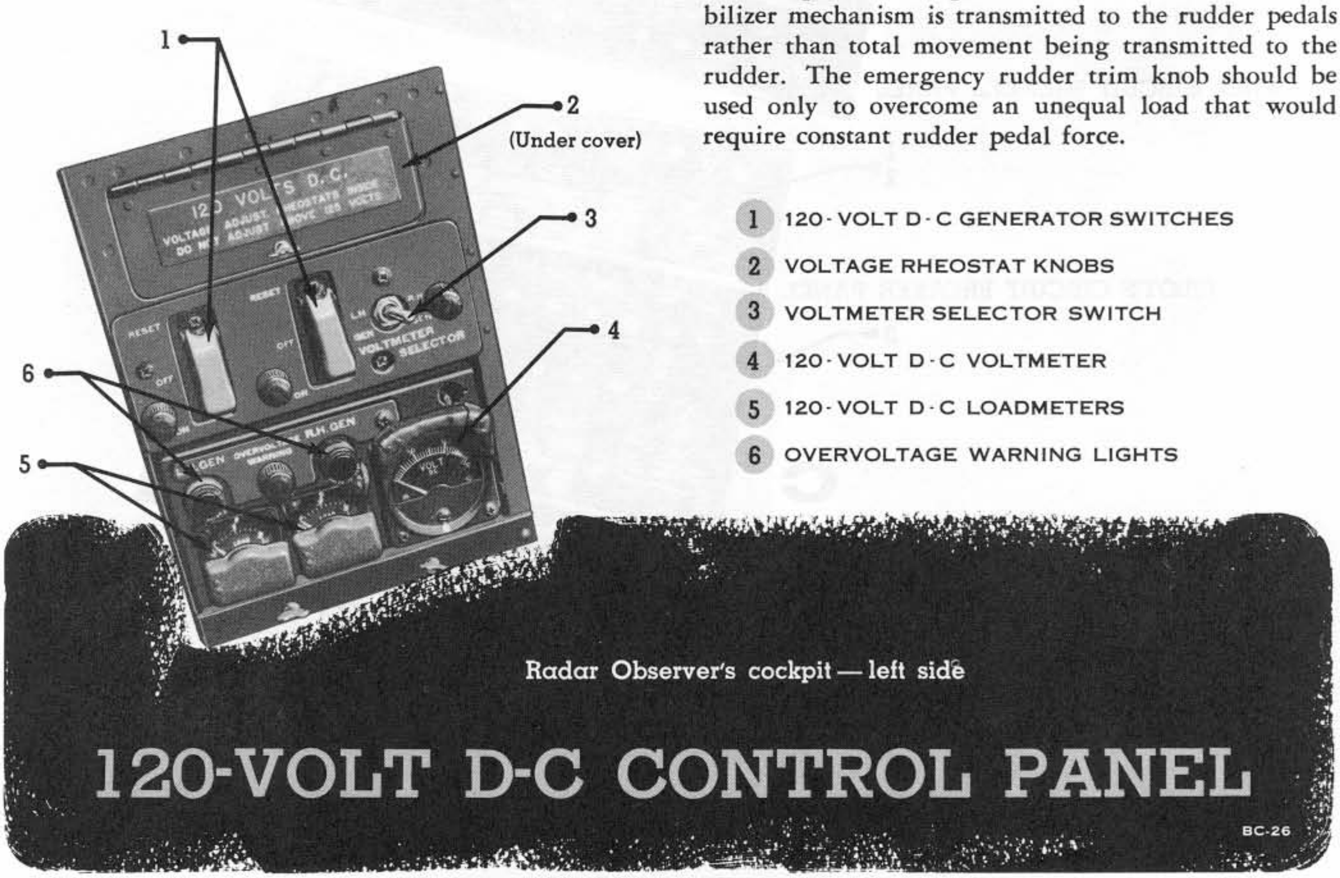
The aileron and elevator trim switch is spring-loaded to the neutral position; however, it should be returned to neutral manually to preclude the possibility of the switch sticking in an actuated position and causing a dangerous overtrim condition in case of malfunction of the limit switches.

Note

The ailerons and elevator cannot be trimmed unless both 28-volt DC electrical power and hydraulic power are available.

EMERGENCY RUDDER TRIM KNOB.

The emergency rudder trim knob (figure 1-11) is located on the pilot's center pedestal. Rotating the knob to the left decreases the force required against the left rudder pedal; rotating the knob to the right decreases the force required against the right rudder pedal. Emergency rudder trim should not be used under normal flight conditions. Moving the rudder trim knob out of neutral will unseat the yaw stabilizer detent. The yaw stabilizer performance is then somewhat impaired since part of the movement of the stabilizer mechanism is transmitted to the rudder pedals rather than total movement being transmitted to the rudder. The emergency rudder trim knob should be used only to overcome an unequal load that would require constant rudder pedal force.



Radar Observer's cockpit — left side

120-VOLT D-C CONTROL PANEL

Figure 1-23.

CIRCUIT BREAKER PANELS

C
1 Groups 1, 5, and 10 airplanes
2 Group 25 and subsequent airplanes VERTICAL VELOCITY INDICATOR
3 Group 25 and subsequent airplanes
4 Group 25 and subsequent airplanes 50-AMP CIRCUIT BREAKERS REPLACE 35-AMP CIRCUIT BREAKERS

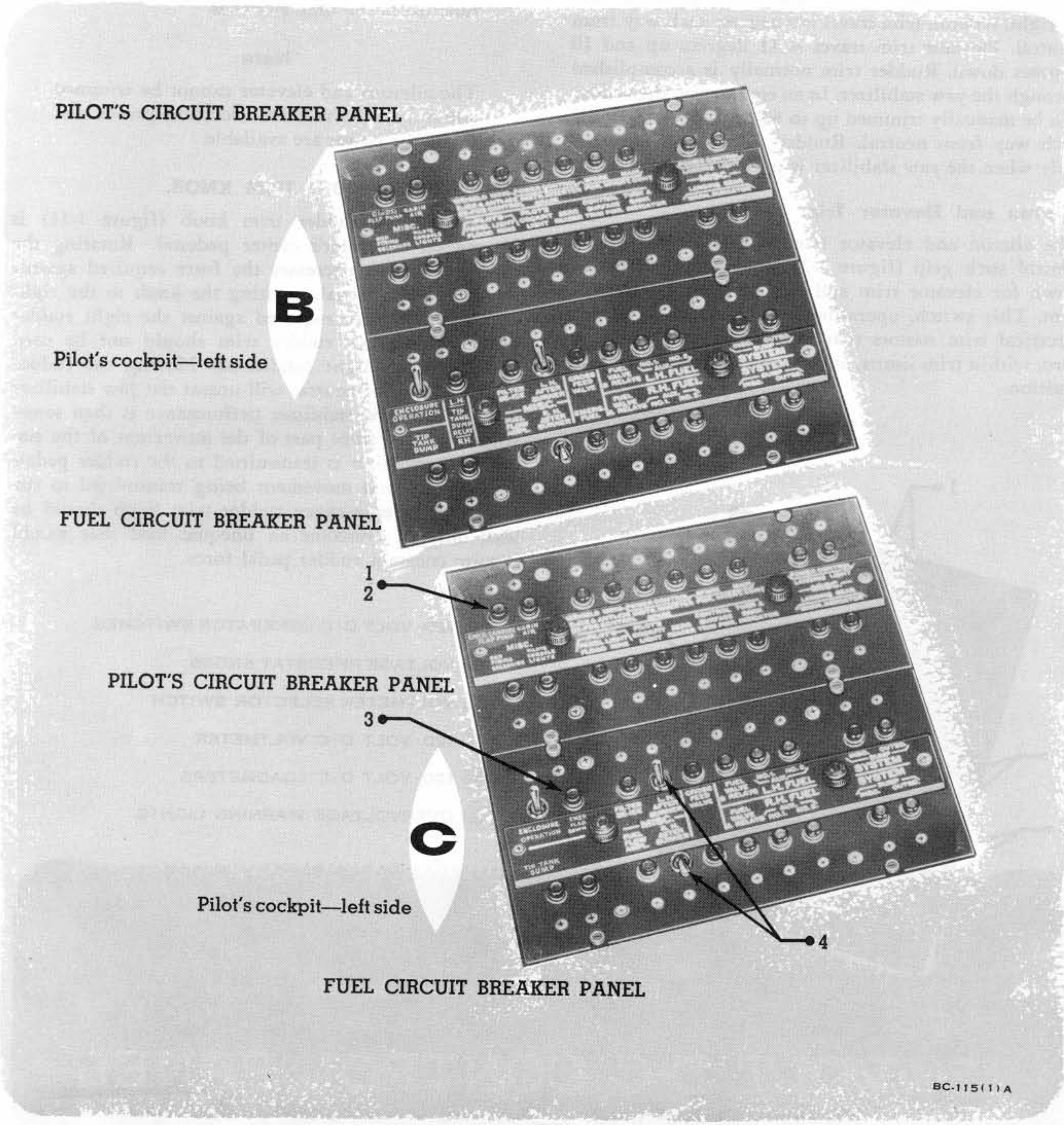
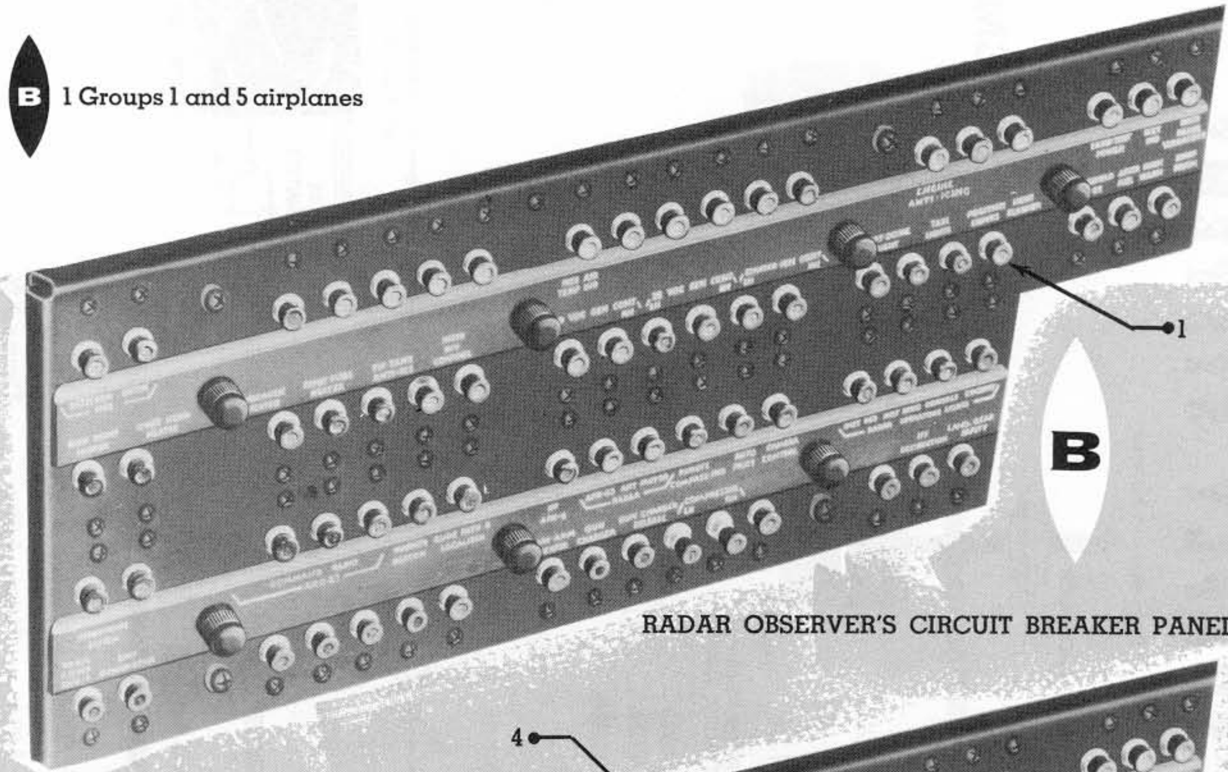


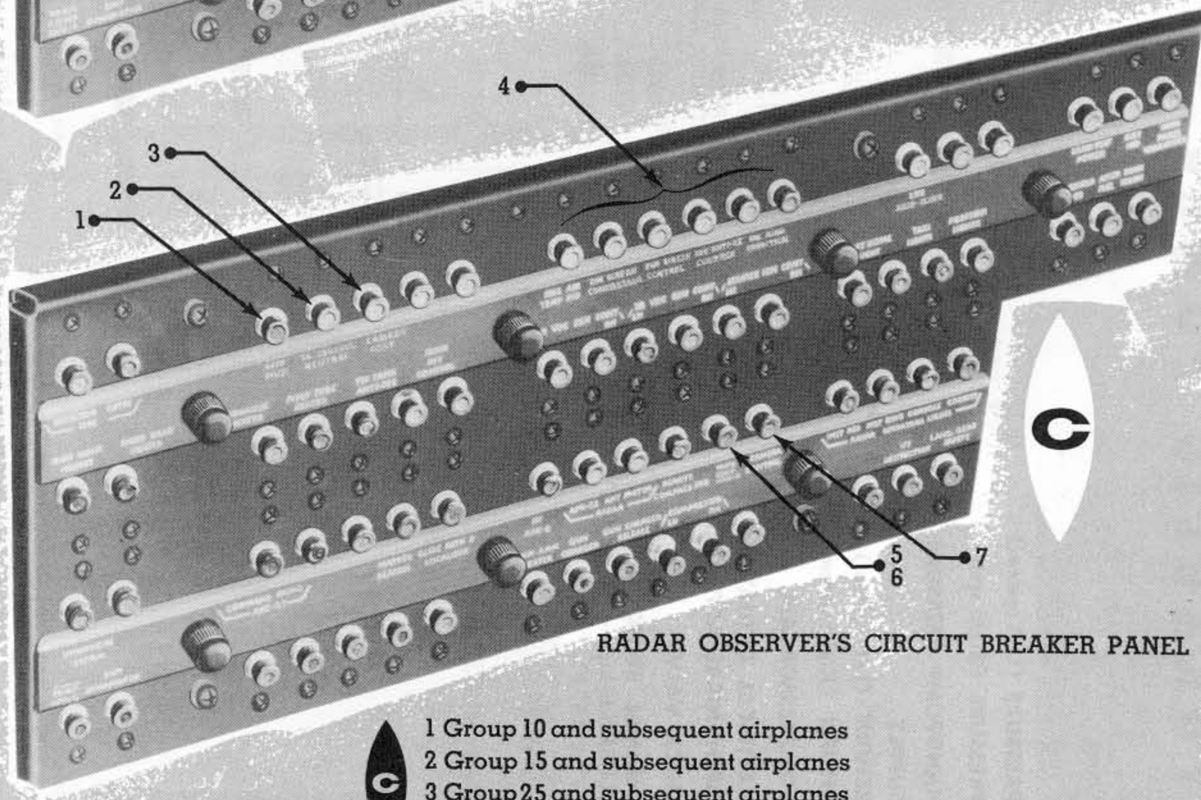
Figure 1-24 (Sheet 1 of 2 Sheets).

B 1 Groups 1 and 5 airplanes



B

RADAR OBSERVER'S CIRCUIT BREAKER PANEL



C

RADAR OBSERVER'S CIRCUIT BREAKER PANEL

C
1 Group 10 and subsequent airplanes
2 Group 15 and subsequent airplanes
3 Group 25 and subsequent airplanes
4 Groups 35 and 40 airplanes
5 Groups 1 and 5 airplanes AUTOMATIC PILOT
6 Group 10 and subsequent airplanes RADIO COMPASS ARN-6
7 Groups 1 through 20 airplanes

BC-115(2)A

Figure 1-24 (Sheet 2 of 2 Sheets).

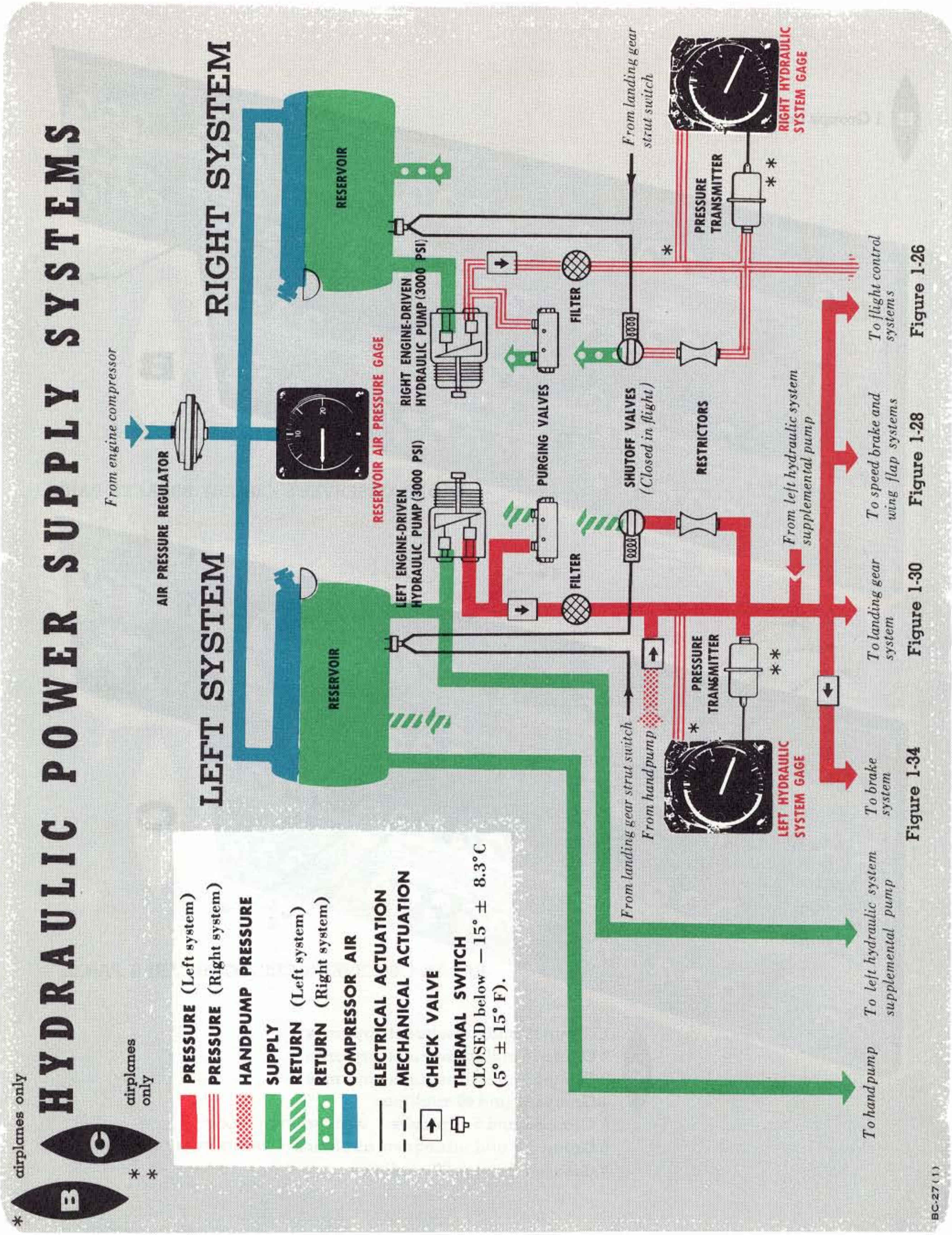


Figure 1-25 (Sheet 1 of 2 Sheets).

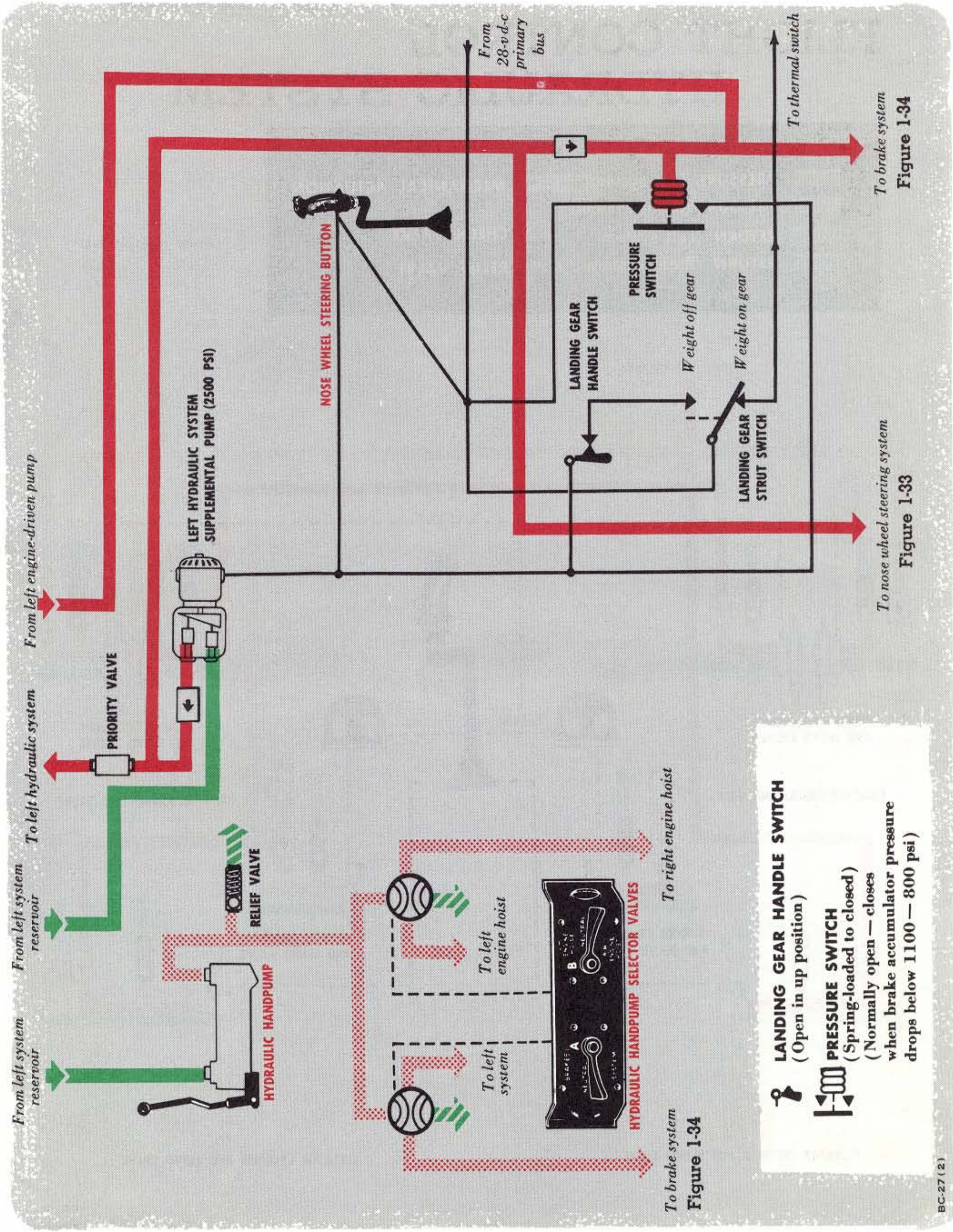


Figure 1-25 (Sheet 2 of 2 Sheets).

FLIGHT CONTROL HYDRAULIC SYSTEM

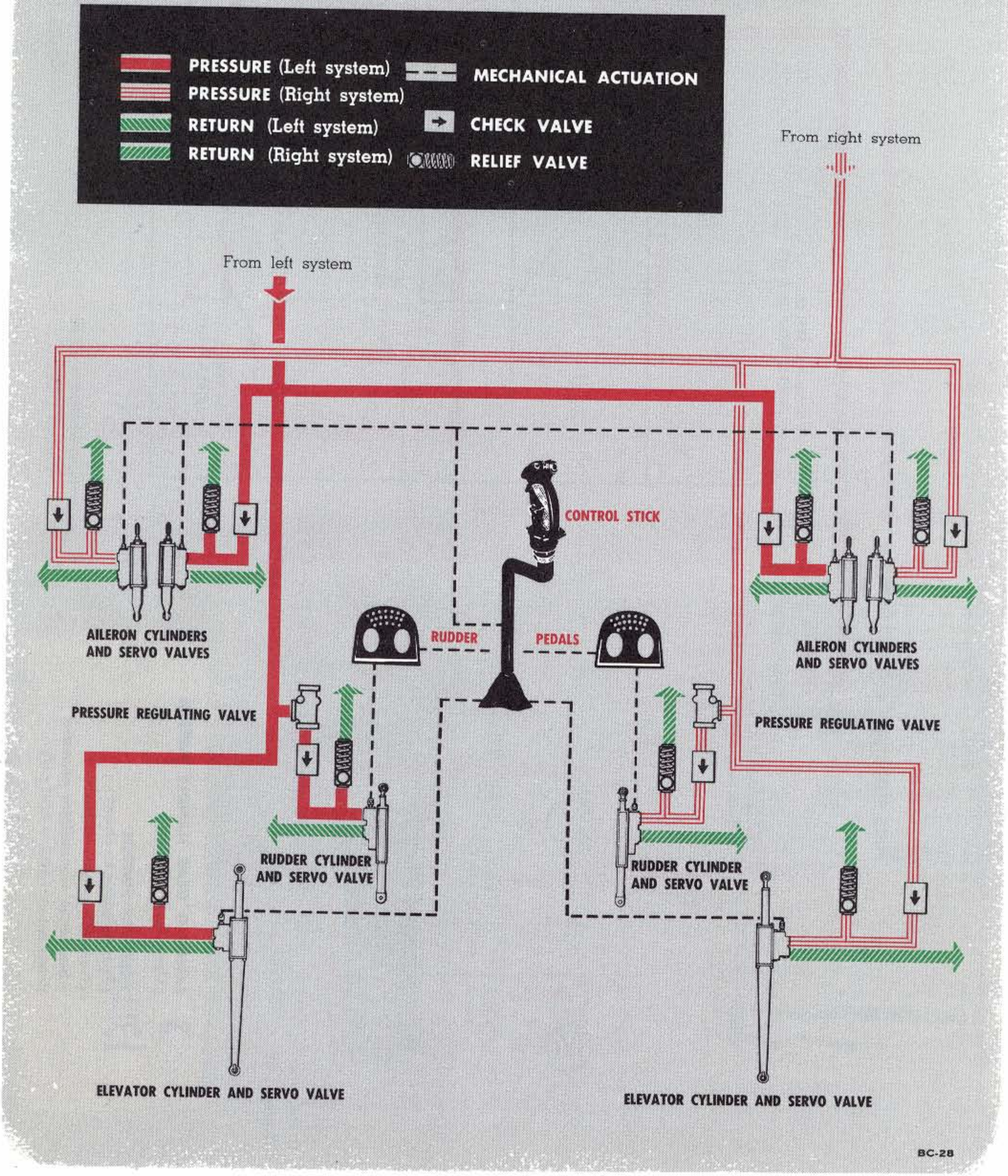


Figure 1-26.

Elevator Trim Position Indicator.

A mechanical elevator trim indicator (figure 1-13) shows the proper trimmed position of the control stick for takeoff. The indicator is located on the floor at the inboard side of the pilot's right console. The indicator pointer is connected directly to the control stick elevator torque tube and the dial is fixed to the structure. The dial has a luminous circular spot marked TAKE-OFF. To trim the stick for takeoff, it must be moved until the pointer is at TAKE-OFF. With the stick held in this position, the elevator trim switch on the control stick grip must be actuated until the stick force is reduced to zero. The stick forces should be reduced to zero within 10 seconds and the stick should remain at the indicated TAKE-OFF position.

YAW STABILIZER SYSTEM.

An automatic yaw stabilizer system improves stability, dampens undesirable oscillations common to most high speed airplanes, and improves the pilot's ability to maneuver without sacrificing his control over the airplane. When an oscillation changes the heading of the airplane, a rate gyro detects the rate of yaw and sends a signal to the system amplifier. The amplifier interprets and amplifies the signal, and causes an electrical servo motor to move the rudder to correct for the deviation. Rudder motion is proportional to the yaw rate and causes no noticeable movement of the rudder pedals. As the yaw rate approaches zero, the rudder returns to the initial trimmed position.

Yaw Stabilizer Switch.

A switch (figure 1-9) for the yaw stabilizer is just outboard of the throttles. The switch has ON and OFF positions and operates on 115-volt AC. When the switch is at ON, 115-volt AC power is supplied to the yaw stabilizer circuits from either the main or spare power inverter. When the switch is at OFF, the power is removed from the circuit.

WING FLAP SYSTEM.

The slotted wing flaps operate on hydraulic power from the left hydraulic system. A wing flap lever on the pilot's left console is connected by cables to the wing flap servo valve mechanism which controls the direction of fluid flow to a hydraulic motor. Four jackscrew actuators, driven by the hydraulic motor through a series of torque tubes, move the flaps to the desired position. The flaps will always operate together. Flap travel is 50 degrees down from the wing reference plane. (See figure 1-28.)

Emergency Wing Flap System.

CAUTION

The emergency flap system should not be operated when the left hydraulic system is operating because the fluid will be pumped into the emergency flap reservoir, causing overflow and loss of fluid.

The emergency wing flap system can be used to operate the flaps when the left hydraulic system fails. Emergency wing flap power is supplied by a 28-volt

Figure 1-27.

SPEED BRAKES AND WING FLAPS HYDRAULIC SYSTEM

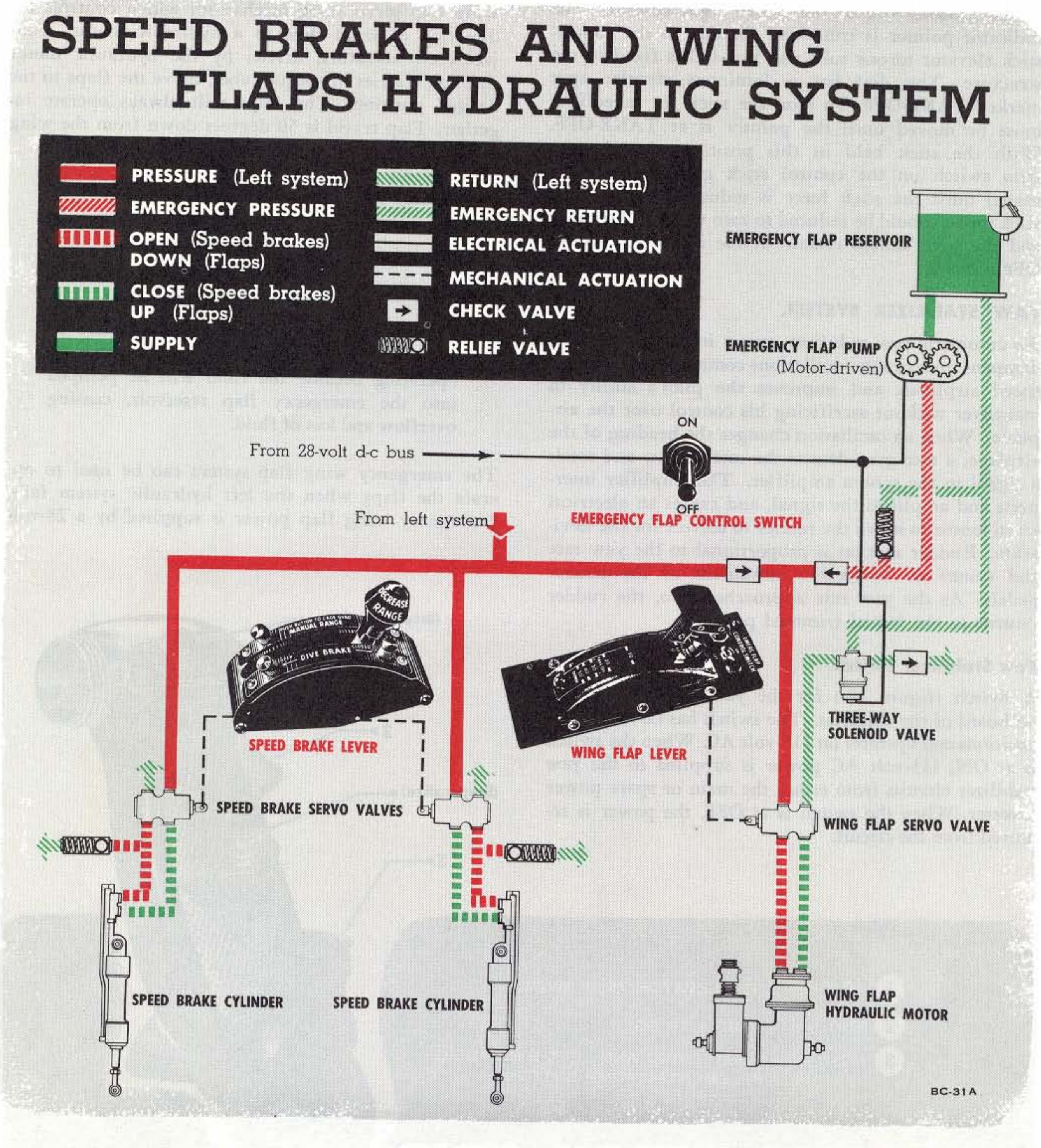


Figure 1-28.

DC electrically driven hydraulic pump and reservoir in the left wing aft of the main gear wheel well. The reservoir sight gage can be read through a window in the aft side of the left main gear wheel well. The emergency flap hydraulic system is controlled by the emergency flap switch and the flap lever.

WING FLAP LEVER AND POSITION INDICATOR.

The wing flap lever and position indicator (figure 1-29) are located on the pilot's left console. The lever provides a means of moving the wing flap to any desired position, and can be pre-positioned at TAKE-OFF (flap 30 degrees down), DOWN (flap 50 degrees fully down), and UP. As the wing flaps travel, the indicator gives visual indication of the flap position at any time during travel. Although the wing flaps can be pre-positioned only to the three detent positions, they can be placed at intermediate positions by holding the wing flap lever in the desired position until the indicator shows the flaps to be in that position. The lever then can be released and the flaps will remain in position until the lever is moved again. Retraction of wing flaps from the TAKE-OFF to the UP position requires approximately 10 seconds.

EMERGENCY FLAP SWITCH AND INDICATOR LIGHT.

An emergency flap switch and indicator light (figure 1-29) are located directly forward of the wing flap lever and operate on 28-volt DC. The switch has OFF and ON positions and is used to arm the emergency flap pump. When the switch is placed at ON, the emergency flap hydraulic pump is armed. When the flap lever is pre-positioned at a detent position or held at any other desired position, the emergency flap pump and the flap operate. The flap pump automatically stops when the flaps reach the selected position. The emergency flap control indicator light comes on when the emergency flap system is put into operation.

SPEED BRAKE SYSTEM.

The trailing section of each aileron splits through the chord line to form two surfaces. The two surfaces, hinged at the front, open to a "V" when used as a

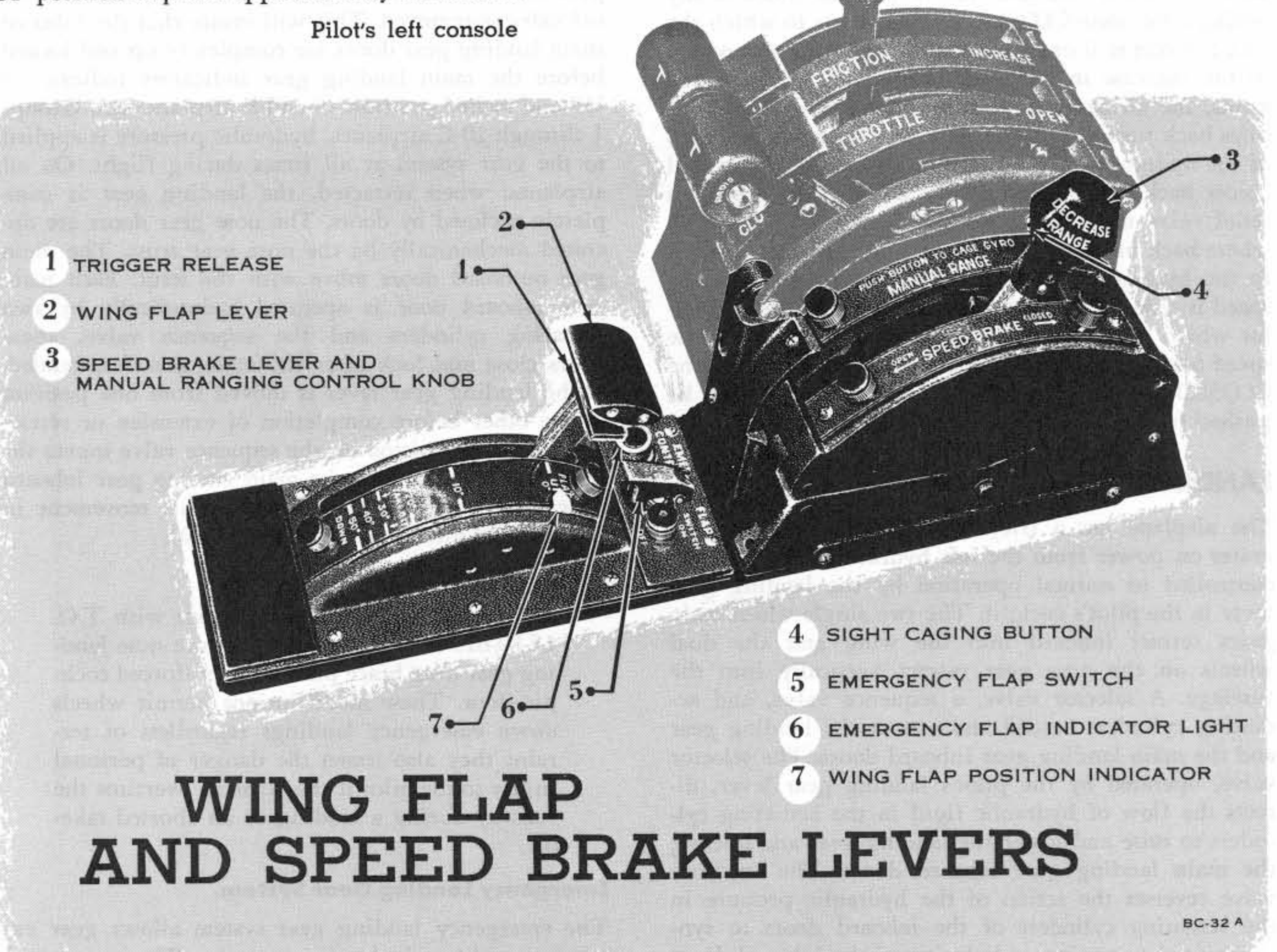


Figure 1-29.

speed brake. They are moved by a hydraulic cylinder powered by the left hydraulic system. Flow to the cylinder is regulated by the speed brake lever in the pilot's cockpit through cables and a servo valve. Speed brakes may blow open if the airplane is parked in a tail wind when the external speed brake locks have not been installed. (See figure 1-28). There is no emergency system for operating the speed brakes; however, they can be operated by supplemental pump pressure if the left engine-driven hydraulic pump fails.

SPEED BRAKE LEVER.

The speed brake lever (figure 1-29), located on the pilot's left console, has OPEN and CLOSED positions and controls the position of the speed brakes. The lever knob incorporates an electrical gyro caging button and a manual ranging control for the type A-1 gunsight. When the speed brake lever is moved, the speed brakes open proportionally to lever movement. The lever can be stopped at any point between OPEN and CLOSED to give intermediate positioning of the speed brakes. At indicated airspeeds up to approximately 260 knots, the speed brakes can be fully opened (120 degrees included angle). At indicated airspeeds above 260 knots, the lever can be pre-positioned at any setting other than CLOSED, but the angle to which the speed brakes will open will be decreased in proportion to the increase in airspeed. If airspeed is above 260 knots, the airload on the fully open speed brakes applies back pressure on the actuating cylinders in excess of the hydraulic system pressure and speed brakes will "blow back." The pressure will be relieved through a relief valve until the speed brakes close to a position where back pressure on the actuating cylinders is equal to the hydraulic system relief valve pressure. As airspeed is reduced, speed brakes will open to the position for which they were pre-positioned by the lever. The speed brake lever cannot be pre-positioned toward the CLOSED position. The speed brake lever must be pushed forward manually as the speed brakes close.

LANDING GEAR SYSTEM.

The airplane has a tricycle landing gear which operates on power from the left hydraulic system and is controlled in normal operation by the landing gear lever in the pilot's cockpit. The two single-wheel main gears retract inboard into the wing and the dual wheels on the nose gear retract vertically into the fuselage. A selector valve, a sequence valve, and actuating cylinders extend and retract the landing gear and the main landing gear inboard doors. The selector valve, operated by the pilot's landing gear lever, directs the flow of hydraulic fluid in the actuating cylinders to raise and lower the landing gear and operate the main landing gear inboard doors. The sequence valve reverses the action of the hydraulic pressure in the actuating cylinders of the inboard doors to synchronize the opening and closing of the inboard doors with the retraction and extension of the main landing gear. If the pressure in the left hydraulic system drops below 1450 PSI, a priority valve closes to give the flight control system priority over the landing gear system by shutting off the flow of fluid through the landing gear selector valve. Independent air bungee systems aid normal and emergency extension of the landing gear. Landing gear extension or retraction normally takes 6 seconds; however, when engine RPM is below 80%, additional time may be required for retraction. Extension time is not affected by engine RPM since gear extension is assisted by the supplemental hydraulic pump. The pilot can reverse the normal landing gear cycle at any time with a reverse movement of the landing gear lever. On C (Group 15 and subsequent) airplanes not modified in accordance with T.O. 1F-89-639, hydraulic pressure is automatically relieved when all landing gear components are up and locked; a normally open hydraulic shutoff valve, operating on 28-volt DC and controlled by microswitches, closes and shuts off the hydraulic pressure to the selector valve. Pressure is reapplied if any uplocks accidentally open during flight. On some airplanes modified in accordance with T.O. 1F-89-639, a microswitch is installed between the aft locks on each inboard main landing gear door and the landing gear electric hydraulic shutoff valve is removed. This will insure that the inboard main landing gear doors are completely up and locked before the main landing gear indicators indicate an UP and locked position. On all B airplanes and Groups 1 through 10 C airplanes, hydraulic pressure is applied to the gear system at all times during flight. On all airplanes, when retracted, the landing gear is completely enclosed by doors. The nose gear doors are operated mechanically by the nose gear truss. The main gear outboard doors move with the strut. Each main gear inboard door is operated hydraulically by two actuating cylinders and the sequence valve; these doors close and lock after the main gear is extended. If the landing gear lever is moved from one position to the other before completion of extension or retraction, a transfer piston on the sequence valve moves the sequence valve to keep the main landing gear inboard door open until the gear completes its movement in the changed direction. (See figure 1-30).

Note

> Airplanes modified in accordance with T.O. 1F-89-615 have a controlled failure nose landing gear drag brace pin and a reinforced cockpit floor. These modifications permit wheels down emergency landings regardless of terrain; they also lessen the danger of personal injury to the pilot if the airplane overruns the runway during a landing or an aborted takeoff.

Emergency Landing Gear System.

The emergency landing gear system allows gear extension without hydraulic pressure. The emergency release for the landing gear is a cable linkage from the

LANDING GEAR HYDRAULIC SYSTEM

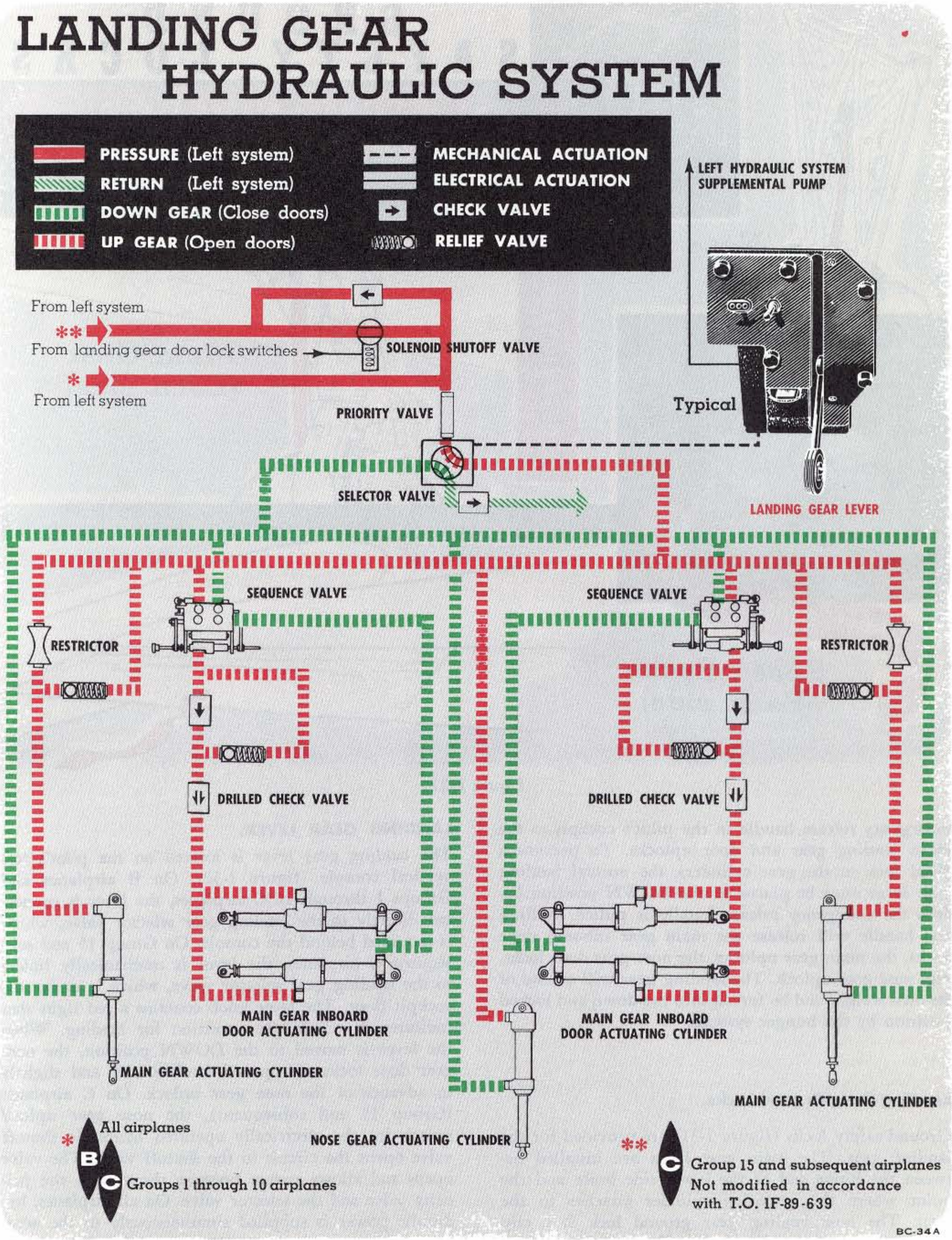


Figure 1-30.

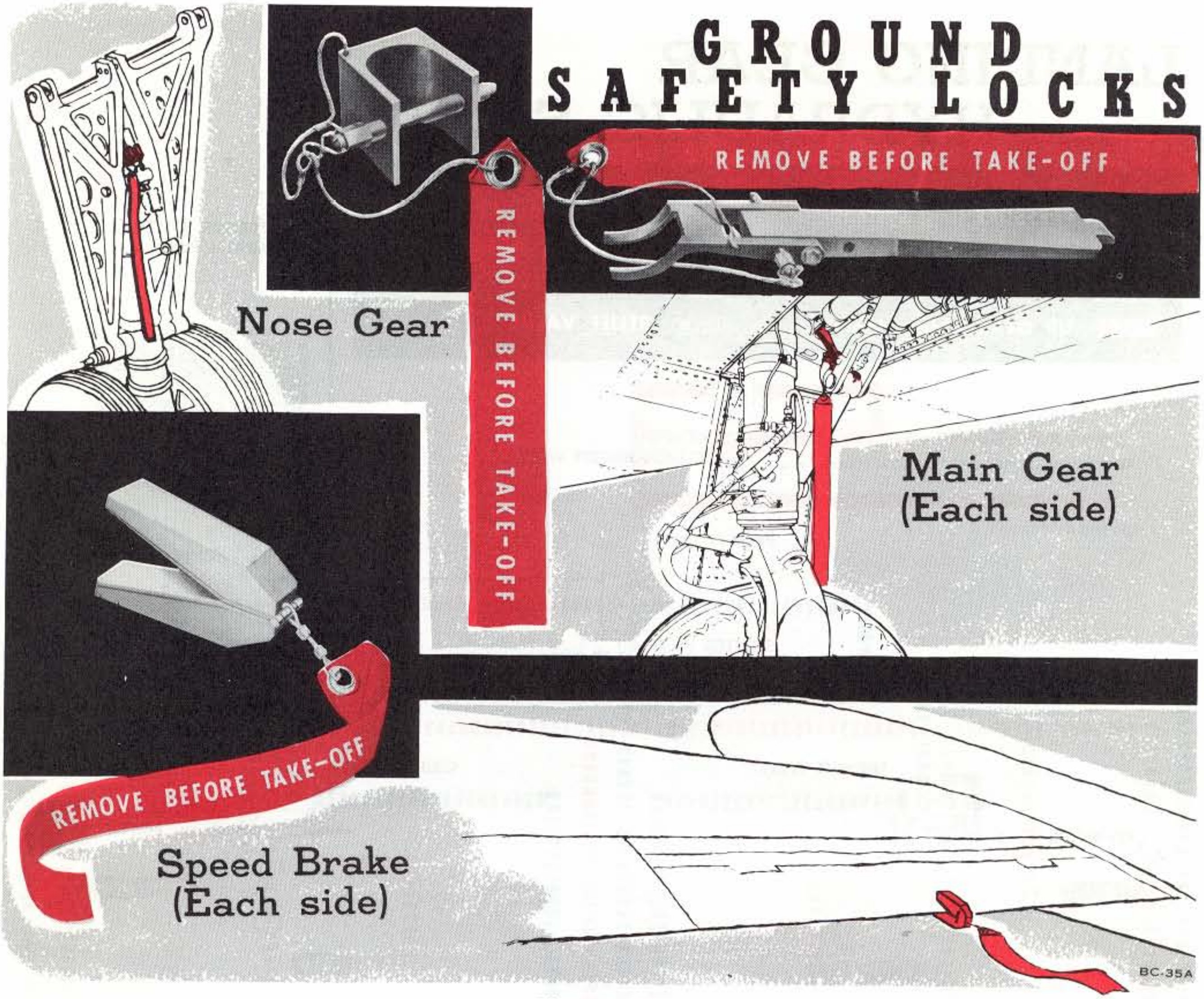


Figure 1-31.

emergency release handle in the pilot's cockpit to the main landing gear and door uplocks. To prevent a fluid lock in the gear cylinders, the normal landing gear lever must be placed at the DOWN position before the emergency release handle is pulled. Pulling the handle will release the main gear inboard door locks, the main gear uplocks, the nose gear door locks, and nose gear uplock. The landing gear will extend of its own weight and be forced into the down and locked position by the bungee systems.

Landing Gear Ground Locks.

Ground safety locks (figure 1-31) are provided for the landing gear. The main gear locks are installed between the hinge end of the lower side brace and the point where the actuating cylinder attaches to the strut. The nose landing gear ground lock is a clip which slips over the downlock cylinder and is pinned in place. All ground locks have red streamers attached.

LANDING GEAR LEVER.

The landing gear lever is located on the pilot's left vertical console (figure 1-32). On B airplanes and Groups 1 through 10 C airplanes, the lever is connected directly to the landing gear selector valve, which is mounted behind the console. On Group 15 and subsequent C airplanes, the lever is mechanically linked to the landing gear selector valve, which is under the cockpit floor. The lever knob contains a red light that indicates an unsafe gear position for landing. When the lever is moved to the DOWN position, the nose gear door locks are opened mechanically and slightly in advance of the nose gear uplock. On C airplanes (Group 15 and subsequent), the nose gear uplock switch for the electrically operated hydraulic shutoff valve opens the circuit to the shutoff valve. The valve opens and allows system pressure through to the priority valve and the selector valve. On all airplanes, hydraulic power is supplied simultaneously to the actuating cylinders of the nose gear, main gear, and inboard doors. As the main landing gear inboard door cylinders are compressed, the inboard door locks release and the door opens, releasing the outboard door locks. Final movement of the inboard doors releases main gear uplocks through a cable system. Final movement of the main gear actuates the sequence valve and reverses the flow of fluid to the inboard door actuating cylinders, causing the inboard door to close and lock. As the nose gear extends, the nose gear doors are moved to the open position. When the landing gear lever is moved to the UP position, the nose gear downlock releases. The inboard door cylinders compress, releasing the inboard door locks and opening the doors. As the doors reach the open position, the landing gear actuating cylinders simultaneously retract the nose and main gears. As the nose gear retracts, the nose gear truss engages the nose gear door operating mechanism and the doors close and lock. The main gear outboard doors are closed by the action of the main gear shock struts. As the main gear enters its uplocks, the sequence valve is actuated and reverses the flow of fluid to the inboard door actuating cylinders, closing and locking the doors. When all the doors lock on Group 15 and subsequent C airplanes, the microswitches for the hydraulic shutoff valve are actuated. (On earlier airplanes pressure remains in the system with the gear retracted.) The circuit is energized and the shutoff valve closes, relieving the pressure in the system. When the weight of the airplane is on the gear, a solenoid plunger safety lock in the landing gear lever quadrant automatically prevents movement of the gear lever to the UP position.

LANDING GEAR EMERGENCY RELEASE HANDLE.

The landing gear emergency release handle (figure 1-32), located on the pilot's left vertical console, is provided to lower the landing gear when the normal extension system fails. Before the emergency release handle is pulled, the normal landing gear lever must be placed at the DOWN position. When the emergency release handle is pulled to its full limit of travel (approximately 14 inches), the main gear inboard door locks and the main gear uplocks are opened mechanically by the cable system. The landing gear extends of its own weight and is forced into the down and locked position by the air bungee systems. As the main gear extends, it pushes the inboard door open, and the door remains open until hydraulic pressure is again applied to the system. The emergency release handle requires a hard pull of approximately 80 pounds to release the locks. The pilot can feel each set of main gear locks release; first the right gear, and then the left. The nose gear will not be felt, as it is unlocked by the landing gear lever. After the gear is down, the emergency release handle must be guided back to the stowed position to prevent whipping. Since use of the emergency system does not affect the operation of the normal system, no readjustments are necessary after the landing gear has been lowered by the emergency system. As soon as hydraulic pressure is available, the gear may be operated by the normal method.

LANDING GEAR EMERGENCY OVERRIDE LEVER.

If it is necessary to retract the landing gear with the airplane on the ground, or if the solenoid plunger safety lock fails, an emergency override lever (figure 1-32) releases the lock. When the airplane is on the ground, the safety lock holds the landing gear lever in the DOWN position to prevent accidental retraction of the landing gear. The lock is automatically retracted when the weight of the airplane is off the wheels. The gear lever can be released in an emergency by inserting a finger in a cutout in the landing gear lever quadrant and pressing the override lever down at the same time the gear lever is moved up.

LANDING GEAR POSITION INDICATORS.

A landing gear position indicator (figure 1-32) on the pilot's instrument panel shows the position of each gear. When a gear is down and locked, a wheel will show in a small window corresponding to that gear. When a gear is up and locked, UP will appear in the window. When the gear is unlocked or in an unsafe condition or if the 28-volt DC power is off, red and cream diagonal stripes will show in the window. The indicator tabs give the position of the gears only; they are not controlled by the gear doors. A red light in the landing gear lever knob, operating on 28-volt DC, will come on for any unsafe condition of the landing gear or main landing gear inboard doors. The gear lever knob light should not be relied upon for a safe gear indication if it is necessary to lower the gear with the emergency handle because of loss of the left hydraulic system pressure. The inboard main gear doors may remain open and cause the light to stay on when the main gear is down and locked. The light will also come on any time the warning horn is sounding and will stay on to indicate the gear is not down and locked even though the warning horn is shut off by the reset switch. The light will go off when either airspeed or altitude is increased.

Note

The landing gear lever warning light will remain on until the inboard main gear doors are retracted, even if the gear is safe. For this reason, the gear position indicators and a visual check for safe main gear should be relied upon following emergency gear drop.

On airplanes modified in accordance with T.O. 1F-89-639, microswitches have been installed between the aft main gear door locks in the left and right wheel wells to ensure that both inboard main landing gear doors are up and locked before the main landing gear indicators indicate an UP and LOCKED position. On airplanes so modified an unsafe condition will be shown on the landing gear indicators if both the main gear and the inboard doors are not up and locked. A landing gear warning light dimming switch is installed on the pilot's left miscellaneous switch panel. The switch is used to provide greater visibility of the landing gear warning light during daylight operations and also dimming provisions for the light during night operations.

LANDING GEAR WARNING HORN AND RESET SWITCH.

The landing gear warning horn will give a steady signal and the landing gear warning light will come on if one or more of the landing gears are not completely down and locked when the airspeed drops within or below the range of 140 to 165 knots on B and C (Groups 1 through 30) airplanes or 155 to 175 knots on C (Group 35 and subsequent) airplanes. An altitude-sensing switch prevents a warning signal at altitudes above 10,000 to 13,000 feet, depending on atmospheric conditions. If airspeed or altitude is

Figure 1-32.

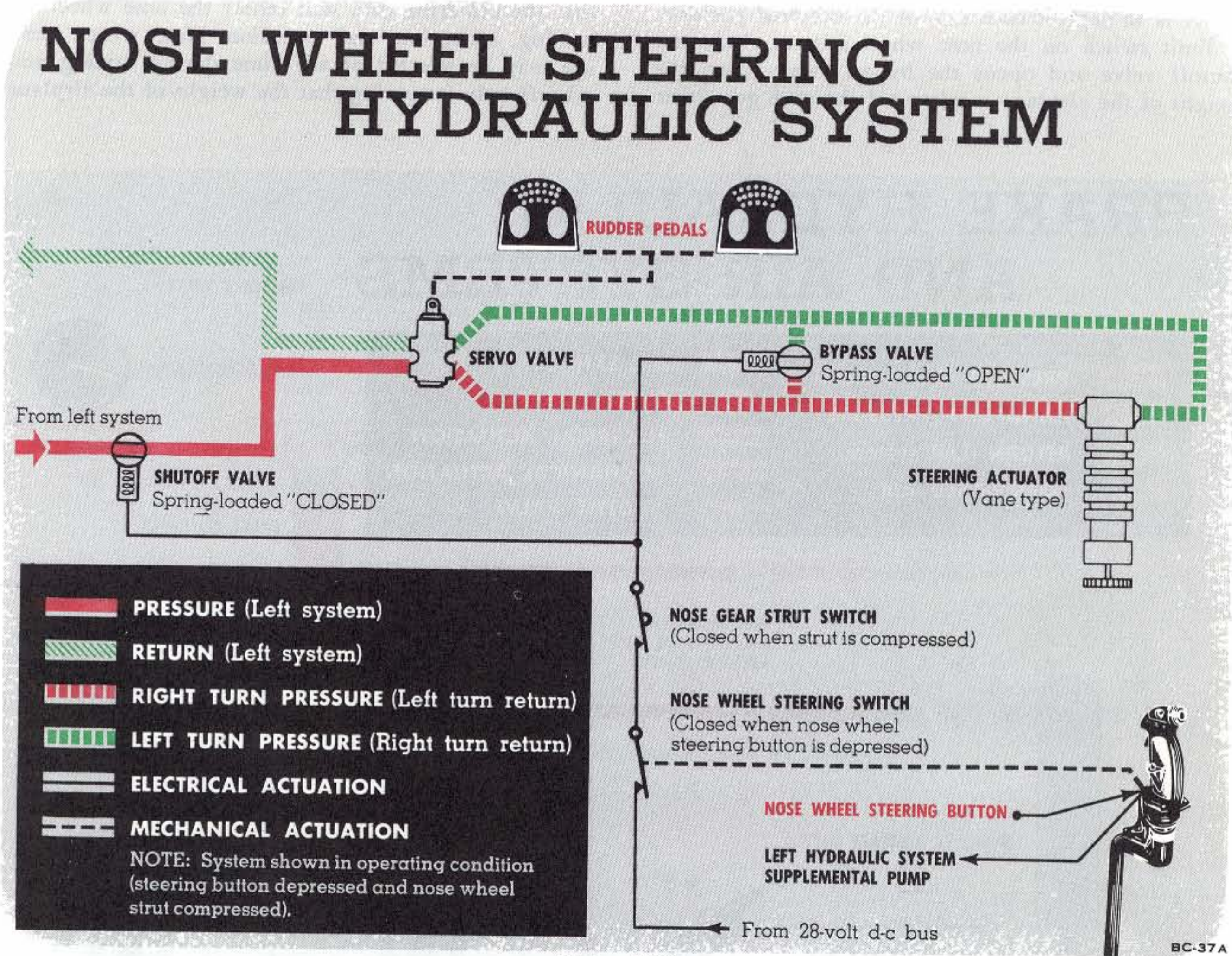


Figure 1-33.

increased above the given values, the horn will stop sounding and the light will go out. A landing gear warning horn reset button on the left cockpit rail above the throttles (figure 1-9) can be pressed to shut off the horn. The warning system will be recycled if either the altitude or the airspeed is increased above the warning range or if the landing gear is extended. On airplanes modified in accordance with T.O. 1F-89-627, the landing gear warning horn has been removed and replaced with an audible warning signal unit. If the landing gear has not extended and locked properly on airplanes so modified, a warning signal will be audible over the pilot's headset. Operation and control of the audible warning signal unit is the same as for the landing gear warning horn which it replaces.

Note

A quick check of the indicator light in the landing gear lever knob can be made when the gear is down and locked. Pressing the warning horn reset button will cause the indicator light to come on.

NOSE WHEEL STEERING SYSTEM.

The dual nose wheel is equipped with a steering system controlled by rudder pedal action. (See figure 1-33.) The purpose of the system is to provide directional control during takeoff and taxiing only. It should not be used during the landing roll. Hydraulic pressure for the system is controlled by a solenoid shutoff valve operated by a button on the control stick grip. The button, when depressed, also actuates the left hydraulic system supplemental pump to supply an additional volume of hydraulic fluid for nose wheel steering. When the shutoff valve is open, a servo valve, mechanically controlled by the rudder pedals, directs pressure, according to the direction of rudder pedal displacement, to a vane-type actuator which turns the nose wheel strut. A mechanical followup device returns the servo valve to neutral when the nose wheel displacement corresponds to the magnitude of rudder pedal deflection. When the nose wheel steering is not being used (shutoff valve closed), a bypass valve is open to permit free flow of hydraulic fluid between both sides of the vane-type actuator, thus allowing the nose wheel to swivel. Both steering and swivel range of the nose wheel is 46 degrees each side of the centered position. A limit switch on the nose wheel scissors closes the shutoff valve and opens the bypass valve when the weight of the airplane is taken off the nose gear strut and it extends. This allows the nose gear to swivel so that the centering cam will center the nose wheel for landing, retraction, and extension. Nose wheel steering may be selected at any time during taxiing and takeoff only (assuming that the weight of the airplane

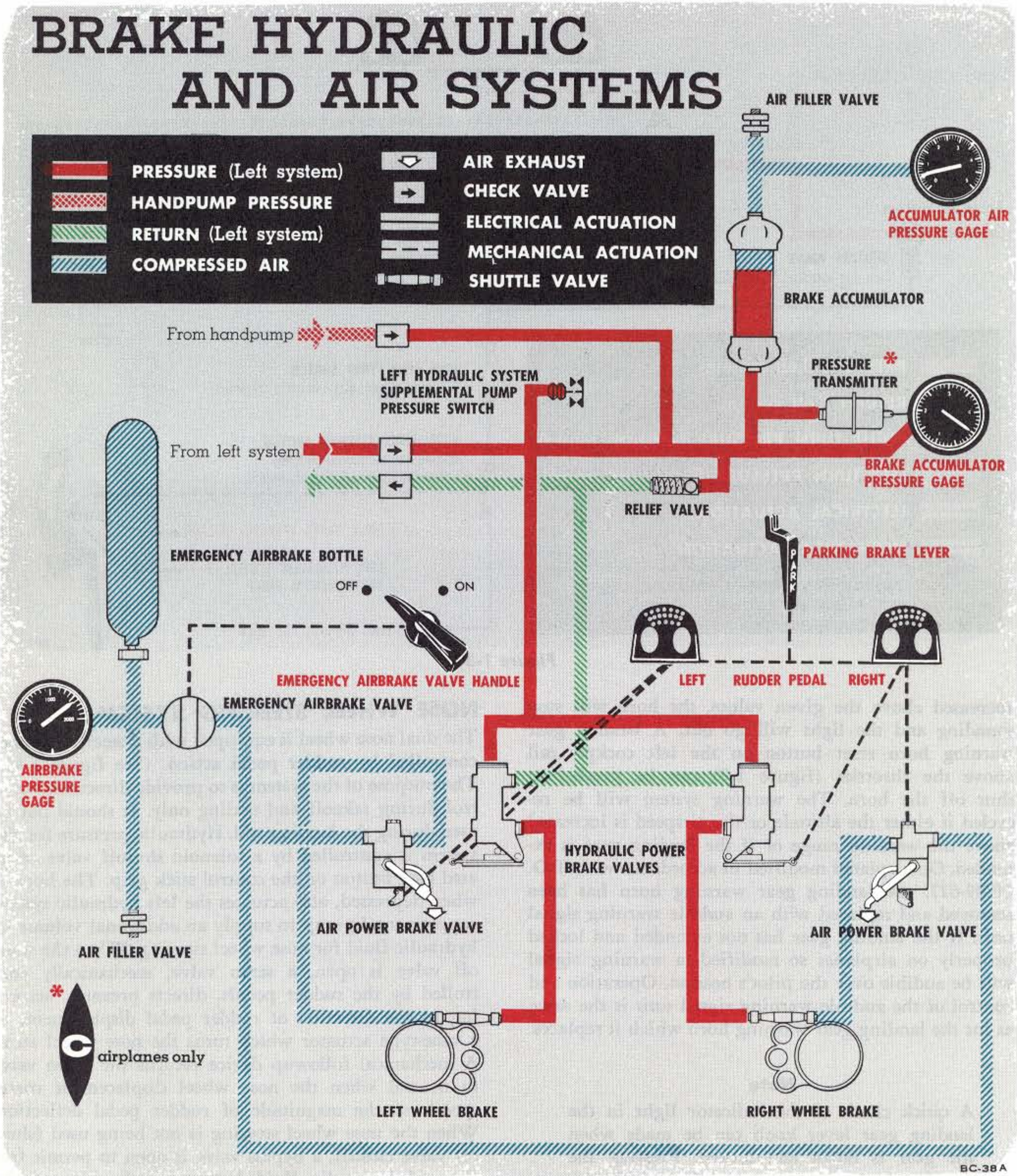


Figure 1-34.

is on the nose wheel and hydraulic and electrical power are available) regardless of the relative positions of the nose wheel and rudder pedals. If the nose wheel position does not correspond with the position of the rudder pedals when nose wheel steering is selected, the nose wheel will turn to correspond with the rudder pedal position. The system operates on pressure from the left hydraulic power supply system. Electrical components are powered by the 28-volt DC bus.

NOSE WHEEL STEERING AND SUPPLEMENTAL HYDRAULIC PUMP BUTTON.

A spring-loaded nose wheel steering button on the control stick grip (figure 1-27) controls the 28-volt DC shutoff valve and the actuator bypass valve in the hydraulic steering system, and the left hydraulic system supplemental pump. When the button is pressed, the shutoff valve opens, the bypass valve closes, the supplemental hydraulic pump starts, and hydraulic pressure is supplied to the system. Subsequent movement of the rudder pedals will then turn the nose wheel in the direction and to the degree desired. The first 50 percent of rudder pedal displacement causes the nose wheel to rotate only 6 degrees from center. The remaining 50 percent of rudder pedal travel rotates the nose wheel through the remaining 40 degrees of angular displacement. The button must be held depressed during nose wheel steering operation. When the button is released the shutoff valve closes, the bypass valve opens, and the nose wheel swivels freely. A limit switch on the nose gear scissors overrides the steering button and prevents the steering system from operating when the weight of the airplane is not on the nose gear. However, pressing the button in flight will start the supplemental hydraulic pump to augment left hydraulic system pressure.

BRAKE SYSTEM.

The main gear wheel brakes operate hydraulically, using pressure from the brake accumulator (which is pressurized by the left hydraulic system). The power brake valves, operated by depressing the brake pedals, individually meter fluid to the wheel brakes. If the left hydraulic system fails, brakes normally will be operated by the pressure in the brake accumulator. In an emergency, when the accumulator pressure is gone, an emergency airbrake is available. (See figure 1-34.) The supplemental hydraulic pump, a normally open pressure switch in the brake accumulator, closes when pressure drops to between 1100-800 PSI (or below). The switch starts the supplemental pump to replenish braking pressure.

Note

Enough hydraulic brake pressure for parking or towing can be obtained by operating the hydraulic handpump in the radar observer's cockpit (figure 4-7).

Emergency Airbrake System.

A 1500-PSI storage bottle in the nose wheel well contains enough air for at least three complete brake applications if brake hydraulic pressure is lost. Pushing down and turning the emergency airbrake handle to ON and pressing a brake pedal operates an airbrake valve that meters air through a shuttle valve to the wheel brake. The shuttle valve closes the hydraulic line to prevent air from going into the hydraulic system.

Note

- On airplanes in compliance with T.O. 1F-89-599, it is not necessary to push the handle down before turning.
- If both emergency airbrake and brake accumulator pressures are applied to the system simultaneously, more pedal pressure will be required for the same amount of braking, as artificial "feel" for both systems must be overcome at the same time.
- Artificial "feel" is lighter for the emergency airbrake system than for the normal hydraulic brake system; therefore, when using the emergency system, anticipate greater braking action for a given pedal pressure.

BRAKE PEDALS.

The brake pedals (figure 1-34) are the conventional toe-operated type. Each pedal controls a hydraulic power brake valve and an air power valve. When the pedals are pressed, all four valves open and either air or hydraulic pressure, or both, supplies the braking action to the wheels. "Feel" will be absent unless pressure is available to one of the power brake valves. Application of both air and hydraulic pressure increases the pedal pressure required to obtain the same braking result.

PARKING BRAKE LEVER.

Pulling up on the parking brake lever (figure 1-11) while depressing the brake pedals sets the parking brakes. The parking brakes are released by manually releasing the parking brake lever slowly while depressing the brake pedals.

EMERGENCY AIRBRAKE VALVE HANDLE.

The emergency airbrake valve handle (figure 1-9) is located on the pilot's left console. Pushing down and turning the handle to ON, then depressing the brake pedals, meters air to the wheel brakes. On modified airplanes, it is not necessary to push the handle down before turning.

INSTRUMENTS.

The free air temperature gage and the turn and slip indicator operate on 28-volt DC electrical power. All the gyro-type instruments except the turn and slip indicator operate on 115-volt AC power from the three-phase instrument inverter. The standby magnetic compass, a self-contained unit of conventional type, is suspended from the windshield structure above and to the right of the pilot's instrument panel. This magnetic compass serves as a reserve directional indicator in case the directional indicator (slaved) fails.

Note

For information on instruments that are an integral part of a particular system, refer to the applicable paragraph in this section or Section IV.

INSTRUMENT PANEL VIBRATORS.

An instrument panel vibrator on the pilot's and radar observer's instrument panels prevents the instruments from sticking. Each unit, a miniature 28-volt DC motor driving an eccentric weight, operates continuously when the 28-volt DC power is on and the circuit breaker is closed.

PILOT'S AIRSPEED INDICATORS.

The pilot's airspeed indicator (figure 1-8) is calibrated in knots and has two pointers: a fluorescent pointer that indicates airspeed and a red pointer that shows the airspeed (for the existing altitude) that corresponds to a preset Mach number. Clockwise movement of the red pointer is limited by a stop which is preset at the limiting structural airspeed of the airplane. When the two pointers meet, the airplane is flying at the maximum allowable airspeed or the maximum allowable Mach number, whichever is less.

RADAR OBSERVER'S AIRSPEED INDICATOR.

The radar observer's airspeed indicator (figure 4-5) is calibrated in knots and shows true airspeed. In the true airspeed indicator a temperature-sensing bulb and an altitude diaphragm automatically compensate for temperature and altitude variations that affect the airspeed reading.

ACCELEROMETER.

A type B-6 accelerometer (figure 1-8) on the pilot's instrument panel indicates in "G's" both positive and

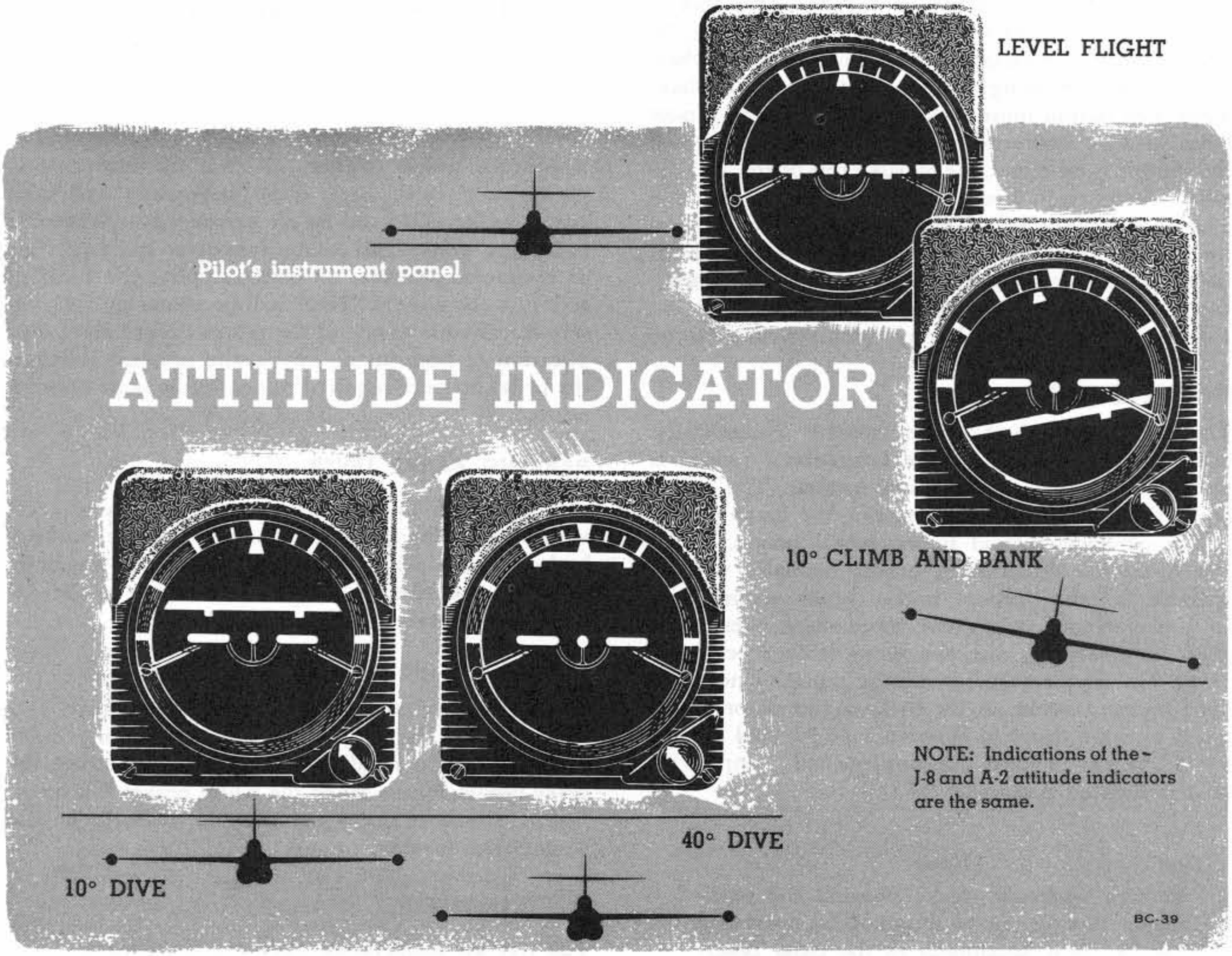


Figure 1-35.

negative load factors. The accelerometer has three pointers. The main pointer indicates existing load factors. The two auxiliary pointers stop at the highest load factor that has been reached; one indicates maximum positive load factor, and one indicates maximum negative load factor. A knob on the front of the instrument case is used to reset the auxiliary pointers to zero. Until they are reset, the auxiliary pointers will show the maximum plus and minus movements of the main pointer.

ATTITUDE INDICATOR. B, C (GROUPS 1-20)

A J-8 attitude indicator (figure 1-35) on the pilot's instrument panel operates on 115-volt AC power from the three-phase instrument inverter. The horizon bar on the J-8 attitude indicator is separate from the sphere and moves in an opposite direction to the sphere. In a climb the horizon bar will appear below the miniature airplane. In a climb (or dive) exceeding 27 degrees, the horizon bar of the indicator stops at the bottom (or top) of the instrument case, and the sphere then becomes the reference. The instrument has effective freedom through 360 degrees of roll. After prolonged turns or acrobatics, the indicator may have errors from the accumulated effect of centrifugal forces, sensed as gravitational forces by the instrument. The indicator will immediately begin to correct these errors once true gravitational forces are sensed; however, the pilot can speed this correction by caging the indicator.

WARNING

A slight amount of pitch error in the indication of the Type J-8 attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run. At this time, a climb indication error of about 1 1/2 bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

Note

The J-8 should never be caged to correct inflight errors unless the airplane is in straight and level flight with visual reference to a true horizon. In acrobatic attitudes, the indicator cages to the attitude of the airplane and not to the true horizon.

Attitude Indicator Cage Knob. B, C (Groups 1-20)

The J-8 indicator can be caged by pulling the cage knob on the front of the instrument. Manual caging erects the indicator quickly for scrambles, making it unnecessary to apply external power to the airplane to keep the indicator erected. When the cage knob is pulled, a momentary stop will be felt when the bank caging mechanism is engaged; as the cage knob is pulled farther, the pitch mechanism is engaged. This erects the indicator promptly, and the knob should then be released immediately. To determine whether the caging mechanism has completely released, the caging knob should be pushed against the instrument case after it has been released. If further travel is evident, the caging mechanism is not releasing properly or the erection mechanism is malfunctioning.

CAUTION

The caging knob should be drawn smoothly away from the face of the indicator; a violent or hard pull may damage the instrument. When the knob reaches the limit of its travel, it should be released quickly. Failure of the caging mechanism to release completely may result in tumbling of the indicator in maneuvers.

Note

To prevent unnecessary torque stresses on the instrument mechanism of the J-8 attitude indicator, allow 30 seconds after power is applied for the gyro to attain speed, then cage immediately thereafter.

ATTITUDE INDICATOR. C (GROUPS 25 AND SUBSEQUENT)

A B-1A attitude indicator (figure 1-35) on the pilot's instrument panel operates basically the same as the J-8 indicator and uses 115-volt AC power from the three-phase instrument inverter. The B-1A indicator is non-caging and incorporates a zero-pitch trim knob that positions both the sphere and the horizon bar to the zero position. The pitch trim knob has a triangular mark for zero-pitch trim, three dots corresponding to a one-half inch deflection in the downward direction, and six dots corresponding to a one-inch deflection in the upward direction. The indicator has a followup rate of 180 degrees per second in the pitch and bank axes. The indicator has a fast initial erection period, approximately 2 minutes and 30 seconds, but if the indicator tumbles in flight, erection may take 15 minutes. Included in the indicator is an electrically-driven power warning flag that disappears from view when the gyro is up to full speed and the system is ready for operation. The flag appears when the power supplying the system is off or when the gyro is not up to speed. However, a slight reduction in AC or DC

Figure 1-36.

power or failure of certain electrical components within the system, which could cause the indicator to function improperly, will not necessarily cause the flag to appear. The instrument operates through 360 degrees of roll and through 164 degrees of pitch. The instrument is compensated for turn-errors; however, the lower sensitivity limit of the turn-error compensating mechanism is 40 degrees per minute. Any turn made below 40 degrees per minute will result in turn-errors common to other instruments. Turns made above 40 degrees per minute will be compensated for turn-errors. In level flight, the maximum error in the indication of the airplane's attitude is less than one-half degree.

WARNING

- It is possible that a malfunction of the attitude indicator can be determined only by checking it with the directional indicator (slaved) and the turn and slip indicator.
- A slight amount of pitch error in the indication of the type B-1A attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run. At this time a climb indication error of approximately 1-1/2 bar widths will normally be observed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases. If the power supply to the attitude indicator is interrupted, the instrument will be unreliable for 1 minute.

EMERGENCY EQUIPMENT.

FIRE EXTINGUISHING SYSTEM.

The fire extinguishing system (figure 1-36) has overheat detectors and fire detectors in each engine nacelle, and a single bromochloromethane extinguisher bottle in the nose wheel well, with a discharge line to each engine. Two electrically fired, cartridge-operated, release valves and a pressure gage are assembled on the bottle. When either engine fire selector switch is actuated, the main engine fuel valve is closed and the electrical circuit for the fire extinguishing system is armed. When the agent discharge switch is closed, 28-volt DC flows to the selected discharge valve on the bottle and fires the cartridge which pierces a frangible disk. The bottle discharges its entire contents into the manifolding of the selected engine; the agent vaporizes and dilutes the oxygen content of the air in the engine bay so that it will no longer support combustion. If both fire selector switches are actuated before the agent discharge switch is actuated, the charge will be distributed to both engines but it will be insufficient to put out the fire in either engine. Both the fire extinguishing system and its controls operate on power from the 28-volt DC bus. Overheat lights, fire warning lights, and controls for the extinguisher are located on a fire extinguisher control panel on the pilot's right vertical console.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

CAUTION

This is a "one-shot" fire extinguisher system and must be recharged after each use.

Fire and Overheat Warning Lights and Test Switch.

Two red fire warning lights (figure 1-36), one for each engine, are located on the fire extinguishing control panel and will come on when a rapid temperature rise occurs in the engine area. Two amber overheat warning lights (figure 1-36), one for each engine, are located on the fire extinguishing control panel, and will come on when the temperature in the engine bay area rises above 178°C (350°F). A single spring-loaded switch (figure 1-36) marked L & R FIRE CKT 1 and L OVERHEAT, L & R FIRE CKT 2 and R OVERHEAT, and an unmarked OFF position provide a means of checking the fire and overheat warning circuits. When this switch is held at L & R FIRE CKT 1 and L OVERHEAT, both fire warning lights should come on to indicate that fire warning circuit NO. 1 is operative on both engines, and the left overheat warning light should come on to indicate that the overheat detectors in the left engine bay are operative. When the switch is held at L & R FIRE CKT 2 and R OVERHEAT, both left and right fire warning lights again should come on to indicate that fire warning circuit NO. 2 is operative, and the right engine overheat warning light should come on to indicate that the overheat detectors in the right engine are operative. When the circuits are being tested, the overheat lights should come on immediately and the fire warning lights should come on after a 2 to 10 second delay. The warning lights, test switch, and detector circuits operate on 28-volt DC.

Engine Fire Selector Switches.

Two guarded fire selector switches (figure 1-36), one for each engine, are mounted on the fire extinguishing control panel. These switches are used to turn off the main fuel shutoff valves to the engines and to arm the fire extinguishing agent discharge switch. When the guards over the switches are down, the 28-volt DC circuits to the agent discharge switch are broken. The guard must be raised and the switch moved up to close the fuel valves for the affected engine and to complete the circuit to the agent discharge switch. When the switch is returned to OFF, fuel valves will open and normal fuel flow will result.

Agent Discharge Switch.

A spring-loaded agent discharge switch (figure 1-36), located on the fire extinguishing control panel, operates the fire extinguisher. When the switch is down, the 28-volt DC circuits to the discharge valves on the fire extinguisher bottle are broken. When the switch is held momentarily to the UP position, the circuit is closed and the current flows to the selected discharge valve on the fire extinguisher bottle. There, a cartridge is fired to pierce a sealing disk, and the full charge of extinguishing agent is directed to the area surrounding the engine selected by either engine fire selector switch.

WARNING

The agent discharge switch is ineffective (unarmed) unless one of the engine fire selector switches has been actuated.

CANOPY.

The transparent canopy is operated by an electric motor geared to a chain and can be controlled normally by any one of three canopy switches: the pilot's, the radar observer's, or the external switch. The canopy motor is powered directly from the battery. In an emergency, the canopy can be fast-jettisoned in flight by either crewmember, or slow-jettisoned on the ground by an external emergency release. The canopy travels fore and aft on roller trucks, and is sealed for pressurization by a pneumatic seal that is automatically deflated and inflated by movement of the canopy locks. The seal can also be deflated by depressing the spring button on the seal valve at the left of the pilot's left

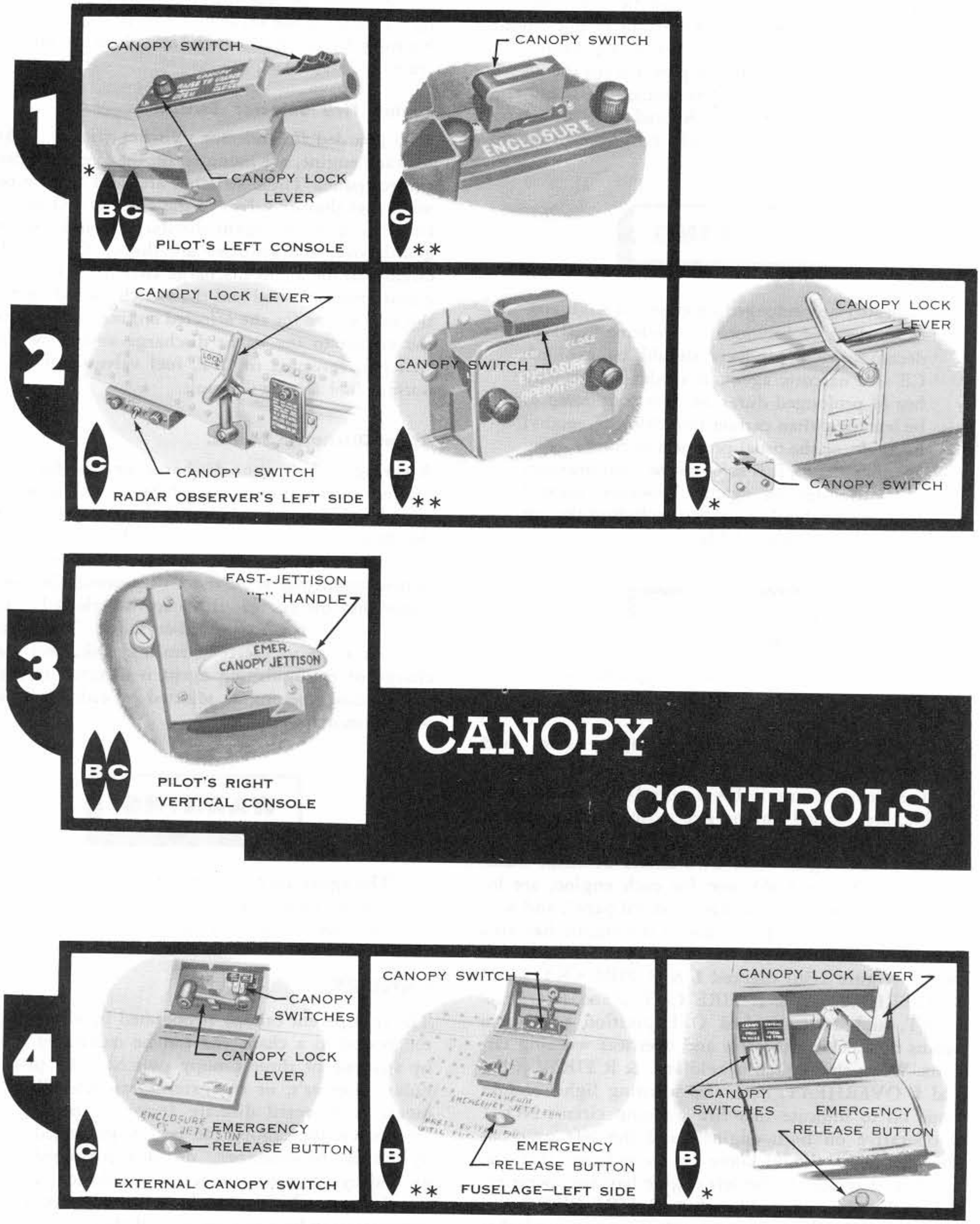


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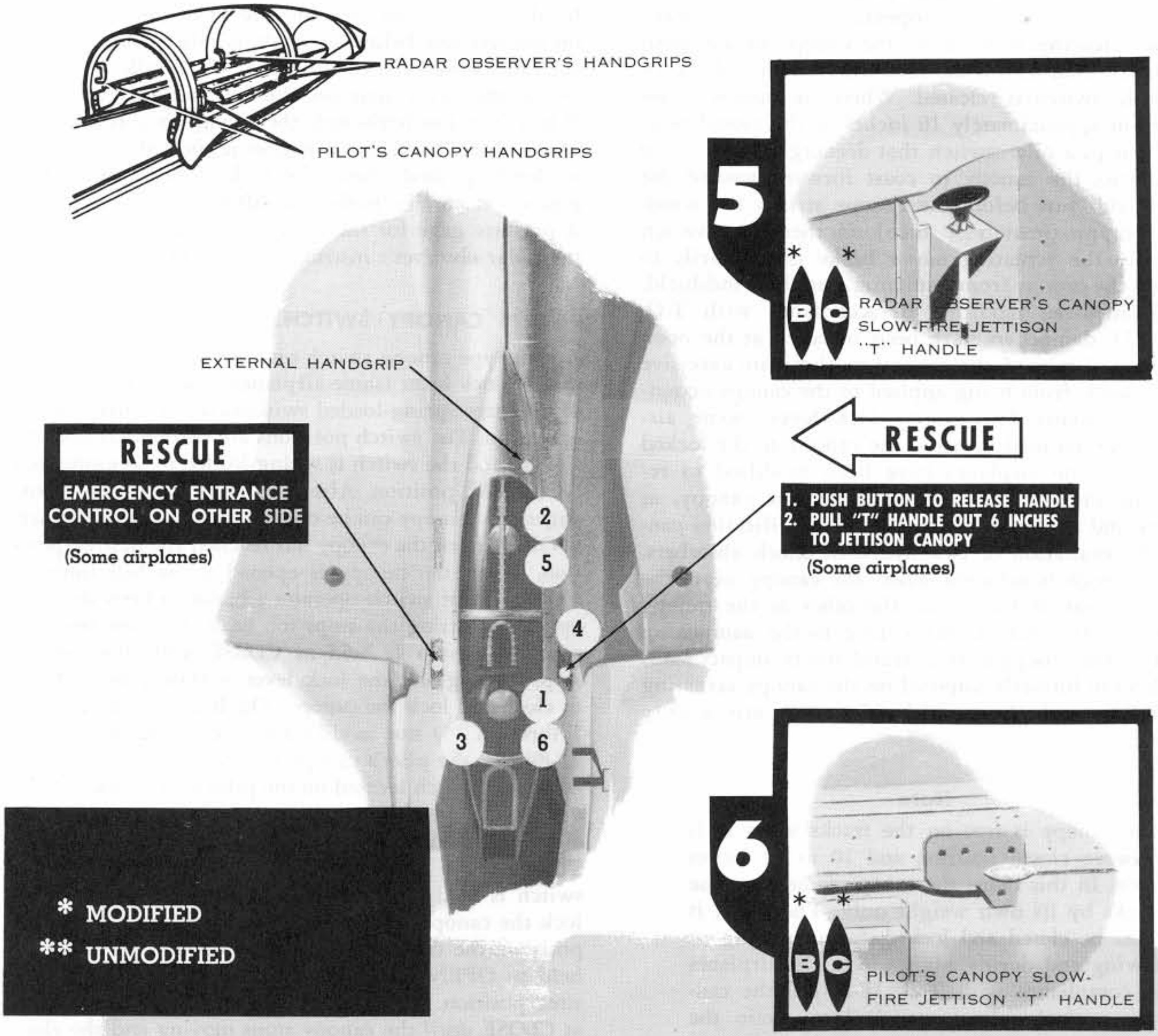
Figure 1-37.



1 PILOT'S CANOPY SWITCH AND LOCK LEVER

2 RADAR OBSERVER'S CANOPY SWITCH AND LOCK LEVER

3 PILOT'S CANOPY FAST-JETTISON "T" HANDLE

4 EXTERNAL CANOPY CONTROLS

5 RADAR OBSERVER'S CANOPY SLOW-FIRE JETTISON "T" HANDLE

6 PILOT'S CANOPY SLOW-FIRE JETTISON "T" HANDLE

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vertical console. On C (Group 35 and subsequent) air planes, a canopy braking control and a time-delay have been added to the canopy operating system. A brake on the actuating motor stops the canopy in any position other than within the forward 10 inches of travel, when the switch is released. When the canopy closes to within approximately 10 inches of the closed position, it trips a microswitch that deenergizes the motor and allows the canopy to coast forward toward the windshield. Just before the canopy strikes the windshield (approximately 1 inch) another microswitch energizes the actuating motor brake momentarily to prevent the canopy from slamming into the windshield. On C airplanes modified in accordance with T.O. 1F-89-271, dampeners have been installed at the open and closed limits of the canopy to eliminate excessive impact loads from being applied to the canopy actuating components The canopy lock lever (some airplanes) is then used to bring the canopy to the locked position. Some airplanes have been modified to reduce the impact loads, generated by the canopy, at its fore and aft limits of travel. The modification consists of installation of two hydraulic shock absorbers, one of which is actuated when the canopy nears the forward limit of travel and the other as the canopy nears the aft limit of travel. Due to the dampening effect on the canopy at both travel limits, impact loads which were formerly imposed on the canopy actuating mechanism and the windshield frame, are greatly reduced.

Note

The canopy is free on the tracks when it is between closed position and 10 to 12 inches open. In this range the canopy is held on the tracks by its own weight only. Therefore, it must be closed and locked during taxiing or towing and during high winds. On airplanes in compliance with T.O. 1F-89-116 the canopy track has been modified to retain the canopy at all positions.

Canopy Jettison System.

In an emergency, the canopy can be fast-jettisoned by either crewmember by raising the ejection seat right armrest, or by the pilot by pulling out (approximately 2 inches) the pilot's canopy jettison "T" handle. The canopy can also be slow-jettisoned by the ground crew by pulling out (approximately 5 inches) the external emergency release handle. The radar observer may slow-jettison the canopy by using the emergency hydraulic handpump handle to put pressure against the cable attached to the external canopy jettison lever and the canopy jettison initiator. Either method releases compressed gas to the canopy jettison cylinder. On airplanes modified in accordance with T.O. 1F-89-586, both the pilot's and radar observer's cockpits are equipped with an internal canopy slow-fire jettison "T" handle. This enables either the pilot or the radar observer to slow-jettison the canopy by pulling the "T" handle. In the pilot's cockpit the "T" handle is located on the left side below the cockpit rail (figure 1-9). In the radar observer's cockpit, the "T" handle is located below the main spar on the left side (figure 4-6). When it is fast-jettisoned, the canopy is thrown clear of the airplane. When it is slow-jettisoned, the canopy is slowly pushed above the cockpit rails. From this position it may be pushed or lifted from the airplane. A pressure gage for the canopy jettison cylinders is on the radar observer's instrument panel (figure 4-6).

PILOT'S CANOPY SWITCH.

A slide-type canopy switch on the handle of the pilot's canopy lock lever (some airplanes) (figure 1-37) is one of the three spring-loaded switches that control canopy operation. The switch positions are marked OPEN and CLOSE and the switch is spring-loaded to an unmarked NEUTRAL position. After the locks have been disengaged, the canopy can be opened by holding the switch at OPEN until the canopy has reached the desired position. When the canopy is opened to its full limit of travel, a limit switch operates a brake to keep the canopy from hitting the stops too hard. To close the canopy, the switch is held at CLOSE until the canopy stops moving and the lock lever is then pushed down to close and lock the canopy. On B airplanes (Groups 1 through 15) not modified in accordance with T.O. 1F-89-214, the pilot's canopy control switch is a guarded toggle switch located on the pilot's left console (figure 1-37). On these airplanes, the canopy locks are electrically actuated through the canopy control switch. To open the canopy from the closed position, the switch is held to OPEN. The lock actuators will unlock the canopy; as the locks reach the fully unlocked position, the canopy will start to open. The switch is held to OPEN until the canopy has reached the desired position. To close the canopy, the switch is held at CLOSE until the canopy stops moving and the electrical locks are actuated to the locked position. The pilot's switch overrides the radar observer's switch, and the external switch overrides both cockpit switches. All canopy switches operate on 28-volt DC from the battery bus.

CAUTION

- On B and C (Groups 1 through 30) airplanes, the switch must be held at the desired position until the canopy stops completely to prevent damage to the actuating chain.
- On some airplanes, if the canopy is not closed and locked it is free on the tracks and could fall off when the airplane is taxied over rough ground or blow off in a crosswind.

RADAR OBSERVER'S CANOPY SWITCH.

A spring-loaded canopy switch on the left side of the radar observer's cockpit (figure 1-37) is marked OPEN and CLOSE, and operates the canopy in the same manner as the pilot's switch.

EXTERNAL CANOPY SWITCH.

To permit electrical actuation of the canopy from outside the cockpit, on B airplanes, an external spring-loaded canopy switch (figure 1-37) inside a key-locked access door just below the left cockpit rail is marked OPEN and CLOSE, and operates the canopy in the same manner as the pilot's switch. The external canopy switch over-rides both cockpit switches. On C and some B airplanes, two battery-powered control switches located inside a key-locked access door on the left side of the fuselage above the wing leading edge permit electrical actuation of the canopy from outside the cockpit. One of the two push-type switches is marked PRESS TO OPEN and the other is marked PRESS TO CLOSE. When either switch is held depressed, the canopy moves in the desired direction until either the switch is released or the canopy reaches its full limit of travel. The external canopy switches override the pilot's and radar observer's switches.

WARNING

When opening the canopy with the external canopy switches, use caution to prevent the forward corner of the canopy from striking the operator's hand.

Note

If the canopy cannot be opened by actuating the external canopy switch, push the button on the external emergency handle and then pull the handle. The canopy will be lifted by slow-jettison until it is clear of the tracks.

CANOPY LOCK LEVERS AND INDICATOR LIGHT.

There are three canopy lock levers (some airplanes): the pilot's (figure 1-37), near the floor at the left of the pilot's seat; the radar observer's (figure 1-37), on the left side of the cockpit; and the external lever (figure 1-37), just below the left cockpit rail inside a key-locked access door. Moving the lock levers to lock position fully closes and locks the canopy and inflates the canopy pressure seal. On B airplanes (Groups 1 through 15) not modified in accordance with T.O. 1F-89-214, the canopy lock actuators are electrically actuated by a toggle switch at each of the following locations: the pilot's left console, the left side of the radar observer's cockpit on the cockpit rail, and the external switch just below the left cockpit rail inside an access door. A 28-volt DC "Canopy Unlocked" red indicator light comes on when the canopy locks are released. The light is located next to the left windshield defogging duct. The light goes out when the locks are engaged. The external lever must be disengaged and pushed into its clip for stowage.

PILOT'S CANOPY HANDGRIPS.

If 28-volt DC electrical power is not available, the canopy can be opened or closed manually. After release of the canopy locks, the canopy is free to roll. Two handgrips on the forward frame of the canopy (figure 1-37) are for the pilot's use in manual operation.

RADAR OBSERVER'S CANOPY HANDGRIPS.

The radar observer can move the canopy manually by using "U"-shaped handgrips (figure 1-37) located on each canopy rail.

EXTERNAL CANOPY HANDGRIP.

An external hinged handgrip (figure 1-37), in the aft structure of the canopy, can be used by personnel outside the cockpit to assist in manually moving the canopy.

EJECTION SEAT RIGHT ARMREST.

The canopy can be fast-jettisoned by raising the right armrest of either crewmember's ejection seat. When either crewmember ejects the canopy by raising his right armrest, compressed gas under approximately 1800 PSI flows to the actuating cylinders, the canopy locks release, and the canopy is thrown into the air.

WARNING

- The canopy goes straight up when it is jettisoned. Lack of airstream may cause it to fall back into the cockpit.
- If canopy is to be jettisoned for reasons other than ejection (such as a forced landing), the pilot should not use the seat armrest, as this will also cause the seat to bottom, thus restricting vision. The canopy can be jettisoned by the pilot without bottoming the seat by pulling out the pilot's canopy jettison handle, discussed in a subsequent paragraph.
- Keep hands and arms clear of canopy control levers during canopy jettison. As the canopy is jettisoned the radar observer's control lever will rotate rapidly to the open position and the pilot's canopy lock lever will snap to the up (OPEN) position.

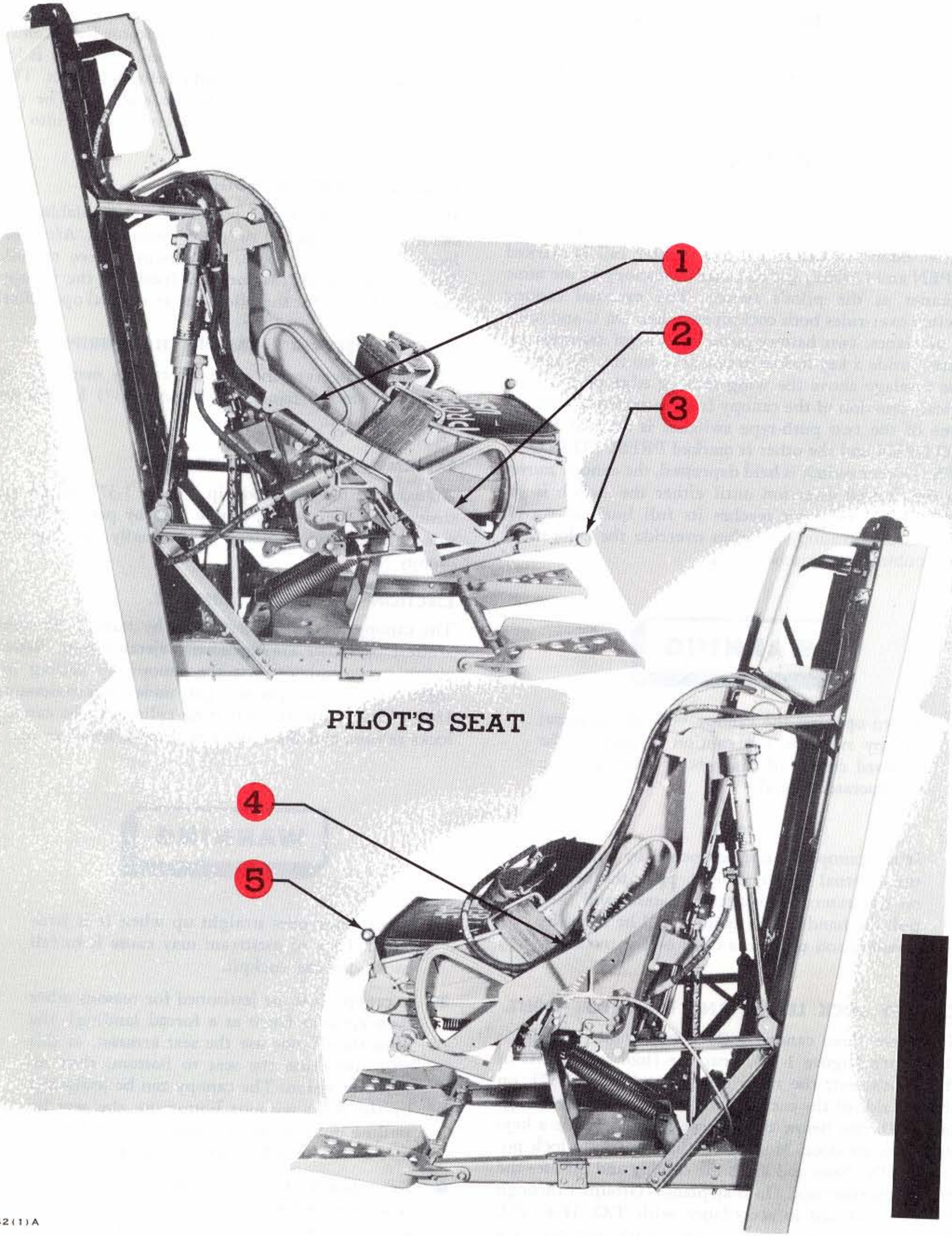

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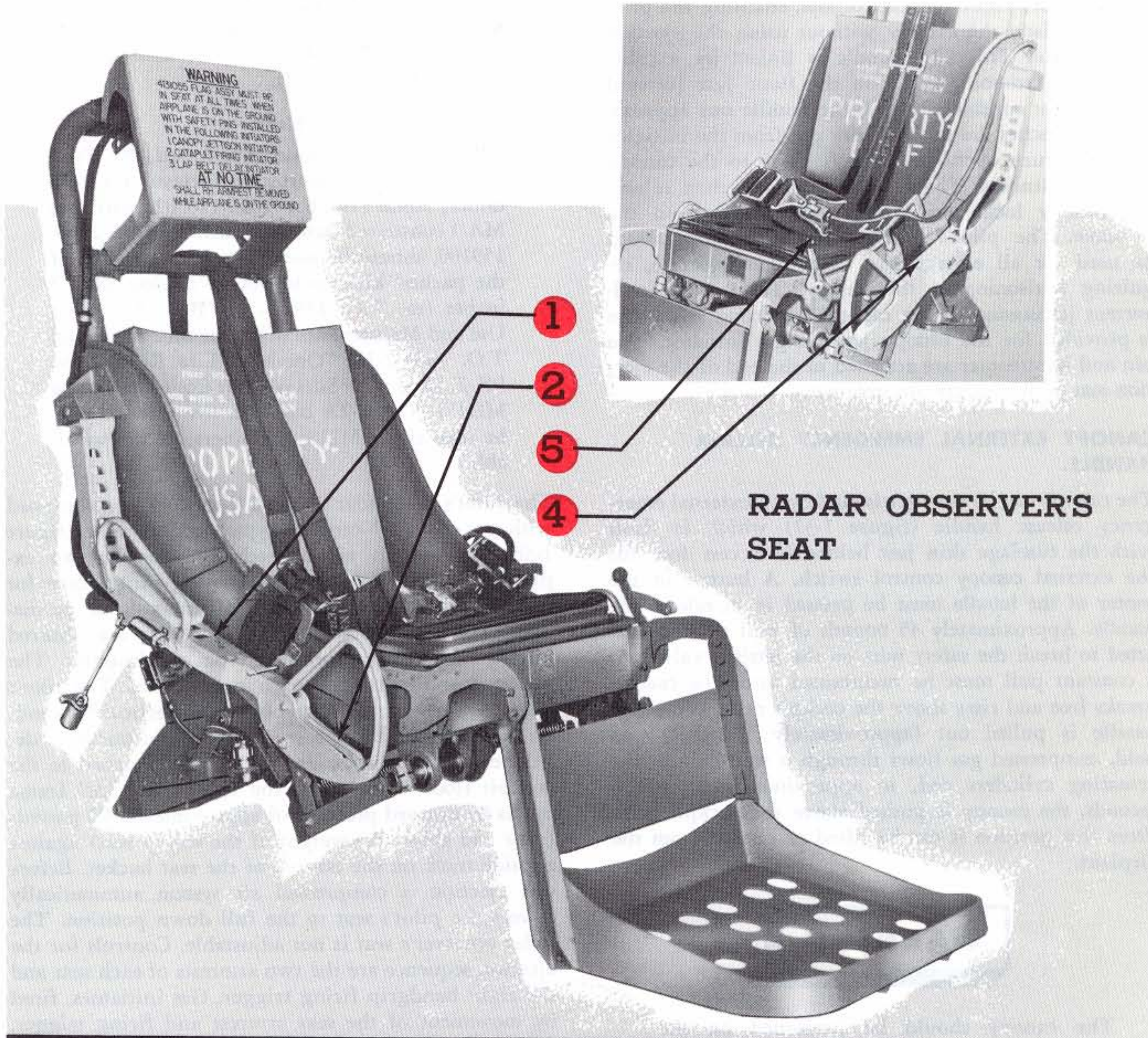
Figure 1-38.



EJECTION SEATS

1. RIGHT ARMREST
2. RIGHT HANDGRIP AND FIRING TRIGGER
3. SEAT ADJUSTMENT LEVER
4. LEFT ARMREST
5. INERTIA REEL LOCK LEVER

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PILOT'S CANOPY FAST-JETTISON "T" HANDLE.

A canopy jettison "T" handle (figure 1-37), is located on the pilot's right vertical console, enabling the pilot to fast-jettison the canopy without using the ejection seat control. This "T" handle is linked by a cable to a gas initiator located on the floor just forward of the right console. Pulling the handle out approximately 2 inches draws the firing pin from the initiator which in turn opens the shutoff valve to the canopy jettison cylinders. The jettison cylinders then release the canopy locks and throw the canopy from the airplane. The pilot's canopy jettison handle should be used for all emergencies, other than ejection, requiring jettisoning of the canopy. To prevent inadvertent jettisoning of the canopy, a ground safety pin is provided for the canopy jettison gas initiator. The pin and its streamer are attached to the end of the ejection seat ground safety pin streamer.

CANOPY EXTERNAL EMERGENCY RELEASE HANDLE.

The canopy can be slow-jettisoned by an external emergency release handle (figure 1-37) which is flush with the fuselage skin just below the access door for the external canopy control switch. A button in the center of the handle must be pressed in to release the handle. Approximately 45 pounds of pull must be exerted to break the safety wire on the jettison valve and a constant pull must be maintained until the canopy breaks free and rises above the cockpit rails. When the handle is pulled out (approximately 5 inches) and held, compressed gas flows through a restrictor to the actuating cylinders and, in approximately 10 to 20 seconds, the canopy is pushed above the cockpit rails. From this position it can be lifted or pushed from the airplane.

WARNING

The canopy should be jettisoned on the ground only in an emergency. To prevent accidental jettisoning of the canopy when the airplane is on the ground, safety pins must be installed in the canopy jettison components in both cockpits (as discussed in Ejection Seat Ground Safety Pins, this section).

EJECTION SEATS.

WARNING

If the C-2A life raft is being carried, the A-5 seat cushion should not be left on the seat. If both are used and it becomes necessary to eject or crash land, severe injury to the back may be caused by the excessive compressibility of the combination of life raft and cushion. If additional height in the seat is needed, a solid filler block may be used in conjunction with a life raft.

Note

When the seat cushion is not used, the Type MD-1 contoured seat style survival kit container, stock Number 2010-126602, with the MA-1 contoured cushion, Stock Number 2010-159100, should be used. The forward edge of the packed kit should not be thicker than 7 inches (see T.O. 14S1-3-51, "Base Assembly, Use and Maintenance of Sustenance Kits" and T.O. 14S3-2-31, "One-Man Life Raft, Type PK-2, Used with Survival Kit Container, Type MD1"). The C-2A one-man life raft kit may be used if the MD-1 containers are not available.

The pilot's and radar observer's stations are equipped with gas-operated catapult-type ejection seats (figure 1-38). A catapult aft of each seat contains an explosive charge that supplies the propelling force for seat ejection. The seat ejection catapult is permanently safetied by two shear pins that are sheared during firing by gas pressure from the initiator. The headrests and footrests of each seat are fixed. The pilot's seat is adjustable in a combination vertical-fore-and-aft direction. Lift pressure for seat adjustment is developed by a spring-loaded "A" frame attached to the cockpit floor. A roller at the top of the "A" frame exerts an upward pressure of approximately 93 pounds (over and above the weight of the empty seat) against a guide track on the bottom of the seat bucket. Before seat ejection, a compressed air system automatically lowers the pilot's seat to the full down position. The radar observer's seat is not adjustable. Controls for the ejection sequence are the two armrests of each seat and the right handgrip firing trigger. Gas initiators, fired by movement of the seat armrest and firing trigger, perform the necessary operations with a minimum of manual force required. As the seat is ejected, anti "G" suit hose, oxygen tube, microphone, and headset connections automatically disconnect at the seat. Each seat is equipped with an automatic safety belt (figure 1-38). The belt releases automatically by means of gas pressure from a delay initiator which is fired as the seat is ejected and which allows approximately 2 seconds more for the seat to clear the airplane before the safety belt is released. For ejection the canopy can be jettisoned by either the pilot or radar observer, but seat ejection is controlled by the individual occupying the seat.

Note

Actuation of either the pilot's or radar observer's right armrest will jettison the canopy and stow the radar scope.

WARNING

- Keep hands and arms clear of canopy lock levers during canopy jettison. As the canopy is jettisoned the radar observer's lock lever will rotate rapidly to the OPEN position and the pilot's lock lever will snap to the UP (OPEN) position.
- The canopy goes straight up when it is jettisoned. Lack of airstream may cause it to fall back into the cockpit.
- If the canopy is to be jettisoned for reasons other than ejection (such as forced landing), the pilot should not use the seat armrest, as this will also cause the seat to bottom, thus restricting vision. The canopy can be jettisoned by the pilot without bottoming the seat by pulling out the pilot's canopy jettison "T" handle.

ARMRESTS.

The right and left armrests (figure 1-38) are not interconnected and may be moved independently of each other. Each armrest terminates in a loop-type handgrip, the right handgrip containing the catapult firing trigger. The pilot's and radar observer's armrest are painted grey and the handgrips orange-yellow to focus attention on the actual ejection controls. Each armrest is fitted with a two-piece hinged brace the lower half of which is attached to a torque tube spring-loaded to the armrest up position. The armrest, normally down, is held down by a latch that consists of a pair of rollers that grip a sear attached to the lower side of the armrest. To raise the armrest, an upward force of approximately 20 pounds is required to pull the sear from the latch. When the latch is released (the first half inch of movement) the spring-assisted lower brace snaps the armrest to the full up position. The brace hinge stops slightly overcenter and is held there by spring tension on the torque tube, locking the brace in the up position to prevent collapse of the armrest due to shock of seat ejection. On either the pilot's or radar observer's seat, raising the right armrest jettisons the canopy, snaps that seat's catapult firing trigger up into the ready position, and moves the radar scope into the stowed position; in addition, on the pilot's seat, raising the right armrest lowers the seat. Raising the left armrest locks the shoulder harness inertia reel.

WARNING

If canopy fails to jettison after raising the right armrest, the pilot may pull the canopy jettison handle. If that system fails to operate, raise the canopy locking lever and move the canopy switch to OPEN. When the canopy moves aft from the windshield frame, it will be free on the tracks and the airstream will blow it from the fuselage. If canopy fails to blow off when unlocked, continue with normal ejection procedure and eject through the canopy.

CATAPULT FIRING TRIGGER.

The catapult firing trigger (figure 1-38), located in the loop-type handgrip of the right armrest, is locked in the stowed position when the armrest is down in normal flying position. When the right armrest is raised, the trigger lock releases and the trigger is snapped up into firing position. Squeezing the trigger pulls the initiator firing pin, and gas pressure sufficient to shear the permanent safety pins drives the catapult firing pin into the detonator to fire the seat catapult.

ADJUSTMENT LEVER.

A lever (figure 1-38) at the forward right corner of the seat bucket controls the locking pins in the seat adjustment mechanism. The lever moves fore and aft to engage or withdraw the locking pins in the seat positioning struts aft of the seat bucket. When the lever is full forward, the seat is locked in place. When the lever is moved aft approximately 15 degrees, the locking pins are withdrawn and the seat may be adjusted upward or downward by relieving or applying weight to the seat bucket. The spring-loaded "A" frame beneath the seat exerts a constant net upward pressure on the seat bucket of approximately half the weight of a crewmember.

SAFETY BELT AUTOMATIC RELEASE.

The primary purpose of the safety belt automatic release, particularly when used with an automatic-opening aneroid-type parachute, is to extend the maximum and minimum altitudes at which the successful escape can be made using the ejection seat. In a high altitude ejection (above 15,000 feet), the automatic system delays deployment of the parachute until an altitude is reached where sufficient oxygen is available to permit a safe parachute descent and air density is great enough to slow a free fall, thus reducing opening parachute shock. In a low altitude ejection, use of the automatic system greatly reduces the overall time required for separation from the seat and deployment of the parachute, and consequently reduces the altitude required for safe ejection. The various types of safety belt automatic releases have been thoroughly tested and are completely reliable. Under no circumstances should the automatic belt be opened manually before ejection, regardless of altitude. Human reaction time cannot possibly beat the automatic operation of the release in

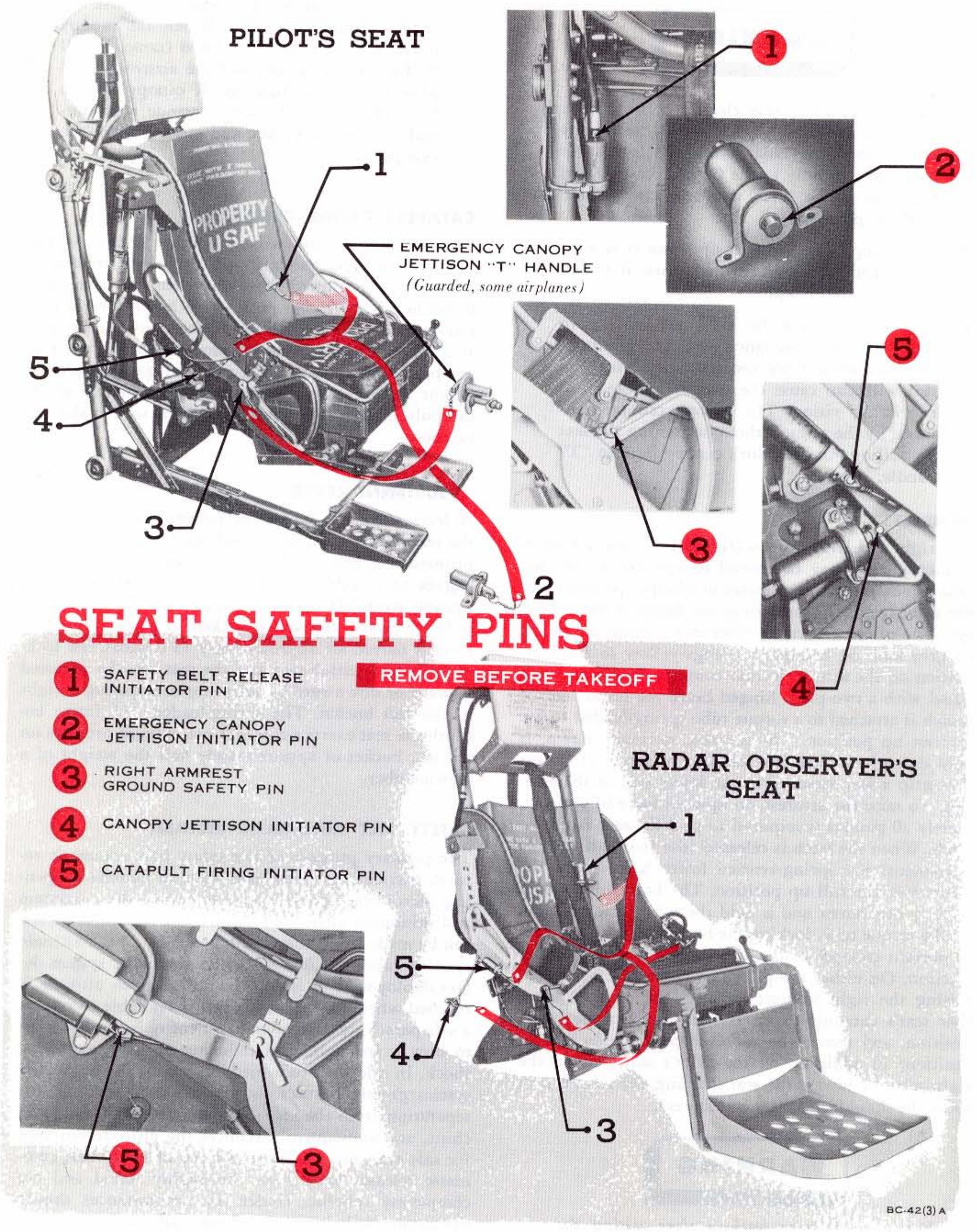

PILOT'S SEAT
EMERGENCY CANOPY JETTISON "T" HANDLE
(Guarded, some airplanes)
SEAT SAFETY PINS
REMOVE BEFORE TAKEOFF
1 SAFETY BELT RELEASE INITIATOR PIN
2 EMERGENCY CANOPY JETTISON INITIATOR PIN
3 RIGHT ARMREST GROUND SAFETY PIN
4 CANOPY JETTISON INITIATOR PIN
5 CATAPULT FIRING INITIATOR PIN
RADAR OBSERVER'S SEAT
PROPERTY USAF
BC-42(3) A

Figure 1-39.

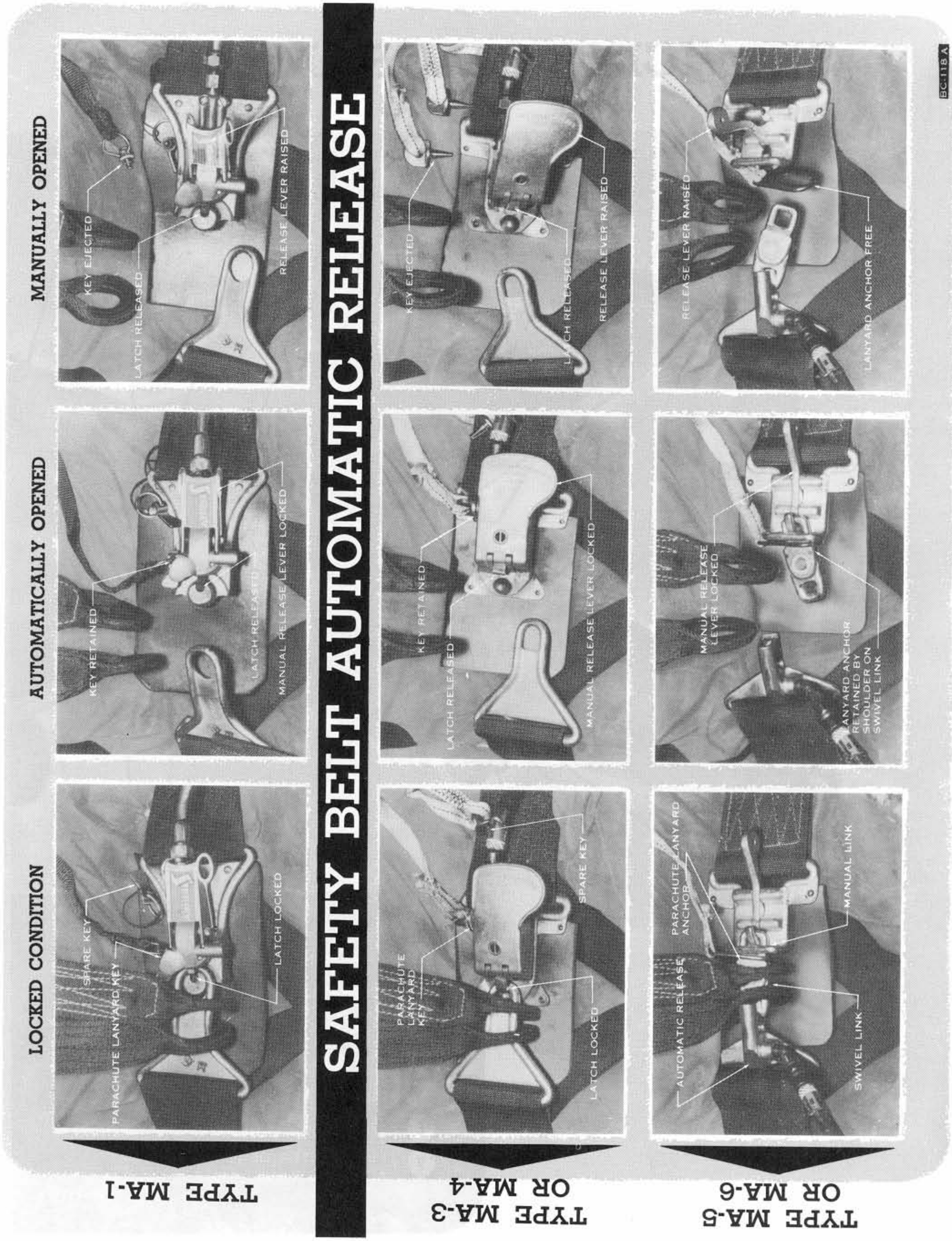

SAFETY BELT AUTOMATIC RELEASE
LOCKED CONDITION
AUTOMATICALLY OPENED
MANUALLY OPENED
TYPE MA-1
TYPE MA-3 OR MA-4
TYPE MA-5 OR MA-6
SPARE KEY
PARACHUTE LANYARD KEY
LATCH LOCKED
KEY RETAINED
LATCH RELEASED
MANUAL RELEASE LEVER LOCKED
KEY EJECTED
RELEASE LEVER RAISED
PARACHUTE LANYARD KEY
PARACHUTE LANYARD ANCHOR
AUTOMATIC RELEASE
MANUAL LINK
SWIVEL LINK
MANUAL RELEASE LEVER LOCKED
LANYARD ANCHOR RETAINED BY SHOULDER ON SWIVEL LINK
LANYARD ANCHOR FREE
BC-118A

Figure 1-40.

SERVICING DIAGRAM

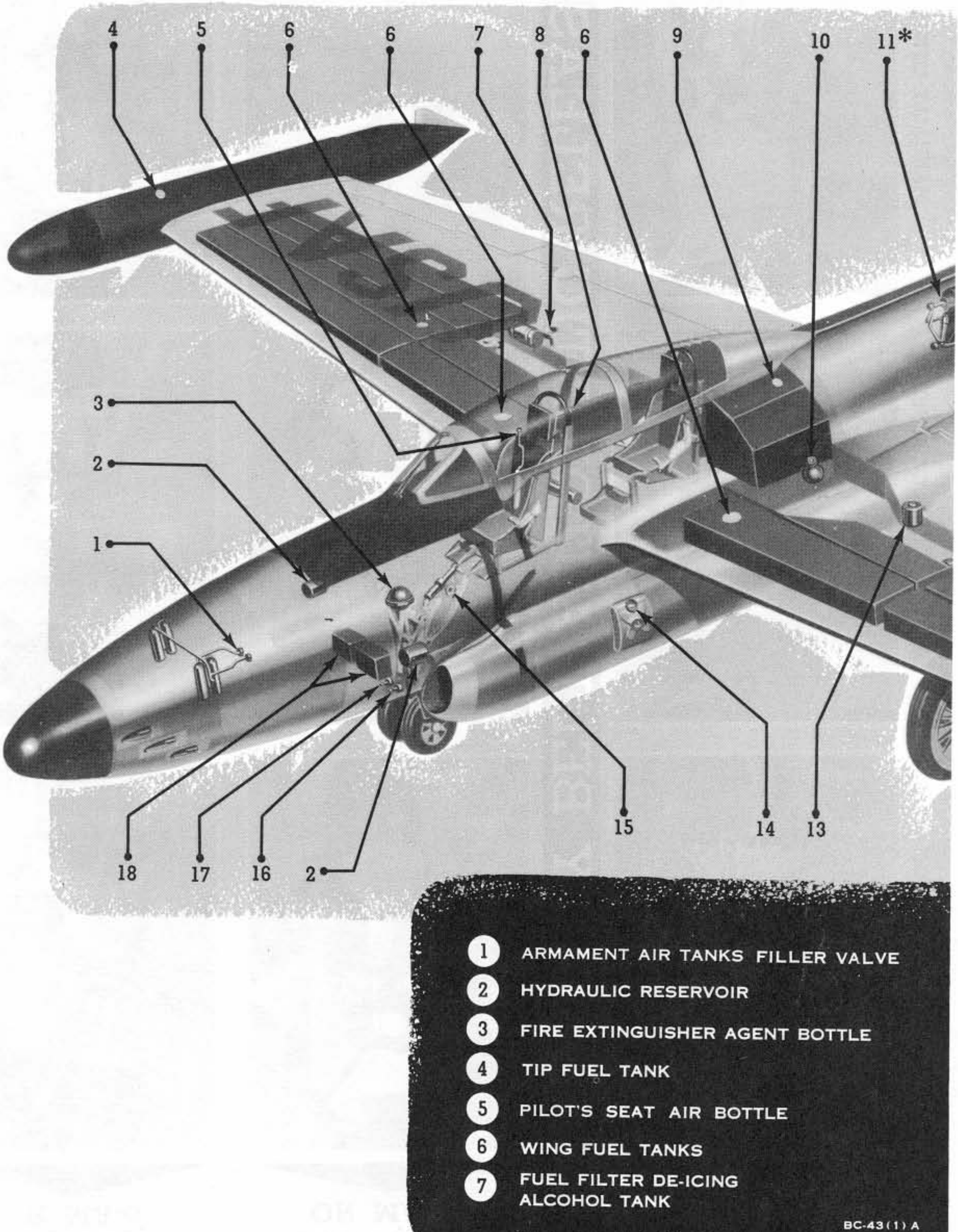
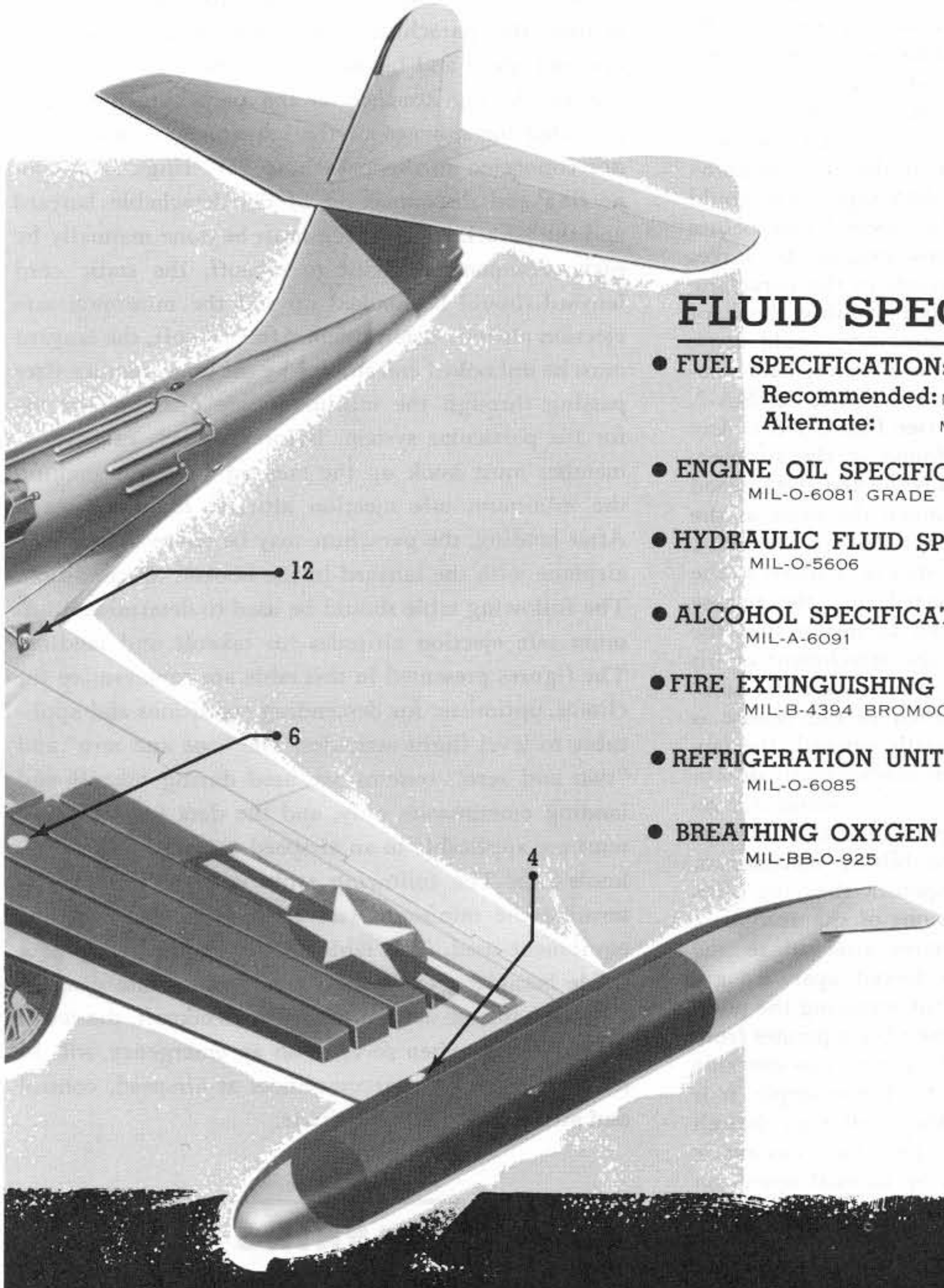


Figure 1-41.



FLUID SPECIFICATIONS

- **FUEL SPECIFICATION:**
  - **Recommended:** MIL-F-5624A GRADE JP-4
  - **Alternate:** MIL-F-5572 ANY GRADE
- **ENGINE OIL SPECIFICATION:**
  MIL-O-6081 GRADE 1010
- **HYDRAULIC FLUID SPECIFICATION:**
  MIL-O-5606
- **ALCOHOL SPECIFICATION:**
  MIL-A-6091
- **FIRE EXTINGUISHING AGENT SPECIFICATION:**
  MIL-B-4394 BROMOCHLOROMETHANE
- **REFRIGERATION UNIT SPECIFICATION:** *
  MIL-O-6085
- **BREATHING OXYGEN SPECIFICATION:**
  MIL-BB-O-925

8 CANOPY JETTISON AIR BOTTLE FILLER VALVE
9 FUSELAGE FUEL TANKS
10 MAIN GEAR BUNGEE AIR FILLER (Each side)
11 REFRIGERATION UNIT OIL FILLER *
12 OXYGEN FILLER VALVE
13 FLAP EMERGENCY HYDRAULIC RESERVOIR
14 ENGINE OIL TANK (Each side)
15 NOSE GEAR BUNGEE FILLER VALVE
16 HYDRAULIC BRAKE ACCUMULATOR AIR FILLER
17 EMERGENCY AIRBRAKE BOTTLE
18 BATTERIES

* B airplanes only

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opening the safety belt and arming the parachute, particularly under the stresses imposed by escape. The escape operation using the automatic release is not only faster, since it opens 2 seconds after ejection, but also protects the crewmember from severe injury at high speeds. Because the deceleration of a crewmember alone is considerably greater than that of the crewmember and seat together, immediate separation would result if the belt were manually opened just before ejection. This would not only cause greater "G" forces during deceleration, but could result in the parachute pack being blown open. The high opening shock of the parachute under these circumstances could cause fatal injuries. Currently, three types of safety belt automatic releases are in general use: the MA-1, the MA-2, -3, and -4, and the MA-5 and -6 (see figure 1-40). Any of these various types may be found in the airplane. All three releases are designed to be locked and opened manually under normal usage, much the same as the standard manual safety belt, except that on the MA-1 through the MA-4 models, a key that is attached to the parachute lanyard must be inserted into the release before it can be manually locked to insure that the crewmember does not overlook the attachment of his parachute lanyard to the release. (If an automatic parachute is not used, the key attached to the release is used.) When the release is manually opened, the key drops out of the release to prevent inadvertently dumping the parachute. On the MA-5 and -6 automatic releases, a ring on the end of the parachute lanyard slips over the locking tongue of the release mechanism; when the release is manually opened, the ring slips free. However, on all three versions of the automatic release, the key (or ring) remains attached to the mechanism when the release is forced apart by gas pressure following an ejection, thus actuating the parachute mechanism when the crewmember separates from the seat. Manual operation of the system can override the automatic features at any time. For example, it is possible to manually open the safety belt even though initiator action has started. The parachute automatic features may also be overridden by manual operation even though the automatic parachute rip cord release has been actuated.

LOW ALTITUDE "ONE AND ZERO" EJECTION SYSTEM.

A system incorporating a one-second safety belt delay and a zero-second parachute delay ("one and zero") is provided (some airplanes) for ejection seat escape systems to improve low altitude escape capability. This system utilizes a detachable lanyard that connects the parachute timer knob to the parachute "D" ring. At very low altitudes and at low airspeeds, the detachable lanyard must be connected to provide for parachute actuation immediately after separation of the crewmember from the ejection seat. At higher altitudes and airspeeds, the detachable lanyard must be disconnected from the "D" ring, to allow the parachute timer to actuate the parachute below the critical parachute opening speed and below the parachute timer altitude setting. A ring attached to the parachute harness is provided for stowage of the lanyard hook when it is not connected to the parachute "D" rings. The connecting and disconnecting of the detachable lanyard and the parachute "D" ring must be done manually by each crewmember. Prior to takeoff, the static cord lanyard should be hooked up and the minimum safe ejection altitude determined. After takeoff, the lanyard must be unhooked and stowed by the crewmember after passing through the minimum safe ejection altitude for his particular system. Before landing, each crewmember must hook up the lanyard prior to reaching the minimum safe ejection altitude for his system. After landing, the parachute may be removed from the airplane with the lanyard in the hooked up condition. The following table should be used to determine minimum safe ejection altitudes for takeoff and landing. The figures presented in this table are conservative for climbs, optimistic for descending conditions and applicable to level flight attitudes. The "one and zero" and "two and zero" systems are used during takeoff and landing emergencies only, and the data for these systems are applicable to an airspeed range of 140 to 300 knots IAS. The following table is to be used to determine the minimum safe ejection altitude for the equipment used. The table should be used only as a guide because even though a minimum safe ejection altitude has been determined prior to takeoff, the actual decision as to when to eject on an emergency will be influenced by such circumstances as airspeed, control and attitude, as well as altitude.

WARNING

If the detachable lanyard has been installed before the one-second safety belt initiator, a "two and zero" system is temporarily provided wherein higher minimum safe ejection altitudes must be observed. (See following table.)

For non-automatic parachutes used with automatic safety belts, lanyard, part NO. 57C6200, will be used. The minimum safe escape altitudes specified for one or two second safety belt and zero second parachute settings apply when the lanyard is attached to the rip cord and safety belt.

	1-Second Automatic Lap Belt (M12 Initiator)	2-Second Automatic Lap Belt (M4 Initiator)
2-Second Parachute, (F-1A Timer), B-4 or B-5 Pack, C-O Canopy	350 Feet	550 Feet
2-Second Parachute, (F-1A Timer), B-5 Pack, C-11 Canopy	400 Feet	600 Feet
1-Second Parachute, (F-1B Timer), B-4 or B-5 Pack, C-9 Canopy	200 Feet	350 Feet
1-Second Parachute, (F-1B Timer), B-5 Pack, C-11 Canopy	250 Feet	400 Feet
0-Second Parachute, (Lanyard to "D" Ring), B-4 or B-5 Pack, C-9 Canopy	100 Feet	200 Feet
0-Second Parachute, (Lanyard to "D" Ring), B-4 or B-5 Pack, C-11 Canopy	150 Feet	250 Feet

EJECTION SEAT GROUND SAFETY PINS.

Ground safety for the ejection seats is achieved by inserting a safety pin through each initiator collar (figure 1-39) to prevent the initiator firing pin from being withdrawn. The safety pin engages an annular groove in the firing pin when the latter is into the case as far as it will go. With the safety pin in place, the firing pin may be turned to align the eye for rigging purposes, but cannot be withdrawn without shearing the safety pin. Five safety pins are provided for the pilot's cockpit and four for the radar observer's. The points to be safetied in each cockpit are the canopy fast-jettison valve initiator and the catapult firing initiator, both under the right armrest, and the safety belt release initiator, mounted on the left of the seat frame aft of the backrest. For each cockpit there is also a special right armrest safety pin. This "L" shaped pin with its separate red streamer is to be kept in the cockpit at all times and must be installed in the receptacle above the right armrest before the occupant leaves the seat, to prevent inadvertent jettisoning of the canopy and arming the seat catapult before the other ground safety pins can be installed. In the pilot's cockpit a fifth safety pin is used in the emergency canopy jettison initiator located on the floor forward of the right console.

SHOULDER HARNESS INERTIA REEL LOCK LEVER.

A two-position LOCKED-UNLOCK shoulder harness inertia reel lock lever (figure 1-38) is used to manually lock the shoulder harness reel or leave it free subject to the inertia lock. This lever is located on the left side of the pilot's and radar observer's seat. The lever is held in position by a friction disk and may be moved forward to lock, or aft to unlock, the reel. When the lever is in the UNLOCK position, the reel harness cable will extend to allow the pilot to lean forward in the cockpit; however, the inertia reel will automatically lock the shoulder harness tension cable when an impact force of two to three "G's" is encountered. When the reel is locked in this manner, it will remain locked until the lever is moved to the LOCKED position and then returned to the UNLOCK position. When the lever is in the LOCKED position, the reel harness cable is manually locked so that the pilot is prevented from bending forward. The LOCKED position provides an added safety precaution over and above that of the automatic inertia-operated safety lock. The reel will also lock automatically when the left armrest is raised prior to seat ejection.

AUXILIARY EQUIPMENT.

Section IV of this handbook contains information on the following auxiliary equipment: cabin air conditioning system, canopy defogging system, anti-icing systems, communication and associated electronic equipment, lighting equipment, oxygen system, armament equipment, and miscellaneous equipment.


FBC-25

NORMAL PROCEDURES

Procedure steps in this section are followed by the symbols P, RO, or P—RO in parentheses to indicate whether the particular step is applicable to the pilot, radar observer, or both crewmembers.

TABLE OF CONTENTS

PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Refer to Section V, Operating Limitations, for restrictions and limitations.

FLIGHT PLANNING.

Prepare a complete flight plan to determine the required fuel, oil, oxygen, airspeed, power settings, and other items for the proposed mission. Use the operating data in Appendix I to assist you in planning.

TAKEOFF AND LANDING DATA CARDS.

Fill out the takeoff and landing data cards using the operating data in Appendix I to assist you.

WEIGHT AND BALANCE.

1. Check takeoff and anticipated landing gross weight and balance.

2. Make sure that the airplane has been serviced and that the required armament and special equipment are loaded.

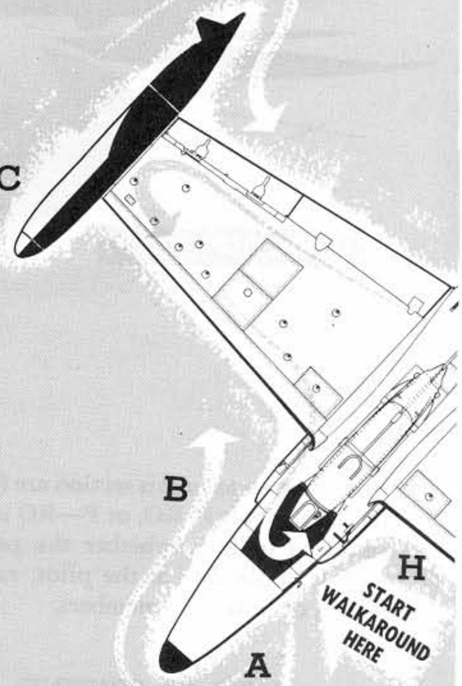
3. Refer to Section V for weight limitations.

4. Refer to Handbooks of Weight and Balance Data, T.O. 1-1B-40 and T.O. 1F-89A-5, for detailed loading information.

5. Make sure that the weight and balance clearance DD Form 365F (formerly Form F) is satisfactory.

EXTERIOR INSPECTION

NOTE: When approaching the airplane, note the general overall appearance and then check the following items:



LEFT FORWARD SIDE

A

1. Pitot tube, static vents, and probe clear.
2. Hydraulic fluid level checked; cap secured.
3. Nose wheel tires for condition, inflation, and slippage.
4. Nose wheel door condition.
5. Nose wheel strut extension (approximately 3 inches); ground lock removed.
6. Static ground contact.
7. Fire extinguishing agent and bungee air pressures.
8. Landing-taxi light condition.
9. Battery access door—remove.
10. Engine screen pressure gages—check for pressure.
11. Brake accumulator gage—600—2500 psi.
12. Emergency airbrake pressure gage—1500 $\pm$50 psi.
13. Battery connected and secured.
14. Battery access door secured.
15. Gun compartment access door—open.
16. Gun charger pressure gage—check for pressure.
17. All access doors secured.
18. Radar nose—check condition.

RIGHT FORWARD SIDE

B

19. All access doors secured.
20. Hydraulic fluid level checked; cap secured.
21. Pitot tube and static vents clear.
22. Cabin pressure regulator outlet clear.
23. Engine intake duct clear; screens and compressor blades aligned and undamaged; check screws inside intake and accessory section for security; check ground for foreign objects.
24. Evidence of fuel, oil, and hydraulic leaks.
25. Engine doors secured.
26. Engine air intake doors free; external engine inlet screens installed.
27. Check oil quantity; oil filler cap and dip stick cotter pin secured.
28. Eleventh-stage compressor bleed port clear.
29. Engine door No. 3 airscoop clear; inside door No. 3 airscoop—check for chafed fuel line. Engine door No. 4 airscoop clear.

RIGHT WING

C

30. Wheel chocks in place; ground lock removed.
31. Tire condition, inflation, and slippage.
32. Brake disk for condition, pucks for proper clearance, and brake shuttle valve checked.
33. Jack lug pointing straight downward.
34. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). Check outboard door locking arm for tension.
35. Wheel well lines for condition and leaks.
36. Inboard main gear door closed and locked.
37. Bungee air pressure.
38. Sequence valve transfer piston for condition and position (out), so that landing gear and door will sequence properly.
39. Gear uplock unlocked, and roller free.
40. Wing leading edge condition.
41. Underside of wing for condition, fuel and hydraulic leaks, tiedown ring flush, and fuel tank vent outlets free of obstructions.
42. Wing access doors secured.
43. Anti-icing overboard duct clear.
44. Tip tank camera window clean and access doors secured.
45. Position light condition.
46. Tip tank fin for security of attachment.
47. Tip tank vent and fuel dump port clear.
48. Aileron and wing flap for condition and hydraulic leaks; aileron neutral, wing flap up. Speed brake external ground lock removed.

RIGHT AFT FUSELAGE

D

49. Tailpipe, fuel manifold, and flameholder condition.
50. Eyelids condition and position (open).
51. Afterburner blastplate condition.
52. Refrigerator air intake and exhaust clear.
53. Aft fuselage access doors secured.
54. Fuselage position light condition.

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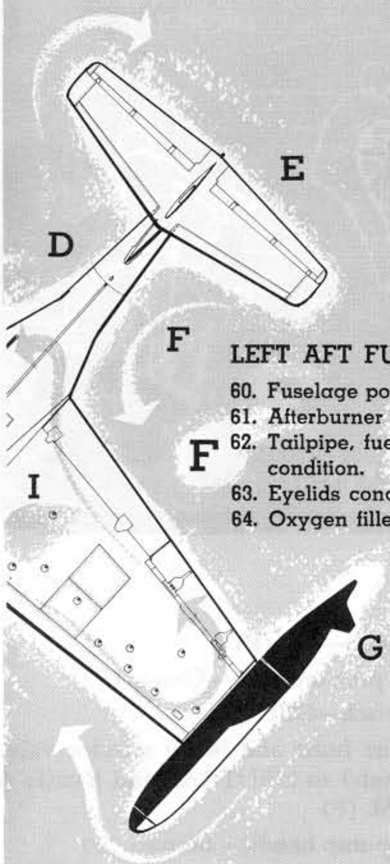
Figure 2-1.

E

EMPENNAGE

55. General condition.
56. Drain ports for hydraulic leaks.
57. Position lights condition.
58. Access doors secured.
59. Rudder for approximately neutral position.



F

LEFT AFT FUSELAGE

60. Fuselage position light condition.
61. Afterburner blastplate condition.
62. Tailpipe, fuel manifold, and flameholder condition.
63. Eyelids condition and position (open).
64. Oxygen filler door secured.

G

LEFT WING

65. Aileron and wing flap for condition and hydraulic leaks; aileron neutral, wing flap up. Speed brake external ground lock removed.
66. Tip tank vent and fuel dump port clear.
67. Tip tank fin for security of attachment.
68. Position light condition.
69. Tip tank access doors secured.
70. Anti-icing overboard duct clear.
71. Wing access doors secured.
72. Underside of wing for condition, fuel and hydraulic leaks; tiedown ring flush, and fuel tank vent outlets free of obstructions.
73. Wing leading edge condition.
74. Wheel chocks in place; ground lock removed.
75. Tire condition, inflation, and slippage.
76. Brake disk for condition, pucks for proper clearance, and brake shuttle valve checked.
77. Jack lug pointing straight downward.
78. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). Check outboard door locking arm for tension.
79. Wheel lines for condition and leaks.
80. Inboard main gear door closed and locked.
81. Bungee air pressure.
82. Sequence valve transfer piston for condition and position (out), so that landing gear and door will sequence properly.
83. Gear uplock unlocked, and roller free.

H

LEFT SIDE

84. Eleventh-stage compressor bleed port clear.
85. Engine door No. 3 airscoop clear; inside door No. 3 airscoop—check for chafed fuel line. Engine door No. 4 airscoop clear.
86. Check oil quantity; oil filler cap and dip stick cotter pin secured.
87. Engine air intake doors free; external engine inlet screens installed.
88. Engine doors secured.
89. Engine intake duct clear; screens and compressor blades aligned and undamaged; check screws inside intake and accessory section for security; check ground for foreign objects.
90. Evidence of fuel, oil, and hydraulic leaks.

I

UPPER WING AND FUSELAGE

91. General condition of surface.
92. Tip tanks for equal amounts of fuel, and pressure release valves flush, and caps secured.
93. All fuel filler caps secured.
94. Static source outlets on top of fuselage clear.
95. Fuselage position light condition.
96. Emergency flap reservoir filler cap secured (left wing).
97. Alcohol tank—check quantity and cap secured (right wing).
98. Canopy and windshield condition.
99. Windshield wiper condition.
100. Radar access doors secured.
101. Canopy control door secured and emergency release handle stowed.

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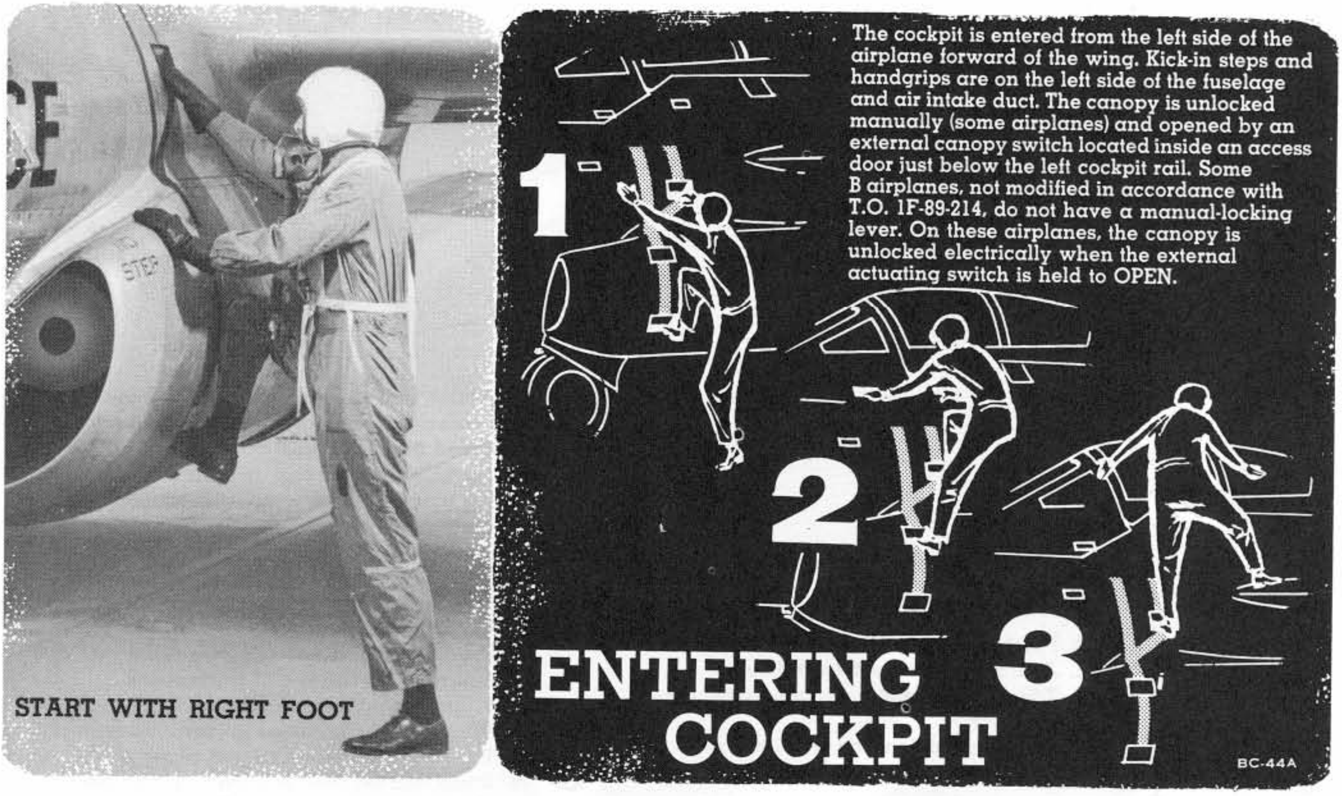


Figure 2-2.

PREFLIGHT CHECK.

BEFORE EXTERIOR INSPECTION.

Check DD Form 781 (formerly Form 1) for the status of the airplane and make sure that the airplane has been serviced.

EXTERIOR INSPECTION.

Conduct the exterior inspection as shown in figure 2-1.

CAUTION

Locate external power unit as far away from the airplane as the power cable will permit to reduce the danger of fire from exhaust gas or hot components of the external power unit.

ENTRANCE.

For the proper method of entering the airplane, refer to figure 2-2.

REAR COCKPIT CHECK (PERFORM WHEN AIRPLANE IS FLOWN SOLO).

1. Safety belt and shoulder harness—Check stowed. (P)
2. All circuit breakers—In. (P)
3. Interior light switches—OFF. (P)
4. Canopy defog knob—IN. (P)
5. Canopy jettison pressure gage—Check. (P)
6. Radar power switch—OFF. (P)
7. Hydraulic engine hoist and brake selector valve handles—Handle B (aft) to NEUTRAL and handle A (forward) to SYSTEM. (P)
8. Hydraulic handpump handle—Stowed. (P)
9. Loose equipment—Check stowed securely. (P)
10. Ejection seat ground safety pins—Installed. (P)

BEFORE ENTERING COCKPIT.

1. Canopy ejection pressure—Check (1500—2000 PSI). (P—RO)
2. Ejection seats—Check. (P—RO)
   Armrests and trigger stowed; safety pins installed; safety belt initiator ground safety pin removed; seat air bottle pressure 1600—1800 PSI; catapult file mark aligned.

Note

If the safety belt initiator ground safety pin is installed, consult maintenance personnel regarding the status of the ejection system before occupying the ejection seat.

3. Circuit breakers—In. (P—RO)
4. Gun selector switch—OFF; guard down. (P)
5. Flashlight—Check operation. (P—RO)

ON ENTERING COCKPIT.

Note

A pilot's checklist is located directly above the center pedestal (figure 1-11).

Interior Check.

Front Cockpit.

WARNING

If the C-2A life raft is being carried, the A-5 seat cushion should not be left on the seat. If both are used, and it becomes necessary to eject or crash land, severe injury to the back may result due to the excessive compressibility of the combination of life raft and cushion. If additional height in the seat is needed, a solid filler block may be used in conjunction with the life raft.

1. Safety belt and shoulder harness—Fasten; inertia reel operation—Check; automatic-opening parachute lanyard—Connected. (P—RO)

WARNING

Improperly attaching the shoulder harness straps to the automatic belt will prevent separation from the ejection seat after ejection. To make the attachment correctly, first place the right and left shoulder harness loops over the manual release end of the swivel link; second, place the automatic parachute lanyard anchor over the manual release end of the swivel link; then, fasten the safety belt by locking the manual release lever.

2. Rudder pedals—Adjust. (P)
3. Battery switch—OFF. (P)
4. Throttles closed—Check. (P)
5. 28-volt external power—Have connected to two power receptacles on right intake duct. (P)

Note

- If more than 15 minutes are to elapse between supplying power to the 28-volt DC bus and starting or operating engines above idle RPM, place the toggle-type afterburner control circuit breakers at unmarked OFF until just before starting engines. This will deenergize the eyelid control solenoids, thus preventing them from being damaged by overheating.
- Check operation of all press-to-test lights on each control or indicator panel as the panel is checked.

6. Power inverter switch—SPARE. (P)
   "Main Out" warning light should come on indicating that the spare inverter is operating.
7. Power inverter switch—MAIN. (P)
   Warning light should go out. Hold power inverter changeover test switch at TEST; the "Both Out" light will come on approximately every 12 seconds, indicating operation of the changeover system. When the "Main Out" light cycles off, release the test switch to keep the main inverter in operation.

CAUTION

Hold the changeover test switch in the TEST position only long enough to allow the inverters to complete one cycle from main to spare and back again. Longer cycling may damage the main inverter.

8. Instrument inverter switch—SPARE. (P)
   "Main Out" warning light should come on indicating the spare inverter is operating.
9. Instrument inverter switch—MAIN. (P)
   Warning light should go out. Hold instrument inverter changeover test switch at TEST; the "Both Out" and "Main Out" warning lights will come on. After about 8 seconds the "Both Out" light will go out and the spare inverter will operate. Release the switch; the system will cycle back to main inverter and the "Main Out" light will go out.
10. Left console circuit breakers—IN. (P)
11. Emergency airbrake handle—OFF. (P)
12. Yaw stabilizer switch—ON. (P)
13. Fuel control panel and fuel gages—Check. (P)
    Crossfeed switch—OFF; auxiliary and tip tank switches—ON (if full); fuel selector switches—AUX. 1. (Auxiliary No. 1 lights should flash and then go out; failure of light to go out indicates booster pump malfunction.) Check fuel quantity gages. Fuel selector switches—AUX. 2. (Auxiliary No. 2 lights should flash and then go out; failure of light indicates booster pump malfunction.) Check fuel quantity gages. Fuel selector switches—ALL TANKS. Check fuel quantity gages.

CAUTION

After positioning the selector switch at any position allow at least 3 seconds to elapse before selecting another position. This will preclude any possibility of the affected fuel system motor valves being reversed in mid-cycle, which will cause shorter valve life.

14. Emergency flap system—Check. (P)
Emergency flap switch ON; check flap operation, movement (approximately 5 degrees), and indicator light; Emergency flap switch—OFF.
15. Wing flap lever—TAKE OFF. (P)
16. Left hydraulic system supplemental pump—Check. (P)
Depress nose wheel steering button and watch left hydraulic system pressure gage for pressure build-up to 2500 PSI.
17. Speed brakes—Check operation, leave closed. (P)
18. Operate all flight controls simultaneously. (P)
Visually check control surface operation.
19. Aileron and elevator trim switch—Check. (P)
Move the switch full travel to left, right, fore and aft positions to make sure that the switch automatically returns to NEUTRAL when released. If the switch sticks in any one of the positions, enter this fact with a red cross on the DD Form 781 and do not fly the airplane. During the check, stick force should be exerted against the trim to assure that trim can be overpowered. Return the elevator trim to the TAKE OFF position when check is completed. Check control stick grip for security.

CAUTION

In checking the control stick grip do not twist the grip as such action may cause the grip to become less secure.

20. Nose wheel steering button—Release. (P)
21. Left hydraulic system supplemental pump pressure switch—Check. (P)
Pump wheel brakes through several cycles to drop accumulator pressure to between 1100—800 PSI. Supplemental pump should come on and accumulator pressure should start to rise to approximately 2100 to 2340 PSI.
22. Position light switches—As required. (P)
23. Landing gear warning horn reset button—Press. (P)
Landing gear lever light should come on.
24. Cabin temperature switch—AUTO. (P)
25. Cabin temperature rheostat—As required. (P)
26. Landing gear lever—Check DOWN and locked. (P)
Check gear position indicator. Emergency landing gear handle—Check IN (stowed position).
27. Canopy seal button—Released. (P)
28. Taxi and landing light switches—As required. (P)
Check operation of both the landing and taxi lamp beams after extending the light.
29. Windshield heat switch—Normal. (P)
30. Windshield wiper switch—OFF. (P)
31. Windshield wiper speed rheostat—INC. (P)
32. Anti-icing switches—OFF. (P)
33. Engine screen emergency extension switch—NORMAL (AUTO position on C airplanes, Group 35 and subsequent). (P)
34. Pitot heat switch—Check. (P)
Turn pitot heat switch ON and check operation with crew chief. Leave on if necessary.
35. Canopy locking lever—Up. (Warning light—On.) (C airplanes and B airplanes modified in accordance with T.O. 1F-89-214.) (P)
36. Cabin air switch—Pressure. (P)
37. Cabin differential pressure switch—5.00 PSI. (C airplanes only.) (P)
38. Attitude indicator—Cage. (P)
Wait at least 30 seconds after switching instrument inverter on so that the gyro will have time to attain speed. (All B airplanes and Groups 1 through 20 C airplanes.)
39. Flight computer (zero reader)—Check. (P)
Selector switch—FLIGHT INST; altitude switch —OFF; perform operational check of flight computer (see Section IV).
40. Directional indicator (slaved) slaving cutout switch—IN. (P—RO)
41. Altimeter and clock—Set. (P—RO)
42. Gunsight caging lever—Cage. (P)
43. Armament switches—Check OFF. (P)
44. Radar and gunsight power switch—OFF. (P)

CAUTION

Armament switches must be at OFF before starting and during ground operation. If they are not at OFF, the sight inverter will be damaged by the initial low voltage.

45. Parking brakes—Set. (P)
46. Emergency rudder trim knob—Centered. (P)
47. Canopy defog knob—IN. (P—RO)
48. Emergency starting power switch—OFF. (ON for emergency start.) (P)
49. Fire and overheat detector test switch—Check operation. (P)
Hold to L & R FIRE CKT 1 and L OVERHEAT, left and right fire warning lights and left overheat warning light should come on within 2 to 10 seconds; hold to L & R FIRE CKT 2 and R OVERHEAT, left and right fire warning lights and right overheat warning light should come on.

50. Canopy jettison "T" handle—IN (stowed position). (P)

51. Interior and instrument lighting rheostats—As required. (P—RO)

52. Communications equipment—Check operation. (P—RO)

Canopy must be closed to check the ARN-6 and ARN-14. Radio compass—Check all positions and set to desired frequency; command radio—Check all channels; VHF navigation set—Check and set to desired frequency; interphone—Check operation.

53. Oxygen equipment—Check operation. (P—RO)

Oxygen pressure gage—400 to 450 PSI; oxygen warning light switch—OFF (some airplanes); oxygen regulator diluter lever—NORMAL OXYGEN; oxygen supply lever—ON. (Refer to Oxygen System Preflight Check, Section IV, for detailed information.)

54. IFF switch—OFF. (P)

55. Generator switches—ON. (P—RO)

CAUTION

During emergency starts, the 28-volt DC generator switches must be at OFF. This is to prevent the left generator from overloading during the right engine start. After the engines have started, the generator switches must be returned to ON.

56. Right console circuit breakers—IN. (P)

57. Right vertical panel circuit breakers—IN. (P)

58. Make sure that all required navigational publications are aboard. (P—RO)

BEFORE STARTING ENGINES.

Whenever possible, start and run up engines on a concrete surface to prevent drawing dirt and foreign objects into the compressors and damaging the engines. Avoid runup on macadam pavement; high exhaust temperatures may cause serious damage to the pavement aft of the airplane. If the airplane is to be operated under conditions of possible carbon monoxide contamination, such as runup or taxiing directly behind another airplane, or during runup with the tail into the wind, put on oxygen mask, connect tube to oxygen regulator, and place diluter lever at 100% OXYGEN. After contamination is no longer suspected, place the diluter lever at NORMAL OXYGEN.

WARNING

- The oxygen diluter lever must be returned to NORMAL OXYGEN as soon as possible. Use of 100 percent oxygen could deplete the supply before the end of the mission.
- To reduce foreign object damage to the engines, external engine and side door air-inlet screens will be installed for taxiing to or from takeoff and landing areas and during ground operations. The engines should be at idle RPM or stopped during installation or removal of screens as a safeguard to ground crews.
- Personnel installing or removing the screens shall approach from a 90-degree angle and to the rear of the inlet duct opening. One man shall stand at the wing tip of the airplane to signal the pilot or operator in case of accident.
- Before starting engines, make sure danger areas (figure 2-3) fore and aft of engines are clear of personnel, airplanes, and vehicles. Suction at the intake ducts is sufficient to kill or seriously injure personnel pulled against or drawn into the ducts. Danger aft of the engines is created by the high exhaust temperature and blast from the tailpipes.

CAUTION

- Starting an engine by using the blast produced by another airplane or engine is prohibited. This method of starting engines forces foreign objects into the intake of the engine compressor section and results in engine failure.

STARTING ENGINES.

Start the left engine first, to supply hydraulic pressure to the brake accumulator. See Section V for normal operating limits on recommended fuels.

LEFT ENGINE.

CAUTION

Make sure that the windshield heat switch is at OFF before starting engines. If the switch is not at OFF on C (Group 25 and subsequent) airplanes, the power inverter may be damaged by an overload.

1. Fire guard posted. (P)
2. Throttles—CLOSED. (P)
3. Fuel selector switches—ALL TANKS. (P)
4. Auxiliary tank switches—ON; tip tank switches—ON. (P)
5. Crossfeed switch—OFF. (P)
6. Starter switch—START momentarily. (P)

   Check for rise in oil pressure. If there is no indication of oil pressure immediately after starting, shut down engine and investigate.
7. Throttle—IDLE when engine reaches 8 to 10% RPM. (P)

The starter circuit should automatically disconnect when load drawn by starter drops to 200 amperes (approximately 26% RPM). If ignition does not occur within 5 seconds after moving throttle to IDLE, close throttle and place starter switch momentarily at STOP. Do not operate the starter continuously for more than 1 minute. A second start may be attempted as soon as the engine stops rotating. A 3-minute interval must elapse after the second starting attempt and a 30-minute interval must elapse between each series of three starting attempts.

CAUTION

The starter is limited to three starts of 1-minute duration each; if more than three starts are required, allow starter to cool for 30 minutes before using again.

8. Hydraulic system pressure gage—Check while starting engine. (P)

When engine RPM is below 19%, the pressure should not exceed 400 PSI; between 19% and 38%

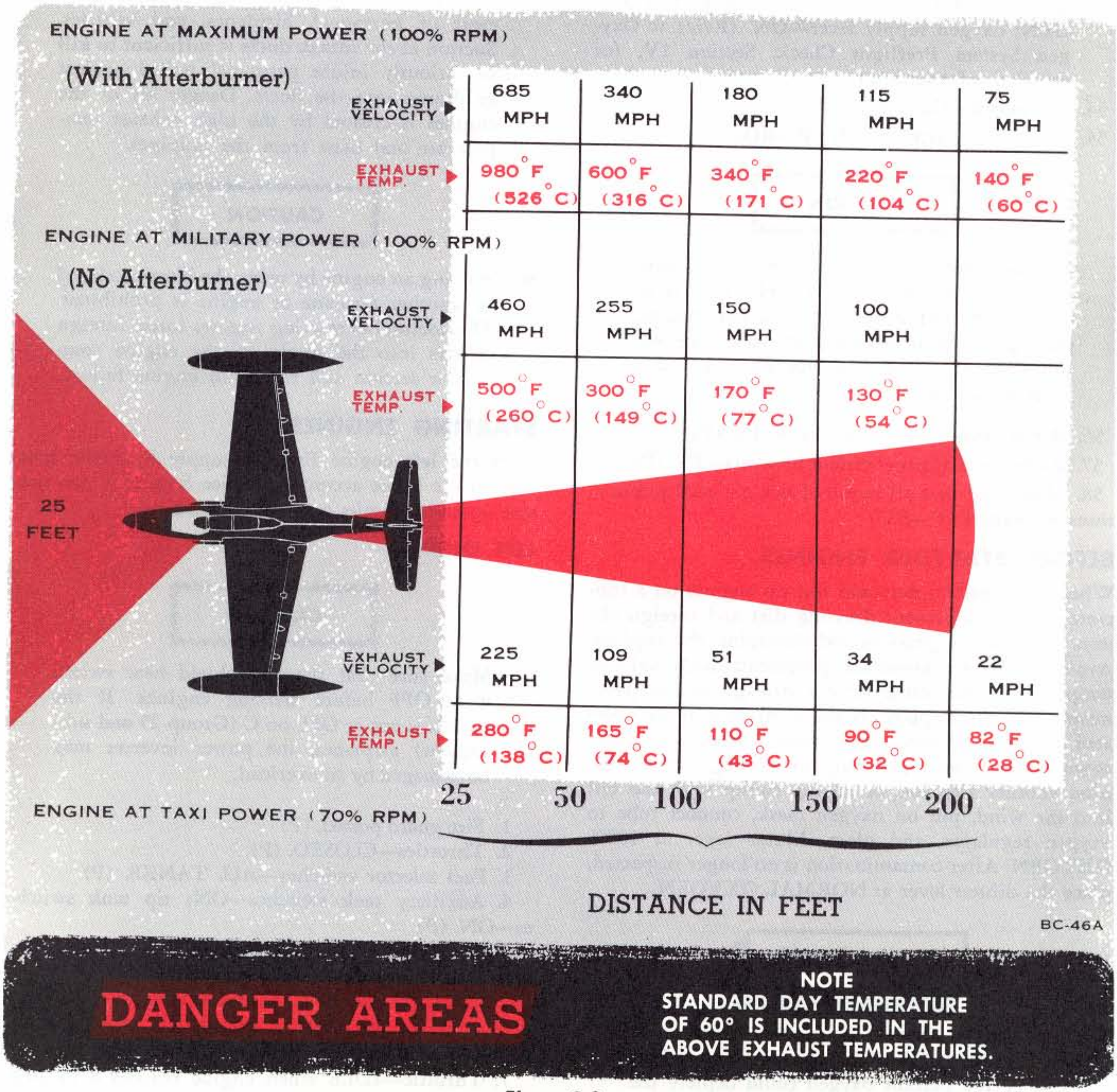


Figure 2-3.

RPM, purge valve should open; when engine RPM is above 38%, the pressure should be between 2800 and 3050 PSI.

9. Exhaust gas temperature and RPM—Stabilized at idle after ignition. (P)

CAUTION

A hot start is a start during which the exhaust gas temperature exceeds 900°C. After any hot start during which the temperature reaches 1000°C, or five hot starts during which the temperature is less than 1000°C, the engine must be removed for inspection and overhaul. Temperatures above 735°C but less than 900°C are permitted for no more than 20 seconds during starting. All hot starts must be entered in DD Form 781.

10. Engine instruments—Check for desired readings at idle RPM. (P)

RIGHT ENGINE.

11. Right engine—Start the same as left engine. (P)
12. External power—Disconnected. (P)
13. Battery switch—ON. (P)
14. Fuel pump warning lights—Off. (P)
15. Engine instruments—Check. (P)
    Check for desired readings at idle RPM.

ENGINE GROUND OPERATION.

No warmup period is necessary. Hold elevator in up position during ground operation.

CAUTION

- During starting and accelerations, the maximum allowable exhaust gas temperature is 900°C. Exhaust gas temperatures between 735°C and 900°C are permissible for no more than 20 seconds.
- Do not exceed maximum RPM. If engine RPM exceeds 104% momentarily or 103% stabilized, with or without excessive exhaust gas temperature, the engine must be removed for overhaul. All overspeeding must be recorded in DD Form 781.
- See Section V for complete discussion of engine limitations.

BEFORE TAXIING.

VOLTAGE CHECK.

1. 28-volt generators—Check. (P)
   With engines above 50% RPM, output of each 28-volt generator should be 27.5 volts; loadmeters should show 0.2 maximum permissible difference.
2. 120-volt generators—Check. (RO)
   With engines above 50% RPM, output of each 120-volt generator should be 110 to 120 volts; loadmeters should show 0.2 maximum permissible difference.
3. IFF switch—STBY. (P)

HYDRAULIC SYSTEM CHECK.

To check the left and right hydraulic flight control systems individually, the left system must be checked before starting the right engine.

1. Speed brakes—Check operation. (P)
2. Flight control surfaces—Check operation. (P)
   Operate all flight control surfaces simultaneously with both engines at idle RPM. Right hydraulic system pressure should not drop below 1500 PSI.

TAXIING.

Maintain directional control with steerable nose wheel.

CAUTION

To reduce foreign object damage to the engines, external engine and side door air-inlet screens will be installed for taxiing to or from takeoff and landing areas and during ground operations.

WARNING

The engines should be at idle RPM or stopped during installation or removal of screens as a safeguard to ground crews.

1. Ejection seat and canopy safety pins—Removed. (P—RO)
2. Canopy—Closed. (P—RO)
   It is not necessary to close the canopy if the airplane is in compliance with T.O. 1F-89-116.
3. Brake accumulator pressure—Check. (P)
4. Wheel chocks—Signal ground crew to remove. (P)

5. Parking brakes—Release. (P)
6. Flight indicators—Check during taxiing. (P)

CAUTION

- Use of both wheel brake and nose wheel steering in turns will result in excessive stress on the nose gear and excessive nose wheel tire wear.
- Nose wheel tires will be severely damaged if maximum deflection turns are attempted at rolling speeds in excess of 10 knots.

Use 70% to 75% RPM to start the airplane rolling from a standing position, and 50% to 55% RPM to keep it rolling. If taxiing with left engine only, a higher RPM is required. Maintain 60% to 70% RPM through turns at low speeds. This requires a large clear area aft of the tailpipes. A minimum of 115 feet of clear space ahead of the airplane is required to make a turn safely, starting from standstill. Minimize taxi time; inflight range is considerably decreased by high fuel consumption during taxiing.

Note

Prolonged engine operation at low RPM can cause sump low level warning light to illuminate. This is normal and is not an indication of fuel system malfunction.

Estimated fuel consumption for taxiing with two engines operating is 35 to 70 pounds per minute; therefore, 1 minute of taxi time costs from 3 to 8 nautical miles at long range cruising speed.

BEFORE TAKEOFF.

PREFLIGHT AIRPLANE CHECK.

After taxiing to takeoff position, complete the following check:

1. External engine and side door air inlet screens—Removed. (P)

WARNING

Obtain clearance from ground crew that screens have been removed. The engines must be at idle RPM as a safeguard for ground crews.

2. Canopy—Closed and locked; warning light—OUT. (P)
3. Flight controls—Check for free and correct movement. (P)
4. Elevator trim—Check for TAKE-OFF setting. (P)

WARNING

Be certain that airplane is trimmed properly for takeoff. Excessive trim will cause dangerous porpoising and possible stall.

5. Fuel selector switches—Check ALL TANKS. (P)

WARNING

An AUX. 1 or AUX. 2 selection will support afterburning for a limited time only. An afterburner will flame out without warning when sump fuel is exhausted.

6. Crossfeed switch—Check OFF. (P)
7. Oxygen diluter lever—NORMAL. (P—RO)
8. Safety belt—Tighten; shoulder harness—Adjust to fit snugly; inertia reel lock lever—UNLOCK; "L" shaped seat safety pin—Remove; static cord lanyard—Connect. (P—RO)
9. Wing flap lever—TAKE-OFF. (P)
10. Speed brake lever—CLOSED. (P)
11. Attitude indicator (B, Groups 1-20 C)—Set and uncage. (P)
12. Brake accumulator, hydraulic system pressure, and hydraulic reservoir pressure gages—Check. (P)
13. Check radar observer prepared for takeoff. (P)
14. Engine screens—Extended (if any foreign objects are likely to enter engine intake ducts. (P)

PREFLIGHT ENGINE CHECK.

Roll into takeoff position, center nose wheel, hold brakes, and perform the following checks:

1. Throttles—Full OPEN. (P)
   Allow engine RPM to stabilize at 98% to 100% RPM; observe exhaust gas temperature and check other instruments for desired ranges.

Note

Acceleration from idling to 100% RPM takes about 12 seconds.

CAUTION

- Stabilized engine speeds greater than 103% RPM or a momentary RPM of 104% or more are prohibited, and engine must be removed for overhaul if this overspeeding occurs. The throttle must be reset if stabilized engine speed exceeds 102% RPM.

- See Section V for complete discussion on engine limitations.

2. Fuel transfer warning lights—Check. (P)
Check with engines at full military power. Tip tank feeding failure will be indicated by the fuel transfer warning lights coming on.
3. Left engine afterburner—ON. (P)
Ignition will be indicated by thrust surge. Check exhaust gas temperature and RPM stabilized.
4. Right engine afterburner—ON. (P)
Check exhaust gas temperature and RPM stabilized.

Note

Stabilization of RPM and exhaust gas temperature takes approximately 3 to 4 seconds after initiation of afterburning. The rise in exhaust temperature and drop in RPM indicate proper afterburner ignition. The subsequent rise of RPM to normal indicates the opening of the eyelids. The stabilization of exhaust temperature is the final indication of eyelid opening, afterburning, and airworthiness of the engine.

5. Engine exhaust gas temperature and RPM—Check. (P)

Note

- Determine normal exhaust gas temperature (figure 5-2) for the existing runway temperature prior to takeoff. When engines have accelerated to 100% RPM and before takeoff ground roll is begun, check to ensure that exhaust gas temperature is within limits. Be sure to execute this check with the engine anti-icing system deactivated, as the engine anti-icing system, when actuated, may increase exhaust gas temperature by as much as 20°C (68°F). If the exhaust gas temperature is abnormally low, sufficient thrust may not be available for takeoff. Return to the line and enter this information in DD Form 781.
- Ambient air temperature does not affect peak temperature limits.

CAUTION

- If eyelids do not open, as indicated by excessive exhaust gas temperature and drop in RPM, shut down afterburner, retard throttles, and taxi back to line.
- Except in cases of emergency, the engines should never be shut down immediately after afterburner shutdown. This practice tends to permit accumulation of raw fuel in the afterburner, which may reignite upon contact with hot metal. For normal operation it is recommended that the engine be operated for at least 5 minutes after shutting down the afterburner. This procedure will eliminate shroud segment warpage, overheated bearings, and the possibility of raw fuel accumulating in the afterburners and igniting from hot engines.

6. Crossfeed switch—ON, after both engines have accelerated to 100% RPM and both afterburners are functioning satisfactorily. (P)

Note

Turn crossfeed ON to prevent loss of both afterburners in event of sump tank booster pump failure.

TAKEOFF.

NORMAL TAKEOFF.

When engines and afterburners are stabilized at 100% RPM, proceed with takeoff as shown in figure 2-4. This procedure will produce the results stated in the Takeoff Distance Chart, figure A-6, in Appendix I. See figure A-8 for refusal speed, and at checkpoint, check airspeed.

Note

Takeoff with military power is possible, but considerably more distance is required. See Takeoff Distance Chart, figure A-6, for military power takeoff distance.

WARNING

- Adhere closely to the recommended nose wheel liftoff and takeoff airspeeds to assure adequate lateral control and acceleration for takeoff.
- The high rate of fuel consumption during takeoff and initial climb with afterburning will use the fuel from the sump tank faster than it can be replenished, causing a drop in the sump tank fuel level. If a sump tank low level warning light comes on, the afterburner should be shut down until the sump tank is replenished (as indicated by the fuel transfer warning light going out).

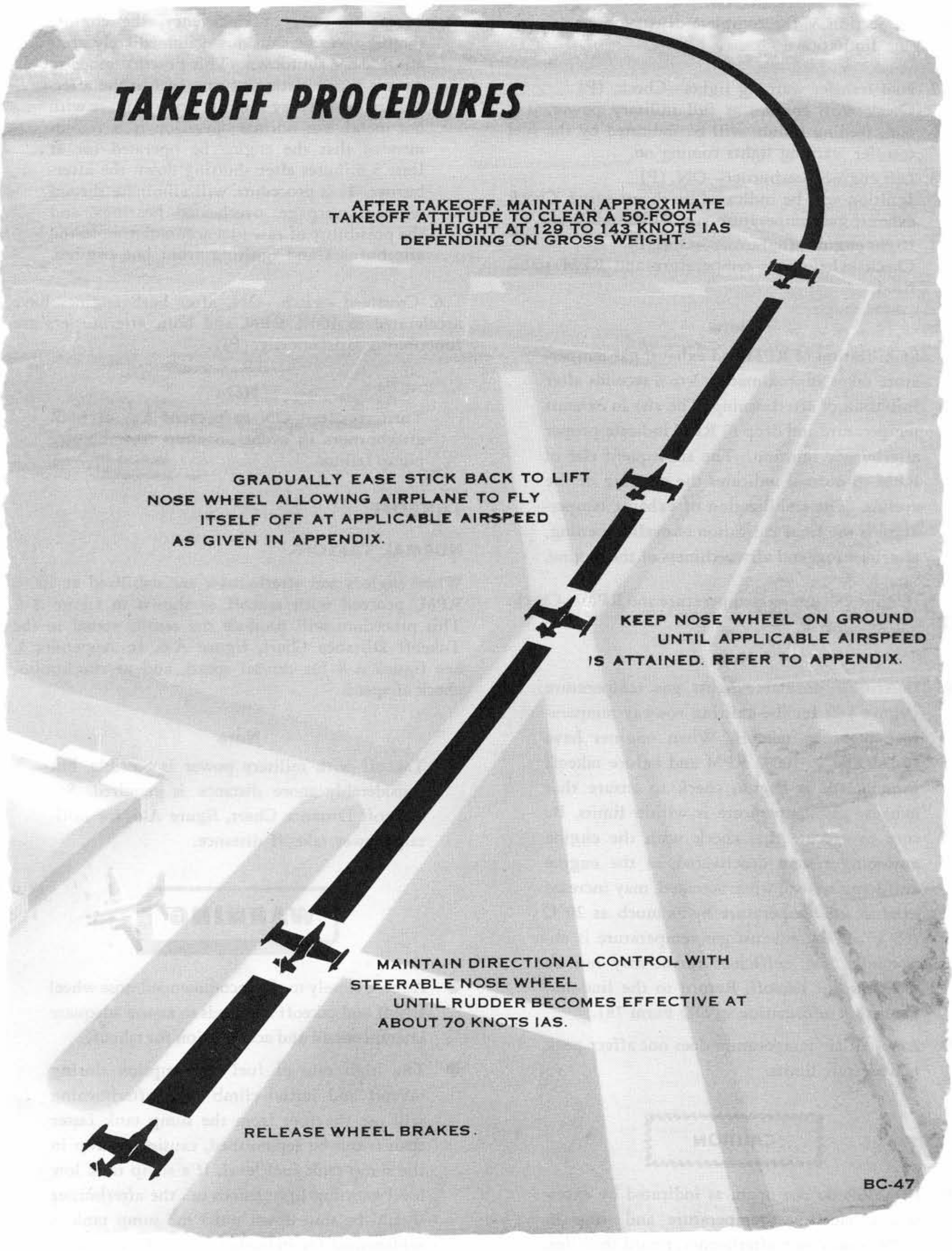

TAKEOFF PROCEDURES
AFTER TAKEOFF, MAINTAIN APPROXIMATE TAKEOFF ATTITUDE TO CLEAR A 50-FOOT HEIGHT AT 129 TO 143 KNOTS IAS DEPENDING ON GROSS WEIGHT.
GRADUALLY EASE STICK BACK TO LIFT NOSE WHEEL ALLOWING AIRPLANE TO FLY ITSELF OFF AT APPLICABLE AIRSPEED AS GIVEN IN APPENDIX.
KEEP NOSE WHEEL ON GROUND UNTIL APPLICABLE AIRSPEED IS ATTAINED. REFER TO APPENDIX.
MAINTAIN DIRECTIONAL CONTROL WITH STEERABLE NOSE WHEEL UNTIL RUDDER BECOMES EFFECTIVE AT ABOUT 70 KNOTS IAS.
RELEASE WHEEL BRAKES.
BC-47

Figure 2-4.

MINIMUM RUN TAKEOFF.

Strict adherence to normal takeoff procedure will result in minimum takeoff ground run. For length of ground run for various gross weights see applicable Takeoff Distance Chart, figure A-6.

OBSTACLE CLEARANCE TAKEOFF.

Follow normal takeoff procedure, using maximum power. After attaining the 50-foot height IAS (see Takeoff Procedure, figure 2-4), maintain this IAS until obstacles are cleared, then proceed with normal climb procedure.

CROSSWIND TAKEOFF.

Follow normal takeoff procedure with the following exceptions: Use ailerons cautiously to maintain a wings-level attitude; lift off at higher speeds than normal, depending on wind velocity; and, hold nose wheel on runway until reaching takeoff speed to get maximum benefit from nose wheel steering. Use of nose wheel steering will facilitate directional control during crosswind takeoff and greatly reduce use of wheel brakes.

CAUTION

Crosswind takeoff ground run distance can be much greater than distances shown in the Takeoff Distance Chart, depending on wind velocity.

Note

Use of nosewheel steering will greatly facilitate directional control during crosswind takeoff and minimize use of brakes.

AFTER TAKEOFF—CLIMB.

To gain altitude efficiently, first accelerate to the best climb speed at constant altitude, then climb, maintaining the best climb airspeed according to the type of climb desired. If a climb is started before reaching the best climb airspeed, total time and fuel consumption will be increased. The best power for climb depends on the performance required. Maximum thrust, military thrust, or normal thrust may be used. Optimum power settings for various performance requirements are described in the following paragraphs.

1. After takeoff, maintain approximate takeoff attitude to clear a 50-foot obstacle. (See Appendix I.) (P)

WARNING

At takeoff airspeeds, aileron response may be somewhat less than at higher airspeeds. Takeoff airspeeds less than those recommended will aggravate this condition.

2. Landing gear lever—UP, when definitely airborne. (P)

CAUTION

Landing gear and landing gear doors should be up and locked and the light in the control handle out before exceeding the structural limit airspeed. Landing gear retraction at speeds in excess of structural limit airspeeds may result in partial gear retraction and possible loss of or damage to the main inboard landing gear doors. If "G" forces or sideslips are attempted during gear retraction, the maximum airspeed at which the landing gear will completely retract will be reduced.

Note

A priority valve in the hydraulic system gives priority to all flight controls over landing gear. Therefore, if the wing flaps are retracted before getting a safe uplock landing gear indication, the gear movement will be delayed until the flaps are up.

WARNING

With wing flaps at takeoff and landing gear down, do not exceed 195 knots IAS as structural damage to the landing gear may result.

3. Wing flap lever—UP after attaining a safe gear and door indication and 150 knots IAS minimum. (P)

WARNING

Wing flaps must be fully retracted before reaching the limit airspeed or structural damage to the wing flaps may result.

4. Crossfeed switch—OFF, upon reaching a safe altitude. (P)

Note

Because of the possibility of an unbalanced fuel load occurring if the crossfeed switch is left ON, the pilot should make certain that the switch is placed at OFF as soon as a safe altitude is reached following takeoff.

5. After reaching a safe altitude, increase airspeed to desired climbing speed. (P)

6. Static cord lanyard—Disconnect above minimum safe ejection altitude. (P—RO)
7. Fuel gages—Check. (P)
8. Oxygen diluter lever—NORMAL OXYGEN. (P—RO)
   Return diluter lever to NORMAL OXYGEN as soon after takeoff as possible if takeoff was made using 100% OXYGEN because of suspected carbon monoxide contamination of cockpit.

WARNING

The oxygen diluter lever must be returned to NORMAL OXYGEN as soon as possible. Use of 100 percent oxygen could deplete the supply before the end of the mission.

9. IFF switch—As required. (P)

CLIMB.

Note

The procedure given below will produce the results stated in the Climb Charts, figure A-11, in Appendix I.

To gain altitude efficiently, first accelerate to the best climb speed at constant altitude, then climb, maintaining the best climb airspeed according to the type of climb desired. If a climb is started before reaching best climb airspeed, total time and fuel consumption will be increased. The best power for climb depends on the performance required. Maximum thrust, military thrust, or normal thrust may be used. Optimum power settings for various performance requirements are described in the following paragraphs. During climb the following should be accomplished at 5000 feet, 10,000 feet, and at level-off altitudes: Oxygen—Check; altimeter and cabin altitude—Check for proper operation; engine instruments—Check operation; wings and fuselage—Check. (P—RO)

MAXIMUM RATE OF CLIMB.

To climb at the maximum rate (minimum time climb), use maximum power and maintain airspeed schedule shown in the applicable Appendix Climb Charts. The resulting performance is shown on these charts.

MINIMUM FUEL CLIMB.

To climb using minimum fuel without regard to distance gained, use military power at low altitudes and maximum power above 20,000 feet pressure altitude. Airspeeds shown in the applicable Appendix Climb Charts are suitable for this type of climb.

MAXIMUM DISTANCE CLIMB.

To climb so that total distance covered, including cruise distance, is greatest for the fuel consumed, use military power and maintain the airspeed shown in the applicable Appendix Climb Charts.

MINIMUM DISTANCE CLIMB.

Minimum distance climb speeds vary with gross weight. For minimum distance climb performance (maximum angle of climb), see figure A-10.

Note

- During locked throttle climb, engine RPM normally will vary not more than ± 2%.
- Minimum distance climb is not a maximum rate of climb.

CRUISE.

See Section VI and Appendix I for cruise characteristics of the airplane.

FLIGHT CHARACTERISTICS.

See Section VI for flight characteristics of the airplane.

DESCENT.

Any combination of power and speed brake position may be used during descent if the airspeed limitations in Section V are not exceeded. Speed brakes can be opened at any airspeed, with degree of opening limited in proportion to airloads above 260 knots IAS. A normal descent provides a compromise in fuel, time, and distance and is ordinarily used during normal operation when loitering or while awaiting landing clearance. The descent is made at Mach 0.70 and idle power, maintaining the airspeeds specified in the Descent Charts, figure A-19. With speed brakes fully open and engines at idle RPM, descents up to 30,000 FPM can be made without exceeding 350 knots IAS. Use the following procedure in making all descents:

1. Throttles and speed brakes—As required. (P)
2. Windshield defrosting system—As required. (P)
3. Canopy defogging system—As required. (P—RO)
   Anticipate canopy fogging at low altitude and operate defogging system accordingly.
4. Altimeter—Set and cross-checked with radar observer. (P—RO)

BEFORE LANDING.

Note

- Before entering traffic pattern, airspeed may be varied within wide limits with speed brakes. It is recommended that the pattern be entered at about 270 knots IAS with speed brakes closed, using 85% RPM, then proceed as shown in figure 2-5 using the applicable final approach speed. If an airspeed lower than 275 knots IAS is desired, open speed brakes in preference to reducing power.

- When power is stabilized at 85% RPM, approximately 4 seconds are required to obtain maximum power.
- Because engine compressors are designed for maximum efficiency at 100% RPM, compressor efficiency will drop as RPM is decreased to approximately 80% RPM. Therefore, if the engine is accelerated rapidly from 80% RPM to maximum power, a compressor stall may result. This is less likely to occur at 85% or higher RPM because of the higher velocity of the airflow through the compressor at the increased RPM.

1. Alert radar observer. (P)
2. Safety belt and shoulder harness—Tightened; static cord lanyard—Connect, prior to reaching minimum safe ejection altitude; inertia reel lock—UNLOCK. (P—RO)
3. Armament switches—OFF. (P)
4. Wing and tip tank anti-ice systems—OFF; engine anti-icing system—As required. (P)

WARNING

Use extreme caution when using wing anti-icing during landing because operation of the system causes a reduction in available thrust which must be considered if a go-around is necessary.

5. Windshield heat switch—As required. (P)
6. Landing light—As required. (P)
7. Brake accumulator and hydraulic pressure gages—Check. (P)
8. Crossfeed switch—ON, before entering traffic pattern. (P)
9. Engine screens—Extended. (P)
   Extend screens if any foreign objects are likely to enter engine intake ducts.
10. Enter traffic pattern at 275 knots IAS, using 85% RPM. (P)
11. Speed brake lever—OPEN. (P)
12. Airspeed 195 knots; speed brake—CLOSED. (P)
13. Landing gear lever—DOWN; check gear down. (P)

CAUTION

Do not extend landing gear at airspeeds in excess of the structural limit airspeed. After a normal landing or during a two-engine go-around the gear retraction cycle must be completed (gear door up and locked) before the airplane exceeds the structural limit airspeed. If practical, the structural limit airspeed restriction should also be observed during single-engine go-around. In the event of simultaneous actuation of the landing gear, flaps, and speedbrakes, landing gear retraction time will be lengthened. After rapid descent from high altitude, allow for appreciably slower landing gear and wing flap extension rates caused by the low temperature of the hydraulic fluid.

14. Wing flap lever—TAKE-OFF. (P)
15. Trim—Adjust as speed is reduced. (P)
16. Instruments—Check for desired ranges. (P)
17. Turn onto final at 170 knots IAS. (P)
18. Final approach: wing flap lever—DOWN; airspeed—Check. (P)

WARNING

Speed brakes must be used with extreme caution while on final approach. If speed brake opening is increased rapidly, rapid deceleration may result in an excessive rate of descent or stalling while still airborne.

19. Maintain 85% RPM until landing is assured. (P)
20. Maintain desired approach at 138 to 160 knots IAS, depending on gross weight. (P)
21. When landing is assured, retard throttle to IDLE. (P)

WARNING

- Speed brakes must be used with extreme caution while on final approach. If speed brake opening is increased rapidly, rapid deceleration may result in an excessive rate of descent, or stalling while still airborne. Recommended final approach airspeeds for various gross weights are given in Appendix I. These speeds are approximately 5 knots above the stall speeds encountered under average gust conditions.
- At final approach and landing airspeeds, aileron response may be somewhat less than at higher airspeeds. Final approach and landing airspeeds less than those recommended will aggravate this condition.

LANDING.

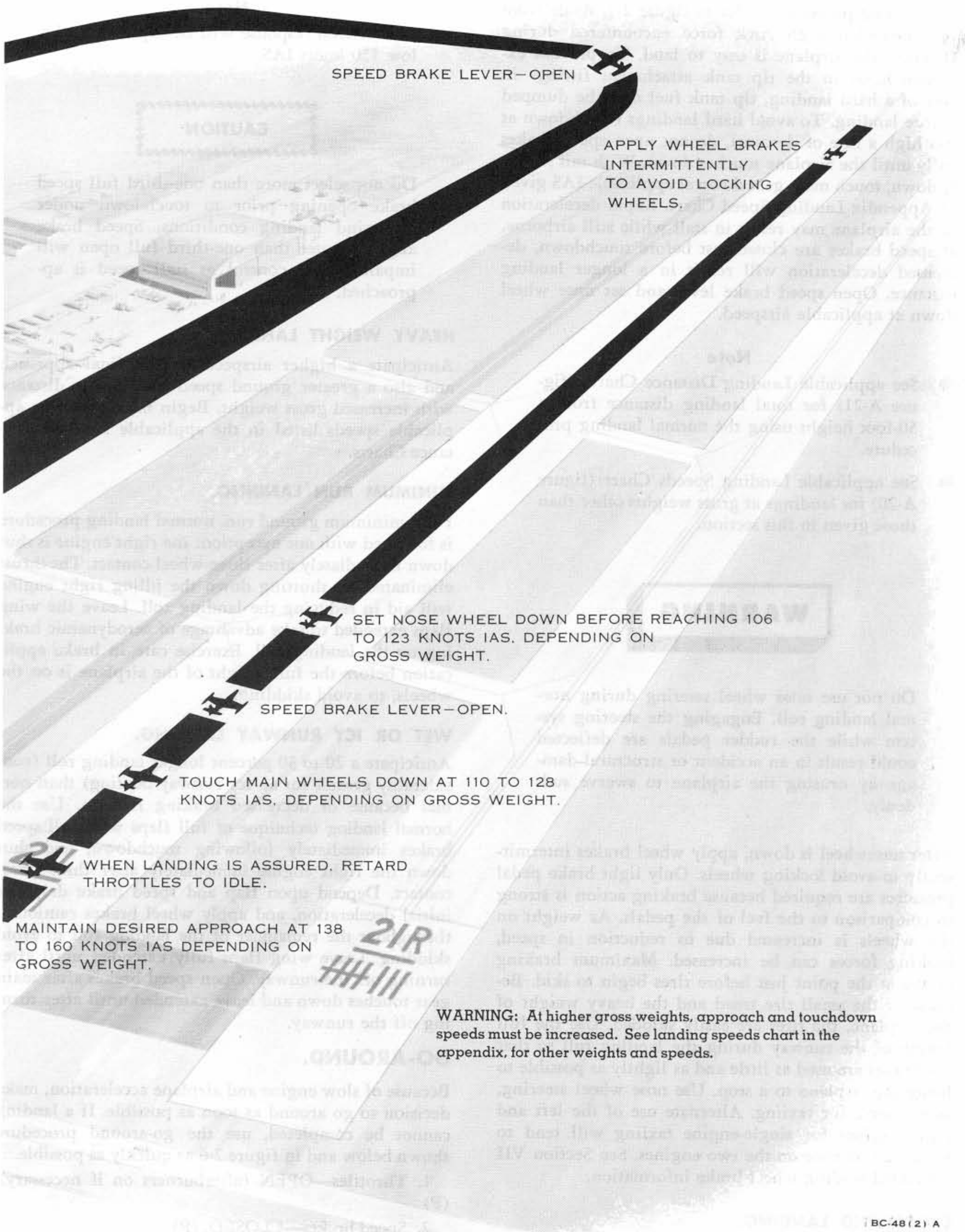
NORMAL LANDING.

Note

The following procedure will produce the results stated in the applicable Landing Distance Charts (figure A-21), in Appendix I.


AIRSPEED 195 KNOTS; SPEED BRAKE LEVER—CLOSED, LANDING GEAR LEVER—DOWN, GEAR POSITION INDICATORS—CHECK, VISUALLY CHECK MAIN GEAR DOWN.
WING FLAP LEVER—TAKEOFF
TRIM—ADJUST AS AIRSPEED IS REDUCED.
CHECK INSTRUMENTS FOR DESIRED RANGES.
MAKE PRETRAFFIC PATTERN CHECK.
ENTER PATTERN AT 270 KNOTS IAS USING 85% RPM.
LANDING PATTERN
BASED ON A TYPICAL GROSS WEIGHT OF 29,500 POUNDS
TURN ONTO FINAL AT 160 TO 170 KNOTS IAS.
MAINTAIN 85% RPM UNTIL LANDING IS ASSURED.
WING FLAP LEVER—DOWN.
NOTE: Typical landing weight is based on typical area intercept mission. Weight includes fuel for 20-minute loiter at sea level plus 5 percent total fuel and full armament.
BC-48(1)A

Figure 2-5.


SPEED BRAKE LEVER—OPEN
APPLY WHEEL BRAKES INTERMITTENTLY TO AVOID LOCKING WHEELS.
SET NOSE WHEEL DOWN BEFORE REACHING 106 TO 123 KNOTS IAS, DEPENDING ON GROSS WEIGHT.
SPEED BRAKE LEVER—OPEN.
TOUCH MAIN WHEELS DOWN AT 110 TO 128 KNOTS IAS, DEPENDING ON GROSS WEIGHT.
WHEN LANDING IS ASSURED, RETARD THROTTLES TO IDLE.
MAINTAIN DESIRED APPROACH AT 138 TO 160 KNOTS IAS DEPENDING ON GROSS WEIGHT.
21R
WARNING: At higher gross weights, approach and touchdown speeds must be increased. See landing speeds chart in the appendix, for other weights and speeds.
BC-48(2) A

For landing procedure, refer to figure 2-5. Aside from the somewhat high stick force encountered during flareout, the airplane is easy to land. To prevent excessive loads in the tip tank attachment fittings in case of a hard landing, tip tank fuel must be dumped before landing. To avoid hard landings (touchdown at too high a rate of descent), do not open speed brakes fully until the airplane touches down. With tail slightly down, touch main gear down at applicable IAS given in Appendix Landing Speed Chart. Rapid deceleration of the airplane may result in stall while still airborne. If speed brakes are closed just before touchdown, decreased deceleration will result in a longer landing distance. Open speed brake lever and set nose wheel down at applicable airspeed.

Note

- See applicable Landing Distance Charts (figure A-21) for total landing distance from a 50-foot height using the normal landing procedure.
- See applicable Landing Speeds Chart (figure A-20) for landings at gross weights other than those given in this section.

WARNING

Do not use nose wheel steering during normal landing roll. Engaging the steering system while the rudder pedals are deflected could result in an accident or structural damage by causing the airplane to swerve suddenly.

After nosewheel is down, apply wheel brakes intermittently to avoid locking wheels. Only light brake pedal pressures are required because braking action is strong in comparison to the feel of the pedals. As weight on the wheels is increased due to reduction in speed, braking forces can be increased. Maximum braking occurs at the point just before tires begin to skid. Because of the small tire tread and the heavy weight of the airplane, the tires are easily skidded. Use the full length of the runway during the landing roll so that the brakes are used as little and as lightly as possible to bring the airplane to a stop. Use nose wheel steering, as required, for taxiing. Alternate use of the left and right engines for single-engine taxiing will tend to equalize taxi time on the two engines. See Section VII for added landing wheel brake information.

CROSSWIND LANDING.

Use normal landing procedure and correct for drift as necessary on approach and landing.

Note

Low aileron response will be experienced below 150 knots IAS.

CAUTION

Do not select more than one-third full speed brake opening prior to touchdown under crosswind landing conditions. Speed brake angles greater than one-third full open will impair lateral control as stall speed is approached.

HEAVY WEIGHT LANDING.

Anticipate a higher airspeed on the final approach and also a greater ground speed and rolling distance with increased gross weight. Begin braking at the applicable speeds listed in the applicable Landing Distance Charts.

MINIMUM RUN LANDING.

For a minimum ground run, normal landing procedure is followed with one exception: the right engine is shut down immediately after three-wheel contact. The thrust eliminated by shutting down the idling right engine will aid in reducing the landing roll. Leave the wing flaps extended to take advantage of aerodynamic braking on the landing roll. Exercise care in brake application before the full weight of the airplane is on the wheels, to avoid skidding.

WET OR ICY RUNWAY LANDING.

Anticipate a 20 to 30 percent longer landing roll (considerably greater for an icy runway landing) than normal because of decreased braking friction. Use the normal landing technique of full flaps with full speed brakes immediately following touchdown, and shut down the right engine immediately after three-wheel contact. Depend upon flap and speed brake drag for initial deceleration, and apply wheel brakes cautiously throughout the remainder of the landing roll to avoid skidding. Leave wing flaps fully extended until after turning off the runway. Open speed brakes after main gear touches down and leave extended until after turning off the runway.

GO-AROUND.

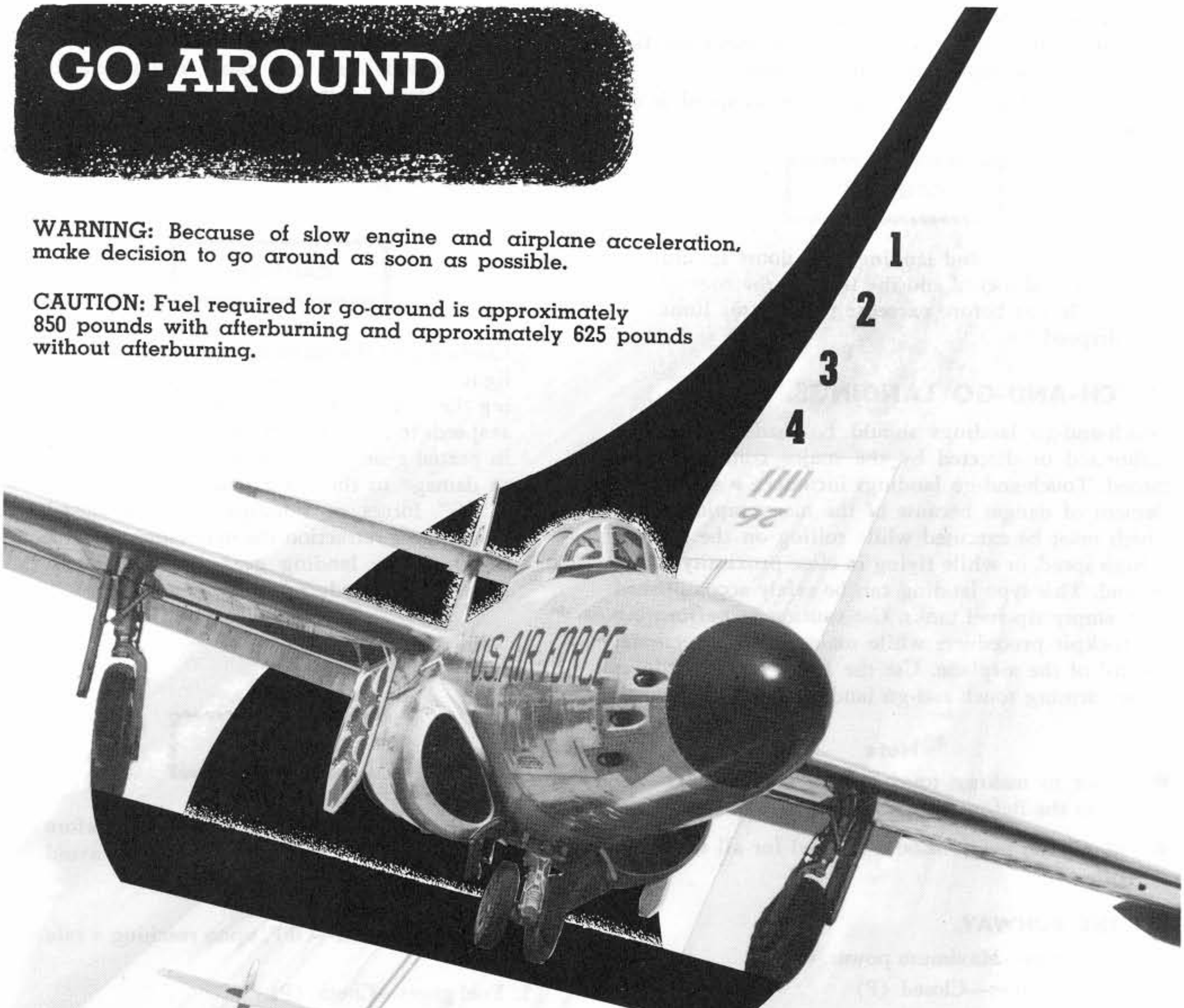
Because of slow engine and airplane acceleration, make decision to go around as soon as possible. If a landing cannot be completed, use the go-around procedure shown below and in figure 2-6 as quickly as possible.

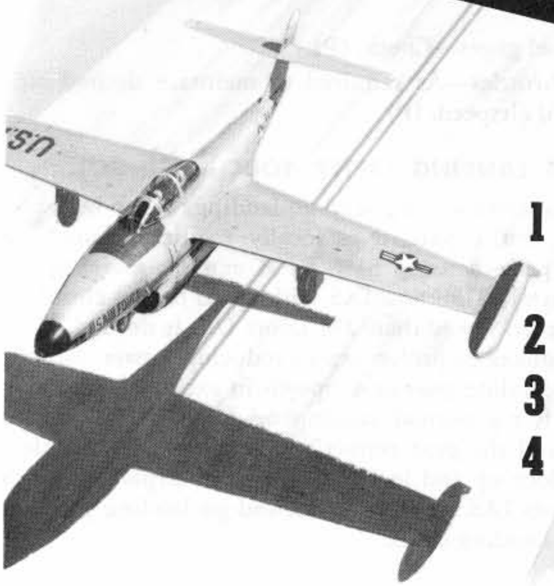
1. Throttles—OPEN (afterburners on if necessary). (P)
2. Speed brakes—CLOSED. (P)
3. Landing gear—UP (when definitely airborne). (P)

GO-AROUND

WARNING: Because of slow engine and airplane acceleration, make decision to go around as soon as possible.

CAUTION: Fuel required for go-around is approximately 850 pounds with afterburning and approximately 625 pounds without afterburning.





IF A LANDING CANNOT BE COMPLETED, DO THE FOLLOWING AS QUICKLY AS POSSIBLE:

1 THROTTLES—OPEN; AFTERBURNERS—ON **(if necessary)**, AS SOON AS ENGINE SPEED PERMITS **(at or above 90% rpm).**

2 SPEED BRAKE LEVER—CLOSED.

3 LANDING GEAR LEVER—UP **(when airplane is definitely airborne).**

4 GRADUALLY RAISE WING FLAPS AS AIRSPEED INCREASES. **(See figure 6-2 for applicable stalling speeds.)**

NOTE: Landing gear retraction during go-around is slower than normal due to the increased demands on the hydraulic system by speed brake and wing flap operation. Landing gear retraction will be further slowed if engine rpm drops below 80%.

BC-49 A

Figure 2-6.

4. Wing flap lever—As required. (P)
Gradually raise flaps as airspeed increases. See figure 6-2 for applicable stalling speeds.

5. Clear traffic as soon as adequate airspeed is attained. (P)

CAUTION

Landing gear and landing gear doors should be up and locked and the light in the control handle out before exceeding structural limit airspeed.

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 introduce a significant element of danger because of the many rapid actions which must be executed while rolling on the runway at high speed, or while flying in close proximity to the ground. This type landing can be safely accomplished with empty tip fuel tanks. Use caution in performing the cockpit procedures while maintaining directional control of the airplane. Use the following procedures in performing touch-and-go landings:

Note

- Prior to making touch-and-go landing, perform the Before Landing check.
- Maximum power should be used for all takeoffs.

ON THE RUNWAY.

1. Throttles—Maximum power. (P)
2. Speed brakes—Closed. (P)
3. Wing flaps—Takeoff. (P)
4. Keep nose wheel on runway until nose wheel liftoff speed is attained. (P)
5. Gradually ease stick back to lift nose wheel, allowing airplane to fly itself off the runway at applicable airspeed. (P)

AFTER TAKEOFF.

1. After takeoff maintain approximate takeoff attitude to clear a 50-foot obstacle at 129 to 143 knots IAS depending on gross weight. Trim aircraft to eliminate excessive stick pressures. (P)

WARNING

- It is important to adhere to applicable airspeed since stalling may be approached at a lower airspeed, and takeoff distance will be increased appreciably at a higher airspeed.
- At takeoff airspeed, aileron response may be somewhat less than at higher airspeeds. Takeoff airspeeds less than those recommended will aggravate this condition.

2. Landing gear lever—UP, when definitely airborne. (P)

CAUTION

Landing gear should be up and locked and the light in the control handle out before exceeding 195 knots IAS. Landing gear retraction at speeds in excess of 195 knots IAS may result in partial gear retraction and possible loss of or damage to the main landing gear doors. If "G" forces or sideslips are experienced during gear retraction the maximum airspeed at which the landing gear will completely retract will be reduced.

3. Wing flap lever—UP. (P)

CAUTION

Wing flaps must be fully retracted before reaching structural limit airspeed to avoid possibility of structural damage.

4. Crossfeed switch—OFF, upon reaching a safe altitude. (P)
5. Fuel gages—Check. (P)
6. Throttles—As required to maintain desired altitude and airspeed. (P)

BEFORE LANDING (AFTER TOUCH-AND-GO).

When a series of touch-and-go landings are to be made, reenter traffic pattern as locally required. Enter the traffic pattern using 85% RPM and maintaining approximately 275 knots IAS with speed brakes closed. If an airspeed lower than 275 knots IAS is desired, open speed brakes in preference to reducing power. Do not extend landing gear at airspeeds in excess of 195 knots IAS. After a normal landing or during a two-engine go-around the gear retraction cycle must be complete (gear door up and locked) before the airplane exceeds 195 knots IAS. Prior to touch-and-go landing perform Before Landing check.

Note

After completion of last touch-and-go landing, perform the After Takeoff—Climb or After Landing check as applicable.

AFTER LANDING.

WARNING

- If carbon monoxide contamination is anticipated during ground operation, oxygen should be used with the diluter lever at 100% OXYGEN.
- Do not use nose wheel steering during a normal landing. Engaging the steering system while the rudder pedals are deflected could result in an accident or structural damage by causing the airplane to swerve suddenly.

CAUTION

- If the normal hydraulic brake pressure is lost, release brake pedals, turn the emergency airbrake handle to ON, and operate the brake pedals with caution. The emergency airbrake system will supply enough pressure for three complete brake applications.
- Nose wheel tires will be severely damaged if maximum deflection turns are attempted at rolling speeds in excess of 10 knots.

Note

Adequate hydraulic pressure in the left system will be maintained during final approach through actuation of the supplemental pump by the landing gear lever switch. After touchdown, the pump will stop but will start again as brake accumulator pressure drops to between 1100 and 800 PSI when the airplane is decelerated.

1. Turn off runway and come to a complete stop. (P)
2. Seat armrest safety pins—Installed. (P—RO)
3. Cabin air switch—RAM and DUMP (before opening canopy). (P)
4. With engines at *idle* have *external* engine screens installed. (P)
5. Wing flap lever—UP. (P)
6. Speed brake lever—CLOSED. (P)
7. Trim—Reset to TAKE-OFF. (P)
8. Anti-icing, windshield de-ice, and pitot heat switches—OFF. (P)
9. Crossfeed switch—OFF. (P)
10. IFF—OFF. (P)
11. Taxi light—As required. (P)

STOPPING ENGINES.

WARNING

To minimize the danger of explosion or fire due to fuel vapor, park the airplane into the wind when possible. Wait at least 15 minutes after engine operation (flight or ground) before going near the jet exhausts.

1. Parking brakes—Set. (P)
2. Canopy—Open. (P)
3. Flight controls—Neutral. (P)
4. Engines—Run up before shutdown. (P)
   If engines have been operating at normal rated thrust or above (with or without afterburning) for 5 minutes or more, either in flight or on the ground, operate the engines at idle to 70% RPM, whichever gives the lowest exhaust gas temperature, for at least 3 to 5 minutes before shutting down, except in an emergency. During flight operation, approach and taxi time may be considered as part of this period.

Note

This procedure will eliminate possible shroud segment warpage, overheated bearings, and the possibility of raw fuel accumulating in the afterburner and igniting from hot engines.

5. Throttles—CLOSED. (P)
   Move past IDLE stop to CLOSED by raising fingerlifts. Throttle friction lever—INCREASE.
6. Fuel tank switches and selector switches—OFF. (P)
7. All other switches—OFF except generator switches. (P—RO)

BEFORE LEAVING AIRPLANE.

Surface control locks (except for speed brake locks) are not necessary because of the irreversible hydraulic control system.

1. Wheels chocked and brakes released. (P)
2. All ground safety pins—Check installed. (P—RO)
3. Oxygen tube, radio cord and personal equipment—Check properly stowed. (P—RO)

WARNING

- If wearing an automatic opening aneroid-type parachute that has a key attached to the aneroid arming lanyard, make sure the key does not foul when leaving cockpit, to prevent parachute from being opened inadvertently.

- When leaving airplane, make certain that no personal equipment which could become entangled with the seat armrests when the canopy is closed or opened is left in the cockpit. Otherwise, the canopy may be accidentally jettisoned with attendant personnel injury.

4. Complete DD Form 781. (P)

CAUTION

To insure inspection and maintenance of the airplane, make appropriate entries in the Form 781 covering any airplane limitations that have been exceeded during the flight. Entries must also be made when the airplane has been exposed to unusual or excessive operations such as hard landings, excessive braking action during aborted takeoffs, long and fast landings, and long taxi runs at high speeds.

5. Check pitot covers on; landing gear ground locks installed. (P)

CAUTION

When leaving the airplane unattended, close and lock the canopy. This inflates the canopy seal, preventing moisture and dust from entering the cockpit.

ABBREVIATED CHECKLIST.

The following checklist is an abbreviated version of the procedures presented in the amplified checklists of Section II. This abbreviated checklist is arranged so you may remove it from your flight manual and insert it into a flip pad for convenient use. It is arranged so that each action is in sequence with the amplified procedure given in Section II. Presentation of the abbreviated checklist does not imply that you need not read and thoroughly understand the amplified version. To fly the airplane safely and efficiently you *must* know the reason why each step is performed and why the steps occur in certain sequence.

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

F-89B AND C ABBREVIATED CHECKLIST

Note

The following checklist is an abbreviated version of the airplane checklists. This checklist is accomplished by the radar observer calling off the items to the pilot. At the discretion of the pilot, the radar observer will assist in making the exterior inspection.

BEFORE EXTERIOR INSPECTION.

Check DD form 781 for the status of the airplane; make sure that the airplane has been properly serviced.

EXTERIOR INSPECTION.

Left Forward Side.

1. Pitot tube, static vents, and probe clear.
2. Hydraulic fluid level checked; cap secured.
3. Nose wheel tires for condition, inflation, and slippage.
4. Nose wheel door condition.
5. Nose wheel strut extension (approximately 3 inches); ground lock removed.
6. Static ground contact.
7. Fire extinguishing agent and bungee air pressures.
8. Landing-taxi light condition.
9. Battery access door—Remove.
10. Engine screen pressure gages—Check for pressure.
11. Brake accumulator gage—600—2500 PSI.
12. Emergency airbrake pressure gage—1500 ± 50 PSI.
13. Battery connected and secured.
14. Battery access door secured.
15. Gun compartment access door—Open.
16. Gun charger pressure gage—Check for pressure.
17. All access doors secured.
18. Radar nose—Check condition.

Right Forward Side.

19. All access doors secured.
20. Hydraulic fluid level checked; cap secured.

CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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21. Pitot tube and static vents clear.
22. Cabin pressure regulator outlet clear.
23. Engine intake duct clear; screens and compressor blades aligned and undamaged; check screws inside intake and accessory section for security; check ground for foreign objects.
24. Evidence of fuel, oil, and hydraulic leaks.
25. Engine doors secured.
26. Engine air intake doors free; external engine inlet screens installed.
27. Check oil quantity; oil filler cap and dip stick cotter pin secured.
28. Eleventh-stage compressor bleed port clear.
29. Engine door No. 3 airscoop clear; inside door No. 3 airscoop—Check for chafed fuel line. Engine door No. 4 airscoop clear.

Right Wing.

30. Wheel chocks in place; ground lock removed.
31. Tire condition, inflation, and slippage.
32. Brake disk for condition, pucks for proper clearance, and brake shuttle valve checked.
33. Jack lug pointing straight downward.
34. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). Check outboard door locking arm for tension.
35. Wheel well lines for condition and leaks.
36. Inboard main gear door closed and locked.
37. Bungee air pressure.
38. Sequence valve transfer piston for condition and position (out), so that landing gear and door will sequence properly.
39. Gear uplock unlocked, and roller free.
40. Wing leading edge condition.
41. Underside of wing for condition, fuel and hydraulic leaks, tiedown ring flush, and fuel tank vent outlets free of obstructions.
42. Wing access doors secured.
43. Anti-icing overboard duct clear.
44. Tip tank camera window clean and access doors secured.
45. Position light condition.
46. Tip tank fin for security of attachment.
47. Tip tank vent and fuel dump port clear.
48. Aileron and wing flap for condition and hydraulic leaks; aileron neutral, wing flap up. Speed brake external ground lock removed.

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

Right Aft Fuselage.

49. Tailpipe, fuel manifold, and flameholder condition.
50. Eyelids condition and position (open).
51. Afterburner blastplate condition.
52. Refrigerator air intake and exhaust clear.
53. Aft fuselage access doors secured.
54. Fuselage position light condition.

Empennage.

55. General condition.
56. Drain ports for hydraulic leaks.
57. Position lights condition.
58. Access doors secured.
59. Rudder for approximately neutral position.

Left Aft Fuselage.

60. Fuselage position light condition.
61. Afterburner blastplate condition.
62. Tailpipe, fuel manifold, and flameholder condition.
63. Eyelids condition and position (open).
64. Oxygen filler door secured.

Left Wing.

65. Aileron and wing flap for condition and hydraulic leaks; aileron neutral, wing flap up. Speed brake external ground lock removed.
66. Tip tank vent and fuel dump port clear.
67. Tip tank fin for security of attachment.
68. Position light condition.
69. Tip tank access doors secured.
70. Anti-icing overboard duct clear.
71. Wing access doors secured.
72. Underside of wing for condition, fuel hydraulic leaks, tiedown ring flush, and fuel tank vent outlets free of obstructions.
73. Wing leading edge condition.
74. Wheel chocks in place; ground lock removed.
75. Tire condition, inflation, and slippage.
76. Brake disk for condition, pucks for proper clearance, and brake shuttle valve checked.
77. Jack lug pointing straight downward.

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CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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78. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). Check outboard door locking arm for tension.
79. Wheel lines for condition and leaks.
80. Inboard main gear door closed and locked.
81. Bungee air pressure.
82. Sequence valve transfer piston for condition and position (out), so that landing gear and door will sequence properly.
83. Gear uplock unlocked, and roller free.

Left Side.

84. Eleventh-stage compressor bleed port clear.
85. Engine door No. 3 airscoop clear; inside door No. 3 airscoop—Check for chafed fuel line. Engine door No. 4 airscoop clear.
86. Check oil quantity; oil filler cap and dip stick cotter pin secured.
87. Engine air intake doors free; external engine inlet screens installed.
88. Engine doors secured.
89. Engine intake duct clear; screens and compressor blades aligned and undamaged; check screws inside intake and accessory section for security; check ground for foreign objects.
90. Evidence of fuel, oil, and hydraulic leaks.

Upper Wing and Fuselage.

91. General condition of surface.
92. Tip tanks for equal amounts of fuel, and pressure release valves flush, and caps secured.
93. All fuel filler caps secured.
94. Static source outlets on top of fuselage clear.
95. Fuselage position light condition.
96. Emergency flap reservoir filler cap secured (left wing).
97. Alcohol tank—Check quantity and cap secured (right wing).
98. Canopy and windshield condition.
99. Windshield wiper condition.
100. Radar access doors secured.
101. Canopy control door secured and emergency release handle stowed.

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CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

REAR COCKPIT CHECK (PERFORM WHEN AIRPLANE IS FLOWN SOLO).

1. Safety belt and shoulder harness—Check stowed. (P)
2. All circuit breakers—IN. (P)
3. Interior lights—OFF. (P)
4. Canopy defog knob—IN. (P)
5. Canopy jettison pressure—Check. (P)
6. Radar power—OFF. (P)
7. Hydraulic engine hoist and brake selector valve handles—Check. (P)
8. Hydraulic pump handle—Stowed. (P)
9. Loose equipment stowed securely—Check. (P)
10. Ejection seat ground safety pins—Installed. (P)

BEFORE ENTERING COCKPIT.

1. Canopy ejection pressure—Check. (P—RO)
2. Ejection seats—Check. (P—RO)
3. Circuit breakers—IN. (P—RO)
4. Gun selector switch—OFF; guard down. (P)
5. Flashlight—Check operation. (P—RO)

ON ENTERING COCKPIT.

Note

A pilot's checklist (figure 1-11) is located above the center pedestal.

INTERIOR CHECK.

Front Cockpit.

1. Safety belt and shoulder harness—Fasten; inertia reel operation—Check; automatic-opening parachute lanyard—Connected. (P—RO)
2. Rudder pedals—Adjust. (P)
3. Battery switch—OFF. (P)
4. Throttles—Closed. (P)
5. 28-volt external power—Connected. (P)
6. Power inverter switch—SPARE. (P)
7. Power inverter switch—MAIN. (P)
8. Instrument inverter switch—SPARE. (P)
9. Instrument inverter switch—MAIN. (P)

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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10. Left console circuit breakers—IN. (P)
11. Emergency airbrake handle—OFF. (P)
12. Yaw stabilizer—ON. (P)
13. Fuel control panel and fuel gages—Check. (P)
14. Emergency flap system—Check. (P)
15. Flaps—TAKEOFF. (P)
16. Supplemental pump—Check. (P)
17. Speed brakes—Closed. (P)
18. Flight controls—Check operation. (P)
19. Aileron and elevator trim switch—Check. (P)
20. Nose wheel steering button—Release. (P)
21. Supplemental pump pressure switch—Check. (P)
22. Position lights—As required. (P)
23. Gear horn reset button—Press. (P)
24. Cabin temperature switch—AUTO. (P)
25. Cabin temperature rheostat—As required. (P)
26. Gear—DOWN. (P)
27. Canopy seal button—Released. (P)
28. Taxi and landing light—As required. (P)
29. Windshield heat—Normal. (P)
30. Windshield wiper—OFF. (P)
31. Windshield wiper speed—INC. (P)
32. Anti-icing—OFF. (P)
33. Engine screen switch—NORMAL (AUTO on some airplanes). (P)
34. Pitot heat—Check. (P)
35. Canopy locking lever—UP (some airplanes). (P)
36. Cabin air switch—Pressure. (P)
37. Cabin differential pressure switch—5.00 PSI (C airplanes only). (P)
38. Attitude indicator (B, C, Groups 1—20)—Cage. (P)
39. Flight computer (zero reader)—Check. (P)
40. Directional indicator (slaved) slaving cutout switch—IN. (P—RO)
41. Altimeter and clock—Set. (P—RO)
42. Gunsight caging lever—Cage. (P)
43. Armament switches—OFF. (P)
44. Radar and gunsight power—OFF. (P)
45. Parking brakes—Set. (P)
46. Emergency rudder trim knob—Centered. (P)
47. Canopy defog knob—IN. (P—RO)

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

48. Emergency starting power switch—OFF. (ON for emergency start.) (P)
49. Fire and overheat warning circuits—Check. (P)
50. Canopy jettison "T" handle—IN. (P)
51. Lighting rheostats—As required. (P—RO)
52. Communications equipment—Check operation. (P—RO)
53. Oxygen equipment—Check operation. (P—RO)
54. IFF—OFF. (P)
55. Generators—ON. (P—RO)
56. Right console circuit breakers—IN. (P)
57. Right vertical panel circuit breakers—IN. (P)
58. Navigational publications aboard—As required. (P)

STARTING ENGINES.

Left Engine.

1. Fire guard posted. (P)
2. Throttles—CLOSED. (P)
3. Fuel selector—ALL TANKS. (P)
4. Auxiliary tank—ON; tip tank—ON. (P)
5. Crossfeed—OFF. (P)
6. Starter switch—START. (P)
7. Throttle—IDLE. (P)
8. Hydraulic pressure—Check while starting engine. (P)
9. Exhaust gas temperature and RPM—Stabilized at idle. (P)
10. Engine instruments—Check at idle RPM. (P)

Right Engine.

11. Right engine—Start the same as left engine. (P)
12. External power—Disconnected. (P)
13. Battery—ON. (P)
14. Fuel pump warning lights—OFF. (P)
15. Engine instruments—Check. (P)

BEFORE TAXIING.

Generator Voltage Check.

1. 28-volt generators—Check. (P)
2. 120-volt generators—Check. (RO)
3. IFF—STBY. (P)

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CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

Hydraulic System Check.

8

1. Speed brakes—Check operation. (P)
2. Flight controls—Check operation. (P)

TAXIING.

1. Ejection seat and canopy safety pins—Removed. (P—RO)
2. Canopy (some airplanes)—Closed. (P—RO)
3. Brake accumulator pressure—Check. (P)
4. Wheel chocks—Remove. (P)
5. Parking brakes—Release. (P)
6. Flight indicators—Check. (P)

BEFORE TAKEOFF.

PREFLIGHT AIRPLANE CHECK.

1. External air inlet screens—Removed. (P)
2. Canopy—Locked. (P)
3. Flight controls—Check. (P)
4. Elevator trim—TAKE-OFF (P)
5. Fuel selector—ALL TANKS. (P)
6. Crossfeed—OFF. (P)
7. Oxygen—NORMAL. (P—RO)
8. Safety belt—Tighten; shoulder harness—Adjust; inertia reel lock—UNLOCK; "L" shaped seat safety pin—Remove; static cord lanyard—Connect. (P—RO)
9. Flaps—TAKEOFF. (P)
10. Speed brake—CLOSED. (P)
11. Attitude indicator—Set and uncage. (P)
12. Brake accumulator, hydraulic system pressure, and hydraulic reservoir pressure gages—Check. (P)
13. Check radar observer prepared for takeoff. (P)
14. Engine screens—Extended. (P)

PREFLIGHT ENGINE CHECK.

1. Throttles—OPEN. (P)
2. Fuel transfer warning lights—Check. (P)
3. Left afterburner—ON. (P)
4. Right afterburner—ON. (P)
5. EGT and RPM—Check. (P)
6. Crossfeed—ON. (P)

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CUT ON DOTTED LINE

TAKEOFF DATA

Gross Weight	______ LB	Pressure Altitude	______ FT
Runway Length	______ FT	Headwind	______ KN
Temperature	______ °C	Surface: Dry, Wet, Icy	
Takeoff Distance, Normal	______ FT	50-FT Obstacle	______ FT
Takeoff Distance, 1 ENG	______ FT	50-FT Obstacle	______ FT
Critical Field Length	______ FT	Refusal Speed	______ KN

TAKEOFF (MAXIMUM POWER)

Acceleration Check . . . . 75 KN at	______ FT
Nose Wheel Liftoff Speed	______ KN
Takeoff Speed	______ KN
Initial Climb Speed (Clear 50 FT)	______ KN

LANDING IMMEDIATELY AFTER TAKEOFF DATA

Maximum Emergency Landing Weight. . . . . ______ LB
(Takeoff Weight Less Jettisonable Items)

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	______ KN	______ KN
Touchdown Speed	______ KN	______ KN
Ground Roll Distance	______ FT	______ FT
Total Distance (to Clear 50 FT)	______ FT	______ FT

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

AFTER TAKEOFF—CLIMB.

1. Obstacle clearance speed—Check. (P)
2. Gear—UP. (P)
3. Flaps—UP (150 knots). (P)
4. Crossfeed—OFF. (P)
5. Airspeed—As required. (P)
6. Static cord lanyard—Disconnect. (P—RO)
7. Fuel gages—Check. (P)
8. Oxygen—Check. (P—RO)
9. IFF—As required. (P)

DESCENT.

1. Throttles and speed brakes—As required. (P)
2. Windshield defrosting—As required. (P)
3. Canopy defogging—As required. (P—RO)
4. Altimeter—Set. (P—RO)

BEFORE LANDING.

1. Alert radar observer. (P)
2. Safety belt and shoulder harness—Tightened; static cord lanyard—Connect; inertia reel lock—UNLOCK. (P—RO)
3. Armament switches—OFF. (P)
4. Wing and tip tank anti-ice—OFF; engine anti-icing—As required. (P)
5. Windshield heat—As required. (P)
6. Landing light—As required. (P)
7. Brake accumulator and hydraulic pressure gages—Check. (P)
8. Crossfeed—ON. (P)
9. Engine screens—Extended. (P)
10. Enter pattern—275 knots; 85% RPM. (P)
11. Speed brake—OPEN. (P)
12. Airspeed 195 knots; speed brake—CLOSED. (P)
13. Gear—DOWN. (P)
14. Flaps—TAKEOFF. (P)
15. Trim—Adjust. (P)
16. Instruments—Check. (P)
17. Turn onto final at 170 knots IAS. (P)
18. Final approach: flaps—DOWN; airspeed—Check. (P)
19. Maintain 85% until landing is assured. (P)
20. Maintain desired approach. (P)
21. When landing is assured, retard throttle to IDLE. (P)

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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GO-AROUND.

1. Throttles—OPEN. (P)
2. Speed brake—CLOSED. (P)
3. Gear—UP. (P)
4. Flaps—As required. (P)
5. Clear traffic as soon as adequate airspeed is attained. (P)

TOUCH-AND-GO LANDINGS.

Perform Before Landing check.

ON THE RUNWAY.

1. Throttles—Maximum power. (P)
2. Speed brakes—Closed. (P)
3. Flaps—Takeoff. (P)
4. Keep nose wheel on runway until nose wheel liftoff speed is attained. (P)
5. Gradually ease stick back to lift nose wheel, allowing airplane to fly itself off the runway. (P)

AFTER TAKEOFF.

1. Maintain approximate takeoff attitude to clear 50-foot obstacle; trim aircraft. (P)
2. Gear—UP. (P)
3. Flaps—UP. (P)
4. Crossfeed—OFF. (P)
5. Fuel gages—Check. (P)
6. Throttles—As required. (P)

BEFORE LANDING (AFTER TOUCH-AND-GO).

Reenter traffic pattern and perform Before Landing check. (P)

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CONTINUED ON NEXT PAGE

CUT ON DOTTED LINE

LANDING DATA

Landing Gross Weight ______________ LB

Runway Length ______________ FT Headwind ______________ KN

Temperature ______________ °C Pressure Altitude ______________ FT

Surface: Dry, Wet, Icy

LANDING

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	______ KN	______ KN
Touchdown	______ KN	______ KN
Ground Roll Distance	______ FT	______ FT
Total Distance (to Clear 50 FT)	______ FT	______ FT

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

AFTER LANDING.

1. Turn off runway; stop. (P)
2. Seat armrest safety pins—Installed. (P—RO)
3. Cabin air—Ram and dump. (P)
4. External screens—Installed. (P)
5. Flaps—UP. (P)
6. Speed brake—CLOSED. (P)
7. Trim—TAKE-OFF. (P)
8. Anti-icing, windshield de-ice, and pitot heat—OFF. (P)
9. Crossfeed—OFF. (P)
10. IFF—OFF. (P)
11. Taxi light—As required. (P)

STOPPING ENGINES.

1. Parking brakes—Set. (P)
2. Canopy—Open. (P)
3. Flight controls—Neutral. (P)
4. Engines—Run up. (P)
5. Throttles—CLOSED; throttle friction lever—INCREASE. (P)
6. Fuel switches—OFF. (P)
7. All other switches OFF except generator switches. (P—RO)

BEFORE LEAVING AIRPLANE.

1. Wheels chocked and brakes released. (P)
2. All ground safety pins—Check installed. (P—RO)
3. Oxygen tube, radio cord, and personal equipment—Stowed. (P—RO)
4. Complete DD Form 781. (P)
5. Check pitot covers on; landing gear locks installed. (P)

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ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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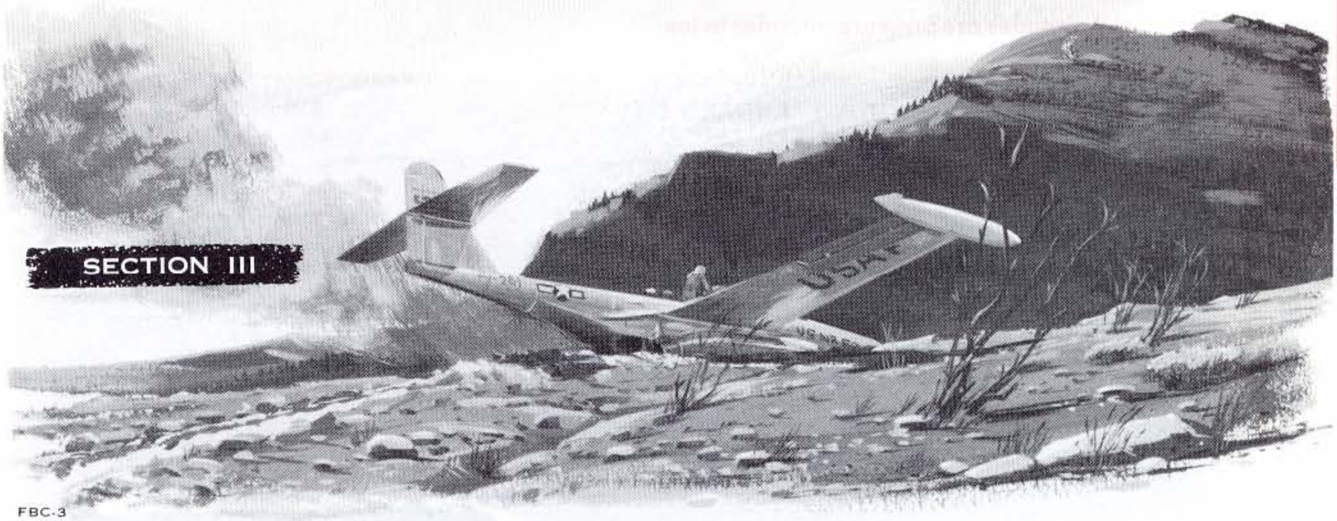

FBC-3

TABLE OF CONTENTS

ENGINE FAILURE.

SINGLE-ENGINE FLIGHT CHARACTERISTICS.

Single-engine directional flight control characteristics are essentially the same as normal flight characteristics because of the proximity of the thrust lines of the engines to the centerline of the airplane. With one engine inoperative, very little rudder deflection is required. Thus, good control of the airplane is assured in the single-engine operating range. Minimum single-engine control speed is airspeed at stall. This airspeed varies with gross weight, wing flap setting, speed brake setting, and acceleration (such as that encountered in banks and pull-ups). An airspeed of 150 knots IAS is a safe minimum for all weights, all configurations, and moderate accelerations. See figure 3-1 for single-engine service ceilings.

SINGLE-ENGINE PROCEDURE.

Immediately after experiencing engine failure in flight it is important to reduce drag to a minimum while maintaining IAS and directional control while investigating for the cause of the engine failure. If the cause of the malfunction cannot be determined, or if it is not safe to continue operation, the following procedure should be used for shutting down an engine in flight. This procedure can be used for simulating flameouts, engine failure resulting from mechanical failure, fuel system malfunction, icing conditions, and all other conditions of engine failure:

1. Throttle on inoperative engine—CLOSED. (P)
2. Landing gear and flaps—Retract, if extended. (P)
3. Engine fire selector switch on inoperative engine—Raise guard and actuate switch. (P)
4. Agent discharge switch—Actuate if necessary. (P)

CAUTION

Do not actuate agent discharge switch unless the engine is on fire. This is a "one-shot" system and until the extinguishing agent bottle has been replaced, there will be no further fire protection available.

5. Generator switch (inoperative engine)—OFF. (P)
6. Inverter switches—As required. (P)
7. Unnecessary electrical equipment—Off. (P—RO)
8. Crossfeed switch—ON. (P)

SINGLE-ENGINE SERVICE CEILING

NOTE: All altitudes are pressure altitudes in feet.

GROSS WEIGHT (POUNDS)	ALTITUDE STANDARD DAY (59°F AT SEA LEVEL)			ALTITUDE HOT DAY (100°F AT SEA LEVEL)		
	96% rpm without afterburning	100% rpm without afterburning	100% rpm with afterburning	96% rpm without afterburning	100% rpm without afterburning	100% rpm with afterburning
38,000	14,600	15,500	28,200	10,250	12,800	25,200
34,000	18,200	19,700	31,800	14,100	16,700	29,100
30,000	21,800	22,900	34,700	18,000	19,800	31,800
26,000	25,700	26,500	37,500	22,100	23,900	33,800

NO EXTERNAL LOAD

DATA AS OF: 1 AUG 1956 DATA BASIS: FLIGHT TEST

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Figure 3-1.

9. Fuel tank switches—ON, except on empty tanks. (P)
10. Fuel selector switches—ALL TANKS. (P)

CAUTION

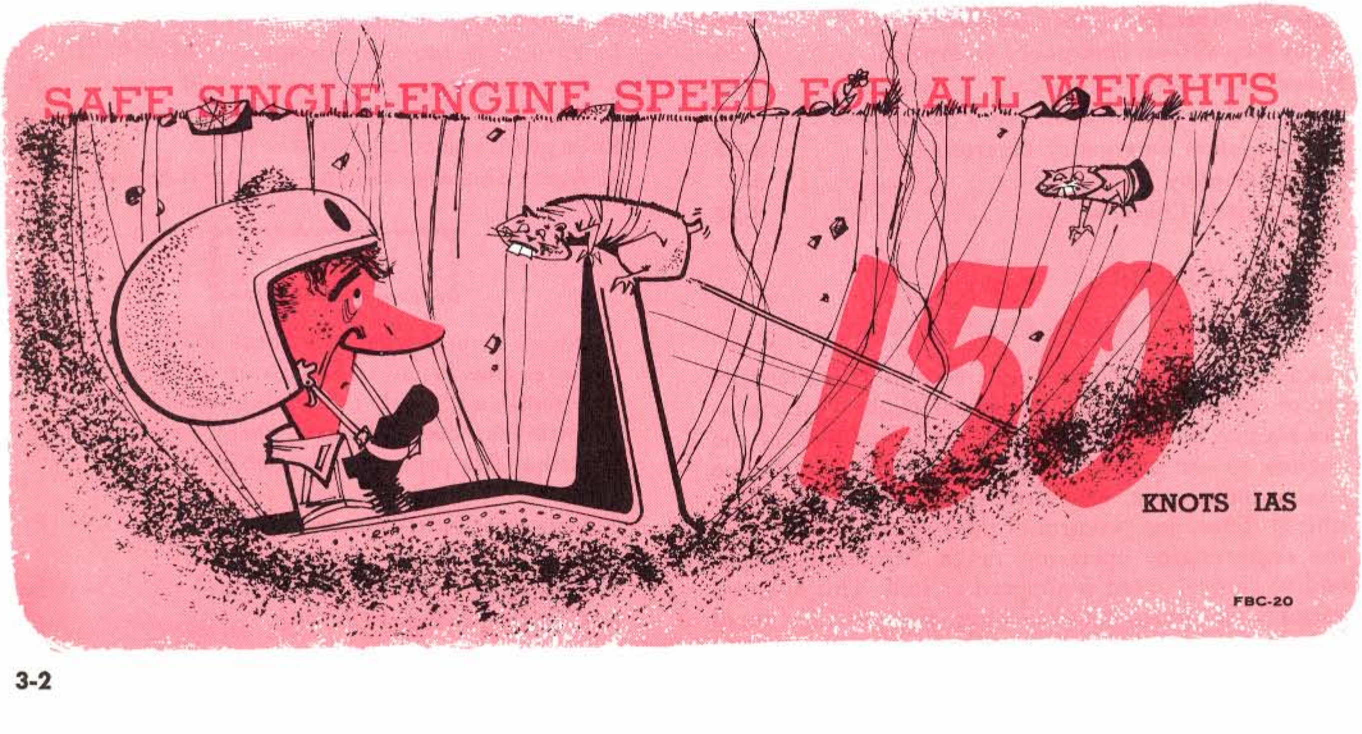
If right engine is inoperative, do not operate speed brakes unless left engine RPM is at least 85%. At lower RPM, the demand of speed brake operation on the hydraulic system causes limited aileron control.

11. Power on good engine—Readjust. (P)
12. Trim for straight and level flight. (P)

ENGINE FAILURE DURING TAKEOFF (BEFORE LEAVING GROUND).

Takeoff Aborted.

If an engine fails before leaving the ground, continuing a takeoff depends upon the length of runway, gross weight airspeed, field elevation, and ambient temperature. To help the pilot make a decision, single-engine takeoff distances for various gross weights, altitudes, and ambient temperatures are shown in the Appendix



(figure A-6). This chart gives entire takeoff distance with one engine operating, and is to be used only if an engine fails during the takeoff roll. If a decision to stop is made, use the following procedure:

1. Alert radar observer. (P)
2. Throttles—CLOSED. (P)
3. Nose wheel steering button—As required. (P)
4. Speed brake lever—OPEN. (P)
5. Wheel brakes—Apply. Maximum braking occurs at a point just before tires skid. (P)
6. Emergency airbrake system—As required. If hydraulic pressure is insufficient for adequate braking, use the emergency airbrake system. (P)
7. Canopy—Jettison with canopy jettison "T" handle. (P)
8. Inertia reel—Lock. (P—RO)

Note

All equipment should be set as required prior to locking inertia reel because some pilots may find it difficult to reach such items as the canopy jettison "T" handle after the inertia reel is locked.

9. Steer for smoothest terrain if remaining runway is insufficient for stopping. (P)
10. If necessary, raise landing gear by depressing the emergency override lever and simultaneously moving the landing gear lever to UP. (P)

WARNING

- On airplanes not modified in accordance with T.O. 1F-89-615, place feet on instrument panel to avoid injury as the nose gear strut may come through the floor of the pilot's compartment.
- If the left engine fails, depress the nose wheel steering button. This will energize the left hydraulic system supplemental pump which in turn will supply adequate hydraulic pressure to all units normally supplied by the left hydraulic system engine-driven pump.

11. Engine fire selector switches—Raise guards and actuate. (P)
12. Agent discharge switch—Actuate. (P)
13. Battery switch—OFF. (P)
14. Generator switches—OFF. (P)
15. When stopped—Abandon airplane. (P—RO)

Note

If decision is made to continue takeoff with one engine inoperative, use the procedure under Takeoff Continued, this section.

ENGINE FAILURE DURING TAKEOFF (AFTER LEAVING GROUND).

If an engine fails immediately after takeoff, lateral and directional control of the airplane can be maintained if airspeed remains above stalling speed, but ability to maintain altitude or to climb depends upon gross weight and air density. Figure 3-3 shows the maximum gross weights at which a climb rate of 100 feet per minute can be maintained with landing gear down and flaps in takeoff position. Use the following applicable procedure for engine failure immediately after takeoff.

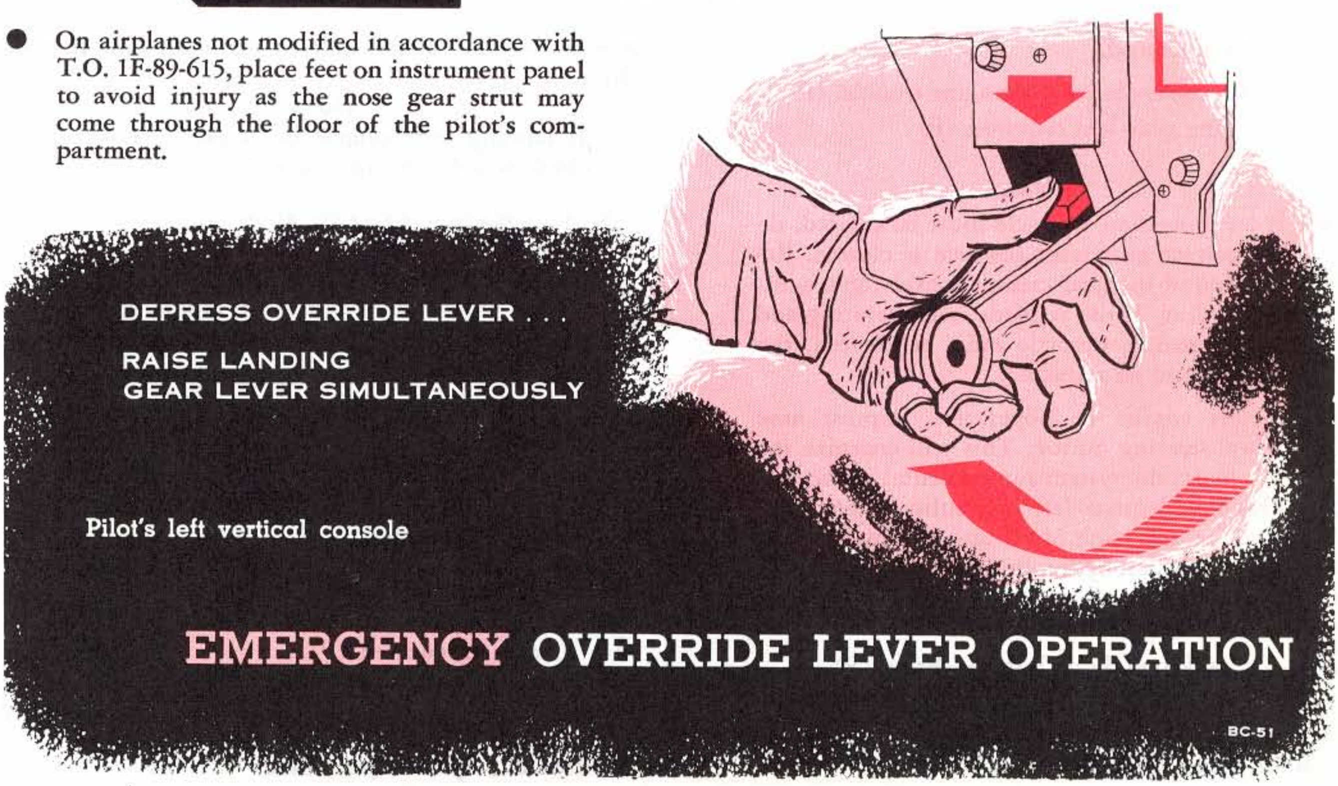


Figure 3-2.

MAXIMUM WEIGHTS FOR CONTINUED FLIGHT AFTER ENGINE FAILURE ON TAKEOFF

Weights at which 100 feet per minute rate of climb can be maintained with gear down and flaps in TAKEOFF position.

AMBIENT TEMPERATURE —°C

FIELD ELEVATION (FEET)	−10°C	+10°C	+30°C	+50°C
5000	38,000	36,900	31,900	25,700
4000	38,000	38,000	33,100	26,700
3000	38,000	38,000	34,250	27,700
2000	38,000	38,000	35,550	28,750
1000	38,000	38,000	36,950	29,850
SEA LEVEL	38,000	38,000	38,000	31,000

NO EXTERNAL LOAD

DATA AS OF: 1 AUG 1956 DATA BASIS: FLIGHT TEST

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Figure 3-3.

Takeoff Continued.

1. Warn radar observer of engine trouble. (P)
2. Landing gear—As required. (P)

Note

- If an immediate obstacle must be cleared, do not retract gear until obstacle is cleared. Retraction of the gear creates considerable additional drag. If the airplane is accelerating and no immediate obstacle must be cleared, the gear should be retracted.
- If left engine is inoperative, depress nose wheel steering button. This will energize the left hydraulic system supplemental pump and provide adequate left hydraulic system pressure for operation of all units normally powered by the left hydraulic system engine-driven pump.

3. Tip tank fuel dump button—Press. (P)
4. Throttle (inoperative engine)—CLOSED. (P)
5. Engine fire selector switch for inoperative engine—Raise guard and actuate. (P)
6. Agent discharge switch—As required. (P)
7. If obstacle must be cleared, hold airspeed at minimum safe value above stall to maintain best rate of climb. (P)

Note

If landing gear cannot be retracted, rate of climb will be greatly reduced.

8. After obstacle is cleared, allow airspeed to increase to 150 knots. (P)
9. Wing flap lever—UP at 150 knots IAS; emergency flaps switch—ON only if left engine and supplemental pump fail. (P)

WARNING

Do not raise wing flaps below 150 knots IAS as airplane may stall.

10. Electrical equipment (nonessential)—OFF. (P—RO)
11. Trim—As required. (P)
12. Crossfeed switch—ON. (P)
13. Generator switch on inoperative engine—OFF. (P)

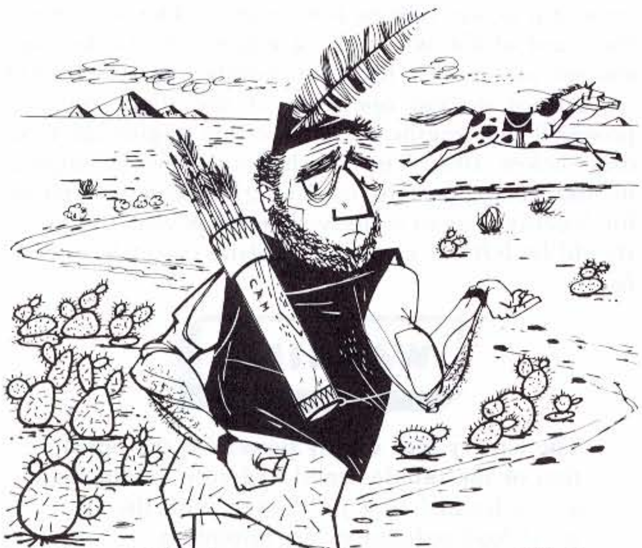
Continued Flight Impossible.

1. Warn radar observer of impending forced landing. (P)

2. Lower nose to maintain flying speed. Prepare to land straight ahead. Alter course only to miss obstacles. (P)

3. Landing gear lever—UP (DOWN, if the airplane has been modified in accordance with T.O. 1F-89-615 and T.O. 1F-89-520). (P)

WARNING



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If the airplane has not been modified in accordance with T.O. 1F-89-615 and T.O. 1F-89-520, all forced landings should be made gear-up, unless the forced landing is made on a runway. If the airplane has been modified, all forced landings should be made with the landing gear down regardless of terrain.

4. Wing flaps—As required; emergency wing flap switch—ON only if left engine and supplemental pump fail. (P)

5. Speed brakes—As required. (P)

6. Throttles—CLOSED. (P)

WARNING

Do not dump tip tank fuel as this will increase fire hazard.

7. Canopy—Jettison with the canopy jettison "T" handle. (P)

Note

On airplanes not equipped with a canopy jettison "T" handle, have the radar observer jettison the canopy by raising the right armrest of his ejection seat.

8. Inertia reel lock lever—Lock (by moving to forward position). (P—RO)

9. Engine fire selector switches—Raise guards and actuate. (P)

10. Agent discharge switch—As required. (P)

11. Generator switches—OFF. (P)

12. Battery switch—OFF just before touchdown. (P)

Note

When the battery switch is placed at OFF, the left hydraulic system supplemental pump will be deenergized.

13. When stopped—Abandon airplane. (P—RO)

ENGINE FAILURE DURING FLIGHT (LEFT OR RIGHT ENGINE).

If an engine fails during flight, investigate to determine the cause before attempting an air restart. It is recommended that the fuel system be checked first for proper operation. If failure is from improper fuel system operation and condition is corrected, restart engine using the procedure given in Restarting Engine in Flight, this section. If failure is caused by mechanical breakdown or malfunction, as may be indicated by engine indicators or excessive vibration, engine should be shut down. See figure 3-1 for single-engine service ceilings, and applicable Appendix Charts for single-engine operating data. For procedures on shutting down or restarting engine in flight, see Single-Engine Procedure and Restarting Engine In Flight, this section.

Note

If both engines fail, turn battery switch to OFF to conserve electrical power needed to operate the left hydraulic system supplemental pump. If failure of both engines can be anticipated, all radio communications should be made before failure occurs.

RESTARTING ENGINE IN FLIGHT.

For best starting conditions and wherever practical, attempt air starts at 20,000 feet or below.

Note

Before a restart is attempted and the igniter plugs are energized, fly the airplane in a nose high attitude (5 to 10 degrees above the horizontal) to drain excess fuel from engine.

A normal restart can be made if the engine RPM is at least 12.5% and the airspeed is approximately 150 to 250 knots IAS. If both engines have failed, no attempt should be made to restart both engines at the same time. Electrical power may be insufficient for simultaneous ignition of both engines; therefore it is recommended that only one engine be started at a time. Successful air starts after double flameout are dependent upon sufficient altitude and battery power. When above 20,000 feet, conserve battery power while descending to 20,000 feet or below, by turning fuel selector switches to OFF position, power inverter selector switch to OFF position, and all other unnecessary electrical equipment off. Normally the left engine will be started first, unless there are known reasons for a hazardous or unlikely left engine start. Place the fuel selector switch, for the engine to be restarted, in a position other than the position existing at the time of the flameout, provided there is sufficient fuel in the new selection. This will cause relays and valves to recycle and may clear up the difficulty. Place the crossfeed switch at CLOSED and turn the power inverter to SPARE.

Note

If both engines fail the main power inverter, which is powered by the 120-volt DC engine-driven generators, will be lost. To provide ignition, the power inverter selector switch should be placed at SPARE. The spare power inverter is powered by 28-volt DC.

Restart the selected engine and when RPM and exhaust gas temperature are stabilized, restart the other engine. If the second engine fails to start, place the crossfeed switch to OPEN and attempt another start. If a double flameout is experienced at low altitude, the fuel selection for the engine to be restarted first should be changed, provided there is sufficient fuel remaining in the new selection and time permits. The following procedure should be used for all air starts:

CAUTION

Failure to windmill at least 12.5% RPM indicates damage to an engine. Under this condition, do not attempt an air start.

1. Throttle—CLOSED. (P)
2. Fuel selector switch—Change tank selection provided there is fuel remaining in new selection. (P)
3. Power inverter—ON. (P)
4. Altitude start switch—ALTITUDE START momentarily (for selected engine only). (P)
5. Throttle—IDLE (RPM and exhaust gas temperature stabilized) then advance to desired RPM. (P)
6. If starting is unsuccessful, attempt another start at a lower altitude. In case of double flameout, reduce electrical load and attempt another start at lower altitude. (P)

Note

If both engines fail and no restart is to be attempted, turn battery switch to OFF to conserve electrical power needed to operate the left hydraulic system supplemental pump for emergency landing. If failure of both engines can be anticipated, all radio communications should be made before failure occurs.

WARNING

If both engines fail, battery switch must be turned to ON again to operate supplemental hydraulic pump.

MAXIMUM GLIDE.

See figure 3-4 for glide configuration and airspeeds to be used if power fails on both engines. During descent, the speed of the windmilling engines should be high enough (above 13% RPM) to supply hydraulic power for normal descent operation of the flight controls, provided that engine RPM on either engine does not drop below 10%. The left hydraulic system supplemental pump must be used to give adequate control for landing; but to conserve battery power, the pump should be left off until the airplane descends to 5000 feet.

WARNING

The battery will supply power for the operation of the supplemental hydraulic pump for a very limited time only, even with the electrical load reduced to the minimum.

LANDING WITH ONE ENGINE INOPERATIVE.

If a landing with one engine is necessary, dump any remaining tip tank fuel. Approach the airport at 270 knots IAS using no more than the following engine RPM:

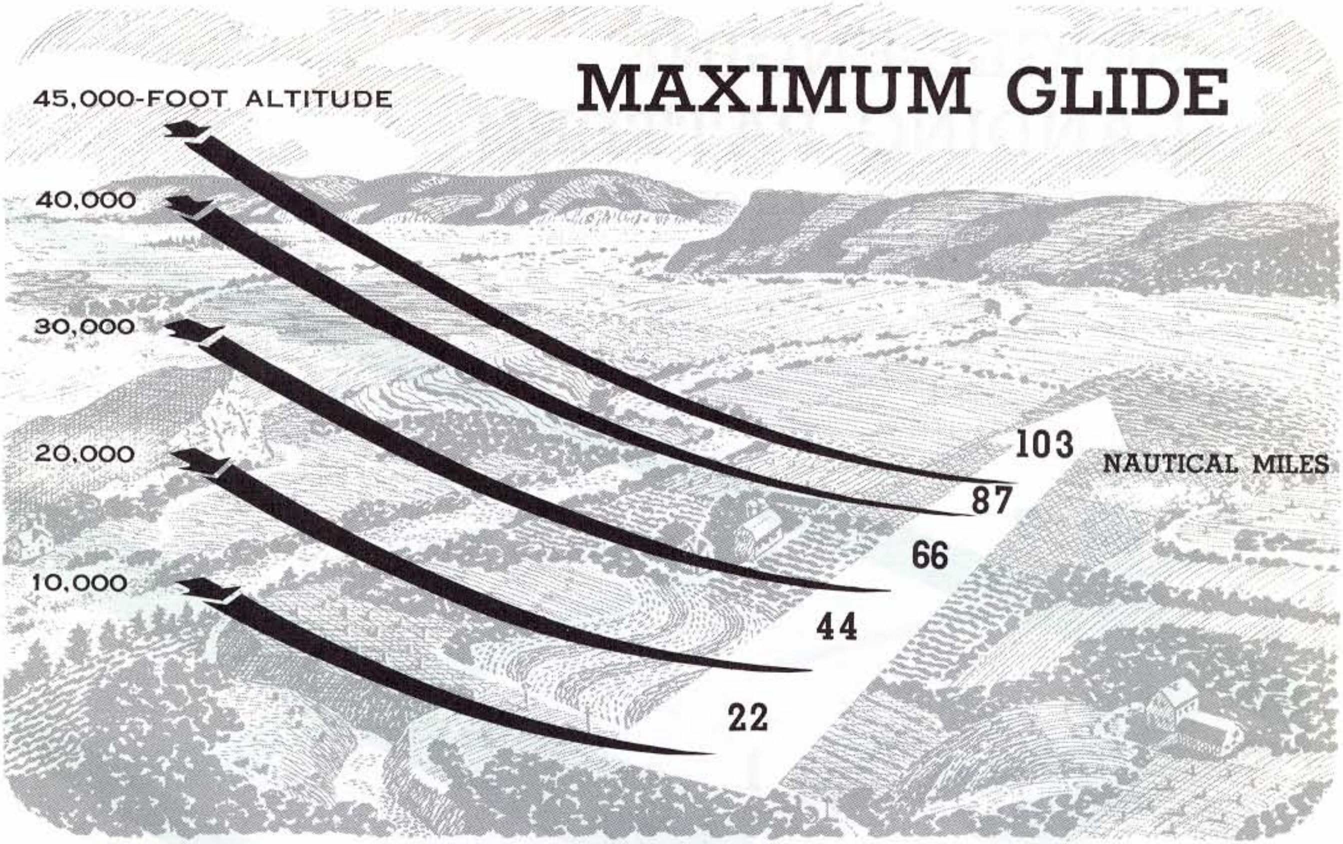
Ambient Temperature	*Engine RPM*
50°C	93%
30°C	92%
10°C	91%

WARNING

If more than above power is required to sustain level flight at 250 knots IAS, gross weight must be reduced before landing; otherwise, reserve power may not be adequate to maintain desired approach path after landing gear and flaps are lowered.

Note

At airspeeds below 160 knots IAS, it may be necessary to lose altitude in order to increase airspeed. Bear this in mind if single-engine landing becomes necessary and there is the slightest chance that a go-around may be necessary.



- Both engines windmilling
- Wing flaps up
- Landing gear up
- Speed brakes closed

- HOLD THE FOLLOWING IAS:

GROSS WEIGHT—LB	IAS KNOTS
38,000	188
34,000	179
30,000	170
26,000	161

(NO WIND) BC-53A

Figure 3-4.

WARNING

Do not extend flaps below the takeoff position. If flaps are extended lower than takeoff position, they must be raised to at least the takeoff position in case of a go-around. Single-engine go-around with flaps in full down position is impossible because level flight cannot be maintained.

The downwind leg of the pattern should be extended for a single-engine landing so that a lower than normal approach angle will be flown, thus allowing the use of higher engine RPM in case a go-around is necessairy. Wing flaps are available with either or both engines inoperative. In the event of electrical failure, the radar observer can normally maintain enough brake accumulator pressure by pumping the hydraulic handpump so that the emergency airbrake system need not be used. However, if it becomes necessary to use the airbrakes during the landing roll, the pilot should apply the brakes carefully since they are very sensitive and effective. Do not pump the brakes because air is lost each time pedal pressure is released.

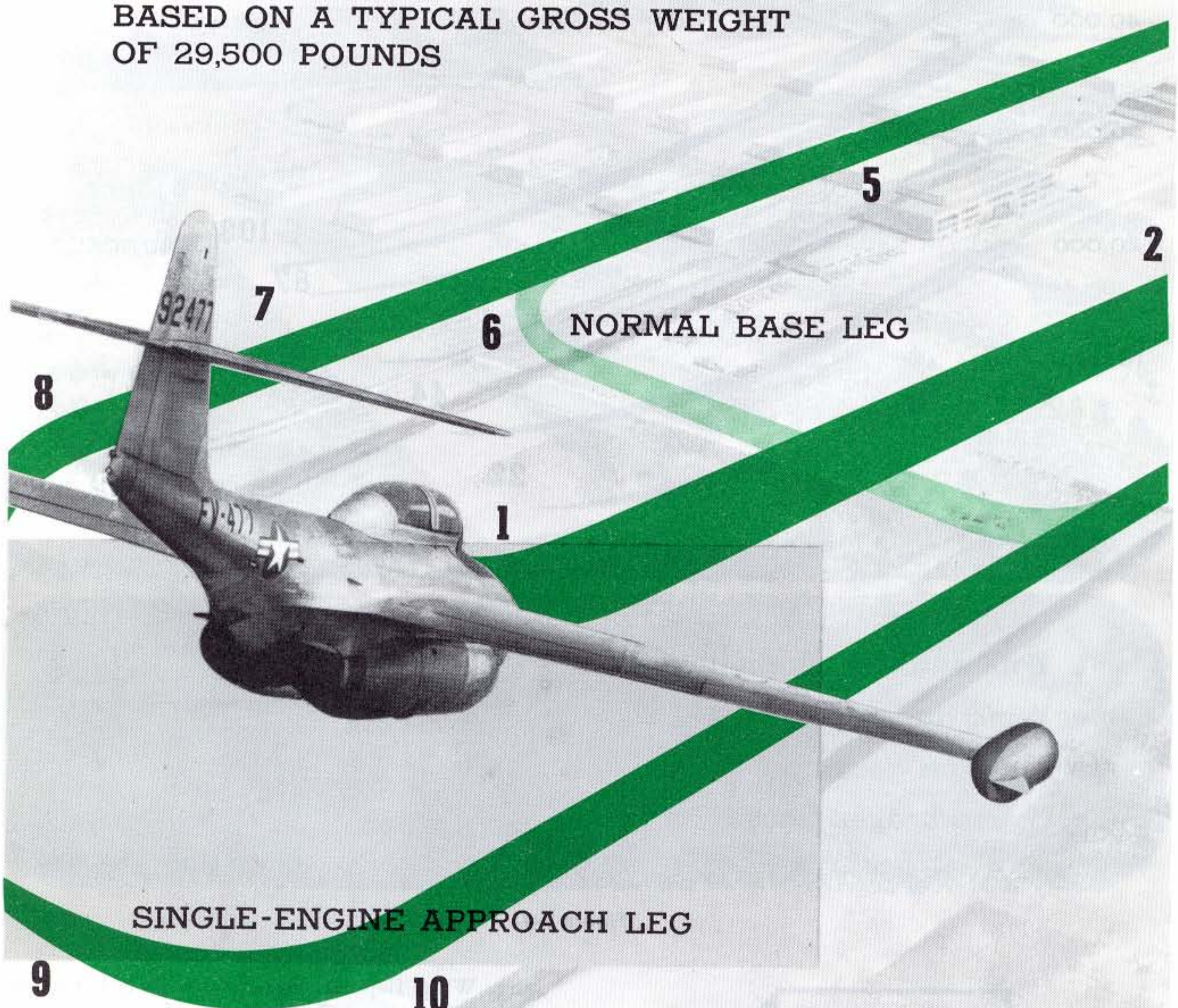
Right Engine Inoperative.

See Single-Engine Landing Pattern, figure 3-5.

1. Decelerate to 195 knots IAS on downwind leg. (P)

SINGLE-ENGINE LANDING PATTERN

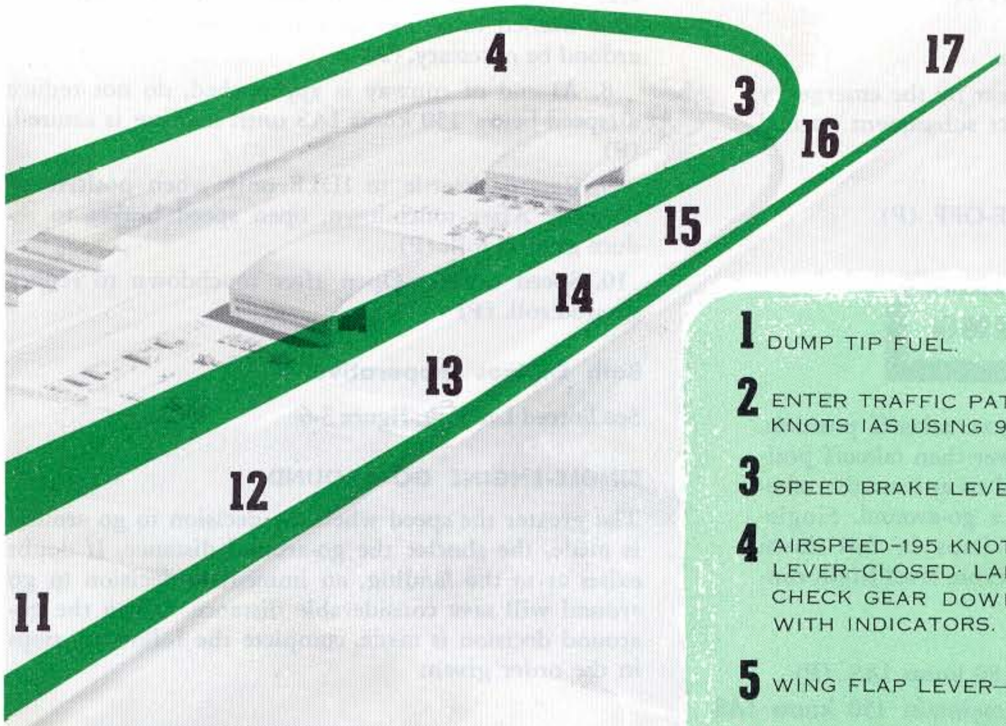
BASED ON A TYPICAL GROSS WEIGHT OF 29,500 POUNDS



NOTE: Typical landing weight is based on typical area intercept mission. Weight includes fuel for 20-minute loiter at sea level plus 5 percent total fuel and full armament.

BC-116(1)A

Figure 3-5.



WARNING: At higher gross weights, approach and touchdown speeds must be increased. See landing speeds chart in the appendix, for other weights and speeds.

1 DUMP TIP FUEL.

2 ENTER TRAFFIC PATTERN AT 270 KNOTS IAS USING 91-93% RPM.

3 SPEED BRAKE LEVER–OPEN

4 AIRSPEED–195 KNOTS: SPEED BRAKE LEVER–CLOSED· LANDING GEAR LEVER–DOWN. CHECK GEAR DOWN VISUALLY AND WITH INDICATORS.

5 WING FLAP LEVER–TAKEOFF

6 STABILIZE AIRSPEED AT 180 KNOTS: TRIM–ADJUST AS AIRSPEED IS REDUCED.

7 CHECK INSTRUMENTS FOR DESIRED RANGES.

8 EXTEND DOWNWIND LEG TO ALLOW LOWER THAN NORMAL FINAL APPROACH ANGLE. THIS WILL PERMIT A HIGHER RPM TO BE USED.

9 TURN ONTO FINAL AT 180 KNOTS IAS AND STABILIZE AT 150 KNOTS IAS (takeoff flaps).

10 MAINTAIN HIGH ENGINE RPM THROUGHOUT FINAL APPROACH.

11 DO NOT REDUCE AIRSPEED BELOW 150 KNOTS UNTIL LANDING IS ASSURED.

12 RETARD THROTTLE TO IDLE ONLY WHEN POSITIVE OF LANDING.

13 WITH TAIL SLIGHTLY DOWN, TOUCH MAIN WHEELS DOWN AT 116 KNOTS IAS (takeoff flaps).

14 SPEED BRAKE LEVER–OPEN

15 SET NOSE WHEEL DOWN BEFORE REACHING 112 KNOTS IAS (takeoff flaps).

16 APPLY WHEEL BRAKES INTERMITTENTLY TO AVOID LOCKING WHEELS.

17 EMERGENCY BRAKING AIR–ON (if necessary).

BC-116(2)A

2. Landing gear lever—DOWN. (P)

Note

Lowering the landing gear by the emergency procedure will not affect subsequent normal operation.

3. Wing flap lever—TAKE-OFF. (P)

WARNING

Do not extend flaps below takeoff position. If flaps are extended lower than takeoff position, they must be raised to at least the takeoff position in case of a go-around. Single-engine go-around with flaps in full down position is impossible because level flight cannot be maintained.

4. Airspeed—Stabilize at 180 knots IAS. (P)

5. Turn on to final and maintain 150 knots IAS. Fly a lower than normal approach angle so that high RPM can be used. Use of high RPM will reduce the time needed to obtain maximum power should a go-around be necessary. (P)

6. As end of runway is approached, do not reduce airspeed below 150 knots IAS until landing is assured. (P)

7. Retard throttle to IDLE only when positive of landing. After touchdown, open speed brakes to reduce ground roll. (P)

8. Speedbrakes—Open after touchdown to reduce ground roll. (P)

Left Engine Inoperative.

See Single-Engine Landing Pattern, figure 3-5.

1. Decelerate to 195 knots IAS on downwind leg. (P)

2. Landing gear lever—DOWN. (P)

3. Check landing gear position indicators and visually check main gear down. (P)

4. Emergency flap switch—ON, only if left engine and supplemental pump have failed. (P)

5. Wing flap lever—TAKE-OFF. (P)

Note

Flaps will lower at approximately one-third the normal rate on emergency pressure.

6. Airspeed—Stabilize at 180 knots IAS. (P)

7. Turn on to final and maintain 150 knots IAS. Use a lower than normal approach angle so that high RPM can be used. Use of high RPM will reduce the time needed to obtain maximum power should a go-around be necessary. (P)

8. As end of runway is approached, do not reduce airspeed below 150 knots IAS until landing is assured. (P)

9. Retard throttle to IDLE only when positive of landing. After touchdown, open speed brakes to reduce ground roll. (P)

10. Speed brakes—Open after touchdown to reduce ground roll. (P)

Both Engines Inoperative.

See Forced Landing, figure 3-6.

SINGLE-ENGINE GO-AROUND.

The greater the speed when the decision to go around is made, the shorter the go-around distance. If doubt exists as to the landing, an immediate decision to go around will save considerable distance. When the go-around decision is made, complete the following steps in the order given:

1. Throttle on operating engine—OPEN. (P)
2. Afterburner—On (above 90% RPM). (P)
3. Speed brake lever—Check Closed. (P)
4. Wing flaps—20 degrees. (P)

WARNING

Single-engine go-around with flaps in full down position must never be attempted because level flight cannot be maintained.

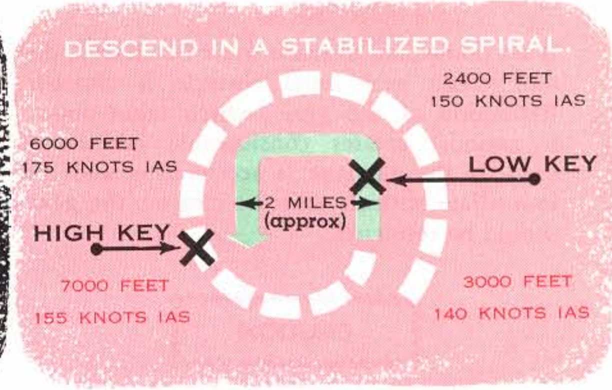
Note

During level flight accelerations at go-around airspeeds, greater acceleration will result with 20 degrees of flaps than with takeoff position of 30 degrees. Any value of flap setting greater than the takeoff setting should be reduced to at least the takeoff position immediately after decision to go around has been made. Flap retraction with emergency system requires considerably more time than with the normal system. Retraction from full down to takeoff position requires from 20 to 25 seconds; retraction from takeoff to full up position takes over a full minute. Flap position of full down should not be used because of this long retraction time.

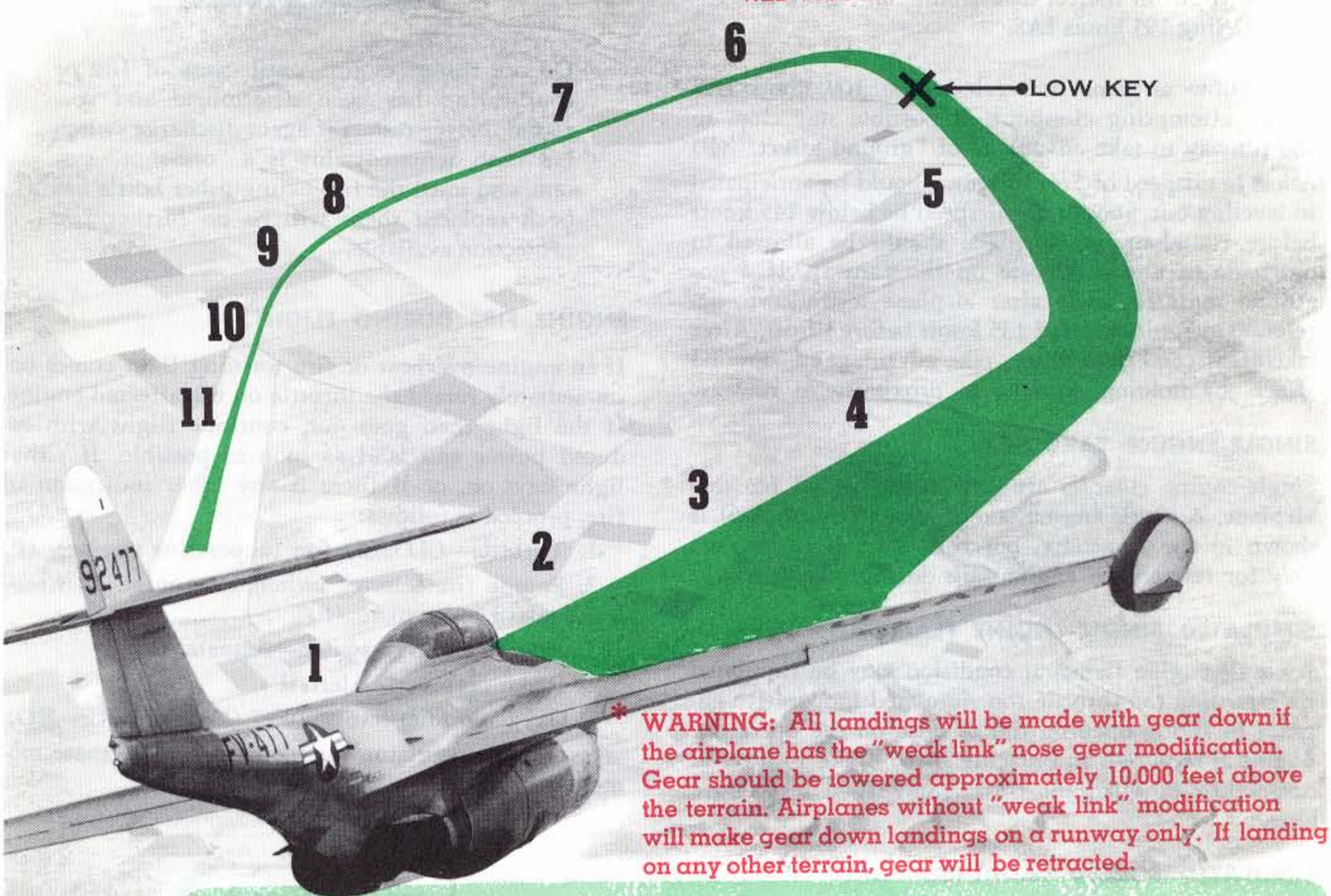
5. Landing gear lever—UP. (P)

FORCED LANDING

WARNING: If terrain is unknown or unsuitable for a forced landing, eject in preference to attempting a forced landing.



BLACK FIGURES DENOTE GEAR UP
RED FIGURES DENOTE GEAR DOWN



* WARNING: All landings will be made with gear down if the airplane has the "weak link" nose gear modification. Gear should be lowered approximately 10,000 feet above the terrain. Airplanes without "weak link" modification will make gear down landings on a runway only. If landing on any other terrain, gear will be retracted.

1. WARN RADAR OBSERVER.
2. TIP TANK FUEL—DUMP
3. THROTTLES—CLOSED (if landing is caused by complete power failure); OTHERWISE USE AVAILABLE POWER.
4. LANDING GEAR LEVER—UP.*
5. WING FLAP LEVER—TAKEOFF (before entering downwind).
6. UNBUCKLE PARACHUTE AND TIGHTEN SAFETY BELT.
7. ENGINE FIRE SELECTOR SWITCHES—ACTUATE.
8. NOSE WHEEL STEERING BUTTON—DEPRESS (if landing is to be made with gear retracted).
9. CANOPY JETTISON T-HANDLE—PULL.
10. BATTERY AND GENERATOR SWITCHES—OFF.
11. INERTIA REEL LOCK LEVER—LOCKED.

BC54B

Figure 3-6.

Note

If an immediate obstacle must be cleared, do not retract gear until obstacle is cleared. Retraction of the gear (which takes about 6 seconds) creates considerable additional drag. If the airplane is accelerating and no immediate obstacle must be cleared, the gear should be retracted.

CAUTION

Landing gear should be up and locked and the light in the control handle out before exceeding 195 knots IAS.

6. Allow airplane to accelerate to 160 knots IAS before attempting climbout. If possible stay close to the runway to take advantage of "ground effect." (P) A loss in airspeed of 5 to 10 knots should be anticipated in leveling out. Should the airspeed be below 145 knots before roundout, the airplane should be allowed to touch down and accelerate on the runway. If a go-around must be made after airplane touchdown, accelerate to a minimum of 135 knots before liftoff. After takeoff, if conditions allow, take advantage of "ground effect" by holding airplane in proximity to runway.

SINGLE-ENGINE TAKEOFF.

Single-engine takeoffs are not recommended for this airplane. A single-engine takeoff chart (figure A-6) is shown in the Appendix, but this chart is to be used only for reference if engine fails during takeoff.

SIMULATED SINGLE-ENGINE FLAMEOUT.

A single-engine flameout condition may be simulated by retarding the throttle (on simulated inoperative engine) to IDLE, opening the throttle on the operating engine as required, and placing speed brake 15 lever at one-eighth of quadrant travel. Stay 1000 feet above terrain.

SIMULATED FORCED LANDING.

A two-engine flameout condition may be simulated for practicing forced landings by retarding the throttles to IDLE RPM and opening the speed brake lever at one third of quadrant travel. Stay 1000 feet above terrain. (See figure 3-6.)

FIRE.

ENGINE FIRE DURING START.

If an engine overheat warning light comes on, close both throttles and keep affected engine starter engaged. If the light does not go out, if an engine fire warning light comes on, or if there is any other indication of fire, proceed as follows:

1. Engine fire selector switch for engine on fire—Raise guard and actuate switch. (P)
2. Agent discharge switch—Actuate. (P)
3. Starter switch—STOP momentarily. (P)
4. Battery switch—OFF. (P)
5. Generator switch—OFF. (P)
6. Warn radar observer to leave airplane. (P)
7. Abandon airplane as quickly as possible. (P—RO)

WARNING

Do not restart engine until cause of fire or overheating has been determined and corrected. Never restart if agent discharge switch has been actuated; this is a "one-shot" system, and until the fire extinguisher bottle has been replaced there will be no further fire protection available.

ENGINE FIRE DURING FLIGHT.

If an engine overheat or fire warning light comes on, immediately retard the throttle on the affected engine. If the light then goes out, continue flight with reduced power and land as soon as possible. If either light stays on, or if there is any other indication of fire, proceed as follows:

1. Throttle—CLOSED (on inoperative engine). (P)
2. Engine fire selector switch for engine on fire—Raise guard and actuate. (P)
3. Agent discharge switch—Actuate. (P)
4. Radar observer—Alert. (P)
5. Oxygen diluter lever—100% OXYGEN. (P—RO)
6. Oxygen regulator emergency lever—Actuate momentarily to clear oxygen mask. (P—RO)

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

7. Generator switch—OFF (for inoperative engine). (P)

8. Do not attempt to restart engine. (P)

9. Land as soon as possible. (P)

WARNING

The "one-shot" fire extinguishing system delivers its entire charge when actuated and fire extinguisher bottle must be replaced before the system can be used again.

FUSELAGE, WING, OR ELECTRICAL FIRE.

If fuselage, wing, or electrical fire occurs, perform the following immediately:

1. Radar equipment—Off. (P—RO)
2. All electrical equipment—Off. (P—RO)
3. Eject—If necessary. (P—RO)

SMOKE AND FUMES ELIMINATION.

If smoke or fumes are entering the cockpit, proceed as follows:

1. Cabin air switch—RAM & DUMP. (P)
2. Oxygen diluter lever—100% OXYGEN. (P—RO)
3. Oxygen regulator emergency lever—Actuate momentarily, to clear oxygen mask. (P—RO)

EJECTION.

Escape from the airplane should be made with the ejection seat. Follow the procedure shown in figure 3-7. Ejection at airspeeds ranging from stall speed to 525 knots IAS results in relatively minor forces being exerted on the body. Ejection at airspeeds of 525 to 600 knots IAS exerts greater forces on the body, making escape more hazardous, and ejection in excess of 600 knots IAS is extremely hazardous because of the excessive forces exerted on the body. Ejection at low altitudes is facilitated by pulling the nose of the airplane up above the horizon in a "zoom up" maneuver. Ejection seat velocity is small compared to the velocity of the airplane so that ejection accomplished when the airplane is flying horizontally results in the ejection seat following a nearly horizontal path. A "zoom up" maneuver will result in the ejection seat trajectory coming closer to the vertical, thus effecting an increase in altitude. This altitude gain will increase the time available for separation from the seat and deployment of the parachute. When emergencies necessitate ejections, slow the airplane down as much as possible. Minimum safe ejection altitudes are 2000 feet with a manual belt and parachute, 1000 feet with an automatic belt and manual parachute, 1000 feet with a manual belt opened before ejection and any type of parachute, and 500 feet with an automatic belt and automatic parachute (if the key attached to the parachute timer lanyard is inserted in the belt automatic release).

WARNING

Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out, as the chances of successful ejection under this condition at low altitude are greatly reduced.

BEFORE EJECTION.

1. Reduce airspeed as much as possible and, if below 2000 feet, pull the nose up above the horizon to reduce airspeed ("zoom up" maneuver). (P)
2. Pull handle on bailout bottle if altitude necessitates. (P—RO)
3. Cabin air switch—RAM & DUMP. (P)
4. Loose equipment—Stow. (P—RO)
5. Automatic-opening parachute—Check. (P—RO) Make sure the key is attached to the automatic-opening safety belt and the lanyard is free.
6. Canopy—Jettison. (P—RO)

WARNING

Keep hands and arms clear of canopy control levers during canopy jettison. As the canopy is jettisoned, the radar observer's control lever will rotate rapidly to the open position, and the pilot's control lever will snap to the up (open) position.

EJECTION PROCEDURE.

1. Left handgrip—Grasp and pull upward. (P—RO)
2. Right handgrip—Grasp and pull upward. (P—RO)
3. Firing trigger (on right handgrip)—Squeeze. (P—RO)
4. After ejection (with safety belt released)—Kick free of seat. (P—RO)

FAILURE OF SEAT TO EJECT.

If the ejection seat fails to operate, the following procedure may be used for leaving the airplane:

1. Reduce speed. (P)
2. Oxygen hose, radio equipment, and "G" suit lines—Disconnect. (P—RO)

WARNING

MINIMUM SAFE LEVEL FLIGHT ALTITUDE FOR EJECTION IS 2000 FEET FOR MANUALLY OPERATED SAFETY BELT AND PARACHUTE; 1000 FEET FOR AUTOMATIC SAFETY BELT AND MANUAL PARACHUTE; 1000 FEET WITH A MANUAL BELT OPENED BEFORE EJECTION AND ANY TYPE OF PARACHUTE; AND 500 FEET WITH AN AUTOMATIC BELT AND AUTOMATIC PARACHUTE (PROVIDED KEY ATTACHED TO THE PARACHUTE TIMER LANYARD IS INSERTED IN THE BELT AUTOMATIC RELEASE)

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Figure 3-7.

EJECTION PROCEDURE
PILOT AND RADAR OBSERVER

3 **SQUEEZE FIRING TRIGGER — RIGHT HANDGRIP.**

AFTER SEAT CATAPULT FIRES— SEAT BELTS AND SHOULDER HARNESS ARE UNCOUPLED AUTOMATICALLY BY A DELAY INITIATOR.

4 **AFTER EJECTION (WITH SAFETY BELT RELEASED) KICK FREE OF SEAT.**

WARNING

IF TIME AND CONDITIONS PERMIT, THE RADAR OBSERVER RATHER THAN THE PILOT SHALL JETTISON THE CANOPY. THIS WILL ASSURE THAT THE RADAR OBSERVER IS IN POSITION FOR EJECTION AND WILL HAVE NO DIFFICULTY IN REACHING THE EJECTION SEAT CONTROLS DUE TO WIND BLAST OR "G" FORCES.

WARNING

KEEP HANDS AND ARMS CLEAR OF CANOPY CONTROL LEVERS DURING CANOPY JETTISON AS THE CANOPY IS JETTISONED, THE RO'S CONTROL LEVER WILL ROTATE RAPIDLY TO THE OPEN POSITION AND THE PILOT'S CONTROL LEVER WILL SNAP TO THE UP (OPEN) POSITION.

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3. Safety belt—Release. (P—RO)

4. Bailout—If possible roll airplane on its back and push clear. If it is not possible to roll the airplane over, bail out the side of cockpit toward the aft trailing edge of the wing. (P—RO)

FAILURE OF CANOPY TO JETTISON.

1. Canopy jettison "T" handle—Pull. (P)

2. Canopy lock lever—Raise (if step *1* is ineffective). (P—RO)

3. Canopy switch—Move to OPEN (if step *1* is ineffective). (P—RO)

As the canopy moves aft from the windshield frame, the airstream will blow it from the fuselage.

4. Continue with normal ejection procedure and eject through canopy (if steps *1*, *2*, and *3* are ineffective). (P—RO)

AFTER EJECTION.

1. After safety belt releases automatically, kick away from seat. (P—RO)

If automatic release fails, release safety belt manually.

2. Conventional parachute—Delay opening to allow body to decelerate so that opening shock will be reduced. (P—RO)

If ejection is at high altitude, free fall to normal breathing altitude will reduce the dangers of hypoxia and cold.

WARNING

- With a manual opening safety belt, open the belt before ejection under the following conditions: below 2000 feet if position in seat can be maintained, in a dive, or at high airspeeds up to 5000 feet. Opening the belt before ejection will facilitate pulling the D-ring, and parachute opening after ejection.
- At altitudes higher than 5000 feet do not open manually operated safety belt before ejection, especially at high airspeeds.
- With an automatic opening safety belt do not open the belt before ejection at any altitude. The automatic opening feature will give you the maximum safety factor under all conditions.
- In all ejections below 14,000 feet, manually pull the parachute D-ring immediately following separation from the ejection seat. This applies regardless of parachute type, manual or automatic.

LANDING EMERGENCIES.

LANDING WITH FLAPS AND SPEED BRAKES RETRACTED.

If wing flaps and speed brakes are unavailable for landing, higher touchdown airspeeds must be used to compensate for the lack of extra lift normally supplied by the flaps. If both engines are operative, use speed brakes (if available) and maintain a minimum of 85% RPM throughout the final approach for rapid acceleration if a go-around is necessary. Lengthen the downwind leg to provide for a flat final approach and maintain engine RPM at as high a setting as possible. The airplane should be flown strictly by the airspeed indicator throughout the final approach and touchdown. Recommended final approach speeds are as follows:

Gross Weight—LB	*Approach IAS—Knots*
26,000	150
31,000	164
36,000	176

Note

The preceding speeds are approximately 5 knots above the stall speed encountered under average gust conditions.

Gross Weight—LB	*Landing IAS—Knots*
26,000	118
31,000	128
36,000	138

Set the nose wheel down before the following applicable airspeed is reached:

Gross Weight—LB	*Nose Wheel Down IAS—Knots*
26,000	112
31,000	122
36,000	132

Anticipate a landing roll 25 to 35 percent longer than normal for a dry, hard-surfaced runway.

RUNNING OFF RUNWAY ON LANDING.

During the landing roll, if the airplane leaves the runway because of brake failure, etc, raise the landing gear by depressing the emergency override lever and simultaneously moving the landing gear lever to UP if the airplane is not modified in accordance with T.O. 1F-89-615 and 1F-89-520. If the airplane has been so modified, the landing gear may be left down.

WARNING

On airplanes not modified in accordance with T.O. 1F-89-615 and 1F-89-520, the pilot should place his feet on the instrument panel to avoid injury. The nose gear strut may come through the floor of the pilot's compartment, causing the control stick to lock his legs in the cockpit.

FORCED LANDING.

If the airplane has been modified in accordance with T.O. 1F-89-615 and T.O. 1F-89-520, there is less likelihood of personal injury and extensive damage to the airplane if forced landings are made with gear down, regardless of terrain, to allow the landing gear to absorb initial impact loads. However, unless landing on a runway, gear-down forced landings are recommended *only* if the airplane has been modified in accordance with T.O. 1F-89-615, and T.O. 1F-89-520. Otherwise, the nose gear may cause structural damage to the pilot's cockpit and result in the pilot being trapped in the airplane. If it is necessary to make a forced landing, accomplish as much of the procedure shown below and on figure 3-6 as possible.

Note

A two-engine flameout condition may be simulated for practicing forced landings, by retarding the engines to idle RPM and placing the speed brake lever at one-third of quadrant travel. Stay 1000 feet above terrain.

1. Radar observer—Warn of impending forced landing. (P)
2. Tip tank fuel—Dump. (P)
3. Throttles—CLOSED if power failure is complete; otherwise, use available power. (P)
4. Landing gear lever—DOWN at 10,000 feet if airplane has been modified in accordance with T.O. 1F-89-615 and 1F-89-520; UP if not so modified. (P)
5. Wing flap lever—TAKEOFF. (P)
6. Parachute—Unbuckle; safety belt—Tighten. (P—RO)
7. Engine fire selector switches—Actuate. (P)
8. Nose wheel steering button—Depress (if landing is to be made with gear retracted). (P)
9. Canopy—Jettison with "T" handle. (P)
10. Battery and generator switches—OFF. (P)
11. Inertia reel lock lever—LOCKED, just before touchdown. (P—RO)

WARNING

Do not raise helmet visor prior to landing emergencies. Retaining the helmet visor in the lowered position will afford protection from impact injury, dislodged objects in the cockpit, flame and smoke, and from windblown objects if the canopy is jettisoned. The helmet visor is a protection device that should be worn in the lowered position in all landing emergencies.

Note

For practicing forced landings, a two-engine flameout condition may be simulated by placing the speed brake lever at one-third of quadrant travel and operating the engines at idle RPM. Stay more than 1000 feet above terrain.

CAUTION

When the inertia reel is locked, either by use of the inertia reel lock lever or by raising left armrest, the pilot is prevented from bending forward; therefore, all controls not readily accessible should be positioned before inertia reel is locked.

LANDING WITH GEAR PARTIALLY EXTENDED.

If the landing gear fails to extend completely after both the normal and emergency procedures have been used, and if the landing is to be made on a runway suitable for a normal wheels-down landing, leave as many wheels down as will extend, jettison the canopy through use of the canopy jettison "T" handle to avoid bottoming the pilot's seat, then proceed with forced landing. Less damage will result with this procedure than with a gear-up landing. When landing on any type terrain other than a runway, retract the gear if the airplane has not been modified in accordance with T.O. 1F-89-615 and T.O. 1F-89-520.

LANDING WITH FLAT TIRE.

Because of the comparatively large diameter wheels and small width of tires, directional control of the airplane is easily maintained with rudder and wheel brakes if a main gear tire blows out on landing. If the airplane is landed with one nose wheel tire flat, there will be a slight veering. If landing is made with both nose wheel tires flat, sufficient up-elevator should be applied to take weight off the nose wheel and use of wheel brakes should be minimized.

EMERGENCY ENTRANCE.

If it is necessary to gain entrance to the cockpit in an emergency, first attempt to open the canopy by using the external lock lever and canopy switch, both located behind an access door on the left side of the fuselage above the wing leading edge. If the canopy switch fails to open the canopy after it is unlocked, attempt to open it manually using the external handgrip in the aft structure of the canopy. If this fails, slow-jettison the canopy by use of the external emergency canopy release handle, located flush with the fuselage skin just below the access door for the external canopy switch. Pushing the button in the center of the handle will release it. The handle must be pulled out, with a force of about 45 pounds, approximately 5 inches and held 10 to 20 seconds until the canopy is raised above the cockpit rails. The canopy can then be lifted or pushed from the airplane. If all of the foregoing procedures fail, then, as a last resort, chop a hole in the canopy with an ax, using extreme caution not to injure crewmembers inside the cockpit.

EMERGENCY EXIT ON GROUND.

If the canopy cannot be opened by the normal procedure, and immediate exit is necessary in the emergency, the radar observer can slow-jettison the canopy by using the emergency hydraulic pump handle to put pressure against the cable attached to the canopy external jettison lever and the canopy jettison initiator. When pressure is applied to the cable between the control lever and the initiator, the initiator is actuated and the canopy is slow-jettisoned. The cable is located in the forward left side of the radar observer's cockpit. If the canopy cannot be slow-jettisoned, fast-jettison the canopy by pulling the canopy jettison handle on the pilot's right vertical console or by raising the right armrest of either ejection seat. On airplanes modified in accordance with T.O. 1F-89-586, both the pilot's and radar observer's cockpits are equipped with an internal canopy slow-fire jettison "T" handle. This enables either the pilot or the radar observer to slow-jettison the canopy by pulling the "T" handle.

WARNING

General direction of canopy movement when jettisoned is straight up. Lack of airstream may cause it to fall back into cockpit.

DITCHING.

This airplane should never be ditched if there is sufficient altitude for a safe ejection. Ditching is not recommended because it is assumed that the engine air intake ducts will cause the airplane to dive violently when it hits the water. However, if altitude is insufficient for ejection, warn radar observer, then proceed as follows:

1. Tip tank fuel—Dump. (P)

CAUTION

Empty tip tanks do not contact the water until the airplane comes to rest, where they afford additional buoyancy. If the tip tanks contain fuel on ditching, they may plane through the water and create serious deceleration loads.

2. IFF master control knob—EMERGENCY. (P)
3. Canopy—Jettison with "T" handle. (P)
4. Landing gear lever—UP. (P)
5. Safety belt—Tighten. (P—RO)
6. Oxygen diluter lever—100% OXYGEN. (P—RO)
7. Wing flap lever—TAKEOFF. (P)
8. Throttles—CLOSED. (P)
9. Engine fire selector switches for both engines—Raise guards and actuate. (P)
10. Select a headling parallel to the wave crest if possible. Try to touch down along wave crest or just after crest passes. (P)
11. Make normal approach. (P)
12. Flare out to landing attitude, keeping the nose high. (P)
13. Generator switches—OFF just before contact. (P)
14. Battery switch—OFF just before contact. (P)
15. Inertia reel—LOCKED. (P—RO)

WARNING

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Do not attempt to ditch in a near level attitude. It is assumed that the airplane will dive violently when the intake ducts hit the water.

OIL SYSTEM FAILURE.

If loss of oil is experienced, the airplane need not be abandoned immediately as a gas turbine engine will not fail immediately after loss of oil. An aircraft gas turbine engine depends on oil to cool the roller and ball bearings, so in the event of oil loss, reduce power to keep temperatures at a minimum. A J-35 engine has been operated for 27 minutes at 86% RPM without oil before experiencing destructive engine failure. In most instances, ultimate failure of the engine will not occur within 10 minutes after loss of oil and will be characterized by a steadily increasing vibration. At this time engine shutdown should be made to prevent a destructive engine failure that would jeopardize a successful ejection or power-off control of the airplane in a landing attempt. In most cases the airplane has remained controllable during its descent. When oil loss is experienced, the following procedure should be performed immediately:

1. Tip tank fuel—Dump. (P)
2. "G" forces—Minimize. (P)
3. Power setting (affected engine)—Minimum. (P)
4. Land at nearest airbase. (P)

FUEL VENT SYSTEM MALFUNCTION.

Under certain conditions of fuel vent or transfer system malfunction, fuel may be lost overboard through a sump tank vent. If fuel overboarding occurs, use the corrective procedures described in the following paragraphs.

FUEL OVERBOARDING DURING CLIMB OR DIVE.

Overboarding of fuel during a climb or dive indicates mechanical failure of a sump tank dive valve in the open position. When this condition occurs, the airplane should be leveled immediately. If the fuel venting stops, malfunction of a dive valve is confirmed. If another climb or dive is made, and fuel overboarding starts again, the airplane should be leveled immediately, and the auxiliary tank and tip tank selector switches should be turned OFF until approximately 100 pounds of fuel has been used from the sump tank. Auxiliary and tip tank selector switches should then be returned to the ON position. If fuel overboarding continues, repeat the operation as necessary. If this procedure fails to stop fuel overboarding, auxiliary tanks should be selected and the airplane landed as soon as possible.

WARNING

If fuel overboarding cannot be stopped, it is recommended that a no-flap landing be made because overboarding fuel could be drawn into the flap wells and drain into the hot engine bay, resulting in a fire or explosion.

FUEL SYSTEM EMERGENCY OPERATION.

SUMP TANK BOOSTER PUMP FAILURE.

If the normal booster pump in a sump tank fails, the auxiliary tank fuel can be routed directly to the engine by placing the fuel selector switch at each auxiliary tank position until the tank is empty. When the auxiliary tanks are empty, the selector switch must be turned to ALL TANKS. At low altitude, fuel will flow by gravity from the sump tank. If electrical power fails, the auxiliary tanks will not feed to the sump tanks; but at 10,000 feet or below, gravity will supply fuel from the sump tanks to the engine-driven pumps, and the pressurized tip tanks will replenish the sump tanks until the tip tanks are empty. Above 10,000 feet, vapor lock may result; therefore, descent to a lower altitude should be made as quickly as possible to avoid flameout.

AUXILIARY TANK BOOSTER PUMP FAILURE.

If the booster pump in an auxiliary tank fails during automatic sequencing, the warning light will come on and the next tank in sequence will start feeding. The switch for the inoperative tank must then be turned to OFF. If the pump fails while the fuel selector switch is set at the affected tank, turn the selector switch to ALL TANKS and the switches for the operative tanks to ON for automatic sequencing.

FUEL PUMP FAILURE.

If an engine-driven fuel pump fails, as may be indicated by a sharp drop in fuel pressure or loss of power, shut down the engine. Turn the crossfeed switch to ON so total remaining fuel can be used by the operating engine.

Note

Due to a pressure drop across the crossfeed line, fuel will flow faster from the system with the operating engine. A slight wing heaviness may develop, but will not be critical.

DAMAGED TANKS.

If tanks are damaged or a severe leak is suspected, take corrective action as described below:

Damaged Sump Tank.

If a leak is known to be in a sump tank use sump tank fuel first, then auxiliary NO. 2 fuel, then auxiliary NO. 1 fuel. To accomplish this, use the following procedure:

1. Fuel selector switch—ALL TANKS. (P)
2. Auxiliary tank switches—OFF. (P)
3. Fuel selector switch (after sump tank fuel is used)—AUX 2; auxiliary NO. 2 tank switch—ON. (P)
4. Fuel selector switch (after auxiliary NO. 2 fuel is used)—AUX 1; auxiliary NO. 1 tank switch—ON; auxiliary NO. 2 tank switch—OFF. (P)

Damaged Tip Tank.

If either tip tank is damaged or pressure is lost from other cause, place tip tank switches at OFF (leave fuel selector switches at ALL TANKS). If tip tank fuel cannot be used because of malfunction, then dump tip fuel.

Damaged Auxiliary Tank.

If either auxiliary tank is damaged and its booster pump is operative, use the available fuel in the damaged tank first, then use fuel of other tanks. If the damage is such that it creates an obvious fire hazard, shut down the engine on the damaged side.

FUEL SYSTEM OPERATION FOLLOWING COMPLETE ELECTRICAL POWER FAILURE.

Without electrical power, fuel is only available by gravity feed directly from the tank selected to the engine. Fuel will not transfer from either auxiliary wing tank to the sump tank without electrical boost pump operation. In the event of complete electrical power failure, use the following procedure to control fuel operation:

1. Turn battery switch to OFF and descend to safe gravity feed altitude (approximately 10,000 feet or less). (P)
2. Pull all fuel pump circuit breakers to conserve on battery power. (P)
3. Turn off all other unnecessary electrical equipment. (P)
4. Turn battery switch to ON. (P)
5. Monitor fuel quantity remaining in the sump tank and tip tank versus fuel remaining in auxiliary NO. 1 or auxiliary NO. 2. If the total fuel remaining in the sump tank plus tip tank is less, fuel selection should be made as soon as possible to the auxiliary tank with the highest fuel quantity remaining. If auxiliary fuel is not available, then the fuel selector should be left at ALL TANKS. This will gravity feed from the sump tank. (P)
6. Turn battery switch OFF. (P)

If it is necessary to extend the flight beyond the limits of the available selected fuel, utilize the following procedure:

7. Turn battery switch to ON. (P)
8. Turn fuel selector switch to the next selection with the largest quantity of fuel remaining. (P)
9. Allow several seconds for the valves to realign themselves then turn battery switch to OFF. (P)

Note

To conserve battery, make tank selection first, then turn battery on for from 3 to 5 seconds, then turn battery OFF; calculate fuel consumption by elapsed time.

ELECTRICAL SYSTEM EMERGENCY OPERATION.

See figure 1-19 for equipment rendered inoperative due to failure of the 28-volt DC, 120-volt DC, or AC inverter systems. In case of complete electrical failure, do not abandon airplane as control of the airplane can be maintained. Figure 3-8 covers 28-volt DC generator malfunction for which corrective action may be taken by the pilot.

GENERATOR OVERVOLTAGE.

If the voltage of a generator (either 28-volt or 120-volt DC system) becomes excessive, an overvoltage relay will cut the generator out of the circuit and the warning light will come on. To return the generator to the circuit, proceed as follows:

1. Generator switch—RESET momentarily, then return to ON. If the warning light goes out and remains out, overvoltage was temporary. (P)
2. Generator switch—OFF, if warning light remains on. (P)
3. Voltage regulator rheostat knob—Turn toward DEC to reduce voltage. (P)
4. Generator switch—RESET momentarily, then return to OFF. (P)
5. Voltage selector switch—Turn to affected generator. (P)
6. Voltage regulator rheostat knob—Adjust until voltage is slightly above the voltage of the other generator. (P)
7. Generator switch—ON. (P)

GENERATOR FAILURE.

If one of the generators in either the 28-volt DC system or 120-volt DC system fails, the remaining generator of the system can carry the entire load. If both 120-volt DC generators fail, the main power inverter will be inoperative. If both 28-volt DC generators fail, the main instrument inverter, the spare instrument inverter, and the spare power inverter will be lost. If this occurs, the following procedure should be performed immediately:

1. Battery switch—OFF. (P)
2. Battery switch—ON and OFF as required to control the fuel system. (P)
3. All switches not essential to emergency flight—OFF. (P—RO)
4. To dump tip tank fuel—Place battery switch in the ON position, push tip tank dump button and hold for 5 seconds, then place the battery switch in the OFF position. (The tip tank dump valve will remain open until the battery switch is again placed in the ON position.) (P)

See figure 1-19 for equipment powered by the two direct-current systems. See figure 3-8 for procedure in case of 28-volt DC malfunction. See figure 1-20 for equipment lost due to generator failure.

28-VOLT D-C GENERATOR MALFUNCTION CHART

NOTE: Only those failures for which specific corrective action can be taken in flight are shown. For failures other than those listed here, turn off malfunctioning generators and reduce load on operative generators.

	FIRST INDICATION OF MALFUNCTION		VERIFICATION OF MALFUNCTION	
	MALFUNCTIONING GENERATOR	OTHER GENERATOR	MALFUNCTIONING GENERATOR	OTHER GENERATOR
OVER-VOLTAGE	WARNING LIGHT ON: VOLTMETER 0-3 VOLTS: LOADMETER ZERO	LOADMETER ABOVE NORMAL	VOLTMETER OFF SCALE ON HIGH SIDE: LOADMETER ZERO *	LOADMETER ABOVE NORMAL
			(READINGS OBTAINED WHILE MALFUNCTIONING GENERATOR RESET SWITCH IS HELD MOMENTARILY AT RESET.)	
IMPROPER PARALLELING	MALFUNCTIONING GENERATOR	OTHER GENERATOR	MALFUNCTIONING GENERATOR	OTHER GENERATOR
CONDITION 1	HIGH LOADMETER READING	LOW LOADMETER READING	HIGH VOLTMETER READING: ZERO LOADMETER READING	LOADMETER ABOVE NORMAL
CONDITION 2	ZERO OR VERY LOW LOADMETER READING: WARNING LIGHT ON (ON AIRPLANES WITH GENERATOR OFF WARNING LIGHTS)	LOADMETER ABOVE NORMAL	LOW VOLTMETER READING: ZERO LOADMETER READING	LOADMETER ABOVE NORMAL
			(READINGS OBTAINED WHILE MALFUNCTIONING GENERATOR RESET SWITCH IS HELD MOMENTARILY AT RESET.)	

CORRECTIVE ACTION:

IMPROPER PARALLELING

1. Adjust voltage to 28 volts with voltage regulator rheostat knob.
2. Place generator switch to "ON."
3. Check loadmeters for approximately equal load. If necessary, equalize load by adjusting the voltage regulator rheostat knobs.
4. Frequently check operation of generator for evidence of further malfunctioning.

NOTE: If generator malfunctioning cannot be corrected, turn generator off and reduce load on remaining generators by turning off nonessential equipment.

OVERVOLTAGE

1. Place malfunctioning generator switch at "ON" and immediately return to "OFF." This will allow overvoltage condition to trip the generator field control relay, thus deenergizing generator field circuits to prevent possible damage.

* NOTE: If voltage is normal when generator switch is placed at RESET, overvoltage was momentary and generator can be returned to service by placing switch at ON.

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Figure 3-8.

INVERTER FAILURE.

If either main inverter fails, its "Main Out" warning lights will come on and the spare inverter will take over automatically. If the automatic changeover fails, and the "Both Out" warning light comes on, place the inverter switch at SPARE. If the light remains on and there is no output voltage, place the inverter switch at OFF. See figure 1-19 for equipment powered by the inverter systems.

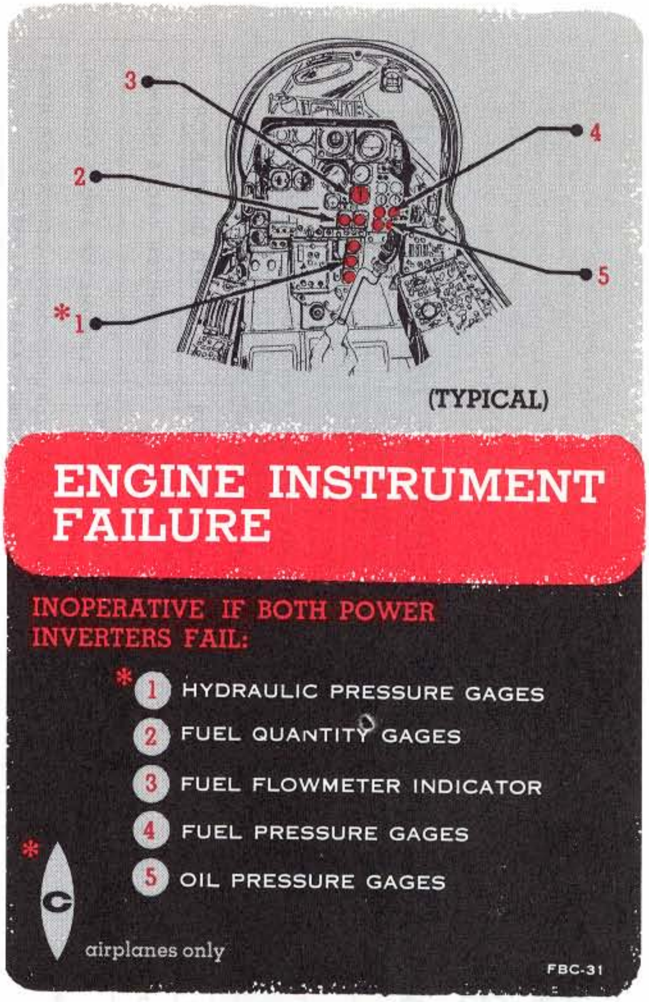
WARNING

- If both single-phase inverters fail below 10,000 feet, or if the afterburner AC control circuit breaker disengages, the afterburner and afterburner control circuits will be inoperative. When this occurs, the throttle-actuated eyelid switches will cause the eyelids to open (without regard to afterburner operation) when the throttles are advanced to OPEN, resulting in very low tailpipe temperatures and extreme loss of thrust. If both inverters fail below 10,000 feet while in afterburning, afterburner operation will be unaffected. However, if the afterburners are shut down by depressing the throttle fingerlifts, the eyelids will remain open. The eyelids must be closed by moving the afterburner control circuit breakers to OFF or by retarding throttles to approximate 90% position. Eyelid closure will be apparent by an immediate increase in thrust and a return to normal temperature. Only military power will be available for the duration of the flight.
- If both single-phase inverters fail while in afterburning above 10,000 feet, afterburning will be unaffected because the holding relay in the afterburner control box keeps the eyelids open; however, once afterburning is shut off, it cannot be reinitiated. If both single-phase inverters fail above 10,000 feet, afterburning cannot be initiated and eyelids will remain in closed position, because the altitude switch breaks DC operating circuit, allowing the "fail safe" eyelid control valve to keep the eyelids closed.

INSTRUMENT FAILURE.

Engine Instruments.

If both the main and spare power inverters fail, all engine instruments will become inoperative except the tachometers and exhaust temperature gages, both self-generating instruments. The pointers of the oil pressure gages, fuel pressure gages, fuel quantity gages, fuel flowmeter indicator, brake accumulator pressure gage, and left and right hydraulic pressure gages, all powered by the main or spare power inverter, will remain at the last indicated setting before failure. If the 28-volt DC system fails, the fuel quantity gages and the fuel flowmeter indicator will become inoperative, even though the main power inverter is operating.



Flight Instruments.

If all electrical systems fail, the following instruments will remain in operation: vertical velocity indicator, airspeed indicator, standby magnetic compass, and altimeter. The vertical velocity indicator, altimeter, and airspeed indicators will operate as long as the inlets on the pitot tube and static ports are not iced over. The turn and slip indicator depends on 28-volt DC power for operation. If the 28-volt DC system or both the main and spare instrument inverters fail, the attitude indicator will tumble, the directional indicator (slaved) will not give a dependable reading (although it may oscillate occasionally), and the course indicator and zero reader (A-1 flight computer) will display flags indicating that they are inoperative. If the 28-

volt DC system fails, the free air temperature gage needle will fall against the stop.

HYDRAULIC SYSTEM EMERGENCY OPERATION.

If the right hydraulic system fails, all hydraulically operated units will operate normally by pressure from the left hydraulic system; however, the flight control operation will be limited in degree and rate of surface movement. To increase the degree and rate of control surface movement during operation of the other hydraulic units, depress the nose wheel steering button to start the left hydraulic system supplemental pump.

WARNING

With right hydraulic system pressure unavailable, do not operate speed brakes unless the left engine RPM is at least 85% or the supplemental hydraulic pump is operating.

At lower RPM the demand on the left hydraulic system by speed brake operation results in limited aileron control unless supplemental pump volume is available.

If the left hydraulic system fails through loss of fluid, the flight control system will operate on the right system pressure, but the degree and rate of surface movement will be limited. Speed brakes will be inoperative. The landing gear, wing flaps, and wheel brakes (if accumulator pressure is not available) must be operated by emergency procedures. If partial failure occurs through failure of an engine but the engine is still windmilling, pressure can be expected to vary between approximately 700 and 2000 PSI. Care should be taken not to allow the pressure to bleed below approximately 600 PSI. This allows a slight margin above the purge valve setting of 300 PSI. When this valve opens, pump energy is routed to the return line with the resultant loss of the system. The only means for closing the valve would be to increase engine RPM to about 38%. Engine windmill speeds to be expected are approximately 16%, 12%, and 9% engine RPM for 175, 140, and 100 knots IAS respectively. With the hydraulic pressure available from one windmilling engine, and with extreme caution in rate of control movement, the pilot can complete the following *independently*: Partially or fully extend flaps (if left engine is windmilling), correct for slight turbulence, make 30-degree bank turns, and flare out for landings. If both hydraulic systems fail, the flight controls can be operated by the supplemental pump if the left system has not failed through loss of fluid; however, caution should be exercised in the rate of control movement and the use of accessory hydraulic units, since the supplemental pump volume is less than that of an engine-driven pump.

FLIGHT CONTROL SYSTEM EMERGENCY OPERATION.

If the right or left hydraulic system fails, one 3000-PSI hydraulic system is available for basic flight control. Little difference will be noted normally with flight under such conditions. This includes flight at maximum level flight speed down to stall for the landing configuration. Due to limited elevator deflection, available load factor is lowered by approximately 0.3 "G." A limit in surface deflection occurs when there is a balance in elevator power and airloads (limiting elevator hinge moment). This means that time for recovery from a dive is slightly extended with only one hydraulic system operating. To be specific, maximum load factor obtainable at 0.85 true Mach number and 10,000-foot altitude is approximately 2.0 "G's"; with both systems operating about 2.3 "G's" are available. The limiting load factor, or "G" value, increases with any one or a combination of the following: decrease in Mach number, decrease in dynamic pressure, aft movement of the airplane center of gravity, and a decrease in horizontal stabilizer angle caused by manufacturing tolerances. Under 0.8 true Mach number, longitudinal control to limit load factor or airplane buffet is available. Full basic control of the airplane is possible in flight using the supplemental pump. Pilot stick and pedal actuating forces are comparable to those with the normal system in operation. The supplemental pump replenishing rate is sufficient to maintain pressure during fast actuation of the control surfaces. Such a condition would exist during flight in turbulent air. Battery life when supporting both the supplemental pump and limited use of the radios is short. For this reason it is suggested that the supplemental pump be used only when absolutely necessary if electrical generating power is unavailable. With the hydraulic pressure of one windmilling engine available, a safe landing can be executed. However, it is necessary for the pilot to exercise caution in the *rate* of control movement. The engine-driven hydraulic pump replenishing rate at engine windmill speeds is low. Full control deflections applied at a slow rate, as necessary for a crosswind landing, are possible. During flight in moderate to heavy turbulent air, basic stability should be depended upon to a great extent for maintaining an approximate pilot-selected airplane attitude.

WARNING

With right hydraulic system pressure unavailable, do not operate speed brakes, unless left engine RPM is at least 85% or the supplemental pump is operating. At lower RPM, the demand on the hydraulic system made by speed brake operation will result in limited aileron control unless the supplemental pump is operating.

YAW STABILIZER EMERGENCY OPERATION.

If the yaw stabilizer system fails, causing the airplane to oscillate violently, turn the yaw stabilizer switch to OFF and reduce airspeed. With the yaw stabilizer off, "Dutch Roll" is extremely light under many flight conditions, and can be controlled by the pilot. Damping can be improved by descending to a lower altitude.

WING FLAP SYSTEM EMERGENCY OPERATION.

If the left hydraulic system fails, or if the wing flaps cannot be operated normally, place the emergency flap switch to ON and move the wing flap lever to desired position. Flaps will extend to the takeoff position in about 35 seconds. In the event the pre-positioning spring in the flap handle has broken, the flaps may be actuated by placing wing flap handle in desired position and moving the wing flap position indicator to extend or retract flaps as needed. Considerable pressure may be necessary to position the wing flap indicator using this method.

SPEED BRAKE SYSTEM EMERGENCY OPERATION.

The speed brakes cannot be operated if the left hydraulic system fails through loss of fluid, however, if the speed brakes are open at the time of failure, they will float back to the streamlined position when the speed brake lever is placed at CLOSED.

LANDING GEAR SYSTEM EMERGENCY PROCEDURES.

If the normal landing gear lowering procedure fails to extend the gear to a safe condition the pilot should first try to determine what is causing the malfunction, then execute the appropriate emergency procedure for lowering the landing gear to a safe landing condition. For example, the pilot can determine if there is flow in the landing gear system by recycling the landing gear lever from DOWN to UP and back to DOWN while watching the left hydraulic system pressure gage for fluctuations. If no fluctuations are indicated on the pressure gage during the check, indicating no flow in the landing gear system, it may be assumed that the landing gear position 4-way valve is stuck in the gear-up position. If this occurs the only way the gear can be lowered is by reducing the left hydraulic system pressure to zero. In order to accomplish this, the left engine must be shut down, flaps partially lowered, speed brakes partially opened, and then the flaps retracted at the same time the speed brakes are closed. This will reduce the left hydraulic system pressure to the point that the system purge valve (figure 1-25) will open automatically (approximately 350 PSI) and reduce the system pressure to zero. The safety relays circuit breaker in the radar observer's cockpit must be pulled prior to flap and speed brake operation to disarm the supplemental pump. After the system pressure has been reduced to zero the landing gear emergency release handle may be pulled to lower the gear.

CAUTION

- The left engine must remain inoperative after the landing gear has been lowered by purging the system pressure. If the engine is restarted, left hydraulic system pressure will be restored to normal and the landing gear will retract.

- When using the landing gear emergency release handle, the pilot should make certain the handle is pulled to its full limit of travel (approximately 14 inches). This will assure that all landing gear uplocks have been unlocked. Allow at least 30 seconds for gear to extend. The handle then should be returned to its stowed position. Do not allow the handle to whip back to its stowed position, as damage to the cockpit equipment may result.

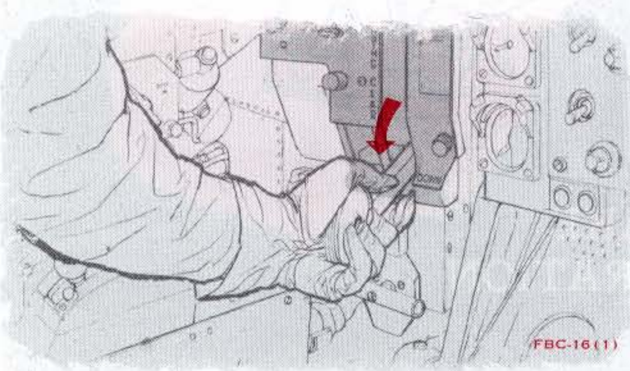
If any one or all of the landing gears fail to extend after the landing gear lever is placed in the DOWN position and the landing gear emergency release handle has been pulled, the pilot should execute a coordinated maneuver to pull positive "G's". This should be done with the landing gear lever at DOWN and the emergency release handle pulled and held to its full limit of travel. Care should be taken to avoid exceeding the maximum allowable "G's" for the altitude at which the maneuver is being executed.

GEAR FAILS TO EXTEND ON NORMAL PROCEDURE.

1. Airspeed—195 knots IAS or below. (P)
2. Landing gear lever—Check full DOWN. (P)
3. Left hydraulic system pressure gage—2000 PSI (if pressure is below 2000 PSI and time and conditions permit, allow pressure to build up). (P)
4. Landing gear emergency release handle—Pull to full limit of travel (14 inches). Allow at least 30 seconds for gear to extend. (P)
5. Main landing gear—Check visually. (P)
6. Landing gear position indicators—Check for safe indication. (P)

GEAR FAILS TO EXTEND ON EMERGENCY PROCEDURE.

1. Airspeed—195 knots IAS or below. (P)
2. Landing gear lever—Recycle, leave in DOWN position. (P)



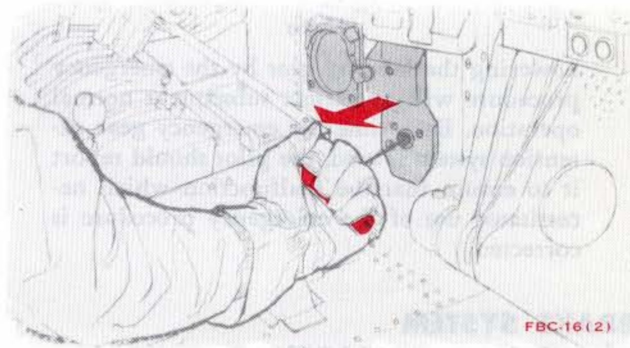
FBC-16(1)

3. Left hydraulic system pressure gage—Check for fluctuations. (P)

Note

If no fluctuations occur and the pilot is assured that no gears have moved, proceed with the emergency procedure by purging the left hydraulic system.

4. Left engine—Shut down. (P)
5. Safety relays circuit breaker—Pull. (RO)
6. Flaps—Lower partially. (P)
7. Speed brakes—Open partially. (P)
8. Raise flaps and close speed brakes at the same time, to open the left hydraulic system purge valve. (P)
9. Left hydraulic system pressure gage—Check for 0 PSI. (P)
10. Emergency landing gear release handle—Pull to full limit of travel (14 inches). Allow at least 30 seconds for gear to extend. (P)



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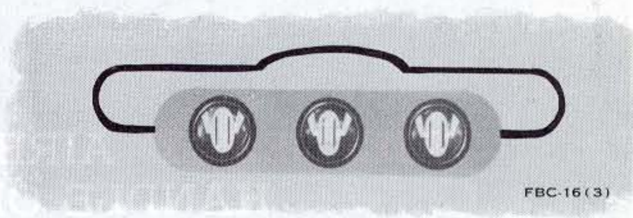
Note

If gear fails to extend, continue with following procedures.

11. Emergency landing gear release handle—Pull second time and hold at full limit of travel. (P)
12. Pull positive "G's". (P)
13. Main landing gear—Check visually. (P)
14. Landing gear position indicators—Check for safe landing gear indication. (P)



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Note

- After a prolonged flight at high altitude (where temperature is low) emergency extension may be slower than normal.

- Allow sufficient time for gear to extend by emergency means.

GEAR FAILS TO EXTEND BECAUSE OF MECHANICAL "BINDING."

When nose or main gear fails to extend because of suspected mechanical "binding," with hydraulic pressure available, use the following procedure:

1. Landing gear lever—DOWN. (P)
2. Landing gear emergency release "T" handle—Pull to full limit of travel. (P)
3. Landing gear lever—UP, while maintaining tension on "T" handle in full-out position. (P)
4. When gear has fully retracted, immediately place landing gear lever DOWN, while maintaining tension on "T" handle in full-out position. After nose gear extends, guide "T" handle back to stowed position. (P)
5. Check gear down. (P)

Note

Lowering the landing gear by the emergency procedure will not affect subsequent normal operation. Each time the emergency gear extension system is used, the pilot should report it to ensure that the malfunction which necessitated use of the emergency procedure is corrected.

BRAKE SYSTEM EMERGENCY OPERATION.

If the left hydraulic system fails, the brakes can still be operated by the accumulator pressure. If necessary, the radar observer can charge the accumulator by placing the forward handpump selector valve (A) at BRAKES and the rear valve (B) at NEUTRAL (see figure 4-7) and pumping the hydraulic handpump. A normal ground roll stop can be made by using accumulator pressure only, provided there is 3000 PSI pressure in the system. In using brake accumulator pressure to stop the airplane, avoid too many applications which would deplete hydraulic pressure. If wheel brakes fail to respond to brake pedal pressure, release brakes, immediately turn the emergency airbrake handle to ON, then operate the brakes as usual. (See figure 3-9.) When applying airbrakes, use caution as pedal resisting forces will be lighter than normally experienced. If both emergency airbrake and brake accumulator pressures are applied to the system simultaneously, more pedal pressure than normal will be required.

CAUTION

Do not turn emergency airbrake handle to ON while brakes are being applied; sudden increase in braking efficiency may result in a locked wheel and subsequent tire failure.

Note

- The air bottle contains sufficient pressure for three complete applications of the brakes.
- Brakes must be bled after using the emergency airbrake system.

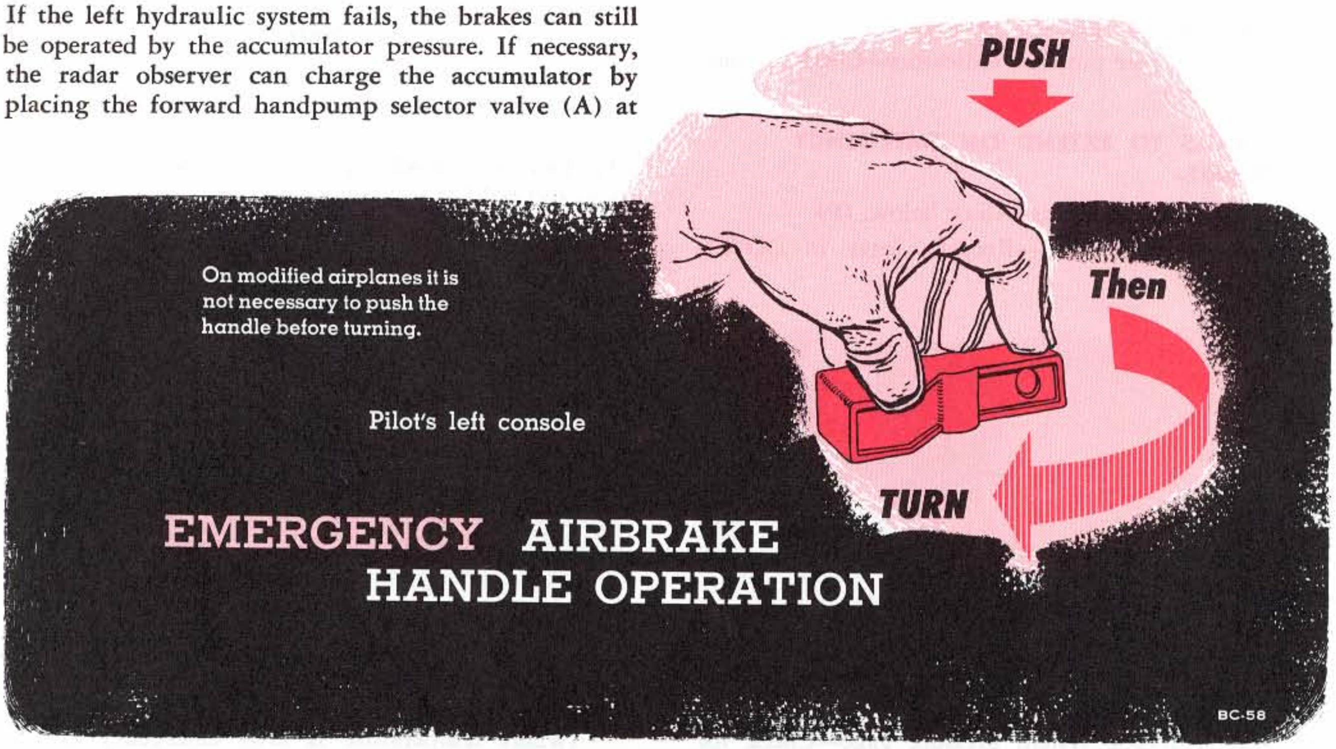

Figure 3-9.

- On airplanes in compliance with T.O. 1F-89-599, it is not necessary to push the emergency airbrake handle down before turning.

LOSS OF CANOPY.

If the canopy is lost, the airplane should immediately be decelerated to 200 knots IAS or less. If no other emergency exists, the pilot and radar observer should communicate this fact to each other by using the command control shift light or the canopy locking lever to relay messages.

ABBREVIATED CHECKLIST.

The following checklist is an abbreviated version of the procedures presented in the amplified checklists of Section III. This abbreviated checklist is arranged so that you may remove it from your flight manual and insert it into a flip pad for your convenient use. It is arranged so that each action is in sequence with the amplified procedure given in Section III. Presentation of the abbreviated checklist does not imply that you need not read and thoroughly understand the amplified version. To fly the airplane safely and efficiently you *must* know the reason why each step is performed and why the steps occur in certain sequence.


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CUT ON DOTTED LINE

EMERGENCY PROCEDURES
F-89B AND C PILOT'S ABBREVIATED CHECKLIST

Note

The following checklist is an abbreviated version of the emergency procedures in Section III.

ENGINE FAILURE.

SINGLE ENGINE PROCEDURE.

1. Throttle on inoperative engine—CLOSED. (P)
2. Gear and flaps—Retracted. (P)
3. Engine fire selector switch (inoperative engine)—Actuate. (P)
4. Agent discharge switch—As required. (P)
5. Generator switch (inoperative engine)—OFF. (P)
6. Inverter switches—As required. (P)
7. Unnecessary electrical equipment—Off. (P—RO)
8. Crossfeed switch—ON. (P)
9. Fuel tank switches—ON. (P)
10. Fuel selector switches—ALL TANKS. (P)
11. Power—Readjust on good engine. (P)
12. Trim for straight and level flight. (P)

ENGINE FAILURE DURING TAKEOFF (BEFORE LEAVING GROUND).

Takeoff Aborted.

1. Radar observer—Alert. (P)
2. Throttles—CLOSED. (P)
3. Nose wheel steering button—As required. (P)
4. Speed brakes—Open. (P)
5. Wheel brakes—Apply. (P)
6. Emergency airbrake system—As required. (P)
7. Canopy—Jettison. (P)
8. Inertia reel—Lock. (P—RO)
9. Steer for smoothest terrain—As required. (P)
10. Landing gear—As required. (P)
11. Engine fire selector switches—Actuate. (P)

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ABBREVIATED CHECKLIST

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12. Agent discharge switch—Actuate. (P)
13. Battery switch—OFF. (P)
14. Generator switches—OFF. (P)
15. When stopped—Abandon airplane. (P—RO)

ENGINE FAILURE DURING TAKEOFF (AFTER LEAVING GROUND).

Takeoff Continued.

1. Radar observer—Alert. (P)
2. Landing gear—As required. (P)
3. Tip tank fuel—Dump. (P)
4. Throttle (inoperative engine)—CLOSED. (P)
5. Engine fire selector switch (inoperative engine)—Actuate. (P)
6. Agent discharge switch—As required. (P)
7. IAS (to clear obstacle)—Minimum safe IAS (best climb angle). (P)
8. IAS (after obstacle is cleared)—150 knots. (P)
9. Wing flaps—Up at 150 knots IAS; emergency flap switch—ON, only if left engine and supplemental pump fail. (P)
10. Electrical equipment (nonessential)—OFF. (P—RO)
11. Trim—As required. (P)
12. Crossfeed switch—ON. (P)
13. Generator switch on inoperative engine—OFF. (P)

Continued Flight Impossible.

1. Radar observer—Alert. (P)
2. Airspeed—Check. (P)
3. Landing gear—As required. (P)
4. Wing flaps—As required; emergency wing flap switch—ON only if left engine and supplemental pump fail. (P)
5. Speed brakes—As required. (P)
6. Throttles—CLOSED. (P)
7. Canopy—Jettison. (P)
8. Inertia reel—Lock. (P—RO)
9. Engine fire selector switches—Actuate. (P)
10. Agent discharge switch—As required. (P)

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11. Generator switches—OFF. (P)
12. Battery switch—OFF. (P)
13. When stopped—Abandon airplane. (P—RO)

RESTARTING ENGINE IN FLIGHT.

1. Throttles—CLOSED. (P)
2. Fuel selector switch—Change tank selection provided fuel is available in new selection. (P)
3. Power inverter—ON. (P)
4. Altitude start switch—ALTITUDE START momentarily (for selected engine only). (P)
5. Throttle—IDLE (RPM and exhaust gas temperature stabilized) then advance to desired RPM. (P)
6. If start is unsuccessful, attempt another start at lower altitude. (P)

LANDING WITH ONE ENGINE INOPERATIVE.

RIGHT ENGINE INOPERATIVE.

1. Airspeed—Decelerate to 195 knots IAS on downwind leg. (P)
2. Landing gear—Down. (P)
3. Wing flaps—Take-off. (P)
4. Airspeed—Stabilize at 180 knots IAS. (P)
5. Turn on to final and maintain 150 knots IAS. (P)
6. Maintain 150 knots until landing is assured. (P)
7. Throttle—Retard to IDLE only when positive of landing. (P)
8. Speed brakes—Open after touchdown. (P)

LEFT ENGINE INOPERATIVE.

1. Airspeed—Decelerate to 195 knots IAS on downwind leg. (P)
2. Landing gear—Down. (P)
3. Landing gear position—Check. (P)
4. Emergency flap switch—On only if left engine and supplemental pump have failed. (P)
5. Wing flaps—Take off. (P)
6. Airspeed—Stabilize at 180 knots IAS. (P)

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7. Turn on final and maintain 150 knots IAS. (P)
8. Maintain 150 knots IAS until landing is assured. (P)
9. Throttle—Retard to IDLE when positive of landing. (P)
10. Speed brakes—Open after touchdown. (P)

SINGLE-ENGINE GO-AROUND.

1. Throttle on operating engine—OPEN. (P)
2. Afterburner—On. (P)
3. Speed brakes—Closed. (P)
4. Wing flaps—20 degrees. (P)
5. Landing gear—Up. (P)
6. Airspeed—160 knots before climbout. (P)

FIRE.

ENGINE FIRE DURING START.

1. Engine fire selector switch—Actuate. (P)
2. Agent discharge switch—Actuate. (P)
3. Starter switch—STOP momentarily. (P)
4. Battery switch—OFF. (P)
5. Generator switch—OFF. (P)
6. Radar observer—Warn to abandon airplane. (P)
7. Abandon airplane. (P—RO)

ENGINE FIRE DURING FLIGHT.

1. Throttle—CLOSED on inoperative engine. (P)
2. Engine fire selector switch (engine on fire)—Actuate. (P)
3. Agent discharge switch—Actuate. (P)
4. Radar observer—Alert. (P)
5. Oxygen diluter lever—100% OXYGEN. (P—RO)
6. Oxygen regulator emergency lever—Actuate momentarily. (P—RO)
7. Generator switch—OFF (on inoperative engine). (P)
8. Do not attempt to start inoperative engine. (P)
9. Land as soon as possible. (P)

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FUSELAGE, WING, OR ELECTRICAL FIRE.

1. Radar equipment—Off. (P—RO)
2. All electrical equipment—Off. (P—RO)
3. Eject—If necessary. (P—RO)

SMOKE AND FUMES ELIMINATION.

1. Cabin air switch—RAM & DUMP. (P)
2. Oxygen diluter lever—100% OXYGEN. (P—RO)
3. Oxygen regulator emergency lever—Actuate momentarily. (P—RO)

EJECTION.

BEFORE EJECTION.

1. Airspeed—Reduce. (P)
2. Bailout bottle—Pull handle. (P—RO)
3. Cabin air switch—RAM & DUMP. (P)
4. Loose equipment—Stow. (P—RO)
5. Automatic-opening parachute—Check. (P—RO)
6. Canopy—Jettison. (P—RO)

EJECTION PROCEDURE.

1. Left handgrip—Grasp and pull upward. (P—RO)
2. Right handgrip—Grasp and pull upward. (P—RO)
3. Firing trigger (on right handgrip)—Squeeze. (P—RO)
4. After ejection (with safety belt released)—Kick free of seat. (P—RO)

FAILURE OF SEAT TO EJECT.

1. Airspeed—Reduce. (P)
2. Oxygen hose, radio equipment, and "G" suit lines—Disconnect. (P—RO)
3. Safety belt—Release. (P—RO)
4. Airplane—Roll on its back and push clear, if possible. (P—RO)

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FAILURE OF CANOPY TO JETTISON.

1. Canopy jettison "T" handle—Pull. (P)
2. Canopy lock lever (if step *1* is ineffective)—Raise. (P—RO)
3. Canopy switch (if step *1* is ineffective)—OPEN. (P—RO)
4. Eject through canopy (if steps *1*, *2*, and *3* are ineffective). (P—RO)

AFTER EJECTION.

1. Kick clear of seat. (P—RO)
2. With conventional parachute—Delay opening to reduce shock. (P—RO)

LANDING EMERGENCIES.

FORCED LANDING.

1. Radar observer—Warn. (P)
2. Tip tank fuel—Dump. (P)
3. Throttles—As required. (P)
4. Landing gear—As required. (P)
5. Wing flaps—Takeoff. (P)
6. Parachute—Unbuckle. (P—RO)
7. Safety belt—Tighten. (P—RO)
8. Engine fire selector switches—Actuate. (P)
9. Generator switches—OFF. (P)
10. Canopy—Jettison. (P)
11. Final approach airspeed—150 knots IAS gear up; 140 knots IAS gear down. (P)
12. Battery switch—OFF. (P)
13. Inertia reel—Locked. (P—RO)

DITCHING.

1. Tip tank fuel—Dump. (P)
2. IFF master control knob—EMERGENCY. (P)
3. Canopy—Jettison. (P)
4. Landing gear—Up. (P)
5. Safety belt—Tighten. (P—RO)

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6. Oxygen diluter lever—100% OXYGEN. (P—RO)
7. Wing flaps—Takeoff. (P)
8. Throttles—CLOSED. (P)
9. Both engine fire selector switches—Actuate. (P)
10. Select heading parallel to wave crest. (P)
11. Approach—Normal. (P)
12. Flare out to landing attitude. (P)
13. Generator switches—OFF. (P)
14. Battery switch—OFF. (P)
15. Inertia reel—Locked. (P—RO)

OIL SYSTEM FAILURE.

1. Tip tank fuel—Dump. (P)
2. "G" forces—Minimize. (P)
3. Power setting (affected engine)—Minimum. (P)
4. Land at nearest airbase. (P)

FUEL SYSTEM EMERGENCY OPERATION.

DAMAGED SUMP TANK.

1. Fuel selector switch—ALL TANKS. (P)
2. Auxiliary tank switches—OFF. (P)
3. Fuel selector switch (after sump tank fuel is used)—AUX 2; auxiliary NO. 2 tank switch—ON. (P)
4. Fuel selector switch (after auxiliary NO. 2 fuel is used)—AUX 1; auxiliary NO. 1 tank switch—ON; auxiliary NO. 2 tank switch—OFF. (P)

FUEL SYSTEM OPERATION FOLLOWING COMPLETE ELECTRICAL POWER FAILURE.

1. Battery switch—OFF and descend to safe gravity feed altitude. (P)
2. All fuel pump circuit breakers—Pull. (P)
3. All unnecessary electrical equipment—Off. (P)
4. Battery switch—ON. (P)
5. Fuel selection—As required. (P)

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6. Battery switch—OFF. (P)
7. Battery switch—ON, if it is necessary to extend the flight beyond the limits of available selected fuel. (P)
8. Fuel selector switch—As required. (P)
9. Battery switch—OFF, after allowing time interval for fuel valve realignment. (P)

ELECTRICAL SYSTEM EMERGENCY OPERATION.

GENERATOR OVERVOLTAGE.

1. Generator switch—RESET momentarily, then return to ON. (P)
2. Generator switch—OFF, if warming light remains on. (P)
3. Voltage regulator rheostat—DEC. (P)
4. Generator switch—RESET momentarily, then return to OFF. (P)
5. Voltage selector switch—Turn to affected generator. (P)
6. Voltage regulator rheostat—Adjust. (P)
7. Generator switch—ON. (P)

GENERATOR FAILURE.

1. Battery switch—OFF. (P)
2. Battery switch—ON and OFF as required to control fuel system. (P)
3. All switches not essential to emergency flight—OFF (P—RO)
4. To dump tip tank fuel—Battery switch ON. Push and hold tip tank dump button for 5 seconds, then battery switch OFF. (P)

LANDING GEAR SYSTEM EMERGENCY OPERATION.

GEAR FAILS TO EXTEND ON NORMAL PROCEDURE.

1. Airspeed—195 knots IAS maximum. (P)
2. Landing gear—Check down. (P)
3. Left hydraulic system pressure gage—2000 PSI. (P)
4. Landing gear emergency release handle—Pull. (P)
5. Main landing gear—Check visually. (P)
6. Landing gear position indicators—Check. (P)

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CONTINUED ON NEXT PAGE

CUT ON DOTTED LINE

GEAR FAILS TO EXTEND ON EMERGENCY PROCEDURE.

1. Airspeed—195 knots IAS maximum. (P)
2. Landing gear lever—Recycle, then DOWN. (P)
3. Left hydraulic system pressure gage—Check. (P)
4. Left engine—Shut down. (P)
5. Safety relays circuit breaker—Pull. (RO)
6. Flaps—Lower partially. (P)
7. Speed brakes—Open partially. (P)
8. Raise flaps and close speed brakes simultaneously. (P)
9. Left hydraulic system pressure gage—Check for 0 PSI. (P)
10. Emergency landing gear release handle—Pull. (P)
11. Emergency landing gear release handle (if gear fails to extend the first time)—Pull and hold. (P)
12. Pull positive "G's." (P)
13. Main landing gear—Check visually. (P)
14. Landing gear position indicators—Check. (P)

GEAR FAILS TO EXTEND BECAUSE OF MECHANICAL "BINDING."

1. Landing gear lever—DOWN. (P)
2. Landing gear emergency release "T" handle—Pull. (P)
3. Landing gear lever—UP.
4. Landing gear lever (when gear has fully retracted)—DOWN. (P)
5. Check gear down. (P)

CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

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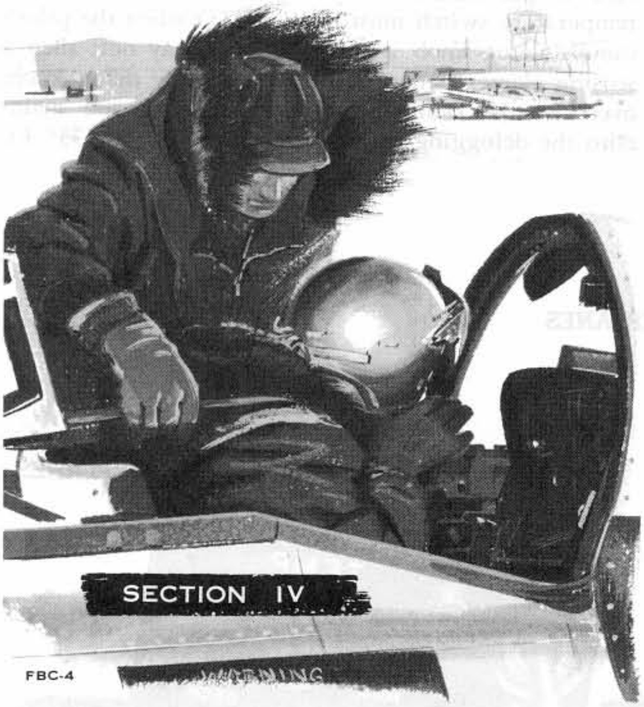
Description and Operation of

AUXILIARY EQUIPMENT



FBC-4

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CABIN AIR-CONDITIONING SYSTEM.

Air for cabin air-conditioning and pressurizing and for canopy defogging is taken from the eleventh stage of the engine compressors. It flows through a shutoff valve in the supply duct to a bypass valve and refrigeration unit. An electronic temperature-sensing system determines the setting of the bypass valve. Cooled air from the refrigeration unit mixes in the main duct with the hot air bypassing the unit and flows through floor outlets into the cabin. (See figure 4-2.) A cabin temperature rheostat regulates the temperature of the air entering the cabin and an automatic pressure regulator controls the pressure. The cabin air-conditioning system is controlled by 28-volt DC power and the electronic temperature-sensing system is operated by 115-volt AC power from the main or spare power inverter.

Cabin Pressure Regulator. B

An air pressure regulator automatically controls pressure within the cabin. Between 10,000 and 18,000 feet, the regulator maintains the cabin air pressure at the 10,000-foot altitude pressure. Above 18,000 feet, the regulator maintains a constant differential pressure of 2.75 PSI. (See figure 4-3.) If the cabin pressure regulator fails, a pressure-vacuum-relief valve will automatically relieve excessive pressure. When the airplane dives to an altitude where the outside pressure is greater than that in the cabin, the pressure-vacuum-relief valve opens, allowing the pressure to equalize.

Cabin Pressure Regulator.

The cabin is not pressurized below 12,500 feet. From 12,500 to either 21,000 or 31,000 feet, depending on cabin pressure schedule desired, the air pressure regulator maintains the cabin air pressure at the 12,500-foot altitude pressure. For normal operation the regulator maintains a constant differential pressure of 5 PSI above 31,000 feet. For combat operation the regulator should be set to the lower pressure schedule to maintain a differential pressure of 2.75 PSI above 21,000 feet. This will minimize the effects of explosive decompression if the cabin is suddenly depressurized. If the cabin pressure regulator fails, a pressure-vacuum-relief valve automatically relieves excessive pressure. When the airplane dives to an altitude where the outside pressure is greater than that in the cabin, the pressure-vacuum-relief valve opens to equalize the pressure.

CABIN AIR SWITCH.

The 28-volt DC cabin air switch (figure 4-1) on the pilot's instrument panel controls the source of cabin air and pressure. When the switch is at RAM & DUMP, ram air ventilates the cabin, the engine compressor air is shut off, and the cabin temperature control system is deenergized. When the switch is at PRESS., the ram air is shut off, the engine compressor air is turned on, and the cabin temperature control is energized.

CABIN AIR TEMPERATURE SWITCH.

The 28-volt DC cabin air temperature switch (figure 4-1) on the pilot's instrument panel has a center neutral position marked OFF; other positions are AUTO, MOM. INCR, and MOM. DECR. The switch is spring-loaded to OFF from the latter two positions. The switch provides a means of controlling cabin air temperature. When the switch is at AUTO, the cabin temperature is maintained automatically according to the setting of the cabin temperature rheostat knob. When the switch is held at MOM. INCR or MOM. DECR, the cabin temperature rheostat is cut out of the circuit and the cabin temperature increases or decreases in proportion to the length of time the switch is held. When the switch is released to OFF, the cabin temperature is not automatically controlled. The cabin air temperature switch must be at AUTO when the pilot's canopy defog knob is pulled all the way out; then a sensing element, energized by the canopy defog knob, overrides the cabin temperature rheostat and maintains the defogging air temperature at 79° C (175° F).

Figure 4-1.

CABIN TEMPERATURE RHEOSTAT KNOB.

When the cabin air temperature switch is at AUTO, the cabin temperature can be varied by adjusting the cabin temperature rheostat knob along its range from COOLER to WARMER. When the cabin air temperature switch is held at MOM. INCR or MOM. DECR, the rheostat is cut out of the electronic temperature-sensing circuit. The rheostat knob (figure 4-1) is on the pilot's instrument panel and operates on 28-volt DC.

CABIN DIFFERENTIAL PRESSURE SELECTOR SWITCH. C

For all normal operations the 28-volt DC cabin differential pressure selector switch (figure 4-1), located on the pilot's instrument panel, should be at 5.00 P.S.I., so that, from 12,500 to 31,000 feet, the cabin air pressure regulator will maintain the cabin pressure at the 12,500-foot level, and above 31,000 feet, will maintain a constant differential pressure of 5.00 PSI. For combat operations the switch should be moved to 2.75 P.S.I. to minimize explosive decompression effects if the cabin is depressurized suddenly.

CABIN AIR-CONDITIONING SYSTEM NORMAL OPERATION.

1. Cabin air switch—PRESS.
2. Cabin air temperature switch—AUTO.
3. Cabin temperature rheostat knob—As desired.
4. Cabin differential pressure selector switch (C airplanes only)—5.00 P.S.I.

CABIN AIR-CONDITIONING SYSTEM EMERGENCY OPERATION.

If the automatic temperature control fails, proceed as follows:

1. Cabin air temperature switch—Hold momentarily at MOM. INCR for warmer air or at MOM. DECR for cooler air.
2. Wait a few minutes for change to become evident; then repeat until desired temperature is attained.
3. If this fails, place cabin air temperature switch at RAM & DUMP.

CANOPY DEFOGGING SYSTEM.

Canopy defogging air is diverted from the cabin air-conditioning floor outlets and flows through ducts along the canopy rail. The temperature of the air is kept at 79° C (175° F) by a separate temperature-sensing unit which overrides the cabin temperature rheostat if the cabin temperature switch is set at AUTO and the pilot's canopy defog knob is pulled all the way out.

CANOPY DEFOG KNOBS.

Two canopy defog knobs (figure 1-11), one on the bottom of the pilot's center pedestal and one on the left side of the radar observer's cockpit (figure 4-6), are pulled out for canopy defogging. The defog knob mechanically adjusts a valve which diverts the cabin air from the floor outlet to the defogging ducts. Each crewmember controls canopy defogging for this cockpit, but only the pilot's defog knob can energize the sensing element which overrides the cabin temperature rheostat and maintains the defogging air at 79° C (175° F). The pilot's defog knob must be pulled all the way out to energize the sensing element, and the cabin temperature switch must be at AUTO to ensure automatic control of the air temperature. Turning the defog knob toward LOCK or UNLOCK increases or decreases the resistance to movement.

Note

Stub nozzles, installed in the radar observer's cockpit, improve torso comfort and eliminate the danger of direct hot air blasts on the canopy. These stub nozzles have the same flow characteristics as defog ducts, and flow is controlled by the radar observer's canopy defog knob.

CANOPY DEFOGGING SYSTEM OPERATION.

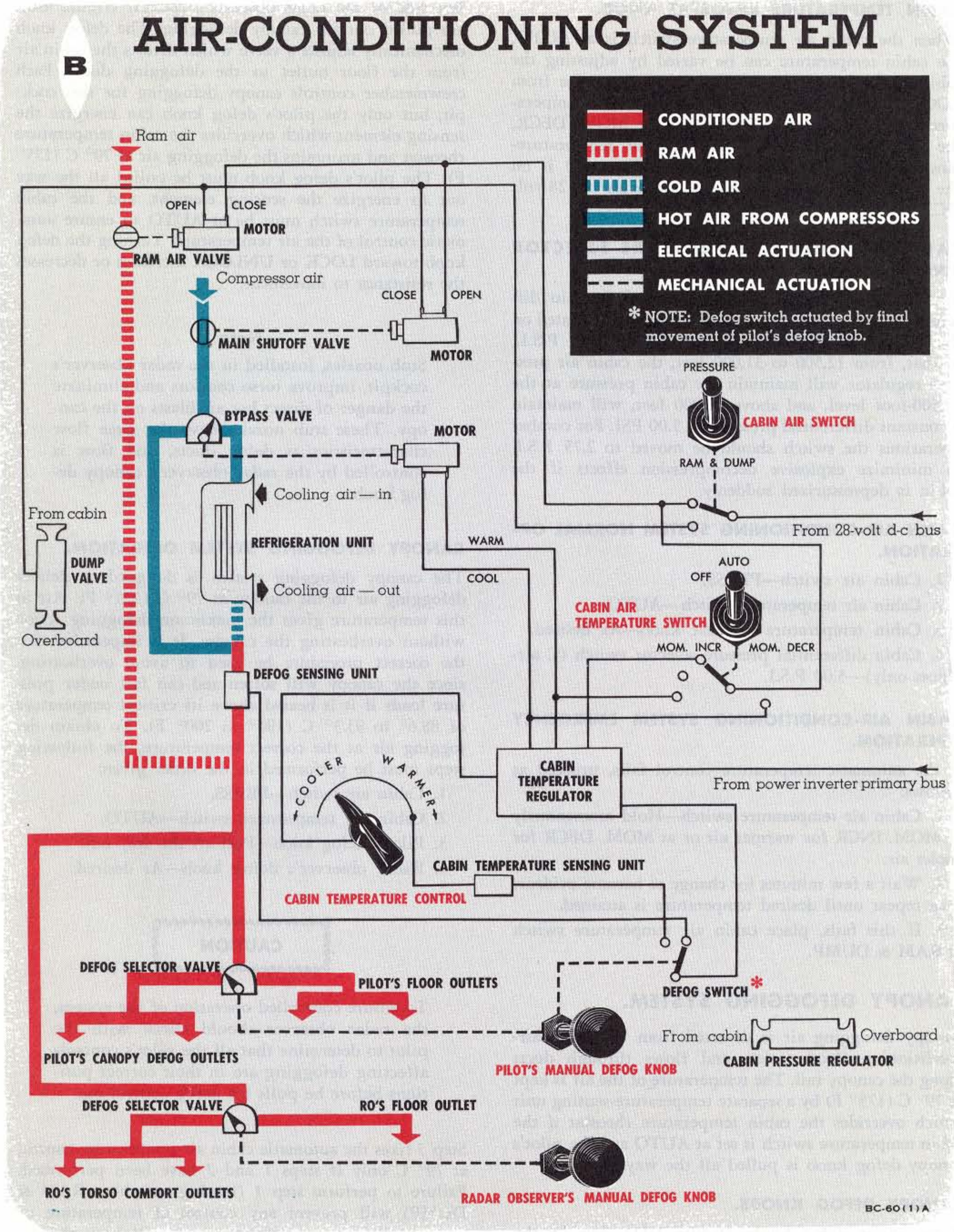
The canopy defogging system is designed to deliver defogging air to the canopy at 79° C (175° F). Air at this temperature gives the maximum defogging action without overheating the canopy. It is imperative that the correct procedure be used to avoid overheating, since the canopy will soften and can fail under pressure loads if it is heated above its critical temperature of 88.6° to 93.3° C (190° to 200° F). To obtain defogging air at the correct temperature, the following steps must be performed in the order given:

1. Cabin air switch—PRESS.
2. Cabin air temperature switch—AUTO.
3. Pilot's defog knob—Pull all the way out.
4. Radar observer's defog knob—As desired.

CAUTION

To ensure controlled operation of the system, the radar observer should check with the pilot to determine that all the pilot's controls affecting defogging are in their correct positions before he pulls his defog control out.

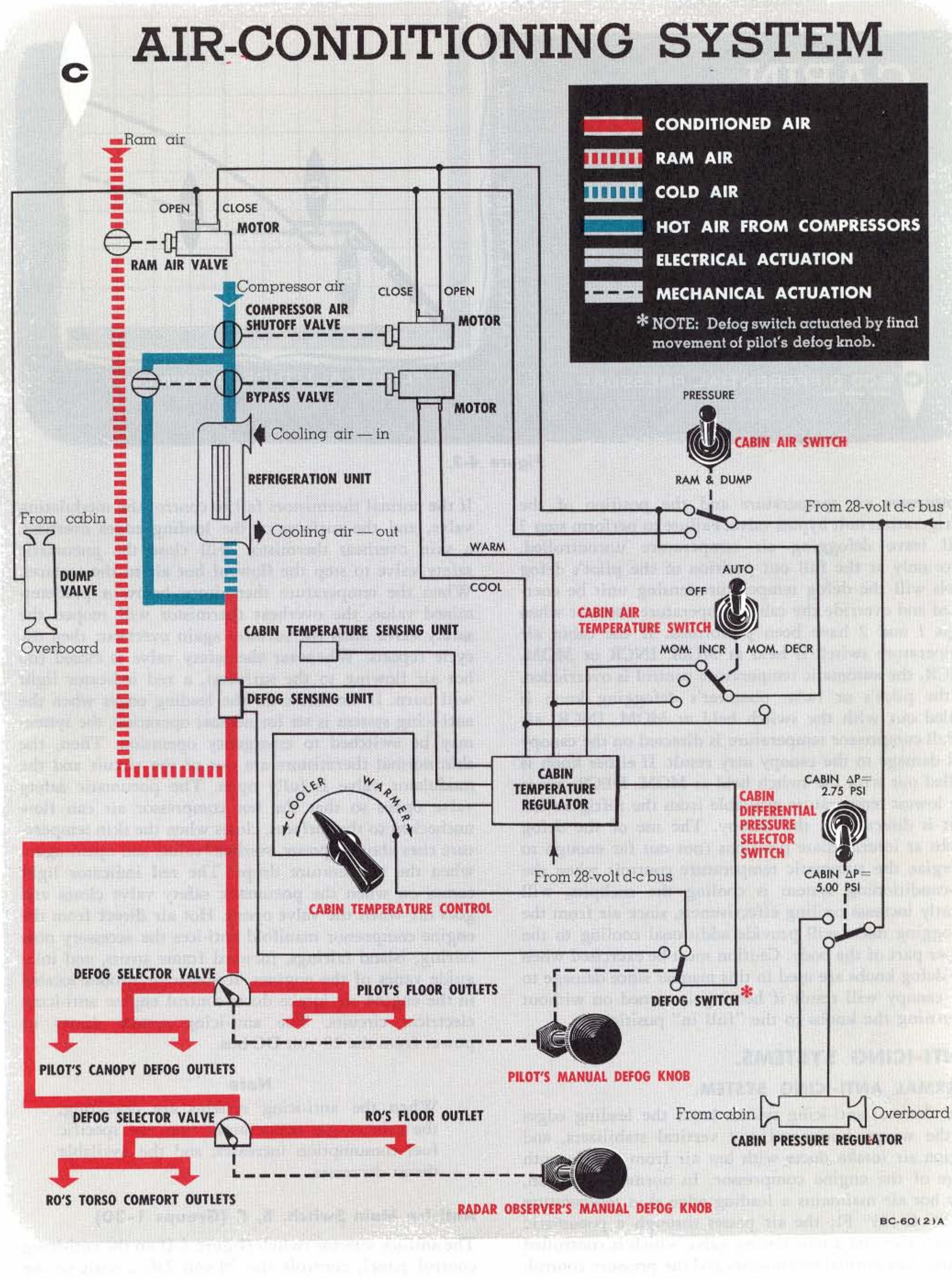
Step *3* fixes the automatic cabin air temperature control at 79° C only if steps *1* and *2* have been performed. Failure to perform step *1* (leaving switch at RAM & DUMP) will prevent any control of temperature or pressure. Failure to perform step *2* will leave the defogging air temperature uncontrolled, affected only by



B
AIR-CONDITIONING SYSTEM
CONDITIONED AIR
RAM AIR
COLD AIR
HOT AIR FROM COMPRESSORS
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
* NOTE: Defog switch actuated by final movement of pilot's defog knob.
Ram air
OPEN
CLOSE
MOTOR
RAM AIR VALVE
Compressor air
CLOSE
OPEN
MAIN SHUTOFF VALVE
MOTOR
BYPASS VALVE
MOTOR
PRESSURE
CABIN AIR SWITCH
RAM & DUMP
From 28-volt d-c bus
Cooling air — in
From cabin
REFRIGERATION UNIT
WARM
DUMP VALVE
COOL
Cooling air — out
AUTO
OFF
CABIN AIR TEMPERATURE SWITCH
MOM. INCR
MOM. DECR
Overboard
DEFOG SENSING UNIT
CABIN TEMPERATURE REGULATOR
From power inverter primary bus
COOLER
WARMER
CABIN TEMPERATURE SENSING UNIT
CABIN TEMPERATURE CONTROL
DEFOG SELECTOR VALVE
PILOT'S FLOOR OUTLETS
DEFOG SWITCH*
From cabin
Overboard
CABIN PRESSURE REGULATOR
PILOT'S CANOPY DEFOG OUTLETS
PILOT'S MANUAL DEFOG KNOB
DEFOG SELECTOR VALVE
RO'S FLOOR OUTLET
RO'S TORSO COMFORT OUTLETS
RADAR OBSERVER'S MANUAL DEFOG KNOB
BC-60(1)A

Figure 4-2.

AIR-CONDITIONING SYSTEM



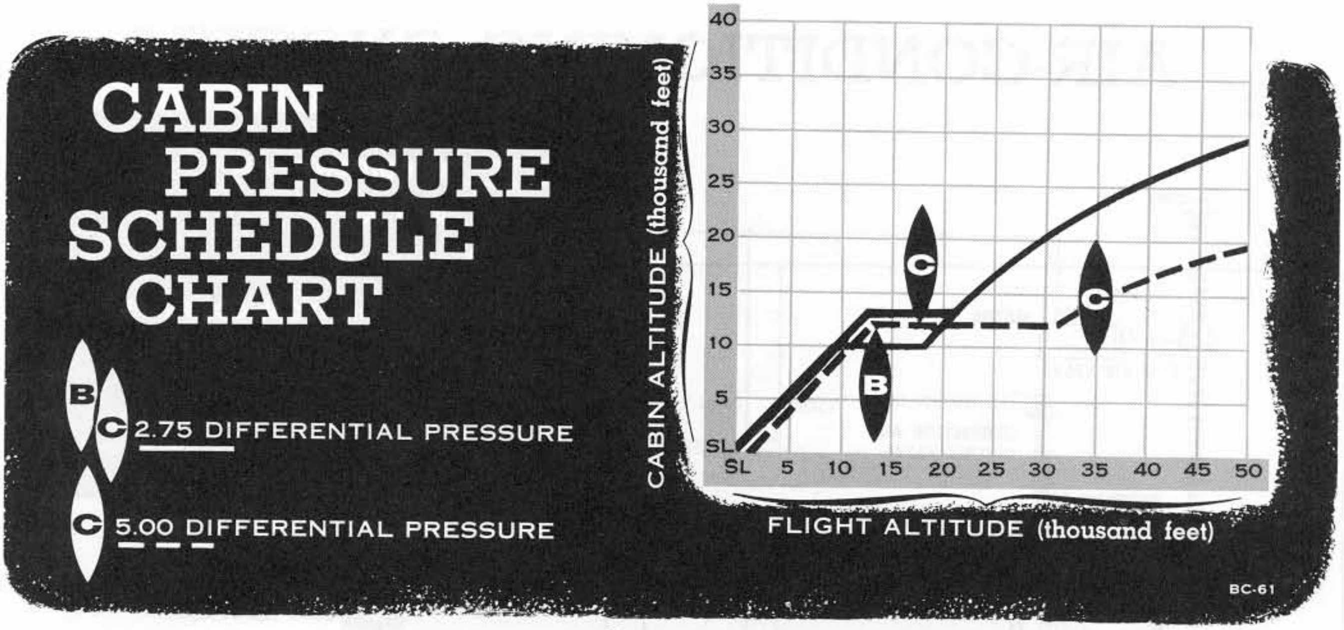


Figure 4-3.

compressor air temperature and the position of the refrigeration unit bypass valve. Failure to perform step *3* will leave defogging air temperature uncontrolled, since only at the full out position of the pilot's defog knob will the defog temperature-sensing unit be energized and override the cabin temperature rheostat when steps *1* and *2* have been performed. If the cabin air temperature switch is held at MOM. INCR or MOM. DECR, the automatic temperature control is overridden. If the pilot's or radar observer's defogging knob is pulled out with the switch held at MOM. INCR, air at full compressor temperature is directed on the canopy and damage to the canopy may result. If either knob is pulled out with the switch held at MOM. DECR, air at the lowest temperature available from the refrigeration unit is directed on the canopy. The use of the defog knobs at intermediate positions (not out far enough to energize the automatic temperature control) when the air-conditioning system is cooling the cockpits, will greatly increase cooling effectiveness, since air from the defogging ducts will provide additional cooling to the upper part of the body. Caution must be exercised when the defog knobs are used in this manner since damage to the canopy will result if heating is turned on without returning the knobs to the "full in" position.

ANTI-ICING SYSTEMS.

THERMAL ANTI-ICING SYSTEM.

The thermal anti-icing system heats the leading edges of the wings, horizontal and vertical stabilizers, and engine air intake ducts with hot air from the eleventh stage of the engine compressor. In normal operation, this hot air maintains a leading edge skin temperature of 28° C (83° F); the air passes through a pneumatic safety valve and a modulating valve which is controlled by the skin normal thermistors and the pressure control. If the normal thermistors fail to control the modulating valve, and the surfaces of the leading edges overheat, a skin overheat thermistor will close the pneumatic safety valve to stop the flow of hot air to the surfaces. When the temperature then drops below a predetermined value, the overheat thermistor will reopen the safety valve until the surfaces again overheat; then the cycle repeats. Whenever the safety valve is closed (no hot air flowing to the surfaces), a red indicator light will burn. If ice forms on the leading edges when the anti-icing system is set for normal operation, the system may be switched to emergency operation. Then, the skin normal thermistors are out of the circuit and the modulator valve is fully open. The pneumatic safety valve opens so that the hot compressor air can flow unchecked to the surfaces, closes when the skin temperature rises above a preset overheat value, and opens again when the temperature drops. The red indicator light comes on when the pneumatic safety valve closes and goes off when the valve opens. Hot air direct from the engine compressor manifold anti-ices the accessory nose fairing, island fairings, forward frame struts, and inlet guide vanes of the engines. Ice-detector probes located in the engine air intake ducts control engine anti-icing electrical circuits. The anti-icing system draws its power from the 28-volt DC bus.

Note

When the anti-icing systems are operating, the exhaust gas temperature rises, the specific fuel consumption increases, and the available thrust decreases.

Anti-Ice Main Switch. B, C (Groups 1-30)

The anti-ice selector switch (figure 4-4) on the anti-icing control panel, controls the 28-volt DC circuit to the anti-icing system. There are three switch positions: ANTI-ICE ENG & WING, OFF, and ENG ONLY. When engine anti-icing is desired for takeoff or during final approach prior to landing, the switch should be placed at ENG ONLY. In flight, if wing and engine anti-icing is desired, the switch should be placed at ANTI-ICE ENG & WING. When the switch is at OFF all anti-icing circuits are deenergized and the modulating valve and pneumatic safety valve are closed.

Anti-Ice Master Switch. C (Group 35 and Subsequent)

The anti-ice master switch (figure 4-4), on the anti-icing control panel, controls the 28-volt DC circuits for the anti-icing systems. When the switch is at OFF, all circuits in the anti-icing system are deenergized. Placing the switch at TAKE OFF arms the engine and tip tank anti-icing circuits. When ice forms on the engine ice-detector probes, the engine anti-icing system begins operating; after the airplane is airborne, the tip tank heating system is energized. Placing the switch at FLIGHT arms the wing, tip tank, and engine anti-ice systems; when ice forms on the ice-detector probes, the normal circuits are energized and the systems operate automatically. When the switch is turned to ENG ON EMER—WING ON AUTO, the engine ice-detector probes control only the tip tank heaters, and the engine and wing anti-icing systems begin immediately and continue until the anti-ice master switch is turned to OFF. When the switch is placed at ALL EMER, all systems operate immediately and the engine ice-detector probes and the wing system normal temperature controls are out of the circuits.

Engine Probe Reset Switch. C (Group 35 and Subsequent)

The spring-loaded, 28-volt DC engine probe reset switch on the anti-icing control panel (figure 4-4) is held momentarily at ON to energize the engine ice-detector probe heaters. When the probes are de-iced, the ice detector system is reset and the probe heaters and all anti-icing circuits are deenergized. If ice forms on the probes again, the anti-icing circuits are re-energized and the systems operate until the reset switch is held at ON or the anti-ice master switch is turned to OFF.

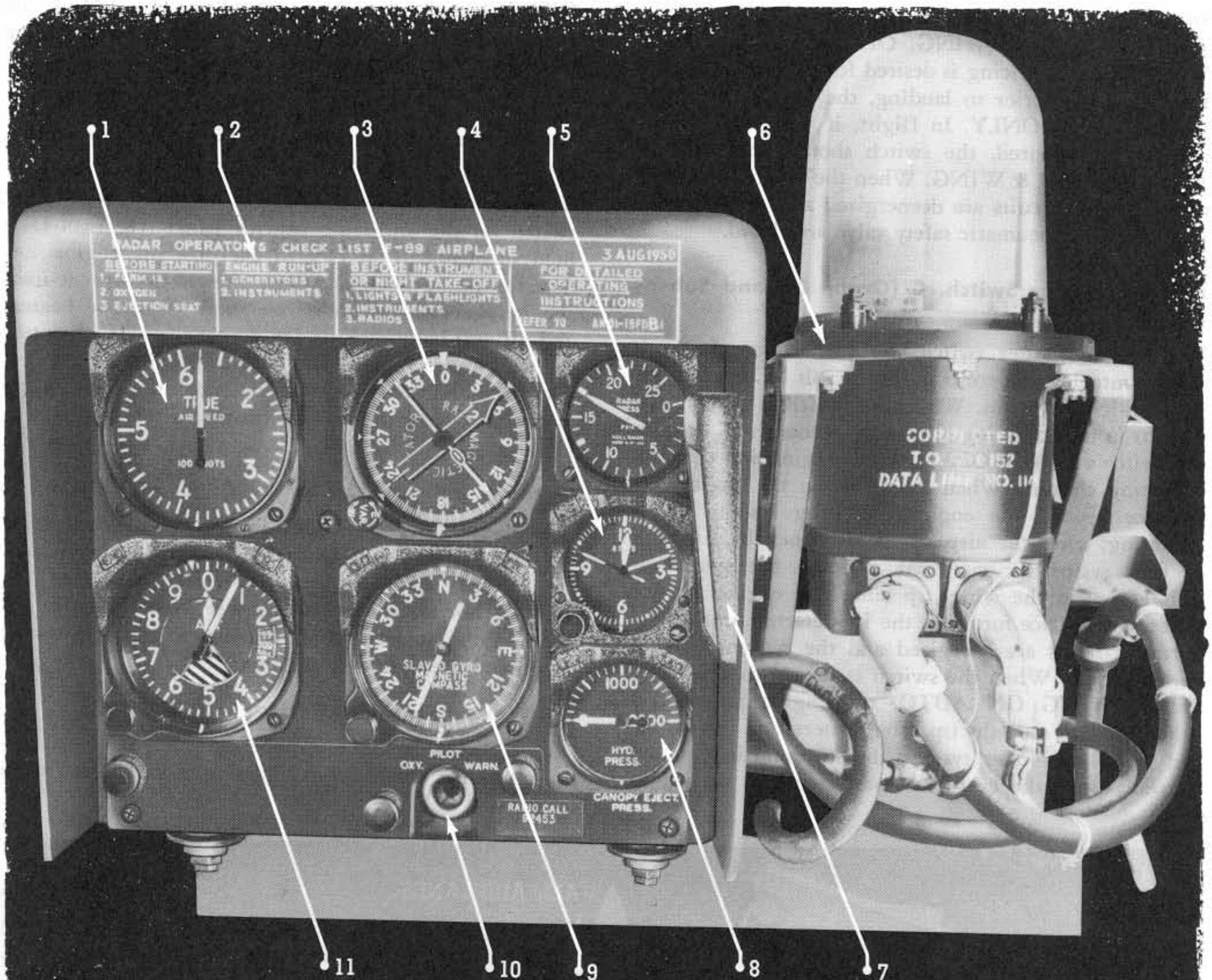
Anti-Ice Indicator Light. B, C (Groups 1-30)

The 28-volt DC thermal anti-ice indicator light (figure 4-4), on the anti-icing control panel, will come on during normal and emergency operation whenever the flow of hot air is stopped because of overheating. As soon as the surfaces cool, hot air will start flowing again and the light will go out.

Ice Warning Light. B, C (Groups 1-30)

An ice warning light located on the pilot's left defogging duct comes on to signal presence of ice in the

Figure 4-4.



(TYPICAL)

RADAR OBSERVER'S INSTRUMENT PANEL

1. TRUE AIRSPEED INDICATOR
2. RADAR OBSERVER'S CHECKLIST
3. RADIO MAGNETIC INDICATOR
4. CLOCK
5. RADAR PRESSURE GAGE
6. RADIO COMPASS LOOP ANTENNA
7. COMPASS CORRECTION CARD HOLDER
8. CANOPY EJECTION PRESSURE GAGE
9. DIRECTIONAL INDICATOR (SLAVED)
10. OXYGEN WARNING LIGHTS * (Inoperative on some airplanes.)
11. ALTIMETER

* C Two oxygen warning lights on Group 20 and subsequent airplanes

BC-64 A

Figure 4-5.

engine air inlet duct. The light goes out when the thermal anti-icing system is turned on.

Anti-Ice Indicator Lights. C (Group 35 and Subsequent)

Two 28-volt DC thermal anti-icing indicator lights are on the anti-icing control panel. The engine anti-ice probe light (figure 4-4) is on whenever the engine anti-icing system is operating. The wing anti-ice overheat light (figure 4-4) comes on whenever the flow of wing anti-icing air is stopped because of overheating. As soon as the surfaces cool, hot air starts flowing again and the light goes out.

Anti-Icing System Normal Operation. B, C (Groups 1-30)

The following operating procedures are recommended for use of the anti-icing system when icing conditions are known or when they are indicated by the ice warning light.

Takeoff. Select ENG ONLY position of the anti-icing switch. This will retract the engine inlet screens and provide hot air anti-icing of the engine forward frame components.

WARNING

- Unless the anti-icing switch is placed at ENG ONLY when taking off into icing conditions, the engine screens will remain extended until the airplane leaves the ground. In severe icing conditions the engine screens may become iced within a few seconds, resulting in dangerous loss of power.
- ENG & WING position of anti-icing switch is not to be used on takeoff, because complete airplane surface anti-icing increases the demand on the compressor hot air bleed and causes a much greater loss in thrust.

In Flight (Level Flight and Climb). Select ENG & WING position of the anti-icing switch. This retracts the engine inlet screens if switch is in COMBAT position and provides hot air anti-icing of the airframe leading edge surfaces and engine forward frame components.

Descent. In making a descent from altitude through icing conditions, select ENG & WING position of the anti-icing switch, maintain a minimum of 85% engine RPM and use speed brakes to regulate airspeed and rate of descent. If ice then accumulates (additional hot air is required for anti-icing), increase the engine RPM and maintain airspeed.

Landing. To provide ice protection for the wings and empennage, place the anti-icing switch in ENG & WING position before the final approach of a landing in icing conditions with one or both engines operating. Use of the anti-icing system affords protection against icing conditions, but causes a decrease in available thrust. If a go-around is necessary, the anti-icing switch may remain in the ENG & WING position *only* if two engines with maximum thrust and afterburning are available. To provide maximum thrust in case of a possible go-around, place the anti-icing switch in ENG ONLY position during approach and landing under single-engine operation in light or moderate icing conditions. Adequate ice protection is available from one engine; however, available thrust may be dangerously reduced. In most cases moderate icing of the airfoil leading edges can be tolerated in preference to loss of engine thrust. When a go-around is necessary with both engines operating but afterburners are inoperative, or when a single-engine go-around is necessary, place the anti-icing switch in the ENG ONLY position until a safe go-around altitude is obtained. After a safe altitude is reached, the anti-icing switch may be moved back to ENG & WING position. In single-engine operation available thrust is low in landing and takeoff configurations. Therefore, it is imperative that flaps and landing gear are raised as soon as possible when making a single-engine go-around.

CAUTION

The hot air anti-icing systems use air from the engine compressor and thereby reduce the available thrust, increase the specific fuel consumption, and decrease the airspeed. The anti-icing systems should therefore be turned off when icing conditions no longer exist and should not be turned on in the absence of icing conditions.

Note

If the thermal anti-icing system has been in operation, the continued presence of icing conditions can be tested by placing the thermal anti-ice main switch at OFF. If the ice indicator light comes on in a few seconds, icing conditions are still present.

Anti-Icing System Normal Operation. C (Group 35 and Subsequent)

The following operating procedures are recommended for use of the anti-icing system in conditions of known or anticipated icing.

Figure 4-6 (Sheet 1 of 2 Sheets).

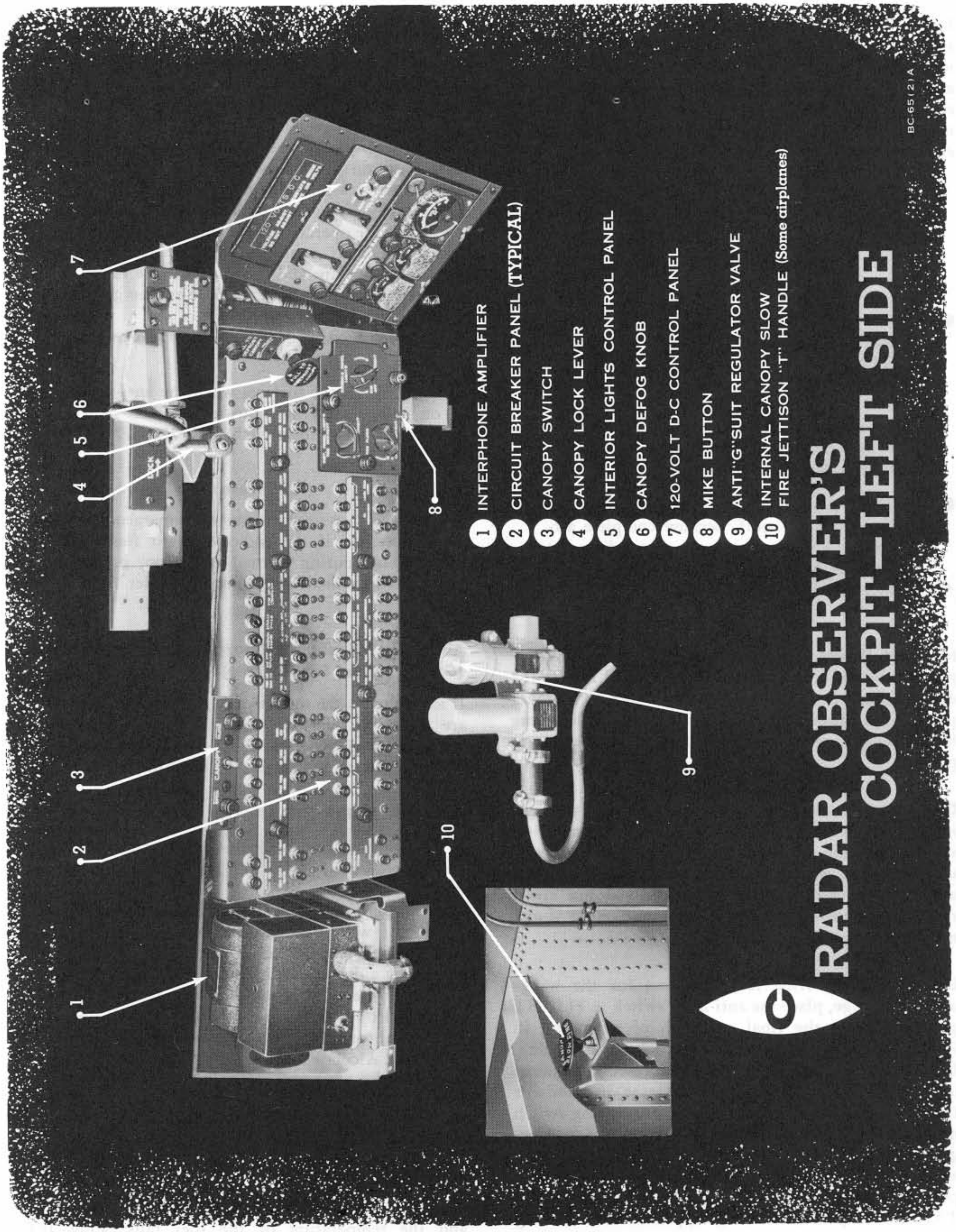


Figure 4-6. (Sheet 2 of 2 Sheets).

Takeoff. Select TAKE OFF position of anti-icing switch. This arms the engine circuit. The engine anti-ice probe light will come on to indicate the engine anti-icing system is operating. When ice forms on the engine ice detector probes, the engine anti-icing system is energized; the engine screens will retract if engine screen switch is in EXTENDED position.

WARNING

- Unless the anti-icing switch is placed at TAKE OFF and the engine screen switch at EXTENDED when taking off into icing conditions, the engine screens will remain extended until the airplane leaves the ground. In severe icing conditions the engine screens may become iced within a few seconds, resulting in dangerous loss of power.
- FLIGHT position of anti-icing switch is not to be used on takeoff, because complete airplane anti-icing increases the demand on the compressor hot air bleed and causes a much greater loss in thrust.

In Flight (Level Flight and Climb). Select FLIGHT position of the anti-icing switch. This will retract the engine inlet screens if screen switch is in EXTENDED position, and provide hot air anti-icing of the airframe leading edge surfaces and engine forward frame components.

Descent. In making a descent from altitude through icing conditions, select FLIGHT position of anti-icing switch, maintain a minimum of 85% engine RPM and use speed brakes to regulate airspeed and rate of descent. If ice then accumulates (additional hot air is required for anti-icing), increase the engine RPM and maintain airspeed.

Landing. To provide ice protection for the wings and empennage, place the anti-icing switch in FLIGHT position before the final approach of a landing in icing conditions with one or both engines operating. Use of the anti-icing system affords protection against icing conditions, but causes a decrease in available thrust. If a go-around is necessary, the anti-icing switch may remain in the FLIGHT position only if two engines with maximum thrust and afterburning are available. To provide maximum thrust in case of a possible go-around, place the anti-icing switch in TAKE OFF position during approach and landing under single-engine operation in light or moderate icing conditions. Adequate ice protection is available from one engine; however, available thrust may be dangerously reduced. In most cases moderate icing of the airfoil leading edges can be tolerated in preference to loss of engine thrust. When a go-around is necessary with both engines operating but afterburners are inoperative, or when a single-engine go-around is necessary, place the anti-icing switch in the TAKE OFF position until a safe go-around altitude is obtained. After a safe altitude is reached, the anti-icing switch may be moved back to FLIGHT position. In single-engine operation, available thrust is low in landing and takeoff configurations. Therefore, it is imperative that flaps and landing gear are raised as soon as possible when making a single-engine go-around.

Anti-Icing System Emergency Operation. B, C (Groups 1-30)

If ice forms on the surfaces when the anti-icing system is on and the thermal anti-ice selector switch is at NORMAL, place the switch at EMERGENCY.

Note

If it is necessary to use the emergency procedure, or if the indicator light flashes on and off during normal operation, have the system checked for malfunction after landing.

Anti-Icing System Emergency Operation. C (Group 35 and Subsequent)

If ice forms on the surfaces when the anti-icing systems are operating and the anti-ice master switch is at FLIGHT or ENG ON EMER—WING ON AUTO, turn the master switch to ALL EMER.

LOW PRESSURE FUEL FILTER DE-ICING SYSTEM.

A low pressure fuel filter de-icing system is provided for the engines. Alcohol can be injected into the system to dissolve ice particles in the low pressure fuel filter and in the engine fuel control. Low pressure fuel filter icing will be indicated by a warning light on the fuel control panel. Fuel control icing will be evidenced by a drop in RPM, by overspeeding, or by lack of throttle response in the affected engine. Overspeeding or a drop in RPM in excess of 2% while operating at 100% throttle setting can be construed as an icing condition. Alcohol from a 3.9 US gallon tank, located in the right wing, affords approximately 3 minutes total de-icing time. A 28-volt DC pump supplies pressure for operation of the low pressure fuel filter de-icing system. Two solenoid valves, one for each engine, control the flow of alcohol. Engine fuel icing is not necessarily associated with other icing conditions, but can occur whenever water particles exist in the fuel and the temperature of the fuel falls below 0°C (32°F).

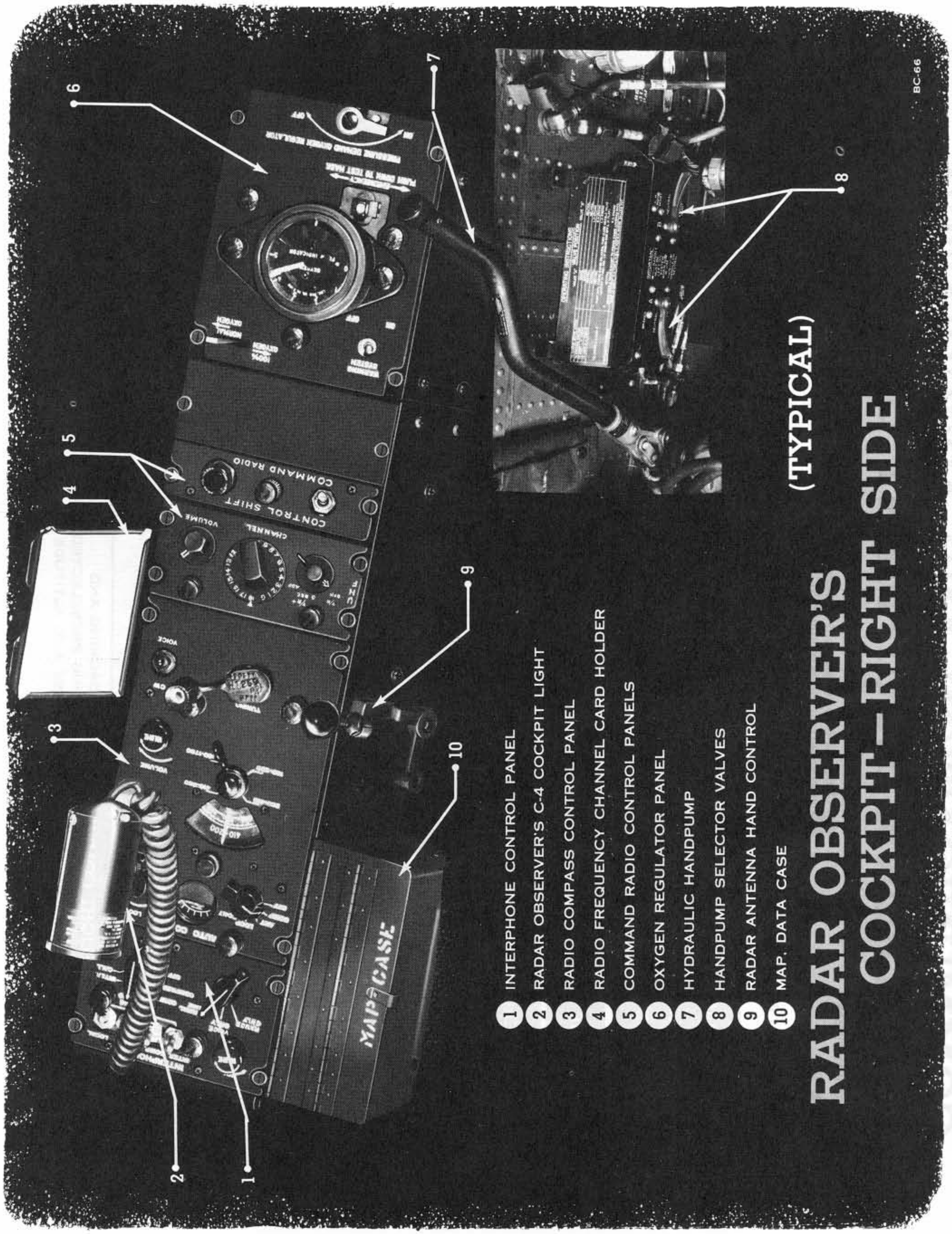

RADAR OBSERVER'S COCKPIT—RIGHT SIDE
(TYPICAL)
1 INTERPHONE CONTROL PANEL
2 RADAR OBSERVER'S C-4 COCKPIT LIGHT
3 RADIO COMPASS CONTROL PANEL
4 RADIO FREQUENCY CHANNEL CARD HOLDER
5 COMMAND RADIO CONTROL PANELS
6 OXYGEN REGULATOR PANEL
7 HYDRAULIC HANDPUMP
8 HANDPUMP SELECTOR VALVES
9 RADAR ANTENNA HAND CONTROL
10 MAP. DATA CASE
COMMAND RADIO
CONTROL SHIFT
VOLUME
CHANNEL
MAP CASE
BC-66

Figure 4-7.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT CHART

* B some airplanes

C Groups 1 through 20 airplanes

** C Group 25 and subsequent airplanes and some airplanes modified in accordance with T.O. 1F-89-518

TYPE AND DESIGNATION	FUNCTION	OPERATOR	RANGE	LOCATION OF CONTROLS
UHF COMMAND AN/ARC-27	AIR-TO-AIR AND AIR-TO-GROUND COMMUNICATION	PILOT OR RO	LINE-OF-SIGHT	Pilot's and Radar Observer's right consoles
RADIO COMPASS AN/ARN-6	VOICE RECEPTION, RADIO NAVIGATION	PILOT OR RO	UP TO 1000 MILES	Pilot's and Radar Observer's right consoles
INTERPHONE AN/AIC-2	CREW INTERCOMMUNICATION	PILOT OR RO	COCKPIT	Pilot's and Radar Observer's right consoles
MARKER BEACON AN/ARN-12	RECEPTION OF MARKER BEACON SIGNALS ON RANGE AND LOCALIZER LEGS	PILOT	FROM GROUND TRANSMITTER TO AIRPLANE	Pilot's instrument panel
RADAR AN/APG-33	ALL-WEATHER AIR-TO-AIR SEARCH	RO	LINE-OF-SIGHT	Radar Observer's azimuth range indicator
RADAR IFF AN/APX-6	AUTOMATIC AIRCRAFT IDENTIFICATION	PILOT	2-200 MILES	Pilot's right console
GLIDE SLOPE * .... AN/ARN-5B GLIDE SLOPE ** AN/ARN-18	INSTRUMENT APPROACH GLIDE SLOPE	PILOT	15 MILES	Pilot's right console
VHF NAVIGATION AN/ARN-14	VOR, VAR NAVIGATION, VOICE RECEPTION, LOCALIZER	PILOT	LINE-OF-SIGHT	Pilot's right console
ZERO READER (FLIGHT COMPUTER) Operation of the A-1 flight computer and the zero reader are basically the same. (Refer to applicable text.)	APPROACHING AND HOLDING PRESELECTED COURSE AND ALTITUDE	PILOT	LINE-OF-SIGHT	Pilot's instrument panel

BC-63A

Figure 4-8.

Low Pressure Fuel Filter De-Ice Switch and Warning Light.

A three-position 28-volt DC switch, spring-loaded to OFF (center) with other positions RH (or RIGHT) and LH (or LEFT) (figure 1-18) is located on the fuel control panel. This switch controls power to a 28-volt DC motor-driven de-icing pump, and opens either of two normally closed solenoid valves in the lines from the pump to the engine fuel filters. The fuel filter de-ice warning lights (figure 1-18), one for each engine, are mounted on the fuel control panel. These lights, controlled by a pressure switch at each filter, will come on when the fuel flow through the filter is restricted by ice formation (or by excessive sediment). When filter icing is indicated by either the right or the left light coming on, or when engine fuel control icing is indicated by variation in engine RPM or lack of throttle response, the switch should be held to the position representing the affected engine (RH or LH) until the light goes out, or until engine RPM ceases to fluctuate, indicating that the fuel flow is back to normal. Normal flow should resume in 30 seconds or less. When the switch is released, the alcohol pump will stop operating and the solenoid valve in the line to the filter that was de-iced will return to its normally closed position. The alcohol supply will afford 3 minutes or more of the total pump operation as the pump delivery rate averages slightly more than 1 gallon per minute.

Note

If foreign matter, other than ice, restricts the flow of fuel through the filter, the warning light will come on as during icing. A filter clogged by foreign matter will be indicated if the warning light remains on after approximately 30 seconds of de-icing operation. This should not cause alarm, for before the fuel pressure drop across the filter becomes critical, a bypass valve will open and fuel will be routed around the filter. However, it is important to make sure that the filter is cleaned immediately after completion of flight.

TIP TANK ANTI-ICING SYSTEM. (INOPERATIVE)

An electrically-heated anti-icing blanket is inside the removable nose section of each wing tip tank. When the system is energized, 28-volt DC closes a relay which directs 120-volt DC to the heating element of the blanket. A thermostat in series with this relay limits the blanket temperature to 88°C (190°F) by controlling the 120-volt direct current. A microswitch on the landing gear prohibits the tip tank anti-icing system from operating while the airplane is on the ground.

Tip Tank Anti-Ice Switch. B, C (Groups 1-30)

A tip tank anti-ice switch (figure 4-4), on the anti-icing control panel, has ON and OFF positions to control tip tank anti-icing. When the switch is at OFF, the tip tank anti-icing circuits are not energized. When the switch is moved to ON, 28-volt DC closes a relay which directs 120-volt DC to the heating element of the tip tank anti-icing blanket and the system operates automatically to maintain a blanket temperature of 88° C (190° F).

Tip Tank Anti-Ice Switch. C (Group 35 and Subsequent)

The master anti-ice switch (figure 4-4), on the anti-ice control panel, controls the tip tank anti-ice system. When the switch is placed at any position except OFF, the tip tank anti-ice system is energized.

Note

A microswitch on the landing gear breaks the tip tank anti-ice circuits while the airplane is on the ground, except when the master anti-ice switch is placed at ALL EMER.

PITOT HEAT SYSTEM.

A 28-volt DC heating element heats each pitot tube. A pitot heater switch is on the anti-icing control panel and the circuit breaker for the system is on the radar observer's left console. Care should be exercised in ground operation to prevent overheating the pitot tubes.

Pitot Heater Switch.

A pitot heater switch (figure 4-4), on the anti-icing control panel, has ON and OFF positions. When the switch is turned to ON, the 28-volt DC heating elements are energized. When the switch is turned to OFF, all pitot heater circuits are deenergized. The switch should be OFF during ground operation to prevent burning out the heater element.

WINDSHIELD HEAT SYSTEM.

The windshield is defrosted and de-iced by two transparent heat-conducting films within the windshield glass. The defrost system utilizes the 28-volt DC and 115-volt AC single-phase inverter systems for control and sensing circuits, and alternating current from the 115-volt single-phase inverter system for windshield heat. The temperature is automatically controlled by heat-sensing elements and temperature regulators.

Windshield Heat Switch.

The rotary windshield heat switch (figure 4-4) is on the anti-icing control panel on B and C (Groups 1 through 30) airplanes, and at the forward end of the miscellaneous control panel (figure 4-4) above the pilot's left console on C (Group 35 and subsequent) airplanes. The switch, rotating from OFF to DEFROST & WARM-UP and then DE-ICE, controls the windshield defrost and de-ice AC circuits. When the switch is at DEFROST & WARM-UP, full 115-volt AC power is supplied to the inner conducting film, and medium AC power is supplied to the outer conducting film. When the switch is at DE-ICE, full AC power is supplied to both conducting films. DE-ICE should be used only for emergency conditions (heavy ice). The switch should be returned to DEFROST & WARM-UP as soon as possible. If the main power inverter fails, the spare power inverter will supply power for the defrost circuits only.

CAUTION

- To prevent possible bubbling of the transparent conducting films in the windshield glass, keep the windshield heat switch at DEFROST & WARM-UP for at least 1 minute before turning to DE-ICE. Never operate the system on DE-ICE longer than necessary.
- On C (Group 25 and subsequent) airplanes, the windshield heat switch must be at OFF during the entire engine starting procedure. The electrical power requirement for ignition on these airplanes is higher than that on the earlier C airplanes. If the switch is not at OFF, an overload condition may burn out the inverter.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

COMMAND RADIO AN/ARC-27.

The command radio set is used for airplane-to-airplane and airplane-to-ground communication. Range varies with altitude and atmospheric conditions. The command radio and its controls operate on 28-volt DC power.

Command Radio Controls.

Controls for the command radio (figure 4-9) are on the command radio control panel on the pilot's right console and the radar observer's right console. Each control panel has a power control switch, channel selector switch, and a volume control knob. A control-shift switch and a green indicator light are adjacent to each control panel. The control-shift switches transfer control of the command radio to either cockpit, and the green light comes on in the cockpit having control. To transmit, the pilot has a press-to-talk microphone button on the throttle knob (figure 1-7). The radar observer has either a foot microphone switch or a press-to-talk button.

Command Radio Operation.

1. Interphone selector switch—MIX. SIG. & COMMAND.
2. Power control switch—T/R. Allow equipment to warm up for at least 1 minute.
3. Channel selector switch—Rotate to desired frequency channel. Set is now ready to transmit and receive.
4. Power control switch—T/R G REC, if simultaneous reception on guard-frequency channel and another channel is desired.

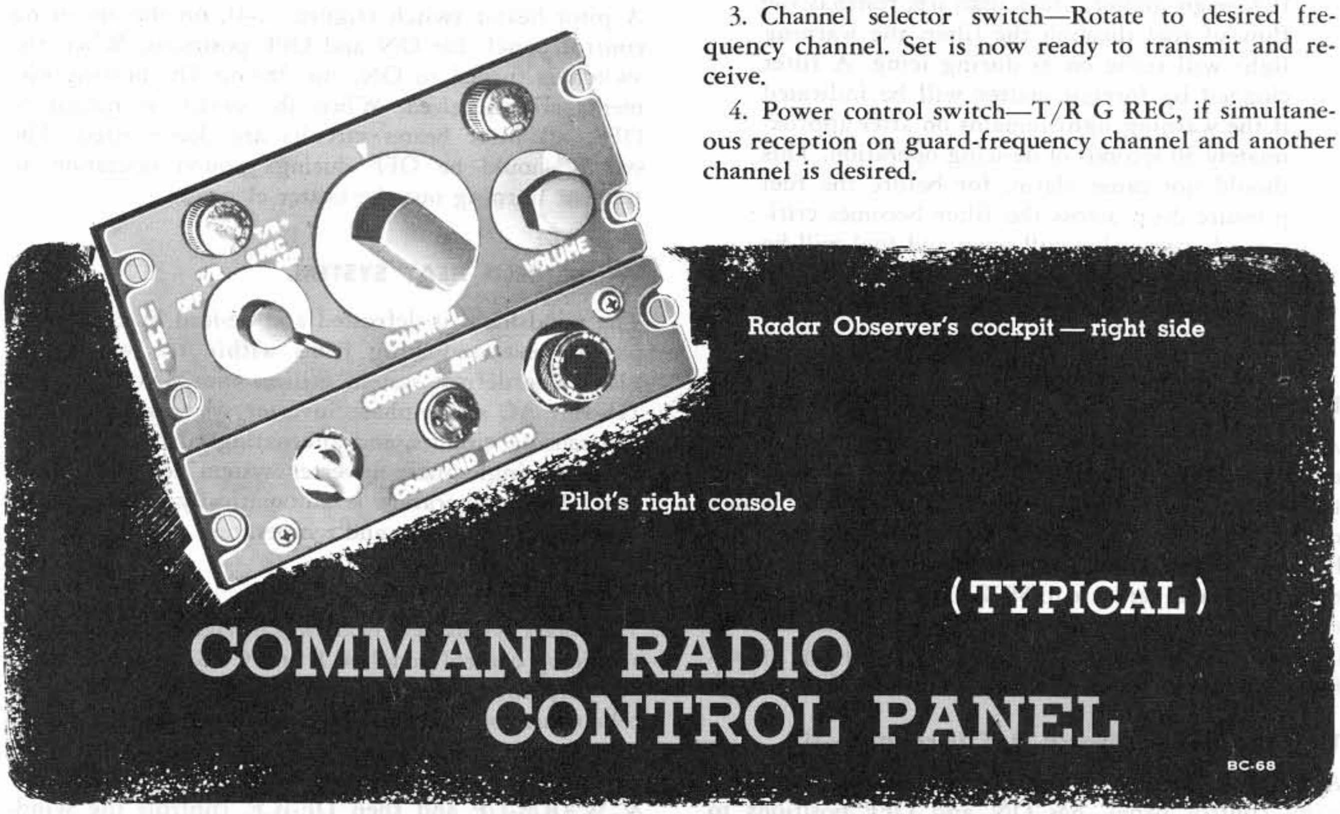


Figure 4-9.

5. Volume control knob—Adjust as desired.
6. Microphone button—Press to transmit.
7. Power control switch—OFF to turn set off.

CAUTION

- When the command radio set has been turned off, do not turn on again for 1 minute. This allows the condensers to discharge and prevents excessive power surge.
- To avoid damage to the selector mechanism, do not select another channel while set is in midcycle.

Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, the radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

RADIO COMPASS AN/ARN-6.

The radio compass, operating on 28-volt DC power, indicates the direction of any desired low-frequency transmitting station when the radio compass is set for homing operation of the loop antenna. The signal is fed to one of the needles of each radiomagnetic indicator (figure 4-16).

Radio Compass Controls.

The controls for the radio compass are on the radio compass panels (figure 4-10), on the right console of each cockpit. Each control panel has a function switch, frequency band selector switch, loop L-R switch, volume control knob, cw-voice switch, and tuning crank. Either crewmember can gain control of the radio compass by turning the function switch to CONT.

Radio Compass Operation.

1. Function switch—CONT momentarily to gain control; then turn to desired position. Warm up for at least 5 minutes.
2. Interphone selector switch—MIX. SIG. & COMMAND.

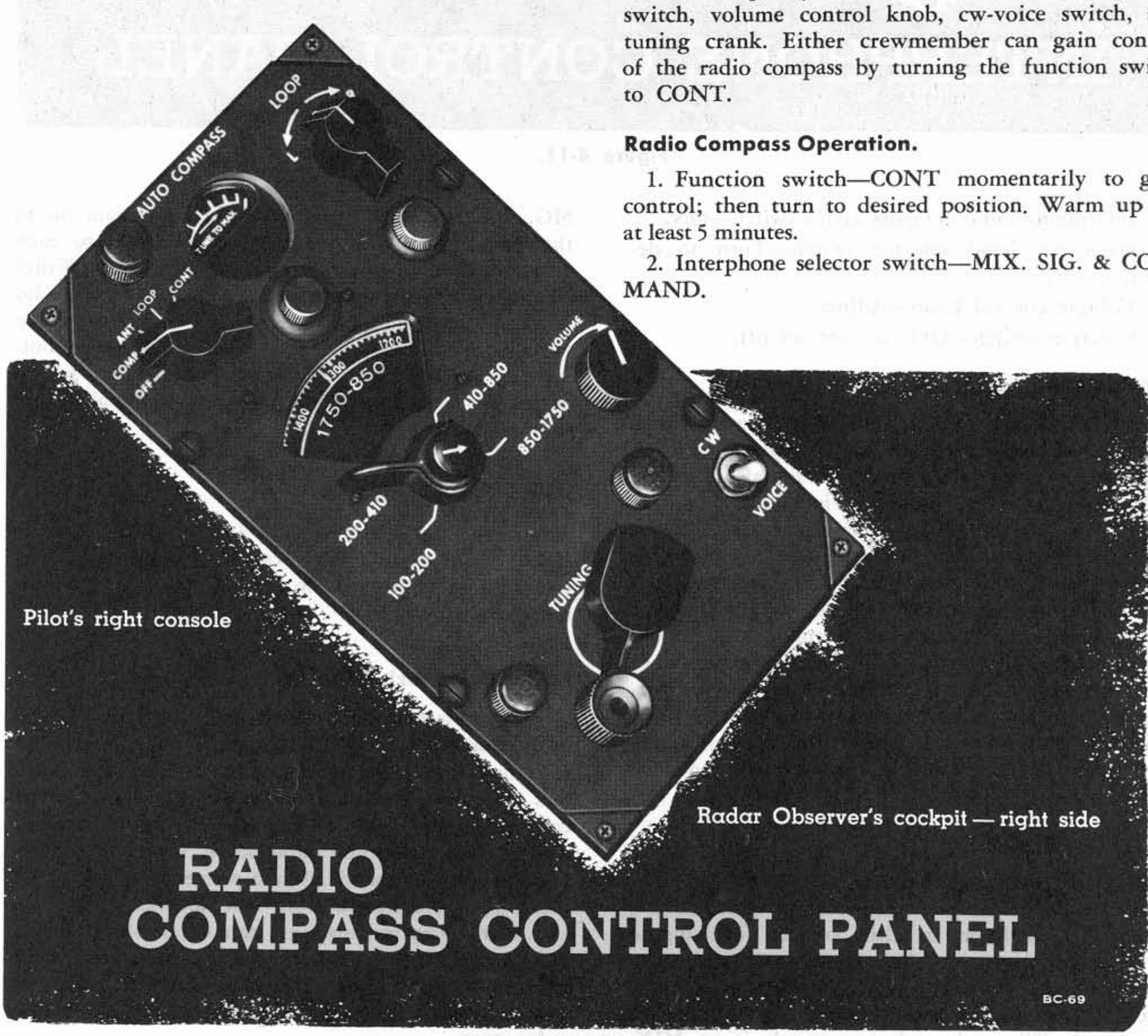


Figure 4-10.

Figure 4-11.

3. Interphone radio compass audio switch—ON.
4. Frequency band selector switch—Turn to desired frequency.
5. Volume control knob—Adjust.
6. Function switch—OFF, to turn set off.

INTERPHONE AN/AIC-2.

The interphone system is for communication between the pilot and the radar observer. The system also has switches to control incoming audio signals from the other radio equipment and to mix incoming signals so that the operator can listen to several receivers at the same time. On airplanes modified in accordance with T.O. 1F-89-627, an audible landing gear warning signal is transmitted to the pilot's headset when the gear is in an unsafe condition. The interphone system and controls operate on 28-volt DC power. The system "hot mike" enables the crew to communicate without operating a microphone switch. Jackboxes in the radio equipment section and the right wheel well allow communications between the airplane crew and the ground crew.

Interphone Controls.

The interphone controls (figure 4-11) are on the right console in each cockpit. Each control panel has a volume control knob, a filter switch, four toggle switches (which enable the operator to receive incoming signals simultaneously), and rotary selector switch (to connect the microphone to the appropriate equipment). When the selector switch is at MIX. SIG. & COMMAND, the microphones remain on so that the pilot and radar observer can talk to each other without pressing a microphone button. Either crewmember can transmit on the command radio without changing the position of the interphone selector switch. Pressing the pilot's microphone button or the radar observer's switch cuts the "hot mike" out of the circuit and connects the microphone to the command transmitter.

Pilot's Microphone Switch.

A microphone switch (figure 1-7) is located on the right engine throttle knob, can be pressed to transfer the microphone input from the interphone to the command transmitter.

Radar Observer's Microphone Switches.

A radar observer's microphone switch (figure 4-6) is located on the left side of the cockpit just below the interior lights control panel and, when pressed, transfers the microphone input from the interphone to the command transmitter. A foot-operated switch, located on the floor under the radar scope, serves as a radio audio disconnect switch. When pressed, it prevents all incoming radio signals from reaching both the front and rear cockpits; however, the radar observer can talk to the pilot on the interphone. This arrangement permits the radar observer to shut out temporarily any distracting radio noises while concentrating on the radar scope.

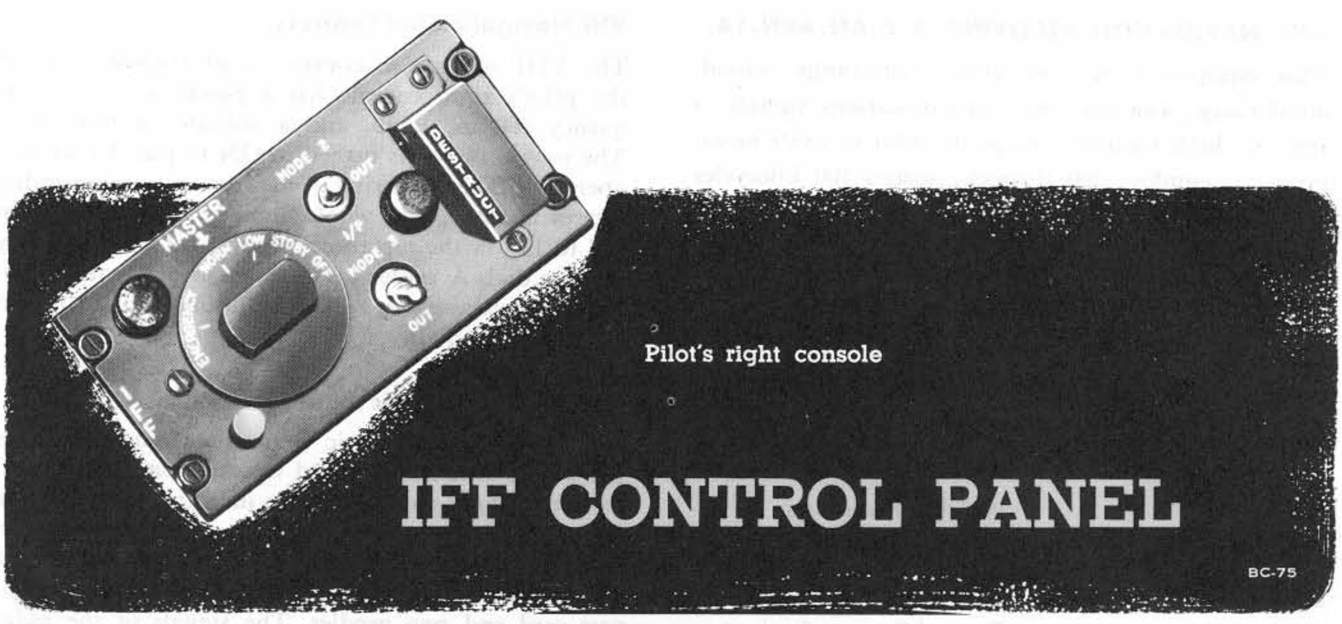


Figure 4-12.

Interphone Operation.

1. Filter switch—NORMAL USE.
2. Interphone selector switch—MIX. SIG. & COMMAND.
3. Interphone toggle switch—INTER.
4. Volume control knob—Adjust as desired.

MARKER BEACON RECEIVING SET AN/ARN-12.

The marker beacon receiving set gives visual and aural coded signals whenever the airplane passes over a marker beacon transmitter, thus enabling the pilot to determine his exact position. The visual signal is given by an amber light on the course indicator (figure 4-14); the aural signal is heard through the interphone system whenever the interphone marker beacon switch is on. The set operates whenever the 28-volt DC bus is energized.

RADAR EQUIPMENT AN/APG-33.

See Armament Equipment, this section.

IFF AN/APX-6.

The AN/APX-6 identifies the airplane in which it is installed as friendly when correctly challenged by an interrogator-responsor, or I-R, associated with friendly radars. When the interrogator receives a proper IFF reply from the target airplane, the target is considered friendly. The AN/APX-6 operates on 115-volt, single-phase AC from the main or spare inverter and 28-volt DC from the primary bus, with the circuit breaker on the radar observer's circuit breaker panel.

IFF Controls.

The master control knob, mode selector switches, and destruction switch (figure 4-12) are on the IFF control panel on the pilot's right console. The destruction switch is wired directly to the battery.

IFF Normal Operation.

Turn on the IFF equipment by placing the master control knob at STBY. The tactical situation or the communications officer will determine the ultimate position of the master control knob and mode switches for each mission. To turn the equipment off, place the master control knob at OFF.

IFF Emergency Operation.

For emergency operation, press dial stop and turn master control to EMERGENCY. A switch is installed on each ejection seat to provide automatic selection of IFF emergency mode whenever either seat is ejected from the airplane.

IFF Destruction.

To fire destructors, lift the guard labeled DESTRUCT with enough force to break the safety wire; then push switch forward to ON. A crash switch will automatically fire the destructors in case of a crash.

WARNING

The destruction switch should be operated only when the IFF is in danger of falling into enemy hands. If fired inadvertently, report it immediately so that a new receiver-transmitter can be installed.

VHF NAVIGATION RECEIVING SET AN/ARN-14.

This equipment receives visual omnirange, visual-aural range, localizer, and communications signals in the very high frequency range of 108.0 to 135.9 megacycles. It employs 280 channels, spaced 100 kilocycles apart, in the following categories:

FREQUENCY ALLOCATIONS

Frequency Band In Megacycles	*Type of Service*
108.0—111.9	Runway Localizer
108.3—110.3	Visual-Aural Range (VAR)
111.0—111.9	Weather Broadcasts
112.0—117.9	Visual Omnirange (VOR)
118.0—121.9	Tower
122.0—135.9	General Communications

As the transmission in these bands is line-of-sight, reception varies from 3 miles unobstructed distance at sea level, to approximately 100 miles at 10,000 feet, and even greater distances at higher altitudes. The dynamotor operates on 28-volt DC; the indicators operate on 115-volt AC from the single-phase bus.

VHF Navigation Set Controls.

The VHF navigation control panel (figure 4-13) on the pilot's right console has a power switch, a frequency selector knob, and a volume control knob. The power switch is turned to ON to put the set into operation. The outer ring of the frequency selector dial rotates to show, as a whole number, megacycles from 108 to 135 in the top three windows of the frequency selector dial. A center knob tunes in one-tenth megacycle intervals, which appear as decimals in the fourth window of the dial.

VHF Radio-Magnetic Indicator.

The VHF radio-magnetic indicator (figure 4-16) on the pilot's instrument panel operates on 115-volt AC from the single-phase bus. This indicator combines the functions of the gyromagnetic compass repeater with those of the radio compass and omnirange indicators. The radio magnetic indicator includes a rotating compass card and two needles. The signals of the radio compass are fed to one needle; the signals of the omnirange receiver are fed to the other needle when the receiver is tuned to a VOR transmitter. The angle between the needle and the index at the top of the instrument face will give the relative bearing; and the radio-magnetic indicator will read, on the card under the point of the needle, the actual magnetic bearing to the station regardless of the heading of the airplane. Since the card will hold to magnetic north and the two needles will hold to the tuned radio stations, the card and the needles will appear to rotate as if fixed together whenever a tight turn is made at some distance from the stations. On C (Group 25 and subsequent) airplanes, the rotating compass card will be electrically locked into place with the zero bearing

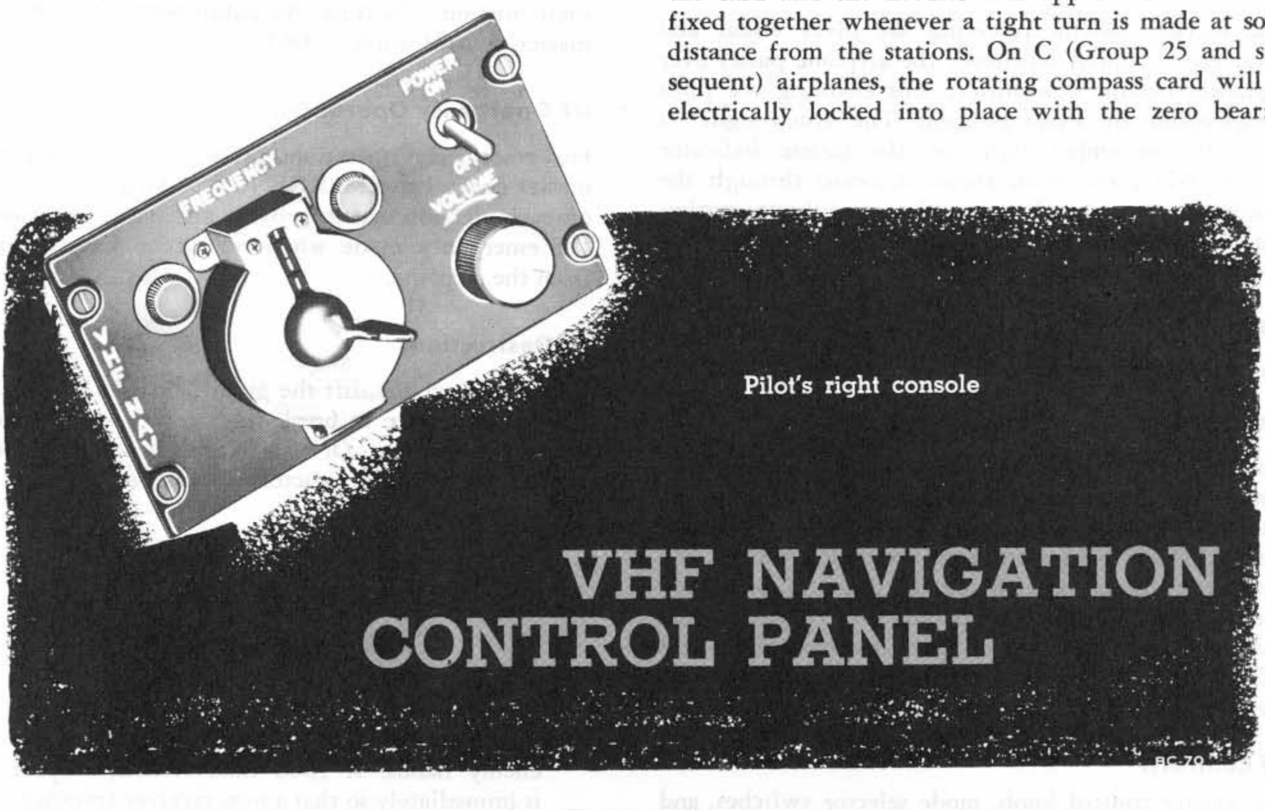


Figure 4-13.

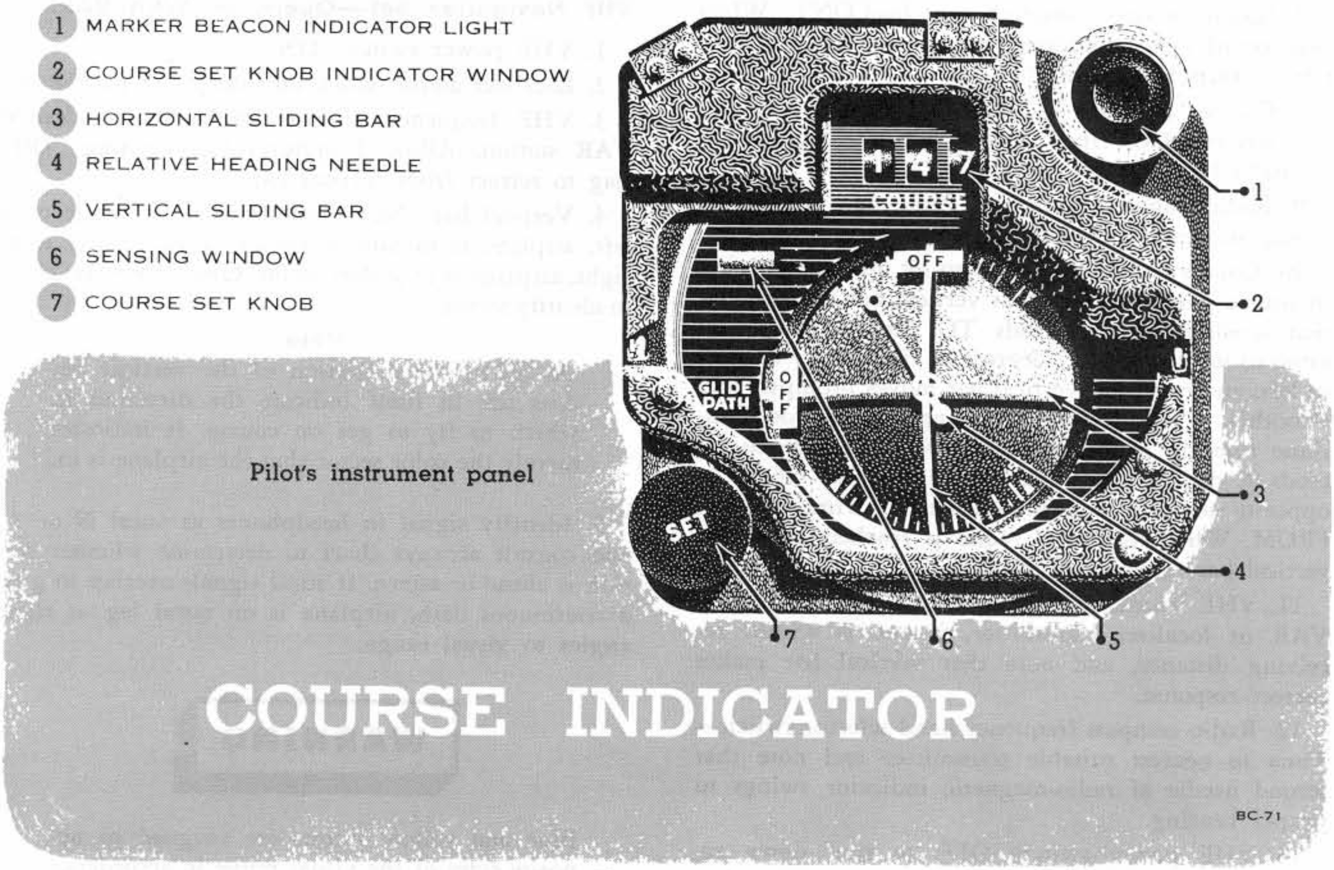


Figure 4-14.

under the index at the top of the instrument face until a necessary amplification unit is installed to couple the card to the gyromagnetic compass. A duplicate radio-magnetic indicator is on the radar observer's instrument panel.

VHF Course Indicator.

The VHF course indicator (figure 4-14) on the pilot's instrument panel operates on 115-volt AC from the single-phase bus to register VOR, VAR, localizer, and glide-path orientation. This instrument has a marker beacon indicator light on one corner and a course set knob in the opposite corner. On the face of the instrument are a course window which displays the number of the omnirange radial set up by the knob, a sensing window which indicates whether the radial course leads toward or away from the omnirange station, a vertical bar, a horizontal bar, and a relative heading needle which is coupled to the gyromagnetic compass. When the power is on and the warning "Off" flags have retracted from the face of the instrument, the instrument shows, with respect to the tuned VOR station, which of the 360 radials of the omnirange has been selected (course window), whether that radial course leads to or from the station (sensing window), whether the radial leads right or left of the airplane (vertical bar indication), and whether the airplane is headed right or left of the selected course (relative heading needle). The horizontal bar does not respond to VOR signals, but when a glide-path transmitter has been tuned in, the bar will show the position of the airplane with respect to the glide path. On C (Group 25 and subsequent) airplanes, the relative heading needle will be electrically locked in place to prevent wandering until a necessary amplification unit is installed to couple the needle to the gyromagnetic compass.

VHF Navigation Set Operation.

1. VHF power switch—ON.
2. VHF frequency selector knob—Select frequencies.
3. VHF volume control knob—Adjust as desired.
4. VHF power switch—OFF, to turn set off.

VHF Navigation Set Ground Check.

1. Power inverter switch—MAIN.
2. Interphone selector switch—MIX. SIG. & COMMAND.
3. Localizer audio switch on interphone panel—On.
4. Interphone radio compass audio switch—COMP.
5. VHF power switch—ON.
6. VHF frequency selector knob—Set on frequency of nearest omnirange station.

7. Radio compass function switch—CONT. When reaction of meter indicates that control has been obtained, turn to COMP.

8. Course indicator—Check that warning "Off" flag has retracted from vertical bar after equipment has had a 2- to 5-minute warmup.

9. Radio-magnetic indicator—Note that one needle swings to bearing of omnirange station.

10. Course set knob—Rotate to set up same bearing in course window. Note that vertical bar centers, and that sensing window reads TO. Rotate course set knob to set up radials 7 degrees to right and 7 degrees to left, and note that vertical bar moves promptly and smoothly to full deflection on appropriate side. Continue rotating course set knob. When difference exceeds 90 degrees, note that the vertical bar crosses to opposite side of instrument and sensing window shows FROM. When reciprocal radial is reached, note that vertical bar returns to center.

11. VHF frequency selector knob—Tune to nearest VAR or localizer transmitter, if one is within receiving distance, and note that vertical bar makes correct response.

12. Radio compass frequency band selector switch—Tune to nearest suitable transmitter and note that second needle of radio-magnetic indicator swings to proper bearing.

13. VHF power switch—OFF, to shut down receiver.

14. Radio compass function switch—OFF, to turn set off.

VHF Navigation Set Operation—With VOR.

1. VHF power switch—ON.

2. VHF frequency selector knob—Set for desired VOR station. Allow 2 minutes for warning "Off" flag to retract from vertical bar.

3. Course set knob—Rotate to center vertical bar. Read radial in course window and identify it as course to or from station as indicated in sensing window. If reciprocal is desired, rotate course set knob to add or subtract 180 degrees; read course and sensing as now indicated. To fly on a radial other than the one the airplane is on, set up desired radial in course window. Vertical bar will then be deflected toward new radial. Fly toward vertical bar to arrive at desired radial, then turn onto course as bar centers. Adjust heading as necessary to compensate for drift. As long as vertical bar is centered, airplane is tracking along displayed radial, regardless of heading. When airplane crosses the station while tracking along displayed radial, sensing will reverse with no changes in other indications of the instrument. When airplane is not tracking along displayed radial, vertical bar will be off center. In such a case, bar will swing to opposite side when airplane crosses displayed radial. Sensing will reverse when airplane crosses radial that is at 90 degrees to displayed radial.

VHF Navigation Set—Operation With VAR.

1. VHF power switch—ON.

2. Localizer audio switch on interphone panel—On.

3. VHF frequency selector knob—Set to desired VAR station. Allow 2 minutes for warning "Off" flag to retract from vertical bar.

4. Vertical bar—Note deflection. If bar deflects to left, airplane is in blue sector of range; if bar is to right, airplane is in yellow sector. Consult airways chart to identify sector.

Note

On VAR, the deflection of the vertical bar does not in itself indicate the direction in which to fly to get on course. It indicates merely the color sector that the airplane is in.

5. Identify signal in headphones as aural N or A, and consult airways chart to determine whether station is ahead or astern. If aural signals overlap to give a continuous dash, airplane is on aural leg at right angles to visual range.

WARNING

Blue and yellow sectors are assigned to opposite sides of the visual range in accordance with the course defined by the airway. At certain terminal airports VAR is used in the absence of a localizer. In such cases, the sector orientation is the same as for the ILS localizer. That is, the blue sector is charted on the right, and the yellow sector is charted on the left when the airplane is inbound on final approach, regardless of the course defined by the beam.

VHF Navigation Set—Operation With Localizer.

1. VHF power switch—ON.

2. Localizer audio switch on interphone panel—On.

3. VHF frequency selector knob—Set to localizer station. Allow 2 minutes for warning "Off" flag to retract from vertical bar.

4. Vertical bar—Note deflection. If vertical bar is deflected to left, airplane is in blue sector of localizer range; if bar is to right, airplane is in yellow sector. Blue sector of a localizer is always charted to the right of the inbound course; therefore, a pilot on final approach can center on the beam by flying toward the bar.

VHF Navigation Set—Operation For Communications.

This receiver can be tuned to the appropriate transmitter to receive weather broadcasts, tower instructions, and general communications.


HEADING SELECTOR
1 HEADING SET KNOB
2 SELECTOR POINTER
3 MAGNETIC HEADING POINTER
4 FIXED COMPASS CARD
Pilot's instrument panel
ZERO READER
CONTROLS AND INDICATORS
ZERO READER
OFF
FLIGHT
COMPUTER INDICATOR
5 CROSSBARS
6 PITCH-TRIM CONTROL KNOB
7 ALTITUDE CONTROL SWITCH
8 ALTITUDE CONTROL
SWITCH "ON" INDICATOR LIGHT
FLIGHT
INST.
LEFT
VOR-LOC.
RIGHT
APPROACH
ON
ALT
OFF
SELECTOR
SWITCH
ZERO READER
SELECTOR SWITCH
BC-72

Figure 4-15.

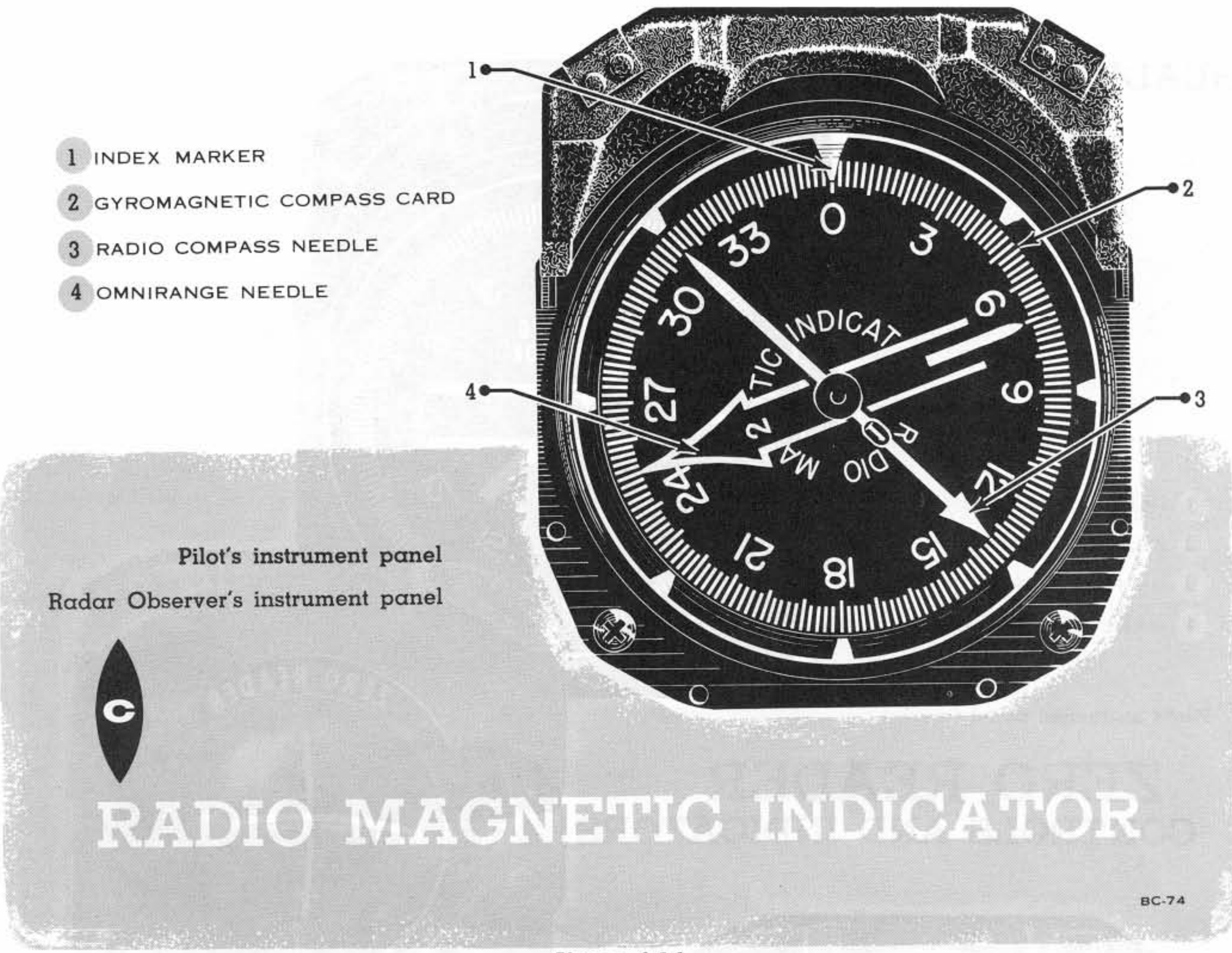


Figure 4-16.

GLIDE-SLOPE RECEIVER AN/ARN-18 OR AN/ARN-5B. (SOME AIRPLANES)

The glide-slope receiver gives vertical guidance to a pilot making an instrument approach to an airport equipped with a glide-slope transmitter. The receiver operates on 28-volt DC power and has no separate control panel. It is operated and tuned by the power switch and the frequency selector knob (figure 4-13) on the VHF navigation control panel. The signals of the glide-slope receiver are fed automatically to the horizontal bar of the course indicator. When the set is tuned to a glide-slope transmitter and the signal is strong enough to retract the warning "Off" flag for the horizontal bar, the pilot merely keeps the horizontal bar centered to follow the glide slope down to the runway. In brief, centering the two crossbars of the course indicator keeps him on course and on glide slope for an instrument approach under adverse weather conditions.

FLIGHT COMPUTER (ZERO READER). B, C (Groups 1-20)

The flight computer electronically combines attitude, altitude, heading, and radio information to advise the pilot that the airplane is flying in accordance with a selected flight plan. The flight plan may call for the use of the flight computer as a flight instrument, navigation instrument, or an approach-landing system. The flight computer has a selector switch, a flight indicator, and a heading selector (figure 4-15) on the pilot's instrument panel. The flight computer is energized whenever either instrument inverter is on.

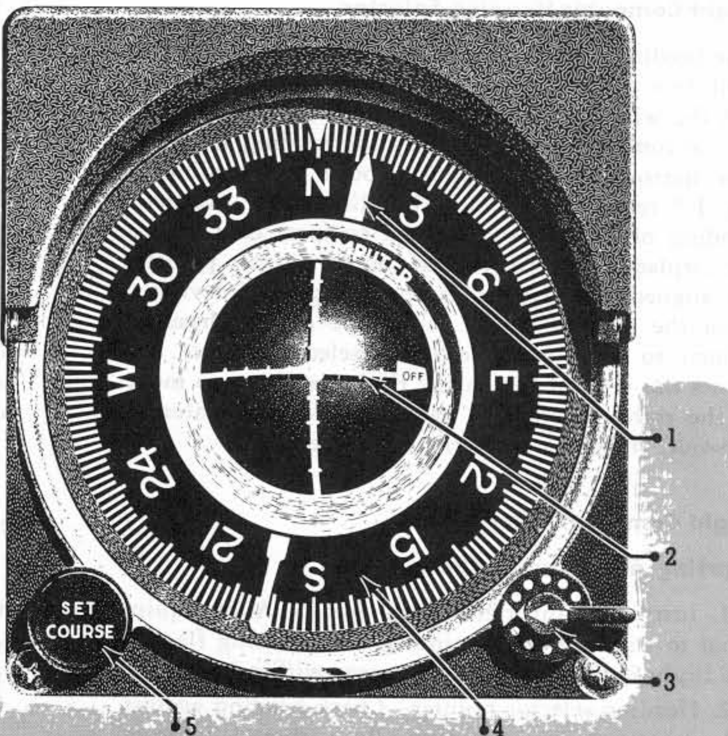
FLIGHT COMPUTER. C (Group 25 and Subsequent)

The A-1 flight computer indicator (figure 4-17) at the top center of the pilot's instrument panel, combines into one instrument a flight indicator and heading selector. With a few exceptions, the operating principles and the controls of the flight computer are the same as those of the zero reader. Turning the set course knob, in the lower left corner of the computer, rotates the course dial to bring the desired track figure under the course index. The heading pointer is coupled to, and rotates simultaneously with the gyromagnetic compass so that the heading of the airplane can be read continuously on the course dial under the heading pointer, and the vertical bar deflects to give an appropriate "fly right" or fly left" indication. As the pilot flies the airplane to zero the vertical bar, the heading pointer follows the heading of the airplane as it turns onto the new course. When the airplane is on the selected course, the heading pointer and the vertical bar are centrally aligned with the course index. In addition, the A-1 flight computer has a go-around feature not found in the flight computer in B and C (Groups 1 through 20) airplanes. When the flight computer selector switch is at APPROACH and a go-around is necessary, the pilot can press the altitude control switch so that the horizontal bar will move to the optimum climbout angle and the flight computer will be disconnected from all radio signals. On C (Groups 25 and 30) airplanes, the flight computer operates on electrical power from the main instrument inverter only. On C (Group 35 and subsequent) airplanes, it operates on both main and spare instrument inverters.

Flight Computer Selector Switch.

The pilot can select a desired flight plan by turning the flight computer selector switch (figure 4-15) to LEFT, FLIGHT INST, VOR-LOC RIGHT, or APPROACH. When the selector switch is at FLIGHT INST, the flight computer flight indicator operates as a flight instrument independent of radio signals. When the selector switch is at any other position, radio signals are relayed into the flight indicator for localizer, approach, and landing purposes. When the selector switch is on any position but APPROACH and the airplane is flying at the desired flight altitude, the altitude control switch on the right side of the selector switch can be turned on. Altitude control signals will be sent into the flight indicator and any deviation in altitude will cause the horizontal bar on the flight indicator to move off zero. When the altitude control switch is turned on, the pitch-trim control on the flight computer flight indicator becomes inoperative and the green light in the lower left corner of the selector switch goes out. When the selector switch is turned to APPROACH, the green light comes on to indicate that the altitude control switch has turned off automatically to prevent conflicting signals from going into the flight indicator. The selector switch controls the 115-volt, three-phase alternating current from the instrument inverters.

1 HEADING POINTER
2 CROSSBARS
3 PITCH-TRIM KNOB
4 COURSE DIAL
5 COURSE SET KNOB



Pilot's instrument panel

C FLIGHT COMPUTER INDICATOR

GROUP 25 AND SUBSEQUENT AIRPLANES

BC-73

Figure 4-17.

Flight Computer Flight Indicator.

The flight indicator (figure 4-17) has two crossbars at right angles to each other and a pitch-trim control knob in the lower left corner. For any flight plan the crossbars remain zeroed when the airplane is flying in the desired attitude, altitude, and direction. Any deviation from the flight plan causes one or both of the bars to move in the direction of the necessary correction. Deviations in pitch, altitude, and glide-slope signals cause the horizontal bar to move up or down. Deviations in heading and lateral attitude cause the vertical bar to move left or right. For example, if the airplane moves off course to the left, the vertical bar moves to the right to indicate that the airplane should fly to the right. As the correcting maneuver is being made, the bar rezeroes to indicate that the airplane is coming back on course. The bar remains zeroed after the correction has been made; it will not go past zero unless the airplane is over-controlled in making the correction. The flight computer pitch-trim knob on the indicator adjusts the horizontal bar to compensate for changes in airplane pitch trim during flight. The flight indicator operates on 115-volt, three-phase, alternating current.

Flight Computer Heading Selector.

The heading selector (figure 4-15) has a fixed compass card, two pointers, and a heading set knob. The pilot sets the wide selector pointer on any desired heading on the compass card by turning the heading set knob. The narrow heading pointer repeats the heading of the J-2 remote compass and indicates the magnetic heading of the airplane on the compass card. When the airplane is on the selected course, the two pointers are aligned and give the same reading. Any deviation from the selected course causes the narrow heading pointer to move away from the selector pointer and causes the vertical bar on the flight indicator to move to the right or left. The heading selector operates on 115-volt, three-phase, alternating current.

Flight Computer Operation.

Starting and Ground Check.

1. Instrument inverter switch—MAIN. Allow equipment to warm up for 5 minutes. Red warning flag on the flight indicator should disappear within 3 minutes.
2. Heading selector pointer—Check heading against J-2 remote compass reading. Both should indicate magnetic heading of the airplane.
3. Altitude control switch—OFF. Green light should be on.
4. Selector switch—FLIGHT INST.
5. Heading set knob—Turn until selector pointer is aligned with heading pointer. Vertical bar on zero reader flight indicator should zero. Then turn heading set knob clockwise and counterclockwise so that selector pointer moves to right and left of heading pointer. Vertical bar on flight indicator should deflect to right and left respectively as knob is turned. Turn heading set knob until selector pointer realigns with heading pointer. Vertical bar should zero.
6. Pitch-trim knob—Turn clockwise and counter-clockwise. Horizontal bar should move up and down respectively.
7. VHF power switch—ON.
8. VHF frequency selector knob—Select frequency.
9. Zero reader selector switch—APPROACH. Vertical bar on the zero reader flight indicator should move to the left or right, depending on position of airplane relative to the beam.
10. VHF power switch—OFF, to turn receiver off.

Flight Computer Flying Compass Course at Constant Altitude.

1. Selector switch—FLIGHT INST.
2. Heading set knob—Turn until heading selector pointer is on desired course. Vertical bar will move to left or right.
3. Vertical bar—Note deflection and fly to rezero and to align heading pointer with selected heading.
4. Pitch-trim knob—Turn to zero horizontal bar at desired airplane pitch attitude.
5. Altitude control switch—ON when airplane reaches desired altitude. Green light on the selector switch should go out.

CAUTION

Whenever sudden altitude changes in excess of 500 feet are anticipated, the altitude control switch should be turned OFF to prevent damage to the altitude control unit.

6. Fly airplane to keep horizontal and vertical bars zeroed at all times.

Note

When airplane configuration is changed, turn the altitude switch to OFF until the new attitude is established.

LIGHTING EQUIPMENT.

EXTERIOR LIGHTING.

Position Lights and Control Switches. B (Groups 1 and 5)

The position light controls and the indicator light (figure 4-18) are on the exterior light control panel on the right side of the pilot's cockpit. A position

Figure 4-18.

light switch and the adjacent toggle switch control the operation and intensity of the wing tip and tail lights. The position light switch can be placed at STEADY, OFF, or FLASH; the intensity switch at DIM or BRIGHT. A fuselage light switch controls the small lamps in the fuselage lights; it can be placed at BRIGHT, OFF, or DIM. A master code switch and a code selector knob operate the large lamps in the fuselage lights. When the code selector knob is set for the recognition code and the master code switch turned to ON, the large lamps in the fuselage lights and the code indicator light on the control panel simultaneously flash the code.

Position Lights and Control Switches. B (Group 10 and Subsequent) C

The position lights are conventional in color and arrangement and will operate steadily or will flash. The position light switch (figure 4-18) on the pilot's position light control panel has STEADY, OFF, and FLASH positions for controlling the operation of the lights. A toggle switch next to the position light switch has DIM or BRIGHT positions to control the intensity of the lights. A flasher unit flashes the position lights 40 cycles per minute. If the flasher unit fails, steady operation of the lights is automatic. The position lights operate on 28-volt DC; the circuit breaker is on the radar observer's circuit breaker panel.

Landing-Taxi Light and Control Switches.

A single retractable light, located on the underside of the fuselage just forward of the nose wheel, serves for both landing and taxiing. The light is controlled by two switches (figure 4-19) on the left vertical console: an extension-retraction switch with EXTEND, RETRACT, and OFF positions, and a lamp switch with LANDING, TAXI, and OFF positions. The light is extended or retracted by placing the extension-retraction switch at EXTEND or RETRACT. The lamp may be stopped in any position along the arc of travel by placing the switch at OFF. Extension or retraction takes about 10 seconds. Limit switches automatically stop the extension-retraction motor when the lamp is fully extended or retracted. The lamp is turned on and off by the lamp switch. When the switch is placed at LANDING (with the extension-retraction switch at EXTEND), the lamp burns at maximum intensity and is positioned at the correct angle for landing (or takeoff). When the switch is placed at TAXI (with the extension-retraction switch at EXTEND), the lamp is positioned at the correct angle for taxiing (about 7 degrees higher beam than for landing) and the lamp beam widens and dims. The lamp can be turned on before extension if necessary so that the heat generated by the lamp filament will de-ice the lamp assembly. After retraction, the lamp must be turned off by the lamp switch. The lamp and control switches are powered by the 28-volt DC bus.

CAUTION

To prevent damage to the lamp by the intense heat it generates, do not use the lamp in the landing position longer than necessary, nor use the lamp in taxi or landing positions when the airplane is not moving.

Note

When changing from one position of the lamp (taxi or landing) to the other, the extension-retraction switch must be placed at EXTEND, otherwise the extension-retraction motor will not operate and the lamp will remain in the original position.

INTERIOR LIGHTING.

Pilot's Cockpit Lighting. B

Four red floodlamps light the pilot's instrument panel and forward cockpit area. Two are on the instrument panel glare shield; the other two are just forward of the pilot, one on each side of the cockpit structure. Red bulbs under the individual ring-type lighting shields illuminate each instrument in the cockpit. The shields are hinged to facilitate replacement of the bulbs. The lights for the engine instruments are on one circuit and the lights for the flight instruments on another, so that either group of instruments can be lighted independently. Indirect plastic panel lighting is used for all other panels, control position indicators, and markings. A C-4 cockpit light with a removable red filter can be swiveled or removed from the mount. Individual rheostats on the lighting control panel control the operation and intensity of the floodlamps, instrument ring lights, and indirect lighting. All lighting circuits for the pilot's cockpit operate on 28-volt DC and are protected by circuit breakers on the pilot's circuit breaker panel. A stowage case for spare lamps (figure 1-9) is attached to the structure above the pilot's left console.

Pilot's Cockpit Lighting Rheostat Knobs.

Four rotary, 28-volt DC rheostat knobs (figure 4-20) on the pilot's lighting control panel on the right console rotate from OFF to DIM to BRIGHT to control the operation and intensity of the interior lights. The first knob, at the forward end of the panel, controls the engine instrument lights; the second, the flight instrument lights; the third, the instrument floodlights; and the fourth, the indirect panel lighting.

Pilot's Cockpit Lighting.

Four red floodlamps light the pilot's instrument panel and forward cockpit area. Two are on the instrument panel glare shield; the other two are just forward of the pilot, one on each side of the cockpit structure. On C (Group 35 and subsequent) airplanes, three red floodlamps are spaced evenly below the rail on each side of the cockpit, so that each console in the pilot's cockpit is lighted. On some C (Groups 1, 5, and 10) airplanes, red bulbs under individual ring-type lighting shields illuminate each instrument in the cockpit. The shields are hinged to permit replacement of the bulbs. On some C (Groups 1, 5, and 10) airplanes modified in accordance with T.O. 1F-89C-507 and all C (Group 15 and subsequent) airplanes, ring

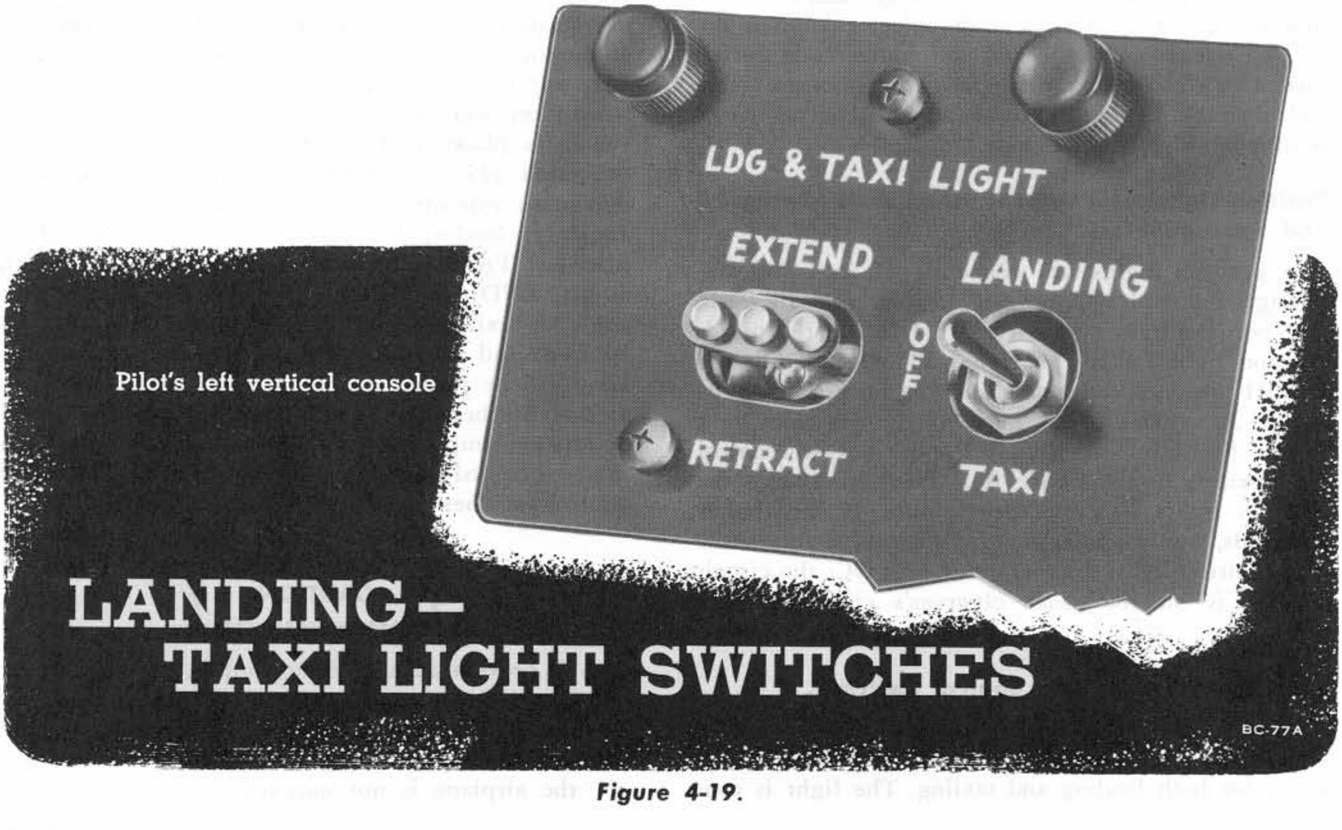


Figure 4-19.

Figure 4-20.

lights illuminate all the flight instruments, the fuel flowmeters, and the fuel quantity gages. The remaining engine instruments are lighted by red floodlamps. On all airplanes, the lights for the engine instruments are on one circuit and the lights for the flight instruments on another, so that either group of instruments can be lighted independently. Indirect plastic panel lighting is used for all other panels, control position indicators, and markings. A C-4 cockpit light with removable red filter can be swiveled or removed from the mount. Individual rheostats on the lighting control panel control the operation and intensity of the floodlamps, instrument ring lights, and indirect lighting. All lighting circuits for the pilot's cockpit operate on 28-volt DC and are protected by circuit breakers on the pilot's circuit breaker panel. A stowage case for spare lamps (figure 1-9) is attached to the structure above the pilot's left console.

Pilot's Cockpit Lighting Rheostat Knobs. C

On C (Groups 1 through 30) airplanes, four rotary 28-volt DC rheostat knobs (figure 1-13) on the pilot's lighting control panel on the right console, rotate from OFF to DIM to BRIGHT to control the operation and intensity of the interior lights. The first knob, at the forward end of the panel, controls the engine instruments; the second, the flight instruments; the third, the instrument floodlights; and the fourth, the indirect panel lighting. On C (Group 35 and subsequent) airplanes, the four rheostat knobs (figure 1-13) on the pilot's lighting control panel control the operation and intensity of the cockpit, panel, and console floodlights, and the indirect panel lighting. Two rheostat knobs on the instrument lighting panel (figure 1-13) control the operation and intensity of the flight instrument ring lighting and the engine instrument ring and floodlighting.

Radar Observer's Cockpit Lighting.

The radar observer's cockpit has two red floodlights on the top of the glare shield. Two red bulbs under individual ring-type lighting shields illuminate each instrument on the instrument panel. The shields are

CREW: 2

CYLINDERS: 2 TYPE F-2
2 TYPE D-2

BOLD FACE (upper) figures indicate diluter lever at "100%."

LIGHT FACE (lower) figures indicate diluter lever at "NORMAL."

* NOTE: Descend to altitude not requiring oxygen.

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	BELOW 100
40,000	**5.7** / 5.7	**4.9** / 4.9	**4.1** / 4.1	**3.3** / 3.3	**2.5** / 2.5	**1.6** / 1.6	**0.8** / 0.8	EMERGENCY *
35,000	**4.3** / 4.3	**3.6** / 3.6	**3.0** / 3.0	**2.4** / 2.4	**1.8** / 1.8	**1.2** / 1.2	**0.6** / 0.6	
30,000	**3.1** / 3.2	**2.6** / 2.7	**2.2** / 2.2	**1.8** / 1.8	**1.3** / 1.4	**0.9** / 0.9	**0.4** / 0.4	
25,000	**2.4** / 3.0	**2.0** / 2.5	**1.7** / 2.1	**1.4** / 1.7	**1.0** / 1.3	**0.7** / 0.9	**0.3** / 0.4	
20,000	**1.8** / 3.4	**1.5** / 2.9	**1.3** / 2.4	**1.0** / 1.9	**0.9** / 1.4	**0.5** / 1.0	**0.3** / 0.5	
15,000	**1.4** / 4.1	**1.2** / 3.5	**1.0** / 2.9	**0.8** / 2.3	**0.6** / 1.7	**0.4** / 1.2	**0.2** / 0.6	
10,000	**1.2** / 5.4	**1.0** / 4.6	**0.8** / 3.9	**0.7** / 3.1	**0.5** / 2.3	**0.3** / 1.6	**0.2** / 0.8	

OXYGEN DURATION HOURS

BC-78 A

Figure 4-21.

hinged to permit replacement of bulbs. All other panels have indirect lighting. A C-4 cockpit light can be swiveled or removed from its mount for either red or white lighting. Three rheostats control the operation and intensity of the floodlights, instrument ring lights, and indirect panel lighting. The circuit breakers for the 28-volt DC lights are on the radar observer's circuit breaker panel.

Radar Observer's Cockpit Lighting Rheostat Knobs.

Three 28-volt DC rheostat knobs (figure 4-20), on the interior lights control panel, rotate from OFF to DIM to BRIGHT to control the operation and intensity of the interior lights. The rheostat knob at the forward end of the panel controls the indirect panel lighting; the knob in the aft corner of the panel controls the instrument flooodlamps; and the knob directly above, controls the instrument ring lights.

Pilot's and Radar Observer's C-4 Cockpit Lights.

A removable, swivel-mouthed C-4 cockpit light with a red filter (figure 1-13 and figure 4-7) is on the right side of each cockpit. A knob near the back of the light case turns the lamp on and off, and controls its intensity. A white, spring-loaded button on the back of the case can be pressed for momentary lighting. A small knob extending through a groove on the side of the case moves for spot or floodlighting; tightening the knob screw locks the shield in any position. The red filter can be removed if white light is desired.

OXYGEN SYSTEM.

The airplane is equipped with a gaseous oxygen system having an operating pressure of 400 to 450 PSI. The gaseous oxygen is carried in four oxygen cylinders which are check-valved and installed in the aft fuselage for combat safety. Two of the cylinders supply oxygen to the pilot, and two supply the radar observer. Each crewmember's supply is kept separate by the seated check valves at the filling manifold. When the check valves are unseated during filling, interflow between the four oxygen cylinders supplying the pilot and radar observer occurs. However, when filling of the system is completed, the check valves at the individual cylinders are seated when the pressure in the filler manifold is bled off by depressing the core in the filler valve. On each crewmember's right console is an oxygen regulator panel which contains the oxygen system controls. A pressure-demand oxygen mask should be used with this system. The approximate duration of the oxygen supply at various altitudes is given in figure 4-21.

OXYGEN REGULATOR.

A diluter-demand oxygen regulator with a pressure gage and flow indicator is in the oxygen regulator control panel (figure 4-22) on the right console of each cockpit. From sea level to 30,000 feet (cabin altitude) the regulator automatically varies the ratio of oxygen to air to supply the proper mixture to the crew. Above

30,000 feet (cabin altitude), the regulator delivers pure oxygen with the pressure increasing sharply with altitude until the regulator delivers maximum pressure. A relief valve in the regulator prevents excessive pressure in the oxygen mask.

REGULATOR SUPPLY LEVER.

The oxygen supply lever (figure 4-22) on the regulator panel controls oxygen flow to the regulator. The radar observer's oxygen supply lever should be turned to OFF whenever the radar observer's regulator is not being used. If it is left at ON, oxygen will be lost. The supply lever in the pilot's cockpit is safetywired in the ON position.

Note

Because of the automatic pressure-breathing feature of the regulator, a continuous flow of oxygen at altitude will result if the regulator is not being used and the supply lever is left at ON. This condition causes a rapid loss of oxygen at altitude.

REGULATOR DILUTER LEVER.

The diluter lever (figure 4-22) on the oxygen regulator panel has two positions: NORMAL OXYGEN and 100% OXYGEN. When the lever is at NORMAL OXYGEN, the regulator automatically varies the ratio of oxygen to air and supplies the proper mixture to the crew from sea level to 30,000 feet (cabin altitude). Above 30,000 feet (cabin altitude) the regulator delivers pure oxygen. At any altitude, the diluter lever can be turned to 100% OXYGEN if pure oxygen is desired for emergencies.

REGULATOR EMERGENCY LEVER.

The emergency toggle lever (figure 4-22) should remain in the center position at all times, unless an unscheduled pressure increase is required. Moving the toggle lever either way from its center position provides continuous positive pressure to the mask for emergency use. When the lever is depressed in the center position, it provides positive pressure to test the mask for leaks. Normally the lever should remain at the center (off) position.

Figure 4-22.

CAUTION

When positive pressures are required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to ensure no leakage, continued use of positive pressure under these conditions will result in rapid depletion of the oxygen supply.

REGULATOR WARNING SYSTEM SWITCH AND INDICATOR LIGHTS. (Some Airplanes)

The warning system switch (figure 4-22) on the oxygen regulator panel can be placed at ON or OFF to control the oxygen warning lights. Two warning lights are located on the instrument panels in the pilot's and radar observer's cockpits (figure 1-8 and figure 4-5). One light indicates breathing in the pilot's mask; the other indicates breathing in the radar observer's mask. When the warning system switch is ON, the light dims when oxygen is being used, and glows brightly when oxygen is not being used. On airplanes modified in accordance with T.O. 1F-1-533, the warning system switch is placed in the OFF position, the lamps are removed from the warning lights, and the warning system is deactivated.

Note

At flight altitudes below 10,000 feet with the oxygen regulator operating and the mask being used, the lights may blink brightly. Since this can happen only at low altitudes, it should not cause undue concern. The oxygen regulator warning circuit may be turned off below 10,000 feet (flight altitude) since the possibility of hypoxia is critical only at higher altitudes.

OXYGEN SYSTEM PRESSURE GAGE AND FLOW INDICATOR.

A combination pressure gage and flow indicator (figure 4-22) on the oxygen regulator panel registers on the upper half of the dial the pressure of the oxygen supply. In the lower half of the dial, the slots in the flow indicator are luminous when oxygen is flowing through the regulator; dull black when it is not.

Note

As an airplane ascends to higher altitudes where the temperature normally is quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes quite rapidly. With a 100° F decrease in cylinder temperature, the gage pressure can be expected to drop 20 percent. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is decending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

OXYGEN SYSTEM PREFLIGHT CHECK (D-2 REGULATOR).

1. Fasten the attachment strap on the mask male connector to the parachute chest strap by routing the connector strap up under the chest strap as close to the center as possible, then down in front of the chest strap, then around again; then snap it to the connector.
2. Connect the mask-to-regulator tubing female disconnect to the mask male connector, listen for the click and look to see that the sealing gasket is only half exposed.
3. Attach the alligator clip to the end of the mask male connector strap. (See figure 4-23.)
4. Check oxygen regulator with diluter valve first at NORMAL OXYGEN and then at 100% OXYGEN by blowing gently into the end of the regulator tubing as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a leak or malfunction.

Note

Items pertaining to the oxygen warning system apply only to airplanes not modified to T.O. 1F-1-533.

5. Place oxygen warning light switches (some airplanes) at ON. Warning lights should emit a bright (steady or blinking) light. Move emergency toggle from center (off) to left or right position. The warning lights should change from a bright light to a filament glow and back to a bright light. Return emergency toggle to center (off) position.
6. With regulator supply valve at ON, oxygen mask connected to regulator, diluter lever at 100% OXYGEN, and normal breathing, conduct the following check: Observe blinker for proper operation. Warning light should change from bright to a dim filament glow (some airplanes). Deflect emergency toggle right or left. A positive pressure should be supplied to mask. Hold breath to determine if there is a leakage around mask. Return emergency toggle to center (off) position. Positive pressure should cease.
7. Return diluter lever to NORMAL OXYGEN.

OXYGEN SYSTEM NORMAL OPERATION.

1. Regulator diluter—NORMAL OXYGEN.
2. Regulator supply lever—ON.
3. Regulator warning system switch—ON (on airplanes not modified in accordance with T.O. 1F-1-533).

OXYGEN SYSTEM EMERGENCY OPERATION.

If either of the crew detects symptoms of hypoxia, or if smoke or fuel fumes enter the cockpit:

1. Regulator diluter lever—100% OXYGEN.
2. Regulator emergency lever—Push in and hold momentarily to clear mask.

Note

The duration of the oxygen supply is reduced when either of the crew turns to 100% OXYGEN or holds the oxygen emergency lever in.

Figure 4-23.

3. Oxygen diluter lever—NORMAL OXYGEN after the emergency. If the oxygen regulator fails or if the mask develops a severe leak, push the regulator emergency lever right or left. If necessary, pull the cord of the bailout bottle.

WARNING

If either crewmember uses his bailout bottle, the pilot must descend immediately to an altitude not requiring oxygen.

ARMAMENT EQUIPMENT.

The AN/APG-33 radar set, A-1C gunsight, and gunnery equipment make up the E-1 fire control system.

RADAR EQUIPMENT AN/APG-33.

Radar set AN/APG-33 is an airborne gun sighting system for the detection and automatic tracking of aircraft in azimuth, elevation, and range. It delivers range information to a type A-1C gunsight computer and receives from the computer predicted angles to enable the pilot to fly on a course which provides proper lead angles for firing fixed nose guns. The radar equipment receives power from the 115-volt main power inverter, and is inoperative if this inverter fails.

Radar Equipment Controls.

The radar power selector switch, intensity control knob, focus control knob, dial illumination control knob, search button, scan selector switch, range-in—range-out switch, range search rotary control knob, I-F gain rotary control knob, antenna search pattern switch, and IFF switch are on the radar observer's azimuth range indicator. The antenna hand control is on the right side of the radar observer's cockpit; the antenna hand control action switch is a pushbutton switch on the antenna hand control. The pilot has no radar controls other than the power inverter switch and a radar scope intensity knob, except that he has means of turning the radar power on and off from his cockpit.

Radar Observer's Range Meter.

The radar observer's range meter is on the radar observer's azimuth range indicator to the left of the scope. This electrically operated meter indicates target range in thousands of yards during attack operation. Two scales are provided, one calibrated for 25,000-yard range, the other for 5000-yard range. The operator reads range directly from the meter.

Pilot's Range Meter.

The pilot's range meter (figure 1-8), mounted on the pilot's instrument panel, indicates target range directly from zero to 25,000 yards in the inital stages of the attack operation. When target range is reduced below 2000 yards, the range circle on the pilot's

Figure 4-24.

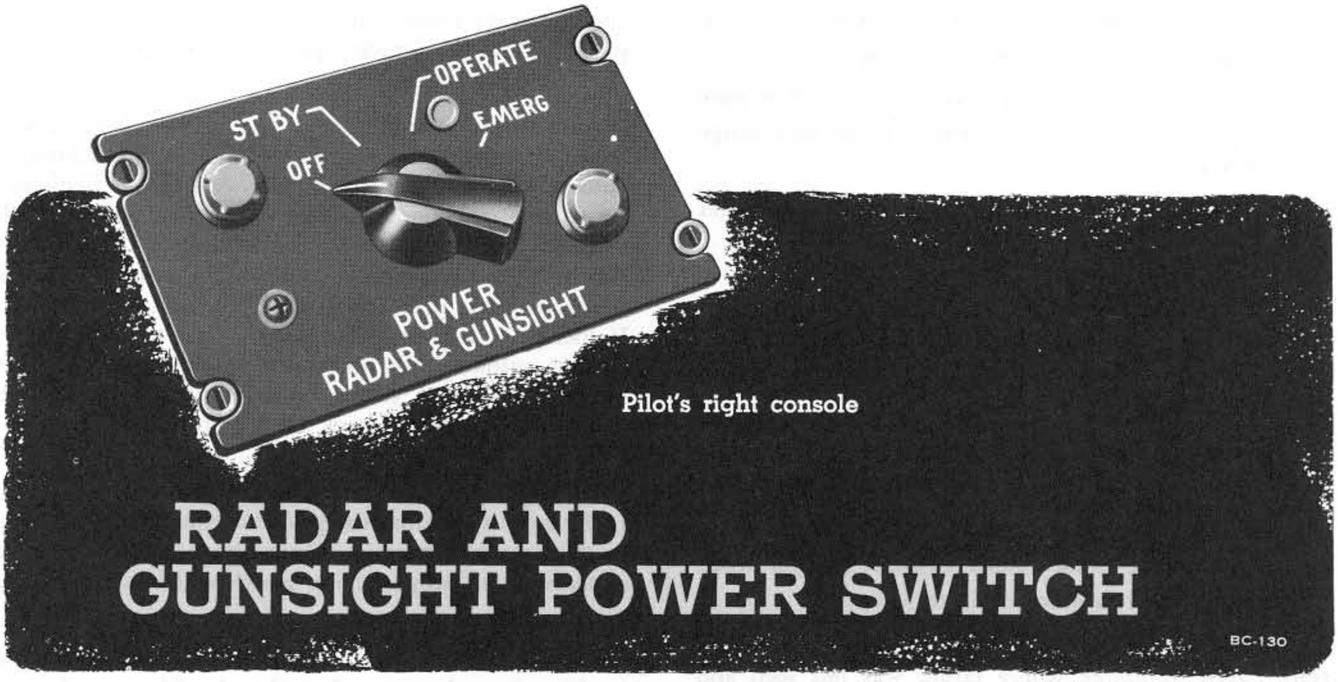


Figure 4-25.

scope begins to contract toward the center and range can be read directly from the scope.

Overtaking Speed Meter.

The electrically operated speed meter on the radar observer's azimuth range indicator is calibrated in knots from zero to 100 with the zero mark at the center. The right portion of the scale indicates the closing rate and the left the opening rate of the target being tracked. The meter operates only during the attack operation.

Pilot's Radar and Gunsight Power Switch.

A rotary-type switch (figure 4-26), located on the pilot's right console, provides a radar and gunsight power control for the pilot independent of the radar power switch in the rear cockpit. Switch positions are OFF, STBY, OPERATE, and EMER. This switch functions the same as the radar power switch described in Radar Equipment Operation.

Radar Equipment Operation.

1. Power inverter switch—MAIN.

2. Radar power switch—OPERATE. After a 3-minute time delay the set is in operation. Artificial horizon should be displayed on the pilot's scope.

3. Radar power switch—STBY (standby) until radar operation is required. Then, provided that the normal 3-minute time delay has elapsed, the radar operates immediately when the switch is turned to OPERATE. If the power switch is OFF and an emergency requires rapid radar operation, the time-delay period can be reduced to 1 minute by pressing the red safety button and simultaneously turning the power switch to EMERG. To turn the set off, turn the power switch OFF. The pilot can use his radar and gunsight power switch to put the equipment in operation as described.

CAUTION

Do not use EMERG unless it is vital to shorten the time delay. Emergency operation materially shortens the life of some of the components.

RADAR FIRING.

Radar Observer's Functions.

Searching.

1. Power inverter switch—MAIN. Check with pilot.

2. Radar power switch—OPERATE.

3. Focus, intensity, scale illumination control knobs—Adjust for maximum image visibility.

4. Antenna search pattern switch—Turn to desired position.

5. Search button—Press down and note sweep trace and noise indication.

6. I-F gain control knob—Set so that noise indication on the scope appears as light snow.

7. Scan selector switch—LONG. Equipment is now searching the area forward of the airplane to a range of 30,000 yards.

8. Watch scope until target appears. Select target to be hand tracked.

Hand Tracking. When the selected target is within 20,000 yards or less, hand track the target as follows:

1. Antenna hand control action switch—Press to operate hand control.

2. Antenna hand control—Move until range gate sweeps through target-free area.

3. I-F gain control knob—Adjust sensitivity to a point just before noise causes lockon. Then a weak target signal will produce definite lockon.

4. Antenna hand control—Move so that range-sweep trace passes over area where target was last seen and target reappears on scope. Move antenna hand control forward and back until target is brightest.

5. Range search control knob—Turn simultaneously with antenna hand control, until 5000-yard range gate searching sector brackets target and range gate sweeps across target. Maintain hand control until range gate locks exactly on target.

Note

The range-in—range-out switch can accelerate range gate. If the target is beyond the range gate, move the switch to RANGE OUT. If target is below the range gate on the sweep trace, move the switch to RANGE IN.

6. Antenna hand control action switch—Release to place system in attack operation. Notify pilot that attack is under way.

Automatic Tracking. After lockon has been established, the set is in attack operation and tracking is automatic. For a more detailed check of the airplane's maneuvers, occasionally turn the scan selector switch to the C position. Increase the setting of the I-F gain control if lockon is liable to be lost because of weather conditions, the presence of other aircraft, or jamming. If lockon is lost, the equipment, after a slight delay, returns automatically to search operation. To recover lockon, hand track target again as quickly as possible and place equipment back in attack operation.

Pilot's Functions.

In flying his mission, the pilot maintains visual search as the weather permits. Only the artificial horizon appears on his scope during search and hand tracking.

Attack Operation. When advised by the radar observer that a target has been selected and automatic tracking is under way, the pilot should proceed with the attack operation:

Figure 4-26.

1. Gun selector switch—GUNS.
2. Bomb target wind selector knob—ROCKET-GUN.
3. Rocket dive angle knob—GUN-BOMB.
4. Gun charger switch—CHARGE momentarily.

For required steering information, observe the error circle (course target error) indication on the scope. Direct the airplane into the target so that the error circle moves toward the center of the screen. When the target is within 5 degrees of the airplane heading, the error dot (fine target dot) appears. Direct the airplane to bring error dot within error circle.

Note

The A-1C sight is held caged by the radar set until the range to the target is approximately 2500 yards, then the A-1C sight is automatically uncaged. Uncaging displaces the error dot from the center of the screen. The degree of displacement represents the lead and curvature angles computed by the A-1C sight.

When the sight uncages, alter the course of the airplane to recenter the error dot within the error circle. The airplane is then flying the computed attack course.

Note

If the error circle and error dot are reasonably centered when the A-1C sight becomes uncaged, press the gyro caging button on the speed brake lever and maintain the caged condition until the airplane is in a normal attitude and in line-of-sight course toward the target. Then release the gyro caging button.

For target range, frequently observe target range meter. For overtaking speed, observe the break in the range circle on the scope. When target range is reduced to 2000 yards, the range circle on the attack display begins to contract. Thereafter, read range on the range circle. When the range circle diameter overlaps that of the circle inscribed on the range scale, the range is 800 yards. This is the maximum firing range. When the range circle merges with the error circle, the indicated range is 200 yards. This is the minimum firing range.

WARNING

To avoid colliding with target, break off the attack when the range circle has decreased to 200 yards.

RADAR PRESSURIZATION SYSTEM.

An automatic pressurization system prevents high-altitude flash-over in the frequency converter transmitter and modulator units of the radar system. The gun charger compressors supply air pressure and maintain constant 15 ± 2 PSI absolute in the pressurized units. The radar pressure gage (figure 4-5) in the upper right corner of the radar observer's instrument panel indicates, in PSI absolute, the pressure in the radar equipment.

A-1C SIGHT.

The A-1C sight automatically computes leads as a gun, bomb, or rocket sight. The sight head is above the instrument panel shroud. The sight reticle image is a circle and dot reflected on the windshield. In tracking, the pilot observes the reflection and flies to keep the dot on the target with the circle continually spanning the target. The sight can be used as a gunsight from sea level to 50,000 feet or as a bombsight from sea level to 10,000 feet. Radar ranging is used with the sight for gunnery operation. However, radar ranging is more difficult when used for overland targets below 6000 feet; then, manual ranging may be necessary. The main power inverter supplies electrical power for the sight. The sight is turned on automatically when the radar is turned on.

Reticle Dimmer Knob.

The rotary reticle dimmer knob (figure 1-9) on the pilot's left console adjusts the brilliance of the reticle from bright to dim. The dimmer knob should be turned to DIM when the sight is not in use to prevent damage to the reticle bulb in the event of voltage surge.

Sight Filament Selector Switches.

The two sight filament switches (figure 1-8) on the pilot's instrument panel are two-position toggle switches which select primary or secondary filaments for the bulbs that illuminate the reticle image. One switch controls the filaments in the reticle circle bulb; the other controls the filaments in the reticle dot. Normally the switches are set at PRIMARY to energize the normal filaments in the bulbs. If the normal filaments burn out, the switches are moved to SECONDARY to energize alternate filaments in the bulbs.

Electrical Caging Button.

The spring-loaded electrical caging button (figure 1-28) on the speed brake lever is pressed to stabilize the reticle image before making an attack. The image must be stabilized so that maneuvering on the initial approach to the target will not cause false data to be fed to the sight. The sight should also be caged during tracking when the range is between 1000 and 1500 yards, because the resultant leads at these distances are too great to give proper reticle presentations. When the range is reduced to approximately 500 yards, the sight should be uncaged to permit normal operation. The caging button should be held down for approximately 30 seconds, the approximate time required to stabilize the gyro.

Note

To prevent damage to the sight, the electrical caging button should be pressed whenever severe turbulence is encountered.

Mechanical Caging Lever.

The mechanical caging lever on the right side of the sight is placed at UNCAGE for normal automatic operation of the sight. If the sight fails or if a ground attack is being made, the lever should be moved to CAGE; then the reticle image can be used as a fixed sight. On C (Group 15 and subsequent) airplanes, a remote control knob labeled PULL TO CAGE GUN SIGHT is on the pilot's left vertical console. It is mechanically linked to the gyro caging lever to provide a more convenient means of caging the gyro. The sight should be caged mechanically for landing and takeoff to avoid damaging the sight gyros.

Wingspan Adjustment Wheel.

The wingspan adjustment wheel on the sight is used during radar and manual ranging in the attack operation. After identifying the target, the pilot sets the adjustment wheel to the dimensions of the target. On C (Group 15 and subsequent) airplanes, a gunsight viewer on the windshield frame reflects the adjustment of the target span adjustment wheel.

Manual Ranging Knob.

The manual ranging knob (figure 1-29) is on the end of the speed brake lever. When the radar ranging system is inoperative, the manual ranging knob is turned clockwise to increase the size of the reticle circle as the target range decreases. Manual ranging is also employed below 6000 feet on overland targets because ground effects often make radar ranging erratic. Range sweep of manual ranging is from approximately 1200 to 2700 feet. The manual ranging knob is spring loaded in the counterclockwise position and should not be turned when the radar ranging system is functioning properly.

Bomb Target Wind Selector Knob.

The bomb target wind selector knob (figure 1-10) on the pilot's left vertical console is used for bombing operations only. When the sight is used for rockets or guns, the knob should be turned to ROCKET-GUN.

Rocket Dive-Angle Knob.

The rotary rocket dive-angle knob (figure 1-9) on the pilot's left console is used in rocket firing to give a depression angle correction for the type of rocket to be fired and the intended dive angle of attack. The control has a GUN BOMB position and settings for three types of rockets: 5-inch HVAR; 3.5-inch AR; and 5-inch AR. Each of the three settings has two detents marked S and N; the S settings are used for steep dive angles and the N settings for normal dive angles. When the sight is used for firing guns or dropping bombs, the rocket dive-angle knob should be at GUN BOMB.

Sight Range Dial.

The sight range dial in the sighthead indicates the target range in hundreds of feet. The dial is graduated from 600 to 6000 feet to present range distances in either manual or radar ranging.

Figure 4-27.

GUNNERY EQUIPMENT.

Three 20MM guns are on each side of the fuselage nose section and a gun camera is in the nose section of the right tip tank. Each gun has a pneumatic charger, 200 rounds of ammunition stored in a container, and two heaters which keep the gun and feeder from freezing. The guns and camera operate on 28-volt DC power. The gun firing trigger and the gun selector switch control the camera and gun operation. The camera will operate automatically when the guns are fired or it can be operated separately.

Gun Charger Compressors and Air Pressure Tanks.

Two gun charging compressors are located in the nose of the airplane, forward of the ammunition boxes (figure 1-3). When the compressor circuit breakers on the radar observer's circuit breaker panel are in, the circuit from the 28-volt DC bus to the compressor motors is armed. When system pressure drops to 1250 PSI, the compressor pressure switch will automatically actuate the compressor. When system pressure reaches 1500 PSI, the compressor pressure switch will automatically shut off the compressor. Four air pressure storage tanks, located forward of the compressors, maintain air pressure to operate the gun chargers. Each tank has a safety valve set at 1750 PSI. Gun charging system pressure is also utilized to pressurize components of the AN/APG-33 radar set.

Gun Selector Switch.

The 28-volt DC guarded gun selector switch (figure 4-26) on the armament control panel on the pilot's center pedestal controls the 28-volt DC circuits for the guns and camera. When the gun selector switch is at GUNS, the circuits for the camera and the guns are armed; and when the trigger is squeezed to the full stop, the camera operates and the guns fire. When the switch is at SIGHT & CAMERA, the circuit for the camera is armed, and only the camera operates when the trigger is squeezed. When the switch is at OFF, all electrical circuits for guns and camera are deenergized.

Gun Trigger.

The 28-volt DC gun trigger (figure 1-27) is on the control stick grip. When the trigger is squeezed to the detent, the gun camera starts operating. When the gun selector switch is at GUNS and the trigger is squeezed to its full stop, the camera will operate and the guns will fire.

Gun Charger Switch.

When the 28-volt DC charging switch (figure 4-26) on the armament panel is placed momentarily at CHARGE, all guns are charged simultaneously. The bolts retract and remain retracted until the firing trigger is squeezed to fire the guns or until the charging switch is placed at RELEASE. This hold-back prevents cook-off when the gun is hot and allows air to flow through the barrel for faster cooling. When the gun charger switch is turned to RELEASE, the guns are loaded for firing. However, it is not necessary to place the gun charger switch at RELEASE; once charged, the guns will load and fire when the trigger is squeezed.

CAUTION

One charging of the guns is sufficient. If one or more guns jam, recharging to clear the guns may cause more serious malfunctions.

Armament Heater Switch.

When the 28-volt DC heater switch (figure 4-26) on the armament control panel is at ON, the 120-volt DC gun and feeder heaters are thermostatically controlled. Turning the switch to OFF turns the heaters off.

Firing Guns in Radar Ranging.

WARNING

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Do not charge guns on the ground. Accidental firing could injure personnel and damage other airplanes.

1. Power inverter switch—MAIN.
2. A-1C sight gyro caging lever—UNCAGED.
3. Gun selector switch—GUNS.
4. Armament heater switch—ON, if required.

5. Gun charger switch—CHARGE, momentarily.
6. Reticle dimmer knob—Adjust to desired brillance.
7. Radar scope intensity knob—Adjust to desired brilliance.
8. Target span adjustment wheel—Set to span target.

Note

The above step is not mandatory when using radar ranging, but it is a desirable precaution should radar lockon be lost and manual ranging follow.

9. A-1C sight gyro caging button—Press for 30 seconds to stabilize reticle image after radar has automatically uncaged gunsight.
10. Begin tracking with reticle circle and dot. As range decreases, the reticle enlarges and the range circle on the radar scope contracts. If the sight fails, move the mechanical caging lever to CAGE and use as a fixed-reticle sight.
11. When target is within gun range, track smoothly for 1 second, without slipping or skidding, and fire.

Firing Guns in Manual Ranging.

If the radar fails but the target can be seen, continue the attack as follows:

1. A-1C sight gyro caging lever—UNCAGED.
2. Target span adjustment wheel—Set to known dimension of target, if it was not set before failure of radar.
3. A-1C sight gyro caging button—Press momentarily to stabilize reticle image, and begin tracking with reticle circle and dot. If the sight fails, move mechanical caging lever on the sight to CAGE and use the sight as a fixed-reticle sight.
4. Manual ranging knob—Rotate clockwise to enlarge reticle circle and keep target framed in circle.
5. When target is within gun range, track smoothly, without slipping and skidding for 1 second; then fire.

MISCELLANEOUS EQUIPMENT.

WINDSHIELD WIPER.

The windshield wiper on the center panel of the windshield uses 28-volt DC power. The windshield wiper switch and speed control knob are located either on the lower right corner of the pilot's instrument panel (figure 1-8), or on the pilot's right console (figure 1-13). The windshield wiper switch, using 28-volt DC, has ON, OFF, and spring-loaded PARK positions; a rotary speed control knob adjacent to the windshield wiper switch has INC and DEC positions for controlling the speed of the wiper motor. The speed control must be at INC before the windshield wiper switch is turned ON. If the wiper blade stops at an undesirable position when the switch is turned OFF, the switch can be held momentarily to the spring-loaded PARK position; the blade will move to the extreme right and stop automatically. If the wiper stops and cannot be started with the speed knob, turn wiper off.

CAUTION

The speed rheostat should not be used to stop the wiper. Before the wiper is either stopped or started, the speed rheostat should be turned to INC.

ANTI "G" SUIT EQUIPMENT.

The pilot's and radar observer's anti "G" suits are inflated by air pressure from the engine compressors. The anti "G" suit intake tube attaches to an air pressure outlet on the front of the seat. A pressure regulator valve (figure 1-9) on the left side of the seat is moved to LO or HI to control the pressure in the suit. Acceleration above 1.75 "G's" causes the valve to open, inflating the anti "G" suit; for each additional "G" acceleration, the suit is inflated 1 PSI (LO setting) or 1.5 PSI (HI setting). A button on top of the valve can be pressed when the wearer desires to inflate the suit momentarily.

Note

Pilot's anti "G" suit equipment has been rendered inoperative.

REAR VIEW MIRRORS.

Two rear view mirrors have been installed in the airplane. The mirror on the left frame of the windshield enables the pilot to see the empennage. The mirror on the right side of the canopy frame allows the pilot and radar observer to see each other.

RELIEF TUBES.

The pilot's relief tube (figure 1-13) is on the floor to the right of the seat. The radar observer's relief tube is to the right of his seat, aft of the wing spar.

CHECKLISTS.

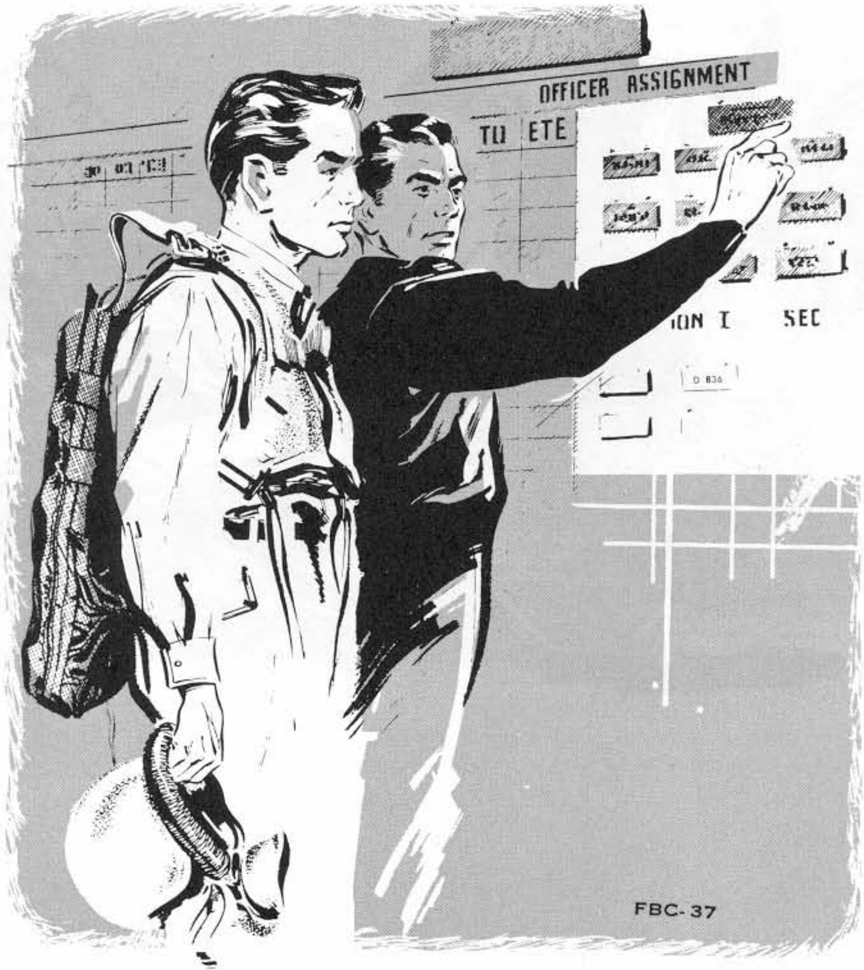
The pilot and radar observer each has a permanently installed metal checklist in his cockpit. The pilot's checklist slides out at the top of the center pedestal; the radar observer's is above his instrument panel, see figure 1-11 and figure 4-5.

MAP AND DATA CASES.

The pilot's flight report holder, and map and data case (figure 1-9) are on the left console. The radar observer's map and data case (figure 4-7) is on the right side of the cockpit floor. An airplane data case is in the aft fuselage radio section.

MISCELLANEOUS PARTS STOWAGE.

Two bags containing fuselage and wing jack pads, mooring fittings, and microphones are stored in the radio section of the aft fuselage. In C (Group 10 and subsequent) airplanes, a third bag containing the landing gear ground safety locks and pitot tube covers is stored forward of the seat near the floor on the left side of the radar observer's cockpit.



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OPERATING LIMITATIONS

SECTION V

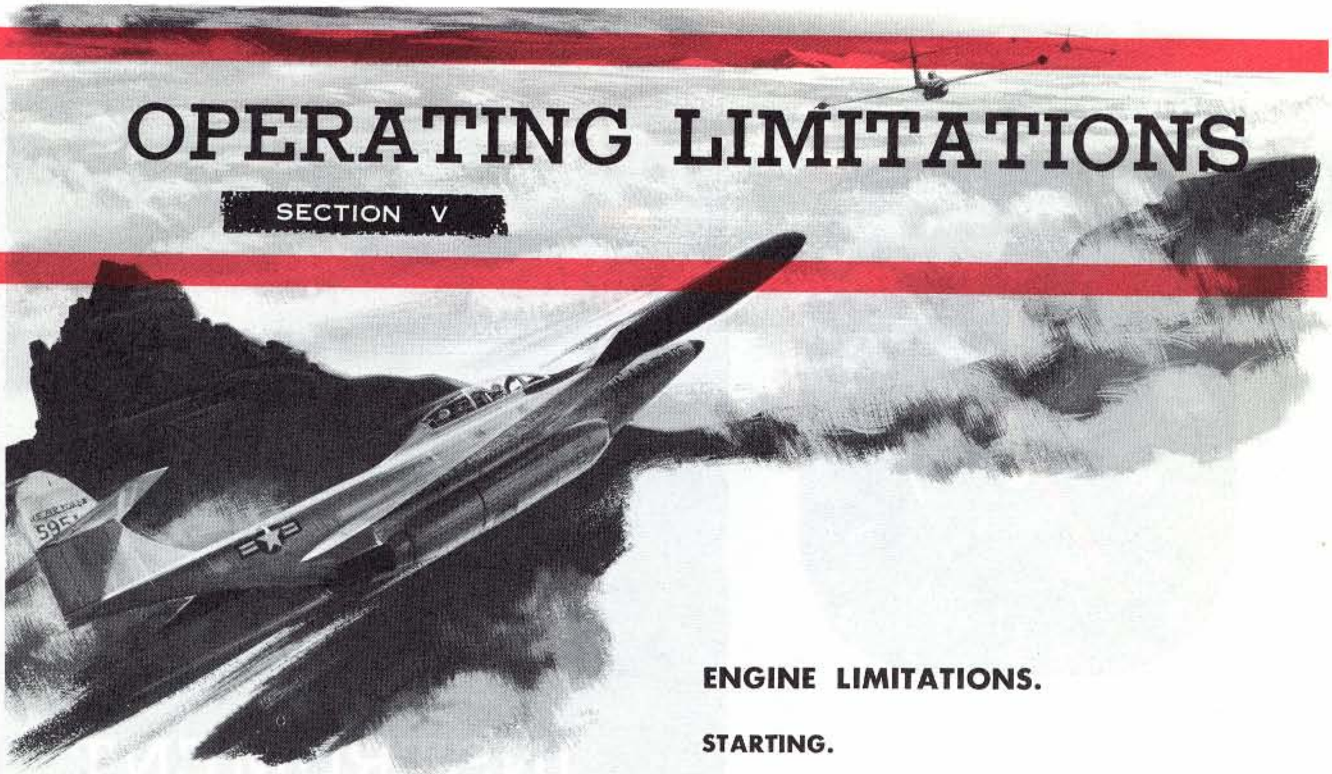

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TABLE OF CONTENTS

Operating limitations and restrictions are subject to change; therefore, the latest technical orders pertaining to the airplane must be consulted. In addition to the operating limitations in this section, instrument markings (figure 5-1) must be noted since they represent limitations that are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENTS.

The minimum crew is a pilot for local day flights under VFR conditions. A radar observer or a qualified crewmember will be added for cross-country, or night, or IFR flights, or for other operations as deemed necessary by the commander.

ENGINE LIMITATIONS.

STARTING.

During engine starting, the maximum allowable exhaust temperature is 900°C. Exhaust gas temperatures above 735°C but less than 900°C, are permitted for no more than 20 seconds. Afterburning should be stopped if the exhaust gas temperature momentarily exceeds 900°C or if the exhaust gas temperature remains between 735°C and 900°C for 5 seconds or longer. Normal power is 95.6% RPM; military power is 100% without afterburning; and maximum power is 100% with afterburning. There are no engine operating time limits.

ACCELERATION.

During accelerations, the exhaust gas temperatures must not exceed 900°C except that a peak temperature between 900°C and 925°C is permitted for a maximum of 3 seconds at engine speeds below 75% RPM. Temperatures between 735°C and 900°C are permitted for no more than 20 seconds. If engine speed momentarily exceeds 103% RPM, the engine must be removed for overhaul. Stabilized engine speeds greater than 103% RPM are prohibited. Engine must be removed for overhaul if this RPM is exceeded under stabilized conditions or if 104% RPM is exceeded momentarily. If stabilized engine speed exceeds 102% RPM, have throttle reset.

AFTERBURNER OPERATING TIME LIMITS.

Afterburner operation is subject to a time limitation of 15 minutes followed by at least 30 minutes of non-afterburning operation below 20,000-foot altitude to

AIRSPEED

ACCELEROMETERS

AIRSPEED

- (Yellow) 195 KNOTS MAXIMUM FOR FULL FLAPS OR LANDING GEAR DOWN.
- (Red) BELOW 20,000 FEET PRESSURE ALTITUDE, THE AIRSPEED LIMITATION IS 425 KNOTS IAS OR MACH 0.90, WHICHEVER IS THE LOWER IAS.

NOTE: The instrument setting is such that the red pointer will move to indicate the limiting structural airspeed of 425 knots IAS or the airspeed representing the limiting Mach number of 0.90, whichever is the lower IAS.

INSTRUMENT MARKINGS

ACCELEROMETERS

C

- −2.00 "G's" MAX AT ANY **GROSS WEIGHT**.
- +3.00 "G's" MAX WITH ANY AMOUNT OF TIP FUEL.
- +4.00 "G's" MAX WITH EMPTY TIP TANKS **BELOW** 12,000 FEET.
- +4.50 "G's" MAX WITH EMPTY TIP TANKS **ABOVE** 12,000 FEET.

B

- +3.00 "G's" MAX WITH ANY AMOUNT OF TIP FUEL.
- +4.00 "G's" MAX WITH EMPTY TIP TANKS **BELOW** 12,000 FEET.
- +4.50 "G's" MAX WITH EMPTY TIP TANKS **ABOVE** 12,000 FEET.

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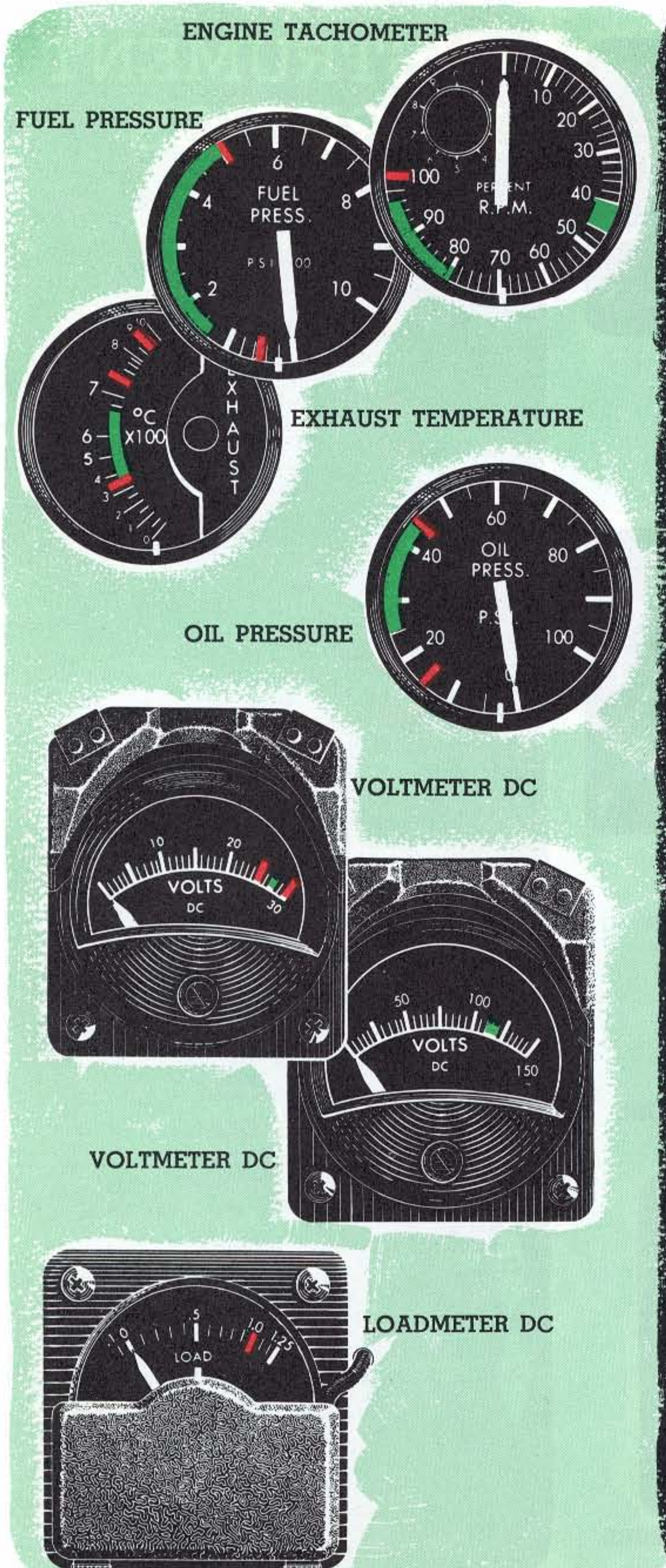
Figure 5-1 (Sheet 1 of 5 Sheets).



ENGINE TACHOMETER

- (green) 80% – 96% OPERATING RPM RANGE.
- (red) 100% MAX RPM.
- (green) 40%–45% RPM IDLE

FUEL PRESSURE

- (red) 50 PSI MIN FOR FLIGHT.
- (green) 140 – 500 PSI CONTINUOUS OPERATION.
- (red) 500 PSI MAX FOR FLIGHT.

EXHAUST TEMPERATURE

- (red) 315°C MIN FOR FLIGHT.
- (green) 315° – 665°C CONTINUOUS OPERATION.
- (red) 735°C MAX FOR FLIGHT.
- (red) 900°C MAX DURING STARTING AND ACCELERATION ONLY.

OIL PRESSURE

- (red) 15 PSI MIN FOR FLIGHT.
- (green) 25–45 PSI CONTINUOUS OPERATION.
- (red) 45 PSI MAX FOR FLIGHT.

based on all fuel grades

VOLTMETER DC

- (red) 25.0 VOLTS MINIMUM.
- (green) 27.5 VOLTS DESIRED.
- (red) 30.0 VOLTS MAXIMUM.

VOLTMETER DC

- (green) 110 – 120 VOLTS OPERATING RANGE.

LOADMETER DC

120-volt d-c loadmeter

- (red) 1.0 CONTINUOUS OPERATING LIMIT.

28-volt d-c loadmeter

- (red) 1.0 CONTINUOUS OPERATING LIMIT.

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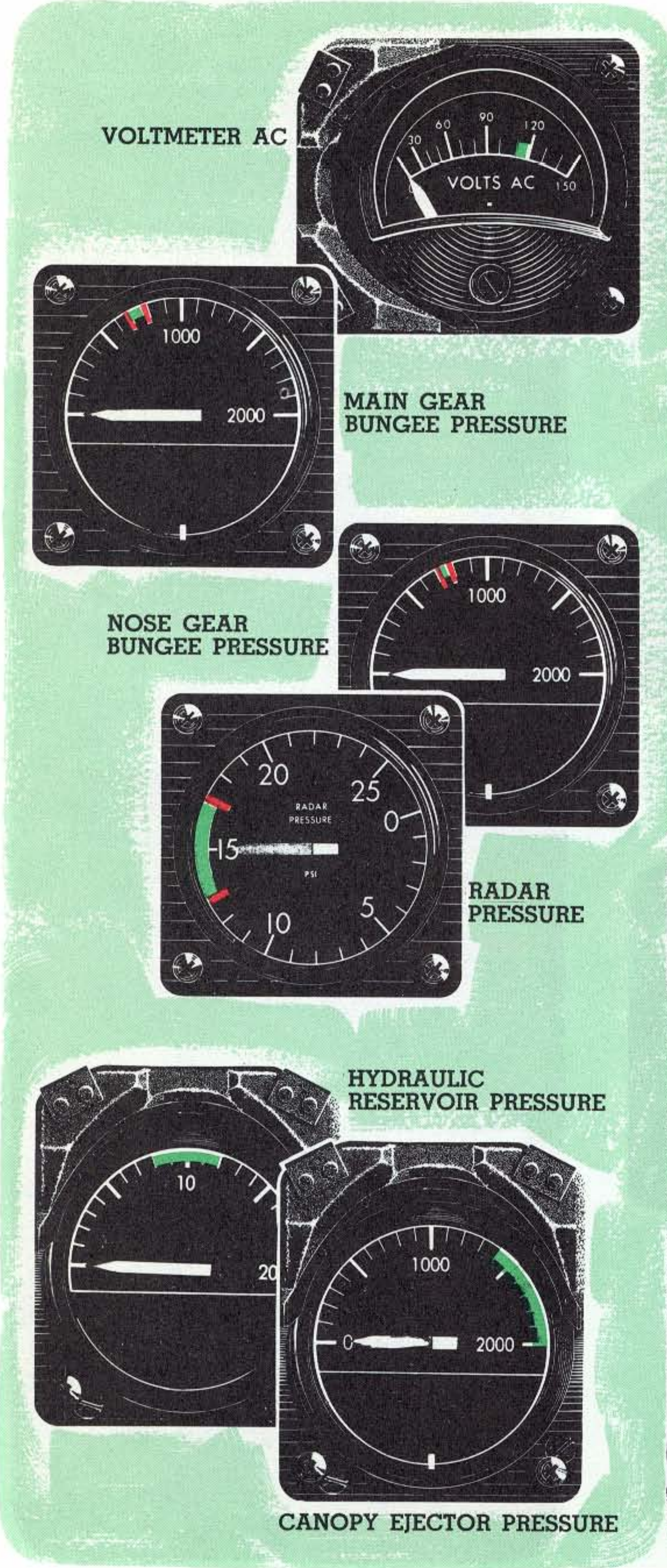
Figure 5-1 (Sheet 2 of 5 Sheets).



INSTRUMENT MARKINGS

VOLTMETER AC

110 – 120 VOLTS OPERATING RANGE.

MAIN GEAR BUNGEE PRESSURE

675 PSI MIN. FOR FLIGHT.
675 – 775 PSI OPERATING RANGE.
775 PSI MAX. FOR FLIGHT.

NOSE GEAR BUNGEE PRESSURE

720 PSI MIN. FOR FLIGHT.
720 – 780 PSI OPERATING RANGE.
780 PSI MAX. FOR FLIGHT.

RADAR PRESSURE

13 PSI MIN. FOR FLIGHT.
13 – 17 PSI OPERATING RANGE.
17 PSI MAX. FOR FLIGHT.

HYDRAULIC RESERVOIR PRESSURE

8 – 12 PSI OPERATING RANGE.

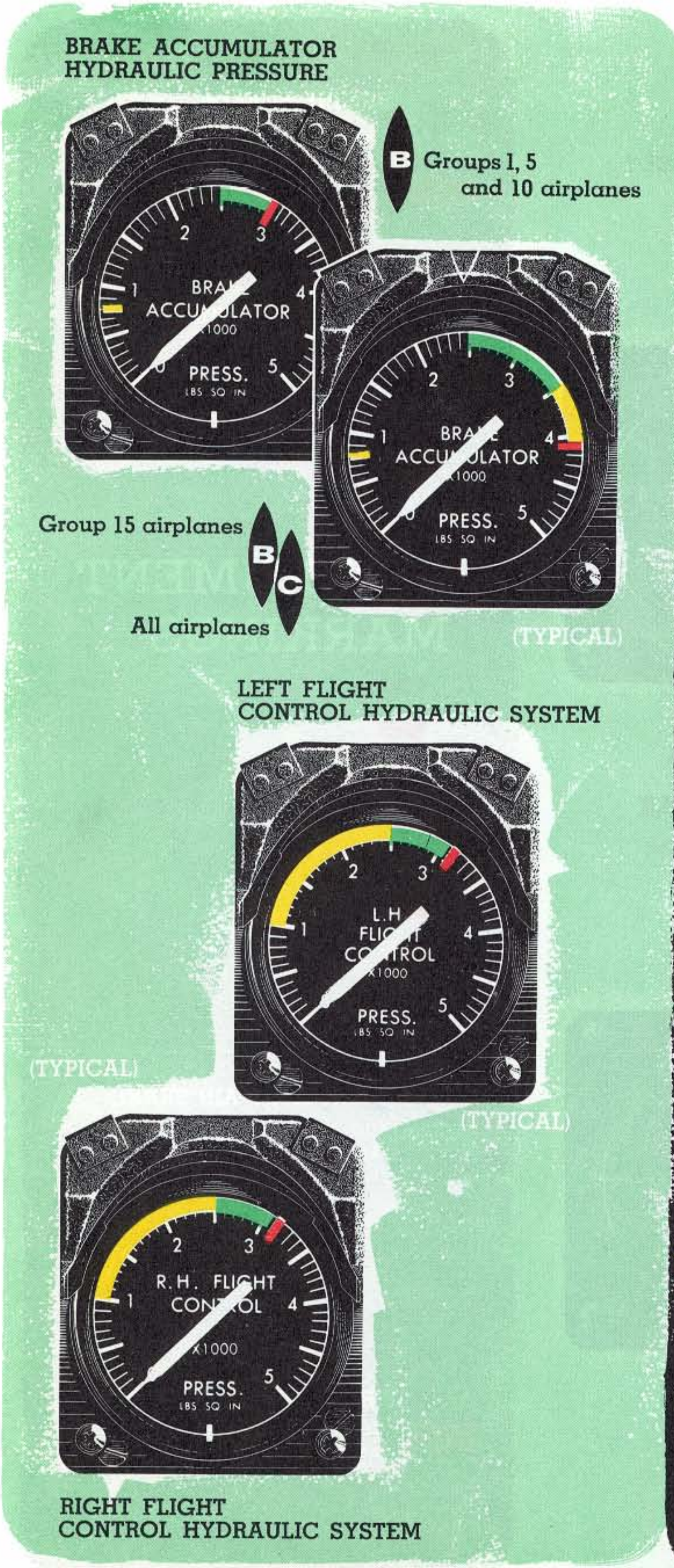
CANOPY EJECTOR PRESSURE

C 1400 – 2000 PSI OPERATING RANGE.

B 1500 – 2000 PSI OPERATING RANGE.

BC-84(3)

Figure 5-1 (Sheet 3 of 5 Sheets).



BRAKE ACCUMULATOR HYDRAULIC PRESSURE (B)

- (yellow) 800 PSI ONE APPLICATION REMAINING.
- (green) 2500 – 3000 PSI NORMAL FOR FLIGHT.
- (red) 3000 PSI MAX FOR FLIGHT.

BRAKE ACCUMULATOR HYDRAULIC PRESSURE (B, C)

- (yellow) 800 PSI ONE APPLICATION REMAINING.
- (green) 2500 – 3500 PSI NORMAL FOR FLIGHT.
- (yellow) 3500 – 4100 PSI ABOVE NORMAL: ALLOWABLE.
- (red) 4100 PSI MAX FOR FLIGHT.

LEFT FLIGHT CONTROL HYDRAULIC SYSTEM

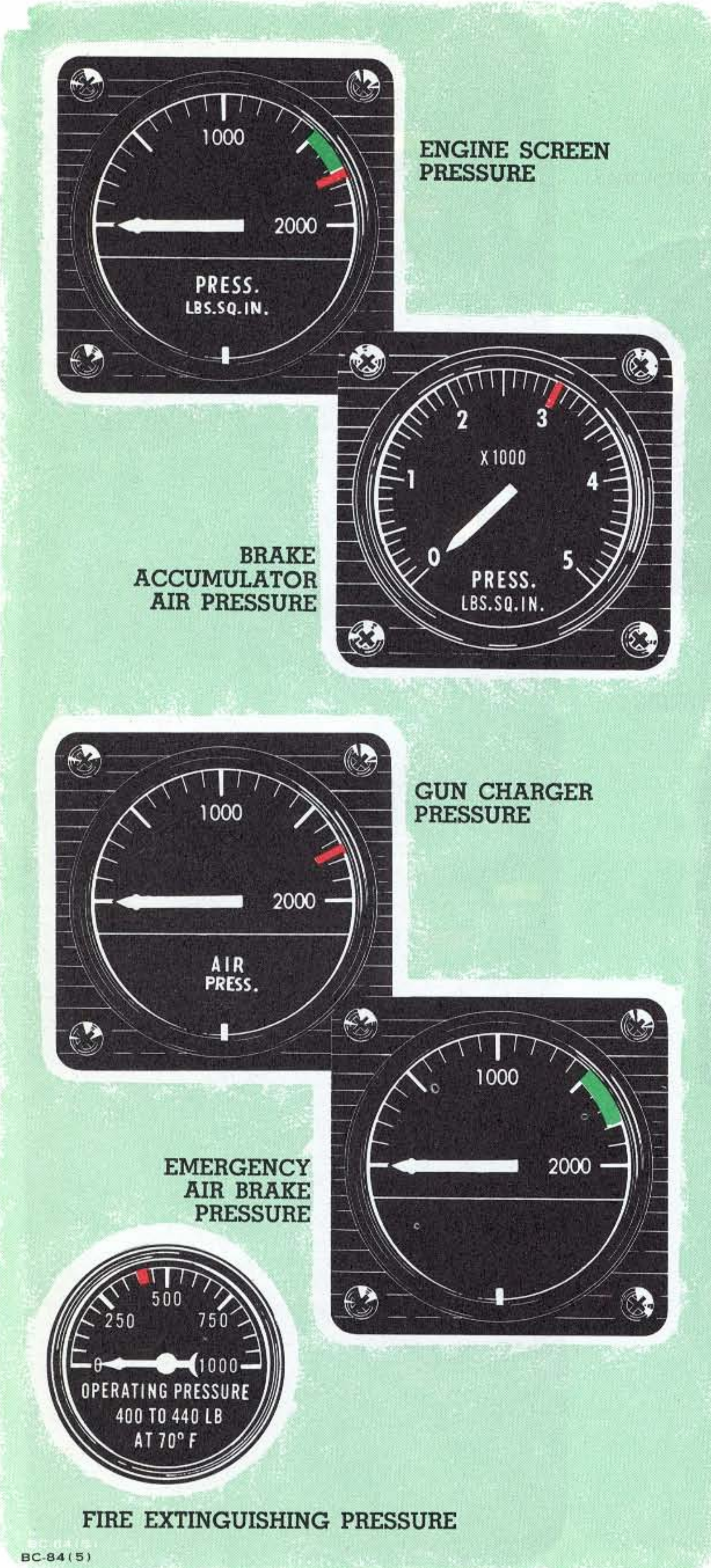
- (yellow) 1000 – 2500 PSI MOMENTARY ALLOWABLE.
- (green) 2500 – 3050 PSI NORMAL FOR FLIGHT.
- (red) 3150 PSI MAX FOR FLIGHT.

RIGHT FLIGHT CONTROL HYDRAULIC SYSTEM

- (yellow) 1000 – 2500 PSI MOMENTARY ALLOWABLE.
- (green) 2500 – 3050 PSI NORMAL FOR FLIGHT.
- (red) 3150 PSI MAX FOR FLIGHT.

BC-84(4)A

Figure 5-1 (Sheet 4 of 5 Sheets).



INSTRUMENT MARKINGS

ENGINE SCREEN

1500–1750 PSI OPERATING RANGE.

1750 PSI MAX FOR FLIGHT.

BRAKE ACCUMULATOR AIR PRESSURE

3000 PSI MAX FOR FLIGHT.

GUN CHARGER

1750 PSI MAX FOR FLIGHT.

EMERGENCY AIR BRAKE

1500–1800 PSI OPERATING RANGE.

FIRE EXTINGUISHING

400–440 LB OPERATING RANGE AT 70° F.

Figure 5-1 (Sheet 5 of 5 Sheets).

EXHAUST GAS TEMPERATURES VS AMBIENT TEMPERATURES

Air inlet screens extended.
Without afterburning.

NOTE: Afterburning lowers exhaust gas temperatures up to 5°c.

J35-47 ENGINES

AMBIENT TEMPERATURE °C	AMBIENT TEMPERATURE °F	EXHAUST GAS TEMPERATURE °C MAX.	EXHAUST GAS TEMPERATURE °C MIN.
		100% RPM	
38	100	735	715
32	90	735	715
27	80	729	709
21	70	721	701
16	60	713	693
10	50	705	685
4	40	697	677
−1	30	687	667
−7	20	678	658
−12	10	669	649
−18	0	659	639
−23	−10	649	629
−29	−20	639	619
−34	−30	632	612
−40	−40	623	603
−46	−50	616	596
−51	−60	611	591
		98% RPM	
43	110	733	713
49	120	735	715

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Figure 5-2.

prevent excessive afterburner boost pump wear. There is no limitation on afterburner usage above 20,000 feet.

AIRSPEED LIMITATIONS.

Below 20,000-foot pressure altitude, maximum airspeed must not exceed 470 knots IAS or Mach 0.9, whichever is the lower airspeed. These limits are imposed to reduce the hazard of low elevator control at high airspeeds and low altitudes. The 470 knots IAS and 0.9 Mach number restrictions coincide at approximately 13,000-foot pressure altitude. Above 20,000-foot pressure altitude, airspeed is unrestricted.

WARNING

The preceding limitations are superseded by temporary limitations for airplanes *not in compliance* with applicable technical orders as follows: Below 20,000-foot pressure altitude, do not exceed 425 knots IAS or Mach 0.90 whichever is the lower. Above 20,000-foot pressure altitude, airspeed is unrestricted. Compliance with T.O. 1F-89-530 will remove temporary limitations from all airplanes.

WING FLAP LIMITATIONS.

The wing flaps may fail if the following structural limit airspeed of the wing flaps is exceeded.

Wing Flap Positions	*IAS Knots*
Wing flaps down—7½ degrees	285
Wing flaps at takeoff (gear up)	230
Wing flaps full down (gear up or down)	195

Note

A wing flaps full down and 195-knot IAS condition can occur only when the airplane is accelerated to 195 knots IAS after extending the flaps. Airloads prevent fully extending flaps beyond 35 degrees at airspeeds greater than approximately 175 knots IAS.

LANDING GEAR LIMITATION.

With the wing flaps in any position, the structural limit airspeed of the landing gear and the main landing gear doors is 195 knots IAS and 1.20 "G's" during retraction.

TIRE LIMITATIONS.

Speed on the ground should not exceed 140 knots at takeoff or 122 knots at landing to obtain normal tire life. Exceeding these speeds on occasion will not necessarily result in tire failure; however, continual operation at excessive ground roll speeds will result in reduced tire life and premature failure. For proper tire pressure see figure 5-3.

LANDING LIGHT LIMITATION.

Do not extend landing light at speeds above 175 knots IAS. The light was designed for use only during final approach and landing. If this limitation is exceeded, the landing light may fail structurally.

CANOPY LIMITATIONS.

Speeds up to 50 knots IAS are permitted when the airplane is taxied with the canopy open. Flight with the canopy open is prohibited.

PROHIBITED MANEUVERS.

SPINS.

Intentional spins are prohibited.

ACROBATICS.

Acrobatics will not be performed below 12,000 feet.

INVERTED FLIGHT.

Inverted flight without afterburning may be maintained for approximately 8 seconds at 20,000-foot pressure altitude as the only fuel available to the engines is the fuel in the lines and fuel controller. At lower altitudes, time will be reduced because of the increased fuel flow.

Note

Inverted flight (and any other maneuver involving negative "G" forces) with maximum power will result in immediate afterburner flameout.

LANDING.

Landing with any tip tank fuel is prohibited. Landings at heavier than normal landing weight should be made with caution. Normal landing weight is one-half or less of internal fuel.

AILERON AND RUDDER MOVEMENT.

With no fuel in the tip tanks, aileron and rudder motions are unrestricted. With any amount of fuel in the tip tanks, abrupt rudder deflections and aileron deflections are prohibited. Aileron deflections greater than one-third full throw are prohibited except during take-off or landing.

ACCELERATION LIMITATIONS.

The load factor envelope is shown on the Operating Flight Strength Diagram, figure 5-4. The figures include the operating gross weight and operating altitude ranges of the airplane. Lines on the left side of the chart represent maximum lift limitations, top and bottom lines specify structural limit load factor, and lines on the right indicate limit airspeeds, elevator control boundaries, or both. The elevator control boundary lines show the necessity for careful regulation of airspeed during dive maneuvers; a small increase in IAS will result in a noticeable decrease in available load factor or ability to maneuver. This effect will be dangerous during dives at low altitudes and prolonged dives from high altitudes, where IAS can increase considerably above the maximum level flight airspeed. With empty tip tanks, do not exceed the following load factors:

Above 12,000 Feet

Symmetrical maneuvering flight +5.67 to −2.33 "G's"

Asymmetrical maneuvering flight +3.78 to −1.00 "G's"

Below 12,000 Feet

Symmetrical maneuvering flight +5.00 to −2.33 "G's"

Asymmetrical maneuvering flight +3.33 to −1.00 "G's"

With any fuel in the tip tanks, and at any altitude, do not exceed the following load factors:

Symmetrical maneuvering flight +3.67 to −1.67 "G's"

Asymmetrical maneuvering flight +2.45 to −1.00 "G's"

Note

- Asymmetrical maneuvers are those which create unequal airloads resulting from aileron or rudder deflection. A coordinated turn, however, is a symmetrical maneuver once bank angle is established.
- Above maximum level flight airspeed, the maximum allowable negative load factor reduces as airspeed increases, reaching −1.00 "G" at the limit airspeed attainable.

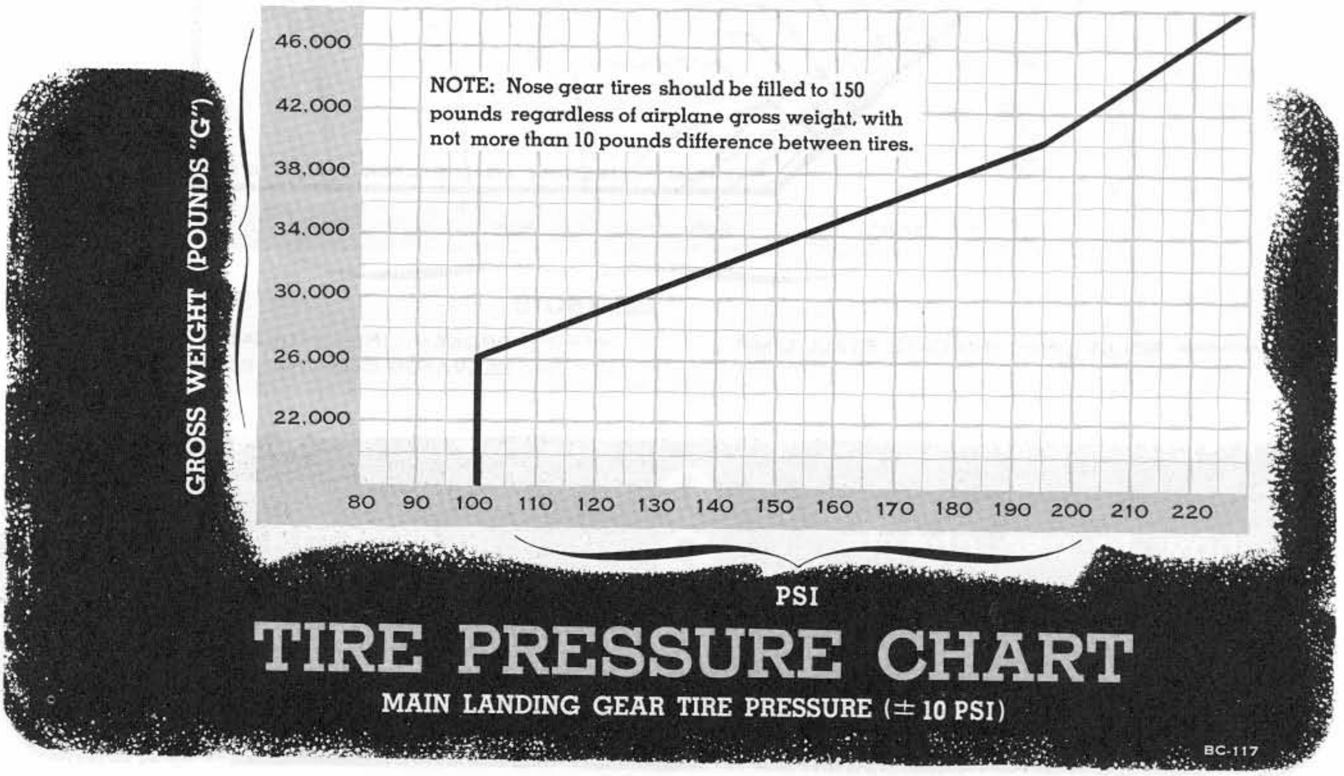


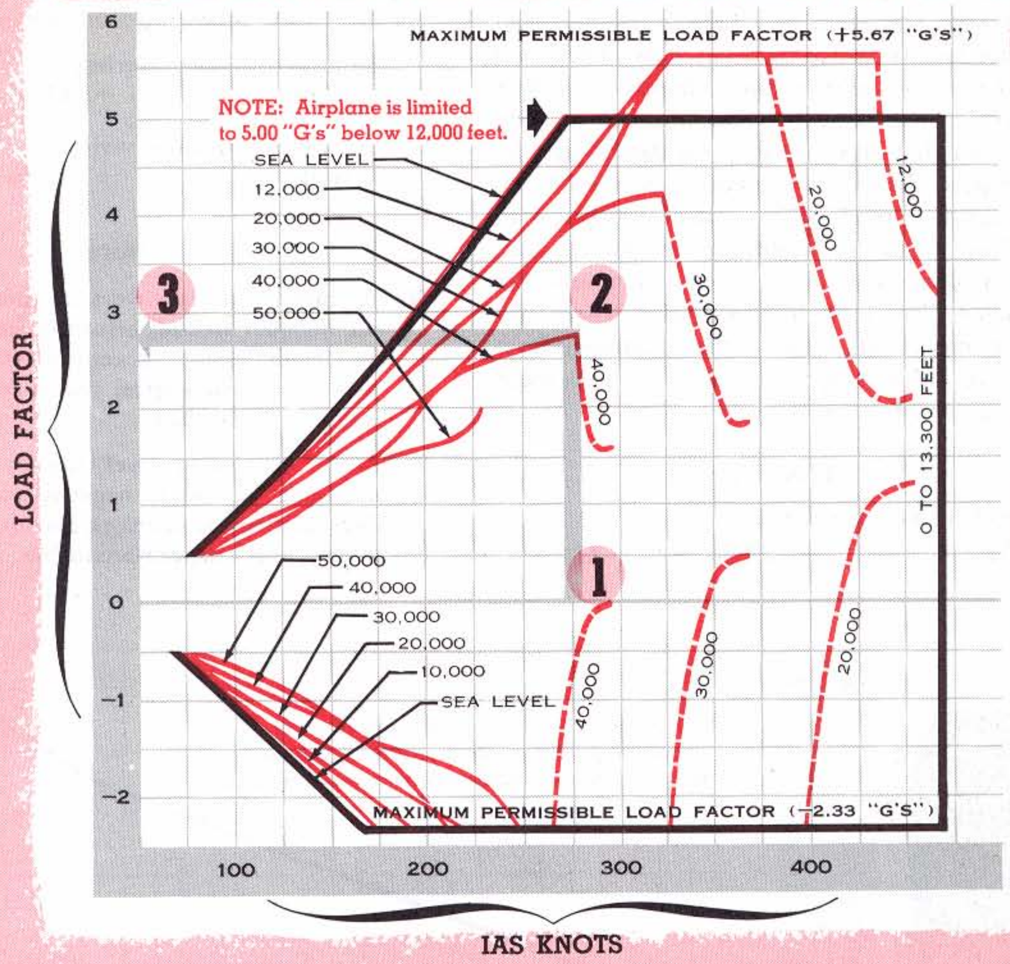
Figure 5-3.

APPROXIMATELY **28,000** POUNDS GROSS WEIGHT

OPERATING FLIGHT STRENGTH DIAGRAM

FOR SYMMETRICAL FLIGHT IN SMOOTH AIR

● No tip tank fuel ● No internal fuel



SOLID LINES INDICATE STALL LIMIT

BROKEN LINES INDICATE ELEVATOR CONTROL POWER LIMITS

how to use charts . . .

1. SELECT AN INDICATED AIRSPEED.
2. MOVE UP THE CHART TO A SELECTED ALTITUDE (SOLID OR BROKEN LINE).
3. MOVE TO THE LEFT TO FIND THE MAXIMUM NUMBER OF "G's" YOU CAN PULL AT THAT ALTITUDE AND AIRSPEED.

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST

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Figure 5-4 (Sheet 1 of 3 Sheets).

OPERATING FLIGHT STRENGTH DIAGRAM

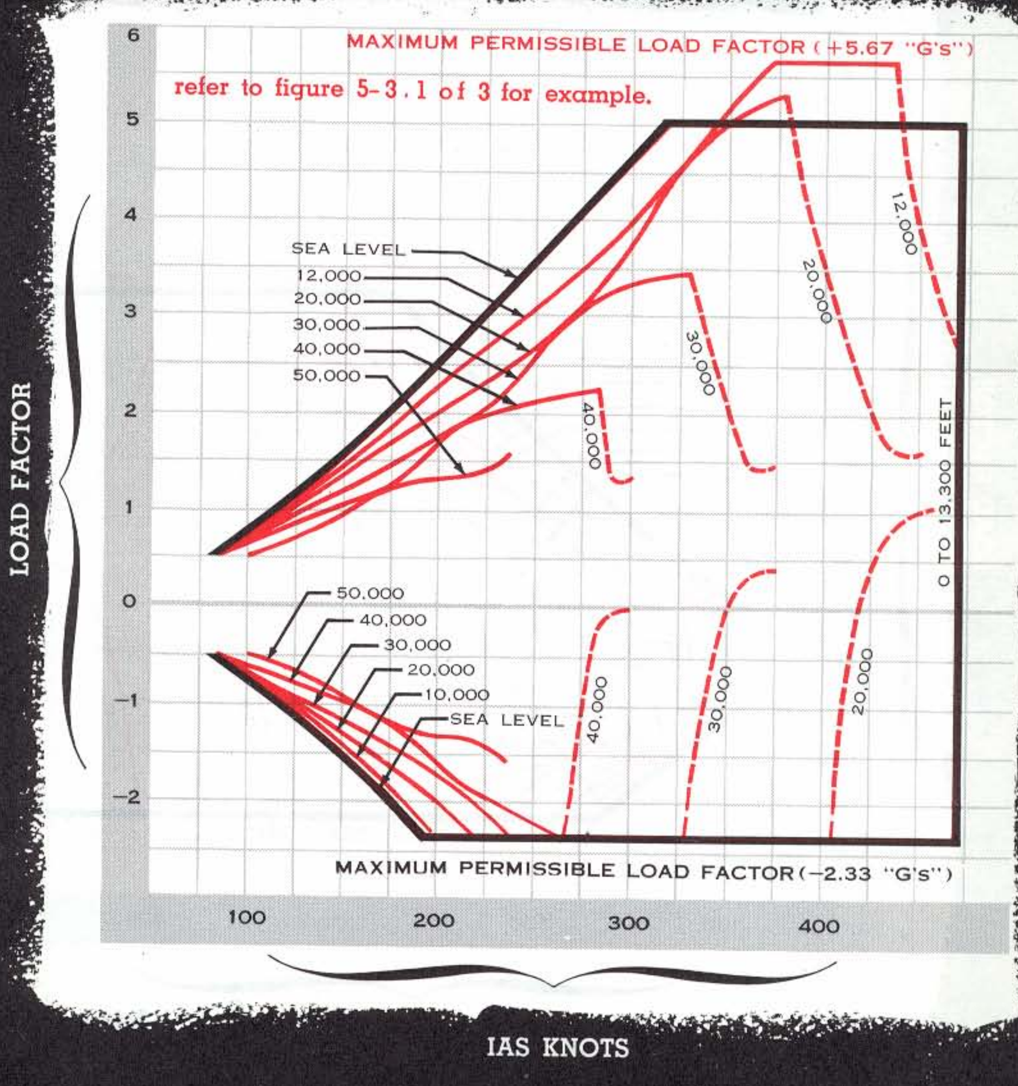
FOR SYMMETRICAL FLIGHT IN SMOOTH AIR

APPROXIMATELY
34,000
POUNDS GROSS WEIGHT

NOTE: Airplane is limited to 5.00 "G's" below 12,000 feet.

Full internal fuel

No tip tank fuel



SOLID LINES INDICATE STALL LIMIT

BROKEN LINES INDICATE ELEVATOR CONTROL POWER LIMITS

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST

BC-89

Figure 5-4 (Sheet 2 of 3 Sheets).

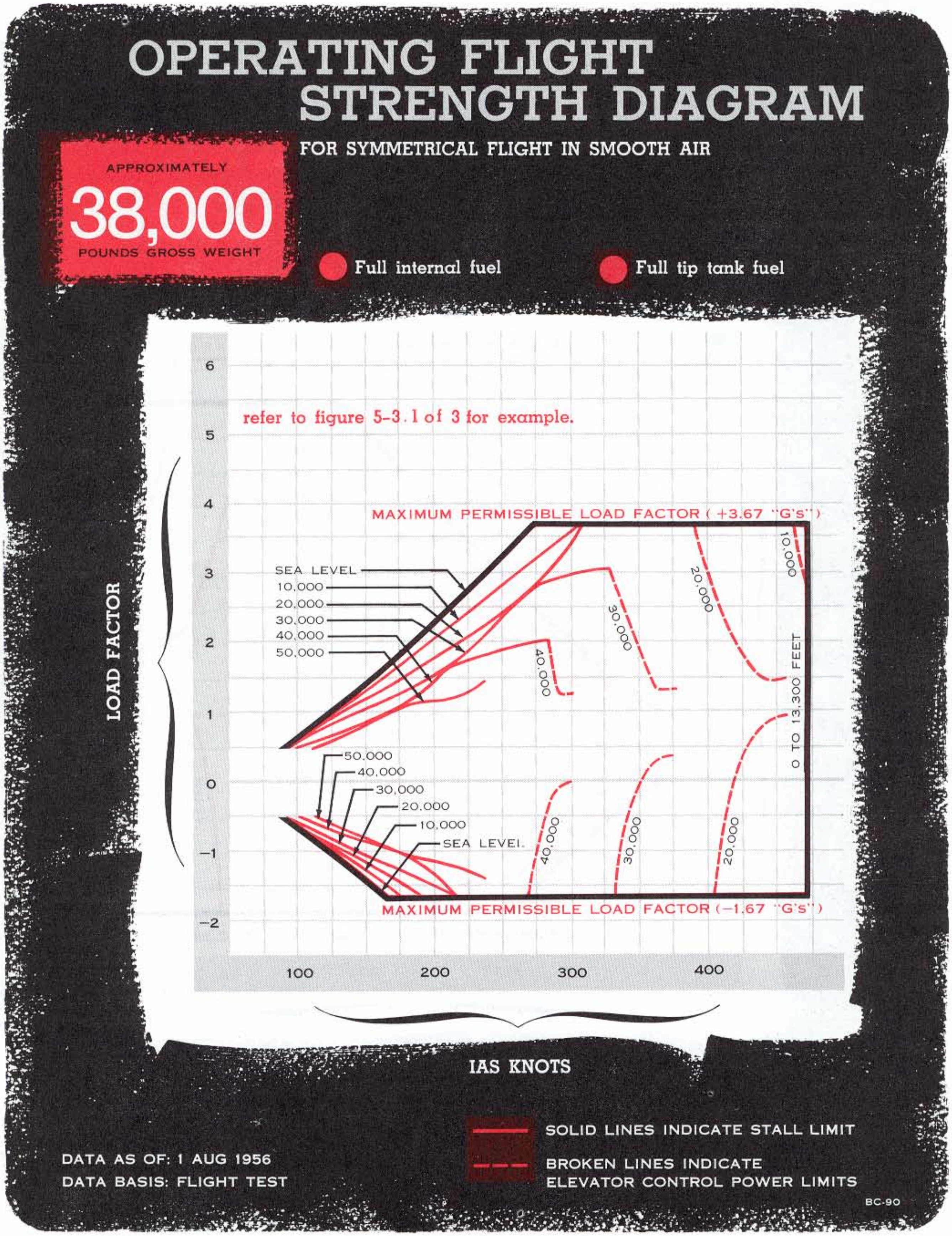


Figure 5-4 (Sheet 3 of 3 Sheets).

WARNING

- The preceding limitations are superseded by the following temporary limitations for airplanes not in compliance with applicable technical orders:
- With any amount of tip fuel at any altitude, do not exceed +3.00 "G's" or −1.50 "G's."
- For any configuration above 12,000 feet with no tip fuel, do not exceed +4.50 "G's" or −1.50 "G's."
- With no tip fuel below 12,000 feet, do not exceed +4.00 "G's" or −1.50 "G's."

GROSS WEIGHT CHART

LANDING	34,000 POUNDS
TAKEOFF	38,000 POUNDS

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Figure 5-5.

Note

Compliance with T.O. 1F-89-530 will remove temporary limitations from all airplanes.

CAUTION

Maneuvers involving negative "G's" at high speed should be avoided to prevent inadvertently exceeding negative "G" limitations.

CENTER-OF-GRAVITY LIMITATIONS.

Center-of-gravity limits are between 22 percent and 27 percent of the mean aerodynamic chord. Under normal operating conditions (i.e. expending fuel and ammunition), it is impossible to exceed these limits. However, if armament (guns, ammunition, ammunition cases) is removed from the airplane, ballast will be required to compensate for the removal. For detailed instructions on weight and balance see T.O. 1-1B-40 and T.O. 1F-89A-5.

WEIGHT LIMITATIONS.

The design of the airplane precludes exceeding the maximum takeoff gross weight (figure 5-5) under normal operating conditions. Landing with any available fuel in the tip tanks is prohibited. For detailed instructions on weight and balance see T.O. 1-1B-40 and T.O. 1F-89A-5.


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FLIGHT CHARACTERISTICS

FBC-6

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INTRODUCTION.

The airplane is a large, high speed, fast-climbing all-weather interceptor. The two-engine design increases dependability and permits top performance while carrying the heavy load of armament and equipment necessary for an intercept mission. With one engine operating, interception can be made up to about 25,000 feet. All flight control surfaces are 100 percent hydraulically actuated. Full powered controls permit accurate control of the airplane at airspeeds which would otherwise make control forces prohibitively high. They also prevent sudden airload changes on control surfaces from affecting the stick or pedals. The wide range of speed control possible with split-aileron type speed brakes increases combat effectiveness. The yaw stabilizer provides satisfactory damping of the high speed Dutch Roll and provides a stable gun platform at high speeds. Tip tank fins, besides decreasing wing twist and keeping the center of the spanwise lift more nearly constant, add materially to the stability and control characteristics of the airplane. The fins also increase the stick force gradient in the airspeed range where maneuvering stability is critical (from approximately 0.70 to 0.80 Mach number), particularly for the aft CG conditions. Power response to throttle adjustment is slow because of the high inertia of the engine rotors. However, rapid changes in effective power are obtainable by stabilizing airspeed at a power setting higher than required by use of partially opened speed brakes, then quickly changing speed brake position as changes in effective power are required. Excess power is greatest at medium to high airspeeds. Consequently, to perform any maneuver involving altitude and airspeed changes, maintain medium to high airspeeds.

STALLS.

The stall in this airplane is a mild pitch down, with dropoff usually to the left. (See figure 6-2 for stall speeds for clean, landing, and takeoff configurations.) At low altitudes, power-on stall IAS is approximately 3 knots lower than power-off stall IAS for the configurations indicated in the Stall Speed Chart. The airspeeds shown in the chart for the landing and takeoff configurations are for idle power. Recovery from a stall is normal; release back pressure from the stick, allowing nose to drop, and advance throttles. Near a 1 "G" stall, response to aileron motion may be slightly slower than normal. Altitude lost during recovery is approximately 500 feet. During the stall and approach to stall, both aileron and rudder retain adequate effectiveness to control the airplane. Landing gear position does not affect stall speed. Speed brake position affects stall speed as follows: with wing flaps up, stall IAS decreases as speed brake opening increases, reaching a maximum decrease of 6 knots with speed brakes fully open. With wing flaps in the landing position, no change in stall IAS occurs until speed brakes are 30 degrees open; then stall IAS increases as speed brake opening increases, reaching a maximum increase of 7 knots with speed brakes fully open.

ACCELERATED STALLS.

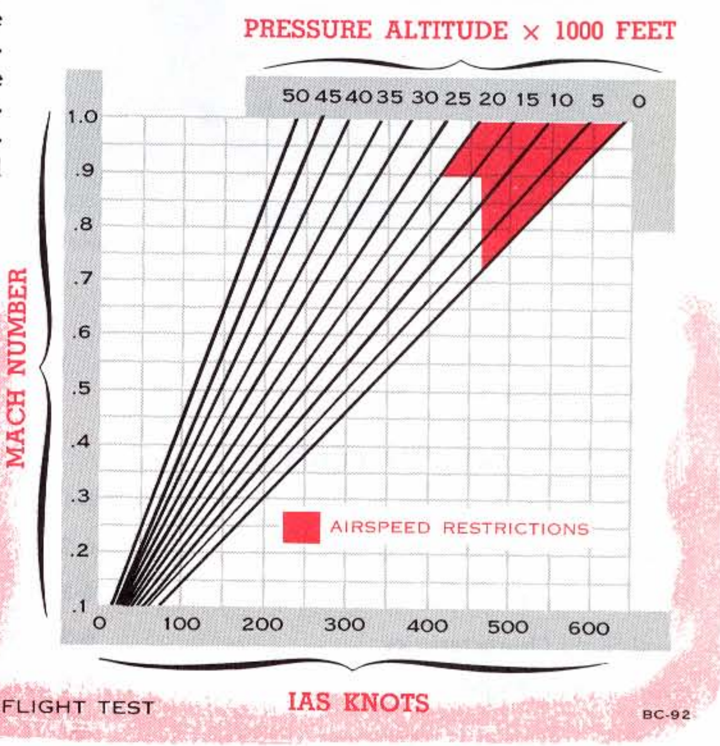
At airspeeds above Mach 0.25 the accelerated stall region (shown by the sloping lines on the left of the Operating Flight Strength Diagram, figure 5-4) is characterized by buffeting, pitching, and rolling, which increases as load factor increases. Any increase of load factor after buffet onset is accompanied by rapid loss of airspeed and extreme buffet. For this reason, the buffet region should not be penetrated beyond a mild buffet. It is recommended that accelerated stalls be practiced so that they may be anticipated by feel of the airplane.

SPINS.

Intentional spins are prohibited. Damage to the airplane's heavy complement of electronic equipment may occur from the unusual loads developed in spins. The airplane will not spin inadvertently and has no dangerous inherent spin characteristics. However, because of the airplane's high wing loading, considerable altitude will be lost during a spin. Total altitude lost during spins varies from about 3000 feet between stall and complete recovery for a one-turn power-off spin in landing configuration, to about 12,000 feet for a three-turn spin with continuous power in clean configuration. A three-turn power-off spin in clean configuration generally uses up about 10,000 feet total altitude. With the use of conventional spin recovery technique, recovery characteristics are normal. Recovery from a power-off three-turn spin in clean configuration requires from one half to three quarters of a turn and recovery from a power-off one-turn spin in landing configuration requires from one quarter to one-half of a turn. With power on, the rate of recovery is slightly slower. The conventional spin recovery technique of full opposite rudder followed by forward stick is normal and will produce satisfactory results; however, a faster recovery can be effected by neutralizing the stick at the same time opposite rudder is applied. This method also lessens the chance of inadvertently entering a secondary inverted spin while recovering from a normal spin. Aileron position during the spin, whether with the spin, neutral, or against the spin, has no effect on the recovery. Direction of spin has no pronounced influence on spin recovery characteristics. Raising flaps and closing speed brakes aid spin recovery.

FLIGHT CONTROLS.

The full-powered irreversible flight control system gives the airplane good handling characteristics. Artificial stick feel provides a definite sense of control and is adequate under normal conditions. Control



MACH NUMBER CHART

Wing flaps up

DATA AS OF: 1 AUG 1956 DATA BASIS: FLIGHT TEST

Figure 6-1.

STALL SPEED CHART

NO EXTERNAL STORES — Gear up or down

STALLING SPEED—IAS KNOTS

Power	Wing Flap Position	Speed Brake Position	Angle of Bank	Pressure Altitude (Feet)	Gross Weight 26,000	Gross Weight 30,000	Gross Weight 34,000	Gross Weight 38,000
Power on	0°	CLOSED	0°	0	102	110	118	125
Power on	0°	CLOSED	0°	5000	102	110	118	125
Power on	0°	CLOSED	0°	10,000	103	111	118	125
Power on	0°	CLOSED	0°	20,000	105	115	124	132
Power on	0°	CLOSED	0°	30,000	111	122	132	143
Power on	0°	CLOSED	0°	40,000	120	135	149	164
Power on	0°	CLOSED	0°	45,000	129	143	156	169
Power on	0°	CLOSED	30°	0 TO 5000	113	120	128	137
Power on	0°	CLOSED	45°	0 TO 5000	124	133	142	152
Power on	0°	CLOSED	60°	0 TO 5000	149	162	175	188
Idle power	30°	CLOSED	0°	0 TO 5000	101	108	115	122
Idle power	30°	CLOSED	30°	0 TO 5000	108	116	123	130
Idle power	30°	CLOSED	45°	0 TO 5000	120	127	135	144
Idle power	30°	CLOSED	60°	0 TO 5000	141	153	165	176
Idle power	50°	½ OPEN	0°	0 TO 5000	101	108	114	121
Idle power	50°	½ OPEN	30°	0 TO 5000	108	116	123	129
Idle power	50°	½ OPEN	45°	0 TO 5000	118	126	134	142
Idle power	50°	½ OPEN	60°	0 TO 5000	140	152	164	177

DATA AS OF: 1 AUG 1956 DATA BASIS: FLIGHT TEST

BC-93

Figure 6-2.

forces remain within moderate limits through a wide range of airspeeds.

ELEVATOR.

Elevator control is satisfactory under normal operating conditions. However, between Mach 0.72 and 0.78 the elevator becomes extremely effective, and very small deflections will produce an additional "G" of acceleration. Since the maximum power climb schedules are at these Mach numbers, more than normal effort may be required in turbulent air to hold to a close climb schedule. A slight nose heaviness occurs at about Mach 0.82. This nose-down tendency can be trimmed out; however, if during a turn or other maneuver, the airspeed drops 3 to 5 knots, the airplane will pitch up rather sharply. At high indicated airspeeds or at high Mach numbers, elevator control will be limited as shown on the Operating Flight Strength Diagram (figure 5-4). Under these conditions, twisting and bending of the airplane structure, together with high Mach effects, cause elevator effectiveness to decrease rapidly, approaching zero at sea level at approximately Mach 0.925 (which is above the maximum airspeed restriction of the airplane). This is due to high dynamic pressures associated with high airspeeds at low altitude and high Mach number effects at high altitude. The result is that the maximum load factor attainable at high airspeeds at a given altitude will decrease as airspeed increases. This means that the higher the airspeed, the fewer the available "G's." At speeds of Mach 0.86 and above, elevator effectiveness is so reduced that less than 2 "G's" are available at Mach 0.98 at 35,000 feet (an important point to remember during a high Mach dive recovery).

CAUTION

If airplane control should become sluggish at altitudes above 30,000 feet, check the hydraulic reservoir pressure. If pressure is below operating limits, reduce altitude until control response is again normal.

"G" Overshoot.

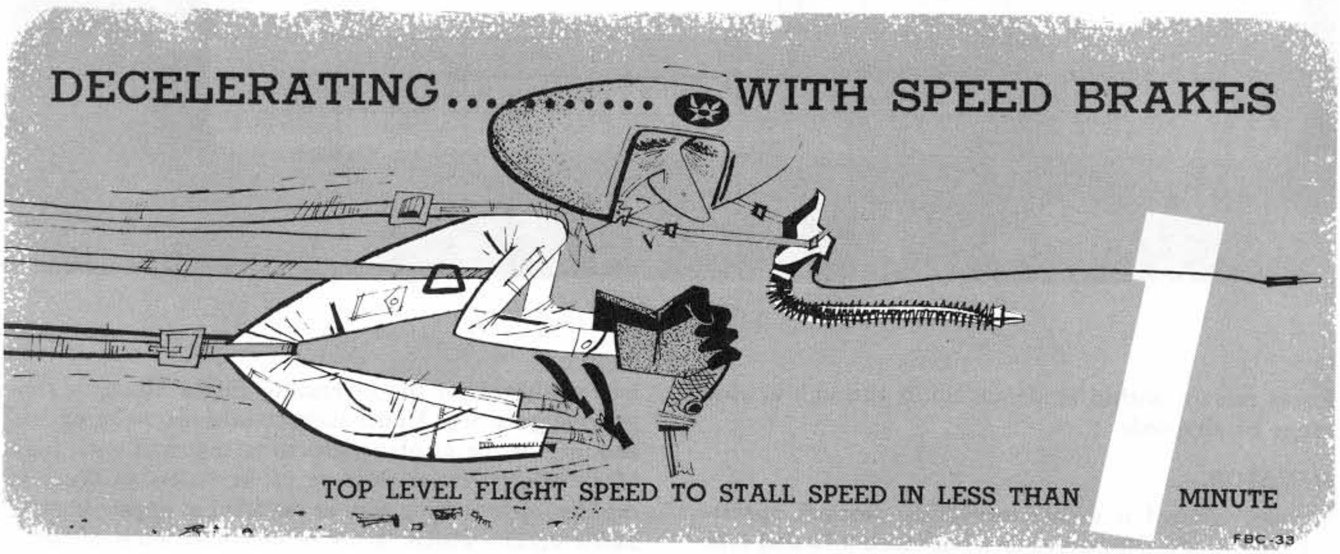
As positive or negative load factor develops on the airplane, an elevator force-feel bobweight tends to move the stick in the opposite direction opposing further stick application. For each "G" increase, the bobweight increases the force against the stick 4.5 pounds. It must be remembered, however, that if the stick is moved abruptly, it is possible to obtain elevator position corresponding to high "G's" before the "G's" have built up on the airplane and have increased the stick force through the action of the bobweight. This is apparent particularly between Mach 0.65 and Mach 0.80. Once the "G" load starts to develop, the buildup to the point of failure can occur before corrective action becomes effective. Thus, by abruptly pulling back on the stick indiscriminately, it is possible to overshoot the "G" limit and pull the airplane apart. *When you are at low altitudes, do not attempt abrupt pull-ups.* Do not rely on the "feel" of the stick to keep you out of trouble.

AILERONS.

Aileron effectiveness is adequate under all conditions other than in spins at extreme airspeeds (above Mach 0.85), where aileron effectiveness decreases rapidly. However, sufficient lateral control for performing essential maneuvers at these extreme airspeeds can be maintained with speed brakes opened from about 5 to 10 degrees. Partly opening the speed brakes from 10 to 20 degrees also improves aileron effectiveness at medium airspeeds (above Mach 0.75). At low airspeeds near the ground (such as those used for takeoffs and landings), aileron response may be lower than normal, particularly in turbulent air. This condition may exist at any airplane gross weight but can be minimized by strict adherence to nose wheel liftoff, takeoff, approach, and landing airspeeds.

RUDDER.

Rudder operation is satisfactory under all operating conditions. The yaw stabilizer should be turned on before takeoff and left on for the duration of the flight. This system automatically attempts to maintain a constant direction of flight; therefore, the pilot must override the stabilizing action by maintaining light rudder pedal pressure throughout the turn.



SPEED BRAKES.

The split-aileron type speed brakes provide a much larger drag surface than other types, making them highly effective under all operating conditions with no adverse effect on aileron control. In fact, lateral control is improved at Mach numbers near cruise and above by slightly open speed brakes. Since the speed brakes are symmetrical and are located almost in line with the airplane CG, their use has little or no effect on trim. There is ample and positive control about all axes with speed brakes in any position. Pitch and yaw characteristics are not directly affected by their use. In executing turns with maximum power, opening speed brakes reduces radius of turn appreciably. Letdowns up to 30,000 feet per minute can be made without exceeding 350 knots IAS. Speed brakes are especially effective in controlling airspeed and altitude during approach. During landing, this airspeed control permits fast acceleration for go-arounds. Ground roll is reduced appreciably by moving the speed brakes to full open after touchdown. They give excellent airspeed control at constant throttle settings, thus permitting a high rate of closure in combat while retaining maximum power for a fast breakaway. At high indicated airspeeds, sufficient lateral control for maneuvering can be maintained with speed brakes 5 to 10 degrees open without affecting airspeed. A 5-degree speed brake opening will also eliminate the natural rolloff tendency at high Mach numbers.

Note

By moving the speed brake lever to full open position and reducing power, the airplane can be decelerated in level flight from maximum speed to stalling speed in less than 1 minute at any altitude.

TRIM.

Longitudinal trim is not affected by lowering the landing gear during approach or by changes in thrust at high airspeeds. However, when shutting down afterburners between approximately Mach 0.80 and Mach 0.86, the high airspeed can no longer be maintained (in level flight) and a push force on the stick is required as airspeed decreases, requiring retrimming at the lower airspeed. Nominal change in longitudinal trim is required when changes in thrust are made at low airspeeds. When speed brakes are opened, no immediate change in trim is required; however, as airspeed is reduced, longitudinal trim may be necessary. The aileron trim motor operation is independent of stick position. When trimming the elevator, however, the trim mechanism will not operate after the stick force is reduced to zero for any given stick position. Trim motor operation is slow at low airspeeds and fast in the region of neutral stability. Available rudder trim is 40 degrees left or right. Under normal flight conditions, the rudder trim knob should not be used, as the yaw stabilizer mechanism will be adversely affected.

HIGH AIRSPEED OVERTRIM.

Stick forces vary with airspeed changes (see figure 6-3) and can be trimmed out for level flight. However, for flight at relatively low altitudes, extreme caution should be used in trimming out all of the stick force. If all the push force required for level flight at relatively high airspeeds is trimmed out, and the airplane then slows down, it is possible for the pull force required for level flight (at the lower airspeed) to build up in magnitude faster than the pilot anticipates, causing the airplane to nose down sharply: an unsafe attitude with the airplane close to the ground.

WARNING

Do not trim out all stick push force during low-level flight at high airspeeds as the airplane may dive sharply as airspeed is reduced.

LEVEL FLIGHT CHARACTERISTICS.

At any operating altitude and at all airspeeds, except the range between Mach 0.80 and Mach 0.86, a push force on the stick is required as airspeed is increased if 1 "G" is to be maintained. As airspeed is increased from Mach 0.80 to Mach 0.86 a slight relaxation in push force is required to maintain 1 "G" flight.

LOW SPEED.

The handling characteristics of the airplane at low airspeeds are good, except that near 1 "G" stall, rolling response to aileron motion may be lower than normal.

WARNING

Adhere closely to nose wheel liftoff, takeoff, approach, and landing airspeeds, especially in turbulence or crosswinds, to assure adequate lateral control.

CRUISING AND HIGH SPEED.

With the exception of the elevator stick force and position characteristics previously explained, no unusual characteristics will be experienced in the medium to high airspeed range. Figure 6-3 shows typical variation of stick force with the airplane trimmed to fly "hands off" at cruise airspeed, and indicates the airspeed range of the mild reversal in normal stick force variation.

BUFFET—1 "G" FLIGHT.

During 1 "G" flight you will experience a mild compressibility buffet in the airspeed range from Mach 0.85 to Mach 0.90. This buffeting effect, which can be likened to driving a car along a washboard road, is not objectionable. The intensity of buffeting increases slightly with airspeed while in the buffet range, but practically disappears above Mach 0.90.

HIGH-AIRSPEED WING-DROP.

At airspeeds between Mach 0.85 and Mach 0.90 (the same range in which light buffeting is experienced in level flight) the wing-drop, common to many jet airplanes at high Mach numbers, is most likely to occur. Wing-drop may be either to the right or left, but is usually to the left and can be eliminated by opening the speed brakes approximately 5 degrees.

MANEUVERING FLIGHT.

STICK FORCES.

In level flight, minimum stick force per "G" will occur at airspeeds in the region of Mach 0.75 (see Mach Number Chart, figure 6-1). Due to light stick forces, care must be exercised when maneuvering near this airspeed not to exceed the allowable load factor by overcontrol. If the airplane enters accelerated flight above Mach 0.80, the stick force necessary to pull load factor will be high, but may be partially trimmed out to a comfortable value. However, never trim out all of the stick force while in accelerated maneuvers. If enough stick force is applied and held to pull the desired load factor, either by trim or pilot effort, the applied stick force will result in a rapid increase in load factor if airspeed is reduced. This can result in rapidly exceeding the design or even the ultimate load factor.

WARNING

Use no more elevator trim than necessary during maneuvers. Use extreme caution to avoid excessive "G's" as airspeed decreases during high speed maneuvers.

LOAD FACTORS.

The maximum permissible symmetrical flight load factor of 5.67 (as specified for all-weather interceptor) is the highest allowable under any flight conditions. Above approximately 20,000 feet it is impossible to attain 5.67 load factor because the airplane will either be forced into an accelerated stall or the elevator control power limit will be reached.

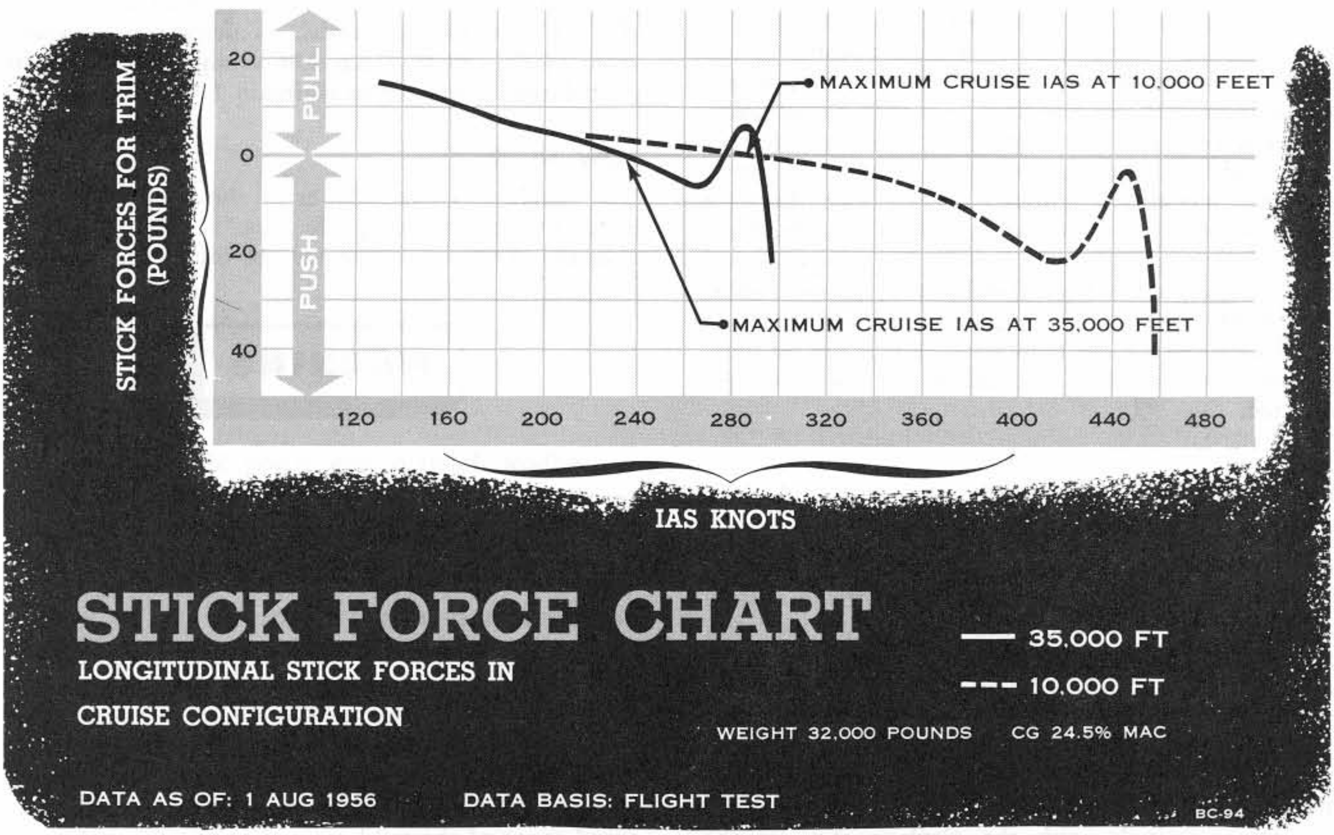


Figure 6-3.

At these altitudes, the airplane is controllable at high Mach numbers and its flight characteristics are normal for a high performance airplane. At medium to high airspeeds at low altitudes, this airplane, like all high performance airplanes, can be overstressed to the point of structural failure; therefore, the airplane is limited to a load factor of 5.00 below 12,000 feet. Flying at high indicated airspeeds at low altitudes is dangerous because elevator effectiveness, or ability to develop load factor, can change within wide limits with relatively small changes in airspeed. Do not attempt abrupt pull-ups at low altitudes, and do not rely entirely on stick feel to keep you out of trouble. Be aware of the definite distinction between the structural strength of an interceptor and of a fighter designed for fighter-versus-fighter combat.

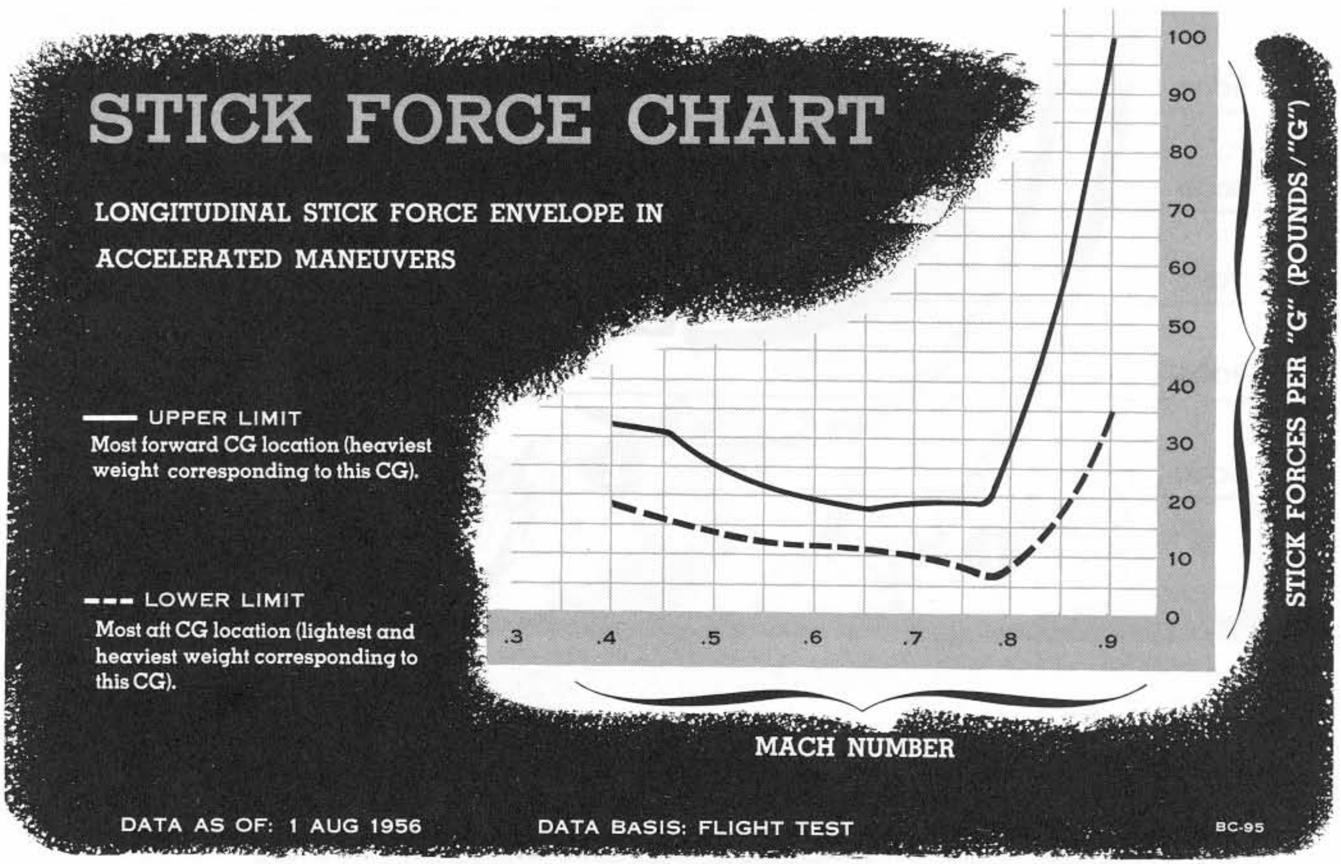
DIVING.

At any gross weight, the altitude lost during recovery is dependent on the altitude at which recovery is started, the angle of dive from which the recovery is made, airspeed at start of recovery, and the load factor ("G's") held during recovery. See figure 6-4 for examples of typical dive recovery flight paths.

Note

Altitude lost during dive recovery as shown in the Typical Dive Recovery illustration (figure 6-4) and Dive Recovery Charts (figure 6-5), does *not* include the altitude lost entering the dive. Dive recovery charts are based on the premise that a constant airspeed is held during entire recovery.

The Dive Recovery Charts (figure 6-5) show the interrelation between these variables. The charts should be studied collectively in order to understand the capabilities of the airplane and to be able to exercise proper judgment in planning dive maneuvers. The limiting airspeed lines on these charts represent the maximum and minimum operating airspeeds at which the airplane may be flown at a specific pressure altitude and for which the load factor designated on the chart is attainable. At minimum airspeeds (maximum lift lines) an accelerated stall will occur. At airspeeds greater than the maximum (elevator power limit lines), elevator control is limited by aeroelastic distortion of the airplane structure and by elevator control power to such extent that the airplane can no longer develop the load factor shown on the chart. The resultant effect causes the maximum attainable load factor to decrease rapidly (and therefore increase the altitude lost during recovery) for a relatively small increase in IAS above the limiting value shown on the chart. See figure 6-5 (sheet 1 of 5) for instructions on chart use.



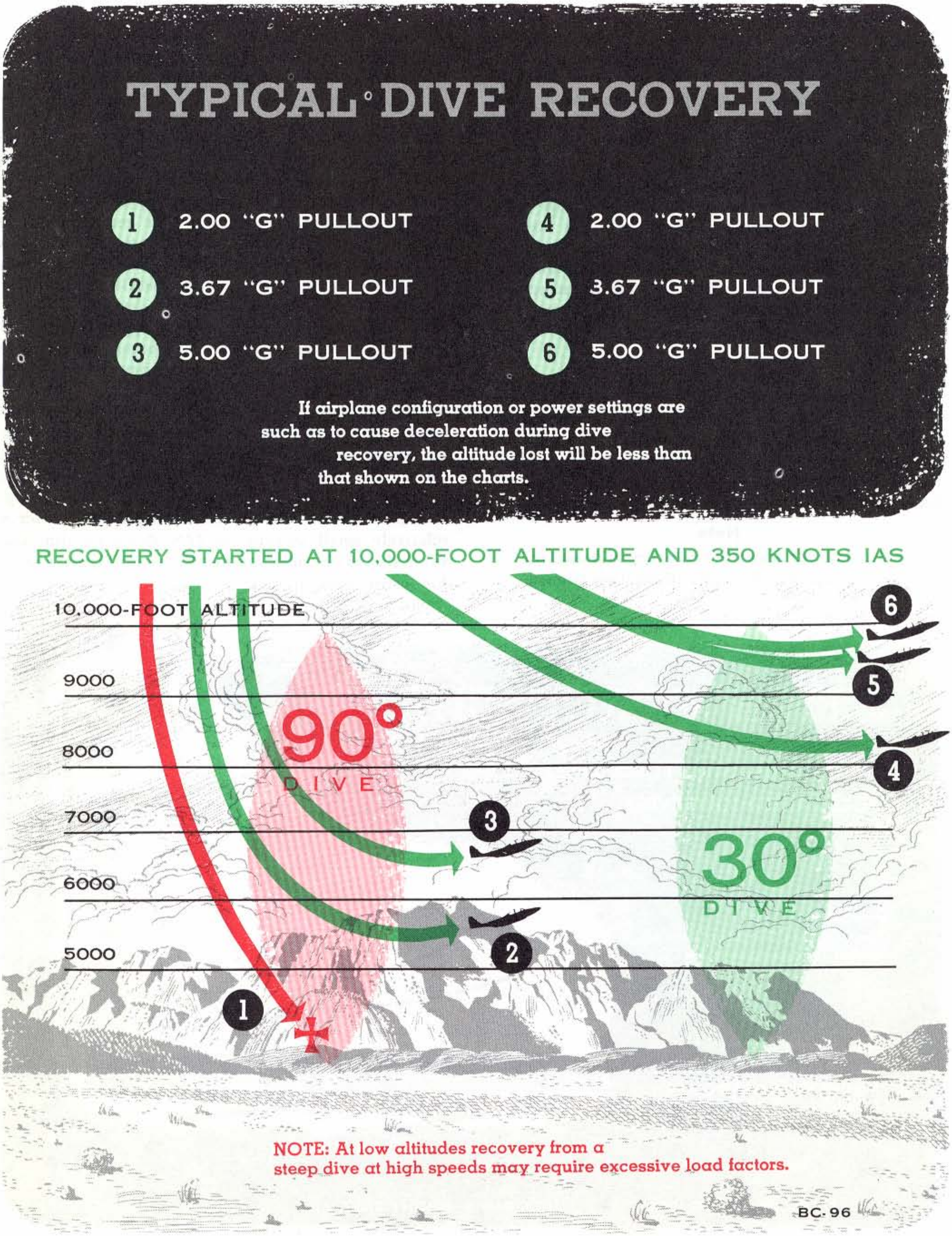

TYPICAL DIVE RECOVERY
1 2.00 "G" PULLOUT
2 3.67 "G" PULLOUT
3 5.00 "G" PULLOUT
4 2.00 "G" PULLOUT
5 3.67 "G" PULLOUT
6 5.00 "G" PULLOUT
If airplane configuration or power settings are such as to cause deceleration during dive recovery, the altitude lost will be less than that shown on the charts.
RECOVERY STARTED AT 10,000-FOOT ALTITUDE AND 350 KNOTS IAS
10,000-FOOT ALTITUDE
9000
8000
7000
6000
5000
90° DIVE
30° DIVE
NOTE: At low altitudes recovery from a steep dive at high speeds may require excessive load factors.
BC-96

Figure 6-4.

> **WARNING**
>
> The altitude and IAS at which a maximum (allowable or attainable) load factor recovery is started should be anticipated so as not to exceed airspeed restrictions and to insure the minimum ground clearance.

HIGH MACH DIVE.

Performing a high Mach dive at high altitude is the best way to become familiar with the high Mach characteristics of the airplane. This maneuver is useful in combat for a breakaway, as an evasive maneuver, or as an effective way to let down rapidly. Since the purpose of the high Mach dive is to lose altitude as rapidly as possible, enter the dive at high IAS and get into a 60-degree dive as fast as possible.

> **WARNING**
>
> Generally, the steeper you dive the greater the airspeed; however, if the angle of the dive is increased steeper than 60 degrees, the increase in speed is negligible. Dive angles steeper than 60 degrees result in far greater altitude loss during recovery. A vertical dive requires twice the altitude for recovery that a 60-degree dive requires. At speeds associated with high Mach dives (Mach 0.90 and above), elevator and speed brake effectiveness are greatly reduced. Because of the reduced elevator effectiveness at Mach 0.98 at 35,000 feet, less than 2 "G's" are available; therefore until the airplane is slowed down the elevator will have little effect for recovery. At speeds of Mach 0.90 and above, the speed brakes will open only 30 degrees or less, and because of adverse compressibility effects, little drag may result from their use. In a vertical or near vertical dive at high Mach numbers any delay in starting recovery, combined with the greatly reduced elevator and speed brake effectiveness, may result in such loss in altitude that recovery may be impossible. Therefore, do not perform high Mach dives at angles greater than 60 degrees, or start recovery from any high Mach dive under 35,000 feet. The flight path for the 90-degree dive shown in figure 6-6 illustrates the excessive loss of altitude during vertical dive recovery.

Enter the dive with a wingover. Maintain positive "G's" throughout the dive to prevent flameout. Since in a

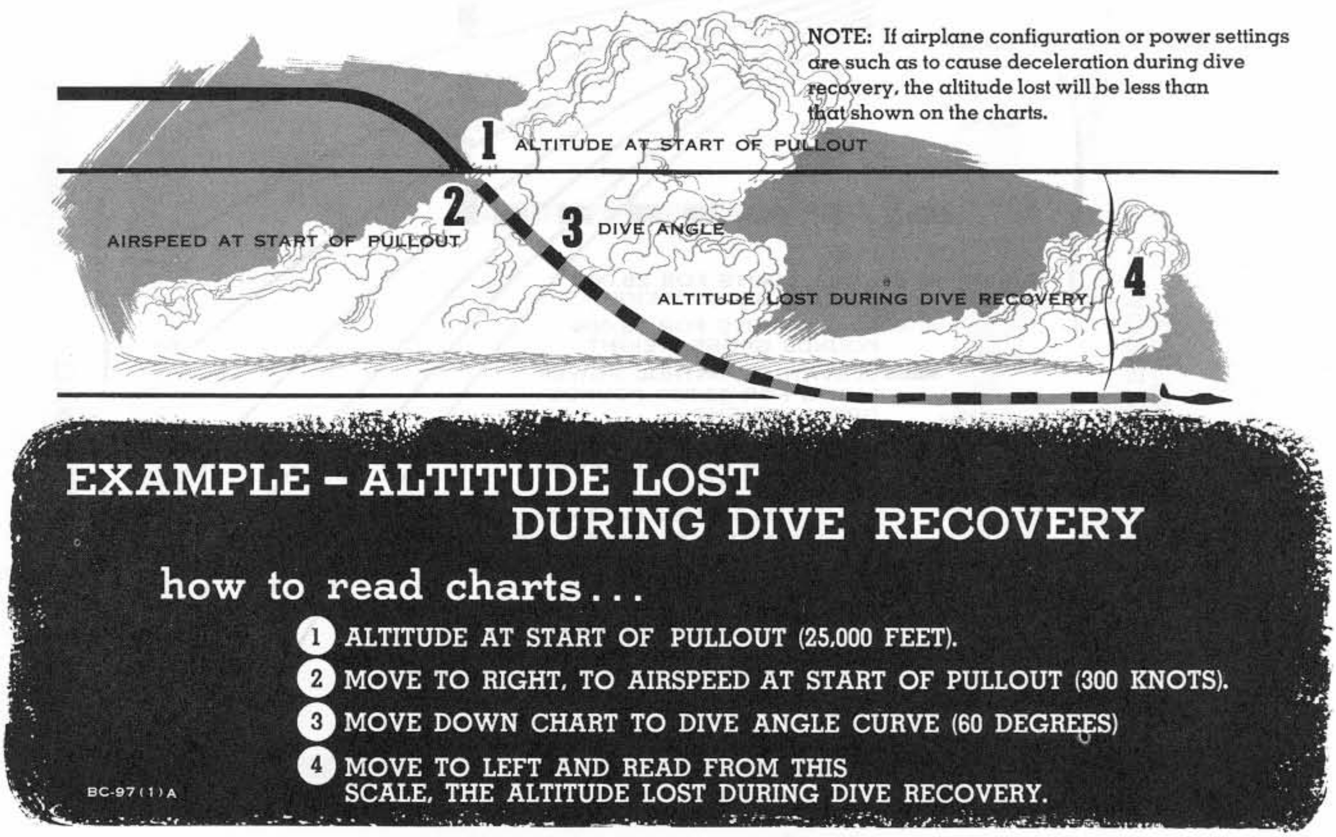


Figure 6-5 (Sheet 1 of 5 Sheets).

ALTITUDE LOST DURING DIVE RECOVERY

AT CONSTANT **2.00 "G"** ACCELERATION

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST

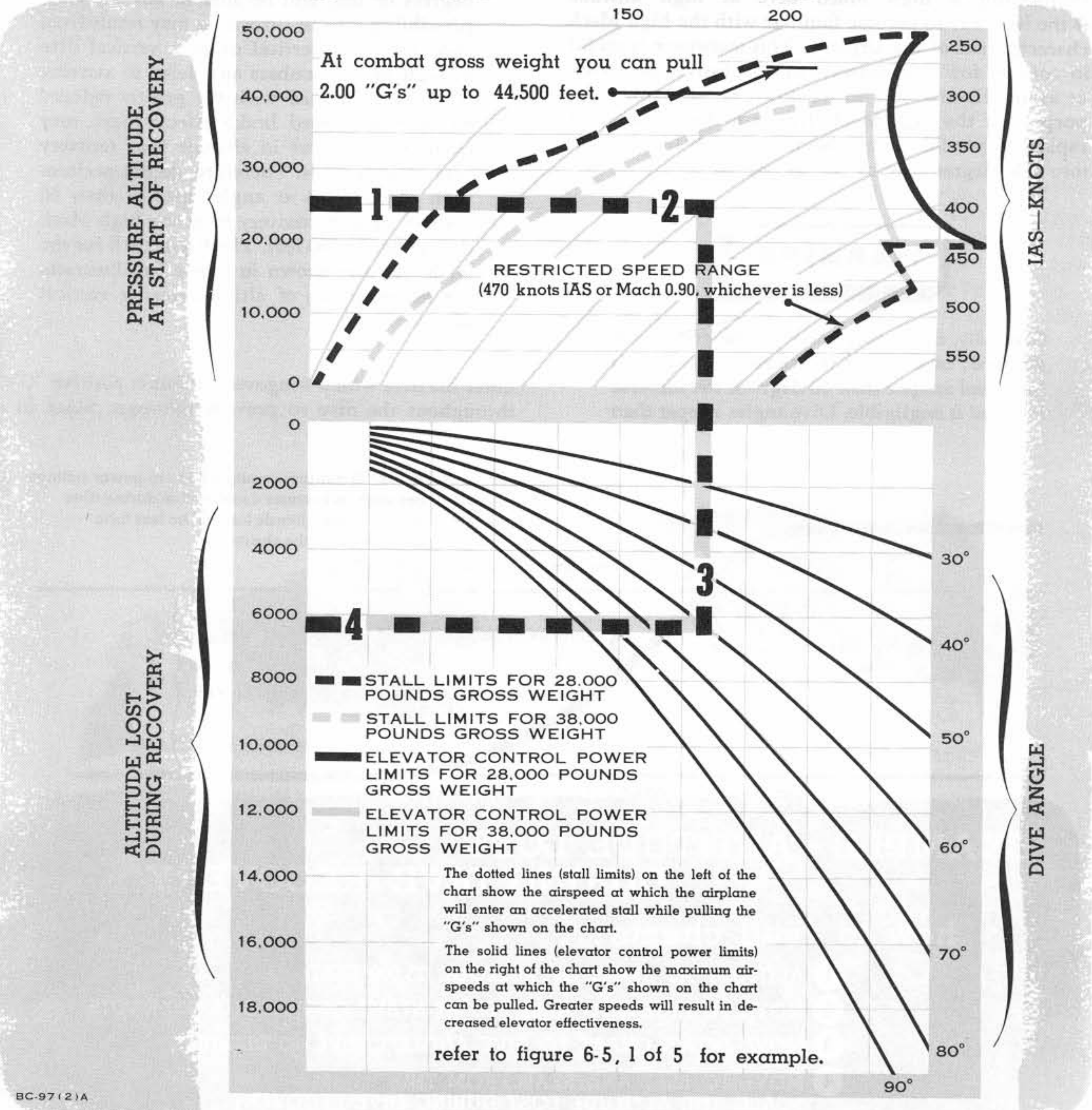
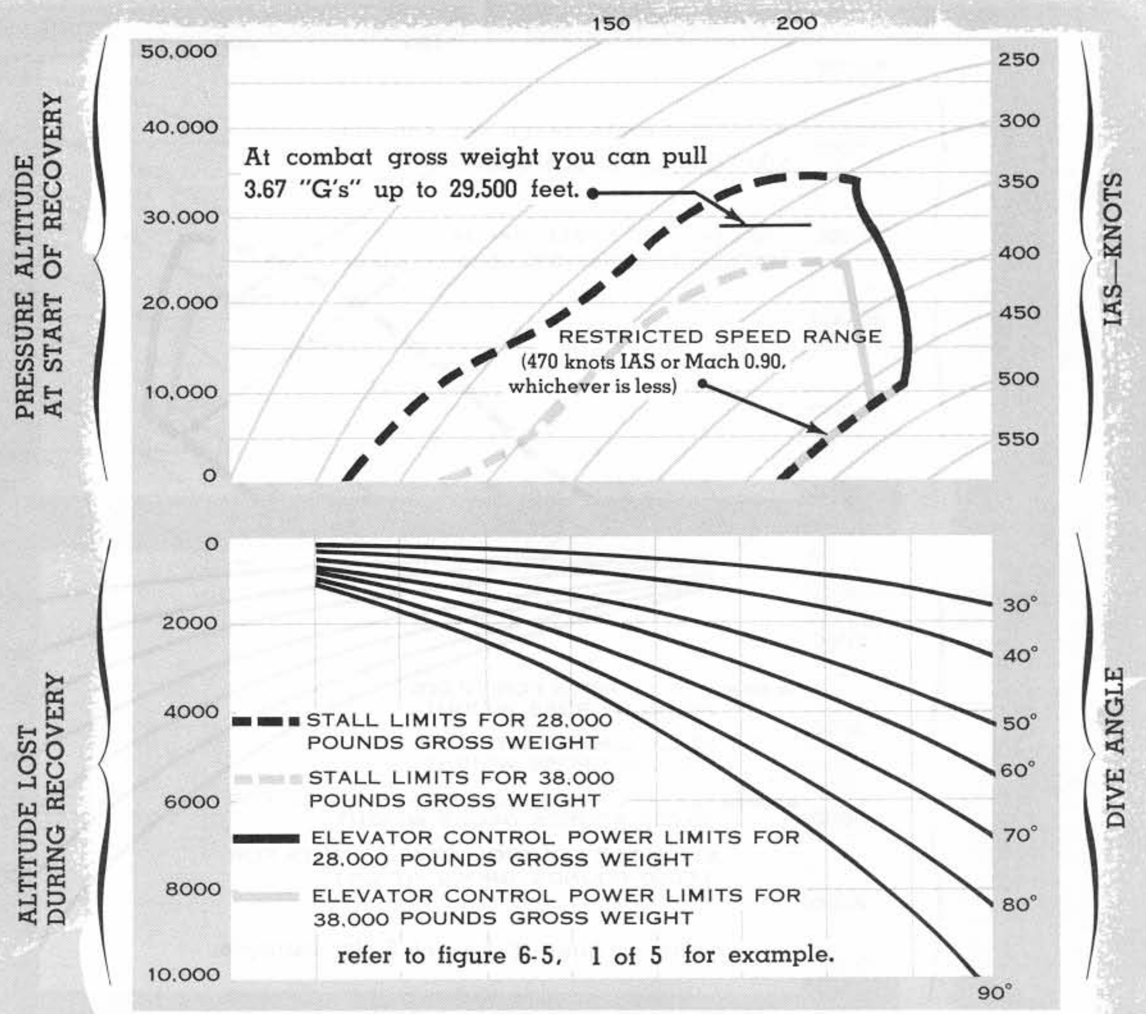


Figure 6-5 (Sheet 2 of 5 Sheets).

ALTITUDE LOST DURING DIVE RECOVERY

AT CONSTANT 3.67 "G" ACCELERATION

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST



The dotted lines (stall limits) on the left of the chart show the airspeed at which the airplane will enter an accelerated stall while pulling the "G's" shown on the chart.

The solid lines (elevator control power limits) on the right of the chart show the maximum airspeeds at which the "G's" shown on the chart can be pulled. Greater speeds will result in decreased elevator effectiveness.

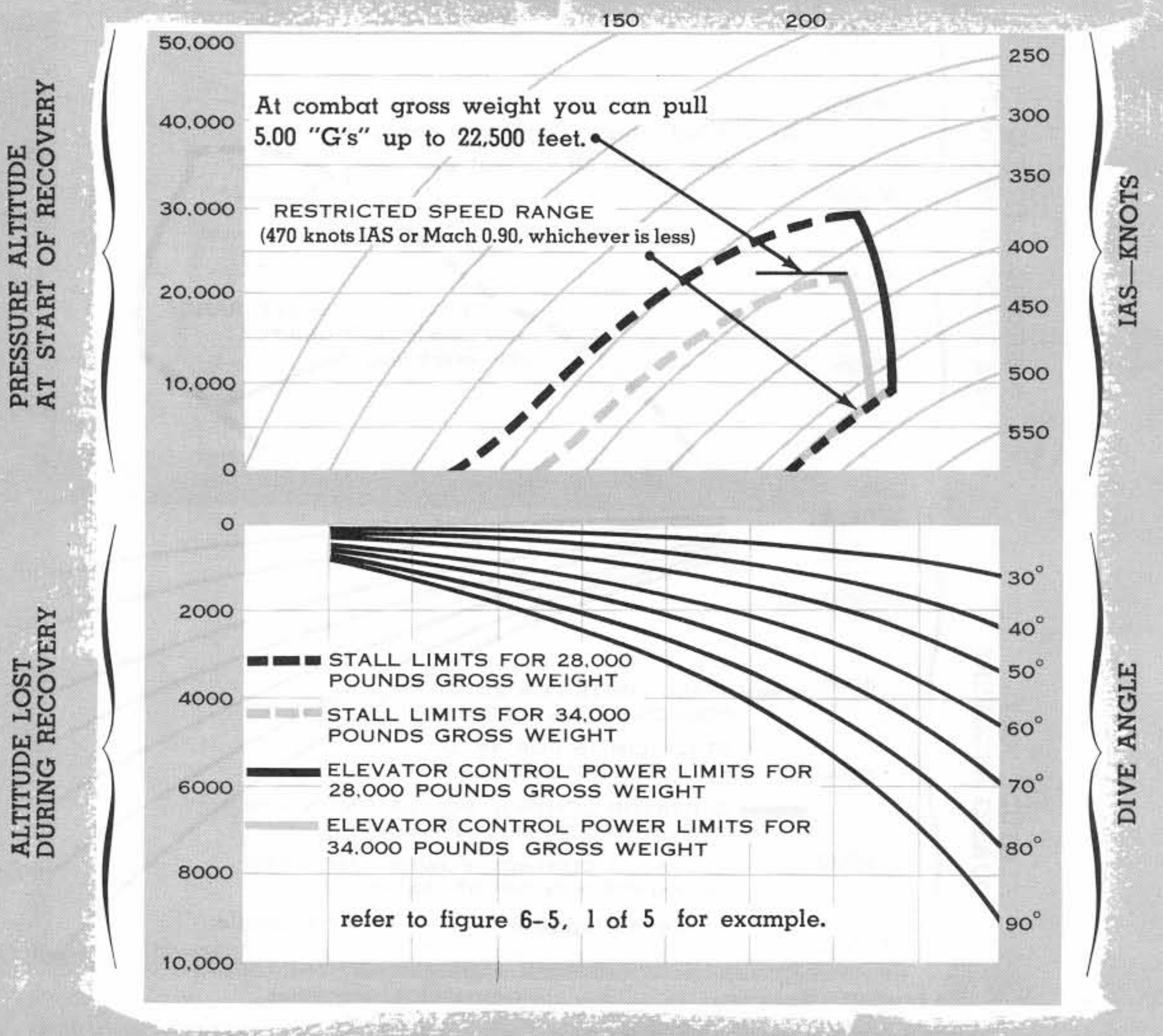
BC-98A

Figure 6-5 (Sheet 3 of 5 Sheets).

ALTITUDE LOST DURING DIVE RECOVERY

AT CONSTANT 5.00 "G" ACCELERATION

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST



The dotted lines (stall limits) on the left of the chart show the airspeed at which the airplane will enter an accelerated stall while pulling the "G's" shown on the chart.

The solid lines (elevator control power limits) on the right of the chart show the maximum airspeeds at which the "G's" shown on the chart can be pulled. Greater speeds will result in decreased elevator effectiveness.

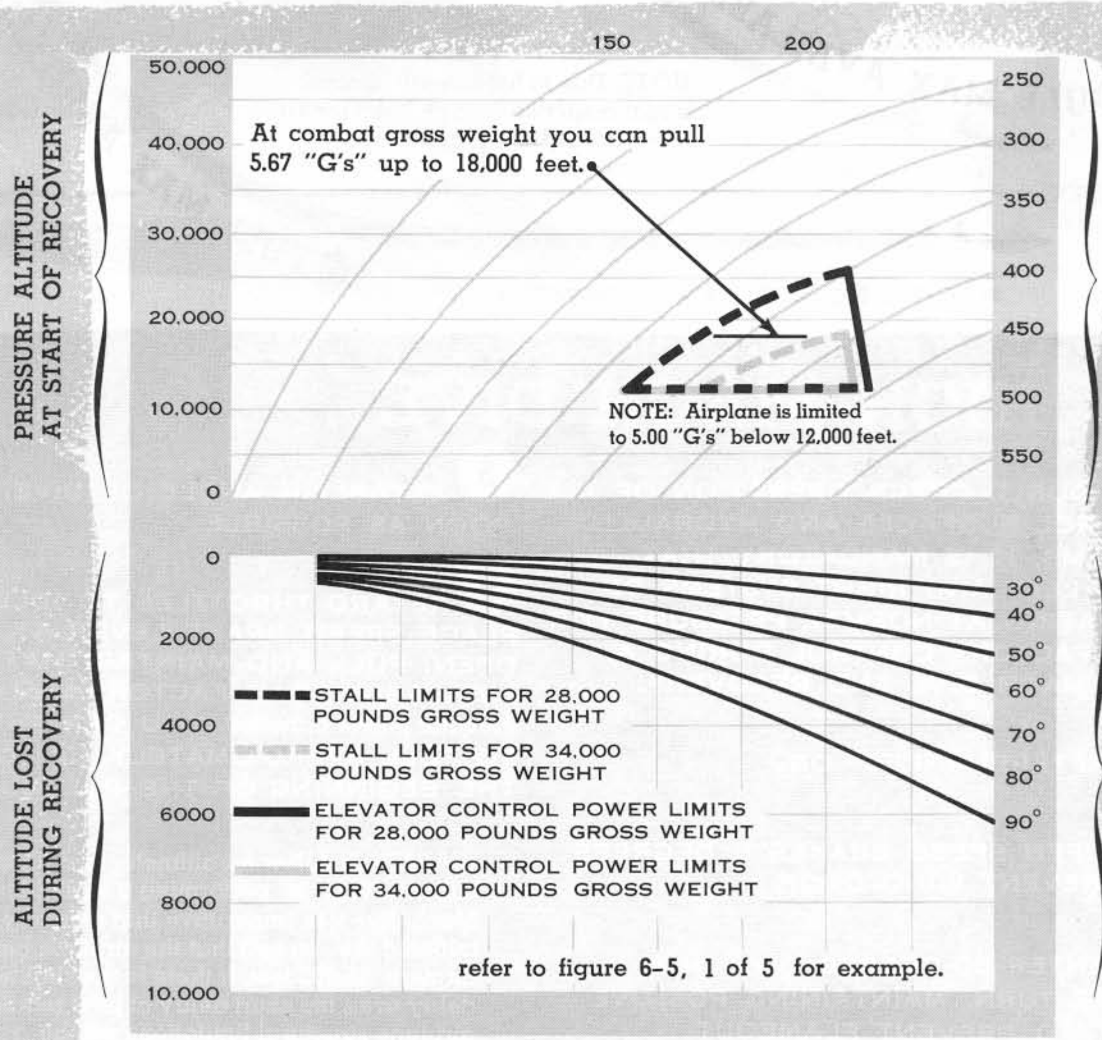
BC-99(1)A

Figure 6-5 (Sheet 4 of 5 Sheets).

ALTITUDE LOST DURING DIVE RECOVERY

AT CONSTANT **5.67 "G"** ACCELERATION

DATA AS OF: 1 AUG 1956
DATA BASIS: FLIGHT TEST

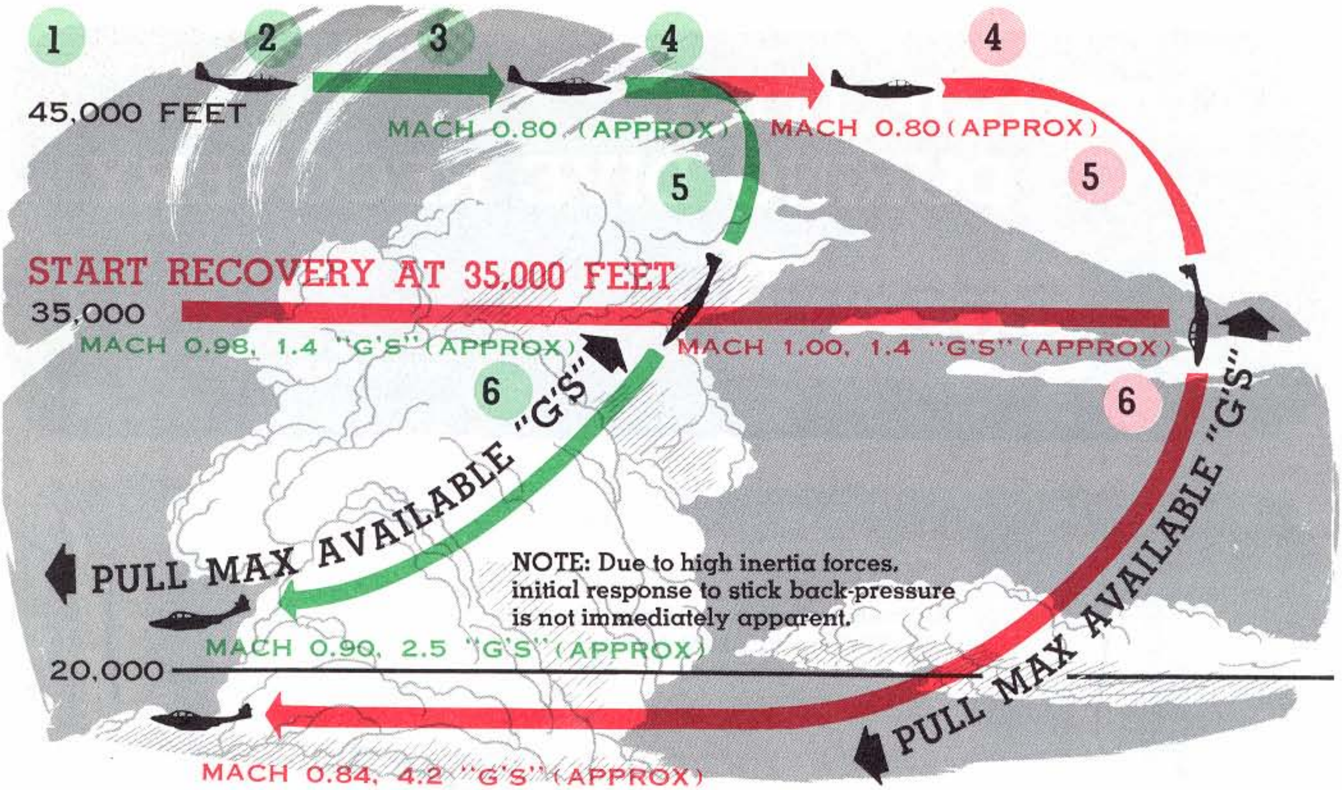


The dotted lines (stall limits) on the left of the chart show the airspeed at which the airplane will enter an accelerated stall while pulling the "G's" shown on the chart.

The solid lines (elevator control power limits) on the right of the chart show the maximum airspeeds at which the "G's" shown on the chart can be pulled. Greater speeds will result in decreased elevator effectiveness.

BC-99(2)A

Figure 6-5 (Sheet 5 of 5 Sheets).



HIGH MACH DIVE

1 DOUBLE CHECK OPERATION OF ALL CONTROL SURFACES AND HYDRAULIC SYSTEMS. IT IS MANDATORY THAT BOTH LEFT AND RIGHT SYSTEMS BE OPERATING AT NORMAL PRESSURE FOR SATISFACTORY CONTROL DURING A HIGH MACH DIVE AND RECOVERY.

2 AFTERBURNERS—ON.

3 OPEN SPEED BRAKES 5 DEGREES TO PREVENT WING DROP.

4 ENTER 60-DEGREE DIVE IN A DIVING TURN, MAINTAINING POSITIVE "G'S" TO PREVENT FLAMEOUT.

4 ENTER 90-DEGREE DIVE WITH A HALF ROLL AND MAINTAIN MAXIMUM AVAILABLE "G'S" THROUGHOUT DIVE AND RECOVERY.

5 ESTABLISH ANGLE OF DIVE AS SOON AS POSSIBLE.

6 RETARD THROTTLES TO IDLE AND PLACE SPEED BRAKE LEVER AT FULL OPEN. PULL AND MAINTAIN MAXIMUM AVAILABLE LOAD FACTOR (limited either by elevator power or buffet). YOU CAN EXPECT TO PULL APPROXIMATELY 1.4 "G'S" AT THE BEGINNING OF THE PULLOUT.

WARNING: Allow for altimeter and airspeed indicator lag. In performing a vertical high Mach dive it is imperative that recovery be initiated the instant that the airplane passes through 35,000 feet. If there is the slightest delay, even the short delay of pilot reaction, airplane structural limitations will be exceeded; also the additional loss of altitude may make it impossible to complete the recovery.

BC-100

Figure 6-6.

steep dive the thrust of the airplane weight is high compared to engine thrust, the speed of descent can be varied only within relatively narrow limits by throttle changes. Observe the effect of buffet as the airplane accelerates to high Mach numbers and again as it decelerates during pullout. The airplane has normal dive attitude and responds to a normal recovery technique. Begin normal recovery procedure at approximately 35,000 feet. See figure 6-6 for correct procedure.

WARNING

Do not use excessive elevator trim in recovering from a dive. When airplane slows down during pullout, elevators become more effective, and applied trim may result in pulling "G's" in excess of the load factor limit.

At approximately Mach 0.75, stick pressure is light and elevators are most sensitive. Exercise caution in this airspeed range so that the design load factor is not exceeded. Because of elevator power limits you may be able to pull only approximately 1.3 "G's" at the beginning of recovery and about 2.5 "G's" maximum at the end of the pullout. The exact available load factor is, of course, dependent on Mach number and altitude.

WARNING

Since the airplane can lose altitude rapidly, avoid steep low-level dives.

FLIGHT WITH ASYMMETRICAL LOADING.

Flight with asymmetrical loading should be avoided if possible. The most probable cause of asymmetrical loading would be uneven fuel consumption between the left and right fuel systems. If, through malfunction or mismanagement of the fuel system, an asymmetrical load condition develops, first attempt to correct the condition by balancing the fuel load (see Section VII) or dumping tip tank fuel. However, if this cannot be done, land as soon as practicable to preclude the possibility of the condition becoming worse. In flight tests, the airplane has been flown and landed with the asymmetrical load condition of one full and one empty tip tank. When flying in this condition, lateral control cannot be maintained down to stall speed using trim alone, but requires additional aileron stick force. With trim alone, control can be maintained with full flaps, down to about 150 knots IAS. Flying near stall speed is not recommended because nearly full aileron deflection is necessary to maintain level flight. With clean configuration and in level flight, the airplane will have a tendency to snake at about 280 knots IAS if the yaw stabilizer is not operating properly. Landing may be made using about one-half aileron and an airspeed above 140 knots IAS until just before touchdown to provide adequate lateral control.

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ENGINE.

BURST ACCELERATION.

If conditions warrant, the engines can be burst accelerated by moving the throttles rapidly to OPEN. The engine fuel control will meter the fuel required by the engine, but normally will not pass sufficient fuel for excessive exhaust temperatures or RPM above 100%.

Note

During a burst acceleration from 80% RPM to maximum power, a compressor stall may result. This will be noted by audible pulsation, lag in RPM, and increase in tailpipe temperature above limits.

COMPRESSOR STALL.

Compressor stall may occur at times and can be recognized by a loud rumble and vibration in the engine and rapid EGT rise, accompanied by RPM stagnation or drop. Compressor stall is caused by a back pressure at the compressor outlet, which in turn is usually caused by an exceedingly rich fuel mixture. Under stall conditions, considerably greater than normal resistance to compressor rotation is encountered, resulting in the rumble or surge previously described. Compressor stall is most likely to be encountered under high ambient temperature conditions during accelerations from below 80% RPM to higher RPM, as compressor stall is a phenomenon of acceleration only and will not occur at stabilized power settings. Since compressor stall is most likely to occur at approximately 80% RPM, it is recommended that engine RPM be maintained at 85% RPM or above on final approach until committed to landing. In addition, it is suggested that accelerations through the 80% RPM range be made with rapid advancement of the throttle to full open position, in order to obtain open eyelid conditions. If compressor stall is experienced, the throttle should be retarded to below the 80% RPM position and exhaust gas temperature should be allowed to drop to normal before advancing the throttle. If engine temperature exceeds the permissible limitation, notation of this fact should be made in DD Form 781 after landing so that an engine overheat inspection will be made.

EXHAUST GAS TEMPERATURE VARIATION.

Exhaust gas temperature is affected by ambient temperature, altitude, and airspeed. Because of the wide range of ambient air temperatures at various bases where the airplane is operated, familiarity with the corresponding variation in exhaust gas temperature is essential to avoid damage to the engine and assure flight safety. Abnormally low exhaust gas temperature for the existing ambient air temperature will result in a loss of thrust which could be serious on takeoff under critical field length conditions. With constant RPM, exhaust gas temperature generally decreases with an increase in altitude and increases with greater airspeed and higher ambient temperatures. These factors can change singly or in combination to cause variable exhaust temperatures at any given RPM. If the engines are operated at military power, the exhaust gas temperatures may decrease approximately 65° as the altitude increases. When maximum power is used, the exhaust gas temperatures drop a maximum of approximately 60° between takeoff and absolute ceiling. In cold weather, exhaust gas temperatures at 100% RPM are considerably lower than in hot weather. It is important to check the exhaust gas temperature against the RPM prior to takeoff. There is no direct control for regulating the exhaust gas temperature; however, temperature can be indirectly controlled by throttle settings. Starting the afterburner causes a slight increase in exhaust gas temperature and a drop in engine RPM. This condition is temporary and both temperature and RPM soon stabilize. Refer to figure 5-2, Section V, for runway temperatures and corresponding exhaust gas temperatures to be expected at 100% RPM.

OVERTEMPERATURE VERSUS ENGINE LIFE.

The operational life of a jet engine is directly affected by the number of hot starts and high temperature and high RPM operations. At maximum and near maximum performance, hot section parts are exposed to temperatures requiring their functioning at near structural limits. The turbine wheel, in particular, is subject to early failure when subjected to serious overtemperatures or repeated slight overtemperatures because it operates with a rim temperature close to the peak of tolerance for the metal from which it is manufactured. The J35 turbine wheel has operated satisfactorily for as long as 2000 hours at normal expected steady exhaust gas temperature. However, an increase of as little as 15°C under the same conditions will appreciably reduce the turbine wheel life. Transient temperatures that exceed maximum allowable for as little as 2 seconds can render the turbine wheel unserviceable. Obviously, any overtemperatures, even momentary, beyond the limitations stipulated in Section V are serious and should be recorded accurately. When the engine is properly adjusted, the exhaust gas temperature indicating system properly calibrated, and the engine controls properly handled, all operating temperatures including transients will fall within the serviceability limits established for the engine. The careful monitoring of exhaust gas temperature by the pilot, and the recording of all overtemperature operation is imperative. Particularly during starting the pilot, with a clear understanding of the fuel flow characteristics and their relation to exhaust gas temperature, should be alert for an incipient overtemperature condition and recognize it in time to take rapid corrective action.

ENGINE OVERSPEEDING AT ALTITUDE.

The engine will operate at sea level (with or without afterburning) within the limits preset on the engine fuel control. However, when operating at altitude, the fuel requirements without afterburning are somewhat reduced and the engine may overspeed. Under most conditions the governor will prevent the engine from exceeding 100% RPM, but because of the inherent acceleration lag of the engine fuel control governors, a slight engine overspeeding in excess of 100% RPM may occur. If the engine overspeeds, retard the throttle to prevent exceeding a stabilized RPM of 100%.

INLET DUCT NOISE.

Due to the mass flow properties of the air entering the engine air intake ducts, it is possible to obtain combinations of engine and airplane speeds which will result in pulsating airflow in the engine air intake ducts (duct rumble). This condition will exist at altitudes below 20,000 feet and must be avoided. With both engines operating, duct rumble can be eliminated either by advancing the throttles or reducing airspeed with speed brakes. Duct rumble on a windmilling engine can be eliminated by reducing airspeed (maintaining a safe margin above stall) or by yawing the airplane away from the inoperative engine (i.e., if the left engine is windmilling, apply right rudder).

EYELID OPERATION

The eyelids are provided to increase the diameter of the tailpipe nozzle during afterburning. This permits an increase of thrust without operating at prohibitively high temperatures. During nonafterburning operation, the eyelids are closed. The eyelids are operated by two pneumatic cylinders which derive their power from the eleventh stage of the engine compressor. A solenoid valve directs compressor air to either side of the pneumatic cylinders. The solenoid valve is controlled by a pressure differential switch which is actuated by the differential pressures within the tail cone. If the eyelids fail to open when afterburning is selected, the exhaust temperature will rise and RPM will drop. If this occurs, afterburning must be shut down immediately to prevent excessive exhaust gas temperatures. Failure of the eyelids to close when afterburning is discontinued will be indicated by a very low exhaust temperature and extreme loss of thrust.

AFTERBURNER OPERATION.

STARTING AFTERBURNERS AT HIGH ALTITUDE.

If difficulty is encountered when initiating afterburning at altitudes above 45,000 feet using the normal procedure, use the following procedure to decrease the time required to reach full afterburner operation.

1. Retard throttle to 95% RPM.

2. Lift throttle fingerlift, and simultaneously jab the throttle forward. Jabs of more than 3% RPM are not recommended as they may result in overtemperature conditions. This procedure will materially decrease the time required to reach full afterburner operation.

FUEL SYSTEM OPERATION.

FUEL SYSTEM NORMAL OPERATION.

In normal fuel system operation, fuel tank sequencing is automatic when the selector switches are set at ALL TANKS and the tip tank and auxiliary tank switches are at ON. When nearly all of the fuel in an auxiliary tank is used, as indicated by the tank warning light, the tank switch should be turned OFF. If the tip tank fails to feed, turn the tip tank switch OFF and normal automatic sequencing will continue as though the tip tanks were empty. If the tip tank fuel cannot be used, it should be dumped. See figure 7-1 for flow during normal sequencing.

Note

- If an auxiliary tank switch is left ON after its warning light comes on, the remaining fuel will be pumped at a continually reduced rate for approximately 5 minutes.
- Under certain conditions, which occur only at sea level with afterburning, the fuel transfer warning lights may come on when the tip tanks are feeding properly. On a cold day immediately after the takeoff roll is started or on a standard day soon after the airplane leaves the runway, the lights may come on and remain on until the airplane is at an altitude of several thousand feet.

AUXILIARY TANK MANUAL OPERATION.

If fuel tank automatic sequencing fails, placing the fuel selector switch to the desired auxiliary tank position allows the auxiliary tank fuel to bypass the sump tank and feed directly to the engine. The corresponding tank switch should be ON so the warning light will indicate when the tank is empty. Figure 7-2 shows fuel flow when auxiliary tank fuel is bypassing the sump tanks.

Note

When the selector switches are on AUX. 1 or AUX. 2, no fuel is fed into the sump tanks and the afterburners should not be used. In an emergency, afterburners can be used while there is fuel in the sump tank, but when the sump tank becomes empty afterburning will stop suddenly without warning.

CROSSFEED OPERATION.

One Engine Inoperative.

The crossfeed line connects the two fuel systems so that during single-engine operation both fuel systems can supply the operating engine. For crossfeed operation the crossfeed switch is turned ON; the selector switches can be at ALL TANKS, AUX. 1, or AUX. 2. A fuel pressure drop in the crossfeed line causes the system with the operative engine to drain faster. The fuel load will become unbalanced, but not enough to be critical. For crossfeed fuel flow in single-engine operation, see figure 7-2.

One Fuel System Empty.

If one fuel system is empty, the selector switch for the empty side should be at ALL TANKS and the crossfeed switch should be placed to ON so that the other fuel system can supply both engines. For crossfeed fuel flow when one fuel system is supplying both engines, see figure 7-2.

Balancing Fuel Load.

If an asymmetrical fuel load condition develops, the fuel system crossfeed can be used to balance the load by feeding both engines from the fuel system having the most fuel. The above should be continued until the fuel quantity gages show even distribution or the airplane trims laterally as desired. Use the following procedure:

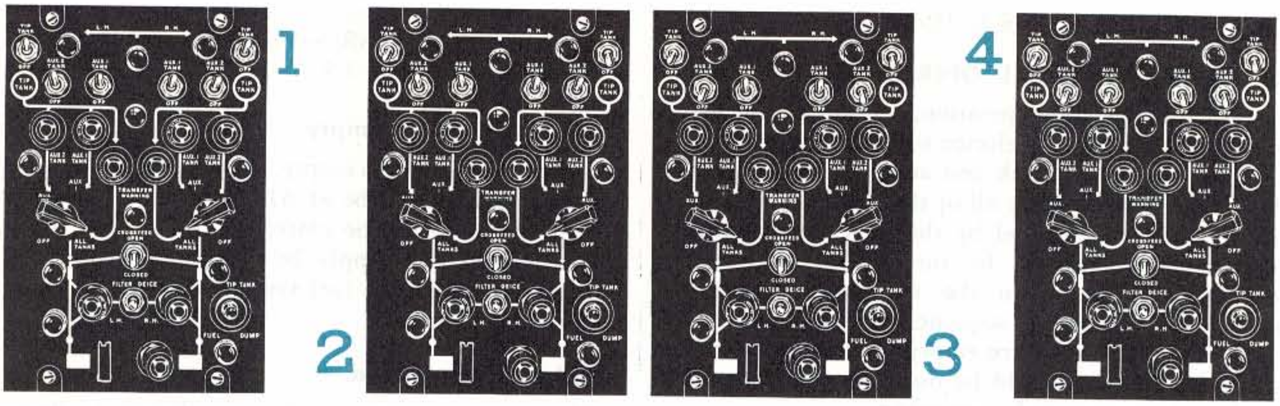
WARNING

Before balancing fuel load by feeding both engines from the system having more fuel (cross-feed valve open), make certain the normal sump pump circuit breaker is IN on the side that is feeding. If sump pump is not operating, engines may draw air from the empty wing tanks. This will result in flame-out of one or both engines.

1. Crossfeed switch—ON.
2. Outboard sump pump circuit breaker on the low side—Pull OUT.
3. When fuel is balanced, reset circuit breaker.
4. Crossfeed switch—OFF.

TIP TANK FUEL DUMPING

When the tip tank dump button (on the fuel accessory control panel, figure 1-18) is pushed momentarily, both tip tank dump valves open simultaneously and are held open by a time-delay relay for 75 seconds. Air pressure from the normal tip tank pressure line forces fuel out the dump port at a rate that normally will empty a full tip tank in approximately 60 seconds (in level flight or climb). To preclude the possibility of sump low level warning lights illuminating because of reduced sump tank fuel level, the tip tank switches should be turned OFF before the tip tank dump button is energized. If required, a new dumping cycle can be initiated by again momentarily pressing the dump button when the dump valve closes at the end of the first 75-second interval. Because of the aft location of the dump valves, the tip tank fuel cannot be dumped completely in a steep dive, and will dump at a lower



FUEL CONTROL PANELS INDICATED (TYPICAL)

NORMAL FUEL SEQUENCING

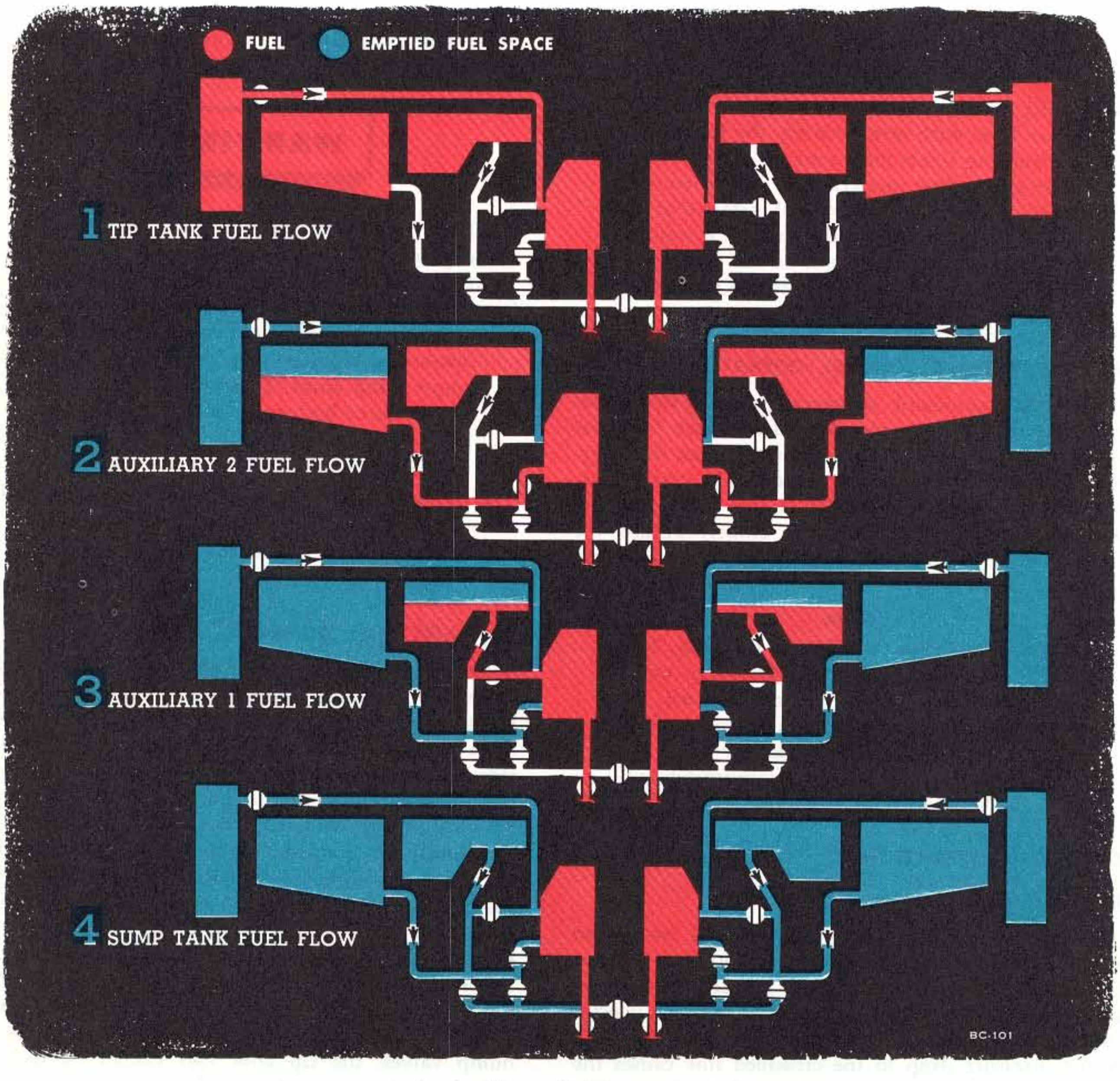
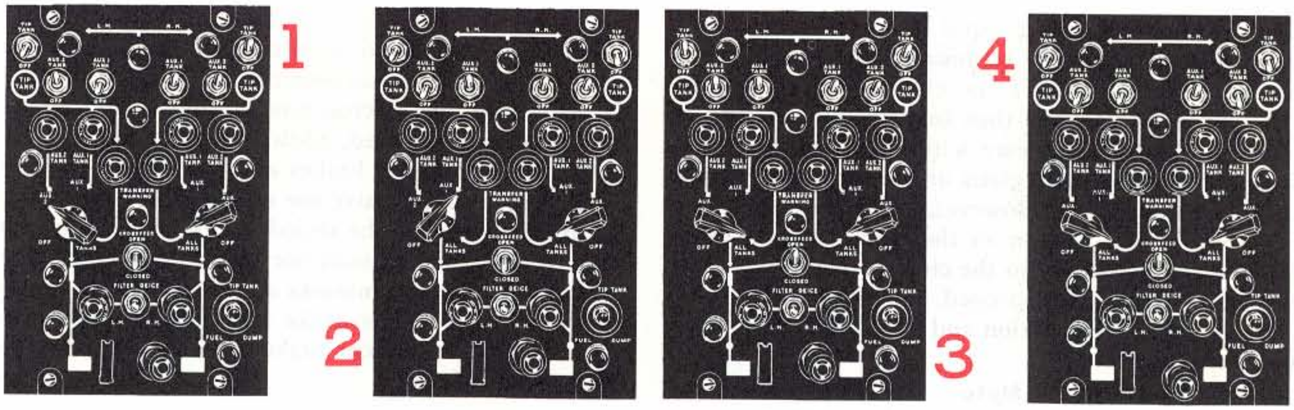


Figure 7-1.



FUEL CONTROL PANELS INDICATED (TYPICAL)

EMERGENCY FUEL FLOW

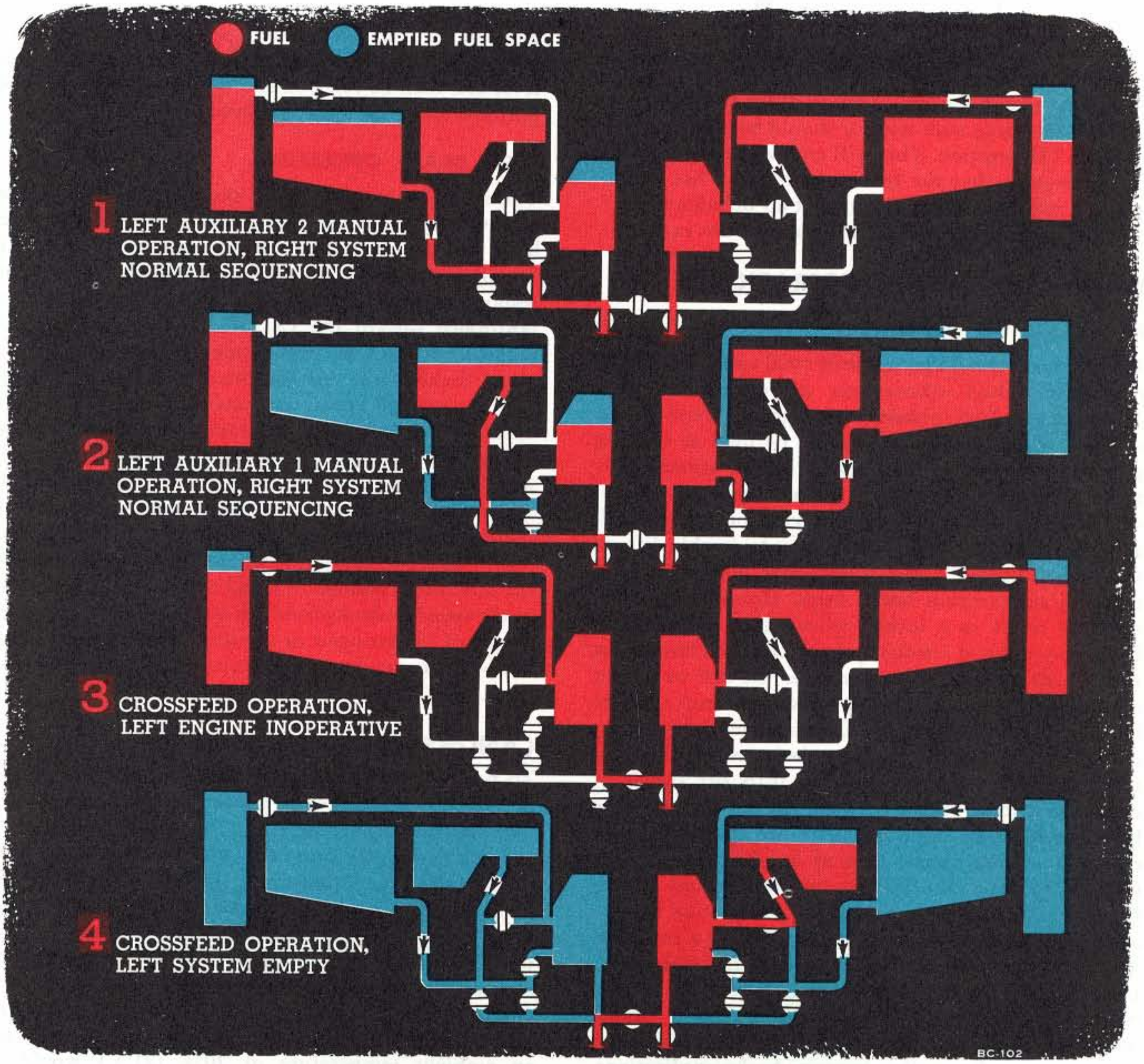


Figure 7-2.

than normal rate during rapid deceleration. The tip tank dump cycle can be terminated after it has been initiated by pulling OUT the circuit breaker marked TIP TANK DUMP and then immediately pushing it back IN. The holding relay within the fuel dumping circuitry will be deenergized at the time the circuit breaker is pulled OUT. However, the motor-driven fuel dump valves will remain in the open position until power is again restored to the circuit; therefore, when the circuit breaker is depressed, the motor valves will move to the closed position and stop the flow of fuel from the tip tank.

Note

Fuel dump cycle must be completed before landing.

WARNING

Prior to and during dumping of tip tank fuel, the fuel gage tank selector should be placed in the TIP position. This will enable the pilot to determine that the fuel in both tanks has or has not been dumped and that an unbalanced tip tank fuel condition does or does not exist.

HYDRAULIC SYSTEM OPERATION.

BRAKE SYSTEM OPERATION.

Wheel brakes should be properly used and treated with respect to reduce maintenance difficulties and accidents due to wheel brake failure. Brakes should not be dragged when taxiing and should be used as little as possible for turning the airplane on the ground. Extreme care should be used to prevent locking a wheel and skidding the tires when applying brakes immediately after landing when there is considerable lift on the wings. Proper brake action does not occur until the tires are carrying heavy loads. Heavy brake pressure can result in a locked wheel far more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the airplane is on the wheels. Brakes can stop a wheel from turning, but stopping the airplane is dependent on the friction of the tires on the runway. Skidding resulting from improper braking tears off shreds of rubber that act as rollers between tire and runway; the heat generated by skidding melts tire rubber and the resultant molten rubber acts as a lubricant between tire and runway. The full landing roll should be utilized to minimize the use of wheel brakes and to take advantage of aerodynamic braking. When either normal or emergency braking systems are used, short landing rolls (executed only when necessary) are accomplished by a single, smooth application of brakes with constantly increasing pedal pressure. To allow sufficient time for cooling between brake applications, a 15-minute interval is required between full stop landings when the landing gear remains extended in the slipstream and 30 minutes between full stop landings when the gear has been retracted. If the brakes are used for steering or crosswind taxiing, or if a series of landings is performed, additional time for cooling is required. When the brakes are in a heated condition resulting from excessive use in an emergency stop, the airplane should not be taxied into a crowded area and the parking brake should not be set. Peak temperatures occur from 5 to 15 minutes after a maximum braking operation and proper brake cooling procedure should be followed to prevent brake fire and possible wheel assembly explosion.

WING FLAP OPERATION.

When the wing flap lever is pre-positioned at UP, TAKE-OFF, or DOWN, the flaps will move to the selected position. For intermediate positions, the lever must be held at the desired position until the indicator shows the flaps to be in the desired position. The lever can then be released and the flaps will remain in position until the lever is moved again.

SPEED BRAKE OPERATION.

The speed brake lever opens the speed brakes proportionately to the lever movement. Pre-positioning the lever at any point between the OPEN and CLOSED limits of travel will stop the speed brakes in the corresponding position. The speed brake cannot be pre-positioned toward the CLOSED position. The speed brake lever must be pushed forward manually as the speed brakes close. At indicated airspeeds up to approximately 260 knots, the speed brake surfaces can be opened to any position. At indicated airspeeds above 260 knots, the angle to which the speed brakes open will be decreased proportionately to the increase in airspeed. If the airspeed is great enough, the airflow creates a back pressure and the speed brakes will "blow back" to the point where the back pressure on the actuating cylinders is equal to that of a relief valve in the speed brake hydraulic line. As airspeed decreases, the speed brakes open to the original position if there has been no change in the position of the speed brake lever.

CANOPY JETTISON SYSTEM.

To properly jettison the canopy, a minimum pressure of 1400 PSI is required in the canopy jettison cylinder. The decrease in temperature that accompanies high-altitude flight may cause the cylinder pressure to drop below 1400 PSI. A pressure of 1800 PSI, when the ambient temperature is 100°F (38°C), will assure a minimum pressure of 1400 PSI if the temperature decreases to −50°F (−46°C). To determine the required pressure at other ambient temperatures, subtract 40 PSI from 1800 PSI for each 15°F (8.4°C) increment below 100°F (38°C). For example, the required pressure for an ambient temperature of 70°F (21°C) would be 1720 PSI.

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PILOT'S DUTIES.

The duties of the pilot have been covered thoroughly in other sections of this manual and will not be repeated here.

RADAR OBSERVER'S DUTIES.

The radar observer's primary duty is operating the radar equipment; therefore, he must be on every mission in which radar equipment is utilized. See Section V for minimum crew requirements. In addition to operating the radar equipment, he reads all checklists to the pilot and performs other important duties which are covered in the following paragraphs.

Note

For information regarding radar and armament, refer to Section IV.

EXTERIOR INSPECTION.

At the discretion of the pilot, the radar observer will assist in making the exterior inspection (figure 2-1).

BEFORE ENTERING COCKPIT.

1. Ejection seat—Check.
   Armrests and trigger stowed; safety belt release initiator ground safety pin removed; safety pins installed; catapult file mark aligned.

Note

If the safety belt initiator ground safety pin is installed, consult maintenance personnel regarding the status of the ejection system before occupying the ejection seat.

2. Flashlight—Check operation.
3. Circuit breakers—IN.

ON ENTERING COCKPIT.

Note

A radar observer's checklist is located on the radar observer's instrument panel.

INTERIOR CHECK.

Rear Cockpit.

WARNING

If the C-2A life raft is being carried, the A-5 seat cushion should not be left on the seat. If both are used, and it becomes necessary to eject or crash land, severe spinal injury may result due to the excessive compressibility of the combination of life raft and cushion. If additional height is needed, a solid filler block may be used in conjunction with the life raft.

1. Safety belt and shoulder harness—Fasten; inertia reel operation—Check; detachable lanyard—Connect; automatic-opening parachute lanyard—Connected.

WARNING

Improperly attaching the shoulder harness straps to the automatic belt will prevent separation from the ejection seat after ejection.

To make the attachment correctly, first place the right and left shoulder harness loops over the manual release end of the swivel link; second, place the automatic parachute lanyard anchor over the manual release end of the swivel link; then, fasten the safety belt by locking the manual release lever.

2. Interphone amplifier switch—ON.
3. Circuit breakers—As required.
4. Interior lights switches—As required.
5. Canopy defog knob—IN.
6. Generator switches—Check one at ON and one at OFF.
7. Altimeter and clock—Set and cross-checked with pilot.
8. Radar and canopy jettison pressure gages—Check pressure.
9. Interphone selector switch—MIX SIG & COMMAND; interphone switch—INTER.
10. Communications equipment—Check operation.
11. Emergency signal system—Check (with pilot).
12. Oxygen equipment—Check operation. Pressure gage—400 PSI; oxygen regulator diluter lever—NORMAL OXYGEN; oxygen regulator supply lever—ON. (Refer to Oxygen System, Section IV, for detailed information.)
13. Hydraulic handpump system—Check. Engine hoist and brake selector valve handles positioned with aft handle (B) to NEUTRAL and forward handle (A) to SYSTEM; handpump handle stowed.
14. APG-33 radar—STDBY.

Note

With the radar on STDBY or OPERATE position, the attitude indication is presented on the pilot's radar scope for use during the attack phase of interceptions. Inasmuch as this attitude information is adjacent to the zero reader, it provides an additional cross-check of attitude for all instrument flying.

GROUND TESTS.

Check the 120-volt DC generators as follows:

1. Check 120-volt DC voltmeter for 110 to 120 volts at each position of the voltmeter selector switch (engine RPM above 50%).
2. Check 120-volt DC loadmeters for 0.2 maximum permissible difference.

BEFORE TAKEOFF.

1. Ejection seat ground safety pins—Remove.
2. Safety belt—Tighten; shoulder harness—Adjust to fit snugly; inertia reel lock lever—LOCKED.
3. Anti "G" suit valve button—Press to check operation.

AFTER TAKEOFF—CLIMB.

1. Detachable lanyard—Disconnect above minimum safe ejection altitude.

DURING FLIGHT.

The radar equipment is put into operation as follows:

1. Radar power switch—OPERATE.
2. Intensity control—Set for optimum brilliance.
3. Focus control—Set for sharply defined presentation.
4. Scan selector—LONG.
5. I-F gain control—NORMAL.
6. Scale illumination—Set for optimum brilliance.
7. Antenna search pattern selector—Desired scan level.
8. Search button—Press momentarily to start antenna in search pattern.

BEFORE LANDING.

1. Safety belt and shoulder harness—Check for tightness; detachable lanyard—Connect above minimum safe ejection altitude.
2. Inertia reel lock lever—LOCKED.
3. Viewing scope—Place in stowed position.
4. Radar console assembly—Move to forward position.

BEFORE LEAVING AIRPLANE.

1. Radar intensity control—Full counterclockwise.
2. Radar power switch—OFF.
3. Generator switches—One at ON and one at OFF.
4. All other switches—OFF.
5. Ejection seat ground safety pins—IN.
6. Oxygen tube, radio cord, and personal equipment—Check properly stowed.

WARNING

When leaving airplane, make certain that no personal equipment which could become entangled with the seat armrests when the canopy is closed or opened is left in the cockpit. Otherwise, the canopy may be accidentally jettisoned with attendant personnel injury.

Note

The following checklist is an abbreviated version of the procedures presented in the amplified checklists of Section VIII. This abbreviated checklist is arranged so you may remove it from your flight manual and insert it into a flip pad for convenient use. It is arranged so that each action is in sequence with the amplified procedure given in Section VIII.

CUT ON DOTTED LINE

F-89B AND C ABBREVIATED CHECKLIST (Radar Observer)

Note

The following checklist is an abbreviated version of the radar observer's duties and is accomplished by the radar observer.

EXTERIOR INSPECTION.

At the discretion of the pilot, the radar observer will assist in making the exterior inspection (figure 2-1).

BEFORE ENTERING THE COCKPIT.

1. Ejection seat—Check.
2. Flashlight—Check operation.
3. Circuit breakers—IN.

INTERIOR CHECK.

REAR COCKPIT.

1. Safety belt and shoulder harness—Fasten; inertia reel operation—Check; detachable lanyard—Connect; automatic-opening parachute lanyard—Connected.
2. Interphone amplifier switch—ON.
3. Circuit breakers—As required.
4. Interior lighting—As required.
5. Canopy defog knob—IN.
6. Generator switches—Check.
7. Altimeter and clock—Set and cross-checked with pilot.
8. Radar and canopy jettison pressure gages—Check pressure.
9. Interphone selector switch—MIX SIG & COMMAND; interphone switch—INTER.
10. Communications equipment—Check operation.
11. Emergency signal system—Check (with pilot).
12. Oxygen equipment—Check operation.
13. Hydraulic handpump system—Check.
14. APG-33 radar—STDBY.

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CONTINUED ON NEXT PAGE

ABBREVIATED CHECKLIST

CUT ON DOTTED LINE

2

GROUND TESTS.

1. 120-volt DC voltmeter—Check.
2. 120-volt DC loadmeters—Check.

BEFORE TAKEOFF.

1. Ejection seat ground safety pins—Remove.
2. Safety belt—Tighten; shoulder harness—Adjust; inertia reel lock—LOCKED.
3. Anti "G" suit valve button—Press to check operation.

AFTER TAKEOFF—CLIMB.

1. Detachable lanyard—Disconnect above minimum safe ejection altitude.

DURING FLIGHT.

1. Radar power switch—OPERATE.
2. Intensity control—Set for optimum brilliance.
3. Focus control—Set.
4. Scan selector—LONG.
5. I-F gain control—NORMAL.
6. Scale illumination—Set.
7. Antenna search pattern selector—Desired scan level.
8. Search button—Press momentarily.

BEFORE LANDING.

1. Safety belt and shoulder harness—Check; detachable lanyard—Connect, above minimum safe ejection altitude.
2. Inertia reel—LOCKED.
3. Viewing scope—Place in stowed position.
4. Radar console assembly—Move to forward position.

BEFORE LEAVING AIRPLANE.

1. Radar intensity control—Full counterclockwise.
2. Radar power switch—OFF.
3. Generator switches—One at ON and one at OFF.
4. All other switches—OFF.
5. Ejection seat ground safety pins—IN.
6. Oxygen tube, radio cord, and personal equipment—Check properly stowed.

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ALL-WEATHER OPERATION

SECTION IX

Except for some repetition 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 instructions covered in Sections II and IV relative to instrument flight.

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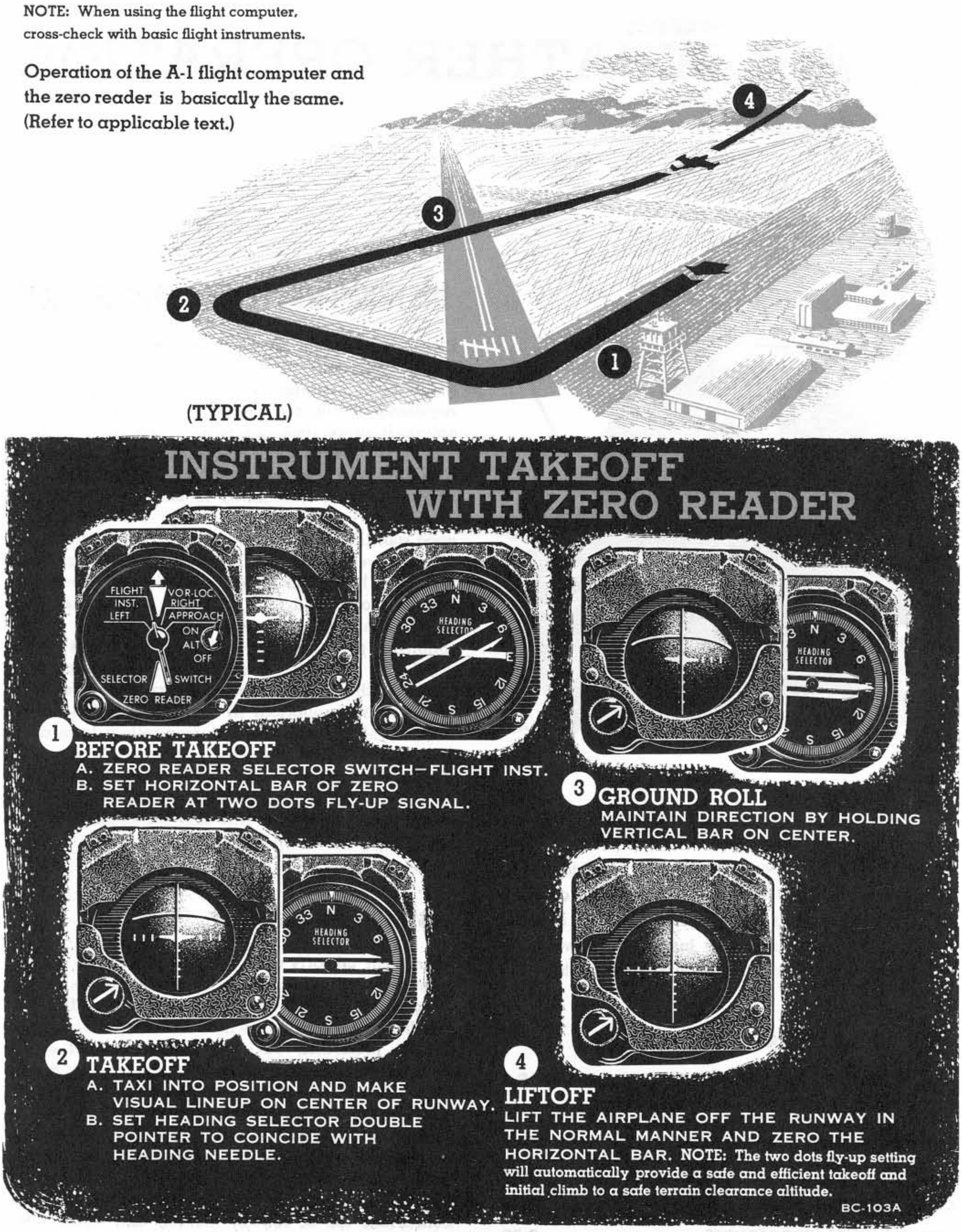
INSTRUMENT FLIGHT PROCEDURES

Flying the airplane in instrument weather conditions requires instrument proficiency and thorough preflight planning. In planning IFR flights, remember that fuel requirements for completion of instrument letdown approach procedures and possible diversion to alternate fields must be added to that normally required for VFR flights. Therefore, maximum range or endurance of the airplane, if required to land in IFR weather conditions, is reduced accordingly. The airplane has good stability characteristics and flight handling qualities for weather flying. For ease of handling, banks should be limited to 30 degrees unless maximum rate turns are ordered by GCI during interceptions. The flight computer or zero reader installation greatly simplifies precision instrument flying. Pilots should avoid any tendency, however, to concentrate exclusively on the flight computer indicator or zero reader, or to be hypnotized by it. Concentration on the indicator alone, particularly during rollout from turns, may cause a temporary sense of vertigo. When using the flight computer or zero reader, monitor the action of the airplane with the basic standard flight instruments at all times to be sure that the airplane follows the flight path set up on the flight computer or zero reader controls.

INSTRUMENT TAKEOFF.

Instrument takeoffs without afterburning are not recommended. Afterburning is recommended to shorten the takeoff roll when conditions of low visibility exist or when takeoff in crosswind is made. After completing the prescribed Taxi and Before Takeoff checks and after aligning the airplane on the runway, set the course dial on the flight computer (or zero reader) indicator to coincide with the runway heading. As the takeoff roll is started, maintain proper directional control with nose wheel steering until the rudder becomes effective at about 70 knots IAS. Maintain heading with reference to the directional indicator. Concurrent use of runway markers and visual references, as long as they remain visible, is recommended. Continue the instrument takeoff, lifting off the nose



NOTE: When using the flight computer, cross-check with basic flight instruments.
Operation of the A-1 flight computer and the zero reader is basically the same. (Refer to applicable text.)
(TYPICAL)
INSTRUMENT TAKEOFF WITH ZERO READER
FLIGHT INST. LEFT
VOR-LOC RIGHT
APPROACH ON ALT OFF
SELECTOR SWITCH
ZERO READER
HEADING SELECTOR
1 BEFORE TAKEOFF
A. ZERO READER SELECTOR SWITCH—FLIGHT INST.
B. SET HORIZONTAL BAR OF ZERO READER AT TWO DOTS FLY-UP SIGNAL.
2 TAKEOFF
A. TAXI INTO POSITION AND MAKE VISUAL LINEUP ON CENTER OF RUNWAY.
B. SET HEADING SELECTOR DOUBLE POINTER TO COINCIDE WITH HEADING NEEDLE.
3 GROUND ROLL
MAINTAIN DIRECTION BY HOLDING VERTICAL BAR ON CENTER.
4 LIFTOFF
LIFT THE AIRPLANE OFF THE RUNWAY IN THE NORMAL MANNER AND ZERO THE HORIZONTAL BAR. NOTE: The two dots fly-up setting will automatically provide a safe and efficient takeoff and initial climb to a safe terrain clearance altitude.
BC-103A

Figure 9-1.

wheel and becoming airborne at the normal VFR speeds. Establish and maintain the proper takeoff attitude on the attitude indicator until definitely airborne. As the airplane leaves the ground the attitude indicator is primary for both bank and pitch and remains primary until the climb is definitely established. When the vertical velocity indicator and the altimeter show a definite climb indication, retract the gear and flaps as under VFR conditions. Upon reaching a safe altitude, accelerate to a normal climb speed. If necessary, turn the anti-icing switch to FLIGHT.

Note

Approximately 5 degrees of roll error may appear on the attitude indicator on accelerated turn after takeoff. This error will be in the direction of the turn and should disappear within a short time. See figure 9-1 for typical instrument takeoffs with the flight computer.

INSTRUMENT CLIMB.

Once the desired climb speed is reached the airspeed indicator becomes the primary instrument for pitch and remains such throughout the remainder of the climb. Refer to figure 9-2 for a typical flight computer climb. Use the climb procedures as outlined in Section II.

INSTRUMENT CRUISING FLIGHT.

Keep the airplane trimmed for hands-off flight and use the flight computer (or zero reader) with the altitude control on. Maintain altitude by holding the horizontal bar of the flight computer (or zero reader) centered. After leveling off and adjusting power as necessary, trim the airplane for hands-off flight. Altitude may be maintained by holding the horizontal bar of the flight computer (or zero reader) centered, with the altitude control switch ON. However, the altimeter is still the primary instrument for pitch since it alone can provide the pilot with an indication of altitude. The attitude indicator is the only direct reading instrument for pitch and bank changes. Turn errors occur in both its pitch and bank indications. As a result a close cross-check on the altimeter and turn needle must be accomplished in rolling out of turns. After a short time the gyro will precess back to a correct indication. In accomplishing turns with the flight computer (or zero reader) the maximum bank angle required to center the vertical bar is set at 30 degrees regardless of airspeed and altitude. Banks of more than 30 degrees may be made by holding the vertical bar at one or more dots beyond center. The maximum amount of heading change that should be selected on the flight computer (or zero reader) at any time is 150 degrees. Example: If when flying on a heading of 360 degrees a right turn to 180 degrees is desired, rotate the heading selector until 150 degrees is under the course index. Start the turn, and when more than 30 degrees of the turn has been accomplished, rotate the heading selector to 180 degrees and continue the turn. The flight computer (or zero reader) will initiate a rollout indication 22 degrees before the selected heading is reached. It is advantageous to roll out without reference to the vertical bar when a more rapid change of heading is desired.

Note

If more than 150 degrees from present heading is selected under the course index, the vertical bar will indicate a turn in the opposite direction.

See figure 9-3 for a typical flight computer (or zero reader) turn procedure.

IFR INTERCEPTIONS.

With sufficient practice, interceptions can be performed under instrument conditions without difficulties. With proper coordination between pilot and radar observer, the pilot can perform the attack phase of the interception under instrument conditions, using the attitude indication and target information on his radar scope. Use of the flight computer (or zero reader) for principal flight reference greatly simplifies instrument flight during ground control phase of interceptions. When given vectors by the GCI controller, turn the flight computer heading selector to the corresponding heading and roll immediately into the turn to center the vertical bar on the indicator. Keep the airplane trimmed while tracking the target, particularly when decelerating after lockon.

Note

Use the windshield wiper in precipitation to increase visual sighting range of the target after lockon.

SPEED RANGE.

Aircraft flight characteristics at high and low airspeeds are the same for VFR and IFR flying. For best cruise or loitering indicated airspeeds refer to applicable Appendix charts.

RADIO AND NAVIGATION EQUIPMENT.

For proper background and use of radio and navigation equipment refer to Section IV. The operation of the UHF and VHF navigation set and the IFF beacon is not affected by most weather conditions. The radio compass, however, is susceptible to precipitation static.

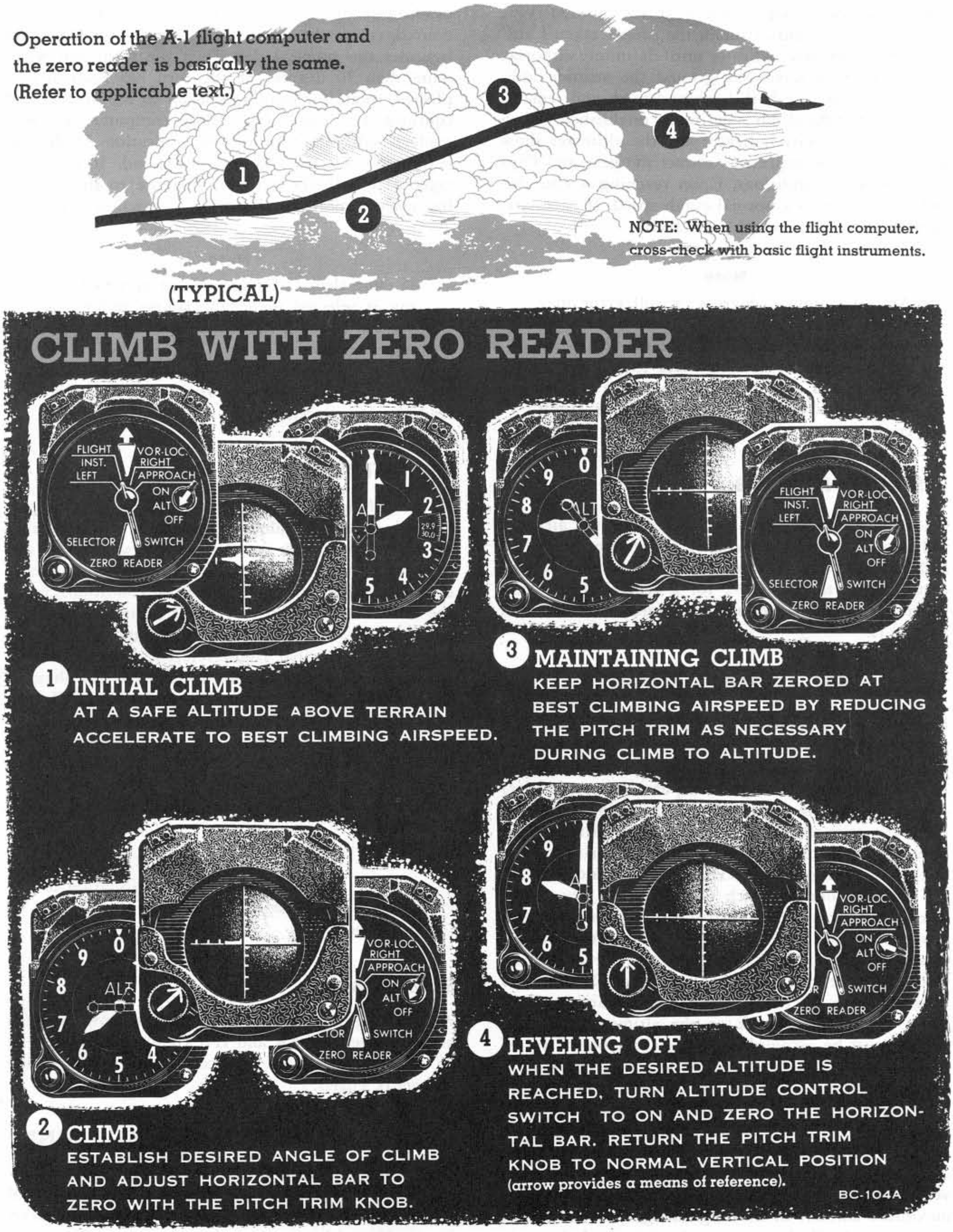

Operation of the A-1 flight computer and the zero reader is basically the same. (Refer to applicable text.)
NOTE: When using the flight computer, cross-check with basic flight instruments.
(TYPICAL)
CLIMB WITH ZERO READER
1 INITIAL CLIMB
AT A SAFE ALTITUDE ABOVE TERRAIN ACCELERATE TO BEST CLIMBING AIRSPEED.
2 CLIMB
ESTABLISH DESIRED ANGLE OF CLIMB AND ADJUST HORIZONTAL BAR TO ZERO WITH THE PITCH TRIM KNOB.
3 MAINTAINING CLIMB
KEEP HORIZONTAL BAR ZEROED AT BEST CLIMBING AIRSPEED BY REDUCING THE PITCH TRIM AS NECESSARY DURING CLIMB TO ALTITUDE.
4 LEVELING OFF
WHEN THE DESIRED ALTITUDE IS REACHED, TURN ALTITUDE CONTROL SWITCH TO ON AND ZERO THE HORIZONTAL BAR. RETURN THE PITCH TRIM KNOB TO NORMAL VERTICAL POSITION (arrow provides a means of reference).
FLIGHT INST. LEFT
VOR-LOC. RIGHT APPROACH
ON
ALT
OFF
SELECTOR
SWITCH
ZERO READER
BC-104A

Figure 9-2.

1
2
3
4
NOTE: When using the flight computer, cross-check with basic flight instruments.
Operation of the A-1 flight computer and the zero reader is basically the same. (Refer to applicable text.)
(TYPICAL)
TURNS WITH ZERO READER
STRAIGHT AND LEVEL
1
SET THE HEADING SELECTOR TO THE NEW HEADING. THE VERTICAL BAR OF THE ZERO READER INDICATOR WILL BE DEFLECTED IN THE DIRECTION THE TURN IS TO BE MADE.
15° BANK
3
KEEP THE VERTICAL BAR ZERC ED.
(Note that the compass needle is approaching the heading selector double needle.)
STRAIGHT AND LEVEL
30° BANK
2
ZERO THE VERTICAL BAR.
4
THE AIRPLANE IS ON THE NEW COURSE AND THE COMPASS NEEDLE AND DOUBLE NEEDLE COINCIDE.
BC-105A

Figure 9-3.

DESCENT.

If icing conditions are probable, the descent should be made with sufficient power to provide adequate hot air for the anti-icing system. For maximum ease of handling, a constant-speed letdown is recommended. The optimum speed brake position depends on the IAS and rate of descent combination desired. The adjustable speed brakes make possible various rates of descent at the same IAS and throttle setting.

RADIO PENETRATIONS.

Radio penetrations can be accomplished satisfactorily with various aircraft configurations. Recommended, however, is idle power, 200 knots IAS, and 4,000 FPM descent, maintained with gear and flaps retracted and approximately one-half speed brakes. The exact procedures for jet penetrations *(Pilot's Handbook—Jet, East or West)* will vary with each field due to local terrain and radio variations. See figure 9-4 for a typical flight computer descent procedure.

Note

The canopy defogging system should be actuated approximately 10 minutes prior to descent from altitude.

INSTRUMENT APPROACHES.

The airplane has excellent handling characteristics during instrument approaches. When power is at idle or low RPM, the power response to throttle movement is very slow. Therefore, use relatively high power settings in the approach configuration, and control airspeed and rate of descent by using the speed brakes. Very little pitch change is required during transition from glide slope to touchdown because the airplane is approximately in a landing attitude while on the glide slope. With takeoff flaps, speed brakes open, and maximum practicable braking, the required runway length to stop, following instrument approaches, is short compared to other jet fighters. A 6500-foot GCA- and/or ILS-equipped runway is considered minimum for actual all-weather operations.

RADIO APPROACHES.

Normally, radio range and omnirange approaches will be required only if the airplane is not VFR after descent to the low station and no GCA or ILS is available. Refer to the Pilot's Handbook—Jet for the local procedures of the standard instrument approach. The fuel required to complete an approach is largely determined by the time the airplane flies outbound before making the procedure turn and by the distance from the fix to the field. The time outbound from the radio fix, prior to initiating the procedure turn, need only be sufficient to permit completion of the cockpit check after the procedure turn and precision beam following to the station at the proper altitude. For radio approaches after a tear-drop type penetration the following procedures may be used.

Note

If a procedure turn is to be made after a penetration, use 84% RPM and adjust speed brakes as required to maintain 195 knots IAS. Fly outbound for a minimum of 30 seconds and a maximum of 60 seconds (or as locally prescribed); then make procedure turn.

Inbound.

1. Landing gear lever—DOWN.
2. Wing flap lever—TAKEOFF.
3. Throttle—Minimum of 84% RPM.
4. Speed brake lever—As required to maintain 150 knots IAS.
5. Descend to proper altitude.

Note

If time from the radio fix to the field exceeds 2 minutes, it is best to delay final configuration until over the station in order to expedite the approach and conserve fuel.

Low Station.

1. Make the proper position report and descend to minimum altitude. Use the speed brakes to maintain airspeed in the descent. Descents during approaches are normally made at 500 FPM and should not exceed 1,000 FPM.

See figure 9-6 for typical radio approach.

GROUND CONTROLLED APPROACH (GCA).

GCA approaches may consist of a rectangular pattern, a straight in approach from the penetration, or modified versions of either, dependent upon local facilities and terrain features. Therefore, the fuel and time required for a GCA will vary at different fields. The basic procedures remain the same for all patterns. That is, the cockpit checks and the final configuration are accomplished prior to being turned over to the final controller. On a cross-country flight, the GCA procedures at the destination should be checked and fuel allowances made as part of the preflight planning. Emergency GCA approaches can be made using less fuel by requesting the GCA controllers to shorten the pattern. Fuel also can be conserved by delaying the final configuration. The procedures for a typical GCA pattern are outlined in figure 9-7. Single-engine GCA's can be accomplished satisfactorily using the following procedures.

1. Downwind—195 knots, throttle as required (approximately 84% RPM minimum), gear up, flaps up, speed brakes closed.

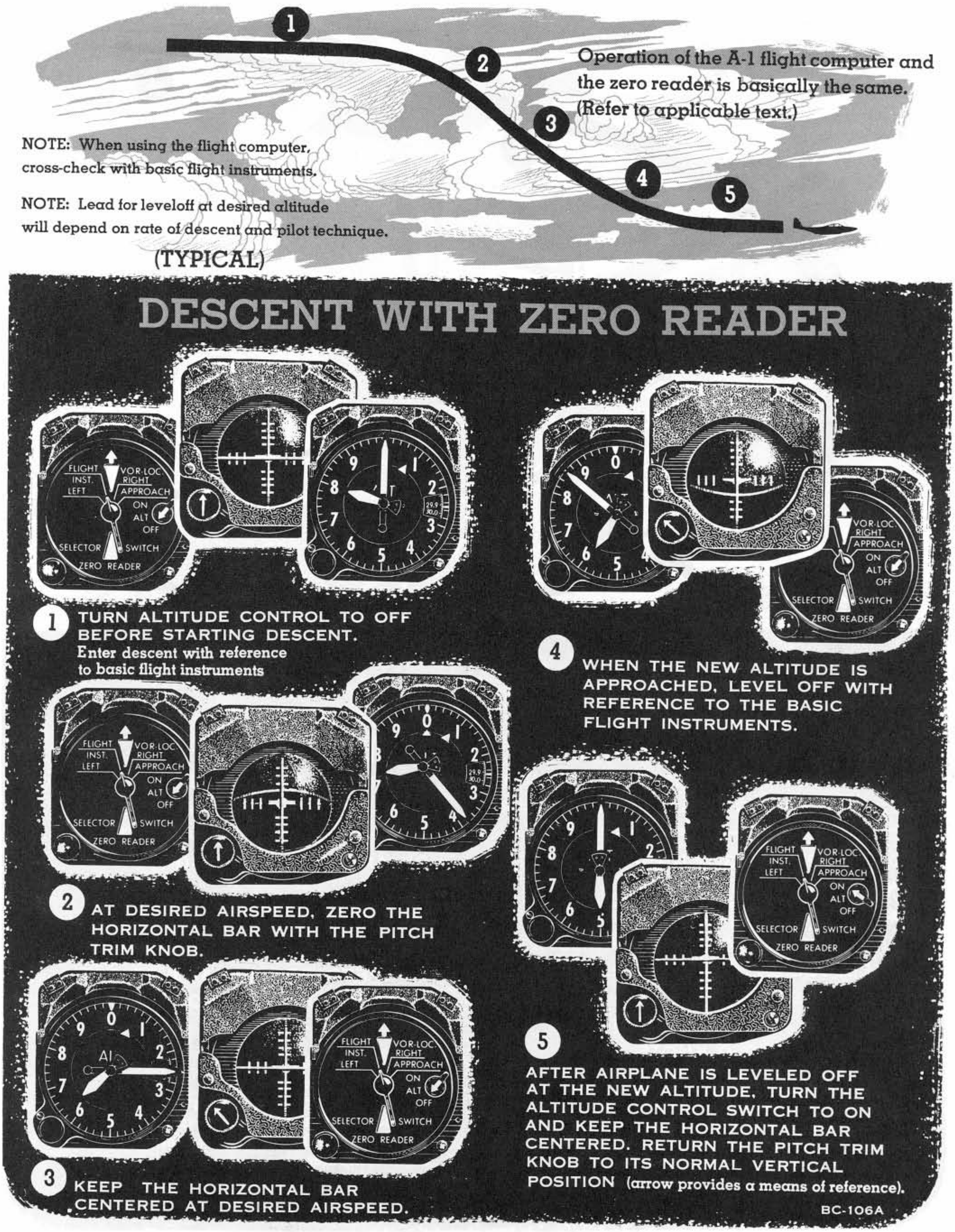
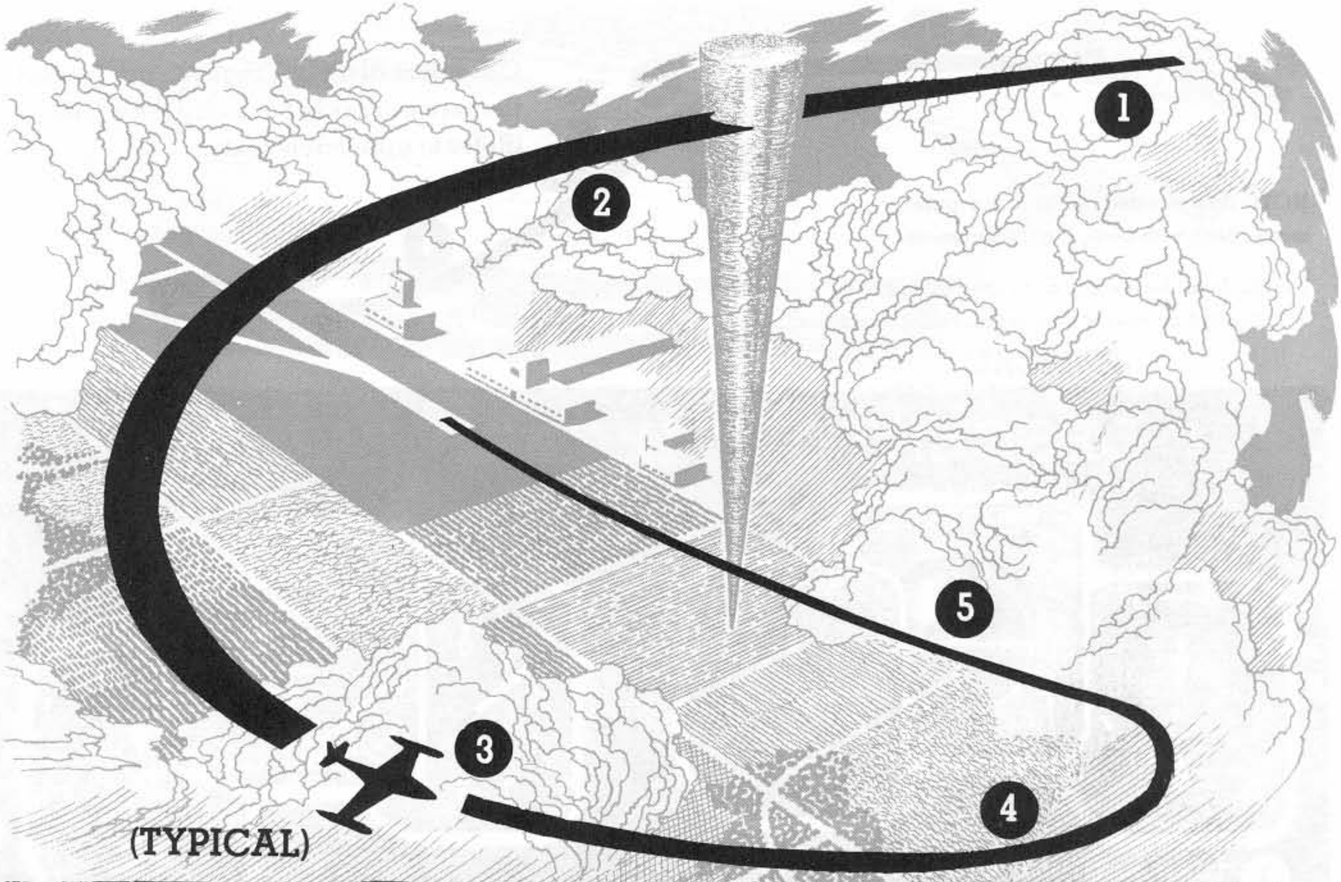

Operation of the A-1 flight computer and the zero reader is basically the same. (Refer to applicable text.)
NOTE: When using the flight computer, cross-check with basic flight instruments.
NOTE: Lead for leveloff at desired altitude will depend on rate of descent and pilot technique.
(TYPICAL)
DESCENT WITH ZERO READER
1 TURN ALTITUDE CONTROL TO OFF BEFORE STARTING DESCENT. Enter descent with reference to basic flight instruments
2 AT DESIRED AIRSPEED, ZERO THE HORIZONTAL BAR WITH THE PITCH TRIM KNOB.
3 KEEP THE HORIZONTAL BAR CENTERED AT DESIRED AIRSPEED.
4 WHEN THE NEW ALTITUDE IS APPROACHED, LEVEL OFF WITH REFERENCE TO THE BASIC FLIGHT INSTRUMENTS.
5 AFTER AIRPLANE IS LEVELED OFF AT THE NEW ALTITUDE, TURN THE ALTITUDE CONTROL SWITCH TO ON AND KEEP THE HORIZONTAL BAR CENTERED. RETURN THE PITCH TRIM KNOB TO ITS NORMAL VERTICAL POSITION (arrow provides a means of reference).
FLIGHT INST. LEFT
VOR-LOC RIGHT APPROACH
ON ALT OFF
SELECTOR SWITCH
ZERO READER
BC-106A

Figure 9-4.



RADIO PENETRATION

1 APPROACH TO STATION

A. CANOPY DEFOGGING—AS REQUIRED.
B. WINDSHIELD HEAT—AS NECESSARY.
C. PITOT HEAT—AS REQUIRED.
D. INTERIOR LIGHTING—AS DESIRED.

2 PENETRATION ENTRY

A. THROTTLE—76% RPM MINIMUM.
B. ESTABLISH 4000 FPM RATE OF DESCENT.
C. SPEED BRAKES—ADJUST TO MAINTAIN 250 KNOTS IAS.

3 PENETRATION TURN

MAINTAIN DESCENT AND TURN AS PRESCRIBED IN "PILOT'S HANDBOOK—JET."

4 LEVEL OFF

DECREASE RATE OF DESCENT 1000 FEET ABOVE LEVEL-OFF ALTITUDE, AND LEAD LEVEL-OFF ALTITUDE BY APPROXIMATELY 10%.

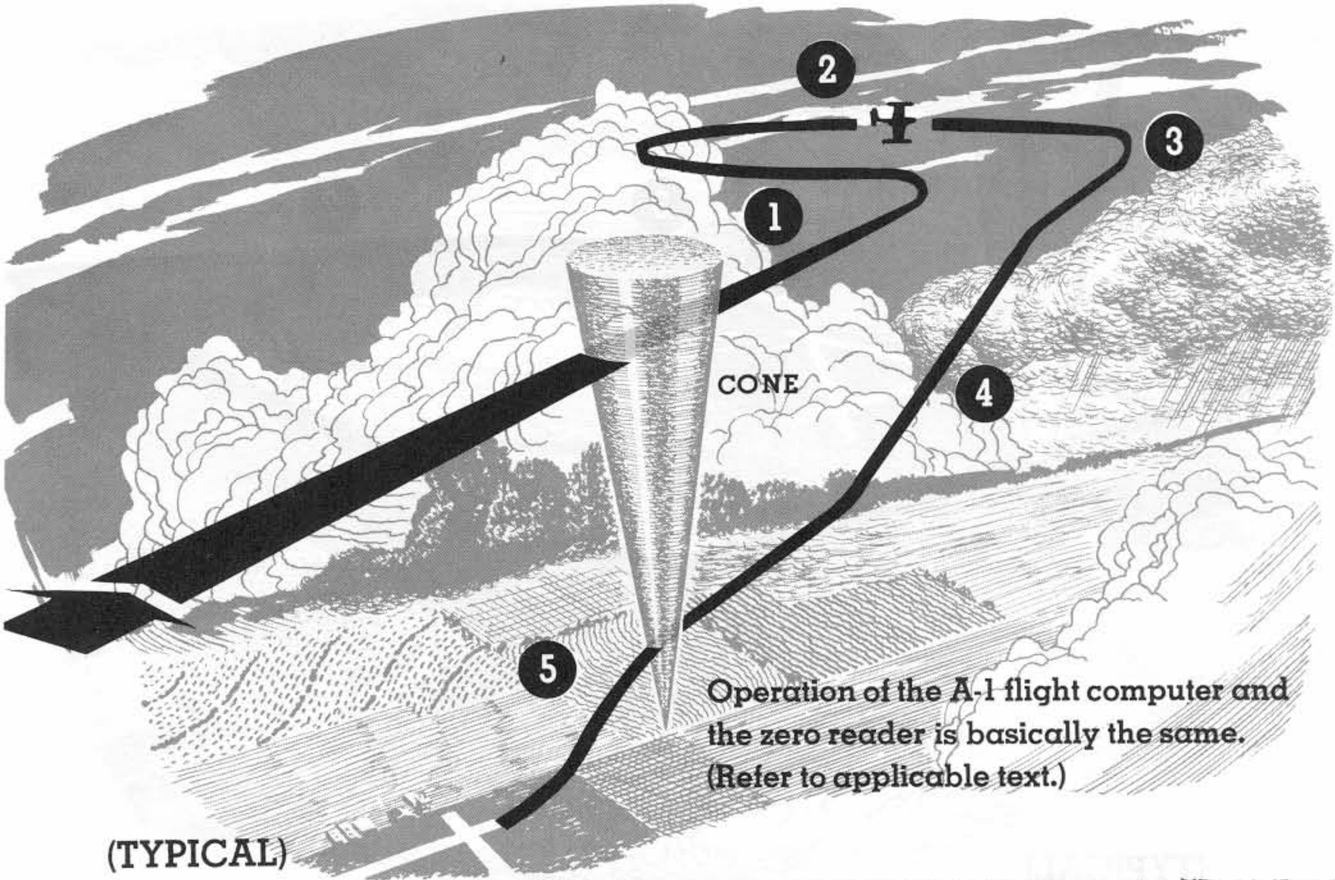
5 INBOUND

A. THROTTLE—72% MINIMUM.
B. SPEED BRAKES—ADJUST TO MAINTAIN 195 KNOTS IAS.

NOTE: Refer to appropriate "Pilot's Handbook—Jet" for specific penetration instructions. Use the basic instruments and cross check with zero reader or flight computer.

BC-107A

Figure 9-5.



RADIO APPROACH

1 OUTBOUND

A. THROTTLE—72% RPM MINIMUM.
B. SPEED BRAKES—AS REQUIRED TO MAINTAIN 195 KNOTS IAS.
C. TIME—AS LOCALLY REQUIRED.

2 PROCEDURE TURN

3 COCKPIT CHECK

A. LANDING GEAR—DOWN.
B. WING FLAPS—TAKEOFF.
C. THROTTLE—84% RPM MINIMUM.
D. SPEED BRAKES—AS REQUIRED TO MAINTAIN 150 KNOTS IAS.

4 INBOUND

A. DESCEND TO PROPER ALTITUDE.
B. MAINTAIN FINAL CONFIGURATION.

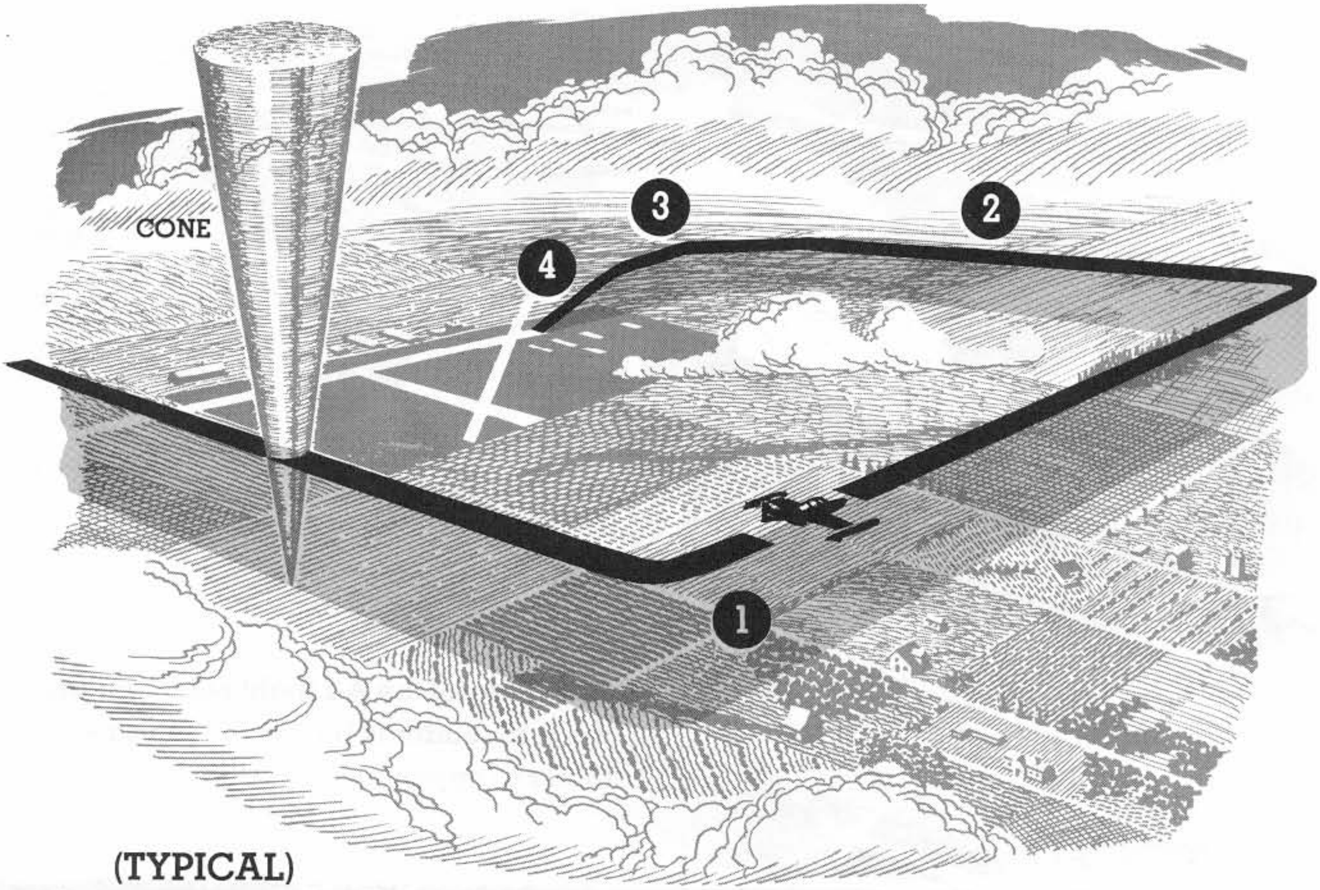
5 LOW STATION

A. MAKE PROPER POSITION REPORT.
B. DESCEND TO MINIMUM ALTITUDE.

NOTE: Refer to Pilot's Handbook—Jet for instrument approach procedure.

BC-108A

Figure 9-6.



GCA APPROACH

1 DOWNWIND LEG

A. LANDING GEAR—UP.
B. WING FLAPS—UP.
C. THROTTLE—72% RPM MINIMUM.
D. SPEED BRAKES—AS REQUIRED TO MAINTAIN 195 KNOTS IAS.

2 BASE LEG

A. LANDING GEAR—DOWN.
B. WING FLAPS—UP.
C. THROTTLE—84% RPM MINIMUM.
D. IAS—150 KNOTS.

3 FINAL APPROACH

A. WING FLAPS—TAKEOFF.
B. IAS—150 KNOTS (SPEED BRAKES AS REQUIRED).

4 GLIDE SLOPE

USE SPEED BRAKES TO MAINTAIN 150 KNOTS IAS.

BC-109A

Figure 9-7.

2. Base leg—180 knots IAS, throttle as requested (approximately 94% RPM minimum), gear down, flaps up, and speed brakes closed.

3. On final approach prior to glide slope entry—160 to 170 knots IAS, throttle as required (approximately 98% RPM minimum), gear down, flaps at takeoff and speed brakes closed.

4. Glide slope—160 to 170 knots IAS, maintain as high RPM as possible.

5. As end of runway is approached, do not reduce airspeed below 160 knots IAS until landing is assured.

6. Retard throttle to idle only when positive of landing. After touchdown open speed brakes to reduce ground roll.

ILS APPROACH.

ILS is very similar to GCA in that it is designed to give indications of both azimuth and elevation to the pilot throughout the complete approach. It does differ from a GCA since ILS gives a visual presentation of deviations from the approach, while in GCA the pilot is given verbal corrections throughout the approach. The procedures for the airplane are very similar for both GCA and ILS, and are as follows:

Outbound.

1. Landing gear—Up.
2. Wing flaps—Up.
3. Throttles—72 ± 2% RPM minimum.
4. Speed brakes—As required to maintain 200 knots IAS.
5. Altitude as locally required.

Procedure Turn.

1. Begin procedure turn as locally prescribed.

Inbound to Outer Marker.

1. Descend to proper altitude.
2. Landing gear—Down.
3. Wing flaps—Takeoff.
4. Throttles—84 ± 2% RPM minimum, to maintain 150 knots IAS.

Outer Marker and Inbound on Approach.

1. Make the appropriate position report.
2. Intercept and bracket the glide slope, maintaining airspeed with use of the speed brakes.
3. Heading corrections should not exceed 5 degrees. Pitch corrections of 200 to 300 FPM generally will be sufficient.

The flight computer (or zero reader) greatly simplifies the initial turn-on to the localizer as well as precision beam following on the localizer and glide slope. To use the flight computer the pilot must accomplish the steps as outlined in figure 9-8.

MISSED-APPROACH GO-AROUND PROCEDURE.

If a missed approach or a go-around is required, accomplish the following:

1. Throttles—OPEN; use afterburners for acceleration if necessary, but consideration must be given to increased fuel consumption.
2. Speed brake lever—CLOSED.
3. Establish a takeoff or climb attitude.
4. When vertical velocity indicator and the altimeter show definite climb indication, retract gear and flaps.
5. Execute established missed-approach procedure for the particular field.

ZERO READER MISSED APPROACH WITH ILS. B, C (Groups 1-20).

WARNING

Do not use flight computer or zero reader missed-approach procedure if a go-around with both afterburners and a clean configuration cannot be accomplished.

If an approach is missed and a straight-ahead climbout can be safely made, the zero reader may be used for climbout by using the following procedure:

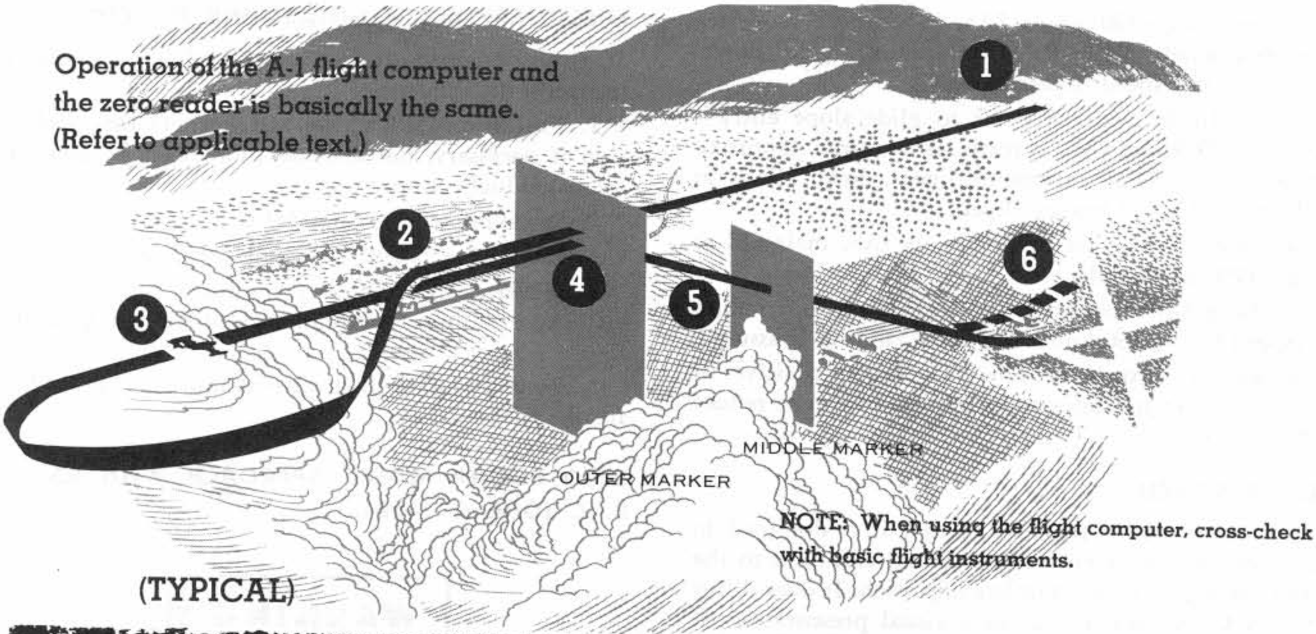
1. Throttles—OPEN. If sufficient fuel is available, turn on afterburners as soon as engine speed permits.
2. Speed brakes—Closed.
3. Landing gear—Up.
4. Wing flaps—Gradually raise as airspeed increases (see figure 6-2 for applicable stalling airspeeds).
5. Zero reader selector switch—FLIGHT INST.
6. Zero reader pitch-trim knob—Adjust for desired climbout attitude.
7. Fly to maintain zero indication.

FLIGHT COMPUTER MISSED APPROACH WITH ILS. C (Group 25 and Subsequent).

WARNING

Do not use flight computer or zero reader missed-approach procedure if a go-around with both afterburners and a clean configuration cannot be accomplished.

In the event of a missed approach on ILS and a straight-ahead climbout can be safely made, the flight computer can be used to accomplish a go-around. Pressing the



ILS APPROACH with zero reader or flight computer

1 OUTBOUND

A. ZERO READER SELECTOR SWITCH—(VOR-LOC) LEFT.
B. ALTITUDE—AS LOCALLY PRESCRIBED.
C. ALTITUDE CONTROL SWITCH—ON.
D. LANDING GEAR—UP.
E. WING FLAPS—UP.
F. THROTTLE—84% RPM MINIMUM.
G. SPEED BRAKES—AS NECESSARY TO MAINTAIN 195 KNOTS IAS.

2 PROCEDURE TURN

A. BEGIN PROCEDURE TURN AS LOCALLY PRESCRIBED.
B. FLIGHT COMPUTER OR ZERO READER SELECTOR SWITCH—FLIGHT INST.
C. ALTITUDE CONTROL SWITCH—OFF (prior to descent).

3 INBOUND

A. SET HEADING POINTER TO LOCALIZER HEADING.
B. TURN ZERO READER SELECTOR SWITCH TO (VOR-LOC) RIGHT. THIS WILL CAUSE ZERO READER VERTICAL BAR TO DEFLECT.
C. WHEN THE COURSE INDICATOR VERTICAL BAR BEGINS TO MOVE OFF THE PEG, CENTER THE VERTICAL BAR. THIS WILL BRING YOU TO LOCALIZER BEAM.

4 INTERCEPTING GLIDE SLOPE

WHEN THE COURSE INDICATOR HORIZONTAL BAR REACHES CENTER (indicating you are on glide slope), TURN SELECTOR SWITCH TO APPROACH.

COCKPIT CHECK

A. DESCEND TO PROPER ALTITUDE.
B. LANDING GEAR—DOWN.
C. WING FLAPS—TAKEOFF.
D. THROTTLE—84% RPM MINIMUM TO MAINTAIN 150 KNOTS IAS.

5 ON GLIDE SLOPE

FLY AIRPLANE TO CENTER HORIZONTAL AND VERTICAL BARS TO MAINTAIN POSITION ON LOCALIZER AND GLIDE SLOPE.

6 MISSED APPROACH

TO GO AROUND IN THE EVENT OF A MISSED APPROACH, TURN SELECTOR SWITCH TO FLIGHT INST. AND INITIATE AFTERBURNING. BY CENTERING THE BARS, YOU WILL ASSUME A SAFE CLIMBING ATTITUDE. THEN FOLLOW LOCAL MISSED APPROACH PROCEDURE.

BC-110A

Figure 9-8.

flight computer altitude switch with the flight computer selector switch at APPROACH, will displace the horizontal bar to the optimum climbout angle. Flying the airplane to center the horizontal and vertical bars will then result in a safe climbout airspeed if maximum power is used on both engines. In the following go-around procedure, each step should be performed one after the other without hesitation.

1. Throttles—OPEN; afterburners—ON.
2. Speed brakes—Closed.
3. Flight computer go-around button—Press.
4. Landing gear—Up.
5. Wing flaps—Up.
6. Fly the airplane to center the horizontal and vertical bars until desired altitude is reached. Execute missed approach procedure for the particular field.

Note

When the desired altitude is reached, the go-around feature is cut out by turning the flight computer selector switch from the APPROACH position.

INSTRUMENT LETDOWNS AND APPROACHES ON SINGLE ENGINE.

Letdowns and approaches on single engine, either by radar control or on the radio range, can be made satisfactorily. Use the following procedure when making single-engine GCA or ILS approach:

1. GCA downwind leg and ILS outbound—Use 200 knots IAS, power at 84% ± 2% RPM, gear down, flaps up, and speed brakes closed.
2. GCA base leg and ILS inbound—Use 150 to 160 knots IAS, power at 92% ± 2% RPM, gear down, flaps up, and speed brakes closed.
3. Final approach—Use 150 to 160 knots IAS, gear down, flap lever at TAKE-OFF, power as required to maintain desired flight path. If left engine is operative, use 98% RPM and control rate of descent with speed brakes.

Single-engine go-around can be made with the gear down provided afterburner is used and airspeed is not allowed to drop below 150 knots IAS.

The thin wings and high speeds of jet airplanes can result in critical ice accumulations in relatively light icing conditions in airplanes with inoperative anti-icing systems. Surface icing can reduce IAS and range of the airplane considerably. Icing occurs when the supercooled water in fog, clouds, or rain, freezes on the airplane surfaces. Normally the heaviest icing takes place in clouds with strong vertical currents (cumulus clouds, projections above strato-cumulus clouds, etc). Icing conditions as found in stratus clouds are generally light to moderate. However, severe icing conditions may occur in this type of cloud. Prolonged flights through moderate icing conditions can build up as much ice as a short flight through severe icing conditions. The most severe type of ice formation will generally occur above −5° C (23° F).

SURFACE ICING.

Surface icing normally occurs at temperatures near 0° C (32° F) on the outside air temperature gage. Operation of the thermal (hot air) anti-icing system will prevent serious ice accumulation. When icing is anticipated or experienced, all anti-icing systems should be used until clear of the icing layer or area. See Section IV for operation of the anti-icing systems.

WARNING

If the thermal anti-icing system is inoperative and any low level flying is to be performed under icing conditions, a higher than normal IAS should be used. Icing will cause the stalling speed to increase considerably; therefore extreme caution should be used, especially during takeoff, approaches, and landings.

ENGINE ICING.

Axial-flow jet engines are seriously affected by icing. The engine air intake anti-icing is controlled by the anti-icing switch and care must be taken to prevent ice buildup on these surfaces since ice ingestion by the engine can result in engine failure. Ice forms on the inlet screens (when extended) and compressor inlet guide vanes (stator), and restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in exhaust gas temperature. As the air flow decreases, the fuel-air ratio increases, which in turn raises the temperature of the gases going into the turbine. Complete turbine failure from extreme overtemperature may occur in a matter of seconds after ice builds up in the engine inlet. Critical ice buildup on inlet screens can occur in less than 1 minute under severe conditions. The idea that heating due to ram pressure at high speed will prevent icing is dangerous. The heat generated at subsonic speed is insufficient to prevent ice formation. Care must be taken to prevent ice from building up on the engine air intake scoops, since ice ingestion by the engine can result in engine failure. Engine screens should be extended after penetration or icing has been terminated. This procedure will minimize damage caused by large chunks of ice being ingested into the engine.

IN BELOW-FREEZING AIR TEMPERATURE.

The rate of engine icing for a given atmospheric icing intensity with outside air temperature below freezing is relatively constant up to an airspeed of approximately 250 knots TAS. The rate of icing increases with increasing airspeed above 250 knots. Therefore, a reduction of airspeed to a safe minimum will reduce the rate of engine icing.

IN ABOVE-FREEZING AIR TEMPERATURE.

Unlike surface icing, engine inlet icing can occur at temperatures above freezing. Because serious inlet duct icing can occur without the formation of ice on the external airplane surfaces, it is necessary to understand what causes this type of icing in order to anticipate it if possible, so that immediate corrective action will be taken when positive indications of engine icing appear. When jet airplanes fly at velocities below approximately 250 knots TAS and at high power settings, the intake air is sucked, instead of rammed, into the engine compressor inlet. This suction causes a decrease of air temperature (adiabatic cooling). Under these conditions, air at an ambient temperature above freezing may be reduced to subfreezing temperature as it enters the engine. Free moisture in the air could become supercooled and cause engine icing while no external surface icing is evident. The maximum temperature drop which can occur on most current engines is a drop of approximately 5° C (9° F). The greatest temperature drop occurs at high RPM on the ground and decreases with, (1) decreasing engine RPM, and (2) increasing airspeed.

INDICATION OF ENGINE ICING.

The initial indication of engine icing is increased exhaust gas temperature. This is usually the only indication prior to complete engine failure. At the first sign of engine icing, immediately turn on the engine anti-icing system. See Section IV for operation of the different types of engine anti-icing systems.

FLIGHT IN ICING CONDITIONS.

If a flight must be made in icing conditions and if either the engine or surface anti-icing system is inoperative, observe the following precautions:

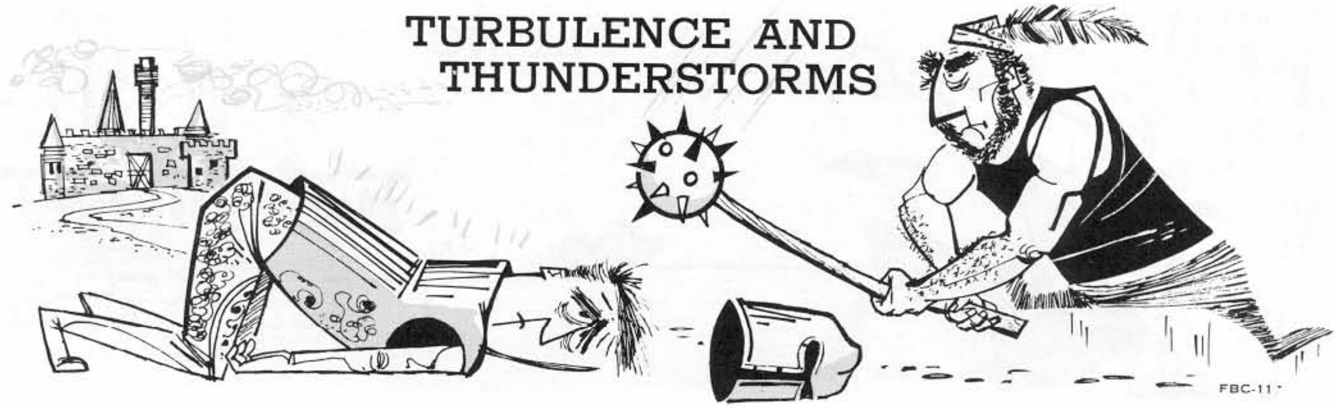
1. Avoid known areas of icing conditions. Many areas of probable icing conditions can be avoided by careful flight planning and study of weather conditions.

2. If possible, avoid takeoff when the temperature is between −10° C (14° F) and 5° C (41° F) if fog is present or the dew point is within 4° C (7° F) of the ambient temperature. These are the conditions under which engine icing can occur without surface icing. When freezing rain or other icing conditions exist at takeoff, the anti-icing switch should be placed at TAKEOFF. The loss of thrust on takeoff is not noticeable to the pilot. Afterburners should be used to climb rapidly above the icing conditions.

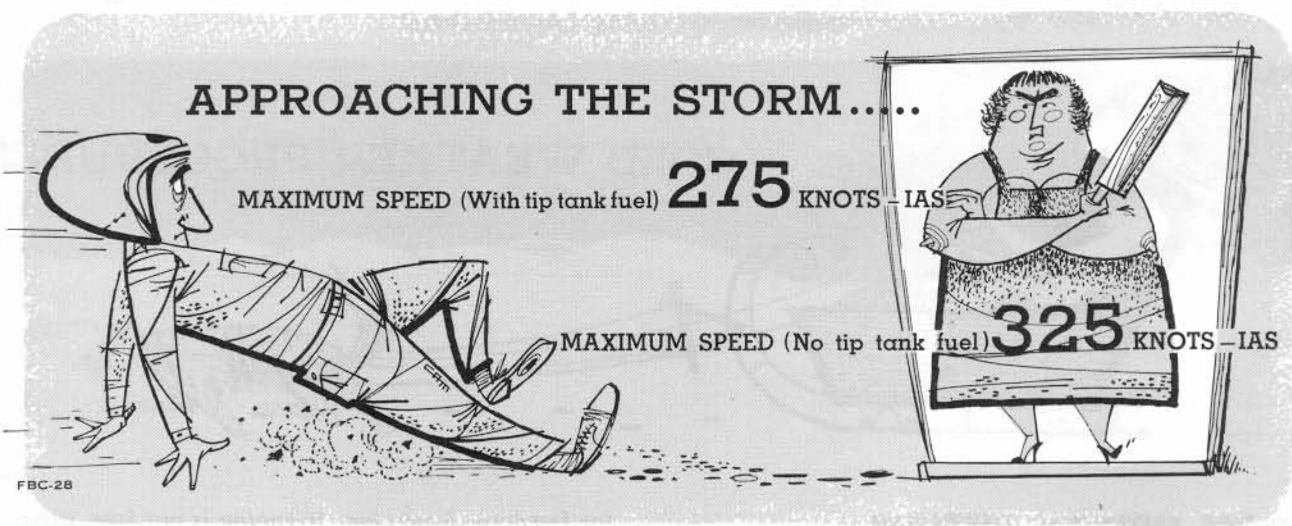
3. If the ambient temperature is between 0° C (32° F) and 5° C (41° F), the speed of the airplane should be maintained above 250 knots to lessen inlet duct icing due to suction effect.

4. If icing conditions are encountered at freezing atmospheric temperatures, immediate action should be taken as follows: Change altitude rapidly by climbing or descending if in layer clouds, or vary course as appropriate to avoid cloud formations; reduce airspeed (in freezing air) to minimize rate of ice buildup; maintain close watch on exhaust gas temperature; and reduce engine RPM as necessary to prevent excessive tailpipe temperature.

TURBULENCE AND THUNDERSTORMS



Thunderstorms and their accompanying turbulence should be avoided if possible. The following information and procedures are to be used only when flying into a thunderstorm cannot be avoided. At altitudes above 35,000 feet, sufficient power is not available to regain airspeed once it has dropped to about 200 knots IAS. If it is noted that airspeed is dropping below 200 knots IAS, lower the nose slightly while maintaining descent of approximately 1000 feet per minute until airspeed is regained. Do not use afterburners in the storm as serious trouble could be encountered if the airplane inadvertently goes into a steep spiral. At 30,000-foot altitude or lower, once the throttle adjustment is made, airspeed control is not a problem and the most serious trouble to be encountered is severe turbulence and possible hail damage. In the storm, the airplane should not be maneuvered intentionally. However, by observing the recommended turbulent air penetration airspeed, a maximum maneuverability margin will be sustained at all operating gross weights without developing prohibitive accelerations. In less severe turbulence there are no airspeed restrictions, but maneuvering should be restricted in proportion to the degree of turbulence.



APPROACHING THE STORM.

Prepare the airplane as follows before entering the storm:

1. Adjust power to obtain a safe and comfortable penetration speed of 225 knots IAS. If higher airspeeds are desired, do not exceed the following:

With *any* tip tank fuel	275 knots IAS
Without tip tank fuel	325 knots IAS

Above 20,000-foot pressure altitude, thunderstorm penetration airspeed is not restricted.

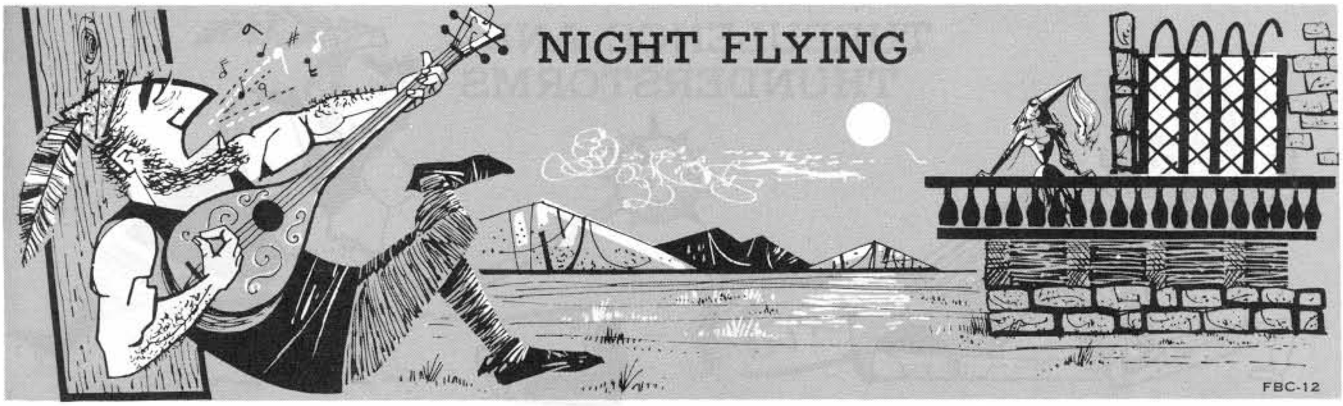
2. Pitot heat switch—ON.

3. Trim airplane for level flight at the selected penetration altitude.

4. Windshield heat and anti-ice switches—ON, if required.

5. Zero reader (or flight computer) altitude control switch—OFF.

6. At night, turn cockpit lights to full brightness to minimize the blinding effect of lightning.



NIGHT TAKEOFF.

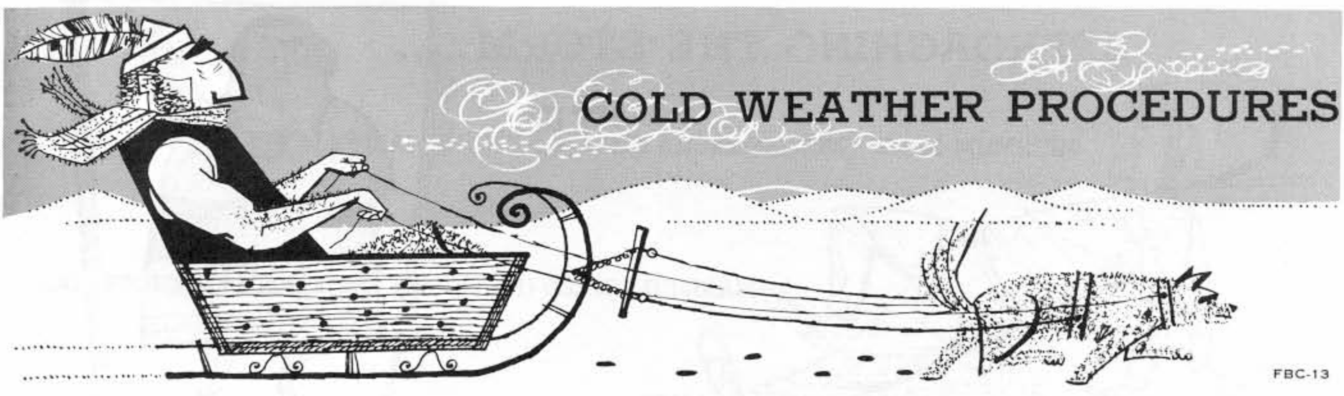
Night flying in this airplane is accomplished in the same manner as day flight, with the following additional information. Use the zero reader (or flight computer) and cross-check with all flight instruments until a safe altitude with visual attitude reference is reached.

CAUTION

- Taxi light does not light area near the wing tips. Be on the alert for other airplanes, crew chief stands, and other hazards in the taxi and takeoff areas.
- After takeoff check altimeter, vertical velocity indicator, and airspeed indicator, to insure positive climb and acceleration.

NIGHT LANDING.

Prior to landing, visually check gear by turning on landing light in retracted position. Extension or retraction of the landing light takes approximately 10 seconds. The light may be positioned at any point along the arc of travel by placing the extension switch at OFF. Use normal landing procedure (figure 2-5).



BEFORE ENTERING AIRPLANE.

Check to see that the following items have been accomplished:

1. Airplane covers removed.

2. Plugs removed from engine air intake ducts, exhaust nozzles, and engine nacelle doors.

3. Bottom section of front stator blades visually checked for evidence of ice. Engine heat on shutdown will melt ice accumulated on previous flight causing it to refreeze in the lower section of the front stator and rotor blades. An attempted engine start will result in starter failure. If ice is suspected, check the engine for freedom of rotation. If engine is not free, external heat must be applied to forward engine section to permit thawing. Start engine as soon as possible after heat application to remove all moisture before refreezing can occur.

4. Wing flap servo followup screw and shaft cleaned of excessive oil and grease.

5. All ice removed from fuel tank vents, static air sources, and pitot tubes.

6. Ice and snow removed from nose wheels to prevent shimmy.

7. Fuel filters and draincocks checked for freedom from ice. Heat, if necessary, to drain condensate.

8. Oil tanks preheated if temperature is −45°C (−49° F) or lower, to reduce starter loads and assure proper lubrication. However, cold engine starts can be made if operations warrant.

9. Shock struts checked for proper inflation, and dirt and ice removed.

CAUTION

Ice should not be chipped away because the airplane may be damaged. Check that water resulting from ice removal does not refreeze on airplane surfaces, especially on control surface hinge lines.

10. All snow and ice accumulations removed from the wings, fuselage, and tail prior to flight.

WARNING

Snow and ice that accumulate on the airplane on the ground seriously affect the airplane's flight performance and alter handling characteristics. These accumulations result in longer takeoff distance requirements, increased stall speeds, poor climbout performance, and a vibration in flight that could result in an accident.

11. Canopy jettison system serviced before each flight at temperatures below −35° C (−31° F).

BEFORE STARTING ENGINES.

A type A-4 ground power unit with two 28-volt DC leads (or equivalent power source) is required for starting engines at low temperatures.

1. Pilot's seat—Adjust as desired. At temperatures below −35°C (−31°F), heat must be applied to the seat mechanism before the seat can be adjusted.

2. Hydraulic handpump handle—Install in pump. In flight, the radar observer may not be able to reach the handle in its stowed position because of his heavy arctic clothing.

3. Hydraulic supplemental pump—Check.

Note

Under some conditions of extreme subzero temperatures, difficulty in maintaining normal hydraulic pressure during supplemental pump check may occur. Operation of the pump for from 3 to 5 minutes should provide normal pump operation.

4. In extremely low temperatures, below −40°C (−40°F), apply heat to the back side of the landing gear handle mechanism to clear any ice from the selector valve cable and prevent possible cable slippage.

STARTING ENGINES.

Follow normal starting procedure outlined in Section II. When the engine reaches 10% RPM, open the throttle halfway and return to IDLE. This additional movement of the throttle loosens any connections that have become stiff, but does not alter the fuel flow. Oil pressure may be high after starting cold engines. This is not dangerous unless the pressure remains high. Delay takeoff until the pressure drops to normal.

CAUTION

When ambient temperature is 0°C (32°F) or below, have hot air from a portable heater blown into the engine air intake ducts and tailpipes for 10 to 15 minutes. This procedure prevents the starter-generator unit from being damaged due to ice seizure of the compressor rotor.

GROUND TESTS.

Due to increased air density at low ambient temperatures, thrust developed at all engine speeds is greater than normal. For ground tests at low temperatures use the following procedures:

1. Generator—Check output and make all checks requiring electrical power before having external power disconnected.

2. Cabin heat, windshield heat, and canopy defog—As required.

CAUTION

To prevent cracking of the windshield glass, keep windshield heat at NORMAL for at least 1 minute before turning to EMER. Never keep windshield heat at EMER longer than necessary.

3. Flight controls—Check operation. At temperatures below −35° C (−31° F), operate flight controls

three or four times during engine runup until flight controls operate freely and easily.

CAUTION

At very low temperatures, hydraulic packing may fail and cause hydraulic leaks. Have ground personnel check flight control mechanism access doors for signs of excessive leakage.

4. Wing flaps—Check operation.
5. Speed brakes—Check operation and cycle several times to assure free movement.
6. Instruments—Check operation. Flight instruments require approximately 2 minutes for warmup.

WARNING

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

TAXIING INSTRUCTIONS.

When taxiing in cold weather, observe the following precautions:

1. Avoid taxiing in deep snow because steering is very difficult, and the brakes may freeze.
2. Taxi very slowly on icy or wet surfaces; the airplane is difficult to control during a skid.

Note

The airplane has a strong tendency to weathervane when taxiing on ice. Use the nose wheel steering system to maintain directional control.

CAUTION

Under freezing conditions use caution when actuating nose wheel steering in taxiing out of parking area or after landing as nose wheel may be frozen in deflected position.

3. To preserve the battery, use only essential electrical equipment while taxiing at low engine speeds.
4. When taxiing behind another airplane on icy taxiways, allow enough distance between airplanes for safe stopping and to prevent icing of the airplane surfaces by melted ice and snow in the jet blast of the preceding airplane.
5. When fine powder snow is on the taxiway, the preceding airplane's jet blast will cause a large blinding cloud of flying snow; the distance between airplanes must be increased for visibility.
6. Minimize taxi time to conserve fuel and to reduce amount of fog generated by jet engines.
7. At very low temperatures, operate flight controls frequently.

BEFORE TAKEOFF.

When the taxiway is covered with ice, a full power check may not be possible before takeoff because the airplane may slip on the ice. In this case, the power check can be made at the start of the takeoff run by opening the throttle rapidly and turning on the afterburners. If afterburners do not ignite on both engines, discontinue takeoff. Very low temperatures do not appreciably affect rudder and elevator operation. However, at temperatures below −35° C (−31° F), the ailerons become stiff and should be cycled several times before takeoff to ensure easy movement.

1. Armament heater switch—ON, if mission requires use of armament.
2. Anti-icing system—ON, if necessary.

WARNING

During takeoff the anti-icing switch should not be used in the FLIGHT position unless the runway will allow a 20 to 25 percent longer run than required for a normal takeoff. This is due to the reduction of engine thrust caused by anti-icing hot air being bled (at a very high rate) from the 11th stage of the engine compressors whenever the anti-icing system is used with the switch placed in the FLIGHT position.

3. Fuel filter de-ice switch—Hold at each position for approximately 10 seconds to remove any accumulation of ice.

TAKEOFF.

At the start of the takeoff run, advance the throttles rapidly and turn on afterburners to make power check. If both afterburners do not ignite, do not take off.

Exercise extreme caution when steering with brakes during takeoff on an icy runway. After a takeoff from a snow or slush covered field, operate the landing gear, wing flaps, and speed brakes several times to remove slush and snow that might cause these units to freeze in the streamlined positions.

CAUTION

Do not exceed landing gear and flap structural airspeed limitations.

Arctic flight tests have shown that light frost accumulations have no effect on takeoff, and disappear at 250 knots IAS.

Note

Depending on the weight of snow and ice accumulated on the airplane, takeoff distances and climbout performance can be seriously affected. The roughness and distribution of the ice and snow could vary stall speeds and characteristics to an extremely dangerous degree. Loss of an engine shortly after takeoff is a serious enough problem without the added, and avoidable, hazard of snow and ice on the wings. In view of the unpredictable and unsafe effects of such a practice, the ice and snow must be removed before flight is attempted.

DURING FLIGHT.

Flight characteristics are unchanged by arctic conditions except for aileron stiffness at temperatures below −35°C (−31°F). The ailerons should be operated periodically throughout the flight if these temperatures are encountered. If only the left hydraulic system is operating, the rudder should also be operated periodically. Turn on de-icing and anti-icing systems as needed. Check all instruments since some instruments may be unreliable at low temperatures. Prior to penetration, fuel filter should be used for 10 seconds.

Note

Engine fuel control icing will cause the fuel pressure gage to fluctuate and may result in a flameout.

APPROACH TO PATTERN.

At temperatures below −35°C (−31°F), operate the ailerons several times before entering the pattern to ensure smooth and easy operation. Follow normal pattern and approach procedures, but allow for longer approach than normal because higher thrust at low temperatures results in a flatter glide. Wing flap extension requires 2 seconds longer than normal, and retraction requires 7 seconds longer than normal at −65°F. Speed brake operation is essentially the same at all temperatures (1.5 seconds additional time is required to open or close speed brakes at −65°F). Landing gear extension and retraction requires 2 seconds longer than normal at −65°F; however, emergency extension requires 25 seconds longer than normal.

Note

- When making GCA approaches during arctic operations, decrease power settings about 3 percent because of increased thrust at low temperatures.
- The canopy defogging system should be actuated approximately 10 minutes prior to descent from altitude to ensure satisfactory operation.
- On initial approach, use alcohol for 10 seconds on each engine.

LANDING.

CAUTION

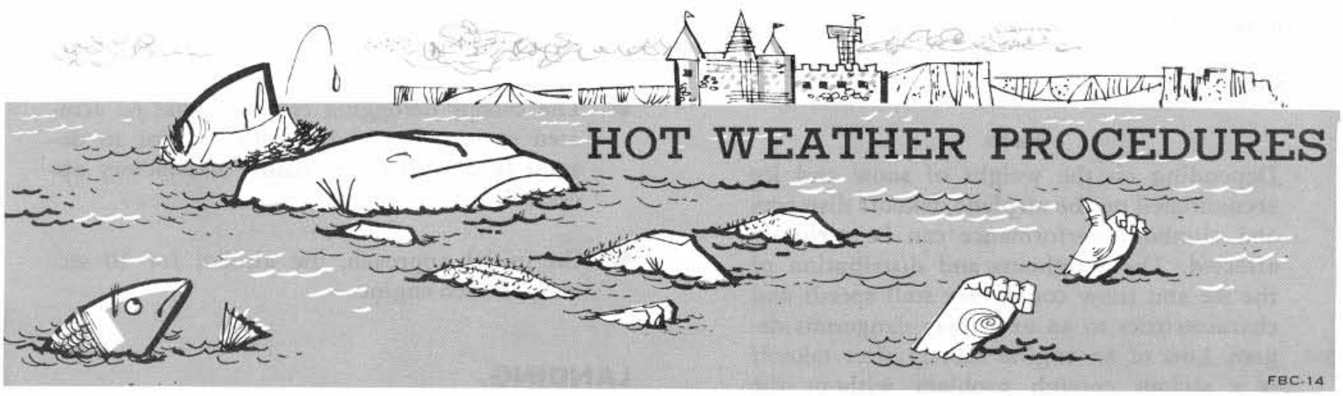
Operation of anti-icing system during landing affords protection against icing conditions but causes loss of thrust. If a go-around is necessary, the anti-icing switch may remain in the FLIGHT position only if two engines with maximum thrust and afterburning are available.

For minimum landing roll on wet or icy runways, both the wing flaps and speed brakes should be fully extended during landing roll, and the right engine should be shut down immediately after three wheel contact. Open the speed brakes after main gear touches down and leave extended until after turning off runway. The aerodynamic drag of the wing flaps and speed brakes partially offsets the decreased braking efficiency experienced when landing on wet or icy runways and the thrust eliminated by shutting down the idling right engine will aid in reducing the landing roll. Apply brakes carefully and intermittently after touchdown. Even if the airplane has snow-and-ice tires, apply brakes carefully and intermittently after touchdown to prevent tread from filling and glazing over. Glazing reduces braking effectiveness on icy runways, and landing ground roll distance may be increased as much as 100 percent more than the distances shown in the Landing Distance Chart.

BEFORE LEAVING AIRPLANE.

Check that ground personnel perform the following:

1. Service airplane as soon as possible.
2. Remove dirt and ice from shock struts.
3. Clear snow and ice from nose wheels.
4. Service canopy jettison system if temperature is below −35° C (−31° F) and the airplane is to be used for another flight.
5. Check flight control access doors for signs of excessive hydraulic leakage.
6. Install plugs in engine air intake ducts, tailpipes, and engine nacelle doors.
7. Cover pitot tubes and all static air sources.
8. Check fuel pumps, filters, and draincocks for ice, and drain condensate within 30 minutes after stopping engines.
9. Bleed and recharge engine screen compressor.
10. Install covers on wings, empennage, and canopy.
11. Remove batteries and store in a heated room if layover of several days is anticipated, or if temperature is below −29° C (−20° F).



Takeoff rolls are longer and stall speeds are higher in hot weather because engine performance is decreased by the lower air density. Landing rolls in hot weather are also longer because of the lower air density. Added precaution should be taken to protect rubber and plastic parts of the airplane from damage by excessive heat.

BEFORE ENTERING AIRPLANE.

Check tires for blisters and be sure external ground cooler is disconnected.

TAKEOFF.

Anticipate a longer takeoff distance than normal. Refer to Appendix, figure A-6 for takeoff distances.

AFTER TAKEOFF.

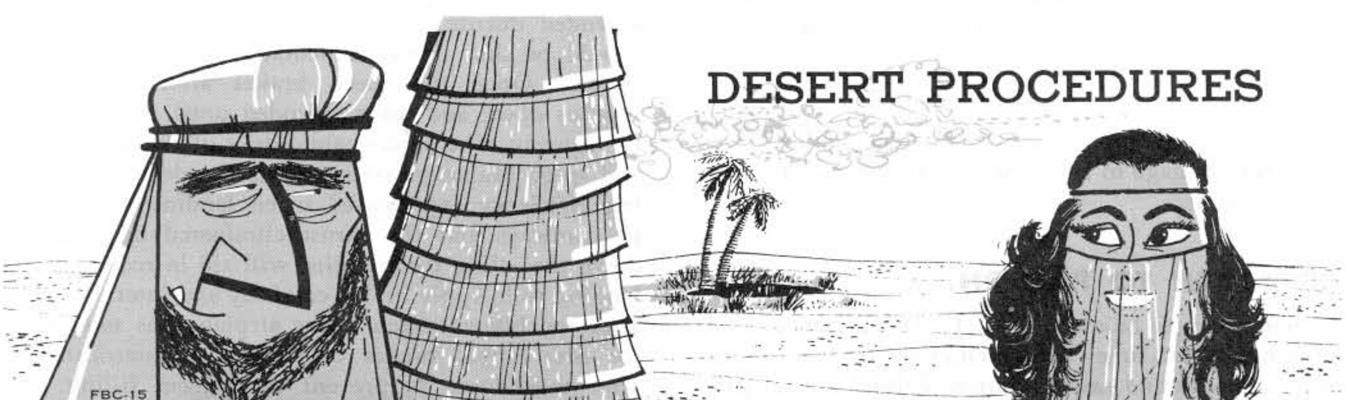
Be sure to maintain specified climbing airspeed, correcting maximum rates of climb for temperature effects. Refer to Appendix Climb Chart, figure A-11.

LANDING.

Anticipate longer landing distance and use minimum wheel braking to prevent overheating of brakes. Refer to Appendix, figure A-21, for landing distance.

BEFORE LEAVING AIRPLANE.

Be sure canopy is protected from direct rays of the sun.



When operating under desert conditions, follow the normal hot weather procedure. In addition, precautions must be taken to prevent external abrasion of the airplane surfaces and to keep sand and dust from entering the airplane systems.

BEFORE ENTERING THE AIRPLANE.

1. Check exposed shock struts and actuating cylinders for dust and sand. Have them cleaned if necessary.
2. Check all air intakes for sand and dust.
3. Check wheel brake discs for excessive abrasion.

BEFORE TAKEOFF.

Do not run engines during a dust or sand storm unless absolutely necessary. Before engine runup, position the airplane so that it will not receive dust from, or blow dust on, other airplanes.

TAKEOFF.

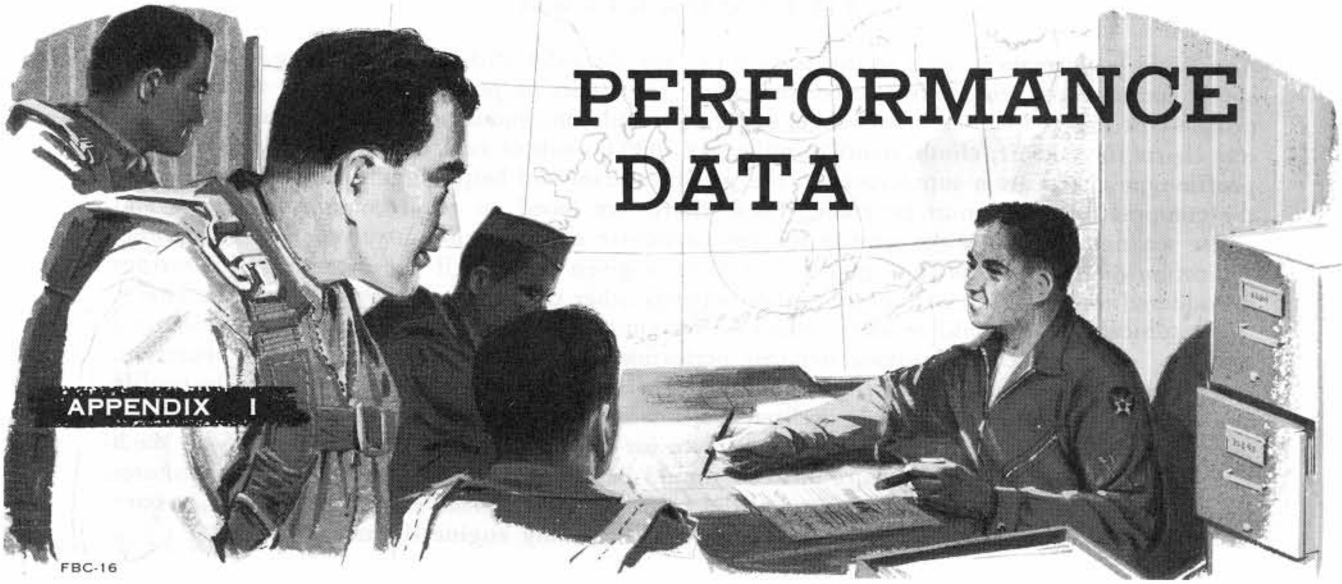
Avoid takeoff in blowing dust or sand.

BEFORE LEAVING AIRPLANE.

Close and seal the canopy during dust or sand storms, and check that ground personnel perform the following:

1. Cover canopy to prevent sand abrasion.
2. Cover all air intakes and ducts as soon as possible after landing.


FBC-19



FBC-16

APPENDIX I
PERFORMANCE DATA

TABLE OF CONTENTS

INTRODUCTION

The flight performance charts in this section provide the pilot with flight planning data and airspeed and ambient temperature correction data. Two types of performance charts are included: profile-type charts for maximum range, endurance, and continuous power operation, and graphical charts for takeoff, climb, nautical miles per 1000 pounds of fuel, descents, and landings. The profile-type charts are a supplement to the graphical data and help flight planning by reducing the computations that must be made. These charts are based on the recommended climb and cruise settings shown on the profile for the particular configuration involved and give direct indication of the fuel and time required to cover a given distance if the recommended settings are adhered to. For flight planning based on settings other than those given on the profile charts, the graphical charts should be used. Decreased weight due to fuel consumption has been accounted for. The graphical charts provide detailed performance data for one- and two-engine operation. These charts should be used for flight planning when performance data not covered in the profile charts is needed. Unless otherwise indicated, all data pertains exactly to NACA standard ambient temperatures but may be considered approximate for nonstandard conditions. The CAS or Mach number tabulated for each pressure altitude should be maintained for nonstandard temperatures regardless of the deviations of other quantities from the given values, except when it is necessary to use a lower CAS value or Mach number to avoid exceeding engine limits.

CORRECTION TABLES.

AIRSPEED CORRECTIONS.

Assuming zero instrument error, the pilot's airspeed indicator reads correct indicated airspeed (IAS). Corrections must be applied to IAS to determine calibrated airspeed (CAS), equivalent airspeed (EAS), and true airspeed (TAS). The algebraic sum of the installation correction and IAS equals CAS. The CAS value minus the compressibility correction equals EAS. EAS divided by the square root of the relative air density ($\sqrt{\sigma}$) equals TAS. Relative air density is equal to the ratio of the free airstream ambient density at altitude to standard sea level density. Wind velocity added vectorially to TAS equals ground speed (GS). Corrections to be applied to convert IAS to CAS are shown in the Airspeed Position Correction Table (figure A-1). These corrections are given for values of IAS and pressure altitude for the operating range of the airplane; corrections for flap settings are also shown. Landing gear position has no effect on airspeed readings. Values for converting CAS to EAS are shown in the Compressibility Correction to Calibrated Airspeed Table (figure A-2), which covers the operating CAS and pressure altitude range of the airplane. Values of the reciprocal of the square root of the relative air density ($1 \div \sqrt{\sigma}$), used for determining TAS, are obtained from the Density Altitude Table (figure A-4). The airspeed indicator in the radar observer's cockpit indicates approximate TAS; therefore, only the wind correction need be applied to determine ground speed.

AMBIENT TEMPERATURE CORRECTION.

A compressibility correction must be applied to the temperature gage reading to obtain true ambient temperature. This correction is shown as a function of CAS and pressure altitude in the Temperature Correction for Compressibility Table (figure A-3).

EXAMPLE OF THE USE OF THE CORRECTION TABLES.

Assume the following instrument readings:

1.	Altimeter	35,000 FT
2.	Airspeed indicator	286 KN
3.	Free air temperature gage	−19°C

The correct airplane speed and ambient temperature are:

4.	IAS (zero instrument error)	286 KN
5.	Installation correction	+4 KN
6.	CAS	290 KN
7.	Compressibility correction	−18 KN
8.	EAS	272 KN
9.	Free air temperature gage reading	19°C
10.	Temperature correction for compressibility error	25°C
11.	Correct ambient temperature	44°C

At 35,000-foot pressure altitude and −44°C, the reciprocal of the square root of the relative air density ($1 \div \sqrt{\sigma}$) from figure A-4 is 1.85. Therefore, TAS is $272 \times 1.85 = 503$ knots.

RELATIVE WIND CHART.

A relative wind chart (figure A-5) enables a pilot to convert crosswind to a component headwind down the takeoff runway. The component headwind is then used to accurately determine takeoff ground run.

Use of Relative Wind Chart.

When wind direction and velocity and runway heading are known, the component headwind down the takeoff runway can be determined from the relative wind chart. With a wind from 305 degrees at 37 knots velocity and using runway 27, the chart is entered at

(305 degrees — 270 degrees) 35 degree angle and 37 knot wind velocity. Reading to the left, the component headwind down the runway is found to be 30 knots.

PERFORMANCE CHARTS.

TAKEOFF DISTANCE CHARTS.

The Takeoff Distance Charts (figure A-6) show takeoff distances (ground roll and total distance to clear a 50-foot obstacle) as a function of gross weight, pressure altitude, wind velocity, and ambient temperature for a dry, hard-surfaced runway. Gross weight, wind velocity, and ambient temperature are always known factors; the pressure altitude of the field can be determined by setting the altimeter to 29.92 (sea level standard day pressure in inches of mercury). The charts show data for two-engine takeoffs with maximum or military power, using the normal procedure given in Section II. If an engine fails during military power takeoff, afterburning on the operating engine should be started immediately or the takeoff discontinued. Military power data may be used to estimate adequate field length if afterburners fail during takeoff.

Note

Takeoff with military power will result in a fuel saving of only 250 pounds. This fuel saving will result in an increased range of only 25 nautical miles. The slight increase in range must be weighed against the additional risks involved in military power takeoffs.

Single-engine maximum power takeoff data is also included to determine the required takeoff distance when power on one engine is lost during takeoff (see Section III). If the takeoff technique used is different from that specified in Section II, the distances will differ from those shown in the charts. A deviation of 5 percent from the airspeeds in Section II will result in a distance deviation of 10 percent or more.

Use of Takeoff Distance Charts.

Example I shows a maximum power takeoff with an ambient air temperature of 15°C, pressure altitude of 2000 feet, gross weight of 38,000 pounds, and a 20-knot headwind. This results in a ground roll of 2250 feet and a total distance of 2900 feet to clear a 50-foot obstacle.

CRITICAL FIELD LENGTH CHART.

The Critical Field Length Chart (figure A-7), in conjunction with the Refusal Speed Chart (figure A-8), can be used to determine a course of action if an engine fails at any point during the takeoff ground run for any combination of critical field and runway lengths. For example, comparison of the critical field length with the runway length available indicates the following takeoff limitations:

Runway Length Greater Than Critical Field Length.

1. At engine failure speeds below maximum refusal speed: If the runway is longer than necessary for one-engine takeoff, the pilot has the option of either taking off or stopping. If the runway is shorter than necessary for one-engine takeoff, pilot must stop.
2. At engine failure speeds above refusal speed, pilot must take off, as stopping within the limits of the runway is impossible.

Critical Field Length Greater Than Runway Length.

1. At engine failure speeds below refusal speed, pilot must stop, as takeoff within the limits of the runway is impossible.
2. At engine failure speeds above refusal speed, takeoff and stopping within the limits of the runway are both impossible.

Use of Critical Field Length Charts.

The sample chart shows a maximum power takeoff with an ambient air temperature of 15°C, a pressure altitude of 2000 feet, a gross weight of 38,000 pounds, and a 20-knot headwind. These conditions indicate a critical field length of 4200 feet. According to the Takeoff Distance Chart (A-6) for one-engine takeoff, the runway length required for one-engine takeoff is 6600 feet. If the available runway length is 6000 feet, the refusal speed is found to be 109 knots IAS. Thus, the available runway length is greater than the critical field length but shorter than necessary for one-engine takeoff. Under these conditions, if the speed at the point of engine failure is less than 109 knots IAS, the pilot should stop the airplane rather than attempt a one-engine takeoff; if the speed at the point of engine failure is greater than 109 knots IAS, the pilot should take off, as stopping within the limits of the runway would not be possible.

REFUSAL SPEED CHART.

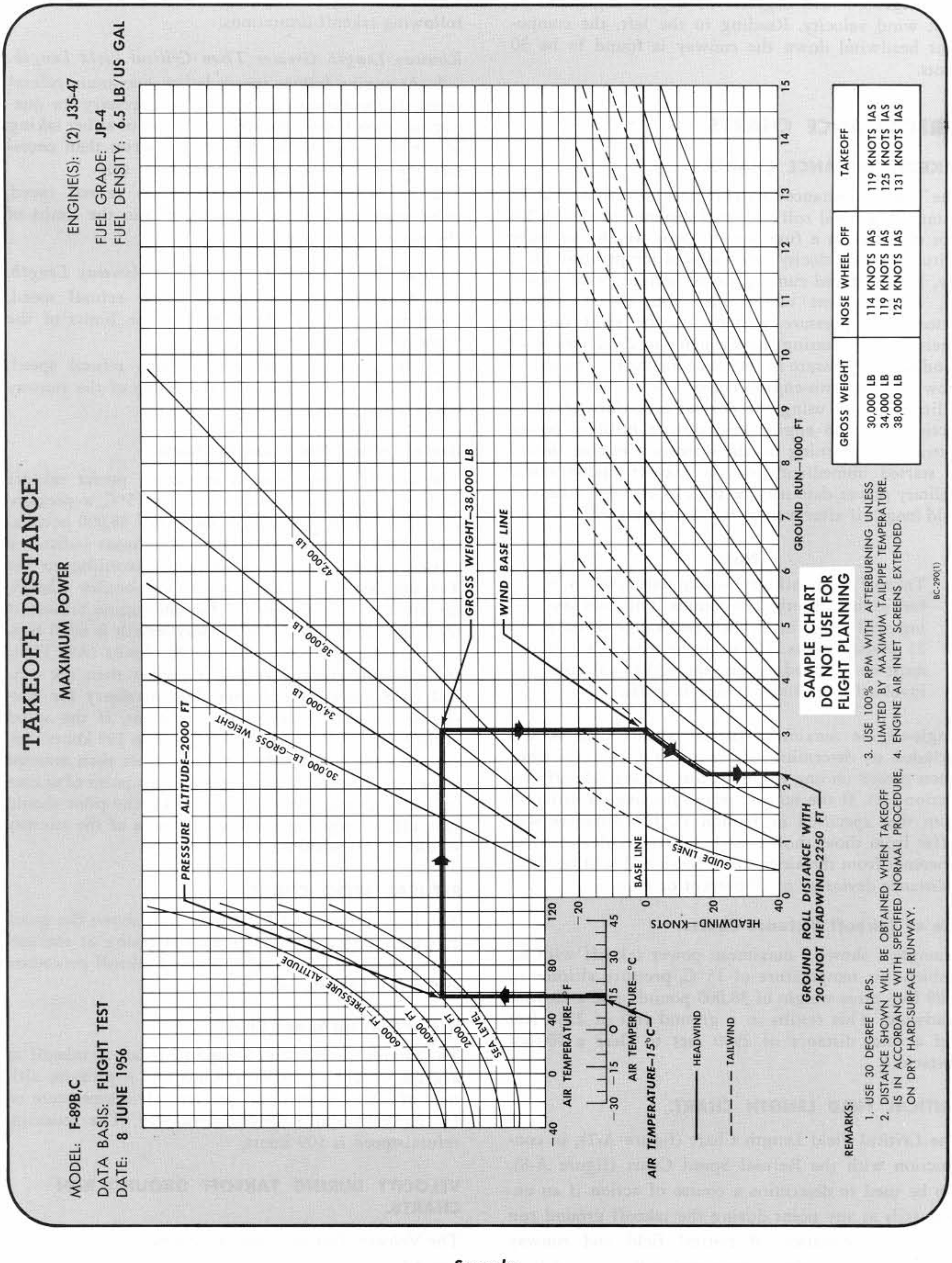
The Refusal Speed Chart (figure A-8) shows the speed at which engine failure permits stopping at the end of the runway. It is based on normal takeoff procedure and a dry hard-surfaced runway.

Use of Refusal Speed Chart.

The sample chart shows a maximum power takeoff at a gross weight of 38,000 pounds and a pressure altitude of 2000 feet with an ambient air temperature of 15°C (59°F) and a 6000-foot runway. The resulting refusal speed is 109 knots.

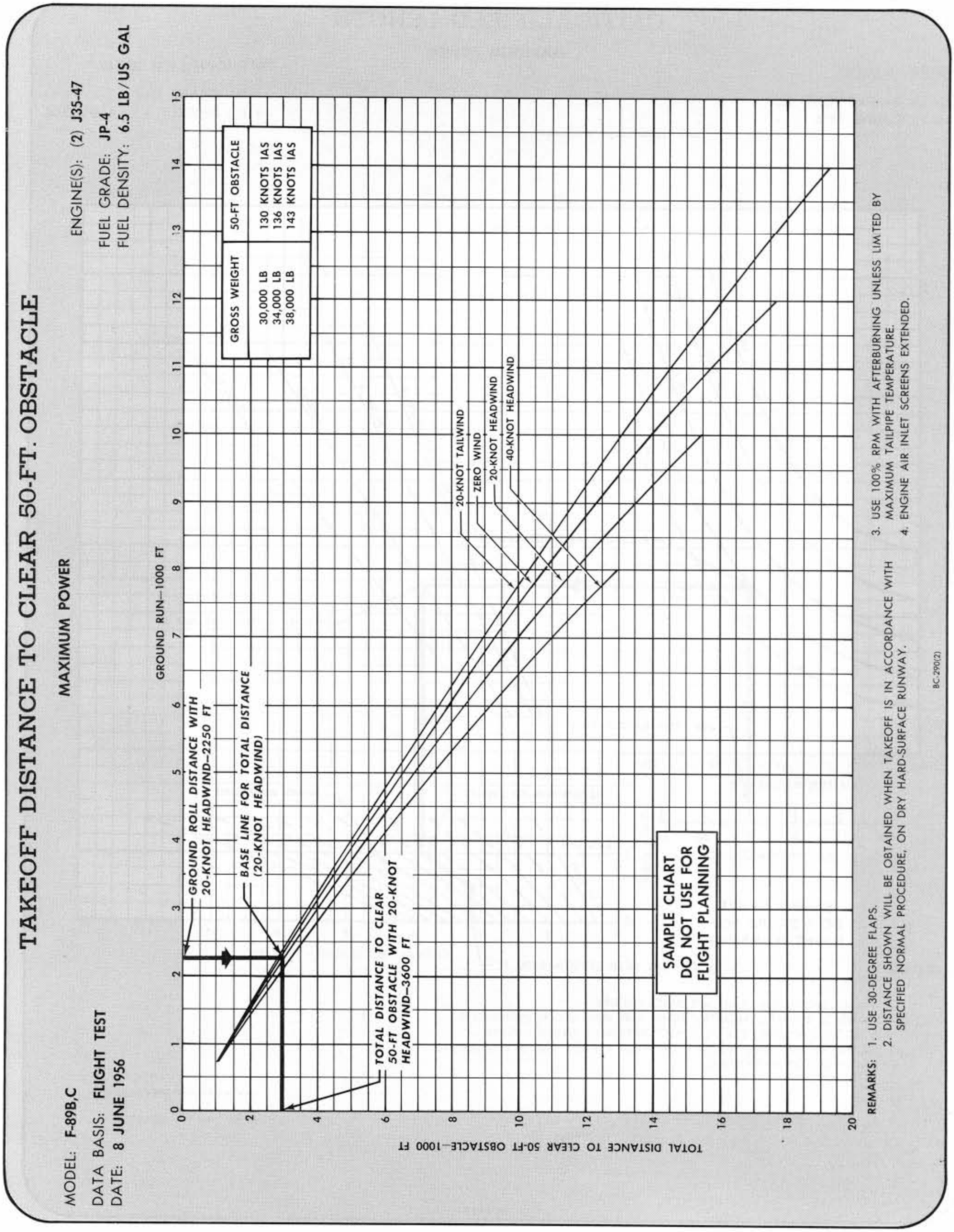
VELOCITY DURING TAKEOFF GROUND RUN CHARTS.

The Velocity During Takeoff Ground Run Charts (figure A-9) are based on normal operating procedures as



GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
30,000 LB	114 KNOTS IAS	119 KNOTS IAS
34,000 LB	119 KNOTS IAS	125 KNOTS IAS
38,000 LB	125 KNOTS IAS	131 KNOTS IAS

Sample.


TAKEOFF DISTANCE TO CLEAR 50-FT. OBSTACLE
MAXIMUM POWER
MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956
ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
GROSS WEIGHT
50-FT OBSTACLE
30,000 LB
34,000 LB
38,000 LB
130 KNOTS IAS
136 KNOTS IAS
143 KNOTS IAS
GROUND RUN—1000 FT
TOTAL DISTANCE TO CLEAR 50-FT OBSTACLE—1000 FT
GROUND ROLL DISTANCE WITH 20-KNOT HEADWIND—2250 FT
BASE LINE FOR TOTAL DISTANCE (20-KNOT HEADWIND)
TOTAL DISTANCE TO CLEAR 50-FT OBSTACLE WITH 20-KNOT HEADWIND—3600 FT
20-KNOT TAILWIND
ZERO WIND
20-KNOT HEADWIND
40-KNOT HEADWIND
SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING
REMARKS: 1. USE 30-DEGREE FLAPS.
2. DISTANCE SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE, ON DRY HARD-SURFACE RUNWAY.
3. USE 100% RPM WITH AFTERBURNING UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURE.
4. ENGINE AIR INLET SCREENS EXTENDED.
BC-290(2)

Sample.

CRITICAL FIELD LENGTH

MAXIMUM POWER

MODEL: **F-89B,C**

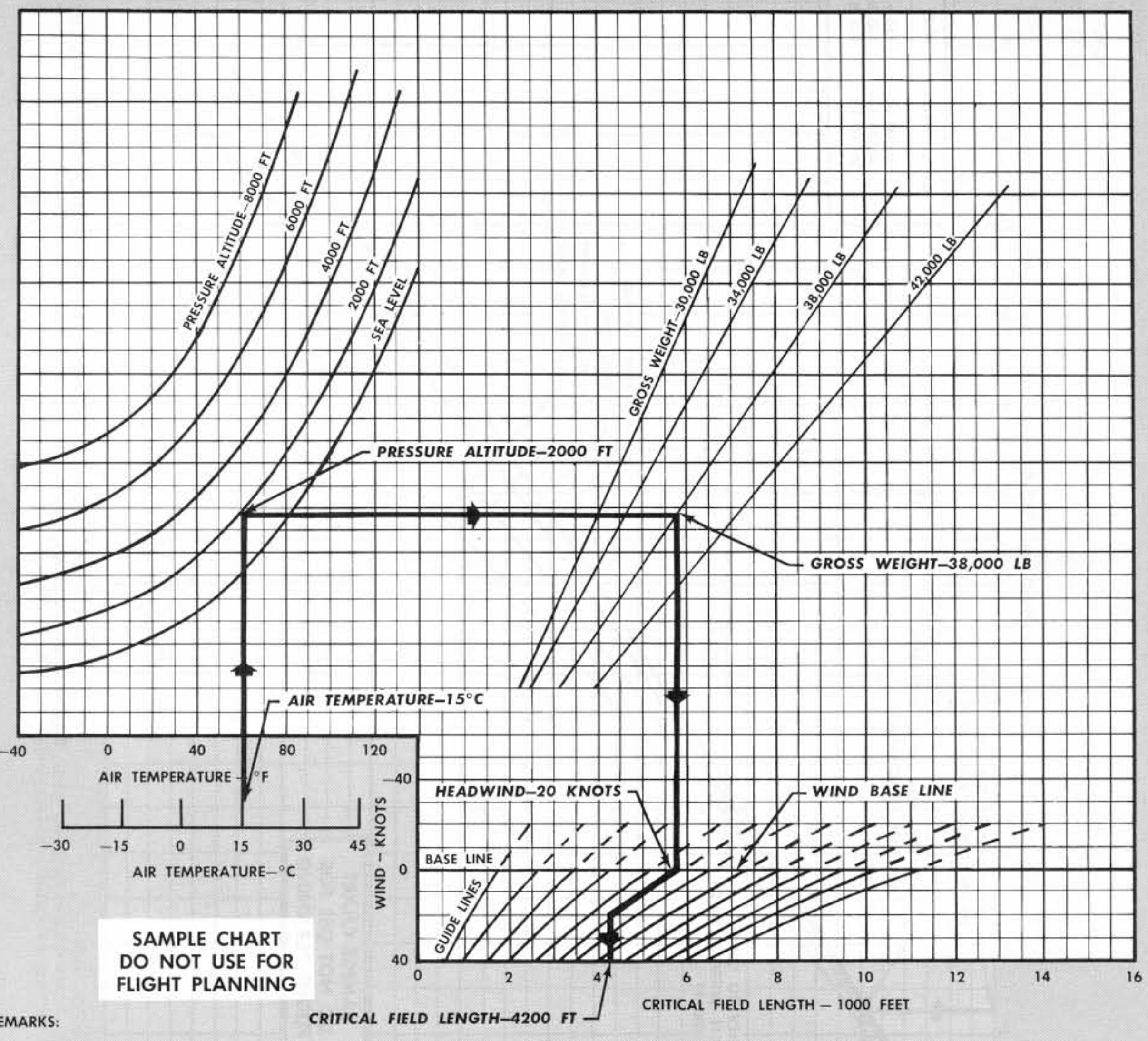
ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ALL VALUES SHOWN ON CHART ARE BASED ON DRY, HARD SURFACE RUNWAY, 30 DEGREE FLAPS, AND SPEED BRAKES INOPERATIVE.
2. THREE SECONDS ALLOWED FOR PILOT RECOGNITION OF ENGINE FAILURE; AT THE END OF THE THREE SECONDS, THROTTLES ARE CUT AND BRAKES APPLIED.
3. ENGINE INLET SCREENS EXTENDED.

——— HEADWIND

— — — TAILWIND

BC-285 A

Sample.

REFUSAL SPEEDS

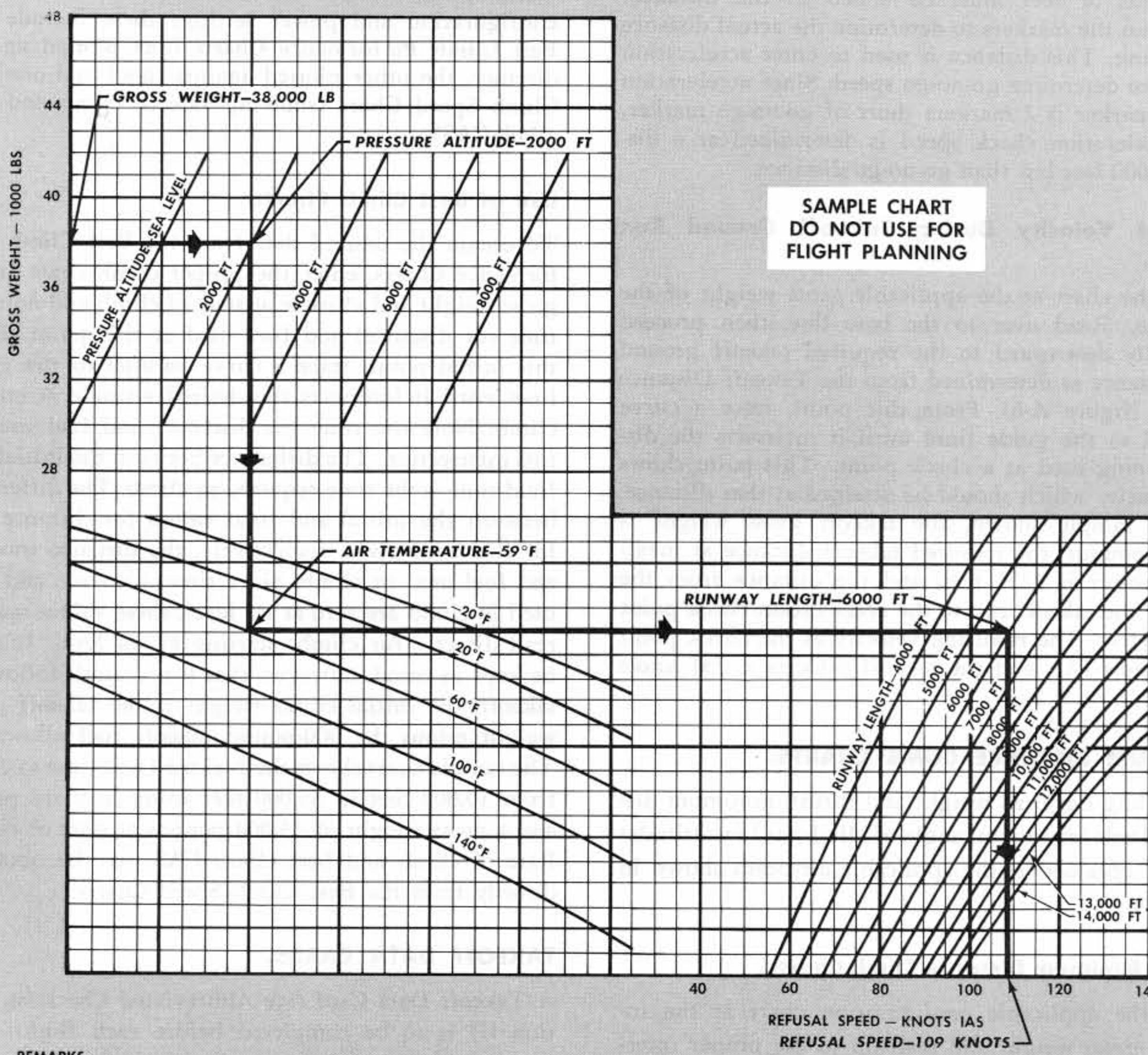
MAXIMUM POWER

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ABOVE VALUES ARE BASED ON DRY, TAKEOFF HARD SURFACE RUNWAY, USING SPECIFIED NORMAL PROCEDURE UP TO POINT OF ENGINE FAILURE, AND OPERATION IN ACCORDANCE WITH SECTION III AFTER ENGINE FAILURE.
2. ENGINE AIR INLET SCREENS EXTENDED.

BC-283A

Sample.

specified in Section II and show the relationship between indicated airspeed and distance traveled during takeoff ground run on a dry hard-surfaced runway. These charts are useful for checking takeoff acceleration by reference to a go-no-go marker located a known distance from the end of the runway. This is determined by subtracting distance remaining at go-no-go marker from runway available. On an odd length runway, one half of the odd figure over exact thousands of feet must be added to the distances shown on the markers to determine the actual distance remaining. This distance is used to enter acceleration curves to determine go-no-go speed. Since acceleration check marker is 2 markers short of go-no-go marker, the acceleration check speed is determined at a distance 2000 feet less than go-no-go distance.

Use of Velocity During Takeoff Ground Run Charts.

Enter the chart at the applicable gross weight of the airplane. Read over to the base line, then proceed vertically downward to the required takeoff ground run distance as determined from the Takeoff Distance Charts (figure A-6). From this point, trace a curve parallel to the guide lines until it intersects the distance being used as a check point. This point shows the velocity which should be attained at that distance. In the sample shown, the takeoff gross weight is 38,000 pounds, the required takeoff distance at maximum power is 2250 feet, and the distance from the start of the takeoff run to the acceleration check point is 1000 feet. The resulting velocity at the check point is 89 knots IAS, and the takeoff velocity is 131 knots IAS.

MINIMUM DISTANCE CLIMB CHARTS.

Depending on gross weight and thrust, minimum distance climb (maximum angle of climb) at low altitudes may be obtained at the applicable airspeeds shown in figure A-10.

Use of Minimum Distance Climb Charts.

Enter the applicable configuration chart at the intended gross weight and read up to the proper intersecting thrust line. From the point of intersection of gross weight and thrust lines, follow to the left and read minimum distance climb airspeed from the left side of the chart. For a climb following takeoff, initial climb weight is the takeoff gross weight minus the 906-pound takeoff fuel allowance.

BEST CLIMB CHARTS.

The Best Climb Charts (figure A-11) show climb performance in terms of fuel, time, air distance, rate of climb, and climb CAS necessary to attain this performance. Data is given for climbing with two engines at maximum, military, and normal power, and with one engine at maximum and military power. The fuel, time, and air distance values shown include the effects of kinetic energy change and weight reduction during climb, but do not include any allowance for start, takeoff, or acceleration. Time and distance are plotted against gross weight with guide lines to show the reduction in gross weight during climb due to fuel consumption. Three charts are provided for each configuration and power setting; these include two Best Climb Performance Charts (one plotted against distance, the other plotted against time) and one Best Climb Speed Chart (showing rate of climb and best climb CAS).

Use of Best Climb Charts.

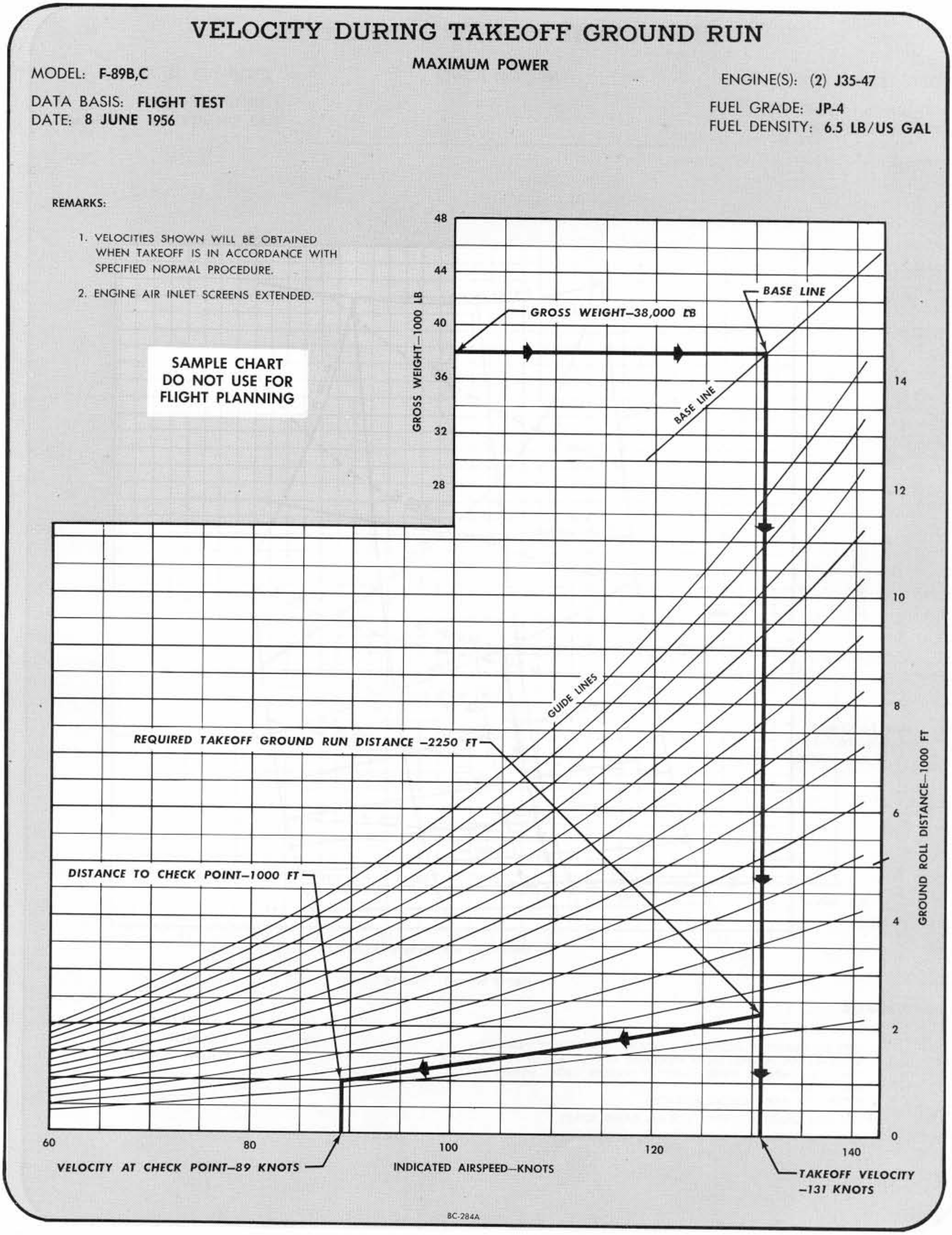
To obtain the desired data from the Best Climb Performance Charts, enter the proper climb chart at the gross weight and altitude at start of climb and note the time (or distance) and fuel used at this point. From this initial point, trace a curve parallel to the guide lines until it intersects the desired altitude at end of climb. Note the time (or distance) and fuel used at this intersection. The difference between the initial and final time is the time required to climb. The difference between the initial and final values for distance and for fuel used gives, respectively, the distance traveled and fuel used in climb. Since time, distance, and fuel used in climb are zero at sea level, these values may be read directly for climbs starting at sea level. It must be kept in mind, however, that for a climb following takeoff, the initial climb weight is the takeoff gross weight minus the 900-pound takeoff fuel allowance. The sample chart shows the fuel used and time to climb from 10,000 feet to 35,000 feet using military power and a gross weight of 33,000 pounds at start of climb. Rate of climb and best climb CAS may be obtained directly from the Best Climb Speed Charts.

TAKEOFF DATA CARDS.

A Takeoff Data Card (see Abbreviated Checklist, Section II) is to be completed before each flight. The purpose of the takeoff data card is to familiarize the pilot with emergency procedures to be followed in the event of engine failure or other emergencies which may occur on takeoff. Critical field length, refusal speed, acceleration checkpoint speed, and the other information required on the Takeoff Data Card may be found in the Appendix charts.

Use of Takeoff Data Cards.

Sample Problem. Assuming that maximum power with takeoff flaps is used and that the center of gravity is within limits, the following conditions are given



VELOCITY DURING TAKEOFF GROUND RUN
MAXIMUM POWER
MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956
ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
REMARKS:
1. VELOCITIES SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE.
2. ENGINE AIR INLET SCREENS EXTENDED.
SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING
GROSS WEIGHT—1000 LB
48
44
40
36
32
28
GROSS WEIGHT—38,000 LB
BASE LINE
BASE LINE
GUIDE LINES
REQUIRED TAKEOFF GROUND RUN DISTANCE —2250 FT
DISTANCE TO CHECK POINT—1000 FT
GROUND ROLL DISTANCE—1000 FT
14
12
10
8
6
4
2
0
60
80
100
120
140
VELOCITY AT CHECK POINT—89 KNOTS
INDICATED AIRSPEED—KNOTS
TAKEOFF VELOCITY —131 KNOTS
8C-284A

Sample.

BEST CLIMB PERFORMANCE (TIME)

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**

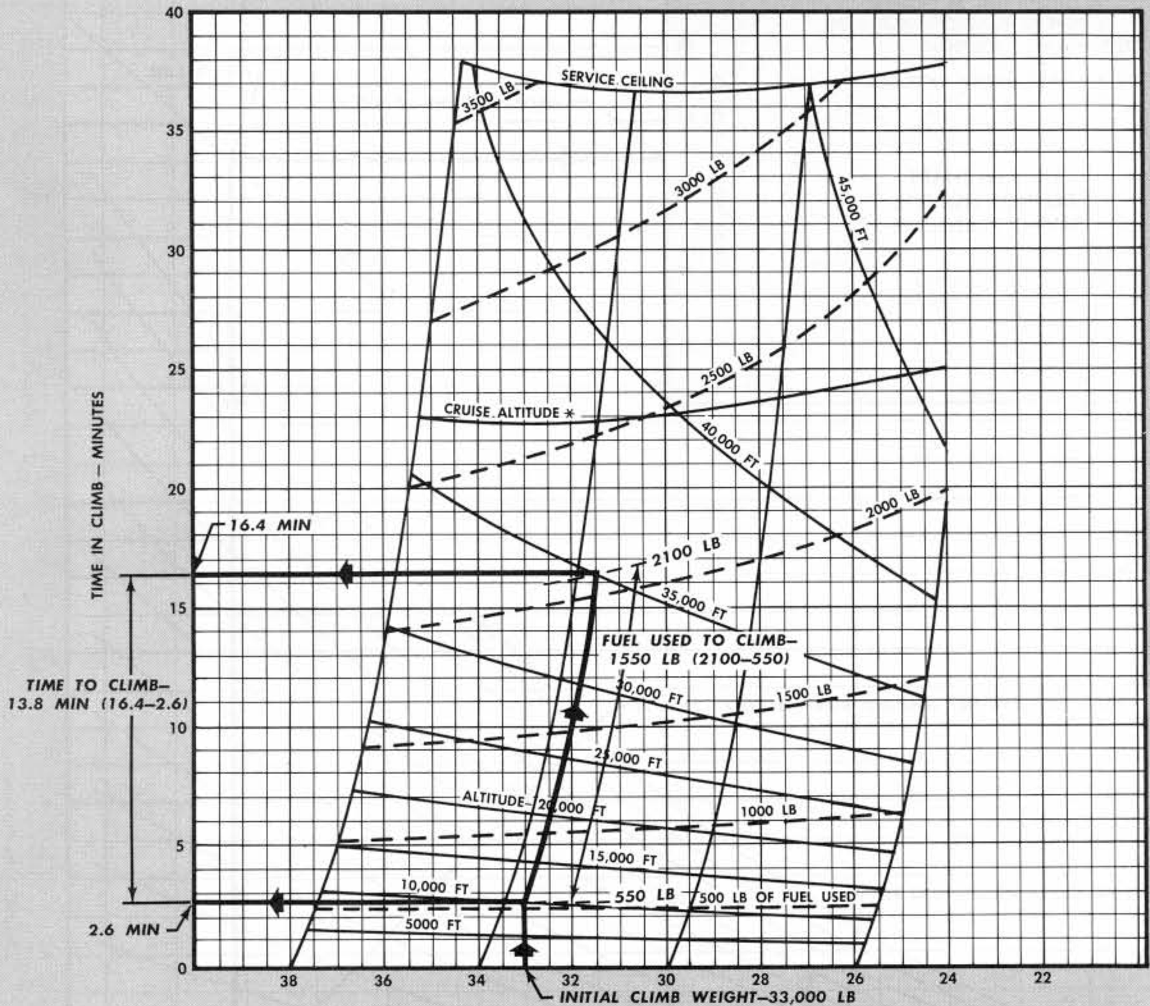
DATE: **8 JUNE 1956**

MILITARY POWER

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING

BC-289A

Sample.

preparatory to completing the check items section of the Takeoff Data Card that follows:

TAKEOFF DATA

Gross Weight	38,000 LB	Pressure Altitude	2000 FT
Runway Length	8000 FT	Headwind	20 KN
Temperature	15°C	Surface: Dry, Wet, Icy	
Takeoff Distance...Normal	2300 FT	50-FT Obstacle	3000 FT
Takeoff Distance...1 ENG	6600 FT	50-FT Obstacle	10,500 FT
Critical Field Length	4200 FT	Refusal Speed	125 KN

TAKEOFF (MAXIMUM POWER)

Acceleration Check	89 KN at	1000 FT
Nose Wheel Liftoff Speed		125 KN
Takeoff Speed		131 KN
Initial Climb Speed (Clear 50 FT)		143 KN

Decision Factors:

1. Critical field length is less (greater or less) than runway length.

2. If engine failure occurs at a speed *below* refusal speed, you should *abort the takeoff.*

3. If engine failure should occur at a speed *in excess* of refusal speed, you should *proceed with maximum power and use engine failure during takeoff procedure.*

NAUTICAL MILES PER 1000 POUNDS FUEL CHARTS.

Cruise data throughout the normal speed range may be obtained from the Nautical Miles Per 1000 Pounds Fuel Charts (figure A-12). Each chart includes specific range (nautical miles per 1000 pounds), fuel flow (pounds per hour), and power settings (% RPM), as well as curves of maximum endurance and recommended long range cruise speeds for zero wind and 50-knot headwind. Specific range is plotted against Mach number, with subscales of calibrated airspeed (CAS) and true airspeed (TAS).

Use of Nautical Miles Per 1000 Pounds Fuel Charts.

To obtain the cruising range for a given amount of fuel, use the following steps:

1. Select the proper chart for the airplane configuration and altitude.

2. Determine the average weight of the airplane for the amount of fuel being considered.

3. Enter the graph at this average weight and the desired Mach number or desired power setting (% RPM), to obtain specific range (nautical miles per 1000 pounds of fuel).

4. Multiply the specific range by the amount of fuel (pounds ÷ 1000) to obtain cruising range.

5. Interpolate the approximate fuel flow and power setting (% RPM) at the Mach number and average weight.

MISSION PROFILE CHART.

The Mission Profile Chart (figure A-13) shows the relationship of time, fuel, distance, and altitude to maximum range for no-wind conditions. This relationship is based on a mission sequence of takeoff, military power climb, and long range cruise. The fuel curves include a 900-pound allowance for start, taxi, and takeoff, the fuel used in climbing to each altitude, and the fuel required for long range cruise. The time lines include the time required for climbing to cruise altitude, but do not include the time for start, taxi, or takeoff. The line labeled Initial Climb Path shows the distance traveled during the military power climb from sea level to cruising altitude, using the climb speed schedule tabulated at the left of the chart. The continuation of the initial climb path is the cruise-climb path based on a constant Mach number. The approximate best cruise-climb altitude can be obtained by climbing at the recommended military power schedule until the rate of climb is 500 feet per minute, then leveling off and setting up the recommended power setting and Mach number. The airplane will automatically seek the cruise-climb altitude for its particular gross weight. The initial throttle setting should be maintained throughout the remainder of cruise-climb. For cruise at a constant altitude, the recommended Mach number should be set up at the intersection of the climb path and the cruise altitude. As the flight progresses, the power setting must be decreased gradually to maintain the recommended Mach number as fuel is consumed. As an aid to preflight planning, a line of best range for constant-altitude flight appears on the chart. This curve is not a flight path, but a plot of best cruise altitude against distance. For distances greater than those covered by the curve, cruise-climb procedure for maximum range should be used. A cruise table gives recommended Mach numbers and approximate operating conditions for both cruise-climb procedure and cruise at constant altitude.

Use of Mission Profile Chart.

The chart may be entered with one or more of the four range factors of time, fuel, distance, and altitude. By entering the chart with the known factors, the others may readily be determined for a no-wind condition. To determine wind effect upon time, fuel, and distance, compute the average true airspeed (distance ÷ time, no wind) and apply wind to TAS to obtain ground speed (GS). Then compute the time with wind (distance ÷ GS). Reenter the profile at the cruising altitude and the computed time with wind to determine the fuel required with wind.

Sample Problem 1. Using the sample chart, find the fuel required, time, necessary speed, and power setting to cruise 250 N MI at 20,000 FT against a headwind of 40 KN.

MISSION PROFILE

TAKEOFF GROSS WEIGHT
38,000 POUNDS
LONG RANGE CRUISE

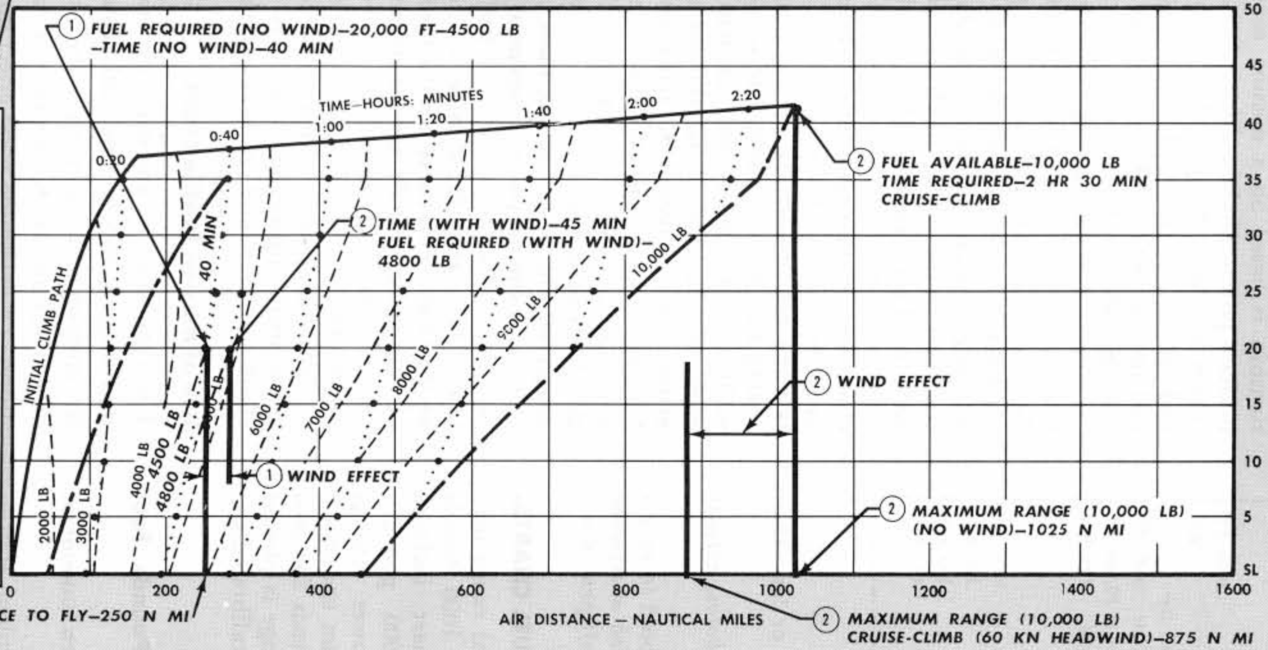
CONFIGURATION: NO EXTERNAL LOAD

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

(1) AND (2) CLIMB SPEED SCHEDULE

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.73	215	40
.74	250	35
.73	275	30
.72	300	25
.70	325	20
.68	345	15
.66	370	10
.64	390	5
.62	405	SL



REMARKS:

1. FUEL ALLOWANCE FOR START, TAXI, AND TAKEOFF 900 POUNDS.
2. NO ALLOWANCE OR RESERVE MADE FOR LOITER, DESCENT, OR LANDING.
3. CLIMB AT MILITARY POWER.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING

LEGEND

- (heavy long dash) ZERO FUEL REMAINING
- (short dash) FUEL CONSUMED
- (solid line) CRUISE-CLIMB PATH
- (dots) TIME (START, TAXI, AND TAKEOFF NOT INCLUDED)
- (dash) LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT

* (1) CRUISE SETTINGS

(2) CRUISE SETTINGS →

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
37,000	90	.71
38,000	90	.71
39,000	90	.71
40,000	91	.71
41,000	93	.71

CRUISE—NO EXTERNAL LOAD					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE -CLIMB	.71		410	3300-2700	*
35,000	.69	230	400	3200	87
30,000	.66	245	385	3500	86
25,000	.62	260	375	3800	85
20,000	.59	270	360	4100	83
15,000	.55	280	345	4500	82
10,000	.52	290	330	4900	81
5,000	.48	295	315	5400	79
SEA LEVEL	.42	275	275	5500	75

BC-288A

Sample.

1. Enter at 250 N MI and 20,000 FT to obtain fuel required (no wind) 4500 LB
2. Time (no wind) 40 MIN (0.67 HR)
3. Calculate average TAS (250 ÷ 0.67) 375 KN
4. Apply wind to obtain GS (375 − 40) 335 KN
5. Calculate time with a 40-KN wind (250 ÷ 335) 45 MIN (0.75 HR)
6. Reenter at cruise altitude at the time with wind. Fuel required with wind 4800 LB
7. Tabular cruise speed 0.59 Mach
8. Tabular cruise power setting 83% RPM (approx)

Note

If this flight had been made at 32,500-FT cruising altitude (reference, the line of best range at 250 N MI), the time and fuel required would have been less.

Sample Problem 2. Determine the maximum distance flyable with 10,000 LB of fuel and a 60-KN headwind.

1. Enter at 10,000 LB of fuel and obtain maximum air distance at cruise-climb (no wind) 1025 N MI
2. Time (no wind) 2 HR 30 MIN (2.50 HR)
3. Calculate average TAS (1025 ÷ 2.50) 410 KN
4. Apply wind to obtain GS (410 − 60) 350 KN
5. Calculate distance with wind (2.50 × 350) 875 N MI
6. Tabular cruise-climb speed 0.71 Mach

INTERCEPT PROFILE CHART.

The Intercept Profile Chart (figure A-14) presents the fuel required to fly a given distance in a minimum of time, consistent with reasonable range capabilities. These charts are based on maximum power climb and military power cruise; they are similar to the Mission Profile Charts and are used in the same manner. Notice, however, that use of the Intercept Profiles should be restricted to flights that require a minimum of time, whereas the Mission Profile Charts are used for maximum range flights.

OPTIMUM RETURN PROFILE CHART.

The Optimum Return Profile Chart (figure A-16) shows the minimum fuel required for maximum distance (no wind) based on an optimum flight path from any point within the range of the airplane configuration. The flight path required is indicated by the different shaded areas and the notes relative to them. The fuel curves are based on a military power climb to, and recommended cruise at, the optimum altitude. The military power climb speed schedule and recommended cruise settings are tabulated on each chart. No reserve for loiter, descent, or landing has been included. The time shown at the optimum altitude is cruise time only; it does not include the time required for climb to optimum altitude or any allowance for loiter, descent, or landing.

Use of Optimum Return Profile Chart.

The chart may be entered at the initial altitude with either the fuel on board (to determine the distance available) or with the distance to be flown (to determine the fuel required). The shaded area in which the initial point falls establishes the necessary procedure, as stated in the note relative to the area, to obtain maximum range. The time required to fly the distance is the time at cruise altitude (obtained from the profile) plus the time required to climb, if necessary (obtained from the military power climb chart for the applicable configuration). The effect of wind must be applied to obtain the actual fuel and time to fly the distance. A close approximation can be obtained by considering the head or tailwind for the time it requires to complete the flight (neglecting the difference in wind at the lower altitudes since comparatively little time is spent during the climb phase).

Sample Problem. From the sample, determine the fuel and time required to return to a base 500 N MI away. The airplane is at 20,000 FT with 6000 lb of fuel on board (gross weight = 34,000 LB. A 60-KN headwind is assumed.

1. Enter profile at 500 N MI and 20,000 FT to establish starting point. Fuel required (no wind) 4100 LB
2. In this area, note that a climb is required and a cruise-climb procedure followed.
3. By following the climb path guide lines, the initial cruise altitude is 39,500 FT
4. Cruise time (no wind) 54 MIN
5. From the military power climb chart, time to climb 16 MIN
6. Total time (no wind; "4" + "5") 1 HR 10 MIN
7. Average TAS (distance ÷ total time) 428 KN
8. Average ground speed (TAS − headwind) 368 KN
9. Total time with headwind (distance ÷ average ground speed) 1 HR 22 MIN
10. Cruise time with wind ("9" − "5") 1 HR 6 MIN
11. Using the cruise time ("10" on the profile), backtrack down the climb path from the line of best range to 20,000 FT to obtain fuel required with wind 4800 LB
12. Fuel remaining over base at altitude (6000 − 4800 LB) 1200 LB
13. Use the flight path originally determined at no wind.

OPTIMUM RETURN PROFILE

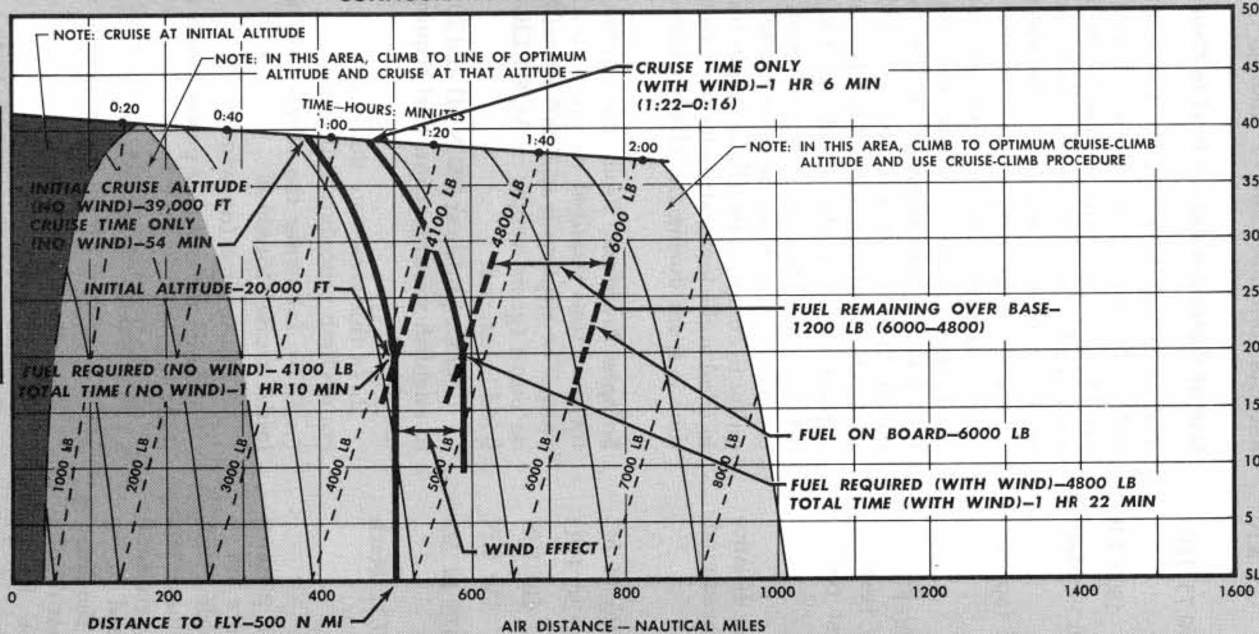
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.73	215	40
.74	250	35
.73	275	30
.72	300	25
.70	325	20
.68	345	15
.66	370	10
.64	390	5
.62	405	SL



REMARKS:

1. FUEL REQUIRED AT ANY POINT INCLUDES MILITARY POWER CLIMB TO FLIGHT ALTITUDE (IF BELOW THAT).
2. NO ALLOWANCE MADE FOR LOITER, DESCENT, OR LANDING.
3. BEST CRUISE CONDITION DETERMINED BY INTERSECTION OF CLIMB PATH GUIDE LINES AND LINES OF BEST RANGE.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING

LEGEND

- • • TIME AT CRUISE-CLIMB ALTITUDE
- ----- FUEL REQUIRED
- ——— CLIMB PATH GUIDE LINE
- — — LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT
- ▬▬ LINE OF BEST RANGE FOR CRUISE-CLIMB FLIGHT

*

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
37,000	90	.71
38,000	90	.71
39,000	90	.71
40,000	91	.71
41,000	93	.71

CRUISE-CLIMB PROCEDURE

CRUISE—NO EXTERNAL LOAD					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE -CLIMB	.71		410	2700 3300	*
35,000	.69	230	400	3200	87
30,000	.66	245	385	3500	86
25,000	.62	260	375	3800	85
20,000	.59	270	360	4100	83
15,000	.55	280	345	4500	82
10,000	.52	290	330	4900	81
5,000	.48	295	315	5400	79
SEA LEVEL	.42	275	275	5500	75

BC-282A

Sample.

MAXIMUM ENDURANCE CHART.

The Maximum Endurance Chart (figure A-17) shows the maximum time available with the fuel on board when loitering at a constant altitude. The recommended calibrated airspeed and the approximate operating conditions are tabulated on each chart.

Use of Maximum Endurance Chart.

To determine the time available for a given amount of fuel, enter the chart at the amount of fuel on board at the start of loiter and the flight altitude and note the initial time. Reenter the chart at the amount of fuel on board at the end of the endurance flight (initial fuel on board less fuel to be used) and read the final time. The difference between the initial and final time is the time available to loiter at constant altitude. To obtain the fuel required to loiter a given time, enter the chart at the amount of fuel on board at the start of loiter and flight altitude and note the initial time. Reenter the chart at time of end of loiter (initial time less time to loiter) and read final fuel on board. The difference between the initial and final fuel on board is the fuel required to loiter.

Sample Problem. From the sample chart determine the fuel required to loiter at 30,000 FT for 45 MIN. The fuel on board at start of loiter is 6000 LB (gross weight = 34,000 LB).

1. Initial time at 6000 LB and 30,000 FT — 2 HR 12 MIN
2. Final time (2:12 − 45) — 1 HR 27 MIN
3. Fuel on board at end of loiter (1:27 at 30,000 FT) — 3800 LB
4. Fuel required to loiter (6000 LB − 3800 LB) — 2200 LB
5. Recommended loiter CAS — 190 KN

OPTIMUM MAXIMUM ENDURANCE PROFILE CHART.

The Optimum Maximum Endurance Profile Chart (figure A-18) gives the maximum time in the air with the fuel remaining, based on an optimum flight path from any starting altitude. The flight path required is indicated by the different shaded areas and the notes relative to them. Time and fuel lines shown are based on a normal power climb (military power climb in the case of one engine operation) to best endurance altitude, loiter at that altitude, and a maximum range descent to sea level (no reserve for landing). The climb speed schedule is tabulated at the left of the chart; the loiter speed schedule is tabulated below the chart.

Use of Optimum Maximum Endurance Profile Chart.

The chart may be entered at the initial altitude with either the fuel remaining (to determine the time available) or the time desired (to determine the fuel requirement). The shaded area in which the initial point falls establishes the flight path to be used, as stated in the note relative to the area.

Sample Problem. From the sample chart determine the time available and the necessary flight path for maximum endurance aloft with 6000 LB of fuel remaining at 25,000 FT.

1. Enter profile at 25,000 FT and 6000 LB of fuel remaining to establish starting point. Total time available — 2 HR 17 MIN
2. In this area, note that a climb is required.
3. Follow the climb path guide lines for the best endurance altitude — 35,500 FT
4. Descent time from 35,500 FT to sea level — 39 MIN
5. Elapsed time from start of climb to start of descent (2:17 − 0.39) 1 HR 38 MIN. Suppose a reserve of 1000 LB of fuel had been desired for landing; then enter the profile at 5000 LB fuel (6000 − 1000) and proceed as outlined in "1" through "5".
6. Time available — 1 HR 56 MIN
7. Obtain endurance altitude — 34,000 FT
8. Descent time — 37 MIN
9. Elapsed time — 1 HR 19 MIN

DESCENT CHARTS.

The Descent Charts (figure A-19) show descent performance for one and two engines operating in terms of fuel, time, air distance, and rate of descent for a gross weight range from 26,000 to 38,000 pounds, denoted by the shaded areas. Interpolation must be used for intermediate gross weights within this range. Three types of descents are shown: recommended descent with speed brakes closed (based on 0.70 Mach number), recommended descent with speed brakes open (also based on 0.70 Mach number), and maximum range descent (based on 185 knots IAS). All three types of descent are based on idle power. These charts may be used for descending from one altitude to another by taking the incremental values between the initial and final altitudes.

LANDING DISTANCE CHARTS.

The Landing Distance Charts (figure A-21) show landing distances (ground roll and total distance to clear a 50-foot obstacle) for a dry hard-surfaced runway as a function of gross weight, pressure altitude, wind velocity, and ambient temperature. The pressure altitude of the field can be determined by setting the altimeter to 29.92 (sea level standard day pressure in inches of mercury). The chart for two-engine operation shows data for landing using the normal procedure given in Section II. The chart for one engine operation is based on inoperative speed brakes and flaps, which is the

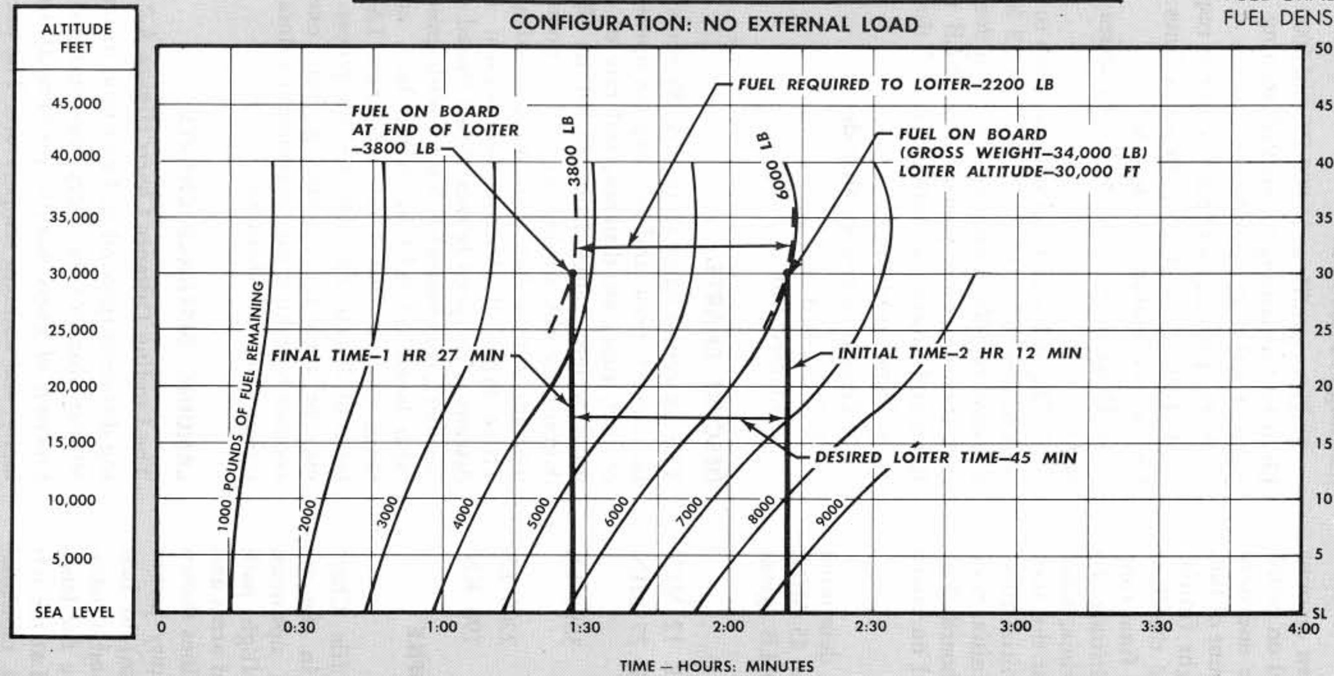
MAXIMUM ENDURANCE

TAKEOFF GROSS WEIGHT
38,000 POUNDS

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MODEL: **F-89B,C**
ENGINE(S): (2) **J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD



REMARKS:

1. LOITER AT RECOMMENDED CAS.
2. MAINTAIN CONSTANT ALTITUDE.
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.

SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING

LOITER					
ALTITUDE FEET	CAS	APPROXIMATE			
		TAS	MACH NO.	LB/HR	% RPM
40,000	190	365	.63	2900	92
35,000	190	330	.56	2800	86
30,000	190	300	.50	2900	83
25,000	185	270	.45	3000	80
20,000	185	250	.41	3200	77
15,000	185	230	.37	3400	75
10,000	180	210	.33	3700	72
5,000	180	195	.30	4000	70
SEA LEVEL	180	180	.27	4300	67

RECOMMENDED LOITER CONDITIONS → (30,000 row)

BC-287A

Sample.

OPTIMUM MAXIMUM ENDURANCE PROFILE

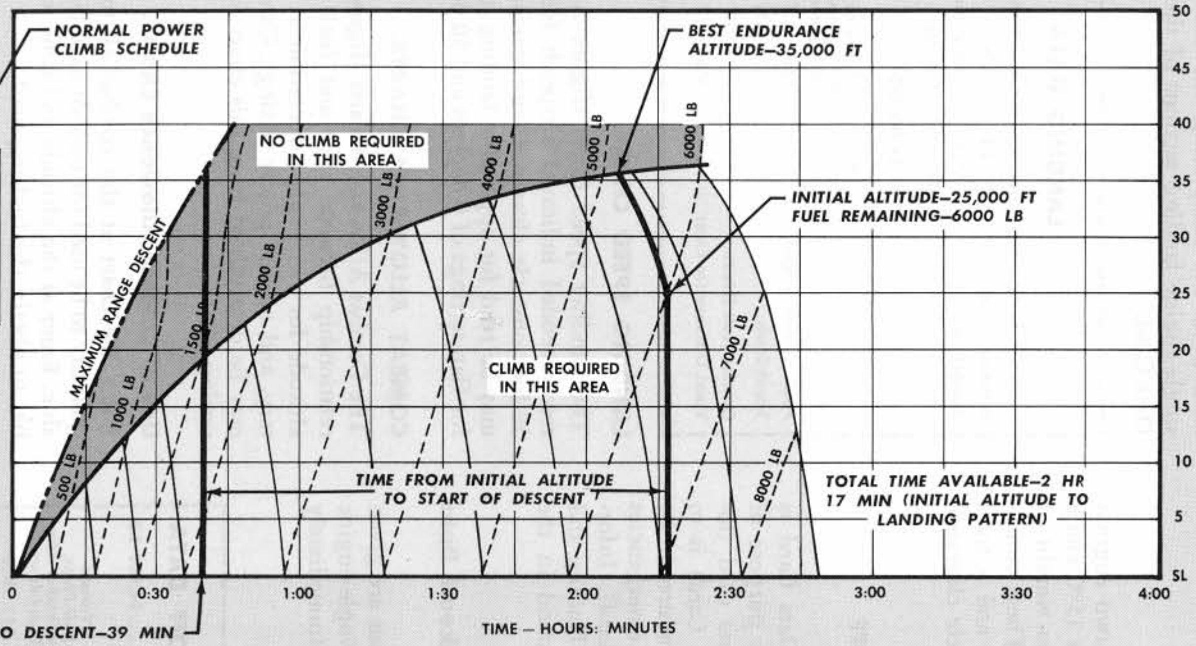
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS

MODEL: **F-89B,C**
ENGINE(S): (2) **J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.71	210	40
.72	240	35
.70	265	30
.68	285	25
.66	300	20
.63	320	15
.60	330	10
.56	340	5
.51	335	SL



REMARKS:

1. USE NORMAL POWER FOR CLIMB.
2. LOITER AT RECOMMENDED CAS.
3. USE MAXIMUM RANGE DESCENT.
4. NO ALLOWANCE OR RESERVE MADE FOR LANDING.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING

LOITER – NO EXTERNAL LOAD

ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
40,000	185	.63	360	2900	92
35,000	185	.56	320	2700	85
30,000	180	.49	290	2600	82
25,000	175	.43	260	2600	78
20,000	175	.38	235	2800	74
15,000	170	.34	215	3100	72
10,000	170	.31	195	3400	69
5,000	170	.28	180	3700	67
SEA LEVEL	165	.25	165	3900	64

RECOMMENDED LOITER → 35,000

LEGEND

- – · – · – FUEL REMAINING
- ▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
- —— NORMAL POWER CLIMB GUIDE LINES

BC-281A

Sample.

landing configuration for some airplanes with the left engine inoperative. If the landing technique used differs from that specified, the landing distances will vary from those shown on the charts. A 5-percent variation in speed causes approximately a 10-percent variation in distances; insufficient wheel braking may increase ground roll by 50 percent.

Use of Landing Distance Charts.

The sample chart shows a landing with two engines operating at an ambient air temperature of 15°C and a pressure altitude of 2000 feet with a gross weight of 30,000 pounds and a 20-knot headwind. These conditions require a ground roll of 2250 feet and a total distance of 3250 feet from a 50-foot obstacle clearance to end of ground roll.

LANDING IMMEDIATELY AFTER TAKEOFF DATA CARD.

A Landing Immediately After Takeoff Data Card is to be completed before each takeoff. The purpose of the landing immediately after takeoff data card (located at the bottom of the Takeoff Data Card) is to familiarize the pilot with emergency procedures to be followed if loss of an engine or other emergencies necessitate landing immediately after takeoff. Information necessary to complete the normal landing and single-engine landing sections may be found in the Appendix charts.

Use of Landing Immediately After Takeoff Data Card.

Sample Problem. The following conditions are given as a basis for completing the normal and single-engine landing sections of the sample Landing Immediately After Takeoff Data Card.

LANDING IMMEDIATELY AFTER TAKEOFF DATA

Maximum Emergency Landing Weight ....34,100 LB
(Takeoff Weight Less Jettisonable Items)

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	172 KN	157 KN
Touchdown Speed	135 KN	124 KN
Ground Roll Distance	3450 FT	2550 FT
Total Distance (to Clear 50 FT)	6300 FT	3600 FT

LANDING DATA CARD.

A Landing Data Card (see Abbreviated Checklist, Section II) is to be completed before each flight. The purpose of the landing data card is to familiarize the pilot with emergency procedures to be followed if loss of an engine or other emergencies occur during landing. The information required by the normal landing and single-engine landing sections of the landing data card may be found in the Appendix charts.

Use of Landing Data Cards.

Sample Problem. The following conditions are given as a basis for completing the normal landing and single-engine landing sections of the sample Landing Data Card.

LANDING DATA

Landing Gross Weight 29,800 LB

Runway Length	8000 FT	Headwind	20 KN
Temperature	15°C	Pressure Altitude	2000 FT

Surface: Dry, Wet, Icy

LANDING

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	160 KN	147 KN
Touchdown	126 KN	116 KN
Ground Roll Distance	2950 FT	2200 FT
Total Distance (to Clear 50 FT)	5750 FT	3200 FT

LANDING SPEED CHART.

The Landing Speed Chart (figure A-20) presents the recommended indicated airspeeds for final approach, 50-foot obstacle clearance, and touchdown. The chart may be read for applicable landing gross weights and for flap settings of 0 degrees and 50 degrees.

COMBAT ALLOWANCE CHARTS.

The Combat Allowance Charts (figure A-15) show the relationship between time and fuel with changes in altitude for two-engine operation at maximum, military, and normal power settings. Combat time or fuel may be determined from this chart for a given power setting.

Use of Combat Allowance Charts.

Enter the chart at the combat altitude and the fuel quantity to be used for combat to obtain the time available. Enter at the altitude and time available for combat to obtain the fuel required.

TYPICAL MISSION.

This sample problem combines the use of the charts in this section to plan a typical mission.

FLIGHT PLAN DATA.

A combat mission is to be flown. Prepare a flight plan based on the following data:

1. Distance to combat area 300 N MI
2. Assigned altitudes:

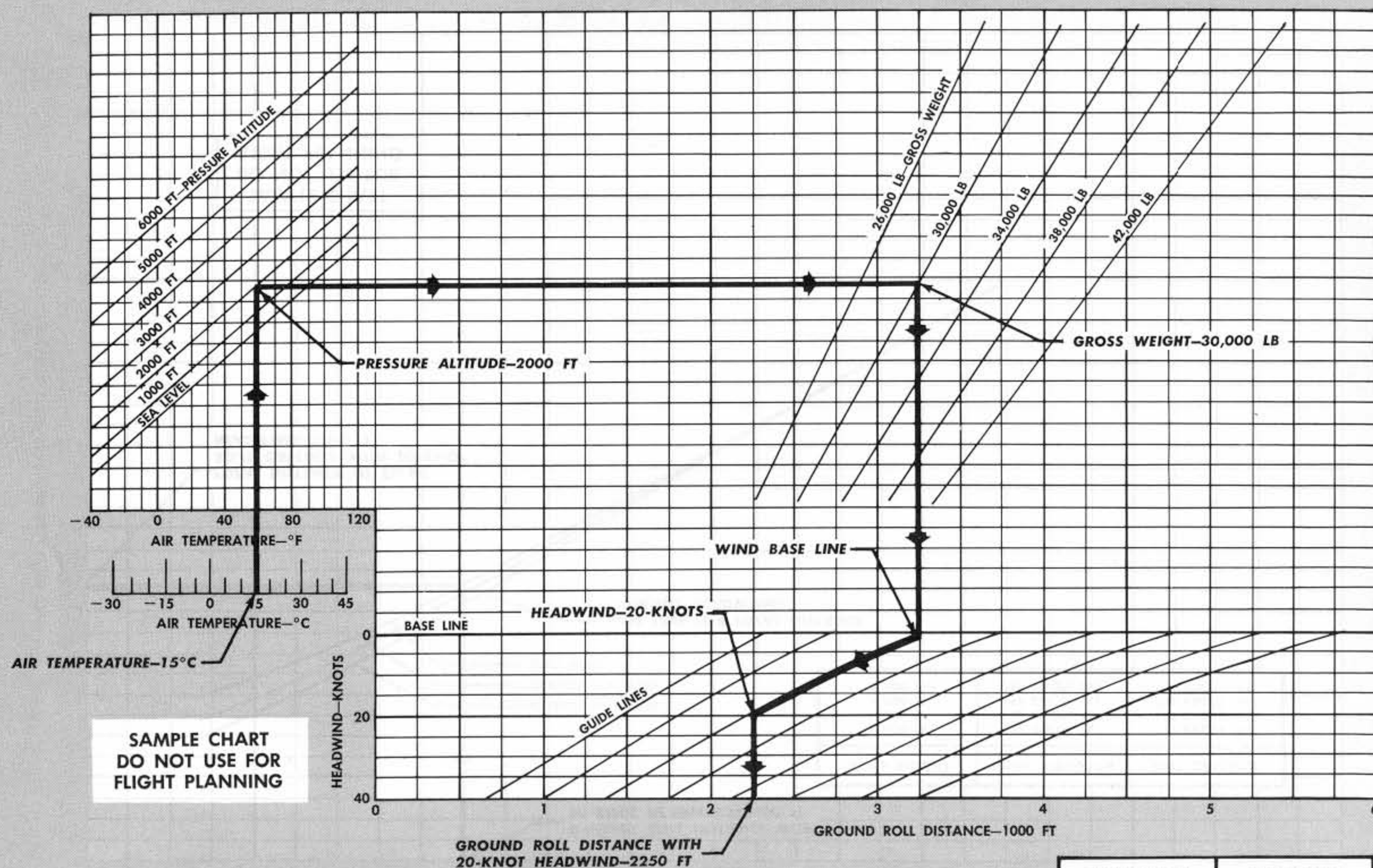
Inbound to combat (cruise-climb) 3700 FT and above

LANDING DISTANCE

MODEL: **F-89B,C**
ENGINE(S): (2) **J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



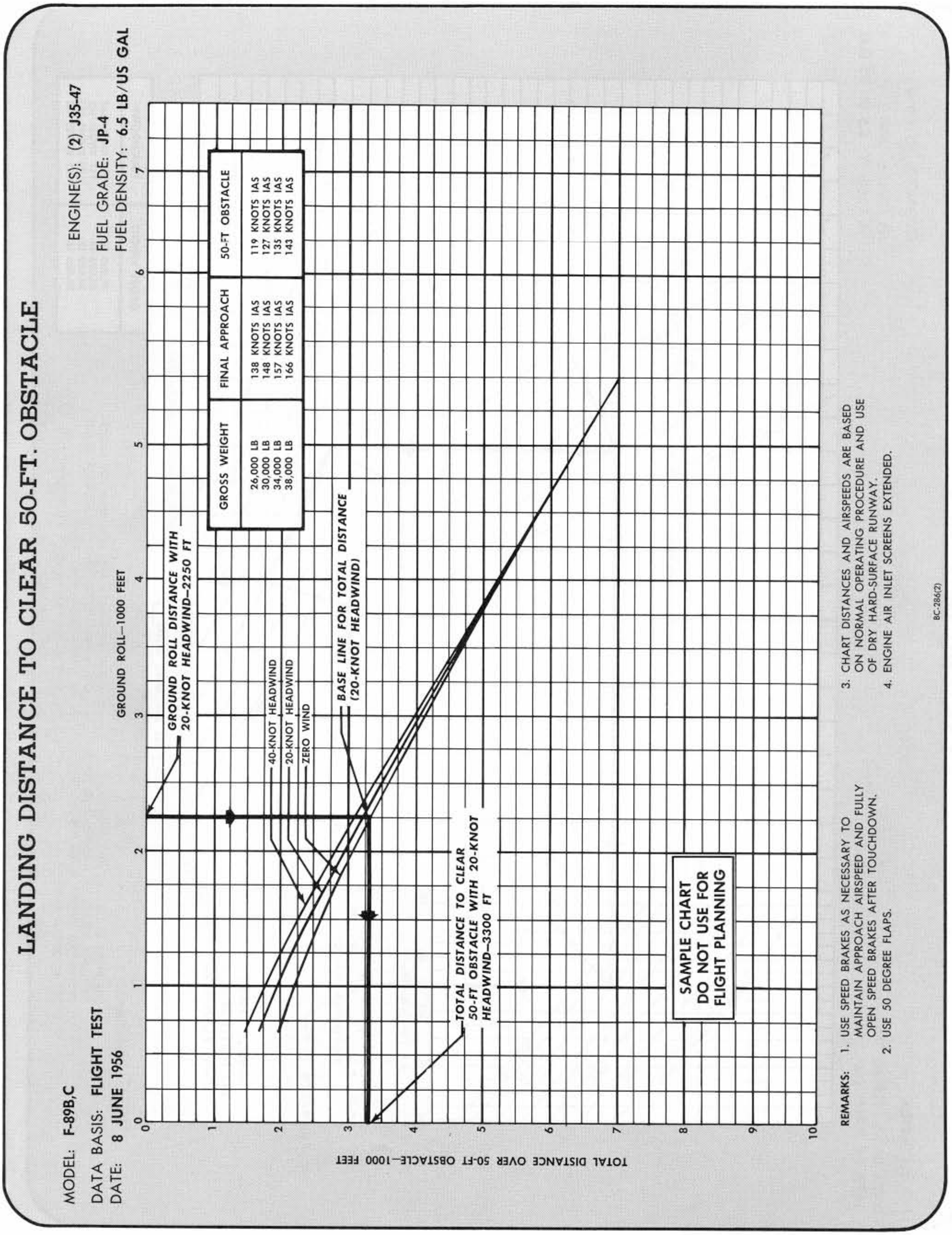
GROSS WEIGHT	TOUCHDOWN
26,000 LB	109 KNOTS IAS
30,000 LB	117 KNOTS IAS
34,000 LB	124 KNOTS IAS
38,000 LB	131 KNOTS IAS

REMARKS:

1. USE SPEED BRAKES AS NECESSARY TO MAINTAIN APPROACH AIRSPEED AND FULLY OPEN SPEED BRAKES AFTER TOUCHDOWN.
2. USE 50 DEGREE FLAPS.
3. CHART DISTANCES AND AIRSPEEDS ARE BASED ON NORMAL OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
4. ENGINE AIR INLET SCREENS EXTENDED.

BC-286(1)

Sample.


LANDING DISTANCE TO CLEAR 50-FT. OBSTACLE
MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956
ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
GROUND ROLL—1000 FEET
TOTAL DISTANCE OVER 50-FT OBSTACLE—1000 FEET
GROSS WEIGHT
26,000 LB
30,000 LB
34,000 LB
38,000 LB
FINAL APPROACH
138 KNOTS IAS
148 KNOTS IAS
157 KNOTS IAS
166 KNOTS IAS
50-FT OBSTACLE
119 KNOTS IAS
127 KNOTS IAS
135 KNOTS IAS
143 KNOTS IAS
GROUND ROLL DISTANCE WITH 20-KNOT HEADWIND—2250 FT
40-KNOT HEADWIND
20-KNOT HEADWIND
ZERO WIND
BASE LINE FOR TOTAL DISTANCE (20-KNOT HEADWIND)
TOTAL DISTANCE TO CLEAR 50-FT OBSTACLE WITH 20-KNOT HEADWIND—3300 FT
SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING
REMARKS: 1. USE SPEED BRAKES AS NECESSARY TO MAINTAIN APPROACH AIRSPEED AND FULLY OPEN SPEED BRAKES AFTER TOUCHDOWN.
2. USE 50 DEGREE FLAPS.
3. CHART DISTANCES AND AIRSPEEDS ARE BASED ON NORMAL OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
4. ENGINE AIR INLET SCREENS EXTENDED.
BC-286(2)

Sample.

Outbound from combat (cruise-climb) 39,000 FT and above

3. Combat at 45,000 FT (maximum power) 5 MIN

4. Weather (assume Standard Day temperature throughout) CAVU

Winds aloft inbound (37,000 FT and above) 40 KN HW

Winds aloft outbound (39,000 FT and above) 50 KN TW

Field elevation 2000 FT

5. Airplane gross weight:

Operating minimum (includes crew of two, oil, trapped fuel, miscellaneous equipment, and armament) 27,530 LB

Ejectable ammunition 470 LB

Maximum usable fuel — internal and external (1550 gallons) 10,000 LB

Total airplane gross weight 38,000 LB

TAKEOFF.

Obtain the takeoff distance from the Maximum Power Takeoff Distance Chart (figure A-6). (Standard Day temperature at 2000 FT is 11°C.) Assume zero wind.

1. Ground roll distance (38,000 LB) 3000 FT
2. Total takeoff distance over 50-foot obstacle 3900 FT
3. Takeoff speed (IAS) 131 KN

INBOUND LEG.

Cruise.

The inbound leg may be determined directly from the Mission Profile Chart (figure A-13). The profile includes a 900-LB fuel allowance for start, taxi, and takeoff, as well as the fuel required for climb to and cruise at the cruise-climb altitude.

1. Distance 300 N MI
2. Fuel required (no wind) from profile 4700 LB
3. Time (no wind) from profile 43 MIN
4. Average TAS ("1" ÷ "3") 418 KN
5. Ground speed ("4" − 40 kn) 378 KN
6. Time with wind ("1" ÷ "5") 48 MIN
7. Fuel required (with wind) from profile 5000 LB
8. Cruise speed (cruise-climb altitude) 0.71 Mach
9. Cruise power setting 90% RPM (approx)
10. Military power climb speed schedule (see figure A-11)
11. Gross weight at end of cruise (38,000 LB − "7") 33,000 LB

Climb to Combat Altitude.

Maximum power climb to combat altitude (45,000 FT).

1. Distance traveled in climb 28 N MI
2. Gross weight at start of climb from 37,600 FT 33,000 LB
3. Gross weight at end of climb to 45,000 FT 32,400 LB
4. Fuel used to climb (33,000 LB − 32,400 LB) 600 LB
5. Time required to climb 4 MIN
6. Maximum power climb speed schedule (see figure A-11)

COMBAT.

From the Combat Allowance Chart (figure A-15), obtain the fuel required for combat at 45,000 FT.

1. Combat — maximum power (5 MIN): 700 LB
2. Gross weight at end of combat 32,400 LB − 700 LB (combat fuel) 470 LB (ejectable ammunition) 31,230 LB

Assume zero distance traveled during combat. Determine the fuel remaining at end of combat.

3. Takeoff, climb, and cruise 5000 LB
4. Climb to combat altitude 600 LB
5. Combat 700 LB
6. Total fuel used 6300 LB
7. Fuel remaining (10,000 LB − 6300 LB) 3700 LB

OUTBOUND CRUISE — CLIMB.

At the end of combat, the airplane is 328 N MI (300 + 28) from base at an altitude of 45,000 FT. Enter the Optimum Return Profile Chart (figure A-16) at the distance from the base, and determine the fuel required and reserve with the existing tailwind. Note that the optimum altitude for start of return at the distance is 39,700 FT; therefore, a recommended descent (with speed brakes open) is made from 45,000 FT to 39,700 FT (time, distance, and fuel consumed are negligible).

1. Distance 328 N MI
2. Fuel required (no wind) 2300 LB
3. Initial cruise altitude 39,700 FT
4. Total time (no wind) 46 MIN
5. Average TAS ("1" ÷ "4") 426 KN
6. Average ground speed ("5" + 50) 476 KN
7. Total time with wind ("1" ÷ "6") 41 MIN
8. Fuel required (wind) 2000 LB
9. Cruise speed 0.71 Mach
10. Power setting (see figure A-13)
11. Reserve over base at 41,500-FT altitude (3700 LB − "8") 1700 LB

DESCENT.

Obtain the fuel required to descend to base from the Descent Chart (figure A-19).

1. Recommended descent, speed brakes open, from 41,500 FT — 50 LB

2. Time to descend — 1 MIN

3. Descent speed, using idle power and speed brakes open — 0.70 Mach

4. Fuel reserve for loiter and landing (1700 LB − 50 LB) — 1650 LB

5. Airplane gross weight for landing — 29,180 LB

LANDING.

Obtain the landing distance from the Landing Distance Chart, figure A-21. Use 2000-FT altitude, 11°C, and no wind.

1. Ground roll distance — 3200 FT
2. Total distance over 50-FT obstacle — 4350 FT
3. Approach speed (IAS) — 145 KN
4. 50-FT obstacle speed (IAS) — 125 KN
5. Touchdown speed (IAS) — 115 KN

The sum of all the time required gives the time from takeoff to landing — 1 HR 39 MIN

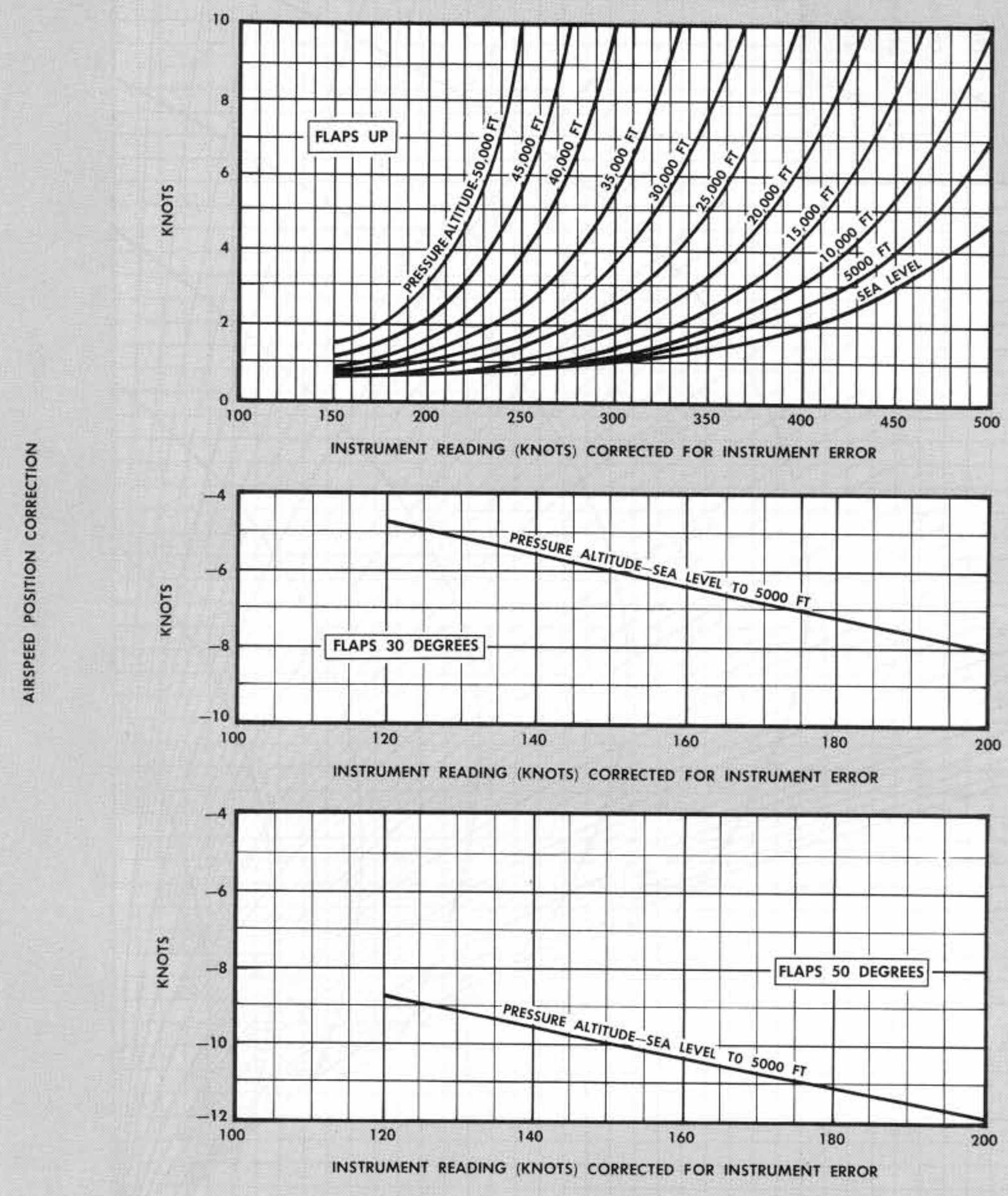
AIRSPEED POSITION CORRECTION

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ADD CORRECTION TO CORRECTED INSTRUMENT READING (IAS) TO OBTAIN CALIBRATED AIRSPEED.
2. GEAR UP OR DOWN.

BC-200 A

Figure A-1.

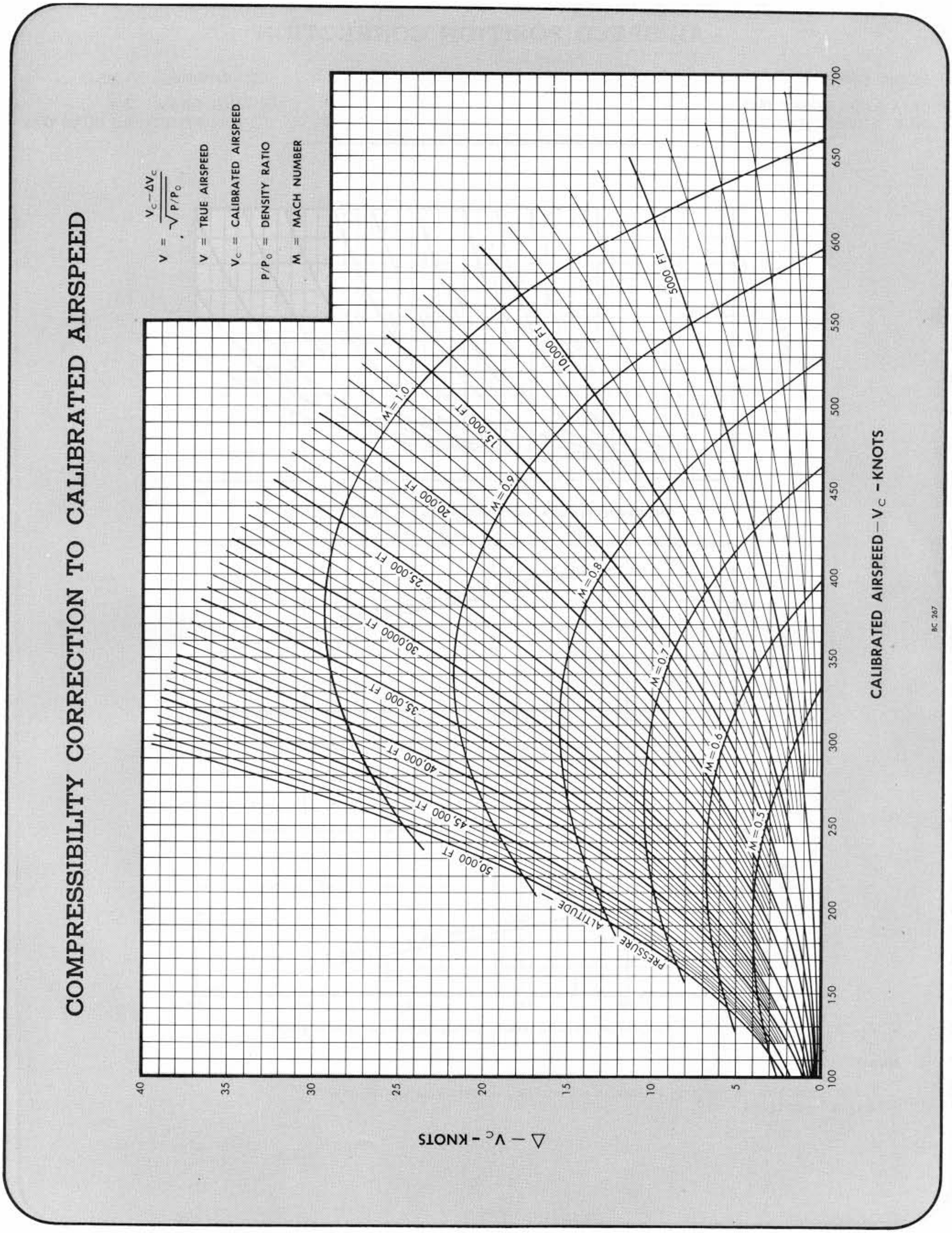

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED
$V = \frac{V_C - \Delta V_C}{\sqrt{P/P_0}}$,
V = TRUE AIRSPEED
V_C = CALIBRATED AIRSPEED
P/P_0 = DENSITY RATIO
M = MACH NUMBER
$\Delta - V_C$ - KNOTS
CALIBRATED AIRSPEED — V_C - KNOTS
PRESSURE ALTITUDE
5000 FT
10,000 FT
15,000 FT
20,000 FT
25,000 FT
30,0000 FT
35,000 FT
40,000 FT
45,000 FT
50,000 FT
M=1.0
M=0.9
M=0.8
M=0.7
M=0.6
M=0.5
0
5
10
15
20
25
30
35
40
100
150
200
250
300
350
400
450
500
550
600
650
700
BC 267

Figure A-2.

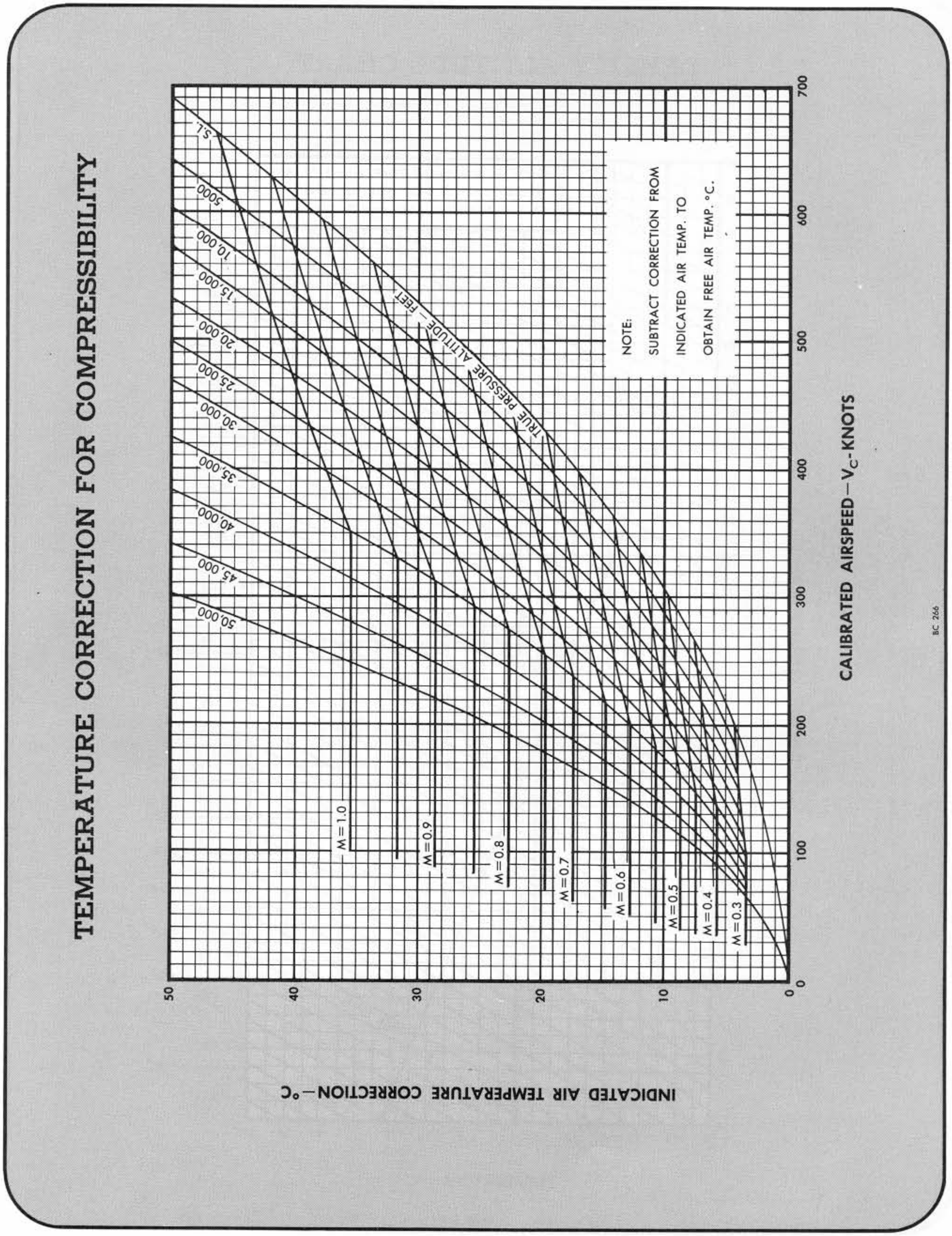

TEMPERATURE CORRECTION FOR COMPRESSIBILITY
NOTE:
SUBTRACT CORRECTION FROM
INDICATED AIR TEMP. TO
OBTAIN FREE AIR TEMP. °C.
TRUE PRESSURE ALTITUDE – FEET
S.L.
5000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
M = 1.0
M = 0.9
M = 0.8
M = 0.7
M = 0.6
M = 0.5
M = 0.4
M = 0.3
INDICATED AIR TEMPERATURE CORRECTION – °C
0
10
20
30
40
50
CALIBRATED AIRSPEED – V_C-KNOTS
0
100
200
300
400
500
600
700
BC 266

Figure A-3.

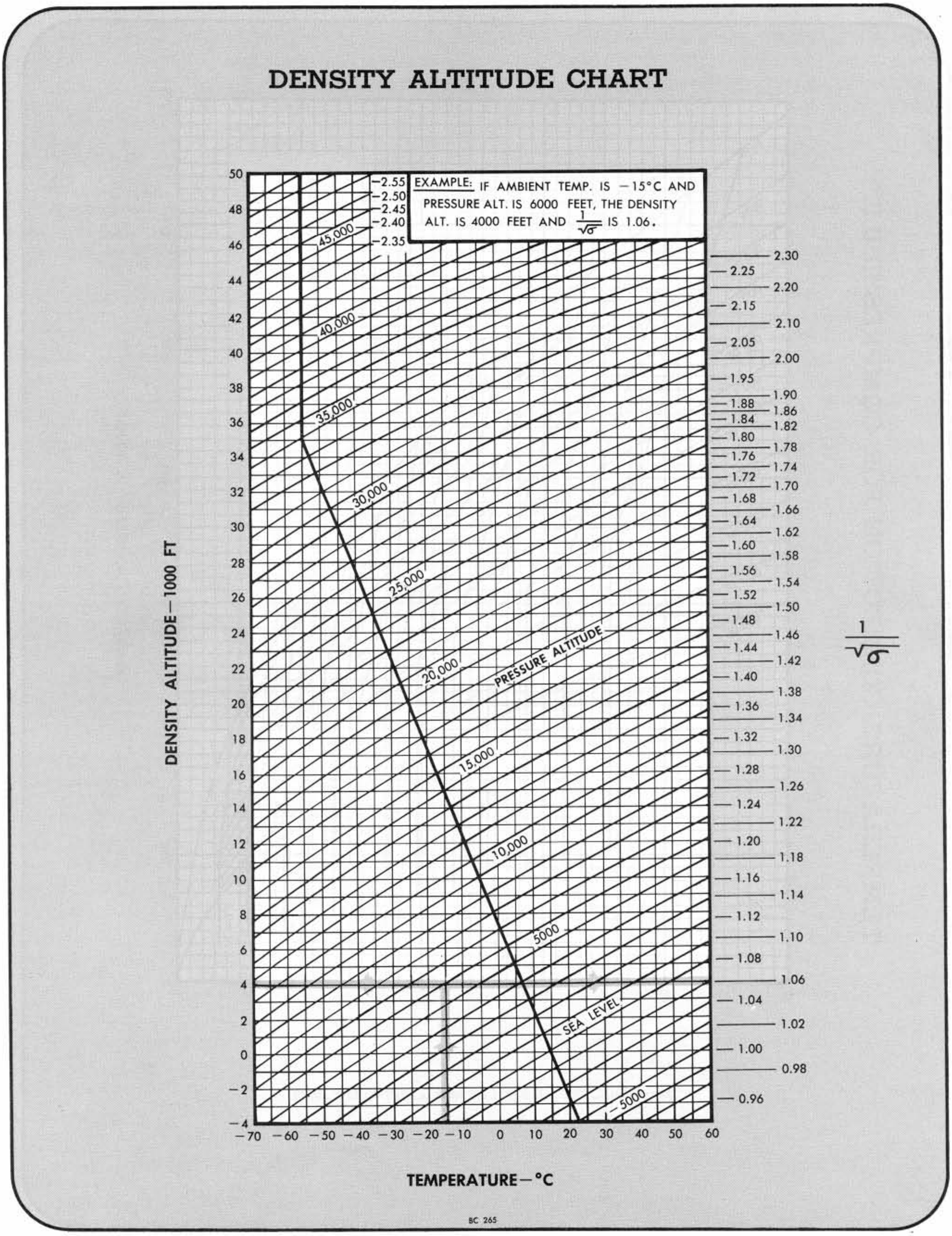
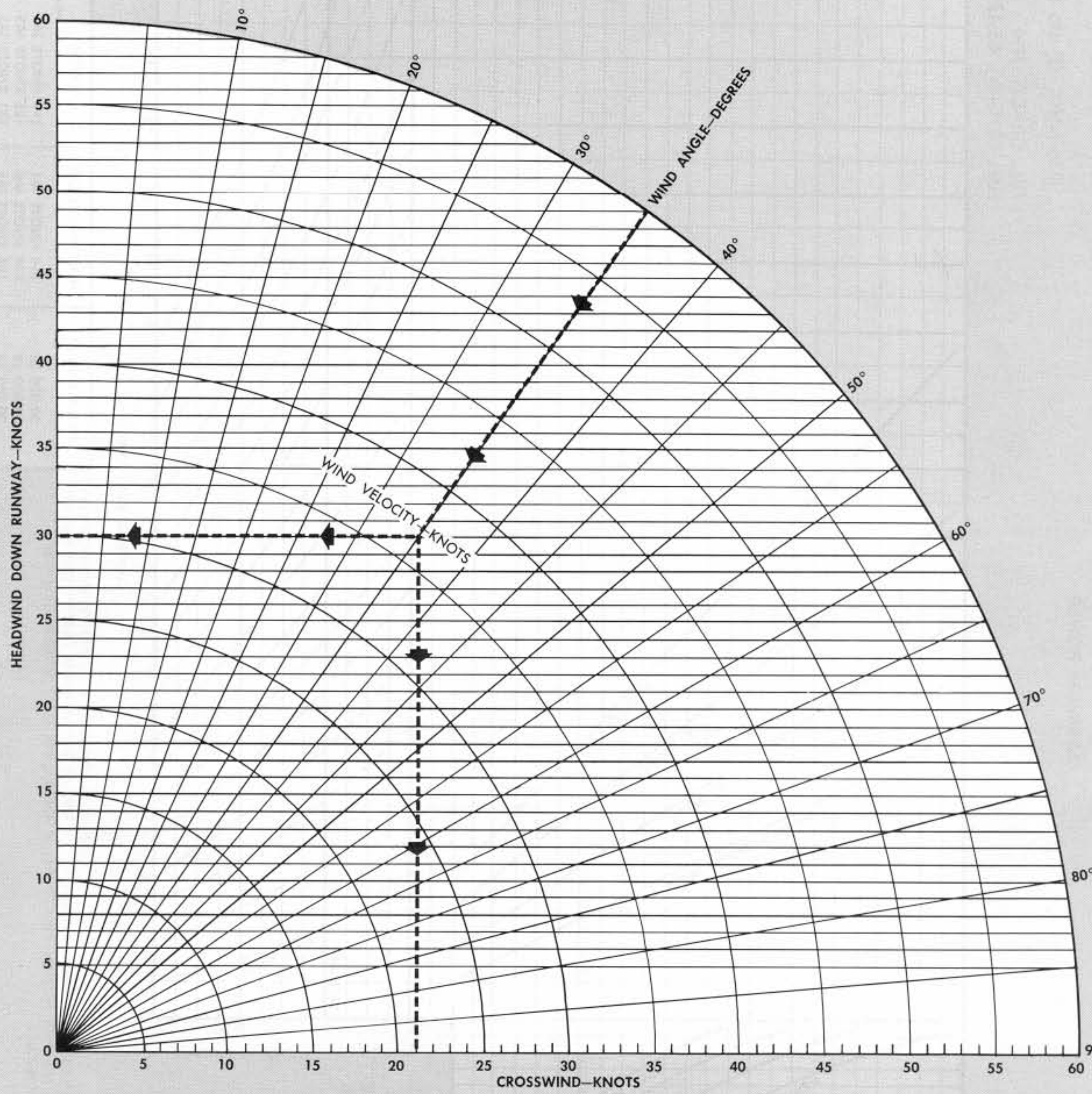

DENSITY ALTITUDE CHART
EXAMPLE: IF AMBIENT TEMP. IS −15°C AND PRESSURE ALT. IS 6000 FEET, THE DENSITY ALT. IS 4000 FEET AND $\frac{1}{\sqrt{\sigma}}$ IS 1.06.
DENSITY ALTITUDE—1000 FT
TEMPERATURE—°C
PRESSURE ALTITUDE
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5000
SEA LEVEL
−5000
$\frac{1}{\sqrt{\sigma}}$
BC 265

Figure A-4.

RELATIVE WIND CHART



EXAMPLE:

GIVEN: TAKEOFF RUNWAY—27, WIND 305°/37 KNOTS

FIND: TAKEOFF HEADWIND AND CROSSWIND.

SOLUTION:
1. RUNWAY WIND ANGLE=35°.
2. ENTER CHART AT 35° ANGLE AND 37-KNOT WIND VELOCITY.
3. READ TO LEFT AND FIND HEADWIND 30-KNOTS.
4. READ STRAIGHT DOWN AND FIND CROSSWIND—21-KNOTS.

BC-296

Figure A-5.

TAKEOFF DISTANCE

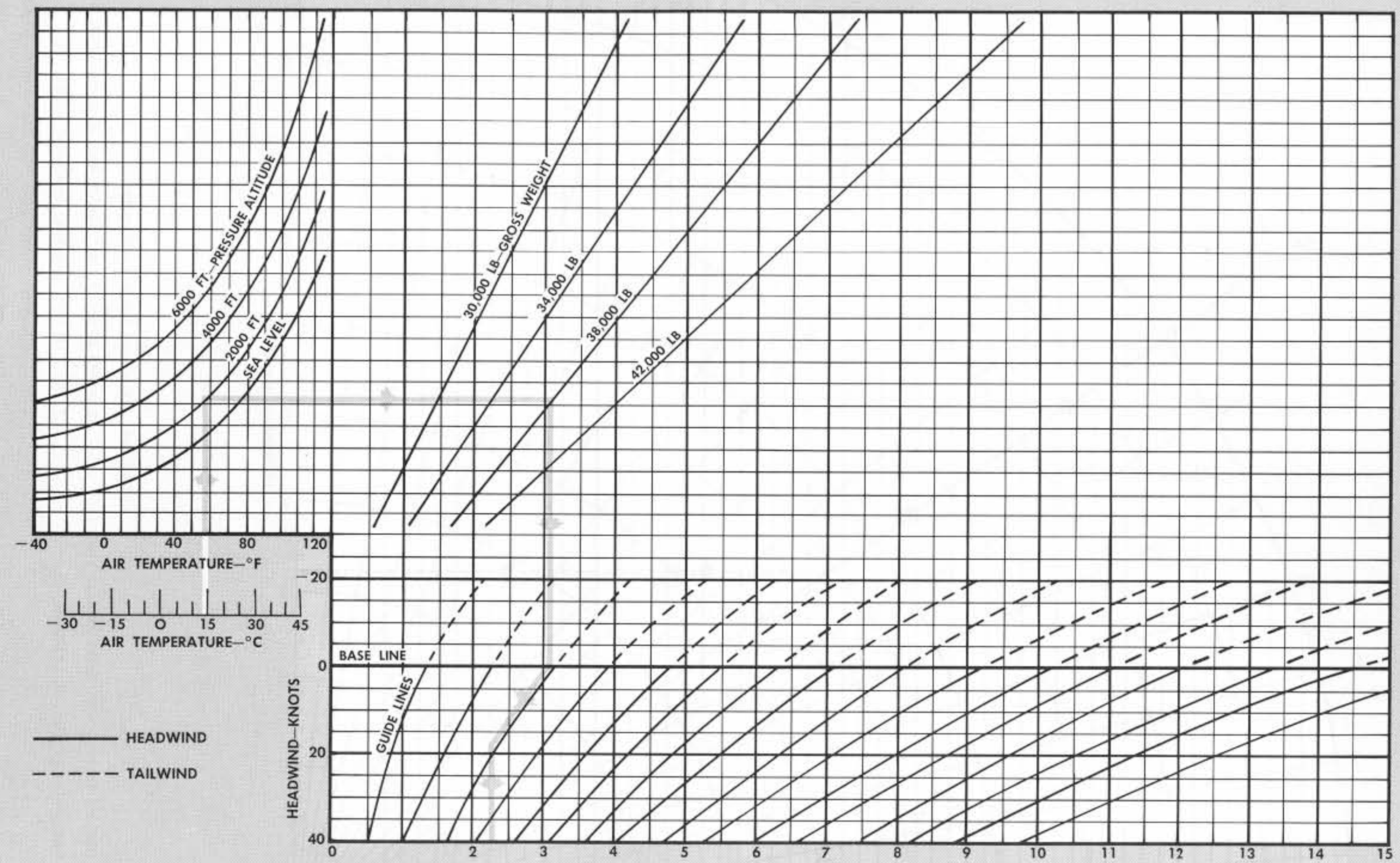
MAXIMUM POWER

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): (2) **J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. USE 30 DEGREE FLAPS.
2. DISTANCE SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE, ON DRY HARD-SURFACE RUNWAY.
3. USE 100% RPM WITH AFTERBURNING UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURE.
4. ENGINE AIR INLET SCREENS EXTENDED.

GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
30,000 LB	114 KNOTS IAS	119 KNOTS IAS
34,000 LB	119 KNOTS IAS	125 KNOTS IAS
38,000 LB	125 KNOTS IAS	131 KNOTS IAS

BC-201(1)

Figure A-6 (Sheet 1 of 6 Sheets).

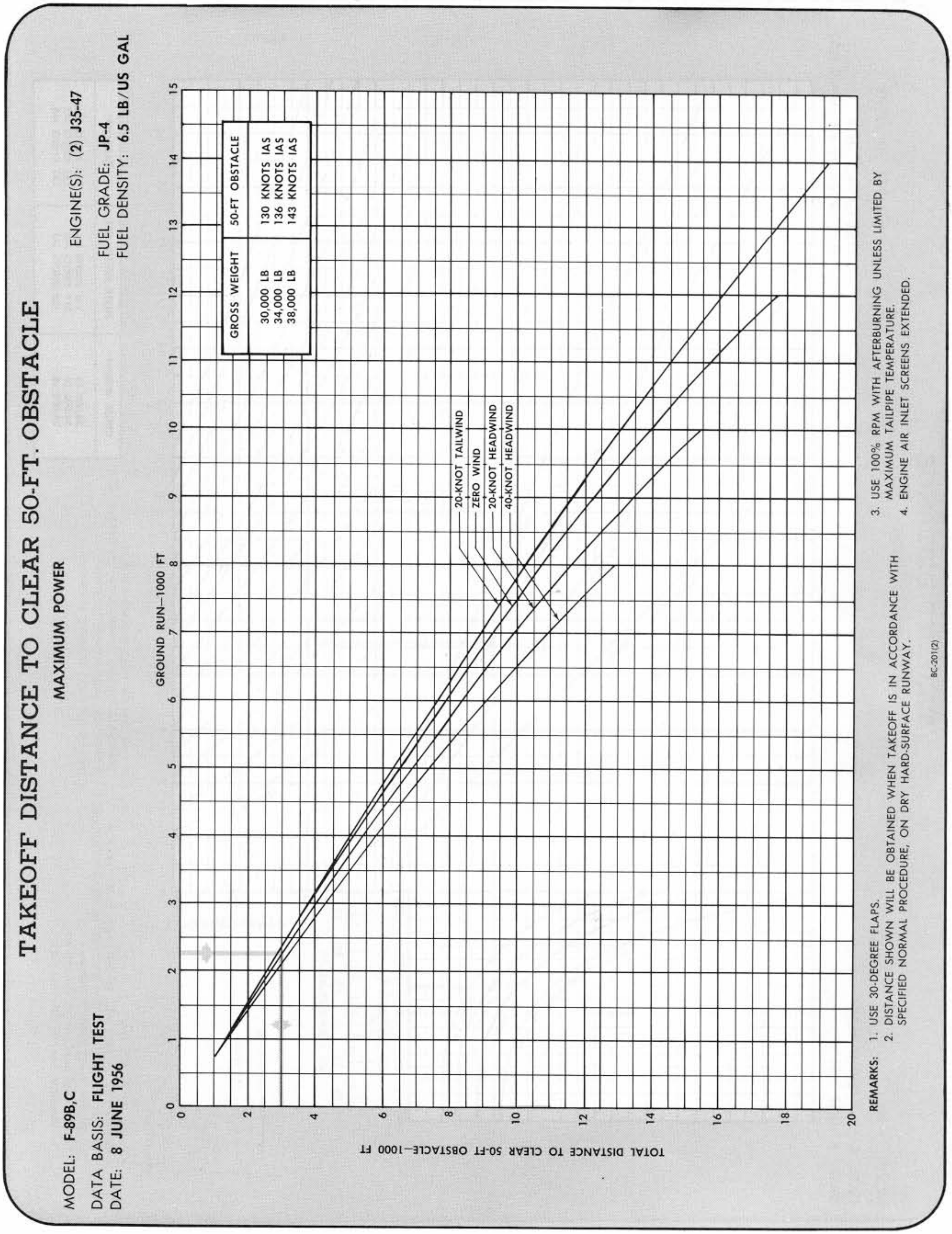


Figure A-6 (Sheet 2 of 6 Sheets).

TAKEOFF DISTANCE

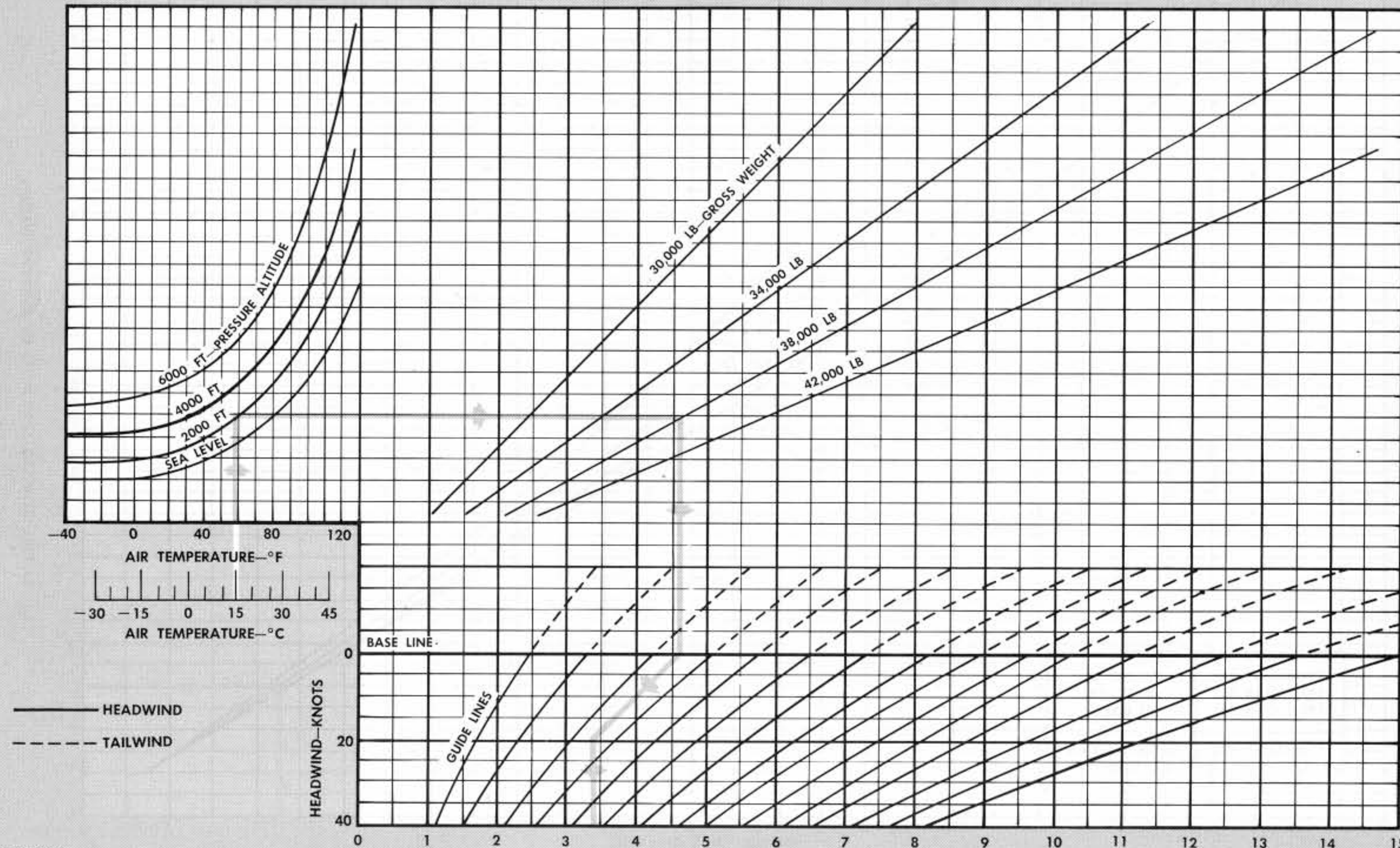
MILITARY POWER

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. USE 30 DEGREE FLAPS.
2. DISTANCE SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE, ON DRY HARD-SURFACE RUNWAY.
3. USE 100% RPM UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURE.
4. IF ONE ENGINE FAILS DURING TAKEOFF, IMMEDIATELY START AFTERBURNER ON OPERATING ENGINE OR DISCONTINUE TAKEOFF.
5. ENGINE AIR INLET SCREENS EXTENDED.

GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
30,000 LB	114 KNOTS IAS	119 KNOTS IAS
34,000 LB	119 KNOTS IAS	125 KNOTS IAS
38,000 LB	125 KNOTS IAS	131 KNOTS IAS

BC-202(1)

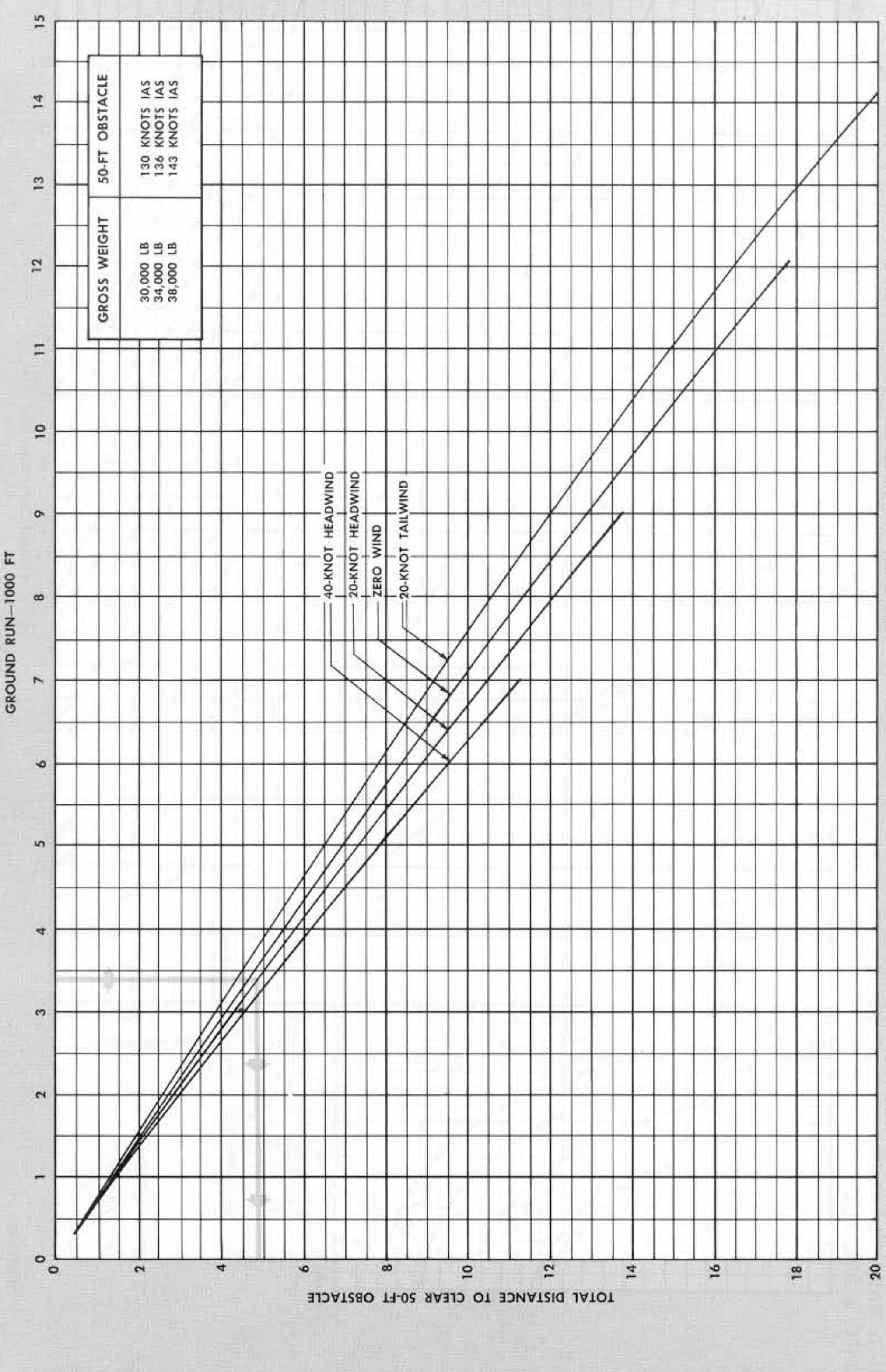
Figure A-6 (Sheet 3 of 6 Sheets).

TAKEOFF DISTANCE TO CLEAR 50-FT. OBSTACLE

MILITARY POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

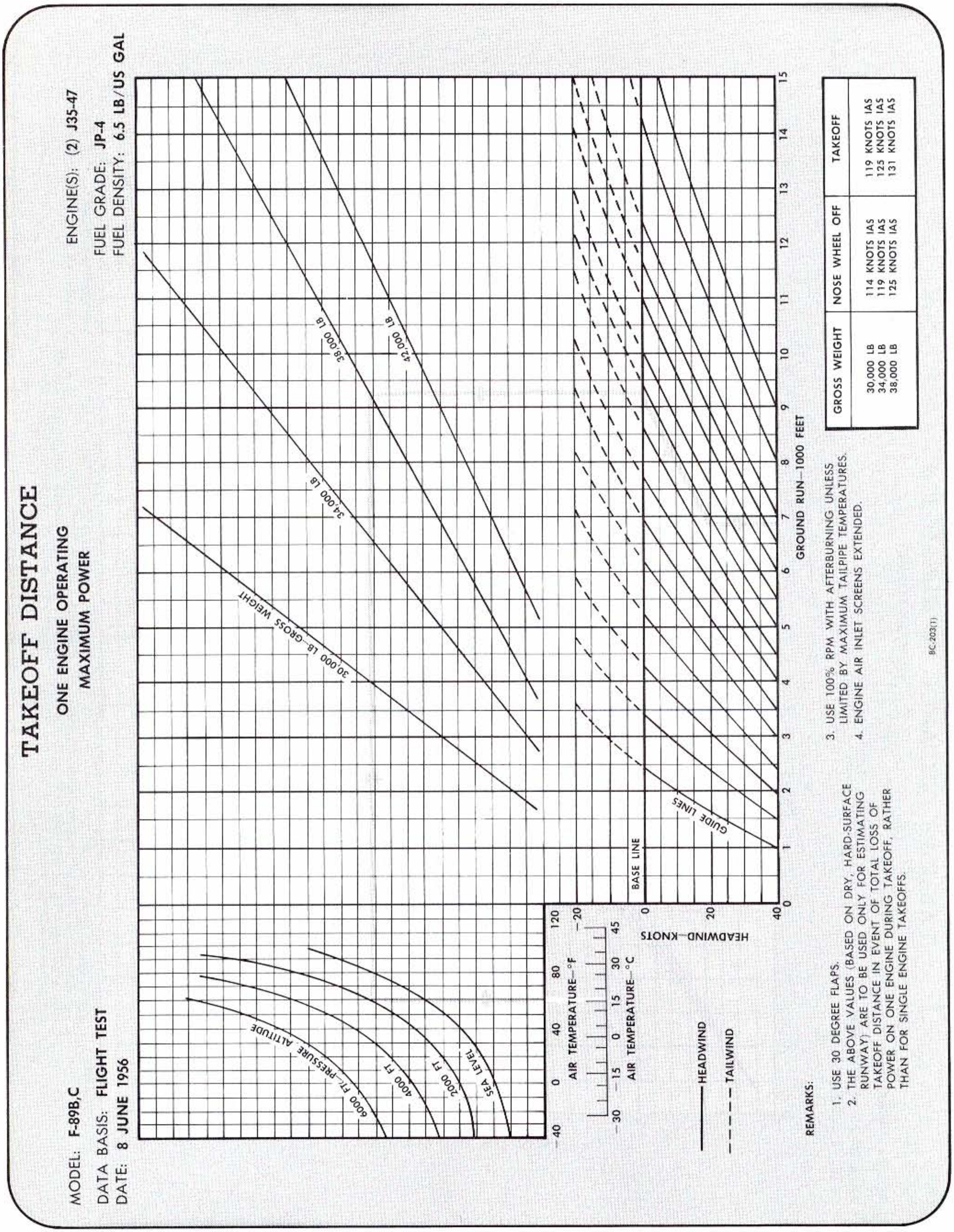
ENGINE(S): (2) J35-47
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. USE 30 DEGREE FLAPS.
2. DISTANCE SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE, ON DRY HARD-SURFACE RUNWAY.
3. USE 100% RPM UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURE.
4. IF ONE ENGINE FAILS DURING TAKEOFF, IMMEDIATELY START AFTERBURNER ON OPERATING ENGINE OR DISCONTINUE TAKEOFF.
5. ENGINE AIR INLET SCREENS EXTENDED.

Figure A-6 (Sheet 4 of 6 Sheets).



GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
30,000 LB	114 KNOTS IAS	119 KNOTS IAS
34,000 LB	119 KNOTS IAS	125 KNOTS IAS
38,000 LB	125 KNOTS IAS	131 KNOTS IAS

REMARKS:

1. USE 30 DEGREE FLAPS.
2. THE ABOVE VALUES (BASED ON DRY, HARD-SURFACE RUNWAY) ARE TO BE USED ONLY FOR ESTIMATING TAKEOFF DISTANCE IN EVENT OF TOTAL LOSS OF POWER ON ONE ENGINE DURING TAKEOFF, RATHER THAN FOR SINGLE ENGINE TAKEOFFS.
3. USE 100% RPM WITH AFTERBURNING UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURES.
4. ENGINE AIR INLET SCREENS EXTENDED.

Figure A-6 (Sheet 5 of 6 Sheets).

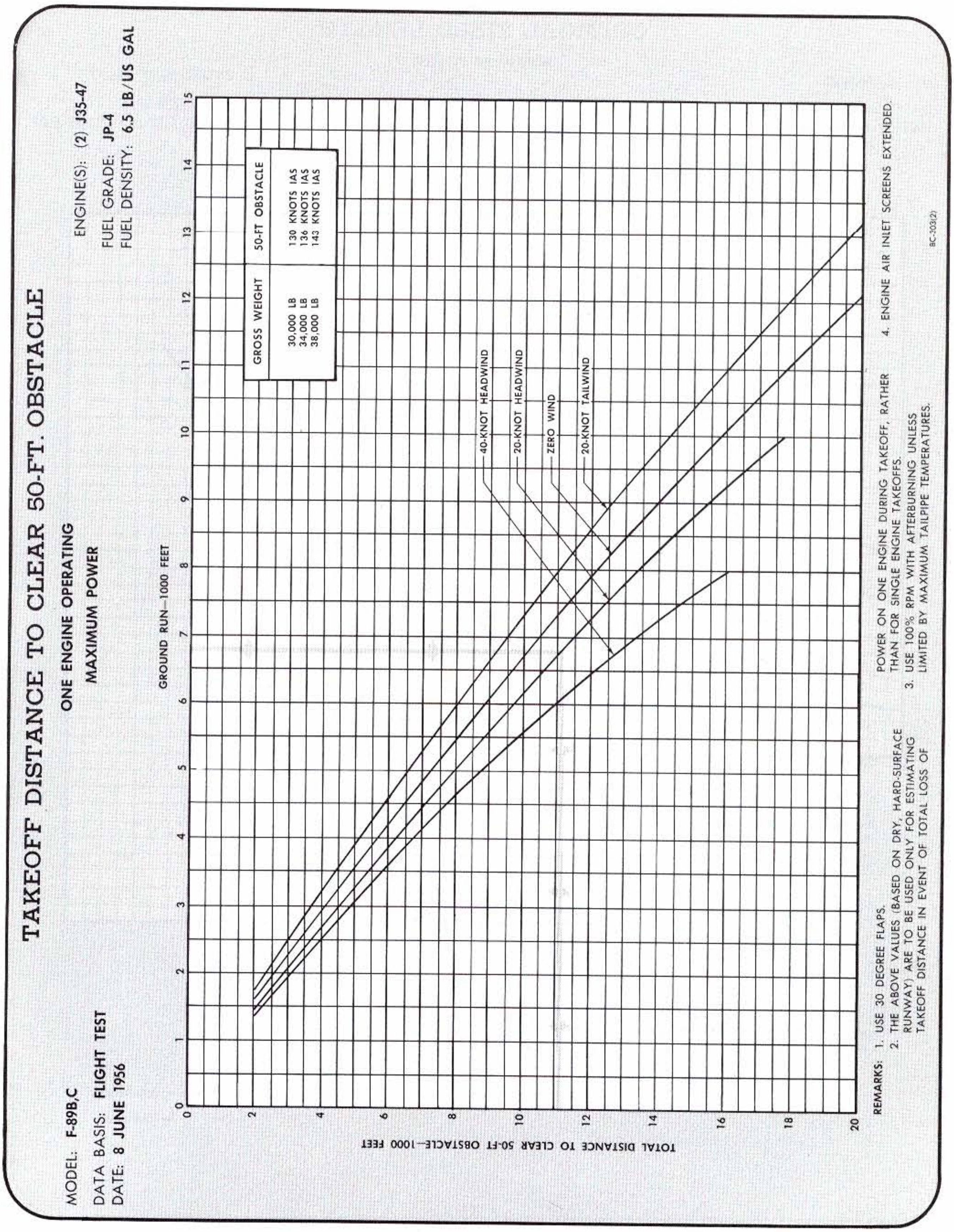


Figure A-6 (Sheet 6 of 6 Sheets).

CRITICAL FIELD LENGTH

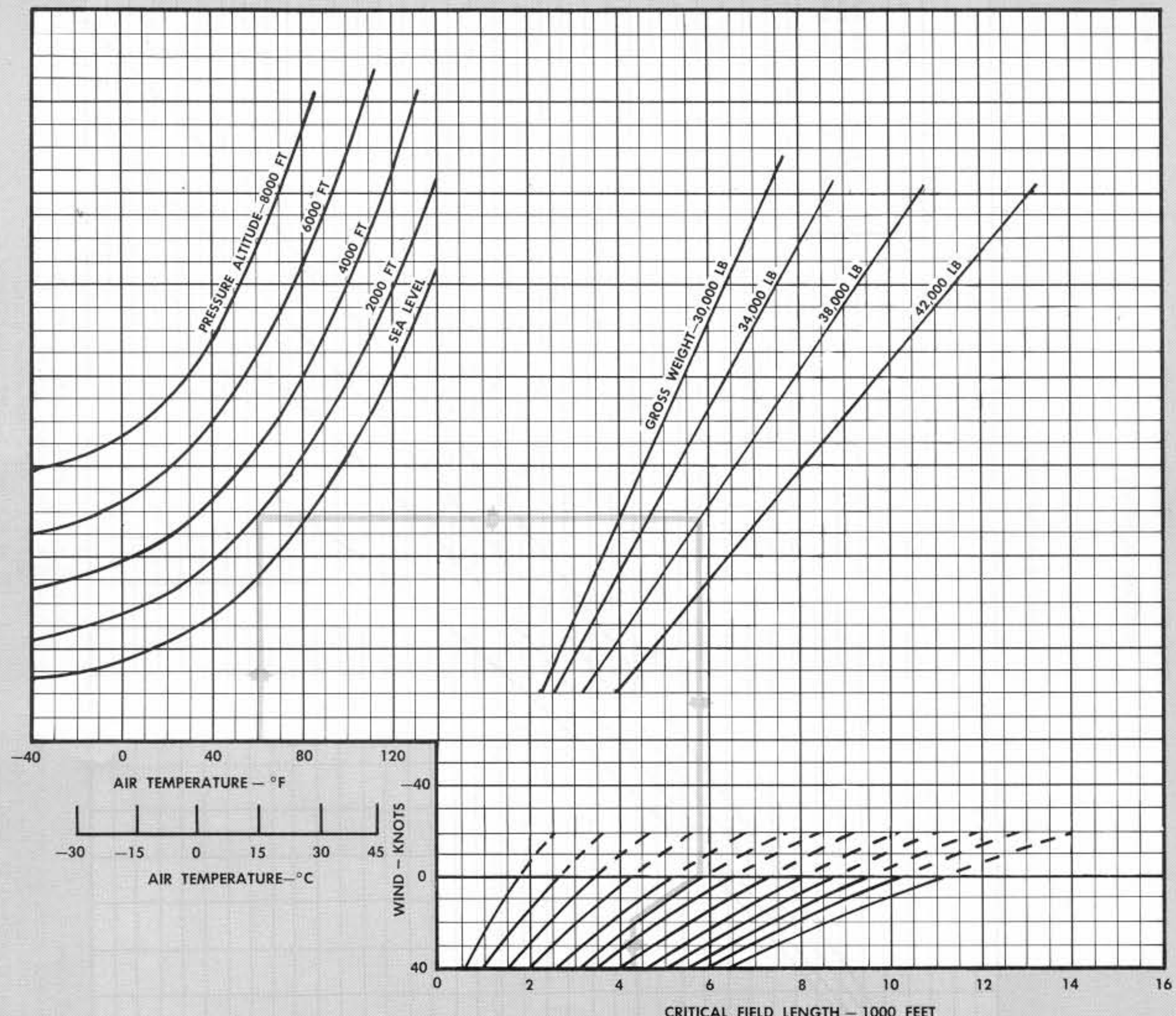
MAXIMUM POWER

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ALL VALUES SHOWN ON CHART ARE BASED ON DRY, HARD SURFACE RUNWAY, 30 DEGREE FLAPS, AND SPEED BRAKES INOPERATIVE.
2. THREE SECONDS ALLOWED FOR PILOT RECOGNITION OF ENGINE FAILURE; AT THE END OF THE THREE SECONDS, THROTTLES ARE CUT AND BRAKES APPLIED.
3. ENGINE INLET SCREENS EXTENDED.

BC-204A

Figure A-7.

REFUSAL SPEEDS

MAXIMUM POWER

MODEL: **F-89B,C**

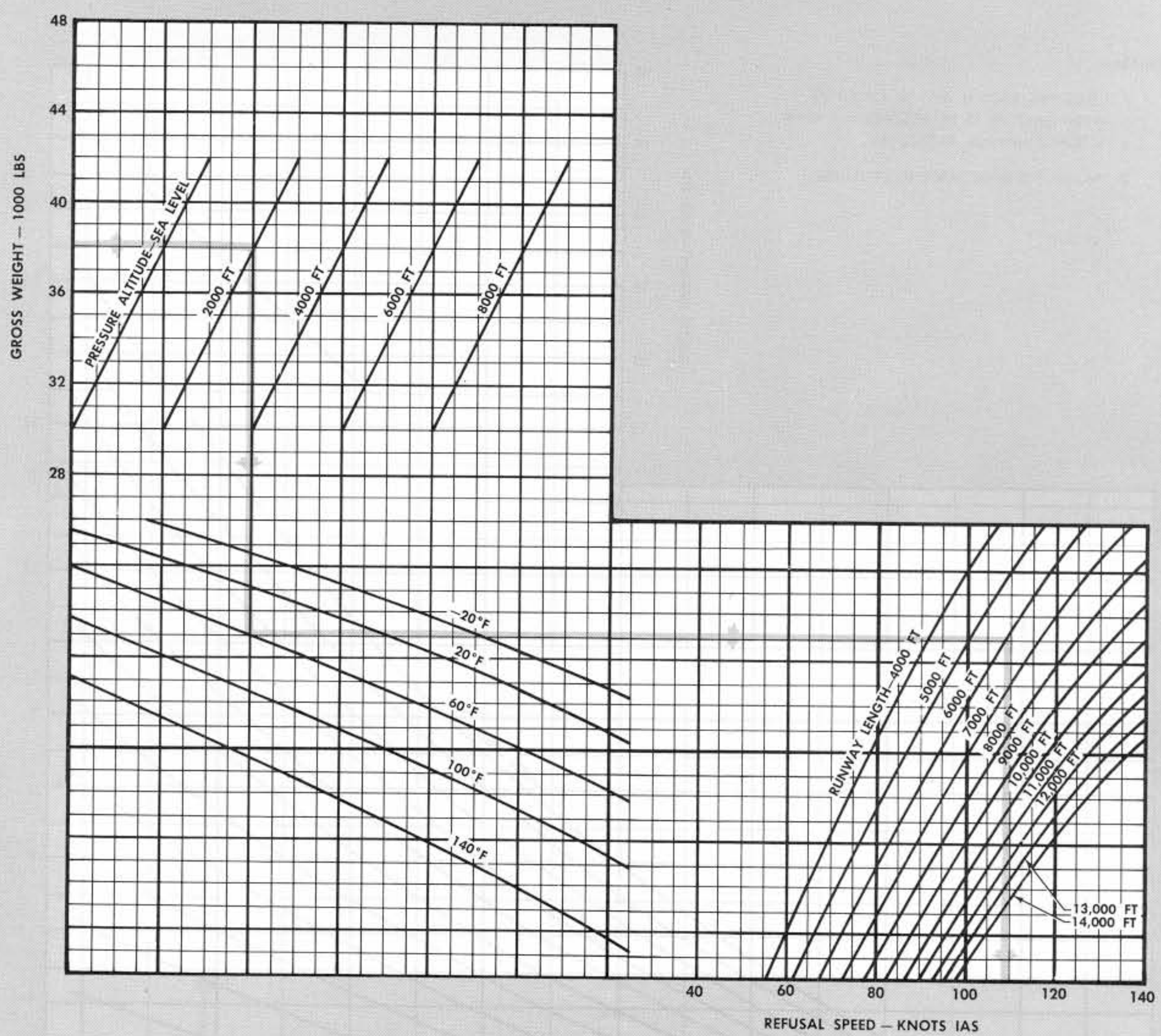
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ABOVE VALUES ARE BASED ON DRY, TAKEOFF HARD SURFACE RUNWAY, USING SPECIFIED NORMAL PROCEDURE UP TO POINT OF ENGINE FAILURE, AND OPERATION IN ACCORDANCE WITH SECTION III AFTER ENGINE FAILURE.
2. ENGINE AIR INLET SCREENS EXTENDED.

BC-205A

Figure A-8.

VELOCITY DURING TAKEOFF GROUND RUN

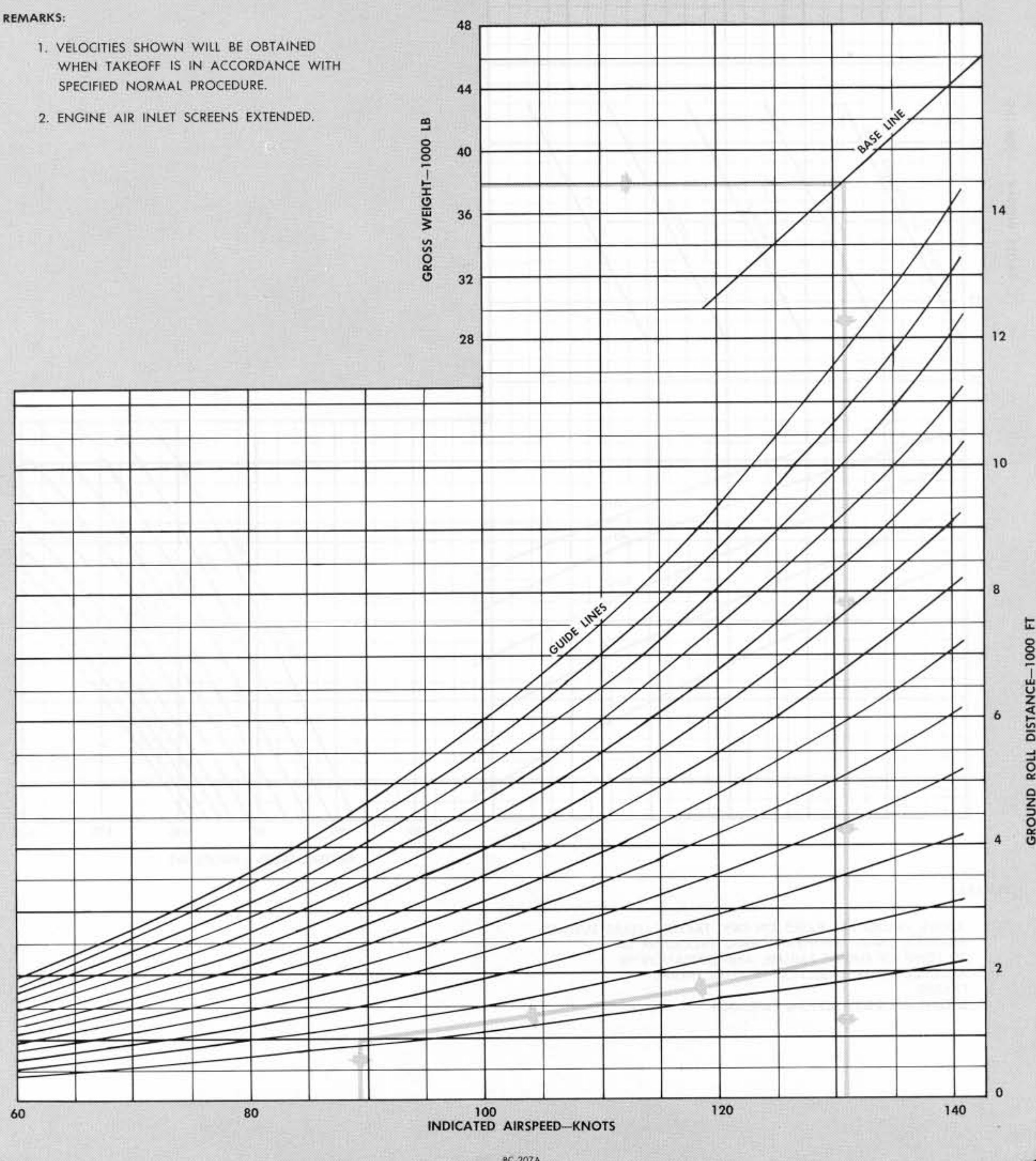
MODEL: **F-89B,C** | **MAXIMUM POWER** | ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

REMARKS:

1. VELOCITIES SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE.
2. ENGINE AIR INLET SCREENS EXTENDED.



BC-207A

Figure A-9 (Sheet 1 of 2 Sheets).

VELOCITY DURING TAKEOFF GROUND RUN

MILITARY POWER

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

REMARKS:

1. VELOCITIES SHOWN WILL BE OBTAINED WHEN TAKEOFF IS IN ACCORDANCE WITH SPECIFIED NORMAL PROCEDURE.
2. ENGINE AIR INLET SCREENS EXTENDED.

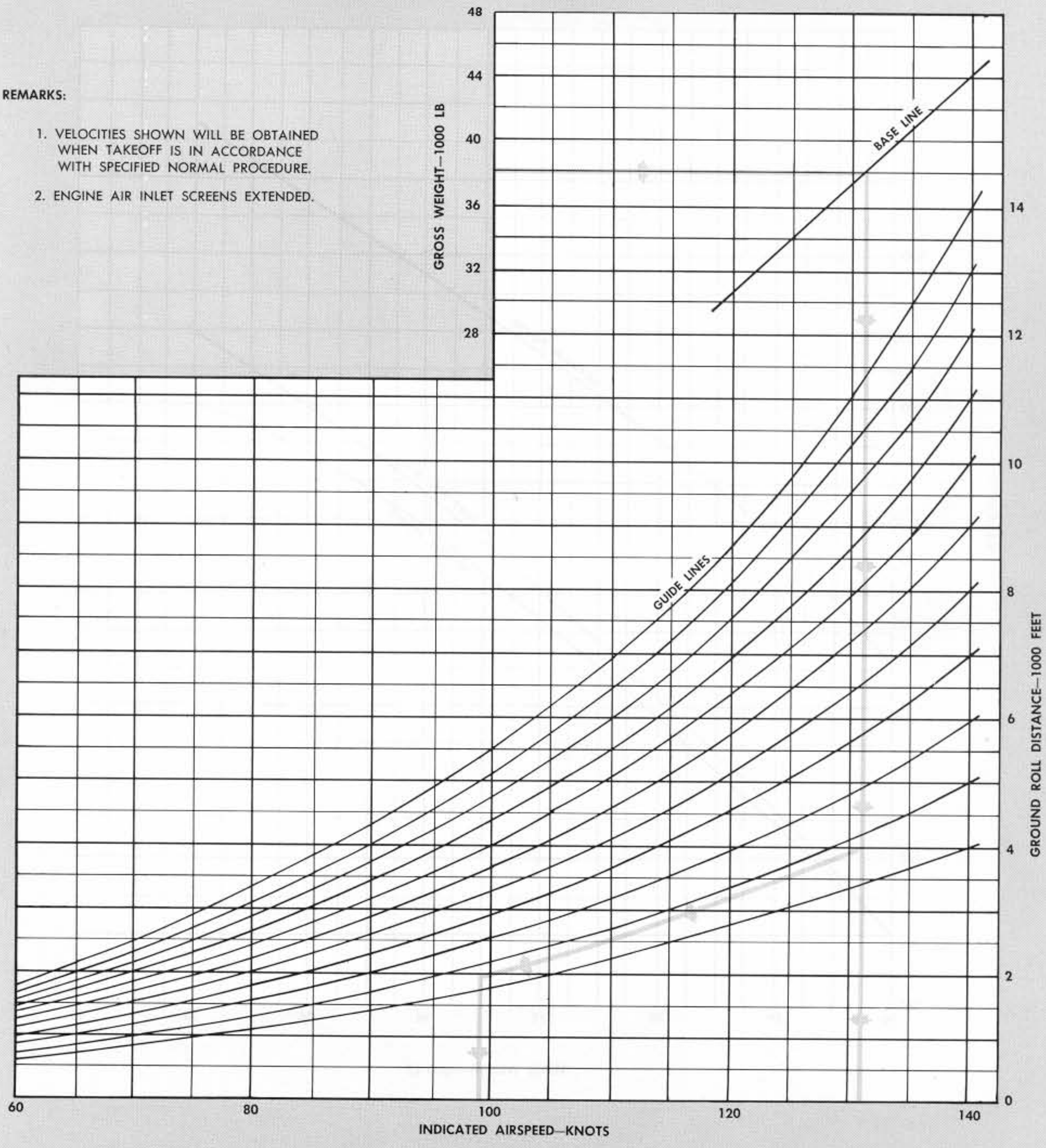


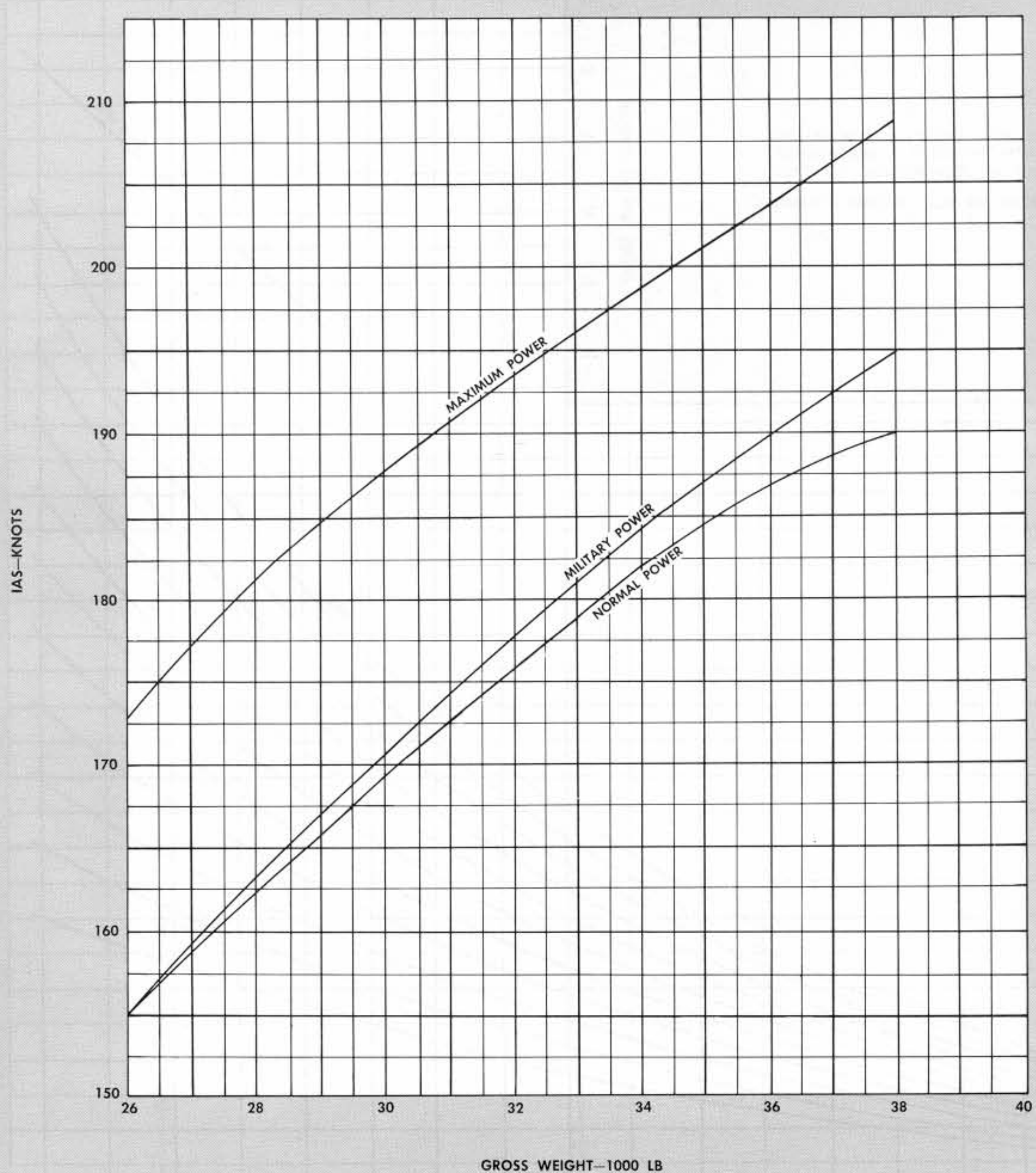
Figure A-9 (Sheet 2 of 2 Sheets).

MINIMUM DISTANCE CLIMB

SEA LEVEL TO 10,000 FT

MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956

ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



8C-297

Figure A-10.

BEST CLIMB PERFORMANCE (RANGE)

MODEL: **F-89B,C**

MAXIMUM POWER

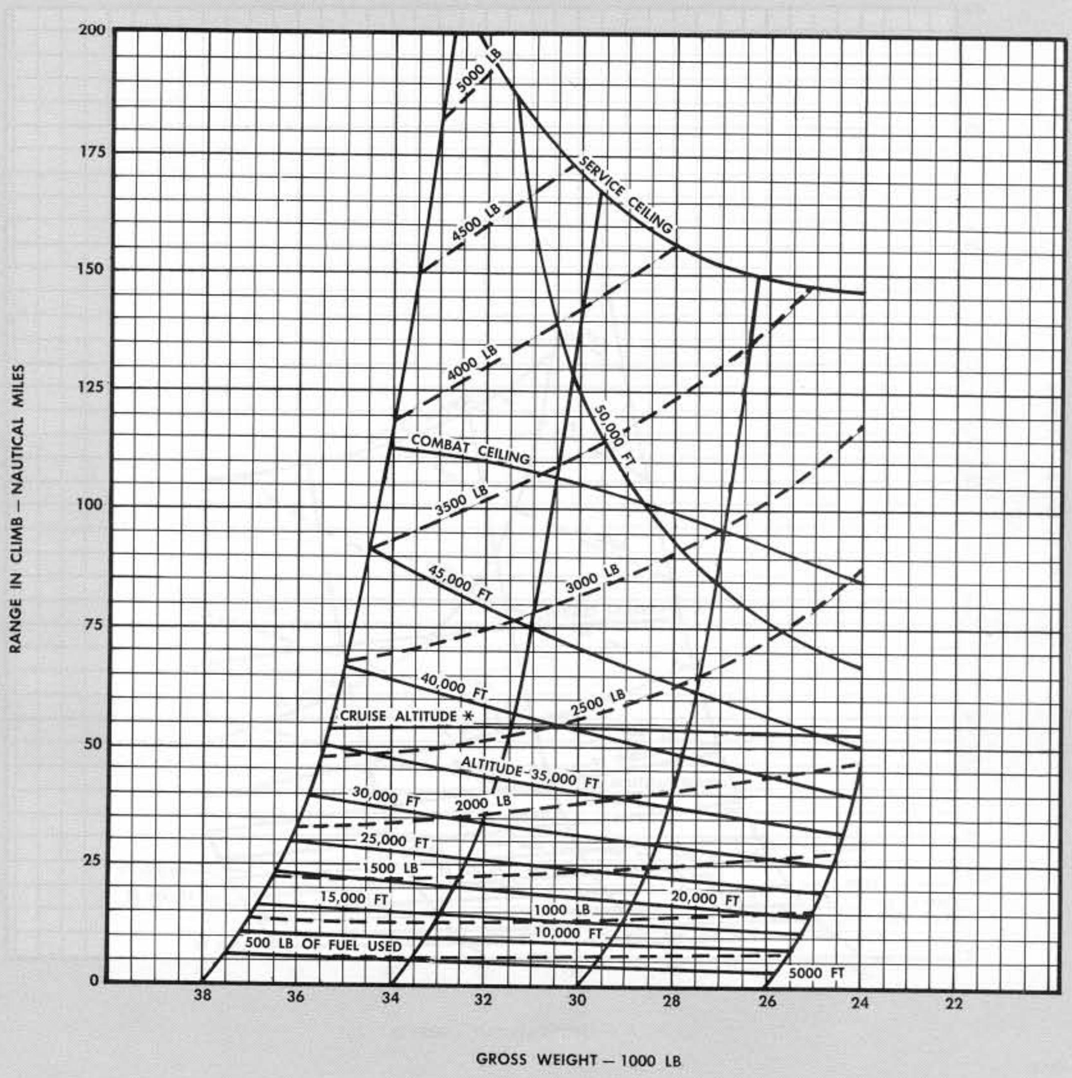
ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE – NORMAL RATED POWER.

BC-219A

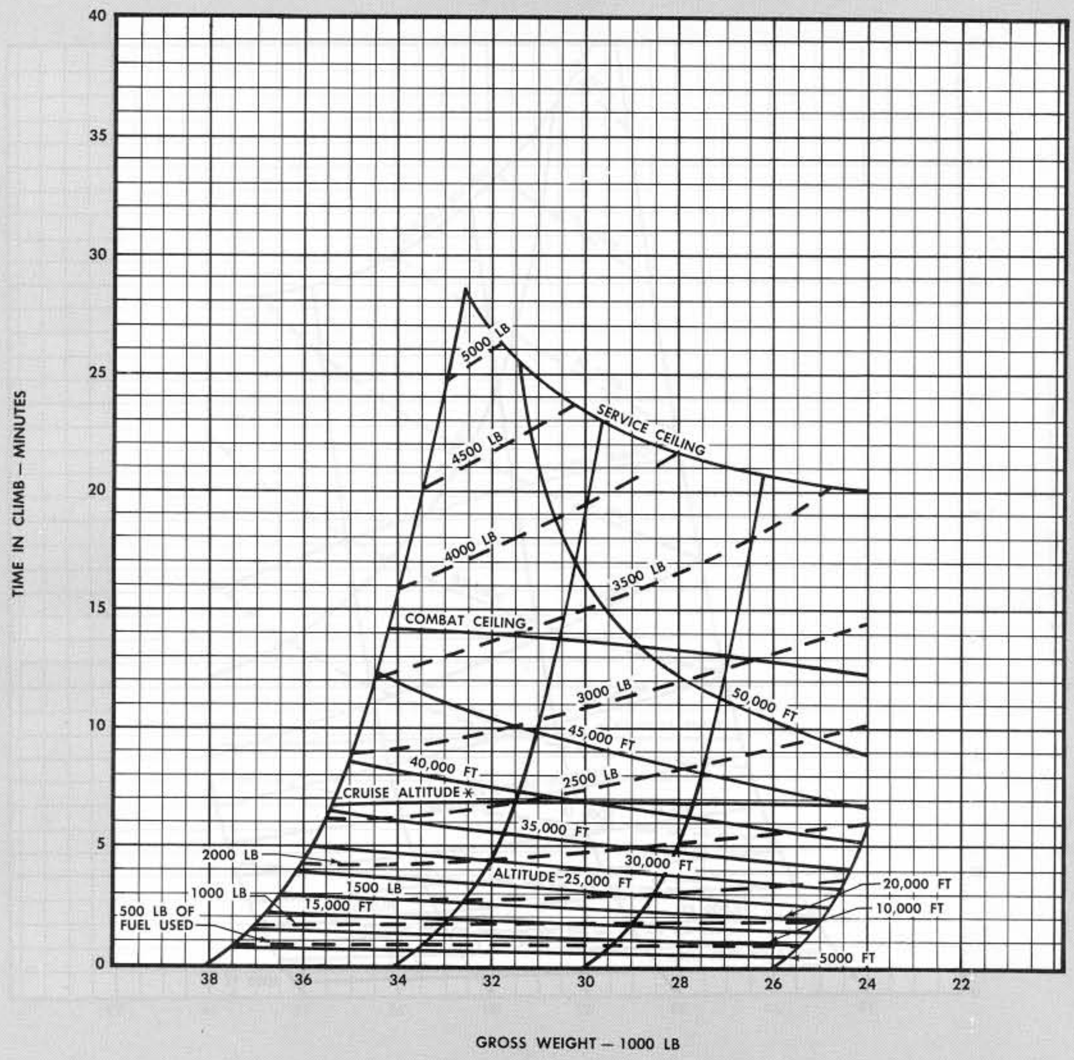
Figure A-11 (Sheet 1 of 15 Sheets).

BEST CLIMB PERFORMANCE (TIME)

MAXIMUM POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

BC-218A

Figure A-11 (Sheet 2 of 15 Sheets).

BEST CLIMB SPEED

MAXIMUM POWER

MODEL: **F-89B,C**

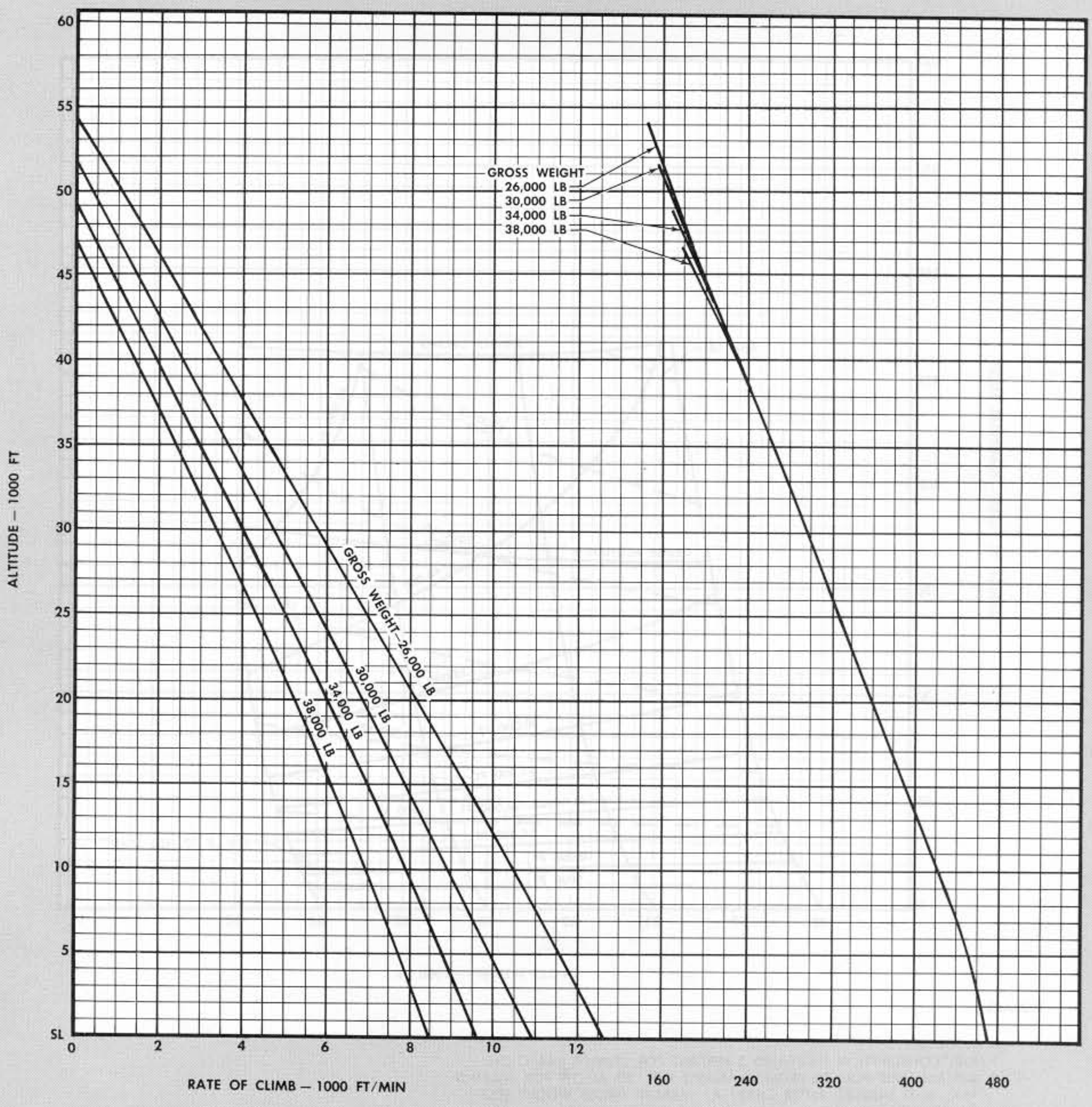
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
2. ENGINE AIR INLET SCREENS RETRACTED.

BC-210A

Figure A-11 (Sheet 3 of 15 Sheets).

BEST CLIMB PERFORMANCE (RANGE)

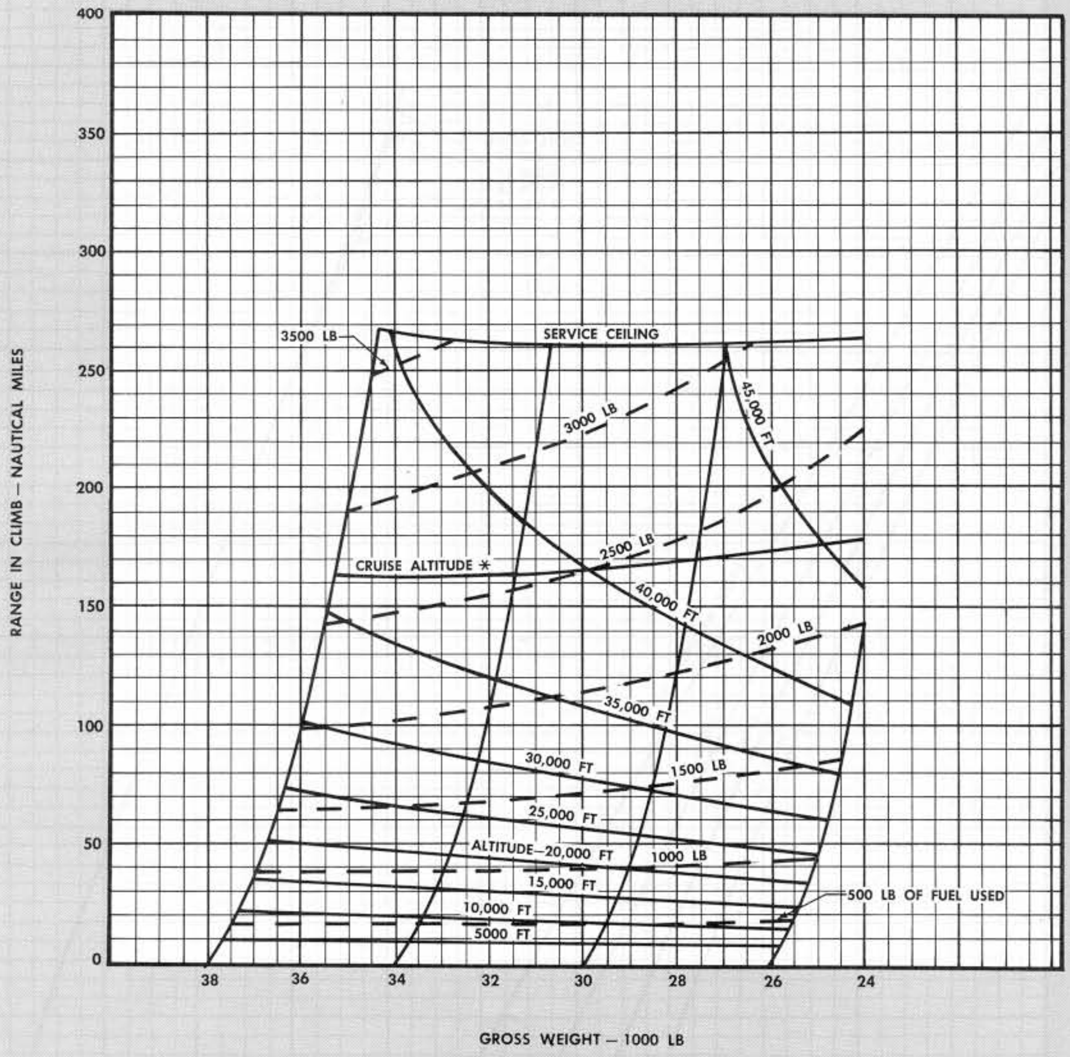
MODEL: **F-89B,C**

MILITARY POWER

ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE – NORMAL RATED POWER.

BC-221A

Figure A-11 (Sheet 4 of 15 Sheets).

BEST CLIMB PERFORMANCE (TIME)

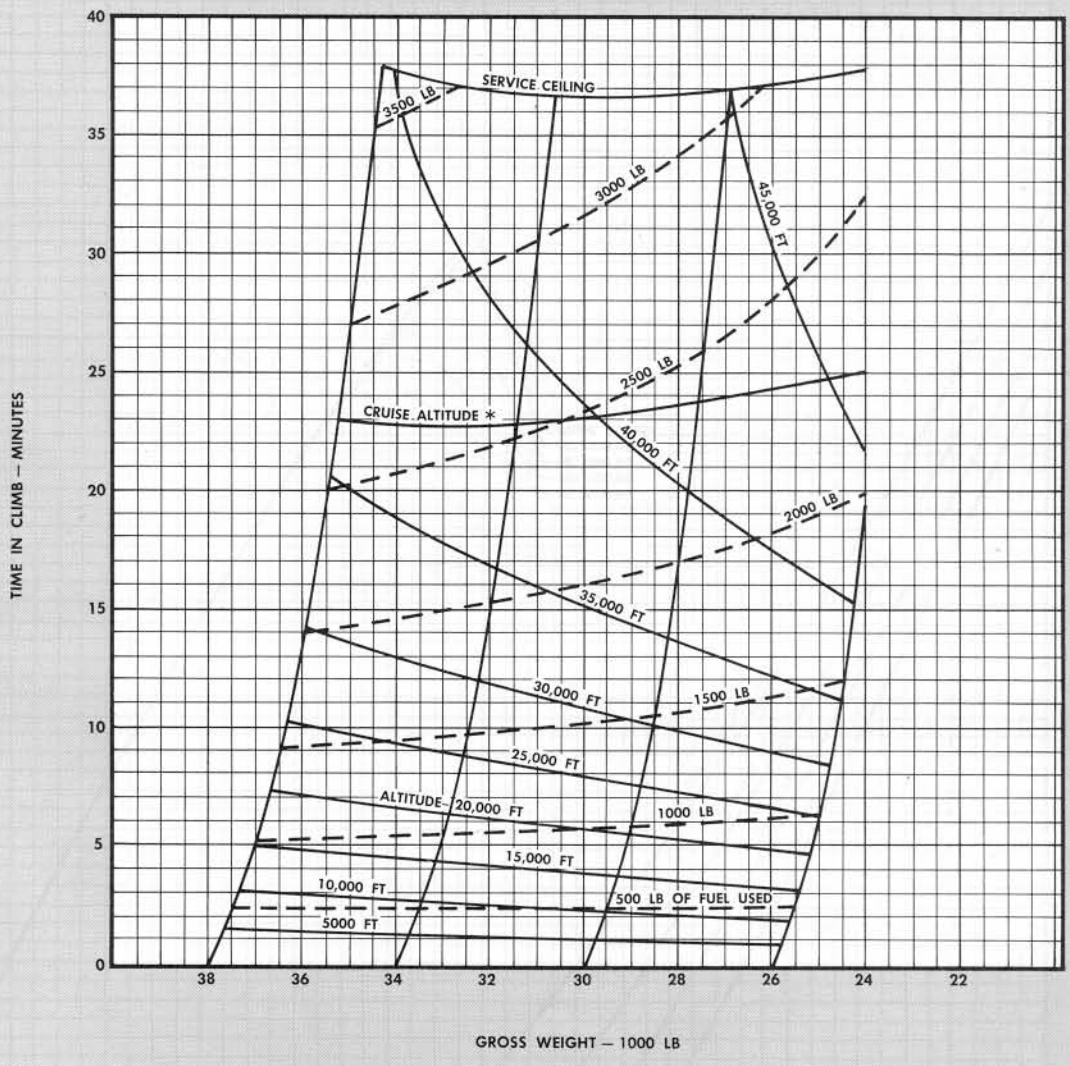
MODEL: **F-89B,C**

MILITARY POWER

ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

BC-220A

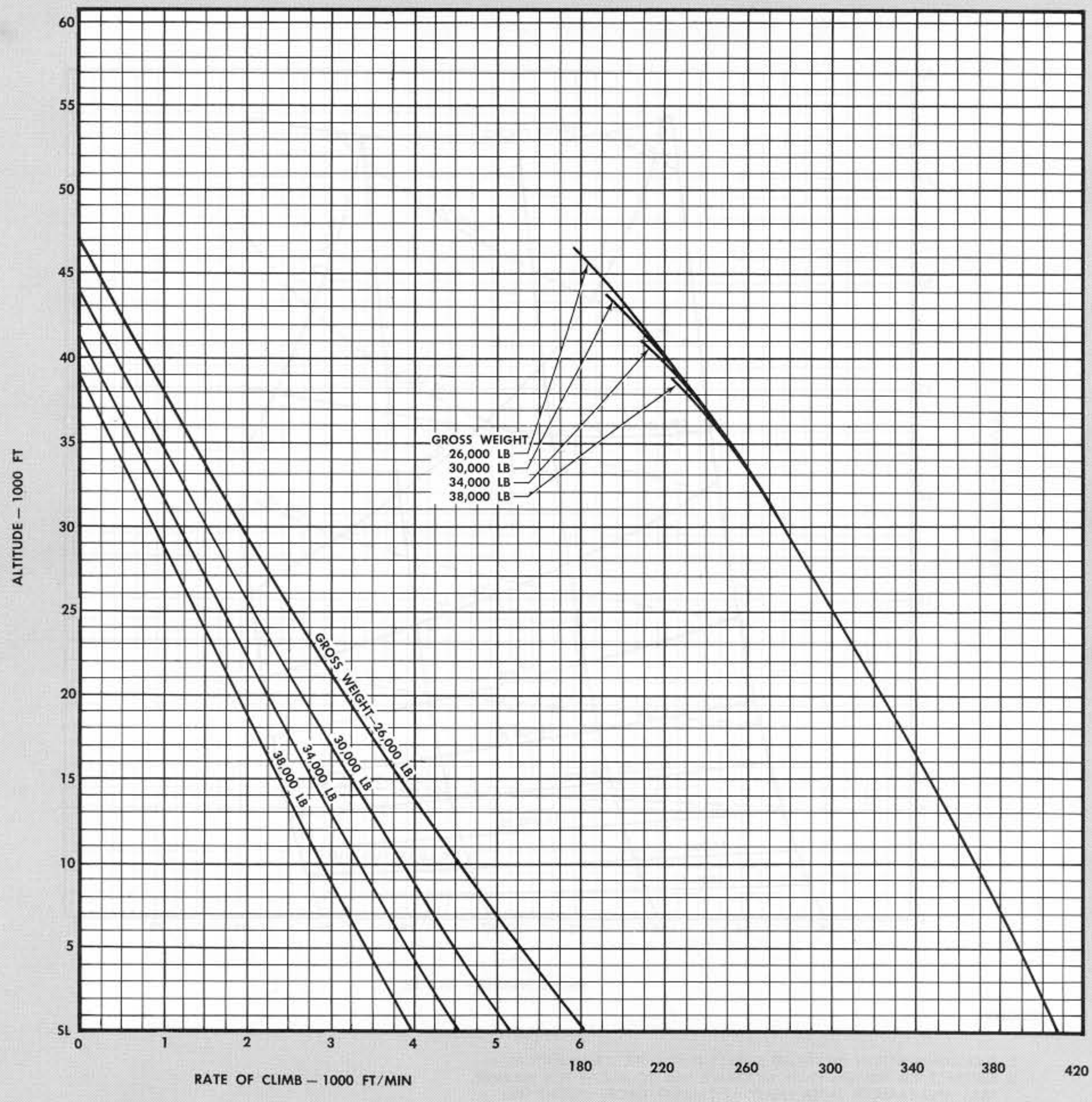
Figure A-11 (Sheet 5 of 15 Sheets).

BEST CLIMB SPEED

MILITARY POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
2. ENGINE AIR INLET SCREENS RETRACTED.

BC-211A

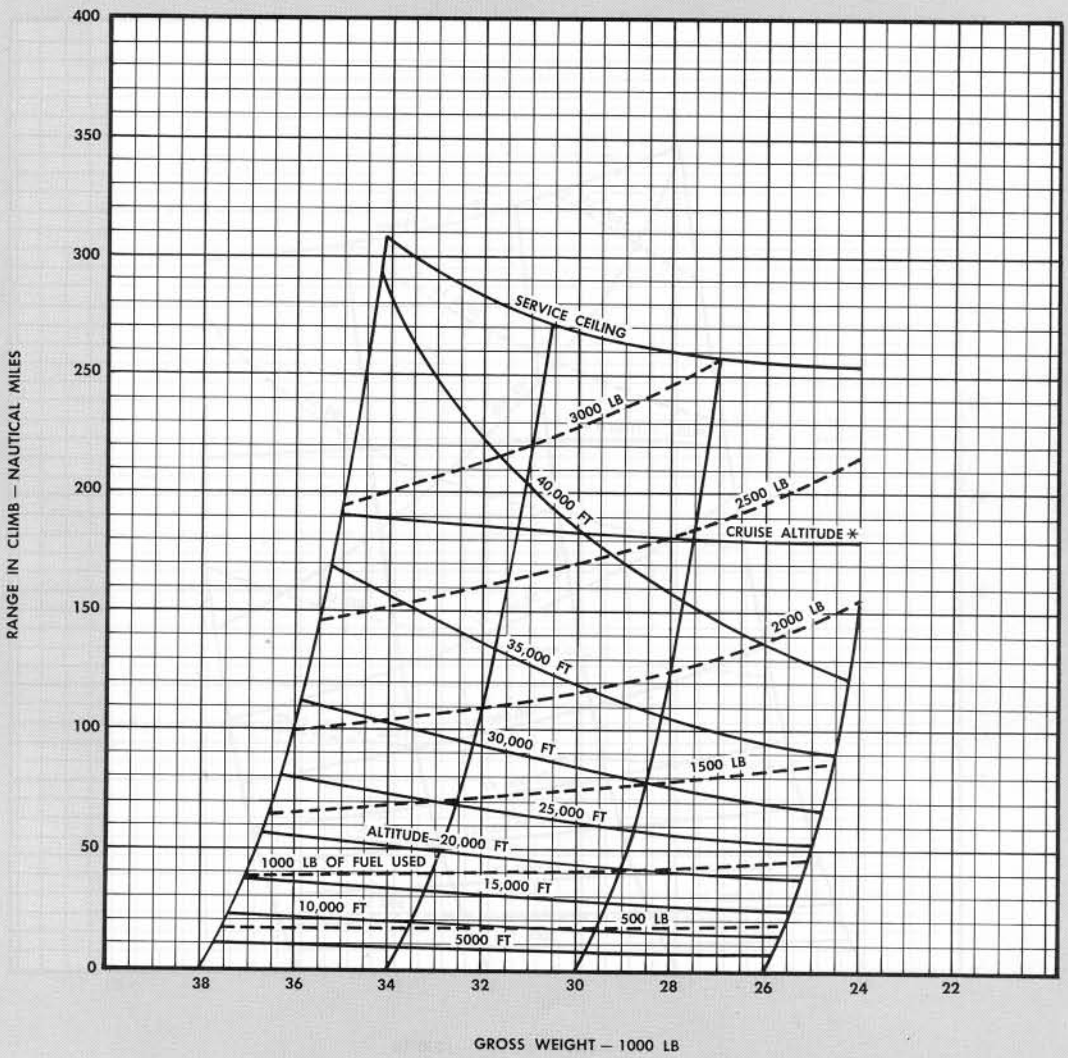
Figure A-11 (Sheet 6 of 15 Sheets).

BEST CLIMB PERFORMANCE (RANGE)

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

NORMAL POWER

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

BC-223A

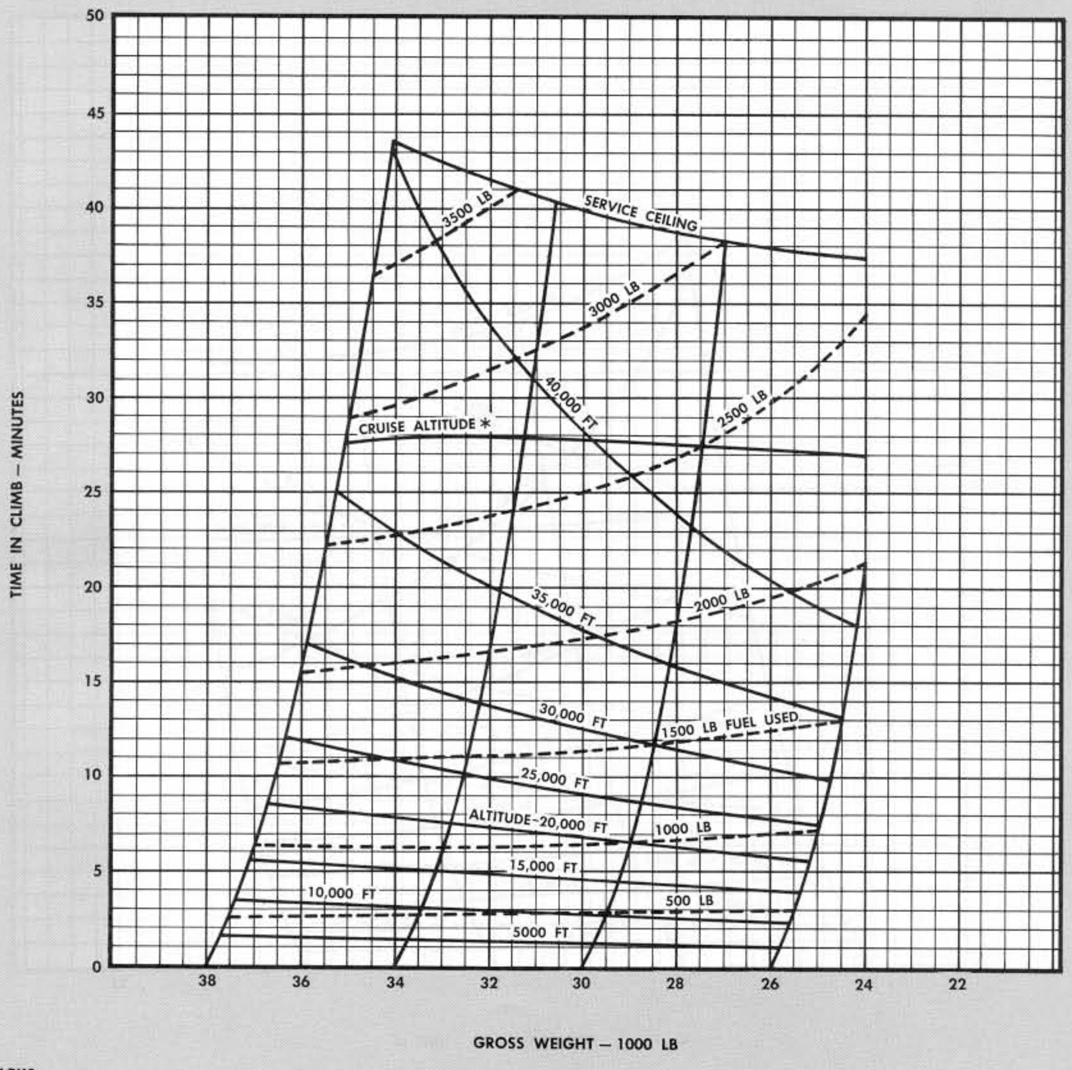
Figure A-11 (Sheet 7 of 15 Sheets).

BEST CLIMB PERFORMANCE (TIME)

NORMAL POWER

MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956

ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

BC-222A

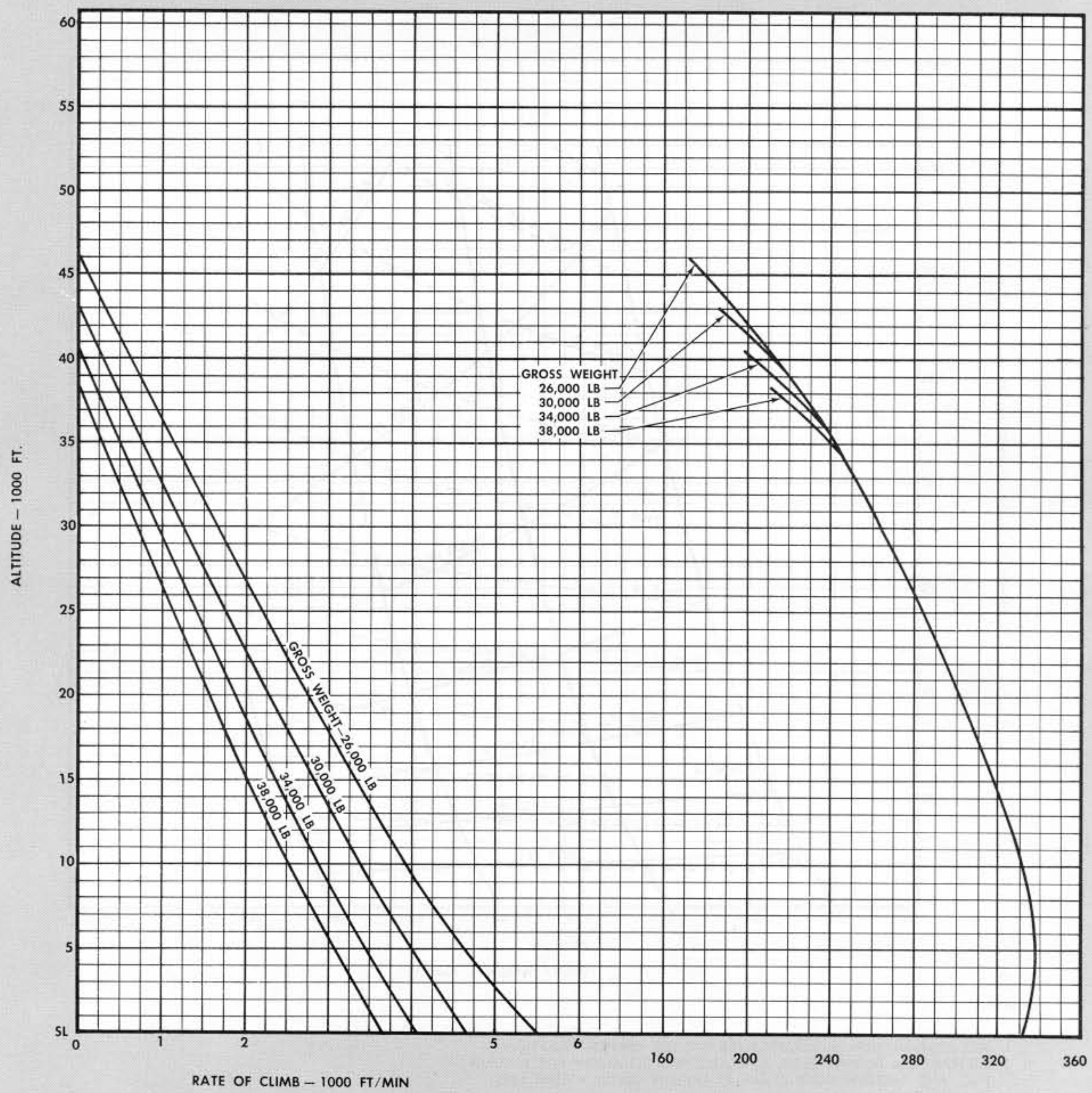
Figure A-11 (Sheet 8 of 15 Sheets).

BEST CLIMB SPEED

NORMAL POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
2. ENGINE AIR INLET SCREENS RETRACTED.

BC-212A

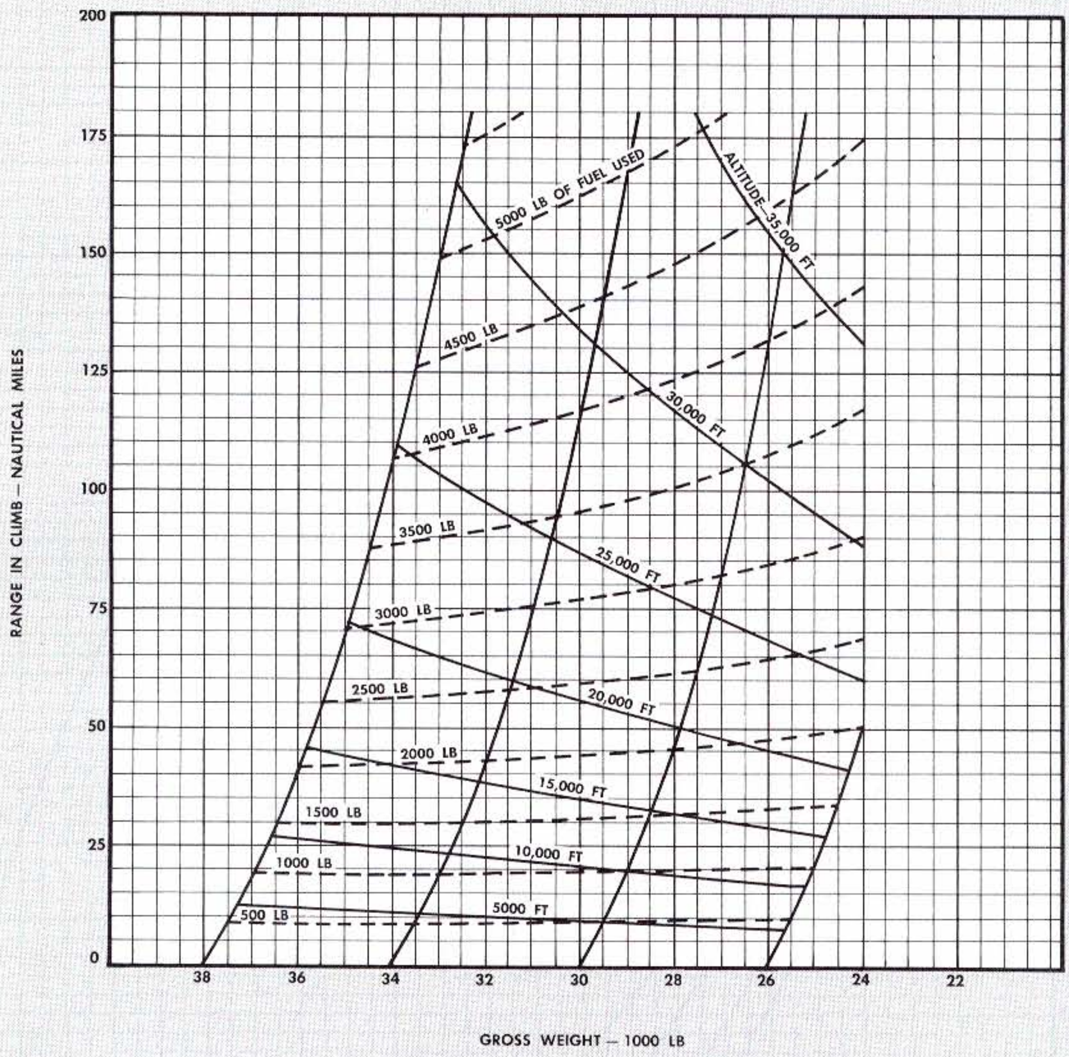
Figure A-11 (Sheet 9 of 15 Sheets).

BEST CLIMB PERFORMANCE (RANGE)

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
MAXIMUM POWER

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-217A

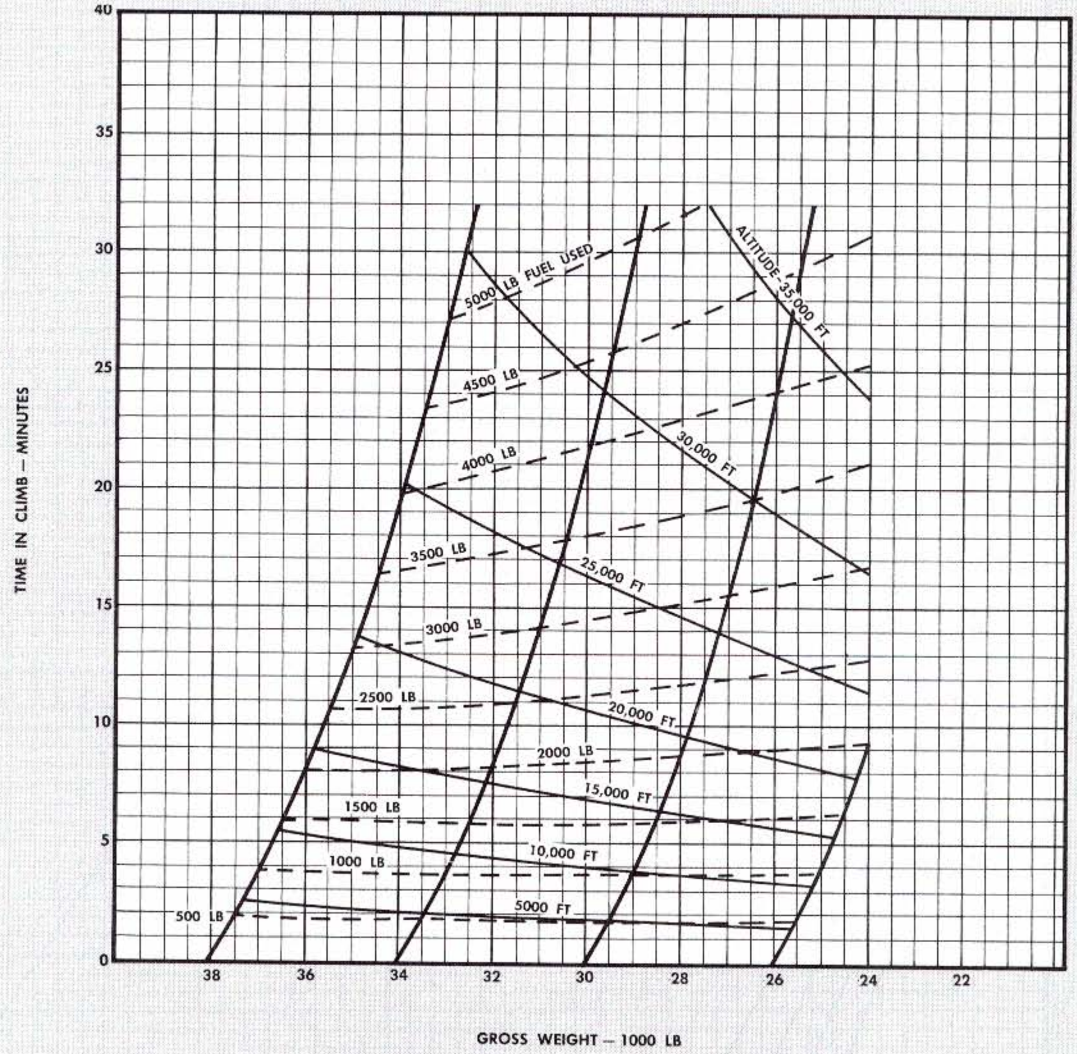
Figure A-11 (Sheet 10 of 15 Sheets).

BEST CLIMB PERFORMANCE (TIME

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
MAXIMUM POWER

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-216A

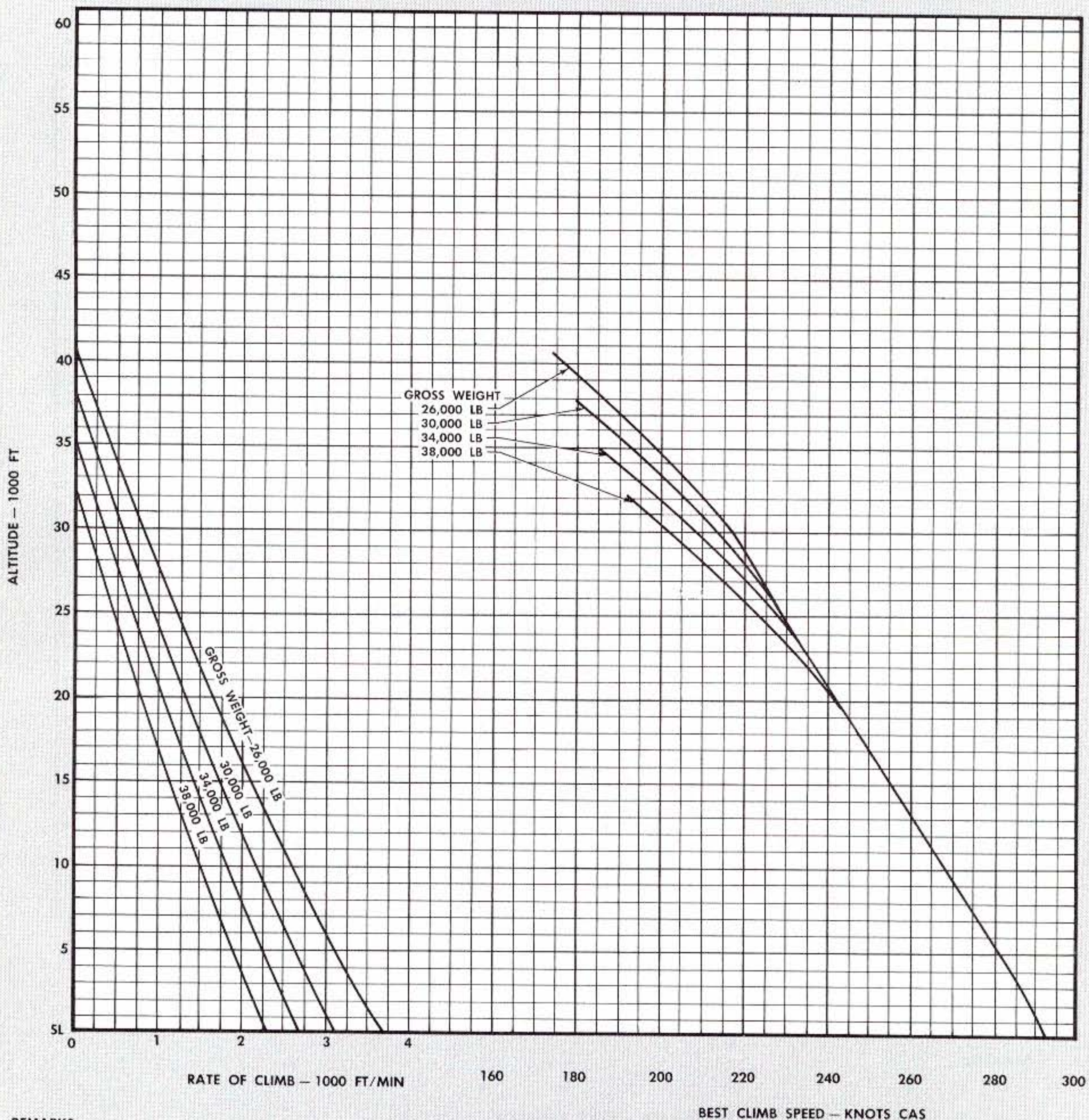
Figure A-11 (Sheet 11 of 15 Sheets).

BEST CLIMB SPEED

ONE ENGINE OPERATING
MAXIMUM POWER

MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956

ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



REMARKS:

1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
2. ENGINE AIR INLET SCREENS RETRACTED.

BC-209A

Figure A-11 (Sheet 12 of 15 Sheets).

BEST CLIMB PERFORMANCE (RANGE)

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**

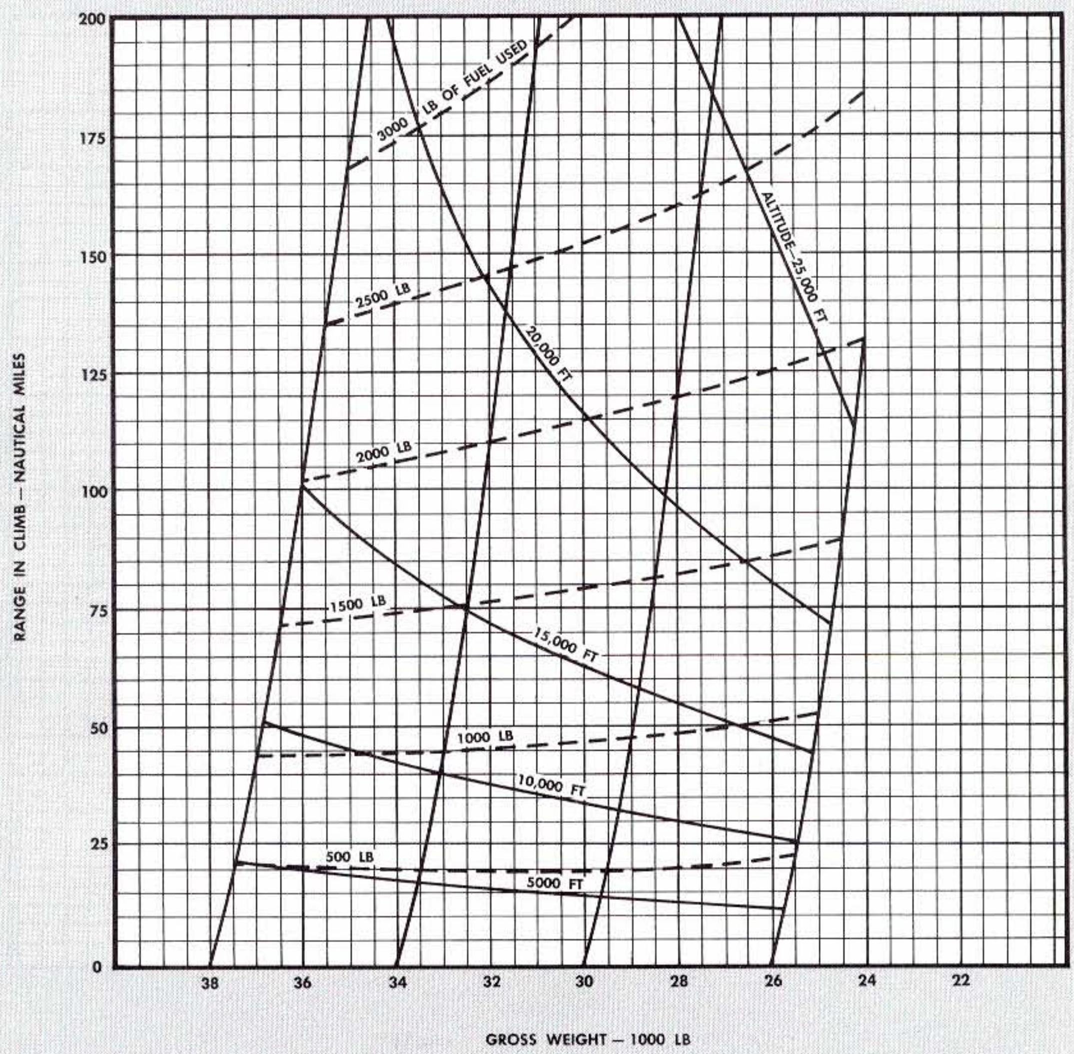
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
MILITARY POWER

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-294A

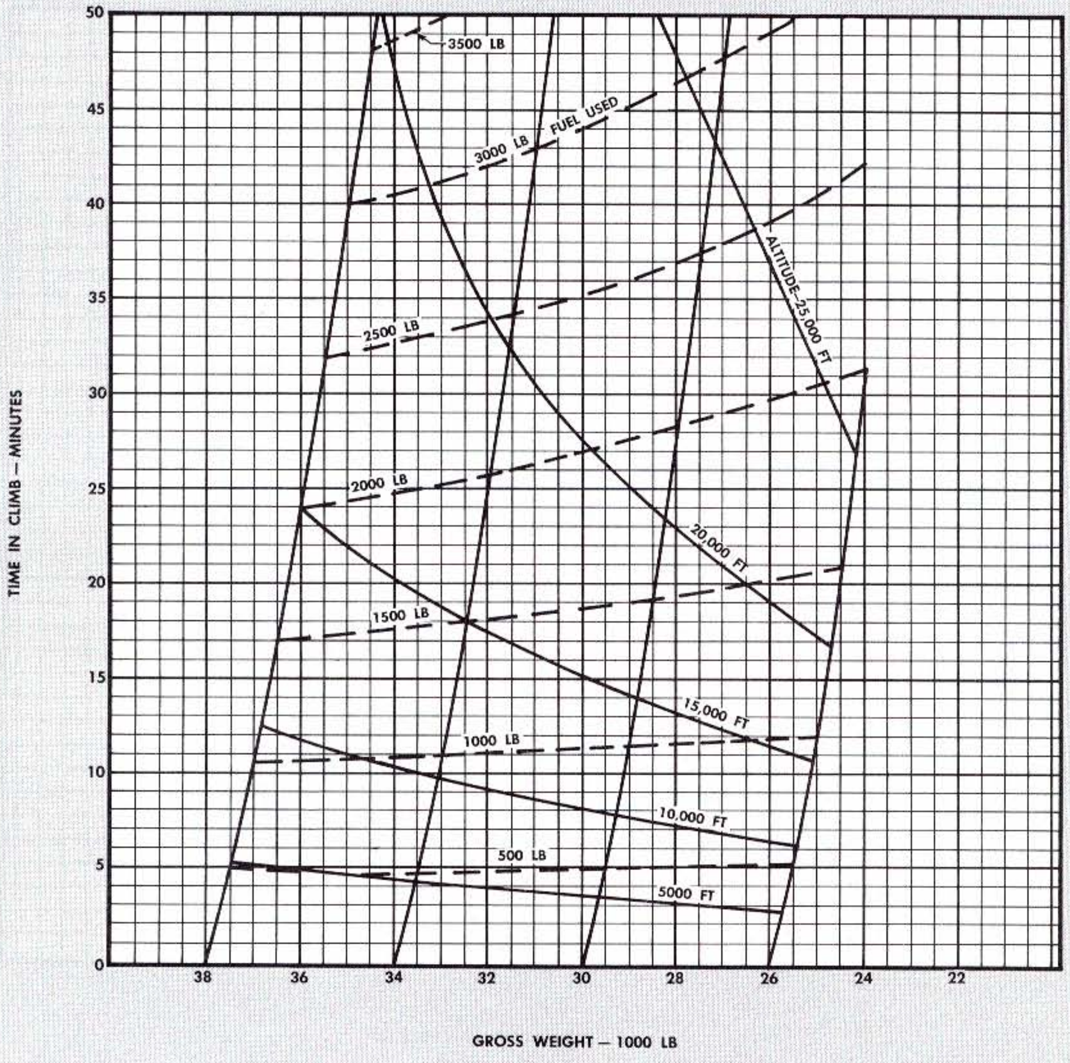
Figure A-11 (Sheet 13 of 15 Sheets).

BEST CLIMB PERFORMANCE (TIME)

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
MILITARY POWER

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. SUBTRACT 906 POUNDS FROM AVAILABLE FUEL TO ALLOW FOR WARMUP, TAXI, AND TAKEOFF; ENTER CHART AT TAKEOFF GROSS WEIGHT LESS 906 POUNDS.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-293A

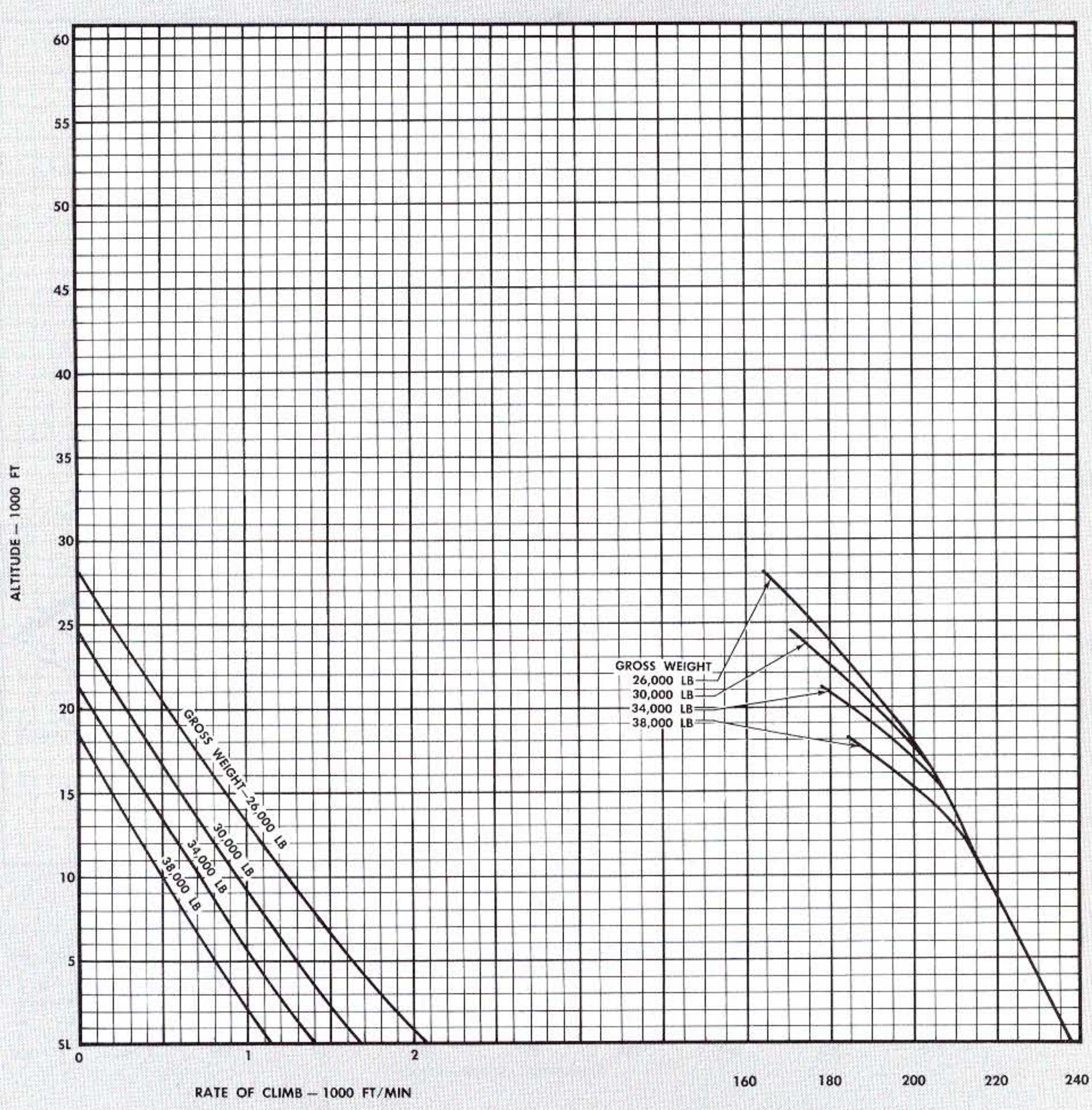
Figure A-11 (Sheet 14 of 15 Sheets).

BEST CLIMB SPEED

ONE ENGINE OPERATING
MILITARY POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
2. ENGINE AIR INLET SCREENS RETRACTED.

BC-295A

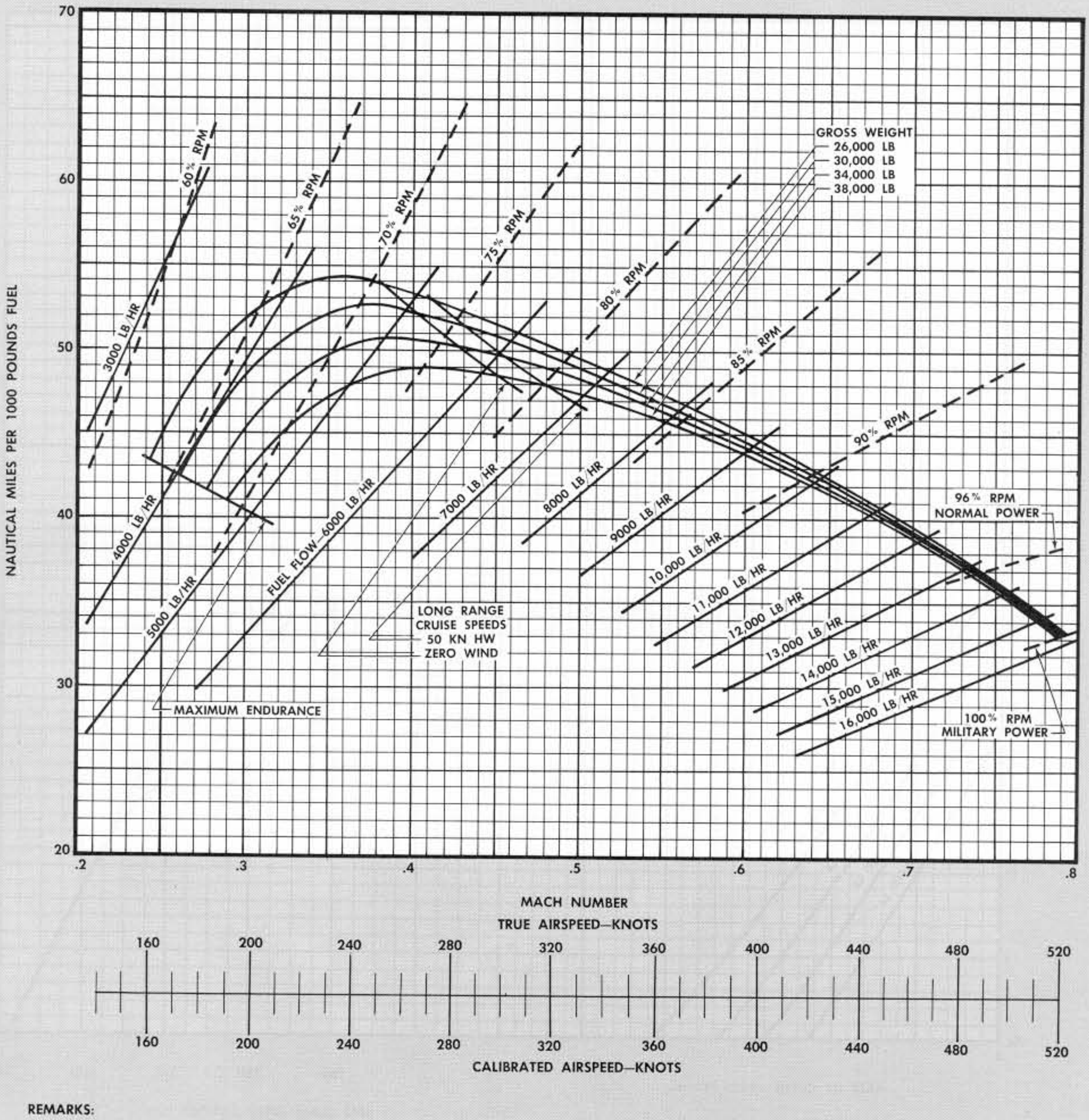
Figure A-11 (Sheet 15 of 15 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

SEA LEVEL

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-248A

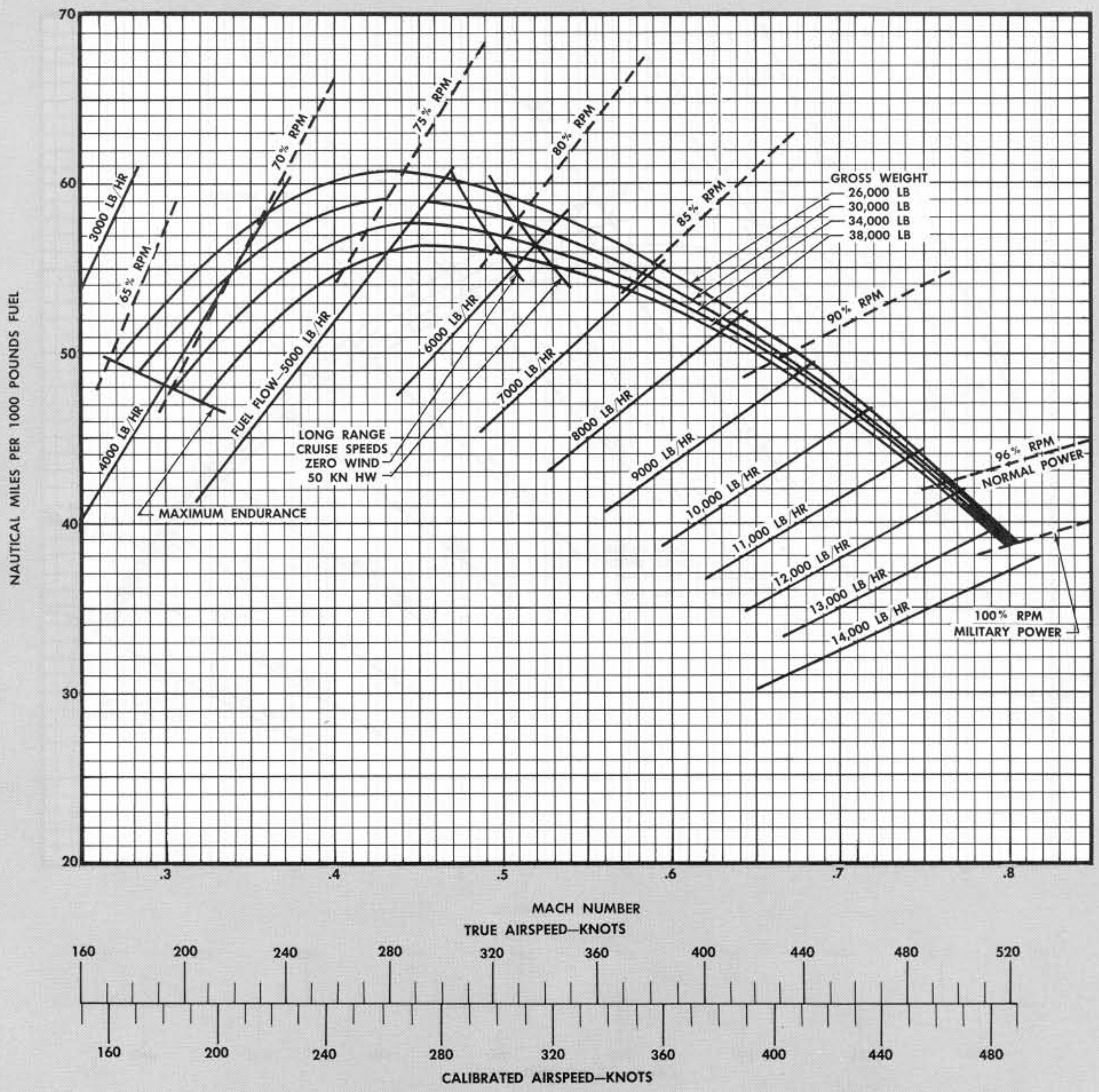
Figure A-12 (Sheet 1 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

5000 FEET

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-249A

Figure A-12 (Sheet 2 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

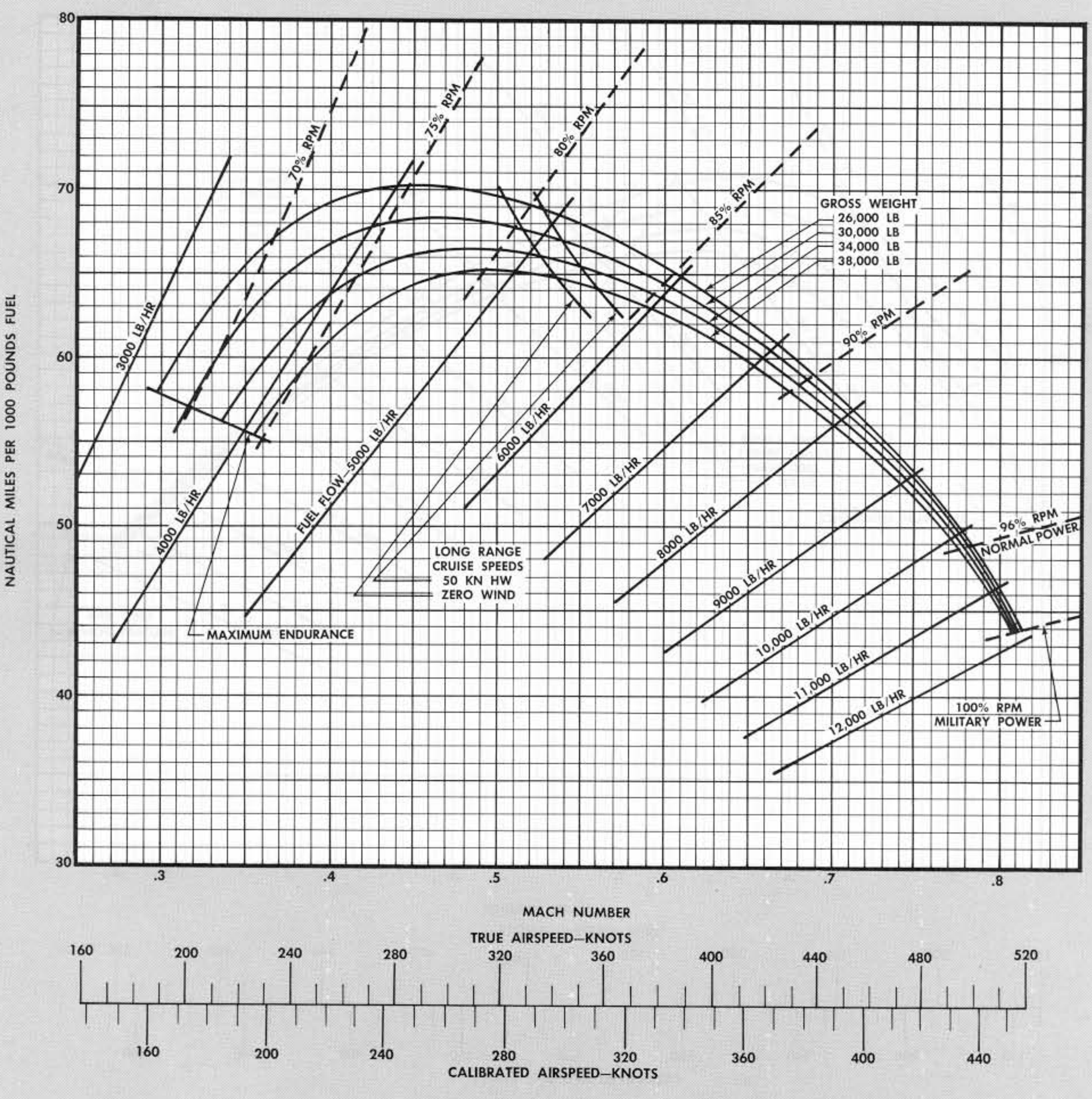
MODEL: **F-89B,C**

10,000 FEET

ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-250A

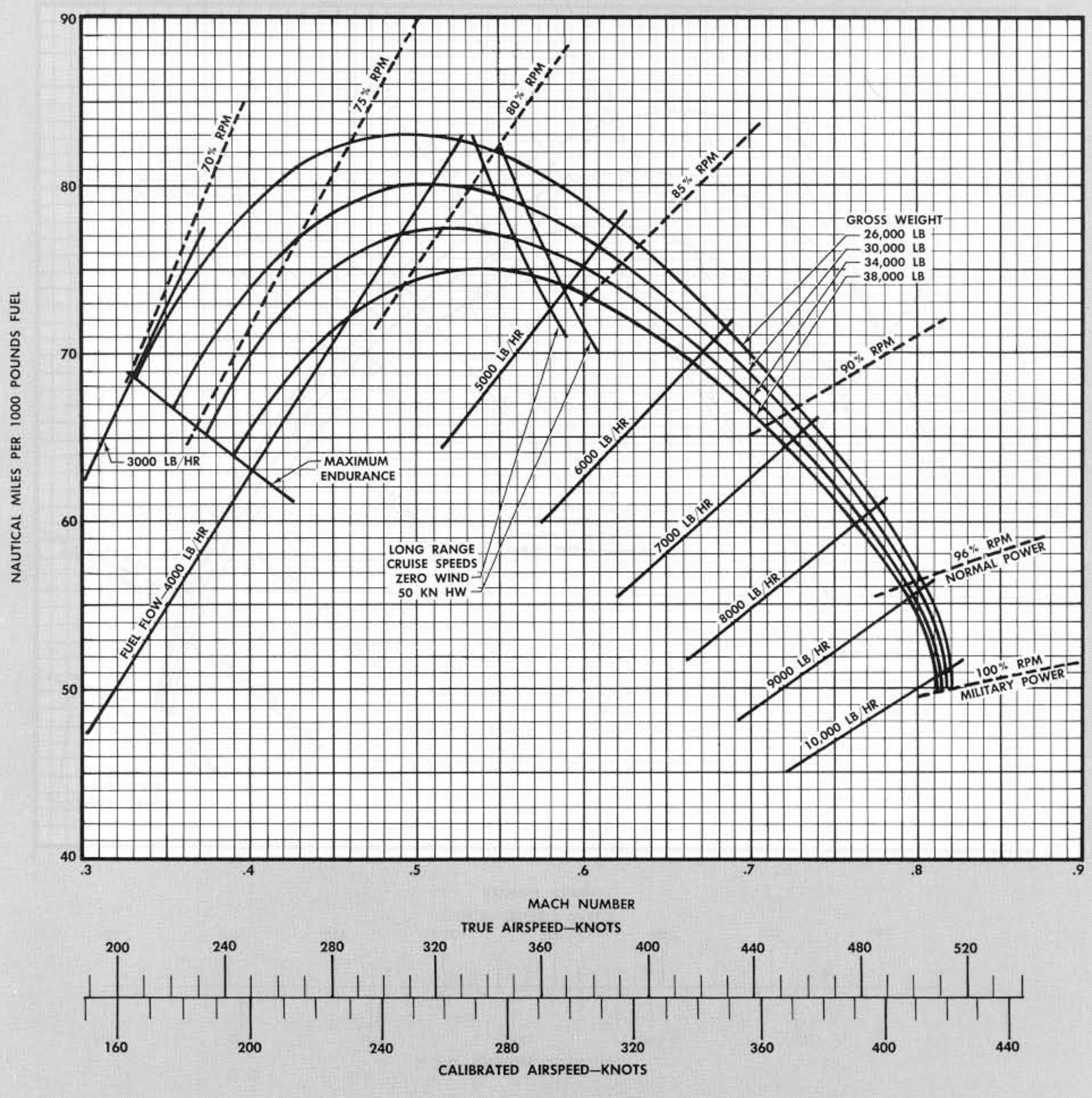
Figure A-12 (Sheet 3 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

15,000 FEET

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-251A

Figure A-12 (Sheet 4 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

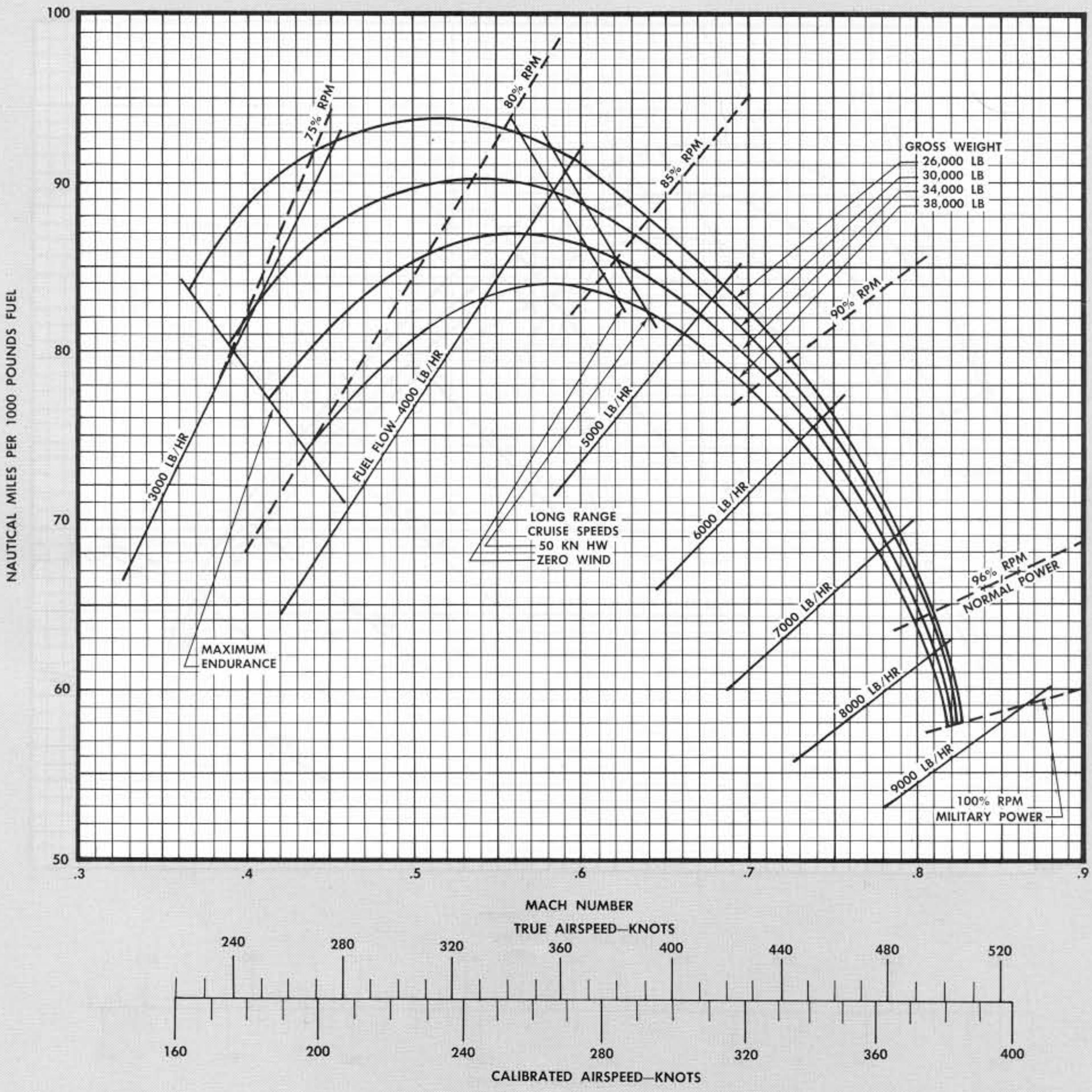
MODEL: **F-89B,C**

20,000 FEET

ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-252A

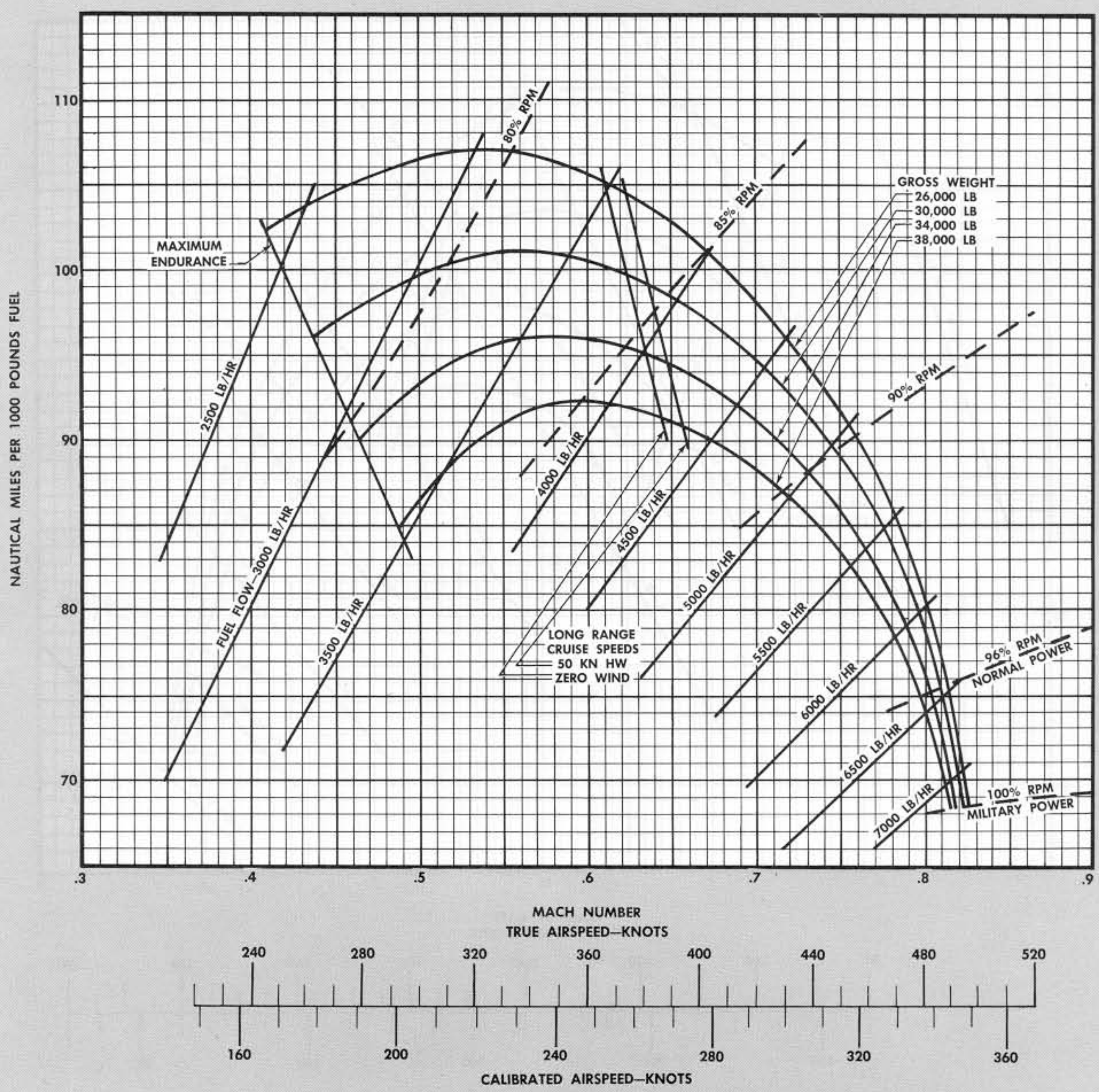
Figure A-12 (Sheet 5 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

25,000 FEET

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PER CENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-253A

Figure A-12 (Sheet 6 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

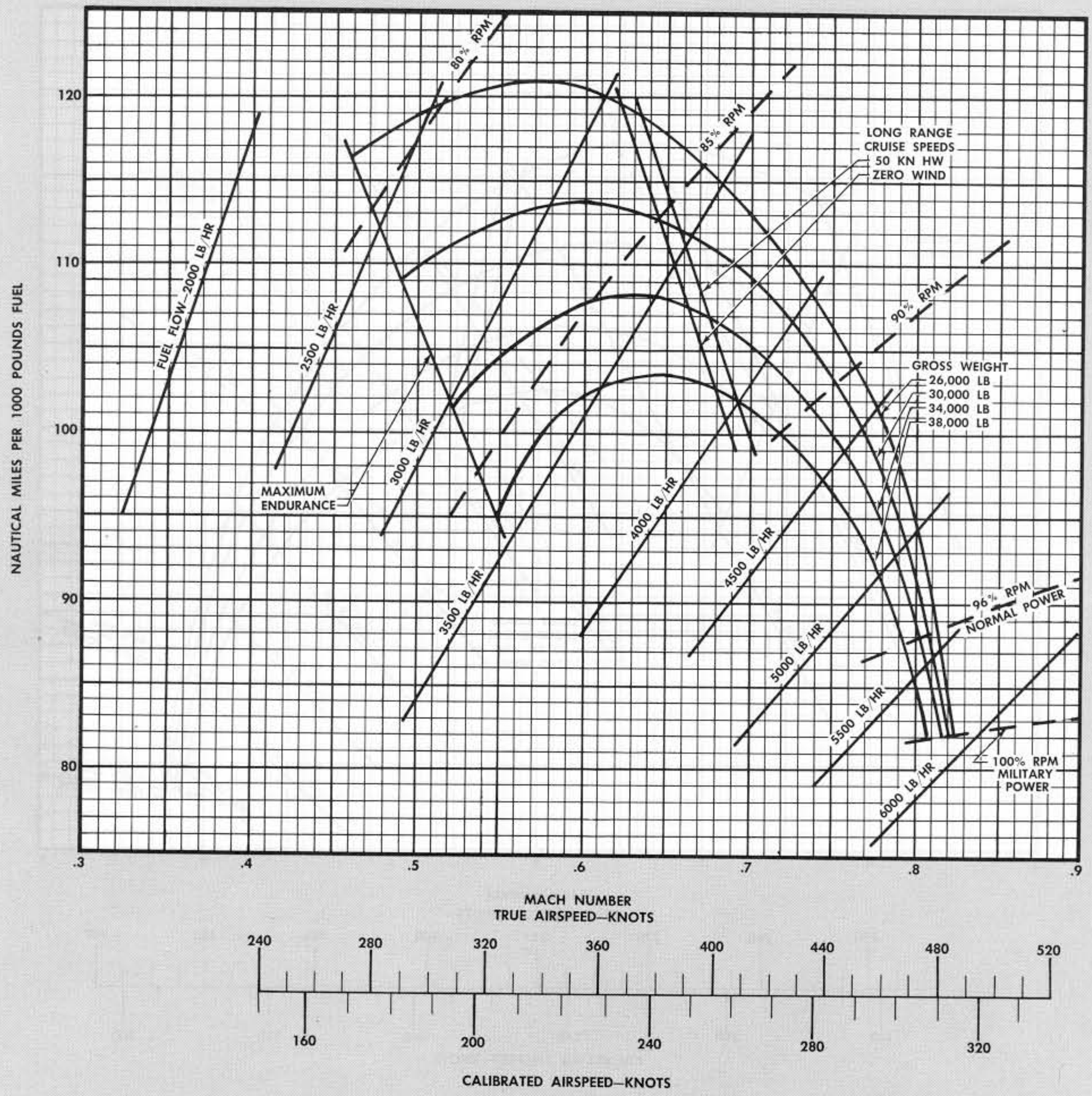
MODEL: **F-89B,C**

30,000 FEET

ENGINE(S): **(2) J35-47**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-254A

Figure A-12 (Sheet 7 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

35,000 FEET

MODEL: **F-89B,C**

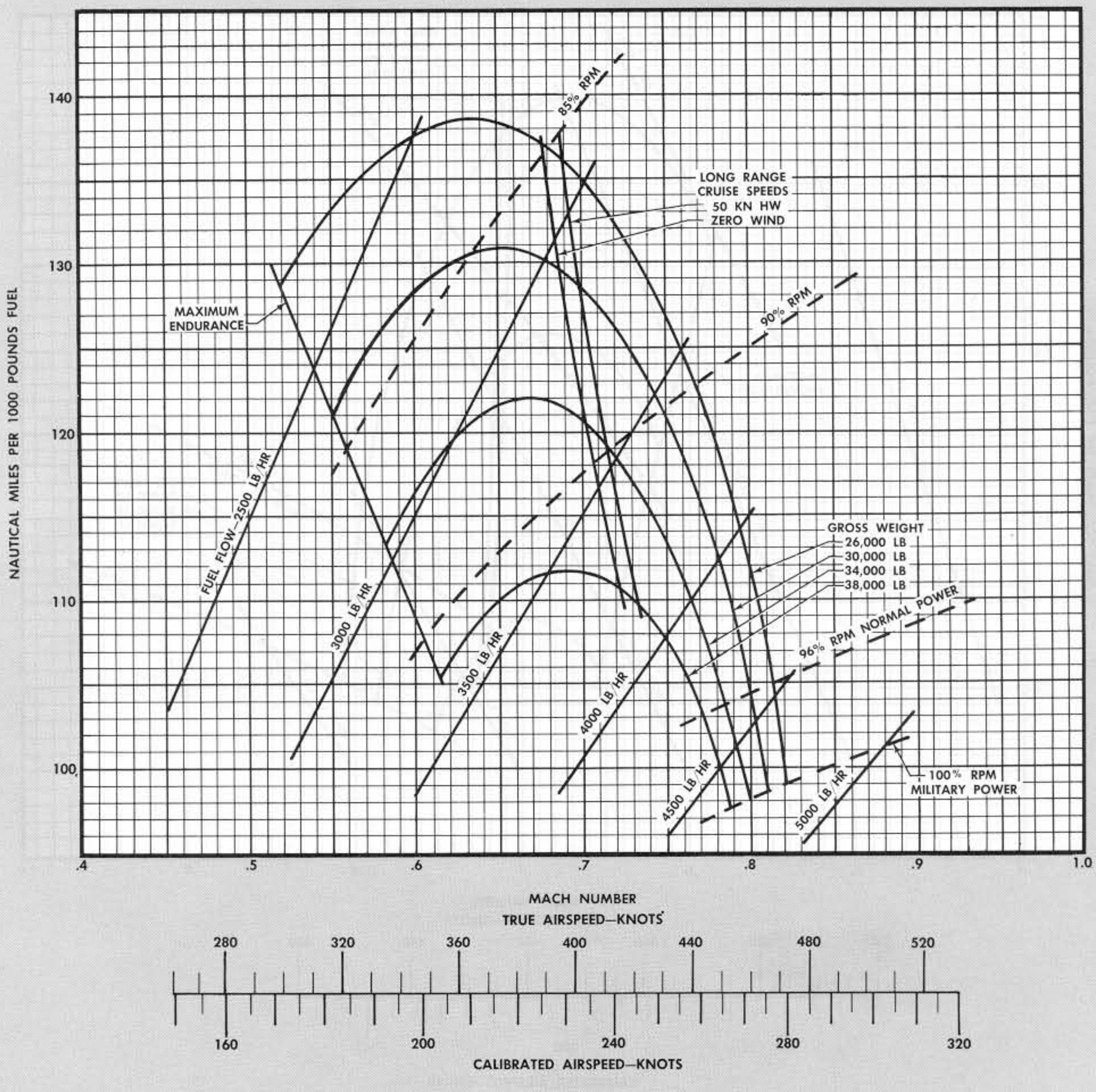
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-255A

Figure A-12 (Sheet 8 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

40,000 FEET

MODEL: **F-89B,C**

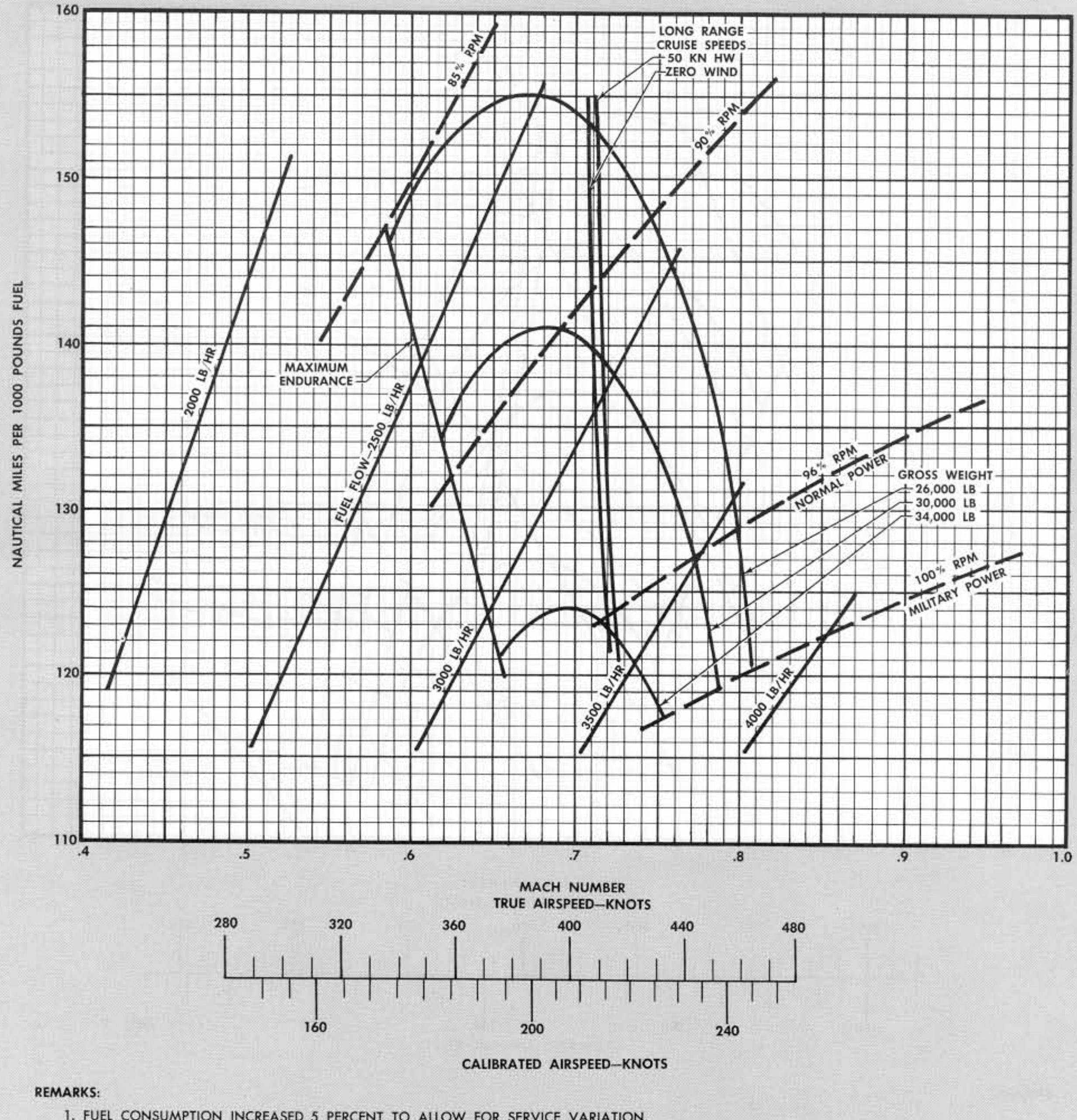
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-256A

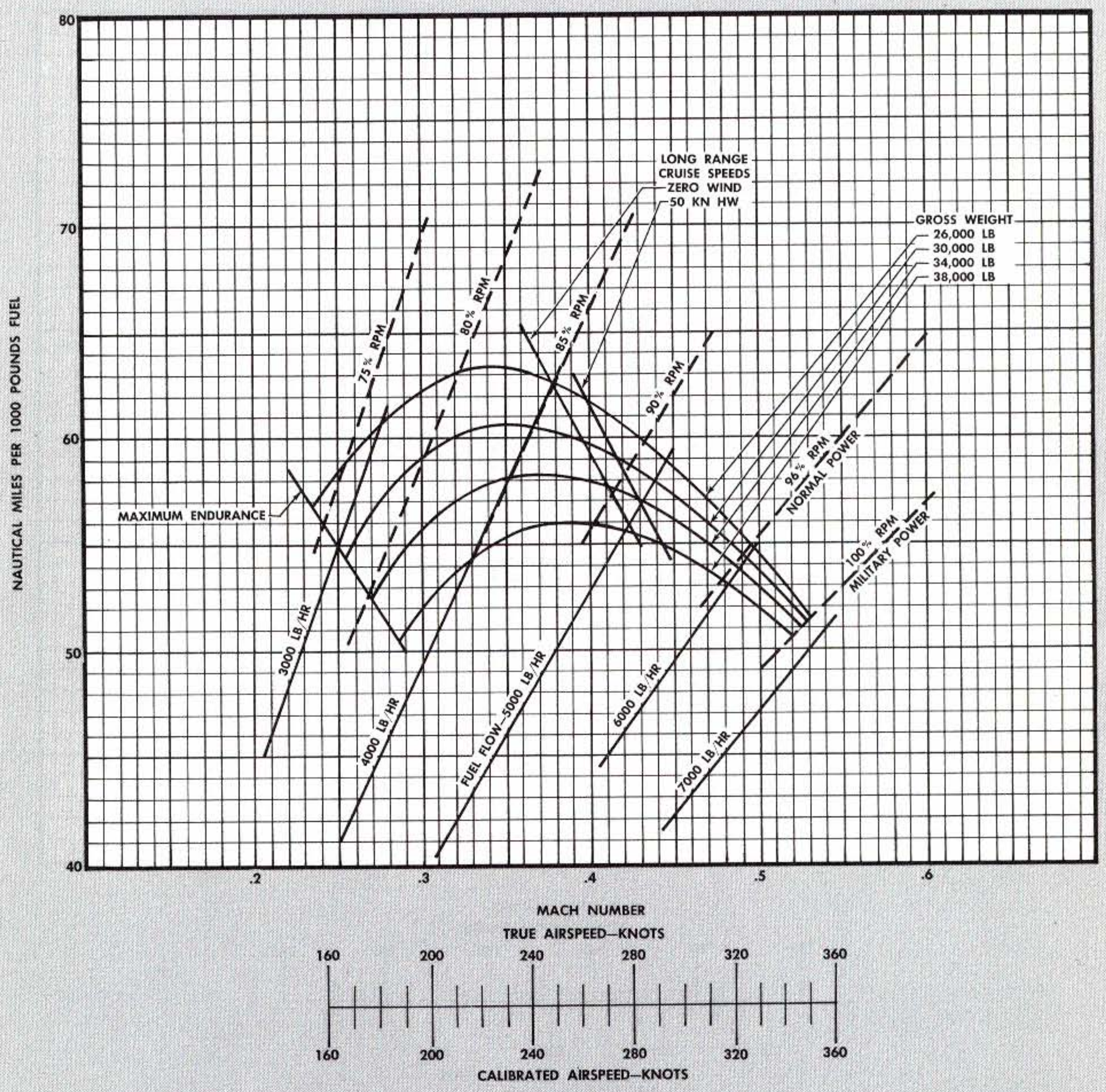
Figure A-12 (Sheet 9 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
SEA LEVEL

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-273A

Figure A-12 (Sheet 10 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: F-89B,C

DATA BASIS: FLIGHT TEST

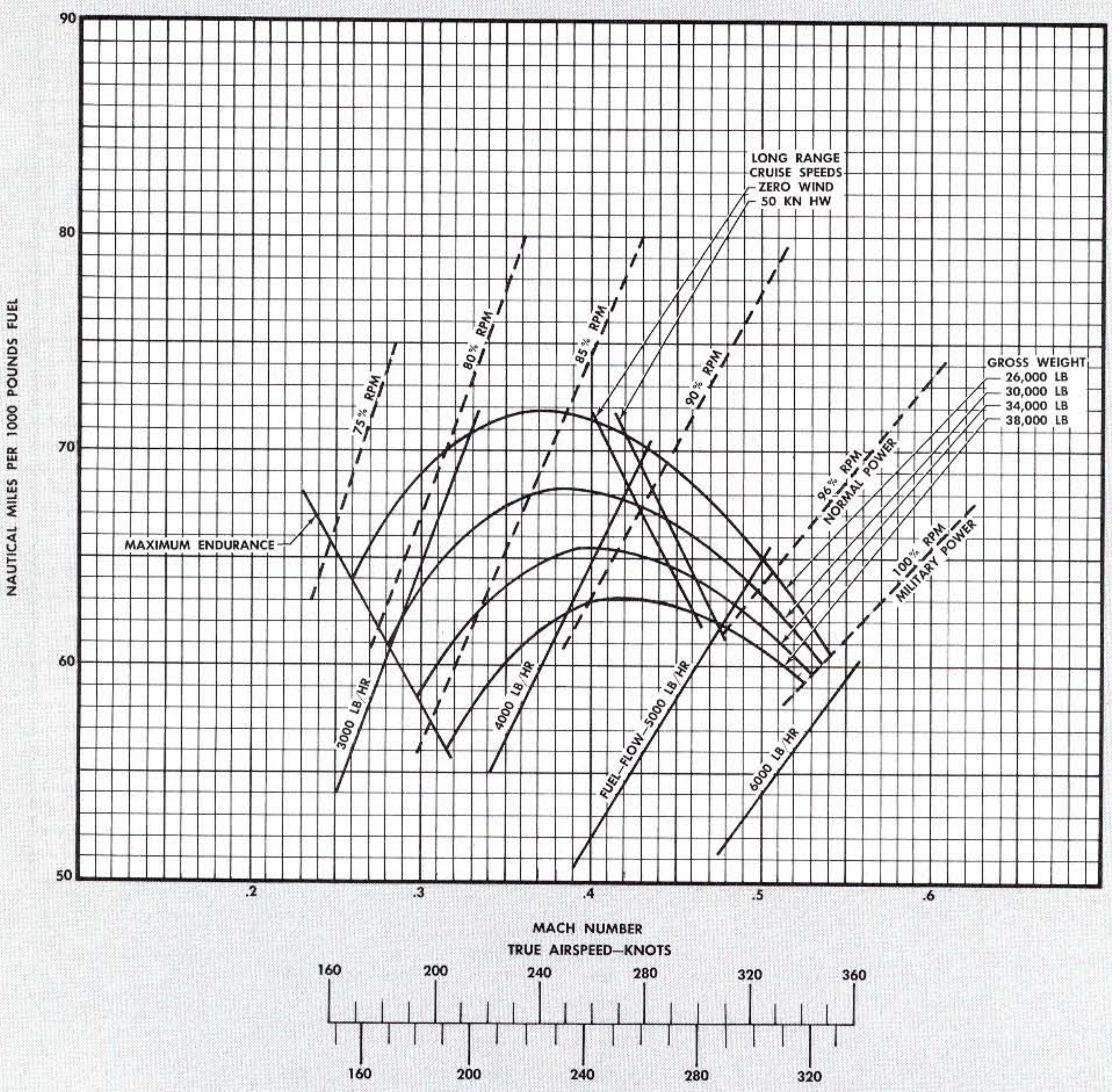
DATE: 8 JUNE 1956

ONE ENGINE OPERATING
5,000 FEET

ENGINE(S): (2) J35-47

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/US GAL



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-272A

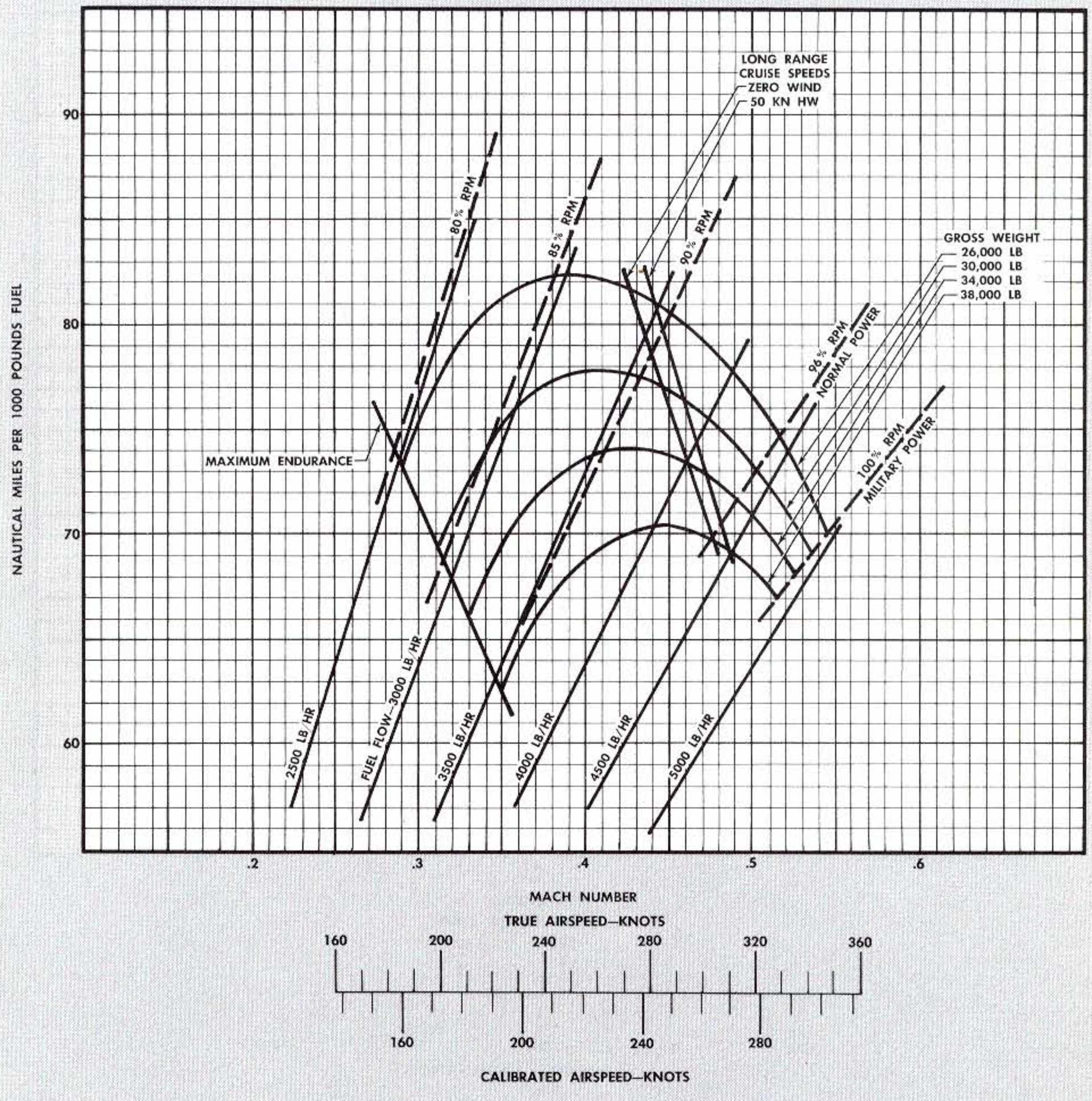
Figure A-12 (Sheet 11 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
10,000 FEET

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-271A

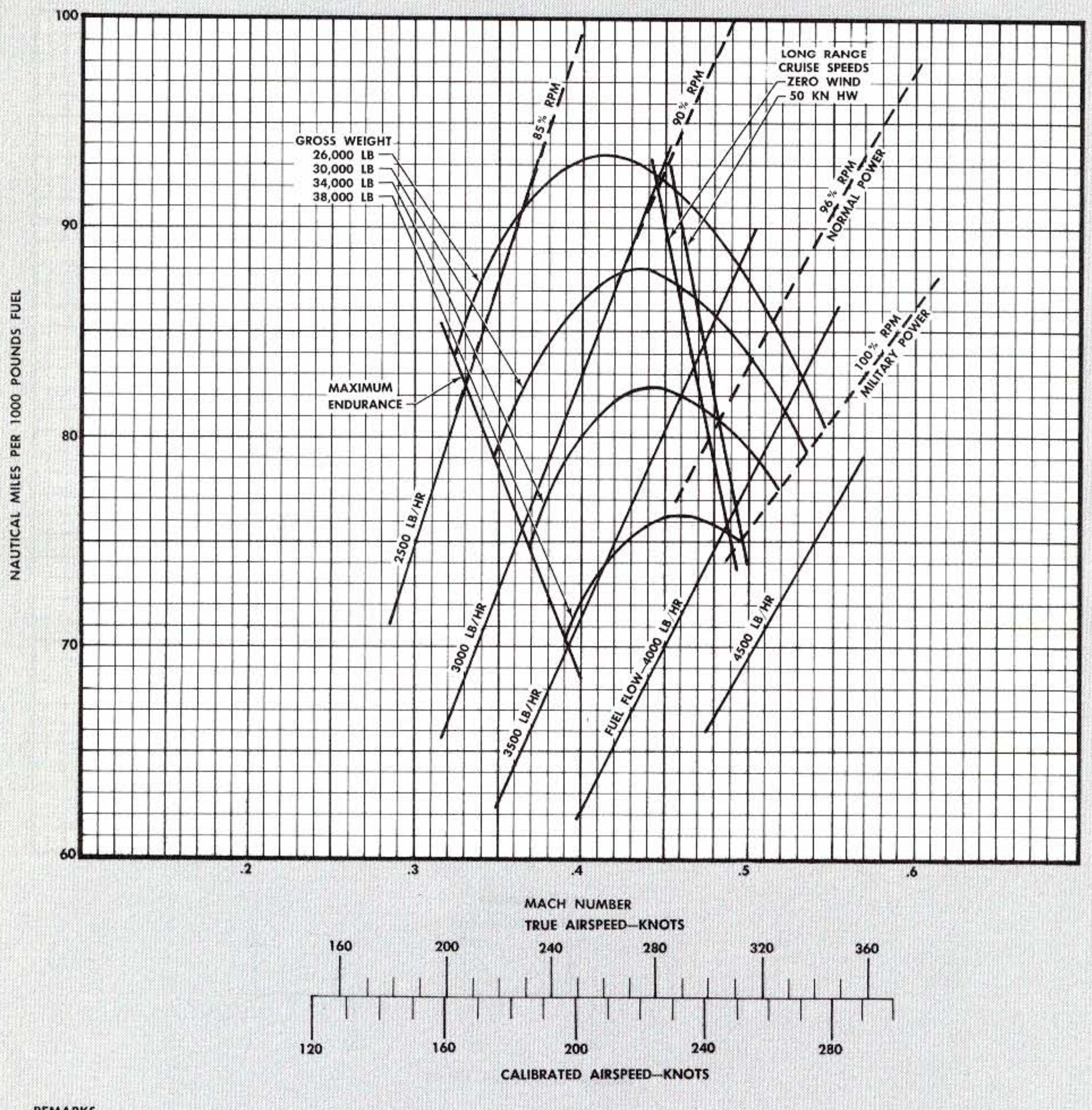
Figure A-12 (Sheet 12 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
15,000 FEET

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-270A

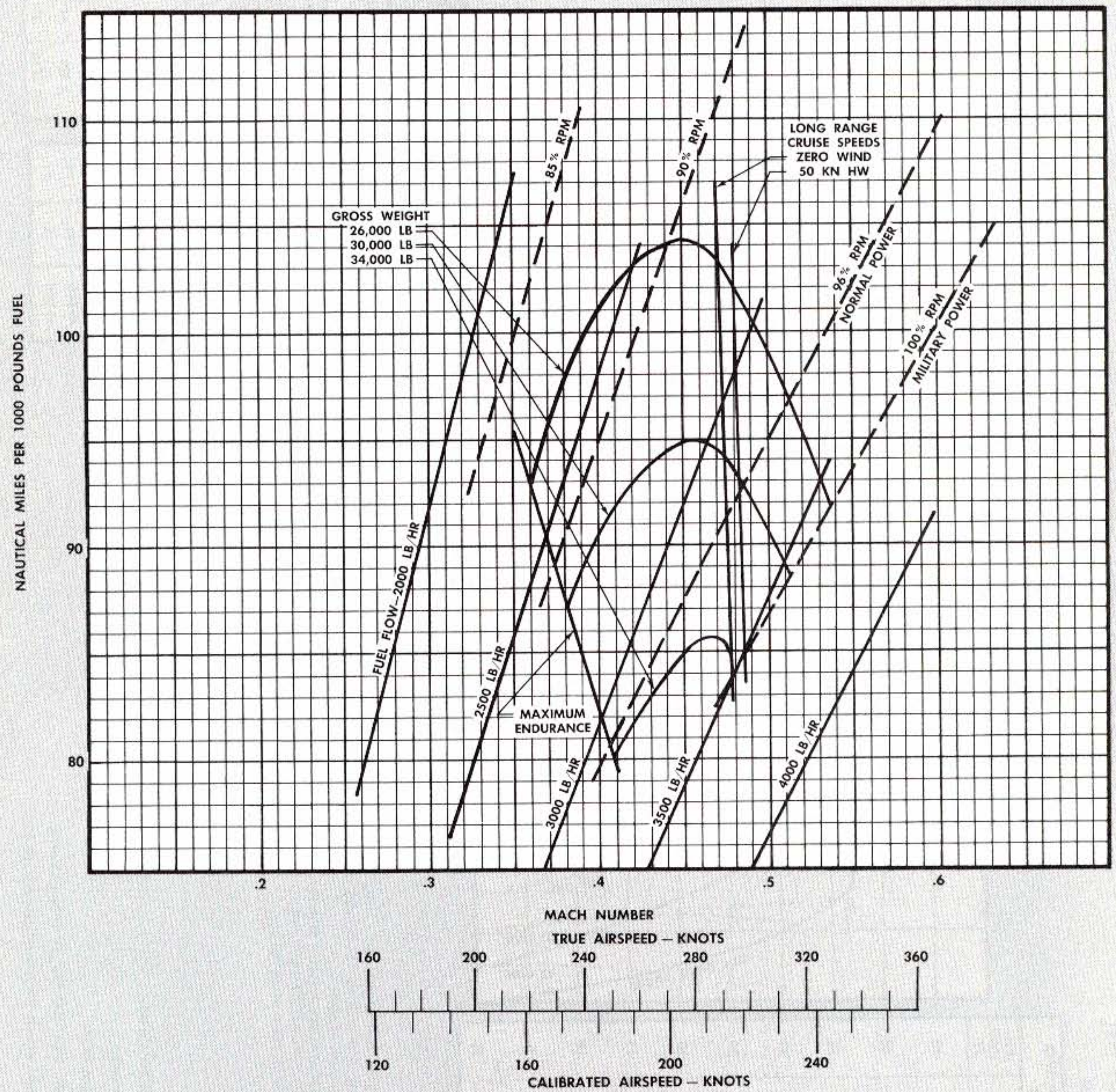
Figure A-12 (Sheet 13 of 14 Sheets).

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ONE ENGINE OPERATING
20,000 FEET

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATIONS.
2. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.
3. ENGINE AIR INLET SCREENS RETRACTED.

BC-269A

Figure A-12 (Sheet 14 of 14 Sheets).

MISSION PROFILE

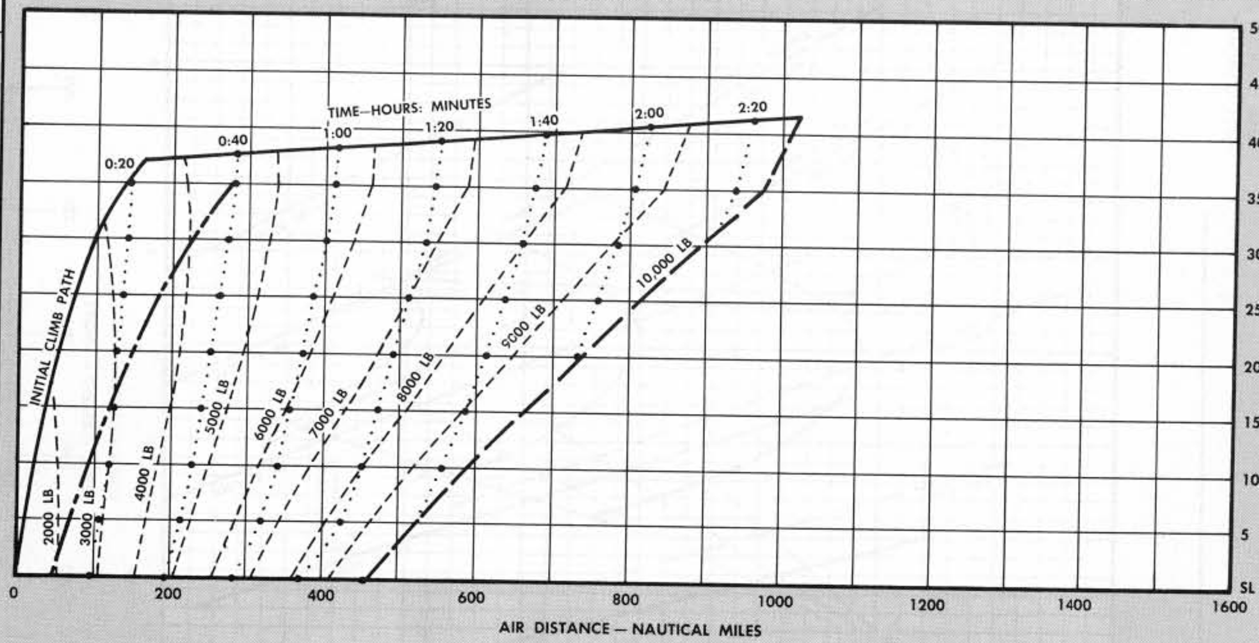
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS
LONG RANGE CRUISE

MODEL: F-89B,C
ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: NO EXTERNAL LOAD

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.73	215	40
.74	250	35
.73	275	30
.72	300	25
.70	325	20
.68	345	15
.66	370	10
.64	390	5
.62	405	SL



REMARKS:

1. FUEL ALLOWANCE FOR START, TAXI, AND TAKEOFF 906 POUNDS.
2. NO ALLOWANCE OR RESERVE MADE FOR LOITER, DESCENT, OR LANDING.
3. CLIMB AT MILITARY POWER.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LEGEND

- — — ZERO FUEL REMAINING
- - - - - FUEL CONSUMED
- ——— CRUISE-CLIMB PATH
- •····• TIME (START, TAXI, AND TAKEOFF NOT INCLUDED)
- —— - — LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT

* CRUISE-CLIMB PROCEDURE

ALTITUDE FEET	%RPM	MACH NO.
37,000	90	.71
38,000	90	.71
39,000	90	.71
40,000	91	.71
41,000	93	.71

CRUISE—NO EXTERNAL LOAD

ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE -CLIMB	.71		410	3300-2700	*
35,000	.69	230	400	3200	87
30,000	.66	245	385	3500	86
25,000	.62	260	375	4100	85
20,000	.59	270	360	3800	82
15,000	.55	280	345	4500	83
10,000	.52	290	330	4900	81
5,000	.48	295	315	5400	79
SEA LEVEL	.42	275	275	5500	75

BC-229A

Figure A-13.

INTERCEPT PROFILE

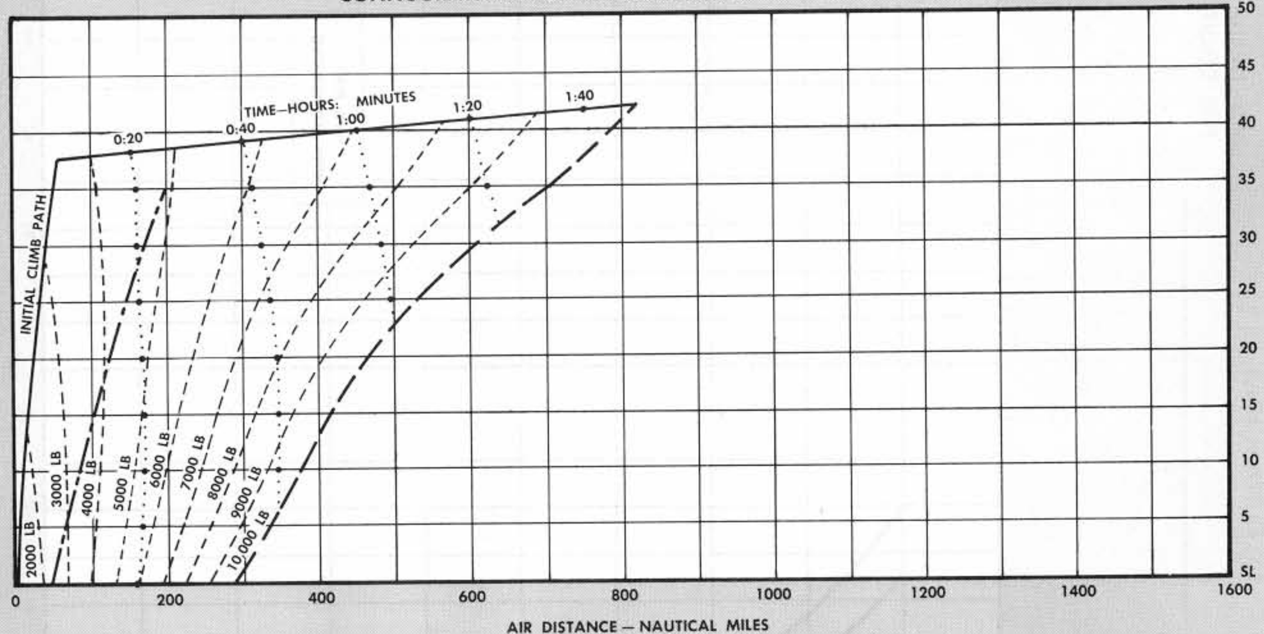
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS
MILITARY POWER CRUISE

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD

MAXIMUM POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.78	230	40
.79	265	35
.78	295	30
.78	330	25
.77	360	20
.77	390	15
.76	425	10
.75	455	5
.71	470	SL



REMARKS:

1. FUEL ALLOWANCE FOR START, TAXI, AND TAKEOFF 906 POUNDS.
2. NO ALLOWANCE OR RESERVE MADE FOR LOITER, DESCENT, OR LANDING.
3. CLIMB AT MAXIMUM POWER.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LEGEND

- — — ZERO FUEL REMAINING
- - - - - - FUEL CONSUMED
- ——— CRUISE-CLIMB PATH
- • • • • TIME (START, TAXI, AND TAKEOFF NOT INCLUDED)
- — - — LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
38,000	100	.78
39,000	100	.78
40,000	100	.78
41,000	100	.78
42,000	100	.78

CRUISE—NO EXTERNAL LOAD					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE -CLIMB	.78		450	4100-3400	100
35,000	.81	275	465	4700	100
30,000	.82	310	480	5900	100
25,000	.82	350	495	7200	100
20,000	.82	385	505	8700	100
15,000	.82	420	510	10,200	100
10,000	.81	455	515	11,700	100
5,000	.78	475	510	13,300	100
SEA LEVEL	.72	475	475	15,000	100

BC-231A

Figure A-14.

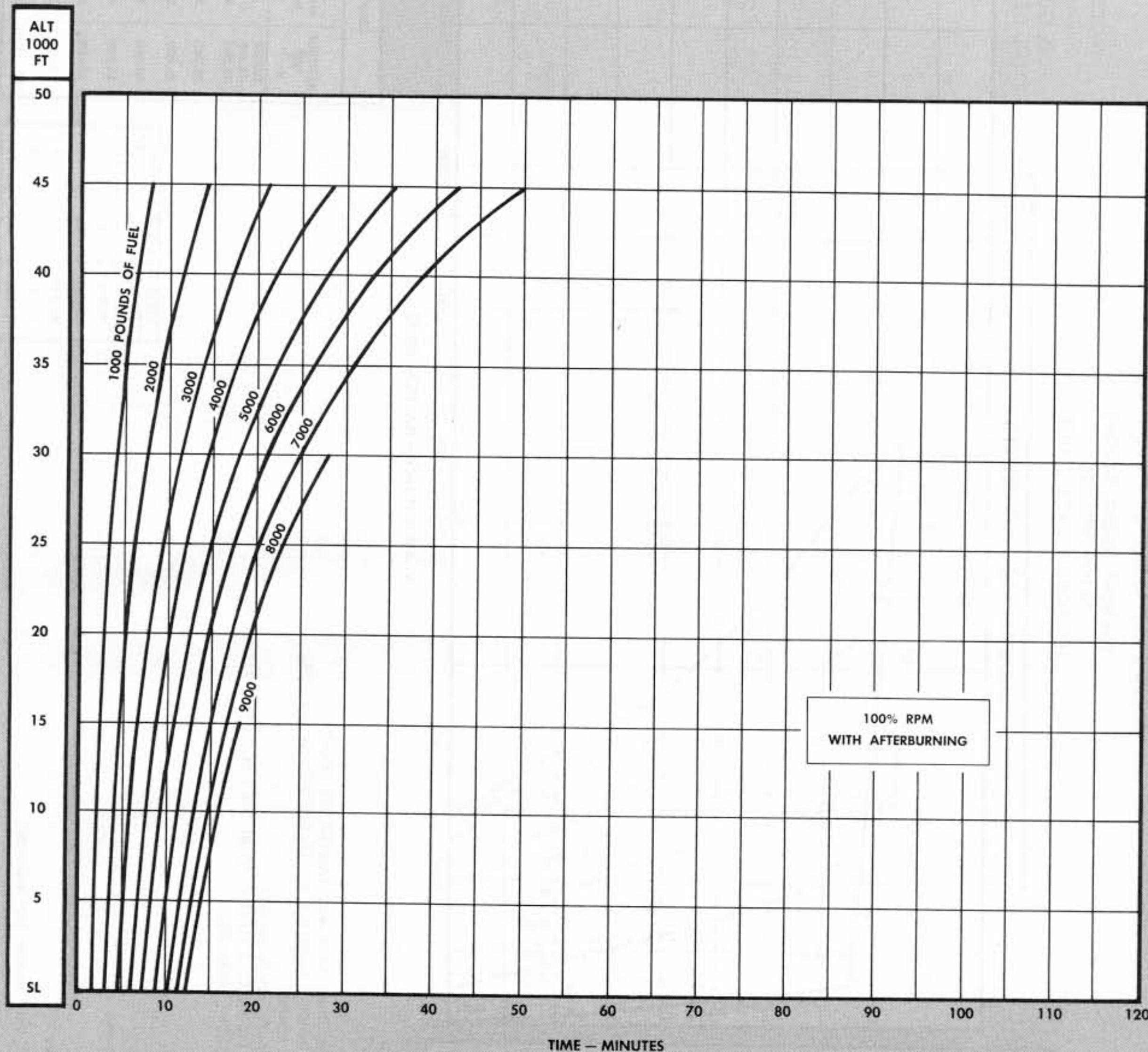
COMBAT ALLOWANCE CHART

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MAXIMUM POWER
NO EXTERNAL LOAD

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. ENGINE AIR INLET SCREENS RETRACTED.
3. EXHAUST TEMPERATURE LIMIT: 735°C.

BC-242A

Figure A-15 (Sheet 1 of 3 Sheets).

COMBAT ALLOWANCE CHART

MILITARY POWER

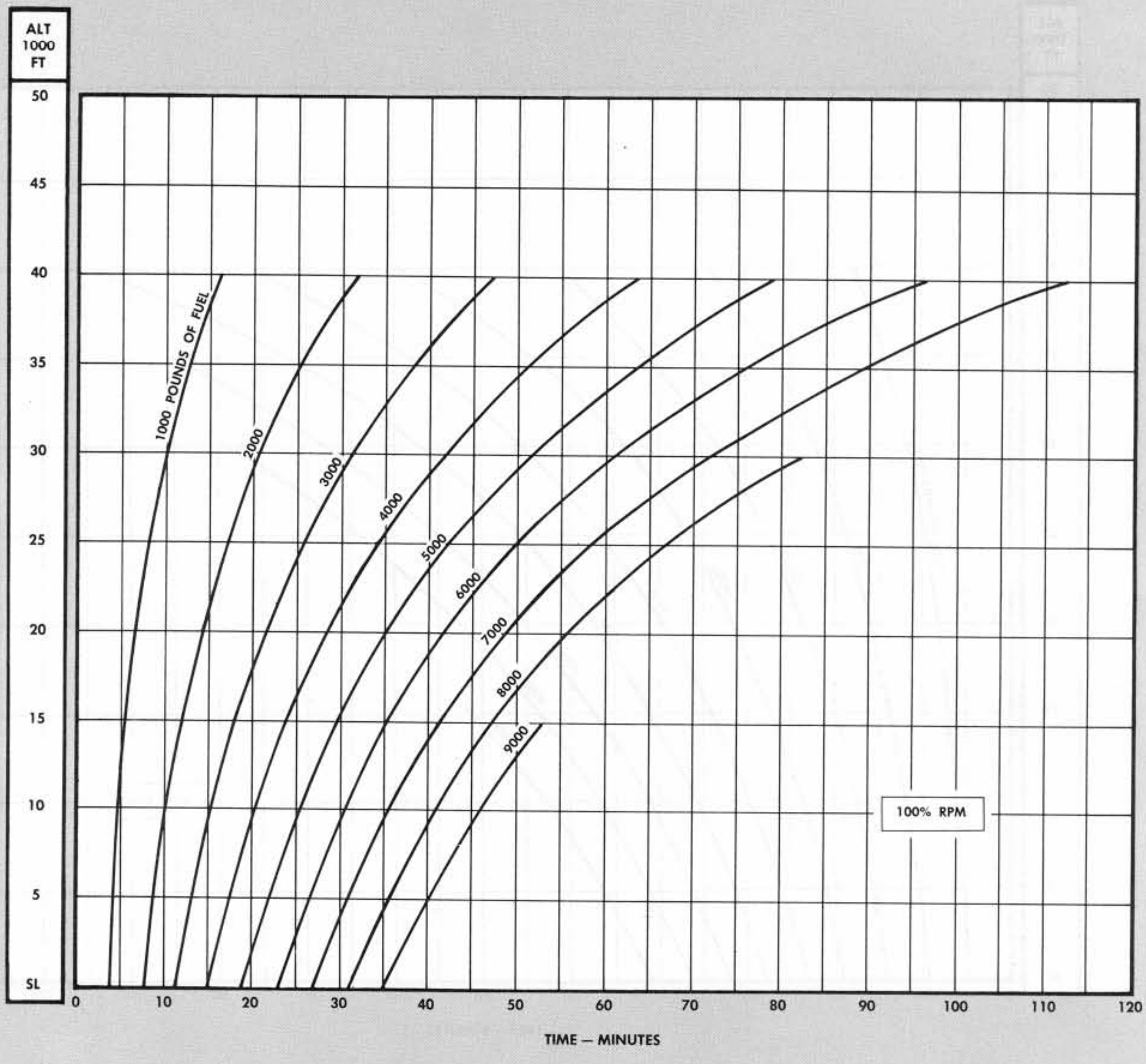
NO EXTERNAL LOAD

MODEL: **F-89B,C**

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. ENGINE AIR INLET SCREENS RETRACTED.
3. EXHAUST TEMPERATURE LIMIT: 666°C.

BC-243A

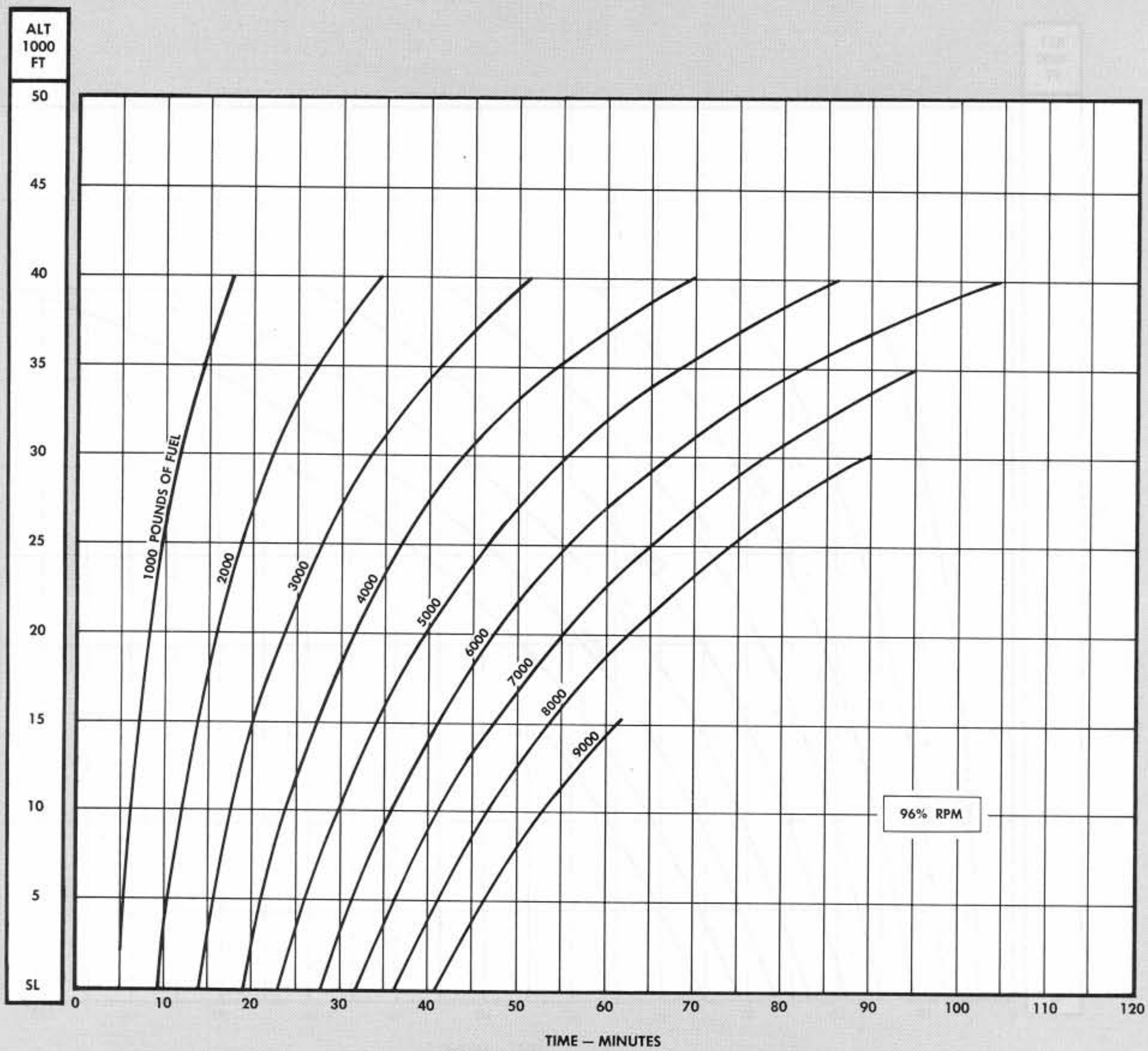
Figure A-15 (Sheet 2 of 3 Sheets).

COMBAT ALLOWANCE CHART

NORMAL POWER
NO EXTERNAL LOAD

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
2. ENGINE AIR INLET SCREENS RETRACTED.
3. EXHAUST TEMPERATURE LIMIT: 666°C.

BC-244A

Figure A-15 (Sheet 3 of 3 Sheets).

OPTIMUM RETURN PROFILE

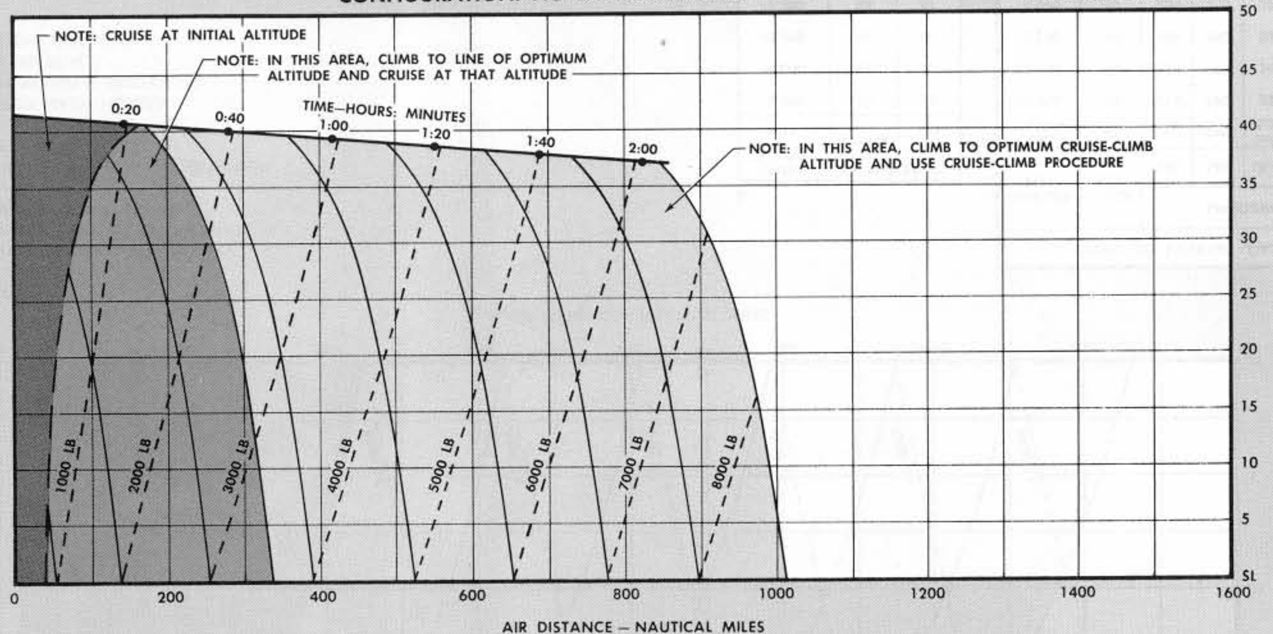
TAKEOFF GROSS WEIGHT
38,000 POUNDS

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.73	215	40
.74	250	35
.73	275	30
.72	300	25
.70	325	20
.68	345	15
.66	370	10
.64	390	5
.62	405	SL



REMARKS:

1. FUEL REQUIRED AT ANY POINT INCLUDES MILITARY POWER CLIMB TO FLIGHT ALTITUDE (IF BELOW THAT).
2. NO ALLOWANCE MADE FOR LOITER, DESCENT, OR LANDING.
3. BEST CRUISE CONDITION DETERMINED BY INTERSECTION OF CLIMB PATH GUIDE LINES AND LINES OF BEST RANGE.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LEGEND

- • • TIME AT CRUISE-CLIMB ALTITUDE
- - - - - - FUEL REQUIRED
- ——— CLIMB PATH GUIDE LINE
- — — LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT
- ━━━ LINE OF BEST RANGE FOR CRUISE-CLIMB FLIGHT

*

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
37,000	90	.71
38,000	90	.71
39,000	90	.71
40,000	91	.71
41,000	93	.71

CRUISE—NO EXTERNAL LOAD					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	.71		410	2700 3300	*
35,000	.69	230	400	3200	87
30,000	.66	245	385	3500	86
25,000	.62	260	375	3800	85
20,000	.59	270	360	4100	83
15,000	.55	280	345	4500	82
10,000	.52	290	330	4900	81
5,000	.48	295	315	5400	79
SEA LEVEL	.42	275	275	5500	75

BC-233A

Figure A-16 (Sheet 1 of 2 Sheets).

OPTIMUM RETURN PROFILE

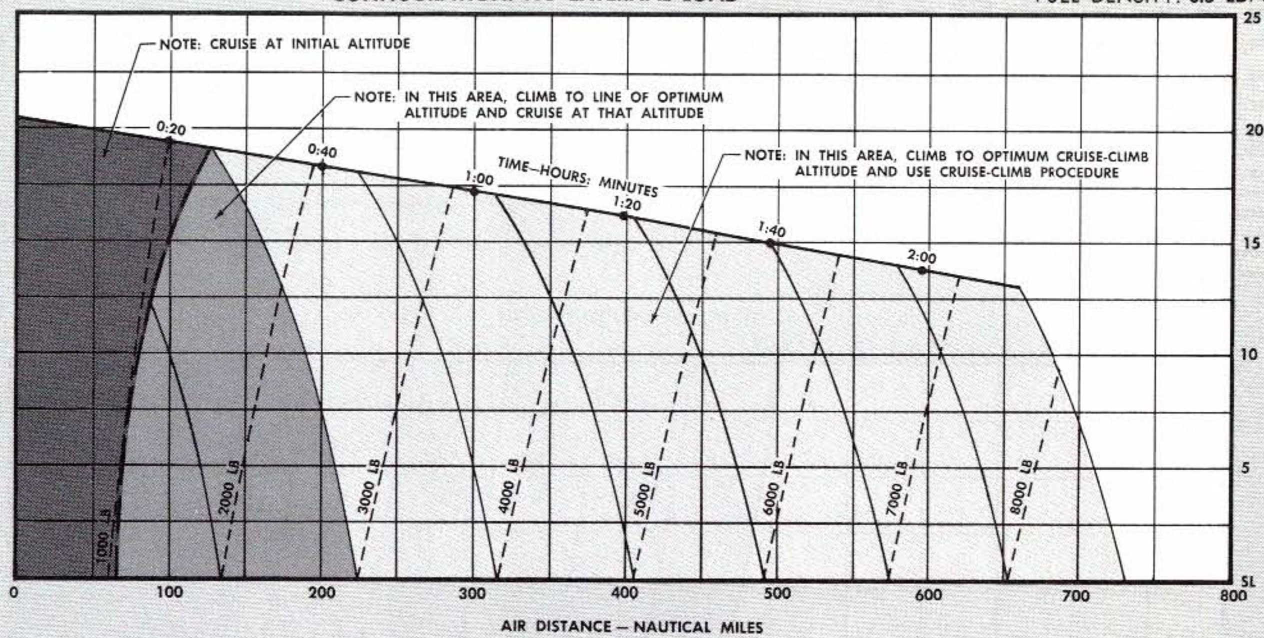
TAKEOFF GROSS WEIGHT
38,000 POUNDS
ONE ENGINE OPERATING

CONFIGURATION: NO EXTERNAL LOAD

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MODEL: **F-89B,C**
ENGINE(S): (2) **J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
.42	190	20
.41	205	15
.39	220	10
.37	230	5
.36	240	SL



REMARKS:

1. FUEL REQUIRED AT ANY POINT INCLUDES MILITARY POWER CLIMB TO FLIGHT ALTITUDE (IF BELOW THAT).
2. NO ALLOWANCE MADE FOR LOITER, DESCENT, OR LANDING.
3. BEST CRUISE CONDITION DETERMINED BY INTERSECTION OF CLIMB PATH GUIDE LINES AND LINES OF BEST RANGE.
4. CRUISE AT RECOMMENDED MACH NUMBER.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LEGEND

● ● TIME AT CRUISE-CLIMB ALTITUDE
– – – – – FUEL REQUIRED
———— CLIMB PATH GUIDE LINE
—— —— LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT
▬▬▬ LINE OF BEST RANGE FOR CRUISE-CLIMB FLIGHT

*

CRUISE—CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
13,000	93	.47
14,000	93	.47
15,000	93	.47
16,000	94	.47
17,000	94	.47
18,000	95	.47
19,000	95	.47
20,000	96	.47

CRUISE—NO EXTERNAL LOAD					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE —CLIMB	.47		290	3600—3200	*
17,500	.46	225	290	3300	94
15,000	.46	235	290	3400	93
12,500	.46	240	290	3600	93
10,000	.45	250	290	3800	93
7,500	.44	255	285	4000	92
5,000	.43	260	280	4300	91
2,500	.42	265	275	4400	90
SEA LEVEL	.40	265	265	4600	88

BC-235A

Figure A-16 (Sheet 2 of 2 Sheets).

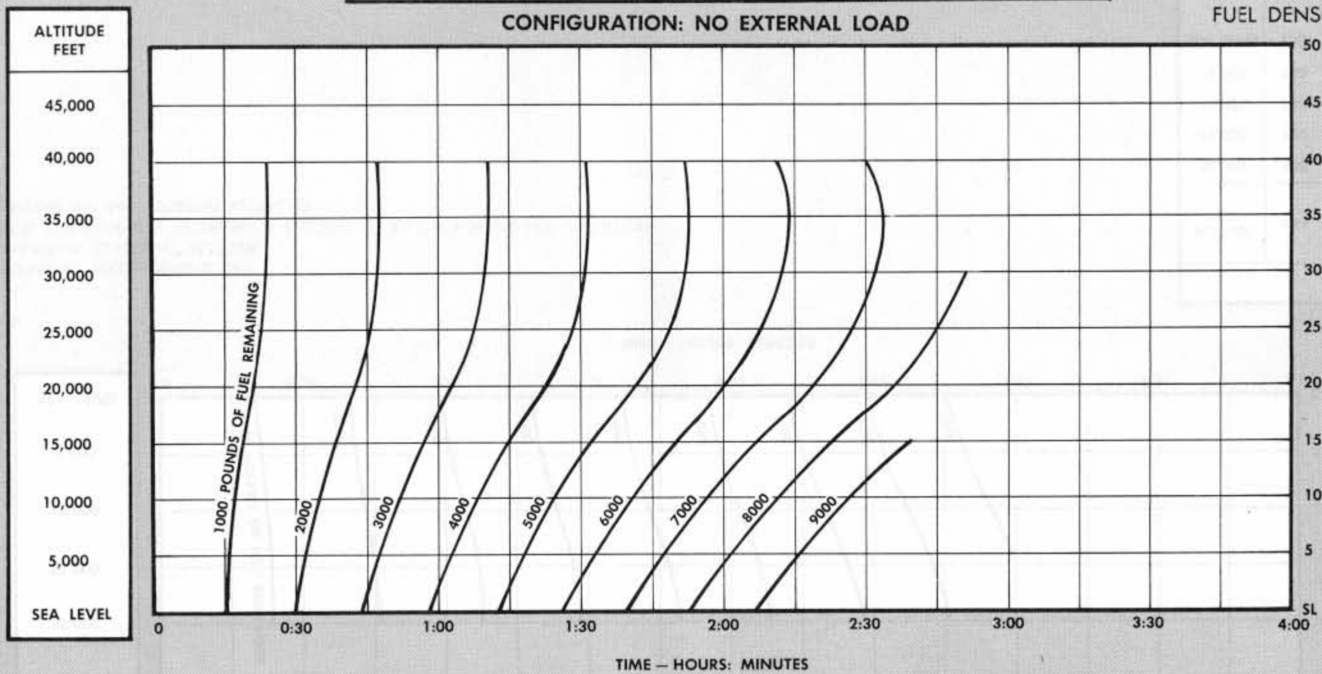
MAXIMUM ENDURANCE

TAKEOFF GROSS WEIGHT
38,000 POUNDS

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD



REMARKS:

1. LOITER AT RECOMMENDED CAS.
2. MAINTAIN CONSTANT ALTITUDE.
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.

LOITER					
ALTITUDE FEET	CAS	APPROXIMATE			
		TAS	MACH NO.	LB/HR	% RPM
40,000	190	365	.63	2900	92
35,000	190	330	.56	2800	86
30,000	190	300	.50	2900	83
25,000	185	270	.45	3000	80
20,000	185	250	.41	3200	77
15,000	185	230	.37	3400	75
10,000	180	210	.33	3700	72
5,000	180	195	.30	4000	70
SEA LEVEL	180	180	.27	4300	67

BC-237A

Figure A-17 (Sheet 1 of 2 Sheets).

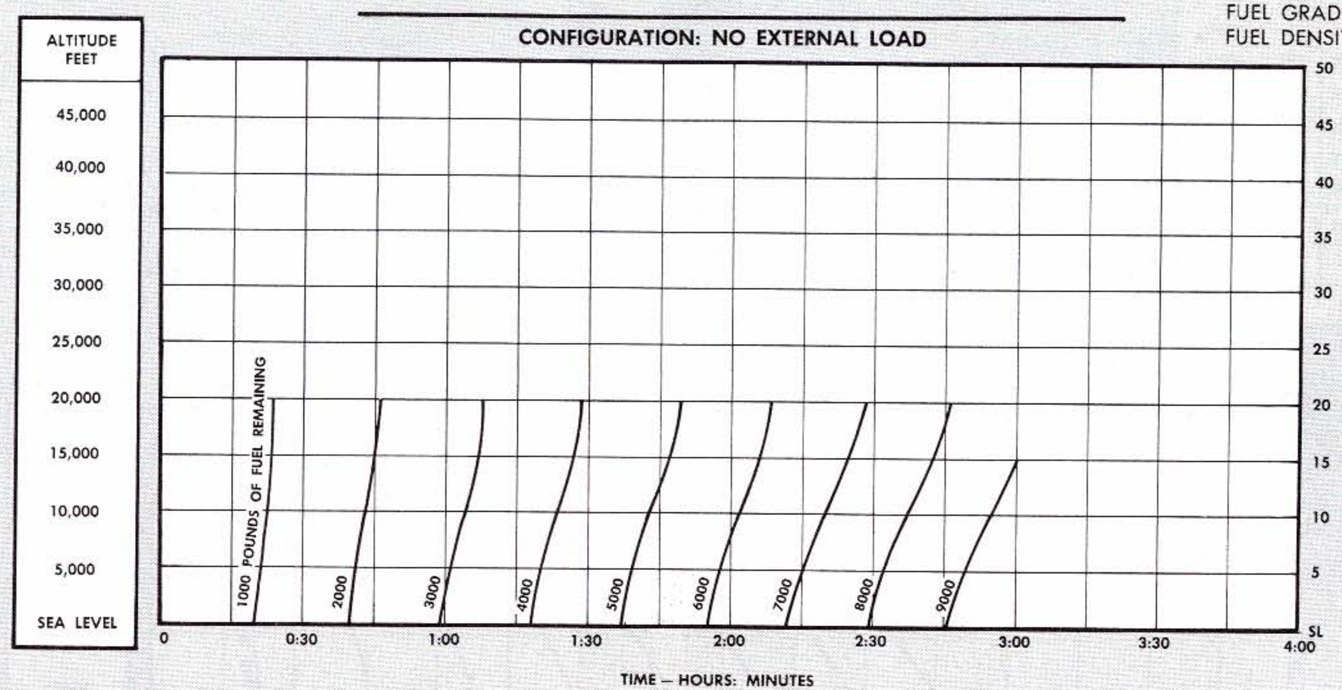
MAXIMUM ENDURANCE

DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS
ONE ENGINE OPERATING

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD



LOITER					
ALTITUDE FEET	CAS	APPROXIMATE			
		TAS	MACH NO.	LB/HR	% RPM
20,000	180	245	.40	3000	94
15,000	180	225	.36	3000	90
10,000	180	210	.33	3100	87
5,000	180	190	.29	3200	83
SEA LEVEL	175	175	.27	3300	80

REMARKS:

1. LOITER AT RECOMMENDED CAS.
2. MAINTAIN CONSTANT ALTITUDE.
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.

BC-236A

Figure A-17 (Sheet 2 of 2 Sheets).

OPTIMUM MAXIMUM ENDURANCE PROFILE

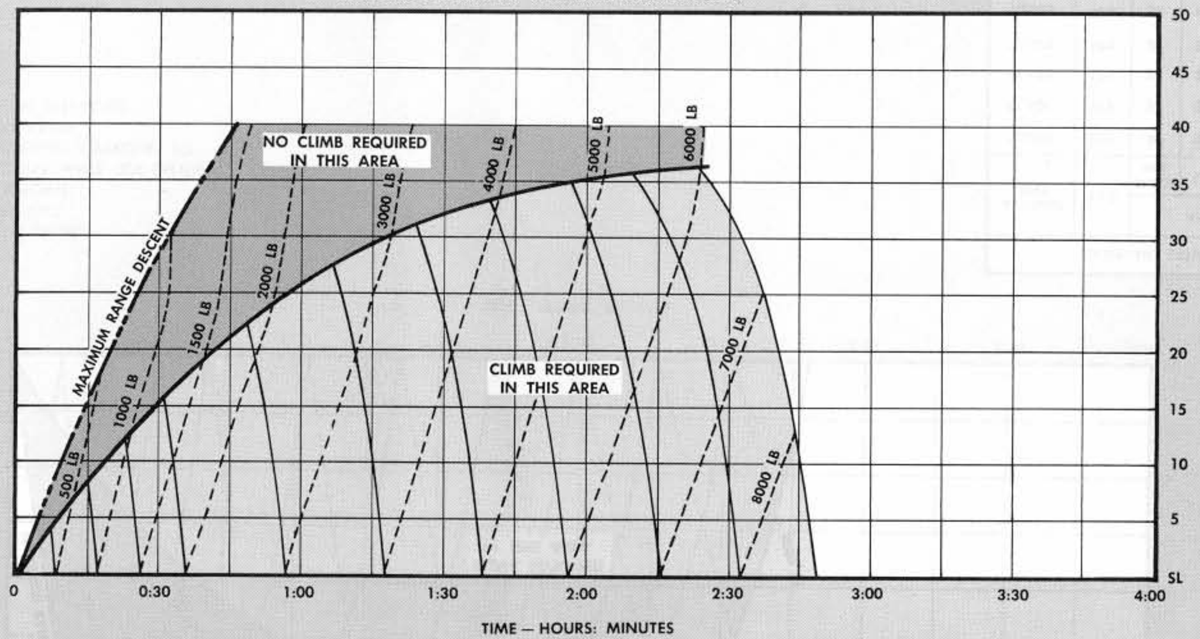
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: NO EXTERNAL LOAD

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
.71	210	40
.72	240	35
.70	265	30
.68	285	25
.66	300	20
.63	320	15
.60	330	10
.56	340	5
.51	335	SL



REMARKS:

1. USE NORMAL POWER FOR CLIMB.
2. LOITER AT RECOMMENDED CAS.
3. USE MAXIMUM RANGE DESCENT.
4. NO ALLOWANCE OR RESERVE MADE FOR LANDING.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LOITER — NO EXTERNAL LOAD					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
40,000	185	.63	360	2900	92
35,000	185	.56	320	2700	85
30,000	180	.49	290	2600	82
25,000	175	.43	260	2600	78
20,000	175	.38	235	2800	74
15,000	170	.34	215	3100	72
10,000	170	.31	195	3400	69
5,000	170	.28	180	3700	67
SEA LEVEL	165	.25	165	3900	64

LEGEND

- – – – – FUEL REMAINING
- ▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
- —— NORMAL POWER CLIMB GUIDE LINES

BC-240A

Figure A-18 (Sheet 1 of 2 Sheets).

OPTIMUM MAXIMUM ENDURANCE PROFILE

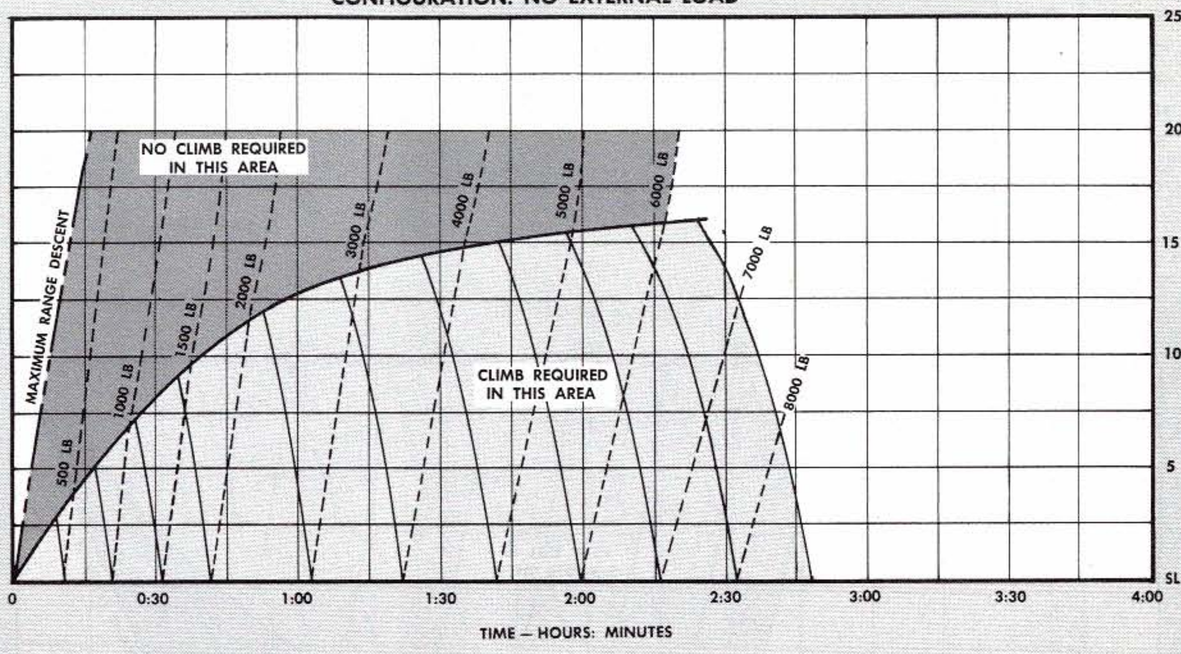
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

TAKEOFF GROSS WEIGHT
38,000 POUNDS
ONE ENGINE OPERATING

CONFIGURATION: NO EXTERNAL LOAD

MODEL: **F-89B,C**
ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
.42	190	20
.41	210	15
.39	220	10
.37	225	5
.36	240	SL



REMARKS:

1. USE MILITARY POWER FOR CLIMB.
2. LOITER AT RECOMMENDED CAS.
3. USE MAXIMUM RANGE DESCENT.
4. NO ALLOWANCE OR RESERVE MADE FOR LANDING.
5. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
6. ENGINE AIR INLET SCREENS RETRACTED.

LOITER—NO EXTERNAL LOAD					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
20,000	175	.39	240	2800	92
17,500	175	.37	230	2800	89
15,000	175	.34	215	2700	87
12,500	170	.32	205	2700	85
10,000	170	.30	195	2800	83
7,500	165	.28	185	2800	81
5,000	165	.27	175	2900	79
2,500	165	.26	170	2900	77
SEA LEVEL	160	.24	160	3000	76

LEGEND

- - - - - FUEL REMAINING
▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
—— MILITARY POWER CLIMB GUIDE LINES

BC-239A

Figure A-18 (Sheet 2 of 2 Sheets).

DESCENTS

IDLE POWER

MODEL: **F-89B,C**

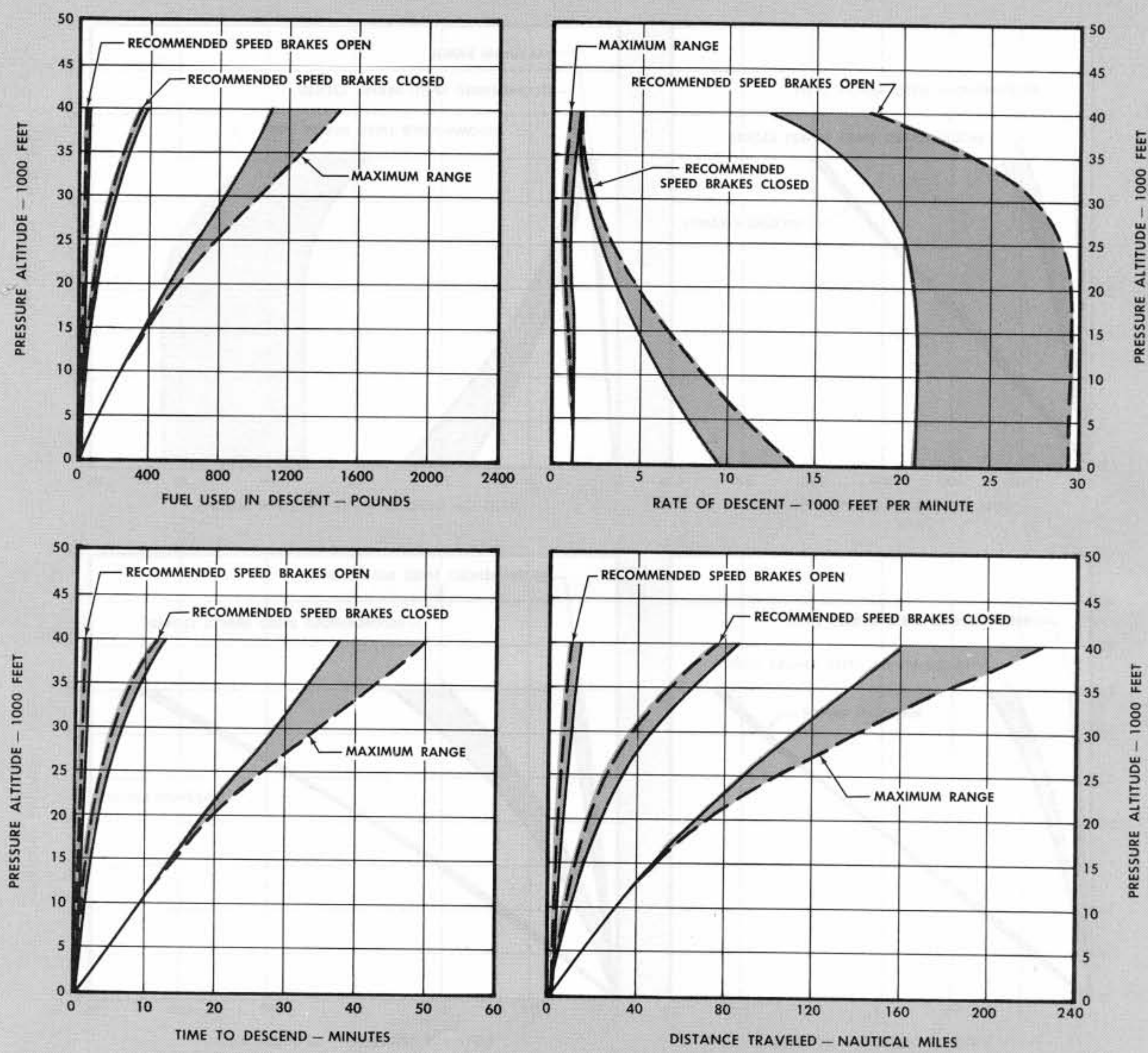
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FOR MAXIMUM RANGE DESCENT, MAINTAIN 185 KNOTS INDICATED AIRSPEED (IAS).
2. FOR RECOMMENDED DESCENT, MAINTAIN .7 MACH NUMBER (SPEED BRAKES OPEN OR CLOSED).
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.

——— 38,000 LB

— — — 26,000 LB

BC-246A

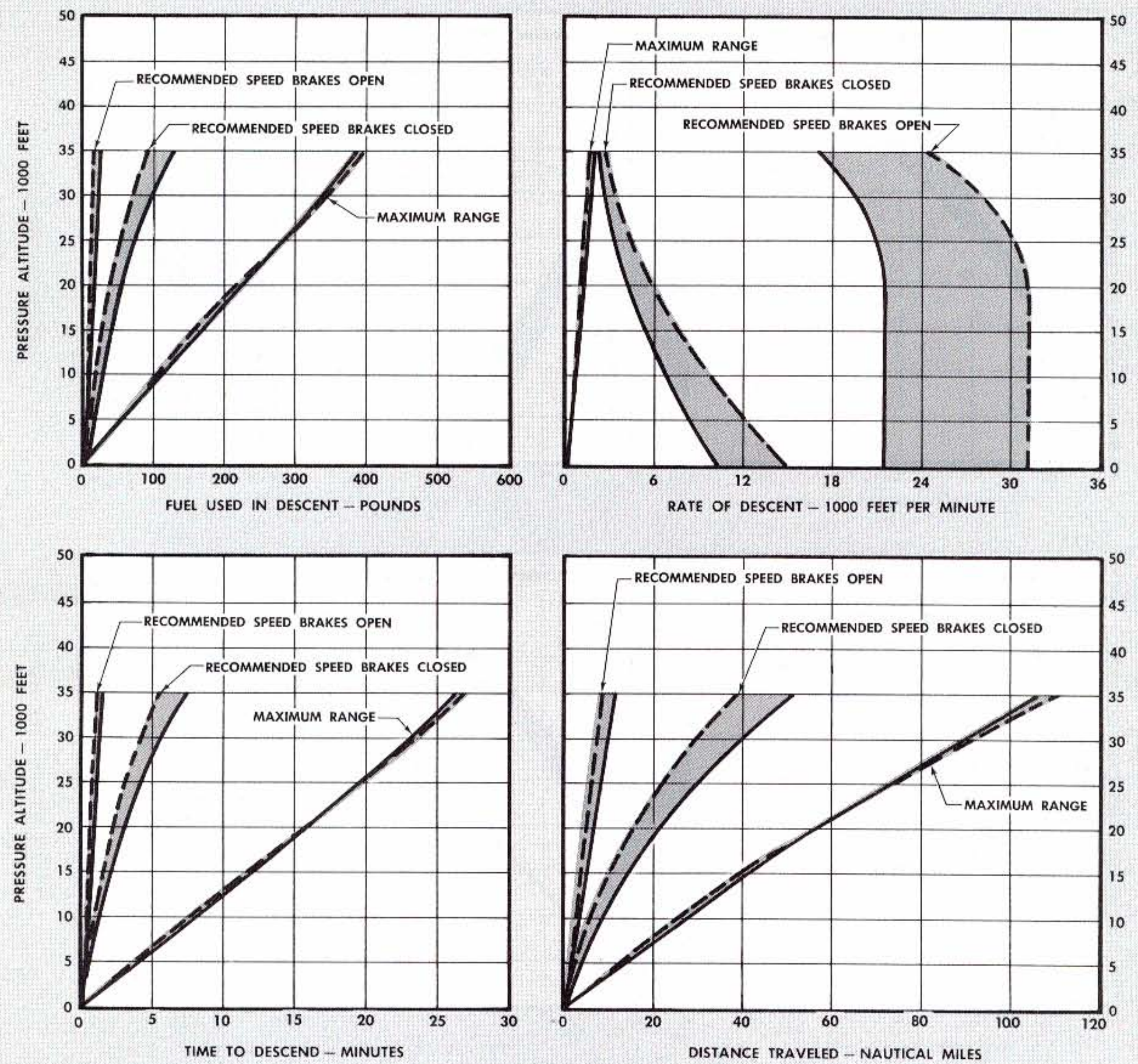
Figure A-19 (Sheet 1 of 2 Sheets).

DESCENTS

ONE ENGINE OPERATING
IDLE POWER

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FOR MAXIMUM RANGE DESCENT, MAINTAIN 185 KNOTS INDICATED AIRSPEED (IAS).
2. FOR RECOMMENDED DESCENT, MAINTAIN .7 MACH NUMBER (SPEED BRAKES OPEN OR CLOSED).
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.
5. SINGLE ENGINE DESCENTS NOT RECOMMENDED BECAUSE OF "DUCT RUMBLE" ON THE WINDMILLING ENGINE.

——— 38,000 LB
– – – 26,000 LB

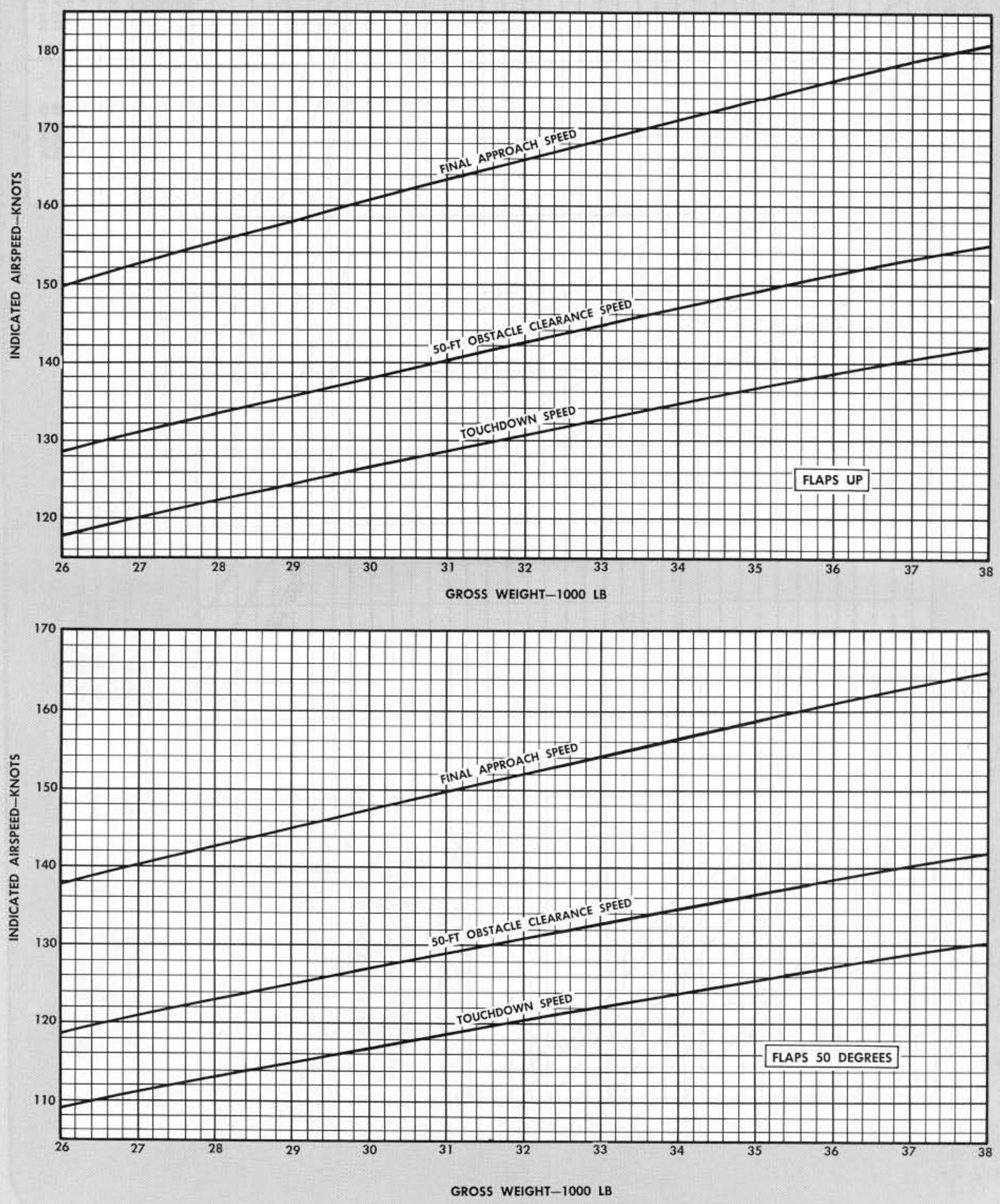
BC-245A

Figure A-19 (Sheet 2 of 2 Sheets).

LANDING SPEEDS

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



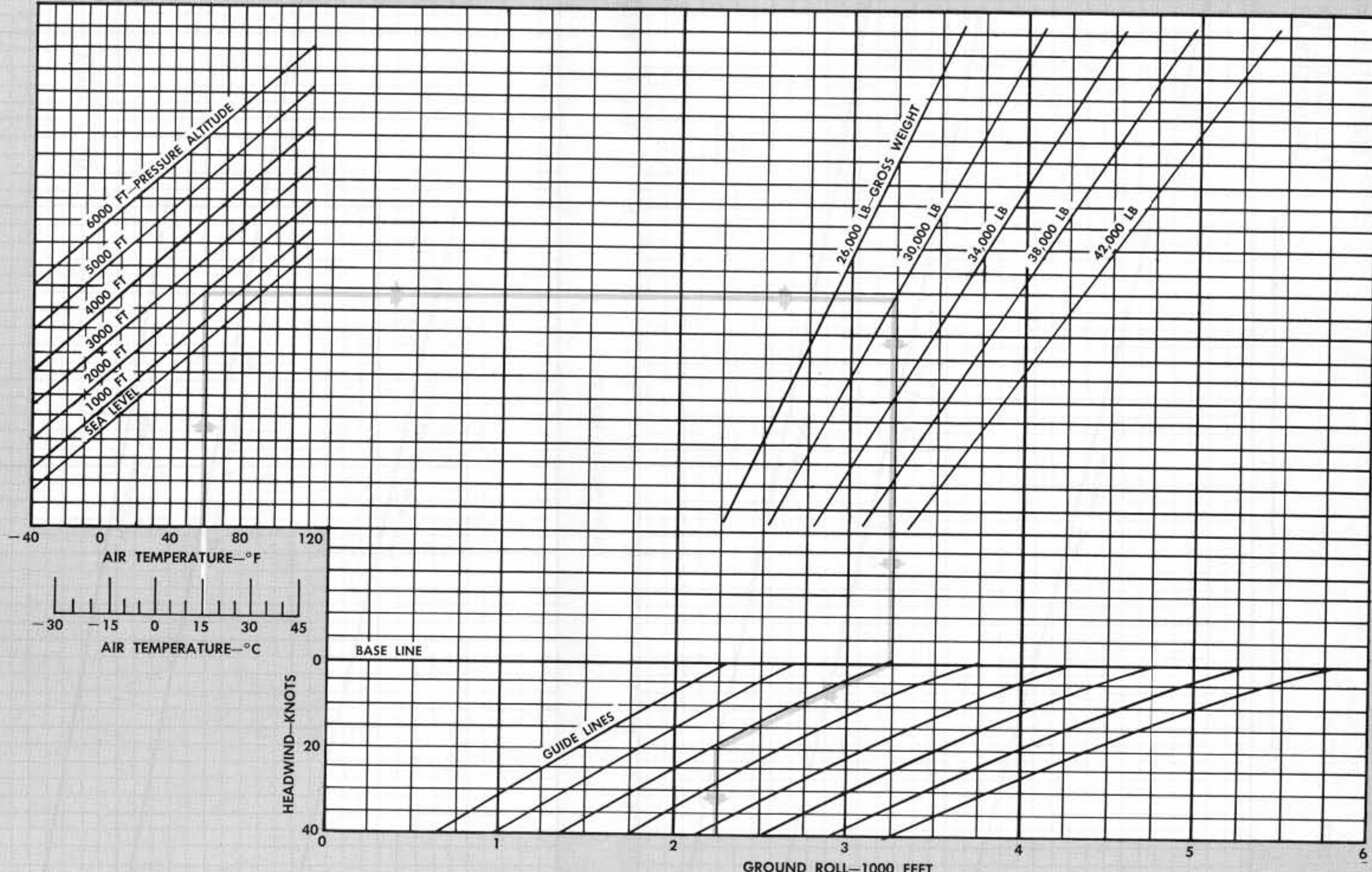
BC-292A

Figure A-20.

LANDING DISTANCE

MODEL: **F-89B,C**
DATA BASIS: **FLIGHT TEST**
DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. USE SPEED BRAKES AS NECESSARY TO MAINTAIN APPROACH AIRSPEED AND FULLY OPEN SPEED BRAKES AFTER TOUCHDOWN.
2. USE 50 DEGREE FLAPS.
3. CHART DISTANCES AND AIRSPEEDS ARE BASED ON NORMAL OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
4. ENGINE AIR INLET SCREENS EXTENDED.

GROSS WEIGHT	TOUCHDOWN
26,000 LB	109 KNOTS IAS
30,000 LB	117 KNOTS IAS
34,000 LB	124 KNOTS IAS
38,000 LB	131 KNOTS IAS

BC-291(1)

Figure A-21 (Sheet 1 of 4 Sheets).

LANDING DISTANCE TO CLEAR 50-FT. OBSTACLE

MODEL: **F-89B,C**

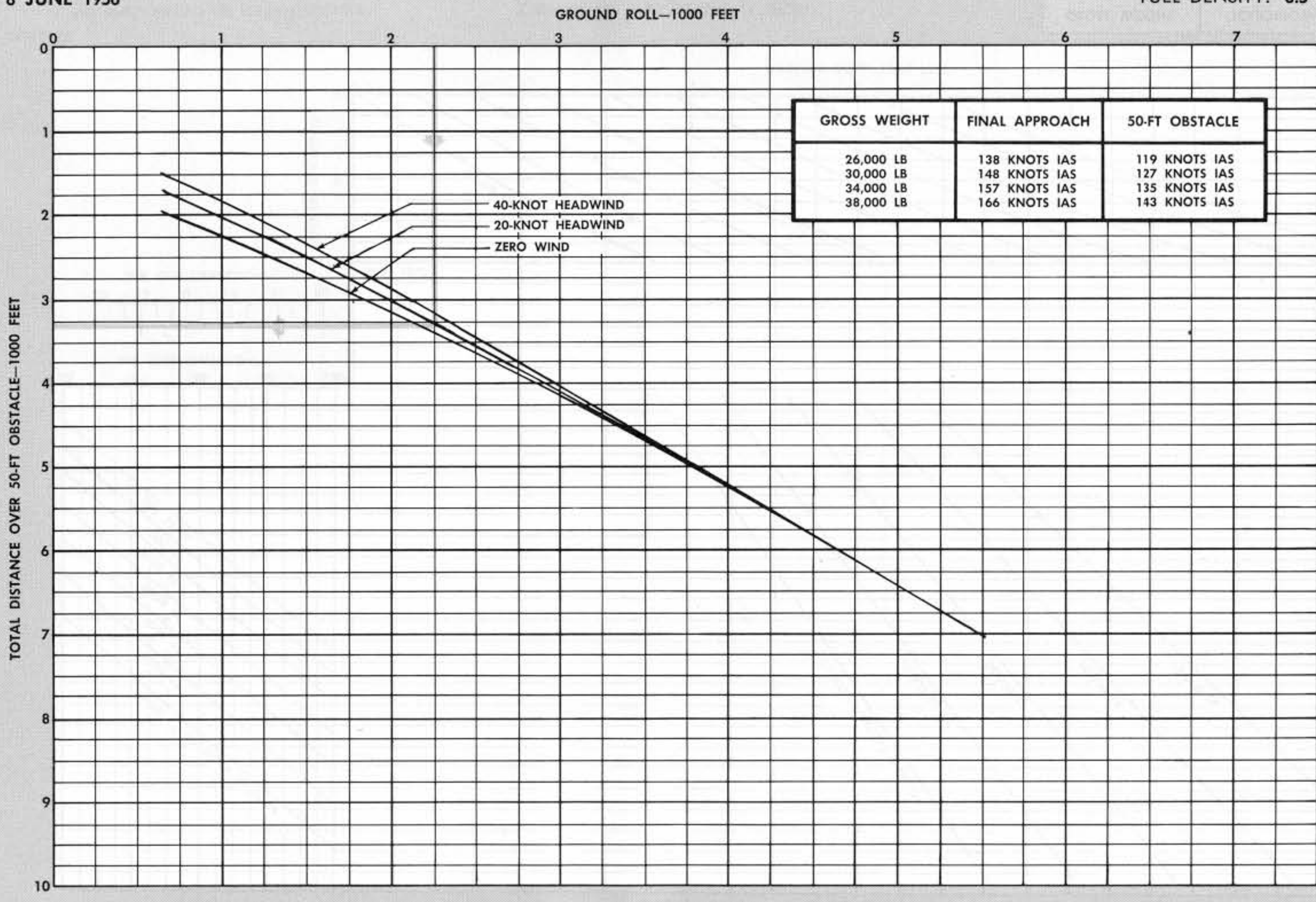
DATA BASIS: **FLIGHT TEST**

DATE: **8 JUNE 1956**

ENGINE(S): **(2) J35-47**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



GROSS WEIGHT	FINAL APPROACH	50-FT OBSTACLE
26,000 LB	138 KNOTS IAS	119 KNOTS IAS
30,000 LB	148 KNOTS IAS	127 KNOTS IAS
34,000 LB	157 KNOTS IAS	135 KNOTS IAS
38,000 LB	166 KNOTS IAS	143 KNOTS IAS

REMARKS:

1. USE SPEED BRAKES AS NECESSARY TO MAINTAIN APPROACH AIRSPEED AND FULLY OPEN SPEED BRAKES AFTER TOUCHDOWN.
2. USE 50 DEGREE FLAPS.
3. CHART DISTANCES AND AIRSPEEDS ARE BASED ON NORMAL OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
4. ENGINE AIR INLET SCREENS EXTENDED.

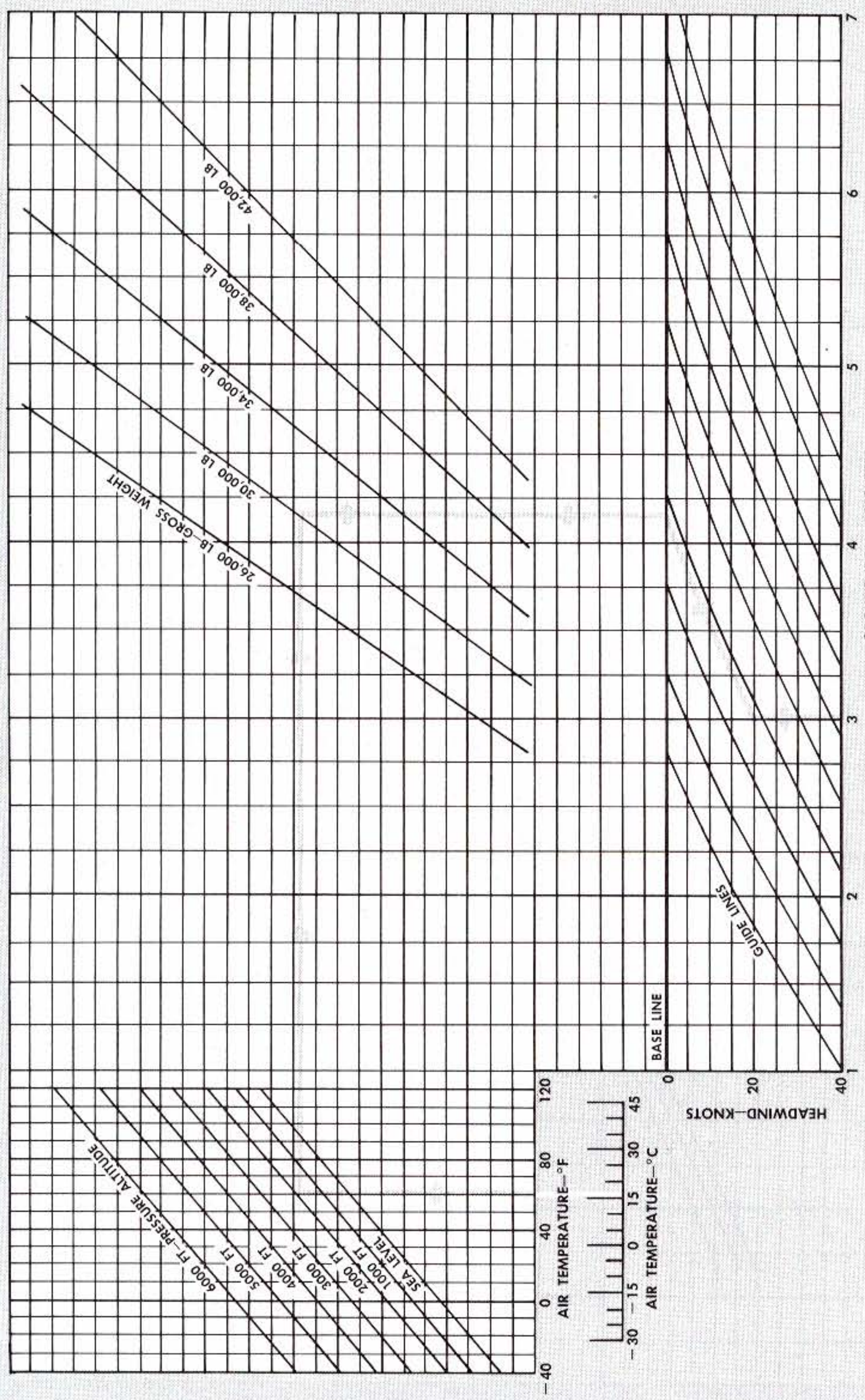
BC-291(2)

Figure A-21 (Sheet 2 of 4 Sheets).

LANDING DISTANCE
ONE ENGINE OPERATING

MODEL: F-89B,C
DATA BASIS: FLIGHT TEST
DATE: 8 JUNE 1956

ENGINE(S): (2) J35-47
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



GROSS WEIGHT	TOUCHDOWN
26,000 LB	118 KNOTS IAS
30,000 LB	127 KNOTS IAS
34,000 LB	135 KNOTS IAS
38,000 LB	143 KNOTS IAS

REMARKS:
1. NO SPEED BRAKES OR FLAPS AVAILABLE.
2. CHART DISTANCES AND AIRSPEEDS ARE BASED ON EMERGENCY OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
3. ENGINE AIR INLET SCREENS EXTENDED.

BC-247(1)

Figure A-21 (Sheet 3 of 4 Sheets).

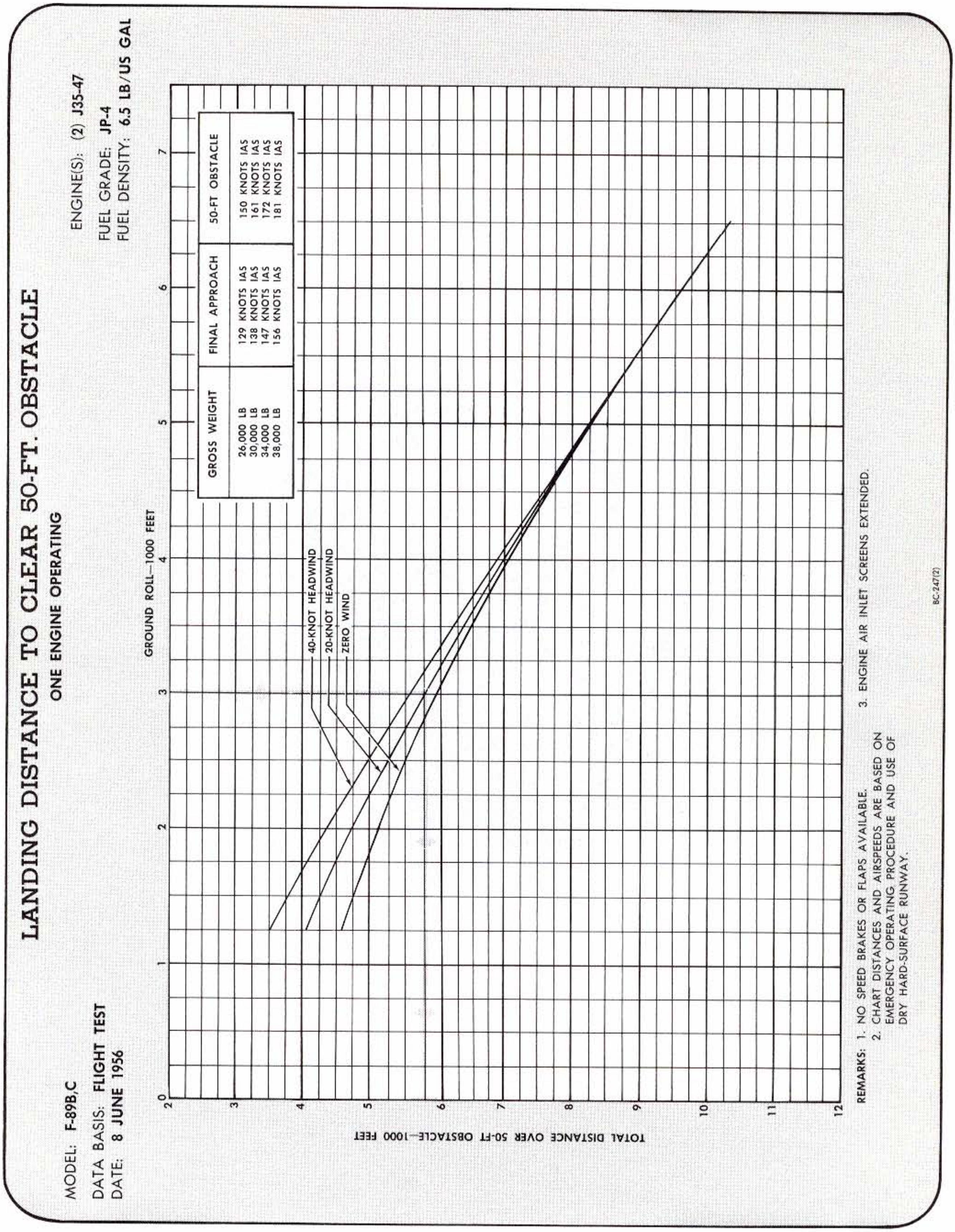


Figure A-21 (Sheet 4 of 4 Sheets).


FBC-18

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