FLIGHT MANUAL

USAF SERIES
F-89J
AIRCRAFT

THIS MANUAL IS NOT COMPLETE WITHOUT CONFIDENTIAL SUPPLEMENT T.O. 1F-89J-1A.

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

This publication includes Safety of Flight Supplements 1F-89J-1SS-6 and 1F-89J-1SS-7. See Safety of Flight Supplement Index T.O. 0-1-4A, for current status of Safety of Flight Supplements.

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Insert changed pages into basic publication. Destroy superseded pages.

J-1R

AIR FORCE DPSU/Aug 66/1600

9 JUNE 1961
CHANGED 18 AUGUST 1965

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 418. CONSISTING OF THE FOLLOWING:

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*A4-10 and A4-11	15 June 1965
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*A4-21	15 June 1965
A4-22	Original
*A4-23	15 June 1965
A4-24	Original
*A4-25	15 June 1965
A4-26 thru A4-34	Original
*A4-35 thru A4-38	15 June 1965
*1 and 2	15 June 1965
3 and 4	15 October 1963
*5 thru 7	15 June 1965
8 thru 13	15 October 1963
*14	15 June 1965
15	15 October 1963
16 Blank	15 October 1963

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* REFER TO T.O. 1F-89J-1A FOR ADDITIONAL INFORMATION.

THE FOLLOWING IMPORTANT INFORMATION IS

NOT TO BE NEGLECTED

SCOPE.

This Flight Manual contains all the information necessary for safe and efficient operation of the F-89J. 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 Flight 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 in the manual.

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 Flight 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 manual straight through when it is first received and to use it as a reference thereafter. The independence of these sections also makes it possible for the user to rearrange the manual to satisfy his personal taste and requirements. The first three sections cover the minimum information required to get the airplane safely 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 self-explanatory. Section VII contains 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 evident.

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 manual, let us know right away. We cannot correct an error if its 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 Manuals. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Manual. These handsome 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 Publications 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 the publications 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 10 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. 0-1-4A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manuals 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.

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

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

Note *Operating procedures, conditions, etc., which it is essential to emphasize.*

GROUP CODING

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

GROUP 35 AF52-1829 THROUGH AF52-1868

GROUP 40 AF52-1869 THROUGH AF52-1910

GROUP 45 { AF52-1911 THROUGH AF52-1961 / AF52-2127 THROUGH AF52-2165 }

GROUP 50 AF53-2447 THROUGH AF53-2461

GROUP 55 AF53-2462 THROUGH AF53-2521

GROUP 60 AF53-2522 THROUGH AF53-2581

GROUP 65 AF53-2582 THROUGH AF53-2641

GROUP 70 AF53-2642 THROUGH AF53-2686

U.S. AIR FORCE F-89J-35 NO.
A.F. SERIAL NO. AF52 - 1829

J-3G

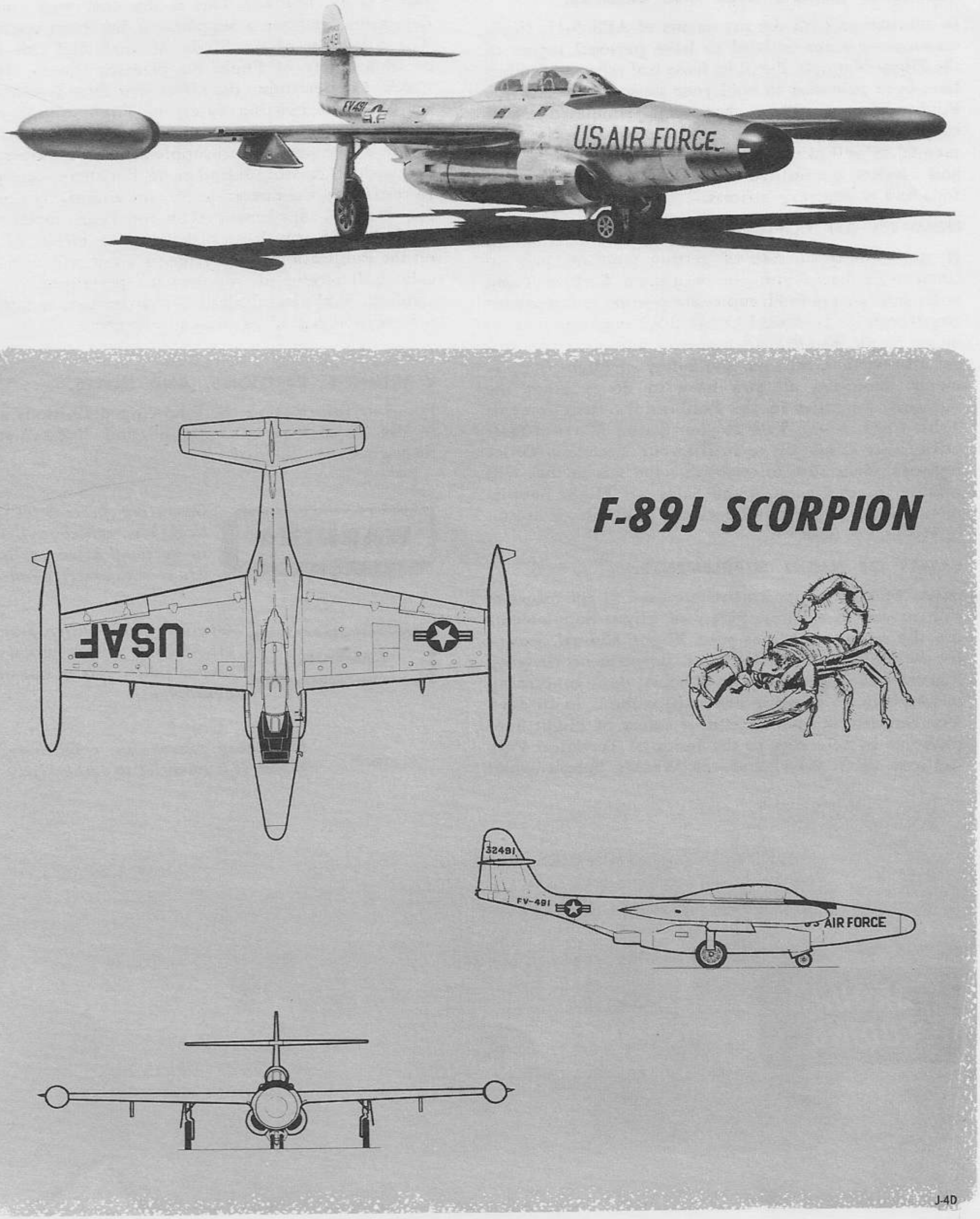
U.S. AIR FORCE
FV-491
USAF
F-89J SCORPION
32491
FV-491
U.S. AIR FORCE
J-4D

Figure 1-1.

SECTION I

DESCRIPTION

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THE AIRPLANE.

The Northrop F-89J airplane is a two-place, midwing, jet-propelled, all-weather fighter interceptor 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 intercept officer (referred to as radar observer or RO throughout the manual). The pilot and radar observer have individual cockpits with ejection seats, 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 to the 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 aircraft 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 the forward edge. 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. A large pylon under each wing can carry a special weapon.

AIRPLANE DIMENSIONS.

Refer to figure 1-2 for dimensions of this airplane.

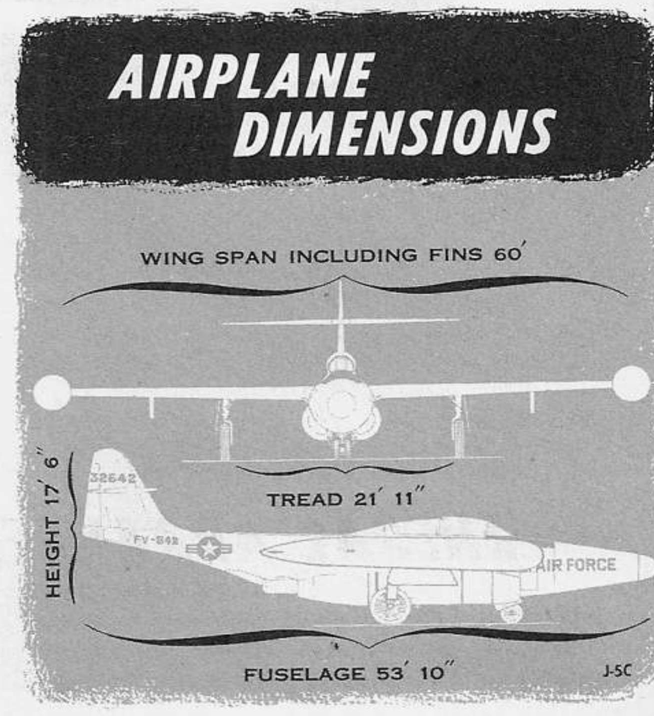
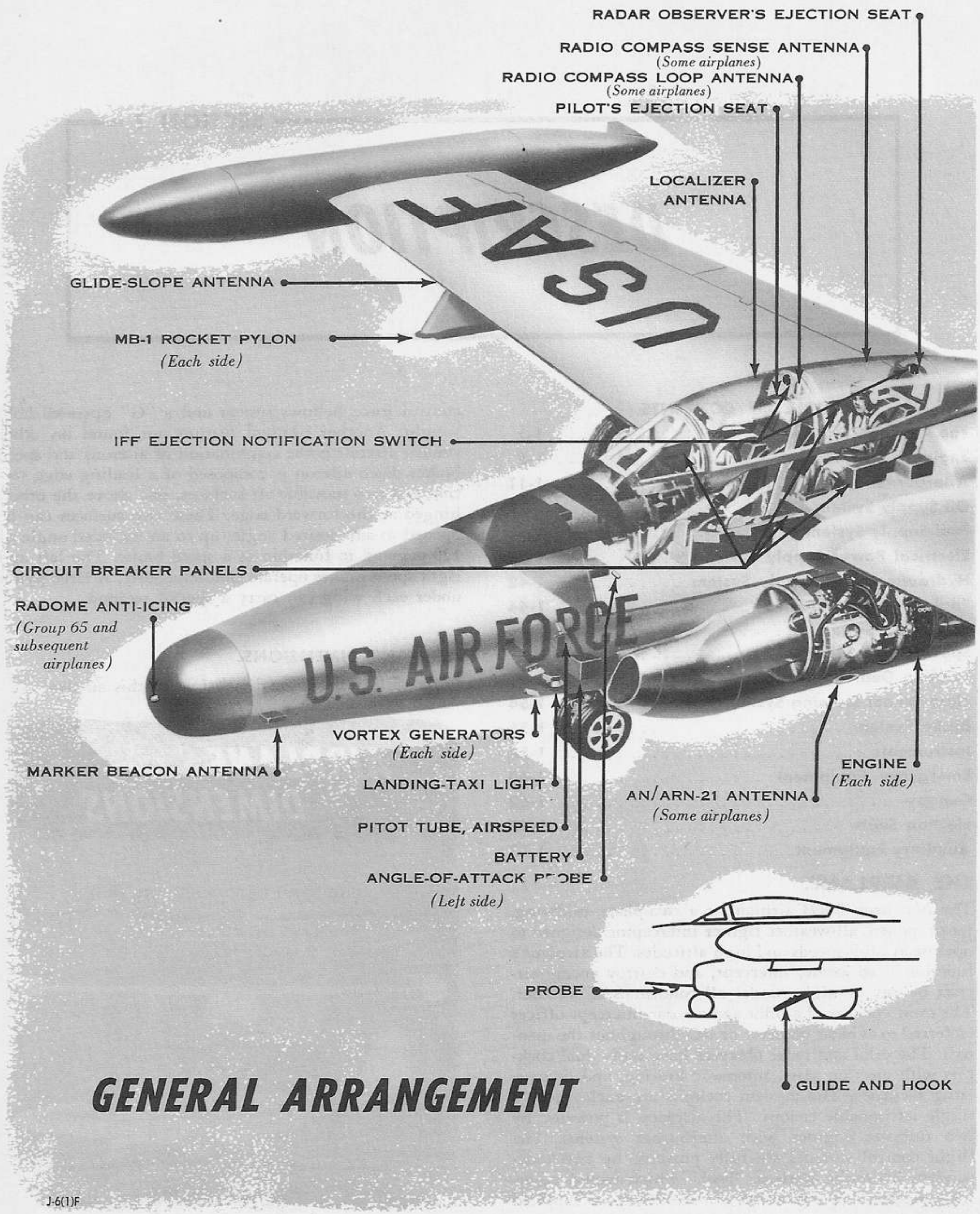
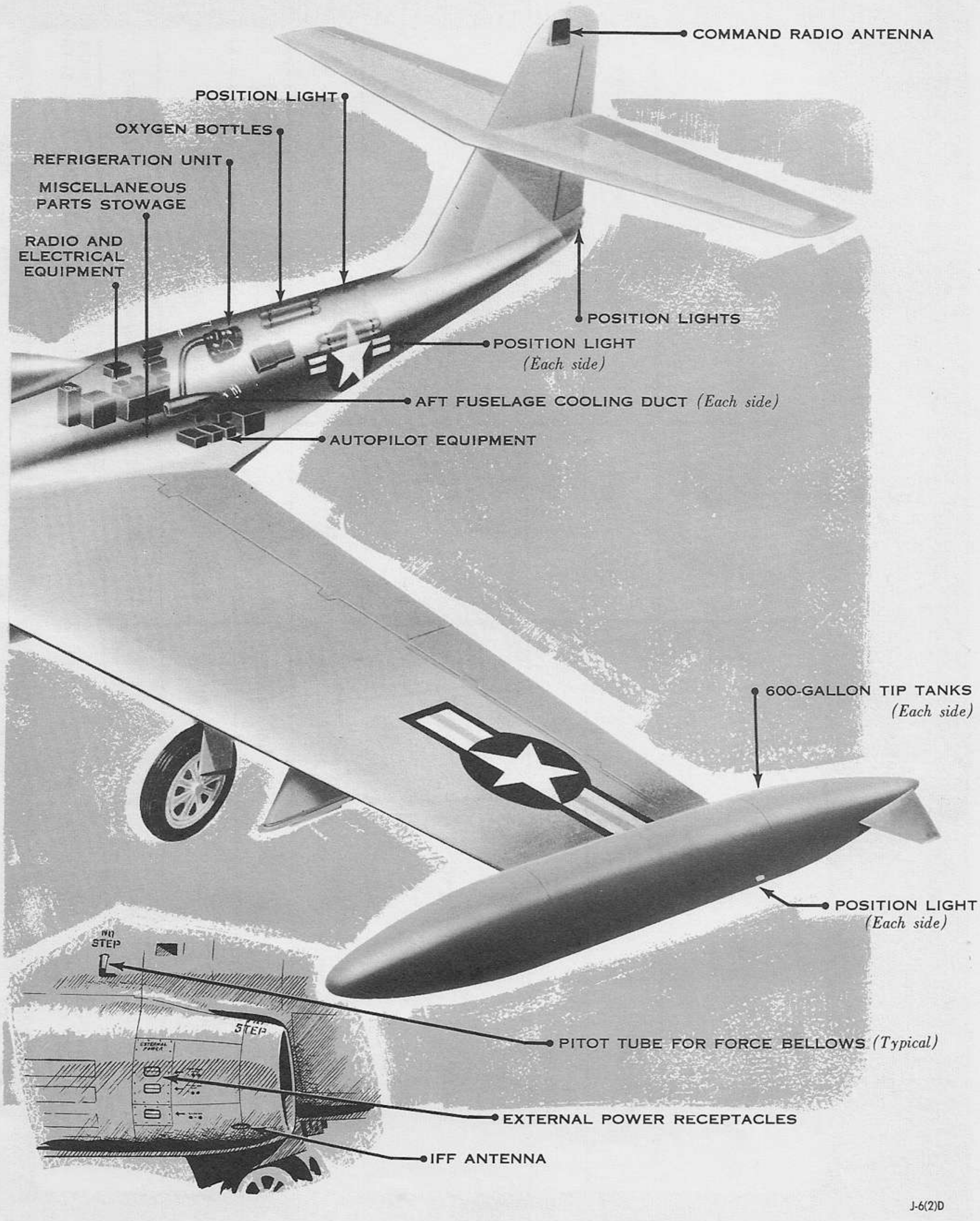


Figure 1-2.



GENERAL ARRANGEMENT

Figure 1-3.


COMMAND RADIO ANTENNA
POSITION LIGHT
OXYGEN BOTTLES
REFRIGERATION UNIT
MISCELLANEOUS PARTS STOWAGE
RADIO AND ELECTRICAL EQUIPMENT
POSITION LIGHTS
POSITION LIGHT (Each side)
AFT FUSELAGE COOLING DUCT (Each side)
AUTOPILOT EQUIPMENT
600-GALLON TIP TANKS (Each side)
POSITION LIGHT (Each side)
NO STEP
STEP
PITOT TUBE FOR FORCE BELLOWS (Typical)
EXTERNAL POWER RECEPTACLES
IFF ANTENNA
J-6(2)D

MAIN DIFFERENCES TABLE

ITEM	F-89B	F-89C	F-89D	F-89H	F-89J
EXTERNAL POWER RECEPTACLES	THREE: *Groups 1, 5, and 10 airplanes* FOUR: *Group 15 airplanes*	FOUR	FOUR: *Groups 1 through 25 airplanes* THREE: *Group 30 and subsequent airplanes*	THREE	THREE
AUTOPILOT	NONE	NONE	*Group 35 and subsequent airplanes*	ALL AIRPLANES	ALL AIRPLANES
SINGLE-POINT FUELING	NONE	NONE	ALL AIRPLANES	ALL AIRPLANES	ALL AIRPLANES
ENGINES	J35-47	J35-47	J35-47: *Groups 1 through 20 airplanes* J35-35: *Group 25 and subsequent airplanes* J35-35A: *Some airplanes*	J35-35 J35-35A: *Some airplanes*	J35-35A
ARMAMENT	SIX 20MM NOSE GUNS	SIX 20MM NOSE GUNS	ROCKETS	ROCKETS AND MISSILES	MB-1 ROCKETS
WING TIP CONFIGURATION	FUEL TANKS	FUEL TANKS	FUEL-ROCKET PODS	FUEL-ROCKET-MISSILE PODS	600-GALLON TIP TANKS
PYLON TANKS	NONE	NONE	ALL AIRPLANES	ALL AIRPLANES	NONE
NOSE FUEL TANK	NONE	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	AN/ARN { -6, -14, -18 OR -14, -18, -21 OR -6, -21 }

J-7F

Figure 1-4.

AIRPLANE GROSS WEIGHTS.

The gross weights vary with airplane configuration (see figure 5-5). Detailed information on weight limitations will be found in Section V.

ARMAMENT.

Standard armament consists of MB-1 rockets. For detailed information on armament, refer to T.O. 1F-89J-1A, a confidential supplement to this publication.

The airplane is powered with two J35-35A turbojet engines 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. A portion of the 11th stage compressor air is used to pressurize the pylon and wing tip fuel tanks and to operate the thermal anti-icing system, the afterburner fuel pump, the air-conditioning system, hydraulic reservoir, and the canopy seal. 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 if more thrust is desired. The gases are then discharged from the tailpipe. The afterburner tailpipe nozzle is equipped with eyelids that open automatically to increase tailpipe diameter, thus allowing additional thrust without excessive exhaust gas temperatures. The afterburner eyelids, in addition to opening during afterburning, will stay open during starting to prevent high temperature, and during rapid acceleration to decrease acceleration time. Each engine at 100% rpm has a rated thrust of 5600 pounds without afterburning, and 7400 pounds with afterburning. For a detailed discussion of the eyelids, see Eyelid Operation, 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 engine-driven fuel pump incorporates two pumping elements. Should one element fail, the other element will maintain the required fuel pressure. 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 combustion more evenly throughout the chamber as the engine accelerates. The change in spray characteristics 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.

Note

> Since some variation in rpm can occur with change in altitude, the tachometer should be monitored during 100% rpm settings.

A centrifugal governor in the fuel control varies the flow of fuel to the nozzles according to engine speed and throttle position. (See figure 1-5.) Refer to Section VII for additional information on engine operation.

Throttles.

Each of the two throttles (figure 1-6) on the pilot's left console mechanically regulates an engine fuel control. Markings on the throttle quadrant are CLOSED and OPEN. Mechanical stops at the idle position prevent retarding the throttle below the idle speed 50% ±1% rpm of the engines. The throttles can be retarded past the idle stops by raising the fingerlifts under the throttles knobs. This allows the throttles to be placed at CLOSED, shutting off fuel flow to the engines at the engine fuel control. Each throttle fingerlift connects to an afterburner demand switch that will start afterburning on the corresponding engine when the throttle is between the 90% and 100% rpm range.

ENGINE FUEL CONTROL SYSTEM

LEFT ENGINE (TYPICAL)

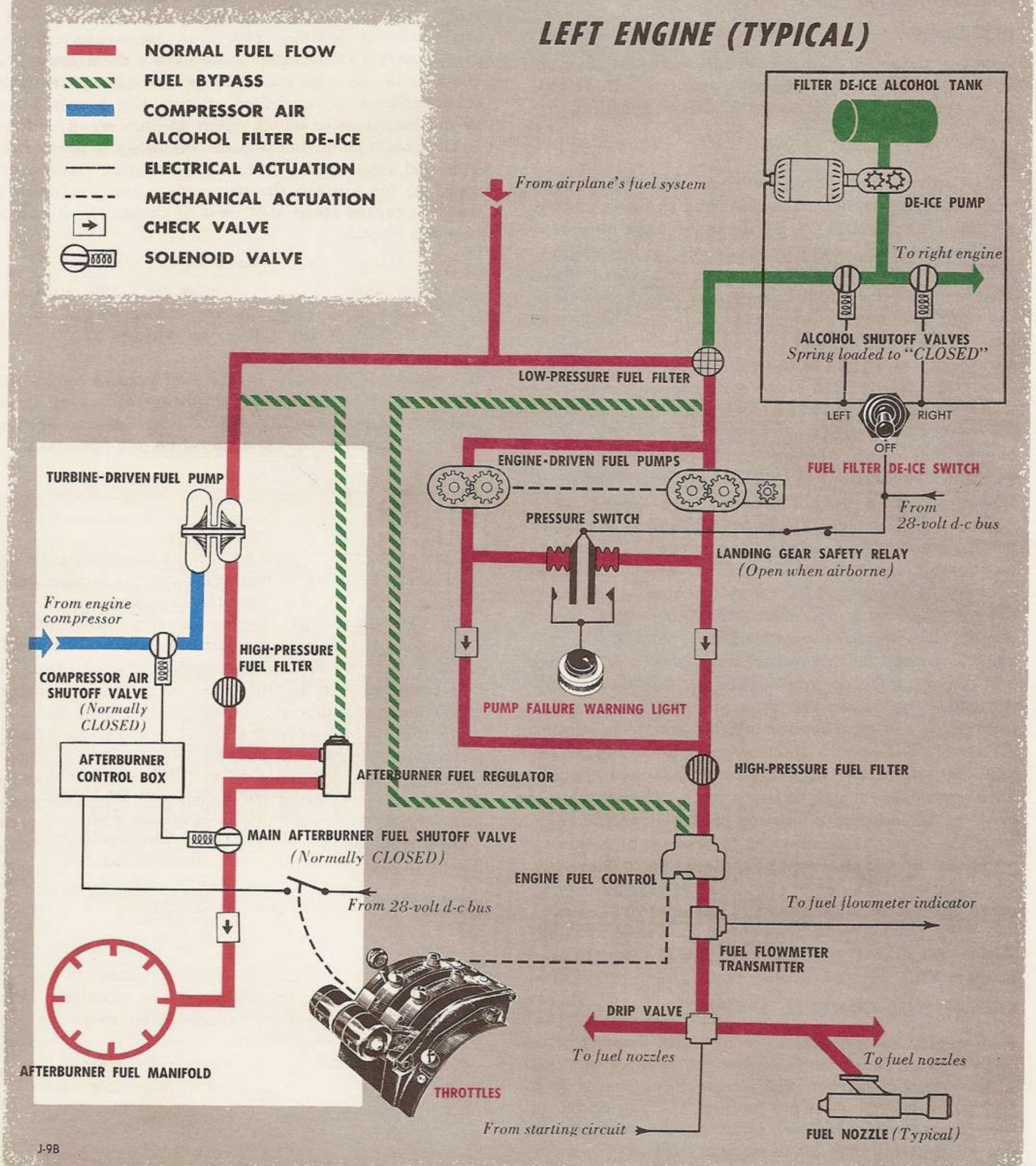


Figure 1-5.

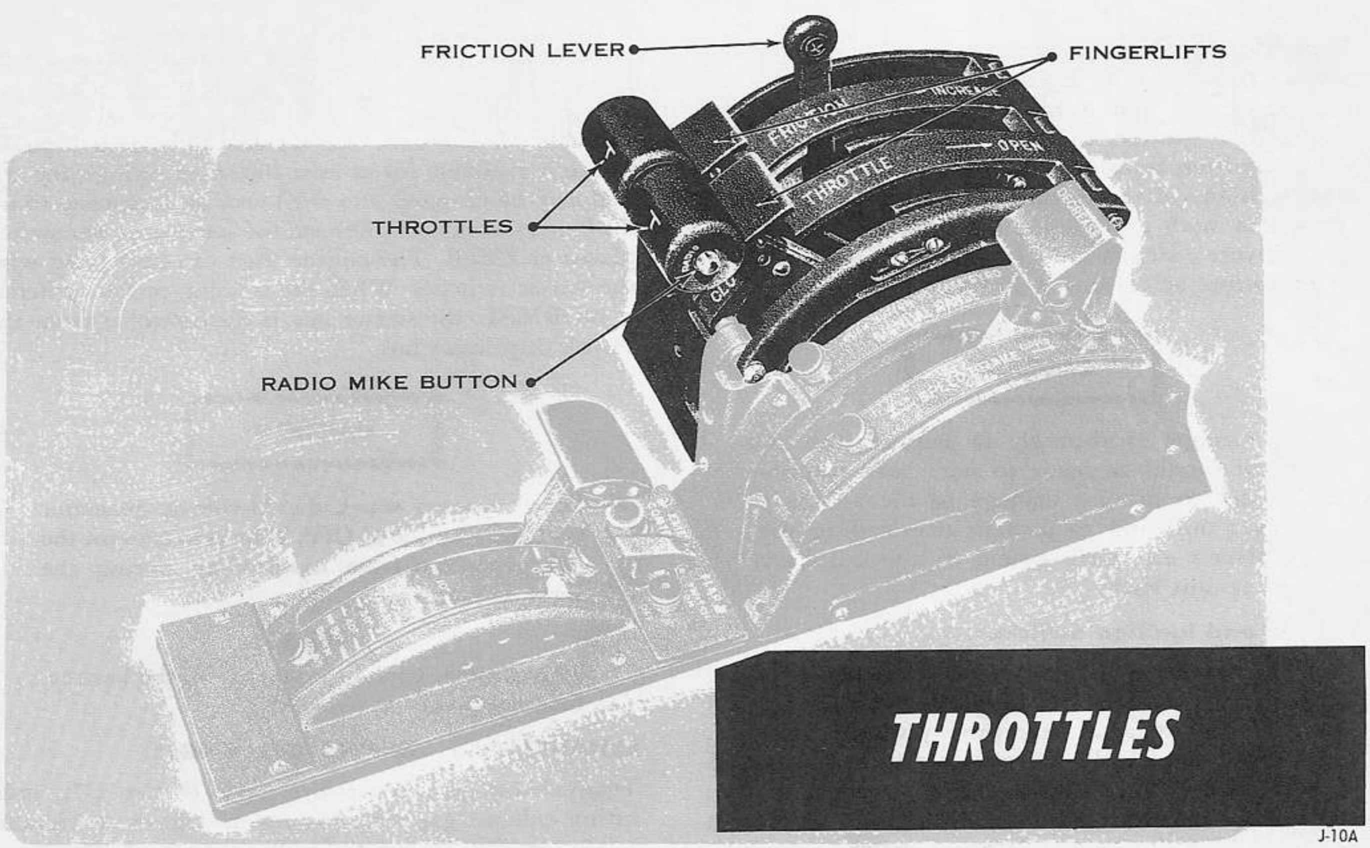


Figure 1-6.

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 air scoop on the lower forward section of the engine's No. 3 door. The afterburner section is cooled by ram air supplied through a flush-type air inlet located on the engine's No. 4 door. Vortex generators in the form of two small air-directing vanes are installed approximately 40 inches forward of each engine air intake duct. The effect of these vanes is to prevent the intermittent separation of airflow through the engine transition duct and the resultant noise and vibration which would occur at high airspeed and low rpm.

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; however, an engine screen switch provides for screen extension and retraction during flight.

Engine Screen Switch.

The 28-volt dc engine screen switch (figure 4-4) on the anti-icing control panel provides a means for extending the engine screens during combat, or at other times when there is danger of foreign matter entering the engine intake ducts. The switch has two positions: NORMAL and EMER EXTEN. When the switch is placed at NORMAL, the screens extend and retract automatically with the landing gear. When the switch is placed at EMER EXTEN, the screens extend; however, if anti-icing system operation is selected, the screen control is overriden and the screens retract.

STARTING AND IGNITION SYSTEM.

Power for starting is supplied by external power units connected to the power receptacles on the right air intake duct. On Group 50 and subsequent airplanes only one engine can be started at a time, because actuating one starter-generator breaks the dc power circuit to the other engine's starter and ignition system. When a starter switch is 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. The engine ignition system operates on 115-volt ac power. The primary (essential) bus of the single-phase (power) inverter system supplies current to the ignition transformers which, in turn, send extremely high voltage to the two igniter plugs in each engine for both ground and air starting. The single-phase inverter switch must be placed at NORMAL or EMER before ac current is available for starting.

CAUTION

On Groups 35 through 45 airplanes no attempt should be made to start both engines at once to prevent damage to the auxiliary power unit and to prevent overloading the airplane's electrical system at the auxiliary power unit leads.

Starter and Ignition Switches.

Two starter and ignition switches (figure 1-11), 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 power, control the electrical circuits to the starter and to the 115-volt ac ignition system. When a switch is at NEUTRAL, starter 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 starter 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 (figure 1-16), one for each engine, are located on the aft miscellaneous control panel above the pilot's left console. 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: TEST, NEUTRAL, and START. They are spring-loaded to NEUTRAL. The switches, using 28-volt dc power, control separate electrical circuits to the 115-volt ac ignition system and the 28-volt dc starter. When a switch is at NEUTRAL, starter and ignition circuits are open. When an air start is required, placing the switch momentarily at START will supply ignition to the windmilling engine for approximately 120 ± 30 seconds through a time-delay unit. When the switch is held at TEST (for ground operation only), the starter will turn the engine over without ignition.

Starting Power Switch.

A guarded emergency starting power switch (figure 1-11) with two positions, EMER and NORMAL, is located on the pilot's right vertical console. This switch connects the 28-volt dc primary bus to the starter bus for emergency starting when limited external power is available. When only one 28-volt dc external power source is available (of at least 1000-amp rating), the one lead may be plugged into the lower dc receptacle (with the battery switch at OFF) and the starting power switch placed at EMER. The engine then can be started with the starter switches. When the starting power switch is at NORMAL, the starter bus is disconnected from the 28-volt dc primary bus.

CAUTION

For 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.

Note

This airplane cannot be started on the battery. External power is required.

EXHAUST GAS TEMPERATURE GAGES.

Two exhaust gas temperature gages (figure 1-7), indicating exhaust gas 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 gas temperatures; however, limited control for these temperatures can be indirectly achieved by changing the throttle settings. See Section VII for a discussion of exhaust gas temperature versus ambient temperature.

TACHOMETERS.

Two tachometers (figure 1-7), indicating engine speed in percent of maximum rpm, are located on the pilot's instrument panel. The main dial is marked in increments of 2% rpm from 0 to 100% rpm. A small dial is marked in increments of 0.1% rpm from 0 to 1 rpm. 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. On this airplane, 100% engine speed is 8000 rpm.

OIL PRESSURE GAGES.

Two oil pressure gages (figure 1-7), 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 single-phase inverter system.

FUEL FLOWMETER INDICATORS.

The two fuel flowmeter indicators (figure 1-7) are located on the pilot's instrument panel and register the

PILOT'S INSTRUMENT PANEL *(SOME AIRPLANES)*

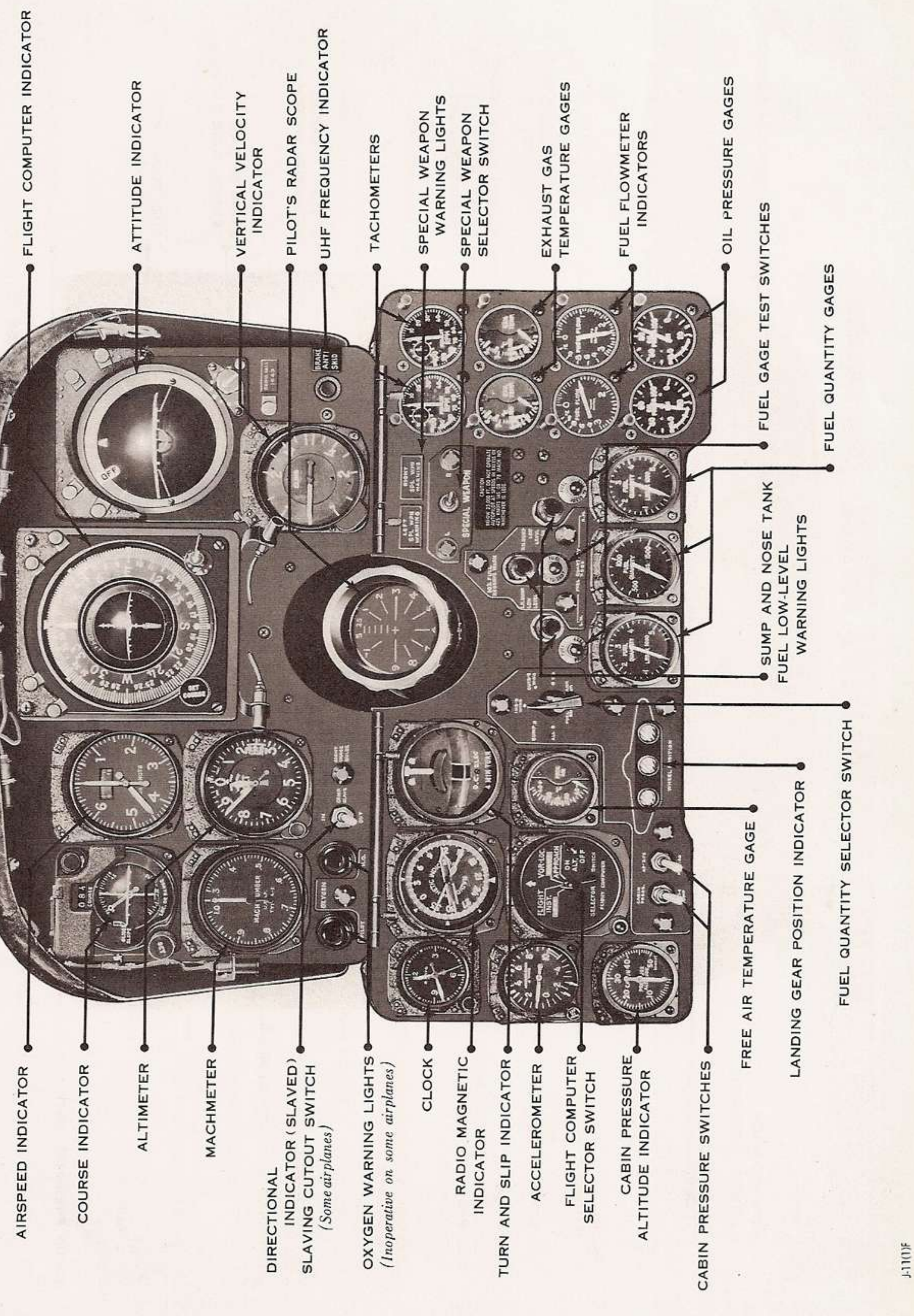


Figure 1-7. (Sheet 1 of 2)

Figure 1-7. (Sheet 2 of 2)

rate that fuel (any grade or weight) is being consumed by the engines (exclusive of afterburners) in pounds per hour. The fuel flowmeter system depends on 28-volt dc and 115-volt single-phase ac for operation.

Note

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

ENGINE-DRIVEN FUEL PUMP FAILURE WARNING LIGHT.

Two 28-volt dc warning lights (figure 1-8), one for each engine, are mounted on a bracket extending from the pilot's left console. The lights are provided to warn the pilot that one or both of the two elements of each engine-driven fuel pump are inoperative. The lights are controlled by a pressure switch connected to the two pumping elements. If the fuel pressure drops at the outlet of one element, the switch closes and turns on the light. The lights will indicate an element failure during ground operation only. A switch on the left main landing gear prevents operation when the weight of the airplane is removed from the landing gear.

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 1-5) 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 differential 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. Initial afterburner combustion is normally accompanied by a momentary drop in engine speed and a momentary rise in exhaust gas 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 fingerlifts are depressed and then raised again. Exhaust gas temperature with afterburning should stabilize at about the same temperature as with military thrust. Toggle-type control circuit breakers are provided to facilitate deactivation of the afterburner system.

Note

> When afterburners are started or shut down, a momentary rpm increase may be experienced. Retarding throttles to 98% or below will prevent engine overspeeding.

WARNING

- If there is no power to the ac single-phase essential bus, the operation of the afterburner and afterburner eyelids will be affected. This effect is related to the altitude of the aircraft and whether the afterburner is in operation at the time power is lost to this bus. Without eyelid action there will be an extreme loss of thrust.

  1. Below 10,000 feet.

     a. While in afterburner: The afterburner operation will be unaffected. When the afterburner is terminated, the eyelids will remain open and can be closed by retarding the throttle below 90%.

     b. Not in afterburner: The eyelids will be open when the throttle for the engine is above the 90% position. Afterburner cannot be initiated.

  2. Above 10,000 feet.

     a. In afterburner: Afterburning will be unaffected. However, once afterburning is terminated, it cannot be reinitiated.

     b. Not in afterburner: The eyelids will remain closed and afterburner cannot be initiated.

- Normal operation of the afterburner and eyelids can be restored by supplying power to the ac single-phase essential bus.

- If an afterburner ac circuit breaker is popped, the effect for its respective engine is the same as no ac single-phase essential bus power.
- The eyelids may be closed by retarding the throttle to the 90% position or by moving the afterburner control circuit breaker (toggle type), to the OFF position.
- The 90% rpm mentioned above is approximate; however, eyelid closure can be determined by a rise in EGT and increased thrust.

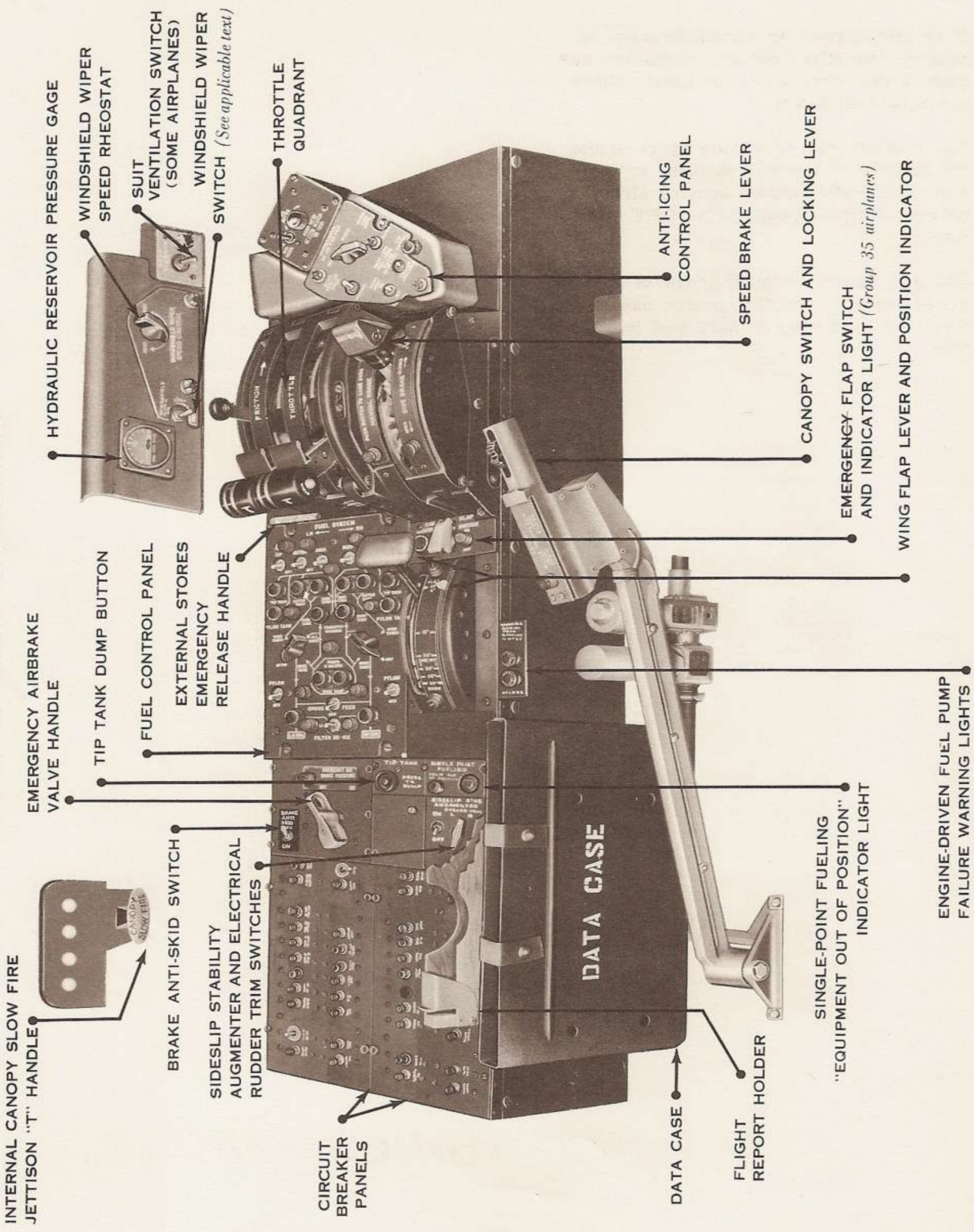
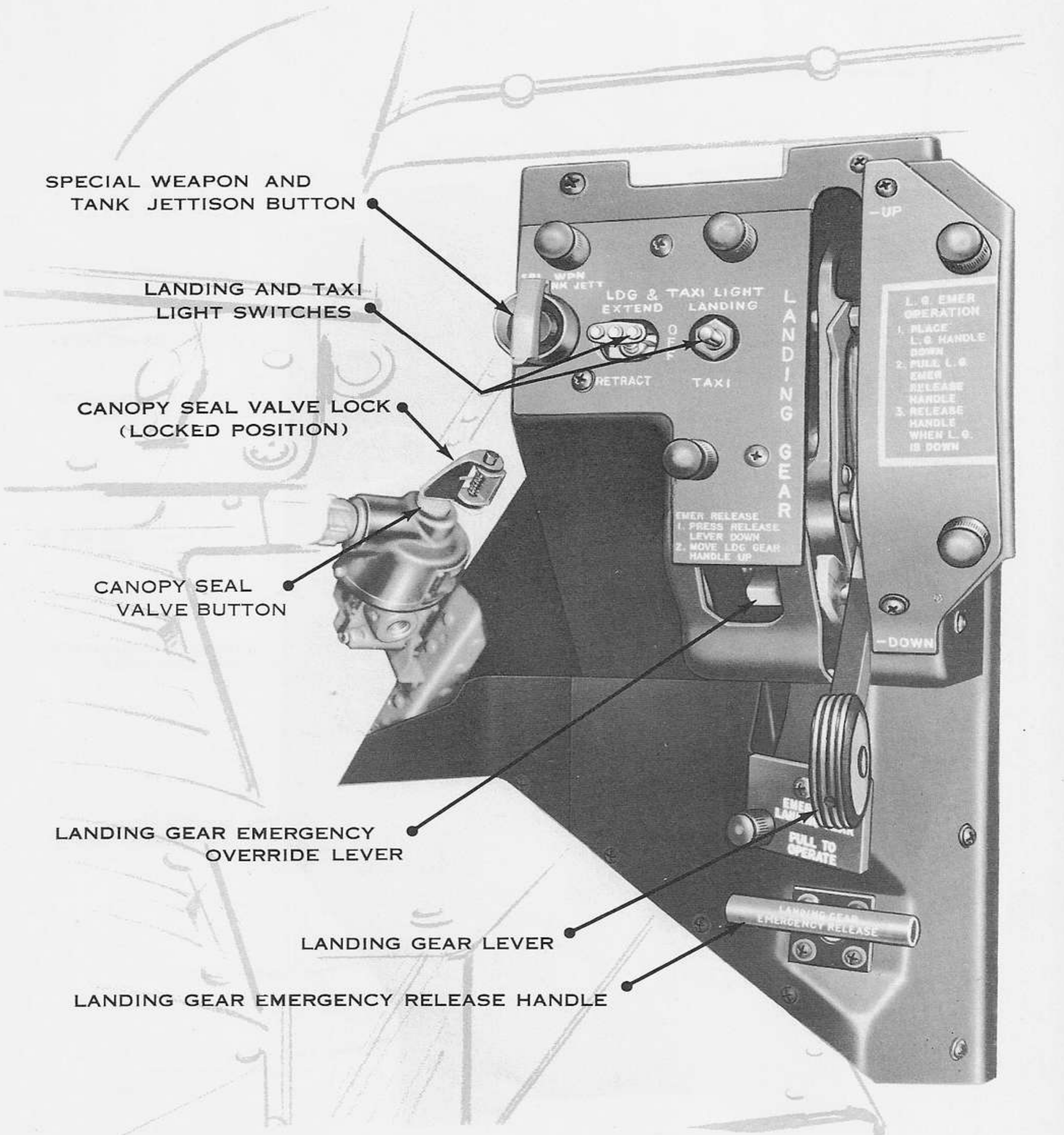

PILOT'S LEFT CONSOLE (TYPICAL)
INTERNAL CANOPY SLOW FIRE JETTISON "T" HANDLE
CANOPY SLOW FIRE
BRAKE ANTI-SKID SWITCH
SIDESLIP STABILITY AUGMENTER AND ELECTRICAL RUDDER TRIM SWITCHES
EMERGENCY AIRBRAKE VALVE HANDLE
TIP TANK DUMP BUTTON
FUEL CONTROL PANEL
EXTERNAL STORES EMERGENCY RELEASE HANDLE
HYDRAULIC RESERVOIR PRESSURE GAGE
WINDSHIELD WIPER SPEED RHEOSTAT
SUIT VENTILATION SWITCH (SOME AIRPLANES)
WINDSHIELD WIPER SWITCH (See applicable text)
THROTTLE QUADRANT
ANTI-ICING CONTROL PANEL
SPEED BRAKE LEVER
CANOPY SWITCH AND LOCKING LEVER
EMERGENCY FLAP SWITCH AND INDICATOR LIGHT (Group 35 airplanes)
WING FLAP LEVER AND POSITION INDICATOR
ENGINE-DRIVEN FUEL PUMP FAILURE WARNING LIGHTS
SINGLE-POINT FUELING "EQUIPMENT OUT OF POSITION" INDICATOR LIGHT
FLIGHT REPORT HOLDER
DATA CASE
CIRCUIT BREAKER PANELS
DATA CASE
FRICTION
THROTTLE
FUEL SYSTEM
TIP TANK
J-12G

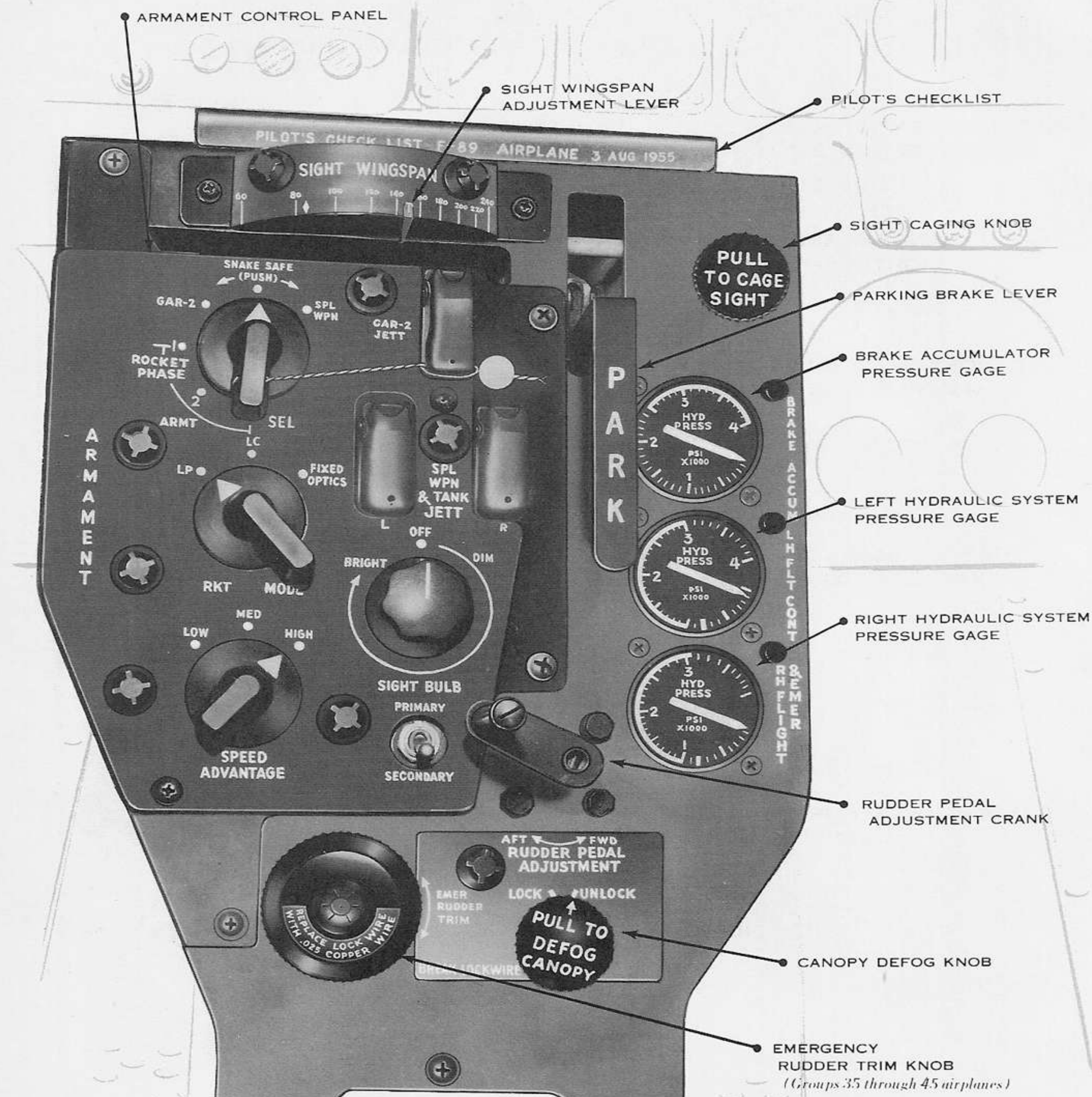
Figure 1-8.



PILOT'S LEFT VERTICAL CONSOLE

J-13C

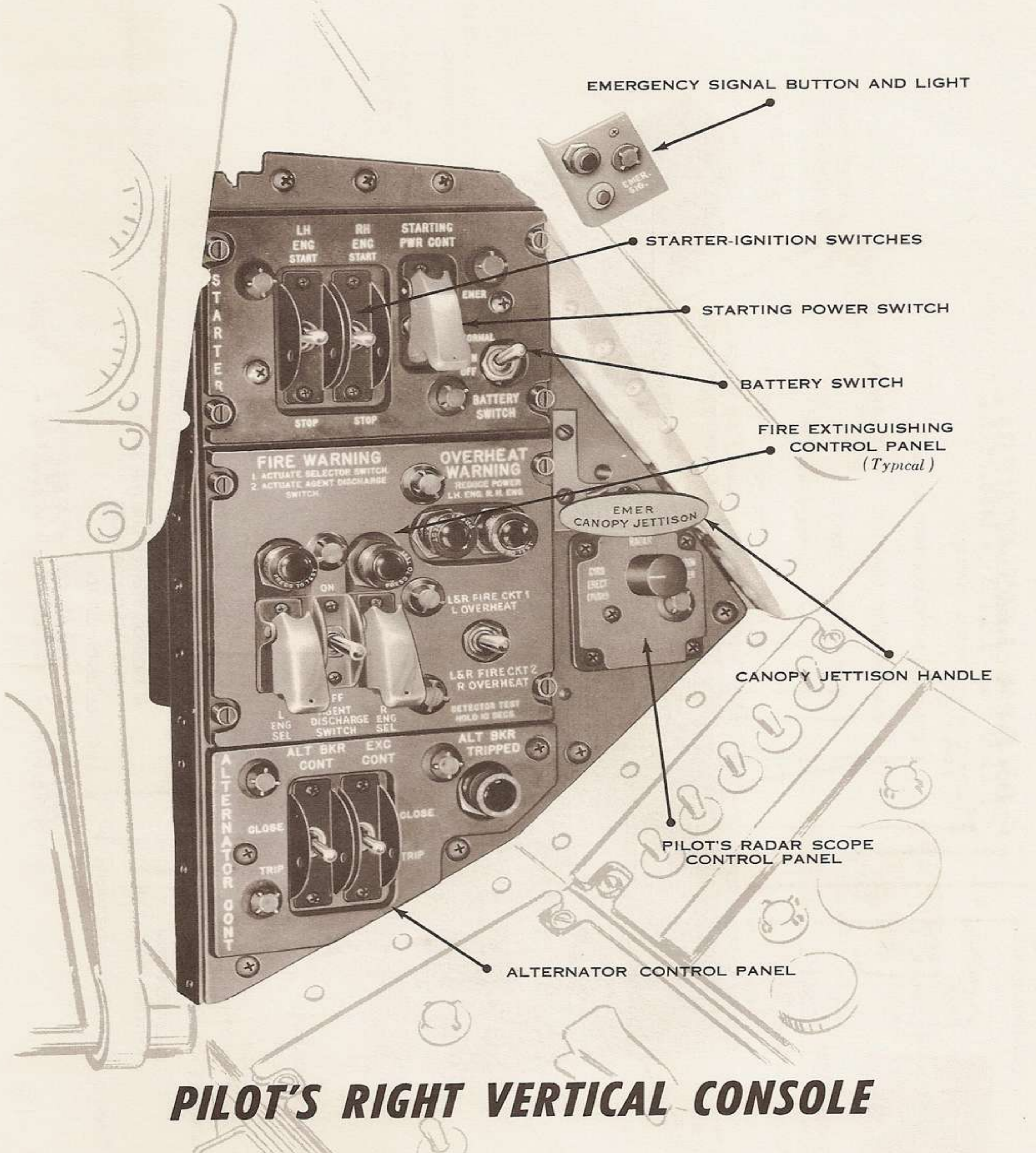
Figure 1-9.



PILOT'S CENTER PEDESTAL

J-14E

Figure 1-10.



PILOT'S RIGHT VERTICAL CONSOLE

J-15C

Figure 1-11.

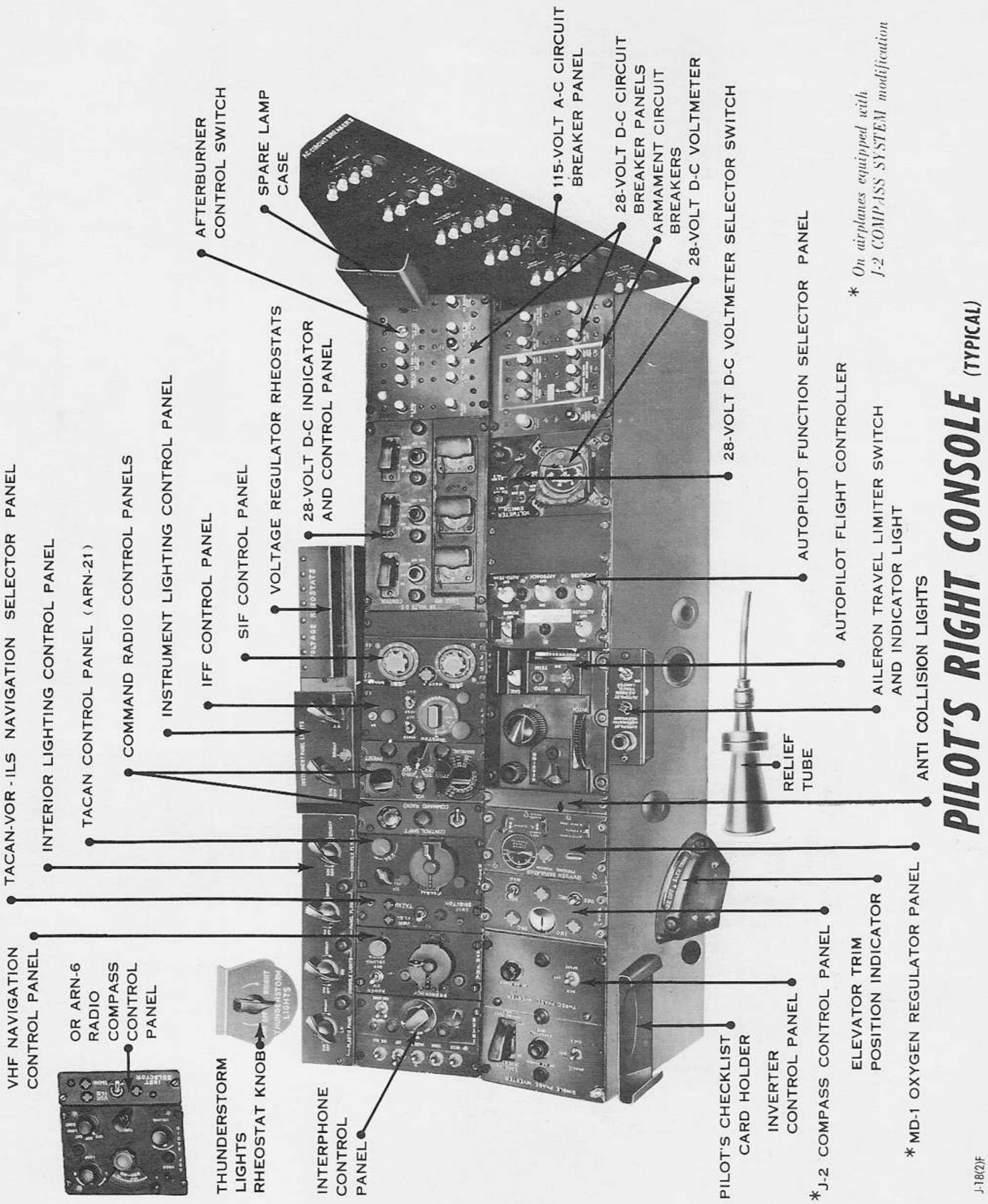

VHF NAVIGATION CONTROL PANEL
OR ARN-6 RADIO COMPASS CONTROL PANEL
TACAN-VOR-ILS NAVIGATION SELECTOR PANEL
INTERIOR LIGHTING CONTROL PANEL
TACAN CONTROL PANEL (ARN-21)
COMMAND RADIO CONTROL PANELS
INSTRUMENT LIGHTING CONTROL PANEL
IFF CONTROL PANEL
SIF CONTROL PANEL
VOLTAGE REGULATOR RHEOSTATS
28-VOLT D-C INDICATOR AND CONTROL PANEL
AFTERBURNER CONTROL SWITCH
SPARE LAMP CASE
115-VOLT A-C CIRCUIT BREAKER PANEL
28-VOLT D-C CIRCUIT BREAKER PANELS
ARMAMENT CIRCUIT BREAKERS
28-VOLT D-C VOLTMETER
28-VOLT D-C VOLTMETER SELECTOR SWITCH
AUTOPILOT FUNCTION SELECTOR PANEL
AUTOPILOT FLIGHT CONTROLLER
AILERON TRAVEL LIMITER SWITCH AND INDICATOR LIGHT
ANTI COLLISION LIGHTS
RELIEF TUBE
THUNDERSTORM LIGHTS RHEOSTAT KNOB
INTERPHONE CONTROL PANEL
PILOT'S CHECKLIST CARD HOLDER
INVERTER CONTROL PANEL
*J-2 COMPASS CONTROL PANEL
ELEVATOR TRIM POSITION INDICATOR
*MD-1 OXYGEN REGULATOR PANEL
* On airplanes equipped with J-2 COMPASS SYSTEM modification
PILOT'S RIGHT CONSOLE (TYPICAL)
J-18(2)F

Figure 1-12.

AFTERBURNER DEMAND SWITCHES.

Two afterburner demand switches control afterburner operation. Each switch is connected by mechanical linkage to a fingerlift (figure 1-6) 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 98% and 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 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 linkage, and retarding the throttle does it by means of a cam arrangement in the throttle quadrant. If afterburning is stopped by retarding the throttle, the fingerlift will be lowered 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 1-13 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 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 cool the scavenged oil. This system has no manual controls as its operation is entirely automatic. See figure 1-45 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 1-15). The tanks in each system include a fuselage sump tank, two bladder-type multicelled

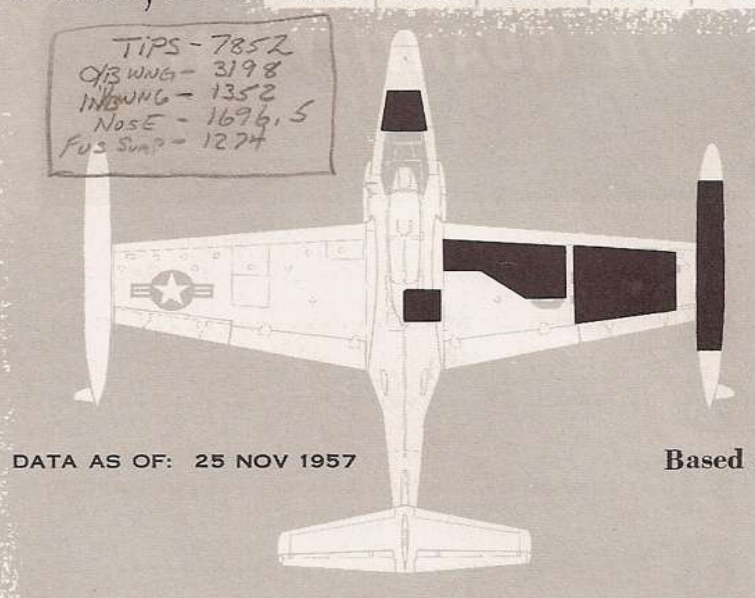
Figure 1-13.

wing tanks, and a permanently installed metal tip tank. There are provisions for a jettisonable pylon tank to be carried under each wing. A nose tank supplements both systems. For fuel quantity data see figure 1-14. During normal operation, fuel flows to the engine from the sump tank which is automatically replenished by the pylon tank (if carried), tip tank, and the wing tanks. Fuel from pylon tanks and tip tanks is fed to the sump tanks by air pressure drawn from the 11th stage of the engine compressor and regulated to approximately 9 psi. Pressurization of either pylon tank is controlled manually by individual pylon tank switches on the fuel control panel, and is automatically shut off when a tank is emptied or dropped. There is no manual shutoff for compressor air to the tip tanks which are pressurized whenever either engine is operating. Fuel from the wing tanks is fed by electric booster pumps within the tanks. When the pylon tank is empty, a float switch closes the pylon tank fuel shutoff valve and the air shutoff valve, and opens the tip tank fuel shutoff valve to start the tip tank feeding. When the tip tank is empty, a float switch closes the tip tank valve and opens the wing tank valve to the sump tank and starts the wing tanks booster pumps; fuel flows from both wing tanks simultaneously to the sump tank. When the wing tanks are empty, the sump tanks continue to feed fuel to the engine until a predetermined sump low level (two-thirds full) is reached. At this point a float switch falls, closing a 28-volt dc circuit that powers both nose tank booster pumps. This switch also opens a valve in the nose tank line, thus enabling the nose tank to join in feeding directly to the corresponding engine when the sump tank is still more than one-half full. When the other sump tank reaches its equivalent low level, the float switch in that tank falls, the other nose tank valve opens, and the nose tank supplies fuel to both engines; as the sump tanks empty, the nose tank continues to supply fuel to the engines as long as fuel remains. The fuel system may be manually switched out of automatic sequence, and the nose or wing tanks may be selected. If a sump tank float switch fails to start nose tank feeding during normal sequencing, as may be noted by a rapid drop in sump tank fuel quantity, then the nose tank can be manually selected. However, this automatically closes the sump tank fuel shutoff valve and no fuel can go to that engine except from the nose tank. The

FUEL QUANTITY DATA

US gallons and pounds (each tank)

		TIP (2)		OUTBOARD WING (2)		INBOARD WING (2)		NOSE (1)		FUSELAGE SUMP (2)	
		GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS
USABLE FUEL	EACH	604	3926	246	1599	104	676	261	1696.5	98	637
	TOTAL	1208	7852	492	3198	208	1352	261	1696.5	196	1274
FULLY SERVICED	EACH	610	3965	252	1638	106	689	263	1709.5	100	650
	TOTAL	1220	7930	504	3276	212	1378	263	1709.5	200	1300



TOTAL USABLE FUEL { 2365 US GALLONS / 15.372.5 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.

DATA AS OF: 25 NOV 1957

Based on 6.5 lb per gallon, (STANDARD DAY)

DATA BASIS: CALIBRATION

J-17E

Figure 1-14.

crossfeed line allows fuel from both systems to feed through one main fuel line during single-engine operation, or allows fuel from one system to supply both engines if the other fuel system fails. Fuel for afterburner operation flows from the sump tank afterburner booster pump through a turbine-driven engine-mounted pump and afterburner fuel regulator to the afterburner manifold. In an emergency, the pylon tanks may be jettisoned, and wing tip fuel may be dumped. Only two of the three fuel compartments in the tip tanks can be dumped; fuel in the forward compartment (approximately 200 gallons) cannot be dumped. For a detailed discussion of fuel system operation, refer to Section VII; for fuel specification and grade, see figure 1-45.

Booster Pumps.

Each fuselage sump tank contains two booster pumps, one for normal operation and one for afterburner operation. The normal booster pump operates continuously during normal fuel sequencing; the afterburner booster pump starts and operates only when afterburning is selected. Each of the wing tanks contains one booster pump. The wing tank booster pumps are controlled automatically by a float switch in the tip tank and by switches on the pilot's fuel control panel. The tip tank switch on the fuel control panel can be placed at OFF to start the wing tank booster pumps if the tip tank float switch fails. The nose tank contains two booster pumps which operate simultaneously to pump fuel to either or both engines when the fuel in either sump tank reaches a predetermined low level. Moving either fuel selector switch to NOSE TANK position will also start both nose tank booster pumps operating. For additional information on fuel system management, refer to Section VII.

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. For alcohol specification see figure 1-45; for complete description and operation of this system, refer to Section IV.

Pylon Tank or MB-1 Rocket Jettison System.

The pylon tanks can be ejected or, in an emergency, released manually. The ejection system in each tank pylon includes an ejector mechanism, consisting of an electrically ignited propellant charge. When the pylon tanks are ejected, 28-volt dc power ignites the propellant charge which releases the attaching hooks and actuates an ejection piston which forcibly ejects the tanks clear of the airplane. When the tanks are manually released by pulling the external stores emergency release handle, they fall by gravity alone. The pylon tanks may be ejected singly or in salvo, or released in salvo by pulling the emergency release handle. The ejection system in each MB-1 rocket pylon consists of explosive-type jettison bolts. MB-1 rockets may be electrically jettisoned singly or in salvo. When the MB-1 rockets are jettisoned, 28-volt electrical current ignites the explosive charge which shatters the bolts and the MB-1 rockets drop free. When MB-1 rockets are jettisoned, they drop by gravity alone.

CAUTION

If pylon tanks are manually or electrically released, minor damage to the airplane may occur.

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 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. If air pressure is not available, fuel in the aft compartment of the tip tank may be dumped by gravity, using the normal dumping procedure as discussed in Section VII.

Note

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

Single-Point Fueling System.

For description and operation of the single-point fueling system, refer to Section IV.

FUEL SELECTOR SWITCHES.

The 28-volt dc rotary-type fuel tank selector switches (figure 1-17), one for each fuel system, are located on the fuel control panel, and have the following positions: ALL TANKS, WING TANKS, NOSE TANK, and OFF. When the selector switch is at ALL TANKS and the individual tank switches are at ON (the combination for normal fuel tank sequencing), the normal booster pump in the sump tank operates continuously. When the selector switch is at WING TANKS (with both wing tank switches at ON), the wing tank booster pumps will operate until the switches are turned to OFF. If either selector switch, the left one for example, is moved to NOSE TANK, both nose tank booster pumps will operate, the left sump tank fuel shutoff valve will close, and a shutoff valve will open in the left branch of the nose tank fuel line to the left engine fuel control, allowing only the nose tank to feed directly to that engine. Similar action will take place to supply nose tank fuel to the right engine when the right fuel selector switch is moved to NOSE TANK. When the fuel selector switch is at either ALL TANKS or WING TANKS position, and there is fuel in the sump tank, afterburning can be initiated. For complete information on fuel system management refer to Section VII.

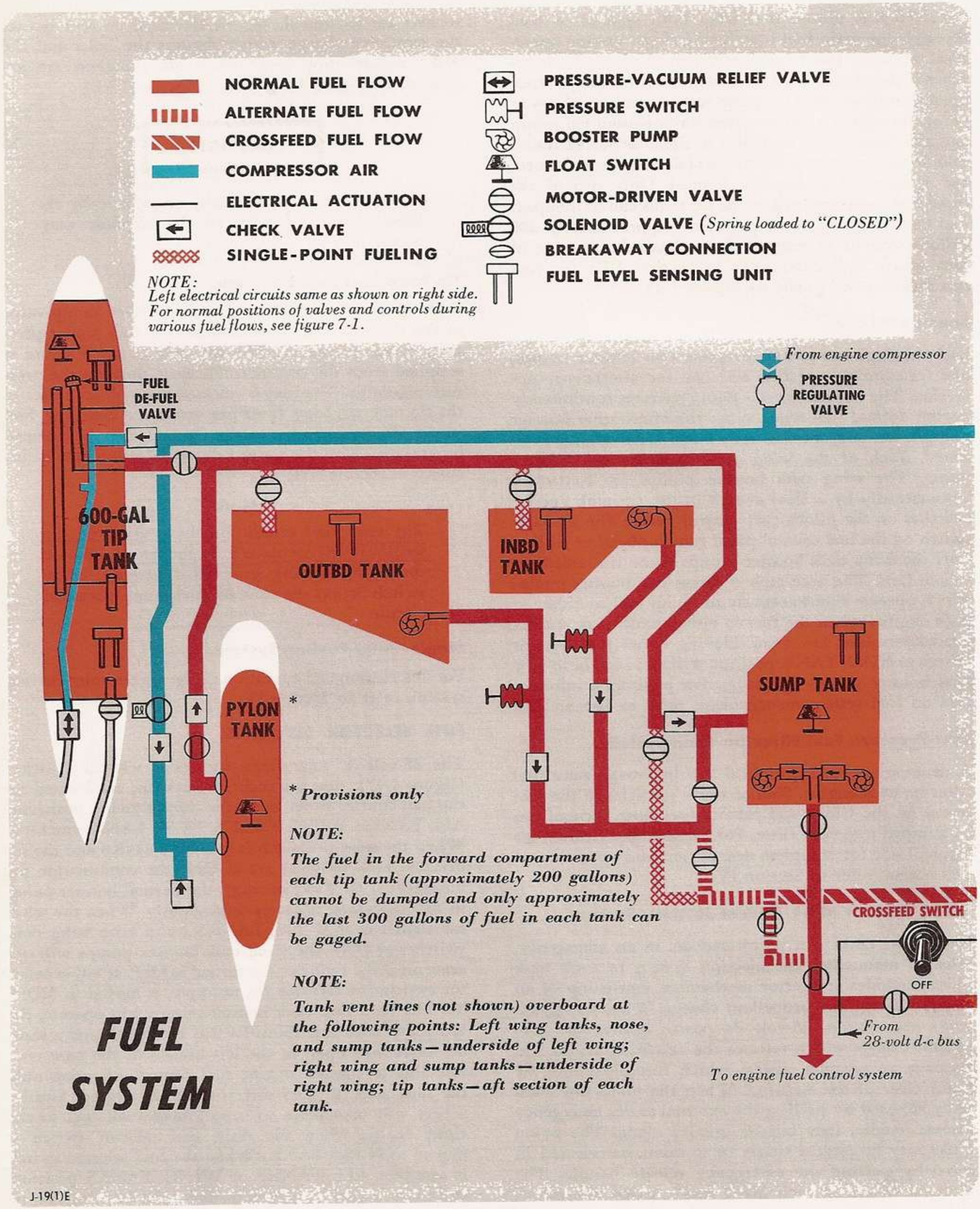

NORMAL FUEL FLOW
ALTERNATE FUEL FLOW
CROSSFEED FUEL FLOW
COMPRESSOR AIR
ELECTRICAL ACTUATION
CHECK VALVE
SINGLE-POINT FUELING
PRESSURE-VACUUM RELIEF VALVE
PRESSURE SWITCH
BOOSTER PUMP
FLOAT SWITCH
MOTOR-DRIVEN VALVE
SOLENOID VALVE (Spring loaded to "CLOSED")
BREAKAWAY CONNECTION
FUEL LEVEL SENSING UNIT
NOTE: Left electrical circuits same as shown on right side. For normal positions of valves and controls during various fuel flows, see figure 7-1.
From engine compressor
PRESSURE REGULATING VALVE
FUEL DE-FUEL VALVE
600-GAL TIP TANK
OUTBD TANK
INBD TANK
SUMP TANK
PYLON TANK
*
* Provisions only
NOTE: The fuel in the forward compartment of each tip tank (approximately 200 gallons) cannot be dumped and only approximately the last 300 gallons of fuel in each tank can be gaged.
NOTE: Tank vent lines (not shown) overboard at the following points: Left wing tanks, nose, and sump tanks—underside of left wing; right wing and sump tanks—underside of right wing; tip tanks—aft section of each tank.
CROSSFEED SWITCH
OFF
From 28-volt d-c bus
To engine fuel control system
FUEL SYSTEM
J-19(1)E

Figure 1-15.

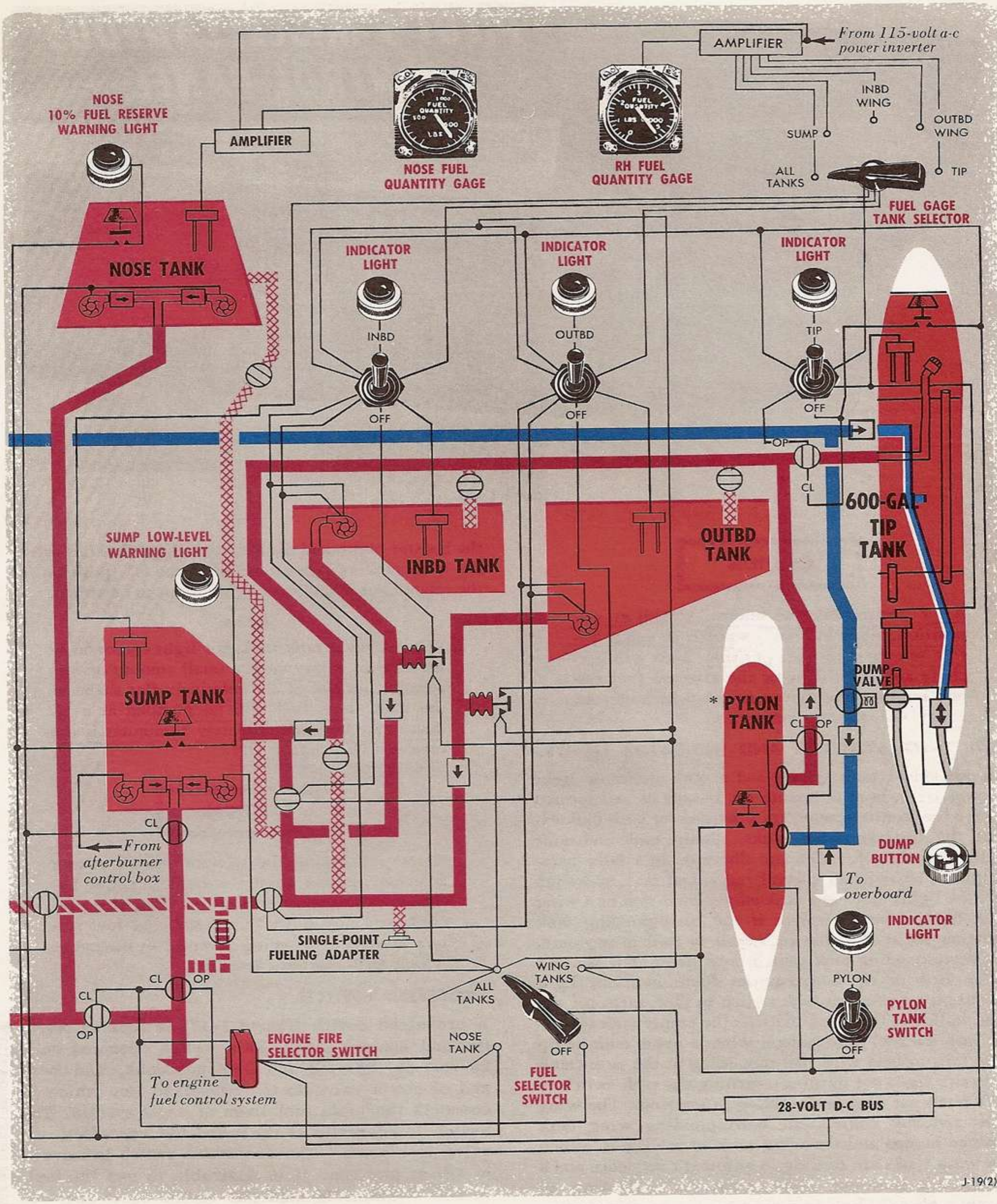

AMPLIFIER
From 115-volt a-c power inverter
NOSE 10% FUEL RESERVE WARNING LIGHT
AMPLIFIER
NOSE FUEL QUANTITY GAGE
RH FUEL QUANTITY GAGE
INBD WING
SUMP
OUTBD WING
ALL TANKS
TIP
FUEL GAGE TANK SELECTOR
NOSE TANK
INDICATOR LIGHT
INBD
OFF
INDICATOR LIGHT
OUTBD
OFF
INDICATOR LIGHT
TIP
OFF
OP
CL
600-GAL TIP TANK
INBD TANK
OUTBD TANK
SUMP LOW-LEVEL WARNING LIGHT
SUMP TANK
* PYLON TANK
CL
OP
DUMP VALVE
DUMP BUTTON
To overboard
CL
From afterburner control box
SINGLE-POINT FUELING ADAPTER
INDICATOR LIGHT
PYLON
PYLON TANK SWITCH
OFF
CL
OP
CL
OP
WING TANKS
ALL TANKS
NOSE TANK
OFF
ENGINE FIRE SELECTOR SWITCH
To engine fuel control system
FUEL SELECTOR SWITCH
28-VOLT D-C BUS
J-19(2)E

Figure 1-16.

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, which will shorten valve life.

FUEL TANK SWITCHES AND INDICATOR LIGHTS.

An individual tank switch and a tank indicator light (figure 1-17), both operating on 28-volt dc and located on the fuel control panel, are provided for each tank except the fuselage sump tanks. (Sump tank indicator lights and their function are discussed in a later paragraph.) The switches control individual tank operation and the lights indicate a tank-empty condition or a wing tank booster pump failure if the corresponding tank switches are at ON. For each tank to feed in sequence, the corresponding tank switch must be at ON. When a pylon tank or tip tank empties (tank indicator light burning), moving the tank switch to OFF turns off the tank indicator light and switches the empty tank capacitor into the fuel gage system; when a pylon tank or tip tank fails to feed with fuel remaining in the tank (tank indicator light not burning), turning the tank switch to OFF starts the next tank feeding in sequence. The wing tank switches control the corresponding wing tank booster pumps and the wing tank empty lights. When the wing tanks are feeding in automatic sequence and a wing tank indicator light comes on (indicating an empty tank or a drop in wing tank booster pump pressure), turning the corresponding switch to OFF turns off the booster pump and the indicator light. One or both of the wing tank switches must be in the ON position for the related sump low-level light circuit to be armed.

Note

When a wing tank indicator light comes on to indicate an empty tank, a small amount of fuel remains because of the relatively flat shape of the tank. This fuel will be pumped at a reduced 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, which will shorten valve life.

CROSSFEED SWITCH.

A crossfeed switch (figure 1-17) is located on the fuel control panel. This switch operates on 28-volt dc, has ON and OFF positions, and opens and closes a valve in the crossfeed line which connects the main fuel lines of each system. The switch is normally at OFF and the crossfeed valve is closed. The crossfeed switch is moved to ON at any time it is desirable to use the fuel in both systems to feed one engine or to operate both engines on the fuel from one system.

ENGINE FIRE SELECTOR SWITCHES.

There are two guarded engine fire selector switches (figure 1-38) located on the pilot's right vertical console. Actuating either switch closes the dc motor-operated main fuel line valve to the engine in the related fuel system and arms the circuit to the fire extinguishing agent discharge switch. These switches operate on 28-volt dc.

EXTERNAL STORES JETTISON SWITCHES AND RELEASE HANDLE.

Pylon Tank or Special Weapon Jettison Switches.

Two guarded tank or special weapon jettison switches (figure 1-10) are located on the armament control panel on the pilot's center pedestal and are powered by the primary 28-volt dc electrical system. These switches enable the pilot to jettison either pylon tanks or MB-1 rockets selectively. When the safety wire is broken and the guard on the jettison switch marked L is raised, the switch lever (spring-loaded to center OFF position) can be momentarily raised, jettisoning the external store on the left MB-1 rocket or tank pylon. In order to jettison the store on the right MB-1 rocket or tank pylon, the same procedure should be used on the switch marked R.

Special Weapon and Tank Jettison Button.

A pushbutton-type 28-volt dc special weapon and tank jettison button (figure 1-9), located on the pilot's left vertical console, enables the pilot to jettison either pylon tanks or MB-1 rockets simultaneously. When this switch is depressed, the jettison propellant charge in each tank pylon or the explosive bolts in each MB-1 rocket pylon are ignited, jettisoning the stores. A positive safety guard has been installed over the special weapon and tank jettison button. The guard should be safety wired in the safe position.

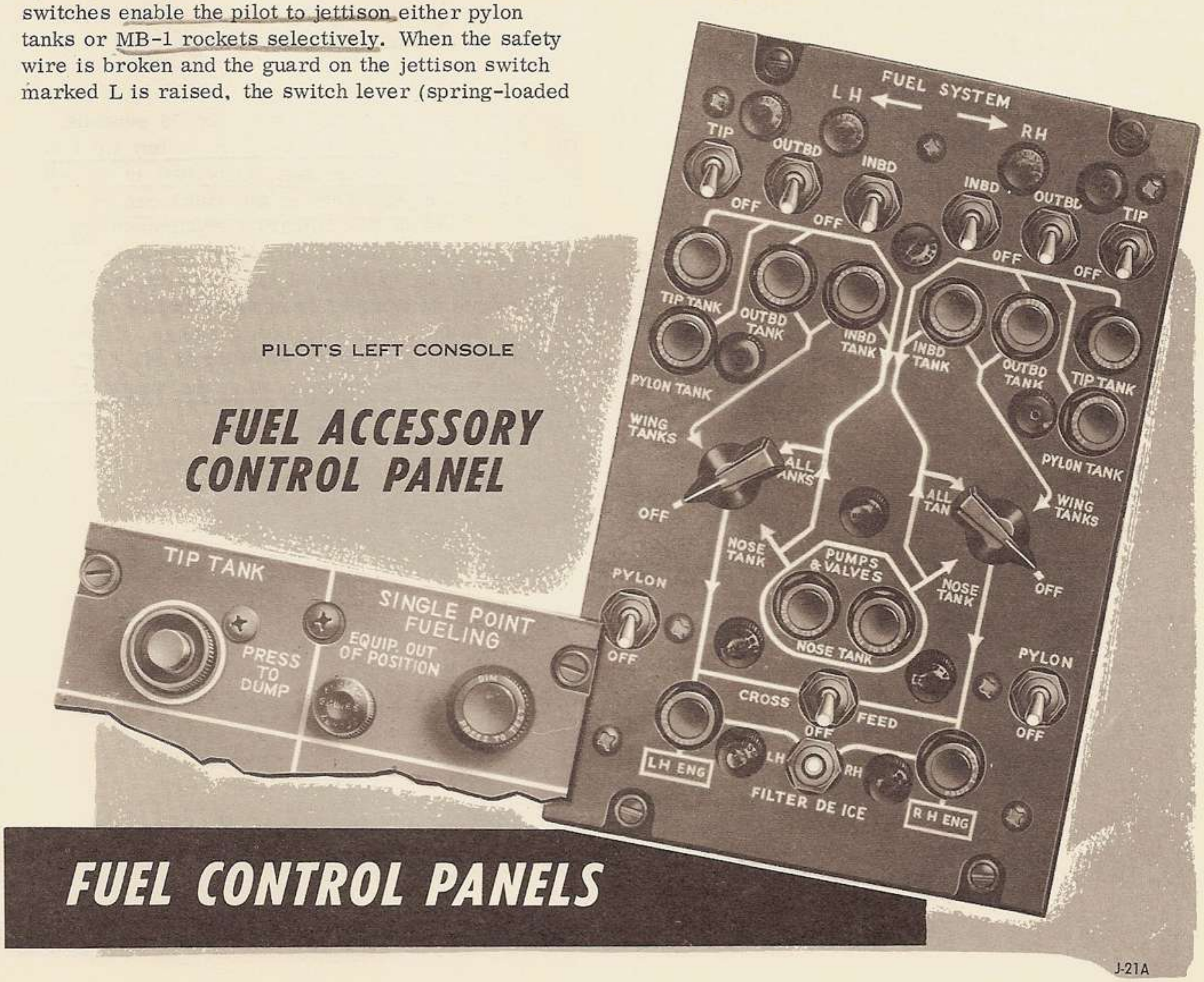


Figure 1-17.

CAUTION

In the event of complete electrical failure, there is no method of jettisoning the special weapons after the battery is discharged. If jettisoning is necessary, it should be accomplished as soon as possible after loss of the d-c generators.

External Stores Emergency Release Handle.

The external stores emergency release handle (figure 1-8) is stowed on the pilot's left console just outboard of the throttle quadrant. The handle is linked by cables and bellcranks to the bomb shackle release in each tank. When the handle is pulled with a force of about 50 pounds to its limit of travel (approximately 7 inches from its stowed position), the pylon tank shackles will be tripped simultaneously and both pylon tanks will drop by gravity.

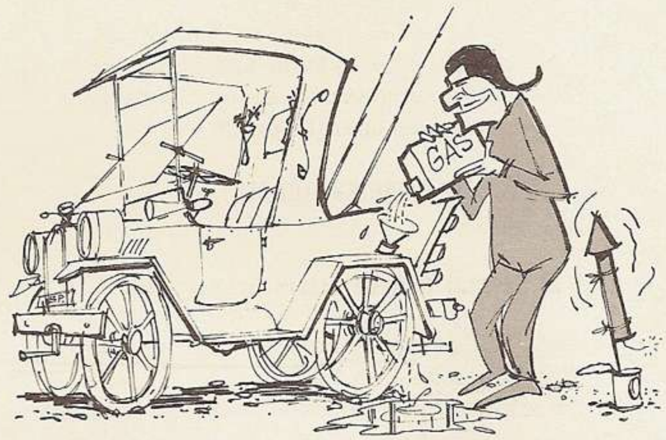
CAUTION

When pylon tanks are jettisoned manually, minor damage to the airplane may result.

TIP TANK FUEL DUMP BUTTON.

A tip tank fuel dump button (figure 1-17) on the fuel accessory control panel is used to dump the tip tank fuel. Pressing this button operates a time-delay relay, operating on 28-volt dc, which opens both tip

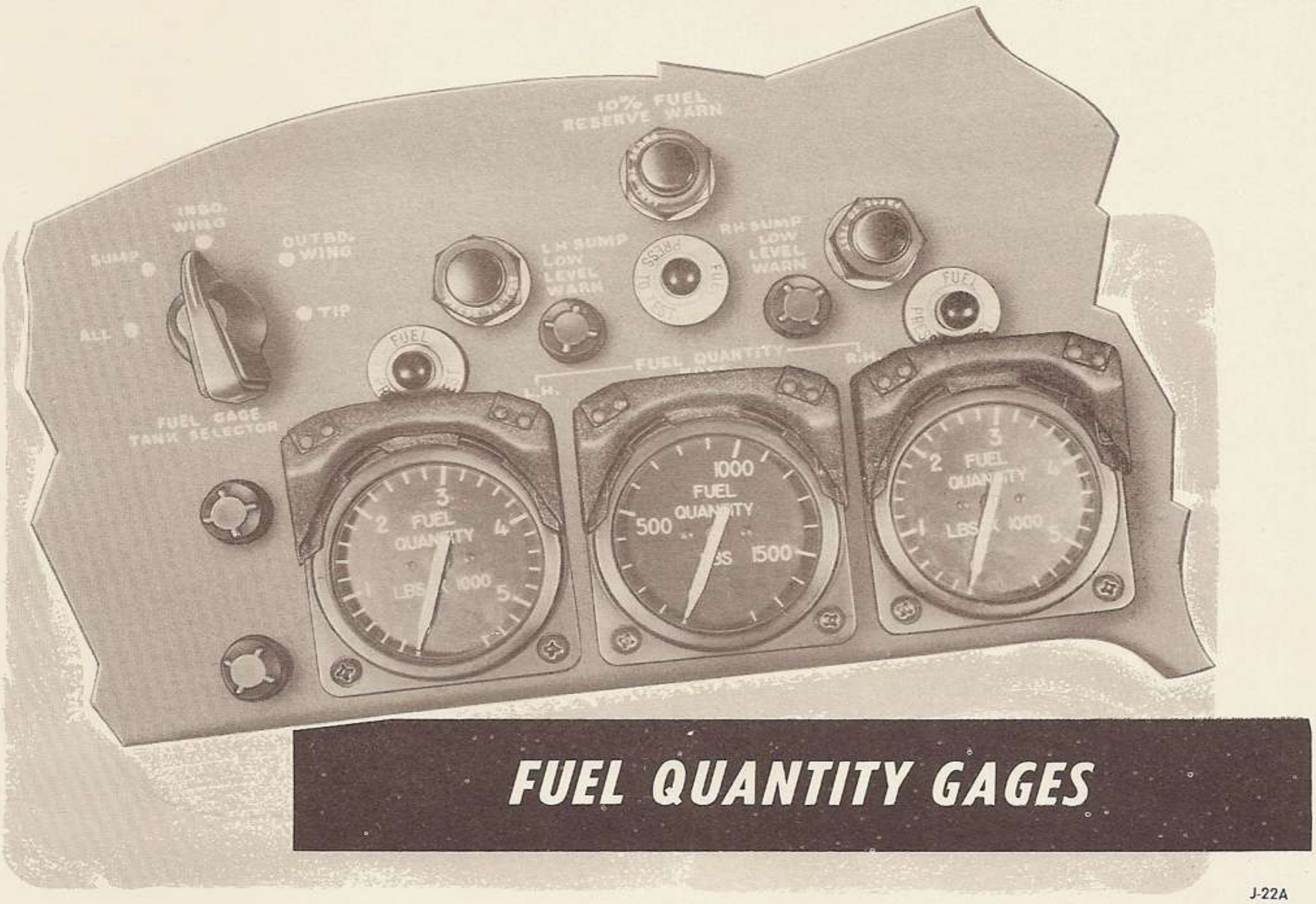
WARNING



Do not attempt to dump fuel during rocket firing because of the fire hazard.

tank dump valves for approximately 75 seconds. The normal time required to dump a full tip tank is approximately 60 seconds. Only fuel in the aft and center compartments of the tanks can be dumped. Fuel in the forward compartment (approximately 200 gallons) cannot be dumped. Because of the aft location of the dump valves, the tanks cannot be completley drained during decelerations or dives. For complete drainage, the airplane must be in level or climbing flight. Tip tank fuel cannot be dumped while the weight of the airplane is on the wheels.

PILOT'S INSTRUMENT PANEL



J-22A

Figure 1-18.

FUEL QUANTITY GAGES AND FUEL GAGE TANK-SELECTOR SWITCH.

Three fuel quantity gages (figure 1-18) operating on 115-volt single-phase ac, and a five-position fuel gage tank-selector switch operating on 28-volt dc, all located on the pilot's instrument panel, enable the pilot to check the fuel quantities in the entire fuel system or in the individual tanks. When the gage tank selector is turned to ALL, the right and left quantity gages indicate in pounds the total fuel available to the engines in the right and left systems. When the tank selector is turned to SUMP, INBD WING, or OUTBD WING, the left and right gages will show the quantity of fuel in the selected tanks. When the tank selector is turned to a TIP or ALL selection the left and right gages will indicate full tanks until approximately 300 gallons (1950 pounds) of tip tank fuel have been consumed. The gaging system then gages remaining fuel in a normal manner. The nose tank gage indicates only the quantity of fuel in the nose tank and is not affected by the gage tank-selector switch. (Pylon tank fuel quantities are not included in the fuel gage system.) The fuel quantity gaging system is the electrical capacitance-type employing tank units that produce electrical signals proportional to the fuel level at each tank unit. The tank units are calibrated individually to match the shape of the particular tank so that the signal when amplified and fed through a bridge circuit will give a linear reading on the gage indicator regardless of the varying cross-sectional area of the tank at different fuel levels. The tank units are compensated for changes in temperature and fuel density so that any variation in accuracy due to these factors is negligible. The right and left fuel quantity gage systems include totalizers that add the quantity indications from the various fuel tanks in either the right or left systems and show a total usable fuel quantity on the corresponding gage (with the exception of the "top" 300 gallons of fuel in each tip tank). The switch settings that will provide this indication are as follows: fuel selector switch at ALL TANKS; fuel gage tank-selector switch at ALL; individual tank switches at ON unless tanks are known to be empty or contain fuel that is unusable due to fuel system malfunction. (If either case is true, the tank switch for the affected tank should be turned to OFF.)

Note

On Group 35 airplanes, tip tank fuel will be included in the total fuel quantity when the tip tank switch is at OFF, provided the pylon tank switch is at ON and fuel is in the pylon tank. On Group 40 and subsequent airplanes, the tip tank switch must be at ON to read tip tank fuel.

To verify that the gages are operating, each fuel quantity gage is provided with a button-type press-to-test switch, located above each gage. Pressing one of these test switches causes the needle of the related gage to swing to the lower side of the dial to an off-scale position, showing that the gage system is energized. Releasing the switch button causes the needle to return to its original position, indicating proper functioning of the fuel quantity gage system.

SUMP LOW-LEVEL WARNING LIGHTS.

There are two sump low-level warning lights (figure 1-18) on the pilot's instrument panel. The lights operate on 28-volt dc and serve to indicate when the sump fuel is below the two-thirds full level. A light is armed only when one or both corresponding wing tank switches are at ON. Each light is connected to a float switch in the corresponding sump tank. When the fuel in a sump tank drops to about 450 pounds remaining, 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.

WARNING

It is possible to encounter a double flameout without getting sump low-level warning light indications if all four wing tank booster pump switches are at OFF, since the switches will disarm the lights when placed at OFF.

NOSE TANK WARNING LIGHTS.

A single nose tank fuel reserve red warning light (figure 1-18) on the pilot's instrument panel illuminates when only 1220 pounds of fuel remain in the nose tank. This is approximately 10 percent of the airplane's total fuel (excluding pylon tank fuel). Two nose tank warning lights (figure 1-17), operating on 28-volt dc, are located on the fuel control panel to indicate the failure of the nose tank booster pumps or the valves in the fuel line from the nose tank to the engines. For details on identifying trouble indicated by these lights, refer to Section VII. These lights operate on 28-volt dc.

ELECTRICAL POWER SUPPLY SYSTEMS.

One direct-current system and three alternating-current systems supply the electrical power. The 28-volt dc system obtains power from three engine-driven generators, one on the left engine and two on the right engine. A 24-volt, 36 ampere-hour storage battery in the nose serves as standby for the dc circuit. The dc generator on the left engine and one of the dc generators on the right engine also function as starters. Full generator output is reached at 35% engine rpm. Alternating current is supplied by a constant-frequency 115-volt ac single-phase (power) inverter system, a constant-frequency 115-volt ac three-phase (instrument) inverter system, and a variable-frequency 200/115-volt ac three-phase alternator system. Each inverter system has two inverters. All four inverters, two for each system, are powered by the primary 28-volt dc bus. A variable-frequency alternator mounted on the left engine supplies power for the 200/115-volt ac three-phase alternator system. The alternator supplies current at frequencies ranging from 380 to 900 cycles, depending on engine speed, for heating systems and sighting equipment. External power receptacles for the 28-volt dc system and 115-volt ac alternator system are on the right engine air intake duct. The 28-volt dc external power receptacles are used for ground operation and starting; the 115-volt ac external power receptacle is used for ground operation only.

Electrically Operated Equipment.

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

External Power Receptacles.

Three external power receptacles (figure 1-3) are located on the right engine air intake duct. The top receptacle is for 28-volt dc starting power only. The center receptacle is for external power to the 28-volt dc distribution bus. The lower receptacle is for external 115-volt ac power.

28-VOLT DC SYSTEM.

The 28-volt dc system obtains power from three engine-driven generators, one on the left engine and two on the right engine. The dc generator on the left engine and one of the dc generators on the right engine function as starter-generators, cranking the engines until the electrical load drops to about 200 amperes (approximately 26% rpm), and then cutting in as generators after engine speed reaches 28% rpm. Three bus bars provide for distribution of direct current; a battery bus, a primary bus, and a secondary bus. When the engines are being cranked, reverse-current relays disconnect the dc generators from all but the starter bus. When the engines are operating, the three dc generators supply both the primary bus and the secondary bus, and the two bus bars are interconnected by a bus-tie relay. Failure of any two generators will separate the two buses and the remaining dc generator will supply power to the primary bus only. A 24-volt, 36 ampere-hour storage battery is connected in series to the main 28-volt dc bus through the battery relay. If the 28-volt dc generator system fails, the battery will operate essential 28-volt dc equipment for a limited time. If an emergency start is necessary, with only one 28-volt dc external power source available, an emergency bus-tie relay (through the starting power switch) connects the main 28-volt dc bus (energized by plugging external power into the lowest dc receptacle) to the starter bus. With the exception of the battery switch on the pilot's right vertical console, all controls and indicators for the 28-volt dc system are on the pilot's right console.

Battery Switch.

The battery switch (figure 1-11), located on the pilot's right vertical console, connects the battery bus with the 28-volt dc primary bus and has ON and OFF positions. When the switch is at ON, the battery bus is connected to the 28-volt dc primary bus. When the 28-volt dc system is operating and the battery switch is ON, the battery is being charged. When the switch is at OFF, the circuit connecting the battery bus to the primary bus is broken.

CAUTION

The battery switch must not be turned to ON when the external 28-volt dc starting power supply is being used to start the engines, as damage to the battery will result.

28-Volt DC Voltage Regulator Rheostat Knobs.

Three voltage regulator rheostat knobs (figure 1-12), one for each 28-volt dc generator, are located under a hinged cover next to the 28-volt dc indicator and control panel on the pilot's right console. The 28-volt dc generator voltage output can be increased or decreased by turning the voltage regulator rheostat knobs toward INCR or DEC. The voltage regulators are normally preset on the ground by qualified maintenance personnel and should not be readjusted in flight unless the voltage output is abnormal.

28-Volt DC Generator Switches.

For each 28-volt dc generator there is a guarded generator switch (figure 1-22) located on the 28-volt dc control panel. 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 switch is spring-loaded to OFF from the RESET position. 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 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 placed momentarily at RESET. A circuit is then completed to the generator field, and generator voltage builds up to normal. Then the switch can 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 (counterclockwise). Next, the generator switch must be placed momentarily at 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.

Each generator has a 28-volt dc generator-off warning light (figure 1-22) located on the 28-volt dc control

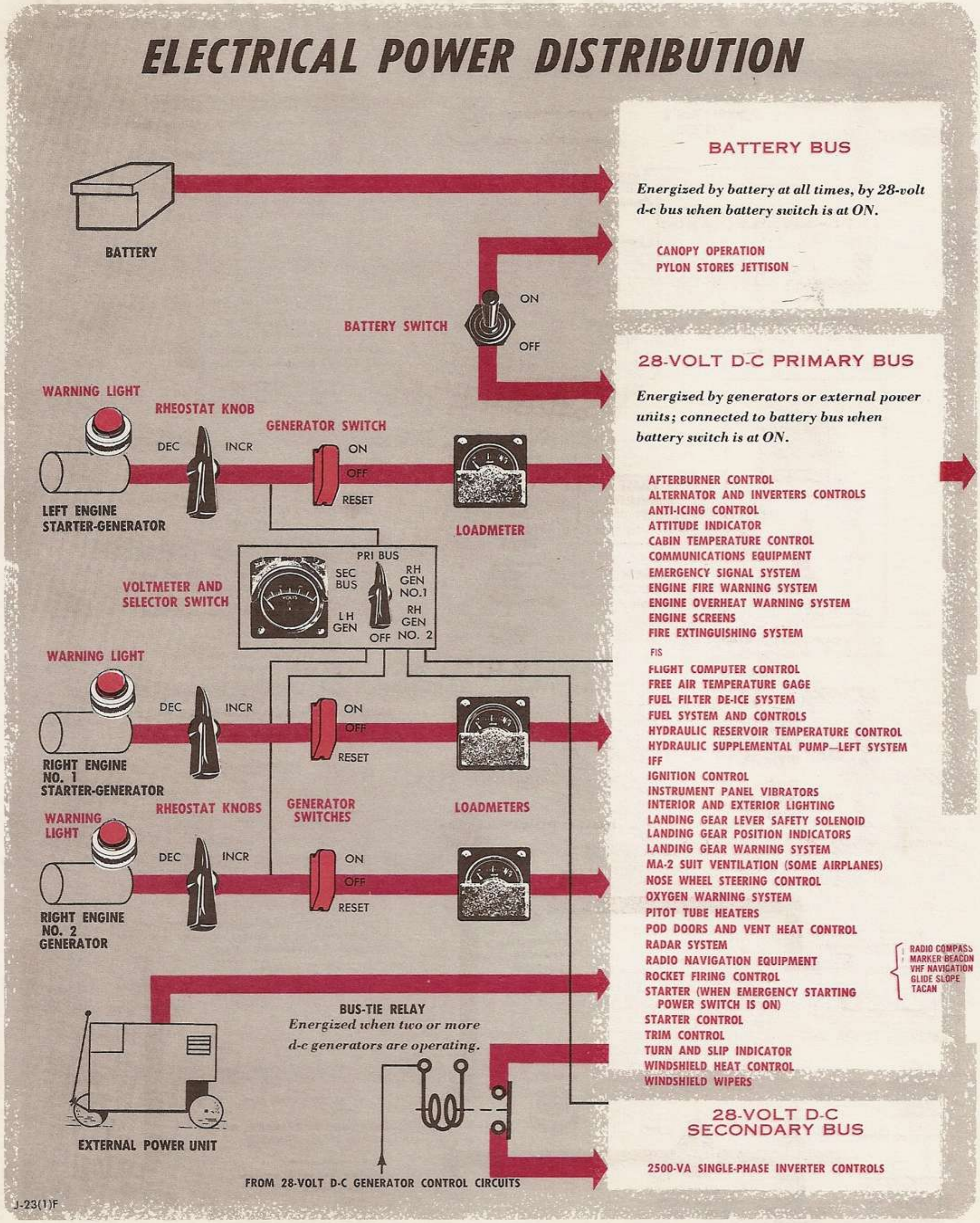


Figure 1-19. (Sheet 1 of 3)

ELECTRIC POWER DISTRIBUTION (Continued)

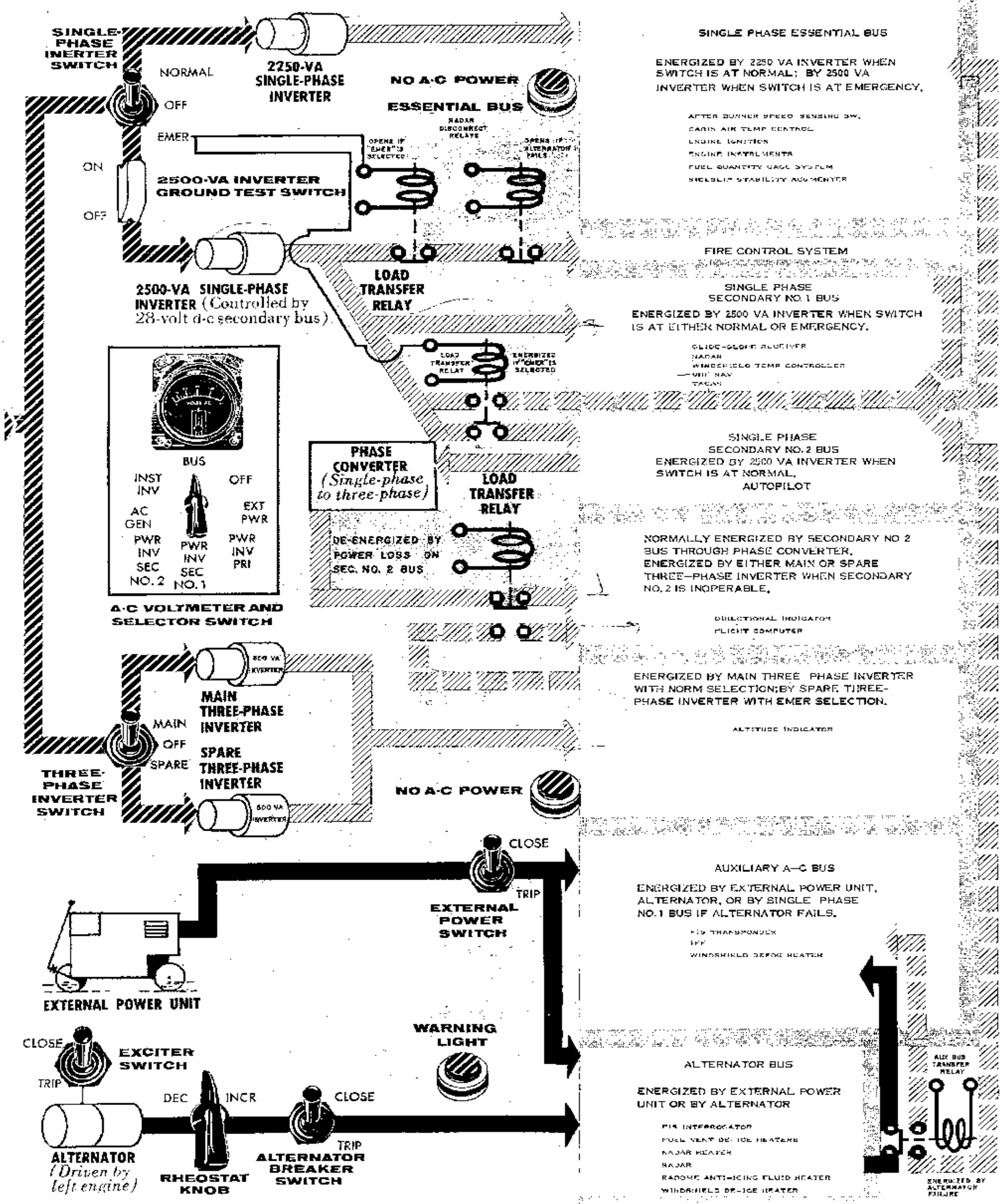


Figure 1-19. (Sheet 2 of 3)

Figure 1-19. (Sheet 3 of 3) DELETED

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 2250-va (main)	AFTERBURNER SPEED-SENSING SWITCH CABIN AIR TEMPERATURE CONTROL ENGINE IGNITION ENGINE INSTRUMENTS FUEL QUANTITY GAGE SYSTEM SIDESLIP STABILITY AUGMENTER	NONE	*By manually selecting emergency operation, the 2500-va (spare) inverter will supply power to all equipment normally powered by the 2250-va (main) inverter.*	*Power to the fire control system and autopilot will be cut off when power from the spare inverter is shifted to the essential bus upon selecting emergency operation.*
b. 115-volt a-c single-phase 2500-va (spare)	VHF NAVIGATION TACAN NADAR GLIDE SLOPE RECEIVER NADAR WINDSHIELD TEMPERATURE CONTROLLER AUTOPILOT DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER FIRE CONTROL SYSTEM	DIRECTIONAL INDICATOR (SLAVED) FLIGHT COMPUTER VHF NAV	NONE	GLIDE SLOPE RECEIVER NADAR WINDSHIELD TEMPERATURE CONTROLLER AUTOPILOT FIRE CONTROL SYSTEM TACAN
2. INSTRUMENT a. 115-volt a-c three-phase 500-va (main)	ATTITUDE INDICATOR	NONE	Only one inverter, main or spare, operates at a time. If one fails, select the other.	NONE
ALTERNATOR: 200/115-volt a-c three-phase	HADAR TACAN FIS INTERROGATOR FIS INTERROGATOR FUEL VENT DE-ICE HEATERS NADAR HEATER RADAR RADOME ANTI-ICING FLUID HEATER WINDSHIELD DE-ICE HEATER FIS TRANSPONDER IFF WINDSHIELD DEFOG HEATER	FIS TRANSPONDER IFF WINDSHIELD DEFOG HEATER	NONE	FIS INTERROGATOR FUEL VENT DE-ICE HEATERS NADAR HEATER RADAR RADOME ANTI-ICING FLUID HEATER WINDSHIELD DE-ICE HEATER
GENERATORS: a. One 28-volt d-c generator b. Two 28-volt d-c generators	None 2500 VA Single-Phase Inverter, See 1.b.	NONE See 1.b.	NONE NONE	None 2500 VA See 1.b.
BATTERY: 24-volt, 36 ampere-hour storage	NONE *(The battery serves as standby for d-c circuit during flight.)*	NONE	NONE	NONE

1-125013

Figure 1-20.

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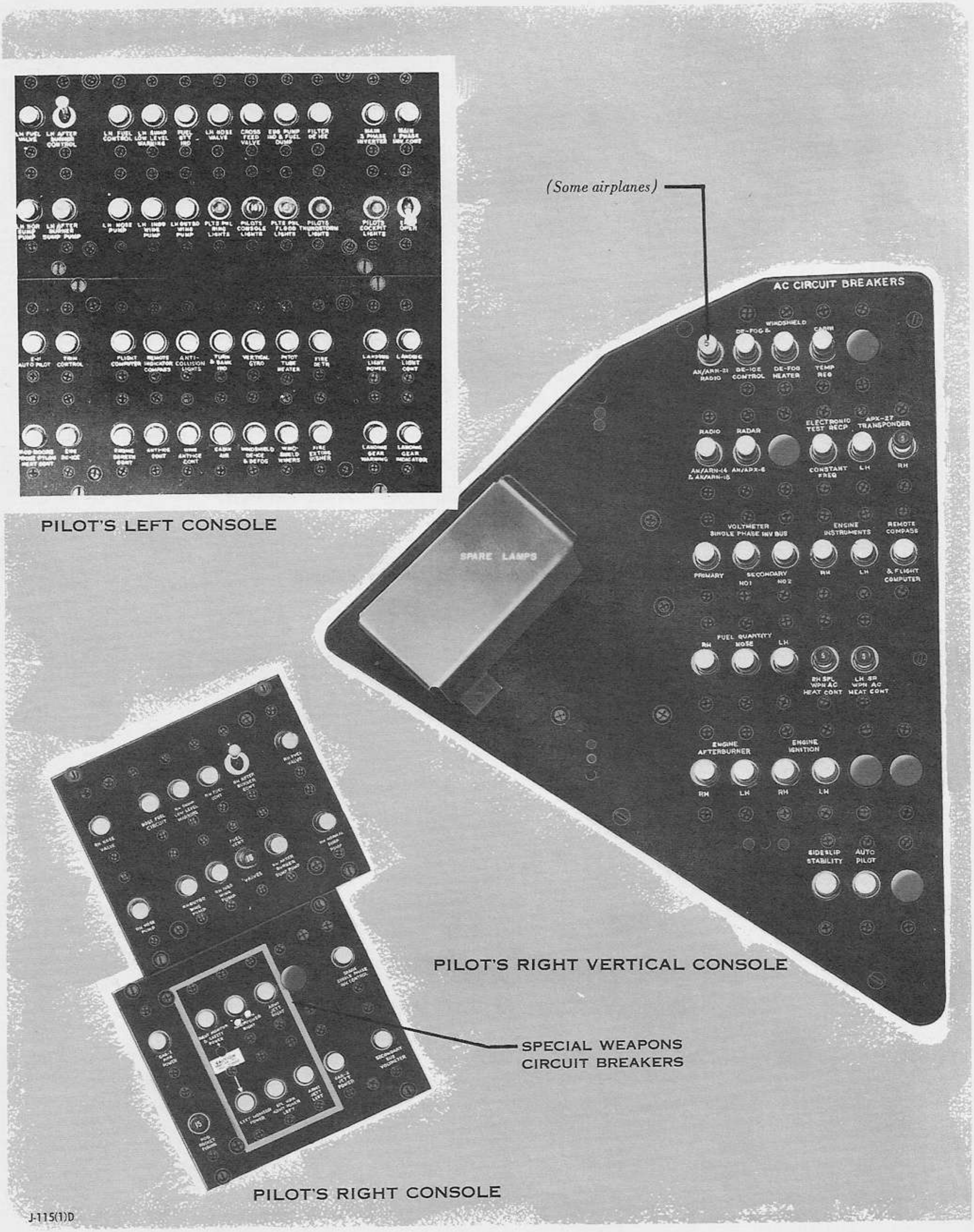
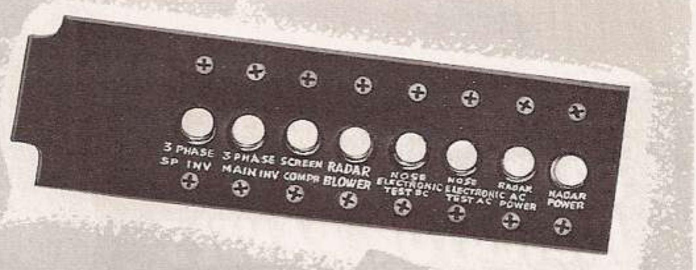

PILOT'S LEFT CONSOLE
(Some airplanes)
AC CIRCUIT BREAKERS
SPARE LAMPS
PILOT'S RIGHT VERTICAL CONSOLE
SPECIAL WEAPONS CIRCUIT BREAKERS
PILOT'S RIGHT CONSOLE
J-115(1)D

Figure 1-21.



NOSE SECTION—RIGHT SIDE

RADAR OBSERVER'S COCKPIT—LEFT SIDE

RADAR OBSERVER'S COCKPIT—RIGHT SIDE

CIRCUIT BREAKER PANELS (TYPICAL)

J-115(2)C

28-VOLT D-C CONTROL AND INDICATOR PANELS

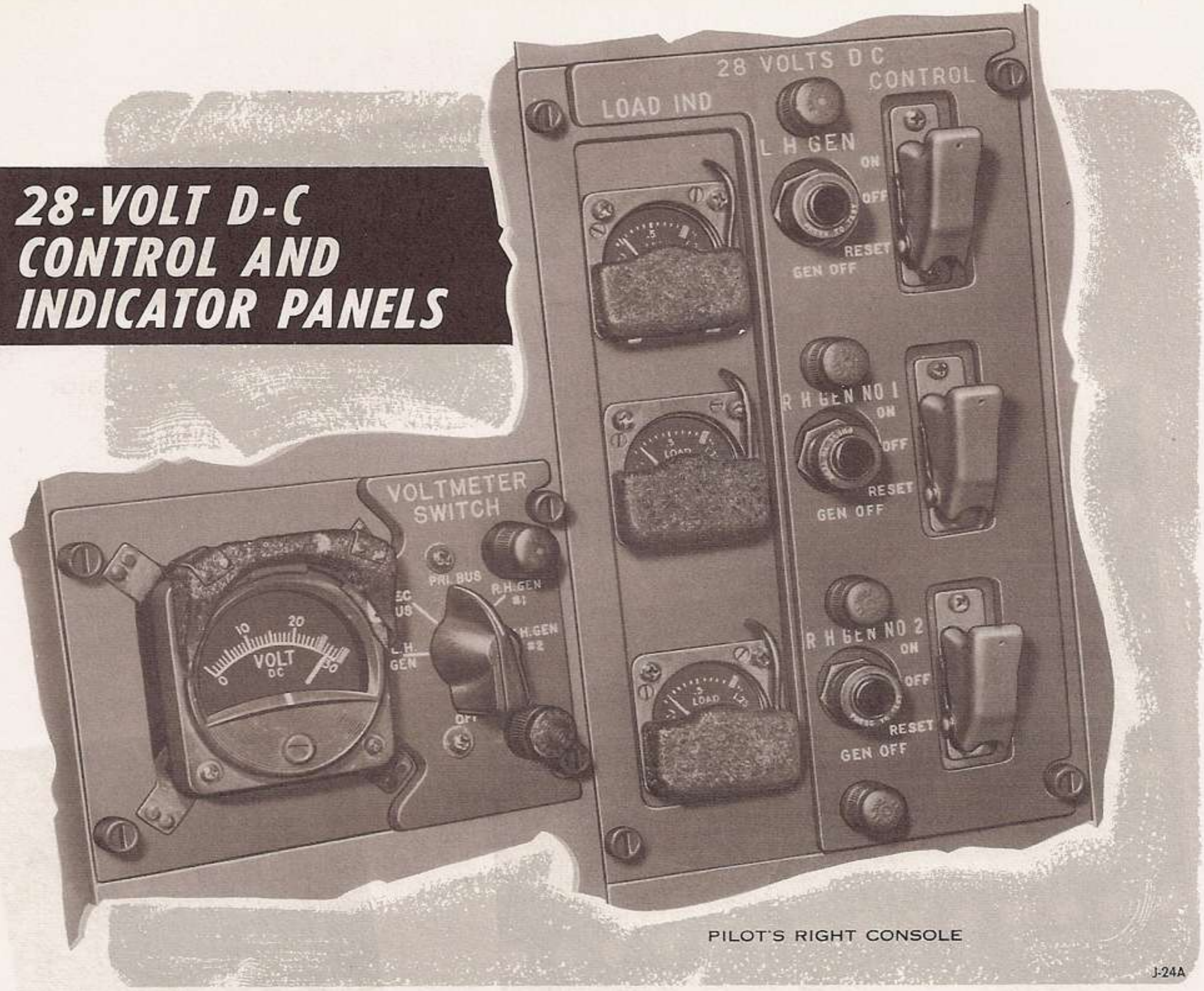


Figure 1-22.

panel. These lights are marked "Gen Off." The function of these lights is to warn the pilot when the corresponding generator is disconnected from the 28-volt bus. Each light, powered by 28-volt dc through a connection with the generator reverse-current cutout relay, illuminates 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 placed at ON or an external source of dc power is applied to the airplane, when the engines are operating but the generator switch is at OFF, or when the generator has been automatically disconnected because of an overvoltage condition.

28-Volt DC Circuit Breakers.

Most of the 28-volt dc electrical circuits (all except a few emergency circuits) are protected by push-pull circuit breakers (figure 1-21) on four circuit breaker panels: one on the pilot's left console, one on the pilot's right console, and one on the left and one on the right side of the radar observer's cockpit. 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 pushing in the circuit breaker, or the circuit can be opened manually by pulling out the circuit breaker.

28-Volt DC Loadmeters.

Three loadmeters (figure 1-22), one for each generator, are located on the 28-volt dc control and indicator panel on the pilot's right console. The loadmeters indicate the proportion of generator rated output being used.

28-Volt DC Voltmeter and Voltmeter Selector Switch.

A voltmeter and a voltmeter selector switch (figure 1-22), on the 28-volt dc indicator panel on the pilot's right console, provide a means of determining generator voltage output. The selector switch has LH GEN, RH GEN NO. 1, RH GEN NO. 2, PRI BUS, SEC BUS, and OFF positions. When the switch is turned to one of the three generator positions, the voltmeter indicates the output of the generator selected. When the switch is turned to PRI BUS or SEC BUS, the voltmeter indicates the voltage being supplied to the bus selected. When the switch is OFF, the circuits to the voltmeter are open and the voltmeter reads zero.

Note

Whenever the engines are operating, the voltmeter will indicate a voltage from each 28-volt dc generator whether the generator switch is at ON or at OFF, unless the generator field circuit has been broken by action of the overvoltage relay or by generator failure. The loadmeter, however, will indicate load only when the generator switch is at ON and power is being supplied to the 28-volt dc primary bus.

AC INVERTER SYSTEMS

Alternating current is supplied by two 115-volt ac inverter systems: single-phase (power) system and a three-phase (instrument) system. Each system has two inverters powered by 28-volt dc. In the single-phase inverter system, a 2250-VA (main) inverter and a 2500-VA (spare) inverter supply current to three buses: an essential (primary) bus, a secondary NO. 1 bus, and a secondary NO. 2 bus. (See figure 1-19.) During normal operation, both single-phase inverters operate at the same time; the 2250-VA inverter powers the essential bus and the 2500-VA inverter powers the secondary NO. 1 and the NO. 2 buses. If the 2250-VA single-phase inverter fails during normal operation, a red warning light will come on to indicate that the essential bus is not energized. Then by manually selecting emergency operation, the 2500-VA inverter, by means of a load-transfer relay, will power the essential bus and the secondary NO. 1 bus; the secondary NO. 2 bus will not be energized. If the 2500-VA inverter fails during normal operation, the 2250-VA inverter will continue to power the essential bus; the two secondary buses will not be energized. The secondary NO. 1 bus, in addition to carrying its normal load, also supplies power to the auxiliary ac bus (normally powered by the alternator) in case the alternator fails. In addition to the equipment operating directly from the secondary NO. 2 bus, the gyrosyn compass system and the flight computer are powered through a phase converter by the secondary NO. 2 bus. The phase converter changes single-phase to three-phase current. If the secondary NO. 2 bus is not energized, as would occur if either one or both of the single-phase inverters fail, a load-transfer relay will automatically shift the load of the gyrosyn compass system and the flight computer to the three-phase (instrument) inverter system. In the three-phase (instrument) inverter system, both main and spare inverters are rated at 500 volt-amperes. Only one inverter (main or spare) operates at a time. Normally, only the attitude indicator is powered by the three-phase inverter system; however, if the secondary NO. 2 bus of the single-phase inverter system is not energized, then the three-phase system will automatically supply power to the gyrosyn compass system and the flight computer. Operation of either main or spare three-phase inverter is manually selected. A red warning light comes on if the selected three-phase inverter fails. All controls and indicators, except the ac voltmeter and voltmeter selector switch for both the single-phase and three-phase inverter systems, are mounted on one inverter control panel (figure 1-23) located on the pilot's right console.

INVERTER CONTROL PANEL (TYPICAL)

J-25B

Figure 1-23.

The voltmeter and voltmeter selector switch, which serve both inverter systems and alternator system, are located in the radar observer's cockpit on the alternator control panel. All equipment powered by the single-phase inverter system is protected by circuit breakers located on a panel mounted on the right side of the bulkhead aft of the pilot's seat. All four inverters are powered by the primary 28-volt dc bus; however, the control circuit for the 2500-VA single-phase inverter receives its power from the secondary 28-volt dc bus (energized when two or more 28-volt dc generators are operating).

Single-Phase (Power) Inverter Switch

A 28-volt dc switch (figure 1-23) on the inverter control panel provides a means of selecting normal or emergency operation of the single-phase inverter system. The switch has three positions: NORMAL, OFF, and EMER. When the switch is placed at NORMAL, a circuit is completed from the 28-volt dc bus and both the 2250-VA (main) 2500-VA (spare) single-phase inverters operate: the 2250-VA inverter supplies power to the essential bus and the 2500-VA inverter supplies power to the secondary NO. 1 and NO. 2 buses. When the switch is placed at EMER, the 2500-VA inverter supplies power to the essential bus and the NO. 1 secondary bus; the NO. 2 secondary bus will not be energized and the 2250-VA inverter will not operate. The EMER position should be used only when the 2250-VA inverter fails. If emergency operation is selected when the 2500-VA inverter fails, all single-phase buses will be without power. If both the 2250-VA and the 2500-VA inverters fail, as would be indicated by the "Essential Bus" warning light burning when the switch is placed at both NORMAL and EMER, the switch should be placed at OFF. When the switch is placed at OFF, the control circuits from the 28-volt dc primary bus to the single-phase inverters are broken. Both single-phase inverters and the control circuit for the 2250-VA inverter receive their power from the 28-volt dc primary bus; the control circuit for the 2500-VA inverter receives its power from the 28-volt dc secondary bus (energized when two or more 28-volt dc generators are operating).

Single-Phase 2500-VA Inverter Ground Test Switch.

A 28-volt dc guarded switch (figure 1-23) on the inverter control panel provides a means of operating the single-phase 2250-VA main inverter independently of the 2500-VA spare inverter for ground testing purposes. The switch is marked 2500-VA INVERTER - GROUND TEST ONLY and has ON and OFF positions. When the switch is at ON (guard down), with the single-phase inverter switch at NORMAL, both single-phase inverters operate. When the switch is at OFF (guard raised), with the inverter switch at NORMAL, only the main inverter will operate. The 2500-VA spare inverter can be operated independently of the main inverter by placing the inverter switch at EMER.

CAUTION

The ground test switch is for maintenance purposes only. Do not use it in flight. If the switch is placed at OFF during normal operation, all equipment powered by the secondary NO. 1 and NO. 2 buses will become inoperative.

Three-Phase (Instrument) Inverter Switch

A 28-volt dc switch on the inverter control panel is used to select either the main or spare three-phase inverter. The switch has three positions: MAIN, SPARE, and OFF. When the switch is placed at MAIN or SPARE, a circuit is completed from the 28-volt dc bus to the corresponding inverter. When the switch is at OFF, both main and spare inverters are inoperative. A red warning light illuminates if the selected inverter (main or spare) is not operating, or if the inverter switch is at OFF.

Single-Phase (Power) Inverter Warning Light.

A red warning light (figure 1-23) on the single-phase portion of the inverter control panel indicates when the essential bus of the single-phase inverter system is not energized. The light is marked "No AC Power - Essential Bus" and operates on the 28-volt dc. If the light comes on while the single-phase inverter switch is at

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NORMAL, the switch can be moved to EMER so that the 2500-VA inverter will supply power to the essential bus. As soon as the essential bus receives power, the light will go out. The light will stay on when the switch is at OFF.

Three-Phase (Instrument) Inverter Warning Light

A red warning light (figure 1-23), marked "No AC Power" and located on the three-phase portion of the inverter control panel, comes on if the selected (main or spare) three-phase inverter is inoperative or if the inverter switch is at OFF. The light operates on 28-volt dc.

AC Voltmeter and Selector Switch.

One voltmeter is provided for both the inverter systems and the alternator system. This voltmeter, with its selector switch (figure 1-24), is located on the radar observer's alternator control panel. For a complete discussion on the voltmeter and selector switch, see paragraph entitled AC Voltmeter and Selector Switch included in subsequent discussion on the ac alternator system, this section.

AC ALTERNATOR SYSTEM.

A variable-frequency alternator, driven by the left engine, supplies three-phase 115-volt ac to two buses: the alternator bus and the auxiliary ac bus. (See figure

Figure 1-24.

1-19.) An exciter switch turns on the alternator and an alternator circuit breaker switch connects the alternator output to the two buses. Both switches must be placed at CLOSE momentarily to obtain any alternator output. If the alternator fails, an auxiliary bus-tie relay connects the auxiliary ac bus to the secondary No. 1 inverter bus. The external power receptacle for the alternator system is the bottom receptacle on the right engine air intake duct. An external power circuit breaker connects the external power source to the alternator and auxiliary ac buses when the external power switch is held momentarily at CLOSE. Before the external power switch can be closed, the 28-volt dc external power must be connected. Tripping the external power switch or closing the alternator circuit breaker switch trips the external power circuit breaker. A voltmeter and a selector switch permit voltage readings of the external power, the alternator bus, the alternator ac generator, and all inverter buses. A guarded voltage rheostat can be used to adjust the voltage output of the alternator. A complete set of controls for the alternator is on the alternator control panel on the left side of the radar observer's cockpit. The pilot has only an exciter switch, an alternator circuit breaker switch, and a red indicator light on his alternator control panel. The pilot's switches and indicator light parallel those of the radar observer. The red indicator light comes on to warn that the alternator circuit breaker is in the tripped position. Fuses for the alternator system are in the forward electrical equipment section.

Alternator External Power Switch.

The three-position external power switch (figure 1-24) on the radar observer's alternator control panel controls the external power circuit breaker. The switch is spring-loaded to NEUTRAL from the CLOSE and TRIP positions. After a 115-volt 400-cycle ac external power source is connected to the external power receptacle, the external power switch can be held momentarily at CLOSE to close the circuit breaker connecting the external power source to the distribution bus. Holding the switch momentarily at TRIP discontinues external ac power to the distribution bus. When the alternator circuit breaker switch is held to CLOSE, it automatically trips the external power circuit breaker.

Note

Before the external power switch can be closed, 28-volt dc external power must be connected.

Alternator Exciter Switch.

A three-position exciter switch (figure 1-24) on the pilot's alternator control panel and a similar switch on the radar observer's alternator control panel (figure 1-24) control 28-volt dc circuits to the alternator exciter relay and provide a means for either crewmember to turn the alternator on and off. These switches are spring-loaded to NEUTRAL from the CLOSE and TRIP positions. When either switch is held momentarily at CLOSE, a circuit is completed from the 28-volt dc bus to the exciter relay, which in turn closes and turns on the alternator. When the switch is held momentarily at TRIP, the circuit from the 28-volt dc bus to the exciter relay is broken; the relay opens and cuts off alternator output.

CAUTION

Operation of more than one alternator switch at a time will result in damage to the alternator control circuit. The exciter switch should be actuated before the circuit breaker switch.

Alternator Circuit Breaker Switch and Indicator Light.

A three-position circuit breaker switch (figure 1-24) on the pilot's alternator control panel and the radar observer's control panel (figure 1-24) closes or trips the alternator circuit breaker. The switch is spring-loaded to NEUTRAL from the CLOSE and TRIP positions. Holding the switch momentarily in the CLOSE position closes the circuit breaker connecting the alternator to the distribution bus and automatically trips the external power circuit breaker. Holding the switch momentarily in the TRIP position opens the circuit breaker, discontinuing alternator output to the distribution bus. The red indicator light to the right of the circuit breaker switch in each cockpit comes on when the alternator circuit breaker is in the tripped position.

CAUTION

Operation of more than one alternator switch at a time will result in damage to the alternator control circuit. The exciter switch should be actuated before the circuit breaker switch.

Alternator Voltage Rheostat.

A guarded voltage rheostat (figure 1-24) on the radar observer's alternator control panel can be used to adjust the voltage output of the alternator.

AC Voltmeter and Selector Switch.

A voltmeter and selector switch (figure 1-24), located on the radar observer's alternator control panel, is used to check the voltage of all ac power systems. The rotary selector switch has eight positions: OFF, EXT PWR, PWR INV PRI, PWR INV SEC NO. 1, PWR INV SEC NO. 2, AC GEN, INST INV, and BUS. When the switch is at EXT PWR, the voltmeter indicates external ac power voltage before the external power switch is closed. When the switch is at PWR INV PRI, PWR INV SEC NO. 1, or PWR INV SEC NO. 2, the voltmeter indicates the voltage of the corresponding single-phase bus. When the switch is at AC GEN, the voltmeter indicates the voltage output of the alternator. When the switch is at INST INV on some airplanes, the voltage indicated is that of the selected three-phase inverter (main or spare). On airplanes with GAR-2A

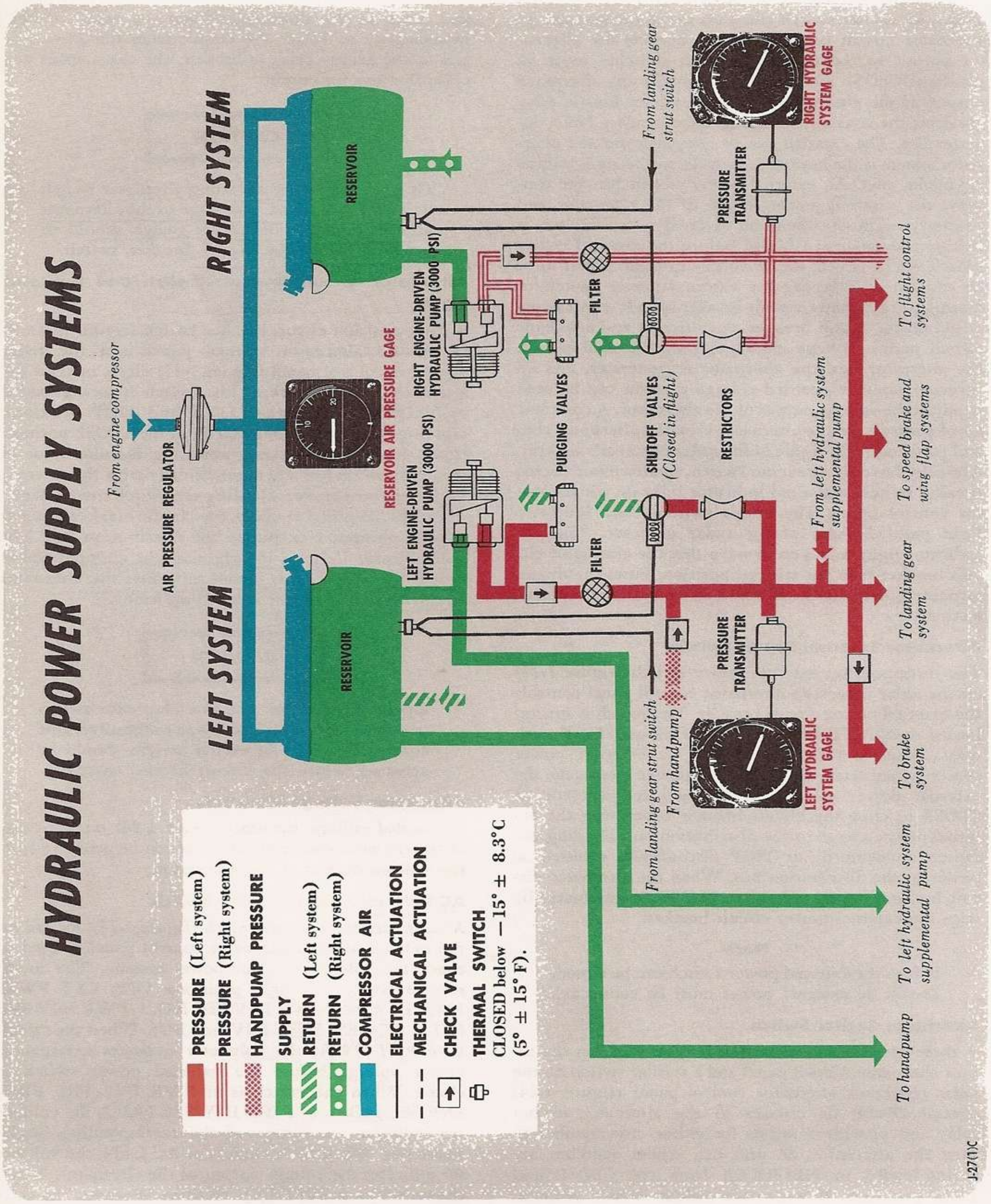
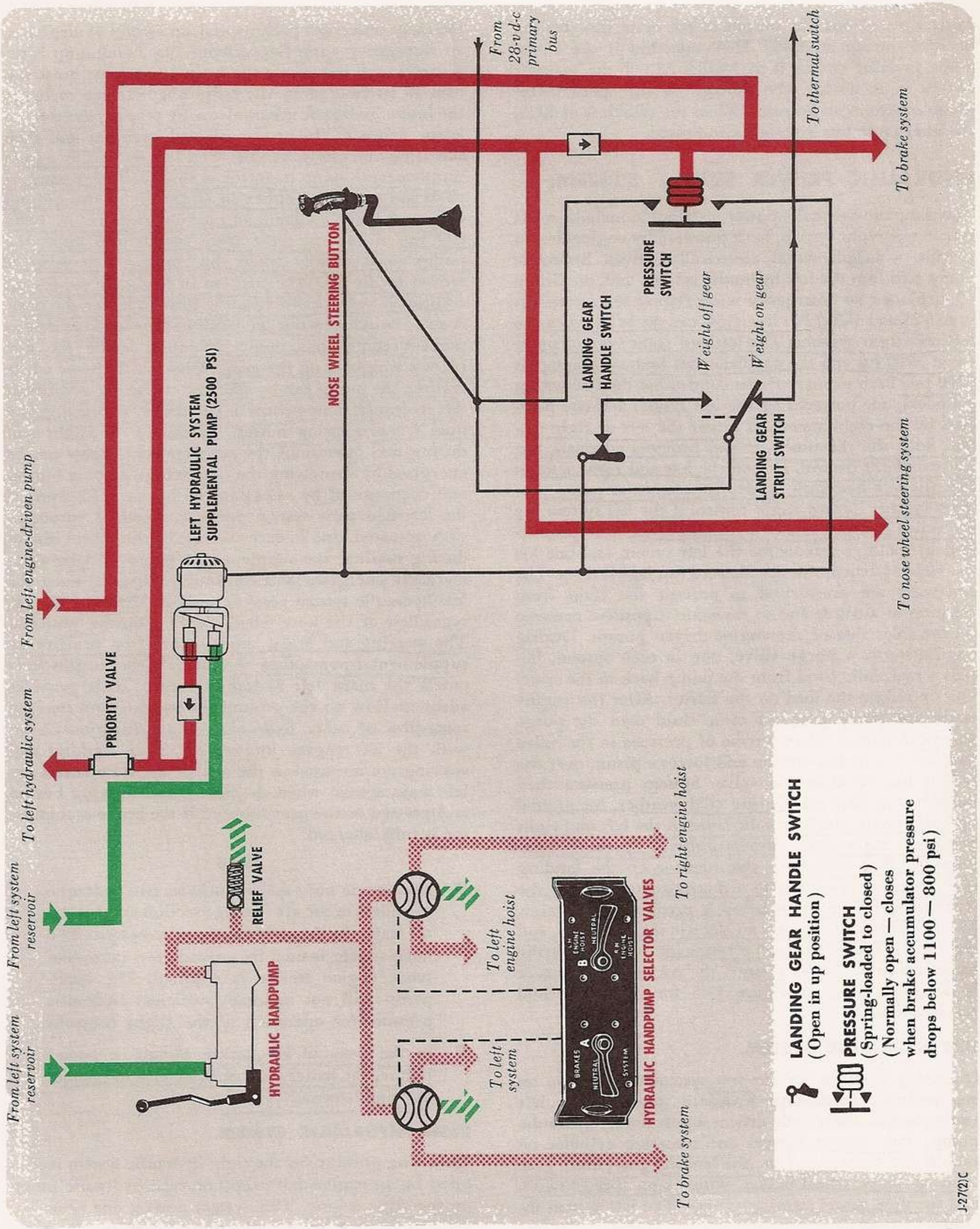

HYDRAULIC POWER SUPPLY SYSTEMS
LEFT SYSTEM
RIGHT SYSTEM
From engine compressor
AIR PRESSURE REGULATOR
RESERVOIR
RESERVOIR
RESERVOIR AIR PRESSURE GAGE
LEFT ENGINE-DRIVEN HYDRAULIC PUMP (3000 PSI)
RIGHT ENGINE-DRIVEN HYDRAULIC PUMP (3000 PSI)
PURGING VALVES
FILTER
FILTER
SHUTOFF VALVES (Closed in flight)
RESTRICTORS
PRESSURE TRANSMITTER
PRESSURE TRANSMITTER
From landing gear strut switch
From landing gear strut switch
From handpump
From left hydraulic system supplemental pump
LEFT HYDRAULIC SYSTEM GAGE
RIGHT HYDRAULIC SYSTEM GAGE
To handpump
To left hydraulic system supplemental pump
To brake system
To landing gear system
To speed brake and wing flap systems
To flight control systems
PRESSURE (Left system)
PRESSURE (Right system)
HANDPUMP PRESSURE
SUPPLY
RETURN (Left system)
RETURN (Right system)
COMPRESSOR AIR
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
CHECK VALVE
THERMAL SWITCH
CLOSED below −15° ± 8.3°C
(5° ± 15° F).
J-27(1)C

Figure 1-25.


From 28-v d-c primary bus
To thermal switch
To brake system
NOSE WHEEL STEERING BUTTON
PRESSURE SWITCH
LANDING GEAR HANDLE SWITCH
Weight off gear
Weight on gear
LANDING GEAR STRUT SWITCH
To nose wheel steering system
LEFT HYDRAULIC SYSTEM SUPPLEMENTAL PUMP (2500 PSI)
From left engine-driven pump
PRIORITY VALVE
To left hydraulic system
From left system reservoir
RELIEF VALVE
HYDRAULIC HANDPUMP
From left system reservoir
To left engine hoist
To right engine hoist
To left system
To brake system
HYDRAULIC HANDPUMP SELECTOR VALVES
BRAKES
NEUTRAL
SYSTEM
A
B
LH ENGINE HOIST
NEUTRAL
RH ENGINE HOIST
LANDING GEAR HANDLE SWITCH (Open in up position)
PRESSURE SWITCH (Spring-loaded to closed) (Normally open — closes when brake accumulator pressure drops below 1100 — 800 psi)
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missile provisions, the output of the main inverter can be read during an INST INV selection if the three-phase inverter switch is at NORMAL; if the inverter switch is at EMER, the voltage of the spare three-phase inverter can be read. When the switch is at BUS, the alternator bus voltage is indicated.

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, on Group 35 airplanes, an emergency wing flap system. (See figures 1-25 and 1-29.) 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 provides further limited flight control if the left 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. Refer to figure 1-45 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 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, a handpump and two selector valves in the radar observer's cockpit, and, on Group 35 airplanes, an emergency wing flap system. 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 1100-800 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 continuous pump operation while the airplane's weight is on the gear. 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. 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, due to 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. 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 hydraulic 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.

FLIGHT CONTROL HYDRAULIC SYSTEM

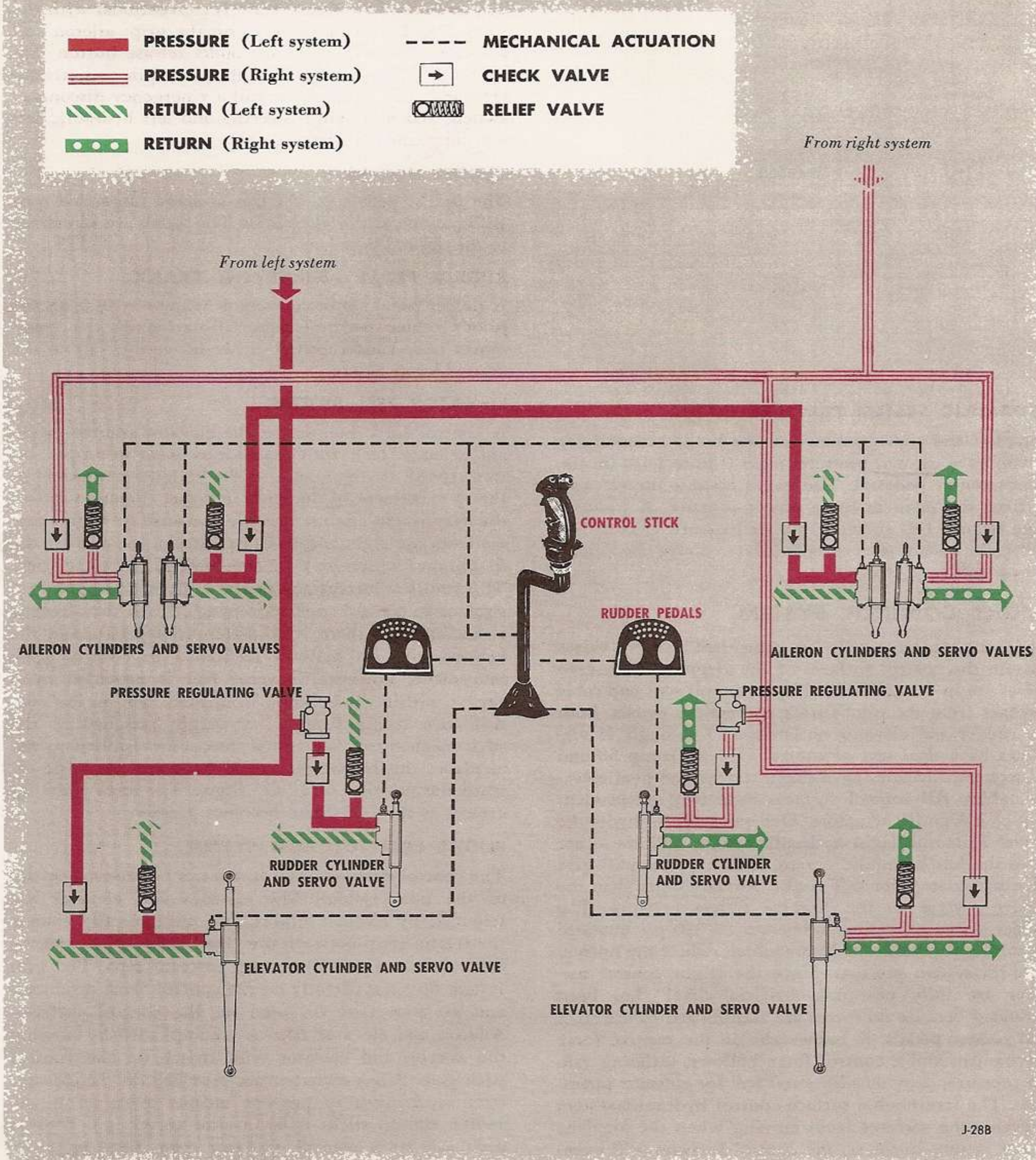

Figure 1-26.

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HYDRAULIC SYSTEM PRESSURE GAGES.

Both left and right systems and the brake accumulator system have autosyn pressure gages (figure 1-10) on the pilot's center pedestal. The gages operate on 115-volt ac from the main or spare power inverter. A pressure gage (figure 1-8) showing the air pressure in both left and right system reservoirs is located above the pilot's left console.

FLIGHT CONTROL SYSTEM.

Hydraulic actuating cylinders 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. Both the rudder and elevator on Groups 35 through 45 airplanes have dual sets of control cables; Group 50 and subsequent airplanes have single rudder and dual elevator cables. 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 means of pressure reducers which reduce the normal 3000-psi system pressure. Since the flight control surfaces are fully powered, artificial "feel" has been provided because no forces are transmitted to the stick and rudder pedals. A bobweight on the control force 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 (figure 1-27) is conventional with the following 28-volt dc switches on the grip: aileron and elevator trim switch, pylon tanks release button (inoperative), firing trigger (with safety pin and streamer), radio mike button, autopilot emergency disconnect switch, and nose wheel steering and left hydraulic system supplemental pump button.

RUDDER PEDALS.

The rudder pedals are the conventional suspended type with toe-operated brake pedals. The pedals are adjustable to the desired position.

RUDDER PEDAL ADJUSTMENT CRANK.

A rudder pedal adjustment crank (figure 1-10) 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 the position of 1 "G" flight. The stick force increases as the "G" force becomes greater.

FLIGHT CONTROL TRIM SYSTEM.

The control stick or pedal forces can be relieved by use of the trim system. The ailerons and elevator are trimmed by electric motors that mechanically change the relationship between the "feel" mechanism and the control system to reduce stick force to zero. The trim system 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. Safety switches are provided on the elevator trim mechanism to prevent serious overtrim if the switch should stick. 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 sideslip stability augmenter. On Groups 35 through 45 airplanes, the rudder may also be trimmed manually in emergencies by rotating the emergency rudder trim knob either left or right. The rudder can be manually trimmed up to 5 degrees (full travel) each way from neutral. Manual rudder trim should be used only when the sideslip stability augmenter system is inoperative.

Aileron and Elevator Trim Switch.

The aileron and elevator trim switch (figure 1-27) on the pilot's control stick grip 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. Stick pressure should not be required when trimming elevator.

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 the actuated position and causing a dangerous overtrim condition in case of malfunction of the safety switches.

Note

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

Electrical Rudder Trim Knob.

A rudder trim knob (figure 1-28), located on the sideslip stability augmenter control panel on the pilot's left console, provides the normal means of trimming the rudder manually. Hydraulic pressure, 115-volt single-phase ac, and 28-volt dc are required for effective use of the knob. The knob operates through the sideslip stability augmenter, which has a travel limit of 5 degrees in each direction. Rotation of the knob changes the position of the rudder servo with respect to the neutral pedal position. When the rudder trim knob is rotated clockwise, the rudder deflects to the right. When the rudder trim knob is rotated counterclockwise, the rudder deflects to the left. Normally the knob is centered at a neutral position. On Group 50 and subsequent airplanes, the rudder trim knob is safetied in the neutral position. On these airplanes the knob is used only as an alternate means of trimming the rudder in case of malfunction of the autotrim feature of the (modified) sideslip stability augmenter. To use this trim knob, the rudder trim switch is moved to MANUAL TRIM position and the trim knob is rotated, to the right or left as required, with sufficient force to break the light safety wire.

Figure 1-27.

Rudder Trim Switch (Group 50 and Subsequent Airplanes).

A rudder trim switch (figure 1-28) on the sideslip stability augmenter control panel provides means for selecting either of two methods of trimming the airplane directionally through the sideslip stability augmenter system. This switch operates on 28-volt dc and has positions marked AUTO TRIM and MANUAL TRIM. When the switch is at AUTO TRIM, the airplane is automatically kept in directional trim. When the switch is moved to MANUAL TRIM position, directional trim is accomplished through a rudder trim potentiometer and the rudder centering mechanism, by the pilot's turning the rudder trim knob to the right or left as required.

Note

- The rudder cannot be trimmed unless hydraulic power, 28-volt dc electrical power, and 115-volt ac essential bus power are available.
- At low indicated airspeeds, normally associated with takeoff, landing, and cruise at extreme altitudes, a pressure switch (in the landing gear warning system) overrides the AUTO TRIM position of the rudder trim switch. This action takes place automatically when the airspeed drops below 165 knots IAS; then the system returns to normal when the airspeed builds up to 180 knots IAS. The rudder trim switch itself does not move, as the pressure switch is in sequence with it. During the time that the autotrim feature is not in operation, electrical manual trim will be available through the sideslip stability augmenter system just as though the rudder trim switch were placed in MANUAL TRIM position. This automatic switching in and out of autotrim is to prevent undesirable oscillations that might occur with the autotrim feature operating at low indicated airspeeds.

Figure 1-28.

Emergency Rudder Trim Knob (Groups 35 Through 45 Airplanes).

The emergency rudder trim knob (figure 1-28) is located on the pilot's center pedestal and provides a manually operated mechanical means of trimming the airplane directionally if the sideslip stability augmenter is inoperative. 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 sideslip stability augmenter detent. The sideslip stability augmenter performance is then somewhat impaired since part of the movement of the sideslip stability 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 if the electric rudder trim knob or the sideslip stability augmenter is inoperative. The trim knob is safetied in the center position with light wire. If the electric trim fails, the wire should be broken by rotating the knob in the desired direction.

Note

- Do not use the emergency rudder trim knob under normal flight conditions. Using the knob unseats the sideslip stability augmenter detent.
- If emergency rudder trim has been used in flight, the pilot will enter the fact in DD Form 781 so that the sideslip stability augmenter detent will be reseated and the knob will be safetied in the neutral detent before the next flight.
- On Group 50 and subsequent airplanes, a modification of the rudder cable system eliminates the mechanical emergency rudder trim. The rudder is trimmed in these later airplanes by use of the normal and alternate trimming methods controlled by the sideslip stability augmenter trim switch.

Elevator Trim Position Indicator.

A mechanical elevator trim indicator (figure 1-28) 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.

SIDESLIP STABILITY AUGMENTER SYSTEM (GROUPS 35 THROUGH 45 AIRPLANES).

The sideslip stability augmenter system controls rudder motion to eliminate sideslip. This improves stability, dampens undesirable oscillations common to most high speed airplanes, and permits fully coordinated turns to be made without use of the rudder pedals. If the airplane begins to sideslip, an accelerometer (liquid type) senses the sideslip and transmits an electrical signal, proportional to the amount and direction of sideslip, to a preamplifier where it is amplified and modified by means of an airspeed compensator. The modified signal then leaves the preamplifier and is combined with signals from an aileron potentiometer. The aileron potentiometer signal is proportional to the amount of aileron deflection, and is also modified by the airspeed compensator. The combined signals are then transmitted into a calibrator unit where the signal is compared with a servo motor signal which indicates the position of the servo actuator shaft. The difference between the combined signal and the servo motor signal determines the amount of servo shaft rotation necessary to correct for the sideslip. This difference, or error signal, is then passed through an amplifier to operate the servo motor which moves the rudder, by means of the rudder cable and actuating cylinders, in the direction to oppose the sideslip. During pushovers and other maneuvers involving negative "G" loads, some yaw is usually experienced due to the action of the liquid type accelerometer. To prevent the rudder cable movement (resulting from the sideslip stability augmenter) from moving the rudder pedals instead of the rudder actuating cylinders, the main rudder cable drum, located between the sideslip stability augmenter servo motor and the rudder pedals, is held stationary by a spring-loaded detent. However, if the mechanical emergency rudder trim knob is moved from the neutral position, the detent will be unseated and part of the rudder cable movement will be transmitted to the rudder pedals, resulting in decreased efficiency of the system. The pilot can override the action of the sideslip stability augmenter by merely pushing the rudder pedals farther than normal. A warmup period of approximately 3 minutes is necessary before the system is ready for operation. During this warmup period, the rudder may be deflected as much as 5 degrees (maximum system authority). Therefore, if the system is turned off during flight and then turned on again, the rudder may deflect and the airplane will yaw sharply. For this reason, the system should not be turned off or on during flight. If the sideslip stability augmenter should fail during flight, the rudder will eventually deflect 5 degrees to one side or the other and will remain deflected until neutralized by trim. The system is powered by 28-volt dc and 115-volt single-phase ac.

CAUTION

If the sideslip stability augmenter system should fail, reduce airspeed below the range in which large directional oscillations might occur, thus avoiding undue stress on the airplane's structure.

Sideslip Stability Augmenter Switch (Groups 35 through 45 Airplanes).

A switch for the sideslip stability augmenter (figure 1-28) is located on the sideslip stability augmenter control panel. This switch has ON and OFF positions and controls the single-phase ac power that operates the stability augmenter equipment. The switch should be at ON at all times during flight.

SIDESLIP STABILITY AUGMENTER SYSTEM (GROUP 50 AND SUBSEQUENT AIRPLANES).

On Group 50 and subsequent airplanes, the sideslip stability augmenter has been modified extensively by changes that improve the performance of the system while reducing the number of component units required. A redesigned single rudder cable system is used and the mechanical rudder trim is eliminated. A sensitive accelerometer of the mass-spring-damper type replaces the liquid type used on Groups 35 through 45 airplanes. The mass-spring-damper type accelerometer has a bob-weighted wand to detect lateral movement. The advantage of the newer type accelerometer is that the sensing element is not affected by negative "G" loads as is the liquid accelerometer. For example, on the earlier system some yaw is usually experienced during pushovers; this characteristic is absent from the modified augmenter. The preamplifier, calibrator, and amplifier have been combined into one electronic control unit. This unit also includes an integrator that evaluates and combines signals from steady-state accelerations (sideslip) with signals from lateral oscillations (Dutch Roll) to provide an automatic trimming feature in the stability augmenter system. Rudder displacement within the range (5 degrees either side of neutral) of the system is controlled by an electrohydraulic servo which is connected in series with the rudder power cylinders. This electrohydraulic servo operates in response to electrical impulses from the electronic control unit. The stability augmenter can be operated selectively either in automatic trim or in manual trim at the pilot's discretion. Automatic trim is recommended at all times and especially during the "on target" stage of interception and the firing phase, because in this setting the system will produce the most completely stabilized flight path at cruising speeds and above; however, the system will provide satisfactorily stabilized flight, and is capable of continuous operation, in the manual trim setting. If a failure occurs in the automatic trim portion of the electronic control unit and power is still available to the system, trim control may be obtained through selection of the manual trim system. The sideslip stability augmenter system can be overridden by moving the rudder pedals farther than normal. The system is powered by 28-volt dc and 115-volt single-phase ac. If the sideslip stability augmenter system should fail completely in flight, the rudder may deflect as much as 5 degrees (maximum authority) right or left. The rudder will return to neutral, however, within 60 seconds after the sideslip stability augmenter system is turned off.

Sideslip Stability Augmenter Power Switch (Group 50 and Subsequent Airplanes).

A two-position PWR ON, PWR OFF switch (figure 1-28), located on the sideslip stability augmenter control panel, controls the single-phase ac power that operates the stability augmenter system. The switch is guarded in the PWR ON position, and should be left in that position at all times during flight, except in case of failure of the entire stability augmenter system, in which case it should be placed at PWR OFF.

WING FLAP SYSTEM.

The slotted wing flaps operate on hydraulic power from the left hydraulic system (figure 1-29). 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 operate together. Flap travel is 50 degrees down from the wing reference plane. There is no emergency system for operating the wing flaps; however, the flaps can be operated with supplemental pump pressure if the left engine-driven hydraulic pump fails.

WING FLAP LEVER AND POSITION INDICATOR.

The wing flap level and position indicator (figure 1-30) are located on the pilot's left console. The lever provides a means of moving the wing flaps to any desired position, and can be prepositioned at TAKE-OFF (flap 30 degrees down), DOWN (flap 50 degrees fully down), and UP. After the lever has been moved to one of these positions, the lever may be released and the flaps will continue to move until the selected position is reached. Although the wing flaps can be prepositioned 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 can then be released and the flaps will remain in position until the lever is moved again. As the wing flaps travel, the indicator gives visual indication of the flap position at any time during travel. Retraction of wing flaps from the TAKE-OFF to the UP position requires approximately 10 seconds.

SPEED BRAKES AND WING FLAPS HYDRAULIC SYSTEM

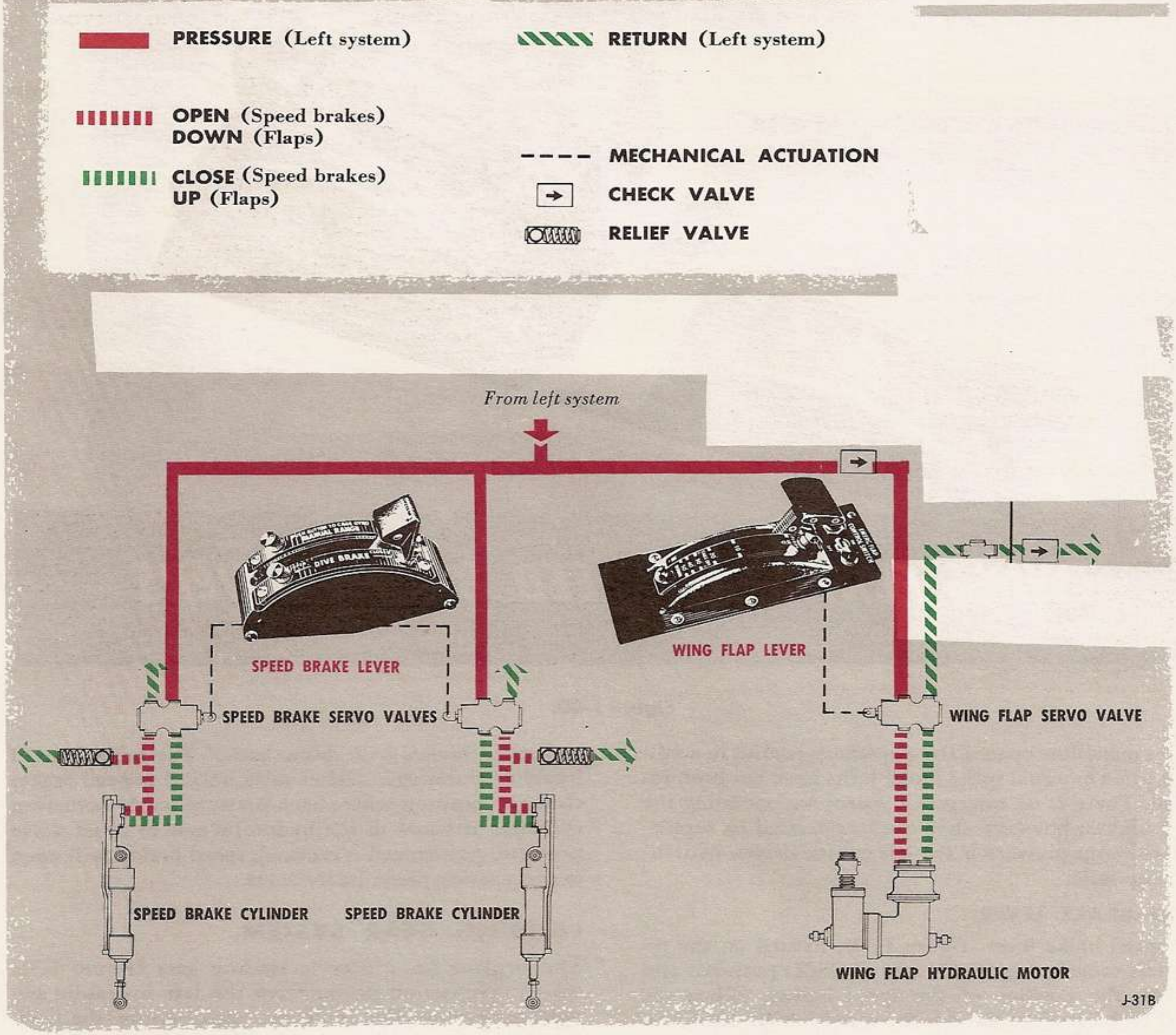

Figure 1-29.

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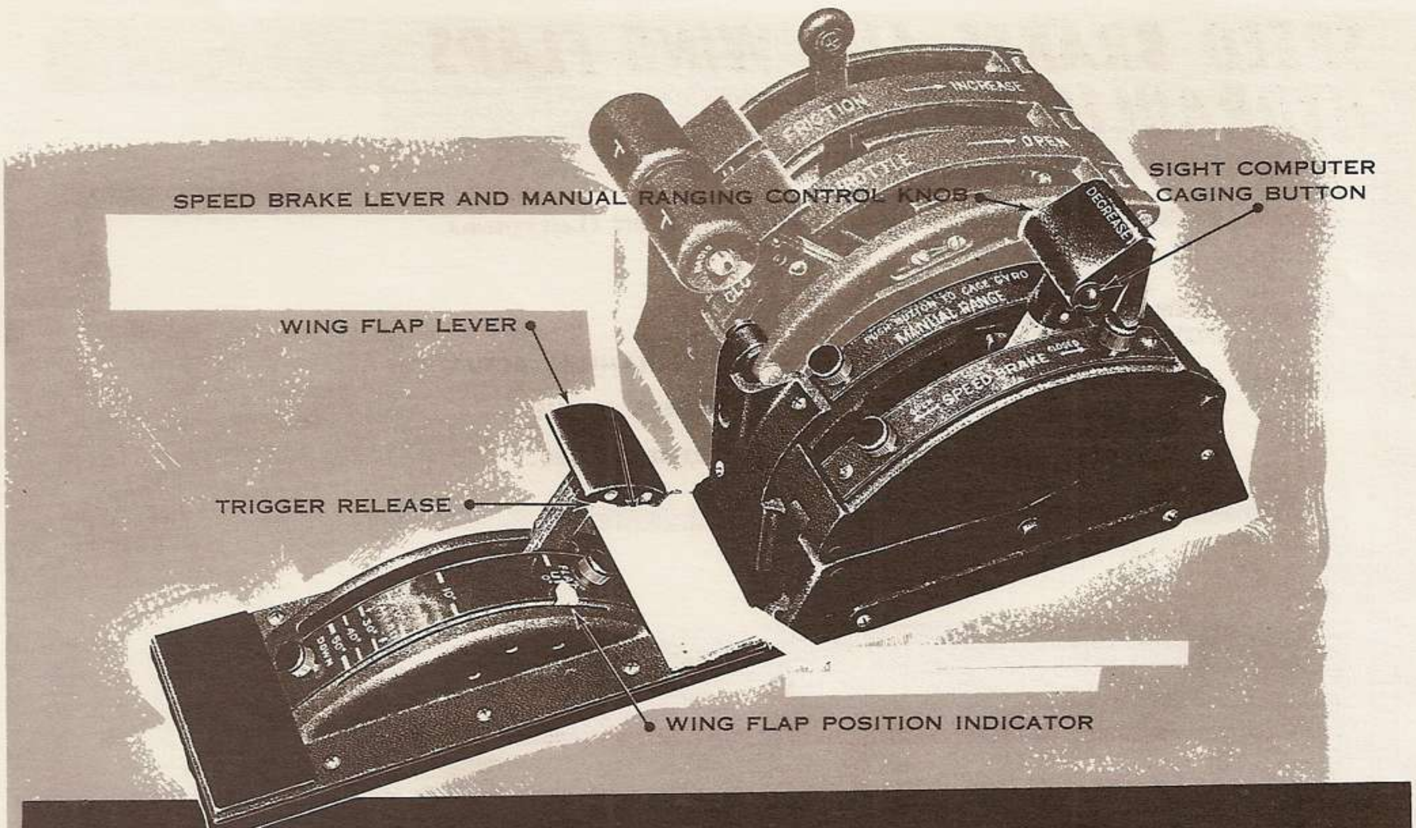
SPEED BRAKE SYSTEM.

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 speed brake. They are moved by a hydraulic cylinder (figure 1-29) 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



WING FLAP AND SPEED BRAKE LEVERS

Figure 1-30.

brakes may blow open if the airplane is parked in a tailwind when external speed brake locks have not been installed. 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 1-30), located on the pilot's left console, has OPEN and CLOSED positions and controls the position of the speed brakes. 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 increased 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 preset by the lever.

LANDING GEAR SYSTEM.

The airplane has a tricycle landing gear (figure 1-31) 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 gear 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, attached by mechanical linkage to 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

LANDING GEAR HYDRAULIC SYSTEM

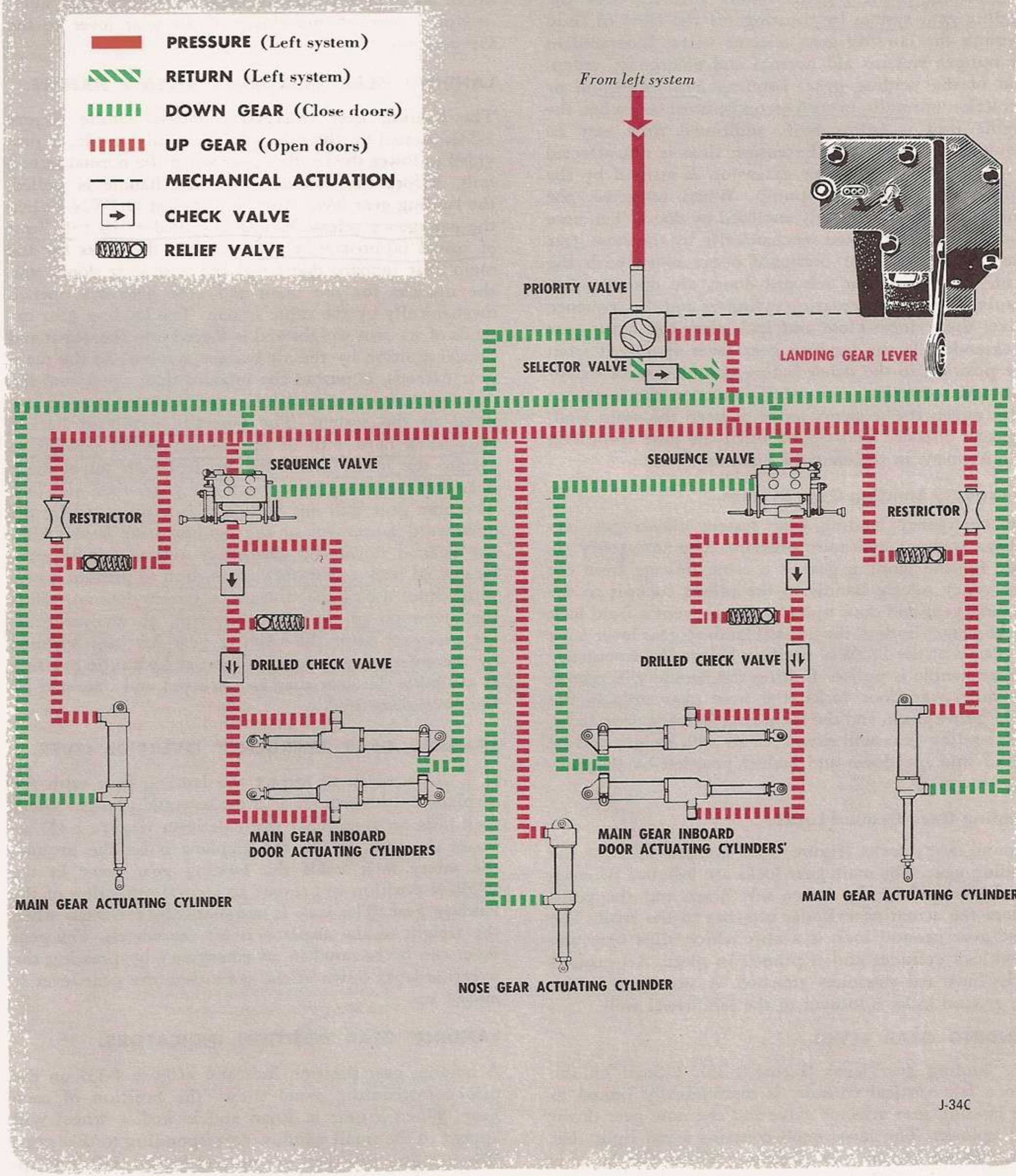


Figure 1-31.

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 the 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. 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. The main gear inboard doors are 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 and retraction, a transfer piston on the sequence valve moves the sequence valve to keep the main landing gear inboard doors open until the gear completes its movement in the changed direction.

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 emergency release handle in the pilot's cockpit to the 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 nose gear door locks, the nose gear uplock, the main gear uplock, and the main gear inboard door locks. The landing gear will extend of its own weight and be forced into the down and locked position by the bungee system.

Landing Gear Ground Locks.

Ground safety locks (figure 1-32) 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 gear ground lock is a clip which slips over the downlock cylinder and is pinned in place. All ground locks have red streamers attached. A stowage box for the ground locks is located in the left wheel well.

LANDING GEAR LEVER.

The landing gear lever (figure 1-33), located on the pilot's left vertical console, is mechanically linked to the landing gear selector valve and the nose gear down and uplocks. The lever knob contains a red light that indicates an unsafe gear position. When the lever is moved to the DOWN position, landing gear extension is initiated. Placing the gear lever at UP initiates landing gear retraction. The pilot can reverse the normal landing gear cycle at any time with a reverse movement of the landing gear lever. 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 1-33), located on the pilot's left vertical console, is provided to lower the landing gear when the normal system fails. Before the emergency release handle is pulled, the landing gear lever must be placed at DOWN. When the emergency release handle is pulled to its full limit of travel (approximately 14 inches), the locks for the main gear inboard doors and the nose gear doors, and the uplocks for the main and nose gear 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, then the left. The nose gear will not be felt as it is unlocked by the downward movement of 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 retracted and 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 1-33) 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 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 1-33) on the pilot's instrument panel shows the position of each gear. When a gear is down and locked, a wheel will appear in the small window corresponding to that gear. When a gear and door are up and locked, UP will appear in the corresponding window. If a gear or main gear door is in an unlocked position, red and cream

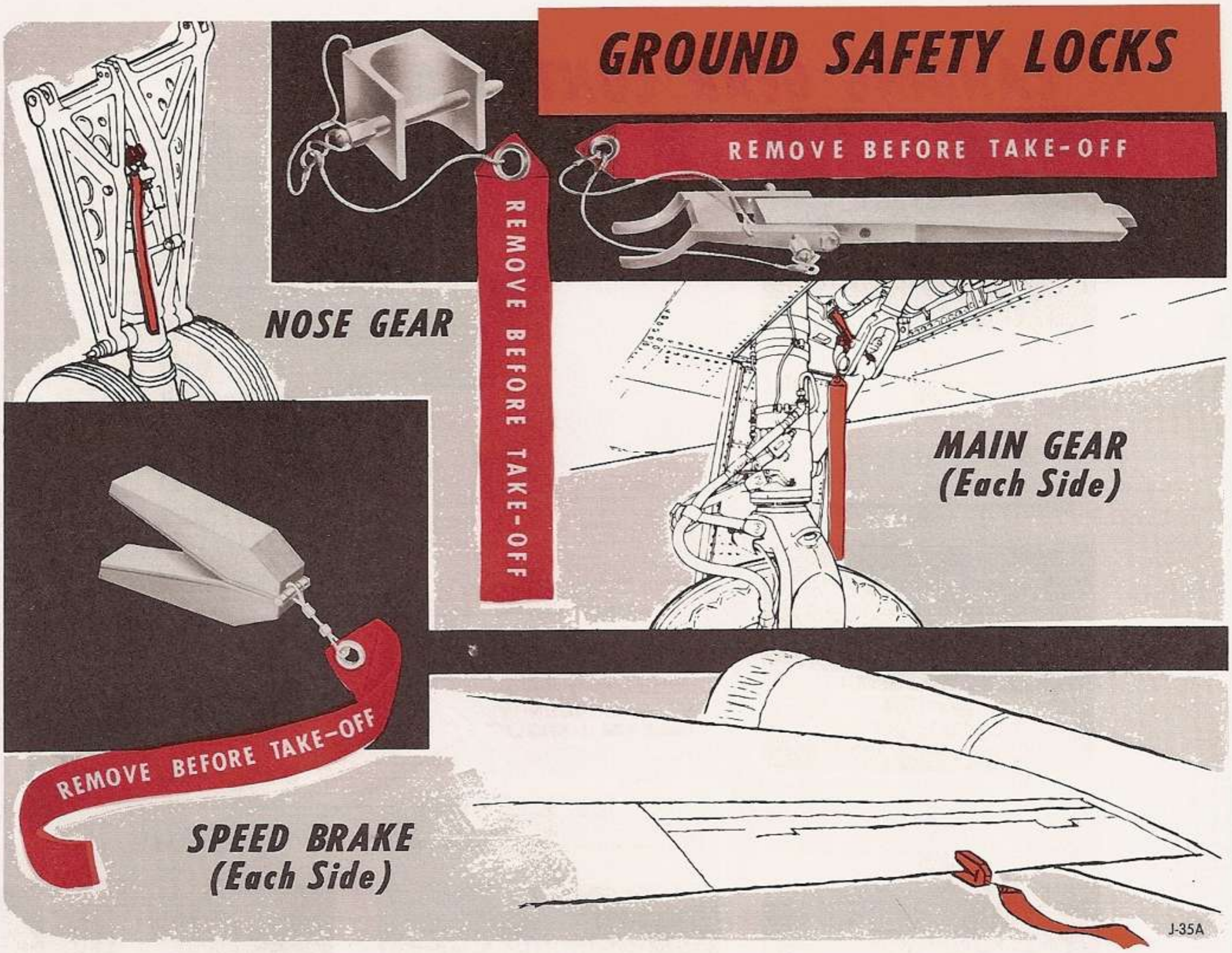


Figure 1-32.

diagonal stripes will appear in the corresponding window. If 28-volt dc power is not available, all three windows will display the diagonal stripes. The gear position indicators and a visual check for safe main gear should be relied upon following emergency gear drop. The landing gear lever knob warning light, operating on 28-volt dc, will illuminate for any unsafe condition of the landing gear or main landing gear doors. The light will also illuminate any time the warning horn is sounding and will remain illuminated until either airspeed or altitude is increased beyond the warning range. The light is unaffected by warning horn reset switch actuation. On some airplanes the brightness of the landing gear warning light is controlled during night operation with a dimming switch located on the pilot's aft miscellaneous control panel.

LANDING GEAR WARNING HORN AND RESET BUTTON.

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 to 165 knots, plus or minus 10 knots. An altitude-sensing switch prevents a warning signal at altitudes above 10,000 to 13,000 feet, depending on atmospheric conditions. A landing gear warning horn reset button (figure 1-16) on the pilot's aft miscellaneous control panel 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. If the pilot does not use the reset button, the horn will stop blowing automatically when the airspeed reaches approximately 175 knots. On some airplanes 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.

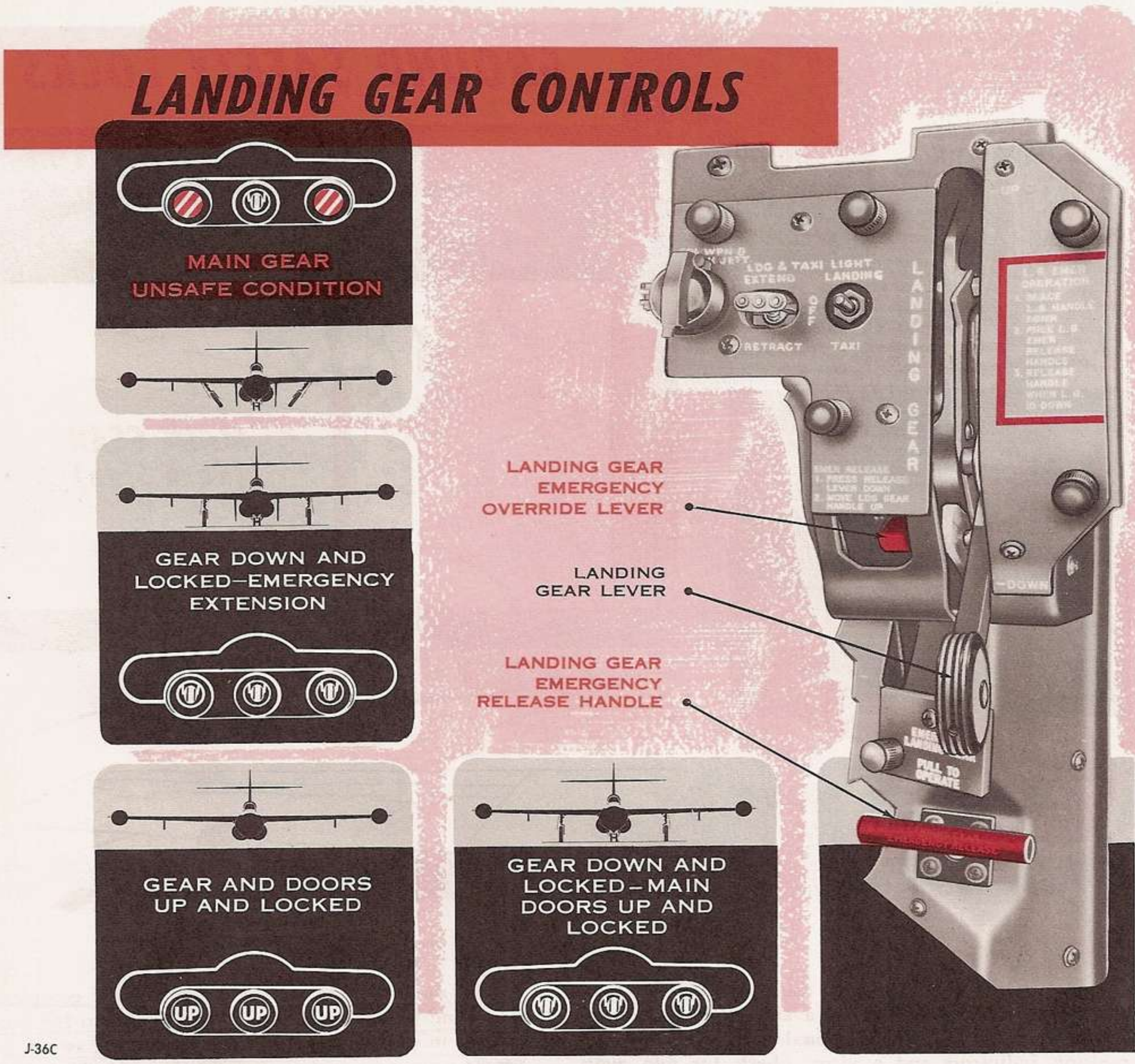


Figure 1-33.

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 1-34.) The purpose of the system is to provide directional control during taxiing and takeoff only. Hydraulic pressure for the system is controlled by a solenoid shutoff valve operated by a button on the control stick grip. 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. 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. When the nose wheel steering system 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 gear scissors closes the shutoff valve and opens the bypass valve when the weight of the airplane is taken off the nose gear strut, allowing it to extend. This allows the nose gear to swivel so that the centering cam will center the nose wheel for landing gear retraction and extension. Nose wheel steering may be selected at any time (assuming that the weight of the airplane 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 to 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 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 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 pump to augment left hydraulic system pressure.

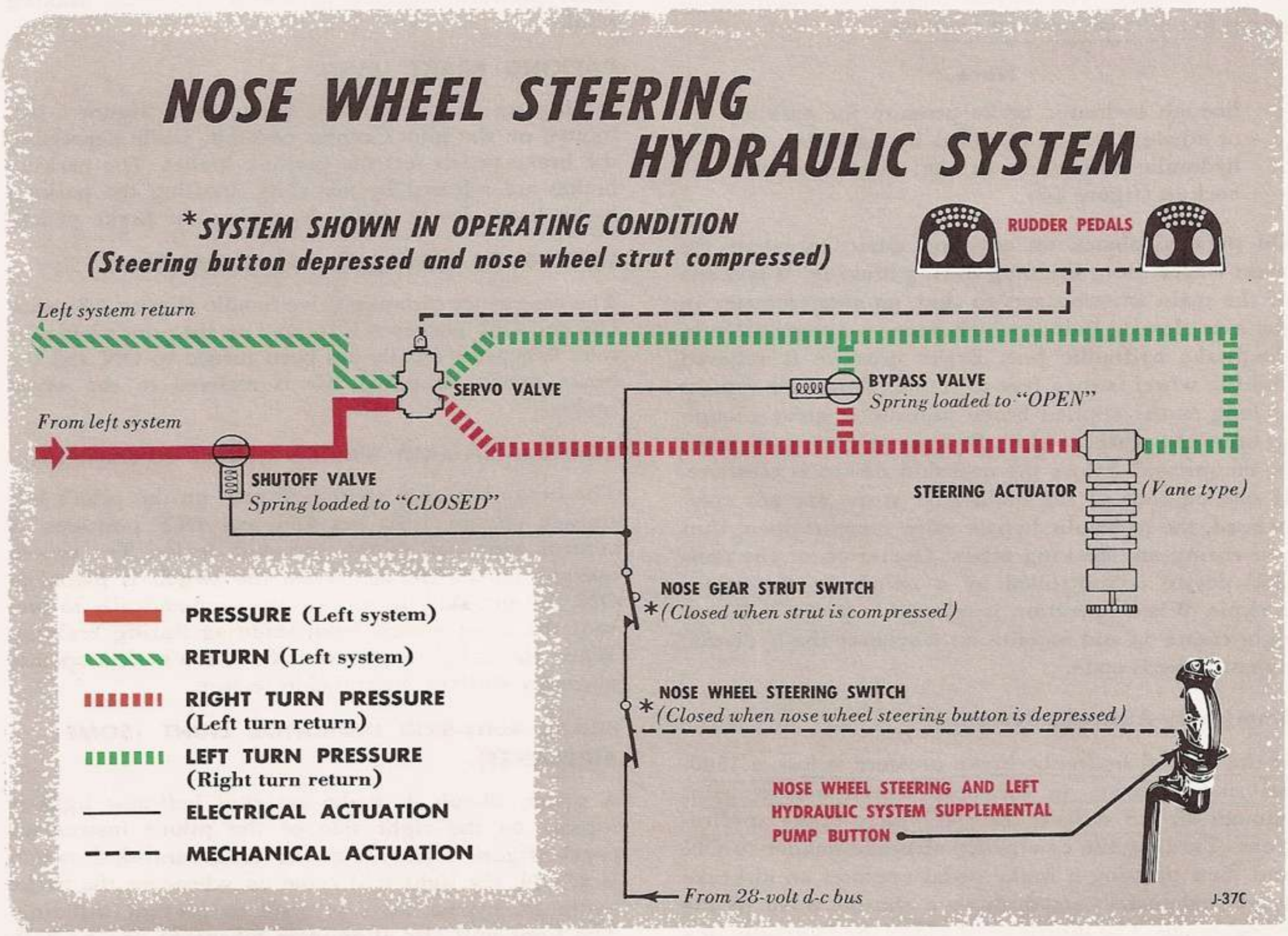


Figure 1-34.

WARNING

Nose wheel steering system malfunction can cause the nose wheel to go full left or right. If a malfunction is detected, immediately release the nose wheel steering button.

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 1-35.) A normally open pressure switch in the brake accumulator closes when pressure drops to between 1100 and 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).

On some airplanes, an anti-skid device prevents the main wheels from skidding during braking. When one of the main wheels starts to skid, an accelerometer in the axle closes a switch which opens a bypass valve in the brake hydraulic line. Brake pressure is relieved and the wheel is then free to rotate. This cycle repeats as long as the applied brake pressure is great enough to cause the wheel to skid. Both main gear struts must be compressed before the anti-skid device is effective. If one or both of the main gear struts are not compressed, the hydraulic bypass valve remains open, thus preventing any braking effect. Operation of the anti-skid device is controlled by a switch in the pilot's cockpit. When operation is selected, a green indicator light comes on and remains on whenever the hydraulic bypass valve is open.

Emergency Airbrake System.

If the normal hydraulic brake pressure is lost, a 1500-psi storage bottle in the nose wheel well contains enough air for at least three complete brake applications. Turning the emergency airbrake handle to ON and then pressing a brake pedal operates an airbrake valve and 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

- 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.
- 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 because the artificial "feel" for both systems must be overcome at the same time.

BRAKE PEDALS.

The brake pedals are the conventional, toe-operated type. Each pedal controls a hydraulic power brake valve and an air power brake valve. When the pedals are pressed, all four valves open and either air or hydraulic pressure, or both, supply the braking action to the wheels. "Feel" will be greatly reduced 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 1-10), located on the pilot's center pedestal, 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 1-8) with ON and OFF positions is located on the pilot's left console. When the handle has been turned to ON and the brake pedals depressed, air is metered to the wheel brakes.

BRAKE ANTI-SKID SWITCH (SOME AIRPLANES).

The brake anti-skid switch, located on the pilot's left console (figure 1-8), has ON and OFF positions to control operation of the anti-skid device. The switch operates on 28-volt dc. When the switch is placed at ON, the anti-skid device operates automatically to prevent the main wheels from skidding during braking. When the switch is placed at OFF, the brakes operate normally without the anti-skid feature.

BRAKE ANTI-SKID INDICATOR LIGHT (SOME AIRPLANES).

A green, 28-volt dc brake anti-skid indicator light is located on the right side of the pilot's instrument panel (figure 1-7). When the brake anti-skid switch is at ON, the light will come on whenever the brake hydraulic bypass valve is open to prevent skidding. The light will also illuminate whenever one or both of the main gear struts are not compressed.

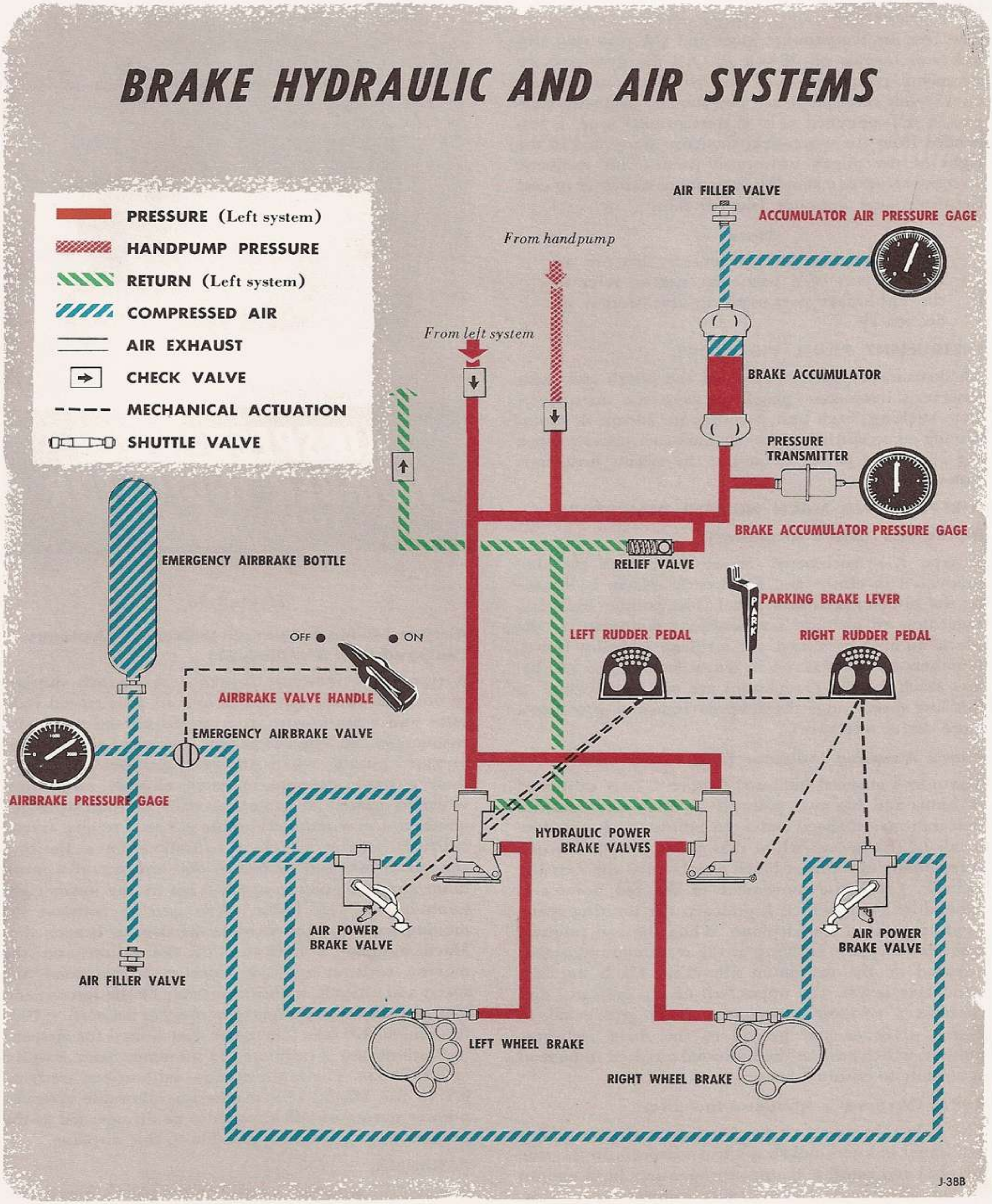

BRAKE HYDRAULIC AND AIR SYSTEMS
PRESSURE (Left system)
HANDPUMP PRESSURE
RETURN (Left system)
COMPRESSED AIR
AIR EXHAUST
CHECK VALVE
MECHANICAL ACTUATION
SHUTTLE VALVE
AIR FILLER VALVE
ACCUMULATOR AIR PRESSURE GAGE
From handpump
From left system
BRAKE ACCUMULATOR
PRESSURE TRANSMITTER
BRAKE ACCUMULATOR PRESSURE GAGE
EMERGENCY AIRBRAKE BOTTLE
RELIEF VALVE
PARKING BRAKE LEVER
PARK
OFF
ON
LEFT RUDDER PEDAL
RIGHT RUDDER PEDAL
AIRBRAKE VALVE HANDLE
EMERGENCY AIRBRAKE VALVE
AIRBRAKE PRESSURE GAGE
HYDRAULIC POWER BRAKE VALVES
AIR POWER BRAKE VALVE
AIR POWER BRAKE VALVE
AIR FILLER VALVE
LEFT WHEEL BRAKE
RIGHT WHEEL BRAKE
J-38B

Figure 1-35.

INSTRUMENTS.

The free air temperature gage and the turn and slip indicator operate on 28-volt dc. All the gyro-type instruments except the turn and slip indicator operate on 115-volt three-phase ac. 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 standby 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.

AIRSPEED AND MACH NUMBER INDICATORS.

Machmeter (Some Airplanes).

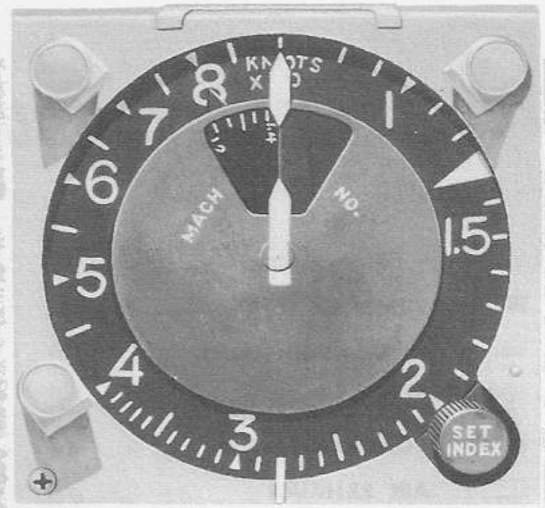
A type A-1 machmeter (figure 1-7), with the dial graduated in tenths and hundredths Mach, is located on the pilot's instrument panel. The pointer indicates, regardless of altitude and ambient temperature, the Mach number at which the airplane is being flown. Numbers on the dial run in tenths from 0.3 to 1.0 (below Mach 0.3 the graduations are omitted because in this low speed range the airspeed indicator provides a more useful reference).

Pilot's Airspeed Indicator (Some Airplanes).

The pilot's airspeed indicator (figure 1-7) is calibrated in knots and has two pointers: a fluorescent pointer that indicates airspeed and a red pointer with alternate bands of fluorescent white that shows airspeed which corresponds to a preset Mach number for the existing altitude. 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. The upper half of the indicator dial contains a window exposing a drum, graduated in 2-knot divisions and geared to the main indicator pointer, which enables the indicated airspeed to be read accurately to within 1 knot.

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.



AIRSPEED-MACH NUMBER INDICATOR (SOME AIRPLANES)

J-120

Figure 1-36.

Airspeed—Mach Number Indicator (Airplanes Equipped with AN/ARN-21).

A type ME-4 indicator (figure 1-36), which displays in one instrument the indications of an airspeed indicator and a machmeter, is mounted on the pilot's instrument panel. The instrument consists of a pitot-static operated pointer which indicates airspeed on a fixed dial; a static pressure operated altitude mechanism which is geared to a moving scale to indicate Mach number; a maximum allowable airspeed striped (cross-hatched) pointer which is adjustable for a limiting equivalent airspeed of 600 to 800 knots; and a minimum airspeed pointer which is set by the lower right knob labeled "set index." The gearing between the moving scale and the altitude mechanism is such that Mach number is indicated by the pointer on the moving scale at any combination of indicated airspeed and altitude within the range of the instrument. The instrument is designed to operate between −1000 feet and 80,000 feet. The outer dial is used for airspeed indications and is calibrated in numerals from .8 to 8.5 (x 100 knots). The Mach number calibrations are from 0.5 to 2.2 Mach. The maximum allowable airspeed pointer setting of 800 knots is to be disregarded as the pointer setting is not applicable to this airplane.

ALTIMETER.

The pilot's altimeter, located on the pilot's instrument panel (figure 1-7), displays barometric pressure indications calibrated in feet of altitude. The altimeter has two hands, a notched disk with a pointer extension, two settings marks, a warning indicator, and a barometric scale with an adjustment knob. The longer of the concentrically arranged hands indicates hundreds of feet, the shorter hand indicates thousands of feet, and the notched disk with a pointer extension indicates 10,000 feet. A warning indicator consisting of a striped (cross-hatched) sector painted on a dial above numeral five appears through the notched disk at altitudes below 16,000 feet. An outer setting mark indicating hundreds of feet and an inner setting mark indicating thousands of feet operate in conjunction with the barometric scale and are used when the pressure to be read is outside the limits of the barometric pressure scale. The adjustment knob is used to adjust the hands, setting marks, and barometric scale simultaneously to correct for atmospheric pressure changes caused by changing climatic conditions.

ATTITUDE INDICATOR.

A type B-1A attitude indicator (figure 1-37) on the pilot's instrument panel indicates the airplane's attitude

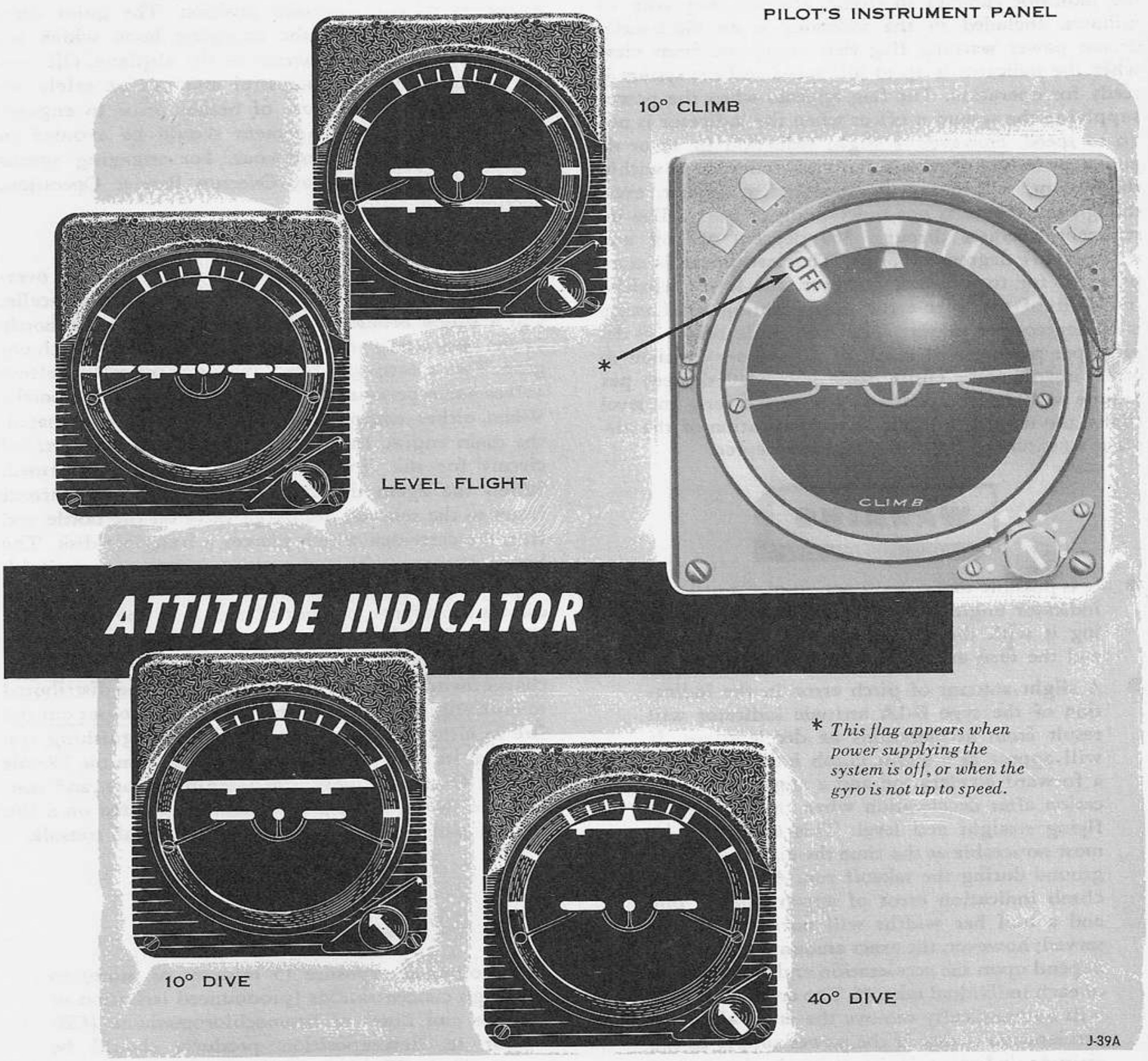


Figure 1-37.

with respect to an artificial horizon. The instrument obtains dc power from the 28-volt dc bus and ac power from the instrument inverter bus. The B-1A indicator is noncaging 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 axis. The indicator has a fast initial erection period, approximately 2 minutes ± 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 indicator 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 indicator is not up to speed. However, a slight reduction in ac or dc power, or failure of certain electrical components within the system, will not cause the flag to appear, even though the system is not functioning properly. 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 might 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 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 one and a half 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.

RUNWAY OVERRUN BARRIER OPERATION.

A runway overrun barrier engagement modification is provided to prevent injury to crewmembers and damage to equipment by preventing airplanes from overrunning runways in cases where the pilot is unable to stop the airplane during landings or unsuccessful takeoffs. Airplanes so modified are equipped with a barrier triggering probe located just forward of the nose wheel well and a barrier guide and hook located just forward of the main landing gear. When the airplane overruns the end of the runway, the probe triggers the barrier, actuating it to an upright position. The guide then guides the barrier to the engaging hook which arrests the forward momentum of the airplane. Off center engagements are successful and can be safely accomplished. Excessive use of brakes prior to engagement and during engagement should be avoided to prevent possible tire blowout. For engaging speeds information, see Runway Overrun Barrier Operation, Section III.

FIRE EXTINGUISHING SYSTEM.

The fire extinguishing system (figure 1-38) 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, current 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 so dilutes the oxygen content of the air in the engine bay 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 extinguishing system are located on a fire control panel on the pilot's right vertical console.

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

CAUTION

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

Engine Fire Selector Switches.

Two guarded fire selector switches (figure 1-38), 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 valve for the affected engine and to complete the circuit to the agent discharge switch.

Agent Discharge Switch.

A spring-loaded agent discharge switch (figure 1-38), located on the fire extinguishing control panel, operates the fire extinguisher. When the switch is held momentarily to the UP position, the circuit is closed and current flows to the selected discharge valve on the fire extinguishing 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.

CAUTION

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

Fire and Overheat Warning Lights and Test Switches.

Two red fire warning lights (figure 1-38), 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 1-38), 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 1-38) 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

Figure 1-38.

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.

CANOPY.

The transparent canopy is operated by an electric motor geared to a chain, and can be controlled normally by any one of three 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 vertical console. 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. The canopy lock lever is then used to bring the canopy to the locked position. A limit switch also brakes the canopy motor to prevent the canopy from slamming into the rear stops. Hydraulic dampers aid the actuating motor brake in preventing the canopy from slamming against the windshield or rear stops. This also provides the needed braking action when the canopy is operated manually and the actuating motor brake is inoperative. A toggle-type circuit breaker to facilitate deactivation of the canopy system for manual ground operation is provided.

WARNING

- While operating the canopy manually, do not slam the canopy open or closed as damage to the stops may result.
- When taxiing with canopy open, keep hands clear of canopy track when applying brakes, as sudden brake application may cause canopy to slam forward.
- When certain types of survival equipment are used, ejection through the canopy may result in neck injuries. As an example, when the MD-1 survival kit is used, a seated height of 34-1/2 inches is available. A crewmember having a greater sitting height, and using this equipment, would have his head above the headrest. If ejection through the canopy were necessary under this condition, the possibility of neck injury would exist. Ejection through the canopy should be attempted only after all efforts to jettison the canopy have failed and ejection is mandatory.
- Do not open or close the canopy during braking.

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 handle. 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 1-8). In the radar observer's cockpit, the "T" handle is located below the main spar on the left side (figure 4-6). The canopy can also be slow-jettisoned by the ground crew by pulling out (approximately 5 inches) the external emergency release handle. Either method releases compressed gas to the canopy jettison cylinders. When the canopy 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 the canopy may be pushed or lifted from the airplane. A pressure gage for the canopy jettison system is located on the radar observer's instrument panel. (See figure 4-5.)

PILOT'S CANOPY SWITCH.

A slide-type canopy switch (figure 1-39) on the handle of the pilot's canopy lock lever is one of the three spring-loaded switches that control canopy operation. The switch positions are marked OPEN and CLOSE. The switch also has a 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 slamming against the mechanical stops. 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. The pilot's switch overrides the radar observer's switch, and


1 EXTERNAL CANOPY HANDGRIP
2 INTERNAL CANOPY HANDGRIPS
3 PILOT'S CANOPY JETTISON "T" HANDLE (FAST FIRE)
4 PILOT'S CANOPY SWITCH AND LOCK LEVER
5 PILOT'S CANOPY SLOW FIRE JETTISON "T" HANDLE
6 EXTERNAL CANOPY CONTROLS
7 RADAR OBSERVER'S CANOPY SLOW FIRE JETTISON "T" HANDLE
8 RADAR OBSERVER'S CANOPY SWITCH AND LOCKING LEVER
RESCUE
1. PUSH BUTTON TO RELEASE HANDLE
2 PULL "T" HANDLE OUT 6 INCHES TO JETTISON CANOPY
RESCUE
EMERGENCY ENTRANCE CONTROL ON OTHER SIDE
CANOPY SWITCHES
CANOPY LOCK LEVER
EMERGENCY RELEASE HANDLE
CANOPY CONTROLS
J-41D

Figure 1-39.

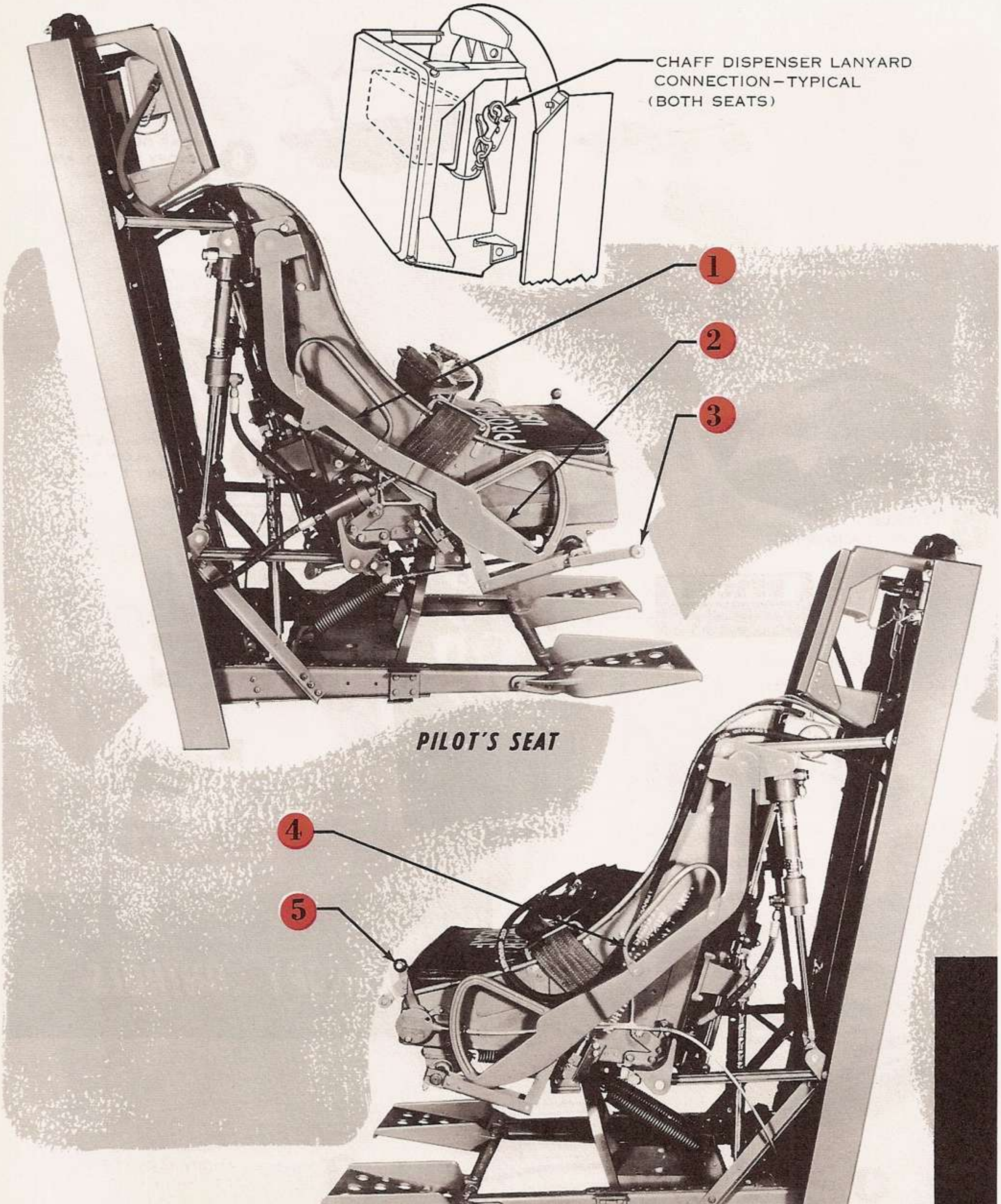
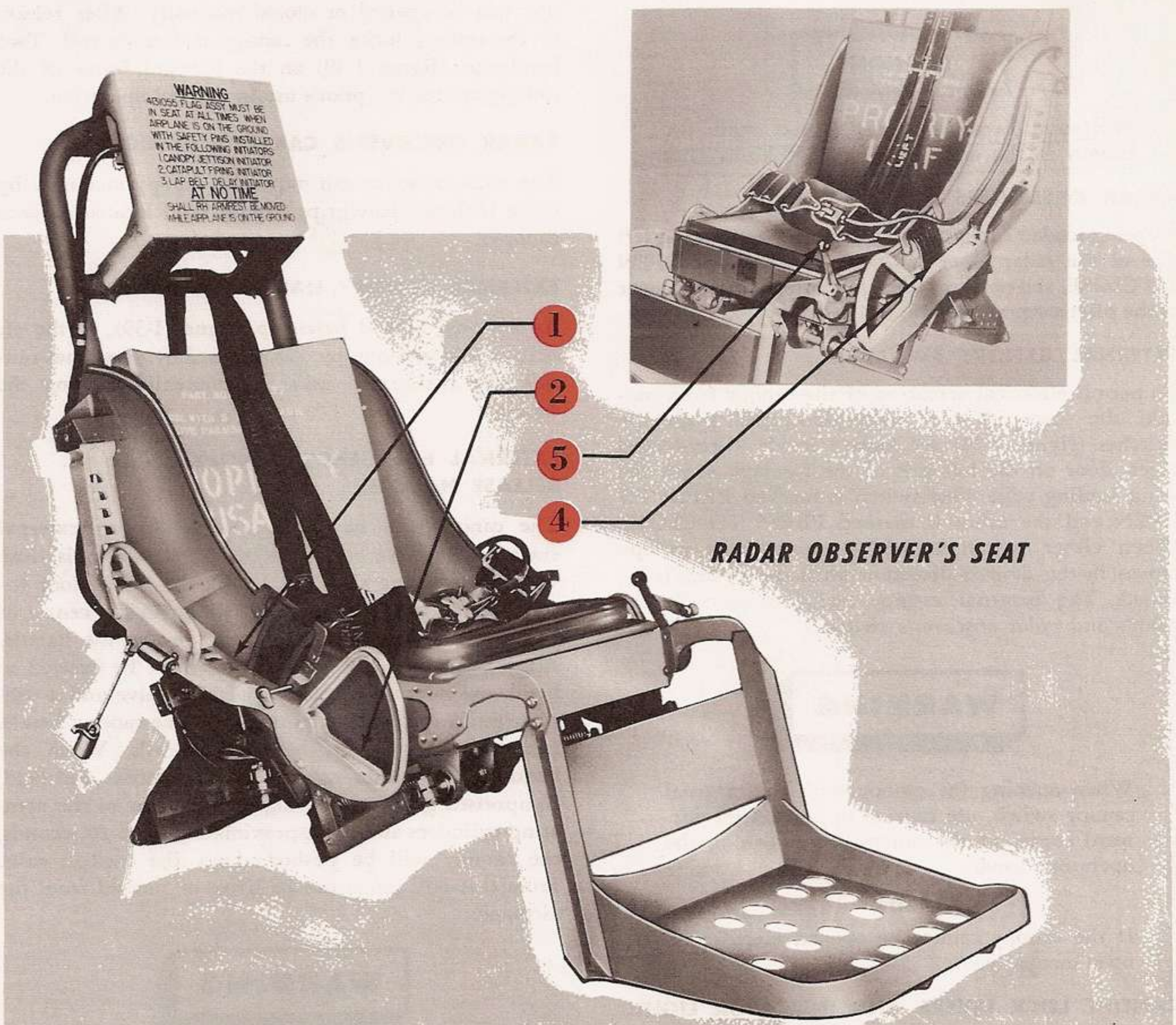

CHAFF DISPENSER LANYARD CONNECTION—TYPICAL (BOTH SEATS)
1
2
3
PILOT'S SEAT
4
5
J-42(1)C

Figure 1-40.



EJECTION SEATS

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

J-42(2)B

the external switch overrides both cockpit switches. All canopy switches operate on 28-volt dc from the battery bus.

CAUTION

Maximum permissible taxi speed with the canopy in the open position is 50 knots IAS.

RADAR OBSERVER'S CANOPY SWITCH.

A spring-loaded canopy switch (figure 1-39) on the left side of the radar observer's cockpit is marked OPEN and CLOSE, and operates the canopy in the same manner as the pilot's canopy switch.

EXTERNAL CANOPY SWITCHES.

To permit electrical actuation of the canopy from outside the cockpit, two battery-powered push-type switches (figure 1-39) are located inside a key-locked access door on the left side of the fuselage above the wing leading edge. One switch 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 the switch is released. The external canopy switches override the pilot's and radar observer's switches.

WARNING

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

Note

If the canopy cannot be opened electrically, open manually.

CANOPY LOCK LEVERS AND INDICATOR LIGHT.

There are three canopy lock levers (figure 1-39): the pilot's, near the floor at the left of the pilot's seat; the radar observer's, on the left side of the cockpit; and the external lever, just below the left cockpit rail inside a key-locked access door. Moving the lock levers forward, when the canopy is within 1 inch of full forward travel, fully closes and locks the canopy and inflates the canopy pressure seal. Pulling the lock levers back releases the locks and a "Canopy Unlocked" 28-volt dc red indicator light next to the left windshield defogging duct comes on. The light goes out when the locks are engaged. The external lever must be disengaged and pushed into its clip for stowage.

Note

Prior to opening the canopy, place cabin air switch at RAM & DUMP.

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 (figure 1-39) on the forward frame of the canopy 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 1-39) located on each canopy.

EXTERNAL CANOPY HANDGRIP.

An external hinged handgrip (figure 1-39), in the aft structure of the canopy, can be used by personnel outside the cockpit to assist in manually moving the canopy.

EXTERNAL EMERGENCY CANOPY RELEASE HANDLE.

The canopy can be slow-jettisoned by an external emergency release handle (figure 1-39) which is flush with the fuselage skin just below the access door for the external canopy 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 will be 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 SEAT RIGHT ARMREST.

The right armrest (figure 1-40) of either ejection seat can be raised to fast-jettison the canopy. When either crewmember raises 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 the 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 his 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.
- Keep hands and arms clear of canopy control 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.

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

A "T" handle (figure 1-11), located on the pilot's right vertical console, enables 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. The cable also is linked to a microswitch in the 28-volt dc circuit to the canopy retention solenoids. Pulling the "T" handle out approximately 1 inch opens the microswitch and interrupts the circuit to the canopy retention solenoids; pulling the handle another inch (a total of approximately 2 inches) draws the firing pin from the initiator which in turn opens the shutoff valve to the canopy jettison cylinders. The retraction mechanism for stowing the radar observer's scope and console is then automatically actuated to the stowed position. The jettison cylinders then release the canopy locks and throw the canopy from the airplane. The pilot's canopy jettison "T" handle should be used for all emergencies requiring jettisoning of the canopy, other than ejection. To prevent inadvertent canopy jettisoning, a ground safety pin is provided for the canopy jettison gas initiator. This pin with its streamer is attached to the end of the pilot's ejection seat ground safety pin streamer. On some airplanes a guard has been installed over the pilot's emergency canopy jettison initiator linkage to prevent damage to linkage and inadvertent actuation.

EJECTION SEATS.

WARNING

If the C-2A life raft is being carried, the A-5 seat cushion (some airplanes) 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 because of the excessive compressibility of the combination of life raft and cushion. If additional height in the seat is needed, a solid block may be used in conjunction with the life raft.

Note

- When the seat cushion is not used, the Type MD-1 contoured seat 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 MD-1"). The C-2A one-man life raft kit may be used if the MD-1 containers are not available.
- On some airplanes the A-5 seat cushion has been replaced by the MC-1 cushion.

The pilot's and radar observer's stations are equipped with gas-operated, catapult-type ejection seats (figure 1-40). 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 headrest and footrests of each seat are fixed. A chaff dispenser is mounted behind each headrest. The dispenser lid is opened automatically during ejection by a lanyard connecting the lid latch pin and the airplane structure. Dispersion of chaff during ejection marks the location and aids rescue operations. 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, oxygen tube, microphone, and headset connections automatically disconnect at the seat and chaff dispenser lid is opened. Each seat is equipped with an automatic safety belt (figure 1-42). The belt releases automatically by means of gas pressure from a delay initiator which is fired as the seat is ejected and which provides a time delay for the seat to clear the airplane before the safety belt is released.

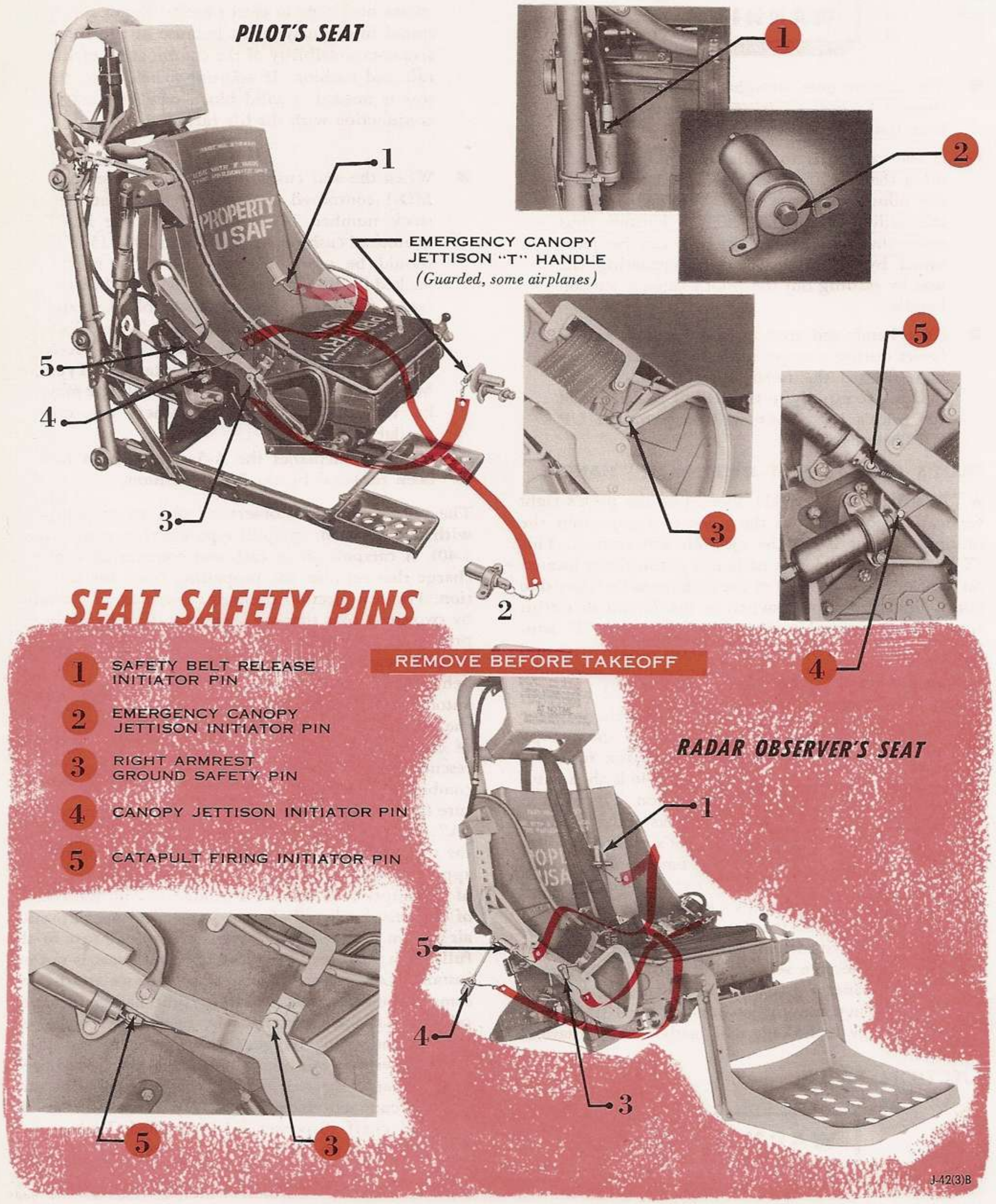

PILOT'S SEAT
EMERGENCY CANOPY
JETTISON "T" HANDLE
(Guarded, some airplanes)
SEAT SAFETY PINS
REMOVE BEFORE TAKEOFF
1 SAFETY BELT RELEASE INITIATOR PIN
2 EMERGENCY CANOPY JETTISON INITIATOR PIN
3 RIGHT ARMREST GROUND SAFETY PIN
4 CANOPY JETTISON INITIATOR PIN
5 CATAPULT FIRING INITIATOR PIN
RADAR OBSERVER'S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

Figure 1-41.

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. An ejection notification switch is installed on each crewmember's ejection seat. When either pilot's or radar observer's seat is ejected from the airplane, the ejection notification switch automatically actuates the emergency mode of the IFF system if the set is on either ON or LOW.

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.
- If time and conditions permit, the radar observer rather than the pilot should 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.

ARMRESTS.

The right and left armrests (figure 1-40) 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. On some airplanes the pilot's and radar observer's armrests have been painted gray and the handgrips orange-yellow to focus attention on the actual ejection controls. Each armrest is fitted with a jack-knife-type brace that is spring-loaded to assist the armrest into the full up position, once the armrest is lifted free of its stowed position. In normal flying position each armrest is stowed in the full down position and held there by a roller lock. Approximately 30 pounds upward pull is required to pull the armrest through its first one-half inch of travel. After that, the assist braces snap the armrest into the full up position where it is held in place by spring tension and the overcenter action of the braces. On either 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 the right armrest has been raised, the pilot may pull the canopy fast-jettison "T" 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, 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.
- When certain types of survival equipment are used, ejection through the canopy may result in neck injuries. As an example, when the MD-1 survival kit is used, a seated height of 34-1/2 inches is available. A crewmember having a greater sitting height, and using this equipment, would have his head above the headrest. If ejection through the canopy were necessary under this condition, the possibility of neck injury would exist. Ejection through the canopy should be attempted only after all efforts to jettison the canopy have failed and ejection is mandatory.

CATAPULT FIRING TRIGGER.

The catapult firing trigger (figure 1-40), 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.

SEAT ADJUSTMENT LEVER.

A lever (figure 1-40) at the forward right corner of the seat bucket controls locking pins in the seat adjustment mechanism. The lever moves fore and aft to engage or retract 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 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 successful escape can

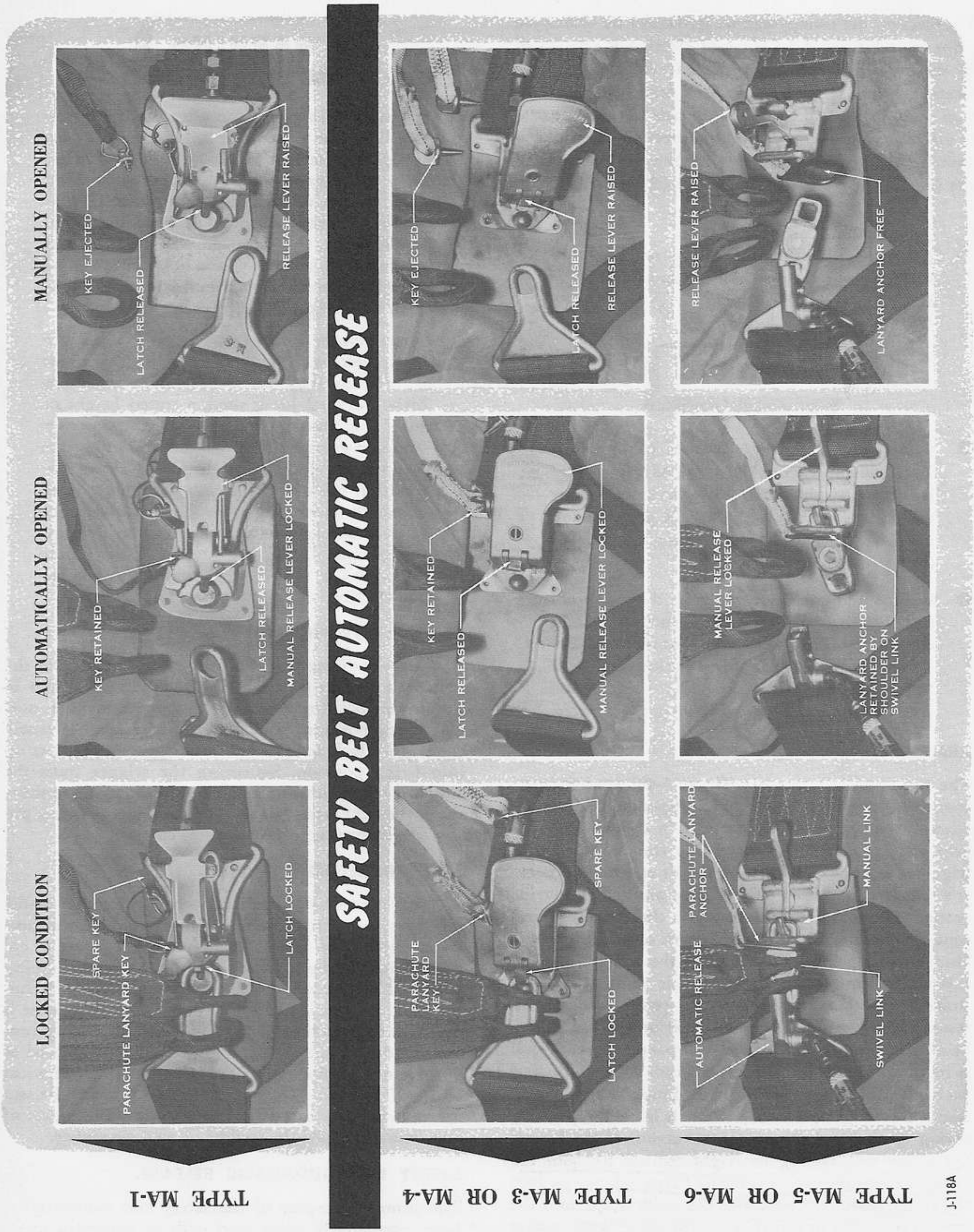

SAFETY BELT AUTOMATIC RELEASE
LOCKED CONDITION
AUTOMATICALLY OPENED
MANUALLY OPENED
TYPE MA-1
PARACHUTE LANYARD KEY
SPARE KEY
LATCH LOCKED
KEY RETAINED
LATCH RELEASED
MANUAL RELEASE LEVER LOCKED
KEY EJECTED
LATCH RELEASED
RELEASE LEVER RAISED
TYPE MA-3 OR MA-4
PARACHUTE LANYARD KEY
SPARE KEY
LATCH LOCKED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

Figure 1-42.

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 parachute opening 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 manually opened before ejection, regardless of altitude. Human reaction time cannot possibly beat the automatic operation of the release in 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, 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 1-42.) 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 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 his 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.

WARNING

- If the safety belt is opened manually, the parachute rip cord must be pulled manually.
- The M-4 or M-12 safety belt initiator ground safety pin with warning streamer must be removed prior to flight. If the pin is not removed, automatic uncoupling of the safety belt will not occur if ejection becomes necessary. If pin is installed, maintenance personnel should be consulted on the status of the ejection system before occupying the seat.
- Improperly attaching the shoulder harness and safety belt tiedown straps to the automatic belt may 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.

LOW ALTITUDE "ONE AND ZERO" EJECTION SYSTEM.

A system incorporating a 1-second safety belt delay and a 0-second parachute delay ("one and zero") is provided on some airplanes for ejection seat escape systems to improve low altitude escape capability. This system utilizes a detachable zero delay lanyard (figure 1-43) that connects the seat belt to the parachute "D" ring. At very low altitudes and at low airspeeds, the 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 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" ring. The connecting (hookup) and disconnecting (unhooking) of the lanyard and the parachute "D" ring must be done manually by each crewmember. Prior to takeoff, the 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 the minimum safe ejection altitude for his particular system. Before landing, each crewmember must hookup the lanyard prior to reaching the minimum safe ejection altitude for his system. See figure 1-43 for zero delay lanyard engagement requirements. After landing, the parachute may be removed from the airplane with the lanyard in the hooked up condition. Even though a minimum safe ejection altitude has been determined prior to takeoff, the actual decision as to when to eject in an emergency will be influenced by such circumstances as airpeed, control and attitude, as well as altitude.

EJECTION SEAT GROUND SAFETY PINS.

Ground safety for the gas-operated ejection seats is achieved by inserting a safety pin through each initiator collar to prevent the initiator firing pin from being withdrawn. When the firing pin is inserted fully into the case, the safety pin engages an annular groove. 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 jettison initiator located on the floor forward of the right console. (See figure 1-41.)

SHOULDER HARNESS INERTIA REEL LOCK LEVER.

A two-position (LOCKED—UNLOCK) shoulder harness inertia reel lock lever (figure 1-41) is used to manually lock the shoulder harness reel or leave it free, subject to the inertial lock. The lever is located on the left side of the pilot's and radar observer's seats. The lever is held in position by a friction disk and may be moved by a firm pressure 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 2 to 3 "G's" is encountered. When the reel is locked in this

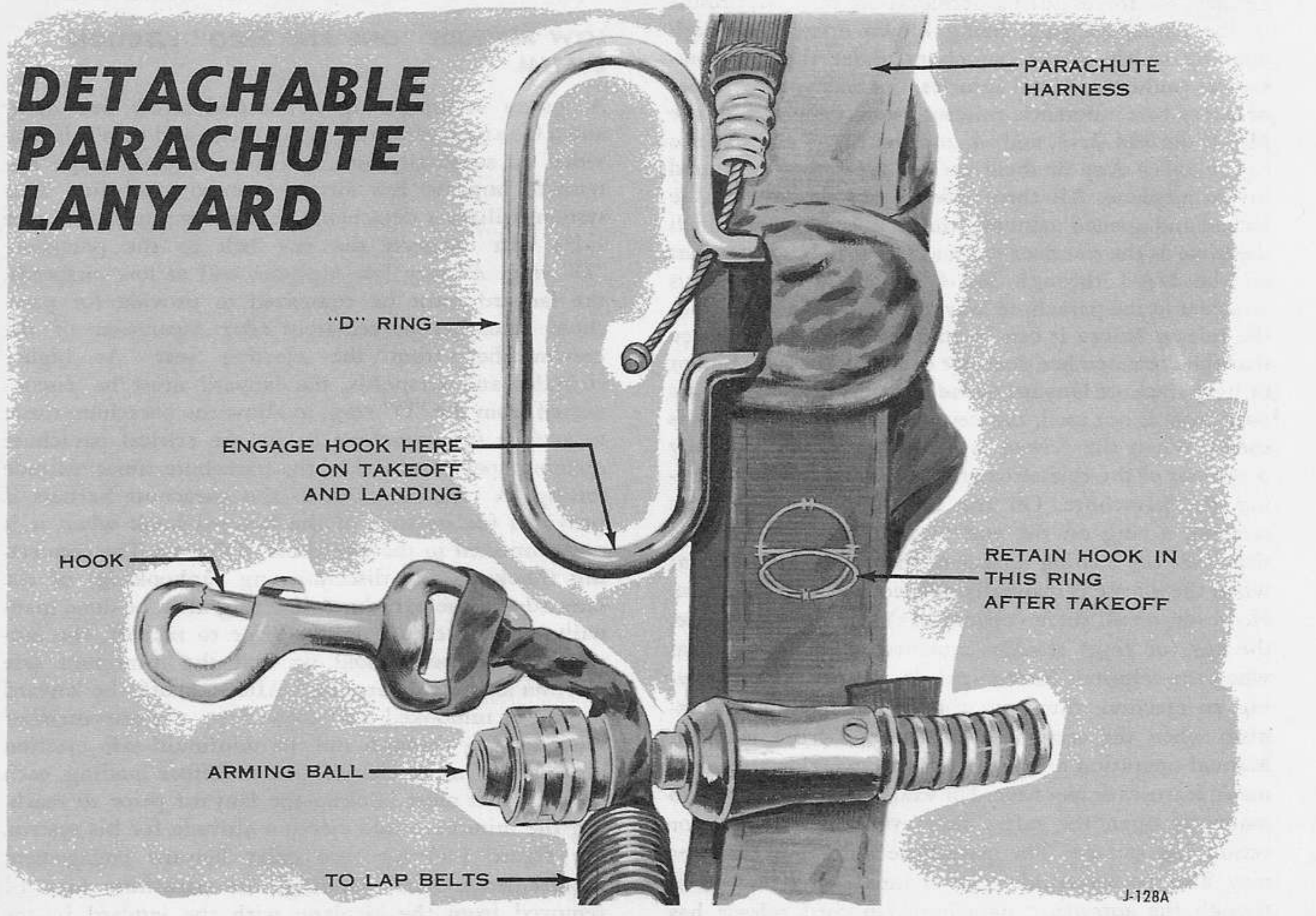


Figure 1-43.

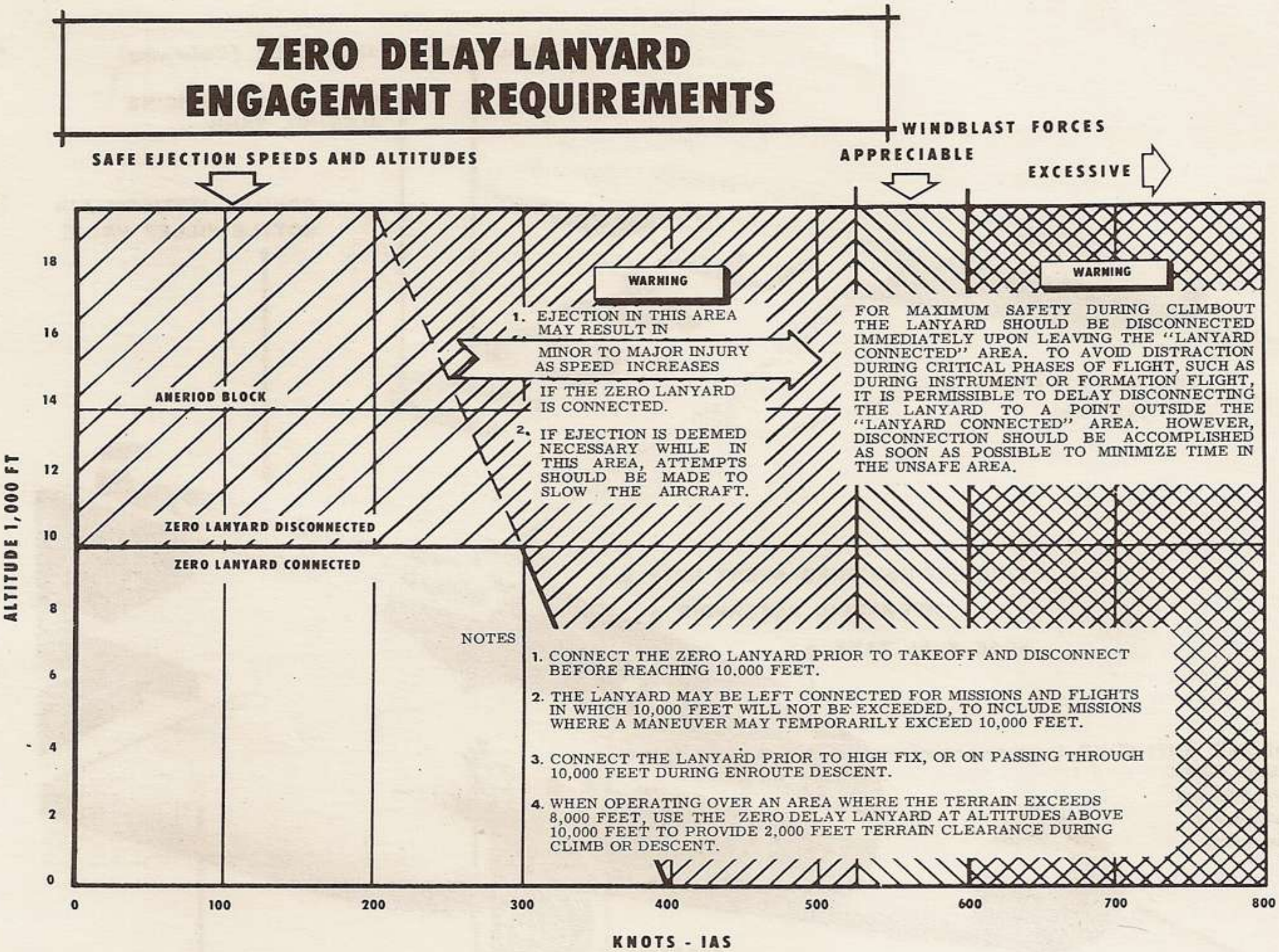
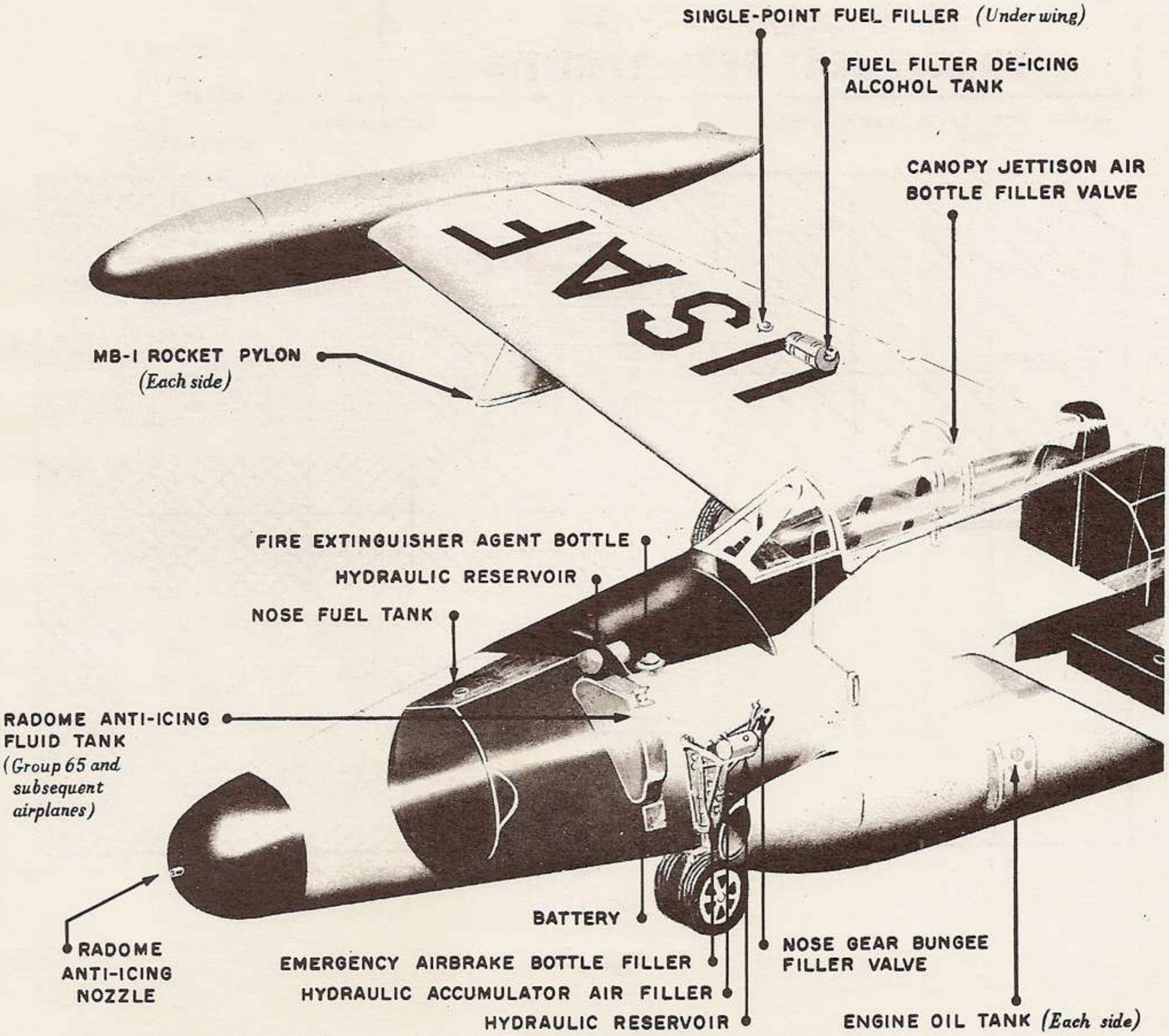


Figure 1-44.

manner, it will remain locked until the lever is moved to the LOCKED position and then returned to the UNLOCKED 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.

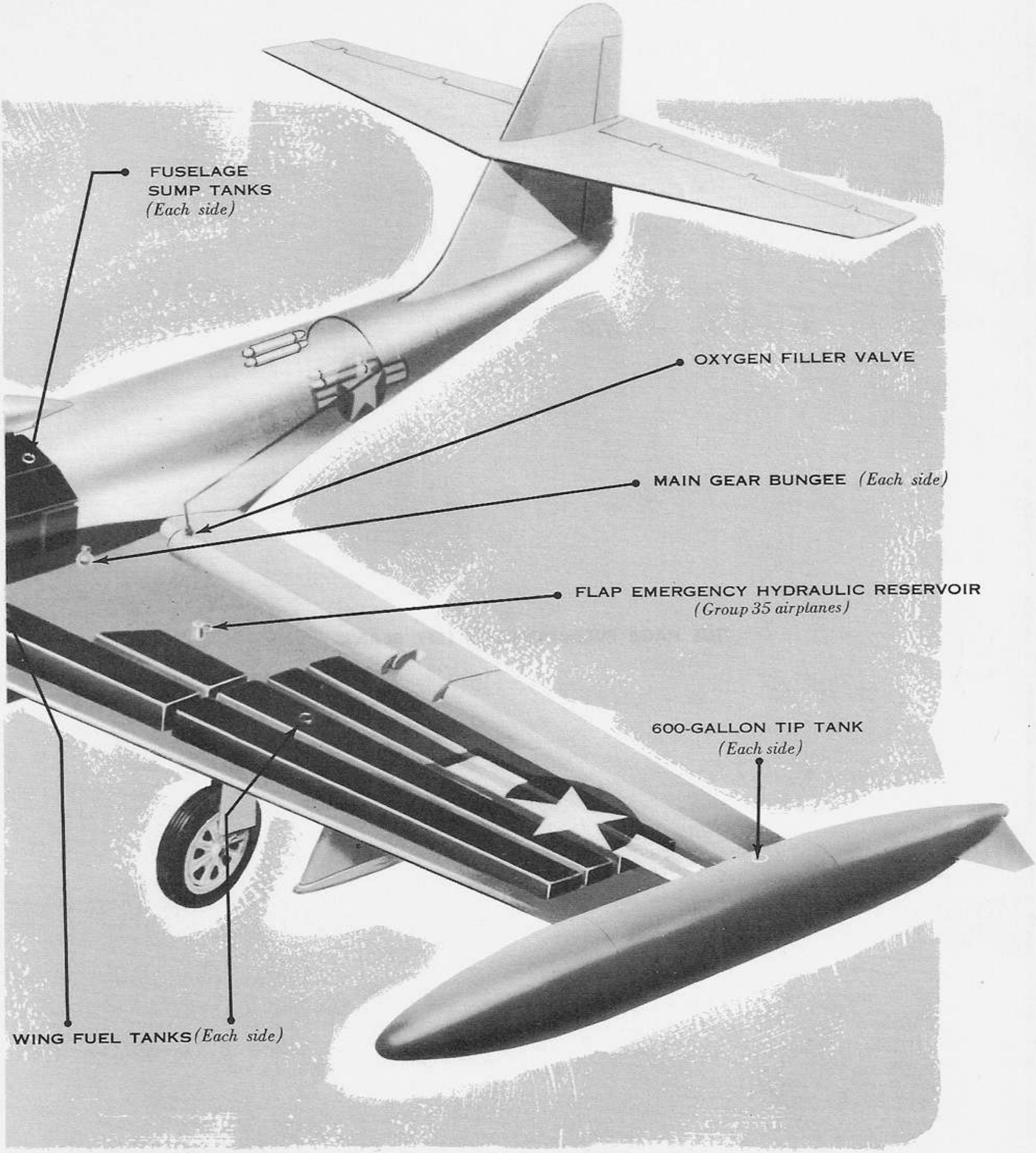
AUXILIARY EQUIPMENT.

Section IV of this handbook describes the following auxiliary equipment and its operation: cabin air conditioning system, canopy defogging system, anti-icing systems, communication and associated electronic equipment, lighting equipment, oxygen system, autopilot, armament, single-point fueling system, and miscellaneous equipment.



FLUID SPECIFICATIONS

FUEL SPECIFICATIONS	*Recommended:* JP-4, MIL-F-5624C (NATO F-40)(COM'L JET B) (FREEZE POINT - 60° F) *Alternate:* 1. JP-5, MIL-J-5624C, (NATO F-44) (FREEZE POINT - 55°F) 2. COM'L JET A-1 (NATO F-34) (FREEZE POINT - 58°F) 3. COM'L JET A (NATO F-30) (FREEZE POINT - 40° F) EMERGENCY FUEL AYGAS MIL-F-5573 LOWEST AVAILABLE GRADE OR THE NATO EQUIVALENT *SEE ALTERNATE FUEL LIMITATIONS SECTION V.	HYDRAULIC FLUID SPECIFICATION	MIL-O-5606
		OXYGEN SPECIFICATION	MIL-BB-O-925
		RADOME ANTI-ICING FLUID SPECIFICATION (*By volume*)	*60% Ethylene glycol* MIL-E-9500 *40% Distilled water* MIL-D-16791B
		ALCOHOL SPECIFICATION	MIL-A-6091
ENGINE OIL SPECIFICATION	MIL-O-6081, GRADE 1010	FIRE EXTINGUISHING AGENT SPECIFICATION	BROMOCHLOROMETHANE MIL-B-4394



SERVICING DIAGRAM

J-43(2)D

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SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

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.

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 the Appendixes to assist you in planning.

TAKEOFF AND LANDING DATA CARD.

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

WEIGHT AND BALANCE.

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

2. Make sure 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-89J-5, for detailed loading information.

ENTRANCE.

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

PREFLIGHT CHECK.

BEFORE EXTERIOR INSPECTION.

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

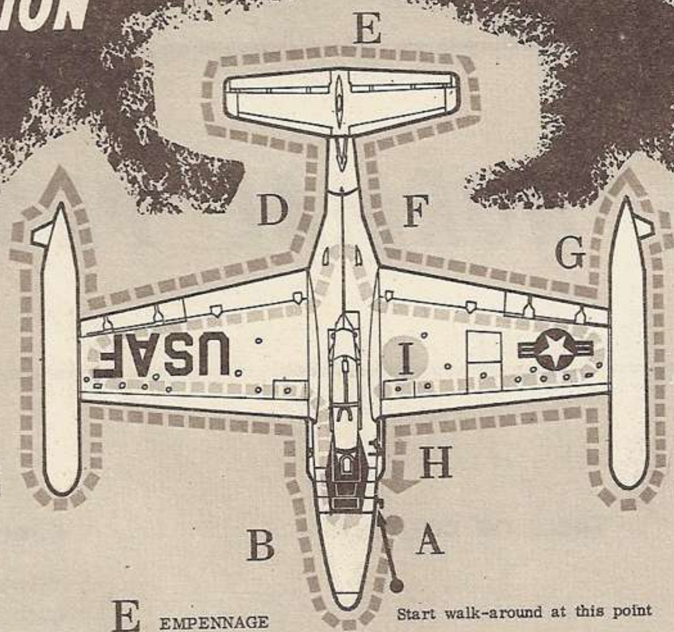
1. Canopy ejection pressure—Check. (1500—2000 psi). (P—RO)

2. Ejection seats—Check. (P—RO)

Armrests and trigger stowed; safety pins installed; safety belt initiator ground safety pin removed; seat

EXTERIOR INSPECTION

When approaching the airplane, note the general overall appearance. During the walk-around check for condition of external components and surfaces, evidence of fluid leaks, and security of access doors and filler caps.



A LEFT FORWARD SIDE

1. Pitot tube, static vents, and probe clear.
2. Hydraulic fluid level checked, cap secure.
3. Nose wheel tires for condition.
4. Nose wheel strut extension (approximately 3 inches); ground lock removed.
5. Static ground contact.
6. Fire extinguishing agent pressure (375 psi) and bungee air pressure (750 ±50 psi).
7. Landing-taxi light condition.
8. Battery access door--remove.
9. Engine screen pressure (1500 +0/-50 psi).
10. Brake accumulator pressure (600 psi minimum).
11. Emergency airbrake pressure (1500 ±50 psi).
12. Battery connected and secure.
13. Battery door secured.
14. 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.
15. Angle-of-attack computer probe cover removed; check freedom of movement.

B RIGHT FORWARD SIDE

16. Nose tank filler cap secure.
17. Hydraulic fluid level checked; cap secure.
18. 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.
19. Pitot tube and static vents clear.
20. Right and left engine doors locking handles flush and safety straps secured.
21. Check oil quantity; filler cap and dip stick cotter pin secured.
22. Eleventh-stage compressor bleed port clear.
23. Engine door No. 3 airscoop clear; inside door No. 3--check for chafed fuel line. Engine door No. 4 airscoop clear.

C RIGHT WING

24. Wheel chocks in place; ground lock removed.
25. Tire condition.
26. Brake condition.
27. Jack lug pointing straight down.
28. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). Check outboard door locking arm tension.
29. Wheel well lines for condition.
30. Bungee air pressure (725 ±50 psi).
31. Sequence valve transfer piston for condition and position (out).
32. Gear uplock unlocked and roller free.
33. Single-point refueling cap secured; refueling door locked.
34. Aileron and wing flap for condition; speed brake external ground lock removed.

D RIGHT AFT FUSELAGE

35. Tailpipe, fuel manifold, and flameholder condition.
36. Eyelids condition and position (open).
37. Afterburner blastplate condition.

E EMPENNAGE

38. General condition.

F LEFT AFT FUSELAGE

39. Afterburner blastplate condition.
40. Tailpipe, fuel manifold, and flameholder condition.
41. Eyelids condition and position (open).

G LEFT WING

42. Aileron and wing flap for condition; speed brake external ground lock removed.
43. Wheel chocks in place; ground lock removed.
44. Tire condition.
45. Brake condition.
46. Jack lug pointing straight down.
47. Landing gear outboard door condition; strut extension (approximately 6 inches between torque arm pivot points). check outboard door locking arm tension.
48. Wheel well lines for condition.
49. Bungee air pressure (725 ±50 psi).
50. Sequence valve transfer piston for condition and position (out).
51. Gear uplock unlocked and roller free; ground locks stowage box closed.

H LEFT SIDE

52. Eleventh-stage compressor bleed port clear.
53. Engine door No. 3 airscoop clear; inside door No. 3--check for chafed fuel line. Engine door No. 4 airscoop clear.
54. Check oil quantity; filler cap and dip stick cotter pin secured.

I UPPER WING AND FUSELAGE (P OR RO)

55. General condition of surfaces.
56. Tip tanks for equal amounts of fuel and caps secured.
57. All fuel filler caps secured.
58. Cooling scoops on top of fuselage clear.
59. Fuselage position light condition.
60. Emergency flap reservoir filler cap secured (left wing on Group 35 airplanes).
61. Alcohol tank--check quantity and cap secured (right wing).
62. Canopy seal and windshield condition.
63. Radar access doors secured.
64. Canopy control door secured and emergency release handle stowed.

Figure 2-2.

air bottle pressure 1600—1800 psi; chaff dispenser lanyard connected.

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 or RO)
4. Armament selector switch—SNAKE-SAFE. (P)
5. Oxygen quantity—Check. (P or RO)
6. Battery switch—OFF. (P or RO)

EXTERIOR INSPECTION.

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

CAUTION

- Locate external power unit as far from the airplane as the power cable will permit to reduce the hazard of fire from exhaust gas or hot components of the power unit.
- On some airplanes, two lockbolt position indicators on each engine nacelle door are provided to permit visual reference of their position when doors are being locked. When the small inspection door coverplates are removed, a movable lockbolt position indicator and a stationary reference indicator will be visible. These indicators must be aligned within 1/32 inch when the lockbolt is in locked position.

INTERIOR CHECK.

Front Cockpit.

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

2. Rudder pedals--Adjust. (P)

3. Battery switch--OFF. (P)

4. Throttles--CLOSED. (P)

5. 28-volt external power--Connected. (P)

Note

- If more than 15 minutes are to elapse between supplying power to the 28-volt d-c bus and starting or operating engines above idle rpm, turn off the afterburner control circuit breakers (toggle-type) and leave them off until just before starting engines. This will de-energize the eyelid control solenoids, thus preventing them from being damaged by overheating.
- Check operation of press-to-test lights on each control or indicator panel as the panel is checked.

6. 2500-VA ground test switch--ON (guard down). (P)

7. Single-phase inverter switch--Check at EMER and NORMAL. (P)

8. Three-phase inverter--Check at EMER and NORMAL. (P)

9. Left console circuit breakers--IN. (P)

10. Emergency airbrake valve handle--OFF. (P)

11. Sideslip stability augmenter power switch--ON; rudder trim switch (Group 50 and subsequent airplanes)--AUTO TRIM; electrical rudder trim knob (Group 50 and subsequent airplanes)--Safety-wired in center position. (P).

12. Single-point fueling light--Out. (P)

13. Fuel control panel--Check. (P)

    a. Fuel filter de-ice warning lights--Check.

    b. Crossfeed switch--OFF.

    c. Left pylon and tip tank switches--OFF.

    d. Left inboard and outboard wing tank switches--ON.

    e. Left fuel selector switch--WING TANKS (warning lights should flash).

    f. Left fuel selector switch--NOSE TANK (warning light should flash).

    g. Left fuel selector switch--ALL TANKS (wing tank lights should flash).

    h. Left fuel vent--Check that fuel is not overboarding.

    i. Left tip tank switch--ON (warning light should blink momentarily).

    j. Left pylon tank switch--OFF.

    k. Repeat steps "c" through "j" for right fuel system.

14. Fuel quantity gages--Check all positions, return selector switch to SUMP. (P)

15. Brake accumulator pressure switch--Check. (P)
    Pump wheel brakes through several cycles to drop accumulator pressure to between 1100--800 psi.

16. Left hydraulic system supplemental pump--Check. (P)
    Depress nose wheel steering button and watch left hydraulic system pressure gage for pressure buildup to 2500 psi.

17. Speed brakes and wing flaps--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 elevator trim to assure proper operation of safety switches. 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) Supplemental pump should come on and accumulator pressure should start to rise to approximately 2100 to 2340 psi.

21. Parking brakes--Set. (P)

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. Windshield wiper switch--OFF. (P)

27. Windshield wiper speed rheostat--INC. (P)

28. Canopy seal button--Released. (P)

29. Landing gear lever--Check DOWN and locked. (P)
Check gear position indicator. Emergency landing gear handle--Check In (stowed position).

30. Taxi and landing light switches--As required. (P)
Check operation of both the landing and taxi lamp beams after extending the light.

31. Windshield de-ice and defog knob--NORMAL. (P)

32. Anti-ice switch--OFF. (P)

33. Engine screen emergency extension switch--As required. (P)

34. Pitot heat switch--As required. (P)
Check operation with crew chief.

35. Canopy locking lever--UP. (Warning light--On.) (P)

36. Cabin air switch--PRESSURE. (P)

37. Cabin differential pressure switch--5.00 psi. (P)

38. Attitude indicator warning flag--Retracted. (P)

39. Flight computer--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)

41. Altimeter and clock--Set and cross-check with RO. (P--RO)

WARNING

Use caution in rotating the barometric set knob and note the position of the 10,000-foot pointer to prevent an erroneous altimeter setting. If the set knob is continuously rotated, after the barometric scale is out of view in the Kollsman window, until the numbers reappear on the opposite side, an error of 10,000 feet in altimeter setting can occur.

42. Armament switches--Safe. (P)

43. Emergency rudder trim knob (Groups 35 through 45 airplanes)--Check safetywired at center position. (P)

44. Canopy defog knob--IN. (P)

45. Starting power switch--NORMAL (OFF). For emergency start--EMER (ON). (P)

46. 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.

47. Canopy jettison "T" handle--In (stowed position). (P)

48. Thunderstorm light rheostat (Group 45 and subsquent airplanes)--OFF. (P)

49. Interior and instrument lighting rheostats--As required. (P--RO)

50. Autopilot switches--OFF; turn knob--Centered. (P)

51. IFF switch--OFF. (P)

52. Generator switches--ON. (P)

CAUTION

During alternate starts, one of the following procedures must be used: If generator switches are normally left in the OFF position, they must be turned ON (following engine start) in the following order--left, right NO. 2, and right NO. 1. If generator switches are normally left in the ON position, the left generator switch only must be turned OFF, then turned ON after engines are started. Using other than the above procedures may result in the loss of secondary bus and 2500-VA inverter, or the tripping of the bus-tie relay circuit breaker due to a current overload of the left generator during right engine start (external power connected), In either case the right NO. 2 generator should be turned ON second, never first or third.

53. Right console circuit breakers--IN. (P)

54. Right vertical panel circuit breakers--IN. (P)

55. Make sure that all required navigational publications are aboard. (P)

56. Oxygen equipment--Check proper connections and operation. (P)

Oxygen pressure gage--400 to 450 psi; oxygen warning light switch--OFF; oxygen regulator diluter lever--NORMAL OXYGEN; oxygen regulator supply lever--ON. (Refer to Oxygen Hose Hookup and Oxygen System Preflight Check, Section IV, for detailed information.)

57. Communication equipment--Check operation. (P)

Canopy must be closed to check the ARN-6 and ARN-14. Radio compass (some airplanes)--Check all positions and set to desired frequency; UHF command radio--Check all channels; VHF navigation set (some airplanes)--Check and set to desired frequency; interphone--Check operation; ARN-21 (some airplanes)--Check operation; J-2 compass control panel (some airplanes)--Check.

58. Emergency signal button and light--Check with RO. (P--RO)

BEFORE STARTING ENGINES.

Whenever possible, start and run up engines on a concrete surface to prevent dirt and foreign objects from entering the compressors and damaging the engines. Avoid runup on macadam pavement; high exhaust gas 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% oxygen could deplete the supply before the end of the mission.

- Before starting engines, make sure danger areas (figure 2-3) fore and aft of the engines are clear of personnel, airplanes, and vehicles. Suction at the intake ducts is sufficient to kill or seriously injure personnel if pulled against or drawn into the ducts. Danger aft of the engines is created by the high exhaust temperature and blast from the tailpipes.

- If external engine and side door air inlet screens are 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 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 radar observer in case of accident.

CAUTION

Starting an engine by using the blast produced by another airplane or engine is prohibited. This method of starting an engine 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.

LEFT ENGINE.

1. Fire guard posted. (P)

2. 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.

3. Throttle--IDLE when engine reaches 7.5% rpm. (P)
   The starter should automatically disconnect when load drawn by starter drops to 200 amperes (approximately 26%). 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 3 starting attempts.

   CAUTION

   The starter is limited to 3 starts of 1-minute duration each; if more than three starts are required, allow starter to cool for 30 minutes before using again.

4. Exhaust gas temperature and rpm--stabilized at idle 50% ±1% rpm after ignition. (P)

5. Hydraulic system pressure gage--Check while starting engine. (P)
   When engine rpm is below 19%, the pressure should not exceed 400 psi; when engine rpm is above 38%, the pressure should be between 2800 and 3050 psi.

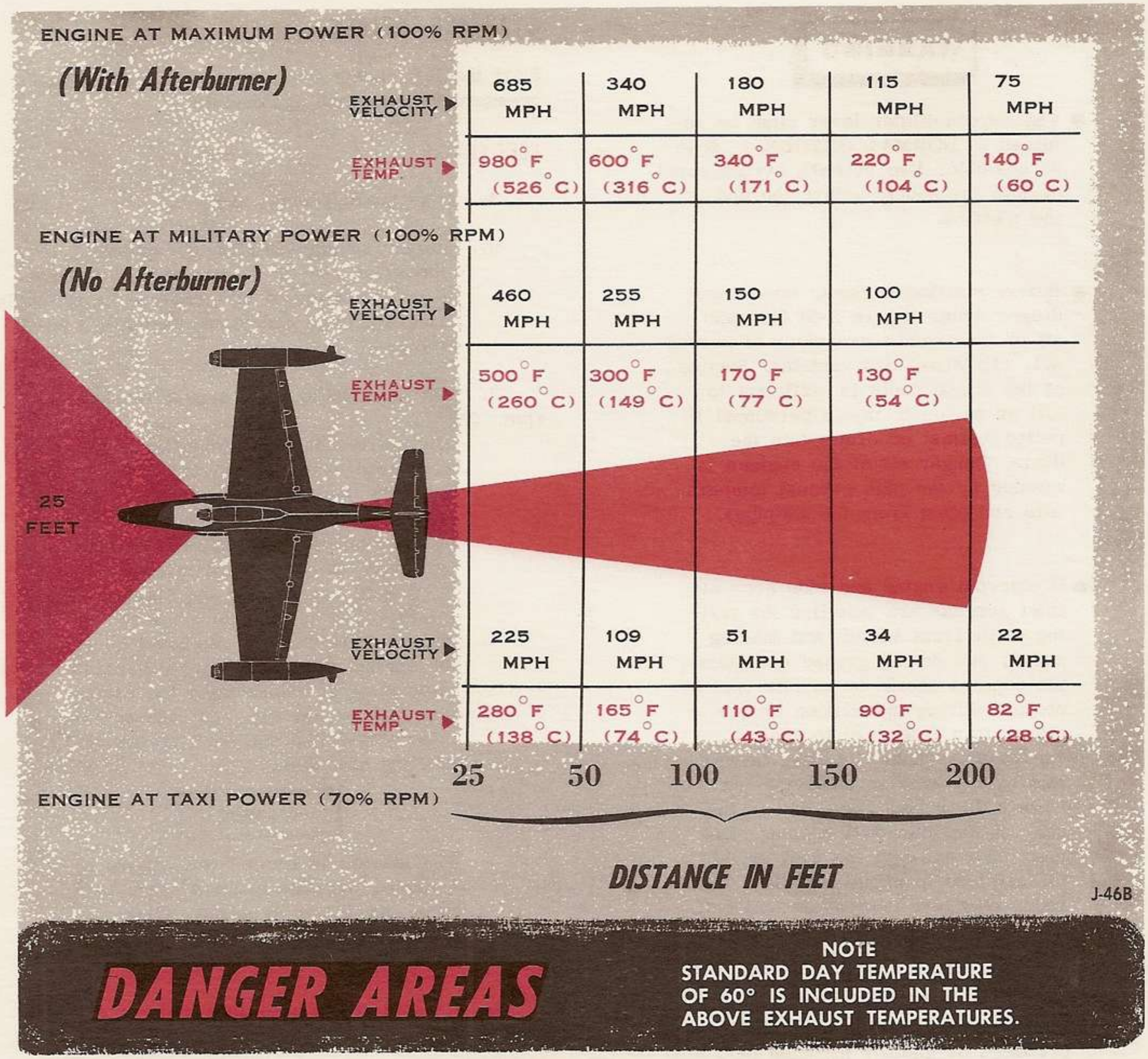


Figure 2-3.

CAUTION

A hot start is a start during which the exhaust gas temperature exceeds 900°C on J35-35A engines. On J35-35A engines, a "hot-start" inspection must be accomplished after:

a. Five (5) hot starts during which E.G.T. momentarily ranges between 900°C and 1000°C.

b. One (1) hot start in which E.G.T. momentarily exceeds 1000°C.

c. One (1) hot start in which E.G.T. exceeds 900°C for 20 seconds.

All hot starts must be entered in DD Form 781.

RIGHT ENGINE.

6. Right engine--Start as for left engine. (P)

7. External power--Disconnected. (P)

8. Battery switch--ON. (P)

9. Fuel pump warning lights--OFF. (P)

10. Engine instruments--Check for desired readings at idle rpm. (P)

ENGINE GROUND OPERATION.

No warmup period is necessary.

CAUTION

- To prevent overtemperatures from disintegrating internal engine screens and causing internal engine damage, do not exceed 75% rpm with external engine screens installed.
- Do not exceed maximum rpm or temperature.

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. Alternator--Check. (P--RO)

   a. Alternator exciter switch and then alternator circuit breaker switch--CLOSE (left engine rpm above idle may be required).

   b. Voltage--Check alternator voltmeter for desired readings.

3. Single-phase and three-phase inverter buses--Check output. (RO)
All buses should read 115 $\pm$5 volts with voltmeter selector switch at PWR INV PRI, PWR INV SEC NO. 1, INST INV, and PWR INV SEC NO. 2.

4. Three-phase inverter switch--SPARE (EMER). (P)

5 Three-phase inverter bus--Check output. (RO)
With voltmeter selector switch at INST INV, voltmeter should read 115 volts.

6. Three-phase inverter switch--MAIN (NORMAL). (P)

7. IFF switch--STDBY. (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)
With both engines operating at idle rpm, operate all flight control surfaces simultaneously at maximum rate. The right flight control hydraulic pressure should not drop below 1500 psi.

AUTOPILOT CHECK.

Perform the following autopilot check while taxiing to save time and fuel.

1. Autopilot power switch--ON. (P)

2. Turn knob--Check knob in detent position. (P)

3. Engaging switch--ENGAGE. (P)
Move switch to ENGAGE after 1-1/2 to 2-minute warmup. The switch should remain at ENGAGE and the manual controls should resist movement.

4. Turn knob--Rotate clockwise and counterclockwise; pitch knob--Rotate fore and aft. (P)
Stick should follow to right and left as turn knob is moved; stick should follow fore and aft as pitch knob is moved. Return knobs to detent position.

5. With nose wheel steering disengaged, yaw the airplane to the right, then to the left, with brakes. (P)
Left rudder pedal should more forward slightly when airplane is yawed to the

right; right rudder pedal should move forward slightly when airplane is yawed to the left.

6. Check force required to override autopilot. (P)

Operate the stick and the rudder pedals manually. Forces required to overpower the autopilot should not be excessive.

7. Autopilot emergency disconnect switch on control stick--Squeeze. (P)

The engaging switch should return to the disengage position and the controls should be free.

WARNING

Elevator trim must be reset to TAKEOFF because autopilot operational check disturbs setting.

TAXIING.

Maintain directional control with steerable nose wheel.

1. Ejection seat and canopy safety pins--Removed. (P--RO)

2. Brake accumulator pressure--Check. (P)

3. Wheel chocks--Signal ground crew to remove. (P)

4. Parking brakes--Release. (P)

5. Flight indicators--Check during taxiing. (P)

6. Autopilot--Perform check. (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.

Note

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

In addition, aircraft tires are not designed to withstand extended durations of ground rolling operations. Long taxi periods will build up excessive temperatures and pressures in the tires, resulting in decreased margin of safety and service life of the tires. Estimated fuel consumption for taxiing with two engines operating is 30 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 checks:

1. External engine and side door air inlet screen--Removed (if installed). (P)

WARNING

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

2. Canopy--Closed and locked; warning light--Out. (P)

3. Flight controls--Check for free and correct movement. (P)

4. Elevator trim--Check for TAKEOFF setting. (P)

WARNING

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

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

WARNING

If the fuel selector switches are placed at NOSE TANK or WING TANKS, afterburners, if ignited, may flame out. In additon, if a takeoff is attempted on a NOSE TANK selection, the aft CG limits of the airplane may be exceeded by expending nose tank fuel with full tip and sump tanks.

6. Safety belt--Tighten; zero delay lanyard--Check attached; shoulder harness--Adjust to fit snugly; inertial reel--Unlock; "L" shaped seat safety pin--Remove. (P--RO)

7. Wing flap lever--TAKEOFF. (P)

8. Speed brake lever--CLOSED. (P)

9. Attitude indicator--Set. (P)

10. Hydraulic flight control, brake accumulator, and hydraulic reservoir pressure gages--Check. (P)

11. Check radar observer prepared for takeoff. (P)

12. Engine screens--As required. (P)

13. IFF/SIF--As required. (P)

14. Anti-collision lights--On (As required).

PREFLIGHT ENGINE CHECK.

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

1. Throttles--Full OPEN; exhaust gas temperature and rpm--Check. (P)
Allow engine rpm to stabilize at 98% to 100% rpm. Observe exhaust gas temperatures and check instruments for desired ranges.

Note

Acceleration from idle to 100% rpm takes about 12 seconds.

CAUTION

Stabilized engine speeds greater than 103% rpm are prohibited and engine must be removed for overhaul if this rpm, or a momentary rpm of 104%, is exceeded. The throttle must be reset if stabilized engine speeds exceeds 102% rpm.

2. Left engine afterburner--ON. (P)
Ignition will be indicated by thrust surge.

3. Right engine afterburner--On. (P)
Ignite right afterburner as soon as exhaust gas temperature and rpm stabilize after lighting left afterburner.

Note

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

4. 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 EGT 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 temperatures 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.

Note

- 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 engine parts. For normal operation it is recommended that the engine be operated from idle to 70% rpm, whichever rpm gives lowest exhaust gas temperature, for at least 3 to 5 minutes after shutting down the afterburners. This procedure will eliminate shroud segment warpage, overheated bearings, and the possibility of raw fuel accumulating in the afterburners and igniting from hot engines.

TAKEOFF.

Check fuel siphoning. If siphoning occurs during takeoff, correct the condition after safely airborne. (P) (RO)

NORMAL TAKEOFF.

Note

The following procedure will produce the results stated in the applicable Takeoff Distance Charts in Appendix II.

When engines and afterburners are stabilized at 100% rpm, proceed with takeoff as shown in figure 2-4. See Appendix II for refusal speed and at checkpoint check airspeed.

WARNING

Adhere closely to the recommended nose wheel liftoff airspeeds to assure adequate lateral control and acceleration for takeoff.

Note

- Takeoff with military power is possible, but more distance is required. (See Takeoff Distance Charts, Appendix II, for military power takeoff distance.)
- The high rate of fuel consumption during takeoff and initial climb with afterburning may cause a slight drop in sump tank fuel level. (See Preflight Engine Check, this section.)

MINIMUM RUN TAKEOFF.

Strict adherence to takeoff procedure will result in minimum takeoff ground run. For length of ground run for various gross weights, see applicable Takeoff Distance Charts, Appendix II.

OBSTACLE CLEARANCE TAKEOFF.

Follow normal takeoff procedure, using maximum power. After attaining the 50-foot height IAS (see After Takeoff--Climb, this section), maintain this IAS until obstacles are cleared, then continue 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. Hold nose wheel on runway until reaching takeoff speed to get maximum benefit from nose wheel steering. (See Takeoff and Landing Crosswind Chart, (Appendix II.)

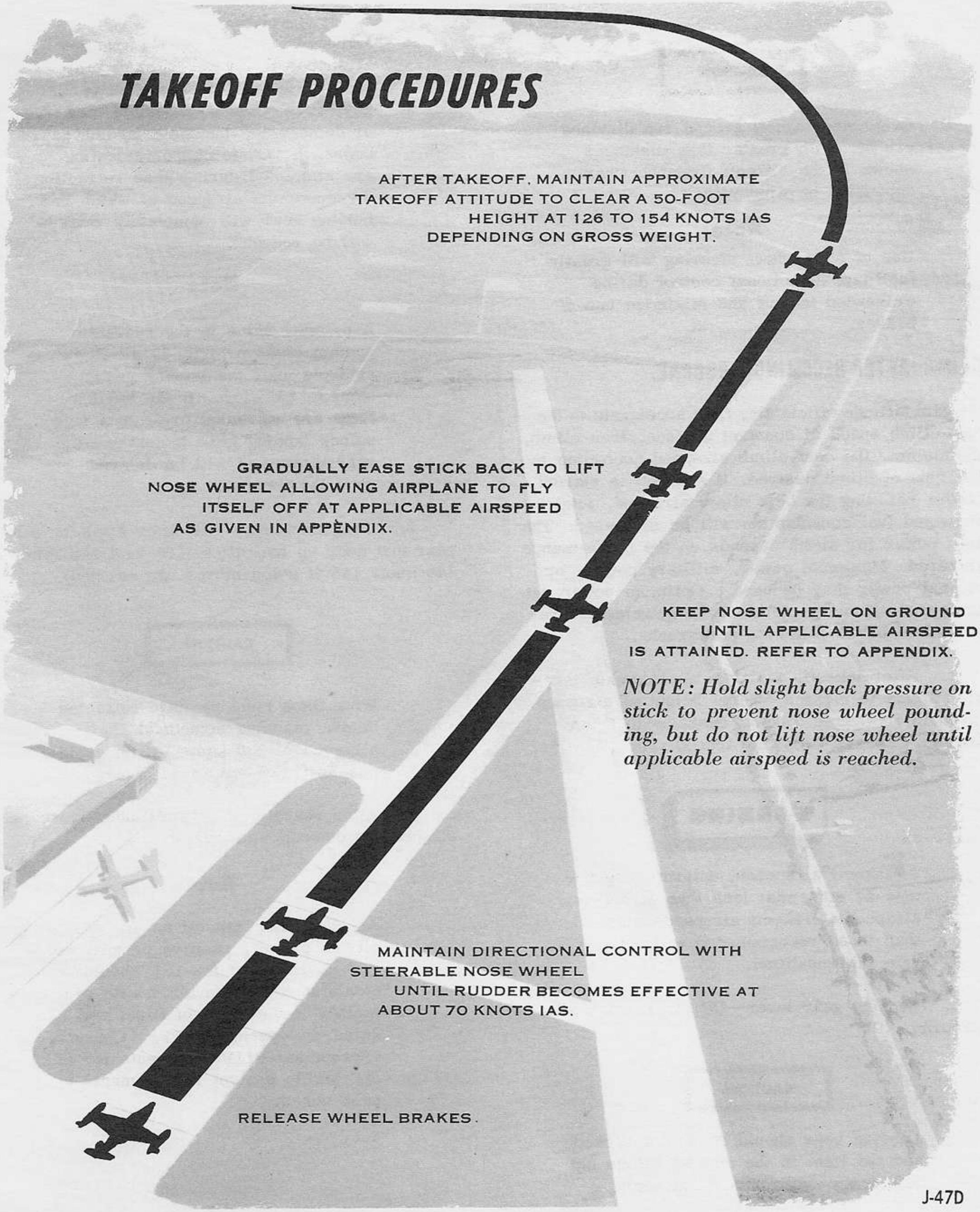

TAKEOFF PROCEDURES
AFTER TAKEOFF, MAINTAIN APPROXIMATE TAKEOFF ATTITUDE TO CLEAR A 50-FOOT HEIGHT AT 126 TO 154 KNOTS IAS DEPENDING ON GROSS WEIGHT.
GRADUALLY EASE STICK BACK TO LIFT NOSE WHEEL ALLOWING AIRPLANE TO FLY ITSELF OFF AT APPLICABLE AIRSPEED AS GIVEN IN APPENDIX.
KEEP NOSE WHEEL ON GROUND UNTIL APPLICABLE AIRSPEED IS ATTAINED. REFER TO APPENDIX.
NOTE: Hold slight back pressure on stick to prevent nose wheel pounding, but do not lift nose wheel until applicable airspeed is reached.
MAINTAIN DIRECTIONAL CONTROL WITH STEERABLE NOSE WHEEL UNTIL RUDDER BECOMES EFFECTIVE AT ABOUT 70 KNOTS IAS.
RELEASE WHEEL BRAKES.
J-47D

Figure 2-4.

CAUTION

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

Note

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

CLIMB--AFTER BECOMING AIRBORNE.

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 power, military power, or normal power 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 height at airspeed given in applicable Takeoff Distance to Clear 50-Foot Obstacle Chart in Appendix II. (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 should be up and locked and the light in the control handle out before exceeding structural limit airspeed. Landing gear retraction at speeds in excess of structural limit airspeed may result in partial gear retraction and possible loss of, or damage to, the main 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 the landing gear system; therefore, if the landing flaps are retracted prior to a safe uplock landing gear indication, the gear movement will be delayed until the flaps are up.

3. Wing flap lever--UP after attaining a safe gear and door up indication (160 knot IAS minimum; 170 knots IAS if pylon stores are carried). (P)

CAUTION

Wing flaps must be fully retracted before reaching structural limit airspeed of 230 knots IAS to avoid possibility of structural damage.

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

Note

As soon after takeoff as flight conditions permit, positive permit, positive operation of the IFF should be established with an air traffic control facility if the route of flight will require an operative IFF. Consult appropriate FLIP documents for IFF/SIF traffic control requirements and procedures.

DURING 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 upon 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 and will produce the results presented in the applicable Appendix Climb Charts. During climb, the following should be accomplished at 5000 feet, 10,000 feet, and at level-off altitudes:

1. Oxygen--Check. (P--RO)

2. Altimeter and cabin altitude--Check for proper operation. (P--RO)

3. Engine instruments--Check operation. (P)

4. Wings and fuselage--Check. (P--RO)

5. Altimeter-Set to 29.92 passing 18,000 feet. (P--RO)

6. Zero delay lanyard--Disconnect and stow upon reaching 10,000 feet in accordance with Zero Delay Lanyard Engagement Requirements Chart (figure 3-6A). (P--RO)

Note

When operating above terrain over 8000 feet high, the zero delay lanyard should remain connected until the A/C is at least 2000 feet above the terrain, and should be connected at least 2000 feet above the terrain on descent.

7. Fuel gages--Check. (P)

8. Engine screen switch--NORMAL. (P)

9. Oxygen diluter lever--NORMAL OXYGEN. (P--RO) If 100% oxygen is used for takeoff because of suspected carbon monoxide contamination of cockpit, move diluter lever to NORMAL OXYGEN as soon as contamination is no longer suspected.

WARNING

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

10. IFF switch--As required; check for operation. (P)

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-foot 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.

Depending on gross weight and power, minimum distance climb (maximum angle of climb) at low altitudes may be obtained at the airspeeds shown in figure A2-11.

Note

Minimum distance climb is not a maximum rate of climb.

CRUISE.

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

Note

For missions requiring low-altitude work, the zero delay lanyard should be unhooked or hooked when climbing or descending through minimum-ejection altitudes. Refer to Zero Delay Lanyard Engagement Requirements, Section III.

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. 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 (figures A2-12 through A2-14). With speed brakes fully open and engines at idle rpm, descents up to 30,000 feet per minute can be made without exceeding 350 knots IAS. Use the following procedure in making all descents:

1. IFF--Check (perform within 1 hour prior to estimated time of landing). (P)

2. Throttles and speed brakes--As required. (P)

3. Windshield defrosting system--As required. (P)

4. Canopy defogging system--As required. (P--RO)

   Operate windshield defrosting system as required. Anticipate canopy fogging at low altitude and operate defogging system accordingly.

5. Altimeter--Set to current setting descending through 18,000 feet; cross-check with RO. (P--RO)

6. Zero delay lanyard--CONNECT prior to high fix penetration, or at 10,000 feet enroute descent IAW zero delay lanyard engagement requirements (figure 3-6A). (P)

BEFORE LANDING.

Note

- 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 engine is accelerated rapidly from 80% rpm to maximum power, a compressor stall may result. This is less likely to occur, however, at 85% or higher rpm since the compressor efficiency increases quite rapidly with an increase in rpm.
- Before entering traffic pattern, airspeed may be varied within wide limits with speed brakes. Enter traffic pattern, using approximately 85% rpm and maintaining 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.

1. Alert radar observer. (P)

2. Safety belt and shoulder harness--Checked; Zero delay lanyard--Check attached in accordance with Zero Delay Lanyard Engagement Requirements Chart (figure 3-6A); inertia reel--Unlock. (P)

3. Armament selector switch--SNAKE-SAFE. (P)

4. Wing anti-ice systems--Off; engine anti-ice 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 de-ice and defog knob--As required. (P)

6. Fuel gage selector switch--SUMP. (P)

7. Brake accumulator and hydraulic pressure gages--Check. (P)

8. Engine screens--As required. (P)

9. Enter traffic pattern at 275 knots IAS, using 85% rpm. (P)

10. Speed brake lever--OPEN. (P)

11. Speed brake lever--CLOSED at 195 knots IAS. (P)

CAUTION

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. If practical, the 195-knot IAS restriction should also be observed on single-engine go-around. If landing gear, flaps, and speed brakes are actuated simultaneously, 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.

12. Landing gear lever--DOWN; check gear down. (P)

13. Fuel siphoning--CHECK. If siphoning, correct before lowering flaps. (P) (RO)

14. Wing flap lever--TAKEOFF. (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. Landing lights--As required. (P)

19. 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.

CAUTION

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.

20. Maintain 85% rpm until landing is assured. (P)

21. Maintain desired approach at 132 to 157 knots IAS, depending on gross weight. (P)

22. When landing is assured, retard throttle to IDLE. (P)

LANDING.

NORMAL LANDING.

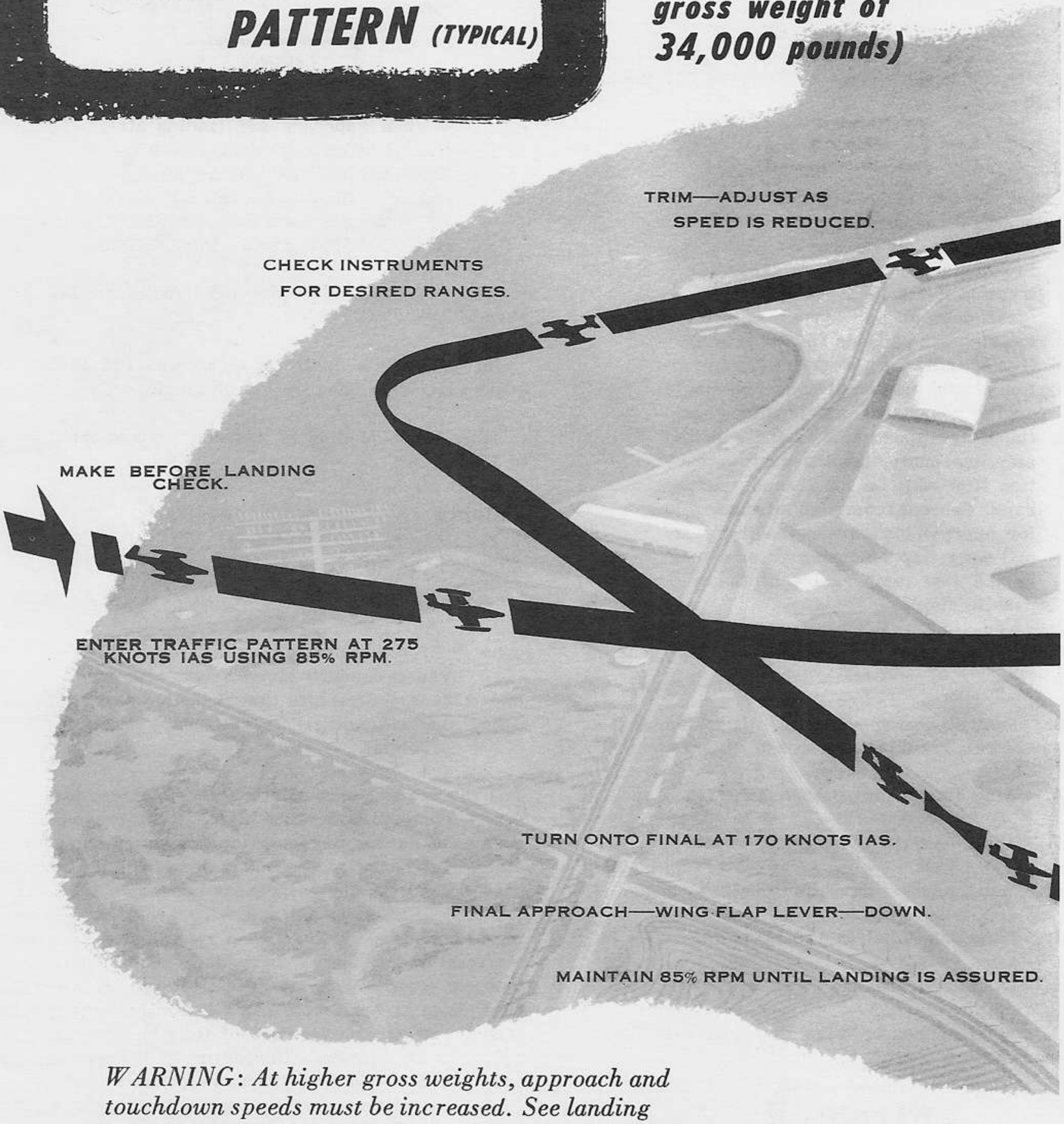
Note

The procedure given below will produce the results stated in the applicable Landing Distance Chart in Appendix II.

For the landing procedure, refer to figure 2-5. Aside from the somewhat high stick force encountered during flareout, the airplane is easy to land. Tip tanks must contain less than 200 pounds each before landing to prevent excessive loads in the tank attachment fittings. 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 Landing Speeds Chart. Rapid deceleration of the airplane may result in a 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.

LANDING PATTERN (TYPICAL)

(Based on a typical gross weight of 34,000 pounds)



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

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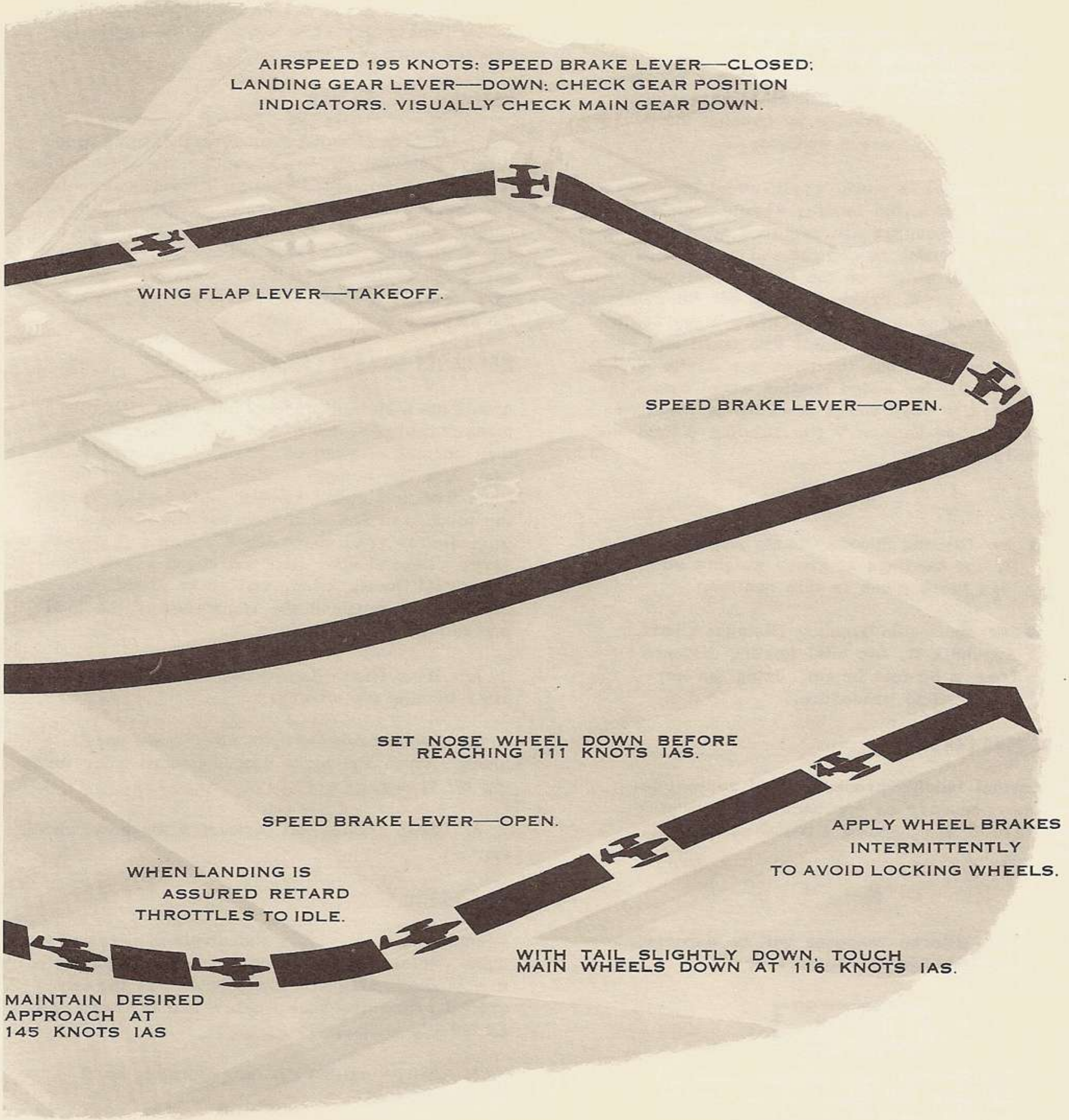
Figure 2-5.


AIRSPEED 195 KNOTS: SPEED BRAKE LEVER—CLOSED; LANDING GEAR LEVER—DOWN; CHECK GEAR POSITION INDICATORS. VISUALLY CHECK MAIN GEAR DOWN.
WING FLAP LEVER—TAKEOFF.
SPEED BRAKE LEVER—OPEN.
SET NOSE WHEEL DOWN BEFORE REACHING 111 KNOTS IAS.
SPEED BRAKE LEVER—OPEN.
APPLY WHEEL BRAKES INTERMITTENTLY TO AVOID LOCKING WHEELS.
WHEN LANDING IS ASSURED RETARD THROTTLES TO IDLE.
WITH TAIL SLIGHTLY DOWN, TOUCH MAIN WHEELS DOWN AT 116 KNOTS IAS.
MAINTAIN DESIRED APPROACH AT 145 KNOTS IAS

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CAUTION

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 nose wheel 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 increases with reduction in speed, braking forces can be increased. Maximum braking occurs just before tires begin to skid. Because of the small tire tread and heavy weight of the airplane, the tires are easily skidded. See Section VII for added landing wheel brake information. Use nose wheel steering as required for taxiing. See Section V for Landing Weight and CG Limitations.

Note

- See Landing Speeds Chart, Appendix II, for landings at gross weights other than those given in this section.
- See applicable Landing Distance Chart, Appendix II, for total landing distance from a 50-foot height, using the normal landing procedure.

CROSSWIND LANDING.

Use normal landing procedure and correct for drift as necessary on approach and landing. (See Takeoff and Landing Crosswind Chart, Appendix I.)

Note

Low aileron response will be experienced below 150 knots IAS.

CAUTION

Speed brake angles greater than 1/3 full open will impair lateral control as stall speed is approached.

HEAVY WEIGHT LANDING.

Anticipate greater ground speed and rolling distance with increased gross weight, and begin braking at the applicable airspeeds 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 if necessary. 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.

1. Wing flaps--Leave fully extended until after turning off runway.

2. Speed brakes--Open after main gear touches down and leave extended until after turning off runway.

3. Nose trim--Full forward after nose wheel contact.

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 brake lever--CLOSED. (P)

3. Landing gear lever--UP, when airplane is definitely airborne. (P)

4. Wing flaps--As required. Gradually raise wing flaps as airspeed increases. See figure 6-2 for applicable stalling airspeeds. (P)

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

CAUTION

If engines are being operated on nose tank only, with sump tanks empty, afterburning cannot be maintained on both engines; however, at the low-gross weight associated with this fuel loading, military power is adequate for two-engine go-around.

Landing gear and 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 and pylong 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 height at 126 to 154 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 will 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)

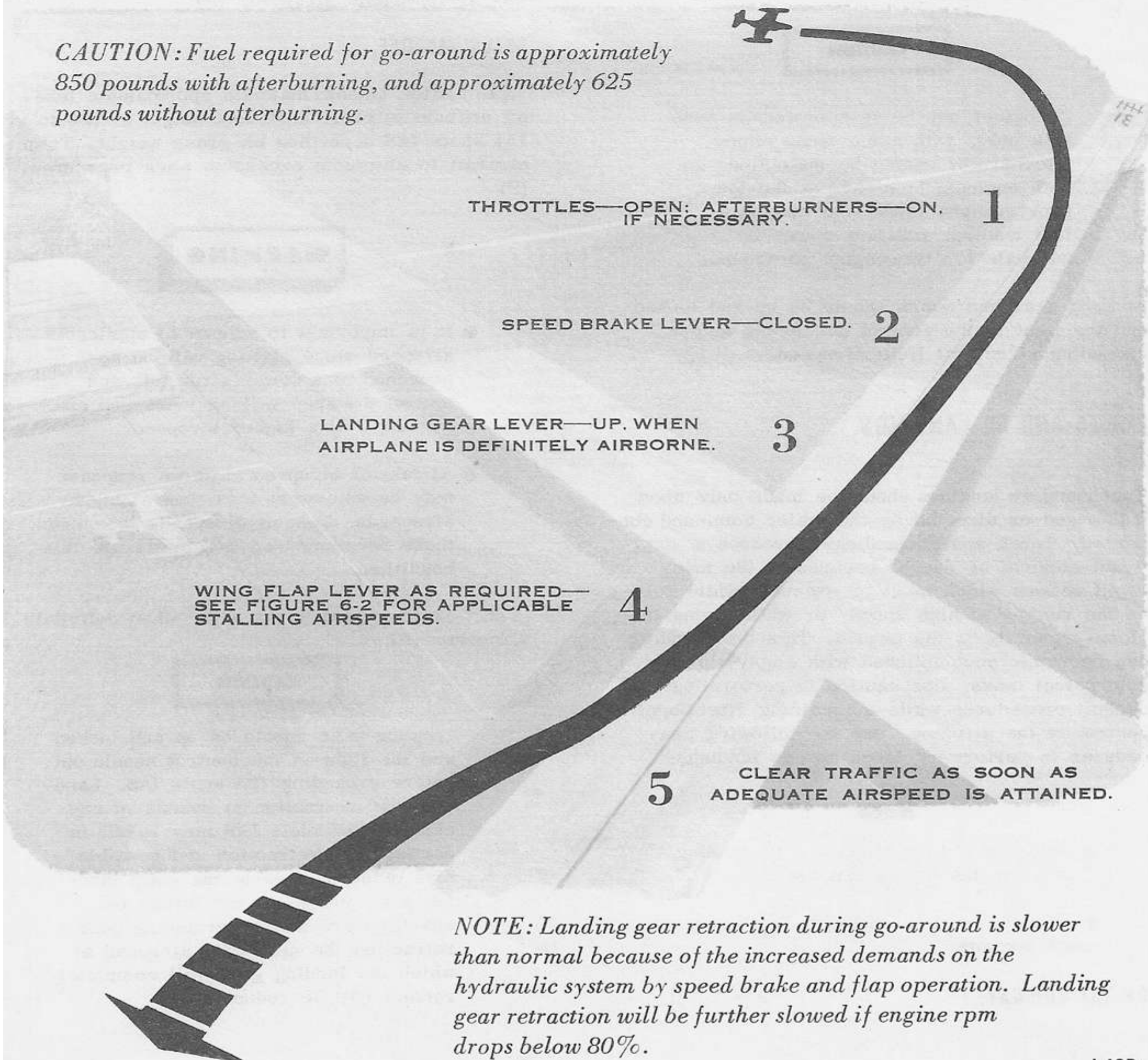
CAUTION

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 attempted during gear retraction the maximum airspeed at which the landing gear will completely retract will be reduced.

GO-AROUND

WARNING: Because of slow engine and airplane acceleration, make decision to go around as soon as possible. If a landing cannot be completed, do the following as quickly as possible:

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



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

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Figure 2-6.

3. Wing flap lever--UP. (P)

CAUTION

Wing flaps must be fully retracted before reaching 230 knots IAS to avoid possibility of structural damage.

4. Zero delay lanyard--Unhook in accordance with Zero Delay Lanyard Engagement Requirements Chart. (P--RO)

5. Crossfeed switch--As required. (P)

6. Fuel gages--Check. (P)

7. Throttles--As required to maintain desired altitude and airspeed. (P)

AFTER LANDING.

After nose wheel 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 increases with reduction in speed, braking forces can be increased. Maximum braking occurs just before tires begin to skid. Because of the small tire tread and heavy weight of the airplane the tires are easily skidded. Use nose wheel steering as required for taxiing.

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. Safety pins--Insert in ejection seat right armrest and canopy jettison mechanism. (P--RO)

3. Cabin air switch--RAM & DUMP (before opening canopy). (P)

4. External engine screens--When required, have installed with engines at IDLE. (P)

5. Wing flap lever--UP. (P)

6. Speed brake lever--CLOSED. (P)

7. Trim--Reset to TAKEOFF. (P)

8. Anti-icing, windshield de-ice, and pitot heat switches--OFF. (P)

9. IFF--Off. (P)

10. Taxi light--As required. (P)

11. Anti-collision lights - Off.

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 exhaust.

1. Brakes--Set or wheels chocked. (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 rpm 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 may be considered as part of this period.

Note

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

5. Alternator circuit breaker switch--TRIP. (P--RO)

6. Throttles--CLOSED. (P)
Move past IDLE stop to CLOSED by raising fingerlifts. Throttle friction lever--INCREASE.

7. Fuel tank switches and selector switches--OFF after engine rotor has stopped turning. (P)

8. All other switches--OFF, except generator switches. (P--RO)

BEFORE LEAVING AIRPLANE.

Surface control locks (except 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 armrest 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 Form 781. (P)

CAUTION

To ensure 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 landing, excessive braking action during aborted takeoffs, long and fast landings, and long taxi runs at high speeds.

5. IFF--Codes removed.

CAUTION

- In addition to established requirements for reporting any system defects, unusual and excessive operations, the flight crew will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.
- When leaving the airplane unattended, close and lock the canopy. This inflates the canopy seal, preventing moisture and dust from entering the cockpit.
- If battery is left connected and canopy handle is left in UNLOCKED position, the battery will discharge.

SECTION III

EMERGENCY PROCEDURES

Note

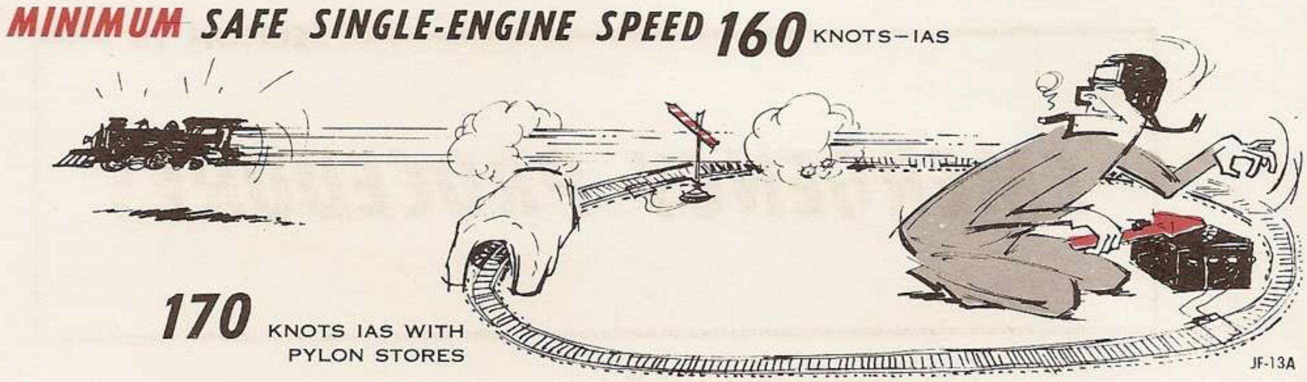
Critical emergency check list items are those actions which must be performed immediately if the emergency is not to be aggravated. To permit immediate identification, these critical steps appear in boldface capital letters. The radar operator should be notified that an emergency exists so that he may prepare his compartment for the emergency and be prepared to render any assistance the pilot may require.

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 to the centerline of the airplane. With one engine inoperative, very little rudder trim is required. Thus, good control is assured in the single-engine 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 pullups). An airspeed of 160 knots IAS (170 knots IAS if external stores are carried) is a safe minimum for all weights, all configurations, and moderate accelerations. See figure 3-2 for single-engine service ceilings. In single-engine flight where only military power (100% rpm without afterburning) is available on the operating engine, there are certain airplane configurations in which level flight cannot be maintained. At a typical takeoff gross weight of 42,000 pounds, one engine windmilling, flaps down 30 degrees or more, and with the landing gear UP or DOWN, it is impossible to maintain level flight. With the flaps up and the landing gear UP or DOWN, level flight is possible; however, until the landing gear is retracted or afterburning initiated, performance will be marginal and any turns or maneuvers may be accompanied by a loss of altitude.



ENGINE FAILURE DURING TAKEOFF (BEFORE LEAVING GROUND).

Takeoff Aborted.

If a decision is made to abort the takeoff before leaving the ground, follow the procedure given under ABORT, this section. If an engine fails before leaving the ground, continuing the takeoff depends on length of runway, configuration, gross weight, airspeed at time of failure, 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 Takeoff Distance Chart, Appendix II. This chart gives entire takeoff distance with only one engine operating at maximum power, and is to be used only if an engine fails during the takeoff roll.

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, airplane configuration, and air density. Figure 3-3 shows the maximum gross weights at which a 100 feet-per-minute rate of climb can be maintained with landing gear down, and flaps at takeoff. For engine failure immediately after takeoff, use the following applicable procedure:

Takeoff Continued.

1. **TIP TANK DUMP BUTTON--DEPRESS. (P)**

Figure 3-1.

WARNING

Complete dumping of tip tank fuel requires up to a full minute; therefore, the weight reduction is gradual rather than instantaneous.

Note

Fuel cannot be dumped from the forward compartment of tip tanks.

2. **THROTTLE (INOPERATIVE ENGINE)--CLOSED. (P)**

3. **ENGINE FIRE SELECTOR SWITCH FOR INOPERATIVE ENGINE--RAISE GUARD AND ACTUATE. (P)**

4. Agent discharge switch--As required. (P)

5. Landing gear and flaps--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.

6. If obstacle must be cleared, hold airspeed at minimum safe value above stall to maintain best angle of climb. (P)

7. After obstacle is cleared, allow airspeed to increase to 160 knots. (P)

8. Wing flap lever--UP at 160 knots IAS. (P)

9. Electrical equipment (nonessential)--OFF. (P--RO)

WARNING

Do not raise wing flaps below 160 knots IAS because maximum lift will be reduced, possibly below the minimum required to maintain altitude.

10. Trim--As required. (P)

11. Crossfeed switch--ON. (P)

12. Generator switch(es) for inoperative engine--OFF. (P)

Continued Flight Impossible.

1. **LOWER NOSE TO MAINTAIN FLYING SPEED. PREPARE TO LAND STRAIGHT AHEAD IF POSSIBLE. ALTER COURSE ONLY TO MISS OBSTACLES. (P)**

2. **LANDING GEAR LEVER--DOWN. (P)**

3. Wing flaps--As required. (P)

4. Speed brakes--As required. (P)

5. Throttles--CLOSED (before touchdown). (P)

WARNING

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

6. Canopy--Jettison with canopy jettison "T" handle. (P)

7. Inertial reel--Lock. (P--RO)

8. Engine fire selector switches--Raise guards and actuate. (P)

9. Agent discharge switch--As required. (P)

SINGLE-ENGINE SERVICE CEILING

(TWO MB-1 ROCKETS)

GROSS WEIGHT (Lb)	ALTITUDE, STANDARD DAY 59°F (15°C) AT SEA LEVEL			ALTITUDE, HOT DAY 100°F (38°C) AT SEA LEVEL		
	96% RPM without AB	100% RPM without AB	100% RPM with AB	96% RPM without AB	100% RPM without AB	100% RPM with AB
42,000	9,800	12,300	24,450	1100 *	8,500	21,450
38,000	13,000	14,850	27,700	7400 *	11,300	24,650
34,000	16,450	18,000	31,100	12,900	14,300	27,900
30,000	20,200	21,600	34,850	16,900	17,400	31,400

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NOTE: All altitudes are pressure altitudes in feet.

* *WITH POWER REDUCED TO PREVENT EXCEEDING EXHAUST GAS TEMPERATURE LIMIT.*

DATA AS OF: 1 JAN 1957 DATA BASIS: FLIGHT TEST

Figure 3-2.

10. Generator switches--OFF. (P)

11. Battery switch--OFF just before touchdown. (P)

Note

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

12. When stopped--Abandon airplane. (P--RO)

SINGLE-ENGINE PROCEDURE (DURING FLIGHT).

Immediately after experiencing engine failure in flight it is important to reduce drag to a minimum while maintaining IAS and directional control while investigating 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.

1. **THROTTLE (INOPERATIVE ENGINE)--CLOSED. (P)**

2. **ENGINE FIRE SELECTOR SWITCH ON INOPERATIVE ENGINE--RAISE GUARD AND ACTUATE SWITCH. (P)**

3. Agent discharge switch--actuate if necessary. (P)

CAUTION

Do not actuate agent discharge switch unless 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.

4. Generator switches (inoperative engine)--OFF. (P)

5. Inverter switches--As required. (P)

6. Unnecessary electrical equipment--OFF. (P--RO)

7. Crossfeed switch--ON. (P)

8. Fuel tank switches--ON, except on empty tanks. (P)

9. Fuel selector switches--ALL TANKS. (P)

10. Power on good engine--Readjust. (P)

11. Trim for straight and level flight. (P)

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 the failure is caused by improper fuel system operation and the condition is corrected, restart the engine. (See Restarting Engine in Flight, this section.) If failure is caused by mechanical breakdown, as may be indicated by engine instruments or excessive vibration, the engine should be shut down. See figure 3-2 for single-engine service ceilings and applicable Appendix charts for single-engine operating data. For procedure on shutting down engine in flight, see Single-Engine Procedure, 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.

ENGINE FAILURE DURING FLIGHT AT LOW ALTITUDE.

If an engine fails during flight at extremely low altitude but with sufficient airspeed available, the airplane should be pulled up (zoom up) to exchange airspeed for an increase in altitude. This will allow more time for accomplishing subsequent emergency procedures (air start, establishing forced landing pattern, ejection, and so forth). The point at which climb should be terminated will depend on whether the pilot intends to eject or whether he intends to continue attempting air starts, establish forced landing pattern, and so forth. In any event, it is recommended that an air start be attempted immediately upon detection of engine flameout and repeated as many times as possible during the zoom-up. If the decision is to eject, the airplane should be allowed to climb as far as possible. Ejection should be accomplished while the nose of the airplane is above the horizon but prior to reaching a stall or sink. If the decision is to continue attempting air starts, the climb should be terminated prior to the airspeed dropping below best glide speed in order that engine windmilling rpm will not drop below the minimum required for air start. In the zoom-up maneuver, more altitude can be gained if external loads are jettisoned. Maximum altitude gain can be achieved by jettisoning external loads prior to zoom-up. The further up the climbing flight path that external loads are jettisoned, the less additional altitude will be gained. Therefore, to attain the most altitude in the zoom-up, the external load should be jettisoned as soon as possible. However, when jettisoning external loads, consideration must be given to the following factors: Sufficient airspeed to allow time for pilot reaction and jettisoning external loads; terrain where external load will fall; type of stores to be jettisoned; and controllability of the airplane if one or more stores fail to release, resulting in a dangerous asymmetrical condition at low altitude. External load release limits (refer to Section V) must be observed if damage to the airplane is to be prevented. Depending on the emergency it may be advisable to jettison the external load outside the release limits, risking damage to the airplane to increase the probability of accomplishing subsequent emergency procedures. The decision to jettison or retain external loads must be made by the pilot on the basis of his evaluation of the above factors and conditions existing at the time of the emergency.

RESTARTING ENGINE IN FLIGHT.

For best starting conditions and wherever practical, attempt air starts at 20,000 feet or below. However, successful air starts have been made at higher altitudes. An air restart can be made if the engine rpm is at least 12.5%, and the airspeed is approximately 170 to 250 knots IAS. If both

FIELD ELEVATION (Feet)	AMBIENT TEMPERATURE −10°C (+14°F)	+10°C (+50°F)	+30°C (+86°F)	+50°C (+122°F)
5000	40,100	37,050	31,920	———
4000	41,620	38,200	33,140	———
3000	43,220	39,760	34,350	———
2000	44,280	41,200	35,640	28,800
1000	44,280	42,780	36,980	29,850
SEA LEVEL	44,280	44,280	38,300	30,920

MAXIMUM WEIGHTS FOR CONTINUED FLIGHT AFTER ENGINE FAILURE ON TAKEOFF

Weight in pounds at which 100 feet per minute rate of climb can be maintained with gear down, flaps in takeoff position, and maximum power.

DATA AS OF: 1 JAN 1957 DATA BASIS: FLIGHT TEST J-52C

Figure 3-3.

engines have failed, no attempt should be made to restart both engines at the same time. Immediately upon experiencing a double flameout, turn off all unnecessary electrical equipment, including the inverters, and descend to 20,000 feet, if practical, before attempting a restart. Battery power may be insufficient for ignition. Select NOSE TANK by turning the fuel selector switch through the OFF position. This will cause relays and valves to recycle and may clear up the difficulty. Turn on single-phase inverter for engine ignition and restart one engine (rpm and exhaust gas temperature stabilized), then restart the other, using the same procedure. The following procedure should be used for all air starts.

CAUTION

- Do not attempt to restart both engines at the same time.
- 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. Fire selector switch--Check OFF. (P)

3. Fuel selector switch--Turn to OFF position, then return to NOSE TANK. (P)

4. Altitude start switch--ALTITUDE START momentarily. (P)

5. Throttle--Approximately one-half open until exhaust gas temperature stabilizes, then accelerate to desired rpm. (P)

6. Fuel system controls--As required. (P)

7. If start is unsuccessful, attempt another start at lower altitude. (P)

Figure 3-4.

MAXIMUM GLIDE.

For the distance this airplane will glide, power off, at various gross weights, refer to figure 3-4. During descent, the speed of the windmilling engines will be high enough to supply power to the hydraulic system for normal descent operation of the flight controls, provided that engine rpm on either engine does not drop below 10%. The supplemental pump should be used to ensure adequate control for landing; but to conserve battery power, the pump should be left off until final approach. This can be done by having RO pull the safety relay circuit breaker or by turning off the battery switch before lowering the landing gear, lowering the gear with the emergency handle, and turning the battery switch ON again when turning on to final approach.

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.

EJECTION VERSUS FORCED LANDING.

Normally, ejection is the best course of action if a complete engine flameout occurs, or if positive control of the airplane cannot be maintained. Because of the many variables encountered, the final decision to attempt a flameout landing or to eject must remain with the pilot. It is impossible to establish a predetermined set of rules and instructions which would provide a readymade decision applicable to all emergencies of this nature. The basic conditions listed below, combined with the pilot's analysis of the condition of the airplane, type of emergency, and his proficiency, are of prime importance in determining whether to attempt a flameout landing or to eject. These variables make a quick and accurate decision difficult. If the decision is made to eject, prior to ejection the pilot should attempt to turn the airplane toward an area where injury or damage to persons or property on the ground or water is least likely to occur. Refer to figure 3-6 before a decision is made to attempt a flameout landing, and be sure the following conditions exist.

1. Flameout landings should be attempted only by pilots who have satisfactorily completed simulated flameout approaches in this type airplane.

2. Flameout landings should be attempted only on a prepared or designated suitable surface.

3. Approaches to the runway should be clear, presenting no problem during flameout approaches.

WARNING

No attempt should be made to land a flameout airplane where landing approaches are over heavily populated areas. Prior to ejection, the pilot should attempt to turn the airplane toward an area where injury or damage to persons or property on the ground or water is least likely to occur.

4. Weather, terrain conditions--Favorable. Cloud cover, ceiling, visibility, turbulence, surface wind, and so forth, must not impede the establishment of a proper flameout landing pattern.

5. Flameout landings should be attempted only when either a satisfactory "high key" or "low key" position can be achieved.

6. If at any time during the flameout approach, conditions do not appear ideal for successful completion of the landing, ejection should be accomplished. Eject no later than the "low key" altitude.

LANDING WITH ONE ENGINE INOPERATIVE.

If a landing with one engine is necessary, dump tip fuel and drop pylon tanks. Approach the airport at 250 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.

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 necessary. Wing flaps are available with either or both engines inoperative if left hydraulic pressure is available. In the event of electrical failure, the radar observer can normally maintain enough brake accumulator pressure by pumping the hydraulic hand pump so that the emergency airbrake system need not be used. However, if it becomes necessary to use the airbrakes, the pilot should apply the brakes carefully since they are very sensitive and effective. Do not pump the brakes since air is lost each time pedal pressure is released.

One Engine Inoperative.

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

1. Check single-phase inverter--ON. If off the line, turn AB toggle switch OFF on operating engine. (P)

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

3. Landing gear lever--DOWN. (P)

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

5. Wing flap lever--TAKEOFF. (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.

Note

Flaps are not available without left hydraulic system pressure.

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

7. Turn on to final at 170 knots and stabilize at 160 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)

8. Do not reduce airspeed below 160 knots IAS until landing is assured. (P)

9. Retard throttle to IDLE only when positive of landing. (P)

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

Note

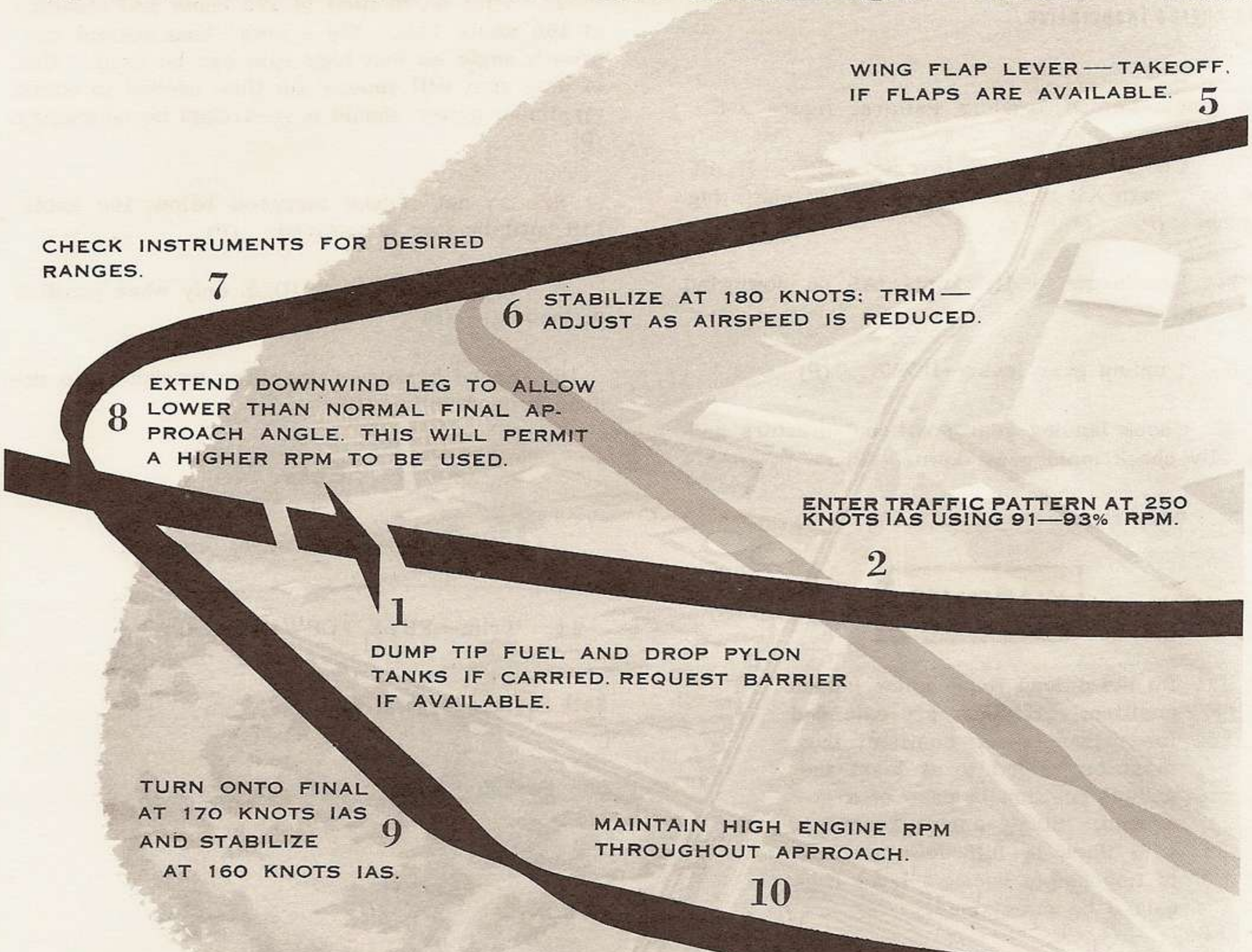
Do not use nose wheel steering button.

11. Trim--FULL FORWARD. (P)

Both Engines Inoperative.

See Forced Landing, figure 3-6.

SINGLE-ENGINE LANDING PATTERN



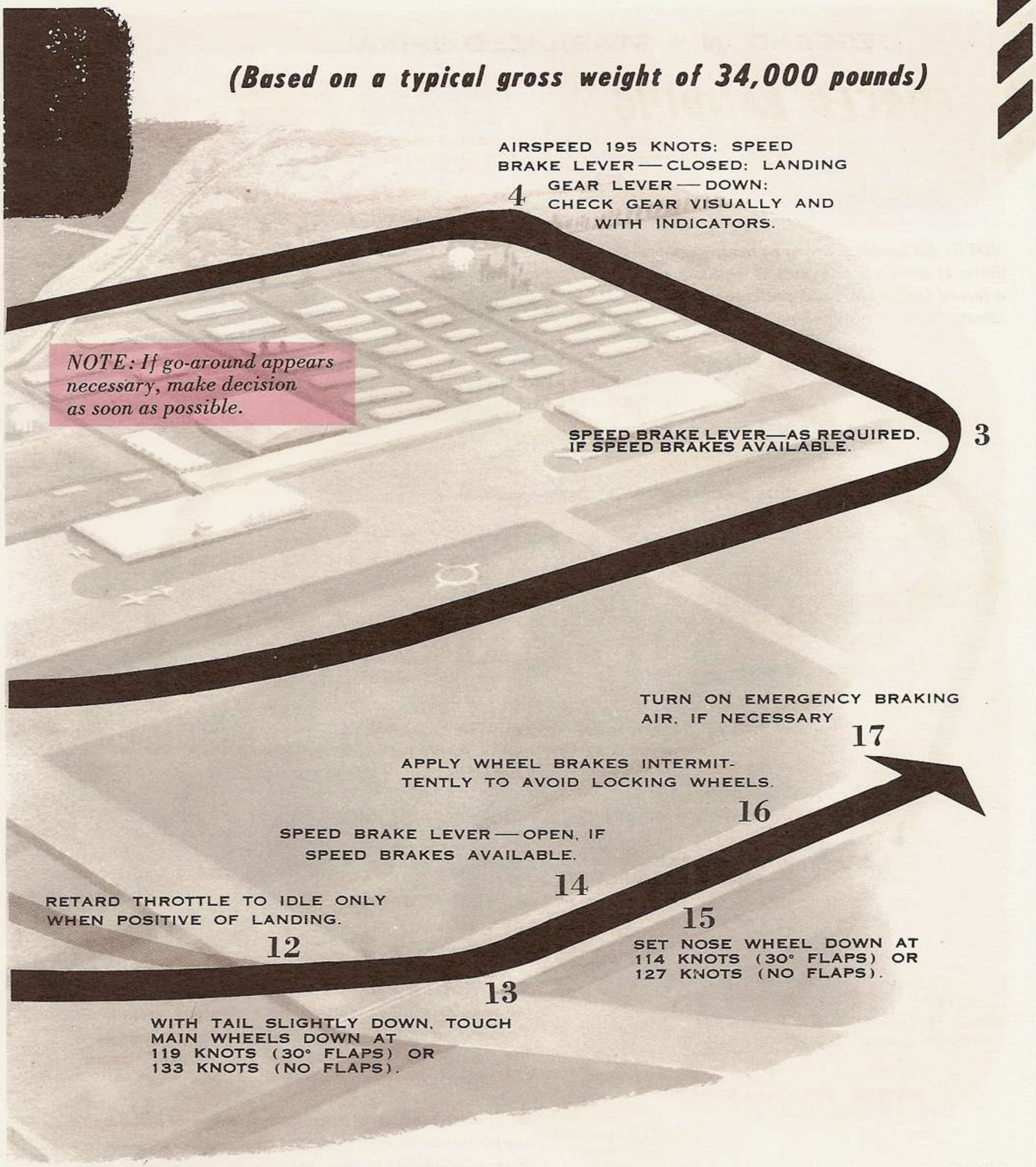
WARNING

- *At higher gross weights, approach and touchdown speeds must be increased. See landing speeds chart in appendix for other weights and speeds for single-engine landings.*
- *Do not extend flaps beyond TAKE OFF setting for a single-engine landing, as the airplane will not accelerate with full flaps and one engine operating.*

J-116(1)D

Figure 3-5.

(Based on a typical gross weight of 34,000 pounds)



J-116(2)D

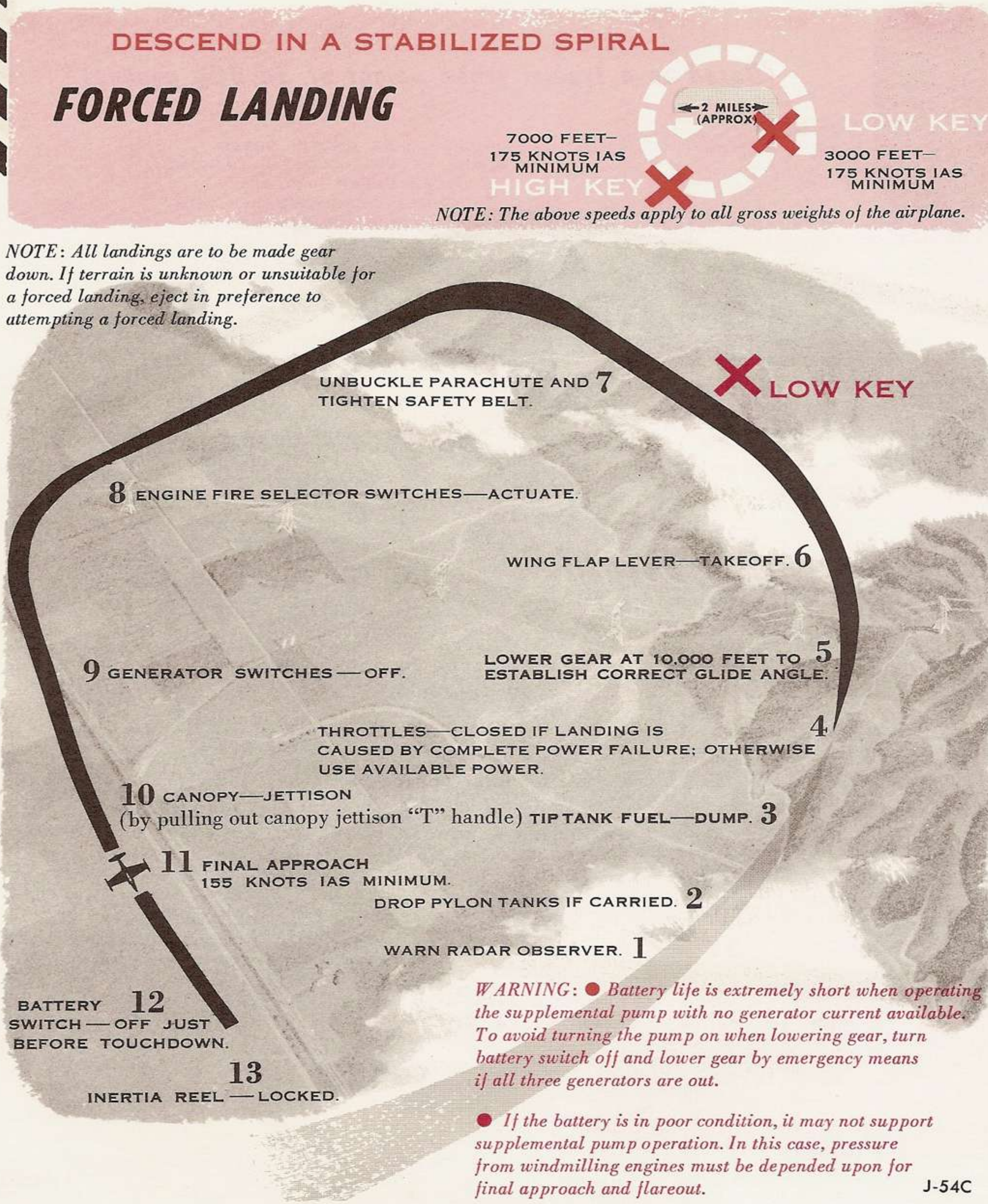

DESCEND IN A STABILIZED SPIRAL
FORCED LANDING
2 MILES (APPROX)
7000 FEET— 175 KNOTS IAS MINIMUM
HIGH KEY
LOW KEY
3000 FEET— 175 KNOTS IAS MINIMUM
NOTE: The above speeds apply to all gross weights of the airplane.
NOTE: All landings are to be made gear down. If terrain is unknown or unsuitable for a forced landing, eject in preference to attempting a forced landing.
LOW KEY
1 WARN RADAR OBSERVER.
2 DROP PYLON TANKS IF CARRIED.
3 TIP TANK FUEL—DUMP.
4 THROTTLES—CLOSED IF LANDING IS CAUSED BY COMPLETE POWER FAILURE; OTHERWISE USE AVAILABLE POWER.
5 LOWER GEAR AT 10,000 FEET TO ESTABLISH CORRECT GLIDE ANGLE.
6 WING FLAP LEVER—TAKEOFF.
7 UNBUCKLE PARACHUTE AND TIGHTEN SAFETY BELT.
8 ENGINE FIRE SELECTOR SWITCHES—ACTUATE.
9 GENERATOR SWITCHES—OFF.
10 CANOPY—JETTISON (by pulling out canopy jettison "T" handle)
11 FINAL APPROACH 155 KNOTS IAS MINIMUM.
12 BATTERY SWITCH—OFF JUST BEFORE TOUCHDOWN.
13 INERTIA REEL—LOCKED.
WARNING: ● Battery life is extremely short when operating the supplemental pump with no generator current available. To avoid turning the pump on when lowering gear, turn battery switch off and lower gear by emergency means if all three generators are out.
● If the battery is in poor condition, it may not support supplemental pump operation. In this case, pressure from windmilling engines must be depended upon for final approach and flareout.
J-54C

Figure 3-6.

SINGLE-ENGINE GO-AROUND.

The greater the speed when the decision is made to go around the shorter the go-around distance. If doubt exists as to the landing, an immediate decision to go-around will save considerable distance. If icing conditions are encountered, see Section IV, Anti-icing Systems, under Landing. When the go-around decision is made, complete the following steps in the order given.

1. **THROTTLE ON OPERATING ENGINE--OPEN. AFTERBURNER ON OPERATING ENGINE--ON. (P)**

2. **SPEED BRAKE LEVER--CLOSED. (P)**

3. Wing flap--20 degrees. (P)

WARNING

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

- 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 flap extension greater than the takeoff setting should be reduced to at least the takeoff position immediately after decision to go around has been made. 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 positions lower than takeoff position must be used with caution because of this long retraction time.

4. Landing gear lever--UP. (P)

Note

- If an immediate obstacle must be cleared, do not retract gear until obstacle is cleared. Retraction of the gear (which takes up to 10 seconds) creates considerable additional drag. If the airplane is accelerating and no immediate obstacle must be cleared, the gear should be retracted.

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

5. Allow airplane to accelerate to 160 knots IAS before attempting climbout. If possible, stay close to the runway to take advantage of "ground effect." 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 IAS before liftoff is attempted. If runway distance is available, attain more than 135 knots before liftoff. After takeoff and if conditions allow, take advantage of "ground effect" by holding aircraft close to runway. (P)

SINGLE-ENGINE TAKEOFF.

Intentional single-engine takeoffs are prohibited for this airplane. Single-engine takeoff charts are shown in Appendix II, but these charts are to be used only for reference if an 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 opening speed brakes 15 degrees.

SIMULATED FORCED LANDING.

A two-engine flameout condition may be simulated for practicing forced landings by retarding the throttles to 85% rpm and opening the speed brakes to approximately 85 degrees (about 2/3 lever travel). (See figure 3-6.)

FIRE.

ENGINE FIRE DURING START.

If an engine overheat warning light comes on, close both throttles and keep affected engine windmilling with ground test switch. 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. APU--OFF. (P)

5. Radar observer--Warn to abandon airplane. (P)

6. Leave 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 because this is a "one-shot" system and, until the extinguishing agent 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:

WARNING

During flight conditions when reduction in power or engine shutdown would create a hazardous flight condition, no action should be taken until safe single-engine speed or minimum ejection altitude is reached.

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

1. **ENGINE FIRE SELECTOR SWITCH FOR ENGINE ON FIRE--RAISE GUARD AND ACTUATE. (P)**

2. **AGENT DISCHARGE SWITCH--ACTUATE. (P)**

3. **THROTTLE (ON INOPERATIVE ENGINE)--CLOSED. (P)**

4. Radar observer--Alert. (P)

5. Cabin air switch--RAM & DUMP. (P)

6. Oxygen diluter lever--100% OXYGEN. (P--RO)

7. Oxygen regulator emergency lever--Actuate momentarily, to clear oxygen mask. (P--RO)

8. Generator switch(es) (for inoperative engine)--OFF. (P)

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

10. Land as soon as possible. (P)

WARNING

The "one-shot" fire extinguishing system delivers its entire charge when actuated and must be recharged before it is 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. AB toggle switches OFF for landing if single-phase inverters are OFF. (P)

4. Check for sump fuel siphoning prior to lowering flaps. (P--RO)

5. Eject--If necessary. (P--RO)

SMOKE AND FUME ELIMINATION.

1. Cabin air switch--RAM and DUMP. (P)

2. Oxygen diluter lever--100% OXYGEN. (P-RO)

3. Oxygen regulator emergency lever--Actuate momentarily, to clear oxygen mask. (P--RO)

EJECTION.

Note

For considerations affecting the decision to eject, refer to Ejection Versus Forced Landing, this section.

Escape from the airplane during flight should be made with the ejection seat. The basic seat ejection procedures are shown in figure 3-7.

UNDER LEVEL FLIGHT CONDITIONS, EJECT AT LEAST 2000 FEET ABOVE THE TERRAIN WHENEVER POSSIBLE.

UNDER SPIN OR DIVE CONDITIONS, EJECT AT LEAST 10,000 FEET ABOVE THE TERRAIN WHENEVER POSSIBLE.

EJECT AT THE LOWEST PRACTICAL AIRSPEED ABOVE 120 KNOTS IAS ("LOWEST PRACTICAL" WOULD BE THAT SPEED BELOW WHICH LEVEL FLIGHT CANNOT BE MAINTAINED).

CAUTION

DO NOT DELAY EJECTION BELOW 2000 FEET IN FUTILE ATTEMPTS TO START THE ENGINE OR FOR OTHER REASONS THAT MAY COMMIT YOU TO AN UNSAFE EJECTION OR A DANGEROUS FLAMEOUT LANDING. ACCIDENT STATISTICS EMPHATICALLY SHOW A PROGRESSIVE DECREASE IN SUCCESSFUL EJECTIONS AS ALTITUDE DECREASES BELOW 2000 FEET.

WARNING

Simultaneous ejection should be avoided when possible to prevent chute entanglement. When practical, ejection should be staggered by one-half second or more.

1. Below 120 knots IAS, airflow is not sufficient to assure rapid parachute deployment. Therefore, it becomes extremely important during low-altitude ejection to obtain at least 120 knots IAS, if possible, to assure complete parachute deployment at the greatest height above the terrain.

2. During high-altitude ejection, observing this minimum speed, (120 knots IAS) becomes less important since there is adequate time (altitude) for parachute deployment.

3. The need to be at the lowest possible airspeed down to 120 knots IAS, prior to ejection, is predicated on many factors such as avoiding bodily injury, precluding parachute or seat structural failure, and providing adequate tail clearance.

4. Proper coverage of maximum safe airspeeds for ejection requires a complex chart as a result of the many factors involved. Because the limiting airspeeds vary with altitude and Mach number, this chart would be very difficult to commit to memory. Actually, there is no need to quote maximum airspeeds since the ejecting crewmember has no practical use for this information. If the aircraft is controllable, airspeed will be reduced to as near 120 knots IAS as practical, which eliminates any high speed problems. If the aircraft is not controllable, ejection must be accomplished at whatever speed exists at the time, since ejection offers the only opportunity for survival. As a matter of general interest, it may be well to point out that at sea level, wind blast will exert minor forces on the body up to 525 knots IAS; appreciable forces from 525 to 600 knots IAS; and excessive forces above 600 knots IAS. As altitude is increased, these critical speeds of reference become progressively less. In view of the preceding, a detailed presentation of maximum safe airspeeds for ejection would be purely academic and therefore, does not warrant inclusion in this manual.

During any low altitude ejection, the possibility of success can be improved by zooming and ejecting while the nose of the airplane is above the horizon and the airspeed is at least 120 knots and not more than 525 knots IAS. The zoom-up maneuver will exchange airspeed for altitude, thus providing maximum terrain clearance at time of ejection, as well as reducing airspeed within safe limits for ejection. It must be remembered that altitude and airspeed conditions alone will not insure a successful ejection. If sink rate is allowed to become high after completing the zoom climb, all advantages of the increased altitude may be lost. Ejection while the airplane is in a positive climb attitude will result in a more nearly vertical trajectory for the seat and crewmember, thus providing more altitude and time for seat separation and parachute deployment.

The automatic belt shall not be opened prior to ejection regardless of altitude because of several serious disadvantages, the most important of which is that the automatic opening feature of the parachute is eliminated, and crewmember separation from the seat may be too rapid at high speeds.

Note

Improper routing of personal leads may cause inadvertent opening of the lap belt latch during ejection. Care must be taken to insure that flight clothing, such as sleeves, will not catch and release the lap belt during ejection.

Immediately after ejection, attempt to manually open the seat belt. This is strictly a precautionary measure in case the belt fails to open automatically. If the belt operates normally, it will be impossible to beat the automatic opening action.

As soon as the belt releases, a determined effort must be made to separate from the seat to obtain full parachute deployment at maximum terrain clearance--THIS IS EXTREMELY IMPORTANT FOR LOW ALTITUDE EJECTIONS.

If the seat belt is opened manually, the automatic feature of the parachute is eliminated. Therefore, under these circumstances, the parachute arming lanyard must be pulled if above 14,000 feet or the ripcord handle must be pulled if below 14,000 feet.

Manually pull the parachute ripcord handle immediately following seat separation for all ejections below 14,000 feet. This is strictly a precautionary measure since the parachute should deploy automatically.

Minimum safe ejection altitudes for the "one and zero" system for various combinations of equipment are listed below.

Emergency Minimum Altitudes for Ejection

AUTOMATIC SAFETY BELT WITH 1-SECOND (M-12) INITIATOR (B-18 PACK, C-9 CANOPY)

350 Feet	2-Second Parachute (F-1A Timer)
200 Feet	1-Second Parachute (F-1B Timer)
100 Feet	0-Second Parachute (Lanyard to "D" Ring)

WARNING

Emergency minimum ejection altitudes quoted in this table were determined through extensive flight tests and are based on distances above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitude you must go up to in the event of such low altitude emergencies as fire on takeoff. They shall not be used as the basis for delaying ejection when above 2000 feet since accident statistics emphatically show a progressive decrease in successful ejections as altitude decreases below 2000 feet. Therefore, whenever possible, eject above 2000 feet to insure survival during extremely low altitude ejections, the automatic features of the equipment must be used and depended upon.

BEFORE EJECTION

1. Reduce airspeed as much as possible, and if below 2000 feet, pull the nose 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 AND DUMP. (P)

4. Loose equipment--Stow. (P--RO)

5. If using an automatic-opening parachute, check to make sure the key is attached to the automatic-opening safety belt and the lanyard is free. (P--RO)

6. Zero delay lanyard--CONNECT below 10,000 feet, DISCONNECT above 10,000 feet in accordance with Zero Delay Lanyard Engagement Requirements Chart (figure 3-6A).

7. Lower helmet visor. (P-RO)

8. Canopy--Jettison. (P--RO)

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.

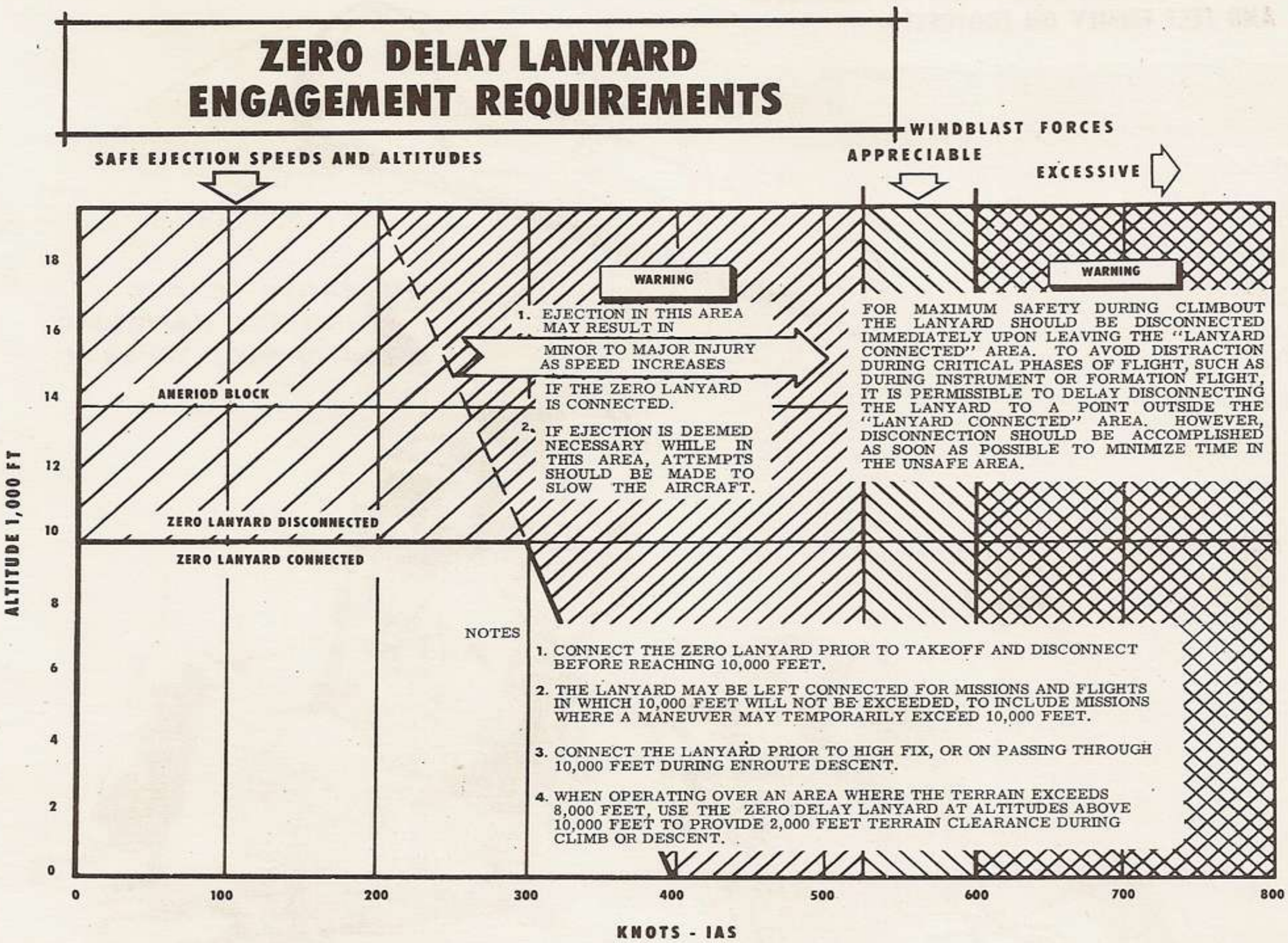

ZERO DELAY LANYARD ENGAGEMENT REQUIREMENTS
SAFE EJECTION SPEEDS AND ALTITUDES
WINDBLAST FORCES
APPRECIABLE
EXCESSIVE
WARNING
1. EJECTION IN THIS AREA MAY RESULT IN MINOR TO MAJOR INJURY AS SPEED INCREASES IF THE ZERO LANYARD IS CONNECTED.
2. IF EJECTION IS DEEMED NECESSARY WHILE IN THIS AREA, ATTEMPTS SHOULD BE MADE TO SLOW THE AIRCRAFT.
WARNING
FOR MAXIMUM SAFETY DURING CLIMBOUT THE LANYARD SHOULD BE DISCONNECTED IMMEDIATELY UPON LEAVING THE "LANYARD CONNECTED" AREA. TO AVOID DISTRACTION DURING CRITICAL PHASES OF FLIGHT, SUCH AS DURING INSTRUMENT OR FORMATION FLIGHT, IT IS PERMISSIBLE TO DELAY DISCONNECTING THE LANYARD TO A POINT OUTSIDE THE "LANYARD CONNECTED" AREA. HOWEVER, DISCONNECTION SHOULD BE ACCOMPLISHED AS SOON AS POSSIBLE TO MINIMIZE TIME IN THE UNSAFE AREA.
ANERIOD BLOCK
ZERO LANYARD DISCONNECTED
ZERO LANYARD CONNECTED
NOTES
1. CONNECT THE ZERO LANYARD PRIOR TO TAKEOFF AND DISCONNECT BEFORE REACHING 10,000 FEET.
2. THE LANYARD MAY BE LEFT CONNECTED FOR MISSIONS AND FLIGHTS IN WHICH 10,000 FEET WILL NOT BE EXCEEDED, TO INCLUDE MISSIONS WHERE A MANEUVER MAY TEMPORARILY EXCEED 10,000 FEET.
3. CONNECT THE LANYARD PRIOR TO HIGH FIX, OR ON PASSING THROUGH 10,000 FEET DURING ENROUTE DESCENT.
4. WHEN OPERATING OVER AN AREA WHERE THE TERRAIN EXCEEDS 8,000 FEET, USE THE ZERO DELAY LANYARD AT ALTITUDES ABOVE 10,000 FEET TO PROVIDE 2,000 FEET TERRAIN CLEARANCE DURING CLIMB OR DESCENT.
ALTITUDE 1,000 FT
0
2
4
6
8
10
12
14
16
18
KNOTS - IAS
0
100
200
300
400
500
600
700
800

Figure 3-6A.

SIT ERECT WITH HEAD BACK, CHIN TUCKED IN, BOTH ARMS ON ARMRESTS AND FEET FIRMLY ON FOOTRESTS.

NOTE:
BOTH HANDGRIPS MAY BE RAISED SIMULTANEOUSLY; HOWEVER, SEPARATE ACTUATION OF LEFT AND RIGHT HANDGRIPS IS RECOMMENDED.

WARNING

MINIMUM SAFE LEVEL FLIGHT ALTITUDE FOR EJECTION IS 500 FEET WITH AN AUTOMATIC BELT AND AUTOMATIC PARACHUTE (PROVIDED KEY ATTACHED TO THE PARACHUTE TIMER LANYARD IS INSERTED IN THE BELT AUTOMATIC RELEASE)

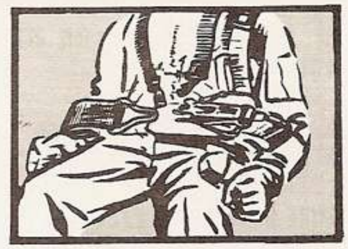
J-55(1)C

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.

J-55(2)A

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 and radio equipment lines--Disconnect. (P--RO)

3. Safety belt--Release. (P--RO)

4. 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 trailing edge of the wing. (P--RO)

FAILURE OF CANOPY TO JETTISON.

1. Canopy fast-jettison "T" handle--Pull. (P)

2. Canopy slow-fire jettison handle--Pull (if step 1 is ineffective). (P--RO)

3. Canopy lock lever--Raise (if step 2 is ineffective). As the canopy moves aft from the windshield frame, the airstream will blow it from the fuselage. (P--RO)

5. Continue with normal ejection procedure and eject through canopy (if step 4 is ineffective). (P--RO)

WARNING

To avoid the risk of neck injury which exists during ejection, with the use of certain types of equipment, ejection through the canopy should be attempted only after all efforts to jettison the canopy have failed and ejection is mandatory.

AFTER EJECTION.

1. After safety belt releases automatically, kick away from seat. (If automatic release fails, release safety belt manually). (P--RO)

WARNING

- If the safety belt is released manually, the parachute rip cord must be pulled manually.
- Do not open the safety belt prior to 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 ripcord grip immediately following separation from the ejection seat. This applies regardless of parachute type, manual or automatic.

TAKEOFF AND LANDING EMERGENCIES.

ABORT.

1. THROTTLES (BOTH ENGINES)--IDLE. (P) (ENGINES CAN BE SHUTDOWN IF REQUIRED.)

2. SPEED BRAKE LEVER--OPEN. (P)

3. WHEEL BRAKES--APPLY (MAXIMUM BRAKING OCCURS AT A POINT JUST BEFORE TIRES SKID). (P)

4. Nose wheel steering button--As required. (P)

5. Nose trim--Full down. (P)

WARNING

If hydraulic pressure is insufficient for adequate braking, depress the nose wheel steering button. This energizes the 2500 psi supplemental pump which will provide adequate pressure for braking. If this should fail, use the emergency airbrake system.

6. Emergency airbrake system--As required. (P)

7. Canopy--Jettison with canopy fast-jettison "T" handle if leaving runway. (P)

8. Inertia reel--Lock. (P--RO)

Note

All equipment should be set as required before locking inertia reel, as some smaller 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)

Note

- Leave landing gear lever in DOWN position if runway is equipped with Type MA-1A runway overrun barrier and aircraft is modified to contain the necessary arresting gear equipment.

- 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 guard and actuate. (P)

12. Agent discharge switch--Actuate. (P)

13. Battery switch--OFF. (P)

14. When stopped--Abandon airplane. (P--RO)

LANDING WITH LATERAL UNBALANCE AND CRITICAL AFT CG.

In the event the lateral unbalance cannot be corrected by using the procedures as outlined under "Fuel System Emergency Operation" (Balancing Fuel Load or Tip Tank Not Feeding) the following procedure for landing is recommended.

1. TIP TANK FUEL--DUMP. (P)

Note

Tip tank fuel dumping is dependent upon pressure to force the fuel from the tank. When pressure is lost, fuel remaining in the forward section of the tank cannot be jettisoned. Placing the airplane in a climbing attitude and initiating two or more dumping cycles will jettison most of the fuel.

2. Speed brakes--Use approximately 15 degrees for increased lateral control. There will be no drag penalty and the aileron effectiveness will be increased approximately 30%. (P)

3. If time and fuel are available, test the airplane in the intended landing configuration at a minimum altitude of 12,000 feet to determine how slow the airplane can be flown in a wings level attitude, using a maximum of 1/2 aileron throw. Touchdown should be made at this speed. (P)

WARNING

If this speed exceeds 180 knots IAS, the aircraft should be abandoned.

4. Make a straight in approach. If adequate runway exists, plan the approach and landing without flaps for better aileron control. (P)

WARNING

If it is necessary to turn the airplane, the turn should be made to the lighter side. This will provide the best control for returning to level flight. Do not exceed a 30-degree bank angle in turns and hold roll rates to an absolute minimum.

5. After touchdown open speed brakes and lower full flaps. (P)

WARNING

Under no circumstances will speed brakes be opened more than 15 degrees until aircraft is firmly on runway.

6. Maintain directional control with opposite rudder and differential braking. (P)

WARNING

- If it is necessary to turn the airplane, the turn should be made to the lighter side (side having the least fuel). This will provide the best control for returning to level flight.
- Do not exceed a 30-degree bank angle in turns and hold roll rates to an absolute minimum.
- To provide a margin of safety, aileron deflection should be limited to approximately one-half aileron throw to maintain wing-level flight. For minimum recommended approach airspeeds with asymmetrical tip fuel condition, see figure 3-8.

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. 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
30,000	141
34,000	151
38,700	160

Note

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

Touch the main wheels down at the following applicable airspeed.

Gross Weight--Lb	Landing IAS--Knots
30,000	128
34,000	137
38,700	145

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

Gross Weight--Lb	Nose Wheel Down IAS--Knots
30,000	124
34,000	131
38,700	141

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

RUNWAY OVERRUN BARRIER OPERATION.

A runway overrun barrier engagement modification is provided to prevent injury to crewmembers

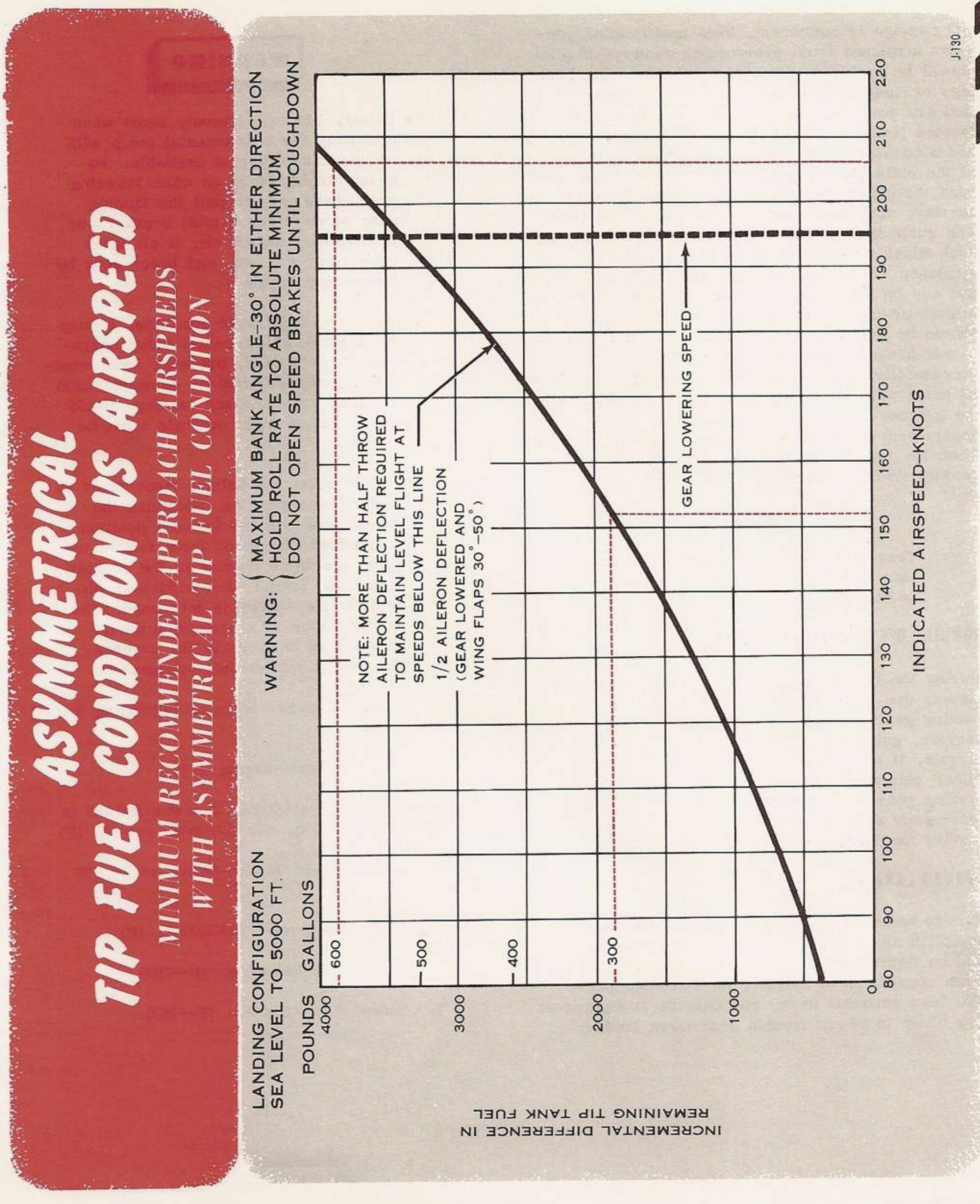

ASYMMETRICAL TIP FUEL CONDITION VS AIRSPEED
MINIMUM RECOMMENDED APPROACH AIRSPEEDS WITH ASYMMETRICAL TIP FUEL CONDITION
LANDING CONFIGURATION
SEA LEVEL TO 5000 FT.
WARNING:
MAXIMUM BANK ANGLE–30° IN EITHER DIRECTION
HOLD ROLL RATE TO ABSOLUTE MINIMUM
DO NOT OPEN SPEED BRAKES UNTIL TOUCHDOWN
NOTE: MORE THAN HALF THROW AILERON DEFLECTION REQUIRED TO MAINTAIN LEVEL FLIGHT AT SPEEDS BELOW THIS LINE
1/2 AILERON DEFLECTION (GEAR LOWERED AND WING FLAPS 30°–50°)
GEAR LOWERING SPEED
POUNDS
GALLONS
4000
3000
2000
1000
0
600
500
400
300
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
INDICATED AIRSPEED–KNOTS
INCREMENTAL DIFFERENCE IN REMAINING TIP TANK FUEL
J-130

Figure 3-8.

and damage to equipment. This modification prevents airplanes from overrunning runways if pilot should be unable to stop the airplane during landings or unsuccessful takeoffs. Airplanes so modified are equipped with a barrier triggering probe located just forward of the nose wheel gear well and a barrier guide and hook located just forward of the main landing gear. When the airplane overruns the end of the runway, the probe triggers the barrier, actuating barrier to an upright position. The guide then guides the barrier to the engaging hook which arrests the forward momentum of the airplane. Off-center engagements are successful and can be safely accomplished. Excessive use of brakes prior to engagement and during engagement should be avoided to prevent possible tire blowout. A test program showed that the airplane could be successfully arrested at speeds ranging from 29 to 83 knots with all wheels making firm contact with the ground. Maximum recommended speed for engagement is 130 knots. This system is operable when the runway is equipped with Type MA-1A runway overrun barriers.

Note

Test data for barrier engaging speeds less than 29 knots and over 83 knots is not available.

RUNNING OFF RUNWAY ON LANDING.

During the landing roll, if the airplane leaves the runway due to failure of brakes or failure of arresting gear to engage the MA-1A runway overrun barrier, guide the airplane towards the smoothest terrain, if possible. The landing gear may be either raised or left extended. If desired, the landing gear can be raised by depressing the emergency override lever and simultaneously moving the landing gear lever to UP.

FORCED LANDING.

If it is necessary to make a forced landing, accomplish as much of the procedure shown below and on figure 3-6 as possible. Land with the gear down regardless of terrain, as statistics prove that less personal injury and damage to equipment are likely to result from a gear-down landing.

WARNING

- Battery life is extremely short when operating the supplemental pump with no generator current available. To avoid turning pump on when lowering gear, have the RO pull the landing gear safety relay circuit breaker, or turn battery switch off, if all three generators are out, and lower gear by emergency means.

- If battery is in poor condition, it may not support supplemental pump operation. In this case, pressure from windmilling engines must be depended upon for final approach and landing. Rapid movement of flight controls must be avoided.

- Do not raise the 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 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.

1. Radar obsever--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. (P)

5. Wing flap lever--TAKEOFF. (P)

6. Parachute--Unbuckle. (P--RO)

7. Safety belt--Tighten. (P--RO)

8. Engine fire selector switches--Actuate. (P)

9. Canopy--Jettison with "T" handle. (P)

10. Final approach airspeed--160 knots IAS. (P)

11. Battery switch--OFF. (P)

12. Inertia reel--Locked, just before touchdown. (P--RO)

CAUTION

When the shoulder harness 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.

Note

This airplane has a "weak link" in the nose gear, allowing the gear to collapse without damage to the cockpit when excessive loads are placed on the gear.

LANDING WITH GEAR PARTIALLY EXTENDED.

If the landing gear fails to extend completely after both the normal and the emergency procedures have been used, leave as many wheels down as will extend, jettison canopy with "T" handle, and proceed with landing. Less damage will result with this procedure than with a gear-up landing.

TAKEOFF OR LANDING WITH FLAT TIRE.

If a tire blows out on takeoff and remaining runway is adequate, abort the takeoff (see Abort, this section). If a safe abort cannot be accomplished, continue the takeoff.

WARNING

Center the rudder pedals before actuating the nose wheel steering button. Engaging the nose wheel steering system while rudder pedals are deflected can make directional control more difficult by causing the airplane to swerve suddenly.

Because of the comparatively large diameter wheels and small width of tires, directional control of the airplane normally is easily maintained with rudder and wheel brakes if a main gear tire blows out on takeoff or landing. If takeoff or landing is accomplished with one nose wheel tire flat, there will be a slight veering. If a takeoff or landing is accomplished with both nose wheel tires flat, sufficient control stick back pressure should be applied to take the 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 (see figure 3-9), first attempt to 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 (from 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 this fails, actuate the external canopy lock lever to release the canopy locks, and then lift (do not roll back) the canopy from the airplane. If 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 canopy cannot be opened by the normal procedure and immediate exit is necessary, pull the canopy slow-fire jettison "T" handle. 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.

WARNING

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

Note

After compliance with T.O. 1F-89J-748, a canopy breaker tool is available for emergency exit through the canopy glass upon failure of the canopy to open through normal or emergency procedures. A canopy breaker tool is located on the right side of the control stick in the front cockpit and on the map case in the rear cockpit.

DITCHING.

This airplane should never be ditched if there is sufficient altitude for ejecting safely. Ditching is not recommended because it is assumed that the engine air intake ducts will cause the airplane to dive violently when it hits water. However, if altitude is insufficient for ejecting, 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 heading 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. Battery switch--OFF just before contact. (P)
14. Inertia reel--Locked. (P--RO)

WARNING

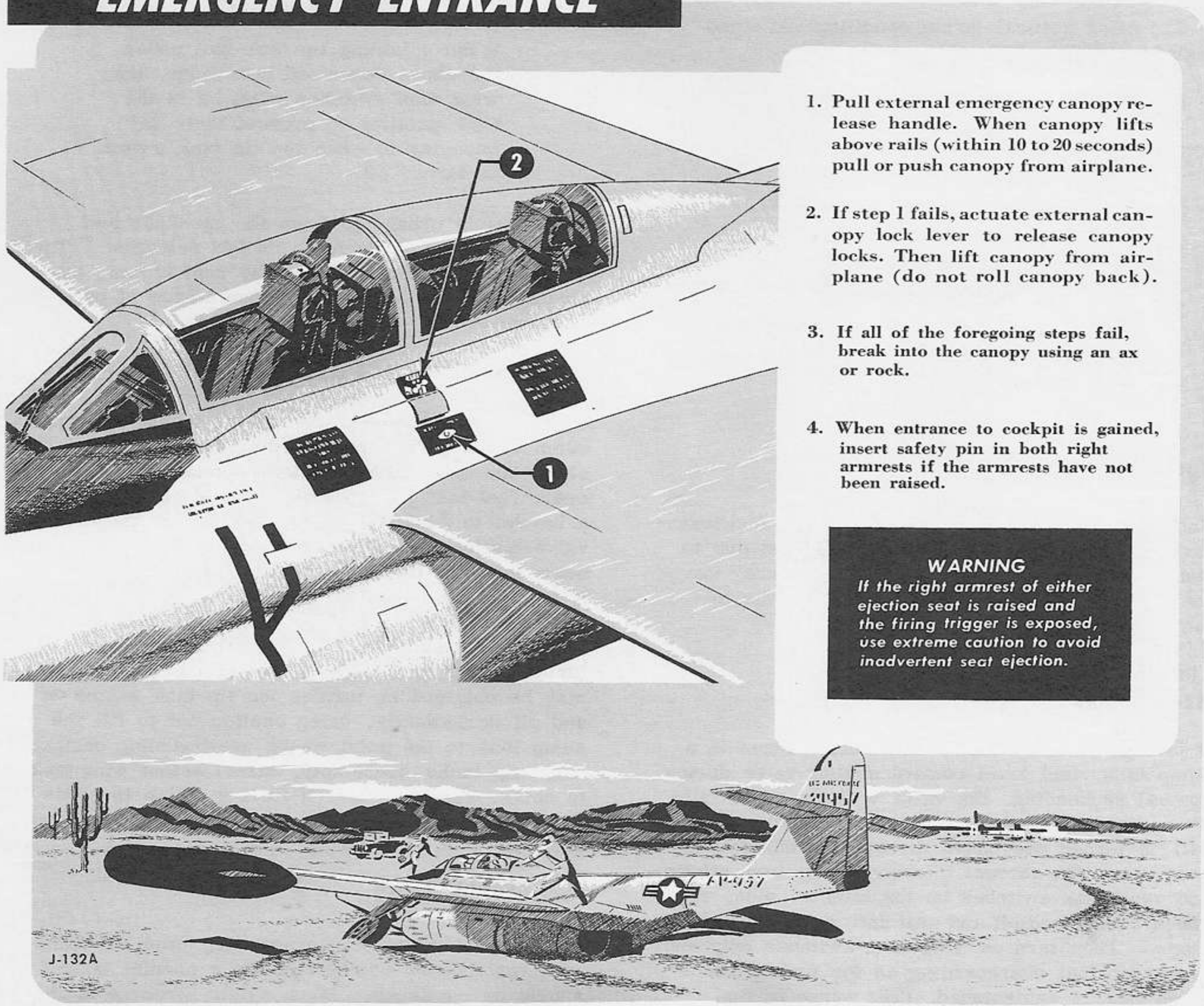
Do not attempt to ditch in a near level attitude.

OIL SUPPLY SYSTEM FAILURE.

An oil system failure is recognized by a decrease or a complete loss of oil pressure. If an oil system malfunction has caused prolonged oil starvation of engine bearings, the result will be progressive bearing failure and subsequent engine seizure. This progression of bearing failure starts slowly and will normally continue at a slow rate up to a certain point, at which the progression of failure accelerates rapidly to complete bearing failure. The time interval from the moment of oil starvation to complete failure depends on such factors as: Condition of bearings prior to oil starvation, operational temperature of bearings and bearing loads.

A good possibility exists for an additional 10 to 30 minutes of engine operation after experiencing a complete loss of lubricating oil. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration, and when the vibration becomes moderate to heavy, complete failure is only seconds away. In order to minimize engine damage and conserve remaining

EMERGENCY ENTRANCE



1. Pull external emergency canopy release handle. When canopy lifts above rails (within 10 to 20 seconds) pull or push canopy from airplane.

2. If step 1 fails, actuate external canopy lock lever to release canopy locks. Then lift canopy from airplane (do not roll canopy back).

3. If all of the foregoing steps fail, break into the canopy using an ax or rock.

4. When entrance to cockpit is gained, insert safety pin in both right armrests if the armrests have not been raised.

WARNING

If the right armrest of either ejection seat is raised and the firing trigger is exposed, use extreme caution to avoid inadvertent seat ejection.

Figure 3-9.

operating time for possible emergencies, the affected engine should be shut down upon first recognition of oil system failure, unless the additional thrust is needed to maintain flight.

Upon first recognition of sustained oil system failure, above or below oil pressure limits, complete the following:

UNDER CRITICAL THRUST CONDITION.

1. Affected engine--REDUCE THRUST (P) if affected engine thrust is needed, reduce thrust to lowest setting to maintain flight.

2. Avoid rapid throttle movement. (P)

3. Tip tank fuel--DUMP. (P)

4. Avoid abrupt maneuvers. (P) Avoid maneuvers that require excessive "G" forces.

5. After critical thrust condition--Affected engine--SHUT DOWN. (P)

6. Land at nearest airbase. (P)

UNDER NONCRITICAL THRUST CONDITION.

1. Affected engine--SHUT DOWN. (P)

2. Tip tank fuel--DUMP. (P)

3. Power setting (affected engine)--Minimum. (P)

4. Land at nearest airbase. (P)

FUEL VENT SYSTEM MALFUNCTION.

Under certain conditions of fuel vent of fuel transfer system malfunction, fuel may be lost due to overboarding. If fuel overboarding occurs, use the corrective procedures described in the following paragraphs.

FUEL LEVEL CONTROL SHUTOFF VALVE MALFUNCTION.

If foreign matter collects or water freezes in a sump tank, fuel level control shutoff valve during normal sequencing, the valve will not close fully when the sump tank is full. As a result, fuel will be forced overboard through the sump tank vent line. To correct this condition, turn off tip and wing tank switches on the affected side, recheck cross feed off and wait until overboarding stops. Then turn on wing tank switches only and check for fuel overboarding as the fuel in the sump tank is replenished. (The surge of fuel into the sump tank should break loose the stuck sump tank fuel level control shutoff valve.) If overboarding recurs, repeat the procedure. If overboarding does not recur, the condition has been corrected and normal fuel sequencing may be resumed. If overboarding cannot be corrected, fuel from the tip tank may be obtained by turning the tip tank switch on and off periodically, using caution not to fill the sump tank to the point where overboarding occurs. After the tip tanks are empty, direct select wing tanks to obtain wing tank fuel.

WARNING

When obtaining tip tank fuel under the above described conditions, the wing tank switches must be in the OFF position to prevent their sequencing in when the tip tank switch is turned off.

After fuel is exhausted from the tip tanks and wing tanks, return to ALL TANKS selection. The sump tank fuel level will not be replenished, precluding the possibility of the recurrence of overboarding.

CLIMB AND DIVE VALVE MALFUNCTION.

Climb and dive valves are located in the wing and sump tanks. Fuel overboarding from wing tank climb and dive valve is often encountered; however, fuel lost is negligible and not considered a hazard to flight. A sump tank climb and dive valve malfunction will be indicated by fuel overboarding from the sump tank vent during a climb. If this occurs, level the aircraft as soon as practicable. If the venting stops, the malfunction of the climb and dive valve is confirmed. If further climb is required, fuel from the tip tank may be obtained by turning the tip tank switch on and off periodically, using caution not to fill the sump tank to the point where overboarding occurs. After tip tanks are empty, direct select wing tanks to obtain wing tank fuel if further climb is necessary. When level flight is maintained, normal sequencing may be initiated.

FUEL OVERBOARDING.

In the event that fuel overboarding from the sump tank vent occurs during takeoff, a normal takeoff should be continued. When safely airborne at the point where distraction in the cockpit is not a factor, the procedure outlined for a stuck fuel level control shutoff valve malfunction will be initiated.

WARNING

Landing with fuel overboarding from the sump tank can be critical as the fuel may collect in the flap well and drain on to the hot engine section causing fire. Consequently, since fuel overboarding from the sump tank vent can ALWAYS be stopped by reducing the level of fuel in the sump tank, the aircraft should not be landed while fuel overboarding exists. If a compound emergency requires immediate landing while sump tank overboarding is occurring, a no flap landing should be made. When landing with fuel venting, it should be remembered that the sump tank vent line is in close proximity to the main landing gear and that the overboarding fuel could ignite from contact with hot brake discs. Consequently, minimum possible use of brakes during the landing roll is recommended.

FUEL SUPPLY SYSTEM EMERGENCY OPERATION.

SUMP TANK BOOSTER PUMP FAILURE.

If the normal booster pump in a sump tank fails, the wing tank fuel can be routed directly to the engine by placing the fuel selector switch at WING TANKS. When the wing tanks are empty the selector switch should be placed at ALL TANKS (NOSE TANK must not be selected when sump tanks are more than two-thirds full because of aft CG limitations). At low altitude, fuel will flow by gravity from the sump tank. If electrical power fails, the wing 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 (or pylon 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.

WING TANK BOOSTER PUMP FAILURE.

If the booster pump in a wing tank fails during automatic sequencing, the warning light for that tank will come on. The other wing tank on the same side will continue to supply fuel to the sump tank. During normal sequencing, the fuel in the wing tank with the inoperative booster pump cannot be used. However, at low altitude and reduced power, the tank will gravity feed to the engine if the tank selector is set at WING TANKS and the other wing tank on the same side is empty or its tank switch is at OFF.

FUEL PUMP FAILURE.

The engine-driven fuel pump has two pumping elements. If one element fails, the other element will continue to supply adequate pressure. Warning lights are provided to indicate that one or both elements have failed. These lights are for ground check only; they will not operate when airborne.

DAMAGED TANKS.

If tanks are damaged or a severe leak is suspected, take corrective action as described in following paragraphs.

Damaged Sump Tank.

If a leak is known to be in a sump tank:

1. Fuel selector switch--ALL TANKS (use sump tank fuel first). (P)

2. Tip and wing tank switches--OFF. (P)

3. Nose tank booster pump circuit breakers--Pull. (P)

Note

To preclude the possibility of an inadvertent flameout when sump tanks run dry, place fuel quantity selector switch to SUMP and monitor fuel quantity.

4. Wing tank switches--ON. (P)

5. Fuel selector switch (after sump tank fuel is used)--WING TANKS. (P)

6. Nose tank booster pump circuit breaker--Push (when wing tank fuel is nearly exhausted). (P)

7. Fuel selector switch (when wing tank empty lights come on)--NOSE TANK. (P)

8. Dump excess tip tank fuel.

Damaged Tip Tank.

If a tip tank is damaged and pressure is lost, both tip tanks will be depressurized and fuel cannot be used. Therefore, dump tip tank fuel.

Note

Tip tank fuel dumping is dependent upon pressure to force the fuel from the tank. When pressure is lost, fuel may be jettisoned by placing the airplane in a climbing attitude and initiating two or more dumping cycles.

One Tip Tank Not Feeding.

In the event fuel is not feeding from one of the tip tanks and an asymmetrical fuel condition is indicated, use the following procedure.

1. Tip tank switches--OFF to stop fuel flow from tip tanks. (P)

2. Utilize tip fuel as required (to remain airborne) down to 1500 pounds remaining, or as needed.

3. Airspeed--Increase if more than one-half throw of the stick is required to maintain a wings level attitude. (P)

WARNING

- Limiting the aileron deflection to approximately one-half throw of the stick to maintain a wings level attitude allows a margin of safety to allow for possible airspeed errors, gusts, inability to determine the exact fuel unbalance or excessive bank angles.
- If it is necessary to turn the airplane before the asymmetric fuel condition has been corrected, the turn should be made toward the lighter side. This will give the best control for returning to level flight.

4. Tip tank fuel--Dump, using normal procedures. (P)

If unsuccessful, place the airplane in a moderate speed climb and dump tip tank fuel by gravity. It is necessary to press the tip tank fuel dump button every time it becomes visually obvious that dumping from the tip tank has stopped. It will take approximately five minutes to dump the fuel by gravity.

BALANCING FUEL LOAD (P).

The fuel system crossfeed can be used to balance the fuel load (figure 3-9A). The simplest method is to feed both engines from the system having more fuel (the heavier side), until the fuel quantity gages show even distribution or the airplane trims laterally as desired. When balancing fuel, monitor the sump fuel quantity to assure that the sump fuel is not gravity feeding. The following procedure should be used to balance the fuel load:

1. Fuel quantity gages - Check quantities in individual tanks by turning fuel gage selector switch as desired to obtain individual tank quantity readings on the gage indicators.

2. Crossfeed switch - ON.

3. Fuel selector switch (for the side with less fuel) - WING TANKS (this shuts down the sump tank booster pump).

4. Wing tank pump switches (for the side with less fuel) - OFF.

5. When fuel load is balanced, return fuel selector switches - ALL TANKS, and all pump switches - ON.

6. Crossfeed switch - OFF.

CAUTION

If the tip tank on the side with more fuel (the heavier side), will not feed or maintain a full sump, use BALANCING FUEL LOAD - (TIP TANK NOT FEEDING) procedure.

BALANCING FUEL LOAD - (TIP TANK NOT FEEDING) (P).

1. Crossfeed switch - ON.

2. Fuel quantity gages - ALL TANKS. Check quantity in individual tanks by turning gage selector

switch as desired to obtain individual quantity readings on gage indicators.

3. Both fuel tank selector switches - WING TANK POSITION. (Fuel quantity will indicate remaining fuel in wing group.)

WARNING

Double flame-out may result if wing tanks are allowed to run dry.

4. Wing tank pump switches (for side with less fuel) - OFF. (Fuel quantity will read zero.)

5. Tip tank fuel - DUMP (remaining tip tank fuel will not crossfeed with fuel selector switches in the wing position).

6. When fuel load is balanced, return fuel selector switches - ALL TANKS, and all pump switches - ON.

7. Crossfeed switches - OFF.

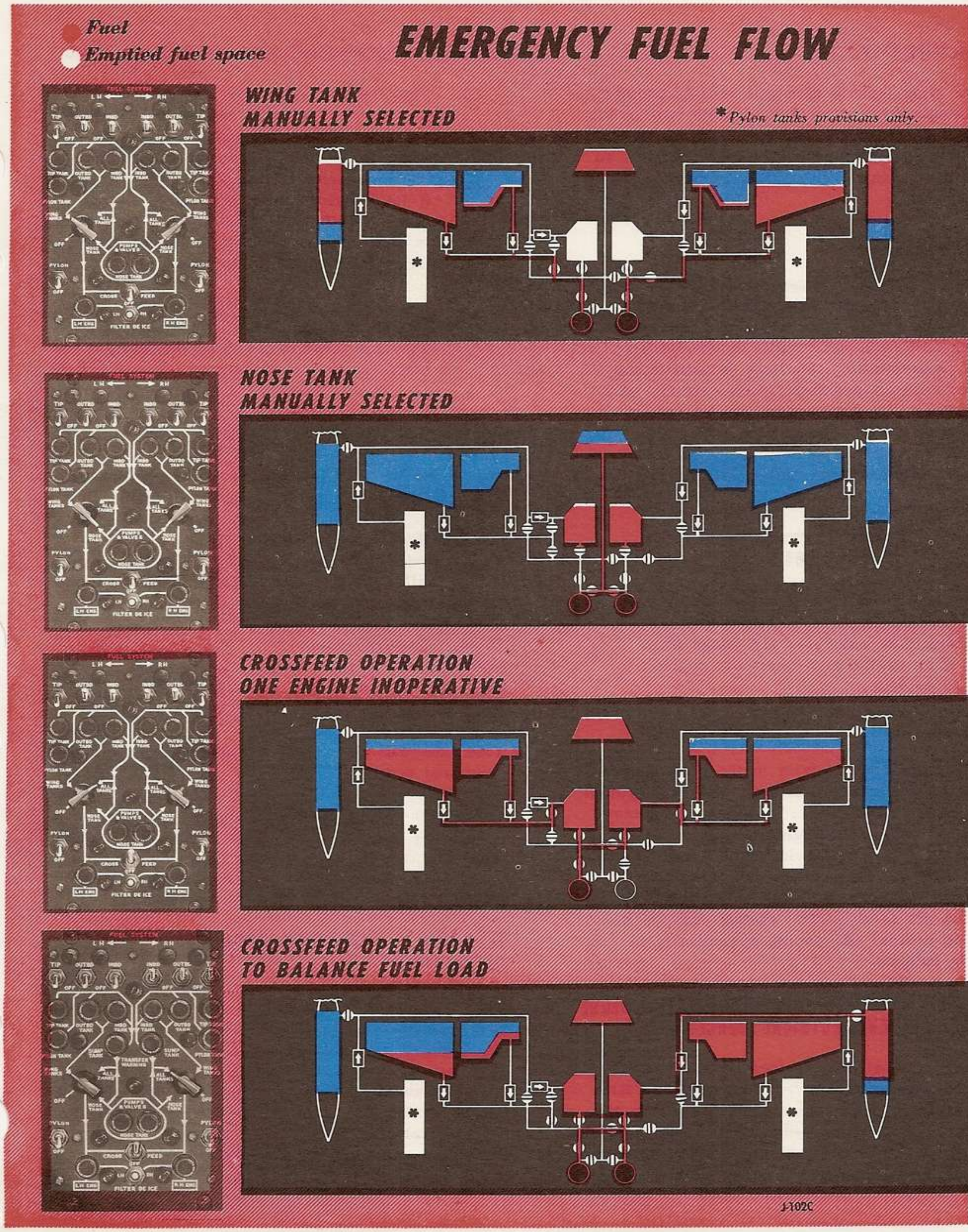

Fuel
Emptied fuel space
EMERGENCY FUEL FLOW
WING TANK
MANUALLY SELECTED
*Pylon tanks provisions only.
NOSE TANK
MANUALLY SELECTED
CROSSFEED OPERATION
ONE ENGINE INOPERATIVE
CROSSFEED OPERATION
TO BALANCE FUEL LOAD
J-102C

Figure 3-9A.

Damaged Wing Tank.

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

Damaged Nose Tank.

If the nose tank is damaged to the extent that considerable fuel will be lost (or will have to be consumed out of normal sequence), and the escaping fuel does not create an obvious fire hazard (necessitating ejection), terminate the flight as soon as possible. Use extreme care when making elevator movements because a light control stick force will be experienced when the fuel weight is removed from the nose section with sump tanks full or nearly full (aft CG).

WARNING

Escaping fuel from a damaged nose tank may enter the air intake duct of an engine and cause the engine to explode.

CROSSFEED VALVE (STUCK IN OPEN POSITION).

If the crossfeed valve fails in the open position, both engines may use fuel from one fuel system causing lateral unbalance. If fuel load becomes unbalanced from this condition, use the same procedure as for "Balancing Fuel Load" (figure 3-9A). The fuel quantity should be monitored closely so that unbalance in the opposite direction does not occur. The system may be returned to normal sequencing periodically to maintain balance.

FUEL SUPPLY SYSTEM OPERATION COMPLETE FAILURE OF ENGINE DRIVEN ELECTRICAL SOURCE.

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

1. Fuel quantity--Monitor. (P)
   Monitor fuel quantity remaining in wing tanks versus fuel remaining in tip and sump tanks. Fuel selection should be made as soon as possible to wing tanks if total fuel quantity remaining in sump tanks and tip pod tanks is less than that in the wing tanks. Turn battery switch to OFF to conserve battery power.

Note

Tip tank fuel transfers to the sump tanks under air pressure.

2. Battery switch--ON to select "ALL TANKS" when fuel is low in wing tanks, if it is necessary to extend the flight beyond the limits of available fuel in the wing tanks. Return battery switch to OFF position after making selection. (P)

3. Fuel selector switch--Leave at ALL TANKS and battery switch--OFF if wing tank fuel is not available. This will gravity feed fuel from the sump tank. (P)

4. Battery switch--ON, fuel tank selector--NOSE TANK, if it is necessary to extend the flight beyond the limits of available fuel in the sump tanks. (P)

Nose tank will not sequence automatically without electrical power.

Check fuel consumption, by time computation, to reduce use of battery as much as possible. Make tank selection first, then turn battery switch ON for 3 to 5 seconds; then turn battery switch to OFF.

ELECTRICAL SYSTEM EMERGENCY OPERATION.

See figure 1-19 for equipment rendered inoperative because of failure of the 28-volt d-c system, the 115-volt alternator system, or the a-c inverter systems. In case of complete electrical failure, do not abandon airplane as control of the airplane can be maintained. Figure 3-10 covers 28-volt d-c generator malfunction for which corrective action may be taken by the pilot.

GENERATOR OVERVOLTAGE.

If the voltage of a generator becomes excessive, an overvoltage relay will cut the generator out of the circuit and a 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)

WARNING

Use the following steps only if returning the generator to the circuit is essential.

3. Voltage regulator rheostat--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--Adjust until voltage is slightly above the voltage of the other generators. (P)

7. Generator switch--ON. (P)

GENERATOR FAILURE.

If any one of the three 28-volt d-c generators fails, the remaining two can carry the entire load. If any two generators fail, the secondary bus is automatically disconnected from the electrical system. The remaining generator supplies power to the primary bus only. If all three 28-volt d-c generators fail, and at least one cannot be reset, the following procedure is recommended.

1. Make emergency transmission and IFF--EMER. (P)

2. Select largest fuel source group. (P)

3. Battery--OFF (P)

4. All nonessential equipment--OFF. (P--RO)

5. Battery ON as required prior to landing. (P)

Note

- Battery must be on to jettison special weapons, control tip tank dump valve, pitot heat, supplemental hydraulic pump, and subsequent fuel selection.
- To dump tap 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 power distribution. See figure 3-10 for procedure in case of 28-volt d-c malfunction.

CAUTION

If vibration accompanies failure, shut down applicable engine.

ALTERNATOR FAILURE.

If the 115-volt alternator fails, all the components powered by it will be inoperative, except the IFF and the windshield defog heat. These will be switched to the main power inverter (figure 1-19) and will remain in operation. If failure results from over-voltage, turn rheostat down.

CAUTION

If vibration accompanies failure, shut down applicable engine.

INVERTER FAILURE.

If the single-phase 2250-VA main inverter fails during normal operation, as indicated by the essential bus warning light coming on, place the single-phase inverter switch at EMER, and the 2500-VA (spare) inverter will take over the load of the essential bus. The single-phase secondary NO. 2 bus will be disconnected from the 2500-VA inverter; however, the three-phase inverter system will automatically take over the load of the flight computer and the directional indicator (slaved), normally powered by the secondary NO. 2 bus. If the essential bus warning light comes on again, after emergency operation has been selected, failure of the 2500-VA inverter is indicated and the single-phase inverter switch should be placed at OFF. If the selected (main or spare) three-phase inverter fails, as indicated by the three-phase inverter warning light coming on, place the three-phase inverter switch at the other position. If the light comes on again, indicating failure of both inverters, place the switch at OFF. See figure 1-19 for equipment powered by the inverter systems.

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

OVERVOLTAGE

MALFUNCTIONING GENERATOR	OTHER GENERATORS
WARNING LIGHT ON; VOLTMETER 0-3 VOLTS; LOADMETER ZERO	LOADMETER ABOVE NORMAL

IMPROPER PARALLELING

MALFUNCTIONING GENERATOR	OTHER GENERATORS
COND 1 HIGH LOADMETER READING	LOW LOADMETER READING
COND 2 ZERO OR VERY LOW LOADMETER READING; WARNING LIGHT ON	LOADMETER ABOVE NORMAL

VERIFICATION OF TYPE OF MALFUNCTION

MALFUNCTIONING GENERATOR	OTHER GENERATORS
VOLTMETER OFF SCALE ON HIGH SIDE; LOADMETER ZERO *	LOADMETER ABOVE NORMAL
(READINGS OBTAINED WHILE MALFUNCTIONING GENERATOR RESET SWITCH IS HELD MOMENTARILY AT RESET.)	

MALFUNCTIONING GENERATOR	OTHER GENERATORS
HIGH VOLTMETER READING; ZERO LOADMETER READING	LOADMETER ABOVE NORMAL
LOW VOLTMETER READING; ZERO LOADMETER READING	LOADMETER ABOVE NORMAL
(READINGS OBTAINED WHILE MALFUNCTIONING GENERATOR RESET SWITCH IS HELD MOMENTARILY AT RESET.)	

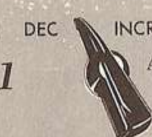
CORRECTIVE ACTION:

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 preventing possible damage by deenergizing generator field circuits.

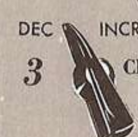
* NOTE: If voltage is normal when generator switch is placed at RESET, overvoltage was momentary and generator can be returned to service by placing switch at ON.

IMPROPER PARALLELING



1 Adjust voltage to 28 volts with voltage regulator rheostat knob.

2 Place generator switch at 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.

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Figure 3-10.

WARNING

- If there is no power to the a-c single-phase essential bus, the operation of the afterburner and afterburner eyelids will be affected. This affect is related to the altitude of the aircraft and whether the afterburner is in operation at the time power is lost to this bus. Without eyelid action there will be an extreme loss of thrust.

  1. Below 10,000 feet.

     a. While in afterburner: The afterburner operation will be unaffected. When the afterburner is terminated, the eyelids will remain open and can be closed by retarding the throttle below 90%.

     b. Not in afterburner: The eyelids will be open when the throttle for the engine is above the 90% position. Afterburner cannot be initiated.

  2. Above 10,000 feet.

     a. In afterburner: Afterburning will be unaffected. However, once afterburning is terminated, it cannot be reinitiated.

     b. Not in afterburner: The eyelids will remain closed and afterburner cannot be initiated.

- Normal operation of the afterburner and eyelids can be restored by supplying power to the a-c single-phase essential bus.

- If an afterburner a-c circuit breaker is popped, the effect for its respective engine is the same as a no a-c single-phase essential bus power.

- The eyelids may be closed by retarding the throttle to the 90% position or by moving the afterburner control circuit breaker (toggle type) to the OFF position.

- The 90% rpm mentioned above is approximate; however, eyelid closure can be determined by a rise in EGT and increased thrust.

INSTRUMENT FAILURE.

Engine Instruments.

If both the main and spare power inverters fail, all engine instruments will become inoperative except the tachometers and exhaust gas 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 single-phase inverter system, will remain at the last setting indicated before inverter failure.

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 indicator will operate as long as the inlets on the pitot tube and static ports are not iced over. The turn and slip indicator and course deviation indicator depends on 28-volt d-c power for operation. If both three-phase inverters fail, the attitude indicator will tumble. The directional indicator (slaved) and flight computer are powered by the single-phase 2500-VA (spare) inverter; if the 2500-VA inverter fails, or if emergency operation of the single-phase inverter system is selected, then the gyrosyn compass system and flight computer will receive power from the three-phase inverter system. If both single-phase (power) inverters fail, the glide-slope receiver will be inoperative. If the 28-volt d-c system fails, the free air temperature gage needle will fall against the stop, and all instruments depending on power from either the single-phase or three-phase inverter system will be inoperative.

HYDRAULIC SYSTEM EMERGENCY OPERATION.

If the right hydraulic system fails, all hydraulically operated units will operate by pressure from the left hydraulic system; however, 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 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 pressure 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 the failure is caused by engine-driven pump failure only, system pressure can be maintained with the supplemental pump, and all units normally operated by the left system will be available, although rate of response may be somewhat less than normal. Operation of speed brakes, flaps, and gear in rapid sequence should be avoided. Use of nose wheel steering should be held to a minimum because of the high volume of fluid required. If partial failure occurs through the failure of an engine but the engine is still windmilling, pressure can be expected to vary between 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 350 psi. When this valve opens, pump flow 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% or energize the supplemental pump. Engine windmill speeds to be expected are approximately 16%, 12%, and 9% rpm for 175, 140, and 100 knots IAS respectively. When hydraulic pressure is available from one windmilling engine and extreme caution is taken in *rate* of control movement, the following can be completed *independently:* extension of flaps partially or fully (if left engine is windmilling); correction for slight turbulence; 30-degree bank turns; and flareout for landings. If both hydraulic systems fail, 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. Normally, little difference will be noted 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. Under 0.80 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 which occur with the normal system in operation. The supplemental pump replenishing rate is sufficient to maintain pressure during fast actuation of the control surfaces, as would occur during flight in turbulent air. Battery life when supporting both the supplemental pump and limited use of the radios is extremely short. For this reason it is suggested that the supplemental pump be used only when absolutely necessary if 28-volt generator power is unavailable. With only the hydraulic pressure of one windmilling engine available, a safe landing can be executed; however, it is necessary to exercise extreme caution in the rate of control movement. The engine-driven hydraulic pump replenishing rate at engine windmill speeds is low, but full control deflections applied at a slow rate, as necessary for a crosswind landing, are possible. During flight in moderate to heavy turbulence, basic stability should be depended upon to a great extent for maintaining the selected 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.

SIDESLIP STABILITY AUGMENTER EMERGENCY OPERATION.

If the sideslip stability augmenter system fails, causing the airplane to oscillate violently, turn the sideslip stability augmenter switch to OFF. With the sideslip stability augmenter off, damping of the "Dutch Roll" oscillation is extremely light under flight conditions, but can be controlled by the pilot. Damping can be improved by descending to a lower altitude.

Note

On Group 50 and subsequent airplanes equipped with the modified sideslip stability augmenter, if there is a malfunction of the electronic control unit, making the stability augmenter system inoperative with the rudder trim switch in AUTO TRIM position, move the switch to MANUAL TRIM. If the power amplifier is still operative, the system will continue to provide satisfactory damping of "Dutch Roll" oscillations but may require some manual adjustment of the rudder trim knob.

Deleted

Deleted

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 such a failure, they will float back to the streamlined position when the speed brake lever is placed at CLOSED. If speed brakes fail and remain in the full open position, maximum power is required to maintain level flight up to 15,000 feet.

LANDING GEAR SYSTEM EMERGENCY OPERATION.

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 1-27) 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. Wing flap control--Takeoff position. (P)
5. Landing gear emergency release handle--Pull to full limit of travel (14 inches). Allow at least 30 seconds for gear to extend. (P)

CAUTION

The landing gear emergency release handle should be guided back to its stowed position to prevent the handle from whipping back and causing damage to cockpit equipment.

6. Main landing gear--Check visually. (P)
7. 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)
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)

CAUTION

The landing gear emergency release handle should be guided back to its stowed position to prevent the handle from whipping back and causing damage to cockpit equipment.

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)

Note

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

15. After landing touchdown, shut down right engine. (P)

GEAR FAILS TO EXTEND BECAUSE OF MECHANICAL "BINDING."

When nose gear 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)

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 then 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. To stop the airplane using brake accumulator pressure, 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. 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 blowout.

Note

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

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 emergency signal system should be used, with prearranged signals, by the pilot and radar observer for intercommunication. On airplanes not equipped with emergency signal systems, local procedure should be developed using the command control shift light or the canopy locking lever to relay messages.

SECTION IV

AUXILIARY EQUIPMENT

TABLE OF CONTENTS

CABIN AIR-CONDITIONING SYSTEM.

Air for cabin air-conditioning and pressurizing and for canopy defogging is taken from the 11th stage of the engine compressors. It then flows through a shutoff valve in the supply duct to a bypass valve and refrigeration unit. An electronic temperature-sensing system automatically determines the settings 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 single-phase inverter system.

Cabin Pressure Regulator.

The cabin is not pressurized below 12,500 feet. From 12,500 to 31,000 feet, the air pressure regulator maintains the cabin pressure at the 12,500-foot altitude pressure. Above 31,000 feet, the regulator normally maintains a constant differential pressure of 5.00 psi. For combat operation above 12,000 feet, an alternate differential pressure of 2.75 psi can be selected so that the drop in cabin pressure will not be explosive if the cabin is suddenly depressurized. If the cabin pressure regulator fails, a pressure-vacuum-relief valve 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 cabin air switch (figure 4-1) on the pilot's instrument panel controls 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 DIFFERENTIAL PRESSURE SWITCH.

The cabin differential pressure selector switch (figure 4-1), a 28-volt dc switch on the pilot's instrument panel, provides a means of selecting either of two available cabin pressures. For all normal operations this switch should be at 5.00 psi so that from 12,500 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 psi to minimize any adverse effects if the cabin is suddenly depressurized. (See figure 4-3.)

CABIN AIR TEMPERATURE SWITCH.

The cabin air temperature switch (figure 4-1) provides a means for lowering or raising cockpit temperature and is located on the pilot's aft miscellaneous panel. The cabin air temperature switch operates on 28-volt dc and has a center neutral position marked OFF; other positions are AUTO, MOM. INC, and MOM. DEC. The switch is spring-loaded to OFF from the latter two positions. When the switch is at AUTO, the cabin temperature is maintained automatically according to the setting of the cabin temperature rheostat. When the switch is held at MOM. INC or MOM. DEC, 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 cooling unit bypass valve remains in the position it is in, and the temperature of the air entering the cabin will remain constant provided that the speed of the engine and the airplane altitude remain constant. 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, can override the cabin temperature rheostat and maintain a constant defogging air temperature of 79°C (175°F).

CABIN TEMPERATURE RHEOSTAT.

The 28-volt dc cabin temperature rheostat (figure 4-1) is located on the pilot's aft miscellaneous panel. When the cabin air temperature switch is at AUTO, the cabin temperature rheostat automatically controls the temperature of the air in the cabin. The rheostat can be rotated between COOLER and WARMER as desired to control the temperature in the cabin. The rheostat is out of the circuit when the cabin air temperature switch is not at AUTO.

CABIN AIR-CONDITIONING SYSTEM NORMAL OPERATION.

1. Cabin air switch—PRESS.
2. Cabin air temperature switch—AUTO.
3. Cabin air temperature rheostat—As desired.
4. Cabin differential pressure switch—5.00 PSI.

CABIN AIR-CONDITIONING SYSTEM EMERGENCY OPERATION.

If the automatic temperature control fails, proceed as follows:

1. Cabin air temperature switch—Hold momentarily at MOM. INC for warmer air or at MOM. DEC 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 switch at RAM & DUMP.

CANOPY DEFOGGING SYSTEM.

Canopy defogging air is diverted from the cabin air-conditioning floor outlets and released through ducts along the canopy rail. The temperature of the air is maintained at 79°C (175°F) by a separate temperature-sensing unit. This sensing unit 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, one on the bottom of the pilot's center pedestal (figure 1-10) and one on the left

Figure 4-1.

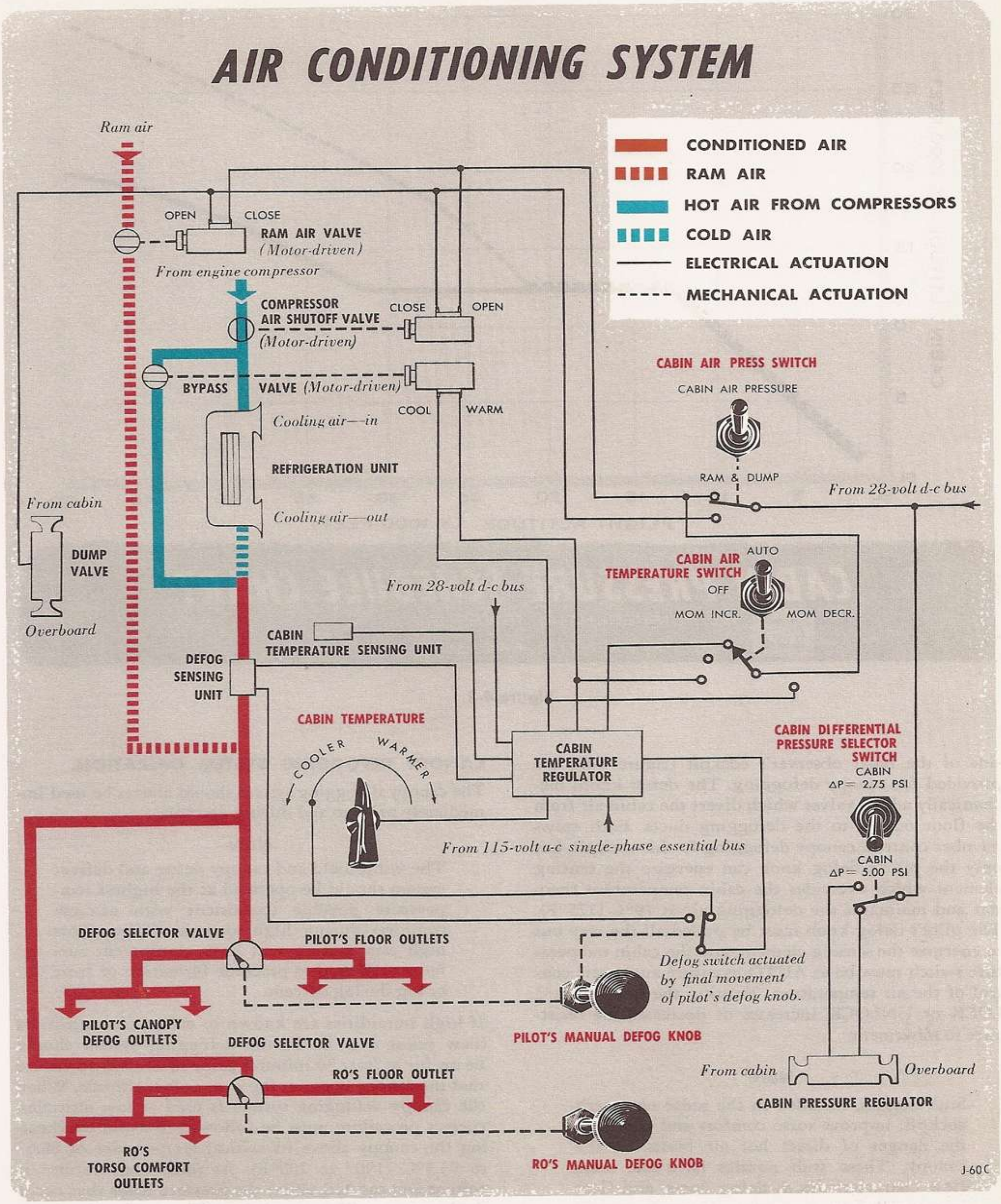
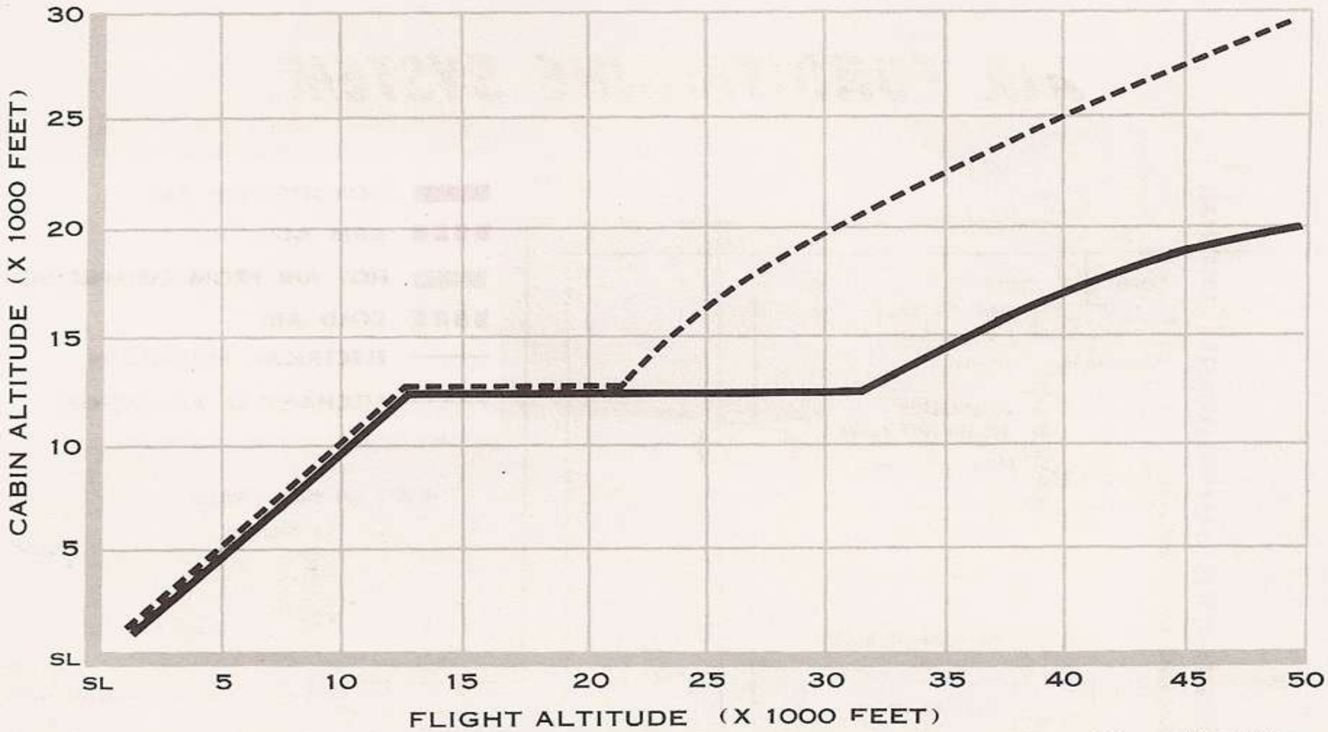

AIR CONDITIONING SYSTEM
CONDITIONED AIR
RAM AIR
HOT AIR FROM COMPRESSORS
COLD AIR
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
Ram air
OPEN
CLOSE
RAM AIR VALVE
(Motor-driven)
From engine compressor
COMPRESSOR
AIR SHUTOFF VALVE
(Motor-driven)
CLOSE
OPEN
BYPASS
VALVE (Motor-driven)
COOL
WARM
Cooling air—in
REFRIGERATION UNIT
Cooling air—out
From cabin
DUMP
VALVE
Overboard
CABIN AIR PRESS SWITCH
CABIN AIR PRESSURE
RAM & DUMP
From 28-volt d-c bus
CABIN AIR
TEMPERATURE SWITCH
AUTO
OFF
MOM INCR.
MOM DECR.
From 28-volt d-c bus
CABIN
TEMPERATURE SENSING UNIT
DEFOG
SENSING
UNIT
CABIN TEMPERATURE
COOLER
WARMER
CABIN
TEMPERATURE
REGULATOR
From 115-volt a-c single-phase essential bus
CABIN DIFFERENTIAL
PRESSURE SELECTOR
SWITCH
CABIN
ΔP= 2.75 PSI
CABIN
ΔP= 5.00 PSI
DEFOG SELECTOR VALVE
PILOT'S FLOOR OUTLETS
Defog switch actuated
by final movement
of pilot's defog knob.
PILOT'S CANOPY
DEFOG OUTLETS
DEFOG SELECTOR VALVE
PILOT'S MANUAL DEFOG KNOB
From cabin
Overboard
CABIN PRESSURE REGULATOR
RO'S FLOOR OUTLET
RO'S
TORSO COMFORT
OUTLETS
RO'S MANUAL DEFOG KNOB
J-60C

Figure 4-2.



CABIN PRESSURE SCHEDULE CHART

— 5.00 DIFFERENTIAL PRESSURE

- - - 2.75 DIFFERENTIAL PRESSURE

J-61A

Figure 4-3.

side of the radar observer's cockpit (figure 4-6), are provided for canopy defogging. The defog knobs mechanically adjust valves which divert the cabin air from the floor outlets to the defogging ducts. Each crewmember controls canopy defogging for his 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 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 should always be used immediately prior to and during descents.

Note

> The windshield and canopy defog and defrost system should be operated at the highest temperature possible (consistent with aircrew comfort) during high altitude flights. This high temperature will keep transparent surfaces preheated to preclude formation of frost or fog during descent.

If high humidities are known to exist at low altitudes (dew point over 60°F) the defogging system should be on for at least 30 minutes prior to descent to ensure that the canopy does not fog over at low altitude. When the canopy defogging system is used at low altitudes, correct procedure must be followed to avoid overheating the canopy above its critical temperature of 88.6° to 93.3°C (190° to 200°F). At these temperatures it softens and can fail under the pressure loads that occur during certain flight conditions. The overheating itself does not permanently damage the canopy, for when it cools back below the critical temperature, it regains its original strength. To obtain defogging air at the correct temperature, the following steps should be performed in the order given:

1. Cabin air pressure 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

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, to ensure controlled operation of the system.

Step *3* fixes the automatic cabin air temperature control at 79°C (175°F) only if steps *1* and *2* have been performed. Failure to perform step *1* will prevent any control of temperature or pressure. Failure to perform step *2* will leave the defogging air temperature uncontrolled, affected only by compressor air temperature and the position of the refrigeration unit bypass valve. Failure to perform step *3* will leave the 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 temperature switch is held at MOM. INC or MOM. DEC, the automatic temperature control is overridden. If the pilot's or radar observer's defogging knob is pulled out when the switch is held at MOM. INC, air at full compressor temperature is directed on the canopy and damage to the canopy may result. If either knob is pulled out when the switch is held at MOM. DEC, 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 AND ELECTRICAL ANTI-ICING SYSTEMS.

For the thermal anti-icing system, hot air is extracted from the 11th stage of the engine compressor to anti-ice the leading edge of the wings, empennage, and engine air intake scoop. In normal operation, the hot air maintains a predetermined leading edge skin temperature. 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

Figure 4-4.

temperature then drops below a predetermined value, the overheat thermistor will reopen the safety valve until the surfaces again overheat; then the cycle repeats. The engine inlet guide vanes, bullet nose, island fairings, and forward frame struts are heated by hot air bled directly from the 11th stage duct whenever the anti-icing system is in operation. Icing conditions are detected by means of a pressure-sensing icing probe located in each engine air inlet duct. When ice forms on either probe, a 28-volt dc red warning light on the anti-icing control panel illuminates, the engine screen normal controls are overridden, and the engine screens are retracted. When the airplane is parked with the power on and the anti-icing switch is at OFF, the warning light will come on and remain on, whether ice is present or not, until the engines attain a speed of 62.5% rpm. Below 62.5% engine rpm the inlet air pressure is insufficient to actuate the pressure switch. Operation of the thermal anti-icing system causes a rise in exhaust gas temperature, an increase in specific fuel consumption, and a decrease in available thrust. The electrical controls for the system operate on 28-volt dc. In the electrical anti-icing systems, 28-volt dc heating elements heat the pitot tubes, angle-of-attack probe, and engine icing probes. The fuel tank vents are energized by the 115-volt alternator. Anti-icing is necessary to ensure operation of the doors and release mechanisms. The anti-icing switch controls the circuits for all of these electrical heating units except the pitot heaters. When the airplane is on the ground, an oleo ground safety switch on the main landing gear deenergizes all circuits except the pitot heating circuit.

WARNING

Place the anti-icing switch in the FLIGHT position before final approach of a landing in icing conditions, with one or both engines operating, to provide ice protection for the wings and empennage. 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.

The 28-volt dc anti-icing switch (figure 4-4) on the anti-icing control panel controls the electrical circuits of the thermal and electrical anti-icing systems. When the red light warns that ice has formed on the engine icing probes, the switch can be turned to TAKE OFF for engine anti-icing or to FLIGHT for complete anti-icing. The probe heater circuits provide intermittent probe heat to avoid excessive heat buildup and possible probe malfunctioning. When the anti-icing switch is at TAKE OFF or FLIGHT and ice forms on the probes, the probe heating elements are automatically energized until the ice melts; they are then automatically deenergized. This cycle will be repeated as long as the engine icing condition exists, or the anti-icing switch is placed at OFF, or the circuit is broken by the landing gear strut ground safety switch. When icing conditions no longer exist, the anti-icing switch should be turned to OFF to deenergize all anti-icing circuits.

Wing Anti-Icing Override Switch.

On Group 65 and subsequent airplanes and on some earlier airplanes, a 28-volt dc wing anti-icing override switch (figure 4-4), located on the anti-icing control panel, provides manual control of the flow modulating valve in the event of failure of the normal thermistor circuit. The switch has two positions: NORMAL and EMER. When the switch is placed at NORMAL, the modulating valve is controlled automatically by the normal thermistors and the pressure control. When the switch is placed at EMER, the modulating valve will open; however, if an overpressure condition exists, the pressure control will prevent the valve from opening regardless of switch position. When the switch is at EMER, the overheat thermistor will continue to control the pneumatic safety valve.

Pitot Heat Switch.

Each pitot tube is heated by 28-volt dc power. The pitot heat switch (figure 4-4) on the anti-icing control panel can be turned to OFF and ON to control the operation of the pitot heaters. The pitot heat switch is not overridden by the oleo ground safety switch and can be turned to ON at any time. Ground operation should be kept to a minimum.

Ice Warning Light.

When ice forms on the engine probes, the 28-volt dc ice warning light (figure 4-4) on the anti-icing control panel comes on to indicate that the anti-icing system should be turned on. When the anti-icing switch is turned to TAKE OFF or FLIGHT, the light goes out and will not come on again while the anti-icing systems are energized. When the anti-icing switch is at TAKE OFF or FLIGHT, the heating elements for the icing probes are energized unless the circuits are broken by the oleo strut ground safety switch. The probe heaters operate until the anti-icing switch is turned to OFF; then the probe heaters are deenergized and the warning light will come on if ice again forms on the probes.

Anti-Icing System Operation.

The following operating procedures are recommended for use of the anti-icing system in conditions of known icing or when indicated by the ice warning light.

Takeoff. Select TAKE OFF position of 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 TAKE OFF 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 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 FLIGHT position of the anti-icing switch. This will retract the engine inlet screens if screen switch is in EMER EXTEN position, provide hot air anti-icing of the airframe leading edge surfaces and engine forward frame components, and provide electrical anti-icing of the fuel vents, and the tip pod rocket doors.

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 regulate airspeed and rate of descent as in normal descent. If ice then accumulates (additional hot air is required for anti-icing), increase the engine rpm without increasing airspeed.

Landing. Place the anti-icing switch in FLIGHT position before the final approach of a landing in icing conditions with one or both engines operating to provide ice protection for the wings and empennage. 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. Place the anti-icing switch in TAKE OFF position during approach and landing under single-engine operation in light or moderate icing conditions to provide maximum thrust in case of a possible go-around. 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 reaching a safe altitude, the anti-icing switch may be moved back to FLIGHT position. In single-engine operation excess 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.

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 fuel filter and in the engine fuel control. 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 lack of throttle response in the affected engine. Overspeeding or 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 temperature of the fuel falls below 0°C (32°F).

Low-Pressure Fuel Filter De-Ice Switch and Warning Lights.

A three-position 28-volt dc low-pressure fuel filter de-ice switch, spring loaded to OFF (center) with other positions RH (or RIGHT) and LH (or LEFT) (figure 1-17) 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 1-17), 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

RADAR OBSERVER'S COCKPIT—FRONT VIEW
(TYPICAL)

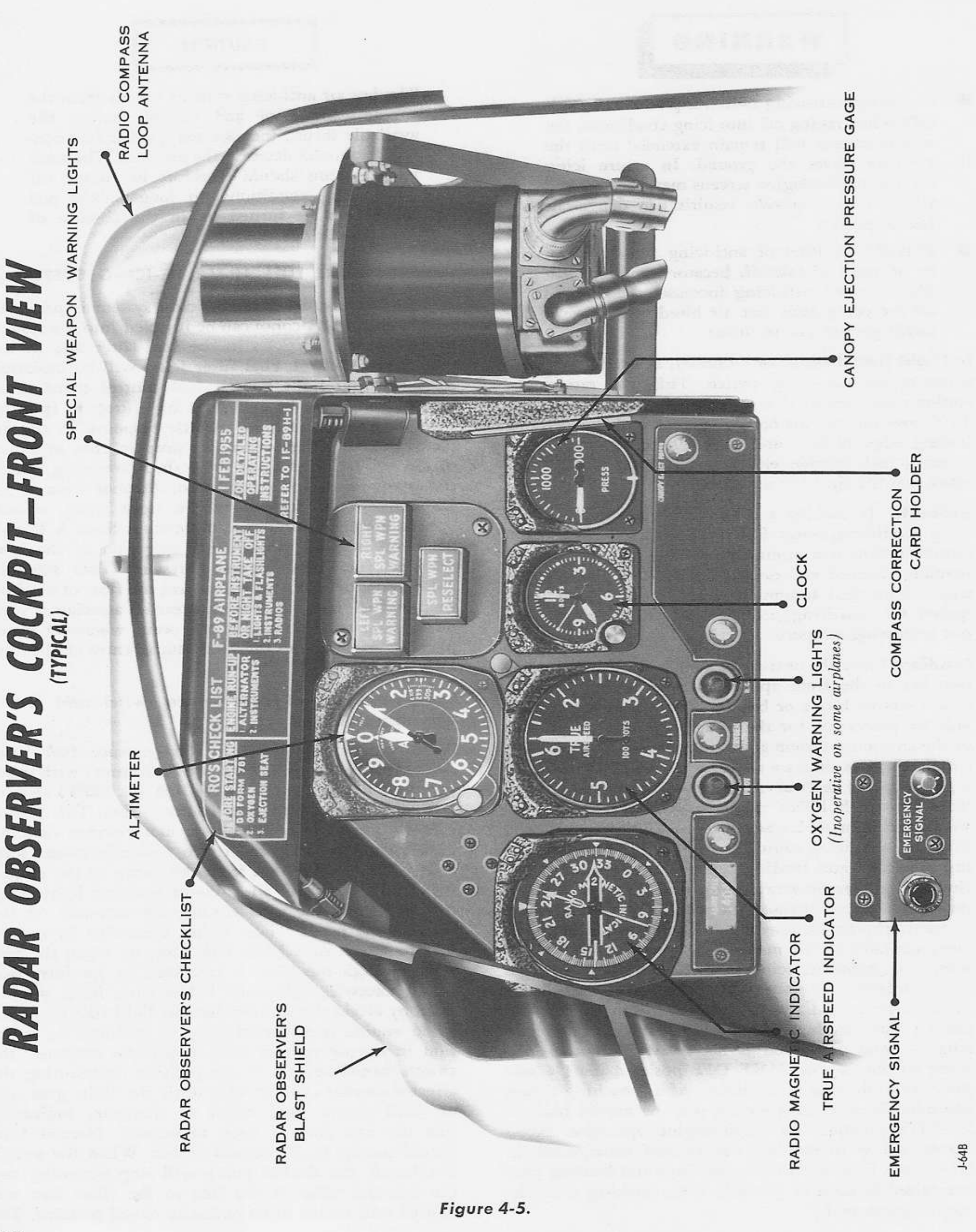


Figure 4-5.

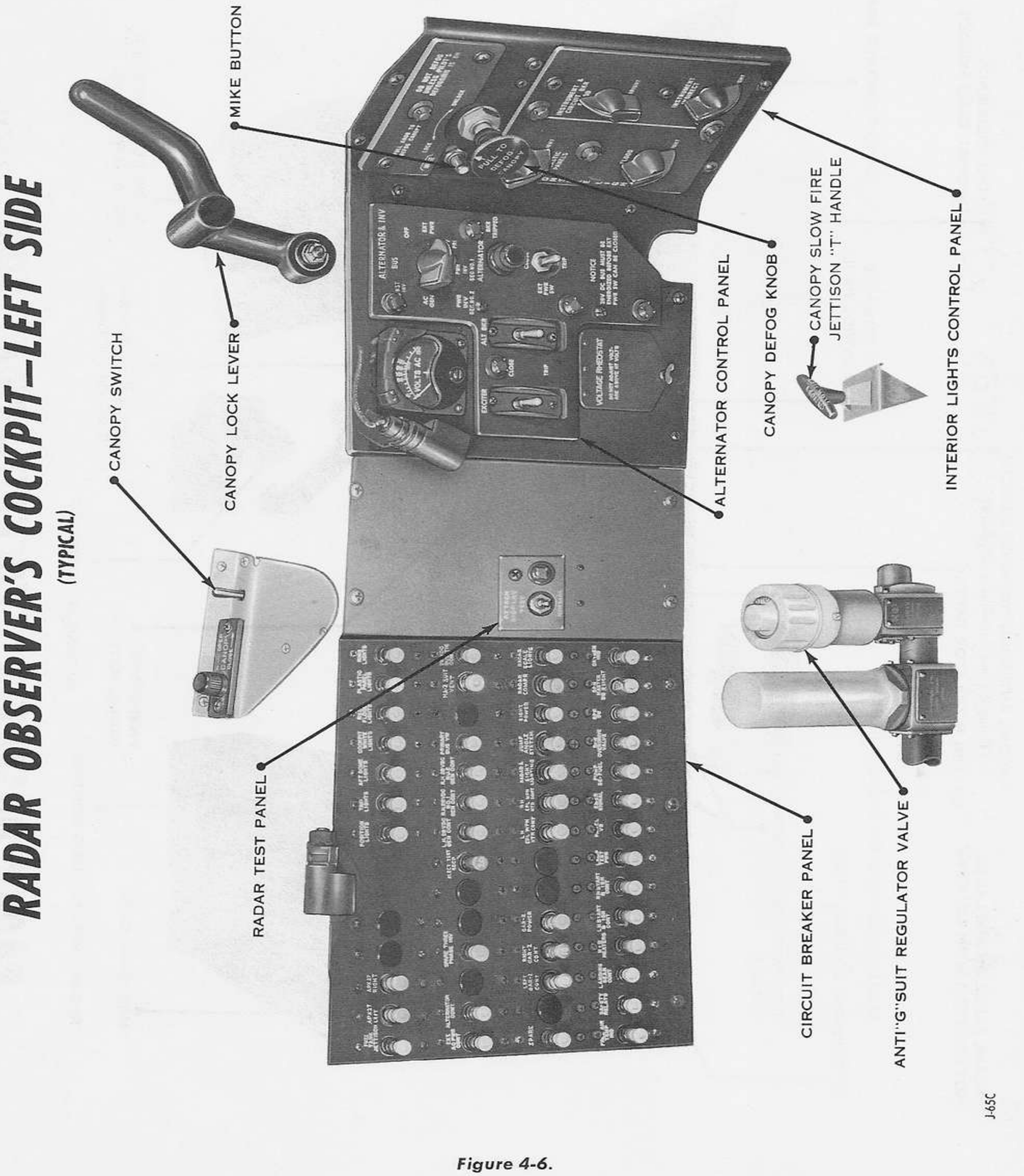

RADAR OBSERVER'S COCKPIT—LEFT SIDE
(TYPICAL)
CANOPY SWITCH
CANOPY LOCK LEVER
MIKE BUTTON
RADAR TEST PANEL
CIRCUIT BREAKER PANEL
ANTI"G"SUIT REGULATOR VALVE
ALTERNATOR CONTROL PANEL
CANOPY DEFOG KNOB
CANOPY SLOW FIRE JETTISON "T" HANDLE
INTERIOR LIGHTS CONTROL PANEL
J-65C

Figure 4-6.

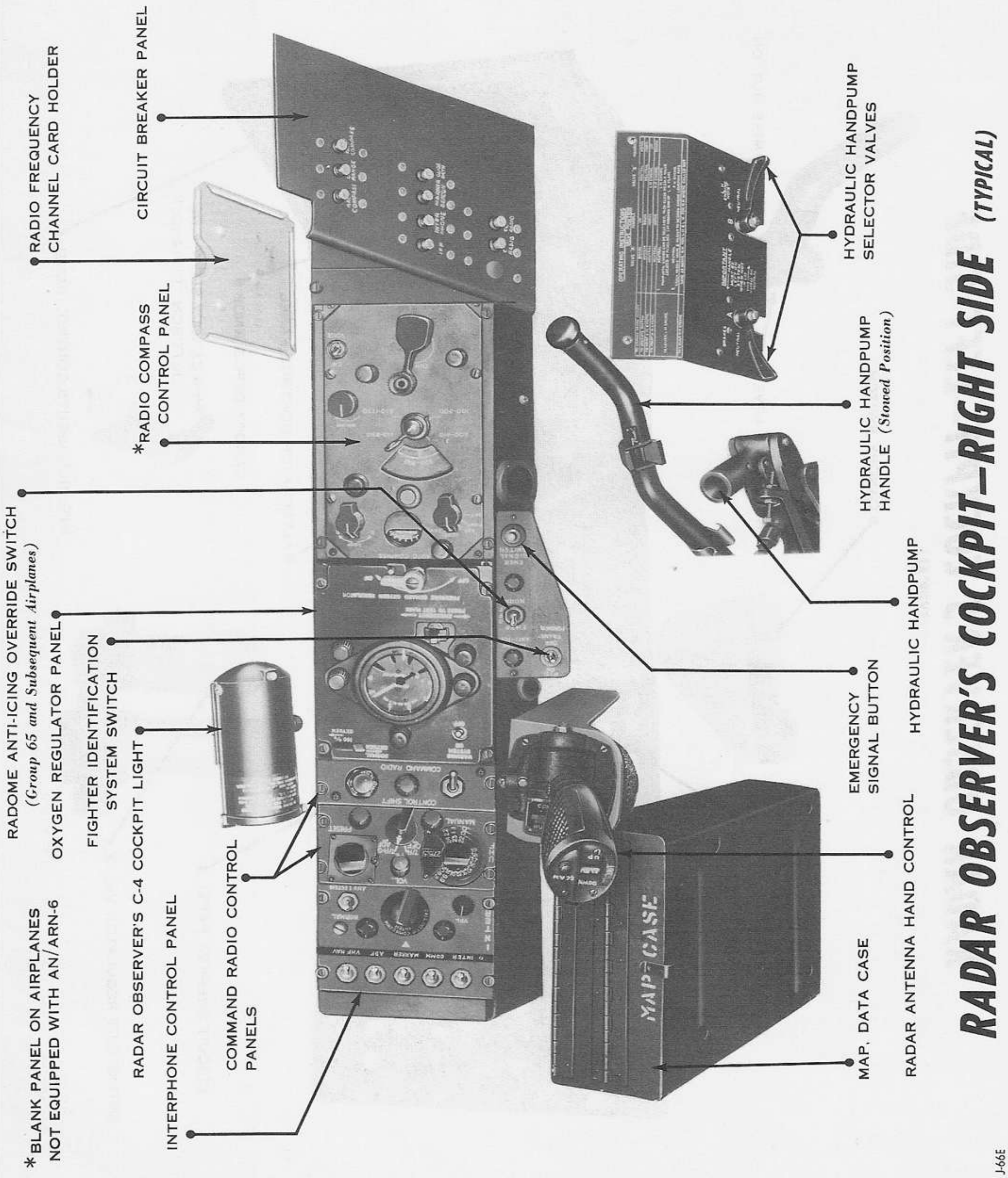

RADAR OBSERVER'S COCKPIT—RIGHT SIDE (TYPICAL)
*BLANK PANEL ON AIRPLANES NOT EQUIPPED WITH AN/ARN-6
INTERPHONE CONTROL PANEL
RADAR OBSERVER'S C-4 COCKPIT LIGHT
COMMAND RADIO CONTROL PANELS
FIGHTER IDENTIFICATION SYSTEM SWITCH
OXYGEN REGULATOR PANEL
RADOME ANTI-ICING OVERRIDE SWITCH
(Group 65 and Subsequent Airplanes)
*RADIO COMPASS CONTROL PANEL
CIRCUIT BREAKER PANEL
RADIO FREQUENCY CHANNEL CARD HOLDER
HYDRAULIC HANDPUMP SELECTOR VALVES
HYDRAULIC HANDPUMP HANDLE (Stowed Position)
HYDRAULIC HANDPUMP
EMERGENCY SIGNAL BUTTON
RADAR ANTENNA HAND CONTROL
MAP, DATA CASE
MAP CASE
J-66E

Figure 4-7.

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.

Note

The average 1 gallon per minute delivery rate of the alcohol pump will decrease as altitude increases. This will decrease the ice removing effectivity for a given period of time, however, it will increase the overall length of operating time with the given supply of alcohol.

Deleted

Note

When anti-icing fluid has been used, make notation in Form 781.

WINDSHIELD HEAT SYSTEM.

The windshield is defogged and de-iced by two transparent heat-conducting films within the windshield glass. The defrost system utilizes 28-volt dc and 115-volt single-phase inverter system ac for control and sensing circuits and alternating current from the 115-volt alternator or from the single-phase inverter system for windshield heat. The temperature is automatically controlled by heat-sensing elements and temperature regulators.

Windshield De-Ice and Defog Knob.

A 28-volt dc rotary windshield de-ice and defog knob (figure 4-4), on the anti-icing control panel, has OFF, NORMAL, and EMER positions to control the windshield defog and de-ice circuits. For defogging, the knob is placed at NORMAL; full ac power is supplied to the inner heat-conducting film and medium ac power to the outer heat-conducting film. For de-icing, the knob is placed at EMER, and full ac power is supplied to both heat-conducting films. The EMER position should be used only for heavy icing conditions, and the knob should be returned to NORMAL as soon as possible. The EMER position should never be used when the airplane is on the ground because the extreme heat applied to the outer film could damage the windshield. Primary power for windshield heat is supplied by the alternator; but if the alternator fails, the single-phase inverter system will supply power for the defogging circuits.

CAUTION

To prevent possible bubbling of the heat-conducting film in the windshield glass, leave the windshield de-ice and defog knob at NORMAL for at least 1 minute before turning it to EMER. Only in heavy icing conditions should it be turned to EMER. Never operate the system on EMER longer than necessary.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

One of three combinations of radio navigation equipment is installed in each airplane for air navigation. One combination is radio compass (AN/ARN-6), VHF (AN/ARN-14), and glide slope (AN/ARN-18). A second combination is Tacan (AN/ARN-21), VHF (AN/ARN-14), and glide slope (AN/ARN-18). A third combination is radio compass (AN/ARN-6) and Tacan (AN/ARN-21).

INTERPHONE SYSTEM AN/AIC-10.

The interphone system, operating on 28-volt dc, provides the following facilities: speech communication within the airplane with or without the use of microphone switches; communication beyond the airplane by integration with its radio equipment; monitoring of received signals either individually or simultaneously; a call facility which permits transmission of urgent communication to both headsets regardless of individual control panel switch settings; and, on airplanes modified in accordance with T.O. 1F-89-627, transmission of an audible landing gear warning signal to the pilot's

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT CHART

TYPE	DESIGNATION	FUNCTION	OPERATOR	RANGE	LOCATION OF CONTROLS
INTERPHONE	AN/AIC-10	CREW INTERCOMMUNICATION	PILOT OR RO	COCKPIT	Pilot's and RO's right consoles
UHF COMMAND	AN/ARC-27	AIR-TO-AIR AND AIR-TO-GROUND COMMUNICATION	PILOT OR RO	LINE-OF-SIGHT	Pilot's and RO's right consoles
*RADIO COMPASS (Some airplanes)	AN/ARN-6	VOICE RECEPTION, RADIO NAVIGATION	PILOT OR RO	150 MILES UNDER AVERAGE CONDITIONS	Pilot's and RO's right consoles
*VHF NAVIGATION (Some airplanes)	AN/ARN-14	VOR, VAR NAVIGATION, VOICE RECEPTION, LOCALIZER	PILOT	LINE-OF-SIGHT	Pilot's instrument panel and right console
*GLIDE-SLOPE (Some airplanes)	AN/ARN-18	INSTRUMENT APPROACH GLIDE-SLOPE	PILOT	15 MILES	Pilot's right console
MARKER BEACON	AN/ARN-12	RECEPTION OF MARKER BEACON SIGNALS ON RANGE AND LOCALIZER LEGS	PILOT	VERTICAL	Pilot's instrument panel
FLIGHT COMPUTER	A-2	APPROACHING AND HOLDING PRE-SELECTED COURSE AND ALTITUDE	PILOT	LINE-OF-SIGHT	Pilot's instrument panel
IFF-SIF	AN/APX-25	AUTOMATIC AIRCRAFT IDENTIFICATION	PILOT	LINE-OF-SIGHT	Pilot's right console
* TACAN (Some airplanes)	AN/ARN-21	DISTANCE, TRUE BEARING, AND RELATIVE BEARING TO TRANSMITTER, AND CODED AUDIO STATION IDENTIFICATION	PILOT	LINE-OF-SIGHT (MAXIMUM 195 MILES)	Pilot's right console

* *The airplane is equipped with one of the following combinations of Radio Navigation Equipment:* AN/ARN-6, AN/ARN-14, AN/ARN-18 OR AN/ARN-14, AN/ARN-18, AN/ARN-21 OR AN/ARN-6, AN/ARN-21.

J-63E

Figure 4-8.

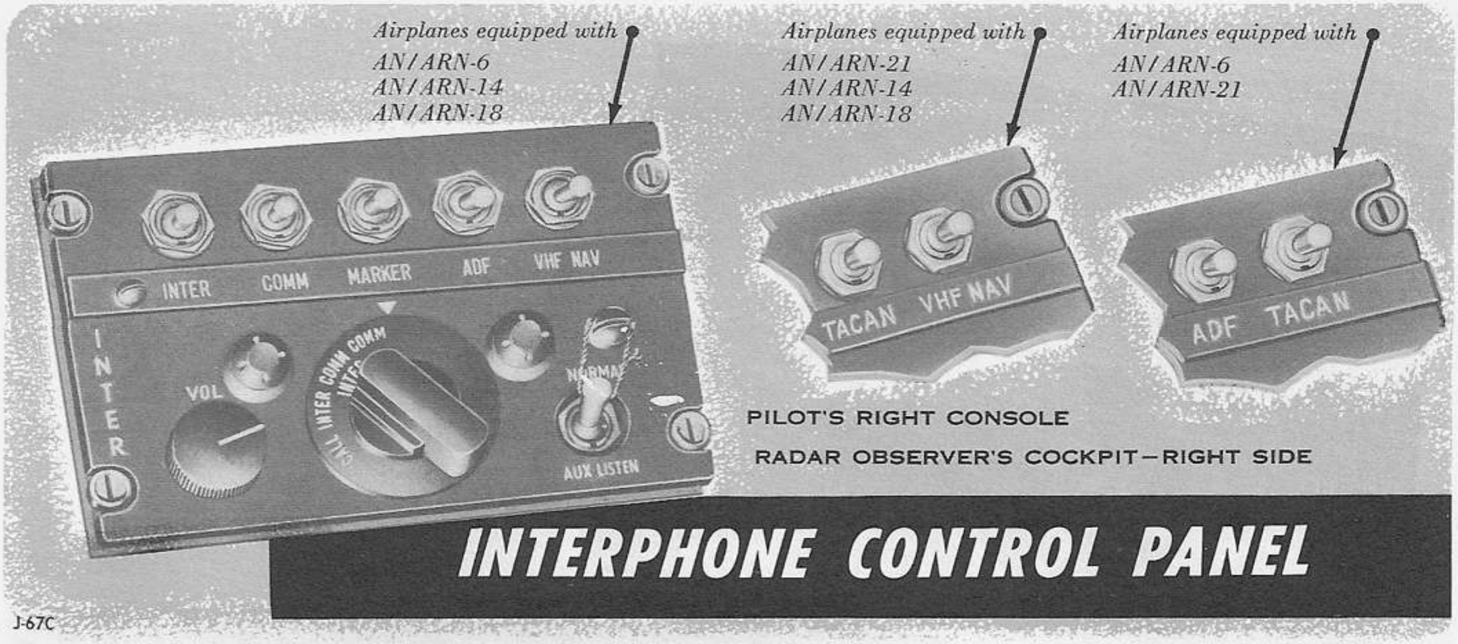


Figure 4-9.

headset when the gear is in an unsafe condition. Receptacles in the right wheel well and in the aft radio and equipment section allow communication between the airplane crew and the ground crew.

Interphone Control Panel.

An interphone control panel (figure 4-9) is located on the right console in each cockpit. Each panel has a volume control knob, five (toggle) mixing switches, a rotary selector switch, and an auxiliary listen switch. The mixing switches marked INTER, COMM, MARKER, ADF (or TACAN, some airplanes), and VHF NAV enable the operator to monitor incoming signals from all five sources (interphone, command, marker beacon, radio compass or omnirange and localizer) or to select any combination. The rotary selector switch has positions COMM, COMM-INTER, INTER, and CALL. The switch's function is conventional. For example, with the switch at COMM-INTER or CALL, the microphone is open for interphone communication, but with the switch at either COMM or INTER, the operator must press a microphone button to talk or transmit. The auxiliary listen switch has NORMAL and AUX LISTEN positions. The toggle is safetied at NORMAL (up). When the switch is moved to AUX LISTEN any incoming signals bypass the interphone amplifier and come into the headset at line level (unamplified). Only that facility of the nearest inboard monitoring switch in the ON position will be received.

ADF Filter Switch (Some Airplanes).

On airplanes equipped with AN/ARN-6 radio compass, an ADF filter switch panel (figure 1-12) is located on the pilot's right console. The filter switch is conventional in function, and has VOICE, RANGE, and BOTH positions to mix or filter voice and range signals when the radio compass is receiving on loop or antenna.

Pilot's Microphone Switches.

A pilot's microphone switch (figure 1-6) located on the throttle for the right engine, and an alternate microphone switch (figure 1-27) located on the control stick grip can be pressed to transfer the microphone input from the interphone to the command transmitter.

Radar Observer's Microphone Button and Switch.

The radar observer's microphone button (figure 4-6) is located adjacent to the canopy defog knob, 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 communicate with the pilot on the interphone. This arrangement permits the radar observer to call the pilot without using the interphone rotary selector switch at CALL position.

Interphone Operation.

1. ADF filter switch (some airplanes) — BOTH.
2. Interphone selector switch—COMM-INTER.
3. Interphone toggle switch—INTER.
4. Auxiliary listen switch—NORMAL.
5. Volume control knob—Adjust as desired.

Note

The interphone set is in operation whenever electrical power is on the airplane, unless the interphone circuit breakers (on the radar observer's circuit breaker panel) are pulled out.

Figure 4-10.

COMMAND RADIO AN/ARC-27.

The command radio set, operating on 28-volt dc, is used for air-to-air and air-to-ground communication. The range varies with altitude and atmospheric conditions. A UHF channel identification holder is on the forward right sliding canopy frame directly below the defog duct.

Command Radio Controls.

Control panels (figure 4-10) for the command radio are on the pilot's and the radar observer's (some airplanes) right consoles. Each control panel on unmodified airplanes contains a control switch, channel selector switch, volume control knob, control shift switch, a green indicator light, and, on airplanes modified in accordance with T.O. 1F-89-719, a preset channel selector knob. On these modified airplanes both the radar observer's and pilot's control panels provide manual frequency selection of all channels and preset selection of 20 channels. On all airplanes 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 to the ground or to another airplane, a microphone switch must be depressed.

Command Radio Operation.

1. Power control switch—T/R. Allow equipment to warm up for at least 1 minute.
2. Channel selector switch—Rotate to desired frequency channel. Set is now ready to transmit and receive.
3. Power control switch—T/R +G REC (T/R +G on airplanes modified in accordance with T.O. 1F-89-719), if simultaneous reception on guard-frequency channel and another channel is desired.

Note

If ADF position is selected, transmitter will be inoperative.

4. Volume control knob—Adjust as desired.
5. Microphone button—Press to transmit.
6. Power control switch—OFF, to turn set off.

CAUTION

- When the command radio set has been turned off, do not turn set on again for 1 minute. Allowing the condensers to discharge 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.

Figure 4-11.

Figure 4-12.

ADIO COMPASS AN/ARN-6 (SOME AIRPLANES).

'he radio compass, operating on 28-volt dc power, ıdicates the direction to any selected transmitting sta- on when the radio compass is set for homing opera- on of the loop antenna. The signal of this receiver is ·d to one of the needles of each radio magnetic indi- ator on the pilot's and radar observer's instrument anels.

adio Compass Controls (Some Airplanes).

n airplanes equipped with the AN/ARN-6 radio ompass, radio compass control panels (figure 4-11) re on the right console of each cockpit. Each control anel has a function switch, frequency band selector witch, loop L-R switch, volume control knob, CW- oice switch, and tuning crank. In addition, the radar bserver's panel has a maximum tuning dial. Either rewmember can gain control of the radio compass y turning the function switch to CONT.

adio Compass Operation (Some Airplanes).

1. Function switch—CONT momentarily to gain ontrol; then turn to desired position. Allow at least 5 ninutes for warmup.
2. Interphone selector switch—Any position.
3. Interphone radio compass switch—ADF.
4. Frequency band selector switch—Turn to desired requency.
5. Volume control knob—Adjust.
6. Function switch—OFF, to turn set off (both cock- pits).

Note

- Operation of the MG-12 fire control system will cause mild to severe radio interference in the AN/ARN-6 radio compass, depending upon received signal strength and frequency selected.
- The function switch in either the pilot or radar observer's cockpit will turn the set off only when the function switch in the other cockpit is also in the OFF position.

TACAN AN/ARN-21 (SOME AIRPLANES).

This equipment, operating on 28-volt dc and 115- volt ac, is designed to operate in conjunction with a specifically constructed surface navigation beacon to form a radio navigation system called Tacan (Tactical Air Navigation). This system enables an equipped airplane to obtain continuous indications of its dis- tance and bearing from any selected Tacan surface bea- con located within a line-of-sight distance of approxi- mately 195 nautical miles. The AN/ARN-21 utilizes the radio magnetic indicator, a range indicator, the course deviation indicator (vertical needle) of the course indicator, a control panel, and an instrument selector panel. The AN/ARN-21 transmits interrogation pulses, receives beacon pulses from the Tacan surface beacon, and prepares the received information for display on the bearing and distance indicators. The system operates on the following UHF transmitter frequency range: 1025 to 1150 megacycles. There are 126 frequency channels, any one of which may be selected by setting the proper controls on the control panel. The equipment is designed to operate at altitudes up to 50,000 feet.

Note

- Successful operation of the AN/ARN-21 is dependent on the availability of Tacan surface beacons. On airplanes flying with this equipment, care should be exercised not to plan flights where compatible ground stations are not operable.
- It is possible that improperly adjusted or malfunctioning ground or airborne Tacan equipment may "Lock-on" to a false heading. The error will probably be plus or minus 40 degrees, but can be any value which is a multiple of 40 degrees, and can be either side of the correct heading. The possibility of a wrong 40 degrees lock-on is inherent in the Tacan system and can on only be completely avoided by the use of other navigation equipment in addition to Tacan. After takeoff, the Tacan should be cross-checked with ground radar, airborne radar, or VOR. When using Tacan for instrument departures, penetrations or letdowns, utilize airborne radar monitor or ground radar monitor, when possible, to verify Tacan bearing information.

Tacan Control Panel (Some Airplanes).

The Tacan control panel (figure 4-12), located on the pilot's right console, has a power switch with OFF, REC, and T/R positions, two channel selector knobs, a channel window, and a volume-control knob. With the power switch in the REC position, the distance function of the set is disabled and only bearing information is available. With the power switch in the T/R position, both bearing and distance information is displayed on the indicators. The left channel selector knob selects the first two figures of the Tacan beacon channel number, and the right channel selector knob selects the third number. The volume control knob is used to adjust the volume of aural identification signal received from the Tacan surface beacon.

Note

The Tacan surface beacon channels range from 00 to 129; however, the AN/ARN-21 is designed to operate only on channels 01 to 126.

Tacan Instrument Selector Panel (Some Airplanes).

An instrument selector panel (figure 4-12) containing a two-position switch is located on the pilot's right console. One switch position is marked TACAN and the other is marked VOR-ILS. With the switch in TACAN position, the panel illuminates the area labeled TACAN and the verticle needle of the course indicator responds to AN/ARN-21 functions. With the switch in ILS position, the area surrounding ILS is illuminated, and the verticle needle responds to localizer signals used in conjunction with the AN/ARN-14 and AN/ARN-18 during an instrument landing system approach when in the 108 to 111.9 MC frequency range or omnirange operation in the 112 to 122 MC range. On airplanes equipped with AN/ARN-6 and AN/ARN-21 the VOR-ILS switch position is inoperative.

Tacan Indicators (Some Airplanes).

The three indicators for this equipment, located on the pilot's instrument panel (figure 1-7), are the NO. 2 needle of the radio magnetic indicator, the course deviation indicator, and a range indicator. Azimuth signals from the Tacan surface beacon are received by AN/ARN-21 and relayed to the radio magnetic indicator (figure 4-14), causing the NO. 2 needle to point to the magnetic bearing of the Tacan surface beacon. The bearing indication will also be indicated on the NO. 2 needle of the radar observer's radio magnetic indicator. With the control switch in the REC position, bearing information may be received even though the transmitter portion of the set is not energized. When the correct bearing information cannot be determined or the equipment is not functioning satisfactorily, the NO. 2 needle will "search" or rotate rapidly so that the pilot will be unable to obtain reliable information from the indicator. Signals received by the AN/ARN-21 from the surface beacon are also relayed to the course deviation indicator of the course indicator (figure 4-14). Deviation of the airplane course either to the left or to the right of the transmitting beacon will be indicated by displacement of the needle. The range indicator (figure 4-14) displays the distance in nautical miles between the airplane and the transmitting Tacan surface beacon. The numerals in the window are controlled by the range circuits of the AN/ARN-21. These circuits measure the time elapsed between transmissions of the signal and the reception of the response signal from the Tacan surface beacon. The time difference is then converted into digital information which is displayed on the range indicator. While the indicator is "searching" for the correct range or the switch is in REC position, the rotating numbers are partially covered by a red flag, which warns the pilot against reading incorrect distance indications.

Tacan Operation (Some Airplanes).

1. Instrument selector switch--TACAN.

2. Power switch--REC or T/R.

3. Allow approximately 90 seconds for warm-up. There is no delay when switching from REC to T/R.

4. Channel selector knobs--Adjust to appropriate dial setting.

WARNING

Check the channel setting to be sure that the bearing and distance indications are those of the desired channel and not those of a different beacon in another location selected in error.

5. Volume control--Adjust as desired.

6. Power switch--OFF, to turn equipment off.

VHF NAVIGATION SET AN/ARN-14 (SOME AIRPLANES).

This equipment receives visual omnirange, visual-aural range, localizer, and communications signals in the high-frequency range of 108.0 to 135.9 megacycles. It employs 280 channels spaced 100 kilocycles apart, in the following catagories:

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 26-volt ac from the C-4 amplifier. For instructions covering use of this equipment for autopilot-controlled approach, see Automatic Approach Equipment, this section.

VHF Navigation Set Controls (Some Airplanes).

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 from OFF 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 is calibrated in increments of one-tenth of a megacycle which appear in the bottom window of the dial.

VHF Navigation Set Indicators.

Two indicators for radio navigation equipment are on the pilot's instrument panel. A course indicator registers VOR, VAR, localizer, glide-slope, and, on some airplanes, TACAN orientation. A radio magnetic indicator combines the functions of a directional indicator (slaved) repeater with those of an azimuth indicator. A duplicate radio magnetic indicator is on the radar observer's instrument panel.

Radio Magnetic Indicator. The radio magnetic indicator (figure 4-14) includes a rotating compass card and two needles. The rotating card is coupled to the directional indicator (slaved). On airplanes equipped with the AN/ARN-6 radio compass, the signals of the radio compass are fed to the NO. 1 needle; the signals of the omnirange receiver are fed to the NO. 2 needle when the receiver is tuned to VOR transmitter. On airplanes equipped with the AN/ARN-21 Tacan set and AN/ARN-14 VHF navigation set, the NO. 1 needle is inoperative and either the AN/ARN-21 or the AN/ARN-14 omnirange signals, depending upon which set is selected, are fed to the NO. 2 needle. On airplanes equipped with AN/ARN-6 and AN/ARN-21, the AN/ARN-6 indications are fed to the NO. 1 needle and the AN/ARN-21 indications are fed to the NO. 2 needle. 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.

Course Indicator. The course indicator (figure 4-14) has a marker-beacon indicator light in 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 to or from the omnirange station; a relative heading needle, which is coupled to the directional indicator (slaved); a vertical sliding bar; and a horizontal sliding bar. When the receiver is tuned to a VOR station and the warning flags have retracted from the face of the instrument, the instrument shows which of the 360 radials of the omnirange station has been selected (course window), whether that radial course leads to or from the station (sensing window), whether the radial lies 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-slope transmitter has been tuned in, the bar will show the position of the airplane with respect to the glide slope. On airplanes equipped with both radio compass and Tacan sets, the glide-slope (horizontal) bar of the course indicator is inoperative. The vertical bar is operated by the AN/ARN-21 set. A two-dot deflection to left or right of center indicates that approximately 10 degrees of heading correction in the appropriate direction is required.

VHF Navigation Set Ground Check (Some Airplanes).

1. Single-phase inverter switch—MAIN (NORMAL).
2. Three-phase inverter switch—MAIN.
3. Directional indicator (slaved) slaving cutout switch—IN.
4. Interphone selector switch—Any position.
5. Interphone radio compass switch—ADF on airplanes equipped with a radio compass.
6. Interphone localizer switch—VHF NAV.
7. VHF power switch—ON.

Figure 4-13.

8. VHF frequency selector knob—Set on frequency of nearest omnirange station.

9. Radio compass function switch—CONT. When reaction of meter indicates that control has been obtained, turn to COMP.

10. Course indicator—Check that warning flag has retracted from vertical bar after equipment has had a 2- to 5-minute warmup.

11. Radio magnetic indicator—Note that compass card reads the airplane heading and that one needle swings to bearing of omnirange station.

12. Course set knob—Rotate to set bearing to VOR station in course window. Note that vertical bar centers, and that sensing window reads TO. Note that relative heading needle is displaced to the same side of the station as the airplane's heading. 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 the opposite side of instrument, and sensing window shows FROM. When reciprocal radial is reached, note that vertical bar comes to center.

13. 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.

14. Radio compass frequency band selector switch—Tune to nearest suitable transmitter and note that second needle of radio magnetic indicator swings to proper bearing if airplane is equipped with a radio compass.

15. VHF power switch—OFF, to shut down receiver.

16. Radio compass function switch—OFF, to turn set off.

VHF Navigation Set Operation (Some Airplanes).

1. VHF power switch—ON.
2. VHF frequency selector knob—Rotate inner and outer ring of dial to select frequency.
3. VHF volume control knob—Adjust as desired.
4. VHF power switch—OFF, to turn set off.

VHF Navigation Set—Operation with VOR (Some Airplanes).

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 the station as indicated in sensing window. Read relative heading needle to determine whether airplane is headed right or left of course. If recriprocal is desired, rotate course set knob to add or subtract 180 degrees; read course and sensing as now indicated. To fly

NAVIGATION
INSTRUMENTS
PILOT'S INSTRUMENT PANEL
COURSE INDICATOR
0 1 9
COURSE
GLIDE SLOPE
GLIDE PATH AND LOCALIZER INOPERATIVE
LOC. OR RANGE
SET
On airplanes equipped with AN/ARN-6 and AN/ARN-21
RANGE INDICATOR
(Airplanes equipped with AN/ARN-21)
0 0 3
DISTANCE NAUTICAL MILES
RADIO MAGNETIC INDICATOR
FLIGHT COMPUTER INDICATOR
SET COURSE
FLIGHT INST.
LEFT
VOR-LOC.
RIGHT
APPROACH
ON
ALT
OFF
FOR GO AROUND PUSH
SELECTOR SWITCH
FLIGHT COMPUTER
FLIGHT COMPUTER SELECTOR SWITCH
J-71C

Figure 4-14.

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. Relative heading needle will indicate drift angle. When airplane crosses 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. To turn smoothly onto radial, steer to hold point of relative heading needle on vertical bar until both are centered. Sensing will reverse when airplane crosses the radial, that is at 90 degrees to displayed radial.

VHF Navigation Set—Operation with VAR (Some Airplanes).

1. VHF power switch—ON.
2. VHF frequency selector knob—Set to desired VAR station. Allow 2 minutes for warning "Off" flag to retract from vertical bar.
3. 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 in which the airplane is flying.

4. 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.
5. Relative heading needle—Indicates heading relative to course selected.

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 an 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 (Some Airplanes).

1. VHF power switch—ON.
2. VHF frequency selector knob—Set to localizer station. Allow 2 minutes for warning "Off" flag to retract from vertical bar.
3. 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.
4. Relative heading needle—Indicates required correction angle.

VHF Navigation Set—Operation for Communications (Some Airplanes).

The receiver can be tuned to the appropriate transmitter to receive weather broadcasts, tower instructions, and general communications.

GLIDE-SLOPE RECEIVER AN/ARN-18 (SOME AIRPLANES).

The glide slope gives vertical guidance to a pilot making an instrument approach to an airport equipped with a glide-slope transmitter. The receiver has no separate control panel. It is operated and tuned by the power switch and the frequency selector knob on the VHF navigation control panel (figure 4-13), and its signals 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 from 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 the airplane on course and on glide slope for an instrument approach under adverse weather conditions. The set is powered by the single-phase inverter system.

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 (figure 4-14) on the pilot's course indicator, the aural signal through the interphone system when the interphone marker beacon switch is ON. The set operates when the 28-volt dc bus is energized.

A-2 FLIGHT COMPUTER.

The A-2 flight computer electronically combines attitude, altitude, direction, and radio information on a single instrument. The flight computer may be used in flying a constant altitude compass course, in making ground controlled approaches, in making instrument low approaches, or in establishing the proper climb angle during a go-around. The radio rate unit feeds into the computer a signal derived from the rate of change of the localizer signal as the airplane nears the runway, so that the pilot, by keeping the vertical bar centered, can fly the localizer beam heading without correcting for wind drift on the directional indicator. This added feature reduces the likelihood of over-correcting for wind drift during the latter stages of a low approach. The flight computer has a selector switch and a flight computer indicator (figure 4-14) on the pilot's instrument panel. The system is energized whenever the airplane's electrical power is on and the main or spare three-phase inverter is operating. If the main and spare three-phase inverters fail, the direction indicator on the flight computer will continue to operate; however, the horizontal and vertical bars will be inoperative.

Flight Computer Indicator.

The flight computer indicator (figure 4-14), centered at the top of the pilot's instrument panel, has a course dial, a directional indicator, and two crossbars. A course set knob is on the lower left corner of the case and a pitch-trim knob on the lower right corner. Turning the course set knob rotates the course dial to bring the desired track figure under the course index at the top of the instrument face. The directional indicator is coupled to the gyrosyn compass system so that the magnetic heading of the airplane can be read continuously on the course dial under the directional indicator. The vertical bar deflects to give an appropriate "fly right" or "fly left" indication. When the pilot turns the airplane to zero the vertical bar, the directional indicator follows the direction of the airplane as it turns onto the new course. The vertical bar will not go past zero unless the airplane is overcontrolled in making the correction. When the airplane is on the selected course, the directional indicator and the vertical bars are centrally aligned with the course index. Deviations in pitch, altitude, and glide-slope signals cause the horizontal bar to move up or down. The pitch-trim knob in the lower right corner adjusts the horizontal bar to compensate for changes in airplane pitch trim during flight. Clockwise rotation of the pitch-trim knob causes the horizontal bar to give a "fly up" indication.

Flight Computer Selector Switch.

The flight computer selector switch (figure 4-14) on the pilot's instrument panel has positions LEFT, FLIGHT INST, VOR-LOC RIGHT, and APPROACH. When the selector switch is at FLIGHT INST, the flight computer indicator is used 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, an altitude control switch on the right side of the selector switch can be turned to ON. Altitude control signals will then be sent into the flight indicator and any deviation in altitude will cause the horizontal bar to move off zero. When the altitude control switch is turned to ON, the pitch-trim knob on the 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 has turned off automatically to prevent conflicting signals from going into the flight computer. When the selector switch is at APPROACH and a go-around is necessary, the pilot can press the altitude control switch and the horizontal bar will move to indicate the optimum climbout angle.

Starting and Ground Check.

1. Three-phase inverter switch—MAIN (NORMAL).
2. Directional indicator (slaved) slaving cutout switch—IN.
3. Flight computer selector switch—FLIGHT INST.
4. Course set knob—Turn to make course dial read the heading shown by the directional indicator (slaved). When the flag disappears, indicating that the quick erector has completed its cycle, the vertical crossbar should be approximately at zero and the directional indicator should be aligned with the index.
5. Altitude control switch—ON. Horizontal bar should not move more than one needle width, if at all. Green light should be off when altitude control switch is ON.
6. Course set knob—Turn to rotate card to the right and then to the left; the vertical bar should signal "fly left" and "fly right" respectively. Turn course set knob to make course dial read the heading of the directional indicator (slaved). Vertical bar should zero and directional indicator should realign with the index.
7. Pitch-trim knob—Turn clockwise and counterclockwise. Horizontal bar should move up and down respectively.
8. VHF power switch—POWER ON.
9. VHF frequency selector knob—Turn for proper channel.
10. Flight computer selector switch—APPROACH. Vertical bar on the flight computer indicator should move to left or right, depending on position of airplane relative to the beam.
11. Altitude control switch—Push in to energize go-around circuit. Horizontal bar should indicate "fly-up" and the orange flag should appear.
12. Flight computer selector switch — VOR-LOC RIGHT. Orange flag and "fly-up" indication should disappear.
13. VHF power switch—OFF.

Flying Compass Course at Constant Altitude.

1. Selector switch—FLIGHT INST.
2. Course set knob—Rotate to bring desired track figure on course dial under the course index. Vertical bar will move to right or left.

3. Vertical bar—Note deflection and fly to rezero and to align directional indicator with course index.

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. Airplane—Fly to keep horizontal and vertical bars zeroed at all times.

Figure 4-15.

Note

When airplane configuration is changed, turn the altitude control switch to OFF, because a change in altitude may occur while establishing the new attitude.

J-2 COMPASS CONTROL PANEL (SOME AIRPLANES).

A J-2 compass system control panel is installed on the pilot's right console (figure 1-12) and contains a mode selector toggle switch, a correction toggle switch, and an annunciator. When the J-2 gyro compass precesses, the course indicator, autopilot headings, and radio magnetic indicator displays are inaccurate. The J-2 compass control panel provides a means of detecting and correcting precession error in the J-2 compass system. The system operates on three-phase, 115-volt ac and 28-volt dc and is operative at all times during flight. A 28-volt dc power lock-in relay is added to the circuitry to provide a self-sustaining dc circuit during changeover of the load transfer relay. Therefore, if the single-phase or three-phase inverters fail, causing the load transfer relay to be actuated, the 28-volt dc lock-in relay will be energized to provide uninterrupted power to the J-2 compass system.

Mode Selector Switch (Some Airplanes).

The mode selector toggle switch (figure 4-15) has DG placarded above and MAG below the toggle switch. The switch can be placed in either position. In areas where magnetic mode of operation is unreliable, use the DG mode of operation.

Correction Switch (Some Airplanes).

The correction toggle switch (figure 4-15) is marked DEC on the left and INC on the right and can be moved toward DEC or INC to center the annunciator needle. When the mode selector switch is in MAG mode of operation, if the annunciator needle is noted in a position other than center, precession error in the J-2 compass system is indicated, and the correction toggle switch can be moved as required to center the annunciator needle.

Annunciator (Some Airplanes).

An annunciator dial and needle is on the J-2 compass control panel (figure 4-15). The dial is marked INC on the left and DEC on the right. When the selector switch is in the MAG mode of operation, the annunciator needle displays precession error by moving to the left or right of the center position. The annunciator needle, with selector switch in MAG mode, indicates to the pilot the direction of precession error in the J-2 compass system.

Note

When operating in DG mode, annunciator indications of precession are inaccurate and are not to be used.

J-2 Compass Control Preflight Check (Some Airplanes).

1. Mode selector switch—MAG. Allow the system to operate for a minimum of 3 minutes. This will allow the system to become stabilized.

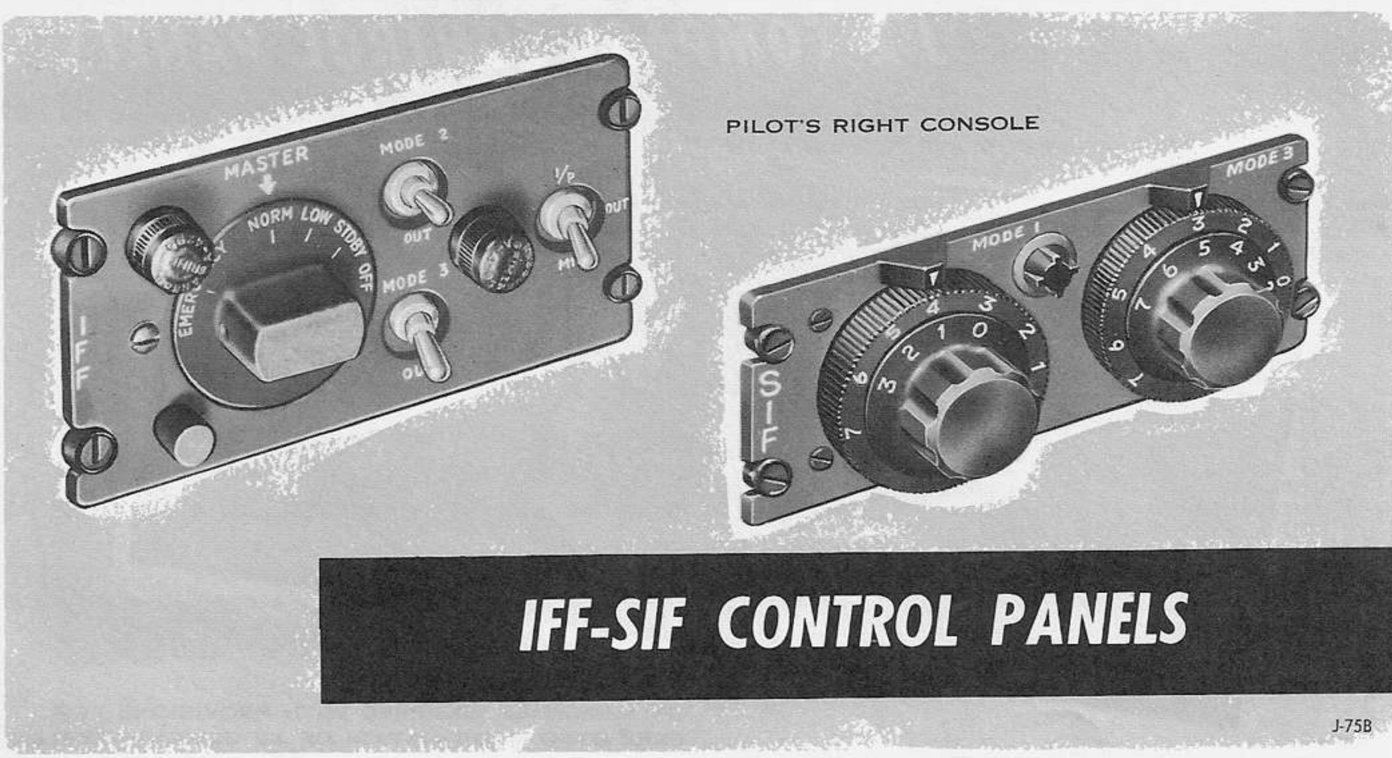


Figure 4-16.

2. Correction switch—INC. The annunciator needle should move to the right.

3. Correction switch—DEC. The annunciator needle should move to the left.

4. Mode selector switch—DG.

5. Correction switch—INC. The annunciator needle should move to the right.

6. Correction switch—DEC. The annunciator needle should move to the left.

J-2 Compass Control Normal Operation—MAG Mode of Operation (Some Airplanes).

When the annunciator needle has moved from the center position, precession error exists in the J-2 compass system. To correct this precession error, use the following procedure:

1. Mode selector switch—MAG.

Note

In areas where the magnetic (MAG) mode of operation is unreliable, use the DG mode of operation.

2. Correction switch—Move to INC or DEC as required to center the annunciator needle.

J-2 Compass Control Normal Operation—DG Mode of Operation (Some Airplanes).

To correct predetermined precession error use the following procedure:

1. Mode selector switch—DG.

2. Correction switch—Move to INC or DEC as required to correct predetermined precession.

Note

Annunciator indications of precession in DG mode of operation are inaccurate and unreliable. Corrections in DG mode must be for predetermined precession error.

IFF-SIF AN/APX-25.

The purpose of the IFF equipment is to identify as friendly the airplane in which it is installed when challenged by an interrogator-responsor associated with friendly radars. When a radar target is accompanied by a proper IFF reply, that target is considered friendly. This system operates on 28-volt dc from the primary bus, and 115-volt ac from the auxiliary ac bus.

IFF-SIF Control Panels.

Two control panels (figure 4-16) marked IFF and SIF on the right console contain the system master switch, two mode switches, two code selector switches and an I/P switch. The master switch has OFF, STDBY, LOW, NORM, and EMERGENCY positions. In the STDBY position the set is inoperative but ready for instant use. In the LOW position, the set operates on reduced power and responds only to strong interrogations. In the NORM position the set operates on full power for maximum performance. In the EMERGENCY position the set replies to all modes of interrogation with a special coded signal to indicate an emergency. The mode 2 switch is used for personal identification. The mode 3 switch is used for traffic identification. The I/P switch is used to provide momentary identification of position when held in the I/P position. When placed at MIC, the position signals are transmitted while the microphone button is depressed. Two rotary code selector switches are used to select the specified code signals to be used in mode 1 or mode 3 operation. The specified coded signals to be used in mode 2 are preset.

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 the master control knob to EMERGENCY. An ejection notification switch is installed on each crewmember's ejection seat. When either pilot's or radar observer's seat is ejected from the airplane, the ejection notification switch automatically actuates the emergency mode of the system if either NORM or LOW has been selected.

LIGHTING EQUIPMENT.

EXTERIOR LIGHTING.

Position Lights and Control Switches.

The position lights are conventional in color and arrangement and operate on 28-volt dc. The position light switch (figure 4-17) on the pilot's aft miscellaneous control panel has STEADY, OFF, and FLASH positions for controlling the operation of the lights. A switch to the left of the position light switch has DIM or BRIGHT positions to determine the intensity of the position lights. A flasher unit flashes the position lights at 40 cycles per minute; if the flasher unit fails, steady operation of the lights is automatic. The circuit breaker for the position lights is on the radar observer's circuit breaker panel.

Anti-Collision Light and Control Switches.

Two red rotating beacon type lights are provided for anti-collision warning after completion of T.O. 1F-89J-559. One light is mounted aft of the canopy and the other is mounted on the under side of the left engine nacelle. The switch for these lights is mounted on the pilot's right console panel just aft of the oxygen regulator panel. The circuit breaker is located on the pilot's left circuit breaker panel.


PILOT'S AFT MISCELLANEOUS CONTROL PANEL
STEADY
POSITION LIGHTS
OFF
FLASH
DIM
BRIGHT
POSITION LIGHTS CONTROL PANEL
LANDING-TAXI LIGHT SWITCHES
PILOT'S LEFT VERTICAL CONSOLE
SPL WPN & TANK JETT
LDG & TAXI LIGHT
EXTEND
LANDING
OFF
RETRACT
TAXI
LIGHTING CONTROL PANELS
INTERIOR LIGHTS CONTROL PANEL
DIM OFF
BRIGHT
LH
RH
PLASTIC PANEL
CONSOLE LIGHTS
PANEL FLOOD
CONSOLE FLOOD
PILOT'S RIGHT CONSOLE
INSTRUMENT PANEL LIGHTS CONTROL PANEL
INSTRUMENT PANEL LIGHT
ENGINE
FLIGHT
PILOT'S RIGHT CONSOLE
DIM OFF
BRIGHT
THUNDERSTORM LIGHTS
PILOT'S RIGHT CONSOLE
THUNDERSTORM LIGHTS RHEOSTAT
(Group 45 and subsequent airplanes)
J-76B

Figure 4-17.

Note

The rotating anti-collision lights may be turned off during flight through actual instrument conditions. With the light on during instrument conditions, the pilot could experience vertigo as a result of the rotating reflection of the light against the clouds. In addition, the light would be ineffective as an anti-collision light under these conditions since it could not be observed by pilots of other airplanes.

Landing-Taxi Light and Control Switches.

A single retractable light, located on the underside of the fuselage nose section just forward of the nose wheel, serves for both landing and taxiing. The light is controlled by two switches (figure 4-17) on the left vertical console: an extension-retraction switch with EXTEND, RETRACT, and OFF positions; and a light switch with LANDING, TAXI, and OFF positions. The light is extended or retracted by placing the extension-retraction switch at EXTEND or RETRACT. The light 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 light is fully extended or retracted. The light is turned on and off by the light switch. When the switch is placed at LANDING (with the extension-retraction switch at EXTEND), the light 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 light is positioned at the correct angle for taxiing (about 7 degrees higher beam than for landing), and the light beam widens and dims. The light can be turned on before extension, if necessary, so that the heat generated by the filament will de-ice the light assembly. After retraction, the light must be turned off by the light switch. The light and control switches are powered by the 28-volt dc bus.

CAUTION

To prevent damage to the light by the intense heat it generates, do not use the light in the landing position longer than necessary nor use the light in taxi (or landing) position when the airplane is not moving.

Note

When changing from one position of the light (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 light will remain in the original position.

INTERIOR LIGHTING.

Pilot's Cockpit Lighting.

Red floodlights, operating on 28-volt dc, light the pilot's instrument panel and cockpit area. Two are on the movable section of the instrument panel glare shield; others are on the left side and right side of the cockpit structure. Three red floodlights, spaced evenly below the rail on each side of the cockpit, light the pilot's consoles. Red bulbs under individual ring-type, hinged lighting shields illuminate the flight instruments, the fuel flowmeter, indicators, and the fuel quantity gages; the engine instruments are lighted by the red floodlights. The lights for the engine instruments are on one circuit and the lights for the flight instruments on another, so that the two groups of lights can be used 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. On Group 45 and subsequent airplanes, two rheostat-controlled thunderstorm lights, operating on 28-volt dc, are provided to counteract temporary blindness when eyes, adapted to the dark, are exposed to lightning flashes. These lights also provide interior illumination required for high-altitude daytime flying. They consist of two white floodlights mounted one on each side of the pilot's cockpit approximately 4 inches above the left and right consoles and aligned so that their light beams converge on the lower center of the instrument panel. On the cockpit lighting control panel individual rheostats are provided to control the operation and intensity of the floodlights, instrument ring lights, and indirect lighting. All lighting circuits for the pilot's cockpit are protected by circuit breakers on the pilot's circuit breaker panel. A stowage case for spare bulbs is attached to the bulkhead aft of the right console.

Pilot's Cockpit Lighting Rheostats.

Six 28-volt dc rheostats (figure 4-17), outboard of the pilot's right console, rotate from OFF to DIM to BRIGHT to control the pilot's cockpit lighting circuits. The first rheostat, at the forward end of the pilot's cockpit lighting control panel, controls the plastic panel lights; the second, the console lights. The third controls the instrument panel floodlighting, and the fourth, the console floodlighting. The fifth rheostat controls the ring lighting for the flight instruments; the sixth, lighting for the three fuel quantity gages and the eight engine instruments. On Group 45 and subsequent airplanes, a thunderstorm light rheostat (figure 4-17), mounted outboard of the pilot's right vertical console, rotates from OFF to DIM to BRIGHT to control both thunderstorm lights.

Radar Observer's Cockpit Lighting.

Two 28-volt dc red floodlights, mounted under the radar observer's glare shield, light the cockpit area. Two red bulbs under individual ring-type lighting shields illuminate each instrument on the instrument panel. The shields are hinged to permit replacement of the bulbs. All other panels have indirect or floodlight lighting. A C-4 cockpit light can be swiveled or removed from its mount for either red or white lighting. Rheostats control the operation and intensity of the floodlights, instrument ring lights, and indirect panel lighting. The circuit breakers for the lights are on the radar observer's circuit breaker panel.

Radar Observer's Cockpit Lighting Rheostats.

Four rheostats (figure 4-6), located forward of the alternator control panel in the radar observer's cockpit, provide means for regulating the radar observer's cockpit lighting. These rheostats rotate from OFF to DIM to BRIGHT. The rheostat at the top left controls the lighting of the console plastic panels; the one at the top right controls the instrument and circuit breaker floodlights; the one at the bottom left controls the console floodlights; and the bottom right rheostat controls the instrument indirect lights.

Pilot's and Radar Observer's C-4 Cockpit Lights.

A removable 28-volt dc swivel-mounted C-4 cockpit light with a red filter is on the right side of each cockpit. The pilot's light is stowed on the left console with an alternate socket on the left windshield frame. A knob near the back of the light case turns the light 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 can be moved for spot or flood lighting; 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 system 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, loss of pressure in one cylinder will result in the check valves being seated in the three remaining cylinders. The mate of the tank losing pressure is the only remaining source of oxygen to the crewmember being supplied by the system containing the damaged tank. 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 4-18.

D-2 OXYGEN REGULATOR (SOME AIRPLANES).

A diluter-demand oxygen regulator with a pressure gage and flow indicator (figure 4-19) is in the oxygen regulator control panel 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), where the regulator delivers pure oxygen, the oxygen pressure increases sharply with altitude until the regulator delivers maximum pressure.

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	BELOW 100
35,000 & ABOVE	**5.7** / 5.7	**4.9** / 4.9	**4.0** / 4.0	**3.2** / 3.2	**2.4** / 2.4	**1.6** / 1.6	**0.8** / 0.8	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
30,000	**4.1** / 4.2	**3.5** / 3.6	**2.9** / 3.0	**2.3** / 2.4	**1.8** / 1.8	**1.2** / 1.2	**0.6** / 0.6	
25,000	**3.2** / 4.0	**2.7** / 3.4	**2.3** / 2.8	**1.8** / 2.3	**1.4** / 1.7	**0.9** / 1.1	**0.5** / 0.6	
20,000	**2.4** / 4.5	**2.1** / 3.8	**1.7** / 3.2	**1.4** / 2.6	**1.0** / 1.9	**0.7** / 1.3	**0.3** / 0.6	
15,000	**2.0** / 5.4	**1.7** / 4.7	**1.4** / 3.9	**1.1** / 3.1	**0.9** / 2.3	**0.6** / 1.6	**0.3** / 0.8	
10,000	**2.0** / 5.4	**1.7** / 4.7	**1.4** / 3.9	**1.1** / 3.1	**0.9** / 2.3	**0.6** / 1.6	**0.3** / 0.8	

BOLD FACE (UPPER) FIGURES INDICATE DILUTER LEVER "100%."
LIGHT FACE (LOWER) FIGURES INDICATE DILUTER LEVER "NORMAL."

OXYGEN DURATION HOURS TABLE

CYLINDERS: 4 TYPE F2

CREW: 2

The above figures apply whether one or two crewmembers are using oxygen, as each member's system is separate from the others.

J-78B

Figure 4-18.

A relief valve in the regulator prevents excessive pressure in the oxygen mask.

Regulator Supply Lever (Some Airplanes).

The oxygen supply lever (figure 4-19) on the regulator panel controls oxygen flow to the regulator. The radar observer's oxygen supply lever should be turned OFF when 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.

WARNING

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 (Some Airplanes).

The diluter lever (figure 4-19) 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 4-19) 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.

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.

This system has been made inoperative.

Oxygen System Pressure Gage and Flow Indicator (Some Airplanes).

A combination pressure gage and flow indicator (figure 4-19) on the oxygen regulator panel registers the pressure of the oxygen supply on the upper half of the dial. 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 the 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 descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

Oxygen Hose Hook-Up.

Refer to figure 4-20 for proper oxygen hose hook-up procedures.

Oxygen System Preflight Check (D-2 Regulator).

1. Oxygen regulator—Check with diluter valve first at NORMAL OXYGEN and then at 100% OXYGEN by blowing gently into the end of the regulator tube as during normal exhalation. If there is resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a leak or malfunction.

Note

Conduct the following check with regulator supply valve at ON, oxygen mask connected to regulator, diluter lever at 100% OXYGEN, and normal breathing.

2. Blinker—Observe for proper operation.
3. Emergency toggle lever—Deflect to right or left. A positive pressure should be supplied to mask. Hold breath to determine if there is leakage around mask. Return emergency toggle to center; positive pressure should cease.
4. Diluter lever—Return to NORMAL OXYGEN.

Oxygen System Normal Operation.

1. Regulator diluter lever—NORMAL OXYGEN.
2. Regulator supply lever—ON.

Oxygen System Emergency Operation.

If either of the crew detects symptoms of hypoxia or if smoke or fuel fumes enter the cabin:

1. Regulator emergency lever—EMERGENCY.
2. Regulator diluter lever—100% OXYGEN.
3. Regulator emergency lever—NORMAL after assured of positive oxygen flow and symptoms of hypoxia have disappeared.

Note

The duration of the oxygen supply is reduced when either of the crew turns to 100% OXYGEN or leaves the emergency lever in other than NORMAL position.

4. Oxygen diluter lever—NORMAL OXYGEN after the emergency. If the oxygen regulator fails or if the mask develops a severe leak, use emergency oxygen. 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.

MD-1 OXYGEN REGULATOR (SOME AIRPLANES).

The MD-1 oxygen regulator (figure 4-19) is similar in function to the type D-2, but features a more compact design and more readable system of controls. It is of the diluter-demand type and has a pressure indicator, a blinker type flow regulator, and three toggle controls to regulate the flow and the oxygen-to-air ratio. Both indicators and all three toggle controls are illuminated through the edge-lighted panel. With the air toggle control set at NORMAL, the regulator automatically mixes oxygen and air in the proper ratio to sustain the crew, gradually decreasing the amount of air until at approximately 30,000 feet (cabin altitude) 100 percent oxygen is delivered. Above cabin

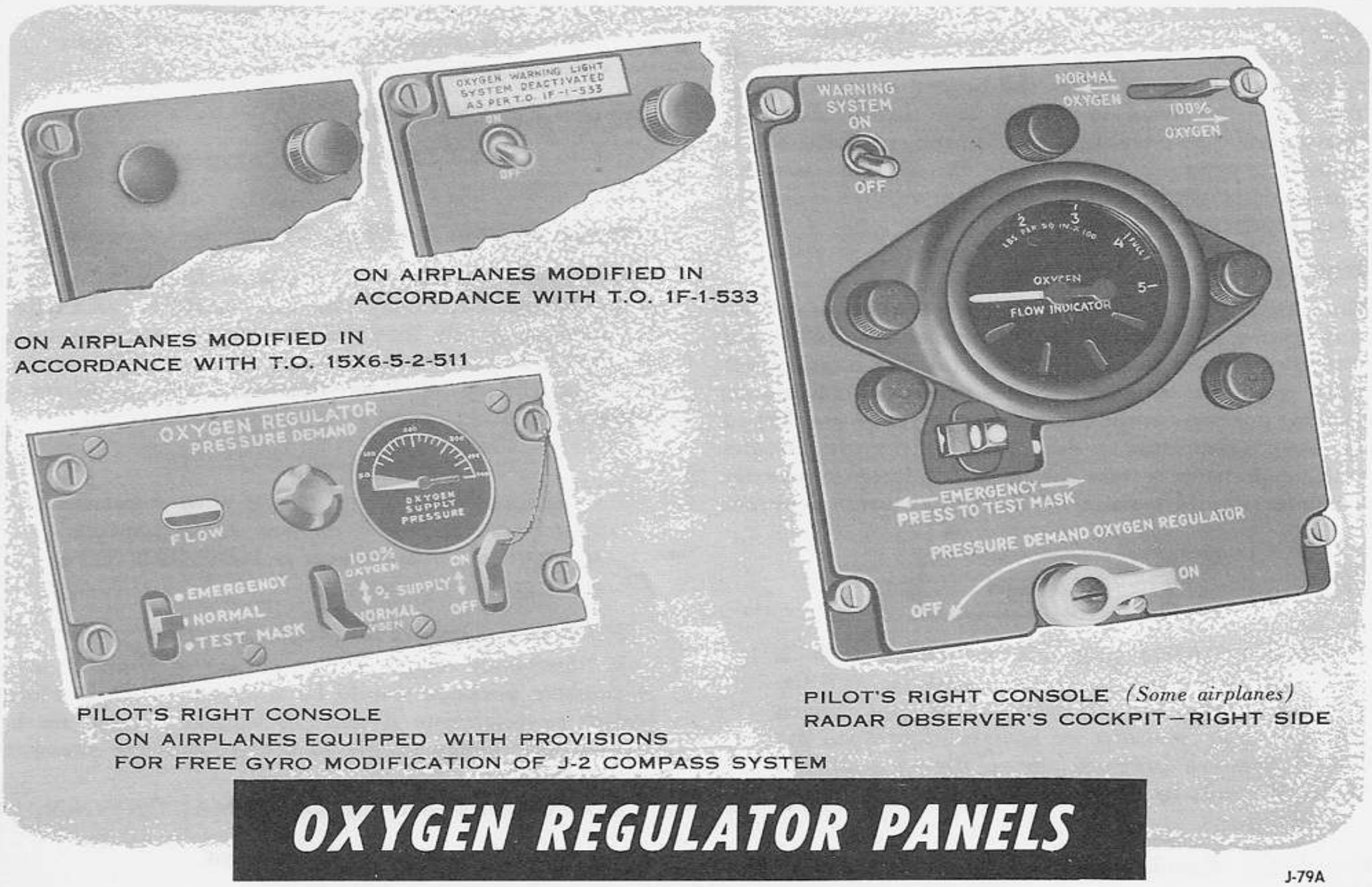


Figure 4-19.

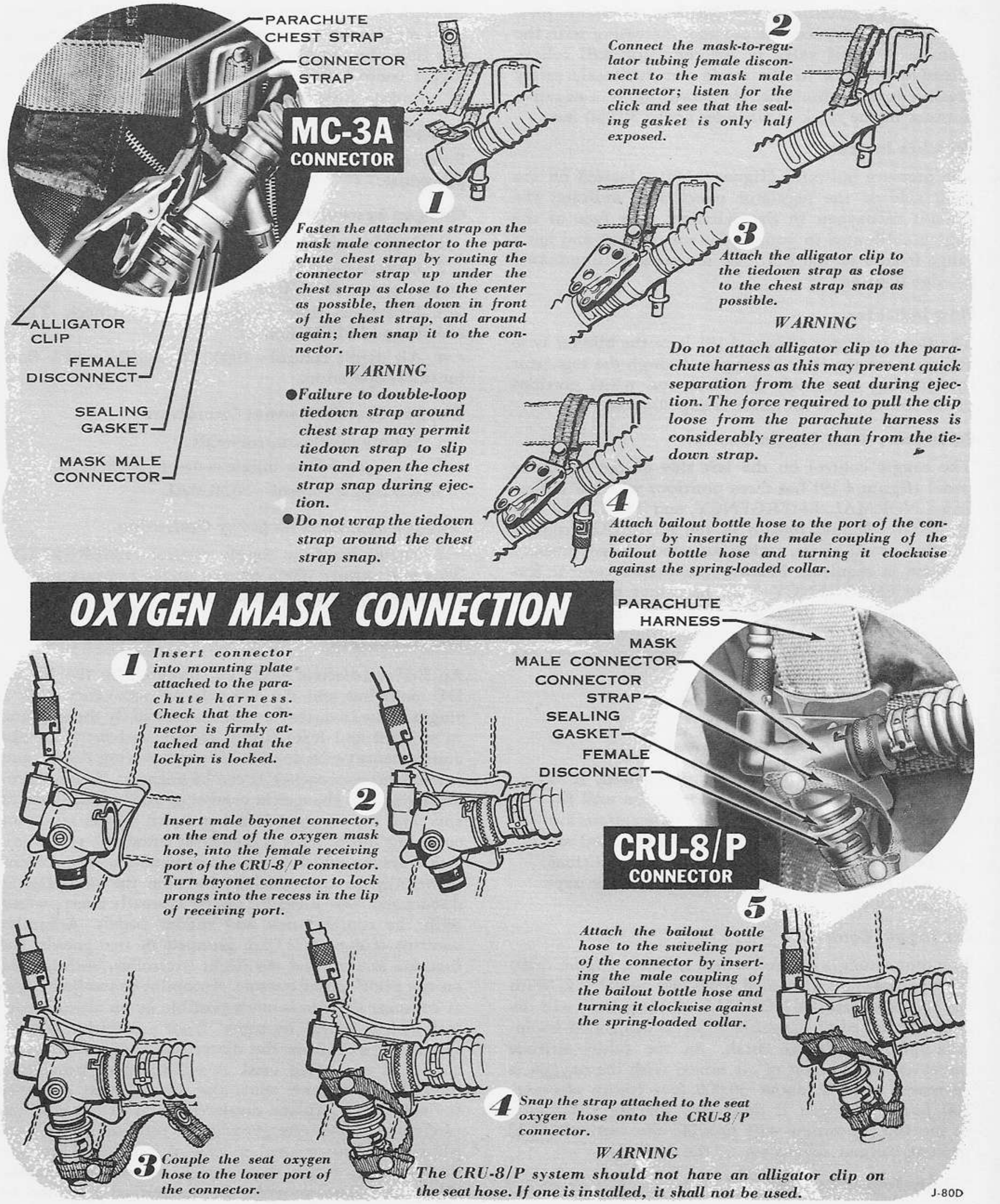

PARACHUTE CHEST STRAP
CONNECTOR STRAP
MC-3A CONNECTOR
ALLIGATOR CLIP
FEMALE DISCONNECT
SEALING GASKET
MASK MALE CONNECTOR
1 Fasten the attachment strap on the mask male connector to the parachute chest strap by routing the connector strap up under the chest strap as close to the center as possible, then down in front of the chest strap, and around again; then snap it to the connector.
WARNING
Failure to double-loop tiedown strap around chest strap may permit tiedown strap to slip into and open the chest strap snap during ejection.
Do not wrap the tiedown strap around the chest strap snap.
2 Connect the mask-to-regulator tubing female disconnect to the mask male connector; listen for the click and see that the sealing gasket is only half exposed.
3 Attach the alligator clip to the tiedown strap as close to the chest strap snap as possible.
WARNING
Do not attach alligator clip to the parachute harness as this may prevent quick separation from the seat during ejection. The force required to pull the clip loose from the parachute harness is considerably greater than from the tiedown strap.
4 Attach bailout bottle hose to the port of the connector by inserting the male coupling of the bailout bottle hose and turning it clockwise against the spring-loaded collar.
OXYGEN MASK CONNECTION
PARACHUTE HARNESS
MASK MALE CONNECTOR
CONNECTOR STRAP
SEALING GASKET
FEMALE DISCONNECT
CRU-8/P CONNECTOR
1 Insert connector into mounting plate attached to the parachute harness. Check that the connector is firmly attached and that the lockpin is locked.
2 Insert male bayonet connector, on the end of the oxygen mask hose, into the female receiving port of the CRU-8/P connector. Turn bayonet connector to lock prongs into the recess in the lip of receiving port.
3 Couple the seat oxygen hose to the lower port of the connector.
4 Snap the strap attached to the seat oxygen hose onto the CRU-8/P connector.
5 Attach the bailout bottle hose to the swiveling port of the connector by inserting the male coupling of the bailout bottle hose and turning it clockwise against the spring-loaded collar.
WARNING
The CRU-8/P system should not have an alligator clip on the seat hose. If one is installed, it shall not be used.
J-80D

Figure 4-20.

altitudes of approximately 40,000 feet, automatic pressure breathing is used, the pressure increasing with the altitude. A relief valve in the regulator will relieve excessive pressure in the mask. An automatic safety pressure feature eliminates the possibility of a negative pressure in the mask at altitudes above 30,000 feet.

Pressure Indicator.

The pressure indicator (figure 4-19) is located on the right side of the regulator panel, and indicates the amount of oxygen in the cylinders. The face of the gage is calibrated in pounds per square inch and has a range from 0 to 500 PSI. The indicator is illuminated by edge lighting.

Flow Indicator.

The flow indicator (figure 4-19) is of the blinker type and registers any flow of oxygen through the regulator by exposing alternately the black and white portions of the shutter. The indicator is edge-lighted.

Emergency-Flow Toggle Control.

The toggle control on the left side of the regulator panel (figure 4-19) has three positions which are placarded NORMAL, EMERGENCY, and TEST. The toggle control should remain in the NORMAL (center) position at all times, unless an unscheduled pressure increase is required. Moving the toggle control forward to EMERGENCY from its center position provides continuous positive pressure to the mask for emergency use. Moving the toggle control aft to the TEST position provides positive pressure to test the mask for leaks.

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 insure no leakage, then continued use of positive pressure under these conditions will result in the rapid depletion of the oxygen supply.

Air Toggle Control.

The center toggle control, which is black, (figure 4-19) has two positions placarded 100% and NORMAL. With the toggle control at NORMAL, the regulator will deliver a mixture of oxygen and air as demanded by inhalation through the mask. As the cabin altitude increases, the amount of air mixed with the oxygen is decreased until at about 30,000 feet (cabin altitude) 100 percent oxygen is delivered. Placing the toggle at the 100% position will provide the user with 100 percent oxygen regardless of the altitude.

Supply Toggle Control.

The green toggle control at the right side of the regulator (figure 4-19) controls the supply of oxygen through the regulator and has ON and OFF positions. This toggle control must be in the ON position before any flow through the regulator can occur. The supply toggle control may be placed at OFF between flights to minimize leakage through the regulator.

Oxygen Hose Hook-Up.

Refer to figure 4-20 for proper oxygen hose hook-up procedure.

Oxygen System Preflight Check.

1. Supply toggle control—Check (safetywired) ON.
2. Oxygen supply pressure—Check. Pressure should range between 400-450 psi.
3. Emergency-flow toggle control — Check TEST MASK and EMERGENCY.
4. Air toggle control—100% OXYGEN; check flow indicator operation.

Oxygen System Normal Operation.

1. Supply toggle control—ON.
2. Emergency-flow toggle control—NORMAL.
3. Air toggle control—NORMAL.

Oxygen System Emergency Operation.

1. Emergency-flow toggle control—EMERGENCY. This will supply 100% oxygen under pressure regardless of air toggle control setting.

AUTOPILOT.

An E-11 all-electric autopilot, powered by the 28-volt DC main bus and the 115-volt AC secondary NO. 2 single-phase inverter bus, can be used to fly the airplane in straight and level flight, coordinated turns, climbs and descents (with or without maneuvering turns), and instrument approaches. It can be engaged, without producing abrupt changes in control or airplane attitude, at any time the airplane is being flown within autopilot engaging limits. This is due to an automatic synchronization system which keeps the autopilot bridge circuits electrically in trim during the time the autopilot is disengaged. The autopilot can be manually overpowered with the control stick and rudder pedals. Autopilot controls (figure 4-21) are grouped in two panels, the function selector and the flight controller, both located on the pilot's right console. Autopilot-controlled flight at constant altitude is made possible by an altitude control which derives its signal from a sensitive aneroid system. Signals from the directional indicator (slaved) control is not being used. A vertical gyro provides a directional reference when the manual turn reference for measuring airplane displacement is in the roll and pitch axes. Three rate gyros (yaw, roll, and pitch) supply signals proportional to rate of change in airplane displacement. When these signals are added algebraically to the signal provided by the vertical gyro, the result is a smooth coordination of the flight controls in both the starting of maneuvers and the return to straight and level flight. When the autopilot is engaged, the airplane's elevator trim system is operated automatically to minimize stick forces at the time of autopilot disengagement. A localizer coupler and glide-slope coupler provide means for automatic flight control during the approach and glide-slope phases of instrument landing procedure. After the autopilot is engaged, it will control the airplane through a maximum of 60 degrees of roll and 50 degrees of pitch in either direction from the horizontal. The engaging limits are 50 degrees of pitch, 29 degrees of roll, and 10 degrees of yaw. The elevator servo contains a slip clutch which limits servo output to 13 pounds of stick force in the pitch axis. This limits "G's" during autopilot-controlled flight to a safe value for all flight conditions. The autopilot aileron deflection is limited to 5 degrees. When the autopilot is engaged, the airplane displacement signals to the sideslip stability augmenter are interrupted, but the latter system remains in standby status and will resume its stabilizing function the instant that the autopilot is disengaged.

POWER SWITCH.

An autopilot power switch (figure 4-21), located on the function selector panel, controls the electrical power supply to the autopilot system. When the switch is placed at ON, power is supplied to the autopilot system. When the switch is placed at OFF, all electrical power to the autopilot is disconnected and the engaging switch, if at ENGAGE, snaps to OFF.

ENGAGING SWITCH.

The autopilot engaging switch (figure 4-21), located on the flight controller panel, has ENGAGE and OFF positions. The switch is solenoid-held and it will remain in the ENGAGE position only when the following conditions have been met: The autopilot circuit breakers are IN, the power switch has been at ON for 90 seconds or more, the turn knob on the flight controller is in detent, and the airplane is in an attitude within autopilot engaging limits. When the engaging switch is placed at OFF, the autopilot disengages. The switch will snap to the OFF position if the power switch is turned to OFF or if the pilot's emergency disconnect switch is used to disengage the autopilot.

EMERGENCY DISCONNECT SWITCH.

A 28-volt dc, spring-loaded lever-type emergency disconnect switch (figure 1-27), located on the control stick grip, provides a means of instantaneous autopilot disengagement. If the autopilot is engaged, squeezing the emergency disconnect switch will disengage the autopilot and cause the engaging switch to snap to OFF. The autopilot power switch will remain at ON until manually moved to OFF. When the emergency disconnect switch is used to disengage the autopilot, any of the solenoid-held coupler switches that may be at ON at the time (altitude switch, localizer switch, or approach switch) will snap to OFF.

TURN KNOB.

A turn knob (figure 4-21), located on the flight controller panel, provides a means of making coordinated

Figure 4-21.

turns with the autopilot. The knob normally rests in a neutral detent (knob pointing forward). When the knob is in this position, directional signals from the airplane's directional indicator (slaved) provide the autopilot with a heading or directional reference. Moving the turn control knob to the right or left out of the detent will result in an autopilot-controlled coordinated turn in the direction that the knob is turned and at a bank angle proportional to the amount the knob is turned, up to a maximum bank angle of 60 degrees. When the turn knob is returned to the neutral detent the airplane will roll smoothly out of the turn and continue to fly at the new compass heading. The autopilot will not engage with the turn knob out of detent.

HEADING TRIM INDICATOR AND KNOB.

A heading trim indicator and heading trim knob (figure 4-21), located on the flight controller panel, are used to indicate and correct heading mistrim during autopilot-controlled flight. To correct heading mistrim, rotate the heading knob in direction of needle deflection: clockwise for right needle deflection, counterclockwise for left needle deflection.

Note

The heading trim indicator will indicate a mistrim condition whenever the autopilot is engaged, with the airplane in a bank. It will also indicate a mistrim condition whenever lateral trim conditions change during autopilot-controlled flight. To eliminate the requirement for trimming after engagement, it is recommended that the autopilot be engaged with the airplane in a coordinated zero-bank attitude.

PITCH CONTROL KNOB.

A pitch control knob (figure 4-21), located on the flight controller panel, is used to control the airplane in climbs and descents (when the altitude control is not engaged) and to trim for level flight. The pitch control may also be used in coordination with the turn control for combined maneuvers. Rotating the knob forward lowers the nose; rotating the knob aft raises the nose.

WARNING

If autopilot is operated prior to takeoff, elevator trim must be reset to TAKE-OFF because autopilot operation disturbs previous setting.

ROLL TRIM KNOB.

A roll trim knob (figure 4-21), on the flight controller panel, is used to center the ball on the turn and slip indicator after engagement of the autopilot. Rotate the knob clockwise for a ball-left condition, counterclockwise for a ball-right condition.

Note

It will be necessary to use the roll trim knob only if the autopilot is engaged when the airplane is flying in an uncoordinated manner. If the autopilot is engaged during uncoordinated flight, it is usually faster to disengage the autopilot, trim for coordinated flight manually and reengage. The autopilot will synchronize with the new flight attitude automatically, thus eliminating the need for using the roll trim knob.

ALTITUDE SWITCH.

A solenoid-held altitude switch (figure 4-21), located on the function selector panel, connects the altitude control to the autopilot elevator bridge circuits. When the switch is at ON, the autopilot will fly the airplane accurately at the pressure altitude at which it was flying when the switch was turned to ON. For a change in flight altitude, the switch is turned to OFF; the airplane is flown to the new altitude and trimmed for level flight; and then the switch is placed at ON. The altitude switch snaps to OFF if the autopilot is disengaged or if the ILS approach switch is moved to ON.

Note

The altitude switch can provide limited trim; however, the airplane should be trimmed for approximately level flight before placing the altitude switch at ON. When large trim changes are required, it is necessary to retrim manually by means of the pitch control knob or by disengaging the autopilot, retrimming the airplane, and reengaging the autopilot and altitude control.

AUTOPILOT NORMAL OPERATION.

Ground Tests.

During engine runup and taxi phase, turn on and engage autopilot and perform ground check as detailed in Section II.

Normal Engaging Procedure.

The autopilot can be engaged at any time the airplane is flying within the autopilot engaging limits. Engage the autopilot as follows:

1. Power switch—ON (1 1/2- to 2-minute warmup required).
2. Turn knob—Detent position.
3. Trim the airplane for coordinated zero-bank attitude within ±50-degree pitch attitude.
4. Engaging switch—ENGAGE. Switch will hold in ENGAGE position if proper conditions for engagement have been met; otherwise the switch will snap back when released.
5. Autotrim indicator—Check that needle is fluctuating about center.

Engaging Procedure in Turns or Uncoordinated Flight.

When the autopilot is engaged in turns or in uncoordinated flight, it will be necessary to trim the autopilot as follows:

1. Ball on the turn and slip indicator—Center using the roll trim knob. Rotate the knob clockwise for ball left, counterclockwise for ball right.
2. Needle on the heading trim indicator—Center using the heading trim knob. Rotate the knob clockwise for right needle, counterclockwise for left needle. It is usually quicker and easier, however, to disengage the autopilot, trim the airplane for coordinated zero-bank attitude, and reengage the autopilot.

Autopilot Trimming Procedure.

1. Trim the airplane manually after takeoff.
2. Turn and slip indicator—Check after engaging autopilot. If a ball-left or ball-right condition exists, center the ball by rotating the roll trim knob clockwise or counterclockwise respectively. Wings will level after this step and the following step are completed.
3. Heading trim indicator—Check after centering the ball. If the needle is deflected, return it to approximate center by rotating the heading trim knob in the direction indicated by the needle.

If the airplane trim condition changes during flight on autopilot, always center the ball with the roll trim *before* centering the heading trim indicator needle. This procedure makes it possible to trim the autopilot precisely in one operation, and should always be used.

Straight and Level Flight.

Fly to the desired altitude, trim the airplane for approximate level flight, and place the altitude switch at ON. The autopilot will fly the airplane at the pressure altitude existing when the switch is placed at ON. (If the altitude switch is OFF, the autopilot will maintain the airplane in the pitch attitude established by the pitch control but will not necessarily maintain level flight.) When the turn control knob is in detent, the directional indicator (slaved) establishes a heading reference to maintain the airplane in straight and level flight. If a lateral mistrim condition develops (such as would be caused by an unbalanced fuel load), the autopilot will maintain the airplane laterally level and in straight flight but with heading mistrim in the direction of the heavy wing. To compensate for this condition, center the heading trim indicator needle using the heading trim knob.

Maneuvering Flight.

Autopilot-controlled climbs and descents can be made using the pitch control knob. (Altitude switch should be at OFF.) Rotate the pitch knob slowly and smoothly to change pitch attitude. If the pitch knob is rotated rapidly, thus calling for excessive "G's," the "G" limiting clutch in the elevator servo will slip, and the airplane will not respond. To correct this situation, disengage the autopilot, trim the airplane to the desired attitude, and reengage the autopilot. The autopilot will maintain the new attitude until changed by means of the pitch knob. Pull-ups from shallow dives may be made using the pitch knob, but pull-ups from steep dives must be made manually. Coordinated turns can be made using the turn knob. Bank angle (and corresponding turning rate) will be proportional to turn knob rotation. When the turn knob is returned to detent, the airplane will return to level, ending the turn. After a 5-second delay (which allows the airplane to stabilize on the new heading), the autopilot will fly the airplane on the compass heading existing at that instant. Combined maneuvers can be made by coordinated use of the turn and pitch knobs.

Releasing Procedure.

The autopilot may be released in three ways: squeezing the disconnect switch on the control stick, moving the engaging switch to OFF, or moving the power switch to OFF. Squeezing the disconnect switch or moving the engaging switch to OFF leaves the autopilot in standby status (ready to operate as soon as it is reengaged). Moving the power switch to OFF turns off all electrical power to the autopilot, putting it completely out of operation. If it is left off for an appreciable length of time, a 1 1/2- to 2-minute warmup will be required before the autopilot can be used again. Normally the power switch should be ON at all times during the flight.

AUTOPILOT EMERGENCY OPERATION.

If the autopilot system fails or functions erratically, disengage the autopilot, and turn the power switch to OFF. When the autopilot is disengaged, the sideslip stability augmenter will resume its normal function of directionally stabilizing the airplane.

AUTOMATIC APPROACH EQUIPMENT.

Automatic approach equipment is provided in the autopilot system. Localizer and glide-slope couplers enable the autopilot to use signals from the VHF navigation and VHF glide-slope receivers for reference in azimuth and elevation during autopilot-controlled ILS approaches. (The localizer coupler is not designed for autopilot-controlled flight on omnirange and should not be used.) The signals fed to the localizer and glide-slope couplers are the same as those used to move the vertical and horizontal bars on the ILS course indicator. The localizer and glide-slope couplers supply autopilot signals to maintain the airplane at the center of the localizer and glide-slope beams, respectively. This equipment can be disengaged instantly by squeezing the autopilot emergency disconnect switch on the control stick.

LOCALIZER SWITCH.

A solenoid-held localizer switch (figure 4-21) on the function selector panel connects the localizer coupler to the autopilot. The switch has ON and OFF positions. When the switch is placed at ON (after the localizer beam has been intercepted according to standard ILS procedures), the coupler feeds signals to the autopilot to provide automatic bracketing and beam following. The localizer switch can be turned off manually, or will snap to OFF automatically when the approach switch (figure 4-21) is placed at ON, or when the autopilot is disengaged.

APPROACH SWITCH.

A solenoid-locked approach switch (figure 4-21) on the function selector panel connects the glide-slope coupler to the autopilot. The switch has ON and OFF positions. When the switch is placed at ON, the airplane noses down and follows the glideslope, and the localizer switch snaps to OFF. (The autopilot continues to receive localizer signals, however.) The approach switch cannot be turned to OFF manually. It snaps to OFF only when the autopilot is disengaged.

AUTOMATIC APPROACH EQUIPMENT OPERATION.

Refer to ILS—Autopilot-Controlled Approach, Section IX.

ARMAMENT.

For reasons of security, information on this equipment is given in T.O. 1F-89J-1A, Confidential Supplement. The following figures are also included in T.O. 1F-89J-1A:

Figure 4-22. Armament and Fire Control Equipment
Figure 4-23. Pilot's and Radar Observer's Scopes
Figure 4-24. Armament Control Panel
Figure 4-25. Special Weapon Warning Lights
Figure 4-26. Control Stick Grip

MG-12 FIRE CONTROL SYSTEM.

For reasons of security, information on this equipment is given in T.O. 1F-89J-1A, Confidential Supplement. The following figures are also included in T.O. 1F-89J-1A:

Figure 4-27. Radar Console
Figure 4-28. Radar Test Panel
Figure 4-29. Antenna Hand Control
Figure 4-30. Pilot's Radar Scope Control Panel
Figure 4-31. Pilot's Power-Control Box

SINGLE-POINT FUELING SYSTEM.

All fuel tanks of the airplane except pylon tanks can be fueled through a single-point fitting aft of the right wheel well. Lines, valves, control switches, and indicator lights in addition to those needed for in-flight fuel management are included in the fuel system so that the airplane can be fueled quickly through a single connection with ground equipment. The system is designed to use a maximum of 50 ±5 psi during single-point fueling operation. To prevent the tanks from overflowing when they are filled, a servo-actuated shutoff valve inside each tank shuts off the inflow when the tank is full. Outside each tank (except the sump tanks), a motor-actuated shutoff valve provides an additional means of shutting off the incoming fuel. (See figure 4-32.)

SINGLE-POINT FUELING CONTROLS.

All control switches and indicator lights, except a warning light on the pilot's console, are on the single-point fueling control panel (figure 4-33) in the right wheel well, and operate on 28-volt dc. Opening the control panel door turns on two panel lights that illuminate the switches and surrounding area; a warning light burns on the pilot's left console while the door is open. Bars on the inside of the panel door prevent it from being closed until all the fueling panel switches are off. The pilot's warning light serves also to warn of failure in the closed position of two shutoff valves in the main fuel system. These valves close only during single-point fueling to prevent high fueling pressures from damaging engine fuel components. (For further discussion see Single-Point Fueling Operation, this section.)

Note

On some airplanes, the existing single-point equipment out-of-position light, which has dimming features, is replaced with a new non-dimming light to eliminate the possibility of insufficient system malfunction warning if the dimming cover plate vibrates to the closed position.

Fueling Master Switch.

A fueling master switch (figure 4-33) on the single-point fueling control panel has ON and OFF positions. When the switch is moved to ON (and 28-volt dc power is on the airplane), motor-actuated shutoff valves in the fuel system open or close as required to route the inflowing fuel from the single-point fueling adapter to the fueling lines of each tank. When the master switch is moved to OFF, the action of the shutoff valves is reversed.

Fueling Tank Switches.

Individual tank switches (figure 4-33) for all except the sump tanks are located on the single-point fueling panel. These 28-volt dc switches have OPEN and CLOSE positions; with the fueling master switch at ON, moving any of these tank switches to OPEN causes a motor-actuated shutoff valve to open in the fueling line to the corresponding tank. Moving the switch to CLOSE causes the valve to shut off flow into the tank.

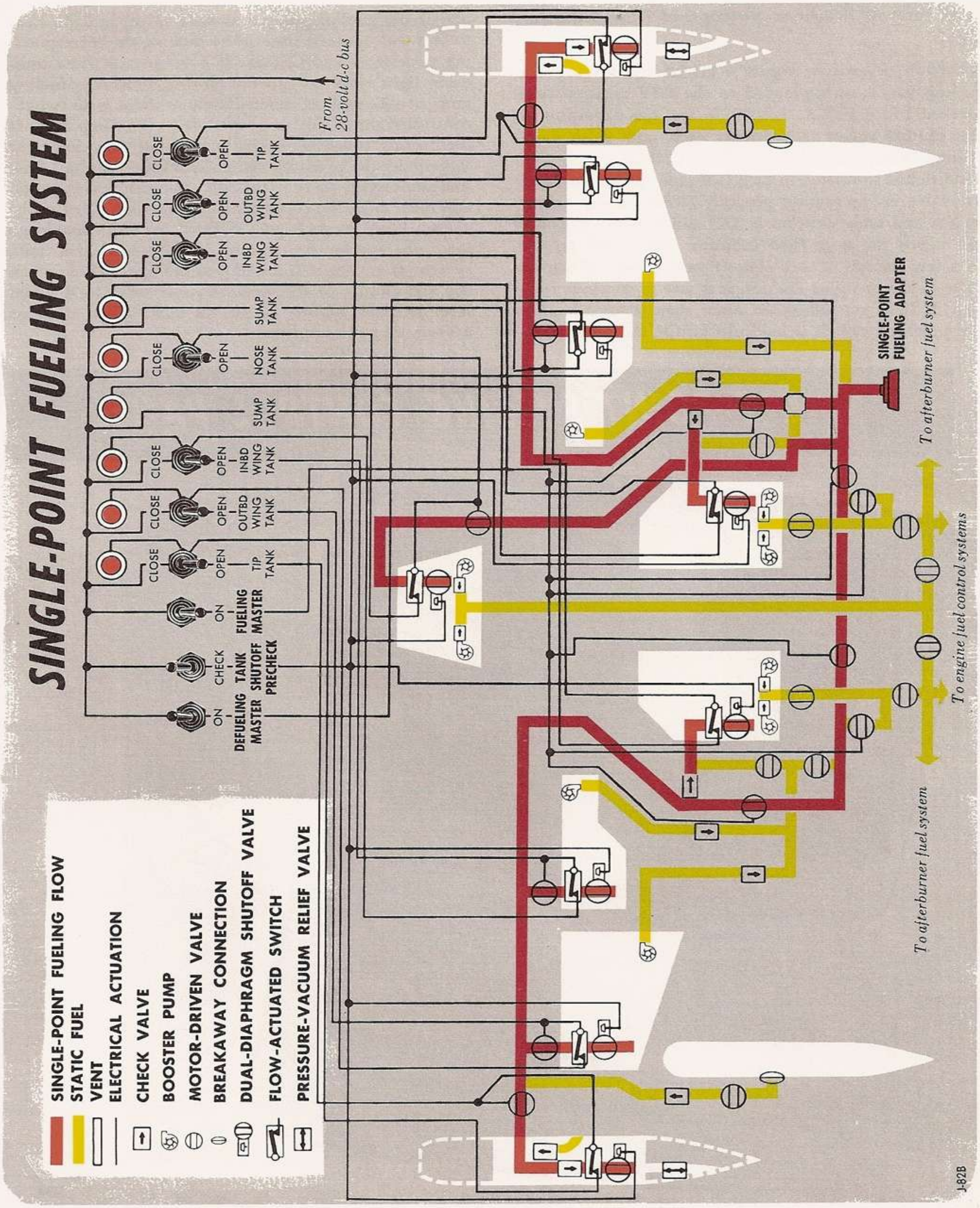

SINGLE-POINT FUELING SYSTEM
SINGLE-POINT FUELING FLOW
STATIC FUEL
VENT
ELECTRICAL ACTUATION
CHECK VALVE
BOOSTER PUMP
MOTOR-DRIVEN VALVE
BREAKAWAY CONNECTION
DUAL-DIAPHRAGM SHUTOFF VALVE
FLOW-ACTUATED SWITCH
PRESSURE-VACUUM RELIEF VALVE
From 28-volt d-c bus
CLOSE OPEN TIP TANK
CLOSE OPEN OUTBD WING TANK
CLOSE OPEN INBD WING TANK
SUMP TANK
CLOSE OPEN NOSE TANK
SUMP TANK
CLOSE OPEN INBD WING TANK
CLOSE OPEN OUTBD WING TANK
CLOSE OPEN TIP TANK
ON FUELING MASTER
CHECK TANK SHUTOFF PRECHECK
ON DEFUELING MASTER
SINGLE-POINT FUELING ADAPTER
To afterburner fuel system
To engine fuel control systems
To afterburner fuel system
J-82B

Figure 4-32.

Tank Shutoff Precheck Switch and Flow Indicator Light.

A 28-volt dc switch (figure 4-33) on the single-point fueling panel, spring-loaded to the OFF position, and marked PRE-CHECK, is used to test the operation of the shutoff valves that protect each tank from overfilling. When the switch is held to CHECK, a full-tank condition is simulated in each fuel tank; and if the shutoff valve is functioning properly (with fueling master switch and tank switches at ON and fuel flowing into the tank), the tank flow indicator lights will go out in a few seconds as each shutoff valve closes. When all flow indicator lights are out, it is safe to continue fueling. A light remaining on more than 9 seconds after the precheck switch is held to CHECK indicates a failure of the dual-diaphragm shutoff valve, and the flow to that tank must be shut off by moving the corresponding tank switch to CLOSE. If a sump tank flow indicator light does not go out during precheck, fueling must be discontinued immediately as there is no switch-controlled shutoff valve in the line to the sump tank. If the fueling precheck is satisfactory (all flow indicator lights out) the precheck switch is released, and all flow indicator lights (except for full tanks) should come on and burn until the corresponding tanks are filled to the correct level. As each tank is filled, its light should go out, whereupon the operator should turn that tank switch off at once to forestall possible intermittent opening and closing of the tank's shutoff valve as the fuel level oscillates slightly within the tank. When all lights are out, all tanks are filled.

SINGLE-POINT FUELING CONTROL PANEL

Figure 4-33.

Defueling Master Switch.

A defueling master switch (figure 4-33), operating on 28-volt dc and located on the single-point fueling panel, provides a means for emptying the wing tanks, sump tanks, or nose tank through the single-point fueling adapter as a ground operation. This switch must be at ON for defueling and must be at OFF when the airplane is being fueled through the single-point system. To defuel the left wing tanks or the left sump tank, the crossfeed switch on the pilot's fuel control panel must also be at ON. The pylon tanks and the tip tanks can be defueled through the single-point system by operating the engines or by using an external source of air to pressurize the tanks.

Note

Use of the single-point defueling system is normally in connection with a maintenance operation.

SINGLE-POINT FUELING OPERATION.

1. Supply 28-volt dc external power.
2. Check fuel supply for 50 ± 5 psi fuel pressure.
3. Connect fueling nozzle to airplane's single-point fueling adapter, with fueling nozzle valve turned to OFF.
4. Single-point fueling circuit breakers—Check IN.
5. Fueling master switch—ON.
6. All warning lights—Press-to-test.
7. Switches for tanks to be filled—OPEN.
8. Switches for tanks not to be filled—CLOSE.

Note

Sump tanks have no shutoff valve and cannot be closed.

9. Single-point nozzle valve—OPEN.
10. Precheck switch—Hold immediately to CHECK.

CAUTION

- If warning lights do not go out within 9 seconds, stop flow into the corresponding tank immediately.
- If sump light remains on, shut off nozzle valve immediately.

11. When precheck has been satisfactorily completed, release precheck switch to allow airplane to be fueled.
12. When a flow indicator light goes out (corresponding tank is full), place tank switch at CLOSE.
13. Fueling master switch—OFF; close panel door.

CAUTION

- If during the single-point fueling operation, fuel is forced out any of the tank vents under pressure, *immediately* turn fueling nozzle valve handle to OFF and investigate the cause of trouble. Do not open affected fuel tank cap.
- Do not take off with the single-point fueling equipment-out-of-position warning light burning on the pilot's left console, because the burning light indicates either that the single-point panel door is open and could interfere with the landing gear retraction, or that the door is closed but one or both valves that close during single-point fueling to protect the engine fuel components from high fueling pressures have failed in the closed position. If this has occurred, the engine on the side of the closed shutoff valve cannot be fed through the crossfeed line, nor can fuel flow directly from the wing tanks to the engine on that side (fuel selector switch set at WING TANKS).

DEFUELING OPERATION.

1. Connect 28-volt dc external power.
2. Single-point defueling circuit breakers—Check IN.
3. Fuel selector switch and tank switches (on pilot's fuel control panel)—Set to tanks desired to empty. For example: to defuel a sump tank, set the corresponding selector switch to ALL TANKS and turn all tank switches on that side to OFF.
4. To defuel tanks in the left system, proceed as with the right system and turn the crossfeed switch to ON.

MISCELLANEOUS EQUIPMENT.

WINDSHIELD WIPER.

The windshield wiper operates on 28-volt dc power. The windshield wiper switch turns the wiper on and off, and has ON, OFF, and PARK positions. The switch is located adjacent to the speed rheostat control knob (figure 1-8). The speed rheostat above the pilot's left console has INC and DEC positions for controlling the speed of the wiper motor. The speed rheostat control must be at INC before the windshield wiper switch is turned to ON. If the wiper blade stops at an undesirable position when the switch is turned to OFF, the switch can be held momentarily to the spring-loaded PARK position; the blade will move to the right and stop automatically. If the wiper blade stops and cannot be started with the speed rheostat, turn wiper off.

CAUTION

The speed rheostat should not be used to stop the wiper. Before either stopping or starting the wiper, the speed rheostat should be turned to INC.

RELIEF TUBES.

The relief tube for the pilot is on the floor to the right of his seat; one for the radar observer is to the right of his seat, aft of the wing spar.

MISCELLANEOUS PARTS STOWAGE.

Fuselage and wing jack pads, mooring fittings, and microphones are stored in two bags in the radio equipment section in the aft fuselage. The ground safety locks and the pitot tube covers are in a third bag near the floor to the left of the radar observer's seat.

MAP AND DATA CASES.

A data case and a flight report holder (figure 1-8) are beside the pilot's left console. A map data case (figure 4-7) is beside the right console in the radar observer's cockpit, and an airplane data case is in the aft radio and equipment section. Two spring clips are located on the upper right surface of the pilot's glare shield to be used as required for temporary storage of maps, computer, flight plan, etc. while pilot is navigating.

REAR VIEW MIRRORS.

A mirror on the left frame of the windshield enables the pilot to see rearward. A mirror on the right side of the canopy frame allows the pilot and radar observer to see each other.

EMERGENCY SIGNAL SYSTEM.

A red light and spring-loaded button-type switch in each cockpit provides a visual emergency system for the pilot and radar observer. In case of interphone failure or loss of the canopy, each crewmember can communicate with the other by means of code or prearranged signals. In the pilot's cockpit the button and signal light (figure 1-11) are mounted on a bracket directly below the right canopy defog duct. In the radar observer's cockpit the button (figure 4-7) is mounted on the inboard side of the right console and the signal light (figure 4-5) is located below the left side of the main instrument panel. The system is powered by the 28-volt primary bus.

RADAR OBSERVER'S BLAST SHIELD (SOME AIRPLANES).

On airplanes modified in accordance with T.O. 1F-89-692, a plastic blast shield has been installed over the top and around three sides of the radar observer's instrument panel. The blast shield is designed and installed to protect the radar observer from wind blast when the canopy is jettisoned or lost during flight.

MA-2 SUIT VENTILATION SYSTEM (SOME AIRPLANES).

Airplanes modified in accordance with T.O. 1F-89-699 have provisions for utilization of type MA-2 ventilation garment. A hose disconnect beneath each ejection seat and a two-position control switch, located on the windshield wiper control panel (figure 1-8) and operating on 28-volt dc, provide for utilization and control of the MA-2 suit ventilating system. When the control switch is placed at ON, the system is energized to provide suit ventilation. Placing the switch at OFF de-energizes the system.

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

INTRODUCTION.

Cognizance must be taken of instrument markings, figure 5-1, since they represent limitations that are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENTS.

The minimum crew is one pilot for all flights. A radar observer or qualified crewmember may be required at the discretion of the commander.

ENGINE LIMITATIONS.

STARTING AIRPLANES EQUIPPED WITH J35-35A ENGINES.

During starting, the maximum allowable exhaust gas temperature is 900°C. Exhaust gas temperatures between 735°C and 900°C are permissible for no longer than the following:

735°C - 60 Seconds
750°C - 47 Seconds
800°C - 30 Seconds
850°C - 23 Seconds
900°C - 20 Seconds

On afterburner starts, if the exhaust gas temperature momentarily exceeds 900°C or if 5 seconds after an afterburner start, the exhaust gas temperature exceeds 735°C, stop the afterburner. No attempt should be made to start both engines at the same time. This is to prevent damage to the auxiliary power unit and to prevent overloading the airplane's electrical system at the auxiliary power unit leads.

Airspeed

195 KNOTS MAXIMUM FOR FULL FLAPS OR LANDING GEAR DOWN.

BELOW 20,000-FOOT PRESSURE ALTITUDE. AIRSPEED LIMITATION IS 450 KNOTS IAS.

The instrument setting should be such that the red pointer indicates the limiting structural airspeed.

Machmeter

BELOW 20,000- FOOT PRESSURE ALTITUDE, THE AIRSPEED LIMITATION IS 450 KNOTS IAS OR MACH 0.90, WHICHEVER IS LESS.

Airspeed-Mach Number Indicator

(Some airplanes)

195 KNOTS IAS MAXIMUM FOR FULL FLAPS OR LANDING GEAR DOWN.

BELOW 20,000-FOOT PRESSURE ALTITUDE, THE AIRSPEED LIMITATION IS 450 KNOTS IAS.

INSTRUMENT

Accelerometer

SYMMETRICAL MANEUVER LOAD FACTOR

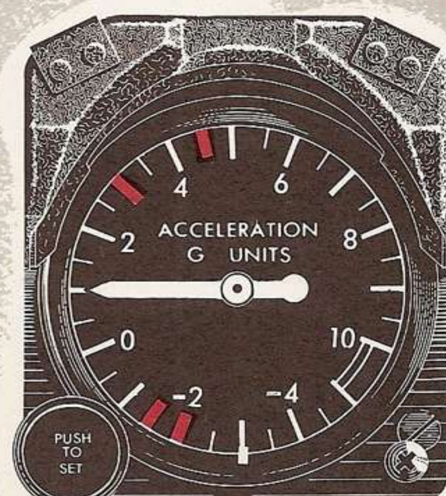
+4.50 / −2.00 "G'S" WITH NO AFT AND CENTER CELL TIP FUEL.

+3.00 / −1.50 "G'S" WITH ANY AMOUNT OF AFT AND CENTER CELL TIP FUEL.

ASYMMETRICAL MANEUVER LOAD FACTOR

+3.00 / −0.00 "G'S" WITH NO AFT AND CENTER CELL TIP FUEL.

+2.00 / −0.00 "G'S" WITH ANY AMOUNT OF AFT AND CENTER CELL TIP FUEL.



J-84(2)D

Figure 5-1. (Sheet 1 of 5)

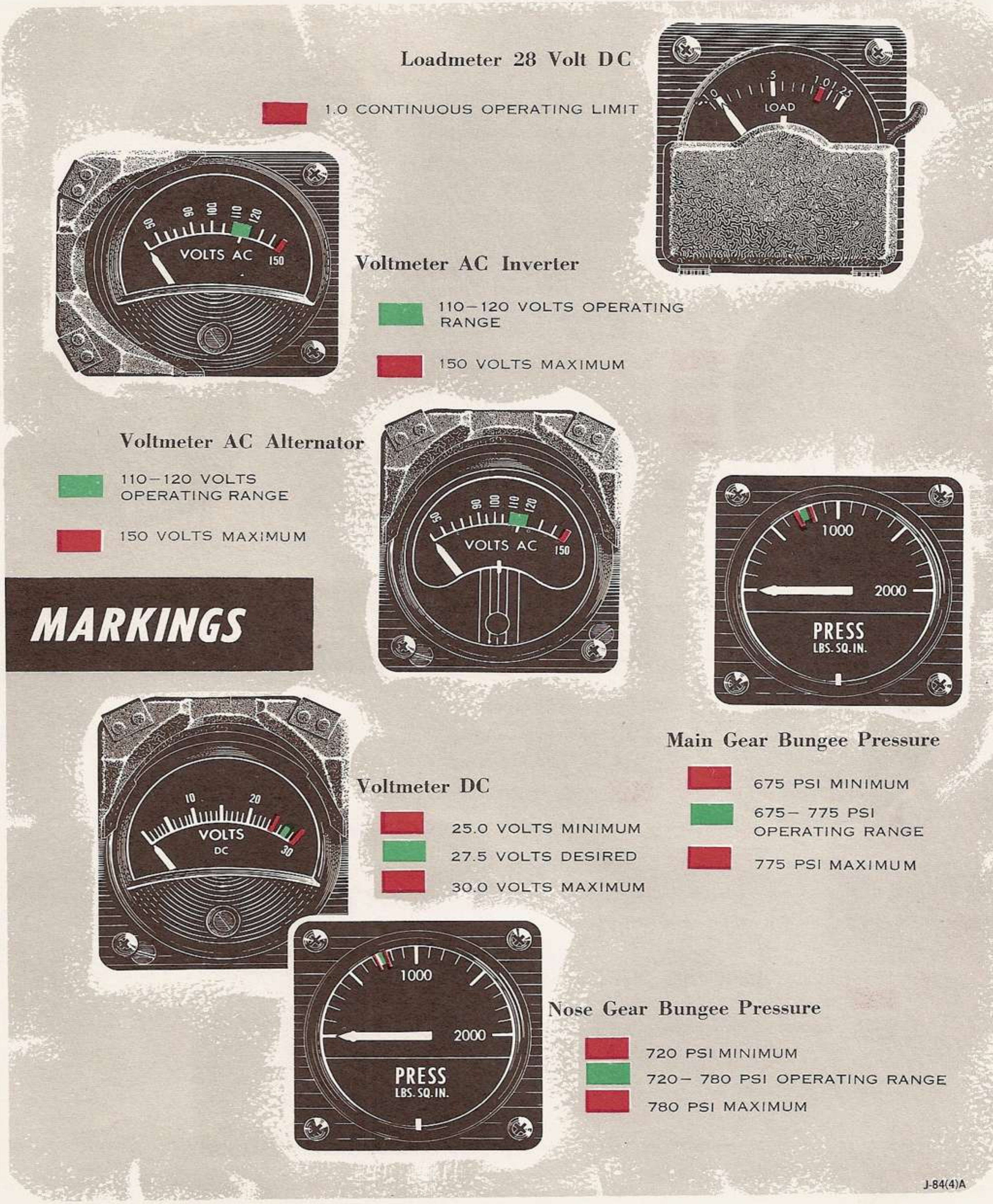


Figure 5-1. (Sheet 2 of 5)

Oil Pressure

- 15 PSI MIN FOR FLIGHT
- 25-45 PSI CONTINUOUS OPERATION
- 45 PSI MAX FOR FLIGHT

Exhaust Temperature

J35-35A Engines	J35-35 Engines
315°C MIN FOR FLIGHT	315°C
315°C-625°C CONTINUOUS	315°C-680°C
735°C MAX FOR FLIGHT	750°C
900°C MAX—STARTING & ACCELERATION ONLY	915°C

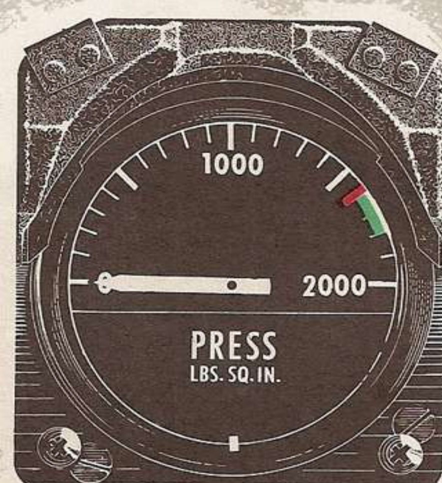
Based on all fuel grades

Engine Tachometer

- 49%-51% IDLE
- 80%-95% OPERATING RANGE
- 100% MAXIMUM

Pilot's Seat Pressure Gage

- 1600 PSI MINIMUM
- 1600-1800 PSI OPERATING RANGE



J-84(3)D

Figure 5-1. (Sheet 3 of 5)

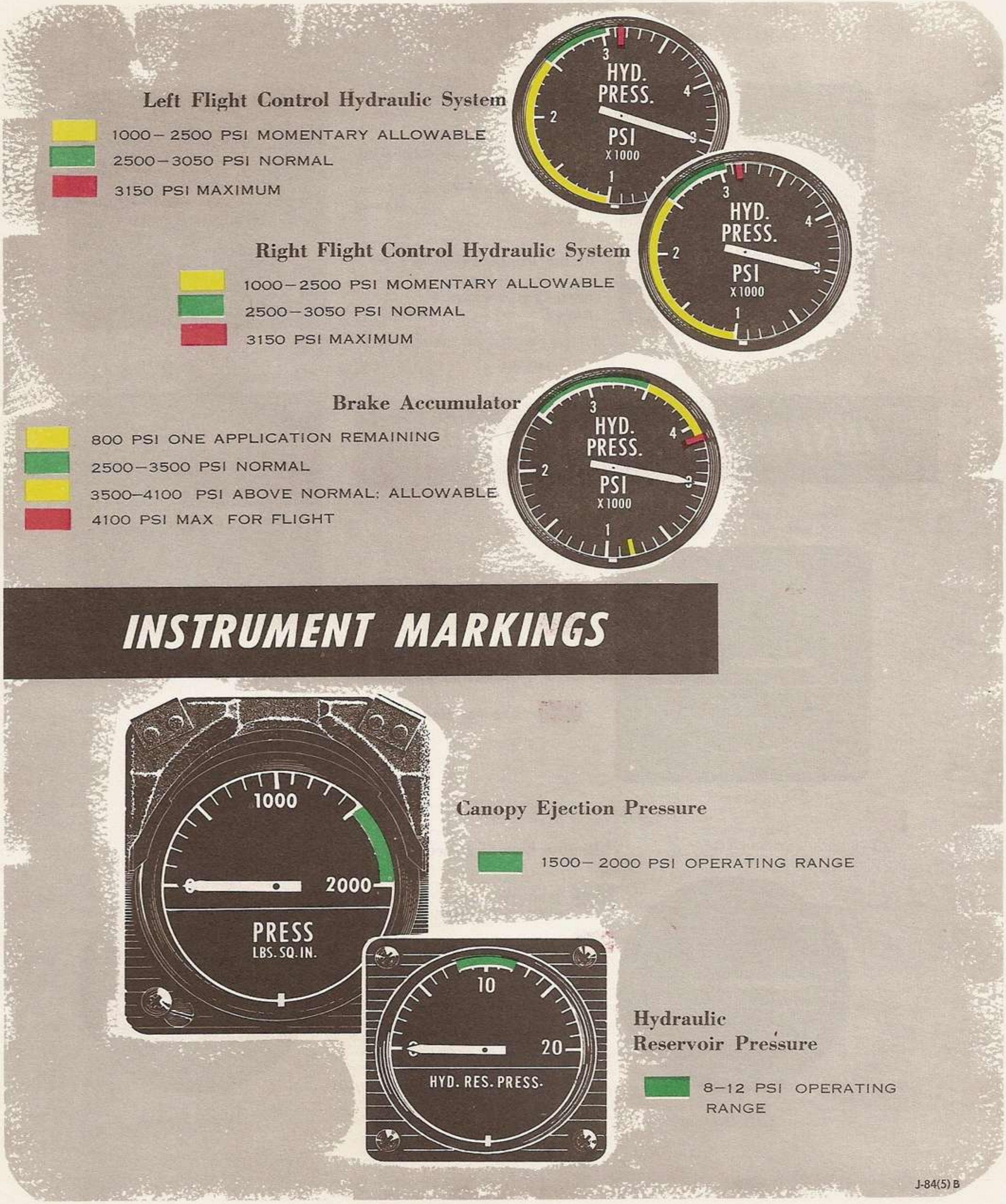
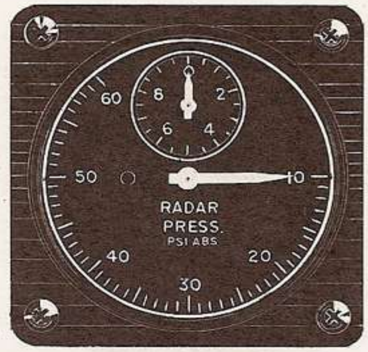


Figure 5-1. (Sheet 4 of 5)



Radar Pressure-High

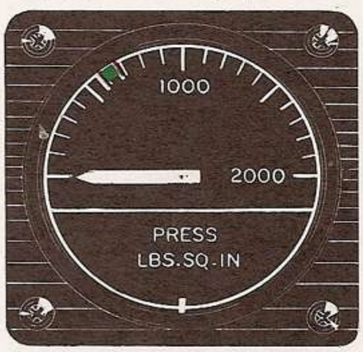
27–31 PSI OPERATING RANGE

Radar Pressure-Low

19–22 PSI OPERATING RANGE

INSTRUMENT MARKINGS

CHANGE TO 600 PSI MINIMUM WITH BRAKE HYDRAULIC PRESSURE DEPLETED



Brake Accumulator Air Pressure Gage

575 PSI MINIMUM

575–675 PSI OPERATING RANGE

675 PSI MAXIMUM

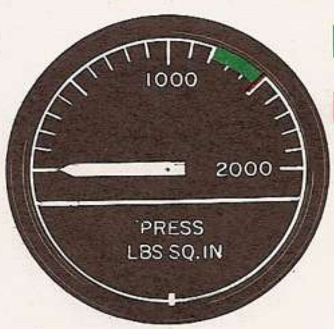
INFLATE TO 1500 PSI AIR CHARGE

Emergency Air Brake Pressure

1500–1800 PSI OPERATING

Engine Screen System Pressure

ENGINE SCREEN SYSTEM FILLER AIR CHARGE TO 1500 PSI

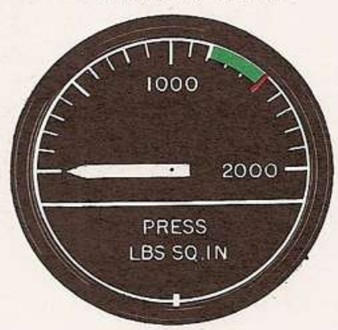


Left System

1200–1500 PSI OPERATING RANGE

1500 PSI MAXIMUM

ENGINE SCREEN SYSTEM FILLER AIR CHARGE TO 1500 PSI



Right System

1200–1500 PSI OPERATING RANGE

1500 PSI MAXIMUM

Figure 5-1 (Sheet 5 of 5)

ACCELERATION (AIRPLANES EQUIPPED WITH J35-35A ENGINES).

During acceleration, the momentary exhaust gas temperature is not to exceed 900°C, except that peak temperatures between 900°C and 925°C are permitted for a maximum of 3 seconds at engine speeds below 75% rpm. Temperatures between 735°C and 900°C are permissible for no longer than the following:

735°C - 60 Seconds
750°C - 47 Seconds
800°C - 30 Seconds
850°C - 23 Seconds
900°C - 20 Seconds

Engine must be removed for overhaul if speed momentarily exceeds 104% rpm or 103% rpm stabilized with or without excessive exhaust gas temperature. The throttle must be reset if stabilized engine speed exceeds 102% rpm. Stabilized engine speed over 102% rpm must be entered in Form 781.

ENGINE RPM AND/OR FUEL FLOW FLUCTUATIONS.

There is possibility of experiencing rpm and fuel flow fluctuations on the J-35A-35 and -47 engines in the 80 - 90% rpm range. The maximum allowable rpm fluctuation for the J-35A-35 and -47 engines is ±60 rpm (±0.75%). The fluctuation, however, shall not be checked at a stabilized engine speed between 80% and 86% rpm. If a fluctuation occurs in this range, the power setting should be varied (if possible) at increments of 1% until the fluctuations cease. Fuel pressure fluctuations are not detrimental unless accompanied by exhaust gas temperature and/or engine speed fluctuations.

EXHAUST GAS TEMPERATURE VERSUS RUNWAY TEMPERATURE.

Abnormally low exhaust gas temperatures for the existing ambient temperature will result in a loss of thrust. Available thrust may be insufficient for takeoff under this condition on a runway of limited length. Refer to figure 5-2 to ensure that exhaust gas temperature and runway temperature are within limits which allow sufficient thrust for takeoff.

Note

Ambient temperature does not affect peak exhaust gas temperature limits.

ALTERNATE FUEL LIMITATIONS.

When using military fuel, JP-5, or commercial fuels, ASTM Jet A or Jet A-1, as alternate fuels, the following limitations and/or precautions should be observed.

1. Ground starts and air restarts at low temperatures will be more difficult.
2. It may be necessary to manually adjust fuel controls of the engines to avoid exceeding specified engine operating limits, particularly RPM and EGT.
3. Do not operate the aircraft at altitudes above which temperatures of less than the freeze point of the particular fuel being used will be encountered.

AIRSPEED LIMITATIONS.

Note

The following airspeed limitations are not applicable when approaching or entering thunderstorms, or during flight in thunderstorms. For further information, see Turbulence and Thunderstorms, Section IX.

WARNING

- In the speed range from 0.78 Mach to 0.82 Mach, relatively light stick forces are required to cause a pitch attitude change. This factor increases the possibility of overstressing the airplane, especially below 20,000 feet during high dynamic pressure conditions.
- Above 0.82 Mach, stick forces increase rapidly with increase in Mach number and the elevator effectiveness rapidly decreases, resulting in limited longitudinal maneuverability.

AUTOPILOT LIMITATIONS.

Autopilot-controlled flight is limited to 425 knots IAS or Mach 0.78 below 20,000-foot pressure altitude.

WING FLAP LIMITATIONS.

Do not exceed the following structural limit airspeed of the wing flaps, or the wing flaps may fail:

Wing Flap Positions	*IAS—knots*
Wing flaps ~~at takeoff~~ (gear up)	230
Wing flaps full down (gear up or down)	195

Note

A wing flaps full down and 195 knots IAS condition can occur only when the airplane is accelerated to 195 knots IAS after extending the flaps. Airloads prevent fully extending the flaps at or above this airspeed.

LANDING GEAR LIMITATIONS.

With the wing flaps in any position, the structural limit airspeed of the landing gear and main landing gear doors is 195 knots IAS and 1.20 "G's" during retraction.

TIRE LIMITATION.

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 tire pressure see figure 5-3.

LANDING LIGHT LIMITATION.

Do not extend landing light 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.

CANOPY LIMITATIONS.

Speeds up to 50 knots IAS are permitted while taxiing with the canopy open.

PROHIBITED MANEUVERS.

SPINS.

Intentional spins, with or without external stores, are prohibited.

ACROBATICS.

Acrobatics will not be performed below 12,000 feet.

INVERTED FLIGHT.

Inverted flight can be maintained without afterburning for approximately 8 seconds at 20,000-foot pressure altitude, because of the limited amount of fuel available to the engines. At the time the airplane is inverted only that fuel already in the fuel lines, fuel pumps, and fuel controller will be available for use; when that has been used flameout will occur. At lower altitudes this time will be reduced considerably because of increased fuel consumption.

Note

Inverted flight (and any maneuver involving negative "G" forces) with maximum power will result in immediate afterburner flameout.

EXHAUST GAS TEMPERATURES VS AMBIENT TEMPERATURES

Air inlet screens extended
Without afterburning

NOTE: Retracting air inlet screens will lower the exhaust gas temperatures 8° C.

J35-35A ENGINES

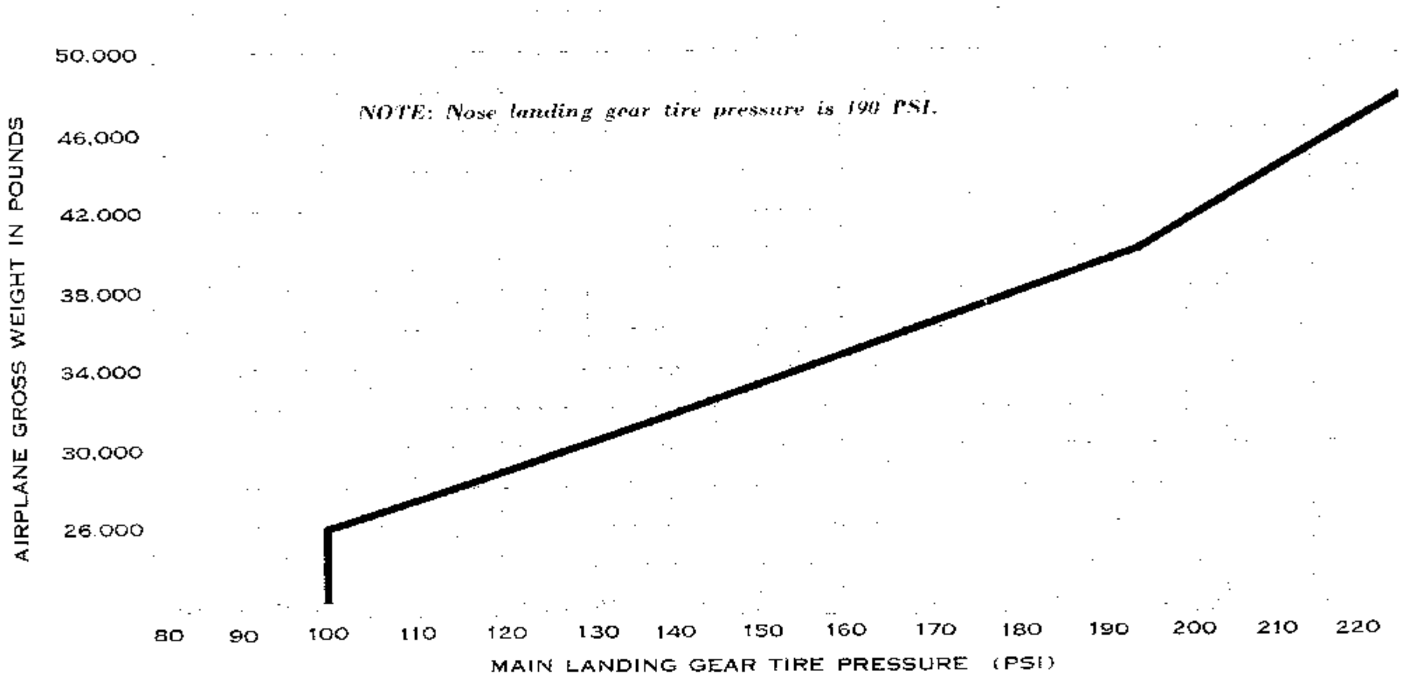
AMBIENT TEMP °C	AMBIENT TEMP °F	EXHAUST GAS TEMP 100% RPM °C MAX	EXHAUST GAS TEMP 100% RPM °C MIN
38	100	743	732
32	90	736	725
27	80	729	718
21	70	721	710
16	60	713	702
10	50	705°	694
4	40	697	686
-1	30	689	676
-7	20	678	667
-12	10	669	658
-18	0	659	648
-23	-10	649	638
-29	-20	639	628
-34	-30	632	621
-40	-40	623	612
-46	-50	616	605
-51	-60	611	600
		98% RPM	
43	110	733	722
49	120	741	730

NOTE: Afterburning lowers exhaust gas temperatures up to 5°C.

NOTE: Maximum exhaust gas temperature for flight:

J35-35A engine - 735°C

Figure 5-2.



TIRE PRESSURE CHART

MAIN LANDING GEAR TIRE PRESSURE VARIATION ± 10 PSI

J-117A

Figure 5-3.

LANDING.

Landings at heavier than normal landing weights should be made with caution. Normal landing weight is one half or less of internal fuel and no armament. These limitations are imposed to avoid overstressing the pod attachment fittings.

WARNING

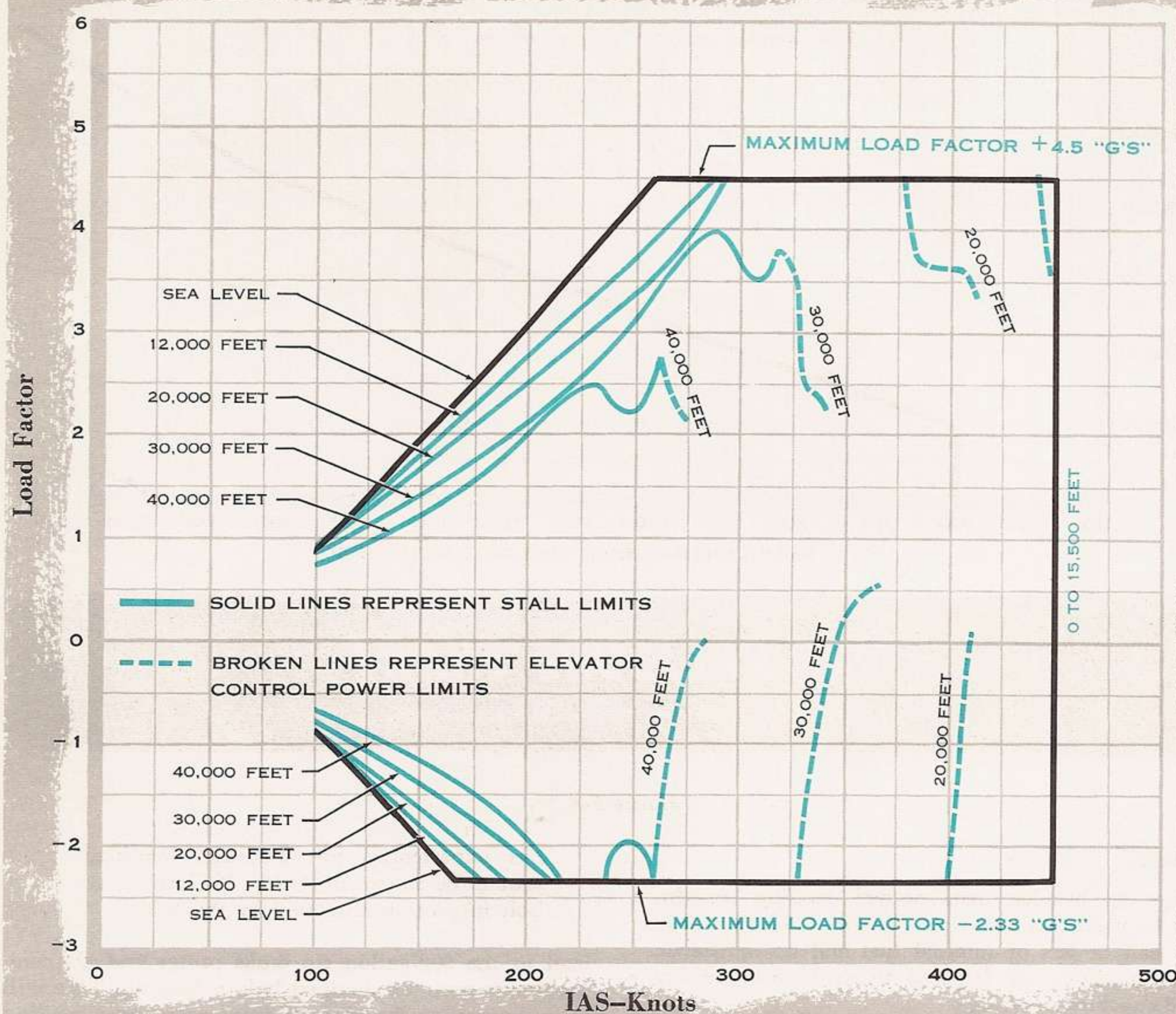
- Do not select more than one-third full speed brake opening until after touchdown if landing with only one MB-1 weapon aboard. Speed brake angles greater than one-third full open will impair lateral control as stall speed is approached.
- When a landing is to be made with MB-1 armament aboard, hard landings (sinking rate of 300 feet per minute or more) and particularly unsymmetrical touchdowns should be avoided to prevent MB-1 shear bolt damage. MB-1 rocket shear bolt failures have occurred during landings in which a sinking rate of 300 feet per minute was used. If the aircraft has experienced an abnormal landing, it should be noted in Form 781 and a shear bolt inspection requested by the pilot.

Fuel in the 600-gallon tip tanks center and aft compartments must be dumped before landing. This will be indicated on the fuel quantity gages by a reading of 1300 pounds (200 gallons) or less in each tip tank.

ARMAMENT FIRING.

The following limitations must be complied with when firing armament:

1. Firing of MB-1 rockets is prohibited while fuel remains in the center and aft compartments of the tip tanks, as indicated on the fuel quantity gages by a reading of 1300 pounds (200 gallons) or more in each tip tank.
2. Do not exceed +4.50 "G's" or −2.00 "G" in a symmetrical maneuver when firing MB-1 rockets.
3. Aileron and rudder deflection is limited to that amount required for trimmed flight while firing MB-1 rockets.
4. Speed brake deflection is not permitted during firing.
5. Maximum permissible speed at the time of firing MB-1 rockets is Mach 0.85.



● NO INTERNAL FUEL ● NO TIP TANK FUEL ● NO ARMAMENT

OPERATING FLIGHT STRENGTH DIAGRAM

for symmetrical flight in smooth air

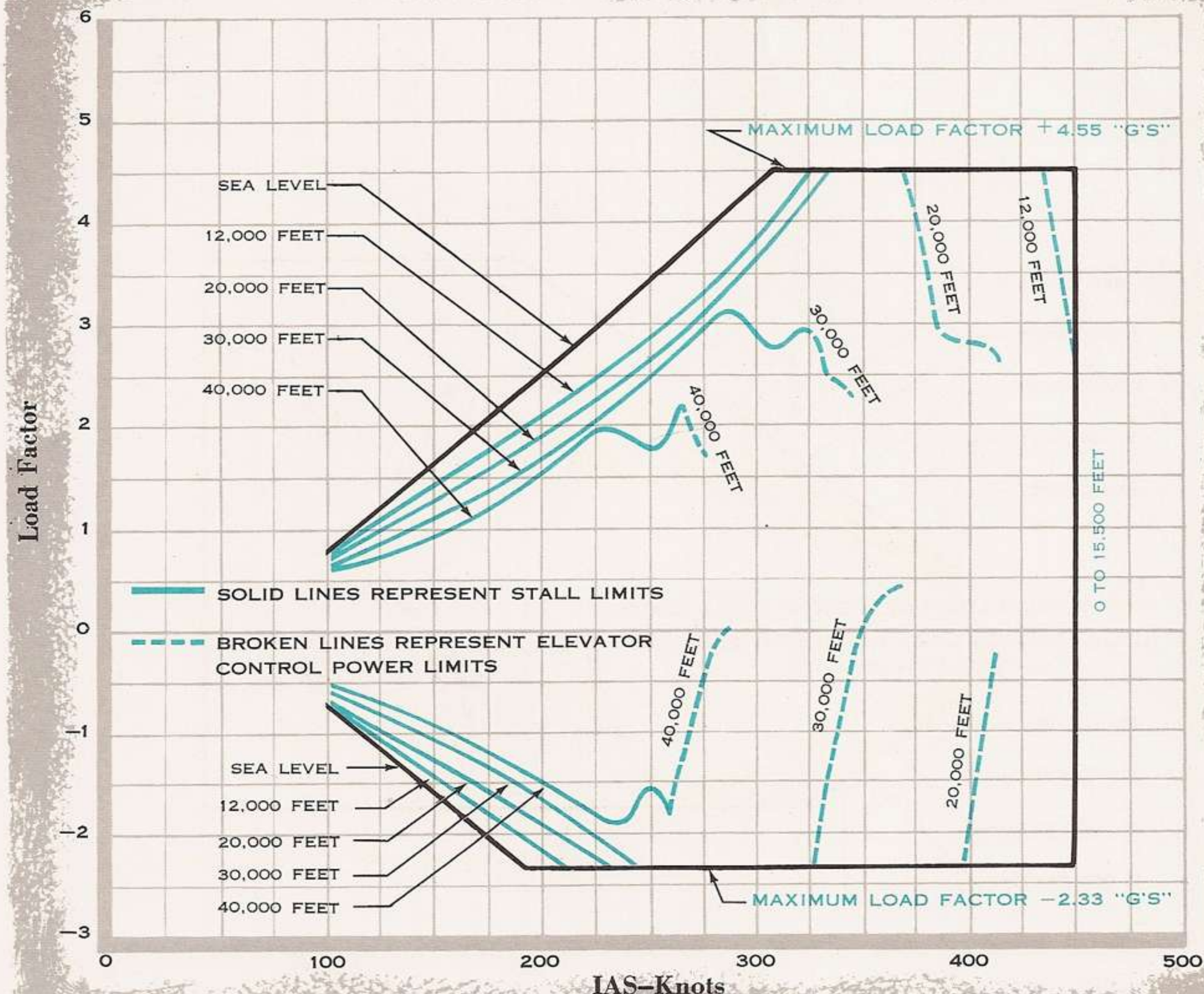
APPROXIMATELY **27,790** POUNDS GROSS WEIGHT

DATA AS OF: 17 SEPT 1957

DATA BASIS: ESTIMATED

J-90(1) D

Figure 5-4. (Sheet 1 of 4)



● FULL INTERNAL FUEL ● NO TIP TANK FUEL ● NO ARMAMENT

OPERATING FLIGHT STRENGTH DIAGRAM

for symmetrical flight in smooth air

APPROXIMATELY **35,310** POUNDS GROSS WEIGHT

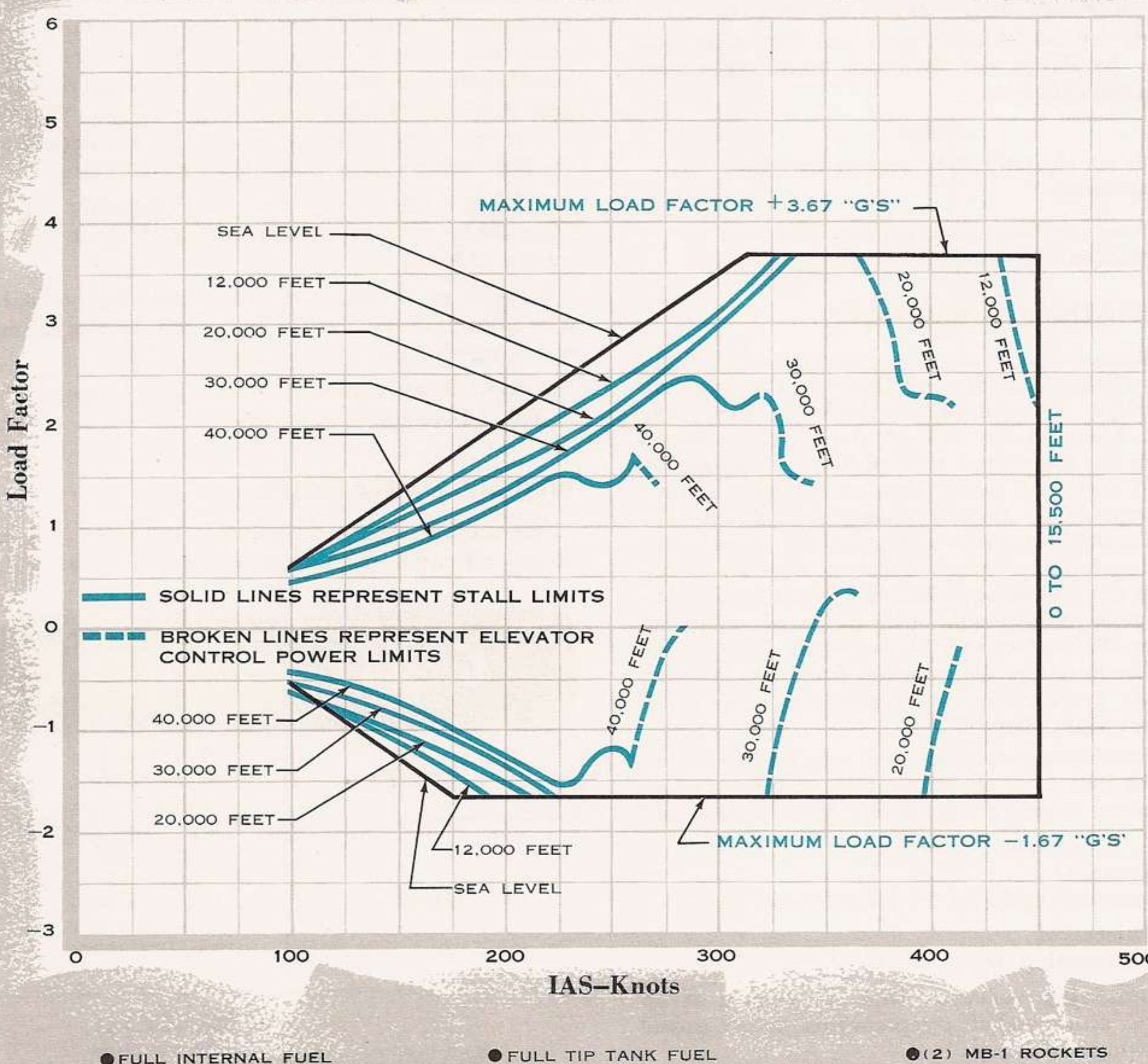
DATA AS OF: 17 SEPT 1957

DATA BASIS: ESTIMATED

J-90(2)D

Figure 5-4. (Sheet 2 of 4)

Figure 5-4. (Sheet 3 of 4)



OPERATING FLIGHT STRENGTH DIAGRAM

for symmetrical flight in smooth air

APPROXIMATELY **44,744** POUNDS GROSS WEIGHT

DATA AS OF: 17 SEPT 1957

DATA BASIS: ESTIMATED

J-88(4) B

Figure 5-4. (Sheet 4 of 4)

AILERON AND RUDDER MOVEMENT.

The following restrictions to aileron and rudder movement apply except during takeoff and landing:

1. With any available tip tank fuel, aileron motion must not be abrupt and deflection must not exceed one-third full deflection.

Note

- With no tip tank fuel, aileron deflection is unrestricted.
- Without tip tank fuel, rudder deflection is unrestricted, except for fish-tailing maneuvers.

ACCELERATION LIMITATIONS.

A load factor envelope shown on the Operating Flight Strength Diagram (figure 5-4), includes the operating gross weight and operating altitude ranges of the airplane. Lines on the left of the charts represent maximum lift limitations; top and bottom lines specify structural limit load factor; lines on the right indicate limit airspeeds or elevator control boundaries. The elevator control boundary lines show the necessity for careful regulation of airspeed during dive maneuvers because 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 altitude and prolonged dives from high altitudes where IAS can increase considerably above the maximum level flight airspeed.

1. In nonfiring maneuvers with any amount of tip fuel in the forward compartment, and the center and aft compartments empty, do not exceed the following load factors:

Symmetrical
maneuvering flight +4.50 or −2.00 "G's"

Asymmetrical
maneuvering flight +3.00 or −0.00 "G's"

2. In nonfiring maneuvers with any amount of tip fuel in the center and aft compartments, do not exceed the following load factors:

Symmetrical
maneuvering flight +3.00 or −1.50 "G's"

Asymmetrical
maneuvering flight +2.00 or −0.00 "G's"

CENTER-OF-GRAVITY LIMITATIONS.

The forward CG limit is at 21 percent of the mean aerodynamic chord. The aft limit varies linearly with gross weight. For example, the aft CG limit for 48,000 pounds gross weight is 26.3 percent MAC and 28.3 percent MAC at 28,000 pounds gross weight. The CG should never be allowed to pass behind the normal aft CG limit except under the following conditions:

1. With a full load of fuel, it is allowable for the CG to be aft of the normal operating aft limit by 0.80 percent of MAC.

2. With no armament nor fuel remaining on board, it is allowable for the CG to be aft of the normal operating aft limit by 0.70 percent of MAC.

For detailed instructions of weight and balance, refer to T.O. 1-B-40 and T.O. 1F-89J-5.

WEIGHT LIMITATIONS.

There are no weight limitations. See figure 5-5 for design, alternate, and maximum gross weights.

GROSS WEIGHTS

EMPTY	27,790 LB NO ARMAMENT, RESIDUAL FUEL
DESIGN	39,544 LB TWO MB-1'S, FULL INTERNAL FUEL, AND 200 GALLONS FUEL IN EACH TIP TANK
MAXIMUM	44,744 LB 400 GALLONS FUEL ADDED TO EACH TIP TANK

J-91D

Figure 5-5.

SECTION VI

FLIGHT CHARACTERISTICS

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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 high performance while carrying the heavy load of armament and equipment necessary for an intercept mission. 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 rudder pedals. The wide range of speed control possible with split-aileron speed brakes increases combat effectiveness. The sideslip stability augmenter provides satisfactory damping of the high speed Dutch Roll, assists the pilot in making coordinated turns in combat maneuvers, and provides a stable firing platform at high speeds. Tip tank fins, in addition to decreasing wing twist and keeping the center of spanwise lift more nearly constant, add to the longitudinal stability and control characteristics of the airplane. The fins increase the stick force per "G" in the airspeed range where maneuvering stability is critical (from approximately 0.70 to 0.80 Mach number). The elevator control for the airplane with tip tank fins is less sensitive (a higher stick force is required to pull a given load factor), 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 of 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

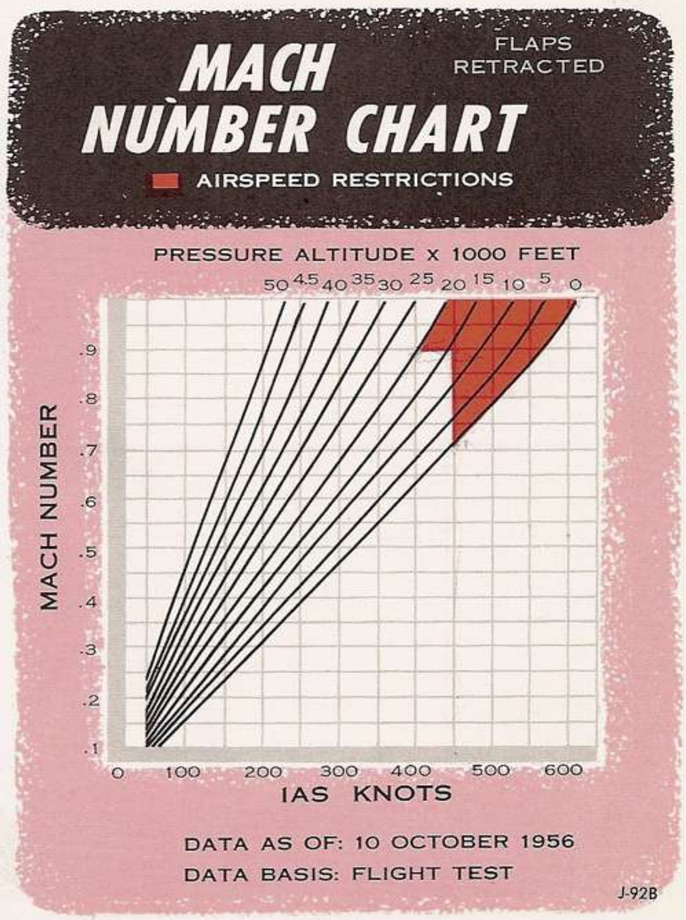


Figure 6-1.

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 configuration. 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. Ailerons and rudder retain sufficient effectiveness to maintain adequate control during a stall. Recovery from a stall is made by lowering the nose slightly and adding power as may be required. The altitude lost in a stall will be approximately 500 feet. 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.

STALL SPEED CHART (All configurations)

gear up or down — *stalling speed — IAS knots*

WING FLAP POSITION	SPEED BRAKE POSITION	ANGLE OF BANK	PRESSURE ALTITUDE—FEET	GROSS WEIGHT—POUNDS 30,000	34,000	38,000	42,000	47,400	
0°	CLOSED	0°	0	117	124	132	139	147	POWER ON
			5,000	118	126	133	140	149	
			10,000	119	127	134	141	150	
			20,000	121	129	138	147	159	
			30,000	127	138	150	161	176	
			40,000	140	153	165	175	187	
			45,000	149	160	169	178	189	
		30°	0 TO 5,000	124	132	140	147	157	
		45°		136	145	153	164	175	
		60°		162	175	188	201	220	
30°	CLOSED	0°	0 TO 5,000	105	113	121	128	137	IDLE POWER
		30°		113	120	128	136	146	
		45°		125	133	141	150	162	
		60°		150	162	171	180	191	
50°	½ OPEN	0°		100	107	114	121	129	
		30°		106	114	122	130	140	
		45°		119	128	136	146	157	
		60°		146	159	170	179	190	

DATA AS OF: 1 JAN 1957 DATA BASIS: FLIGHT TEST

J-93C

Figure 6-2.

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 increase 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. Flight tests have proved that 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 requires about 10,000 feet total altitude. With the use of conventional spin recovery technique, recovery characteristics are normal. Recovery from a three-turn power-off spin in clean configuration requires between one-half and three-quarters turn, and recovery from a one-turn power-off spin in landing configuration requires from one-quarter to one-half turn. With power on, the rate of recovery is slightly slower. The conventional spin recovery technique of full opposite rudder followed by forward stick 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 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 are required to obtain an additional "G" of acceleration. Since the maximum power climb schedules are at these Mach numbers, more than normal effort may be necessary 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 from 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 altitudes and high Mach number effects at high altitudes. The result is that the maximum load factor attainable at high airspeeds at a given altitude will decrease as airspeed increases above about Mach 0.82. This means that the higher the airspeed the fewer the available "G's". At speeds of Mach 0.90 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 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're at low altitudes, do not attempt abrupt pull-ups. Do not rely upon the feel of the stick to keep you out of trouble.

AILERONS.

Aileron effectiveness is adequate under all conditions other than in spins and at extreme airspeeds (above Mach 0.85), where aileron effectiveness decreases rapidly. However, sufficient lateral control for performing normal maneuvers at these extreme airspeeds can be maintained with speed brakes opened approximately 5 degrees. Partially opening the speed brakes (from 10 to 20 degrees) also improves aileron effectiveness at medium airspeeds (above Mach 0.75).

RUDDER.

Rudder operation is satisfactory under all operating conditions. The sideslip stability augmenter should be turned on before takeoff and left on for the duration of the flight. This system operates automatically to damp out any sideslipping or rolling tendencies induced by high speed and high altitude effects; through a signal derived from movement of the aileron controls, the system also applies rudder in a turn in proportion to aileron deflection, thereby enabling the pilot to make coordinated turns with ailerons alone.

SPEED BRAKES.

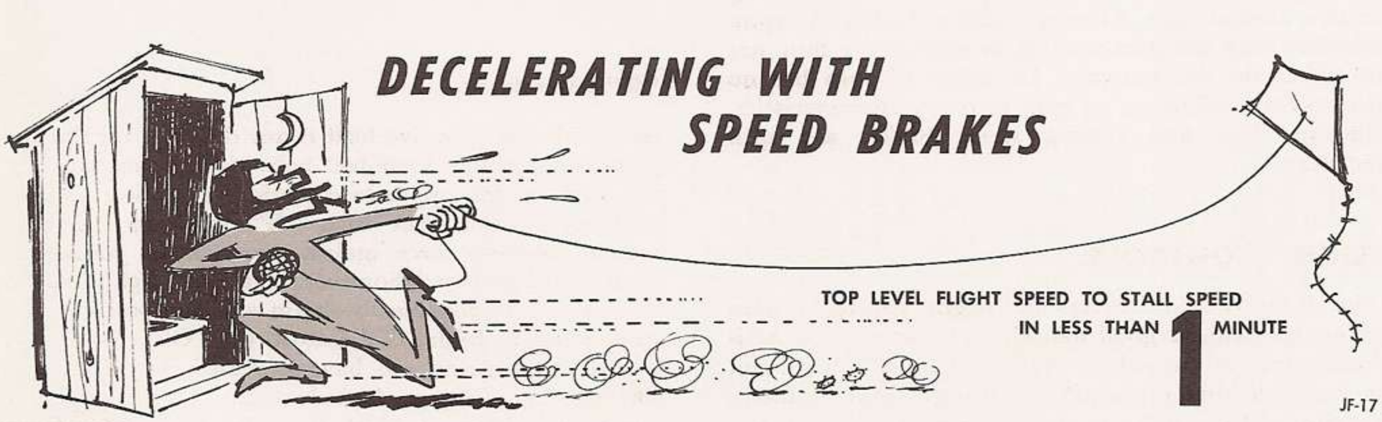
The split-aileron speed brakes provide a much larger drag surface than other types, making them highly effective under all operating conditions. Lateral control is improved at Mach numbers near cruise and above by slightly opened speed brakes. Since the speed brakes are symmetrical and are located almost in line with the airplane center of gravity, their use has little 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. Letdowns up to 30,000 feet per minute can be made without exceeding 350 knots IAS. Altitude loss is reduced by using speed brakes in high speed dive recoveries; however, as the speed increases above Mach 0.90, speed brake effectiveness decreases. Above approximately 260 knots the speed brakes will not open fully. At Mach 0.90 they will only open approximately 30 degrees; and because of adverse compressibility effects, little drag may result from their use. 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 speed brake lever to the 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 0.84 and Mach 0.88, the high speed 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 is independent of stick position. When trimming the elevator, the trim mechanism will not operate after the stick force is reduced to zero for any given stick position. Elevator trim will appear more sensitive at cruise speeds as less elevator is required to trim for a small change in speed in this region. Normal available rudder trim is 5 degrees left or right. Under normal flight conditions, the emergency rudder trim knob should not be used, as the sideslip stability augmenter system 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 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" flight 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 slightly lower than normal.

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 6-4 shows a 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.

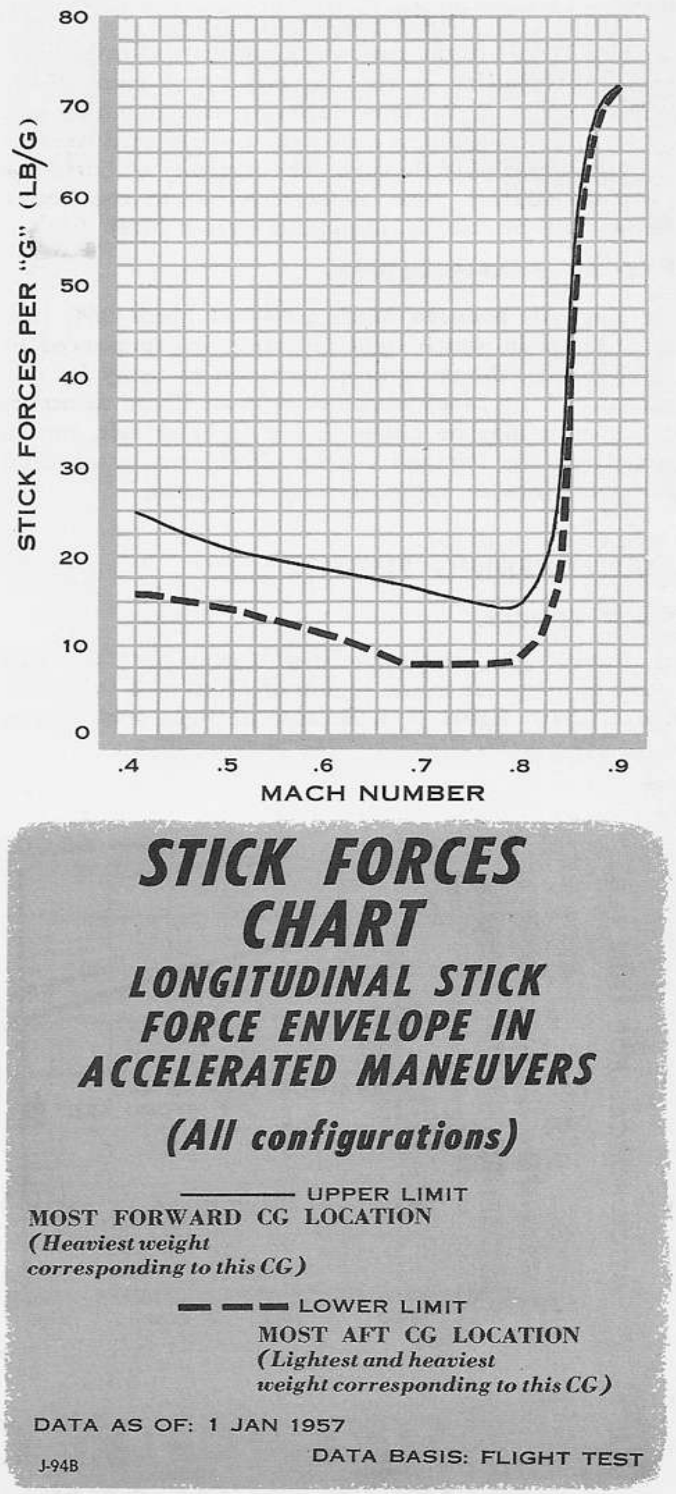


Figure 6-3.

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 considered 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 forces per "G" will occur at airspeeds in the region of Mach 0.78 (see Stick Force Chart, figure 6-4). Because of 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 as airspeed drops. 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 4.50 is the highest allowable under any flight

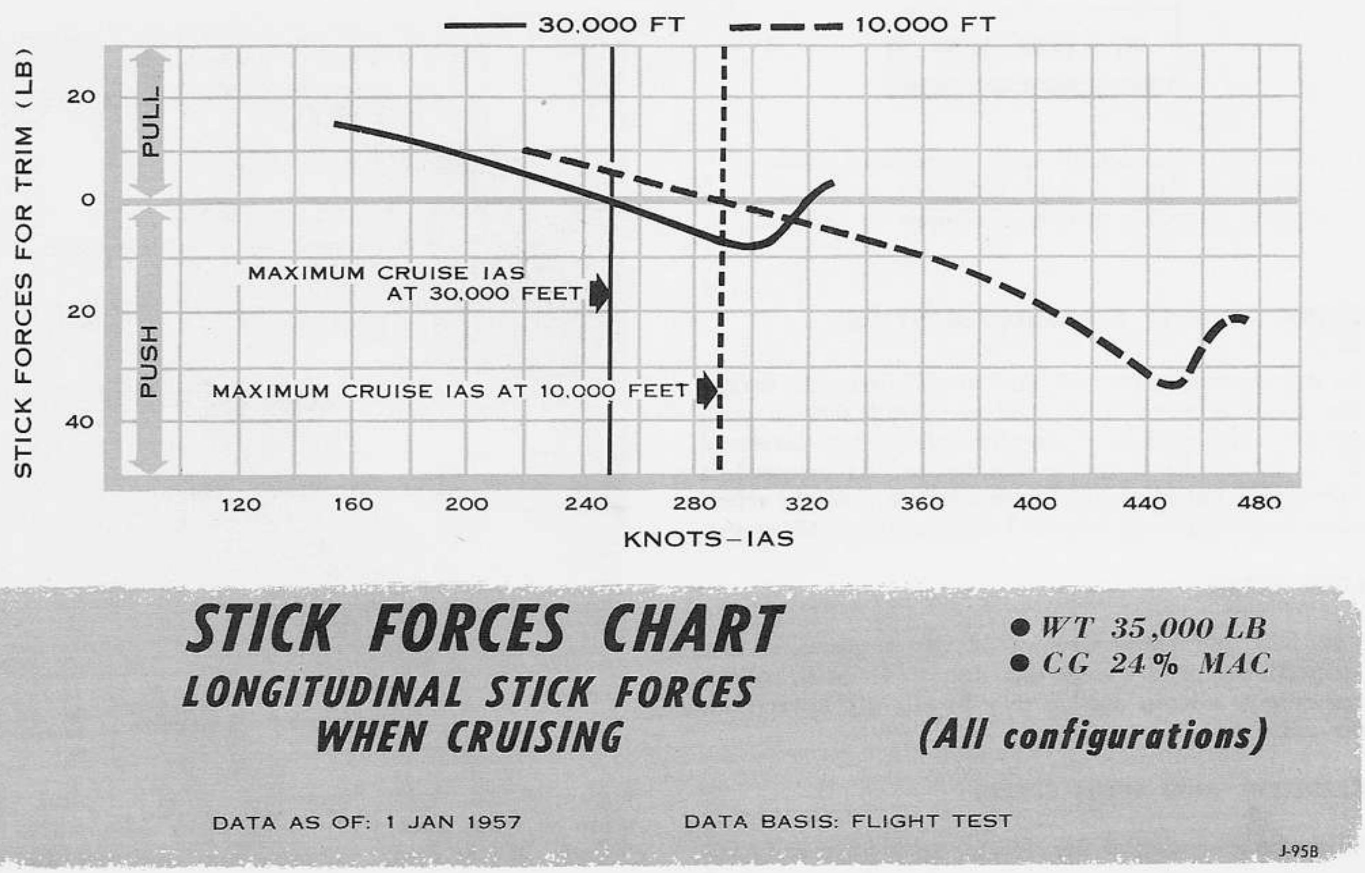


Figure 6-4.

conditions. Above approximately 25,000 feet it is impossible to attain 4.50 load factor because the airplane will either be forced into an accelerated stall or the elevator control power limit will be reached. At these altitudes, the airplane is controllable at high Mach numbers and its flight characteristics are normal for a high performance airplane. 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 from which the recovery is made, airspeed at start of recovery, and the load factor ("G's") held during recovery. See figure 6-5 for examples of typical dive recovery flight paths.

Note

- Altitude lost during dive recovery as shown in the Typical Dive Recovery illustration (figure 6-5), and Dive Recovery Charts (figure 6-6), does not include the altitude lost entering the dive.
- Dive Recovery Charts are based on a constant airspeed being held during entire recovery.

The Dive Recovery Charts (figure 6-6) 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 an 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 increases the altitude lost during recovery) for a relatively small increase in IAS above the limiting value shown on the chart. See figure 6-6 for instructions on chart use.

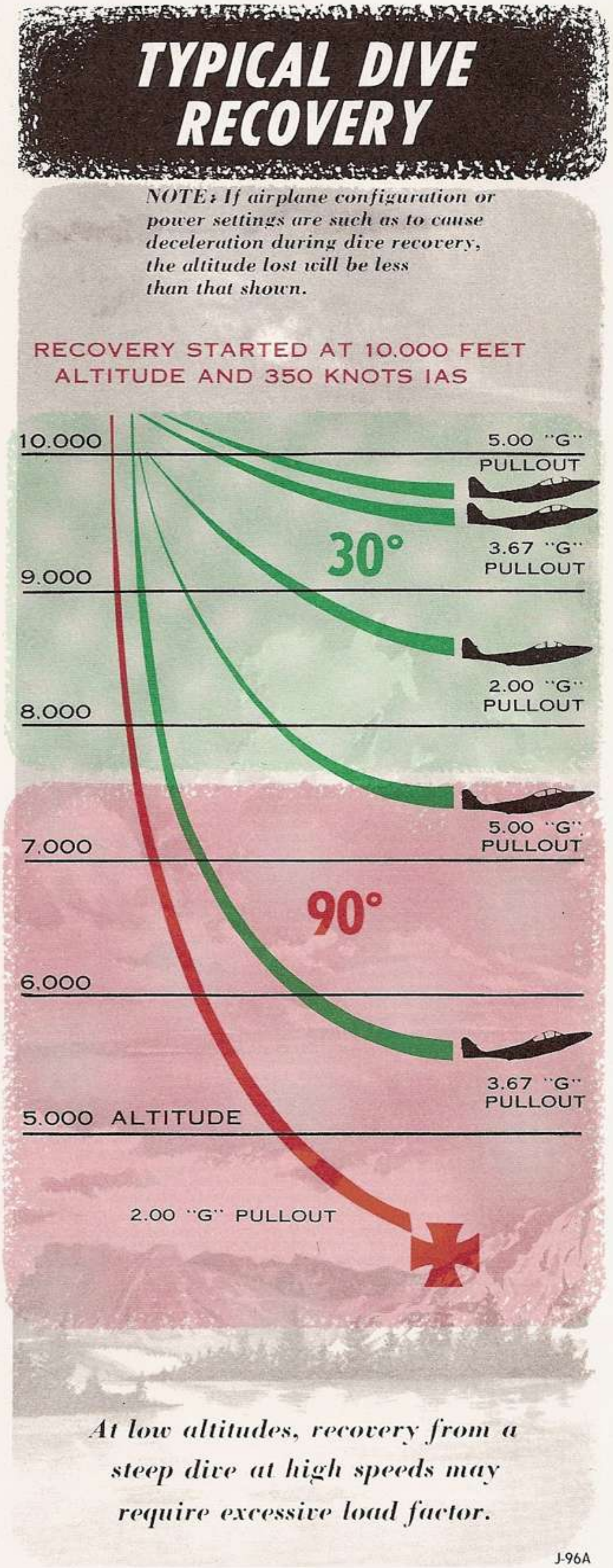
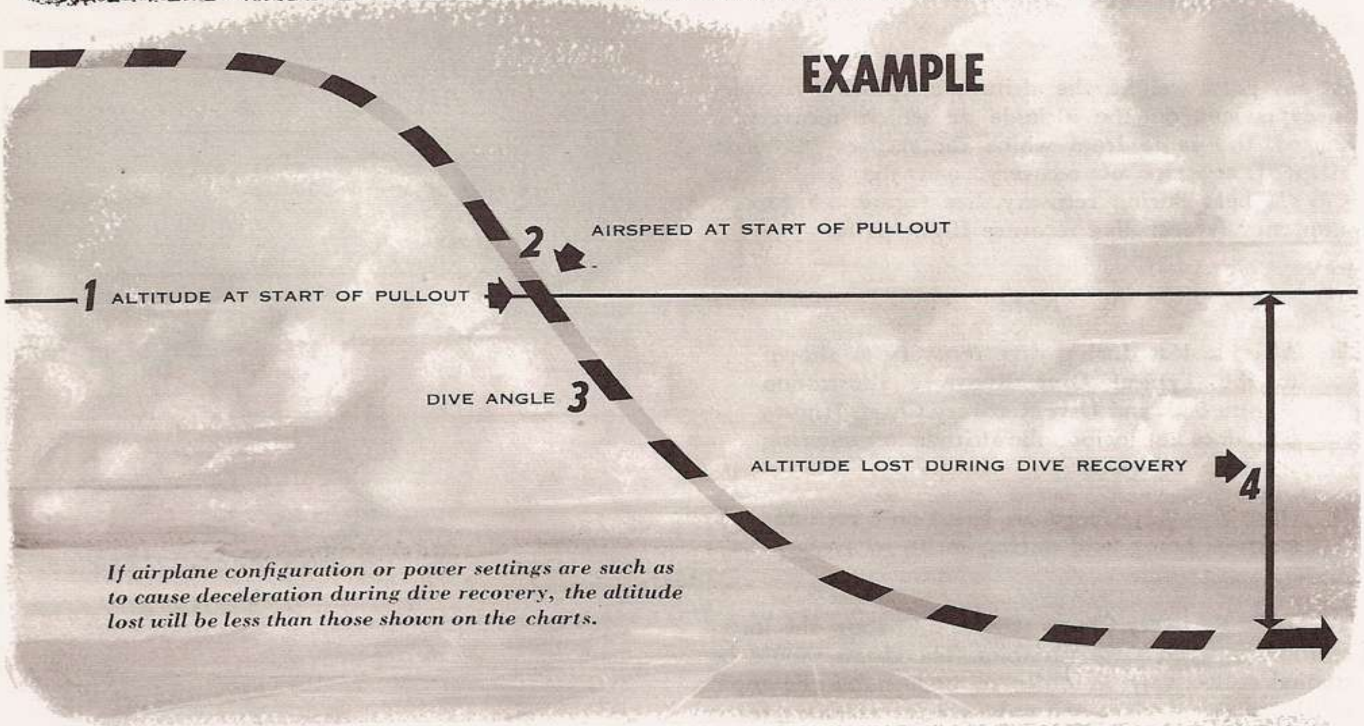


Figure 6-5.

HOW TO READ DIVE RECOVERY CHARTS

1. ***ALTITUDE at start of PULLOUT (25,000 FEET).***
2. ***MOVE TO RIGHT, to AIRSPEED at start of PULLOUT (300 KNOTS).***
3. ***MOVE DOWN CHART to DIVE ANGLE CURVE (60°).***
4. ***MOVE to LEFT and READ from this SCALE, the ALTITUDE LOST during DIVE RECOVERY (6300 FEET).***



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.

STALL LIMITS FOR 31,250 POUNDS GROSS WEIGHT

STALL LIMITS FOR 46,920 POUNDS GROSS WEIGHT

ELEVATOR CONTROL POWER LIMITS FOR 31,250 POUNDS GROSS WEIGHT

ELEVATOR CONTROL POWER LIMITS FOR 46,920 POUNDS GROSS WEIGHT

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Figure 6-6. (Sheet 1 of 3)

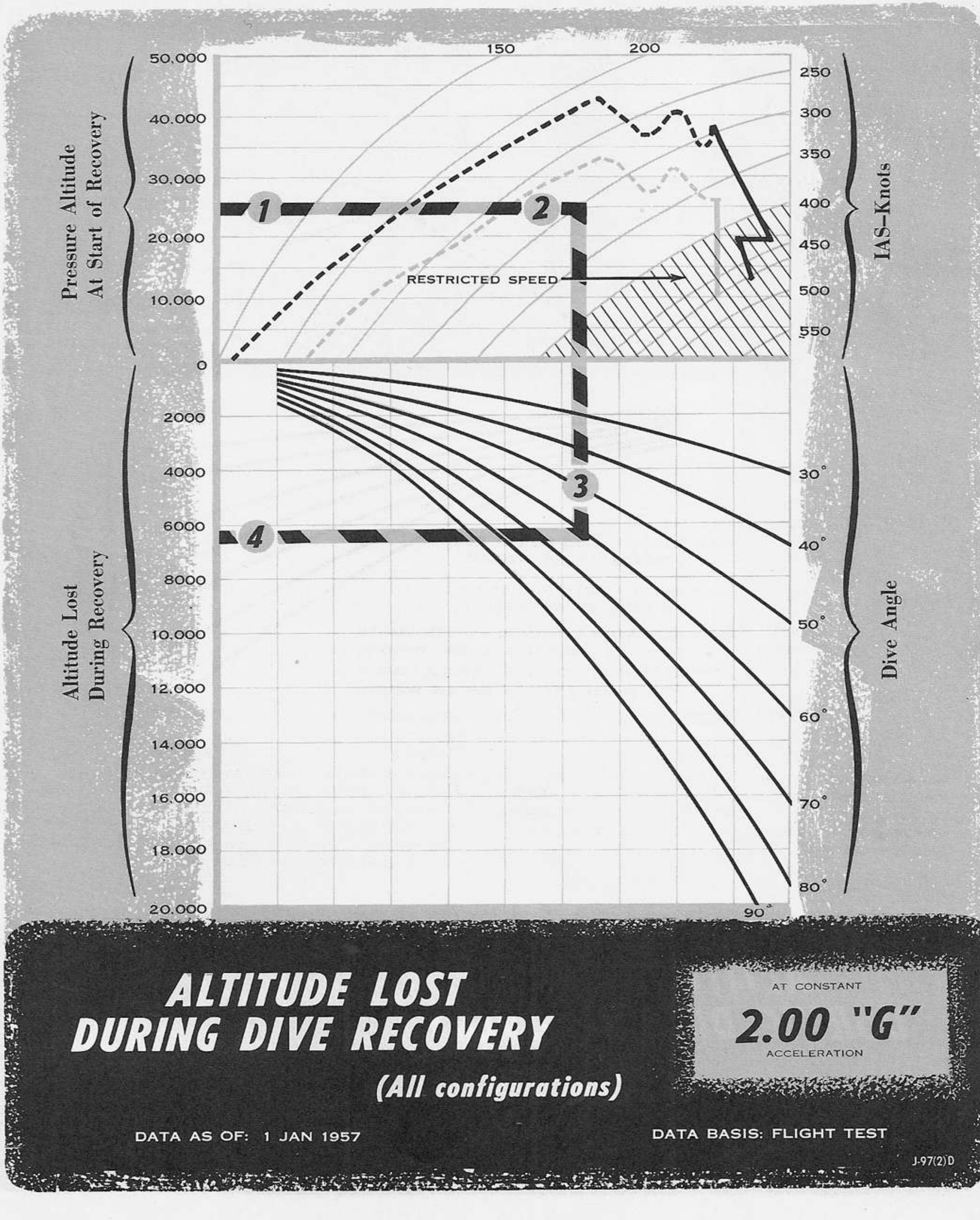
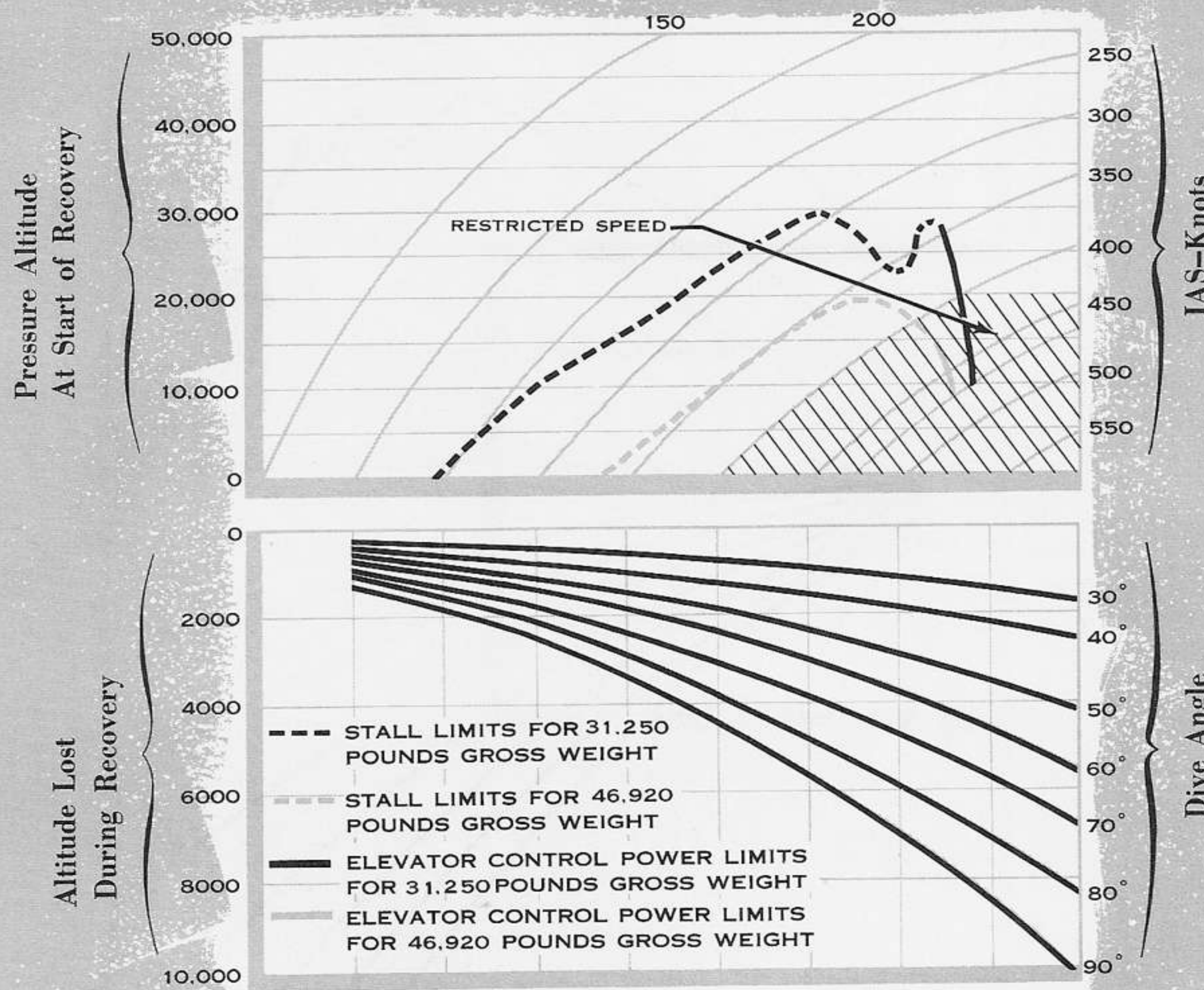


Figure 6-6. (Sheet 2 of 3)



- - - 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.

ALTITUDE LOST DURING DIVE RECOVERY

(All configurations)

AT CONSTANT

3.60 "G"

ACCELERATION

DATA AS OF: 1 JAN 1957

DATA BASIS: FLIGHT TEST

J-97(3)B

Figure 6-6. (Sheet 3 of 3)

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 ensure at least the minimum ground clearance.

HIGH MACH DIVE.

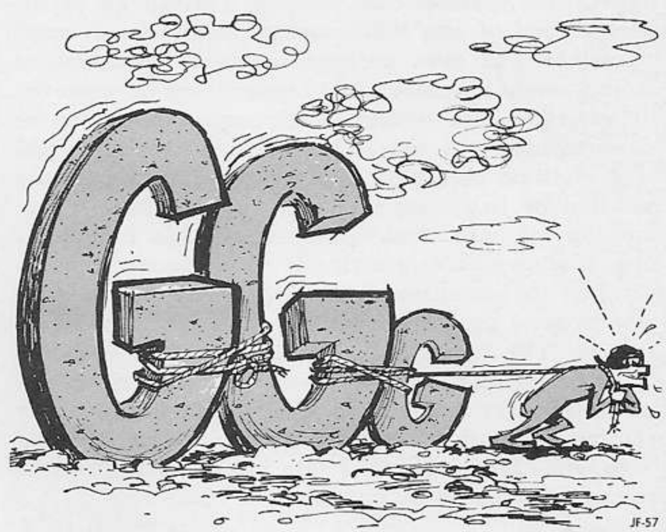
Performing a high Mach dive at high altitude is the best way to become familiar with the high Mach characteristics of the airplane. This maneuver is useful in combat for a breakaway, as an evasive maneuver, or as an effective way to let down rapidly. Since the purpose of the high Mach dive is to lose altitude as rapidly as possible, enter the dive with maximum power and at high IAS and get into a 60-degree dive as soon as possible.

WARNING

Generally, the steeper you dive, the greater the airspeed; however, as 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. At speeds associated with high Mach dives (Mach 0.90 and above), elevator and speed brake effectiveness is 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 partially; and because of adverse compressibility effects, little drag will result from their use. In a vertical or nearly 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 of altitude that recovery may be impossible. Therefore, use extreme caution in performing high Mach dives at angles greater than 60 degrees, and make certain that recovery from *any* high Mach dive is initiated no lower than 35,000 feet. The flight path for the 90-degree dive shown in figure 6-7 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 the inertia of the airplane weight is comparatively high compared to engine thrust, in a steep dive 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 6-7 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 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.

Note

The windshield and canopy defog and defrost system should be operated at the highest temperature possible (consistent with aircrew comfort) during high altitude flights. This high temperature will keep the transparent surfaces preheated and will preclude the formation of frost or fog during descent.

FLIGHT WITH ASYMMETRICAL LOADING.

Flights with asymmetrical loading (except an asymmetrical load of one MB-1 rocket) 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 fuel load (see Section III) 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. 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. 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.

Note

With clean configuration in level flight, the airplane may start to snake through the air at about 280 knots IAS if the sideslip stability augmenter is not operating properly.

FLIGHT WITH EXTERNAL LOADS.

Flight characteristics (such as buffet, stall, stability, and control) are essentially the same with or without external stores except for the restrictions covered in Section V.

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.

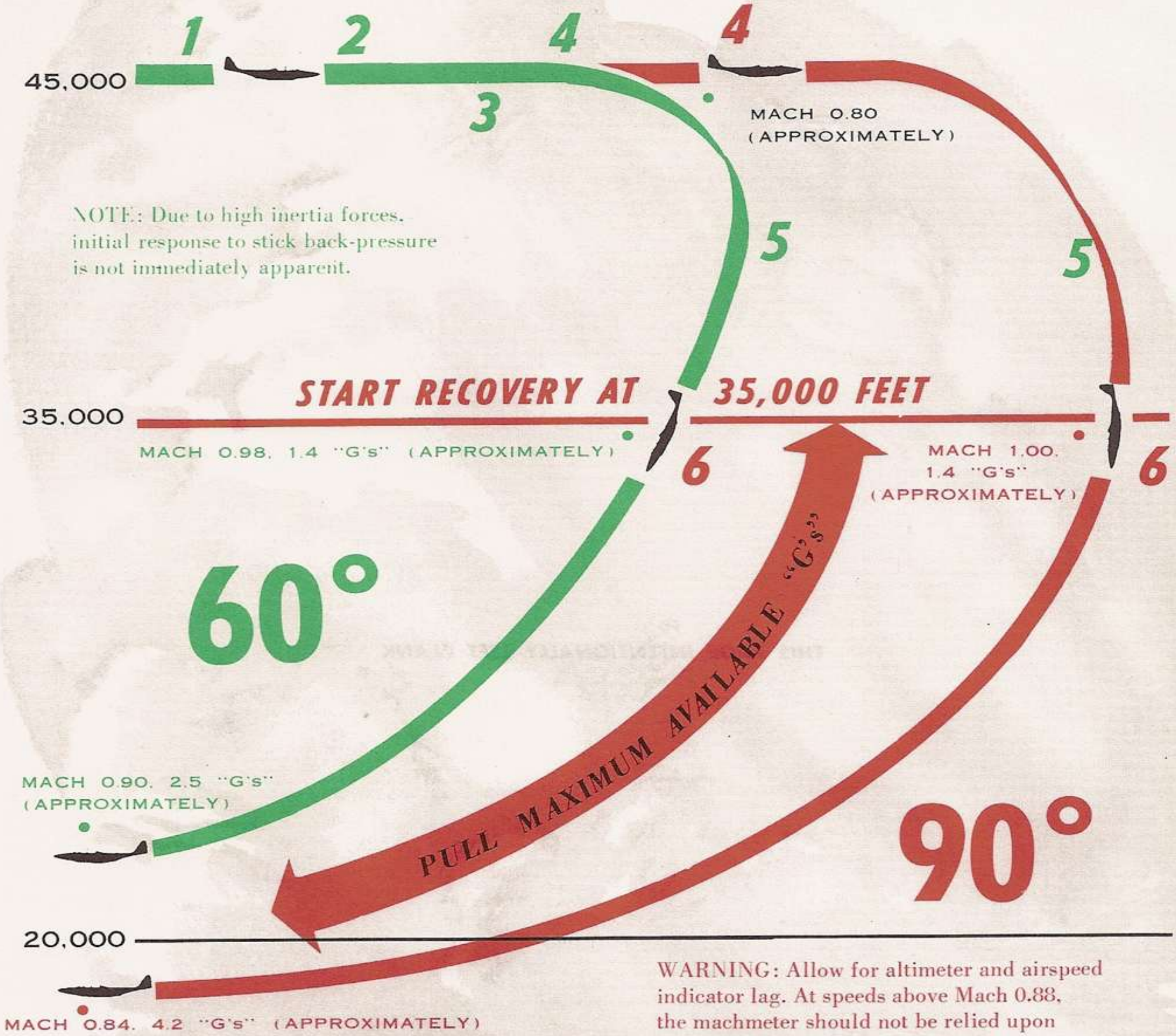
4 ENTER 60-DEGREE DIVE IN A DIVING TURN, MAINTAINING POSITIVE "G's" TO PREVENT FLAMEOUT.

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.

J-100(1)A



WARNING: Allow for altimeter and airspeed indicator lag. At speeds above Mach 0.88, the machmeter should not be relied upon for accurate airspeed indications. 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.

J-100(2)A

Figure 6-7.

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SECTION VII

SYSTEMS OPERATION

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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 out the fuel required by the engine, but normally will not pass sufficient fuel for excessive exhaust gas 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 during engine acceleration, and can be recognized by a loud rumble and vibration in the engine and rapid exhaust gas temperature 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 on the J35-35 engine 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 Form 781 after landing so that an engine overheat inspection will be made.

EXHAUST GAS TEMPERATURE VARIATION.

Exhaust gas temperature is affected by outside air 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. With constant rpm, exhaust gas temperature generally decreases with an increase in altitude and increases with greater airspeed and higher ambient temperatures. Abnormally low exhaust gas temperature for the existing ambient air temperature will result in a loss of thrust. These factors can change singly or in combination to cause variable exhaust temperatures at any given rpm. This could be serious on takeoff under critical field length conditions. 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. If the engines are operating at military power, the exhaust gas temperatures may decrease approximately 65° as the altitude increases.

Using maximum power the exhaust gas temperatures drop a maximum of approximately 65° between takeoff and absolute ceiling. 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 should, with a clear understanding of the fuel flow characteristics and their relation to exhaust temperature, 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 there is a possibility that 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. In the event of overspeeding, retard the throttle to a setting that will prevent exceeding a stabilized rpm of 100%.

INLET DUCT NOISE.

Because of the mass flow properties of the air entering the engine intake ducts, it may be possible to obtain combinations of engine and airplane speeds which will result in fluctuation of airflow through the engine transition ducts (duct rumble). The vortex generators (figure 1-4) suppress the fluctuation of airflow through the engine transition ducts to such an extent that duct rumble should not occur during descents at routine airspeeds. If duct rumble is encountered with engines operating, it 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 to a safe margin above stall.

EYELID OPERATION.

The eyelids are provided to increase the diameter of the tailpipe nozzle during afterburning. This is to permit an increase in thrust without operating at prohibitively high temperatures. In addition to opening in conjunction with afterburning, the eyelids will stay open during starting to prevent high temperatures, and during rapid acceleration to decrease acceleration time. An open-throttle switch and an idle switch, both operating on 28-volt dc, are in the NO. 4 inlet duct island and are mechanically actuated by the throttle shaft. The idle switch will be actuated when the throttle is at IDLE or below and will cause the eyelids to stay open in this speed range. The open-throttle switch is actuated when the throttle is full open and causes the eyelids to open during burst accelerations, or when the throttle is opened faster than engine rpm rises; however, an engine speed-sensing switch will open, interrupting the open-throttle switch circuit when the engine rpm reaches 87.5% and causing the eyelids to close. A pressure switch is in series with the idle switch and full throttle switch and will open the idle switch circuit at 10,000-foot altitude and cause the eyelids to stay closed during high-altitude idle. When the throttles are opened slowly, the eyelids will remain closed from idle to 100% rpm since the speed switch will be actuated in advance of the open-throttle switch to maintain closed eyelids during slow acceleration. Failure of the engine speed-sensing switch, or loss of power from the primary ac single-phase bus, will cause the eyelids to open during nonafterburning operation if the open-throttle switch is closed (throttle at 100% rpm position) and the airplane is below 10,000-foot pressure altitude (altitude switch closed). This will result in an extreme loss of thrust and low exhaust gas temperature. However, the eyelids can be closed by moving the afterburner toggle-type (some airplanes) control circuit breaker to the OFF position or, if trouble is caused by failure of a single-phase inverter, by moving the single-phase inverter switch to the EMER position. The eyelids are operated by two pneumatic cylinders powered by air from the 11th-stage engine compressor. The compressor air is directed to either side of the pneumatic cylinders by a solenoid valve which is controlled by a pressure differential switch which senses pressure changes in the engine tail cone. If the eyelids fail to open when afterburning is selected, engine rpm will drop and exhaust gas temperature will rise. If this occurs, afterburning must be discontinued immediately to prevent excessive exhaust gas temperatures. A failure of both single-phase inverters during afterburning will have no effect on engine and afterburner performance until the afterburners are shut down. If the airplane is below 10,000 feet and the throttles at 100% rpm, the eyelids must be closed by moving the afterburner control circuit breaker to the OFF position. Afterburning will not be available again until the single-phase power failure is corrected. Failure of the eyelids to close following afterburner operation will result in very low exhaust gas temperature and extreme loss of thrust.

AFTERBURNER OPERATION.

STARTING AFTERBURNERS AT HIGH ALTITUDE.

If difficulty is encountered when initiating afterburning at altitude using the normal procedure, use the following procedure:

1. Throttle—Retard to 95% rpm.

2. Throttle fingerlift—Lift and simultaneously jab the throttle forward. Large 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. In shutting down afterburners, depress fingerlifts manually rather than by throttle action.

FUEL SUPPLY SYSTEM OPERATION.

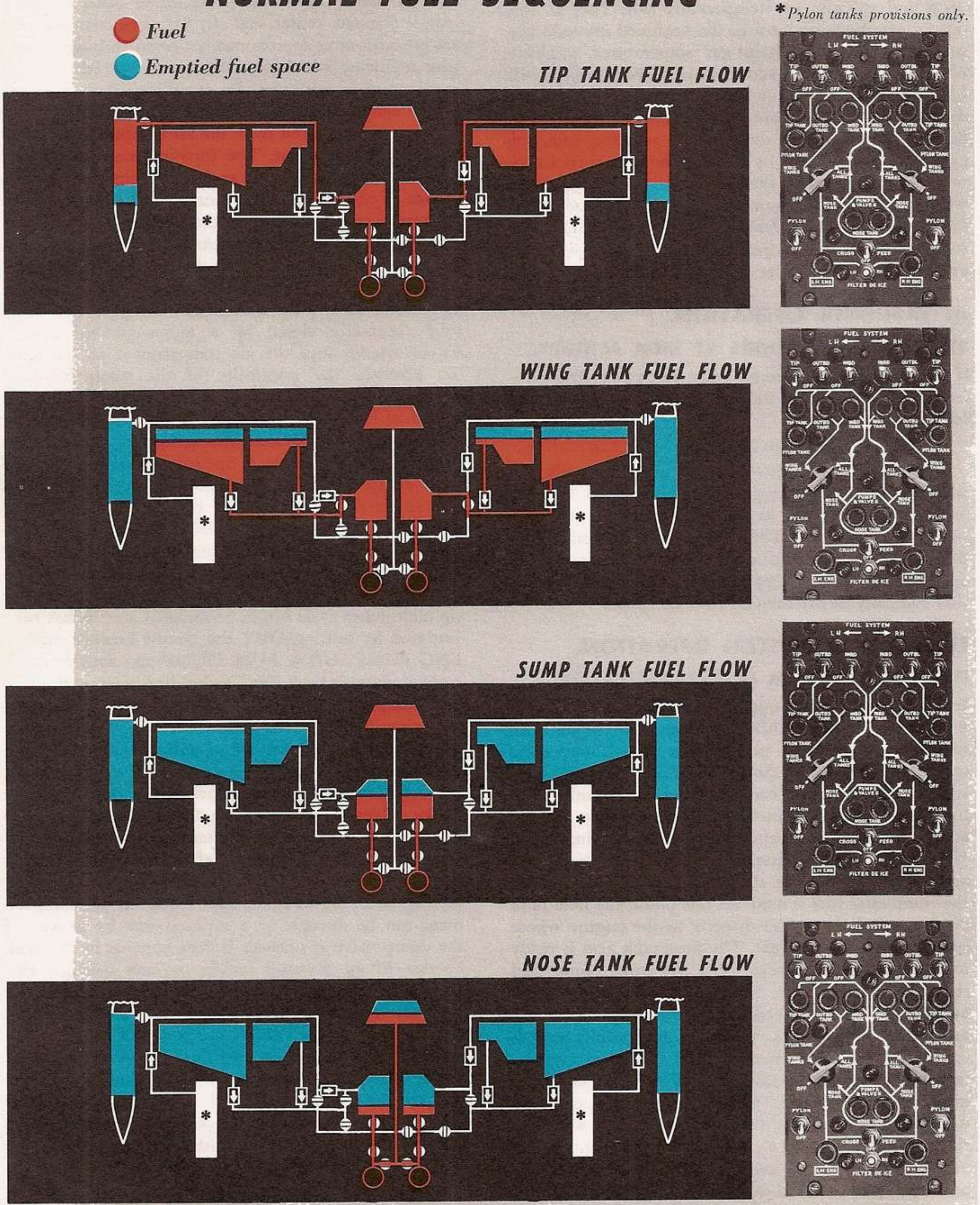
FUEL SUPPLY SYSTEM NORMAL OPERATION.

In normal fuel system operation, with the fuel selector switches at ALL TANKS and all individual tank switches at ON, fuel tank sequencing is automatic (pylon tank switches should be OFF). Fuel flows to each engine from its corresponding sump tank. Each sump tank is continuously replenished: first, by the tip tank; and then, simultaneously, by both wing tanks. When fuel transfer from the wing tanks stops, the sump tank alone feeds the engine until one-third of the sump tank fuel is used. At this point, the nose tank cuts in and delivers fuel directly to the engine whose sump tank is low on fuel. The nose tank also is ready to feed the other engine when the other sump fuel reaches the preset low level. When the sump tanks empty, the nose tank feeds fuel to both engines as long as the fuel supply lasts. When the fuel in any tank is consumed, the tank warning light comes on and the tank switch should be turned to OFF. When the wing tanks are nearly empty, both warning lights come on to indicate empty wing tanks; however, fuel will continue to be pumped at a reduced rate for about 5 minutes if the wing tank switches are left at ON. If tip tank fuel does not feed during normal sequencing, the corresponding tank switch should be turned to OFF; this starts the next tank feeding. See figure 7-1 for fuel flow during normal sequencing.

Tip Tank Normal Operation.

The tip tanks are divided into three equal compartments: forward, center, and aft. All three compartments are pressurized at approximately 9.5 psi through a pressure regulator which operates from the 11th stage of the engine compressors. In operation, fuel from the center compartment of the tank is transferred to the aft compartment, and from the aft compartment to the forward compartment. The forward compartment replenishes the sump tank as fuel is consumed by the engine. Consequently, the center compartment of the tip tank empties first, then the aft compartment, and finally the forward compartment. This arrangement helps to maintain the CG of the airplane within permissible limits. Only the fuel from the center and aft compartments of a tip tank can be dumped. The dump tube (normally closed by a motor-operated shutoff valve) extends into the aft compartment of the tank. To preclude the possibility of the sump low-level warning light illuminating because of reduced sump tank fuel level, the tip tank switches should be turned OFF before the tip tank dump button is energized. When the dump valve is opened by pressing the tip tank dump button on the pilot's left console, fuel is forced out the dump tube by the internal pressure of the tank. As the fuel is dumped from the aft compartment, fuel from the center compartment is forced aft to the aft compartment and is also dumped. The time of a dumping cycle is approximately 75 seconds. The tip tank dump cycle can be terminated after it has been initiated by pulling OUT the circuit breaker marked ENG PUMP IND & FUEL 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. If pressurization of a tank is lost, the center and aft compartments cannot be completely dumped. However, if the airplane is in a steep climbing attitude, fuel from the aft compartment can be dumped at a reduced rate by gravity if the dump valve is opened. If fuel remains in the tank because of air pressure failure or tank damage, that fuel cannot be used. At low altitudes, the fuel transfer rate from the tip tank may be less than engine demand at maximum power. This condition will normally exist only for a minute or two during takeoff and early stages of climb. Sump tank replenishment may be checked by turning the fuel quantity gage selector switch to SUMP and then checking for a drop in sump tank fuel. When climbing with maximum power and operating from tip tanks, the pilot should not permit the sump fuel to drop to the level that will cause the nose tank to feed out of sequence (before tip tank and wing fuel have been used). This condition, evidenced by the sump low-level lights coming on, is to be avoided

NORMAL FUEL SEQUENCING



J-101C

Figure 7-1.

because of a weight and balance consideration that will affect the airplane's handling characteristics. If either sump low-level light comes on while the engines are operating at maximum power, the related afterburner should be shut down. If the sump low-level light does not go out within a few seconds, fuel transfer from the affected tank has been interrupted, and action must be taken to bring the next tank into sequence to replenish the sump tank; for as long as the sump low-level light continues to burn, it indicates that the nose tank is also feeding the engine. This condition may be further verified by observing the nose tank fuel quantity gage. When the airplane is carrying full tip tanks, the entire amount of fuel aboard cannot be read on the fuel quantity gages. The gages will indicate approximately 1950 pounds (300 gallons) of fuel in each tip tank until half the tip fuel has been consumed. At this time the readings will start to decrease as fuel is used, reflecting the amount of fuel remaining. When tip tanks are empty, a float switch automatically starts the wing booster pumps, opens the wing fuel valves, and turns on the tip tank warning light. The tip tank switch should then be placed at OFF to close the tip fuel valve and turn out the tip tank warning light. (See figure 7-1)

Note

Single-point fueling circuit breakers must be pushed IN for the tip tank to feed, because it is through these circuit breakers that the tip tank fuel valves receive the power required for opening and closing.

Wing Tank Normal Operation.

After tip tank fuel is exhausted, both the inboard and the outboard wing tanks (simultaneously) feed the sump tank (figure 7-1). When the wing tank booster pumps start operating, the wing tank warning lights will flash on momentarily. The lights will burn steadily if the booster pumps fail or the tanks become empty. When the inboard tank is nearly empty the outboard tank is still half full. However, neither tank warning light will burn steadily until both tanks on a side become empty. Because of the relatively flat wing tanks, the pumps can pick up residual fuel for about 5 minutes after the lights come on; then the wing tank switches should be turned to OFF.

Note

Momentary flashing of the inboard wing tank empty warning light can be expected to occur when the inboard wing tank is approximately empty during the transfer of fuel from both wing tanks to their sump tank.

Sump Tank and Nose Tank Normal Operation.

When the wing tanks are empty, the fuel in the sump tanks is pumped to the engines (figure 7-1). When the fuel level in a sump tank falls to the two-thirds full point (63 US gallons remaining), both nose tank booster pumps start and pump fuel directly to the corresponding engine. When the fuel in the other sump tank falls to the two-thirds point, the nose tank feeds the other engine also. With the sump tank and nose tank feeding either or both engines, afterburning can be used as long as the corresponding sump tank contains fuel.

Note

Because of booster pump pressure variations that may exist between the nose tank and the sump tank booster pumps, the sump tank fuel may be exhausted before the nose tank begins to feed fuel to the engines during normal sequencing.

Nose Tank Normal Operation (Sump Tank Empty).

When a sump tank empties, the nose tank alone will continue to feed the corresponding engine (figure 7-1). After all the fuel has been used from either the right or left main systems and the fuel gage shows that a sump tank is nearly empty, select NOSE TANK with the corresponding fuel selector switch, because selecting NOSE TANK will close the sump tank fuel outlet shutoff valve. This will allow the engine to draw fuel out of the nose tank by suction if the nose tank booster pumps fail. If an empty sump tank shutoff valve were open and both nose tank pumps were to fail, a flameout would result from the engine's drawing air through the empty sump tank. The other engine would be similarly affected when its sump tank emptied unless that tank's shutoff valve were closed by turning the fuel selector to NOSE TANK. When the nose tank is feeding both engines and both sump tanks are empty, both engines can be operated at 100% rpm without afterburning if both nose tank booster pumps are running. If both engines are feeding from the nose tank and one engine is idling, the other engine can use afterburning provided that it is developing a minimum of 90% rpm.

Nose Tank (Pumps and Valves) Warning Lights.

If a nose tank (pumps and valves) warning light (figure 1-17) is on when the nose tank is brought into sequence by the sump tank (or by manual selection), the light may mean either the failure of the corresponding nose tank shutoff valve to open or the failure of the corresponding nose tank booster pump to start. To determine which malfunction is indicated, make the following check:

1. Crossfeed switch—ON.
2. If the light goes out, the corresponding nose tank shutoff valve has failed in the closed position, but the engine will continue to receive fuel from the opposite system through the crossfeed line. If a nose tank valve has failed in the closed position, it is still possible to route fuel to the corresponding engine by leaving the crossfeed valve open and opening the nose tank valve

to the other engine (by manual selection of NOSE TANK or by automatic selection when the sump tank fuel drops to 63 US gallons remaining).

3. If the light remains on, the corresponding nose tank booster pump is inoperative. The other pump will continue to supply fuel at a reduced rate, but at a rate sufficient to maintain two-engine military power at all altitudes.

FUEL SUPPLY SYSTEM MANUALLY SELECTED OPERATION.

Wing Tanks Manually Selected Operation.

When necessary, the fuel in the wing tanks can by-pass the sump tanks (figure 3-9A) and feed directly to the engines. When the fuel selector switch is at WING TANKS and both wing tanks switches are at ON, power is cut off from the sump normal booster pump; however, the sump-to-engine fuel line remains open so that afterburning can be used as long as fuel remains in the sump tank. When the sump tank empties, afterburning will stop without warning. If fuel remains in the sump tank after the wing tanks are empty, the fuel will gravity feed at low altitudes. When the wing tank booster pumps start operation, the wing tank warning lights should flash on momentarily until booster pump pressure builds up. If the pressure drops, because of a pump failure, the light will come on and remain on.

Nose Tank Manually Selected Operation.

Either fuel selector switch can be turned to NOSE TANK (figure 3-9A) to start both nose tank booster pumps feeding fuel directly to an engine. If both selector switches are turned to NOSE TANK, the nose tank fuel will feed both engines. When the fuel in the nose tank drops to 188 US gallons, the 10 percent fuel reserve warning light comes on.

CROSSFEED OPERATION.

One Engine Inoperative.

The crossfeed line connects the two fuel systems so that, in single-engine operation, both fuel systems can supply the operating engine (figure 3-9A). For this operation the crossfeed switch must be at on. (Refer to Single-Engine Procedure, Section III.)

One Fuel System Empty.

If one fuel system becomes empty, the selector switch should be at ALL TANKS and the crossfeed switch at on so that the other fuel system can feed both engines.

CAUTION

Do not turn the fuel selector switch for the empty fuel system to OFF, as the fire-wall valve to the corresponding engine will close and isolate that engine from its fuel supply regardless of the position of the crossfeed switch.

BALANCING FUEL LOAD.

(Deleted)

All data on page 7-7, figure 7-2 deleted.

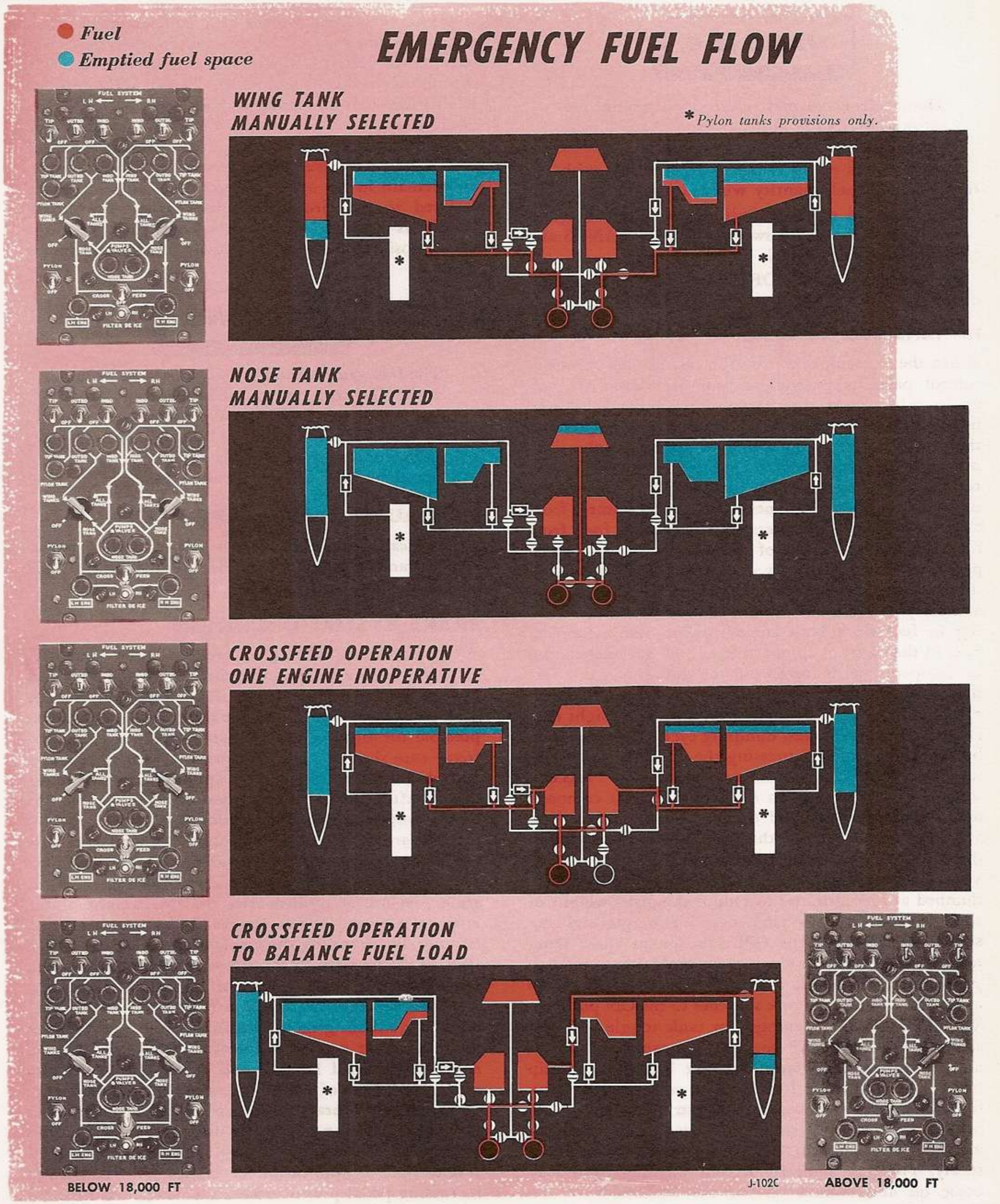

Fuel
Emptied fuel space
EMERGENCY FUEL FLOW
WING TANK MANUALLY SELECTED
*Pylon tanks provisions only.
NOSE TANK MANUALLY SELECTED
CROSSFEED OPERATION ONE ENGINE INOPERATIVE
CROSSFEED OPERATION TO BALANCE FUEL LOAD
BELOW 18,000 FT
ABOVE 18,000 FT
J-102C

Figure 7-2.

WARNING

Double flameout may result if wing tanks are allowed to run dry.

4. Wing tank pump switches (for the side with less fuel)—OFF. (Fuel quantity will read zero.)

5. When fuel quantity indicates a balanced condition, return fuel selector switches to ALL TANKS and turn all tank switches ON.

6. Crossfeed switch—OFF. Continue with normal operation.

TIP TANK FUEL DUMPING.

When the tip tank dump button on the fuel accessory control panel is pushed momentarily, both tip tank dump valves open simultaneously and are held open by a time-delay relay for 75 seconds. 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. Air pressure from the normal tip tank pressure line forces fuel from the center compartment of the tank into the aft compartment. Fuel in the aft compartment is forced out through the dump port (in the tip tank cone) by fuel and air pressure from the center compartment, resulting in fuel from both compartments being dumped. Fuel in the forward compartment (200 gallons) cannot be dumped. Fuel is forced out the dump port at a rate that normally will empty full center and aft compartments in approximately 60 seconds in level flight or a climb. 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. Tip tank fuel in the center and aft compartments cannot be dumped completely in a steep dive, and will dump at a lower than normal rate during rapid deceleration. During maximum rate-of-climb maneuvers and emergency conditions in which tip tanks are dumped at low altitudes to reduce the gross weight of the airplane, the tip tank override toggle switches should be turned to the OFF position to allow wing tank fuel to sequence during tip tank dumping. Approximately 2 minutes after completion of the dump cycle, return both tip tank switches to the ON position. When tip tanks are empty, tip tank toggle switches should be turned OFF to close tip tank fuel valves and to turn off tip tank warning lights. If the tip tanks are dumped at low altitude without following the recommended procedure, it can be normally expected to have both sump low-level lights come on and the nose tank to start to sequence fuel prematurely. The nose tank 10 percent warning light may come on and remain on for the remainder of the flight. This is because of the time required for the tip tanks to repressurize after dumping and again start to sequence fuel from the forward compartment to the respective sump tank. The tip tank dump cycle can be terminated after it has been initiated by pulling OUT the circuit breaker marked ENG PUMP IND & FUEL 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.

WARNING

The fuel gage selector switch should be placed at the TIP position prior to and during dumping of tip tank fuel. This will enable the pilot to determine if the fuel in both tip tanks has been dumped and whether or not an unbalanced tip tank fuel condition exists.

HYDRAULIC SYSTEM OPERATION.

Hydraulically powered systems whose normal operation is standard to most aircraft will not be discussed in this section.

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 the 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.

The wing flap lever can be pre-positioned at UP, TAKE-OFF, or DOWN; and 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 that position. The lever can then be released and the flaps will remain in position until the lever is moved.

SPEED BRAKE OPERATION.

The speed brake lever opens the speed brakes proportionately to the lever movement. Pre-positioning the lever at any point toward the OPEN limit of travel will stop the speed brakes in the corresponding position. At indicated airspeeds up to approximately 260 knots, the speed brake surface can be opened to any position (from 0 degrees to 120 degrees included angle). At indicated airspeeds above 260 knots, the angle to which the speed brakes open will be decreased proportionally to the increase in airspeed. If the speed is great enough, the airflow creates a back pressure in the system 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 the 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 PRESSURE.

To properly jettison the canopy, a minimum pressure of 1400 psi is required in the canopy jettison air bottle. The decrease in temperature which accompanies high-altitude flight may cause the bottle 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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SECTION VIII

CREW DUTIES

TABLE OF CONTENTS

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 to operate the radar equipment; therefore, he must be on every mission in which the radar equipment will be used. In addition to operating the equipment, he reads all check lists to the pilot and performs other important duties which are covered in the following paragraphs.

Note

For information regarding radar and armament refer to T.O. 1F-89J-1A.

BEFORE EXTERIOR INSPECTION.

Check Form 781 for status of the radar and other equipment pertinent to the duties of the radar observer.

1. NADAR access door--Open and check all circuit breakers--In.

2. Install NADAR magazine; door secure.

3. Canopy ejection pressure--Check (1500--2000 psi). (P--RO)

4. 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; chaff dispenser lanyard connected.

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.

5. Circuit breakers--IN. (P or RO)

6. Oxygen quantity--Check. (P or RO)

7. Battery switch--OFF. (P or RO)

EXTERIOR INSPECTION.

The exterior inspection is shown in figure 2-1. At the discretion of the pilot, the radar observer will perform the inspection of the upper wing and fuselage.

1. Through 54., pilot only.

UPPER WING AND FUSELAGE. (P or RO)

55. General condition of surfaces.
56. Tip tanks for equal amounts of fuel and caps secured.
57. All fuel filler caps secured.
58. Cooling scoops on top of fuselage clear.
59. Fuselage position light condition.

60. Alcohol tank - Check quantity and cap secured (right wing).
61. Canopy seal and windshield condition.
62. Canopy control door and emergency release handle stowed.

INTERIOR CHECK.

Rear Cockpit.

1. Radar Master switch--OFF (Pull).

2. Safety belt and shoulder harness--Fasten; inertia reel operation--Check; zero delay lanyard--Attach, automatic-opening parachute lanyard--Connected.

WARNING

Improperly attaching the shoulder harness and safety belt tie-down straps to the automatic belt may 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.

3. Alternator external power switch--CLOSE (after external power is connected).

4. Interphone amplifier switch--ON.

5. Interior light switches--As necessary.

6. Canopy defog knob--IN.

7. Altimeter and clock--Set and cross-checked with pilot.

WARNING

Use caution in rotating the barometric set knob and note the position of the 10,000-foot pointer to prevent an erroneous altimeter setting. If the set knob is continuously rotated, after the barometric scale is out of view in the Kollsman window, until the numbers reappear on the opposite side, an error of 10,000 feet in altimeter setting can occur.

8. Interphone selector switch--MIX AND SIG COMMAND (COMM INTER); interphone toggle switch--ON.

9. Communications equipment--Check operation.

10. Emergency signal system--Check (with pilot).

11. Oxygen regulator diluter level--NORMAL OXYGEN; supply lever--ON.

12. Oxygen equipment--Check proper connections and operation. (Refer to Oxygen System, Section IV, for detailed operation.)

13. Hydraulic engine hoist and brake selector valve handles--Handle B (aft) to NEUTRAL and Handle A (forward) to BRAKES.

14. Hydraulic hand pump handle--Stowed.

15. Make sure that all required navigational publications are aboard.

Note

For additional instructions regarding radar observer's equipment refer to T.O. 1F-89J-1A.

BEFORE TAXIING.

Voltage Check.

1. Alternator voltage--Check (left engine rpm above 60%).

2. Single-phase and three-phase inverter buses--Check output.
   All buses should read 115 ±5 volts with voltmeter selector switch at PWR INV PRI, PWR INV SEC NO. 1, INST INV, and PWR INV SEC NO. 2.

3. Three-phase inverter switch--SPARE (EMER). (P)

4. Three-phase inverter bus--Check output.

5. Three-phase inverter switch--MAIN (NORMAL). (P)

6. Ejection seat ground safety pins--Remove.

BEFORE TAKEOFF.

Preflight Airplane Check.

1. Safety belt--Tighten; zero delay lanyard--Check attached; shoulder harness--Adjust to fit snugly; inertia reel lock lever--LOCKED

AFTER TAKEOFF--CLIMB.

1. Zero delay lanyard -- DISCONNECT and STOW upon reaching 10,000 feet with Zero Delay Lanyard Engagement Requirements Chart (Figure 3-6A).
2. Oxygen system--Check.

CLIMB.

1. Oxygen system--Check.

2. Altimeter and cabin altitude--Check for proper operation.

3. Wings and fuselage--Check.

4. Altimeter--Set to 29.92 passing 24,000 feet.

DURING FLIGHT.

1. Adjust radar controls for set operation (refer to T.O. 1F-89J-1A).

DESCENT.

1. Canopy defogging system--As required.
2. Altimeter -- Set to current setting descending through 24,000 feet; cross-check with pilot.

3. Zero Delay Lanyard - CONNECT prior to high fix for penetration, or at 10,000 feet enroute descent IAW Zero Delay Lanyard Engagement Requirements (Figure 3-6A).

BEFORE LANDING.

1. Safety belt and shoulder harness--Check for tightness; zero delay lanyard--Check attached in accordance with Zero Delay Lanyard Engagement Requirements Chart (Figure 3-6A).

2. Viewing scope--Stowed.

3. Radar console assembly--Forward position.

4. Inertia reel--Locked.

TOUCH-AND-GO LANDINGS.

After Takeoff.

1. Zero delay lanyard--Unhook in accordance with Zero Delay Lanyard Engagement Requirements Chart.

After Landing.

1. Ejection seat ground safety pins--Insert.

STOPPING ENGINES.

1. Electrical equipment--Off.

BEFORE LEAVING AIRPLANE.

1. Oxygen tube, radio cord, and personal equipment--Properly stowed.

EMERGENCY PROCEDURES.

In addition to the forgoing normal procedures, the following emergency procedures, all contained in Section III, require duties to be performed by the radar observer:

ENGINE FAILURE
- SINGLE ENGINE PROCEDURE
- ENGINE FAILURE DURING TAKEOFF (BEFORE LEAVING GROUND)
- TAKEOFF ABORTED
- ENGINE FAILURE DURING TAKEOFF (AFTER LEAVING GROUND)
- TAKEOFF CONTINUED
- CONTINUED FLIGHT IMPOSSIBLE
- EJECTION VERSUS FORCED LANDING

FIRE
- ENGINE FIRE DURING START
- ENGINE FIRE DURING FLIGHT
- FUSELAGE, WING, OR ELECTRICAL FIRE

SMOKE AND FUME ELIMINATION

EJECTION
- BEFORE EJECTION
- EJECTION PROCEDURE
- FAILURE OF SEAT TO EJECT

FAILURE OF CANOPY TO JETTISON AFTER EJECTION
TAKEOFF AND LANDING EMERGENCIES
ABORT
FORCED LANDING
DITCHING
ELECTRICAL SYSTEM EMERGENCY OPERATION
GENERATOR FAILURE (ALL THREE)
LANDING GEAR SYSTEM EMERGENCY OPERATION
GEAR FAILS TO EXTEND ON EMERGENCY PROCEDURE

SECTION IX

ALL-WEATHER OPERATION

TABLE OF CONTENTS

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.

INSTRUMENT FLIGHT PROCEDURES

INTRODUCTION.

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 installation greatly simplifies precision instrument flying. *Pilots should avoid any tendency, however, to concentrate exclusively on the flight computer indicator, 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, 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 controls.*

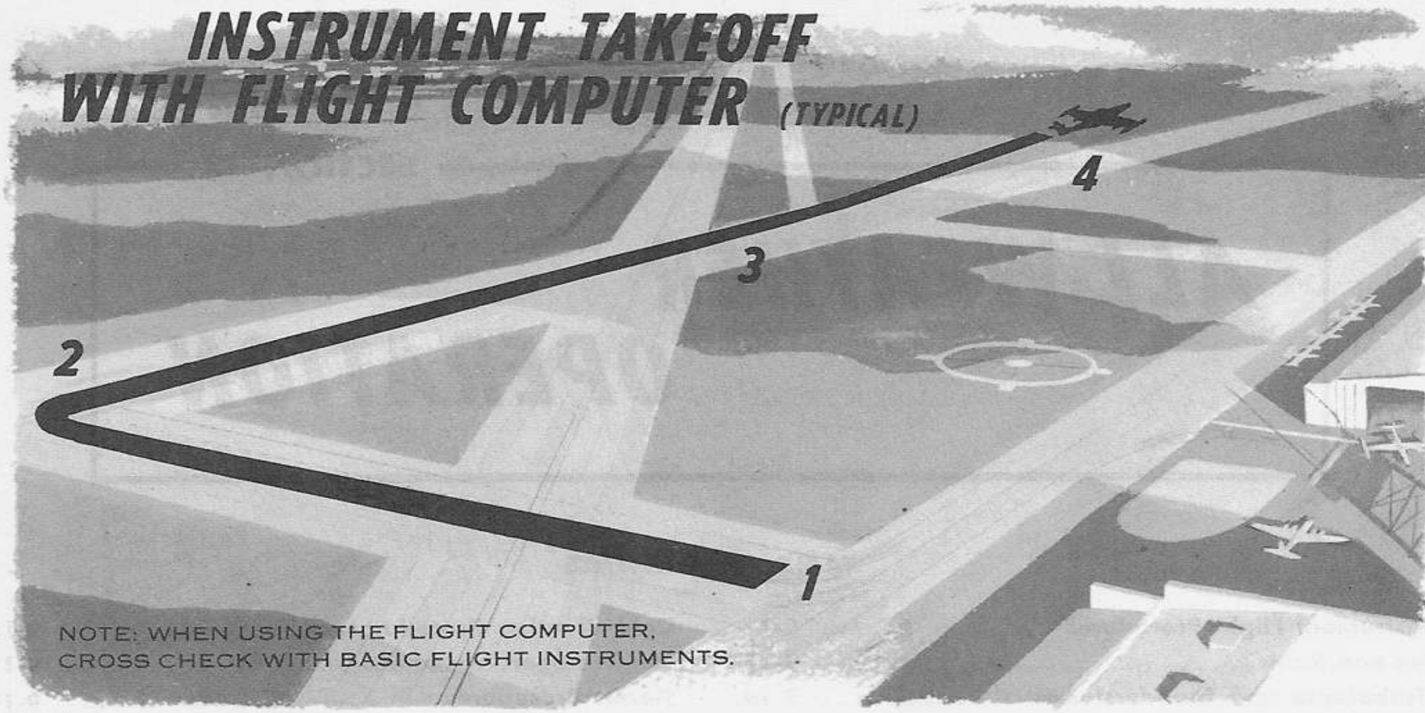
Note

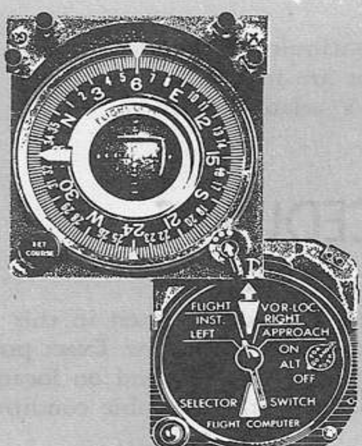
The instrument procedures given in this section represent typical conditions. Exact power settings, speeds, etc., will depend on location, existing traffic, and other variable conditions.

INSTRUMENT TAKEOFF.

Instrument takeoffs without afterburning are not recommended. Afterburning is recommended to shorten the takeoff roll in conditions of low visibility and 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 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 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

INSTRUMENT TAKEOFF WITH FLIGHT COMPUTER (TYPICAL)

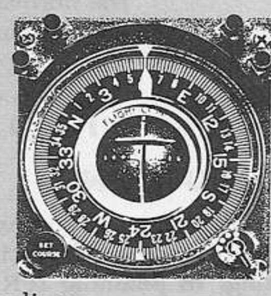




1 BEFORE TAKEOFF

A Flight computer selector switch—FLIGHT INST.

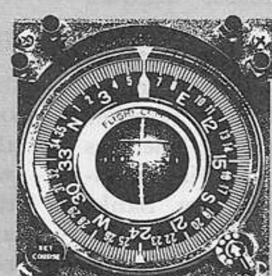
B Set horizontal bar of flight computer at two dots fly-up signal.



2 TAKEOFF

A Taxi into position and make visual lineup on center of runway.

B Set course dial on flight computer indicator to coincide with runway heading.



3 GROUND ROLL

Maintain direction by holding vertical bar on center.

4 TAKEOFF

Lift airplane off the runway in normal manner and zero the horizontal bar. The two dots fly-up setting will automatically provide a safe and efficient takeoff and initial climb to a safe terrain altitude.

J-103B

Figure 9-1.

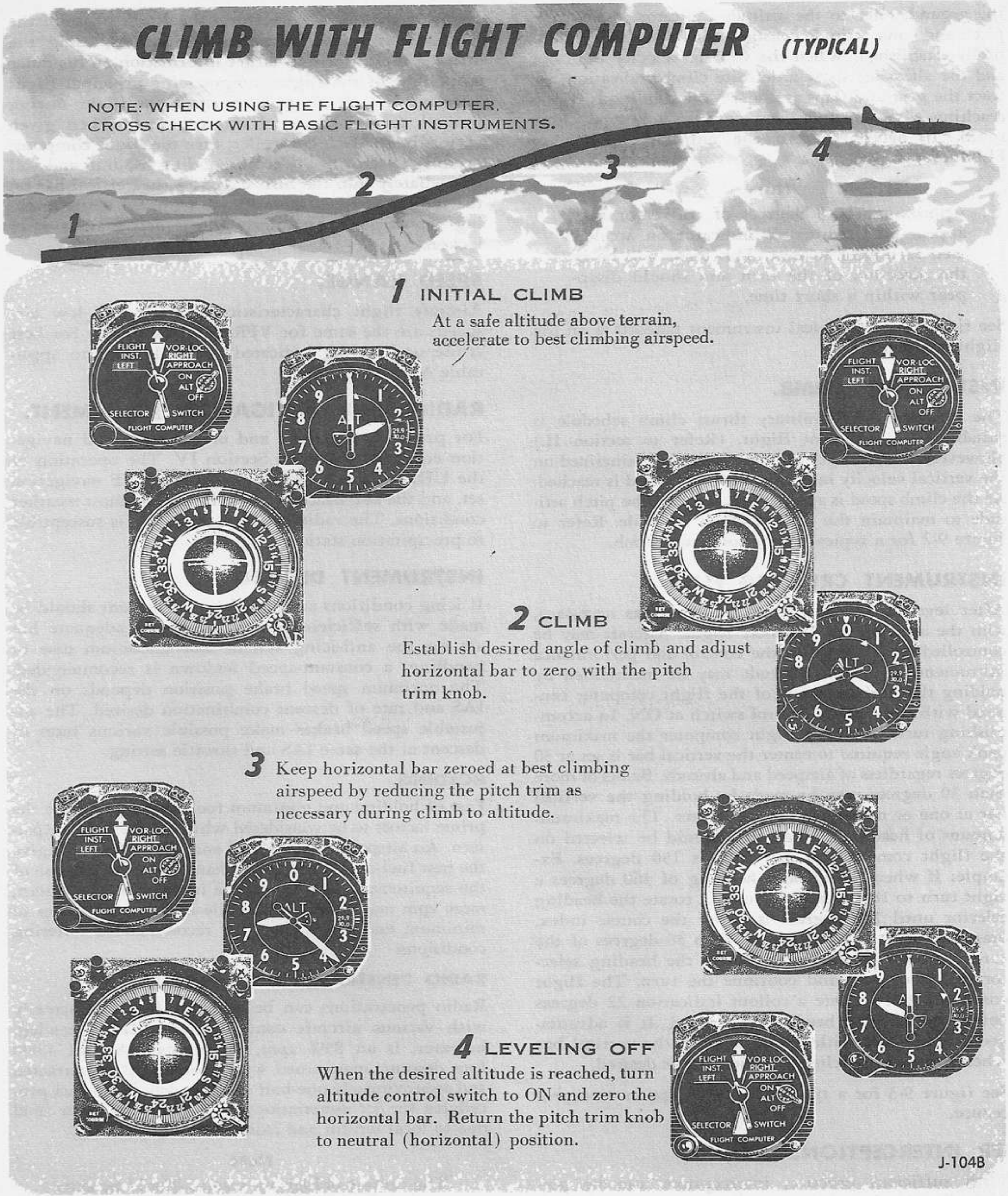

CLIMB WITH FLIGHT COMPUTER (TYPICAL)
NOTE: WHEN USING THE FLIGHT COMPUTER, CROSS CHECK WITH BASIC FLIGHT INSTRUMENTS.
1 INITIAL CLIMB
At a safe altitude above terrain, accelerate to best climbing airspeed.
2 CLIMB
Establish desired angle of climb and adjust horizontal bar to zero with the pitch trim knob.
3 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 neutral (horizontal) position.
J-104B

Figure 9-2.

the ground, refer to the attitude indicator to hold the pitch and bank attitude constant 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.

The optimum VFR military thrust climb schedule is suitable for instrument flight. (Refer to section II.) However, 1000 feet per minute should be maintained on the vertical velocity indicator until this speed is reached. As the climb speed is approached, increase the pitch attitude to maintain the desired climb schedule. Refer to figure 9-2 for a typical flight computer climb.

INSTRUMENT CRUISING FLIGHT.

After leveling off and adjusting power as necessary, trim the airplane for hands-off flight. Aircraft may be controlled by reference to the control and performance instruments. However, altitude may be maintained by holding the horizontal bar of the flight computer centered with the altitude control switch at ON. In accomplishing turns with the flight computer 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 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 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.

See figure 9-3 for a typical flight computer 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 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.

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, TACAN (some airplanes), VHF navigation set, and the IFF beacon is not affected by most weather conditions. The radio compass, however, is susceptible to precipitation static.

INSTRUMENT 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.

HOLDING.

Ease of holding and minimum fuel consumption are the prime factors to be considered while in the holding pattern. An airspeed of 200 KIAS and 20,000 feet will give the best fuel consumption and handling ease. Because of the requirement for turns while in the holding pattern, more rpm may be required while in the turns. Refer to minimum endurance chart for recommended loitering conditions.

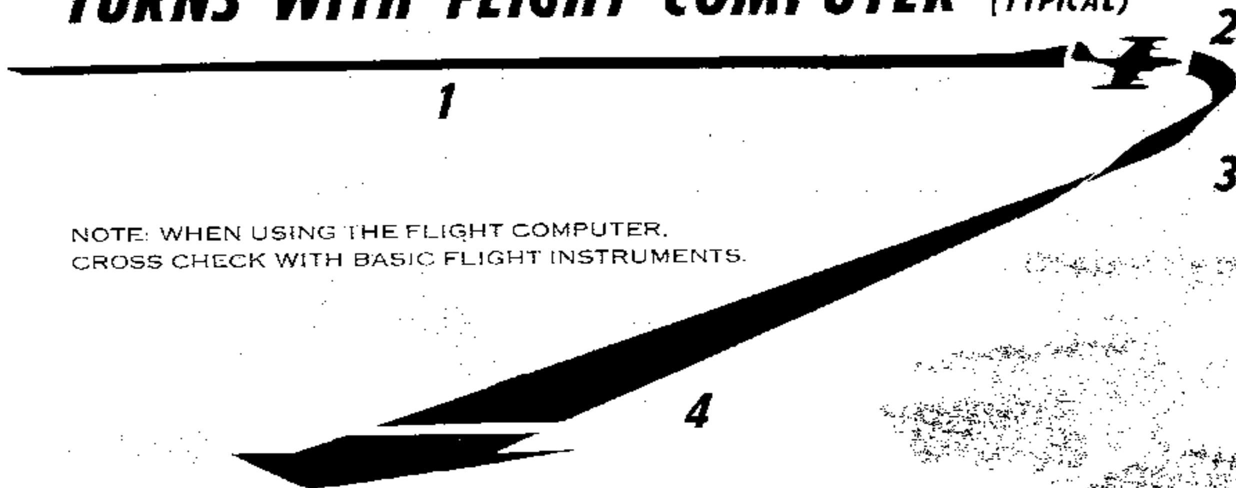
RADIO PENETRATIONS.

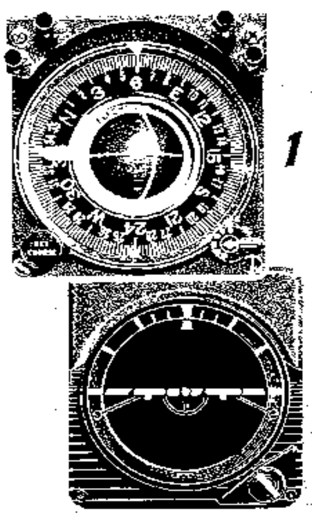
Radio penetrations can be accomplished satisfactorily with various aircraft configurations. Recommended, however, is an 85% rpm, 250 knots IAS, and 4,000 fpm descent, maintained with gear and flaps retracted and approximately one-half speed brakes. The exact procedures for jet penetrations will vary with each field due to local terrain and radio variations.

Note

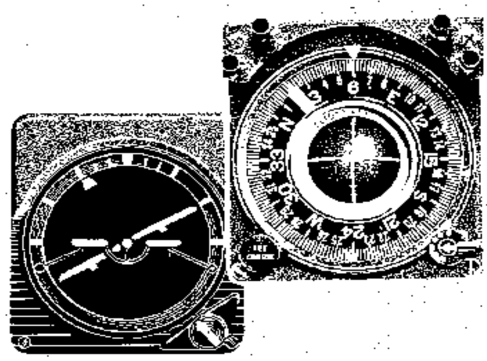
The canopy defogging system should be actuated approximately 30 minutes prior to descent from altitude.

TURNS WITH FLIGHT COMPUTER (TYPICAL)

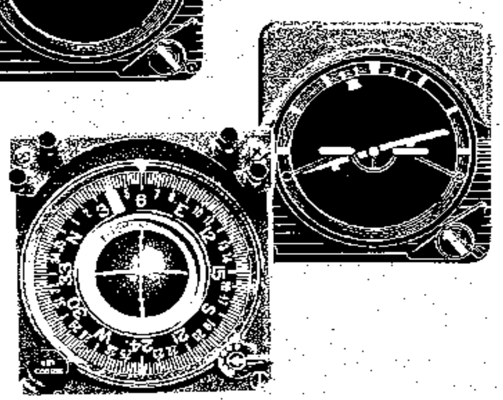




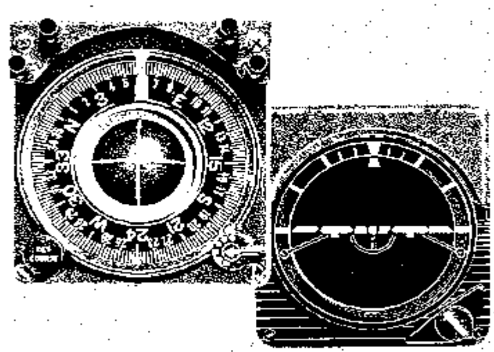
1 Set the course dial on the flight computer indicator to the new heading. The vertical bar of the indicator will be deflected in the direction the turn is to be made.



2 Zero the vertical bar.



3 Keep the vertical bar zeroed. (Note that the heading pointer is approaching the selected course at the top of the indicator dial.)



4 The airplane is on the new course and the heading pointer coincides with the selected course.

J-105C

Figure 9-3.

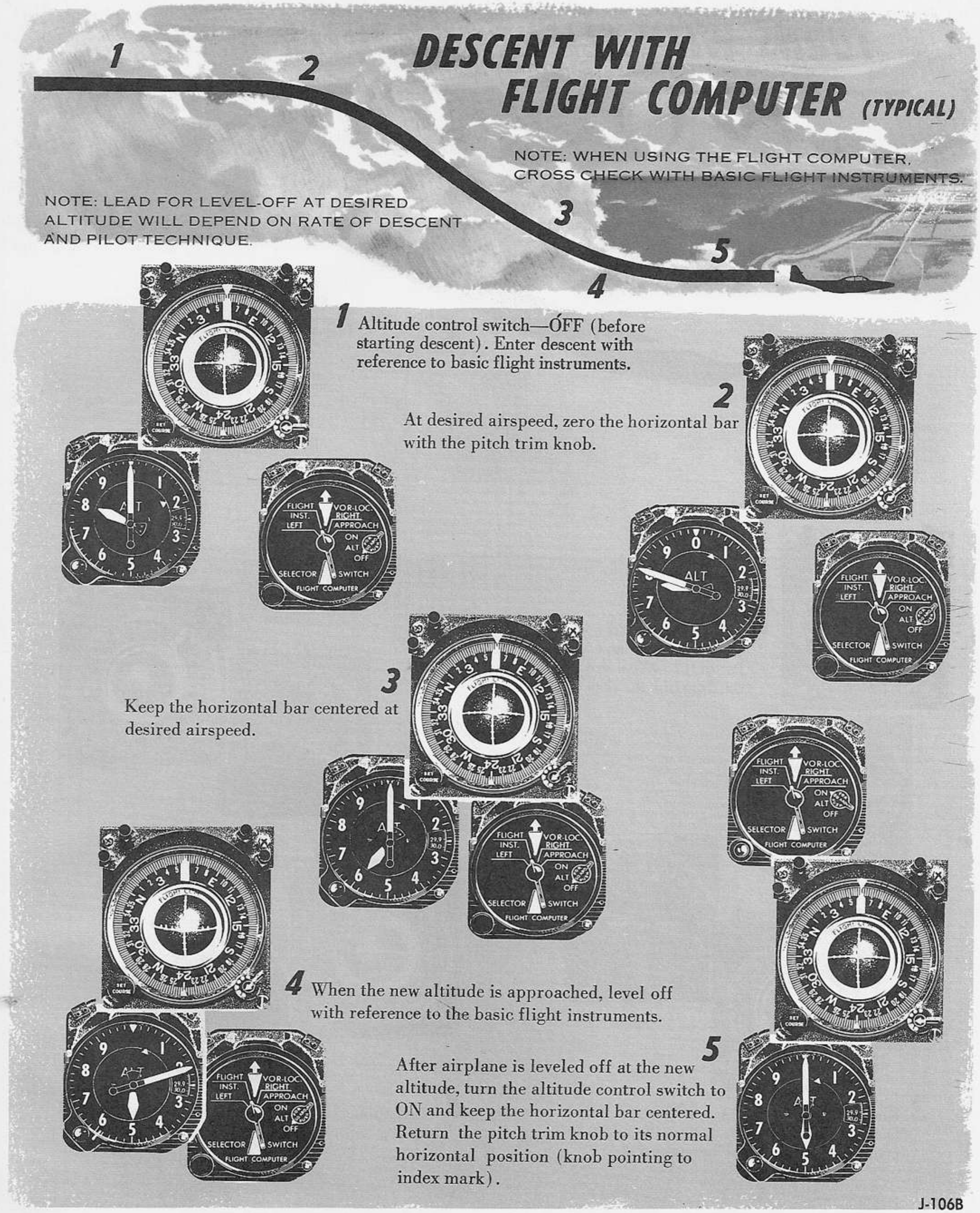

DESCENT WITH FLIGHT COMPUTER (TYPICAL)
NOTE: WHEN USING THE FLIGHT COMPUTER, CROSS CHECK WITH BASIC FLIGHT INSTRUMENTS.
NOTE: LEAD FOR LEVEL-OFF AT DESIRED ALTITUDE WILL DEPEND ON RATE OF DESCENT AND PILOT TECHNIQUE.
1 Altitude control switch—OFF (before starting descent). Enter descent with reference 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 horizontal position (knob pointing to index mark).
J-106B

Figure 9-4.

See figure 9-4 for a typical flight computer descent procedure.

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 flaps at takeoff, 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 or ILS equipped runway is considered minimum for actual all-weather operations.

RADIO APPROACHES.

Normally, radio 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 Flight Information Publication Terminal High Altitude. 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. Use 85% rpm and adjust speed brakes to maintain 195 KIAS while in procedure turn.

Inbound.

1. Landing gear lever—DOWN.
2. Wing flap lever—TAKE-OFF.
3. Throttle—Minimum of 85% rpm.
4. Speed brake lever—As required to maintain 160 knots IAS.
5. Descend to proper altitude.

Note

If the 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 is 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.

Single Engine GCA Approach.

1. Downwind—195 knots IAS, throttle as required (approximately 86% rpm), gear up, flaps up, speed brakes closed.
2. Base leg—180 knots IAS, throttle as required (approximately 94% rpm), 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), 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—85% rpm, minimum.
4. Speed brakes—As required to maintain 195 knots IAS.
5. Altitude as locally required.

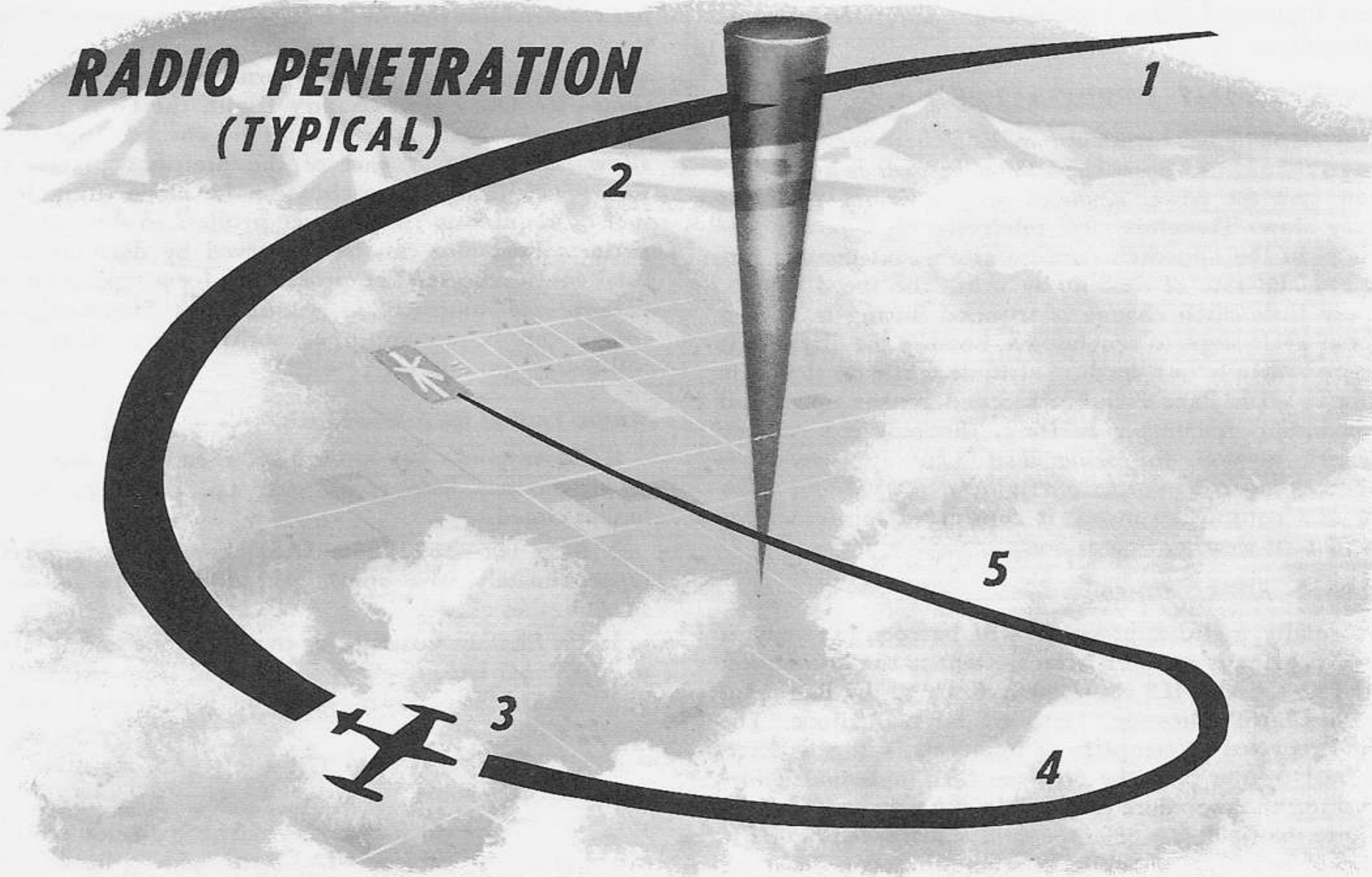
Procedure Turn.

1. Begin procedure turn as locally prescribed.

Inbound to Outer Marker.

1. Descend to proper altitude.
2. Landing gear—Down.

RADIO PENETRATION (TYPICAL)



1 APPROACH TO STATION

A Canopy defogging—As required.
B Windshield heat—As required.
C Pitot heat—As required.
D Interior cockpit lighting—As required.

2 PENETRATION ENTRY

A Throttle—85% rpm.
B Establish 4000 feet per minute rate of descent.
C Speed brakes—Adjust to maintain 250 knots IAS.

3 PENETRATION TURN

Maintain descent criteria and turn as prescribed by appropriate "Flight Information Publication Terminal (High Altitude)."

4 LEVEL OFF

A Rate-of-descent—Decrease 1000 feet above level-off altitude.
B Lead level-off altitude by approximately 10% of rate of descent.

5 INBOUND

A Throttle—85% rpm.
B Speed brakes—Adjust to maintain 195 knots IAS.

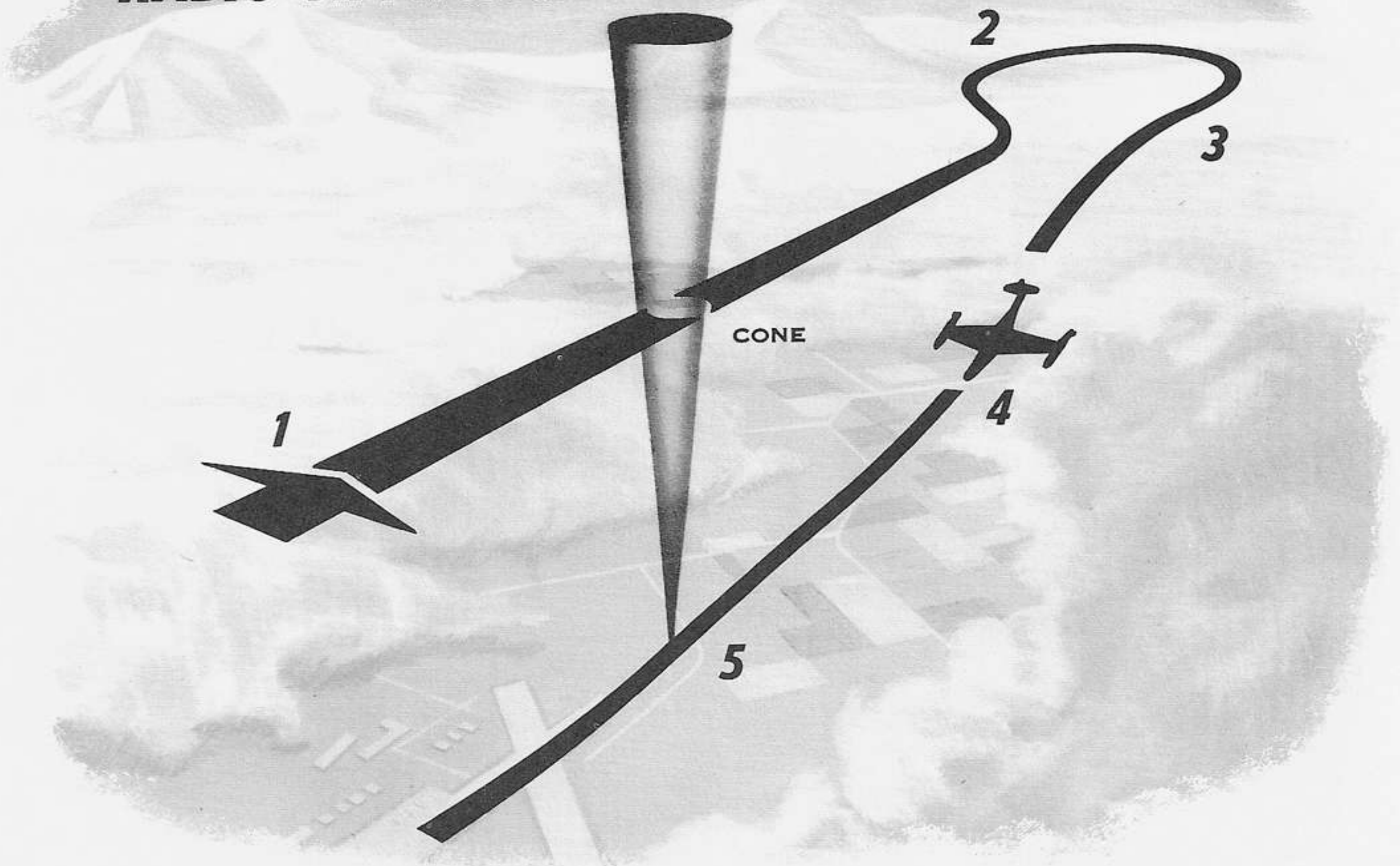
NOTE

REFER TO APPROPRIATE "FLIGHT INFORMATION PUBLICATION TERMINAL (HIGH ALTITUDE)" FOR SPECIFIC PENETRATION INSTRUCTIONS. USE THE BASIC INSTRUMENTS AND CROSS CHECK WITH THE FLIGHT COMPUTER

J-107C

Figure 9-5.

RADIO APPROACH (TYPICAL)



1 OUTBOUND

- A Throttle—85% 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—85% rpm minimum.
- D Speed brakes—As required to maintain 160 knots IAS.

4 INBOUND

- A Descend to proper altitude.
- B Maintain final configuration.

5 LOW STATION

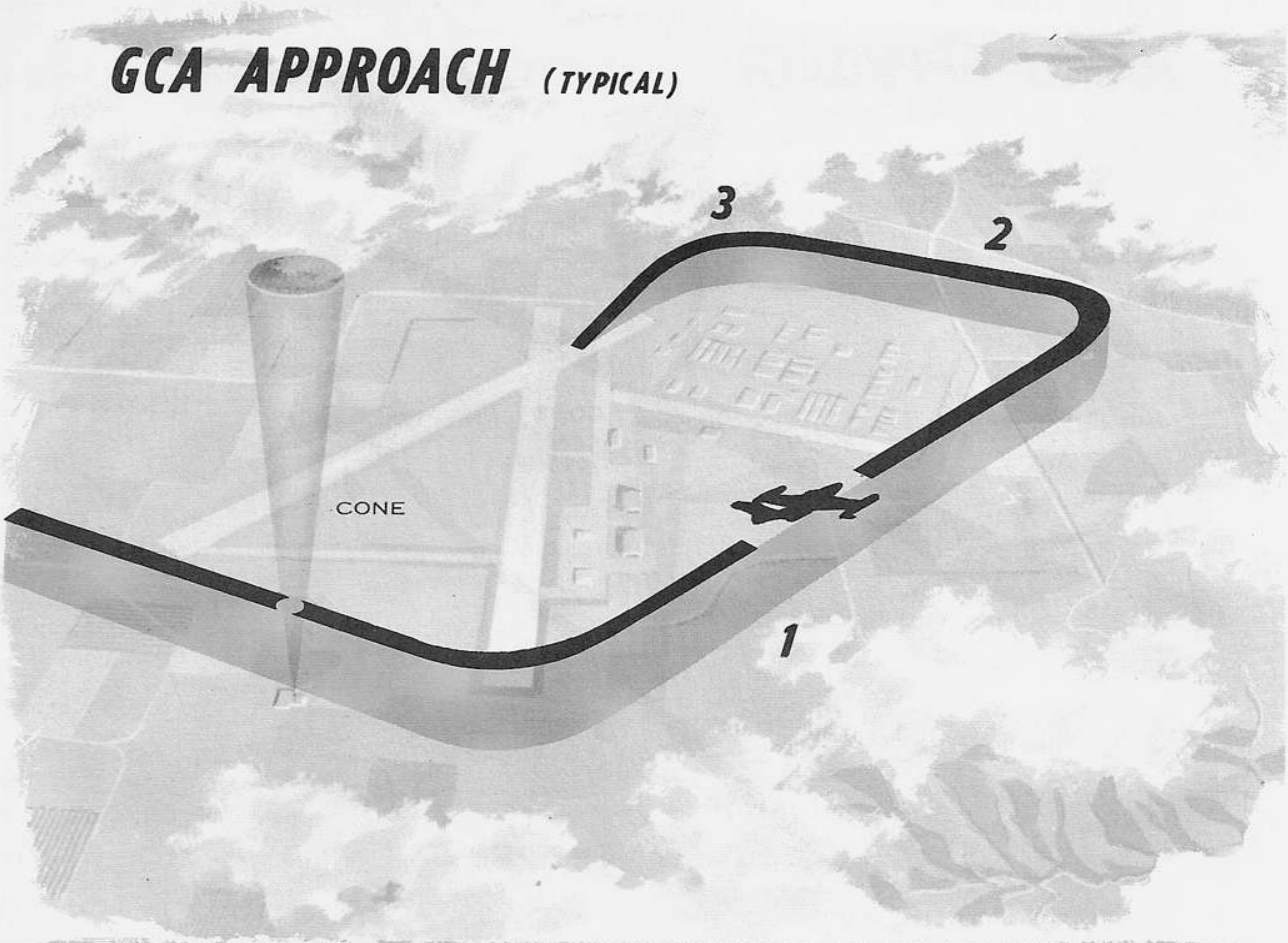
- A Make proper position report.
- B Descend to minimum altitude.

NOTE: REFER TO FLIGHT INFORMATION PUBLICATION TERMINAL (HIGH ALTITUDE) FOR INSTRUMENT APPROACH PROCEDURE.

J-108C

Figure 9-6.

GCA APPROACH (TYPICAL)



1 DOWNWIND LEG

A Landing gear—UP.
B Wing flaps—UP.
C Throttle—85% 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—85% rpm minimum.
D IAS—180 knots.

3 FINAL APPROACH

A Wing flaps—TAKEOFF.
B IAS—Refer to LANDING SPEEDS chart, Appendix II, for final approach speeds.

J-109C

Figure 9-7.

3. Wing flaps—Takeoff.

4. Throttles—85% rpm minimum, to maintain 160 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 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.

ILS—AUTOPILOT-CONTROLLED APPROACH.

Engage the autopilot and, using any standard approach, maneuver the airplane to intercept the localizer beam at approximately 45 degrees, 10 miles out, and at 1200 to 1500 feet above the terrain. (The allowable intercept angle is 45 degrees at 8 miles, increasing proportionally to 90 degrees at 13 miles.) Use the following general procedure to obtain consistently good results.

1. Approach to localizer—Lower flaps and landing gear, adjust power for 160 knots IAS, and check that both flags on the course indicator are down. Trim the airplane for approximately level flight at 1200 to 1500 feet above the terrain, and place the altitude switch at ON if desired. Limit turns to 30-degree bank angle.

2. Intercepting localizer—When the airplane enters the localizer beam, the vertical bar on the course indicator will leave its stop. As soon as this occurs, place the localizer switch at ON. The airplane will bracket the beam automatically.

3. Intercepting the glide slope—When the airplane enters the glide slope, the horizontal needle of the course indicator will approach the center of the meter. When the needle enters the top half of the small circle, set the approach switch at ON. The airplane will start down the beam automatically.

4. On the glide slope—Adjust flaps and speed for flareout and landing.

5. Breakthrough or minimum altitude—Disengage the autopilot, complete flareout, and land manually.

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.

FLIGHT COMPUTER MISSED APPROACH WITH ILS.

WARNING

Do not use flight computer missed approach procedure if a go-around with both afterburners and a clean configuration cannot be accomplished.

If an approach has been missed on ILS and a straight-ahead climbout can be safely made, the flight computer can be used to accomplish a go-around. Pressing the flight computer go-around button (altitude switch) (figure 4-14) 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; use afterburners.

2. Speed brake lever—CLOSED.

3. Flight computer go-around button—Press.

4. Landing gear lever—UP.

5. Wing flap lever—UP.

6. Fly the airplane to center the horizontal and vertical bars until desired altitude is reached. Execute established 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.

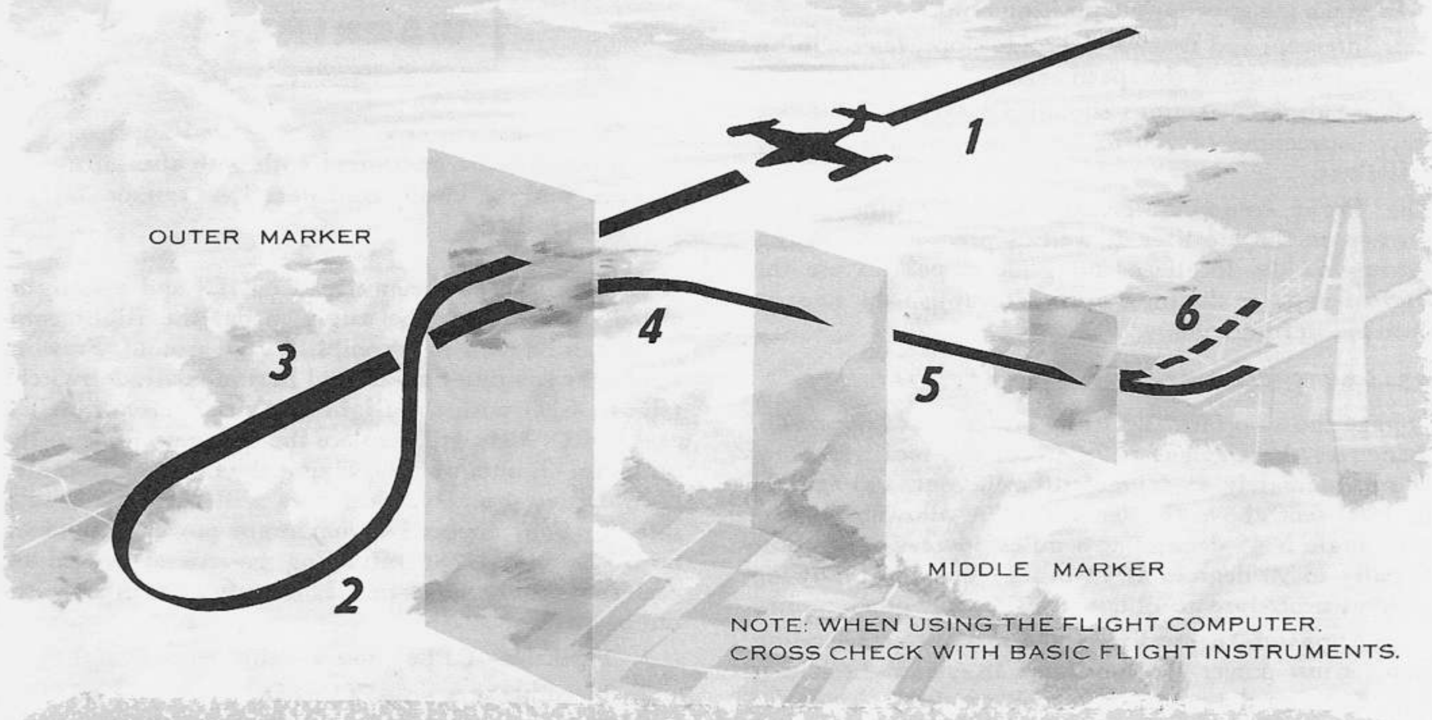
Letdowns and approaches on single engine, either by radar control or on the radio range, can be made satisfactorily. Use the following procedure when making single-engine GCA or ILS approach:

1. GCA downwind leg and ILS outbound—Use 195 knots IAS, power at 86% ±2% rpm, gear down, flaps up, and speed brakes as required.

2. GCA base leg and ILS inbound—Use 180 knots IAS, power at 94% ±2% rpm, gear down, flaps up, and speed brakes as required.

3. Final approach—Use 160 to 170 knots IAS, gear down, flaps at takeoff, power as required to maintain desired flight path.

ILS APPROACH WITH FLIGHT COMPUTER (TYPICAL)



NOTE: WHEN USING THE FLIGHT COMPUTER, CROSS CHECK WITH BASIC FLIGHT INSTRUMENTS.

1 OUTBOUND

A Flight computer 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—85% 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 selector switch—FLIGHT INST.
C Altitude control switch—OFF (prior to descent).

3 INBOUND

A Set heading pointer to localizer heading.
B Turn flight computer selector switch to (VOR-LOC) RIGHT. This will cause flight computer vertical bar to deflect.
C Zero 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—85% rpm minimum. to maintain 160 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, press go-around button and initiate afterburning. By centering the bars, you will assume a safe climbing attitude. Then follow local missed approach procedure.

J-110B

Figure 9-8.

ICE AND RAIN

The thin wings and high speeds of jet airplanes can result in critical ice accumulation in relatively light icing conditions on those airplanes with the anti-icing systems inoperative. Surface icing can reduce IAS and range of the airplane considerably. Icing occurs when the supercooled water in fog, clouds, or rain impinges and 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 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. The anti-icing system will keep all heated surfaces clear of ice without noticeable loss of engine thrust. The system will also effectively de-ice the airplane if ice is allowed to accumulate on the wings and tail. The purpose of the system is to prevent formation of ice; therefore, use the system continuously whenever conditions indicate a possibility of ice. Refer to Section IV for operating instructions on the anti-icing system.

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, approach, and landing.

ENGINE ICING.

Axial flow jet engines are seriously affected by icing. 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 temperatures. As the airflow decreases, the fuel-air ratio increases, which in turn raises the temperature of the gases going into the turbine. Complete turbine failure may occur in a matter of seconds after ice builds up in the engine air 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 below freezing temperature is relatively constant up to an airspeed of approximately 250 knots TAS. Assuming constant icing conditions, 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 ambient temperatures of 0°C (32°F) or below.

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 TAS, and at high power setting, the intake air is sucked, instead of rammed, into the engine compressor inlet. This suction causes a decrease in air temperature (adiabatic cooling). Under these conditions, air at a temperature above freezing may be reduced to subfreezing temperature as it enters the engine. Free moisture in the air may become supercooled and cause engine icing although 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, turn on the engine anti-icing system immediately. Refer to Section IV for the operation of this system.

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), when fog is present, or when 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 TAKE-OFF. 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 in the range of 0°C (32°F) to 5°C (41°F), the speed of the airplane should be maintained at 250 knots IAS or above to lessen the possibility of inlet duct icing due to suction effect.

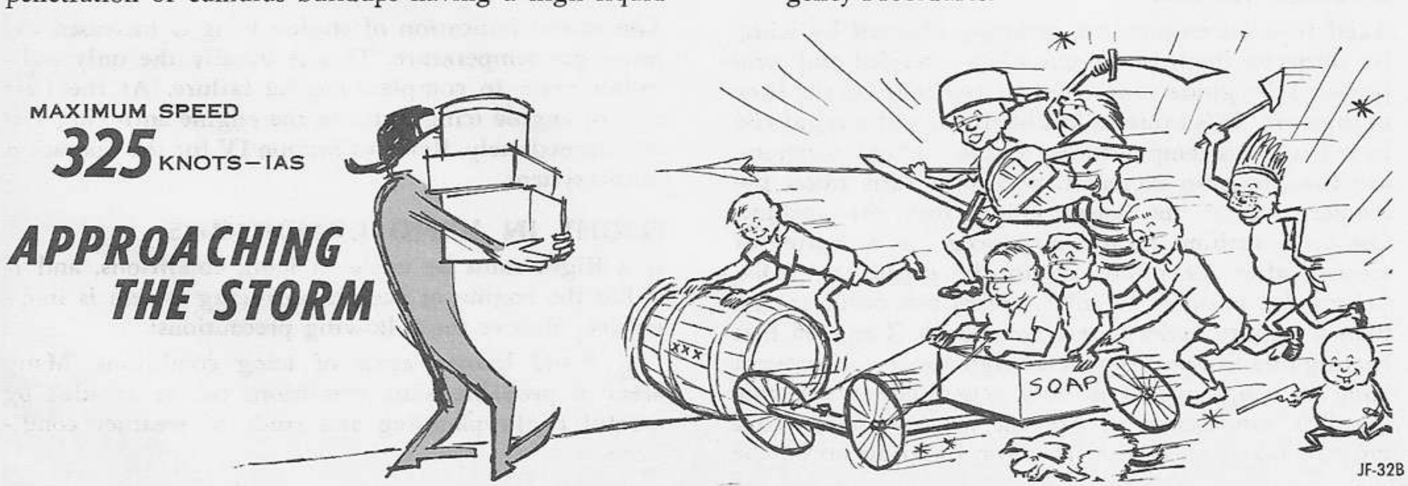
4. If icing conditions are encountered at freezing atmospheric temperatures, immediate action should be taken as follows: change altitude rapidly by climb or descent in layer clouds, or vary course as appropriate to avoid cloud formations; reduce airspeed (in freezing air) to minimize rate of ice buildup; maintain close watch of exhaust gas temperature and reduce engine rpm as necessary to prevent excessive exhaust gas 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 in level flight 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 and maintain a 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 went 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 load factors. In less severe turbulence there are no airspeed restrictions, but maneuvering should be restricted in proportion to the degree of turbulence. In adverse weather, engine surge and flameout can be caused by one or more of the following factors: penetration of cumulus buildups having a high liquid content, engine icing of either nose cowl or inlet guide vanes, turbulence associated with penetration resulting in high angles of attack (+9 degrees or more) and thus causing marginal engine performance, and reduced surge margin above 40,000-feet with poor air distribution across the face of the compressor. If the storm cannot be avoided, the engine anti-icing system should be turned on prior to weather penetration and the EGT gages should be monitored continuously. If ice has already commenced to build up before the anti-icing system is turned on, reduce the throttle setting to minimize the danger of internal engine damage until all ice has been dissipated or ingested by the engine. When the presence of ice is no longer evident, check the engine at idle, then advance the throttle to any desired setting.

CAUTION

Flying in turbulence or hail may increase inlet distortion. At higher altitudes this distortion can result in engine surge and possible flameout. However, normal air restarts may be accomplished as outlined in Section III, Emergency Procedures.



APPROACHING THE STORM.

Prepare the airplane as follows before entering the storm:

1. Adjust power to obtain a recommended penetration speed of 250 knots IAS. If higher airspeeds are desired, do not exceed the following:

With *any* tip tank fuel	275 knots IAS
With *no* tip tank fuel	325 knots IAS

2. Pitot heat switch—ON.
3. Anti-ice switch—FLIGHT; windshield heat switch—NORMAL.
4. Flight computer altitude switch—OFF.
5. Turn cockpit lights (and thunderstorm lights on Group 45 and subsequent airplanes) to full brightness.
6. Autopilot—Disengage.
7. Flight instruments—Check for proper operation.
8. Alert crew.
9. Safety belt—Tighten; shoulder harness—Lock.
10. Seat—Adjust for proper head clearance.
11. Loose equipment—Secure.
12. Turn off radio equipment not being used or rendered useless by static.

NIGHT FLYING

Night flying in this airplane is accomplished in the same manner as day flight, with the following additional information.

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 ensure positive climb and acceleration.

Note

Prior to landing, visual check of main gear down can be accomplished by turning landing lights on in the retracted position.

COLD WEATHER PROCEDURES

BEFORE ENTERING THE AIRPLANE.

Check to see that the following items have been accomplished:

1. MB-1 rocket fins—Extended and ice accumulations removed.
2. Airplane covers removed.
3. Plugs removed from engine air intake ducts, exhaust nozzles, and engine nacelle doors.
4. Visual check of bottom section of front stator blades for evidence of ice. Engine heat on shutdown will melt ice accumulated on previous flight. Melted ice will then 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 melt the ice. Start engine as soon as possible after heat application to remove all moisture before refreezing can occur.
5. Wing flap servo followup screw and shaft cleaned of excessive oil and grease.

Note

- Excessive oil or grease on this mechanism can cause shaft to bind in screw and move the servo valve spool to partially restrict hydraulic flow to flap motor, causing abnormally slow movement of flaps.
- During wet and freezing weather, an accumulation of moisture in the speed brake hinge areas, leading edges, and inner surfaces, and on the flap actuator screws may impair operation of these systems. To reduce the possibility of malfunction because of freezing, remove as much moisture as possible from these areas.

6. All ice removed from fuel tank vents, static air sources, and pitot tubes.
7. Ice and snow removed from nose wheels to prevent shimmy.
8. Fuel filters and draincocks checked for freedom from ice, and heated, if necessary, to drain condensate.
9. 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.

10. 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.

11. All snow and ice accumulations removed 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.

12. Canopy jettison system, seat air, and airbrakes serviced before each flight at temperatures below −35°C (−31°F).

BEFORE STARTING ENGINES.

1. Pilot's seat—Adjusted 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 hydraulic 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 exhaust nozzles 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.

Because of 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 switch at NORMAL for at least 1 minute before turning to EMER. Never keep windshield heat switch 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.

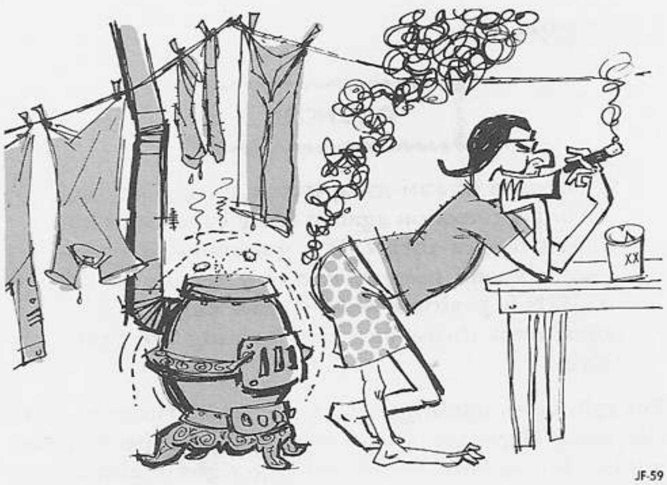
5. Speed brakes—Check operation and cycle several times to assure free movement.

Note

During wet and freezing weather, an accumulation of moisture in the speed brake hinged areas and inner surface may cause the speed brakes to freeze in a closed position. To reduce this possibility under these conditions, open the speed brakes prior to taxiing and leave in the OPEN position while taxiing. Prior to takeoff, cycle the speed brakes two or three times to permit accumulated water to drain.

6. Instruments—Check operation. Flight instruments require approximately 2 minutes for warmup.

WARNING



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In cold weather, make sure that 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 taxiing and 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. Use the steerable nose wheel to maintain directional control.

CAUTION

Under freezing conditions use caution when actuating nose wheel steering on taxiing out of parking area or after landing as nose wheel may be frozen in deflected position.

Note

The airplane has a strong tendency to "weather vane" when taxiing on ice. Use the nose wheel steering system to maintain directional control.

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 snow and ice in jet blast of preceding airplane.

5. When fine powdered snow is on the taxiway, the preceding airplane's jet blast will cause a large blinding cloud of flying snow; therefore, 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 throttles 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. Anti-icing system—TAKE-OFF 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.

2. 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 afterburner on either engine does not ignite, do not take off. 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.

WARNING

Depending on the weight of snow and ice accumulated, 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 de-icing should be used for 10 seconds.

Note

Engine fuel control icing may result in a flameout. This type of icing will be detected by fluctuation of the fuel flowmeter indicator.

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 high thrust at low temperature 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.
- Actuate the canopy defogging system for approximately 10 minutes prior to descent from altitude.
- On initial approach use alcohol on each engine for 10 seconds.

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 and 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. 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 distances may be increased as much as 100 percent more than the distances shown in the Landing Distance Charts shown in Appendix II.

BEFORE LEAVING AIRPLANE.

Check that the 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 wheel.

4. Service canopy jettison system and airbrake bottle 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, exhaust nozzles, 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).

HOT WEATHER PROCEDURES

Takeoff rolls are longer 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 THE AIRPLANE.

Check tires for blisters, abrasions, proper inflation and excessive wear. Be sure external ground cooler is disconnected.

TAKEOFF.

Anticipate a longer takeoff distance than normal. Refer to Appendix II for takeoff distances.

AFTER TAKEOFF.

Be sure to maintain specified climbing airspeed, correcting maximum rates of climb for temperature effects. Refer to Climb Charts in applicable Appendix.

LANDING.

Anticipate longer landing distances and use minimum wheel braking to prevent overheating of brakes. Refer to Appendix II for applicable landing distance chart.

BEFORE LEAVING AIRPLANE.

Be sure canopy is protected from direct rays of the sun.

DESERT PROCEDURES

When operating under desert conditions, the normal hot weather procedure is followed. 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 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 disks 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 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.

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APPENDIX I

PERFORMANCE DATA

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INTRODUCTION.

The Appendix consists of four sections—Appendixes I through IV. Appendix I provides the pilot with explanations of how to use the flight performance charts, flight planning data, takeoff and landing data cards, sample problems, airspeed, compressibility temperature correction, density altitude and relative wind charts. 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, descent and landings. The performance charts in Appendix I are sample charts and should not be used for flight planning. Refer to Appendix II for performance data applicable to all airplane configurations for takeoff, minimum distance climb, descent and landing. Refer to Appendixes III and IV for flight performance data for the applicable airplane configuration.

Note

Sample charts and problems given in Appendix I may refer to configurations no longer used on the aircraft. The method of using charts, however, is the same, regardless of airplane configuration.

PROFILE SAMPLE CHARTS.

The profile-type sample 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 in applicable Appendix should be used. Decreased weight due to fuel consumption has been accounted for.

GRAPHICAL SAMPLE CHARTS.

The graphical sample charts provide detailed performance data for one- and two-engine operation. These charts (in applicable Appendix) 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 A1-1). These corrections are given for values of IAS and pressure altitude for the operating range of the clean configuration; corrections for flap settings and gross weights 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 A1-2), 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 Chart (figure A1-4). The airspeed indicator in the radar observer's cockpit indicates approximate TAS; therefore, only the wind correction need be applied to determine ground speed.

ALTIMETER POSITION ERROR CORRECTION.

This chart (figure A1-1A) is provided to give altimeter error correction for given airspeeds at various altitudes. A sample problem is included on this chart.

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 A1-3).

EXAMPLE OF THE USE OF THE CORRECTION TABLES.

Assume the following instrument readings:

1.	Altimeter	35,000 FT
2.	Airspeed indicator	284 KN
3.	Free air temperature gage	$-19^{\circ}C$

The correct airplane speed and ambient temperature are:

4.	IAS (zero instrument error)	284 KN
5.	Installation correction	+6 KN
6.	CAS	290 KN
7.	Compressibility correction	-18 KN
8.	EAS	272 KN
9.	Free air temperature gage reading	$-19^{\circ}C$
10.	Temperature correction for compressibility error	$-25^{\circ}C$
11.	Correct ambient temperature	$-44^{\circ}C$

At 35,000-foot pressure altitude and $-44^{\circ}C$, the reciprocal of the square root of the relative air density ($1 \div \sqrt{\sigma}$) from figure A1-4 is 1.85. Therefore, TAS is 272 x 1.85 = 503 knots.

TAKEOFF AND LANDING CROSSWIND CHART.

A takeoff and landing crosswind chart (figure A1-5) enables a pilot to convert crosswind to a component headwind down the takeoff or landing runway. The component headwind is then used to accurately determine takeoff ground run or landing roll.

Use of Takeoff and Landing Crosswind Chart.

When wind direction and velocity and runway heading are known, the component headwind down the takeoff or landing runway can be determined from the takeoff and landing crosswind chart. With a wind from 305 degrees at 37 knots velocity and using runway 27, the chart is entered at ($305^{\circ} - 207^{\circ}$) 35-degree angle and 37-knot wind velocity. Reading to the left the component headwind down the takeoff or landing runway is found to be 30 knots.

USE OF PERFORMANCE CHARTS.

TAKEOFF DISTANCE CHARTS.

The Takeoff Distance Charts (figures A2-1 through A2-6) 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

- The data presented in the Takeoff Distance Charts take into account ground effect. Ground effect, in general, refers to a reduction in the overall drag of an airplane when operated close to the ground. The degree of drag reduction will vary with distance of the wing or supporting surface from the ground, being greatest when the wing is at ground level and will have, for all practical purposes, disappeared when the wing is one half the wing span above the ground. The reduction in drag is also greatest at low velocities and becomes a lesser reduction as velocity increases.

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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 A1-4 is 1.85. Therefore, TAS is $272 \times 1.85 = 503$ knots.

TAKEOFF AND LANDING CROSSWIND CHART.

A takeoff and landing crosswind chart (figure A1-5) enables a pilot to convert crosswind to a component headwind down the takeoff or landing runway. The component headwind is then used to accurately determine takeoff ground run or landing roll.

Use of Takeoff and Landing Crosswind Chart.

When wind direction and velocity and runway heading are known, the component headwind down the takeoff or landing runway can be determined from the takeoff and landing crosswind chart. With a wind from 305 degrees at 37 knots velocity and using runway 27, the chart is entered at (305° − 207°) 35-degree angle and 37-knot wind velocity. Reading to the left the component headwind down the takeoff or landing runway is found to be 30 knots.

USE OF PERFORMANCE CHARTS.

TAKEOFF DISTANCE CHARTS.

The Takeoff Distance Charts (figures A2-1 through A2-6) 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

- The data presented in the Takeoff Distance Charts take into account ground effect. Ground effect, in general, refers to a reduction in the overall drag of an airplane when operated close to the ground. The degree of drag reduction will vary with distance of the wing or supporting surface from the ground, being greatest when the wing is at ground level and will have, for all practical purposes, disappeared when the wing is one half the wing span above the ground. The reduction in drag is also greatest at low velocities and becomes a lesser reduction as velocity increases.

- 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.

The Takeoff Distance Sample Chart shows a maximum power takeoff at an ambient air temperature of 15°C, pressure altitude of 2000 feet, gross weight of 40,000 pounds, and a 20-knot headwind. This results in a ground roll of 2700 feet and a total distance of 3600 feet to clear a 50-foot obstacle.

CRITICAL FIELD LENGTH CHART.

The Critical Field Length Chart (figure A2-7), in conjunction with the Refusal Speed Chart (figure A2-8), 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 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 Critical Field Length Sample Chart shows a maximum power takeoff with ambient air temperature of 15°C, a pressure altitude of 2000 feet, a gross weight of 40,000 pounds, and a 20-knot headwind. These conditions indicate a critical field length of 4700 feet. According to the Takeoff Distance Chart (A2-5) for one-engine takeoff, the runway length required for one-engine takeoff is 7500 feet. If the available runway length is 7000 feet, the refusal speed is found to be 115 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 115 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 115 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 A2-8) shows the maximum 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 Charts.

The Refusal Speed Sample Chart shows a maximum power takeoff at a gross weight of 40,000 pounds and a pressure altitude of 2000 feet with an ambient air temperature of 59°F and a 7000-foot runway. The resulting refusal speed is 115 knots.

VELOCITY DURING TAKEOFF GROUND RUN CHARTS.

The Velocity During Takeoff Ground Run Charts (figures A2-9 and A2-10) are based on normal operating procedures as 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 Velocity During Takeoff Ground Run Charts (figures A2-9 and A2-10) 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.

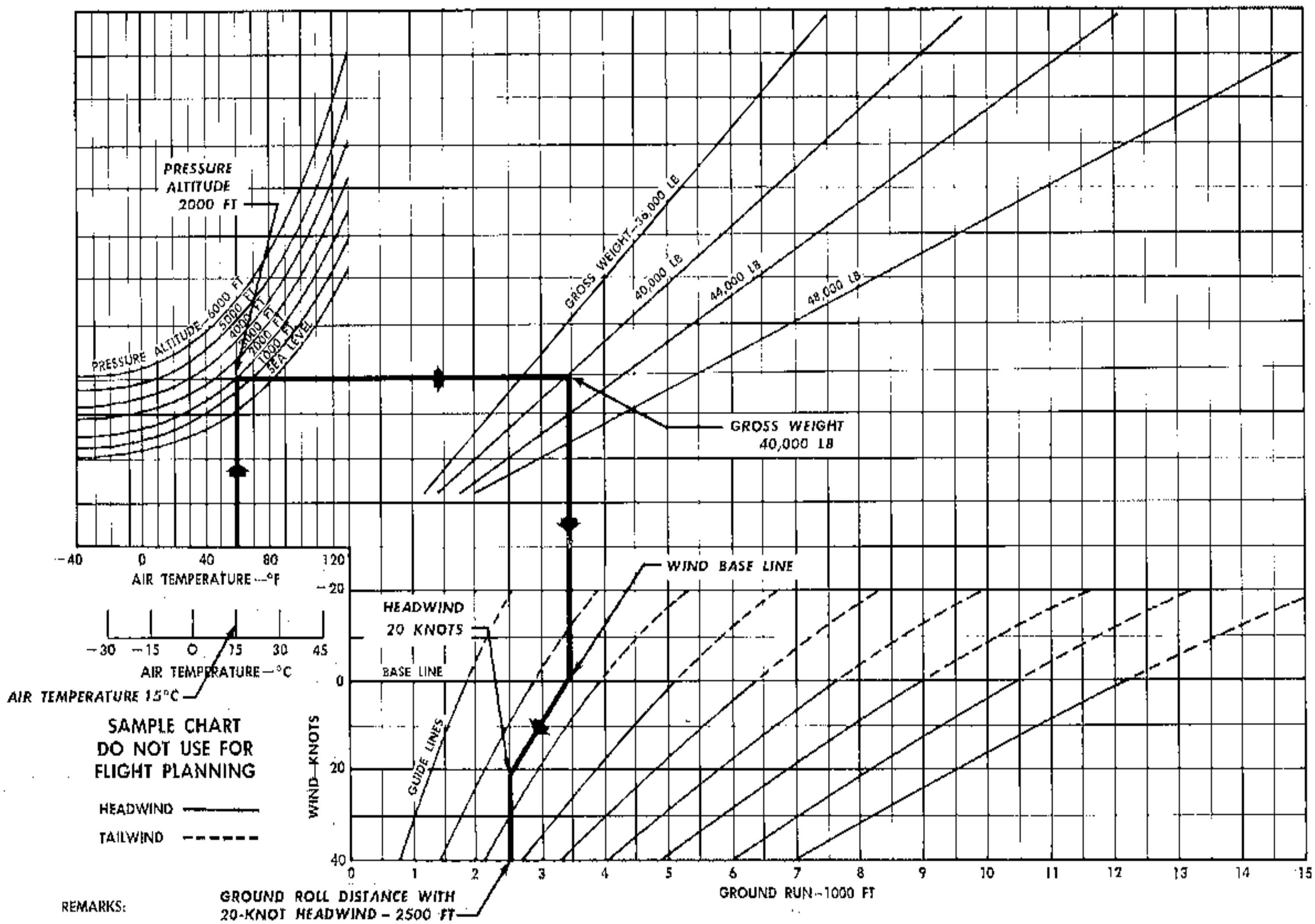
Enter the chart at the applicable gross weight of the airplane. Read over to the base line, then proceed vertically downward to the required takeoff ground run distance as determined from the Takeoff Distance Charts (figures A2-1 through A2-6). From this point, trace a curve parallel to the guide lines 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 Velocity During Takeoff Ground Run Sample Chart, the takeoff gross weight is 42,000

TAKEOFF DISTANCE

MAXIMUM POWER
WITH OR WITHOUT EXTERNAL STORES

MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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
36,000 LB	120 KNOTS IAS	124 KNOTS IAS
40,000 LB	127 KNOTS IAS	131 KNOTS IAS
44,000 LB	133 KNOTS IAS	138 KNOTS IAS
46,920 LB	138 KNOTS IAS	143 KNOTS IAS

JA-HIA

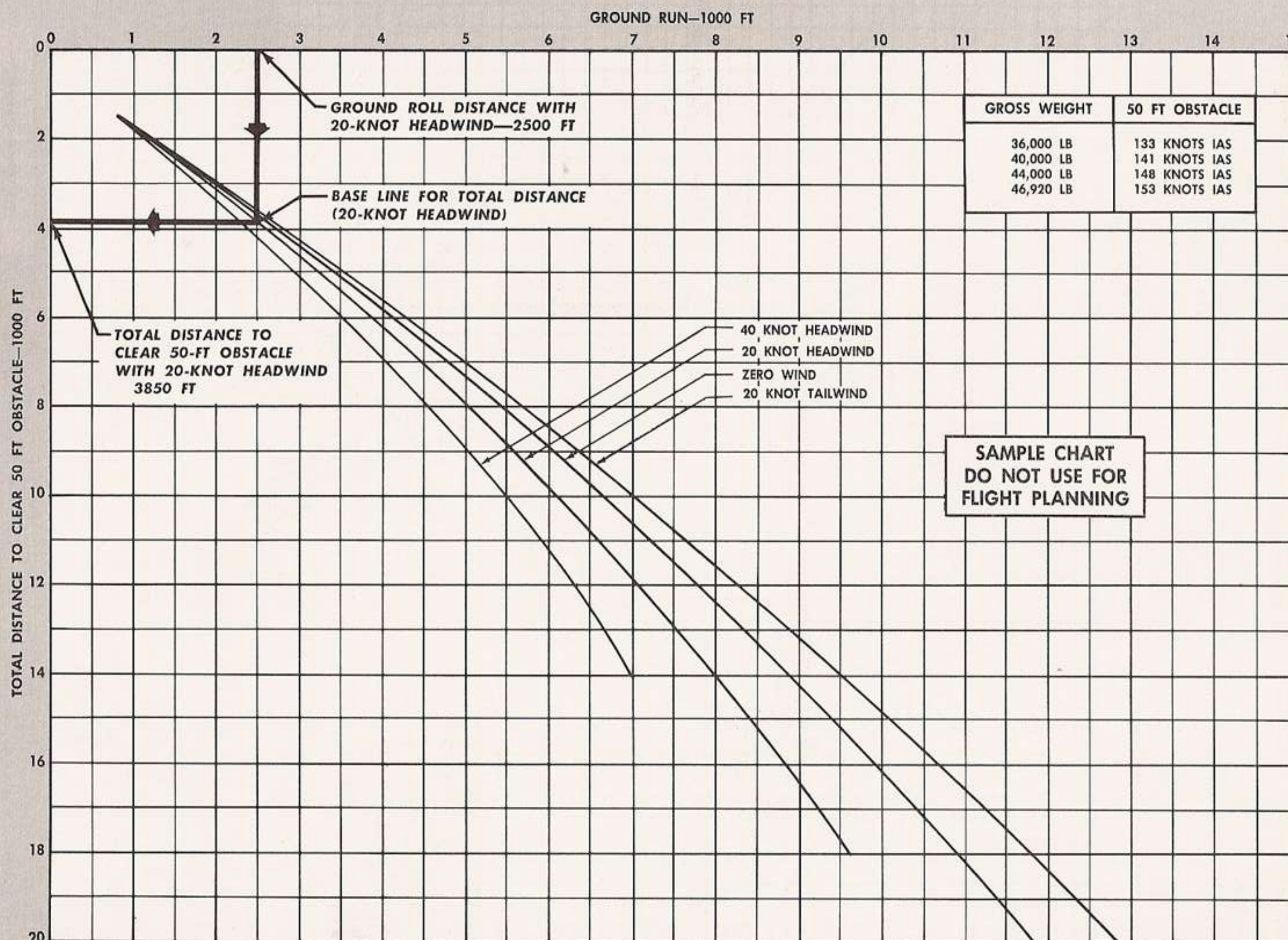
Sample.

TAKEOFF DISTANCE TO CLEAR 50 FT OBSTACLE

MODEL: **F-89J**
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

MAXIMUM POWER
WITH OR WITHOUT EXTERNAL STORES

ENGINE(S): (2) **J35-35**
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.

JA-1(2)A

Sample.

CRITICAL FIELD LENGTH

MAXIMUM POWER

WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

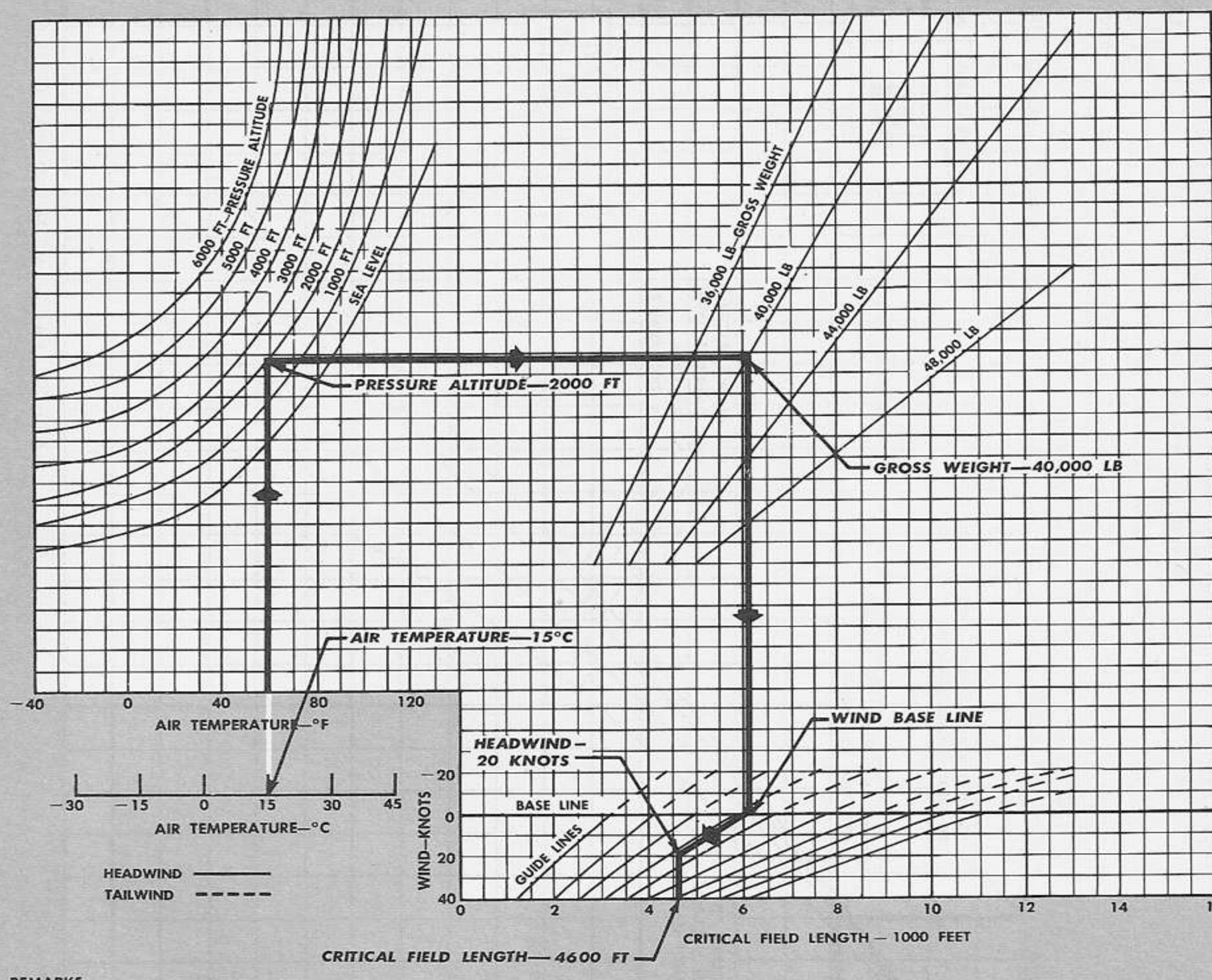
DATA BASIS: **FLIGHT TEST**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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.

SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING.

JA-2A

Sample.

REFUSAL SPEEDS

MAXIMUM POWER

WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

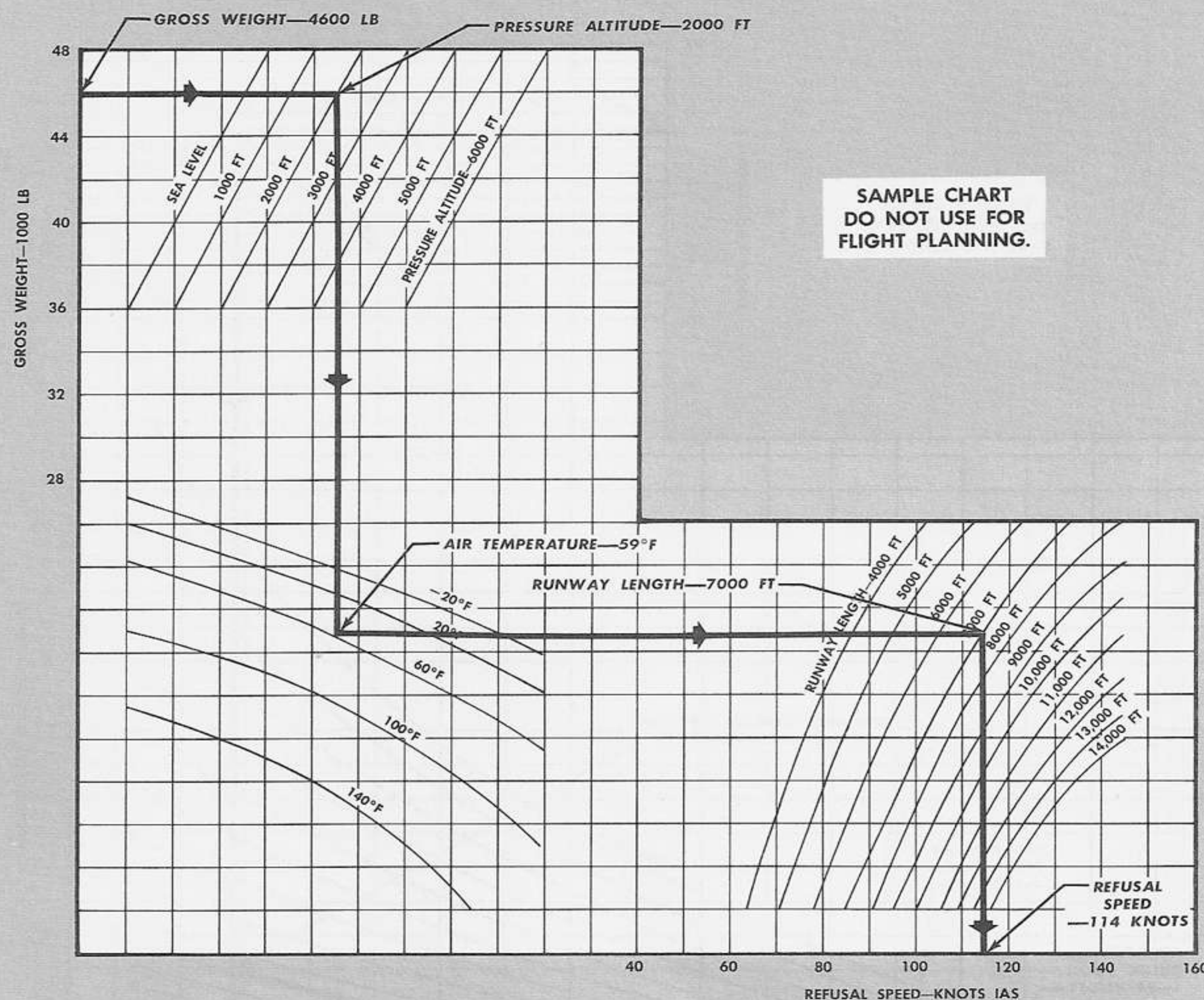
DATA BASIS: **FLIGHT TEST**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ABOVE VALUES ARE BASED ON DRY HARD-SURFACE RUNWAY, USING SPECIFIED NORMAL TAKEOFF PROCEDURE UP TO POINT OF ENGINE FAILURE AND OPERATION IN ACCORDANCE WITH SECTION III AFTER ENGINE FAILURE.
2. ENGINE AIR INLET SCREENS EXTENDED.

JA-3A

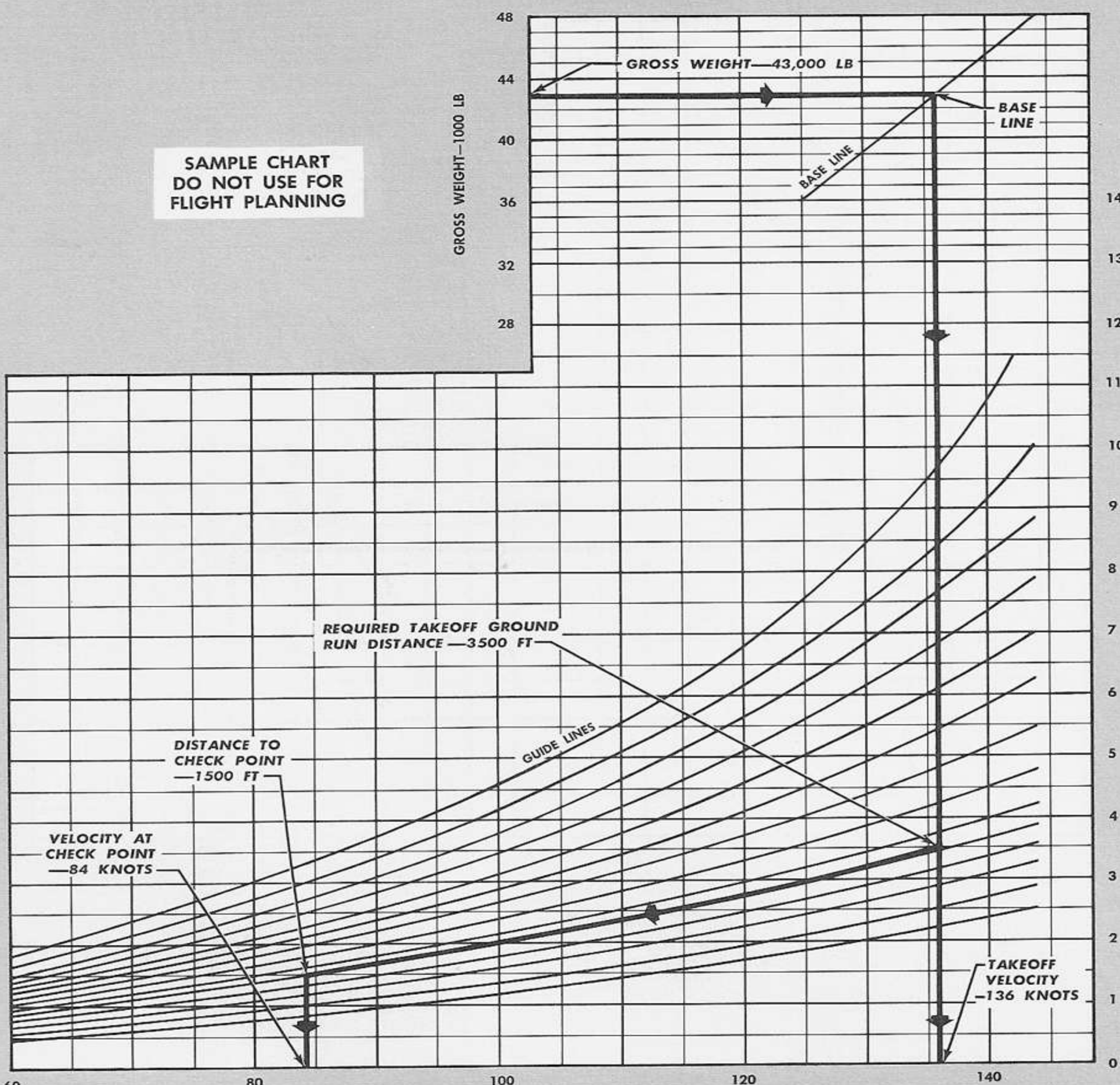
Sample.

VELOCITY DURING TAKEOFF GROUND RUN

MAXIMUM POWER
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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.

JA-4B

Sample.

pounds, the required takeoff distance at maximum power is 6000 feet, and the distance from the start of the takeoff run to the acceleration check point is 2500 feet. The resulting velocity at the check point is 91 knots IAS, and the takeoff velocity is 132 knots IAS.

MINIMUM DISTANCE CLIMB CHART.

Depending on gross weight and power setting, minimum distance climb (maximum angle of climb) at low altitudes may be obtained at the applicable airspeeds shown in figure A2-11.

Use of Minimum Distance Climb Chart.

Enter the chart (figure A2-11) 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 (see Best Climb Charts for applicable configuration) 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. In most cases, 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 (see Best Climb Charts for applicable configuration) 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 906-pound takeoff fuel allowance. The Best Climb Performance Sample Chart shows the fuel used and time to climb from 10,000 feet to 35,000 feet using military power with pylon tanks and a gross weight of 41,000 pounds at start of climb. Rate of climb and best climb CAS may be obtained directly from the Best Climb Speed Charts.

TAKEOFF DATA CARD.

A Takeoff Data Card (TAKEOFF AND LANDING DATA CARD) 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 Card.

Assuming that the center of gravity is within limits, the following *conditions* are given preparatory to completing the Takeoff Data Card that follows:

Conditions:

Runway length (hard surface assumed)	8000 FT
Headwind	20 KN
Runway ambient temperature	59°F
Pressure altitude	2000 FT
Gross weight	40,000 LB
Braking surface (wet, icy, dry)	dry
Flaps and trim	TAKEOFF

TAKEOFF AND LANDING DATA CARD

CONDITIONS

Runway Length	8,000 FT	Gross Weight	40,000 LB
Headwind	20 KN	Critical Field Length	4700 FT
Temperature	59°F	Flap T.O. Trim T.O	
Pressure Altitude	2000 FT	Surface: Dry, Wet, Icy	

TAKEOFF

Takeoff Distance—Normal	2500 FT	50-FT Obstacle	3800 FT
Takeoff Distance—1 ENG	6850 FT	50-FT Obstacle	17,200 FT
Refusal Speed	125 KN		
Acceleration Check	80 KN	IAS at	1000 FT
Nosewheel Liftoff Speed	127 KN	Takeoff Speed	131 KN
Initial Climb Speed (Clear 50 FT)			141 KN

Decision Factors:

1. Critical field length is 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 on operating engine and use engine failure during takeoff procedure.

BEST CLIMB PERFORMANCE (TIME)

MODEL: **F-89J**

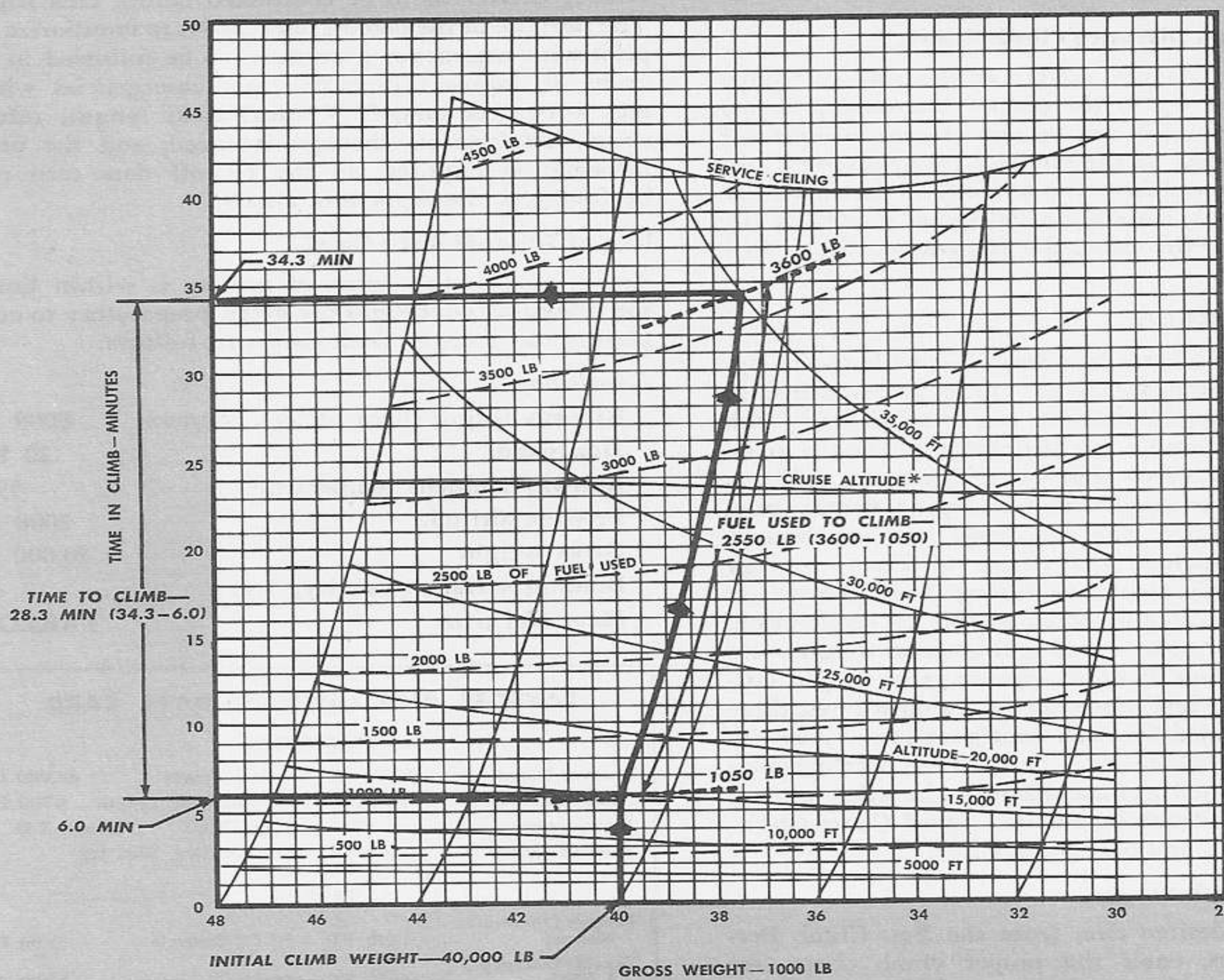
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

MILITARY POWER

TWO PYLONS, TWO MB-1 ROCKETS, AND FUEL-ROCKET PODS
OR
TWO PYLONS, TWO PYLON TANKS, AND FUEL-ROCKET PODS

ENGINE(S): **(2) J35-35**

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

JA-5A

Sample.

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 (see Nautical Miles Per 1000 Pounds Fuel Charts for applicable configuration). 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, in most cases, 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.

Sample Problem. Determine the range obtainable from 6000 pounds of fuel at an altitude of 30,000 feet with long range cruise speed. The long range cruise speed is the highest of two speeds for a given altitude and gross weight where 99 percent of the maximum range is obtainable. With an initial airplane weight of 40,000 pounds and basic configuration plus pylons:

1. Select the proper chart for the airplane configuration and altitude.
2. Find the average weight

$$\left(40{,}000 - \frac{6000}{2}\right) \qquad 37{,}000 \text{ LB}$$

3. Enter the chart at the intersection of the zero wind cruise line and 37,000 LB gross weight and read:

Specific range	100.4 N MI/1000 LB fuel
Mach NO.	0.681
RPM	90%
WT	4000 LB/HR

4. The range is then found

$$\left(100.4/1000 \times 6000\right) \qquad 602 \text{ N MI}$$

5. Average speed is

Mach NO × speed of sound
(0.681 × 589) 401 KN

6. Time in cruise

$$\left(\frac{\text{N MI}}{\text{KN}} = \frac{602}{401}\right) 1.51 \text{ HR or } 1 \text{ HR } 31 \text{ MIN}$$

When wind conditions are encountered, the air nautical miles per 1000 pounds of fuel read from the chart may be converted to ground nautical miles per 1000 pounds fuel as follows:

$$\text{ground}\ \frac{\text{N MI}}{1000\text{ LB}} = \text{air}\frac{\text{N MI}}{1000\text{ LB}} \times \frac{V_{ground}}{V_{air}}$$

where

V_{air} = airplane true airspeed

V_{ground} = airplane true ground speed $= V_{air} \pm V_{wind}$

MISSION PROFILE CHARTS.

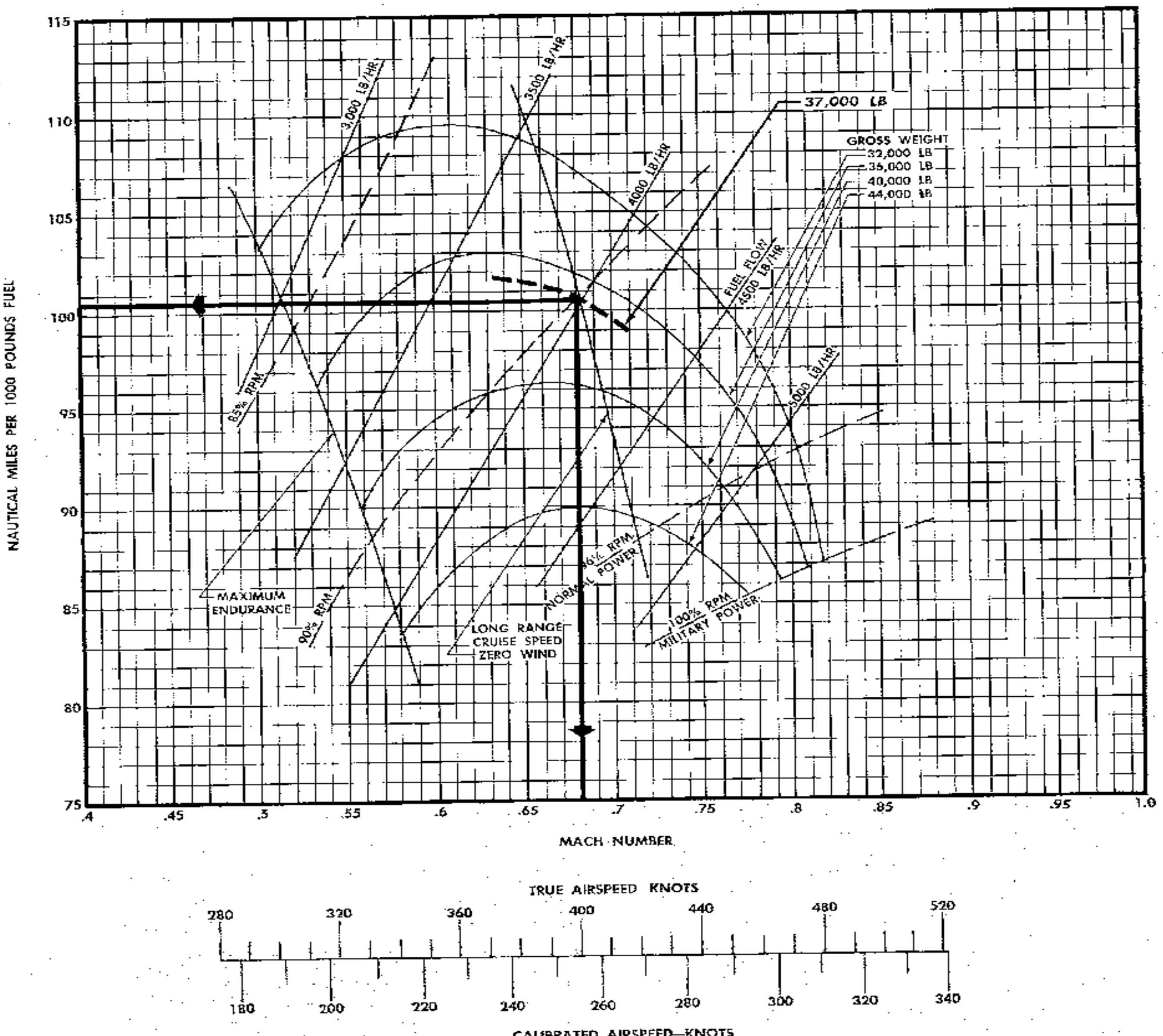
The Mission Profile Charts (see Mission Profile Charts for applicable configuration) show the relationship of time, fuel, distance, and altitude to maximum range for no-wind conditions. This relationship is based on a mission sequence of takeoff, military power climb, and long range cruise. The fuel curves include a 906-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 for 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.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

30,000 FEET
TWO PYLONS AND FUEL-ROCKET PODS OR
SIX PYLONS AND 600-GALLON TIP TANKS

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING

JA-755

Sample.

MISSION PROFILE

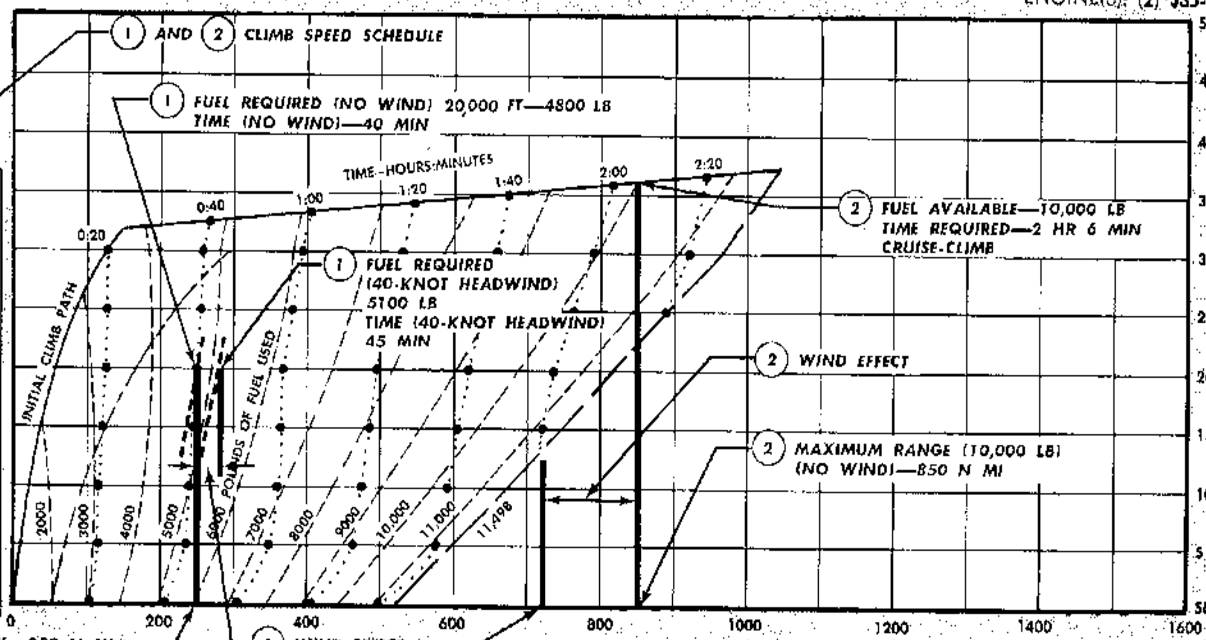
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
42,743 POUNDS
LONG RANGE CRUISE

MODEL: F-89J
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
ENGINE(S): (2) J35-35

CONFIGURATION: TWO PYLONS AND FUEL-ROCKET PODS

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.66	225	35
.68	255	30
.66	275	25
.63	280	20
.60	300	15
.56	310	10
.52	315	5
.48	315	SL



REMARKS:

1. FUEL ALLOWANCE FOR START, TAXI, AND TAKEOFF—906 LB.
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.

(1) CRUISE SETTINGS

CRUISE						
ALTITUDE FEET	MACH NO.	APPROXIMATE				
		CAS	TAS	LB/HR	% RPM	
CRUISE-CLIMB	*			4200-3200	*	
30,000	.68	255	400	4200	91	
25,000	.65	270	390	4300	89	
20,000	.61	280	375	4600	87	
15,000	.58	295	365	5000	85	
10,000	.54	315	360	5500	85	
5,000	.54	325	350	6100	84	
SEA LEVEL	.46	305	305	6200	80	

(2) CRUISE SETTINGS

*

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
32,000	92	.70
33,000	92	.70
34,000	92	.70
35,000	92	.70
36,000	91	.70
37,000	91	.70

LEGEND

- ZERO FUEL REMAINING
- FUEL CONSUMED
- CRUISE-CLIMB PATH
- TIME (START, TAXI, AND TAKEOFF NOT INCLUDED)
- LINE OF BEST RANGE FOR CONSTANT-ALTITUDE FLIGHT

SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING

JA-6A

Sample.

Use of Mission Profile Charts.

The charts 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. Using the Mission Profile 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 with no external load.

1. Enter at 250 N MI and 20,000 FT to obtain fuel required (no wind) — 4800 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. Calculated time with 40-KN wind (250 ÷ 335) — 45 MIN (0.75 HR)
6. Reenter at cruise altitude at the time with wind. Fuel required with wind — 5100 LB
7. Tabular cruise speed — 0.60 Mach
8. Tabular cruise power setting — 86% RPM (APPROX)

Note

If this flight had been made at 28,500-FT cruising altitude (reference, the line of best range at 250 N MI), the time and fuel required would have been less.

Sample Problem. Determine the maximum distance flyable with no external load and 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) — 850 N MI
2. Time (no wind) — 2 HR 6 MIN (2.1 HR)
3. Calculated average TAS (850 ÷ 2.1) — 405 KN
4. Apply wind to obtain GS (405 − 60) — 345 KN
5. Calculate distance with wind (2.1 × 345) — 725 N MI
6. Tabular cruise-climb speed — 0.70 Mach

INTERCEPT PROFILE CHARTS.

The Intercept Profile Charts (see Intercept Profile Charts for applicable configuration) present 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.

Use of Intercept Profile Charts.

For the proper method of using Intercept Profile Charts, see Use of Mission Profile Charts.

Sample Problem. Using the Intercept Profile Sample Chart, find the fuel required, time, necessary speed and power setting to cruise 200 N MI at 25,000 FT against a headwind of 40 KN with no external load.

1. Enter at 200 N MI and 25,000 FT to obtain fuel required (no wind) — 5350 LB
2. Time (no wind) — 24 MIN (0.40 HR)
3. Calculate average TAS (200 ÷ 0.40) — 500 KN
4. Apply wind to obtain GS (500 − 40) — 460 KN
5. Calculated time with 40-KN wind (200 ÷ 460) — 26 MIN (0.435 HR)
6. Reenter at cruise altitude at the time with wind. Fuel required with wind — 5530 LB
7. Tabular cruise speed — 0.81 Mach
8. Tabular cruise power setting — 100% RPM

Sample Problem. Determine the maximum distance flyable with no external load and 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) — 695 N MI
2. Time (no wind) — 1 HR 36 MIN (1.60 HR)
3. Calculate average TAS (695 ÷ 1.60) — 435 KN
4. Apply wind to obtain GS (435 − 60) — 375 KN
5. Calculate distance with wind (1.60 × 375) — 600 N MI
6. Tabular cruise-climb speed — 0.77 Mach

OPTIMUM RETURN PROFILE CHARTS.

The Optimum Return Profile Charts (see Optimum Return Profile Charts for applicable configuration) show 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.

INTERCEPT PROFILE

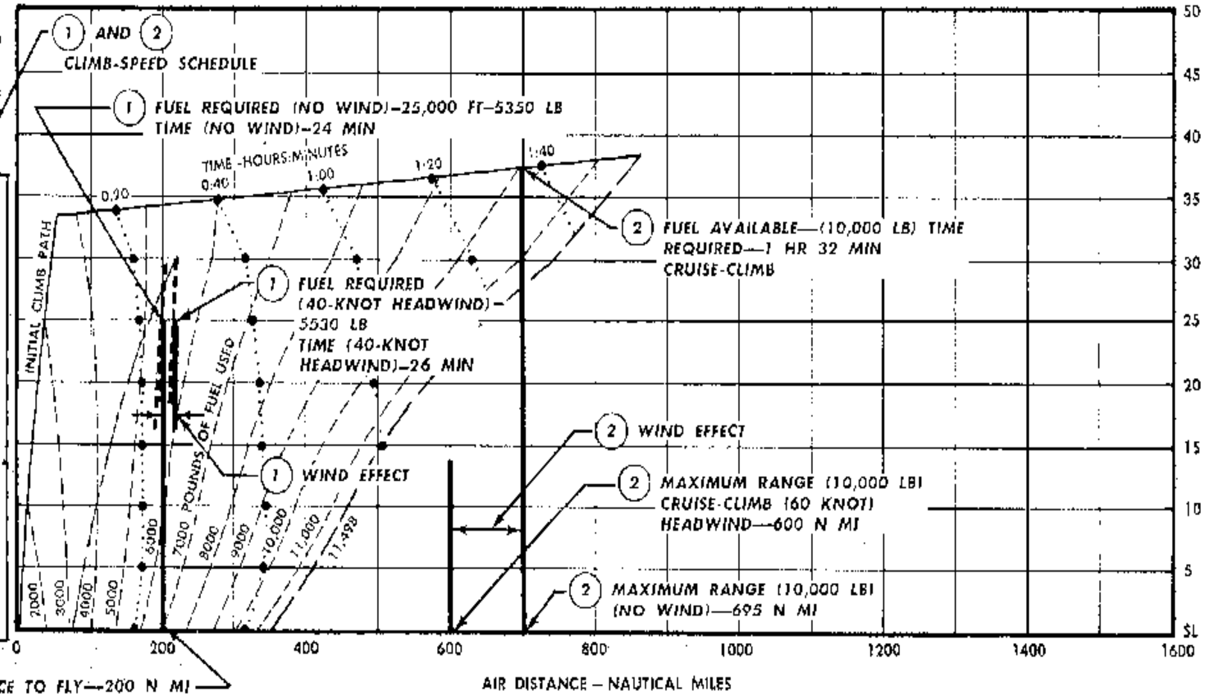
TAKEOFF GROSS WEIGHT
42,743 POUNDS
MILITARY POWER CRUISE

CONFIGURATION: TWO PYLONS AND FUEL-ROCKET PODS

DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.79	265	35
.79	300	30
.79	335	25
.79	365	20
.78	400	15
.77	430	10
.74	450	5
.69	460	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

SAMPLE CHART DO NOT USE FOR FLIGHT PLANNING.

(2) CRUISE SETTINGS

*

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
33,000	100	.76
34,000	100	.77
35,000	100	.77
36,000	100	.77
37,000	100	.77
38,000	100	.77

(1) CRUISE SETTINGS

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*		440	4700-3900	100
30,000	.80	305	470	5500	100
25,000	.81	340	485	6800	100
20,000	.82	385	505	8200	100
15,000	.81	415	505	9600	100
10,000	.81	450	515	11,100	100
5,000	.78	475	510	12,700	100
SEA LEVEL	.72	475	475	14,300	100

JA-256

Sample.

OPTIMUM RETURN PROFILE

DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

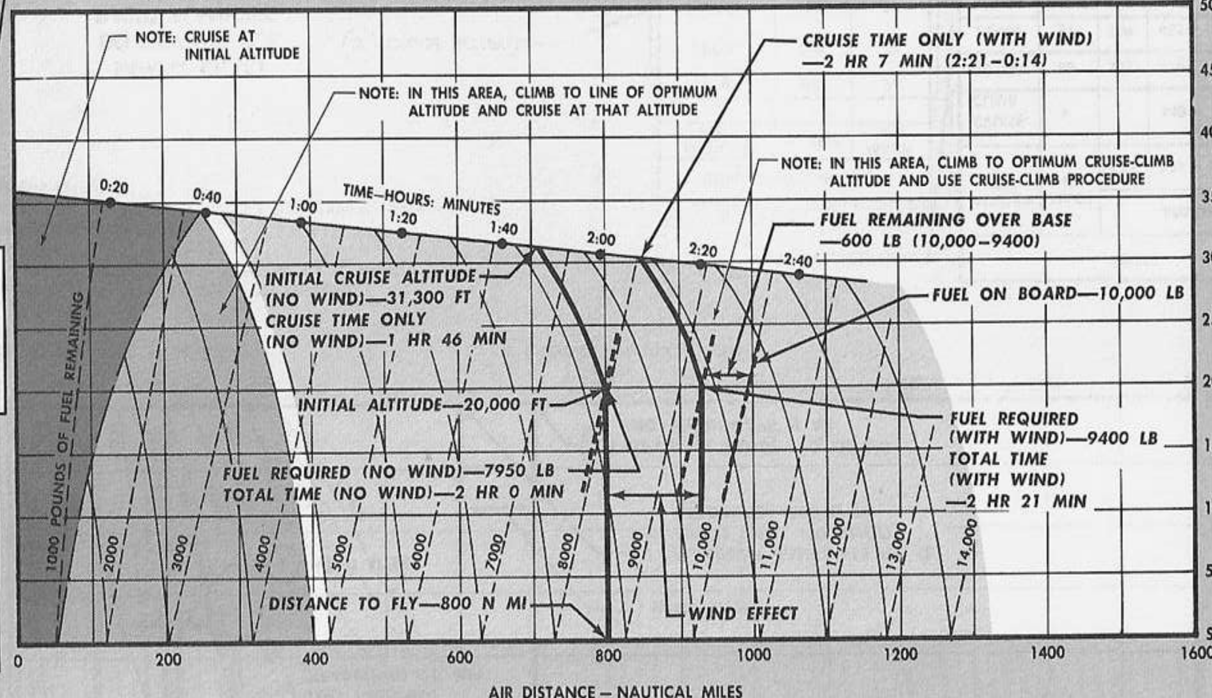
TAKEOFF GROSS WEIGHT
46,923 POUNDS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO PYLONS, TWO PYLON TANKS, AND FUEL-ROCKET PODS

CLIMB SCHEDULE
TIME TO CLIMB—14 MIN
(MILITARY CLIMB CHART)

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
		35
.67	250	30
.65	275	25
.62	290	20
.58	295	15
.54	300	10
.50	305	5
.47	315	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.

CRUISE-CLIMB PROCEDURE

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE CEILING	*			4800-3500	*
25,000	.64	265	385	4400	89
20,000	.60	275	370	4700	88
15,000	.57	290	360	5000	87
10,000	.55	305	350	5700	86
5,000	.53	325	345	6300	85
SEA LEVEL	.46	305	305	6600	81

*

CRUISE—CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
28,000	94	.68
29,000	94	.68
30,000	94	.68
31,000	93	.68
32,000	93	.68
33,000	93	.68
34,000	93	.69
35,000	92	.69

CRUISE-CLIMB PROCEDURE

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

JA-7A

Sample.

Use of Optimum Return Profile Charts.

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 Optimum Return Profile Sample Chart determine the fuel and time required to return to a base 800 N MI away. The airplane is at 20,000 FT with 10,000 LB of fuel on board (gross weight = 41,525 LB). A 60-KN headwind is assumed.

1. Enter profile at 800 N MI and 20,000 FT to establish starting point. Fuel required (no wind)	7950 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 found to be 31,300 FT.	
4. Cruise time (no wind)	1 HR 46 MIN
5. From the military power climb chart for pylon tank or MB-1 rocket configuration, time to climb	14 MIN
6. Total time (no wind; "4" + "5")	2 HR 0 MIN
7. Average TAS (distance ÷ total time)	400 KN
8. Average ground speed (TAS − headwind)	340 KN
9. Total time with headwind (distance ÷ average ground speed)	2 HR 21 MIN
10. Cruise time with wind ("9"−"5")	2 HR 7 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	9400 LB
12. Fuel remaining over base at altitude (10,000 LB − 9400 LB)	600 LB
13. Use the flight path originally determined at no wind.	

MAXIMUM ENDURANCE CHARTS.

The Maximum Endurance Charts (see Maximum Endurance Charts for applicable configuration) show 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 Charts.

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 Maximum Endurance Sample Chart, determine the fuel required to loiter at 30,000 FT with no external load for 45 MIN. The fuel on board at start of loiter is 6000 LB (gross weight = 37,245 LB).

1. Initial time at 6000 LB and 30,000 FT	1 HR 58 MIN
2. Final time (1:58 − 0:45)	1 HR 13 MIN
3. Fuel on board at end of loiter (1:13 at 30,000 FT)	3550 LB
4. Fuel required to loiter (6000 LB − 3550 LB)	2450 LB
5. Recommended loiter CAS	195 KN

OPTIMUM MAXIMUM ENDURANCE PROFILE CHARTS.

The Optimum Maximum Endurance Profile Charts (see Optimum Maximum Endurance Profile Charts for applicable configuration) give 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 Charts.

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.

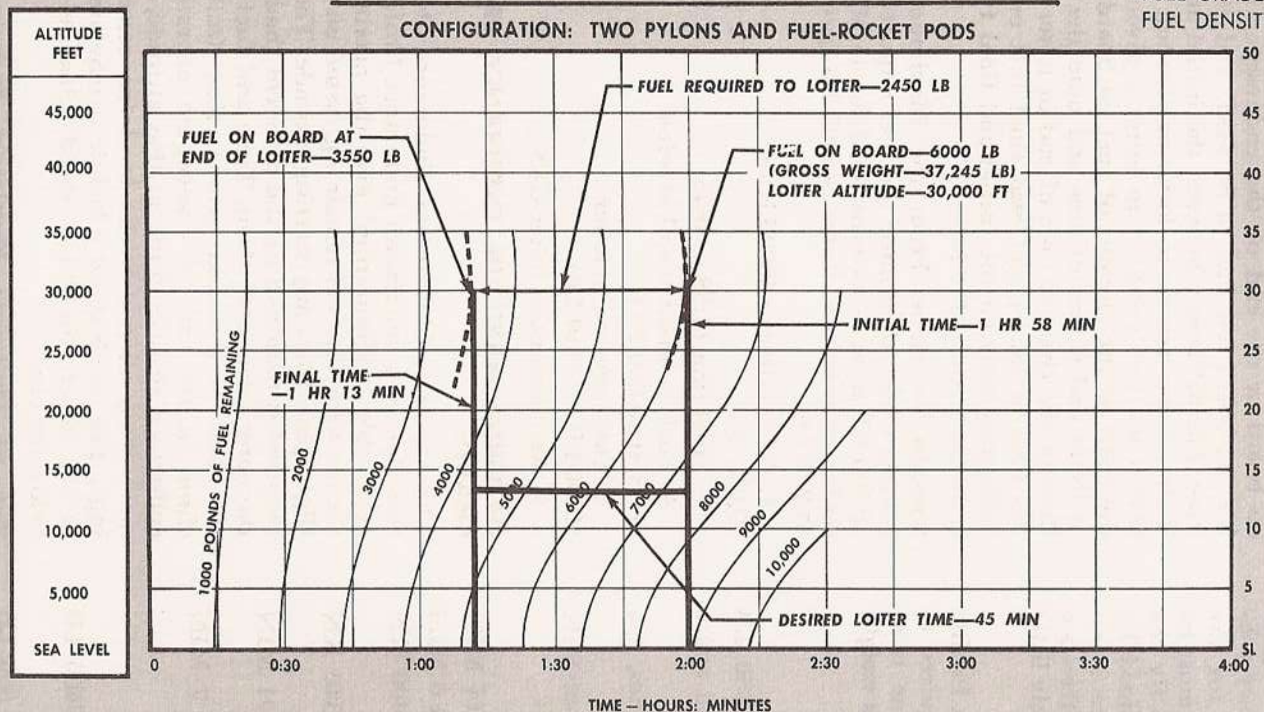
MAXIMUM ENDURANCE

DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

TAKEOFF GROSS WEIGHT
42,743 POUNDS

MODEL: **F-89J**
ENGINE(S): **(2) J35-35**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: TWO PYLONS AND FUEL-ROCKET PODS



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.

RECOMMENDED LOITER CONDITIONS

LOITER					
ALTITUDE FEET	CAS	APPROXIMATE			
		TAS	MACH NO.	LB/HR	% RPM
35,000	195	345	.60	3400	94
30,000	195	310	.53	3500	89
25,000	195	280	.47	3600	85
20,000	200	265	.43	3700	83
15,000	200	250	.40	3900	79
10,000	195	225	.35	4200	77
5,000	200	215	.33	4700	75
SEA LEVEL	200	200	.30	4800	71

JA-8A

Sample.

OPTIMUM MAXIMUM ENDURANCE PROFILE

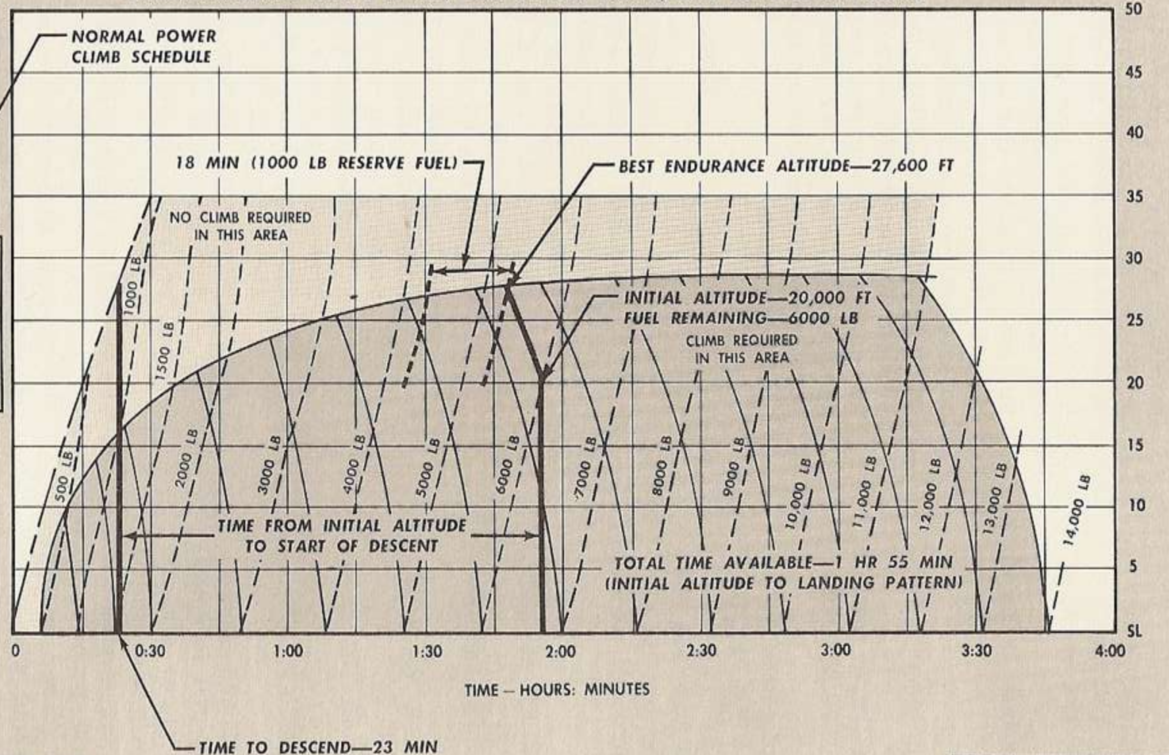
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

TAKEOFF GROSS WEIGHT
46,923 POUNDS

MODEL: **F-89J**
ENGINE(S): (2) **J35-35**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: TWO PYLONS, TWO PYLON TANKS, AND FUEL-ROCKET PODS

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT 1000 FT
		45
		40
.63	210	35
.63	235	30
.61	255	25
.57	260	20
.52	260	15
.48	265	10
.44	265	5
.41	270	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 — WITH PYLON TANKS					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
35,000 FT	200	.60	345	3500	95
30,000	195	.53	310	3500	88
25,000	185	.45	270	3100	82
20,000	175	.39	240	3000	78
15,000	185	.37	230	3400	76
10,000	180	.32	240	3800	74
5,000	180	.29	190	4000	72
SEA LEVEL	185	.28	185	4100	68

RECOMMENDED LOITER (30,000 and 25,000)

SAMPLE CHART
DO NOT USE FOR
FLIGHT PLANNING

LEGEND

- - - - - FUEL REMAINING
━━━ LINE OF OPTIMUM ALTITUDE FOR LOITER
——— NORMAL POWER CLIMB GUIDE LINES
— - — MAXIMUM RANGE DESCENT

JA-9A

Sample.

Sample Problem. From the Optimum Maximum Endurance Profile Sample Chart, determine the time available and the necessary flight path for maximum endurance aloft in the pylon tank configuration 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 1 HR 59 MIN

2. In this area, note that a climb is required.

3. Follow the climb path guide lines for the best endurance altitude 33,500 FT

4. Descent time from 33,500 FT to sea level 27 MIN

5. Elapsed time from start of climb to start of descent 1:59 - 0:27 1 HR 32 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 42 MIN

7. Obtain endurance altitude 33,000 FT

8. Descent time 26 MIN

9. Elapsed time 1 HR 16 MIN

DESCENT CHARTS.

The Descent Charts (figures A2-12 and A2-13) show descent performance for one and two engines operating in terms of fuel, time, air distance, and rate of descent for the gross weight range of the airplane denoted by the shaded areas. Three types of descents are shown: recommended descent with speed brakes closed (based on 0.70 Mach number), recommended descent with speed brakes open (based on 0.70 Mach number), and maximum range descent (based on approximately 200 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 (figures A2-15 through A2-18) 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. If the landing technique used differs from that specified, the landing distances will vary from those shown on the charts. A 5 per cent variation in speed causes approximately a 10 per cent variation in distances; insufficient wheel braking may increase ground roll by 50 per cent.

Note

> The data presented in the Landing Distance Charts take into account ground effect. Ground effect, in general, refers to a reduction in the overall drag of an airplane when operated close to the ground. The degree of drag reduction will vary with distance of the wing or supporting surface from the ground, being greatest when the wing is at ground level and will have, for all practical purposes, disappeared when the wing is one-half the wing span above the ground. The reduction in drag is also greatest at low velocities and becomes a lesser reduction as velocity increases.

Use of Landing Distance Charts.

The Landing Distance 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 32,000 pounds and a 20-knot headwind. These conditions require a ground roll of 2550 feet and a total distance of 3600 feet from a 50-foot obstacle clearance to end of ground roll.

UNUSUAL RUNWAY CONDITION CHART.

Once the Landing Ground Roll distance has been determined, it should be corrected for runway condition by using figure A2-19 to find actual ground run distance.

EXPLANATION OF TERMS.

RCR - Runway Condition Reading
P - Patchy
WR - Wet Runway
SLR - Slush on Runway
LSR - Loose Snow on Runway
PSR - Packed Snow on Runway
IR - Ice on Runway

When other than dry runway conditions exist on active runways, Base Operation Officers are responsible for determining and relaying to the weather station the type of runway covering and the relative slickness of the runway. This information will be transmitted as part of the teletype weather sequence. The number will either be a one or two digit number and is referred to as the runway condition reading. This number will be followed by the letter "P" if the runway is patchy. A report of SLR14P would indicate slush on the runway, RCR14, and patchy conditions.

Sample Problem. Enter the chart at Landing Ground Distance with the distance determined by chart A2-16 or A2-18. Proceed horizontally to RCR15, then vertically down to read Actual Ground Run Distance.

Note

If no RCR is available, use 12 for wet runways and 5 for icy runways. For ICAO report of good, use RCR23; for medium, use RCR121; and for poor, use RCR05.

LANDING SPEEDS CHART.

The Landing Speeds Chart (figure A2-14) presents the recommended indicated airspeeds for final approach, 50-foot obstacle clearance, touchdown, and nose wheel down. The chart may be read for applicable landing gross weights and for flap settings of 0 degrees, 30 degrees, and 50 degrees.

LANDING IMMEDIATELY AFTER TAKEOFF DATA CARD.

A Landing Immediately After Takeoff Data Card (TAKEOFF AND LANDING DATA CARD) is to be completed before each takeoff. The purpose of the Landing Immediately After Takeoff Data Card is to familiarize the pilot with emergency procedures to be followed in the event loss of an engine or other emergencies necessitate landing immediately after takeoff. Information necessary to complete the normal and 1 engine landing sections may be found in the Appendix Charts.

Use of Landing Immediately After Take-off Data Card.

The following conditions are given as a basis for completing the normal and 1 engine landing sections of the sample Landing Immediately After Takeoff Data Card.

Conditions:

1.	Runway length	8000 FT
2.	Headwind	20 KN
3.	Runway ambient temperature	$59^{o}F$
4.	Pressure altitude	2000 FT
5.	Maximum emergency landing weight	38,000 LB

LANDING DISTANCE

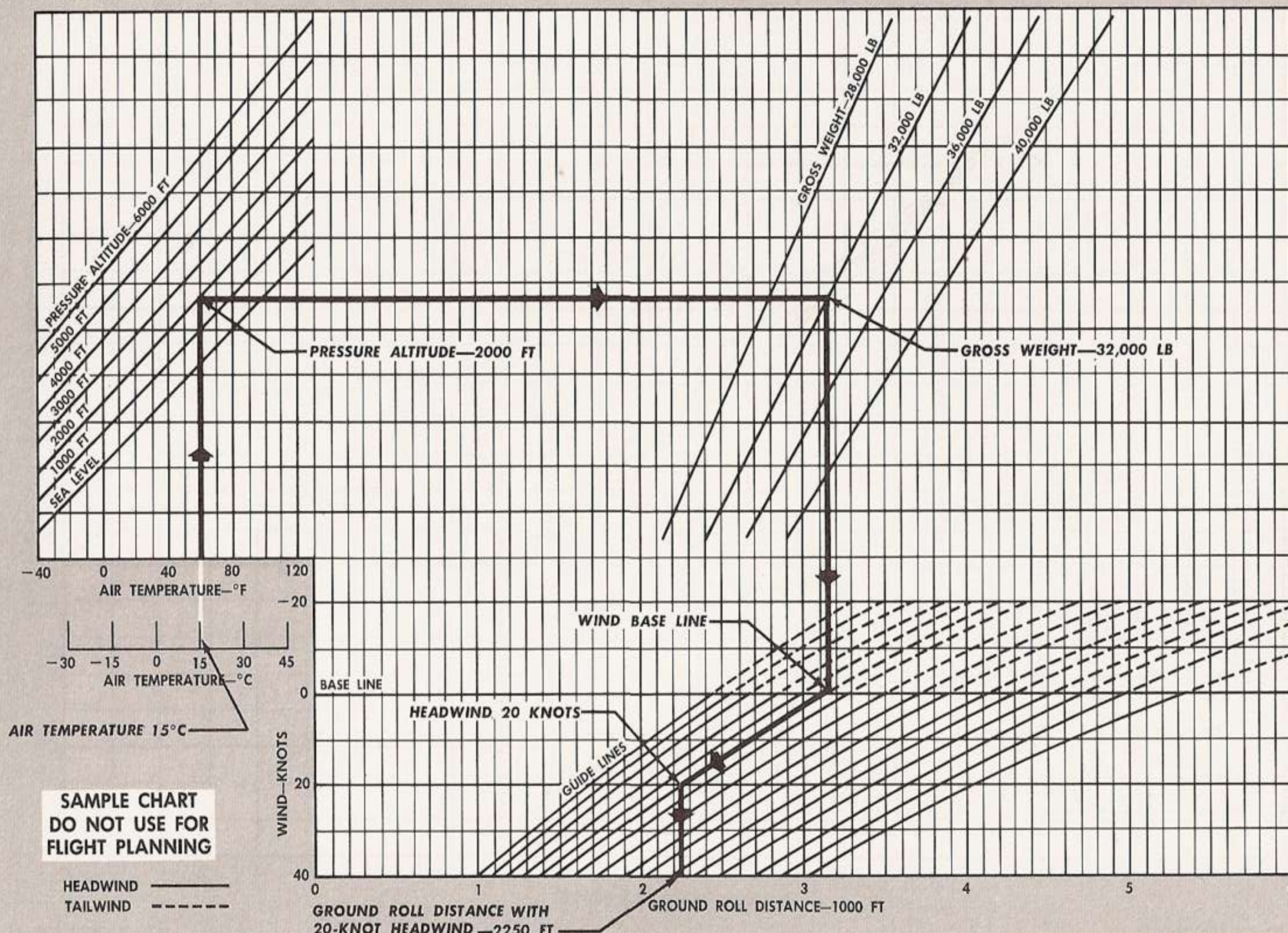
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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
28,000 LB	105 KNOTS IAS
32,000 LB	112 KNOTS IAS
36,000 LB	118 KNOTS IAS
40,000 LB	125 KNOTS IAS

JA-10(1)A

Sample.

LANDING DISTANCE TO CLEAR 50 FT OBSTACLE

MODEL: **F-89J**

DATA BASIS: **FLIGHT TEST**

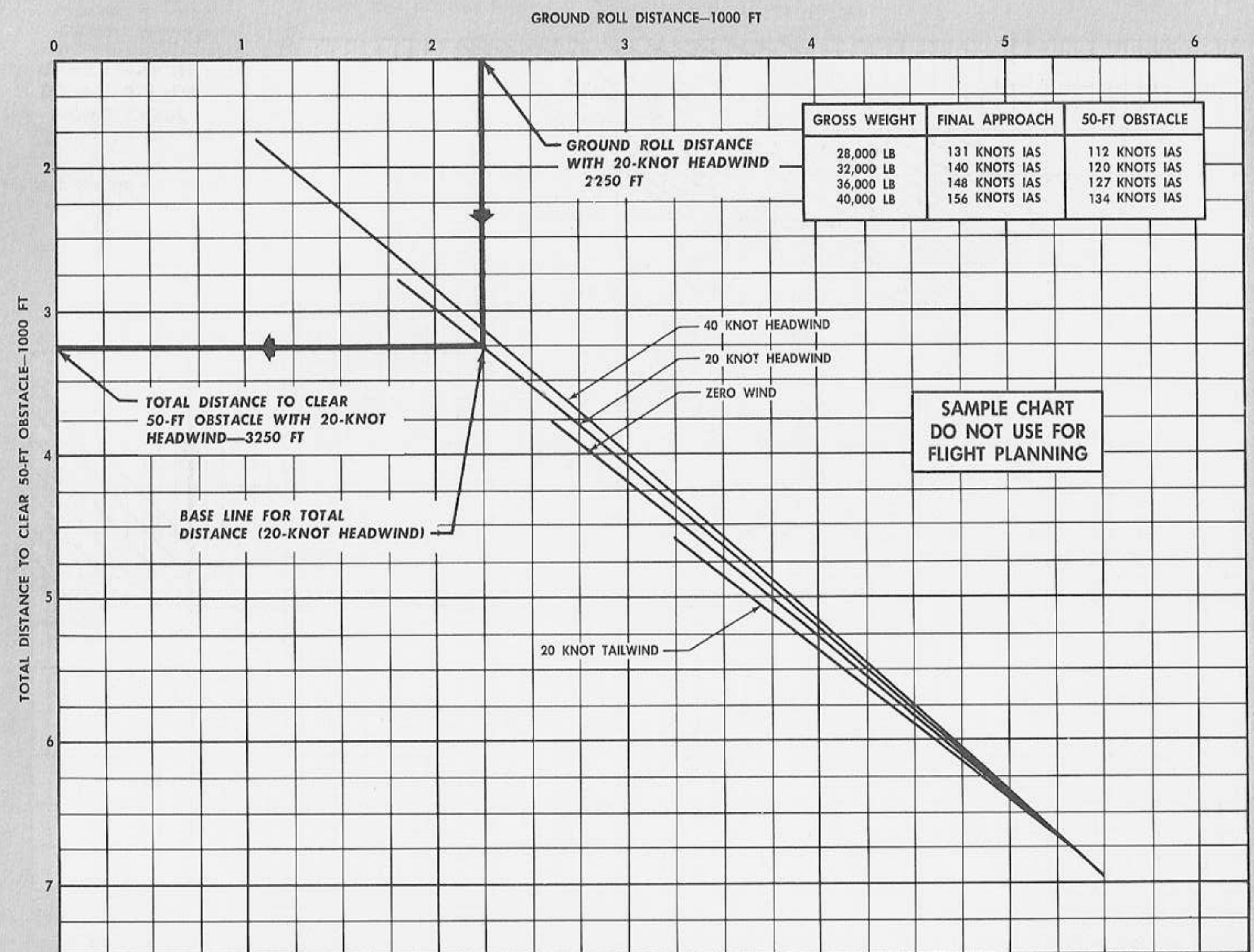
DATE: **17 SEPTEMBER 1957**

WITH OR WITHOUT EXTERNAL STORES

ENGINE(S): (2) J35-35

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/US GAL



GROSS WEIGHT	FINAL APPROACH	50-FT OBSTACLE
28,000 LB	131 KNOTS IAS	112 KNOTS IAS
32,000 LB	140 KNOTS IAS	120 KNOTS IAS
36,000 LB	148 KNOTS IAS	127 KNOTS IAS
40,000 LB	156 KNOTS IAS	134 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.

JA-10(2)A

Sample.

6. Mission profile landing weight 32,000 LB
7. Braking conditions (dry, icy, wet) dry

*Takeoff weight less jettisonable items

LANDING IMMEDIATELY AFTER TAKEOFF DATA

Maximum Emergency Landing Weight.................38,000 LB
(Takeoff Weight Less Jettisonable Items)

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	159 KN	152 KN
Touchdown Speed	144 KN	122 KN
Ground Roll Distance	3250 FT	2700 FT
Total Distance (to clear 50 FT)	4300 FT	3750 FT

LANDING DATA CARD.

A Landing Data Card (TAKEOFF AND LANDING DATA CARD) is to be completed before each landing. The purpose of the Landing Data Card is to familiarize the pilot with emergency procedures to be followed in the event of an engine failure or other emergencies which may occur during landing. The information required by the *normal* and *1 engine* landing sections of the Landing Data Card may be found in the Appendix Charts.

Use of Landing Data Card.

The following *conditions* are given as a basis for completing the sample Landing Data Card.

Conditions:

1. Runway length 8000 FT
2. Headwind 20 KN
3. Runway ambient temperature 59°F
4. Pressure altitude 2000 FT
5. Maximum emergency landing weight 38,000 LB*
6. Mission profile landing weight 32,000 LB
7. Braking conditions (dry, icy, wet) dry

* Takeoff weight less jettisonable items.

LANDING

Landing Gross Weight	32,000 LB	Runway Length	8000 FT
Temperature	59°F	Pressure Altitude	2000 FT
Headwind	20 KN	Surface: Dry, Wet, Icy	

	1 Engine No Flaps or Speedbrakes	*Normal Full Flaps, Speedbrakes After Touchdown*
Final Approach Speed	146 KN	140 KN
Touchdown Speed	133 KN	112 KN
Ground Roll Distance	2725 FT	2250 FT
Total Distance (to clear 50 FT)	3650 FT	3250 FT

COMBAT ALLOWANCE CHARTS.

The Combat Allowance Charts (see Combat Allowance Charts for applicable configuration) show the relationship between time and fuel with changes in altitude for two-engine operation at maximum, military, and normal power. 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 to plan a typical mission.

FLIGHT PLAN DATA.

A combat mission is to be flown using two MB-1 rockets. Prepare a flight plan based on the following data:

1. Distance to combat area 400 N MI
2. Assigned altitude:
   - Inbound to combat (cruise-climb) 28,000 FT and above
   - Outbound from combat (cruise-climb) 35,000 FT and above
3. Combat at 40,000 FT (maximum power) 10 MIN
4. Weather (assume standard day temperature throughout): CAVU
   - Winds aloft inbound (28,000 FT and above) 40 KN HW
   - Winds aloft outbound (35,000 FT and above) 50 KN TW
   - Field elevation 2000 FT
5. Airplane gross weight:
   - Operating minimum (includes crew of two, oil, trapped fuel, pylons, and miscellaneous equipment) 27,790 LB
   - Two MB-1 rockets 1634 LB
   - Maximum usable fuel—internal, and external (2365 gallons) 15,320 LB
   - Total gross weight 44,744 LB

TAKEOFF.

Obtain takeoff distance from the Maximum Power Takeoff Distance Chart, figures A2-1 and A2-2. (Standard day temperature at 2000 feet is 11°C.) Assume zero wind.

1. Ground roll distance (44,744 LB) 4200 FT
2. Total takeoff distance over 50-foot obstacle 6000 FT
3. Takeoff speed (IAS) 139 KN

INBOUND LEG.

Cruise.

The inbound leg may be determined directly from the mission profile chart for two MB-1 rockets. The profile includes a 906-pound 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	400 N MI
2. Fuel required (no wind) from profile	6600 LB
3. Time (no wind) from profile	1 HR 5 MIN
4. Average TAS ("1" ÷ "3")	370 KN
5. Ground speed ("4" − 40 KN)	330 KN
6. Time with wind ("1" ÷ "5")	1 HR 13 MIN
7. Fuel required (with wind) from profile	7300 LB
8. Cruise speed (cruise-climb altitude)	0.67 Mach NO.
9. Cruise power setting	90% RPM (APPROX)
10. Military power climb speed schedule	(see Best Climb Performance Chart for applicable configuration)
11. Gross weight at end of cruise (44,744 LB − "7")	37,444 LB

Climb to Combat Altitude.

Maximum power climb to combat altitude (40,000 feet).

1. Distance traveled in climb	30 N MI
2. Gross weight at start of climb (31,000 FT)	37,444 LB
3. Gross weight at end of climb to 40,000 FT	36,644 LB
4. Fuel used to climb (37,444 LB − 36,644 LB)	800 LB
5. Time to climb	4 MIN
6. Maximum power climb speed schedule	(see Best Climb Performance Chart for applicable configuration)

COMBAT.

From the Combat Allowance Chart (see Combat Allowance Chart for applicable configuration), obtain the fuel required for combat at 40,000 feet.

1. Combat—maximum power (10 MIN)	1750 LB
2. Gross weight at end of combat 36,644 LB − 1750 LB (combat fuel) − 1634 LB (2 MB-1 rockets)	33,260 LB

Assume zero distance traveled during combat. Determine the fuel remaining at end of combat.

3. Takeoff, climb and cruise	7300 LB
4. Climb to combat altitude	800 LB
5. Combat	1750 LB
6. Total fuel used	9850 LB
7. Fuel remaining (15,320 LB − 9850 LB)	5470 LB

OUTBOUND LEG.

Cruise-Climb.

At the end of combat, the airplane is 430 N MI (400 + 30) from the base at an altitude of 40,000 feet. Enter the Optimum Return Profile Chart for two pylons 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 37,500 feet; therefore, a recommended descent (with speed brakes open) is made from 40,000 feet to 37,500 feet (time, distance, and fuel consumed are negligible).

1. Distance	430 N MI
2. Fuel required (no wind)	3100 LB
3. Initial cruise altitude	37,500 FT
4. Total time (no wind)	1 HR 2 MIN
5. Average TAS ("1" ÷ "4")	416 KN
6. Average ground speed ("5" + 50)	466 KN
7. Total time with wind ("1" ÷ "6")	55 MIN
8. Fuel required (wind)	2700 LB
9. Cruise speed	0.70 Mach NO.
10. Power setting	(See figure A4-19)
11. Reserve over base at 39,500 FT altitude (5470 LB − "8")	2770 LB

Descent.

Obtain the fuel required to descend to base from the Descent Chart (figure A2-12).

1. Recommended descent, speed brakes open, from 39,500 FT	50 LB
2. Time to descend	1.4 MIN
3. Descent speed, using idle power and speed brakes open	0.70 Mach NO.
4. Fuel reserve for loiter and landing (2770 LB − 50 LB)	2720 LB
5. Airplane gross weight for landing	30,510 LB

Landing.

Obtain the landing distance from the Landing Distance Charts (figures A2-15 and A2-16). Use 2000-foot altitude, 11°C, and no wind.

1. Ground roll distance	3000 FT
2. Total distance over 50-foot obstacle	4200 FT
3. Approach speed (IAS)	136 KN
4. 50-foot obstacle speed (IAS)	117 KN
5. Touchdown speed (IAS)	109 KN

The sum of all the time required gives the time from takeoff to landing 2 HR 23.4 MIN

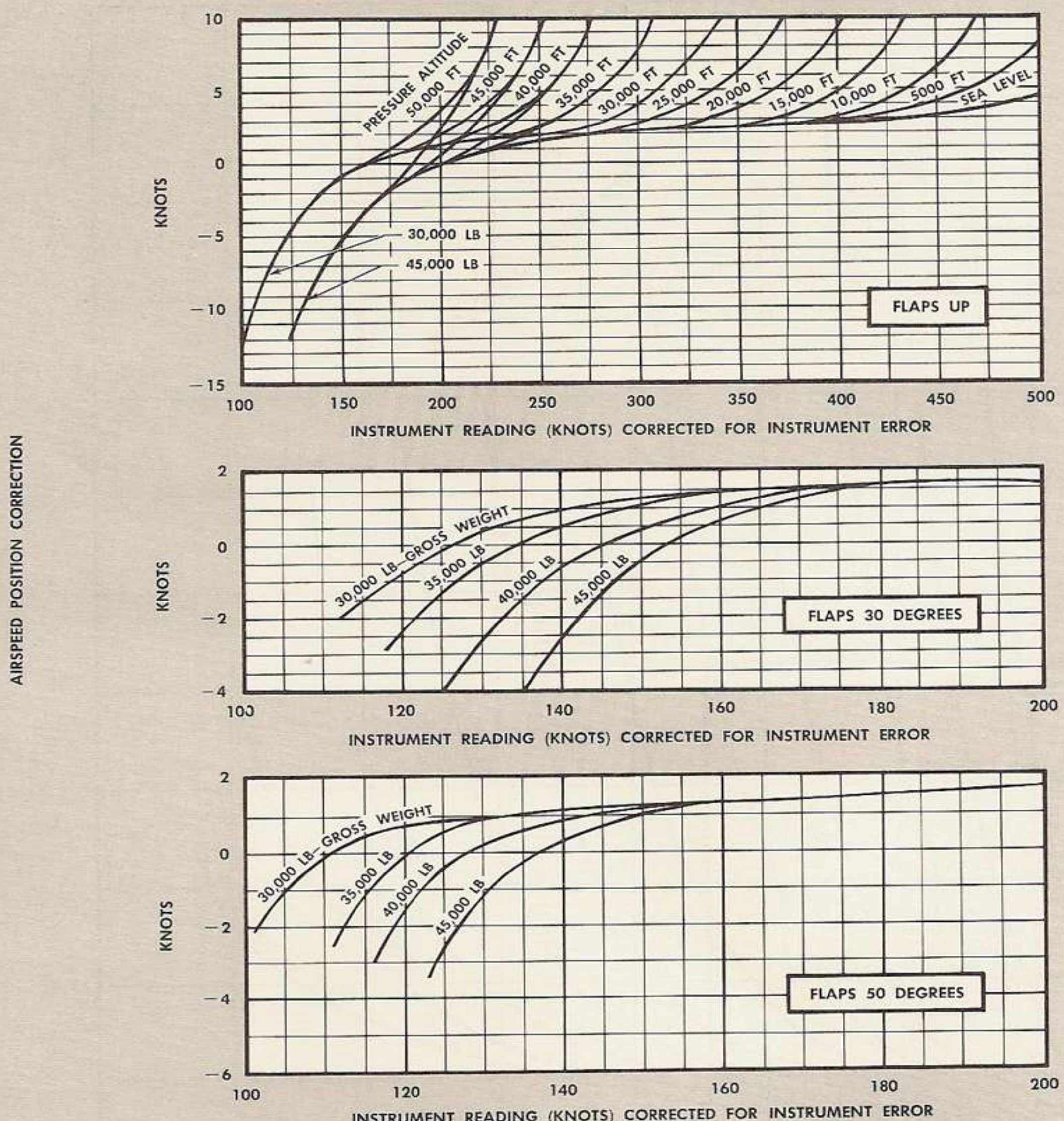
AIRSPEED POSITION CORRECTION

MODEL: **F-89J**

DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

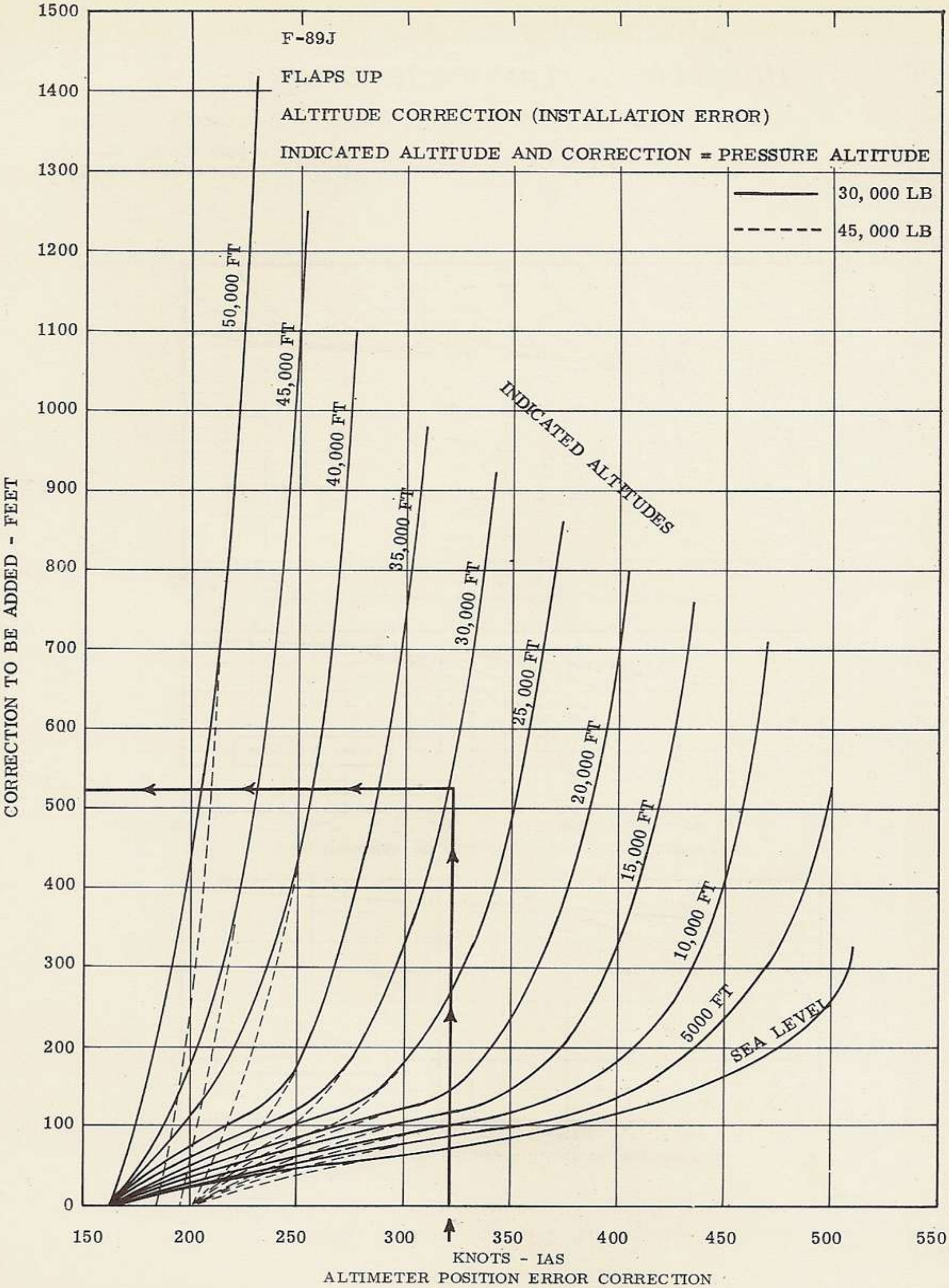


REMARKS:

1. ADD CORRECTION TO CORRECTED INSTRUMENT READING (IAS) TO OBTAIN CALIBRATED AIRSPEED.
2. GEAR UP OR DOWN.

JA-11A

Figure A1-1.



ALTIMETER POSITION ERROR CORRECTION

Figure A1-1A.

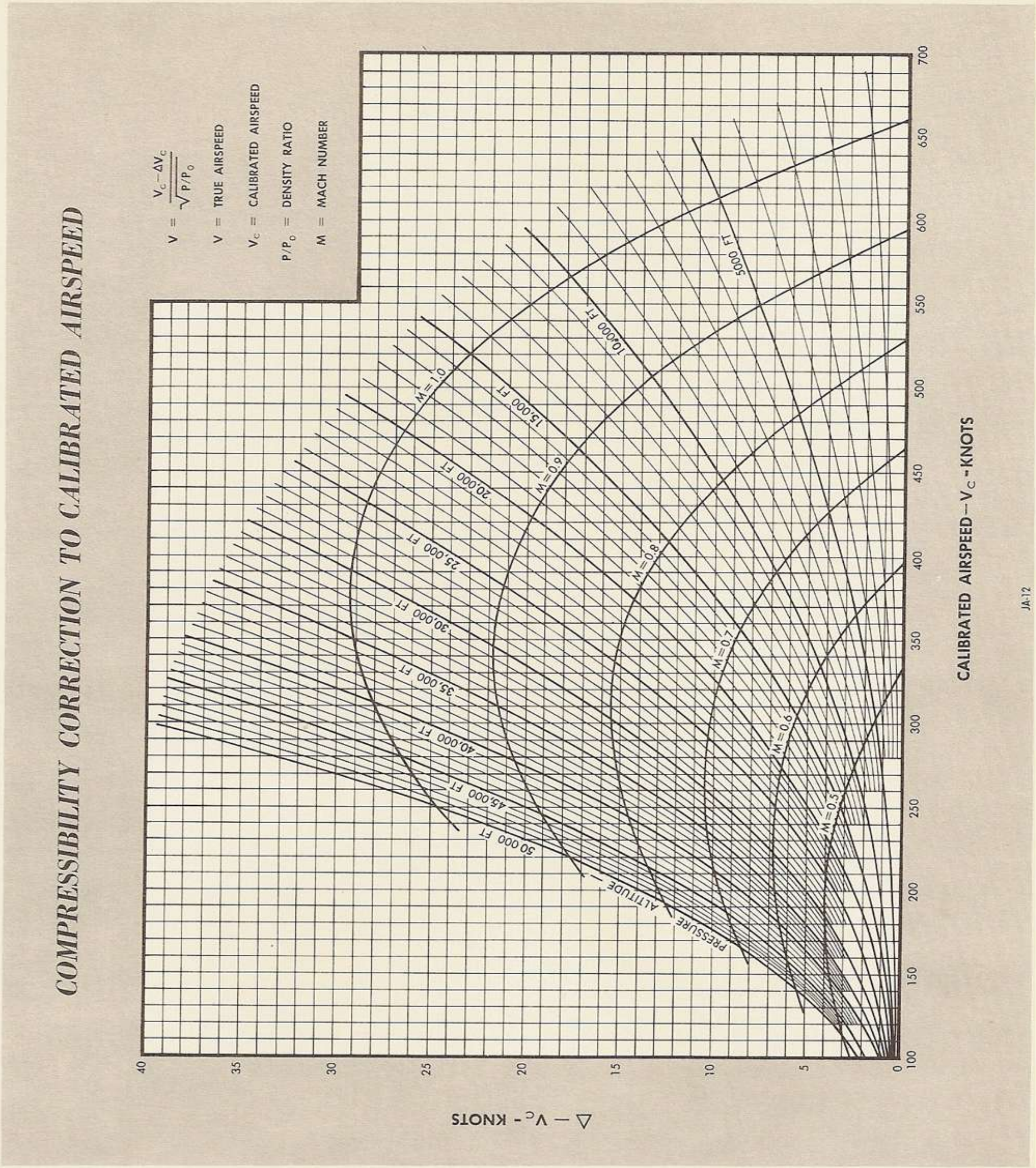

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED
V = (V_C − ΔV_C) / √(P/P_0)
V = TRUE AIRSPEED
V_C = CALIBRATED AIRSPEED
P/P_0 = DENSITY RATIO
M = MACH NUMBER
PRESSURE ALTITUDE
5000 FT
10,000 FT
15,000 FT
20,000 FT
25,000 FT
30,000 FT
35,000 FT
40,000 FT
45,000 FT
50,000 FT
M = 1.0
M = 0.9
M = 0.8
M = 0.7
M = 0.6
M = 0.5
Δ — V_C - KNOTS
CALIBRATED AIRSPEED — V_C - KNOTS
0
5
10
15
20
25
30
35
40
100
150
200
250
300
350
400
450
500
550
600
650
700
JA-12

Figure A1-2.

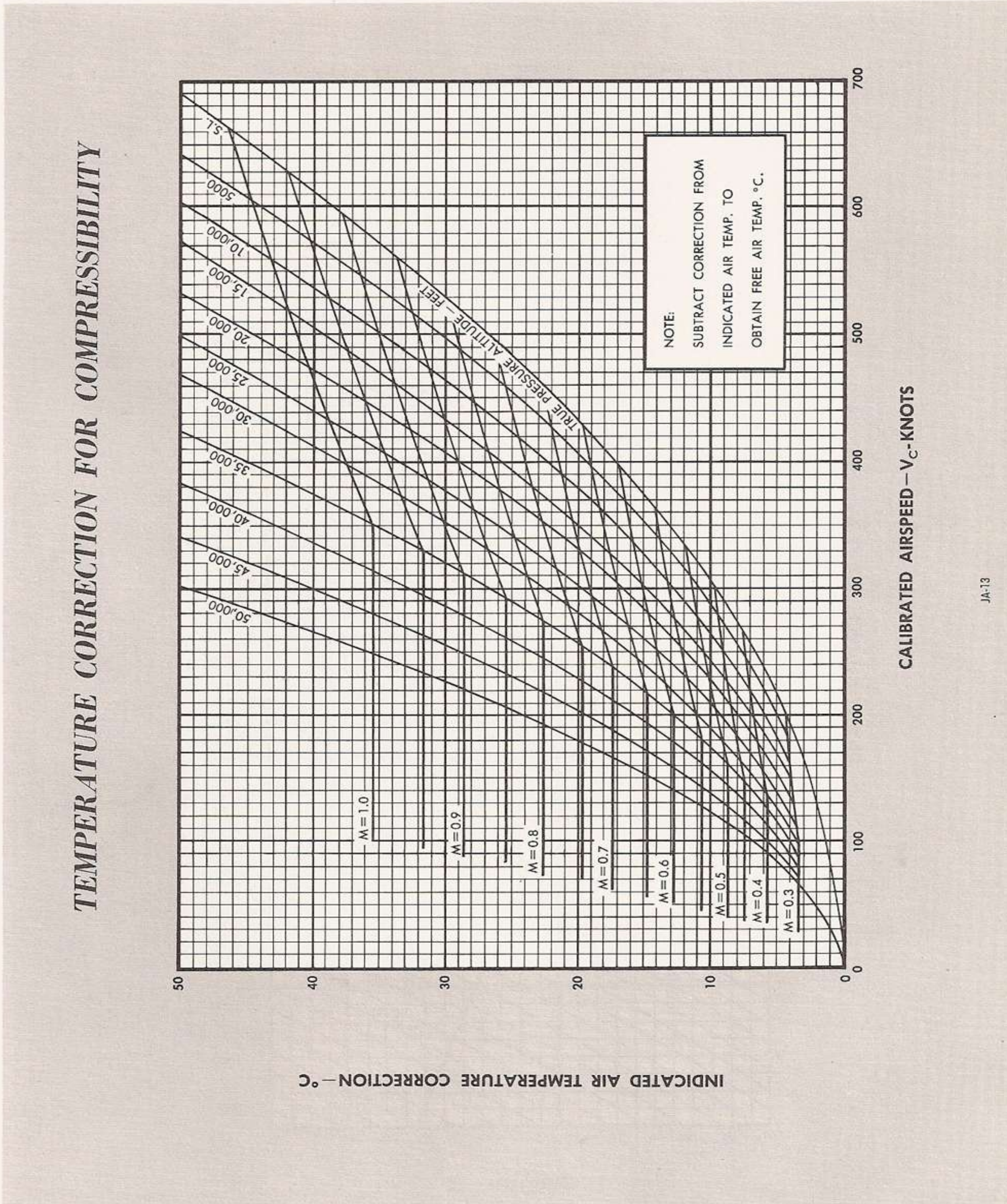

TEMPERATURE CORRECTION FOR COMPRESSIBILITY
NOTE:
SUBTRACT CORRECTION FROM INDICATED AIR TEMP. TO OBTAIN FREE AIR TEMP. °C.
TRUE PRESSURE ALTITUDE — FEET
S.L.
5000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
M = 1.0
M = 0.9
M = 0.8
M = 0.7
M = 0.6
M = 0.5
M = 0.4
M = 0.3
INDICATED AIR TEMPERATURE CORRECTION — °C
CALIBRATED AIRSPEED — V_C-KNOTS
0
100
200
300
400
500
600
700
10
20
30
40
50
JA-13

Figure A1-3.

DENSITY ALTITUDE CHART

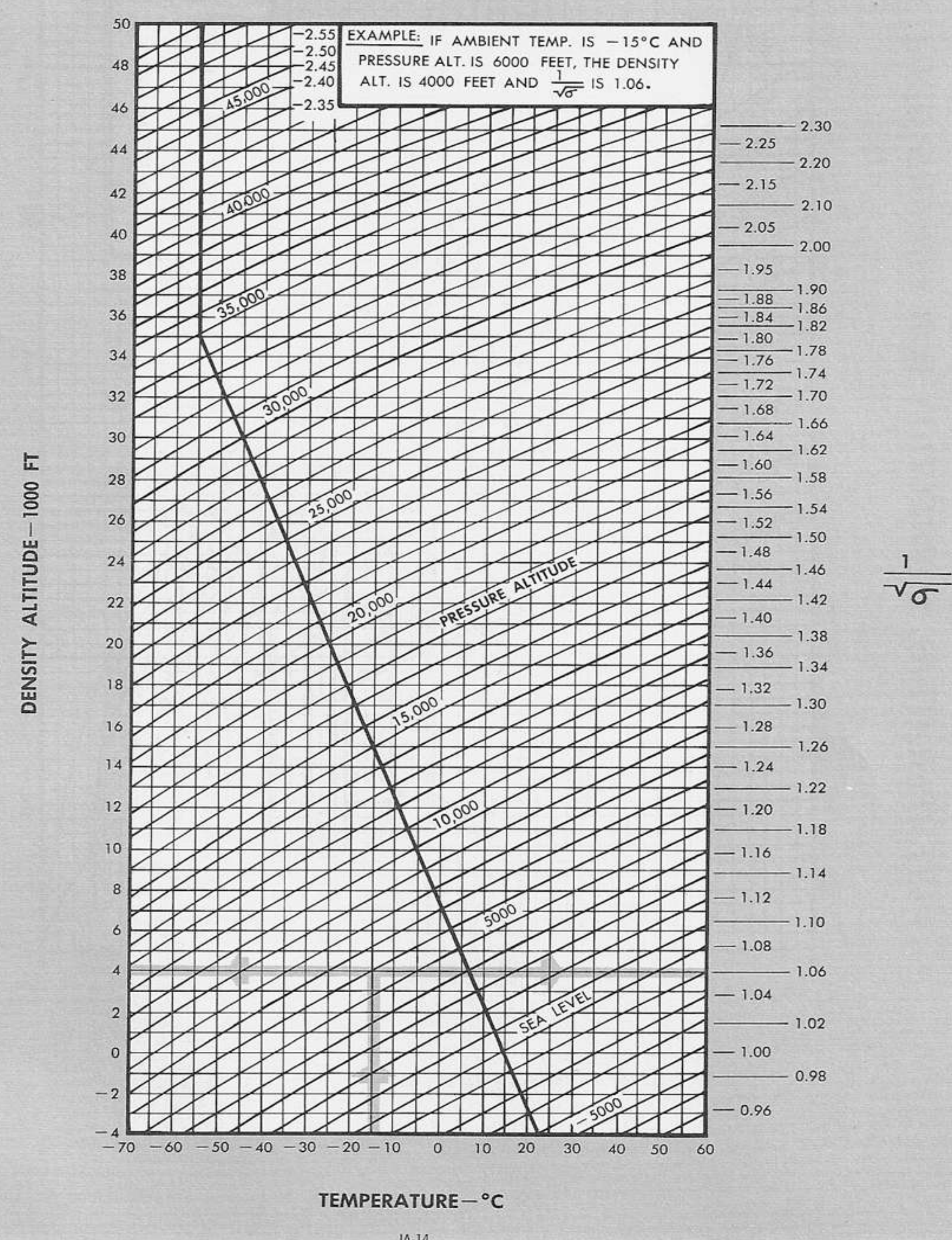
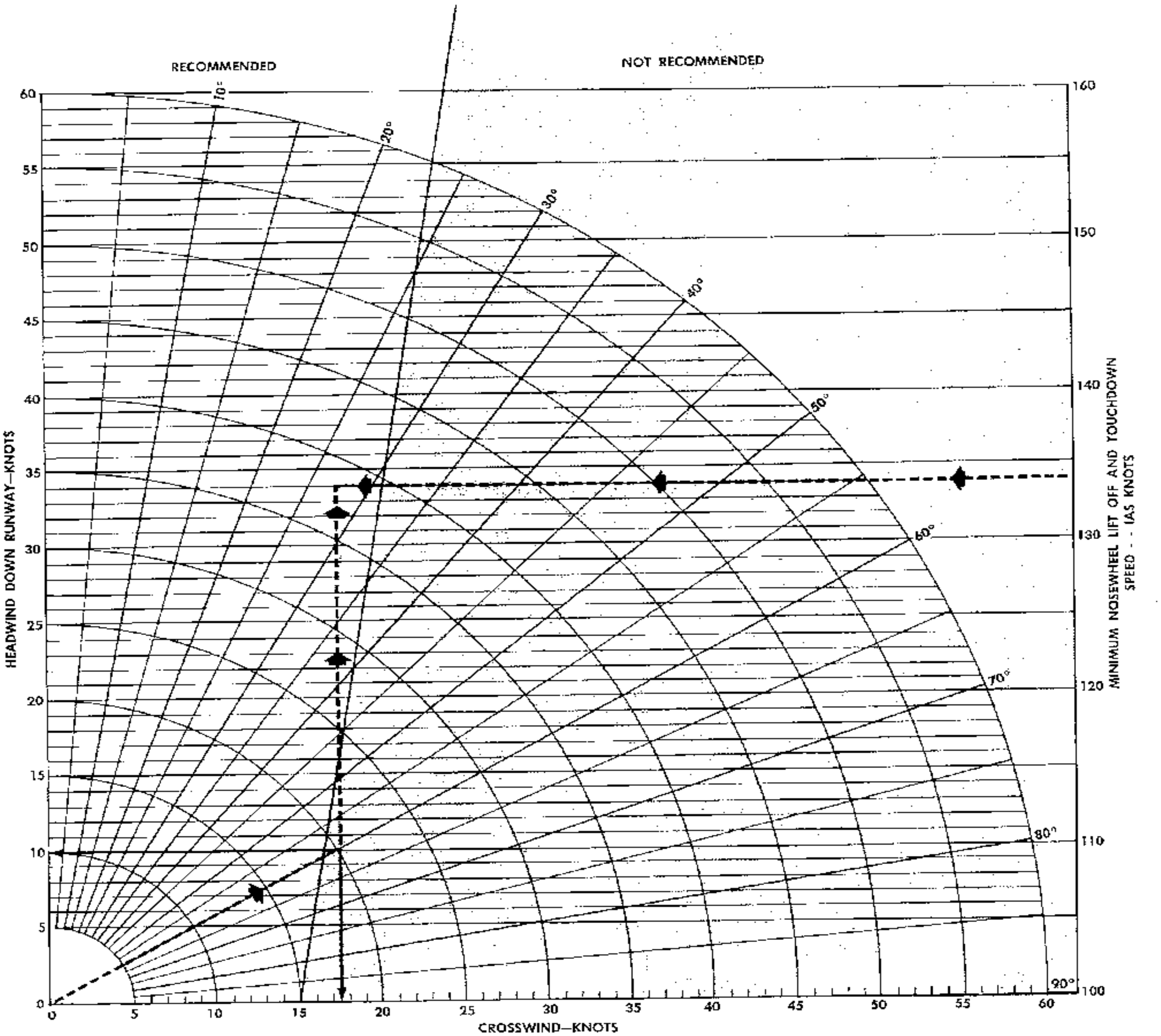


Figure A1-4.

TAKEOFF AND LANDING CROSSWIND CHART



GIVEN:
TAKEOFF RUNWAY=27
WIND=330°/20-KNOTS.

FIND:
IS TAKEOFF RECOMMENDED AT TAKEOFF SPEED OF 134-KNOTS IAS.

SOLUTION:
1. RUNWAY WIND ANGLE=60°
2. AT WIND VELOCITY OF 20-KNOTS AND 60° RUNWAY ANGLE FIND CROSS WIND COMPONENTS OF 18-KNOTS, HEAD WIND=10-KNOTS.
3. PROCEED VERTICALLY TO PREDICTED TAKEOFF AIRSPEED OF 134-KNOTS AND DETERMINE TAKEOFF AS RECOMMENDED.

JA-210A

Figure A1-5.

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APPENDIX II

PERFORMANCE DATA

Appendix II contains performance data applicable to all airplane configurations for takeoff, minimum distance climb, descent and landing.

TABLE OF CONTENTS

Refer to Appendix I for use of charts, takeoff and landing data cards, sample problems, airspeed, compressibility, temperature correction, density altitude and relative wind charts.

The airplane will produce the results stated in the applicable charts referenced above when the procedures given in Section II are followed.

MODEL: F-89J

DATA BASIS: FLIGHT TEST

DATE: 17 SEPTEMBER 1957

TAKEOFF DISTANCE

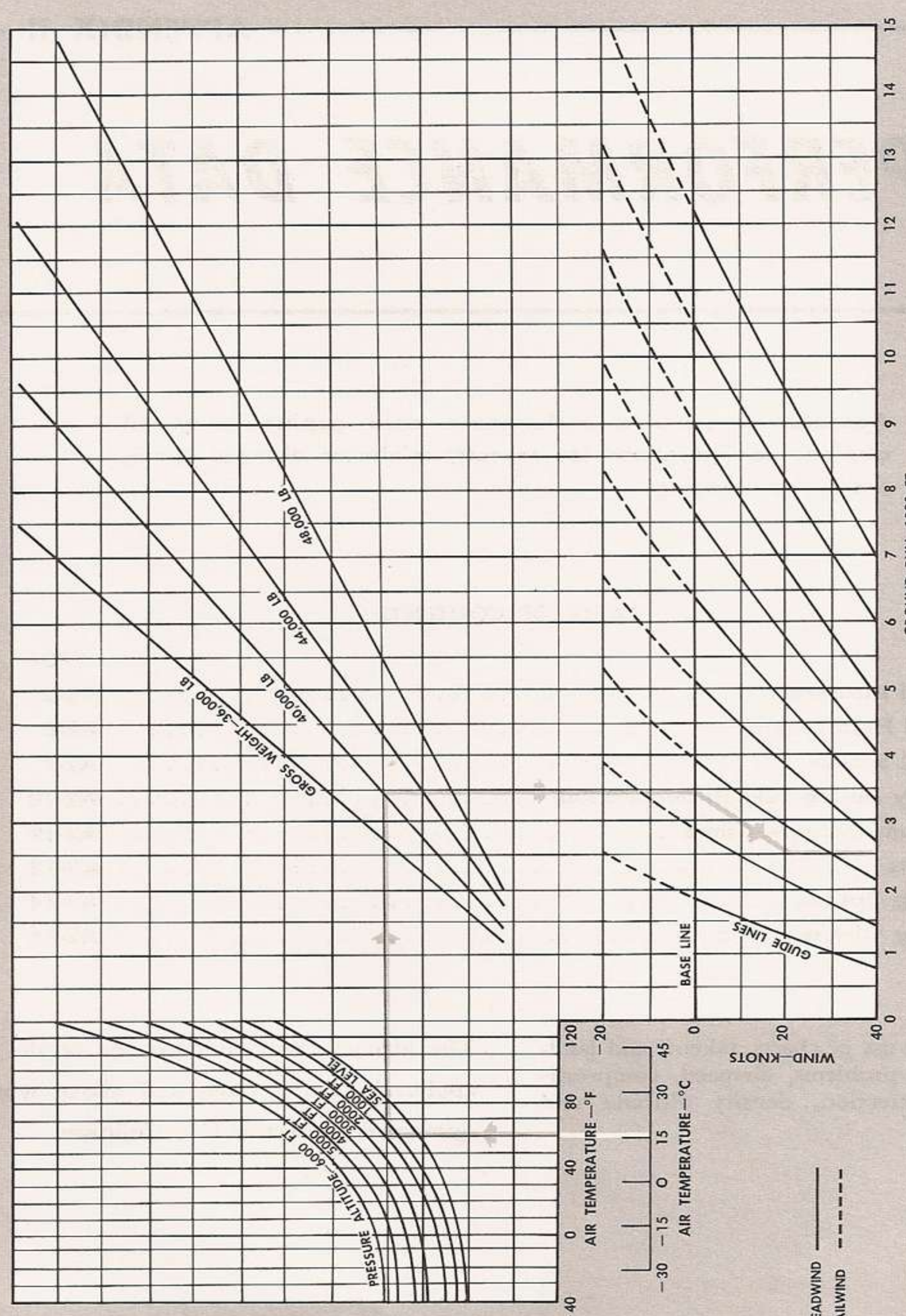
MAXIMUM POWER

WITH OR WITHOUT EXTERNAL STORES

ENGINE(S): (2) J35-35

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
36,000 LB	120 KNOTS IAS	124 KNOTS IAS
40,000 LB	127 KNOTS IAS	131 KNOTS IAS
44,000 LB	133 KNOTS IAS	138 KNOTS IAS
46,920 LB	138 KNOTS IAS	143 KNOTS IAS

JA-15(1)A

Figure A2-1.

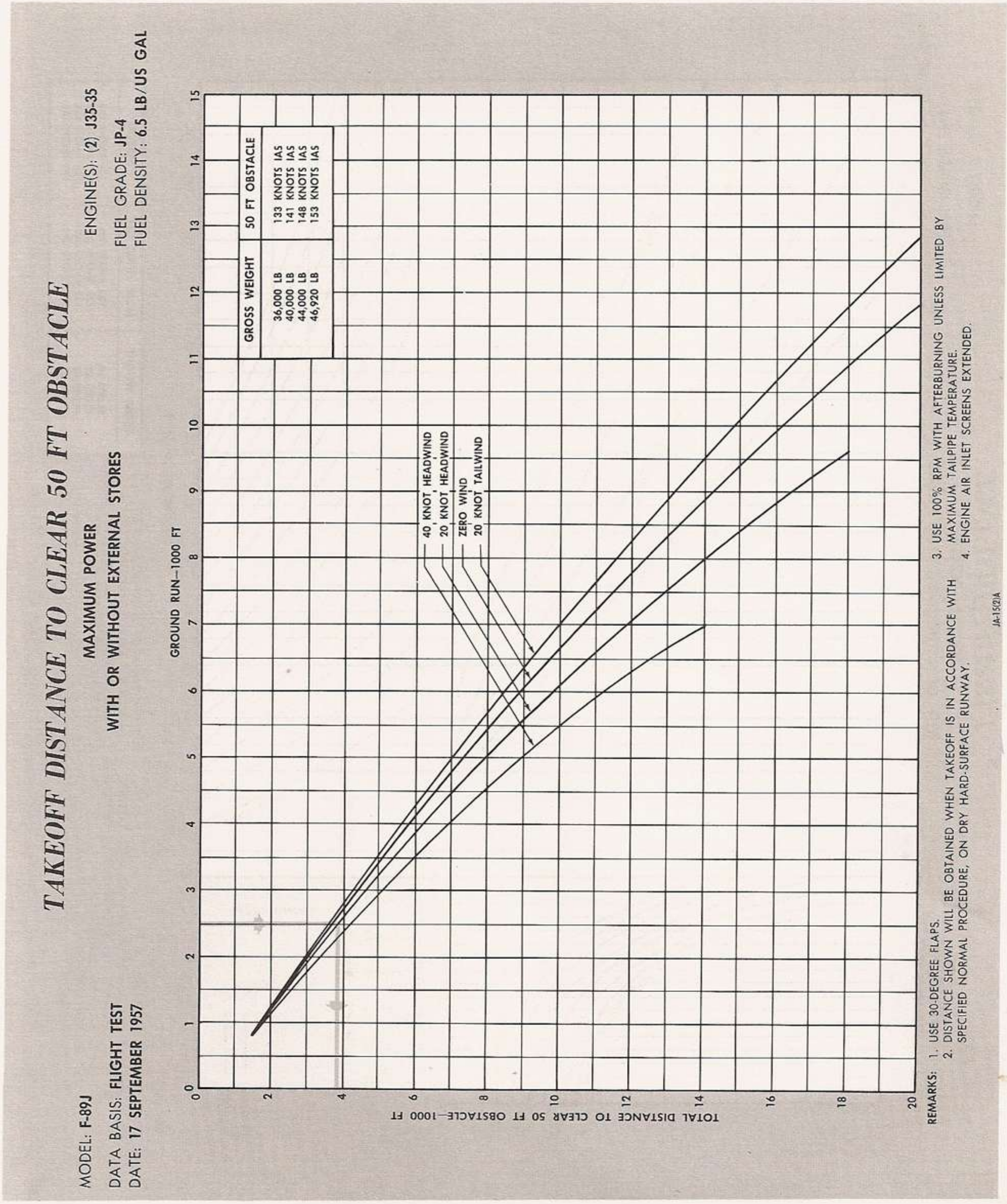

TAKEOFF DISTANCE TO CLEAR 50 FT OBSTACLE
MAXIMUM POWER
WITH OR WITHOUT EXTERNAL STORES
MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
GROSS WEIGHT
36,000 LB
40,000 LB
44,000 LB
46,920 LB
50 FT OBSTACLE
133 KNOTS IAS
141 KNOTS IAS
148 KNOTS IAS
153 KNOTS IAS
40 KNOT HEADWIND
20 KNOT HEADWIND
ZERO WIND
20 KNOT TAILWIND
GROUND RUN—1000 FT
TOTAL DISTANCE TO CLEAR 50 FT OBSTACLE—1000 FT
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
18
20
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.
JA-1502A

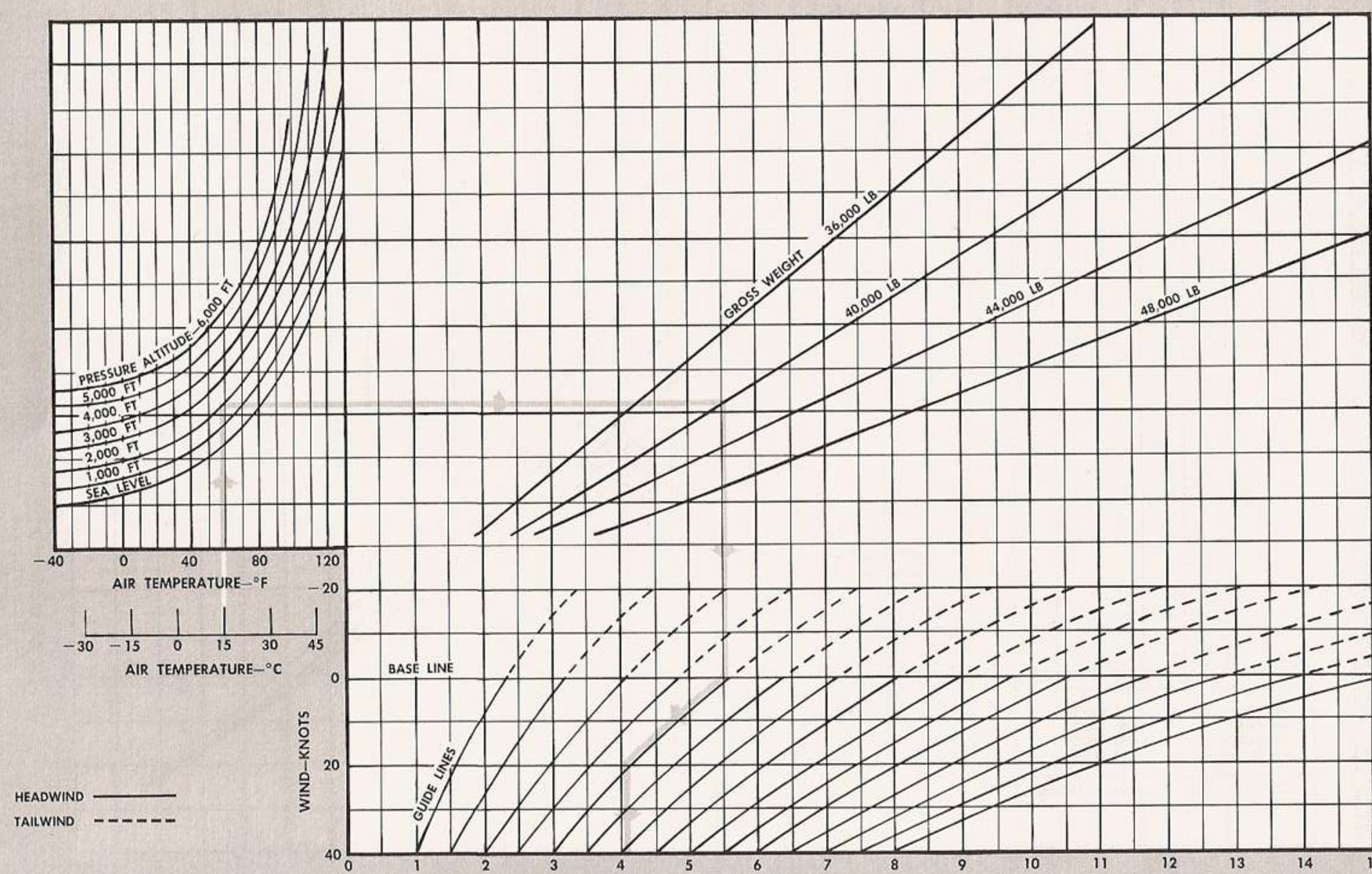
Figure A2-2.

MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

TAKEOFF DISTANCE

MILITARY POWER
WITH OR WITHOUT EXTERNAL STORES

ENGINE(S): (2) J35-35
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 AFTERBURNING ON OPERATING ENGINE OR DISCONTINUE TAKEOFF.
5. ENGINE AIR INLET SCREENS EXTENDED.

GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
36,000 LB	120 KNOTS IAS	124 KNOTS IAS
40,000 LB	127 KNOTS IAS	131 KNOTS IAS
44,000 LB	133 KNOTS IAS	138 KNOTS IAS
46,920 LB	138 KNOTS IAS	143 KNOTS IAS

JA-16(1)A

Figure A2-3.

TAKEOFF DISTANCE TO CLEAR 50 FT OBSTACLE

MILITARY POWER

WITH OR WITHOUT EXTERNAL STORES

MODEL: F-89J

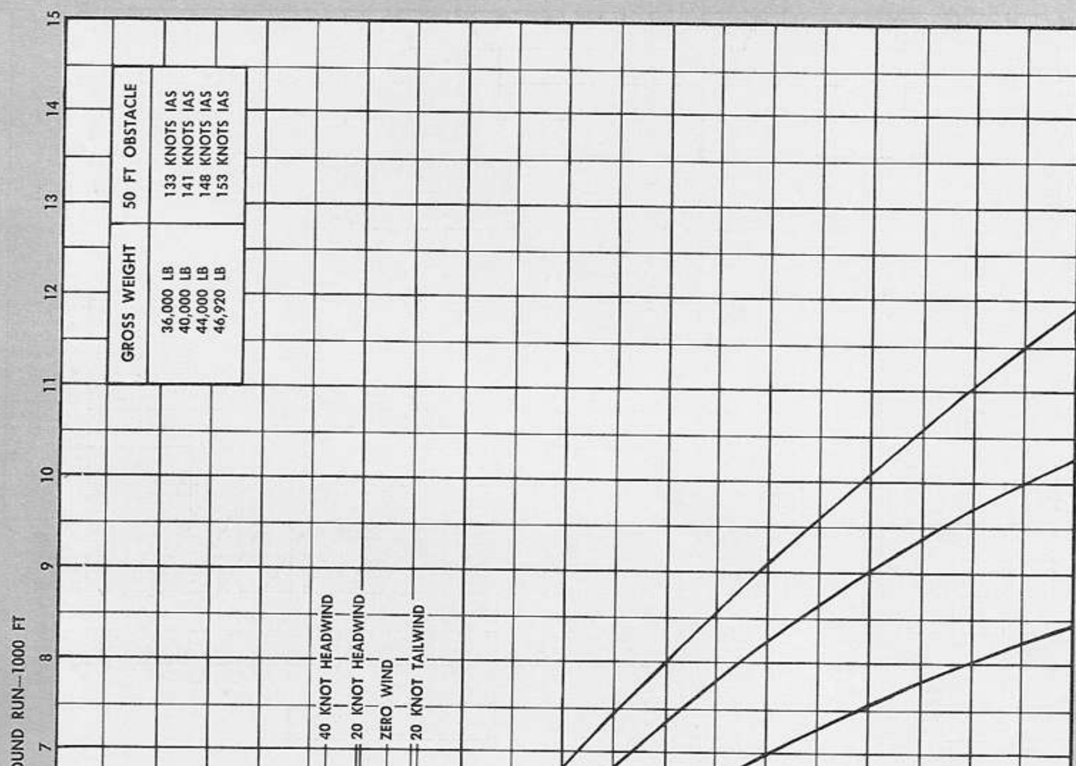
DATA BASIS: FLIGHT TEST

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/US GAL



GROSS WEIGHT	50 FT OBSTACLE
36,000 LB	133 KNOTS IAS
40,000 LB	141 KNOTS IAS
44,000 LB	148 KNOTS IAS
46,920 LB	153 KNOTS IAS

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.

JA-1612A

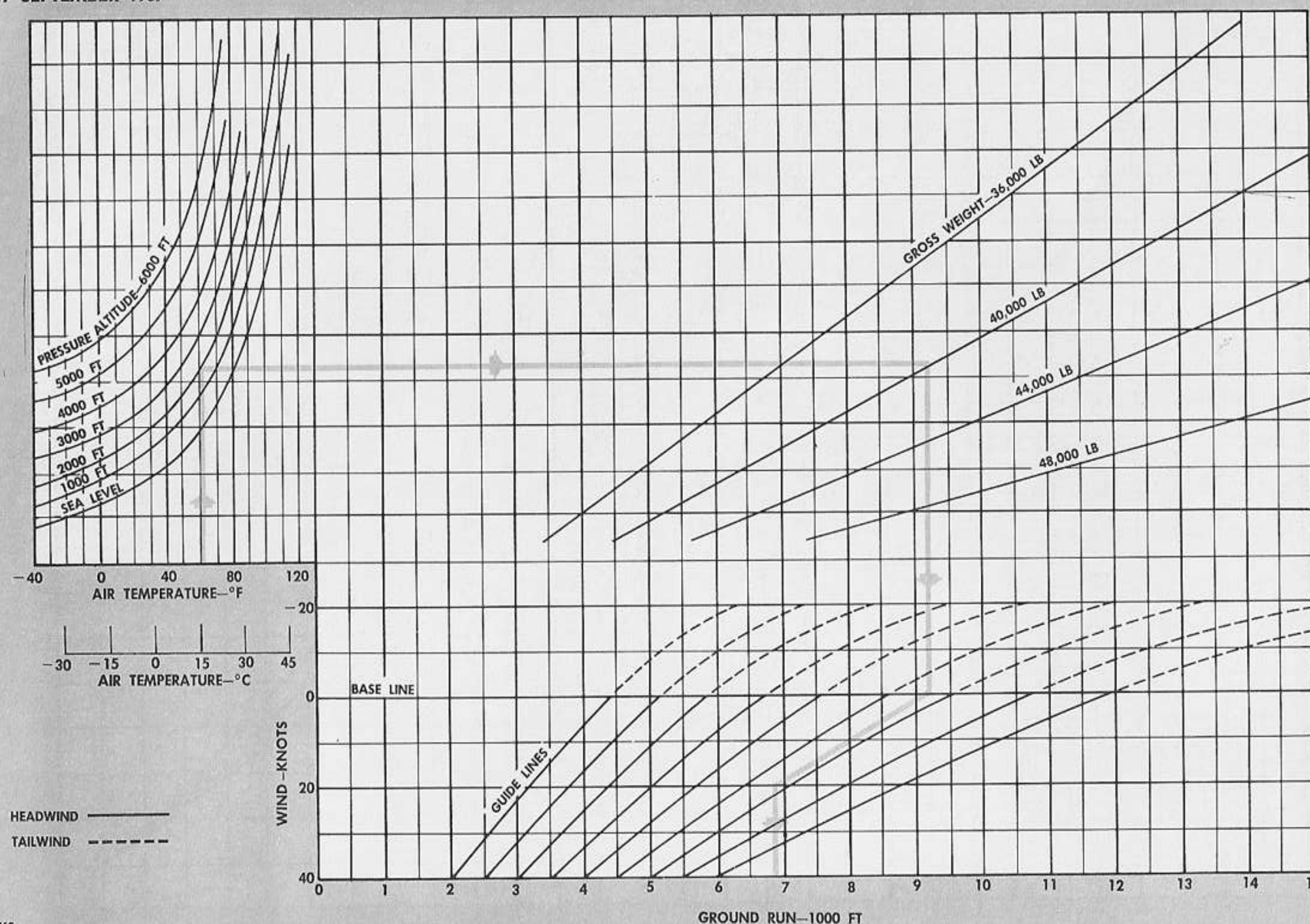
Figure A2-4.

TAKEOFF DISTANCE

MAXIMUM POWER
ONE ENGINE OPERATING
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



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 TEMPERATURE.
4. ENGINE AIR INLET SCREENS EXTENDED.

GROSS WEIGHT	NOSE WHEEL OFF	TAKEOFF
36,000 LB	124 KNOTS IAS	120 KNOTS IAS
40,000 LB	131 KNOTS IAS	127 KNOTS IAS
44,000 LB	138 KNOTS IAS	133 KNOTS IAS
46,920 LB	143 KNOTS IAS	138 KNOTS IAS

JA-17(1)A

Figure A2-5.

TAKEOFF DISTANCE TO CLEAR 50 FT OBSTACLE

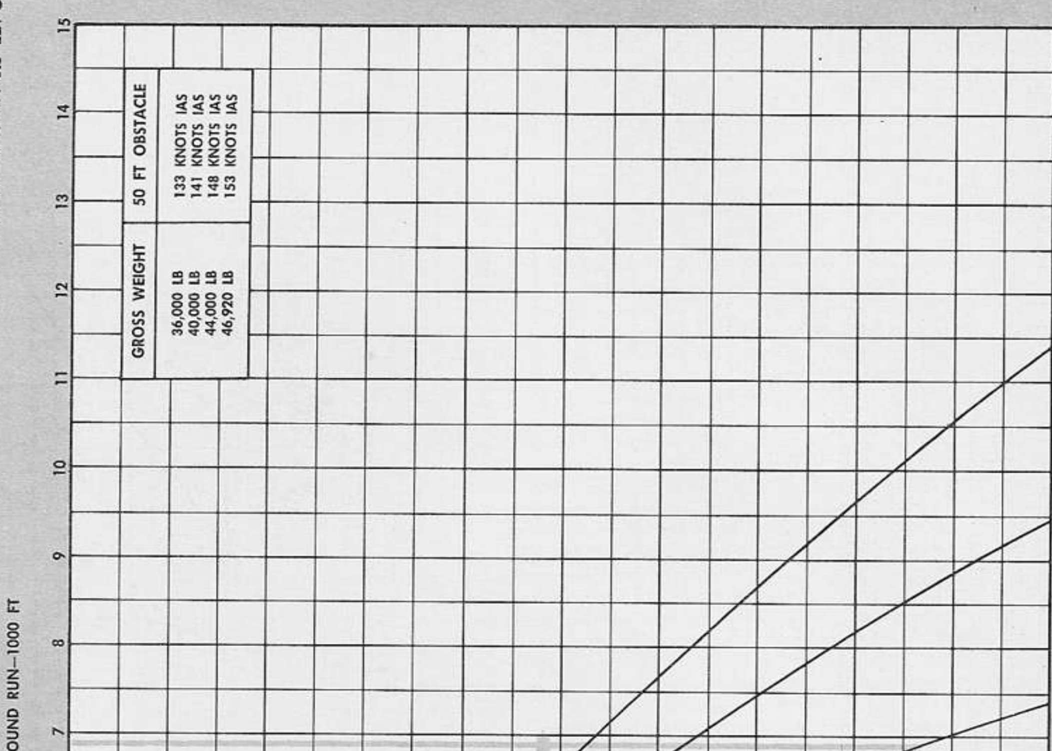
MAXIMUM POWER
ONE ENGINE OPERATING
WITH OR WITHOUT EXTERNAL STORES

MODEL: F-89J

DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



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 TAKEOFF.
3. USE 100% RPM WITH AFTERBURNING UNLESS LIMITED BY MAXIMUM TAILPIPE TEMPERATURE.
4. ENGINE AIR INLET SCREENS EXTENDED.

JA-1712A

Figure A2-6.

CRITICAL FIELD LENGTH

MAXIMUM POWER

WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

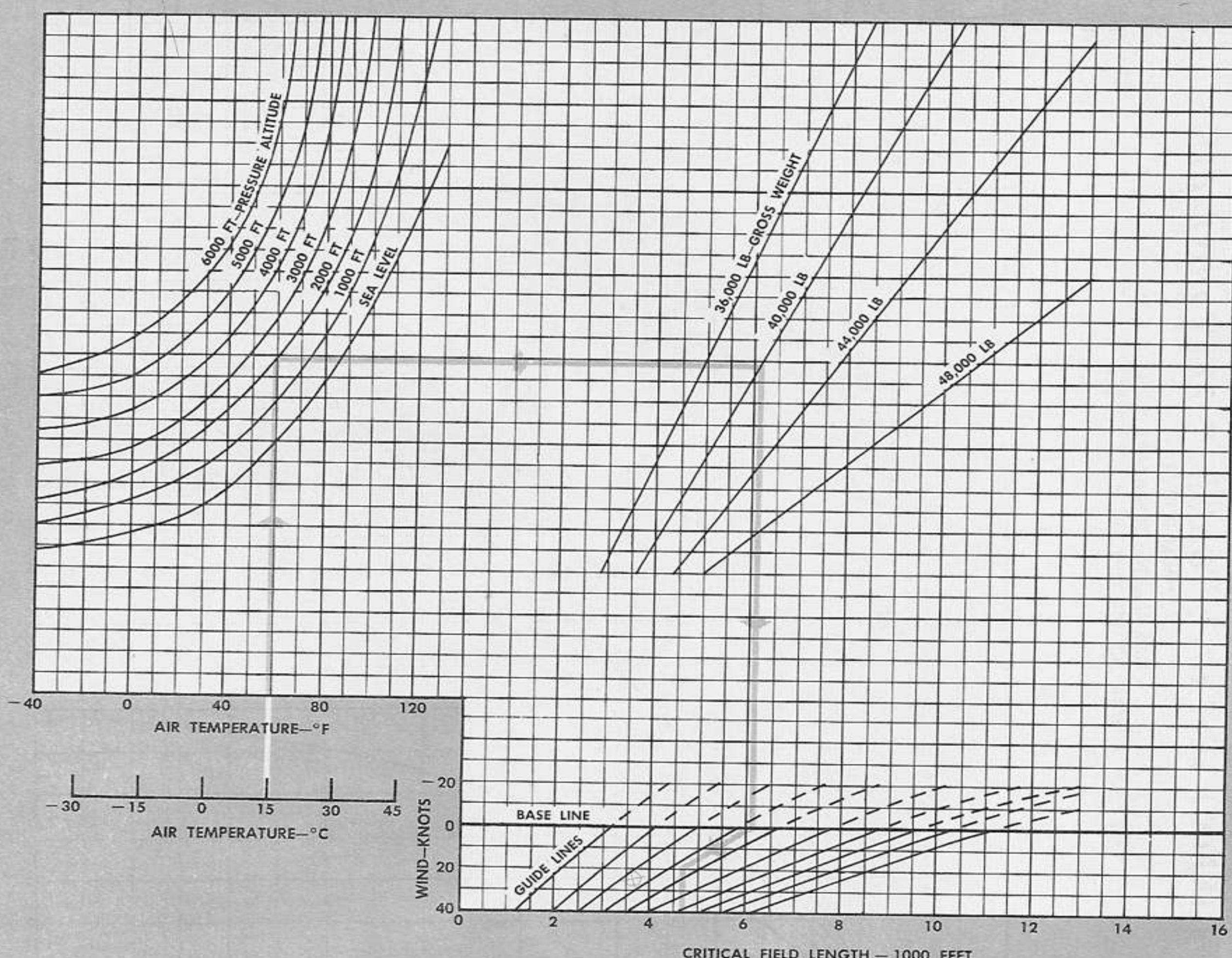
DATA BASIS: **FLIGHT TEST**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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.

JA-18B

Figure A2-7.

REFUSAL SPEEDS

MAXIMUM POWER

WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

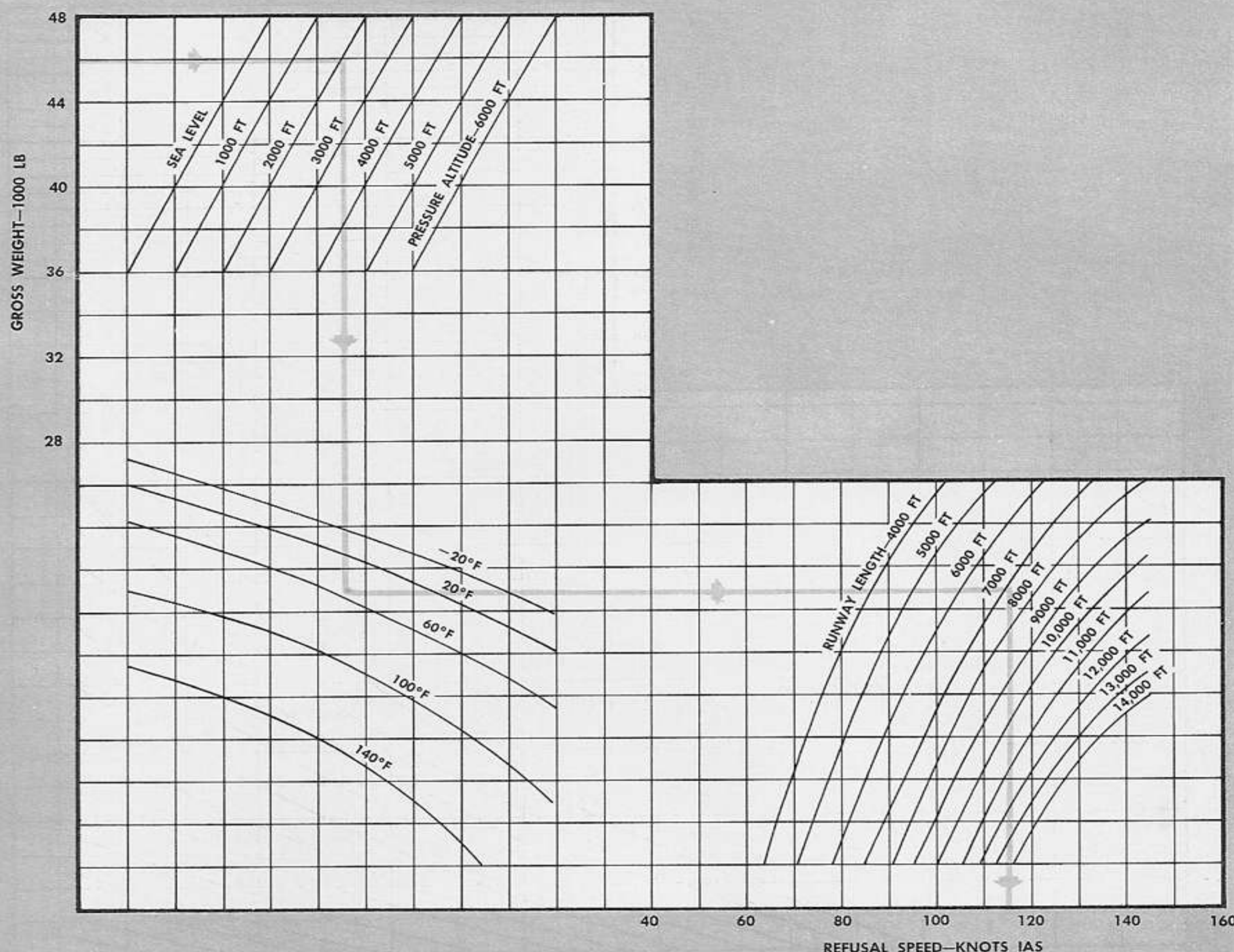
DATA BASIS: **FLIGHT TEST**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. ABOVE VALUES ARE BASED ON DRY HARD-SURFACE RUNWAY, USING SPECIFIED NORMAL TAKEOFF PROCEDURE UP TO POINT OF ENGINE FAILURE AND OPERATION IN ACCORDANCE WITH SECTION III AFTER ENGINE FAILURE.
2. ENGINE AIR INLET SCREENS EXTENDED.

JA-19B

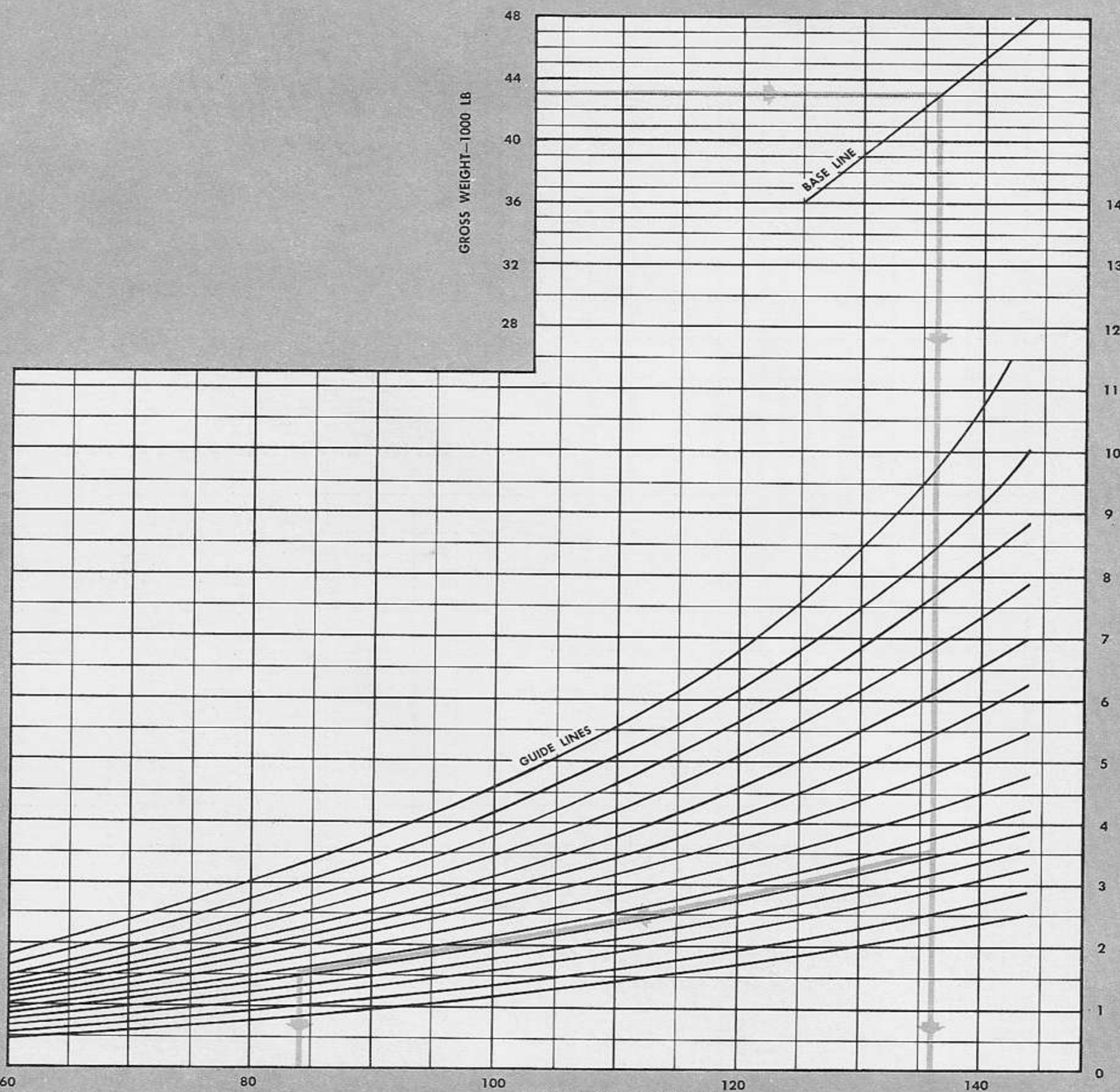
Figure A2-8.

VELOCITY DURING TAKEOFF GROUND RUN

MAXIMUM POWER
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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.

JA-20A

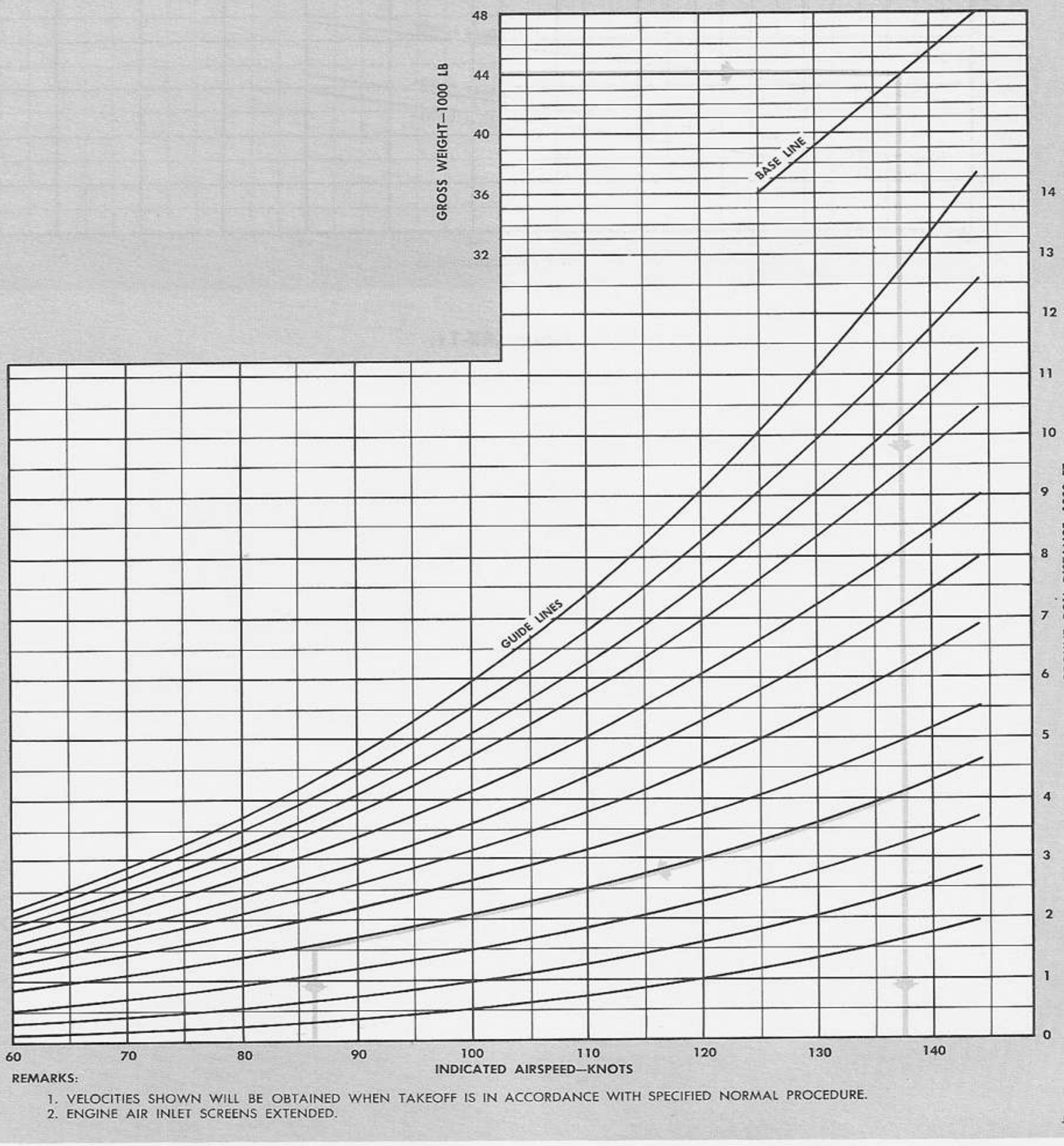
Figure A2-9.

VELOCITY DURING TAKEOFF GROUND RUN

MILITARY POWER
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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.

JA-21B

Figure A2-10.

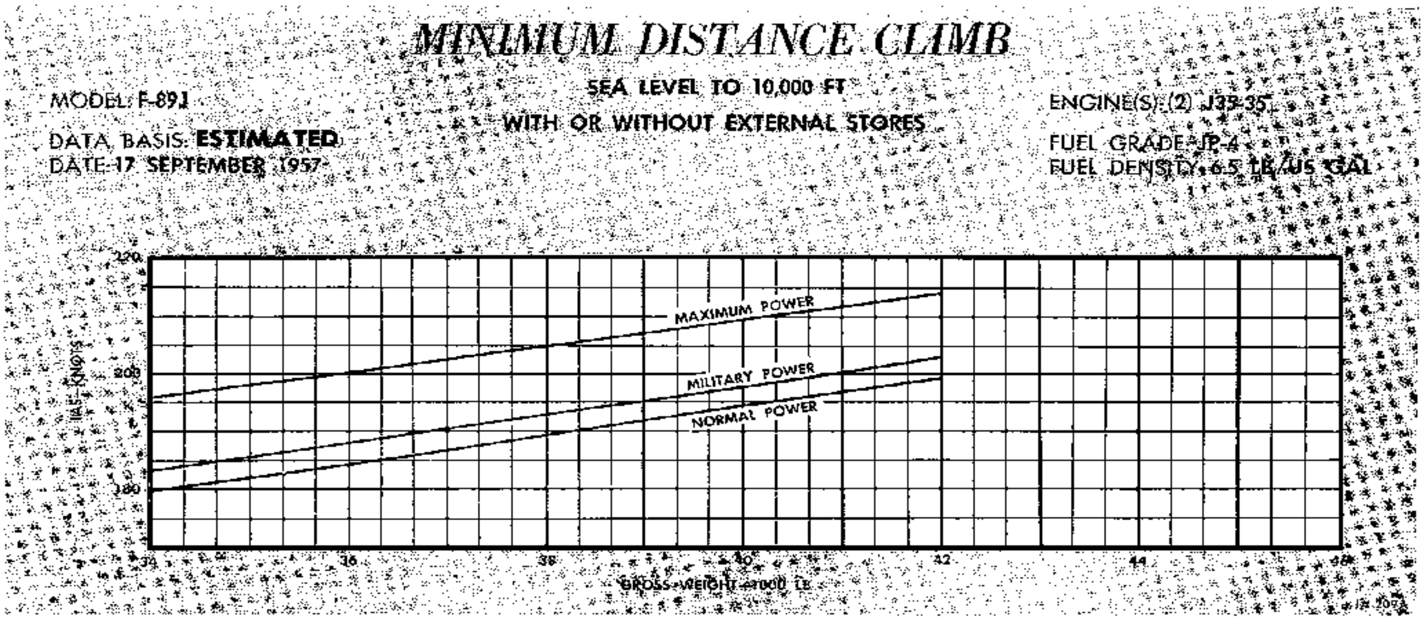

MINIMUM DISTANCE CLIMB
SEA LEVEL TO 10,000 FT
WITH OR WITHOUT EXTERNAL STORES
MODEL: F-89J
DATA BASIS: ESTIMATED
DATE: 17 SEPTEMBER 1957
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
MAXIMUM POWER
MILITARY POWER
NORMAL POWER
IAS - KNOTS
220
200
180
34
36
38
40
42
44
46
GROSS WEIGHT-1000 LB

Figure A2-11.

DESCENTS

WITH OR WITHOUT EXTERNAL STORES

IDLE POWER

MODEL: **F-89J**

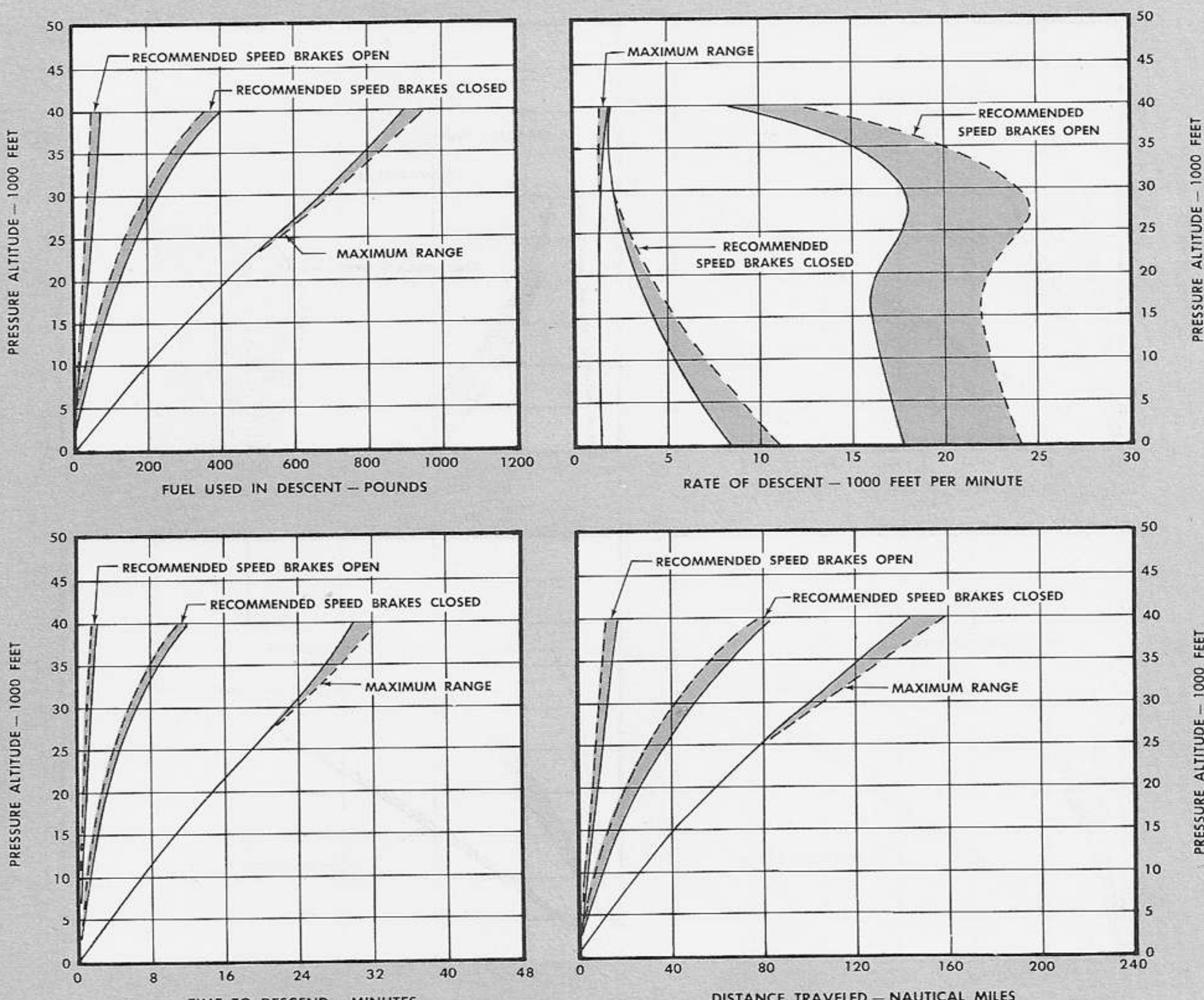
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

FUEL GRADE: **JP-4**

FUEL DENSITY: **6.5 LB/US GAL**



REMARKS:

1. FOR MAXIMUM RANGE DESCENT, MAINTAIN 208 KNOTS INDICATED AIRSPEED (IAS).
2. FOR RECOMMENDED DESCENT, MAINTAIN 0.7 MACH NUMBER (SPEED BRAKES OPEN OR CLOSED).
3. FUEL CONSUMPTION INCREASED 5 PERCENT TO ALLOW FOR SERVICE VARIATION.
4. ENGINE AIR INLET SCREENS RETRACTED.

——— 44,000 LB
— — — 32,000 LB

JA-203 B

Figure A2-12.

DESCENTS

MODEL: F-89J

DATA BASIS: **ESTIMATED**

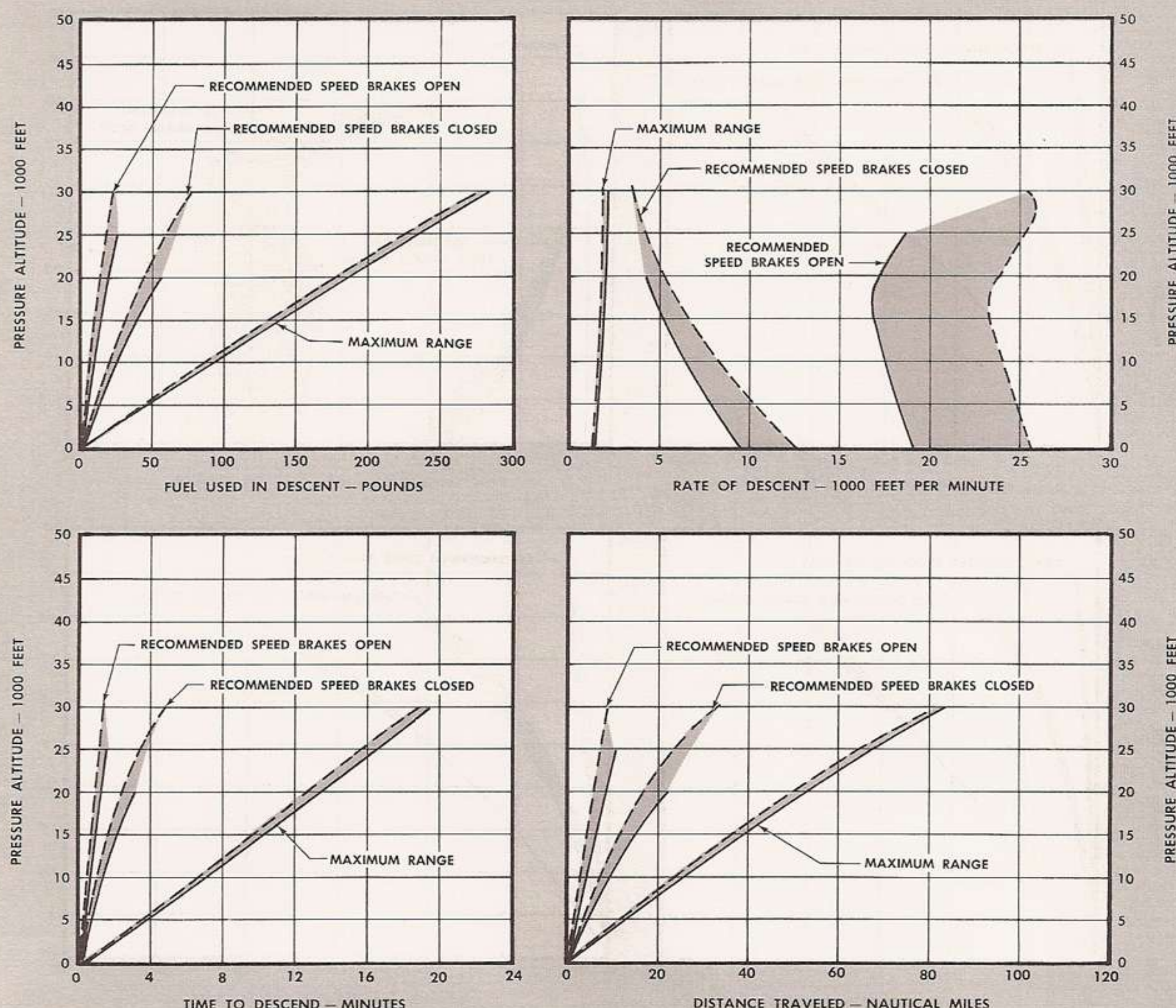
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
WITH OR WITHOUT EXTERNAL STORES
IDLE POWER

ENGINE(S): (2) J35-35

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/US GAL



REMARKS:

1. FOR MAXIMUM RANGE DESCENT, MAINTAIN 208 KNOTS INDICATED AIRSPEED (IAS).
2. FOR RECOMMENDED DESCENT, MAINTAIN 0.7 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 THE POSSIBILITY OF "DUCT RUMBLE" ON THE WINDMILLING ENGINE.

——— 44,000 LB
– – – – 32,000 LB

JA-204 B

Figure A2-13.

LANDING SPEEDS

MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 10 MAY 1960

WITH OR WITHOUT EXTERNAL STORES

ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

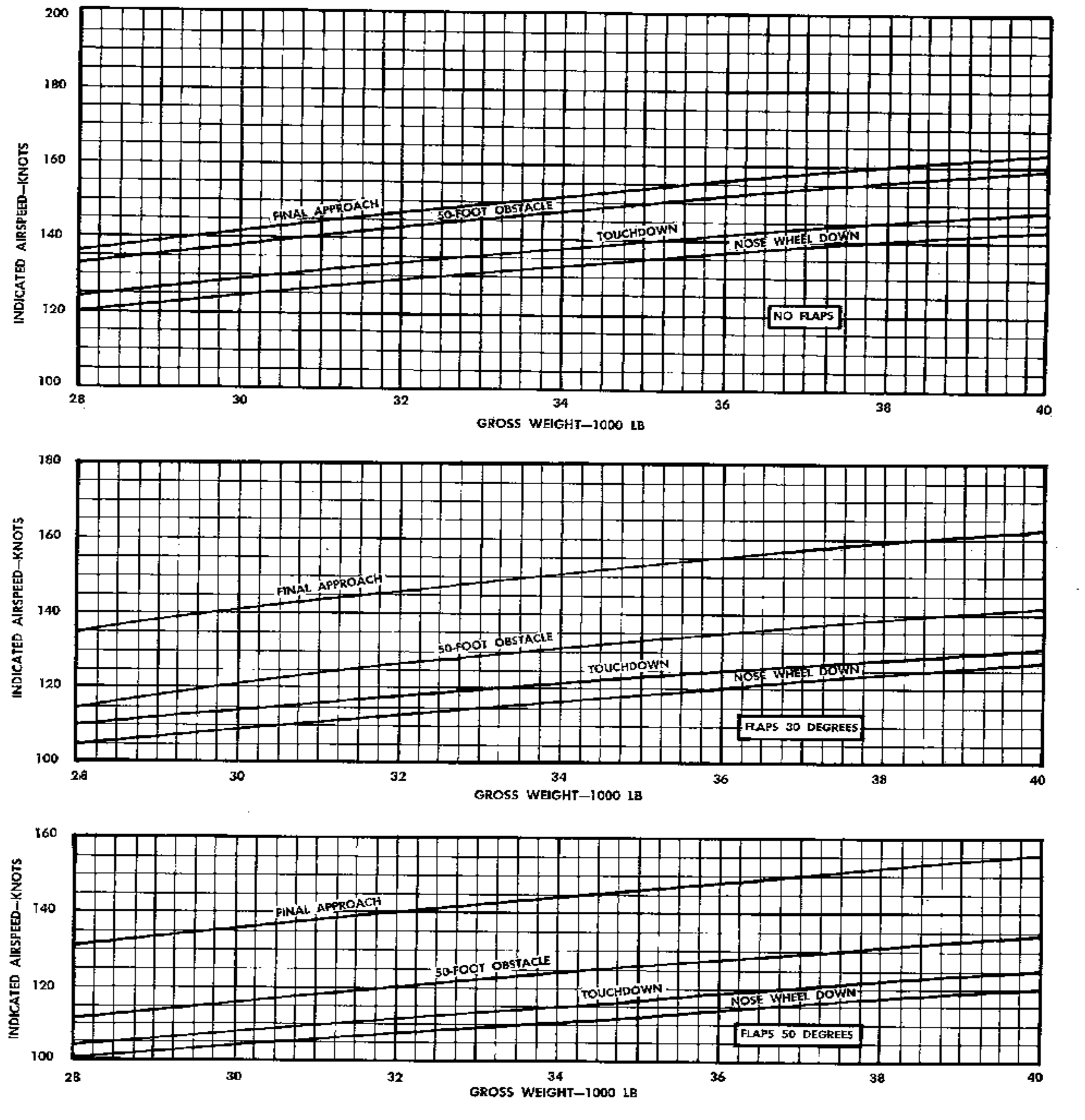


Figure A2-14.

LANDING DISTANCE

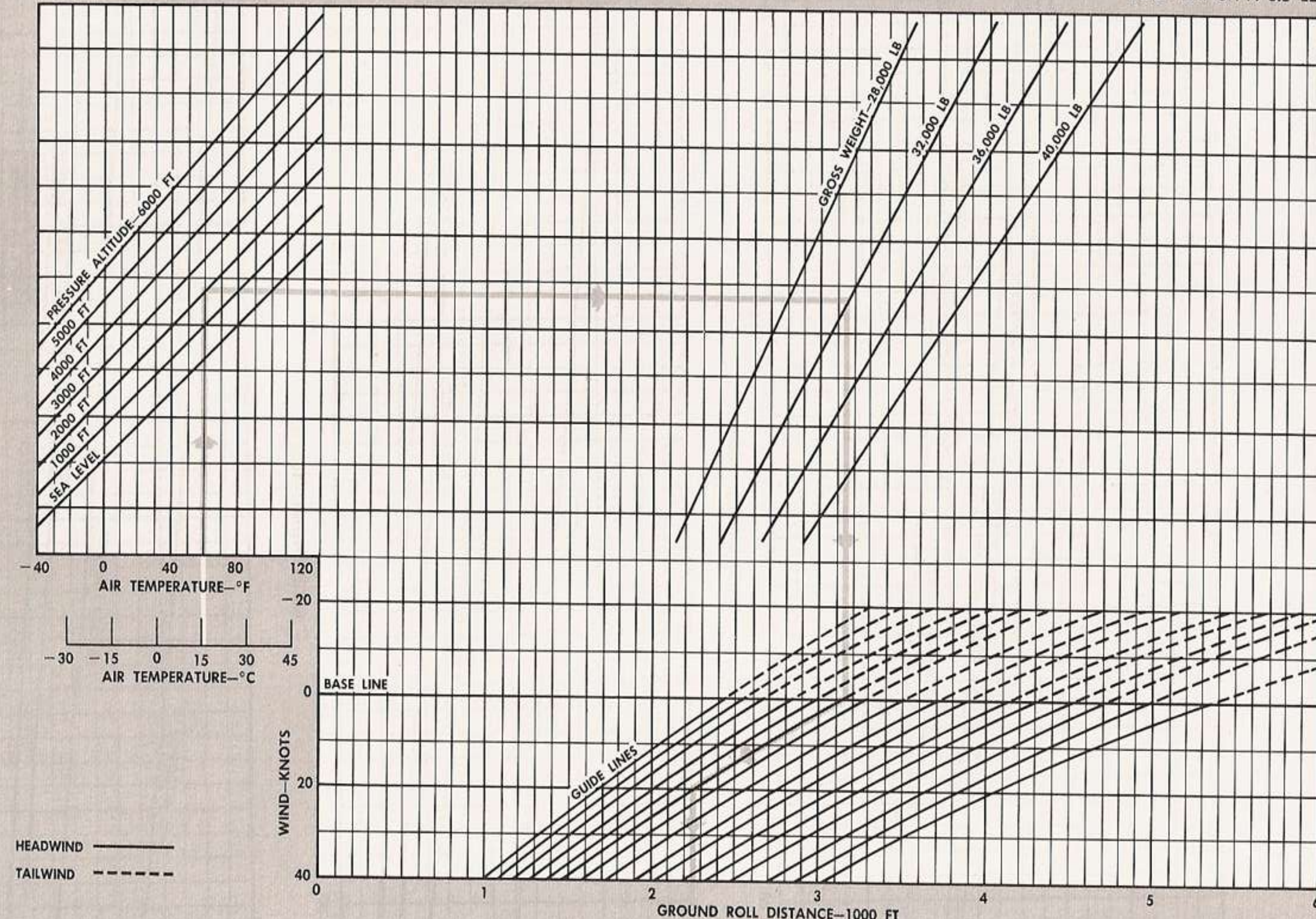
WITH OR WITHOUT EXTERNAL STORES

MODEL: **F-89J**

DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): (2) J35-35

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
28,000 LB	105 KNOTS IAS
32,000 LB	112 KNOTS IAS
36,000 LB	118 KNOTS IAS
40,000 LB	125 KNOTS IAS

JA-207(1)A

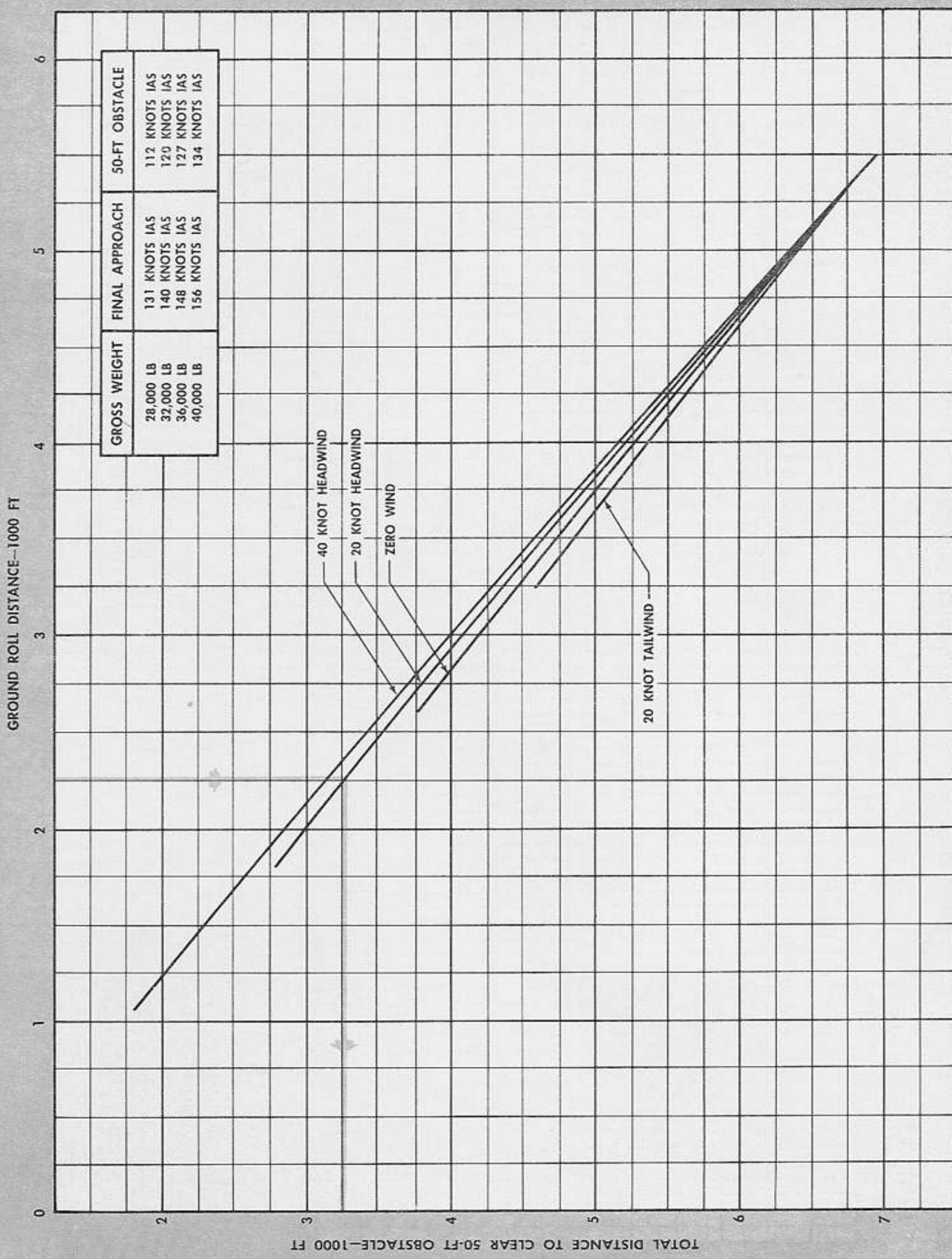
Figure A2-15.

LANDING DISTANCE TO CLEAR 50 FT OBSTACLE

WITH OR WITHOUT EXTERNAL STORES

MODEL: F-89J
DATA BASIS: **FLIGHT TEST**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): (2) J35-35
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.

Figure A2-16.

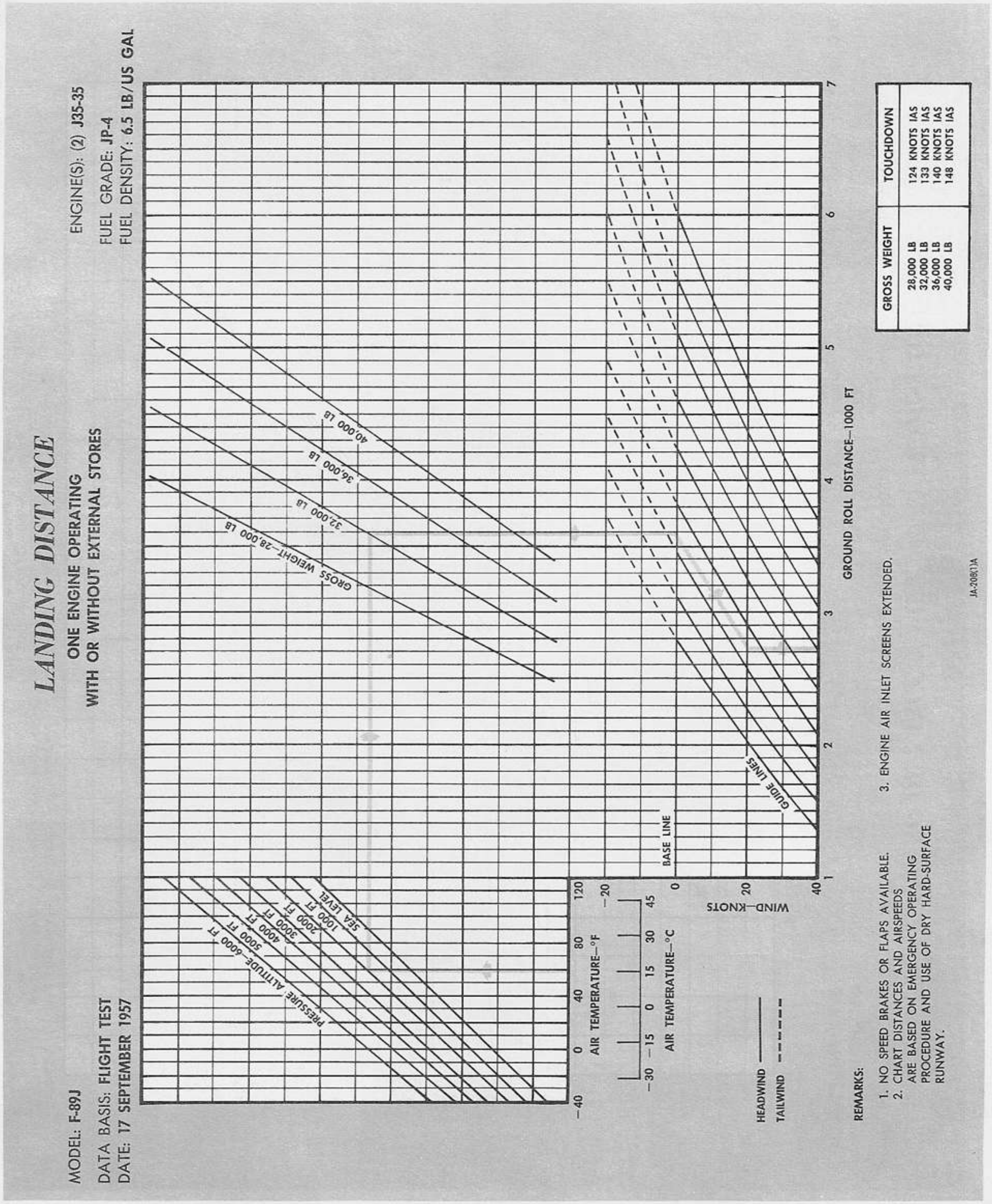

LANDING DISTANCE
ONE ENGINE OPERATING
WITH OR WITHOUT EXTERNAL STORES
MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
PRESSURE ALTITUDE—6000 FT
5000 FT
4000 FT
3000 FT
2000 FT
1000 FT
SEA LEVEL
-40 0 40 80 120
AIR TEMPERATURE—°F
-30 -15 0 15 30 45
AIR TEMPERATURE—°C
GROSS WEIGHT—28,000 LB
32,000 LB
36,000 LB
40,000 LB
BASE LINE
GUIDE LINES
-20 0 20 40
WIND—KNOTS
1 2 3 4 5 6 7
GROUND ROLL DISTANCE—1000 FT
HEADWIND
TAILWIND
GROSS WEIGHT
TOUCHDOWN
28,000 LB 124 KNOTS IAS
32,000 LB 133 KNOTS IAS
36,000 LB 140 KNOTS IAS
40,000 LB 148 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.
JA-208(1)A

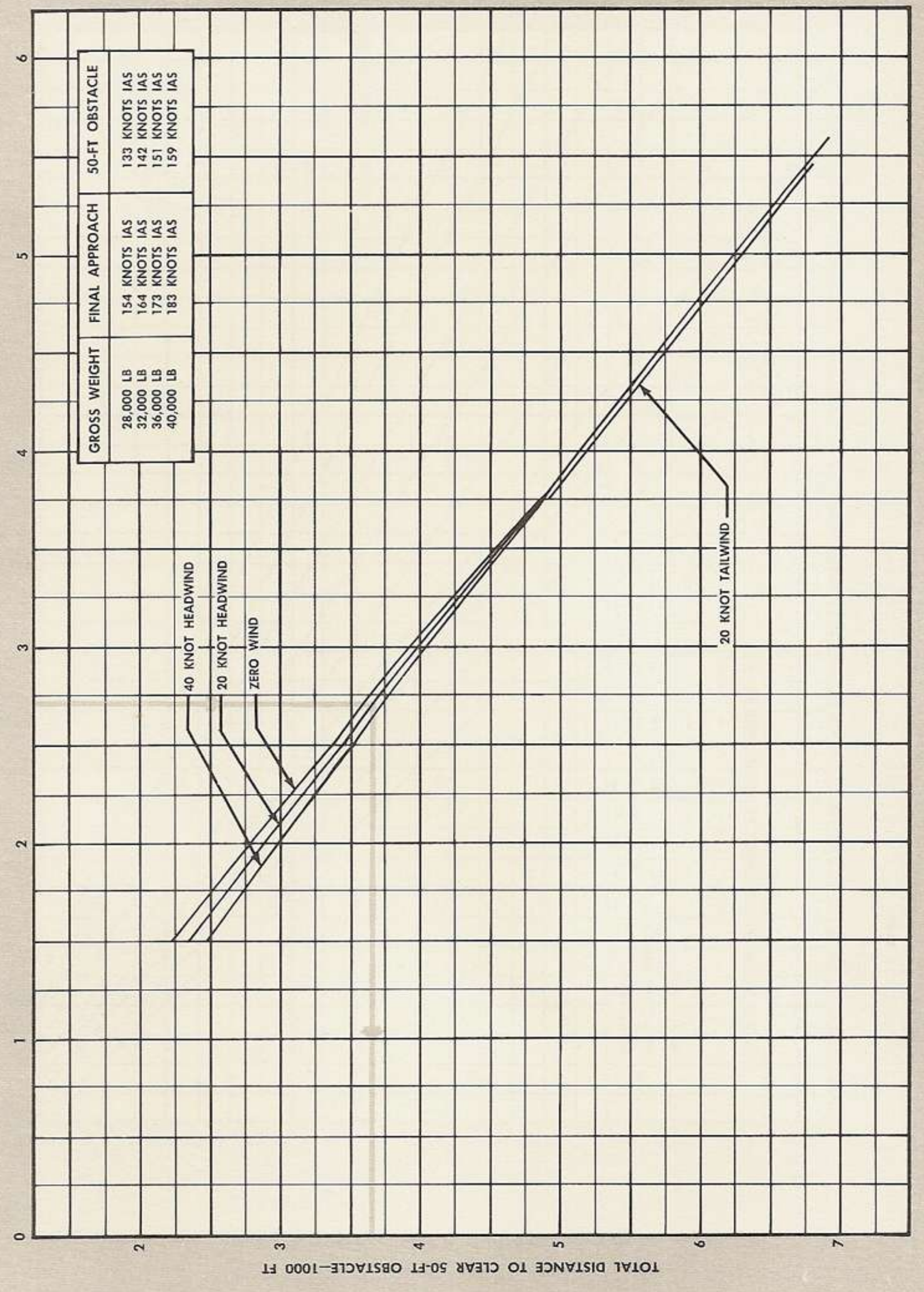
Figure A2-17.

LANDING DISTANCE TO CLEAR 50-FT OBSTACLE

ONE ENGINE OPERATING
WITH OR WITH EXTERNAL STORES

MODEL: F-89J
DATA BASIS: FLIGHT TEST
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



GROSS WEIGHT	FINAL APPROACH	50-FT OBSTACLE
28,000 LB	154 KNOTS IAS	133 KNOTS IAS
32,000 LB	164 KNOTS IAS	142 KNOTS IAS
36,000 LB	173 KNOTS IAS	151 KNOTS IAS
40,000 LB	183 KNOTS IAS	159 KNOTS IAS

REMARKS:
1. NO SPEED BRAKES OR FLAPS AVAILABLE.
2. CHART DISTANCE AND AIR SPEEDS ARE BASED ON EMERGENCY OPERATING PROCEDURE AND USE OF DRY HARD-SURFACE RUNWAY.
3. ENGINE AIR INLET SCREENS EXTENDED.

Figure A2-18.

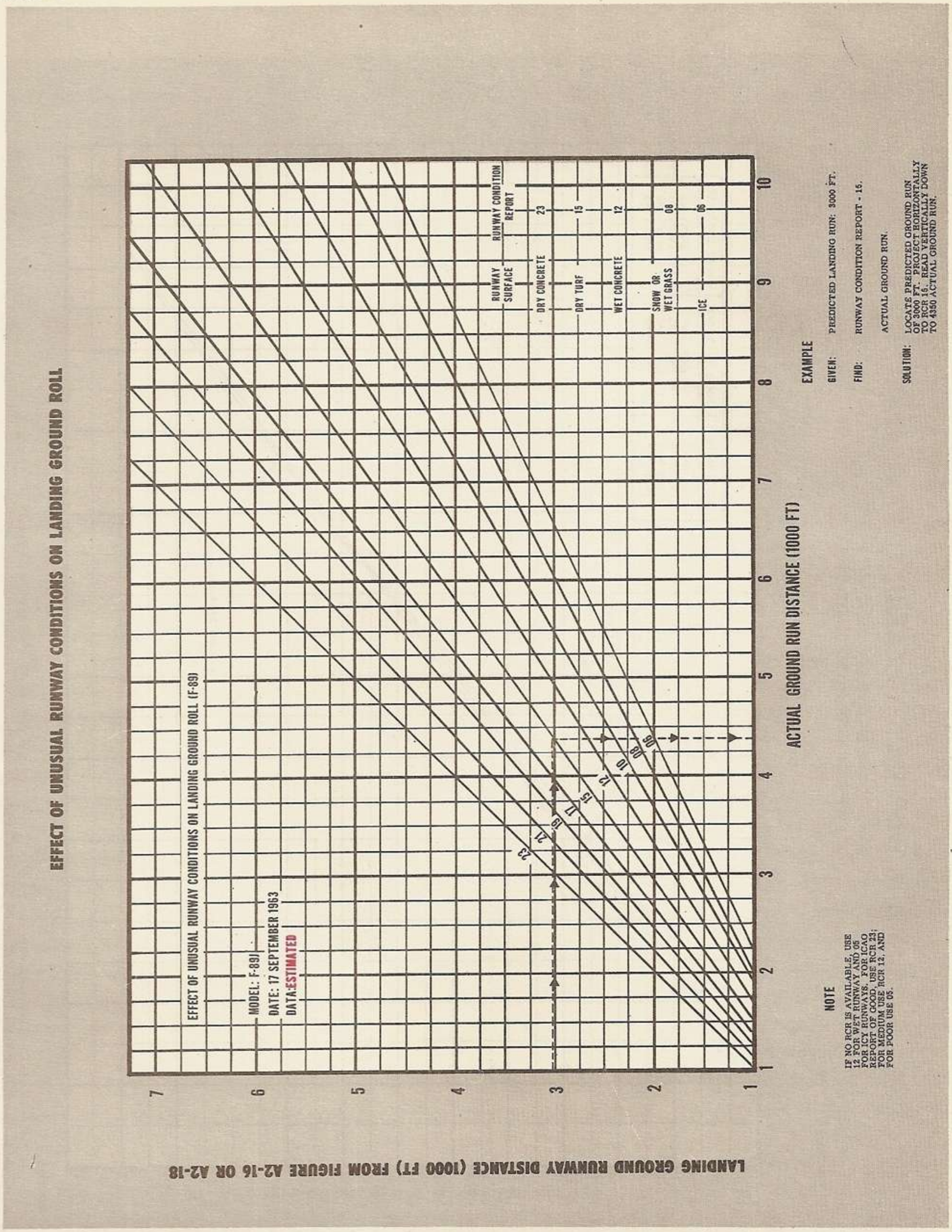

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL
EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL (F-89)
MODEL: F-89J
DATE: 17 SEPTEMBER 1963
DATA: ESTIMATED
RUNWAY SURFACE
RUNWAY CONDITION REPORT
DRY CONCRETE 23
DRY TURF 15
WET CONCRETE 12
SNOW OR WET GRASS 08
ICE 06
23
21
19
17
15
12
10
08
06
LANDING GROUND RUNWAY DISTANCE (1000 FT) FROM FIGURE A2-16 OR A2-18
ACTUAL GROUND RUN DISTANCE (1000 FT)
1
2
3
4
5
6
7
8
9
10
NOTE
IF NO RCR IS AVAILABLE, USE 12 FOR WET RUNWAY AND 05 FOR ICY RUNWAYS. FOR ICAO REPORT OF GOOD, USE RCR 23; FOR MEDIUM USE RCR 12, AND FOR POOR USE 05.
EXAMPLE
GIVEN: PREDICTED LANDING RUN: 3000 FT.
FIND: RUNWAY CONDITION REPORT - 15.
ACTUAL GROUND RUN.
SOLUTION: LOCATE PREDICTED GROUND RUN OF 3000 FT. PROJECT HORIZONTALLY TO RCR 15. READ VERTICALLY DOWN TO 4350 ACTUAL GROUND RUN.

Figure A2-19.

APPENDIX III

PERFORMANCE DATA

Appendix III contains performance data applicable to the airplane when its configuration consists of two pylons, two MB-1 rockets, and 600-gallon tip tanks.

TABLE OF CONTENTS

Refer to Appendix I for use of charts, takeoff and landing data cards, sample problems, airspeed, compressibility, temperature correction, density altitude and relative wind charts.

Refer to Appendix II for takeoff, minimum distance climb, descent and landing charts.

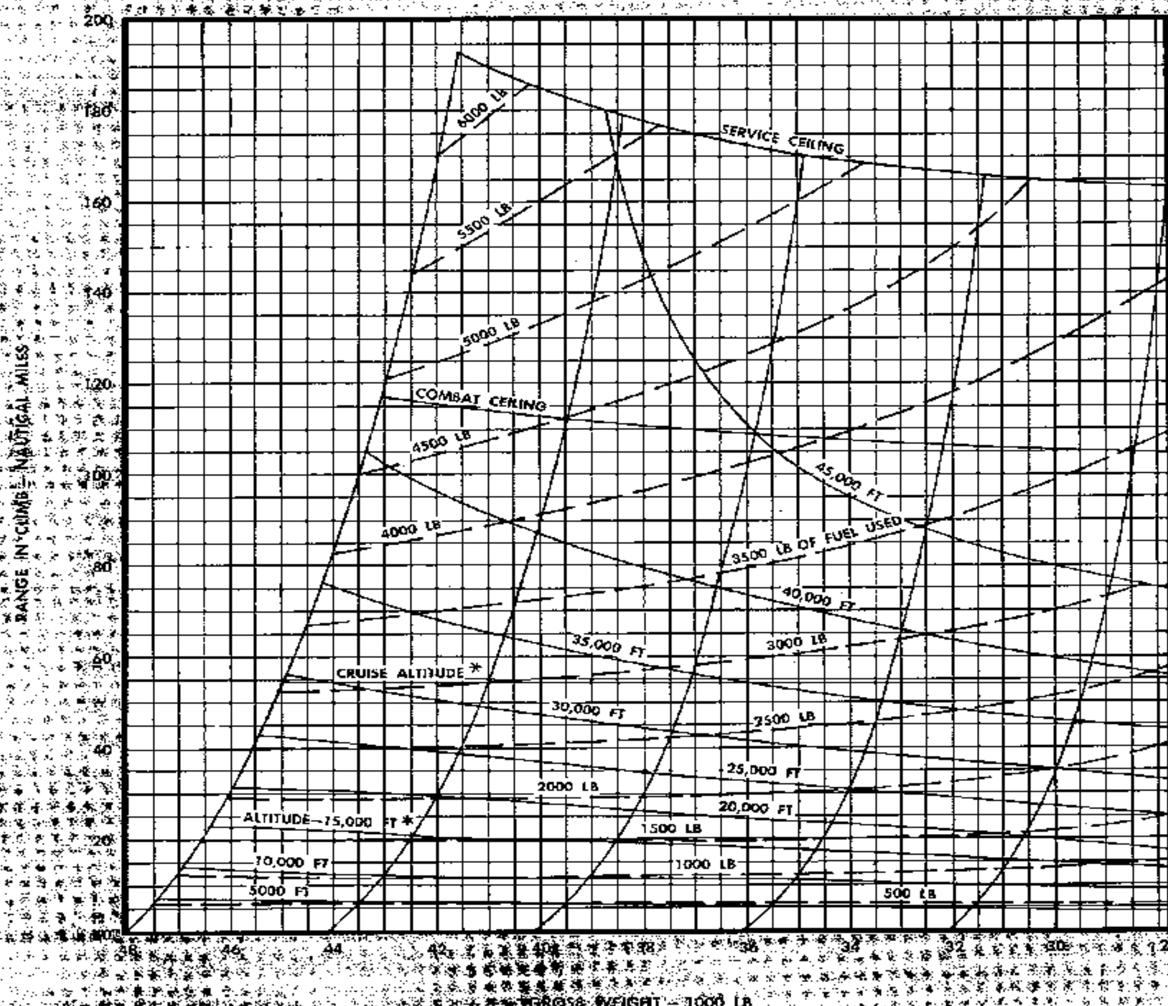
When landing with MB-1 rockets aboard, landing with a sinking rate of 300 FPM or more should be avoided to prevent MB-1 shear bolt damage.

BEST CLIMB PERFORMANCE (RANGE)

MAXIMUM POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: ESTIMATED
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE—NORMAL RATED POWER.

Figure A3-1.

BEST CLIMB PERFORMANCE (RANGE)

MILITARY POWER

TWO MB-1 ROCKETS

MODEL: F-89J

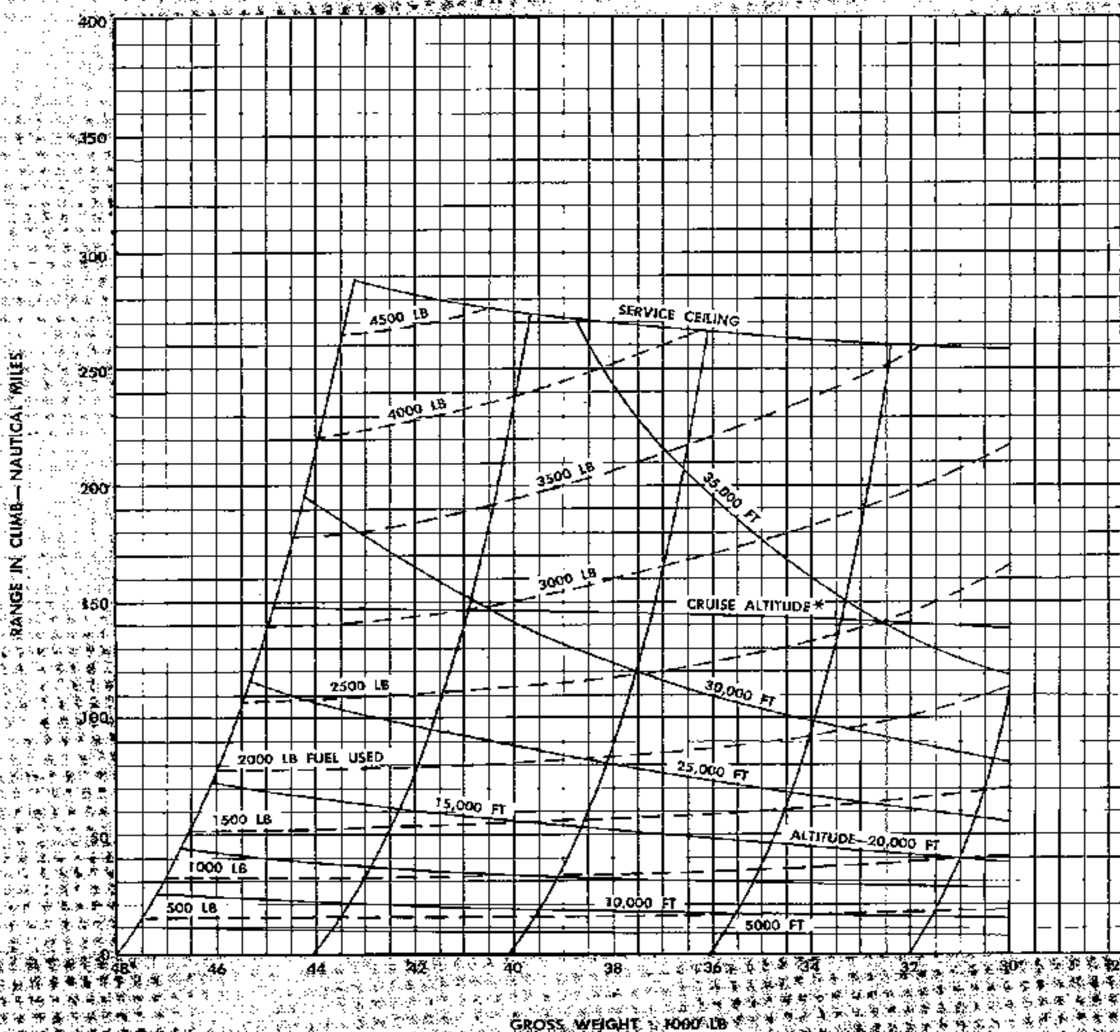
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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.

*OPTIMUM CRUISE ALTITUDE—NORMAL RATED POWER

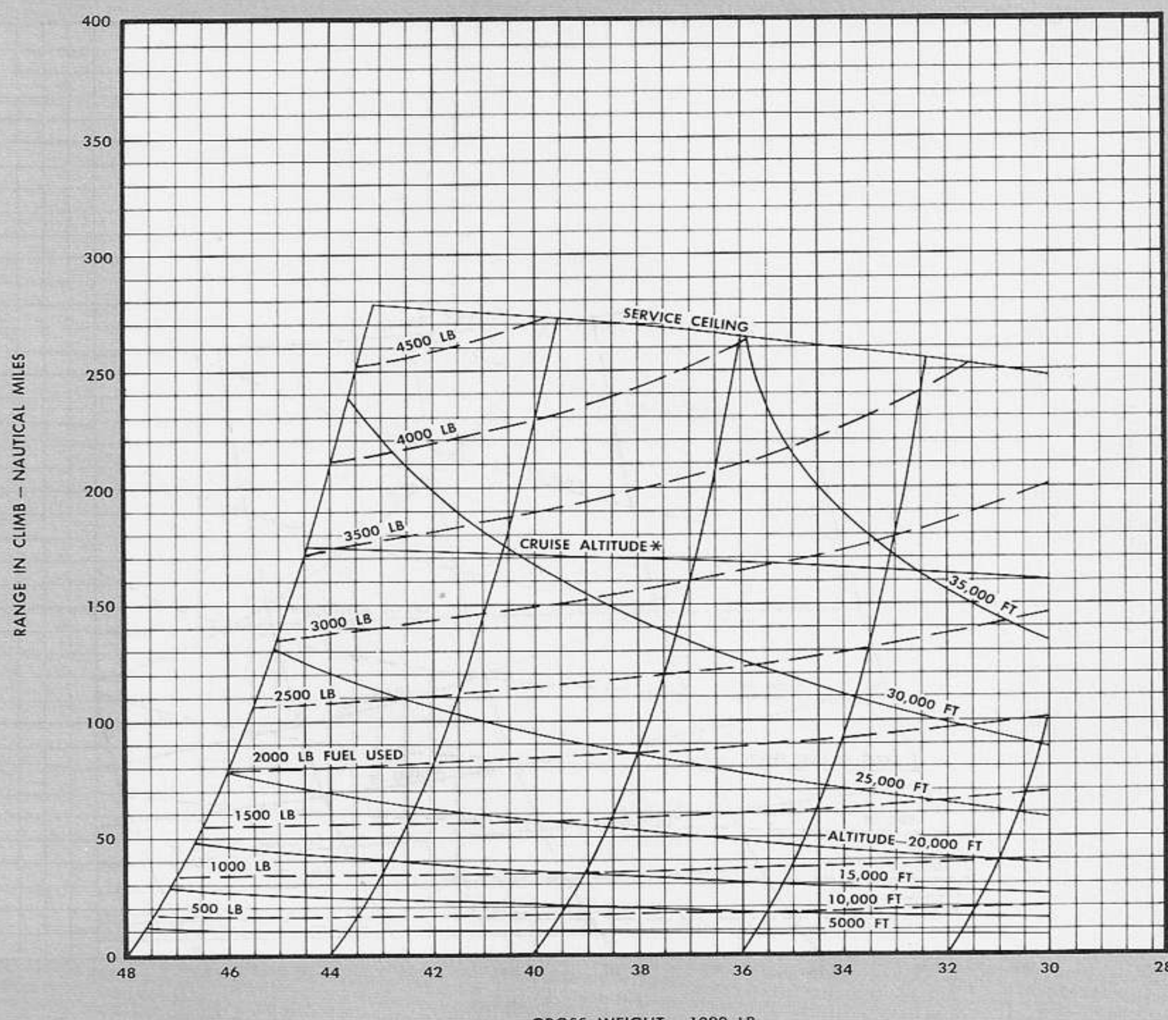
Figure A3-2.

BEST CLIMB PERFORMANCE *(RANGE)*

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

NORMAL POWER
TWO MB-1 ROCKETS

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-61C

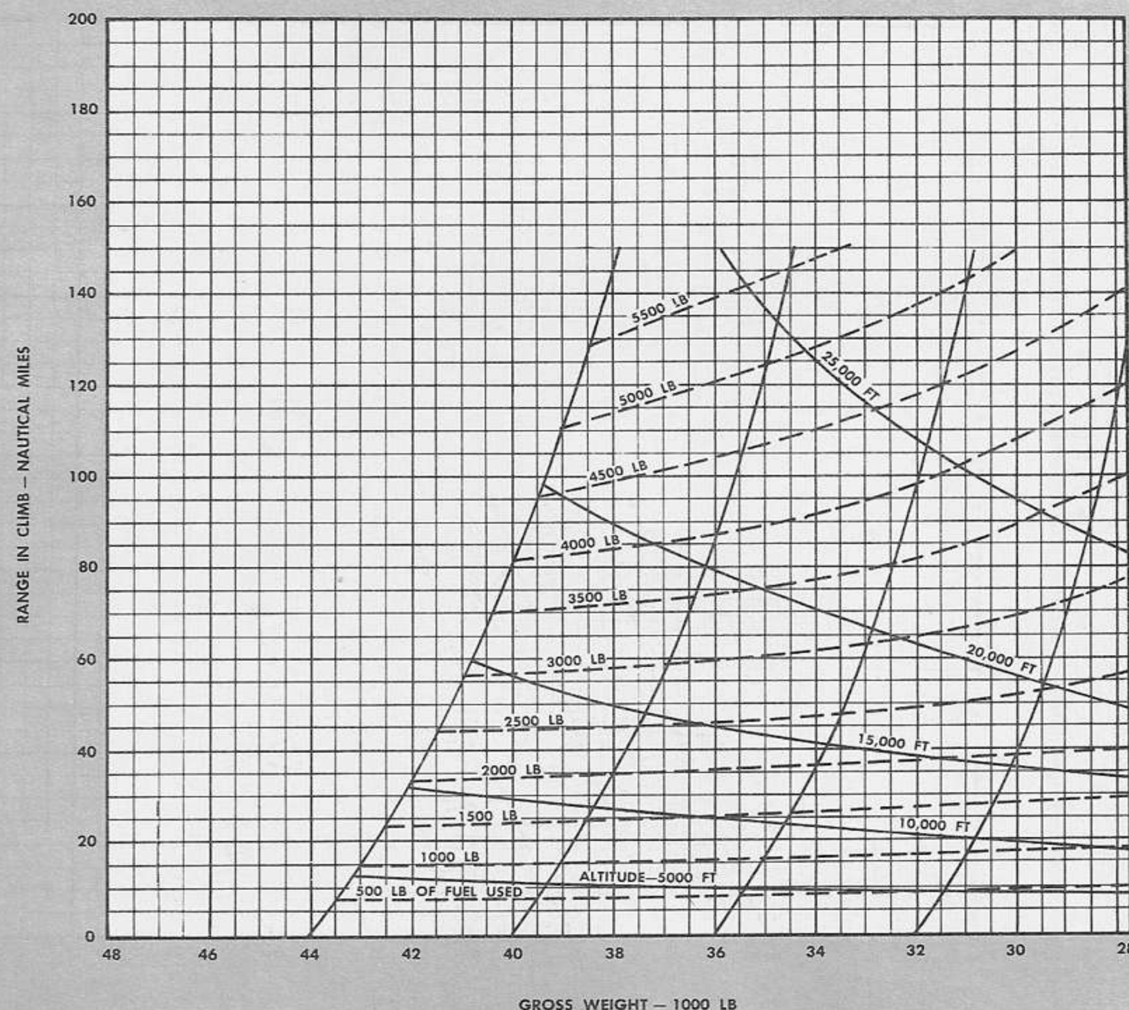
Figure A3-3.

BEST CLIMB PERFORMANCE (RANGE)

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
MAXIMUM POWER
TWO MB-1 ROCKETS

ENGINE(S): (2) J35-35
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.

JA-62B

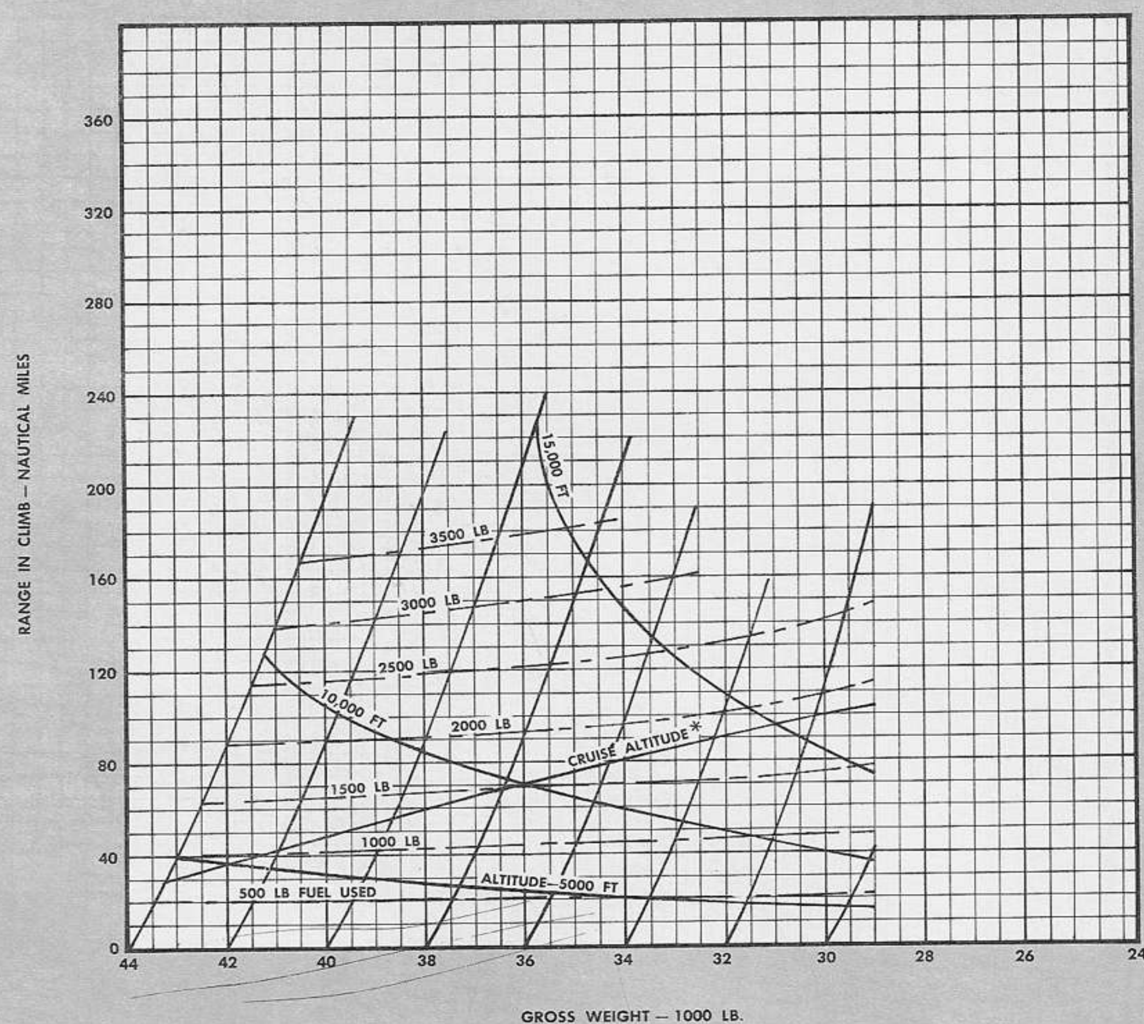
Figure A3-4.

BEST CLIMB PERFORMANCE (RANGE)

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
MILITARY POWER
TWO MB-1 ROCKETS

ENGINE(S): (2) J35-35
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.

JA-63B

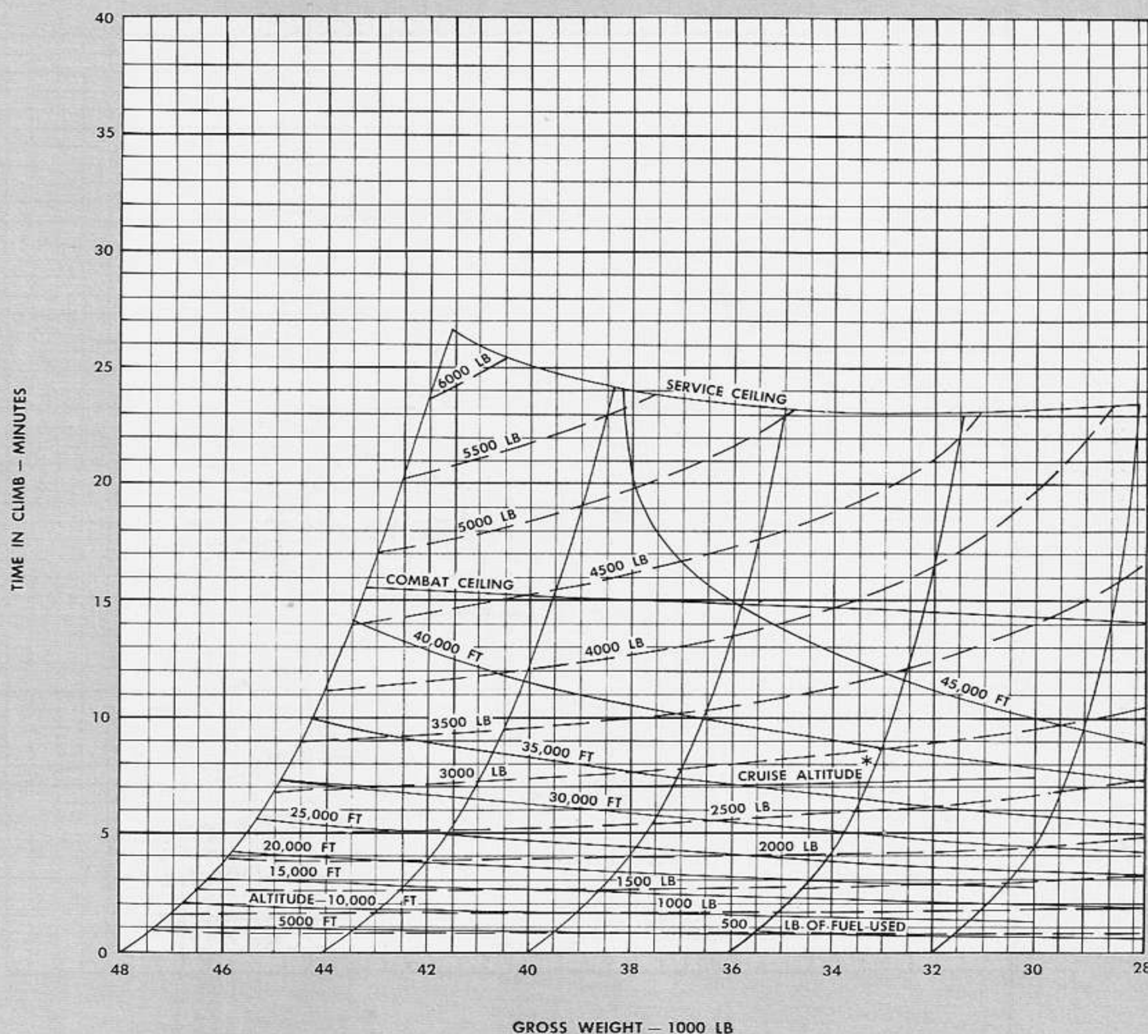
Figure A3-5.

BEST CLIMB PERFORMANCE (TIME)

MAXIMUM POWER
TWO MB-1 ROCKETS

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-64C

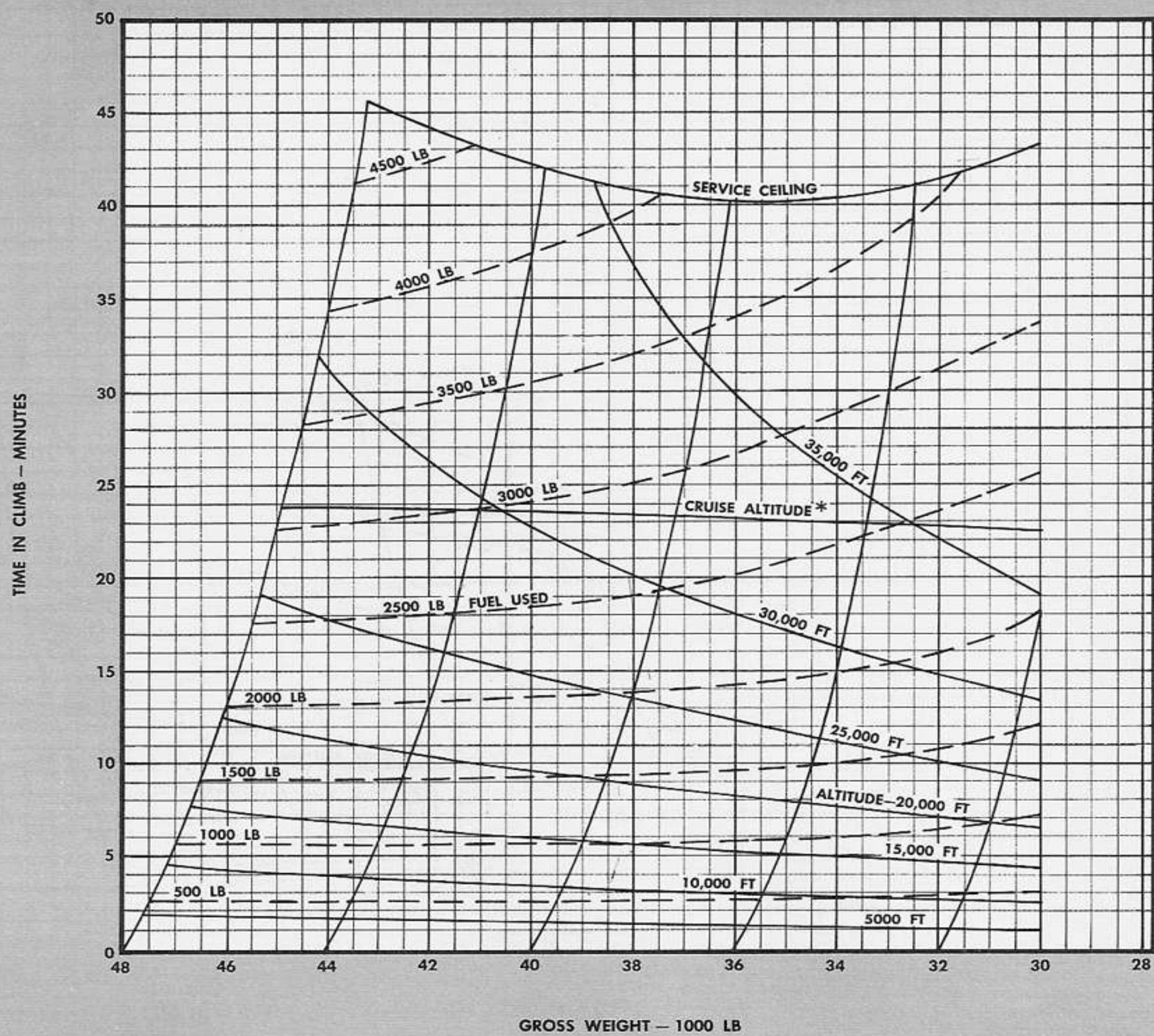
Figure A3-6.

BEST CLIMB PERFORMANCE (TIME)

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

MILITARY POWER
TWO MB-1 ROCKETS

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE – NORMAL RATED POWER.

JA-65 C

Figure A3-7.

BEST CLIMB PERFORMANCE *(TIME)*

NORMAL POWER

TWO MB-1 ROCKETS

MODEL: **F-89J**

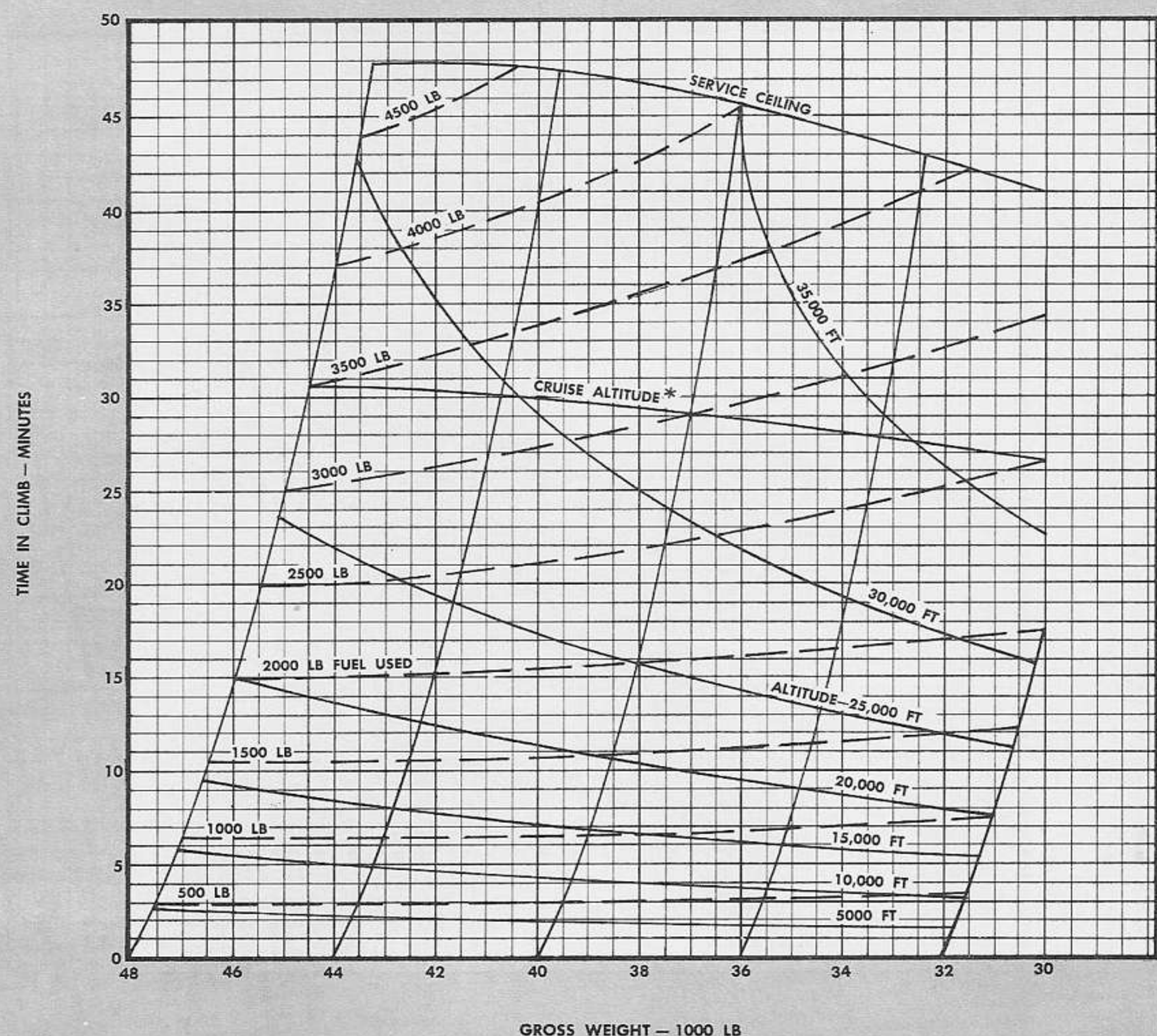
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): (2) **J35-35**

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.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-66 C

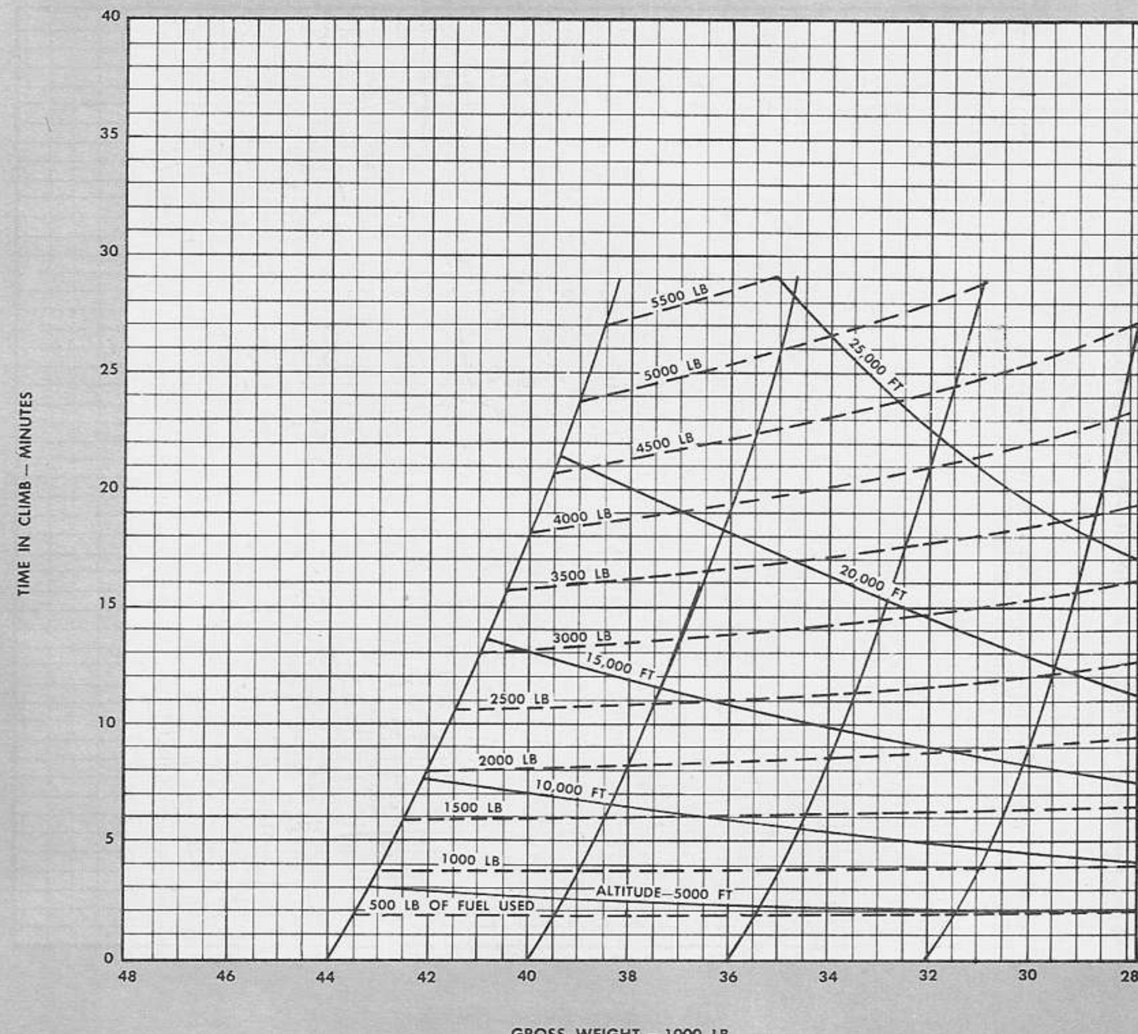
Figure A3-8.

BEST CLIMB PERFORMANCE (TIME)

ONE ENGINE OPERATING
MAXIMUM POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S):(2) J35-35
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.

JA-67 B

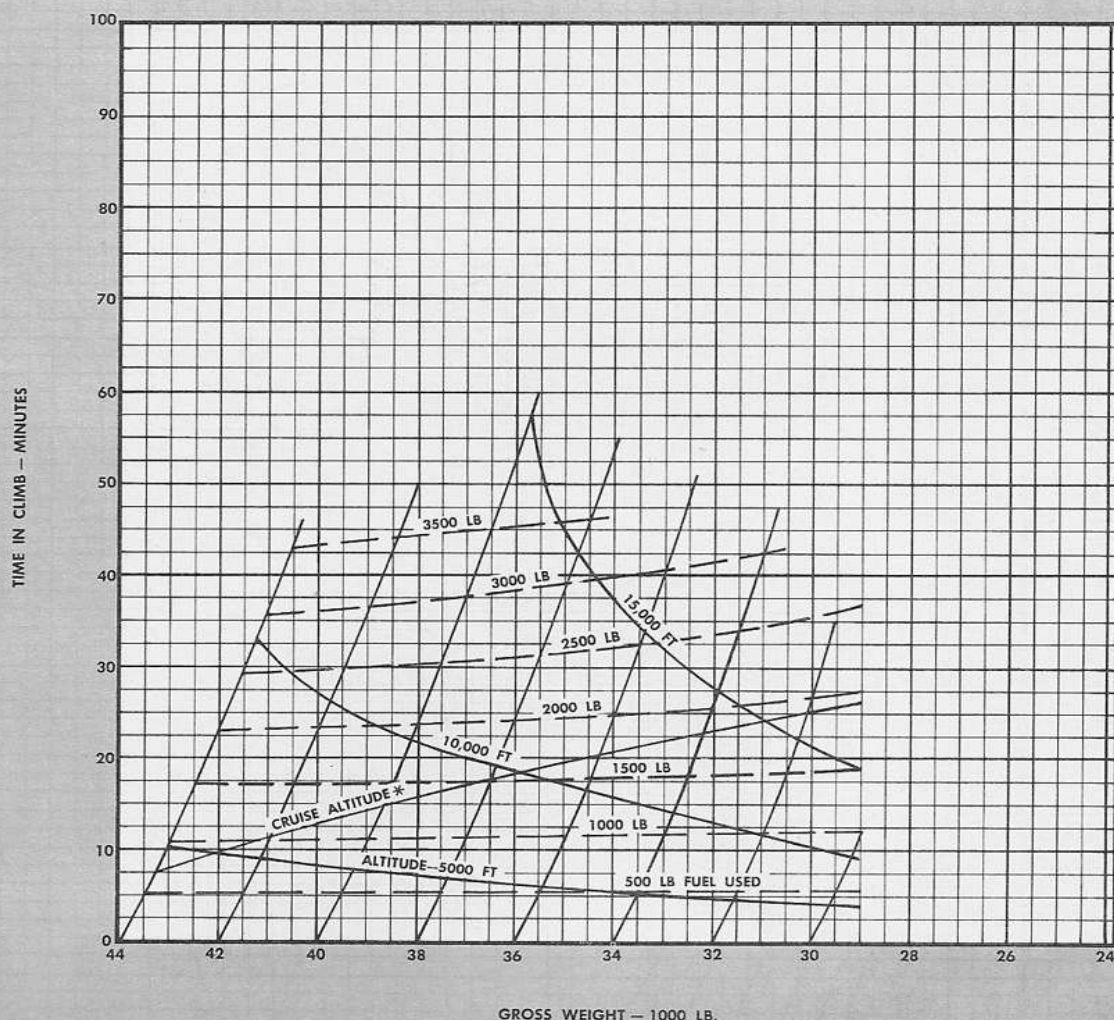
Figure A3-9.

BEST CLIMB PERFORMANCE (TIME)

ONE ENGINE OPERATING
MILITARY POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-68B

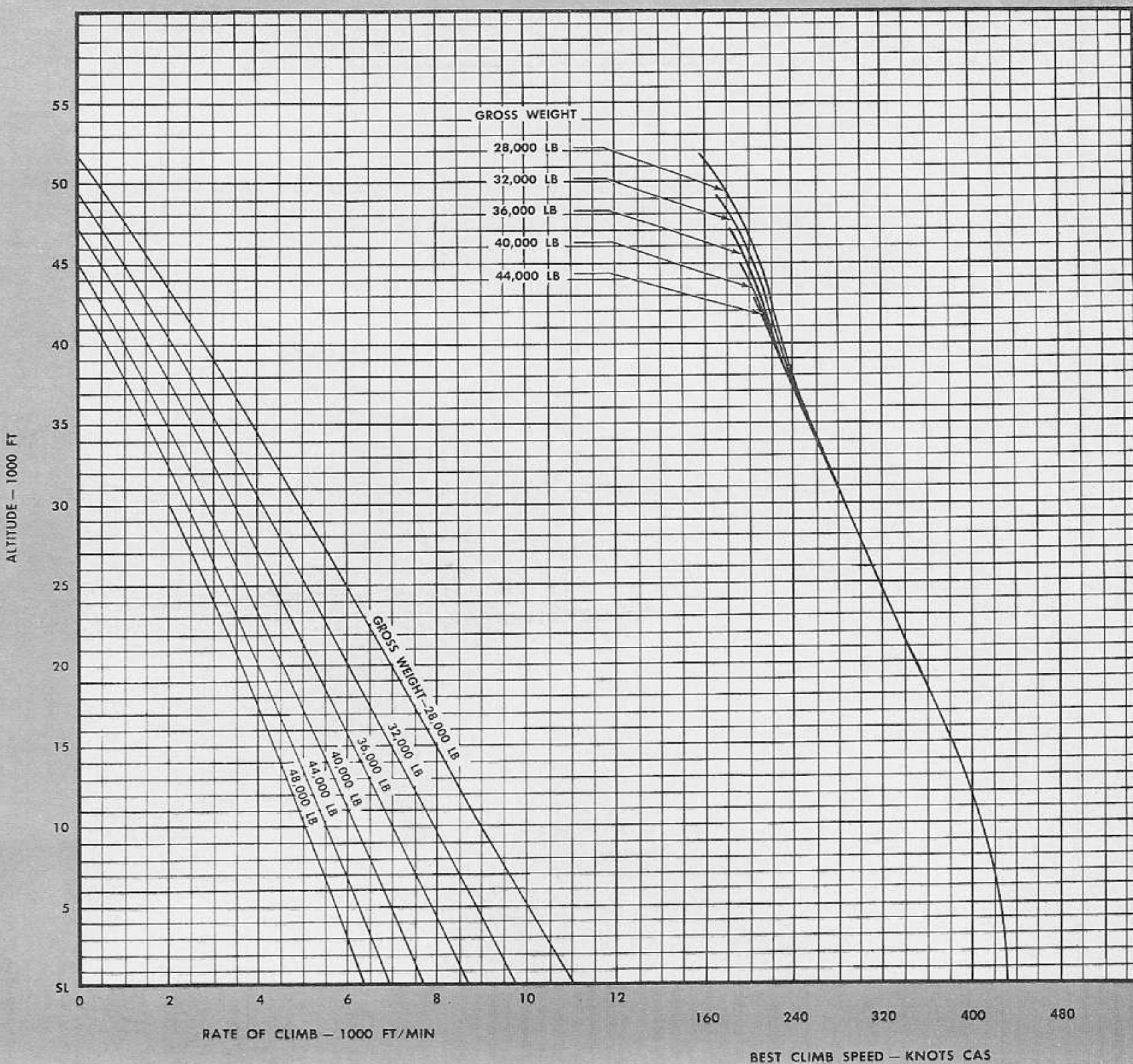
Figure A3-10.

BEST CLIMB SPEED

MAXIMUM POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-257 A

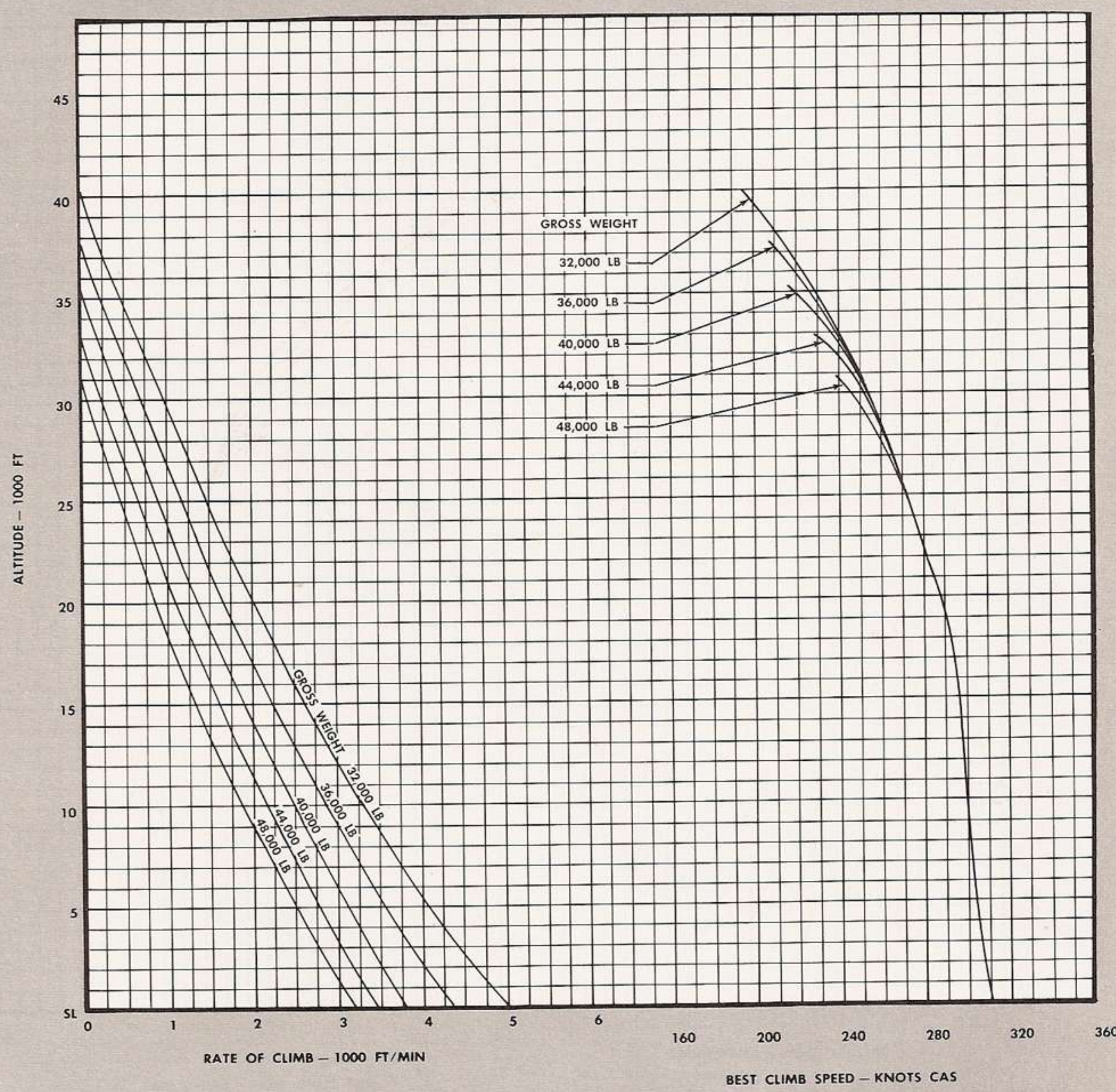
Figure A3-11.

BEST CLIMB SPEED

MILITARY POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-258A

Figure A3-12.

BEST CLIMB SPEED

NORMAL POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

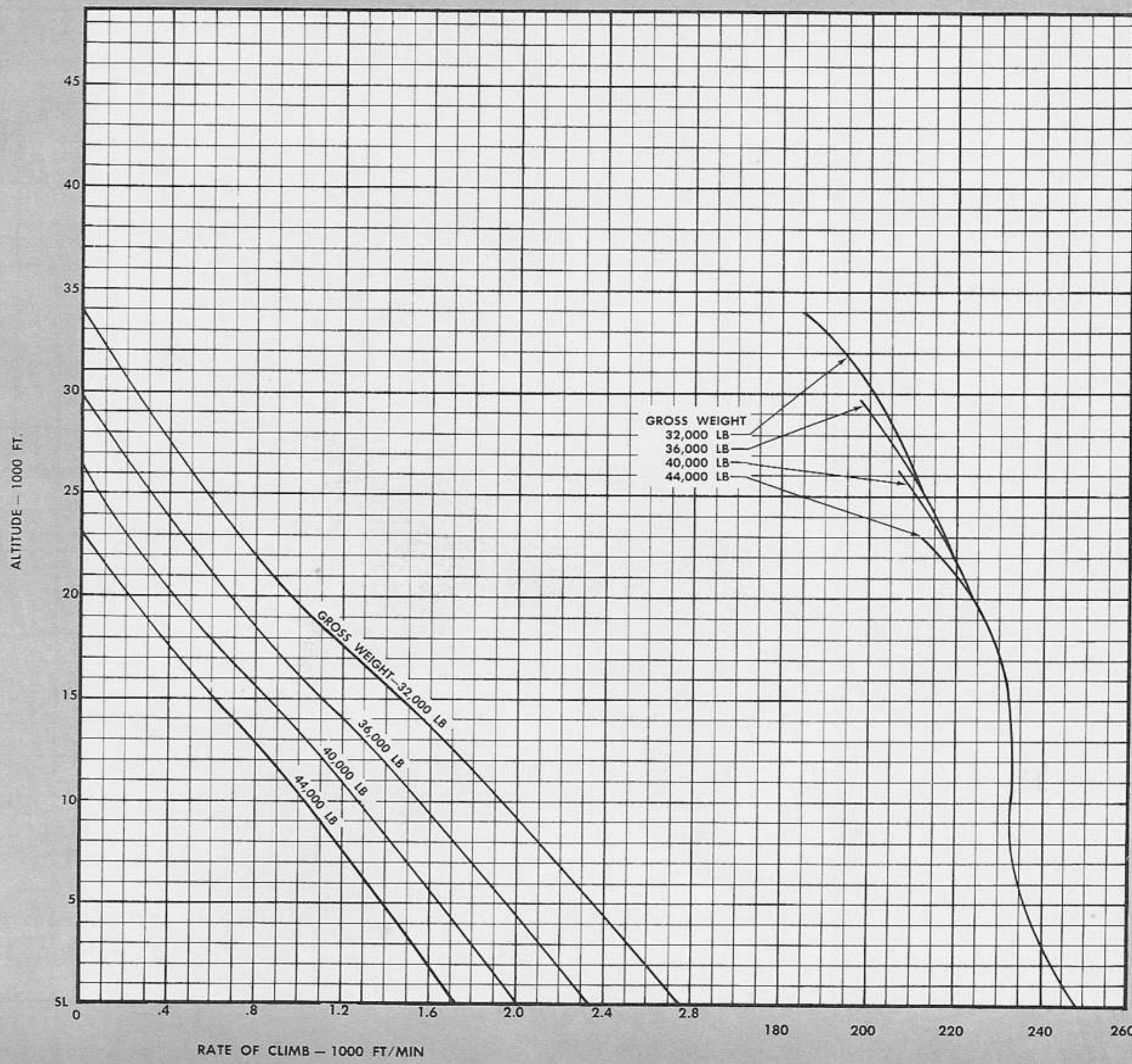
Figure A3-13.

BEST CLIMB SPEED

MAXIMUM POWER
ONE ENGINE OPERATING
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-246A

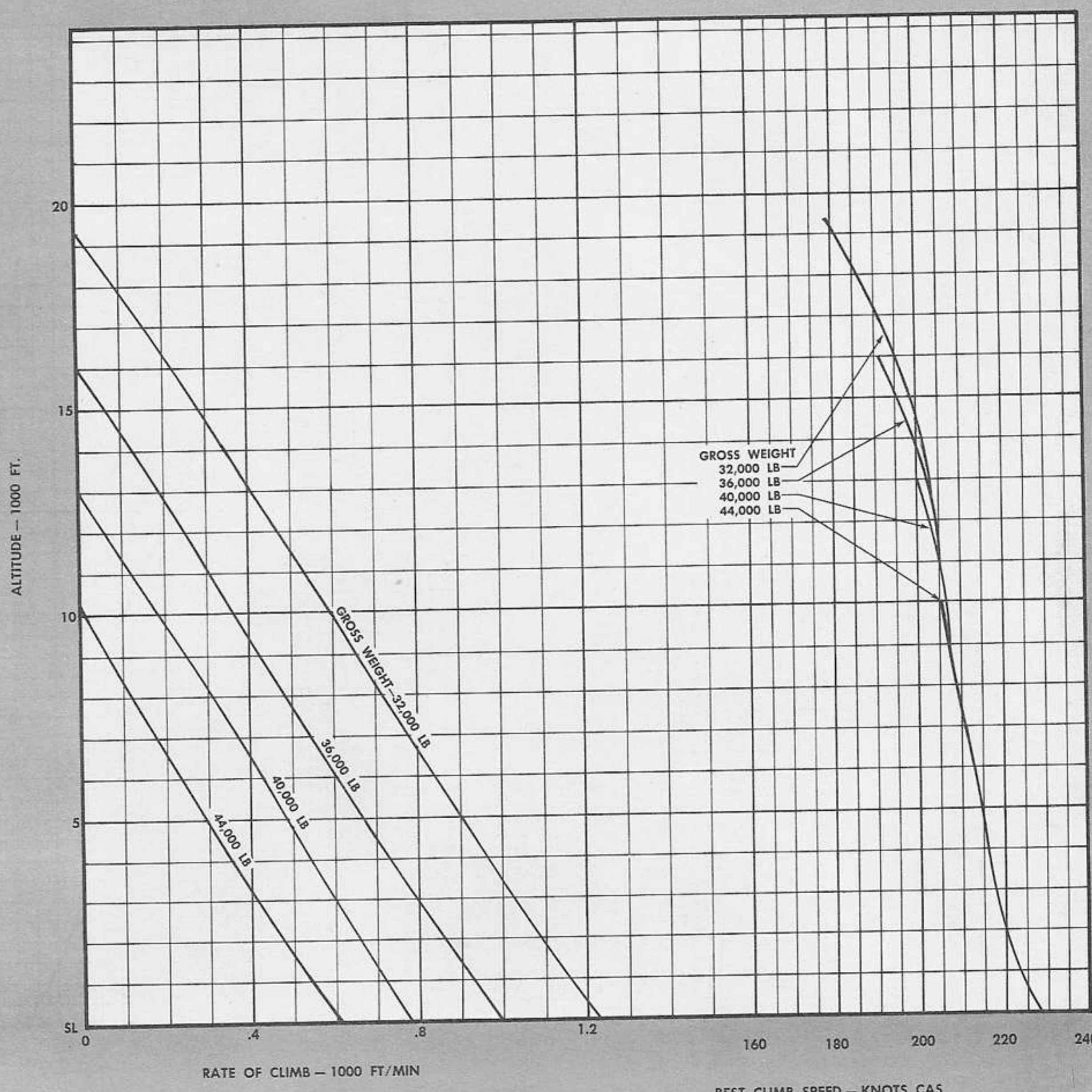
Figure A3-14.

BEST CLIMB SPEED

MILITARY POWER
ONE ENGINE OPERATING
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-247 A

Figure A3-15.

MISSION PROFILE

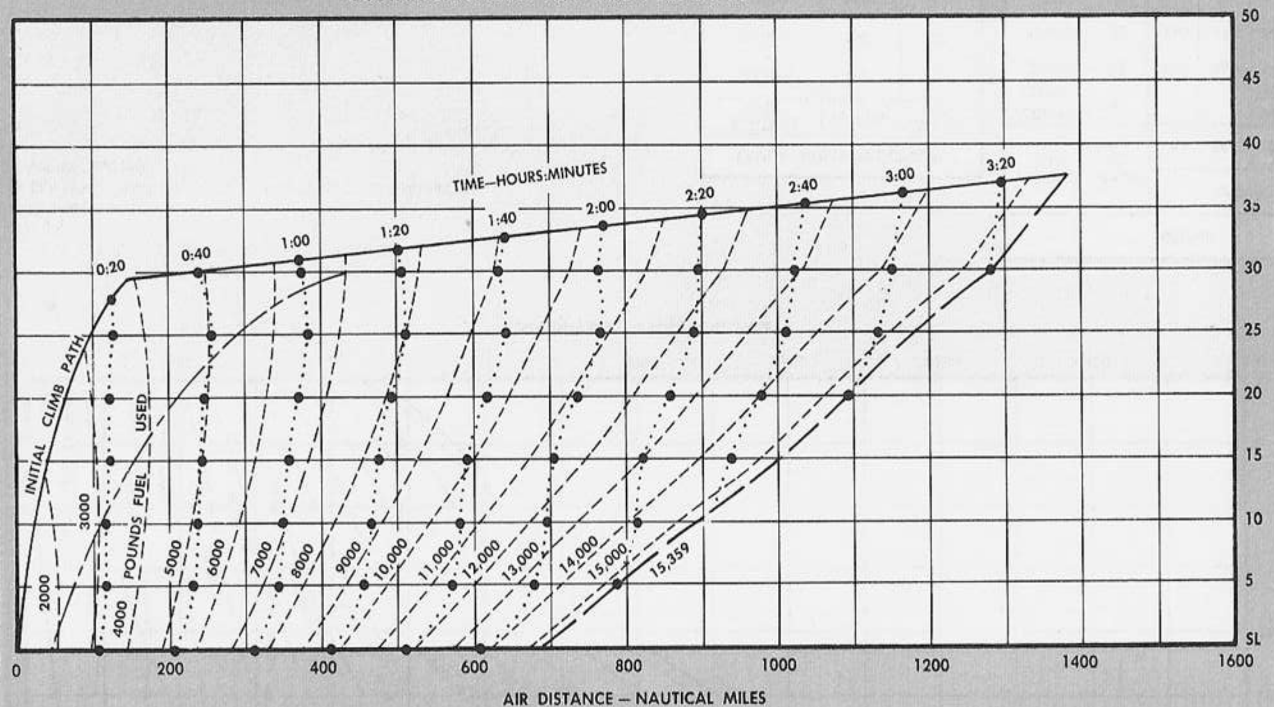
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
LONG RANGE CRUISE

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO MB-1 ROCKETS

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
		35
.67	250	30
.65	275	25
.62	290	20
.58	295	15
.54	300	10
.50	305	5
.47	315	SL



REMARKS:

1. FUEL ALLOWANCE FOR START, TAXI, AND TAKEOFF—906 LB.
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.
30,000	93	.68
31,000	93	.68
32,000	93	.68
33,000	93	.68
34,000	93	.68
35,000	94	.69
36,000	94	.69
37,000	94	.69

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*		400	4000-3500	*
30,000	.67	250	395	4000	90
25,000	.64	265	385	4400	89
20,000	.60	275	370	4600	87
15,000	.56	285	350	4900	85
10,000	.55	305	350	5500	85
5,000	.52	320	340	6200	84
SEA LEVEL	.46	300	300	6400	81

JA-211B

Figure A3-16.

INTERCEPT PROFILE

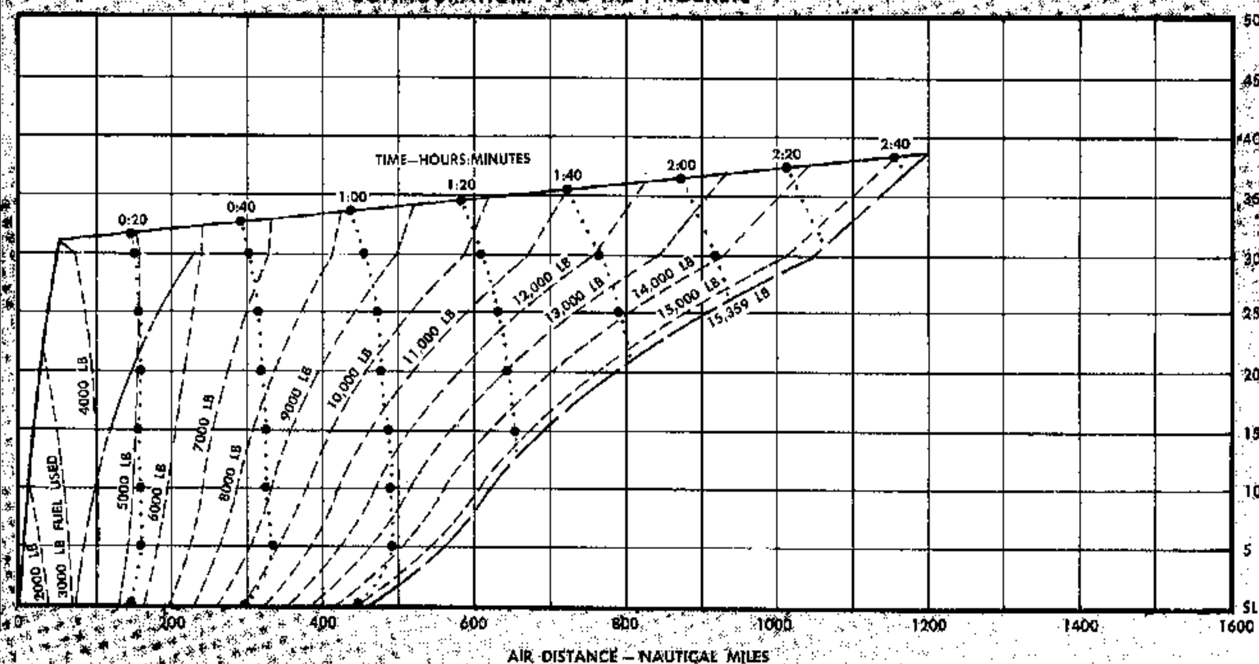
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
MILITARY POWER CRUISE

CONFIGURATION: TWO MB-1 ROCKETS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.76	255	35
.76	285	30
.76	315	25
.76	350	20
.76	385	15
.73	410	10
.70	425	5
.66	435	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.
32,000	100	.78
33,000	100	.77
34,000	100	.77
35,000	100	.78
36,000	100	.77
37,000	100	.76
38,000	100	.75

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*			5400-3800	100
30,000	.78	295	460	5400	100
25,000	.79	335	475	6600	100
20,000	.79	370	485	8000	100
15,000	.79	405	495	9500	100
10,000	.78	435	495	10,900	100
5,000	.77	470	500	12,600	100
SEA LEVEL	.68	450	450	14,000	100

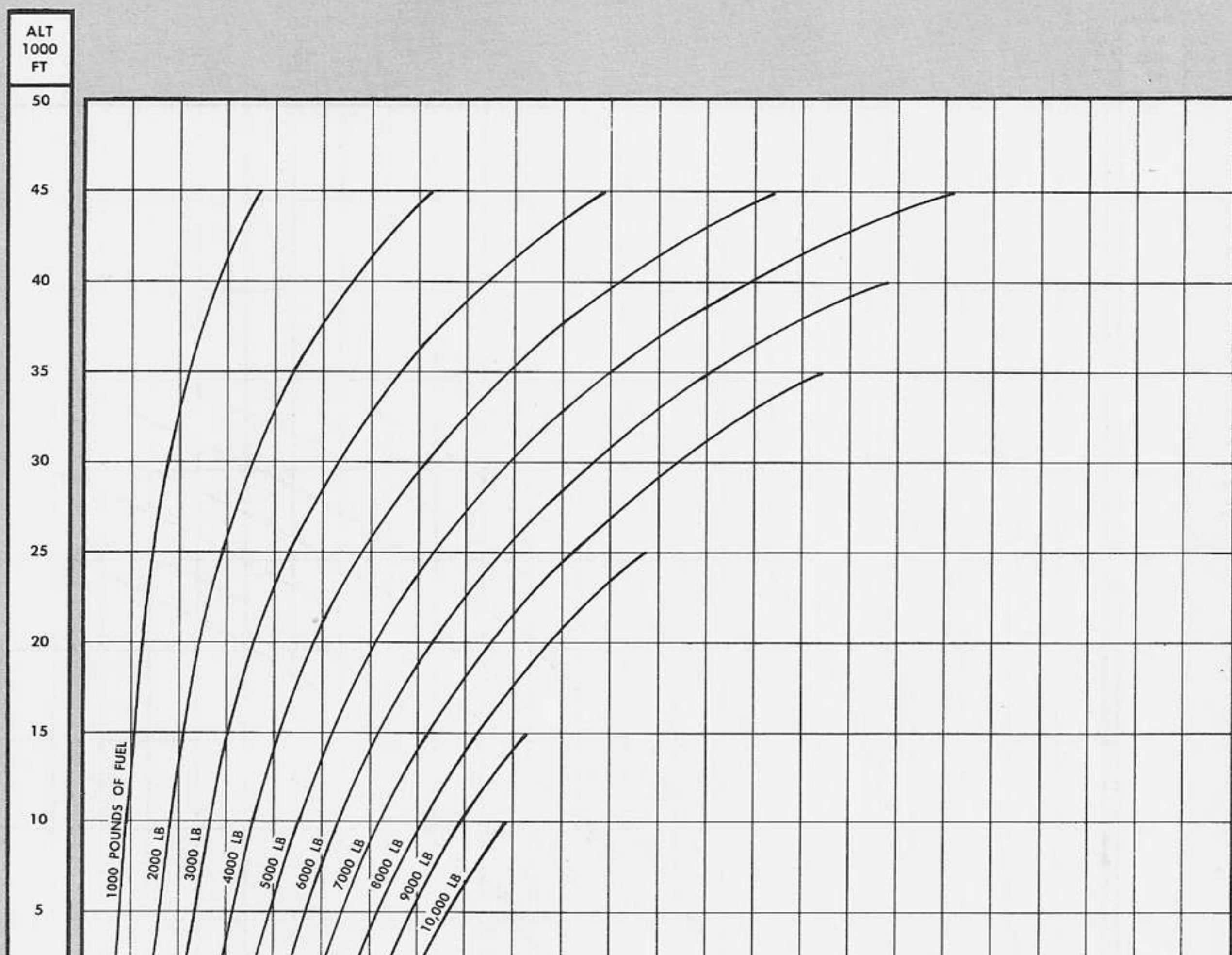
Figure A3-17.

COMBAT ALLOWANCE CHART

MAXIMUM POWER
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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: 750°C.

JA-213 A

Figure A3-18.

COMBAT ALLOWANCE

MILITARY POWER

TWO MB-1 ROCKETS

MODEL: F-89J

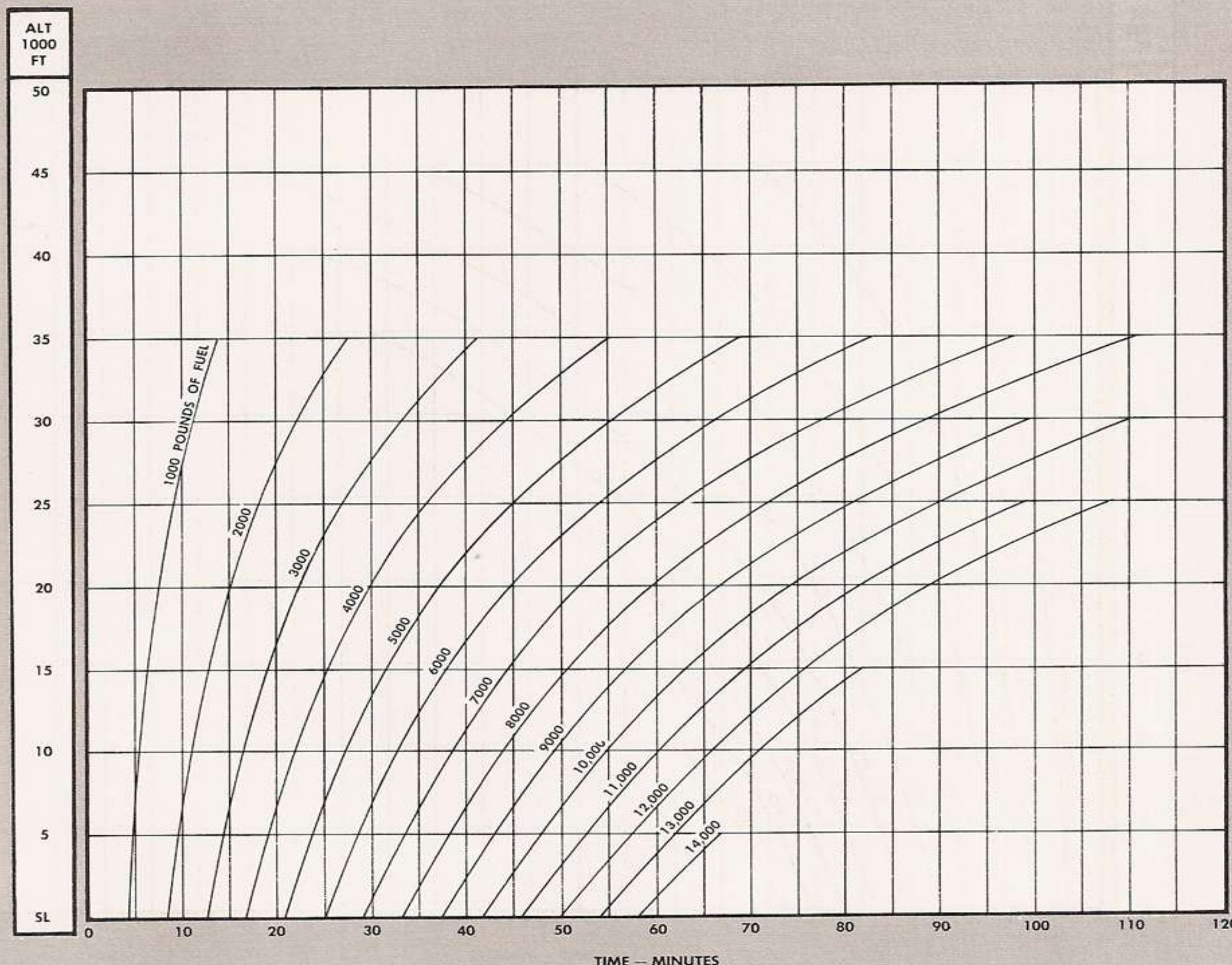
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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: 750°C.

JA-214 A

Figure A3-19.

COMBAT ALLOWANCE CHART

NORMAL POWER

TWO MB-1 ROCKETS

MODEL: F-89J

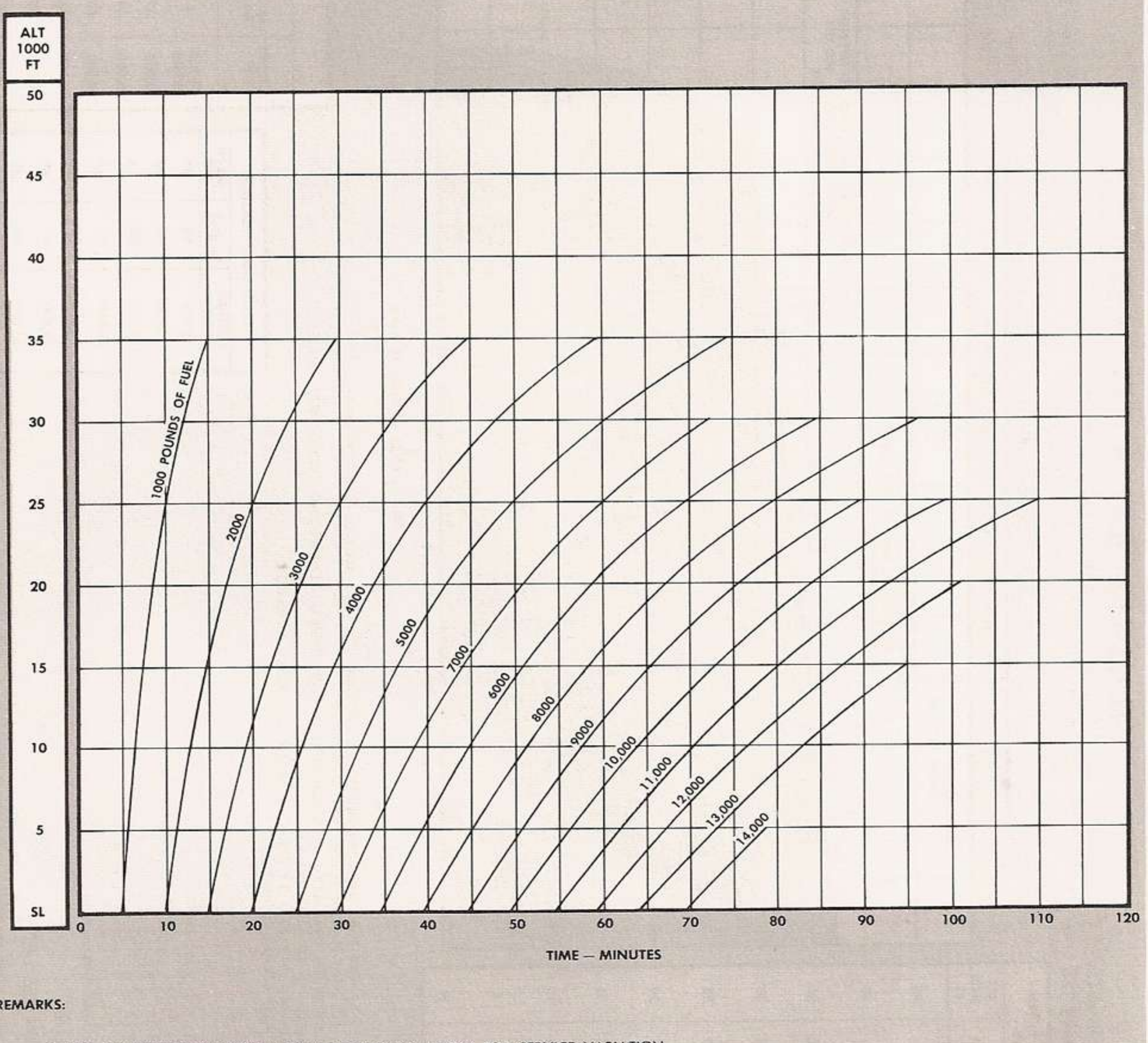
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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: 680°C.

JA-215A

Figure A3-20.

OPTIMUM RETURN PROFILE

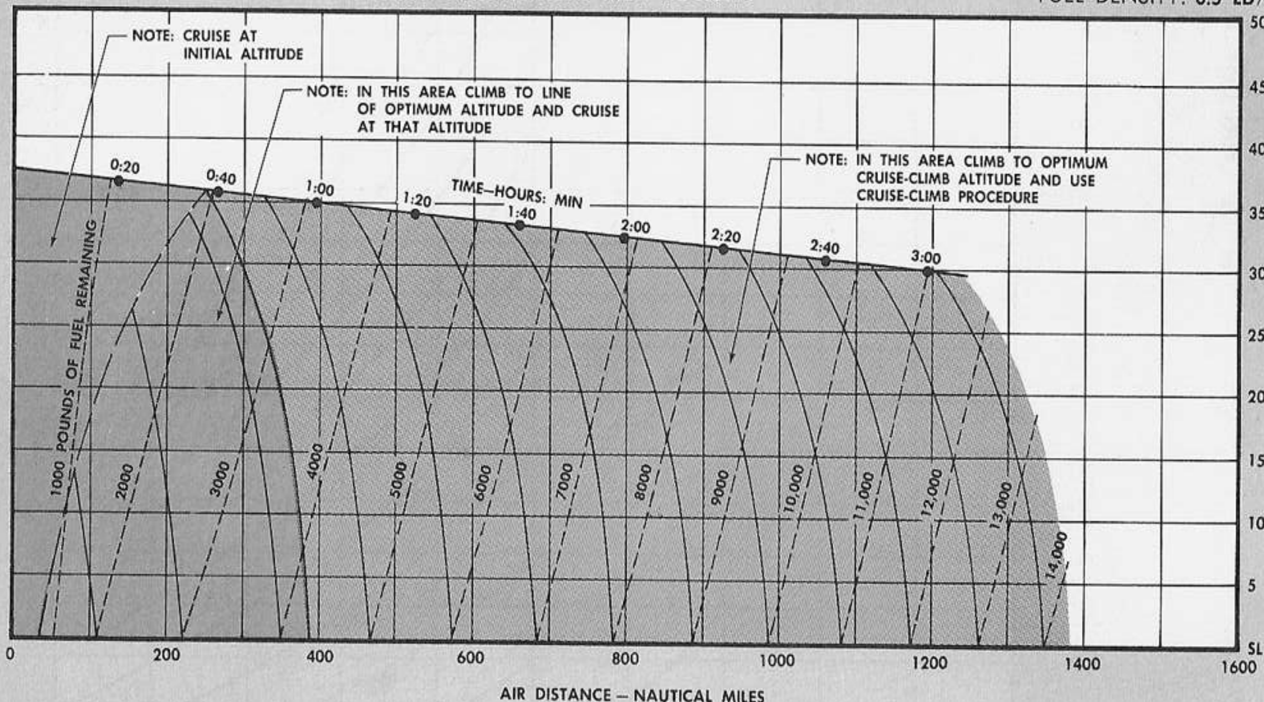
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
LONG RANGE CRUISE

CONFIGURATION: TWO MB-1 ROCKETS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.65	220	35
.67	250	30
.65	275	25
.62	290	20
.50	295	15
.54	300	10
.50	305	5
.47	315	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.

*

CRUISE-CLIMB PROCEDURE		
ALTITUDE FEET	% RPM	MACH NO.
30,000	93	.68
31,000	93	.68
32,000	93	.68
33,000	93	.68
34,000	93	.68
35,000	94	.69
36,000	94	.69
37,000	94	.69

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*			4000-3500	*
30,000	.67	250	375	4000	90
25,000	.64	265	385	4400	89
20,000	.60	275	370	4600	87
15,000	.56	285	350	4900	85
10,000	.55	305	350	5500	85
5000	.52	320	340	6200	84
SEA LEVEL	.46	305	305	6400	81

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

JA-172D

Figure A3-21.

OPTIMUM RETURN PROFILE

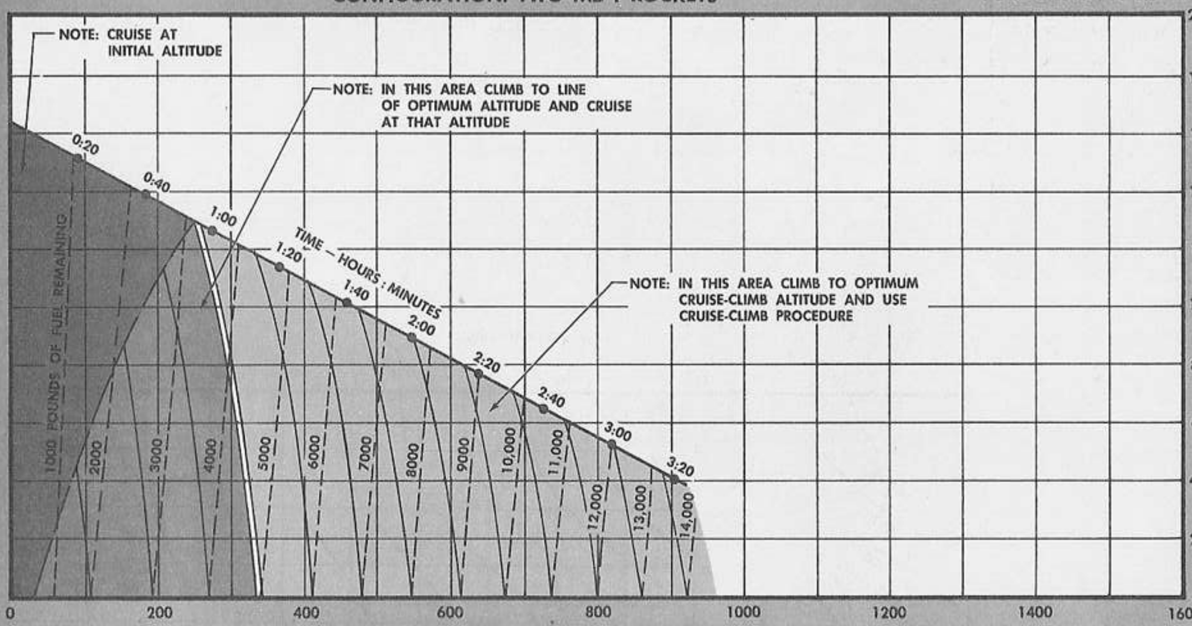
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
ONE ENGINE OPERATING
LONG RANGE CRUISE

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO MB-1 ROCKETS

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		18
		16
.39	200	14
.38	205	12
.37	205	10
.37	210	8
.36	215	6
.35	215	4
.34	220	2
.34	225	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.
4000	94	.40
5000	94	.41
6000	94	.41
7000	95	.41
8000	95	.42
9000	95	.42
10,000	95	.42
11,000	95	.43
12,000	95	.43
13,000	95	.43
14,000	95	.43
15,000	95	.44
16,000	95	.44

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*			4500-3300	*
14,000	.43	220	270	3500	95
12,000	.43	225	270	3700	95
10,000	.42	235	270	3900	95
8000	.42	240	270	4000	95
6000	.41	245	265	4300	94
4000	.40	245	260	4500	94
2000	.39	250	255	4600	92
SEA LEVEL	.38	250	250	4700	91

JA-1738

Figure A3-22.

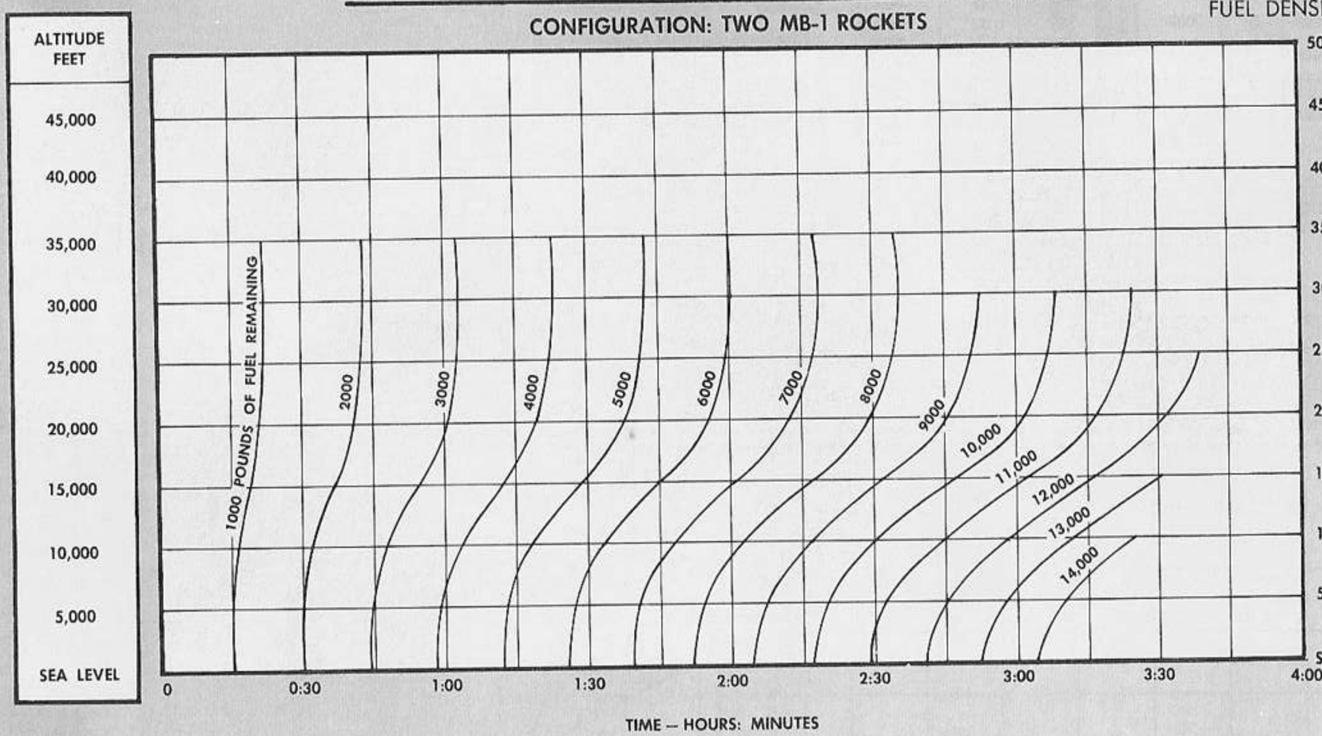
MAXIMUM ENDURANCE

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO MB-1 ROCKETS



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
35,000	190	330	.57	3100	90
30,000	190	305	.52	3300	87
25,000	190	280	.47	3400	84
20,000	185	250	.41	3400	81
15,000	200	250	.40	3800	79
10,000	185	215	.34	4100	76
5000	185	200	.31	4300	74
SEA LEVEL	200	200	.30	4500	70

JA-185C

Figure A3-23.

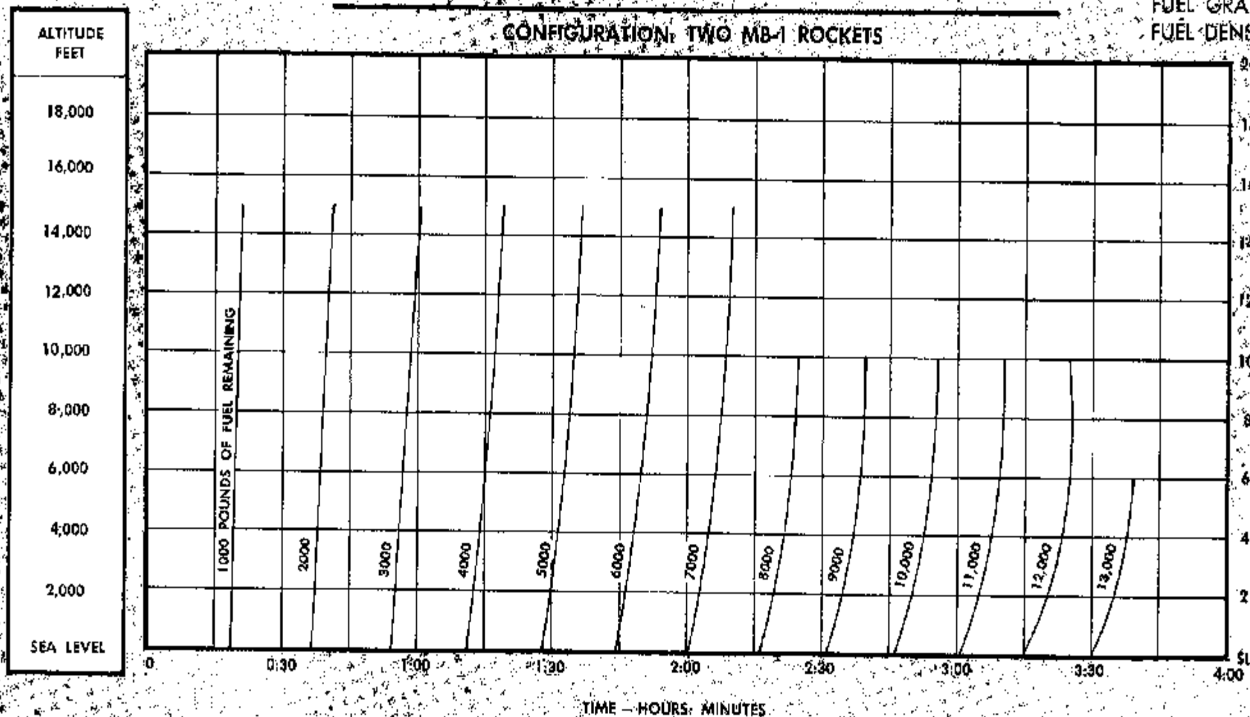
MAXIMUM ENDURANCE

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
ONE ENGINE OPERATING

CONFIGURATION: TWO MB-1 ROCKETS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



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
16,000					
14,000	185	225	.36	3600	92
12,000	185	215	.34	3400	92
10,000	180	210	.33	3600	92
8000	180	205	.32	3600	92
6000	185	200	.31	3600	90
4000	180	195	.30	3600	88
2000	185	190	.29	3700	86
SEA LEVEL	180	185	.28	3700	85

Figure A3-24.

OPTIMUM MAXIMUM ENDURANCE PROFILE

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT

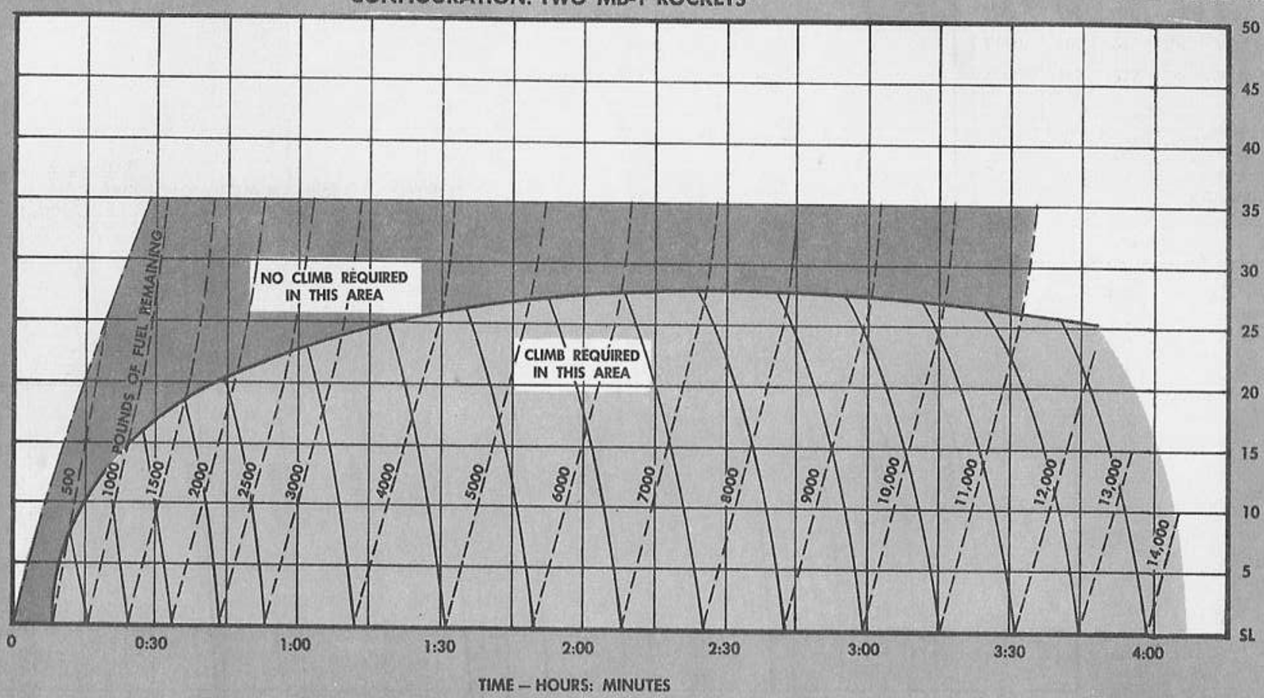
44,744 POUNDS

CONFIGURATION: TWO MB-1 ROCKETS

MODEL: F-89J
ENGINE(S): (2) J35-35

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.63	235	35
.61	255	30
.57	260	25
.52	265	20
.41	265	15
.46	265	10
.44	270	5
.41	270	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					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
35,000	190	.57	330	3100	91
30,000	190	.51	300	3200	81
25,000	190	.46	275	3300	84
20,000	175	.38	235	2800	76
15,000	180	.36	225	3200	74
10,000	170	.31	195	3600	73
5000	170	.28	180	3700	70
SEA LEVEL	180	.27	180	3800	67

LEGEND

- - - - - FUEL REMAINING
——— LINE OF OPTIMUM ALTITUDE FOR LOITER
——— NORMAL POWER CLIMB GUIDE LINES
—-— MAXIMUM RANGE DESCENT

JA-198C

Figure A3-25.

OPTIMUM MAXIMUM ENDURANCE PROFILE

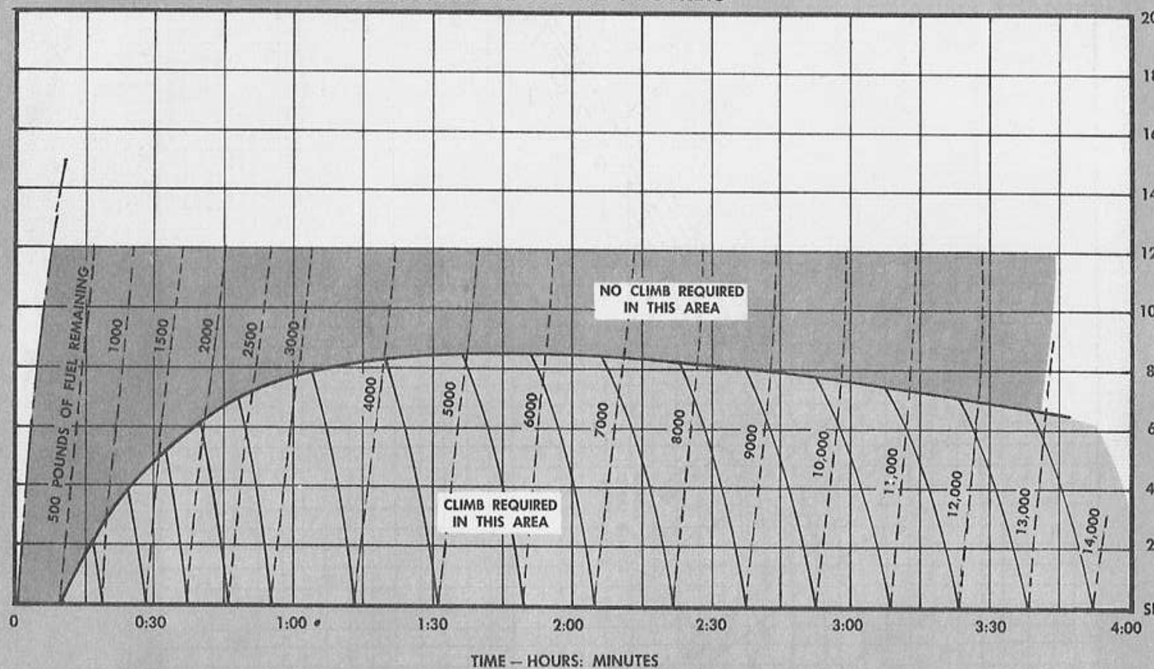
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
44,744 POUNDS
ONE ENGINE OPERATING

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO MB-1 ROCKETS

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		18
		16
		14
.38	205	12
.37	210	10
.37	210	8
.36	215	6
.35	215	4
.34	220	2
.34	225	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					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
12,000	185	.35	220	3600	93
10,000	180	.33	210	3500	92
8000	180	.32	205	3600	91
6000	165	.28	180	3000	85
4000	165	.27	175	3000	83
2000	165	.26	170	3000	81
SEA LEVEL	165	.25	165	3200	80

LEGEND

- - - - - FUEL REMAINING
▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
—— NORMAL POWER CLIMB GUIDE LINES
— - — MAXIMUM RANGE DESCENT

JA-1998

Figure A3-26.

NAUTICAL MILES PER 1000 POUNDS FUEL

SEA LEVEL

TWO MB-1 ROCKETS

MODEL: F-89J

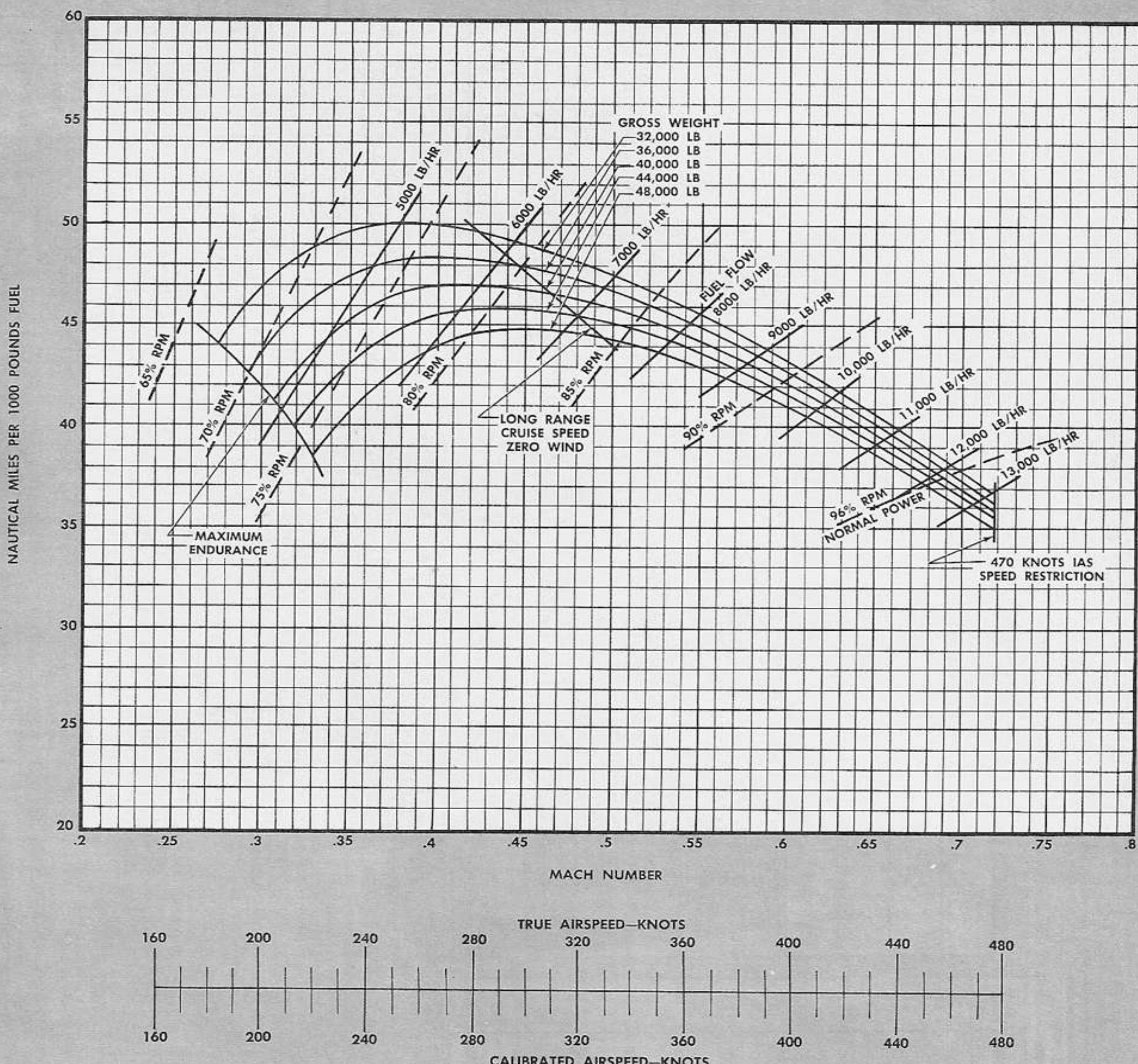
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

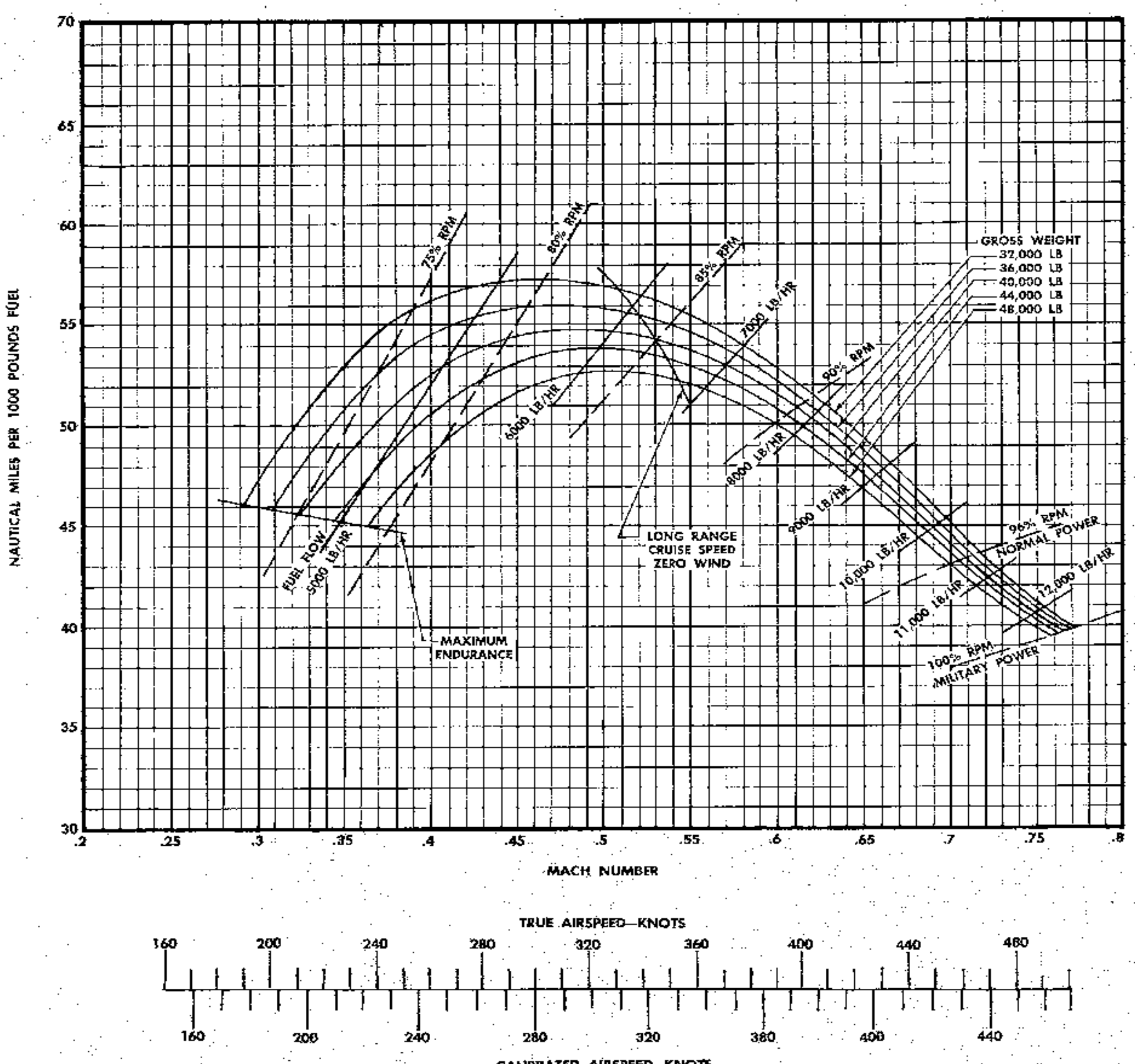
Figure A3-27.

NAUTICAL MILES PER 1000 POUNDS FUEL

5000 FEET
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA125C

Figure A3-28.

NAUTICAL MILES PER 1000 POUNDS FUEL

10,000 FEET

TWO MB-1 ROCKETS

MODEL: F-89J

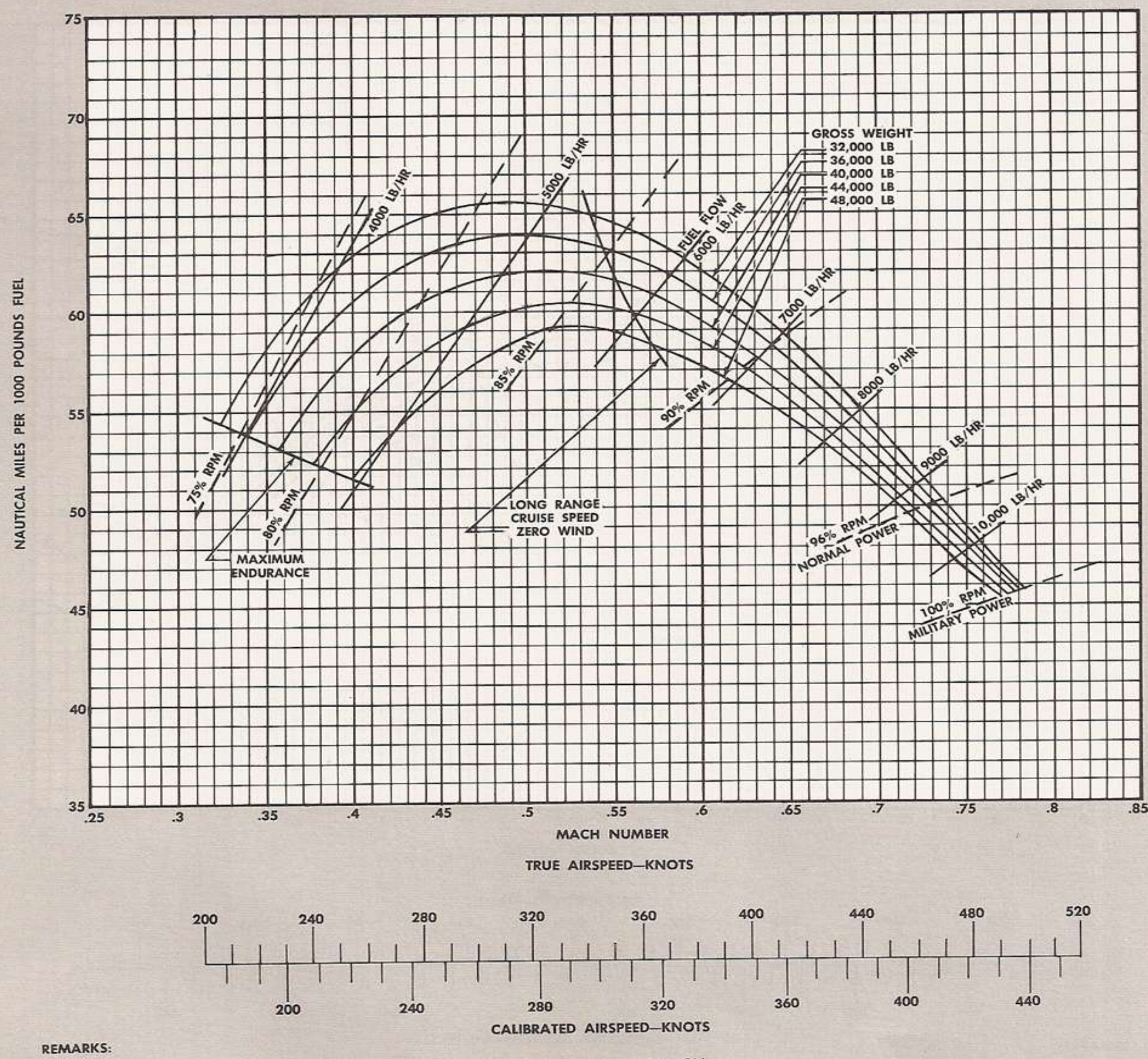
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-126C

Figure A3-29.

NAUTICAL MILES PER 1000 POUNDS FUEL

15,000 FEET

TWO MB-1 ROCKETS

MODEL: **F-89J**

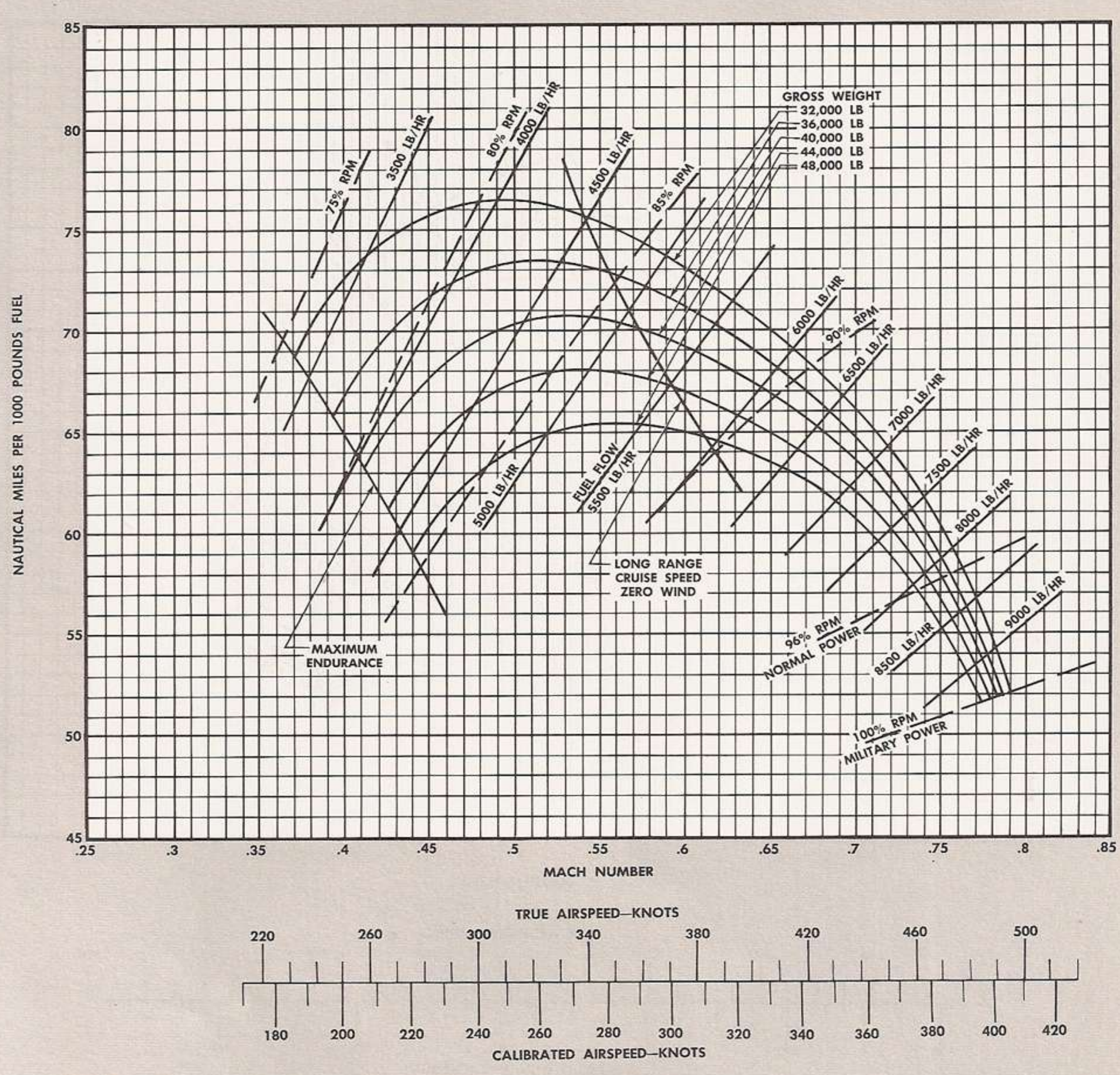
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-127C

Figure A3-30.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89J**

DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

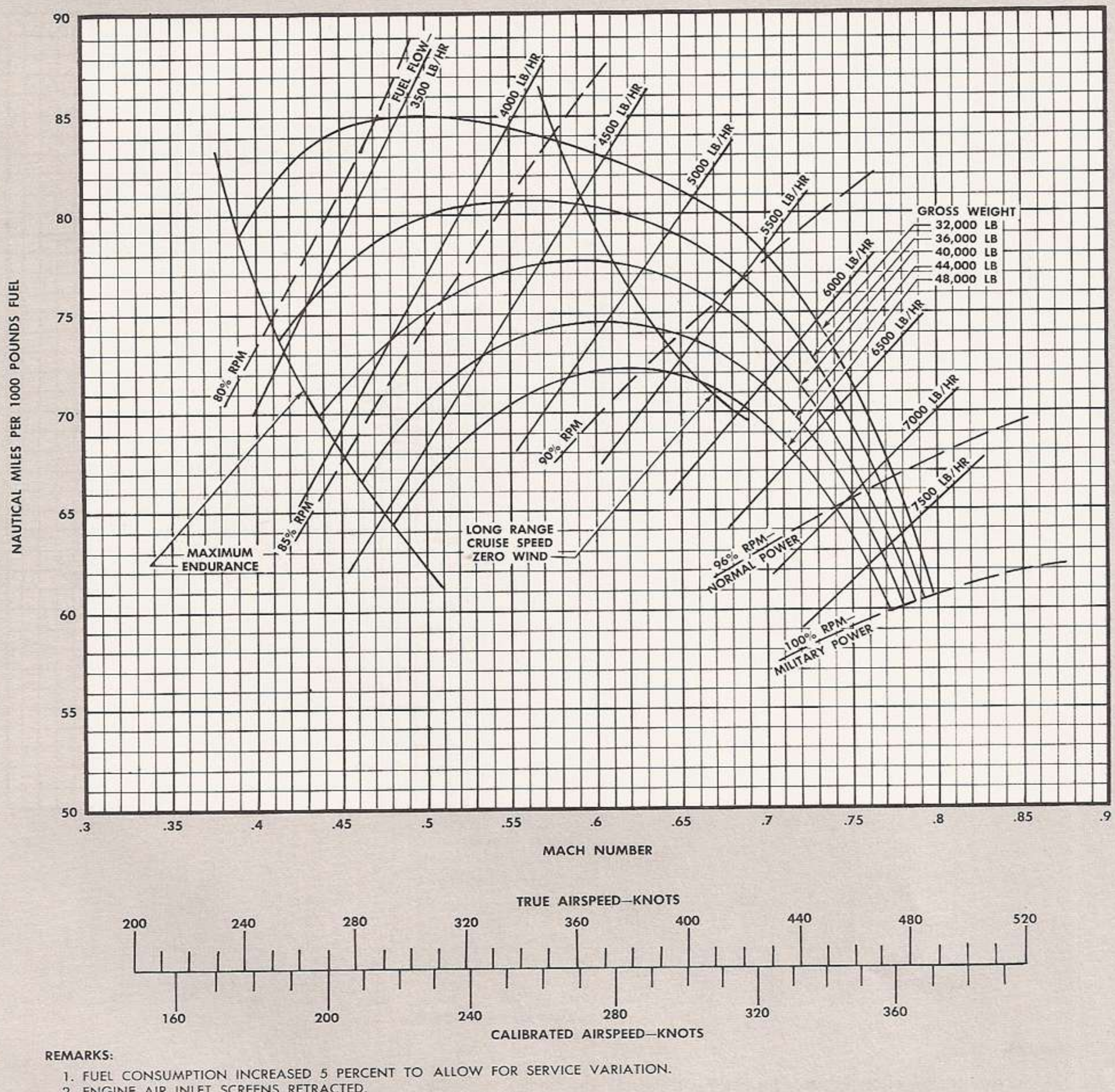
20,000 FEET

TWO MB-1 ROCKETS

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-128C

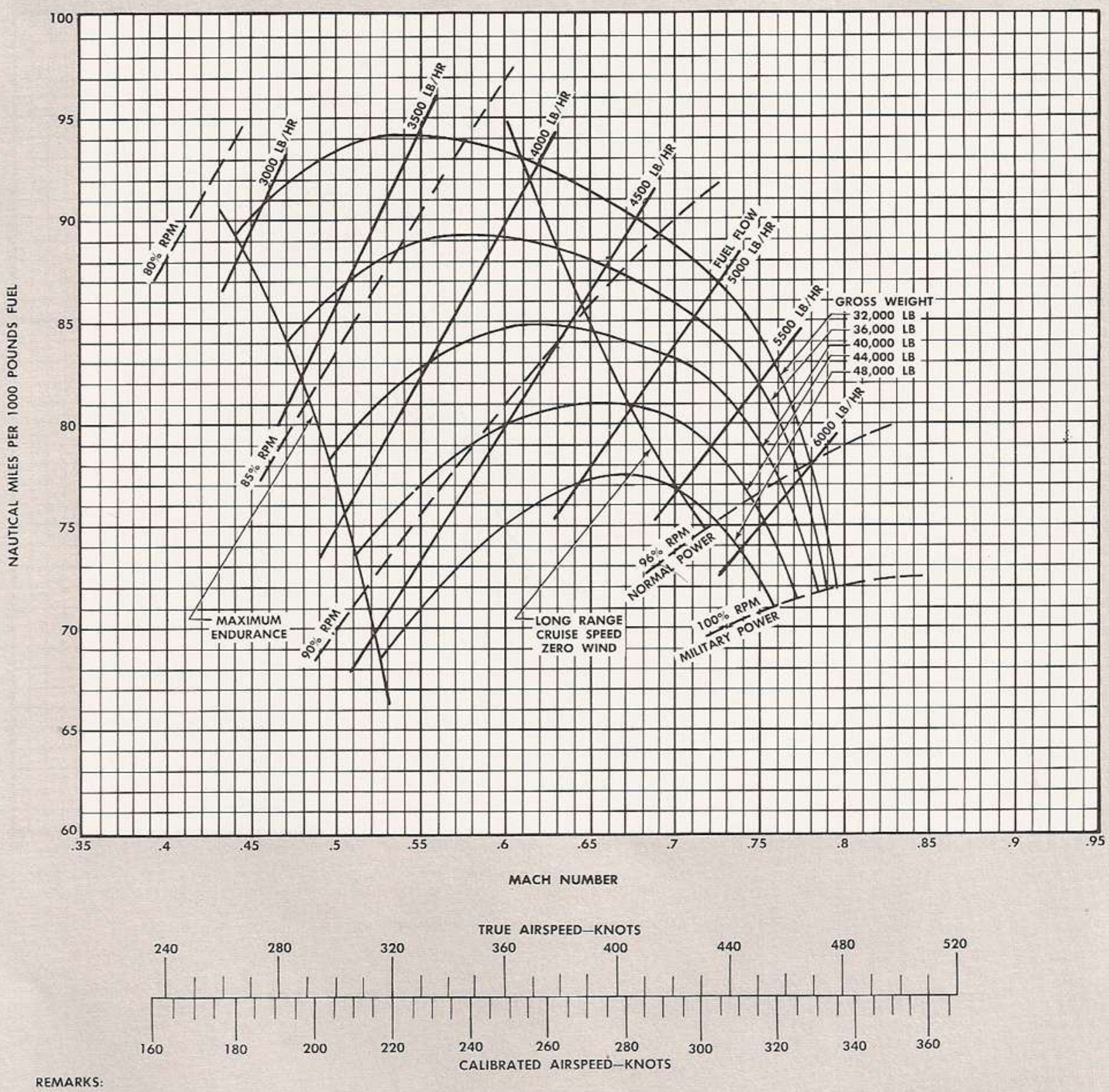
Figure A3-31.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

25,000 FEET
TWO MB-1 ROCKETS

ENGINE(S): **(2) J35-35**
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-129C

Figure A3-32.

NAUTICAL MILES PER 1000 POUNDS FUEL

30,000 FEET

TWO MB-1 ROCKETS

MODEL: **F-89J**

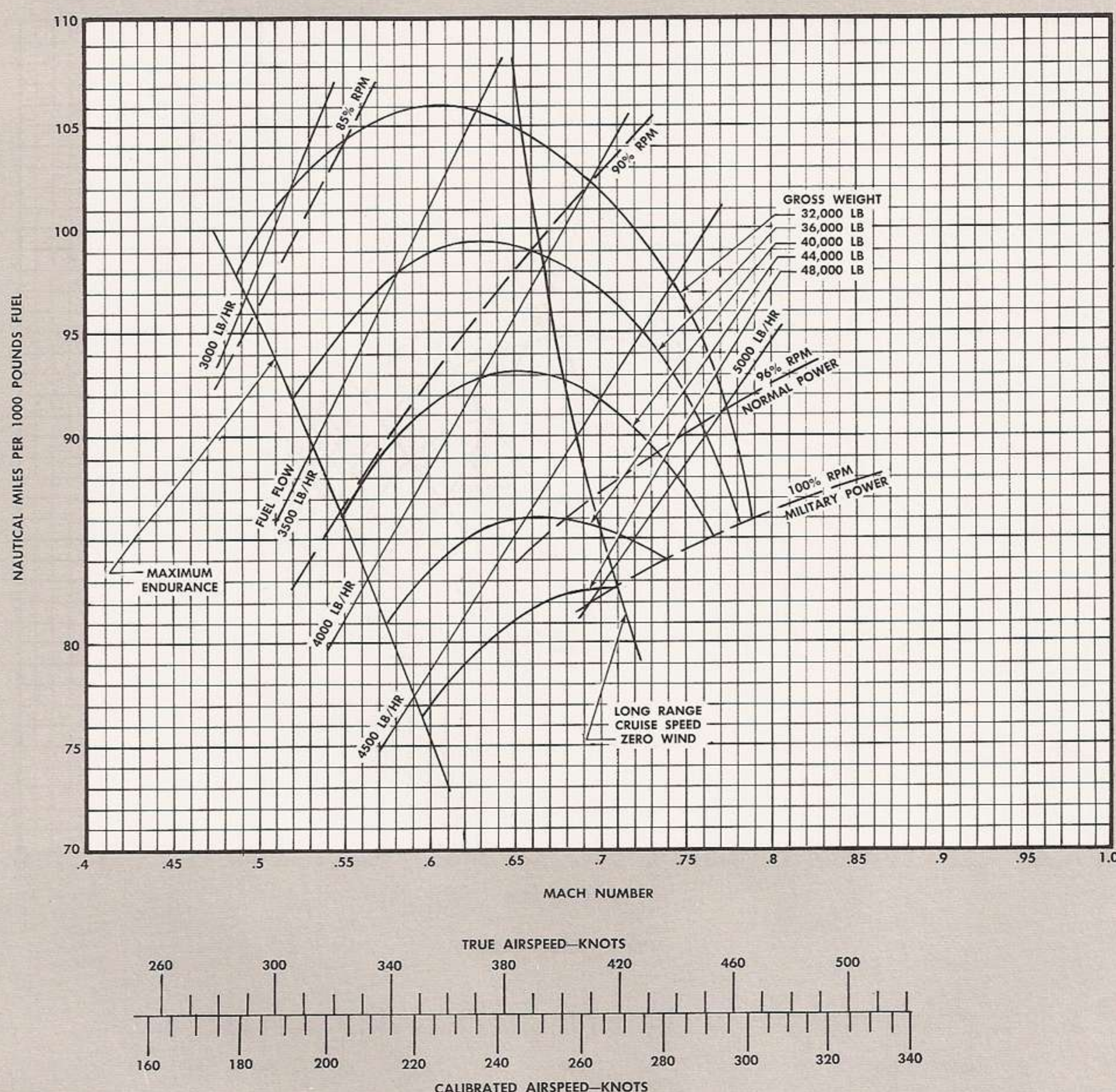
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-130C

Figure A3-33.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89J**

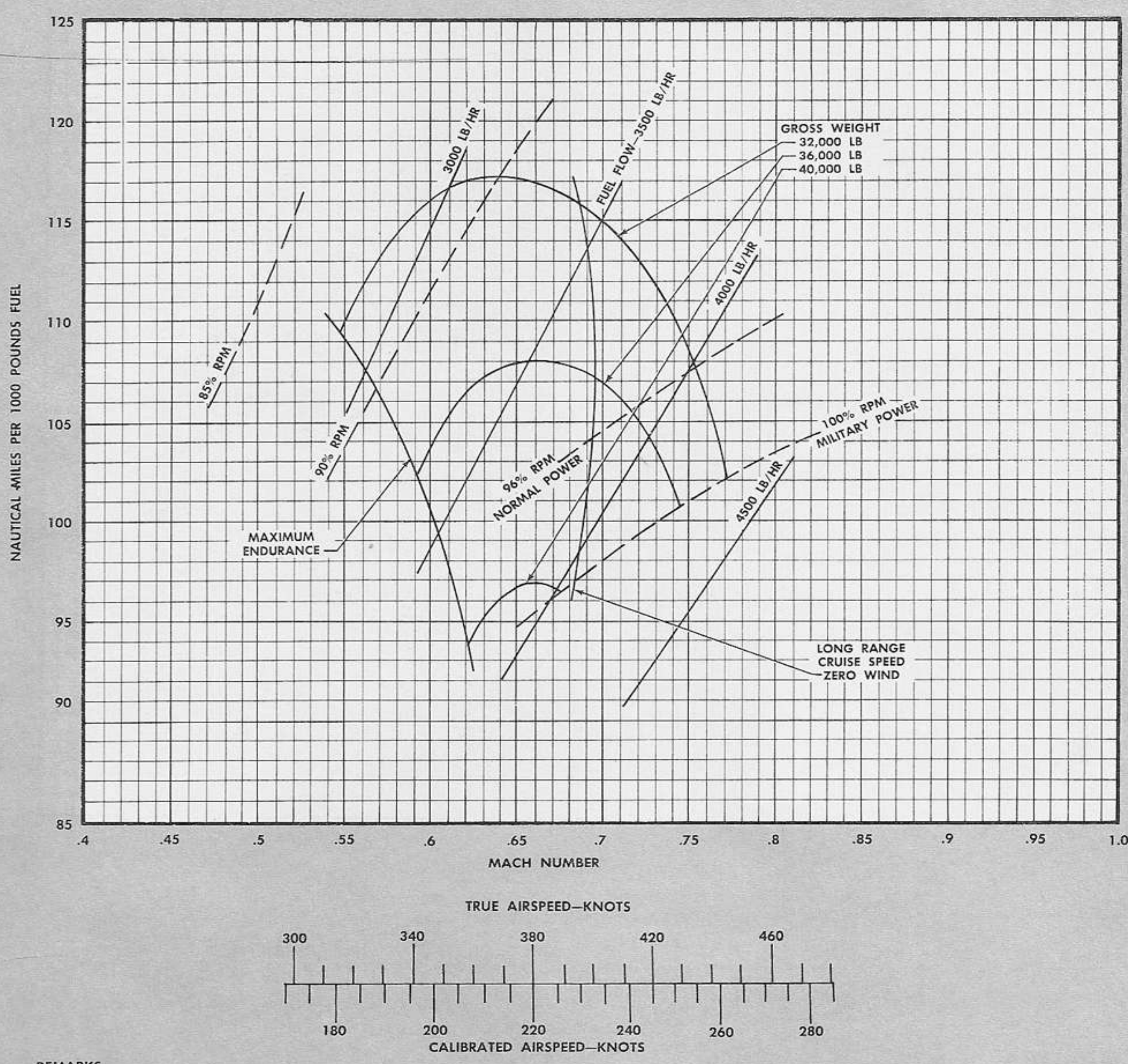
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

35,000 FEET

TWO MB-1 ROCKETS

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-131C

Figure A3-34.

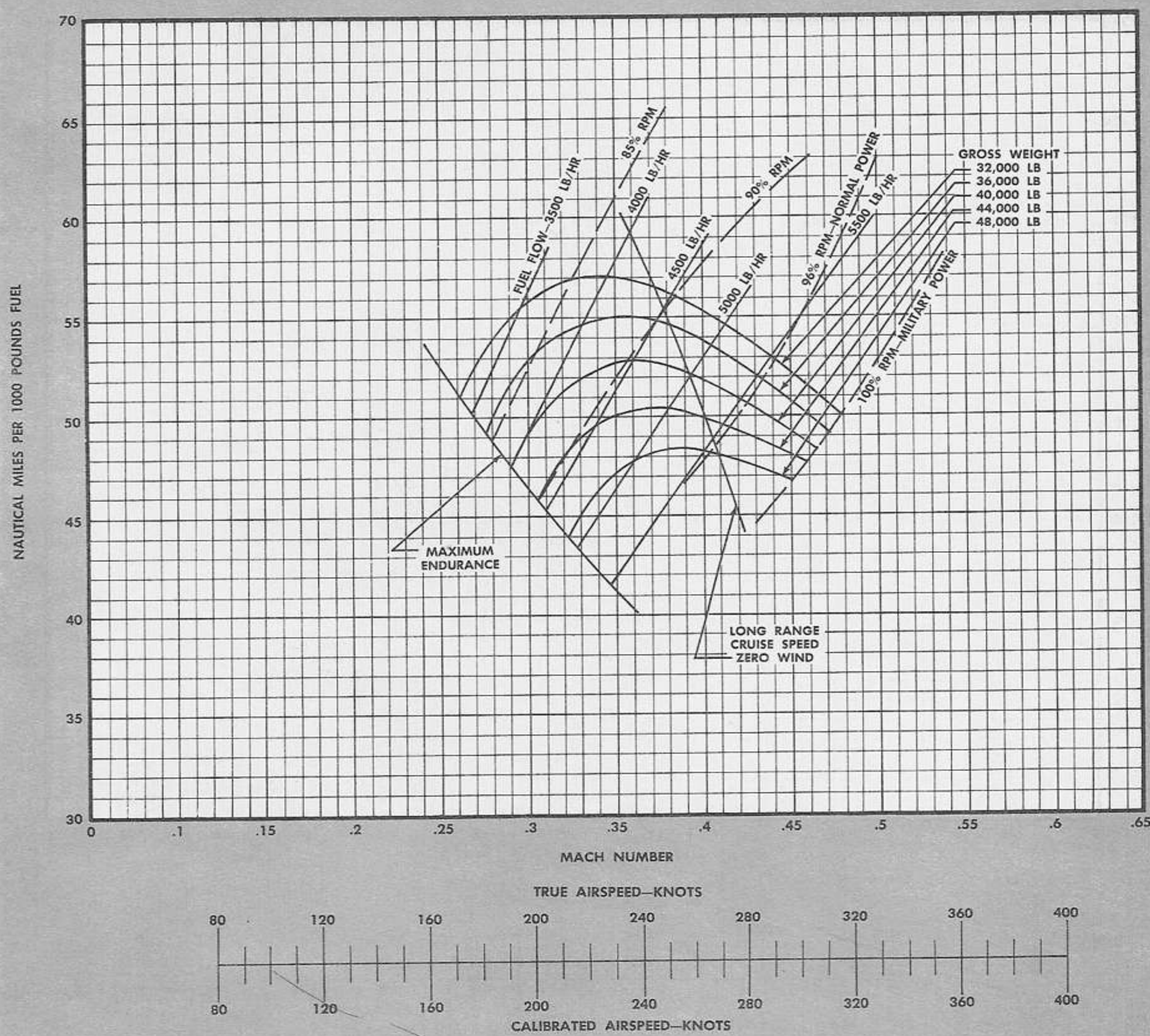
NAUTICAL MILES PER 1000 POUNDS FUEL

ONE ENGINE OPERATING
SEA LEVEL

TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

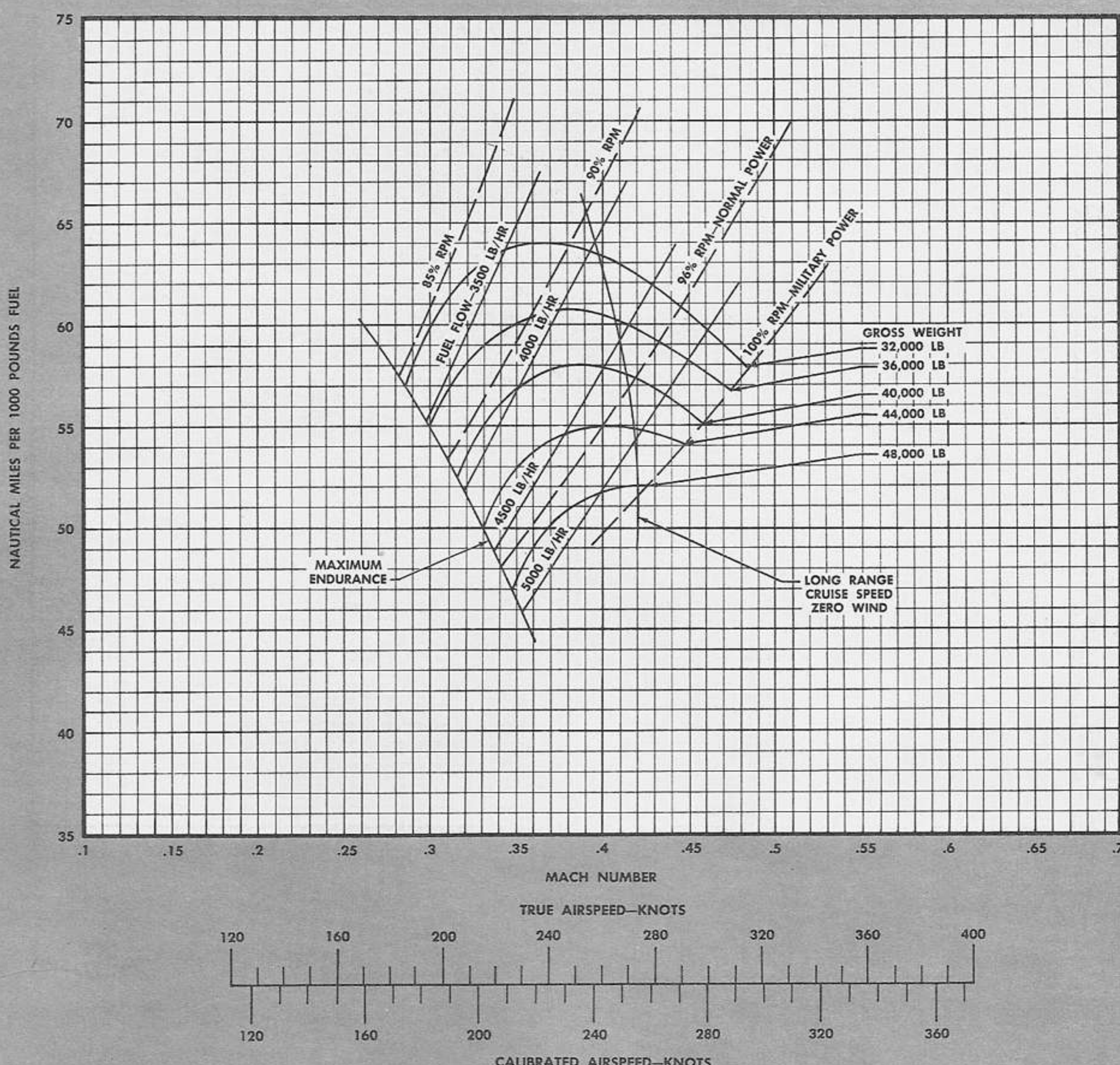
Figure A3-35.

NAUTICAL MILES PER 1000 POUNDS FUEL

ONE ENGINE OPERATING
5000 FEET
TWO MB-1 ROCKETS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-1338

Figure A3-36.

NAUTICAL MILES PER 1000 POUNDS FUEL

ONE ENGINE OPERATING
10,000 FEET

TWO MB-1 ROCKETS

MODEL: **F-89J**

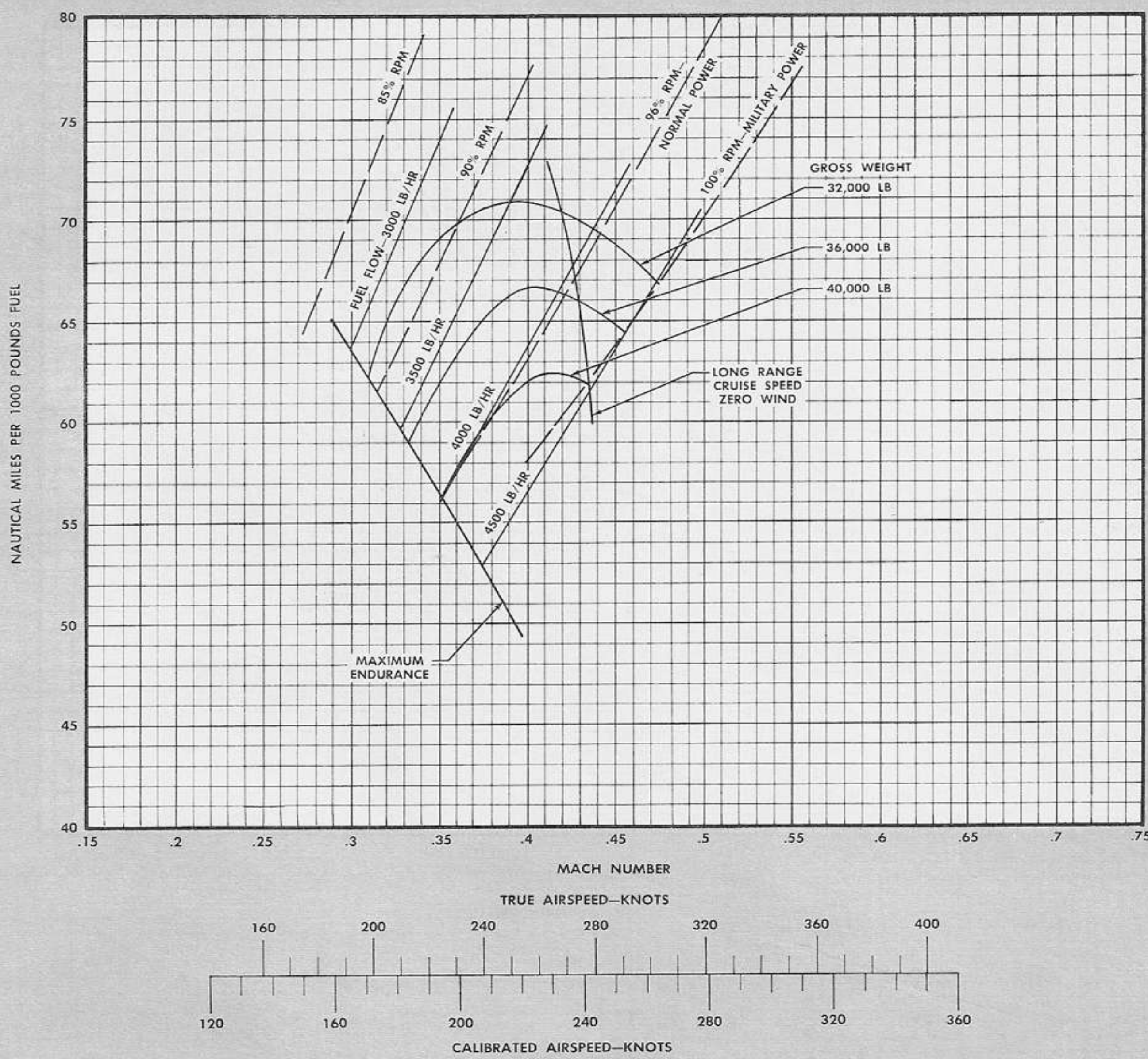
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-134 B

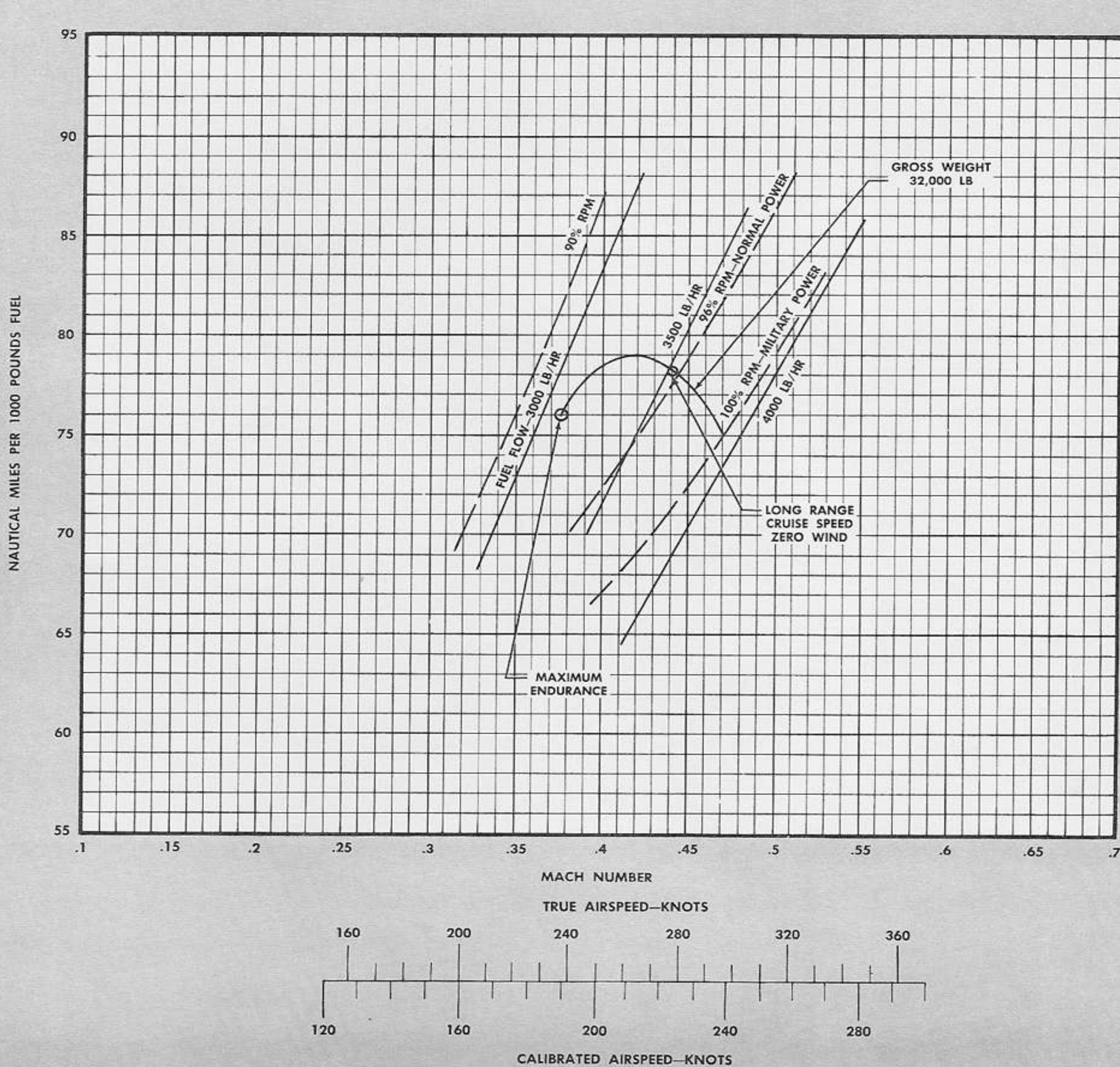
Figure A3-37.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
15,000 FEET
TWO MB-1 ROCKETS

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-135B

Figure A3-38.

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APPENDIX IV

PERFORMANCE DATA

Appendix IV contains performance data applicable to the airplane when its configuration consists of two pylons and 600-gallon tip tanks.

TABLE OF CONTENTS

Refer to Appendix I for use of charts, takeoff and landing data cards, sample problems, airspeed, compressibility, temperature correction, density altitude and relative wind charts.

Refer to Appendix II for takeoff, minimum distance climb, descent and landing charts.

BEST CLIMB PERFORMANCE (RANGE)

MAXIMUM POWER

TWO PYLONS

MODEL: F-89J

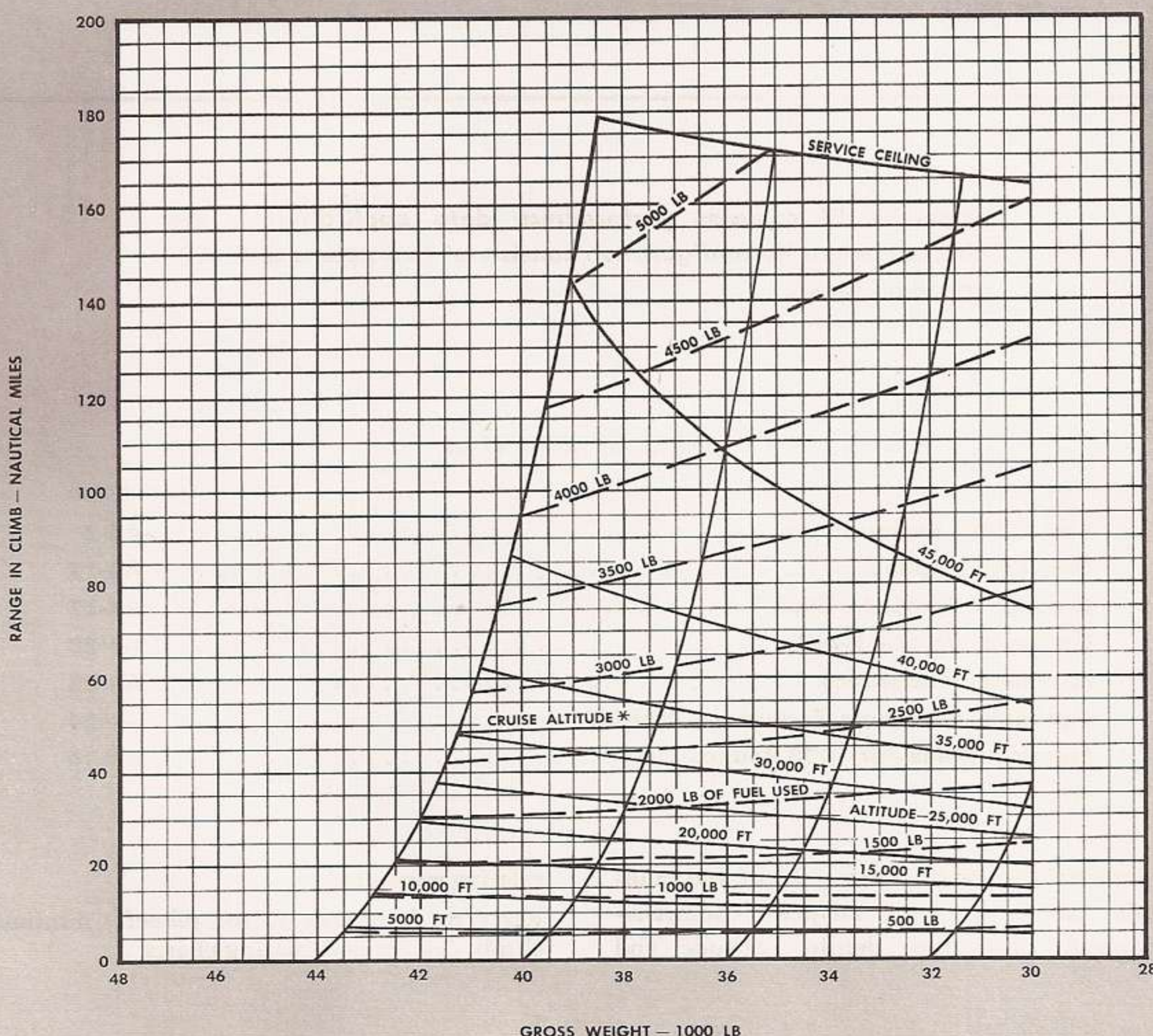
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-22B

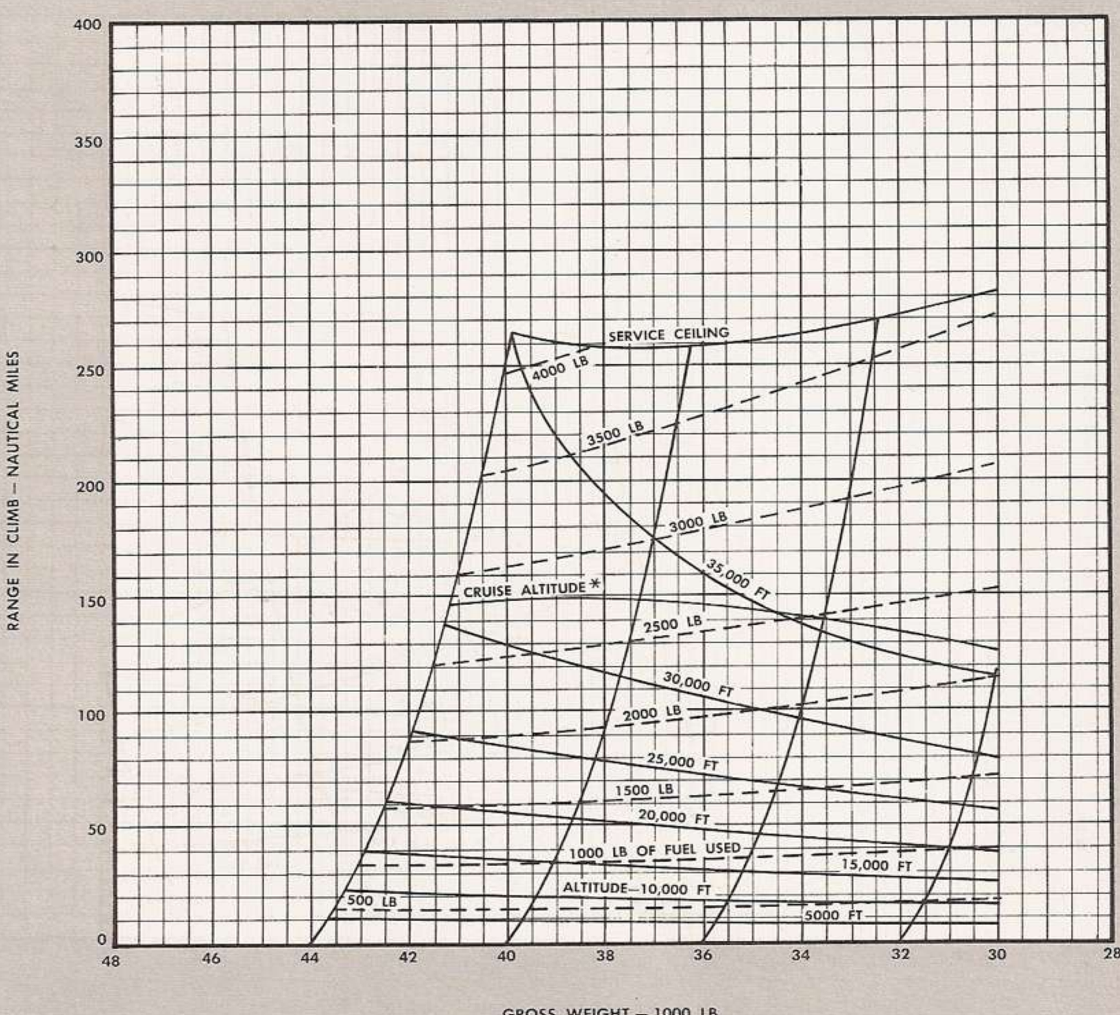
Figure A4-1.

BEST CLIMB PERFORMANCE (RANGE)

MILITARY POWER
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-23 B

Figure A4-2.

BEST CLIMB PERFORMANCE *(RANGE)*

NORMAL POWER

TWO PYLONS

MODEL: F-89J

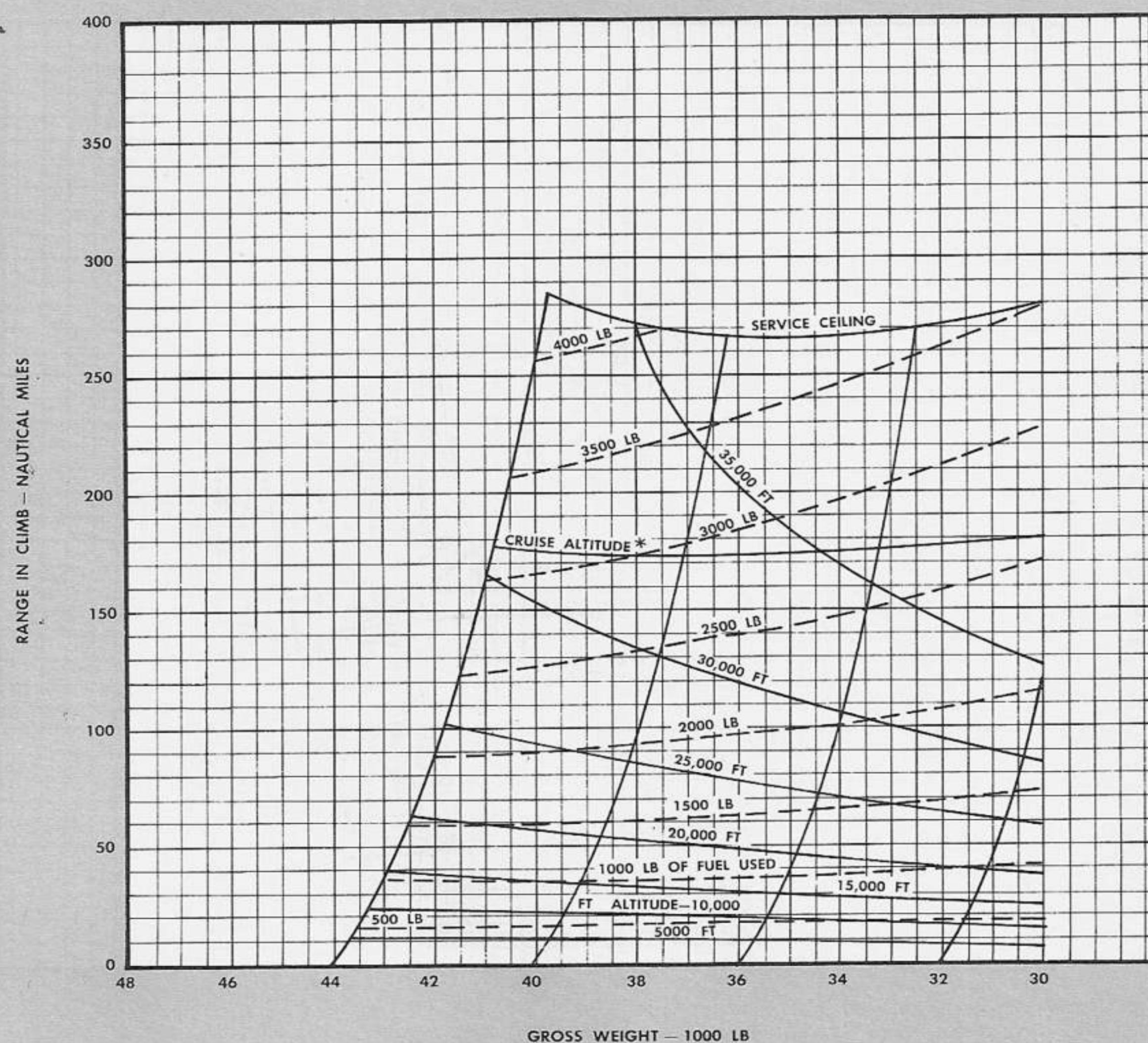
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-248

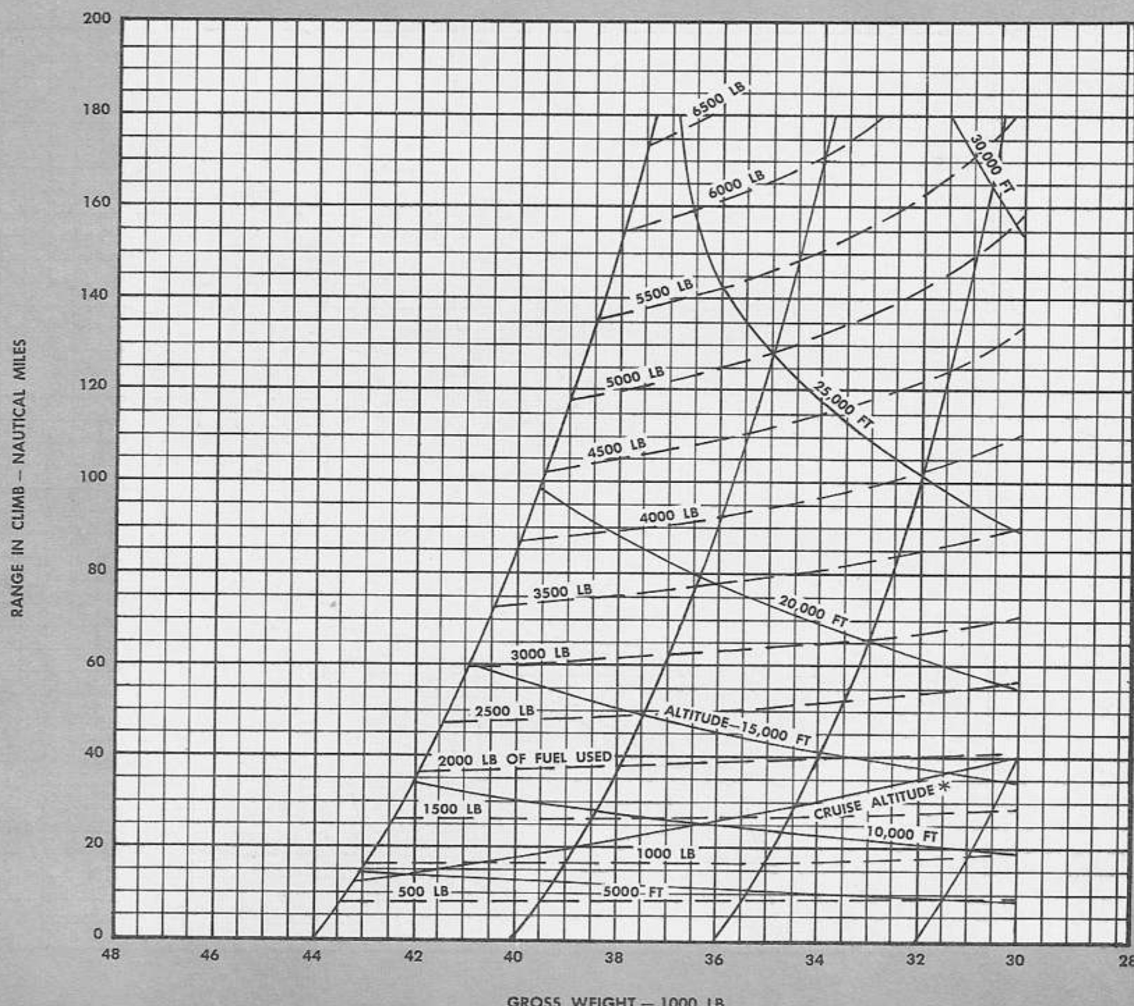
Figure A4-3.

BEST CLIMB PERFORMANCE *(RANGE)*

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
MAXIMUM POWER
TWO PYLONS

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-25B

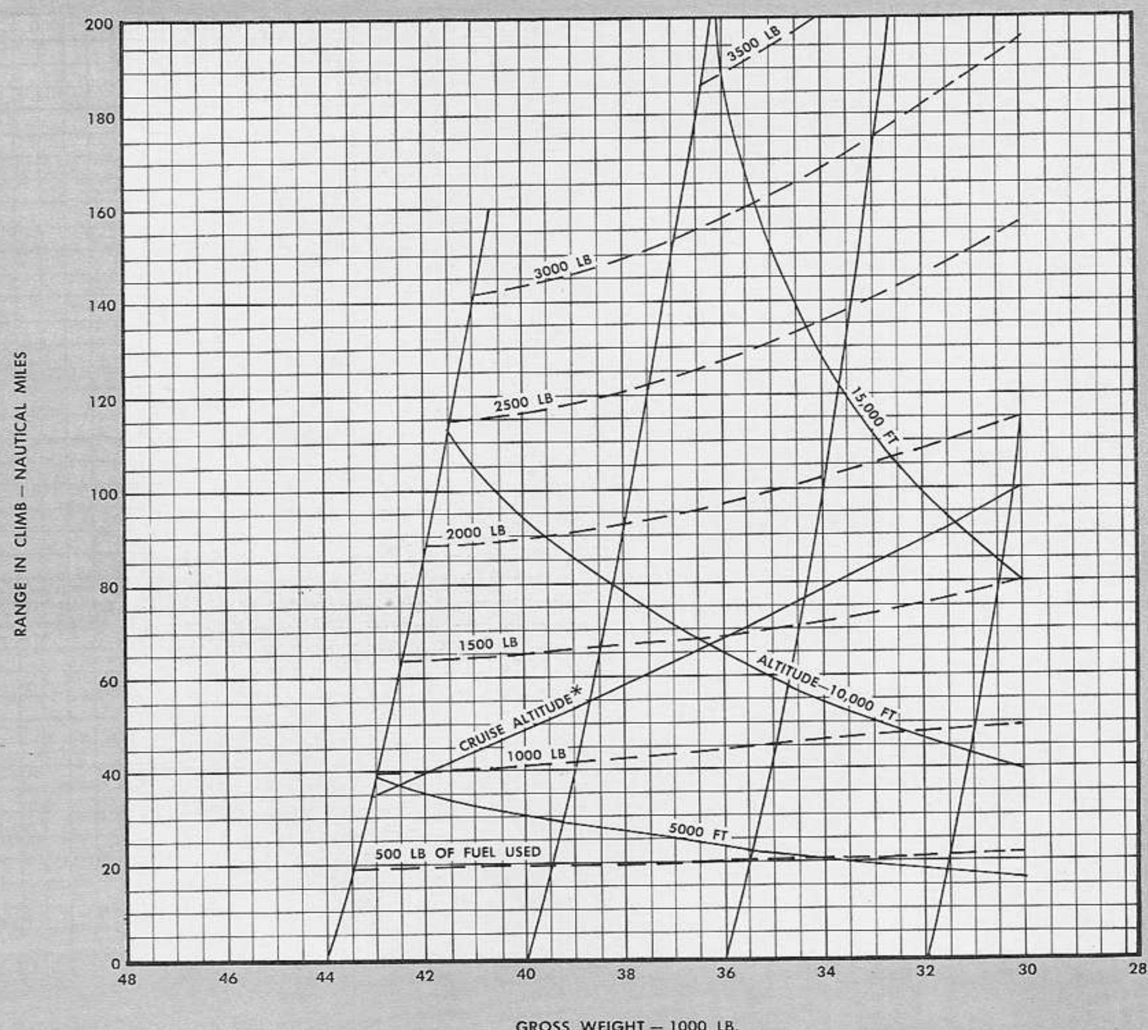
Figure A4-4.

BEST CLIMB PERFORMANCE (RANGE)

ONE ENGINE OPERATING
MILITARY POWER
TWO PYLONS

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-26B

Figure A4-5.

BEST CLIMB PERFORMANCE (TIME)

MAXIMUM POWER

TWO PYLONS

MODEL: **F-89J**

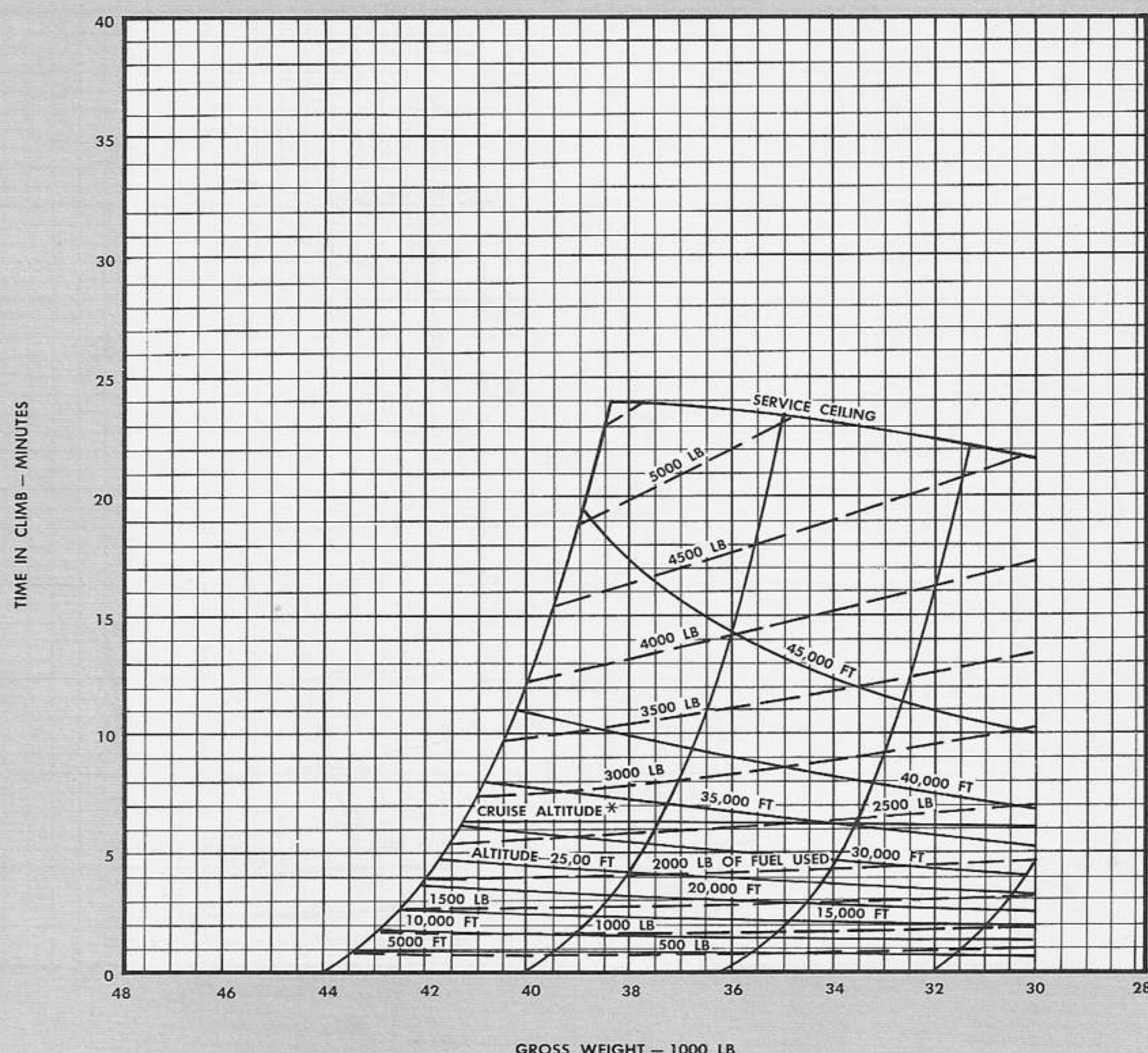
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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.

* OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-278

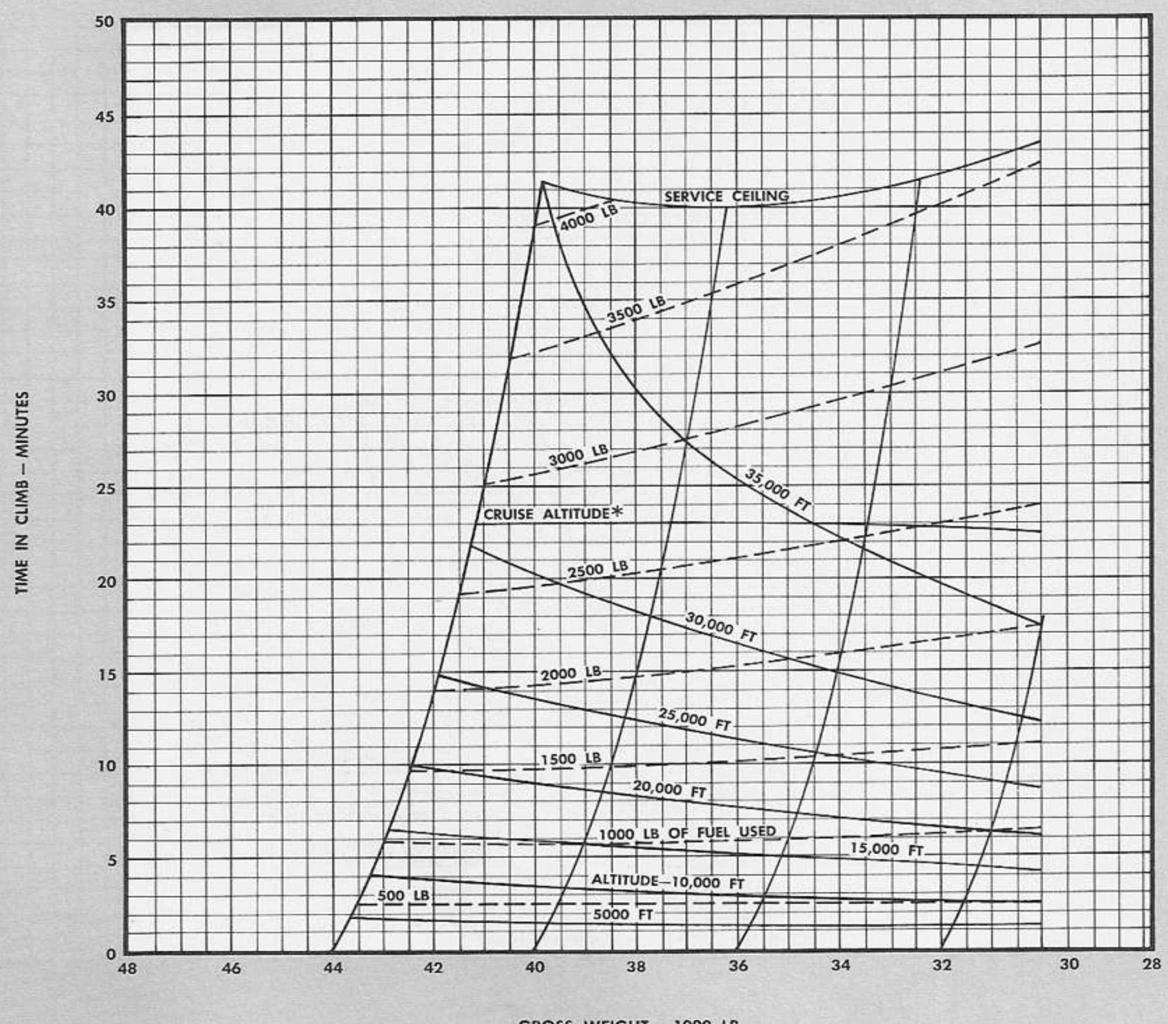
Figure A4-6.

BEST CLIMB PERFORMANCE (TIME)

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

MILITARY POWER
TWO PYLONS

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-28B

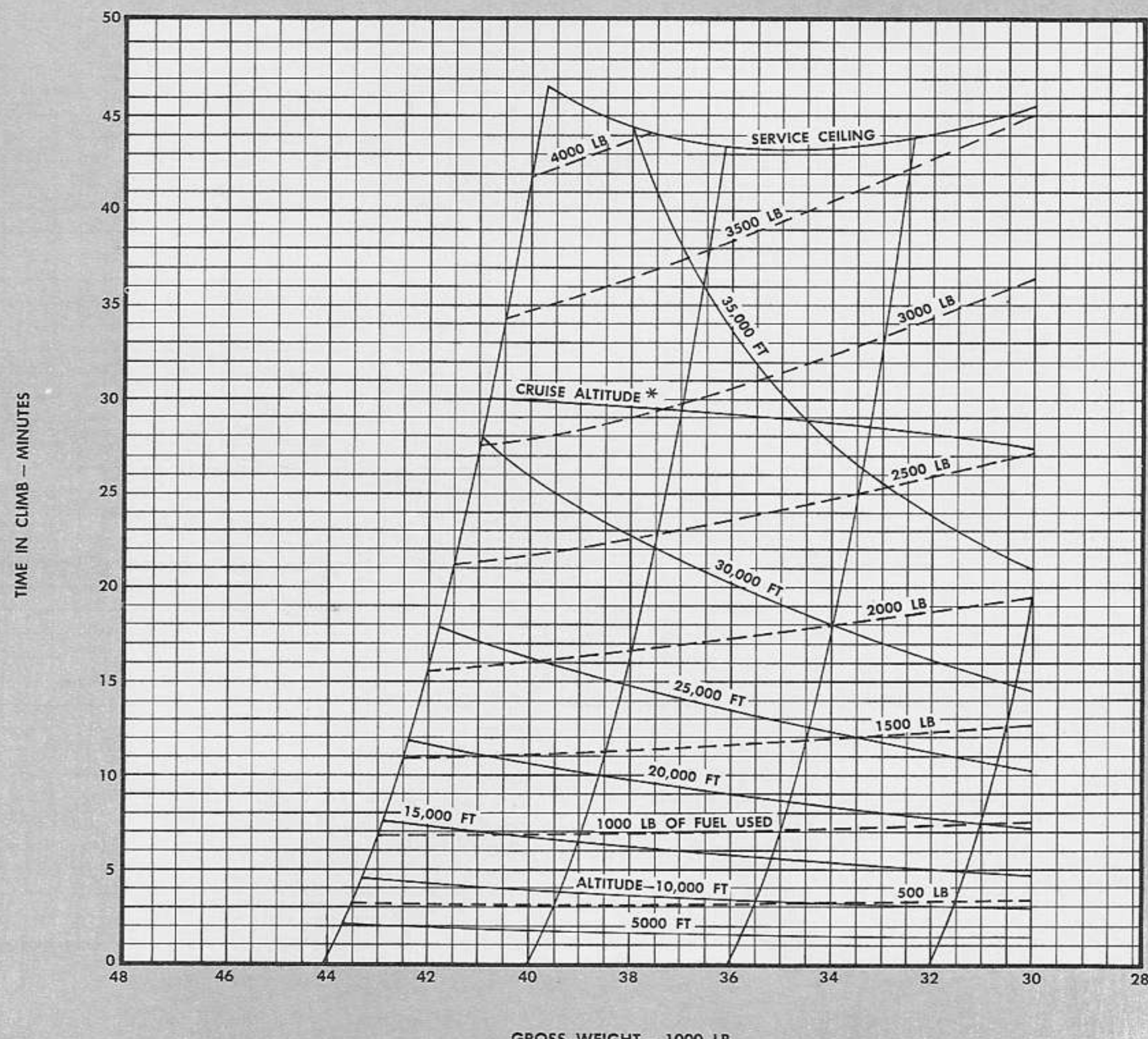
Figure A4-7.

BEST CLIMB PERFORMANCE (TIME)

NORMAL POWER
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

* OPTIMUM CRUISE ALTITUDE – NORMAL RATED POWER.

JA-29 B

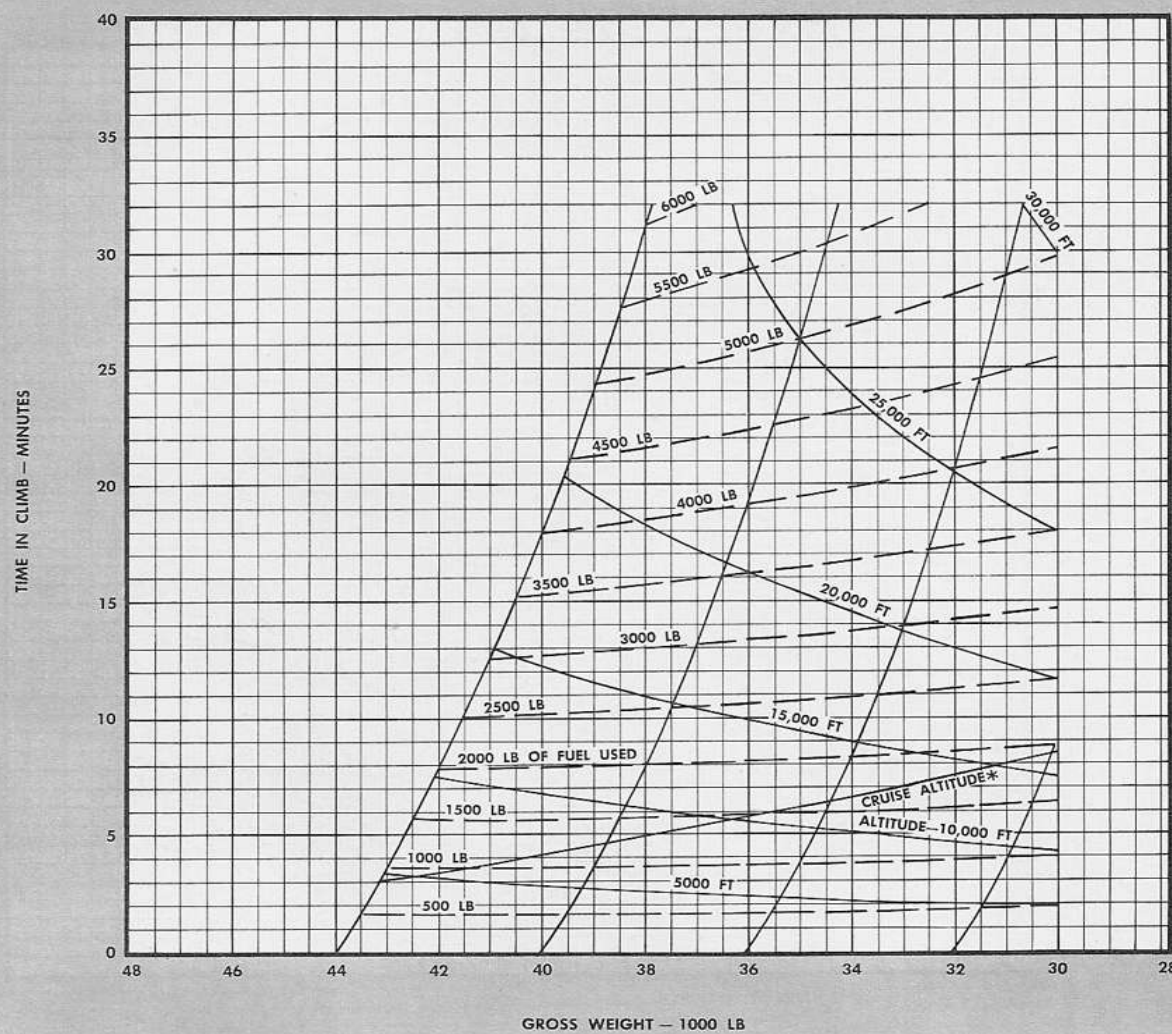
Figure A4-8.

BEST CLIMB PERFORMANCE (TIME)

ONE ENGINE OPERATING
MAXIMUM POWER
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-30B

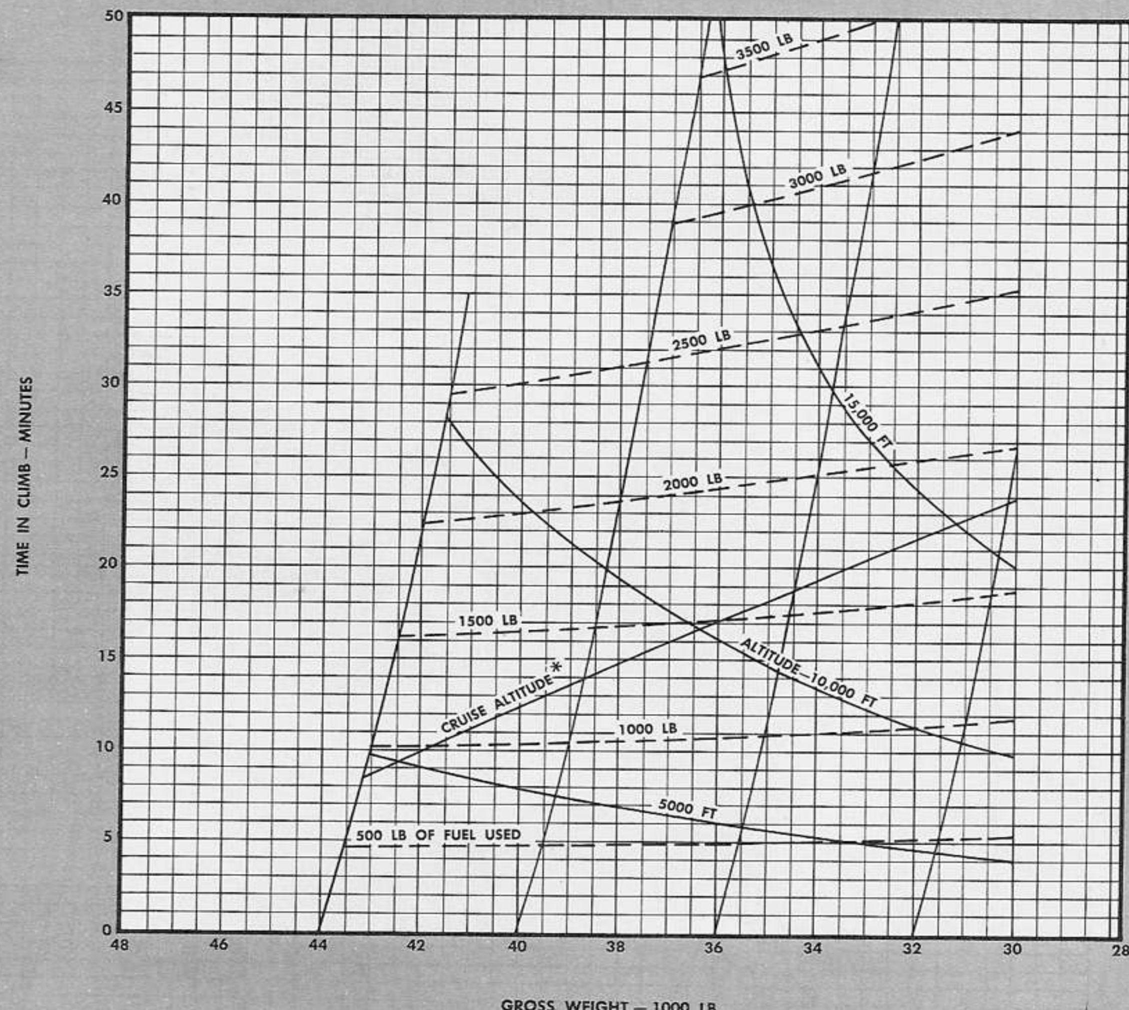
Figure A4-9.

BEST CLIMB PERFORMANCE (TIME)

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
MILITARY POWER
TWO PYLONS

ENGINE(S): (2) J35-35
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.

*OPTIMUM CRUISE ALTITUDE — NORMAL RATED POWER.

JA-31A

Figure A4-10.

BEST CLIMB SPEED

MAXIMUM POWER

TWO PYLONS

MODEL: F-89J

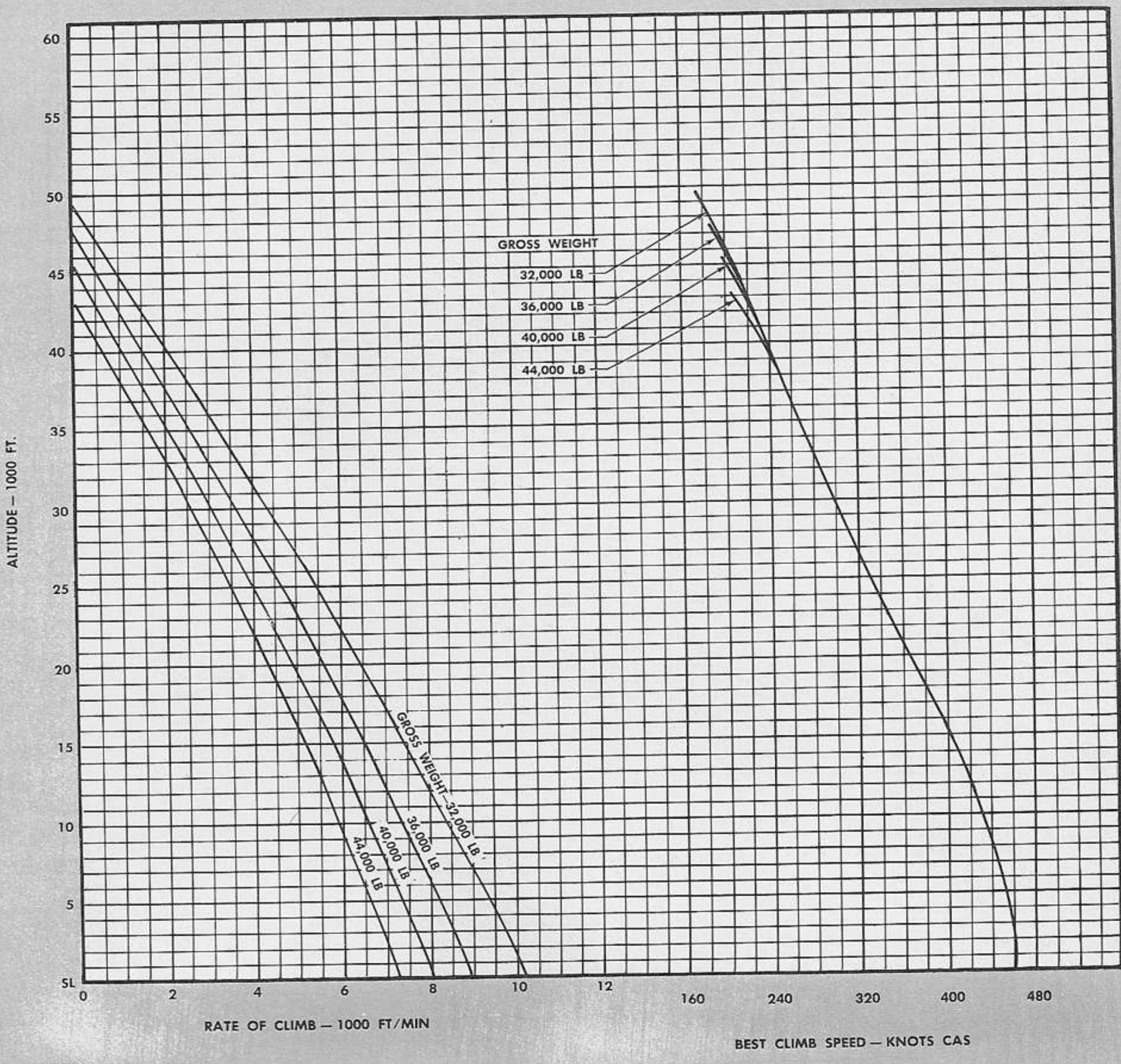
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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.

JA-32B

Figure A4-11.

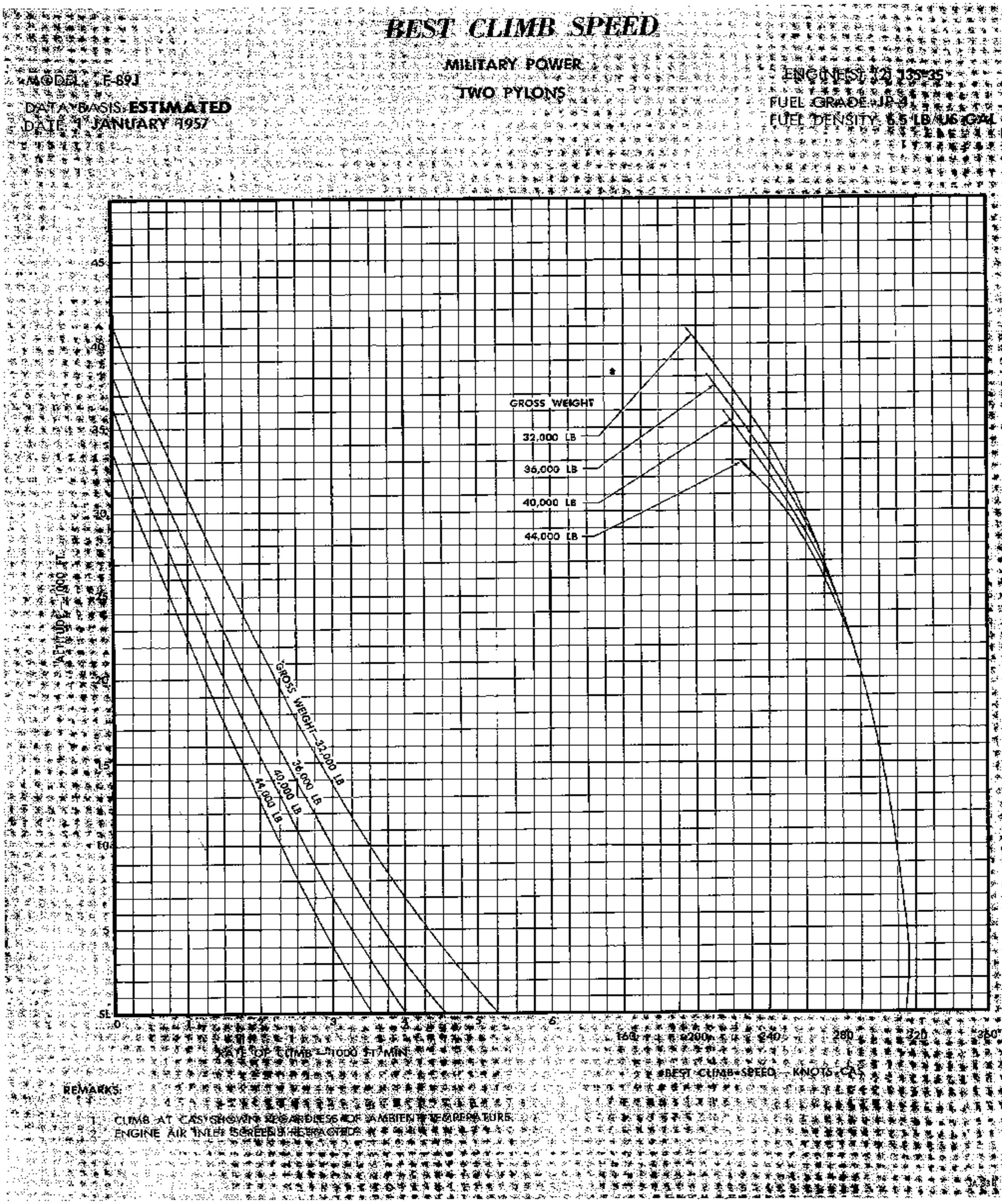

BEST CLIMB SPEED
MILITARY POWER
TWO PYLONS
MODEL: F-89J
DATA BASIS: ESTIMATED
DATE: 1 JANUARY 1957
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
GROSS WEIGHT
32,000 LB
36,000 LB
40,000 LB
44,000 LB
GROSS WEIGHT—32,000 LB
36,000 LB
40,000 LB
44,000 LB
ALTITUDE—1000 FT.
RATE OF CLIMB—1000 FT/MIN
BEST CLIMB SPEED—KNOTS CAS
REMARKS:
1. CLIMB AT CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE
2. ENGINE AIR INLET SCREENS RETRACTED

Figure A4-12.

BEST CLIMB SPEED

NORMAL POWER

TWO PYLONS

MODEL: F-89J

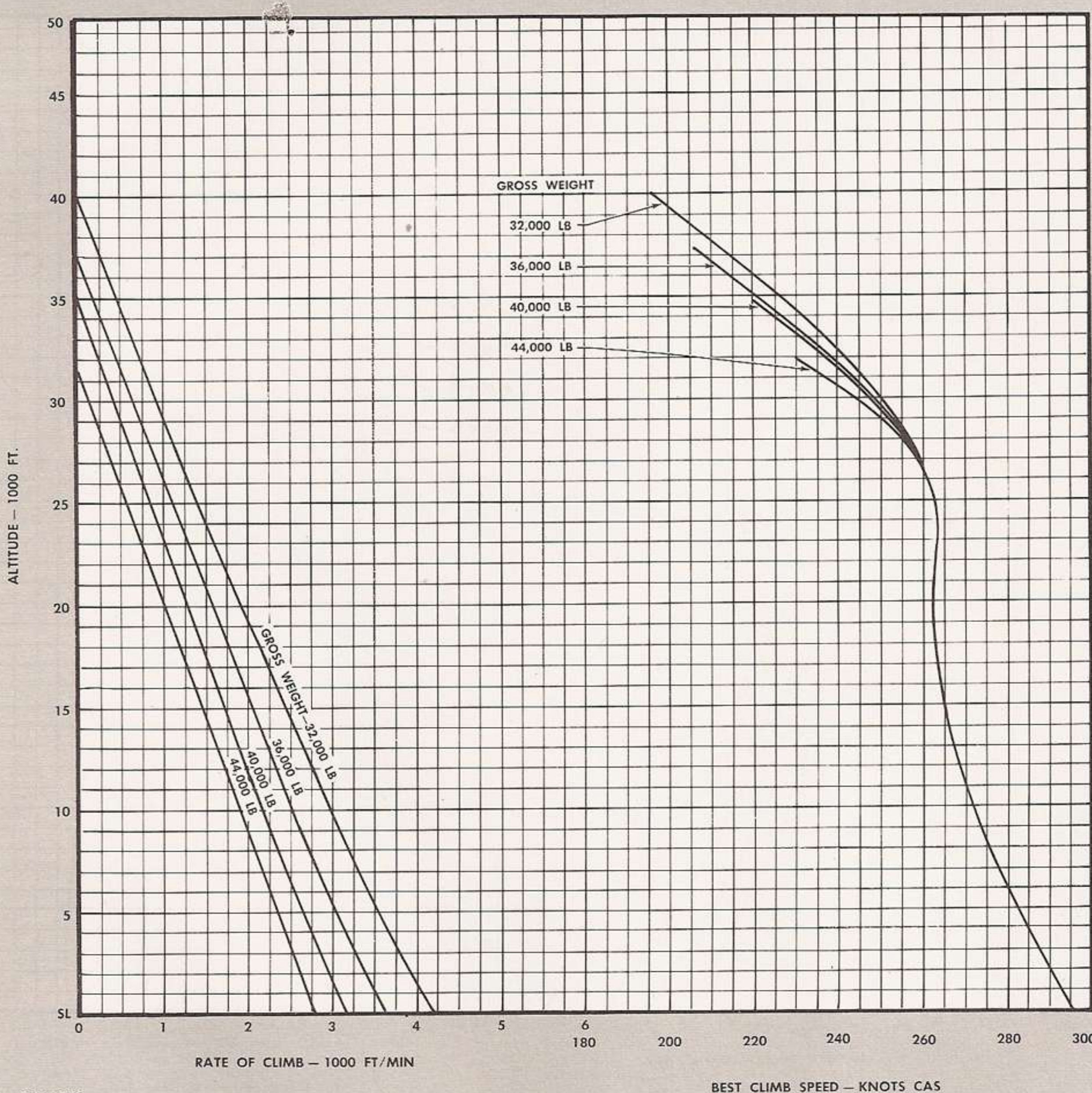
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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.

JA-348

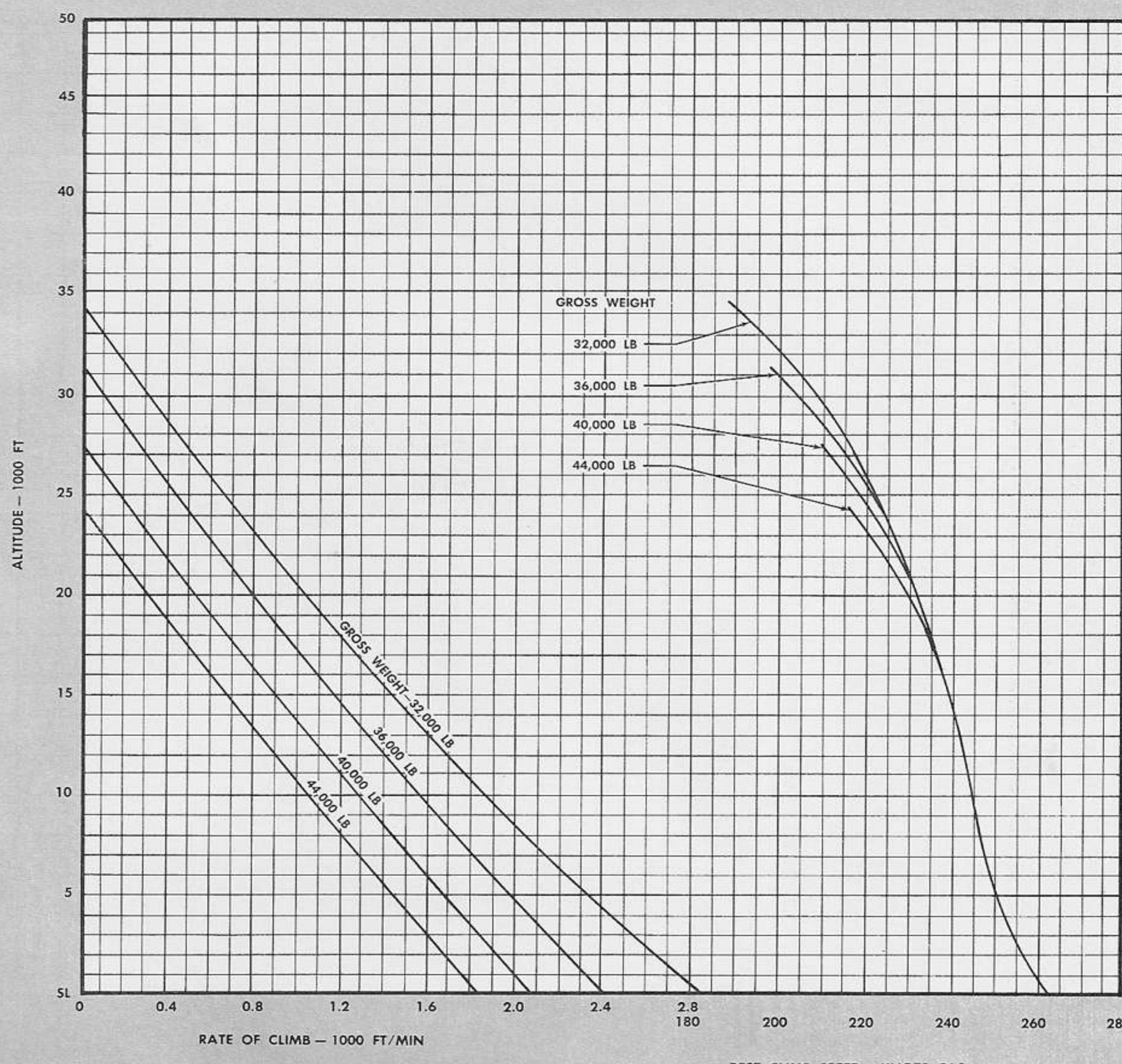
Figure A4-13.

BEST CLIMB SPEED

ONE ENGINE OPERATING
MAXIMUM POWER
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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.

JA-35B

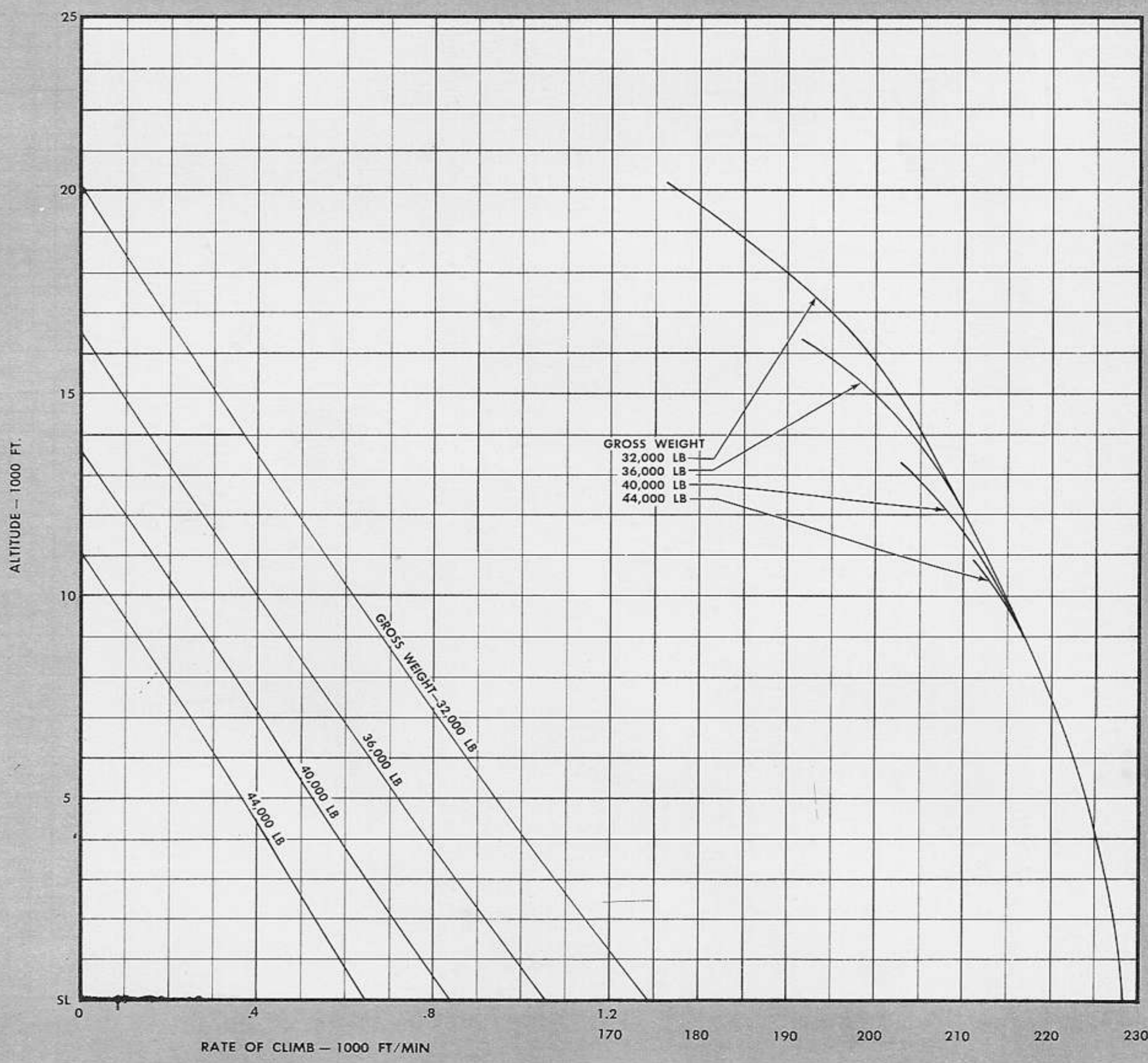
Figure A4-14.

BEST CLIMB SPEED

MILITARY POWER
ONE ENGINE OPERATING
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S):(2) J35-35
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.

JA-368

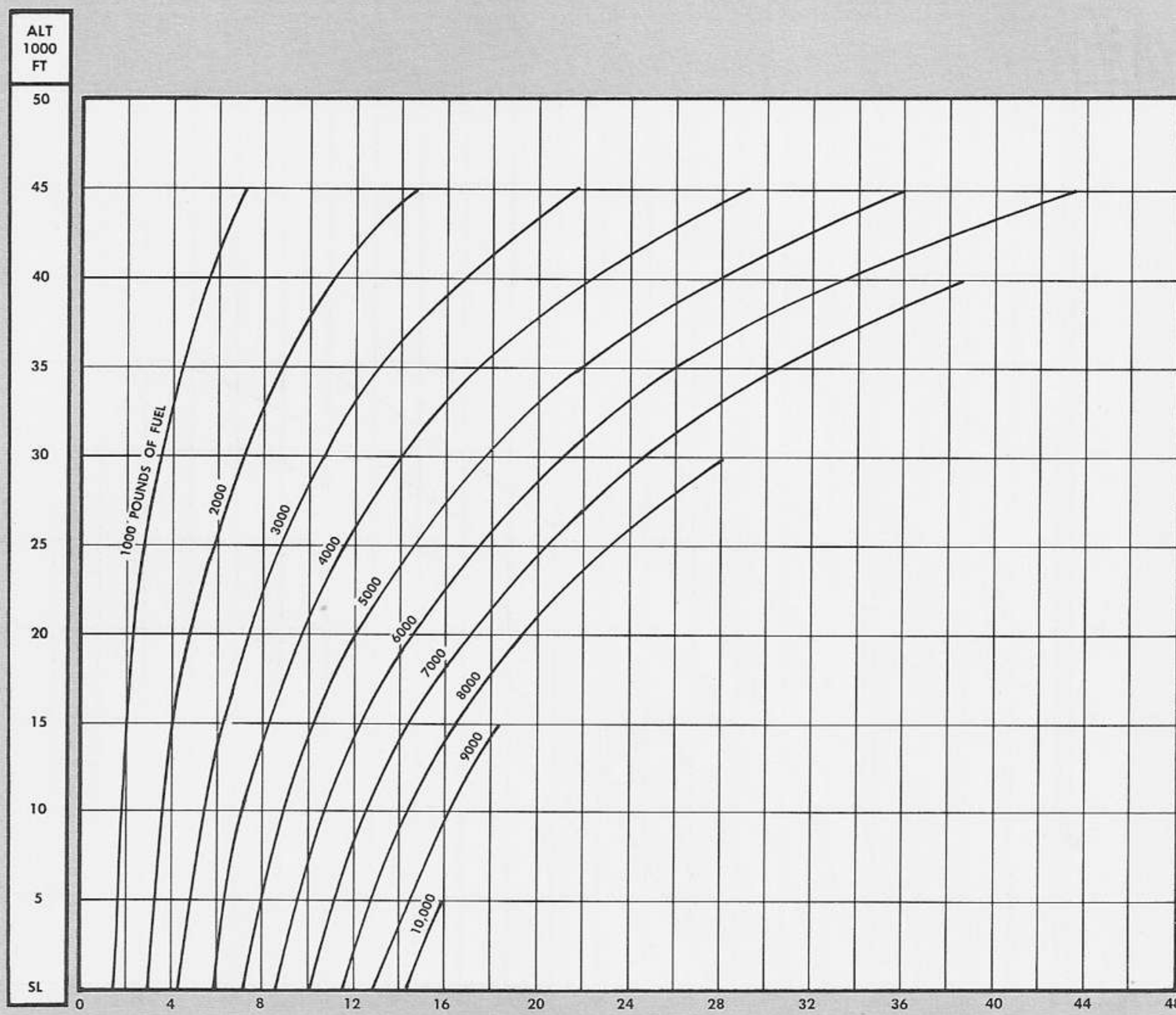
Figure A4-15.

COMBAT ALLOWANCE CHART

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

MAXIMUM POWER
TWO PYLONS

ENGINE(S): **(2) J35-35**
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: 750°C.

JA-1558

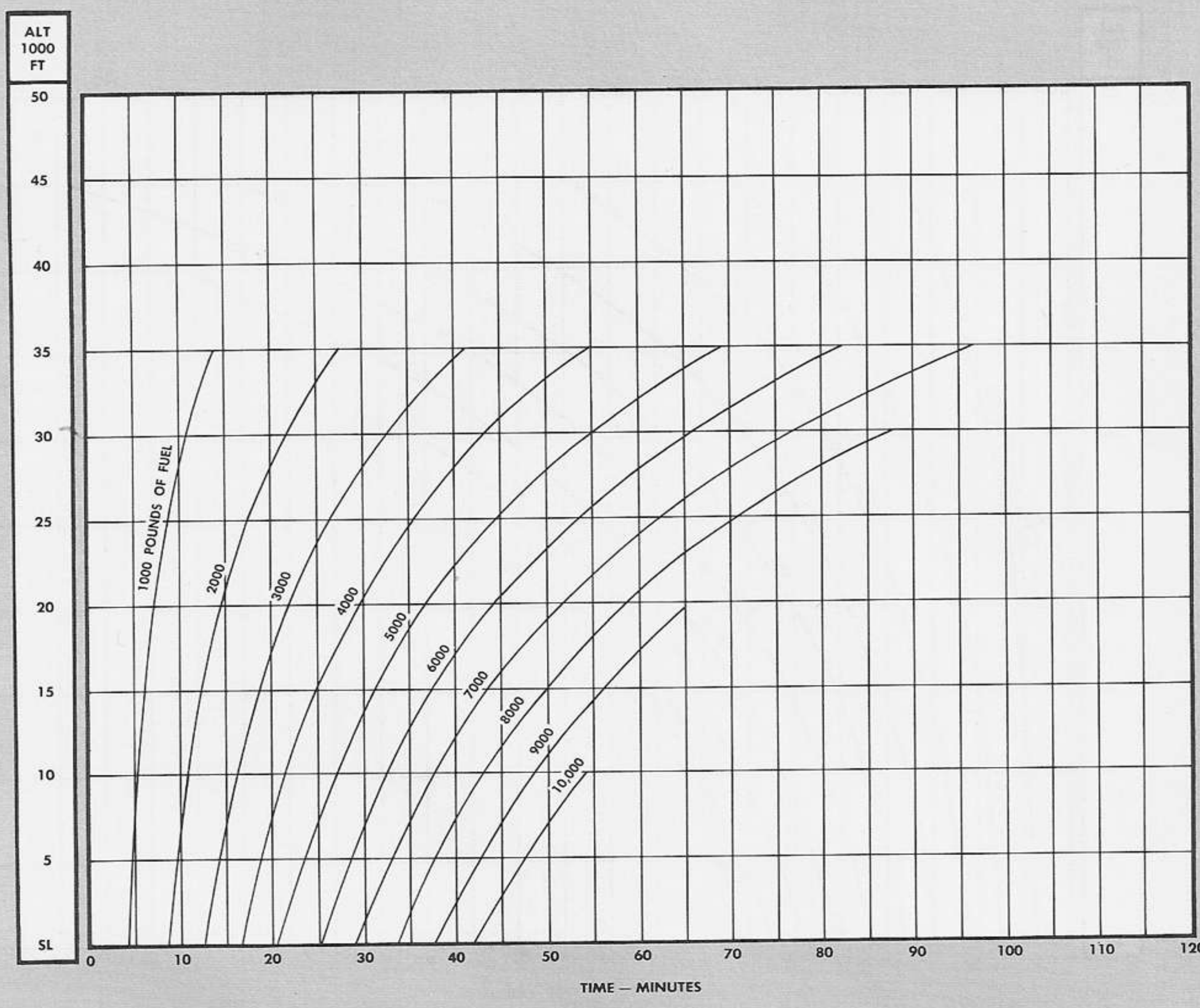
Figure A4-16.

COMBAT ALLOWANCE CHART

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

MILITARY POWER
TWO PYLONS

ENGINE(S): (2) J35-35
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: 750°C.

JA-156B

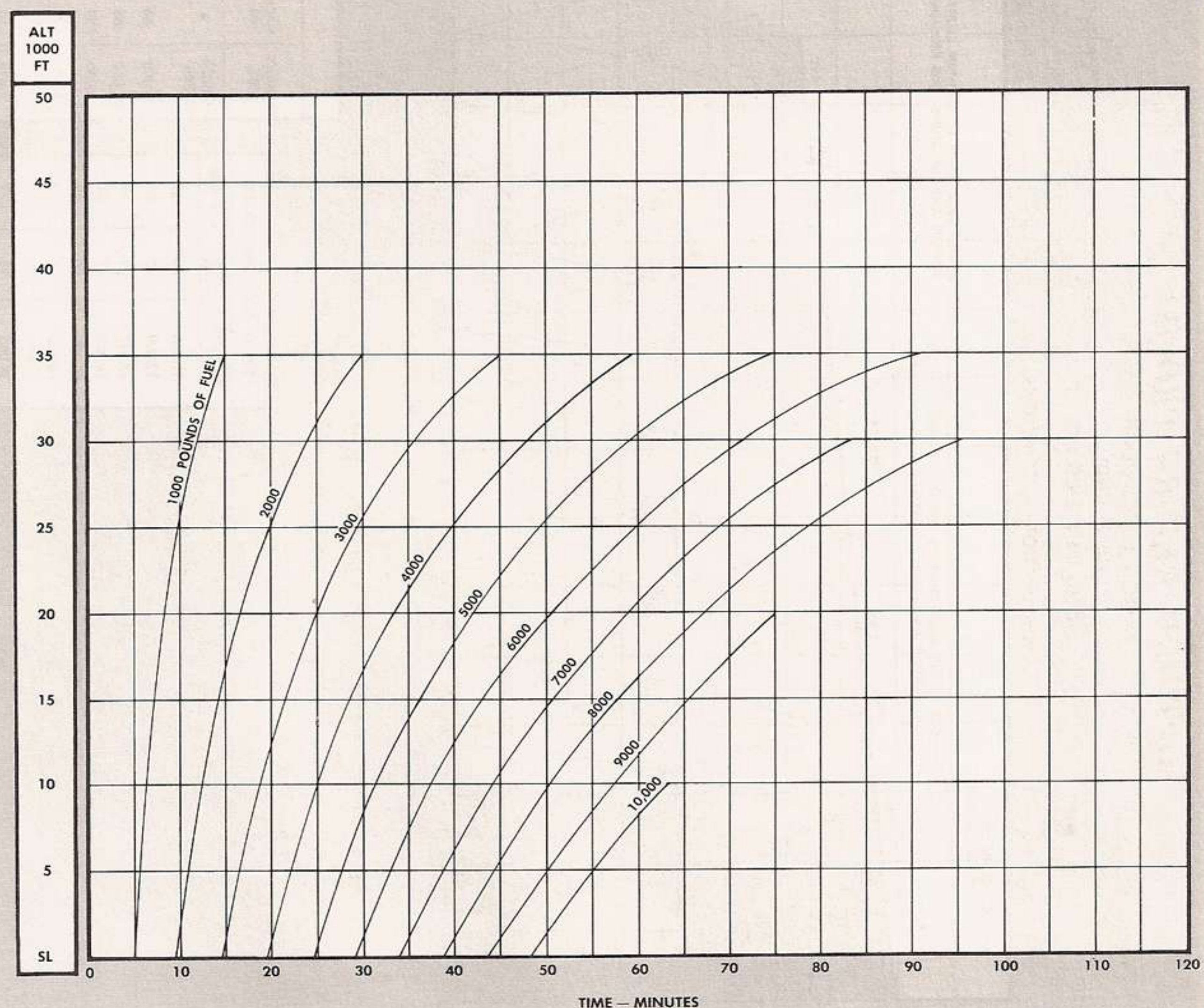
Figure A4-17.

COMBAT ALLOWANCE CHART

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

NORMAL POWER
TWO PYLONS

ENGINE(S): (2) J35-35
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: 680°C.

JA-157B

Figure A4-18.

OPTIMUM RETURN PROFILE

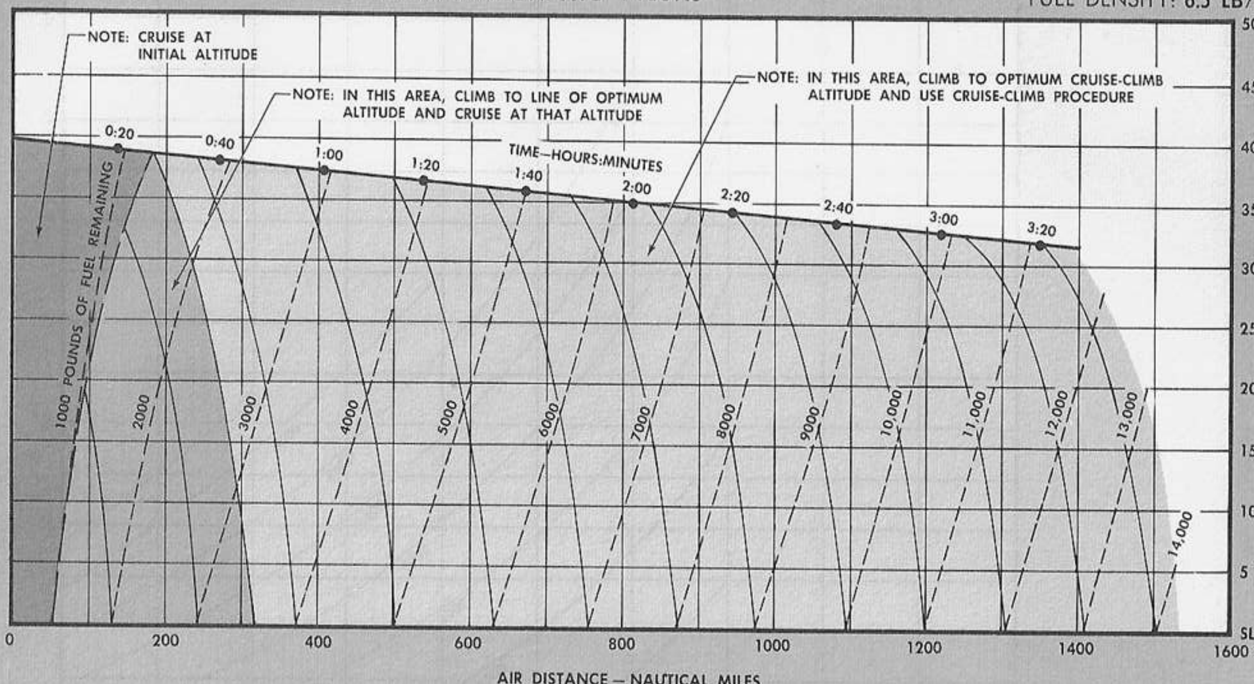
TAKEOFF GROSS WEIGHT
43,110 POUNDS
LONG RANGE CRUISE

CONFIGURATION: TWO PYLONS

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
.67	225	35
.68	250	30
.66	275	25
.63	290	20
.60	300	15
.56	310	10
.52	315	5
.48	315	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	MACH NO.	% RPM
31,000	89	.67
32,000	89	.68
33,000	89	.68
34,000	89	.68
35,000	90	.69
36,000	90	.70
37,000	92	.70
38,000	92	.71
39,000	92	.71

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*			3900-3700	*
30,000	.66	250	390	3800	89
25,000	.63	265	380	4000	87
20,000	.59	270	360	4300	86
15,000	.57	290	360	4700	84
10,000	.55	305	350	5400	84
5,000	.53	325	345	5900	83
SEA LEVEL	.45	300	300	6000	79

JA-175 C

Figure A4-19.

OPTIMUM RETURN PROFILE

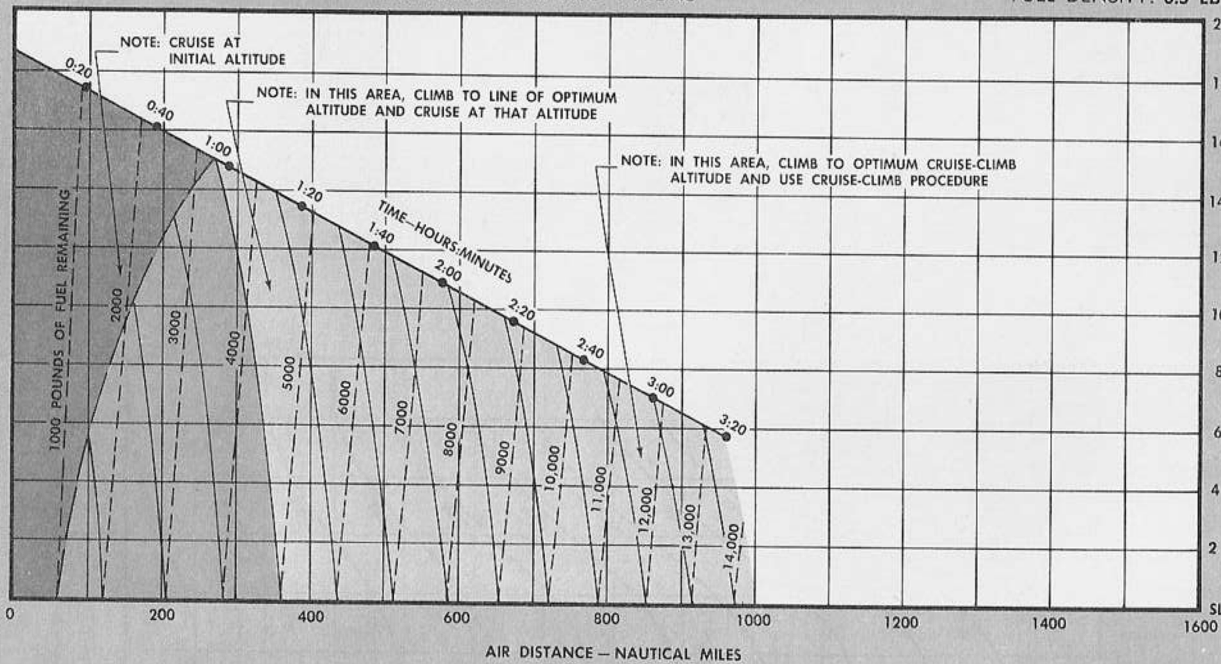
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

TAKEOFF GROSS WEIGHT
43,110 POUNDS
ONE ENGINE OPERATING
LONG RANGE CRUISE

CONFIGURATION: TWO PYLONS

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		18
		16
.39	200	14
.39	210	12
.39	215	10
.38	220	8
.37	220	6
.36	220	4
.35	225	2
.35	230	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	MACH NO.	% RPM
7,000	94	.43
8,000	94	.43
9,000	94	.43
10,000	94	.44
11,000	94	.44
12,000	95	.45
13,000	95	.45
14,000	95	.45
15,000	96	.46
16,000	96	.47
17,000	97	.47
18,000	97	.47

CRUISE					
ALTITUDE FEET	MACH NO.	APPROXIMATE			
		CAS	TAS	LB/HR	% RPM
CRUISE-CLIMB	*			4200-3500	*
14,000	.46	235	290	3600	95
12,000	.45	240	285	3800	95
10,000	.44	245	280	4000	94
8,000	.44	250	280	4100	94
6,000	.43	260	280	4300	94
4,000	.42	260	275	4500	93
2,000	.41	265	270	4600	92
SEA LEVEL	.40	265	265	4800	91

JA-176 B

Figure A4-20.

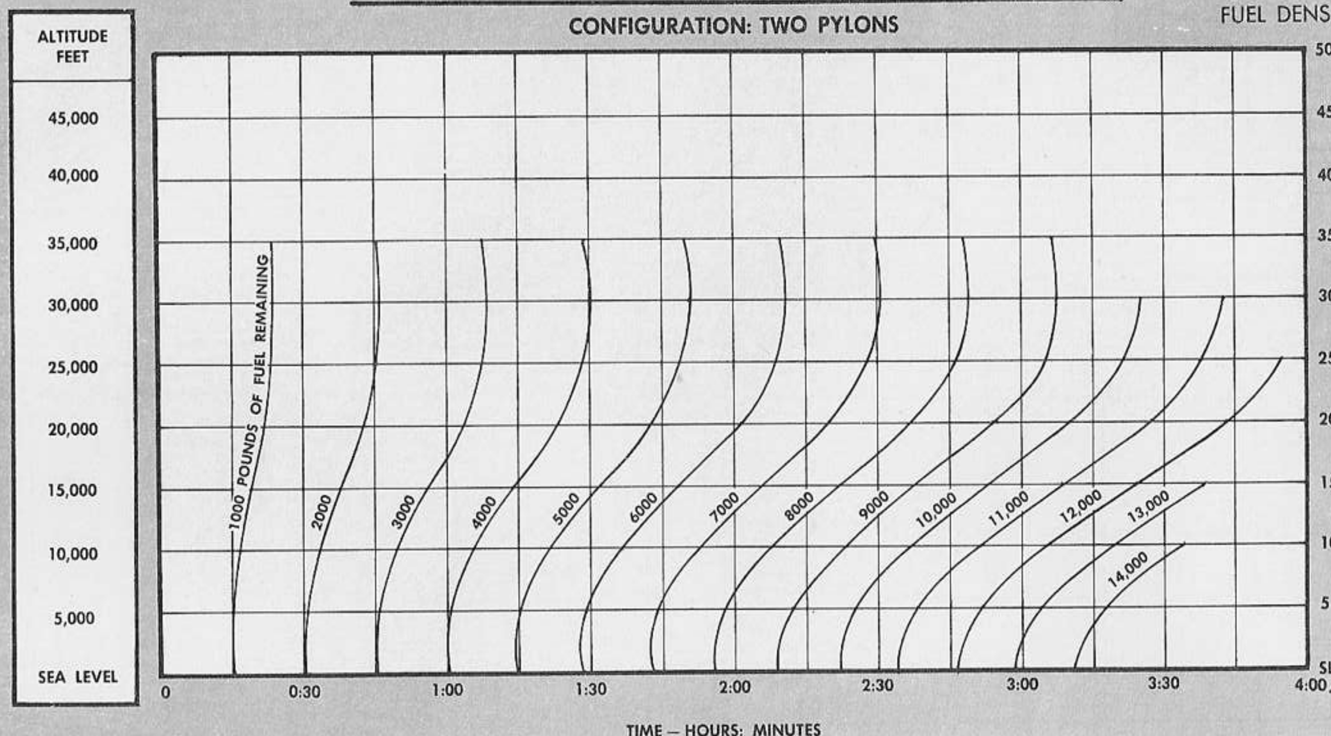
MAXIMUM ENDURANCE

DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

TAKEOFF GROSS WEIGHT
43,110 POUNDS

MODEL: **F-89J**
ENGINE(S): **(2) J35-35**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

CONFIGURATION: TWO PYLONS



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
35,000	185	320	.56	3000	89
30,000	185	295	.50	3100	85
25,000	190	275	.46	3200	83
20,000	185	250	.41	3200	79
15,000	190	·240	.38	3600	77
10,000	195	225	.35	3900	75
5,000	200	210	.32	4200	73
SEA LEVEL	190	190	.29	4300	69

JA-188 C

Figure A4-21.

MAXIMUM ENDURANCE

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

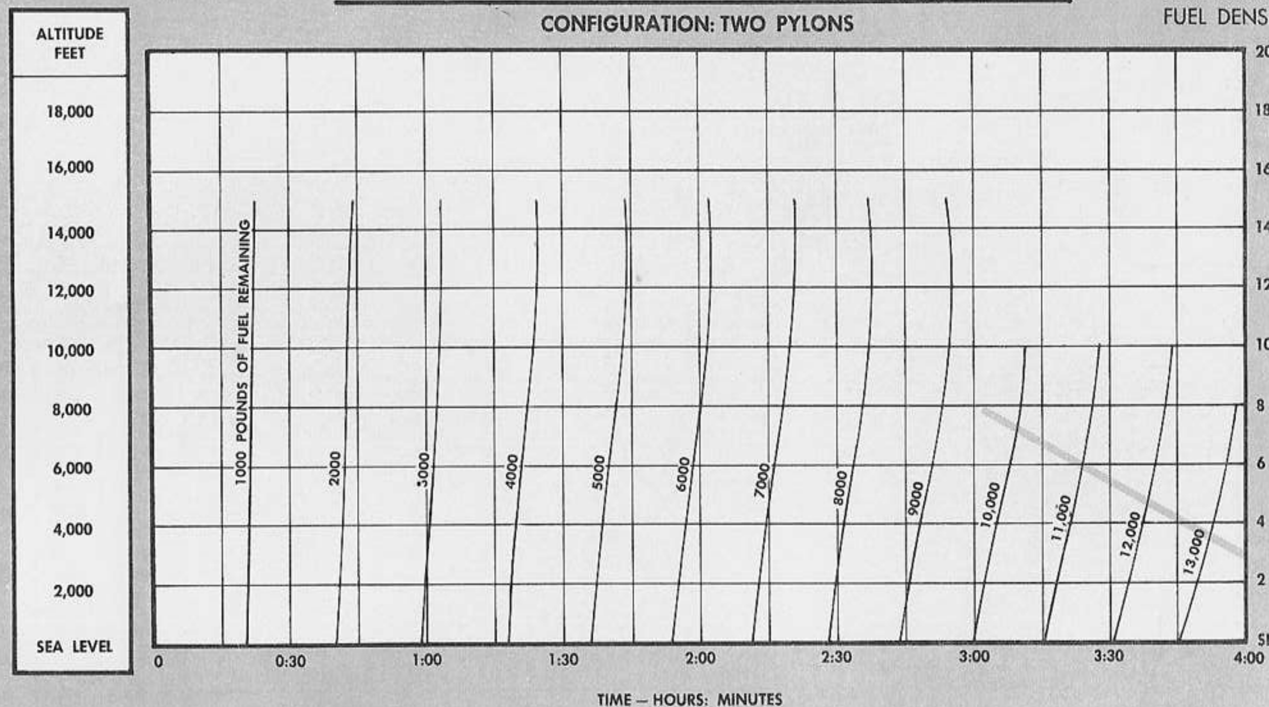
TAKEOFF GROSS WEIGHT
43,110 POUNDS

ONE ENGINE OPERATING

CONFIGURATION: TWO PYLONS

MODEL: F-89J
ENGINE(S): (2) J35-35

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



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
16,000					
14,000	175	215	.34	3100	92
12,000	175	210	.33	3100	91
10,000	180	210	.33	3300	90
8,000	180	200	.31	3300	88
6,000	185	200	.31	3400	87
4,000	185	195	.30	3400	86
2,000	185	190	.29	3400	84
SEA LEVEL	185	185	.28	3600	83

JA-189B

Figure A4-22.

OPTIMUM MAXIMUM ENDURANCE PROFILE

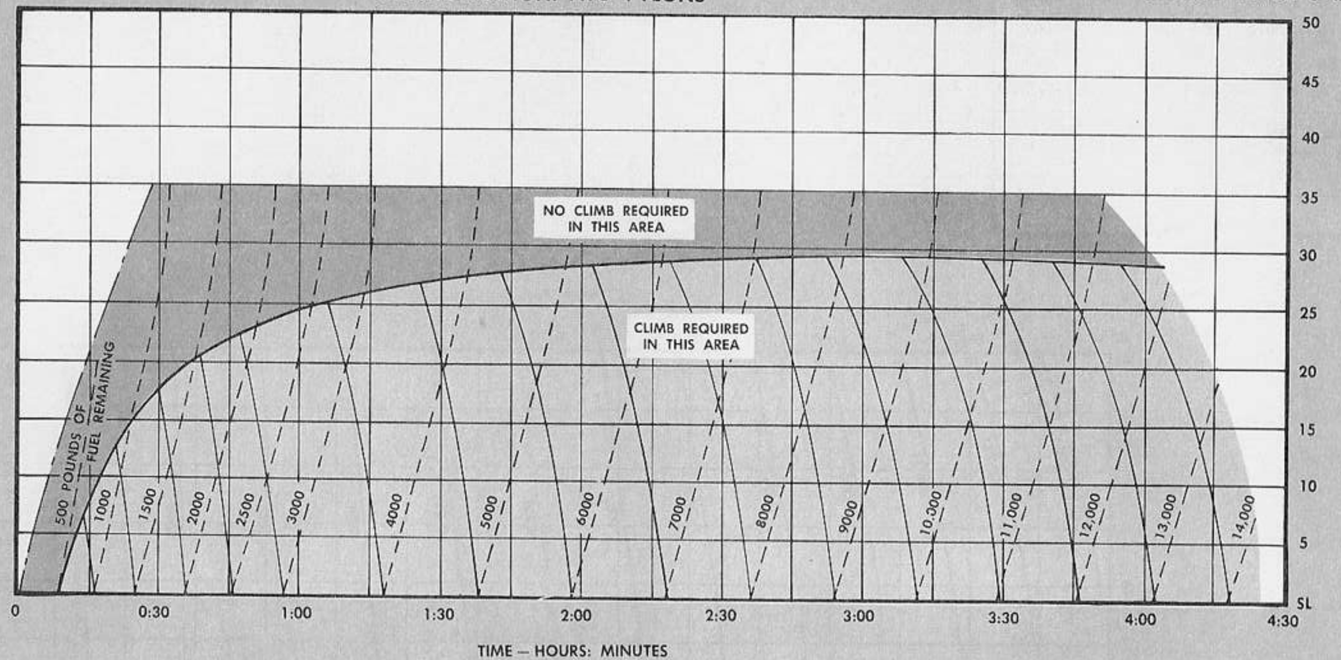
TAKEOFF GROSS WEIGHT
43,110 POUNDS

DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

MODEL: F-89J
ENGINE(S): (2) J35-35
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONFIGURATION: TWO PYLONS

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		45
		40
		35
.66	250	30
.63	265	25
.57	265	20
.53	245	15
.49	270	10
.46	280	5
.45	300	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					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
35,000	190	.57	330	2800	88
30,000	190	.51	300	3000	85
25,000	170	.42	250	2500	78
20,000	175	.38	235	2700	75
15,000	165	.33	205	3100	74
10,000	175	.32	205	3400	72
5,000	180	.29	190	3600	70
SEA LEVEL	180	.27	180	3600	66

LEGEND

- - - - - FUEL REMAINING
▬▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
——— NORMAL POWER CLIMB GUIDE LINES
— · — MAXIMUM RANGE DESCENT

JA-2010

Figure A4-23.

OPTIMUM MAXIMUM ENDURANCE PROFILE

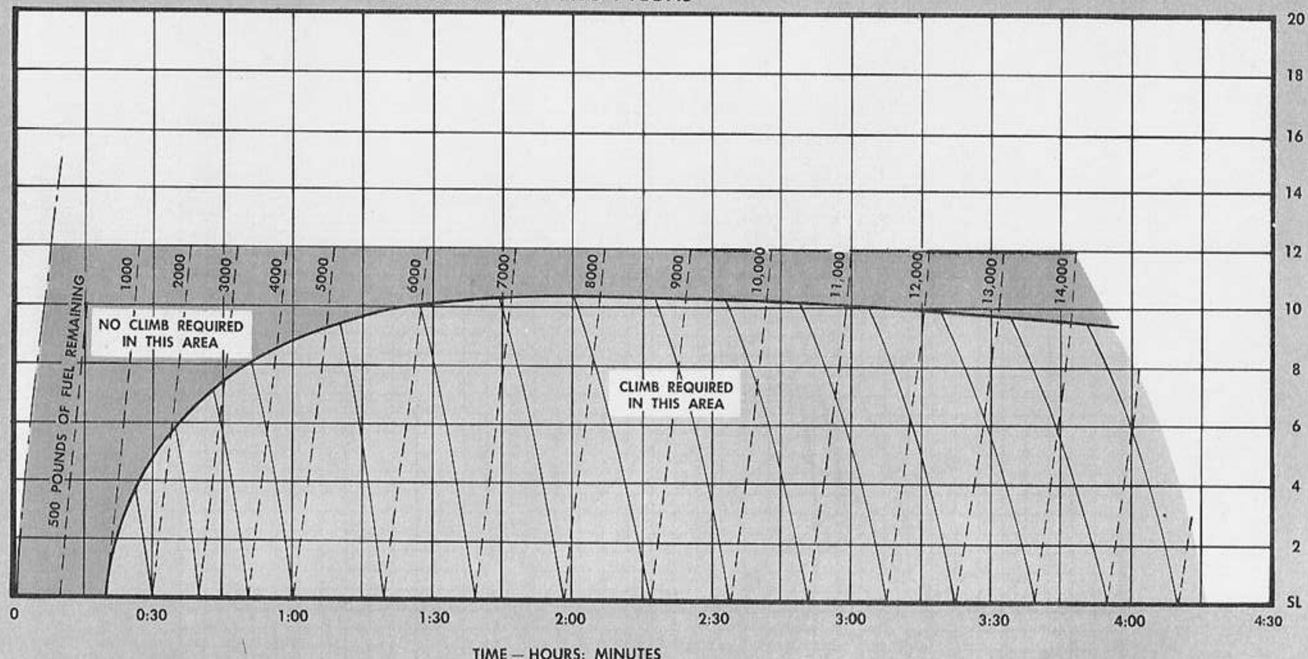
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

TAKEOFF GROSS WEIGHT
43,110 POUNDS
ONE ENGINE OPERATING

CONFIGURATION: TWO PYLONS

MODEL: **F-89J**
ENGINE(S): (2) **J35-35**
FUEL GRADE: **JP-4**
FUEL DENSITY: **6.5 LB/US GAL**

NORMAL POWER CLIMB		
MACH NO.	CAS	ALT. 1000 FT.
		18
		16
		14
.39	210	12
.39	215	10
.38	220	8
.37	220	6
.36	220	4
.35	225	2
.35	230	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					
ALTITUDE FEET	CAS	APPROXIMATE			
		MACH NO.	TAS	LB/HR	% RPM
12,000	185	.34	215	3200	91
10,000	175	.32	205	3200	90
8,000	170	.30	195	2800	84
6,000	165	.28	180	2800	83
4,000	165	.27	175	2800	81
2,000	165	.26	170	2900	79
SEA LEVEL	165	.25	165	2500	78

LEGEND

- - - - - FUEL REMAINING
▬▬▬ LINE OF OPTIMUM ALTITUDE FOR LOITER
——— NORMAL POWER CLIMB GUIDE LINES
-—— - MAXIMUM RANGE DESCENT

JA-202 C

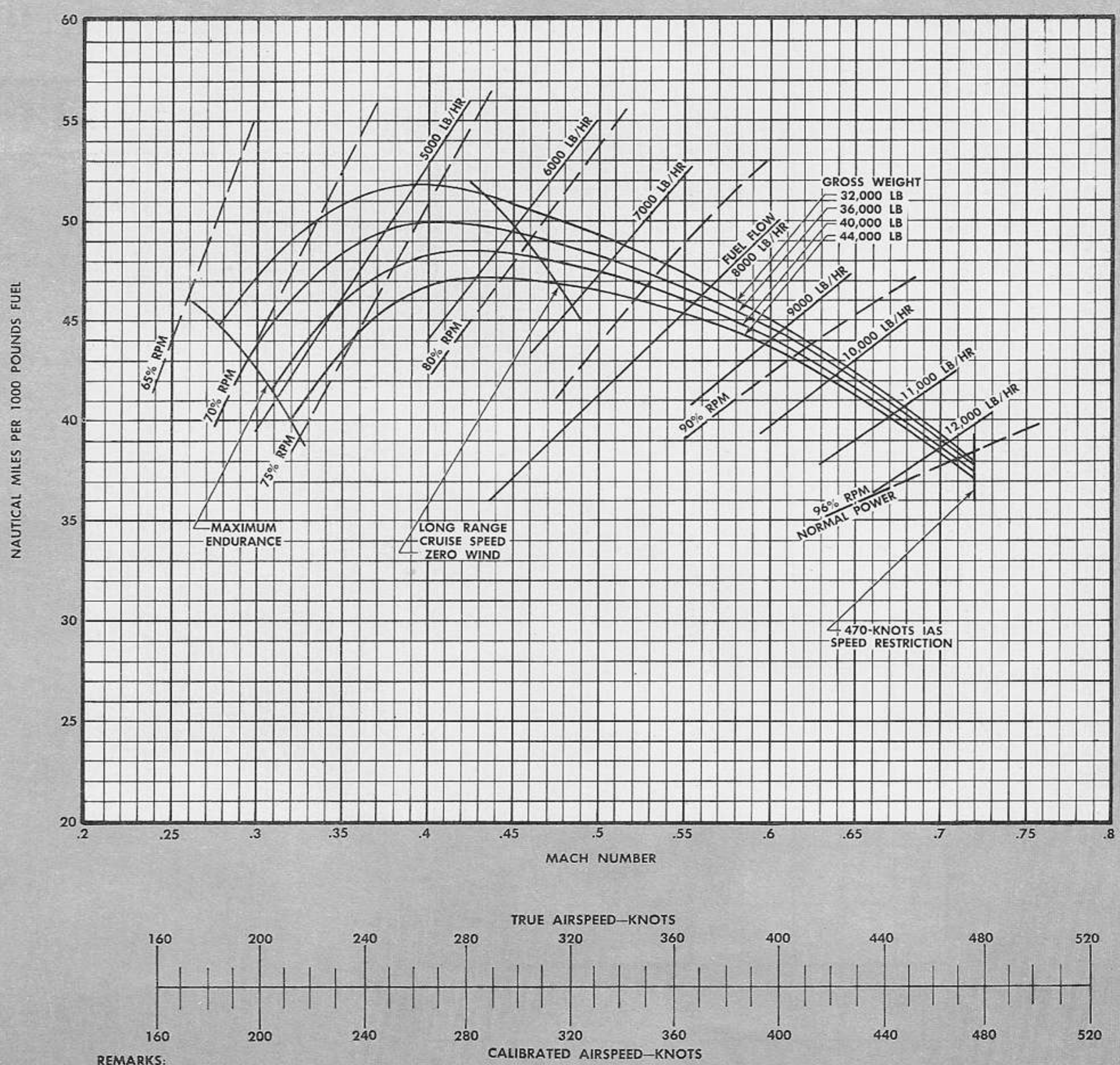
Figure A4-24.

NAUTICAL MILES PER 1000 POUNDS FUEL

SEA LEVEL
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 **SEPTEMBER** 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-75B

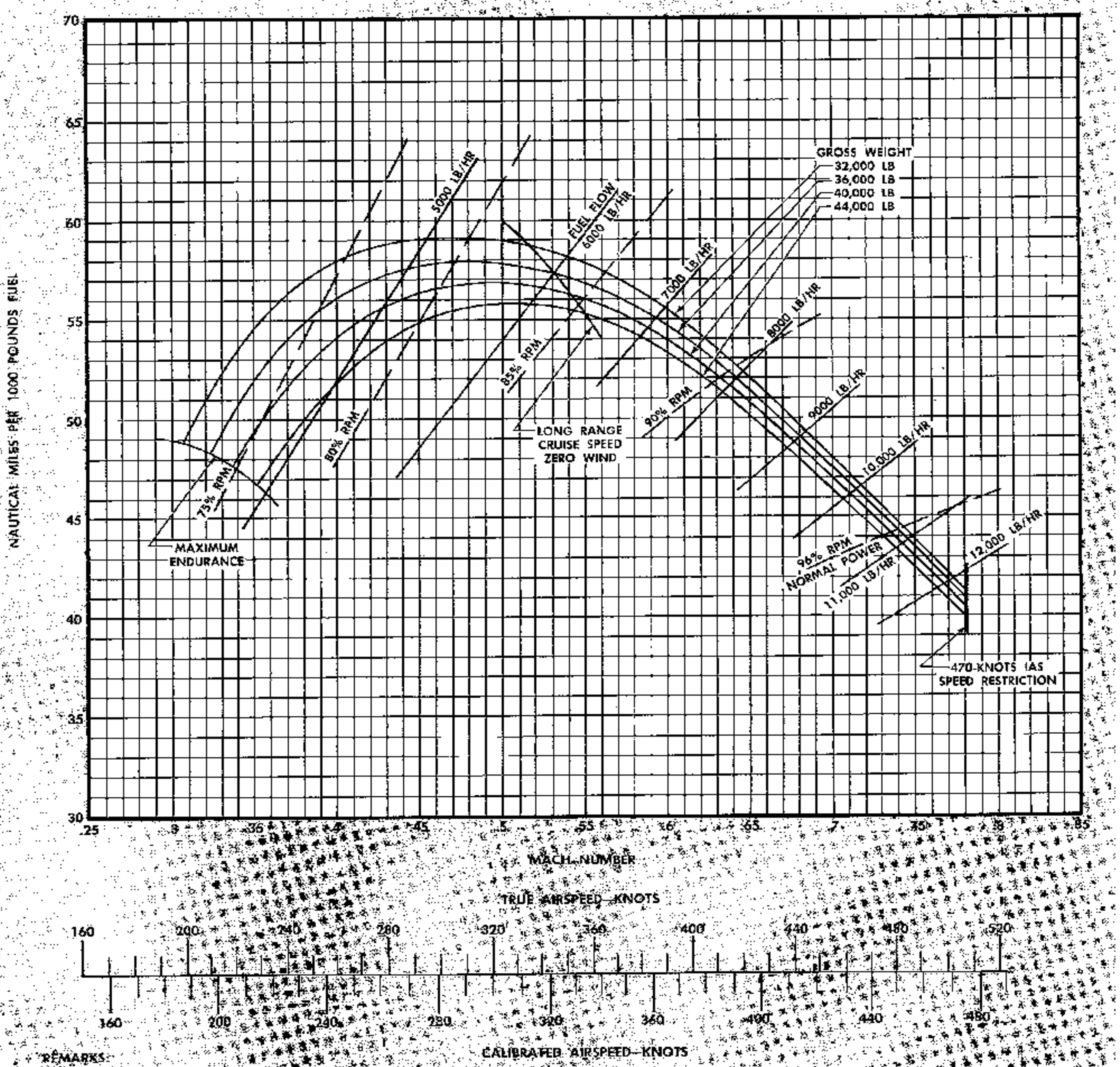
Figure A4-25.

NAUTICAL MILES PER 1000 POUNDS FUEL

5000 FEET
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN, REGARDLESS OF AMBIENT TEMPERATURE.

Figure A4-26.

NAUTICAL MILES PER 1000 POUNDS FUEL

10,000 FEET

TWO PYLONS

MODEL: F-89J

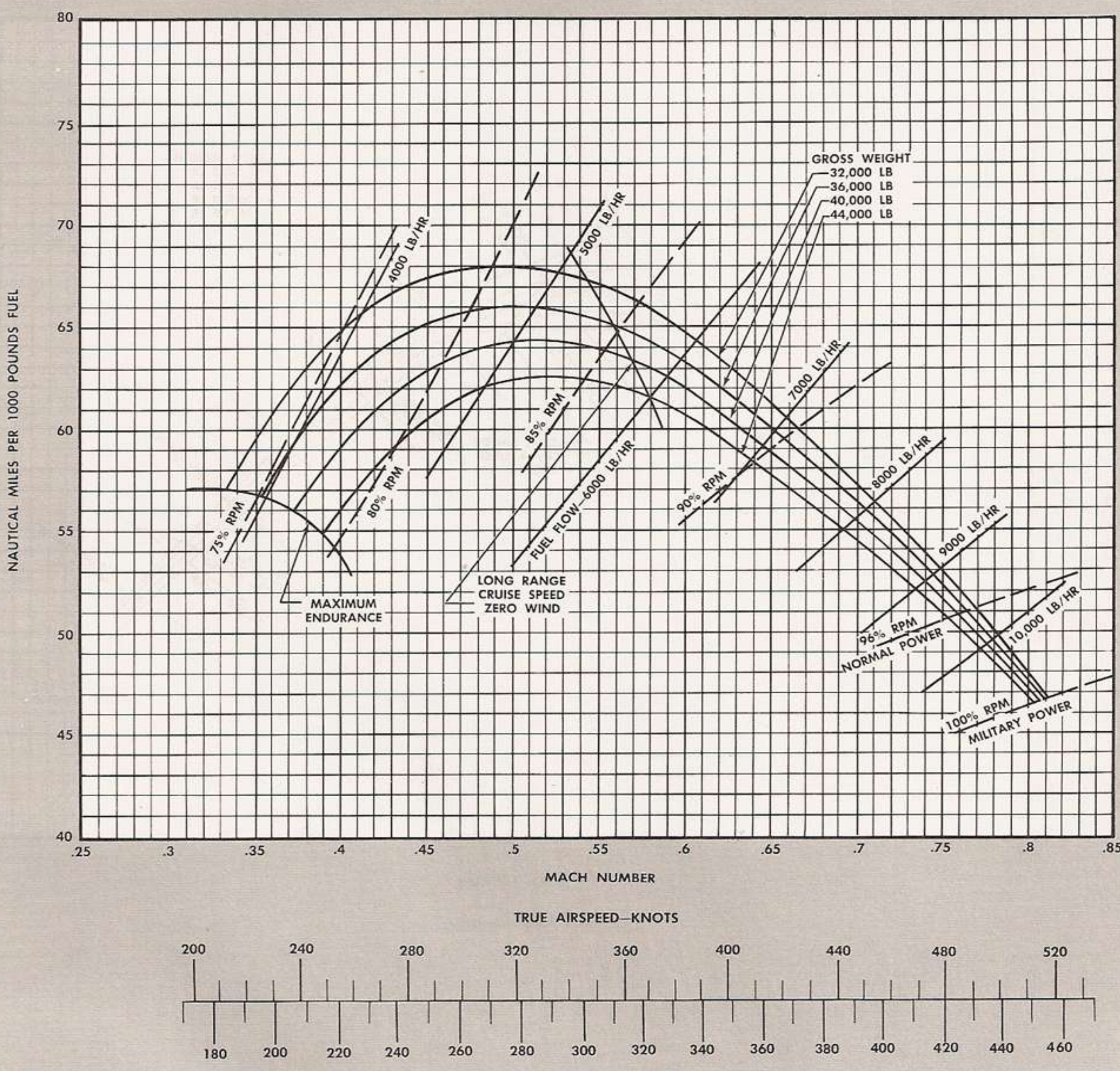
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-77B

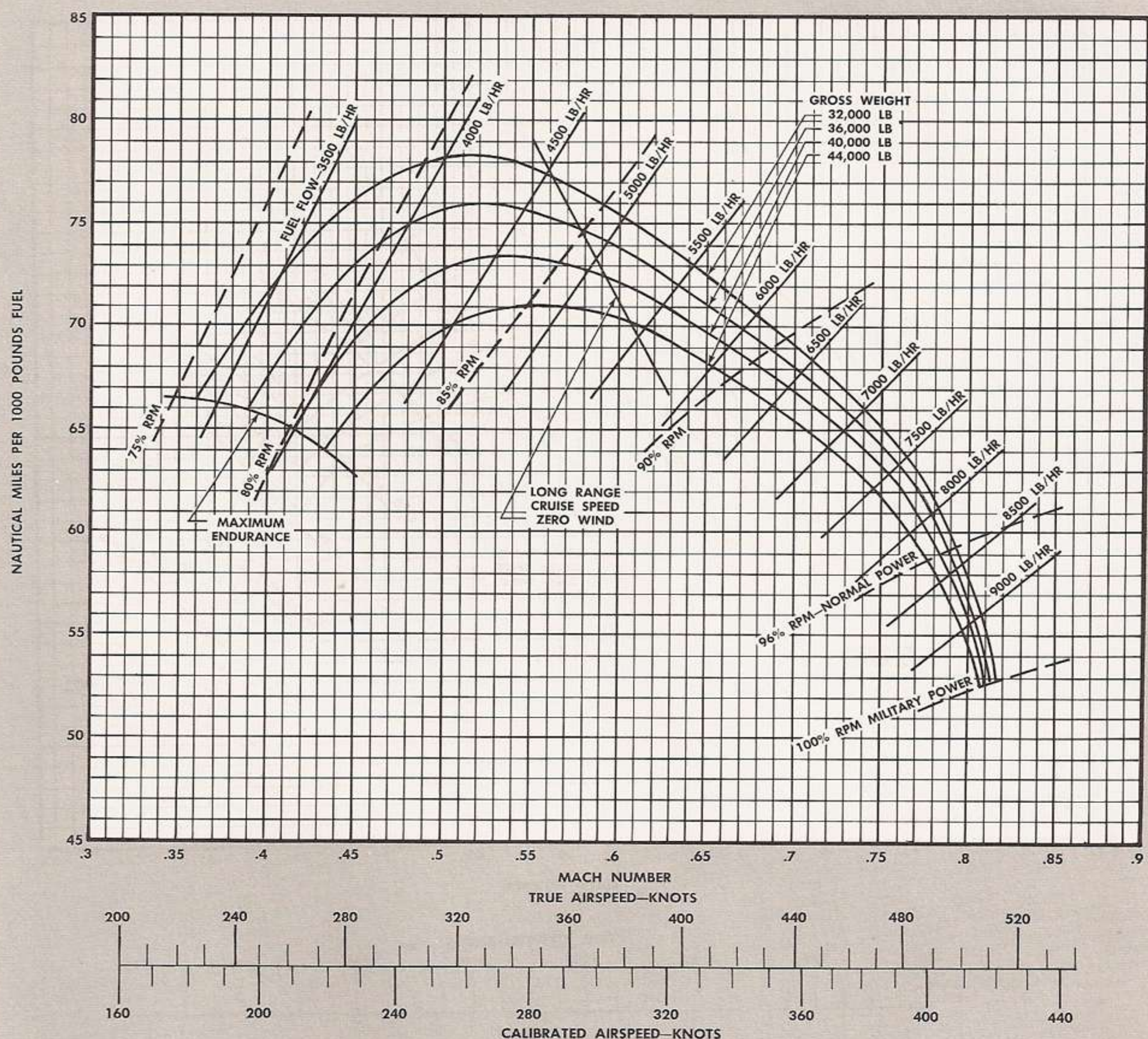
Figure A4-27.

NAUTICAL MILES PER 1000 POUNDS FUEL

15,000 FEET
TWO PYLONS

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-78B

Figure A4-28.

NAUTICAL MILES PER 1000 POUNDS FUEL

20,000 FEET

TWO PYLONS

MODEL: **F-89J**

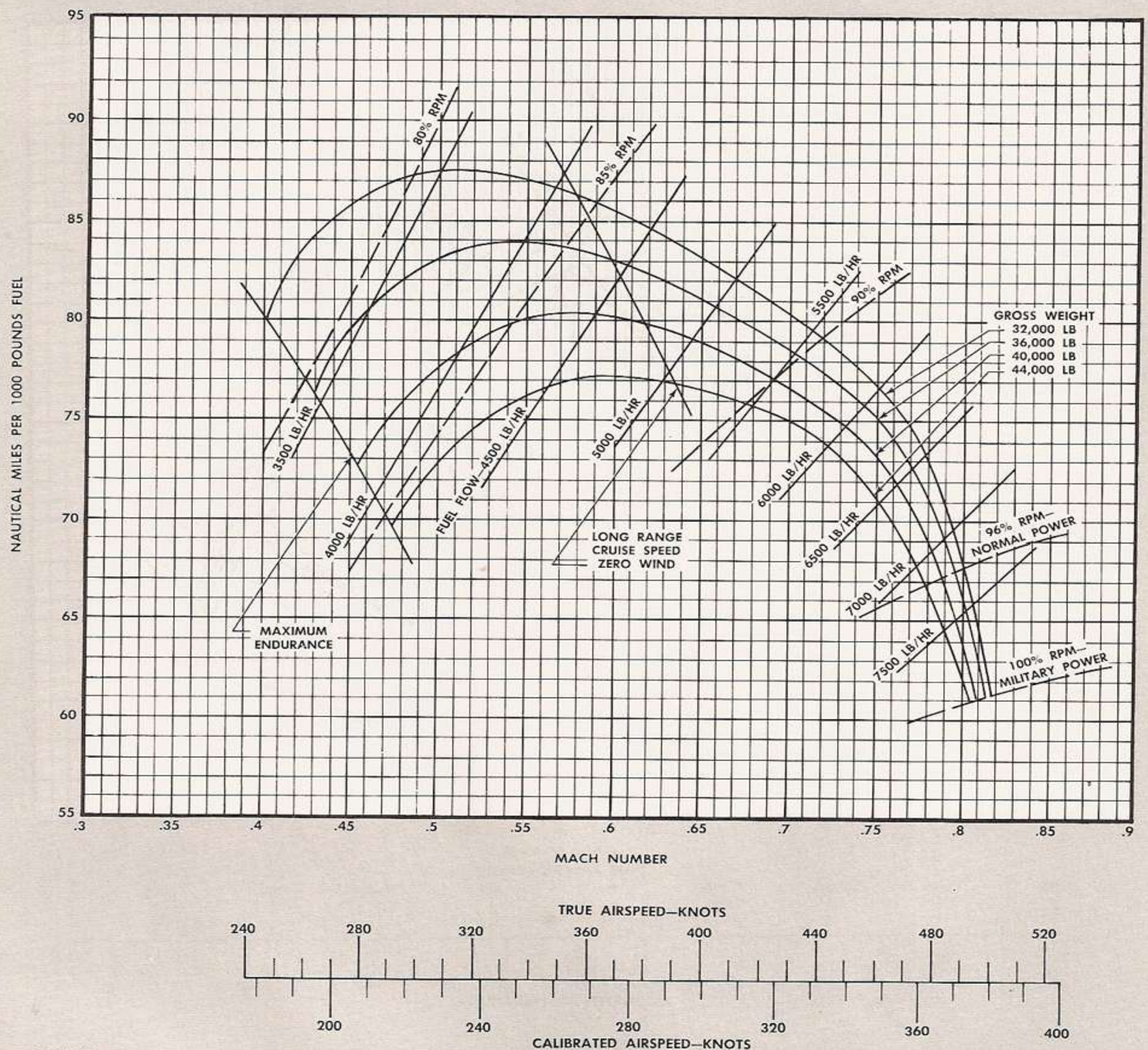
DATA BASIS: **ESTIMATED**

DATE: **17 SEPTEMBER 1957**

ENGINE(S): **(2) J35-35**

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-79B

Figure A4-29.

NAUTICAL MILES PER 1000 POUNDS FUEL

25,000 FEET

TWO PYLONS

MODEL: F-89J

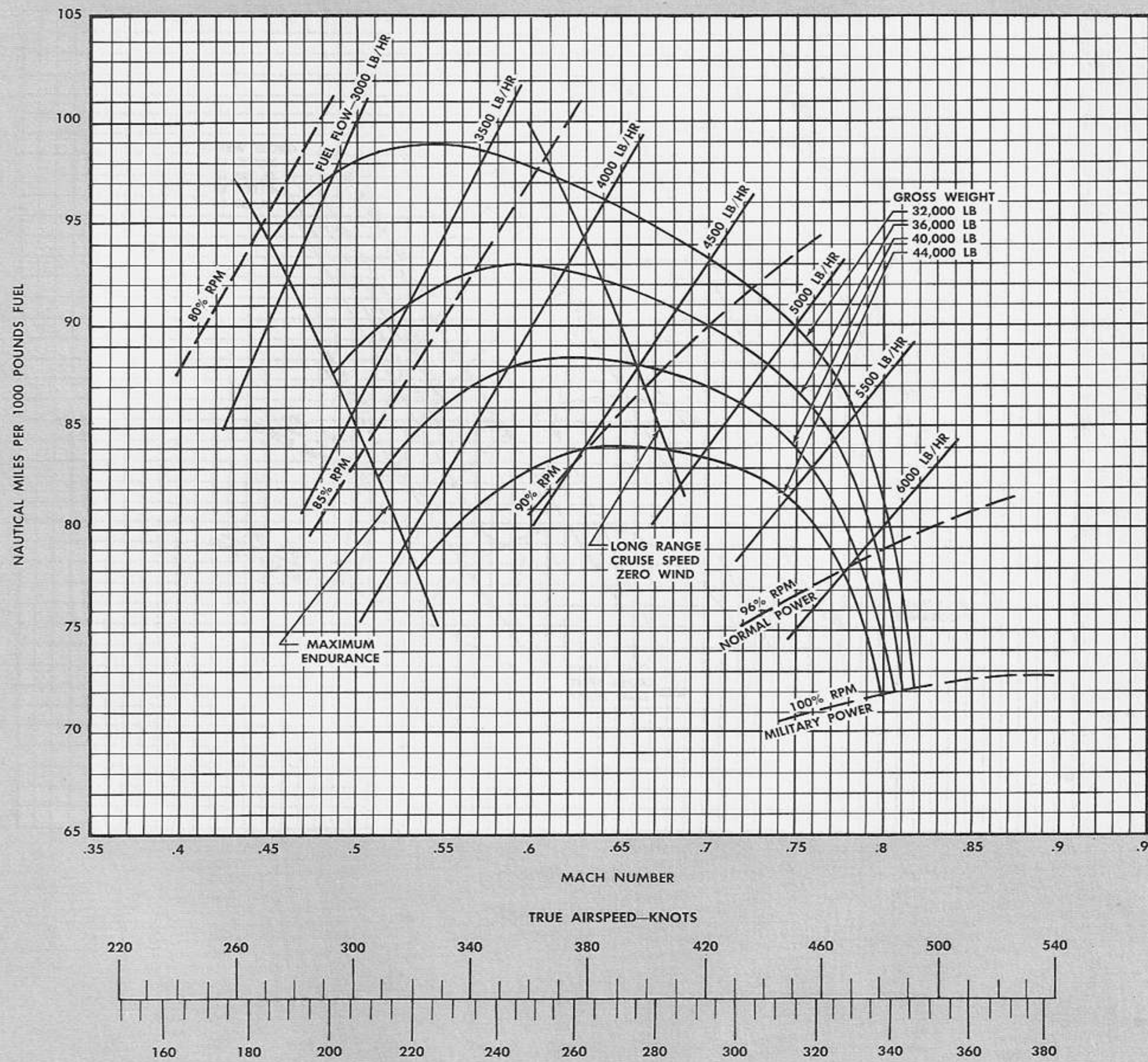
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-808

Figure A4-30.

NAUTICAL MILES PER 1000 POUNDS FUEL

30,000 FEET

TWO PYLONS

MODEL: F-89J

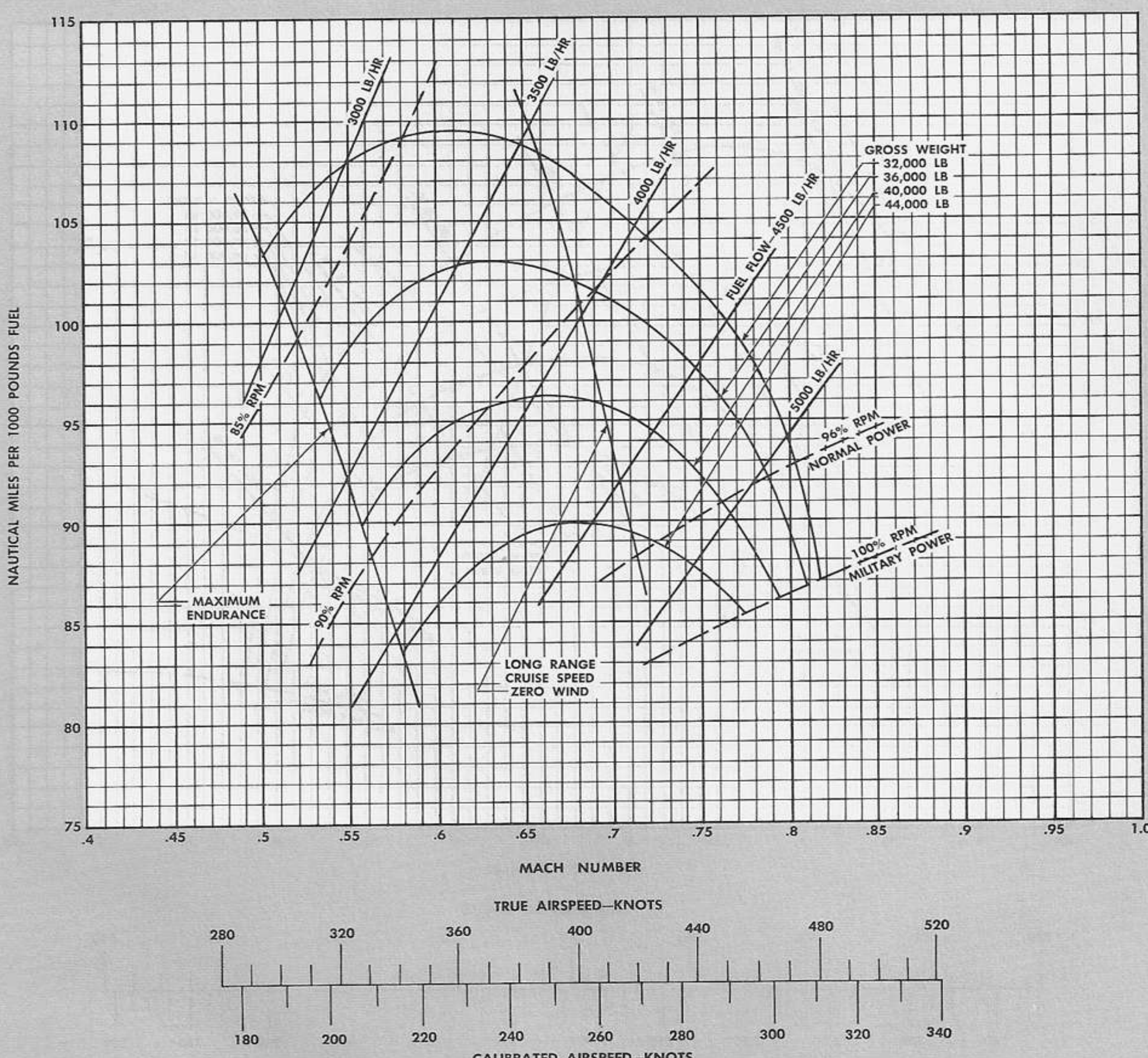
DATA BASIS: **ESTIMATED**

DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35

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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-81B

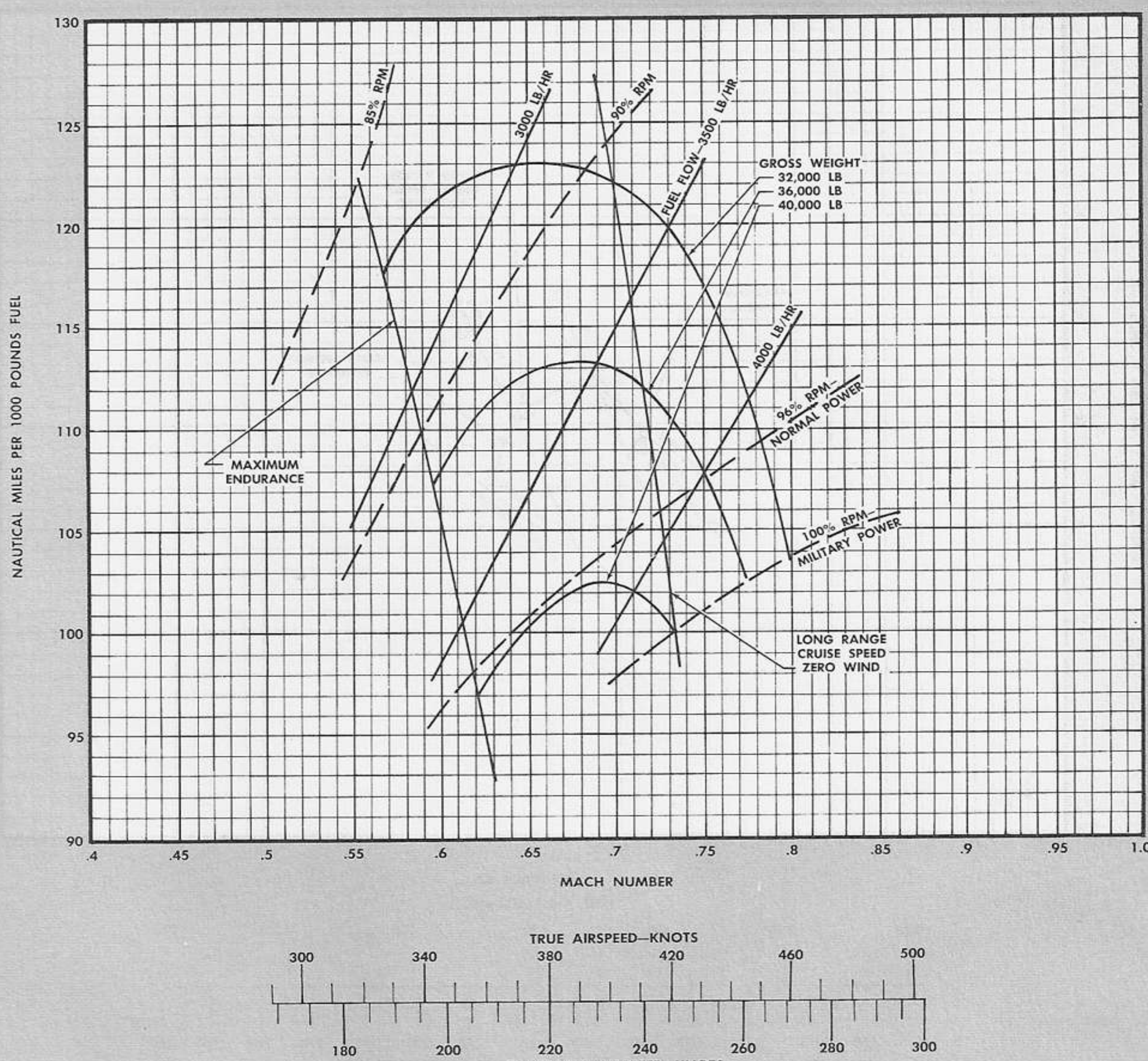
Figure A4-31.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

35,000 FEET
TWO PYLONS

ENGINE(S): **(2) J35-35**
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-82B

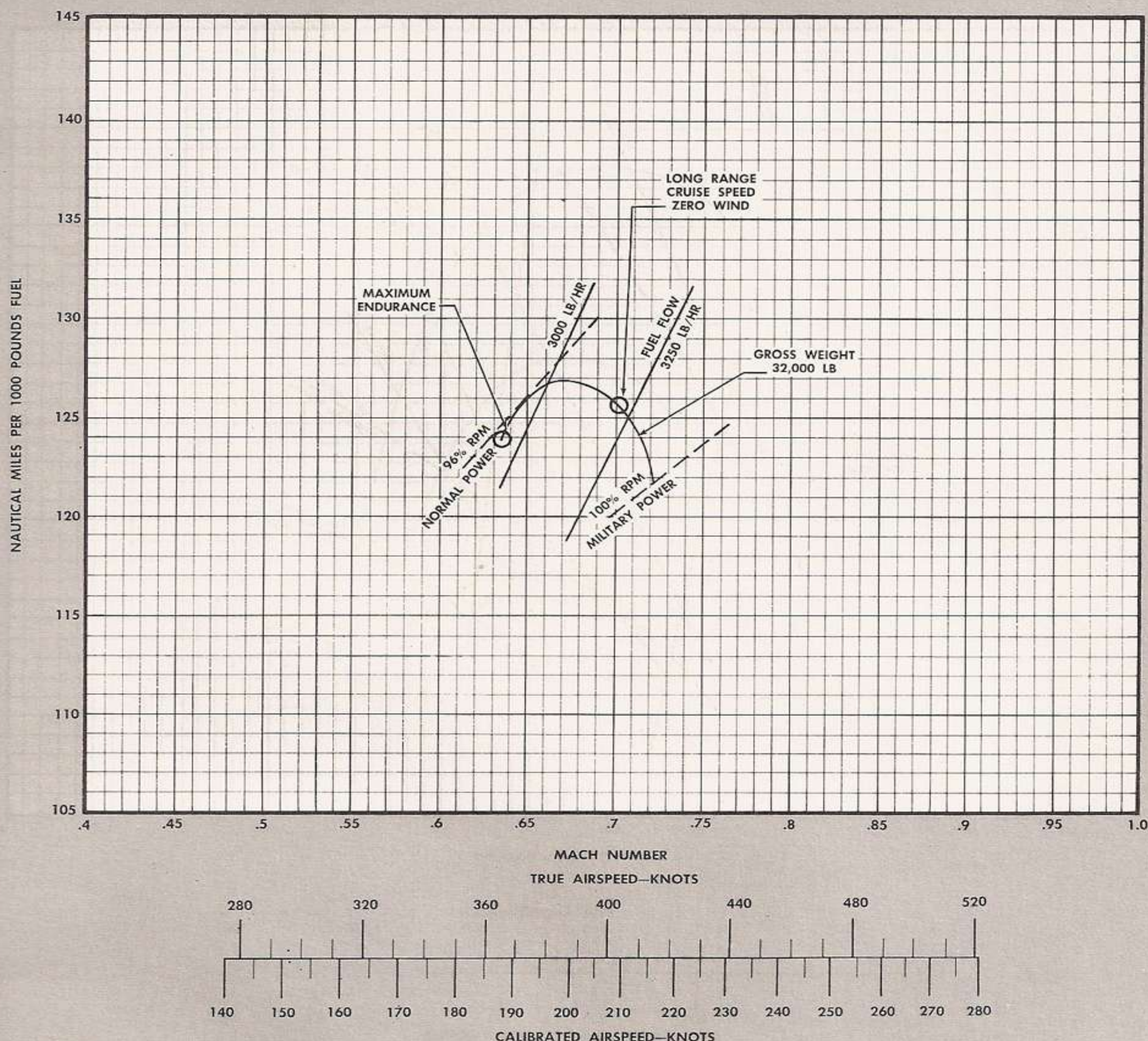
Figure A4-32.

NAUTICAL MILES PER 1000 POUNDS FUEL

40,000 FEET
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-83 B

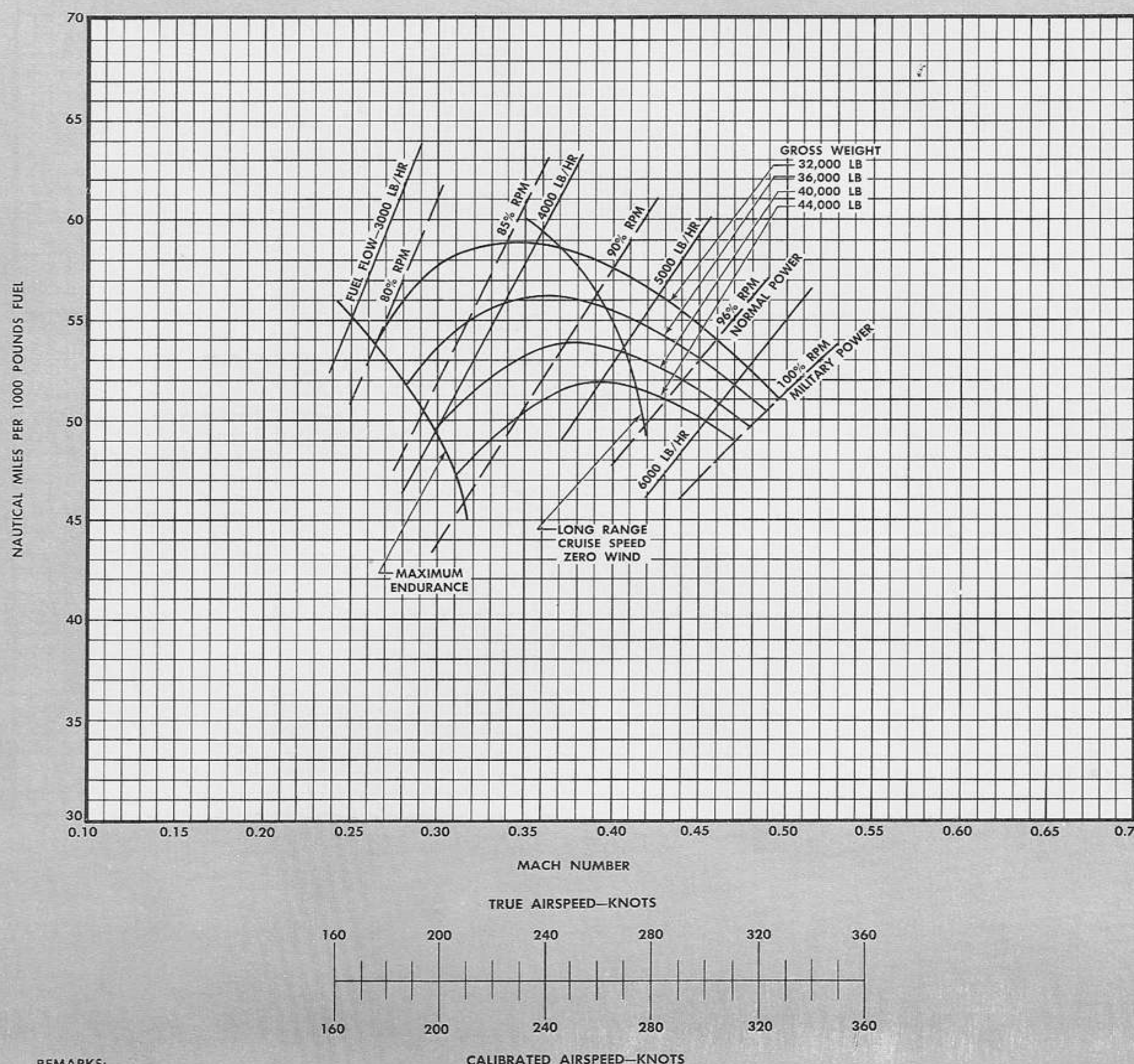
Figure A4-33.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ONE ENGINE OPERATING
SEA LEVEL
TWO PYLONS

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-84C

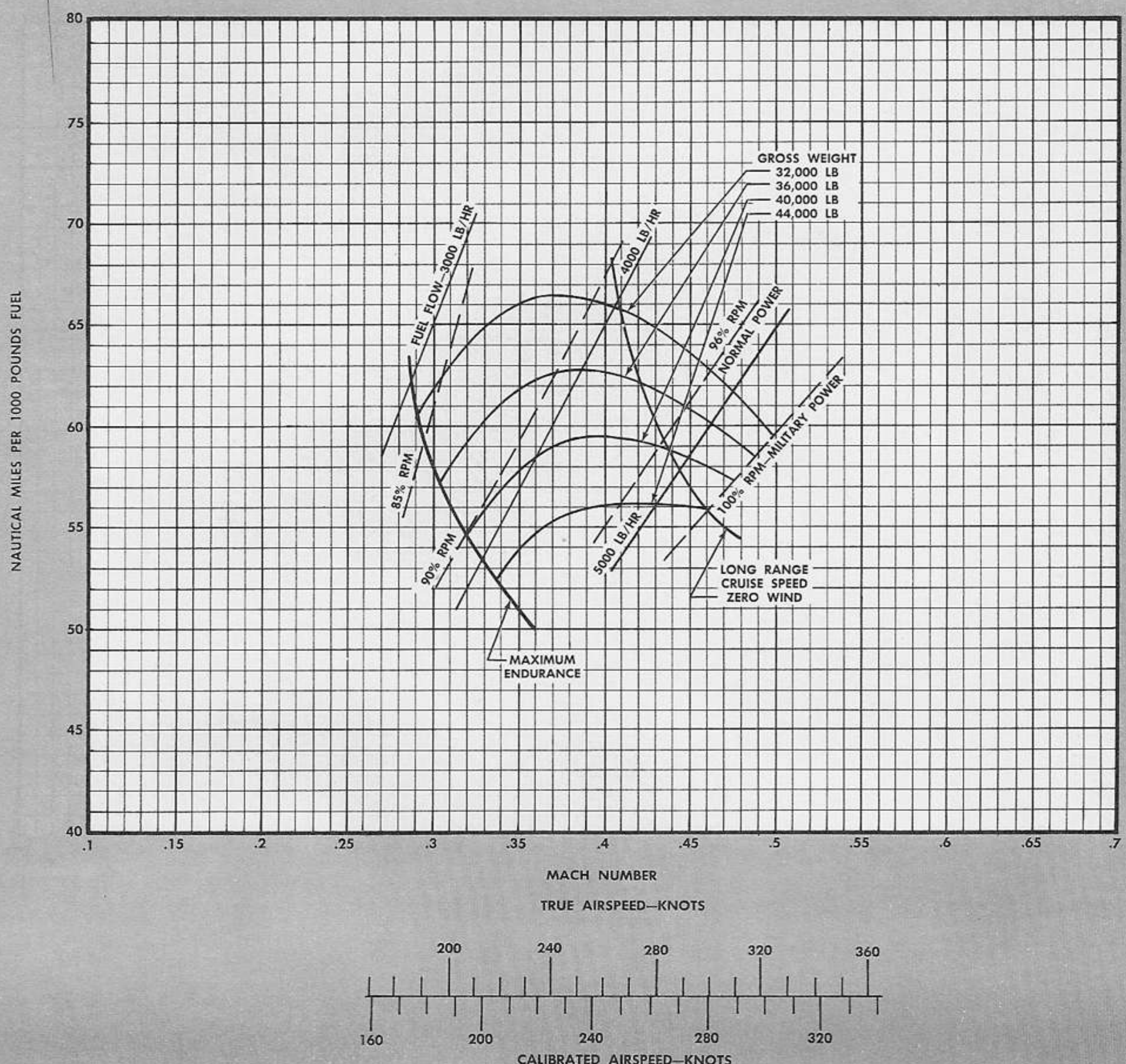
Figure A4-34.

NAUTICAL MILES PER 1000 POUNDS FUEL

ONE ENGINE OPERATING
5000 FEET
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-85B

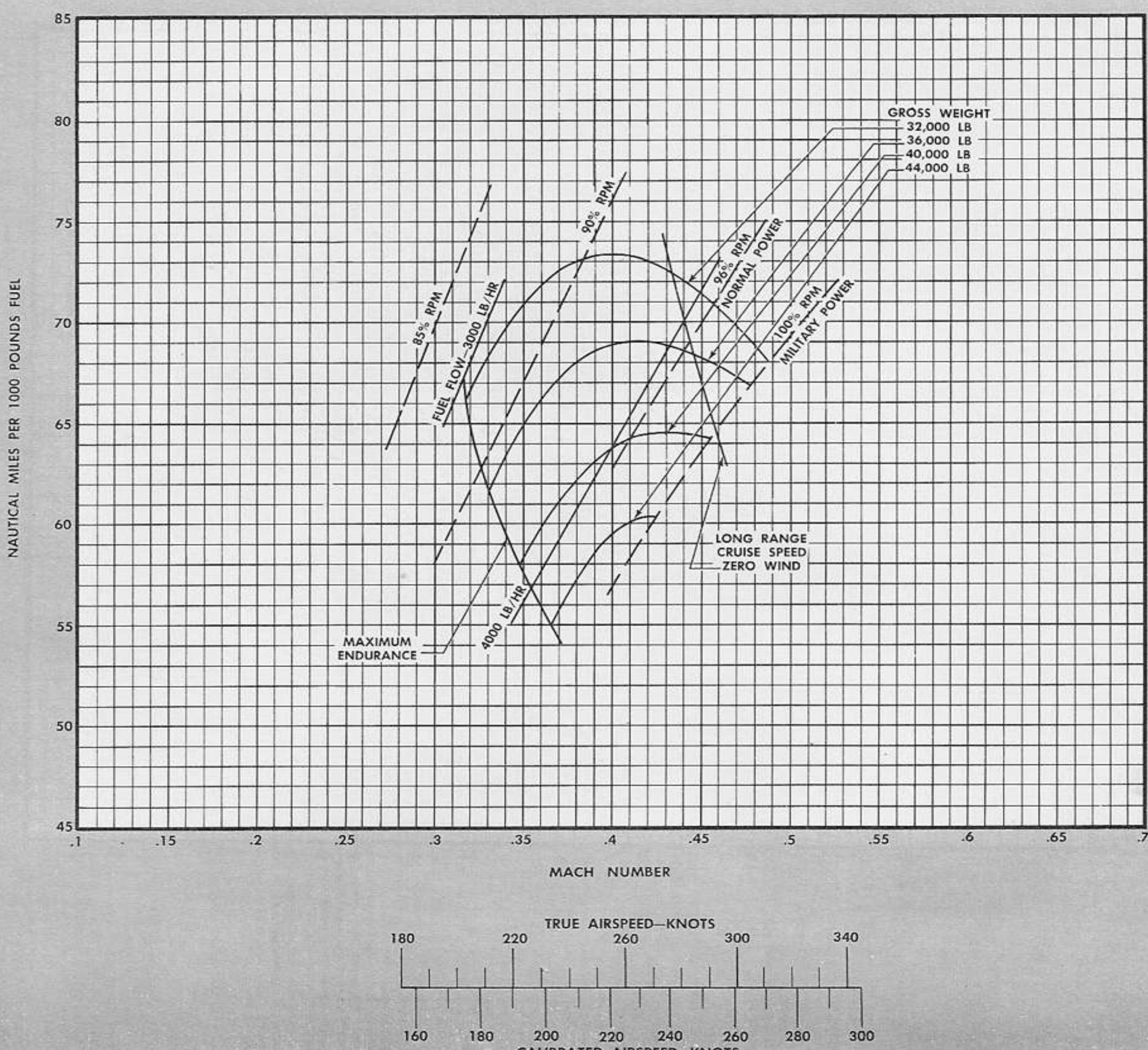
Figure A4-35.

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: **F-89J**
DATA BASIS: **ESTIMATED**
DATE: **17 SEPTEMBER 1957**

ONE ENGINE OPERATING
10,000 FEET
TWO PYLONS

ENGINE(S): **(2) J35-35**
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-868

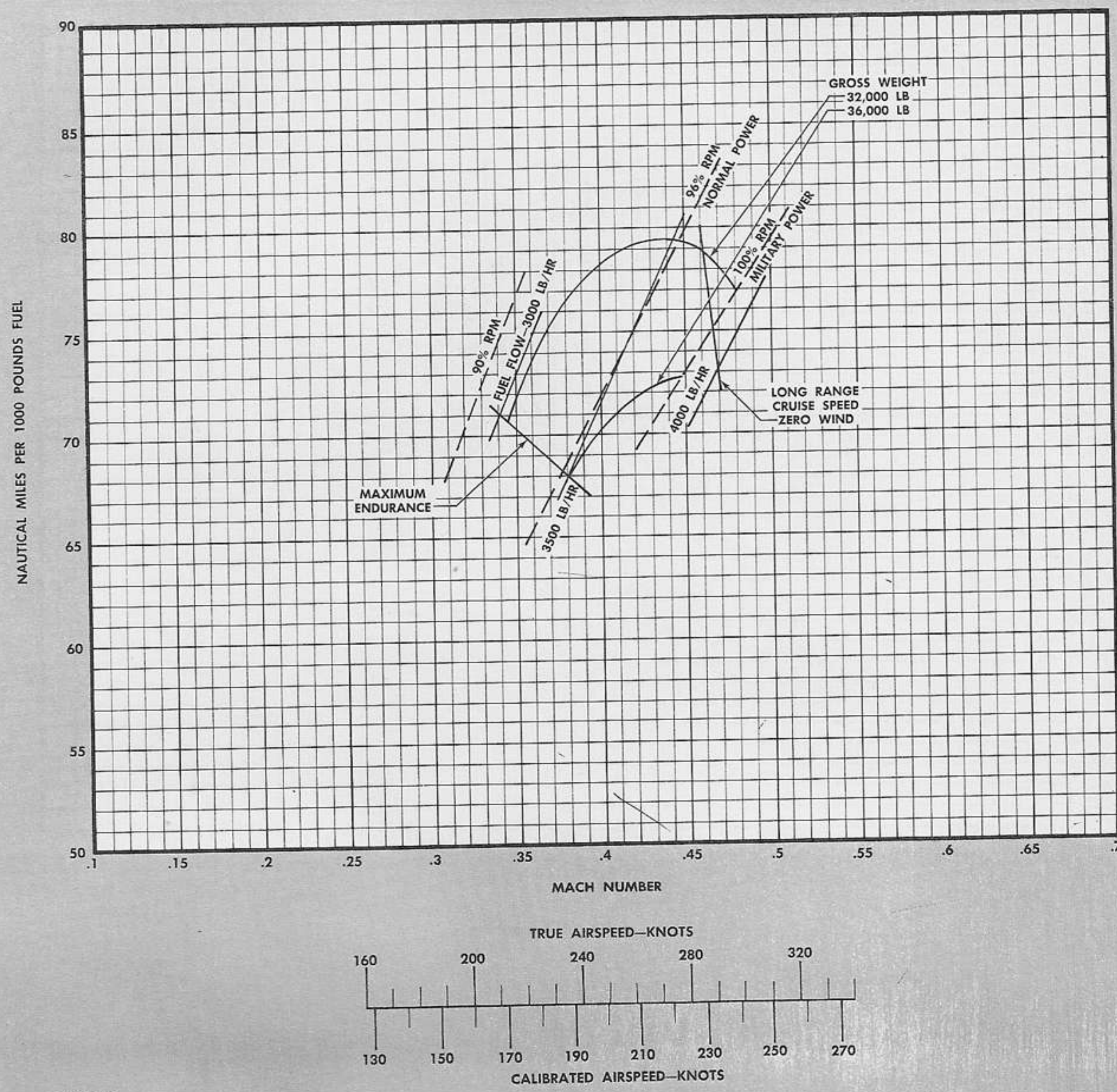
Figure A4-36.

NAUTICAL MILES PER 1000 POUNDS FUEL

ONE ENGINE OPERATING
15,000 FEET
TWO PYLONS

MODEL: F-89J
DATA BASIS: **ESTIMATED**
DATE: 17 SEPTEMBER 1957

ENGINE(S): (2) J35-35
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. MAINTAIN CAS SHOWN REGARDLESS OF AMBIENT TEMPERATURE.

JA-87B

Figure A4-37.

ALPHABETICAL INDEX

(ASTERISK (*) DENOTES ILLUSTRATION)

A

B

F

J

L

M