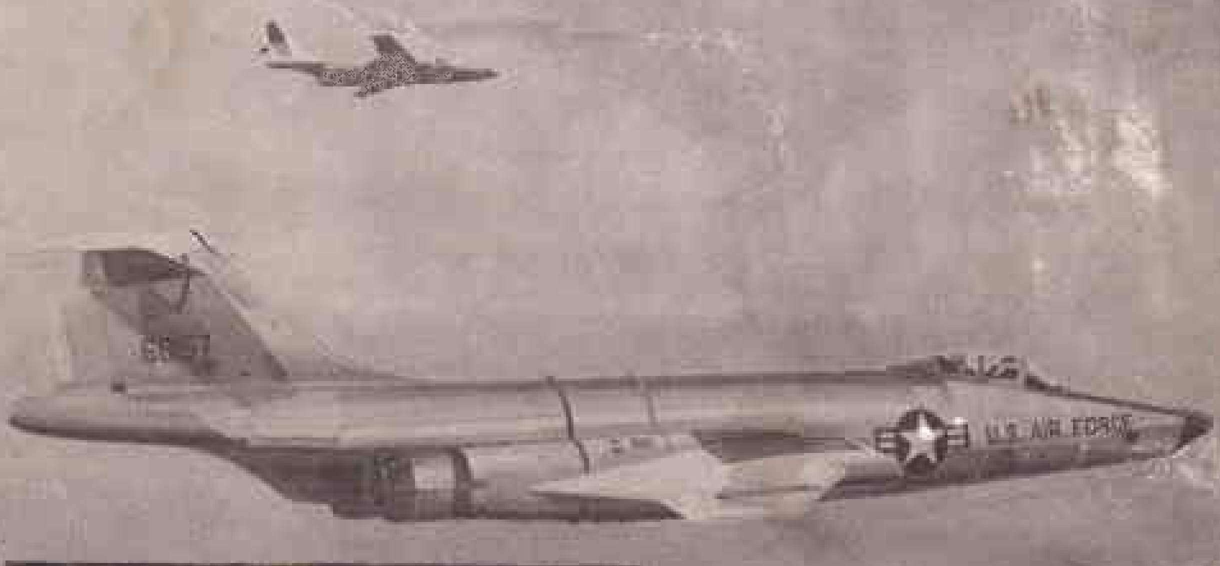
FLIGHT MANUAL

USAF SERIES
RF-101A
AIRCRAFT

Commanders are responsible for bringing this manual to the attention of all personnel cleared for operation of affected aircraft.



This revision replaces T.O. 1F-101(R)A-1, dated 15 April 1958, and Safety of Flight Supplements -1CE through -1CJ. See Basic Index, T.O. 0-1-1 and Weekly index, T.O. 0-1-1A for current status of Safety of Flight Supplements.

This manual is incomplete without Confidential Supplement T.O. 1F-101(R)A-1A

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE.

15 DECEMBER 1958

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

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

This publication consists of 236 pages made up of the following:

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

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

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

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* REFER TO CONFIDENTIAL SUPPLEMENT, T. O. 1F-101 (R) A-1A

For the Best Reflection ....

CONSULT YOUR FLIGHT MANUAL

SCOPE This manual contains all the information necessary for safe and efficient operation of the RF-101A. The instructions do not attempt the teaching of basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT The instructions in this manual are designed to provide the needs of a pilot inexperienced in the operation of this particular aircraft. The Air Force and manufacturer have compiled the data from extensive flight test programs plus engineering experience and design to provide the best possible operating instructions under most circumstances. However, all this is a poor substitute for sound judgment. Compounded or multiple emergencies, adverse weather, terrain, etc., may require modification of procedures contained herein.

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

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

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

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

PERSONAL COPIES, TABS AND BINDERS In accordance with the provisions of AFR 5-13, flight crew members 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 good-looking, simulated-leather binders will make it much easier for you to revise your manual as well as to keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.

HOW TO GET COPIES If you want to be sure of getting your manual on time order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 00-5-2 explains how to order Flight Manuals, classified supplements thereto, and Safety of Flight Supplements so that you automatically will get all original issues, changes, and revisions. Basically, all you have to do is order the required quantities in the Publication Requirement 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 books and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 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 Supplement Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and the 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. Technical Order 00-5-1 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 carefully followed.

CAUTION

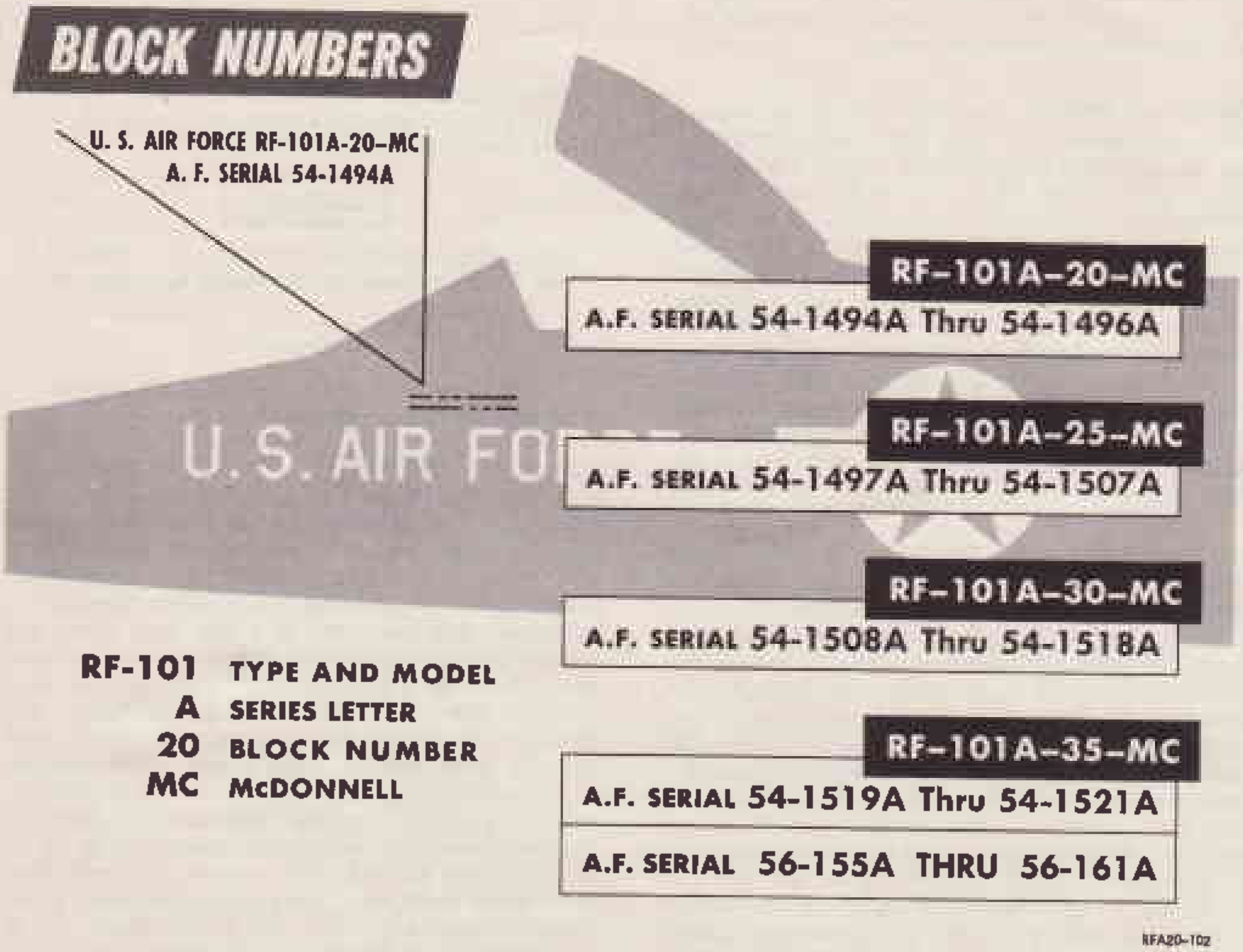
Operating procedures, practices, etc., which if not strictly observed will result in damage to equipment.

Note

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

MB-8 FLIGHT COMPUTER The MB-8 Flight Computer for this aircraft is presently available. This computer is designed to provide pilots of single and twin jet engine aircraft with compact cruise control data which will aid in preparation of flight plans, inflight operation, and emergency inflight planning and operation. The computer is a five disc, metal and plastic circular computer with a canvas carrying case. Three of the discs can be used with any aircraft and are referred to as "standard discs". The remaining discs contain data only for this aircraft and are described as "data discs". The standard discs and carrying case are carried in Class 05-A and are available through normal supply channels. The data discs are distributed automatically to all bases having this aircraft. New or revised discs are issued each time the performance data in the Flight Manual is revised. The performance data in the computer and the Manual is always kept current and consistent. If you have not yet received your computer, see your Base Operations Officer or T.O. 5F5-1-1. Reference should also be made to T.O. 5F5-1-1 for information on the operation of the computer.

COMMENTS AND QUESTIONS Comments and questions regarding any phase of the Flight Manual program are invited and should be forwarded through your Command Headquarters to Commander, Detachment #1, Hq. Air Research and Development Command, Wright-Patterson AFB, Ohio, ATTN: RDZSPH.



BLOCK DESIGNATION CODES

CODE

The information contained in this manual is applicable to F-101A aircraft, block 20 (54-1494) through block 35 (56-161). Effectivity differences within this group of airplanes are designated by block number symbols which appear on illustrations and within the text. An illustration or paragraph heading bearing a block number symbol indicates that the information is pertinent only to that block of airplanes. When no symbol appears, the information is applicable to all blocks within the scope of coverage. See Block Number Diagram.

EXAMPLE

20	Pertains to block 20 airplanes only (54-1494 thru 54-1496).
30 35	Pertains to blocks 30 and 35 airplanes only (54-1508 thru 54-1521 and 56-155 thru 56-161).
25 30 35	Pertains to blocks 25, 30 and 35 airplanes only (54-1497 thru 54-1521 and 56-155 thru 56-161).

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RF-101A
"VOODOO"
U.S. AIR FORCE

RFA20-100

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AIRPLANE

The RF-101A is a single place, supersonic, long range photo reconnaissance aircraft built by McDonnell Aircraft Corporation. The aircraft is powered by twin axial-flow turbojet engines with afterburners. Its appearance is characterized by very thin, short, swept wings with triangular intake ducts in the wing roots, and swept back empennage. The horizontal stabilizer is a one-piece controllable unit mounted high on the vertical stabilizer. The ailerons, mounted on the outer trailing edge of the wings, and the empennage control surfaces operate through irreversible hydraulic systems and give desirable control effectiveness throughout the entire speed range. Aerodynamic pilot feel is simulated by an artificial feel system. Hydraulically operated, electrically controlled wing flaps, mounted inboard of the ailerons, are deployed through a 50 degree range. Panel type speed brakes are installed on the aft portion of each side of the fuselage and may be utilized at all speeds. Internal fuselage fuel sequencing is completely automatic. The aircraft incorporates air-refueling and single-point refueling capabilities. The pressurized cockpit is enclosed by a clam-shell canopy. A drag chute contained in the empennage and deployed after landing significantly reduces landing roll distances.

AIRPLANE DIMENSIONS

The approximate over-all dimensions of the airplane are as follows:

Span	39 feet 8 inches
Length	69 feet 3 inches
Height	18 feet 0 inches

Refer to Section II (figure 2-4) for turning radius and ground clearances.

AIRPLANE GROSS WEIGHT

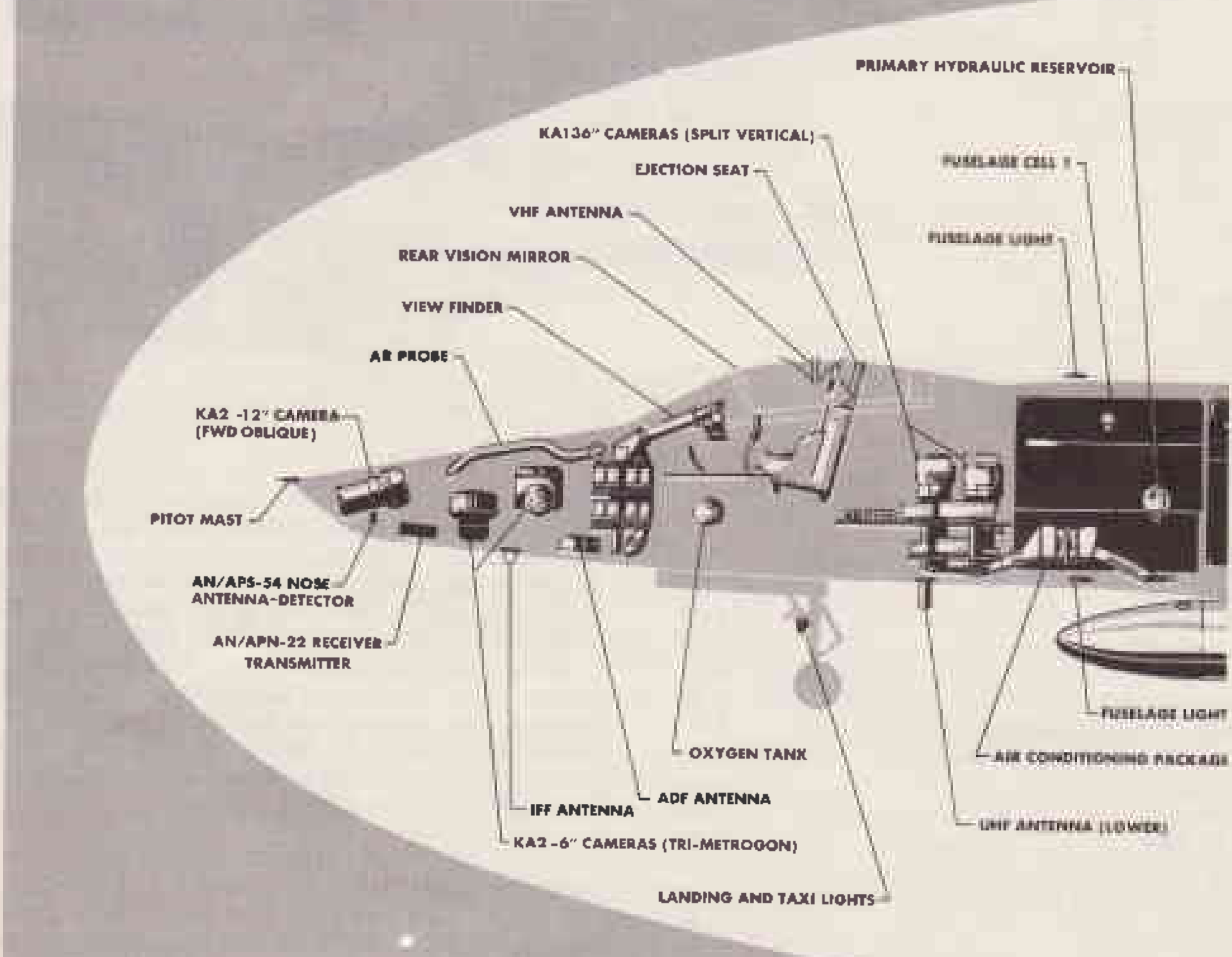
The approximate ramp gross weight of the aircraft including full internal load and the pilot, is as follows:

	(20)
Airplane with no external load	39,777 pounds
Airplane with full external tanks	46,022 pounds

	(25)(30)(35)
Airplane with no external load	41,075 pounds
Airplane with full external tanks	47,331 pounds

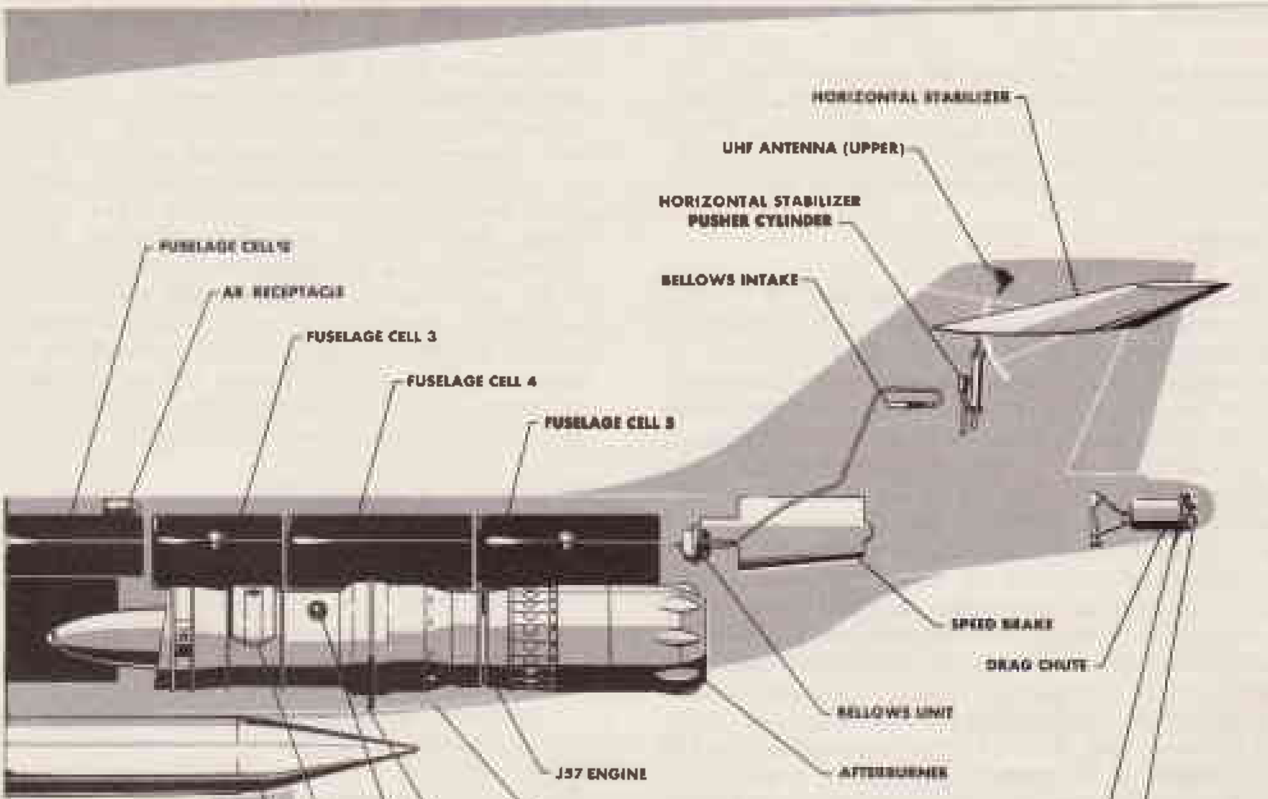
Refer to Section V for additional weight information.

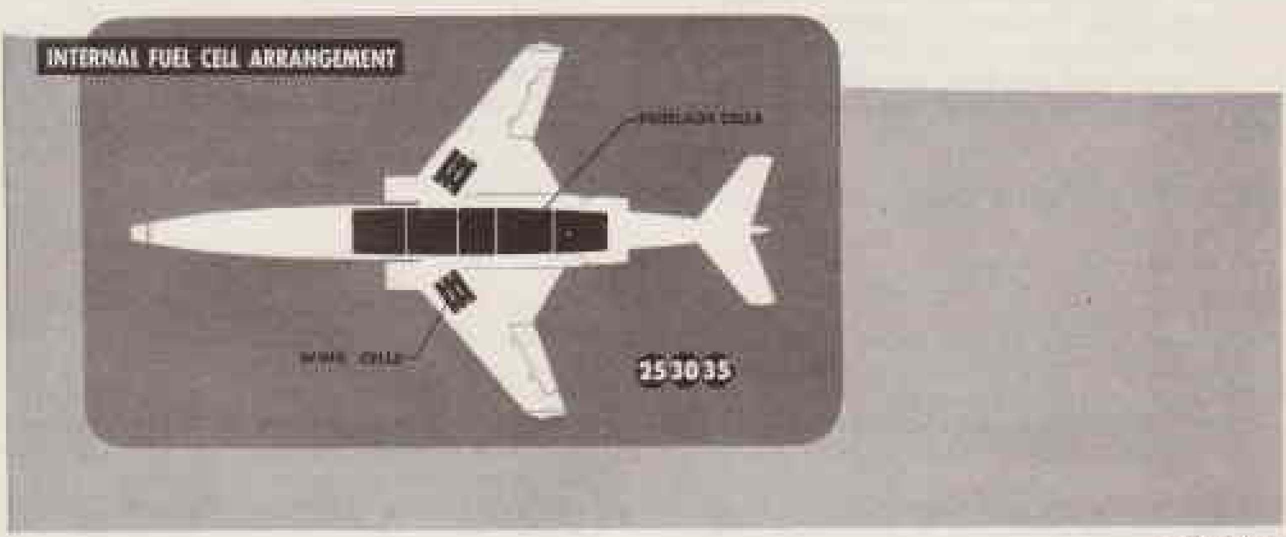
GENERAL ARRANGEMENT



RFA20-101A-1

Figure 1-1


HORIZONTAL STABILIZER
UHF ANTENNA (UPPER)
HORIZONTAL STABILIZER PUSHER CYLINDER
BELLOWS INTAKE
AR RECEPTACLE
FUSELAGE CELL 3
FUSELAGE CELL 4
FUSELAGE CELL 5
SPEED BRAKE
DRAG CHUTE
BELLOWS UNIT
J57 ENGINE
AFTERBURNER
AFT ENGINE COMPARTMENT
POSITION LIGHTS
FORWARD ENGINE COMPARTMENT
BLEED VALVE
AN/APS-54 TAIL ANTENNA-DETECTOR
OIL TANK
GALLON EXTERNAL TANK


INTERNAL FUEL CELL ARRANGEMENT
FUSELAGE CELLS
WING CELLS
253035

ARMAMENT

There is no armament provided for this aircraft. The mission of this aircraft is day photo reconnaissance. Portions of the aircraft that normally house armament equipment are modified to incorporate the precision camera equipment discussed in Section IV.

ENGINE

Airplane power is provided by two Pratt & Whitney J57-P-13 turbojet engines, equipped with afterburners and mounted side by side in the aft lower portion of the fuselage. Each engine is rated at approximately 10,200 pounds sea level static thrust at Military thrust and at approximately 15,000 pounds, with afterburning, at Maximum thrust. Individual engine compartments are isolated from the rest of the airplane by firewall construction and each compartment is divided by a fireseal between the relatively cool compressor and accessory area, and the much hotter combustion, turbine and afterburner area. Basically, the engine consists of a 16-stage, two-unit compressor; an eight unit can-annular combustion chamber, served by a dual fuel manifold; a three-stage turbine and an afterburner. The compressor is made up of a nine-stage, low speed, low pressure unit, driven by the combined second and third stages of the turbine; and a seven-stage, high-speed, high pressure unit, driven by the first stage of the turbine. The low speed compressor unit powers an accessory drive at the front of the engine, and the high-speed compressor powers the accessory group beneath the center portion of the engine. To provide more rapid surge-free accelerations, a bleed valve is installed to "bleed off" low pressure compressor air at low engine speeds. The valves are open when the engine is started, they close as the engine reaches a surge-free speed, then reopen when the engine decelerates (refer to Engine Breed Valves, Section VII). A relatively small portion of compressed air is separately ducted to the refrigeration package of the cockpit air-conditioning system from where it may be distributed for other compressed air needs. Refer to Section VII for additional information on the engine.

ENGINE FUEL CONTROL SYSTEM

Note

> The fuel control system for each engine is complete in itself and the two systems are identical. For simplicity of discussion, the following considers only one system and should be assumed duplicated for the other engine.

Fuel flow to the engine in response to throttle operation is further regulated by the various units shown in figure 1-4. Since afterburner fuel control is practically independent of the main engine system it is discussed in this section under Engine Afterburner System.

Fuel Pump Unit

The engine-driven fuel pump consists of three individual pumps mounted in the center accessory group. A centrifugal pump receives fuel from the airplane fuel system and in turn supplies it under pressure to two gear-type pumps. One gear-type pump supplies the main engine system, the other the afterburner system. Construction is such that failure of one stage leaves the others unaffected. Also, a part of the pump unit is an afterburner shutoff valve and a transfer valve. The transfer valve automatically directs afterburner pump output to the main engine system in the event of failure of the engine stage of the pump. There are no provisions for transfer in the event of afterburner pump failure.

Note

> With failure of the engine stage of the pump, the main engine system will receive all the fuel it requires. Any additional output can then be utilized for afterburner operation. At altitude, normal operation of both can be expected but with the greatly increased fuel demand at low altitudes, some decay in afterburner power may be noticed.

Engine Fuel Controller

An engine driven hydromechanical fuel controller (figure 1-4) serves to establish a fuel flow to the engine which will result in the power output selected by the pilot. The system is mounted on the accessory gear case located at the engine "wasp waist". In addition to a normal fuel metering system, the fuel controller incorporates an emergency fuel system for use in the event of normal system failure. The principle function of the system is to schedule engine fuel flow automatically in accordance with certain limiting factors imposed by the pilot's throttle position, engine speed, and compressor inlet temperature. The fuel controller also incorporates a cutoff valve which is mechanically actuated by the throttle. The valve is off whenever the throttle is placed at CLS'D. Fuel in excess of engine requirements is returned to the outlet side of the centrifugal pump.

Normal Fuel Control

During fuel control normal operation, (fuel control selector switch in NORMAL position) the throttle is the primary control of the size of a metering valve or orifice that governs fuel flow. The metering orifice is further controlled automatically by a mechanical computer that senses flight conditions. Thus, using throttle setting, engine speed, inlet temperatures, altitudes, and changes in flight conditions, the computer adjusts power output selected by the pilot. During rapid engine accelerations, the system schedules fuel flow to protect the engine from overspeed, overtemperature, and compressor stalls. During rapid decelerations, the system maintains a minimum fuel

J57 ENGINE

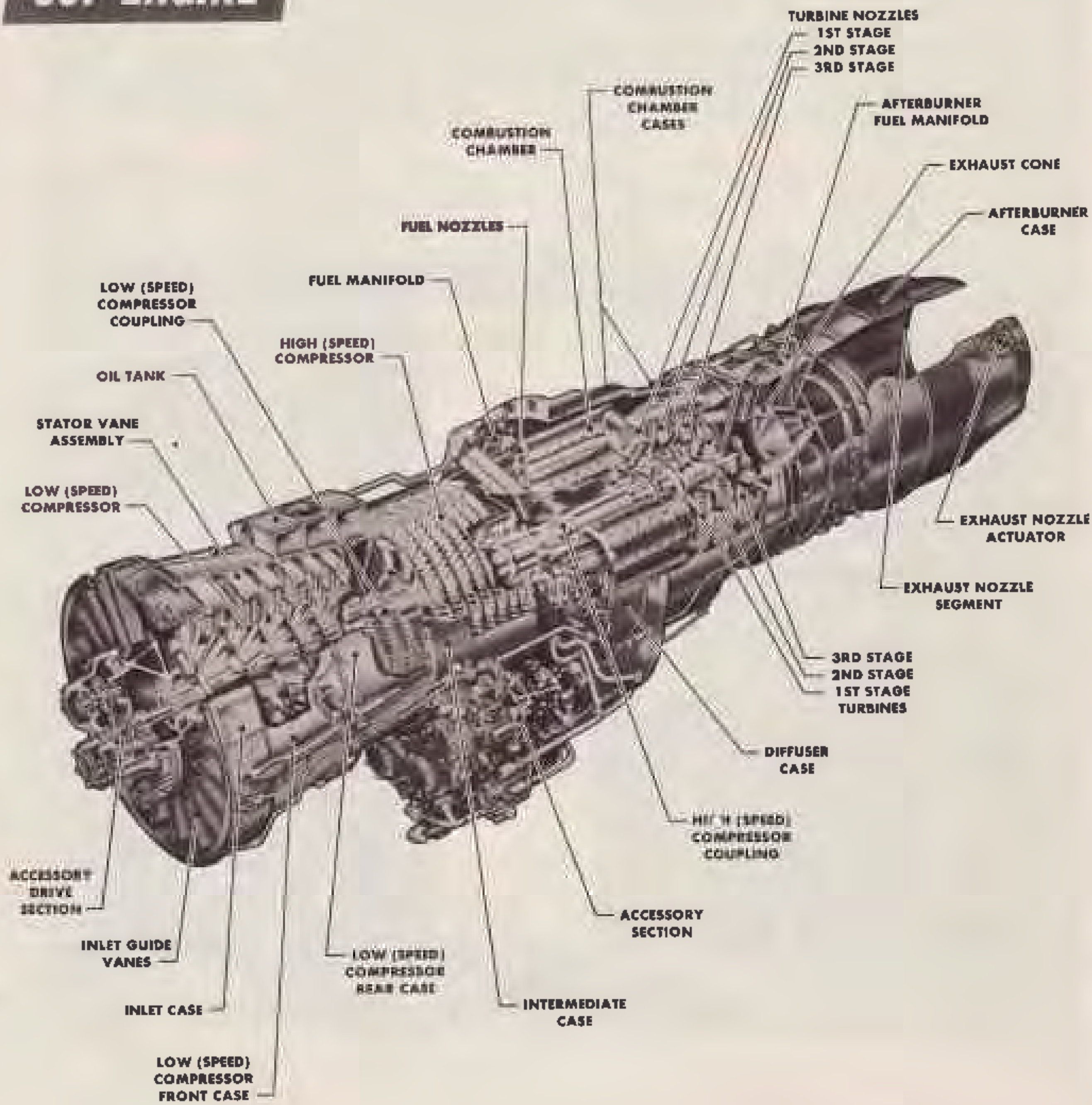


Figure 1-2

flow to prevent engine flame-out. Any excess fuel not required by the engine is routed back to the discharge side of the centrifugal element of the fuel pump by the main by-pass valve.

Emergency Fuel Control

Emergency operation of the fuel control system provides regulation of engine fuel flow if the normal system fails. Emergency operation must be selected by the pilot, (by positioning fuel control selector switch in EMERG). In selecting the emergency system, the normal system is disengaged and the fuel flow is then metered by an entirely different metering valve. This valve is directly connected to the throttle with the result that fuel flow, in effect, is manually controlled. The emergency system does compensate for changes in altitude, however, the compensations are only ef-

MAIN DIFFERENCES TABLE

	F-101A	F-101C	RF-101A	RF-101C	F-101B
ENGINES	J57-P-13	J57-P-13	J57-P-13	J57-P-13	J57-P-53 J57-P-55
ARMAMENT	20 MM CANNONS MK-7 AND MK-8 BOMBING SYSTEM	20 MM CANNONS MK-7 AND MK-8 BOMBING SYSTEM	NO	NO	MB-1 ROCKETS GAR-1 AND GAR-2 MISSILES
CAMERAS	SIGHT AND STRIKE	SIGHT AND STRIKE	UNIVERSAL CAMERA CONTROL SYSTEM	UNIVERSAL CAMERA CONTROL SYSTEM	NO
FIRE CONTROL SYSTEM	MA-7 RADAR AND OPTICAL GUN SIGHTING	MA-7 RADAR AND OPTICAL GUN SIGHTING	NO	NO	MG-13 RADAR WITH DATA LINK PROVISIONS FOR GROUND CONTROLLED INTERCEPTION
AUX FUEL PROVISIONS	DROP TANKS WING TANKS [illegible] AMMO-BAY TANK PROVISIONS	DROP TANKS WING TANKS AMMO-BAY TANK PROVISIONS	DROP TANKS WING TANKS 25-30-35	DROP TANKS WING TANKS	DROP TANKS WING TANKS
ANTI-SKID BRAKES	NO	YES	NO	YES	YES
PITOT STATIC BOOM	NO	NO	NO	YES	YES

Figure 1-3

fective up to 30,000 feet. (At higher altitudes the throttle must be successively retarded to maintain a constant rpm.)

Note

To avoid the surge which may occur, if transfer from normal to emergency is made when there is a great difference between the power being developed and that which is called for by throttle position, transfer should be made with the throttle at IDLE. Under critical circumstances such as take-off, transfer may be made with any power condition, without excessive surge, provided the airplane is not above 10,000 feet density altitude. Above 10,000 feet density altitude, the position of the throttle must approximate the engine power level to avoid violent surge.

ENGINE FUEL CONTROL SYSTEM

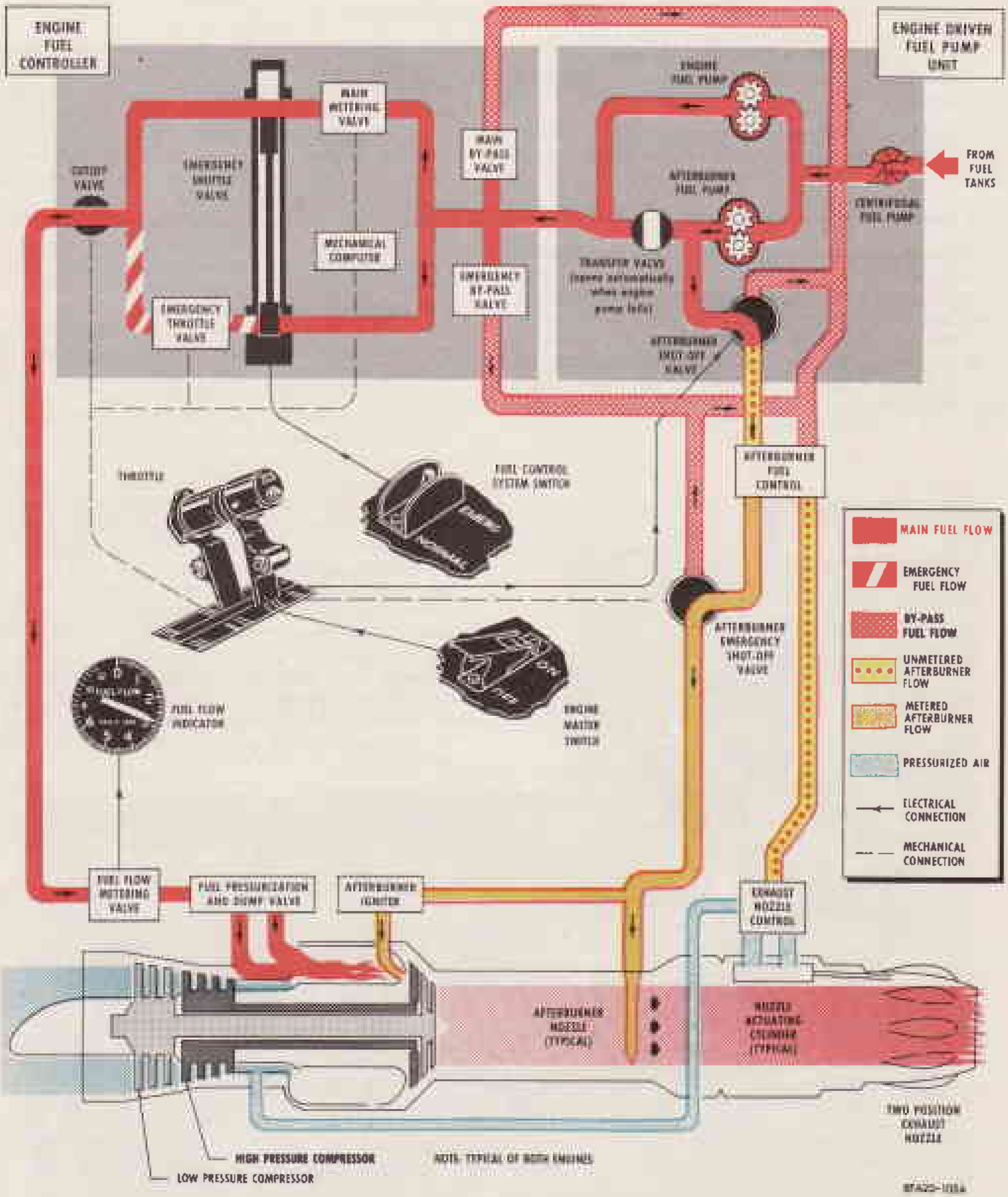


Figure 1-4

CAUTION

Since the emergency system does not offer the automatic overspeed, overtemperature, flame-out, and compressor stall prevention features of the normal system, rapid throttle movements should be avoided during emergency system operation.

The emergency by-pass valve routes the excess fuel not needed by the engines back to the discharge side of the centrifugal element of the fuel pump.

Fuel Pressurization and Dump Valve

This valve serves a dual function in the fuel system. It acts as a pressure operated flow divider, and as a dump valve to eliminate unburned fuel from the engine upon shutdown. Pressure differential created within the unit as a direct result of fuel flow regulates the fuel supplied to the pilot and main engine manifolds. For starting, only the pilot manifold, and consequently the pilot nozzles, are supplied. As fuel flow increases, the main manifold receives fuel. Proper proportion is maintained for efficient operation, under all conditions. The absence of fuel pressure at the valve, as in shutdown, allows the valve to drain both manifolds overboard.

THROTTLES

A throttle (figure 1-5) for each engine is incorporated in the left console to establish a desired engine thrust output. It functions through mechanical connections and electrical switches. A friction adjusting lever is mounted between the throttles which permits adjustment of throttle friction to suit individual requirements. The throttle mechanism is a gear shift type. Included on the throttles are the air start ignition buttons (one for each engine on each throttle), and speed brake switch and microphone button on the right throttle. Limit switches which control the main fuel shutoff valves, ignition, and afterburner systems are built into the throttle quadrant. Initial forward movement of the throttle from CLS'D to IDLE mechanically opens the fuel cutoff valve within the fuel controller allowing fuel flow to the engine. It also actuates switches which, (with the engine master switch ON) complete the circuit, opening the fuel supply shutoff valve, and operate relays which contribute to the continuity of the ignition and afterburner circuits. Further movement to the OPEN position progressively increases power output by altering fuel controller settings. At the OPEN position, the engine should be delivering its rated military power. Afterburning can be initiated, anywhere within the afterburner modulation range (figure 1-5) by shifting the throttles outboard; and terminated by shifting the throttles inboard. Movement of the throttle from the IDLE position to CLS'D requires the throttle to be shifted outboard and retarded. At CLS'D, the fuel cutoff valve in the controller is closed, the fuel supply shutoff valve is closed, and the electrical continuity to the afterburner and normal ignition circuits is interrupted.

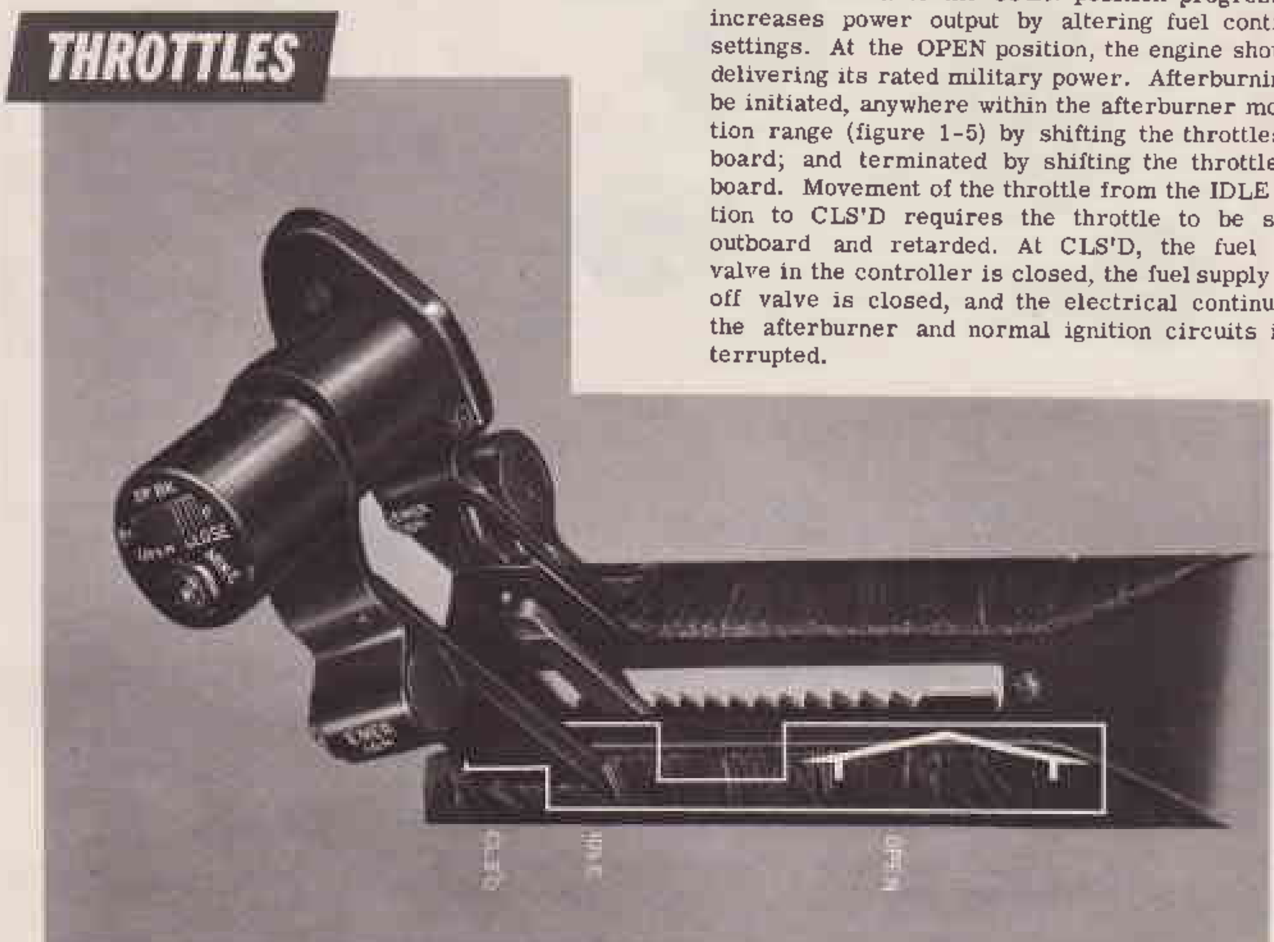


Figure 1-5

ENGINE MASTER SWITCHES

These two-position engine master switches (figure 1-6), one for each engine, are mounted on the engine control panel and are guarded to prevent their being inadvertently moved. When placed from OFF to the ON position, they serve to operate the 28 volt d-c engine control circuit for the fuel boost pumps, direct power for the operation of the anti-ice valves and contribute to the continuity of the afterburner, ignition system and the fuel transfer pumps circuit. The circuits for the fuel shutoff valves, which are normally operated by the throttles, are such that either circuit will be broken when its respective engine master switch is placed OFF, regardless of the throttle position.

FUEL CONTROL SYSTEM SWITCHES

A two-position toggle switch (figure 1-6), one for each engine is mounted on the forward portion of the engine control panel to permit the selection of the fuel controller emergency metering in the event normal metering fails. The switch directs 28 volt d-c to operate a motor-driven valve and is placarded NORMAL and EMERG to indicate which metering system has been selected.

CAUTION

With fuel control switch in EMERG position, fuel flow is manually selected and manually controlled - therefore throttle movement must be cautious with due regard for engine limitations.

RFA20-107A

Figure 1-6

TACHOMETERS

A tachometer (12, figure 1-24) for each engine is mounted on the instrument panel and indicates engine speed as a percentage of the approximate maximum rpm (9976 rpm) of the high speed compressor. This indication is approximate because individual engines produce their rated thrust at slightly varying engine speeds. Thus, maximum rpm for different engines will not be the same. The tachometer is an electrically operated instrument, receiving power from a tachometer generator, independent of the airplane electrical system.

EXHAUST TEMPERATURE GAGES

The exhaust temperature of each engine is indicated, in degrees centigrade, on individual temperature gages (11, figure 1-24) on the instrument panel. Four self-generating thermocouples, located downstream of the turbine, provide current to the indicator which then gives an average reading.

ENGINE PRESURE RATIO GAGES

The engine pressure ratio gages (figure 1-7), located on the instrument panel, presents an indication of the ratio of engine turbine exhaust pressure to engine inlet pressure. The turbine exhaust indication is obtained by a pressure probe in the engine, through a transmitter and amplifier in the right hydraulic bay, and thus through the necessary tubing and connections. Engine inlet pressure is obtained through the pitot-static system which is connected to the transmitter. Thus, the system compares inlet and outlet pressures, computes a ratio of outlet to inlet pressure, and electrically reflects the information to the cockpit indicators so that the pilot may better determine engine operational efficiency. The system utilizes 115 volt single phase a-c power. The gages are used to determine whether engine thrust output on the ground at full throttle, and under existing temperatures, is adequate for take-off. They are also used as a guide to set up optimum in-flight cruise thrust settings. The ratios are shown by a conventional dial needle. The gages are graduated from 1.2 to 3.4 in increments of tenths. Two windows are in the dial face, the upper window marked CRUISE and the lower marked TAKE-OFF. The ratios that appear in these windows are adjustable and are controlled by a knob on the lower left corner of each gage. Two index markers, one with two small pointers, and the other a single pointer, rotate about the edge of the gage when the knob is turned. The control knob must be pushed in and turned to set the desired take-off ratio in the lower window, and pulled out before turning cruise ratio in the upper window. When the desired take-off ratio is set in the lower window, the double pointer index marker will rotate to agree with that ratio. The single pointer marker will rotate to agree with cruise ratio set in the upper window. Take-off and cruise ratios are predetermined in accordance with take-off and flight temperatures and information set into the respective windows. During engine run-up, the indicator needle should fall within the limits set by the take-off double pointer index marker. If the indication is below limits, adequate thrust may not be available and take-off should not be attempted.

Note

If an engine check is made with a relatively cold engine, the pressure ratio gage may

ENGINE PRESSURE RATIO GAGES

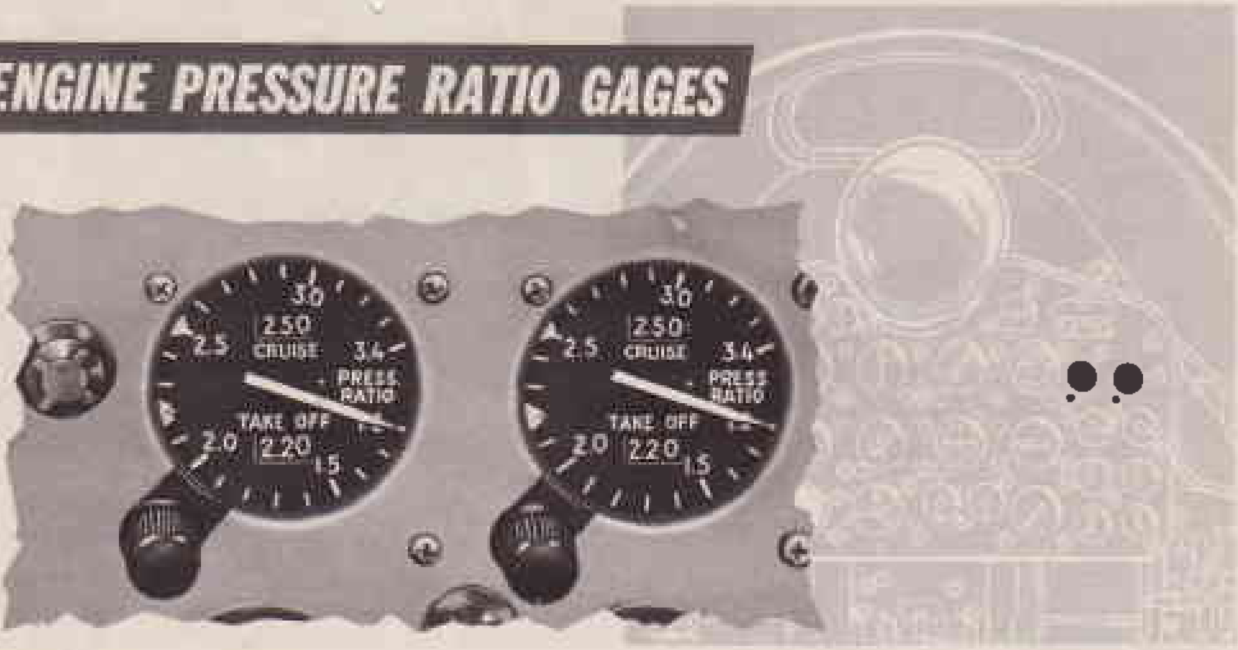


Figure 1-7

normally indicate an overshoot of as much as one tenth for approximately 5 minutes. However, if an overshoot condition persists, engine limits may be exceeded and power should be reduced to bring pressure ratio within limits.

Cruise pressure ratio is obtained by adjusting the throttle until the needle setting corresponds with the predetermined cruise ratio of the single pointer index marker.

CAUTION

In the event of a-c power failure, the gages will become inoperative. The indicating needle will remain fixed at the setting prevailing at the time of power failure.

Note

Take-off settings will vary between left hand and right hand engine installations. Cruise ratio settings will vary due to temperature changes. Proper settings must be determined prior to flight; refer to Appendix I, Performance Data.

OIL PRESSURE GAGES

The oil pressure gages (19, figure 1-24), one for each engine, are located on the instrument panel. These gages utilize 28 volt a-c power to provide an indication of engine oil pressure in pounds per square inch.

FUEL FLOW INDICATORS

Two fuel flow indicators (13, figure 1-24), one for each engine, are located on the instrument panel. They indicate the rate, in pounds per hour, at which fuel is being consumed. Afterburner fuel flow is not indicated. The indicators utilize 28 volt a-c.

ENGINE STARTER AND IGNITION SYSTEMS

Starter System

Pneumatic starters, which require an external source of compressed air, are installed on each engine. Both starters receive air through a single fitting, within an access door (11, figure 1-34) on the right side of the airplane. Separate doors for starter exhaust air are located on the bottom of the airplane beneath each engine. It is important that the exhaust doors be open prior to starter operation. Starter operation is initiated by moving the starter switch which electrically actuates valves in the air inlet lines. These valves automatically close when engine speed reaches approximately 40 percent rpm, or may be closed from the cockpit in the event the engine fails to start. The electrical circuit is such that only one starter valve can be opened at any given time, and an interruption of starter operation also stops ignition.

Ignition System

Engine ignition is accomplished by converting 28 volt d-c to high tension pulsating d-c which then is applied to igniter plugs. Two independent units, either of which is adequate for ignition, supply individual igniters in number 4 and 5 burner chambers. Continuous operation of the ignition system is not necessary since combustion is continuous once it is started. Igniter operation stops automatically with starter operation at an engine speed of 40 percent rpm. No separate ignition switch is required for normal ground starting for when the engine master switch is ON, and the respective throttle is moved from CLS'D to IDLE, the igniters are energized as fuel is introduced into the combustion chambers. Refer to Engine Master Switches, Throttles and Engine Start Switches, this section.

Throttles

Refer to Throttles, this section.

Engine Master Switches

Refer to Engine Master Switches, this section.

Engine Start Switches

Three-position, spring-loaded, toggle switches (figure 1-6) on the engine control panel, energize the circuits which operate the starter air valves. The switches, one for each starter, are placarded START, OFF and STOP START, and operate on the 28 volt d-c bus. By momentarily placing a switch in the START position, the circuit, which opens the air valve for the corresponding starter, is energized and will remain energized until either the engine speed reaches 40 percent rpm or the switch is placed to STOP START. These switches also contribute to the continuity of the ignition circuit and have to be placed to START for normal ground starting ignition.

Emergency Ignition Buttons

An ignition button (figure 1-5) for each engine is installed on the aft face of each throttle. These buttons serve to energize the ignition circuits for air starts independent of the starter circuits. The button is a spring-loaded switch and must be depressed, with the engine master switch ON and the throttle out of the CLS'D position, to get ignition. Depressing the button completes the circuit to supply electrical power from the 24 volt d-c emergency bus for ignition. In the [20][25][30] airplanes prior to incorporation of T.O. 1F-101-617, the ignition button must be held depressed to get ignition. After incorporation of T.O. 1F-101-617 and in [35] airplanes, it is not necessary to hold the ignition button depressed since an automatic timer provides continuity to the ignition system for 30 seconds after the button is released.

Figure 1-8

ENGINE AFTERBURNER SYSTEM

The engine is equipped with an afterburner to produce increased thrust for maximum performance. Due to the extremely high fuel consumption, afterburning should be used only for short periods of time when the additional thrust is required. Refer to Section V for operating limits. Afterburner operation can be initiated by shifting the throttle outboard from the OPEN position. When the throttle is shifted outboard, the electrically operated afterburner shutoff valve in the engine-driven fuel pump is opened, delivering fuel to the afterburner fuel control and to the exhaust nozzle control. The afterburner can be modulated in the afterburner detent, however afterburning can only be terminated by moving the throttle out of detent position. See figure 1-5.

CAUTION

- Due to high fuel consumption, afterburners should not be used except in emergencies when fuel quantity is below 3000 pounds.
- Maneuvers that create sustained negative "g" forces, such as continuous inverted flight, should not be attempted during afterburner operation. Fuel flow cannot be maintained for an appreciable length of time. Compressor stall, engine surge, instability, loss of thrust, or flame-out may result.

EXHAUST NOZZLE

A two-position, eight segment exhaust nozzle (figure 1-8) is installed at the end of the tailpipe. The nozzle is positioned to provide the most efficient exhaust nozzle area for either normal or afterburner engine operation. During afterburner operation the nozzle segments are fully open; during normal operation the segments are closed. Positioning the nozzle segments is accomplished automatically by the exhaust nozzle control unit when the pilot either engages or disengages afterburning.

Exhaust Nozzle Control Unit

The operation of the exhaust nozzle is controlled by the exhaust nozzle control unit. It is essentially a spring-loaded, fuel pressure operated, air relay valve that ports high pressure air (burner can pressure) to either a nozzle open line, or close line. When afterburning is initiated, afterburner fuel pressure is directed through the nozzle control unit repositioning the air relay valve against its spring force. This allows high pressure air to be directed to the nozzle actuators through the open line, causing the exhaust nozzle to open. The close line is ported to atmosphere. When afterburning is terminated, the air relay valve returns to its initial position allowing high pressure air to enter the close line and close the nozzle. The open line is then ported to atmosphere.

AFTERBURNER IGNITER

Afterburner ignition is accomplished by means of a "hot-streak" igniter which is mounted on the right side of the compressor diffuser. This unit injects a charge of fuel into number 3 combustion chamber, causing a temporary overrich condition, which produces a flame streak through the turbine and into the afterburner fuel spray. The igniter includes an air piston, which actually "squirts" the fuel charge, and a pilot valve that triggers the air piston. When afterburning is initiated a fuel pressure signal from the afterburner fuel control shuttles the pilot valve to a position that directs high pressure air behind the air piston. This in turn forces the air piston against its spring and discharges the fuel into number 3 combustion chamber. When afterburning ceases both the air piston and the pilot valve return to their former positions and the igniter is ready for its next sequence. The igniter is a "one-shot" device only, and will not recycle until afterburner fuel pressure is shut off (afterburning terminated). Therefore, if afterburner does not ignite (within 2 seconds at sea level; 3 to 4 seconds at altitude) it is necessary to momentarily move the throttles out of afterburner detent before attempting to relight.

AFTERBURNER FUEL CONTROL

Fuel is metered by the afterburner fuel control unit in direct proportion to engine output, as indicated by combustion chamber pressure. This pressure surrounds a bellows that is connected to a variable orifice area metering valve. As burner can pressure changes, the bellows is deflected to a new position and the metering valve is moved to provide correct fuel flow. The metered fuel is delivered to the afterburner fuel manifold and to the afterburner igniter. Afterburner and main engine fuel are proportioned in their flow and both will vary in response to throttle manipulation.

AFTERBURNER EMERGENCY FUEL SHUTOFF VALVE

The afterburner is shut off mechanically in the event the normal electrical control fails. The afterburner emergency shutoff valve (figure 1-4) is mechanically opened when the throttle is moved out of the afterburner detent and retarded to approximately 83% Military thrust. The open afterburner emergency valve directs fuel from the afterburner fuel control back to the engine-driven fuel pump. This terminates afterburning and the lack of fuel pressure at the exhaust nozzle control unit causes the exhaust nozzle to close.

Note

Advancing the throttle past the afterburner cutoff point closes the emergency cutoff valve and will turn on the afterburner providing the failed electrical switch is still on.

OIL SYSTEM

Each engine employs a dry sump, pressure-type, oil system for the lubrication of the six main bearing locations. Oil is supplied from a 7.1 U.S. gallon tank attached to the left side of each engine at the compressor section. The tank has a fully serviced capacity of 5.5 gallons. Usable oil is 3 U.S. gallons. Oil flows from the tank to a gear-type pump from which it passes under pressure, to the lubrication points. The pump supplies oil for adequate engine lubrication at all engine speeds and reaches normal pressure at approximately 75 percent rpm. Oil is returned under pressure, by five scavenge pumps to a fuel-oil cooler and, if temperatures require, an air-oil cooler. It then flows to the tank from where it is recycled. No cockpit controls are provided for regulating oil temperature since the system is automatic. Maximum allowable oil temperature is 250°F. However, flow through the air-oil cooler is regulated to maintain the temperature of oil entering the fuel-oil cooler at a degree which will result in a minimum fuel temperature of 100°F.

Note

Since engine installation on this airplane renders the oil tank filler inaccessible, two lines have been installed on each engine, from the oil system to a location at the bottom of the engine. These lines, a filler line, and an overflow line, have quick-disconnect fittings. The system should be serviced with the engines at idle rpm or within 30 minutes after engine shutdown. After incorporation of T.O. 1F-101-614, an oil tank dipstick has been added to allow the oil quantity to be checked. The engine is properly replenished when oil flows from the overflow line. There will be an initial overflow upon connecting servicing hose since the overflow line must empty its accumulation.

FUEL QUANTITY DATA TABLE

TANK	NO.	USABLE FUEL IN LEVEL FLIGHT (EACH)		FULLY SERVICED (EACH)	
		U.S.GALLONS	POUNDS	U.S.GALLONS	POUNDS
NUMBER 1 FUEL CELL	1	769	4999	769	4999
NUMBER 2 FUEL CELL	1	430	2795	430	2795
NUMBER 3 FUEL CELL	1	232	1508	234	1521
NUMBER 4 FUEL CELL	1	338	2197	340	2210
NUMBER 5 FUEL CELL	1	310	2015	311	2021
EXTERNAL TANKS	2	450	2925	450	2925

TOTAL USABLE FUEL WITHOUT EXTERNAL TANKS: 2079 GALLONS (13,514 POUNDS).

TOTAL USABLE FUEL WITH TWO 450 GALLON TANKS: 2979 GALLONS (19,363 POUNDS).

NOTES

- CONVERSION FACTOR IS 6.5 POUNDS PER GALLON
- VALUES ARE FOR STANDARD DAY

TANK	NO.	USABLE FUEL IN LEVEL FLIGHT (EACH)		FULLY SERVICED (EACH)	
		U.S.GALLONS	POUNDS	U.S.GALLONS	POUNDS
NUMBER 1 FUEL CELL	1	769	4999	769	4999
NUMBER 2 FUEL CELL	1	430	2795	430	2795
NUMBER 3 FUEL CELL	1	232	1508	234	1521
NUMBER 4 FUEL CELL	1	338	2197	340	2210
NUMBER 5 FUEL CELL	1	310	2015	311	2021
WING TANKS	2	85	553	86	559
EXTERNAL TANKS	2	450	2925	450	2925

TOTAL USABLE FUEL WITHOUT EXTERNAL TANKS: 2249 GALLONS (14,620 POUNDS).

TOTAL USABLE FUEL WITH TWO 450 GALLON TANKS: 3149 GALLONS (20,470 POUNDS).

Figure 1-9

AIRPLANE FUEL SYSTEM (20)

Fuel is carried in five cells, four bladder type and one self-sealing, within the fuselage. See figure 1-9. Provisions are made for carrying auxiliary fuel in two 450 gallon droppable external tanks, mounted on the fuselage. In operation, the tanks are pressurized by air taken from the engine compressor. By using this pressure, fuel is forced to any fuselage cell which is low and its flow control valve is open.

Note

> Since no quantity indication is provided for the external tanks, a drop in the total fuel quantity reading is an indication of external tank fuel exhaustion. However, under conditions of high fuel consumption, the rate of flow from the external tanks may not be adequate and a temporary drop in total fuel will result.

For identification, the fuselage cells are numbered 1 through 5 beginning with the forward cell and progressing aft. No cell selection is required since the system is designed for continuous flow, the engine receiving fuel from cell number 2. Number 2 cell is self-sealing and is baffled to assure fuel supply under conditions of negative "g" load. The cells are connected for gravity flow with cell number 5 flowing to number 4, number 4 to number 3, and both 1 and 3 to number 2. To supplement the gravity flow, electric transfer pumps are installed in cells 1, 4 and 5, each delivering fuel to cells 2 and 3. With electrical power supplied, the transfer pumps are actuated (in sequence) with either engine master switch ON. Also, individual pump operation is stopped when its respective cell becomes empty. Transfer pump operation is sequenced with number 1 and 5 operating initially and number 4 automatically starting when number 5 is empty. A feed tank low level warning light, located on the pedestal panel, will illuminate when approximately 1200 pounds of fuel is in cell number 2. If the level of cell number 2 decreases to approximately 850 pounds, an emergency transfer pump circuit will automatically energize all transfer pumps. The emergency transfer pump circuit can also be energized by placing the fuel pumps switch in the ALL PUMPS position. Two boost pumps in number 2 cell deliver fuel through separate lines to the fuel manifold, from which it goes to the engines. Both pumps operate continuously, however, only the aft pump is effective under conditions of negative "g" loading. In the event of an electrical failure, or failure of both boost pumps, a gravity feed line will deliver fuel to the manifold. All pumps, both transfer and boost, operate on 200 volt, three-phase a-c power; the control circuits, however, utilize 28 volt d-c. In addition to the single-point pressure refueling, for which this system was designed, direct fillers are provided on cells 1, 3 and 5. Cells 2 and 4 fill through gravity flow. All three fillers may be used simultaneously, but if filled individually, the sequence should be 1, 3 and 5. Fuel cell quantities are listed in figure 1-9; fuel specifications are given in figure 1-34. Fuel management information will be found in Section VII.

Note

> Rate of flow from the filler hose may exceed the rate of gravity flow from one cell to another. Therefore, extreme care should be exercised in determining when the system is fully serviced.

AIRPLANE FUEL SYSTEM (25)(30)(35)

Fuel is carried in five cells, four bladder and one self-sealing, within the fuselage. See figure 1-9. Fuel is also carried in an integral wing tank in each wing. The wing tanks are pressurized by air taken from the engine compressor section when either engine is operating. During air refueling or without engine operation the wing tanks are vented to the atmosphere. During transfer, the fueling control valves are open and air pressure forces the fuel from the wing tanks to the fuselage cells. Each fueling control valve is automatically closed, when its tank is empty. The wing tanks are not equipped with direct gravity fillers and can only be refueled by a pressure refueling system. To increase the fuel supply, two 450 gallon droppable external tanks can be installed on the underside of the fuselage. The droppable external tanks are vented to atmosphere. During transfer, compressed air taken from the engine compressor section forces fuel from the external tanks through the fueling control valves to the fuselage cells. Each fueling control valve is automatically closed when its tank is empty. The external tanks can be refueled by direct gravity refueling or a pressure refueling system. A fuel transfer selector switch controls fuel flow from the wing tanks or external tanks to the fuselage cells. The transfer selector switch also controls normal or emergency transfer within the fuselage cells. For identification, the fuselage cells are numbered 1 through 5, beginning with the forward cell and progressing aft. Number 2 cell is self-sealing and is baffled to assure fuel supply to the engines under conditions of negative "g" loads. The cells are connected for gravity flow with cell number 5 flowing into cell 4, cell 4 to cell 3, and both cells 1 and 3 feeding cell 2, which supplies the engine. To supplement the gravity flow, electric transfer pumps are installed in cells 1, 4 and 5 each delivering its fuel to cells 2 and 3. With the fuel transfer selector switch in the FUS position, either engine master switch ON, and electrical power supplied, the transfer pumps are actuated in sequence. Also, individual pump operation is stopped when its respective cell is empty. Transfer pump operation is sequenced with number 1 and 5 operating initially and number 4 automatically starting when cell 5 is empty. A feed tank low level warning light, located on the pedestal, will illuminate when approximately 1200 pounds of fuel is in cell

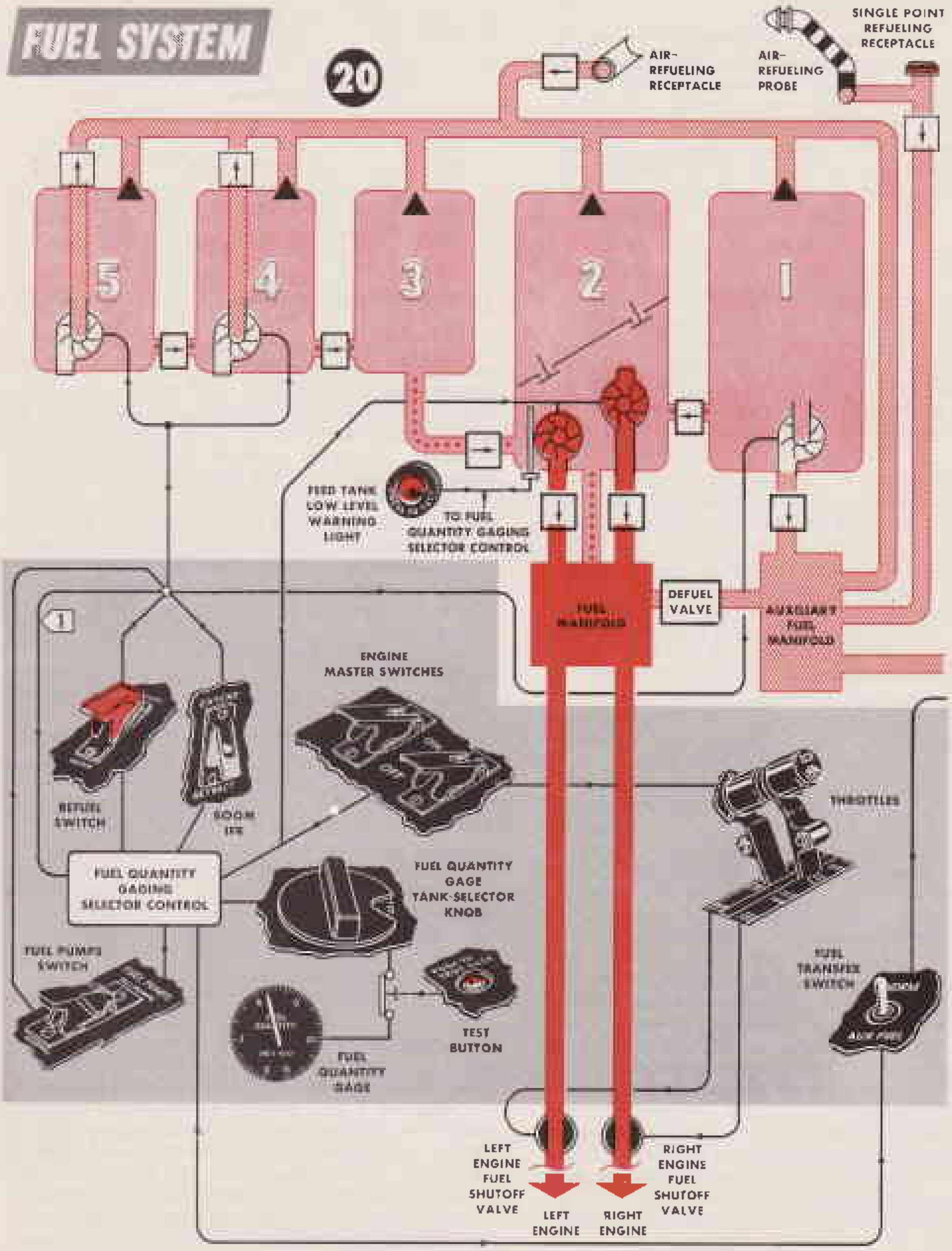
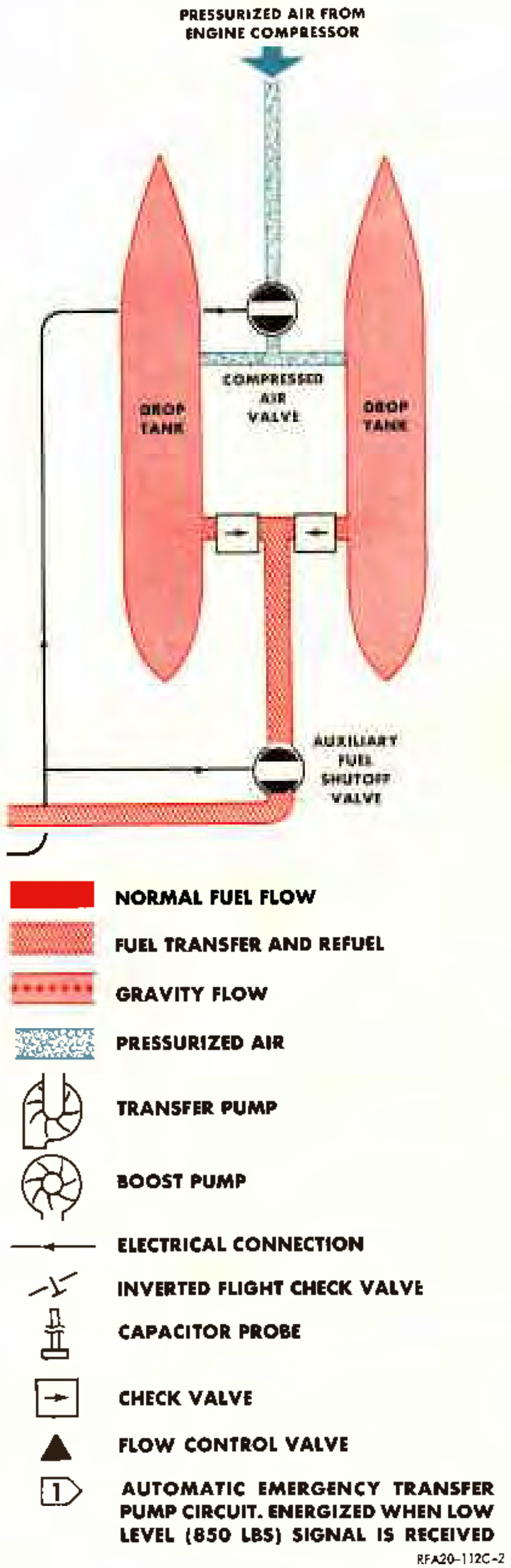

FUEL SYSTEM
20
AIR-REFUELING RECEPTACLE
AIR-REFUELING PROBE
SINGLE POINT REFUELING RECEPTACLE
5
4
3
2
1
FEED TANK LOW LEVEL WARNING LIGHT
TO FUEL QUANTITY GAGING SELECTOR CONTROL
FUEL MANIFOLD
DEFUEL VALVE
AUXILIARY FUEL MANIFOLD
1
ENGINE MASTER SWITCHES
REFUEL SWITCH
BOOM IFR
THROTTLES
FUEL QUANTITY GAGING SELECTOR CONTROL
FUEL QUANTITY GAGE TANK-SELECTOR KNOB
FUEL PUMPS SWITCH
FUEL TRANSFER SWITCH
TEST BUTTON
FUEL QUANTITY GAGE
LEFT ENGINE FUEL SHUTOFF VALVE
RIGHT ENGINE FUEL SHUTOFF VALVE
LEFT ENGINE
RIGHT ENGINE

Figure 1-10



number 2. If the level of cell number 2 decreases to approximately 850 pounds, an emergency transfer pump circuit will automatically energize all fuselage transfer pumps. The emergency transfer pump circuit can also be energized by placing the transfer selector switch to the ALL PUMPS position. Placing the transfer selector switch to the WING or EXT position will transfer fuel from that selected tank or tanks to replenish the fuselage cells. Two booster pumps in number 2 fuselage cell deliver fuel through separate lines to the fuel manifold, from which it goes to the engines. Both pumps operate continuously, however, only the aft pump is effective under conditions of negative "g" loading. In the event of an electrical failure, or failure of both boost pumps, a gravity feed line will deliver fuel to the manifold. All pumps, both transfer and boost, operate on 200 volt, three-phase a-c power; the control circuits, however, utilize 28 volt d-c. In addition to the single point pressure refueling, for which this system was designed, direct fillers are provided on fuselage cells 1, 3 and 5. Cells 2 and 4 fill through gravity flow. The wing tanks can only be refueled by a pressure refueling system. Fuel tank quantities are listed in figure 1-9; fuel specifications are given in figure 1-34. Fuel management information will be found in Section VII.

Note

> When refueling the fuselage cells the rate of flow from the filler hose may exceed the rate of gravity flow from one cell to another, therefore extreme care should be exercised in determining when the fuselage system is fully serviced.

SINGLE POINT REFUELING SYSTEM

The single point pressure refueling of all fuselage cells in the (20) airplanes can be accomplished in approximately 4 minutes. All fuselage cells are filled simultaneously with flow control valves in each cell stopping flow to each cell when it is full. The single point pressure refueling of all fuselage cells, wing tanks and the external tanks in the (25)(30)(35) airplanes can be accomplished in approximately 6 minutes. Refer to Refueling Systems, Section IV, for additional information. The single point pressure refueling filler (figure 1-34) is located on the right side of the fuselage forward of the engine.

AIR REFUELING SYSTEMS

Air refueling of all fuselage cells in the (20) airplanes is accomplished in two ways, the probe-drogue and flying boom methods. Air refueling of all fuselage cells, wing tanks and external tanks in the (25)(30)(35) airplanes is also accomplished by the probe-drogue and flying boom methods. The probe is contained in the nose section, immediately forward of the cockpit. The probe is raised into the servicing position by an electrically controlled hydraulic actuator. The boom receptacle is located behind the canopy and above fuse-

FUEL SYSTEM

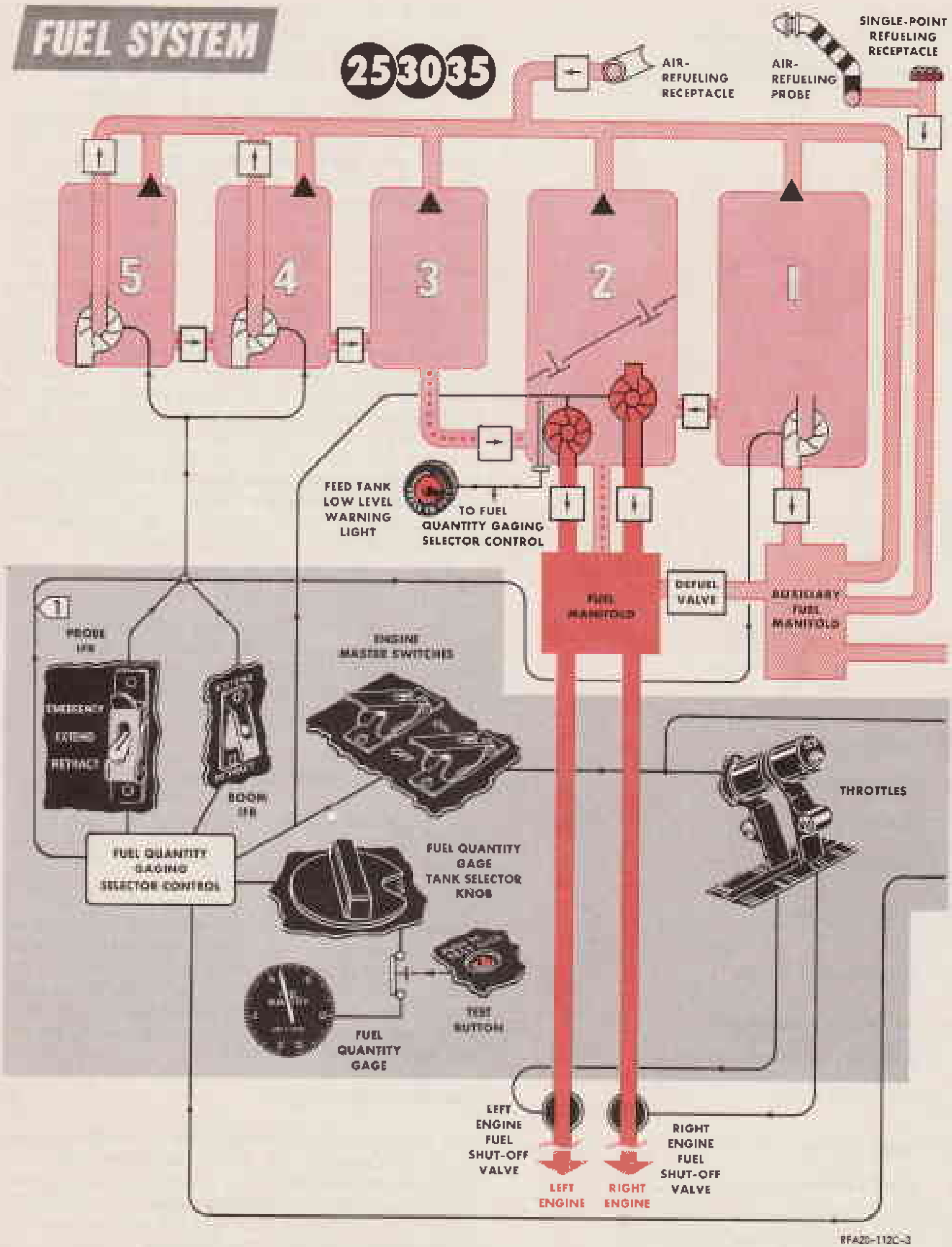
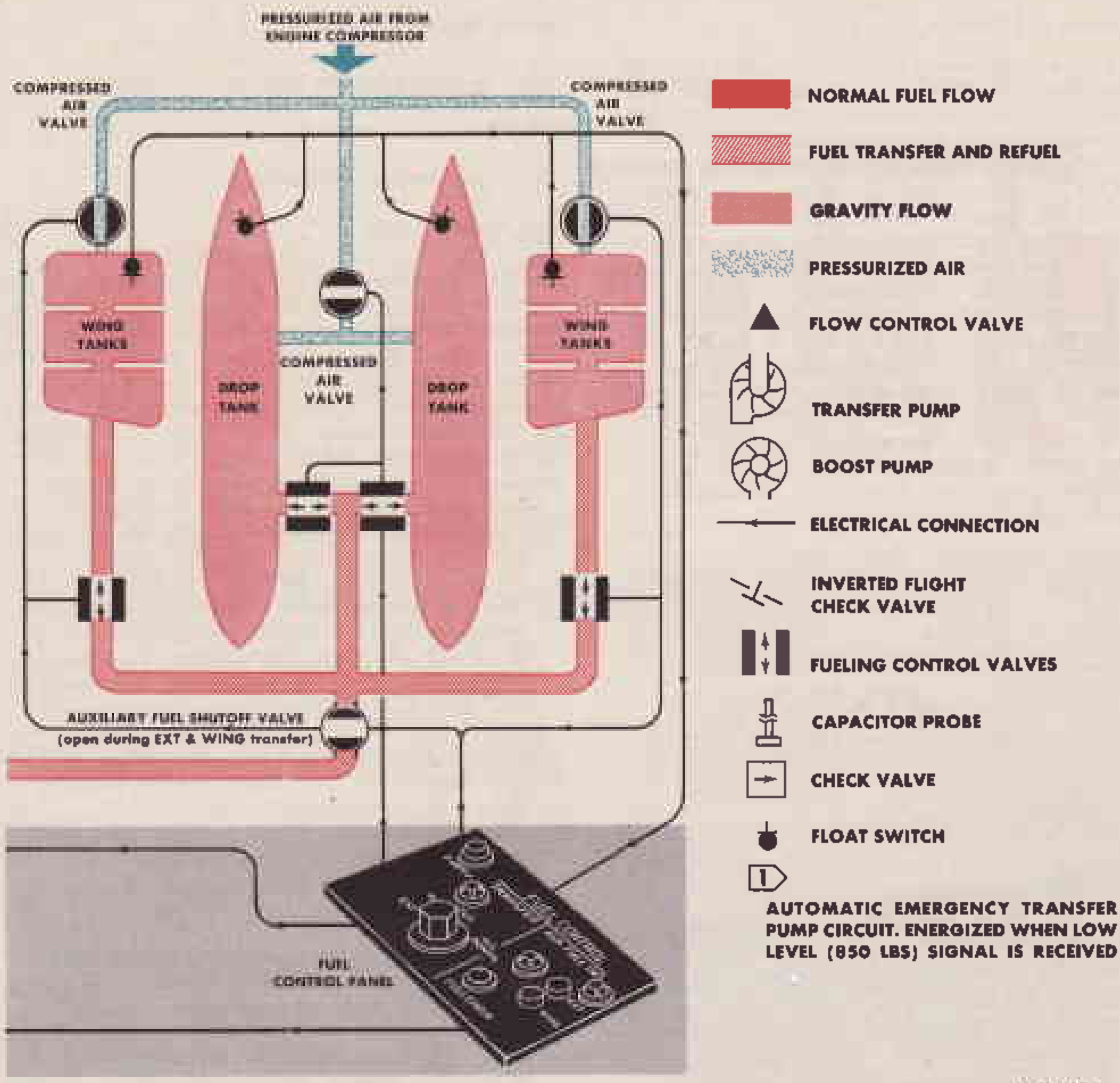


Figure 1-11



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lage cell number 2. The receptacle is hydraulically actuated and electrically selected. Both air refueling systems utilize 28 volt d-c electrical power and utility hydraulic pressure. Refer to Refueling Systems, Section IV, for additional information.

FUEL PRESSURIZATION AND VENT SYSTEM

A fuel tank vent system is provided in order to maintain a positive pressure in the fuselage cells during flight. This minimizes fuel boiling and evaporation at high altitudes, and helps insure positive fuel supply to the engines. The system provides an exit for fuel in the event a flow control valve should fail during refueling operations. While the aircraft is on the ground, it also vents the tanks to atmosphere when temperature changes tend to cause an excessive pressure build-up. The vent lines terminate at two vent masts located in the tail cone at a point beneath the rudder. The masts are cut at different angles and are referred to as "High Scarf" and "Low Scarf". The high scarf mast controls vent pressure from .5 psi to 2.5 psi. The low scarf mast controls vent pressures in excess of 2.5 psi. The pressure selection is made through a pneumatically operated valve and actuated electrically by the pressure switch in the number 1 cell. In the event of a positive pressure greater than 2.5 psi, the valve is positioned to the low scarf vent. In a case of negative pressure within the cell, the vent valve allows ram air from the high scarf vent to enter the cells. The system is designed to maintain cell pressures within 1/2 psi of ambient air pressure.

Fuel Booster and Transfer Pumps

There are two centrifugal type booster pumps mounted in the bottom of the number 2 fuselage fuel cell. The aft pump has a pumping element at both top and bottom of the pump. The top pumping element is provided to supply fuel to the engine driven fuel pumps during inverted flight and negative "g" loads. Either pump is capable of supplying fuel in sufficient quantities to sustain two engine operation at military power settings. There are fuel transfer pumps mounted in fuselage cells 1, 4 and 5 for the purpose of transferring fuel to cells number 2 and 3. Electrical power is supplied to all the boost and transfer pumps by the 200 volt, three-phase a-c bus. A check switch for each boost and transfer pump is mounted in the right wheel well.

Note

The circuit breakers for the booster and transfer pumps are located on the circuit breaker panel.

FUEL CONTROL PANEL

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Figure 1-12

Engine Master Switches

Refer to Engine Master Switches, this section.

Throttles

Refer to Throttles, this section.

Fuel Transfer Switch (20)

The fuel transfer switch (figure 1-14) on the circuit breaker panel provides for a selection of normal or auxiliary fuel. The switch, a two-position toggle type, when in the NORM position, is in series with either engine master switch, the boom IFR switch, the refuel switch and will complete the normal control circuit to the transfer pumps. In the AUX FUEL position, the auxiliary fuel shutoff valve is opened, the compressed air valve to the external tank, or tanks, is opened and normal transfer pump operation is stopped. The fuel transfer switch utilizes 28 volt d-c power.

Note

The emergency transfer pump circuit will by-pass the fuel transfer switch either automatically, (fuselage cell #2 reaching a level of 850 lbs.) or manually by placing fuel pumps switch to ALL PUMPS.

Since no quantity indication is provided for auxiliary fuel, a drop in the total fuel quantity reading is an indication of auxiliary fuel exhaustion. Placing the transfer switch to the NORM position will establish normal fuselage fuel transfer pump operation.

Fail Pump Switch (20)

The fuel pumps switch (figure 1-19) is a two-position toggle switch located on the left console. This switch provides a control of the emergency transfer pump circuit and is guarded in the NORMAL position. In this position it will not affect the automatic emergency transfer pump circuit which operates all fuselage transfer pumps whenever fuselage cell 2 contains 850 pounds of fuel. Placing the switch in the ALL PUMPS position will operate all fuselage transfer pumps regardless of the level of number 2 fuselage cell. The fuel pumps switch utilizes 28 volt d-c electrical power.

Fuel Transfer Selector Switch (25)(30)(35)

The fuel transfer selector switch (figure 1-12) is located on the fuel control panel. This four-position selector switch controls fuel flow from the auxiliary tanks to the fuselage cells and also controls transfer within the fuselage cells. An empty tank warning light operates in conjunction with the transfer selector switch. This light will illuminate when the transfer selector switch is in the WING or EXT position and that selected tank is empty. When the transfer selector switch is in the FUS position and either engine master switch is ON, the fuselage transfer pumps will operate in sequence. Placing the switch in the ALL PUMPS position will energize all fuselage transfer pumps. In the WING position, the refuel shutoff valve will open and the fueling control valves will allow compressed air to force fuel out of the wing tanks to the fuselage cells. Placing the switch in the EXT position will open the refuel shutoff valve and the fueling control valves allowing compressed air to force the fuel from the external tanks to the fuselage cells. The fuel transfer selector switch utilizes 28 volt d-c electrical power.

Note

Normally, fuselage transfer pumps will not operate when the transfer selector switch is in the WING or EXT position, however, the position of this selector switch in no way affects the operation of the emergency circuit which automatically operates all fuselage transfer pumps when fuselage cell number 2 contains 850 pounds of fuel.

Refuel Switch (20)

Refer to Refueling Systems, Section IV.

Probe IFR Switch (25)(30)(35)

Refer to Refueling Systems, Section IV.

Boom IFR Switch

Refer to Refueling Systems, Section IV.

External Tank Jettison Switch

This two-position toggle switch (figure 1-14) will jettison both external tanks when in the JETTISON position. The switch is located on the circuit breaker panel and guarded in the NORM position. Placing the switch to JETTISON completes the circuit to simultaneously operate the jettison units for both external tanks. Electrical power is supplied from the 28 volt d-c bus. External tanks can also be jettisoned by the external tank emergency jettison button.

Note

The external tank jettison switch circuit passes through the landing gear handle. The landing gear handle must be in the UP position before the external tanks can be jettisoned.

External Tank Emergency Jettison Button

In (20)(25) airplanes after incorporation of T.O. 1F-101-612 and in (30)(35) airplanes a red spring-loaded push button (figure 1-22), located on the landing gear control panel, jettisons both external tanks in one operation. Depressing the button completes the circuit from the battery bus to electrically energize the jettison units for the external tanks.

External Tank Emergency Release Handle (20)(25)(30)

This handle, located on the vertical portion of the right console, provides a mechanical means of releasing the external tanks in the event the normal electrical jettison provision fails. The handle is in the shape of an external tank and is connected through a system of cables to the tank racks. Both tanks are released simultaneously when the handle is pulled. Approximately a 12 inch pull is required to operate the release mechanism. The handle will return to its stored position when released. However, the pilot should assist in guiding the handle to the proper position. Upon incorporation of T.O. 1F-101-612, this handle will be removed from the airplane.

Fuel Quantity Gage

The fuel quantity gage (15, figure 1-24) on the instrument panel indicates, in pounds, the fuel in any internal cell or the total of all internal cells. There is no provision for an indication of auxiliary fuel carried externally. The system is electrically operated and requires both 28 volt d-c and 115 volt single-phase a-c.

Fuel Quantity Gage Tank Selector Knob

A selector knob (figure 1-13) on the left console permits a selection of the function of the fuel quantity indicating system. With the selector turned to any of the positions numbered 1 thru 5, the fuel quantity in that particular cell is indicated. In the TOTAL position, the amount of fuel in all of the internal cells is indicated.

Note

The TOTAL fuel quantity indication is considered more accurate than the sum of the individual fuel cells. This eliminates the calibration errors of each individual cell.

Fuel Quantity Gage Test Button

The fuel quantity gage test button (figure 1-13) provides a means of checking the operation of the quantity indicating system when electrical power is supplied. When the button is depressed, the gage needle should move toward zero. When subsequently released, the needle should return to its previous indication.

Aux Full Fuel Indicator and Test Button (25)(30)(35)

The auxiliary full fuel indicator (figure 1-12) is located on the fuel control panel and consists of two green indicator lights. The indicator lights are marked "Wing" and "Ext" and will illuminate during air refueling when their respective tanks are full. Retracting the AR probe or the AR receptacle will cause the indicator lights to go out. Depressing the test button marked "FULL CHECK", on the aux full fuel indicator will illuminate the green indicator light for each auxiliary fuel system, if the system is full. The indicator lights utilize 28 volt d-c electrical power and are actuated by a float-type switch. The lights can be tested by depressing the warning light test button.

Note

- If the external tanks are either not installed or jettisoned, the "Ext" indicator light cannot illuminate.
- The indicator lights will illuminate only when the tanks are full. If the indicator lights do not illuminate the tanks should not be considered empty.

Empty Tank Warning Light (25)(30)(35)

The red empty tank warning light (figure 1-12) is located on the fuel control panel. This light operates in conjunction with the fuel transfer selector switch. The empty tank warning light will illuminate when the fuel transfer selector switch is in the WING or EXT position and that selected tank is empty. The empty tank warning light utilizes 28 volt d-c electrical power, and is actuated by a pressure switch.

Note

If the external tanks are either not installed or jettisoned, the empty tank warning light will illuminate if that transfer option is selected.

Feed Tank Low Level Warning Light

A red light, (figures 1-24 and 1-30) located on the pedestal panel will illuminate when fuel quantity in the number 2 cell drops below 1200 pounds. The feed tank low level warning light does not indicate that the fuselage cells are low on fuel, it only indicates the engine feed tank (fuselage cell 2) is low on fuel. The light operates on 28 volt a-c electrical power.

Note

The accuracy of the light may be checked by positioning the fuel quantity gage tank selector knob to the number 2 position and checking fuel quantity gage indication.

FUEL QUANTITY GAGE TANK SELECTOR PANEL

Figure 1-13

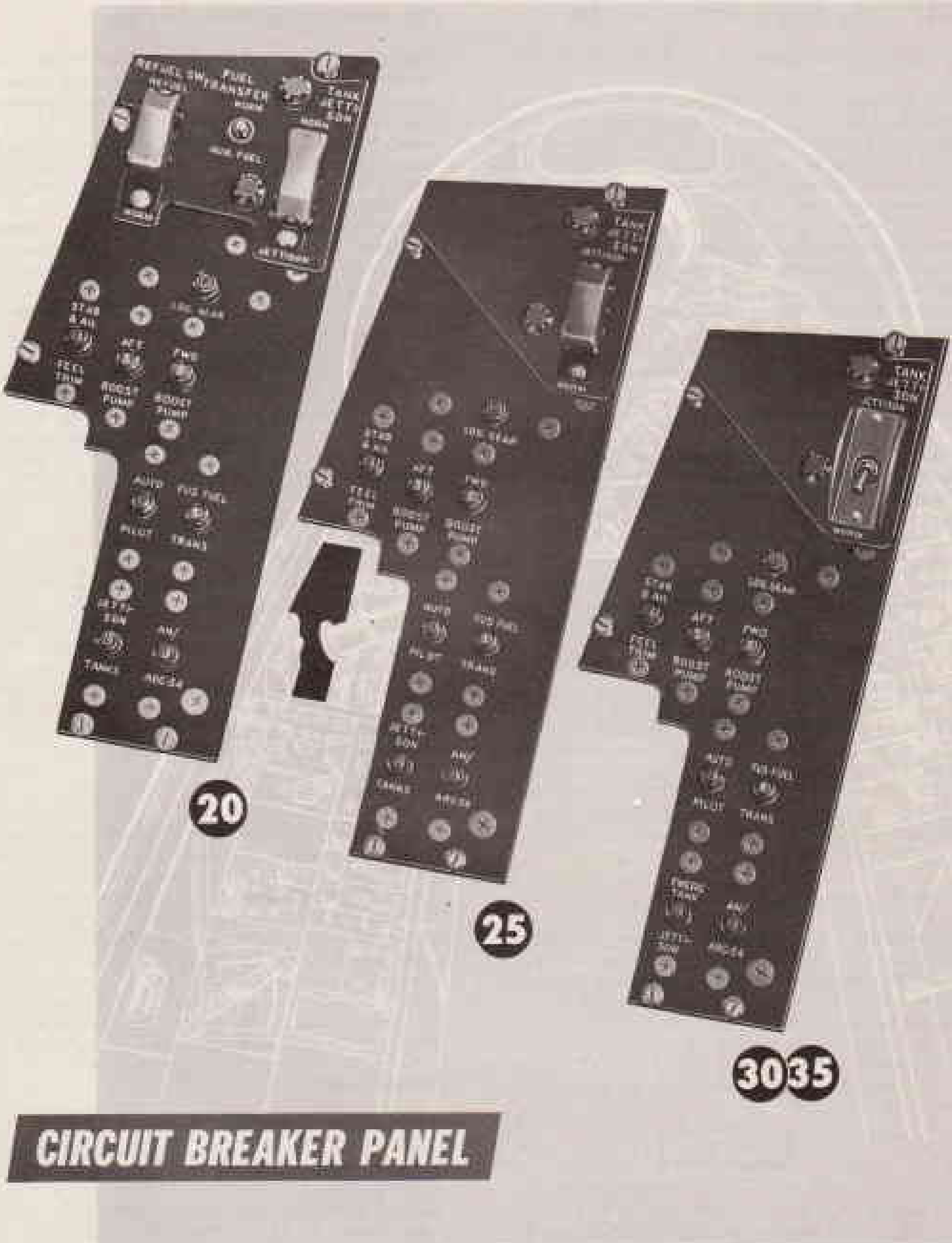

REFUEL SW
FUEL TRANSFER
TANK JETTISON
LDG GEAR
STAB & AIL
AFT
FWD
FEEL TRIM
BOOST PUMP
BOOST PUMP
AUTO PILOT
FUS FUEL TRANS
JETTISON
TANKS
AN/ ARC34
20
25
30 35
CIRCUIT BREAKER PANEL

Figure 1-14

ELECTRICAL POWER SUPPLY SYSTEM

A-C ELECTRICAL POWER

The primary electrical power for the airplane is 200/115 volt, three-phase, 400 cycle alternating current. It is supplied by two 30,000 volt-ampere generators operating in parallel, one driven by each engine. Constant frequency is possible through the use of constant speed drive units which turn the generators. Ground adjusted units automatically provide for current regulation, an equal division of load, and serve to disconnect a generator from the circuit in the event of any malfunction. Either generator is capable of meeting the demands of the airplane in the event the other fails. Figure 1-16 illustrates the use of transformers and transformer-rectifiers to supply the varied currents required by different items of equipment.

D-C ELECTRICAL POWER

Two transformer-rectifiers receive 200 volt, three-phase a-c and supply 28 volt d-c. These units, each capable of delivering 100 amps, are connected in parallel and either can supply all the d-c power required. A 24 volt, 11 ampere-hour battery is provided as an auxiliary source of d-c power. The battery is connected to the 28 volt d-c bus system when the battery switch is in the ON position or when external power is supplied. The battery is connected to the battery bus at all times. Refer to figure 1-16.

External Electrical Power Receptacle

To provide adequate power for ground operation of electrical equipment, an external power receptacle (figure 1-34) is located on the right side of the airplane below the cockpit area. The external power required is 200 volt three-phase a-c and it is distributed through the entire electrical system in the same manner as generator output.

Circuit Breakers and Fuses

Most of the d-c circuits are protected by push-pull type circuit breakers. The circuit breakers (figure 1-14) for essential circuits are located on the left console outboard of the throttles. All circuit breakers for the camera system are mounted on the aft section of the right console, figure 1-27. The remaining circuit breakers and all a-c fuses are located on panels in the camera compartment and are inaccessible during flight.

CAUTION

Circuit breakers should not be pulled or reset without a thorough understanding of all the effects and results. Pulling circuit breakers can eliminate from a system some related warning system, interlocking circuit, or cancel signal, which would result in an undesirable reaction.

Emergency Electrical System Provisions

Any malfunction of the generator, or engine underspeed condition, will cause the generators to become disconnected from the bus system. Each generator, however, is of sufficient capacity to carry the normal electrical load alone. If both generators become disconnected from the line because of underspeed operation, possibly resulting from a double engine flame-out, emergency power will be available for accomplishing an air start. Emergency d-c power from one of three sources will automatically energize the emergency fuel boost pump relays, emergency start relay, and the emergency ignition system. The emergency d-c power may be supplied by the windmilling a-c generators through a transformer-rectifier within each generator control unit, the generator fields supply, or the battery. Low frequency a-c power will operate the boost pumps, by-passing the tripped generator power circuit breakers through the energized emergency boost pump relays. After the engines have been successfully restarted, the generators will be automatically reconnected to the line.

Power Selector Switch

This two-position toggle switch (figure 1-31), located adjacent to the external power receptacle on the right side of the airplane, provides a means of selecting the source of power for the bus system. In the GEN position, generator output only is available to the bus; in the EXT.PWR. position, only external power, when connected, is furnished the bus. The power selector switch is so arranged that when the external power receptacle door is closed, the switch will be automatically positioned to GEN.

Generator Switches

Two guarded toggle switches (figure 1-15), one for each generator, are mounted on the electrical control panel. They have fixed ON and OFF positions and a spring-loaded RESET position. They serve to connect the generators to the bus system and are normally left in the ON position unless there is a generator malfunction. If the generator control circuit breaker has disconnected a generator due to a temporary malfunction, which has been corrected, the generator can be reconnected to the bus system by momentarily placing the switch to RESET, then returning it to ON.

Battery Switch

This channel guarded two-position toggle switch (figure 1-15) is located on the electrical control panel. In the ON position, with no a-c power supplied the bus system, battery power is available to the 28 volt d-c bus. In the ON position, with a-c power being supplied, transformer-rectifier output will be available to the battery bus. Whenever external a-c power is applied, the battery will be charged as required regardless of battery switch position. With the battery switch in the OFF position, and external power is supplied, the 28

ELECTRICAL CONTROL PANEL

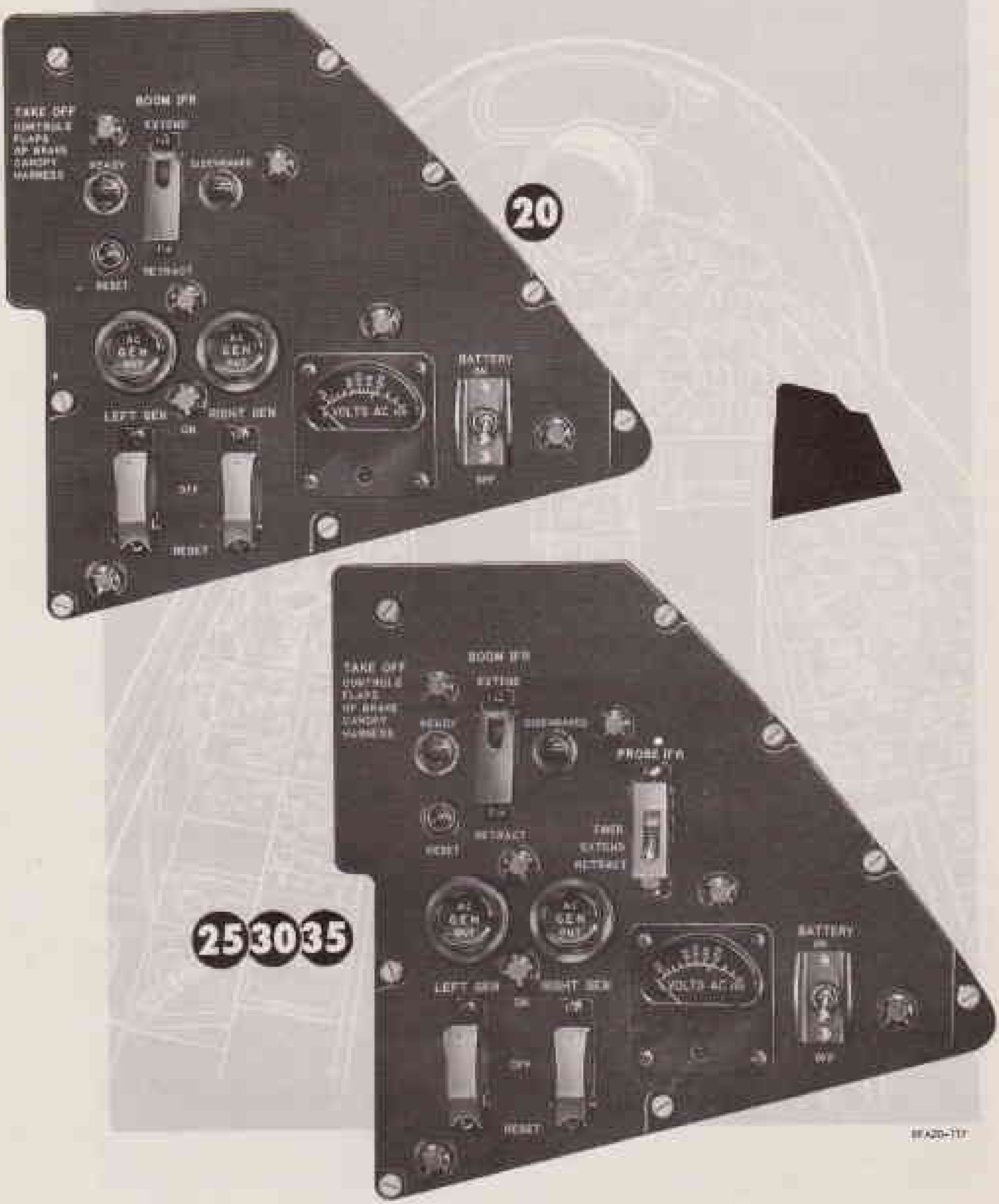


Figure 1-15

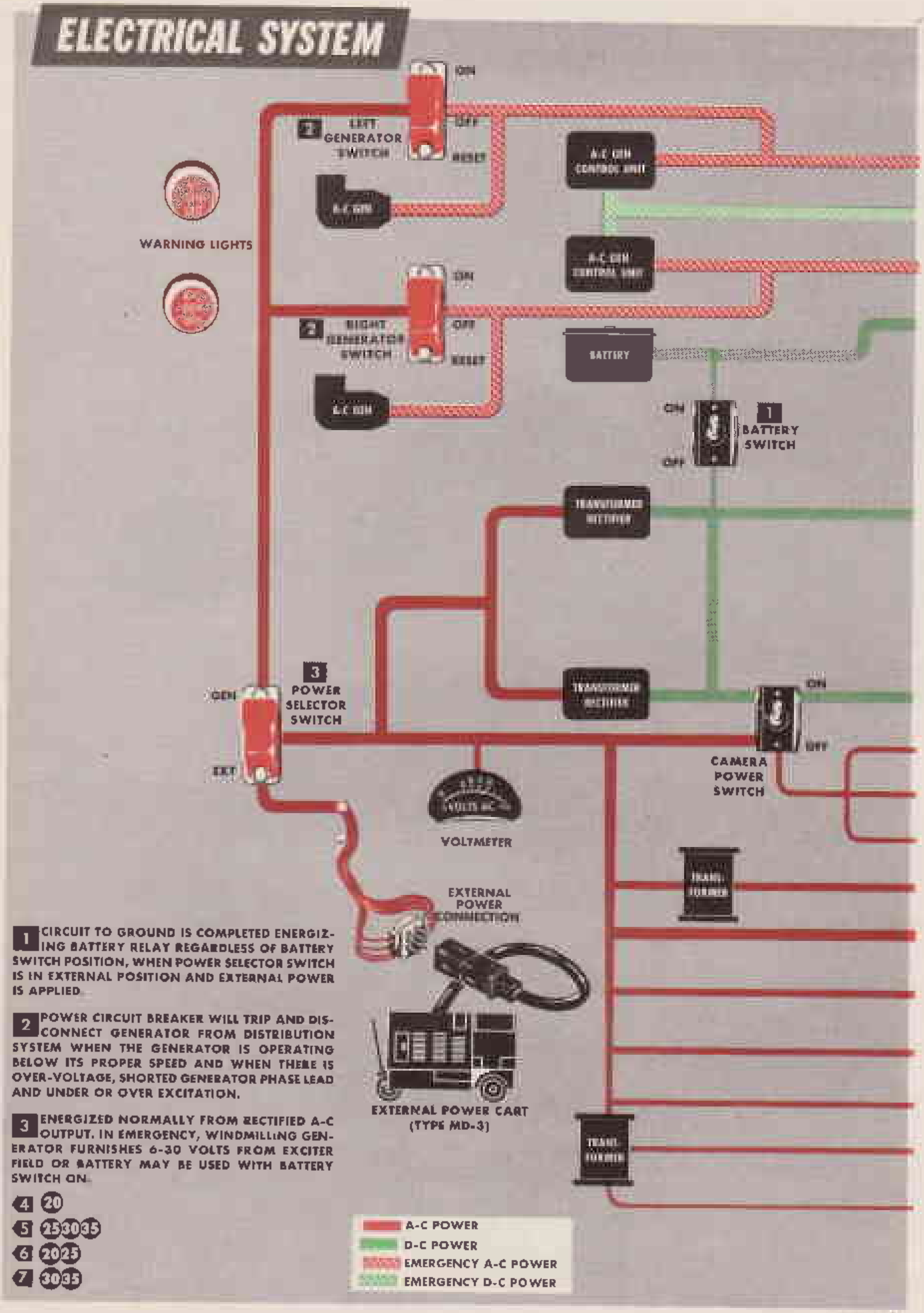

ELECTRICAL SYSTEM
ON
OFF
RESET
2 LEFT GENERATOR SWITCH
A-C GEN
WARNING LIGHTS
A-C GEN CONTROL UNIT
A-C GEN CONTROL UNIT
2 RIGHT GENERATOR SWITCH
A-C GEN
BATTERY
ON
1 BATTERY SWITCH
OFF
TRANSFORMER RECTIFIER
TRANSFORMER RECTIFIER
GEN
3 POWER SELECTOR SWITCH
EXT
ON
OFF
CAMERA POWER SWITCH
VOLTS D-C
VOLTMETER
TRANSFORMER
EXTERNAL POWER CONNECTION
EXTERNAL POWER CART (TYPE MD-3)
TRANSFORMER
1 CIRCUIT TO GROUND IS COMPLETED ENERGIZING BATTERY RELAY REGARDLESS OF BATTERY SWITCH POSITION, WHEN POWER SELECTOR SWITCH IS IN EXTERNAL POSITION AND EXTERNAL POWER IS APPLIED.
2 POWER CIRCUIT BREAKER WILL TRIP AND DISCONNECT GENERATOR FROM DISTRIBUTION SYSTEM WHEN THE GENERATOR IS OPERATING BELOW ITS PROPER SPEED AND WHEN THERE IS OVER-VOLTAGE, SHORTED GENERATOR PHASE LEAD AND UNDER OR OVER EXCITATION.
3 ENERGIZED NORMALLY FROM RECTIFIED A-C OUTPUT. IN EMERGENCY, WINDMILLING GENERATOR FURNISHES 6-30 VOLTS FROM EXCITER FIELD OR BATTERY MAY BE USED WITH BATTERY SWITCH ON.
4 20
5 25 30 35
6 20 25
7 30 35
A-C POWER
D-C POWER
EMERGENCY A-C POWER
EMERGENCY D-C POWER

Figure 1-16

200V A-C (LEFT) EMERGENCY BUS	AFT FUEL BOOST PUMP (ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED)		
24V D-C EMERGENCY BUS	EMERGENCY BOOST PUMP CONTROL IGNITION (ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED)		
200V A-C (RIGHT) EMERGENCY BUS	FORWARD FUEL BOOST PUMP (ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED)		
BATTERY BUS	CAMERA ELEVATOR CANOPY POWER (PRIMARY) EMERGENCY TANK JETTISON [7]	EXTERNAL POWER INTERLOCK FUEL SHUTOFF (LEFT) FUEL SHUTOFF (RIGHT)	AR CONTROL [6] AR PILOT VALVE TEST [6] WING REFUEL [6]
28V D-C BUS	A-C EXTERNAL LOAD A-C GENERATOR LOAD CONTROL (LEFT) A-C GENERATOR LOAD CONTROL (RIGHT) AN/AIC-10 (INTERCOM) AN/APN-22 (RADAR ALTIMETER) AN/ARC-34 (UHF COMMAND) AN/ARN-14 (VHF NAVIGATION) AN/ARN-14 TEST AN/ASN-6 (DPI) AN/APX-25 (IFF) AR RECEIVER POWER ATTITUDE INDICATOR AUTOPILOT AUXILIARY FUEL CONTROL [6] AUXILIARY FUEL FILL INDICATOR [6] BOOST PUMP CONTROL (AFT) BOOST PUMP CONTROL (FORWARD) CABIN PRESSURE [5] CAMERA COMPARTMENT TEMP. IND. CAMERA DOOR COMPARTMENT LIGHTS COMPASS (J-4)	DRIFT COMPUTER ENGINE ANTI-ICE CONTROL ENGINE ANTI-ICE POWER ENGINE CONTROL ENGINE OVERHEAT TEST ENGINE POWER (LEFT) ENGINE POWER (RIGHT) EXTERIOR LIGHTS CONTROL FACE MASK HEAT FLAP CONTROL FLAP POSITION INDICATOR FUEL QUANTITY FUEL TRANSFER FUEL VENT FUSELAGE FUEL CONTROL [6] HIGH MACH SCHEDULER HORN POWER IGNITION INSTRUMENT LIGHTS (SECONDARY) JETTISON STORES & TANK LANDING LIGHTS CONTROL LANDING GEAR CONTROL	LANDING GEAR POSITION IND. NOSE GEAR STEERING PROBE EXTEND PUSHER MACH SCHEDULER PUSHER POWER PUSHER TEST RUDDER FEEL TRIM RUDDER TRIM SPEED BRAKE SEAT ADJUST SPEED BRAKE EMERG. RETRACT STABILIZER & AILERON FEEL & TRIM TAKE-OFF TRIM CONTROL TURN & SLIP INDICATOR UHF POWER UTILITY LIGHT WINDSHIELD BLOWER CONTROL WARNING LIGHTS WINDSHIELD HEATER WING FUEL TRANSFER [6]
CAMERA 28V D-C BUS	CAMERA DOOR EMERGENCY POWER LEFT SPLIT CAMERA LEFT TRI-METROGON CAMERA	MASTER CAMERA CONTROL RIGHT SPLIT CAMERA RIGHT TRI-METROGON CAMERA	VIEWFINDER D-C POWER VERTICAL TRI-METROGON POWER
CAMERA 115V SINGLE PHASE A-C BUS (T-3)	CAMERA WINDOW HEATER POWER FORWARD CAMERA POWER	VERTICAL TRI-METROGON POWER	
CAMERA 115V SINGLE PHASE A-C BUS (T-2)	LEFT TRI-METROGON POWER RIGHT TRI-METROGON POWER	VIEWFINDER POWER	
CAMERA 115V SINGLE PHASE A-C BUS (T-1)	LEFT SPLIT CAMERA POWER RIGHT SPLIT CAMERA POWER	UCCS POWER [6] LANDING LIGHTS POWER	
115V THREE-PHASE A-C BUS	ATTITUDE INDICATOR (J-4) DIRECTIONAL INDICATOR		
200V THREE-PHASE A-C BUS	FUEL BOOST PUMPS FUEL TRANSFER PUMPS		
115V SINGLE-PHASE A-C BUS (T-3)	AIRSPEED AND MACH INDICATOR CAMERA COMPARTMENT TEMP. CONT. CAMERA WINDOW POWER	ENGINE OVERHEAT HORN POWER INSTRUMENT LIGHTS (PRIMARY)	PUSHER POWER WINDSHIELD BLOWER POWER WINDSHIELD HEAT
115V SINGLE-PHASE A-C BUS (T-2)	AN/ASN-6 AUTOPILOT (J-4) DIRECTIONAL INDICATOR	DRIFT COMPUTER ENGINE PRESSURE RATIO (LEFT) ENGINE PRESSURE RATIO (RIGHT)	FUEL QUANTITY POWER AN/APX-25 (IFF) PITOT HEATER
115V SINGLE-PHASE A-C BUS (T-1)	AN/APN-22 AN/APS-54 (RADAR WARNING)	CONSOLE FLOODS CONSOLE LIGHTS	TRIM INLET DE-ICING WINDSHIELD HEATER
14V A-C BUS	EXTERIOR LIGHTS POWER WARNING LIGHTS POWER		
26V A-C BUS	(J-4) DIRECTIONAL INDICATOR ENGINE FUEL FLOW (LEFT) ENGINE FUEL FLOW (RIGHT) ENGINE OIL PRESSURE (LEFT)	ENGINE OIL PRESSURE (RIGHT) EXTERIOR LIGHTS POWER HYDRAULIC PRESSURE (PRIMARY) HYDRAULIC PRESSURE (UTILITY)	[6] LANDING LIGHTS SEXTANT LIGHTS WARNING LIGHTS POWER

volt d-c bus and the battery bus will be supplied by external power. With switch in OFF position, and no external power supplied, only the battery bus will receive battery power. The battery switch is normally retained in the ON position during all flight operations. Refer to figure 1-16.

Voltmeter

This meter (figure 1-15) on the electrical control panel gives an indication of the voltage being supplied to the bus system whether supplied by generators or an external power source. It measures the voltage of only one phase of the three-phase power so will normally indicate 115 volts.

Generator Warning Lights

A warning light (figures 1-15 and 1-30) for each generator, marked "AC Gen Out" is mounted on the electrical control panel above its respective generator switch. A light is illuminated when the applicable generator is disconnected from the bus system for any reason. The light will go out when a circuit has been reset and a generator restored to normal operation. These lights are tested and dimmed by the warning lights test and dimmer switch on the right console and utilize 28 volt a-c power.

HYDRAULIC POWER SUPPLY SYSTEMS

Hydraulic power is supplied by two completely separate systems; a primary system and a utility system. Each system is a closed center type with an operating pressure of 3000 psi. Each system has two pumps, one driven by the right engine and one driven by the left engine. The loss of one pump, in either system, presents no limitations since one pump can supply fluid in adequate quantity for all normal operation. See figure 1-17.

PRIMARY SYSTEM

The primary system is utilized to supply hydraulic pressure for power control of ailerons and horizontal stabilizer.

UTILITY SYSTEM

The utility system, in addition to supplying the aileron, rudder, pusher actuator and horizontal stabilizer power controls provides power for actuation of wheel brakes, nose gear steering, air refuel probe, flaps, landing gear, speed brakes and flying boom receptacle. A priority valve in the utility system will deny pressure to all but the aileron, rudder, horizontal stabilizer, pusher actuator, and wheel brakes should the operating pressure drop below 60 percent of normal (1800 psi). Refer to figure 1-17.

Hydraulic Pressure Gages

Two hydraulic pressure gages (figure 1-6), one for each system, are mounted side by side on the left console, just forward of the throttles. The gages are actuated by transmitters utilizing 28 volt a-c and indicate system pressure in psi.

Hydraulic Pressure Warning Lights

The warning light (figures 1-6 and 1-30) on the left console will illuminate whenever pressure from any of the four pumps drops below 700 psi. The light, which operates on 28 volt a-c, is tested and dimmed by the warning light test and dim switch on the right console.

FLIGHT CONTROL SYSTEM

Since manual operation of the surface controls at the speeds for which this airplane was designed would be impossible, all primary controls are hydraulically powered. Cockpit controls serve only to position valves, through mechanical linkage, in such a manner that control surface movement is proportional to control stick movement. The horizontal stabilizer and ailerons utilize power from both the primary and utility hydraulic systems, while the rudder is operated by the utility system alone. See figure 1-17.

ARTIFICIAL FEEL AND TRIM SYSTEM

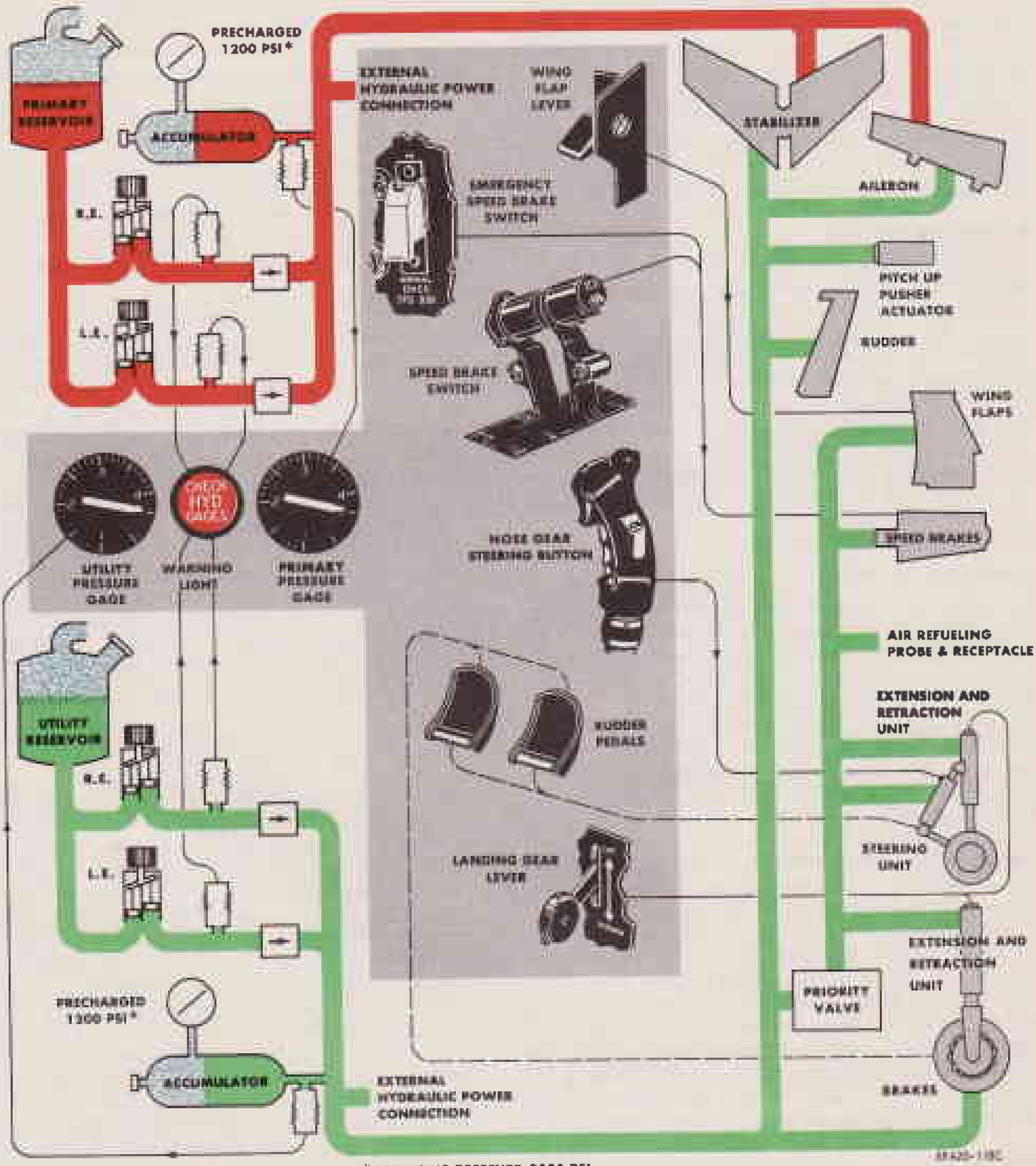
All of the power cylinders are irreversible in their action, that is, they transmit none of the air load back to the stick or rudder pedals. To compensate for this, and so the pilot may experience as nearly as possible the stick and rudder forces to which he has become accustomed, separate artificial feel systems are provided. The same irreversibility feature tends to "snub" the control surfaces, making control locks unnecessary. Each of the primary controls can be "trimmed" electrically and autopilot servos are tied into all controls. Portions of the autopilot system can be used, independent of automatic flight, to provide yaw damping. Provisions are made whereby the ailerons, rudder and stabilizer can be simultaneously trimmed for take-off. Refer to Take-Off Trim Button, this section.

Stabilizer Feel and Trim

"Feel" is induced into the horizontal stabilizer control system by stabilizer bellows forces. The bellows assembly is located at the approximate center line of the aircraft just forward of the speedbrake well. Bellows forces are obtained from ram air pressure acting on a bellows, (figure 1-1), and will therefore vary with airspeed and air density. This bellows force is applied to a variable balance assembly which is connected to the control stick through the control linkage. The control linkage is such that fore and aft stick movements cause the balance assembly to rotate. As the balance assembly rotates, control stick deflections are resisted by the bellows force. This resistance, as transmitted to the stick through the linkage, is the artificial feel. The application of ram air pressure on the bellows makes possible a more accurate simulation of the stick forces encountered under varying flight conditions. Another stick force

HYDRAULIC POWER SYSTEM

PRIMARY HYDRAULIC SYSTEM
UTILITY HYDRAULIC SYSTEM
COMPRESSED AIR
ELECTRICAL CONNECTION
MECHANICAL CONNECTION



*OPERATING PRESSURE-3000 PSI

Figure 1-17

factor and aid in preventing the airplane being subjected to "g" loads beyond its structural capabilities, is the incorporation of a viscous damper in the feel system. This unit will provide a much greater resistance to any abrupt or sudden stick movement, either fore or aft. A bobweight is also installed on the stick which will increase stick forces with an increase in "g" load. Horizontal stabilizer trim is accomplished through the use of the same mechanisms which provide artifical "feel", - namely, the bellows force acting on the balance assembly. An electric actuator in the balance assembly varies the point at which the bellows force is applied to the balance assembly. The actuator is energized by a five-position, spring-loaded switch located on the control stick grip (see figure 1-18), or by the take-off trim button on the landing gear control panel (see figure 1-22).

Aileron Feel and Trim

A spring cartridge, one end of which is attached to the aileron linkage, supplies "feel" to this system. It is designed so that movement in either direction requires compression of the spring and consequently resistance to movement. Trim is provided by attaching the other end of this same cartridge to an electric actuator. When energized, the actuator moves the entire aileron linkage thereby repositioning the neutral or no-load position. The actuator is energized through a five-position switch button on the control stick or by the take-off trim button on the landing gear control panel. See figures 1-18 and 1-22.

Rudder Feel and Trim

The difference in the forces exerted on opposite sides of a piston within a hydraulic cylinder offers the resistance to rudder pedal movement necessary to produce the required "feel". This cylinder joins the rudder linkage in such a manner that control movement in either direction tends to extend the cylinder. At slower airspeeds, full hydraulic system pressure is diverted to both sides of the piston, but due to the difference in area of the two sides, some resistance to pedal movement is offered. At an airspeed of 290 (± 10) knots, an airspeed switch is actuated which in turn operates a valve shutting off hydraulic pressure to the extension side of the piston. This means that full hydraulic pressure then opposes rudder control movement greatly increasing the feel forces. Trim is accomplished by varying the neutral, or no-load position of the control linkage. This is made possible by including an electric actuator in the feel system linkage which by extension and retraction moves the entire rudder control system proportionally. The actuator is energized by a three-position toggle switch on the left console (figure 1-6) or by the take-off trim button on the landing gear control panel (figure 1-22).

Yaw Damper

A hydraulically actuated, electrically controlled yaw damper system is installed in this airplane to insure turn coordination and improve dynamic directional characteristics. This system is controlled by a two-position switch (figure 4-16) located on the autopilot control panel. The system will operate when the yaw damper switch is ON or when the autopilot is operating. Signals from the yaw rate gyro to the servo amplifier will actuate the rudder servo to correct yaw oscillations when the system is engaged. The rudder servo is connected to the rudder pedals by a linkage assembly which permits yaw damping and autopilot maneuvers without disturbing the rudder pedals. The yaw damper system has an automatic airspeed and altitude compensator to insure the proper amount of rudder travel. In the event of any electrical failure the yaw damper will automatically disengage and the yaw damper switch will return to the OFF position. To re-engage the yaw damper the switch must be manually placed to the ON position. The yaw damper should be used during all flight operation. The yaw damper system uses utility hydraulic power, 115 volt, single-phase a-c power and 28 volt d-c electrical power.

Control Stick

The control stick, mechanically connected to the control valves at the aileron and horizontal stabilizer actuators, provides a means of lateral and longitudinal control of the airplane. Movement of the control stick mechanically positions control valves to direct hydraulic pressure to the applicable control surface actuator. Hydraulic pressure to the actuator will be blocked off automatically when desired control surface deflection is obtained. The stick grip (figure 1-18) integral with the control stick, incorporates the lateral and longitudinal trim switch, camera operate switch, extra picture switch, nose gear steering button, air refueling release button, autopilot and pitch-up pusher release switch. In the [illegible] airplanes the nose gear steering button is utilized as an alternate microphone button when the gear is retracted.

Rudder Pedals

Conventional hanging-type rudder pedals, mechanically linked to hydraulic control valves at the rudder actuator, provide a means of directional control of the airplane. Movement of the pedals mechanically positions the control valves to direct hydraulic pressure to the rudder actuator. Hydraulic pressure to the actuator will close off automatically when desired rudder deflection is obtained. The rudder pedals are collectively adjusted fore and aft by the crank on the lower portion of the pedestal panel (17, figure 1-24). Toe action on the rudder pedals conventionally applies wheel brakes. Refer to Wheel Brake System, this section. With nose gear steering system employed, movement of the rudder pedal maintains directional control during ground operation. Refer to Nose Gear Steering System, this section.

Lateral and Longitudinal Trim Switch

The lateral and longitudinal trim switch (figure 1-18), conventionally located on the control stick, is a five-position switch, spring-loaded to the mid (OFF) position. Moving this switch to the LEFT induces left wing-down trim; to the RIGHT, right wing-down. Pushing the trim switch FORWARD applies nose-down trim; moved AFT, nose-up trim is applied. Electrical power for the trim switch is supplied by the 28 volt d-c bus.

WARNING

The trim switch may be subjected to occasional sticking in an actuated position, resulting in application of extreme trim. When this condition occurs in flight, the trim switch must be returned manually to the center OFF position after the desired amount of trim is obtained.

Rudder Trim Switch

The rudder trim switch (figure 1-16), located on the left console, is a three-position toggle switch spring-loaded to the OFF (center) position. Actuation of this switch, either right or left, energizes an electric actuator to reposition the feel system linkage to provide appropriate trim. Moving the switch to L trims for nose-left; to R, trims for nose-right. Electrical power for the switch is supplied by the 28 volt d-c bus.

Take-Off Trim Button

The take-off trim button (figure 1-22), located on the landing gear control panel, provides a means for the pilot to simultaneously trim all flight controls (ailerons, rudder and stabilizer) to proper position for take-off. Depressing this button energizes the electric actuators to reposition the ailerons and rudder and the stabilizer balance assembly to obtain the control settings for take-off. The take-off trim position of the ailerons and rudder is neutral (± 2°); the stabilizer balance assembly is extended to induce a nose-down trim condition. The button must be held depressed until illumination of the take-off trim light indicates that all flight controls are properly trimmed for take-off. Electrical power is supplied from the 28 volt d-c bus.

WARNING

The take-off trim button should not be used in flight, as a dangerous or undesirable flight attitude may result.

CONTROL STICK GRIP

Figure 1-18

Take-Off Trim Light

A green indicator light (figures 1-22 and 1-30) located adjacent to the take-off trim button on the landing gear control panel, is provided to give the pilot an indication that take-off trim has been attained. With the button held depressed, the light will illuminate when all flight controls have reached take-off trim. In the 30 35 airplanes prior to incorporation of T.O. 1F-101-604 the light will remain illuminated until the landing gear handle is placed in the UP position or until one of the control systems is retrimmed. After incorporation of T.O. 1F-101-604 and in the 30 35 airplanes, releasing the take-off trim button will cause the light to go out. This light utilizes 28 volt d-c power and can be dimmed and tested by the dim and test switch on the right console.

Yaw Damper Switch

This two-position toggle switch (figure 4-16), on the function selector (autopilot) panel, is spring-loaded to OFF and held in the ON position by a solenoid so that in the event of any malfunction, it will automatically revert to OFF. When the damper switch is in the ON position, it provides automatic yaw damping and turn coordination regardless of whether autopilot is being utilized or not. The switch is normally retained in the ON position. Electrical power is supplied from the 28 volt d-c bus.

PITCH-UP WARNING SYSTEM

The pitch-up warning system provides an automatic warning when the airplane is approaching the pitch-up boundary by an audible tone in the pilot's headset. Refer to Pitch-Up Warning Characteristics, Section VI. Should the airplane continue into the pitch-up area an additional warning is provided in the form of a pusher force acting on the control stick. The pitch-up warning system utilizes two separate sensing systems, one system produces the audible warning and the other system produces the forward stick force. Each system utilizes an angle of attack probe, Mach scheduler, stabilizer rate sensor, and one channel in the dual channel control box. The critical angle is sensed by two angle of attack probes, located on each side of the nose fuselage. The left probe is for pusher operation while the right probe is for horn operation. The Mach schedulers measure the ratio between pitot and static pressures and converts this ratio into electrical information to be supplied to the control box. The stabilizer rate sensors are utilized to convert the actual stabilizer rate of travel into electrical signals to be supplied to the control box. The dual channel control box receives information from the sensing devices in each system and actuates the headset audible tone and the stick pusher actuator. One channel in control box will electrically actuate the headset tone warning the pilot of approaching the pitch-up boundary. If the airplane continues into the pitch-up area, the other channel in the control will open the electrical solenoid valves allowing utility hydraulic pressure to enter the pusher actuator. Through mechanical linkage, the pusher actuator will allow hydraulic pressure to enter the stabilizer actuator and position the stabilizer for a nose-down condition.

WARNING

> The pusher force that is applied to the control stick can be overpowered by applying a 25 pound aft stick force in excess of the normal maneuvering force. However, once the pusher force is applied to the control stick the pilot should take immediate corrective action by moving the stick forward.

The pitch-up warning control panel (figure 1-19) is located outboard of left console. Power for the system is 115 volt a-c and 28 volt d-c.

PITCH-UP WARNING CONTROL PANEL

Figure 1-19

Pusher Switch

The pusher switch (figure 1-19), a two-position ON-OFF toggle switch, will be guarded in the ON position at all times. The switch guard will be safety wired in the above position to prevent accidental movement. The switch merely admits 28 volt d-c and 115 volt a-c current to the pusher system whenever power is applied to the aircraft. The OFF position, which terminates electrical power to the pusher system and opens the pusher hydraulic by-pass valve, should not be utilized by the pilot unless a system malfunction occurs.

CAUTION

The pusher switch should be placed in the OFF position if light illuminates or at any other indication of malfunction.

Horn Switch

The horn switch (figure 1-19), a two-position ON-OFF toggle switch, is guarded in the ON position. The switch guard is safety wired ON. The switch admits 28 volt d-c and 115 volt a-c power to the horn system whenever power is applied to the aircraft. The OFF position, which terminates electrical power to the horn system, should not be utilized by the pilot unless a system malfunction occurs.

Test Switch

A push button "Test" switch (figure 1-19) provides a means of testing the angle-of-attack probes. Pressing the button allows a 28 volt d-c electrical signal from each probe to enter a comparator control box. There the signals are compared and must concur or else a malfunction will be indicated through the illumination of the "Pitch-Up Warning Out" light. This test must be completed while airborne so that airflow is available for the probes.

Pusher Release Switch

The release switch (figure 1-18) is located on the forward side of the control stick. (Also used for autopilot disengagement.) The switch must be held depressed to disengage the pusher portion of the system. The horn will still function even though the switch is actuated. When the switch is released, the pusher will resume normal operation. Power for the switch is 28 volt d-c.

Pitch-Up Warning Out Indicators

An amber light (figure 1-30) marked "Pitch-Up Warning Out" located above and toward the right side of the instrument panel, will illuminate under any one of the following conditions: Any electrical power failure within the system; the horn or pusher switch in the OFF position; or if the signals from the Mach schedulers are not comparable. The light utilizes 28 volt d-c power.

Note

- With gear or flaps down, only the horn portion of the system will function. Under these conditions, the pusher system will not operate and the horn system has no stabilizer rate sensing.
- If the pusher portion of the pitch-up warning system is for some reason fully actuated during flight, the autopilot will automatically disengage. Thus, the autopilot must be manually re-engaged for continued use.

WING FLAP LEVER

RFA20-122

Figure 1-20

WING FLAPS

Hydraulically operated, electrically controlled, "zap" type flaps are located inboard of the ailerons on the trailing edge of the wing. Each flap is attached to the wing by four links which move the flaps aft as well as down when they are extended. The flaps are held in the down position by hydraulic pressure and in the up position by mechanical locks. A limit switch terminates flap up travel as soon as the flaps are up and locked. Simultaneous operation of each flap is assured by a flow divider which provides equal flow to each flap actuator. The airspeed switch that controls the rudder feel system also automatically retracts the flaps at 290 ± 10 knots and prevents flap extension above this speed. If the wing flap lever is left DOWN, the flaps will automatically extend when the airspeed drops below approximately 290 knots.

CAUTION

During ground operation, repositioning the flap lever while the flaps are being extended will result in serious damage to the flaps and may prevent any subsequent flap operation. The airload will prevent this damage while airborne.

No intermediate flap positions are available and there are no provisions for emergency extension of the flaps.

WING FLAP LEVERS

The two-position wing flap lever (figure 1-20), located on the left console, is placarded RETRACT and EXTEND. In the EXTEND position, a solenoid valve is energized by 28 volt d-c, directing utility hydraulic pressure to extend the flaps to the "full down" (50 degree) position. The solenoids remain energized and pressure is maintained on the actuating cylinders, holding the flaps in the EXTEND position. Placing the lever in the RETRACT position actuates solenoids to deliver utility hydraulic pressure for retraction. However, once the flaps are locked up, limit switches de-energize the circuit.

WING FLAP POSITION INDICATOR

A conventional indicator (figure 1-22) on the landing gear control panel utilizes 28 volt d-c power to indicate flap position full up or down. The flap position indication is obtained from the left flap.

LANDING GEAR HANDLE WARNING LIGHT

As an additional flap position reminder, the warning light in the landing gear handle will illuminate if the flaps are not in the retracted position when the landing gear is retracted. The same light, which operates on 28 volt d-c power, also serves as a landing gear indicator. Refer to Landing Gear, this section.

AUDIO HEADSET SIGNAL

Refer to Landing Gear Warning Buzzer, this section.

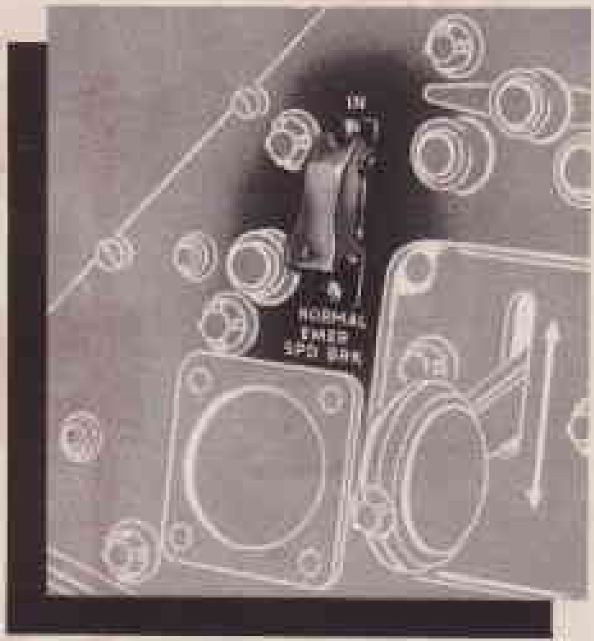
SPEED BRAKES

Panel type speed brakes are installed on the aft portion of each side of the fuselage. The panels are hydraulically operated, from the utility system and electrically controlled with 28 volt d-c power. In normal operation, hydraulic pressure acts to both open and close the speed brakes. In addition, for emergency use, a valve is provided which opens both sides of the actuating cylinder for return, allowing air loads to "trail" the panels.

SPEED BRAKES SWITCH

A serrated toggle switch (figure 1-5) located on the right throttle grip controls the speed brake hydraulic control valve to position the speed brakes. This switch, powered by the 28 volt d-c bus, has three fixed positions; OPEN, CLOSE and a neutral position. Any degree of speed brake deflection can be obtained, during either the extension or retraction cycle, by returning the switch to neutral when speed brakes reach desired position.

EMERGENCY SPEED BRAKES SWITCH



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This switch (figure 1-22) on the landing gear control panel is guarded in the NORMAL position. Should the normal operating system fail with the speed brakes extended, placing this switch to the IN position will operate a valve relieving the hydraulic pressure and allowing the air loads to force the panels closed. Power required is supplied by the 28 volt d-c bus.

Note

When the speed brakes are closed by use of the emergency switch, air loads will not completely close the panels.

LANDING GEAR SYSTEM

The fully retractable tricycle landing gear consists of a dual wheel nose gear and single wheel main gears which are hydraulically operated (utility system) and electrically (28 volt d-c) controlled. The main wheels retract inboard into the wings; the nose wheel retracts forward into a compartment in the nose. When the landing gear is retracted, the compartments are covered by doors which conform to the contour of their

LANDING GEAR GROUND LOCKS

RFA20-124A

Figure 1-21

surrounding surfaces. The doors operate automatically with the landing gear, and in the case of the main wheel doors, the operation is hydraulic; with the nose wheel doors, it is through mechanical linkage. The doors remain open when the landing gear is extended. The gear is mechanically locked in both the retracted and extended positions. Landing gear extension will take place in approximately 8 to 10 seconds, while retraction occurs in approximately 4 seconds. A compressed air bottle is installed for emergency extension of the landing gear in the event the normal hydraulic system fails. Upon incorporation of T.O. 1F-101-711, a nose gear hook has been installed and the main gear door panels have been "beefed up" to improve barrier engagement.

LANDING GEAR SHOCK STRUTS

The main landing gear shock struts are the conventional air-oil type that will be compressed when the landing gear is being retracted. The struts are compressed for stowage in the wings by relieving air pressure in the inflation chamber. In the (20) airplanes air pressure in the inflation chamber is directed to an empty storage chamber within the strut as the landing gear is retracting. When the landing gear is being lowered air pressure in the storage chamber is directed to the inflation chamber extending the strut to its normal landing condition. In the (21)(30)(35) airplanes, air pressure in the inflation chamber is dumped overboard as the landing gear is retracting. As the landing gear is being lowered, air pressure is metered from a high pressure storage chamber in the strut, to the inflation chamber extending the strut to its normal landing condition. The high pressure storage chamber contains enough air pressure to cycle the gear approximately 12 times. Additional landing gear cycling will cause the strut to collapse and remain in that condition. An air pressure indicating pin located on the top of the strut will extend approximately 9/16 of an inch when the storage chamber is fully serviced (3000 psi). The air pressure in the storage chamber will decrease each time the gear is cycled and consequently the pin extension will decrease proportionally.

WARNING

While on the ground, the gear strut may be extended even though there is no air pressure in storage (pin retracted). Consequently the pin is the only indication that the storage chamber is partially or fully serviced (pin extended).

LANDING GEAR GROUND LOCKS

Individual clamps for the main gears, and a pin for the nose gear can be installed on the ground to prevent inadvertent retraction during servicing and ground handling. The locks have regulation red streamers attached and must be removed prior to flight. See figure 1-21.

LANDING GEAR HANDLE

Normal operation of the landing gear is accomplished by means of the landing gear handle (figure 1-22) located on the landing gear control panel. This two-position handle, placarded UP and DOWN, mounts a wheel-shaped knob which contains a warning light. Placing the handle in either position actuates switches which in turn operate a solenoid valve to direct hydraulic pressure. Once the landing gear has reached either extreme and has locked, limit switches disengage the solenoids relieving the system of pressure. The power for this control system is 28 volt d-c. To preclude accidental operation of the landing gear handle, limit switches enable a lever latch mechanism to hold the handle down whenever any of the landing gear struts are compressed. When the struts extend after take-off, a 28 volt d-c solenoid releases the latch mechanism, permitting normal operation of the handle. The latch mechanism can be overridden by exerting a force of approximately 35 pounds on the handle. This permits emergency gear retraction, on the ground, when necessary.

WARNING

With hydraulic pressure available, the landing gear will retract any time the landing gear handle is moved to UP.

LANDING GEAR EMERGENCY HANDLE

[illegible]-155

This handle (figure 1-26) on the vertical panel of the left console, is mechanically connected to a compressed air bottle discharge valve. When the handle is pulled to its full travel (approximately 3 3/4 inches) air is directed to the gear down side of the actuating cylinder, extending the gear. The handle will remain at its extended position until the trip lever directly under the handle is released and the handle returned to the normal position. Returning the handle allows the compressed air to be vented and normal gear operation restored.

CAUTION

The emergency system is actuated only upon failure of the normal system and will extend the gear pneumatically. Once the gear is lowered by the pneumatic system, do not attempt to retract the gear. The gear cannot be retracted by the emergency pneumatic system. Returning the handle to the normal (stowed) position allows the compressed air from the gear down side of the actuating cylinder to be vented overboard.

LANDING GEAR POSITION INDICATORS (20)

Individual red indicator lights (figures 1-22 and 1-30) are provided to indicate the position of each wheel. The lights are mounted in a group on the landing gear control panel. The lights illuminate any time the position of a wheel does not correspond to the position of the landing gear handle. That is, if the handle is UP, a light for any wheel will be illuminated if that wheel is not up and locked. When the handle is placed at DOWN, the lights will remain illuminated until the wheels are down and locked. These lights operate on 28 volt d-c and are dimmed and tested by the dim and test switches on the right console.

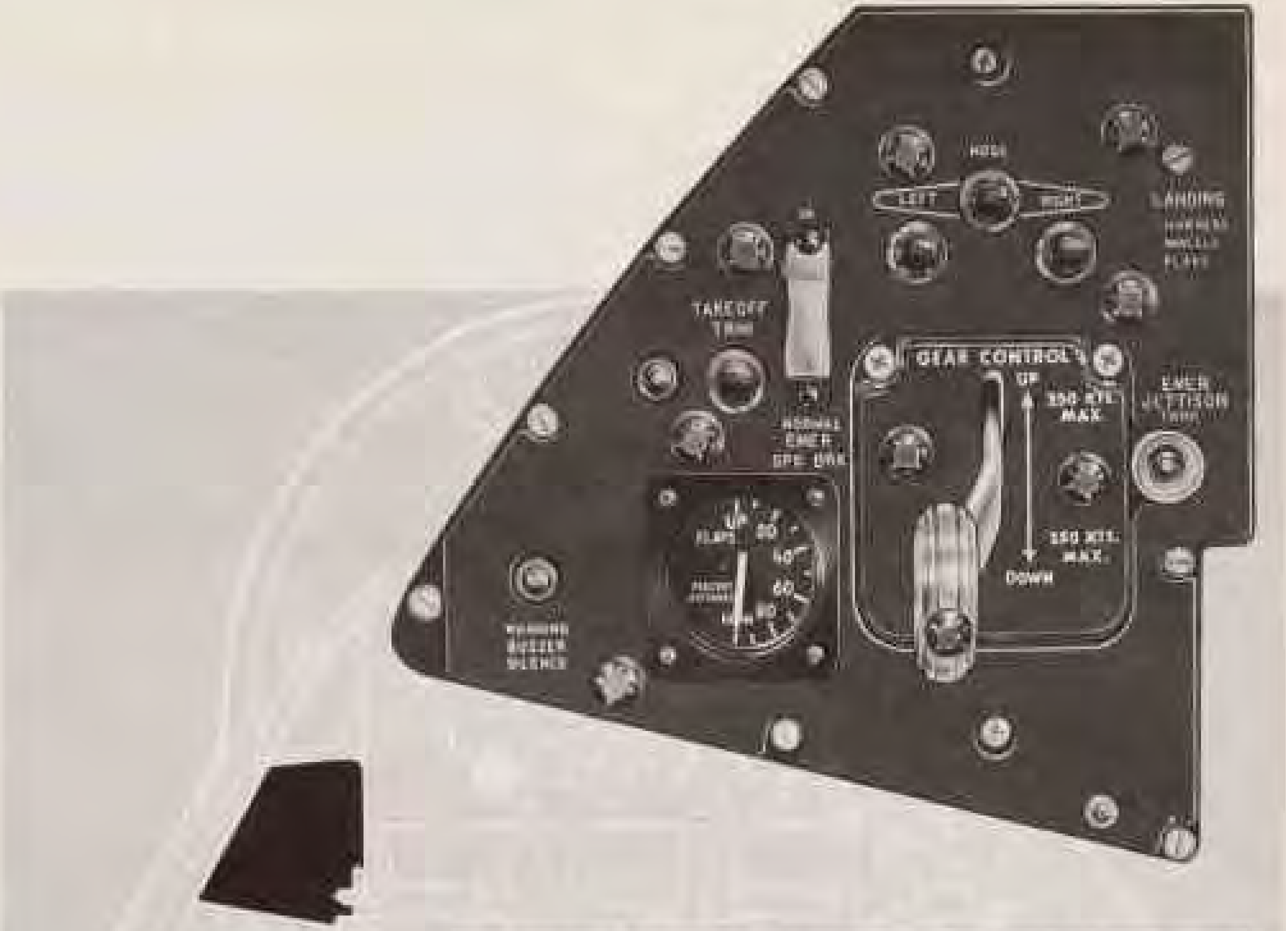
LANDING GEAR POSITION INDICATORS (25)(30)(35)

Individual green indicator lights (figures 1-22 and 1-30) are provided to indicate a gear down and locked condition. The lights are mounted in a group on the landing gear control panel. When the landing gear handle is in the UP position the lights will not be illuminated. With the landing gear handle in the DOWN position the lights will illuminate as each individual gear is down and locked. These lights operate on 28 volt d-c and are dimmed and tested by the dim and test switches on the right console.

LANDING GEAR WARNING LIGHT

The warning light in the landing gear handle (figures 1-22 and 1-30) requires 28 volt d-c. It is illuminated at any of the following circumstances:

1. Gear handle position does not correspond to gear position.
2. Nose gear unsafe.



LANDING GEAR CONTROL PANEL

Figure 1-22

3. Any main gear unsafe.
4. Main gear doors unlocked.
5. Flaps down - Gear up. Either or both throttles retarded below 92%.

LANDING GEAR WARNING BUZZER AND SILENCER

At any time the landing gear handle warning light is illuminated, an intermittent warning buzzer tone will be audible in the headset. This signal is dependent on 28 volt d-c but does not function in conjunction with any radio equipment. A black push-button switch (figure 1-22) on the landing gear control panel, serves to silence the warning buzzer. The buzzer will remain silenced until the gear has been lowered. It will then be ready to emit a warning for any subsequent condition.

NOSE GEAR STEERING SYSTEM

A steerable nose gear system allowing directional control during taxiing is provided. The system is electrically selected (28 volt d-c) and hydraulically (utility system) operated. Steering is engaged by depressing the nose gear steering button (figure 1-18) on the stick grip. In the airplanes prior to incorporation of T.O. 1F-101-599 the nose gear steering is engaged only when the button is held depressed. After incorporation of T.O. 1F-101-599 and in the airplanes, momentary actuation of the button will engage or disengage the nose gear steering system. Depressing the button electrically selects hydraulic pressure to the steering unit. This unit permits the nose gear to be steered, by rudder pedal movement, through a 40 degree arc either side of center. Further travel may be accomplished by differential braking but the steering unit is not operational beyond the 40 degree position. The system should be engaged while the rudder and nose gear are in the neutral or centered position. A safety switch prevents engagement of the steering system when the weight of the aircraft is off the nose gear (strut extended) or when the gear is retracted. The nose gear steering unit further serves as a shimmy damper. In airplanes upon incorporation of T.O. 1F-101

-581 and in the 30 35 airplanes the nose gear steering button is utilized as an alternate microphone button when the gear is retracted.

WHEEL BRAKE SYSTEM

The power brake system is operated from the utility hydraulic system, and incorporates segmented rotor type brakes, which are mounted integrally with the main landing gear wheels. Multiple disks are used to increase braking efficiency, aid in heat dissipation, and prevent brake seizure due to disk warpage caused from high temperatures. The brakes are operated by toe action on the rudder pedals, which meters utility hydraulic system pressure to force the brake disks together. Since the power brake valves are metering type valves, hydraulic pressure cannot be felt at the pedals. A soft, full travel pedal is characteristic of this type brake. For this reason, the pilot should use caution when applying braking pressure to prevent locking the wheels and skidding the tires. For further information regarding wheel brake operation, see Section VII.

Note

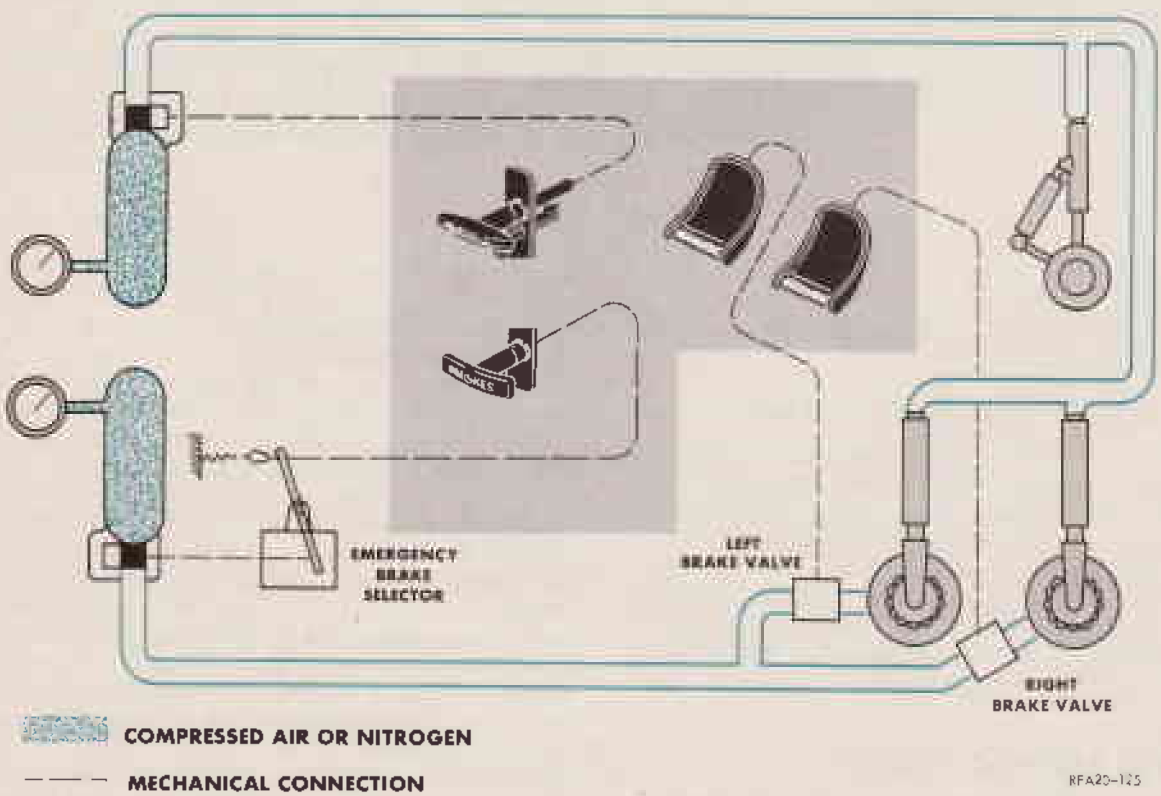
This airplane is not equipped with parking brakes.

EMERGENCY BRAKE HANDLE

RFA20-154

An emergency air bottle (figure 1-34), charged to 3000 psi pressure can be discharged by the pilot, if the normal system should fail. It is located in the forward wall of the nose wheel well, and can be discharged by

EMERGENCY PNEUMATIC SYSTEM



RFA20-125

Figure 1-23

pulling the emergency brakes handle, which is mounted on the vertical panel of the left console. Pulling the handle approximately 5" mechanically opens a valve on the air bottle. This releases pressure to the two metering type valves incorporated with the brake pedals. Brakes are then applied the same as in normal system operation, except braking action is limited, due to depletion of air supply. At least three full brake applications are available. See figure 1-23.

CAUTION

Pilot should not attempt to taxi with normal brake system failure, since the emergency system air pressure is limited.

DRAG CHUTE SYSTEM

The airplane is equipped with a 16-foot ring slot type parachute which is deployed by the pilot after touchdown (when the speed is below 200 knots IAS) to aid in reducing landing roll distances. The drag chute may also be utilized for spin recovery as outlined in Section VI. The chute is carried in a compartment within the empennage at the base of the vertical stabilizer. The chute is pulled into the air stream by a pilot chute when the spring-loaded compartment door is released. The design of the attaching mechanism is such that should the compartment door open inadvertently, without operating the cockpit control handle, the chute will be released and fall free of the airplane. The drag chute is retained to the airplane structure upon normal deployment. There is no "breakaway" fitting within the attaching mechanism.

CAUTION

The drag chute may be deployed in an emergency at speeds in excess of 200 knots IAS but below 215 knots IAS. In event this is done, an entry in AFTO Form 781 must be made to insure structural inspection.

The drag chute is normally deployed for each landing, and is considered a servicing item. See figure 1-34.

DRAG CHUTE HANDLE

The ratchet-type drag chute handle (figure 1-26) on the left console is mechanically connected to the drag chute mechanism in the tail. Pulling the handle to the UP position approximately 3 inches serves two functions: It locks the attaching mechanism so the drag chute cannot pull free, and it releases the drag chute door. Returning the handle to the DOWN position jettisons the chute. However, as an aid in preventing accidental jettisoning, it is necessary to press the lock button, on the top of the handle, and turn the handle one-quarter turn clockwise before it can be returned to the normal position.

PITOT-STATIC SYSTEM

The pitot-static system supplies the pitot and static pressure necessary to operate various flight instruments and system components. Pitot pressure source is a mast and electrically heated tube located on the nose section. The heating element of the tube is operated by the pitot heat switch (figure 1-27) on the air-conditioning control panel. Electrical power to the heating element is supplied from the 115 volt, single-phase a-c bus. The static system consists of four flush vents, one on each side of the lower forward fuselage and one on each side of the fuselage just aft of the canopy. Both pitot and static pressure are supplied to the airspeed pressure switch which retracts the flaps and actuates the rudder feel system at a predetermined airspeed (290 knots IAS); the Mach schedulers of the Pitch-Up Warning System; and the true airspeed and Mach indicating system to assist in the computation of true airspeed. Static pressure alone is supplied to the altimeter, altitude control system of the autopilot, and vertical velocity indicator.

INSTRUMENTS

Most of the instruments are electrically operated, see figure 1-16. Some instruments, such as the accelerometer, are self-contained and do not require external power.

Note

For information regarding instruments that are an integral part of a particular system, refer to applicable paragraphs in this section and Section IV.

Note

There is no outside air temperature gage installed in the aircraft.

ALTIMETER

The airplane is equipped with a conventional sensitive altimeter, (21, figure 1-24), mounted on the instrument panel. This instrument, utilizing static pressure, provides the pilot with a constant indication of barometric altitude. Three pointers on the face of the instrument move over a scale graduated in 20 foot increments, with a major division every hundred feet from zero to one thousand feet. The large pointer indicates hundreds of feet and makes one revolution for each 1000 feet of altitude. An intermediate pointer indicates thousands of feet and makes one revolution for each 10,000 feet of altitude. An additional small pointer indicating tens of thousands of feet is painted on a black disc with an extension line terminating in a triangular section. The pointers and barometric scale can be set manually by turning the knob in the lower left corner of the instrument. A striped warning indicator is also provided to prevent the pilot from misinterpreting the altimeter reading. Above 17,000 feet the striped area is covered; below that altitude however, the striped area is visible indicating to the pilot he is flying at or below 17,000 feet. To determine error pilot sets base altimeter setting on barometric scale, then notes indicated altitude. This indication should be compatible with known field elevation.

VERTICAL VELOCITY INDICATOR

A conventional vertical velocity indicator (14, figure 1-24) with a scale for 0 to 6000 ft./min. climb or dive, is installed on the instrument panel of the airplane.

AIRSPEED AND MACH INDICATOR

This indicator (5, figure 1-24), on the instrument panel reflects airspeed in three values; indicated airspeed (IAS), true airspeed (TAS) and Mach number. Indicated airspeed and Mach number are read on separate scales beneath the same pointer while true airspeed is read from a counter-type indicator. The true airspeed reading displayed by this instrument is "true" only in the sense that the indicated airspeed has been corrected for temperature and pressure. The installation correction must still be applied.

Indicated Airspeed

This value is determined within the indicator by measuring the difference between pitot and static pressure. This, of course, is the conventional airspeed indication and is read from the fixed scale. A "bug" or adjustable reference mark is included as a landing speed reference. It can be positioned by the knob on the face of the instrument.

Mach Number

Mach number is read on a movable scale and is indicated by the same pointer which indicates IAS. The movable scale position is determined by a remote log absolute pressure transmitter to assure the proper relationship between IAS and Mach number. Actual scale movement is by means of synchro motors through the airspeed amplifier.

True Airspeed

A true airspeed computer and transmitter employs three diaphragms to sense changes in temperature and altitude and mechanically correct an IAS indication to a TAS indication. The entire unit is remotely located and synchro motors, through the airspeed amplifier, are used to operate the indicator on the panel. With the exception of IAS indication, 115 volt, single-phase a-c is necessary for proper operation and all three indications are dependent on reliable pitot and static pressures.

MM-2 ATTITUDE INDICATOR

A visual indication of the flight attitude of the airplane in pitch and roll is provided by the MM-2 attitude indicator, (8, figure 1-24). This instrument, part of the K-4 attitude indicator system, is controlled by a remote gyro in the K-4 control unit. This gyro establishes the vertical reference line from which pitch and roll deviation is measured. Changes in aircraft attitude are electrically relayed from the control unit to the indicator causing displacement of the indicator sphere in relation to the fixed miniature airplane. The amount of displacement is directly proportional to actual airplane attitude deviation from level flight. The indicator is unlimited in roll but will indicate pitch only up to 80 degrees dive or climb. Horizontal markings with 5 degrees of separation on the face of the sphere show accurate airplane attitudes during climb or dive. The system is automatically put into operation after 115 volt a-c and 28 volt d-c power is supplied. With power applied, after approximately 2 1/2 minutes, the OFF flag in the upper portion of the instrument will retract. This automatic operation eliminates manual caging. Complete failure of either d-c or a-c power causes the OFF flag to appear.

WARNING

- The OFF flag does not indicate instrument accuracy. It only indicates that the MM-2 attitude indicator is not receiving power. The absence of the flag does not necessarily mean that the attitude indicator is displaying correct information. Therefore, periodically in flight, attitude indications given by the MM-2 should be checked against other flight instruments, such as the directional indicator, turn-and-slip and vertical velocity indicators.

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

A pitch trim knob is provided on the indicator for the pilot to center the horizon bar in relation to the fixed miniature airplane.

TURN AND SLIP INDICATOR

This conventional indicator (22, figure 1-24), on the instrument panel operates on 28 volt d-c power.

ACCELEROMETER

A three pointer accelerometer, (7, figure 1-24), is located on the main instrument panel and indicates flight loads on the aircraft from -5 to +10 "g's". In addition to a conventional indicating pointer, this instrument incorporates two recording pointers (one for positive "g" loads and one for negative "g" loads). These recording pointers remain at the maximum travel positions reached by the indicating pointer, thereby giving a record of maximum "g" loads encountered. The recording pointers can be reset to the normal (1 "g") position by pressing the knob on the lower corner of the instrument. The accelerometer is a self-contained unit and therefore requires no external power.

STANDBY COMPASS

A conventional magnetic compass, mounted on the right windshield sill in the 20 25 30 airplanes and on the right windshield arch in the 35 airplanes, is provided for navigation in event of instrument or electrical malfunction. The compass card illumination is controlled by a two-position toggle switch on the right console. Electrical power required for illumination is supplied from the 115 volt, single-phase, a-c bus. A compass correction card is located on the canopy frame.

WARNING LIGHT TEST AND DIM CIRCUITS

The warning light test and dim circuit provides a means of testing the operation of the bulbs in the warning, caution and indicator lights simultaneously. All warning, caution and indicator light bulbs are included in the test and dim circuit. The test circuit utilizes 28 volt a-c power, while the dim circuit utilizes 14 volt a-c power.

WARNING LIGHT TEST BUTTON

The warning light test button (figure 4-12) provides a means of checking all warning, caution and indicator lights simultaneously. Depressing the test button with the instrument lights knob ON, will illuminate all warning, caution and indicator lights.

Note

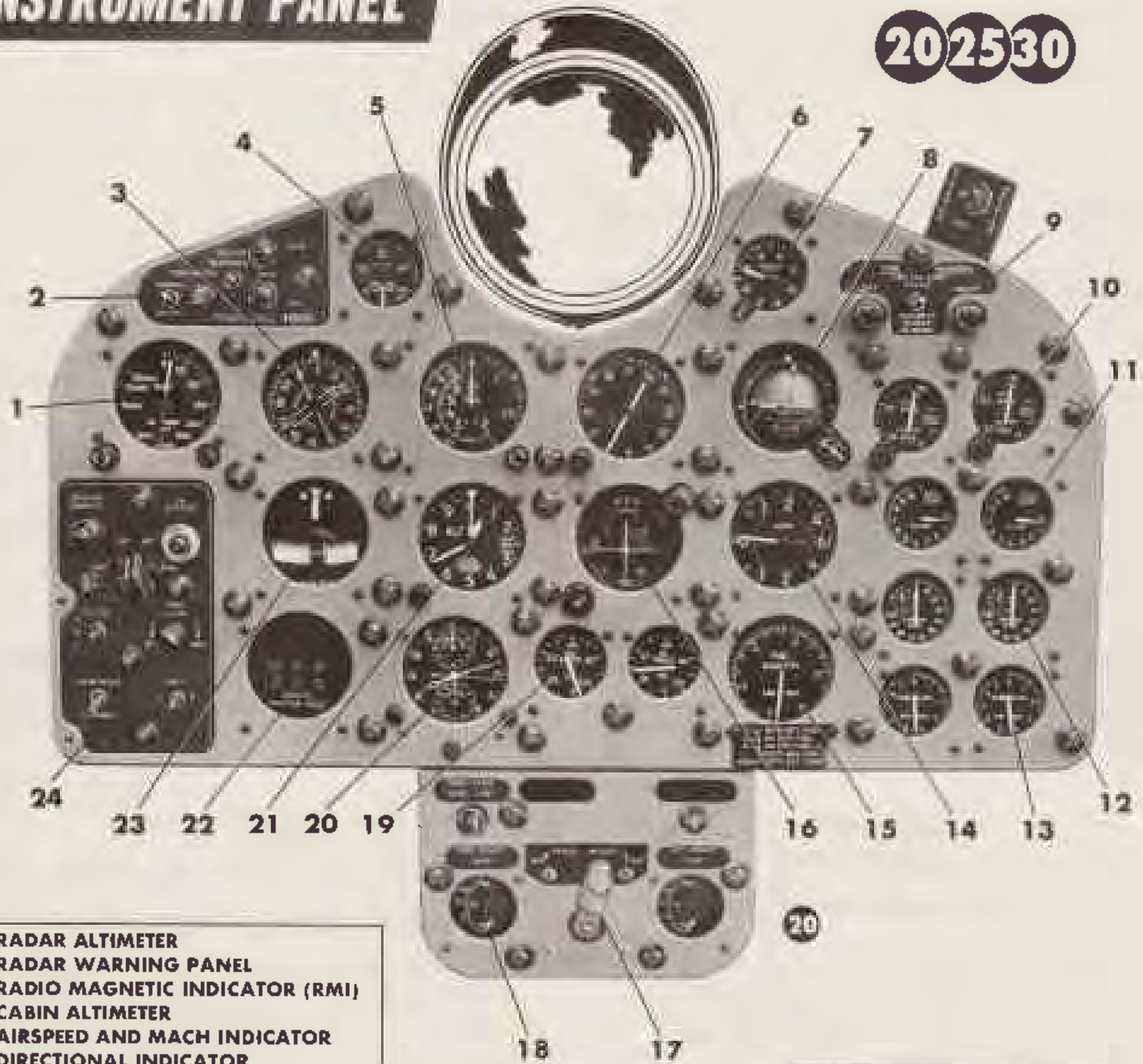
The warning light test circuit does not provide an operational check of any warning, caution and indicator system, it merely checks the light bulbs.

WARNING LIGHT DIM BUTTON

The warning light dim button (figure 4-12) provides a means of checking the dimming circuits of all warning

INSTRUMENT PANEL

20 25 30

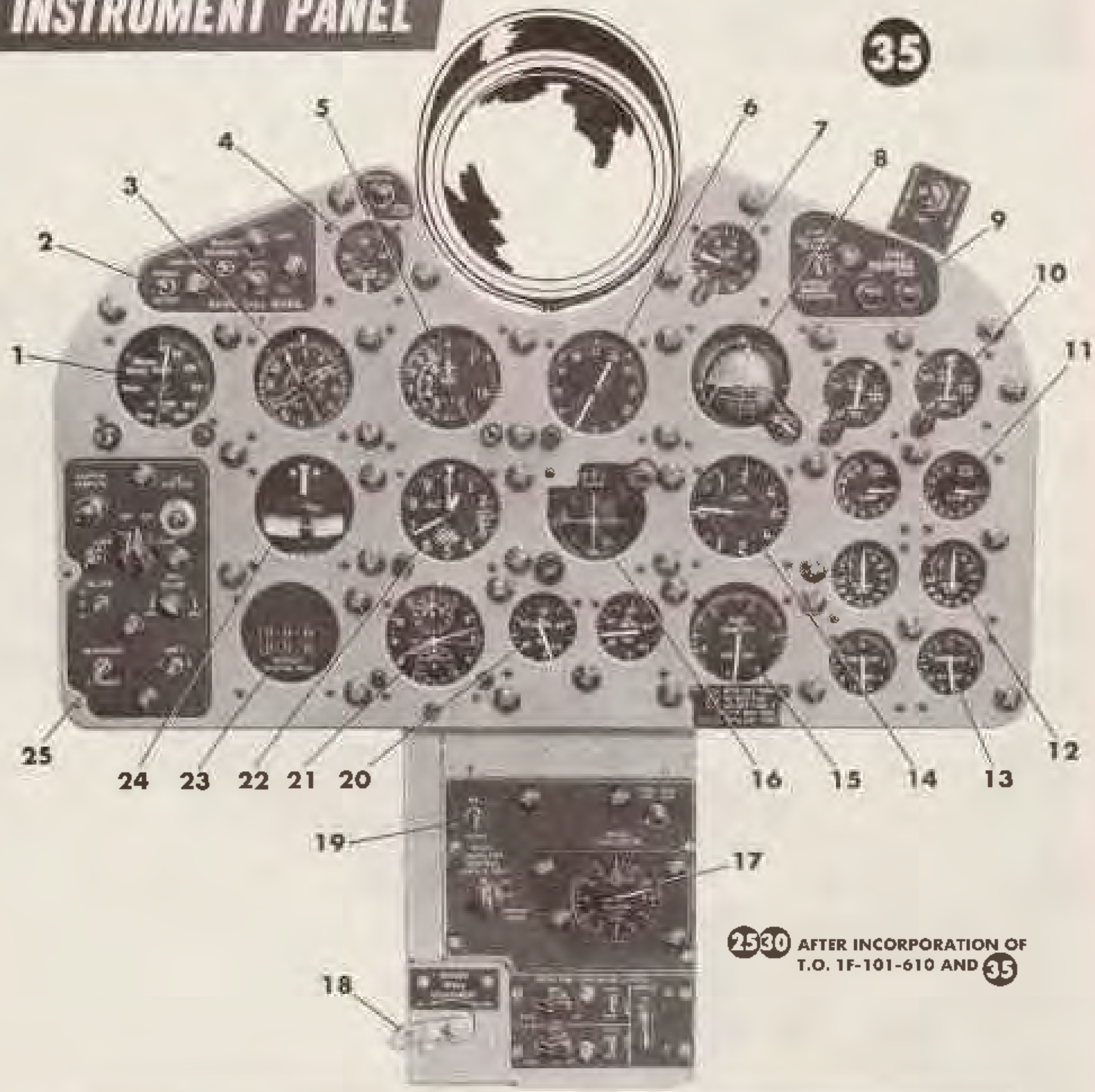


1. RADAR ALTIMETER
2. RADAR WARNING PANEL
3. RADIO MAGNETIC INDICATOR (RMI)
4. CABIN ALTIMETER
5. AIRSPEED AND MACH INDICATOR
6. DIRECTIONAL INDICATOR
7. ACCELEROMETER
8. ATTITUDE INDICATOR
9. FIRE WARNING TEST PANEL
10. ENGINE PRESSURE RATIO GAGES
11. EXHAUST TEMPERATURE GAGES
12. TACHOMETERS
13. FUEL FLOW INDICATORS
14. VERTICAL VELOCITY INDICATOR
15. FUEL QUANTITY GAGE
16. COURSE INDICATOR
17. RUDDER PEDAL ADJUSTMENT CRANK
18. CAMERA COMPARTMENT TEMP GAGES
19. OIL PRESSURE GAGES
20. CLOCK
21. ALTIMETER
22. DISTANCE INDICATOR
23. TURN AND SLIP INDICATOR
24. VIEW FINDER CONTROL PANEL

25 30 PRIOR TO INCORPORATION OF T.O. 1F-101-610

Figure 1-24

INSTRUMENT PANEL



1. RADAR ALTIMETER
2. RADAR WARNING PANEL
3. RADIO MAGNETIC INDICATOR (RMI)
4. CABIN ALTIMETER
5. AIRSPEED AND MACH INDICATOR
6. DIRECTIONAL INDICATOR*
7. ACCELEROMETER
8. ATTITUDE INDICATOR
9. FIRE WARNING TEST PANEL
10. ENGINE PRESSURE RATIO GAGES
11. EXHAUST TEMPERATURE GAGES
12. TACHOMETERS
13. FUEL FLOW INDICATORS
14. VERTICAL VELOCITY INDICATOR
15. FUEL QUANTITY GAGE
16. COURSE INDICATOR
17. WIND INDICATOR
18. RUDDER PEDAL ADJUSTMENT CRANK
19. ILS TACAN SWITCH
20. OIL PRESSURE GAGES
21. CLOCK
22. ALTIMETER
23. DISTANCE INDICATOR
24. TURN AND SLIP INDICATOR
25. VIEW FINDER CONTROL PANEL

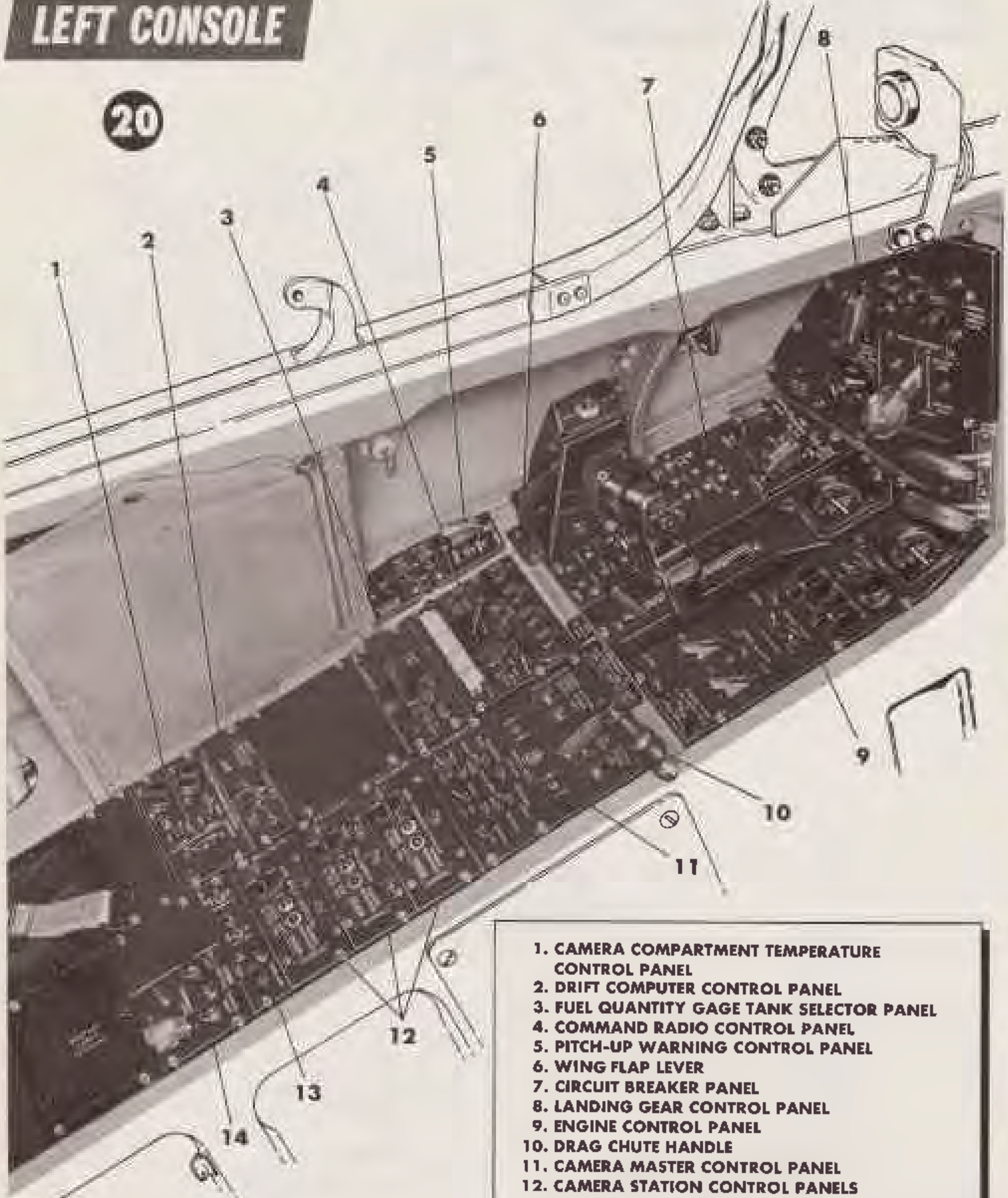
*REPLACED BY COURSE-DISTANCE-TRACK INDICATOR WHEN AN/ASN-7 IS INSTALLED

RFA20-126A-2

Figure 1-25

LEFT CONSOLE

20



1. CAMERA COMPARTMENT TEMPERATURE CONTROL PANEL
2. DRIFT COMPUTER CONTROL PANEL
3. FUEL QUANTITY GAGE TANK SELECTOR PANEL
4. COMMAND RADIO CONTROL PANEL
5. PITCH-UP WARNING CONTROL PANEL
6. WING FLAP LEVER
7. CIRCUIT BREAKER PANEL
8. LANDING GEAR CONTROL PANEL
9. ENGINE CONTROL PANEL
10. DRAG CHUTE HANDLE
11. CAMERA MASTER CONTROL PANEL
12. CAMERA STATION CONTROL PANELS
13. RADAR WARNING CONTROL PANEL
14. EMERGENCY CAMERA DOOR CONTROL PANEL

RFA20-127A-1

Figure 1-26

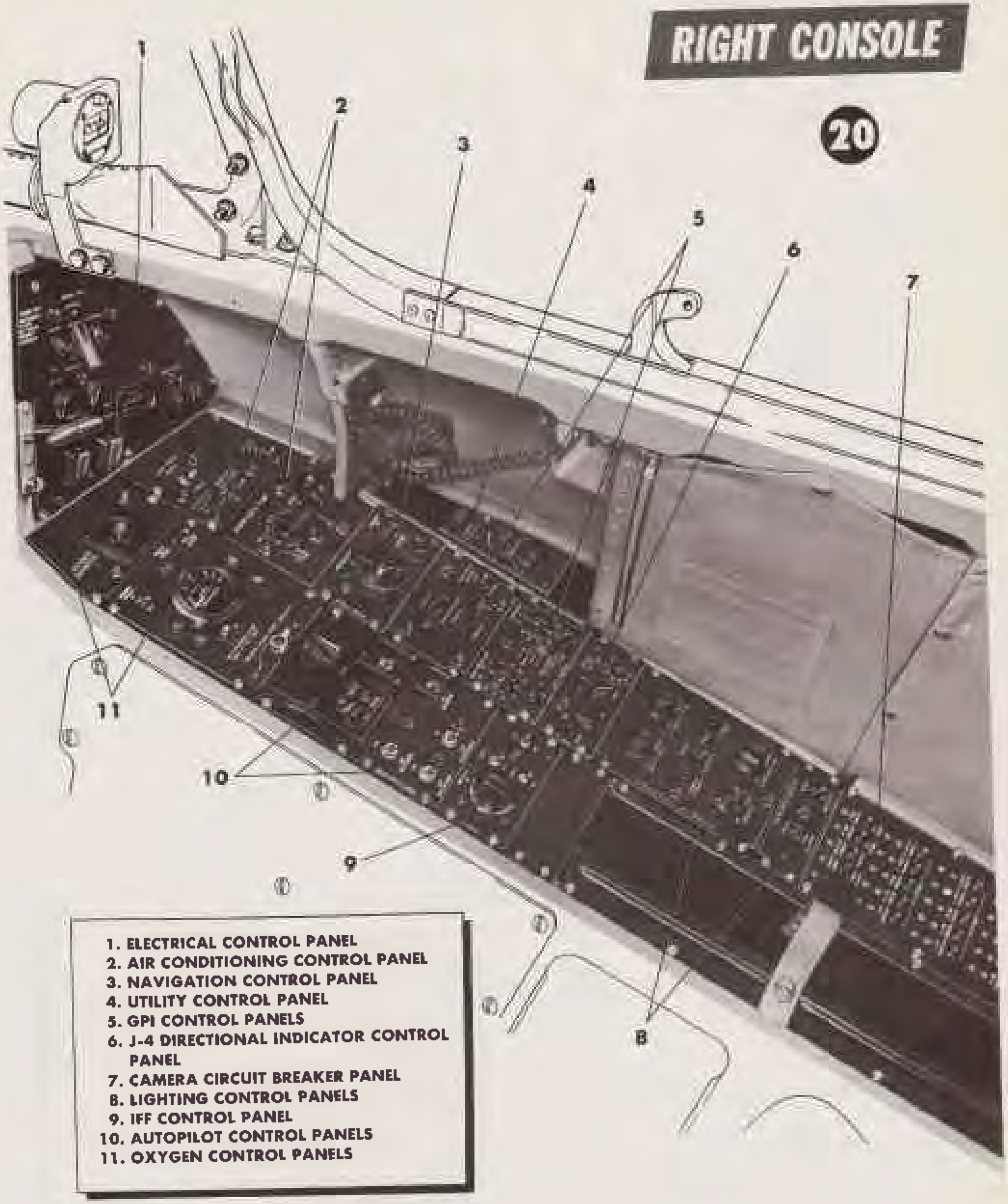
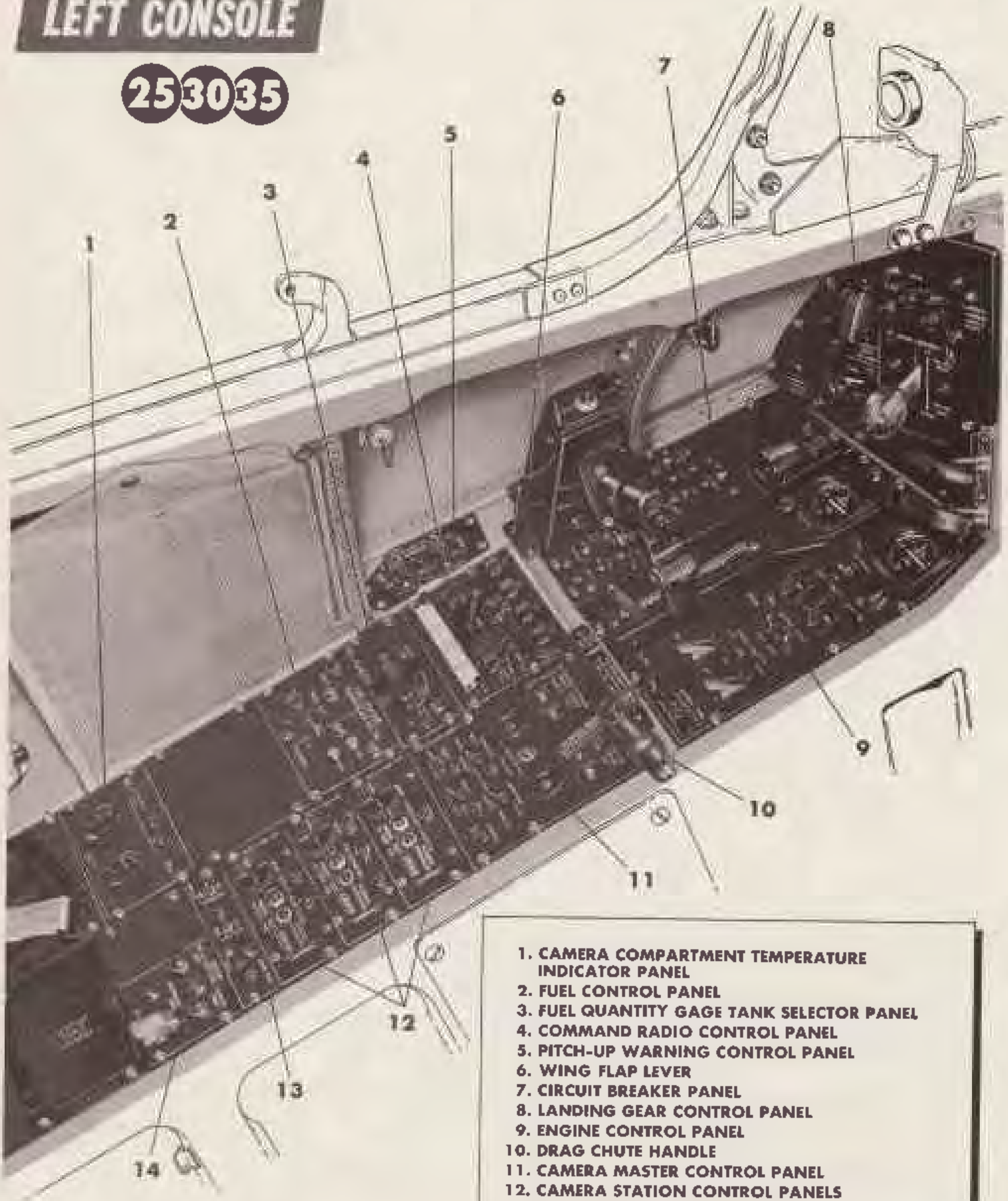

RIGHT CONSOLE
20
1
2
3
4
5
6
7
8
9
10
11
1. ELECTRICAL CONTROL PANEL
2. AIR CONDITIONING CONTROL PANEL
3. NAVIGATION CONTROL PANEL
4. UTILITY CONTROL PANEL
5. GPI CONTROL PANELS
6. J-4 DIRECTIONAL INDICATOR CONTROL PANEL
7. CAMERA CIRCUIT BREAKER PANEL
8. LIGHTING CONTROL PANELS
9. IFF CONTROL PANEL
10. AUTOPILOT CONTROL PANELS
11. OXYGEN CONTROL PANELS

Figure 1-27

LEFT CONSOLE

25 30 35



1. CAMERA COMPARTMENT TEMPERATURE INDICATOR PANEL
2. FUEL CONTROL PANEL
3. FUEL QUANTITY GAGE TANK SELECTOR PANEL
4. COMMAND RADIO CONTROL PANEL
5. PITCH-UP WARNING CONTROL PANEL
6. WING FLAP LEVER
7. CIRCUIT BREAKER PANEL
8. LANDING GEAR CONTROL PANEL
9. ENGINE CONTROL PANEL
10. DRAG CHUTE HANDLE
11. CAMERA MASTER CONTROL PANEL
12. CAMERA STATION CONTROL PANELS
13. RADAR WARNING CONTROL PANEL
14. EMERGENCY CAMERA DOOR CONTROL PANEL

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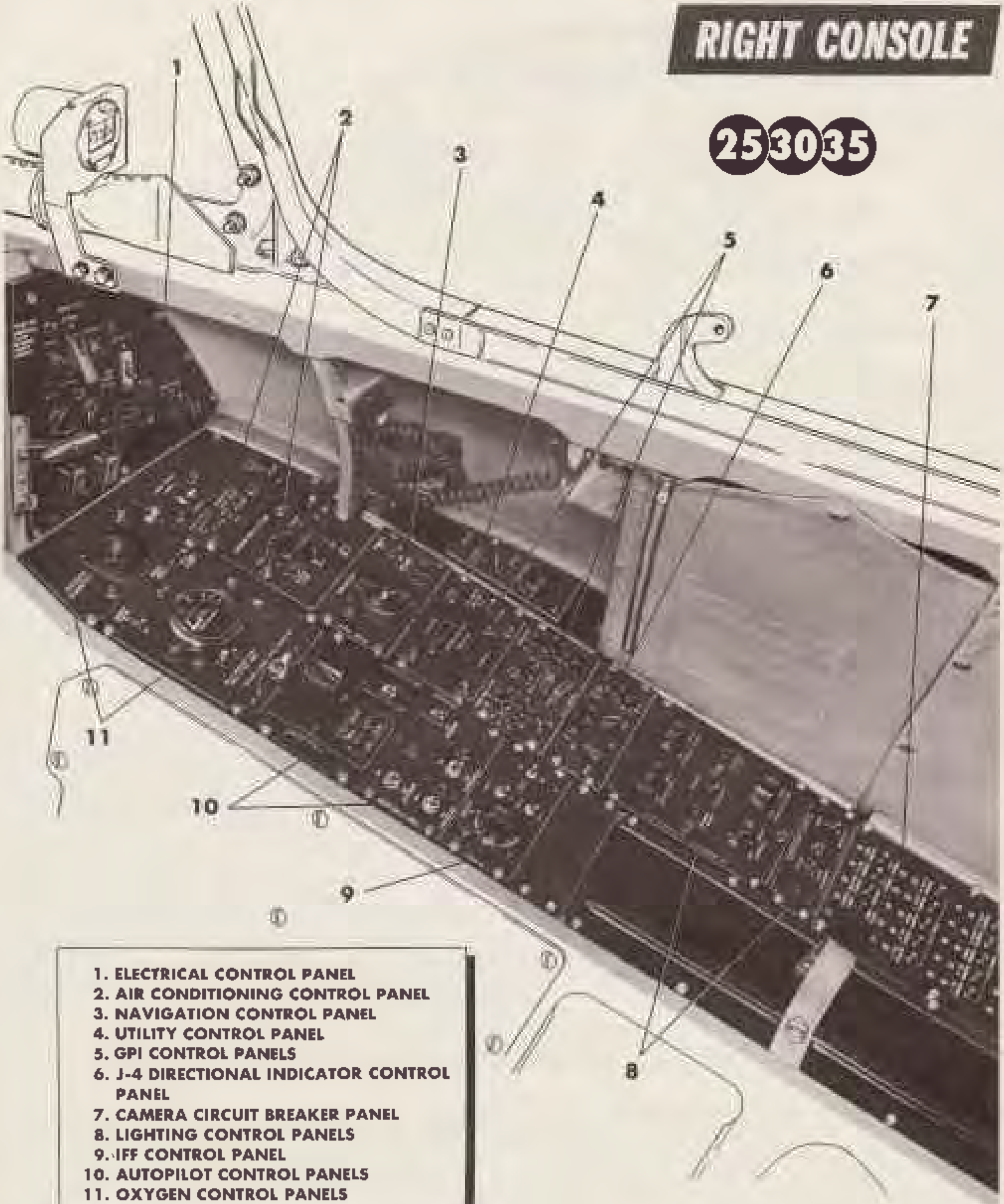
Figure 1-28

RIGHT CONSOLE

25 30 35



1. ELECTRICAL CONTROL PANEL
2. AIR CONDITIONING CONTROL PANEL
3. NAVIGATION CONTROL PANEL
4. UTILITY CONTROL PANEL
5. GPI CONTROL PANELS
6. J-4 DIRECTIONAL INDICATOR CONTROL PANEL
7. CAMERA CIRCUIT BREAKER PANEL
8. LIGHTING CONTROL PANELS
9. IFF CONTROL PANEL
10. AUTOPILOT CONTROL PANELS
11. OXYGEN CONTROL PANELS

Figure 1-29

Figure 1-30

lights simultaneously. Depressing the button with the instrument lights knob ON and the warning light test button depressed will dim all warning, caution and indicator lights. Turning the instrument lights knob OFF will allow the lights to revert to bright.

EMERGENCY EQUIPMENT

Engine Fire and Overheat Detector System

Two complete and separate overheat detecting systems are installed on each engine. One is forward of the fireseal in the compressor and accessory section, the other aft in the combustion-turbine-tailpipe area. The systems primarily consist of heat sensitive continuous sensing elements mounted throughout their respective area, indicator lights in the cockpit and test circuits. The system requires 115 volt a-c, the indicator lights 28 and 14 volts a-c and the test circuits 28 volt d-c.

Burner Overheat and Fire Warning Lights

Two lights (9, figure 1-24) on the instrument panel serve as a warning for both systems on each engine.

EXTERNAL CANOPY CONTROLS

Figure 1-31

The lights, one for each engine, are adjacent. A fire condition in the engine area causes the light to burn steadily while overheat in the burner compartment will cause the light to flash. These lights are dimmed and tested by the warning light dim and test switches on the right console cockpit lights control panel.

ENGINE FIRE DETECTOR TEST SWITCH

This three-position toggle switch (9, figure 1-27) adjacent to the fire warning light, serves to test the operation of the system. Since the test circuit establishes the same condition as actuation of a detector, the entire system is actually tested, not just the indicator light. When placed in the ENG. COMPT. position, the detectors in the engine compartments of both engines are tested with normal operation indicated in each case by steady operation of the lights. Placing the switch in the OVERHEAT-BURNER position tests the detectors in the burner compartment of each engine and will cause a flashing light. The center position of the switch is OFF.

CANOPY

The clam-shell canopy is opened, closed and locked by an electric motor-driven jack screw actuator. This canopy actuator transmits its power to a torque shaft, which in turn locks or unlocks the rail and windshield canopy latches through mechanical linkage. The six canopy latches are positioned to correspond with the six canopy locks, two locks on each canopy sill, and two on the upper edge of the windshield. Mounted between the locks on each sill are canopy dogs that guide the canopy so that the latches are in proper locking position. Canopy side load studs insert into lugs positioned within the forward end of the canopy sill when the canopy closes to brace the canopy against side applied stress. The canopy may be opened manually from either inside or outside the aircraft and, in an emergency, can be jettisoned by means of a cartridge-type remover from either inside or outside, see figure 1-31. The canopy is hinged at the rear and opens to an angular position of 45 degrees. A rubber strip installed on the canopy forms a seal, when the canopy is in the closed position, permitting pressurization to the cockpit. The design of the seal is such that the pressure differential will tend to make the seal more secure. Since the canopy utilizes battery bus power for operation, it is possible to open or close the canopy without external power or without the engine operating. In the (33) airplanes, a defogging duct is located on the forward canopy arch. When the canopy is closed this duct mates with the defogging ducts which extend along the windshield sill.

External Canopy Switch

This two-position toggle switch (figure 1-31), is provided to open and close the canopy from outside the airplane. It is mounted adjacent to the external power receptacle on the right side of the airplane below the front of the canopy. Power is supplied by the 28 volt d-c battery power.

Canopy External Emergency Release Lanyard

This lanyard (figure 1-31) is provided to gain immediate entrance to the cockpit in an emergency. The cable is approximately nine feet long with an attached pull handle. It is stowed in an access door, along with the oxygen filler valve, on the right side of the fuselage above the exterior canopy switch. The cable is connected to a canopy initiator and is another method of jettisoning the canopy. The exterior canopy jettison initiator has a red flagged safety pin installed on the ground. This pin is removed before all flight operations. Failure to remove this safety pin will not affect the normal cockpit canopy jettison system.

Canopy Emergency Release (Ejection Seat Handgrips)

Refer to Ejection Seat, in this section.

Canopy Manual Release Lever

The canopy manual release lever is mounted on the left forward portion of the canopy, within easy reach of the pilot. The lever is mechanically connected to the canopy actuating mechanism and in operation serves the functions of disengaging the normal drive and unlatching the canopy locks. Once the lever has been moved through its full travel, the canopy can be pushed up. When released, the lever will return to its initial position, re-engaging the clutch and maintaining canopy position either partially or fully open. The shaft on which the lever is mounted extends through the canopy, terminating in a flush 3/8 inch socket. This permits use of a wrench to operate the manual release from outside the aircraft.

Note

The canopy cannot be relocked with the canopy manual release lever. Locking must be accomplished with the normal electrical actuating mechanism.

Interior Canopy Switch

The canopy is operated from within the aircraft by a three-position toggle switch (figure 1-26) located under the canopy sill, to the left and opposite the front of the pilot's seat. The switch is spring-loaded to the OFF (center) position and is moved to UP to open and to DOWN to close. Separate limit switches are provided to insure stopping canopy movement at full open or closed. Battery bus 28 volt d-c power is provided for canopy operation.

Note

- The actuating mechanism is such that the canopy can be stopped in an intermediate position simply by releasing the canopy switch, allowing it to return to OFF.
- The canopy switch may be used to open the canopy so that it may be blown off by slip stream in case of canopy jettison malfunction during an in-flight emergency. However, in certain flight conditions, air loads may prevent the canopy from opening by this method.

Canopy Alternate Jettison Handle

The canopy can be jettisoned without arming the seat for ejection by pulling up on the canopy alternate jettison handle (figure 1-32) located in the left side of the seat forward of the inertia reel control handle.

Note

If canopy should fail to jettison after raising handgrips, the canopy alternate jettison handle can be actuated to fire canopy initiator.

Actuation of the canopy alternate jettison handle will fire the canopy initiator cartridge and gas pressure from the initiator will actuate the canopy remover. The canopy will jettison, but, since the ejection seat handgrips are stowed in normal down position, the seat catapult triggers will be guarded and uncocked and the seat will not be armed for ejection. Actuation of the canopy alternate jettison handle will not lock the inertia reel. The canopy alternate jettison handle is guarded and locked in the normal down position by a spring-loaded guard latch hinged to the handle. The guard latch is spring-loaded to the up position and when pushed down will unlock the canopy alternate jettison handle. The canopy alternate jettison handle is actuated by squeezing the guard latch down toward the jettison handle then pulling both upwards. The canopy alternate jettison handle is ground safetied by the same red flagged seat safety "T" pin, that safeties the ejection seat handgrips. Insertion of the "T" pin in the left seat handgrip locks the handgrips and canopy alternate jettison handle in their safe positions.

WARNING

When the "T" pin is installed, the canopy alternate jettison handle guard latch can be pushed down but the canopy alternate jettison handle cannot be pulled up. The "T" pin should be removed prior to flight and installed in left handgrip before leaving the seat.

Canopy Warning Light

A canopy warning light (figure 1-30) is mounted on the left cockpit sill and is illuminated any time the canopy is not closed and locked, provided 28 volt a-c is available. It is operated by the canopy locked limit switch and is tested and dimmed by the warning light test and dim switches on the right console.

EJECTION SEAT

The ejection seat, figure 1-32, permits the pilot to eject from the aircraft at any speed or flight attitude and is equipped with an automatic opening safety belt to aid in separation from the seat after ejection. The free ends of the shoulder harness are connected to the buckle of the safety belt and separate from the buckle when the belt opens automatically. The fixed ends of the shoulder harness are bolted to the inertia reel located on the back of the seat. The inertia reel locks automatically under 2 to 3 "g" deceleration forces and also when either handgrip is raised to jettison the canopy during the ejection sequence. The reel can be manually locked or unlocked by the inertia reel handle located forward on the left side of the seat. The seat can be electrically positioned in vertical direction by the seat adjustment switch on the forward end of the right side of the seat. No forward or aft adjustment is possible. The seat will accommodate a back-type parachute and is equipped with a type MC-2 cushion and a removable parachute support bulkhead. An over land survival kit can be carried in the MC-2 seat cushion by removing the Fiberglas filler block from the zippered compartment in the bottom of the cushion and replacing the block with a survival kit. When the MC-2 seat cushion is not used, a type MD-1 survival kit container will be used. The forward edge of the packed kit shall not exceed seven inches.

WARNING

Do not add an A-5 or MC-1 seat cushion or any form of shock absorbing device to the above standard configuration. If ejection is necessary, serious spinal injury can result when the ejection force compresses the added absorbing device and enables the seat to gain momentum before exerting a direct force on the pilot, or, in event of a forced landing, the pilot will sink in the seat and the shoulder straps will loosen, increasing chances of injury.

Disconnect fittings for the seat positioning leads are located at the left rearward disconnect. Disconnect fittings for radio, face heat, oxygen, anti-G suit hoses are located on the front of the seat. The disconnects separate during seat ejection, freeing the pilot's personal leads and hoses from the airplane. Canopy jettison and seat ejection sequence controls are incorporated in the interconnected seat handgrips forward of the armrests. The canopy is jettisoned and the seat armed for ejection by raising either of the interconnected handgrips. Seat ejection is accomplished by squeezing either of the seat catapult triggers in the handgrips. Upward travel of the seat trips the lap belt initiator which opens the safety belt. The canopy can be jettisoned without arming the seat for ejection by pulling up on the guarded canopy alternate jettison handle located forward of the inertia reel control handle on the left side of the seat. If ejection is necessary and the canopy fails to jettison after lifting the handgrips, or pulling up on the canopy alternate jettison handle, ejection through the canopy can be accomplished by squeezing the catapult triggers. The seat is ground safetied against canopy jettison and seat ejection by installing a red flagged, ground safety "T" pin in the left handgrip. The "T" pin prevents raising the handgrips and also prevents pulling up the canopy alternate jettison handle. The non-adjustable headrest, armrests, and calfguards are located such as to afford maximum protection when used correctly during ejection. The ejection seat is not equipped with stirrups. Positioning the feet on the rudder pedals will provide maximum clearance during ejection and eliminate shock loads that would be imposed with the feet back against the calfguard of the seat. See figure 3-4. The seat handgrips, after being raised for canopy jettison, can be grasped for catapult trigger actuation with the arms down firm against the armrests.

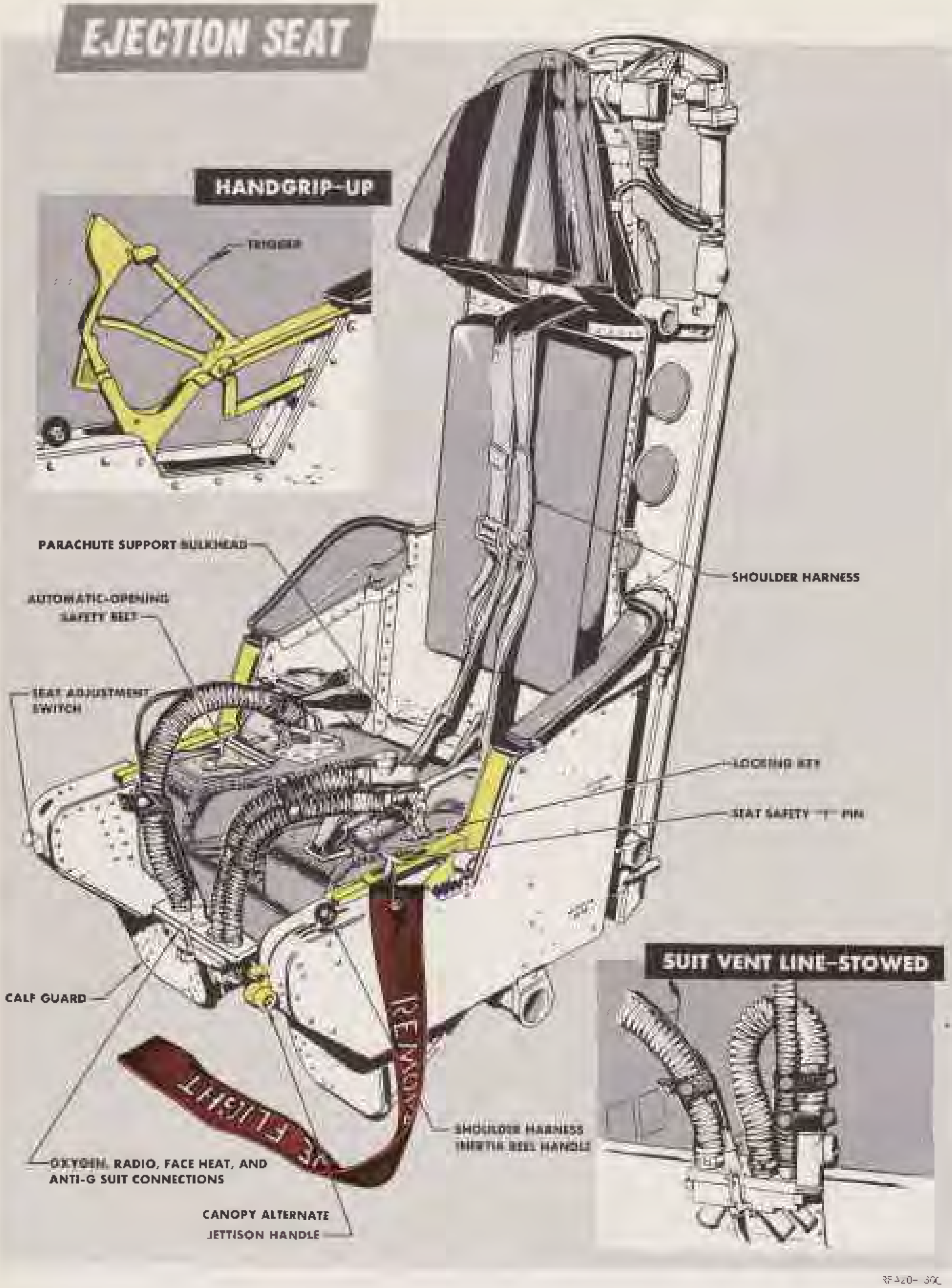

EJECTION SEAT
HANDGRIP-UP
TRIGGER
PARACHUTE SUPPORT BULKHEAD
AUTOMATIC-OPENING SAFETY BELT
SEAT ADJUSTMENT SWITCH
SHOULDER HARNESS
LOCKING KEY
SEAT SAFETY "T" PIN
CALF GUARD
SHOULDER HARNESS INERTIA REEL HANDLE
OXYGEN, RADIO, FACE HEAT, AND ANTI-G SUIT CONNECTIONS
CANOPY ALTERNATE JETTISON HANDLE
SUIT VENT LINE-STOWED

Figure 1-32

EJECTION SEAT HANDGRIPS

The two mechanically interconnected handgrips (figure 1-32), located forward of the armrests, are used to actuate the canopy jettison initiator cartridge and are normally stowed flush with the seat. When raised, they actuate the canopy initiator cartridge, cock the automatic belt initiator, lock the inertia reel, and expose and cock the seat catapult triggers. Gas pressure from the canopy initiator actuates the canopy remover. Lifting either handgrip will also lift the other handgrip and jettison the canopy.

Note

> If canopy fails to jettison after raising handgrips, the canopy alternate jettison handle may be pulled upwards to fire the canopy initiator.

When the handgrips are in the normal down position they guard the seat catapult triggers and position the trigger mechanisms in an uncocked condition. When raised, the handgrips expose the triggers and cock the trigger mechanism.

WARNING

> The handgrips are ground safetied by inserting the red flagged, seat safety "T" pin in a hole in the forward end of the left handgrip. The "T" pin prevents raising either of the interconnected handgrips and prevents pulling up the canopy alternate jettison handle. The "T" pin should be removed prior to flight and reinstalled in left handgrip before leaving the seat.

SEAT CATAPULT TRIGGERS

A seat catapult trigger (figure 1-32) is incorporated into each ejection seat handgrip. The triggers are used to fire the seat catapult initiator cartridges to eject the seat from the airplane. Each trigger fires an individual initiator cartridge and each initiator supplies sufficient pressure to fire the seat catapult.

WARNING

> Both initiators are connected by flexible pressure hose to a common check valve located behind the headrest. A single hose routes pressure from the valve upwards to the catapult. If necessary to disarm a seat that has raised handgrips, the hose connecting the check valve and catapult must be cut. See figure 3-6.

Note

> If one of the hoses connecting an initiator and check valve is cut, the other initiator can still eject the seat if its seat catapult trigger is actuated.

Each trigger works independently of the other and ejection can be accomplished by pulling up, or squeezing either trigger. Normally the triggers are guarded by the ejection seat handgrips and their link mechanisms to the catapult initiators are uncocked when the seat handgrips are in normal full down position. When the handgrips are raised to canopy jettison position the catapult triggers are exposed and their link mechanisms to the catapult initiators are cocked.

AUTOMATIC-OPENING SAFETY BELTS

In this airplane the pilot may encounter one of two different automatic-opening safety belts, the MA-4 or MA-5. See figure 1-33. The primary purpose of the automatic-opening safety belt is to extend the maximum and minimum altitudes at which escape may be successfully accomplished with the ejection seat. In high altitude ejection (above 15,000 feet) use of the automatic safety belt and parachute avoids deployment of the parachute until altitudes of sufficient oxygen are reached. The aneroid action of the parachute release mechanism delays the opening of the parachute until the pilot free falls below the critical altitude. In low altitude ejection, use of the automatic system greatly reduces the time required for separation from the ejection seat and deployment of the parachute, and consequently reduces the altitude required for ejection.

WARNING

> Under no circumstances should the automatic safety belt be manually opened prior to ejection, regardless of altitude.

MA-4 Safety Belt

The release of the MA-4 safety belt (figure 1-33) is accomplished by manual operation by the pilot or by gas pressure from a separate automatically controlled source, the M-4 initiator in the (20)(25)(30) airplanes or the M-12 initiator in the (35) airplanes. The M-4 initiator opens the safety belt 2 seconds after ejection while the M-12 initiator opens the safety belt 1 second after ejection. This power source supplies approximately 1500 psi pressure through a 36-inch length hi-pressure hose which actuates a piston inside the belt, retracting the latch tongue and thus opening the belt. This belt is designed so that the belt cannot be locked until the automatic parachute lanyard key or the spare key is inserted in the receptacle. If the automatic parachute is used the automatic parachute lanyard key is inserted in the belt receptacle. If the automatic

AUTOMATIC-OPENING SAFETY BELTS

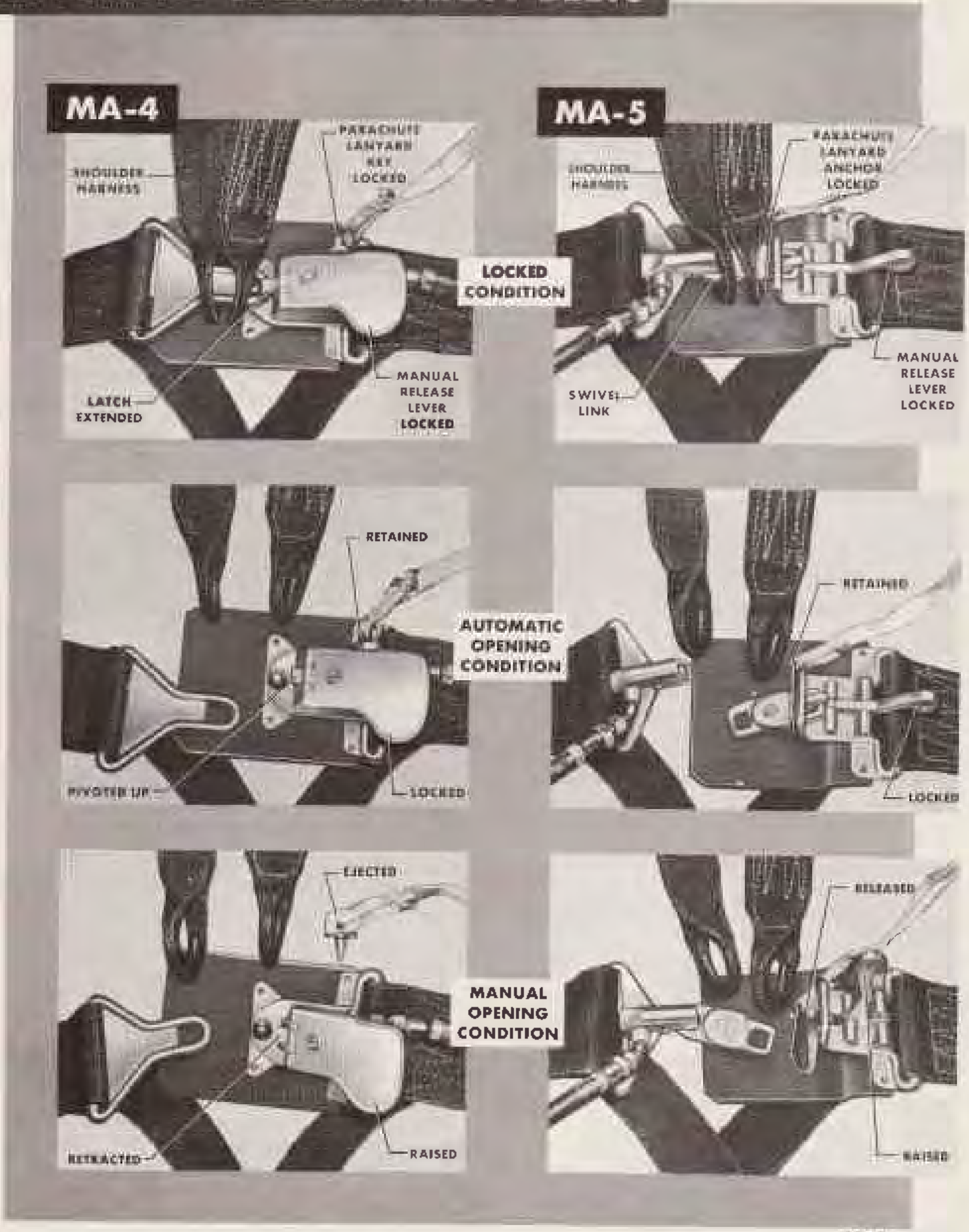


Figure 1-33

parachute is not used, the spare key attached to the safety belt is inserted in the belt receptacles. When the belt is manually opened, the key is ejected automatically so that inadvertent actuation of the automatic parachute will not occur. During automatic operation of the safety belt the key remains firmly locked in the belt receptacle, thereby causing actuation of the parachute timer knob as the pilot separates from the seat.

WARNING

Be certain the automatic parachute lanyard key, rather than the spare key, is inserted in the release mechanism or the parachute will not automatically open. The spare key should be used only if the automatic-opening parachute is not available.

MA-5 Safety Belt

The release of the MA-5 safety belt (figure 1-33) is accomplished by manual operation by the pilot or by gas pressure from a separate automatically controlled source, the M-4 initiator in the (20)(25)(30) airplanes or the M-12 initiator in the (35) airplanes. The M-4 initiator opens the safety belt 2 seconds after ejection while the M-12 initiator opens the safety belt 1 second after ejection. This power source supplies approximately 1500 psi pressure through a 36-inch length hi-pressure hose which actuates a piston within the belt, releasing the right portion of the swivel link thus opening the belt. The right portion of the swivel link is locked at all times to the automatic release mechanism. The left portion of the swivel link is manually locked into a conventional manual release lever. To attach the shoulder harness straps and the automatic parachute lanyard anchor to the MA-5 safety belt place both shoulder harness loops over the manual release end of the swivel link. Place the automatic parachute lanyard anchor over the manual release end of the swivel link. Fasten the safety belt by locking the manual release lever. No keys are necessary. When the belt is manually opened the automatic parachute lanyard anchor is released so that inadvertent actuation of the automatic parachute will not occur. During automatic operation of the safety belt the automatic parachute lanyard anchor remains firmly locked on the swivel link, thereby causing actuation of the parachute timer knob release as the pilot separates from the seat.

WARNING

- The parachute lanyard anchor must be connected in the proper manner or the pilot probably will not separate from the seat after ejection. For proper procedures, refer to figure 1-33.
- The automatic parachute lanyard anchor loop need not be connected to the swivel link to enable closing of the manual release lever. However, it must be connected to insure operation of the automatic parachute.

CANOPY ALTERNATE JETTISON HANDLE

Refer to Canopy Alternate Jettison Handle, this section.

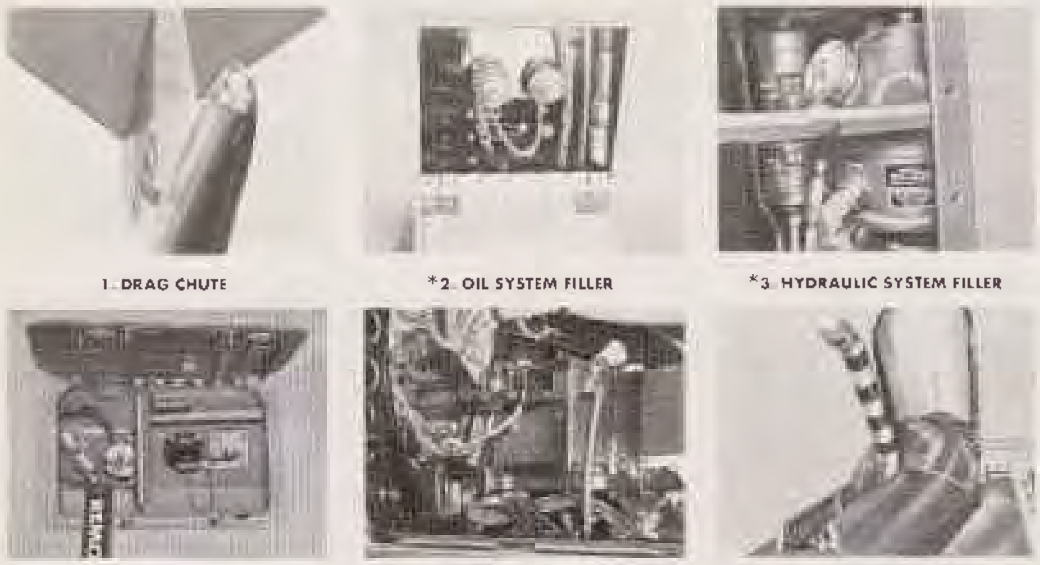
SHOULDER HARNESS INERTIA REEL HANDLE

The inertia reel handle (figure 1-32) is used to manually lock or unlock the shoulder harness inertia reel. When unlocked, the inertia reel permits normal forward and aft movement of the pilot's shoulders. When locked, the reel prevents forward movement but, when the pilot leans aft, the reel automatically takes up slack in the shoulder harness and locks the harness in successive lock positions as the pilot leans aft. When pushed forward, the handle detents in the LOCK position and locks the inertia reel. When pulled aft, the handle detents in UNLOCKED position and unlocks the reel for normal forward and aft movement. Acceleration and deceleration of 2 to 3 "g's" will automatically lock the reel when the handle is in UNLOCKED position and the reel will remain locked until the handle is moved forward to LOCK and moved back to UNLOCKED. The reel can be manually locked during maneuvers, flight in rough air, or as a safety precaution prior to a forced landing. When ejection seat handgrips are raised to jettison the canopy, a control cable from the left handgrip will lock the inertia reel if the inertia reel handle is unlocked and the reel has not been automatically locked by deceleration. Pulling up on the canopy alternate jettison handle will not cause reel to lock and, if reel lock is desired in this condition, it must be accomplished by the inertia reel handle.

Note

- The shoulder harness inertia reel is designed for forward and aft acceleration. If violent side movement is expected, the shoulder harness should be locked manually, as side loads will not automatically lock the inertia reel.
- An inertia reel preflight check can be made by moving the inertia reel handle from UNLOCKED to LOCK and back to UNLOCKED and then pulling suddenly on the shoulder harness straps. The reel should lock and a succession of releases of the harness straps should result in a succession of locked reel positions. The reel should unlock when the handle is moved forward to LOCK and back to UNLOCKED.

SERVICING DIAGRAM



1. DRAG CHUTE

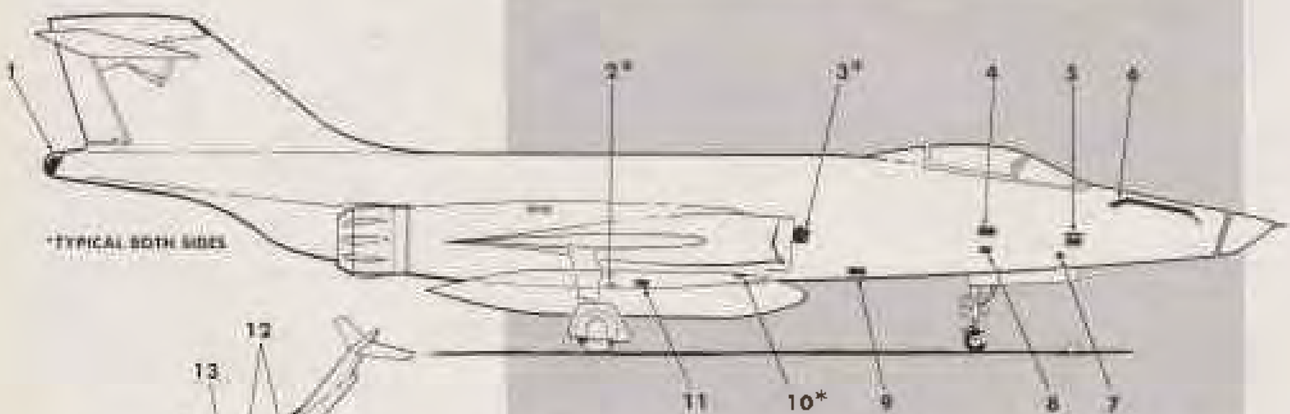
*2. OIL SYSTEM FILLER

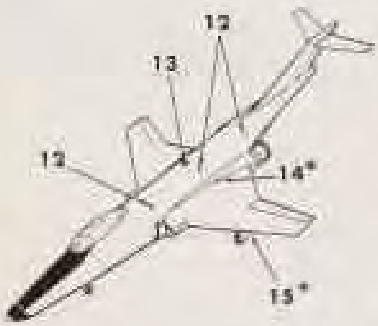
*3. HYDRAULIC SYSTEM FILLER

4. LIQUID OXYGEN FILLER

5. BATTERY

6. AIR REFUELING PROBE





*15. HYDRAULIC FLUID AND AIR FILLER (20)

*15. AIR FILLER (25)(30)(35)

*15. HYDRAULIC FLUID AND AIR FILLER (25)(30)(35)

SPECIFICATIONS

- HYDRAULIC FLUID MIL-O-5606
- FUEL JP-4 MIL-F-5624 (NO ALTERNATE FUEL RECOMMENDED) EMERGENCY FUEL MIL-F-5572
- OIL MIL-L-7808B (AMENDMENT 1)
- OXYGEN BB-O-925

IF THE DRAG CHUTE HAS BEEN USED IT MUST BE REPACKED AND INSTALLED IN ACCORDANCE WITH THE INSTRUCTIONS IN T.O. 1F-101A-2-3 PRIOR TO THE NEXT FLIGHT

FFA20-132-1

Figure 1-34

7. EMERGENCY BRAKE AIR BOTTLE-3000 PSI

8. EXTERNAL POWER RECEPTACLE

9. SINGLE POINT REFUELING

*10. EXTERNAL TANKS

11. AIR STARTER CONNECTION

12. REFUELING FILLERS
13. AIR REFUELING RECEPTACLE
*14. OIL TANK DIPSTICK

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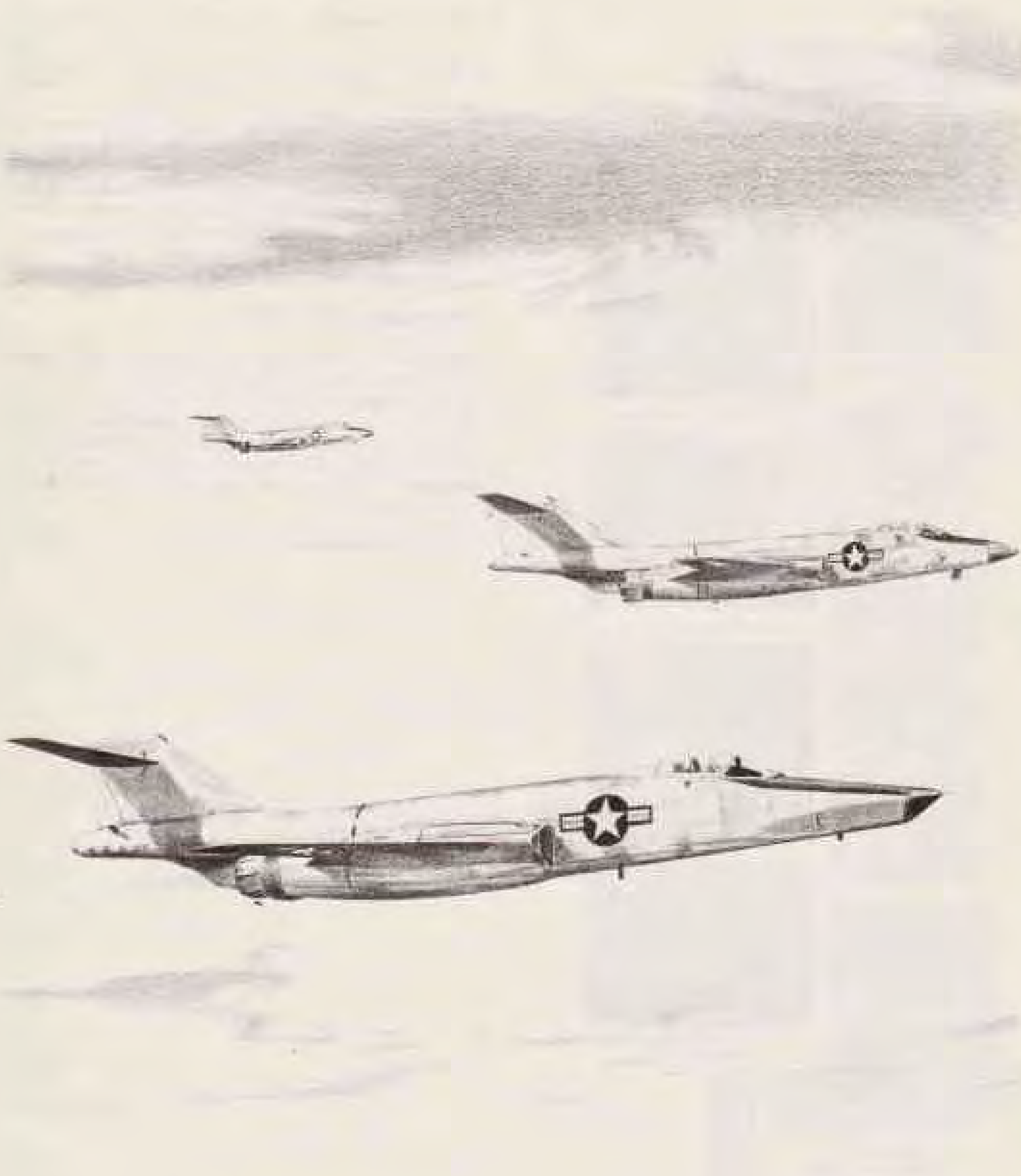
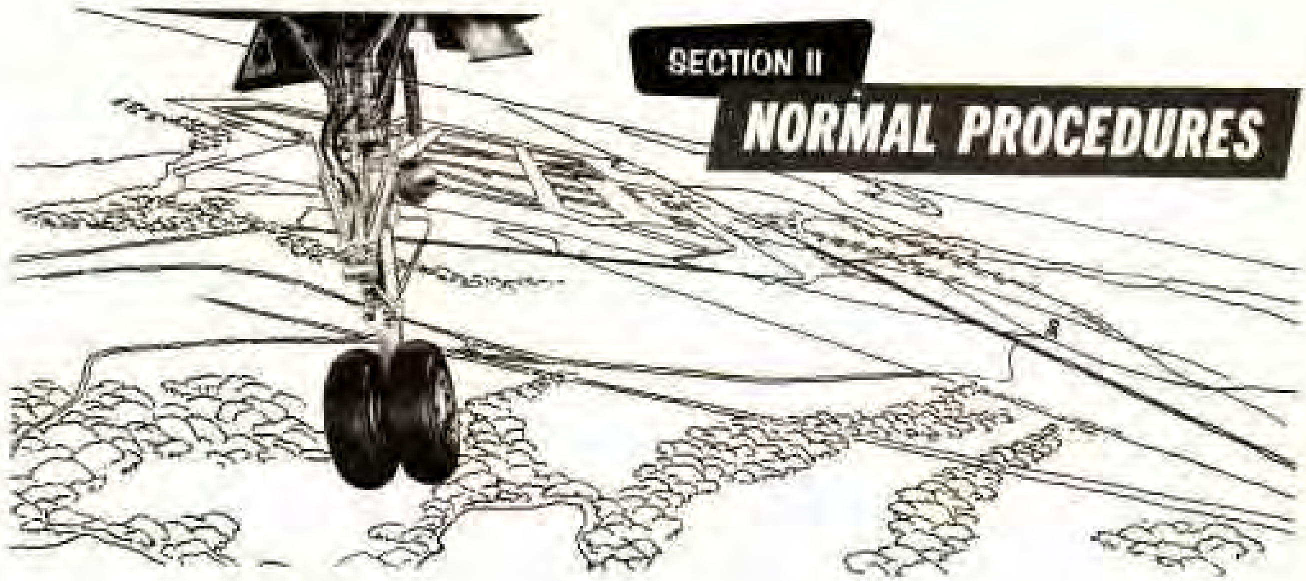
SEAT ADJUSTMENT SWITCH

The three-position seat adjustment switch (figure 1-32) is mounted on the forward end of the right side of the seat and is used to adjust the seat height. The switch is spring-loaded to the center OFF position. Holding the switch in the UP position will raise the seat, and holding the switch downward in the DOWN position will lower the seat. When released, the switch returns to center OFF position and the seat locks in the vertical position at which the switch was released. The seat adjustment switch requires 28 volt d-c power. The seat cannot be manually adjusted in height and no forward or aft adjustment is possible.

AUXILIARY EQUIPMENT

Information concerning the cockpit air-conditioning and pressurization system, cockpit defrosting and anti-icing system, engine anti-icing system, communication and associated electronic equipment, lighting equipment, oxygen system, autopilot, navigation equipment, photographic equipment, refueling systems and miscellaneous equipment is supplied in Section IV of this manual.





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SECTION II
NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to Section V for detailed aircraft and engine limitations.

FLIGHT PLANNING

The Appendix of Confidential Supplement, T.O. 1F-101(R)A-1A is provided to determine fuel consumption, correct airspeed, power settings, and altitude for the intended flight mission.

TAKE-OFF AND LANDING DATA CARDS

Complete the Take-Off and Landing Data cards contained in Section II Condensed Check List. Refer to Part 9. Appendix I (T.O. 1F-101(R)A-1A) for detailed instructions.

WEIGHT AND BALANCE

Refer to Handbook of Weight and Balance Data, T.O. 1-1B-40 (formerly AN 01-1B-40). Before each flight, check the following:

1. Check take-off and anticipated gross weight performance data.
2. Check weight and balance clearance (DD Form 365 F).
3. Enter take-off gross weight in item 26 of AFTO Form 781-2 and check item 16 to assure that main landing gear tire limitations will not be exceeded. Refer to Section VII for detailed information.
4. Make sure amount of fuel, oil, oxygen and special equipment is sufficient for proposed mission.

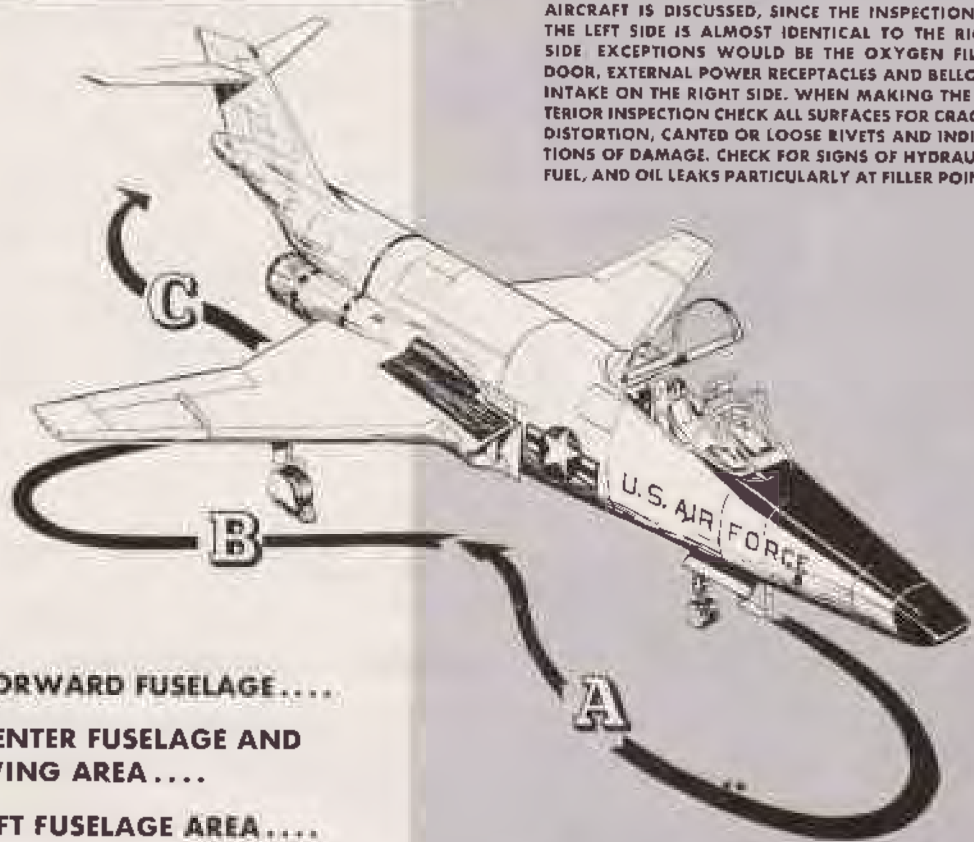
Note

The liquid oxygen quantity gage should read between 4 and 4 1/2 liters when the system is fully charged. Do not be alarmed that the gage does not read 5 liters since it is impossible to charge the liquid converter to 5 liters. Use oxygen duration chart to determine duration of oxygen supply.

EXTERIOR INSPECTION

NOTE

THE EXTERIOR INSPECTION HAS BEEN DIVIDED INTO THREE AREAS AS SHOWN. ONLY THE RIGHT SIDE OF THE AIRCRAFT IS DISCUSSED, SINCE THE INSPECTION OF THE LEFT SIDE IS ALMOST IDENTICAL TO THE RIGHT SIDE. EXCEPTIONS WOULD BE THE OXYGEN FILLER DOOR, EXTERNAL POWER RECEPTACLES AND BELLOWS INTAKE ON THE RIGHT SIDE. WHEN MAKING THE EXTERIOR INSPECTION CHECK ALL SURFACES FOR CRACKS, DISTORTION, CANTED OR LOOSE RIVETS AND INDICATIONS OF DAMAGE. CHECK FOR SIGNS OF HYDRAULIC, FUEL, AND OIL LEAKS PARTICULARLY AT FILLER POINTS.



A FORWARD FUSELAGE....

B CENTER FUSELAGE AND WING AREA....

C AFT FUSELAGE AREA....

A FORWARD FUSELAGE....

NOTE

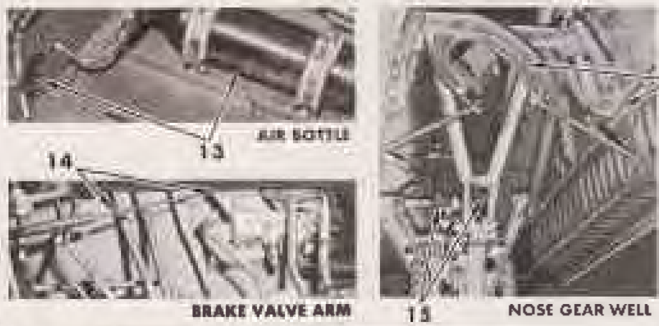
THE CAMERA WINDOWS MAY HAVE INTERIOR COVERS INSTALLED THAT MUST BE REMOVED IF THE CAMERAS ARE TO BE USED.

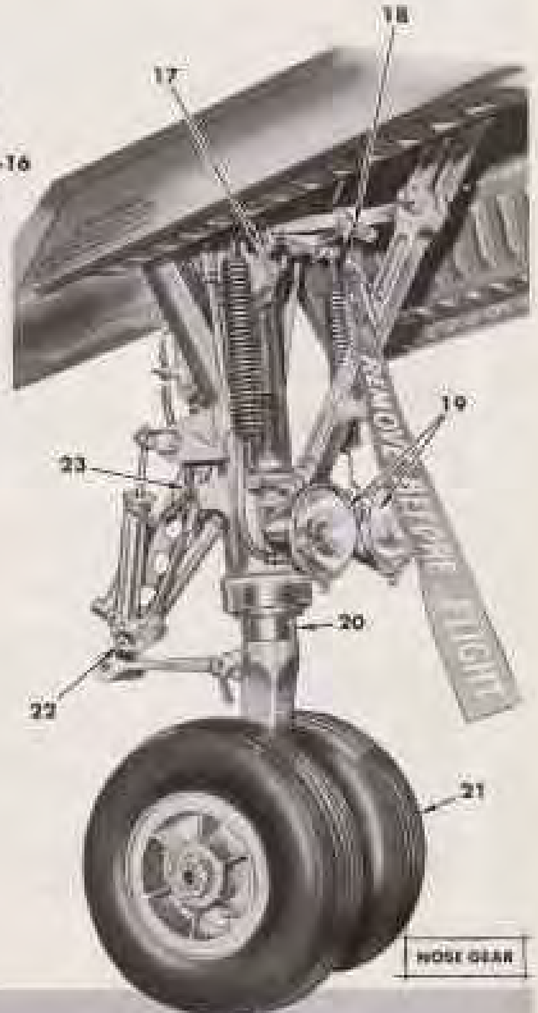
RFA20-201C-1

Figure 2-1 (Sheet 1 of 5 Sheets)

EXTERIOR INSPECTION

A FORWARD FUSELAGE (continued) . . .





CHECK:

1. ANGLE-OF-ATTACK TRANSDUCER PROBE COVER REMOVED, PROBE FREE OF DIRT OR DAMAGE, AND SET. (BOTH SIDES).
2. STATIC VENT CLEAR (BOTH SIDES).
3. OBLIQUE TRI-CAMERA WINDOW COVER REMOVED. (BOTH SIDES).
4. NOSE EQUIPMENT BAY DOORS SECURE, LATCHES LOCKED. (BOTH SIDES).
5. PITOT COVER REMOVED.
6. FORWARD OBLIQUE CAMERA WINDOW COVER REMOVED
7. RADOME SECURED AND FREE OF EROSION.
8. VERTICAL TRI-CAMERA WINDOW COVER REMOVED.
9. IFF ANTENNA SECURE AND FREE OF DAMAGE.
10. AFT TRI-CAMERA BAY WINDOW COVER REMOVED.
11. VIEWFINDER WINDOW COVER REMOVED.
12. OXYGEN FILLER DOOR–OXYGEN FILLER CAP SECURE, VENT AND BUILD-UP VALVE IN BUILD-UP POSITION, EXTERNAL CANOPY EMERGENCY RELEASE LANYARD IN PLACE AND SAFETY PIN REMOVED. CHECK OXYGEN FILLER DOOR SECURELY FASTENED.
13. EMERGENCY BRAKE AIR BOTTLE SECURE, EMERGENCY BRAKE PRESSURE GAGE 3000 PSI.
14. EMERGENCY BRAKE VALVE ARM IN OFF POSITION, PULL WIRE SECURE.
15. NOSE GEAR STEERING UNIT HYDRAULIC LINES SWIVEL FREELY FORE AND AFT.
16. NOSE GEAR DOOR HINGES AND DOOR UPLATCH MECHANISM SECURE.
17. NOSE GEAR WARNING LIGHT LIMIT SWITCH FREE OF DIRT.
18. NOSE GEAR SAFETY PIN REMOVED.
19. LANDING LIGHTS CONDITION.
20. STRUT FOR INFLATION.
21. TIRE CONDITION, SLIPPAGE MARK AND TIRE INFLATION.
22. PIP PIN INSTALLED.
23. NOSE GEAR HYDRAULIC LINES SECURE.
24. SPLIT VERTICAL CAMERA ACCESS DOOR AND CAMERA WINDOW DOORS SECURE.
25. ELECTRICAL EQUIPMENT COMPARTMENT CIRCUIT BREAKERS–IN
26. ELECTRICAL EQUIPMENT ACCESS DOOR LOCKED.
27. HYDRAULIC EQUIPMENT ACCESS DOOR LOCKED.

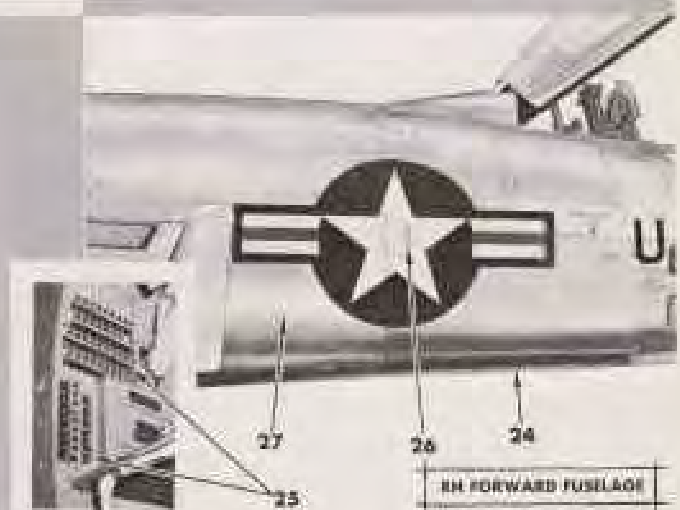


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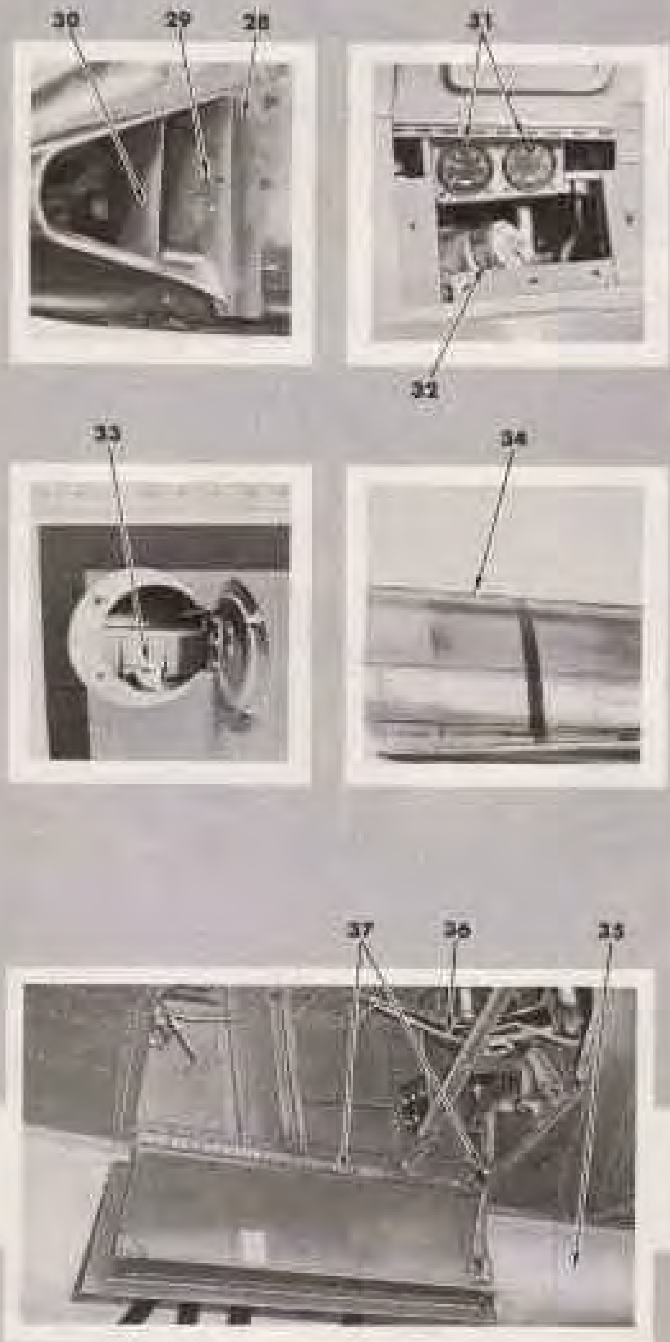
Figure 2-1 (Sheet 2 of 5 Sheets)

EXTERIOR INSPECTION

B CENTER FUSELAGE AND WING AREA....



CHECK:

28. RIGHT HINGED SPLITTER VANE SECURE. CHECK THREE BOLTS IN PLACE AND HINGE SECURE.
29. HYDRAULIC ACCESS DOOR (INSIDE DUCT) SECURE. ALL FASTENERS PRESENT AND SECURE.
30. DUCT SPLITTER VANE SECURE AND DUCT AREA CLEAR.
31. LANDING GEAR EMERGENCY AIR BOTTLE 3000 PSI AND UTILITY ACCUMULATOR AIR PRESSURE 1200 PSI.
32. HYDRAULIC CAP SECURE AND ACCESS DOOR SECURE.
33. OIL TANK DIPSTICK SECURE AND ACCESS DOOR SECURE.
34. UPPER CENTER FUSELAGE SKIN CONDITION.
35. LOWER ENGINE ACCESS DOORS SECURE.
36. MAIN GEAR WELL CONDITION FOR HYDRAULIC LEAKS OR DAMAGE.
37. MAIN GEAR INBOARD DOOR DOWN, CHECK DOOR HINGE MECHANISM.
38. DROP TANK SERVICED (IF INSTALLED). VISUALLY CHECK EACH TANK FOR FUEL LEVEL. IF QUANTITY IS QUESTIONABLE, USE DIPSTICK TO DETERMINE THE AMOUNT. CHECK CAP SECURE AND DROP TANK SAFETY PIN REMOVED.

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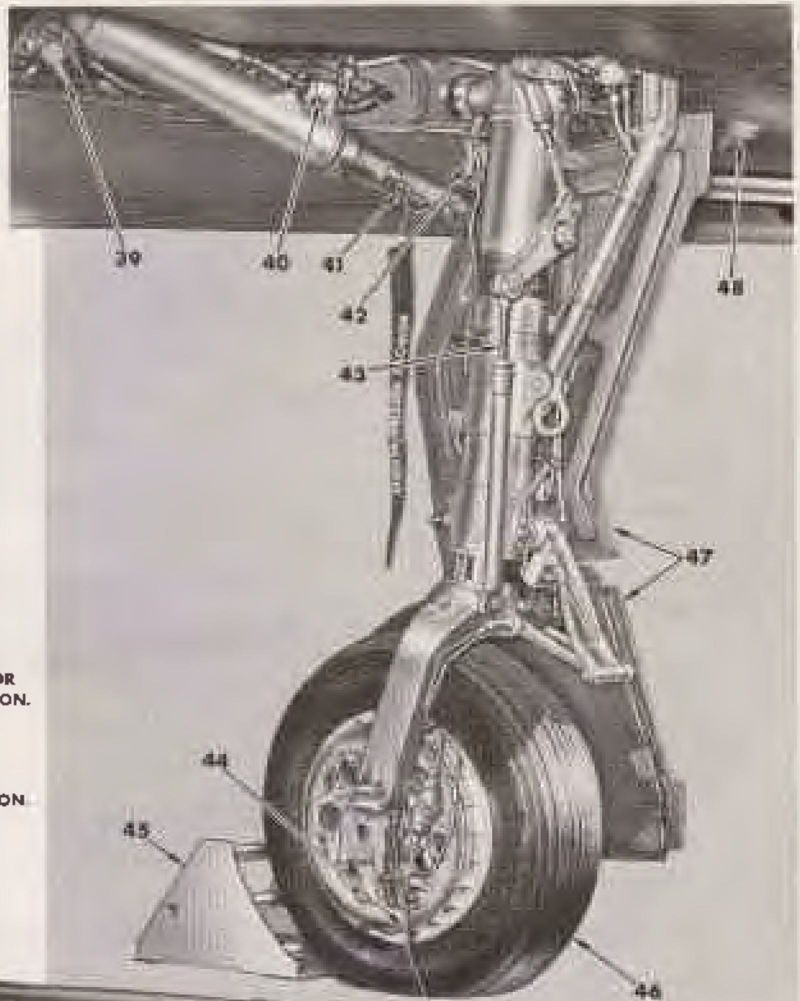
Figure 2-1 (Sheet 3 of 5 Sheets)

EXTERIOR INSPECTION

B CENTER FUSELAGE AND WING AREA (continued)....

39. GEAR UPLATCH HOOK DOWN.
40. GEAR WARNING LIGHT LIMIT SWITCH FREE OF DIRT.
41. GROUND SAFETY LOCK OUT.
42. STORAGE CHAMBER PRESSURE INDICATOR PIN (EXTENDED) 253035
43. GEAR COMPRESSION LINKAGE SECURE.
44. STATIC GROUND SECURE.
45. WHEELS CHOCKED.
46. TIRE INFLATION, SLIPPAGE MARK AND CHECK CAREFULLY FOR CUTS AND BRUISES.
47. GEAR DOORS SECURE AND FREE OF DAMAGE.
48. FLIPPER DOOR SECURE.
49. WING LEADING EDGE AND STALL FENCE FOR DENTS OR DISFIGURATION AND CHECK OVERALL SKIN CONDITION.
50. POSITION LIGHT AND WING TIP FREE OF DAMAGE.
51. AILERON AND FLAP SECURE AND FREE OF DAMAGE.
52. TAILPIPE FOR DENTS, CRACKS, OR FUEL ACCUMULATION.
53. EXHAUST NOZZLE POSITION, SEGMENT CONDITION, AND SEGMENT LINKAGE SECURE.
54. CONDITION OF CONE AND AFTERBURNER FLAME HOLDERS.



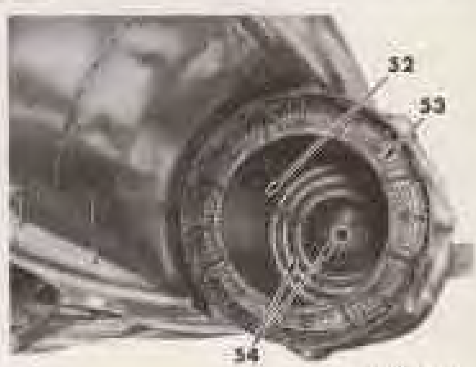


Figure 2-1 (Sheet 4 of 5 Sheets)

EXTERIOR INSPECTION

C AFT FUSELAGE AREA....

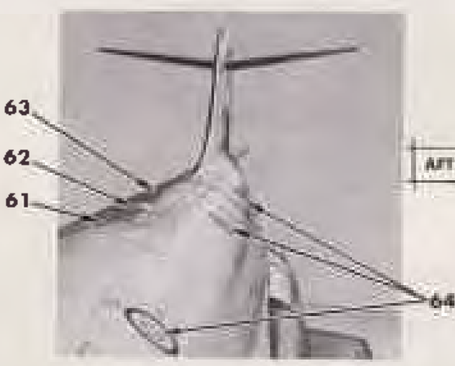
CHECK:

55. BLAST AREA PLATES AND RIVETS SECURE.
56. SPEED BRAKE CONDITION AND POSITION.
57. BELLOWS INTAKE CLEAR.
58. DRAG CHUTE DOOR SECURE.
59. POSITION LIGHTS FREE OF DAMAGE.
60. RUDDER AND STABILIZER CONDITION.

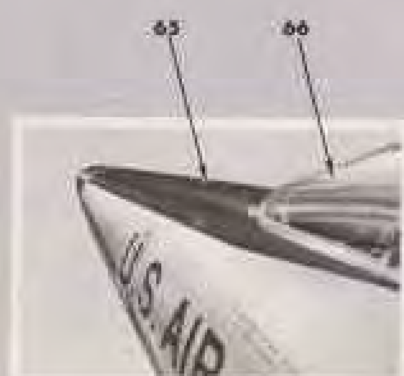
NOW, COMPLETE THE LEFT SIDE VISUAL INSPECTION, INCLUDING THE ITEMS PREVIOUSLY SHOWN...

WHILE STANDING ON THE LEFT WING, LOOK FORE AND AFT AND CHECK....

61. POSITION LIGHT FREE OF DAMAGE.
62. AIR REFUELING RECEPTACLE DOOR SECURE.
63. FUSELAGE SKIN CONDITION.
64. CELLS 1, 3, AND 5 FILLER CAPS IN PLACE AND SECURE.



AFT UPPER FUSELAGE



FORWARD CANOPY AREA

WHILE STANDING ON THE LADDER, LOOK FORWARD AND CHECK....

65. AIR REFUELING PROBE DOORS SECURE AND NOSE SKIN CONDITION.
66. CONDITION OF WINDSHIELD.

RFA20-201C-5

Figure 2-1 (Sheet 5 of 5 Sheets)

ACCESS TO COCKPIT

Figure 2-2

ENTRANCE

Cockpit entry and exit is gained by use of a metal ladder which hooks over the left cockpit sill. No kick steps or handgrips are provided. See figure 2-2. In the event that the ladder is not available for entry or exit some alternate device, i.e., access stand, etc., should be used.

PRE-FLIGHT CHECK

BEFORE EXTERIOR INSPECTION

Check AFTO Form 781 for engineering status and release. Note servicing entries for proper amounts of fuel, oil, hydraulic fluid and oxygen. Note drag chute installed. For servicing points, see figure 1-34.

EXTERIOR INSPECTION

Perform exterior inspection as outlined in figure 2-1.

EJECTION SEAT AND CANOPY CHECK

Note

The canopy must be fully opened and the ladder installed before completing the following checks:

1. Canopy safety pin - CHECK INSTALLED
   Check that safety pin with red warning flag attached is properly installed through canopy emergency jettisoning mechanism.
2. Ejection seat safety pin - INSTALLED
   Check that seat handgrips are in full down position and that seat safety pin with red warning flag attached is properly installed through left handgrip.
3. Ejection seat quick-disconnects - CHECK PROPERLY MATED
   Check quick-disconnect fittings; oxygen, anti-G-suit, radio, face heat, and ventilated suit lines properly mated.

CAUTION

If a ventilated suit is not used, be sure that the suit line is secured to the anti-G suit hose in the proper manner. See figure 1-32. This is to prevent a whipping action which may injure the pilot's legs and also eliminate a hot air blast into the pilot's face on take-off.

CONTINUED ON NEXT PAGE

EJECTION SEAT AND CANOPY CHECK *CONTINUED*

4. Safety belt and shoulder harness - CHECK FREE
   Check safety belt and shoulder harness free from being wedged or caught in other controls.
5. Canopy condition - CHECK
   Check for cracks in canopy and windshield glass. Check canopy seal condition.
6. Canopy safety pin - REMOVED
   Canopy pin will be retained by ground crew, except on cross country mission when it should be retained by the pilot.

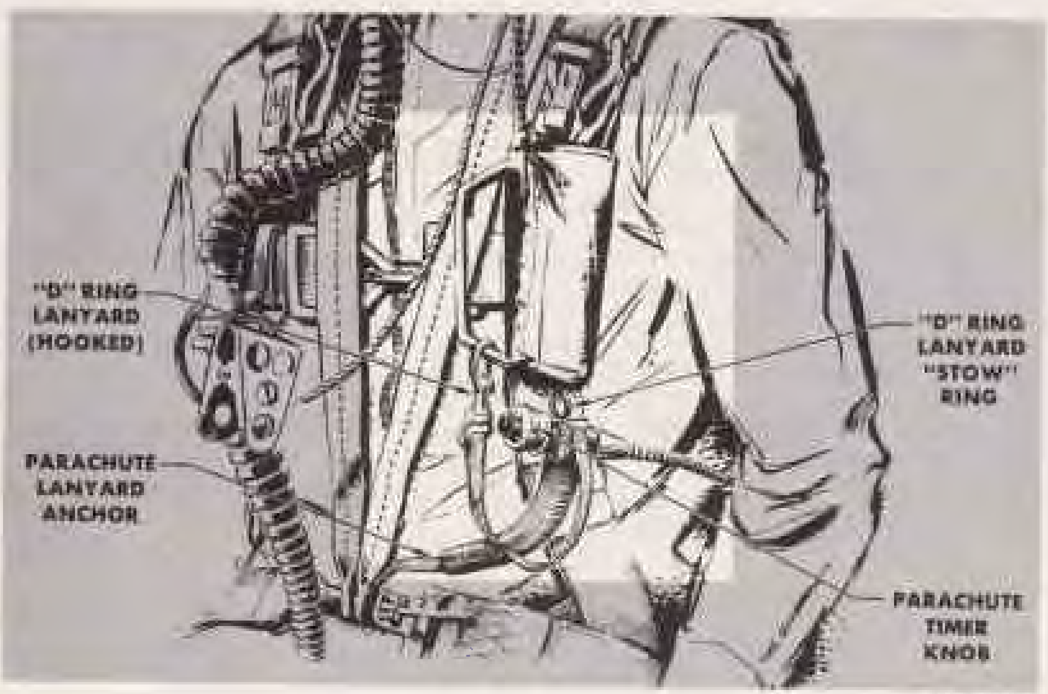
INTERIOR INSPECTION

Upon entering the cockpit make the following safety checks:

1. Battery switch - OFF
2. Landing gear handle - DOWN
   Manually check landing gear handle down.

Before External Power Is Connected

3. Publications and flight data - CHECK
   Check that the radio charts, Pilot's Handbook-Jet and other necessary publications are included and current.
4. Safety belt and shoulder harness - FASTENED
   a. Attach the shoulder harness and parachute lanyard to the safety belt.
   b. Attach the "D" ring lanyard to the parachute "D" ring.



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INTERIOR INSPECTION ***CONTINUED***

CAUTION

Make sure the automatic-opening safety belt is properly fastened. The safety belt should be pulled tight prior to tightening the shoulder harness. Secure the automatic-opening parachute lanyard anchor to the safety belt and check the "D" ring lanyard hooked to the parachute "D" ring to insure proper operation of this equipment. Refer to Automatic-Opening Safety Belt in Section I and Low Altitude Ejection in Section III.

5. Seat - ADJUST
   Turn battery switch ON to supply electrical power to seat adjustment motor. After adjusting seat, return battery switch to OFF.
6. Rudder pedals - ADJUST
   Adjust rudder pedals as desired by use of hand crank located on pedestal.
7. Stick grip - CHECK
   Check stick grip firmly attached.
8. Anti-G suit pressure regulating knob - AS DESIRED
   Adjust G-suit pressure setting on HI or LO as desired.
9. Emergency camera door switch - NORMAL
   Check emergency camera door switch in NORMAL position, guard closed.
10. Photo compartment temperature control panel - CHECK (20)
    a. System master switch - ON
    b. Forward compartment temperature switch - AUTO
    c. Aft compartment temperature switch - AUTO

CAUTION

The system master switch should be ON and the forward and aft temperature switches should be in the AUTO position at all times to prevent the accumulation of moisture in the cameras and camera compartments.

11. AN/APS-54 power switch - OFF
12. Drift computer control knob - CHECK (20)
    Set drift computer control knob as required.
13. Split vertical station control panel - CHECK
    a. Mode switch - Set as briefed.
    b. Frame counter - Set total.
14. Tri-camera station control panel - CHECK
    a. Mode switch - Set as briefed.
    b. Frame counter - Set total.
15. Forward camera station control panel - CHECK
    a. Mode switch - Set as briefed.
    b. Frame counter - Set total.
16. Camera master control panel - CHECK
    a. Power switch - OFF
    b. Ready switch - OFF
    c. Operate switch - OFF
    d. Exposure switch - Set as briefed.
    e. Transport switch - Set as briefed.
17. Fuel transfer selector switch - FUS (25)(30)(35)
18. Fuel quantity gage-tank selector knob - TOTAL
19. Pitch-up warning pusher switch - ON
    Check pusher switch guard safety wired ON.
20. Pitch-up warning horn switch - ON.
    Check horn switch guard safety wired ON.
21. Fuel pumps switch - NORMAL (20)
22. UHF radio - OFF

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION *CONTINUED*

23. Drag chute handle - IN AND SECURE
24. Wing flap lever - RETRACT
25. Landing lights switch - OFF
26. Circuit breakers - IN
27. Refuel switch - NORM [20]
28. Fuel transfer switch - NORM [20]
29. Tank jettison switch - NORM [20] [25]
30. Emergency tank jettison switch - NORM [30] [35]
31. Throttles - CLS'D
32. Speed brake switch - NEUTRAL
33. Rudder trim switch - NEUTRAL
34. Engine master switches - OFF
35. Engine start switches - OFF
36. Fuel control system switches - NORMAL
37. Antenna selector switch - UPR
38. Emergency air brake handle - IN PLACE AND SECURE
39. Emergency gear extension handle - IN PLACE AND SECURE
40. Landing gear handle - DOWN
41. Emergency speed brake switch - NORMAL
42. Viewfinder control panel - CHECK
    a. Drift switch - Neutral
    b. Filter switch - As desired
    c. Grid illumination control knob - OFF
    d. View selector knob - As desired
43. Turn switch - NORMAL
44. Radar warning switch - BOTH
45. Airspeed and Mach indicator - SET
    Set airspeed index pointer on Go-No Go speed
46. Altimeter - SET
47. Clock - SET
48. Drift computer control knob - AS REQUIRED [25] [30] [35]
49. Photo compartment temperature control panel - CHECK [25] [30] [35]
    a. System master switch - ON
    b. Forward compartment temperature switch - AUTO
    c. Aft compartment temperature switch - AUTO

CAUTION

The system master switch should be ON and the forward and aft temperature switches should be in the AUTO position at all times to prevent the accumulation of moisture in the cameras and camera compartments.

50. Vertical velocity indicator - CHECK
    Check vertical velocity indicator needle positioned on zero.
51. Accelerometer - SET
    Depress push to set knob and note all three indicating pointers at 1 "g" position.
52. Viewfinder - CHECK
    Check viewfinder lens clean and free of damage. Check scope head secure and that scope filter is available.
53. Pressure ratio gages - SET
    Set cruise and take-off ratio values in pressure ratio gage windows and check that corresponding outer pointer markers agree with each value. See figure 2-5 for engine pressure ratio gage settings.
54. External tank emergency release handle - IN PLACE AND SECURE [20] [25] [30]
55. Boom IFR switch - RETRACT
56. Probe IFR switch - RETRACT [25] [30] [35]

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION *CONTINUED*

57. Battery switch - OFF
58. Generator switches - CHECK ON
59. Oxygen quantity gage - CHECK
    Check that oxygen quantity is sufficient for intended mission. Refer to Oxygen Duration chart, figure 4-15.
60. Oxygen regulator lever - 100% OXYGEN
    Refer to Oxygen System Preflight Check, Section IV.
61. Oxygen emergency lever - NEUTRAL
62. Oxygen supply lever - ON
63. Oxygen supply pressure gage - 70-100 PSI
64. Cabin pressure switch - NORMAL
65. Pitot heat switch - OFF

CAUTION

Be sure the pitot heat switch is OFF prior to having external power connected to prevent damaging pitot head.

66. Windshield anti-icing switch - LOW
67. Windshield blower switch - OFF
68. Cabin air temperature knob - CLIMATIC
    Set cabin air temperature knob to produce desired temperature for existing climatic condition.

Note

On hot and humid days, the cabin air temperature knob may be positioned to RAM AIR & DUMP to prevent excessive fogging within the cockpit during take-off

69. Air control lever - CLIMATIC
    Position air control lever to direct air flow as desired for existing climatic condition.
70. VHF navigation radio power switch - OFF
71. Standby compass light switch - OFF
72. Face heat knob - OFF
73. Autopilot - OFF
    Check the following autopilot controls:
    a. Altitude switch - OFF
    b. Localizer switch - OFF
    c. Approach switch - OFF
    d. Damper switch - OFF
74. SIF control panel - AS DIRECTED
75. IFF master control knob - OFF
76. J-4 directional indicator controls - CHECK
    a. Control knob - MAG
    b. Latitude knob - SET
77. Lights - CHECK
    Set all interior and exterior light controls as the mission requires.
78. Spare lamps - CHECK
79. Camera circuit breakers - IN
80. Check availability of flashlight if required.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION *CONTINUED*

With External Power Connected

81. Fuel quantity gage - CHECK
    Turn fuel quantity gage tank selector knob to all positions and check fuel quantity. Return to #2 cell.
82. Aux full fuel indicators - CHECK (25)(30)(35)
    Depress aux FULL CHECK button to check auxiliary fuel tanks full.
83. Landing gear indicators - CHECK
    a. Check the three (red) landing gear indicator lights - OUT (20)
    b. Check the three (green) landing gear indicator lights - ON (25)(30)(35)
84. Wing flap position indicator - CHECK
    Check flap position indicator showing flaps up.
85. Fire warning system - CHECK
    Check operation of fire warning lights.
86. Pitot heat switch - CHECK
    Check operation with ground personnel and return switch to OFF.
87. Ground position indicator - CHECK
    Set ground position indicator controls on appropriate mission condition values.
    a. Depart switch - STANDBY
    b. Latitude switch - SET
    c. Longitude switch - SET
    d. Wind direction knob - SET
    e. Wind force knob - SET
    f. Variation knob - SET
88. Warning lights - CHECK
    To test the warning lights dimming circuits, the instrument lights knob must be ON, the warning lights test switch held depressed, and the dimming switch depressed. The warning lights should revert to bright when instrument lights knob is turned OFF.
89. Communication and navigation equipment - CHECK ON
90. IFF control panel(s) - SET AS BRIEFED
91. Cockpit lights - CHECK
    a. Primary-secondary switch - SECONDARY
    b. Instrument light knob - ON
    c. Console floodlights knob - ON
    d. Utility light knob - ON
    e. Primary-secondary switch - PRIMARY
    f. Instrument panel light knob - ON
    g. Console floodlights knob - ON
    h. Console light knob - ON
    i. Thunderstorm light knob - ON
    j. Compass light switch - ON
92. Exterior lights - CHECK
    Check navigation lights in STEADY, FLASH, BRIGHT, and DIM positions. Check landing and taxi lights. Receive acknowledgement from ground crew that these lights are operational.

Note

Steps 81 through 92 may be accomplished during Before Taxiing procedures since the external electrical power source may not be available.

BEFORE STARTING ENGINES

Before starting engines, be sure the wheels are chocked and the danger areas fore and aft are clear of personnel, aircraft and vehicles. See figure 2-3. The rotational planes of the engine and starter turbine wheels (marked by a red stripe on fuselage) should be clear of personnel.

WARNING

Suction at the intake duct is sufficient to kill or severely injure personnel drawn into or pulled suddenly against the duct.

Whenever practicable start and run up engines on paved surface to minimize the possibility of foreign objects being drawn into the compressor with resultant engine damage. Start the engines with the nose into or at right angles to the wind, as exhaust temperatures may be aggravated by tail wind.

WARNING

Danger areas aft of the aircraft are created by high exhaust temperature and velocities. The danger increases with afterburner operation. See figure 2-3.

STARTING ENGINES

Note

Either engine may be started first, however, this procedure establishes the left engine (#1) first.

1. Throttles - CLS'D
2. External compressed air source - CONNECTED
   Check proper external compressed air source is connected to starter system and that sufficient air pressure is available (35 psi indicated from ground crew).
3. Left engine master switch - ON
4. Left engine start switch - START
   Momentarily actuate left engine start switch to START - then release.

CAUTION

The starter is limited to one minute continuous operation during any five minute period.

5. Oil pressure gage - CHECK
   Watch for oil pressure indication as engine rpm begins to raise.
6. At 12-16 percent rpm, advance left throttle to IDLE.

Note

Start should be evident by rise in exhaust temperature within 20 seconds after throttle is moved to IDLE.

7. Fuel flow indicator - CHECK
   Fuel flow will indicate approximately 850 lbs. per hour.
8. Exhaust temperature gage - CHECK
   Exhaust temperature should not exceed the maximum starting temperature limits during transition period to idle range (55-65% rpm).

Note

After engine reaches idle rpm, the exhaust temperature will recede to a temperature below maximum idle limits. The normal starting temperature is 250° - 400°C. In no case should the starting temperature exceed maximum starting limits. Refer to figure 5-4, Section V.

9. Oil pressure gage - CHECK
   Oil pressure should be within limits.

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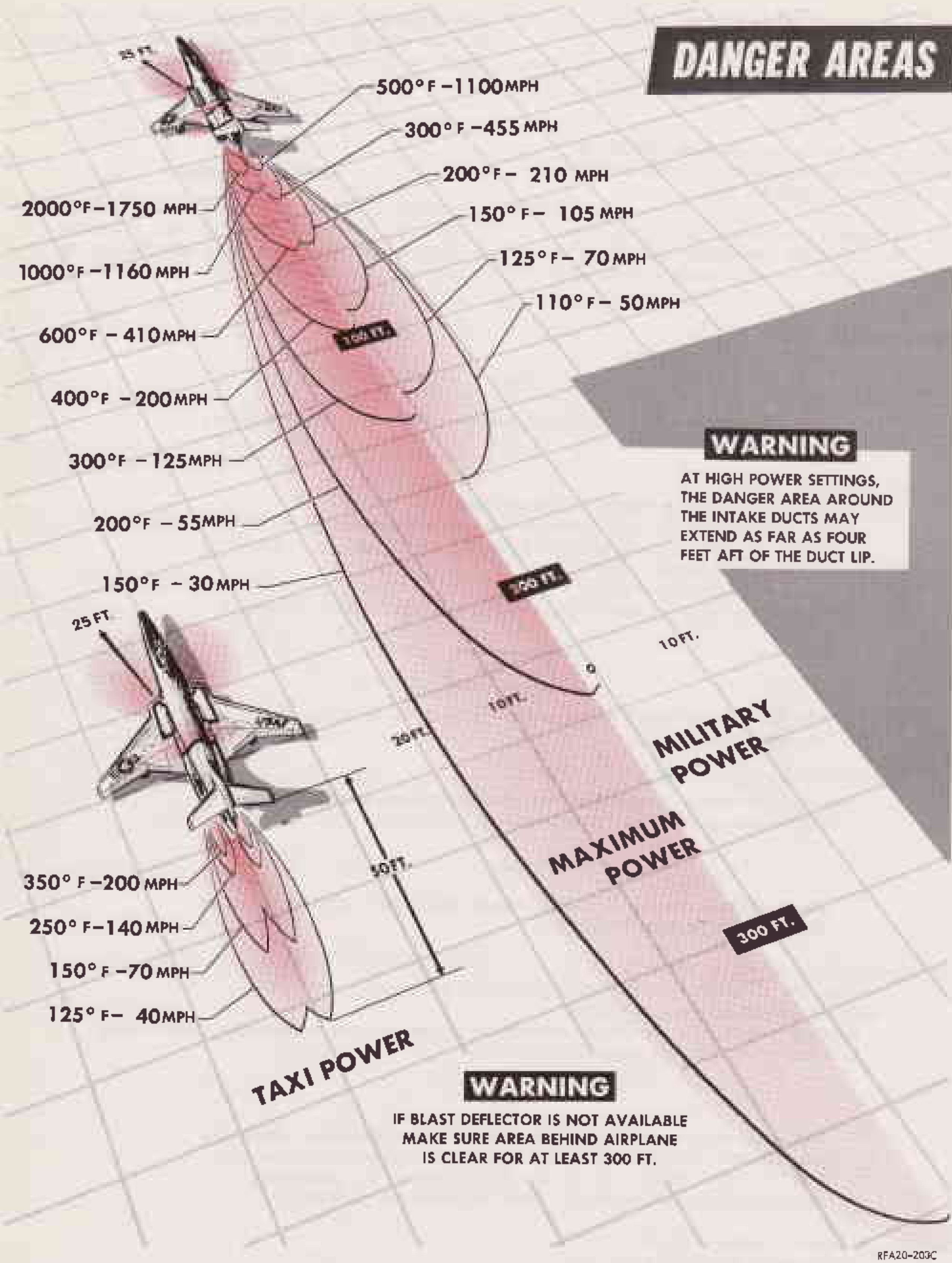
DANGER AREAS
25 FT.
500°F -1100MPH
300°F -455 MPH
200°F - 210 MPH
150°F - 105 MPH
125°F - 70MPH
110°F - 50MPH
2000°F-1750 MPH
1000°F -1160 MPH
600°F - 410MPH
400°F - 200MPH
300°F - 125MPH
200°F - 55MPH
150°F - 30MPH
100 FT.
200 FT.
300 FT.
10 FT.
0
20 FT.
MILITARY POWER
MAXIMUM POWER
WARNING
AT HIGH POWER SETTINGS, THE DANGER AREA AROUND THE INTAKE DUCTS MAY EXTEND AS FAR AS FOUR FEET AFT OF THE DUCT LIP.
25 FT
50 FT.
350° F -200 MPH
250° F-140 MPH
150° F -70 MPH
125° F- 40MPH
TAXI POWER
WARNING
IF BLAST DEFLECTOR IS NOT AVAILABLE MAKE SURE AREA BEHIND AIRPLANE IS CLEAR FOR AT LEAST 300 FT.
RFA20-203C

Figure 2-3

STARTING ENGINES *CONTINUED*

CAUTION

If throttle is inadvertently retarded to CLS'D, a flame-out will occur immediately. DO NOT REOPEN throttle as relight is impossible and resultant fuel flow creates a fire hazard in afterburner section of the engine.

10. Hydraulic pressure gages - CHECK
    With one engine started, both hydraulic pressure gages should read within normal. The hydraulic pressure warning light will remain illuminated until the other engine is started and both hydraulic systems are operating properly. Reduce hydraulic pressure through control movement and watch recovery rate for proper pump operation.
11. Start remaining engine as indicated in steps 3 thru 9.

WARNING

A "hot start" may be anticipated by watching the exhaust temperature gage. If an abrupt rise in temperature is noted or normal starting limits are exceeded, the engine should be shut down immediately.

CAUTION

- Should the engine fail to light-off within 20 seconds after placing the throttle to IDLE, the start should be aborted. The failure to light-off will be indicated by: No rise in exhaust temperature, no increase in rpm, no sound of combustion or abnormally low fuel flow. Shut down engine and actuate stop-start button. After engine stops rotating, allow 30 seconds for fuel drainage and perform Engine Clearing Procedure (as outlined in this section) prior to attempting another start.

- After ignition, if engine rpm does not increase to the idle range (55-65 percent rpm) but remains at some intermediate speed, and the exhaust temperature remains at a figure below maximum, the engine has made a false start. Shut down the engine and actuate stop-start. After engine stops rotating, allow 30 seconds for fuel drainage and perform Engine Clearing Procedure (as outlined in this section) prior to attempting another start.

ENGINE CLEARING PROCEDURE

If for any reason other than hot starts, an unsatisfactory start is made, the engine should be cleared prior to attempting another start.

1. Check external electrical and compressed air sources connected.
2. Throttles - CLS'D
   Check throttle completely closed.
3. Engine master switch - OFF
4. Engine start switch - START
   Move engine start switch momentarily to START, then release.
5. Allow engine to crank for approximately 20 seconds, then move start switch to STOP START and release.

ENGINE GROUND OPERATION

After satisfactory starts are accomplished, allow the engines to idle until instrument readings stabilize. No engine warm-up is necessary. As soon as the engines stabilize at idle speed with normal gage indications, the throttles may be opened to full power.

BEFORE TAXIING

1. External electrical power and starter compressed air sources - DISCONNECTED
   Have starting external electrical and compressed air sources disconnected and check generator warning lights out.

Note

Generator warning lights will not go out until the power selector switch, located in the external power receptacle access, has been placed in the GEN position by the ground crew.

2. Transformer-rectifier - CHECK
   With battery switch OFF, depress any press-to-test warning light. Illumination of the light indicates transformer-rectifiers are operational.
3. Battery switch - ON
4. Hydraulic gages - CHECK
   Check hydraulic gages for normal indications. Rapid stick movement (from right to left) will result in a pressure drop indication on each system gage. Visually check control surface movement.
5. Pitch-up warning system - CHECK

Note

In gusty or high wind conditions, it may be necessary for the ground crew to hold the probes in the desired positions.

   a. Control stick - AFT OF NEUTRAL
   b. Pitch-up warning test button - HOLD DEPRESSED
      Depressing the test button will energize the warning horn and engage the pusher.
   c. Pusher release switch - DEPRESS
      Depressing the release switch will disengage the pusher but the warning horn will continue until the test button is released.
   d. Pitch-up warning out light - CHECK
      Press-to-test the pitch-up warning out light.
6. Speed brakes - CHECK
   Open and close speed brakes and check operation. Obtain ground crew signal that speed brakes are fully closed.
7. Wing flaps - CHECK
   a. Check flap lever - EXTEND
   b. Check flap indicator on landing gear control panel. Observe ground crew signal that flaps are down.
8. Autopilot - CHECK

Note

Allow 2 minutes warm-up before autopilot operation.

   a. Damper switch - ON
      The damper switch is normally retained in the ON position throughout all phases of flight. With the damper switch ON, the damper will operate even though the autopilot is disengaged.

CONTINUED ON NEXT PAGE

BEFORE TAXIING *CONTINUED*

b. Turn knob centered, check in detent.
c. Engage switch - ENGAGE

Note

Autopilot will not engage if turn knob is not in detent or if pitch control wheel is rotating due to a fore or aft movement of the control stick.

d. Rotate turn knob right and left and note corresponding aileron movement. No right and left stick movement will occur with turn knob movement. Replace turn knob to detent.
e. Rotate pitch trim control wheel fore and aft and note corresponding stick movement.
f. Overpower the autopilot by applying aft stick force. Note force required (approximately 25 pounds). Auto trim indicator shows nose-up mistrim condition.

Note

In overpowering autopilot, stick vibrations will be encountered due to overpowering of stabilizer servo motor clutch.

g. Actuate the autopilot release switch on the control stick; engage switch will move out of the ENGAGE position.
h. Altitude switch - OFF
i. Localizer switch - OFF
j. Approach switch - OFF

9. Windshield anti-icing switch - LOW
10. Take-off trim - ADJUST
    Hold take-off trim button depressed until illumination of light indicates airplane is trimmed for take-off.
11. Seat safety pin - REMOVED
    Pull seat safety pin from handgrip and stow in accessible place.

WARNING

DO NOT pull up on handgrips. Seat and canopy ejection systems are fully armed when safety pin is removed.

TAXIING

1. Taxi area - CLEAR
   Check taxi area clear of personnel and other obstructions. Check jet blast area before applying taxi power.
2. Chocks - REMOVED
   Give ground crew positive signal for the removal of chocks.

CAUTION

When chocks are pulled, have feet on brakes since there is no parking brake on the aircraft.

3. Brakes - CHECK
   After initial roll, apply brakes and check operation.

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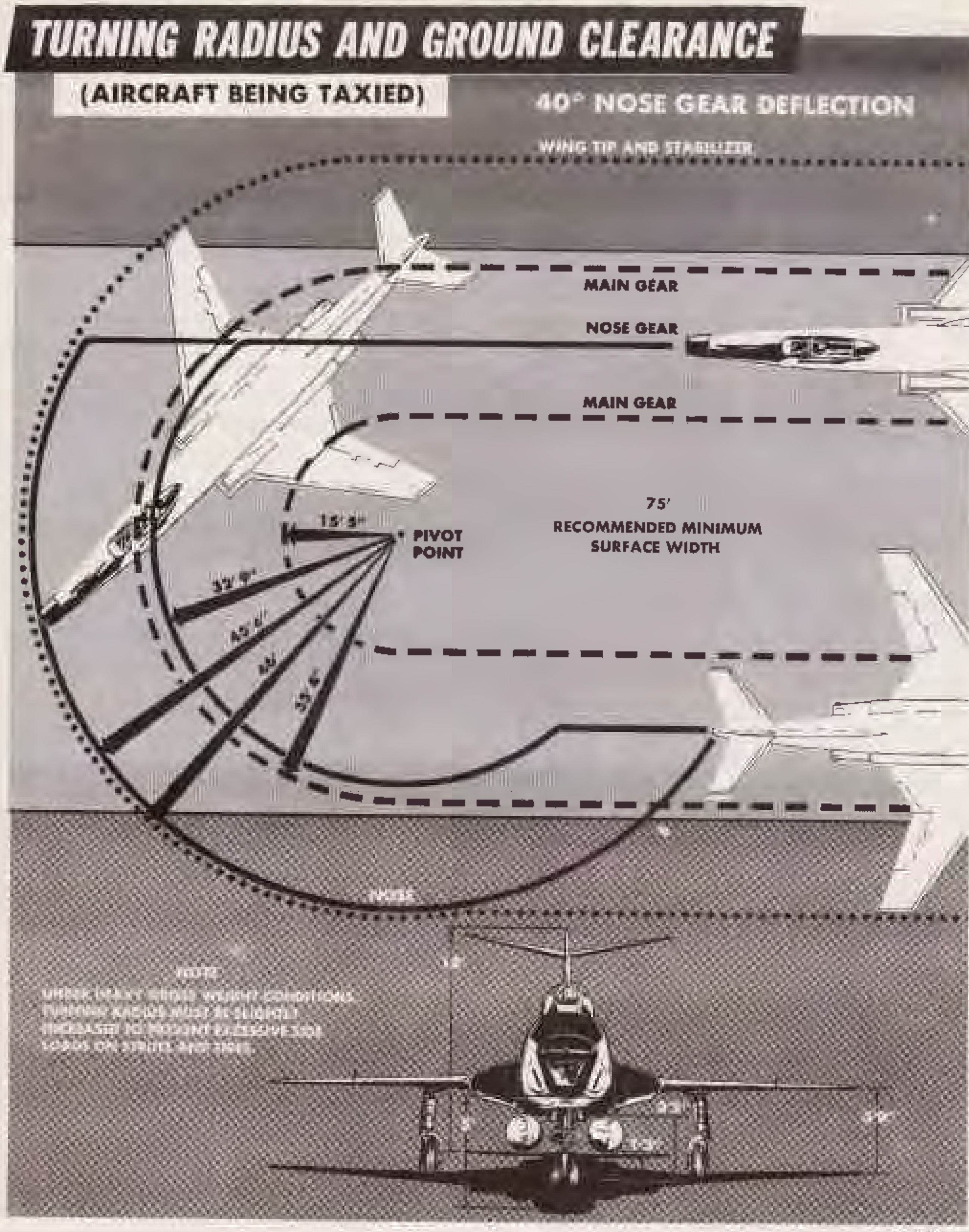
TURNING RADIUS AND GROUND CLEARANCE
(AIRCRAFT BEING TAXIED)
40° NOSE GEAR DEFLECTION
WING TIP AND STABILIZER
MAIN GEAR
NOSE GEAR
MAIN GEAR
75'
RECOMMENDED MINIMUM
SURFACE WIDTH
15' 5"
PIVOT
POINT
48'
NOSE

Figure 2-4

TAXIING *CONTINUED*

CAUTION

Do not exceed 25 knots while taxiing to prevent excessive tire wear and brake heat.

4. Once the aircraft is rolling, it can be taxied on hard surfaces at idle power ranges.

CAUTION

- Since "brake feel" is difficult to sense in aircraft with a power brake system, it is possible for the pilot to inadvertently "ride" the brakes while taxiing. Be careful not to skid the tires as they may cause a blowout and damage to the landing gear.
- With the canopy open, keep speed below 75 knots to prevent damage to canopy operating mechanism.
- Maintain a minimum distance of 125 feet from the exhaust blast of another airplane that is operating at military thrust and 200 feet from the exhaust blast of an airplane that is operating at maximum thrust to prevent damage to the canopy.

5. Nose gear steering system - CHECK
   Depress nose gear steering button on control stick and attempt slight turns to check nose gear steering. Use nose gear steering to the fullest to minimize use of brakes.

CAUTION

While taxiing, do not attempt turns in excess of nose gear steering limits (40° either side of center) due to imposing excessive tire wear. See figure 2-4.

6. Flight instruments - CHECK
   Check flight instruments for correct operation while taxiing.
7. Minimize taxi time to decrease fuel consumption.

CAUTION

The canopy should be closed and adequate distance between aircraft maintained during formation taxiing. An open canopy may become damaged from jet blast.

BEFORE TAKE-OFF

PRE-TAKE-OFF AIRCRAFT CHECK

After taxiing to the take-off position, allow the aircraft to roll straight ahead to assure nose gear alignment. Brake the aircraft and complete the following checks:

1. "D" ring lanyard - HOOKED
   Check "D" ring lanyard hooked to parachute "D" ring.

CONTINUED ON NEXT PAGE

PRE-TAKE-OFF AIRCRAFT CHECK *CONTINUED*

2. Safety belt and shoulder harness - CHECK
   Check automatic parachute key or safety belt key properly inserted.
3. Shoulder harness inertia reel handle - UNLOCKED
   Check for complete freedom of movement to reach all controls.
4. Visually check seat safety pin removed.
5. Personal equipment leads - CHECK
   Check all equipment leads properly attached and that they create no obstruction to movement.
6. Flight controls - CHECK
   Manually check flight controls for freedom of movement and that oxygen and G-suit hoses do not interfere with stick movement.
7. Wing flap lever- EXTEND
8. Canopy - CLOSED
   Check canopy unlocked warning light out. In the 35 airplanes, check canopy defogging ducts mate.
9. Take-off trim light - CHECK
   Depress take-off trim button until take-off trim light illuminates.

PRE-TAKE-OFF ENGINE CHECK

CAUTION

- Check the engines individually because the engines develop enough thrust to slip the tires on their rims if both engines are run up together and maximum braking is applied.

- Exercise care in positioning aircraft on runway for pre-take-off engine check during formation operations. Clearance should include 125 feet at OPEN (MIL) power setting and 200 feet at AFTERBURNER (MAX) power setting. Try to stagger aircraft position so that no aircraft is directly behind another and insure canopy closed and locked. See figure 2-3 for exhaust danger areas.

1. Emergency fuel control system - CHECK
   a. Left throttle - IDLE
   b. Left fuel control switch - EMERG.

   Note

   Slight fluctuation in fuel flow and a drop in rpm at IDLE position indicates the emergency fuel control system is operating properly.

   c. Left fuel control switch - NORMAL
      Recheck fuel flow fluctuation to insure that the normal fuel control system is operating properly.
   d. Check right engine as outlined above.
2. Engine power - CHECK
   a. Left throttle - OPEN
   b. Engine pressure ratio gage - CHECK

   Note

   When engine speed has stabilized, the gage pointer should fall within the arc of the take-off index marker.

CONTINUED ON NEXT PAGE

PRE-TAKE-OFF ENGINE CHECK *CONTINUED*

CAUTION

If the gage pointer does not fall within the prescribed limits, thrust output is not correct and take-off should not be made.

c. Check all engine instruments within limits.
d. Left throttle - IDLE
e. Check right engine as outlined above.

3. Pitot heat switch - CLIMATIC
   Just prior to lining up for take-off, position pitot heat switch as climatic conditions require.

CAUTION

Warm-up time for pitot heat is approximately one minute at 32°F. Allow sufficient time if taking off in freezing rain or other visible moisture with temperatures at or near freezing.

TAKE-OFF

NORMAL TAKE-OFF

Note

- The procedures set forth produce the results shown in the Take-Off Charts, Part 2 of Appendix I.
- When large puddles of water are present on the runway, it is possible to get compressor stalls and afterburner blowout in both engines during take-off at speeds from 80 to 100 knots. This is caused by water thrown into the engine intakes from wakes created by the nose wheel.

1. Brakes - APPLIED
2. Throttles - 80% RPM
3. Instruments and warning lights - CHECK
   Recheck the instruments for proper indications and check that all warning lights are out.
4. Nose gear steering - ENGAGED
5. Brakes - RELEASED
6. Throttles - OPEN

Note

- Shifting throttles outboard from the OPEN position ignites the afterburners for Maximum Thrust take-off.
- Under standard day conditions or with lower temperatures, extremely rapid acceleration will be experienced during afterburner take-off. Therefore, it is recommended that afterburners NOT be used on initial checkouts except when Military thrust would result in an excessive take-off roll (high runway temperatures, short runways, or high field elevation).

7. Use nose gear steering for directional control until the rudder becomes effective at approximately 70 knots IAS.
8. At 150 knots, ease the nose gear off the runway.

CONTINUED ON NEXT PAGE

NORMAL TAKE-OFF CONTINUED

WARNING

Do not rotate the aircraft to an extreme nose high attitude or the aircraft may take-off in a semi-stalled, out of control condition.

9. The aircraft (clean) will fly off at approximately 165 knots IAS.

Note

Nose gear lift-off and take-off speeds must be increased appropriately for heavy gross weight conditions.

Engine Pressure Ratio Gages Setting

AMBIENT TEMPERATURE		TAKE-OFF SETTING INDEX (MINIMUM)	
°C	°F	LEFT ENGINE	RIGHT ENGINE
+50	122	1.82	1.87
+48	118	1.83	1.88
+46	115	1.84	1.89
+44	111	1.86	1.91
+42	108	1.87	1.92
+40	104	1.88	1.93
+38	100	1.90	1.95
+36	97	1.91	1.96
+34	93	1.93	1.97
+32	90	1.94	1.99
+30	86	1.95	2.00
+28	82	1.96	2.01
+26	79	1.98	2.03
+24	75	1.99	2.04
+22	72	2.00	2.05
+20	68	2.02	2.07
+18	64	2.03	2.08
+16	61	2.04	2.09
+14	57	2.06	2.11
+12	54	2.07	2.12
+10	50	2.09	2.13
+8	46	2.10	2.15
+6	43	2.11	2.16
+4	39	2.13	2.18
+2	36	2.14	2.19
0	32	2.16	2.21
−2	28	2.17	2.22
−4	25	2.19	2.24
−6	21	2.20	2.25
−8	18	2.22	2.27
−10	14	2.23	2.28
−12	10	2.25	2.30
−14	7	2.27	2.31
−16	3	2.28	2.33
−18	0	2.30	2.35
−20	−4	2.31	2.36

RFA20-205B

Figure 2-5

MINIMUM RUN TAKE-OFF

A minimum run take-off is the same as a normal after-burner take-off in this airplane.

CROSSWIND TAKE-OFF

Under crosswind conditions, the aircraft tends to "weathervane" into the wind immediately after releasing the brakes. Nose gear steering must be utilized to maintain directional control until the rudder becomes effective at speeds up to 70-90 knots, depending upon crosswind intensity. Avoid using brakes as take-off roll will be increased. As take-off speed is approached and the aircraft starts to fly, it tends to "cock" into the wind and "skip" on the downwind tire until fully airborne. This tendency should be corrected through normal crosswind control procedures.

HEAVY GROSS WEIGHT TAKE-OFF

A heavy gross weight take-off is accomplished in the same manner as a normal take-off with the following exceptions and additions: It is recommended that all heavy gross weight take-offs be made with afterburner. Main landing gear tire failure becomes critical with extended take-off ground roll under heavy gross weight conditions. Nose gear lift-off speed and take-off speed must be increased appropriately for heavy gross weight conditions. In the event of an aborted take-off, it must be remembered that stopping distance is greatly increased under heavy gross weight conditions. Refer to Critical Field Length Charts, Part 2 of Appendix I.

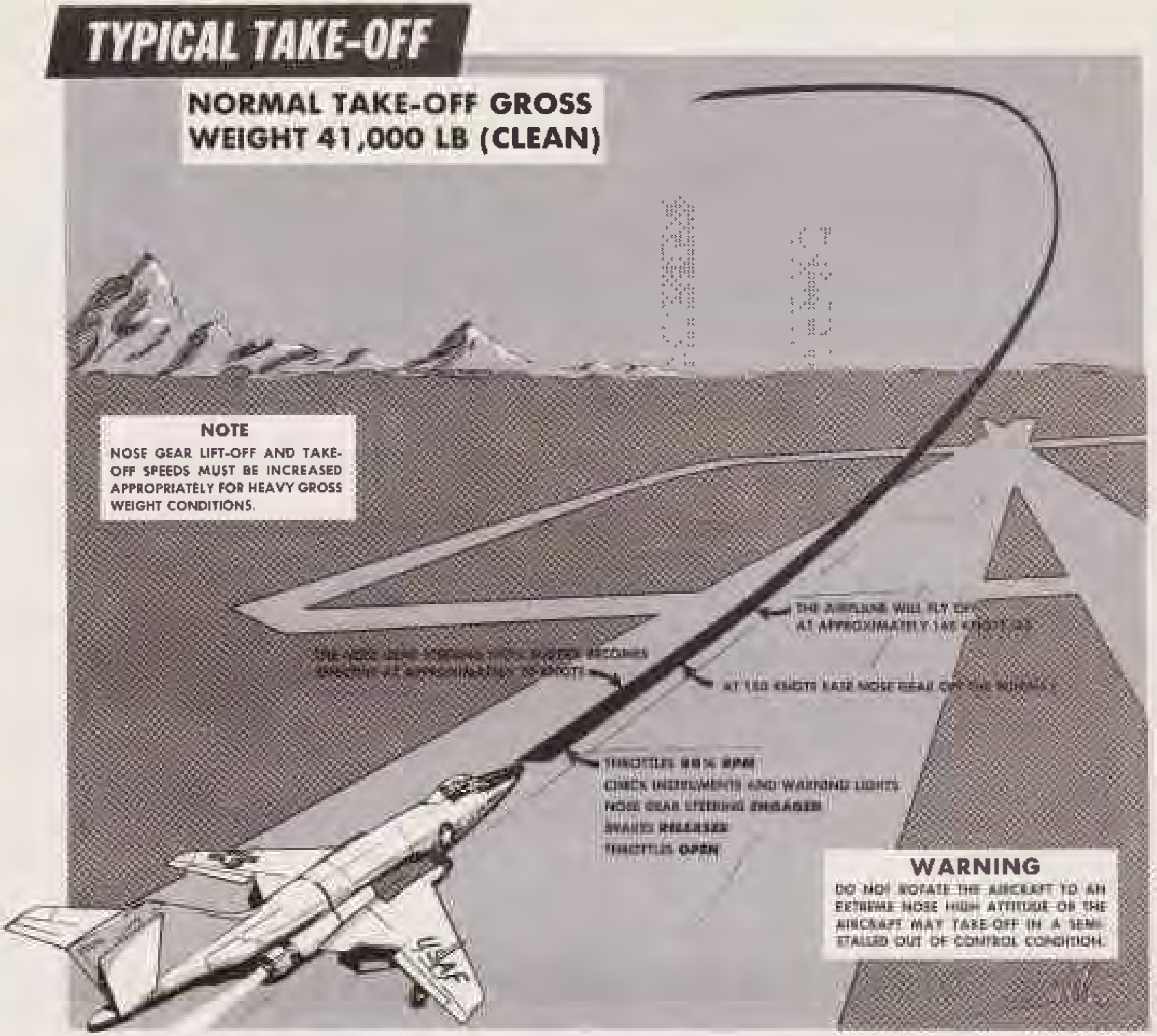

Figure 2-6

AFTER TAKE-OFF–CLIMB

When definitely airborne:

1. Landing gear handle - UP
   Check the gear position indicators OUT and the gear handle warning light OUT.

CAUTION

Landing gear and gear doors should be completely up and locked before gear limit airspeed is reached, otherwise excessive air loads may damage gear mechanisms and prevent subsequent operation.

CONTINUED ON NEXT PAGE

AFTER TAKE-OFF–CLIMB *CONTINUED*

2. Wing flap lever - RETRACT
   Flaps up before reaching flap limit airspeed. Check flap indicator.
3. Accelerate to best climbing speed.
   Accelerate to climbing speed in a climbing attitude rather than leveling the aircraft to obtain climb speed. Intercept climb schedule at 6000 to 10,000 feet.
4. Throttles - OPEN
   As soon as added thrust is no longer needed, turn off afterburner.

Note

- Military thrust is recommended for maximum range climb when climbing time to altitude is not important. Refer to Climb charts in Appendix I of the Confidential Supplement, T.O. 1F-101(R)A-1A, for rate of climb and fuel consumption.
- During climb, it may be necessary to place antenna selector switch to the LWR position to maintain ground communications.
- Position the fuel gage to monitor cell #2 throughout climb to assure proper fuel transfer. Upon leveling off and as soon as Military thrust or less is used, check cells 1, 4 and 5 for proper transfer and then monitor TOTAL throughout remainder of flight.

5. "D" ring lanyard - DISCONNECTED AND STOWED

WARNING

It is imperative that the "D" ring lanyard is disconnected at a safe altitude. If the lanyard is left attached to the parachute "D" ring and high altitude ejection becomes necessary, the pilot may be seriously or fatally injured since the parachute will open immediately upon separation from the seat.

6. Visually check seat safety pin - REMOVED
7. Oxygen regulator diluter lever - NORMAL OXYGEN
   Return lever to NORMAL OXYGEN unless carbon monoxide contamination is suspected.

WARNING

Excessive use of 100% oxygen so depletes the oxygen supply that flight becomes hazardous.

8. Cabin air temperature knob - AUTO
9. Upon reaching level off, auxiliary fuel switch - ON

CLIMB

Due to the rapid acceleration of the aircraft climb speed is usually attained in one minute or less (depending on the temperature) after brake release. After the landing gear ar ' flaps are retracted, the nose must be rotated to a relatively high climb angle in order to maintain the best climb speed. Refer to Climb Charts, Part 3 of Appendix I.

CRUISE

Cruise control data for various gross weights and several configurations are contained in Appendix I of the Confidential Supplement, T.O. 1F-101(R)A-1A.

FLIGHT CHARACTERISTICS

Refer to Section VI for information regarding flight characteristics.

DESCENT

Circumstances may arise which require a fast descent from high altitude. This may be accomplished by increasing the dive angle until limit airspeed and/or Mach number is reached.

Note

Prior to rapid descent, move air control lever to DEFROST to prevent fogging of canopy and windshield.

BEFORE LANDING

1. Camera master control switches - OFF
2. Fuel quantity - CHECK
   a. Check fuel quantity remaining.
   b. Monitor #2 cell.
   c. Airspeed index pointer - SET
3. Hydraulic pressure gages - CHECK
   Check both hydraulic systems pressure for normal indication.
4. Cabin air temperature knob - CLIMATIC
5. Autopilot engage switch - OFF
6. Safety belt and shoulder harness - CHECK
   Check safety belt and shoulder harness tightened.
7. Shoulder harness inertia reel handle - UNLOCKED
8. "D" ring lanyard - HOOKED
   Before entering pattern, check that the "D" ring lanyard is connected to the parachute "D" ring.

CAUTION

Do not lower landing gear in turns or pull-ups as the "g's" encountered may damage the landing gear mechanism.

LANDING

NORMAL LANDING

Note

- The procedures set forth produce the results shown in the Landing Distance Charts in Part 8 of Appendix I.
- Approach speed and touchdown speed quoted above are for a clean airplane with 3000 pounds of fuel remaining. These speeds must be increased with heavier landing gross weights. Refer to Landing Speeds Charts, Part 8 of Appendix I.

1. Enter traffic pattern
   Adjust power to maintain 350 knots and pattern altitude.
2. Break - 350 KNOTS IAS
3. Throttles - 80% MINIMUM
4. Speed brake switch - OPEN
5. At 250 knots, speed brake switch - CLOSED
6. Landing gear handle - DOWN
   Lower gear on downwind below 250 knots IAS.
7. Wing flap lever - EXTEND
8. Turn base leg approximately 2 miles from runway.
9. Base leg airspeed - 220-230 knots IAS

CONTINUED ON PAGE 2-27

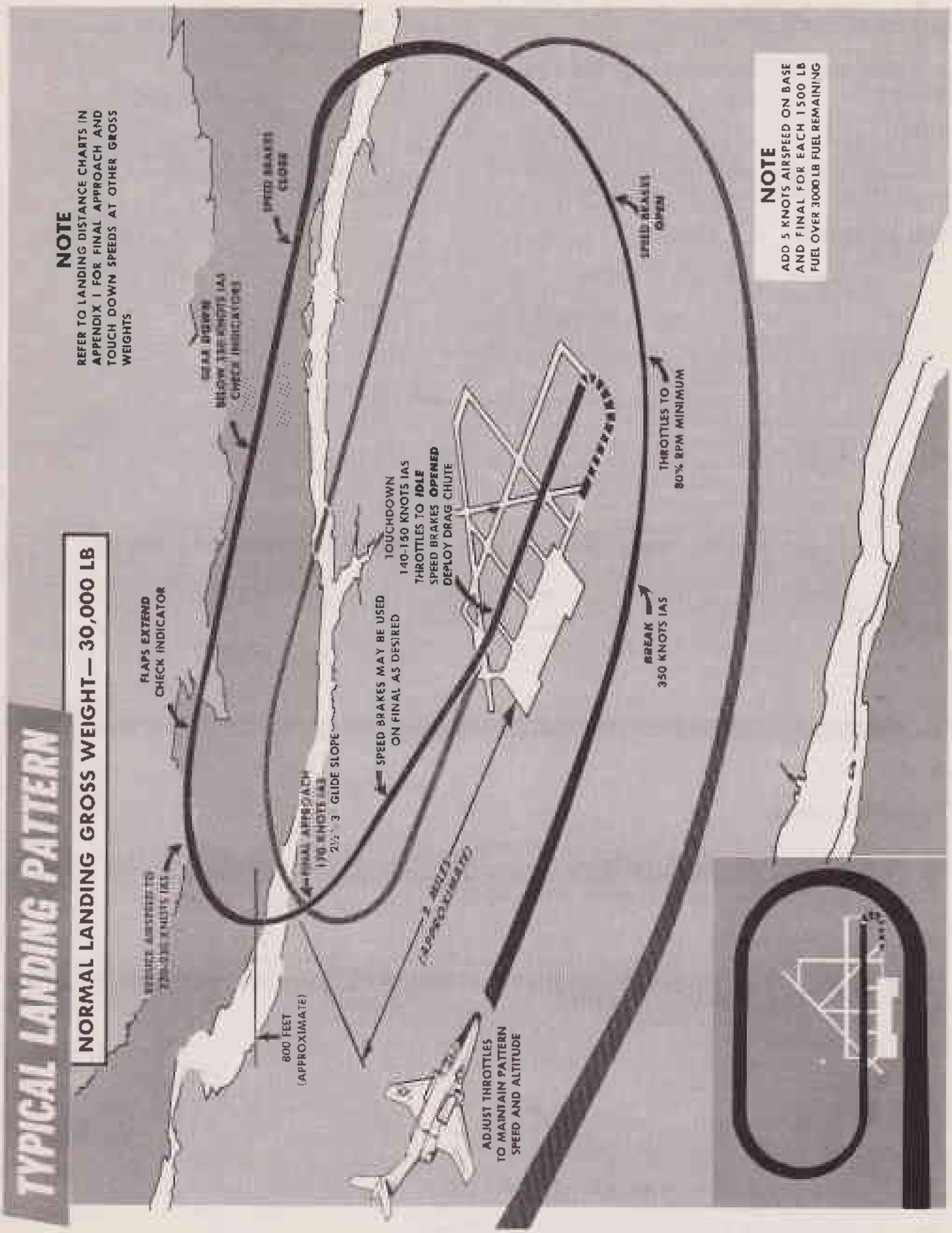
TYPICAL LANDING PATTERN
NORMAL LANDING GROSS WEIGHT— 30,000 LB
NOTE
REFER TO LANDING DISTANCE CHARTS IN APPENDIX I FOR FINAL APPROACH AND TOUCH DOWN SPEEDS AT OTHER GROSS WEIGHTS
FLAPS EXTEND CHECK INDICATOR
GLIDE SLOPE
SPEED BRAKES MAY BE USED ON FINAL AS DESIRED
TOUCHDOWN 140-150 KNOTS IAS THROTTLES TO IDLE SPEED BRAKES OPENED DEPLOY DRAG CHUTE
BREAK 350 KNOTS IAS
THROTTLES TO 80% RPM MINIMUM
800 FEET (APPROXIMATE)
ADJUST THROTTLES TO MAINTAIN PATTERN SPEED AND ALTITUDE
NOTE
ADD 5 KNOTS AIRSPEED ON BASE AND FINAL FOR EACH 1500 LB FUEL OVER 3000 LB FUEL REMAINING

Figure 2-7

NORMAL LANDING *CONTINUED*

10. Turn final approximately 2 miles from runway at 800 feet altitude and establish a 2 1/2° - 3° glide slope angle.
11. Establish final approach speed - 170 knots IAS
    Maintaining 170 knots IAS and a 2 1/2° - 3° glide slope angle provides a mild rate of descent (approximately 900 fpm) and will permit touchdown within the first 1000 feet of runway.
12. After flare-out, throttles - IDLE.

WARNING

Do not attempt to flare or "chop" power prior to crossing the end of the runway because the aircraft decelerates rapidly with throttles retarded to IDLE.

13. Speed brake switch - OPEN
14. Touchdown -140-150 knots IAS
15. Drag chute - DEPLOYED
16. At 110 knots, lower nose gear to the runway.
17. Nose gear steering - ENGAGED
18. Employ normal braking technique.

WARNING

Brakes should be used with extreme caution above 110 knots because of the danger of blowing a tire. Above 110 knots, aerodynamic braking is much more effective.

Note

Normally very light braking is required with the drag chute deployed. Some braking may be required for slowing the airplane to turn-off speeds. Ease off the brakes below 20 knots to prevent landing gear chatter.

CROSSWIND LANDING

Carefully compensate for crosswinds in the traffic pattern to guard against undershooting or overshooting the final turn. On final approach, use wing low and crab combination to maintain course. Maintain normal approach speed aligning airplane with the runway just prior to flare-out. After touchdown, lower nose gear to the runway as soon as possible and apply forward stick to insure nose gear steering engaged. With the nose gear held off, the aircraft's "weathervane" effect may not be correctable with full rudder at airspeeds below 100 knots. If necessary, the drag chute may be deployed, but only after the nose gear is on the runway. Use of the drag chute severely intensifies the "weathervane" effect and should not be deployed if conditions permit, under crosswind conditions where effective crosswinds are in excess of 20 knots. Utilize nose gear steering to maintain directional control during landing roll.

HEAVY GROSS WEIGHT LANDING

As landing gross weight increases, the landing pattern should be expanded and approach and touchdown speeds should be increased accordingly. Follow procedures outlined in Landing Pattern Diagram, figure 2-7, adding 5 knots to quoted airspeeds for each 1500 pounds over normal landing gross weight, i.e., a clean airplane with 6000 pounds of fuel remaining, final approach speed would be 180 knots and touchdown speed would be 150-160 knots IAS.

Note

Airspeeds quoted in Landing Pattern Diagram are for airplane in normal landing gross weight configuration (clean airplane with 3000 pounds, or less, of fuel remaining).

MINIMUM RUN LANDING

In order to reduce landing roll to a minimum, fly a normal pattern and maintain recommended final approach speed as closely as possible. During flare-out, open the speed brakes and retard throttles to IDLE. Do not make these changes prior to flare-out because the rapid deceleration characteristics may cause the aircraft to stall. Touchdown as near the approach end of the runway as possible and deploy the drag chute. After the drag chute is deployed, raise the nose to an indicated pitch attitude of approximately +13° to take advantage of the high aerodynamic drag. Do not exceed a pitch attitude of +15° as the tail may scrape the runway. At approximately 110 knots, gently lower the nose gear to the runway and employ maximum braking technique. Ease off the brakes at approximately 20 knots to prevent landing gear chatter.

WARNING

It is inadvisable to shut down an engine during landing roll. The negligible thrust created by the engine during idle operation will not add materially to the landing roll during a minimum run landing, and in addition offers the increased hazard of possible loss of remaining utility hydraulic pump and consequent loss of braking.

WET RUNWAY LANDING

The procedure to be followed when landing on a wet runway is essentially the same as that set out for the minimum run landing. The brakes should be used with caution as hard braking on wet runways may cause dangerous skidding or fishtailing.

GO-AROUND

The decision to go-around should be made as early as possible. See figure 2-8. Approximately 500 pounds of fuel is consumed during a typical go-around. If decision is made to go-around, proceed as follows:

1. Throttles - AS REQUIRED
   Advance throttles to OPEN or AFTERBURNER as required to check sink rate.

CAUTION

- Due to excessively high fuel consumption, afterburner should be used only in emergencies if total fuel remaining is below 3000 pounds.
- The afterburner can be used while the engine is operating on the emergency fuel control system, however, caution must be exercised in throttle manipulation to prevent compressor stall, engine overspeed and overtemperature.

2. Speed brake switch - CLOSED
3. Landing gear handle - UP
   Retract landing gear only after adequate flying speed is attained as touchdown may be necessary during go-around.
4. Wing flap lever - RETRACT
5. Clear runway as soon as practicable.
6. Reduce power to desired setting for closed traffic airspeed.
7. Re-enter traffic pattern.

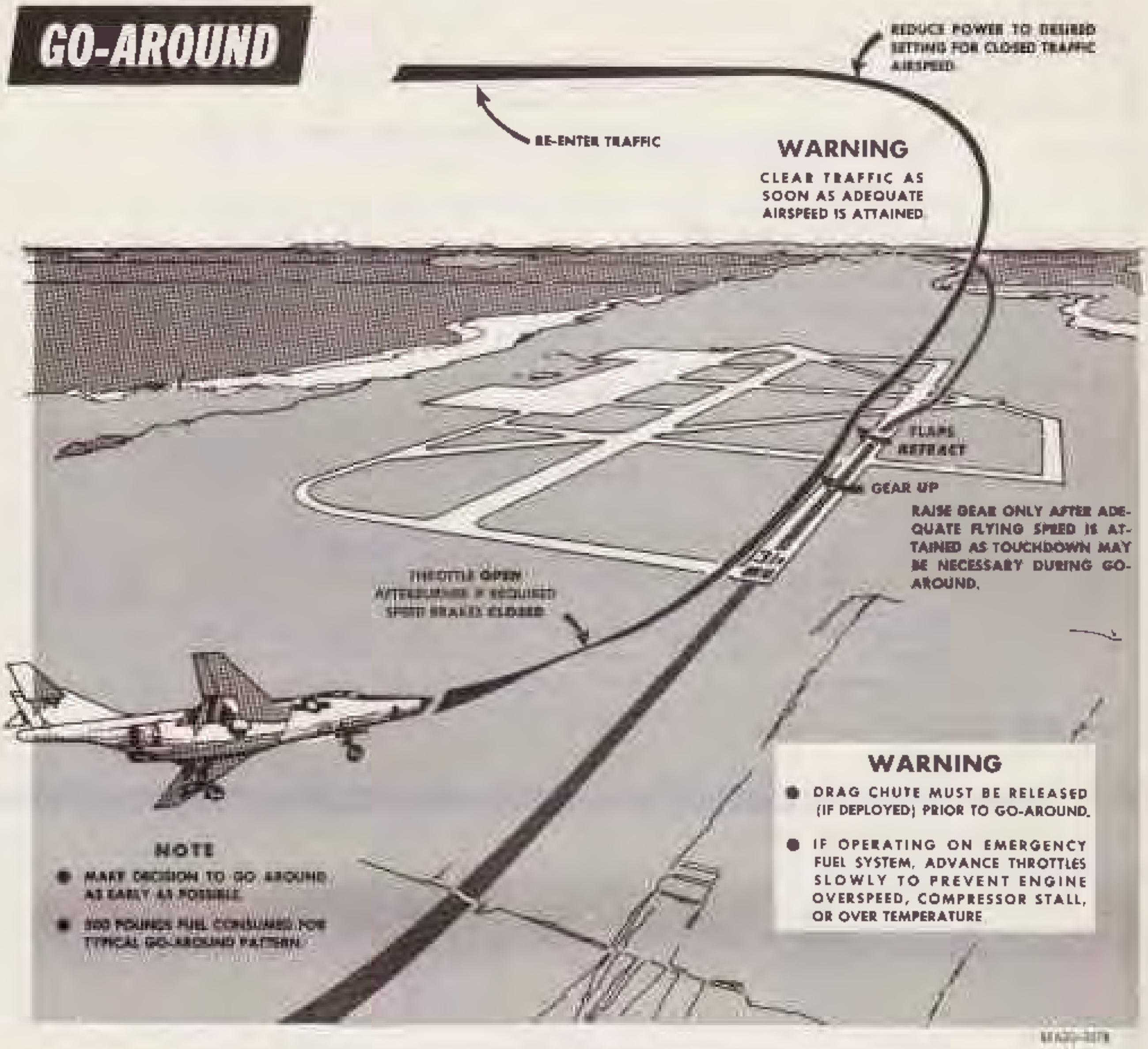

Figure 2-8

AFTER LANDING

After completing the landing roll, turn off the active runway and perform the following:

1. Speed brakes switch - CLOSED
2. Wing flap lever - RETRACT

Note

After clearing active runway, a single engine may be shut down for taxiing. Refer to Engine Shutdown Procedures, this section. Single engine taxiing requires no special technique.

CONTINUED ON NEXT PAGE

AFTER LANDING *CONTINUED*

CAUTION

- If there have been indications of hydraulic system failure, DO NOT attempt an engine shutdown prior to reaching intended parking area.
- If canopy is opened during taxiing, do not exceed canopy open limit of 75 knots.
- Do not make sharp turns during taxiing with the drag chute deployed to prevent chute from collapsing and subsequently damaging the chute.

3. Drag chute - RELEASED
   The drag chute may be released at appropriate area.

CAUTION

- Taxiing at high throttle settings with the drag chute deployed will lead to reduced service life of the drag chute. The pilot should avoid taxiing over drag chutes previously jettisoned by other aircraft so that the chute is not drawn into air intakes causing engine damage.
- The drag chute should be jettisoned before taxiing downwind in winds exceeding 15 to 20 knots, because of the possibility of chute collapsing and burning by contact on hot areas of the exhaust nozzle.

4. Seat safety pin - INSTALLED

ENGINE SHUTDOWN

1. Brakes - APPLIED
2. Throttles - IDLE

Note

Normally the engines will be sufficiently cooled to permit immediate shutdown. However, in instances where the engines have been operated above 85% rpm for periods exceeding one minute during the last five minutes prior to shutdown, it is recommended that they be operated below 85% rpm for 5 minutes in order to prevent seizure of the rotors.

3. Battery switch - OFF
4. Wheels - CHOCKED
   Get signal from ground crew that wheels are chocked before releasing brakes.
5. Right throttle - CLS'D
6. Check hydraulic pressure gages within limits.
7. Left throttle - CLS'D
8. Engine master switches - OFF

Note

Check that engine decelerates freely and listen for excessive noises during shutdown.

BEFORE LEAVING AIRPLANE

1. Electrical switches - OFF except generator switches.
2. Safety pins - INSTALLED

   Check seat and canopy safety pins properly installed.

CAUTION

- Insure that all of the pilot's equipment and straps are free of cockpit controls and seat handgrips so that no damage is incurred, or that the handgrips are not accidentally pulled up upon leaving the cockpit.
- If wearing an aneroid type automatic-opening parachute that has an arming key attached to the lanyard, make sure key does not foul when leaving cockpit to prevent chute from opening inadvertently.

3. Landing gear ground locks - INSTALLED
4. AFTO Form 781 - COMPLETED

CAUTION

Make appropriate entries in the AFTO Form 781 covering any limits in the Flight Manual that have been exceeded during flight. Entries must also be made when in the pilot's judgment the aircraft has been exposed to unusual or excessive operations such as hard landings; excessive braking action during aborted take-off, long and fast landings and long taxi runs at high speeds, etc.

Note

To prevent tire failure resulting from high brake heat generated during taxiing, take-off, and landing, the minimum time between flights (turn around time) is one hour.

CUT ON THIS LINE

RF-101A CONDENSED CHECK LIST

The following check lists are condensed versions of the procedures presented in Section II. These condensed check lists are arranged so that you may remove them from your Flight Manual and insert them into a flip pad for convenient use. They are arranged so that each action is in sequence with the expanded procedure given in Section II. Presentation of these condensed check lists does not imply that you need not read and thoroughly understand the expanded versions. To fly the airplane safely and efficiently, you must know the reason why each step is performed and why the steps occur in certain sequence.

CODE

(20) Block 20 airplanes (54-1494 thru 54-1496)

(25) Block 25 airplanes (54-1497 thru 54-1507)

(30) Block 30 airplanes (54-1508 thru 54-1518)

(35) Block 35 airplanes (54-1519 thru 54-1521)

BEFORE EXTERIOR INSPECTION

1. AFTO Form 781 - CHECK

EXTERIOR INSPECTION

Forward Fuselage Area—CHECK

1. Angle-of-attack transducer probe cover removed, probe free of dirt or damage, and set. (Both sides)
2. Static vent clear. (Both sides)
3. Oblique tri-camera window cover removed. (Both sides)
4. Nose equipment bay doors secure, latches locked. (Both sides)
5. Pitot cover removed.
6. Forward oblique camera window cover removed.

7. Radome secured and free of erosion.
8. Vertical tri-camera window cover removed.
9. IFF antenna secure and free of damage.
10. Aft tri-camera bay window cover removed.
11. Viewfinder window cover removed.
12. Oxygen filler door - oxygen filler cap secure, vent and build-up valve in BUILD-UP position, external canopy emergency release lanyard in place and safety pin removed. Check oxygen filler door securely fastened.
13. Emergency brake air bottle secure, emergency brake pressure gage 3000 psi.
14. Emergency brake valve arm in OFF position, pull wire secure.
15. Nose gear steering unit hydraulic lines swivel freely fore and aft.
16. Nose gear door hinges and door uplatch mechanism secure.
17. Nose gear warning light limit switch free of dirt.
18. Nose gear safety pin removed.
19. Landing lights condition.
20. Strut for inflation.
21. Tire condition, slippage mark and tire inflation.
22. Pip pin installed.
23. Nose gear hydraulic lines secure.
24. Split vertical camera access door and camera window doors secure.
25. Electrical equipment compartment circuit breakers - IN
26. Electrical equipment access door locked.
27. Hydraulic equipment access door locked.

Center Fuselage and Wing Area—CHECK

28. Right hinged splitter vane secure.
29. Hydraulic access door (inside duct) secure. All fasteners present and secure.
30. Duct splitter vane secure and duct area clear.
31. Landing gear emergency air bottle 3000 psi and utility accumulator air pressure 1200 psi.
32. Hydraulic cap secure and access door secure.
33. Oil tank dipstick secure and access door secure.
34. Upper center fuselage skin condition.
35. Lower engine access doors secure.
36. Main gear well condition for hydraulic leaks or damage.
37. Main gear inboard door down, check door hinge mechanism.
38. Drop tank serviced (if installed). Visually check each tank for fuel level. If quantity is questionable, use dipstick to determine the amount. Check cap secure and drop tank safety pin removed.

CUT ON THIS LINE

CUT ON THIS LINE

39. Gear uplatch hook down.
40. Gear warning light limit switch free of dirt.
41. Ground safety lock out.
42. Storage chamber pressure indicator pin (Extended) 25 30 35
43. Gear compression linkage secure.
44. Static ground secure.
45. Wheels chocked.
46. Tire inflation, slippage mark and check carefully for cuts and bruises.
47. Gear doors secure and free of damage.
48. Flipper door secure.
49. Wing leading edge and stall fence for dents or disfiguration and check overall skin condition.
50. Position light and wing tip free of damage.
51. Aileron and flap secure and free of damage.
52. Tailpipe for dents, cracks, or fuel accumulation.
53. Exhaust nozzle position, segment condition, and segment linkage secure.
54. Condition of afterburner.

Aft Fuselage Area—CHECK

55. Blast area plates and rivets secure.
56. Speed brake condition and position.
57. Bellows intake clear.
58. Drag chute door secure.
59. Position lights free of damage.
60. Rudder and stabilizer condition.

COMPLETE LEFT SIDE VISUAL INSPECTION

The inspection of the left side is almost identical to the right side.

While Standing on the Left Wing—CHECK

61. Position light free of damage.
62. Air refueling receptacle door secure.
63. Fuselage skin condition.
64. Cells 1, 3, and 5 filler caps in place and secure.

While Standing on the Ladder—CHECK

65. Air refueling probe doors secure and nose skin condition.
66. Condition of windshield.

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EJECTION SEAT AND CANOPY CHECK

1. Canopy safety pin - CHECK INSTALLED
2. Ejection seat safety pin - INSTALLED
3. Ejection seat quick-disconnects - CHECK PROPERLY MATED
4. Safety belt and shoulder harness - CHECK FREE
5. Canopy condition - CHECK
6. Canopy safety pin - REMOVED

INTERIOR INSPECTION

Upon entering the cockpit, make the following safety checks:

1. Battery switch - OFF
2. Landing gear handle - DOWN

Before External Power is Connected

3. Publications and flight data - CHECK
4. Safety belt and shoulder harness - FASTENED
   a. Attach the shoulder harness and parachute lanyard to the safety belt.
   b. Attach the "D" ring lanyard to the parachute "D" ring.
5. Seat - ADJUST
6. Rudder pedals - ADJUST
7. Stick grip - CHECK
8. Anti-G suit pressure regulating knob - AS DESIRED
9. Emergency camera door switch - NORMAL
10. Photo compartment temperature control panel - CHECK 20
    a. System master switch - ON
    b. Forward compartment temperature switch - AUTO
    c. Aft compartment temperature switch - AUTO
11. AN/APS-54 power switch - OFF
12. Drift computer control knob - CHECK 20
13. Split vertical station control panel - CHECK
14. Tri-camera station control panel - CHECK
15. Forward camera station control panel - CHECK
16. Camera master control panel - CHECK
17. Fuel transfer selector switch - FUS 25 30 35
18. Fuel quantity gage-tank selector knob - TOTAL
19. Pitch-up warning pusher switch - ON
20. Pitch-up warning horn switch - ON
21. Fuel pumps switch - NORMAL 20

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CUT ON THIS LINE

CUT ON THIS LINE

22. UHF radio - OFF
23. Drag chute handle - IN AND SECURE
24. Wing flap lever - RETRACT
25. Landing lights switch - OFF
26. Circuit breakers - IN
27. Refuel switch - NORM [20]
28. Fuel transfer switch - NORM [20]
29. Tank jettison switch - NORM [20][25]
30. Emergency tank jettison switch - NORM [30][35]
31. Throttles - CLS'D
32. Speed brake switch - NEUTRAL
33. Rudder trim switch - NEUTRAL
34. Engine master switches - OFF
35. Engine start switches - OFF
36. Fuel control system switches - NORMAL
37. Antenna selector switch - UPR
38. Emergency air brake handle - IN PLACE AND SECURE
39. Emergency gear extension handle - IN PLACE AND SECURE
40. Landing gear handle - DOWN
41. Emergency speed brake switch - NORMAL
42. Viewfinder control panel - CHECK
43. Turn switch - NORMAL
44. Radar warning switch - BOTH
45. Airspeed and Mach indicator - SET
46. Altimeter - SET
47. Clock - SET
48. Drift computer control knob - AS REQUIRED [25][30][35]
49. Photo compartment temperature control panel - CHECK [25][30][35]
    a. System master switch - ON
    b. Forward compartment temperature switch - AUTO
    c. Aft compartment temperature switch - AUTO
50. Vertical velocity indicator - CHECK
51. Accelerometer - SET
52. Viewfinder - CHECK
53. Pressure ratio gages - SET
54. External tank emergency release handle - IN PLACE AND SECURE [20][25][30]
55. Boom IFR switch - RETRACT
56. Probe IFR switch - RETRACT [25][30][35]
57. Battery switch - OFF
58. Generator switches - CHECK ON
59. Oxygen quantity gage - CHECK
60. Oxygen regulator lever - 100% OXYGEN

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61. Oxygen emergency lever - NEUTRAL
62. Oxygen supply lever - ON
63. Oxygen supply pressure gage - 70-100 PSI
64. Cabin pressure switch - NORMAL
65. Pitot heat switch - OFF
66. Windshield anti-icing switch - LOW
67. Windshield blower switch - OFF
68. Cabin air temperature knob - CLIMATIC
69. Air control lever - CLIMATIC
70. VHF navigation radio power switch - OFF
71. Standby compass light switch - OFF
72. Face heat knob - OFF
73. Autopilot - OFF
74. SIF control panel - AS DIRECTED
75. IFF master control knob - OFF
76. J-4 directional indicator controls - CHECK
77. Lights - CHECK
78. Spare lamps - CHECK
79. Camera circuit breakers - IN
80. Check availability of flashlight if required.

With External Power Connected

81. Fuel quantity gage - CHECK
82. Aux full fuel indicators - CHECK (25)(30)(35)
83. Landing gear indicators - CHECK
    a. Check the three (red) landing gear indicator lights - OUT (20)
    b. Check the three (green) landing gear indicator lights - ON (25)(30)(35)
84. Wing flap position indicator - CHECK
85. Fire warning system - CHECK
86. Pitot heat switch - CHECK
87. Ground position indicator - CHECK
88. Warning lights - CHECK
89. Communication and navigation equipment - CHECK ON
90. IFF control panel(s) - SET AS BRIEFED
91. Cockpit lights - CHECK
    a. Primary-secondary switch - SECONDARY
    b. Instrument light knob - ON
    c. Console floodlights knob - ON
    d. Utility light knob - ON
    e. Primary-secondary switch - PRIMARY

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CUT ON THIS LINE

CUT ON THIS LINE

f. Instrument panel light knob - ON
g. Console floodlights knob - ON
h. Console light knob - ON
i. Thunderstorm light knob - ON
j. Compass light switch - ON

92. Exterior lights - CHECK

STARTING ENGINES

1. Throttles - CLS'D
2. External compressed air source - CONNECTED
3. Left engine master switch - ON
4. Left engine start switch - START
5. Oil pressure gage - CHECK
6. At 12-16 percent rpm, advance left throttle to IDLE.
7. Fuel flow indicator - CHECK
8. Exhaust temperature gage - CHECK
9. Oil pressure gage - CHECK
10. Hydraulic pressure gages - CHECK
11. Start remaining engine as indicated in steps 3 thru 9.

ENGINE CLEARING PROCEDURE

1. Check external electrical and compressed air sources connected.
2. Throttles - CLS'D
3. Engine master switch - OFF
4. Engine start switch - START
5. Allow engine to crank for approximately 20 seconds, then move start switch to STOP START and release.

BEFORE TAXIING

1. External electrical power and starter compressed air sources - DISCONNECTED
2. Transformer-rectifier - CHECK
3. Battery switch - ON
4. Hydraulic gages - CHECK
5. Pitch-up warning system - CHECK
   a. Control stick - AFT OF NEUTRAL
   b. Pitch-up warning test button - HOLD DEPRESSED
   c. Pusher release switch - DEPRESS
   d. Pitch-up warning out light - CHECK
6. Speed brakes - CHECK
7. Wing flaps - CHECK

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8. Autopilot - CHECK
9. Windshield anti-icing switch - LOW
10. Take-off trim - ADJUST
11. Seat safety pin - REMOVED

TAXIING

1. Taxi area - CLEAR
2. Chocks - REMOVED
3. Brakes - CHECK
4. Once the aircraft is moving taxi at idle.
5. Nose gear steering system - CHECK
6. Flight instruments - CHECK
7. Minimize taxi time to decrease fuel consumption.

BEFORE TAKE-OFF

PRE-TAKE-OFF AIRCRAFT CHECK

1. "D" ring lanyard - HOOKED
2. Safety belt and shoulder harness - CHECK
3. Shoulder harness inertia reel handle - UNLOCKED
4. Visually check seat safety pin removed.
5. Personal equipment leads - CHECK
6. Flight controls - CHECK
7. Wing flap lever - EXTEND
8. Canopy - CLOSED
9. Take-off trim light - CHECK

PRE-TAKE-OFF ENGINE CHECK

1. Emergency fuel control system - CHECK
   a. Left throttle - IDLE
   b. Left fuel control switch - EMERG
   c. Left fuel control switch - NORMAL
   d. Check right engine as outlined above.
2. Engine power - CHECK
   a. Left throttle - OPEN
   b. Engine pressure ratio gage - CHECK
   c. Check all engine instruments within limits.
   d. Left throttle - IDLE
   e. Check right engine as outlined above.
3. Pitot heat switch - CLIMATIC

CUT ON THIS LINE

CUT ON THIS LINE

TAKE-OFF DATA

Runway Length ________ Ft. Field Pressure Alt. ________ Ft.

Temperature _____ °F Critical Eng. Failure Speed * ______ IAS

Refusal Speed * ______ IAS Critical Field Length * ________ Ft.

Take-off Dist......Normal ________ 50 Ft. Obstacle * ________ Ft.

GO–NO GO CHECK.....Dist. * ________ Speed * _____ IAS

NORMAL TAKE-OFF..............................Speed _____ IAS

SINGLE ENGINE TAKE-OFF...................Speed * _____ IAS

ENGINE PRESSURE RATIO .... Left _____ Right _____

MINIMUM LEVEL FLIGHT SPEED

T.O. Config. _____ IAS Clean Config. _______ IAS

EMERGENCY LANDING DATA

Approach Speed (Single Engine) ___________ IAS

Stopping Distance (No Drag Chute) _________ Ft.

*Complete These Items If The Computed Take-Off Roll Exceeds One Half Available Runway Length.

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CUT ON THIS LINE

CUT ON THIS LINE

LANDING DATA

Total Fuel Remaining Lbs.	Final Approach Speed Kts. IAS	Touchdown Speed Kts. IAS
3000	170	145
4500	175	150
6000	180	155
7500	185	160
9000	190	165
10500	195	170
12000	200	175

Stopping Distance (No Drag Chute)________Ft.

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CUT ON THIS LINE

CUT ON THIS LINE

NORMAL TAKE-OFF

1. Brakes - APPLIED
2. Throttles - 80% RPM
3. Instruments and warning lights - CHECK
4. Nose gear steering - ENGAGED
5. Brakes - RELEASED
6. Throttles - OPEN
7. Use nose gear steering for directional control until the rudder becomes effective at approximately 70 knots IAS.
8. At 150 knots, ease the nose gear off the runway.
9. The aircraft (clean) will fly off at approximately 165 knots IAS.

AFTER TAKE-OFF–CLIMB

When definitely airborne:

1. Landing gear handle - UP
2. Wing flap lever - RETRACT
3. Accelerate to best climbing speed.
4. Throttles - OPEN
5. "D" ring lanyard - DISCONNECTED AND STOWED
6. Visually check seat safety pin - REMOVED
7. Oxygen regulator diluter lever - NORMAL OXYGEN
8. Cabin air temperature knob - AUTO
9. Upon reaching level off, auxiliary fuel switch - ON

BEFORE LANDING

1. Camera master control switches - OFF
2. Fuel quantity - CHECK
   a. Check fuel quantity remaining.
   b. Monitor #2 cell.
   c. Airspeed index pointer - SET
3. Hydraulic pressure gages - CHECK
4. Cabin air temperature knob - CLIMATIC
5. Autopilot engage switch - OFF
6. Safety belt and shoulder harness - CHECK
7. Shoulder harness inertia reel handle - UNLOCKED
8. "D" ring lanyard - HOOKED

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NORMAL LANDING

1. Enter traffic pattern.
2. Break - 350 KNOTS IAS
3. Throttles - 80% MINIMUM
4. Speed brake switch - OPEN
5. At 250 knots, speed brake switch - CLOSED
6. Landing gear handle - DOWN
7. Wing flap lever - EXTEND
8. Turn base leg approximately 2 miles from runway.
9. Base leg airspeed - 220-230 knots IAS
10. Turn final approximately 2 miles from runway at 800 feet altitude and establish a 2 1/2° - 3° glide slope angle.
11. Establish final approach speed - 170 knots IAS
12. After flare-out, throttles - IDLE
13. Speed brakes - OPEN
14. Touchdown - 140-150 knots IAS
15. Drag chute - DEPLOYED
16. At 110 knots, lower nose gear to the runway.
17. Nose gear steering - ENGAGED
18. Employ normal braking technique.

GO-AROUND

1. Throttles - AS REQUIRED
2. Speed brake switch - CLOSED
3. Landing gear handle - UP
4. Wing flap lever - RETRACT
5. Clear runway as soon as practicable.
6. Reduce power to desired setting for closed traffic airspeed.
7. Re-enter traffic pattern.

AFTER LANDING

1. Speed brakes switch - CLOSED
2. Wing flap lever - RETRACT
3. Drag chute - RELEASED
4. Seat safety pin - INSTALLED

ENGINE SHUTDOWN

1. Brakes - APPLIED
2. Throttles - IDLE

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CUT ON THIS LINE

CUT ON THIS LINE

3. Battery switch - OFF
4. Wheels - CHOCKED
5. Right throttle - CLS'D
6. Check hydraulic pressure gages within limits.
7. Left throttle - CLS'D
8. Engine master switches - OFF

BEFORE LEAVING AIRPLANE

1. Electrical switches - OFF except generator switches.
2. Safety pins - INSTALLED
3. Landing gear ground locks - INSTALLED
4. AFTO Form 781 - COMPLETED

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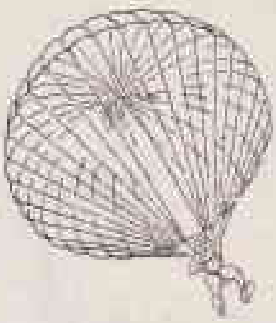
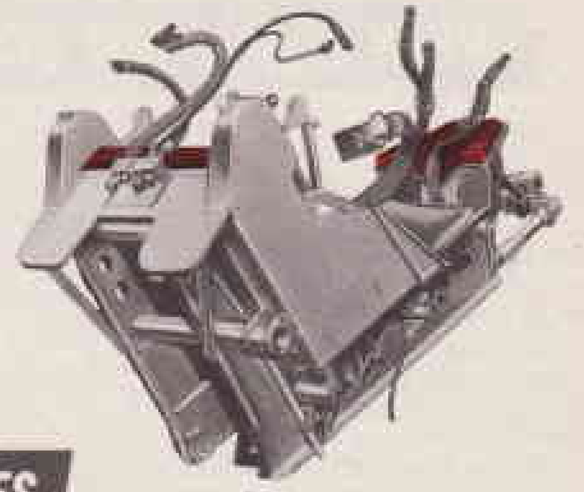
CUT ON THIS LINE





SECTION III
EMERGENCY PROCEDURES

TABLE OF CONTENTS

ENGINE FAILURE

Jet engine failures are often the result of malfunction or incorrect operating technique of the fuel system. Engine instruments often provide indications of failure before the engine stops. Air starts should be accomplished, provided time and altitude permit, if the failure can be attributed to the reasons already noted. In the event of obvious mechanical failure within the engine, air starts should not be attempted.

SINGLE ENGINE FLIGHT CHARACTERISTICS

Single-engine characteristics are essentially the same as the normal characteristics due to the engine installation and its proximity to the centerline of thrust for the aircraft. In event of one engine failure, slight rudder deflection is required to prevent yaw toward the failed engine. Minimum single-engine control speed varies with gross weight, flap setting and landing gear position. The aircraft design is such that no system (hydraulic, electrical, etc.) is dependent on a specific engine. Thus, loss of an engine will not result in subsequent loss of a system.

ENGINE FAILURE DURING TAKE-OFF

Before Airborne

If an engine fails before leaving the ground, the continuation of take-off is dependent on length of remaining runway, gross weight, airspeed, field elevation and ambient temperature, see Critical Field Length and Maximum Refusal Speed charts, Part 2 Appendix I (T.O. 1F-101(R)A-1A).

Note

- During take-off using Military thrust, where take-off will not be aborted, immediately advance operating engine to Maximum thrust and follow Engine Failure During Flight Procedures, this section, as soon as possible.
- If an engine fails using Maximum thrust and take-off will not be aborted, immediately retard "dead" engine throttle from afterburning range and follow Engine Failure During Flight Procedures, this section.

If decision to stop is made, observe the following:

1. Throttles - IDLE.

CAUTION

If both throttles are placed in the CLS'D position, the generators will become disconnected

WHEN FLAME-OUT OCCURS

from the bus system at approximately 30% rpm and volumetric output of the hydraulic pumps will be greatly reduced

2. Drag chute - DEPLOYED
3. Speed brakes switch - OPEN
4. Brakes - APPLIED
5. Nose gear steering - ENGAGED

   If nose gear steering was disengaged, due to nose gear strut extension, hold stick forward and engage nose gear steering.

Note

If normal hydraulic brake pressure is inadequate, use emergency brake system. Refer to Brake System Emergency Operation, this section.

6. If aircraft cannot be stopped - JETTISON CANOPY

   If the aircraft has obtained high speed and the pilot considers the barrier insufficient for stopping, pull canopy alternate jettison handle and lock shoulder harness. If canopy does not jettison, raise either seat handgrip: canopy will eject and shoulder harness will lock automatically.

WARNING

With handgrips up, ejection seat triggers are exposed and armed. Actuating either trigger will eject the seat.

After Airborne

If an engine fails immediately after take-off, lateral and directional control of the aircraft can be maintained if airspeed remains above stalling speed, however, the ability to maintain altitude or to climb depends upon gross weight and air density. Since the pilot's reactions will depend upon conditions mentioned above, after take-off, and at critical airspeeds with heavy gross weight, the pilot must complete the following if level flight cannot be maintained.

1. Operating engine - AFTERBURNER

   If afterburners were not being used, place remaining throttle in afterburner power.
2. Landing gear handle - UP
3. External tanks - JETTISON

   If altitude cannot be maintained, store and tank emergency jettison button - DEPRESS

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Figure 3-1

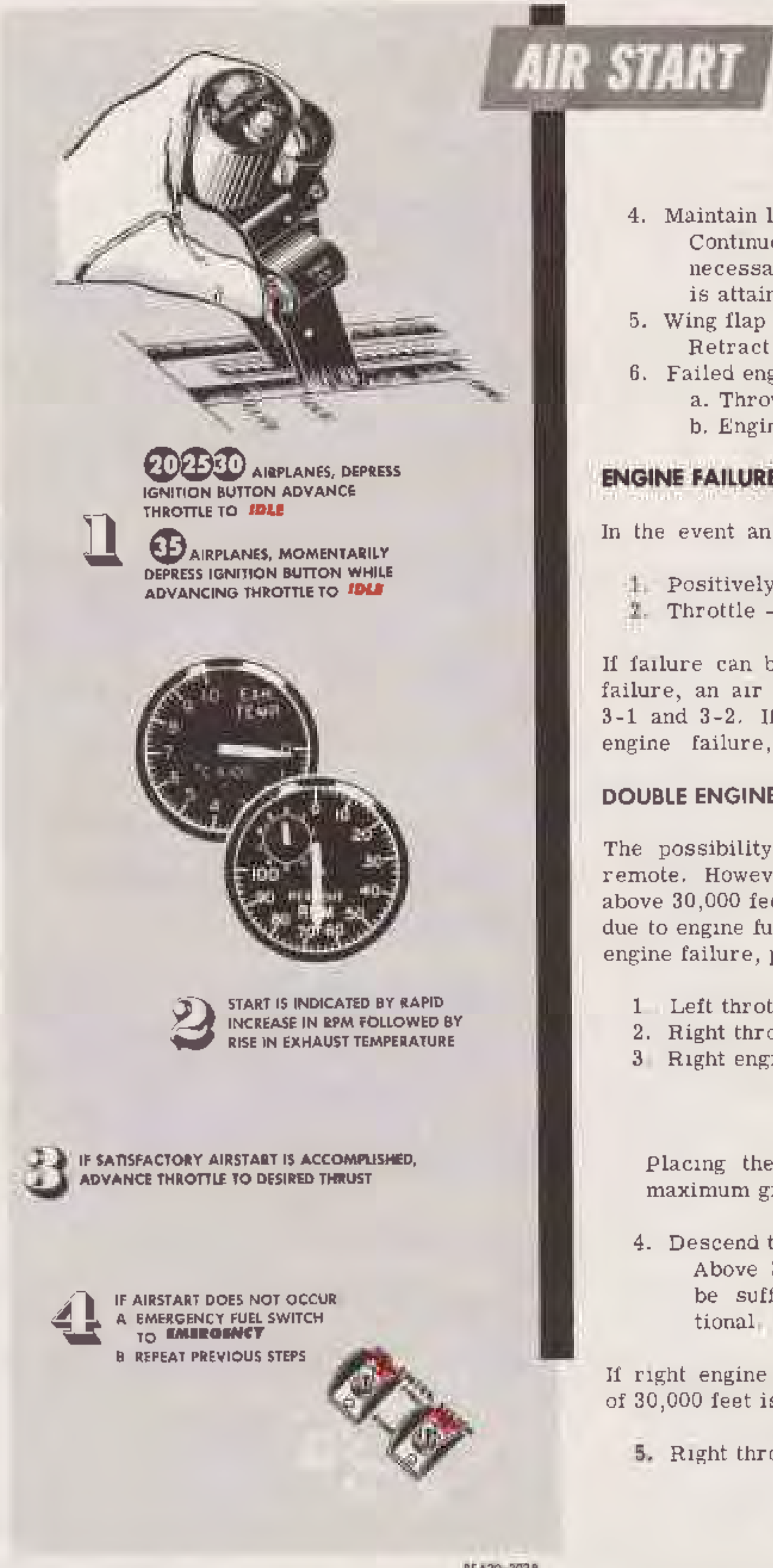

Figure 3-2

4. Maintain level flight
   Continue flight straight ahead. Attempt no unnecessary turns or climb until safe airspeed is attained.
5. Wing flap lever - RETRACT
   Retract flaps after safe airspeed is attained.
6. Failed engine - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF

ENGINE FAILURE DURING FLIGHT

In the event an engine fails, perform the following:

1. Positively determine which engine has failed.
2. Throttle - CLS'D

If failure can be attributed to other than mechanical failure, an air start may be attempted. See figures 3-1 and 3-2. If mechanical failure was the cause of engine failure, turn engine master switch OFF.

DOUBLE ENGINE FAILURE DURING FLIGHT

The possibility of a double engine failure is highly remote. However, failure of both fuel booster pumps above 30,000 feet may result in a double engine failure due to engine fuel starvation. In the event of a double engine failure, proceed as follows:

1. Left throttle - CLS'D
2. Right throttle - IDLE
3. Right engine ignition button - DEPRESS

Note

Placing the left throttle to CLS'D provides maximum gravity fuel flow to the right engine.

4. Descend to 30,000 feet
   Above 30,000 feet gravity fuel flow may not be sufficient to maintain one engine operational.

If right engine does not start by the time an altitude of 30,000 feet is reached:

5. Right throttle - CLS'D

CAUTION

Prior to all subsequent air start attempts, the throttle(s) should be returned to CLS'D to terminate the fuel flow to the engine. Allow

35 seconds after releasing ignition button for the emergency ignition cycle to terminate. Attempts to air start right and left engines must be spaced a minimum of 35 seconds apart or power to the engine ignition system will be lost. In the 20 25 30 airplanes, prior to incorporation of T.O. 1F-101-617, the ignition cycle will terminate when the ignition button is released. After incorporation of T.O. 1F-101-709, it is not necessary to wait 35 seconds between attempts to air start right and left engine.

6. Attempt to air start left engine.
   Refer to Air Start, this section.

CAUTION

Do not lower airspeed below either 250 knots IAS or .5 indicated Mach number.

If neither engine starts it can be assumed the ignition system is at fault due to a blown circuit breaker. If ignition system failure is suspected, proceed as follows:

7. Generator switches - OFF

Note

With both generators disconnected from the bus system, emergency electrical power will be supplied to the emergency start relay from the windmilling generators and the generators field or the battery.

8. In the 20 25 30 airplanes prior to incorporation of T.O. 1F-101-617, depress ignition button and advance right throttle to IDLE. After incorporation of T.O. 1F-101-617 and in the 35 airplanes, momentarily depress ignition button while advancing right throttle to IDLE.
9. If right engine does not start, attempt to start the left engine in the same manner.

If neither engine starts, the normal ground starting procedure utilizing the engine start switch should be attempted.

Note

Only one engine can be started at a time when utilizing the engine start switch and neither engine will start when windmilling above 40% rpm due to the termination of igniter operation above this rpm.

AIRSTART

Air starts may be accomplished at any altitude. For Air Start procedures, see figures 3-1 and 3-2.

Note

During normal air start there may be no significant increase in exhaust temperature until the engine has accelerated to idle rpm.

In the event that:

1. Light-up does not occur within 20 seconds after throttle is advanced to IDLE;
2. The engine fails to accelerate to idle rpm within approximately 45 seconds after light-up;
3. The exhaust temperature exceeds maximum limitations;
4. The oil pressure does not attain the minimum of 35 psi;

retard the throttle to CLS'D to discontinue start.

Note

If a start is made with an engine which has cooled to an ambient temperature of -30°C (-25°F), the throttle should be left at IDLE for two minutes to warm-up the engine if flight conditions permit.

CAUTION

If air start is made on emergency fuel system, exhaust temperature may be controlled by throttle manipulation between CLS'D and IDLE.

GLIDE DISTANCE

The Glide Distance Chart (figure 3-3) provides the pilot with glide distance he may attain with both engines windmilling from given altitudes and at a given airspeed of 250 knots. This airspeed will provide near maximum glide distance capability of the aircraft and will provide engine windmilling speed capable of keeping hydraulic pressure and recovery rate within safe limits.

SINGLE ENGINE LANDING

A single engine landing is basically the same as a normal landing (figure 2-7) except that the pattern is expanded to avoid steep turns and the final approach speeds are increased to preclude high sink rates.

1. Fly a wide normal pattern.
2. Landing gear lever - DOWN
3. Wing flap lever - RETRACT
4. Establish at least two mile straight-in final approach. Maintain a minimum of 85% engine rpm.
5. Establish applicable approach speed using intermittent application of speed brakes.

GLIDE DISTANCE

WITH ENGINES WINDMILLING

GROSS WEIGHT 37,000 POUNDS

NO WIND
NO EXTERNAL TANKS

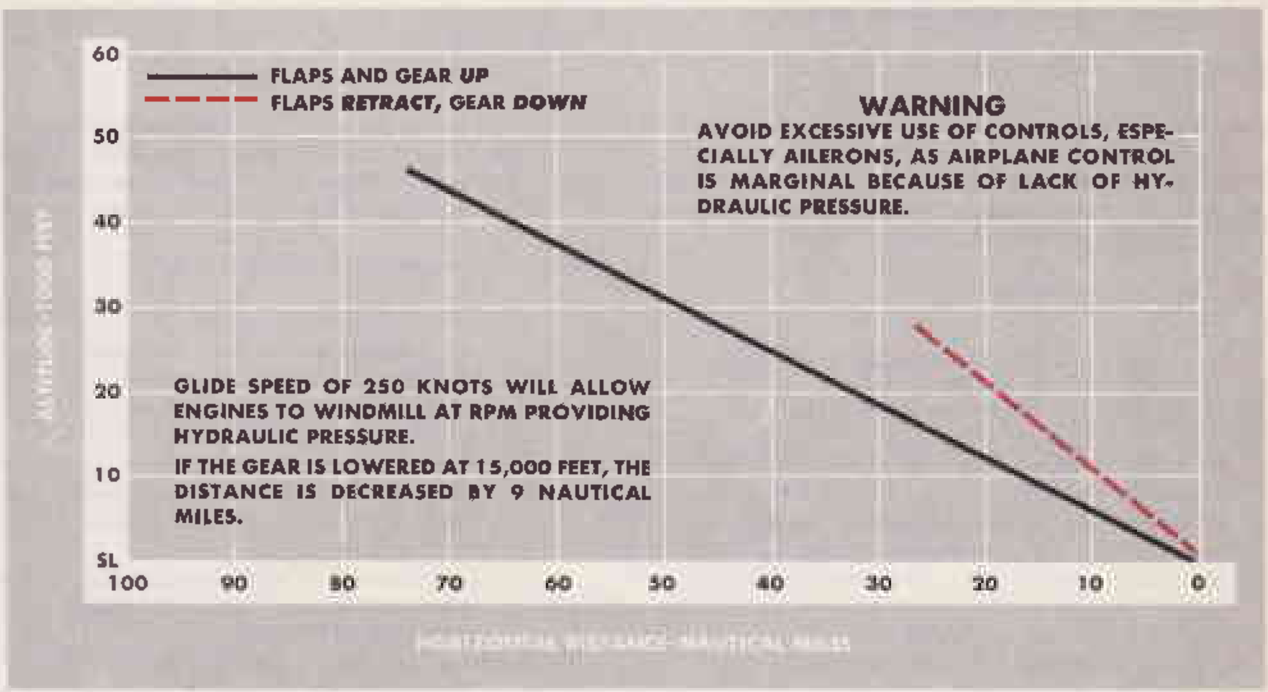

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Figure 3-3

Total Fuel Remaining Lbs.	Final Approach Speed Kts. IAS
3000	185
4500	190
6000	195
7500	200
9000	205
10,500	210
12,000	215

6. Speed brake switch - CLOSED

   After approach speed is attained, close speed brakes until after flare-out has been accomplished.
7. Maintain a mild rate of descent.
8. Wing flap lever - EXTEND

   Prior to flare-out, extend flaps when landing is assured.
9. Fly the aircraft down to the runway.

   Do not flare the aircraft or "chop" power prior to crossing the end of the runway.
10. Make normal touchdown and roll-out.

LANDING WITH BOTH ENGINES INOPERATIVE

Due to the excessively high rates of descent and airspeeds required to maintain control, it is NOT advisable to attempt a "dead stick" landing. If an air start (either engine) cannot be effected, EJECT.

FIRE

The following procedures pertain to the first occurrence of a fire warning indication rather than an actual fire. The lights could illuminate due to an overheat condition or perhaps an electrical short, and thus, the actual conditions that exist when a light illuminates may be difficult to determine. However, if upon first recognition, an actual engine fire is obvious, the affected engine should be shutdown immediately.

ENGINE FIRE DURING STARTING

If the fire warning lights illuminate or there is evidence of fire during starting, follow this procedure:

1. Throttle(s) - CLS'D
2. Engine master switch(es) - OFF
3. External electrical and compressed air units - DISCONNECTED
4. Leave aircraft as quickly as possible.

ENGINE FIRE DURING TAKE-OFF

Before Airborne

If either fire warning light illuminates during take-off roll, it is preferable to abort immediately if sufficient runway is available to stop safely.

1. Throttles - IDLE

CAUTION

If both throttles are placed in the CLS'D position, the generators will become disconnected from the bus system at approximately 30% rpm and volumetric output of the hydraulic pumps will be greatly reduced.

2. Drag chute - DEPLOYED
3. Speed brakes switch - OPEN
4. Brakes - APPLIED
5. Nose gear steering - ENGAGED
   If nose gear steering was disengaged, due to nose gear strut extension, hold stick forward and engage nose gear steering.

Note

If normal hydraulic brake pressure is inadequate, use emergency brake system. Refer to Brake System Emergency Operation, this section.

6. If aircraft cannot be stopped - JETTISON CANOPY
   If the aircraft has obtained high speed and the pilot considers the barrier insufficient for stopping, pull canopy alternate jettison handle and lock shoulder harness. If canopy does not jettison, raise either seat handgrip; canopy will eject and shoulder harness will lock automatically.
7. Throttles - CLOSED
8. Engine mater switches - OFF
9. Leave airplane as soon as possible.

Note

If canopy was not jettisoned, care should be taken to reinstall the seat safety pins, if conditions permit, so that the seat will not be actuated in leaving the airplane.

WARNING

With handgrips up, ejection seat triggers are exposed and armed. Actuating either trigger will eject the seat.

After Airborne

Note

The following procedures are applicable only to the phase immediately after take-off. If these procedures do not eliminate the emergency, refer to Engine Fire During Flight, this section.

Burner Compartment (Flashing) Light

1. Normal operating engine - AFTERBURNER
   If afterburners were not being used, place throttle in afterburner detent.
2. Throttle (engine indicating fire) - IDLE
3. Landing gear handle - UP
4. External tanks - JETTISON
   If altitude cannot be maintained, external tank emergency jettison button - DEPRESS
5. Continue level flight
   Continue level flight straight ahead. Attempt no unnecessary turns or climb until safe airspeed is attained.
6. Wing flap lever - RETRACT
   Retract flaps after safe airspeed is attained.
7. If light continues flashing, shut down appropriate engine.
   a. Throttle - CLS'D
   b. Engine master switch - OFF
8. Check for indications of fire such as trailing smoke, verification from tower or another aircraft, etc.
9. If fire exists, climb to safe ejection altitude and eject.

Engine Compartment (Steady) Light

1. Normal operating engine - AFTERBURNER
   If afterburners were not being used, place throttle in afterburner detent.
2. Throttle (engine indicating fire) - CLS'D
3. Landing gear handle - UP
4. External tanks - JETTISON
   If altitude cannot be maintained, external tank emergency jettison button - DEPRESS
5. Continue level flight
   Continue flight straight ahead. Attempt no unnecessary turns or climb until safe airspeed is attained.

6. Wing flap lever - RETRACT
   Retract flaps after safe airspeed is attained.
7. Engine master switch - OFF
8. Check for other indications of fire such as trailing smoke, verification from tower or another aircraft, etc.
9. If fire is confirmed climb to safe ejection altitude and eject.

ENGINE FIRE DURING FLIGHT

Burner Compartment (Flashing) Light

1. Reduce power and observe fire warning light.
   a. If light goes out, continue flight at reduced power settings and land as soon as possible.
   b. If light continues flashing, proceed with step 2.
2. Check for other fire indications such as fumes or trailing smoke.
   a. If no fire is apparent, continue flight at reduced power setting and land as soon as possible.
   b. If positive fire indications are discernible, proceed with step 3.
3. Engine (indicating fire) - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF
   c. If fire ceases, make single engine landing as soon as possible.
   d. If fire continues - EJECT

Engine Compartment (Steady) Light

1. Engine (indicating fire) - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF
2. If light goes out and there is no evidence of continuing fire, make a single engine landing as soon as possible.
3. If light remains illuminated and evidence of fire is apparent - EJECT
4. If light remains illuminated but no evidence of fire is apparent, make a single engine landing as soon as possible.

ENGINE FIRE AFTER SHUTDOWN

Refer to Engine Clearing Procedures, Section II.

ELECTRICAL FIRE

Circuit breakers and fuses protect most circuits and tend to isolate an electrical fire. However, if an electrical fire occurs, perform the following as conditions permit, and land as soon as possible.

1. Battery switch - OFF
2. Generator switches - OFF
3. All electrical equipment switches - OFF
4. Battery switch - ON
5. Generator switches - ON
6. Slowly reposition the electrical equipment switches to ON, beginning with the most essential equipment first.
7. If the trouble item is found, place the affected equipment OFF and pull the applicable circuit breaker if available.
8. If the cause of the fire cannot be found, continue the flight with only the essential equipment in operation and land when practicable.

CAUTION

If landing is to be made with both generator switches OFF, the battery switch must be ON to provide selective power for landing gear, flaps, speed brakes and nose gear steering.

ELIMINATION OF SMOKE AND FUMES

To eliminate smoke or fumes from the cockpit proceed as follows:

Note

When necessary to depressurize the cockpit descend to 25,000 feet or below if possible.

1. Oxygen regulator diluter lever - 100% OXYGEN
2. Oxygen emergency toggle lever - EMERGENCY

CAUTION

When positive pressures are required, it should be remembered that: Face mask must not leak and must be well fitted to the face; oxygen flowing to the mask will be extremely cold; and continued use will rapidly deplete the oxygen system.

3. Cabin air temperature knob - RAM AIR & DUMP

Note

If above listed methods fail to clear smoke or fumes, and the situation warrants, the canopy may be jettisoned by the canopy alternate jettison handle.

EJECTION

Escape from the aircraft in flight should be made with the ejection seat. The basic seat ejection procedure is shown in figure 3-4.

The study and analysis of escape technique by means of the ejection seat reveals that:

1. Ejection at airspeeds ranging from tall speed to 525 knots IAS results in relatively minor forces being exerted on the body, thus reducing injury hazard.

EJECTION PROCEDURE

BEFORE EJECTION

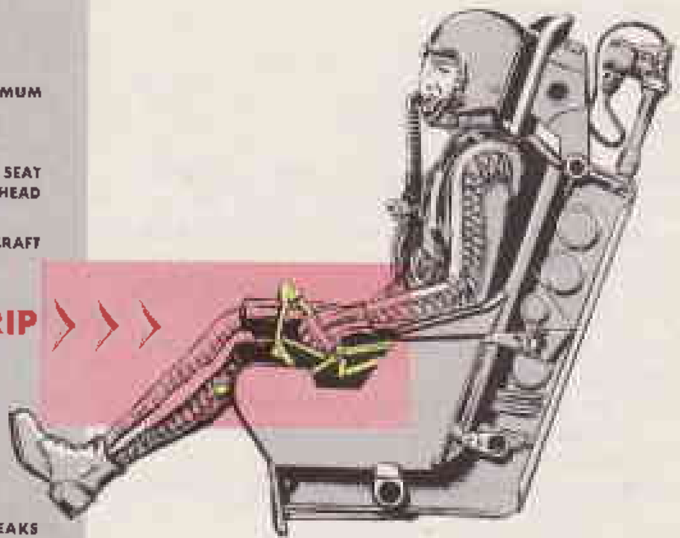
WARNING

DURING OPERATIONS OTHER THAN TAKE-OFF AND LANDING IT IS IMPERATIVE THAT THE "D" RING LANYARD BE STOWED.

IF TIME AND CONDITIONS PERMIT . . .

- SLOW AIRCRAFT AS MUCH AS POSSIBLE.
- STOW ALL LOOSE EQUIPMENT.
- PRESSURIZATION TO RAM AIR & DUMP FOR MINIMUM DECOMPRESSION EFFECTS WHEN JETTISONING CANOPY.
- ACTUATE BAIL-OUT BOTTLE.
- POSITION FEET ON RUDDER PEDALS, BRACE THIGH ON SEAT CUSHION AND BRACE ARMS IN ARM REST. SIT ERECT, HEAD HARD BACK AGAINST HEADREST AND CHIN IN.
- WHEN EJECTING AT LOW ALTITUDE PULL NOSE OF THE AIRCRAFT ABOVE THE HORIZON.

1 PULL UP EITHER HANDGRIP >>>



IF CANOPY FAILS TO JETTISON . . .

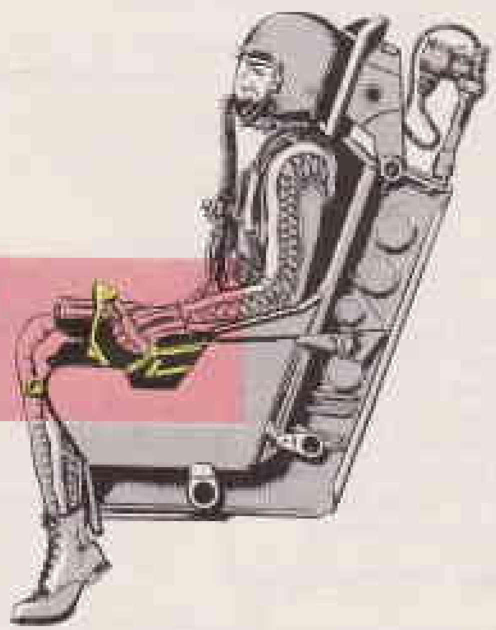
- PULL CANOPY ALTERNATE JETTISON HANDLE.
- HOLD CANOPY SWITCH AT OPEN UNTIL CANOPY BREAKS AWAY.
- PULL CANOPY MANUAL RELEASE LEVER.

WARNING

MANUAL OPENING OF CANOPY MAY INFLICT SERIOUS INJURY WHEN LEVER IS NOT GRIPPED PROPERLY. CANOPY BREAKAWAY IS EXTREMELY RAPID. GRASP LEVER WITH RIGHT HAND, THUMB UPWARD AND PULL AFT.

- IF CANOPY DOES NOT RELEASE, ASSUME PROPER POSITION AND PROCEED TO STEP 2, EJECTING THROUGH CANOPY.

2 SQUEEZE EITHER TRIGGER >>>



AFTER EJECTION

AFTER SEAT EJECTS . . .

- IF AUTOMATIC-OPENING SAFETY BELT FAILS TO OPEN AUTOMATICALLY (AFTER 2 SECONDS) UNFASTEN SAFETY BELT BUCKLE MANUALLY AND KICK FREE OF SEAT.
- IF AUTOMATIC-OPENING, ANEROID-TYPE PARACHUTE IS WORN AND THE PARACHUTE LANYARD IS PLACED OVER SAFETY BELT SWIVEL LINK, THE PARACHUTE WILL OPEN AT THE PRESET ALTITUDE AFTER PILOT SEPARATES FROM SEAT. IF EJECTION IS MADE BELOW PRESET ALTITUDE, PARACHUTE WILL OPEN AT THE PRESET TIME INTERVAL AFTER PILOT SEPARATES FROM SEAT.
- IF WEARING AUTOMATIC-OPENING, ANEROID-TYPE PARACHUTE WITHOUT LANYARD ANCHOR ATTACHED TO SAFETY BELT, KICK FREE OF SEAT AND PULL PARACHUTE ANEROID ARMING LANYARD MANUALLY. THE PARACHUTE WILL OPEN AT THE PRESET ALTITUDE, OR IF BELOW PRESET ALTITUDE, AT THE PRESET TIME INTERVAL. IF PARACHUTE ANEROID FAILS AFTER PILOT SEPARATES FROM SEAT, PULL "D" RING MANUALLY TO OPEN PARACHUTE.
- IF WEARING A CONVENTIONAL, MANUALLY OPERATED PARACHUTE, KICK FREE OF SEAT AND PULL "D" RING TO OPEN PARACHUTE.

WARNING

IMMEDIATELY AFTER LEAVING SEAT, MANUALLY PULL "D" RING FOR ALL EJECTIONS BELOW 14,000 FEET TO OPEN PARACHUTE IMMEDIATELY. THIS APPLIES REGARDLESS OF PARACHUTE TYPE TO INSURE PARACHUTE DEPLOYMENT.

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Figure 3-4

2. Appreciable forces are exerted on the body when ejection is performed at airspeeds of 525 to 600 knots IAS rendering escape more hazardous.
3. At speeds above 600 knots IAS, ejection is extremely hazardous because of excessive forces on the body.

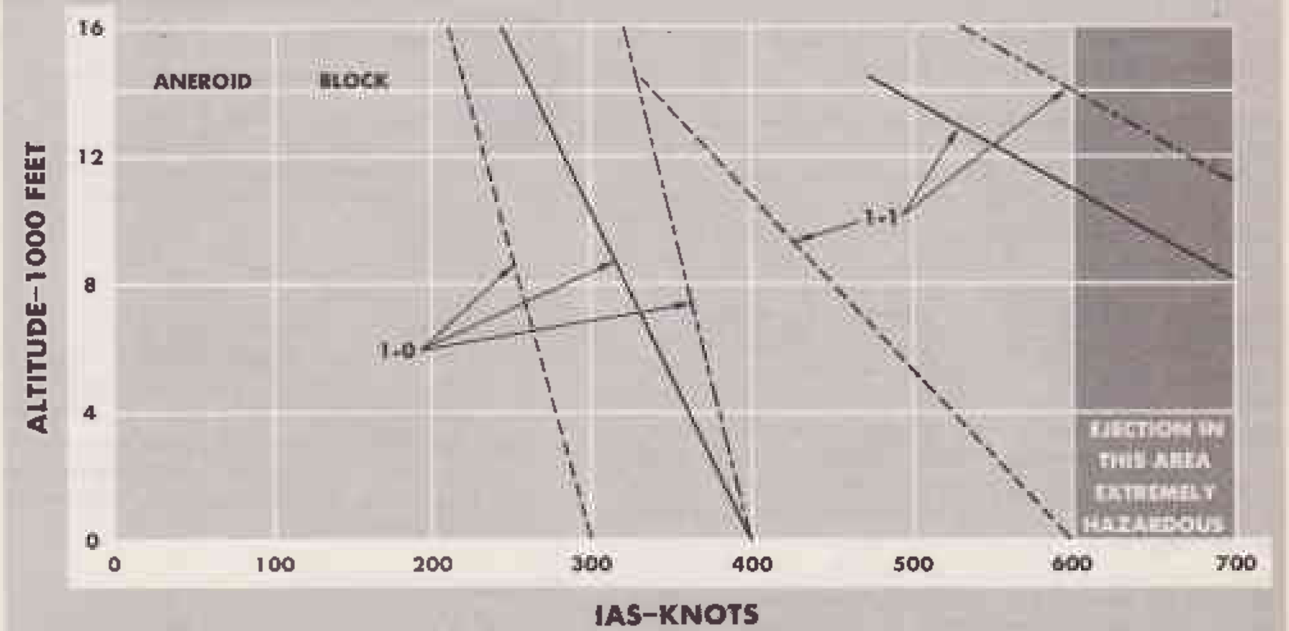
The safe ejection speeds chart gives the maximum safe ejection speeds for the different parachute and automatic seat belt combinations. The "two and one" and "two and two" escape systems provide sufficient time for safe escape at any altitude and any airspeed up to 600 knots IAS.

LOW ALTITUDE EJECTION

Ejection at low altitudes is facilitated by pulling the nose of the airplane above the horizon ("zoom up" maneuver). This maneuver affects the trajectory of the ejection seat providing a greater increase in altitude than if ejection is performed in a level flight attitude. This gain in altitude will increase the time available for separation from the seat and deployment of parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out. When circumstances permit, slow the airplane down as much as possible prior to ejection to reduce the forces exerted on the body. The automatic-opening safety belt and the "zoom-up" maneuver provide maximum safety when ejection is necessary. The automatic-opening safety belt should never be opened before ejection for the following reasons:

1. If the safety belt is manually opened, the escape operation is considerably prolonged and the automatic-opening feature of the automatic-opening parachute will be eliminated. Manual deployment of the parachute will be required.
2. Manually opening the safety belt creates a hazard to survival during uncontrollable flight, since

SAFE EJECTION SPEEDS



---- TYPE C-9, 28 FT. FLAT CANOPY, TYPE B-4 PACK
—— TYPE C-9, 28 FT. FLAT CANOPY, TYPE B-5 PACK WITH ¼ BAG
—·— TYPE C-11, 30 FT. GUIDE CANOPY, TYPE B-5 PACK
WEIGHT–230 TO 250 POUNDS TOTAL

NOTE

This graph depicts safe ejection speeds for parachute structural capability under ideal level flight and average parachute performance conditions. Other ejection attitudes, tumbling, separation delays, variations in parachute opening time, etc., are not included.

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Figure 3-5

negative "g" forces may prevent the pilot from assuming the correct ejection position.

3. Manually opening the safety belt creates a hazard to survival if the pilot decides that he has insufficient altitude for ejection and is required to proceed with a forced landing. Both hands will probably be required to control the airplane and the pilot will not be able to fasten the safety belt and shoulder harness.
4. Manually opening the safety belt may cause the pilot to separate from the seat at any time during ejection. If the pilot separates from the seat immediately after the seat leaves the airplane, severe shock loads will be imposed on the body. The automatic-opening safety belt is designed to open 1 second after ejection, which is sufficient time for safe deceleration of the pilot while still in the seat.

In order to provide an improved low altitude escape capability, a parachute "D" ring lanyard will be provided to enable a "zero-second" time delay in chute deployment after seat separation. The "zero-second" chute timing with the previously discussed one second-automatic-opening safety belt, provides what is known as a "one and zero" escape system.

Note

The two second safety belt, if utilized, would provide a "two and zero" system.

The lanyard merely connects the parachute arming knob to the parachute "D" ring. When the pilot separates from the seat and the parachute arming knob is pulled, the "D" ring is also pulled allowing immediate parachute actuation. This in effect bypasses the automatic-opening parachute device. Thus, the "D" ring lanyard must be connected to the parachute "D" ring under low altitude and low airspeed conditions. At other altitudes and airspeeds, the lanyard must be disconnected from the "D" ring and stowed allowing the automatic-opening parachute timer to actuate the parachute below critical opening speeds and below the prescribed altitude setting. The fastening or unfastening of the "D" ring lanyard to the parachute "D" ring must be done manually and at the correct times by the pilot as outlined in Section II. A ring attached to the parachute harness is provided for stowage of the lanyard when it is not hooked into the parachute "D" ring. There may be several lanyard configurations in service use, but their use will be identical and the hook and attaching positions will be similar. In order to determine the minimum possible ejection altitude with the "D" ring lanyard attached to the parachute "D" ring, the following information must be determined:

1. Ejection seat catapult designation.
2. Automatic-opening safety belt initiator type.
3. Style of automatic-opening parachute, pack, canopy and automatic release which is defined in T.O. 14D1-1-1.

Concerning no. 1 above, the M-3 catapult is utilized in this aircraft. For no. 2 above, the (20)(25)(30) aircraft utilize the two second (M4 initiator) type safety belt, and the (35) airplanes provide the one second (M12 initiator) type safety belt. This information in no. 3 must be determined by the using organization. Utilize the following chart to determine the minimum ejection altitude for the "D" ring lanyard "hooked" or "stowed" conditions, i.e., with the "D" ring lanyard stowed, a two second parachute (F-1A timer) with a B-4 pack and C-9 canopy and the one second safety belt, minimum ejection altitude would be 300 feet. The two second safety belt will affect a minimum of 500 feet ejection altitude with the same equipment. With the "D" ring lanyard hooked and the same equipment, the minimum altitudes would be zero feet and 125 feet respectively.

MINIMUM ALTITUDES FOR UPWARD EJECTION

AUTOMATIC OPENING SAFETY BELT (INITIATOR)	"D" RING LANYARD STOWED				"D" RING LANYARD HOOKED	
	2 SECOND PARACHUTE (F-1A TIMER)		1 SECOND PARACHUTE (F-1B TIMER)		ZERO SECOND PARACHUTE	
	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY
1 SECOND (M12 INITIATOR)	300	350	125	200	0	100
2 SECOND (M4 INITIATOR)	500	550	300	350	125	200

NOTE: These are emergency minimums. Ejection should be started above 2000 feet, if possible.

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Note

The above data and the chart data is applicable for LEVEL FLIGHT attitudes. The data is optimistic for diving flight, and conservative for climbing flight. Since the "D" ring lanyard will only be utilized during take-off and landing phases of flight or similar operations, the chart data is only applicable to speeds at 140 to 300 knots IAS.

HIGH ALTITUDE EJECTION

For a high altitude ejection, the basic ejection procedures (figure 3-4) is applicable. The "zoom up" maneuver is still useful to slow the airplane to a safer ejection speed or provide more time and glide distance as long as an immediate ejection is not mandatory.

WARNING

During high altitude operation, the "D" ring lanyard MUST NOT be hooked to the parachute

"D" ring. If the "D" ring lanyard is hooked to the "D" ring, the safety feature of the automatic-opening parachute will be eliminated. If it becomes necessary to bail out at high altitude, the parachute will open immediately, subjecting the pilot to serious or fatal injury.

EJECTION SEAT FAILURE

In the event that the canopy has been jettisoned but the ejection seat fails, proceed as follows:

1. If time and conditions permit, reduce airspeed to approximately 275 knots IAS.
2. Unfasten safety belt, actuate bail-out bottle (if necessary) and disconnect personal leads (radio, face heat, oxygen, anti-G-suit).
3. Run trim to full nose down, holding aft stick pressure. Invert airplane while maintaining positive "g" loading. When inverted, release stick and push free of seat.
4. Pull "D" ring or automatic-opening parachute lanyard to open parachute.

TAKE-OFF AND LANDING EMERGENCIES

ABORTED TAKE-OFF

Refer to Engine Failure During Take-Off - Before Airborne, Procedures 1 through 6.

FORCED LANDING

WARNING

All forced landings shall be made with the landing gear extended, regardless of terrain. A greater injury hazard is presented whenever emergency landings are made with the landing gear retracted. Increased airspeed or nose-high angle of impact during landings with gear retracted is common practice and contributes greatly to pilot injury and aircraft damage. This nose-high attitude causes the aircraft to "slap" the ground on impact, subjecting the pilot to possible spinal injury. Less injury and less aircraft damage will result with the gear extended.

It is recommended that a gear-up landing NOT be attempted with this aircraft; the pilot should EJECT instead. However, if a gear-up landing is unavoidable, proceed with the following:

1. If external tanks contain fuel - JETTISON
   a. External tank emergency release handle - PULL (20)(25)
   b. External tank emergency button - DEPRESS (30)(35)

Note

Jettison tanks only if fuel cannot be transferred. Empty tanks should be retained to absorb the shock of landing on a prepared surface.

2. If time and conditions permit, burn excess fuel to lighten aircraft as much as possible.
3. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore, locking the shoulder harness may prevent some pilots from reaching the necessary controls.

4. Canopy - JETTISON
   Jettison canopy by pulling the canopy alternate jettison handle.
5. Make normal approach.
6. Touchdown in normal landing attitude.
7. Drag chute - DEPLOYED
8. Engines - SHUTDOWN
   a. Throttles - CLS'D
   b. Engine master switches - OFF
9. Generator switches - OFF
10. Battery switch - OFF
11. Clear aircraft as soon as possible.

ONE GEAR UP OR UNLOCKED

Unsafe Indication

An unsafe gear indication does not necessarily constitute an emergency. The unsafe indication could be caused by a malfunction within the indicating system or the result of incorrect gear lowering procedure coupled with a low pressure condition of the utility hydraulic system. Upon initial detection of unsafe gear indication, proceed as follows:

1. Check utility hydraulic pressure within limits.
2. Check airspeed below 250 knots IAS.
3. Recycle normal landing gear handle.
4. Attempt to lower gear by emergency gear lowering procedure. Refer to Landing Gear Emergency Lowering, this section.
5. Make "fly-by" gear check or wing man visual check.
6. If gear appears safe, make a normal landing and observe the following precautions:
   a. Shoulder harness inertial reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore locking the shoulder harness may prevent some pilots from reaching the necessary controls.

b. Land on side of runway opposite indicated unsafe main gear. Center of runway for indicated unsafe nose gear.
c. Throttles IDLE at touchdown.
d. With main gear unsafe indication: Lower nose gear to runway immediately upon touchdown and deploy drag chute.
e. With nose gear unsafe indication: Deploy drag chute immediately upon touchdown and hold nose gear "off" until approximately 110 knots then lower gently to the runway.

Note

- The horizontal stabilizer begins losing control effectiveness at approximately 110 knots.
- Allow airplane to roll straight ahead applying minimum brake applications. After completing landing roll, do not taxi until maintenance personnel has inserted the ground lock safety pins.

Landing With One Main Gear Up or Unlocked

In the event one main gear remains up or in an intermediate position, after all procedures to extend have failed, the following factors should be considered before making a final decision to land:

1. Crosswind effect.
   Refer to Crosswind Landing, Section II.
2. Width and length of runway.
3. Utility hydraulic system failure.
   With a utility system failure, nose gear steering, wing flaps, and normal braking will not be available.
4. Ground condition.

If the above factors are not sufficiently favorable, the pilot should EJECT.

If a decision to land is made, proceed as follows:

Note

- If time and conditions permit, lighten the aircraft by burning out excess fuel load.
- If external tanks are carried, burn out external fuel and retain tanks to absorb initial shock.

1. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore locking the shoulder harness may prevent some pilots from reaching the necessary controls.

2. Canopy - JETTISON
   Prior to landing, jettison the canopy by pulling the canopy alternate jettison handle.
3. Make normal final approach.
4. Land on side of runway opposite failed gear.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
   c. Ease nose gear to runway.
6. Hold unsafe gear "off" as long as possible.
7. Utilize nose gear steering for directional control.
8. Engine master switches - OFF
9. All electrical switches - OFF
10. Abandon aircraft as soon as possible.

Landing With Nose Gear Up or Unlocked

In event the nose gear remains up or in an intermediate position and all procedures to extend have failed, proceed as follows:

Note

- If time and conditions permit, lighten the aircraft by burning out excess fuel load.
- If external tanks are carried, burn out external fuel and retain tanks to absorb initial shock.

1. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore locking the shoulder harness may prevent some pilots from reaching the necessary controls.

2. Canopy - JETTISON
   Prior to landing, jettison canopy by pulling the canopy alternate jettison handle.
3. Make normal final approach.
4. Land in center of runway.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
   c. Hold nose "off" runway.
6. At approximately 110 knots, gently ease nose to runway.

Note

The horizontal stabilizer begins losing control effectiveness at approximately 110 knots.

7. Engine master switches - OFF
8. All electrical switches - OFF
9. Abandon aircraft as soon as possible.

LANDING WITH BOTH MAIN GEAR UP OR UNLOCKED

In the event both main gear remain up or in an intermediate position, after all procedures to extend have failed, the following factors should be considered before making a final decision to land:

1. Crosswind effect.
   Refer to Crosswind Landing, Section II.
2. Width and length of runway.
3. Utility hydraulic system failure.
   With a utility system failure, nose gear steering, wing flaps, and normal braking will not be available.
4. Ground condition.

If the above factors are not sufficiently favorable, the pilot should eject.

If decision to land is made, proceed as follows:

Note

- If time and conditions permit, lighten the aircraft by burning out excess fuel load.
- If external tanks are carried, burn out external fuel and retain tanks to absorb initial shock.

1. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore locking the shoulder harness may prevent some pilots from reaching the necessary controls.

2. Canopy - JETTISON
   Jettison the canopy by pulling the canopy alternate jettison handle.
3. Make normal final approach.
4. Hold normal attitude for touchdown.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
6. Utilize nose gear steering for directional control.
7. Engine master switches - OFF
8. All electrical switches - OFF
9. Abandon aircraft as soon as possible.

BLOWN TIRE

A situation may occur when the pilot must land with a blown tire, or the tire may rupture during ground roll. A blown tire at high speed will require immediate control action to keep the aircraft aligned with the runway. The following procedures are applicable:

1. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore locking the shoulder harness may prevent some pilots from reaching the necessary controls.

2. Make a normal final approach.
3. Land on side of runway opposite blown tire.
4. Make normal touchdown.
5. Utilize nose gear steering for directional control.
6. Drag chute - DEPLOYED
   When assured of directional control, deploy drag chute.
7. Use light opposite braking to slow the aircraft.

CAUTION

If possible, do not shutdown engines until adequate fire fighting equipment is available. The damaged wheel may be on fire or very hot and fuel drained overboard after engine shutdown could contact the hot wheel causing fire.

NO-FLAPS LANDING

A no-flaps landing is basically the same as a normal landing (figure 2-7) except that the pattern is expanded to avoid steep turns and the final approach speeds are increased to preclude high sink rates.

1. Fly a wide normal pattern.
2. Wing flap lever - RETRACT
3. Establish at least a two mile, low angle, straight-in approach.
4. Maintain applicable approach speed.

Total Fuel Remaining Lbs.	Final Approach Speed Kts. IAS
3000	185
4500	190
6000	195
7500	200
9000	205
10,500	210
12,000	215

5. Speed brake switch - CLOSED
   Leave speed brakes closed until after flare-out has been accomplished.
6. Maintain a mild rate of descent.
7. Fly the aircraft down to the runway.
   Do not flare the aircraft or "chop" power prior to crossing the end of the runway.
8. Make normal touchdown and roll-out.

RUNWAY OVERRUN BARRIER

Any time the aircraft cannot be stopped safely on the runway, attempt to engage the runway barrier executing as many of the procedures listed below as time will permit:

CAUTION

The aircraft may not engage the barrier if the nose gear hook and door beef-up has not been accomplished.

1. External tanks - JETTISON
   Jettison tanks as far away from the barrier as possible. Refer to Emergency Tank Jettison, this section.

CAUTION

In case of known emergency, jettison external tanks before landing. If tanks are jettisoned close to the barrier, they will probably roll into the barrier creating a fire hazard.

2. Speed brake switch - OPEN
3. Drag chute - DEPLOYED
4. Brakes - APPLIED
5. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore, locking the shoulder harness may prevent some pilots from reaching the necessary controls.

6. Utilize nose gear steering for directional control.
7. Steer aircraft toward center of barrier.
   a. If possible, engage barrier at a 90° angle to insure a more positive and safer engagement.
8. Throttles - CLS'D

Note

When engines have decelerated to low rpm, braking and steering will not be available. Emergency braking must be used.

9. Engine master switches - OFF
10. All electrical switches - OFF
11. Abandon aircraft as soon as possible.

EMERGENCY ENTRANCE

Procedures and precautions to be observed by rescue personnel when assisting the pilot from the airplane following a crash landing are outlined in figure 3-6.

DITCHING

Note

Thoroughly inspect emergency and survival equipment. Check parachute life vest, and raft (survival kit) prior to over water flights.

Ditch the aircraft only when no alternative is available. All survival equipment is carried by the pilot, thus ejection is advisable. However, if the situation demands ditching, observe the following:

1. Make radio distress call.
2. IFF master knob - EMERGENCY
3. External tanks - JETTISON
4. All personal leads (except oxygen) - DISCONNECTED
   Disconnect all personal leads, except oxygen hose, to prevent fouling when leaving the cockpit.
5. Oxygen diluter lever - 100% OXYGEN
6. Landing gear handle - UP
7. Wing flap lever - EXTEND
8. Canopy - JETTISON
   Prior to ditching, jettison canopy by pulling canopy alternate jettison handle. If canopy does not jettison, raise either handgrip.

WARNING

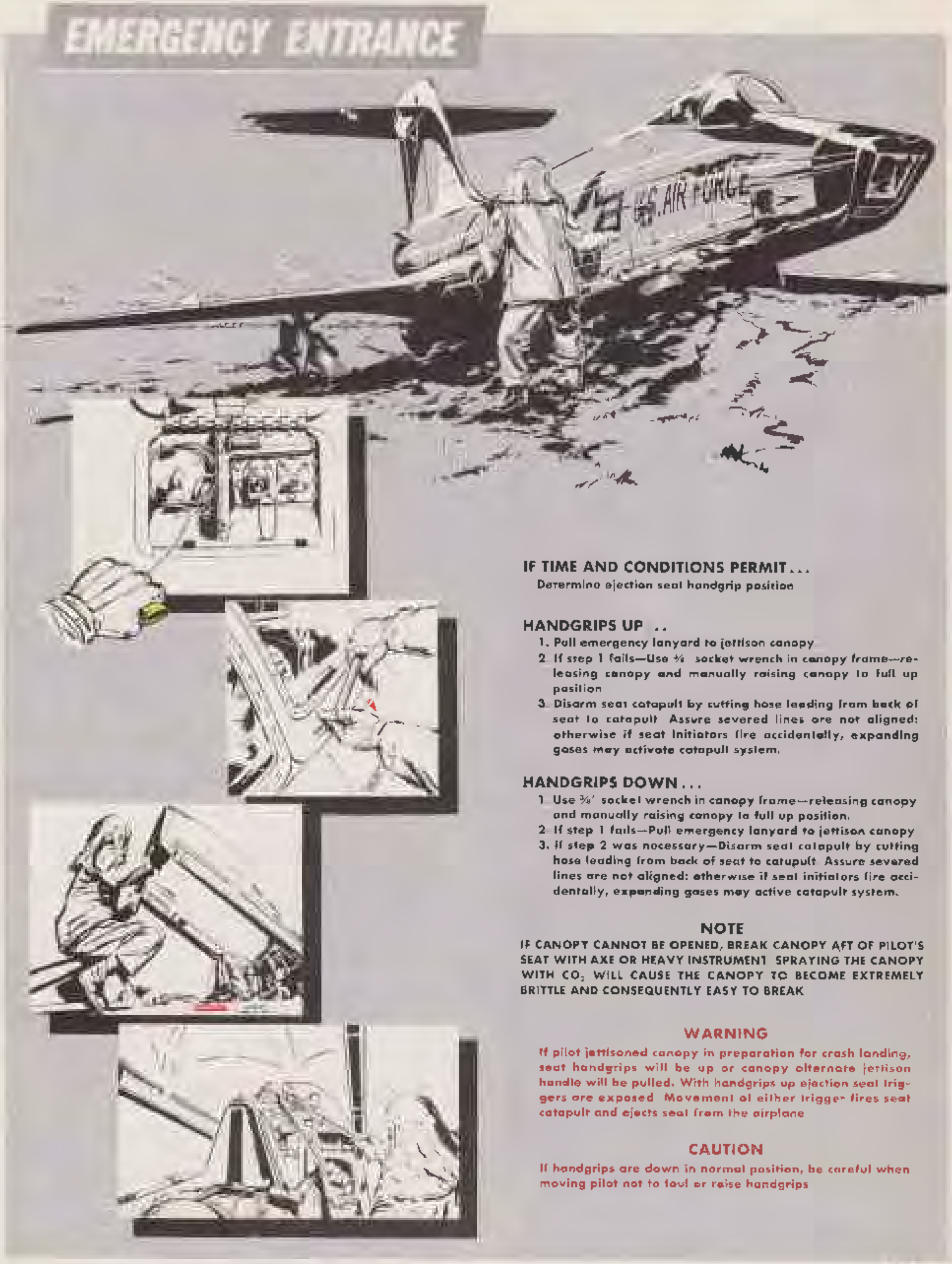
With handgrips up, seat ejection triggers are exposed and armed. Do not actuate either trigger as seat will eject.

9. Shoulder harness inertia reel handle - LOCKED

CAUTION

The pilot is prevented from leaning forward when the shoulder harness is locked. Therefore, locking the shoulder harness may prevent some pilots from reaching the necessary controls.

10. Fly approach heading parallel to any uniform swell pattern.
11. Engines - SHUTDOWN
    Prior to touchdown, shut down engines.
    a. Throttles - CLS'D
    b. Engine master switches - OFF
12. Make water touchdown -
    a. Normal flare-out
    b. Normal landing attitude
    c. Touchdown along wave crest.
13. Oxygen hose - DISCONNECT
    Disconnect oxygen hose and release mask from face as cockpit is abandoned.



IF TIME AND CONDITIONS PERMIT . . .

Determine ejection seat handgrip position

HANDGRIPS UP . .

1. Pull emergency lanyard to jettison canopy
2. If step 1 fails—Use ⅜ socket wrench in canopy frame—releasing canopy and manually raising canopy to full up position
3. Disarm seat catapult by cutting hose leading from back of seat to catapult. Assure severed lines are not aligned: otherwise if seat initiators fire accidentally, expanding gases may activate catapult system.

HANDGRIPS DOWN . . .

1. Use ⅜" socket wrench in canopy frame—releasing canopy and manually raising canopy to full up position.
2. If step 1 fails—Pull emergency lanyard to jettison canopy
3. If step 2 was necessary—Disarm seat catapult by cutting hose leading from back of seat to catapult. Assure severed lines are not aligned: otherwise if seat initiators fire accidentally, expanding gases may active catapult system.

NOTE

IF CANOPY CANNOT BE OPENED, BREAK CANOPY AFT OF PILOT'S SEAT WITH AXE OR HEAVY INSTRUMENT. SPRAYING THE CANOPY WITH CO_2 WILL CAUSE THE CANOPY TO BECOME EXTREMELY BRITTLE AND CONSEQUENTLY EASY TO BREAK

WARNING

If pilot jettisoned canopy in preparation for crash landing, seat handgrips will be up or canopy alternate jettison handle will be pulled. With handgrips up ejection seat triggers are exposed. Movement of either trigger fires seat catapult and ejects seat from the airplane

CAUTION

If handgrips are down in normal position, be careful when moving pilot not to foul or raise handgrips

Figure 3-6

EMERGENCY TANK JETTISON

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Figure 3-7

Note

In the event of ditching, and sinking in water when immediate escape is impossible, it is possible for the pilot to survive under water with oxygen equipment until escape can be made. The MB-1 diluter demand type oxygen regulator is a suitable underwater breathing device when the regulator is set at 100% OXYGEN. It is essential that the mask be tightly strapped, in place, and the diluter lever in 100% OXYGEN.

WARNING

Using the bail-out bottle with oxygen hose disconnected will not supply sufficient oxygen for survival. The decrease of pressure within the mask hose during inhalation allows water to enter the valve at the connection fitting.

EXTERNAL TANK EMERGNCY JETTISON

The procedures for external tank jettison are shown in figure 3-7.

CAUTION

Do not jettison external tanks containing partial fuel except in an emergency. If such action is necessary, jettison tanks in a slight dive to allow fuel to drain forward. This permits a cleaner separation and reduces the possibility of further damage to the aircraft.

AFTERBURNER FAILURE

If the afterburner(s) fails during take-off the resultant loss of thrust is approximately 30 to 35% of Military thrust. After the failure, the exhaust nozzle remains open until afterburner fuel flow is stopped. Take-off need not be aborted if remaining runway is compatible with power available, refer to Appendix I charts. The failed engine afterburner throttle should be moved inboard, out of afterburner, immediately to insure exhaust nozzle closure and Military thrust availability. Relights may be attempted if normal exhaust nozzle operation was evident, when safe altitude and airspeed are reached.

AFTERBURNER NOZZLE FAILURE

Upon initiating afterburner, exhaust nozzle failure to open is recognized by a loud explosion, violent surging, accompanied by a rapid rise in exhaust temperature and an rpm reduction. Any of these conditions is cause to move the throttle inboard immediately, terminating afterburner to prevent possible damage to engine and aircraft structure. There is no emergency override or manual control provided for the exhaust nozzle.

CAUTION

If the exhaust nozzle fails to close when the afterburner is shutdown, a loss of thrust normally available will occur. This thrust reduction will be evident throughout the entire operating range of the engine, with particular effect at the Military (OPEN) thrust setting. Nozzles can be often closed by bringing the throttle of the affected engine to IDLE then readvancing to desired power.

AFTERBURNER "BLOWOUT" DURING FLIGHT

In the event of afterburner "blowout" or loss of afterburning, the failed engine afterburner throttle must be moved inboard immediately. If no obvious cause (overheat) is discernible, a relight may be attempted. If cockpit indications of resumed afterburning are normal, continue afterburner operation.

Note

Allow a 3 to 5 second period between afterburner termination and relight to assure adequate fuel to igniter.

OIL 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 a 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, operating temperatures of bearings, and bearing loads. A good possibility exists for 10 to 30 minutes of 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. At this time, an engine shutdown should be made to prevent such a destructive engine failure that would jeopardize a successful ejection or a forced landing. Upon first recognition of sustained oil system failure (above or below limitations), complete the following:

1. Affected engine - SHUTDOWN
   Unless critical thrust condition exists, shutdown the affected engine.
2. If affected engine thrust is needed, reduce power to lowest setting to maintain flight and avoid rapid throttle movement.
3. Only if conditions warrant, external tanks - JETTISON
4. Avoid abrupt maneuvers.
   Avoid maneuvers that require excessive "g" forces.
5. After critical thrust condition subsides, affected engine - SHUTDOWN

Note

- Since the generator oil supply is taken from the engine supply tank, a generator warning light illumination could be an early indication of engine oil starvation even before an appreciable decrease in oil pressure is indicated on the oil pressure gage. Consequently, if a generator light illuminates, the oil pressure gage for that engine should be monitored until the possibility of oil starvation is disproven.
- If the affected engine was shut down immediately after recognition of oil system failure, it may be restarted just prior to entering the traffic pattern and operated at IDLE throughout the landing phase. This will provide available thrust in the event of an emergency during landing.

FUEL SYSTEM EMERGENCY OPERATION

ENGINE FUEL SYSTEM

Engine Driven Fuel Pump Failure

In the event that engine fuel pump fails, the afterburner pump automatically assumes the full unit demands. There will be no indication to the pilot of this failure. Normal engine performance, both afterburner and normal, is available except at low altitudes where heavy fuel demands may cause partial afterburning power. Should the failure occur in the afterburner pump, there will be no automatic transfer and afterburning will not be available.

Engine Fuel Control Failure

Failure within an engine fuel control is evidenced by abnormal increase or decrease of engine rpm, thrust, or temperature, or by the inability to reduce rpm. For such instances, transfer to the emergency fuel control system by selecting the EMERG position on the selector switch. If time and conditions permit, avoid an immediate transfer and make selection in accordance with the following:

1. Adjust throttle to match engine rpm.
   Adjust throttle setting to match actual engine rpm as closely as practicable. Do not make transfer at or near full throttle because emergency fuel flow may exceed engine requirements and produce compressor stall or overtemperatures.

Note

If conditions permit, most satisfactory transfer will result with the throttle in IDLE.

CAUTION

If the throttle setting and engine rpm are seriously mismatched with throttle setting higher than engine rpm, flame-out, compressor stall, or overtemperature may result during transfer to emergency system. The pilot should be prepared to retard the throttle immediately if required.

2. Fuel control system switch - EMERG
3. Slowly move throttle to desired setting.

CAUTION

- The pilot must monitor all engine instruments while utilizing the emergency system. Throttle movements must be made with caution since the emergency control cannot prevent overtemperature, stall or surge reactions.

- If the emergency system was selected because of main system failure, DO NOT transfer back to the main system. Flame-out or engine limits could be exceeded causing engine damage.

AIRPLANE FUEL SYSTEM

Booster Pump Failure

If fuel booster pumps fail, fuel will still be supplied to the engine by suction feed (below 25,000 feet). During suction feed, high fuel flow rates required by afterburning will limit afterburner operations. There is no indication to the pilot of such a condition until engine or afterburner operation is affected. When the combined demands of engine and afterburner fuel flow cannot be met by suction feed, compressor stall, engine surge, or loss of thrust may result. In the event that abnormal engine performance is encountered during afterburning, shift throttle inboard to terminate afterburning.

CAUTION

If booster pumps fail at altitudes above 30,000 feet flame-out of both engines may occur.

Transfer Pump Failure

Normally, the transfer pumps in fuselage cells 1 and 5 will operate until their respective cells are empty. Cell 5 must empty before the pump in cell 4 will operate. Failure of the pump in cell 5 will result in the inability to transfer fuel from cells 4 and 5 except by gravity flow through the cell interconnectors. Transfer pump failure is indicated by illumination of the feed tank low level warning light, or abnormal reduction of fuel in cell number 2, while the fuel level in cell(s) 4 and/or 5 remain full. If a transfer pump failure has been detected, proceed as follows:

1. Fuel pumps switch - ALL PUMPS (20)
2. Fuel transfer selector switch - ALL PUMPS (25)(30)(35)

Note

Selecting the ALL PUMPS position will energize all fuselage transfer pumps.

3. Check for transfer pump operation.
   A decrease in individual cell (fuselage cells 1, 4 and 5) quantity will indicate transfer pump operation.

CAUTION

To prevent overheating the pump units, the transfer system should be returned to normal operation after the cell, with the defective transfer pump, is empty.

4. If defective transfer pump is still inoperative:
   a. Reduce power.
   b. Land as soon as practical.

WARNING

If either cell 4 or 5 has the defective pump, maintain nose down attitudes to bring the center of gravity forward as much as possible before proceeding to land.

Note

- Use of maximum thrust or military thrust should be governed by the amount of fuel remaining in #2 tank.

- During gravity transfer (all fuselage transfer pumps inoperative) approximately 2000 pounds of fuel will be trapped in the fuselage cells. A nose up flight attitude will reduce the amount of trapped fuel in fuselage cell number 1. A more down attitude will reduce the amount of trapped fuel in fuselage cells 4 and 5.

ELECTRICAL SYSTEM EMERGENCY OPERATION

SINGLE GENERATOR FAILURE

Failure of one generator will be noted by illumination of one warning light. The light will indicate which generator has failed. One generator in normal operation is sufficient to support the entire electrical demand or load. In event of generator failure, the pilot should take the following action:

CAUTION

Upon illumination of a generator warning light, immediately check the corresponding oil gage. The generator failure could have been caused by oil starvation which will warrant an engine shutdown.

1. Generator switch - RESET
2. Generator switch - ON
   After placing generator switch momentarily to RESET, return to ON position.
3. Check generator warning light - OUT
   If generator fault has been corrected, the generator will be reconnected to the system and the warning light will go out.
4. If generator warning light remains illuminated:
   a. Remaining generator switch - OFF
   b. Failed generator - RESET
   c. If a-c power is restored, either generator may be used for the remainder of the flight.
5. If a-c power is not restored:
   a. Return to operational generator.
   b. Failed generator switch - OFF
   c. Land as soon as practicable.

DOUBLE GENERATOR FAILURE

Engines Operating

When both generators fail, both warning lights will be illuminated. All a-c power is lost. The battery will provide d-c power, provided the battery switch is ON, for a limited time only. Attempt to reset the generators. If one or both generators return to operation, the light or lights will go out. If the attempt to reset the generators is unsuccessful, land as soon as possible. Keep radio transmission to a minimum and turn off all non-essential electrical equipment. See figure 1-15, Electrical System Schematic, for battery operated equipment.

CAUTION

With both generators disconnected from the bus system, normal transfer pump sequence is inoperative.

Immediately upon illumination of both generator warning lights, perform the following:

1. Battery switch - OFF
   To conserve the battery, turn battery switch OFF until non-essential electrical equipment can be turned off.
2. All electrical switches - OFF
   Turn off all electrical equipment that is not essential to maintain flight.
3. Generator switches - RESET
4. Generator switches - ON
   After placing generator switches momentarily to RESET, return to ON position.
5. Check generator warning lights - OUT
   If fault has been corrected, the generator(s) will be reconnected to the system and the warning light(s) will go out.
6. If generator warning light(s) remain illuminated:
   a. Generator switch(s) - OFF
   b. Land as soon as possible.

CAUTION

With a double generator failure, thought must be given to conserving the battery for selective power for the gear and flaps and for vital radio transmission. With all electrical equipment off, turn battery switch ON just long enough to extend the landing gear and flaps obtaining a positive indication of gear down and locked and flap position, and to make necessary radio transmission, then turn battery switch OFF. Prior to touchdown, the battery switch may be turned ON again to select nose gear steering.

Engines Inoperative

The generators may automatically disconnect due to engine underspeed or malfunction and through no fault of the generators. A-c power will be available to boost pumps and emergency ignition as long as the engine rotates, however, the power will be low frequency and possibly low voltage. Air starts may be attempted providing engine failure is not attributed to mechanical reasons. With the engines restarted the generator warning lights will go out and normal operation will be resumed. D-c power is available during emergencies providing the battery switch is ON.

HYDRAULIC SYSTEM EMERGENCY OPERATION

The loss of one hydraulic pump will be noted by a warning light illumination. The loss of a pump or one entire system presents no serious problem since both systems support each other through dual cylinders actuating the primary flight controls.

PRIMARY HYDRAULIC SYSTEM FAILURE

In the event of loss of primary hydraulic system pressure, all power control system dual units will operate normally by utility system pressure. Adequate pres-

EMERGENCY GEAR OPERATION

sure from the utility system is insured by a priority valve in the utility system which closes when system pressure drops below 1800 psi. Closure of the priority valve denies pressure to all hydraulically actuated units except the ailerons, stabilizer, rudder, and brakes.

UTILITY HYDRAULIC SYSTEM FAILURE

Loss of utility hydraulic system pressure allows the primary system to assume full demand of the flight control dual units. The rudder will no longer be power operated but will be manually controlled by direct rudder pedal pressure. Most units lost have emergency methods of operation and are available as noted:

1. Speed brake retraction is available by electrical selection which causes the pressure to bypass allowing the airstream to force the panels closed. Refer to Speed Brake System Emergency Operation, this section.
2. Gear extension is available by use of compressed air accomplished by pilot's utilization of the manual pull handle to the left outboard of the console. Refer to Landing Gear Emergency Lowering, this section.
3. Brake action is retained by use of compressed air system, at the pilot's selection by using the manual pull handle on the left forward console. Refer to Brake System Emergency Operation, this section.

CAUTION

With utility hydraulic system failure, neither speed brakes nor flaps will be available for landing. Approach and touchdown speeds must be higher. Refer to No-Flaps Landing, this section.

COMPLETE HYDRAULIC SYSTEM FAILURE

In the event of complete hydraulic failure the aircraft will become uncontrollable. Pilot should, upon initial detection of hydraulic power loss, note trend of failure as to whether the gages show a definite, steady drop, or if the gages fluctuate. With a steady drop indication, hydraulic power will probably not recover. As quickly as possible the pilot should decrease airspeed, attain level flight, then EJECT.

FLIGHT CONTROL SYSTEM EMERGENCY OPERATION

In the event of primary utility system failure, the control forces will remain unchanged, with the exception

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Figure 3-8

of the rudder system. Refer to Utility Hydraulic System Failure, this section.

SPEED BRAKE SYSTEM EMERGENCY OPERATION

Should the normal operating system or the utility hydraulic system fail, and the speed brakes are extended, they may be retracted by placing the emergency switch on the landing gear control panel to the IN position. This allows the air loads to close the panels to a trailing position.

Note

When speed brakes are closed by use of the emergency switch, there is a possibility that speed brakes will reopen by returning the speed brake emergency switch to NORMAL position.

LANDING GEAR SYSTEM EMERGENCY OPERATION

LANDING GEAR RETRACTION

There are no provisions for emergency retraction of the landing gear in flight. In the event of an emergency where gear retraction is necessary during ground operation, the gear handle may be raised by exerting a force of approximately 35 lbs. permitting the gear to collapse.

LANDING GEAR EMERGENCY LOWERING

If normal gear operation fails, the gear can be lowered by utilizing the procedures in figure 3-8.

Note

- The landing gear circuit breaker must be pulled and left in this position to prevent hydraulic reservoir rupture and a subsequent fire hazard. When the landing gear circuit breaker is pulled, neither nose gear steering nor landing lights will be available.

- Actuating the landing gear emergency system will cause a considerable amount of hydraulic fluid to be blown out the left fuel vent mast. This is normal and should not be considered as an additional malfunction by any observing aircraft.

CAUTION

Retain landing gear emergency handle in the locked (out) position. Returning the handle to its normal (stowed) position allows the compressed air from the gear down side of the actuating cylinder to be vented overboard.

BRAKE SYSTEM EMERGENCY OPERATION

In event of utility hydraulic system failure or loss of brake action, the airplane can be stopped by using the emergency brake system.

1. Allow aircraft to decelerate.
   Utilize aerodynamic braking and delay using wheel brakes as long as safety will permit, thus allowing the aircraft to decelerate as much as possible.
2. Emergency brake handle - PULL
   After determining that a go-around will not be made, pull the emergency brake handle.
3. Brakes - APPLIED
   Apply brakes evenly and simultaneously. Best braking will be obtained by applying a steady pressure on the brake pedals, slight at first and gradually increasing to maximum braking (just below the skid point) as the aircraft decelerates.

CAUTION

- Special attention must be given to maintaining directional control since there is approximately a one second delay between actuation or release of brake pedal force and brake response when compressed air is utilized for braking.

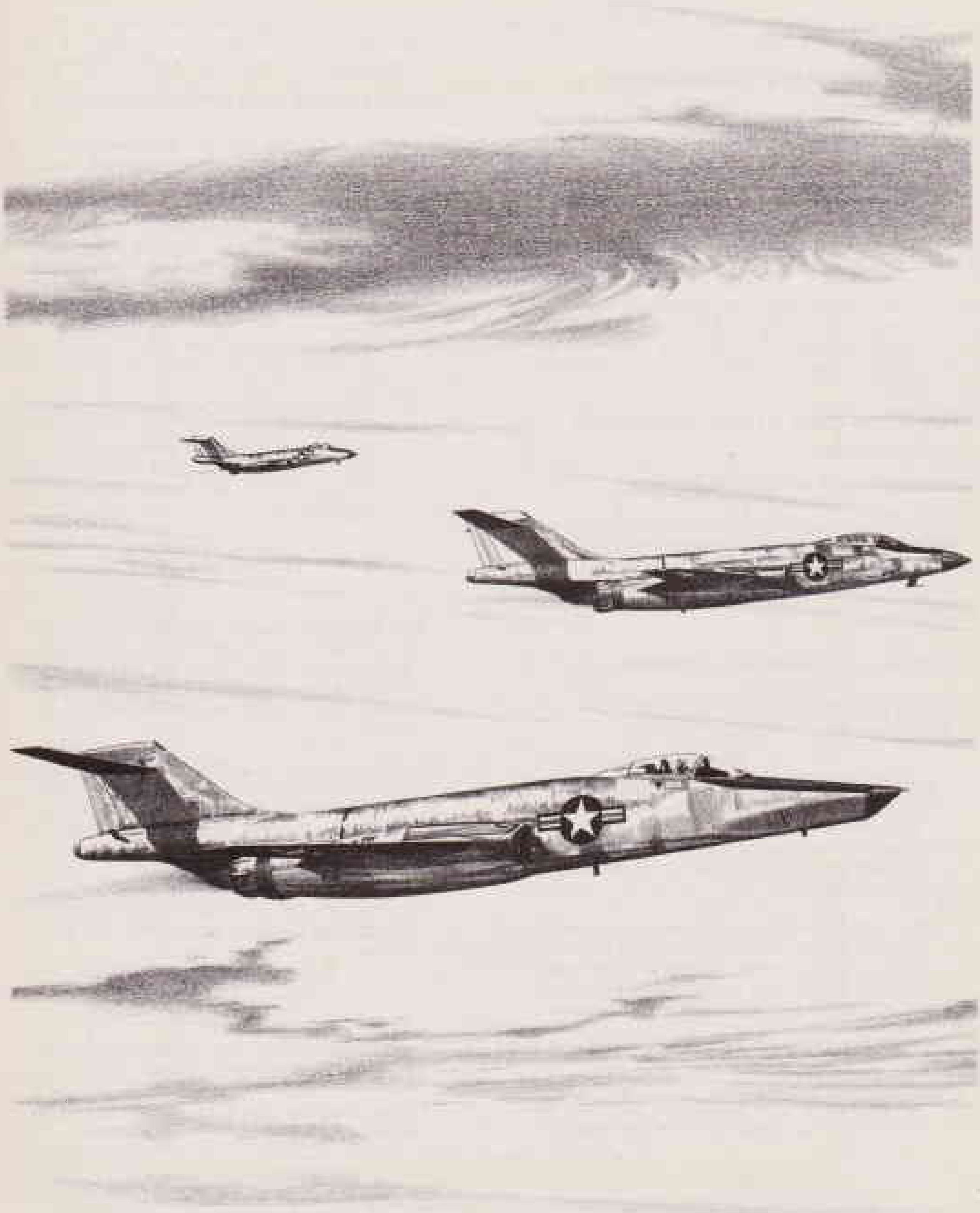
- Approximately three full brake applications will be available from the emergency brake system due to the fact that releasing then reapplying brakes will cause brake pressure to bleed. However, as long as steady force is applied the air will remain constant.

- Aircraft should be stopped straight ahead on runway with minimum number of brake applications.

Note

- Nose gear steering will not be available with utility hydraulic system failure.

- After using the emergency brake system, an entry in AFTO Form 781 must be made.



CUT ON THIS LINE

RF-101A CONDENSED CHECKLIST

The following check lists are condensed versions of the procedures presented in Section III. These condensed check lists are arranged so that you may remove them from your Flight Manual and insert them into a flip pad for convenient use. They are arranged so that each action is in sequence with the expanded procedure given in Section III. Presentation of these condensed check lists does not imply that you need not read and thoroughly understand the expanded versions. To fly the airplane safely and efficiently, you must know the reason why each step is performed and why the steps occur in certain sequence.

CODE

(20) Block 20 airplanes (54-1494 thru 54-1496)

(25) Block 25 airplanes (54-1497 thru 54-1507)

(30) Block 30 airplanes (54-1508 thru 54-1518)

(35) Block 35 airplanes (54-1519 thru 54-1521 and 55-155 thru 55-161)

ENGINE FAILURE

ENGINE FAILURE DURING TAKE-OFF

Before Airborne

1. Throttles - IDLE
2. Drag chute - DEPLOYED
3. Speed brakes switch - OPEN
4. Brakes - APPLIED
5. Nose gear steering - ENGAGED
6. If aircraft cannot be stopped - JETTISON CANOPY

After Airborne

1. Operating engine - AFTERBURNER
2. Landing gear handle - UP
3. External tanks - JETTISON
4. Maintain level flight
5. Wing flap lever - RETRACT
6. Failed engine - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF

ENGINE FAILURE DURING FLIGHT

1. Positively determine which engine has failed.
2. Throttle - CLS'D
3. If engine failed for other than mechanical reasons, prepare for air start.

DOUBLE ENGINE FAILURE DURING FLIGHT

1. Left throttle - CLS'D
2. Right throttle - IDLE
3. Right engine ignition button - DEPRESS
4. Descend to 30,000 feet.

If right engine does not start by 30,000 feet:

5. Right throttle - CLS'D
6. Left engine - AIR START

If neither engine starts by 20,000 feet, it can be assumed that the ignition system is at fault.

7. Generator switches - OFF
8. Right engine - AIR START
9. If right engine does not start, attempt to start the left engine in the same manner.

AIR START

When Flame-Out Occurs

1. Throttle - CLS'D

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CUT ON THIS LINE

CUT ON THIS LINE

2. Engine master switch - ON
3. Generator switch - ON
4. Battery switch - ON
5. Fuel selector switch - NORMAL
    a. If primary fuel system failure is suspected, fuel system selector switch - EMERG

Air Start

1. Emergency ignition button - DEPRESS
    a. Hold emergency ignition button depressed while advancing throttle to IDLE (20)(25)(30)
    b. Momentarily depress emergency ignition button while advancing throttle to IDLE (35)
2. Start is indicated by rapid increase in rpm followed by rise in exhaust temperature.
3. If satisfactory air start is accomplished, advance throttle to desired thrust.
4. Discontinue start if one of the following conditions occur:
    a. Light-up does not occur within 20 seconds after throttle is advanced to IDLE.
    b. The engine fails to accelerate to idle rpm within approimately 45 seconds after light-up.
    c. The exhaust temperature exceeds maximum limitations.
    d. The oil pressure does not attain the minimum of 30 psi.
5. If air start does not occur:
    a. Emergency fuel switch - EMERGENCY
    b. Repeat previous steps.

GLIDE DISTANCE

To obtain maximum glide distance while maintaining sufficient airspeed to provide adequate flight control hydraulic pressure:

1. Landing gear handle - UP
2. Wing flap lever - RETRACT
3. External tanks - JETTISON
4. Airspeed - 250 KNOTS IAS

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SINGLE-ENGINE LANDING

1. Fly a wide normal pattern.
2. Landing gear lever - DOWN
3. Wing flap lever - RETRACT
4. Establish at least two mile straight-in final approach. Maintain a minimum of 85% engine rpm.
5. Establish applicable approach speed using intermittent application of speed brakes.

Total Fuel Remaining Lbs.	Final Approach Speed Kts. IAS
3000	185
4500	190
6000	195
7500	200
9000	205
10,500	210
12,000	215

6. Speed brake switch - CLOSED
7. Maintain a mild rate of descent.
8. Wing flap lever - EXTEND
9. Fly the aircraft down to the runway.
10. Make normal touchdown and roll-out.

ENGINE FIRE DURING STARTING

1. Throttles - CLS'D
2. Engine master switches - OFF
3. External electrical and compressed air units - DISCONNECTED
4. Leave aircraft as quickly as possible.

ENGINE FIRE DURING TAKE-OFF

Before Airborne

1. Throttles - IDLE

CUT ON THIS LINE

CUT ON THIS LINE

2. Drag chute - DEPLOYED
3. Speed brakes switch - OPEN
4. Brakes - APPLIED
5. Nose gear steering - ENGAGED
6. If aircraft cannot be stopped - JETTISON CANOPY
7. Throttles - CLOSED
8. Engine master switches - OFF
9. Leave airplane as soon as possible.

After Airborne

Burner Compartment (Flashing) Light

1. Normal operating engine - AFTERBURNER
2. Throttle (engine indicating fire) - IDLE
3. Landing gear handle - UP
4. External tanks - JETTISON
5. Continue level flight
6. Wing flap lever - RETRACT
7. If light continues flashing, shut down appropriate engine.
   a. Throttle - CLS'D
   b. Engine master switch - OFF
8. Check for indications of fire such as trailing smoke, verification from tower or another aircraft, etc.
9. If fire exists, climb to safe ejection altitude and eject.

Engine Compartment (Steady) Light

1. Normal operating engine - AFTERBURNER
2. Throttle (engine indicating fire) - CLS'D
3. Landing gear handle - UP
4. External tanks - JETTISON
5. Continue level flight
6. Wing flap lever - RETRACT
7. Engine master switch - OFF
8. Check for indications of fire such as trailing smoke, verification from tower or another aircraft, etc.
9. If fire exists, climb to safe ejection altitude and eject.

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ENGINE FIRE DURING FLIGHT

Burner Compartment (Flashing) Light

1. Reduce power and observe fire warning light.
   a. If light goes out, continue flight at reduced power settings and land as soon as possible.
   b. If light continues flashing, proceed with step 2.
2. Check for other fire indications such as fumes or trailing smoke.
   a. If no fire is apparent, continue flight at reduced power setting and land as soon as possible.
   b. If positive fire indications are discernible, proceed with step 3.
3. Engine (indicating fire) - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF
   c. If fire ceases, make single engine landing as soon as possible.
   d. If fire continues - EJECT

Engine Compartment (Steady) Light

1. Engine (indicating fire) - SHUTDOWN
   a. Throttle - CLS'D
   b. Engine master switch - OFF
2. If light goes out and there is no evidence of continuing fire, make a single engine landing as soon as possible.
3. If light remains illuminated and evidence of fire is apparent - EJECT
4. If light remains illuminated but no evidence of fire is apparent, make a single engine landing as soon as possible.

ENGINE FIRE AFTER SHUTDOWN

1. External compressed air source - CONNECTED
2. Throttle - CLS'D
3. Engine master switch - OFF
4. Engine start switch - START

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CUT ON THIS LINE

CUT ON THIS LINE

5. Allow engine to crank approximately 20 seconds.
6. Engine start switch - STOP START

ELECTRICAL FIRE

1. Battery switch - OFF
2. Generator switches - OFF
3. All electrical equipment switches - OFF
4. Battery switch - ON
5. Generator switches - ON
6. Turn on most essential electrical equipment.
7. If the trouble item is found, place the equipment OFF and pull the applicable circuit breaker.
8. If cause of fire cannot be found, continue flight with only essential equipment operating and land as soon as possible.

ELIMINATION OF SMOKE AND FUMES

1. Oxygen regulator diluter lever - 100% OXYGEN
2. Oxygen emergency toggle lever - EMERGENCY
3. Cabin air temperature knob - RAM AIR & DUMP

EJECTION

Before Ejection (High Altitude)

1. Slow aircraft as much as possible.
2. Actuate bail-out bottle.
3. Cabin air temperature knob - RAM AIR & DUMP
4. Loose equipment - STOWED
5. Obtain proper ejecting position.
   a. Feet on rudder pedals
   b. Thighs braced on seat cushion
   c. Sit erect with chin in
   d. Head hard back against headrest
   e. Arms braced in armrest

Before Ejection (Low Altitude)

1. Pull nose of aircraft above horizon.
2. Slow aircraft as much as possible.

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3. Obtain proper ejecting position.
   a. Feet on rudder pedals
   b. Thighs braced on seat cushion
   c. Sit erect with chin in
   d. Head hard back against headrest
   e. Arms braced in armrest

Ejecting

1. Either handgrip - PULL UP
2. Either trigger - SQUEEZE

After Ejecting

1. If automatic-opening safety belt fails to open after 2 seconds - Unfasten belt manually and kick free of seat.
2. With the automatic-opening, aneroid-type parachute, check arming lanyard pulled automatically. If lanyard is not pulled automatically, manually pull lanyard to arm aneroid automatic-opening device.
   a. Parachute will open at preset altitude.
   b. If below preset altitude, parachute will open at preset time interval

EJECTION SEAT FAILURE

1. If time and conditions permit, reduce airspeed to approximately 275 knots IAS.
2. Unfasten safety belt, actuate bail-out bottle (if necessary) and disconnect personal leads (radio, face heat, oxygen, anti-G suit).
3. Run trim to full nose down, holding aft stick pressure. Invert airplane while maintaining positive "g" loading. When inverted, release stick and push free of seat.
4. Pull "D" ring or automatic-opening parachute lanyard to open parachute.

TAKE-OFF AND LANDING EMERGENCIES

ABORTED TAKE-OFF

1. Throttles - IDLE

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CUT ON THIS LINE

CUT ON THIS LINE

2. Drag chute - DEPLOYED
3. Speed brakes switch - OPEN
4. Brakes - APPLIED
5. Nose gear steering - ENGAGED
6. If aircraft cannot be stopped - JETTISON CANOPY

FORCED LANDING

1. If external tanks contain fuel - JETTISON
   a. External tank emergency release handle - PULL (20)(25)
   b. External tank emergency button - DEPRESS (30)(35)
2. If time and conditions permit, burn excess fuel to lighten aircraft as much as possible.
3. Shoulder harness inertia reel handle - LOCKED
4. Canopy - JETTISON
5. Make normal approach.
6. Touchdown in normal landing attitude.
7. Drag chute - DEPLOYED
8. Engines - SHUTDOWN
   a. Throttles - CLS'D
   b. Engine master switches - OFF
9. Generator switches - OFF
10. Battery switch - OFF
11. Clear aircraft as soon as possible.

ONE GEAR UP OR UNLOCKED

Unsafe Indication

1. Check utility hydraulic pressure within limits.
2. Check airspeed below 250 knots IAS.
3. Recycle normal landing gear handle.
4. Attempt to lower gear by emergency gear lowering procedure. Refer to Landing Gear Emergency Lowering, this section.
5. Make "fly-by" gear check or wing man visual check.
6. If gear appears safe, make a normal landing and observe the following precautions:
   a. Shoulder harness inertia reel handle - LOCKED

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b. Land on side of runway opposite indicated unsafe main gear. Center of runway for indicated unsafe nose gear.
c. Throttles IDLE at touchdown.
d. With main gear unsafe indication: Lower nose gear to runway immediately upon touchdown and deploy drag chute.
e. With nose gear unsafe indication: Deploy drag chute immediately upon touchdown and hold nose gear "off" until approximately 110 knots then lower gently to the runway.

Landing With One Main Gear Up Or Unlocked

After all procedures to extend have failed, the following factors should be considered before making a final decision to land:

1. Crosswind effect.
2. Width and length of runway.
3. Utility hydraulic system failure.
4. Ground condition.

If the above factors are not sufficiently favorable, the pilot should EJECT.

If a decision to land is made, proceed as follows:

1. Shoulder harness inertia reel handle - LOCKED
2. Canopy - JETTISON
3. Make normal final approach.
4. Land on side of runway opposite failed gear.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
   c. Ease nose gear to runway.
6. Hold unsafe gear "off" as long as possible.
7. Utilize nose gear steering for directional control.
8. Engine master switches - OFF
9. All electrical switches - OFF
10. Abandon aircraft as soon as possible.

CUT ON THIS LINE

CUT ON THIS LINE

Landing With Nose Gear Up Or Unlocked

1. Shoulder harness inertia reel handle - LOCKED
2. Canopy - JETTISON
3. Make normal final approach.
4. Land in center of runway.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
   c. Hold nose "off" runway.
6. At approximately 110 knots, gently ease nose to runway.
7. Engine master switches - OFF
8. All electrical switches - OFF
9. Abandon aircraft as soon as possible.

LANDING WITH BOTH MAIN GEAR UP OR UNLOCKED

After all procedures to extend landing gear have failed, the following factors should be considered before making a final decision to land:

1. Crosswind effect.
   Refer to Crosswind Landing, Section II.
2. Width and length of runway.
3. Utility hydraulic system failure.
4. Ground condition.

If the above factors are not sufficiently favorable, the pilot should EJECT.

If decision to land is made, proceed as follows:

1. Shoulder harness inertia reel handle - LOCKED
2. Canopy - JETTISON
3. Make normal final approach.
4. Hold normal attitude for touchdown.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOYED
6. Utilize nose gear steering for directional control.
7. Engine master switches - OFF

8. All electrical switches - OFF
9. Abandon aircraft as soon as possible.

BLOWN TIRE

1. Shoulder harness inertia reel handle - LOCKED
2. Make a normal final approach.
3. Land on side of runway opposite blown tire.
4. Make normal touchdown.
5. Utilize nose gear steering for directional control.
6. Drag chute - DEPLOYED
7. Use light opposite braking to slow the aircraft.

NO-FLAPS LANDING

1. Fly a wide normal pattern.
2. Wing flap lever - RETRACT
3. Establish at least a two mile, low angle, straight-in approach.
4. Maintain applicable approach speed.

Total Fuel Remaining Lbs.	Final Approach Speed Kts. IAS
3000	185
4500	190
6000	195
7500	200
9000	205
10,500	210
12,000	215

5. Speed brake switch - CLOSED
6. Maintain a mild rate of descent.
7. Fly the aircraft down to the runway.
8. Make normal touchdown and roll-out.

RUNWAY OVERRUN BARRIER

1. External tanks - JETTISON

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CUT ON THIS LINE

CUT ON THIS LINE

2. Speed brake switch - OPEN
3. Drag chute - DEPLOYED
4. Brakes - APPLIED
5. Shoulder harness inertia reel handle - LOCKED
6. Utilize nose gear steering for directional control.
7. Steer aircraft toward center of barrier.
   a. If possible, engage barrier at a 90° angle to insure a more positive and safer engagement.
8. Throttles - CLS'D
9. Engine master switches - OFF
10. All electrical switches - OFF
11. Abandon aircraft as soon as possible.

DITCHING

1. Make radio distress call.
2. IFF master knob - EMERGENCY
3. External tanks - JETTISON
4. All personal leads (except oxygen) - DISCONNECTED
5. Oxygen diluter lever - 100% OXYGEN
6. Landing gear handle - UP
7. Wing flap lever - EXTEND
8. Canopy - JETTISON
9. Shoulder harness inertia reel handle - LOCKED
10. Fly approach heading parallel to any uniform swell pattern.
11. Engines - SHUTDOWN
    Prior to touchdown, shut down engines.
    a. Throttles - CLS'D
    b. Engine master switches - OFF
12. Make water touchdown -
    a. Normal flare-out
    b. Normal landing attitude
    c. Touchdown along wave crest.
13. Oxygen hose - DISCONNECT

EXTERNAL TANK EMERGENCY JETTISON

1. External tank jettison switch - JETTISON

If step 1 fails, proceed to step 2.

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2. External tank emergency release handle - PULL (20)(25)
3. External tank emergency jettison button - DEPRESS (30)(35)

OIL SYSTEM FAILURE

1. Unless critical thrust condition exists, affected engine - SHUTDOWN
2. If affected engine thrust is needed, reduce power to lowest possible setting and avoid further rapid throttle movement.
3. Only if conditions warrant, external tanks - JETTISON
4. Avoid abrupt maneuvers.
5. After critical thrust condition subsides, affected engine - SHUTDOWN

FUEL SYSTEM EMERGENCY OPERATION

ENGINE FUEL CONTROL FAILURE

1. Adjust throttle to match engine rpm.
2. Fuel control system switch - EMERG
3. Slowly move throttle to desired setting.

TRANSFER PUMP FAILURE

1. Fuel pumps switch - ALL PUMPS (20)
2. Fuel transfer selector switch - ALL PUMPS (25)(30)(35)
3. Check for transfer pump operation.
4. If defective transfer pump is still inoperative:
   a. Reduce power.
   b. Land as soon as practical.

ELECTRICAL SYSTEM EMERGENCY OPERATION

SINGLE GENERATOR FAILURE

1. Generator switch - RESET
2. Generator switch - ON
3. Check generator warning light - OUT
4. If generator warning light remains illuminated:
   a. Remaining generator switch - OFF
   b. Failed generator - RESET

CUT ON THIS LINE

CUT ON THIS LINE

c. If a-c power is restored, either generator may be used for the remainder of the flight.

5. If a-c power is not restored:
   a. Return to operational generator.
   b. Failed generator switch - OFF
   c. Land as soon as practicable.

DOUBLE GENERATOR FAILURE

1. Battery switch - OFF
2. All electrical switches - OFF
3. Generator switches - RESET
4. Generator switches - ON
5. Check generator warning lights - OUT
6. If generator warning light(s) remain illuminated:
   a. Generator switch(es) - OFF
   b. Land as soon as possible.

HYDRAULIC SYSTEM EMERGENCY OPERATION

PRIMARY HYDRAULIC SYSTEM FAILURE

Loss of the primary hydraulic system pressure allows the utility system to assume the full demand of the flight control dual units.

UTILITY HYDRAULIC SYSTEM FAILURE

Loss of utility hydraulic system pressure allows the primary system to assume full demand of the flight control dual units and the rudder will be manually controlled by direct rudder pedal pressure. With utility hydraulic system failure, refer to the following emergency procedures:

1. Speed Brake System Emergency Operation
2. Landing Gear Emergency Lowering
3. Brake System Emergency Operation

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COMPLETE HYDRAULIC SYSTEM FAILURE

In the event of complete hydraulic system failure, gages indicating a definite steady drop, perform the following before aircraft becomes uncontrollable:

1. Decrease airspeed
2. Attain level flight
3. EJECT

SPEED BRAKE EMERGENCY OPERATION

There are no emergency provisions for extending the speed brakes. If speed brakes will not retract normally:

1. Emergency speed brake switch - IN

LANDING GEAR EMERGENCY LOWERING

1. Airspeed - BELOW 250 KTS. IAS
2. Landing gear handle - DOWN
3. Landing gear circuit breaker - PULL
4. Landing gear emergency handle - PULL
5. Landing gear position indicators - CHECK

BRAKE SYSTEM EMERGENCY OPERATION

1. Allow aircraft to decelerate
   a. Utilize aerodynamic braking.
   b. Delay using wheel brakes as long as safety will permit.
2. Emergency brake handle - PULL
3. Brakes - APPLIED
   a. Apply brakes evenly and simultaneously.
   b. Best braking will be obtained by applying a steady pressure on the brake pedals, slight at first and gradually increasing to maximum braking as the aircraft decelerates.

CUT ON THIS LINE

SECTION IV
AUXILIARY EQUIPMENT

TABLE OF CONTENTS

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

COCKPIT AIR CONDITIONING

The cockpit air conditioning system utilizes heated compressed air from the sixteenth stage of both engine compressors to maintain the cockpit temperature and pressurization. The system provides warm or cool air for the windshield and canopy defrosting, and for pilot comfort. In addition, an auxiliary system provides compressed air to the anti-G suit, external fuel tanks, and hydraulic reservoirs. The heated compressed air from the engine is routed through and around a refrigeration unit consisting of an air-to-air heat exchanger combined with an expansion turbine. The temperature of the air entering the cockpit is regulated by an automatic temperature control that proportions the hot air from the engines and cooled air from the refrigeration unit. When maximum cockpit cooling is required, all the air is directed through the refrigeration unit. In the (20)(25)(30) airplanes, cockpit air outlets are located on the floor, just forward of the left rudder pedal and at the base of the windshield which serves as the defroster. In the (35) airplanes, cockpit air outlets are located on the floor by the left rudder pedal and along the windshield sills and canopy arch. Ram air may be selected to clear the cockpit of fumes or should the air conditioning system malfunction. Upon incorporation of T.O. 1F-101-596, a ventilated suit outlet is installed on the ejection seat and a face ventilator is installed below the left canopy rail in the (25)(30)(35) airplanes. Air used for the anti-G suit, external fuel tanks, and hydraulic reservoirs is taken from an auxiliary compressed air take-off using an additional coil heat exchanger located in the ram air inlet duct. See figure 4-1.

COCKPIT PRESSURIZATION

The air conditioning system receives compressed air from the sixteenth stage of each engine compressor for cockpit pressurization as well as air conditioning. Cockpit pressure is maintained at a preselected schedule for various flight altitudes by a pressure regulator. The cockpit is nonpressurized from sea level to 8000 feet. Above this altitude either of the two selected pressure schedules, COMBAT (2.75 psi) or NORMAL (5 psi) is maintained. A dump valve automatically relieves any excess pressure above the scheduled limits. The dump valve may be opened by the pilot, if necessary, by selecting the RAM AIR & DUMP position on the cabin air temperature knob. A comparison of flight altitude to cockpit schedule is shown in figure 4-3.

Cockpit Pressure Switch

The two-position switch (figure 4-2) is located on the forward cockpit temperature control panel enabling selection of the cockpit pressure by means of an electrical solenoid selector. This solenoid requires 28 volt d-c power for selection of the NORMAL position only. Any electrical failure repositions the solenoid

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

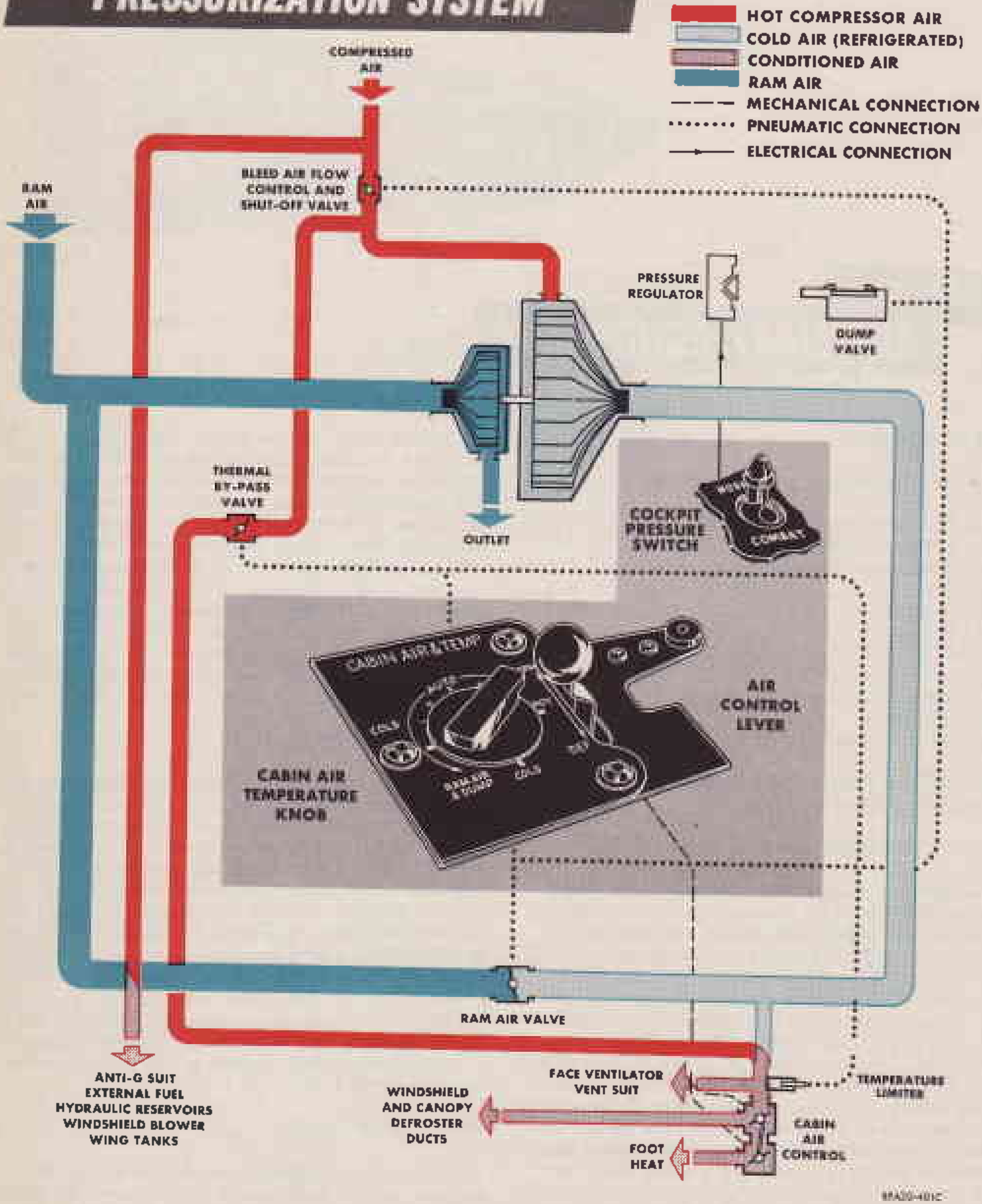

Figure 4-1

to COMBAT selection although the switch position is not affected. The cockpit pressure switch must be raised (pulled-up) to change position. Pressurization is dependent on the cabin air temperature knob position which must be in the AUTO or MANUAL position to close the dump valve, thus allowing pressurization.

Cabin Air Temperature Knob

The cabin air temperature knob (figure 4-2), located on the aft cockpit temperature control panel, may be rotated through the following settings: RAM AIR & DUMP, AUTO with subsequent COLD or HOT adjustment, MANUAL with subsequent HOT to COLD adjustment. The knob allows the pilot to adjust cockpit temperature as desired through pneumatic actuation.

Air Control Lever

Cockpit airflow is controlled by a lever (figure 4-2) on the aft cockpit temperature control panel. Moving the lever forward to the NORM position directs air to the pilot's feet and a small amount to the windshield area. Retarding the lever to the DEF position (full aft) directs all the air to the windshield and canopy defrosting duct. Intermediate positioning determines amounts to either outlet.

CABIN PRESSURE ALTIMETER

The pressure altitude of the cockpit is indicated on the cabin pressure altimeter (4, figure 1-24) located on the instrument panel. The altimeter is vented only to pressure within the cockpit.

NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

1. Cabin pressure switch - NORMAL, or COMBAT
2. Cabin air temperature knob - AUTO heat as desired
3. Air control lever - as desired

AIR CONDITIONING CONTROL PANELS

Figure 4-2

CABIN PRESSURE SCHEDULE

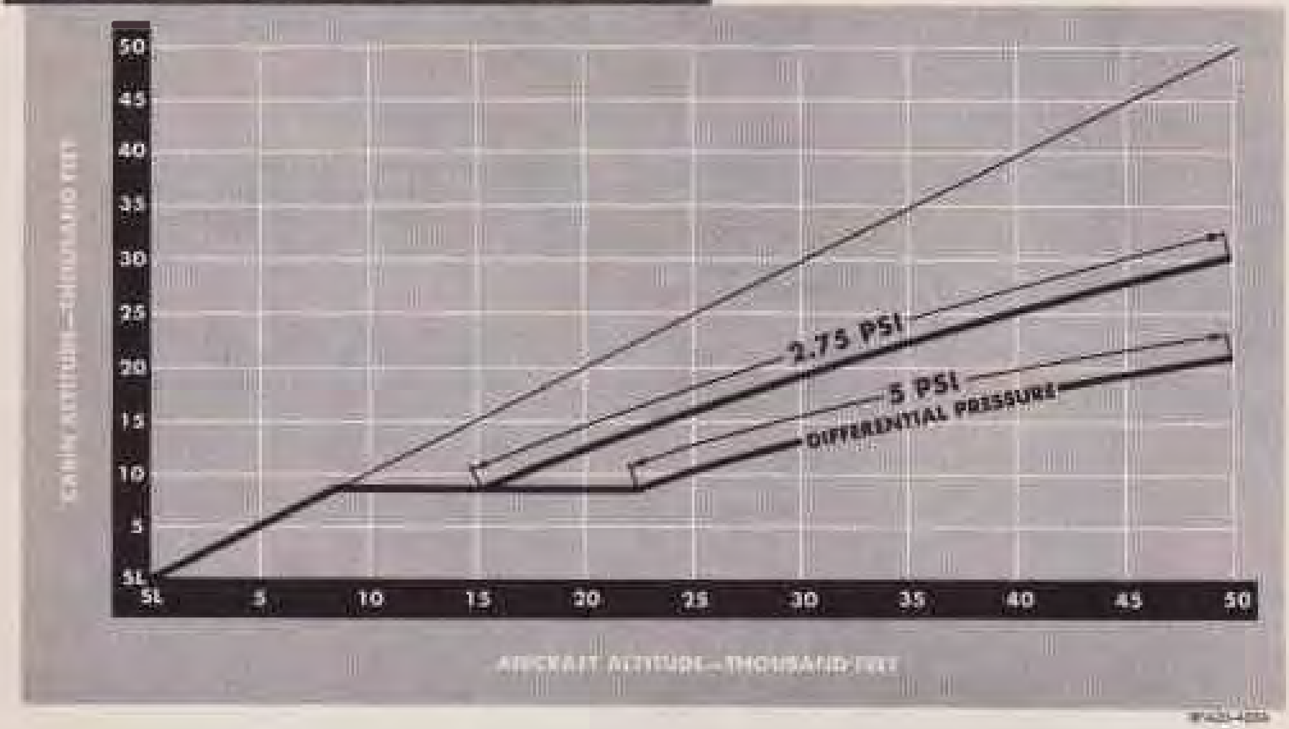

Figure 4-3

EMERGENCY OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

If sudden decompression of the cockpit is necessary:

1. Turn oxygen regulator diluter lever to 100% OXYGEN
2. Push emergency toggle lever from center to insure positive pressure to mask.
3. Descend to 25,000 feet or below if circumstances permit.
4. Move cabin air temperature knob to RAM AIR & DUMP

If cooling unit functions improperly and temperature of cockpit remains high (HOT):

1. Turn cabin air temperature knob to MANUAL and hold in COLD selection to readjust temperature as desired.
2. Descend to 25,000 feet or below if circumstances permit. The ram air temperature can be controlled within limits by increasing or decreasing airspeed.
3. Turn cabin air temperature knob to RAM AIR & DUMP if temperature remains uncomfortably high.

COCKPIT DEFROSTING AND ANTI-ICING SYSTEM

Heated air for defrosting is taken from the engine compressors and passed through a heat exchanger. This air is directed onto the inner surfaces of the canopy and windshield. The pilot controls the temperature of the air through the cabin air temperature control knob. The windshield is anti-iced by a heating element sandwiched between the layers of glass. The heating element warms the flat plate area arresting ice formation on the outside and frost on the inside. The system is controlled by the windshield anti-icing switch. The windshield blower system allows a blanket of warm air to flow over the windshield to remove rain. The air is taken from the 16th stage of each compressor and directed over the left side panel and flat plate glass area through two flush external openings. The system is used to improve forward visibility in rain at low speeds and during air refueling.

Air Control Lever

Placing the air control lever (figure 4-2), located on the aft cockpit temperature control panel, in the DEF (aft) position directs the maximum cockpit air to the windshield and canopy areas. Temperature of this air is dependent on the pilot selected cockpit temperature.

Intermediate positioning of the control lever distributes both defrosting air and foot air as desired.

Windshield Anti-Icing Switch

The windshield anti-icing switch is a three-position toggle switch (figure 4-2) marked HIGH, OFF and LOW, and selects 115 volt a-c and 28 volt d-c electrical power to the heating element within the glass layers of the flat plate area of the windshield. The switch is normally retained in the LOW position since the current supplied would be adequate for most conditions. However, the HIGH position is available to provide greater heat under more severe icing conditions.

Windshield Blower Switch

The windshield blower switch (figure 4-2) allows the pilot to divert a blanket of warm fast moving air over the left side panel and flat plate glass area of the windshield. During approach through rain, this system will improve forward visibility. The system is automatically actuated whenever the air refueling system is selected. The system requires 115 volt, single phase, a-c and 28 volt d-c power. Observe the following operating limitations until incorporation of T.O. 1F-101-724.

1. No system operation permitted above 90% engine rpm.
2. Use in approach speed range and during rain only.
3. No operation permitted during take-off.

NORMAL OPERATION OF WINDSHIELD DEFROSTING AND ANTI-ICING SYSTEM

If any portion of the windshield or flat plate (armor) glass becomes fogged or frosted follow this procedure:

1. Windshield anti-icing switch - HIGH
2. Air control lever - DEF (full aft)
3. Cabin air temperature knob to HOT position if atmospheric or flight conditions cause fog to be emitted from the air outlets.

CAUTION

Full HOT position may crack glass surface therefore, care should be taken to use only enough heat selection to eliminate condition.

PITOT HEAT SWITCH

The pitot heat switch is a two-position circuit breaker type switch located on the forward cockpit temperature control panel and provides 115 volt a-c power to a conventional electrical pitot heating element.

CAUTION

The pitot heat switch should be turned off at all times when not required to prevent damage to the plastic dome from heat.

FACE MASK ANTI-FROST RHEOSTAT

The antifrost elements of the pilot's face mask require 28 volt d-c. The mask antifrost system is energized when the rheostat located on the utility control panel (figure 1-27) is rotated clockwise from its OFF position. Heat is increased with continued clockwise movement of the rheostat. The pilot connects the face mask to the system at a female socket and wire mounted along with the oxygen hose etc.

ENGINE ANTI-ICING SYSTEM

An independent system for anti-icing the engine inlet guide vanes is provided on each engine. Hot air taken directly from the compressor is ducted to the vane area and upon automatic selection by a sensing probe in the left engine inlet duct, directed to the vanes proper. The entire selection is automatic.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

See Communication and Associated Electronic Equipment Table (figure 4-4).

INTERPHONE–AN/AIC-10

This set is designed to provide two-way communication between the pilot and ground crew. There is no control panel in the cockpit for the AN/AIC-10. The set will be ready for operation any time 28 volt d-c (battery or external power) is applied through the AN/AIC-10 circuit breaker. The pilot's interphone switch (figure 1-20) is a push-button type switch and is located on the wing flap handle housing. A panel on the left side of the fuselage just forward of the nose gear well provides the ground crew mike and headset connections. The AN/AIC-10 amplifier is used as a pre-amplifier for the AN/ARC-34 transmitter when the pilot is using the UHF radio.

Note

If the AN/AIC-10 system is inoperative, the AN/ARC-34 will not operate and there will be no audio signals from the navigation radio, gear horn, or pitch-up warning system.

UHF COMMAND RADIO AN/ARC-34

The AN/ARC-34 command set (figure 4-5) provides two-way voice communication, in the frequency range of 225.0 to 399.9 megacycles, between aircraft and ground stations or between aircraft. Any of 20 preset frequencies may be selected. In addition to the

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

TYPE DESIGNATION	FUNCTION	RANGE	LOCATION AND CONTROLS
INTERPHONE [illegible]	Voice communication between cockpit and ground (ground use only).	Not applicable.	Interphone switch outboard of power quadrant.
UHF COMMAND RADIO [illegible]	AM radio communication between airplane and station and between airplanes.	Line of sight up to 250 miles air-to-ground and up to 550 miles air-to-air depending on altitude.	Control panel on the left console. Microphone switch on right throttle grip.
DIRECTION FINDER GROUP (AN [illegible]	Indicates relative bearing of and homes on UHF radio signal sources.	Same as UHF communications radio.	AN/ARC-34 control panel on left console and ID-250/ARN course indicator on instrument panel.
VHF NAVIGATION RADIO [illegible]	Visual facilities for flying to or away from an omni-directional station. Visual and aural airway and runway locating service. AM reception of tower and general communications.	Line of sight up to 175 miles for omni-directional service. 150 miles for visual-aural airway locating service. 20 miles for runway locating service. All ranges depend on altitude.	Control panel on right console, ID-249/ARN and ID-250/ARN course indicators on the instrument panel.
NAVIGATION RADIO [illegible]	Visual facilities for flying to or away from and distance measuring from a TACAN station.	Line of sight up to 195 miles depending on altitude.	Control panel of right console, ID-249, ID-250 and ID-310 indicators on instrument panel, and ILS-TACAN switch on pedestal panel.
GLIDE SLOPE AND LOCALIZER RECEIVERS [illegible]	Vertical and lateral guidance for ILS operations.	20 miles.	AN/ARN-14D or AN/ARN-31 control panel on right console and ID-249 on instrument panel.
MARKER BEACON RECEIVER [illegible]	Receives marker beacon signal to indicate position.	Not applicable.	ID-249 on instrument panel.
SOUND RECORDER [illegible]	Voice recorder for pilot and communications receiver.	Not applicable.	AN/AHN-2 control panel on right console and interphone switch outboard of power quadrant.
IDENTIFICATION RADAR [illegible]	Identifies airplane as friend or foe.	0-200 miles line of sight.	Control panel or panels on the right console.
LATITUDE AND LONGITUDE (GPI) COMPUTER [illegible]	Indicates ground position in terms of latitude and longitude at all times.	Not applicable.	Indicator and control on right console.
NAVIGATION COMPUTER [illegible]	Indicates position of aircraft and course and distance to destination.	Not applicable.	Internal provisions for later installation of this equipment.
RADAR ALTIMETER [illegible]	Indicates the measurement of the terrain clearance to the airplane.	Overland 0-10,000 feet. Overwater 0-20,000 feet.	Control knob located on face of indicator on instrument panel.
RADAR WARNING SYSTEM [illegible]	Supplies visual and audio warning when airplane intercepts pulsed radar signals from airborne interception or airborne gun laying systems.	Not applicable.	Control panel on left console. Indicator lights and controls on radar warning control panel above instrument panel.

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Figure 4-4

UHF CONTROL PANEL

RFA20-438

Figure 4-5

preset frequencies, a manual means of frequency selection is available. The set uses two receivers, a main receiver and a guard receiver. The functions of the set are selected by a four-position control switch on the right side of the control panel. The OFF position of this switch controls 28 volt d-c power to the set. In the MAIN position, the transmitter and receiver are operative on the selected frequency. The BOTH position allows transmission and reception on the selected channel as well as reception on guard channel. The ADF position provides automatic direction finding with the ID-250/HMI course indicator (Number 1 needle). A tone button, next to control switch, provides continuous tone transmission to aid ground stations in obtaining a direction finding bearing. A channel selector knob on the center of the control panel is turned to select the desired frequency. Above the channel selector knob is a window marked MANUAL, PRESET and GUARD. A slide pointer, over the window, may be positioned over either of these three positions. With the slide in MANUAL, the channel must be manually selected by the use of the four selecting knobs at the top of the panel. In PRESET position, the frequency is obtained by turning the channel selector knob. The GUARD position selects the fixed guard frequency for the main receiver and transmitter. A plastic card on the bottom of the control panel records the frequencies that have been preset and assigned the 20 channels. The channels are numbered within the above mentioned window. Audio volume is adjusted by a knob on the left side of the control panel.

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.

Antenna Selector Switch

A two-position toggle switch (figure 1-6), mounted on the Engine Control Panel, allows the pilot to select the upper or lower UHF antenna for transmission and/or reception. The switch utilizes 28 volt d-c electrical power.

OPERATION OF COMMAND RADIO

1. Rotate control switch from OFF to MAIN. Allow approximately one minute for warm-up.
2. Rotate control switch from MAIN to BOTH. This allows monitoring of the guard frequency in addition to the selected frequency.
3. Select PRESET position on slide selector.
4. Rotate channel selector to desired channel. Reception and transmissions will now be on this frequency.
5. Adjust VOLUME control to desired audio level.
6. Actuate microphone button on throttle to transmit.
7. Rotate control switch to MAIN to operate with guard receiver off. To transmit on guard frequency leave control switch on MAIN or BOTH, but position slide selector to GUARD.
8. Rotate control switch to OFF to turn radio off.

Manual Selection of Command Radio

To manually select a frequency not preset on the set perform the following:

1. Rotate control switch from OFF to MAIN. Allow approximately one minute for warm-up.
2. Select MANUAL position on slide selector.
3. Turn four knobs at top of panel to desired frequency (note reading at each knob). Reception and transmission will now be on this frequency.

Note

The guard frequency may be received in both MANUAL and PRESET positions. However, this may be done only if the set control switch is positioned on BOTH.

ADF Selection of Command Radio—AN/ARA-25

To utilize the automatic direction finding feature (AN/ARA-25) of the set, perform the following:

1. Rotate control switch from OFF to MAIN. Allow one minute for warm-up.
2. Select desired frequency for station or common frequency if air-to-air homing is desired.
3. Rotate control switch to ADF. Observe single (1) needle indication on course indicator ID-250/ARN. Reception is garbled while needle is homing.

DF Selection of Command Radio

For direction finding and/or steer information, air-to-air, or air-to-ground, the use of the TONE button will supply a signal on the selector frequency. This transmission will give the necessary signals to the DF receiver.

VHF NAVIGATION RADIO—AN/ARN-14D

The AN/ARN-14D set (figure 4-6) provides reception and steering information utilizing VHF radio frequencies. The set has 280 channel selections covering a frequency range of 108.0 through 135.9 megacycles. The control panel on the right console incorporates an ON-OFF switch, VOLUME control knob, and FREQ indicator and selectors. The navigation information is displayed on the course indicators ID-249/ARN and ID-250/ARN (3, figure 1-34). This set receives power from the 28 volt d-c bus. If an omni-range signal is being received, a small warning flag at the end of the vertical bar will disappear from view to provide positive indication of station reception. The radio magnetic indicator ID-250/RMI indicates bearing to the omni-station.

VHF CONTROL PANEL

RFA20-439

Figure 4-6

Note

When the J4 directional indicator system is inoperative, the heading pointer of the ID-249 course indicator and the compass card of the radio magnetic indicator will also be inoperative. However, VOR magnetic bearing will still be indicated properly on both instruments.

Frequency Selector Switch

A large and a small frequency selector switch (figure 4-6) located on the control panel provides a manual means for tuning the omni-range equipment to the desired operating frequency as shown on the frequency indicator window. The large selector sets up the whole megacycles of the desired frequency and the small selector on top gives the tenths of a megacycle of the desired frequency. Any frequency between 108.0 and 135.9 may be selected. The frequency selectors may be rotated either clockwise or counter-clockwise.

Power Switch

The receiver is turned on and off by the power switch located on the control panel. The ON position provides power for operation of the set and the OFF position turns the set off.

Volume Knob

A volume knob (figure 4-6) is provided on the control panel and is used to adjust the receiver audio signal to the pilot's headset.

ID-249/ARN Course Indicator

The ID-249/ARN course indicator is a composite display of VHF navigation information. An ID-249/ARN indicator (16, figure 1-24) is located on the instrument panel. Omni-range station relationship to the airplane position is shown by information in tab windows and movement of a vertical bar. A horizontal bar shows information from a glide path but this feature is not operational in airplanes that have not been modified by T.O. 1F-101-662. The two bars remain parallel to their rest positions and are always at right angles to each other. A heading pointer shows the relation of the airplane heading to the desired bearing. With the vertical bar centered and the correct omni-bearing set in the "Course" window, deviation of the heading pointer from the vertical index indicates the "crab angle" of the airplane. Magnetic bearing selection is controlled by the course set knob and indicated in the "Course" window. The magnetic bearing as set into the "Course" window will normally be the desired inbound or outbound bearing of an omni-range station when flying omni-range. With the desired magnetic bearing set into the "Course" window, the displacement of the vertical bar from center indicates the direction of turn necessary to position the airplane on course. A "to-from" window indicates whether the course selected by the course knob is to or from the omni-range station. The "to-from" window will show blank upon failure of an omni-range signal during operation. A warning flag will move out of sight when an omni-range signal of dependable strength is being received.

Course Set Knob

A course set knob located on the ID-249/ARN course indicator (16, figure 1-24) is used to set the magnetic bearing of a desired course on three tab indicators within the course window.

ID-250/ARN Radio Magnetic Indicator

The ID-250/ARN radio magnetic indicator (RMI) is a composite display of airplane heading, radio compass (ADF) UHF signal bearing, and (VHF) omni-range station bearing. The ID-250 indicator (3, figure 1-24) receives heading reference information from the J-4 heading indicator system and rotates the circular compass card so that the heading of the airplane will always be under the reference index at the top of the instrument. When the command radio is in the ADF position, the single needle indicates the relative bearing to the selected VHF transmitter. Because the rotating compass card keeps the aircraft heading under the index, the single needle also gives magnetic bearing to the transmitter. The double needle indicates the magnetic bearing to the selected VHF (omni-range) station. If the J-4 system is operating properly, the double needle will also give relative bearing. If the J-4 system is unreliable the double needle will give magnetic bearing only. If the J-4 system is out, the double needle may be unreliable. When the J-4 system is in the DG mode, the compass card and the double needle are referenced to the DG rather than to magnetic north.

OPERATION OF VHF NAVIGATION RADIO

1. Select desired frequency.
2. Power switch ON. Allow approximately one minute for warm-up.
3. VOLUME control as desired.
4. Observe double (2) needle indication on Course Indicator ID-250/ARN.
5. Observe vertical bar deflection on Course Indicator ID-249/ARN.

CAUTION

Check to see the flag-alarm-off indicator for the vertical bar disappears. The flag alarm must be out of sight before indications of the vertical bar can be relied upon.

6. Set course selector on ID-249/ARN to desired course. Fly heading to or from station as desired.
7. Set is off when power switch is OFF.

NAVIGATIONAL RADIO AN/ARN-21 (TACAN)

After incorporation of T.O. 1F-101-662, the AN/ARN-21 TACAN navigational radio may be installed instead of the AN/ARN-14 navigational radio. TACAN is a short-ranged navigational radio which converts radio signals into visual displays of azimuth and range. The azimuth signals are displayed as a magnetic bearing to the station, by the double needle on the ID-250 radio magnetic indicator and in terms of displacement from a selected track to or from the station on the ID-249. Range from the selected station is displayed in nautical miles on the ID-310 range indicator. A pulse signal from the TACAN transmitter in the aircraft triggers a responding pulse from the ground station and the time lapse is translated into distance. The ground equipment can respond to distance inquiries of more than 100 aircraft without interference. The maximum range of the TACAN distance function is 195 nautical miles, however, bearing information is accurate beyond this range under most conditions. TACAN is subject to errors in multiples of 40°. These errors are most likely to occur near maximum range and near the cone of confusion. These errors usually last less than a minute and should correct themselves if the pilot maintains his heading. An altitude limit switch cuts off power to the set at altitudes above 50,000 feet. All controls for the TACAN set, except the ILS-TACAN switch, are located on the TACAN control panel on the right console. The set uses 28 volt d-c and 115 volt a-c power.

ILS-Tacan Switch

The ILS-TACAN switch (19, figure 1-25) is located on the pedestal panel and determines which navigational system (ILS or TACAN) will furnish information to the ID-249 course indicator.

Channel Selector Knobs

The desired operating channel is selected by two knobs. The outer knob selects the first two digits of the desired channel and the inner knob selects the last digit. Any selection from 00 to 129 is possible but only channels 01 to 126 are operative.

CAUTION

Do not select channels above 126 or below 01 as damage to the equipment may result.

Power Switch

The power switch has three positions: OFF, REC, and T/R. In the OFF position, power to the set is shut off. In the REC position, no pulse signals are transmitted and no range information is received. Bearing data only is received and displayed. Both range and bearing signals are received when the switch is in the T/R position.

Volume Knob

This control adjusts the volume of the station identification signal in the pilot's headset.

ID-249/ARN Course Indicator

The operation of this instrument is covered under the discussion of the AN/ARN-14 in this section.

ID-250/ARN Radio Magnetic Indicator

The operation of this instrument is covered under the discussion of the AN/ARN-14 in this section. TACAN information is displayed on the number 2 needle.

ID-310/ARN Range Indicator

The slant range from the airplane to the transmitting station is displayed in the window of the range indicator. A red OFF flag drops down and partially covers the display when the signal is unreliable.

NORMAL OPERATION OF THE AN/ARN-21

1. Power switch - REC or T/R as desired. Allow approximately 90 seconds for warm-up.

TACAN AND ILS CONTROL PANELS

RFA20-447

Figure 4-7

2. ILS-TACAN switch - TACAN
3. Select the desired channel.
4. Volume - as desired
5. Observe the double needle indication on the ID-250 radio magnetic indicator.
6. Observe the vertical cross-pointer deflection on the ID-249 course indicator.
7. Observe the range indication on the ID-310 range indicator.

Note

- The power switch must be in the T/R position to make range information available.
- Check to see that the warning flags disappear completely.
- If reliable signals cannot be received, the ID-249 and the ID-310 will "search" constantly.

8. Set the desired course in the bearing window of the ID-249 course indicator.

EMERGENCY OPERATION OF THE AN/ARN-21

There is no emergency procedure as such for TACAN. If difficulty is experienced, the following checks are recommended. First, check the ILS-TACAN switch in TACAN position. Check to see if there is an obstruction between the ground station and the aircraft for TACAN is subject to line-of-sight restrictions. If there are no obstructions, select a second station within range. If operation is satisfactory on the second channel, switch back to the first station to determine if the faulty operation was caused by a temporary pause in station transmission or an unknown obstruction between the station and the aircraft.

GLIDE SLOPE AND LOCALIZER (ILS) RECEIVER SYSTEM

Airplanes that have been modified by T.O. 1F-101-662 have the AN/ARN-31 installed. The AN/ARN-31 is a VHF navigational system which provides visual guidance signals to the pilot during instrument approaches and landings. The system is composed of two receivers and displays the guidance signals on the ID-249 course indicator. Both receivers are installed when the aircraft is equipped with the TACAN set. Only the glide slope receiver is installed when the AN/ARN-14 VOR receiver is installed since this receiver is capable of receiving localizer signals. The system uses 28 volt d-c and 115 volt a-c power.

ILS Control Panel

The ILS control panel (figure 4-7) is installed whenever the TACAN set is installed in the aircraft. It is located on the right console just aft of the TACAN control panel and contains all the ILS controls except the ILS-TACAN switch. When the VOR receiver is installed, this panel is omitted since the VOR control panel can perform these operations.

Glide Slope Receiver

The glide slope receiver is installed in all aircraft. The glide slope operating frequencies are spaced 0.3 mc apart from 329.3 mc through 335.0 mc. The glide slope receiver frequencies are automatically selected when a localizer frequency is selected on the VOR control panel. When the TACAN set is installed, the glide slope receiver frequency is controlled by the ILS control panel.

Localizer Receiver

The localizer receiver will be found on aircraft equipped with the TACAN set only since the VOR receiver is capable of performing localizer operations. The localizer frequencies are spaced 0.2 mc apart from 108.1 through 111.9 mc. The localizer frequency is selected on the AN/ARN-14 control panel. If the airplane is equipped with the TACAN set, then the frequency is selected on the ILS control panel.

ILS–Tacan Switch

The ILS-TACAN switch (19, figure 1-25) is located on the pedestal panel and determines which of the two navigational systems will furnish information to the ID-249 course indicator. On airplanes equipped with VOR this switch is inoperative.

Frequency Selector Knob

On airplanes equipped with VOR, the ILS frequency is selected on the VOR frequency selector knob. On airplanes equipped with TACAN the ILS frequency is selected by the frequency selector knob located on the ILS control panel. The knob is rotated until the desired localizer frequency appears in the indicator window. The glide slope receiver is automatically tuned upon selection of a localizer frequency. The knob may be rotated in either direction.

Volume Control Knob

This knob, located on either the VOR control panel or the ILS control panel, regulates the volume of the aural signal in the pilot's headset.

Power Switch

The power switch, located on either the VOR control panel or the ILS control panel, turns the system on or off.

ID-249/ARN Course Indicator

The operation of this instrument is covered under the discussion of the AN/ARN-14 in this section. The TO-FROM indicator and the course selector knob are inoperative when using the ILS system.

OPERATION OF ILS

1. ILS-TACAN switch - ILS
2. Power switch - ON
3. Volume control - AS DESIRED
4. Observe the deflections of the cross-pointers on the ID-249.

CAUTION

Check that the red OFF flag for the vertical and horizontal bars disappears. The flag must be out of sight before the indications are reliable.

5. Fly the aircraft to center both cross-pointers.
6. Turn power switch to OFF to de-energize set.

EMERGENCY OPERATION OF ILS

There is no emergency operation of the ILS system. If the indications are erratic or otherwise unsatisfactory, check that the ILS-TACAN switch is in the ILS position.

MARKER BEACON RECEIVER AN/ARN-32

The marker beacon receiver is installed in all airplanes modified by T.O. 1F-101-662 and is a fixed tuned receiver which detects 75 mc signals. The receiver causes the amber light on the ID-249 to illuminate whenever a signal is received. No controls are provided and the set operates automatically whenever power is available. The system uses 28 volt d-c power.

SOUND RECORDER AN/AHN-2

The sound recorder set is installed in airplanes modified by T.O. 1F-101-662 and permits voice recording by the pilot and voice recording of the communications the pilot sends or receives over the radios. Voice frequency sound is magnetically recorded on a spool of fine wire contained in a removable magazine. The spool contains enough wire for one hour of continuous operation. The sound recorder records all signals and communications received through the pilot's headset whenever the pilot holds the interphone button depressed. All controls for the sound recorder are located on the sound recorder control panel on the aft right console. The set uses 28 volt d-c power.

Power Switch

The power switch (figure 4-8), located on the sound recorder control panel, is a two-position switch. When the power switch is placed in the ON position, the recorder will record whenever the interphone button is held depressed.

Record Light

The green record light (figure 4-8) is located on the sound recording control panel. It illuminates whenever the sound recorder is recording.

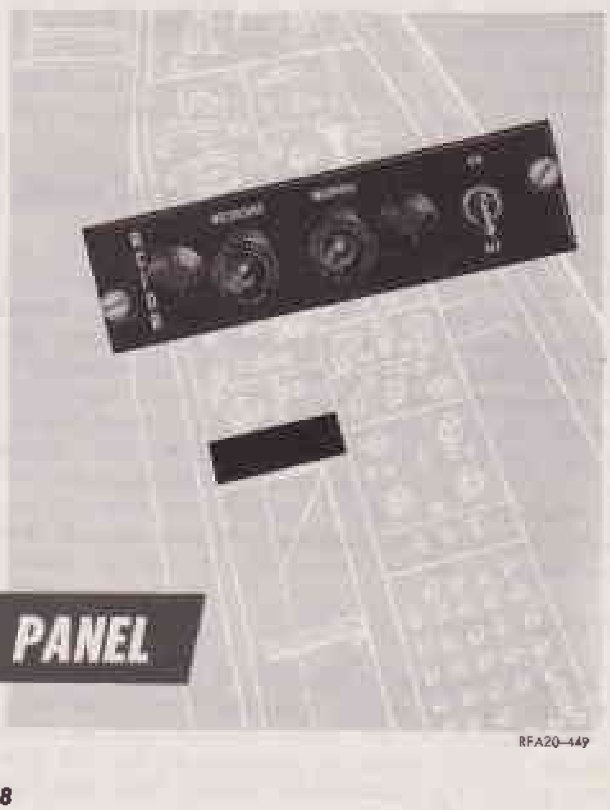
Warning Light

The amber warning light (figure 4-8), located on the sound recording control panel, will illuminate at the end of 55 minutes of recording time. When the warning light illuminates, there will be 5 minutes of recording time left on the wire.

IDENTIFICATION RADAR AN/APX-6A

The AN/APX-6A radar identification set is carried to automatically respond by signal to proper challenge signals. The set can identify the airplane within a group of friendly airplanes, if equipment is installed in the airplane to be identified. The set has means for transmitting a special distress code. In operation the AN/APX-6A set receives challenges and transmits the responsive signal to the source of the challenge, where this response is

SOUND RECORDER CONTROL PANEL



RFA20-449

Figure 4-8

IFF CONTROL PANEL

RFA20-424

Figure 4-9

displayed, together with associated radar information (target, etc.) on radar scopes. Proper reply identifies the target is friendly. The master switch (figure 4-9) located on the right console receives power from the 115 volt single-phase bus, and 28 volt d-c.

Operation of Identification Radar

1. Rotate master switch to NORM.
2. Rotate master switch to STDBY to maintain inoperative but ready for instant use.
3. Set Mode 2 and Mode 3 switches to OUT unless otherwise directed.
4. If in distress, press dial stop (red button), and at the same time, rotate master switch to EMERGENCY position. Set will automatically transmit distress signals in response to interrogation signals.
5. Rotate master switch to OFF to turn set off.

IDENTIFICATION RADAR AN/APX-25

Refer to Confidential Supplement T.O. 1F-101(R)A-1A.

SIF AND IFF CONTROL PANELS

Refer to Confidential Supplement T.O. 1F-101(R)A-1A

Figure 4-10

LATITUDE AND LONGITUDE COMPUTER SYSTEM AN/ASN-6

Refer to Navigation Equipment, this section.

NAVIGATION COMPUTER AN/ASN-7

Refer to Navigation Equipment, this section.

RADAR ALTIMETER SYSTEM AN/ARN-22

The AN/APN-22 radar set is a microwave altimeter which measures the terrain clearance of the aircraft. 28 volt d-c and 115 volt, single-phase a-c power is required to operate the system. No antennas external to the surface of the aircraft are necessary. A frequency-modulated signal is radiated to the ground and a period of time elapses until a portion of this signal is reflected back to the aircraft. During this time lapse, the transmitter frequency changes, causing a frequency difference between the signal being transmitted and the signal arriving from the ground. This difference in frequency is proportional to time lapse which is proportional to height. The system is designed to provide reliable operation over the ranges of 0 to 10,000 feet over land and 0 to 20,000 feet over water. Accuracy of indication is ± 2 feet from 0 to 40 feet and ± 5 percent of indicated altitude from 40 to 20,000 feet. Accuracy is greatly impaired during steep angles of bank, dive or climb.

Radar Altimeter

The radar altimeter (1, figure 1-24), located on the instrument panel, provides indication of the airplane's altitude in a single turn type dial calibrated from 0 to 20,000 feet. "Drop-out" occurs when altitude limits of the system are exceeded. This disables the indicator and places the needle behind a mask. An adjustable "bug" pointer at the outside of the calibrated scale of the indicator can be preset to desired altitudes and used as a reference in flying at a fixed altitude. The indicator system provides a red limit light located just below and to the right of the indicator which is illuminated when the aircraft is flying at or below the preset altitude, and off when the aircraft is above the preset altitude.

Radar Altimeter Control Knob

A control knob (figure 1-24) marked "ON-LIMIT" is the only operating control in the radar altimeter system. This knob is located just below and to the left of the radar altimeter on the instrument panel. The radar altimeter control knob operates the system on-off switch and is also used to set the "bug" pointer on the desired preset altitude. The knob utilizes 28 volt d-c electrical power. Refer to Operation of Radar Altimeter, this section.

Low Altitude Warning Light

A red warning light (figure 1-24), located below and to the right of the altimeter, is provided to indicate upon illumination, that the aircraft is below the altitude preset by the radar altimeter control knob ("bug" pointer). The light will also illuminate when "drop-out" occurs. In (20) airplanes after incorporation of T.O. 1F-101-597 and in (25)(30)(35) airplanes, intensity of the warning light is changed through the aircraft's warning lights dimming system. Power required is 28 volt d-c.

OPERATION OF RADAR ALTIMETER SYSTEM

With electrical power supplied, the radar altimeter system is set into operation by the initial turn (clockwise) of the radar altimeter control knob. Further clockwise rotation of the radar altimeter control knob positions the limit "bug". The system is turned off by rotating the control knob to its full counterwise position.

Note

Allow approximately 12 minutes warm-up time after starting the equipment to insure accuracy. If the temperature is below -40°C (-40°F), 25 minutes warm-up time should be allowed.

Drop-Out

The radar altimeter system will stop indicating altitude when the reflected signal is too weak to override the system noise. "Drop-out" should not occur at altitudes below 10,000 feet over land or 20,000 feet over water. However, a climb, bank or dive of 60° or more will somewhat reduce "drop-out" altitude. When "drop-out" occurs, circuits within the system automatically disconnect the indicator synchro from the servo system and apply a fixed signal to it, which causes the needle to assume a position behind the mask on the indicator dial between the 20,000 point and the 0 point. This fixed off-scale position indicates to the pilot that the reading is meaningless.

Note

When "drop-out" occurs, it is necessary to reduce altitude to a point slightly below where "drop-out" occurred, or to level out from the maneuver which caused "drop-out". The return to normal operation following "drop-out" is indicated by the resumption of normal indicator operation.

RADAR WARNING SYSTEM AN/APS-54

Refer to Confidential Supplement T.O. 1F-101(R)A-1A.

RADAR WARNING CONTROL PANELS

Refer to Confidential Supplement T.O. 1F-101(R)A-1A

Figure 4-11

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

Landing and Taxi Lights

Two sealed-beam lamps provide forward illumination for landing or taxiing. Both units are mounted side by side on the nose gear strut and consequently are in position any time the landing gear is extended. In the (20) airplanes the lamps utilize 28 volt a-c power. In the (25)(30)(35) airplanes the lamps utilize 115 volt a-c power.

LANDING AND TAXI LIGHT SWITCH. A landing and taxi light switch (figure 1-20) actuates 28 volt d-c power to a relay for operation of the landing or taxi light. This three-position toggle switch, located on the flap control panel outboard of the quadrant on the left console, is placarded LDG, OFF and TAXI. In the TAXI position, one lamp is illuminated; in the LDG position the other lamp is illuminated. The lamps are set at different angles to give maximum illumination for landing or taxiing.

CAUTION

There are no provisions for automatically turning off the landing lights when the gear is retracted. Therefore care must be exercised to assure that the switch is in the OFF position prior to retracting the landing gear on night flights.

Position and Fuselage Lights

Conventional position lights are installed on the tail and each wing tip. Three fuselage lights, one on the top and two on the bottom, are mounted aft of the canopy just forward of the wing. The control circuit for the light requires 28 volt d-c power. Actual power for the lights is 28 and 14 volt a-c. The position lights utilize the 14 volt a-c power for "dim" operation. A flasher in the circuit affects only the position lights. When exterior lights are on, the fuselage lights operate continuously.

EXTERIOR LIGHTS FLASHER SWITCH. The three-position exterior lights flasher switch (figure 4-12) on the exterior lights panel of the right console controls the position and fuselage lights. The switch is marked STEADY, OFF and FLASH. In the FLASH position, the flasher unit is included in the position lights circuit (the fuselage lights do not flash); in the STEADY position, all lights burn continuously. The flasher unit is so designed that the lights will operate continuously in the event it fails. Power utilized is 28 volt a-c and 28 volt d-c.

EXTERIOR LIGHTS INTENSITY SWITCH. The exterior lights intensity switch (figure 4-12) adjacent to the exterior lights switch on the exterior lights panel is a two-position toggle switch which determines the intensity of the position and fuselage lights. This switch is placarded BRIGHT (28 volt a-c) and DIM (14 volt a-c) and affords operation as selected.

INTERIOR LIGHTING

Two basic systems, each of which is completely adequate, provide interior lighting. The primary system, which relies on 115 volt a-c, single-phase current, transformed to a maximum of 28 volts, provides edge lighting of instruments on the instrument panel, edge lighting of instruments and controls on the console, floodlighting of the consoles, stand-by compass illumination and thunderstorm light. The secondary system, utilizing 28 volt d-c power, provides for floodlighting of the instrument panel, floodlighting of the consoles and stand-by compass illumination. A conventional C-4 utility light independent of either system, is also installed. Spare lamps are provided in a panel on the right console.

Primary System Lighting Controls

PRIMARY-SECONDARY LIGHTS SWITCH. This toggle switch (figure 4-12) in the center of the cockpit lights panel of the right console, provides for the selection of a basic system as determined by power source. It is placarded PRIMARY-SECONDARY. Power utilized is 115 volt a-c and 28 volt d-c. For primary system operation, the switch must be in the PRIMARY position.

INSTRUMENT LIGHTS KNOB. The instrument lights knob (figure 4-12), on the cockpit lights panel, controls the intensity of the instrument panel lights from OFF through BRIGHT. Compass light brilliance is also controlled by this knob provided the compass light switch is ON. Power supplied is 115 volt a-c.

LIGHTING CONTROL PANELS

Figure 4-12

Note

- The warning light dimming circuit will not function unless the instrument lights knob is moved from the OFF position.
- The same knob is used for operating both the primary and secondary instrument panel lights.

CONSOLE LIGHTS KNOB. The console lights knob (figure 4-12) located on the cockpit lights panel controls the intensity of the edge lighting of both the left and right consoles and the pedestal, making possible any intensity from OFF to BRIGHT. Power is 115 volt a-c.

CONSOLE FLOODLIGHTS KNOB. The console floodlights knob (figure 4-12), located on the cockpit lights panel of the right console, provides for the control of the console floodlights from OFF through any desired intensity to BRIGHT. The four floodlights are mounted beneath the canopy sill to provide additional console lighting. Power is 115 volt a-c.

Note

With the primary-secondary switch positioned at SECONDARY, the console floodlights operate continuously at a dimmed intensity.

THUNDERSTORM LIGHT KNOB. The thunderstorm light knob (figure 4-12), located on the cockpit lights panel, provides any desired intensity from OFF to BRIGHT. The thunderstorm light is mounted under the canopy sill to the right of the pilot. It provides greater illumination over the entire cockpit as an aid to vision when exposed to lightning. Power is 115 volt a-c.

COMPASS LIGHT SWITCH. The compass light switch (figure 1-27), an ON-OFF toggle switch, is provided on the utility control panel of the right console to provide a means of turning OFF the compass light independently of the instrument lights. The stand-by compass light operates from the instrument lights circuit and is controlled by the instrument light knob. Power utilized is 28 volt d-c.

Note

Compass light operation is the same with the secondary lighting system or the primary system.

Secondary System Lighting Controls

PRIMARY-SECONDARY LIGHTS SWITCH. This switch, as previously discussed, provides the means for selecting the primary or secondary system. For secondary system operation, the switch must be in the SECONDARY position.

INSTRUMENT LIGHTS KNOB. The instrument lights knob (figure 4-12) on the cockpit lights panel of the right console makes possible the control of the secondary instrument lights from OFF through any intensity to BRIGHT. Compass light brilliance is also controlled by this knob if the compass light switch is ON. Two floodlights, one on each side of the cockpit, provide instrument panel illumination. Power supplied is 28 volts d-c.

Note

The same knob is used for operating either the primary or secondary instrument panel lights.

CONSOLE FLOODLIGHTS. The console floodlights, with the secondary system in operation, operate continuously at a constant dimmed brilliancy. There are six of these lights, three on each side of the cockpit beneath the cockpit sill. Power is 28 volt d-c.

Utility Light

The utility light (figure 1-27), a conventional Type C-4, is mounted in a bracket beneath the right canopy sill. It is turned ON and its brilliance controlled by the knob on the back of the lamp housing. This light operates independently of either the primary or secondary systems. Power utilized is 28 volt d-c.

OXYGEN SYSTEM

Oxygen is supplied through a Type D-2 pressure demand oxygen regulator from a liquid oxygen supply system, and the supply tank is located in the right forward portion of the fuselage, adjacent to the nose wheel well. The fully serviced capacity is 5 liters (5.3 quarts). The basic system consists of the tank, a coil for converting the liquid to gaseous oxygen, and the regulator. The system functions at a pressure of 70 psi which remains constant, regardless of the quantity in the tank, due to the expansion which occurs as the oxygen changes form. Relief valves are incorporated into the system to prevent excessive pressure. Should these fail, a blow-out patch on the tank will rupture at approximately 120 psi differential pressure. Adjacent to the filler connection, which is reached through an access door on the right-hand forward portion of the fuselage, is the build-up and vent valve. During the servicing operation, this valve must be in the VENT position. Oxygen is added until it flows overboard through the vent which is below the filler connection on the lower portion of the fuselage. The valve is then returned to BUILD-UP. A build-up time of approximately 5 minutes is required, after service, before the system is ready for operation.

Note

During the servicing operation, the system quantity gage will indicate full at all times because certain portions of the system are subjected to pressures which are contrary to the pressures of normal oxygen.

WARNING

Even though there is no flow in the system, and oxygen is not being used, approximately 15% of system capacity is lost every 24 hours. This is the result of slow changes of liquid oxygen to gaseous oxygen and the consequent relief of excess pressure.

OXYGEN REGULATOR

The Type D-2 regulator (figure 4-13) on the right console automatically controls the pressure and rate of oxygen flow based on pilot demand and altitude. This provides for the delivery of the proper mixture of air and oxygen at lower altitudes and pressure breathing at higher altitudes. It also provides for the relief of any excess mask pressures.

Note

Above 30,000 feet, a vibration or wheezing sound may sometimes be noticed in the mask. This noise is a normal characteristic of regulator operation and may be overlooked.

Supply Lever

A two-position (ON-OFF) supply lever (figure 4-13), located at the bottom of the regulator panel, controls flow of oxygen into the regulator and is normally safety wired in the ON position at all times.

Diluter Lever

The diluter lever (figure 4-13) in the top right corner of the regulator provides for NORMAL OXYGEN, a mixture of air and oxygen, or 100% OXYGEN for emergencies.

Emergency Toggle Lever

The emergency toggle lever (figure 4-13) is located immediately below the flow indicator on the oxygen regulator. This lever should remain in the center position at all times, unless an unscheduled pressure increase is required. Moving the toggle lever from its centered position to the right or left provides continuous positive pressure to the mask for emergency use. Depressing the toggle lever when it is centered provides positive pressure to test the mask for leaks.

CAUTION

It is mandatory that the oxygen mask be well fitted to the face. Do not use an oxygen mask that leaks. A leaking mask will result in rapid depletion of the oxygen supply and may also cause extremely cold oxygen flowing to the mask.

Oxygen Warning System Switch

This switch is inoperative.

OXYGEN CONTROL PANELS

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Figure 4-13

OXYGEN DURATION CHART

- UPPER FIGURES INDICATE DILUTER LEVER "100% OXYGEN"
- LOWER FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"

GAGE PRESSURE CONSTANT 70 PSI

OXYGEN DURATION—HOURS

Cabin Altitude Feet	Gage Quantity—Liters 5	4	3	2	1	Below 1
35,000 and Above	31.4	25.2	18.9	12.6	6.3	EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	31.4	25.2	18.9	12.6	6.3	
30,000	22.7	18.1	13.6	9.0	4.5	
	23.3	18.7	14.0	9.3	4.7	
25,000	17.5	14.0	10.5	7.0	3.5	
	22.0	17.6	13.2	8.8	4.4	
20,000	13.3	10.7	8.0	5.3	2.7	
	25.0	20.0	15.0	10.0	5.0	
15,000	10.7	8.6	6.4	4.3	2.2	
	30.2	24.2	18.1	12.1	6.0	
10,000	8.6	6.9	5.2	3.4	1.7	
	30.2	24.2	18.1	12.1	6.0	
5,000	6.8	5.4	4.1	2.7	1.4	
	30.2	24.2	18.1	12.1	6.0	
0	5.5	4.4	3.3	2.2	1.1	
	30.2	24.2	18.1	12.1	6.0	

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Figure 4-14

OXYGEN QUANTITY GAGE

A gage (figure 4-13), mounted immediately forward of oxygen regulator panel, indicates the quantity of liquid oxygen in the supply tank. The gage is directly connected to the tank and utilizes the pressure differential between the liquid and gaseous portions of the systems to indicate quantity in liters.

Note

- The oxygen quantity gage will indicate full throughout the servicing of the system. This is characteristic of the system and should not be considered abnormal.
- The liquid oxygen quantity gage should read between 4 and 4 1/2 liters when the system is fully charged. Do not be alarmed that the gage does not read 5 liters since it is impossible to charge the liquid oxygen converter to 5 liters. Use the oxygen duration graph (figure 4-14) to determine oxygen duration for indicated supply.

PRESSURE GAGE AND FLOW INDICATOR

The system pressure indicator and the flow indicator (figure 4-13) are combined in a single instrument mounted on the regulator panel. Pressure is indicated on the upper portion of dial while slots on the lower portion show alternately black and white, with each breath, indicating flow.

Note

The oxygen pressure gage calibrations are not marked in conjunction with system pressure. The gage reads 70 to 100 psi when full, consequently the gage needle will deflect close to the first (number 1) calibration only.

OXYGEN SYSTEM PRE-FLIGHT CHECK

In order to properly attach the personal oxygen leads to the pilot the following procedure should be followed. This procedure will provide maximum safety with minimum break force in event of ejection.

1. Attachment strap on male connector should be attached to parachute chest strap by routing the connector strap under the chest strap as close to the center as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector. Refer to figure 4-15.
2. Connect the mask-to-regulator tubing female disconnect to the mask male connector, listen for click, and look to see that the sealing gasket is only half exposed evenly around the connection.

3. Attach the alligator clip to the end of the mask male connector strap.

To assure proper operation, check the oxygen system as follows:

Note

This test procedure is applicable only for an initial preflight check of the system. In-flight tests or repeated tests made within short periods may produce false or misleading indications.

1. Proper security of the ejection seat and face mask disconnects - CHECK
2. Oxygen quantity gage - Check. Oxygen pressure gage - Check 70 psi to 100 psi ± 5, oxygen quantity gage at 4 liters minimum.
3. Check oxygen regulator with the diluter valve first at NORMAL OXYGEN and then at 100% OXYGEN as follows: Blow gently into end of the oxygen regulator hose as during normal exhalation. There should be resistance to blowing. Little or no resistance to blowing indicates a leak or faulty operation.
4. Fasten oxygen hose as indicated in figure 4-15.
5. Check oxygen pressure gage at 70 psi to 100 psi, liquid content gage at 4 liters minimum.
6. With regulator supply valve ON, oxygen mask connected to regulator, and diluter lever at 100% OXYGEN, breathe normally into mask and conduct following checks:
   a. Observe blinker for proper operation.
   b. Depress emergency toggle. A positive pressure should result within the mask. Hold breath to determine whether there is leakage around mask. Release emergency toggle; positive pressure should cease.
7. Return diluter lever to NORMAL OXYGEN.

NORMAL OPERATION OF OXYGEN SYSTEM

1. Be sure oxygen pressure gage reads at least 70 psi before each flight and liquid content

Figure 4-15

gage shows a minimum of 4 liters. If content is below this minimum, have oxygen system serviced before take-off.
2. Oxygen supply lever safetied ON.
3. Diluter lever NORMAL OXYGEN.

EMERGENCY OPERATION OF OXYGEN SYSTEM

If symptoms of hypoxia develop or if smoke or fumes enter the cockpit, proceed as follows:

1. Diluter lever - 100% OXYGEN.
2. Emergency toggle lever left or right from center.
3. Pull ball handle on H-2 emergency oxygen bailout bottle (which contains about a 6-minute oxygen supply) if oxygen regulator becomes inoperative.
4. Descend to a cockpit altitude below 10,000 feet as soon as possible.

AUTOPILOT

The Type MB-1 autopilot is electrically operated and gyroscopically controlled. The units are energized whenever 115 volt, single-phase, a-c and 28 volt d-c power are being supplied. Portions of the system are utilized to effect yaw damping and automatic turn coordination independent of autopilot operation. Changes in airspeed and altitude automatically vary the control parameters providing stable operation in all subsonic speeds. The system includes interlocks and devices for disengagement to prevent improper engagement or control action of the autopilot. The system 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 4-16) are grouped in two panels, the function selector and the flight controller, both located on the right console. Autopilot controlled flight at constant altitude is made possible by an altitude control feature which derives its signal from a sensitive aneroid. Signals from the J-4 directional indicating system provide a directional reference that permits the autopilot to hold the aircraft on a magnetic heading when the manual turn control is not being used. A vertical gyro provides a reference for measuring airplane displacement in the roll and pitch axis. Three rate gyros (yaw, roll and pitch) supply signals proportional to rate of change of 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. An automatic trim feature trims the elevator force-producing mechanism while the autopilot is engaged, so that at any time the autopilot is disengaged, control stick forces will be at a minimum. A localizer and glide path coupler provide means for automatic flight control during the approach and glide path phases of instrument landing procedure, however, this phase is not operational. After the autopilot is engaged it will control the airplane through a maximum of 45 degrees of bank and 35 degrees of pitch in either direction from the horizontal. Engagement is possible within pitch and roll maneuvering limits. The elevator servo contains a slip clutch which limits servo output to 25 pounds of stick force in the pitch axis.

Engage Switch

This two-position toggle switch (figure 4-16) mounted on the flight control panel, located in the right console, is spring-loaded to the disengage position. When moved to the ENGAGE position, the switch will be held by a solenoid, provided the autopilot is in a state of readiness. If the autopilot takes control of the aircraft, it will slowly position the aircraft in straight level flight, then slowly reposition the aircraft according to the control settings of the autopilot. The engage switch will spring out of the ENGAGE position, if for any reason the autopilot cannot assume smooth control of the aircraft. Examples of such conditions are: Failure of one or more circuits within the system, power failure, or an airplane attitude which exceeds the limits of the autopilot (45 degrees bank, 35 degrees pitch). The switch may be manually disengaged at any time.

Note

- The autopilot is energized when aircraft power is turned on but requires an interval of approximately 2 minutes before reaching a state of readiness.
- The engage switch will not remain in the ENGAGE position unless the turn knob is in the detent.

Turn Knob

The turn knob (figure 4-16), on the autopilot flight control panel, makes possible coordinated turns up to 45 degree banks without disengaging the autopilot. Normally the knob is in a centered (detent) position. Turns are accomplished by moving the knob off-center in the desired direction of turn. The rate of turn is directly proportional to the degree the knob is moved from center. The stick will not move laterally when turn knob is moved from the center detent.

Pitch Wheel

The pitch wheel (figure 4-16), on the inboard side of the autopilot flight control panel, is included so that changes in pitch, up to 35 degrees either direction from horizontal can be accomplished while the auto-

AUTOPILOT CONTROL PANEL

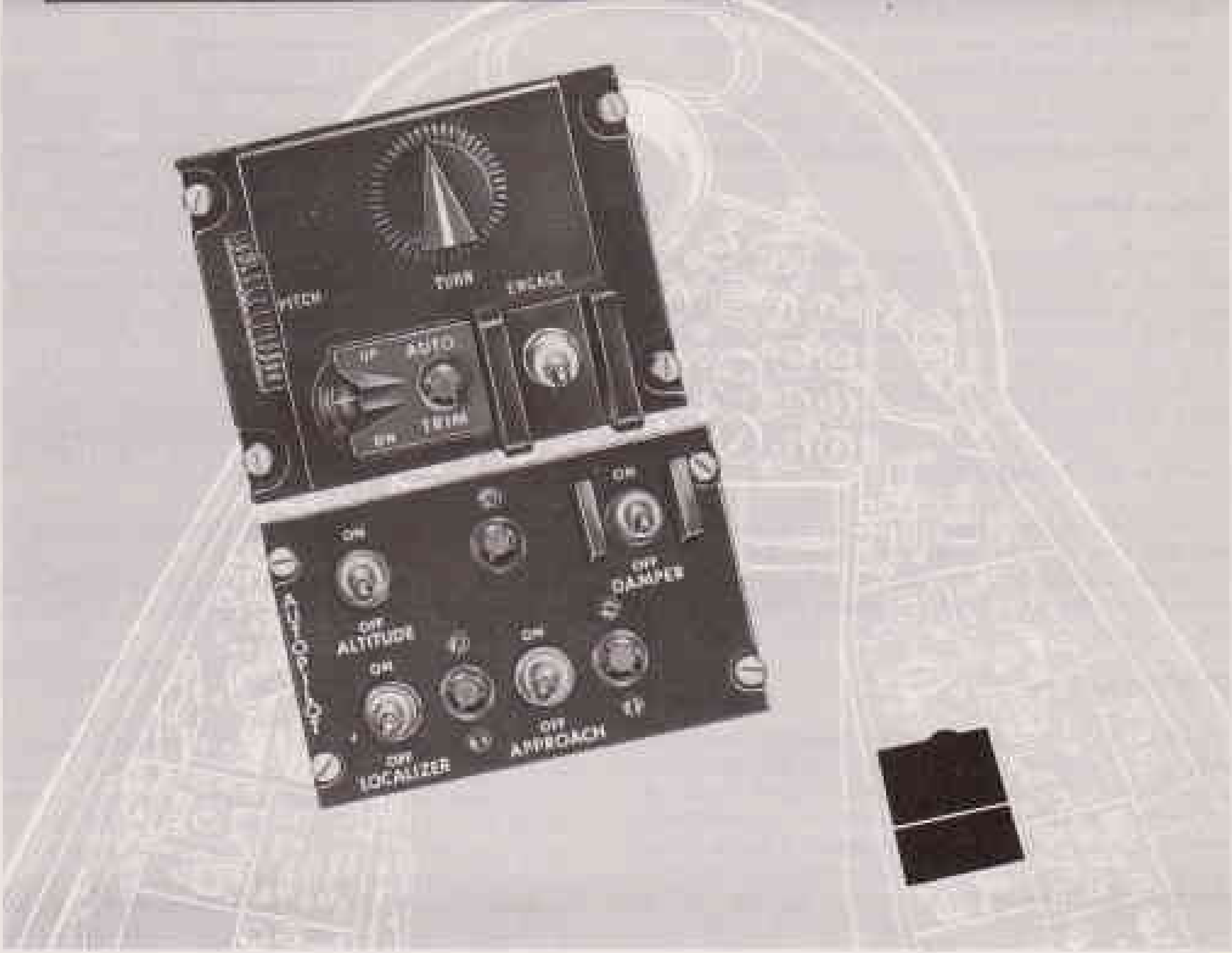

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Figure 4-16

pilot is operating. The pitch wheel is synchronized with pitch of the aircraft, continually changes as a variation in aircraft pitch is made. This enables the pilot to engage the autopilot in any attitude within the limits (as stated above) without erratic pitch changes.

Note

> The stabilizer will automatically be trimmed by its regulator system to coincide with any pitch established by the autopilot.

Release Switch

A momentary contact, push-button switch (figure 1-18) is located on the control stick to facilitate complete disengagement of the autopilot when immediate manual control is desirable. The pilot may also override a pitch change in the autopilot, by applying 25 pounds of pressure on the stick in the direction of pitch change.

Altitude Switch

This two-position switch (figure 4-16) on the function selector (autopilot) panel, is spring-loaded to the OFF position. The switch is held in the ON position by a solenoid, which releases the switch in the event of any malfunction, but may manually be moved to OFF at any time. When this function is utilized, the autopilot will maintain the airplane at the pressure altitude at which it is operating when the switch is placed ON. To change altitude the pilot must turn altitude switch to OFF - make change in altitude - then turn altitude switch ON and the aircraft will remain at the pressure altitude at which the altitude switch is placed in the ON position.

CAUTION

- Be aware that pitch changes will be encountered when the landing gear is lowered while the altitude switch is engaged.
- It is recommended that the altitude switch be disengaged when the landing gear is lowered.

Damper Switch

This two-position toggle switch (figure 4-16) on the function selector (autopilot) panel is spring-loaded to OFF and solenoid held ON so that in the event of any malfunction, it will automatically revert to OFF. When ON it provides automatic yaw damping and turn coordination regardless of whether the autopilot is being utilized or not.

Localizer and Approach Switch

These two-position toggle switches (figure 4-16) on the function selector (autopilot) panel are provided to couple localizer and approach information to the autopilot if the additional equipment is installed. At the present time these switches are inoperative.

Pitch Trim Indicator

This indicator (figure 4-16) on the autopilot controller, indicates the extent the stabilizer trim is in disagreement with the position established by the autopilot. Since the stabilizer trim system is automatically controlled to coincide with any position set up by the autopilot, an indication on this instrument will normally be only momentary.

Note

If indicator does not fluctuate but remains constantly deflected to one side, it indicates a malfunction in the stabilator trim system. Disengage autopilot and hold stick, since the auto-trim indicator will deflect in the direction the aircraft nose will tend to move upon disengagement of the autopilot.

NORMAL OPERATION OF AUTOPILOT

Provided both a-c and d-c power are available and the autopilot is in a state of readiness, it is engaged as follows:

1. Establish an airplane attitude within autopilot limits.
2. Position engage switch to ENGAGE.

EMERGENCY OPERATION OF AUTOPILOT

In an emergency, the autopilot may be disengaged by actuating the autopilot emergency release switch on the control stick or by placing the engage switch, on the autopilot control panel, out of the ENGAGE position. The autopilot can also be overpowered by exerting a force of 25 pounds over the normal force acting on control stick and rudder pedals.

CAUTION

When the autopilot is disengaged, the amplifiers and servos in roll and yaw remain energized to keep the servos centered. It is possible for a combination of malfunctions to cause the servos to oscillate or drive hard-over when the autopilot is disengaged. If this condition is suspected, the autopilot circuit breaker should be pulled.

NAVIGATION EQUIPMENT

STAND-BY COMPASS

Refer to Stand-by Compass, Section I.

J-4 DIRECTIONAL INDICATOR (SLAVED) SYSTEM

The J-4 directional indicator system is a light weight system which may be operated either as a directional gyro corrected for apparent drift due to earth's rotation, or as a directional indicating system slaved to the remote (magnetic) compass transmitter. The system provides an accurate directional gyro for polar navigation as well as incorporating means for magnetic slaving. The compass system is energized when external power is applied to the aircraft or when the a-c generator power supply system is operating. Power requirements for the system are 115 volt three-phase a-c and 28 volt d-c. The J-4 system consists of directional control gyro and a servo amplifier located in the aft cockpit area and a remote compass transmitter located in the vertical stabilizer. The J-4 system control panel (figure 4-17) is located on the right console. The directional control gyro is a motored gyro which stabilizes the compass system when the system is used as a magnetic compass. When the system is operated as a free directional gyro, or as a magnetic compass, the directional control gyro relates heading information to cockpit equipment. The remote compass transmitter is a magnetic sensing device and slaves the compass system to magnetic north and controls the directional control gyro position during magnetic compass operation. The servo amplifier is the receiving and distributing center of the system. It is composed of electronic units that receive and amplify magnetic signals from the remote compass transmitter and distribute these signals to the directional control gyro. Through these signals the directional control gyro is positioned in synchronization with the remote compass transmitter. The J-4 control panel, located on the right console, provides all controls necessary for operation of the system. Instruments in the cockpit that receive heading information from the J-4 system's directional control gyro are: The single needle V-8 directional indicator, the rotating compass card of the ID-250 radio magnetic indicator (RMI), the autopilot, the latitude and longitude indicator (GPI), and the heading pointer needle of ID-249 course indicator. The J-4 system utilizes 28 volt a-c, 115 volts a-c and 28 volts d-c.

Function Selector Switch

The two-position function selector switch (figure 4-17), marked MAG and DG, is used to select the mode of operation of the compass system. When the switch is in the MAG (magnetic) position, the system operates as a magnetic compass with the directional control gyro slaved to the remote compass transmitter. With the switch in the DG position, the directional control gyro is no longer magnetically controlled and the system operates as a latitude corrected directional gyro. During nearly all flight operations, the system should be operated in the MAG position. The DG function is to be used when flying in areas of magnetic interference where remote compass transmitter may be in error. These errors may be caused by flying near large iron deposits, or near the pole areas. Automatic slaving (directional gyro and remote compass synchronization) occurs constantly with the selector switch in the MAG position at the rate of 2° per minute. Fast slaving is initiated by turning the selector switch from MAG to DG, then back to MAG. Fast slaving will occur in approximately 7 seconds.

Synchronizer Switch

The synchronizer switch (figure 4-17) provides a manual means of synchronizing the directional control gyro and the remote compass. The synchronizer switch is marked DECR - (decrease minus) in the full left position, INCR + in the full right position, and SET in the center position. The switch is spring-loaded to the SET position from both left and right positions. Rotating the knob in the clockwise direction (toward the INCR + position) will cause a clockwise heading change on the cockpit indicators. The opposite will occur if the switch is moved left to the DECR - position. Rate of directional gyro rotation can be governed by moving the switch either direction to the first white marker (4° per second), or to the second white marker (45° per second). With the function selector switch in the DG position, rotating the synchronizer switch will merely reposition the directional control gyro, which in turn will change heading indications on the cockpit indicators. With the function selector switch in the MAG position rotation of the synchronizer switch in the direction indicated by the annunciator needle, will synchronize the directional control gyro to the remote compass transmitter signal.

J-4 DIRECTIONAL INDICATOR CONTROL PANEL

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Figure 4-17

Annunciator

The annunciator is a window indicator (figure 4-17) just above the function selector switch on the control panel that indicates whether or not the directional gyro and remote compass are synchronized. With the system operating in the MAG mode, the top center portion of the window is marked MAG, the left side of the window is marked + (plus) and the right side is marked - (minus). In the center of the window is a needle that will deflect either left (+) or right (-) if the directional gyro is not synchronized with the remote compass. If the annunciator needle is deflected to the plus side of the window, the synchronizer switch must be rotated toward the INCR + mark to return the annunciator needle to center (null). With the needle centered, synchronization is complete. In the DG mode of operation, the annunciator is covered with a flag marked DG. Synchronization is not possible until mode of operation is returned to MAG.

Latitude Correction Knob

The manually controlled latitude correction knob (figure 4-17) corrects the system (when in the directional gyro, DG mode of operation only) for apparent gyro drift due to the earth's rotation. The knob is marked with latitudes from 0 to 90 degrees. Correction for gyro drift is clockwise in the northern hemisphere and counterclockwise in the southern hemisphere. This control knob will make relatively little significance in correcting gyro drift flight from west to east or east to west since latitude during these flights will remain fairly constant. Northerly and southerly directed flights, however, will require gyro drift correction through the latitude correction knob. If the DG function is used, the latitude knob is placed on the present latitude of the aircraft, and replaced on new latitudes as the flight progresses.

Hemisphere Switch

The two-position hemisphere switch (figure 4-17) marked S and N is used to select the hemisphere in which the directional gyro mode of operation is operated. As a safety precaution the switch must be positioned with a coin edge or screwdriver type tool. Setting the switch in the N (northern hemisphere) position will effect clockwise correction for gyro drift, and the S (southern hemisphere) position effects a counterclockwise correction.

Turn Switch

The two-position turn switch (figure 1-24), located on the radar warning panel of the main instrument panel, is a toggle switch marked NORMAL and CUT-OUT. The switch is not considered a control of the J-4 system as those on the control panel, but through its use the pilot may obtain accurate heading information during a bank of 30° or more or any violent maneuvers. With the switch in the NORMAL position and the airplane in a bank (turn), the directional control gyro will bank on the same plane as the aircraft producing erroneous heading indications until the aircraft is level. If the switch is placed in the CUT-OUT position, the directional control gyro will remain on a plane with the earth even though the aircraft is banking. This will allow smooth heading changes to be recorded on the cockpit indicator. The turn switch must be replaced to normal or the system will operate as a directional gyro even though the function selector switch is in MAG position.

Note

The turn switch does not eliminate gyro gimbal errors. Gimbal errors are negligible in banks of 30° or less, but they can be as great as 45° when the bank is near vertical. Since the turn switch does not eliminate these errors, banks should never exceed 30° when the accuracy of heading information displayed in a turn is important, as in instrument flight.

CAUTION

If the turn switch is used, it must be repositioned to NORMAL as soon as the aircraft is level after a turn. If the switch is left in the CUTOUT position, the J-4 system will operate as a directional gyro even though the function selector switch is in MAG position, and the directional gyro operates without leveling. Heading errors may then be so excessive as to render the system useless.

J-4 DIRECTIONAL INDICATOR OPERATION—MAG

1. Place function selector switch in MAG position and check turn switch NORMAL.
2. With external power or with generators operating the system is operating. Allow a two-minute warm-up period.
3. The V-8 directional indicator and ID-250 compass card headings should read the same within ± 1-1/2° and indicate the actual aircraft heading. (Check with stand-by compass or known runway heading.)
4. The annunciator needle should have moved to center (null) position indicating synchronization of directional gyro control and remote compass transmitter.
5. If necessary, manual synchronization can now be accomplished by rotating the synchronizer switch in the direction indicated by the annunciator needle until needle moves to center, i.e., if annunciator needle is on the (+) side of center, rotate synchronizer switch toward INCR + mark until annunciator needle reaches center (null). The V-8 directional indicator and ID-250 compass card should smoothly rotate to actual aircraft heading.
6. Automatic synchronization may be initiated by moving the function selector switch from MAG to DG, then back to MAG. When function selector switch is replaced to MAG, the events listed in step 5 above occur automatically.

Note

During manual or automatic synchronization, the annunciator needle may "overshoot" center (null) position. Automatic synchronization will still occur at the rate of 2° per minute until synchronization is complete.

J-4 DIRECTIONAL INDICATOR OPERATION—DG

1. Complete steps 1 thru 6 listed in magnetic operation as necessary to complete synchronization.
2. Place function selector switch in DG position.
3. Check hemisphere switch on N or S according to hemisphere in which flight is made. The gyro will now precess in the proper direction.
4. Set latitude correction control knob on present latitude to govern rate of precession.
5. The V-8 directional indicator and ID-250 compass card will now show turns and headings just as in magnetic operation. The directional gyro is now presenting heading information to these

indicators without signals from the remote compass transmitter. Heading accuracy must be checked with the stand-by compass, a known runway heading, or by placing selector switch back to MAG position to initiate synchronization.

Note

If the remote compass transmitter fails, no magnetic information will be available for the compass system. All cockpit equipment will receive heading information from the directional gyro control as before, however, cockpit course indicators must be set and checked with a known runway heading or the stand-by compass.

CAUTION

During DG operation, the synchronizer switch is still operative even though synchronization is not possible in the DG mode. The switch should not be operated after the gyro has been properly positioned. In polar flight, for example, the pilot would have no way to reset the gyro to an accurate position.

RADIO NAVIGATION

Refer to UHF Command Radio (ADF), (DF) and VHF Navigation Radio (OMNI), this section.

LATITUDE AND LONGITUDE COMPUTER SYSTEM AN/ASN-6

The AN/ASN-6 (GPI) is a dead-reckoning navigation system which continuously computes and indicates the latitudinal and longitudinal position of the aircraft in flight. The system operates in one of two modes, PRESET WIND or COMPUTE DRIFT, and utilizes 28 volt d-c and 115 volt, 400 cycle, single-phase a-c. In the PRESET WIND, the system is dependent on information from the J-4 system and a true airspeed computer, in addition to the manual and automatic inputs obtained from components that are a part of the latitude and longitude system itself. In COMPUTE DRIFT the system is dependent on information from the J-4 system, the true airspeed computer, and the camera view finder, in addition to the self-supplied data. In either mode of operation, the latitude and longitude computer utilizes inputs to generate signals proportional to preset latitude and longitude. These signals are applied to the latitude and longitude indicator (figure 4-18) on the right console, to position dials. In the PRESET WIND mode, the computer control supplies data on wind force and direction to the latitude and longitude computer. This information is obtained from inputs of true heading, true airspeed, and meteorological reports. True heading is computed in the latitude and longitude computer and is a combination of magnetic variation and transmission error corrections with the J-4 signals. Magnetic variation is a value manually preset by a knob on the computer control. Transmission error correction is applied automatically by a cam within the computing mechanism, for each J-4 heading. True airspeed comes from the true airspeed transmitter that is a component of the system. Wind force and wind direction are preset manually by means of knobs on the computer control. The computations performed by the latitude and longitude computer are based then on the meteorological data preset into the control computer. This is altered during flight,

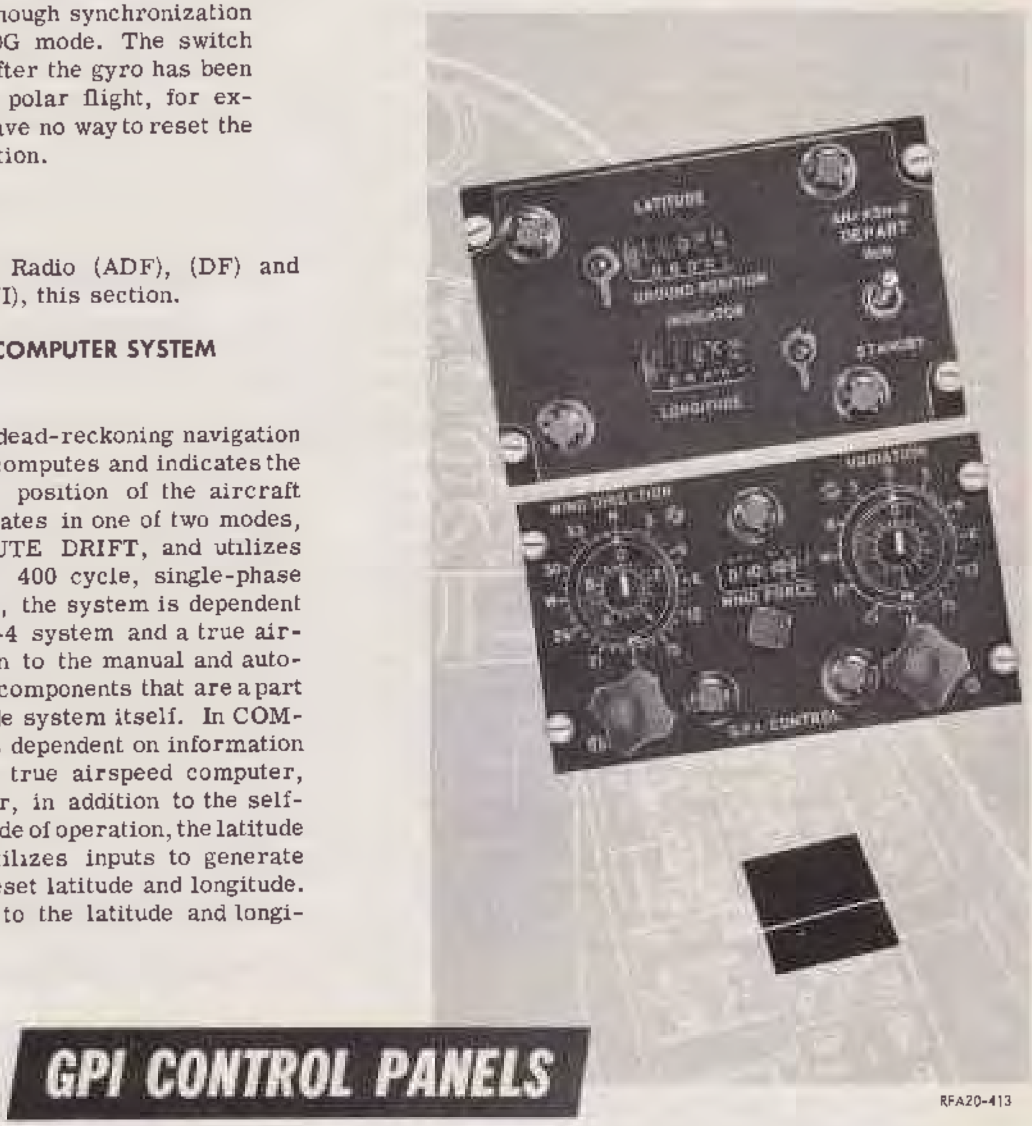

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Figure 4-18

by the automatic inputs of changing airspeed and heading, to give present latitude and longitude signals. In the COMPUTE DRIFT mode, the drift computer supplies the wind force and direction data required by the latitude and longitude computer. The drift computer computes the wind force and direction data from inputs of drift angle, true heading, and true airspeed. Drift angle is set into the drift computer during two drift runs using the camera view finder. True airspeed and true heading are obtained from the same sources as during operation in the PRESET WIND mode. The computations performed by the latitude and longitude computer are, in this case, based on preset value of magnetic variation and drift angle values obtained during the two drift runs. This information is modified during flight by the changing values of airspeed and heading as in the PRESET WIND mode.

GROUND POSITION INDICATOR PANEL

The GPI panel (figure 4-18) on the right console is the primary component of the system. The face of the panel includes two slew levers with integral locks and a two-position toggle switch. The unit receives power from the 28 volt d-c and 115 volt, 400 cycle, single-phase a-c buses.

Slew Levers

The two slew levers located on the cover of the indicator, are used to set values of initial latitude and longitude into the system. They actuate switches that control two operating speeds of the indicator counters, depending on amount of throw of the slew levers. Extreme position of slew-switch-lever travel gives high-speed slew, intermediate position gives slow speed which is used for setting exact values on the counter. The switches are spring-loaded and return the levers to neutral. The slew levers are equipped with safety locks to prevent accidental slewing of the counters. The lever locks have two positions, locked and operate. The lever is unlocked when parallel to its respective indicated window. When the latitude slew lever is actuated upward, the latitude counters indicate increasing values of north latitude or decreasing values of south latitude. When the lever is actuated downward, the values of north latitude decrease and values of south latitude increase. The latitude counters indicate to the nearest minute of latitude. In a similar manner, actuation of the longitude slew lever to the left causes the longitude counters to indicate decreasing values of east longitude or increasing west longitude. Actuation of the lever to the right increases east longitude or decreases west longitude.

Latitude and Longitude Counters

The latitude and longitude counters each have 4 drum type counters. Each drum on the latitude counter has 2 columns of digits, one for north latitude and one for south latitude. The drums are covered with a mask with apertures arranged to display either the left or right column of digits, depending upon the position of the aircraft with respect to the equator. The longitude counter drums have left-hand columns for west longitude and right-hand columns for east longitude values. On the latitude counters the two left columns record degrees of latitude and the two right columns record minutes. The digits in the right-hand column on the minute counter appear twice, one above the other. The digit in the unit of minutes column that is repeated represents 0.5'. For example, when the 1 in 69°31' is repeated, the value is 69°31.5'. The longitude counter is the same except the left-hand drum in the degree counter has 2 sets of digits so that it can record longitude up to 180°.

For example, the minute drums will record the following values during change from 0°59' to 1°00'.

Drum Reading	True Value
0°59'	0°59'
0°59'	0°59.5' (because the 9 in 59' has been repeated)
0°60'	0°60' = 1°00' (1°00' is seen only as 0°60'. See below)
1°00'	1°00' = 1°00.5' (because the 0 in 60' has been repeated.)

The second 0°60' is not actually seen as such because when the repeated zero in the 60 begins to appear, the 6 changes to 0 and the 0° changes to 1°.

Departure Switch

A two-position switch (figure 4-18) is located on the panel to control the output of change-of-latitude and change-of-longitude from the computer unit. In "STANDBY", the departure switch operates a relay which cuts the transmission between the computer unit and the indicator and transmits an electrical zero signal to lock the indicator receivers. To operate the system, the departure switch must be turned to "RUN".

Note

> The departure switch should be left in STANDBY (to prevent indicator from turning) until after take-off is completed.

COMPUTER CONTROL PANEL

The computer control panel (figure 4-18), the second of the two control panels within the system, is mounted on the right console. This panel contains the manually adjusted controls which when properly positioned provide the set with the given meteorological and geographical information.

DRIFT COMPUTER CONTROL PANEL

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Figure 4-19

Wind Direction and Variation Knobs

These knobs are provided with friction grips that prevent them from turning because of vibrations encountered during aircraft flight. To set values into the computing system using these knobs, it is necessary to exert a slight inward pressure on the knob as it is turned. The knobs are used to set in values of wind direction, wind force, and magnetic variation. The "WIND DIRECTION" indicator course scale (outer) is graduated in 10-degree intervals; the fine scale (inner) in 0.5 degree intervals. Magnetic variation is readable on a similar type of indicator in 0.5 degree, east or west of true North.

Wind Force Knob

This knob similar in operation to the wind direction and variation knobs allows the wind force in knots to be set into the counter window. Wind force is displayed on a drum-type counter with a range of zero to 200 knots. The fine scale is graduated to 0.2 knots.

DRIFT COMPUTER CONTROL PANEL

In the (20) airplanes the drift computer control panel (figure 4-19) is located on the left console. In the (25)(30)(35) airplanes, the drift computer control panel (figure 1-21) is located on the pedestal panel. The panel contains only one four-position control knob, which controls the mode of operation of the GPI, either COMPUTE DRIFT or PRESET WIND. The knob is positioned on the remaining two functions, H1 and H2, as the respective first and second drift runs are made in COMPUTE DRIFT operation.

Wind Indicator

In (25) and (30) airplanes upon incorporation of T.O. 1F-101-610 and in (35) airplanes, a wind indicator (figure 1-25) is installed on the pedestal panel. After a drift run is completed in the COMPUTE DRIFT mode, the wind indicator gives a visual indication of the values of wind force and direction which the drift computer is supplying to the latitude and longitude computer. The indicator is calibrated in increments of 5° from 0° to 360°. The wind direction pointer is rotated by electrical inputs from the drift computer to indicate wind direction. The lower portion of the instrument contains a counter-type indicator that indicates wind speed in knots. Three drums are rotated by electrical inputs from the drift computer indicating wind speed over a range of from 0 to 200 knots.

OPERATION OF GPI-PRESET WIND

Note

If a navigation point (IP) other than the field (departure point) is to be used, meteorological conditions, compass variation and latitude and longitude of the navigation point are set into the system instead of those of the field.

1. Drift computer control knob - SET
   Set drift computer knob on PRESET WIND.
2. Variation knob - SET
   Rotate knob to correctly position circular indicator to the present geographical position magnetic variation.
3. Wind force knob - SET
   Rotate knob to position tab indicators of metro-wind force (knots).
4. Wind direction knob - SET
   Rotate knob to correctly position circular indicator to metro-wind direction.
5. Latitude slewing switch - SET and LOCK
   Unlock slewing switch and move button fore or aft to position tab indicators to geographical latitude of desired IP or departure point. Relock switch.

6. Longitude slewing switch - SET and LOCK
   Unlock slewing switch and move button right or left to position tab indicators to geographical longitude of desired IP or departure point. Relock switch.
7. Depart switch - STANDBY
8. At IP or departure point, switch is placed to RUN, thus putting the computer into operation.

Note

- The departure switch should be left in STANDBY (to prevent indicator from turning) until after take-off is completed and the aircraft is on course. Rapid climbs or descents add to system inaccuracy since computations are based on level flight.
- The above steps are used when the pilot has been given meteorological conditions from ground stations and these values set on the appropriate controls. However, different weather conditions will be encountered as the flight progresses and the pilot should complete drift runs by using the compute drift mode of system operation. The compute drift method is considered the most accurate.

OPERATION OF GPI-COMPUTE DRIFT

To operate in the COMPUTE DRIFT mode, the system components are set up as they would be for the PRESET WIND mode. However, once the aircraft is airborne and the pilot wishes to enter the COMPUTE DRIFT mode, he must make two drift runs. This is done in the following manner:

1. View finder control panel - SET
   Set view selector knob on any position, grid illumination as desired, and filter to clear or yellow.
2. Drift computer control knob - H1
3. Pick an easily distinguished point on ground.
4. Hold a constant heading, and using the drift switch (on view finder control panel), rotate the reticle so that the path of the ground point moves parallel to the center track line on the view finder grid.
5. Hold same heading for at least a ten second time lapse and rotate drift computer knob to H2.
6. Make a 30° to 150° heading change and complete another drift run as in step 3 and 4.
7. While holding the heading obtained on the second run for ten seconds, turn the compute drift knob to COMPUTE DRIFT.

Note

Through memory units, the drift computer now supplies wind force and direction information computed from drift angle obtained in the above steps, and from inputs of true heading and true airspeed.

8. The aircraft may now be turned to the desired course.

Note

In succeeding drift runs the procedure is exactly the same as described above in steps 1 through 8. The procedure is begun by turning the drift computer control knob through position H2 to H1 and then continues as described in steps 1 through 8. The depart switch should be placed in the STANDBY position until the drift runs are completed if a known IP is to be crossed before placing the switch to RUN.

CAUTION

After operating in the COMPUTE DRIFT mode, do not replace drift computer knob to PRESET WIND since previously used meteorological values are now useless. If no other IP point is available to obtain known latitude and longitude, the drift runs must be made with the depart switch in RUN position.

Present position will then be constantly computed during these maneuvers. At the completion of the drift runs, return to course in the normal manner.

NAVIGATION COMPUTER SET AN/ASN-7

Airplanes modified by T.O. 1F-101-662 have the necessary internal wiring and mounting provisions for the AN/ASN-7 navigational computer set. The ASN-7 is a dead-reckoning computing system that continuously displays the course and distance to a desired destination as well as the present position of the aircraft in latitude and longitude. The wind force and direction may be computed with the drift computer and the magnetic variation at the present position of the aircraft is continuously computed. The system has two modes of operation, PRESET WIND and COMPUTE DRIFT. In PRESET WIND, the wind velocity and direction are manually set by the pilot. In COMPUTE DRIFT, the wind values are automatically set by the drift computer. In both modes of operation, the computer units use inputs from components that are a part of the navigation computer and data obtained from other systems to compute the present latitude and longitude of the airplane. The latitude and longitude is shown on the position indicator dials. These values are also fed into the course and distance computer which computes the information displayed on the course-distance-track indicator. This indicator provides a continuous display of the course and distance to the destination and the actual ground track of the aircraft. The latitude and longitude of the initial checkpoint and the destination must be set into the computer before take-off. Any flight under 1000 miles, will require only one setting. If the computed distance exceeds 1000 miles, a mask will cover the counter indicating that the destination should be

NAVIGATION COMPUTER CONTROL PANEL

reset to an intermediate point. The ASN-7 computer has the capability of storing an alternate destination for use when the primary destination is weathered in or a flight of more than 1000 miles is planned. If a flight of more than 1000 miles is planned, set an intermediate point less than 1000 miles as the primary destination and the next point as the alternate destination. When the airplane arrives at the intermediate point, the alternate destination may be set into the computer as the new primary destination and a new alternate destination put in. This may be repeated as many times as necessary until the final destination is reached. The computer continuously computes distance and ground track to the destination regardless of deviation from the planned course. To return to course, turn the aircraft to align the course pointer with the index marker and the airplane will be on course.

AN/ASN-7 CONTROL PANEL

The ASN-7 control panel (figure 4-20), located on the right console, contains all controls and indicators except the drift computer and the ID-390 course-distance-track indicator.

Position Indicator

The position indicator shows the present position of the aircraft in degrees and minutes of latitude and longitude. It is also used to set into the computer the latitude and longitude of the primary and alternate destinations.

DISPLAY SELECTOR SWITCH

The display selector switch selects which position will be displayed on the position indicator. In the PP position, the indicator shows the present latitude and longitude of the airplane. In the DEST position, the indicator shows the latitude and longitude of the destination.

Mode Selector Switch

The mode selector switch is a four-position switch that selects the mode of operation. In the OFF position, all power to the set is cut off. In STBY, power is supplied to all functions but the computers are not operating. In RUN, the set will operate normally. The PP. RST. position is used to correct the present position indication of the airplane after the airplane is airborne through operation of the slew switches.

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Figure 4-20

Slew Switches

The two slew switches are three-position switches. They are spring-loaded to the OFF position and are used to set values of latitude and longitude into the position indicator. Rotating the latitude slew switch counterclockwise causes the position indicator to increase values of north latitude or decrease values of south latitude. Rotating the latitude switch clockwise causes the values of north latitude to decrease or values of south latitude to increase. Rotating the longitude switch counterclockwise causes the values of west longitude to increase or values of east longitude to decrease. Rotating the longitude switch clockwise causes the values of west longitude to decrease or the values of east longitude to increase.

Storage Switch

The storage switch is a two-position switch used to insert destination values into the computer. The display selector switch must be in the DEST position and the storage switch in STOR when setting up primary destination values in the position indicator. After the LA and LO flags appear, the storage switch is moved to INSERT position to insert the destination values into the computer. After the primary destination values have been inserted into the computer, the storage switch should be returned to the STOR position to set the alternate destination into the computer. The storage switch is left in the STOR position to store the alternate destination values until they are needed at the change-over checkpoint.

LA and LO Flags

The LA and LO flags appear whenever primary or alternate destination values have been set into the position indicator but have not been inserted into the computer.

Wind Speed Indicator

The wind speed indicator shows the wind speed that is set into the computer in the PRESET WIND mode of operation.

Wind Speed Slew Switch

The wind speed switch is a three-position switch used to set the wind speed in the wind speed indicator when operating in the PRESET WIND mode. The switch is spring-loaded to the OFF position. Rotating the switch clockwise increases and counterclockwise decreases the wind speed shown in the wind speed indicator.

Wind Direction Indicator

The wind direction indicator shows the wind direction that is set into the computer in the preset wind mode of operation.

Wind Direction Slew Switch

The wind direction slew switch is a three-position switch used to set the wind direction into the wind direction indicator. The switch is spring-loaded to the OFF position. Rotating the switch clockwise increases and counterclockwise decreases the indication shown for wind direction.

Variation Indicator

The variation indicator shows the magnetic variation at the present location of the aircraft when the variation is automatically computed. When the variation is manually set, the indicator shows the value set into the computer by the variation slew switch.

Variation Switch

The variation switch is a three-position switch, that determines whether the variation is automatically computed or manually set into the computer. When the switch is in the AUTO position, the variation is automatically computed. When the switch is in the W position, values of west variation may be set into the variation indicator. When the switch is in the E position, values of east variation may be set into the variation indicator.

Variation Slew Switch

The variation slew switch is a three-position switch used to set values of east or west variation into the variation indicator when the variation switch is in the E or W position. The slew switch is spring-loaded to the OFF position. When the variation switch is in the W position, rotating the slew switch to W increases and the E decreases the west variation shown in the variation indicator. When the variation switch is in the E position, rotating the slew switch to E increases and to W decreases the east variation shown in the variation indicator.

ID-390 Course–Distance–Track Indicator

The ID-390 course-distance-track indicator, (figure 4-20) located on the main instrument panel, replaces the V8 directional indicator and shows the course to the destination, the distance to the destination and the present track of the aircraft. The course to the destination is shown by the needle in the instrument. The distance to the destination is shown by a three digit odometer. The rotating card keeps the actual ground track under the index marker at the top of the aircraft.

DRIFT COMPUTER CONTROL PANEL

For a discussion of this panel, refer to the write-up under the latitude and longitude computer system, AN/ASN-6, this section.

Wind Indicator

For a discussion of the instrument, refer to the write-up under the latitude and longitude computer system AN/ASN-6, this section.

OPERATION OF AN/ASN-7-PRESET WIND

Note

> If a navigation point (IP) other than the take-off point is used, meteorological conditions and latitude and longitude of the navigation point are set into the system instead of those of the take-off point.

1. Drift computer control knob - PRESET WIND
2. Mode selector - STBY
3. Display selector switch - P.P.
   Set display selector switch to present position before inserting information.
4. Latitude and longitude counter - SET
   Set the latitude and longitude into the position indicator by use of the latitude and longitude slew switches.

CAUTION

When setting in either the present position or destination, do not allow the distance reading on the ID-390 to exceed 999 miles to prevent wear and tear on the equipment.

5. Wind speed indicator - SET
   Set the wind speed into the wind speed indicator with the wind speed slew switch.
6. Wind direction indicator - SET
   Set the wind direction into the wind direction indicator with the wind direction slew switch.
7. Variation switch - AUTO
   Set variation switch to AUTO unless variation is to be manually set.
8. Display selector switch - DEST
9. Destination storage switch - STORE

CAUTION

When setting in a destination, always have the destination storage switch in the STORE position to save wear and tear on the equipment.

10. Latitude and longitude counter - SET
    Set destination latitude and longitude into the position indicator with the latitude and longitude switch.
11. LA and LO flags - CHECK
    Check that the LA and LO flags appear.
12. Destination storage switch - INS
    Put storage switch to INS to insert destination latitude and longitude into computer. Rhumb line course and distance to destination are automatically computed.
13. ID-390 - CHECK
    The pointer will indicate course and the counter will indicate the distance to the destination.

If an alternate destination is to be stored, proceed with steps 14 through 16.

14. Display selector switch - DEST
15. Destination storage switch - STORE
16. Latitude and longitude counters - SET
    Set the latitude and longitude of the alternate destination into the position indicator with the slew switches.

Note

Leave the storage switch in STORE until ready to proceed to alternate. Then move the storage switch to INS. The computer will then compute course and distance to the alternate.

17. Display selector switch - P.P.
18. At IP or departure point, mode selector switch - RUN

Note

- The departure switch should be left in STBY (to prevent indicator from turning) until after take-off is completed and the aircraft is on course. Rapid climbs or descents add to system inaccuracy since computations are based on level flight.
- The above steps are used when the pilot has been given meteorological conditions from ground stations and these values set on the appropriate controls. However, different weather conditions will be encountered as the flight progresses and the pilot should complete drift runs by using the compute drift mode of system operation. The compute drift method is considered the most accurate.

If the pilot finds himself off course, he can insert the correct position into the computer. As soon as the correct position is known:

19. Mode selector switch - PP RST

As soon as it is convenient, proceed with step 20.

20. Position indicator - SET
    Insert the correct latitude and longitude into the position indicator with the slew switches.
21. Mode selector switch - RUN

All changes in the position of the aircraft which will have accumulated during the interval required to insert the fix are now automatically inserted into the computer and it will show the corrected present position. Because of the storage feature of the ASN-7, this correction may be made at any reasonable time, but until the correction is inserted, the correct position, course, and distance will not be shown.

OPERATION OF AN/ASN-7-COMPUTE DRIFT

To operate in the COMPUTE DRIFT mode, the system components are set up as they would be for the PRESET WIND mode. However, once the aircraft is airborne and the pilot wishes to enter the COMPUTE DRIFT mode, he must make two drift runs. This is done in the following manner:

1. View finder control panel - SET

Set view selector knob on any position, grid illumination as desired, and filter to clear or yellow.

2. Drift computer control knob - H1
3. Pick an easily distinguished point on ground.
4. Hold a constant heading, and using the drift switch (on viewfinder control panel), rotate the reticle so that the path of the ground point moves parallel to the center track line on the viewfinder grid.
5. Hold same heading for at least a ten second time lapse and rotate drift computer knob to H2.
6. Make a 30° to 150° heading change and complete another drift run as in step 3 and 4.
7. While holding the heading obtained on the second run for ten seconds, turn the compute drift knob to COMPUTE DRIFT.

Note

Through memory units, the drift computer now supplies wind force and direction information computed from drift angle obtained in the above steps, and from inputs of true heading and true airspeeds.

8. The aircraft may now be turned to the desired course.

Note

In succeeding drift runs the procedure is exactly the same as described above in steps 1 through 8. The procedure is begun by turning the drift computer control knob through position H2 to H1 and then continues as described in steps 1 through 8. The mode selector switch should be placed in STBY position until the drift runs are completed, if a known IP is to be crossed, before placing the switch to RUN.

CAUTION

After operating in the COMPUTER DRIFT mode, do not replace drift computer knob to PRESET WIND since previously used meteorological values are now useless. If no other IP point is available to obtain known latitude and longitude, the drift runs must be made with the mode selector switch in RUN position. Present position, course correction, and distance data will be constantly computed during these maneuvers. At the completion of the drift runs, return to course in the normal manner.

PHOTOGRAPHIC EQUIPMENT

The nose and forward fuselage sections house the photographic equipment necessary for high or low altitude day reconnaissance and photography. The equipment is located in three separate stations (figure 1-1). The forward oblique station has one KA-2-12 camera installed. The tri-camera station contains the trimetrogon camera. The trimetrogon camera is an assembly of three KA-2-6 cameras arranged to take one vertical and two oblique photographs simultaneously. The split vertical station is located in a compartment aft of the nose gear and contains two KA-1-36 cameras. The split vertical station has doors which protect the camera windows during ground operation and are retracted before operation of the split vertical camera. The camera control system furnishes single point control over the camera equipment either manually or automatically. The camera controls are mounted on the left console in the cockpit. In manual control, the values of aircraft velocity, altitude, shutter speed and diaphragm opening are set into the system through thumb wheels on the master control panel. These values are converted into the proper exposure and IMC (image motion compensation) signals for the cameras and magazines. In automatic operation, the signals for the above values are determined automatically as conditions change. An air conditioning system provides for refrigerated or heated air for the camera compartments and is controlled automatically or manually. Camera window areas are electrically defrosted automatically.

CAMERA OPERATION LIMITS CHART

The camera operation limits chart (figure 4-21) gives the minimum operating altitude at various airspeeds for the split vertical and trimetrogon cameras. The limits given are the mechanical limits of the film advance mechanism. If the cameras are operated below the minimum altitude, the film advance mechanism will not operate fast enough to give the desired photograph overlap. There is no minimum operating altitude for the forward oblique camera.

LOW ALTITUDE OPERATION

For low altitude operation, the following film magazines are normally installed.

STATION	CAMERA	MAGAZINE
Forward Oblique	KA-2-12	A-9B
Trimetrogon	KA-2-6	A-28 (IMC)
Split Vertical	KA-1-36	A-25 (IMC) or A-8B with IMC mount

For low altitude operation, the camera control system controls the shutter speed and aperture diaphragm openings of all the cameras. Exposure values from either the terrain light detector or the master control panel are amplified and transmitted to each camera to adjust the diaphragm opening and shutter speed. The ground speed altitude ratio from either the scanner, the view finder, or the master control panel control the image motion control motors in the split vertical and trimetrogon cameras. The IMC motor drives the film across the magazine format opening at the speed necessary to compensate for image

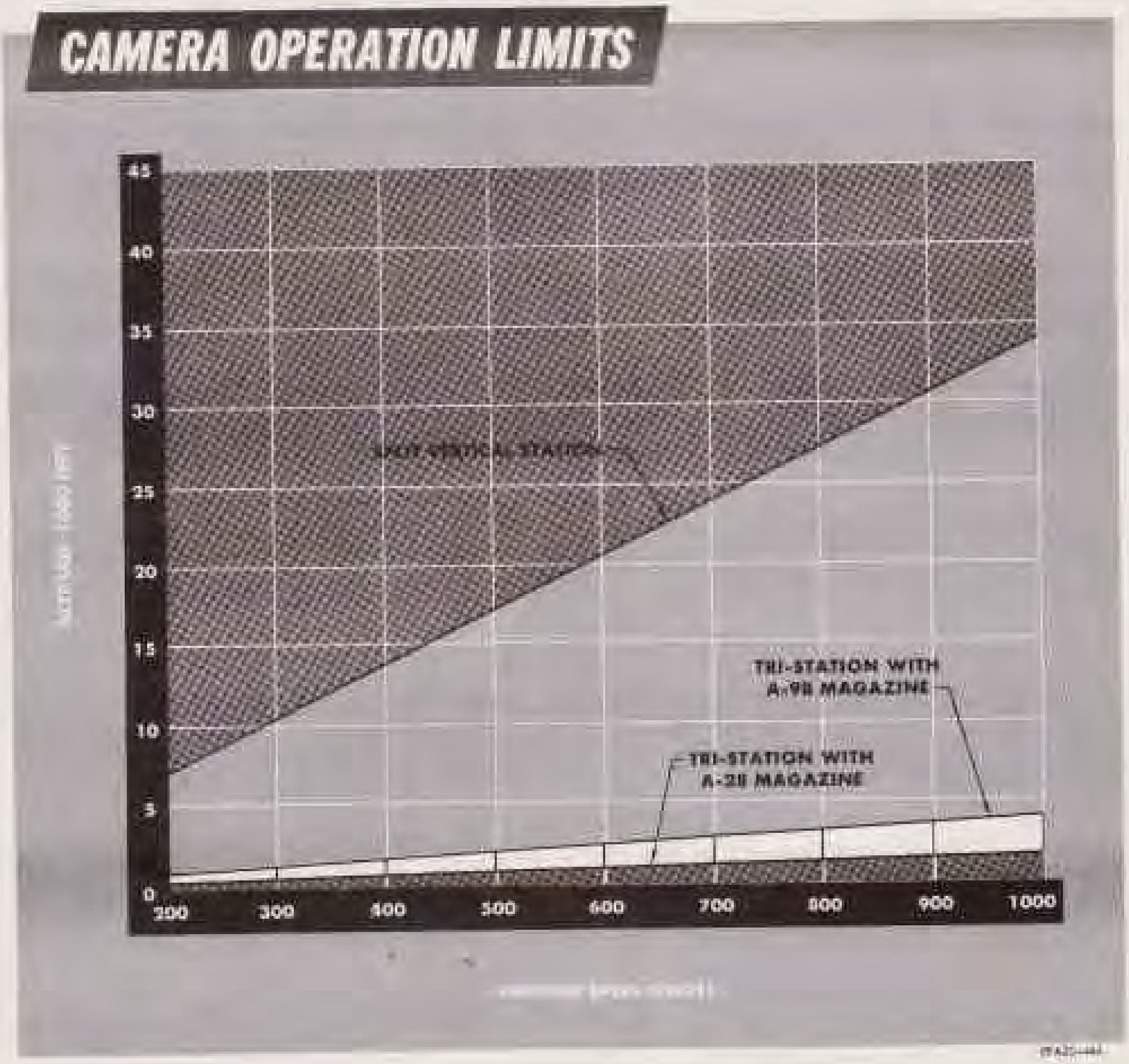


Figure 4-21

motion. Prior to incorporation of T.O. 1F-101-661, the split vertical station has an A-25 film magazine with IMC motors. After incorporation of T.O. 1F-101-661, an A-8B film magazine without IMC is used and image motion is compensated for by mounting the camera in an IMC swing mount. With the split vertical station IMC mount, the actuators move the split vertical station swing mounts at the speed necessary to compensate for image motion. Intervalometers in the camera control system determine the time interval between exposures to provide the proper overlap of photographs. The camera operation limits chart (figure 4-21) shows the minimum operating altitude at various airspeeds for the different magazine and camera combinations.

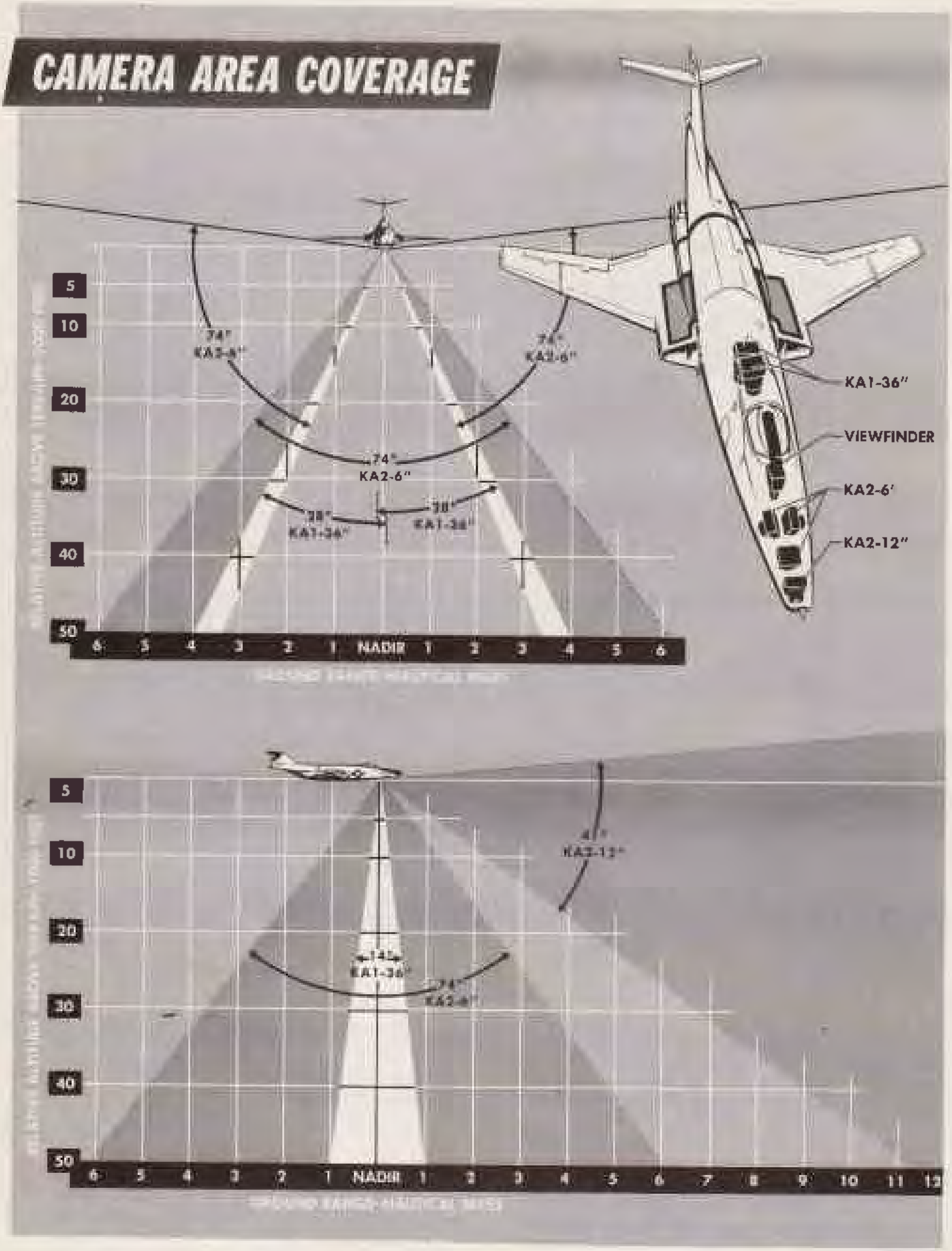
HIGH ALTITUDE OPERATION

For high altitude operation the following film magazine may be installed.

STATION	CAMERA	MAGAZINE
Forward Oblique	KA-2-12	A-9B
Trimetrogon	KA-2-6	A-9B
Split Vertical	KA-1-36	A-8B

For high altitude operation, the camera control system provides control of the shutter speed and diaphragm opening in the same way it does for low altitude operation. High altitude photography does not require

CAMERA AREA COVERAGE



RFA20-41/8

Figure 4-22

CAMERA MASTER CONTROL PANEL

RFA20-415

Figure 4-23

image motion compensation. Therefore, the A-9B and A-8B film magazines, which do not have IMC drives, may be used. Intervalometers in the camera control system determine the time interval between exposures to provide the proper overlap of photographs. The Camera Operation Limits chart (figure 4-21) show the minimum operating altitude at various airspeeds for the different magazine and camera combinations.

CAMERA MASTER CONTROL PANEL

Power Switch

The power switch (figure 4-23) is located on the master control panel. When in the ON position, it completes the circuit necessary for 115 volt a-c and 28 volt d-c power to the camera control system and the warm-up bus.

Ready Switch

The ready switch (figure 4-23) is located on the master control panel and, in conjunction with the power switch (ON), it completes the circuit necessary for 28 volt d-c power to the station controls. The switch also supplies current to the operate and trigger switches.

Operate Switch

The operate switch (figure 4-23) is located on the master control panel and, in conjunction with the power and ready switches (ON), completes the circuits necessary to operate the selected camera. Refer to Operation of Aerial Cameras in this section.

Power Light

An amber indicating light (figure 4-23) is illuminated when the electrical power is supplied to the system during warm-up. After actuation of the ready switch, the light will flash on-off for approximately 60 seconds, provided at least one of the stations has been selected for operation. If no station is selected for operation, the light will continue to flash.

Ready Light

A green indicating light (figure 4-23) is illuminated when the warm-up period is completed and the ready switch is ON, providing at least one of the stations has been selected for operation.

Failure Light

The red failure light (figure 4-23), marked "Failure", will illuminate whenever light from the photo target area is too weak to be detected by the terrain light detector or when there is a malfunction in the terrain light detector. This occurs during AUTO operation only.

Ground Speed Setting

The ground speed window (figure 4-23), marked "Ground Speed Knots", allows a four digit figure to be viewed by the pilot. The figure is preset by a thumb wheel adjustment. It can be set from 200 to 1200 knots.

Altitude Setting

A window (figure 4-23) marked "Altitude X 1000 Feet" allows a two digit figure to be viewed by the pilot. The figure is preset by a thumb wheel adjustment. It can be set from 200 to 60,000 feet.

f/Stop Setting

A window (figure 4-23), marked "Iris f/Stop" allows the pilot to view a two digit figure representative of the f/stop lens setting. It can be set from f/2 to f/22 using the thumb wheel adjustment.

Shutter Speed Setting

A window (figure 4-23) marked "Shutter Speed Sec" allows the pilot to view a fraction representative of the shutter speed. It can be set from 1/10 to 1/800 second by use of the thumb wheel adjustment.

Transport Switch

The transport switch (figure 4-23) on the master control panel, marked AUTO and MANUAL, allows the pilot to select the type of system operation desired.

Exposure Switch

The exposure switch (figure 4-23) on the master control panel, marked AUTO and MANUAL, allows the pilot to select the type of system operation desired.

Test Switch

A "press-to-test" switch (figure 4-23) may be actuated to test all lights on the panel.

CAMERA STATION CONTROL PANELS

Three station control panels (figure 4-24), each identical except for the number of lights which indicate camera operation, are mounted in line aft of the master control panel on the left console. Power for the stations is 115 volt a-c and 28 volt d-c. For camera area coverage, see figure 4-22.

Mode Selector

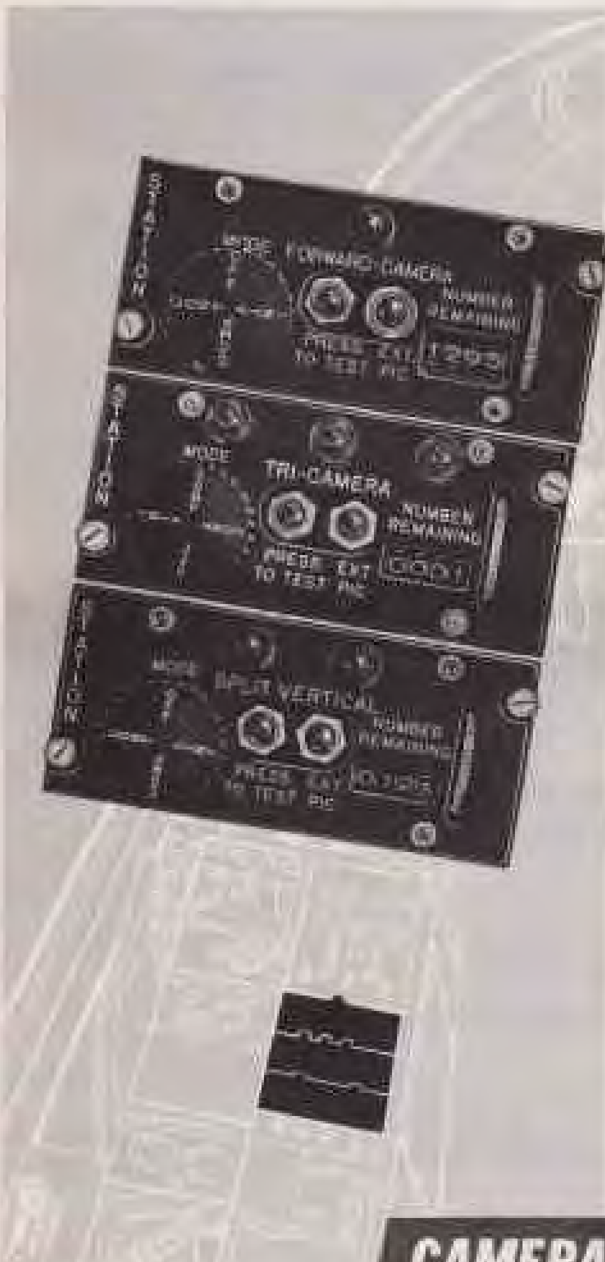
On each of the three station control panels is a four-position selector marked INTV. (intervalometer), COMP. (computer), CONT. (continuous) and OFF. The INTV. position is not utilized. The COMP. position places the camera in operation at a predetermined sequence in conjunction with the intervalometer. The CONT. position allows continuous shutter operation.

CAUTION

Operation of the split vertical station mode selector to any position other than OFF will open the sliding camera doors. If more than 1 minute is required for the door warning lights to extinguish, utilize the emergency camera door switch or the door drive motor will be damaged.

Test Switch

A "press-to-test" switch on each panel may be actuated to test the indicator lamps. The lamps on the selected panel will illuminate when the switch is depressed.



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CAMERA STATION CONTROL PANELS

Figure 4-24

EMERGENCY CAMERA DOOR CONTROL PANEL

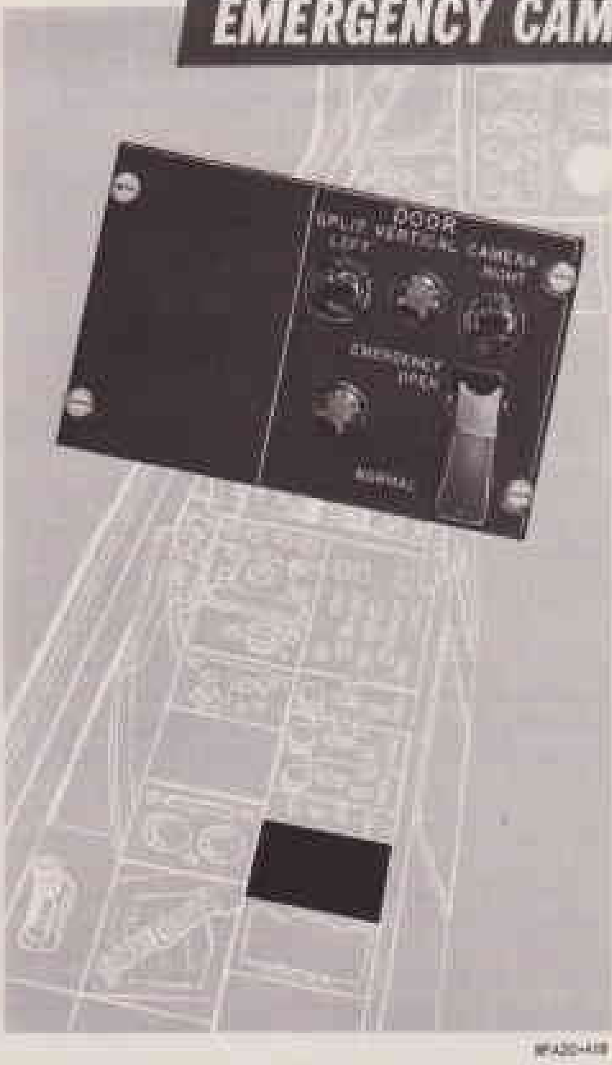


Figure 4-25

Pressing this switch will also test the frame counter, causing the counter to move one digit each time the switch is pressed.

Extra Picture Switch

The extra picture switch, marked "EXT PIC", allows the pilot to by-pass the normal sequence of operation and take exposures between intervalometer pulses by momentarily depressing the switch. This switch also causes continuous camera operation when held depressed. The switch is inoperative when using IMC type film magazines and when the cameras are not operating.

Frame Indication

A window marked "Number Remaining" allows the pilot to view a four digit figure preset by the thumb wheel adjustment and reduced in number each time a frame is exposed.

EMERGENCY CAMERA DOOR CONTROL PANEL

Emergency Camera Door Switch

The emergency camera door switch, a guarded two-position toggle switch (figure 4-25) marked EMERGENCY OPEN and NORMAL, allows the pilot to open the split vertical doors by a pneumatic motor if the normal system fails.

CAUTION

> After selection of the EMERGENCY OPEN, do not return the switch to NORMAL until a ground check of the door actuation system is performed.

Door Position Indicators

Two lights, marked "Left" and "Right" are illuminated to indicate to the pilot that the split vertical doors are moving open or have failed to open. Normal door operation is controlled by the mode selector on the split vertical camera station control panel.

Camera Operate Power Light

In (20)(25)(30) airplanes upon incorporation of T.O. 1F-101(R)A-502 and in the (35) airplanes, a green indicating light (figure 1-30) on the instrument panel, is illuminated when the trigger switch is actuated or the operate switch is ON.

Control Stick Extra Picture Switch

In (20)(25)(30) airplanes upon incorporation of T.O. 1F-101(R)A-502 and in (35) airplanes, the control stick has an extra picture switch (figure 1-18). Momentary actuation of the switch will cycle all cameras without IMC once providing the mode switches are in the COMP position. Holding the switch depressed will cause continuous camera operation. This switch is operational only when the ready light is ON.

CAMERA COMPARTMENT AIR CONDITIONING SYSTEM

A pneumatically operated electrical controlled air conditioning system is utilized to control camera compartment temperatures. The temperature of the air entering the forward or aft camera compartment is controlled individually by an automatic temperature controller. Should either automatic temperature controller fail the pilot can manually control the temperature of the affected compartment. High temperature

CAMERA COMPARTMENT TEMPERATURE CONTROL PANEL

RFA20-419

Figure 4-26

bleed air from the sixteenth stage compressor section of each engine is used by the refrigeration unit to maintain camera compartment at the desired temperatures. The temperature controllers proportion hot air from the engines with cooled air from the refrigeration unit. The system utilizes 115 volt a-c and 28 volt d-c electrical power.

CAUTION

The camera compartment air conditioning system should be on at all times when the aircraft is airborne to prevent the accumulation of moisture in the camera compartments.

Camera Compartment Temperature Control Panel

The camera compartment temperature control panel (figure 4-26), located on the left console in the (20) airplanes and on the pedestal panel in the [illegible] airplanes, provides the pilot with all controls necessary to manually or automatically control the forward and aft camera compartment temperatures.

Master Pneumatic Switch

The master pneumatic switch (figure 4-26) is located on the camera compartment temperature control panel. Placing the switch to ON directs the flow of air from both engine compressor sections to the refrigeration unit for camera compartment air conditioning. Placing the switch to OFF renders the air conditioning system inoperative.

System Selector Switch

A system selector switch (figure 4-26) for each camera compartment allows the pilot to select the desired type of compartment air conditioning. Placing the switch to the AUTO position directs electrical power to the automatic temperature controller which maintains the camera compartment at the desired temperature (30°C). Should the automatic temperature controller malfunction, the camera compartment temperature may be controlled manually by placing the system selector switch to MAN. Placing the switch to MAN directs electrical power to the manual temperature controller and the manual heat control knob. Refer to Manual Heat Control Knob, this section.

Manual Heat Control Knob

A rheostat (figure 4-26) for each camera compartment allows the pilot to manually control the camera compartment temperatures. Moving the rheostat clockwise from COLD to HOT will increase camera compartment temperature providing the system selector switch is in the MAN position. When manually controlling the camera compartment temperature, maintain at least 30°C to prevent the accumulation of moisture.

Camera Compartment Temperature Indicators

A camera compartment temperature indicator (figure 4-27) for each camera compartment is located on the pedestal panel in the (20) airplanes and on the left console in the [illegible] airplanes. The indicators, placarded FWD and AFT, indicate the temperature in degrees centigrade of the camera compartments.

CAMERA CIRCUIT BREAKER PANEL

The camera circuit breaker panel (figure 4-31) is located on the aft portion of the right console. It incorporates all camera circuit breakers available to the pilot.

VIEWFINDER

A Type VF-31 viewfinder is installed in the forward fuselage. The purpose of the system is to furnish aircraft altitude and speed information to the Universal Camera Control System, locate photographic targets, and to aid in flight navigation. Light enters through a window installed in the lower fuselage skin and enters the viewfinder window. The ground is viewed through an eye lens which is located above the instrument panel at the approximate eye level of the pilot. The viewfinder provides two viewfinding systems, a wide angle, and a narrow angle, refer to View Selector, this section. Within the lens arrangement and visible to the pilot upon selection are: A protractor scale from which drift angle may be read, a track line which may be rotated to align with the flight path, a Nadir point used to locate a point vertically beneath the pilot, and two intercept lines (dotted lines) which cross the track line at right angles and each terminating with a small circle. Each intercept line is centered with a small circle where it intercepts the track line. The pilot uses the line to determine image motion information, refer to Operation Aerial Cameras, this section. The viewfinder system requires 28 volt d-c and 115 volt a-c for operation. The viewfinder control panel, incorporating all viewfinder controls, is located on the lower left instrument panel.

Filter Switch

The filter switch (figure 4-28) is a three-position toggle switch mounted on the control panel and marked A, B, and C. The A position causes an opaque element to block the view through the lines, B position provides clear unfiltered vision and C position selects a yellow filter.

Viewfinder Scanner Switch

The viewfinder scanner switch (figure 4-28), marked VIEWFINDER-SCANNER, on the viewfinder control panel selects the means of sending V/H (velocity over height) information to the camera control system. The VIEWFINDER is utilized above 8000 feet in AUTO operation and the image velocity signal detector is utilized below 8000 feet in AUTO operation (SCANNER).

Grid Illumination Control Knob

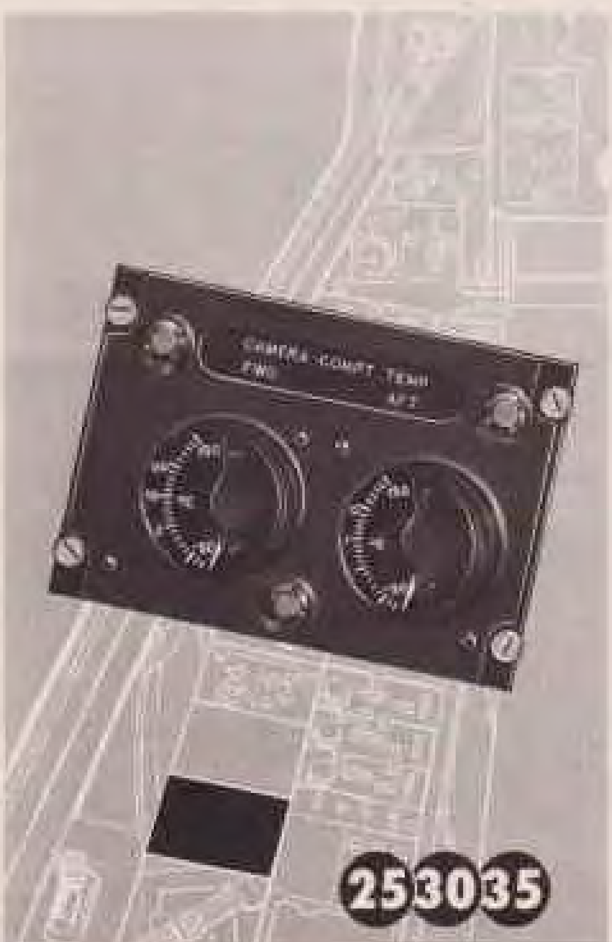
The rheostat knob (figure 4-28) marked OFF-BRT, located on the viewfinder control panel, may be rotated to desired lighting intensity for viewfinder reticle illumination.

View Selector Knob

The view selector knob (figure 4-28) on the viewfinder control panel, marked VERT, 30, 60 and WIDE allows the pilot to select the most desirable of the two viewing systems. The VERT position allows a narrow view 15° forward and 15° aft of a point (NADIR) directly below the pilot. The 30° position shifts the narrow view to begin at an angle of 15° forward of Nadir. The 60° position allows a narrow view starting 45° forward of Nadir. The second viewing system selects the WIDE position of 85° field of view and permits a view angle of 80° forward and 5° aft of Nadir.

IM Compute Switch

A button marked "IM (Image Motion) System" (figure 4-28) on the viewfinder control panel provides a means



CAMERA COMPARTMENT TEMPERATURE INDICATORS

Figure 4-27

VIEWFINDER CONTROL PANEL

RFA20-446

Figure 4-28

of transmitting a V/H (velocity over height) value to the camera control system. When using the IM compute switch, the view selector knob should be in the VERT position if altitude and airspeed permit to obtain more accurate information. The viewfinder IM compute ranges chart (figure 4-29) gives the operating limits of the IM compute system. After drift correction has been made, a distinguishable point (other than the photo target) is selected on the ground. The button is pressed as the ground point crosses the first intercept line on the reticle, and pressed again as the ground point crosses the second intercept line measuring the time interval of the target passage between the two intercept lines. The view selector knob should then be repositioned to wide in order to see the photo target at a greater distance and to avoid missing the photo target.

System Compute Light

A conventional "press-to-test" amber light (figure 4-28) gives a visual indication of system operation. The light illuminates when the IM compute button is depressed as the target crosses the first intercept line. The light remains illuminated until the button is pressed the second time as the target crosses the second intercept line.

Drift L-R Switch

The drift L-R switch is a three-position toggle switch (figure 4-28) spring-loaded to the center position and is located on the lower right portion of the viewfinder control panel. The switch enables the pilot to position the drift reticle and align the track line on the viewfinder to the flight path.

OPERATION OF VIEWFINDER

Refer to Operation Aerial Cameras, this section.

OPERATION OF AERIAL CAMERAS

Automatic Operation (Above 8000 Feet)

Automatic control of cameras above 8000 feet is accomplished by observing the following:

1. Transport and exposure switches - AUTO

Note

When system is operated with transport and exposure switches in AUTO position, the viewfinder should be used to furnish V/H signal information at altitudes above 8000 feet.

2. Power switch - ON, see amber light illuminate.
3. Ready switch - ON, see amber light flash.
4. Rotate mode selector on each station panel - COMP, this operates shutters through the intervalometer, should continuous operation be desired, set mode selector - CONT.
5. See amber light cease flashing (1 minute warm-up) after mode selection has been made.
6. READY light (green) illuminated.

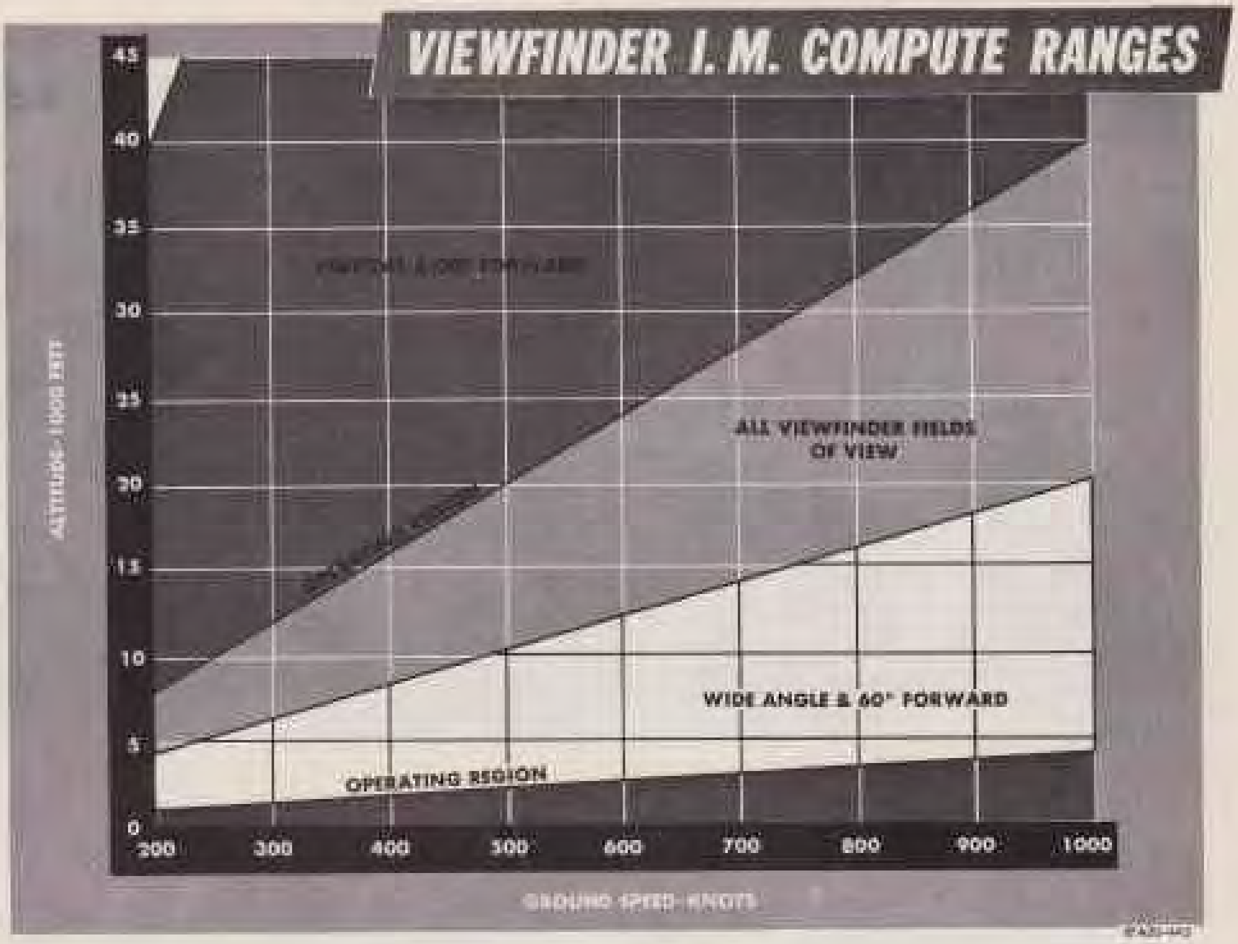


Figure 4-29

Note

Should the split vertical station be selected the ready indication will be affected by split vertical door position. Should the doors fail to fully open the amber light will continue to flash. If the doors operate normally the amber light will flash until the doors are fully open, then observe the green light illuminated. The two lights on the door position panel will also flash until doors are fully open.

7. Viewfinder controls - SET
   a. Filter switch - Set as desired.
   b. Grid illumination knob - Set as desired.
   c. View selector knob - Set as required.
   d. Viewfinder scanner switch - VIEWFINDER.
   e. Determine an easily distinguishable ground point (IP).
   f. Hold airspeed and altitude, and as the IP crosses the first intercept line on the viewfinder reticle, press the IM compute button (note system compute light illuminate). As the IP crosses the second intercept line, again press IM compute button (note system compute light extinguish).
   g. Reposition view selector knob to a wider view, 30, 60 or WIDE to provide a forward view of the photo target.

Note

With view selector switch in VERT, the photo target passes through the viewfinder very quickly during high speed runs. Photography under this condition is difficult to achieve. A greater speed during the above procedures or during a photo run, requires a more forward view selection of the viewfinder.

8. Procedure "f" above has provided V/H information which is automatically transmitted to the camera control system. The pilot may now proceed to the photo target.

9. Camera operation is initiated by stick trigger switch actuation or by placing the operate switch ON. Maintain altitude and airspeed used in step "f" above. The camera operate power light (green) will illuminate when any camera is operating.

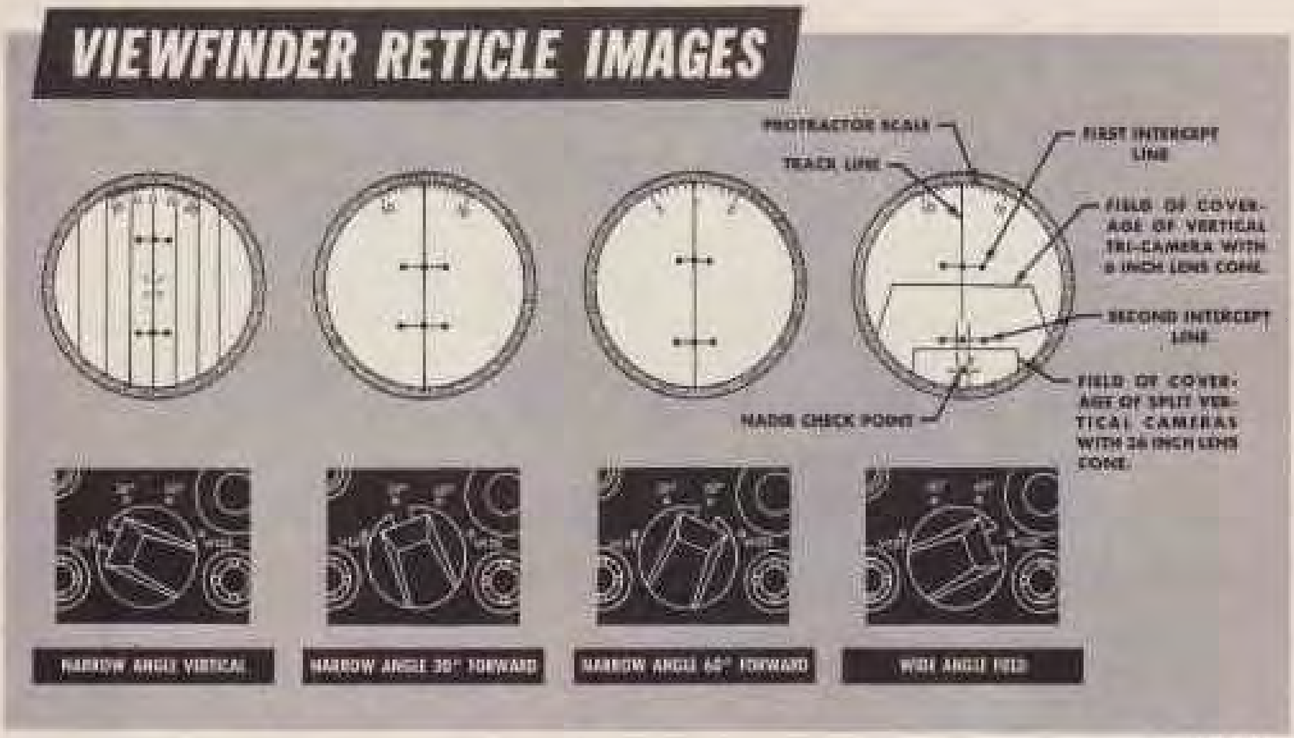


Figure 4-30

Note

If the cameras are being operated by use of the operate switch instead of the stick trigger switch, and if the trigger switch has been inadvertently actuated during operation, the operate switch must be turned OFF and the trigger switch again actuated before camera operation will cease.

Automatic Operation (Below 8000 Feet)

Complete procedures 1 through 6 listed in Automatic Operation above 8000 feet. Below 8000 feet however, V/H information is automatically obtained as shown in the following procedures:

Note

Automatic operation with the scanner above 5000 feet may be unreliable. If the scanner is unreliable, use automatic operation (above 8000 feet) procedures.

1. Filter switch - Set as desired.
2. Grid illumination knob - Set as desired.
3. View selector knob - SET
   Set view selector knob on 30, 60 or WIDE to provide a forward view of the photo target.
4. Viewfinder scanner switch - SCANNER

Note

Positioning the viewfinder scanner switch on SCANNER, enables automatic computation of V/H information. These values are automatically transmitted to the camera control system.

5. Actuate cameras over photo target.

Manual Operation

Determine type of mission obtaining estimated data needed to establish the following:

1. Set transport and exposure switches MANUAL.
2. Rotate thumb wheel to set ground speed.
3. Rotate thumb wheel to set altitude x 1000.
4. Rotate thumb wheel to set IRIS f/STOP.
5. Rotate thumb wheel to set SHUTTER SPEED SEC.
6. Complete procedures 2 through 6 under Automatic Operation.
7. Actuate cameras over photo target.

Note

- It is important that altitude and airspeed be closely maintained during camera runs under low altitude conditions.
- During manual operation, the viewfinder is used only to view the photo target, enabling an accurate flight path over the target.

CAMERA CIRCUIT BREAKER PANEL

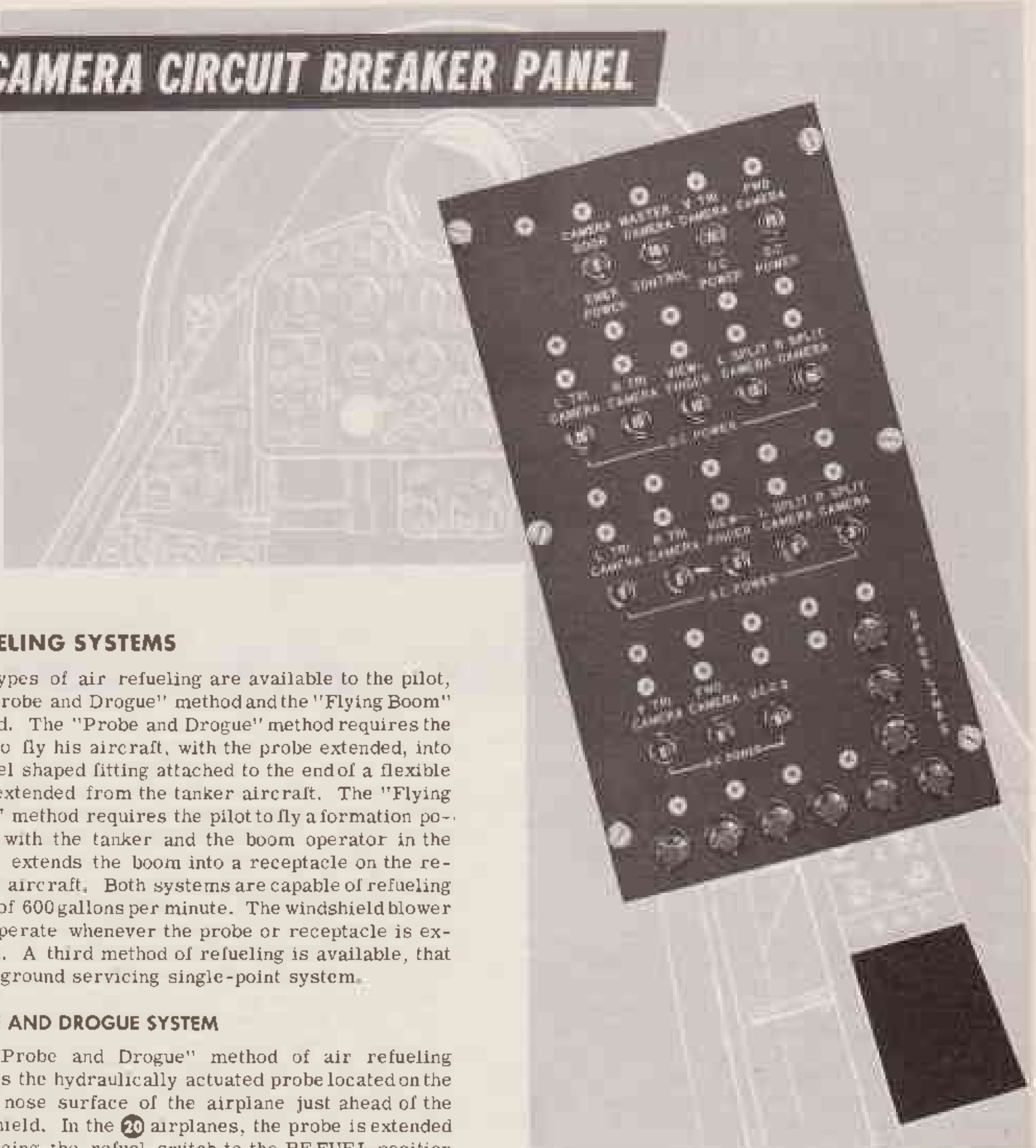


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Figure 4-31

REFUELING SYSTEMS

Two types of air refueling are available to the pilot, the "Probe and Drogue" method and the "Flying Boom" method. The "Probe and Drogue" method requires the pilot to fly his aircraft, with the probe extended, into a funnel shaped fitting attached to the end of a flexible hose extended from the tanker aircraft. The "Flying Boom" method requires the pilot to fly a formation position with the tanker and the boom operator in the tanker extends the boom into a receptacle on the receiver aircraft. Both systems are capable of refueling rates of 600 gallons per minute. The windshield blower will operate whenever the probe or receptacle is extended. A third method of refueling is available, that of the ground servicing single-point system.

PROBE AND DROGUE SYSTEM

The "Probe and Drogue" method of air refueling utilizes the hydraulically actuated probe located on the upper nose surface of the airplane just ahead of the windshield. In the (20) airplanes, the probe is extended by placing the refuel switch to the REFUEL position (refer to Section V for probe extension airspeed limitation). Actuation of the switch interrupts the transfer pump continuity, opens the doors and extends the probe. In the (25)(30)(35) airplanes the probe is extended by placing the probe IFR switch to the EXTEND position. Actuation of the switch interrupts the continuity of the fuel transfer selector switch, opens the doors and extends the probe. With the probe extended the pilot maneuvers his airplane into position and makes contact with the tanker's drogue. Upon successful "hook-up" fuel is transferred into the receiver airplane and is distributed through the transfer lines. At completion of refueling the pilot breaks contact with the drogue and retracts the probe. In the (20) airplanes retraction of the probe is accomplished by placing the refuel switch to the NORMAL position and the continuity of the fuel transfer pumps is renewed. In the (25)(30)(35) airplanes, retraction of the probe is accomplished by placing the probe IFR switch to the RETRACT position. The continuity of the fuel transfer selector switch is renewed when the probe is completely retracted into the well area in (20) airplanes.

Figure 4-32

Refuel Switch (20)

The refuel switch (figure 1-15) is a two-position toggle switch located on the circuit breaker panel and guarded in the NORMAL position. Placing the refuel switch to the REFUEL position interrupts the normal continuity to the fuselage transfer pumps and extends the probe. After a successful "hook-up" fuel is transferred from the tanker airplane to the fuselage cells in the receiver airplane. Flow control valves automatically shut off fuel flow to each fuselage cell when it is full. Placing the refuel switch to the NORMAL position will retract the probe and renew the normal continuity to the fuselage transfer pumps. Electrical power is supplied from the 28 volt d-c bus. Utility hydraulic pressure is utilized to extend and retract probe.

Note

The emergency fuselage transfer pump circuit will by-pass the refuel switch either automatically (fuselage cell number 2 reaching a level of 850 lbs.) or manually by placing fuel pumps switch to ALL PUMPS.

Probe IFR Switch (25)(30)(35)

The probe IFR switch (figure 1-16) is a three-position toggle switch located on the electrical control panel and guarded in the RETRACT position. Placing the probe IFR switch to the EXTEND position extends the probe and interrupts the normal continuity to the fuel transfer selector switch. The refuel shutoff valve opens and the fueling control valves are energized permitting fuel flow into the wing and external tanks. The wing and external compressed air valves are opened venting the tanks to the atmosphere. After a successful "hook-up" fuel is transferred from the tanker to the receiver airplane. When each wing or external tank becomes full, a float switch de-energizes a fueling control valve and stops fuel flow to the tank. Flow control valves shut off fuel flow to each fuselage cell when the cell is full. Placing the probe IFR switch to the RETRACT position retracts the probe, renews the normal continuity to the fuselage transfer selector switch and closes the refuel shutoff valve. If the probe is damaged during refueling and cannot be retracted by placing the probe IFR switch in the RETRACT position, emergency continuity to the fuel transfer selector switch can be established by placing the probe IFR switch to the EMERG position. Placing the switch to the EMERG position also stops the operation of the windshield blower. The probe IFR switch utilizes 28 volt d-c electrical power. Utility hydraulic pressure is utilized to extend and retract the probe.

Note

The emergency fuselage transfer pump circuit will by-pass the probe IFR switch either automatically (fuselage cell number 2 reaching a level of 850 lbs.) or manually by placing the fuel transfer selector switch to ALL PUMPS.

Aux Full Fuel Indicator (25)(30)(35)

Two green indicator lights (figure 1-12) on the fuel control panel, marked "Wing" and "Ext" will illuminate during refueling when their respective tanks are full. The indicator lights utilize 28 volt d-c electrical power. The lights go out when the probe is retracted.

REFUELING PROCEDURES–PROBE AND DROGUE

Note

Do not extend the probe for extended periods of time when not actually refueling, since fuel in number 1 fuselage cell will drain into the external tanks and wing tanks when the probe is extended.

1. Approach the tanker from the rear and slightly below the refueling drogue.
2. Maintain a position approximately 100 feet aft and 50 feet below the drogue until airplane is trimmed and formation speed is determined.
3. Refuel switch - REFUEL (20)
4. Probe IFR switch - EXTEND (25)(30)(35)

CAUTION (25)(30)(35)

If a delay is encountered in hooking up with the tanker after the probe is extended the wing tanks could become full of fuel drained from number 1 fuselage cell. The surge created by initiating the refueling cycle could start a siphoning action resulting in the loss of wing fuel and the possibility of collapsing the wing tanks. When an extended delay is encountered, with the probe extended, the pilot should transfer fuel from the wing tanks to fuselage cells before a hook up is attempted. This is accomplished by placing the probe IFR switch to EMERG and the fuel transfer selector switch to WING. Upon illumination of the empty tank warning light, place the probe IFR switch to EXTEND and proceed to hook up.

5. Maintaining a 3 to 5 knot rate of closure, fly the probe nozzle into the drogue cone.

CAUTION

Rapid rate of closure will move drogue forward too fast for proper reel-in, thus causing slack in the hose, resulting in a violent whipping action which may damage the probe or drogue.

6. After contact is made, slowly fly drogue forward approximately 10 feet which automatically energizes tanker's fuel transfer pumps. This is indicated by a green light on the tanker while the amber light goes out.
7. Maintain a steady position after hookup. Smooth and precise, pitch and bank control is essential to safe refueling operations. Some hose slack is to be expected at times during refueling. If the amount of slack is slight, hold position and allow the reel operator to take up the slack. All corrective action should be smooth and gradual.

CAUTION

Dropping back while the reel operator is taking up slack can cause abrupt tension on the hose. This can cause the hose to whip and possibly damage the probe.

8. With fuel quantity gage tank selector knob in the TOTAL position, note refueling progress by observing the aircraft's fuel quantity gage. In the (25)(30)(35) airplanes the refueling progress of the auxiliary tanks can be checked by observing the auxiliary full fuel indicator.

Note

- The drop tanks cannot be refueled in the (20) airplanes.
- Fuel flow from the tanker is automatically shut off when the receiver tanks are full.

9. When tanks are full, reduce speed slightly to disengage probe from drogue coupling.

CAUTION

High rates of separation when breaking contact should be avoided to preclude sudden loads on tanker hose braking system.

10. Refuel switch - NORMAL (20)
11. Probe IFR switch - RETRACT (25)(30)(35)

Note

Proper refueling technique will prevent any siphoning action from occurring. However, after the refueling cycle is complete and the probe is retracted the pilot should immediately transfer some fuel from the wing tanks to stop any siphoning action that may have started during the refueling cycle.

EMERGENCY OPERATION–PROBE AND DROGUE

In the (20) airplanes, if the probe is damaged during refueling and cannot be retracted, leave the refuel switch in the REFUEL position and place the fuel pumps switch to ALL PUMPS. This will establish emergency continuity to the fuselage transfer pumps and prevent further damage to the airplane. In the (25)(30)(35) airplanes if the probe is damaged during refueling and cannot be retracted, the probe "IFR" switch should be placed in the EMERG position to establish emergency continuity to the fuel control panel, stop the rain clearing system, relieve utility hydraulic pressure against the probe, and prevent further damage to the airplane.

FLYING BOOM SYSTEM

The "Flying Boom" method of air refueling utilizes a hydraulically actuated receptacle located aft of the cockpit and above the number 2 fuselage fuel cell. Actuation of the fuel receptacle is controlled by the boom IFR switch located on the electrical control panel. The receptacle is extended by placing the boom IFR switch to the EXTEND position (refer to Section V for receptacle extension airspeed limitations). Actuation of the switch interrupts the transfer pump continuity and extends the receptacle. With the receptacle extended, the pilot must fly a formation position with the tanker. The boom operator in the tanker extends the boom into the receptacle. Once the boom is locked in the receptacle fuel is transferred from tanker to the receiver airplane and is distributed through the transfer lines. At the completion of the refueling sequence the receptacle is retracted and the continuity to the fuel transfer pumps is renewed by placing the boom IFR switch to the RETRACT position.

Boom IFR Switch (20)

The boom IFR switch (figure 1-16) is a two-position toggle switch located on the electrical control panel and guarded in the RETRACT position. Placing the boom IFR switch to the EXTEND position extends the receptacle and interrupts the normal continuity to the fuselage transfer pumps. After the boom has been locked in the receptacle, the boom operator controls fuel flow from tanker to the receiver airplane. Flow control valves automatically shut off fuel flow to each fuselage cell when it is full. After the refueling sequence is completed the receptacle is retracted by placing the boom IFR switch to the RETRACT position. The normal continuity to the transfer pumps is renewed when the receptacle is retracted. Utility hydraulic pressure is utilized to extend and retract the receptacle. The boom IFR switch utilizes 28 volt d-c electrical power.

Note

The emergency fuselage transfer pump circuit will by-pass the boom IFR switch either automatically (fuselage cell number 2 reaching a level of 850 lbs.) or manually by placing the fuel pumps switch to ALL PUMPS.

Boom IFR Switch (25)(30)(35)

The boom IFR switch (figure 1-16) is a two-position toggle switch located on the electrical control panel and guarded in the RETRACT position. Placing the boom IFR switch to EXTEND position extends the receptacle and interrupts the normal continuity to the fuel transfer selector switch. The refuel shutoff valve opens and the fueling control valves are energized permitting fuel flow into the wing and external tanks. The wing and external tank compressed air valves are opened venting the tanks to the atmosphere. After the boom is locked in the receptacle fuel is transferred from the tanker to the receiver airplane. When each wing or external tank becomes full, a float switch de-energizes a fueling control valve and stops fuel flow to that tank. Fuel flow to the fuselage cells is automatically shut off by the flow control valve in each cell. Placing the boom IFR switch to the RETRACT position retracts the receptacle, closes refuel shutoff valve and renews the normal continuity to the fuel transfer selector switch. The boom IFR switch utilizes 28 volt d-c electrical power. Utility hydraulic pressure is utilized to extend and retract the receptacle.

Note

The emergency fuselage transfer pump circuit will by-pass the boom IFR switch either automatically (fuselage cell number 2 reaching a level of 850 lbs.) or manually by placing the fuel transfer selector switch to ALL PUMPS.

Release Switch

The release switch (figure 1-18) is a push-button switch located on the stick grip. This switch is provided to allow the pilot to end the refueling cycle before the fuel tanks are full. Depressing the release button illuminates the disengage indicator and effects an immediate release from the refueling boom. The switch operation is dependent on 28 volt d-c power.

Reset Switch

The reset switch (figure 1-16) is a push-button switch located on the electrical control panel. If the boom and receptacle are inadvertently disconnected during the refueling operation, the system can be made ready for refueling again by depressing the reset button, 28 volt d-c power is required for operation.

Disengaged Indicator

An amber indicator light (figures 1-16 and 1-30), marked "Disengaged", provides an indication of the boom receptacle disengagement during the refueling cycle. 28 volt d-c is required for operation. Illumination indicates a disconnect has been effected, either accidentally or due to pilot depressing the release switch. The light remains illuminated until the system is reset to continue refueling or the receptacle is retracted.

Ready Indicator

A green indicator light (figures 1-16 and 1-30), marked "Ready", is provided to indicate the receptacle is extended and ready to receive the boom. 28 volt d-c is required for operation. The light will remain illuminated until the boom is locked in the receptacle or the receptacle is retracted.

Aux Full Fuel Indicator (25)(30)(35)

Two green indicator lights (figure 1-12) on the fuel control panel, marked "Wing" and "Ext" will illuminate during refueling when their respective tanks are full. The indicator lights utilize 28 volt d-c electrical power. The lights will go out when the receptacle is retracted.

REFUELING PROCEDURES–FLYING BOOM

Note

Do not extend the receptacle for extended periods of time when not actually refueling, since fuel in number 1 fuselage cell will drain into the external tanks and wing tanks when the receptacle is extended.

1. Approach the tanker at selected altitude and speed.
2. Fuel quantity gage tank selector knob - TOTAL
3. Boom IFR switch - EXTEND
4. Ready indicator (green) light on, indicates receptacle extended.

CAUTION

If a delay is encountered in hooking up with the tanker after the receptacle is extended the wing tanks could become full of fuel drained from the number 1 fuselage cell. The surge created by initiating the refueling cycle could start a siphoning action resulting in the loss of wing fuel and the possibility of collapsing the wing tanks. When an extended delay is encountered, with the receptacle extended, the pilot should transfer fuel from the wing tanks to fuselage cells before a hook-up is attempted. This is accomplished by placing the probe IFR switch to EMERG and the fuel transfer selector switch to WING. Upon illumination of the empty tank warning light, place the probe IFR switch to NORMAL and proceed to hook up.

5. Ready indicator light off, indicates boom is locked in receptacle.

Note

- Fuel from the tanker airplane is now transferred to the receiver airplane. Check the refueling progress by observing the aircraft's fuel quantity gage. In the (25)(30)(35) airplanes, the refueling progress of the auxiliary tanks can be checked by observing the auxiliary full fuel indicator.
- The drop tanks cannot be refueled in the (20) airplanes.

6. When the required amount of fuel has been transferred, initiate electrical disconnect.

CAUTION

If making an "outer limit" disconnect, a high rate of separation should be avoided to prevent damage to the boom or the receptacle.

7. Disengage indicator (amber) light on, indicates boom and receptacle disengaged.
8. Boom IFR switch - RETRACT, disengaged light will go out when the receptacle is retracted.

Note

Proper refueling technique will prevent any siphoning action from occurring. However, after the refueling cycle is complete and the receptacle is retracted the pilot should immediately transfer some fuel from wing tanks to stop any siphoning action that may have started during the refueling cycle.

If disengaged light (amber) illuminates before refueling is complete:

1. Depress reset button.
2. Ready indicator (green) light - ON.

Normal Disconnects

A disconnect may be initiated by the boom operator or the receiver pilot at any time during the refueling sequence. The pilot can initiate a disconnect by depressing the air refueling release switch on the control stick. If at any time fuel pressure in the receiver airplane exceeds approximately 80 psi, a pressure switch in the receiver airplane will initiate an automatic disconnect. When radio silence is required this switch will initiate a disconnect when all fuel valves in the receiver airplane are closed causing a pressure build-up.

Note

An automatic disconnect will result from excess tension on the nozzle or by a change in flight attitude of the receiver airplane when the angular limits of the boom are exceeded.

Emergency Disconnects

If at any time during the refueling sequence the receiver pilot or any crew member of the tanker announce the work "breakaway" over the radio, the receiver pilot will immediately actuate the air refueling release switch and reduce power. The boom operator will also initiate a disconnect while the tanker pilot will increase power and climb on course.

EMERGENCY OPERATION–FLYING BOOM

If the receptacle is damaged during refueling, leave the boom "IFR" switch in the EXTEND position.

In the (20) airplanes, placing the fuel pumps switch to ALL PUMPS will establish emergency continuity to the fuselage transfer pumps. In the (25)(30)(35) airplanes, placing the probe "IFR" switch to the EMERG position will establish emergency continuity to the fuel control panel, extend the probe, stop the rain clearing system, and prevent further damage.

SINGLE-POINT PRESSURE REFUELING SYSTEM (20)

The single-point pressure refueling of all fuselage cells can be accomplished in approximately four minutes. The pressure refueling filler is located on the right side of the airplane just forward of the engine. Fuel from the servicing unit is distributed through the airplanes refueling lines to the fuselage cells. All fuselage cells are filled simultaneously with a flow control valve stopping flow to each cell automatically when the cell is full. An IFR pilot valve check switch adjacent to the single-point pressure refueling connection permits an operational check of the flow control valves to be made during the refueling sequence. Actuation of this switch closes all flow control valves simulating a full condition and thus stopping fuel flow to the airplane. Returning the switch to its normal position opens the flow control valves and permits the normal refueling sequence to continue. To prevent transfer pump operation, external power should not be applied to the airplane during the refueling sequence. The IFR pilot valve check switch utilizes battery bus d-c power. The drop tanks cannot be refueled with the single-point system.

SINGLE-POINT PRESSURE REFUELING SYSTEM (25)(30)(35)

The single-point pressure refueling of the fuselage cells and the auxiliary tanks can be accomplished in approximately six minutes. Opening the pressure refueling doors, located on the right side of the airplane just forward of the engine, provides battery bus voltage to the fueling control valves, the refuel shutoff valve and the flow control valves to position them for refueling. Fuel from the servicing unit is distributed through the airplanes refueling lines to the fuselage cells, wing tanks, and the external tanks. All tanks are filled simultaneously and fuel flow to each tank is shut off when it is full. An IFR pilot valve check switch adjacent to the single-point pressure refueling connection permits an operational check of the flow control valves to be made during the refueling sequence. Actuation of the switch simulates a full condition and stops fuel flow to the airplane. Replacing the switch to its normal position permits the normal refueling sequence to continue. To prevent transfer pump operation, external power should not be applied to the airplane during the refueling operation. The IFR pilot valve check switch utilizes 28 volt d-c power.

Refueling Procedures—Single-Point

1. Assure all fuel caps secure.
2. Insert nozzle grounding plug in aircraft.
3. Connect pressure refueling hose to pressure refueling fitting.
4. Start fuel flow.
5. Move switch to CHECK.

   When the switch is actuated in the (20) airplanes, battery bus electrical power is directed to the flow control valves simulating a full condition and thus stopping pressure refueling. When the switch is actuated in the (25)(30)(35) airplanes, 28 volt d-c electrical power is directed to fueling control valves and flow control valves simulating a full condition and thus stopping pressure refueling.

Note

The maximum allowable time lapse between actuation of the check switch and all fuel flow stopping is ten seconds.

6. Release switch.

   Pressure refueling resumed. Refueling will terminate when actual "full" condition exists.

MISCELLANEOUS EQUIPMENT

ANTI-G SUIT PROVISIONS

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Engine compressor air is taken from the cockpit pressurization unit to provide the necessary pressure for proper anti-G suit operation. This air is ducted through an automatic pressure regulator to an ejection disconnect on the seat. The regulator valve opens when subjected to a force of 1.75 "g" and increasing pressure is applied to the suit in direct proportion to increasing "g" load. The HI-LO control on the regulator makes possible a variation in suit pressure. In the HI position, each "g" above 1.75 "g" causes an additional 1.5 psi to be applied to the suit bladders.

In the LO position, the pressure increase per "g" is 1 psi. The button on the top of the regulator permits manual operation to check flow through the regulator or to periodically apply pressure to the suit to lessen fatigue.

FLIGHT REPORT HOLDERS

Three canvas flight report holders are located along the left console and two on the right console between the canopy sill and the console are provided. A zipper provides access to the holders.

MAP CASE

A map case (well area) is included on the right console. A strap with fastener secures the opening.

SEXTANT CASE

A sextant case (well area) is included on the left console. A strap with fastener secures the sextant when in place.

SEXTANT LIGHTING RECEPTACLE

A receptacle for electrical connection of the sextant is provided on the left canopy sill, see figure 1-27. The sextant requires 28 volt a-c bus.

RELIEF TUBE

A relief tube is stowed on the side of the left console below the throttle quadrant.

VACUUM BOTTLE

A one quart vacuum bottle is stowed in right-hand aft portion of the cockpit.

REAR VIEW MIRRORS

Two rear view mirrors are installed on the windshield enclosure.

CHECK LIST

The take-off check list is located on the right forward console. The landing check list is located on the left forward console.

SPARE LAMPS

Spare lamps for the console panel are provided the pilot. The lamps are located on the right rear portion of the right console.

CHARTBOARD

A hinged chartboard, with spring-loaded clips on each side, is provided and stowed in the map case.

SECTION V
OPERATING LIMITATIONS

TABLE OF CONTENTS

This section includes the aircraft and engine limitations that must be observed during normal operation. Instrument markings giving various operation limitations are shown in figure 5-1. Some markings are self evident and are not discussed in the text.

ENGINE LIMITATIONS

Engine operating limitations are shown in figure 5-1. Additional information is given in the following paragraphs and figure 5-2.

ENGINE OIL PRESSURE

Normal oil pressure is 40-50 psi except at idle. Oil pressures between 35 and 40 psi are undesirable and should be tolerated only for the completion of the flight, preferably at a reduced throttle setting. Oil pressure below normal should be reported as a flight discrepancy and should be corrected before the next take-off. Oil pressures below 35 psi are unsafe and require that the engine be shutdown.

MAXIMUM THRUST

When in maximum thrust, the following time limits are imposed to prevent overheating the engine or empennage, or to prevent the possibility of engine fuel starvation. Refer to figure 5-2 for Engine Operating Limits.

1. Five minutes ground operation (Engine Limitation).
2. Six minutes at altitudes up to 20,000 feet (Fuel Transfer).
3. Ten minutes at altitudes above 20,000 feet (Structural Heating).

CAUTION

- Any periods of afterburning up to 6 minutes should be followed by an equal period of nonafterburning. Above 6 minute periods of afterburning should be followed by a double period of nonafterburning.
- Due to high fuel consumption, afterburner operation should be avoided with less than 3,000 pounds of total fuel remaining.

MILITARY THRUST

30 minutes

NORMAL RATED THRUST

Not Limited

ENGINE OVERSPEED

Should the maximum permissible engine speed of 102% rated rpm be exceeded, under any conditions, the engine must be inspected for damage. Pilot should make AFTO Form 781 entry to insure inspection.

EMERGENCY FUEL

Gasoline MIL-F-5572, lowest grade available, with approximately 2.5% (by volume) of grade 1100 oil added, may be used for emergency fuel. Use this mixture for low altitude emergency evacuation flight.

INSTRUMENT MARKINGS

BASED ON JP-4 FUEL

REFER TO CONFIDENTIAL SUPPLEMENT, T.O. 1F-101(R)A-1A, FOR ADDITIONAL INSTRUMENT MARKINGS.

EXHAUST TEMPERATURE

200°C-610°C	CONTINUOUS ABOVE 30,000 FEET
200°C-580°C	CONTINUOUS BELOW 30,000 FEET
670°C	MAXIMUM IN AFTERBURNER ABOVE 30,000 FEET

NOTE

640°C MAXIMUM IN AFTERBURNER BELOW 30,000 FEET

630°C	MAXIMUM FOR STARTING MAXIMUM IN MILITARY THRUST BELOW 30,000 FEET (30 MIN)

NOTE

660°C MAXIMUM IN MILITARY THRUST ABOVE 30,000 FEET (30 MIN)

680°C	MAXIMUM FOR ACCELERATION (2 MIN)

TACHOMETER

102%	MAXIMUM OVERSPEED
85%-98%	CONTINUOUS

OIL PRESSURE

35 PSI	MINIMUM
35-40 PSI	CAUTION
40-50 PSI	CONTINUOUS
50 PSI	MAXIMUM

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Figure 5-1

CAMERA COMPARTMENT TEMPERATURE

10°C-50°C (green)	CONTINUOUS
50°C (red)	MAXIMUM

HYDRAULIC PRESSURE

PRIMARY — UTILITY	
2000-2700 PSI (yellow)	NORMAL WITH RAPID CONTROL MOVEMENT
	SHOWS MALFUNCTION WITH CONTROLS STATIC
2700-3400 PSI (green)	NORMAL
3400 PSI (red)	MAXIMUM

NOTE

IF HYDRAULIC PRESSURE EXCEEDS 3100 PSI IN THE STEADY STATE AN ENTRY IN THE AFTO FORM 781 IS REQUIRED

CAUTION

Emergency fuel diluted with oil may be used in lieu of JP-4 fuel only in emergencies. Continuous operation should not exceed 2 to 3 hours and such operation should be subsequently followed by operation with JP-4 prior to re-exposure to emergency fuel.

AIRSPEED LIMITATIONS

LANDING GEAR LOWERING SPEEDS

Limiting airspeed for landing gear operation is 250 knots IAS, due to possible damage to landing gear mechanism.

FLAP OPERATING SPEEDS

Limiting speeds for flap operation are:

1. Lowering flaps - 250 knots IAS.
2. Raising flaps - 250 knots IAS.

CANOPY OPERATING SPEEDS

The canopy is not designed to be opened in flight. Any partial opening of the canopy would cause air loads to tear the canopy off the aircraft. During taxiing the canopy may be opened at speeds not in excess of 75 knots IAS.

CAUTION

The pilot should consider gusts or severe surface winds as a contributing factor to the 75 knot restriction.

DRAG CHUTE OPERATING SPEEDS

The drag chute is designed to be deployed after landing at speeds under 200 knots IAS. Should the drag chute door inadvertently open without actuation of the drag chute handle, the drag chute will fall free of the aircraft. Actuation of the handle, however, will cause a locking mechanism to hold the chute.

Note

The drag chute may be deployed in an emergency at speeds in excess of 200 knots IAS but below 215 knots IAS. In event this is done, an entry in AFTO Form 781 must be made to insure structural inspection.

AUTOPILOT OPERATING SPEEDS

With the autopilot system operating and the altitude switch engaged (ON position), limiting airspeed is .95 indicated Mach number.

ENGINE OPERATING LIMITS

OPERATING CONDITIONS	MAXIMUM OBSERVED EXHAUST TEMPERATURE		TIME LIMIT	
	SEA LEVEL TO 30,000 FEET	ABOVE 30,000 FEET	GROUND OPERATION	FLIGHT OPERATION
MAXIMUM	640	670	5 MINUTES	10 MINUTES*
MILITARY	630	660	30 MINUTES	
NORMAL RATED	580	610	CONTINUOUS	
IDLE	340	——	CONTINUOUS	
STARTING	630	630	MOMENTARY	
ACCELERATION	680	680	2 MINUTES	

*REFER TO "MAXIMUM THRUST" THIS SECTION

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Figure 5-2

REFUELING PROBE OPERATING SPEEDS

With the refueling probe extended, maximum allowable airspeed is 310 knots IAS.

REFUELING RECEPTACLE OPERATING SPEEDS

With the refueling receptacle extended, maximum allowable airspeed is 310 knots IAS.

MAXIMUM ALLOWABLE AIRSPEEDS

Refer to Confidential Supplement, T.O. 1F-101(R)A-1A.

PROHIBITED MANUEVERS

The aircraft is restricted from the following maneuvers:

1. Any snap maneuvers.
2. Rolls continued past the 360° point.
3. Inverted flight in excess of 10 seconds.
4. Intentional pitch-up and spins.

Note

- 360° rolls are permitted at +1"g" throughout the placarded speed and altitude range.
- 180° rolls are permitted from 0 "g" up to +4.2 "g's" throughout the placarded speed and altitude range.

ACCELERATION LIMITATIONS

Refer to Confidential Supplement, T.O. 1F-101(R)A-1A.

OPERATING FLIGHT LIMITS

Refer to Confidential Supplement T.O. 1F-101(R)A-1A

Figure 5-3

CENTER OF GRAVITY LIMITATIONS

MOST FORWARD C.G.

The forward c.g. limits are 20% M.A.C. for take-off and 17% M.A.C. for in-flight and landing. In the [illegible] airplanes, the most forward c.g. occurs at take-off gross weight with external fuel. Without external tanks installed, the most forward c.g. occurs with 9,300 pounds of fuel remaining in fuselage cells. In the [illegible] airplanes, the most forward c.g. occurs at take-off gross weight with external fuel and wing fuel. Without external tanks installed, the most forward c.g. occurs with wing fuel consumed and 9,300 pounds fuel remaining in the fuselage cells.

MOST AFT C.G.

The aft c.g. limits are 36% M.A.C. for take-off and 41% M.A.C. for in-flight and landing. The most aft c.g. for take-off occurs with no external or wing fuel. The most aft c.g. for landing occurs with no fuel remaining and external tanks jettisoned.

CENTER OF GRAVITY TRAVEL

Center of gravity locations which are beyond the recommended limits in the [illegible] airplanes, may occur unless fuel is consumed in the following order: External fuel, internal fuselage fuel (cells 1 through 5). Center of gravity locations which are beyond the recommended limits in the [illegible] airplanes, may occur unless fuel is consumed in the following order: External fuel, wing fuel, internal fuselage fuel (cells 1 through 5).

CAUTION

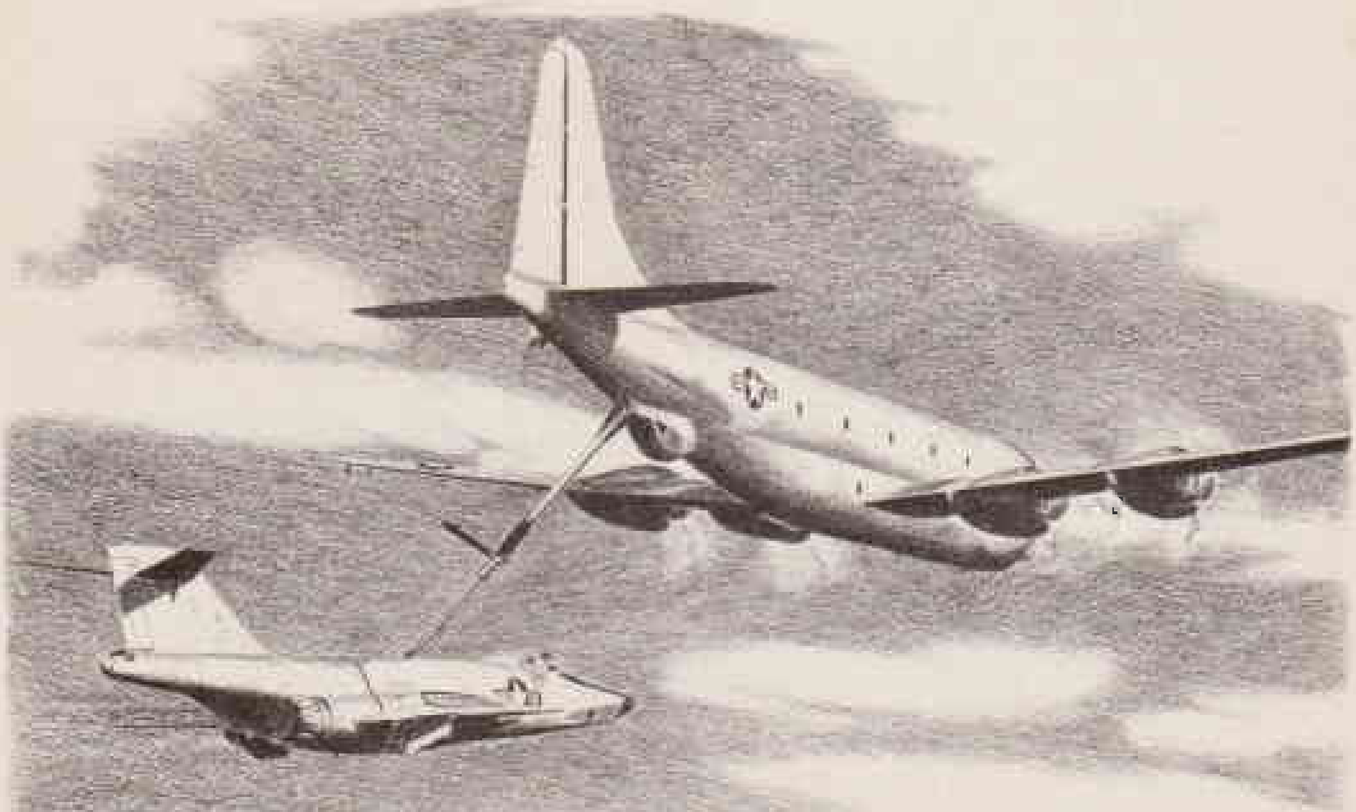
Partial fueling of the fuselage cells can result in an incorrect distribution of fuel which may cause the center of gravity to exceed the recommended limits. It is, therefore, recommended, when fueling the fuselage cells, to fill them completely. The automatic operation of the pumps will then keep the fuel properly distributed among the fuselage cells.

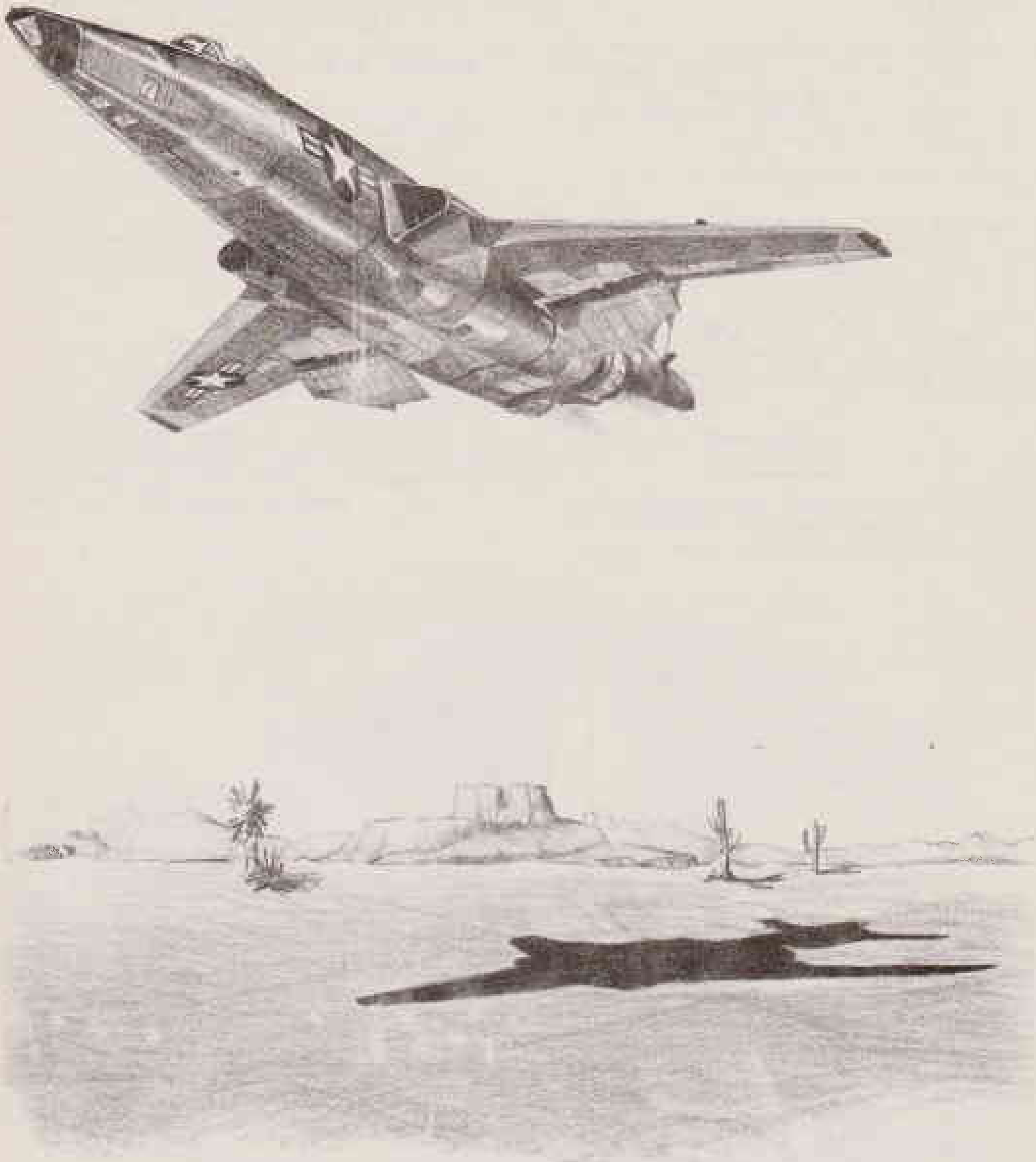
WEIGHT LIMITATIONS

The maximum allowable take-off gross weight is 51,000 pounds. Since the design of the airplane precludes the possibility of overloading, there are no weight limitations to be observed as long as standard external tanks, as described in Section IV, are carried. However, extreme care should be taken to insure that no items of appreciable weight are installed or removed without a weight and balance check. Refer to Weight and Balance, Section II.

CAUTION

While there is no set maximum gross weight limit for landing, if a hard landing is made with the airplane near maximum take-off gross weight, the airplane should be inspected for signs of structural damage before the next flight.





NOTE

For Section VI, refer to the Confidential Supplement, T.O.1F-101(R)A-1A

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ENGINE OPERATION

THRUST–RPM RELATIONSHIP

The J57 engine employs a split, 16-stage axial-flow compressor. The compressor section consists of a nine-stage, low-speed, low pressure rotor unit and a seven-stage high-speed, high pressure rotor unit. The two rotor assemblies are mechanically independent and revolve at different speeds. Each engine is adjusted to produce rated thrust and, since performance will deteriorate as the engine accumulates operating time, periodic adjustments to increase rpm are necessary to maintain rated thrust. Therefore each engine will vary in rpm for a given thrust. For a 1% variation in rpm, the thrust varies approximately 5% while a 1% variation in engine pressure ratio results in approximately 1.5% variation in thrust. Since rpm does not accurately indicate thrust, it is necessary to use the pressure ratio gages for more accurate thrust indications. Refer to Engine Pressure Ratio Gage, Section I.

ENGINE COMPRESSOR BLEED VALVE

A bleed valve is installed on each engine to prevent surging and stalling of the compressor by bleeding low pressure air overboard during acceleration and deceleration. The speed range of compressor surges varies with temperature. An increase in compressor inlet temperature with a decrease in compressor inlet pressure requires a higher rotor speed to attain surge-free operation. The bleed valve is open during starting and idle and remains open during acceleration until the critical surge and stall region of the low pressure compressor has been passed. This critical region is determined by the bleed valve generator which receives low pressure rotor speed and compressor inlet pressure and temperature signals from the sensing units. The bleed valve is actuated pneumatically when the critical speed of the compressor is reached.

COMPRESSOR STALL

The J57 engine, like all turbojet engines, is susceptible to compressor stall. The noise level associated with compressor stall in the J57 engine is appreciably higher than that experienced with other engines. In spite of this higher noise level, the engine will not be damaged unless the exhaust temperature exceeds the limits. Most compressor stalls are associated with throttle movement, especially when operating on the emergency fuel system. Rapid throttle advancement might inject more fuel into the combustion chambers than the engine can utilize for acceleration at existing rpm. The burning of this additional fuel increases the combustion pressures. As these pressures increase, they create a corresponding increase in the pressure against the compressor discharge air. This increase of pressure against the compressor discharge air culminates in a breakdown of airflow through the compressor. As a result, airflow may fluctuate and rapidly alternate in direction, giving rise to a reduction in airflow through the turbine. Thus, the energy available to the turbine wheel is decreased, causing loss in engine rpm. If the engine is allowed to continue operation in a stalled condition, the temperature of the burning gases increases until serious damage to the turbine section occurs, and the airflow fluctuations may damage the engine air intake duct structure. Compressor stall may be recognized by one or more of the following symptoms:

1. Structural vibration of airplane and an intense "boom" that seems to occur under or just aft of the pilot. The effects are severe and might easily be mistaken for an explosion. Frequently, only one "boom" is experienced, but the stall may be heard and felt as a staccato of from three to ten blasts.
2. Loss of thrust. (Usually occurs during or following rapid throttle advancements. May also occur during rapid airplane deceleration.)
3. Loss of engine acceleration, or possibly deceleration.
4. Long flame from tailpipe.

The engine will normally accelerate through the stall condition; however, if three or more blasts occur, the throttle should be retarded and advanced more slowly to the desired rpm. In the event of a single blast the pilot should immediately note engine rpm and exhaust temperature for prescribed limits. If no excessive temperature or rpm is indicated and fire warning system is not actuated, the pilot may assume the blast was the result of a compressor stall. Should the stall persist, decreasing or reversing the throttle motion will eliminate stall. Should the stall be experienced during a stabilized flight condition where no significant throttle movement has been made, a reduction in altitude or engine rpm will usually terminate the stall. If compressor stall occurs during climb with no throttle movement, reducing rate of climb and increasing airspeed may alleviate the stall. If stall persists with abnormal engine indications and fuel control failure is suspected, the emergency fuel system should be selected and landing made as soon as practicable. During landing, throttle manipulation should be kept to a minimum.

Note

The engine need not be shutdown because of compressor stall.

FLAME-OUT

Rapid throttle movement, especially at high altitudes, may cause the engine to flame-out. This type of flame-out, like compressor stall, occurs when more fuel is injected into the combustion chamber than the engine can utilize for acceleration at the existing rpm. But unlike the compressor stall, this mixture is so rich that it cannot burn, so the flame goes out. Flame-out may also occur when engine is decelerated too rapidly, whenever the fuel injected into the combustion chambers is inadequate to sustain combustion at the existing rpm. Flame-outs of this nature can be avoided by slower throttle movements. Flame-outs are indicated by loss of thrust, drop in exhaust temperature and rpm. Single engine flame-out will yaw aircraft slightly. Refer to Engine Air Start in Section III.

ENGINE NOISE AND ROUGHNESS

In-flight engine noises and roughness may occur especially when the engine is operating above 90% rpm. Usually a slight change in rpm will eliminate roughness. However, if roughness occurs at all altitudes and engine speeds it may indicate some mechanical failure, and an immediate landing should be made.

TURBINE NOISE DURING SHUTDOWN

The light scraping or squealing noise, sometimes heard during engine shutdown, results from interference between engine rotating and stationary parts having different cooling rates. This scraping is undesirable since it may damage the engine parts. To minimize this scraping, idle the engine for five minutes before shutdown after any high power operation. If heavy scraping should occur, no attempt should be made to restart or operate engine until exhaust temperature has dropped enough to provide adequate clearance between the affected parts.

SMOKE FROM TURBINE DURING SHUTDOWN

After engine shutdown smoke and vapor may be emitted from the exhaust and intake ducts. This is caused by oil and fuel that has drained into the turbine housing during shutdown. There is a sufficient amount of heat in the turbine housing to cause the fuel to boil, and when it boils it will emit a white vapor. Boiling fuel does not cause damage to the engine, but does create a hazard to personnel, since the vapor may ignite with explosive violence. Black smoke being emitted from the ducts indicates burning oil or fuel which will cause damage to the engine and should be extinguished in the following manner:

1. Connect air compressor and electrical power units.
2. Throttle - CLS'D
3. Engine master switch - ON
4. Move start switch momentarily to - START
5. Allow engine to crank for approximately 20 seconds, then move start switch to STOP START.
6. Engine master switch - OFF
7. If smoke continues use fire extinguishing equipment.

SONIC BOOM

This aircraft is capable of supersonic flight which will produce sonic booms whenever the sonic barrier is penetrated. The sonic boom is the result of a compressibility or "shock" wave which is built up ahead of the aircraft as it approaches the speed of sound. The impingement of this shock wave onto the ground or onto any object in the air will be accompanied by sufficient impact pressure to be startling or dangerous. Sonic booms have been known to break windows and crack plaster on buildings, and to rip the fabric from the wings of light aircraft. The destructive force of these waves is usually more concentrated straight ahead or in a line-of-flight direction. However, like all sound waves, they diverge in all directions from their source, and for this reason are likely to cover a wide area. The intensity of the boom depends upon the size, speed and distance from the observer to the aircraft creating it. The explosion sound is very loud at distances up to one mile. As a measure of safety and courtesy, flight at supersonic speed should not be performed within a distance of one mile of slow flying aircraft or approaching aircraft, within one mile of personnel and installations on the ground or over residential areas.

FUEL SYSTEM MANAGEMENT (20)

The operation of the fuselage fuel transfer system is entirely automatic. This system will automatically transfer fuel within the fuselage cells keeping the center of gravity at an intermediate position between the limits. Fuel may be transferred from the auxiliary tanks to the fuselage cells at any time, except during take-off, depending on the mission requirements. When transferring fuel from the auxiliary tanks, place the fuel quantity gage tank selector knob to TOTAL and monitor the total fuel quantity. A drop in total fuel quantity is an indication that the auxiliary tanks are empty. However, under condition of high fuel consumption, such as afterburning at low altitude, transfer flow from the auxiliary tanks may not be adequate to maintain a steady fuel level in fuselage cell number 2. When transferring under this condition, monitor fuselage cell number 2 and cease transfer operation whenever the feed tank low level light illuminates. Place the fuel pumps switch to ALL PUMPS to insure transfer pump operation whenever the feed tank low level light illuminates. It is recommended that the fuel quantity gage tank selector knob be utilized with the fuel quantity gage for the following fuel cell monitoring sequence.

1. During take-off, initial climb, and all afterburner operation - On cell #2.
2. Upon leveling off and as soon as Military thrust or less is used - Check all tanks for proper feeding.
3. Throughout flight - On TOTAL
   a. If transferring external fuel, monitor TOTAL until gage indicates decrease in total fuel.
   b. If external fuel has been consumed, monitor TOTAL and periodically (once every fifteen minutes) check all tanks for proper feeding.
4. During descent, traffic pattern, and throughout landing phase - On cell #2.

During each step of the fuel cell monitoring sequence, check the total fuel quantity and also check individual cell quantity. Correct fuel cell monitoring will lead to an early detection of fuselage transfer pump failure.

Note

Monitor fuselage cell number 2 whenever the total fuel quantity drops below 3,000 pounds.

FUEL SYSTEM MANAGEMENT (25)(30)(35)

The operation of the fuselage fuel transfer system is completely automatic when the fuel transfer selector switch is in the FUS position. This selected system will automatically transfer fuel within the fuselage cells keeping the center of gravity at an intermediate position between the limits. When transferring fuel from the auxiliary system to the fuselage cells, place the fuel quantity gage tank selector knob to TOTAL and monitor total fuel quantity. However, under conditions of high fuel consumption, such as afterburning at low altitudes, fuel flow from the wing or external tanks may not be adequate to maintain a steady fuel level in fuselage cell number 2. When transferring under this condition, monitor fuselage cell number 2 and cease transfer operation, whenever the feed tank low level light illuminates. Place the fuel transfer selector switch to ALL PUMPS to insure transfer pump operation whenever the feed tank low level light illuminates. The following fuel transfer steps are recommended to insure a proper c.g. position. Using the fuel transfer selector switch proceed as follows:

1. During take-off and initial climb - On FUS
2. As soon as cruise altitude is reached or fuel quantity gage indicates approximately 11,000 pounds of fuselage fuel remaining - On EXT
3. When empty tank warning light illuminates - On WING
4. When empty tank warning light illuminates - On FUS

When positioning the fuel transfer selector switch from FUS to EXT, through the WING position, the wing tanks will momentarily transfer fuel to the fuselage cells. This momentary wing transfer will cause enough fuel to be transferred from the wing tanks to prevent the auxiliary full fuel indicator light for the wing tanks from illuminating. The wing tanks should not be considered empty unless the empty tank warning light is illuminated.

Note

Fuel from the wing tanks may be transferred before fuel from the external tanks has been transferred, depending on mission requirements.

It is recommended that the fuel quantity gage tank selector knob be utilized with the fuel quantity gage for the following fuel cell monitoring sequence.

1. During take-off, initial climb, and all afterburner operation - On cell #2.
2. Upon leveling off and as soon as Military thrust or less is used - Check all tanks for proper feeding.
3. Throughout flight - On TOTAL
   a. If transferring wing and/or external fuel, monitor TOTAL until gage indicates decrease in total fuel.

b. If wing and/or external fuel has been consumed, monitor TOTAL and periodically (once every fifteen minutes) check all tanks for proper feeding.

4. During descent, traffic pattern, and throughout landing phase - On cell #2.

During each step of the fuel cell monitoring sequence, check the total fuel quantity and also check individual cell quantity. Correct fuel monitoring will lead to an early detection of a fuselage transfer pump failure.

Note

Monitor fuselage cell number 2 whenever the total fuel quantity drops below 3,000 pounds.

WHEEL BRAKE OPERATION

The brakes are operated by toe action on the rudder pedals. This action meters utility hydraulic pressure to force the brake disks together. Since the power brake valves are metering type valves, hydraulic pressure cannot be felt at the pedals. A soft full travel pedal is characteristic of this type brake. For this reason the pilot should use caution when applying the brakes to prevent locking the wheels and skidding the tires. To minimize brake wear the full landing roll should be utilized to take advantage of aerodynamic braking and the brakes should be used as little and as lightly as possible. The brakes should not be dragged when taxiing and should be used as little as possible for turning the aircraft on the ground. For short landing rolls, a single smooth application of the brakes with constantly increasing pedal pressure is most desirable. If one wheel is locked during application of the brakes there is a very definite tendency for the airplane to turn away from that wheel and further application of brake pressure will offer no corrective action. Once a wheel is locked it will not free itself until brake pressure is reduced. It has been found that the optimum braking occurs when the wheel is in a slight skid. The wheel continues to rotate but at a speed of approximately 80 to 85 percent of its normal free rolling rotational speed. Increasing the rolling skid above approximately 15 to 20 percent will only decrease the braking effectiveness. After the brakes have been used excessively for an emergency stop and are in a heated condition, the aircraft should not be taxied into a crowded parking area. Peak temperatures occur in the wheel assembly from 25-30 minutes after maximum braking. To prevent brake fire and possible wheel assembly explosion, the specified procedures for cooling brakes should be followed. It is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the slip stream, and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling between brake applications. Additional time should be allowed for cooling if brakes are used for steering, crosswind taxiing operation, or a series of landings.

MAIN GEAR TIRES

The main landing gear tires are not capable of withstanding the high heat conducted through the wheel from the brake during high-energy stops or successive low-energy stops. As a result of this, a tire replacement program has been initiated. This program will use a point system based on airplane gross weight at take-off. This system is as follows:

GROSS WEIGHT AT TAKE-OFF	NO. OF POINTS
42,000 pounds or less	2
42,001 - 47,000 pounds	4
47,001 - 48,500 pounds	7
48,501 - 51,000 pounds	14

A total of 28 points will be allowed for each tire. Upon reaching 28 points, the tires will be replaced. In no case will a take-off be executed which will make the total number of points exceed 28. Tires and tubes shall be removed from the aircraft, tagged unserviceable, and turned into salvage whenever a refused (aborted) take-off mission is made at a speed in excess of 140 knots with a corresponding weight of 46,000 pounds or greater.

SECTION VIII
CREW DUTIES
(Not Applicable)

RFA20-800

SECTION IX
ALL WEATHER OPERATION

TABLE OF CONTENTS

Except for some repetition necessary for emphasis or continuity of thought, this section contains only those procedures which differ from, or are in addition to, the normal procedures presented in Section II. See Section VII for discussion of the operations of various systems.

INSTRUMENT FLIGHT PROCEDURES

Within the limits specified in the following paragraphs, this aircraft handles well during all phases of instrument flight. Like all fighters, it requires the pilot to pay constant attention to his flight instruments. Ordinary instrument techniques must be modified somewhat because of the aircraft's rapid acceleration, lateral control sensitivity and buffet regions. These modifications do not restrict the aircraft's operational effectiveness, nor do they present any particular control difficulties to the pilot. Several navigational aids are furnished which facilitate instrument flight. These aids include UHF direction-finding, a VOR navigational radio (Omni-range) and a latitude and longitude computer (GPI). IFF with the selective identification feature (SIF) is installed to facilitate positive identification of the aircraft by ground radar stations during radar penetrations and radar approaches. An autopilot relieves pilot fatigue on long flights and frees him for in-flight planning.

BEFORE ENTERING AIRPLANE

On instrument flights, delays in departure and descent and a low rate climb to altitude are often required by heavy traffic. These factors make fuel consumption and flight endurance critical and demand that all instrument flights be carefully planned. Consult Appendix I for flight planning information. Pay particular attention to the traffic procedures, found in the Pilot's Handbooks and Radio Facility Charts, for the destination and alternate.

BEFORE INSTRUMENT TAKE-OFF

After aligning the airplane with the centerline of the runway, set the directional indicator and adjust the attitude indicator so that the miniature airplane is two bar widths (4°) below the horizon line.

Note

The effect of take-off acceleration on the attitude indication is negligible.

INSTRUMENT TAKE-OFF

If possible, instrument take-offs at normal take-off weight (41,000 lbs.) should be made with Military rather than Maximum thrust. Maximum thrust take-offs at this weight involve rapid initial changes of attitude and steep pitch angles, and also increase the possibility of accelerating past the gear and flap down limit speeds. If preflight planning shows that a Maximum thrust take-off is required, turn off the afterburners as soon as the aircraft is definitely airborne. Use of Maximum thrust considerably shortens the take-off roll.

Note

When large puddles of water are present on the runway, it is possible to get compressor stalls and afterburner blowout in both engines during take-off at speeds from 80 to 100 knots. This is caused by water thrown into the engine intakes from wakes created by the nose wheel.

Military Thrust Take-Off

a. Recheck all instruments and release brakes.
b. Maintain directional control with nose gear steering until the rudder becomes effective. The rudder will become effective at approximately 60 to 70 knots. Do not use the brakes to maintain heading. Doing so will lengthen the take-off roll, reduce acceleration and increase the possibility of blowing out a tire.

CAUTION

Using the brakes at low speeds may cause a damaging chatter in the main gear struts.

c. At 150 knots, lift the nose gear off the runway. With very light back pressure, lift the nose until the miniature airplane is 1 1/2 bar widths above the horizon line.
d. At 160 knots, smoothly increase back pressure to reach an indication of +5° (first short bar above the horizon bar) on the attitude indicator.
e. The aircraft will fly off at 165 to 170 knots. Hold a +5° attitude indication and wait until the altimeter and vertical velocity indicator show a definite climb before retracting the gear. The first momentary indications of these instruments are downward.
f. Landing gear handle - UP

Note

Asymmetric gear retraction can cause some yaw and roll. The lateral sensitivity of the aircraft requires that corrections be made with smooth even pressures on the controls. If the yaw damper is inoperative, very careful control will be necessary, especially in turbulent air.

g. Smoothly increase the indicated pitch attitude to +10° (first long bar above the horizon bar).
h. At 200 knots, wing flap lever - RETRACT

WARNING

Do not raise the flaps at airspeeds below 200 knots. The aircraft may settle back onto the runway and/or all lateral control could be lost.

CAUTION

Do not exceed 250 knots until the gear and flaps are fully retracted. The nose gear may not retract fully and wheel well covers may be damaged at higher airspeeds.

Note

Longitudinal trim changes are negligible during take-off. Before trimming laterally, equalize engine thrusts and permit the flaps to retract fully.

i. Cross check the vertical velocity indicator to make certain that the rate of climb is increasing steadily.
j. Continue climb straight ahead. Make no turns before reaching 250 knots IAS. Limit low altitude maneuvering to 30° maximum bank angle and 350 knots maximum IAS.

Maximum Thrust Take-Off

a. Recheck all instruments and release brakes.
b. Maintain directional control with nose gear steering until the rudder becomes effective. The rudder will become effective at approximately 60 to 70 knots. Do not use the brakes to maintain heading. Doing so will lengthen the take-off roll, reduce acceleration and increase the possibility of blowing out a tire.

CAUTION

Using the brakes at low speeds may cause a damaging chatter in the main gear struts.

c. At 150 knots, lift the nose gear off the runway. With very light back pressure, lift the nose until the miniature airplane is 1 1/2 bar widths above the horizon line.
d. At 160 knots smoothly increase back pressure to reach an indication of +5° (first horizontal bar above the horizon bar) on the attitude indicator.
e. The aircraft will fly off at 165 to 170 knots.
f. As soon as definitely airborne, increase the pitch attitude to +10°. Raise the nose until the miniature airplane is aligned with the second horizontal bar (the first long bar) above the horizon line.
g. Landing gear handle - UP

CAUTION

Do not exceed 250 knots until the gear and flaps are fully retracted. The nose gear may not retract fully and the wheel well doors may be damaged.

h. Turn off the afterburners at 180 to 200 knots depending on gross weight.

Note

Changes in attitude and trim caused by turning off the afterburners are slight.

i. Wing flap lever - RETRACT
   Raise flaps immediately after gear is fully retracted.

WARNING

Do not raise the flaps at airspeeds below 200 knots. The aircraft may settle back onto the runway and/or all lateral control could be lost. The nose gear may not retract fully and wheel well covers may be damaged at higher airspeeds.

Note

Longitudinal trim changes are negligible during take-off. Before trimming laterally, equalize engine thrusts and permit the flaps to retract fully.

j. Cross check the vertical velocity indicator to make certain that the rate of climb is increasing steadily.
k. Continue climbing straight ahead. Make no turns before reaching 250 knots IAS. Limit low altitude maneuvering to 30° maximum bank angle and 350 knots maximum IAS.

INSTRUMENT CLIMB

The optimum VFR Military power climb schedule is suitable for instrument flight. However, the steep attitude and high rates of climb require thinking well ahead of the aircraft. Maintain approximately +10° to +12° indicated pitch attitude until intercepting the climb schedule between 6000 to 10,000 feet altitude. As soon as the climb schedule is intercepted the Mach indicator becomes the primary pitch control instrument for the remainder of the climb. This technique will consume about the same amount of fuel as would be consumed if the climb schedule were intercepted immediately after take-off. Maintain the recommended airspeeds. If the airspeed falls below the proper schedule, a light buffet may occur at high altitude and high gross weights rendering instrument control more difficult. If airspeed increases as much as .05 Mach above the proper schedule, extreme pitch angles will be needed to return it to normal. Maximum thrust climbs may be made safely on instruments, but they are uncomfortable because the steep pitch angles make detection and correction of minor attitude changes difficult. It is therefore advisable to utilize Military thrust for long climbs under instrument conditions.

INSTRUMENT CRUISING FLIGHT

Level Flight

After leveling off from the climb, establish cruising airspeed and retrim the aircraft for "hands off" flight. Use the power settings for recommended optimum cruise schedule. Precise lateral trimming and equalized engine thrusts are essential due to the sensitive lateral control. When the aircraft is in level flight at cruising airspeed, readjust the miniature aircraft on the attitude indicator to indicate level flight attitude. The aircraft has excellent handling characteristics throughout its normal speed range if properly trimmed and flown by reference to the attitude flight instruments. With heavy gross weights at altitudes above 35,000 feet a slight buffet may occur but creates no control problem. At airspeeds below cruise schedule, buffet at heavy gross weights may be disturbing. The autopilot greatly simplifies the pilot's task and enables him to read his navigational charts without the responsibility of aircraft control. For long cruises use the autopilot as much as possible.

Turns

Single needle width turns (1 1/2° per second) should be used wherever possible. A constant 30° angle of bank may be used instead. At high gross weights, a buffet may be encountered during turns at high altitudes, but it creates no control problem as long as the recommended cruise schedule airspeed is maintained.

Steep Turns

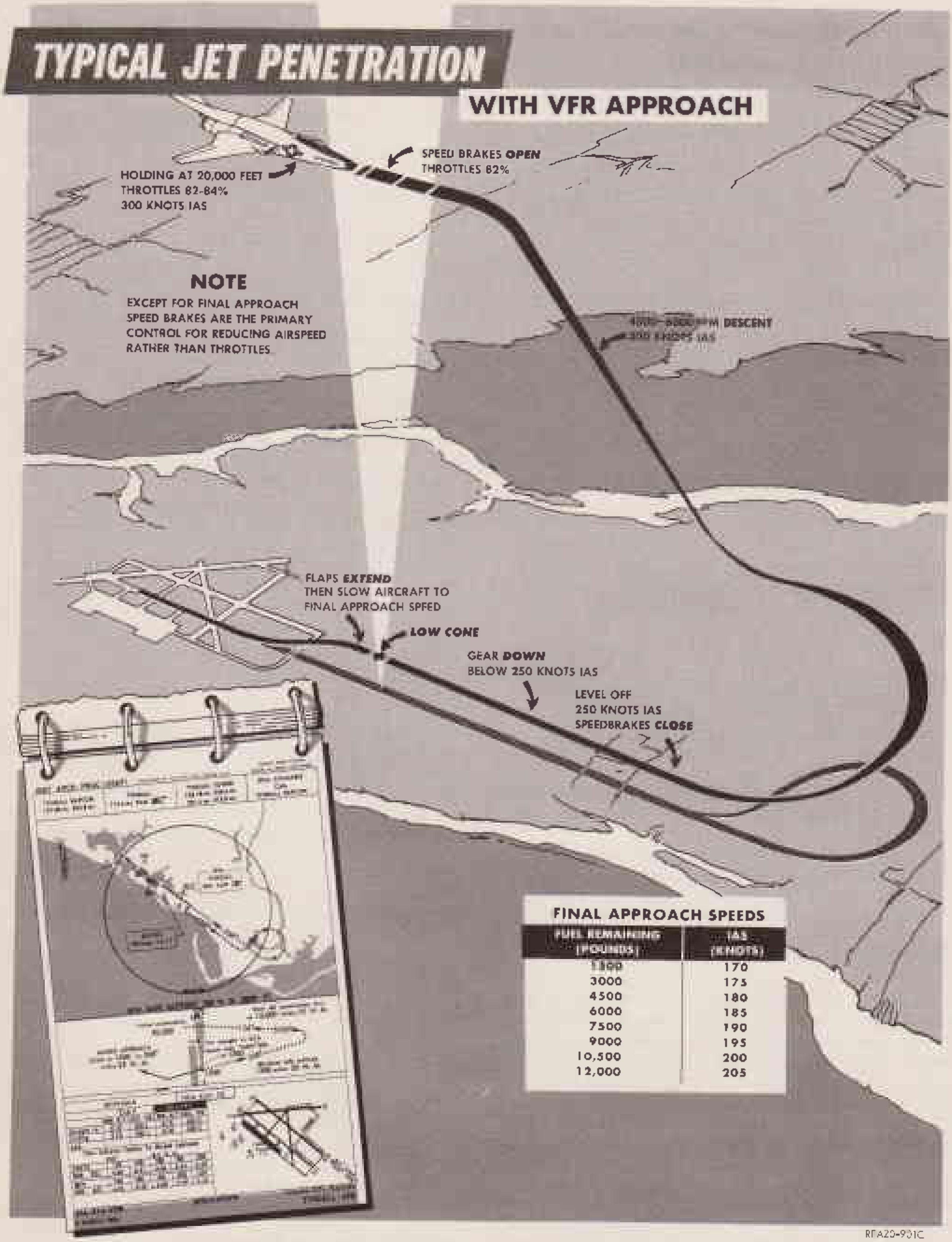
Any angle of bank exceeding 30° is considered a steep turn. The aircraft is easily controlled on instruments in banks up to 60°, however a high airspeed is desirable when the angle of bank exceeds 45°.

Note

The attitude indicator will precess slightly during turns. Precession grows progressively worse as the bank is steepened and the airspeed increased. It may take the attitude indicator several minutes to precess back to a level position after rolling out of a steep turn. Constant cross-checking will be required during these periods.

HOLDING AND STACKING

Holding patterns should be flown at 260 knots with the power settings shown below. Maximum endurance air-



FINAL APPROACH SPEEDS

FUEL REMAINING (POUNDS)	IAS (KNOTS)
1500	170
3000	175
4500	180
6000	185
7500	190
9000	195
10,500	200
12,000	205

Figure 9-1

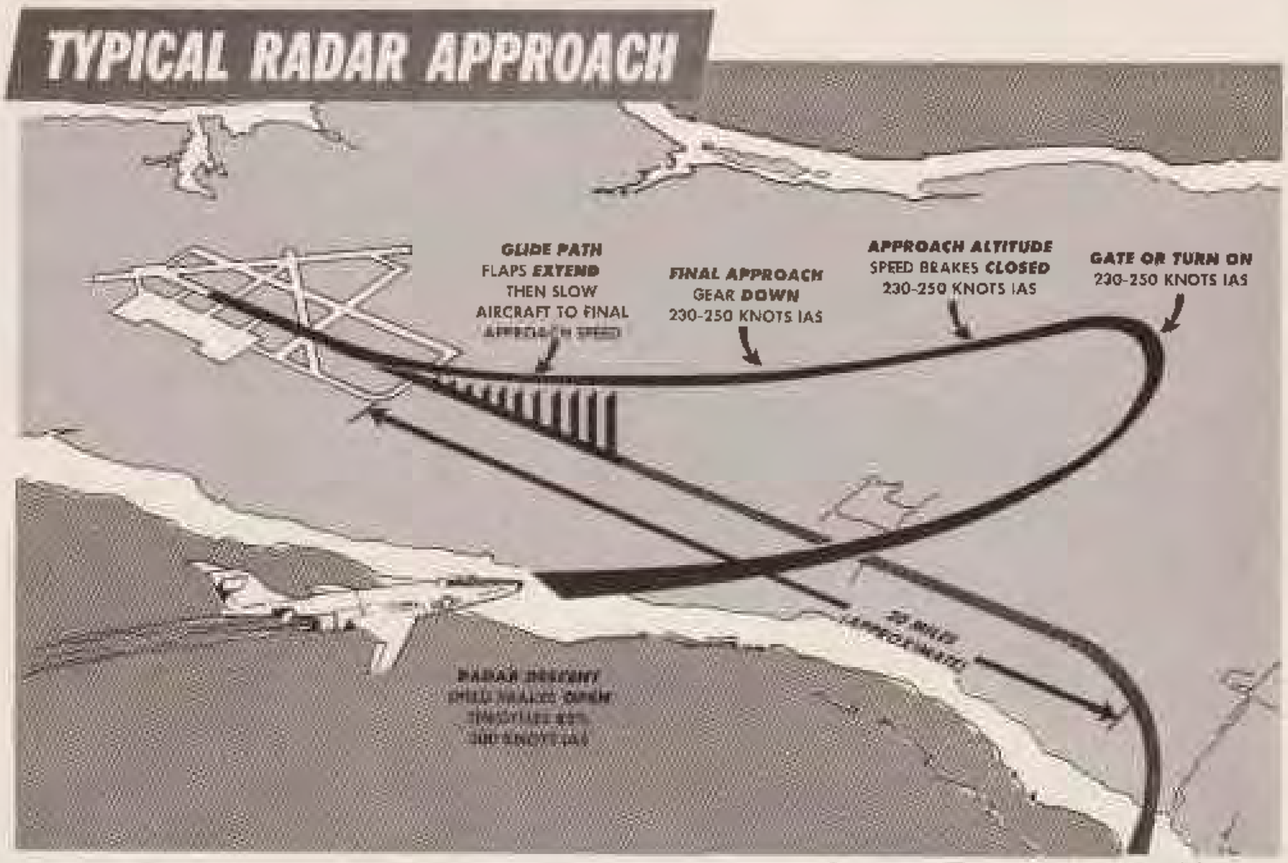


Figure 9-2

speeds are too low for comfortable handling in turns and when turbulence is present. Increase the power setting 1 to 2% rpm before entering the turn in order to maintain airspeed. Single needle width turns (1 1/2° per second) are recommended.

Altitude	RPM	IAS	Fuel Flow
20,000	82-84%	260K	4000 lb./hr.
30,000	82-84%	260K	3600 lb./hr.
40,000	84-86%	260K	3800 lb./hr.

Whenever possible, fly holding patterns between 20,000 and 30,000 feet. Formations can be maintained readily at these altitudes and aircraft control is easy and positive. Holding at 40,000 feet provides no advantage in fuel consumption to compensate for the control difficulty and buffet present at that altitude. Turns should be less than a single needle width when holding at 40,000, the precise degree of bank being determined by the gross weight. To enter a holding pattern begin a turn to the desired heading and simultaneously reduce power to the settings shown in figure 9-1. To descend when holding in a stack, lower the nose and maintain the holding pattern airspeed by extending the speed brakes. Lead the desired level-off altitude by about 1000 feet, first retracting the speed brakes and then adjusting power as necessary.

INSTRUMENT APPROACHES

The aircraft is equipped to make VOR, radar and GCA approaches. Upon incorporation of T.O. 1F-101-662, ILS and TACAN approaches may be made. When flown with recommended power settings, response to throttle movement is rapid and airspeed control is good at all times. The speed brakes and not the throttles should be used to reduce airspeed and to descend in approach patterns, except on final approach. Proper technique consists of extending the brakes partially until the new altitude or airspeed is reached and then closing them again. If airspeed was being reduced, a slight (1 to 2%) power adjustment will then hold the desired speed. Do not keep the speed brakes extended continuously on any leg of the pattern because the increased drag wastes fuel and light buffet may be induced. Lower the flaps (except when one engine is inoperative) on base leg and stabilize the final approach airspeed before intercepting the glide slope. See figures 9-3 and 9-4.

CAUTION

Do not use the AN/APN-22 radar altimeter for landings under instrument conditions.

MISSED APPROACH OR GO-AROUND

As soon as it is determined that a go-around is necessary, apply Military thrust and level off momentarily, staying below the gear down limit speed. Raise the gear as soon as climb has been established, and raise the flaps at 200 knots. Climb to the missed approach altitude at an airspeed of 250 knots, reducing power to establish a climb of about 2000 feet per minute.

Note

After a climb has been established the Military thrust setting must be reduced without delay so that the aircraft does not overshoot the missed approach altitude. The required power setting will vary, depending on the aircraft's gross weight and the height of the local missed approach altitude. Under average conditions, however, (when the climb is 1500 feet or less) a reduction to 85% rpm will permit the aircraft to climb at 250 knots at a rate which is not excessive.

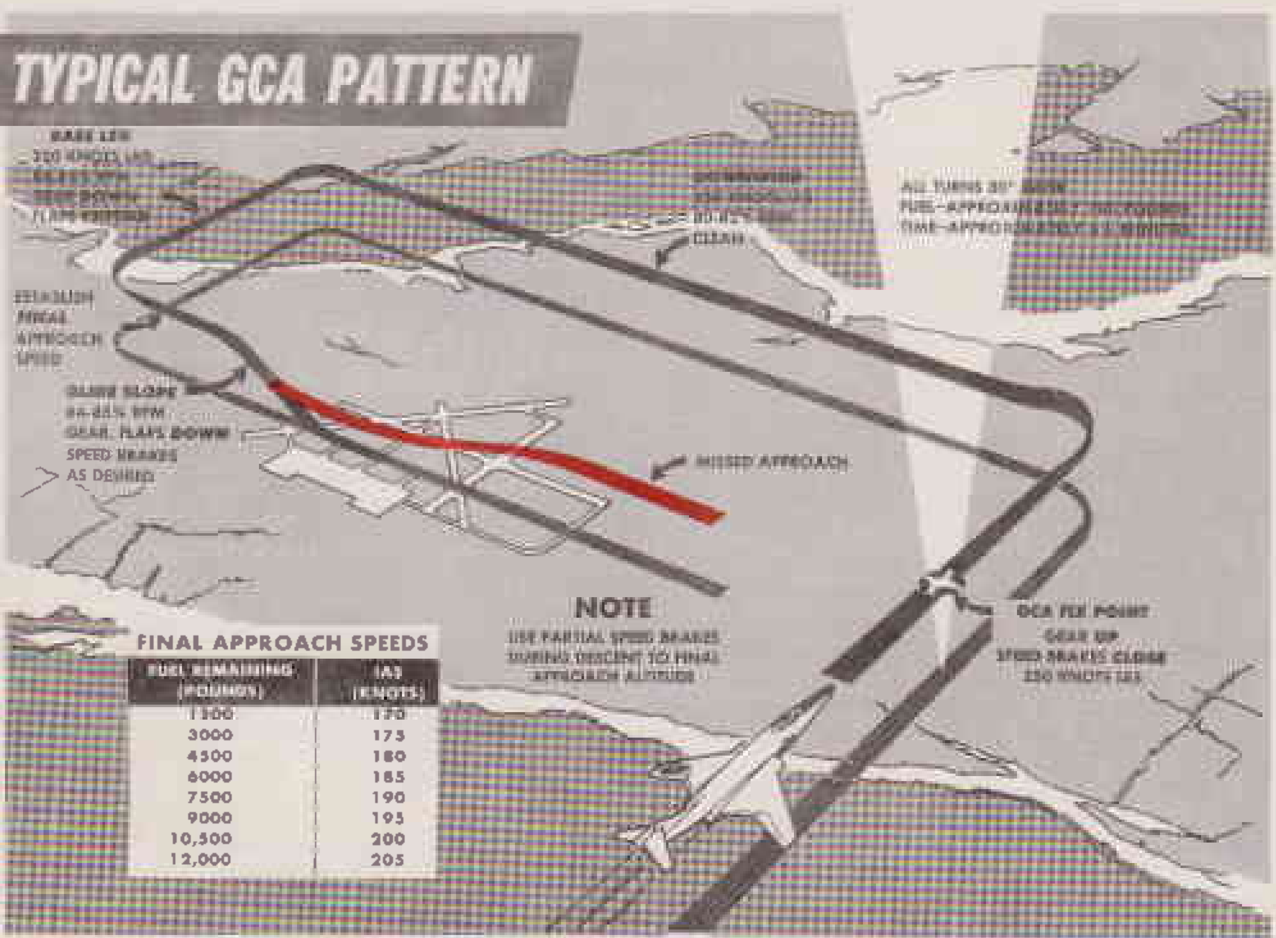
Make no turns below 250 knots and limit bank angles to 30°. Missed approaches can be made from any point before the landing flare, at gross weights up to normal take-off weight, if the recommended approach speed, as shown on the appropriate diagram, is followed.

SINGLE ENGINE APPROACH

In addition to the technique noted under Instrument Approaches, observe the following precautions: Make no large power reductions at any time and never reduce power below 85% rpm. Prevent high rates of descent by making all necessary corrections immediately. Maintain the recommended airspeeds and correct any loss of airspeed immediately with Military thrust. Do not lower the landing gear until the wings are level on final approach.

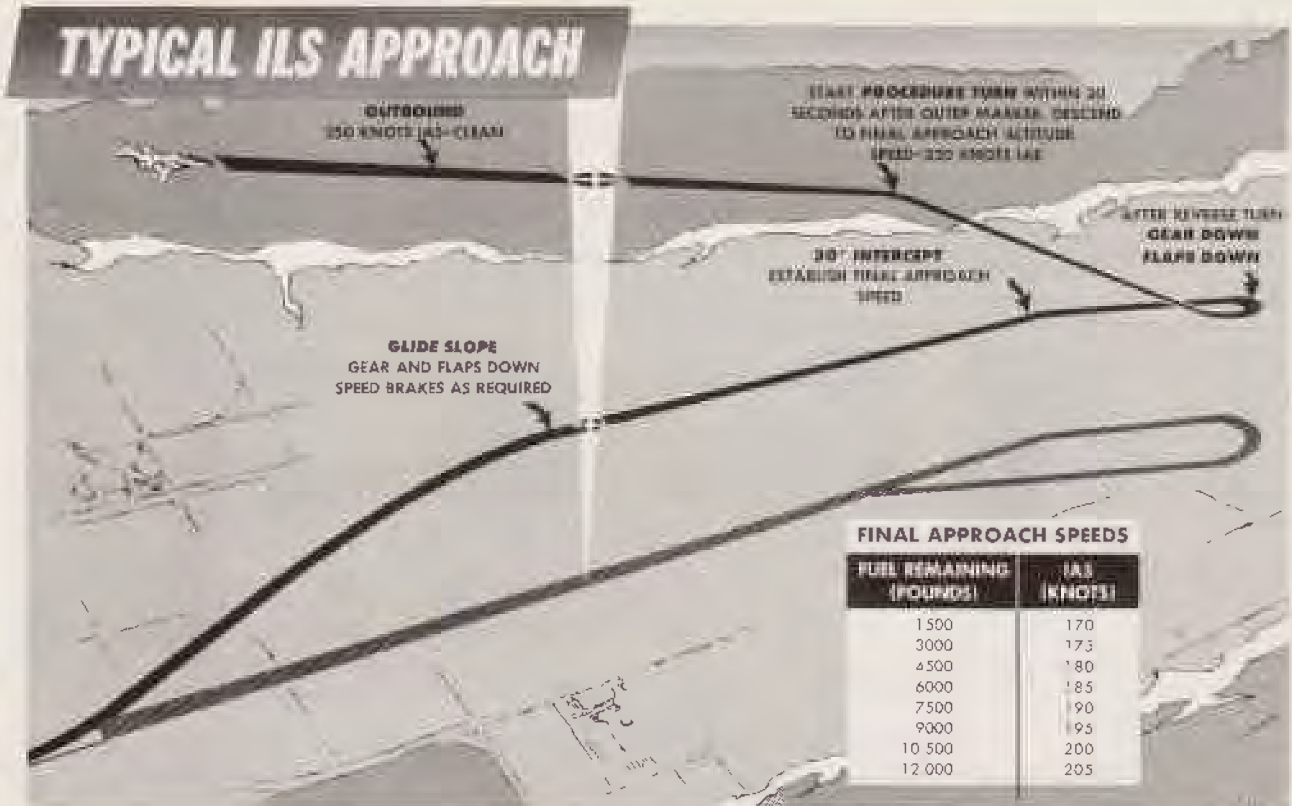
WARNING

Do not lower the flaps until just prior to flare-out and landing is assured. With one engine inoperative and the gear and flaps down, the aircraft cannot maintain altitude at any approach airspeed without afterburner.



FUEL REMAINING (POUNDS)	IAS (KNOTS)
1500	170
3000	175
4500	180
6000	185
7500	190
9000	195
10,500	200
12,000	205

Figure 9-3



FUEL REMAINING (POUNDS)	IAS (KNOTS)
1500	170
3000	175
4500	180
6000	185
7500	190
9000	195
10 500	200
12 000	205

Figure 9-4

SINGLE ENGINE MISSED APPROACH OR GO-AROUND

On a single engine approach, make the decision to go-around early. Apply Military thrust and level off momentarily, maintaining at least 200 knots, plus 5 knots for every 1500 lbs. above 31,000 lbs. gross weight. Raise the gear as soon as the descent has stopped. Allow the airspeed to build up to 250 knots before climbing more than 300 feet per minute and before beginning any turns. Climb to the missed approach altitude at 250 knots. Use the afterburner only if necessary and turn it off as soon as possible in order to conserve fuel. A single engine missed approach can be made without afterburner at any time before the landing flare is begun, at gross weights up to normal take-off weight.

The possibility of engine and/or airframe icing is always present when the aircraft is operating under instrument conditions. Icing is most likely to occur when take-offs must be made into low clouds with temperatures at or near freezing. Normal flight operations are carried on above the serious icing levels, and the aircraft's high performance capabilities will usually enable the pilot to move out of dangerous areas quickly. When an icing condition is encountered, immediate action should be taken to avoid further accumulation by changing altitude and/or course and increasing the rate of climb or airspeed. Ice accretion can best be observed on the wing leading edges inboard of the stall fences. Wing icing changes the shape of the airfoil and destroys lift causing stall speeds to increase, therefore, careful airspeed control is required. Inlet duct icing can be anticipated because critical quantities of ice can be seen accumulating on the airframe. If a 1/2 to 3/4 inch layer of ice gathers on the intake duct lips, or on areas within the ducts, large pieces of it can be drawn into the engine. If this happens, compressor stall will occur and the engine will probably flame-out. The compressor may be damaged, however, there is little chance that the engine will be totally disabled. Ice ingestion and subsequent flame-out can be expected within 4 to 10 minutes after entering an area of heavy icing. Areas of icing enroute should be avoided, but since such areas cannot always be predicted, the following rules of thumb may be used. If the outside air temperature when flying in visible moisture is between 0° and 5°C (32° to 41°F), maintain an airspeed of at least 300 knots to lessen the possibility of inlet icing. Icing may be expected in visible moisture anytime the air temperature is between -10°C and +5°C (14° to 41°F). Except in an emergency, never make an instrument approach into an area where icing is expected at low approach altitude. Ice cannot be evaded while flying an approach pattern and a flame-out at approach altitude is critical. If a GCA must be flown under these conditions, request a minimum fuel (short) pattern. In order to prevent flame-outs and engine damage due to ice ingestion, do not clear to a destination where ice accumulation at low approach altitude is forecast and avoid flight in conditions conducive to the rapid build-up of ice. When ice accumulation is experienced, take immediate corrective action by changing course and/or altitude and increasing airspeed or rate of climb.

Note

> Ice accretion can best be observed on the wing leading edges inboard of the stall fences, however, ice formation may be more rapid on the thinner inlet duct lips.

If possible, dissipate ice accumulations before descending to low altitudes. This will prevent flame-outs due to ice ingestion at critical altitudes.

FLAME-OUTS DUE TO ICE INGESTION

Note

> A flame-out caused by ice ingestion is recognized by a series of light rapid compressor stalls followed by a drop in rpm and exhaust temperature.

If flame-out due to ice ingestion occurs, and loss of altitude is not critical, perform a normal air start. If loss of altitude is critical when the flame-out occurs, perform the following:

a. As soon as rpm begins falling, move the throttle on the affected engine to IDLE and the remaining throttle to OPEN.
b. Depress the ignition button immediately.
c. If the engine rpm falls below 40%, move the throttle to CLS'D and perform a normal air start.

After the air start has been accomplished, maintain on the affected engine the lowest possible rpm necessary to make a safe landing.

Note

> After ice ingestion has been experienced, make a notation in AFTO Form 781 to inspect the engine for damage.

LANDING IN THE RAIN

The windshield anti-icing and blower system will provide a clear left side panel and windshield in medium rain conditions. The blower system may be left on without damaging the glass. However, it must be turned off after landing. A speed increase is necessary on final approach and when landing if icing is present.

Intentional flight through thunderstorms is not recommended. This type of flight requires considerable instrument experience and may result in structural damage to the aircraft. Heavy rain or hail may erode the radome, the tip of the vertical stabilizer, and other plastic parts. Heavy turbulence can be penetrated safely at all normal cruise speeds if the yaw damper is operating. However, penetration will be easier at 300 to 350 knots. Specific instructions for thunderstorm flying are contained in the following paragraphs.

Note

Flight through moderate or heavy turbulence is not recommended when the yaw damper is inoperative because excessive "g" loads may cause the aircraft to be overstressed.

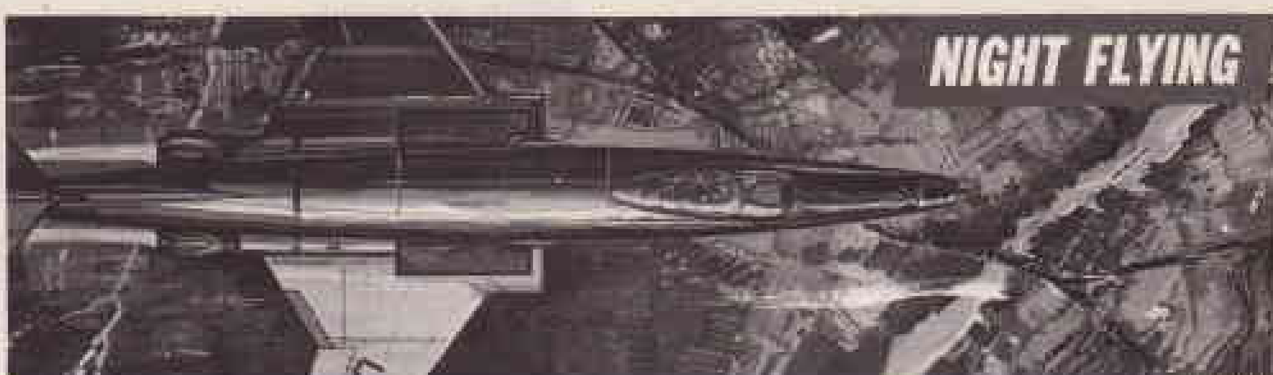
300-350 KNOTS

RECOMMENDED PENETRATION AIRSPEED

RFA20-951B

APPROACHING THE STORM

Prepare the aircraft before entering turbulent air. Adjust power as necessary to obtain a safe penetration airspeed of 300-350 knots.



No special procedures or precautions are required for flying this aircraft at night. Interior and exterior lighting is adequate for all night flying conditions.

Note

The landing light will reflect through the viewfinder unless the filter switch is in "A" (or opaque) position, or the viewfinder cover is installed. Therefore, prior to all night flights, check that the viewfinder filter switch is in the "A" position.

RFA20-907

The success of low temperature operation depends primarily upon the preparations made during the previous postflight inspection. The procedures outlined should be followed to expedite the preflight inspection and to insure satisfactory operation of the airplane and its systems during the next flight. Procedures to be followed when icing is encountered are covered elsewhere in Section IX.

BEFORE ENTERING AIRPLANE

At temperature below -26°C (-15°F) preheat the cockpit. Check that all snow or ice is removed from the wings, fuselage and tail before flight is attempted. Do not permit the ground crew to chip or scrape away ice. This may damage the aircraft surface.

WARNING

Failure to remove snow and ice while the aircraft is on the ground can lead to serious consequences when flight is attempted. At best, take-off distance and climb performance will be adversely affected, and dangerous loss of lift and treacherous stalls may result. Insure that water from melted ice is sponged so that it will not drain into some critical area and refreeze.

Note

Light frost will not affect take-off characteristics.

Carefully inspect for fuel and hydraulic leaks caused by the contraction of fittings and seals. Check all control surfaces and control hinges for freedom of movement. Make sure landing strut limit switches and actuating cylinders are clear of ice and dirt. Check fuel cell drain cocks for ice and drain condensate. Inspect pitot tube, static ports, angle-of-attack transducer probes, fuel tank vents, and remove any ice. Check fuel system for proper fuel.

ON ENTERING AIRPLANE

With external electrical power connected, check fuel quantity (all positions). Make certain that low-temperature conditions did not affect the fuel system calibration so as to cause erroneous gage readings.

BEFORE STARTING ENGINES

Check that the wheels are well chocked. See that all ground equipment is located a safe distance from the aircraft to prevent damage in case the aircraft slips when the engines start.

STARTING ENGINES

Start the engines in the normal manner; however, exercise caution when ambient temperature is 0°C (32° F) or lower, as the engine rotor may be ice-locked by frozen condensation. If any indication of a locked rotor, or unusual noise, or low engine speed is noted, discontinue the start. Hot air blown through the engine will free the rotor if icing is present.

CAUTION

During start, if the engine is not free to rotate, immediately move the engine start switch to STOP START and have external heat applied to the forward section of the engine. The engine should be started as soon as possible after heating to prevent moisture from refreezing.

WARM-UP AND GROUND CHECK

Note

If a start is made with an engine which has cooled to a temperature of -35°C (-31°F), the engine must be allowed to warm up at idle for two minutes before running at higher speeds.

Turn on the cockpit air conditioning and windshield and canopy defrosting systems immediately after engine start. Check canopy and windshield for cracks, paying particular attention to the areas around the mounting screws. Operate all flight controls sufficiently to assure that speed of operation of control surfaces are adequate.

CAUTION

Make sure all instruments have warmed up sufficiently to insure normal operation.

WARNING

This airplane is not equipped with parking brakes. Use firmly anchored wheel chocks for engine run-ups. Make sure the airplane is tied down securely before attempting a full power run-up. Because of low outside air temperature, the thrust developed at all engine speeds is noticeably greater.

TAXIING

Avoid taxiing in deep snow as taxiing and steering are extremely difficult and frozen brakes may result. Increase the space between airplanes while taxiing in freezing temperature to insure a safe stopping distance, and to prevent icing the airplane surfaces by melted snow and ice from the jet blast of the preceding airplane. Minimize taxi time to conserve fuel and to reduce the amount of ice fog generated by the engines. Check with ground personnel to insure that the wheels are actually turning. Taxi slowly over slush and wet snow in order to keep to a minimum the amount of slush thrown up onto the flaps by the wheels.

TAKE-OFF

Start the take-off roll at 70% rpm. After the airplane is rolling and properly aligned with the runway, advance the throttles to OPEN.

Note

Afterburner operation is not necessary and should be avoided. Very rapid acceleration makes take-off difficult and does not allow sufficient time for the landing gear to retract before the gear down limit speed is reached.

AFTER TAKE-OFF

After take-off from a wet snow or slush-covered field, operate the brakes several times to expel wet snow or slush. Cycle the gear several times so that it does not freeze in the retracted position. Expect considerably slower landing gear operation in cold weather because the lubricants are stiffer.

CAUTION

In cold weather operation the increased thrust makes acceleration to gear limit speeds even more critical. Do not exceed 250 knots until gear and flaps are fully retracted. The nose gear may not retract, and wheel well covers may be damaged, at higher airspeeds.

CLIMB

Climb performance at lower altitudes will be improved during cold weather operation. Follow the recommended climb speeds given in Appendix I.

DURING FLIGHT

Use cockpit heat and canopy and windshield defrosting system as required.

APPROACH

Make a normal pattern and landing, but allow for a flatter final approach due to the increased thrust caused by low air temperatures. Pump the brake pedals several times to free any accumulated ice. Maintain recommended final approach speeds as closely as possible. Open the speed brakes and reduce power to idle during flare.

CAUTION

Do not make these changes before flaring as the rapid loss of airspeed may cause the aircraft to stall.

Touchdown as near the approach end of the runway as possible.

BEFORE LEAVING AIRPLANE

Whenever possible, leave the canopy partly open. This permits air to circulate in the cockpit and prevents canopy cracking from differential contraction. Check the exposed portion of the shock strut pistons for accumulations of dirt and ice, and have them cleaned if necessary. If possible, leave the airplane parked with full fuel tanks. Every effort should be made during servicing to prevent moisture from entering the fuel system. Check that the battery is removed if the airplane is parked outside for any extended period of time or if the temperature is below -29°C (-20°F). Check that proper protective covers are installed.

HOT WEATHER AND DESERT PROCEDURES

In general, hot weather procedures do not differ from normal procedures except that precautions must be observed to protect the airplane from damage due to high temperatures and blowing sand. Particular care should be taken to prevent sand from entering the various airplane components and systems.

BEFORE ENTERING AIRPLANE

Check the air intakes for accumulations of dust or sand, and be sure all protective covers are removed if used. Check the exposed portion of the shock strut pistons for accumulation of dust or sand, and have them cleaned if necessary. Inspect tires for blisters or other evidence of deterioration and for proper inflation. Check particularly for hydraulic system leaks as heat and moisture may cause valves and packings to swell.

WARNING

Be careful when removing fuel caps. Thermally expanded fuel vapor may blow the cap or fuel in your face.

ON ENTERING AIRPLANE

Do not permit foreign objects to come in contact with the canopy, since it is possible to damage the plexiglas in extremely hot weather.

Note

Determine whether the emergency fuel system is set for hot weather operation before starting the engines.

STARTING ENGINES

Normal starting procedures are used in hot weather. Temperatures will probably be on the high side of operating ranges. Engine ground operation should be kept to a minimum.

TAKE-OFF

Note

Whenever possible, avoid taking off in air contaminated with blowing sand.

Required take-off distances for jet aircraft are greatly increased by high temperatures. See Appendix I, Take-Off Distances at various temperatures.

LANDING

Hot weather operation requires the pilot to be more cautious of gusts and wind shifts near the ground. Landing ground rolls are only slightly longer than those which occur with normal temperatures. Refer to Appendix I.

BEFORE LEAVING AIRPLANE

Check that protective covers are immediately installed on pitot head, angle-of-attack transducer probes, canopy, and intake and exhaust ducts to prevent contamination of dust or sand. The canopy should be left open if the location is not subject to blowing sand or dust.

APPENDIX I
PERFORMANCE DATA

NOTE

For Appendix I, refer to the Confidential Supplement, T.O. 1F-101(R)A-1A

ALPHABETICAL INDEX

RFA20-A1

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