Utility FLIGHT MANUAL

USAF SERIES F-101A AND RF/YRF-101A AIRCRAFT

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

This publication replaces Confidential Supplement T.O. 1F-101(R)(Y)A-1A, dated 1 October 1960, which should be destroyed in accordance with AFR 205-1.

This change includes Safety of Flight Supplements -7 and -10. See Weekly Index, T.O. 0-1-1A, for current status of Safety of Flight Supplements.

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

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AIR FORCE, Wilco Prtg. Co. 11/1/61 400 (McDonnell A/C Corp.)

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Yup...knowed yew was in trouble when ah seed yew'd lost your'n prop-pellar

SCOPE This manual contains the necessary information for safe and efficient operation of the F-101A, YRF-101A and the RF-101A. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGEMENT Instructions in this manual are for a pilot inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc. may require modification of the procedures.

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

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

SAFETY OF FLIGHT SUPPLEMENTS Information involving safety will be promptly forwarded to you by Safety of Flight Supplements. Supplements covering loss of life will get to you in 48 hours by TWX, and those concerning serious damage to equipment within 10 days by mail. The current status of each Safety of Flight Supplement affecting your airplane can be determined by referring to the Weekly Index of Safety of Flight Supplements (T.O. 0-1-1A). 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 they may have on existing supplements. You must remain constantly aware of the status of all supplements - current supplements must be complied with but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

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

HOW TO GET PERSONAL COPIES Each flight crew member is entitled to personal copies of the Flight Manual, Safety of Flight Supplements, and Check Lists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel - it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirements Table (T.O. 0-3-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

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

MB-8 FLIGHT COMPUTER An MB-8 Flight Computer is available for this airplane. This pocket size computer provides pilots with compact performance data to aid in preparing flight plans, in-flight cruise control and emergency replanning. The computer data discs, which contain specific performance data for this airplane, are distributed automatically to all bases having this airplane. New or revised discs are issued each time the performance data in this manual is revised. Operation of the computer is explained in the Appendix of this manual. If you have not received your computer, see your Base Operations Officer or T.O. 5F5-1-1.

CHANGE SYMBOL Changed text is indicated by a black line in the outer margin of the page. The change symbol indicates changes made in the current revision.

WARNINGS, CAUTIONS, AND NOTES The following definitions apply to "Warnings", "Cautions", and "Notes" found throughout this manual.

WARNING

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

CAUTION

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

Note

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

YOUR RESPONSIBILITY–TO LET US KNOW Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters to Hq WADD, Wright-Patterson AFB, Ohio: ATTN: ASOOH.

BLOCK DESIGNATION CODES

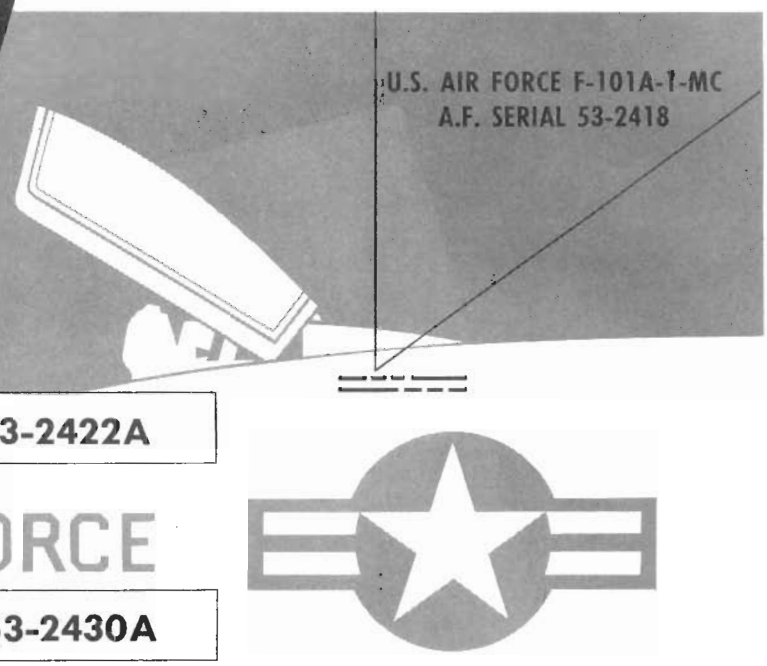
CODE

The information contained in this manual is applicable to F-101A airplanes, block 1 (53-2418) through block 20 (54-1443), YRF-101A airplanes, block 10 (54-149 and 54-150), and RF-101A airplanes, block 20 (54-1494 through 54-1496). Effectivity differences within this group of airplanes are designated by block number symbols which appear on illustrations and within the text. Effectivity differences within a block of airplanes is designated by airplane serial number followed by the block number symbol. 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

❶	Pertains to F-101A airplanes in block 1 (53-2418 thru 53-2422).
❺	Pertains to F-101A airplanes in block 5 (53-2423 thru 53-2430).
❿	Pertains to F-101A airplanes in block 10 (53-2431 thru 53-2436).
⓯	Pertains to F-101A airplanes in block 15 (53-2437 thru 53-2446).
⓴	Pertains to F-101A airplanes in block 20 (54-1438 thru 54-1443).
⑩	Pertains to YRF-101A airplanes in block 10 (54-149 and 54-150).
⑳	Pertains to RF-101A airplanes in block 20 (54-1494 thru 54-1496).

block numbers



F-101A-1-MC
A.F. SERIAL 53-2418A Thru 53-2422A

F-101A-5-MC
A.F. SERIAL 53-2423A Thru 53-2430A

F-101A-10-MC
A.F. SERIAL 53-2431A Thru 53-2436A

F-101A-15-MC
A.F. SERIAL 53-2437A Thru 53-2446A

F-101A-20-MC
A.F. SERIAL 54-1438A Thru 54-1443A

YRF-101A-10-MC
A.F. SERIAL 54-149A Thru 54-150A

RF-101A-20-MC
A.F. SERIAL 54-1494A Thru 54-1496A

F-101	TYPE AND MODEL
YRF-101	TYPE AND MODEL
RF-101	TYPE AND MODEL
A	SERIES LETTER
1	BLOCK NUMBER
MC	McDONNELL

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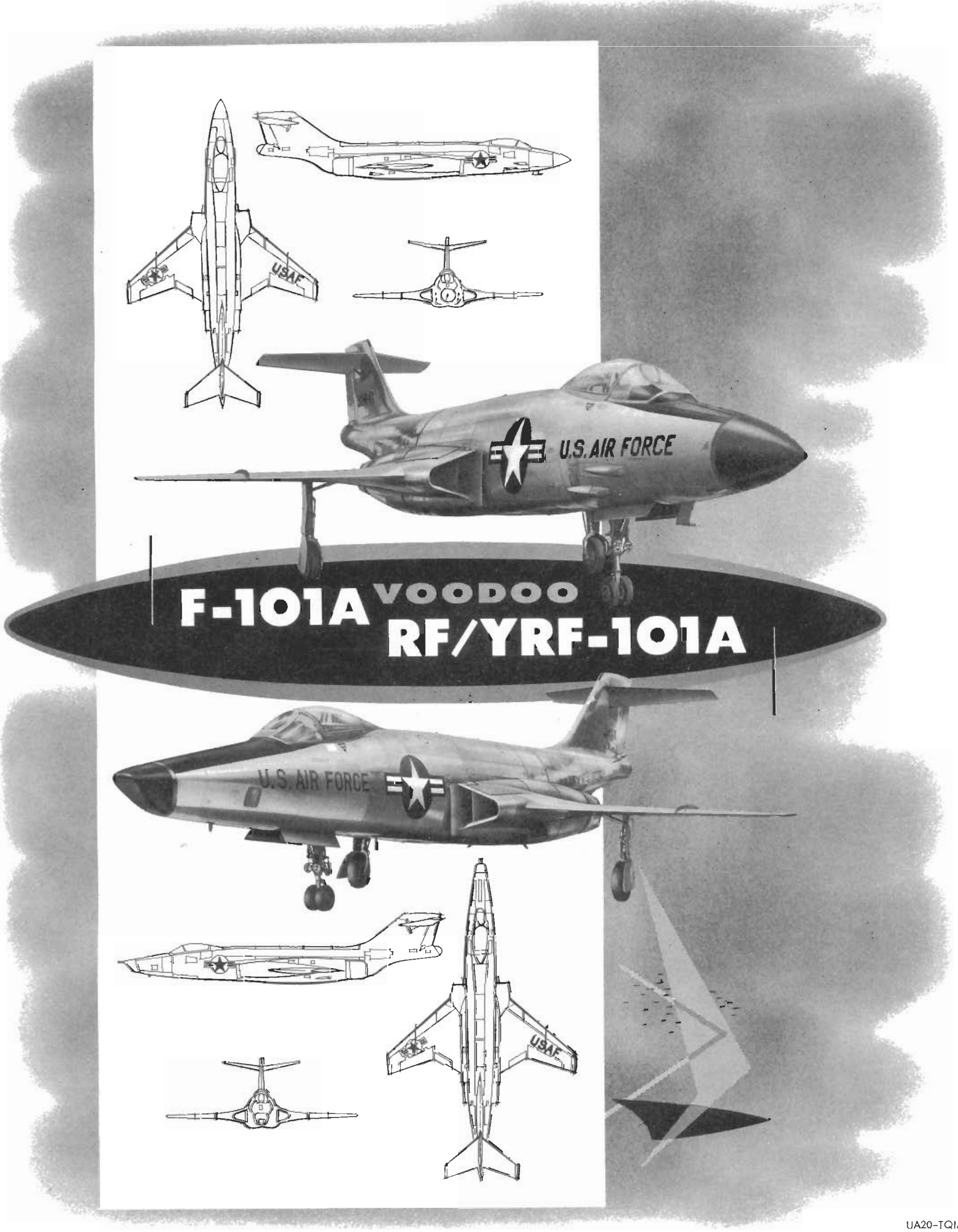

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section I DESCRIPTION

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AIRPLANE

The F-101A, YRF-101A and RF-101A are single place supersonic airplanes built by McDonnell Aircraft Corporation. The F-101A is designed for use as a fighter bomber that can be secondarily used as a long range escort fighter. The YRF-101A and RF-101A are designed for long range reconnaissance. The airplanes are powered by twin axial-flow turbojet engines with afterburners. Their appearance is characterized by very thin, short swept wings and sweptback empennage with triangular intake ducts set forward at the wing root. The horizontal stabilizer is a one-piece controllable unit mounted high on the vertical stabilizer. All 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. The airplane incorporates both the flying boom and probe and drogue air refueling plus the single-point ground refueling system. 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 overall dimensions of the airplanes are as follows:

Span	39 feet 8 inches
Length	67 feet 5 inches (1) THRU (20)
	69 feet 3 inches (10)(20)
Height	18 feet 0 inches

Refer to Section II (figure 2-3) for turning radius and ground clearances.

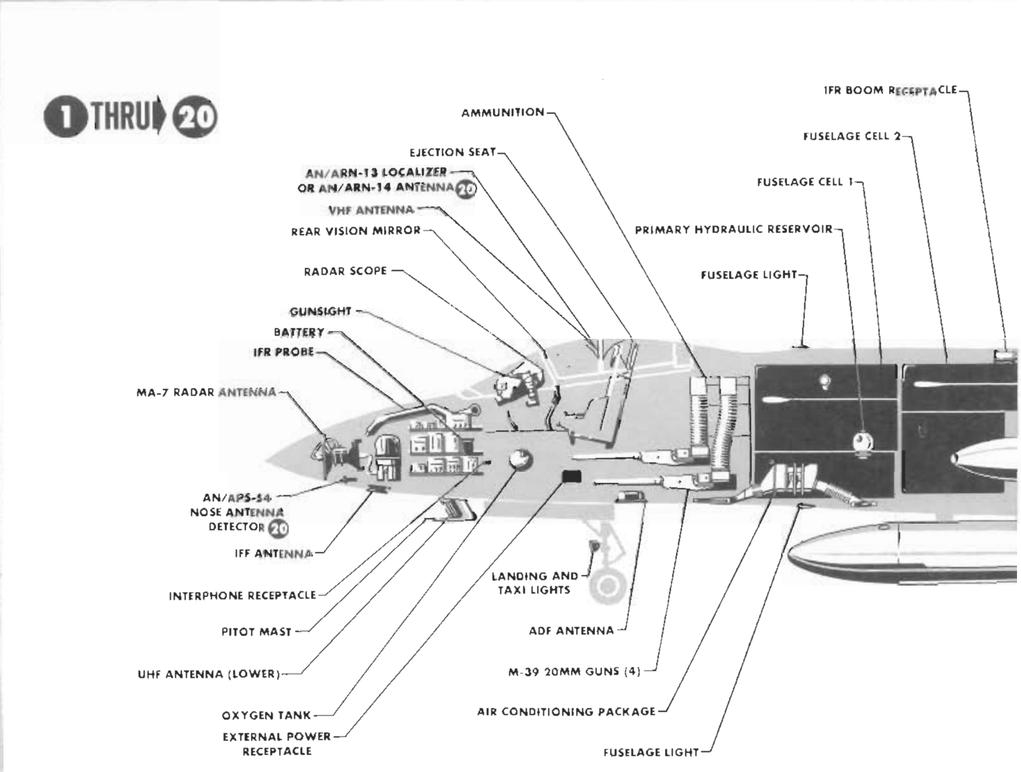
AIRPLANE GROSS WEIGHT

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

	(1)
Airplane with no external load	39,400 pounds
	(5)
Airplane with no external load	39,800 pounds
Airplane with two full external tanks	46,050 pounds
	(10)
Airplane with no external load	40,000 pounds
Airplane with two full external tanks	46,250 pounds
	(15)
Airplane with no external load	40,100 pounds
Airplane with two full external tanks	46,350 pounds
	(20)
Airplane with no external load	40,800 pounds
Airplane with two full external tanks	47,050 pounds
	(10)
Airplane with no external load	39,250 pounds
Airplane with two full external tanks	45,500 pounds
	(20)
Airplane with no external load	39,750 pounds
Airplane with two full external tanks	46,000 pounds

Refer to Section V for additional weight limitations.

general arrangement



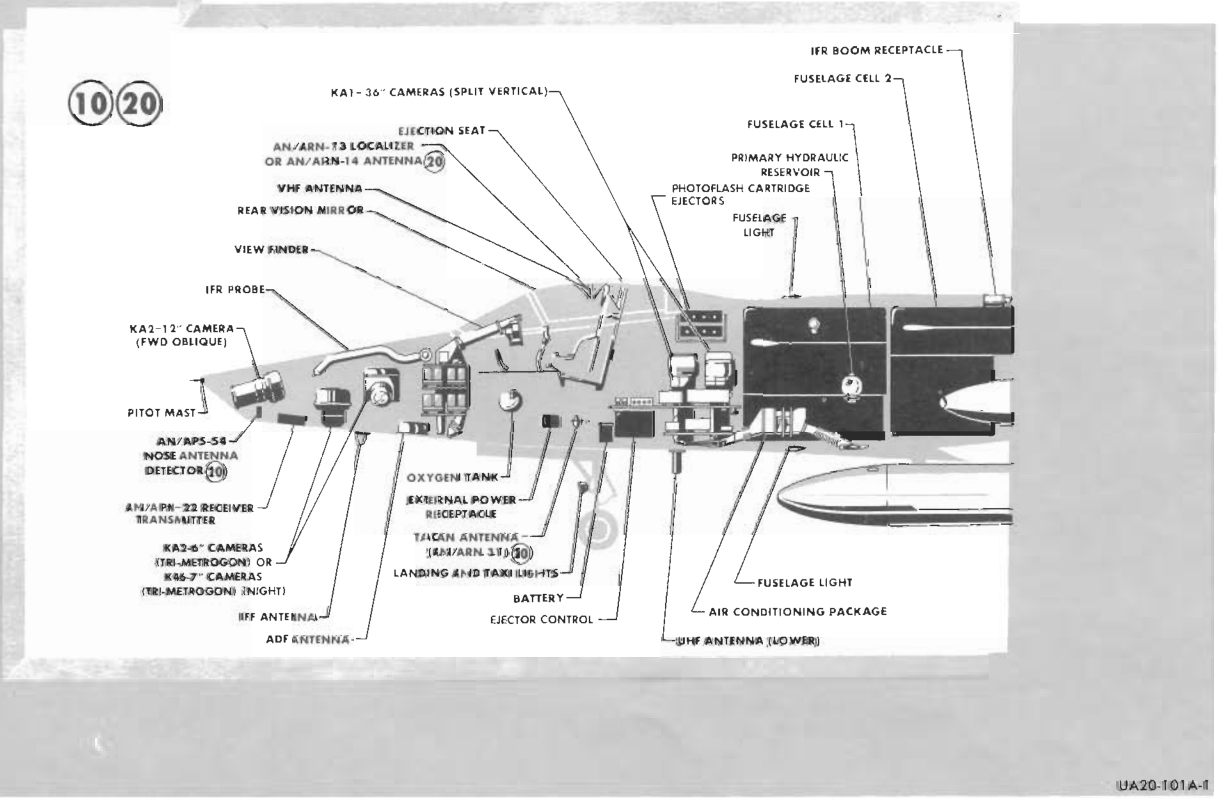


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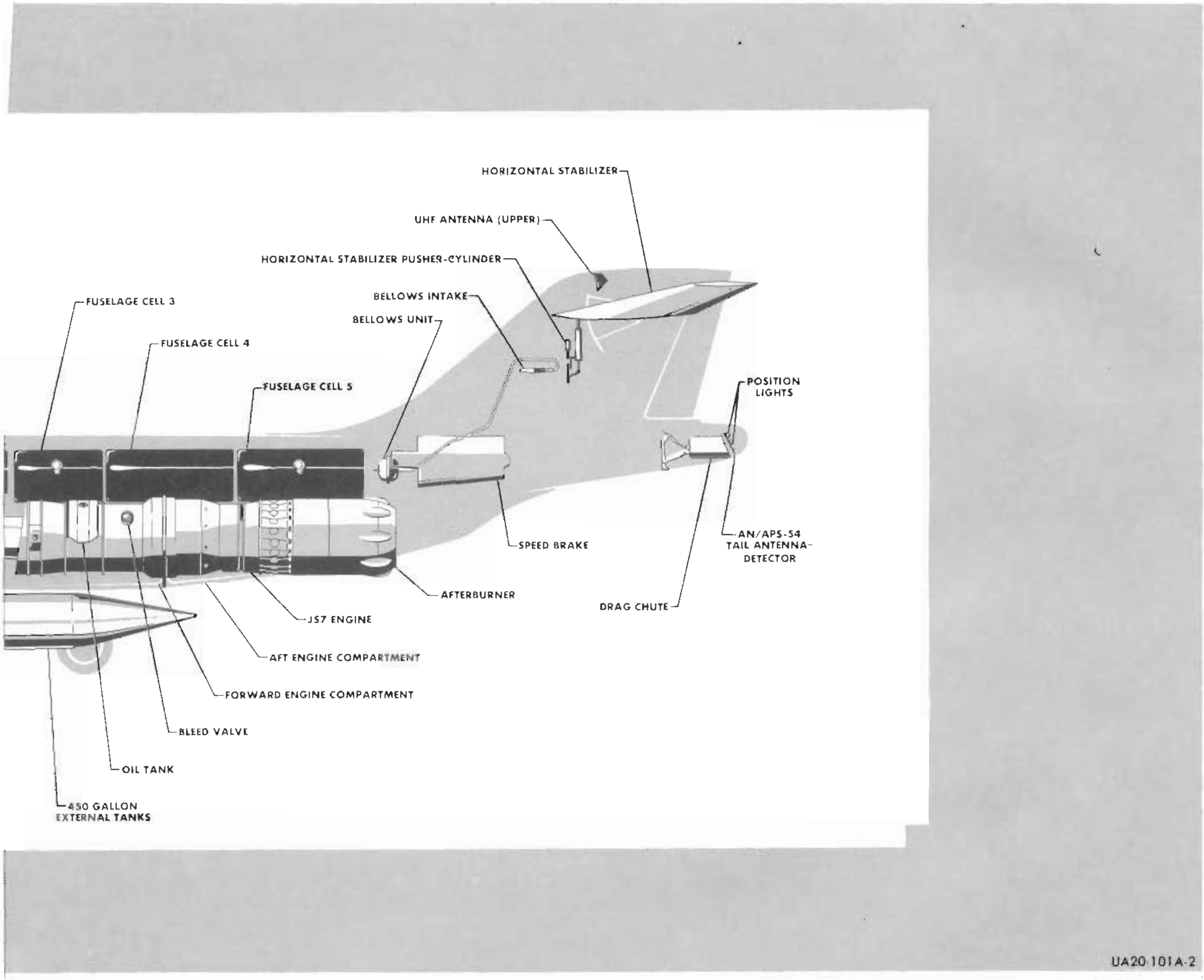
Figure 1-1



ARMAMENT (1) THRU (20)

These airplanes are equipped with four 20mm automatic firing guns. The guns are installed just aft of the cockpit in the lower surface of the fuselage, two on each side, outboard of the nose gear well. External stores can be carried on removable pylons mounted on the underside of the fuselage. An automatic lead-computing sight, coupled with a radar ranging system is provided for more accurate gun firing. Bombing equipment includes the M-1 Dive-Toss Bombing System and the MA-2 Low Altitude Bombing System. For additional information on armament systems, refer to Section IV, this manual.

ARMAMENT (10) (20)

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

ENGINE

Airplane thrust is provided by two Pratt & Whitney J57-P-13 turbojet engines (figure 1-3) equipped with afterburners and mounted side by side on 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 fire-wall 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 valve is open when the engine is started, then closes as the engine reaches a surge-free speed, and reopens when the engine decelerates (refer to Engine Compressor Bleed Valve, 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 engine 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.

main differences table

	F-101A	F-101C	YRF-101A	RF-101A	RF-101C	F-101B
ENGINES	J57-P-13	J57-P-13	J57-P-13	J57-P-13	J57-P-13	J57-P-53 J57-P-55
ARMAMENT	20 MM CANNONS MA-2, MA-1A AND M-1 BOMBING SYSTEM	20 MM CANNONS M1 AND MA-2 BOMBING SYSTEM	NO	NO	NO	MB-1 ROCKETS GAR-1D AND GAR-2A MISSILES
CAMERAS	SIGHT AND STRIKE	SIGHT AND STRIKE	UNIVERSAL CAMERA CONTROL SYSTEM	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	NO	MG 13 RADAR WITH DATA-LINK PROVISIONS FOR GROUND CONTROLLED INTERCEPTION
AUX FUEL PROVISIONS	DROP TANKS WING TANKS (25) THRU (35)	DROP TANKS, WING TANKS	DROP TANKS	DROP TANKS WING TANKS	DROP TANKS WING TANKS	DROP TANKS WING TANKS
ANTI-SKID BRAKES	YES 54-1438 (20), 54-1441 (20) and 54-1442 (20)	YES	YES 54-150 (10)	YES (25) THRU (35)	YES	YES
PITOT-STATIC BOOM	NO	NO	NO	NO	NO	YES
SECONDARY AIR SCOOPS	NO	NO	NO	NO	NO	YES
DUAL CONTROL	NO	NO	NO	NO	NO	YES

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Figure 1-2

① By the engine fuel control system ( ). The system includes the engine-driven fuel pump unit, the fuel control unit, the fuel pressurizing and dump valve, and the afterburner fuel system.

J57 engine

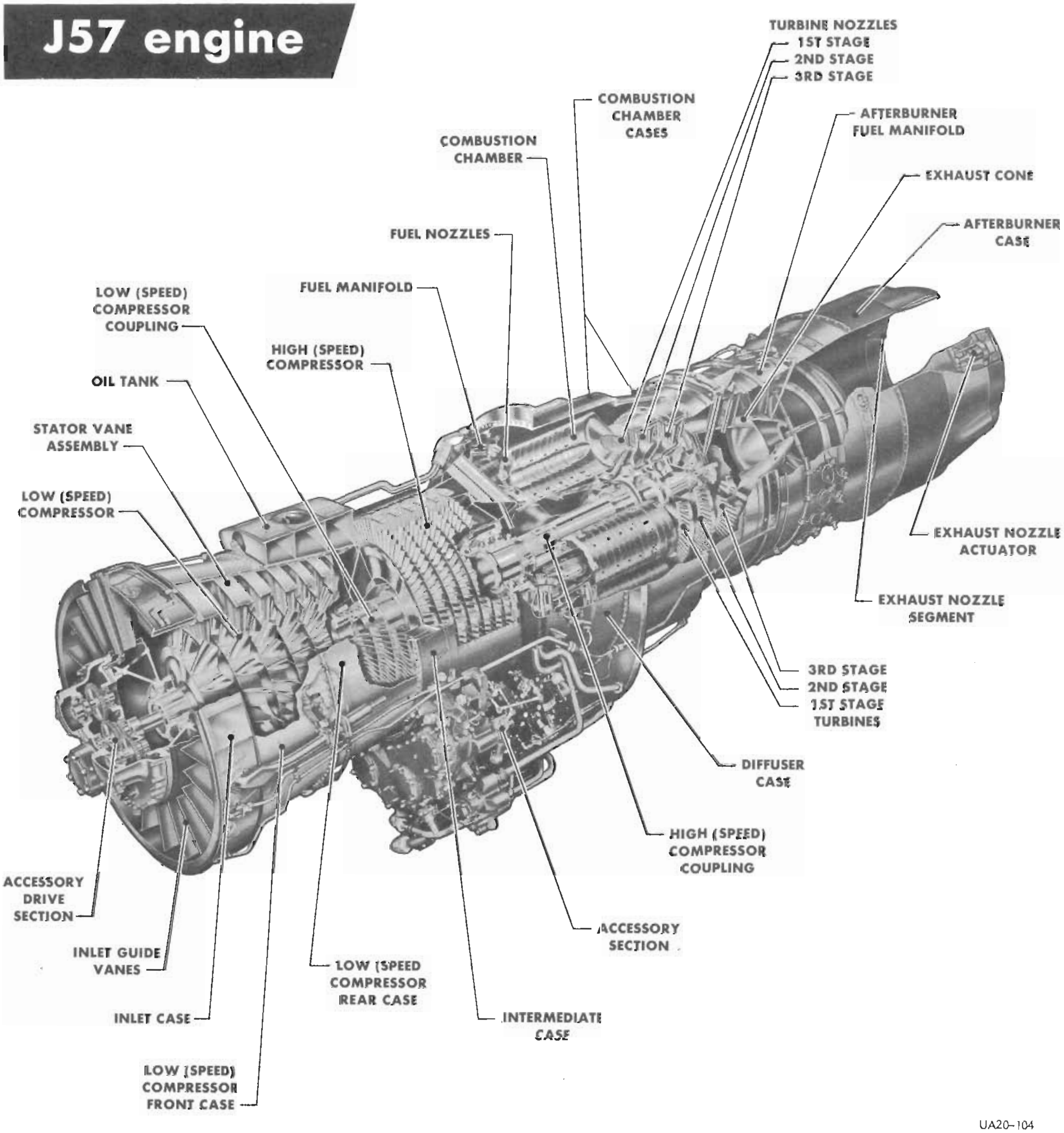

Figure 1-3

Fuel flow to the engine in response to throttle operation is further regulated ① 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 Afterburner System.

Fuel Pump Unit

The engine-driven fuel pump unit consists of three individual pumps mounted in the center accessory group. A centrifugal fuel pump receives fuel from the engine feed tank (No. 2) and in turn, supplies it, under pressure, to the 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 pump leaves the others unaffected. A transfer valve is also a part of the fuel pump unit. The transfer valve automatically directs afterburner pump output to the main engine system in the event of failure of the engine fuel pump.

engine fuel control system

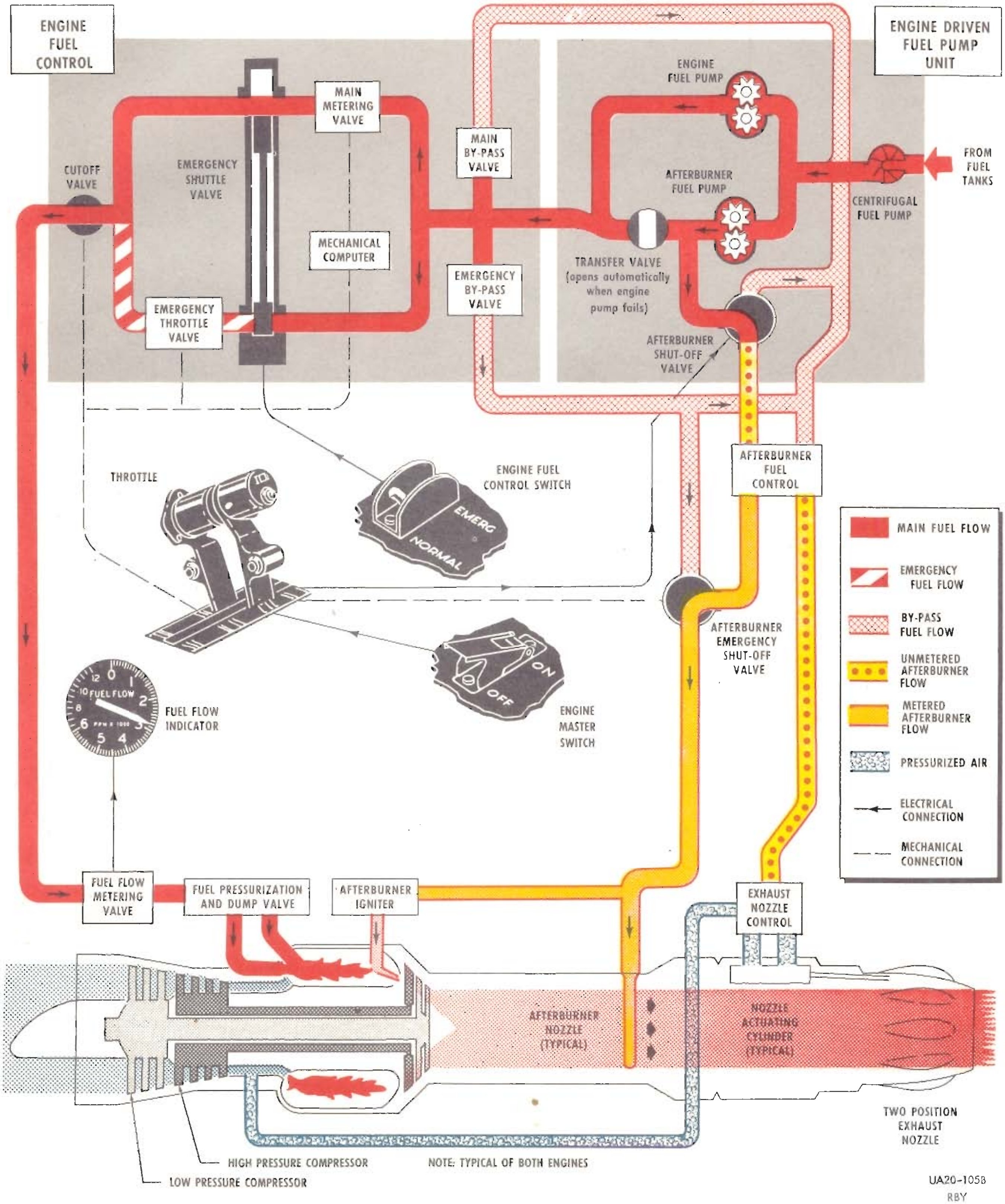

Figure 1-4

Note

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

Engine Fuel Control System

An engine-driven hydromechanical engine fuel control system (figure 1-4), serves to establish a fuel flow to the engine which will result in the thrust 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 control, the engine fuel control system incorporates an emergency fuel control for use in the event of normal fuel control failure. The principle function of the normal fuel control is to schedule engine fuel flow automatically in accordance with certain limiting factors such as throttle position, engine speed, and compressor inlet temperature and barometric pressure. The engine fuel control system 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 discharge side of the centrifugal pump.

Normal Fuel Control

During normal fuel control operation, (engine fuel control switch in NORMAL position) the throttle is the primary control of the size of a metering valve 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 temperature (which is a function of altitude and flight conditions), and burner pressure, the computer adjusts thrust output selected by the pilot with regulated changes in the metering valve orifice. During rapid engine accelerations, the normal fuel control schedules fuel flow to protect the engine from overspeed, overtemperature and compressor stalls. During rapid decelerations, the normal fuel control maintains a minimum fuel 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 bypass valve.

Emergency Fuel Control

Emergency operation of the engine fuel control system provides regulation of engine fuel flow if the normal fuel control fails. Emergency operation must be selected by the pilot (by positioning engine fuel control switch in EMERG). In selecting the emergency fuel control, the normal fuel control 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 fuel control will compensate for changes in altitude, however, compensations are only effective 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 fuel control to emergency fuel control is made when there is a great difference between the thrust 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 at any throttle position, 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 thrust level to avoid violent surge.

CAUTION

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

The emergency bypass 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 main engine and pilot manifold. For starting, only the pilot manifold, and consequently the pilot nozzle are needed. 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 located on the left console to establish 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

throttles

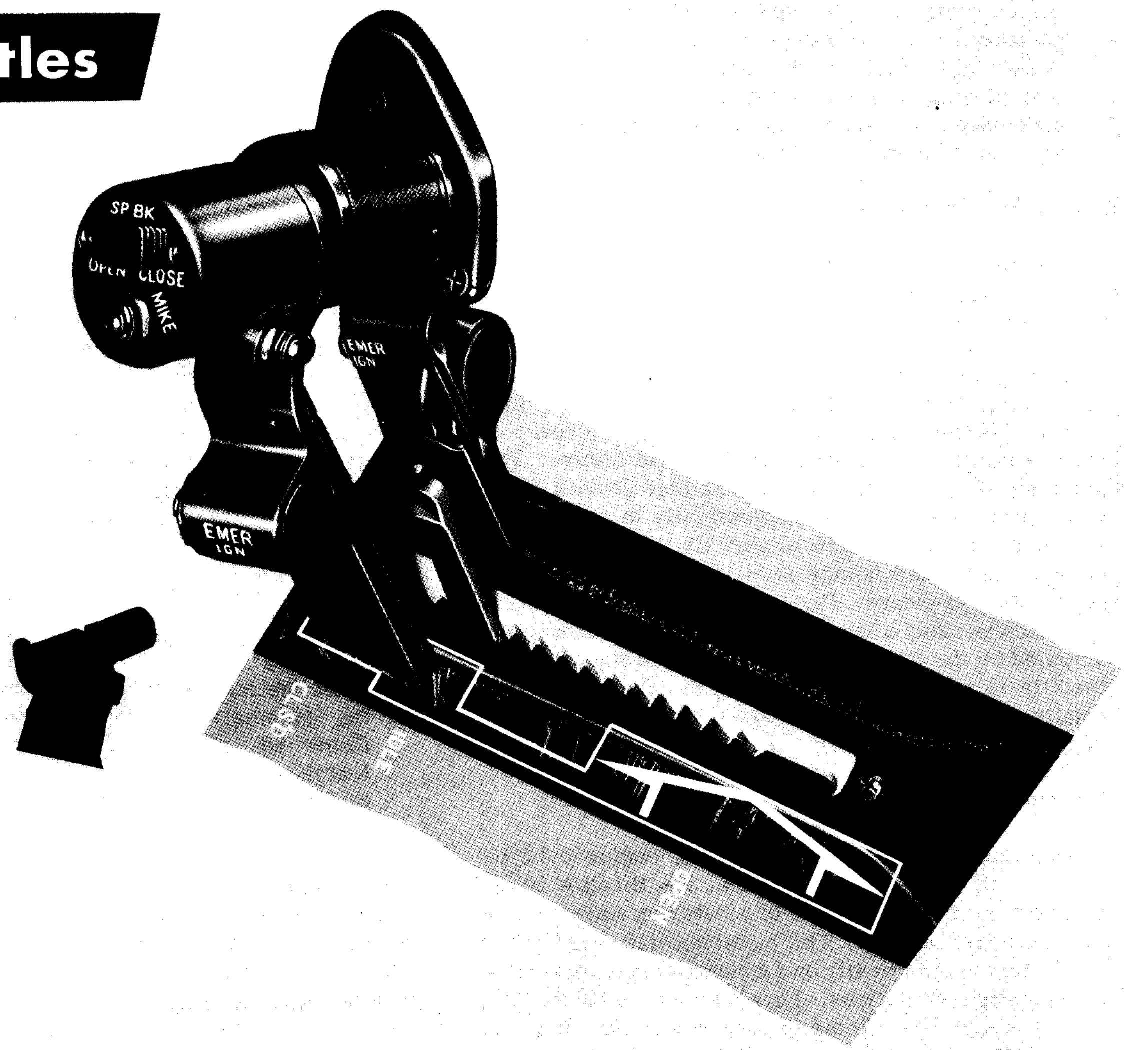

Figure 1-5

on the throttles are the air start ignition buttons (one for each engine on each throttle), speed brake switch, microphone button, and the sight electrical caging button ⓴ on the right throttle. In the ⓴ airplanes, the left hand throttle grip is knurled to provide a gripping surface allowing the rotation of the grip. This rotation manually ranges the gun sight and when in full counterclockwise extreme allows automatic (radar) ranging information to the gun sight. 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 cutoff valve within the engine fuel control system allcwing fuel flow to the engine. It also actuates switches which (with the engine master switch ON) complete the circuit opening the engine fuel shutoff valve, and operate relays which contribute to the continuity of the ignition and afterburner circuits. Further movement to the OPEN position progressively increases thrust output by altering engine fuel control settings. At the OPEN position, the engine should be delivering its rated Military thrust. Afterburning can be initiated, anywhere within the afterburner modulation range (figure 1-5) by moving the throttles outboard; and terminated by moving the throttles inboard. Movement of the throttle from the IDLE position to CLS'D requires the throttle to be moved outboard and retarded. At CLS'D, the cutoff valve in the engine fuel control system is closed, the engine fuel shutoff valve is closed, and electrical continuity to the afterburner and normal ignition circuits is interrupted.

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 operation of the anti-ice valves and contribute to the continuity of the afterburner, ignition system and 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.

CAUTION

To prevent the possibility of cavitation of the main fuel line, do not place the engine master switch in the OFF position until the throttle is in the CLS'D position.

ENGINE FUEL CONTROL SWITCHE

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 emergency fuel control metering in the event normal fuel control metering fails. The fuel control system switch directs 28 volt d-c power to operate a motor-driven

engine control panel

TYPICAL

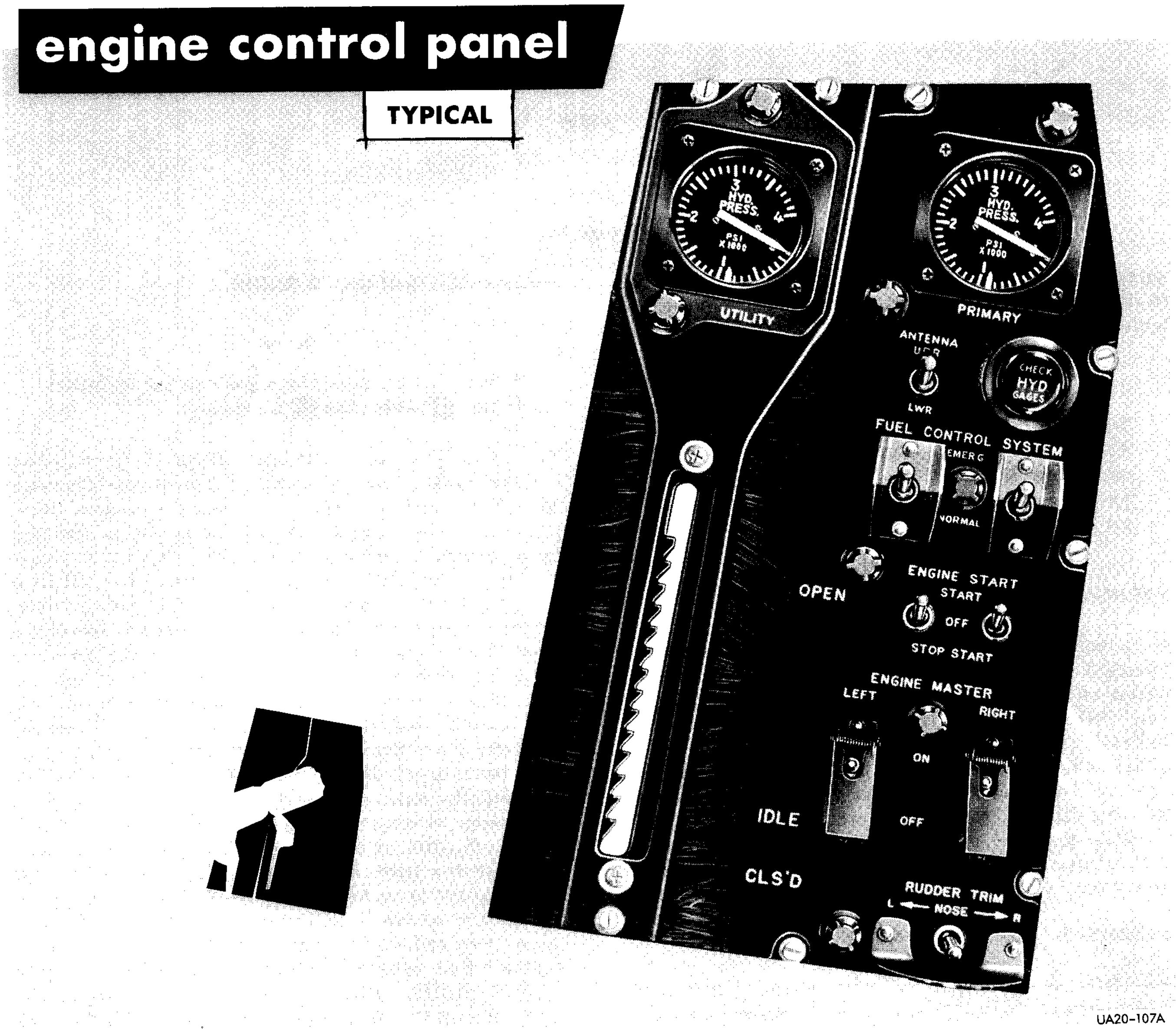

Figure 1-6

engine pressure ratio gages

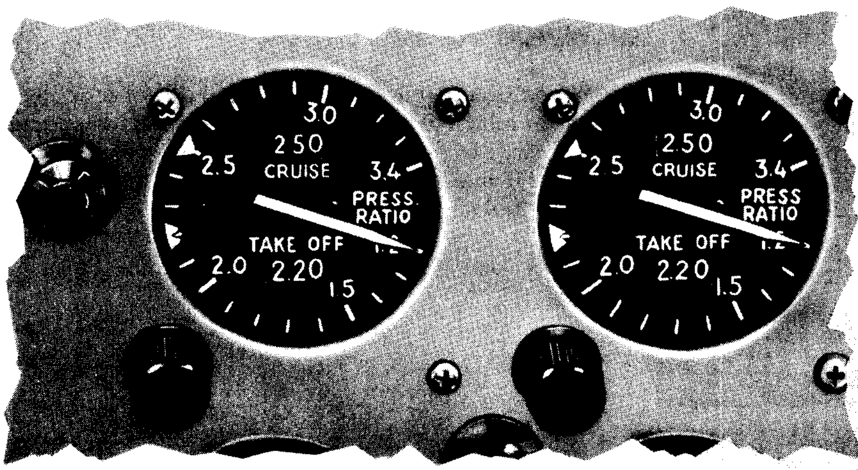

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Figure 1-7

valve and has positions marked NORMAL and EMERG to indicate which fuel control system has been selected.

CAUTION

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

TACHOMETERS

A tachometer (10, 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 (14, figure 1-24) on the instrument panel. Eight self-generating thermocouples, located aft of the turbine, provide current to the indicator which then gives an average reading.

ENGINE PRESSURE RATIO GAGES

Note

Engine pressure ratio gages are not installed in the (1) THRU 53-2425 (5) airplanes.

The engine pressure ratio gages (figure 1-7) located on the instrument panel, present 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 pressures, 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 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 between the double pointers of the take-off index marker to establish a minimum setting as outlined in Appendix I, Performance Data or the Engine Pressure Ratio Gages Setting of the abbreviated check list. 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 normally indicate an overshoot of as much as one tenth up to approximately 5 minutes. However, if an overshoot condition persists, engine limits may be exceeded and thrust 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

Cruise ratio settings will vary due to temperature changes. Proper settings must be determined prior to flight from Appendix I, Performance Data.

OIL PRESSURE GAGES

The oil pressure gages (11, 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 (15, 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. These indicators utilize 28 volt a-c power.

ENGINE STARTER AND IGNITION SYSTEMS

Pneumatic 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 1-45) 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 engine start switch which electrically actuates valves in the air inlet lines. These valves automatically close when engine speed reaches approximately 40 percent rpm, or by placing the engine start switch in the STOP START position if the engines fail 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, have positions marked START, OFF and STOP START, and operate on the 28 volt d-c bus. Momentarily placing the switch to the START position energizes the circuit to open the air valve for the corresponding starter. The circuit will remain energized until the engine speed reaches 40 percent rpm or the switch is placed in the STOP START position. 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 emergency 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 momentarily depressed, with the engine master switch ON and the throttle out of the CLS'D position to get igniter operation. Depressing the switch completes the circuit to supply electrical power from the 24 volt d-c emergency bus for ignition. It is not necessary to hold the emergency ignition button depressed since an automatic timer provides continuity to the ignition circuit 30 seconds after the button is released. Refer to Emergency Electrical System Provisions, this section.

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 moving the throttle outboard from the OPEN position. When the throttle is moved outboard, the electrically operated afterburner shutoff valve, in the engine driven fuel pump unit, 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, normal afterburning can only be terminated by moving the throttle out of the detent. (See Figure 1-5.)

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 afterburner engine operation. During afterburner operation, the nozzle segments are fully open; during normal operation the segments are closed. The nozzle segments are automatically positioned by the exhaust nozzle control unit when the pilot either engages or disengages afterburning. The nozzles will close immediately upon terminating afterburner operation.

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.

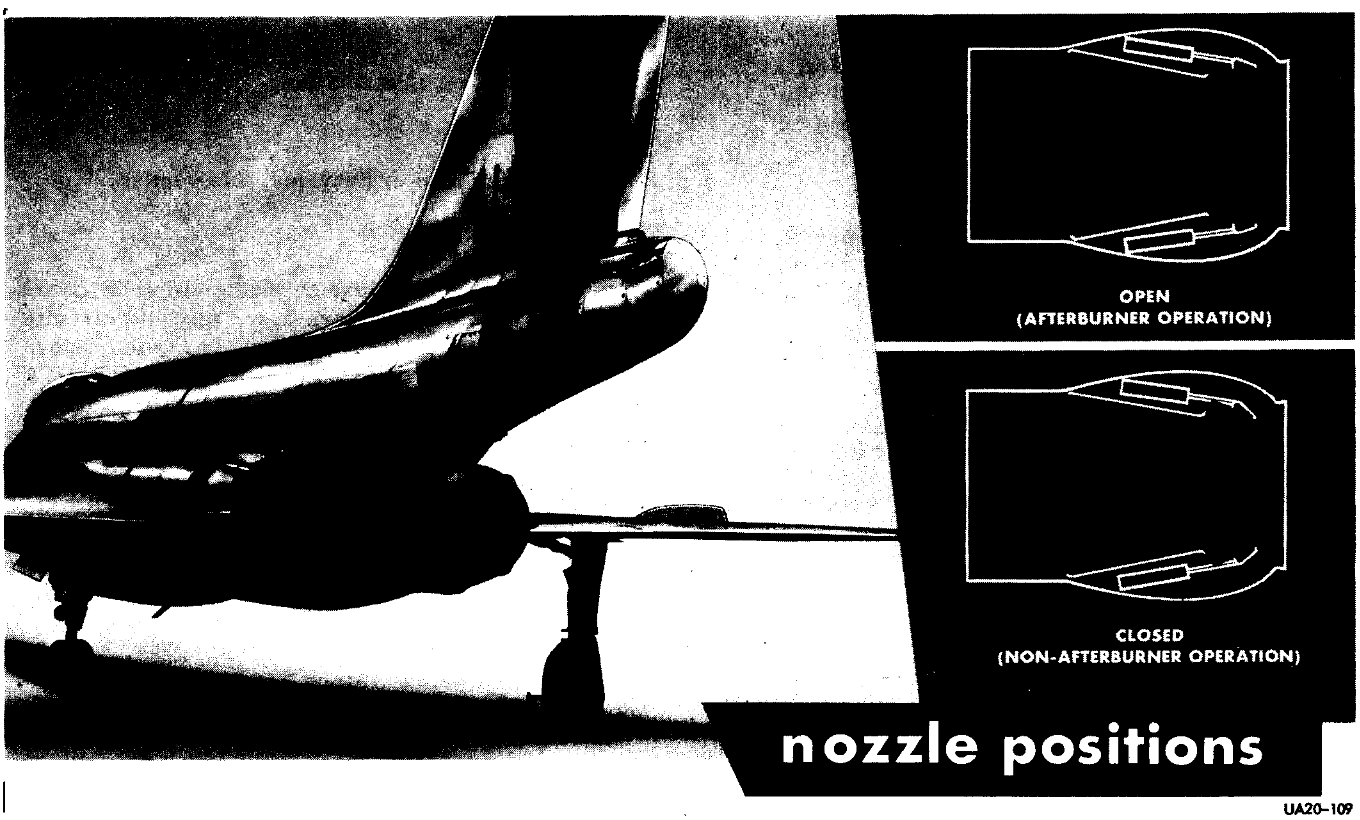


Figure 1-8

AFTERBURNER IGNITION SYSTEM

Afterburner ignition is accomplished by means of a "hot-streak" igniter which 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. Refer to figure 1-4. 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 SYSTEM

Afterburner Fuel Control

Fuel is metered by the afterburner fuel control unit in direct proportion to engine output, as indicated by combustion chamber pressure. Refer to figure 1-4. 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.

CAUTION

Afterburner fuel flow is not affected when the engine fuel control switch is in the EMERG position. However, throttle movement must be cautious with due regard for engine limitations as fuel flow is manually selected and manually controlled by the throttle.

Afterburner Emergency Shutoff Valve

The afterburner system is shut off mechanically in the event the normal electrical control fails. The afterburner emergency shutoff valve (figure 1-4) is mechanically actuated open by the throttle when the throttle is moved out of the afterburner detent and retarded to a position equivalent to 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 shutoff 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 seven 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. Oil flows from the tank to a gear-type pump 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 an air-oil cooler, and if temperatures require, a fuel-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 entirely 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 within 30 minutes after engine shutdown. The engine is properly replenished when oil flows from the overflow line. (See 2, figure 1-45.) There will be an initial overflow upon connecting servicing hose since the overflow line must empty its accumulation.

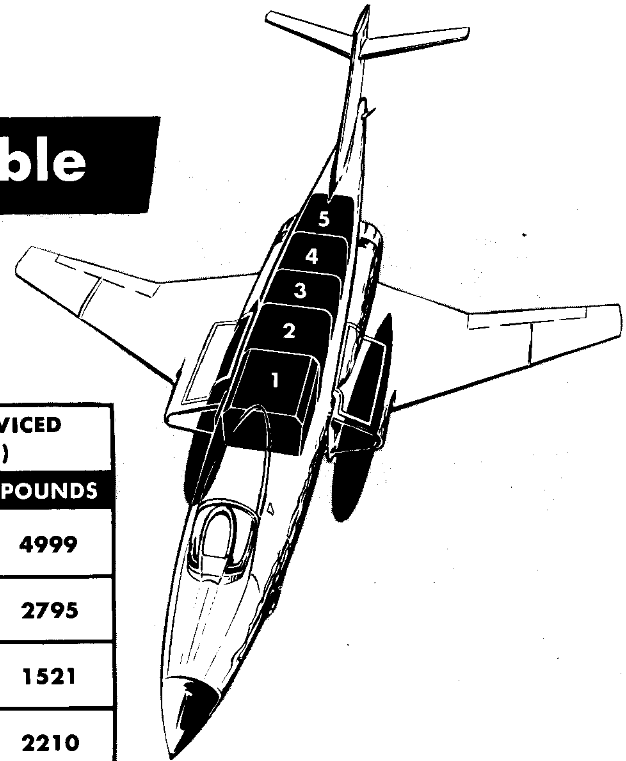
AIRPLANE FUEL SYSTEM

Fuel is carried in five cells, four bladder type and one self-sealing, within the fuselage. See figure 1-10. Provisions are made for carrying external fuel in two 450 gallon droppable external tanks, mounted on the fuselage, in the ❶ THRU ⓴ and ⑳ airplanes. In operation, the external 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.

fuel quantity data table



DATE: 1 MAY 1958
DATA BASIS: FLIGHT TEST

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

NOTE

WEIGHTS ARE BASED ON 6.5 POUNDS PER GALLON FOR STANDARD DAY TEMPERATURE.

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

TOTAL USABLE FUEL WITH EXTERNAL TANKS, 2979 GALLONS (19,364 POUNDS)

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Figure 1-9

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 to 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 1-45.

SINGLE POINT AND AIR REFUELING SYSTEM

Refer to Refueling Systems, Section IV.

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. This system provides an exit for fuel in the event a flow control valve should fail during refueling operations. While the airplane 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 pressure 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. When pressure drops to .5 psi the valve is positioned to the high scarf vent to enter the cells.

FUEL TRANSFER SYSTEM

Fuel Boost and Transfer Pumps

There are two centrifugal type boost 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 thrust 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 boost and transfer pumps are located on the circuit breaker panel. Refer to figure 1-14.

Engine Master Switches

Refer to Engine Master Switches, this section.

Throttles

Refer to Throttles, this section.

Fuel Transfer Switch

The fuel transfer switch (figure 1-14) on the circuit breaker panel provides for a selection of normal or external 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 completes 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 bypass the fuel transfer switch either automatically, (fuselage cell No. 2 reaching a level of 850 lbs.) or manually by placing fuel pumps switch to ALL PUMPS.

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

Fuel Pumps Switch

The fuel pumps switch (figure 1-28) 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 less than 850 pounds of fuel. Placing the switch in the ALL PUMPS position energizes all fuselage transfer pumps regardless of the level of number 2 fuselage cell. The fuel pumps switch utilizes 28 volt d-c electrical power.

Refuel Switch

Refer to Refueling Systems, Section IV.

Boom IFR Switch

Refer to Refueling Systems, Section IV.

FUEL QUANTITY GAGE

The fuel quantity gage (13, figure 1-24) on the instrument panel indicates, in pounds, the fuel in any fuselage cell or the total of all fuselage cells. There are no provisions for an indication of external fuel. The system is electrically operated and requires both 28 volt d-c and 115 volt single-phase a-c.

fuel system

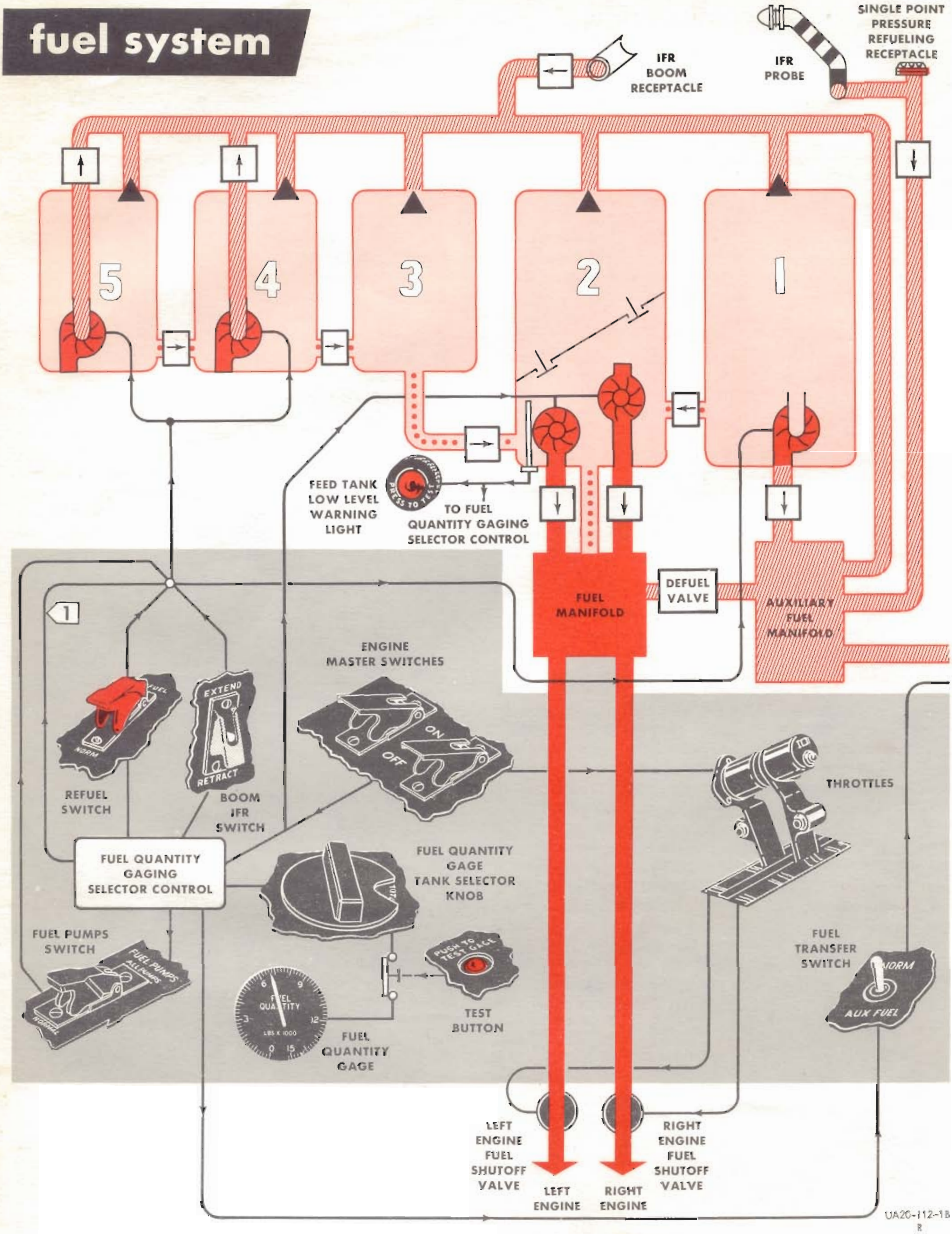
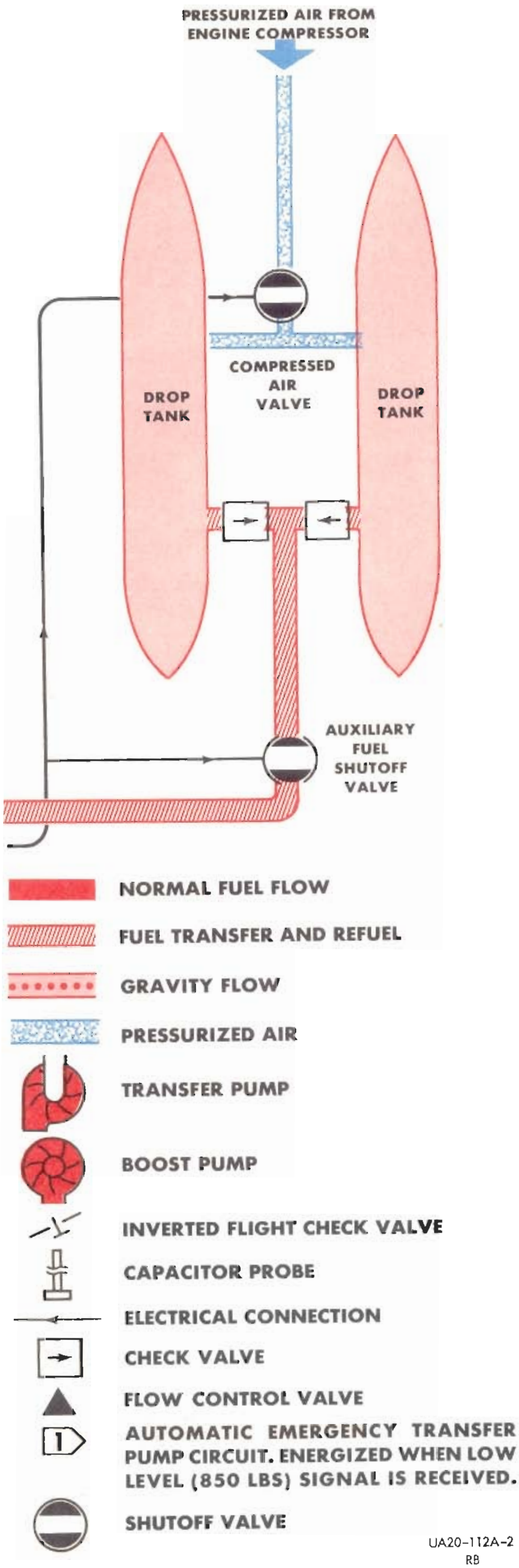


Figure 1-10



Fuel Quantity Gage Tank Selector Knob

A selector knob (figure 1-11) 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 fuselage 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 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 the previous indication.

FEED TANK FUEL LOW WARNING LIGHT

A red light, located above the electrical control panel in the 1 THRU 15 airplanes and on the pedestal panel in the 20, 20 airplanes, illuminates when the quantity of fuel in cell 2 is reduced to 1200 pounds. This indicates low fuel of cell 2 only, and has nothing to do with the amount of fuel in the rest of the system.

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.

BOMBING SYSTEM SELECTOR SWITCH 1 THRU 20

The five-position rotary selector switch (figure 4-36) located on the armament control panel, completes the circuit from the bomb rocket release button to the special store unit. The switch has positions marked OFF, DIRECT, M-1, LABS ALT and LABS NORM. For additional information on bombing systems, refer to Bombing Equipment, Section IV.

SPECIAL STORE AND TANK JETTISON SYSTEM

Bomb-Rocket Release Button 1 THRU 20

The bomb-rocket release button (figure 1-17) located on the control stick, provides a means for jettisoning the special store. Placing the bomb system selector switch (figure 4-36) to the DIRECT position and depressing the bomb-rocket release button completes the circuit from the 28 volt d-c bus to jettison the special store.

Note

The bomb-rocket release button circuit passes through the landing gear handle. Therefore, the landing gear handle must be in the UP position before the special store can be jettisoned by depressing the bomb-rocket release button.

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 store and tank emergency jettison button.

Note

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

Store and Tank Emergency Jettison Button (1) THRU (20)

This red spring-loaded push button (figure 1-20), located on the landing gear control panel, provides a means to jettison all external configurations in one operation. Depressing the button completes the 28 volt d-c circuit to energize the jettison units for the special store and external tanks.

External Tank Emergency Release Handle (1) THRU (20) (20)

This handle (figure 1-28) is located on the vertical panel of the left console in the (1) THRU (15) airplanes and on the vertical panel of the right console in the (20) (20) airplanes. The handle provides a mechanical means of jettisoning external fuel load in event the normal electrical jettison provisions fail. 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 proper position, however, the pilot should assist in guiding the handle in the proper position.

Note

Some airplanes will have a tank jettison switch located on the circuit breaker panel in place of the external tank emergency release handle.

Special Store Emergency Release Handle (1) THRU (20)

This handle (figure 1-28) is located on the vertical panel of the left console in the (1) THRU (15) airplanes and on the vertical panel of the right console in the (20) airplanes. The handle provides a mechanical means of releasing the special store in the event the normal electrical jettison provision fails. The handle is in the shape of a special store to aid in identification. Pulling the handle aft, approximately 7 inches simultaneously releases the special store. The handle is returned to its stored position when released. However, the pilot should assist in guiding the handle in the proper position.

Note

The special store emergency release handle has been removed from some airplanes and the special store may be jettisoned only through the bomb system selector switch or the store and tank emergency jettison button.

fuel quantity gage tank selector panel

UA20-115A

Figure 1-11

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. Generators become operative at approximately 30% engine rpm. Figure 1-12 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 power and supply 28 volt d-c power. 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 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 1-12.

External Electrical Power Receptacle

To provide adequate power for ground operation of electrical equipment, an external power receptacle (8, figure 1-45) 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. The remaining circuit breakers and all a-c fuses in the 1 THRU 20 airplanes are located on the panels in the armament compartment and are inaccessible during flight. All circuit breakers for the camera system in the 20 airplanes are mounted on the aft section of the right console. The remaining circuit breakers and all a-c fuses in the 20 airplanes 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 the system some related warning system, interlocking circuit or cancelling signal, which would result in an undesirable reaction.

Emergency Electrical System Provisions

Any malfunction of the generator or engine underspeed condition, will cause the generator to become disconnected from the electrical 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 flameout, emergency power will be available for accomplishing an airstart. Emergency d-c power from one of three sources will automatically energize the emergency fuel boost pump relays, the emergency start relay, and the emergency ignition system. The emergency d-c power may be supplied by the windmilling a-c generator 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, bypassing 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 1 THRU 15 10

This two-position toggle switch on the vertical panel of the right console (figure 1-15) provides a means of selecting the source of power from the bus system. In the ON GEN position, generator output only is available to the bus; in the ON EXT position, only external power where connected, is furnished the bus.

Power Selector Switch 20 20

The power selector switch (8, figure 1-45), 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 furnishes 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.

Autopilot Gyro Cutoff Switch 20 20

This push-pull circuit breaker type switch (figure 1-40) is located above the external canopy switch in the external power receptacle. The switch is marked PULL TO TEST and when in this position permits the autopilot gyros to remain inoperative when external electrical power is applied. The switch is so arranged that when the external power receptacle door is closed, the switch will be pushed in to complete electrical continuity to the autopilot. This switch is only effective when the power selector switch is in the EXT PWR position. Normal continuity is restored to the autopilot when the power selector switch is in the GEN position.

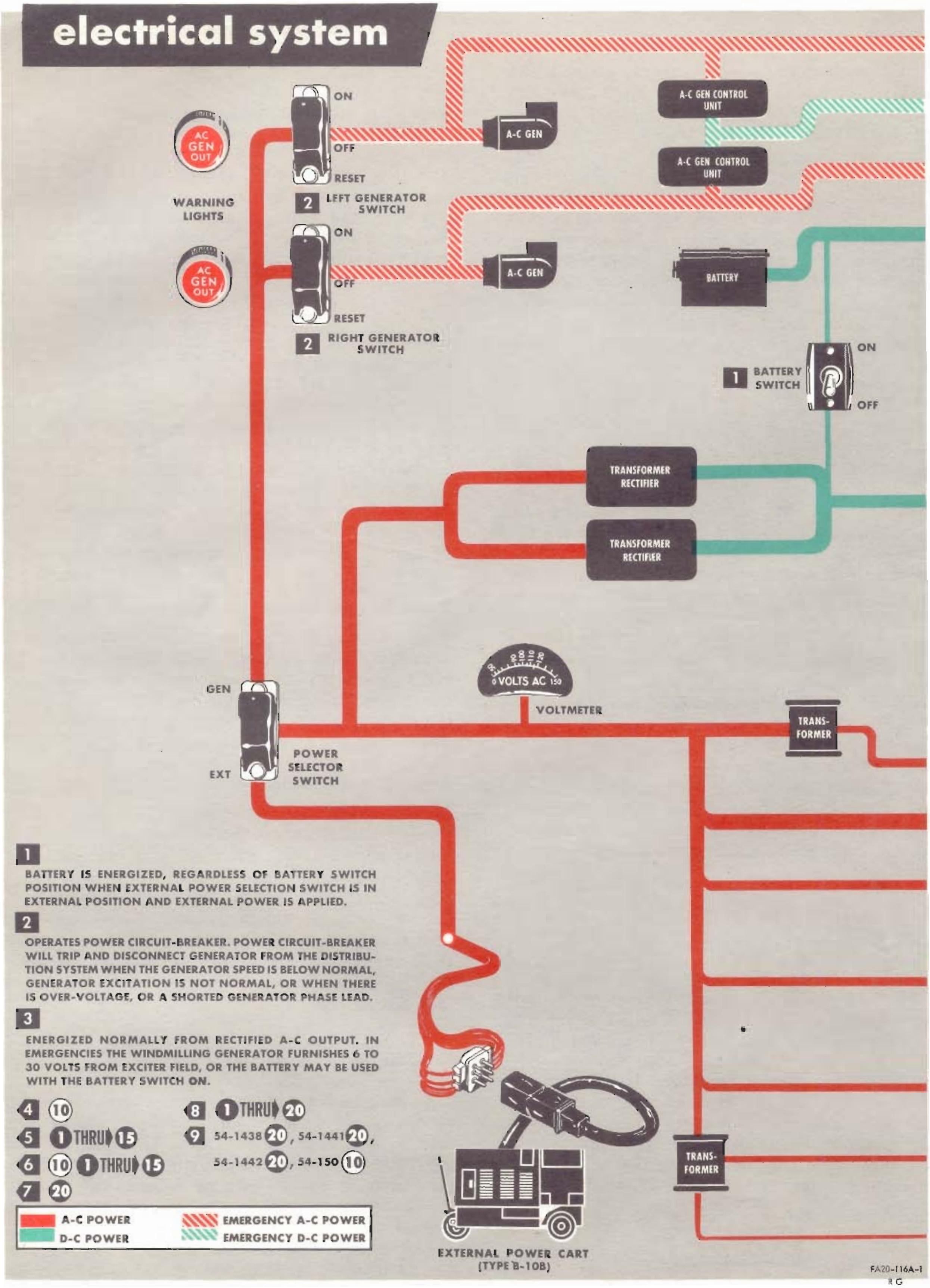
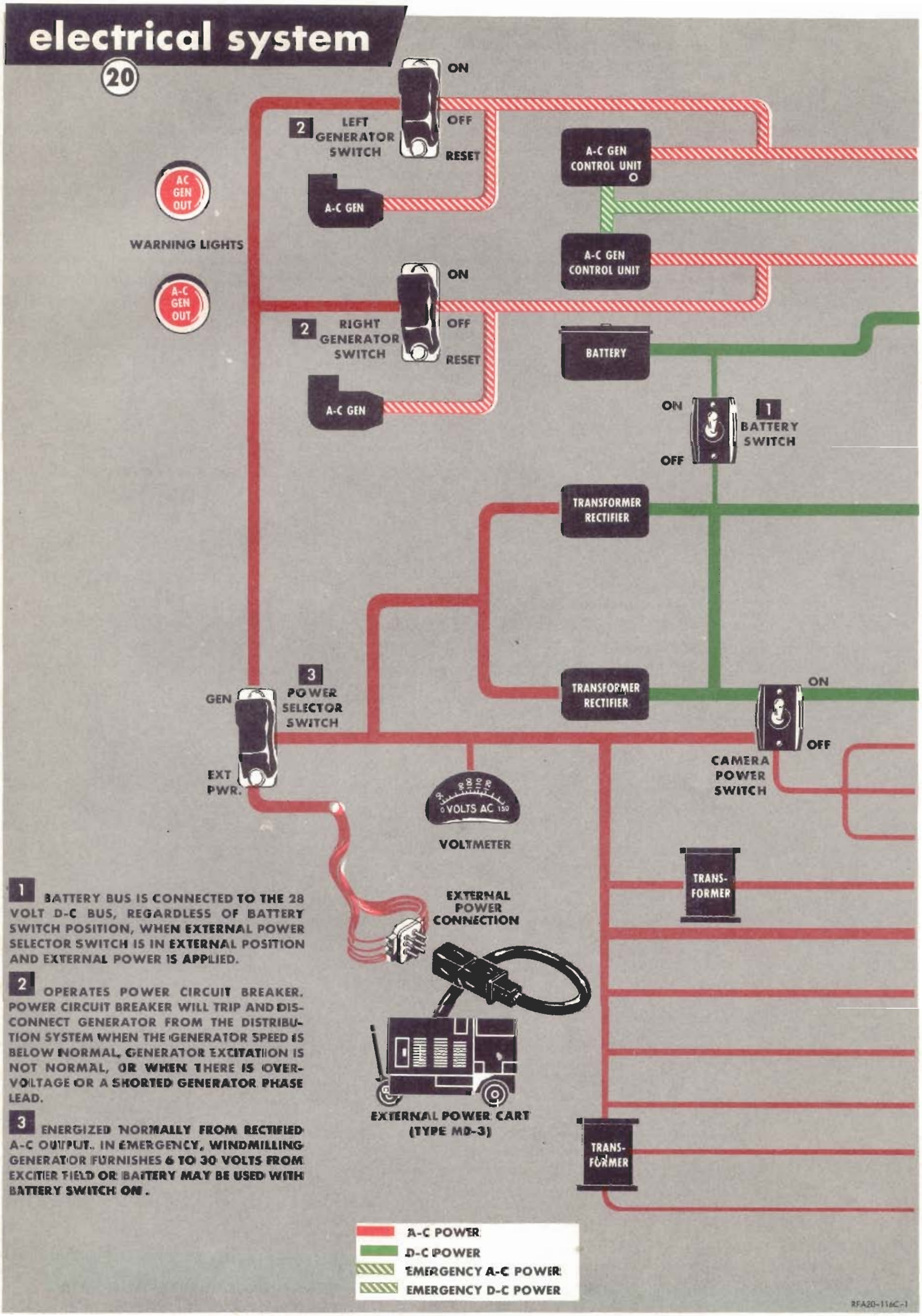

electrical system
AC GEN OUT
AC GEN OUT
WARNING LIGHTS
ON
OFF
RESET
2 LEFT GENERATOR SWITCH
ON
OFF
RESET
2 RIGHT GENERATOR SWITCH
A-C GEN
A-C GEN
A-C GEN CONTROL UNIT
A-C GEN CONTROL UNIT
BATTERY
ON
1 BATTERY SWITCH
OFF
TRANSFORMER RECTIFIER
TRANSFORMER RECTIFIER
VOLTS AC
VOLTMETER
TRANS-FORMER
GEN
EXT
POWER SELECTOR SWITCH
1
BATTERY IS ENERGIZED, REGARDLESS OF BATTERY SWITCH POSITION WHEN EXTERNAL POWER SELECTION SWITCH IS IN EXTERNAL POSITION AND EXTERNAL POWER IS APPLIED.
2
OPERATES POWER CIRCUIT-BREAKER. POWER CIRCUIT-BREAKER WILL TRIP AND DISCONNECT GENERATOR FROM THE DISTRIBUTION SYSTEM WHEN THE GENERATOR SPEED IS BELOW NORMAL, GENERATOR EXCITATION IS NOT NORMAL, OR WHEN THERE IS OVER-VOLTAGE, OR A SHORTED GENERATOR PHASE LEAD.
3
ENERGIZED NORMALLY FROM RECTIFIED A-C OUTPUT. IN EMERGENCIES THE WINDMILLING GENERATOR FURNISHES 6 TO 30 VOLTS FROM EXCITER FIELD, OR THE BATTERY MAY BE USED WITH THE BATTERY SWITCH ON.
4 10
5 1 THRU 15
6 10 1 THRU 15
7 20
8 1 THRU 20
9 54-1438 20, 54-1441 20, 54-1442 20, 54-150 10
A-C POWER
D-C POWER
EMERGENCY A-C POWER
EMERGENCY D-C POWER
TRANS-FORMER
EXTERNAL POWER CART (TYPE B-10B)
FA20-116A-1
RG

Figure 1-12

200V A-C (LEFT) EMERGENCY BUS	FUEL BOOST PUMP (INVERTED FLIGHT) *(ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED WITH ENGINES WINDMILLING)*		
24V D-C EMERGENCY BUS [3]	EMERGENCY BOOST PUMP CONTROL IGNITION *(ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED WITH ENGINES WINDMILLING)*		
200V A-C (RIGHT) EMERGENCY BUS	FUEL BOOST PUMP *(ENERGIZED WHEN BOTH GENERATOR CIRCUIT BREAKERS ARE TRIPPED WITH ENGINES WINDMILLING)*		
BATTERY BUS	AR PILOT VALVE TEST CANOPY POWER EXTERNAL POWER INTERLOCK	FUEL SHUTOFF (LEFT) FUEL SHUTOFF (RIGHT) [6] IFF RADAR DESTRUCTOR	[6] MAIN JUNCTION BOX POWER [6] MASTER CAMERA CONTROL [6] SPEED BRAKE RETRACT
28V D-C BUS	[7] A-C EXTERNAL POWER & LOAD BANK [7] A-C GENERATOR CONTROL (LEFT) [7] A-C GENERATOR CONTROL (RIGHT) AN/AIC-10 (INTERPHONE) [4] AN/APN-22 [7] AN/APX-25 (IFF) AN/ARC-34 (UHF COMMAND) AN/ARN-14 AN/ASN-6 (GPI) [9] ANTI-SKID BRAKES [8] A/S POWER (SPECIAL STORE CIRCUIT) ATTITUDE INDICATOR AUTOPILOT BOMB SYSTEM [5] BOOST PUMP (AFT) (FORWARD) CABIN PRESSURE [4] CAMERA COMPARTMENT LIGHTS [4] CAMERA COMPARTMENT TEMPERATURE INDICATOR [4] CAMERA AND EMERGENCY DOOR [4] CAMERA ELEVATOR [7] CAMERA (N-9) [4] CAMERA WINDOW HEAT CONTROL [4] CANOPY POWER (PRIMARY) [8] DRIFT COMPUTER [4] EJECTOR READY [7] EMERGENCY LANDING GEAR CONTROL [6] ENGINE ANTI-ICE (POWER & CONTROL) [7] ENGINE ANTI-ICE POWER ENGINE CONTROL ENGINE OVERHEAT TEST	ENGINE POWER (LEFT) ENGINE POWER (RIGHT) EXTERIOR LIGHTS CONTROL [8] F-POWER (SPECIAL STORE CIRCUIT) FACE MASK HEAT [8] FIN POWER (SPECIAL STORE CIRCUIT) FLAP CONTROL FLAP POSITION INDICATOR [4] FORWARD CAMERA [7] FUEL BOOST PUMP (INVERTED FLIGHT) [7] FUEL BOOST PUMP (FORWARD) FUEL QUANTITY [6] FUEL SHUTOFF FUEL TRANSFER CONTROL FUEL VENT [5] GUN CAMERA [8] GUNSIGHT [8] GUN GAS DOOR [8] GUN POWER [6] IFF RADAR (AN/APX-6) [8] IFI (SPECIAL STORE CIRCUIT) [7] IFR RECEIVER POWER IGNITION INSTRUMENT LIGHTS (SECONDARY) [7] (J-4) DIRECTIONAL INDICATING SYS [8] JETTISON STORE & TANK LANDING GEAR POSITION INDICATOR LANDING LIGHTS CONTROL [4] MAIN JUNCTION BOX POWER [4] MASTER CAMERA CONTROL NOSE GEAR STEERING	[6] OXYGEN [7] PITCH-UP WARNING SYSTEM PROBE EXTEND [8] RADAR (MA-7) [6] RUDER FEEL TRIM AND FLAPS [7] RUDDER FEEL TRIM [7] RUDDER TRIM [4] SALVO [4] SCAVENGER PULSE [6] SLAVED GYRO DIRECTIONAL SEAT ADJUST SPEED BRAKES SPEEDBRAKE EMERG. RETRACT [4] SPLIT CAMERA (LEFT) (RIGHT) STABILIZER & AIL. FEEL & TRIM [8] STRIKE CAMERA [8] STORES TEST POWER [5] T-23 POWER [7] TAKE-OFF TRIM CONTROL [4] TRI-CAMERA (LEFT) (RIGHT) [4] TRI-CAMERA (VERTICAL PULSE) TURN & SLIP INDICATOR [7] UHF POWER [7] UTILITY LIGHT WARNING LIGHTS [7] WINDSHIELD BLOWER CONT. WINDSHIELD HEATING
115V THREE-PHASE A-C BUS	ATTITUDE INDICATOR [7] (J-4) DIRECTIONAL INDICATING SYSTEM	[6] SLAVED GYRO DIRECTIONAL	
200V THREE-PHASE A-C BUS	[4] CAMERA WINDOW HEATING FUEL BOOST PUMPS	FUEL TRANSFER PUMPS [8] GUN POWER TRANSFORMER RECTIFIER	[8] RADAR (MA-7)
115V SINGLE-PHASE A-C BUS (T-3)	AIRSPEED AND MACH INDICATOR ENGINE OVERHEAT [4] FORWARD CAMERA	INSTRUMENT LIGHTS (PRIMARY) [8] STORES POWER [4] TRI-CAMERA VERTICAL	[4] VIEWFINDER [7] WINDSHIELD BLOWER
115V SINGLE-PHASE A-C BUS (T-2)	[7] AN/APX-25 (IFF) AN/ASN-6 (GPI) AUTOPILOT [7] (J-4) DIRECTIONAL INDICATING SYSTEM [8] DRIFT COMPUTER [4] [7] ENGINE PRESSURE RATIO (LEFT) [4] [7] ENGINE PRESSURE RATIO (RIGHT)	FUEL QUANTITY [8] GUNSIGHT [6] IFF RADAR PITOT HEATER [7] PUSHER POWER [6] SLAVED GYRO DIRECTIONAL CAMERA [8] STRIKE CAMERA TIMER	[4] TRI-CAMERA (LEFT) [4] TRI-CAMERA (RIGHT)
115V SINGLE-PHASE A-C BUS (T-1)	[7] AN/APS-54 (RADAR WARNING) [4] APN-22 RADAR ALTIMETER [8] BOMB SYSTEM CONSOLE FLOODS	CONSOLE LIGHTS [7] FEEL TRIM INLET DE-ICING [7] GUNSIGHT [7] HORN POWER	[7] LANDING LIGHTS [4] MAIN JUNCTION BOX (CAMERA) [4] SPLIT CAMERA (RIGHT) [4] SPLIT CAMERA (LEFT)
14V A-C BUS	EXTERIOR LIGHTS POWER WARNING LIGHTS POWER		
28V A-C BUS	[7] (J-4) DIRECTIONAL INDICATING SYSTEM 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)	LANDING LIGHTS SEXTANT LIGHTS WARNING LIGHTS POWER

FA20-116A-2
R G

electrical system



1 BATTERY BUS IS CONNECTED TO THE 28 VOLT D-C BUS, REGARDLESS OF BATTERY SWITCH POSITION, WHEN EXTERNAL POWER SELECTOR SWITCH IS IN EXTERNAL POSITION AND EXTERNAL POWER IS APPLIED.

2 OPERATES POWER CIRCUIT BREAKER. POWER CIRCUIT BREAKER WILL TRIP AND DISCONNECT GENERATOR FROM THE DISTRIBUTION SYSTEM WHEN THE GENERATOR SPEED IS BELOW NORMAL, GENERATOR EXCITATION IS NOT NORMAL, OR WHEN THERE IS OVERVOLTAGE OR A SHORTED GENERATOR PHASE LEAD.

3 ENERGIZED NORMALLY FROM RECTIFIED A-C OUTPUT. IN EMERGENCY, WINDMILLING GENERATOR FURNISHES 6 TO 30 VOLTS FROM EXCITER FIELD OR BATTERY MAY BE USED WITH BATTERY SWITCH ON.

Figure 1-13

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	AR CONTROL AR PILOT VALVE TEST CAMERA ELEVATOR CANOPY POWER (PRIMARY) EXTERNAL POWER INTERLOCK FUEL SHUTOFF (LEFT) FUEL SHUTOFF (RIGHT) WING REFUEL
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 (GPI) AN/APX-25 (IFF) AR RECEIVER POWER ATTITUDE INDICATOR AUTOPILOT AUXILIARY FUEL CONTROL AUXILIARY FUEL FULL INDICATOR BOOST PUMP CONTROL (FORWARD) BOOST PUMP CONTROL (AFT) 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 HORN 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
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
115V THREE-PHASE A-C BUS	ATTITUDE INDICATOR (J-4) DIRECTIONAL INDICATOR SLAVED GYRO DIRECTIONAL
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/APX-25 (IFF) AN/ASN-6 AUTOPILOT DIRECTIONAL INDICATOR (J-4) DRIFT COMPUTER ENGINE PRESSURE RATIO (LEFT) ENGINE PRESSURE RATIO (RIGHT) FUEL QUANTITY POWER PITOT HEATER
115V SINGLE-PHASE A-C BUS (T-1)	AN/APS-54 (RADAR WARNING) AN/APN-22 CONSOLE FLOODS CONSOLE LIGHTS LANDING LIGHTS POWER TRIM INLET DE-ICING WINDSHIELD HEATER
14V A-C BUS	EXTERIOR LIGHTS POWER WARNING LIGHTS POWER
28V 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) LANDING LIGHTS SEXTANT LIGHTS WARNING LIGHTS POWER

circuit breaker panel

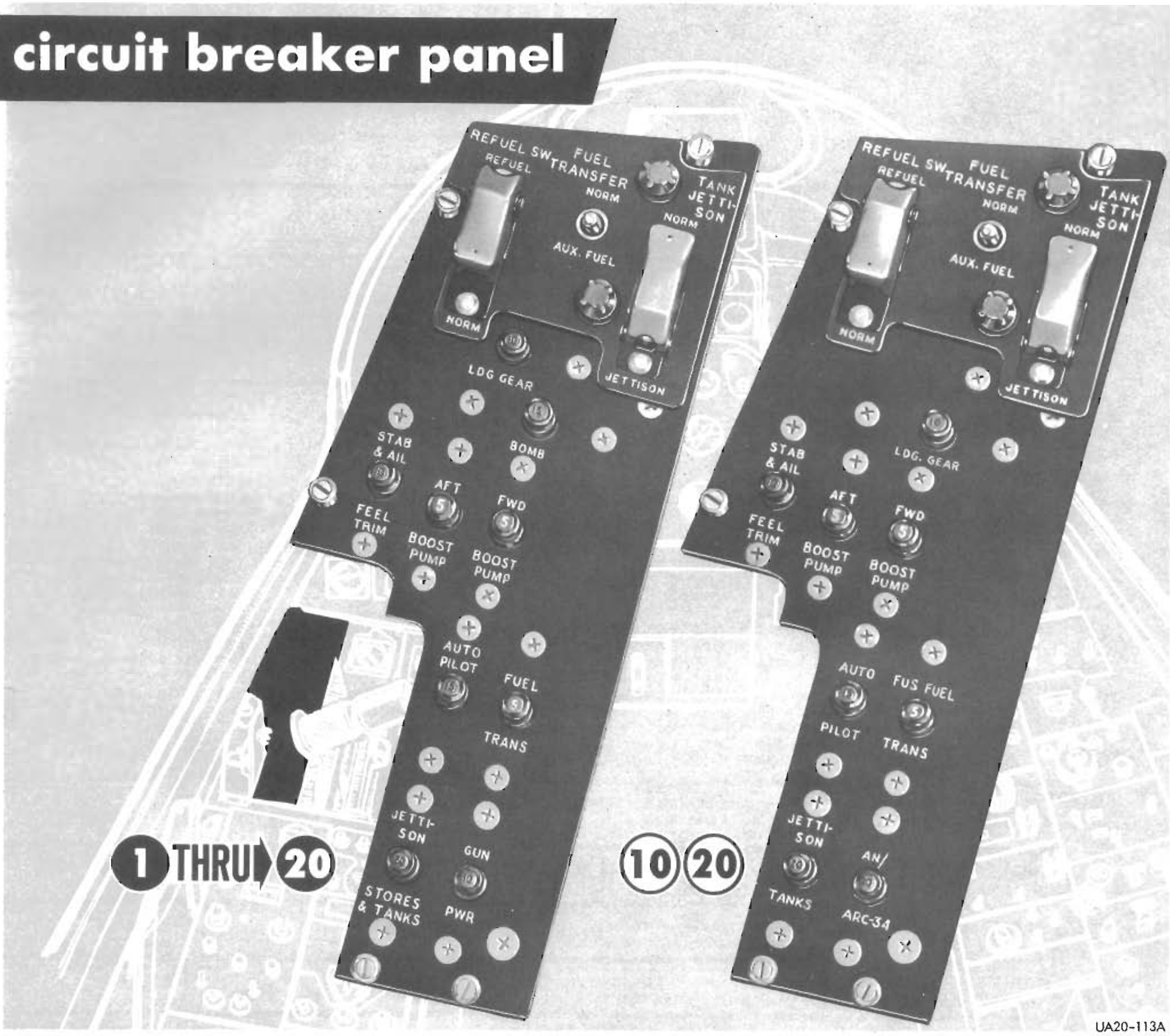


Figure 1-14

Generator Switches

Two 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 placing the switch to RESET, then returning it to ON.

Battery Switch

This two-position toggle switch (figure 1-15) is located on the electrical control panel. In the ON position and with no a-c power supplied to 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 supplied, the 28 volt d-c bus and the battery bus will be supplied by external power. With the switch in the 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 1-12.

Voltmeter

The 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 ex-

electrical control panel

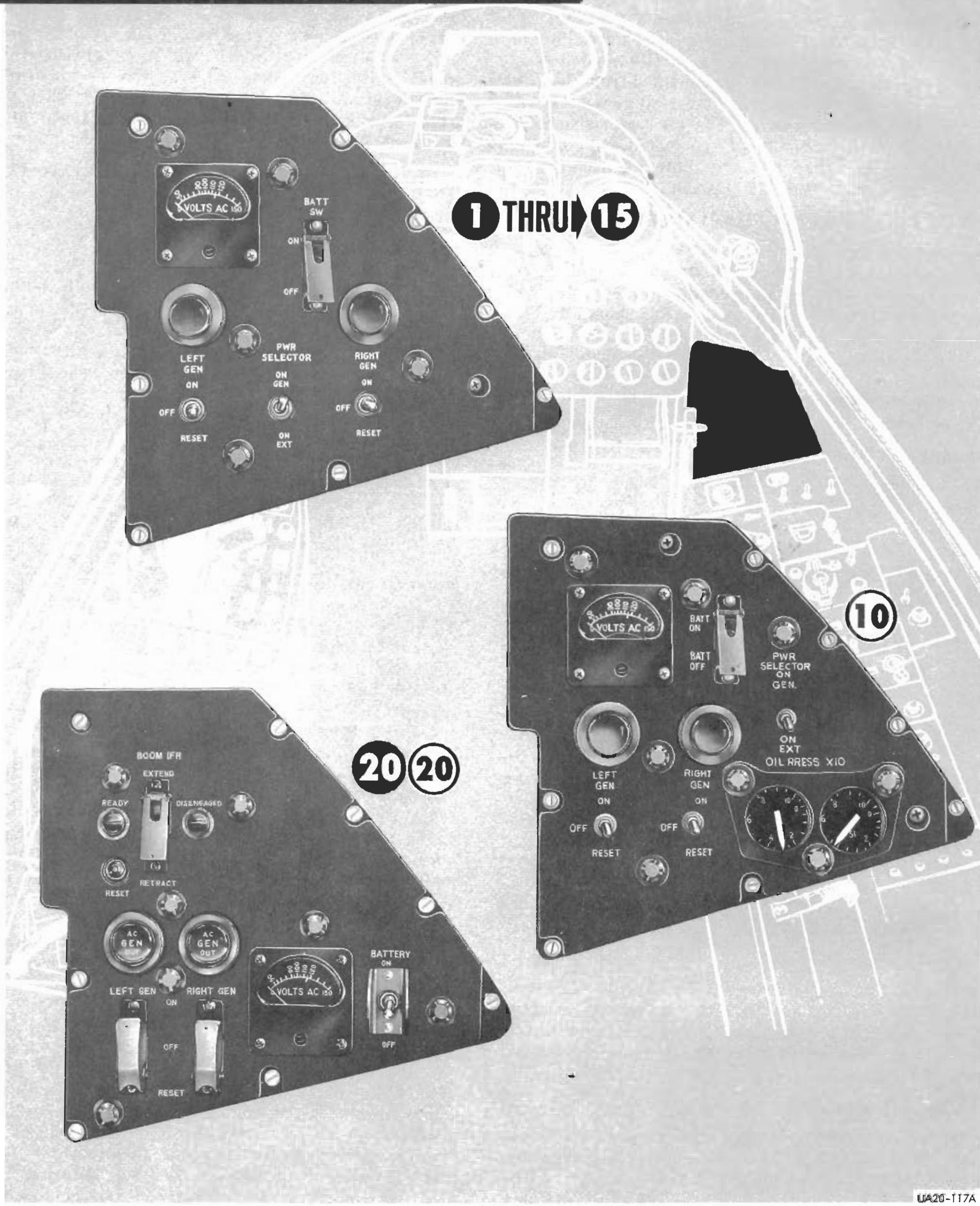


Figure 1-15

ternal 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 (figure 1-15) for each generator, 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 SYSTEM

Hydraulic power is supplied by two completely separate systems; a primary system and a utility system. Each system has an operating pressure of 3000 psi. Each system has two pumps, one pump driven by the right engine and one pump 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 1-16.

PRIMARY SYSTEM

The primary system is utilized to supply hydraulic pressure for power control of the ailerons and horizontal stabilizer. After incorporation of T.O. 1F-101-823, in the 54-1495 (20) and 54-1496 (20) airplanes, the nose gear steering system will obtain its operating pressure from the primary hydraulic system. Refer to figure 1-16.

UTILITY SYSTEM

The utility hydraulic system supplies power to the rudder (yaw damper), pusher actuator, wheel brakes, nose gear steering (in some airplanes), IFR probe, gun gas doors in the (1) THRU (20), flaps, landing gear, speed brakes and power for one section of the aileron and horizontal stabilator tandem power cylinder. 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). Utility hydraulic system failure results in partial (yaw damper) loss of autopilot operation. Refer to figure 1-16.

Hydraulic Pressure Gages

Two 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 Light

This red warning light (figures 1-28 and 1-36), 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 1-16.

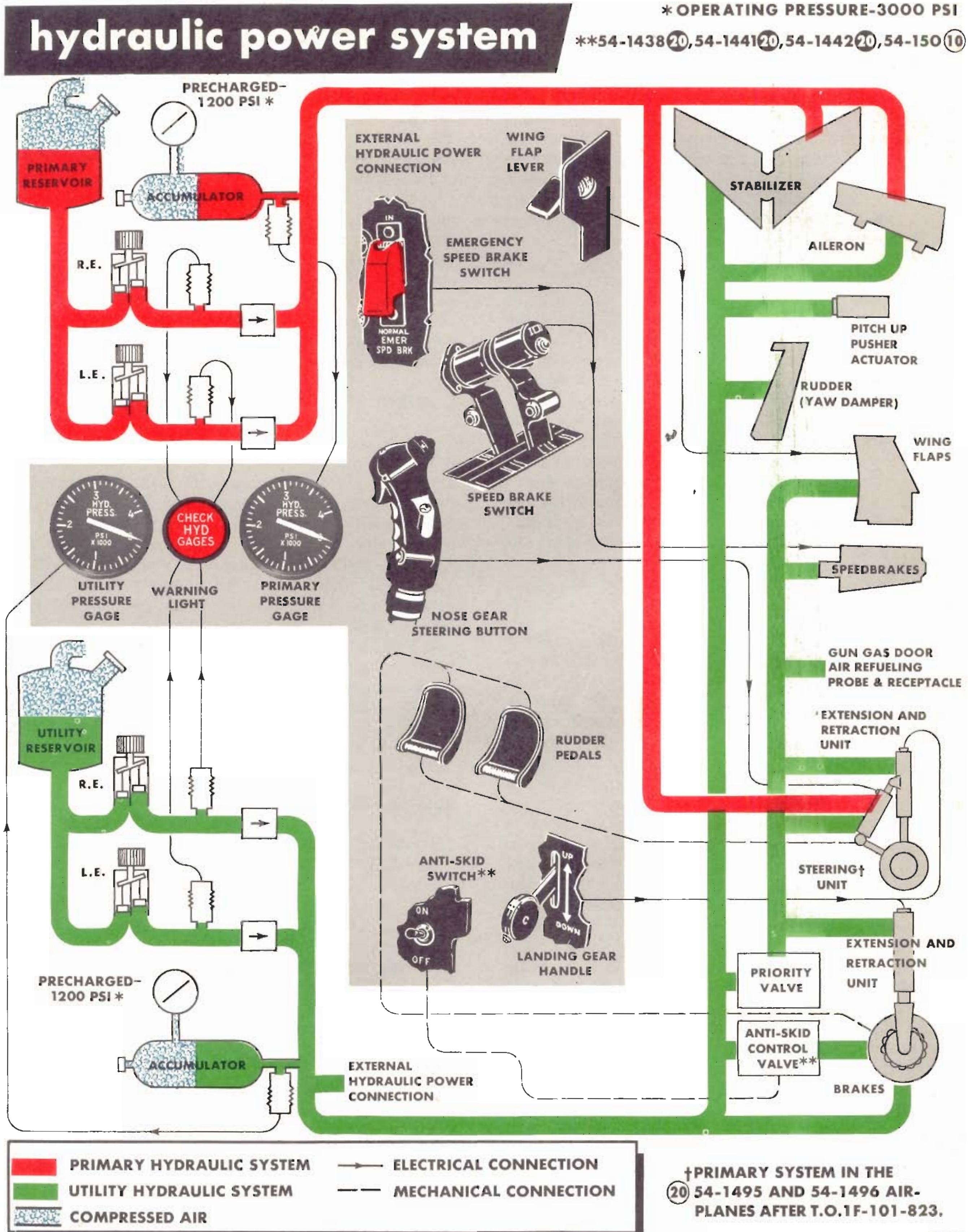
ARTIFICIAL FEEL AND TRIM SYSTEM

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 can 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 features tend 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 approximate centerline of the airplane just forward of the speed brake 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. The ram air intake duct contains a molded type thermostatically controlled heater to prevent icing of the duct and subsequent loss of stabilizer feel. The heater utilizes 115 volt a-c electrical power that is available to the heater whenever a-c power is supplied to the airplane. 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, 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 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 bob-weight is also installed on the stick which will in-

hydraulic power system



†PRIMARY SYSTEM IN THE (20) 54-1495 AND 54-1496 AIRPLANES AFTER T.O.1F-101-823.

Figure 1-16

crease stick forces with an increase in "g" load. Horizontal stabilizer trim is accomplished through the use of the same mechanisms which provide artificial "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 the lateral and longitudinal trim switch located on the control stick grip (see figure 1-7), or by the take-off trim button on the landing gear control panel (see figure 1-20).

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 lateral and longitudinal trim switch located on the control stick or by the take-off trim button on the landing gear control panel. See figures 1-17 and 1-20.

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 engine control panel (figure 1-6) or by the take-off trim button on the landing gear control panel (figure 1-20).

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 4-15) located on the autopilot control panel. The system operates when the yaw damper switch is ON or when the autopilot is operating. Signals from the yaw rate gyro to the servo amplifier actuate the rudder servo to correct yaw oscillations when the system is engaged. The rudder servo is connected to the rudder pedals by 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 operations. The yaw damper system uses utility hydraulic power, 115 volt single phase a-c power and 28 volt d-c electrical power and is protected by the autopilot circuit breaker.

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 1-17) integral with the control stick incorporates the lateral and longitudinal trim switch, gun trigger switch and bomb-rocket release button ❶THRU⑳, air refueling release button, camera operate switch⑩⑳, nose gear steering and alternate microphone button, autopilot, pitch-up pusher and anti-skid release switch. The anti-skid release switch will only be incorporated in some airplanes.

RUDDER PEDALS

Conventional hanging-type rudder pedals, mechanically linked to hydraulic control valves at the rudder actuator, provides 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 applies wheel brakes. Refer to Wheel Brake System, this section. With nose gear steering system engaged, 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 1-17) 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; 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 1-6), located on the engine control panel, 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 1-20), 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.

TAKE-OFF TRIM LIGHT

A green indicator light (figures 1-20 and 1-36) 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 (1) THRU (15) (10) and (20) airplanes, the light will remain illuminated until the landing gear handle is placed in the UP position or until one of the control systems is re-trimmed. In the (20) 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 4-15), on the function selection (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

control stick grip

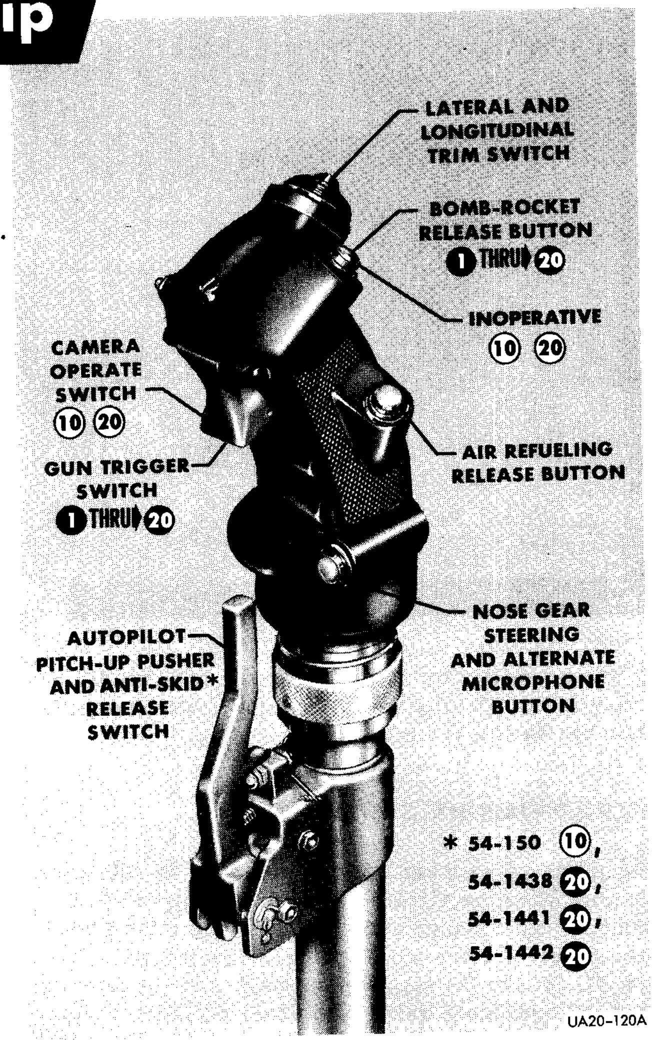
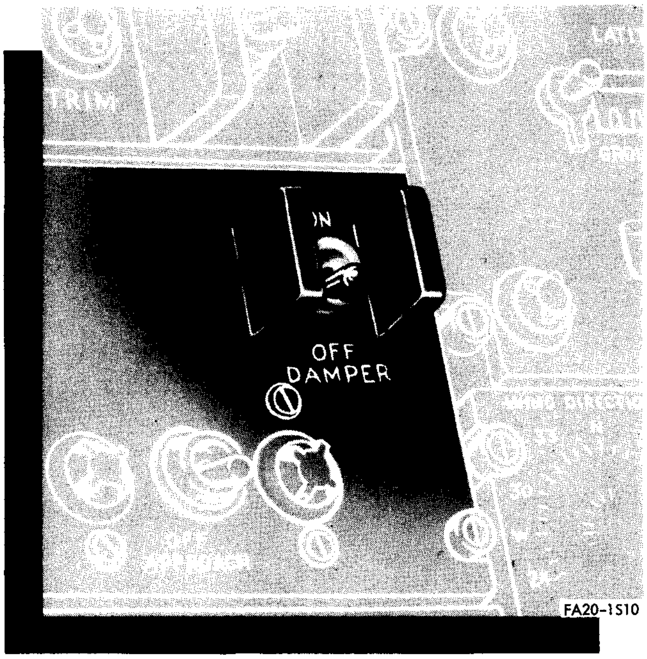


Figure 1-17



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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 a steady 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 forces. 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 all the sensing devices in each system and actuates the headset audible tone and the stick pusher actuator. One channel in the 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 1-18) is located outboard of the left console. Power for the system is 115 volt a-c and 28 volt d-c.

Pusher Switch

The pusher switch (figure 1-18), 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 airplane. 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 a malfunction.

Horn Switch

The horn switch (figure 1-18), 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 airplane. 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 1-18) marked "TEST" 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 1-17) 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 Light

An amber light (figure 1-36) marked "Pitch-Up Warning Out", located above and toward the left 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 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 permit the flaps to move aft as well as down when they are extended by the flap actuators. 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. The flaps will tend to remain down if utility hydraulic pressure is lost when the flaps are in the full down position. 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 LEVER

The two-position wing flap lever (figure 1-19) located on the left console has positions marked 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 1-20) 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.

Figure 1-18

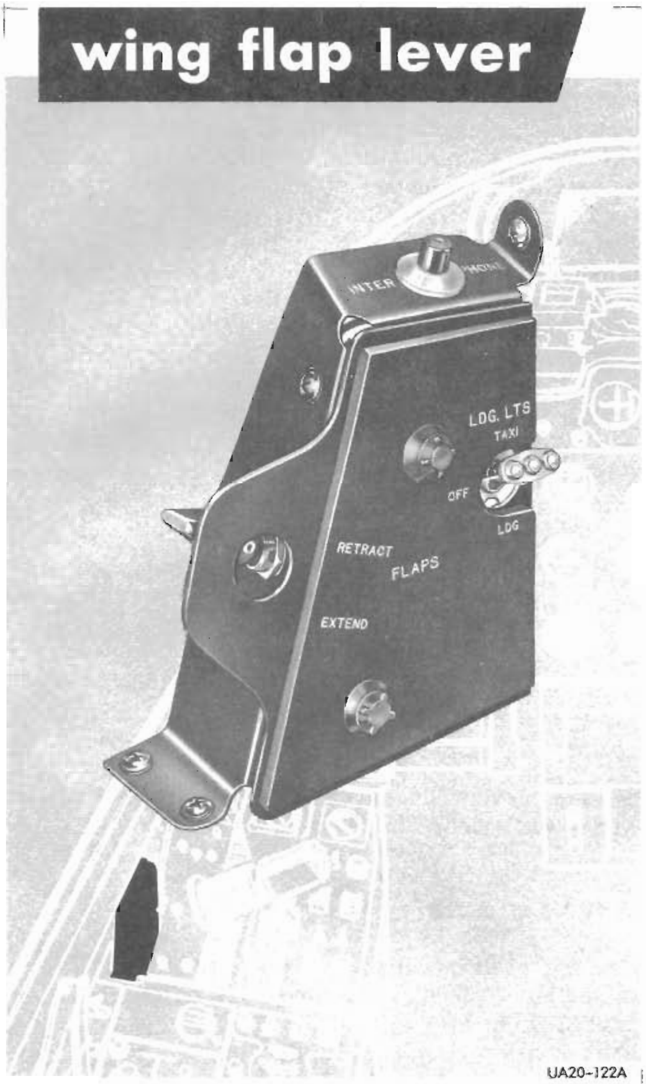


Figure 1-19

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 BRAKE SWITCH

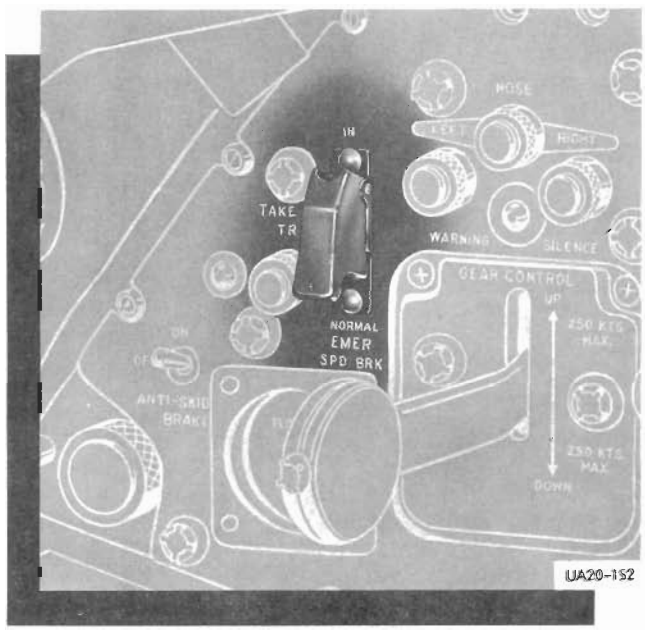
A serrated toggle switch (figure 1-5) located on the right throttle grip controls the speed brake hydraulic control valve to position the speed brakes. This switch, powered by the 28 volt d-c bus, has three fixed positions: OPEN, CLOSE and a neutral position. Any degree of speed brake deflection can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

EMERGENCY SPEED BRAKE SWITCH

This switch (figure 1-20) 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 the use of the emergency switch, air loads will not completely close the panels.

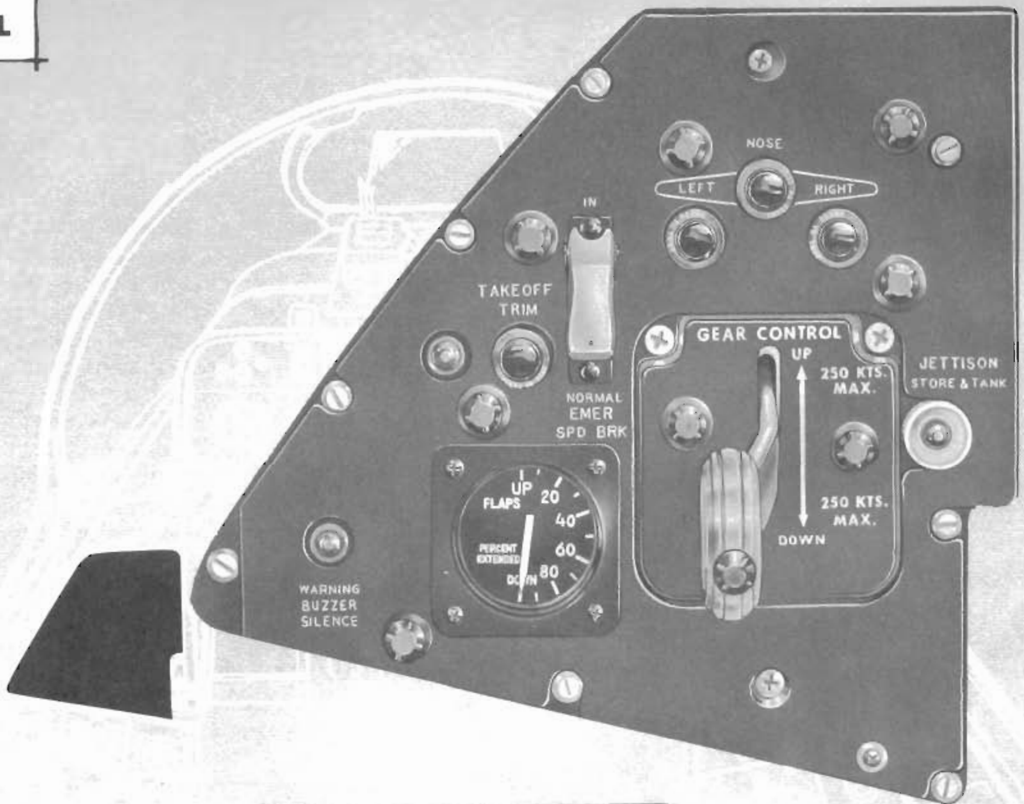


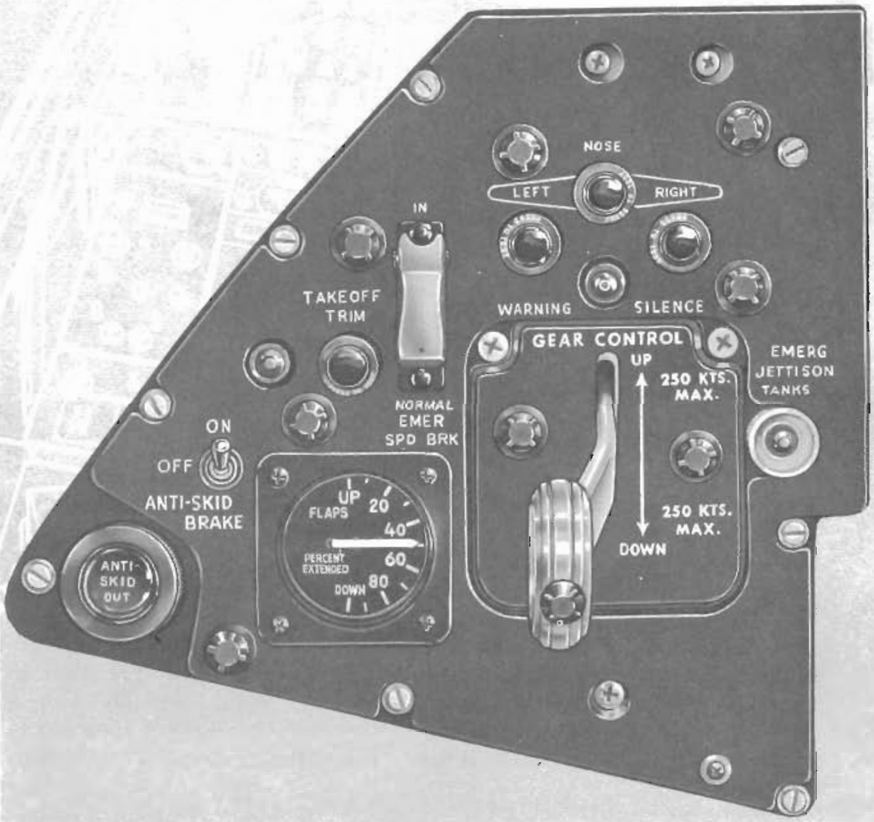
LANDING GEAR SYSTEM

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 re-

landing gear control panel

TYPICAL





54-150 (10),
54-1438 (20),
54-1441 (20),
54-1442 (20)

Figure 1-20

landing gear ground locks

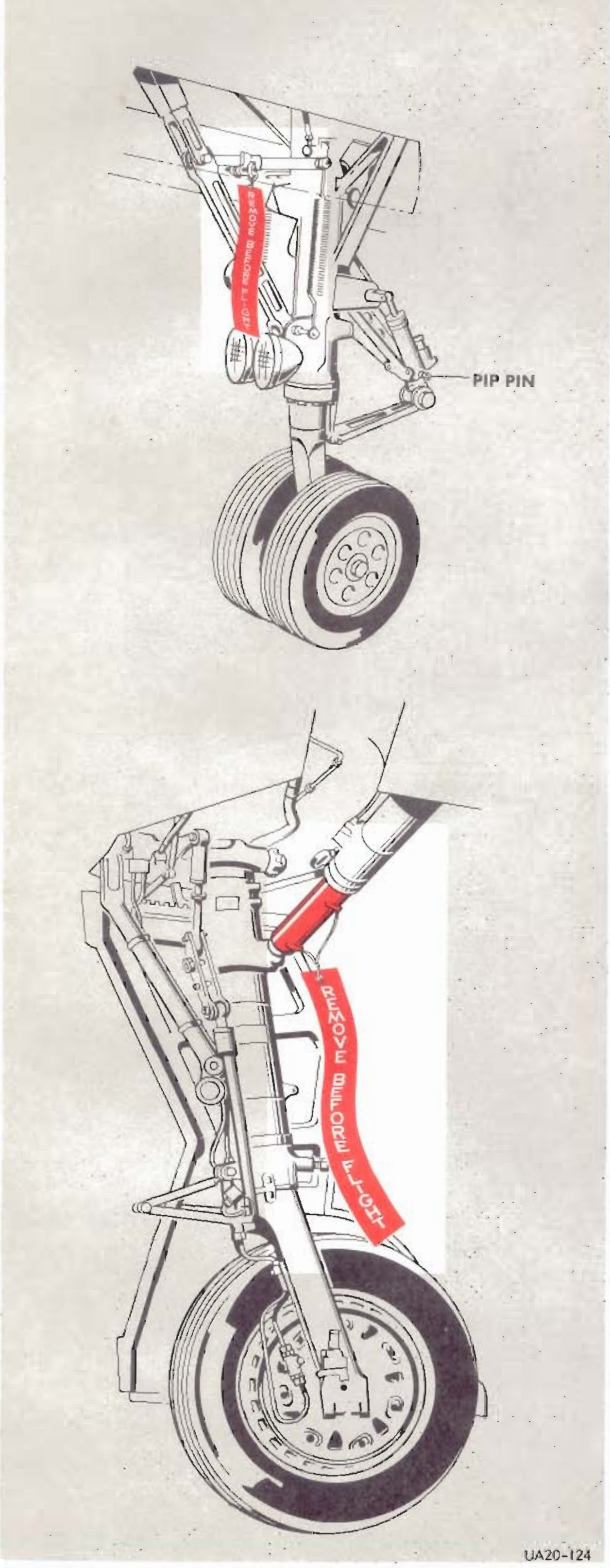


Figure 1-21

tracts 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 surrounding surfaces. The doors operate automatically with the landing gear and in the case of the main wheel doors, the operation is hydraulic. The nose wheel doors are closed through mechanical linkage. The doors remain open when the landing gear is extended. The main landing gear inboard doors will automatically open whenever hydraulic pressure and external electrical power is applied or during the starting cycle. The gear is mechanically locked in both the retracted and extended positions. In the (20)(20) airplanes, as an additional downlock feature, utility hydraulic pressure is applied to the landing gear when in the extended position. Landing gear extension for both normal and emergency 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.

LANDING GEAR SHOCK STRUTS

The main landing gear shock struts are 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. 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 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 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. The landing gear ground locks should not be removed prior to starting at least one engine. Hydraulic pressure to the downside of the landing gear actuator will not be available prior to starting engines and there is the possibility that the landing gear could collapse. See figure 1-21.

LANDING GEAR HANDLE

Normal operation of the landing gear is accomplished by means of the landing gear handle (figure 1-20) located on the landing gear control panel. This two-position handle, with positions marked 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. When the landing gear is up and locked, limit switches disengage the solenoids relieving the system of pressure. When the landing gear is extended and locked, limit switches hold the solenoids engaged and pressure is available at all times. 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. A 35 pound force on the handle will override the latch mechanism. This permits emergency gear retraction on the ground in those instances when necessary.

WARNING

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

LANDING GEAR EMERGENCY HANDLE

This handle (figure 1-29) is located on the vertical panel of the right console in the 1 THRU 15 (10) airplanes, and on the vertical panel of the left console in the 20 (20) airplanes. The handle is mechanically connected to a compressed air bottle discharge valve. When the handle is pulled to its full travel (approximate 3 3/4 inches) air is directed to the gear down side of the actuating cylinder, extending the gear. The hydraulic oil on the up side of the actuating cylinder is dumped overboard. 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. 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

Individual red indicator lights (figures 1-36, 1-37, 1-38, and 1-39) 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 down, the lights will remain illuminated until the wheels are down and locked. These lights are operated on 28 volt d-c and are dimmed and tested by the warning light test and dimmer buttons on the right console.

LANDING GEAR WARNING LIGHTS

The warning light on the landing gear handle requires 28 volt d-c power for operation. It is illuminated at any of the following circumstances:

1. Gear handle position does not correspond to gear position.
2. Nose gear unsafe.
3. Any main gear unsafe.
4. Main gear doors unlocked.
5. Flaps down - Gear up. - Either or both throttles retarded below 92% rpm.

LANDING GEAR WARNING BUZZER AND SILENCER

At any time during flight when the landing gear position does not coincide with the selected position of the landing gear handle or the throttles are retarded past Military thrust with the flaps down and the landing gear retracted, an intermittent buzzer tone will be audible in the headset. The warning

emergency pneumatic system

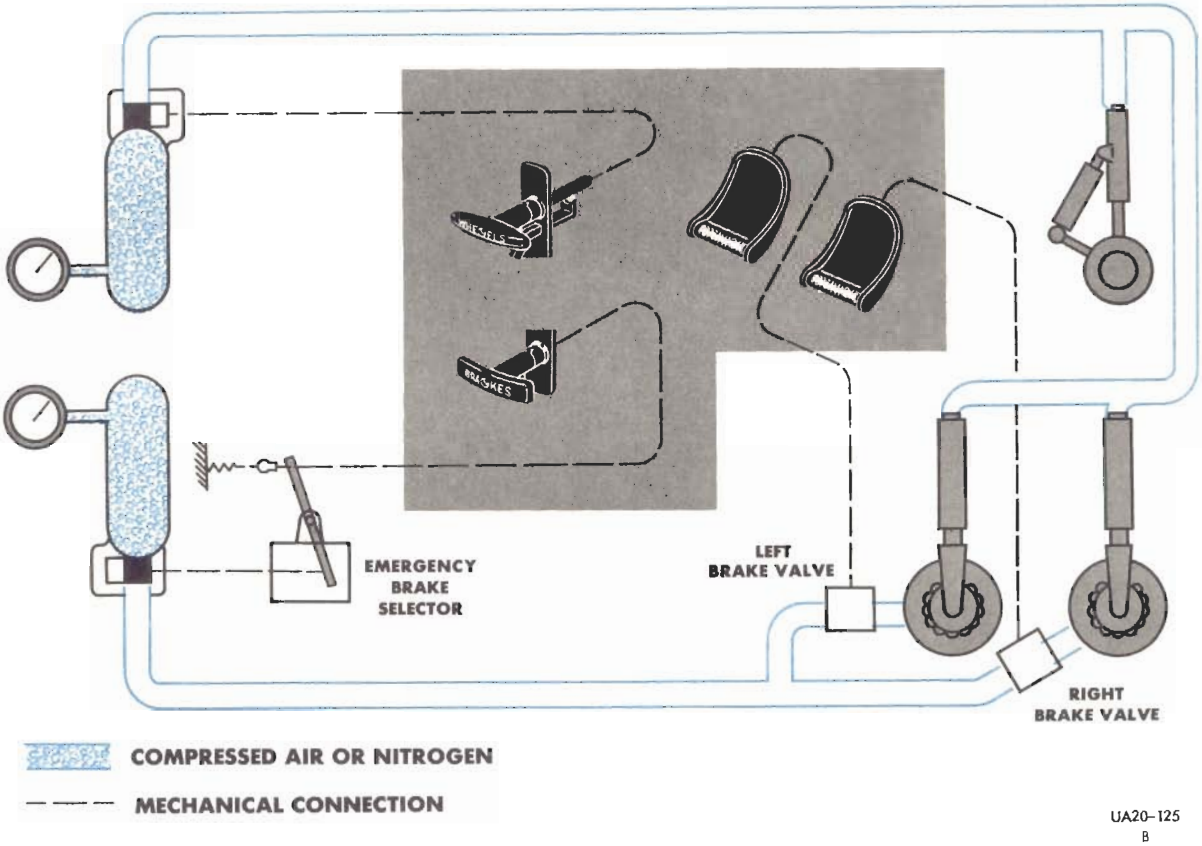


Figure 1-22

buzzer will not sound as throttles are retarded when both gear and flaps are up. 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 1-20) on the landing gear control panel, serves to silence the warning buzzer. The buzzer will remain silenced until the landing gear has been extended or retracted, the flaps have been extended or retracted, or a throttle has been advanced past 92% rpm and retarded. Actuation of any of these will again sound the warning buzzer. The landing gear warning light should be used as the primary warning device to determine a gear safe or unsafe 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. After incorporation of T.O. 1F-101-823, in the 54-1495 (20) and 54-1496 (20) airplanes, the nose gear steering system will obtain its operating pressure from the primary hydraulic system. Depressing and releasing the button will engage nose gear steering. When the button is depressed the second time, steering will still be engaged. However, when the button is released, steering will be disengaged.

Note

After incorporation of T.O. 1F-101-823, nose gear steering will be available at all times when the nose gear steering button is held depressed.

In the (1) through (20), (10) and 54-1494 (20), 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 airplane is off the nose gear (strut extended) or when the gear is retracted. The nose gear steering unit further serves as a shimmy damper.

Note

In some 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.

WHEEL BRAKE ANTI-SKID SYSTEM 54-1438 (20), 54-1441 (20), 54-1442 (20), 54-150 (10)

An electrically controlled anti-skid system is incorporated in the wheel brake system to prevent wheel skid and shorten the landing roll. The system detects the start of a skid condition or a near locked condition of the wheels and releases the break pressure when this occurs. Use of the anti-skid system, offers protection from skids when the normal braking technique is used, provides consistently shorter landing distances on dry runways, and gives some protection on wet or icy runways. The electrical system consists of an arming switch which is utilized to energize the system, an "out" light that illuminates when the system is inoperative, and a fail-safe circuit that automatically reverts the brake system to normal in the event the anti-skid system releases the brakes for an excessive period of time. A disengage switch is provided on the control stick to disarm the anti-skid system in the event of a malfunction. A skid detector unit mounted in each main gear senses the rate of change of wheel speed as well as rotation of the wheel. These detectors supply electrical signals to the system control unit, which controls the anti-skid control valves in the brake lines. The control valves direct the flow of hydraulic pressure applied by pressure on the brake pedal to the wheel brakes or return lines. If either wheel starts to skid after the brakes are applied, the detector sends a "skid" signal to the control unit. The control unit, in response to this signal, opens the anti-skid control valves to release the brakes and prevent additional pressure from reaching the brakes. As the skid condition is corrected by the automatic break release, the anti-skid control valves close and allow metered pressure to reach the brakes. The anti-skid system maintains this automatic skid control cycling of the brakes as long as the brakes are applied and skid conditions prevail. If either brake is released by the system for a continuous period of 3 seconds, the control box automatically shuts off the system and normal braking technique is necessary.

CAUTION

It is possible to land the airplane with the wheels locked. Care must be exercised to avoid applying brake pressure just prior to touchdown.

Anti-Skid Switch

This two-position toggle switch is located on the landing gear control panel. When the switch is ON, 28 volt d-c electrical power is available to the anti-skid system. The anti-skid system is shut off by placing the switch to OFF. The normal braking technique, as described in Section VII, should be used regardless of the switch position.

Anti-Skid Out Light

The amber light marked "Anti-Skid Out", is located on the landing gear control panel. This light will illuminate when the anti-skid switch is OFF or when the system is inoperative. The light utilizes 28 volt a-c electrical power.

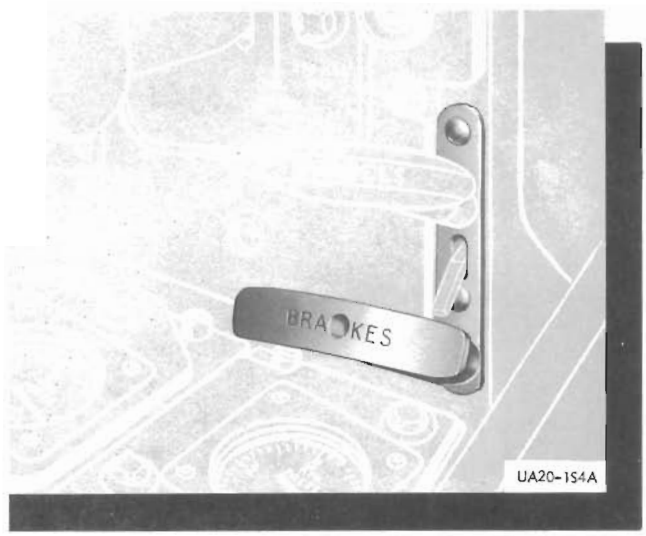
Anti-Skid Release Switch

The anti-skid release switch is located on the control stick. This switch is provided to disengage the anti-skid system during the landing roll if a malfunction occurs or is suspected in the system. The switch must be held depressed to disengage the anti-skid system. Normal braking will be immediately available when the switch is depressed but the anti-skid "inoperative" light will not illuminate for approximately 3-1/2 seconds. The switch utilizes 28 volt d-c electrical power.

CAUTION

If a system malfunction is suspected or the anti-skid out light illuminates during the landing roll, the brakes should be released before the release switch is actuated to prevent skidding when the system is disengaged.

EMERGENCY BRAKE HANDLE



This handle (figures 1-29 and 1-33) is located on the vertical panel of the right console in the (1) THRU (15)(10) airplanes and on the vertical panel of the left console in the (20)(20) airplanes. An emergency air bottle (figure 1-22) charged to 3000 psi can be discharged by the pilot to provide braking in the event that normal braking fails. The bottle, located on the forward wall of the nose wheel well, can be discharged by pulling the emergency brake handle. Pulling the handle approximately 5 inches 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 1-22.

CAUTION

Taxiing should not be attempted with normal brake system failure, since the emergency system 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. The drag chute is normally deployed for each landing, and is considered a servicing item. See figure 1-45.

DRAG CHUTE HANDLE

The ratchet-type drag chute handle (figures 1-28 and 1-30) 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 bottom of the nose section. The heating element of the tube is operated by the pitot heat switch (figure 4-2) 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 K-19 sight pressure transmitter and the M-1 bombing system; 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 by power from the electrical system. See figure 1-12. 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.
- There is no outside air temperature gage installed in the airplane.

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

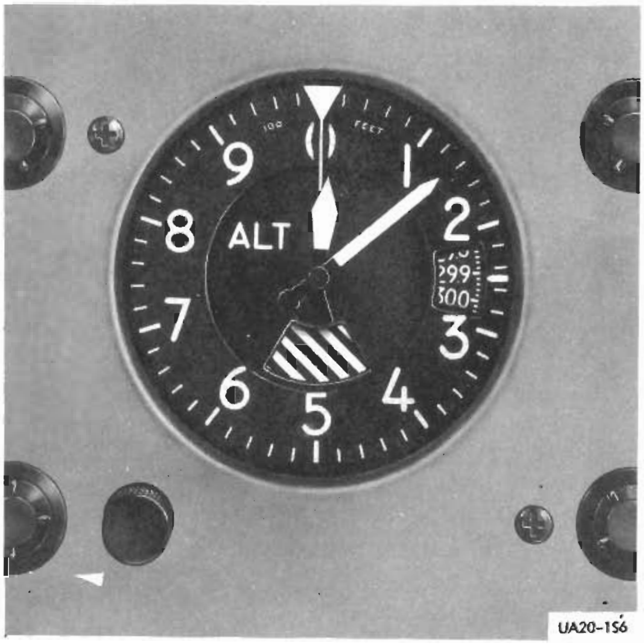


Figure 1-23

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.

VERTICAL VELOCITY INDICATOR

A conventional vertical velocity indicator (18, 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 (22, 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.

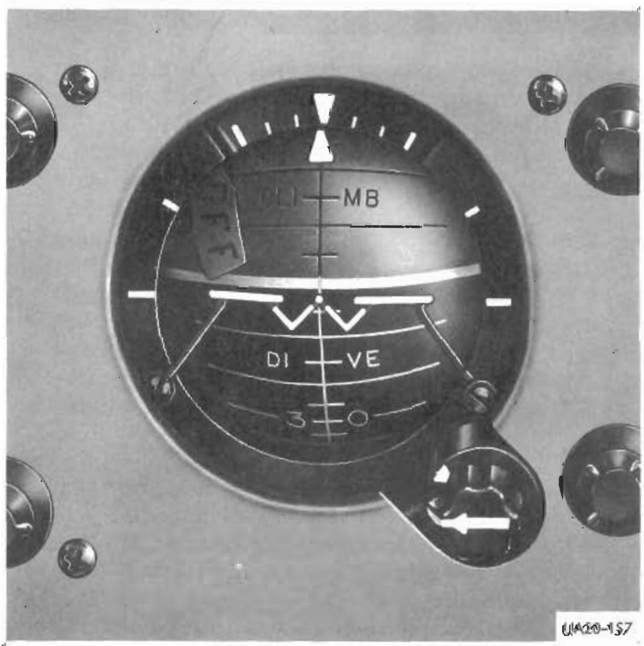
Mach Number

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 insure 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 a temperature bulb and 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.

ATTITUDE INDICATOR

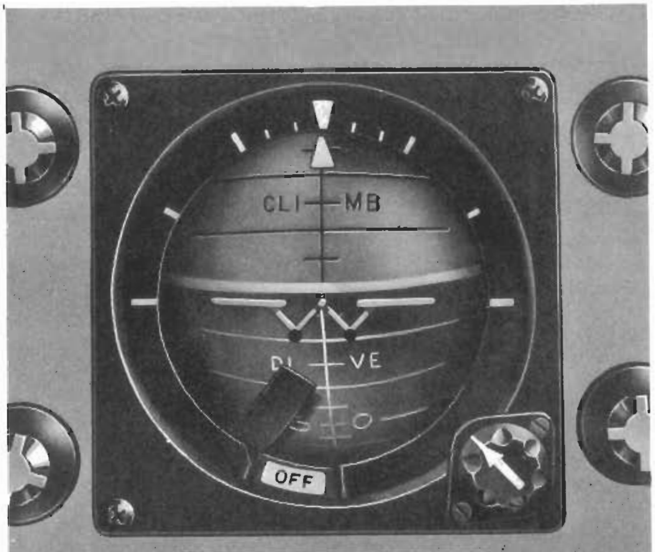


A visual indication of the flight attitude of the airplane in pitch and roll is provided by the MM-2 attitude indicator (5, figure 1-24). This instrument, part of the K-4 attitude indicator system, is controlled by a remote gyro in the K-4 control unit. This gyro establishes the vertical reference line from which pitch and roll deviation is measured. Changes in airplane 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 in dive or climb; beyond 80 degrees, a 180 degree controlled precession "flips" the sphere 180 degrees in roll. Horizontal markings with 5 degree of separation on the face of the sphere show accurate airplane attitudes during climb or dive. This 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, since the flag does not indicate mechanical malfunction. 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 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. 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.

After incorporation of T.O. 1F-101-800, a new attitude indicator, the MM-3, will be installed. The MM-3, being a more reliable instrument, has very little acceleration or deceleration pitch error. During the take-off run, a climb indication error of about 1/2 bar width (1.8° climb) will be noticed. The exact amount of error will depend upon the acceleration and elapsed time of the take-off. The erection system will remove the error when 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.



MM-3 ATTITUDE INDICATOR

UA20-1S16

TURN-AND-SLIP INDICATOR

This conventional indicator (19, figure 1-24), on the instrument panel operates on 28 volt d-c power.

ACCELEROMETER

A three-pointer accelerometer, (4, figure 1-24), is located on the main instrument panel and indicates flight loads on the airplane 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 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.

DIRECTIONAL INDICATOR

Refer to Section IV.

WARNING LIGHT TEST AND DIMMER CIRCUITS

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

WARNING LIGHT TEST BUTTON

The warning light test button (figure 4-11) 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 DIMMER BUTTON

The warning light dimmer button (figure 4-11) provides a means of testing the dimming circuits of the warning, caution, and indicator lights. Also, the warning light dimmer button may be used to dim a warning, caution, or indicator light that comes on during flight. Depressing the dimmer button with the instrument lights knob ON and the warning lights 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.

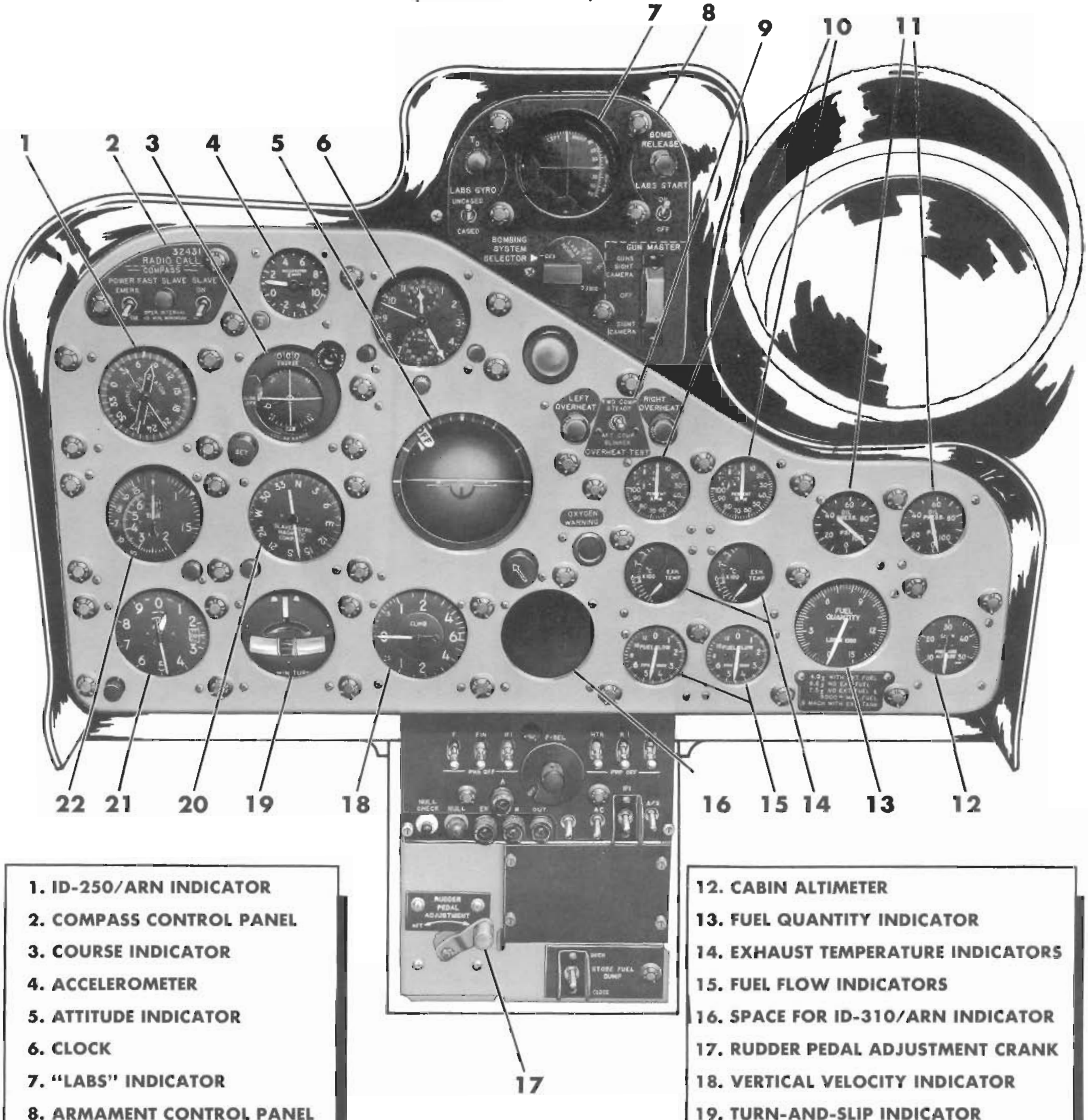
Note

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

instrument panel

1 THRU 15

TYPICAL



1. ID-250/ARN INDICATOR
2. COMPASS CONTROL PANEL
3. COURSE INDICATOR
4. ACCELEROMETER
5. ATTITUDE INDICATOR
6. CLOCK
7. "LABS" INDICATOR
8. ARMAMENT CONTROL PANEL
9. ENGINE OVERHEAT WARNING PANEL
10. TACHOMETERS
11. OIL PRESSURE GAGES
12. CABIN ALTIMETER
13. FUEL QUANTITY INDICATOR
14. EXHAUST TEMPERATURE INDICATORS
15. FUEL FLOW INDICATORS
16. SPACE FOR ID-310/ARN INDICATOR
17. RUDDER PEDAL ADJUSTMENT CRANK
18. VERTICAL VELOCITY INDICATOR
19. TURN-AND-SLIP INDICATOR
20. GYRO COMPASS INDICATOR
21. ALTIMETER
22. TRUE AIRSPEED & MACH INDICATOR

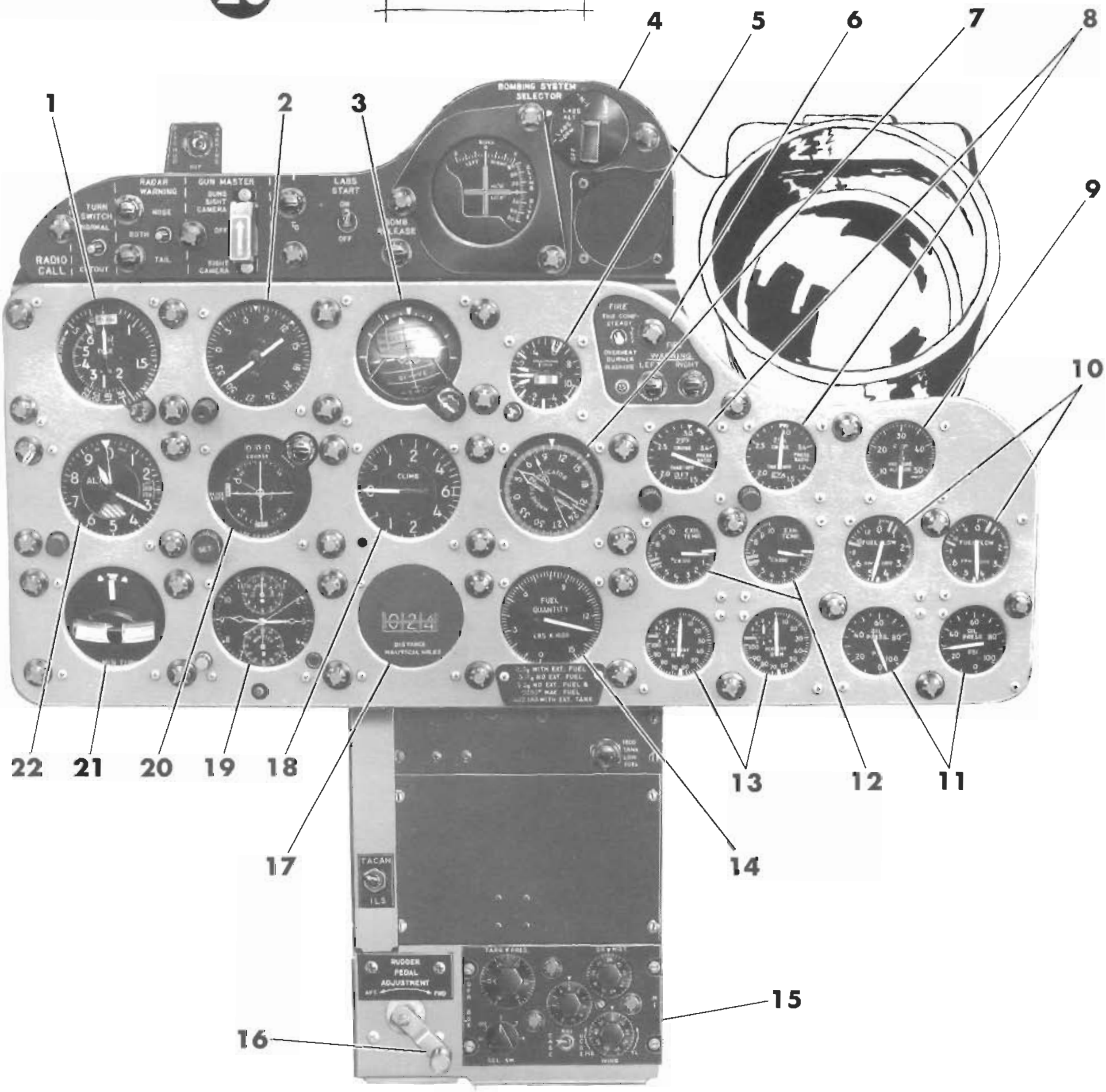
UA20-126-2C

Figure 1-24

instrument panel

20

TYPICAL



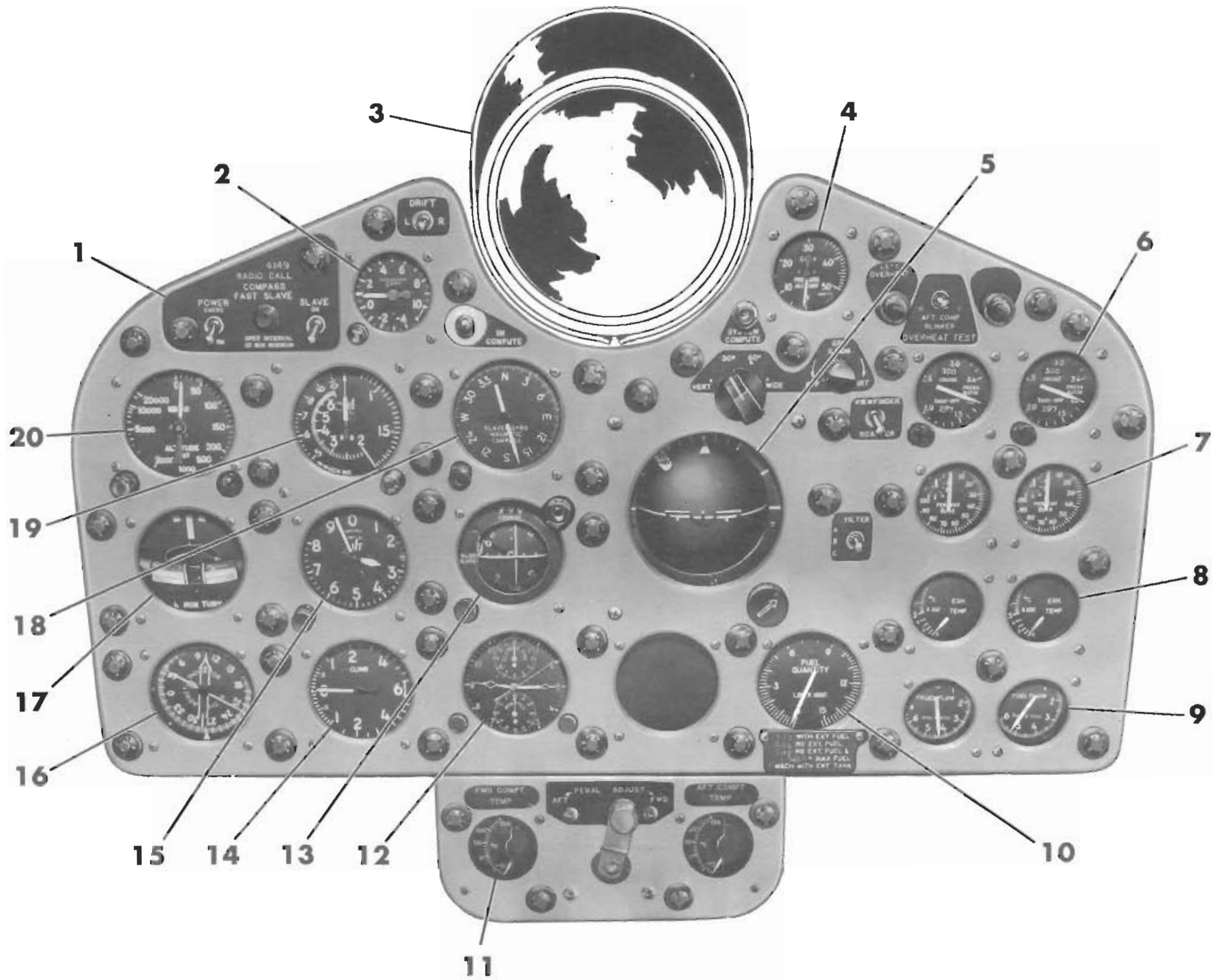
1. AIRSPEED AND MACH INDICATOR
2. DIRECTIONAL INDICATOR
3. ATTITUDE INDICATOR
4. ARMAMENT CONTROL PANEL
5. ACCELEROMETER
6. FIRE WARNING PANEL
7. RADIO MAGNETIC INDICATOR (RMI)
8. ENGINE PRESSURE RATIO GAGES
9. CABIN ALTIMETER
10. FUEL FLOW INDICATORS
11. OIL PRESSURE GAGES
12. EXHAUST TEMPERATURE GAGES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

FA20-126E

Figure 1-25

instrument panel

(10) TYPICAL



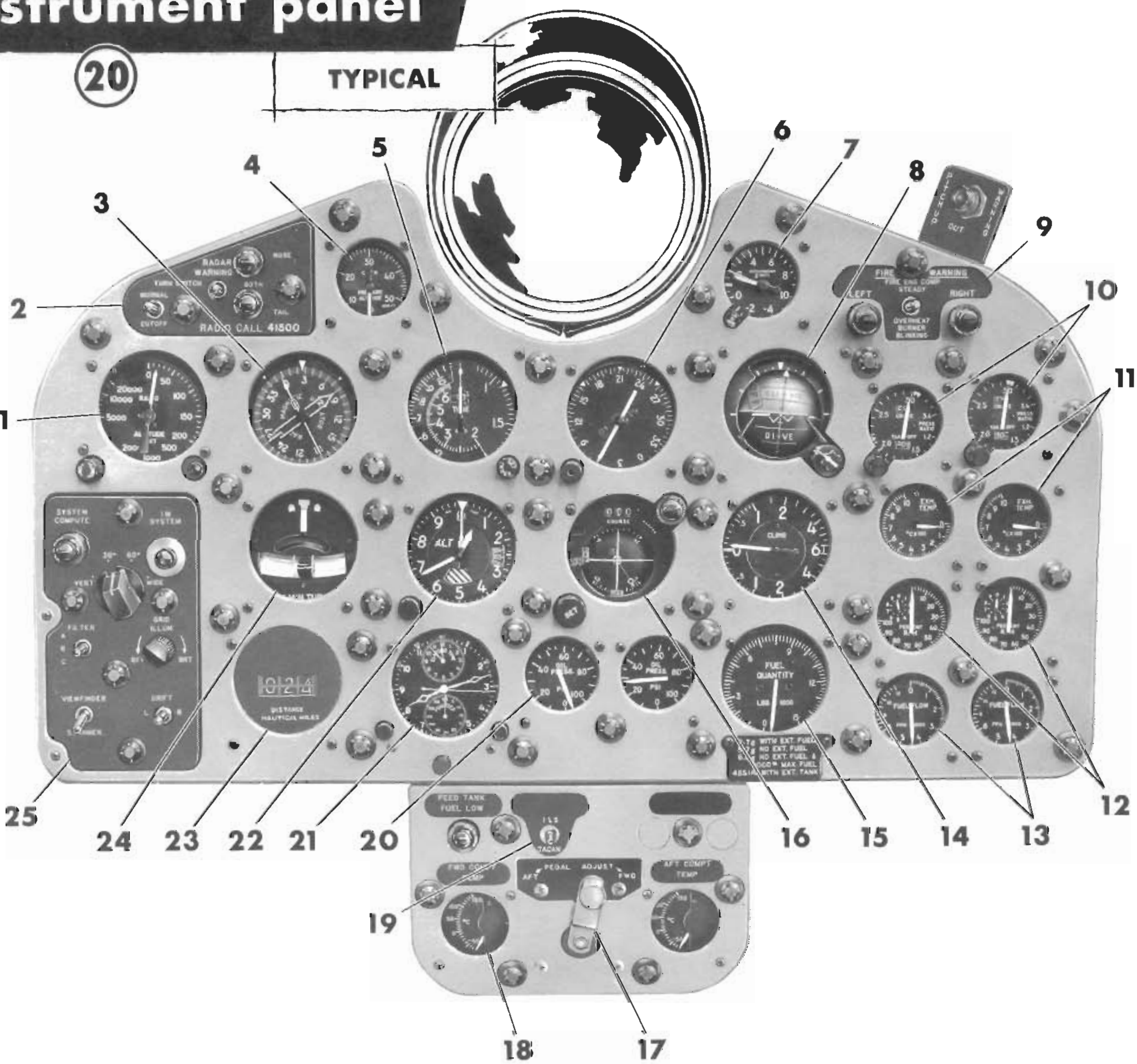
1. COMPASS CONTROL PANEL	11. COMPARTMENT TEMPERATURE INDICATORS
2. ACCELEROMETER	12. CLOCK
3. VIEWFINDER	13. COURSE INDICATOR
4. CABIN ALTIMETER	14. RATE-OF-CLIMB INDICATOR
5. ATTITUDE INDICATOR	15. ALTIMETER
6. ENGINE PRESSURE RATIO INDICATORS	16. ID-250/ARN COURSE INDICATOR
7. TACHOMETERS	17. TURN AND BANK INDICATOR
8. EXHAUST TEMPERATURE INDICATORS	18. GYRO COMPASS INDICATOR
9. FUEL FLOW INDICATORS	19. AIRSPEED AND MACH INDICATOR
10. FUEL QUANTITY INDICATORS	20. RADIO ALTIMETER

UA20-126-1D

Figure 1-26

instrument panel

(20) TYPICAL



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. ILS-TACAN SWITCH
20. OIL PRESSURE GAGES
21. CLOCK
22. ALTIMETER
23. RANGE INDICATOR
24. TURN AND SLIP INDICATOR
25. VIEW FINDER CONTROL PANEL

RFA20-126C

Figure 1-27

EMERGENCY EQUIPMENT

ENGINE FIRE AND OVERHEAT DETECTOR SYSTEM

Two complete and separate overheat detecting systems are installed on each engine. One is forward on the fireseal in the compressor and accessory section, the other aft in the combustion-turbine tail pipe area. The systems primarily consist of heat sensitive continuous sensing elements mounted throughout their respective areas, 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 Detector Warning Lights

Two lights (9, figure 1-24) on the instrument panel serve as a warning for both engine fire detector systems on each engine. 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 1-24) 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 canopy side rail latch mechanism from the stationary hooks through mechanical linkage. The canopy side rail latches are positioned to correspond with the two stationary hooks on each cockpit sill. Mounted between the stationary hooks on each sill are canopy dogs which position the canopy on closing so that the canopy latches will engage the cockpit sill locks. Canopy side load studs insert into lugs positioned within the forward end of the cockpit sill when the canopy closes. The studs brace the canopy against side loads. Opening the canopy may be accomplished manually from either inside or outside the airplane, and in emergency can be jettisoned by means of a cartridge-type remover from either inside or outside. 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. 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 CONTROLS

Canopy External Switch

This two-position toggle switch (figure 1-40) 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 bus.

Canopy External Emergency Jettison Lanyard

This lanyard (figure 1-40) 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. In the event that the safety pin has not been removed, the normal cockpit canopy jettison system will still operate.

INTERNAL CANOPY CONTROLS

Internal Canopy Switch

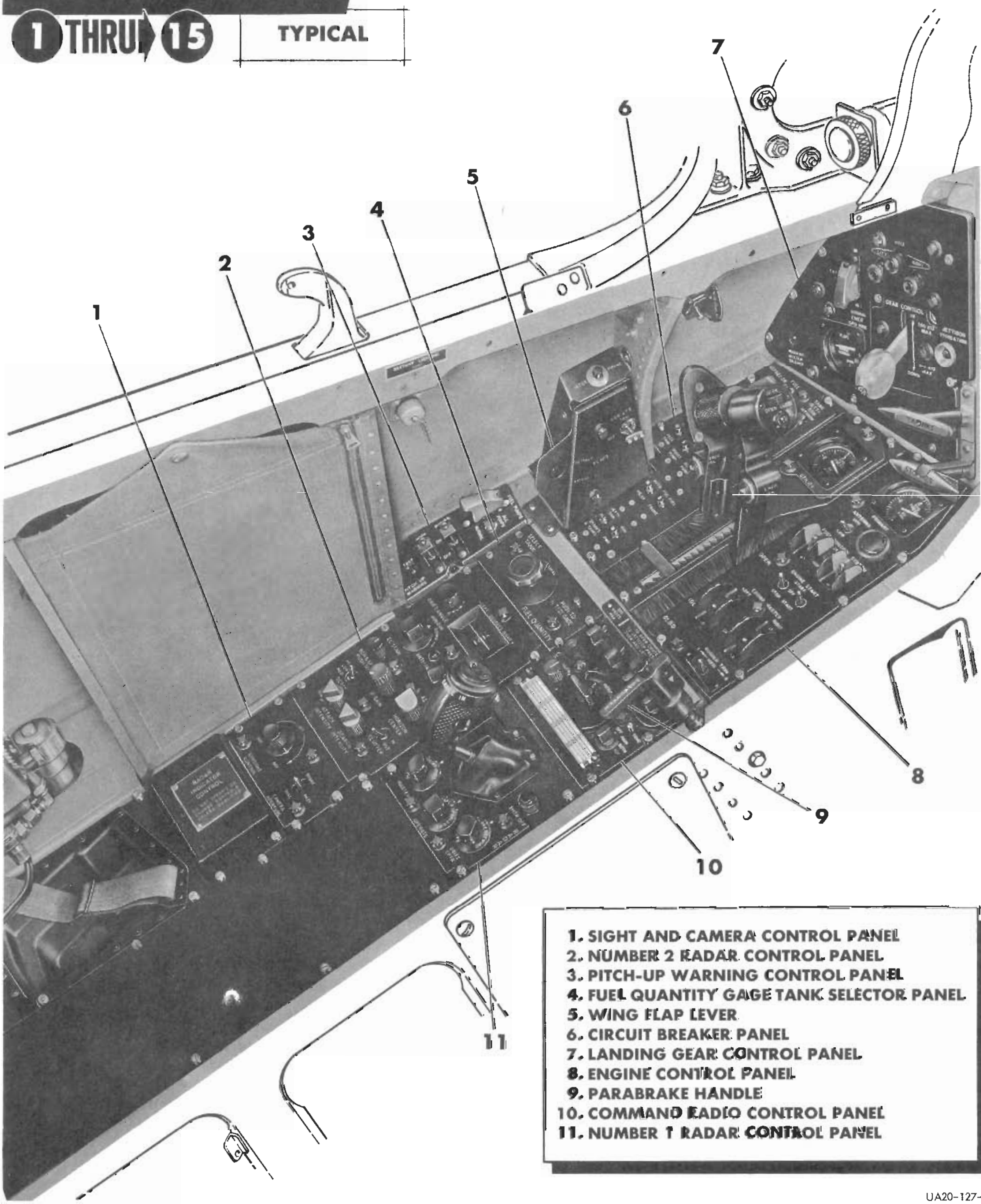
The canopy is operated from within the airplane, by a three-position guarded toggle switch (figure 1-28) located under the canopy sill, to the left and opposite the front of the pilot's seat. The switch is spring-loaded to the OFF (center) position and is moved to UP to open and to DOWN to close. Separate 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 the 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.

left console

1 THRU 15 TYPICAL



1. SIGHT AND CAMERA CONTROL PANEL
2. NUMBER 2 RADAR CONTROL PANEL
3. PITCH-UP WARNING CONTROL PANEL
4. FUEL QUANTITY GAGE TANK SELECTOR PANEL
5. WING FLAP LEVER
6. CIRCUIT BREAKER PANEL
7. LANDING GEAR CONTROL PANEL
8. ENGINE CONTROL PANEL
9. PARABRAKE HANDLE
10. COMMAND RADIO CONTROL PANEL
11. NUMBER 1 RADAR CONTROL PANEL

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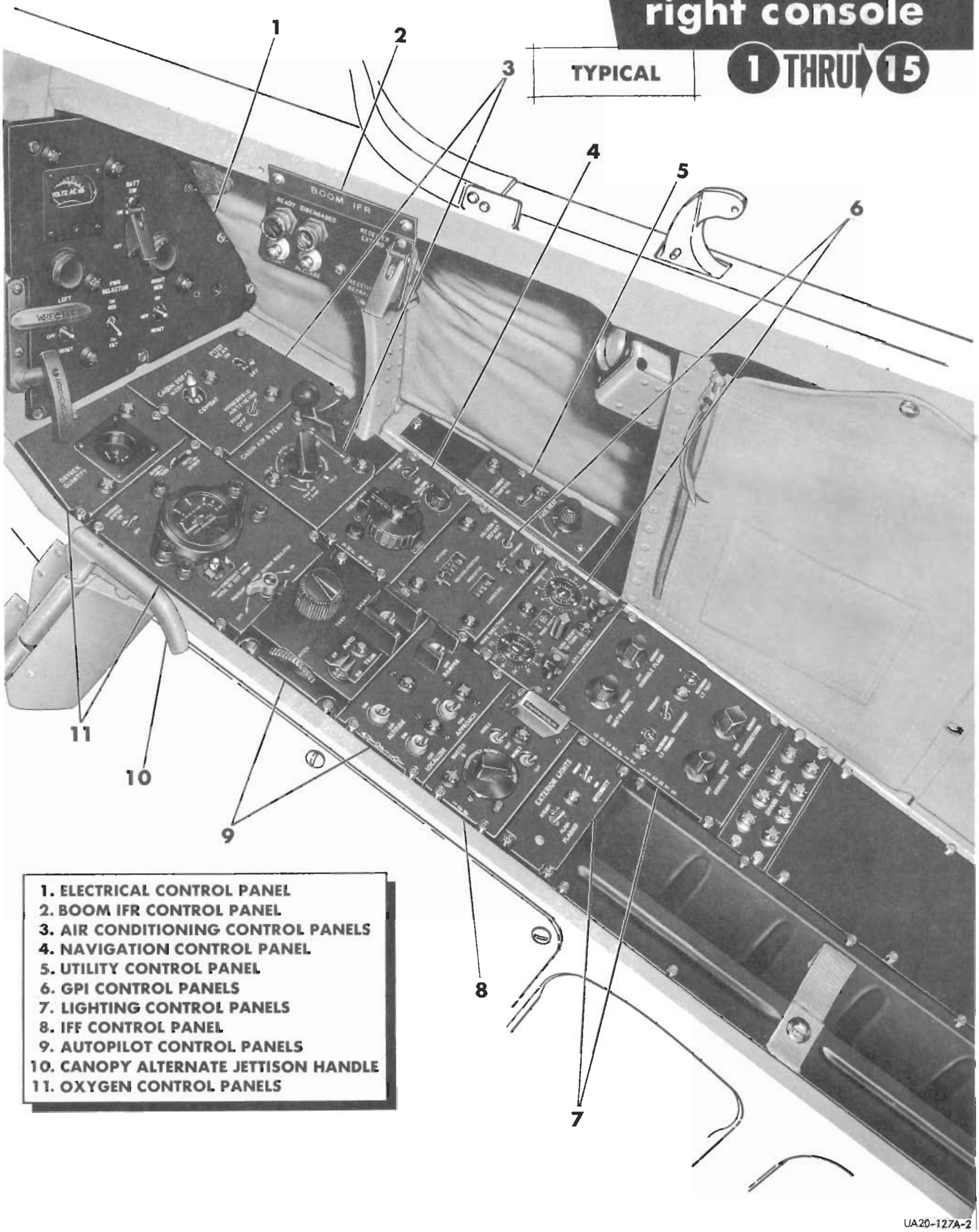
Figure 1-28

right console

TYPICAL 1 THRU 15



1. ELECTRICAL CONTROL PANEL
2. BOOM IFR CONTROL PANEL
3. AIR CONDITIONING CONTROL PANELS
4. NAVIGATION CONTROL PANEL
5. UTILITY CONTROL PANEL
6. GPI CONTROL PANELS
7. LIGHTING CONTROL PANELS
8. IFF CONTROL PANEL
9. AUTOPILOT CONTROL PANELS
10. CANOPY ALTERNATE JETTISON HANDLE
11. OXYGEN CONTROL PANELS

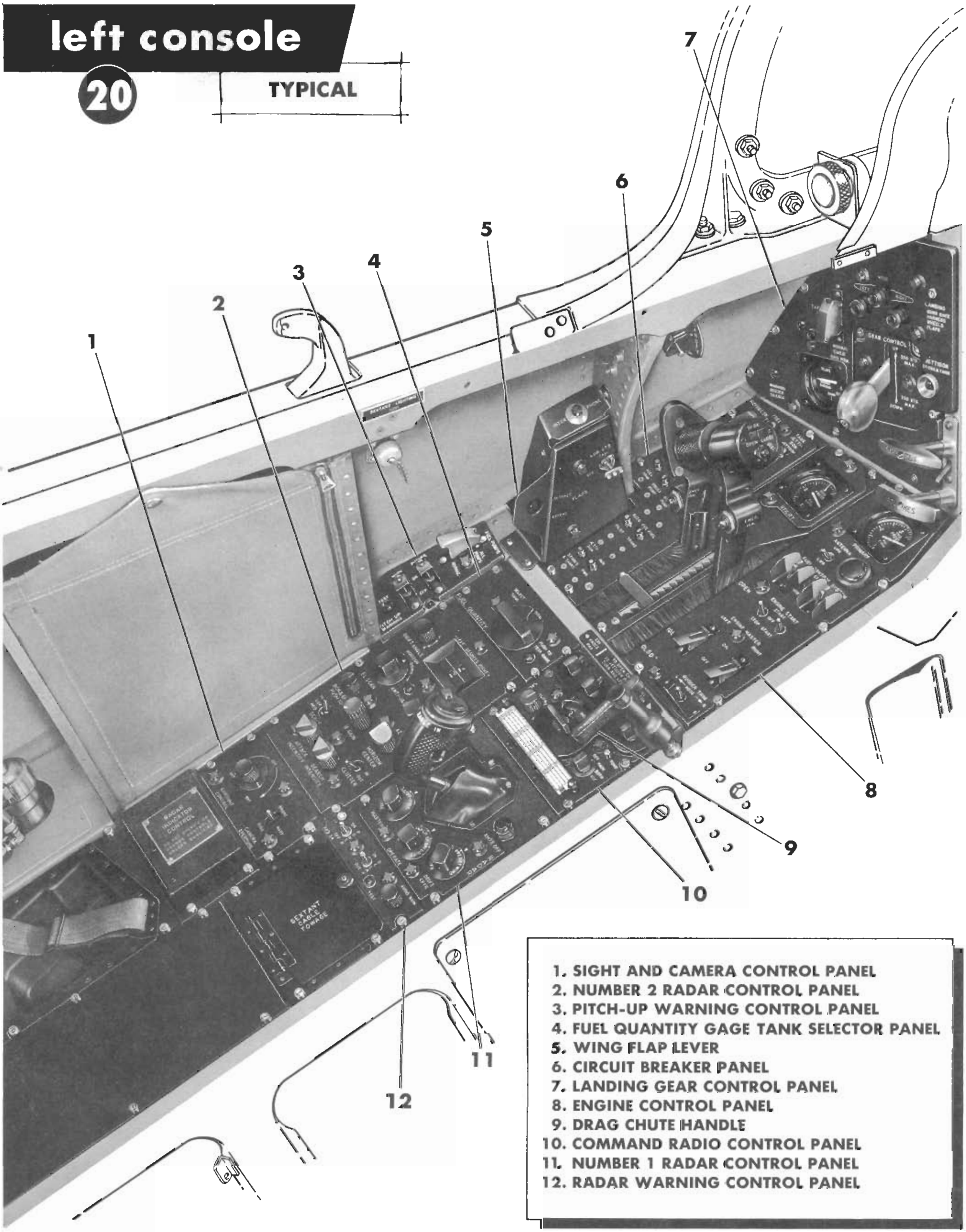
UA20-127A-2

Figure 1-29

left console

20

TYPICAL



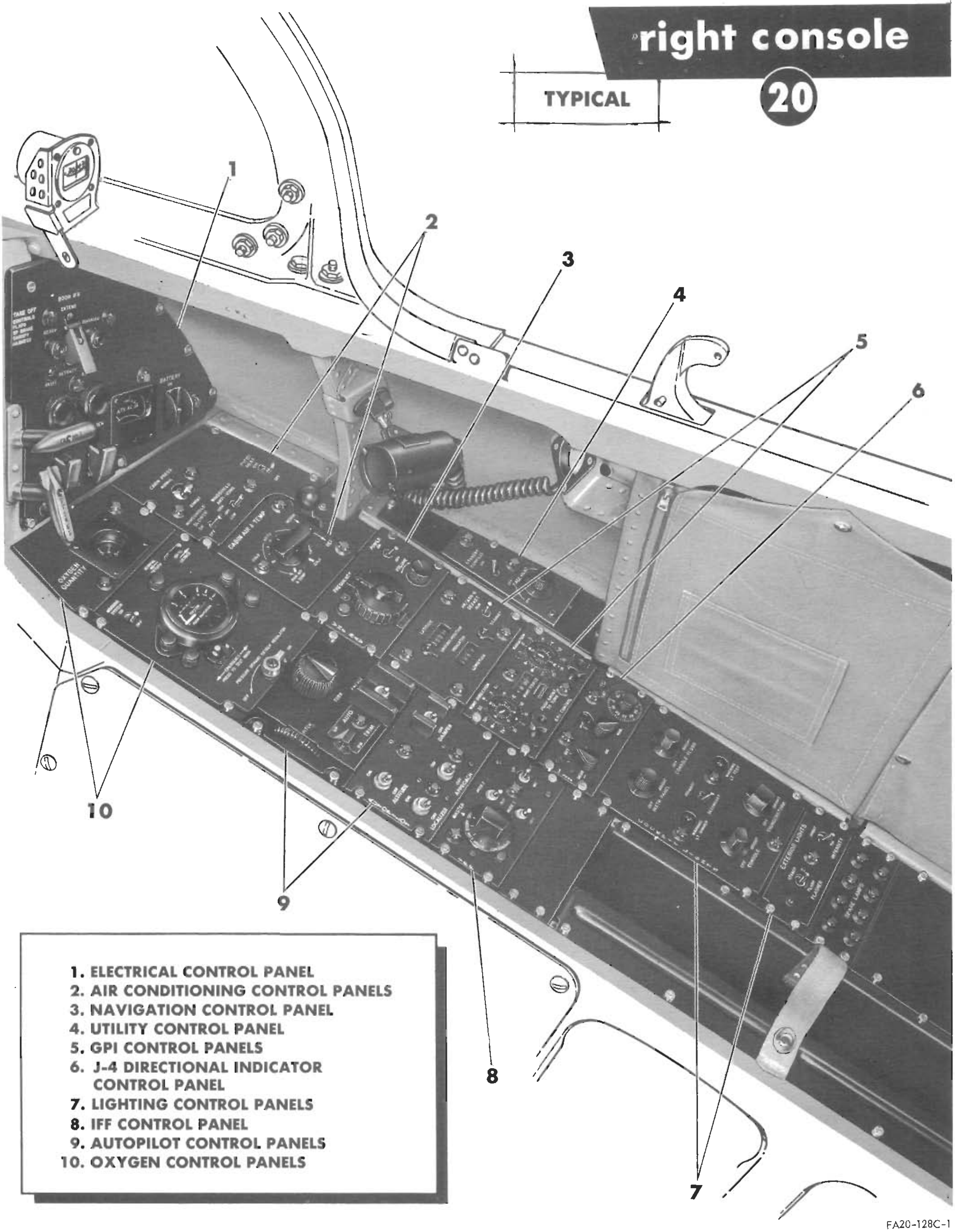
1. SIGHT AND CAMERA CONTROL PANEL
2. NUMBER 2 RADAR CONTROL PANEL
3. PITCH-UP WARNING CONTROL PANEL
4. FUEL QUANTITY GAGE TANK SELECTOR PANEL
5. WING FLAP LEVER
6. CIRCUIT BREAKER PANEL
7. LANDING GEAR CONTROL PANEL
8. ENGINE CONTROL PANEL
9. DRAG CHUTE HANDLE
10. COMMAND RADIO CONTROL PANEL
11. NUMBER 1 RADAR CONTROL PANEL
12. RADAR WARNING CONTROL PANEL

FA20-127C-1

Figure 1-30

right console

TYPICAL 20

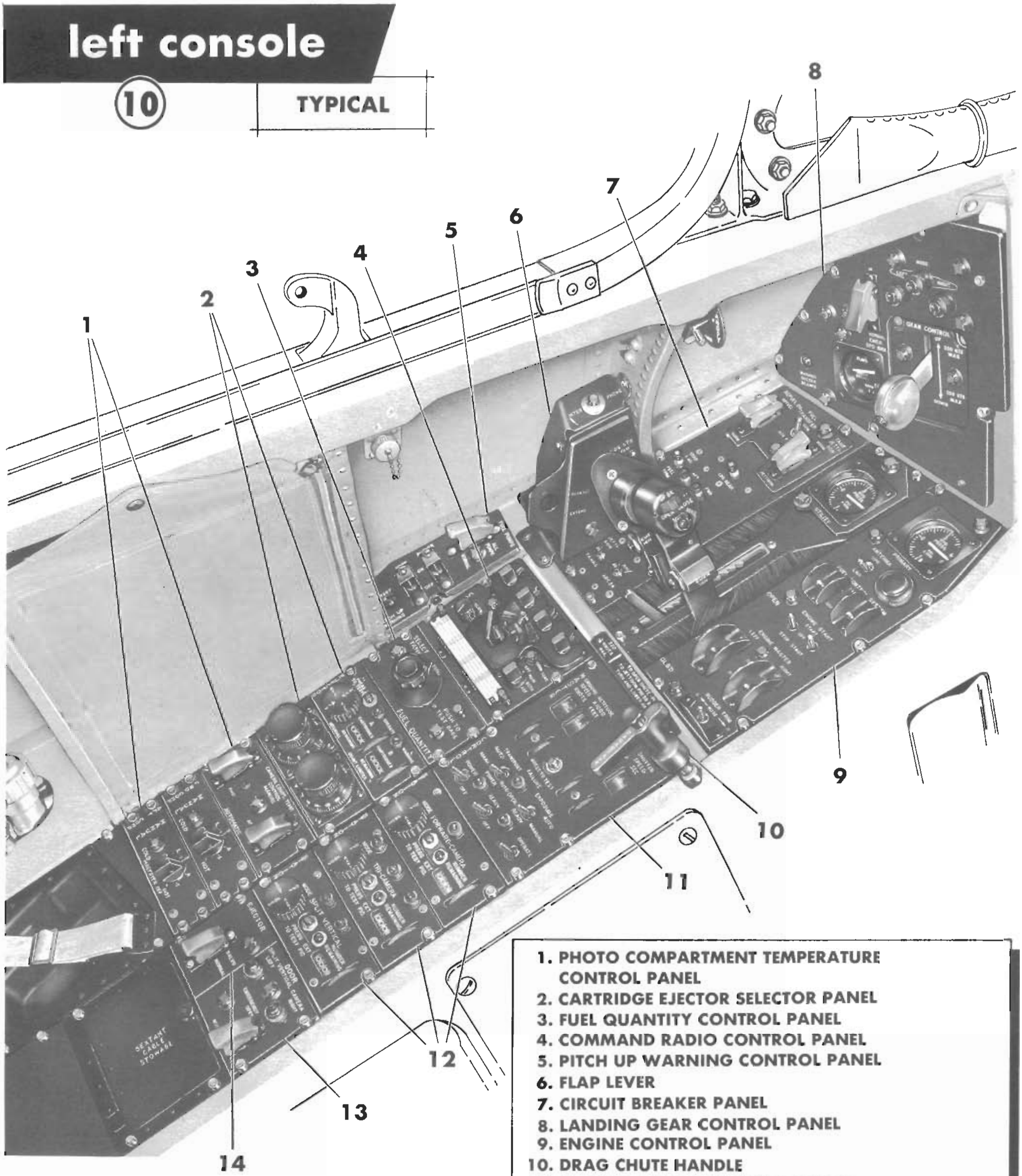


1. ELECTRICAL CONTROL PANEL
2. AIR CONDITIONING CONTROL PANELS
3. NAVIGATION CONTROL PANEL
4. UTILITY CONTROL PANEL
5. GPI CONTROL PANELS
6. J-4 DIRECTIONAL INDICATOR CONTROL PANEL
7. LIGHTING CONTROL PANELS
8. IFF CONTROL PANEL
9. AUTOPILOT CONTROL PANELS
10. OXYGEN CONTROL PANELS

FA20-128C-1

Figure 1-31

left console



1. PHOTO COMPARTMENT TEMPERATURE CONTROL PANEL
2. CARTRIDGE EJECTOR SELECTOR PANEL
3. FUEL QUANTITY CONTROL PANEL
4. COMMAND RADIO CONTROL PANEL
5. PITCH UP WARNING CONTROL PANEL
6. 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 PANEL
13. EMERGENCY CAMERA DOOR CONTROL PANEL
14. CARTRIDGE EJECTOR SALVO CONTROL PANEL

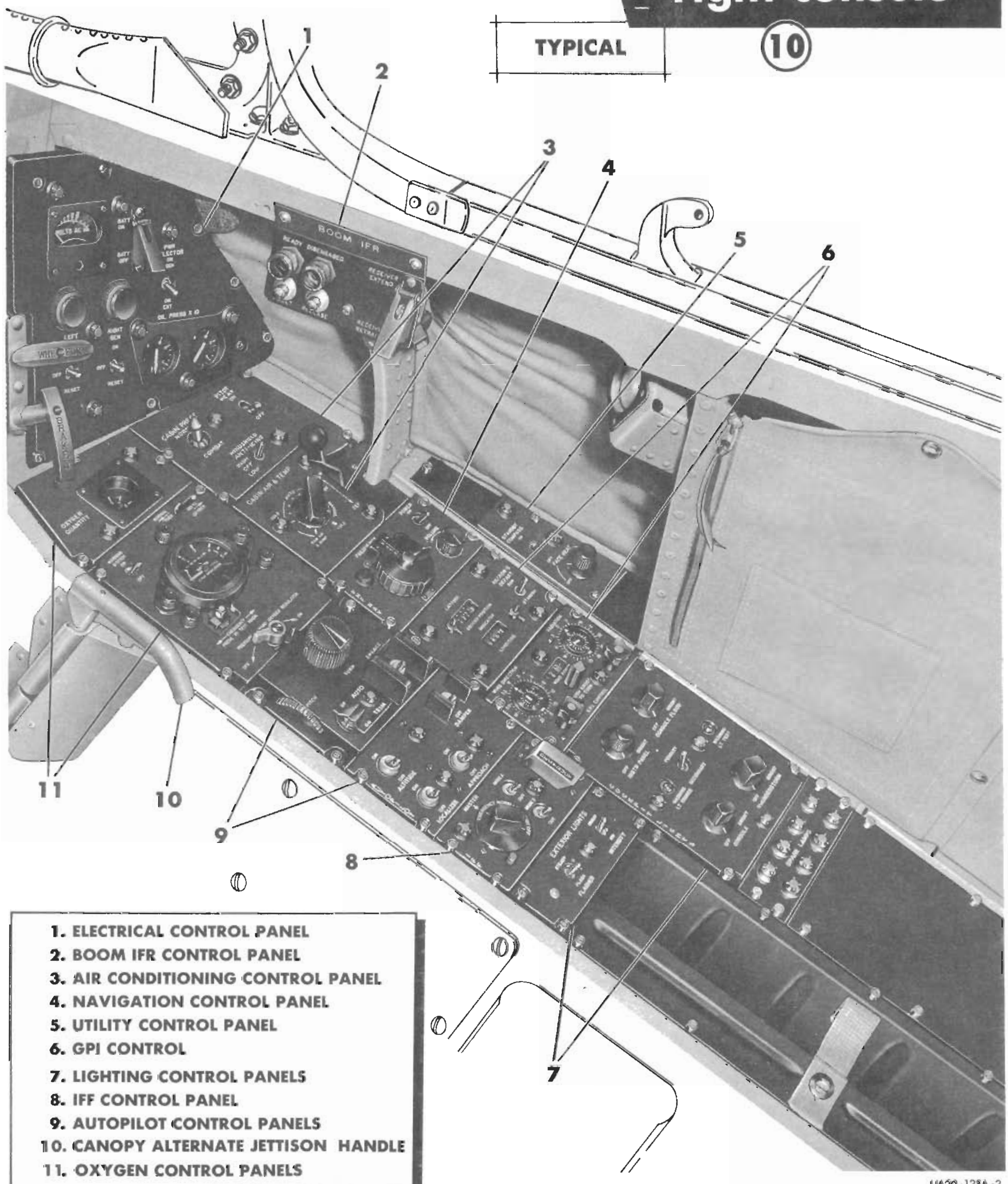
UA20-128-1A

Figure 1-32

right console

TYPICAL

(10)

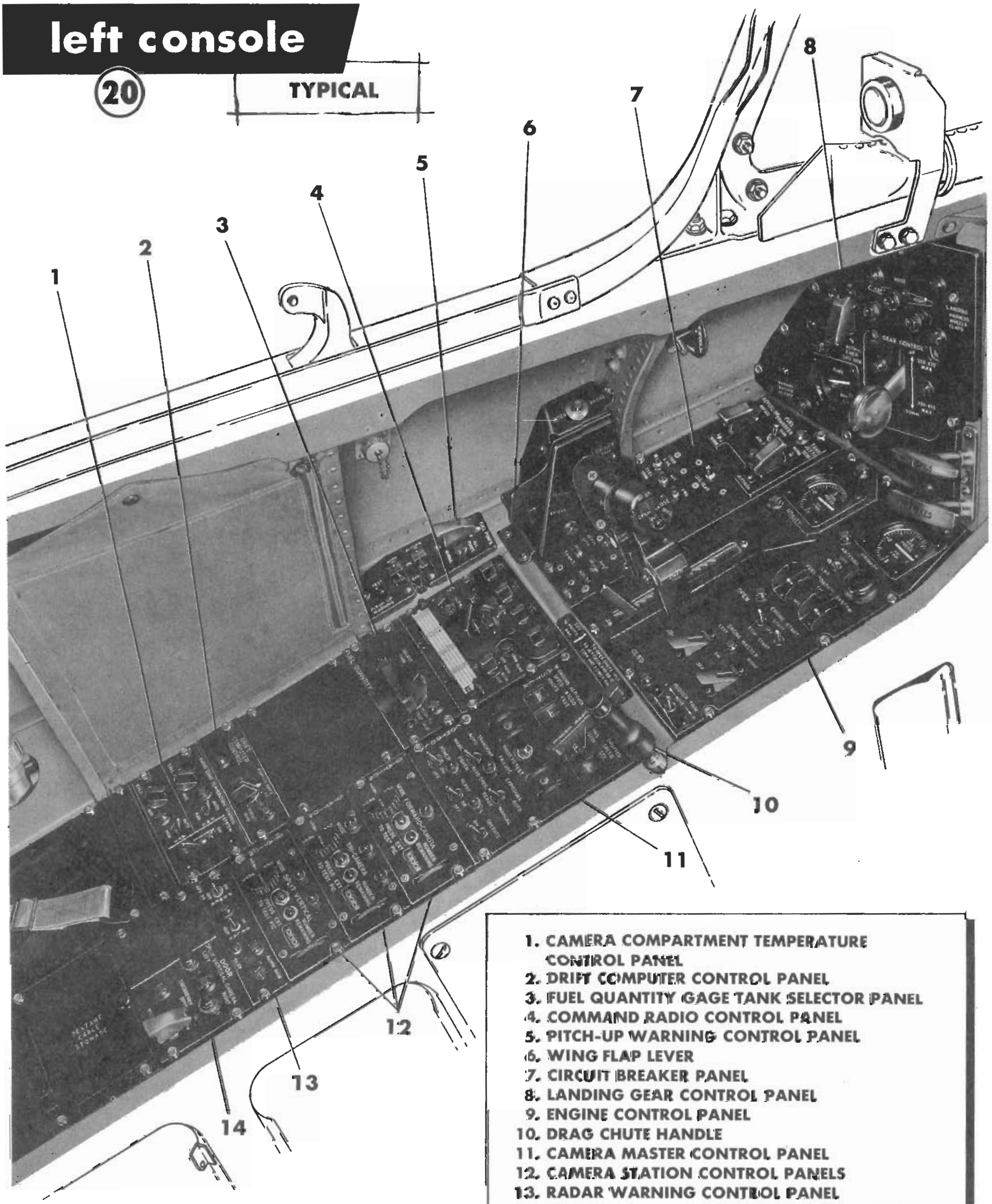


1. ELECTRICAL CONTROL PANEL
2. BOOM IFR CONTROL PANEL
3. AIR CONDITIONING CONTROL PANEL
4. NAVIGATION CONTROL PANEL
5. UTILITY CONTROL PANEL
6. GPI CONTROL
7. LIGHTING CONTROL PANELS
8. IFF CONTROL PANEL
9. AUTOPILOT CONTROL PANELS
10. CANOPY ALTERNATE JETTISON HANDLE
11. OXYGEN CONTROL PANELS

UA20-123A-2

Figure 1-33

left console



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

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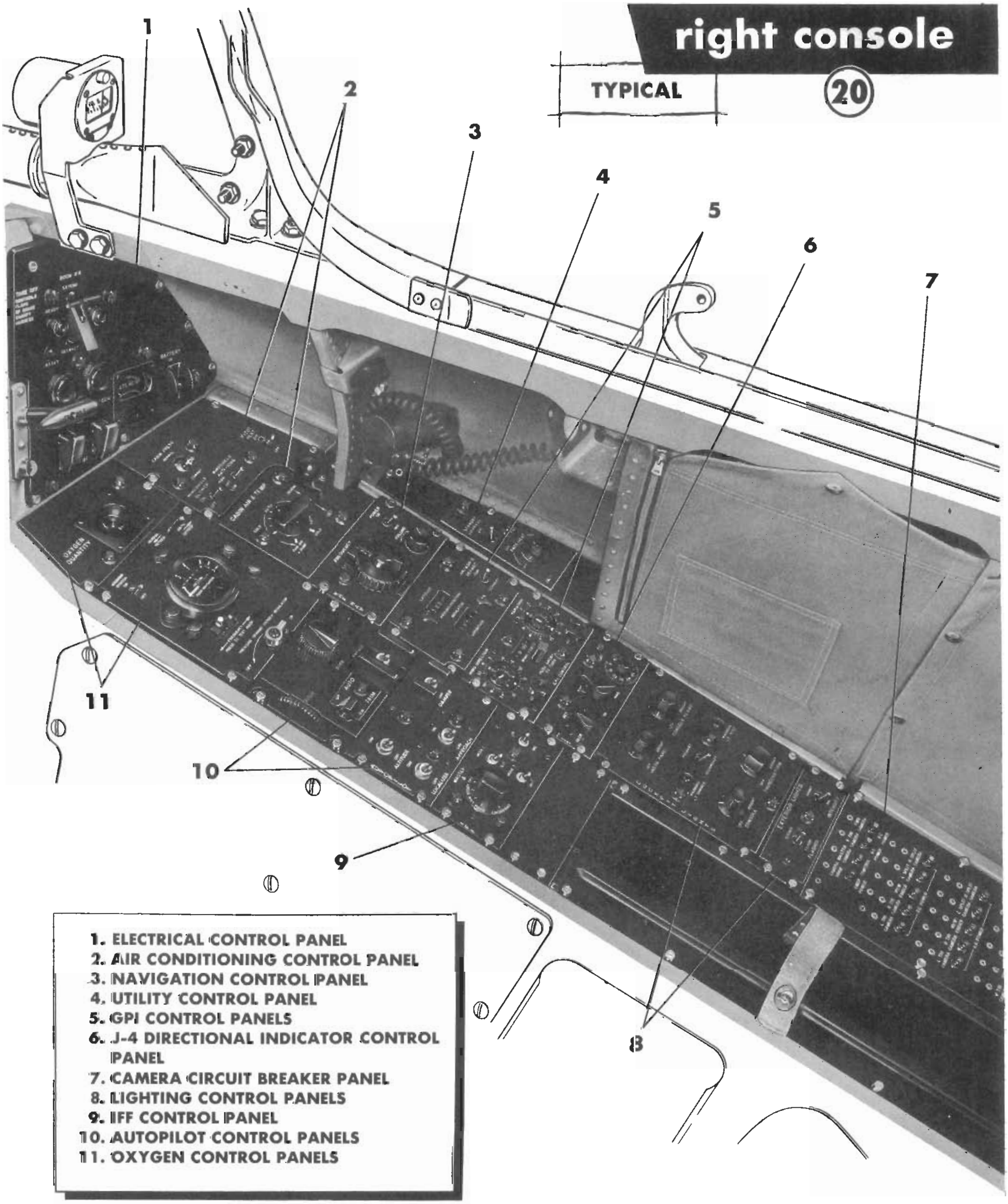
Figure 1-34

right console

TYPICAL 20



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

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Figure 1-35

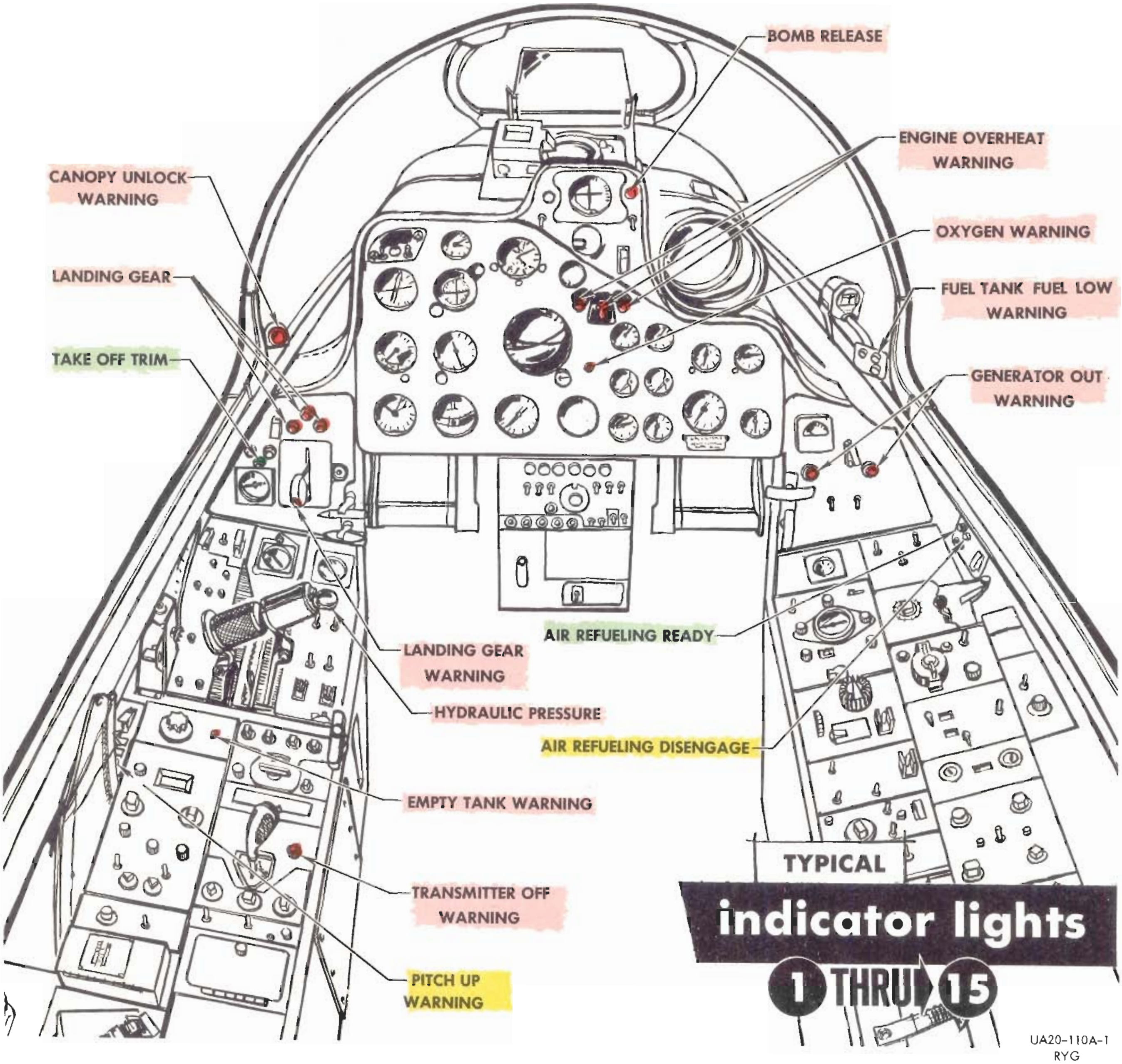


Figure 1-36

CANOPY EMERGENCY JETTISON (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 airplane.

Note

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

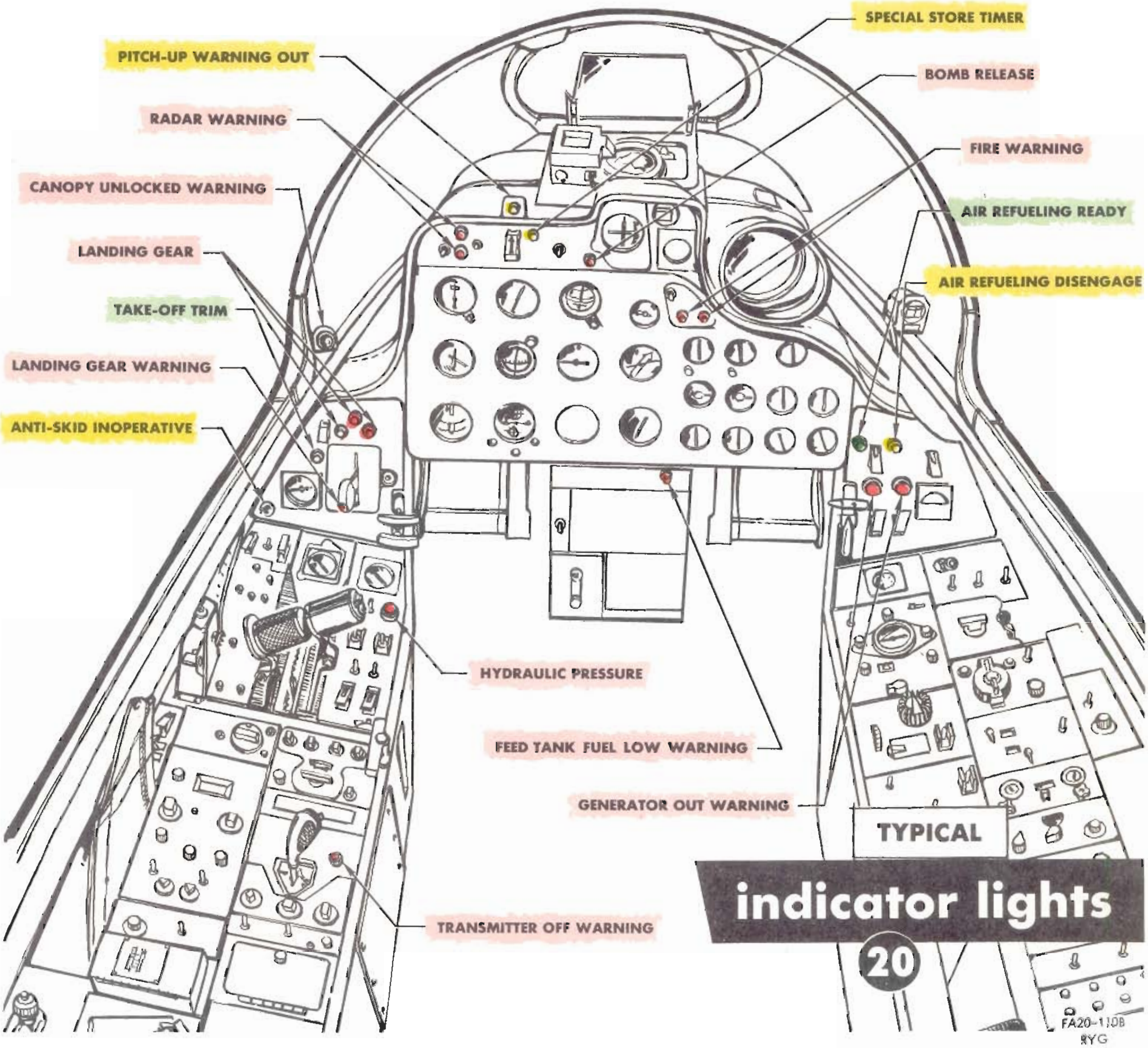


Figure 1-37

Canopy Alternate Jettison Handle (1) THRU (15) (10)

The canopy can be jettisoned without arming the seat for ejection by pulling up on the canopy alternate jettison handle (figure 1-29) located on the right console.

Note

> If the canopy should fail to jettison after raising the handgrips the canopy alternate jettison control handle can be actuated to fire the 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 handle will not lock the shoulder harness inertia reel. The pilot must pull the handle up with enough force to break the copper safety wire, which is safety-wired in the down position to prevent inadvertent jettison of the canopy.

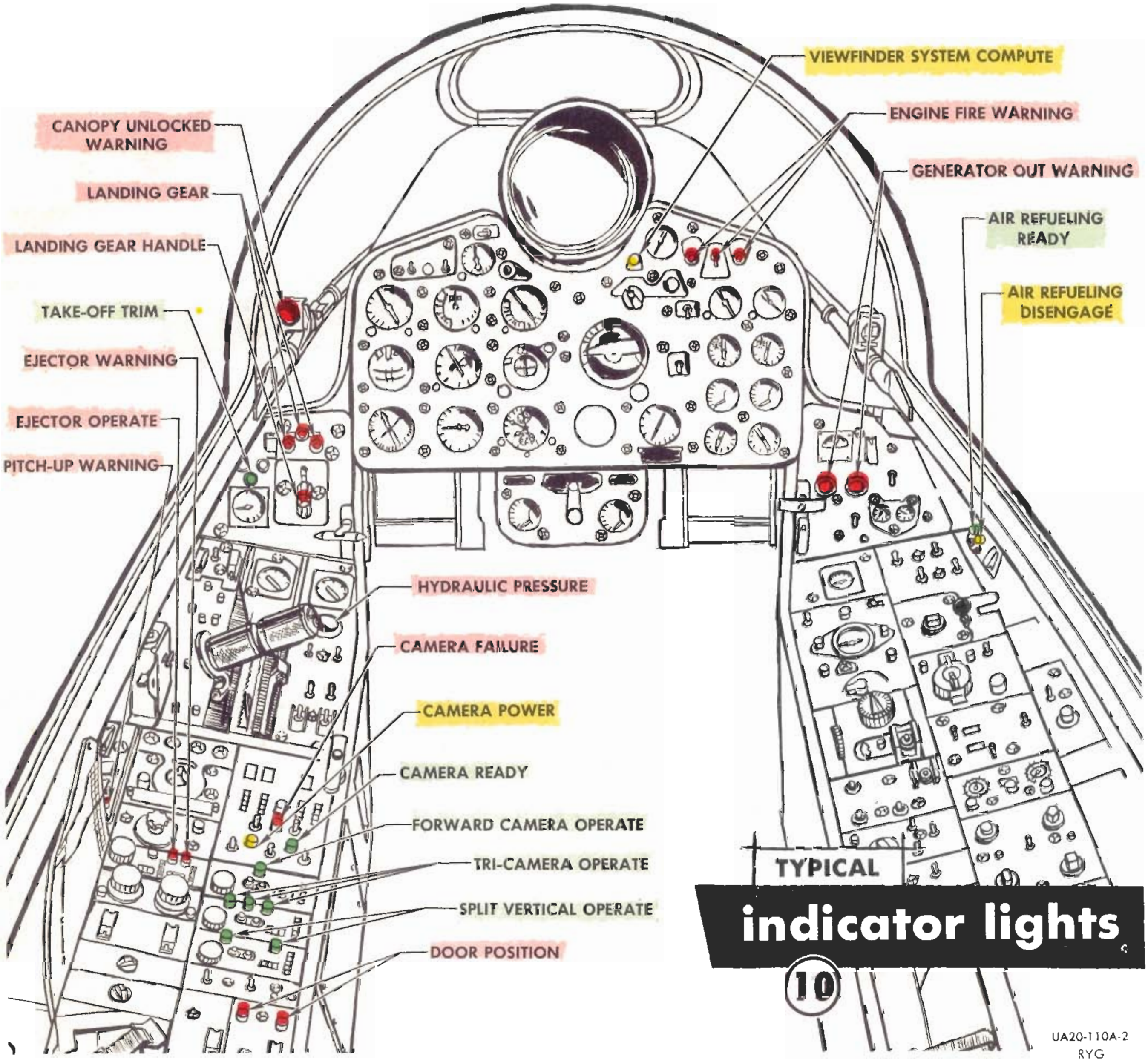


Figure 1-38

Canopy Alternate Jettison Handle (20)(20)

The canopy can be jettisoned without arming the seat for ejection by pulling up on the canopy alternate jettison handle (figure 1-42) located in the left side of the seat forward of the shoulder harness inertia reel 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 shoulder harness 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

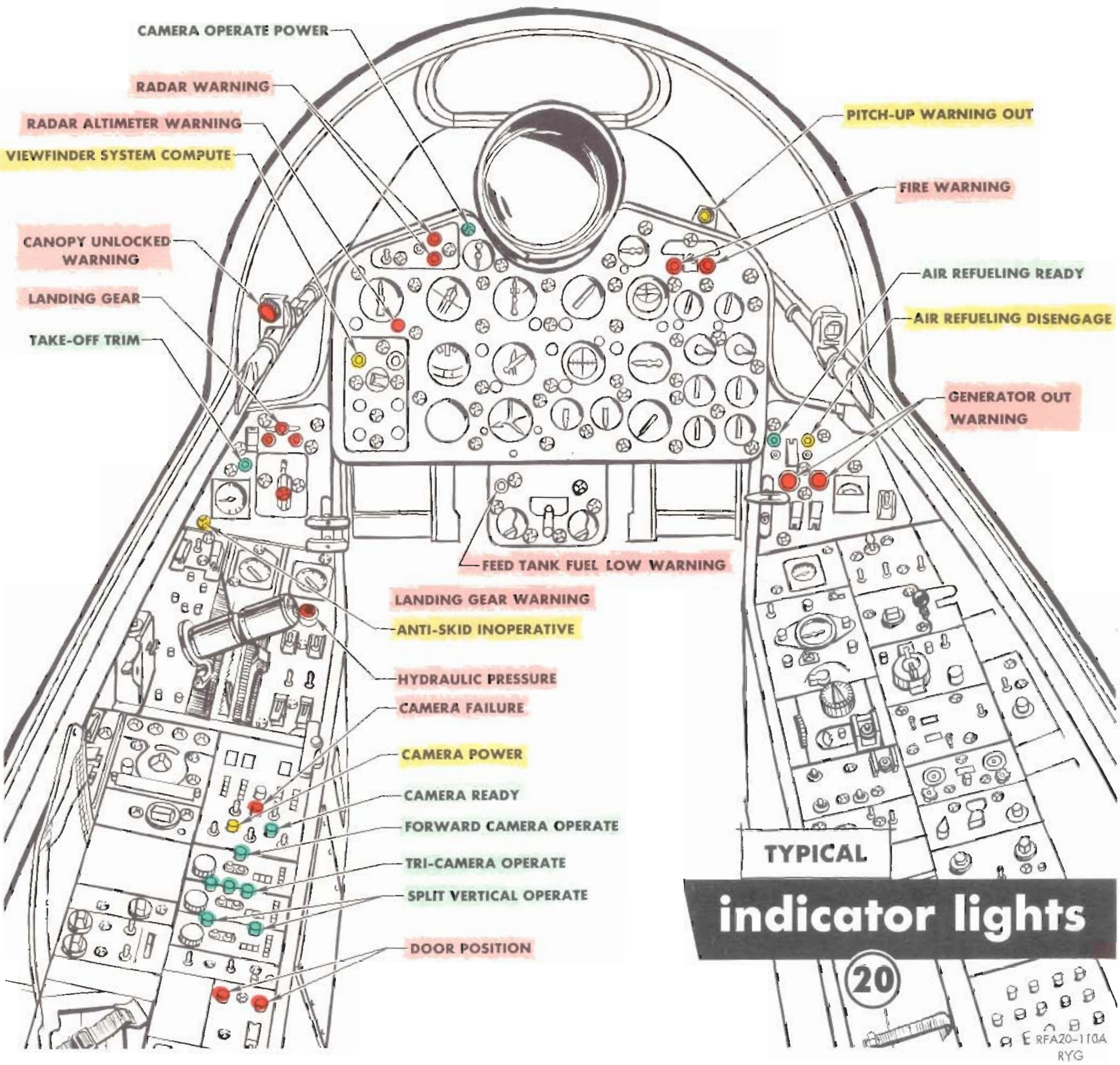


Figure 1-39

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.

external canopy controls

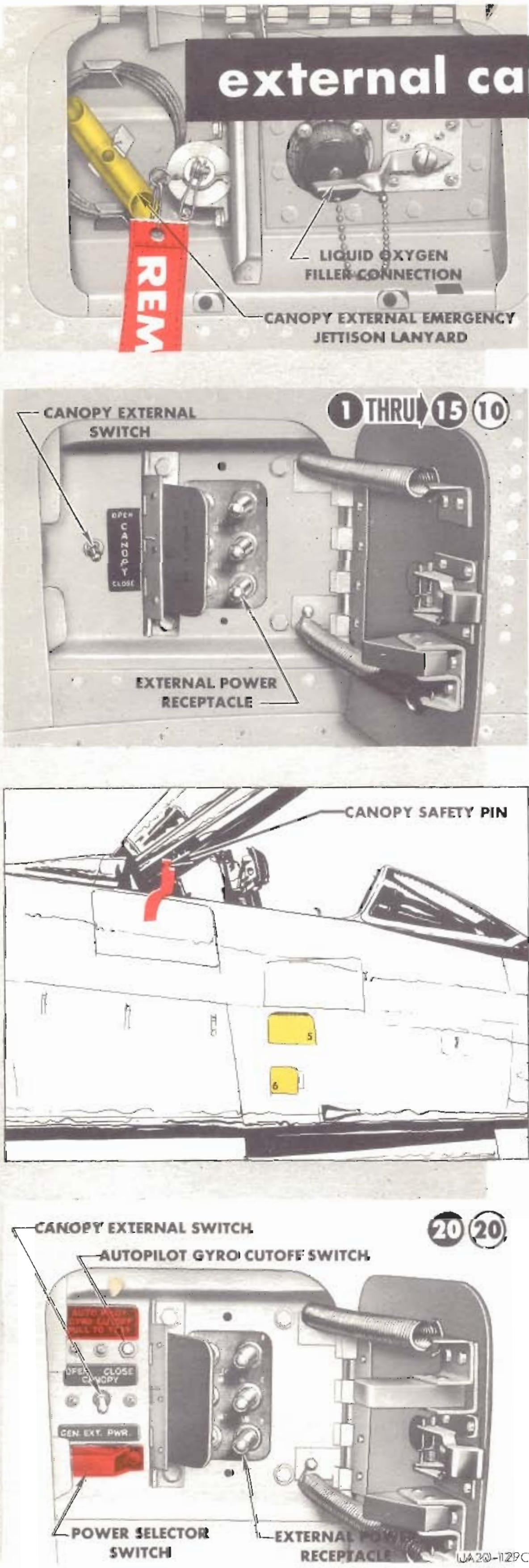


Figure 1-40

Canopy Unlocked Warning Light

A red canopy warning light (figure 1-36) 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 1-41 and 1-42) permits the pilot to eject from the airplane 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 ejection sequence. The reel can be manually locked or unlocked by the shoulder harness inertia reel handle located forward of the left side of the seat. The seat can be electrically positioned in vertical direction by the seat adjustment lever on the rear of the right armrest in the 1 THRU 15 10 airplanes and by the seat adjustment switch on the forward end of the right side of the seat in the 20 20 airplanes. 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 fiberglass 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 use 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. The disconnect assembly, located on the front of the seat, has fittings for radio, face heat, oxygen, and anti-G-suit hoses. The lower portion of the disconnect assembly separates during seat ejection, freeing the pilot's personal leads and hoses from the airplane. The upper portion of the disconnect assembly

remains with the pilot when the pilot separates from the seat after ejection. Two personal leads retainer straps (figure 1-42) are fastened around the base of the personal leads to prevent the upper portion of the disconnect assembly from flying up and striking the pilot or pilot's helmet. These straps should be looped around the leg straps on the parachute harness. In the 54-1495 and 54-1496 (20) airplanes, after the incorporation of T.O. 1F-101-857, the personal leads disconnect assembly will be modified by the addition of a spring clip to each end of the personal leads disconnect mounting bracket. This modification is incorporated to prevent possible injury to the pilot due to the upper portion of the disconnect assembly flying up during ejection.

WARNING

It is imperative that the pilot secure the personal leads retainer straps properly to prevent the upper portion of the disconnect assembly from flying around during ejection and thereby preventing possible serious injury to the pilot.

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 canopy alternate jettison handle, located on the right console in the (1) THRU (15) (10) airplanes, and forward of the inertia reel shoulder harness handle on the left side of the seat in the (20) (20) airplanes. 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 trigger. The seat is ground safetied against canopy jettison and seat ejection by installing a red flagged ground safety pin in the right handgrip in the (1) THRU (15) (10) airplanes and "T" pin in the left handgrip in (20) (20) airplanes. The safety pin prevents raising the handgrips, and in the (20) (20) airplanes, it also prevents pulling up the canopy alternate jettison handle. In the (1) THRU (15) (10) airplanes, the non-adjustable headrest, armrest and stirrups are located such as to afford maximum protection when used correctly during ejection. In the (20) (20) airplanes, 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 in the (20) (20) airplanes. 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 jettisoning, can be grasped for catapult trigger actuation with the arms down firm against the armrests.

EJECTION SEAT HANDGRIPS

The two mechanically interconnected handgrips (figure 1-41) 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 the canopy fails to jettison after raising the seat 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 mechanisms.

WARNING

The handgrips are ground safetied by inserting the red flagged, seat safety pin in a hole in the forward end of the right handgrip in the (1) THRU (15) (10) airplanes and "T" pin in the left handgrip in (20) (20) airplanes. The safety pin prevents raising either of the interconnected handgrips and in the (20) (20) airplanes, it also prevents pulling up the canopy alternate jettison handle. The safety pin should be removed prior to flight and reinstalled in the handgrip before leaving the seat.

SEAT CATAPULT TRIGGERS

A seat catapult trigger (figure 1-41) is incorporated in 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.

ejection seat

1 THRU 15 10

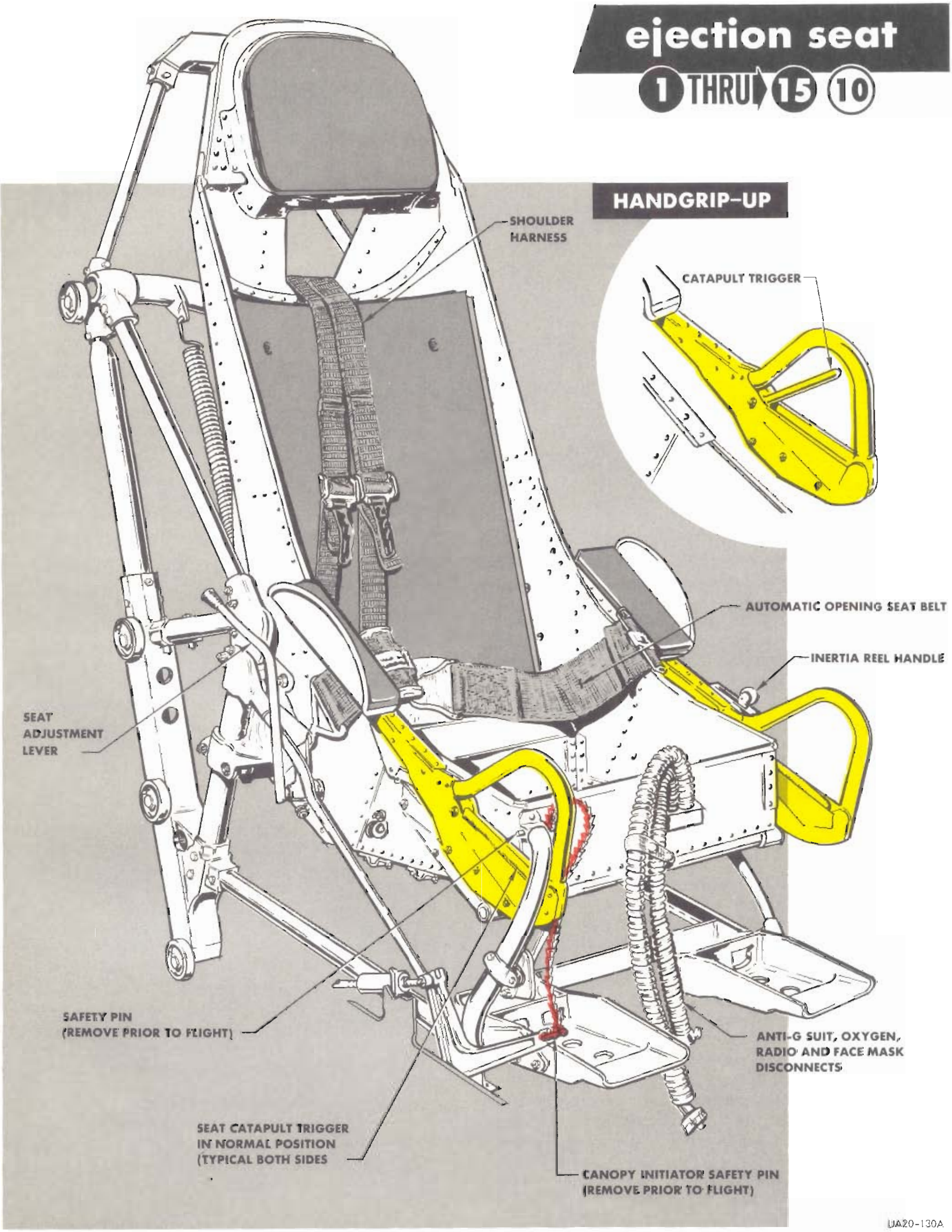


Figure 1-41

ejection seat

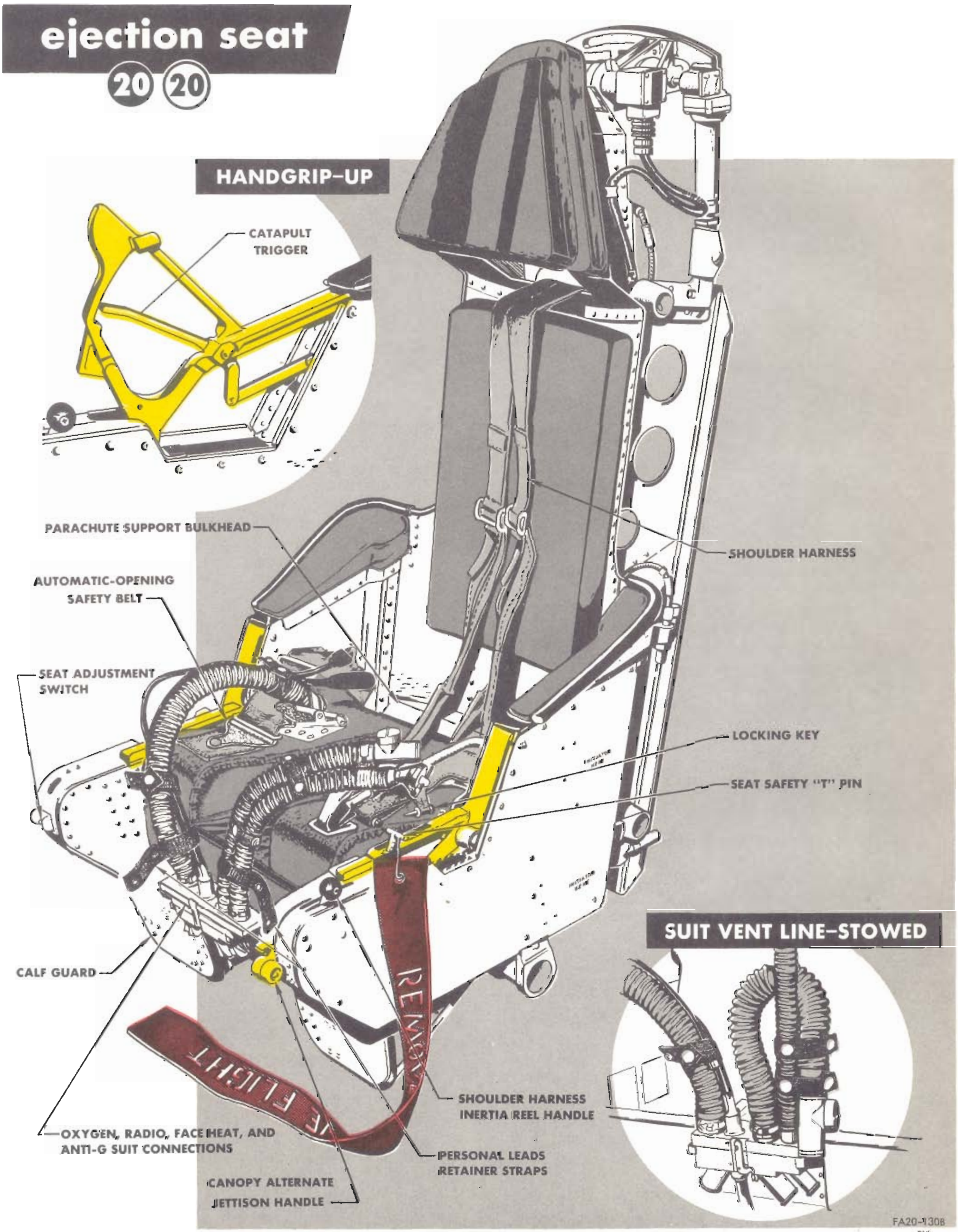


Figure 1-42

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 BELT

In the ❶ THRU ⓯ ⑩ airplanes, the MA-4 type safety belt is utilized. In the ⓴ ⑳ airplanes, the pilot may encounter one of two different automatic-opening safety belts, the MA-4 or MA-5. See figure 1-43. 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 automatic 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 1-43) is accomplished by manual operation by the pilot or by gas pressure from a separate automatically controlled source. 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 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 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 1-43) is accomplished by manual operation by the pilot, or by gas pressure from a separate automatically controlled source. 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 fasten the safety belt, place both shoulder harness loops over the manual release end of the swivel link, then the automatic parachute lanyard anchor (ring shaped) is placed over the manual release end of the swivel link and the swivel link is locked into the manual release lever. 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 as the pilot separates from the seat.

WARNING

- 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.
- The parachute lanyard anchor must be connected in the proper manner or the pilot probably will not separate from the seat after ejection. Refer to figure 1-43.

automatic-opening safety belts

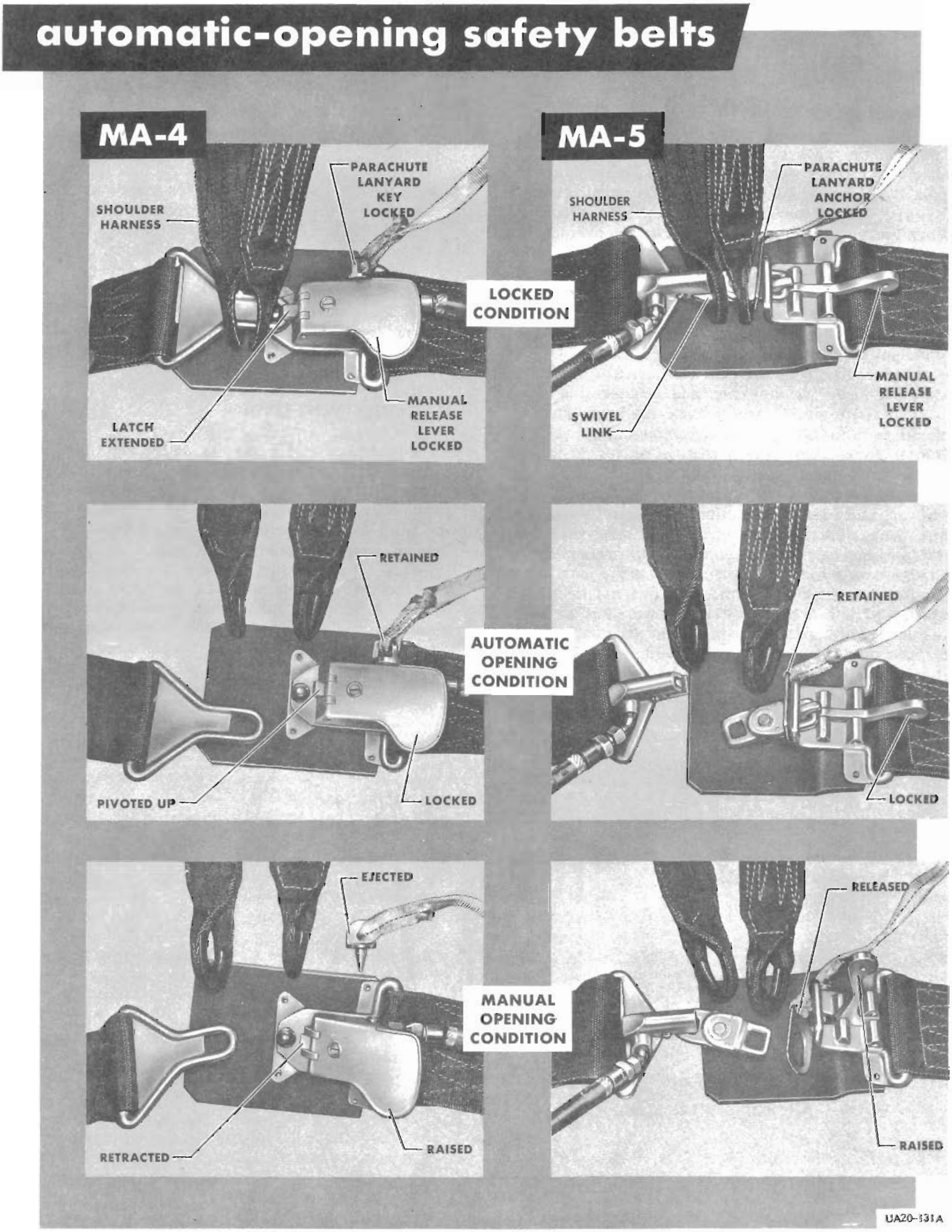


Figure 1-43

CANOPY ALTERNATE JETTISON HANDLE

Refer to Canopy Alternate Jettison Handle, this section.

SHOULDER HARNESS INERTIA REEL HANDLE

The inertia reel handle (figure 1-41) 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 the 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 the 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, the 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 then unlock when the handle is moved forward to LOCK and back to UNLOCKED.

SEAT ADJUSTMENT LEVER 1 THRU 15 10

An adjustment lever, located on the right side of the ejection seat, is incorporated to provide means for vertical seat adjustment. Moving adjustment lever forward pulls locking pins (one on each side) allowing the pilot to raise or lower the seat. The seat moves up and forward. Handles mounted on windshield help pilot remove his weight from seat during adjustment. The foot rests remain on the floor and may be used to assist in adjustments of the seat. White index markers are provided on the seat adjustment link position indicator, and the seat adjustment mechanism to insure pilot that the lock pins are fully inserted.

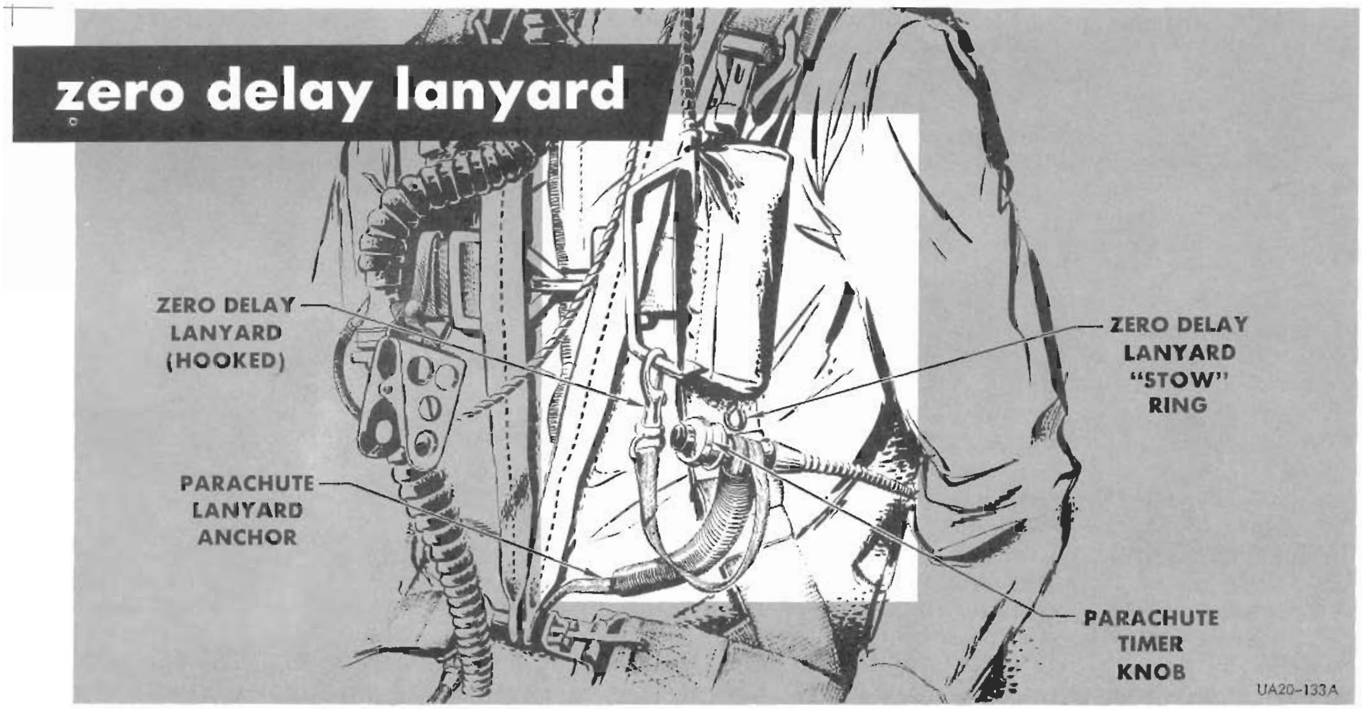


Figure 1-44

SEAT ADJUSTMENT SWITCH (20)(20)

The three-position seat adjustment switch (figure 1-42) 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 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.

LOW ALTITUDE ESCAPE EQUIPMENT

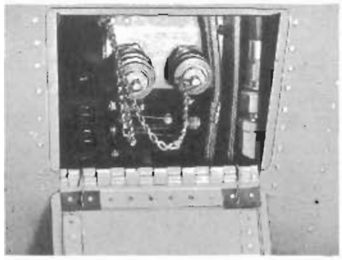
In order to provide an improved low altitude escape capability, a zero delay lanyard is provided to give a "zero-second" time delay in chute deployment after seat separation. The "zero-second" chute timing with the one second automatic-opening safety belt, is known as a "one and zero" escape system. Figure 1-44 illustrates a typical zero delay lanyard hooked to the parachute ripcord handle. There may be several lanyard configurations in service use, but their use will be identical and the hook and attaching positions will be similar. The lanyard merely connects the parachute arming knob to the parachute ripcord handle. When the pilot separates from the seat and the parachute arming knob is pulled, the parachute ripcord handle is also pulled allowing immediate parachute deployment. This, in effect, by-passes the automatic-opening parachute device. Thus, the zero delay lanyard must be connected to the parachute ripcord handle at very low altitudes and low airspeeds. At other altitudes and airspeeds, the lanyard must be disconnected from the parachute ripcord handle and stowed, allowing the automatic-opening parachute timer to actuate the parachute below critical opening speeds and below the prescribed altitude. The fastening or unfastening of the zero delay lanyard to the parachute ripcord handle must be done manually and at the correct times 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 ripcord handle.

AUXILIARY EQUIPMENT

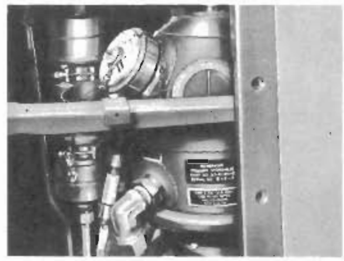
Information concerning the cockpit air conditioning and pressurization system; windshield defrosting, defogging and rain clearing system; engine anti-icing system; communication and associated electronic equipment; lighting equipment, oxygen system; autopilot; navigation equipment; radar system; armament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

servicing diagram

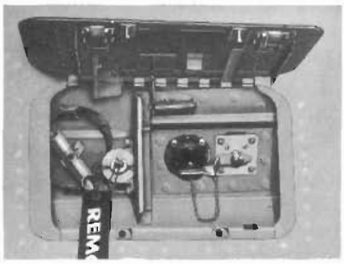
1. DRAG CHUTE



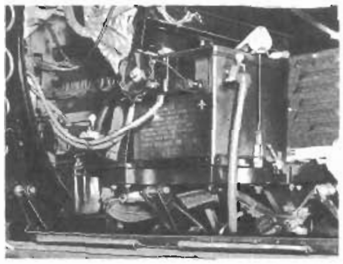
*2. OIL SYSTEM FILLER



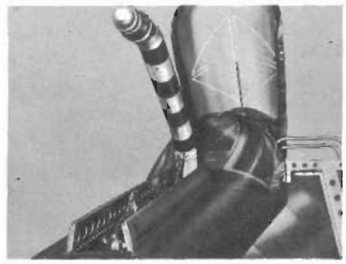
*3. HYDRAULIC SYSTEM FILLER



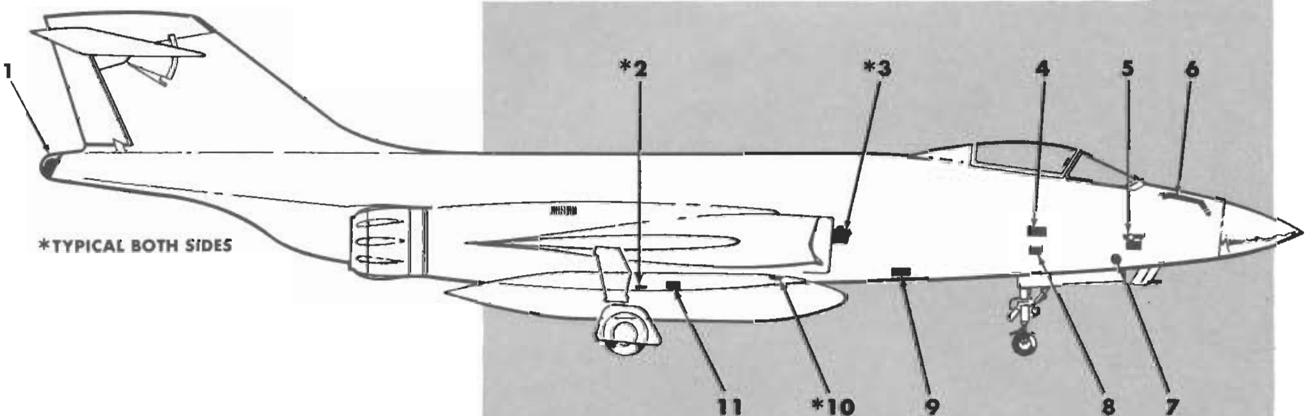
4. LIQUID OXYGEN FILLER



5. BATTERY

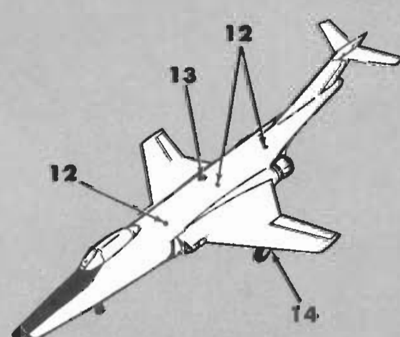


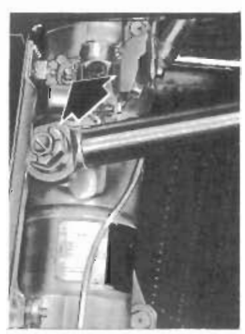
6. AIR REFUELING PROBE



SPECIFICATIONS

- HYDRAULIC FLUID MIL-O-5606
- FUEL JP-4 MIL-F-5624
- ALTERNATE FUEL JP-5
  EMERGENCY FUEL AVIATION GASOLINE MIL-G-5572 LOWEST GRADE AVAILABLE.
- OIL MIL-L-7808C-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.





14. HYDRAULIC FLUID AND AIR FILLER

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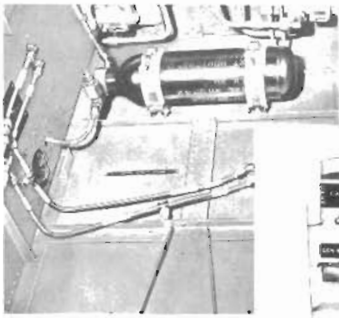
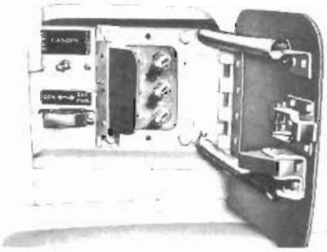
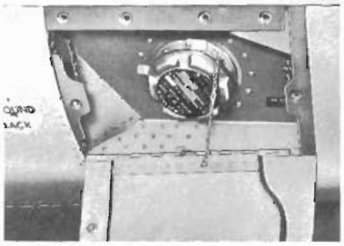
Figure 1-45



7. EMERGENCY BRAKE AIR BOTTLE-3000 PSI

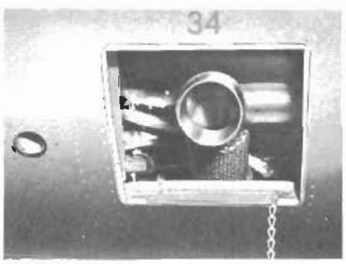


8. EXTERNAL POWER RECEPTACLE

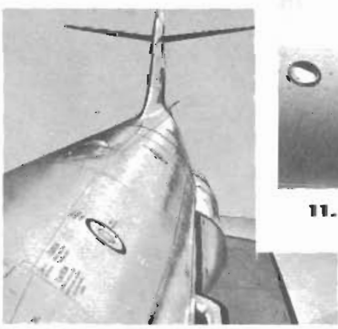


9. SINGLE POINT REFUELING

*10. EXTERNAL TANKS



11. AIR STARTER CONNECTION



12. REFUELING FILLERS
13. AIR REFUELING RECEPTACLE

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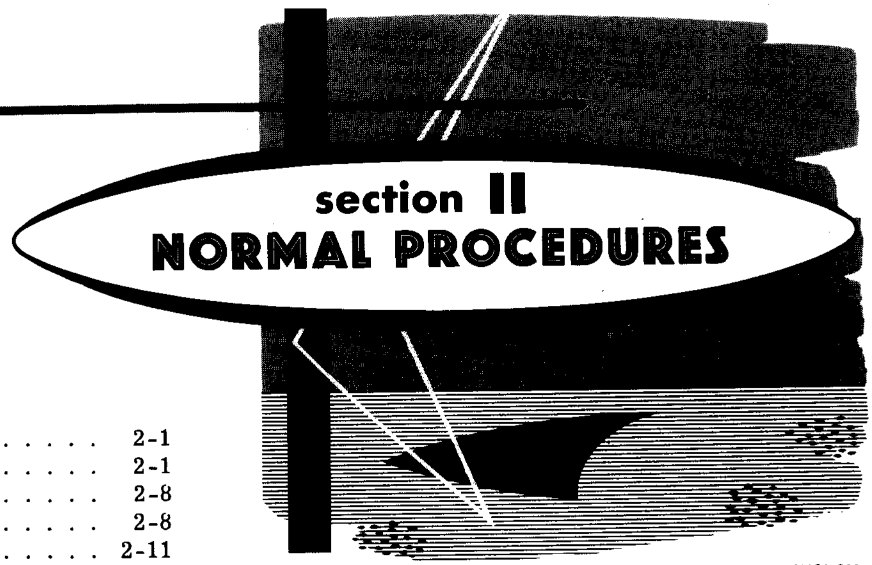


section II NORMAL PROCEDURES

UA20-200

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to Section V for detailed airplane and engine limitations.

FLIGHT PLANNING

Refer to Appendix I to determine fuel consumption, correct airspeed, thrust settings and altitude required for the intended flight mission.

TAKE-OFF AND LANDING DATA CARDS

Complete the Take-Off and Landing Data Cards contained in the Pilot's Abbreviated Flight Crew Checklist (T.O. 1F-101(R)(Y)A-(CL)1-1). Refer to Part 9, Appendix I, for detailed instructions.

WEIGHT AND BALANCE

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

a. Check take-off and anticipated gross weight performance data.
b. Enter take-off gross weight on Form 781, Part II, as directed locally and check to assure that the main landing gear tire limitations will not be exceeded. Refer to Section VII for more detailed information.
c. Make sure amount of fuel, oil, oxygen and special equipment is sufficient for proposed mission.

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. In the event that the ladder is not available for entry or exit some alternate device, i.e., access stand, etc., should be used.

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

Check 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 1-45.

1. Form 781 - CHECK
2. Check availability of flashlight.

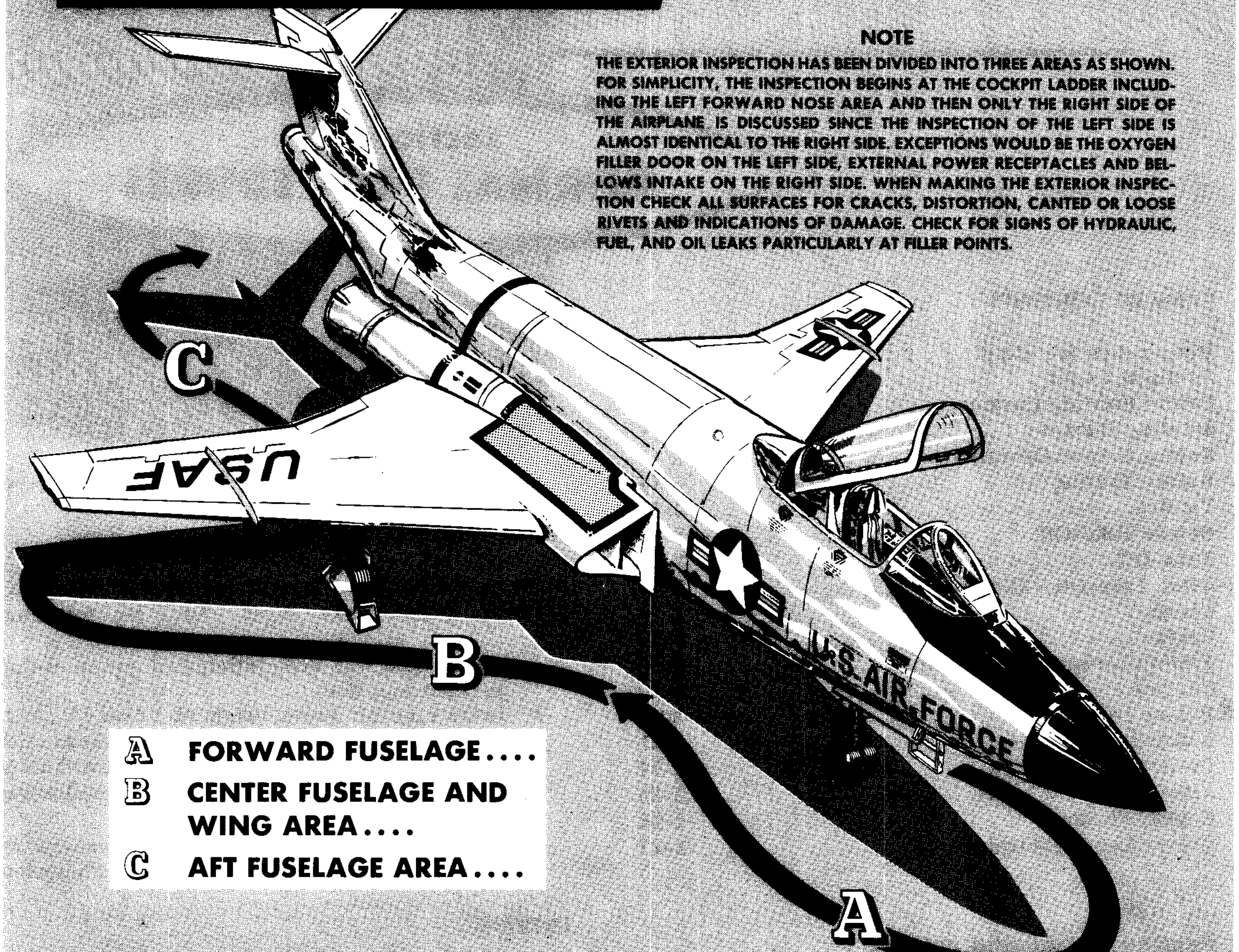
EXTERIOR INSPECTION

Perform exterior inspection as outlined in figure 2-1.

exterior inspection

NOTE

THE EXTERIOR INSPECTION HAS BEEN DIVIDED INTO THREE AREAS AS SHOWN. FOR SIMPLICITY, THE INSPECTION BEGINS AT THE COCKPIT LADDER INCLUDING THE LEFT FORWARD NOSE AREA AND THEN ONLY THE RIGHT SIDE OF THE AIRPLANE IS DISCUSSED SINCE THE INSPECTION OF THE LEFT SIDE IS ALMOST IDENTICAL TO THE RIGHT SIDE. EXCEPTIONS WOULD BE THE OXYGEN FILLER DOOR ON THE LEFT SIDE, 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....

NOTE

IN CHECKING SOME OF THE FOLLOWING ITEMS, IT IS NECESSARY THAT THE PILOT HAVE A FLASHLIGHT DURING DAYLIGHT AS WELL AS NIGHT HOURS.

A FORWARD FUSELAGE AREA 1 THRU 20

CHECK:

1. ANGLE OF ATTACK TRANSDUCER PROBE COVER REMOVED, PROBE FREE FROM DIRT OR DAMAGE AND SET. (BOTH SIDES).
2. RADOME SECURE AND FREE FROM EROSION.
3. STATIC VENT CLEAR. (BOTH SIDES).
4. PITOT COVER REMOVED.
5. OXYGEN FILLER DOOR-OXYGEN FILLER CAP SECURE; VENT AND BUILD-UP VALVE IN BUILD-UP POSITION; EXTERNAL CANOPY EMERGENCY JETTISON LANYARD IN PLACE AND SAFETY PIN REMOVED, AND OXYGEN FILLER DOOR SECURELY FASTENED.
6. NOSE WHEEL AREA CHECK.
   - A. NOSE GEAR STEERING UNIT HYDRAULIC LINES SWIVEL FREELY FORE AND AFT.
   - B. NOSE GEAR DOOR HINGES AND DOOR UPLATCH MECHANISM SECURE.
   - C. NOSE GEAR WARNING LIGHT LIMIT SWITCH FREE OF DIRT.
   - D. LANDING LIGHTS CONDITION.
   - E. STRUT FOR INFLATION. (REFER TO NOSE GEAR NAME PLATE).
   - F. TIRE INFLATION, SLIPPAGE MARKS, AND CONDITION FOR CUTS AND BRUISES.
   - G. NOSE GEAR HYDRAULIC LINES SECURE.
7. EMERGENCY BRAKE AIR BOTTLE SECURE, EMERGENCY BRAKE PRESSURE GAGE 3000 PSI.
8. EMERGENCY BRAKE VALVE ARM IN OFF POSITION, PULL WIRE SECURE.
9. NOSE GEAR SAFETY PIN INSTALLED.
10. PIP PIN INSTALLED.
11. ACCESS DOORS AND LATCHES SECURE.
    - A. NOSE EQUIPMENT BAY DOORS SECURE, LATCHES LOCKED. (BOTH SIDES).
    - B. HYDRAULIC ACCESS DOOR SECURE.

UA20-201-1A

Figure 2-1

A FORWARD FUSELAGE AREA (10)(20)

CHECK:

1. ANGLE OF ATTACK TRANSDUCER PROBE COVER REMOVED, PROBE FREE FROM DIRT OR DAMAGE AND SET. (BOTH SIDES).
2. STATIC VENT CLEAR. (BOTH SIDES).
3. RADOME SECURED AND FREE FROM EROSION.
4. PITOT COVER REMOVED.
5. ALL WINDOW COVERS REMOVED. (BOTH SIDES).
   A. FORWARD OBLIQUE CAMERA WINDOW COVER REMOVED.
   B. VERTICAL TRI-CAMERA WINDOW COVER REMOVED.
   C. AFT-CAMERA BAY WINDOW COVER REMOVED.
   D. TRI-CAMERA OBLIQUE SIDE COVERS (BOTH SIDES) REMOVED.
   E. VIEWFINDER WINDOW COVER REMOVED.
6. IFF ANTENNA SECURE AND FREE OF DAMAGE.
7. OXYGEN FILLER DOOR-OXYGEN FILLER CAP SECURE; VENT AND BUILD-UP VALVE IN BUILD-UP POSITION; EXTERNAL CANOPY EMERGENCY JETTISON LANYARD IN PLACE AND SAFETY PIN REMOVED, AND OXYGEN FILLER DOOR SECURELY FASTENED.
8. NOSE WHEEL AREA CHECK.
   A. NOSE GEAR STEERING UNIT HYDRAULIC LINES SWIVEL FREELY FORE AND AFT.
   B. NOSE GEAR DOOR HINGES AND DOOR UPLATCH MECHANISM SECURE.
   C. NOSE GEAR WARNING LIGHT LIMIT SWITCH FREE OF DIRT.
   D. LANDING LIGHTS CONDITION.
   E. STRUT FOR INFLATION. (REFER TO NOSE GEAR NAME PLATE).
   F. TIRE INFLATION, SLIPPAGE MARKS, AND CONDITION FOR CUTS AND BRUISES.
   G. NOSE GEAR HYDRAULIC LINES SECURE.
9. EMERGENCY BRAKE AIR BOTTLE SECURE, EMERGENCY BRAKE PRESSURE GAGE 3000 PSI.
10. EMERGENCY BRAKE VALVE ARM IN OFF POSITION, PULL WIRE SECURE.
11. NOSE GEAR SAFETY PIN INSTALLED.
12. PIP PIN INSTALLED.
13. SPLIT VERTICAL CAMERA ACCESS DOOR AND CAMERA WINDOW DOORS SECURE.
14. ELECTRICAL EQUIPMENT COMPARTMENT
   A. CIRCUIT BREAKERS IN.
   B. FUSES IN FUSE PANEL.
15. ACCESS DOORS AND LATCHES SECURE.
   A. NOSE EQUIPMENT BAY DOORS SECURE, LATCHES LOCKED. (BOTH SIDES).
   B. ELECTRICAL AND HYDRAULIC EQUIPMENT ACCESS DOORS LOCKED.

B CENTER FUSELAGE AND WING AREA

CHECK:

1. INTAKE DUCT AREA, CLEAR AND SECURE.
   A. RIGHT HINGED SPLITTER VANE SECURE. CHECK THREE BOLTS IN PLACE AND HINGE SECURE.
   B. HYDRAULIC ACCESS DOOR (INSIDE DUCT) SECURE. ALL FASTENERS PRESENT AND SECURE.
   C. DUCT SPLITTER VANE SECURE AND DUCT AREA CLEAR.
2. LANDING GEAR EMERGENCY AIR BOTTLE 3000 PSI. UTILITY HYDRAULIC ACCUMULATOR (RIGHT SIDE) AND PRIMARY HYDRAULIC ACCUMULATOR (LEFT SIDE) AIR PRESSURE 1200 PSI. HYDRAULIC CAPS AND ACCESS DOORS SECURE.
3. OIL TANK CAP AND ACCESS DOOR SECURE.
4. LOWER ENGINE ACCESS DOOR SECURE.
5. DROP TANKS SERVICED (IF INSTALLED). DROP TANK FUEL LEVEL SHOULD BE VISUALLY CHECKED OR, IF QUANTITY IS QUESTIONABLE, A DIP STICK SHOULD BE USED TO DETERMINE CORRECT AMOUNT. CHECK TANK CAP SECURE AND DROP TANK SAFETY PIN REMOVED.
6. MAIN GEAR AND WELL AREA CHECK.
   A. MAIN GEAR WELL CONDITION FOR HYDRAULIC LEAKS OR DAMAGE.
   B. MAIN GEAR INBOARD DOOR DOWN, CHECK DOOR HINGE MECHANISM.
   C. GEAR WARNING LIGHT LIMIT SWITCH FREE OF DIRT.
   D. GEAR COMPRESSION LINKAGE SECURE.
   E. STATIC GROUND SECURE.
   F. WHEELS CHOCKED.
   G. TIRE INFLATION, SLIPPAGE MARKS, AND CONDITION FOR CUTS AND BRUISES.
   H. GEAR DOORS SECURE AND FREE OF DAMAGE.
   J. FLIPPER DOOR SECURE.
7. GEAR UPLATCH HOOK DOWN.
8. GROUND SAFETY LOCK INSTALLED.
9. STRUT FOR INFLATION. (REFER TO MAIN GEAR NAME PLATE).
10. WING GENERAL CONDITION CHECK.
   A. WING LEADING EDGE FOR DENTS OR DISFIGURATION AND CHECK OVERALL SKIN CONDITION.
   B. WING POSITION LIGHT AND WING TIP FREE OF DAMAGE.
   C. AILERON AND FLAP SECURE AND FREE FROM DAMAGE.
11. EXHAUST AREA CHECK.
   A. TAIL PIPE FOR DENTS, CRACKS, OR FUEL ACCUMULATION.
   B. EXHAUST NOZZLE POSITION, SEGMENT CONDITION, AND SEGMENT LINKAGE SECURE.
   C. CONDITION OF CONE AND AFTERBURNER FLAME HOLDERS.
   D. BLAST AREA PLATES AND RIVETS SECURE.

C AFT FUSELAGE AREA

CHECK:

1. SPEED BRAKE CONDITION AND POSITION.
2. BELLOWS INTAKE CLEAR.
3. DRAG CHUTE DOOR AND ACCESS PANEL SECURE.
4. POSITION LIGHTS FREE OF DAMAGE.
5. RUDDER AND STABILIZER CONDITION.

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

WHILE STANDING ON THE LADDER, LOOK FORE AND AFT AND CHECK....

6. FUSELAGE SKIN AND POSITION LIGHT CONDITION.
7. AIR REFUELING RECEPTACLE DOOR AND CELLS 1, 3 AND 5 FILLER CAPS SECURE.
8. NOSE SKIN AND WINDSHIELD CONDITION, AND AIR REFUELING PROBE DOORS SECURE.

UA20-201-2B

EJECTION SEAT AND CANOPY CHECK

1. 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.
2. Ejection seat quick-disconnects - CHECK PROPERLY MATED
   Check quick-disconnect fittings; oxygen, anti-G-suit, radio and face heat lines properly mated and secure.

Note

> If flight suit ventilation line is not to be used in the (20)(20) airplanes, be sure that the lead line is secured to the anti-G suit hose in the downward position. See figures 1-41 and 1-42. 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.

3. Safety belt and shoulder harness - CHECK FREE
   Check safety belt and shoulder harness free from being wedged or caught in other controls.
4. Canopy condition - CHECK
   Check for cracks in canopy and windshield glass. Check canopy seal condition.
5. Canopy safety pin - REMOVED
   Canopy pin will be retained by ground crew, except on cross country missions 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
3. Gun master switch - OFF (1) THRU (20)

Before External Electrical Power Is Connected–

4. Publications and flight data - CHECK
   Check that Flight Information Publications and other necessary publications are included and current.
5. Safety belt and shoulder harness - FASTENED
   a. Attach the shoulder harness and parachute lanyard to the safety belt.
   b. Connect the zero delay lanyard to the parachute ripcord handle.

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 zero delay lanyard hooked to the parachute ripcord handle to insure proper operation of this equipment. Refer to Automatic-Opening Safety Belt in Section I and Low Altitude Ejection in Section III.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION CONTINUED

c. In the 54-1495 and 54-1496 (20) airplanes, prior to the incorporation of T.O. 1F-101-857, and in the (1) THRU (20), (10) and 54-1494 (20) airplanes, secure the personal leads disconnect assembly by looping the personal leads retainer straps around the leg straps of the parachute harness.

WARNING

In the 54-1495 and 54-1496 (20) airplanes, prior to incorporation of T.O. 1F-101-857, and in the (1) THRU (20) (10) and 54-1494 (20) airplanes, it is imperative that the pilot secure the personal leads retainer straps properly to prevent the upper portion of the disconnect assembly from flying around during ejection and thereby preventing possible serious injury to the pilot.

6. Seat, rudder pedals, anti-G suit pressure regulating knob - ADJUST AS DESIRED
   Turn battery switch ON to supply electrical power to seat adjustment motor. After adjusting seat, return battery switch to OFF. Adjust rudder pedals by use of hand crank located on pedestal. Adjust anti-G suit pressure setting on HI or LO.

CAUTION

In airplanes equipped with manual seat adjustment, check alignment of white index marks to insure that seat adjustment lever is properly positioned to lock seat.

7. Stick grip - CHECK
   Check stick grip firmly attached.
8. Gunsight control knob - OFF (1) THRU (20)
9. APS-54 power switch - OFF (20) (20)
10. Radar master switch - OFF (1) THRU (20)
11. Emergency camera door switch - NORMAL (10) (20)
    Check emergency camera door switch in NORMAL position, guard closed.
12. Photo compartment temperature control panel - CHECK (10) (20)
    a. System master switch - OFF
    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.

13. Drift computer control knob - AS REQUIRED (10) (20)
    Set drift computer control as required.
14. Split camera, tri-camera, forward camera, station control panels - CHECK (10) (20)
    a. Mode switches - Set as briefed
    b. Frame counters - Set total
15. Camera master control panel - CHECK (10) (20)
    a. Power switch - OFF
    b. Ready switch - OFF
    c. Operate switch - OFF
    d. Exposure switch - Set as briefed
    e. Transport switch - Set as briefed
16. Fuel quantity gage tank selector knob - TOTAL
17. Pitch-up warning pusher and horn switches - ON
    Check pusher switch and horn switch guards safety wired ON.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION CONTINUED

18. Fuel pumps switch - NORMAL
19. UHF command radio - OFF
20. Drag chute handle - IN AND SECURE
21. Flap lever - RETRACT
22. Landing lights switch - OFF
23. Circuit breakers - IN
24. Refuel switch - NORM
25. Fuel transfer switch - NORM
26. External tank jettison switch - NORMAL
27. Throttles - CLS'D
28. Speed brake switch - NEUTRAL
29. Rudder trim switch - NEUTRAL
30. Engine master switches - OFF
31. Engine start switches - OFF
32. Engine fuel control switches - NORMAL
33. Antenna selector switch - UPR
34. Landing gear handle - DOWN
35. Emergency speed brake switch - NORMAL
36. Anti-skid switch - OFF 54-1438 (20), 54-1441 (20), and 54-150, (10)
37. Turn switch - NORMAL (20)(20)
38. Compass slave switch - ON
39. Compass power switch - NORM
40. Viewfinder control panel - CHECK (10)(20)
    a. Drift switch - NEUTRAL
    b. Filter switch - As desired
    c. Grid illumination knob - OFF
    d. View selector knob - As desired
    e. Viewfinder - Scanner switch - SCANNER
41. Radar warning switch - BOTH (20)(20)
42. Gun master switch - OFF (1) THRU (20)
43. LABS start switch - OFF (1) THRU (20)
44. Bomb system selector switch - OFF (1) THRU (20)
45. Gun sight - CAGED (1) THRU (20)
46. Airspeed and Mach indicator - SET
    Set airspeed index pointer on Go-No Go speed.
47. Altimeter - SET
48. Clock - SET
49. Vertical velocity indicator - CHECK
    Check vertical velocity indicator needle positioned on zero.
50. Accelerometer - SET
    Depress push-to-set knob and note all three indicating pointers at 1 "g" position.
51. Radar scope - CHECK (1) THRU (20)
    Check radar scope clean and free from cracks and damage. Check scope hood secure and that scope filter is available.
52. Viewfinder - CHECK (10)(20)
    Check viewfinder lens clean and free of damage. Check scope head secure and that scope filter is available.
53. Emergency gear extension handle - IN PLACE AND SECURE
54. Emergency brake handle - IN PLACE AND SECURE
55. Battery switch - OFF
56. Generator switches - CHECK ON
57. Boom IFR switch - RETRACT
58. Probe IFR switch - RETRACT
59. Pitot heat switch - OFF

CAUTION

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

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION CONTINUED

60. Windshield blower switch - OFF (20)(20)
61. Windshield anti-icing switch - LOW
62. Cabin pressure switch - NORMAL
63. Cabin air temperature knob - AS DESIRED
    Set cabin air temperature knob to produce desired temperature for existing climatic conditions.

Note

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

64. Air control lever - AS DESIRED
    Position air control lever to direct air flow as desired for existing climatic conditions.
65. VHF navigation radio power switch - OFF
66. Standby compass light switch - OFF
67. Face heat knob - OFF
68. Autopilot - OFF
    Check the following autopilot controls:
    a. Altitude switch - OFF
    b. Localizer switch - OFF
    c. Approach switch - OFF
    d. Damper switch - OFF
69. SIF control panel - AS DIRECTED (20)(20)
70. IFF master knob - OFF
71. J-4 directional indicator controls - CHECK (20)(20)
    a. Control knob - MAG
    b. Latitude knob - SET
72. Lights - CHECK
    Set all interior and exterior light controls as the mission requires.
73. Spare lamps - CHECK
74. Camera circuit breakers - IN (20)

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION CONTINUED

With External Electrical Power Connected—

75. Fuel quantity gage - CHECK
    Turn fuel quantity gage tank selector knob to all positions and check fuel quantity. Return to No. 2 cell.
76. Landing gear position indicators - CHECK
    Check three (red) landing gear indicator lights out.
77. Wing flap position indicator - CHECK
    Check flap position indicator showing flaps up.
78. Fire warning system - CHECK
    Check operation of fire warning lights.
79. Pitot heat switch - CHECK
    Check operation with ground personnel and return switch to OFF.
80. Ground position indicator - CHECK
    Set ground position indicator controls on appropriate mission condition values.
    a. Latitude switch - SET
    b. Longitude switch - SET
    c. Wind direction switch - SET
    d. Wind force switch - SET
    e. Variation switch - SET
81. Warning lights - CHECK
    a. Warning light test button - DEPRESS then RELEASE
       All warning, caution, and indicator lights should illuminate when the warning light test button is depressed, and should go out when the warning light test button is released.
    b. Instrument light knob - ON
    c. Warning light test button - DEPRESS
       All warning, caution, and indicator lights should illuminate.
    d. Warning light dimmer button - DEPRESS then RELEASE
       All warning, caution, and indicator lights should dim when the warning light dimmer button is depressed, and should remain dim when the warning light dimmer button is released.
    e. Instrument light knob - OFF
       All warning, caution, and indicator lights should revert to bright.
    f. Warning light test button - RELEASE
       All warning, caution, and indicator lights should go out.
82. Radio and navigational equipment - ON
83. Oxygen quantity gage - CHECK
    Check that oxygen quantity is sufficient for intended mission. Refer to Oxygen Duration Chart, figure 4-13.
84. Oxygen regulator lever - 100% OXYGEN
    Refer to Oxygen System Preflight Check, Section IV.
85. Oxygen emergency lever - NEUTRAL
86. Oxygen supply lever - ON
87. Oxygen supply pressure gage - 70 to 100 psi
88. Cockpit lights - CHECK
    Check operation of all cockpit lights and set at desired brilliance.
    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

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INTERIOR INSPECTION CONTINUED

89. 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 75 through 89 may be accomplished during the Before Taxiing Check 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 clean of personnel, airplanes and vehicles. See figure 2-2. The rotational planes of the engine and starter turbine wheels (marked by a red stripe on the 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 duct.
- Danger areas aft of the airplane are created by high exhaust temperature and velocities. The danger increases with afterburner operation. See figure 2-2.

Whenever possible start and run up engines on paved surface to minimize the possibility of foreign objects being drawn into the compressor with resultant engine damage.

STARTING ENGINES

Note

- The following procedure can also be used for starting engines without any source of external electrical power (battery start).
- Either engine may be started first, however, this procedure establishes the left engine (No. 1) first.

1. Throttles - CLS'D
2. External compressed air source - CONNECTED
Check that proper external compressed air source is connected to starter system and that sufficient air pressure is available (35 psi indicated from ground crew).
3. Power selector switch - ON EXT 1 THRU 15 10 - EXT PWR 20 20
If a battery start is to be made, place the power selector switch to ON EXT for the 1 THRU 15 10 airplanes or signal the ground crew to place the power selector switch to EXT PWR for the 20 20 airplanes. This eliminates the 200 volt a-c emergency bus and provides ignition from the battery bus.

Note

During a battery start the oil pressure gage, fuel flow indicator, and hydraulic pressure gages will be inoperative until the generator becomes operative at approximately 30% rpm.

4. Left engine master switch - ON

CONTINUED ON NEXT PAGE

STARTING ENGINES CONTINUED

5. 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.

6. Oil pressure gage - CHECK
   Watch for oil pressure indication as engine rpm begins to rise.
7. 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.

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.

8. Fuel flow indicator - CHECK
   The fuel flow indicator should indicate between 850 and 1100 lbs. per hour.
9. Exhaust temperature gage - CHECK
   Exhaust temperature should not exceed the maximum starting temperature limits during transition period of 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 5-1, Section V.

10. Oil pressure gage - CHECK
    Oil pressure should be within limits.
11. Hydraulic pressure gages - CHECK
    With one engine started, both hydraulic pressure gages should read within limits. 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.
12. Landing gear ground locks and nose gear safety pin - REMOVE
    Signal the ground crew to display these three items to assure their removal from the airplane.
13. External electrical power source - DISCONNECTED
    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 in the (20) (20) airplanes, has been placed in the GEN position by the ground crew. In the (1) THRU (15) (10) airplanes, the power selector switch, located on the right vertical console (figure 1-15) must be placed to ON GEN.

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STARTING ENGINES CONTINUED

14. Power selector switch - ON GEN 1 THRU 15 (10) - GEN 20 (20)
    The ground crew should physically position the power selector switch to the GEN position in the 20 (20) airplanes as it is possible for the switch to remain in the EXT PWR position when the access door is closed.
15. Transformer-rectifier - CHECK
    With battery switch OFF, depress any press-to-test warning light. Illumination of the light indicates transformer-rectifiers are operational.
16. Battery switch - ON
17. Start remaining engines.

WARNING

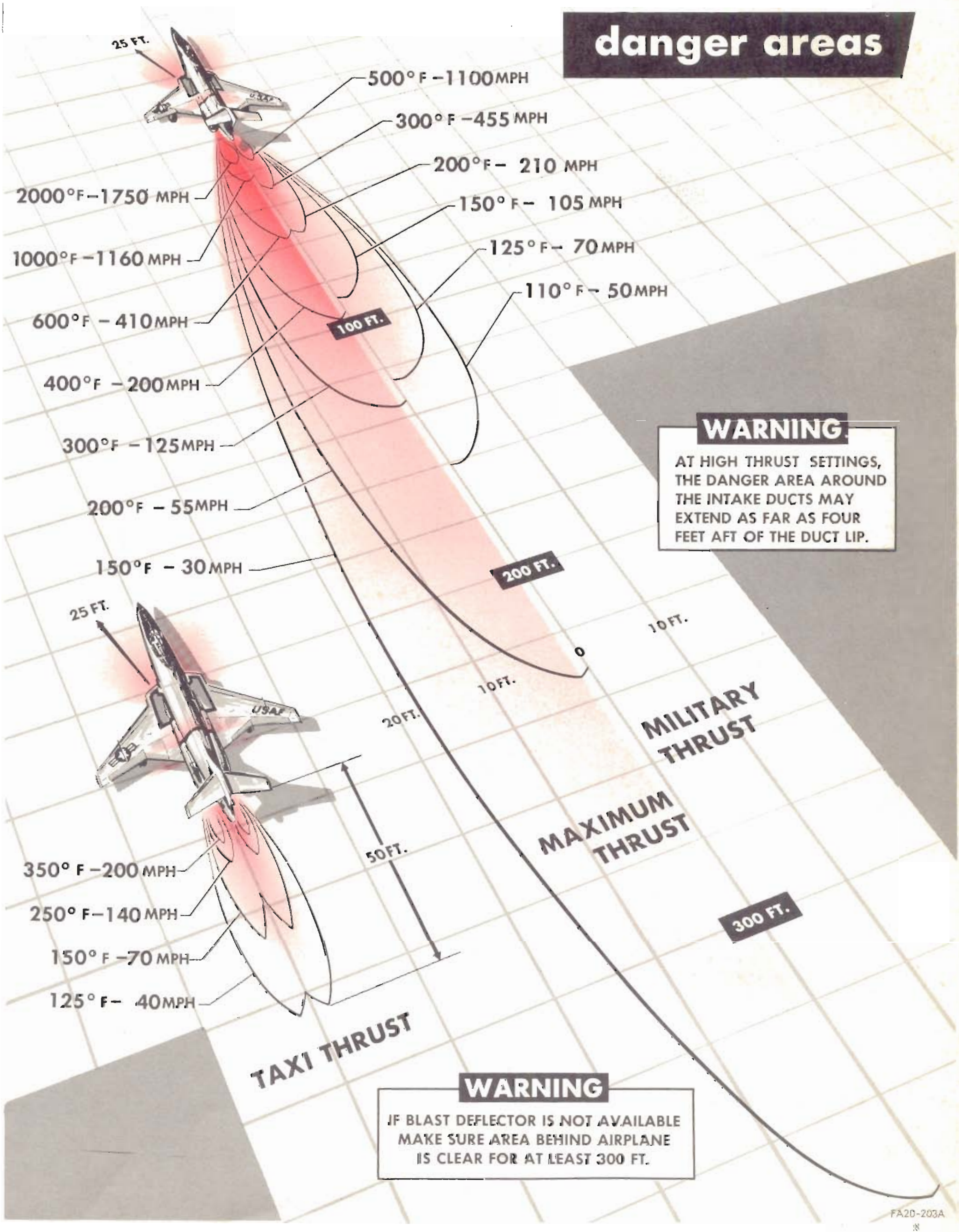
A "hot start" may be anticipated by watching the exhaust temperature gage. If an abrupt rise in temperature is noted or normal starting limits are exceeded, the engine should be shut down immediately.

CAUTION

- Should the engine fail to light-off within 20 seconds after placing the throttle to IDLE, the start should be aborted. The failure of the 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 start switch to 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.

- 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 start switch to 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.

danger areas



WARNING

AT HIGH THRUST SETTINGS, THE DANGER AREA AROUND THE INTAKE DUCTS MAY EXTEND AS FAR AS FOUR FEET AFT OF THE DUCT LIP.

WARNING

IF BLAST DEFLECTOR IS NOT AVAILABLE MAKE SURE AREA BEHIND AIRPLANE IS CLEAR FOR AT LEAST 300 FT.

Figure 2-2

ENGINE CLEARING PROCEDURE

If it becomes necessary to clear the engine, proceed as follows:

1. Electrical and air sources - CONNECTED
2. Throttle - CLS'D
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.
6. Check tailpipe area clear of fuel accumulation prior to attempting another start.

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 Maximum thrust.

BEFORE TAXIING

1. External compressed air source - DISCONNECTED
   Check generator warning lights out.
2. Hydraulic pressure gages - CHECK
   Check hydraulic pressure 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.
3. Pitch-up warning system - CHECK
   a. Autopilot engage switch - ENGAGE
   b. Signal ground crew to position angle of attack sensors.
   c. Rotate left (pusher) sensor to full counterclockwise position and right (horn) sensor to full clockwise position.

   Note

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

   d. Control stick - AFT OF NEUTRAL
   e. Pitch-up warning test button - HOLD DEPRESSED
      Depressing the test button will energize the warning horn and engage the pusher. Pusher will cause the autopilot engage switch to move out of engage.
   f. Rotate left (pusher) sensor to full clockwise position.
   g. Hold control stick slightly aft of neutral and hold pitch-up warning test button depressed.
   h. Slowly rotate left (pusher) sensor counterclockwise and the pusher will engage when the left (pusher) sensor reaches a position to approximately align with reference mark. On airplanes equipped with this reference mark, the pusher should engage when the sensor is slightly clockwise of the center travel position.
   i. Pusher release switch - DEPRESS
      Depressing the release switch will disengage the pusher but the warning horn will continue until the test button is released.
4. SIF/IFF - STDBY
5. 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 and 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 out-of-trim 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

6. Manual flight control system - CHECK
   a. Autopilot engage switch - DISENGAGE
      Check that the autopilot engage switch is out of the ENGAGE position.
   b. Control stick - FULL FORWARD
      Move the control stick slowly and smoothly to the full forward position, and obtain signal from the ground crew that the stabilizer has moved smoothly to the extreme leading edge up position.
   c. Control stick - FULL AFT
      Move the control stick slowly and smoothly to the full aft position, and obtain signal from the ground crew that the stabilizer has moved to the extreme leading edge down position.
   d. Rapidly and smoothly move the control stick forward and aft. Confirm that there is no binding of the controls.
7. Windshield anti-ice switch - LOW
8. Engine 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.
9. Take-off trim - ADJUST
   Hold take-off trim button depressed until illumination of light indicates airplane is trimmed for take-off.
10. Anti-skid system - CHECK and ON 54-1438 (20), 54-1441 (20), and 54-150 (10)
    Hold anti-skid release switch depressed and check that the anti-skid "Out" light illuminates within 3-1/2 seconds.
11. Speed brakes - CHECK
    Open and close speed brakes and check operation. Obtain ground crew signal that speed brakes are fully closed.
12. Wing flaps - CHECK
    Check wing flap lever - EXTEND
    Check wing flap indicator on landing gear control panel.
    Observe ground crew signal that flaps are down.
13. Nose gear steering - CHECK
    Depress nose gear steering button on control stick and obtain ground crew signal that steering unit is operable with rudder movement.

CONTINUED ON NEXT PAGE

BEFORE TAXIING CONTINUED

14. 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.

15. Chocks - REMOVE
    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 airplane.

TAXIING

1. Brakes - CHECK
   After initial roll, apply brakes to check operation.

Note

- The addition of 10% thrust on only one engine is all that is necessary to initiate taxi roll under most conditions. Once the airplane is rolling, it can be taxied on hard surfaces at idle thrust ranges.
- Use nose gear steering as much as possible to minimize use of brakes.

CAUTION

- Do not exceed 25 knots while taxiing to prevent excessive tire wear and brake heat.
- Since "brake feel" is difficult to sense in airplanes with a power brake system, it is possible for the pilot to inadvertently "ride" the brakes while taxiing. Therefore, be careful not to ride the brakes.
- With the canopy open, remain below structural limit speed to prevent damage to canopy operating mechanism.
- Adjust canopy so that minimum side motion will occur to prevent excessive side loads from damaging canopy mechanism.
- The canopy should be closed and adequate distance between airplanes maintained during formation taxiing. An open canopy may become damaged from jet blast.
- 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.
- 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 2-3.

2. Flight instruments - CHECK
   For directional indication, set the runway heading. Magnetic compass - Check proper heading and condition. Attitude indicator - Normal and set for take-off. Turn and slip indicator - Deflected in direction of turn while taxiing and ball free in the race.
3. Radio and navigational equipment - CHECK
   Assume proper operation of communication equipment. Determine operation of radio navigational aids by tuning in a station in close proximity and noting identifier signals. Check all functions of operation.

turning radius and ground clearance

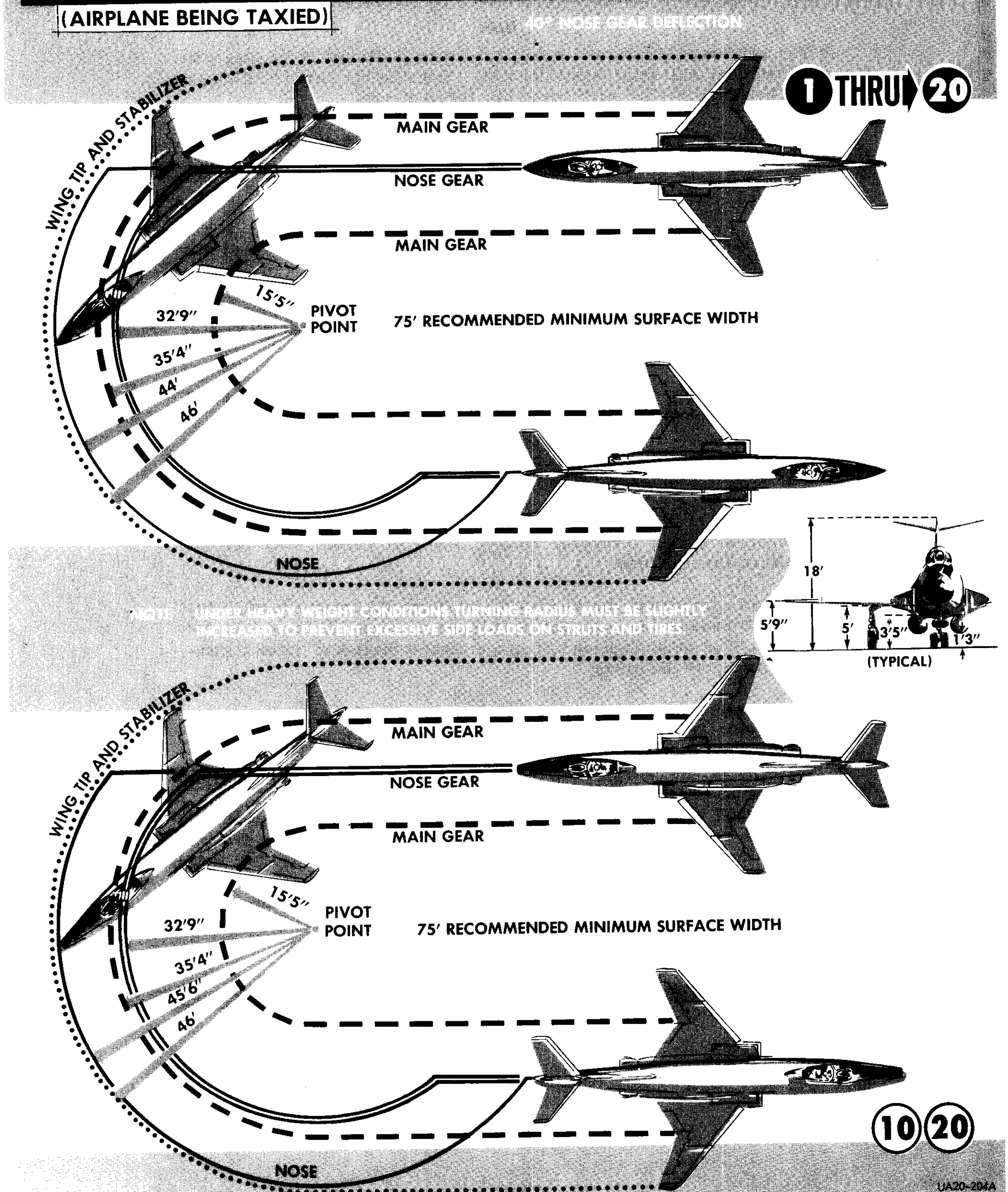


Figure 2-3

BEFORE TAKE-OFF

PRE-TAKE-OFF AIRPLANE CHECK

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

1. Zero delay lanyard - HOOKED
   Check zero-delay lanyard hooked to parachute ripcord handle.
2. Safety belt and shoulder harness - CHECK
   a. MA-4, check automatic parachute key properly inserted.
   b. MA-5, check automatic parachute lanyard anchor properly inserted over safety belt swivel link.
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
   Check flight controls for freedom of movement and that oxygen and G-suit hoses do not interfere with stick movement.
7. Autopilot engage switch - DISENGAGED
   Check that the autopilot engage switch is out of the ENGAGE position.
8. Flap lever - EXTEND
9. Canopy - CLOSED
   Check canopy unlocked warning light out and canopy defogging ducts mate.
10. Take-off trim - CHECK
    Depress take-off trim button until take-off trim light illuminates.
11. Pitot heat switch - AS REQUIRED
    Just prior to lining up for take-off, position pitot heat switch as climatic conditions required.

    CAUTION

    Warm-up time for pitot heat is approximately one minute at 32°F. Allow sufficient heating time if taking off into freezing rain or other visible moisture with surface temperatures at or near freezing.
12. SIF/IFF - NORM
    Select IFF Mode and SIF Code as briefed.

PRE-TAKE-OFF ENGINE CHECK

CAUTION

- Exercise care in positioning airplane on runway for pre-take-off engine check during formation operations. Clearance should include 125 feet at MILITARY thrust setting and 200 feet at MAXIMUM thrust setting. Try to stagger airplane position so that no airplane is directly behind another and insure canopy closed and locked. See figure 2-2 for exhaust danger areas.
- 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.

1. Emergency fuel control system - CHECK
   a. Left throttle - IDLE
   b. Left engine fuel control switch - EMERG
   A slight fluctuation in engine rpm with a fuel flow indication of 750 to 1150 pounds per hour at IDLE indicates the shift from normal fuel control to emergency fuel control.

CONTINUED ON NEXT PAGE

PRE-TAKE-OFF ENGINE CHECK CONTINUED

c. Left engine fuel control switch - NORMAL
A slight fluctuation in engine rpm with a fuel flow indication of 850 to 1100 pounds per hour at IDLE indicates the shift from emergency fuel control to normal fuel control.

d. Check the right engine as outlined above.

2. Engine acceleration and thrust - CHECK

a. Left throttle - OPEN
Full Military thrust should be obtained within 15 seconds. If engine stalls prevent reaching full Military thrust in 15 seconds, the engine should be shutdown and the cause determined prior to flight.

b. Engine pressure ratio gage - CHECK
With the minimum engine pressure ratio setting dialed in, check that the gage pointer falls between the double pointers of the take-off index marker (minimum) or below the maximum prescribed limit.

Note

These limits are outlined in Appendix I, Performance Data and the minimum limits are tabulated in the abbreviated check list.

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.

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. Nose gear steering - ENGAGED
Line up on runway with nose gear steering engaged.

Note

Depressing and releasing the nose gear steering button after the system has been engaged will result in loss of nose gear steering.

2. Brakes - APPLY
3. Throttles - 80% RPM
Smoothly advance throttle to approximately 80% rpm.
4. Instruments and warning lights - CHECK
Recheck the instruments for proper indications and check that all warning lights are out.
5. Brakes - RELEASE

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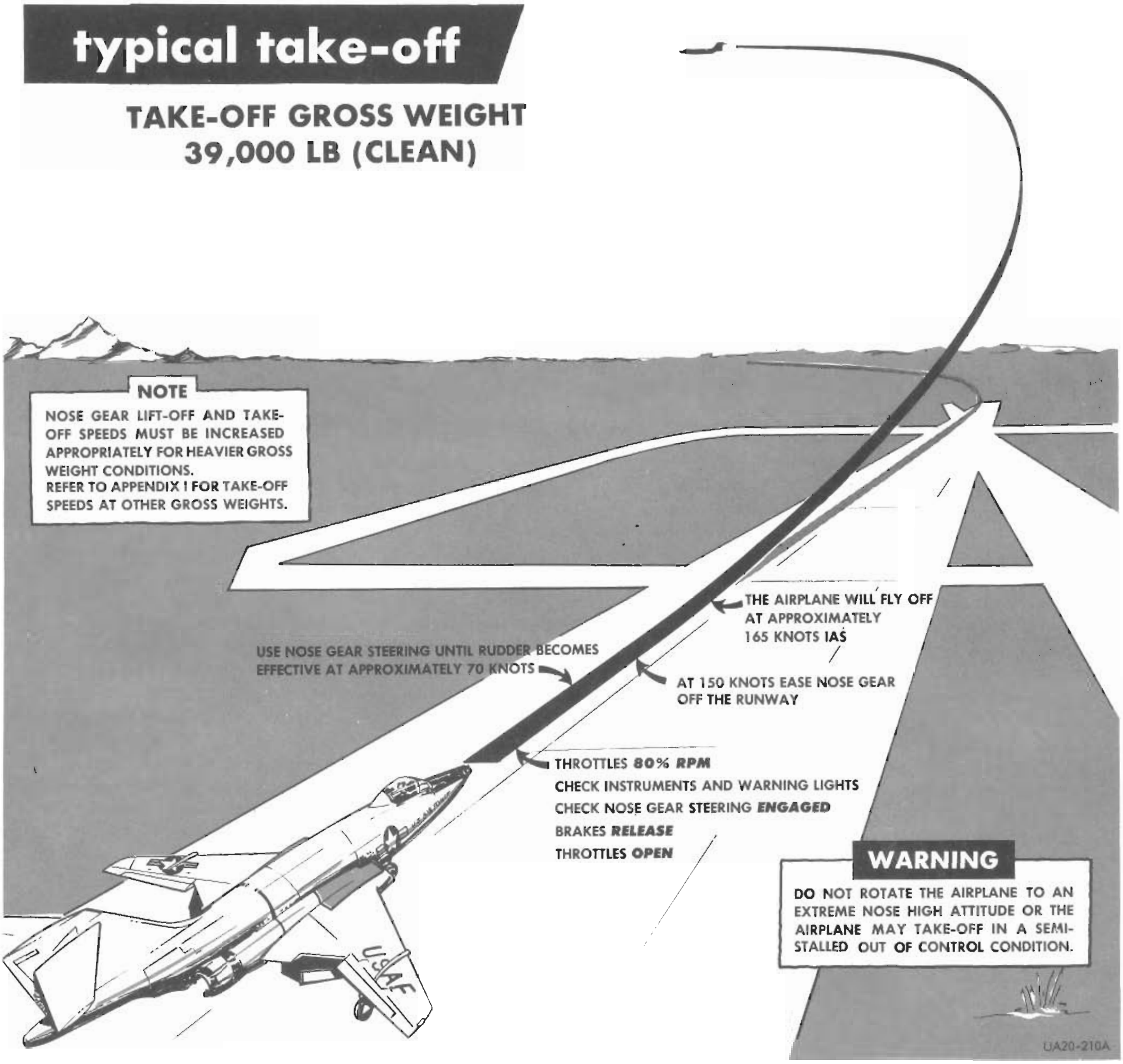


Figure 2-4

NORMAL TAKE-OFF CONTINUED

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 run (high runway temperatures, short runways, or high field elevation).

CONTINUED ON NEXT PAGE

NORMAL TAKE-OFF CONTINUED

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.

WARNING

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

9. Allow the airplane to fly off at take-off airspeed.

Note

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

MINIMUM RUN TAKE-OFF

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

CROSSWIND TAKE-OFF

Under crosswind conditions, the airplane 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 run will be increased. As take-off speed is approached and the airplane 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. Refer to Appendix I.

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 run 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.

AFTER TAKE-OFF–CLIMB

When definitely airborne:

1. Landing gear handle - UP
   Check the gear position indicators out and the gear handle warning handle 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 further operation.

2. Flap lever - RETRACT
   Retract flaps before reaching flap limit airspeed. Check flap indicator.

Note

- Military thrust is recommended for maximum range climb when climbing time to altitude is not important. Refer to Climb charts in Appendix I 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.

CONTINUED ON NEXT PAGE

AFTER TAKE-OFF—CLIMB CONTINUED

Note

- Monitor No. 2 cell with fuel quantity gage tank selector throughout climb to insure 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 monitor TOTAL throughout the remainder of flight. Periodically check 1, 4 and 5 for proper transfer.
- Upon terminating afterburner operation, check the engine pressure ratio gages for proper fluctuation. If the engine pressure ratio does not return to its original setting, reduce thrust to idle, or recycle the afterburner to close the exhaust nozzles. Refer to Afterburner Nozzle Failure, Section III for additional information.

3. Zero-delay lanyard - STOWED
   After reaching minimum safe ejection altitude, manually disconnect zero-delay lanyard and "stow" as outlined in the Zero Delay Lanyard Engagement Requirements chart (figure 3-5).

WARNING

It is imperative that the zero-delay lanyard be disconnected in accordance with the Zero Delay Lanyard Engagement Requirements chart (figure 3-5). If the lanyard is left connected to the parachute ripcord handle, 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 subjecting the pilot to severe shock loads or prolonged exposure to temperature and pressure extremes.

4. Visually check seat safety pin - REMOVED
5. 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.

6. Autopilot engage switch - ENGAGE
   The autopilot should be engaged after passing through 2000 feet terrain clearance unless otherwise directed.

CAUTION

For any extended flights below 5000 feet terrain clearance, the autopilot should be engaged, however, the autopilot must be disengaged when terrain clearance is 500 feet or less.

7. Cabin air temperature knob - AUTO
8. Upon reaching level-off, fuel transfer switch - AUX FUEL

Note

For additional information, refer to Fuel System Management in Section VII.

CONTINUED ON NEXT PAGE

AFTER TAKE-OFF–CLIMB CONTINUED

9. IFF - CHECK
   If positive operation of IFF has not been established during departure with an Air Traffic Control Facility, a check should be made with such a facility as soon after take-off as flight conditions permit.

   Note

   For airplanes operating on Radar Controlled Airways or through Positive Controlled Airspace this check must be performed prior to entering these regions. If IFF is inoperative, consult the appropriate navigation publication before entering controlled areas.

10. Altimeter - 29.92" Hg or AS REQUIRED
    After climbing through 23,500 feet, reset altimeter to 29.92" Hg or as required to compensate for instrument error.

CLIMB

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

CRUISE

Cruise control data for various gross weights and several configurations are contained in Appendix I.

Note

The windshield defrosting system should be operated at the highest temperature possible (consistent with pilot's comfort) during high altitude flight in order to provide sufficient preheating of the transparent surfaces to preclude the formation of frost or fog during descent.

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.

CAUTION

Prior to rapid descent, windshield and canopy surfaces should have been preheated to prevent formation of frost or fog.

1. IFF - CHECK
   Within one hour prior to the estimated time of landing, a positive IFF check should be made with an Air Traffic Control Facility.
2. Altimeter - SET STATION PRESSURE
   After descending through flight level 240, reset altimeter to current station pressure or as required to compensate for instrument error.
3. Autopilot engage switch - DISENGAGE
   Prior to passing through 500 feet terrain clearance, the autopilot must be disengaged.

BEFORE LANDING

1. Zero delay lanyard - HOOKED
   Before entering pattern, check that the zero delay lanyard is hooked to the parachute ripcord handle. Refer to figure 3-5.
2. Armament switches - CHECK 1 THRU 20
   a. Gun master switch - OFF
   b. Radar master switch - OFF
   c. Gunsight - MANUALLY CAGED
3. Camera master control switches - CHECK 10 20
   a. Master power switch - ON
   b. All other camera switches - OFF
4. Fuel quantity - CHECK
   a. Check fuel quantity remaining.
   b. Monitor No. 2 cell.
5. Airspeed index pointer - SET
   Set index pointer for appropriate final approach speed.
6. Cabin air temperature knob - AS DESIRED
7. Anti-skid switch - ON 54-1438 20, 54-1441 20, 54-150 10
8. Enter traffic pattern.
   Adjust thrust to maintain 350 knots IAS and pattern altitude.
9. Break - 350 knots IAS
10. Throttles - 80% MINIMUM
11. Speed brake switch - OPEN
12. At 250 knots, speed brake switch - CLOSE
13. Landing gear handle - DOWN
    Lower landing gear on downwind 250 knots IAS.

CAUTION

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

CONTINUED ON NEXT PAGE

BEFORE LANDING CONTINUED

14. Flap lever - EXTEND
15. Hydraulic pressure gages - CHECK
    Check both hydraulic pressure gages for normal indication.
16. Turn base leg approximately 2-3 miles from runway.
17. Base leg airspeed - 220-230 knots IAS.
18. Turn final approximately 2-3 miles from runway to 800 feet altitude and establish a 2-1/2° - 3° glide slope angle.
19. Speed brake switch - AS REQUIRED
20. Establish final approach speed as required.
    Maintaining proper airspeed 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.

Note

Refer to Landing Speeds Chart in Part 8 of Appendix I for recommended final approach and touchdown speeds for various landing gross weights.

LANDING

Note

The procedures set forth produce the results shown in the Landing Distance Charts in Part 8 of Appendix I.

1. After flare-out, throttles - IDLE.

WARNING

Do not attempt to flare or retard throttles prior to crossing the end of the runway because the airplane decelerates rapidly with throttles retarded to IDLE.

2. Speed brake switch - OPEN
3. Touchdown airspeed - AS REQUIRED
4. Drag chute - DEPLOY
5. At 110 knots, lower nose gear to the runway.
6. Nose gear steering - ENGAGE
7. 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.

NORMAL LANDING

Note

The procedures set forth produce the results plotted in Landing Distance Charts in Part 8 of Appendix I.

For a normal landing with 3000 pounds of fuel remaining, fly the pattern as illustrated in figure 2-5, and observe airspeed limitations as outlined in Section V. Since steep approaches must be avoided to preclude an excessive rate of sink during flare-out, a straight-in final approach of approximately two miles is recommended. Steeper final approaches are not recommended because there is a marked increase in energy required to flare the airplane from steeper finals, meaning higher than normal approach speeds plus a greater chance for error in pilot's judgment during rapid flare-outs. If speeds are flown below those recommended the airplane will develop a given rate of sink because the flow across the wings is not sufficient to produce the necessary lift to sustain the gross weight of the airplane along the desired flight path. This situation in a high gross weight airplane is more critical than a steep final approach since here too, you need energy to flare the airplane. In this low speed situation, there is not enough energy to keep it flying along the desired glide path, much less flare it out. The corrective action is additional thrust to regain your airspeed. More important, the preventive action is to fly the recommended airspeeds. Maintaining the proper final approach speed 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 the runway. Do not attempt to flare or retard throttles prior to crossing the end of the runway as the airplane decelerates rapidly with throttles retarded to IDLE. After flare-out, retard throttles to IDLE, fly the airplane onto the runway and make a normal touchdown. Immediately after touchdown, 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. Above 110 knots aerodynamic braking is much more effective and there is less chance of blowing a tire. At approximately 110 knots, lower the nose gear to the runway and employ normal braking technique. As soon as the nose gear is on the runway, use nose gear steering for directional control. Plan to use the full length of the runway and use the brakes as necessary to stop on remaining runway. Normally very light braking will be required with the drag chute deployed. If maximum braking is required, smoothly apply brake pressure until anti-skid cycling is felt and then ease off slightly. Hold maximum brake pressure that does not result in anti-skid cycling. 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 the airplane with the runway just prior to flare-out and landing with a wing low crosswind correction. After touchdown, deploy the drag chute and maintain a normal nose-high attitude (approximately +10°) to take advantage of the high aerodynamic drag. Utilize aerodynamic braking and rudder steering until approximately 3/4 rudder deflection is required to maintain directional control. At this point, or at approximately 110 knots IAS (whichever occurs first) lower the nose gear to the runway and engage nose gear steering to maintain directional control.

CAUTION

- The nose gear steering system becomes progressively more sensitive at speeds above approximately 120 knots.
- Caution should be used when engaging nose gear steering with rudder deflected as this will result in swerving of the airplane.

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 Typical Landing Pattern, figure 2-5, adding 5 knots to quoted airspeeds for each 1500 pounds over normal landing gross weight.

MINIMUM RUN LANDING

A minimum run landing is essentially the same as a normal landing. During flare-out, retard throttles to IDLE. Touchdown as near the approach end of the runway as possible and deploy the drag chute. Utilize aerodynamic braking down to approximately 110 knots IAS, lower the nose gear to the runway and employ maximum braking technique.

WARNING

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

LANDING ON SLIPPERY RUNWAY

Wet or Icy Runway Landing

The technique involved in landing on wet or icy runways is essentially the same as that outlined for a Minimum Run landing. Utilize aerodynamic braking as long as practical. Avoid the use of brakes as long as possible and use nose gear steering to maintain directional control. Refer to Wheel Brake Operation, Section VII.

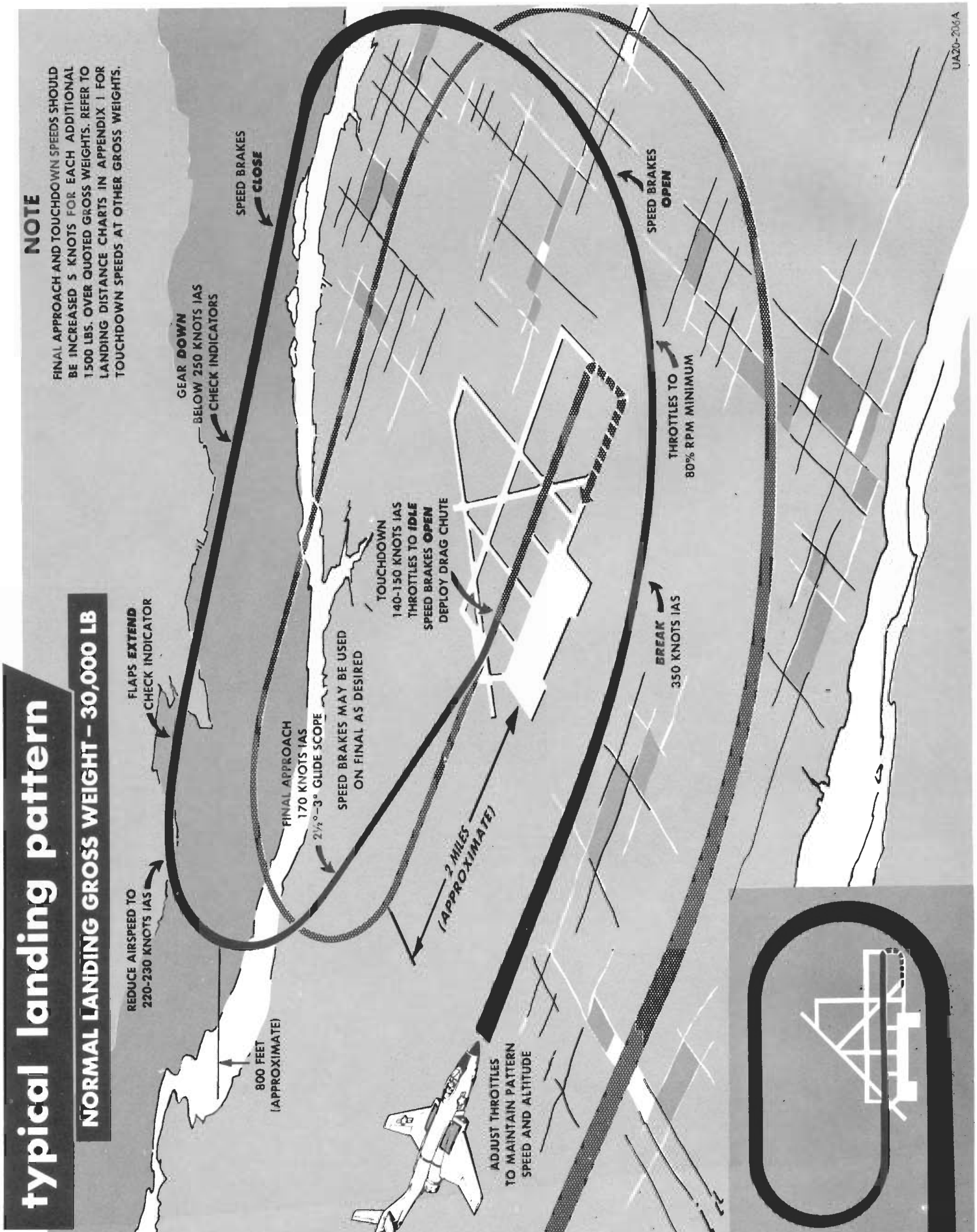

typical landing pattern
NORMAL LANDING GROSS WEIGHT – 30,000 LB
NOTE
FINAL APPROACH AND TOUCHDOWN SPEEDS SHOULD BE INCREASED 5 KNOTS FOR EACH ADDITIONAL 1500 LBS. OVER QUOTED GROSS WEIGHTS. REFER TO LANDING DISTANCE CHARTS IN APPENDIX I FOR TOUCHDOWN SPEEDS AT OTHER GROSS WEIGHTS.
SPEED BRAKES CLOSE
GEAR DOWN BELOW 250 KNOTS IAS CHECK INDICATORS
FLAPS EXTEND CHECK INDICATOR
REDUCE AIRSPEED TO 220-230 KNOTS IAS
800 FEET (APPROXIMATE)
FINAL APPROACH 170 KNOTS IAS 2½°–3° GLIDE SCOPE
SPEED BRAKES MAY BE USED ON FINAL AS DESIRED
TOUCHDOWN 140-150 KNOTS IAS THROTTLES TO IDLE SPEED BRAKES OPEN DEPLOY DRAG CHUTE
2 MILES (APPROXIMATE)
ADJUST THROTTLES TO MAINTAIN PATTERN SPEED AND ALTITUDE
BREAK 350 KNOTS IAS
THROTTLES TO 80% RPM MINIMUM
SPEED BRAKES OPEN
UA20-206A

Figure 2-5

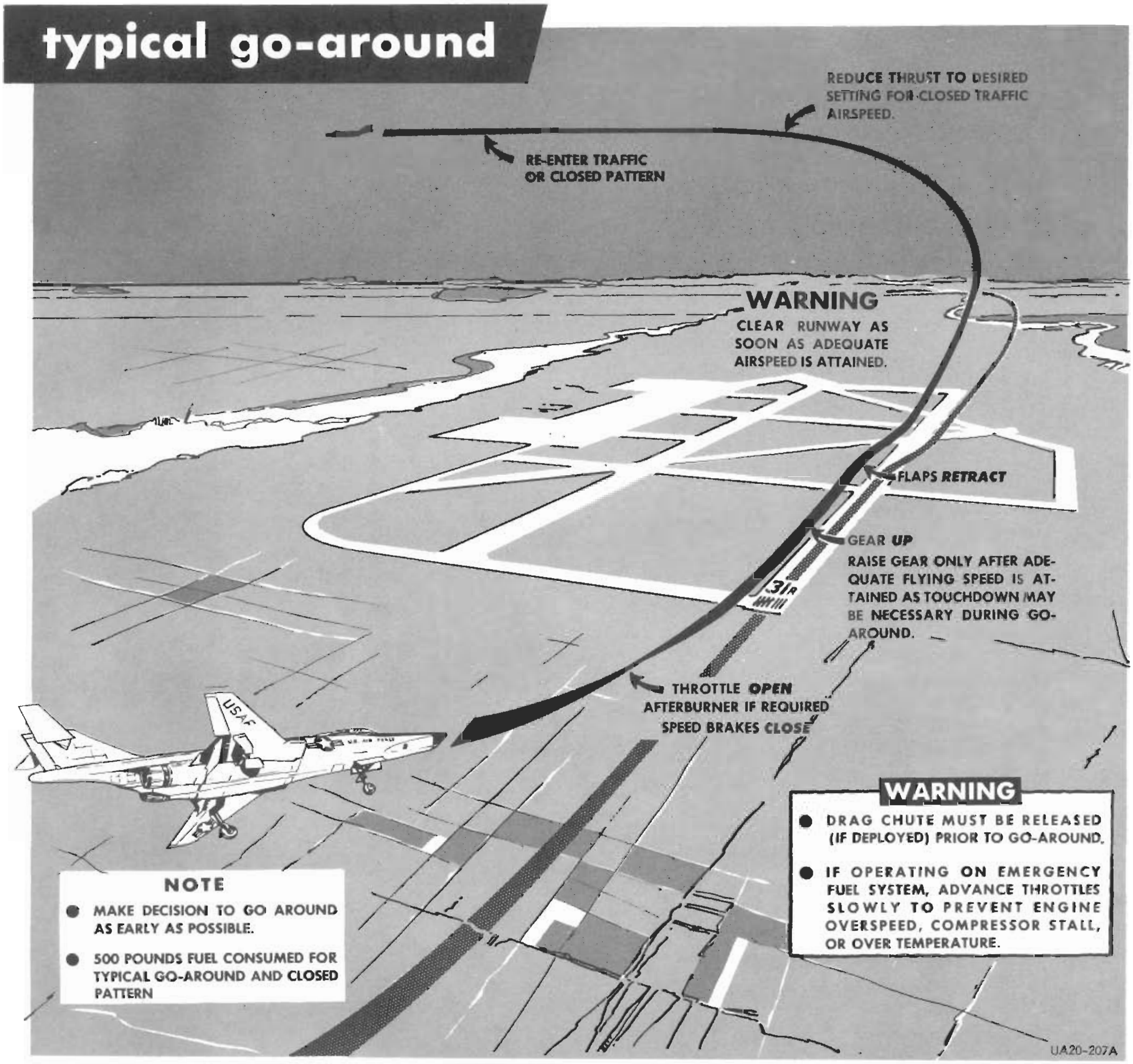


Figure 2-6

GO-AROUND

The decision to go-around should be made as early as possible. See figure 2-6. Approximately 500 pounds of fuel is consumed during a typical go-around and closed pattern. If decision is made to go-around, proceed as follows:

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

CONTINUED ON NEXT PAGE

GO-AROUND CONTINUED

CAUTION

- If decision is made to go-around after touchdown, do not exceed +13° pitch attitude as the tail will scrape the runway.
- Because of excessive fuel consumption, afterburner should be used only if definitely required when fuel remaining is below 3,000 pounds.
- Afterburner can be used when operating on emergency fuel control system; however, exercise caution during throttle movement to prevent compressor stall, engine overspeed and overtemperature.

2. Speed brake switch - CLOSE
3. Drag chute - JETTISON (IF DEPLOYED)
4. Landing gear handle - UP
   Retract landing gear when definitely airborne and rate of climb is established.
5. Wing flap lever - RETRACT
6. Clear runway as soon as practicable.

AFTER LANDING

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

1. Speed brakes switch - CLOSE
2. Flap lever - RETRACT
3. SIF/IFF - OFF
   Turn IFF off as soon after landing as possible. This will illuminate signals from taxiing or parked airplanes which would otherwise block the controller's scope and interfere with the control of the airborne airplanes.

Note

After clearing active runway, a single engine may be shutdown for taxiing, refer to Engine Shutdown Procedure, this section. Single engine taxiing requires no special technique.

CAUTION

- If there have been indications of hydraulic system failure, DO NOT attempt an engine shutdown prior to reaching intended parking area.
- Prior to opening the canopy, check the cabin pressure altimeter to assure that the cockpit is fully depressurized. If the cockpit is not fully depressurized, place the cabin air temperature knob in the RAM AIR & DUMP position. Attempting to open canopy while cockpit is pressurized may cause damage or loss of canopy.
- If canopy is opened during taxiing, do not exceed canopy open structural limit speed.
- Do not make sharp turns during taxiing with the drag chute deployed to prevent chute from collapsing and consequently damaging the chute.

4. Seat safety pin - INSTALL
5. Pitot heat switch - OFF
6. Windshield anti-icing switch - OFF
7. Windshield blower switch - OFF (20)(20)
8. Anti-skid switch - ON 54-1438 (20), 54-1441 (20), and 54-150 (10)

CONTINUED ON NEXT PAGE

AFTER LANDING CONTINUED

9. Drag chute - RELEASE
   The drag chute may be released at appropriate area.

Note

Taxiing at high throttle settings with the drag chute deployed will lead to reduced service life of the drag chute. Airplane should not be taxied over drag chutes previously jettisoned by other airplanes so as not to suck chute into air intakes and cause engine damage.

CAUTION

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.

ENGINE SHUTDOWN

1. Brakes - APPLY
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, it is recommended that they be operated below 85% rpm for five minutes in order to prevent seizure of the rotors.

3. Wheels - CHOCKED
4. Left throttle - CLS'D
5. Hydraulic pressure gages - WITHIN LIMITS
6. Electrical switches - OFF except battery, generator and engine master switches.

Note

To conserve the airplane battery, insure that all electrical, communication and navigation equipment switches are OFF prior to shutdown of remaining engine.

7. Landing gear ground locks and nose gear safety pin - INSTALLED
8. Right throttle - CLS'D
9. Engine master switches - OFF

Note

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

10. Battery switch - OFF

BEFORE LEAVING AIRPLANE

1. 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 when leaving the cockpit.
- Make sure automatic-opening parachute arming key does not foul when leaving cockpit to prevent chute from opening inadvertently.

2. Form 781 - COMPLETE

CAUTION

In addition to established requirements for reporting any system defects, unusual and excessive operations, the pilot will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.

Note

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

ABBREVIATED CHECKLIST

Your normal abbreviated checklist is now contained in T.O. 1F-101(R)(Y)A-(CL)1-1.

section III EMERGENCY PROCEDURES

UA20-300

TABLE OF CONTENTS

Note

Critical actions that must be accomplished instinctively, upon first recognition of an emergency, will be presented in this section in bold face type, i.e., **ABORT TAKE-OFF**. Those items presented in standard type should be accomplished as time and conditions permit.

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 engine flameout occurs. 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 because of the location of the engines relative to the centerline of the airplane. In event of one engine failure, 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 airplane 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.

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, on "dead" engine 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. **ABORT TAKE-OFF**
   Refer to Take-Off and Landing Emergencies, this section.

After Airborne

If an engine fails immediately after take-off, lateral and directional control of the airplane 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 actions will depend upon the 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 thrust.
2. Landing gear handle - UP
3. External tanks - JETTISON
   If altitude cannot be maintained, external tank emergency jettison button - DEPRESS
4. Continue flight
   Continue flight straight ahead. Attempt no unnecessary maneuvers until safe airspeed and altitude are attained.
5. Wing flap lever - RETRACT
   Retract flaps after safe airspeed is attained.
6. Failed engine - SHUTDOWN
   a. Throttles - 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
3. Attempt to determine cause of engine failure.

If failure can be attributed to other than mechanical failure, an air start may be attempted. See figure 3-1. 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. Boost pump circuit breakers - IN
4. Right engine emergency ignition button - DEPRESS

Note

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

5. 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:

6. 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. After incorporation of T.O. 1F-101-709, it is not necessary to wait 35 seconds between attempts to start left and right engines.

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

CAUTION

To maintain sufficient hydraulic pressure for airplane control, do not lower airspeed below either 250 knots IAS or .5 indicated Mach number.

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

8. 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, the generators field, or the battery.
- With the generator switches in the OFF position, a-c power will not be available to operate the heading indicator, attitude indicator, or the fuel quantity indicator, and therefore these instruments will be inoperative.

9. Attempt to air start right engine.
   Momentarily depress emergency ignition button while advancing right throttle to idle.
10. 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 using the engine start switch should be attempted.

CAUTION

Only one engine can be started at a time when using the engine start switch and neither engine will start when windmilling above 40% RPM because normal ignition is cut off above this rpm.

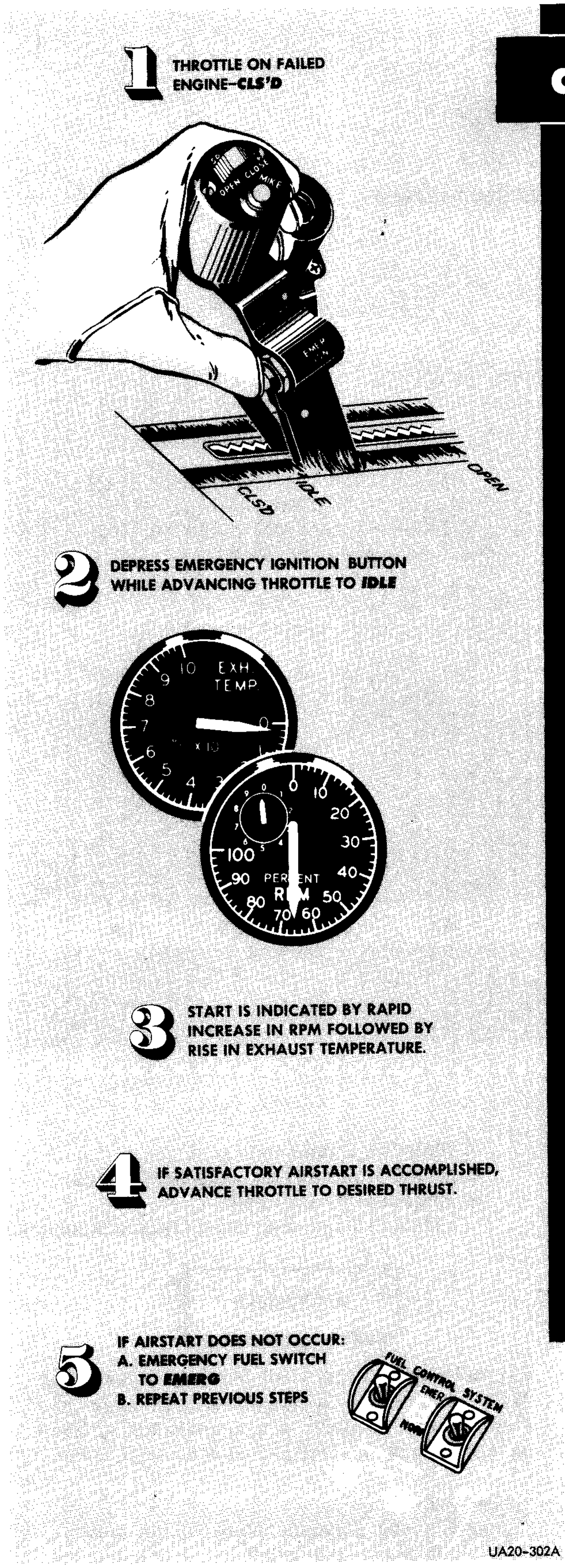


Figure 3-1

air start

AIR START

Note

A normal relight and engine acceleration should not be expected above 35,000 feet. If a relight should be attempted above 35,000 feet and the engine does not come out of idle, descend below 35,000 feet.

For Air Start Procedures, see figure 3-1. 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 light-up does not occur within 20 seconds after throttle is advanced to IDLE, or the engine fails to accelerate to idle rpm within approximately 45 seconds after light-up, the start should be discontinued by retarding throttle to CLS'D. This action will also be necessary if the exhaust temperature exceeds maximum limitations or the oil pressure does not attain the minimum of 35 psi.

Note

If a start is made with an engine which has cooled to an ambient temperature of -30°C (-22°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.

Note

- When shutting down one engine for practice airstarts, retard desired throttle to IDLE and allow engine rpm to stabilize. Advance the other throttle to the thrust level required to maintain level flight. Close remaining throttle and perform air start as shown in figure 3-1.
- During normal air start there may be no significant increase in exhaust temperature until the engine has accelerated to idle rpm.

GLIDE DISTANCE

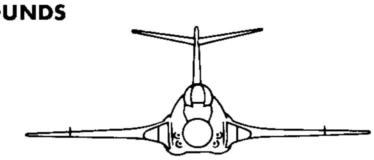
The Glide Distance Chart (figure 3-2) provides the pilot with glide distances he may attain with both engines windmilling from given altitudes and at a given airspeed of 250 knots. This airspeed will provide near maximum glide distance capability of the airplane and will provide engine windmilling speed capable of keeping hydraulic pressure and recovery rate within safe limits.

glide distance

WITH ENGINES WINDMILLING

GROSS WEIGHT–37,000 POUNDS

NO WIND
NO EXTERNAL LOAD



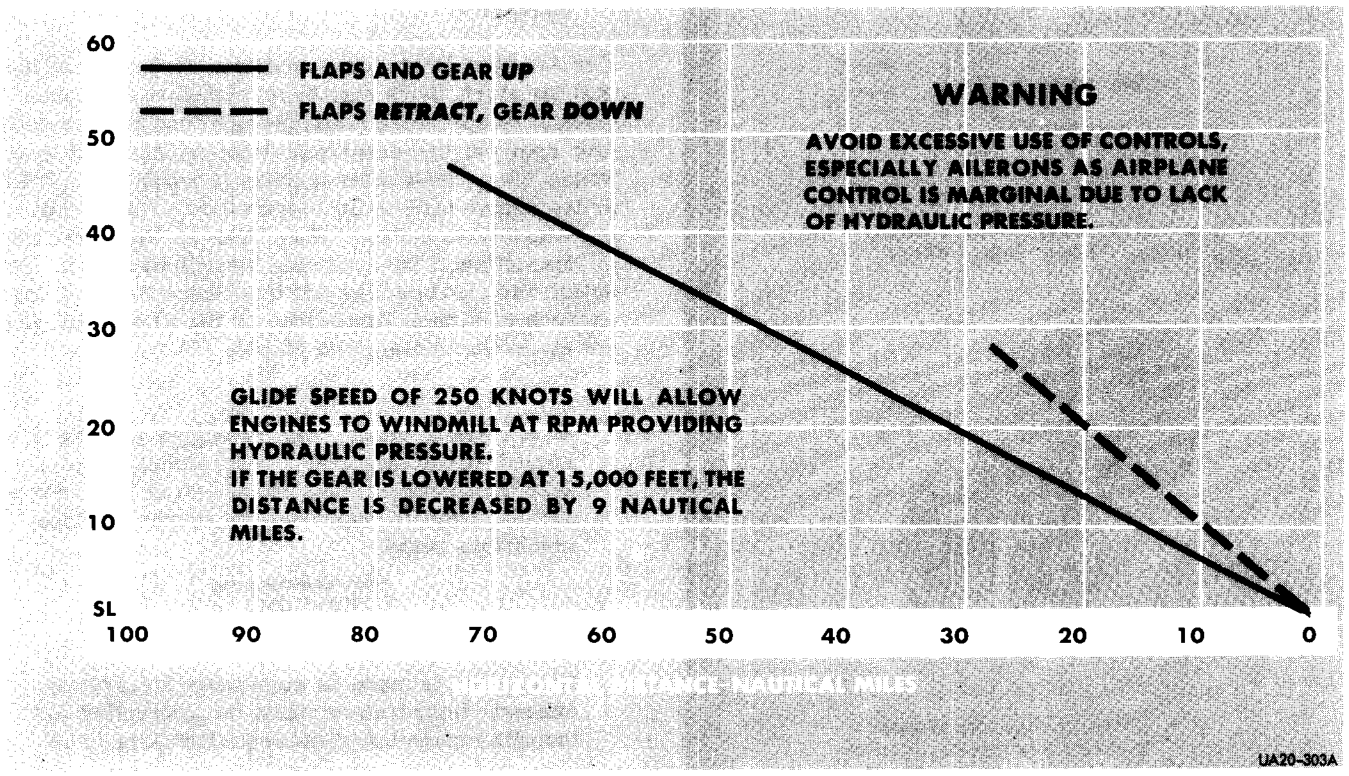


Figure 3-2

SINGLE ENGINE LANDING

A single engine landing is basically the same as a normal landing (figure 3-3) except that the pattern is expanded to avoid steep turns and may be entered at any point, i.e., downwind, base or straight-in. Final approach speeds are increased to preclude high sink rates.

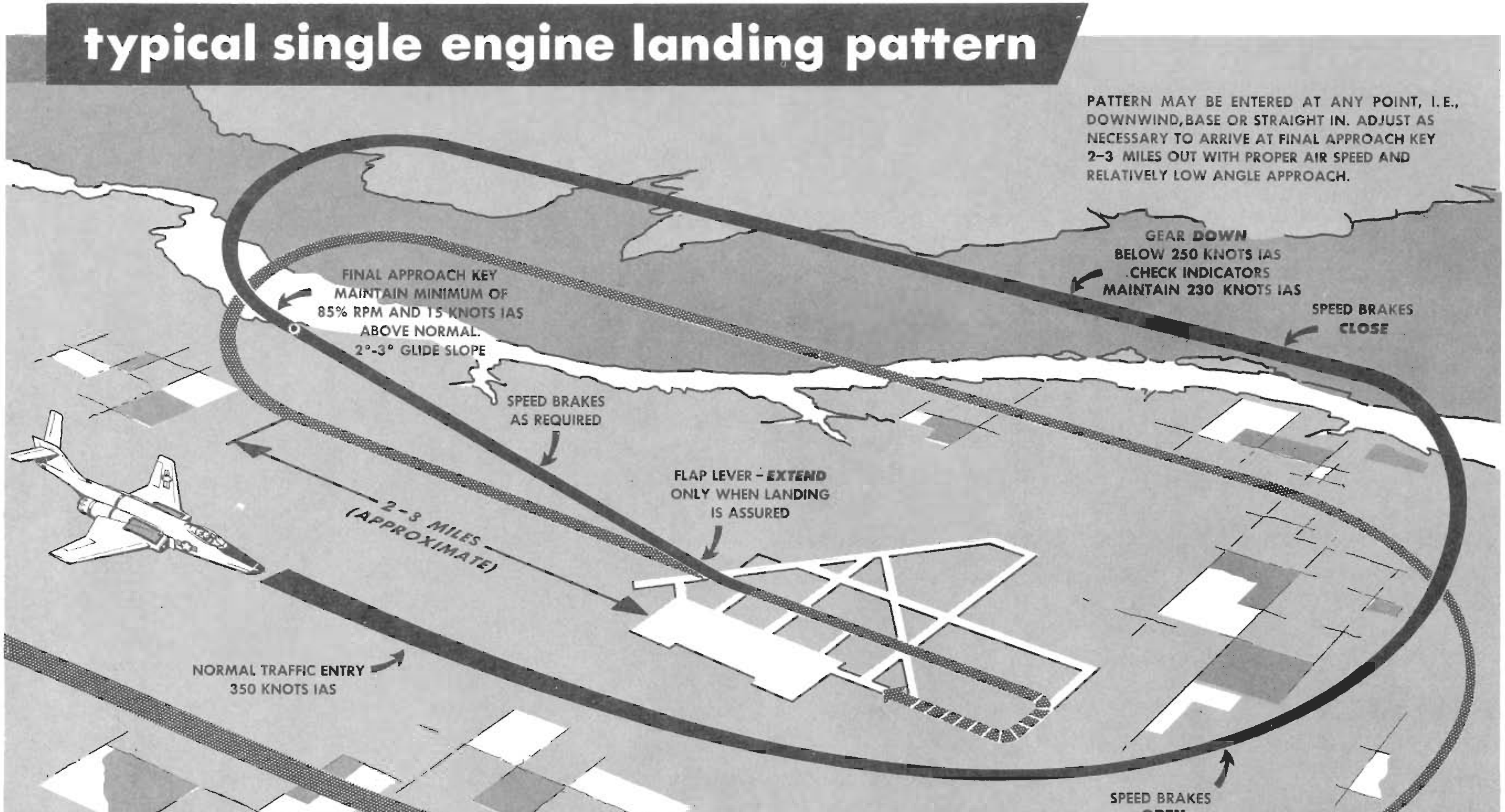
1. Traffic entry will be normal - 350 knots IAS
2. Fly a wide pattern.
3. Flap lever - RETRACT
4. Speed brake switch - CLOSED
5. Landing gear handle - DOWN
6. Final approach:
   a. Establish a two to three mile final approach with a 2-1/2° to 3° glide slope and a minimum of 85% rpm.
   b. Maintain 15 knots IAS above normal approach speed.
   c. Maintain a mild rate of descent.
   d. Speed brake switch - AS REQUIRED
   e. Flap lever - EXTEND
      Extend flaps only when landing is assured.

WARNING

Do not lower flaps until landing is assured. With one engine inoperative, and gear and flaps down, airplane cannot maintain altitude at any approach airspeed without afterburner.

7. Landing
   a. Fly the airplane down to the runway. Do not flare the airplane or retard throttle prior to crossing end of runway.
   b. Speed brake switch - OPEN
      Extend speed brakes after touchdown.

typical single engine landing pattern



FINAL APPROACH SPEEDS

FUEL REMAINING (POUNDS)	*IAS (KNOTS)
3000	185
4500	190
6000	195
7500	200
9000	205
10,500	210
12,000	215

*RECOMMENDED FINAL APPROACH SPEEDS FOR YRF-101A (10) AIRPLANES WILL BE APPROXIMATELY 5 KNOTS SLOWER THAN THE SPEEDS QUOTED.

NOTE

REFER TO SINGLE ENGINE LANDING, THIS SECTION FOR PROPER LANDING TECHNIQUES AND GO-AROUND PROCEDURES

FOR SIMULATED SINGLE ENGINE LANDING

ONE ENGINE AT 83% SPEED BRAKES - *EXTEND*

TRIM AIRPLANE WITH RUDDER TRIM SWITCH PRIOR TO ENTERING PATTERN.

IF THE AIR SPEED DROPS BELOW THAT RECOMMENDED FOR FINAL APPROACH AT ANY TIME DURING THE SINGLE ENGINE APPROACH, IMMEDIATELY RETRACT SPEED BRAKES, ADVANCE BOTH THROTTLES TO FULL MILITARY THRUST AND GO-AROUND.

Figure 3-3

E

SINGLE ENGINE GO-AROUND

1. Make decision to go-around early and definitely prior to flare-out.
2. Smoothly advance throttle on operative engine to OPEN.

E

Note

E

Afterburner may be required if go-around is started after wing flaps have been extended.

3. Continue approach until sufficient airspeed to level off is attained.
4. Landing gear handle - UP
   Retract landing gear only after adequate airspeed is attained as touchdown may be necessary during go-around.
5. Flap lever - RETRACT
   If flaps have been extended, raise wing flaps when airplane reaches 200 knots IAS.
6. Begin climb when airspeed reaches 250 knots IAS.
7. Reduce thrust to setting required to maintain traffic pattern airspeed.
8. Re-enter traffic pattern.

SIMULATED SINGLE ENGINE LANDING

1. Set one engine at 83% rpm.
2. Speed brakes switch - OPEN
3. Trim airplane with rudder trim switch prior to entering pattern.
4. Follow procedures as set forth for Single Engine Landing, this section.

Note

If the airspeed drops below that recommended for final approach at any time during the simulated single engine approach, immediately retract speed brakes, advance both throttles to full Military thrust and go-around.

LANDING WITH BOTH ENGINES INOPERATIVE

In the event of flame-out of both engines and no air start of either engine can be made, eject, if altitude permits, rather than attempt a two-engine flame-out landing. If possible, prior to ejection, the pilot should attempt to turn the airplane toward an area where injury or damage to persons or property on the ground or water is least likely to occur.

FIRE

The following procedure pertains to the first occurrence of a fire warning rather than actual fire. The light could illuminate because of an overheat condition or an electrical short. The actual condition that exists when a light illuminates may be difficult to determine. If an actual fire is obvious, the affected engine should be shutdown.

ENGINE FIRE DURING STARTING

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

1. External electrical and compressed air sources - CONNECTED
2. Throttle - CLS'D
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.
6. External electrical and compressed air sources - DISCONNECTED
7. Leave airplane as quickly as possible.

ENGINE FIRE DURING TAKE-OFF

Before Airborne

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

1. **ABORT TAKE-OFF**
   Refer to Take-Off and Landing Emergencies, this section.

After Airborne

The following procedures outlined are applicable to the take-off phase immediately after airborne and where continued flight is committed. The similarity of these procedures are those later described in ENGINE FIRE DURING FLIGHT are more than a coincidence, since only a brief time interval prevails and essentially the same reactions are required. The procedures establish steps in conjunction with normal take-off technique, i.e., gear-up, flaps-retract. In actual conditions, these steps may be accomplished in a sequence other than that given. The time element must appear lengthened in the procedures, whereas in actual practice, this is a short span.

Burner Compartment (Flashing) Light:

1. **NORMAL OPERATING ENGINE–AFTERBURNER**
   If afterburners were not being used, place remaining throttle in afterburner detent.
2. **THROTTLE (Engine Indicating Fire)–IDLE**
3. **LANDING GEAR HANDLE–UP**
4. **EXTERNAL LOAD–JETTISON**
   If altitude cannot be maintained, depress external tank emergency jettison button.
5. **CONTINUE FLIGHT.**
   Continue flight straight ahead. Attempt no unnecessary maneuvers until safe airspeed is attained.
6. **FLAP LEVER–RETRACT**
   Retract flaps after safe airspeed is attained.

7. CHECK FOR OTHER FIRE INDICATIONS SUCH AS FUMES OR TRAILING SMOKE OR VERIFICATION FROM ANOTHER AIRPLANE.
   a. IF NO FIRE IS APPARENT, LAND AS SOON AS POSSIBLE WITH REDUCED THRUST SETTING.
   b. IF POSITIVE FIRE INDICATIONS ARE DISCERNABLE, PROCEED WITH STEP 8.
8. 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. NORMAL OPERATING ENGINE–AFTERBURNER
   If afterburners were not being used, place remaining throttle in afterburner detent.
2. THROTTLE (Engine Indicating Fire)–CLS'D
3. LANDING GEAR HANDLE–UP
4. EXERNAL LOAD–JETTISON
   If altitude cannot be maintained, depress tank emergency jettison button.
5. CONTINUE FLIGHT.
   Continue flight straight ahead. Attempt no unnecessary maneuvers until safe airspeed is attained.
6. FLAP LEVER–RETRACT
   Retract flaps after safe airspeed is attained.
7. ENGINE MASTER SWITCH–OFF
8. CHECK FOR OTHER INDICATION OF FIRE SUCH AS TRAILING SMOKE, VERIFICATION FROM TOWER OR ANOTHER AIRPLANE.
9. IF NO INDICATION OF FIRE IS APPARENT, MAKE SINGLE-ENGINE LANDING AS SOON AS POSSIBLE.
10. IF FIRE IS CONFIRMED, CLIMB TO SAFE EJECTION ALTITUDE AND EJECT.

ENGINE FIRE DURING FLIGHT

Burner Compartment (Flashing) Light:

1. REDUCE THRUST AND OBSERVE FIRE WARNING LIGHT
   a. IF LIGHT GOES OUT, CONTINUE FLIGHT AT REDUCED THRUST SETTING 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 THRUST 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 INDICATION OF FIRE IS APPARENT, MAKE SINGLE ENGINE LANDING AS SOON AS POSSIBLE.

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 if conditions permit and land as soon as possible.

1. BATTERY SWITCH–OFF
2. GENERATOR SWITCHES–OFF
3. ALL ELECTRICAL EQUIPMENT–OFF
4. Battery switch - ON
5. Generator switches - ON
6. Slowly turn the electrical switches ON, beginning with the most essential equipment first.
7. If the trouble item is found, turn the affected equipment OFF, and pull the circuit breaker if it is available.
8. If the cause of the fire cannot be found, continue the flight with only the essential equipment in operation and land as soon as possible.

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 REGULATOR EMERGENCY TOGGLE LEVER EMERGENCY
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 airplane during 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 techniques by means of ejection seat reveals that:

ejection procedure

1 THRU 15 10

BEFORE EJECTION

IF TIME AND CONDITIONS PERMIT...

- STOW ALL LOOSE EQUIPMENT.
- PRESSURIZATION TO RAM AIR & DUMP (HIGH ALTITUDE).
- ACTUATE BAIL-OUT BOTTLE (HIGH ALTITUDE).

WARNING

IMMEDIATELY AFTER ACTUATING THE EMERGENCY BAILOUT BOTTLE, DISCONNECT THE SEAT OXYGEN HOSE FROM THE CONNECTOR (ATTACHED TO THE PARACHUTE HARNESS) TO PREVENT THE ESCAPE OF EMERGENCY OXYGEN THROUGH THE SEAT OXYGEN HOSE. THIS ACTION IS NOT NECESSARY WHEN USING A SURVIVAL KIT WITH AN INTEGRATED OXYGEN SUPPLY.

- SLOW AIRPLANE (ZOOM-UP MANEUVER).

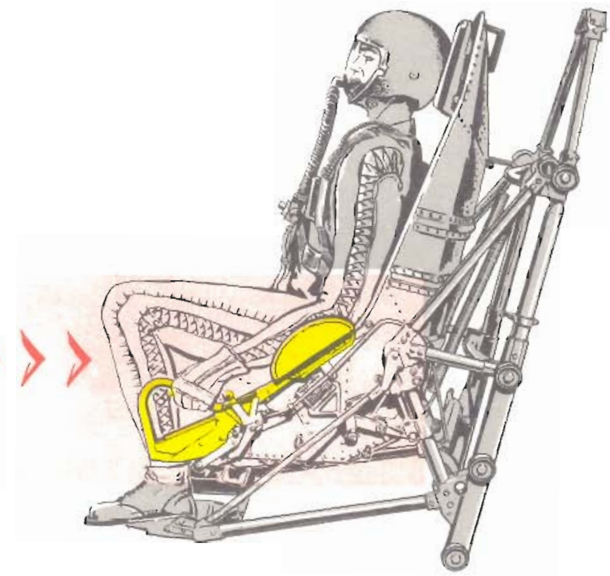
1 ASSUME PROPER POSITION

a. FEET ON FOOT RESTS.

b. SIT WELL BACK IN SEAT.

c. ARMS BRACED IN ARM RESTS.

d. SIT ERECT WITH CHIN IN, HEAD HARD BACK AGAINST HEAD REST.



2 PULL UP EITHER HANDGRIP

IF CANOPY FAILS TO JETTISON...

a. ACTUATE CANOPY ALTERNATE JETTISON HANDLE.

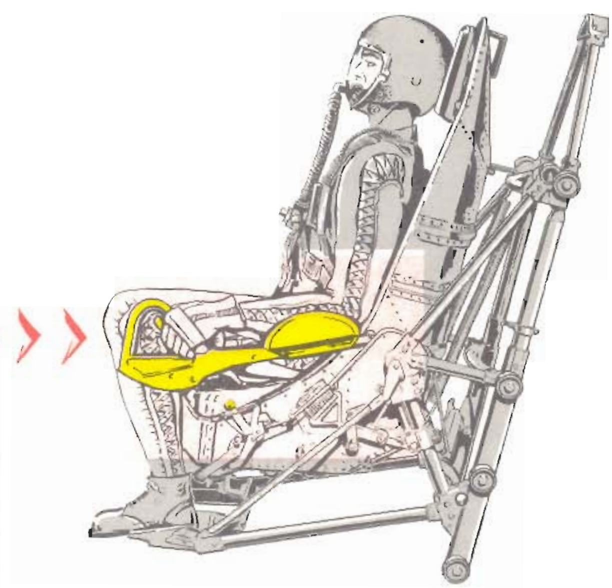
b. HOLD CANOPY SWITCH AT OPEN UNTIL CANOPY BREAKS AWAY.

c. 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 LEFT HAND OR RIGHT HAND AND PULL AFT. WHEN GRASPING LEVER WITH EITHER HAND, MAKE SURE THUMB IS ON INSIDE OF LEVER.

- IF CANOPY DOES NOT RELEASE, PROCEED TO STEP 3, EJECTING THROUGH CANOPY.



3 SQUEEZE EITHER TRIGGER

AFTER EJECTION

AFTER SEAT EJECTS...

- IF SAFETY BELT FAILS TO OPEN AUTOMATICALLY (AFTER 1 SECOND) UNFASTEN SAFETY BELT BUCKLE MANUALLY AND KICK FREE OF SEAT.

WARNING

IMMEDIATELY AFTER LEAVING SEAT, MANUALLY PULL PARACHUTE RIPCORD HANDLE 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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RY

Figure 3-4

ejection procedure

20 20

BEFORE EJECTION

IF TIME AND CONDITIONS PERMIT...

- STOW ALL LOOSE EQUIPMENT.
- PRESSURIZATION TO RAM AIR & DUMP (HIGH ALTITUDE).
- ACTUATE BAIL-OUT BOTTLE (HIGH ALTITUDE).

WARNING

IMMEDIATELY AFTER ACTUATING, THE EMERGENCY BAILOUT BOTTLE, DISCONNECT THE SEAT OXYGEN HOSE FROM THE CONNECTOR (ATTACHED TO THE PARACHUTE HARNESS) TO PREVENT THE ESCAPE OF EMERGENCY OXYGEN THROUGH THE SEAT OXYGEN HOSE. THIS ACTION IS NOT NECESSARY WHEN USING A SEAT SURVIVAL KIT WITH AN INTEGRATED OXYGEN SUPPLY.

- SLOW AIRPLANE (ZOOM-UP MANEUVER).

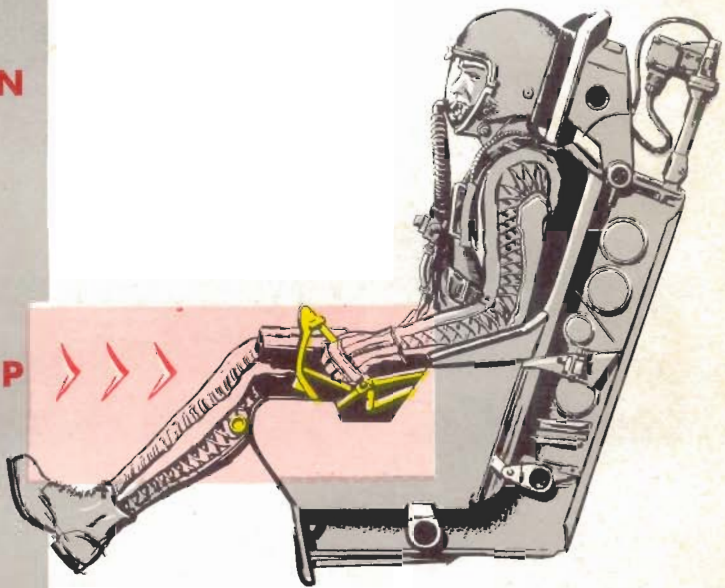
1 ASSUME PROPER POSITION

a. FEET ON RUDDER PEDALS.

b. THIGHS BRACED ON SEAT CUSHION.

c. ARMS BRACED IN ARM RESTS.

d. SIT ERECT WITH CHIN IN, HEAD HARD BACK AGAINST HEAD REST.



2 PULL UP EITHER HANDGRIP

IF CANOPY FAILS TO JETTISON...

a. ACTUATE CANOPY ALTERNATE JETTISON HANDLE.

b. HOLD CANOPY SWITCH AT OPEN UNTIL CANOPY BREAKS AWAY.

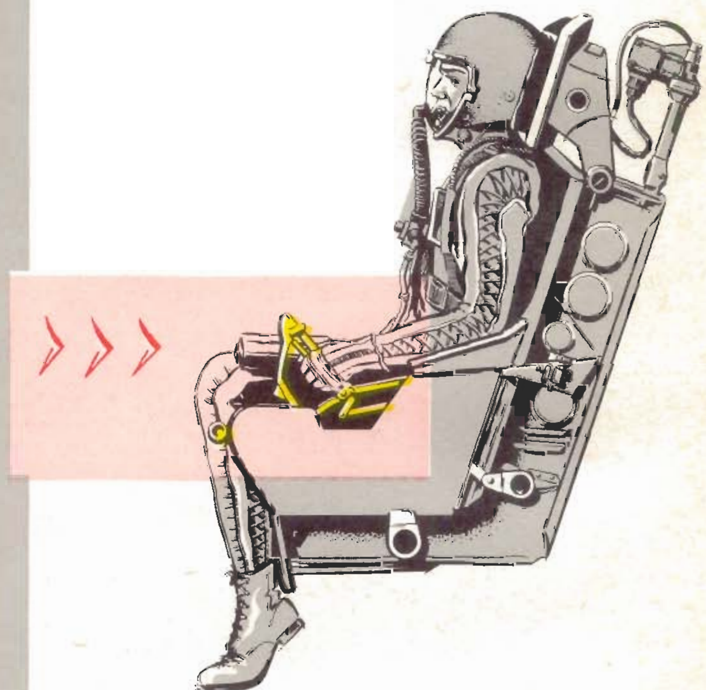
c. PULL CANOPY MANUAL RELEASE LEVER.

WARNING

MANUAL OPENING OF CANOPY MAY INFLICT SERIOUS INJURY WHEN LEVER IS NOT GRIPPED PROPERLY. CANOPY BREAKAWAY IS EXTREMELY RAPID. GRASP LEVER WITH LEFT HAND OR RIGHT HAND AND PULL AFT. WHEN GRASPING LEVER WITH EITHER HAND, MAKE SURE THUMB IS ON THE INSIDE OF LEVER.

- IF CANOPY DOES NOT RELEASE, PROCEED TO STEP 3, EJECTING THROUGH CANOPY.

3 SQUEEZE EITHER TRIGGER



AFTER EJECTION

AFTER SEAT EJECTS...

- IF SAFETY BELT FAILS TO OPEN AUTOMATICALLY (AFTER 1 SECOND) UNFASTEN SAFETY BELT BUCKLE MANUALLY AND KICK FREE OF SEAT.

WARNING

IMMEDIATELY AFTER LEAVING SEAT, MANUALLY PULL PARACHUTE RIPCORD HANDLE 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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1. Ejection at airspeeds ranging from stall speed to 525 knots IAS results in relatively minor forces being exerted on the body, thus reducing injury hazard.
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.

WARNING

- With the zero delay lanyard connected, maximum speed for ejection must be reduced to avoid parachute failure. The Zero Delay Lanyard Engagement Requirements chart (figure 3-5) graphically illustrates zero delay lanyard configurations based on altitude and indicated airspeed.
- Under controlled flight conditions, ejection should be accomplished above 2,000 feet terrain clearance whenever possible. Under descending out-of-control conditions, ejection should be accomplished at the altitude as outlined in the applicable portion of Section VI.

LOW ALTITUDE EJECTION

During any low altitude ejection, the possibility of success can be greatly improved by zooming and ejecting while the nose of the airplane is above the horizon and the airspeed is above 120 knots IAS. The zoom-up maneuver will exchange airspeed for

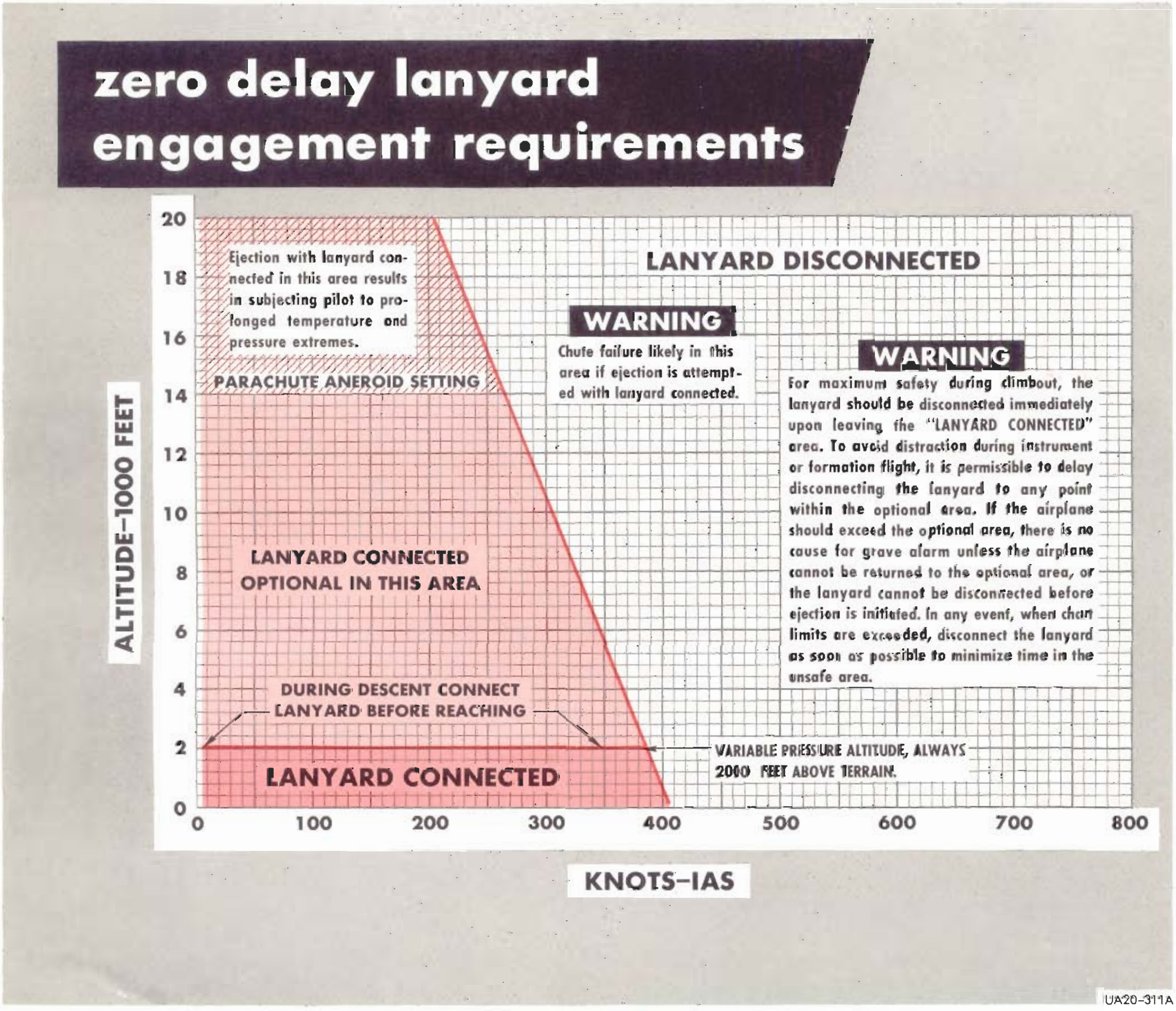

Figure 3-5

altitude, thus providing maximum terrain clearance at time of ejection, as well as reducing airspeed within safe limits for ejection. Ejecting while the nose of the airplane is above the horizon will result in a more nearly vertical trajectory for the seat and crewmember, thus providing more altitude and time for seat separation and parachute deployment. At low altitudes, a minimum airspeed of 120 knots IAS is recommended to assure rapid deployment of the chute. A determined effort to separate from the seat must be made as soon as the belt releases to obtain maximum terrain clearance when the parachute deploys. Manually pull the parachute ripcord handle immediately following seat separation for all ejections below 14,000 feet. This provides a safety factor since the parachute should deploy automatically. 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. The pilot will be required to manually deploy the parachute.
2. Manually opening the safety belt creates a hazard to survival during uncontrollable flight, since 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 zero delay lanyard is provided to give a "zero-second" time delay in chute deployment after seat separation. The "zero-second" chute timing with the one second automatic-opening safety belt is known as a "one and zero" escape system. The lanyard connects the parachute arming knob to the parachute ripcord handle. When the pilot separates from the seat and the parachute arming knob is pulled, the parachute ripcord handle is also pulled allowing immediate parachute deployment. The zero delay lanyard must be connected to the parachute ripcord handle under low altitude and low airspeed conditions. At other altitude and airspeeds, the lanyard must be disconnected from the parachute ripcord handle and stowed to allow the automatic parachute timer to open the parachute below critical opening speeds and below the prescribed altitude.

The lanyard must be fastened, or unfastened from the parachute ripcord handle by the pilot at the correct time as outlined in figure 3-5. A ring on the parachute harness is provided for stowing the lanyard when it is not hooked in the parachute ripcord handle. 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, the type of parachute automatic release timer is all that must be known. The M3 seat ejection catapult, the C-9 canopy, the BA-15 pack and the automatic-opening safety belt one second (M12) initiator are exclusively used in all of the airplanes. Use the chart to determine the minimum emergency ejection altitude. For example, with the zero delay lanyard stowed, and a two second parachute (F-1A timer), minimum ejection altitude is 300 feet.

EMERGENCY MINIMUM EJECTION ALTITUDES

AUTOMATIC OPENING SAFETY BELT (INITIATOR)	ZERO DELAY LANYARD STOWED		ZERO DELAY LANYARD HOOKED
	2 SECOND PARACHUTE (F-1A TIMER)	1 SECOND PARACHUTE (F-1B TIMER)	ZERO SECOND PARACHUTE
	BA-15 PACK C-9 CANOPY	BA-15 PACK C-9 CANOPY	BA-15 PACK C-9 CANOPY
1 SECOND (M12 INITIATOR)	300	125	0

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

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WARNING

Emergency minimum ejection altitudes quoted in this table were determined through extensive flight tests and are based on distance above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitude that must be achieved in the event of such low altitude emergencies as fire on take-off. They shall not be used as the basis for delaying ejection when above 2,000 feet, since accident statistics show a progressive decrease in successful ejections as altitude decreases below 2,000 feet. Therefore, whenever possible, eject above 2,000 feet.

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 zero delay lanyard MUST NOT be connected to the parachute ripcord handle. If the zero delay lanyard is inadvertently connected to the parachute ripcord handle and ejection at high altitude becomes necessary, the safety feature of the automatic-opening parachute will be eliminated, and the parachute will open immediately, subjecting the pilot to serious or fatal injury.
- In the event emergency oxygen is required for any reason, disconnect the seat oxygen hose from the connector (attached to the parachute harness) immediately after actuating the emergency bailout bottle to prevent the escape of emergency oxygen through the seat oxygen hose. This action is not necessary when using a seat survival kit with an integrated oxygen supply.

EJECTION SEAT FAILURE

1. If time and conditions permit, reduce airspeed to approximately 275 knots IAS.
2. Unfasten safety belt, actuate bailout 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 the parachute ripcord handle or automatic-opening parachute lanyard to open parachute.

TAKE-OFF AND LANDING EMERGENCIES

ABORTED TAKE-OFF

1. **THROTTLES–IDLE (For Fire–AFFECTED ENGINE SHUTDOWN)**

CAUTION

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

2. **SPEED BRAKE SWITCH–OPEN**
   Simultaneously open speed brakes while retarding throttles.
3. **DRAG CHUTE–DEPLOY**
4. **BRAKING ACTION–AERODYNAMIC, NORMAL, EMERGENCY**
5. Nose gear steering - ENGAGE
6. Preapre for barrier engagment.
   Refer to Runway Overrun Barrier, this section.

If fire exists:

7. Throttles - CLS'D
8. Engine master switches - OFF
9. Leave airplane.

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 airplane damage. This nose-high attitude causes the airplane to "slap" the ground on impact, subjecting the pilot to possible spinal injury. Less injury and less airplane damage will result with the gear extended.

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

1. If external tanks contain fuel - JETTISON

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 airplane 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. Helmet visor - DOWN
   Lower the helmet visor for maximum protection against wind blast, flying objects and possible flame and smoke.

5. Canopy - JETTISON (if necessary)
   If it is necessary to jettison the canopy, pull the canopy alternate jettison handle.

WARNING

- If canopy is to be jettisoned, make sure it is jettisoned before the airplane comes to a complete stop. Otherwise, sparks from the canopy remover may cause a fire if fuel is spilled in the vicinity of the airplane, or the canopy may become jammed.
- If the canopy is not jettisoned, do not unlock the canopy until the airplane stops.

6. Make normal approach.
7. Touchdown in normal landing attitude.
8. Drag chute - DEPLOY
9. Engines - SHUTDOWN
   a. Throttles - CLS'D
   b. Engine master switches - OFF
10. Generator switches - OFF
11. Battery switch - OFF
12. Clear airplane as soon as possible.

LANDING GEAR UP OR UNLOCKED

Unsafe Indication

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. Cycle speed brakes to check utility system priority valve and pressure indication.
5. Obtain visual gear check.

If gear appears unsafe or cannot be visually checked and/or low utility hydraulic pressure exists:

6. Attempt to lower gear by emergency gear lowering procedure. Refer to Landing Gear Emergency Lowering, this section.

If gear appears down and locked with normal utility hydraulic pressure:

7. Make a normal landing and observe the following precautions:
   a. 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.

   b. Land on side of runway opposite indicated unsafe main gear. Land on 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.

   f. Allow airplane to roll straight ahead and do not taxi after completing landing roll, until maintenance personnel have 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. Availability of flaps, normal braking and nose gear steering.
   With a utility system failure, wing flaps, normal braking and, prior to incorporation of T.O. 1F-101-823 in the 54-1495 (20) and 54-1496 (20) airplanes, nose gear steering will not be available. With a primary system failure, after incorporation of T.O. 1F-101-823 in the 54-1495 (20) and 54-1496 (20) airplanes, nose gear steering 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 airplane 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 (if necessary)
   If it is necessary to jettison the canopy, pull the canopy alternate jettison handle.

WARNING

- If canopy is to be jettisoned, make sure it is jettisoned before the airplane comes to a complete stop. Otherwise, sparks from the canopy remover may cause a fire if fuel is spilled in the vicinity of the airplane, or the canopy may become jammed.
- If the canopy is not jettisoned, do not unlock the canopy until the airplane stops.

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 - DEPLOY
   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 airplane as soon as possible.

Landing With Nose Gear Up or Unlocked

In the 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 airplane 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 (if necessary)
   If it is necessary to jettison the canopy, pull the canopy alternate jettison handle.

WARNING

- If canopy is to be jettisoned, make sure it is jettisoned before the airplane comes to a complete stop. Otherwise, sparks from the canopy remover may cause a fire if fuel is spilled in the vicinity of the airplane, or the canopy may become jammed.
- If the canopy is not jettisoned, do not unlock the canopy until the airplane stops.

3. Make normal final approach.
4. Land in center of runway.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOY
   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 airplane 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. Availability of flaps, normal braking and nose gear steering.
   With a utility system failure, wing flaps, normal braking and, prior to incorporation of T.O. 1F-101-823 in the 54-1495 (20) and 54-1496 (20) airplanes, nose gear steering will not be available. With a primary system failure, after incorporation of T.O. 1F-101-823 in the 54-1495 (20) and 54-1496 (20) airplanes, nose gear steering 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 airplane 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 (if necessary)
   If it is necessary to jettison the canopy, pull the canopy alternate jettison handle.

WARNING

- If canopy is to be jettisoned, make sure it is jettisoned before the airplane comes to a complete stop. Otherwise, sparks from the canopy remover may cause a fire if fuel is spilled in the vicinity of the airplane, or the canopy may become jammed.
- If the canopy is not jettisoned, do not unlock the canopy until the airplane stops.

3. Make normal final approach.
4. Hold normal attitude for touchdown.
5. Immediately after touchdown -
   a. Throttles - CLS'D
   b. Drag chute - DEPLOY
6. Utilize nose gear steering for directional control.
7. Engine master switches - OFF
8. All electrical switches - OFF
9. Abandon airplane as soon as possible.

BLOWN TIRE DURING TAKE-OFF

Prior to Reaching Go-No Go Speed:

A blown tire during the take-off run presents no special problem. The decision to take-off or abort will depend on airspeed relative to Go-No Go speed and length of runway remaining. Prior to reaching Go-No Go speed, proceed as follows:

1. **ABORT TAKE-OFF**
2. **ANTI-SKID SWITCH-OFF (If Installed)**
   Turn anti-skid switch off to prevent loss of braking on the good tire resulting from skid indications from blown tire.

Note

Anti-skid may also be disengaged by depressing the pusher release switch on the control stick.

E
E
E

3. Shoulder harness inertia reel handle - LOCKED
4. Use light opposite braking to slow airplane.

CAUTION

Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further wheel rotation and make airplane control more difficult.

Note

Directional control can be effectively maintained throughout the aborted take-off run by use of rudder and nose gear steering.

5. If possible, do not shut down engines until adequate fire fighting equipment is available.

CAUTION

The damaged wheel may be either on fire or very hot, and fuel drained overboard after engine shutdown could contact the hot wheel, causing fire.

After Reaching Go-No Go Speed:

If Go-No Go speed is reached, continue take-off and leave the landing gear extended to permit cooling of the blown tire. After reaching Go-No Go speed, proceed as follows:

1. Continue take-off.
2. Damaged tire condition - CHECK
   Check condition of blown tire, if possible, by verification from another airplane.

Note

If it can be determined that the blown tire has been torn from the wheel, the landing gear may be retracted and intended mission completed, depending on mission urgency. If the tire has remained with the wheel and is severely shredded, it is recommended that the gear remain extended so as not to foul the tire in the wheel well.

3. Speed brake switch - OPEN
   Extend speed brakes to remain below maximum gear down airspeed and to rapidly reduce fuel load for lighter gross weight landing.

Note

Should conditions dictate an immediate landing, external tanks should be jettisoned in appropriate salvo area prior to landing.

BLOWN TIRE DURING LANDING

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 airplane 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. Anti-skid switch - OFF (if installed)
   Turn anti-skid switch off to prevent loss of braking on the good tire resulting from skid indications from blown tire.
3. Make a normal final approach.
4. Land on side of runway opposite blown tire.
5. Make normal touchdown.
6. Drag chute - DEPLOY
   When assured of directional control, deploy drag chute.
7. Utilize aerodynamic braking until 2/3 rudder deflection is required to maintain directional control.

WARNING

In the event the rudder fails to correct or maintain directional control, immediately lower the nose gear to the runway and engage the nose gear steering. Hold the control stick forward to increase nose gear steering effectiveness.

8. Lower nose gear to runway and engage nose gear steering for directional control.
9. Use light opposite braking to slow airplane.

CAUTION

Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further wheel rotation and make airplane control more difficult.

10. If possible, do not shut down engines until adequate fire fighting equipment is available.

CAUTION

The damaged wheel may be either 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 2-5) except that the pattern is expanded to avoid steep turns and may be entered at any point, i.e., downwind, base or straight-in. Final approach speeds are increased to preclude high sink rates.

1. Fly a wide normal pattern.
2. Landing gear handle - DOWN
3. Wing flap lever - RETRACT
4. Establish at least two mile, low angle, straight-in final approach.
5. Maintain 15 knots IAS above normal approach speed.
6. Speed brake switch - AS REQUIRED
7. Maintain a mild rate of descent.
8. Fly the airplane down to the runway.
   Do not flare the airplane or retard throttles prior to crossing end of runway.
9. Make normal touchdown and roll-out.

RUNWAY OVERRUN BARRIER

Any time the airplane 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 airplane may not engage the barrier since the nose gear hook is not installed and the gear doors have not been reinforced.

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.

Note

Special stores should be retained during barrier engagement.

2. **SPEED BRAKE SWITCH-OPEN**
3. **DRAG CHUTE-DEPLOY**
4. **BRAKES-APPLY**

CAUTION

Care should be exercised while applying brakes to avoid blowing a tire. Fuel drained overboard after engine shutdown could contact the hot wheel causing a fire hazard.

5. **SHOULDER 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 airplane towards the center of barrier.
   If possible, engage barrier at a 90° angle to insure a more positive and safe 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 airplane 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.

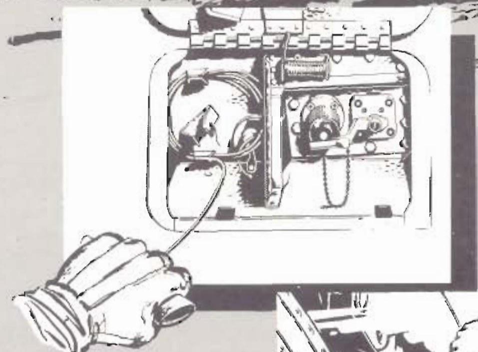
Ditch the airplane only when no alternative is available. All survival equipment is carried by the pilot, thus ejection is advisable. However, if altitude and situation demand ditching, observe the following:

1. Make radio distress call.
2. IFF master knob - EMERGENCY
3. External load - JETTISON
   Depress store and/or tanks emergency jettison button.
4. All personal leads (except oxygen) - DISCONNECT
   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. Helmet visor - DOWN
   Lower the helmet visor for maximum protection against wind blast, flying objects and possible flame and smoke.
9. Canopy - JETTISON
   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.

emergency entrance



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 3/8" 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 3/8" 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.

UA20-304

Figure 3-6

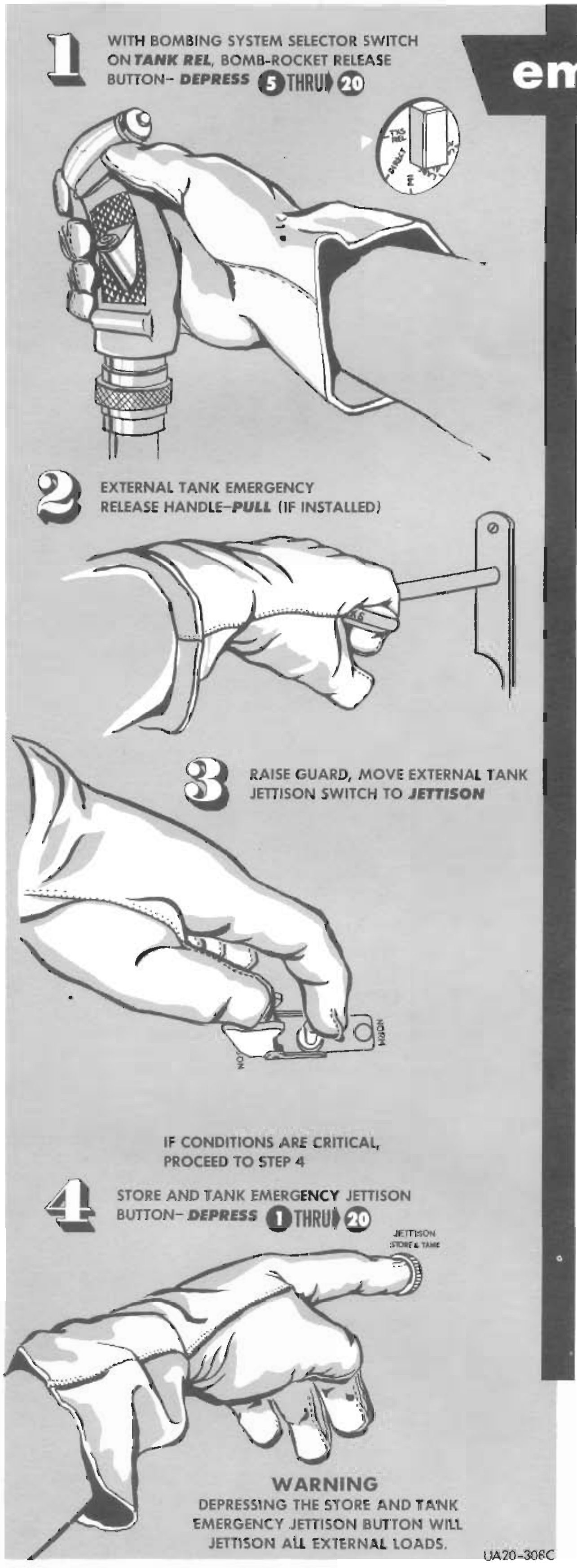


Figure 3-7

emergency tank jettison

10. 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.

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

Note

In the event of ditching, when immediate escape is impossible, it is possible for the pilot to survive under water with oxygen equipment untail escape can be made. The MD-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.

EMERGENCY JETTISONING

EXTERNAL TANKS

The procedures for external fuel 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 airplane.

emergency store jettison

1 THRU 20

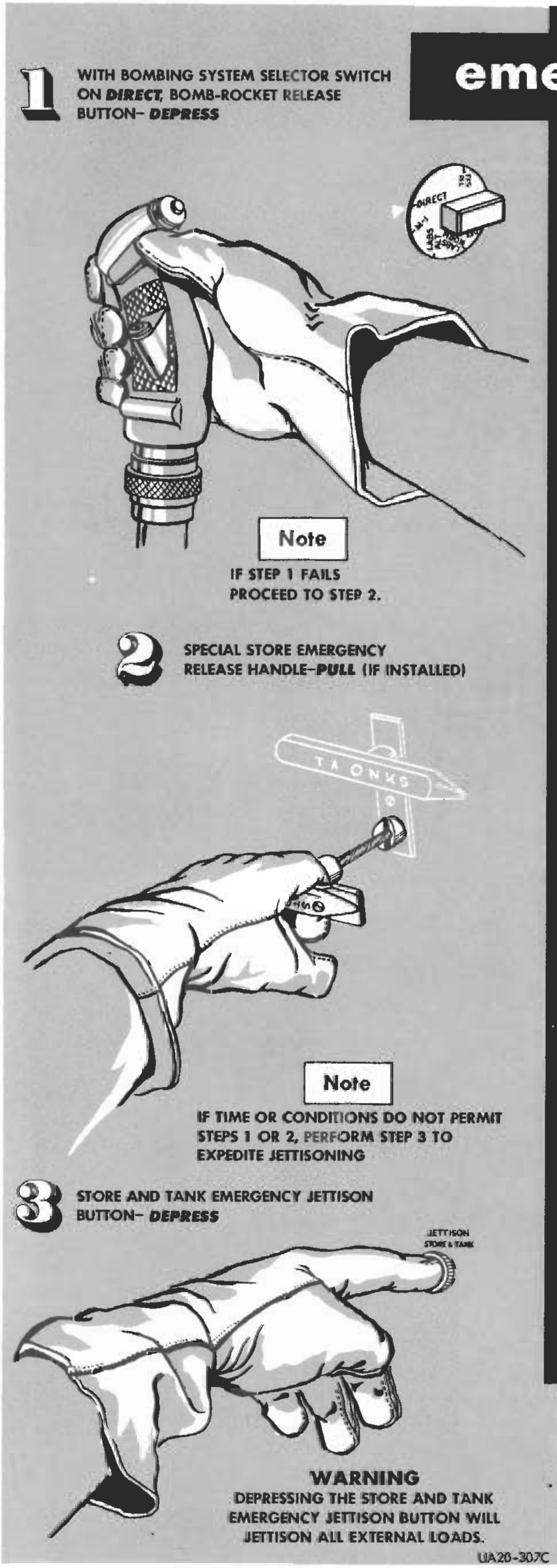


Figure 3-8

SPECIAL STORE

1 THRU 20

The procedure for special store jettison are shown in figure 3-8.

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 nozzles will remain open until afterburner fuel flow is stopped. Take-off need not be aborted if remaining runway is compatible with Military thrust requirements, 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

Failure of the exhaust nozzle to open when initiating afterburner is recognized by higher than normal engine pressure ratio and rapid rise in exhaust gas temperature. The condition may be (but not necessarily always) accompanied by compressor stall. Engine rpm will be near normal. When these abnormal conditions occur, the throttle should be moved inboard immediately, terminating afterburner to prevent possible damage to engine and airplane structure. There is no emergency override or manual control provided for the exhaust nozzle. Exhaust nozzle failure to close when shutting down the afterburner results in lower than normal engine pressure ratio, fuel flow and exhaust gas temperature.

CAUTION

If the exhaust nozzle fails to close when the afterburner is shut down, 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 often be closed by bringing the throttle of the affected engine to IDLE and then advancing to desired thrust.

In the event the afterburner fails to shutoff when the throttle is moved out of the afterburner detent, the throttle must be retarded to a position equivalent to 83% Military thrust in order to terminate afterburning. This action mechanically terminates afterburning by opening the afterburner emergency shutoff valve and the lack of fuel pressure at the exhaust nozzle control unit causes the exhaust nozzle to close.

Subsequent advancement of the throttle past the 83% Military thrust position will automatically initiate afterburning providing the failed electrical switch is still on. Refer to Section I, Afterburner Emergency Shutoff Valve.

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 temperature of bearings, and bearing loads. A good possibility exists for an additional 10 to 30 minutes of engine operation after experiencing a complete loss of lubricating oil. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration, and when the vibration becomes moderate to heavy, complete failure is only seconds away. In order to minimize engine damage and conserve remaining operating time for possible emergencies, the affected engine should be shut down upon first recognition of oil system failure.

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 warning light illuminates, the oil pressure gage for that engine should be monitored until the possibility of oil starvation is determined.

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

1. Unless critical thrust condition exists, affected engine SHUTDOWN
2. If affected engine thrust is needed, reduce thrust to lowest setting to maintain flight and avoid further 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

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 additional available thrust in the event of an emergency during landing.

FUEL SYSTEM EMERGENCY OPERATION

Note

It is possible that the feed tank fuel low warning light will illuminate during afterburner operation with fuel remaining in cells 2 and 3 only. Since cell number 3 transfers by gravity only, it cannot meet the fuel demands of afterburning which results in rapid depletion of cell number 2. If this condition occurs and the feed tank fuel low warning light illuminates, afterburning should be terminated.

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 thrust. 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 the engine fuel control is evidenced by abnormal increase or reduction 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 to approximate engine rpm.

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 over-temperature, 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

Boost 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, thereby 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 be 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

Note

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

2. 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.

3. If defective transfer pump is still inoperative:
   a. Reduce thrust.
   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

- The use of Maximum or Military thrust should be governed by the amount of fuel remaining in the number 2 cell.
- 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 nose-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 actions:

CAUTION

Upon illumination of the warning light, immediately check the corresponding oil gage. The generator failure could have been caused by oil starvation which will also affect the engine oil system.

1. Generator switch - RESET then ON
   After placing generator switch momentarily to RESET, return to ON position.
2. 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.

DOUBLE GENERATOR FAILURE

Engines Operating

When both generators fail, both warning lights will be illuminated and all a-c power will be 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 1-12, Electrical System Schematic, for battery operated equipment.

CAUTION

With complete generator failure, the booster and 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 then ON
   After placing generator switches momentarily to RESET, return to ON position.
4. 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.
5. If generator warning light(s) remain illuminated:
   a. Generator switch(es) - 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, obtain a positive indication of gear down and locked and flap position, and make necessary radio transmissions, 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 (at 700 psi) and may be followed by failure of the remaining pump in the same system. 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. However, a landing should be made as soon as possible.

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. A priority valve in the utility system denies pressure to all units except the ailerons, stabilizer, rudder, pusher actuator, and brakes if the pressure in the utility system drops below 1800 psi.

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. After incorporation of T.O. 1F-101-823, in the 54-1495 (20) and 54-1496 (20) airplanes, the nose gear steering will be operated by the primary hydraulic system. Most units lost have emergency methods of operation and are available as noted:

Note

- The flaps will tend to remain down if utility hydraulic pressure is lost when the flaps are in the full down position.
- The pitch-up pusher force will be lost in the event of a utility hydraulic system failure.

1. Speed brake retraction is available by electrical selection which causes the pressure to by-pass allowing the air stream 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 selection by using the manual pull handle on the right forward 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 airplane 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:

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

FLIGHT CONTROL SYSTEM EMERGENCY OPERATION

In the event of primary or utility system failure, the control forces will remain unchanged, with the exception of the rudder system. Refer to Utility Hydraulic System Failure, this section.

FLIGHT CONTROL FAILURE

If control system difficulties are encountered, perform the following:

1. Reduce speed to below 350 knots IAS.
2. Check hydraulic pressure gages within limits.
3. Autopilot circuit breaker - PULL
4. Avoid high speed maneuvers and abrupt control movements.
5. Land as soon as possible.

INADVERTENT STICK FORCE

If an inadvertent forward stick force occurs, perform the following:

1. Paddle switch - DEPRESS
   Immediately depress the emergency disconnect paddle switch on the stick.
2. Pitch-up pusher switch - OFF
3. Autopilot engage switch - DISENGAGE
   Move the autopilot engage switch out of the ENGAGE position.
4. Autopilot circuit breaker - PULL
5. Speed brakes - EXTEND
6. Landing gear - DOWN
   When below 250 knots IAS, extend the landing gear and land as soon as possible.

FAILURE OF STABILIZER FEEL SYSTEM BELLOWS SKIRT

Failure of the feel system bellows will result in a reduction of longitudinal control stick feel forces and a change in longitudinal trim. Depending on extent of bellows skirt damage, trim will tend to wander in pitch after each attempt to trim out stick forces. The airplane should be trimmed to obtain a minimum stick force and a firm grip retained on the control stick. High speed flight and abrupt fore and aft control stick movement should be avoided to prevent overstressing the airplane. To reduce required pitch activity and to affect a safer landing, a straight-in approach is recommended.

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 in a trailing position.

1. Emergency speed brake switch - IN

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 if utility hydraulic pressure is available.

LANDING GEAR EMERGENCY LOWERING

If normal gear operation fails, the gear can be lowered by utilizing the procedures in figure 3-9.

Note

- The landing gear circuit breaker must be pulled and left in this position to prevent hydraulic reservoir rupture and fire hazard. When the landing gear circuit breaker is pulled in the (20)(20) airplanes, the nose gear steering and the landing and taxi 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 airplane.

CAUTION

Retain landing gear emergency handle in the lock (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.

emergency gear operation

WHEEL BRAKE ANTI-SKID SYSTEM FAILURE

54-1438 (20), 54-1441 (20), 54-1442 (20), 54-150 (10)

If a system malfunction is suspected or the anti-skid out light illuminates the system can be turned off by placing the anti-skid switch OFF. In an emergency, the system can be disengaged by actuating the anti-skid disengage switch. This switch must be held depressed to disengage the system. The normal braking technique, a soft but steadily increasing pedal force, should be used regardless of switch position.

CAUTION

- The brakes shall be released before the system is disengaged to prevent the possibility of skidding.
- Do not pump the brakes when maximum braking is required, since this technique only reduces the pressure available at the brakes.

BRAKE SYSTEM EMERGENCY OPERATION

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

1. Allow airplane to decelerate.
   Utilize aerodynamic braking and delay using brakes as long as safety will permit, allowing the airplane 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. Utilize nose gear steering for directional control (after incorporation of T.O. 1F-101-823 in the 54-1495 (20) and 54-1496 (20) airplanes with a utility system failure).
4. Brakes - APPLY
   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 airplane 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 release when compressed air is utilized for braking.

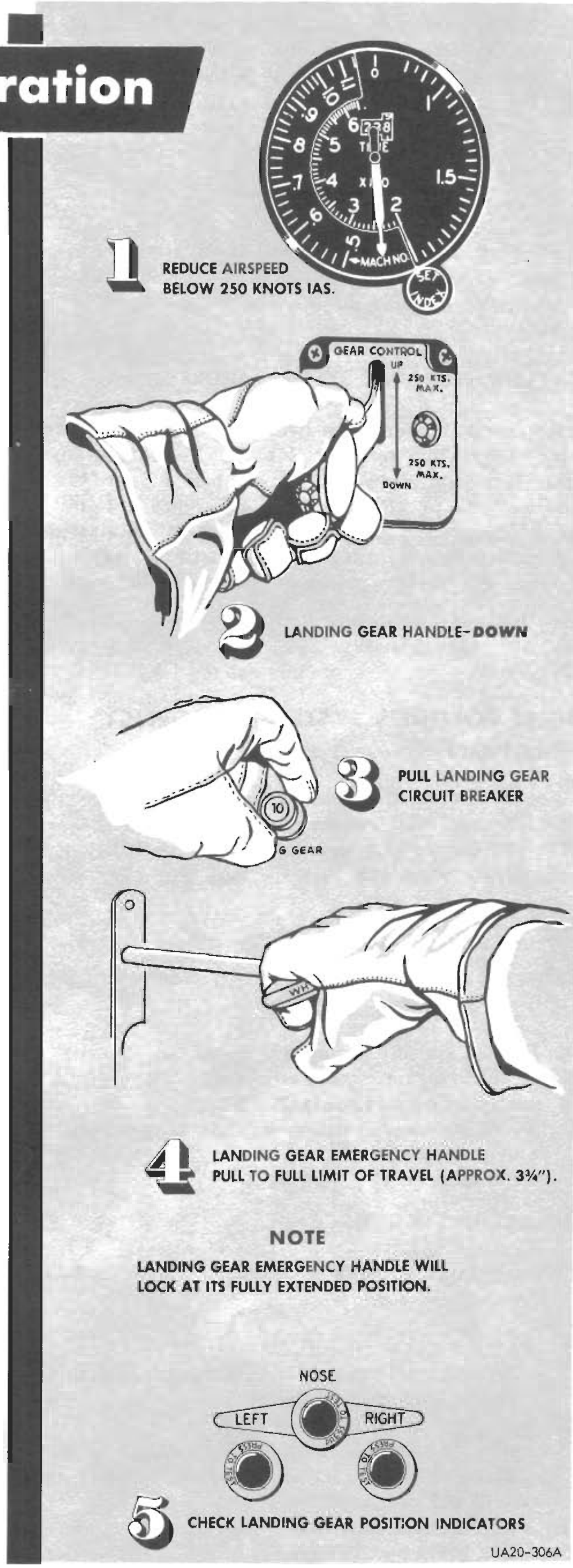


Figure 3-9

CAUTION

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. Because of this situation a steady force should be applied to stop the airplane with a minimum number of applications.

Note

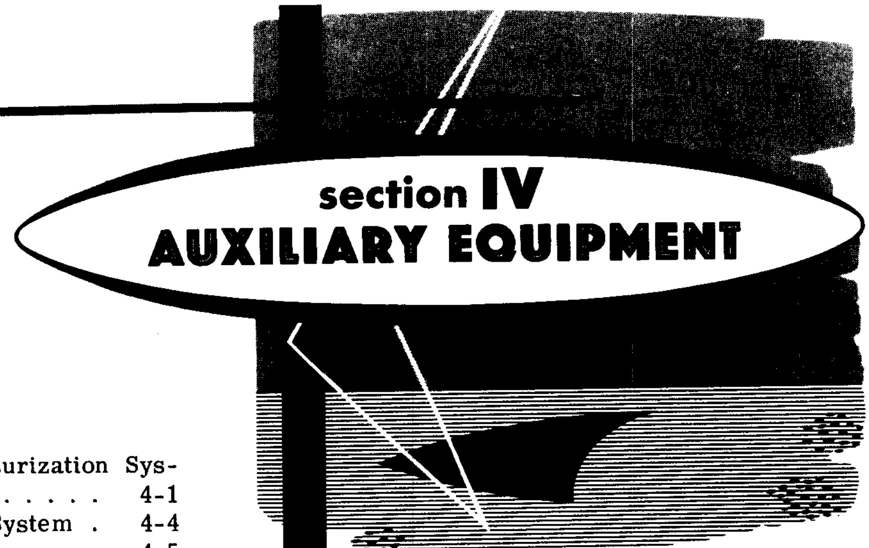
- After incorporation of T.O. 1F-101-823, in the 54-1495 (20) and 54-1496 (20) airplanes, the nose gear steering system will be operated by the primary hydraulic system.

- Differential braking may be achieved, to assist in maintaining directional control, by slightly increasing pressure on one brake without releasing the other. Releasing the brake "dumps" emergency brake air pressure, and decreases the number of brake applications.

- If emergency braking action is exhausted, the throttles may be CLOSED to reduce forward momentum.

ABBREVIATED CHECKLIST

Your emergency abbreviated checklist is now contained in T.O. 1F-101(R)(Y)A-(CL)1-1.



section IV AUXILIARY EQUIPMENT

UA20-400

TABLE OF CONTENTS

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

COCKPIT AIR CONDITIONING

The cockpit is furnished with air at any selected temperature, and at a pressure within safe limits, by the cockpit air conditioning and pressurization system. This system receives air from the last stage of the high pressure compressor of each engine. Hot engine bleed air from the high pressure compressors is ducted to a ram air heat exchanger. The volume of ram air flowing through the heat exchanger regulates the initial amount of cooling of the engine bleed air. To aid in this initial cooling while the airplane is on the ground, a compressor fan, rotated by an expansion turbine, draws air through the heat exchanger and around the engine bleed air coils. From the heat exchanger the engine bleed air flows through the expansion turbine in the refrigeration package. The expansion turbine, which rotates over 82,000 rpm, is directly connected to the compressor fan. Energy expended rotating the turbine and fan, and the expansion of the air as it passes through the turbine, permits the use of engine bleed air for air conditioning purposes. Uncooled engine bleed air is ducted around the heat exchanger and refrigeration package, through a thermal by-pass valve, and is mixed with the cold air from the refrigeration package to attain the desired temperature for cockpit air conditioning. The position of the thermal by-pass valve determines at what proportion the hot engine bleed air is mixed with the cold air. When maximum cooling is selected, the thermal by-pass valve is closed and only cold air is directed to the cockpit. Air conditioning outlets for windshield defrosting are located along the base of the windshield, and the foot heat outlet is located on the floor just forward of the left rudder pedal. An auxiliary air system, in addition to the air conditioning system previously described, supplies slightly cooled air to the anti-G suit, the external fuel tanks, the fuel tank vent valve, and the hydraulic reservoirs. Uncooled engine bleed air is supplied to the windshield heating and rain clearing system. Refer to figure 4-1.

COCKPIT PRESSURIZATION

Conditioned air enters the cockpit under sufficient pressure to pressurize the cockpit. The cockpit pressure is then maintained at a preselected schedule for various flight altitudes by a pressure regulator mounted on the cockpit wall. A cabin pressure switch varies the relief pressure of the pressure regulator. When the cabin pressure switch is in the NORMAL position, a 5.0 psi pressure differential will be maintained above 23,000 ft. With the cabin pressure switch in the COMBAT position, a 2.75 pressure differential will be maintained above 15,000 ft. From 8,000 ft. to 23,000 ft. with the cabin pressure switch in NORMAL, and from 8,000 ft. to 15,000 ft. with the cabin pressure switch in COMBAT, the pressure regulator maintains a cockpit altitude of 8,000 ft. Below 8,000 ft. the cockpit air pressure only slightly exceeds atmospheric pressure. The cockpit air conditioning and pressurization system is controlled by the air conditioning control panel on the pilot's right console. Cockpit air pressures exceeding the 2.75 psi COMBAT pressure or the 5.0 psi NORMAL pressure will be relieved by the automatic opening of a valve in the cockpit air pressure safety valve. To depressurize the cockpit, the air pressure safety valve may be opened by selecting the RAM AIR & DUMP position on the cabin air temperature dial. Refer to figure 4-3 for a comparison of flight altitude to cockpit altitude.

cockpit air conditioning and pressurization system

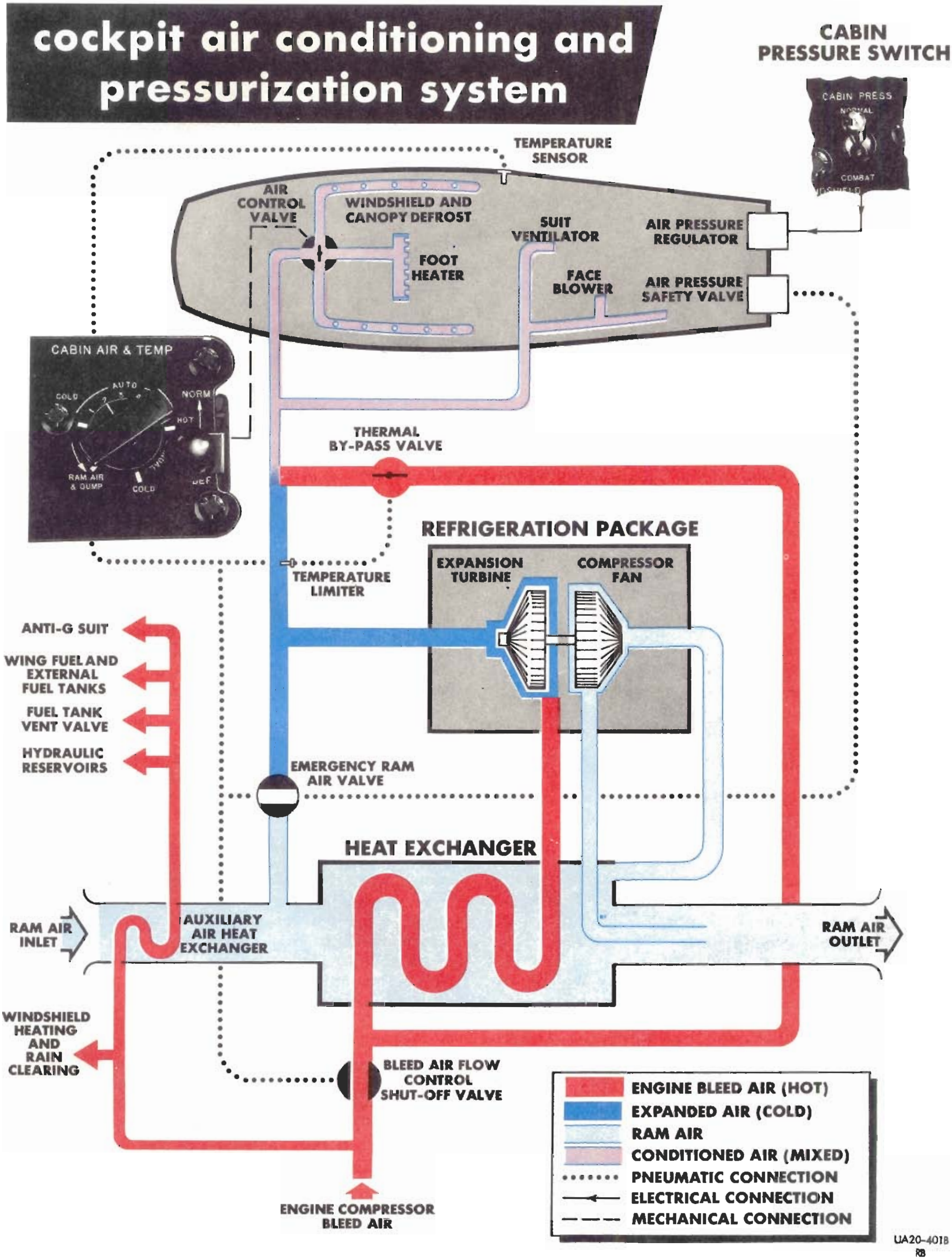


Figure 4-1

Cabin Pressure Switch

The two-position switch (figure 4-2) is located on the air conditioning 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 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 dial position which must be in the AUTO or MANUAL position to close the dump valve, thus allowing pressurization.

Cabin Air Temperature Dial

The cabin air temperature dial (figure 4-2), located on the air conditioning control panel, may be rotated through the following settings: RAM AIR & DUMP, AUTO with a COLD to HOT adjustment and MANUAL with a HOT to COLD adjustment. This dial allows the pilot to adjust the cockpit temperature as desired through pneumatic actuation of the engine bleed air flow control and shutoff valve, the thermal by-pass valve, and the emergency ram air valve.

Air Control Lever

Cockpit air flow is directed to the windshield and canopy defrost or the foot heater by the air control lever on the air conditioning control panel (figure 4-2.) Through a mechanical linkage the air control lever opens or closes two valves located at the junction of the windshield and canopy defrost duct, and the foot heater duct. When NORM is selected on the air control lever, air is directed to the foot heater, and when DEF is selected on the air control lever, air is directed to the windshield and canopy defrost. Any intermediate position will direct air to both the foot heater and the windshield and canopy defrost in proportion to the air control lever position.

Cabin Pressure Altimeter

The pressure altitude of the cockpit is indicated on the cabin pressure altimeter 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

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.

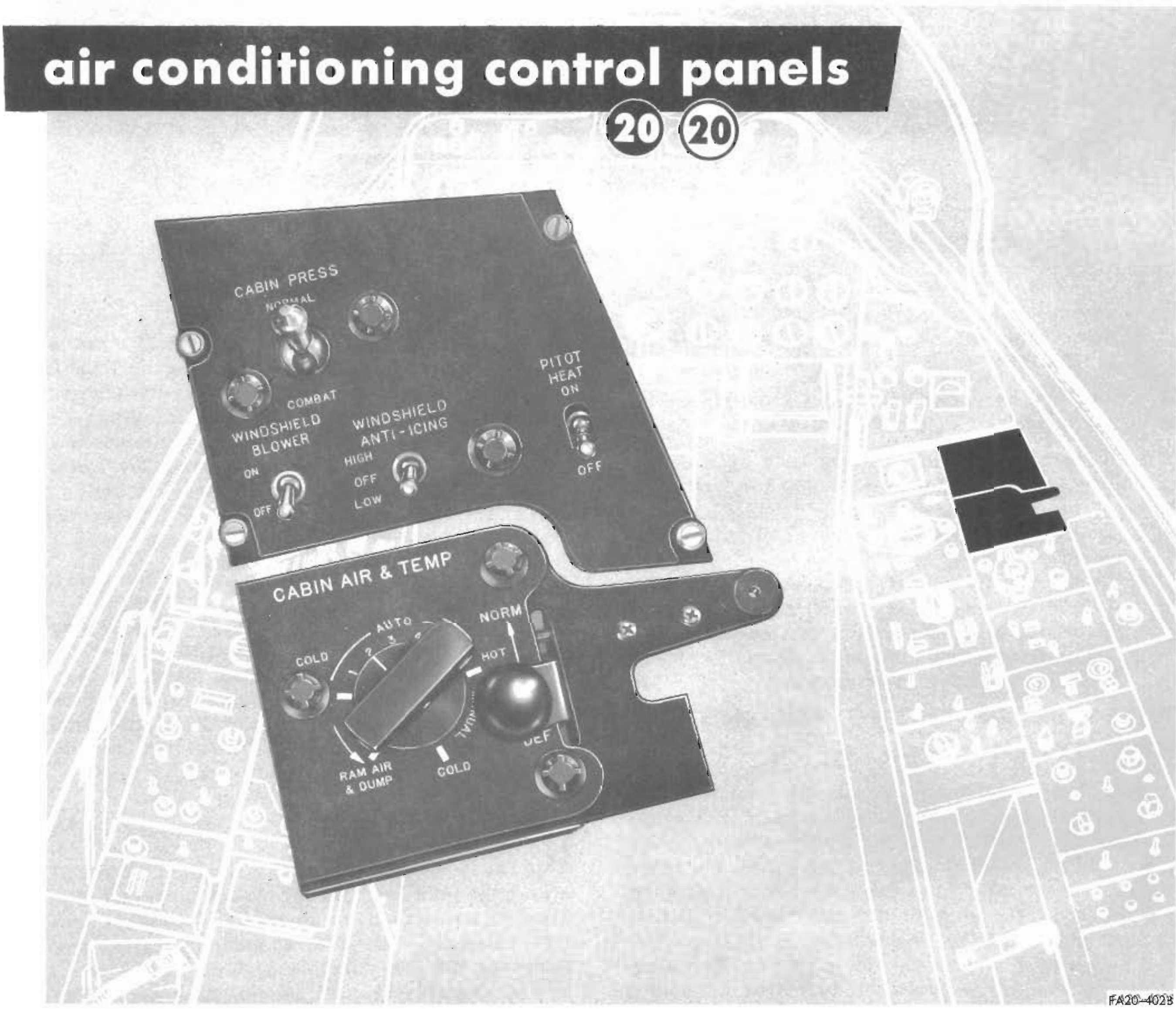


Figure 4-2

cabin pressure schedule

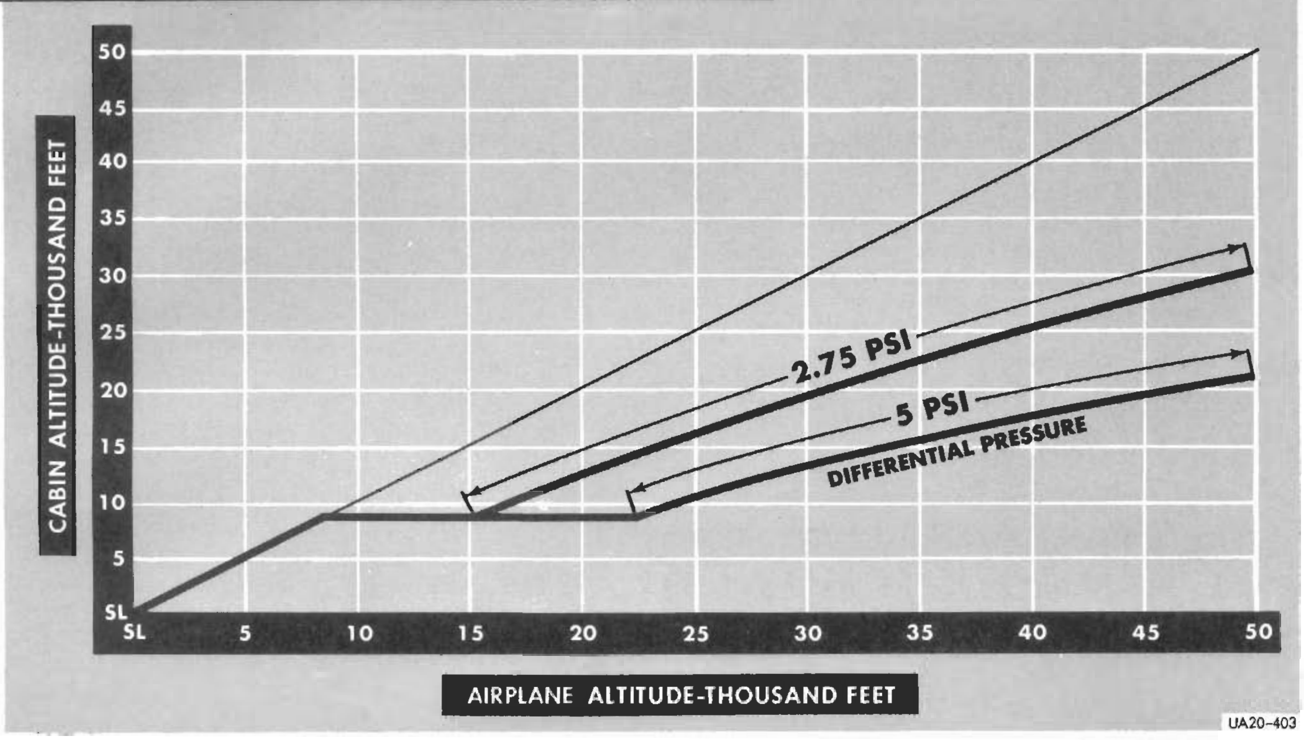


Figure 4-3

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.
3. Turn cabin air temperature knob to RAM AIR & DUMP if temperature remains uncomfortably high. Ram air temperature can be controlled, within limits, by increasing or decreasing speed to increase or decrease temperature.

WINDSHIELD 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.

AIR CONTROL LEVER

Placing the air control lever (figure 4-2), located on the air conditioning 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 the desired defrosting air and foot air as desired, while placing the air control lever to the NORM position directs the maximum air to the pilot's feet.

WINDSHIELD ANTI-ICING SWITCH

This three-position toggle switch (figure 4-2) selects electrical power, 115 volt a-c and 28 volt d-c, to the heating element within the glass layers of the flat plate area of the windshield. The positions are HIGH, LOW and OFF. Selection of the LOW position will be adequate for most conditions. The switch is normally left in the LOW position at all times.

WINDSHIELD BLOWER SWITCH 20 20

This two-position toggle switch, marked ON and OFF, 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. 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. During flight through rain, the visibility is improved by use of this system.

NORMAL OPERATION OF WINDSHIELD DEFROSTING, AND ANTI-ICING SYSTEM

Note

The windshield defrosting system should be operated at the highest temperature possible (consistent with pilot's comfort) during high altitude flight in order to provide sufficient preheating of the transparent surfaces to preclude the formation of frost or fog during descent.

1. Windshield anti-icing switch - LOW
   This switch should be turned on low after engine start and left on low until after engine shutdown subsequent to flight.
2. The windshield and canopy defrosting system should be operated throughout the entire flight at the maximum flow consistent with pilot comfort. The following general procedures are recommended:

Summer

FLIGHT CONDITION	AIR CONTROL LEVER POSITION
Take-off and climb	Normal
Cruise at altitude	Partially open - as much as possible consistent with comfort.
Supersonic	Normal
Descent	Full defrost
Landing	Partially open - same as cruise

Winter

FLIGHT CONDITION	AIR CONTROL LEVER POSITION
Take-off and climb	Partially open
Cruise altitude	Partially open
Supersonic	Normal
Descent	Partially open
Landing	Partially open

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

1. Windshield anti-icing switch - HIGH

CAUTION

The HIGH position may crack glass surface, therefore, care should be taken to use only enough heat selection to eliminate the fogged condition.

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.

PITOT HEAT SWITCH

The pitot heat switch (figure 4-2) is a two-position circuit breaker type switch located on the air conditioning control panel. This switch provides 115 volt a-c power to a conventional electrical pitot heating element.

CAUTION

When pitot heat is not required, the pitot heat switch should remain OFF to prevent heat damage to the pitot plastic dome.

FACE MASK ANTIFROST 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, 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.

CAUTION

Use the minimum amount of heat necessary to prevent or remove any accumulation of moisture on the face plate. It is not necessary that heat be felt on the face. The face plate heat rheostat should be at maximum heat just long enough to remove moisture and then return to the minimum heat required to prevent moisture accumulation.

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 SYSTEM—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 button is a push button type switch and is located on the wing flap handle housing (figure 1-19). 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 preamplifier 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 radios, gear horn, or pitch-up warning system.

UHF COMMAND RADIO–AN/ARC-34

The AN/ARC-34 command set provides two-way voice communication, in the frequency range of 225.0 to 399.9 megacycles, between airplane and ground stations or between airplanes. Any of 20 preset frequencies may be selected. In addition to the 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/ARN radio magnetic 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 at the bottom of the control panel records the frequencies that have been preset and assigned the 20 channels. 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.

Microphone Buttons

The main microphone button, a press-release type switch, is located on the inboard throttle (figure 1-5). The nose gear steering button (figure 1-18), also a press-release type switch, acts as an alternate microphone button during airborne operation.

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 transmission 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 rotate control switch to MAIN or BOTH and 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 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 may be garbled while needle is homing.

DF Function 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 necessary signals to the DF receiver.

communication and associated electronic equipment

TYPE DESIGNATION	FUNCTION	RANGE	LOCATION AND CONTROLS
INTERPHONE AN/AIC-10	Voice communication between cockpit and ground (ground use only).	Not applicable.	Interphone button of flap handle housing.
UHF COMMAND RADIO AN/ARC-34	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 (ADF) AN/ARA-25	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 AN/ARN-14	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-387/ARN and ID-250/ARN course indicators on the instrument panel.
(20) NAVIGATION RADIO (TACAN) AN/ARN-21	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 on right console. ID-387/ARN and ID-250/ARN course indicators on instrument panel.
(20) GLIDE SLOPE AND LOCALIZER (ILS) RECEIVERS AN/ARN-31	Vertical and lateral guidance for ILS operations.	20 miles.	Control panel on right console. ID-387/ARN course indicator on instrument panel.
(20) MARKER BEACON RECEIVER AN/ARN-32	Receives marker beacon signal to indicate position.	Not applicable.	Indicator light on ID-387/ARN course indicator on instrument panel.
(20) RADIO COMPASS AN/ARN-59A	Receives voice and code signals for automatic bearing and homing.	Up to 200 miles, depending on operating frequency and time of day.	Control panel on right console. ID-230/ARN course indicator on instrument panel.
(20) SOUND RECORDER AN/AHN-2	Voice recorder for pilot and communications receiver.	Not applicable.	Control panel on right console. Interphone button on flap handle housing, of power quadrant.
IDENTIFICATION RADAR AN/APX-6A OR AN/APX-25	Identifies airplane as friend or foe.	Up to miles line of sight.	Control panel or panels on the right console.
LATITUDE AND LONGITUDE (GPI) COMPUTER AN/ASN-6	Indicates ground position in terms of latitude and longitude at all times.	Not applicable.	Indicator and control on right console.
(20) NAVIGATION COMPUTER AN/ASN-7	Indicates Airplane position, course, and distance to destination.	Not applicable.	Internal provisions for later installation of this equipment.
ARMAMENT CONTROL SYSTEM (ACS) RADAR MA-7 (1) THRU (20)	All-weather search, track, gun aim and beacon display on scope. Furnishes range information to gun sight for visual attack. Furnishes airplane attitude information to the drift computer.	Map and beacon 0-200 miles Drift 25-32.5 miles Search and track 0-30 miles	Controls on left console, radar scope in instrument panel.
(10) (20) RADAR ALTIMETER AN/APN-22	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.
(20) (20) RADAR WARNING SYSTEM AN/APS-54	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 instrument panel.

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P. 4-16

Figure 4-4

communications panels

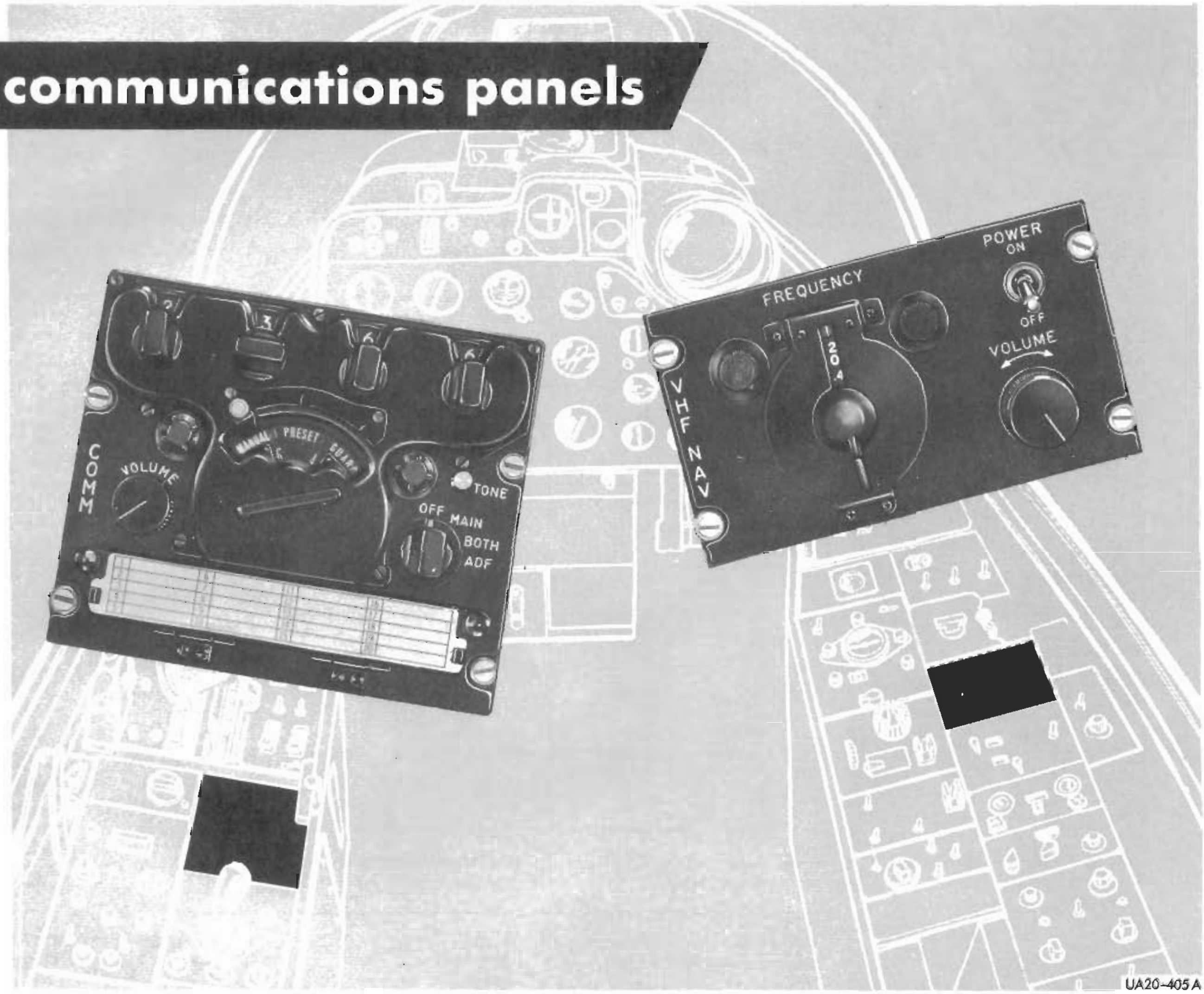


Figure 4-5

VHF NAVIGATION RADIO–AN/ARN-14

The AN/ARN-14 set provides reception and steering information utilizing VHF radio frequencies. The set has 280 channels 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 ID-387/ARN course indicator and the ID-250/ARN radio magnetic indicator. This set receives power from the 28 volt d-c bus. Omnidirectional information (ODR) is received and displayed on the ID-250/ARN No. 2 needle indicating the magnetic heading to the station and indicating which radial is being received. The ID-387 course indicator vertical needle will show azimuth deviations from that radial selected by the set knob on the indicator, and whether or not the course selected is a "to" or "from" station radial. The relative heading pointer will show airplane heading relative to the radial selected. The horizontal needle is not utilized. Visual aural range (VAR) and tone localizer (TL) information is displayed on the ID-387 vertical needle and heading pointer only. No other ID-387 controls or cockpit indicators are operable. With AN/ARN-31 glide slope equipment installed in the (20) airplanes, the AN/ARN-14 is capable of ILS procedure with glide slope information presented on the horizontal needle of the ID-387 course indicator. When an ILS localizer frequency is selected on the AN/ARN-14, the proper glide slope frequency is automatically selected.

Note (20)

With the AN/ARN-14 equipment installed in the airplane, only the AN/ARN-31 glide slope receiver is installed. With the AN/ARN-21 TACAN installed in place of the AN/ARN-14, all AN/ARN-31 equipment must be installed. The AN/ARN-14 radio requires only the addition of the AN/ARN-31 glide slope receiver for ILS capability, while TACAN requires the entire AN/ARN-31 ILS system. Refer to Glide Slope and Localizer (ILS) Receiver System, AN/ARN-31, this section.

Frequency Selector Knob

A large and a small frequency selector knob (figure 4-5) 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 counterclockwise. ODR stations broadcast on frequencies of 112.0 through 117.9 on the even tenth megacycle. VAR and TL stations broadcast over the odd tenth megacycle from 108.1 through 111.9.

Power Switch

The receiver is turned on and off by the power switch (figure 4-5) located on the control panel. The ON position provides power for operation of the set and the OFF position turns the set off.

Volume Control Knob

A volume knob (figure 4-5) is provided on the control panel and is used to adjust the receiver audio to the pilot's headset.

ID-387/ARN Course Indicator

The ID-387 course indicator (figure 1-27), located on the instrument panel, is a composite display of VHF navigation information. Omni-range station relationship to the airplane position is shown by information in tab windows and movement of a vertical bar. 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. During ILS approaches in (20) airplanes, localizer information is presented on the ID-387 vertical needle in the form of left or right deviation and glide path deviations are displayed on the horizontal needle. The horizontal and vertical needle remain parallel to their rest position and are always at right angles to each other. With AN/ARN-14 installed in the airplanes, the localizer frequency is selected on the AN/ARN-14 control panel and the proper glide path frequency is automatically obtained. With AN/ARN-21 TACAN installed in the (20) airplanes, the ILS localizer frequence is selected on the AN/ARN-31 control panel and the glide slope frequency is automatically obtained. During ILS, the "to-from" indicator and the course set knob are not operable.

Course Set Knob

A course set knob located on the ID-387/ARN course indicator (figure 1-27) 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 (16, figure 1-23) receives heading reference information from the slaved gyro 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 airplane 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 slaved gyro system is operating properly, the double needle will also give relative bearing. If the slaved gyro system is unreliable, the double needle will give magnetic bearing only. If the slaved gyro system is out, the double needle may be unreliable.

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-387/ARN.

CAUTION

Check to see that the flag alarm-off indicator for the vertical bar disappears. The flag alarm must be out of sight before indications of the vertical bar are reliable.

6. Set course selector knob on ID-387/ARN to desired course. Fly heading to or from station as desired.
7. With vertical bar centered, observe the heading pointer to determine crab angle of the airplane.

NAVIGATION RADIO AN/ARN-21 (TACAN) (20)

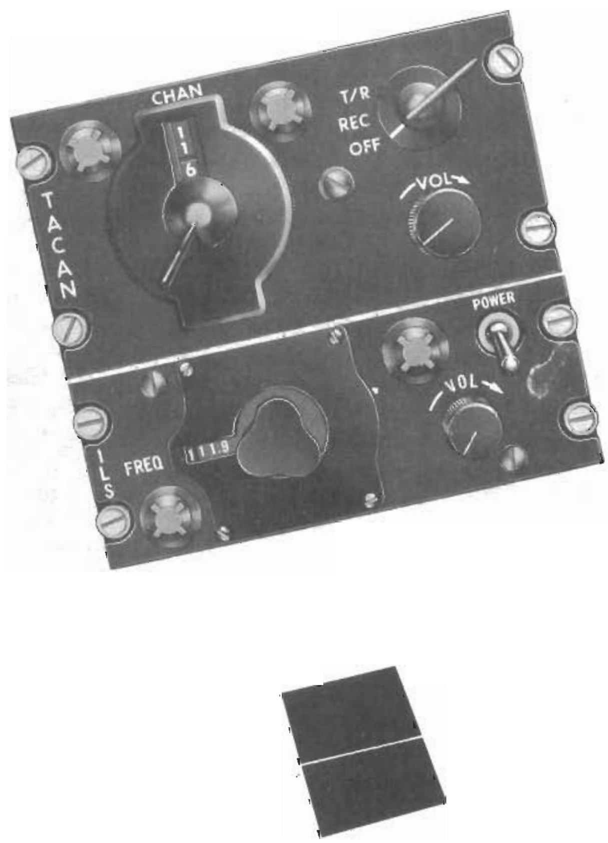
The AN/ARN-21 TACAN navigational radio may be installed instead of the AN/ARN-14 navigational radio. TACAN is a short-range navigational radio which converts radio signals into visual displays of azimuth and range. The signals are displayed as a magnetic bearing to the station by the double needle on the ID-250 radio magnetic indicator and in terms of displacement from a selected to or from radial on the ID-387. 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 airplane 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 airplanes 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. With TACAN installed in the airplane, the AN/ARN-31 glide slope and localizer equipment with the AN/ARN-31 ILS control panel is installed. The TACAN navigational radio and the ILS localizer and glide slope equipment both use the ID-387 course indicator to present the data (TACAN or ILS) to the pilot. The ILS-TACAN switch must be positioned on ILS if the ILS equipment is to be used. The switch is positioned to TACAN if the TACAN equipment is to be used.

ILS-TACAN Switch (20)

The ILS-TACAN switch (19, figure 1-27), located on the pedestal panel, determines which navigational system (ILS or TACAN) will furnish information to the ID-387 course indicator. This switch is a two-position switch, with the ILS selection in the up position, and the TACAN selection in the down position. On airplanes equipped with AN/ARN-14 VOR, this switch is inoperative. Prior to the incorporation of T.O. 1F-101-832, an AN/ARN-21 TACAN indication would automatically be selected on the ID-387 course indicator in the event of an AN/ARN-31 ILS power failure during an ILS approach. After the incorporation of T.O. 1F-101-832, the original single pole ILS-TACAN switch will be replaced with a double pole ILS-TACAN switch enabling the selection of an individual power source for each system, and thereby preventing ambiguous TACAN indications if the ILS system should fail during an ILS approach. The failure of either selected system will be indicated by the appearance of an "OFF" flag, and the centering of its respective needle on the ID-387 course indicator.

Channel Selector Knobs (20)

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.



tacan and ils control panels (20)

RFA20-447A

Figure 4-6

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 (20)

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 Control Knob (20)

This control adjusts the volume of the station identification signal in the pilot's headset.

ID-387/ARN Course Indicator (20)

The operation of this instrument is covered under the discussion of the AN/ARN-14 in this section.

ID-250/ARN Radio Magnetic Indicator (20)

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.

NORMAL OPERATION OF TACAN (20)

1. Power switch - REC or T/R as desired
   Allow approximately 90 seconds for warm-up.
2. ILS-TACAN switch - TACAN
3. Select the desired channel.
4. Volume - AS DESIRED
5. Observe the double needle indication on ID-250 radio magnetic indicator.
6. Observe the vertical cross-pointer deflection on ID-387 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 -387 and the ID-310 will "search" constantly.

8. Set desired course in the bearing window of the ID-387 course indicator.

EMERGENCY OPERATION OF TACAN (20)

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 airplane 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 airplane.

GLIDE SLOPE AND LOCALIZER (ILS) RECEIVER SYSTEM—AN/ARN-31 (20)

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-387 course indicator. Both receivers are installed when the airplane 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. When the AN/ARN 14 VOR equipment is installed, the AN/ARN-31 glide slope receiver is controlled and automatically tuned to the proper frequency when the ILS localizer frequency is selected on the AN/ARN-14 control panel. With TACAN installed, ILS localizer frequencies are selected on the AN/ARN-31 control panel with the glide slope frequency again automatically selected.

ILS Control Panel (20)

The ILS control panel (figure 4-6) is installed whenever the TACAN set is installed in the airplane. 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 (20)

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 (20)

The localizer receiver will be found on airplanes equipped only with the TACAN 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 1-27), located on the pedestal panel, determines which navigational system (ILS or TACAN) will furnish information to the ID-387 course indicator. This switch is a two-position switch, with the ILS selection in the up position, and the TACAN selection in the down position. On airplanes equipped with AN/ARN-14 VOR, this switch is inoperative. Prior to the incorporation of T.O. 1F-101-832, an AN/ARN-21 TACAN indication would automatically be selected on the ID-387 course indicator in the event of an AN/ARN-31 ILS power failure during an ILS approach. After the incorporation of T.O. 1F-101-832, the original single pole ILS-TACAN switch will be replaced with a double pole ILS-TACAN switch enabling the selection of an individual power source for each system, and thereby preventing ambiguous TACAN indications if the ILS system should fail during an ILS approach. The failure of either selected system will be indicated by the appearance of an "OFF" flag, and the centering of its respective needle on the ID-387 course indicator.

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. The glide slope receiver is automatically tuned upon selection of a localizer frequency. The knob may be rotated in either direction.

Volume Control Knob (20)

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 (20)

The power switch, located on either the VOR control panel or the ILS control panel, turns the system on or off.

ID-387/ARN Course Indicator (20)

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.

NORMAL OPERATION OF ILS (20)

1. ILS-TACAN switch - ILS
2. Select the desired localizer frequency. The glide slope frequency is automatically selected.
3. Power switch - ON
4. Volume control - AS DESIRED
5. Observe the deflections of the horizontal and vertical pointers on ID-387.

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.

6. Fly the airplane to center both cross-pointers.
7. Turn power switch OFF to de-energize set.

Note

During ILS operations, the ID-387 "to-from" indicator and course set knob are not operable.

EMERGENCY OPERATION OF ILS (20)

There is no emergency operation of the ILS system, however, prior to incorporation of T.O. 1F-101-832, the possibility exists of erroneous indications on the course indicator during ILS approach with TACAN equipment turned on. (Applicable to those airplanes with AN/ARN-21 installed.) In the event electrical power is lost to the ILS-TACAN selector relays and the ILS-TACAN switch is in the ILS position (for an ILS approach) and TACAN is turned on, the vertical needle on the course indicator will automatically revert to TACAN information. There will be no indication to the pilot at any time during an approach that this situation is occurring since the vertical needle warning "OFF" flag will not appear. Also, if during an ILS approach, disappearance of the horizontal needle warning "OFF" flag is delayed beyond normal expectations (as during an ILS approach started far out), it may be an indication that electrical power to the ILS-TACAN switch relays is lost and the vertical needle signals are being derived from a TACAN station. If the horizontal warning "OFF" flag has disappeared during an ILS approach and subsequent electrical power failure to the relays occurs, the horizontal warning "OFF" flag will appear and the horizontal needle will center itself and it should be assumed that the vertical needle is now receiving TACAN information. Until modification is accomplished to eliminate these conditions, the following instructions should be observed. At the start of an ILS approach where the vertical needle warning "OFF" flag has disappeared but the horizontal warning "OFF" flag is still visible, a check to determine if electrical power loss to the relays has occurred can be made as follows:

1. Momentarily turn off TACAN equipment.
   a. If the vertical needle warning "OFF" flag does not appear immediately, it can be considered that the vertical needle is receiving information from the localizer and TACAN equipment can be switched back on.

b. If the vertical needle warning "OFF" flag appears immediately, assume that the signal to the vertical needle was being received from a TACAN station and not the localizer and the system is no longer reliable for an ILS approach.

WARNING

During an ILS approach (after both warning "OFF" flags have disappeared), an electrical power loss, or an AN/ARN-31 power loss will be detected by the horizontal needle warning "OFF" flag appearing and the horizontal needle will center itself and remain centered regardless of airplane movement.

After the incorporation of T.O. 1F-101-832, a separate power source is provided for the ILS to prevent ambiguous TACAN indications on the course indicator in the event of an AN/ARN-31 power loss during an ILS approach.

MARKER BEACON RECEIVER–AN/ARN-32 (20)

The marker beacon receiver is a fixed tuned receiver which detects 75 mc signals. The receiver causes the amber light on the ID-387 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.

AN/ARN-59A RADIO COMPASS (20)

After incorporation of T.O. 1F-101-746, the AN/ARN -59A radio compass (figure 4-7) will be installed on the right console. The radio compass has an operating frequency range of 190 to 1750 kc and is divided into

radio compass control panel

(20)

three megacycle bands as follows: .19 to .40 mc, .40 to .84 mc, and .84 to 1.75 mc. These bands are selected manually by a band selector switch. The desired frequency is then manually tuned by the tuning crank. The volume control knob, in addition to regulating volume, also serves to supply 28 volt d-c electrical power to the set. Approximately 90 seconds are required for warm-up. The function selector switch is a three-position rotary switch, marked COMP-ANT-LOOP. With the switch in the COMP position, the RMI will indicate relative bearing to the station and presents automatic direction finding features for homing and tracking. Maximum reception in the COMP position is achieved by tuning the desired frequency and obtaining maximum deflection of the tuning meter needle. In the ANT position, the automatic directional features are eliminated, however, coded identification or radio range signals can be received. The LOOP position is used to position the loop antenna manually by use of the Left-Right switch. The BFO switch is used to make audible the cw signals. During automatic direction finding, this switch is normally OFF. The switch can also be used as a tuning aid when the function selector switch is in the ANT or LOOP position. When working with aural null with the function selector switch in the LOOP position, a more defined null may be obtained with the BFO switch ON.

SOUND RECORDER–AN/AHN-2 (20)

The sound recorder set 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 (20)

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 (20)

The green record light (figure 4-8) is located on the sound recorder control panel. It illuminates whenever the sound recorder is recording.

Figure 4-7

Warning Light (20)

The amber warning light (figure 4-8), located on the sound recorder 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

An AN/APX-6 or 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 set receives challenges and transmits the responsive signal to the source of the challenge, where this response is displayed, together with associated radar information (target, etc.,) on radar scopes.

sound recorder control panel

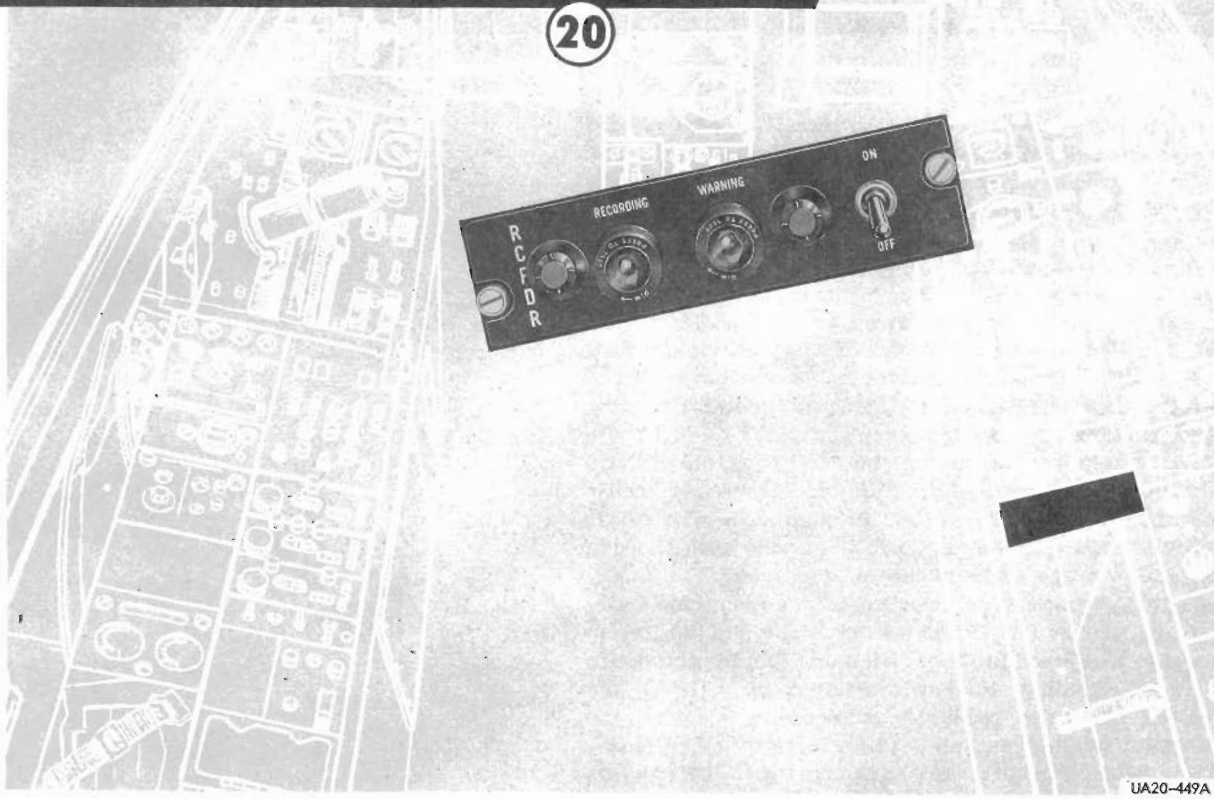


Figure 4-8

Proper reply identifies the target as friendly. The master switch located on the right console, receives power from the 115 volt single-phase bus, and 28 volt d-c. The AN/APX-6 destructor switch is inoperative.

OPERATION OF IDENTIFICATION RADAR-AN/APX-6A

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 (20)(20)

The AN/APX-25 radar identification set provides automatic selective identification of the airplane in which it is installed when properly challenged by surface or airborne radar sets. The system has provisions to identify a specific friendly airplane within a group of friendly airplanes in which the equipment is installed. Supplementary purposes are to provide momentary identification of position upon request and to transmit a specially coded response to indicate an emergency. In operation, the set receives coded interrogation signals and transmits coded responsive signals to the source of the challenge, where this response is displayed, together with associated radar information (target, etc.) on the radar scope. Proper reply indicates the target is friendly. Three modes of operation are provided for interrogation or response to interrogation signals. These are known as mode 1, mode 2, and mode 3, which are used for security identification, personal identification, and traffic identification, respectively. The radar identification set utilizes 115 volt a-c and 28 volt d-c electrical power.

Note

The AN/APX-25 can be preset on the ground for Mark X operation. In Mark X operation, the SIF (Selective Identification Feature) is eliminated rendering the code selector switches inoperative. However, the set will still operate in all three IFF modes of operation, providing limited preset interrogation and response signals.

SIF and IFF control panels

Identification Radar Controls (20) (20)

Two control panels (figure 4-9) marked SIF and IFF on the right console, contain the system master switch, two mode switches, two code selector switches and an I/P switch. The five-position master switch is marked "OFF", "STDBY", "LOW", "NORM", and "EMERGENCY". In the STDBY position the system is inoperative but ready for instant use. In the LOW position, the system operates in partial sensitivity and replies only in the presence of strong interrogations. In the NORM position, the system operates in full sensitivity which provides maximum performance. In the EMERGENCY position the system replies to all modes of interrogation with a special coded signal to indicate an emergency. The mode 2 switch, marked MODE 2 and OUT, is used by the pilot for personal identification. The mode 3 switch, marked MODE 3 and OUT, is used by the pilot for traffic identification. The identification of position (I/P) switch, marked I/P, OUT and MIC, is utilized by the pilot upon request, to provide momentary identification of position when held in the I/P position. When placed in the MIC position the identification of position signals are transmitted while the microphone button is held depressed. Two rotary code selector switches are used to select the specified code signals to be used in Mode 1 or Mode 3 operation. The specified code signals to be used in Mode 2 are preset on the ground and cannot be changed in flight.

OPERATION OF IDENTIFICATION RADAR -AN/APX-25 (20) (20)

1. Rotate master switch to STDBY to maintain equipment inoperative but ready for instant use.
2. Rotate master switch to NORM to place equipment in operation.

Note

- The LOW position of the master switch should not be used except upon proper authorization.
- Mode 1, the security identification feature, is in operation when the master switch is in NORM.

3. Set Mode 2 and Mode 3 switches OUT unless otherwise directed.
4. Set Mode 1 and Mode 3 code selector switches as directed.
5. For emergency operation, press dial stop and rotate master switch to EMERGENCY so that the set will automatically transmit a special coded distress signal.
6. Rotate master switch to OFF to turn set off.

LATITUDE AND LONGITUDE COMPUTER SYSTEM-AN/ASN-6

Refer to Navigation Equipment, this section.

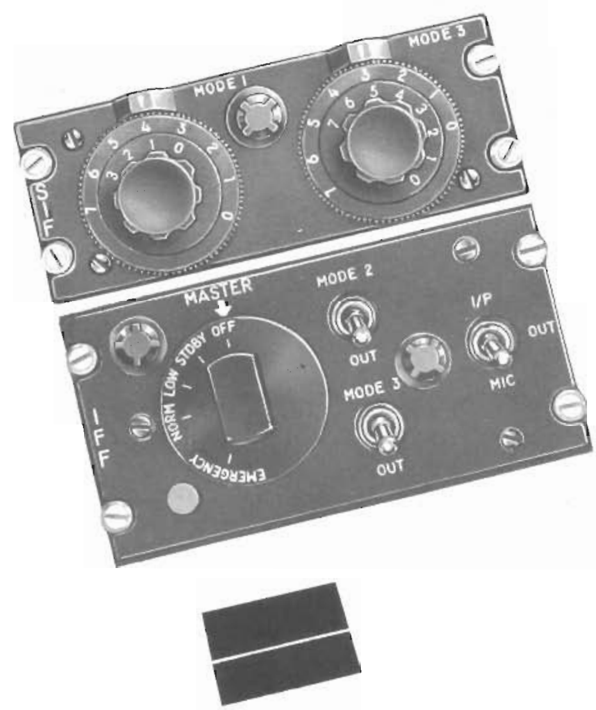


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Figure 4-9

NAVIGATION COMPUTER-AN/ASN-7 (20)

Refer to Navigation Equipment, this section.

ARMAMENT CONTROL SYSTEM RADAR-MA-7 (1) THRU (20)

Refer to Radar System, this section.

RADAR ALTIMETER SYSTEM-AN/APN-22 (10) (20)

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.

CAUTION

Radar waves can penetrate the surface of snow and ice fields, therefore, when radar altimeter equipment is used for measuring terrain clearance over ice or snow, greater terrain clearance may be indicated than actually exists.

Radar Altimeter (10)(20)

The radar altimeter (figure 1-27), 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 airplane is flying at or below the preset altitude, and off when the aircraft is above the preset altitude.

Radar Altimeter Control Knob (10)(20)

A control knob (figure 1-27) 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 (10)(20)

A red warning light (figure 1-27) 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. Intensity of the warning light is changed through the airplane's warning lights dimming system. Power required is 28 volt d-c.

OPERATION OF RADAR ALTIMETER (10)(20)

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 counterclockwise 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 (10)(20)

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 (20)(20)

The radar detector set is designed to warn the pilot when the airplane is within the radiation pattern of some airborne radar system. The detector receiver operates in an untuned frequency range. This frequency range includes the "S-band frequencies" which are most suitable for airborne radar systems. The untuned characteristic of the system allows it to operate properly on any frequency within the frequency range. The operating range of the radar detector receiver is always considerably greater than the operating range of the radar it is detecting. This is possible because the searching radar must utilize a weak reflected signal from a target while the radar detector receiver operates on the stronger directly transmitted pulse from the searching radar. The radar detector set provides the pilot with a visible and audible warning signal. The visible warning consists of two red warning lights. The audible warning signal varies in tone depending on the pulse repetition of the radar being received and is reproduced in the pilot's headset. The control panel is located on the left console just aft of the radar controls, figure 4-10. Power required for the set is 28 volt d-c and 115 volt a-c.

Power Switch (20)(20)

A two-position toggle switch (figure 4-10) on the AN/APS-54 control panel, marked ON and OFF, is pro-

radar warning control panels

20 20

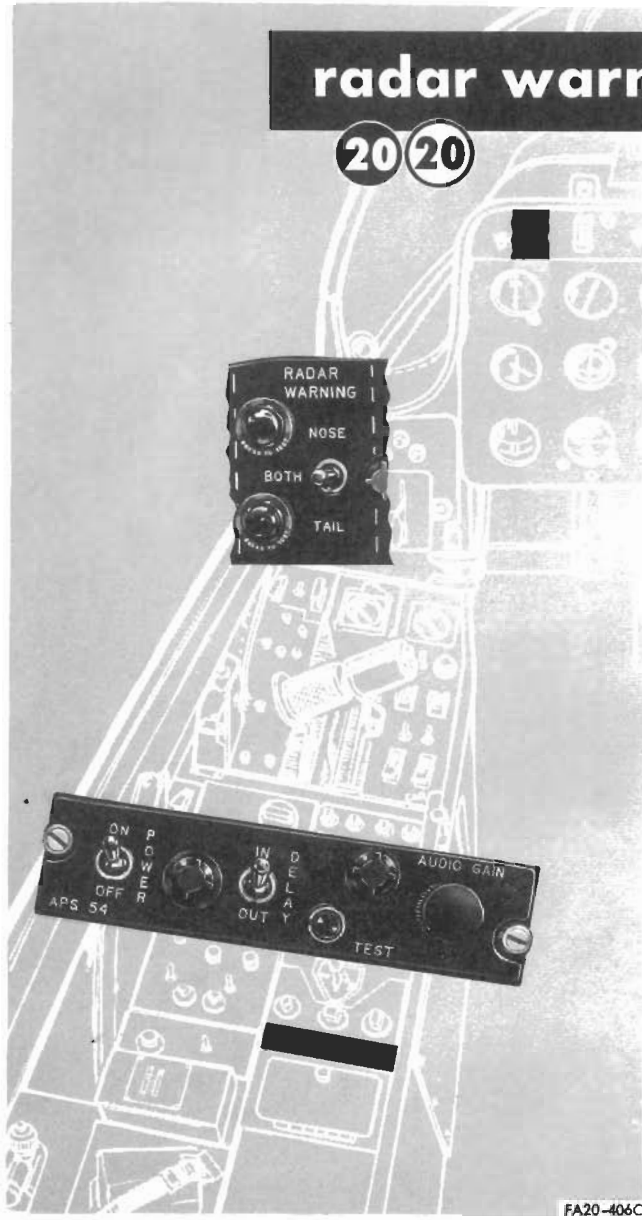

Figure 4-10

vided to select power, 28 volt d-c and 115 volt a-c to operate the set.

Delay Switch 20 20

The delay switch (figure 4-10), located on AN/APS -54 control panel, is a two-position toggle switch marked IN and OUT. When placed to the IN position, it provides a delay between the sounding of the audio tone and illumination of the warning lights. This delay prevents scanning radar signals from causing warning indications and permits a warning only if a radar set is "locked-on" to the airplane.

Test Button 20 20

The test switch (figure 4-10) is a spring-loaded, push button type switch located on the control panel. It controls a signal generating circuit which sends a test signal through the system, excluding the antenna-detector system.

Audio Gain Control Knob 20 20

The audio gain control knob (figure 4-10), located on the control panel, adjusts the volume of the warning tone in the pilot's headset. The audio tone cannot be turned off completely due to the design of the volume control rheostat.

Radar Warning Switch 20 20

The radar warning switch (figure 4-10) is a three-position toggle switch, located on the instrument panel, which permits selection of the audio tone and warning light from the nose antenna, tail antenna, or both antennas simultaneously. This enables the pilot to determine direction of approaching airplanes. This switch is normally retained in the center or BOTH position. Placing the switch to the NOSE or up position selects the nose radar warning only. Placing the switch to the TAIL or down position selects the tail radar warning only.

Radar Warning Light 20 20

Two red lights (figure 4-10), marked "Nose" and "Tail" respectively, are located on the instrument panel and are connected through the nose or tail amplifiers and the radar warning switch. Either one or both of these lights will illuminate depending upon the position of the radar warning switch, and the inbound direction of a supposed interceptor. 28 volt d-c power is utilized.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

Landing and Taxi Lights

Two 600-watt, 115 volt a-c lamps mounted on the nose gear strut and positioned when the gear is extended provide illumination during landing and taxiing. The left light is used for taxiing; the right light for landing. The lamps are set at different angles for the most effective illumination by each light.

Note

In the 20 20 airplanes, the landing and taxi lights will be available with the landing gear circuit breaker pulled.

lighting control panels

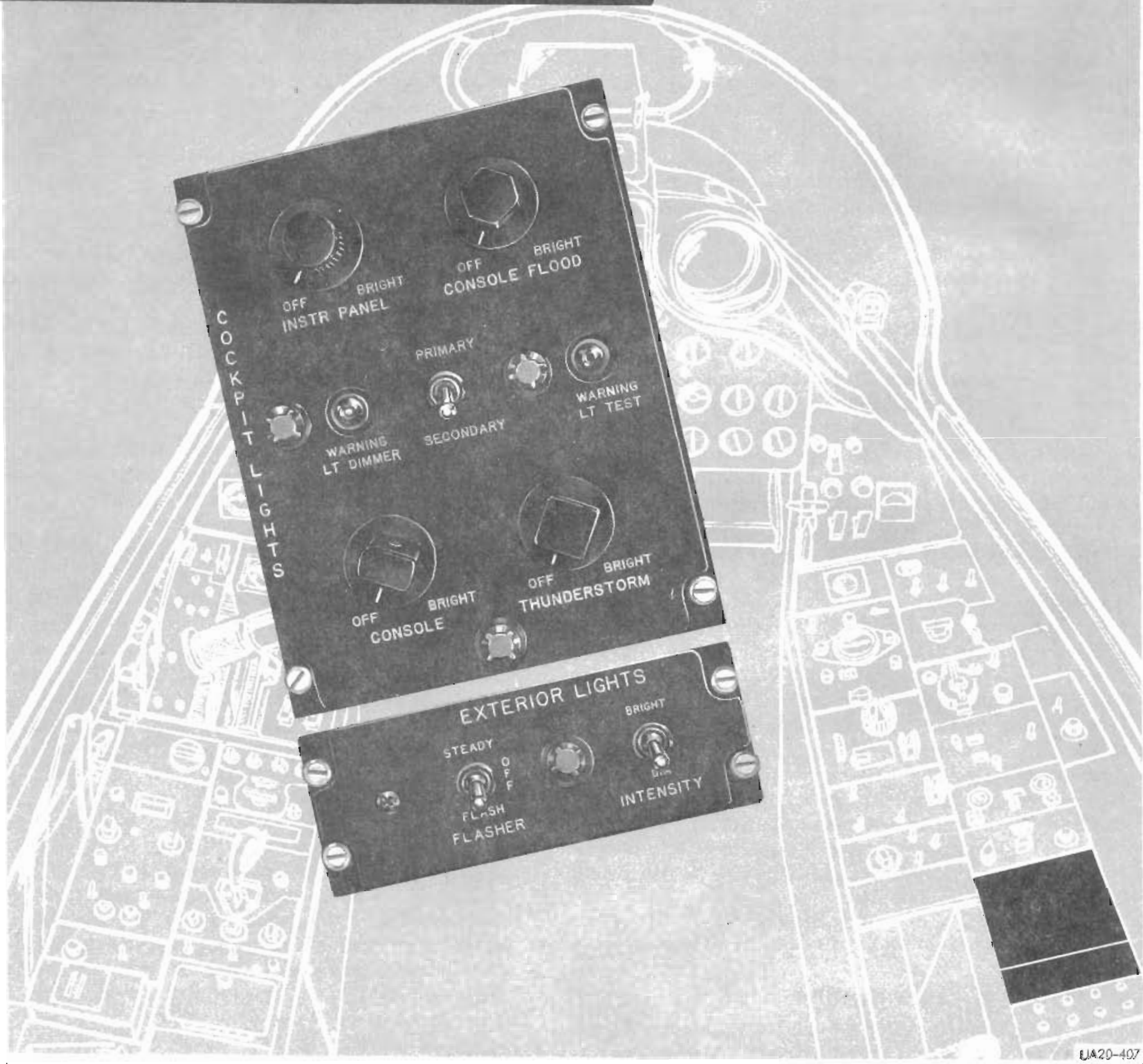

Figure 4-11

Landing and Taxi Lights Switch

A landing and taxi light switch (figure 1-19) 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, has positions marked TAXI, OFF and LDG. The TAXI position is up and the LDG position is down. LDG position is selected to provide power to the right light for landing. Placing the switch to TAXI position removes power from the right light and applies it to the taxi light. The circuit is de-energized automatically by a limit switch when the gear retracts. The lamps are set at different angles to give maximum illumination for landing or taxiing.

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 only utilize the 14 volt a-c power for "dim" operation. A flasher in the circuit effects 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 4-11), 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 4-11), 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 marked 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 and controls on the console, floodlighting of the consoles, standby compass illumination and a thunderstorm light. The secondary system, utilizing 28 volt d-c power, provides for floodlighting of the instrument panel, floodlighting of the consoles and standby 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 4-11) 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. For primary system operation, the switch must be in the PRIMARY position.

Instrument Lights Knob

The instrument lights knob (figure 4-11) 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.

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 primary and secondary instrument panel lights.

Console Lights Knob

The console lights knob (figure 4-11), 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 4-11) on the cockpit lights panel of the right console, provides for 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 Lights Knob

The thunderstorm light knob (figure 4-11) is located on the cockpit lights panel providing 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 1-29), 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 standby compass light operates from the instrument lights circuit and is controlled by the instrument light knob. Power utilized is 115 volt a-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 as desired. For secondary system operation, the switch must be in the SECONDARY position.

Instrument Lights Knob

The instrument lights knob (figure 4-11) 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 115 volt a-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 115 volt a-c.

Utility Light

The utility light (figure 1-29), a conventional Type C-4, is mounted in a bracket beneath the right canopy sill. It is turned ON and its brilliance is 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. 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 filter 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 operation.

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 control panels

Figure 4-12

OXYGEN REGULATOR

The Type D-2 regulator (figure 4-12), 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 4-12), 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 4-12), 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 4-12) 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 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	

UA20-409

Figure 4-13

oxygen connection

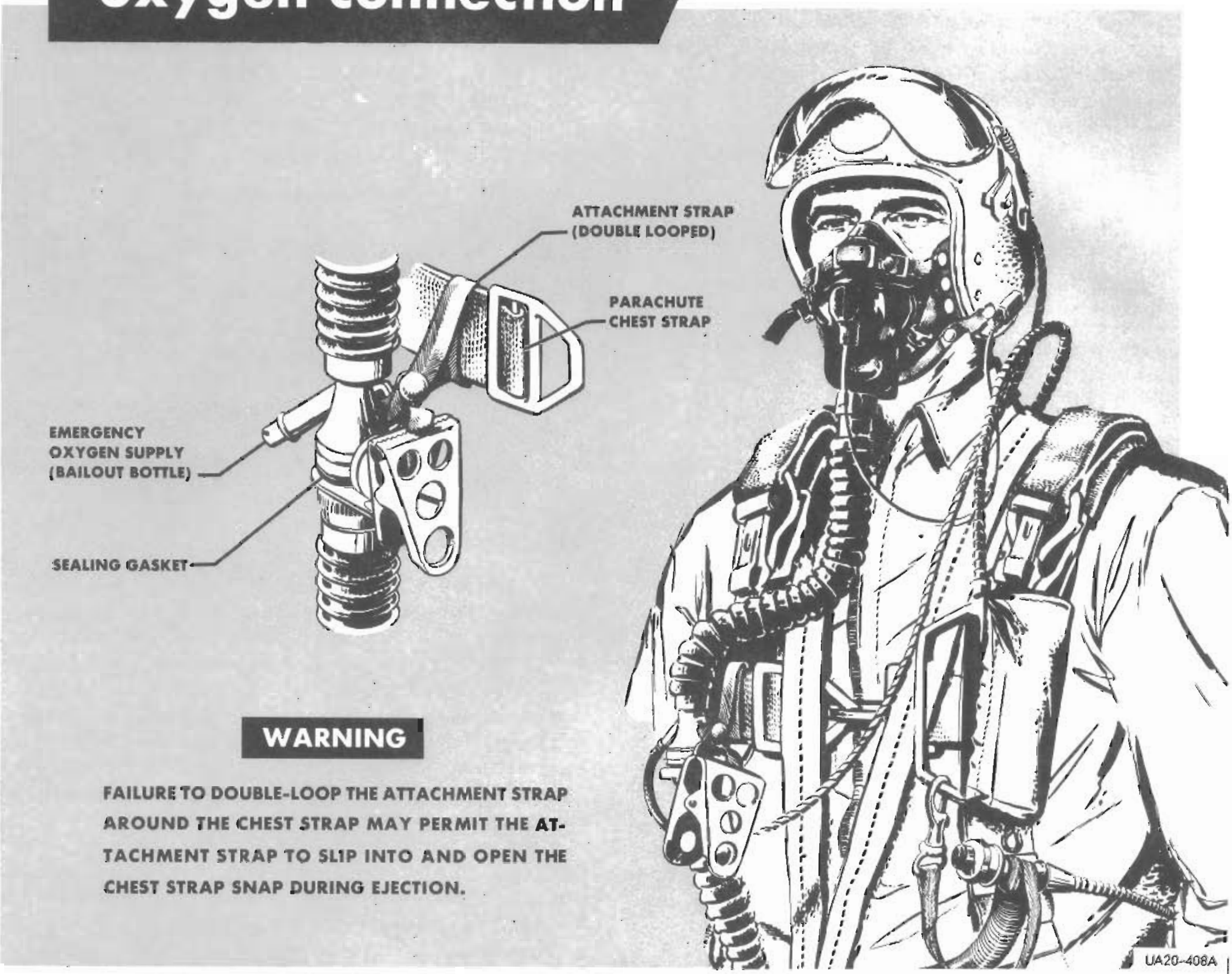

Figure 4-14

OXYGEN QUANTITY GAGE

A gage (figure 4-12), 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 utilize 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 chart (figure 4-13) to determine oxygen duration for indicated supply.

OXYGEN PRESSURE GAGE AND FLOW INDICATOR

The system pressure indicator and the flow indicator (figure 4-12) 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 PREFLIGHT 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 wrapping the connector strap under the chest strap as close to the chest strap snap 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 4-14.
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. Inflight 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 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 4-14.
5. 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.
6. 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 quantity gage shows a minimum of 4 liters. If quantity 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.

WARNING

In the event emergency oxygen is required for any reason, disconnect the seat oxygen hose from the connector (attached to the parachute harness) immediately after actuating the emergency bailout bottle to prevent the escape of emergency oxygen through the seat oxygen hose. This action is not necessary when using a seat survival kit with an integrated oxygen supply.

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. It can be engaged, without producing abrupt changes in control or airplane attitude, at any time the airplane is being flown within autopilot engaging limits. This is due to an automatic synchronization system which keeps the autopilot bridge circuits electrically in trim during the time the autopilot is disengaged. The autopilot engaging limits are ± 35° from the horizontal in pitch. Within these limits in pitch, the autopilot can be engaged in any roll attitude. However, if the autopilot is engaged in any roll attitude other than wings level, the autopilot will automatically bring the airplane to wings level in roll and the pitch attitude will remain the same as it was upon engagement. The autopilot can be manually overpowered with the control stick and rudder pedals. Autocontrols (figure 4-15) 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 sensitivie aneroid. Signals from the compass system provide a directional reference 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 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 glidepath coupler provides means for automatic flight control during the approach and glidepath 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 outputs to 25 pounds of stick force in the pitch axis. Once pitch overpower is achieved, the stick force required to sustain overpower is considerably reduced.

ENGAGE SWITCH

This two-position toggle switch (figure 4-15) 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 airplane, it will slowly position the airplane to wings level flight. Subsequent changes in airplane attitude are made with the pitch and turn knob. The engage switch will spring out of the ENGAGE position if electrical power failure occurs or airplane attitude exceeds the engage limits of the autopilot (± 35 degrees pitch). The switch may be manually disengaged at any time.

Note

- The autopilot is energized when airplane 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 4-15) on the autopilot 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.

Note

A small movement of the turn knob out of the detent disengages heading hold but does not command roll. Therefore, it is possible to use the autopilot when the J-2 compass is malfunctioning or in steep climbs when the J-2 compass errors induce roll oscillations.

PITCH WHEEL

The pitch wheel (figure 4-15) on the inboard side of the autopilot control panel is included so that changes in pitch, up to 35 degrees either direction from horizontal, can be accomplished while the autopilot is operating. The pitch wheel is synchronized with pitch of the airplane continually changes as a variation in airplane 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 regular system to coincide with any pitch established by the autopilot.

RELEASE SWITCH

A momentary contact push button switch (figure 1-17) is located on the control stick to facilitate 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 pressure on the stick in the direction of pitch change.

Note

Pitch and yaw axis control disengages immediately upon actuation of the release switch. However, roll axis control does not disengage immediately but will gradually disengage over a 5 second interval.

ALTITUDE SWITCH

This two-position switch (figure 4-15) 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 electrical power failure 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 airplane 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.
- To prevent altitude oscillations, fly straight and level for 15 seconds prior to engaging the altitude switch.

DAMPER SWITCH

This two-position toggle switch (figure 4-15) on the function selector (autopilot) panel is spring-loaded OFF and the solenoid held ON so that in the event of electrical power failure 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.

autopilot control panels

Figure 4-15

LOCALIZER AND APPROACH SWITCHES

These two-position toggle switches (figure 4-15) 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 4-15) on the autopilot controller, indicates the direction 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 stabilizer trim system. Disengage autopilot and hold stick, since the auto-trim indicator will deflect in the direction the airplane 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 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 hardover when the autopilot is disengaged. If this condition is suspected, the autopilot circuit breaker should be pulled.

NAVIGATION EQUIPMENT

STAND-BY COMPASS

Refer to Standby Compass, Section I.

DIRECTIONAL INDICATOR (SLAVED) SYSTEM

The slaved gyro magnetic compass (J-2 in the (1) thru (15) (10) airplanes and J-4 in the (20) (20) airplanes) is a light weight system which may be operated either as a directional gyro corrected for apparent drift due to the 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 airplane 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 slaved gyro system consists of a directional gyro, remote compass transmitter, servo amplifier, and a control panel. 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 that 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 distributes these signals to the directional control gyro. Through these signals the directional control gyro is positioned in synchronization with the remote compass transmitter. Instruments in the cockpit that receive heading information from the slaved gyro system's directional control gyro are the slaved gyro directional indicator, the rotating compass card of the ID-250 radio magnetic indicator (RMI), and the relative heading pointer of ID-249 course indicator. The autopilot system and the latitude and longitude (GPI) system also receive heading information from the slaved gyro system.

Compass Fast Slave Button (1) THRU (15) (10)

A compass fast slave button (figure 1-24) on the upper left hand corner of the instrument panel provides a means of stabilizing the gyro after it has been upset by overbanking or acrobatics. Pushing the button interrupts the electrical power to the compass. Releasing the button restores the electrical power and initiates the fast slave cycle for recovery to the correct heading.

Note

To avoid damage to the slaving motor, allow 10 minutes between actuations of the fast slaving button and depress the button no longer than 2 seconds.

Compass Slaving Cutout Switch (1) THRU (15) (10)

A two-position toggle switch (figure 1-24) on the upper left hand corner of the instrument panel is used to discontinue the slaving to the remote compass transmitter in areas such as the polar area, where the compass indications are inaccurate. When the switch is moved to the OFF position the electrical power supply to the slaving torque motor is cut off and the gyro functions as a free gyro subject to the normal precession errors. The slave gyro system functions normally with the switch in the ON position.

Function Selector Switch (20) (20)

The two-position function selector switch (figure 4-16), 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.

CAUTION

Allow one minute to elapse between each use of the function selector switch as a means of synchronizing the system. This permits the thermal relay controlling fast synchronization to cool. If the relay is not permitted to cool, direction indications may be erroneous.

J-4 directional indicator control panel

20 20

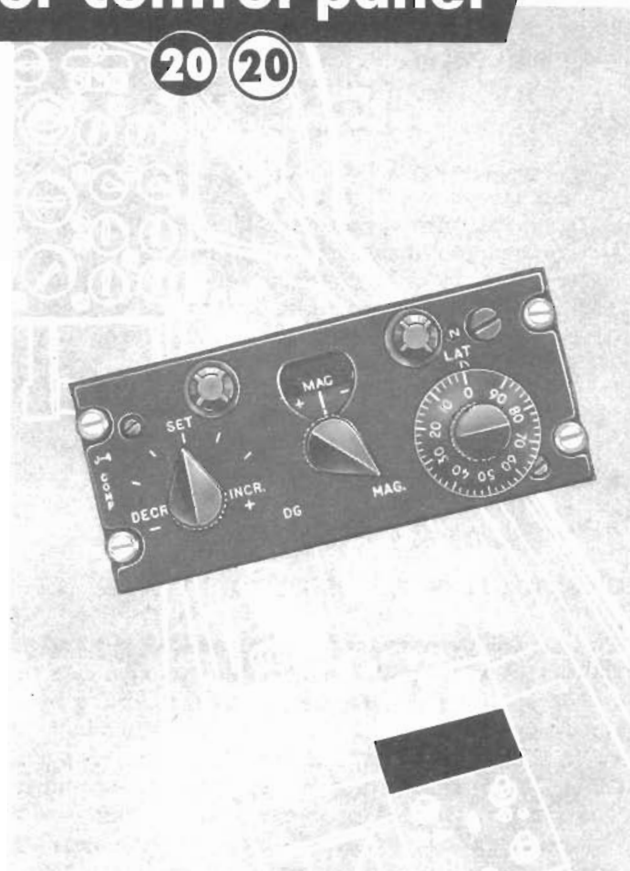

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Figure 4-16

Synchronizer Knob 20 20

The synchronizer knob (figure 4-16) provides a manual means of synchronizing the directional control gyro and the remote compass. The synchronizer knob is marked DECR - (decrease minus) in the full left position, INCR + in the full right position, and SET in the center position. The knob is spring-loaded to the SET position from both left and right positions. Rotating this 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 to the DECR - position. Rate of directional gyro rotation can be governed by moving the knob 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 knob 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 knob in the direction indicated by the annunciator needle, will synchronize the directional control gyro to the remote compass transmitter signal.

CAUTION

To prevent overheating of the slaving motor, do not operate the synchronizer knob for more than 30 seconds. A 5 minute waiting period should be observed whenever the synchronizer knob is utilized for 30 seconds.

Annunciator 20 20

The annunciator is a window indicator (figure 4-16) 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 knob 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 20 20

The manually controlled latitude correction knob (figure 4-16) 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 should be set on the ground for the correct latitude that will be maintained during flight from west to east or east to west. 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 airplane and replaced on new latitudes as the flight progresses.

Hemisphere Switch 20 20

The two-position hemisphere switch (figure 4-16) 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 20 20

The two-position turn switch (figure 1-25), located on the instrument panel, is a toggle switch marked NORMAL and CUTOUT. 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 any extended deviation from straight and level flight. With the switch in the NORMAL position and the airplane in a maneuver, the directional control gyro will bank on the same plane as the airplane producing erroneous heading indications until the airplane is level. If the switch is placed in the CUTOUT position, the directional control gyro will remain on a plane with the earth even though the airplane is in a maneuver. 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 the 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 airplane 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.

DIRECTIONAL INDICATOR OPERATION–MAG 20 20

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 airplane heading. (Check with standby compass or known runway heading;)
4. The annunciator needle should have moved near 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 airplane heading.
6. Automatic fast 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.

DIRECTIONAL INDICATOR OPERATION–DG 20 20

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 standby 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 standby compass.

CAUTION

During DG operation, the synchronizer knob 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), VHF Navigation Radio (OMNI), and Navigation Radio (TACAN) 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 airplane in flight. The two modes of operation provided are: PRESET WIND and RAD WIND (1 THRU 20 airplanes) or COMPUTE DRIFT (10 20 airplanes). In the PRESET WIND mode, the system is dependent on information from the directional indicator (slaved) system, in addition to the manual and automatic inputs obtained from components that are a part of the latitude and longitude system itself. In the RAD WIND (1 THRU 20 airplanes) or COMPUTE DRIFT (10 20 airplanes) mode, the system utilizes information from the directional indicator (slaved) system, either the MA-7 radar or the drift computer, and self-supplied GPI data. In either mode of operation, the latitude and longitude computer utilizes inputs to generate signals proportional to present latitude and longitude. These signals are applied to the latitude and longitude indicator, on the right console, to position its 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, wind force and wind direction. True heading is computed in the latitude and longitude computer and is the combination of magnetic variation and transmission error corrections with the directional indicator system 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 directional indicator system 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, by the automatic inputs of changing airspeed and heading, to give present latitude and longitude signals. In the RAD WIND or 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 the two drift runs. 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 (GPI) Panel

The GPI panel (figure 4-17) 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 (figure 4-17) 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 low 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. The longitude counters indicate to the nearest minute of 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' 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 00' begins to appear, the 6 changes to zero and the 0° changes to 1°.

Departure Switch.

A two-position switch (figure 4-17) 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 that 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 4-17), the second of the two control panels, is located on the right console. The panel contains controls which are manually positioned in order to introduce meteorological data into the GPI's computations. All of the control knobs have friction grips which prevent turning due to aircraft vibration. The friction grips make it necessary to push in on the knobs in order to rotate them.

Wind Direction and Variation Knobs

These knobs (figure 4-17) are provided with friction grips that prevent them from turning because of vibrations encountered during airplane 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 (figure 4-17) 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

The drift computer control (figures 4-18 and 4-20) is a four-position knob provided to select the mode of operation of the GPI. These modes are: PRESET WIND and RAD WIND (1 THRU 20 airplanes) or COMPUTE DRIFT (10 20 airplanes). The remaining two positions on the knob, H1 and H2 are provided for the respective first and second drift runs of the RAD WIND or COMPUTE DRIFT mode of operation.

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.

GPI control panels

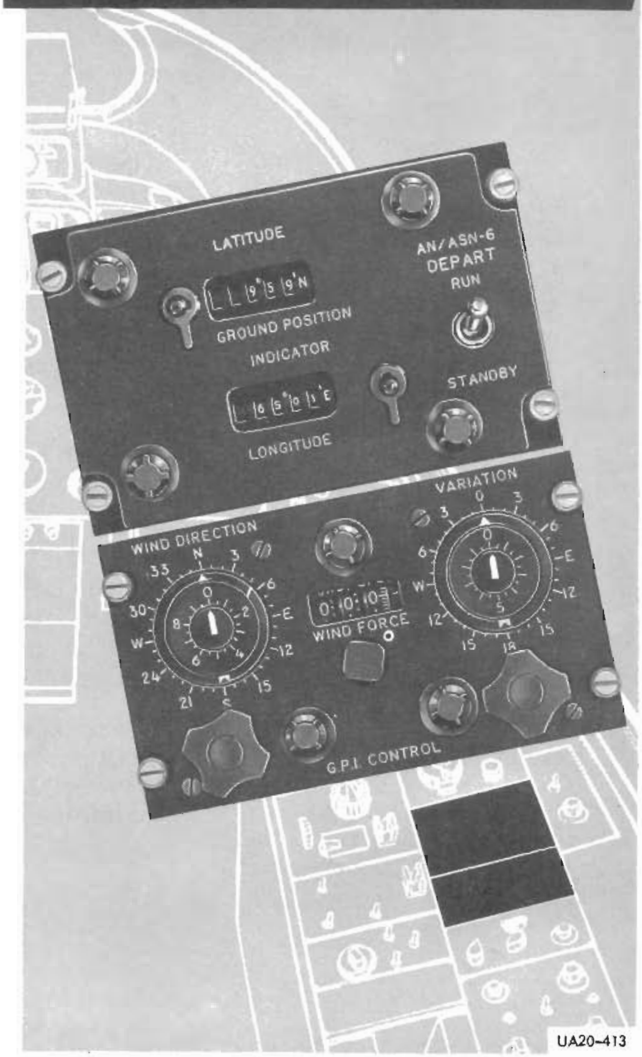

Figure 4-17

drift computer control panel

(20)

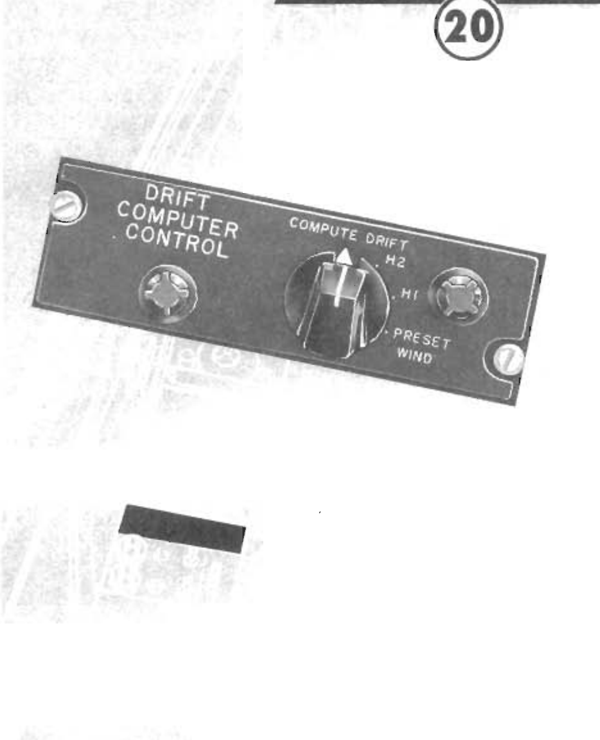

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Figure 4-18

1. Drift computer knob - PRESET WIND
2. Variation knob - SET
   Rotate knob to correctly position indicator to the present geographical position magnetic variation.
3. Wind force knob - SET
   Rotate knob to position tab indicators to 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
   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 airplane 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 ((10)(20) airplanes) or the RAD WIND mode ((1) THRU (20) airplanes) of system operation.

OPERATION OF GPI–RADAR WIND (1) THRU (20)

Refer to Navigation Control System Radar - Radar Wind, this section. (P. 4-39)

OPERATION OF GPI–COMPUTE DRIFT (10)(20)

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 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 airplane may now be turned to the desired course.

navigation computer control panel

(20)

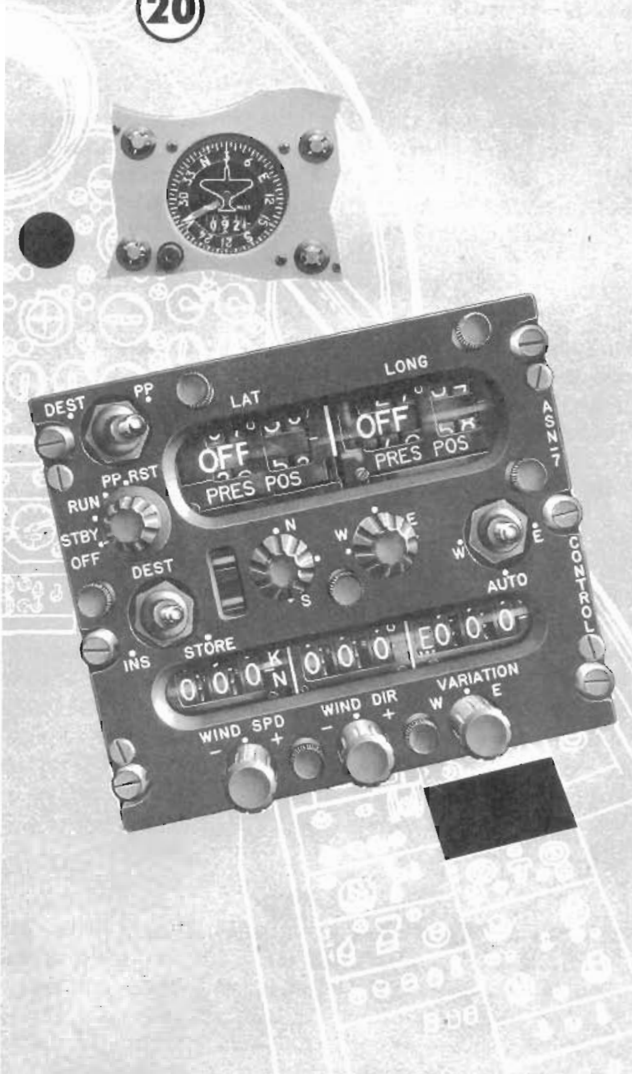

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Figure 4-19

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 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 (20)

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 airplane 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 airplane 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 airplane. 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 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 airplane to align the course pointer with the index marker and the airplane will be on course.

Position Indicator (20)

The position indicator (figure 4-19) 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 (20)

The display selector switch (figure 4-19) 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 (20)

The mode selector switch (figure 4-19) 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.

Slew Switches (20)

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 (20)

The storage switch (figure 4-19) 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 (20)

The LA and LO flags (figure 4-19) 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 (20)

The wind speed indicator (figure 4-19) shows the wind speed that is set into the computer in the PRESET WIND mode of operation.

Wind Speed Slew Switch (20)

The wind speed switch (figure 4-19) 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 (20)

The wind direction indicator (figure 4-19) shows the wind direction that is set into the computer in the preset wind mode of operation.

Wind Direction Slew Knob (20)

The wind direction slew knob (figure 4-19) 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 (20)

The variation indicator (figure 4-19) shows the magnetic variation at the present location of the airplane 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 (20)

The variation switch (figure 4-19) 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 Knob (20)

The variation slew knob 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 (20)

The ID-390 course-distance-track indicator (figure 4-19), 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 airplane. 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 instrument.

Drift Computer Control Panel (20)

For a discussion of this panel, refer to the write-up under the latitude and longitude computer system, AN/ASN-6, this section.

OPERATION OF ASN-7–PRESET WIND (20)

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.
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 airplane 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 - P.P. 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 airplane 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 ASN-7–COMPUTE DRIFT (20)

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 airplane 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 airplane 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 COMPUTE DRIFT mode, do not replace drift computer knob to PRESET WIND since previously used meteorological values are now useless. If no other IP 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.

RADAR SYSTEM–MA-7 (1) THRU (20)

The MA-7 Fire Control system is an all-weather radar and optical gun sighting system. Its primary purpose is to supply the pilot with gunsighting information. As a secondary function the system also operates as a navigational aid. The MA-7 radar utilizes several different, selective modes of operation; some of which operate in conjunction with the attack phase of the system while the others operate in conjunction with the navigation phase of the system. The radar antenna, which functions in all modes of operation, is located in the nose of the airplane. Radar power source is 28 volts d-c and 115 volt, three-phase a-c.

NUMBER 1 CONTROL PANEL

Master Switch (1) THRU (20)

The four-position master switch (figure 4-20) is located aft and to the left of the master control handle. The OFF position controls the power to the equipment, the STBY position provides standby power to the equipment and initiates 4 1/2 minute warm-up and the OP position causes the equipment to go into operation after the warm-up period. The EM position (emergency use only) by-passes equipment overload and safety features and permits the equipment to operate prior to the end of the normal warm-up period. The EM position is presently inoperative. The master switch must be pulled up to select the OFF or EM position.

Manual Control Handle (1) THRU (20)

The manual control handle (figure 4-20) protrudes from the number 1 radar control panel and incorporates

Figure 4-20

the action trigger, range in-out switch and nose-tail switch. By depressing the action trigger on the forward part of the handle, the pilot assumes manual control of the radar antenna. The range in-out switch permits the pilot to reject a target and lock on a more distant target during the AR mode of operation. During manual search mode the range in-out switch is utilized to position the range gate marker up or down until it coincides with the target indication. During the automatic track mode of operation, the range in-out switch permits the pilot to reject a target and lock-on a closer or more distant target. The nose-tail switch on the right side of the handle allows selection of the leading or trailing edge of the target to be tracked.

Operate Switch (1) THRU (20)

The operate switch (figure 4-20) is located just aft of the manual control handle. Its function is to select the desired mode of operation. The switch positions, their names and functions are as follows:

1. AR (some airplanes in (20)) - This mode of operation permits automatic lock-on of a close target that has been visually detected. Automatic lock-on range is from 300 to 3000 yards.
2. DRIFT - Short pulse radar operation on 30 mile sweep.
3. 6 MI - This mode provides a display in both automatic and manual search. Radar operation is in short pulse with a 6 mile sweep.

4. SP - Provides automatic or manual search with radar operating in SP (short pulse) on the 30 mile range.
5. LP - Provides automatic search on 30 mile range with radar on LP (long pulse) operation. Gives stronger echos at 20 to 30 mile range.
6. MAP - Long pulse radar operation on 200 mile range. However, any 20 mile area may be selected by positioning the expand zone strobe around the area. This is accomplished by turning the beacon and ground map expand button, located on number two control panel. Depressing this button will expand the area enscribed by the expand zone strobe to a 20 mile scope.
7. BEACON - Range and expand section same as MAP with coded beacon response being displayed on scope at proper azimuth and range. When beacon and ground map push to expand button is depressed, the beacon response will be expanded to make proper identification easier.

Drift Computer Knob — 1 THRU 20

The drift computer knob (figure 4-20) is located on the right hand aft corner of the number 1 control panel. This knob has four positions; PRESET WIND, H1, H2 and RAD WIND. The PRESET WIND position is used in the preset mode of operation of the GPI. The other positions are used in RAD WIND mode of operation of the GPI. Refer to Operation of GPI, Radar Wind and Preset Wind, this section.

NUMBER 2 CONTROL PANEL

Land-Sea Switch — 20

The land-sea switch, in some of the 20 airplanes, is located on the top of radar control panel number 2. This switch is utilized to reduce the clutter when a drift run is being made over land or sea.

Drift Angle Knob — 1 THRU 20

The drift angle knob and window (figure 4-20) are located across the top of control panel number 2. This variable control adjusts antenna heading to right or left by number of degrees shown in the window. The position of the white marker (right or left of numeral) indicates which side of zero the antenna is positioned. When the drift angle knob is manually turned, a distinct clarification of the video is noticeable when the antenna is pointed in the direction of the airplane ground track path.

EL Scan Control Knob — 1 THRU 20

The elevation scan control knob (figure 4-20) is located on the left of control panel number 2, just forward of center. Its purpose is to control elevation of the radar antenna.

AZ Scan Control Knob — 1 THRU 20

The azimuth scan control knob (figure 4-20) is located on the right side of control panel number 2. Its purpose is to determine the section of azimuth scanned, and has four positions, LEFT, NARROW, BROAD and RIGHT.

1. LEFT - position controls antenna to scan the left portion of area ahead of the airplane.
2. NARROW - position controls antenna to scan a narrow portion of the area ahead of the airplane.
3. BROAD - position controls antenna to scan full azimuth, within limits.
4. RIGHT - position controls antenna to scan the right portion of the area ahead of the airplane.

BCN & Ground Map Control Button — 1 THRU 20

This button (figure 4-20), also on the number 2 control panel, selects a 20 mile portion of the 200 mile range to be expanded to full range deflection of indicator in ground map and beacon modes only. It is necessary to push the button to expand the area selected.

IF Gain Knob — 1 THRU 20

The intermediate frequency gain knob (figure 4-20) varies the strength of the echo signal indication on the scope.

Horizon Center Knob — 1 THRU 20

The horizon center knob (figure 4-20) is for vertical centering of the artificial horizon display on the scope.

Scale Illumination Switch — 1 THRU 20

The scale illumination switch (figure 4-20) is a three-position toggle switch marked HIGH-LOW-MED. Its purpose is to adjust indicator scale lighting to suit the pilot.

Clutter Switch — 1 THRU 20

The clutter switch (figure 4-20), marked IN and OUT, reduces spurious response on the indicator and is used in 6 and 30 mile range, with greater visible action on 6 mile range.

Attack Intensity Control Knob — 1 THRU 20

The attack intensity control knob (figure 4-20) adjusts the intensity of the attack display on the indicator and the intensity of the artificial horizon.

Search Intensity Control Knob — 1 THRU 20

The search intensity control knob (figure 4-20) controls the intensity of the search display on the indicator.

Anti-Jam Control Button — 1 THRU 20

This control (figure 4-20) automatically changes the transmitter frequency between the limits of 8750 to 9250 mc in all modes of operation except beacon. Targets should remain on indicator during anti-jam operation.

radar scope

1 THRU 20

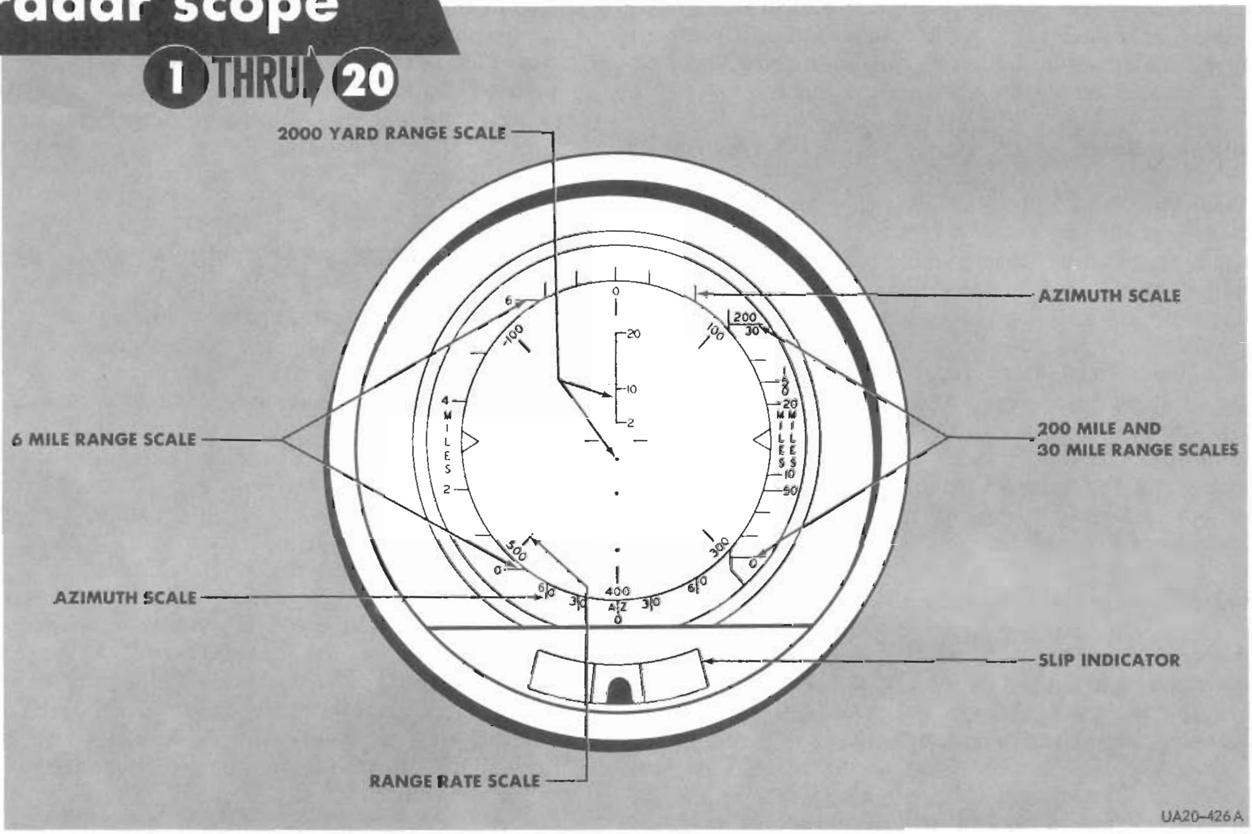


Figure 4-21

RADAR SCOPE

1 THRU 20

The radar scope (figure 4-21) is the display for the MA-7 radar. This scope is mounted on the upper right of the instrument panel and projects upward towards the pilot. Around the perimeter of the scope are several scales, each applicable to its own particular mode of operation. When the system is operating, the appropriate scale is automatically illuminated. Illumination is provided by five sets of scale lights mounted around the upper part of the flight indicator. The scope face itself contains two scales which are illuminated in the attack mode only. A visor-filter assembly, in the form of a hood, is mounted over the face of the indicator to reduce the effect of glare from external light sources.

RADAR ENERGIZE PROCEDURE

1 THRU 20

The number 1 radar control panel contains the switches to energize the radar system. The following procedure is applicable to all modes of operation:

1. Place the master switch in the STB position until 4 1/2 minute warm-up period is completed.
2. After warm-up place the master switch in the OP position; the system will immediately enter automatic search.
3. The operate switch may now be placed in the desired range position. (See Radar Controls, this section.)
4. The system will remain in automatic search until the pilot selects another mode of operation.

ARMAMENT CONTROL SYSTEM RADAR

1 THRU 20

The primary purpose of the radar in the armament control system is to provide the pilot with display information enabling him to locate targets, select one, and fly an accurate lead pursuit course which will bring the airplane into range for manually firing the guns. Steering data in the form of radar scope signals, or optical gunsight indications are available to the pilot as his option.

Automatic Ranging

20

Immediately upon visual contact with the target, select the automatic ranging mode to slave the radar antenna to the gun sight reticle. Using the gun sight reticle, steer the airplane to align the center of the reticle image on the target. As long as the target is framed by the reticle image, the radar antenna is positioned to spotlight the target. If the target is within the 6 mile range, it will appear on the scope. When the target range has decreased to 3000 yards the radar will automatically lock-on. At lock-on, the radar automatically tracks the target in range and feeds target range data to the optical sight to permit accurate lead angle computation. Complete the attack phase in the normal manner using steering information displayed on the optical sight.

Automatic Search (1) THRU (20)

When energized (refer to Radar Energize Procedure, this section), the radar system immediately enters automatic search. During automatic search, the radar equipment detects airborne targets and presents a scope display showing position of the targets in terms of range and azimuth. In the automatic search mode, the antenna scans one of four areas ahead of the airplane, which is selected by the pilot. In this method of operation targets can be detected at a maximum range of 30 nautical miles. Scan selection is accomplished by the azimuth scan selector switch on the number two radar control panel. Refer to Radar Controls in this section.

Manual Search and Lock-On (1) THRU (20)

The transition from automatic search to automatic track is accomplished by manual search, during which the pilot selects his target and establishes a lock-on. Lock-on is accomplished by depressing the action trigger on the forward part of the manual control handle (refer to Radar Controls, this section) and, by turning the handle in the desired direction, focusing the antenna beam over the target on the scope. Then by depressing the range-in-out switch on top of the manual control handle, position the range marker over the target. When both the range marker and antenna beam are over the target, release the handle. The lock-on is accomplished and the system will automatically track.

Automatic Track (1) THRU (20)

When the system enters automatic track the attack display is presented on the scope. The attack display directs the pilot continuously on a lead pursuit-type course to a point where the aircraft is in the correct gunnery range for firing the guns. Steering information, as well as target range, rate of closure or opening, and artificial horizon indications are continuously presented on the scope during the automatic track mode of operation. The system will remain in automatic track until the target is lost or the pilot manually releases it. Releasing is accomplished by pulling the manual control handle as far aft as possible.

Manual Ranging (1) THRU (20)

A range control grip on the left throttle allows manual ranging during gunnery operation when radar becomes inoperative or is erratic due to ground effects (at altitudes below 6000 feet on overland targets). The manual range control covers a span of 3750 feet, from approximately 4500 feet to 750 feet, as indicated on the sight range image. When the twist grip is rotated clockwise, indicated range decreases and the reticle becomes larger; counterclockwise rotation of the grip increases indicated range and reduces reticle size. The control grip is not spring-loaded to any position and therefore must be manually placed in the radar range detent position for normal radar ranging. This is done by rotating the twist grip counterclockwise through the last 10° of its travel.

NAVIGATIONAL CONTROL SYSTEM RADAR (1) THRU (20)

The MA-7 radar system provides navigational aids in the form of ground map and beacon mode of operation and drift computation for radar wind mode. In the ground map mode the system surveys the terrain within the antenna scan limits for a 200 mile range and provides the pilot with a display indicating distinctive geographical configurations. A portion of the display, selected by the pilot, may be expanded on the scope for more accurate identification of the terrain. In the beacon mode of operation the antenna scan is the same as described for ground map. However, in this mode of operation the system is capable of interrogating ground beacon stations within a range of 200 nautical miles and of receiving a coded response which is displayed on the radar scope. As in ground map, a portion of the display may be expanded by the pilot for more accurate identification of the coded response.

Ground Map Operation (1) THRU (20)

Operation in the ground map mode is as follows:

1. Energize radar (refer to Operation of Radar - Energize, this section).
2. Turn operate switch to MAP position.
3. Rotate elevation scan control below HORIZON for desired ground scan.
4. Rotate the beacon and ground map control for area to be expanded.
5. Press beacon and ground map button for expanded view.

Note

Search intensity and IF gain controls must be adjusted when using expanded ground map in order to obtain a clearer display.

Beacon Operation (1) THRU (20)

Operation in the beacon mode is as follows:

1. Energize radar (refer to Operation of Radar - Energize in this section).
2. Turn operate switch to BEACON position.
3. Rotate elevation scan control from HORIZON through DOWN to locate the strongest beacon response.
4. Rotate beacon and ground map control to include beacon response in expanded area.

5. Press beacon and ground map control for expanded view so that the coded beacon response can be read. The beacon response will be in proper azimuth location with reference to airplanes heading. The edge of the beacon response, which is the lowest range indication, will indicate range to the station.

Note

The equipment should be switched off BEACON position as soon as possible to prevent possible interference with other airplanes seeking beacon guidance.

Radar Wind (GPI).

To operate the AN/ASN-6 system in radar wind, the system components are set up exactly as they would be for the preset wind (refer to Operation of GPI - Preset Wind, this section). However, once the airplane is airborne and the pilot wishes to enter radar wind, he must make two drift runs. This is done in the following manner:

Note

The two-position departure switch may be left in STANDBY position until after the initial drift run.

1. On radar control panel number 1, set the operate switch to DRIFT position and the drift computer switch to H1 position.
2. Using the drift angle and elevation scan knob on radar control panel number 2, adjust the antenna position so the scope presentation indicates the antenna is aligned along ground track.
3. While holding steady the airplanes heading and antenna position obtained in step 2, turn the drift computer switch to H2.
4. Make a 30° to 90° turn and align the radar in ground track as in step 2.
5. While holding steady the airplanes heading and antenna position obtained in step 4, turn the drift computer switch to RAD WIND position, and hold airspeed constant for eight seconds.
6. The airplane may now be turned to any destination.

Note

In succeeding drift runs the procedure is exactly the same as described except that the switches sequence begins with the drift computer switch in the RAD WIND position where it remained from the previous run. The procedure is begun by turning the drift computer switch through position H2 and H1 and then continues as described in steps 1 through 6. The depart switch should be left in the STANDBY position until the drift runs are completed.

After the drift runs have been made, the airplane should be flown over the IP at which time the depart switch on the ground position indicator should be placed in the RUN position. The system is now operating in radar wind. The radar itself may be turned off, or to any mode required.

PHOTOGRAPHIC EQUIPMENT (10)(20)

The nose and forward fuselage sections house the photographic equipment necessary for high or low altitude day and night 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 airplane 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 proper settings for shutter speed and diaphragm opening are determined automatically and the values of airplane velocity and altitude may be determined either automatically by the scanner-converter system or semi-automatically by the optical viewfinder system. An air-conditioning system provides for refrigerated or heated air for the camera compartments and is controlled automatically or manually.

CAMERA OPERATION LIMITS CHART (10)(20)

The camera operation limits chart (figure 4-23) 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 of the forward oblique camera.

LOW ALTITUDE OPERATION (10)(20)

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

camera area coverage

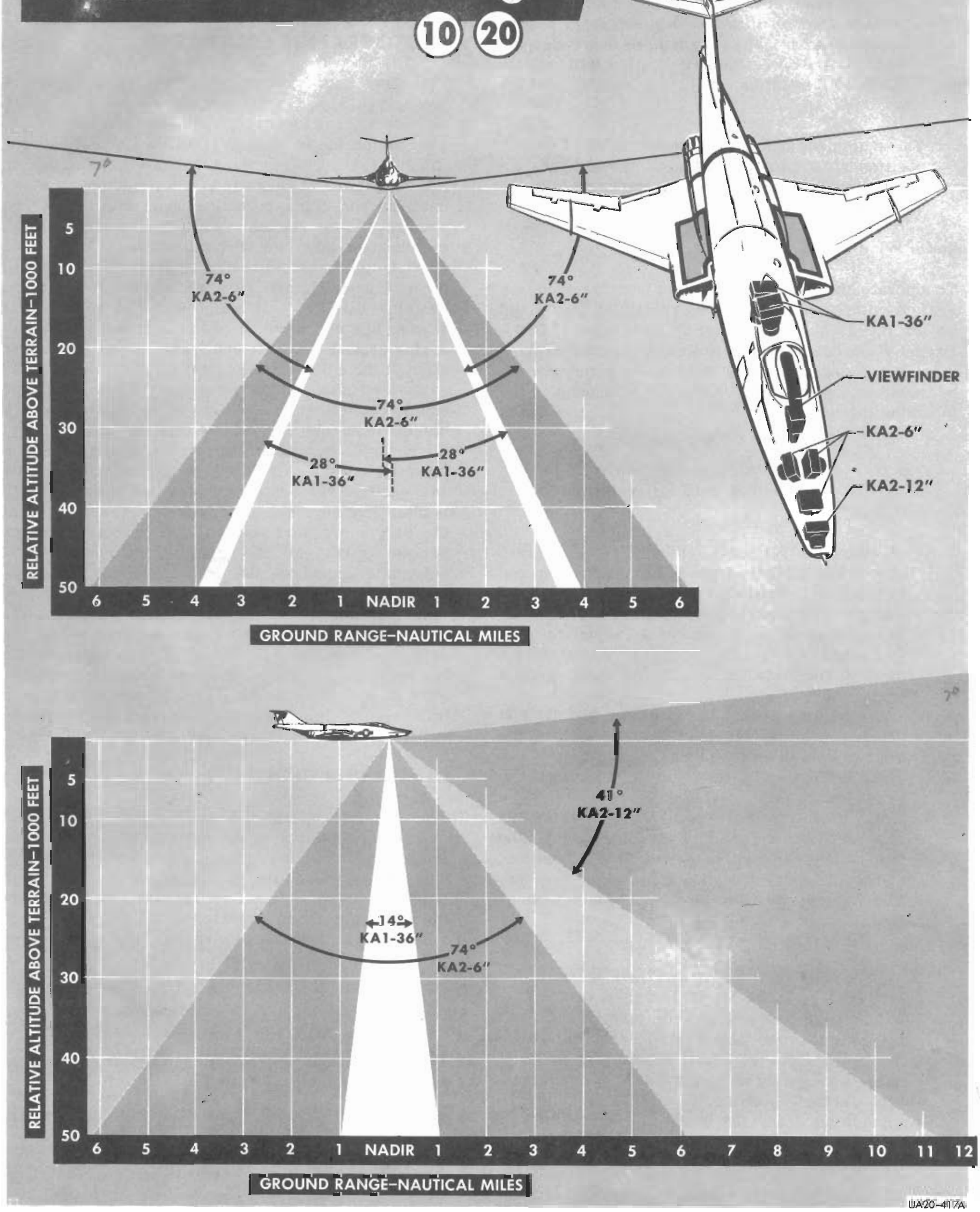


Figure 4-22

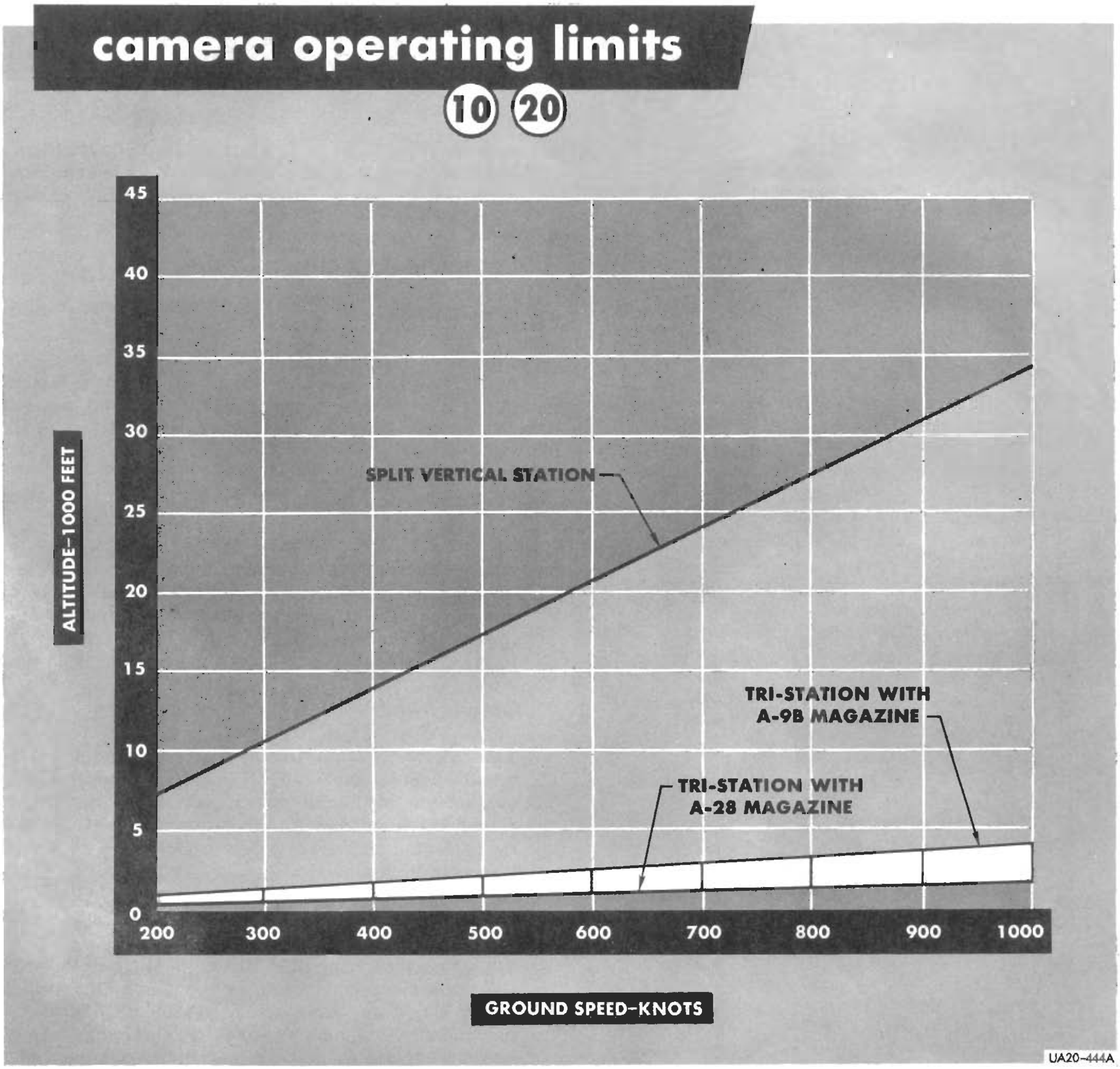


Figure 4-23

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 viewfinder 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 of the speed necessary to compensate for image motion. In the (20) airplanes the split vertical station has an A-8B film magazine without the IMC mount. The image motion is compensated for by mounting the camera in an IMC 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 4-23) shows the minimum operating altitude at various airspeeds for the different magazine and camera combinations.

HIGH ALTITUDE OPERATION (10)(20)

For high altitude operation, the following film magazine may be installed.

camera master control panel

(10)(20)

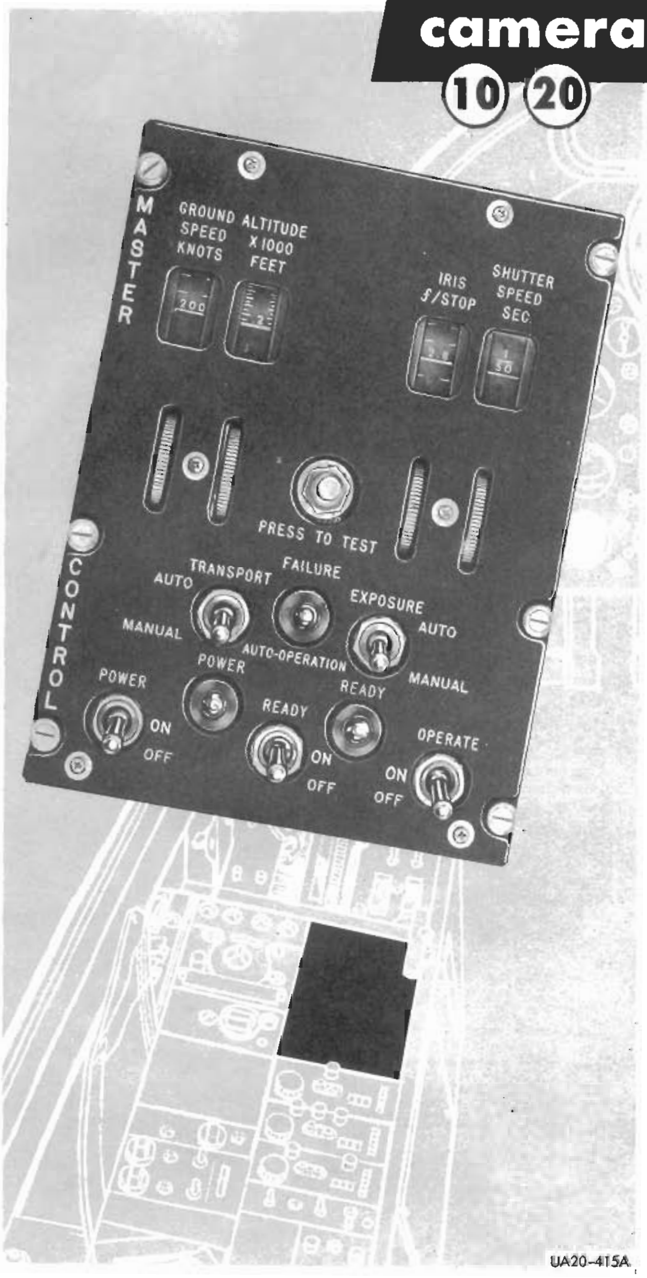


Figure 4-24

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 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 4-23) show the minimum operating altitude at various airspeeds for the different magazine and camera combinations.

CAMERA MASTER CONTROL PANEL

Power Switch (10)(20)

The power switch (figure 4-24) is located on the master control panel. When in 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 (10)(20)

The ready switch (figure 4-24) is located on the master control panel. When in the ON position, 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 (10)(20)

The operate switch (figure 4-24) is located on the master control panel. When in the ON position and in conjunction with the power switch ON and ready switch ON completes the circuits necessary to operate the selected camera. Refer to Operation of Aerial Cameras in this section.

Power Light (10)(20)

An amber indicating light (figure 4-24) 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 have been selected for operation. If no station is selected for operation, the light will continue to flash.

Ready Light (10)(20)

A green indicating light (figure 4-24) 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 (10)(20)

The red failure light (figure 4-24) 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 Window (10)(20)

The ground speed window (figure 4-24) 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 Window (10)(20)

A window (figure 4-24) 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 Window (10)(20)

A window (figure 4-24) 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 Window (10)(20)

A window (figure 4-24) 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 (10)(20)

The transport switch (figure 4-24) on the master control panel, marked AUTO and MANUAL, allows the pilot to select the type of system operation desired.

Exposure Switch (10)(20)

The exposure switch (figure 4-24) on the master control panel marked AUTO and MANUAL, allows the pilot to select the type of system operation desired.

Test Button (10)(20)

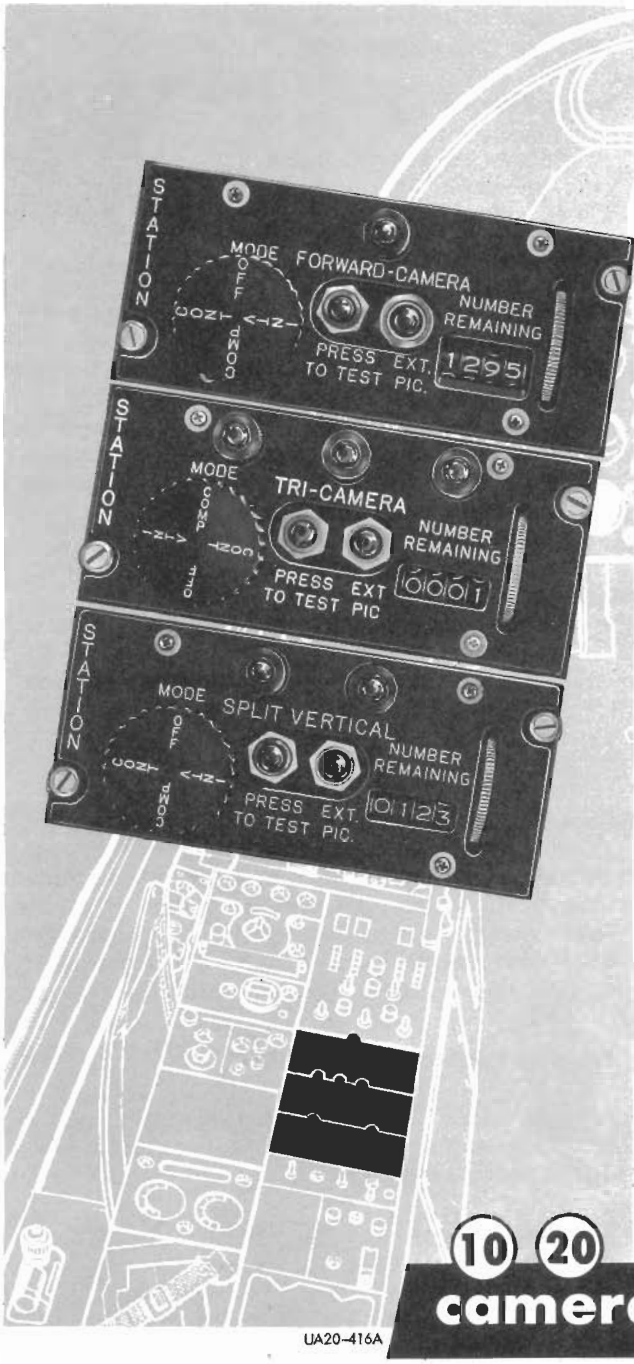
A press-to-test button (figure 4-24) may be actuated to test all lights on the panel.

CAMERA STATION CONTROL PANELS (10)(20)

Three station control panels (figure 4-25), 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.

Mode Selector Knob (10)(20)

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.



(10)(20) camera station control panels

Figure 4-25

emergency camera door control panel

(10)(20)

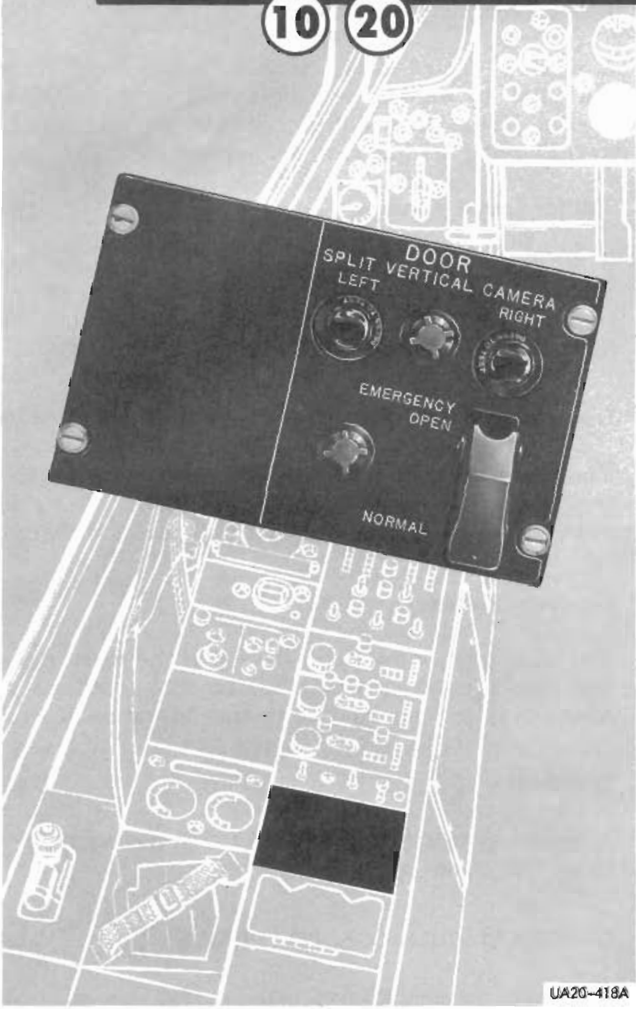


Figure 4-26

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 go out, use the emergency camera door switch or door drive motor may be damaged.

Test Button (10)(20)

A press-to-test button on each panel may be actuated to test the indicator lamps. The lamps on the selected panel will illuminate when the switch is depressed. Pressing this switch will also test the frame counter, causing the counter to move one digit each time the switch is pressed.

Extra Picture Button (10)(20)

A push-button switch marked "Ext Pic" allows the pilot to by-pass the normal sequence of operation and take exposures between intervalometer pauses by momentarily depressing the switch. This switch also causes continuous camera operation when held depressed. The switch is inoperative, however, when using IMC type film magazines.

Frame Remaining Window (10)(20)

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 used.

EMERGENCY CAMERA DOOR CONTROL PANEL

Emergency Camera Door Switch (10)(20)

A guarded two-position toggle switch (figure 4-26) marked EMERGENCY OPEN and NORMAL allows the pilot to open the split vertical doors by a pneumatic motor in event the normal system fails.

CAUTION

After selection of EMERG OPEN, do not return the switch to NORMAL until ground check of the door actuation system is performed.

Door Position Indicators (10)(20)

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 (10)(20)

A green indicating light (figure 1-27) on the instrument panel is illuminated when the trigger switch is actuated or the operate switch is ON.

CONTROL STICK EXTRA PICTURE SWITCH (10)(20)

The control stick has an extra picture switch (figure 1-17). Momentary actuation of the switch will cycle all cameras without IMC 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 temperature control panel

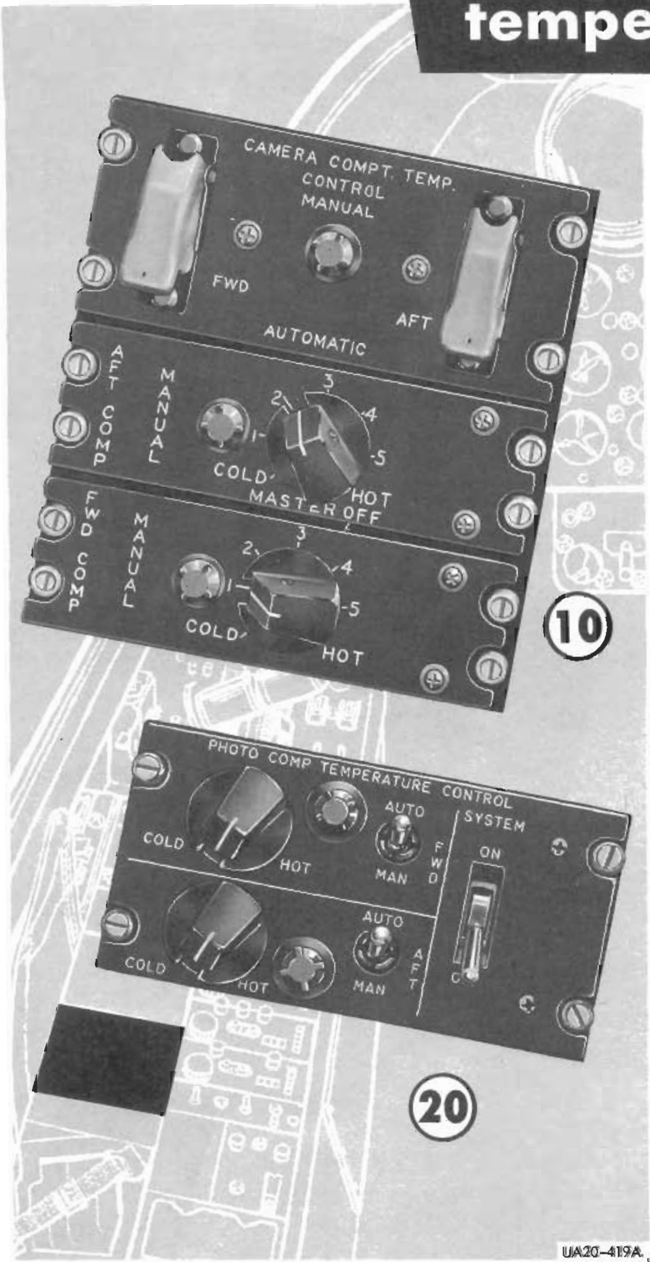


Figure 4-27

CAMERA COMPARTMENT AIR CONDITIONING SYSTEM (10)(20)

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 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 airplane is airborne to prevent the accumulation of moisture in the camera compartments.

Camera Compartment Temperature Control Panel (10)(20)

The camera compartment temperature control panel (figure 4-27), located on the left console, provides the pilot with all controls necessary to manually or automatically control the forward and aft camera compartment temperatures.

Camera Temperature Control Switches (10)

Two guarded two-position toggle switches (figure 4-27) marked FWD and AFT with position markings of MANUAL and AUTOMATIC allow the pilot to select the desired type of compartment heat control. The normal position is AUTOMATIC, the MANUAL position being selected if a malfunction should occur in the automatic system.

Manual Heat Control (10)

A rheostat (figure 4-27) on the FWD COMP MANUAL panel has selections from COLD, 1 through 5, and HOT. This unit and the setting of the rheostat is dependent on manual control selection and use of the MASTER rheostat on the AFT COMP MANUAL panel, the aft panel being identical except the rheostat has an OFF position. The combination of temperature control switches to MANUAL and MASTER rheostat positions, gives the continuity necessary for pilot manual heat control.

Master Pneumatic Switch (20)

The master pneumatic switch (figure 4-27) 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.

camera circuit breaker panel (20)

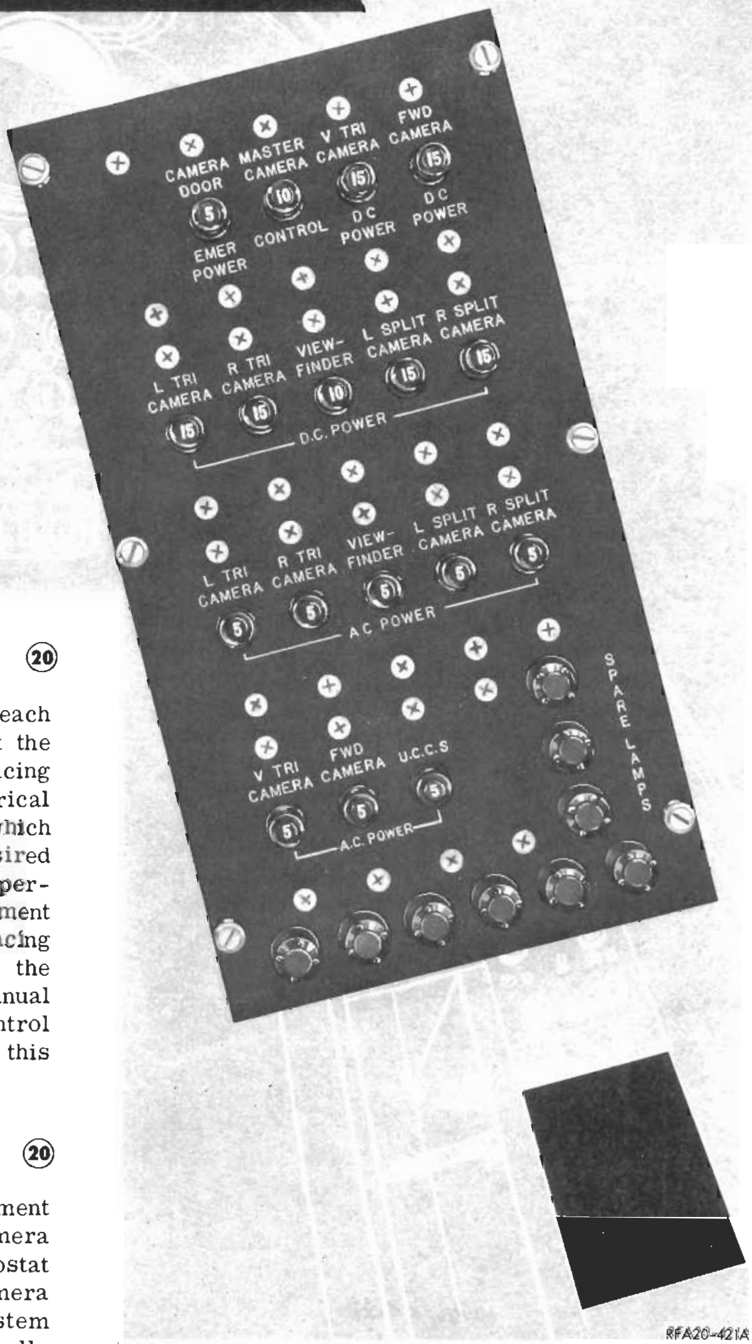


Figure 4-28

System Selector Switch (20)

A system selector switch (figure 4-27) 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 (20)

A rheostat (figure 4-27) 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 (10)(20)

Camera compartment temperature indicators (figure 1-27) for each camera compartment is located on the pedestal panel. The indicators, with positions marked FWD and AFT, indicate the temperature in degrees centigrade of the camera compartments.

CAMERA CIRCUIT BREAKER PANEL (20)

The camera circuit breaker panel (figure 4-28) is located on the aft portion of the right console. It incorporates all camera circuit breakers available to the pilot.

viewfinder control panel (20)

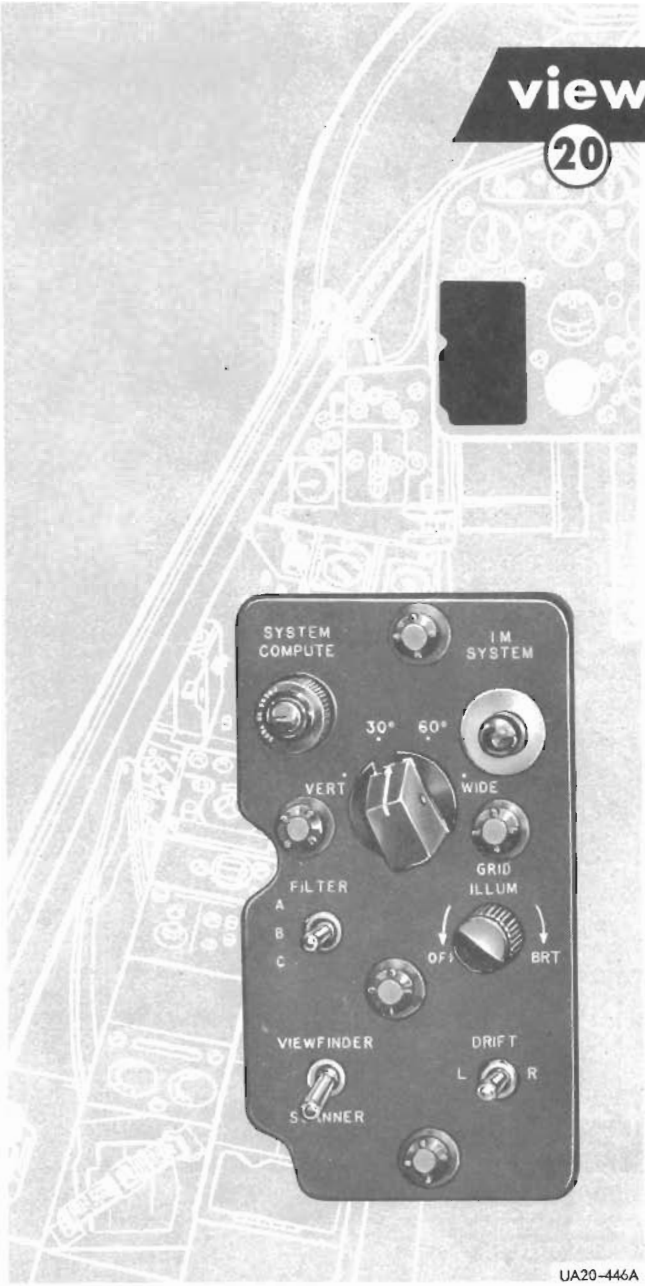


Figure 4-29

VIEW FINDER (10)(20)

A type VF-31 viewfinder is installed in the forward fuselage. The purpose of the system is to furnish airplane 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 lines 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 in the (20) airplanes. In the (10) airplanes, the viewfinder controls are located on the upper portion of the instrument panel.

Filter Switch (10)(20)

The filter switch (figure 4-29) 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 (10)(20)

The viewfinder-scanner switch (figure 4-29) a two-position switch, selects the source of V/H (velocity over height) signal information for the camera control system. The switch positions are VIEWFINDER and SCANNER. The VIEWFINDER position routes the V/H signal, as computed semiautomatically by the viewfinder, to the camera control system. The SCANNER position routes the V/H signal, as automatically computed by the image velocity detector, to the camera control system. The VIEWFINDER position is utilized above 8000 feet in AUTO operation, and the SCANNER position is utilized below 8000 feet in AUTO operation.

Grid Illumination Control Knob (10)(20)

The rheostat knob (figure 4-29), located on the viewfinder control panel, may be rotated to desired lighting intensity for viewfinder reticle illumination.

View Selector Knob (10)(20)

The view selector knob (figure 4-29) 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.

viewfinder IM compute ranges

(10)(20)

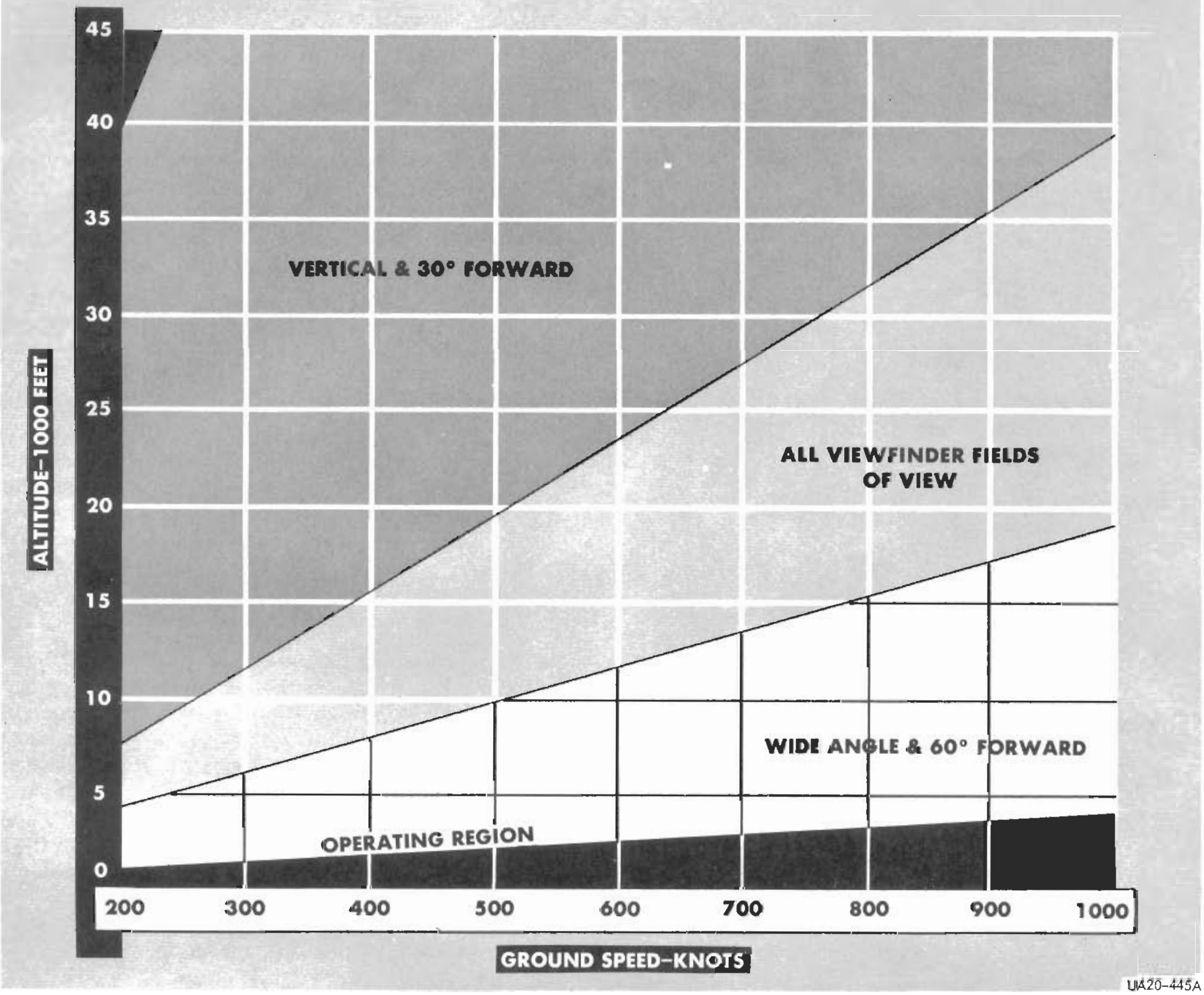


Figure 4-30

IM Compute Button (10)(20)

A button marked IM (Image Motion) System (figure 4-29) on the viewfinder control panel provides a means 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 4-30) 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 (10)(20)

A conventional "press-to-test" amber light (figure 4-29) gives 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.

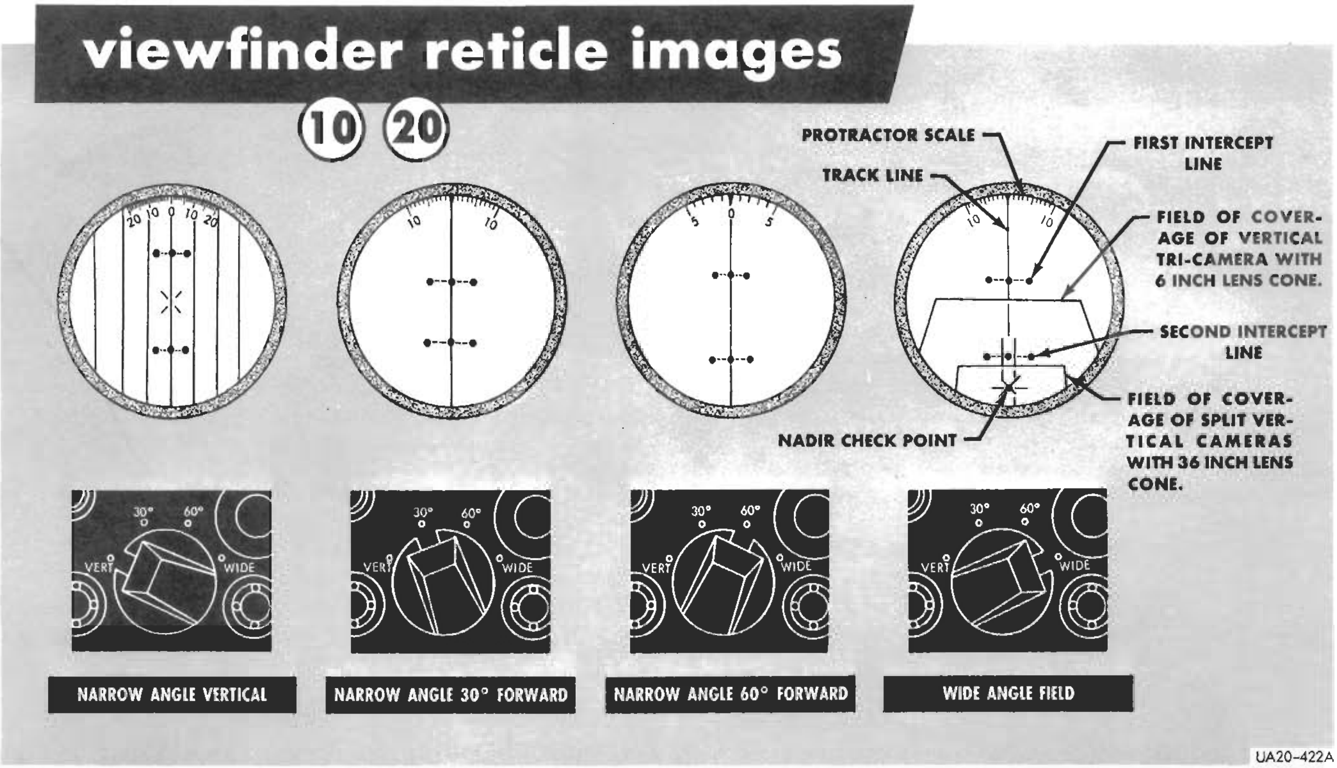


Figure 4-31

Drift L-R Switch (10)(20)

The drift L-R switch is a three-position toggle switch (figure 4-29) 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 (10)(20)

Refer to Operation of Aerial Cameras, this section.

OPERATION OF AERIAL CAMERAS (10)(20)

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 the 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. After 30 seconds delay, ready switch - ON.
4. Rotate mode selector on each station panel - COMP, this operates shutters through the intervalometer; should continuous operation be desired, set mode selector - CONT.

Note

Should the split vertical station be selected for operation, the green light will not illuminate until the split vertical doors are fully open. The two on the door position panel will flash until the doors are fully open.

5. READY light (green) illuminated.
6. 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.

7. 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.
8. 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.

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 5 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 5 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 only used to view the photo target, enabling an accurate flight path over the target.

SHUTDOWN SEQUENCE– SPLIT VERTICAL STATION CONTROL (10)(20)

To prevent damage to the swing mount actuator, the following procedures will be followed in turning off the split vertical station camera control:

1. Master control operate switch - OFF
2. Split vertical station control mode switch - OFF
3. Master camera control ready switch - OFF
4. Master camera control power switch - OFF

ARMAMENT EQUIPMENT (1) THRU (20)

The armament consists of four forward firing 20 mm fixed automatic guns, stores carrying capabilities and equipment necessary for delivery. A type K-19 sight is provided for sighting and is coupled with a radar ranging system. Externally carried stores may be released automatically by use of the LABS or M-1 bombing system or manually by DIRECT release. The guns may be fired or the stores released through switches on the pilot's stick grip. Installed in conjunction with the armament are an N-9 gun camera and P-2 strike camera.

K-19 GUN SIGHT (1) THRU (20)

The type K-19 gyro computing sight (figure 4-32) automatically computes leads for gunnery. The sight reflects to the pilot a reticle image of the circle and dot pattern. The circle furnishes range information by expanding or contracting as range to the target decreases or increases. Range information will be supplied either automatically from the radar or manually by a ranging grip on the left hand throttle, refer to Manual Ranging, this section. Sight computation is entirely automatic requiring only that the pilot keep the reticle center dot on the target and track smoothly.

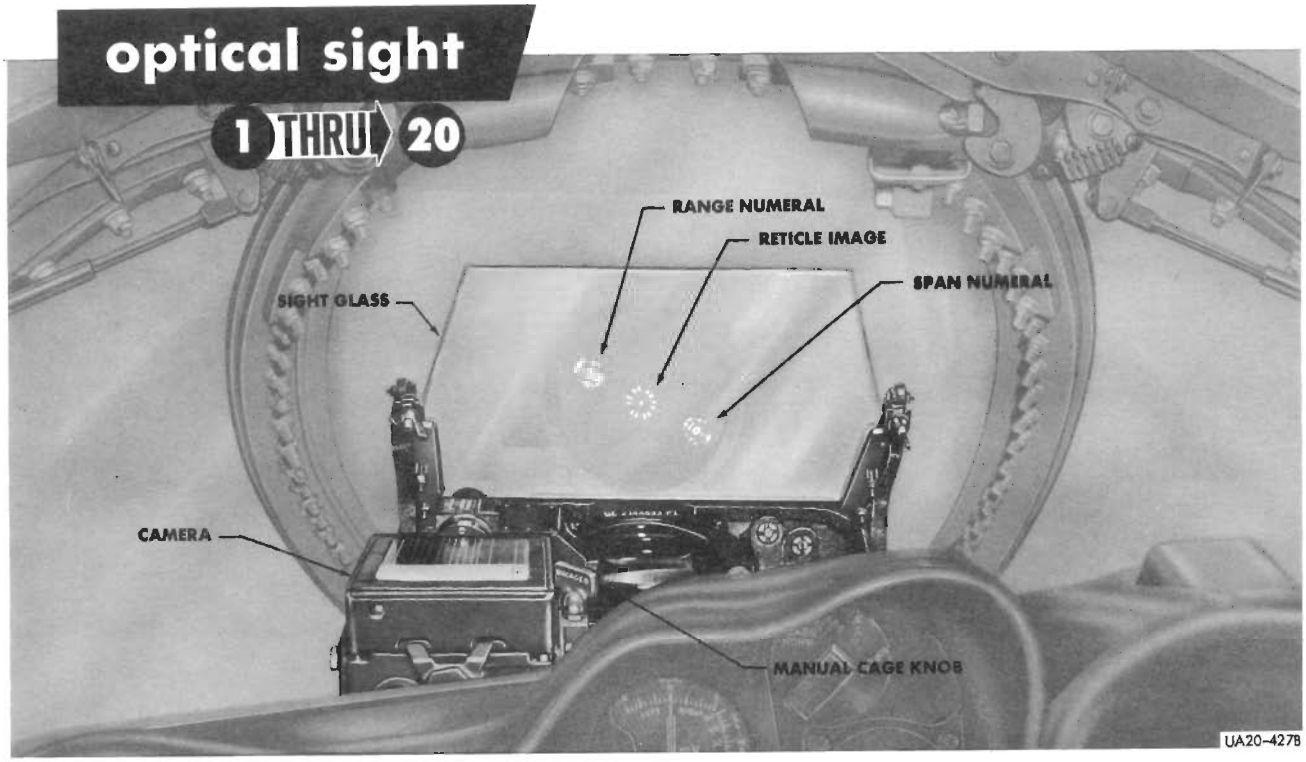


Figure 4-32

Note

Range information is fed automatically to the sight from the radar only when the twist grip on the left hand throttle is in the detent position.

A range numeral above and to the left of the reticle image indicates range in feet. A third indication of range is the span numeral below and to the right of the reticle image. When the target is out of firing range (3000 feet or more) the span numeral is uncovered; when in firing range the span numeral is automatically covered. The dot is used for tracking and aiming, the dot being centered in the circle for firing. The electrical power for the sight system (115 volt a-c) is controlled by the gun master switch (figure 4-36) on the armament control panel. The sight can be operated as a fixed reticle sight if necessary as long as 28 volt d-c power is available.

Gun Master Switch — 1 THRU 20

Refer to Gunnery System in this section.

Reticle Illumination Control Knob — 1 THRU 20

The gunsight control rheostat and filament selectors, marked gunsight control, are included into one control knob (figure 4-33) located on the left console. For each filament (right and left) there is a BRIGHT position. The OFF position is common to both. The filaments require 14 volt a-c power.

Wing Span Adjustment Knob — 1 THRU 20

On the sight head directly behind the mechanical cage lever is a rheostat type control knob which allows the pilot to feed wing span data to the sight unit. Positioning the knob through its range of 12 to 60 feet provides target information to the sight unit when using manual ranging control.

Manual Ranging Control — 1 THRU 20

A twist grip in the left hand throttle allows manual ranging during gunnery operations. Refer to Manual Ranging in this section.

Sight Electrical Caging Button — 1 THRU 20

The sight is caged electrically when the caging button on the forward portion of the right hand throttle is depressed. Prior to an attack the sight should be caged in this manner to stabilize the reticle image. Electrical power source is 28 volts d-c and 115 volts a-c.

Sight Mechanical Caging Lever — 1 THRU 20

Sight caging is accomplished mechanically by means of the caging lever on the sight head. This lever, when rotated approximately 120 degrees, will cage the sight. In event of sight (gyro) failure and fixed sight use is desired, the lever should be rotated to cage the sight and the fixed reticle used. The reticle size will be dependent on selected wing span adjustment

sight and camera control panel

1 THRU 20

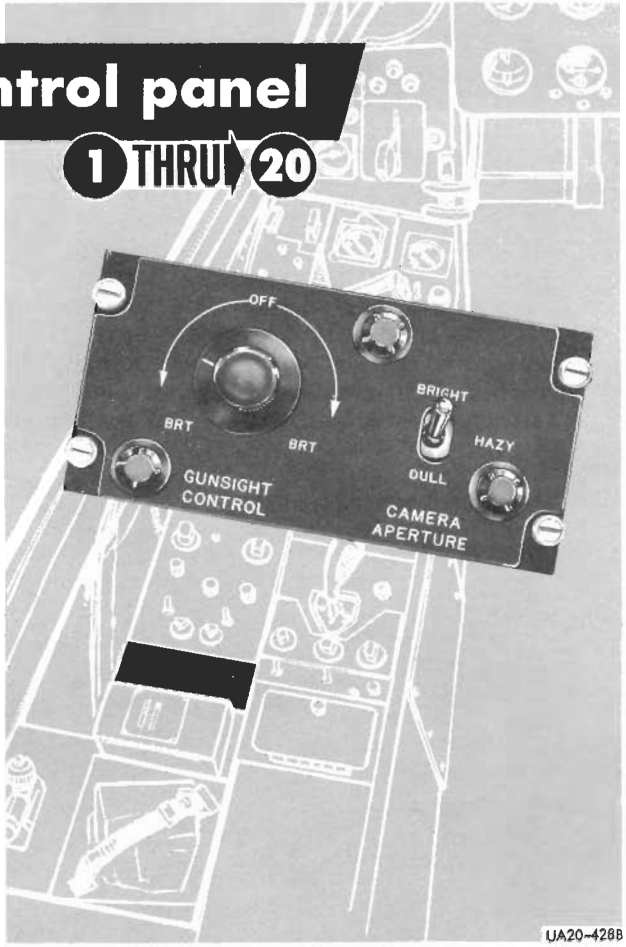


Figure 4-33

setting (refer to Wing Span Adjustment Knob, this section).

CAUTION

The gunsight should be mechanically caged during taxiing, take-off and landing to prevent damage to the sight mechanism.

Reticle Image 1 THRU 20

The reticle image reflected on the sight combining glass is of the six dot circle and center dot pattern. The circle pattern furnishes range information by expanding or contracting as range to the target increases or decreases. This circle is manually controllable by the twist grip on the left throttle in the event manual ranging is necessary, see Manual Ranging, this section. The dot ("pipper") is used for tracking and aiming, the dot being centered in the circle for firing. Power for reticle image illumination is 14 volts a-c.

Range Numeral 1 THRU 20

A further indication of range is the range numeral reflected on the combining glass above and to the left of the reticle image. The range numeral will indicate range to the target from 4,500 to 750 feet. Range data is supplied to the gunsight from the MA-7 radar. This system, when manually or automatically locked-on, will automatically track the target. A manual range control supplements the radar set and should be used if the radar system fails, refer to Manual Ranging, this section. Additional use of the radar is discussed in conjunction with Navigational Control System Radar, this section.

Span Numeral 1 THRU 20

The span numeral reflected to the lower right of the reticle image is determined by rotation of the span control on the aft section of the sight. The span control setting is adjustable from 12 to 60 feet wing span. When the target is out of range (3000 feet or more) the span numeral is visible on the sight glass. When in firing range the numeral disappears. You may fire any time the span numeral visible at long range, disappears from the combining glass.

GUNNERY SYSTEM 1 THRU 20

Two gun compartments, one on each side of the airplane, contain the four 20 mm guns and connect to an ammunition compartment serving both gun compartments. The ammunition compartment is essentially four reels of ammunition, a maximum of 375 rounds per gun. Another compartment beneath the guns and common to both gun compartments receives and stores spent cases and links. Gun gases are scavenged through normal vent outlets and through hydraulically actuated, electrically selected (trigger switch) door on the underside of the fuselage. The guns are electrically fired by 300 volt d-c power which is controlled by a 28 volt d-c circuit through the trigger switch. The guns must be charged on the ground prior to flight.

Gun Master Switch 1 THRU 20

This switch (figure 4-36), when properly positioned, supplies electrical power for operation of the guns, sight and camera. The switch, a channel guarded, three-position toggle switch, is marked GUNS-SIGHT-CAMERA, OFF and SIGHT CAMERA. Power is supplied to the sight and camera when the switch is positioned to SIGHT CAMERA. In the GUNS-SIGHT-CAMERA position the sight and camera are operational and the gun firing circuits may be actuated by depressing the trigger switch. Master switch has a 28 volt d-c power source.

Trigger Switch 1 THRU 20

The gun firing and camera circuits are actuated when the trigger (figure 1-17) is depressed. The trigger has two definite positions, the first actuates the camera, the second the guns, gun gas doors and camera. The gun master switch must be in the correct position before this switch is operational. Power source for trigger switch is 28 volts d-c.

CAMERA SYSTEM 1 THRU 20

The camera system consists basically of a 16mm AN-N9 gun sight motion picture camera, a 70mm P-2 strike camera and timer, and a camera aperture switch. The gun sight camera simultaneously photographs the sight system reticle image and the target during bombing and gun firing. This camera is also operable independent of gun, and bombing operations.

The P-2 strike camera mounted on the underside of the forward fuselage, is provided for air-to-ground rocket and bombing missions. It operates automatically whenever bombs are dropped or rockets are fired. A camera aperture selector switch (figure 4-33) is incorporated for remote selection of aperture size. A strike camera timer unit, ground set and adjusted, is installed to govern the starting and running time of the exposure and starts to function the instant bombs or rockets are released.

Sight Reticle Camera–AN-N9 1 THRU 20

A sight reticle AN-N9 camera is mounted on the sight head to photograph the sight reticle and target simultaneously. The camera is operated through the gun master switch and controlled by the trigger switch. The camera will operate as long as the trigger is depressed plus a 0 to 5 second overrun.

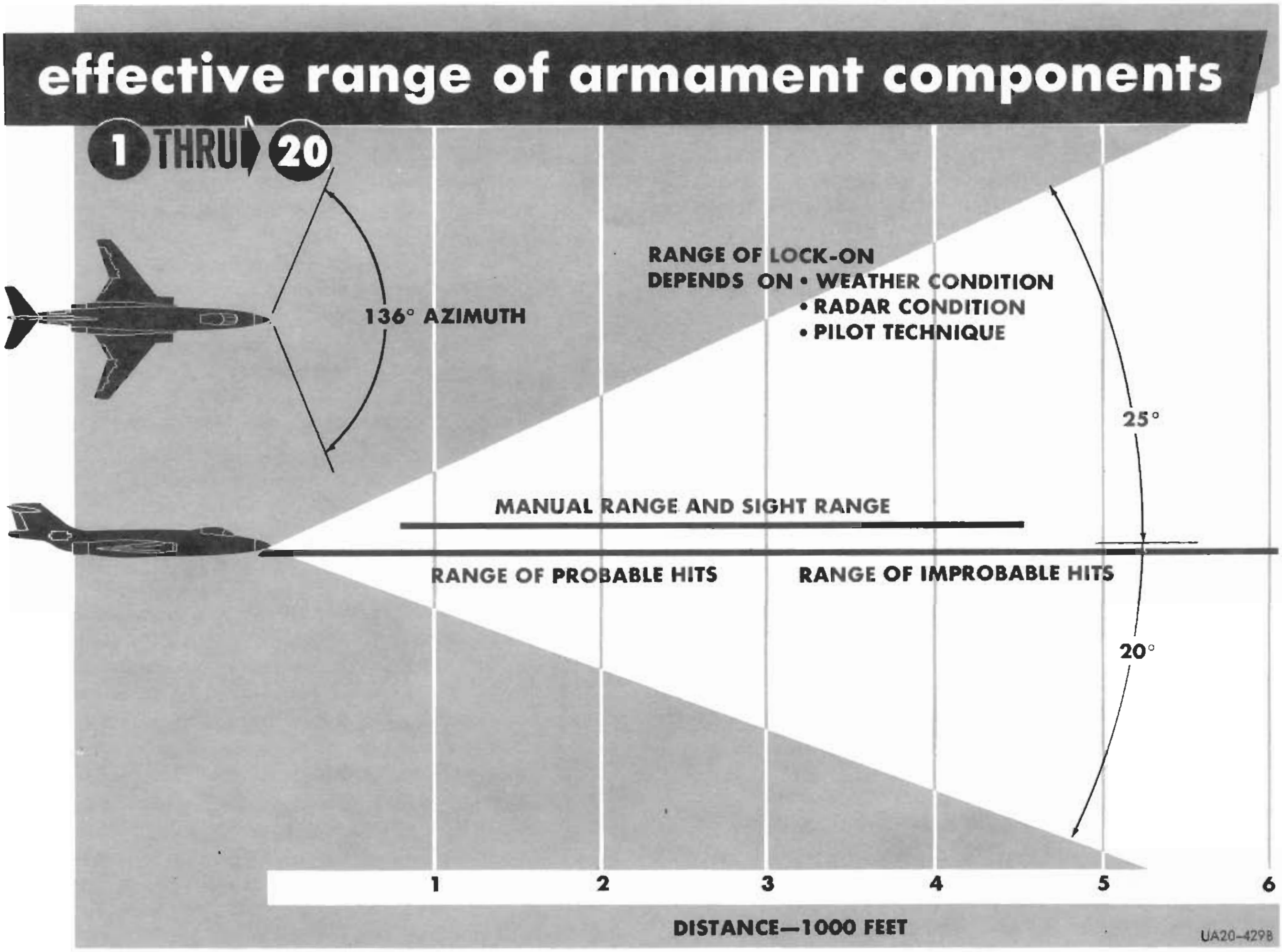


Figure 4-34

Strike Camera–P-2 (1 THRU 20)

To record impact of stores against ground targets, a P-2 strike camera is installed on the left side of the airplane. An access door in the left rear side of the nose gear well permits servicing. The camera coverage angle is a total of 105 degrees (50 degrees forward and 55 degrees aft). When the store release button on the pilot's stick grip is depressed and held the camera operates automatically to take rapid exposures. Releasing the button stops the camera.

Gun Master Switch (1 THRU 20)

Refer to Gunnery System, this section.

Camera Aperture Switch (1 THRU 20)

A three-position toggle switch (figure 4-33) on the left console allows the pilot to control the lens opening appropriate for prevailing light conditions. The three selections are BRIGHT, HAZY, and DULL. This selection controls both N-9 and P-2 cameras.

FIRING GUNS–AUTOMATIC RADAR RANGING (20)

To fire the guns using the sight with automatic radar ranging, proceed as follows:

1. Energize radar
   Energize radar as per procedures outlined in Radar Energizing Procedure, this section.
2. Gun master switch - SIGHT CAMERA
   Place gun master switch to SIGHT CAMERA position to allow for gun sight warm-up.

Note

Before selecting sight operation assure that sight is manually caged.

3. Manual cage knob - UNCAGE
   After two-minute warm-up manually uncage the sight. If reticle image oscillates, further warm-up is necessary. Should further warm-up still not stabilize the gyro the fixed reticle sight must be used for firing.

4. Radar master switch - OP
   In OP position (after 4 1/2 minute warm-up period) system enters automatic search.
5. Operate switch - LP
   Select LP to provide automatic search on extended range.
6. Elevation scan knob - BRD CTR
   In BRD CTR position antenna scans 64° either side of heading.
7. IF GAIN knob - full clockwise
8. Throttle range control grip - DETENT
9. Span control - estimated target span.
10. Camera aperture selector - AS REQUIRED
11. Gun master switch - GUNS-SIGHT-CAMERA
12. Operate switch - AR
    When visual contact is made with target.
13. Obtain automatic lock-on.
    Keep the gunsight reticle directly over the target until target range is decreased to 3000 yards at which time an automatic lock-on occurs.

Note

When lock-on occurs, range and span will appear on sight glass and the reticle will move indicating the proper lead course has been computed.

14. Fly airplane to position reticle on target and fire guns within range (as indicated by span numeral on the sight glass disappearing).

FIRING GUNS-RADAR RANGING 1 THRU 20

To fire the guns using the K-19 sight with radar ranging, proceed as follows:

1. Energize radar
   Energize radar per procedures outlined in Radar Energize Procedure, this section.
2. Gun master switch - SIGHT CAMERA
   Place gun master switch to SIGHT CAMERA position to allow for gun sight warm-up.

Note

Before selecting sight operation assure that the sight is manually caged.

3. Manual cage knob - UNCAGE
   After two-minute warm-up manually uncage the sight. If reticle image oscillates further warm-up is necessary. Should further warm-up still not stabilize the gyro, the fixed reticle sight must be used for firing.
4. Radar master switch - OP
   In OP position (after 4 1/2 minute warm-up period) system enters automatic search.
5. Elevation scan knob - BRD CTR
   In BRD CTR position antenna scans 64° either side of heading.
6. IF GAIN knob - full clockwise
7. Throttle range control grip - DETENT
8. Span control - estimated target span.
9. Camera aperture selector - AS REQUIRED
10. Operate switch 6 MI or SP
    When target contact is made.
11. Gun master switch - GUN-SIGHT-CAMERA
12. Obtain lock-on.
    Depress action switch on the manual control handle and spotlight the target on the scope. Using RANGE IN-OUT switch position range gate marker on target, release action switch to obtain lock-on.

Note

When lock-on occurs, range and span numerals will appear on sight glass.

13. Electrical caging button - DEPRESS
    Depressing button stabilizes reticle for tracking. Track ahead of target with a lead estimated to be that for which the sight will compensate upon release of caging button.
14. Electrical caging button - RELEASE
    When tracking smoothly. When caging button is released reticle will drift down to target.
15. Continue tracking
    Track smoothly without slipping or skidding for one second after releasing caging button.
16. Fire guns.
    Begin firing as soon as target is within range (as indicated by span numeral on the sight glass disappearing).

FIRING GUNS-MANUAL RANGING 1 THRU 20

To accomplish gunnery if radar ranging fails, or at any other time manual ranging is desired, proceed as follows:

1. Span control knob - target setting
2. Camera aperture selector - AS REQUIRED
3. Range control grip - full clockwise
   Rotate clockwise until the reticle image circle is reduced to minimum diameter.
4. Electrical caging button - DEPRESS
   To stabilize reticle image
5. Begin tracking.
   Track ahead of target with a lead estimated to be that for which the sight will compensate upon release of the caging button.
6. Throttle range control grip - AS REQUIRED
   Rotate grip as necessary to maintain size of reticle image same as span of target.
7. Caging button - RELEASE
   Making necessary changes to correct aim. (Reticle should not be completely on target.)
8. Continue tracking.
   Track smoothly, without slipping or skidding, for about one second after releasing caging button.
9. Fire guns
   Begin firing when target is within estimated firing range.

BOMBING EQUIPMENT (1) THRU (20)

Bombing equipment includes the K-19 sight system, the M-1 bombing system, MA-1 low altitude bombing system (1), the MA-1A low altitude bombing system (5) THRU (15) and the MA-2 low altitude bombing system (20). The operational features are manual bomb release, automatic bomb release, special stores release and emergency jettison. The bombing system includes a detachable, forced-ejection type bomb pylon and the necessary electrical controls. Electrical components of the system operate from the 28 volt d-c bus and the 115 volt, 400 cycle a-c bus. The bombs can be released either manually or automatically. The MA-7 optical gunsight, M-1 bombing system and MA-1, MA-1A and MA-2 low-altitude bombing systems can be used for automatic bomb release.

Special Store (1) THRU (20)

A special store can be carried on the underside of the forward fuselage. A control panel for monitoring the store is on the center pedestal panel. Additional information pertaining to the special store can be found in the applicable Aircrew Weapon Delivery Manuals. The special store can be jettisoned electrically or mechanically. Refer to Section I, Store and Tank Emergency Jettison Button and Store Emergency Release Handle.

Store and Tank Emergency Jettison Button (1) THRU (20)

Refer to Store and Tank Emergency Jettison Button, Section I.

Store Emergency Release Handle (1) THRU (20)

Refer to Store Emergency Release Handle, Section I.

Ejector Type Pylon (1) THRU (20)

The ejector type pylon assembly is designed to carry the four hook explosive ejector stores rack. The rack utilizes electrically fired cartridges to open the hooks and eject the stores. Force from a telescoping piston ejects the store and, after firing, is spring returned. The store can also be released manually.

Bombing System Selector Knob (1) THRU (20)

The bombing system selector knob (figure 4-36), located on the armament control panel, allows the pilot a choice of two bombing systems, the M-1 system or the MA-1 (1), M-1 system or the MA-1A (5) THRU (15), and the M-1 system or the MA-2 (20). In all airplanes, the M-1 position selects the "toss" bombing method. The MA-1 system (1) employs two switch positions, LABS and DIRECT. The LABS position selects the "toss" bombing method of the MA-1, while the DIRECT position allows the immediate release of the bomb by merely pressing the bomb button on the control stick. The MA-1A system (1) THRU (15), or the MA-2 (20), employs two switch positions, LABS NORM and LABS ALT. The LABS NORM position selects the "loft" bombing method of the MA-1A or MA-2, while the LABS ALT position selects the "over-the-shoulder" method. The DIRECT position allows the immediate release of the bomb by merely pressing the bomb button. Placing the switch from OFF to any one of the above, supplies 28 volt d-c and 115 volt a-c to the system selected.

Bomb-Rocket Release Button (1) THRU (20)

The bomb-rocket release button is utilized for the M-1, MA-1, MA-1A and MA-2 systems. Depressing the button will initiate the solving of the bombing problems. Other components of both systems allow bomb release when correct release conditions are reached in the respective maneuver. The bomb button must be held depressed, however, until release occurs. The button utilizes 28 volt d-c power. Refer to M-1, MA-1, MA-1A and MA-2 Bombing System, this section. The bomb button, located on the control stick, supplies the potential 28 volt d-c power to fire the ejector rack cartridges, refer to Ejector Type Pylon, this section. It also sets into operation the LABS timer which de-energizes the sight reticle light when the timing cycle is completed indicating to the pilot that the pull-up maneuver should be initiated. The bomb button must remain depressed until bomb release.

M-1 BOMBING SYSTEM (DIVE-TOSS) (1) THRU (20)

The M-1 "dive-toss" bombing system is a method conceived for the safe delivery of a weapon of high explosive yield. The pilot begins a dive on the target, and when automatic inputs of dive angle, impact and static pressures fed to the M-1 computer are within computing capabilities, the "bomb release" light illuminates. The pilot depresses the bomb button and begins a smooth wings level pull-up. Depressing the bomb button initiates the solution of the problem utilizing the variable inputs and the data placed on the M-1 control panel by the pilot. When the computed release angle is reached, the weapon is automatically released and the "bomb release" light goes out. For additional information pertaining to the M-1 bombing system, refer to T.O. 1F-101A-28-1.

Bombing System Selector Knob (1) THRU (20)

Refer to Bombing Equipment, this section.

M-1 Selector Switch (1) THRU

The M-1 selector switch (figure 4-35), is provided to select the mode of bomb release and energizes the M-1 system for operation. Placing the switch from OFF to S (standby) position supplies 115 volt single-phase a-c and 28 volt d-c power for system warm-up. The T (toss) position energizes the complete computing system. D (direct) position by-passes the computer circuit and the bomb may be released immediately. The R (radar) position is not operational.

M-1 control panel

Figure 4-35

M-1 Gyro Switch (1 THRU 20)

The M-1 gyro switch (figure 4-35) is a two-position toggle switch located on the M-1 operating box. The positions marked CAGE and UCGE permit 28 volt d-c power for caging or uncaging of the M-1 vertical gyro. When uncaged, the vertical gyro relates dive angle information to the M-1 computer. Refer to T.O. 1F-101A-28-1 for M-1 vertical gyro uncaging procedures.

M-1 Data Input Knobs (1 THRU 20)

The four remaining knobs on the M-1 box (figure 4-35) are manually positioned by the pilot to introduce the following information into the computing system through numerical representation on the face of the dial. The target pressure knob, marked TARG. PRESS, supplies pressure, in inches of mercury, at the target area made available through weather sources. The ballistics knob, marked BAL., supplies bomb ballistics information pertaining to the store carried. The numerals on the knob (0 thru 10) are a coefficient of the actual ballistics information. The gross weight knob, marked GR. WGT. is set on the computed gross weight of the airplane over the target in thousands of pounds. The wind knob is set on a value based upon forecast rangewind (knots) at the target area. The knob compensates for only HD (head) wind or TL (tail) wind.

Bomb Release Light (1 THRU 20)

The "Bomb Release" light (figure 4-36) will illuminate during the dive on the target to indicate to the pilot that the system is within its computing capabilities, and that the bomb button should be depressed and a smooth pull-up initiated. When the bomb button is depressed, the solving of the actual bombing problem is begun using the variable inputs from the system components and the constant inputs from the M-1 operating box. The bomb button should be held depressed during the pull-up until the bomb release light goes out, indicating a release has occurred at the release angle computed by the system.

Note

The gun sight must be illuminated and used for dive accuracy.

M-1 BOMBING SYSTEM OPERATION (1 THRU 20)

Note

The M-1 system should be allowed at least 15 minutes warm-up before operation.

1. Place bombing system selector switch to M-1.
2. Place M-1 selector switch to S (standby).
3. Set target pressure, gross weight, bomb ballistics, and wind information on the appropriate M-1 controls.
4. Reticle illumination control knob - BRT.
   Adjust gun sight reticle to desired brilliance.
5. M-1 selector switch - T (toss)
   Energize the M-1 system by selecting T (toss) position.
6. Special store lock switch - READY
   Break the wire guard and place the special store lock switch to READY.

Note

The bomb release light is the conventional press-to-test type and should be tested before the bomb run. Pressing the light will test the bulb only.

7. Begin dive toward target utilizing the fixed gun sight pipper. Hold the wings as level as possible.

Note

The pilot may select any dive angle within the limits of 7° minimum to 75° maximum.

Through inputs of dive angle, static and impact pressures obtained automatically through the system components, an angle of divergence is computed in the

M-1 computer. This computation is subject to corrections by the inputs set into the M-1 control panel by the pilot.

8. Continue dive until bomb release light illuminates indicating that the system is within computer capabilities.
9. With wings level and with the sight pipper on target, press bomb button and begin pull-up.
10. The bomb release light will go out when the airplane reaches the correct angle of divergence indicating that the weapon has been released. The pilot may now release the bomb button and the attack may be renewed.

MA-1, MA-1A AND MA-2 LOW ALTITUDE BOMBING SYSTEM (LABS) 1 THRU 20

The Low Altitude Bombing System employs two methods of bomb release. The with IP and without IP methods are selected through the bombing system selector switch LABS NORM and LABS ALT positions respectively. The with IP release is begun by the pilot approaching the target at a closely maintained airspeed, altitude, and heading. When the airplane passes over a preselected IP (identification point) the bomb button is depressed which begins the LABS timing cycle. At the completion of the timing cycle, the gun sight reticle will extinguish indicating that a wings level pull-up at briefed acceleration must begin. When the airplane reaches the predetermined release angle, the weapon is released and will "loft" to the target. The without IP release involves release angles greater than 90°. In this maneuver, the pilot depresses the bomb button and begins pull-up over the target. No timing cycle is used so the sight reticle need not be used. The weapon releases at the predetermined release angle. For additional information pertaining to the low altitude bombing system, refer to T.O. 1F-101A-26-1.

Bombing System Selector Knob 1 THRU 20

Refer to Bombing Equipment, this section.

LABS Start Switch 1 THRU 20

This switch (figure 4-36), located on the armament control panel has two positions, ON and OFF. When this switch is placed in the ON position before IP or before reaching the target (in the case of LABS ALT) the vertical gyro is uncaged and the gun sight reticle is illuminated. Also, the yaw-roll gyro is placed in standby condition. The bombing system selector switch must be placed in a LABS function before this switch is placed ON. When the LABS start switch is placed ON the reticle light is energized. Simultaneously the vertical gyro is uncaged and the dive and roll indicator pointers motion will correspond

to the attitude of the airplane. LABS start switch has a 28 volt d-c power supply.

Note

Should conditions warrant, the timing cycle can be ignored and pull-up initiated any time after the bomb button is depressed. The bomb will release when the predetermined pitch angle is reached.

LABS Indicator (1 THRU 20)

The LABS indicator (figure 4-36) provides the pilot with climb-dive roll, yaw-roll and acceleration information. The face of the indicator contains a roll scale, a climb-dive scale, "HI G" and "LO G" acceleration markings and anti-parallax lines. The roll scale is graduated every 1° from 0° to 9° in left and right roll. The climb-dive scale is graduated every 5° from 0° to 90° in climb and dive. The "HI G" and "LO G" scales are used with the horizontal needle to provide acceleration information during pull-up. Prior to pull-up, the vertical needle shows roll and the horizontal needle shows pitch. At time of pull-up when the timing cycle is complete (or at depression of the bomb button when the LABS timer is not used), the vertical needle shows a combination of yaw and roll and the horizontal needle shows acceleration. After bomb separation the bomb button is released and the vertical needle continues to show yaw-roll and the horizontal needle reverts to pitch. The maneuver from pull-up to release is flown with the needle centered between the anti-parallax lines. Correction is made by correcting away from the needle, i.e., if the vertical needle deflects to the left, roll to the right; if the horizontal needle drops into the "LO G" area, pull more "g's" to correct.

Gun Sight Reticle (1 THRU 20)

The sight reticle light, when used in conjunction with the LABS system, is employed merely as an indicator light. When the LABS start switch is placed in the ON position and the reticle illumination control knob is placed in the BRT position, the reticle light will be reflected on the viewing glass. When the bomb button has been depressed over the IP and the timer cycle is completed by the LABS timer, the reticle light will extinguish indicating to the pilot that he must initiate his pull-up. When the bomb has been released the reticle light will again go on indicating that the pilot may release the bomb button. Releasing the bomb button will cause the reticle to go off until the LABS system is recycled by placing the LABS start switch to OFF, and then back to ON. Power supply is 14 volt a-c.

Special Store Timer (T_0) Light (1 THRU 20)

The "T_0" indicator light (figure 4-36) is located on the armament control panel adjacent to the LABS start switch. This amber light will illuminate when the special store timer has begun its timing cycle.

LABS RELEASE WITH IP (1 THRU 20)

1. Prior to take-off, set LABS timer as required.
2. After take-off, place bombing system selector switch to LABS NORM.
3. Reticle illumination control knob - BRT
4. Special store lock switch - READY
   Break the wire seal and place the store lock switch to ready.
5. Begin bomb run toward target. When the airplane is level, place the LABS start switch ON. The vertical gyro will uncage and pitch and roll indications appear on the LABS indicator.
6. When over IP (at predetermined altitude and airspeed) depress bomb button, which starts the timing cycle. When the timing cycle is completed the reticle light will go out at which time the pilot will initiate his pull-up. The LABS indicator will change to yaw-roll and acceleration indications.
7. When a predetermined release angle is reached, the bomb will release and the reticle light will go on. The pilot may now release the bomb button.
8. Recycle the system by placing the LABS start switch off when the airplane is level, and placing the switch ON, during a new bomb run with the airplane level.

Note

If it becomes necessary to abort in that portion of the bomb run where the reticle light is on, all that is necessary to recycle the LABS system is to release the bomb button. If the reticle light has already gone out, the bomb button must be released and the LABS start switch turned OFF, then ON in order to recycle the system.

LABS RELEASE WITHOUT IP (1 THRU 20)

1. After take-off, bombing system selector switch - LABS ALT
2. Reticle illumination control knob - BRT
3. Special store lock switch - READY
   Break the wire seal and place the store lock switch to READY.
4. Begin bomb run toward target. When the airplane is level, place the LABS start switch ON. The vertical gyro will uncage and pitch and roll indications appear on the LABS indicator.
5. When over the target, depress bomb button, and begin pull-up at briefed acceleration. LABS indicator transfer occurs.
6. The weapon will release automatically at the computed release angle.
7. Recycle the system by placing the LABS start switch off when the airplane is level, and placing the switch ON, during a new bomb run with the airplane level.

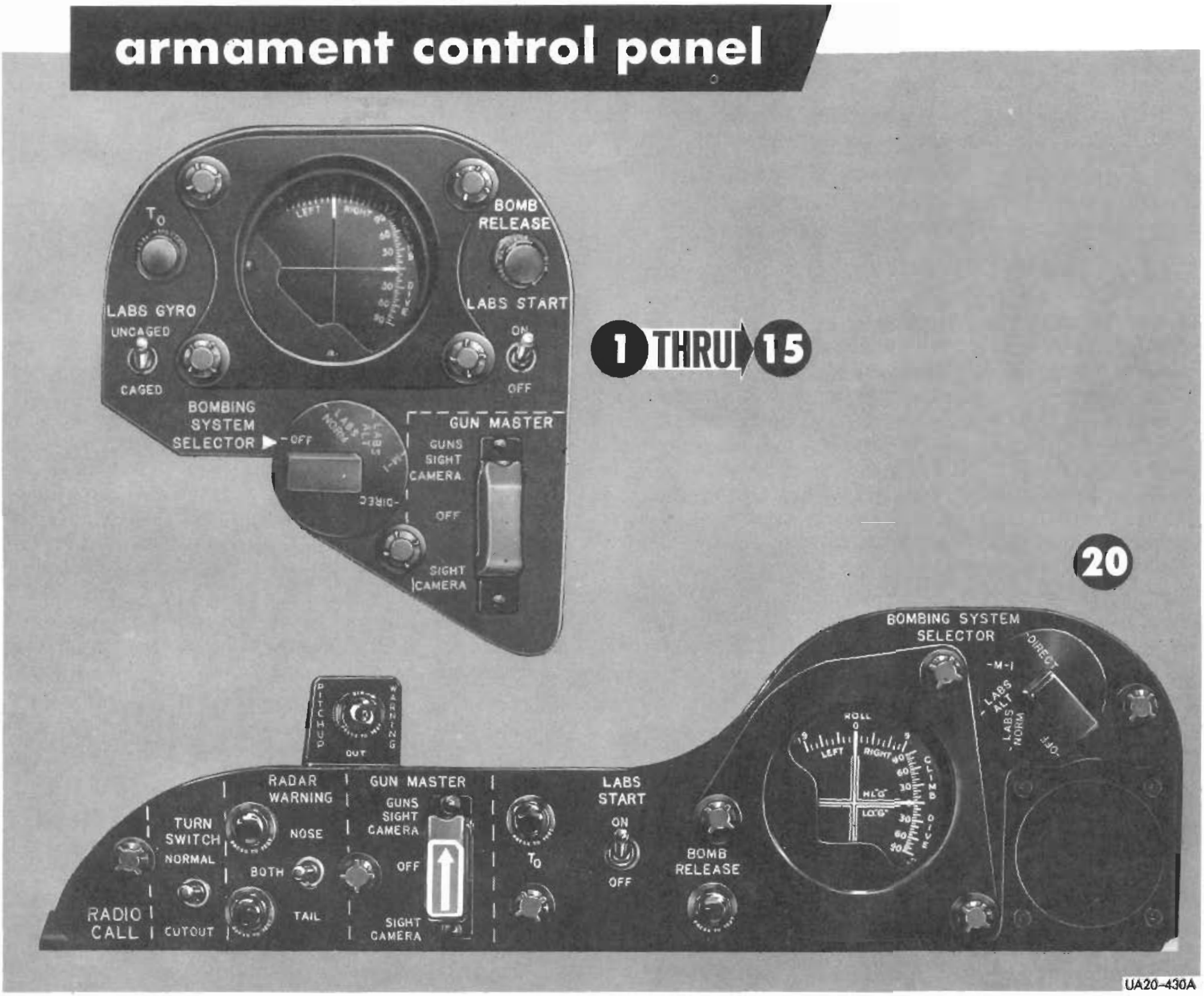


Figure 4-36

REFUELING SYSTEMS

The Probe and Drogue method of air refueling requires the pilot to fly his airplane with the probe extended into a funnel shaped fitting attached to the end of a flexible hose extended from the tanker. The Flying Boom method requires the pilot to fly a formation position with the tanker. 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.

CAUTION

After the incorporation of T.O. 1F-101-598, the external fuel tanks cannot be in-flight refueled. They can only be refueled through their respective filler caps. Mission Planning should be accomplished accordingly.

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. 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. With the probe extended the pilot maneuvers his airplane into position and makes contact with the tanker's drogue. Upon a 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. Retraction of the probe is accomplished by placing the refuel switch to the NORMAL position. The continuity of the fuel transfer pumps is renewed when the probe is completely retracted into the well.

Refuel Switch

The refuel switch (figure 1-14) 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. Control valves will automatically shut off fuel flow to each fuselage cell when it is full. Placing the refuel switch to the NORMAL position retracts the probe. When the probe is completely retracted the normal continuity to the fuselage transfer pumps is renewed. Electrical power is supplied from the 28 volt d-c bus. Utility hydraulic pressure is utilized to extend and retract the 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.

REFUELING PROCEDURE–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 when the probe is extended.

1. Several minutes prior to tanker rendezvous, cycle the IFR probe.

Note

Any difficulty experienced may be due to moisture freezing on the probe doors. Therefore, when difficulty is experienced, descend to a lower altitude to dissipate any ice that may have formed in the probe doors.

2. Approach the tanker from the rear and slightly below the refueling drogue.
3. Maintain a position approximately 100 feet aft and 50 feet below the drogue until airplane is trimmed and formation speed is determined.
4. Flap lever - AS REQUIRED
5. Refuel switch - REFUEL
6. 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.

7. After contact is made, slowly fly drogue forward approximately 10 feet. This is indicated by a green light on the tanker while the amber light goes out.
8. Maintain a steady position after hook-up. 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.

9. With fuel quantity gage tank selector knob in the TOTAL position, note refueling progress by observing the aircraft's fuel quantity gage.

Note

Fuel flow from the tanker is automatically shut off when the receiver tanks are full.

10. When tanks are full, reduce speed slightly to disengage probe from drogue coupling.

Note

High rates of separation when breaking contact should be avoided to preclude sudden loads on the tanker hose braking system.

11. Refuel switch - NORMAL

EMERGENCY OPERATION–PROBE AND DROGUE

If the probe is damaged during refueling and cannot be retracted, the normal continuity of the fuselage transfer pumps cannot be re-established. However, placing the fuel pumps switch to ALL PUMPS will establish emergency continuity to the fuselage transfer pumps.

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. The receptacle is extended by placing the 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 will extend the boom into the receptacle. Once the boom is locked in the receptacle, fuel will flow from tanker to the receiver airplane and will be distributed through the transfer lines. At the completion of the refueling sequence, the receptacle is retracted by placing the boom IFR switch to the RETRACT position. The continuity of the fuel transfer pumps is renewed when the receptacle is retracted.

boom IFR control panel

Figure 4-37

Boom IFR Switch

The boom IFR switch is a two-position toggle switch located on the electrical control panel (figure 1-15) in the (20)(20) airplanes and on the boom IFR control panel (figure 4-37) in the (1) THRU (15) (10) airplanes. Switch positions are: RETRACT and EXTEND in the (20)(20) airplanes and RECEIVER RETRACT and RECEIVER EXTEND in the (1) THRU (15) (10) airplanes. Placing the boom IFR switch to the (RECEIVER) 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 (RECEIVER) 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.

Release Button

The release button is a push-button type switch located on the stick grip (figure 1-17) in the (20)(20) airplanes and on the boom IFR control panel (figure 4-37) in the (1) THRU (15) (10) airplanes. This button is provided as a means for the pilot to end the refueling cycle before the fuel tanks are full. Depressing the release button illuminates the disengage indicator and affects an immediate release from the refueling boom. The release button is dependent on 28 volt d-c power for operation.

Reset Button

The reset button is a push-button type switch located on the electrical control panel (figure 1-15) in the (20)(20) airplanes and on the boom IFR control panel (figure 4-37) in the (1) THRU (15) (10) airplanes. If the boom and receptacle are inadvertently disconnected during the refueling operation, the system can be made ready for the refueling again by depressing the reset button. The reset button is dependent on 28 volt d-c power for operation.

Disengaged Indicator

A red indicator light (figures 1-15 and 4-37) marked "Disengaged", provides an indication of the boom and 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 1-15 and 4-37) marked "Ready", is provided to indicate the receptacle is extended and ready to receive the boom. 28 volt d-c is required for operation. Illumination indicates the receptacle is extended and ready to receive the boom. The light will remain illuminated until the boom is locked in the receptacle or 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 when the receptacle is extended.

1. Approach the tanker at selected altitude and speed.
2. Fuel quantity gage tank selector knob - TOTAL
3. Flap lever - AS REQUIRED
4. Boom "IFR" switch - EXTEND
5. Ready indicator (green) light on, indicates receptacle extended.
6. 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 airplane's fuel quantity gage. The refueling progress of the wing and external tanks can be checked by observing the full fuel indicators.

7. When the required amount of fuel has been transferred, initiate electrical disconnect.

CAUTION

If making an "outer limit" disconnect, high rate of separation should be avoided to prevent damage to the boom or the receptacle.

8. Disengage indicator (amber) light on, indicates boom and receptacle disengaged.
9. Boom "IFR" switch - RETRACT, disengaged light will go out when the receptacle is retracted.
10. Flap lever - RETRACT

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. 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 crewmember of the tanker announce the word "breakaway" over the radio, the receiver pilot will immediately actuate the air refueling release switch and reduce thrust. The boom operator will initiate a disconnect while the tanker pilot will increase thrust and climb on course.

EMERGENCY OPERATION-FLYING BOOM

If the receptacle is damaged during refueling and cannot be retracted, the normal continuity of the fuselage transfer pumps cannot be re-established. However, placing the fuel pumps switch to ALL PUMPS will establish emergency continuity to the fuselage transfer pumps.

SINGLE-POINT PRESSURE REFUELING SYSTEM

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 will close all flow control valves simulating a full condition and stop fuel flow to the airplane. Returning the switch to its normal position will open the flow control valves and permit 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.

REFUELING PROCEDURE-Single-Point

1. Assure all fuel caps secure.
2. Insert nozzle grounding plug in airplane.
3. Connect pressure refueling hose to pressure refueling fitting.
4. Start fuel flow.
5. IFR pilot valve switch - CHECK

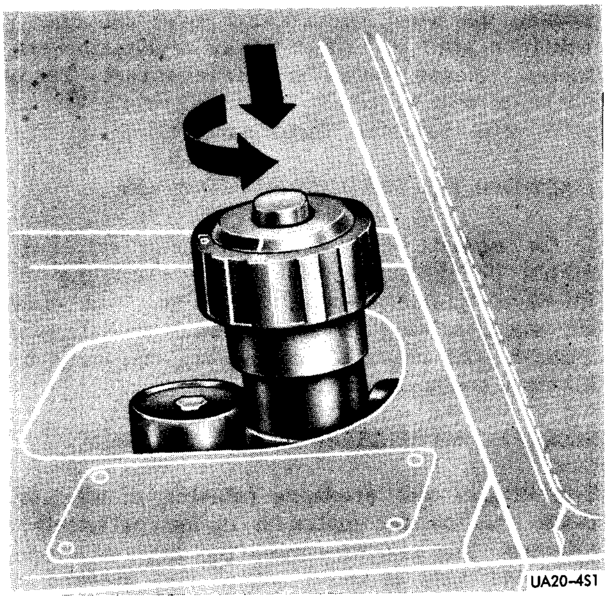
Note

The maximum allowable time lapse between actuation of the check switch and all fuel flow stopping is 30 seconds.

6. Release switch.
   Pressure refueling resumed. Refueling will terminate when actual "full" condition exists.

MISCELLANEOUS EQUIPMENT

ANTI-G SUIT PROVISIONS



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.

WARNING

- Whenever the anti-G suit does not deflate after a maneuver, immediately disconnect the anti-G suit hose and deflate by depressing the check valve located on the end of the hose. Do not completely cover the check valve while deflating the anti-G suit, as it is possible to prevent the release of air with the check valve depressed.
- If the anti-G suit hose becomes disconnected during a positive "g" maneuver, the anti-G suit will remain pressurized. Locate the end of the anti-G suit hose and deflate as described above.

FLIGHT REPORT HOLDERS

A canvas flight report holder is located along the left console between the canopy sill and the console. A zipper provides access to the holder.

MAP CASE

A map case (well area) is included on the right console. A strap with fastener secures the opening.

SEXTANT CASE

A sextent case (well area) is included on the left console. A strap with fastener secures the sextant when in place.

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

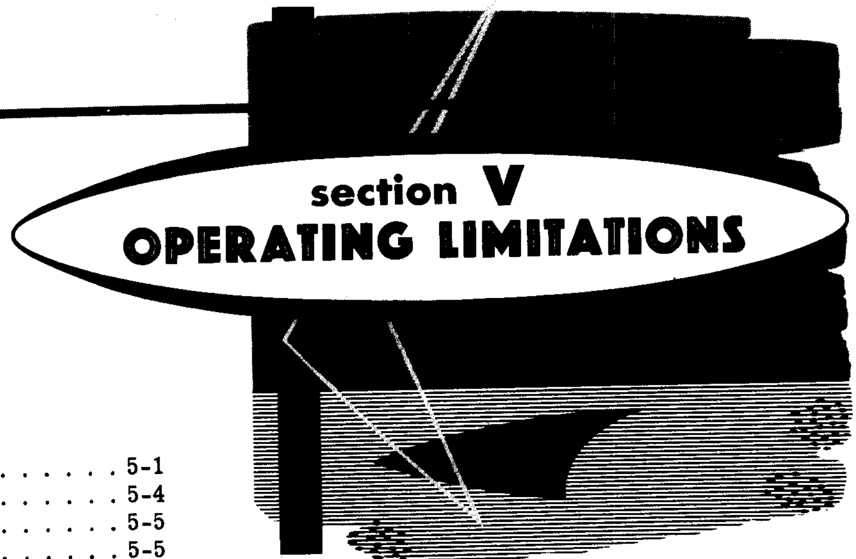
Two rear view mirrors are installed on the canopy enclosure.

SPARE LAMPS

Spare lamps for the console panels 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.



UA20-500

section V OPERATING LIMITATIONS

TABLE OF CONTENTS

This section includes the airplane 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 limitations are shown in figure 5-2. Additional information is given in the following paragraphs and figure 5-1.

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 shut down.

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 non-afterburning. Above 6 minutes period of afterburning should be followed by a double period of non-afterburning.
- Due to high fuel consumption, afterburner operation should be avoided with less than 3,000 pounds of total fuel remaining.

MILITARY THRUST

30 minutes

MAXIMUM CONTINUOUS 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 Form 781 entry to insure inspection.

EMERGENCY FUEL

Aviation gasoline MIL-G-5572, lowest grade available, may be used for emergency fuel. Use this fuel for low altitude emergency evacuation flight.

CAUTION

Emergency fuel 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.

instrument markings

BASED ON JP-4 FUEL

EXHAUST TEMPERATURE

200°C-580°C	green	CONTINUOUS BELOW 30,000 FEET
580°C-610°C	yellow	CONTINUOUS ABOVE 30,000 FEET
670°C	red	MAXIMUM IN AFTERBURNER ABOVE 30,000 FEET
		NOTE 640°C MAXIMUM IN AFTERBURNER BELOW 30,000 FEET
630°	red	MAXIMUM FOR STARTING AND MILITARY THRUST BELOW 30,000 FEET (30 MIN)
		NOTE 660°C MAXIMUM IN MILITARY THRUST ABOVE 30,000 FEET (30 MIN)
680°	red	MAXIMUM FOR ACCELERATION (2 MIN)

TACHOMETER

102%	red	MAXIMUM OVERSPEED
85%-98%	green	CONTINUOUS

HYDRAULIC PRESSURE

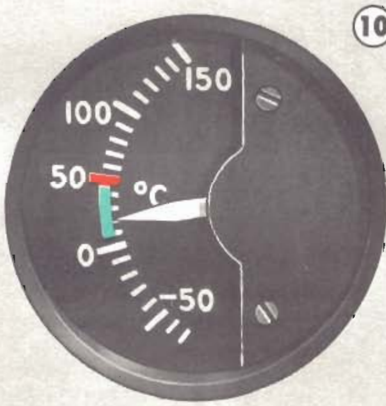
PRIMARY-UTILITY	
2000-2700 PSI (yellow)	NORMAL WITH RAPID CONTROL MOVEMENT
	SHOWS MALFUNCTION WITH CONTROLS STATIC
2700-3400 PSI (green)	NORMAL
3400 PSI (red)	MAXIMUM

NOTE

IF HYDRAULIC PRESSURE EXCEEDS 3100 PSI IN THE STEADY STATE AN ENTRY IN THE AFTO FORM 781 IS REQUIRED

CAMERA COMPARTMENT TEMPERATURE

(10)(20)



10°C-50°C	green	CONTINUOUS
50°C	red	MAXIMUM

UA20-501B-1
RYG

Figure 5-1

OIL PRESSURE

35 PSI	red	MINIMUM
35-40 PSI	yellow	CAUTION
40-50 PSI	green	CONTINUOUS
50 PSI	red	MAXIMUM

AIRSPEED AND MACH

red/yellow/red	500 KNOTS MAXIMUM EXT. TANKS
yellow	250 KNOTS MAXIMUM LANDING GEAR AND FLAPS

ACCELEROMETER

1 THRU 15 10

POSITIVE LOAD FACTOR (g) LIMITS		
+5.0g	red	MAXIMUM CLEAN AND 9000 LBS MAXIMUM FUEL
+4.5g	red	MAXIMUM NO EXTERNAL TANKS
+4.0g	red/yellow/red	MAXIMUM EXTERNAL TANKS (SYMMETRICAL)
NEGATIVE LOAD FACTOR (g) LIMITS		
-2.0g	red/yellow/red	MAXIMUM EXTERNAL TANKS
-2.7g	red	MAXIMUM NO EXTERNAL TANKS
-3.0g	red	MAXIMUM CLEAN AND 9000 LBS MAXIMUM FUEL

ACCELEROMETER

20 20

POSITIVE LOAD FACTOR (g) LIMITS		
6.33g	red	MAXIMUM CLEAN AND 9000 LBS MAXIMUM FUEL
5.7g	red	MAXIMUM NO EXTERNAL TANKS
4.0g	red/yellow/red	MAXIMUM EXTERNAL TANKS (SYMMETRICAL)
NEGATIVE LOAD FACTOR (g) LIMITS		
-2.0g	red/yellow/red	MAXIMUM EXTERNAL TANKS
-2.7g	red	MAXIMUM NO EXTERNAL TANKS
-3.0g	red	MAXIMUM CLEAN AND 9000 LBS MAXIMUM FUEL

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RYG

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	
MAXIMUM CONTINUOUS	580	610	CONTINUOUS	
IDLE	340	———	CONTINUOUS	
STARTING	630	630	MOMENTARY	
ACCELERATION	680	680	2 MINUTES	

*REFER TO "MAXIMUM THRUST" THIS SECTION

UA20-502A

Figure 5-2

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 airplane. 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 airplane. 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 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.

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

See figure 5-1.

Clean Airplane

Above 25,000 ft.	Mast System - 1.57 indicated Mach or 690 knots IAS, whichever is lower. Nose Boom - 1.70 IMN or 700 KIAS whichever is lower.
Below 25,000 ft.	Mast System - 585 knots IAS. Nose Boom - 600 KIAS.

With External Tanks

All Altitudes	1.3 indicated Mach or 500 knots IAS, whichever is lower.

With External Tanks and Center Line Special Store 1 THRU 20

All Altitudes	420 knots IAS or Mach 1.3 whichever is lower.
MK-7 Store Only 1 THRU 20	600 knots IAS or 1.57 indicated Mach, whichever is lower.

EXTERNAL TANKS JETTISON SPEEDS

Full or empty external tanks may be jettisoned below 300 knots IAS and between +.5 "g's" and +3.5 "g's".

GUN FIRING LIMITATIONS 1 THRU 20

Do not fire the guns during flight until the airplane is modified in accordance with T.O. 1F-101-640. This modification prevents the possibility of an explosion in the armament compartment due to gun gas accumulation.

PROHIBITED MANEUVERS

The airplane is restricted from the following maneuvers:

1. Any snap maneuvers.
2. Rolls continued past the 360° point.

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.

3. Intentional pitch-up and spins.
4. Negative "g" condition in excess of 15 seconds.
5. Zero "g" condition in excess of 10 seconds.

ACCELERATION LIMITATIONS

Basic airplane acceleration limitations are shown in figure 5-1 and are quoted for symmetrical flight maneuvers only. Unsymmetrical flight maneuver limitations are 2/3 of the quoted symmetrical limitations. Acceleration limitations for various external configurations are shown in the chart below.

CONFIGURATION	"g" LIMITS 1 THRU 15 10	"g" LIMITS 20 20
WITH FULL INTERNAL FUEL AND NO EXTERNAL LOAD	+4.5 -2.7	+5.7 -2.7
WITH A MAXIMUM OF 9000 POUNDS INTERNAL FUEL AND NO EXTERNAL LOAD	+5.0 -3.0	+6.33 -3.0
WITH EXTERNAL TANKS	+4.0* -2.0	+4.0* -2.0
	1 THRU 20	
EXTERNAL TANKS—WITH OR WITHOUT C_L SPECIAL STORE	+4.0 -2.0	+2.7 -0.0
MK-7 SPECIAL STORE ONLY	+5.0 -2.0	+3.3 -0.0

* This limitation is for RE-560 EXTERNAL TANKS ONLY. Limitation is lowered to +2.7 "g's" with other external tanks installed.

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OPERATING FLIGHT LIMITS

Refer to the operating flight limits chart, figure 5-1.

CENTER OF GRAVITY LIMITATIONS

MOST FORWARD C.G.

The forward c.g. limit is 20% M.A.C. for take-off and 17% M.A.C. for inflight and landing. 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 and with full ammunition.

MOST AFT C.G.

The aft c.g. limits are 36% M.A.C. for take-off and 41% M.A.C. for inflight and landing. The most aft c.g. for take-off occurs with no external tanks or no external stores. The most aft c.g. for landing occurs with no fuel remaining, ammunition expended, and external tanks and special stores jettisoned.

CENTER OF GRAVITY TRAVEL

Center of gravity locations which are beyond the recommended limits may occur unless fuel is consumed in the following order: External fuel, internal fuselage fuel (cells 1 through 5).

operating flight limits

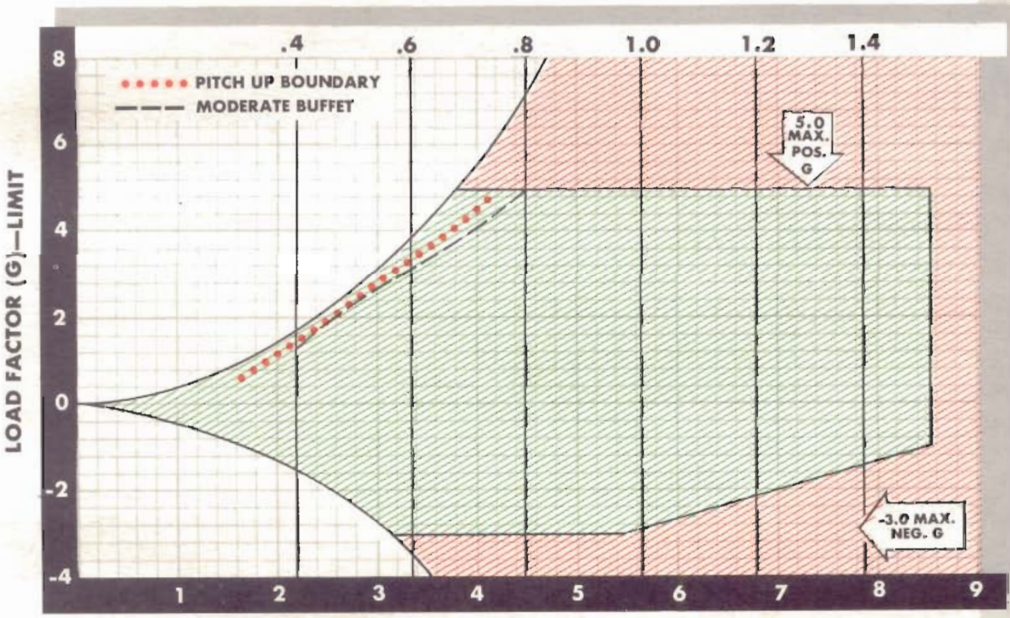
SYMMETRICAL FLIGHT MANEUVERS

1 THRU 15 10

GROSS WEIGHT—37,000 POUNDS

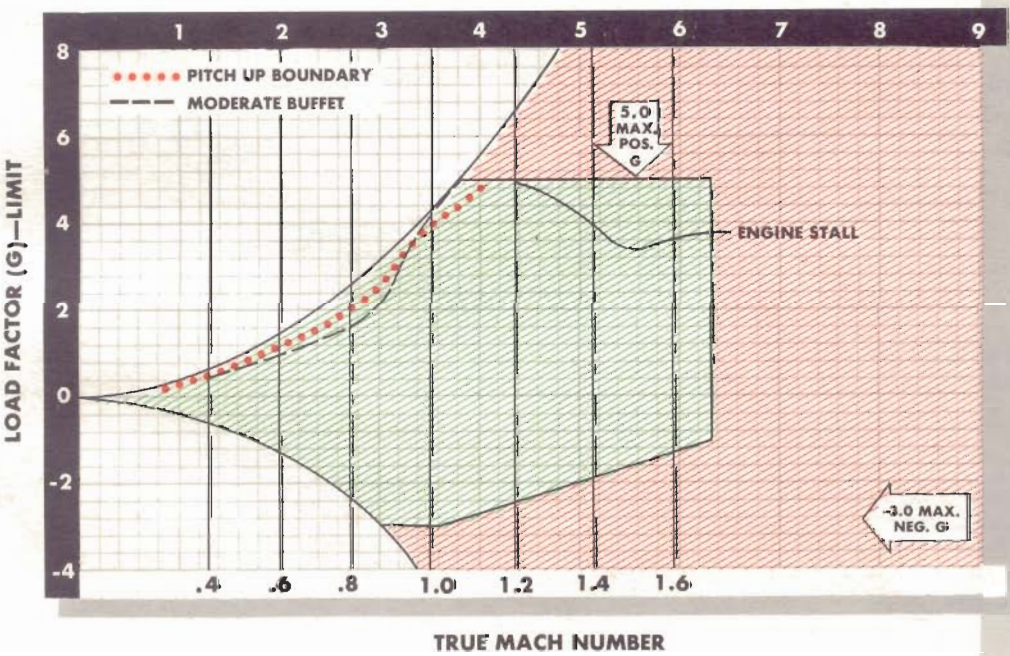
CLEAN CONFIGURATION

10,000 FEET



CALIBRATED AIRSPEED (CAS)—100 KNOTS

35,000 FEET



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RC

Figure 5-3

operating flight limits

SYMMETRICAL FLIGHT MANEUVERS

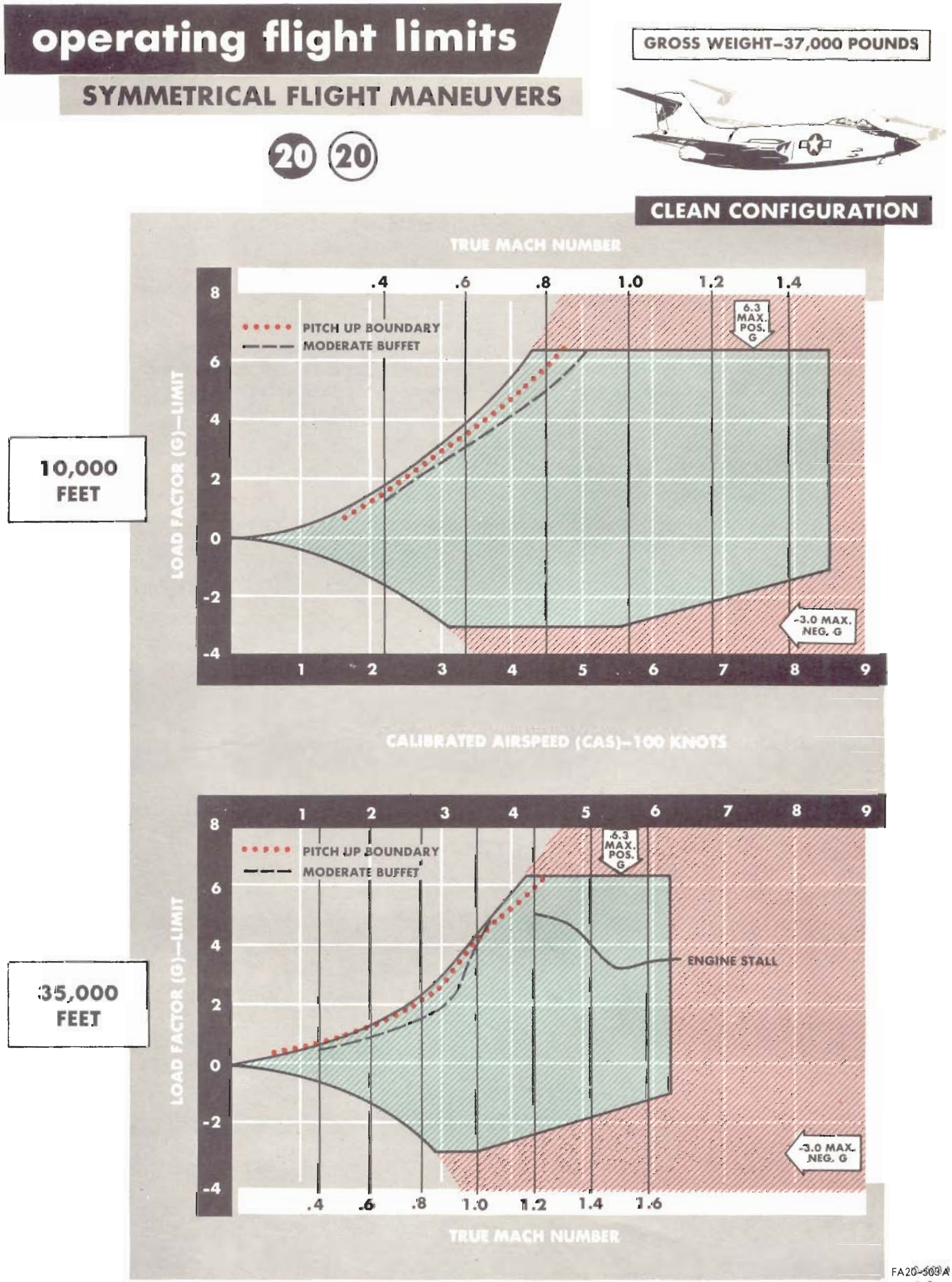


Figure 5-4

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. 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.

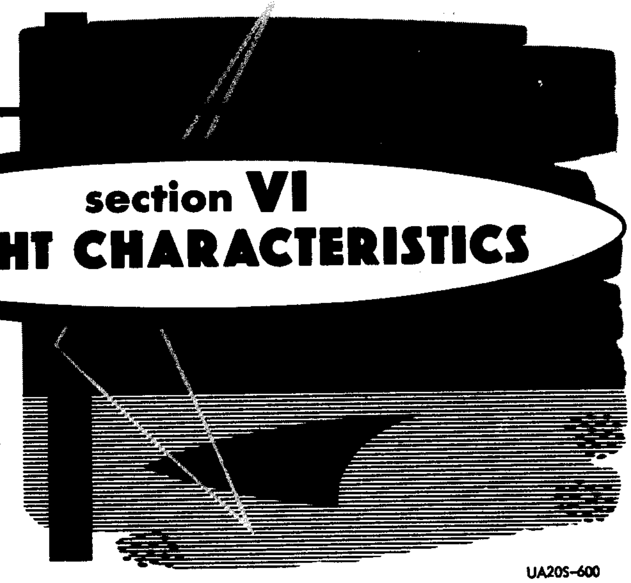
CAUTION

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 and an entry be made in Form 781.

REFUELING LIMITATIONS

Prior to the incorporation of T.O. 1F-101-898, the external tanks can be inflight refueled. After the incorporation of T.O. 1F-101-898, if the external tank pullout plugs are connected, the external tank fuel system will function normally. If the external tank pullout plugs are not connected, the external tanks cannot be inflight refueled. Mission Planning must be accomplished accordingly.

section VI FLIGHT CHARACTERISTICS



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The airplane has been designed with very thin swept wings. This clean design helps reduce drag and improves high speed flight handling characteristics. Conventional flaps are provided at the wing root area and provide excellent stability at landing speeds. Speed brake panels are an integral part of the aft fuselage, and may be extended outward almost perpendicular to the airframe; a mild nose-up trim change accompanies their extension. The speed brakes are very effective and may be extended at any speed. A drag chute contained in the extreme aft fuselage may be deployed to reduce landing roll. An irreversible hydraulic power control system makes possible a minimum pilot effort throughout all speed ranges. With this system, air loads imposed are not transmitted to the pilot; therefore, an artificial feel system provides the conventional control feeling.

MACH NUMBER

The term Mach number represents the relationship of any velocity to the speed of sound. Mach number is simply the percentage of the speed of sound, i.e., Mach 1.30 is 130% of the speed of sound. The use of Mach number eases the pilot's task of remembering a series of indicated airspeeds for various altitudes. Flight characteristics will vary only in intensity for the same Mach number at any altitude. By observation of figure 6-1 the relationship of altitude, indicated airspeed, and Mach number is readily seen. It is further evident that at lower altitudes, the higher the indicated airspeed for any given Mach number, thus the greater the intensity or effect on the airplane. At high altitudes the indicated airspeed is lower for a given Mach number and the intensity or effect on the airplane is less.

Note

The airspeed and Mach number indicator and the altimeter readings are effected at high Mach numbers (.90 and above). This error and necessary corrections are given in Appendix I.

STALLS

This airplane unlike older fighter designs does not stall in the conventional manner, that of a nose high attitude, shudder or tremble, and subsequent loss of control. It does assume a nose high attitude and if allowed to go through the buffet region will completely stall out, see figure 6-2. This is dangerous, since in this stall condition flight control is present and only a high sink rate with constant directional corrections indicates the stall. If the airplane is rotated further a pitch-up condition will develop. This condition is discussed further under longitudinal pitch-up. It is therefore, recommended that full stall conditions never be attempted or practiced, but that the recommended buffet warning be observed and immediate corrective action taken to resume normal flight.

STALLS WITH GEAR AND FLAPS DOWN

In the normal landing configuration a buffet occurs approximately 40 knots ahead of the stall. Midway through the buffet range the maximum intensity of the buffet is reached. Just prior to stall lateral instability is experienced in the form of a mild rolling oscillation. With an operating yaw damper this oscillation is difficult to detect, hence the minimum recommended airspeed is limited to the onset of initial buffet.

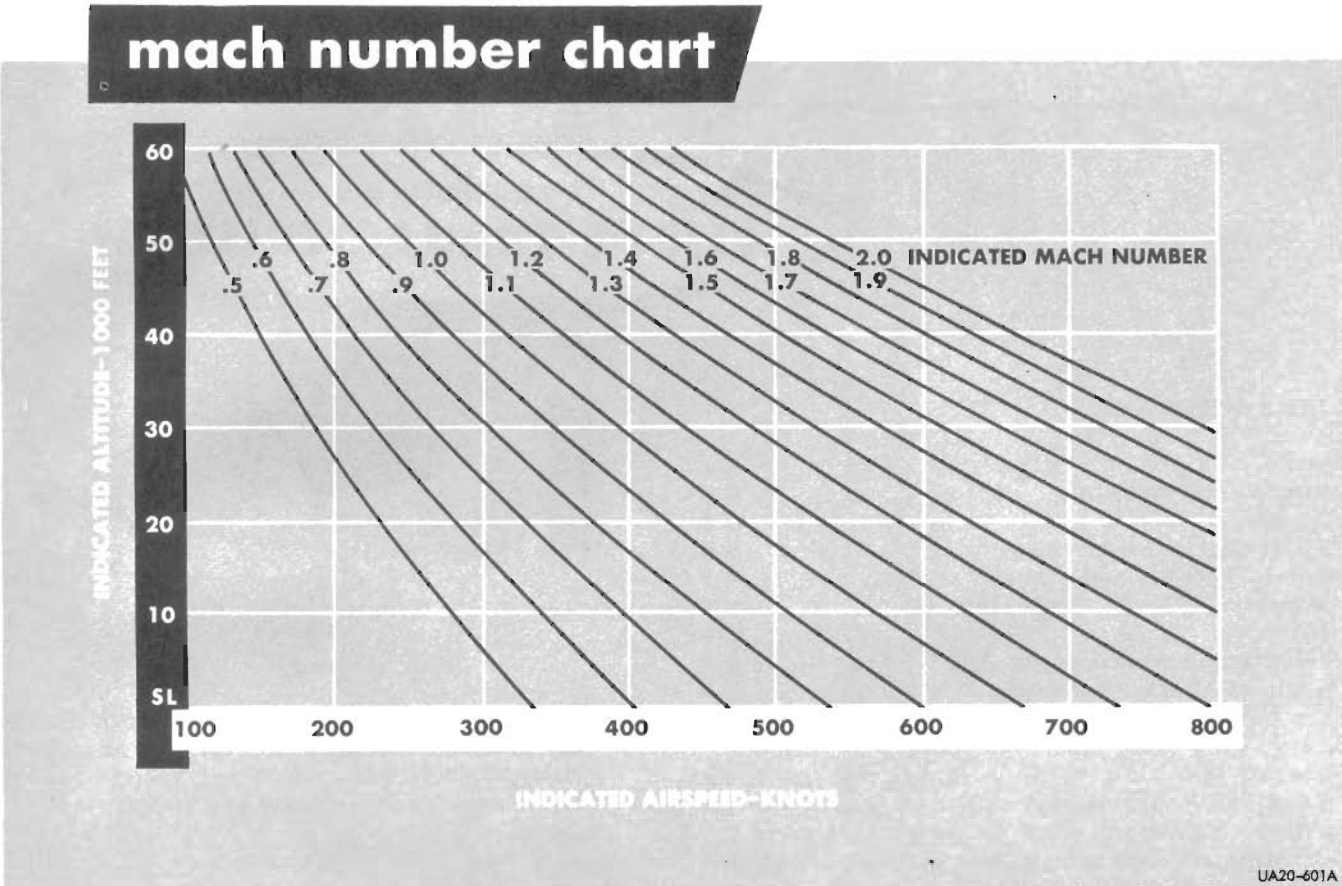


Figure 6-1

STALLS WITH GEAR DOWN AND FLAPS UP

The characteristics of this condition are essentially the same with the exception that initial buffet warning precedes the stall by approximately 60 knots.

STALLS WITH GEAR AND FLAPS UP

Characteristics of clean configuration stalls are similar to those already discussed. Since the stall condition is a prelude to pitch-up any intentional attempt to stall should be avoided.

ACCELERATED STALLS

In the Mach number region between .75 and .95, the lateral oscillation, observed in unaccelerated stall, is sharply defined by an increase in frequency resembling a rapid wing roll-off. This is easily detected, but since an overshoot (abrupt oscillation) could occur and subsequent pitch-up result, the initial buffet warning must be observed and normal flight resumed. During supersonic flight there is little to no buffet warning prior to pitch-up and restrictions to airspeed and "g" must be observed. Refer to Section V of this manual.

STALL RECOVERY

Stall recovery is accomplished by immediately releasing back pressure on the stick. A thrust increase should accompany this action until flying speed is regained. Some rudder control may be necessary to maintain directional control.

CAUTION

If landing gear or flaps are down, do not exceed gear and flaps down limit airspeeds as excessive air loads may damage the operating mechanisms.

LONGITUDINAL PITCH-UP

Note

Intentional pitch-ups are prohibited.

A pitch-up warning system is incorporated into the airplane to provide the pilot with adequate warnings (horn or pusher) of an impending pitch-up condition. However, if the warnings are ignored or the system is inoperative, longitudinal pitch-ups may be encountered at high angles of attack. The condition may occur at both subsonic and supersonic speeds. The pitch-up when encountered at subsonic speeds is in conjunction with moderate airframe buffet. Little or no buffet warning is present at supersonic speeds, see figure 5-3. When encountered during level flight, the pitch-up is characterized by a nose-up rotation without being induced by pilot effort, i.e., without increased aft stick force. If application of nose-down stabilizer is delayed, a fully developed pitch-up may occur in which the airplane will pitch to excessive angles of attack. During accelerated flight maneuvers, the characteristics remain similar to those of level flight. Pitch-up from an accelerated flight maneuver may exceed allowable "g" limits. The pitch-up condition may be experienced in the landing configuration when the airplane is allowed to get well below the recommended minimum approach speeds. Corrective action should be initiated at first warning (horn) of approaching pitch-up and the recommended minimum speeds in level flight must be observed at all times. Refer to figure 6-2.

stall speeds

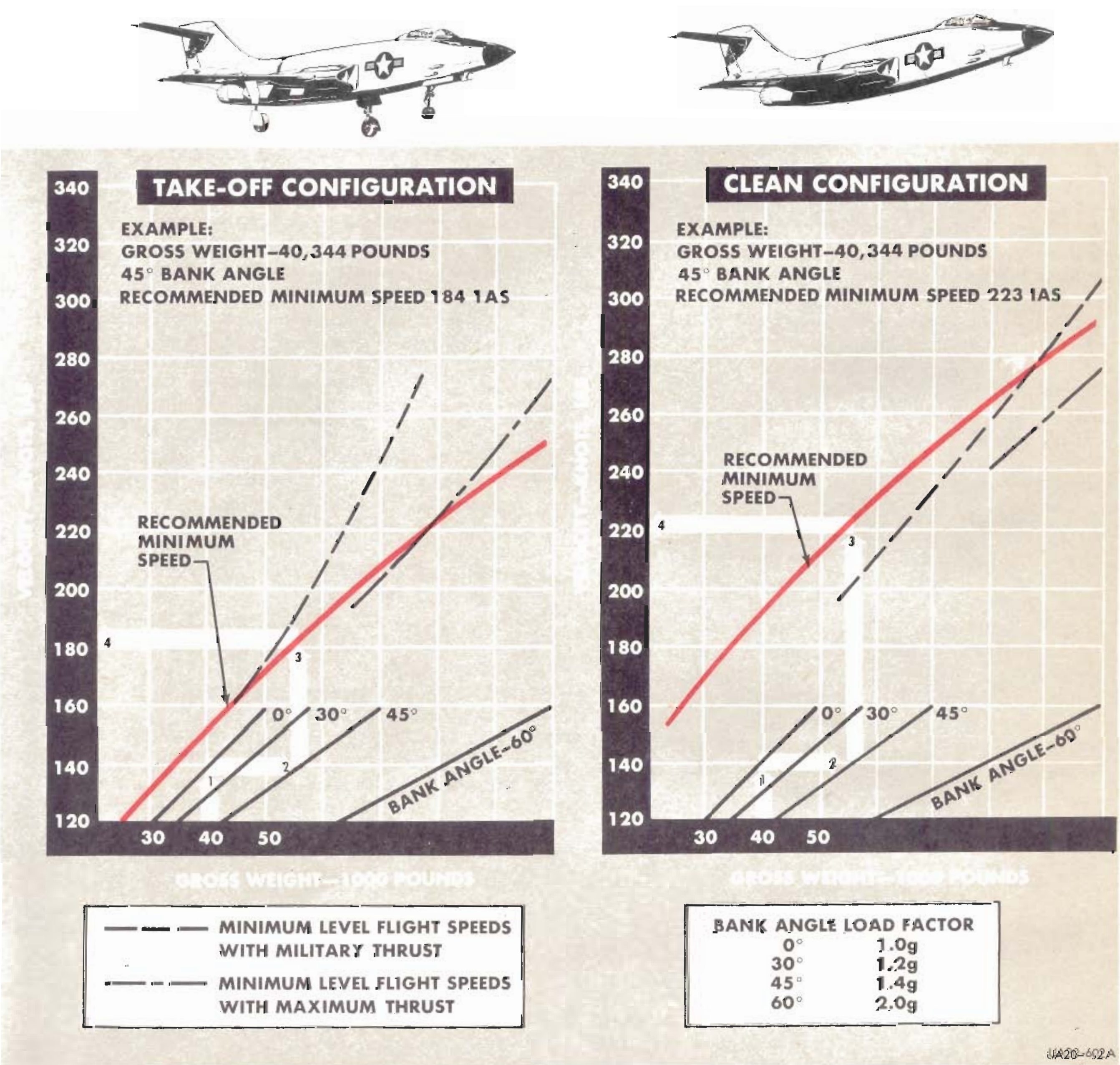


Figure 6-2

PITCH-UP WARNING SYSTEM BOUNDARIES

The speed and load factor at which the horn and pusher are actuated can be determined from the Pitch-Up Warning System Boundaries Chart, figure 6-3.

USE

To obtain the speed at which the horn and pusher are actuated while decelerating in level flight, enter the Airspeed Boundaries Chart at fuel remaining and proceed vertically to the horn or pusher reflector line. Proceed to the left edge and read IAS.

1. Fuel remaining - 5000 lbs.
2. Pusher reflector
3. Pusher is actuated at 168 knots IAS.
4. Horn reflector
5. Horn is actuated at 175 knots IAS.

To determine the load factor at which the horn and pusher are actuated, enter the Load Factor Boundaries Chart at fuel remaining and proceed vertically to the horn or pusher reflector for the indicated altitude and airspeed. Then proceed to the left edge and read the "g's" at which the horn or pusher will be actuated.

1. Fuel remaining - 5000 lbs.
2. IMN 1.20 at 40,000 feet.
3. Horn reflector
4. Horn is actuated at 4.3 "g's".
5. Pusher reflector
6. Pusher is actuated at 4.5 "g's".

PITCH-UP WARNING CHARACTERISTICS

This system provides horn and pusher warning, in that order, as the airplane approaches the pitch-up boundary. Refer to Pitch-Up and Warning System Boundaries, (figure 6-3). The actuation of the pitch-up warning system is directly dependent upon the rate of aft stick movement and the airplane angle of attack. Low angles of attack will allow greater rates of aft stick movement than high angles of attack. Except during fast stabilizer rate of travel, airframe buffet will always precede the horn as angle of attack is increased at subsonic speeds. At supersonic speeds no buffet precedes the horn or pusher.

WARNING

To avoid pitch-up maneuvers, a very slow pull-in rate should be used when approaching the pitch-up boundary as shown in figure 6-3.

Upon encountering the horn or pusher, immediate corrective action should be taken to reduce aft control stick force and/or angle of attack. With the gear or flaps extended, the system provides only horn warning on angle of attack and Mach scheduling. If the "pitch-up warning out" light illuminates during flight, the pilot can assume that electrical power failure has occurred within the system or that one of the Mach schedulers has malfunctioned. Illumination of the "pitch-up warning out" light when the pitch-up warning test button is depressed indicates that the probe signals are not comparable. If any of the above indications occur, the remainder of the flight should be performed as if the system were inoperative. Refer to Pitch-Up Warning Inoperative, this section. After landing, the pilot shall make the necessary notations in the Form 781.

PITCH-UP WARNING-INOPERATIVE

With the pitch-up warning system inoperative the following restrictions must be observed to prevent longitudinal pitch-up.

1. Below .9 indicated Mach number, do not exceed moderate buffet.
2. Above .9 indicated Mach number, do not exceed the following load factors:

300 Knots IAS - 2 g	400 Knots IAS - 4 g
350 Knots IAS - 3 g	450 Knots IAS - 5 g

Note

These load factors are based on 37,000 lbs. gross weight. Load factors may be adjusted in inverse proportion to gross weight.

CAUTION

Special emphasis should be placed on the speeds above .9 Mach number since contractor tests show no buffet warning prior to pitch-up at supersonic speeds.

PITCH-UP RECOVERY

WARNING

If a fully developed pitch-up occurs below 15,000 feet terrain clearance, EJECT, as the possibility of dive recovery is highly improbable. If pitch-up is encountered and the airplane is not under control by 15,000 feet terrain clearance, EJECT.

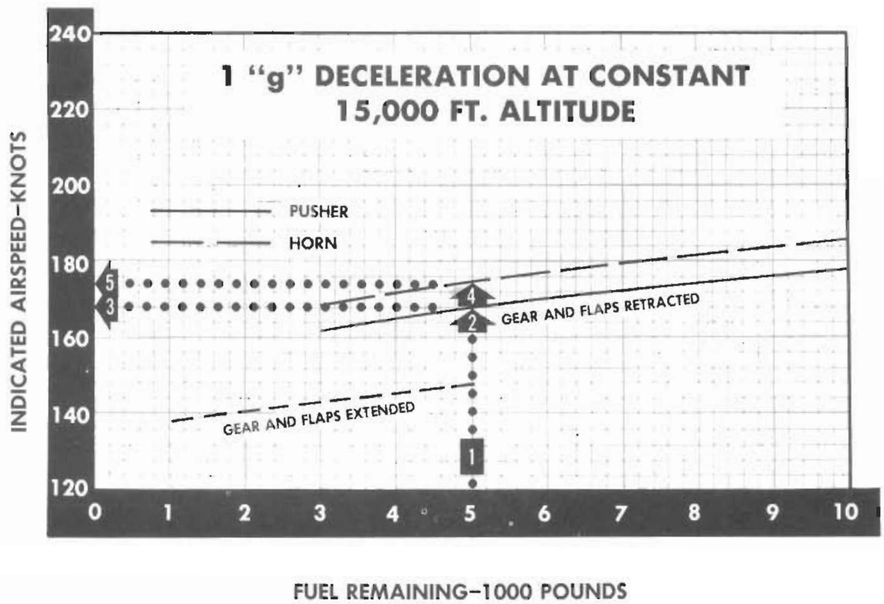
In the event pitch-up is inadvertently entered, and altitude permits, accomplish the following as soon as pitch-up tendency is recognized.

1. Apply full nose-down stabilizer.
2. Neutralize rudder.
3. Neutralize ailerons.
4. If pitch-up continues, deploy drag chute as soon as the peak of pitch-up is reached.

pitch-up warning system boundaries

BASIC GROSS WEIGHT -- 26,500 POUNDS

AIRSPEED BOUNDARIES



LOAD FACTOR BOUNDARIES

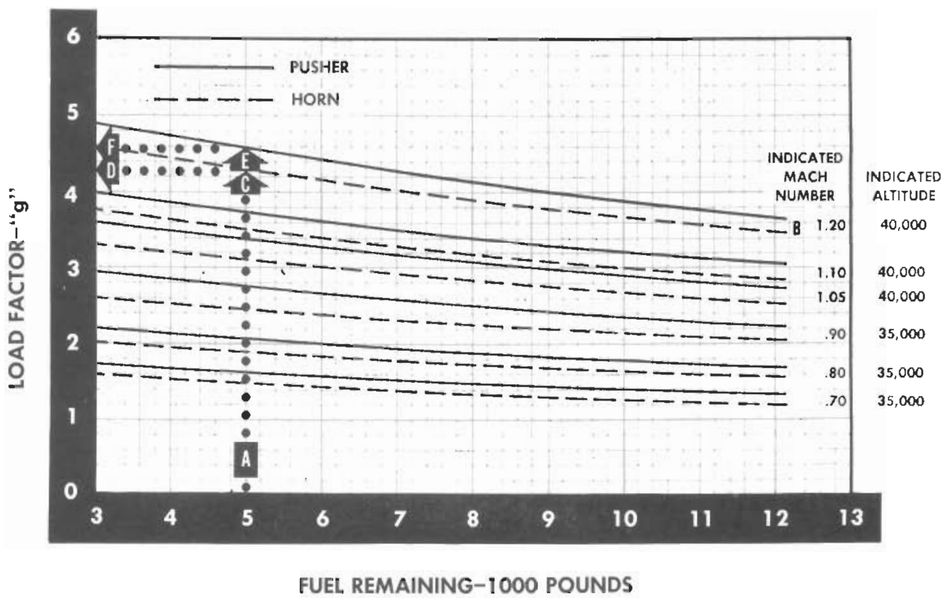


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Figure 6-3

Note

Speed at peak of pitch-up will be less than 150 knots IAS. Drag chute should not be deployed in excess of 200 knots IAS.

CAUTION

Afterburner blowout and subsequent torching-off of afterburner fuel can result in loss of drag chute. Therefore, if pitch-up occurs during afterburner operation, retard throttles out of afterburner detent until pitch-up recovery has been completed.

5. As soon as negative "g" is sensed, return control stick to neutral. Stabilizer position is critical during this phase of recovery, since sustained positive or negative "g" would probably result in re-entering pitch-up.

Note

The airplane feel system will tend to hold the stick full forward until angle of attack is broken, at which time it will tend to move the stick toward neutral as the airplane recovers.

The drag chute will break the pitch-up maneuver immediately and prevent the airplane from spinning. However, the airplane may perform a roll during recovery after the angle of attack has broken. The roll, if encountered, will be fairly rapid and will stop with no action required by the pilot. The airplane will be out of control during the pitch-up maneuver for approximately 4 to 8 seconds. After recovery, slowly roll wings level, while maintaining between 0 and plus 1 "g" to gain flying speed. During and after recovery, do not use rapid and large control stick movements which could produce excessive positive or negative load factors, since the airplane will be very close to stalling speed initially. No attempt should be made to pull out of the ensuing dive until 350 knots IAS has been obtained. The drag chute should not be jettisoned. As speed increases to 230-250 knots IAS, the drag chute will fail and break away from the airplane; this is not detrimental in any way. If the drag chute fails to deploy (see item (4) above), recovery action remains the same, however, an incipient spin may result. Refer to Spins, this section.

SPINS

Intentional spins are prohibited. It is virtually impossible to spin this airplane without first entering pitch-up. Therefore, if the procedures for pitch-up recovery are performed immediately upon recognition of pitch-up tendency, a spin will not result. However, should the drag chute fail to deploy during pitch-up recovery and recovery is not effected, the airplane will enter an incipient spin. This spin will be highly oscillatory in pitch, roll and yaw and will probably reverse direction frequently. Do not attempt to use controls to stop rotation; retain neutral rudder and ailerons and full nose-down stabilizer until negative "g" is sensed. As the airplane recovers to a flying condition, as evidenced by negative "g" condition, the stabilizer should be returned to neutral. During and after recovery, do not use rapid and large control stick movements which could produce excessive or sustained positive or negative load factors, since the airplane will be very close to stalling speed initially. Such action could result in re-entering pitch-up. No attempt should be made to pull out of the ensuing dive until 350 KIAS has been obtained. Recovery will probably be effected but will require considerable altitude loss and the maneuver may be violent with several directional reversals and/or snap rolls.

WARNING

- If recovery has not been accomplished by 15,000 feet terrain clearance, EJECT.
- It is possible, if recovery from an incipient spin is not effected after several turns, that the airplane will enter a steady state spin. This spin is recognized by its extremely flat attitude and rapid non-oscillatory rotation. Recovery from a steady state spin is highly improbable, therefore, EJECTION should be accomplished with at least 15,000 feet terrain clearance.

FLIGHT CONTROL EFFECTIVENESS

STABILIZER

A single piece controllable horizontal stabilizer provides highly responsive control effectiveness at both subsonic and supersonic speeds. The increased effectiveness is particularly noticeable at low altitudes and high indicated airspeeds, therefore you should exercise caution when flying under these conditions in order to prevent excessive "g" or unintentional overshoot resulting from overcontrolling.

CAUTION

Igniting the afterburners in flight and subsequent acceleration may cause inadvertent aft stick movement. This acceleration should be anticipated and by relaxing your grip on the stick avoid unnecessary stick movement.

AILERONS

The ailerons are hydraulically powered by tandem power cylinders and provide excellent lateral control. At high speeds, rapid or extreme aileron movement can impose twisting loads to the wing. Therefore they should be used with caution at high speed.

stick forces diagram

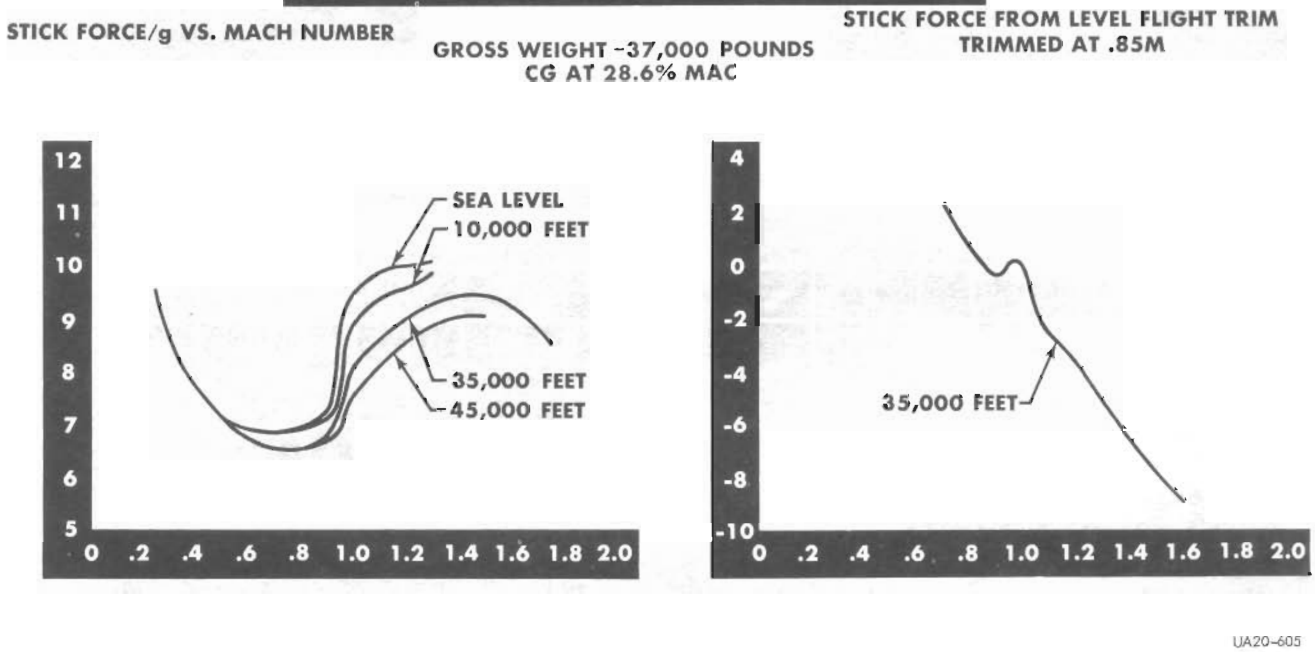


Figure 6-4

CAUTION

Some lateral overcontrol may occur between .7 and .9 Mach number below 10,000 feet due to the high roll rates and rolling accelerations available. Exercise care not to use abrupt lateral control motions in formation flight in this region.

RUDDER

Rudder control becomes effective at approximately 60 knots and remains effective throughout the entire speed range. There will be a pedal force gradient increase above 290 knots airspeed. This is the feel system switch-over as described in Section I of this manual. Inherent to swept wing design in the dihedral effect (roll due to yaw), the rudder is very effective in correcting this tendency. Rudder action will normally be performed by the yaw damper which is used throughout the speed range.

FLAPS

Wing flaps when used for approach and landing and in some instances in flight (air-refueling) improve the stability of the airplane. The flaps act as both lift and drag items and provide slower touchdown speeds and shorten the landing roll distances.

SPEED BRAKES

Two hydraulically extended panels on the empennage act as speed brakes. They are very effective and give rapid deceleration. A mild buffet will be noted when speed brakes are fully extended at high speeds. A mild-nose up trim change occurs with their extension. Speed brakes may be used to good advantage on final approach where airspeed and descent can be adjusted by partial to full extension, as required, without changing the thrust setting.

LEVEL FLIGHT CHARACTERISTICS

LOW SPEEDS

The recommended airspeeds for take-off, approach and landing and their relationship to gross weight, temperature, pressure altitude and wind effect contained in this manual are well above any dangerous flight attitude. Handling characteristics within the recommended speed ranges are excellent and control response positive. High angles of attack, usually associated with low speeds, can create undesirable rates of descent (sink). You should recognize any high rate of descent and correct it by adding thrust. Any attempt to pull back on the stick, further increasing angle of attack, can result in higher rates of descent. This attitude, further aggravated, may result in pitch-up. The recommended final approach airspeeds allow adjustments to your rate of descent well within safe operating flight speed ranges. You should arrive at touchdown with the proper touchdown speed. Should the speed be reached while "high" do not increase the angle of attack to keep within the intended landing area but hold this speed, landing "long" or go around and correct your final approach on the next attempt.

CRUISE SPEEDS

Under cruise conditions recommended in Appendix I, heading and attitude are easily maintained. Under high altitude and gross weight cruise conditions, a slight buffet may occur but creates no control problem. Precise lateral trimming and equalized engine thrusts are essential, otherwise counteracting roll due to out of trim condition can be fatiguing. A cruise relief autopilot is provided for extended range missions.

HIGH SPEEDS

This airplane is capable of very high speeds with the transition from transonic to supersonic speed being completely smooth. No adverse flight characteristics are evidenced at any speeds tested. The airplane is capable of maintaining supersonic speeds during maneuvering flight at constant altitudes. Stick forces will vary with airspeed; figure 6-4 shows this variance in pounds stick force (aft) with airspeed.

MANEUVERING FLIGHT CHARACTERISTICS

MANEUVERING LOADS

Maneuvering loads are incurred when the airplane is turned, roll, yawed, pulled out of dive or accelerated in some manner. It is the pilot's responsibility to prevent these loads from exceeding the imposed limits of the airplane. It should be noted that the accelerometer may mislead a pilot in that: (1) it reads only accelerations in the vertical axis and (2) by location in the cockpit it cannot detect empennage loads. An example will better illustrate the subject. If the airplane is yawed or skidded during flight, the accelerometer may still indicate only 1 "g". During the maneuver fairly large loads are being imposed on the verticai fin of the airplane. Actually these steady loads may not be excessive; however, during rapid application and/or rapid release of large control forces, very high loads can be imposed on the airframe.

DIVES

High Mach number dives are easily entered. A slow pushover entry into a shallow dive angle (less than 40°) will develop the highest obtainable Mach number. During pushover do not exceed the negative "g" limits of the airplane. Refer to figures 6-5, 6-6, 6-7 and 6-8 in this section for dive recovery data.

DIVE RECOVERY

Stick forces (stabilizer) for recovery will be within pilot capabilities. Because of the ease of control the pilot should use caution so as not to overcontrol or develop excessive "g" loads.

FLIGHT WITH EXTERNAL TANKS

Aircraft flight characteristics are essentially the same with the 450 gallons external tanks installed except for normal higher gross weight performance limitations.

ANGLE OF ATTACK RELATIONSHIP

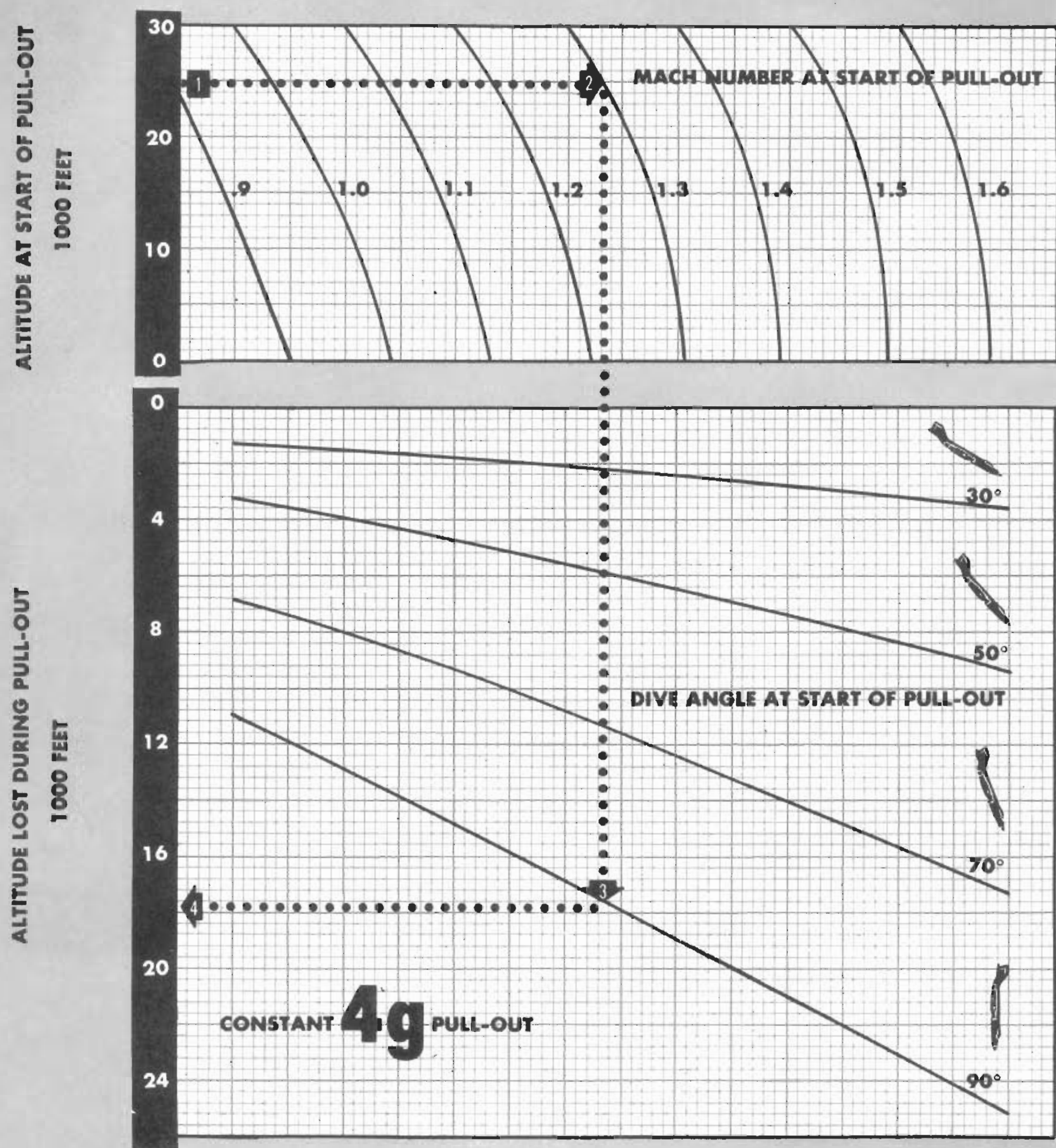
The fuselage angle of attack, or longitudinal leveling line, for any flight condition can be determined from figure 6-9. The line of sight for gunnery can be obtained by subtracting 61 mils (3.5 degrees) from the fuselage angle of attack. The mean gun bore line converges with the line of sight for gunnery, at 2250 ft. The wing angle of attack can be obtained by the addition of 17.45 mils (1 degree) to the fuselage angle of attack.

USE

To obtain Mach number corresponding to calibrated airspeed, enter plot I at CAS scale (A), proceed horizontally to intersect the altitude (B), and descend vertically to read Mach number (C). To obtain fuselage angle of attack, enter plot II at gross weight scale (D), proceed horizontally to intersect dive angle (E) or load factor, and descend vertically to altitude (F), on plot III. Proceed horizontally to Mach number (G) on plot IV and descend vertically to plot V, proceed parallel to the guide line, interpolating for Mach number as required, and read fuselage angle of attack with thrust effects for given thrust setting (H or J).

A. Calibrated Airspeed	300 Kts.
B. Altitude	30,000 Ft.
C. Mach Number	.80
D. Gross Weight	48,000 Lbs.
E. Dive Angle	30°
F. Altitude	30,000 Ft.
G. Mach Number	.80
H. Fuselage Angle (Thrust OFF)	84 Mils
J. Fuselage Angle (Max. Thrust)	79 Mils

dive recovery chart



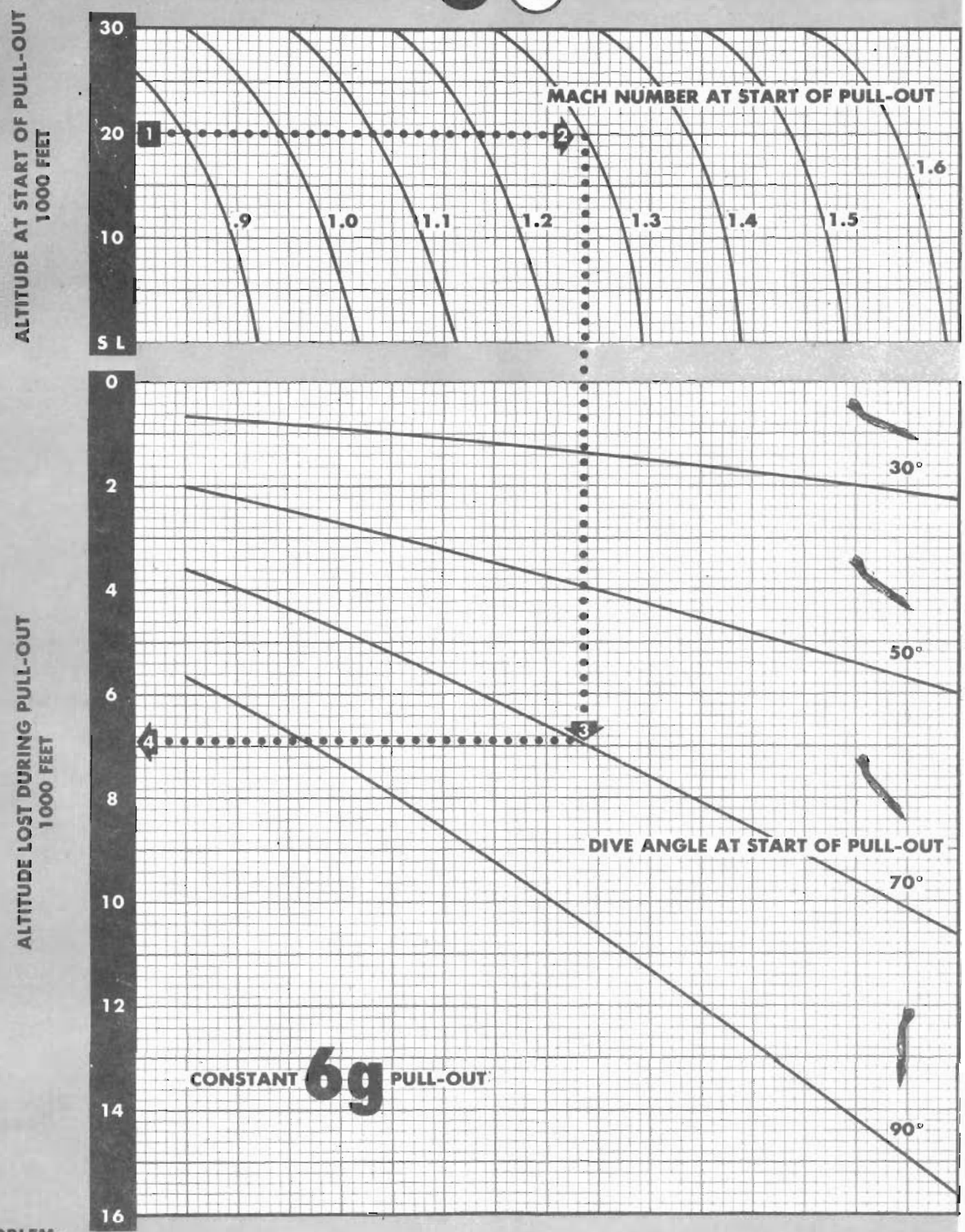
SAMPLE PROBLEM:

1. ENTER CHART AT ALTITUDE AT START OF PULL-OUT (25,000 FT)
2. FOLLOW ALTITUDE HORIZONTALLY TO MACH NO. AT START OF PULL-OUT (1.3)
3. SIGHT VERTICALLY DOWN TO DIVE ANGLE AT START OF PULL-OUT (90°)
4. SIGHT BACK HORIZONTALLY TO READ ALTITUDE LOST DURING CONSTANT 4g PULL-OUT (17,800 FT)

UA20-606

Figure 6-5

dive recovery chart



SAMPLE PROBLEM:

1. ENTER CHART AT ALTITUDE AT START OF PULL-OUT (20,000 FEET)
2. FOLLOW ALTITUDE HORIZONTALLY TO MACH NUMBER AT START OF PULL-OUT (1.3)
3. SIGHT VERTICALLY DOWN TO DIVE ANGLE AT START OF PULL-OUT (70°)
4. SIGHT BACK HORIZONTALLY TO READ ALTITUDE LOST DURING CONSTANT 6g PULL-OUT (6950 FT)

UA20-607A

Figure 6-6

angle of attack relationship

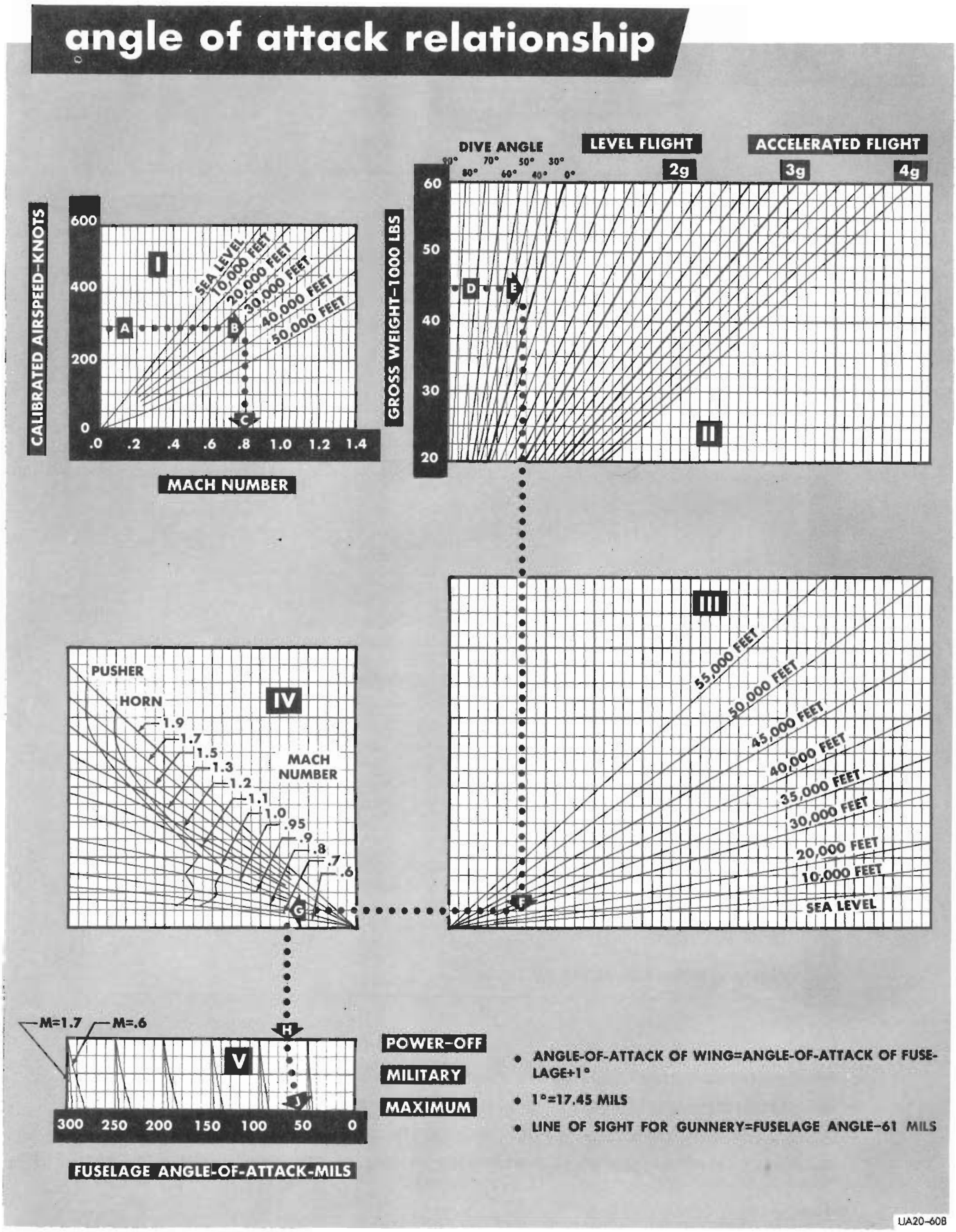
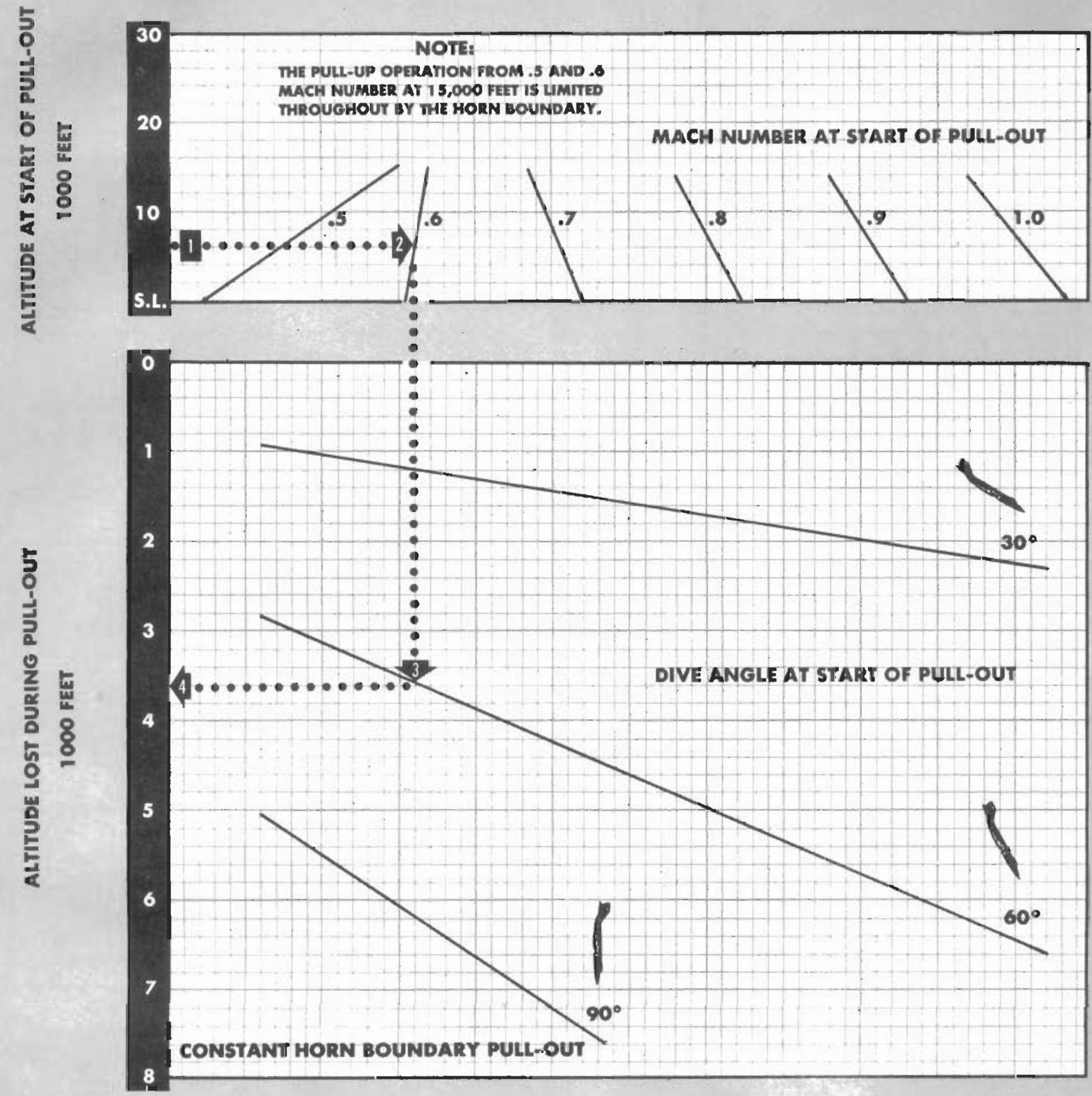


Figure 6-7

dive recovery chart

LOW ALTITUDE



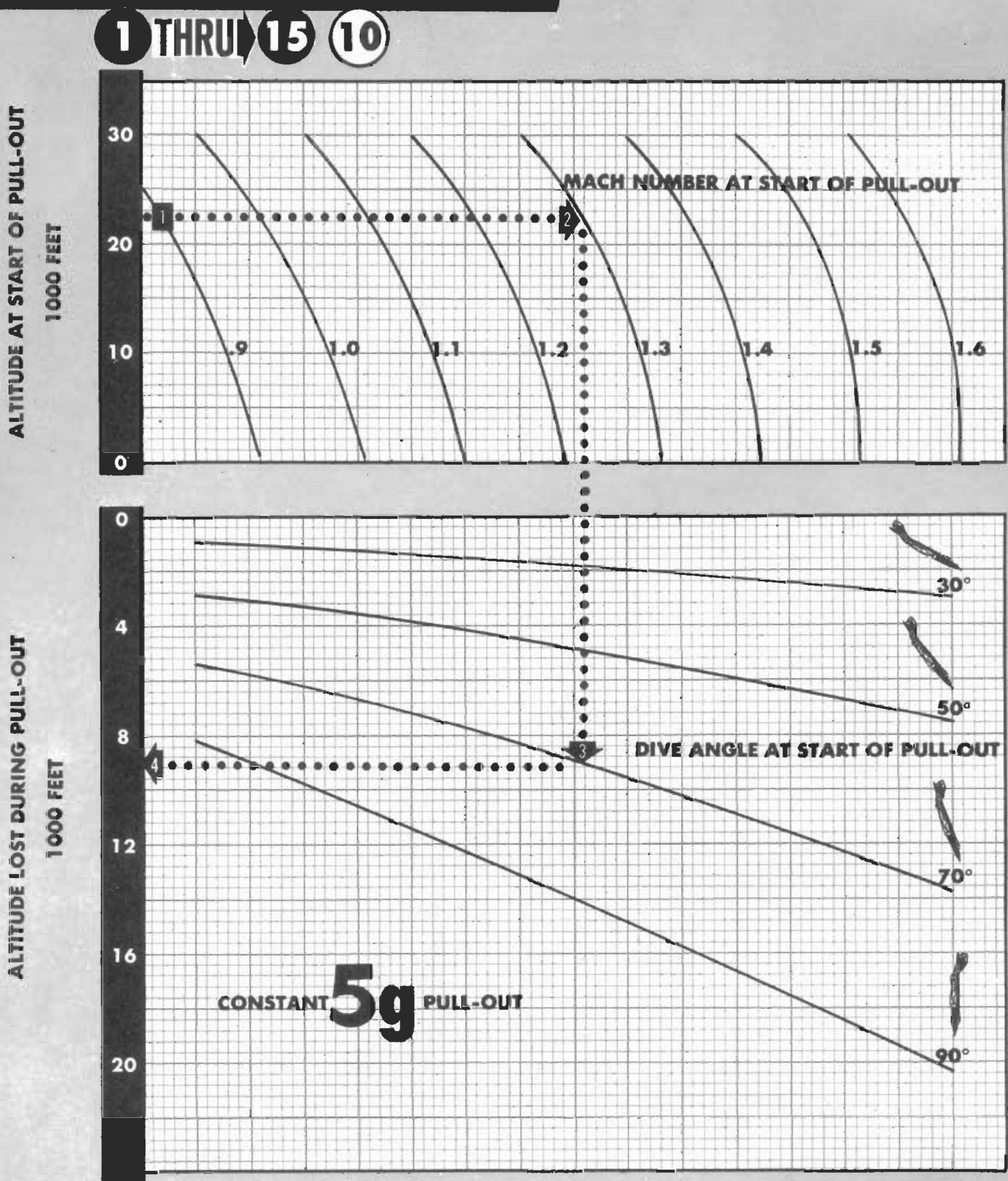
SAMPLE PROBLEM:

1. ENTER CHART AT ALTITUDE AT START OF PULL-OUT (6,000 FT)
2. FOLLOW ALTITUDE HORIZONTALLY TO MACH NO. AT START OF PULL-OUT (.6)
3. SIGHT VERTICALLY DOWN TO DIVE ANGLE AT START OF PULL-OUT (60°)
4. SIGHT BACK HORIZONTALLY TO READ ALTITUDE LOST DURING CONSTANT HORN BOUNDARY PULL-OUT (3,600 FT)

UA20-609

Figure 6-8

dive recovery chart

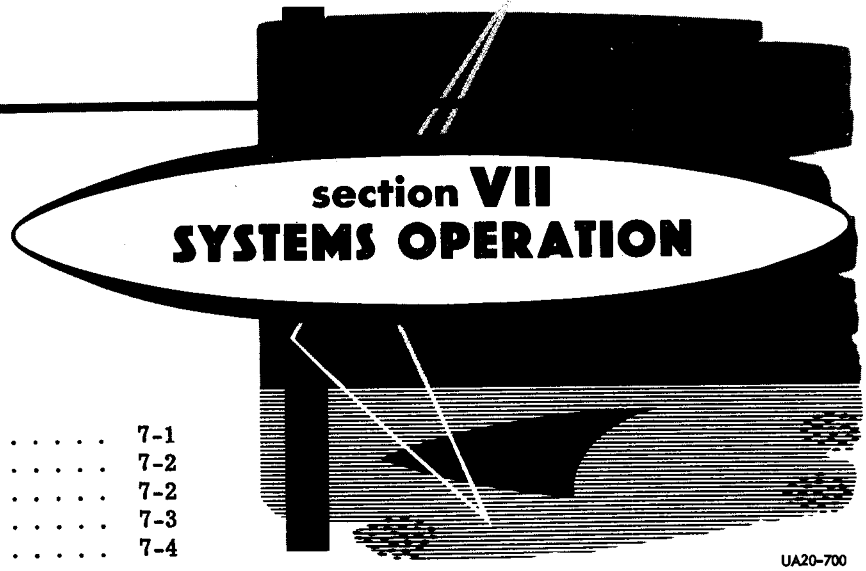


SAMPLE PROBLEM:

1. ENTER CHART AT ALTITUDE AT START OF PULL-OUT (22,500 FT)
2. FOLLOW ALTITUDE HORIZONTALLY TO MACH NO. AT START OF PULL-OUT (1.3)
3. SIGHT VERTICALLY DOWN TO DIVE ANGLE AT START OF PULL-OUT (70°)
4. SIGHT BACK HORIZONTALLY TO READ ALTITUDE LOST DURING CONSTANT 5g PULL-OUT (9225 FT)

UA20-610

Figure 6-9



section VII SYSTEMS OPERATION

UA20-700

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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 governor 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 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 desired rpm. In 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 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. If compressor stall occurs during climb with no throttle movement, reducing rate of climb and increasing airspeed may alleviate the stall.

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 airplane slightly. Refer to Engine Air Start in Section III.

ENGINE NOISE AND ROUGHNESS

In-flight engine noises and roughness may occur especially when 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 thrust 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 - OFF
4. Move start switch momentarily to START.
5. Allow engine to crank for approximately 20 seconds, then move start switch to STOP START.
6. If smoke continues, use fire extinguishing equipment.

SONIC BOOM

This airplane 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 airplane as its speed 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 airplanes. 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 airplane 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 airplanes or approaching airplanes, within one mile of personnel and installations on the ground, or over residential areas.

FUEL SYSTEM MANAGEMENT

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 external tanks to the fuselage cells at any time, except during take-off, depending on the mission requirements. When transferring fuel from the external 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 external tanks are empty. However, under conditions of high fuel consumption, such as afterburning at low altitude, transfer flow from the 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 terminate transfer operation whenever the feed tank low level light illuminates.

Note

Place the fuel pumps switch to ALL PUMPS to insure transfer pump operation whenever the feed tank low level light illuminates.

Using the fuel transfer switch, proceed as follows:

1. During taxi, take-off and climb to altitude - NORM
2. When cruise altitude is reached (with external tanks installed) - AUX FUEL
3. When external tanks are empty - NORM

FUEL CELL MONITORING

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 No. 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 No. 2.

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.

WHEEL BRAKE OPERATION

The brakes are conventionally operated by toe action on the rudder pedals. This action meters utility hydraulic pressure to force the brake disks together. Since the brake valves are spring-loaded metering type valves, hydraulic pressure cannot be felt at the pedals. The resulting characteristic is a soft, full travel brake pedal with slightly increasing pedal force as the brake valve holdback spring is compressed. This characteristic is conducive to inadvertently "riding" the brakes during taxi operation and locking the wheels during the landing roll. Obviously, the soft pedal characteristic should be cautiously considered during the above mentioned phase of operation. Additional techniques that should be used to minimize brake wear are: full utilization of nose gear steering while taxiing and maximum aerodynamic braking during the landing roll. After incorporation of T.O. 1F-101-620, airplanes 54-150 (10) and 54-1438 (20), 54-1441 (20), 54-1442 (20) are equipped with anti-skid brakes. The anti-skid system automatically relieves brake pressure as the skid point is reached and maintains skid control cycling of the brakes as long as skid conditions prevail. For normal landing with the anti-skid system, a single smooth application of the brakes with constantly increasing pedal pressure is most desirable. The pedal force should be increased gradually as the airplane decelerates. If the anti-skid system starts cycling, indicating maximum braking, the pedal force should be reduced.

Note

Cycling of the anti-skid system can be detected by the change in longitudinal deceleration as braking action is released and reapplied by the anti-skid control valve.

In the event the anti-skid system is inoperative, not installed, or the emergency brake system has been activated, it will be possible to lock the wheels. 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. This produces a rapidly decreasing coefficient of friction between the skidding tire and the runway while the coefficient of friction between the other tire and the runway remains near optimum for braking effectiveness. It is, therefore, apparent that a wheel once locked will never free itself until brake pressure to that wheel is reduced sufficiently to permit the wheel to rotate. It has been found that 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. For all conditions, normal and emergency, the most desirable braking technique is a single, smooth application of the brakes with a constantly increasing pedal pressure (to just below the skid point) as the airplane decelerates.

CAUTION

Do not pump the brakes at any time since this action will only reduce the amount of constant pressure available at the brakes and will tend to store heat energy within the brake assembly.

If it is suspected that the brakes have been used excessively, and are in a heated condition, the airplane should not be taxied into a crowded parking area. Peak temperatures occur in the wheel brake assembly from 5 to 15 minutes after maximum braking and is further transferred to the tire. To prevent brake fire and possible tire 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.

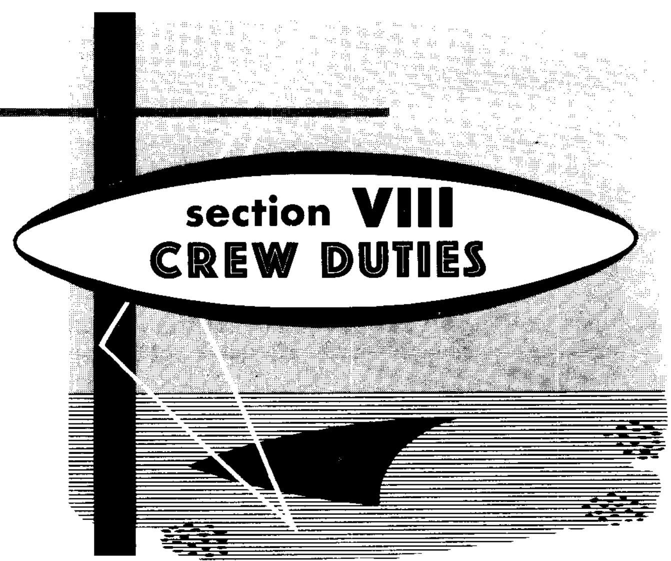
MAIN GEAR TIRES

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 to 47,000 pounds	4
47,001 to 48,500 pounds	6
48,501 to 51,000 pounds	12

A total of 36 points will be allowed for each tire. Upon reaching 36 points, the tires will be replaced. In no case will a take-off be executed which will make the total number of points exceed 36. Tires and tubes should be removed from the airplane, tagged unserviceable, and turned into salvage whenever a refused or (aborted) take-off mission is made at a speed in excess of 140 knots with a corresponding weight of 46,000 pounds or greater.

NOT APPLICABLE



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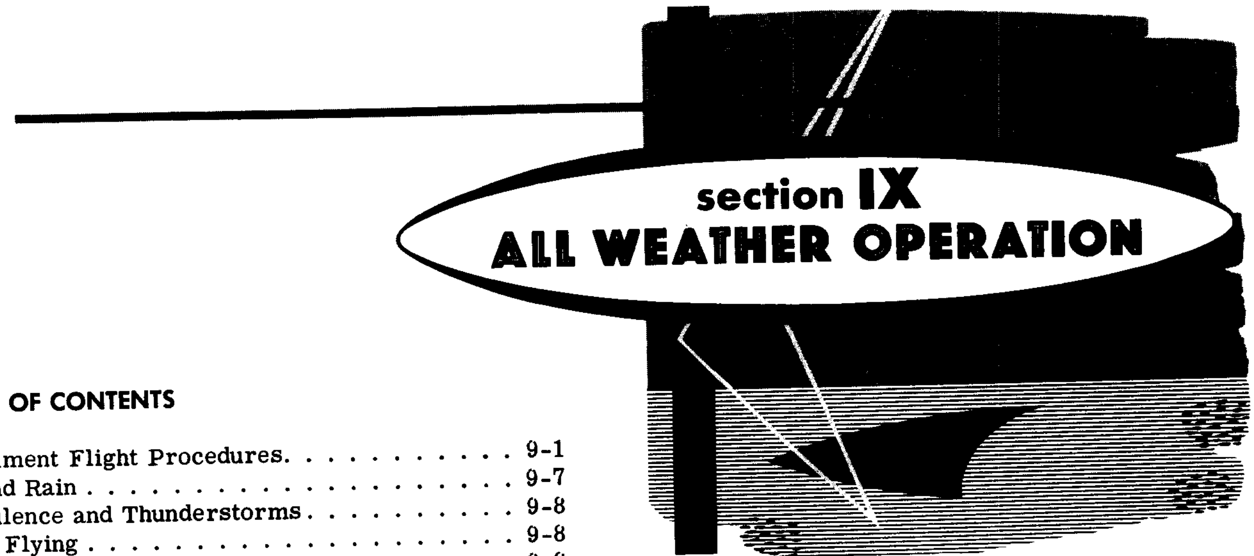

section IX ALL WEATHER OPERATION

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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 airplane 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 airplane's rapid acceleration, lateral control sensitivity and buffet regions. These modifications do not restrict the airplane's 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 is installed to facilitate positive identification of the airplane 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.

INSTRUMENT TAKE-OFF

If possible, instrument take-offs at normal take-off weight 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 airplane is definitely airborne. Use of Maximum thrust considerably shortens the take-off run.

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 run, reduce acceleration and increase the possibility of blowing out a tire.

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 airplane will fly off at take-off speed.
   Hold a +5° attitude indication and wait until the altimeter and vertical velocity indicator shows 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 airplane 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 airplane may settle back onto the runway and/or all lateral control could be lost.

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 70 knots. Do not use the brakes to maintain heading. Doing so will lengthen the take-off run, reduce acceleration and increase the possibility of blowing out a tire.
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 airplane will fly off at take-off speed.
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
h. Wing flap lever - RETRACT
   Raise flaps immediately after gear is fully retracted.

WARNING

Do not raise the flaps at airspeeds below 200 knots. The airplane 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.

i. 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.
- Longitudinal trim changes are negligible during take-off. Before trimming laterally, equalize engine thrusts and permit the flaps to retract fully.

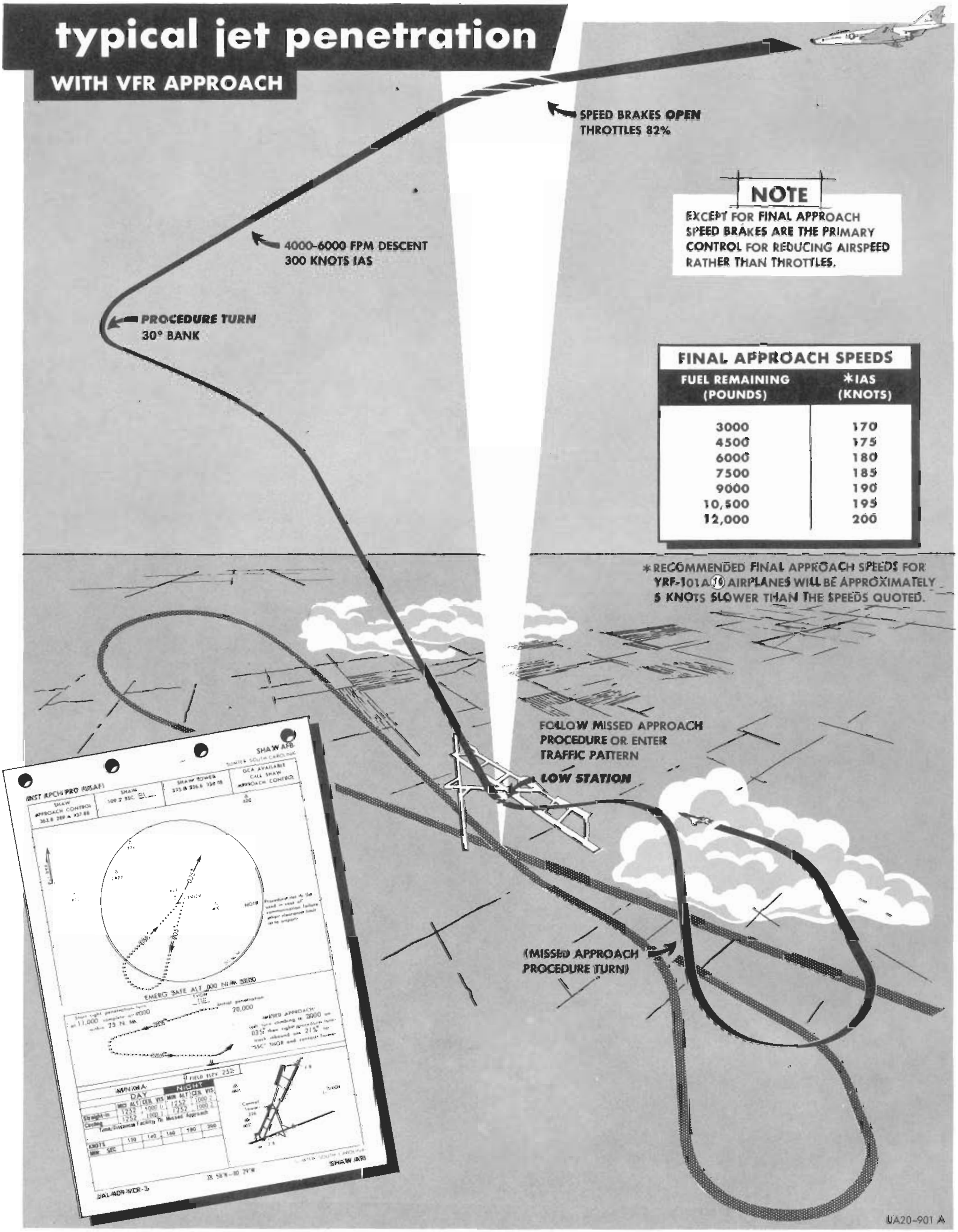
j. Cross check the vertical velocity indicator to make certain that the rate of climb is increasing steadily.
k. Continue climbing straight ahead. Make no turns before reaching 250 knots IAS. Limit low altitude maneuvering to 30° maximum bank angle and 350 knots maximum IAS.

INSTRUMENT CLIMB

The optimum VFR Military thrust climb schedule is suitable for instrument flight. However, the steep attitude and high rates of climb require thinking well ahead of the airplane. 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

typical jet penetration

WITH VFR APPROACH



NOTE

EXCEPT FOR FINAL APPROACH SPEED BRAKES ARE THE PRIMARY CONTROL FOR REDUCING AIRSPEED RATHER THAN THROTTLES.

FINAL APPROACH SPEEDS

FUEL REMAINING (POUNDS)	*IAS (KNOTS)
3000	170
4500	175
6000	180
7500	185
9000	190
10,500	195
12,000	200

*RECOMMENDED FINAL APPROACH SPEEDS FOR YRF-101A(10) AIRPLANES WILL BE APPROXIMATELY 5 KNOTS SLOWER THAN THE SPEEDS QUOTED.

Figure 9-1

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 airplane for "hands off" flight. Use the thrust settings for recommended optimum cruise schedule. Precise lateral trimming and equalized engine thrusts are essential due to the sensitive lateral control. When the airplane is in level flight at cruising airspeed, readjust the miniature airplane on the attitude indicator to indicate level flight attitude. The airplane 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 airplane 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 airplane 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.

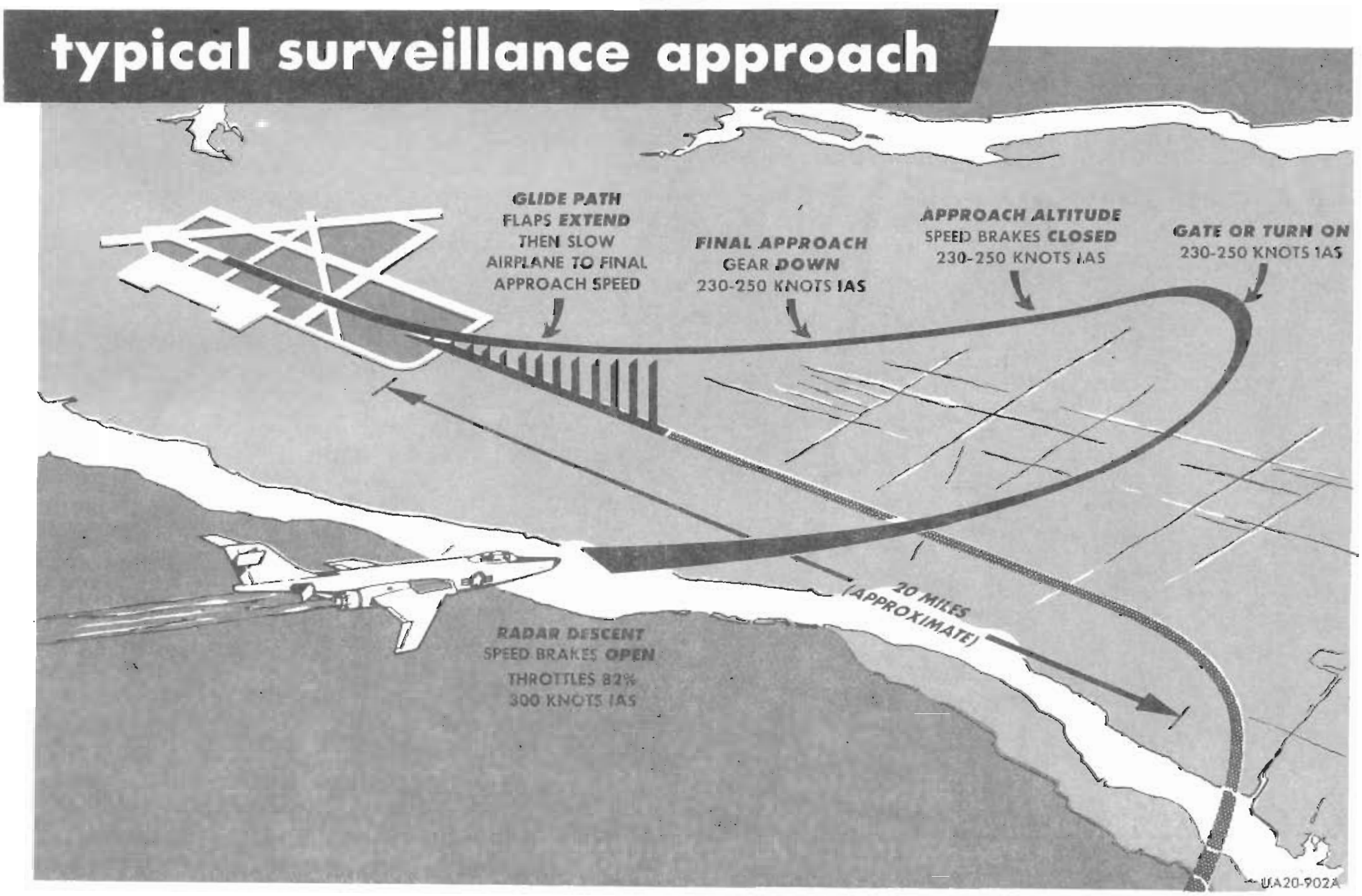


Figure 9-2

HOLDING AND STACKING

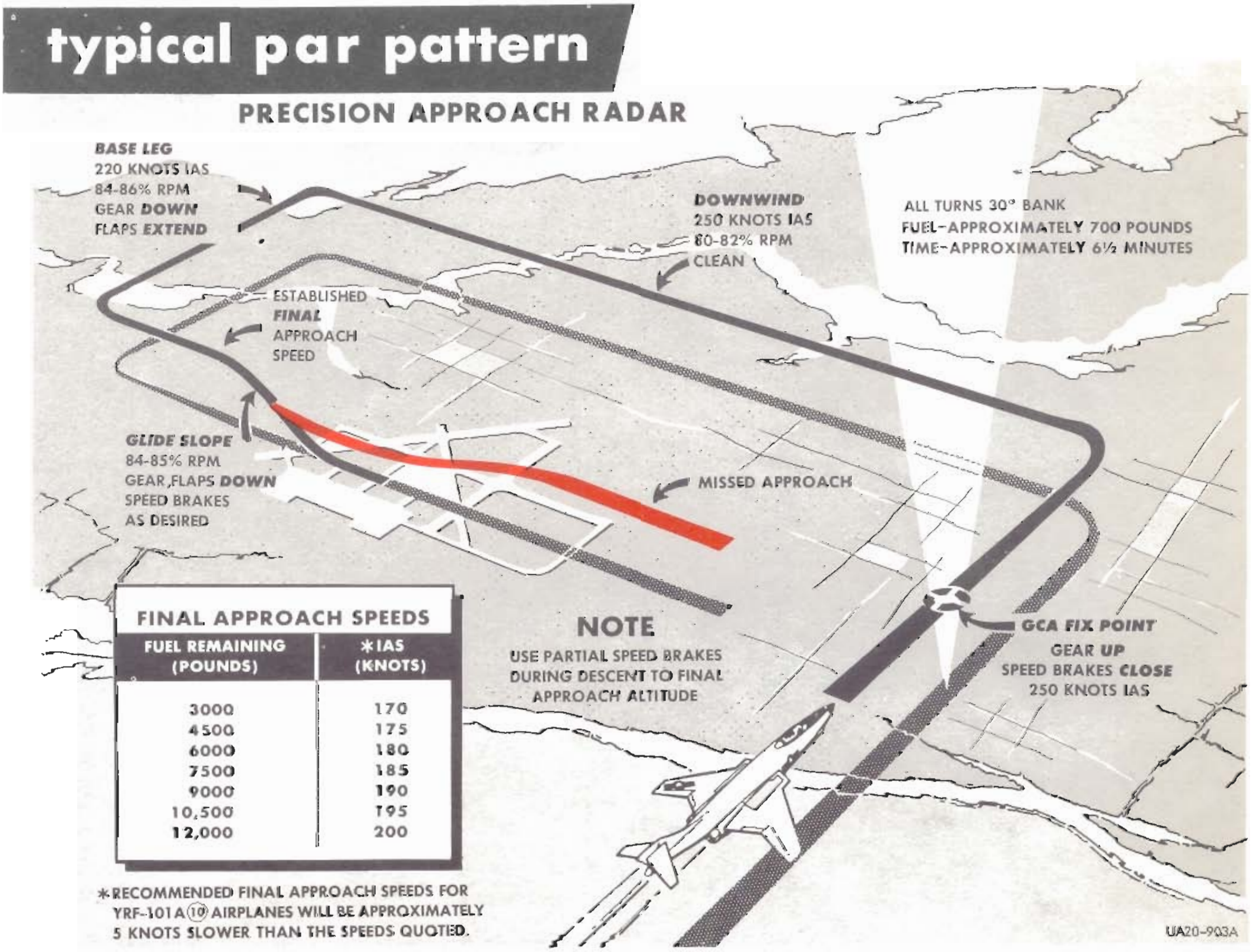
Holding patterns should be flown at 280 knots with the thrust settings shown below. Maximum endurance airspeeds are too low for comfortable handling in turns and when turbulence is present. Increase the thrust setting 1 to 2% rpm before entering the turn in order to maintain airspeed. Single needle width turns (1 1/2° per second) are recommended.

Altitude	RPM	IAS	Fuel Flow
20,000	82-84%	280	3900 lbs./hr.
30,000	84-86%	280	3600 lbs./hr.
40,000	90-92%	280	4700 lbs./hr.

Whenever possible, fly holding patterns between 20,000 and 30,000 feet. Formations can be maintained readily at these altitudes and airplane 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 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 thrust as necessary.

INSTRUMENT APPROACHES

The airplane is equipped to make either VOR, radar and GCA approaches. In the RF-101A (20) airplanes, after incorporation of T.O. 1F-101-662, the AN/ARN-21 TACAN navigational radio may be installed in place of the AN/ARN-14D navigational radio. When flown with recommended thrust 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%) thrust adjustment will then hold the desired speed. Do not keep the speed brakes extended continuously on any



FINAL APPROACH SPEEDS

FUEL REMAINING (POUNDS)	*IAS (KNOTS)
3000	170
4500	175
6000	180
7500	185
9000	190
10,500	195
12,000	200

*RECOMMENDED FINAL APPROACH SPEEDS FOR YRF-101A (10) AIRPLANES WILL BE APPROXIMATELY 5 KNOTS SLOWER THAN THE SPEEDS QUOTED.

Figure 9-3

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 figure 9-2.

WARNING

Until corrective measures have been accomplished on those airplanes equipped with TACAN the possibility exists of erroneous indications on the course indicator during ILS approaches with TACAN equipment turned on. Refer to Emergency Operation of ILS, Section IV, for applicable procedures.

Note

After the incorporation of T.O. 1F-101-832, a separate power source is provided for the ILS to prevent ambiguous TACAN indications on the course indicator in the event of an AN/ARN-31 power loss during an ILS approach.

CAUTION

Do not use the AN/APN-22 radar altimeter for landing under instrument conditions.

MISSED APPROACH OR GO-AROUND

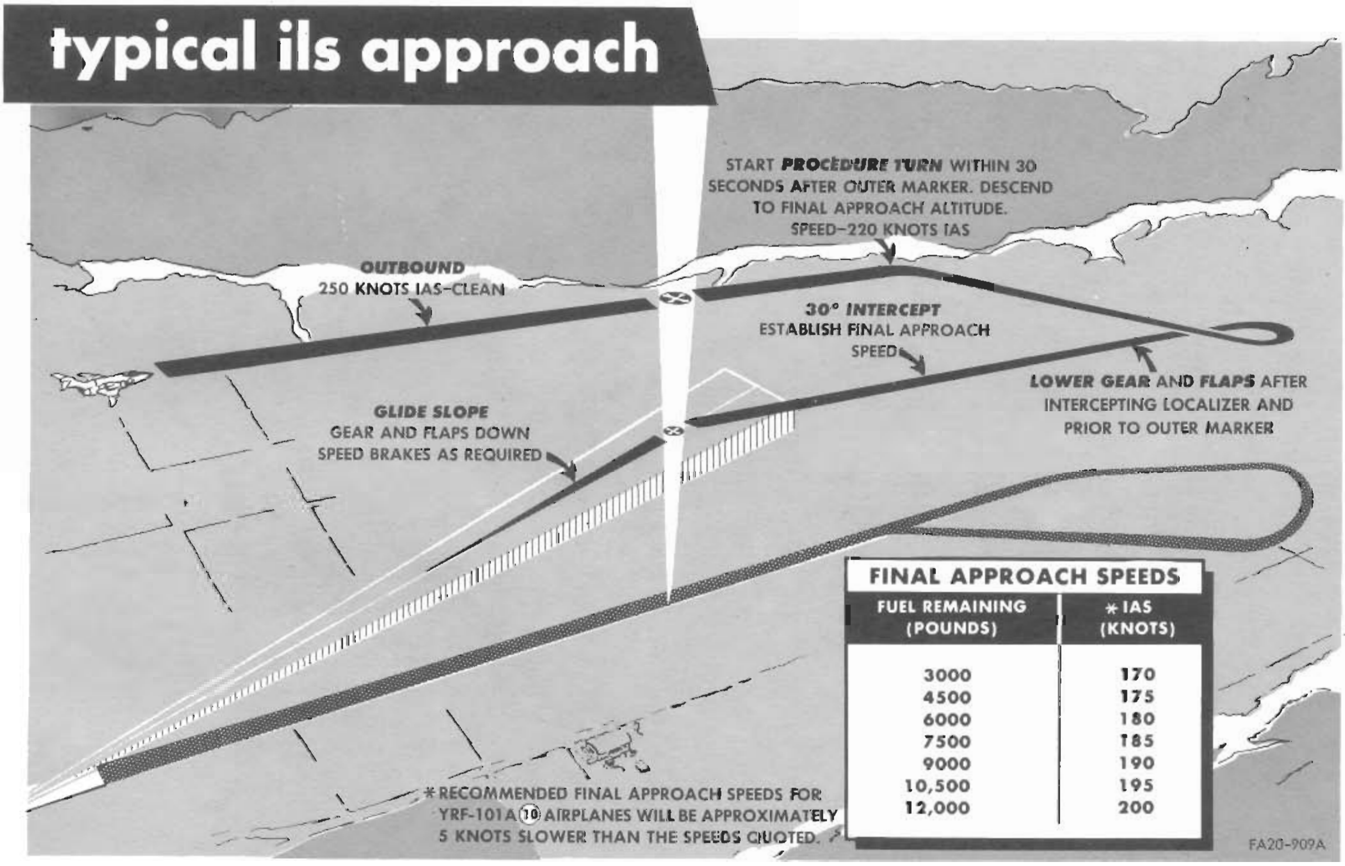
As soon as it is determined that a go-around is necessary, apply Military thrust and level off momentarily, staying below the gear down limit speed. Raise the gear as soon as climb has been established and raise the flaps at 200 knots. Climb to the missed approach altitude at an airspeed of 250-300 knots, reducing thrust 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 airplane does not overshoot the missed approach altitude. The required thrust setting will vary, depending on the airplane 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 airplane 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, as gross weights up to normal take-off weight, if the recommended approach speed, as shown on the appropriate diagram, is followed.

typical ils approach



FINAL APPROACH SPEEDS

FUEL REMAINING (POUNDS)	*IAS (KNOTS)
3000	170
4500	175
6000	180
7500	185
9000	190
10,500	195
12,000	200

Figure 9-4

SINGLE ENGINE APPROACH

In addition to the techniques noted under Instrument Approaches, observe the following precautions: Make no large thrust reductions at any time and never reduce thrust 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 airplane cannot maintain altitude at any approach airspeed without afterburner.

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 3000 lbs. fuel remaining. 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 250-300 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.

ice and rain

The possibility of engine and/or airframe icing is always present when the airplane 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 airplane'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 when 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, since 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 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.

turbulence and thunderstorms

Intentional flight through thunderstorms is not recommended. This type of flight requires considerable instrument experience and may result in structural damage to the airplane. 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. The following factors, singly or in combination have caused engine flameouts:

a. Penetration of cumulus build-ups with associated high liquid content.
b. Engine inlet duct icing.
c. Turbulence associated with penetration can result in angles of attack of plus 9 degrees or more causing marginal engine performance.
d. Above 40,000 feet, the surge margin of the engine is reduced and there is poor air distribution across the face of the compressor.

CAUTION

- Flight through moderate or heavy turbulence is not recommended when the yaw damper is inoperative because excessive "g" loads may cause the airplane to be overstressed.
- Flight through turbulence may increase inlet distortion. At higher altitudes this distortion can result in engine surge and possible flameout. However, normal air starts may be accomplished as outlined in Section III, Emergency Procedures.

APPROACHING THE STORM

300-350 KNOTS

recommended penetration airspeed

UA20-9SIA

Prepare the airplane before entering turbulent air. Adjust thrust as necessary to obtain a safe penetration airspeed of 300-350 knots.

night flying

No special procedures or precautions are required for flying this airplane at night. Interior and exterior lighting is adequate for all night flying conditions.

Note

On (10) and (20) airplanes, 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 filter is in the "A" position.

cold weather procedures

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 temperatures 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 airplane surface.

WARNING

Failure to remove snow and ice while the airplane 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.

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 airplane to prevent damage in case the airplane 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 is adequate.

WARNING

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

Note

Radar waves can penetrate the surface of snow and ice fields, therefore, when radar altimeter equipment is used for measuring terrain clearance over ice or snow, greater terrain clearance may be indicated than actually exists.

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 thrust to idle during flare.

CAUTION

Do not reduce thrust to idle before flaring as the rapid loss of airspeed may cause the airplane 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 airplanes 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.

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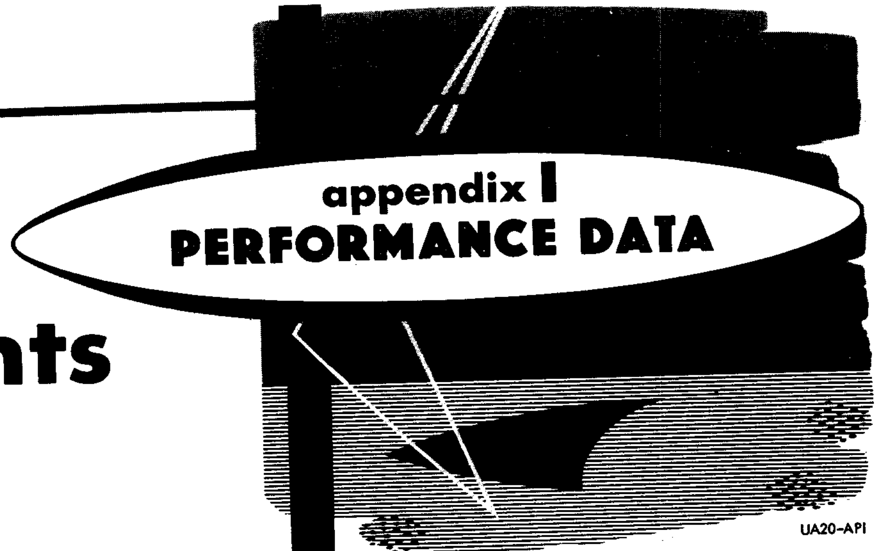


UA20-API

UA20-APTC

introduction part 1

TABLE OF CONTENTS

Charts

Flight performance data, in chart form, is provided for preflight and in-flight planning. The data presented on these charts encompasses the complete weight, speed, and altitude range of the aircraft within the scope of coverage. Data included in Appendix I are: Part 1 - Airspeed, altitude, and temperature corrections; Part 2 - Take-Off distance and airspeed; Part 3 - Climb fuel, time, and distance; Part 4 - Range (nautical miles per pound of fuel); Part 5 - Endurance for maximum, military, and maximum continuous thrust settings; Part 6 - Air refueling data compatible with several tankers; Part 7 - Descent fuel, rate, speed, time, and distance; Part 8 - Landing speed and distance; Part 9 - Mission planning information on the use of take-off and landing data cards and the MB-8 flight computer. Data basis (flight test or estimated), airplane configuration, chase-around guide, and pertinent remarks are included on each chart. All data presented is based on J57-P-13 engines using JP-4 fuel on an ICIO standard day. In some instances, temperature corrections for non-standard atmosphere have been included.

Note

The Mach numbers quoted throughout this appendix are True Mach numbers unless otherwise indicated.

AIRSPEED CONVERSION

An airspeed conversion chart (figure A1-1) is provided to correct calibrated airspeed (CAS) to true airspeed (TAS), and true Mach number (M).

AIRSPEED POSITION ERROR CORRECTION

These charts (figures A1-2 and A1-3) are provided to obtain calibrated airspeed (CAS) from indicated airspeed (IAS) and true Mach number from indicated Mach number. Two airplane configurations are given.

Indicated Airspeed

Indicated airspeed (IAS) is read directly from the airspeed indicator.

Calibrated Airspeed

Calibrated airspeed (CAS) is indicated airspeed corrected for position error. To obtain calibrated airspeed, add correction shown in figure A1-2 or A1-3 to indicated airspeed.

Equivalent Airspeed

Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility effect. To obtain equivalent airspeed, subtract correction shown in figure A1-4 from calibrated airspeed.

True Airspeed

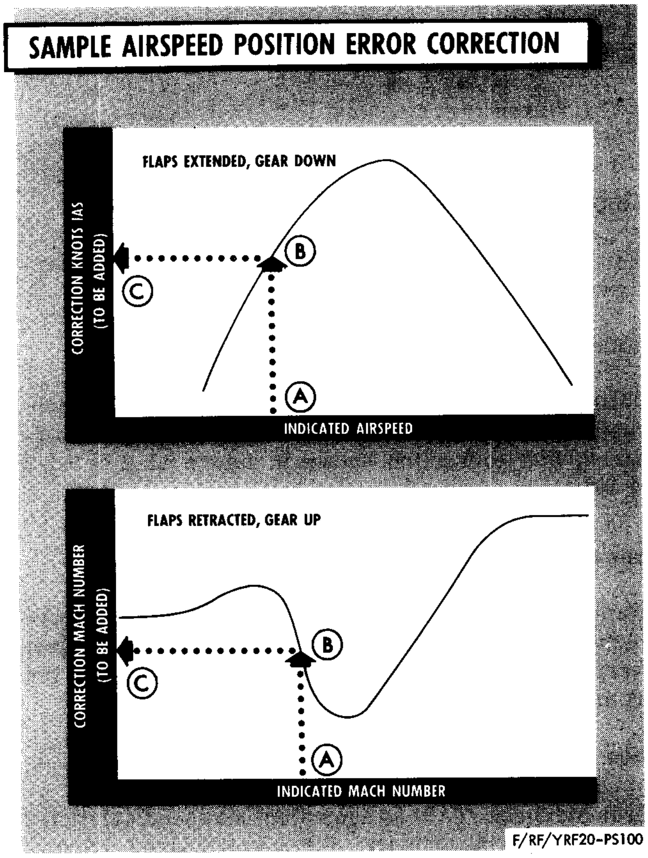
True airspeed (TAS) is equivalent airspeed corrected for atmospheric density. Refer to Airspeed Conversion, figure A1-1.

MACH NUMBER CORRECTION

Since most speeds in this section are quoted in terms of true Mach number, a correction chart is provided. Add correction shown in figures A1-2 or A1-3, to indicated Mach number (as seen on the indicator) to obtain true Mach number.

USE

For purpose of explaining the use of the Airspeed Position Error Correction Chart, consider a (20) airplane flying at an indicated airspeed (IAS) of 170 knots, flaps extended and gear down. Read up the 170 knot line to where it intersects the correction curve and from this point draw a straight line to the left margin of the chart to find the correction factor, which is +2 knots. Therefore, the CAS is 172 knots. For Mach number correction, consider the same airplane flying at an indicated Mach number of 1.1 Mach, flaps and gear up. Read up the 1.1 (indicated Mach number) line to where it intersects the correction curve, and from this point draw a straight line to the left margin of the chart to find the correction factor, which is +.03 Mach. Therefore, the true Mach number is 1.13 Mach.



SAMPLE PROBLEM

A. Indicated Airspeed	170 Knots
B. Reflector Line	
C. Correction	+2 Knots
D. Calibrated Airspeed (A. + C.)	172 Knots

A. Indicated Mach Number	1.1
B. Reflector Line	
C. Correction	+.03
D. True Mach Number (A. + C.)	1.13

COMPRESSIBILITY CORRECTION

Calibrated airspeed (CAS) may be corrected for compressibility by using the chart presented in figure A1-4. Subtract correction from calibrated airspeed to obtain equivalent airspeed (EAS).

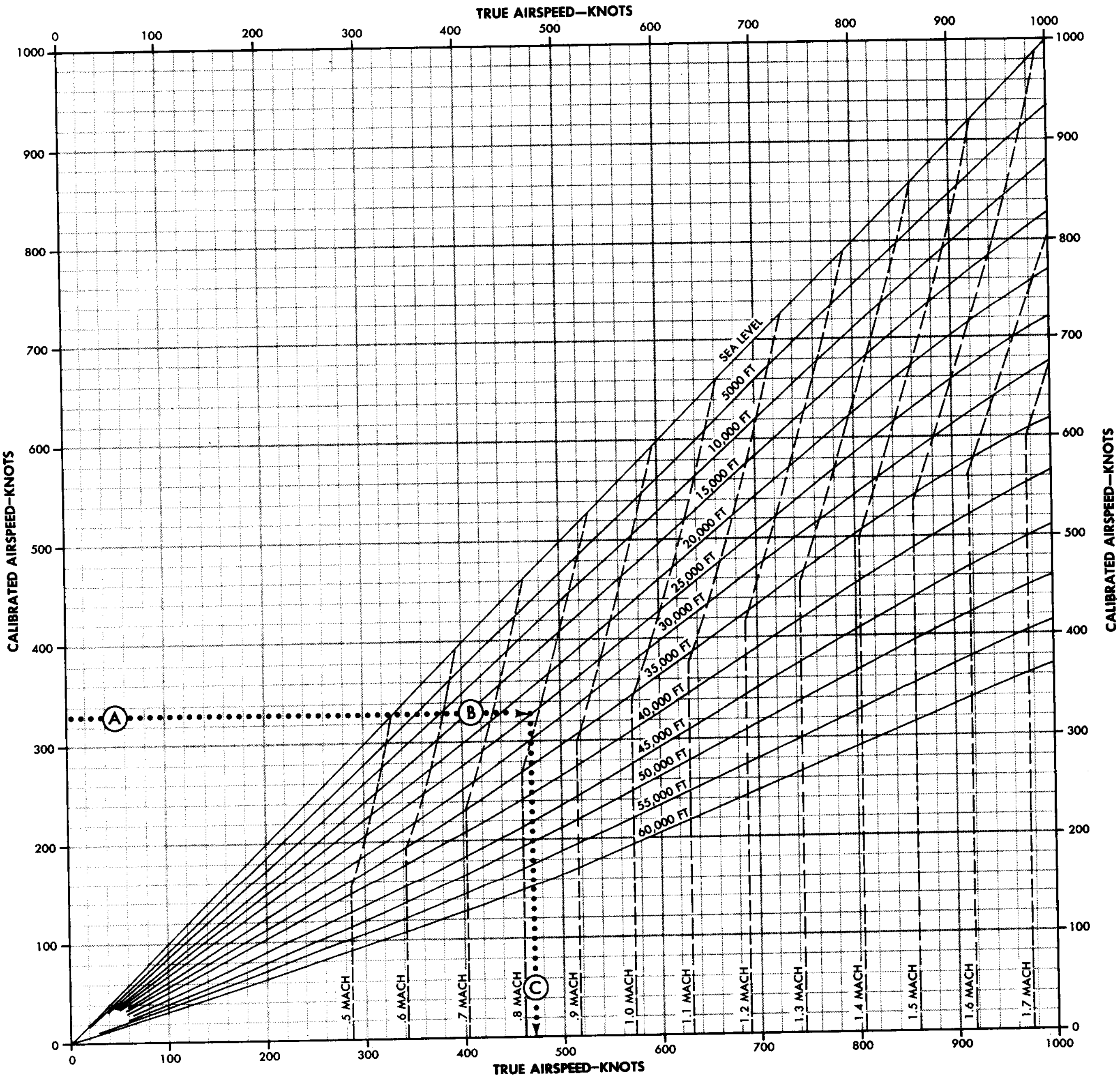
ALTIMETER POSITION ERROR CORRECTION

These charts (figures A1-5 and A1-6) are provided to give altimeter error corrections for given Mach numbers at various altitudes. A sample problem is included on the chart.

ENGINE THRUST CHECK CURVE (PRESSURE RATIO)

This chart (figure A1-7) is provided to give maximum and minimum acceptable limits of engine pressure ratio for the existing ambient temperature. Separate plots for right and left engine are included.

AIRSPEED CONVERSION



USE OF CHART

ENTER WITH CAS "A". MOVE HORIZONTALLY TO ALTITUDE "B" TO FIND TRUE MACH NUMBER. DROP VERTICALLY TO FIND TAS "C". TAS VALUES FROM THE GRAPH ARE CORRECT ONLY ON ICAO STANDARD DAY. OTHERWISE, TAS VALUES TEND TO BE CONSERVATIVE WHEN TRUE. FREE AIR TEMPERATURE IS GREATER THAN STANDARD AND HIGHER WHEN TRUE FREE AIR TEMPERATURE IS LOWER THAN STANDARD.

EXAMPLE

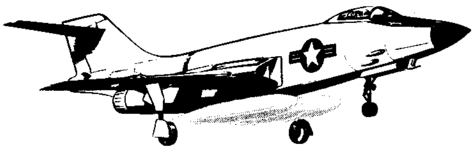
A=330 KNOTS CAS
B=.78 TRUE MACH NUMBER AT 25,000 FEET
C=470 KNOTS TAS

F/RF/YRF20-P100A

Figure A1-1

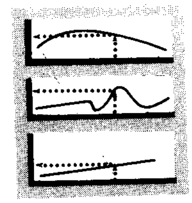
AIRSPEED POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION
F-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



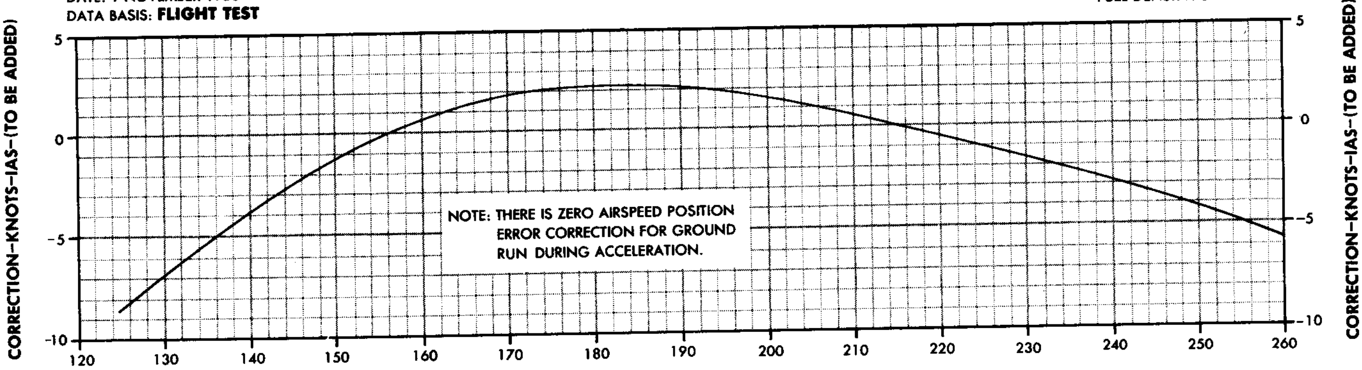
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE

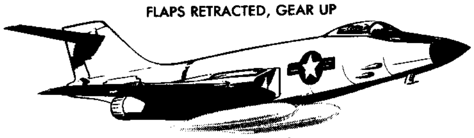


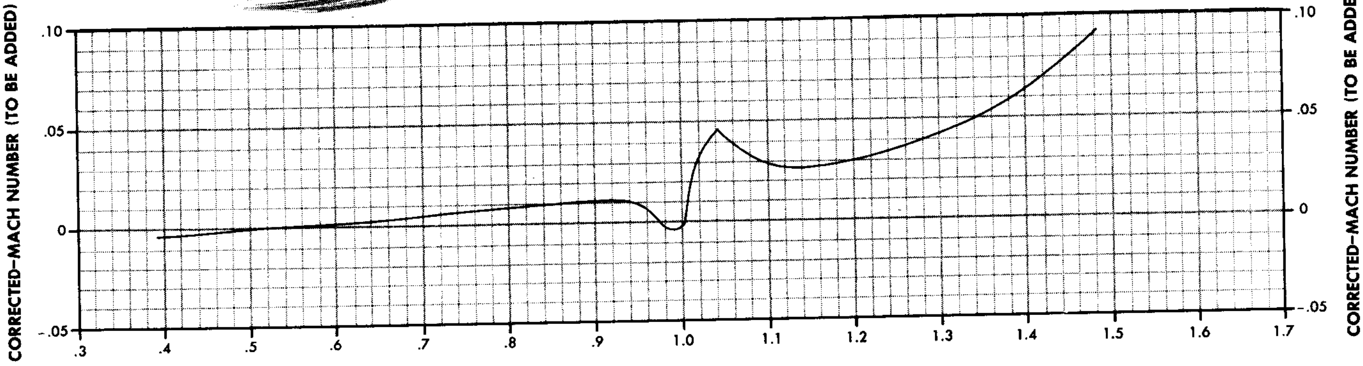
DATE: 1 NOVEMBER 1958
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL.

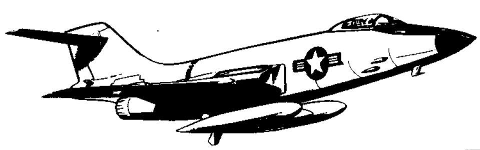


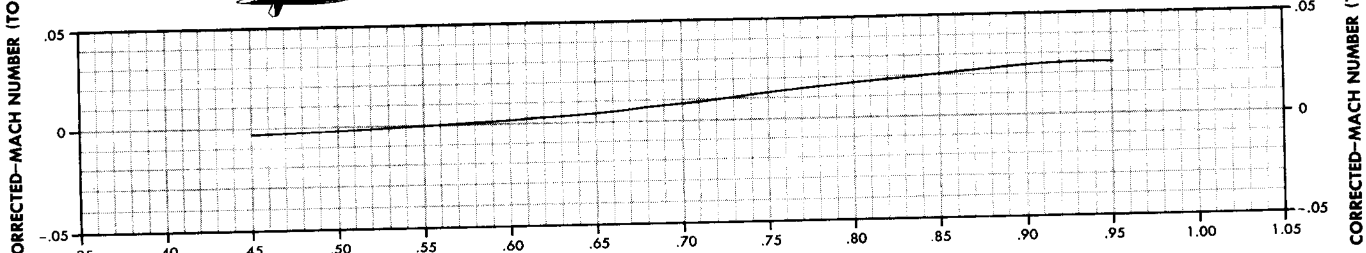
AIRPLANE CONFIGURATION
F-101A: CLEAN OR (2) 450 GALLON TANKS
FLAPS RETRACTED, GEAR UP





AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



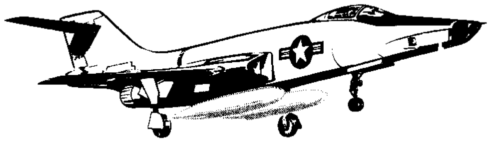


FA20-P101A-1

Figure A1-2

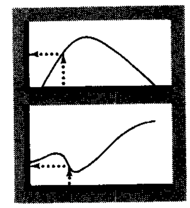
AIRSPEED POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION
RF/YRF-101A: ALL CONFIGURATIONS
FLAPS AND GEARS AS NOTED

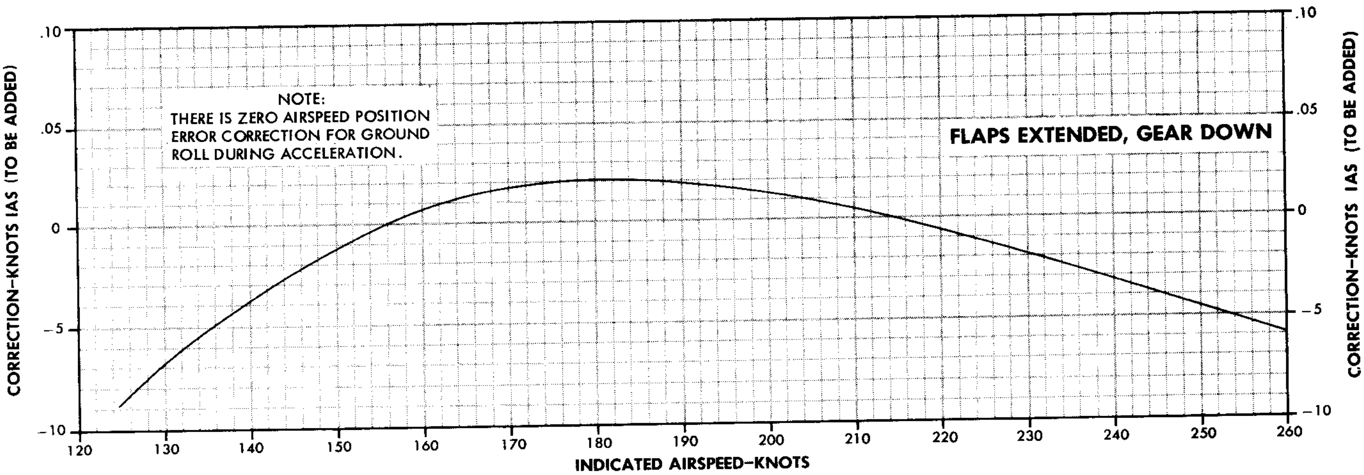


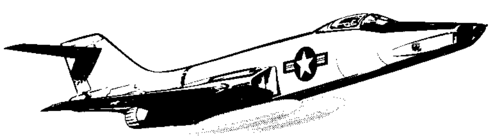
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

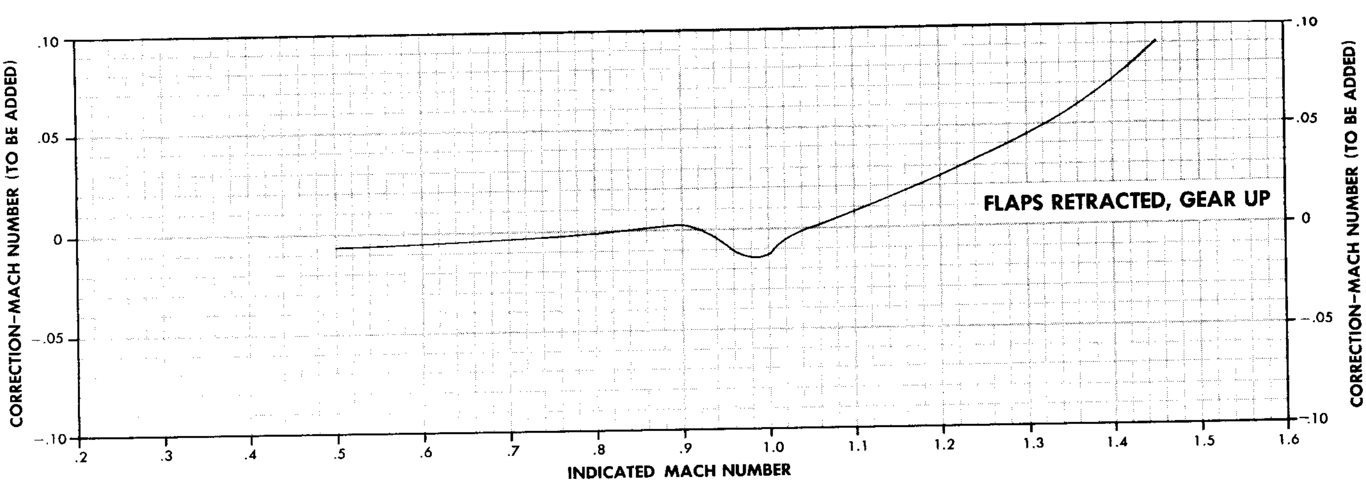
GUIDE



DATE: 1 MARCH 1958
DATA BASIS: **FLIGHT TEST**





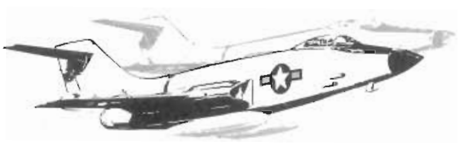


RF/YRF20-P101A-2

Figure A1-3

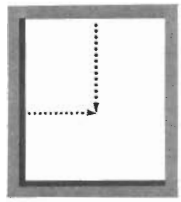
COMPRESSIBILITY CORRECTION

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS



REMARKS
ICAO STANDARD DAY

GUIDE



PRESSURE ALTITUDE-FEET	CAS-KNOTS											
	150	200	250	300	350	400	450	500	550	600	650	700
5000	0	0	1	2	2	3	5	6	8	10	12	14
10,000	0	1	2	3	5	7	10	13	17	21	24	26
15,000	1	2	3	5	8	12	17	23	31	32	36	40
20,000	1	3	5	8	12	17	23	31	37	43	47	50
25,000	2	4	7	11	17	24	32	41	48	54	57	59
30,000	2	5	9	15	23	32	41	50	58	63	66	68
35,000	3	7	12	20	29	40	50	59	67	72	75	76
40,000	4	9	16	25	37	48	59	68	75	80	82	—
45,000	5	11	20	32	44	56	66	74	82	88	—	—
50,000	7	14	25	38	51	62	72	81	89	—	—	—

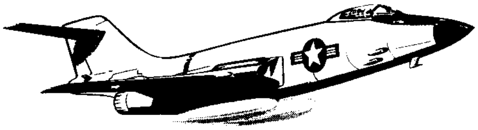
SUBTRACT CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED

F/RF/YRF20-P102A

Figure A1-4

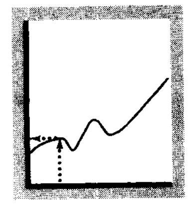
ALTIMETER POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION
F-101A: ALL CONFIGURATIONS



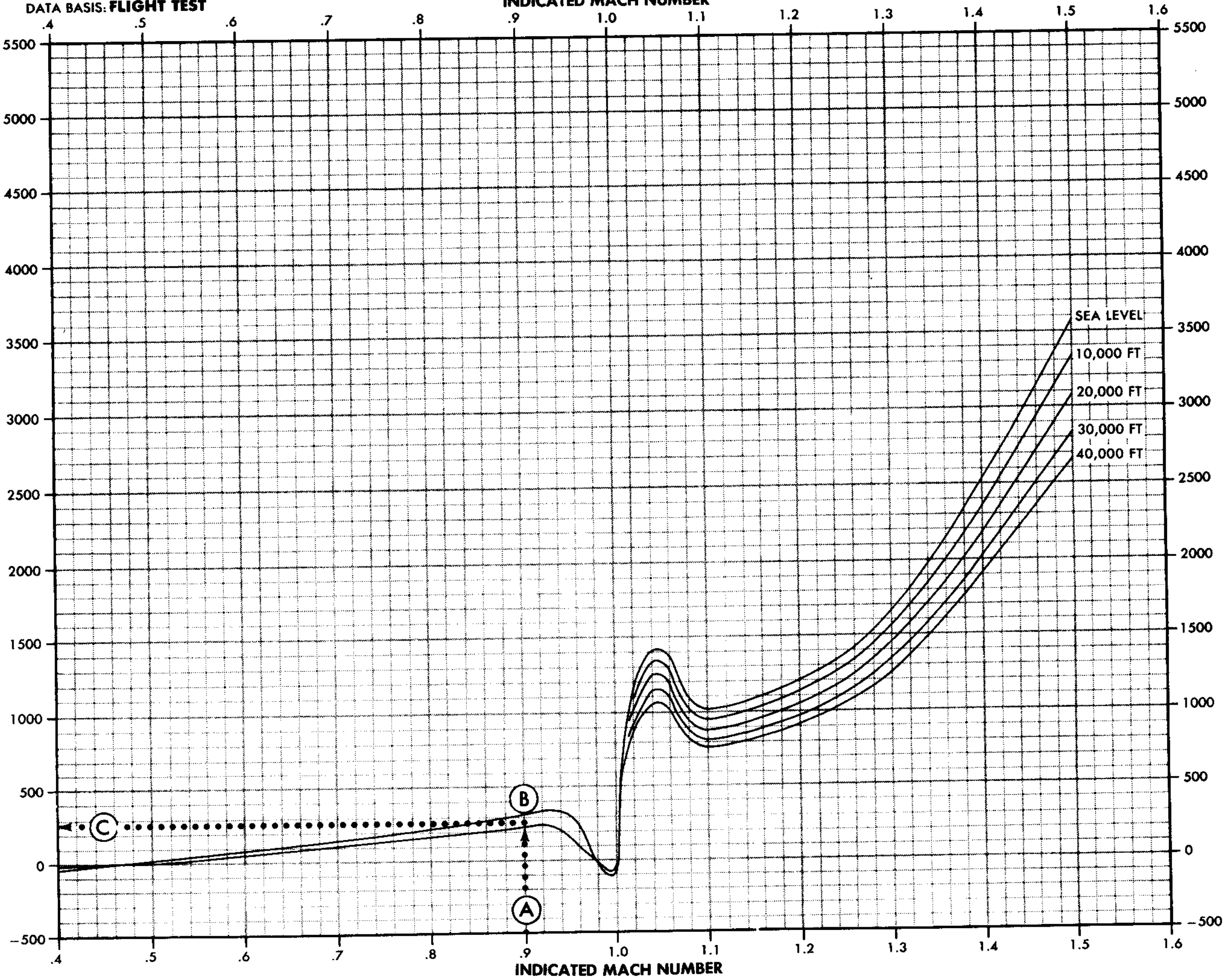
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1958
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



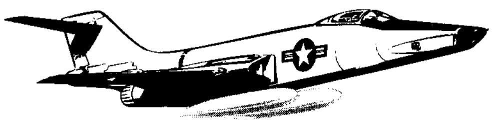
USE OF CHART	EXAMPLE
ENTER GRAPH AT INDICATED MACH NUMBER "A". PROCEED VERTICALLY TO INTERSECTION OF INDICATED ALTITUDE "B". READ CORRECTION FACTOR ON VERTICAL SCALE "C", ADDING THIS FACTOR TO INDICATED ALTITUDE (B+C) GIVES FLIGHT LEVEL PRESSURE ALTITUDE. COMPUTATIONS MUST STILL BE MADE FOR CORRECTION ALTITUDE, I.E. PRESSURE ALTITUDE AND TEMPERATURE.	A = .9 INDICATED MACH NUMBER B = 20,000 FEET INDICATED ALTITUDE C = CORRECTION FACTOR = 275 FEET D = TRUE ALTITUDE = 20,275 FEET

FA20-P103-1

Figure A1-5

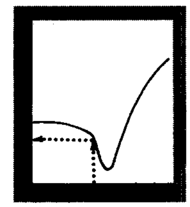
ALTIMETER POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION
RF/YRF-101A: ALL CONFIGURATIONS

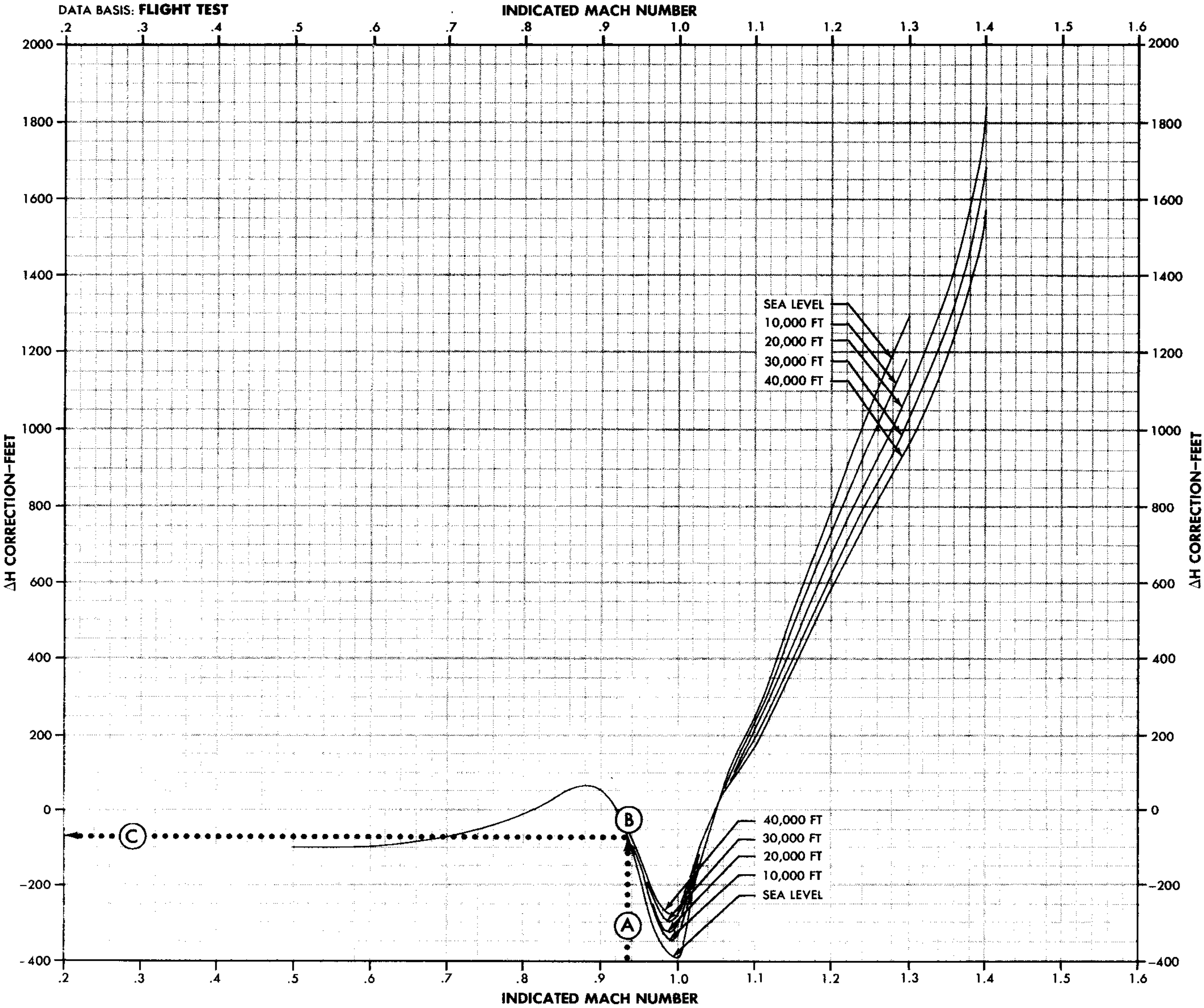


REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1958
DATA BASIS: **FLIGHT TEST**



USE OF CHART

ENTER GRAPH AT INDICATED MACH NUMBER. PROCEED VERTICALLY TO INTERSECTION OF INDICATED ALTITUDE. READ CORRECTION FACTOR ON VERTICAL SCALE, ADDING THIS FACTOR TO INDICATED ALTITUDE GIVES FLIGHT LEVEL PRESSURE ALTITUDE. COMPUTATIONS MUST STILL BE MADE FOR CORRECTION ALTITUDE, I. E. PRESSURE ALTITUDE AND TEMPERATURE.

EXAMPLE

A = .935 INDICATED MACH NUMBER
B = SEA LEVEL
C = CORRECTION FACTOR = −67 FEET
D = CORRECTED ALTITUDE B+C

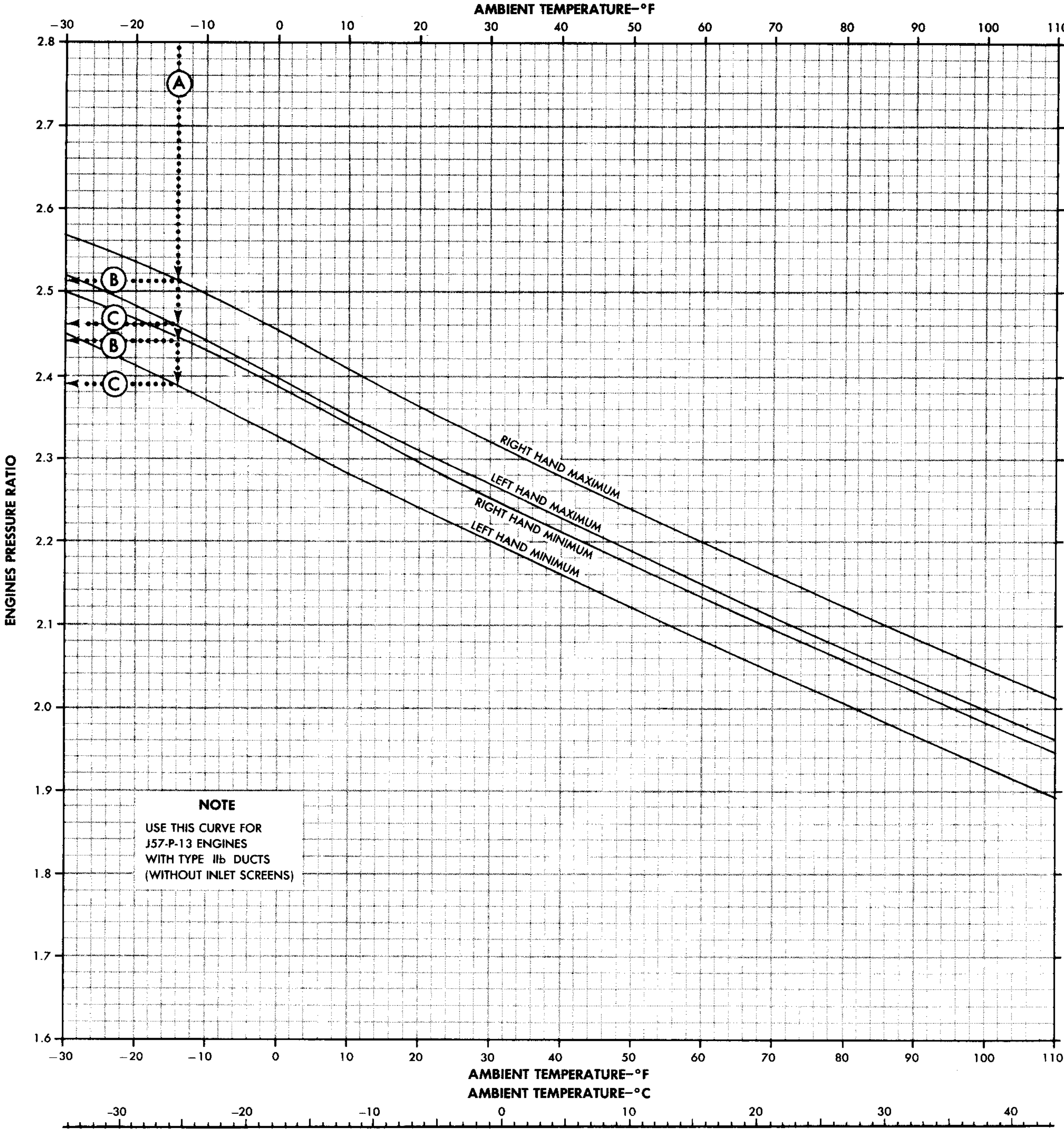
RF/YRF20-P103A-2

Figure A1-6

ENGINE THRUST CHECK CURVE

J57-P-13 ENGINES

DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**



NOTE

USE THIS CURVE FOR J57-P-13 ENGINES WITH TYPE IIb DUCTS (WITHOUT INLET SCREENS)

USE OF CHART

ENTER GRAPH AT THE HORIZONTAL SCALE WITH THE EXISTING AMBIENT TEMPERATURE "A". PROCEED VERTICALLY TO THE CURVES, THEN HORIZONTALLY FROM EACH CURVE TO THE VERTICAL SCALE. THE VALUES THUS LOCATED ON THE VERTICAL SCALE ARE THE INDIVIDUAL ENGINE'S MAXIMUM AND MINIMUM ACCEPTABLE LIMITS OF ENGINE PRESSURE RATIO ("B" TO "B" AND "C" TO "C") FOR THE EXISTING AMBIENT TEMPERATURE.

EXAMPLE

ACCEPTABLE RATIO FOR:
A = AMBIENT TEMPERATURE -14°F
B = RIGHT ENGINE ACCEPTABLE LIMITS 2.51 TO 2.44
C = LEFT ENGINE ACCEPTABLE LIMITS 2.46 TO 2.39

F/RF/YRF20-P106B

Figure A1-7

take-off part 2

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Charts

DEFINITIONS OF TERMS USED

CRITICAL FIELD LENGTH

The critical field length (figure A2-2) is the runway length required to accelerate the airplane, experience an engine failure, and then either take-off with the remaining engine or fully stop in the same total runway distance. It is used to determine the critical engine failure speed that is used in take-off planning and incorporates climb-out restrictions. The critical field length must be no greater than the runway length available.

CRITICAL ENGINE FAILURE SPEED

The critical engine failure speed (figure A2-3) is the speed at which engine failure permits acceleration to lift-off in the same distance that the airplane may be decelerated to a stop. If engine failure occurs at a lower speed, a shorter distance is required to stop than to take-off with one engine. If engine failure occurs at a higher speed, a shorter distance is required to take-off with one engine than to stop. This speed is used during take-off planning to determine the minimum Go-No Go speed.

REFUSAL SPEED

Refusal speed (figure A2-3) is the maximum speed at which engine failure permits stopping at the end of the runway and is used during take-off planning to determine the maximum Go-No Go speed. If engine failure occurs at a speed greater than refusal speed, the pilot must take-off with the remaining engine.

REFUSAL DISTANCE

Refusal distance (figure A2-3) is the distance required to accelerate to refusal speed under normal conditions. The refusal distance, in conjunction with refusal speed, is useful only as a criterion for establishing the Go-No Go distance.

GO–NO GO SPEED AND DISTANCE

The Go-No Go distance (figure A2-7) is the line check marker distance from the start of take-off run to the first runway marker below refusal distance. The Go-No Go speed is the acceleration line check speed that the airplane will normally attain within the Go-No Go distance. Since the rapid acceleration of the airplane makes more than one line speed check impractical, the Go-No Go distance together with qualifying restrictions imposed on the Go-No Go speed (by critical engine failure speed and refusal speed) provides an optimum acceleration line check.

TAKE-OFF PLANNING CHARTS

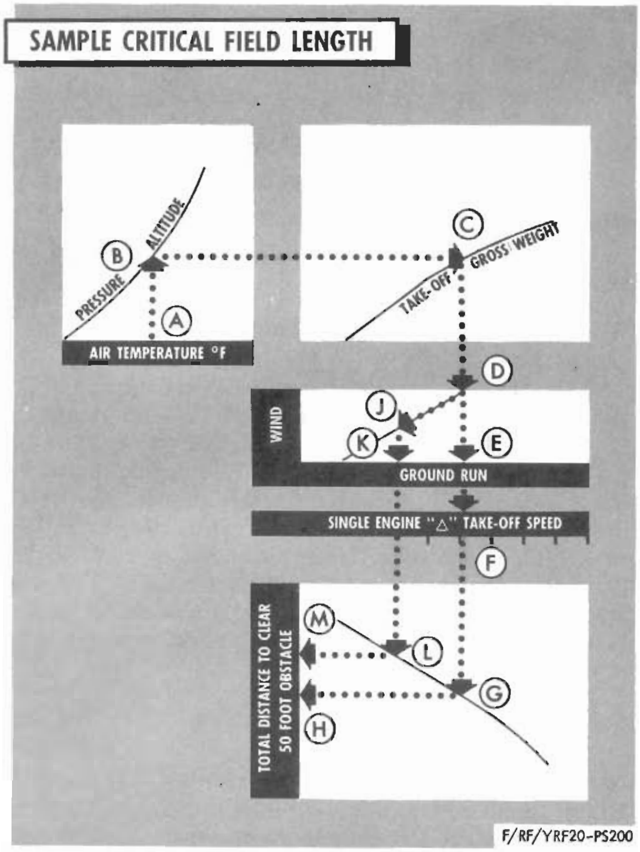
The following charts are provided for take-off planning. Refer to Mission Planning, Part 9 of Appendix I, for detailed instructions in completing the Take-Off Data Card.

CRITICAL FIELD LENGTH CHARTS

The critical field length chart (figure A2-2) is provided to give graphically an indication of the runway length required to accelerate the airplane, experience an engine failure, and then either take-off with the remaining engine or fully stop in the same total runway distance. Critical engine failure speed is read for the critical field length on figures A2-3 and A2-4 and represents the minimum engine failure speed at which take-off with one engine is advantageous. To permit a single-engine climb-out, when the critical field length exceeds 5,600 feet, the single engine take-off speed increment must be added (before applying the wind factor) to normal take-off speed.

USE

Enter the chart at the temperature scale and proceed vertically to intersect the pressure altitude. Proceed horizontally to intersect the take-off gross weight line. From this point, descend to the ground run for critical field length. Proceed along the proper guide line to adjust for wind effects and vertically downward to the reflector line for distance required to clear a 50-foot obstacle.



SAMPLE PROBLEM

Configuration: Gear Down, Flaps Extended; Maximum Thrust

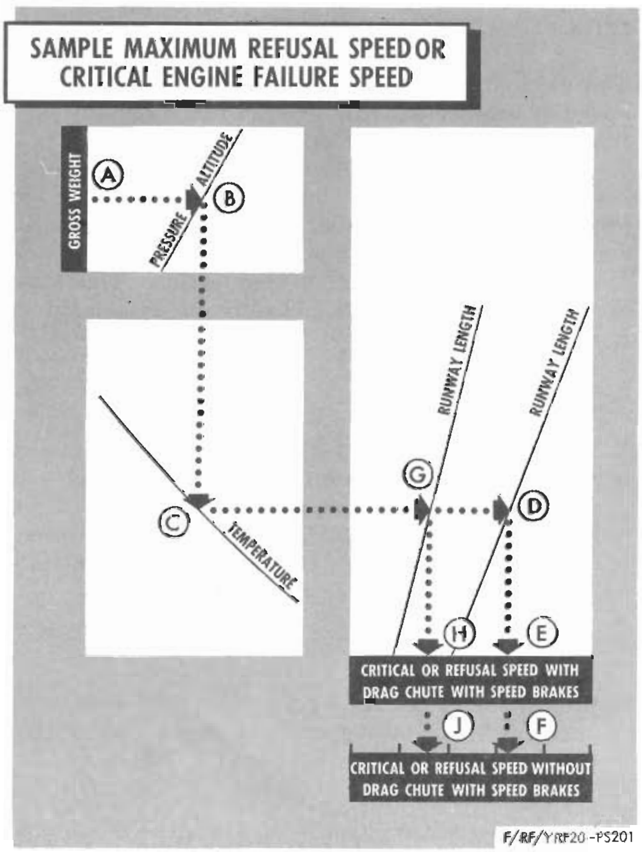
A. Air Temperature	75°F
B. Pressure Altitude	Sea Level
C. Take-Off Gross Weight	45,000 Lbs.
D. Wind Base Line	
E. Critical Field Length Ground Run (no wind)	6,100 Ft.
F. Single Engine "Δ" Take-Off Speed	+3 Kts.
G. Reflector Line	
H. Distance Required to Clear 50-Foot Obstacle (no wind)	8,750 Ft.
J. Effective Headwind	20 Kts.
K. Critical Field Length Ground Run (with wind)	5,100 Ft.
L. Reflector Line	
M. Distance Required to Clear 50-Foot Obstacle (with wind)	7,300 Ft.
N. Normal Take-Off Speed (Velocity During Take-Off Ground Run Chart)	180 Kts.
P. Single Engine Take-Off Speed (F. + N.)	183 Kts.

MAXIMUM REFUSAL SPEED OR CRITICAL ENGINE FAILURE SPEED CHARTS

These charts (figures A2-3 and A2-4) present both the maximum refusal speeds and the critical engine failure speeds. The maximum refusal speed is read for the total runway length and represents the maximum speed at which a single engine failure may occur and successful stopping accomplished within the runway length. The critical engine failure speed is read for the critical field length and represents the minimum engine failure speed at which take-off with one engine is advantageous provided that the normal take-off speeds (figure A2-7) are increased as noted on the Critical Field Length Chart (figure A2-2) to realize 100 ft./min. rate-of-climb at lift-off if the critical field length exceeds 5,600 feet. Stopping distance is based on using flaps and speed brakes and with or without the drag chute as noted on separate scales.

USE

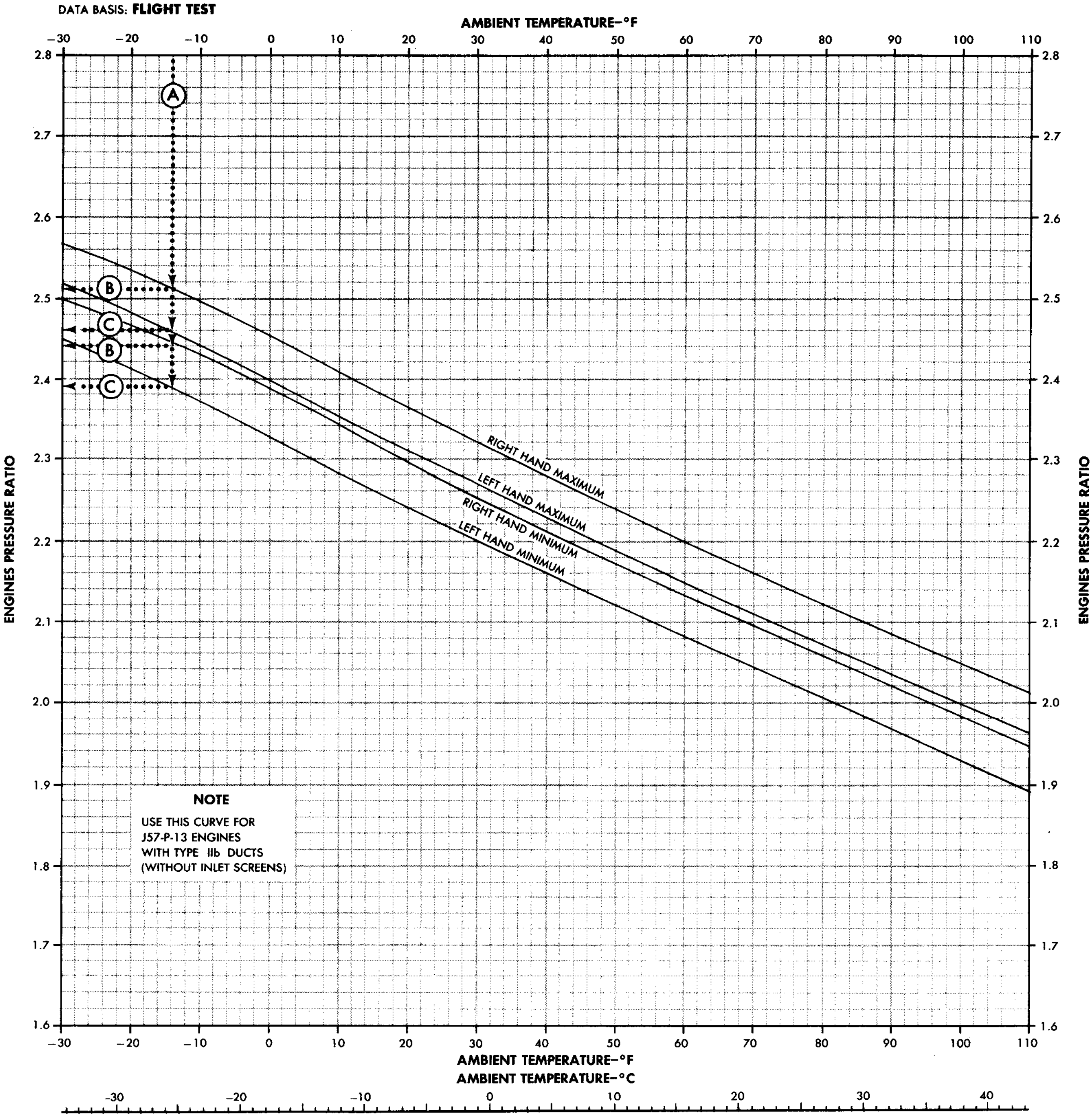
Enter the chart at the airplane gross weight and proceed horizontally to the intersection of the pressure altitude. Descend to intersect the temperature scale and proceed horizontally to intersect the critical field length and total runway length. From the total runway length intersection, descend to the base of the chart to read maximum refusal speed with drag chute and further to the red scale to read maximum refusal speed without the drag chute. From the critical field length intersection, descend to the base of the chart to read critical engine failure speed with drag chute and further to the red scale to read critical engine failure speed without the drag chute.



ENGINE THRUST CHECK CURVE

J57-P-13 ENGINES

DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**



USE OF CHART

ENTER GRAPH AT THE HORIZONTAL SCALE WITH THE EXISTING AMBIENT TEMPERATURE "A". PROCEED VERTICALLY TO THE CURVES, THEN HORIZONTALLY FROM EACH CURVE TO THE VERTICAL SCALE. THE VALUES THUS LOCATED ON THE VERTICAL SCALE ARE THE INDIVIDUAL ENGINE'S MAXIMUM AND MINIMUM ACCEPTABLE LIMITS OF ENGINE PRESSURE RATIO ("B" TO "B" AND "C" TO "C") FOR THE EXISTING AMBIENT TEMPERATURE.

EXAMPLE

ACCEPTABLE RATIO FOR:
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C = LEFT ENGINE ACCEPTABLE LIMITS 2.46 TO 2.39

F/RF/YRF20-P106B

Figure A1-7

take-off part 2

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Charts

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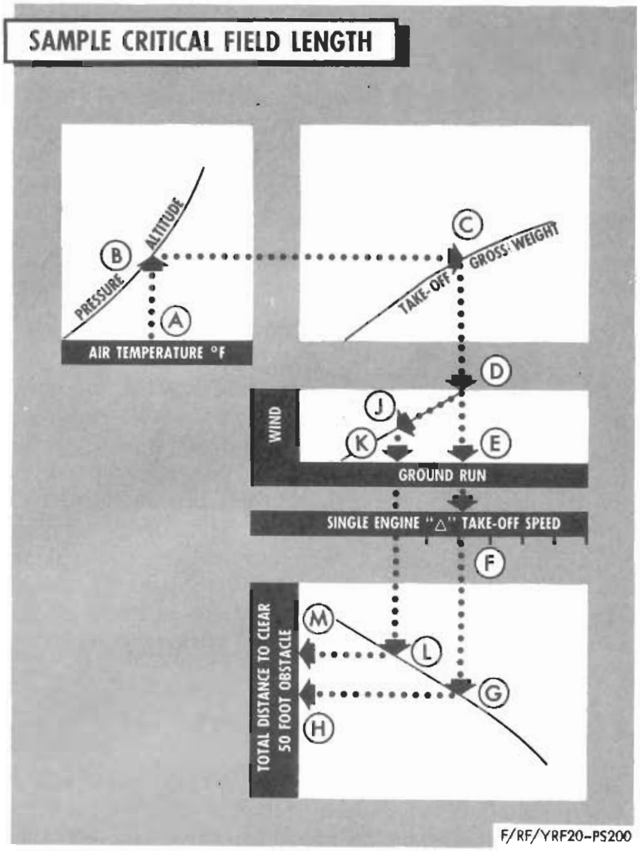
USE

Enter the chart at the temperature scale and proceed vertically to intersect the pressure altitude. Proceed horizontally to intersect the take-off gross weight line. From this point, descend to the ground run for critical field length. Proceed along the proper guide line to adjust for wind effects and vertically downward to the reflector line for distance required to clear a 50-foot obstacle.



SAMPLE PROBLEM

Configuration: Gear Down, Flaps Extended; Maximum Thrust

A. Air Temperature	75°F
B. Pressure Altitude	Sea Level
C. Take-Off Gross Weight	45,000 Lbs.
D. Wind Base Line	
E. Critical Field Length Ground Run (no wind)	6,100 Ft.
F. Single Engine "Δ" Take-Off Speed	+3 Kts.
G. Reflector Line	
H. Distance Required to Clear 50-Foot Obstacle (no wind)	8,750 Ft.
J. Effective Headwind	20 Kts.
K. Critical Field Length Ground Run (with wind)	5,100 Ft.
L. Reflector Line	
M. Distance Required to Clear 50-Foot Obstacle (with wind)	7,300 Ft.
N. Normal Take-Off Speed (Velocity During Take-Off Ground Run Chart)	180 Kts.
P. Single Engine Take-Off Speed (F. + N.)	183 Kts.

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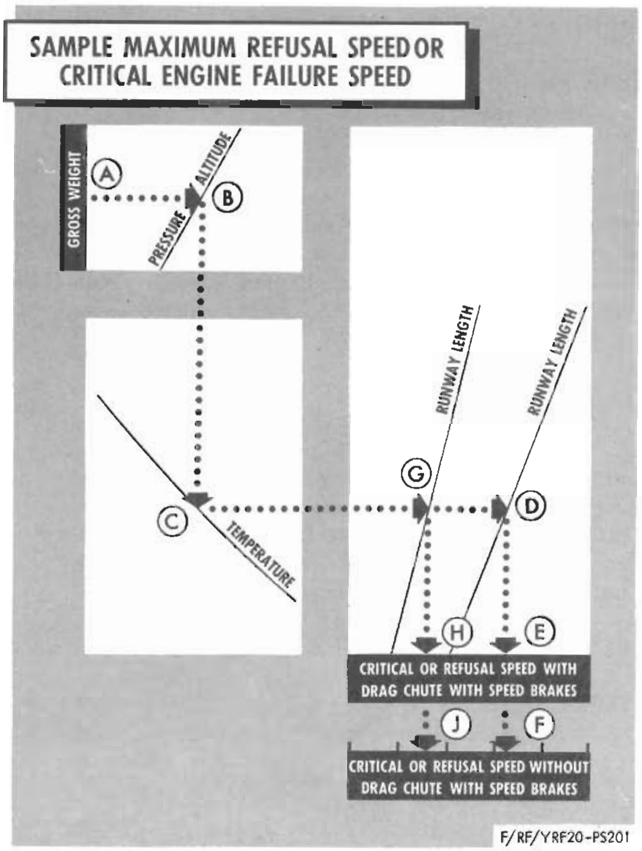
USE

Enter the chart at the airplane gross weight and proceed horizontally to the intersection of the pressure altitude. Descend to intersect the temperature scale and proceed horizontally to intersect the critical field length and total runway length. From the total runway length intersection, descend to the base of the chart to read maximum refusal speed with drag chute and further to the red scale to read maximum refusal speed without the drag chute. From the critical field length intersection, descend to the base of the chart to read critical engine failure speed with drag chute and further to the red scale to read critical engine failure speed without the drag chute.



SAMPLE PROBLEM

Configuration: Gear Down, Flaps Extended; Maximum Thrust

A.	Take-Off Gross Weight	45,000 Lbs.
B.	Pressure Altitude	Sea Level
C.	Temperature	60°F
D.	Length of Actual Runway	7,500 Ft.
E.	Refusal Speed (with drag chute)	163 Kts.
F.	Refusal Speed (without drag chute)	145 Kts.
G.	Critical Field Length Ground Run (Critical Field Length Chart)	5,300 Ft.
H.	Critical Engine Failure Speed (with drag chute)	129 Kts.
J.	Critical Engine Failure Speed (without drag chute)	119 Kts.

TAKE-OFF DISTANCE CHARTS

Ground run distances and distance required to clear a 50-foot obstacle using Maximum and Military thrust are shown in the Take-Off Distance Charts (figures A2-5 and A2-6). All distances computed are for normal technique on a dry, hard surface runway. Temperature, pressure altitude, gross weight, head and tail winds are variables plotted on this graph. The graphs may be used for any configuration, considering gross weight. Airspeeds given (IAS) for take-offs are shown on the gross weight lines.

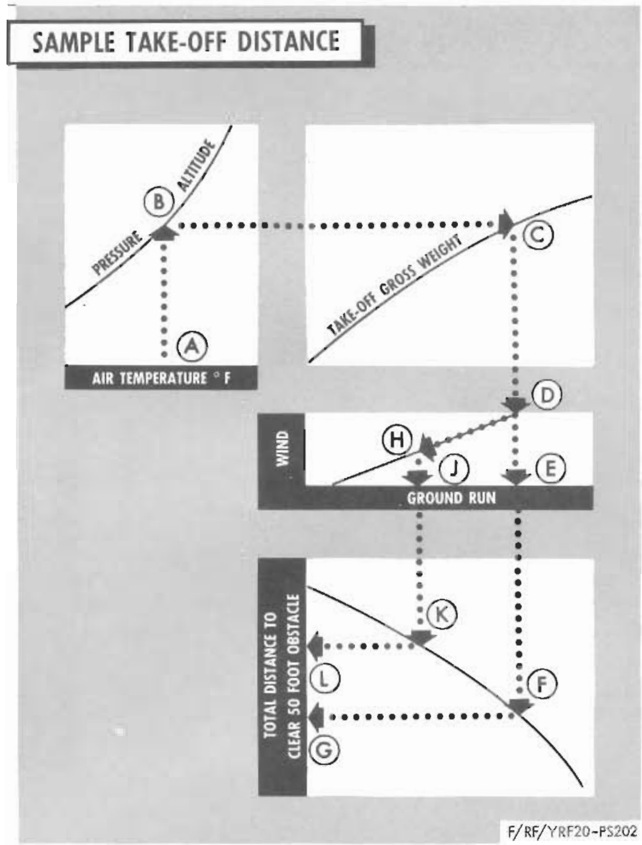
USE

The example shown assumes 644 pounds of fuel used for start and taxiing to take-off position. Pressure altitude may be obtained by setting the cockpit altimeter to 29.92" Hg. and reading indicated altitude. Temperatures given on the surface are usually given in degrees Fahrenheit. Enter the chart at the temperature scale, proceeding vertically to intersect the pressure altitude. Proceed horizontally to the take-off gross weight and read airspeed for take-off. Descend to the base line for wind effect and apply effective wind. Descend to the ground run scale reading ground run distance and further to the reflector for reading total distance required to clear a 50-foot obstacle.

SAMPLE PROBLEM

Configuration: Gear Down, Flaps Extended: Maximum Thrust

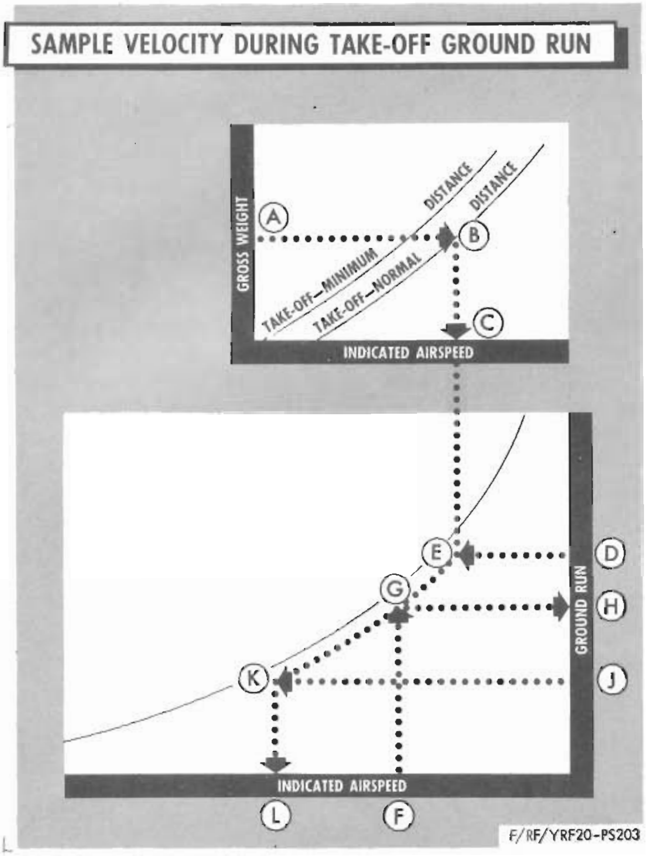
A.	Temperature	60°F
B.	Pressure Altitude	Sea Level
C.	Take-Off Gross Weight	45,000 Lbs.
	Take-Off Airspeed	180 Kts.
D.	Wind Base Line	
E.	Ground Run (no wind)	2,900 Ft.
F.	Reflector Line	
G.	Distance Required to Clear a 50-Foot Obstacle (no wind)	3,900 Ft.
H.	Effective Headwind	20 Kts.
J.	Ground Run (with wind)	2,350 Ft.



K.	Reflector Line	
L.	Distance Required to Clear a 50-Foot Obstacle (with wind)	3,200 Ft.

VELOCITY DURING TAKE-OFF GROUND RUN CHARTS (GO-NO GO LINE CHECK)

These charts (figures A2-7 and A2-8) provide the normal take-off speed, with both engines operating, for the various take-off gross weights of the airplane and a means of obtaining a Go-No Go line check. The Go-No Go line check distance marker speed is the 1000 ft. marker speed below refusal speed. The charts can be used to obtain any line distance and speed relationship such as: Line distance at critical engine failure speed, line distance at refusal speed, speed at any runway marker or take-off ground run for other than normal take-off speed. However, it is recommended that the Go-No Go line check distance marker, as defined above, be used as the criterion for decision to abort or take-off after engine failure. If a definite failure occurs prior to reaching the Go-No Go distance marker, the airplane should be stopped. If the marker is reached and partial failure is indicated by the fact that the airplane speed is less than that predicted for that marker, the airplane should be stopped, if the Go-No Go line check distance marker failure occurs thereafter or not. If failure occurs, the pilot must not attempt to rotate the airplane to lift-off attitude until single engine take-off speed is attained. If critical field length exceeds the total runway length or 10,000



ft. for any take-off gross weight, temperature and altitude combination, climb-out capabilities with one engine are insufficient.

USE

Enter the chart at the airplane gross weight and read airspeed determined by the intersection of the take-off - normal distance reflector line. The take-off - minimum distance reflector line is used only where field length is a critical factor. Re-enter the chart at the ground run scale for the previously computed take-off distance and proceed horizontally to intersect the line projected down from the take-off - normal distance reflector line. From this intersection (E) project a line, to the left, parallel to the nearest acceleration guide line. Re-enter the chart at the indicated airspeed scale with the previously computed refusal speed, and project up to intersect the newly plotted acceleration guide line (G). From this point, project horizontally to the ground run scale and read refusal distance. Re-enter the ground run scale at the Go-No Go distance marker (the first 1000 ft. marker below refusal distance; i.e., Go-No Go distance marker would be 2000 feet if refusal distance fell between the 2000 ft. and 3000 ft. markers) proceed horizontally to intersect the newly plotted acceleration guide line (K) then vertically to the indicated airspeed scale to read Go-No Go line check speed.

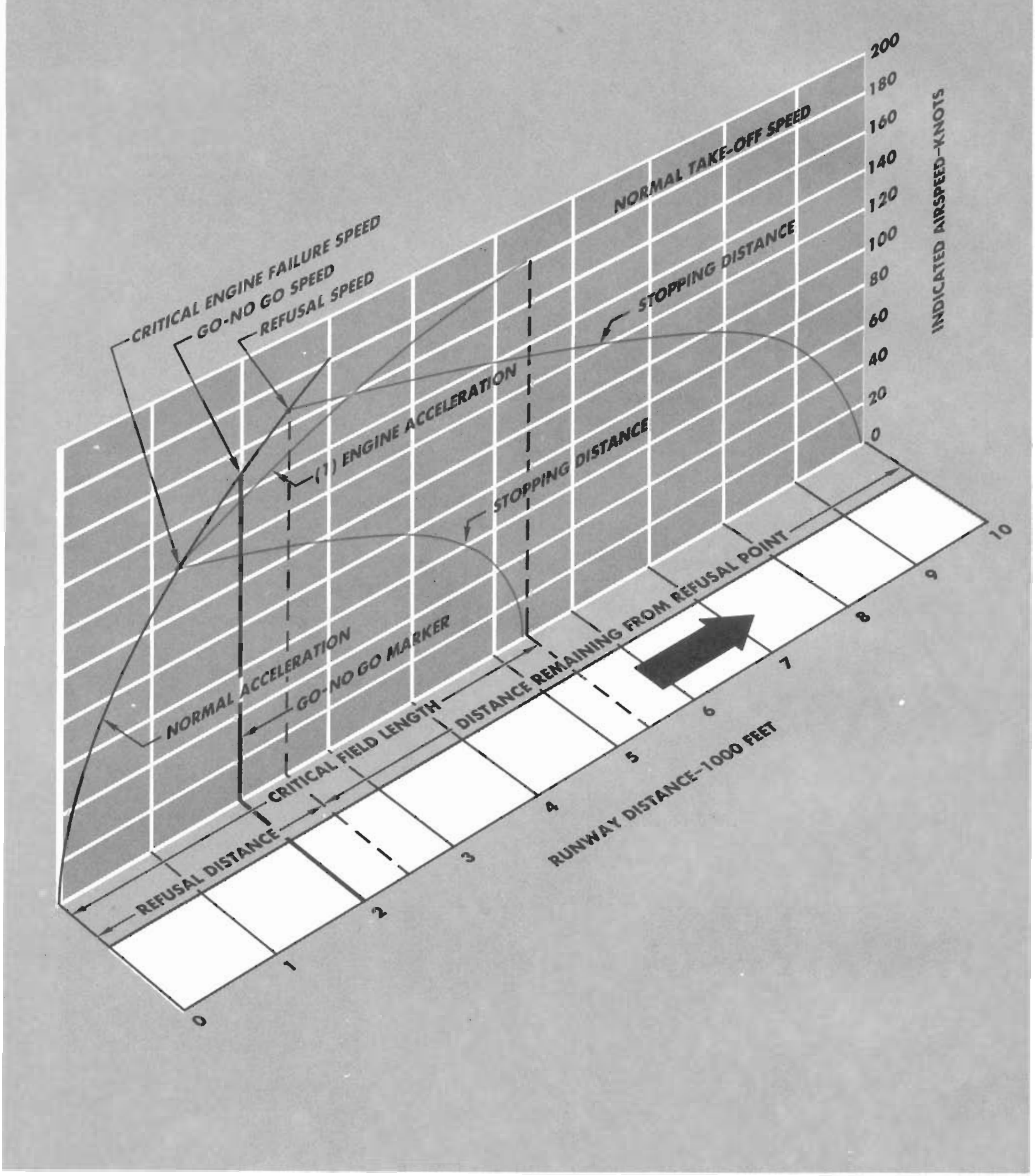
SAMPLE PROBLEM

Configuration: Gear Down, Flaps Extended; Maximum Thrust

A. Take-Off Gross Weight	45,000 Lbs.
B. Take-Off - Normal Distance Intersection	
C. Normal Take-Off Speed	180 Kts.
D. Normal Take-Off Ground Run (Take-Off Distance Chart)	2,900 Ft.
E. Intersection of C. and D.	
F. Refusal Speed (with drag chute) (Maximum Refusal Speed or Critical Engine Failure Speed Chart)	163 Kts.
G. Intersection of E. and F.	
H. Refusal Distance	2,300 Ft.
J. Go-No Go Distance (First Runway Marker Before Refusal Distance)	2,000 Ft.
K. Intersection of E. and J.	
L. Go-No Go Speed	150 Kts.

TAKE-OFF—ABORT CRITERIA

(GO-NO GO CONCEPT)



F/RF/YRF20-P211
R

Figure A2-1

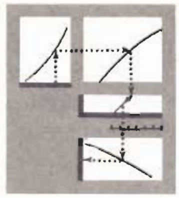
CRITICAL FIELD LENGTH

MAXIMUM THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS AND GEAR AS NOTED

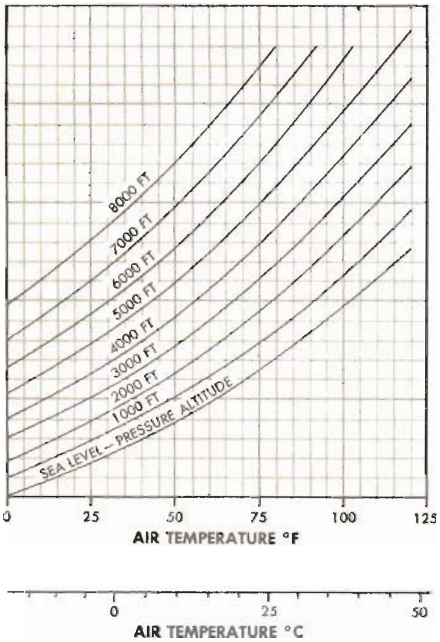
REMARKS
SINGLE ENGINE FAILURE

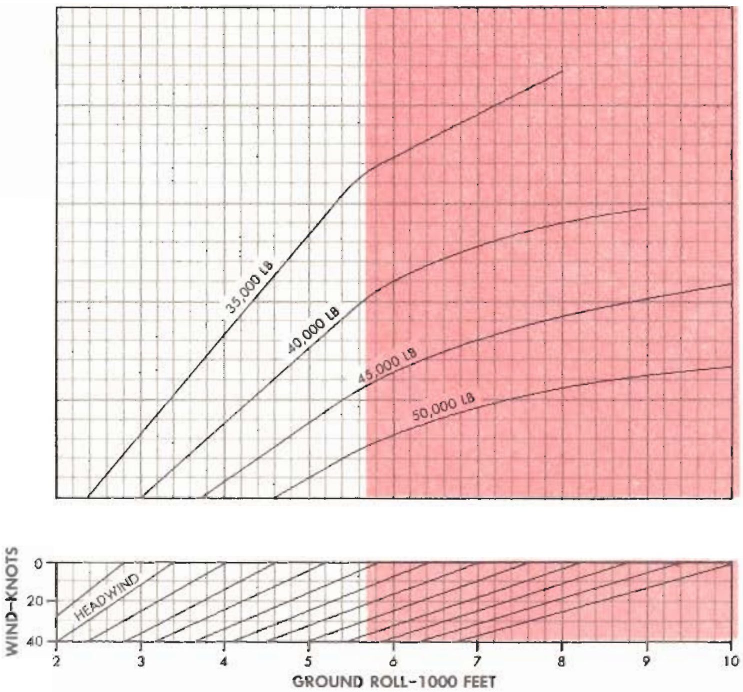
GUIDE

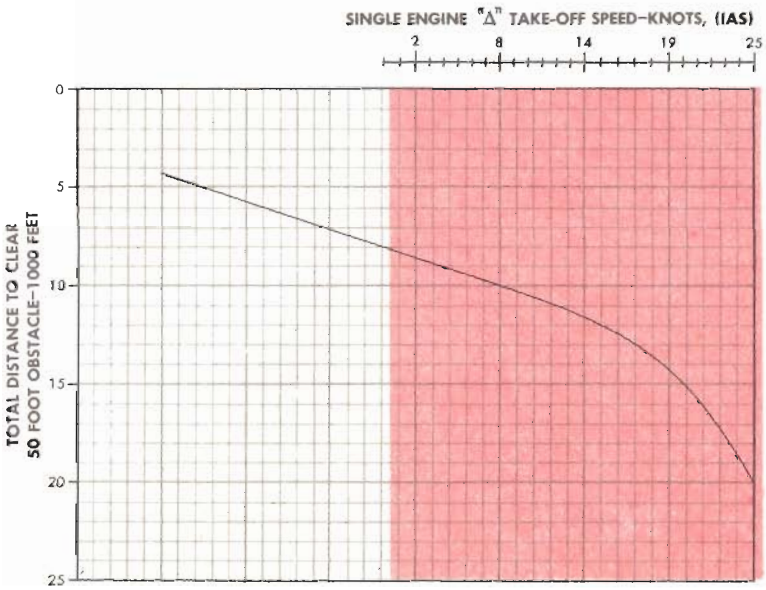


DATE: 1 MARCH 1956
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL







NOTES

1. CRITICAL ENGINE FAILURE SPEED (THE SPEED AT WHICH ENGINE FAILURE PERMITS ACCELERATION TO TAKE-OFF IN THE SAME DISTANCE THAT THE AIRPLANE MAY BE DECELERATED TO A STOP) IS READ FOR CRITICAL FIELD LENGTH ON "MAXIMUM REFUSAL" CHARTS.
2. TO OBTAIN SINGLE ENGINE TAKE-OFF SPEED, ADD SINGLE ENGINE Δ SPEED TO NORMAL TAKE-OFF SPEED. ("VELOCITY DURING TAKE-OFF GROUND RUN" CHART.)
3. TO REALIZE BEST SINGLE ENGINE PERFORMANCE, LANDING GEAR MUST BE RETRACTED AS SOON AS POSSIBLE.

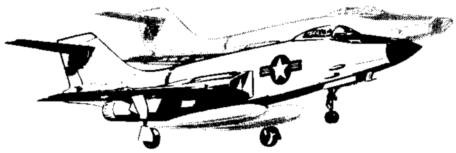
F/RF/YRF20–P200A
R

Figure A2-2

MAXIMUM REFUSAL SPEEDS OR CRITICAL ENGINE FAILURE SPEEDS

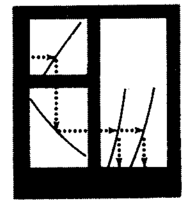
MAXIMUM THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



REMARKS
SINGLE ENGINE FAILURE

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

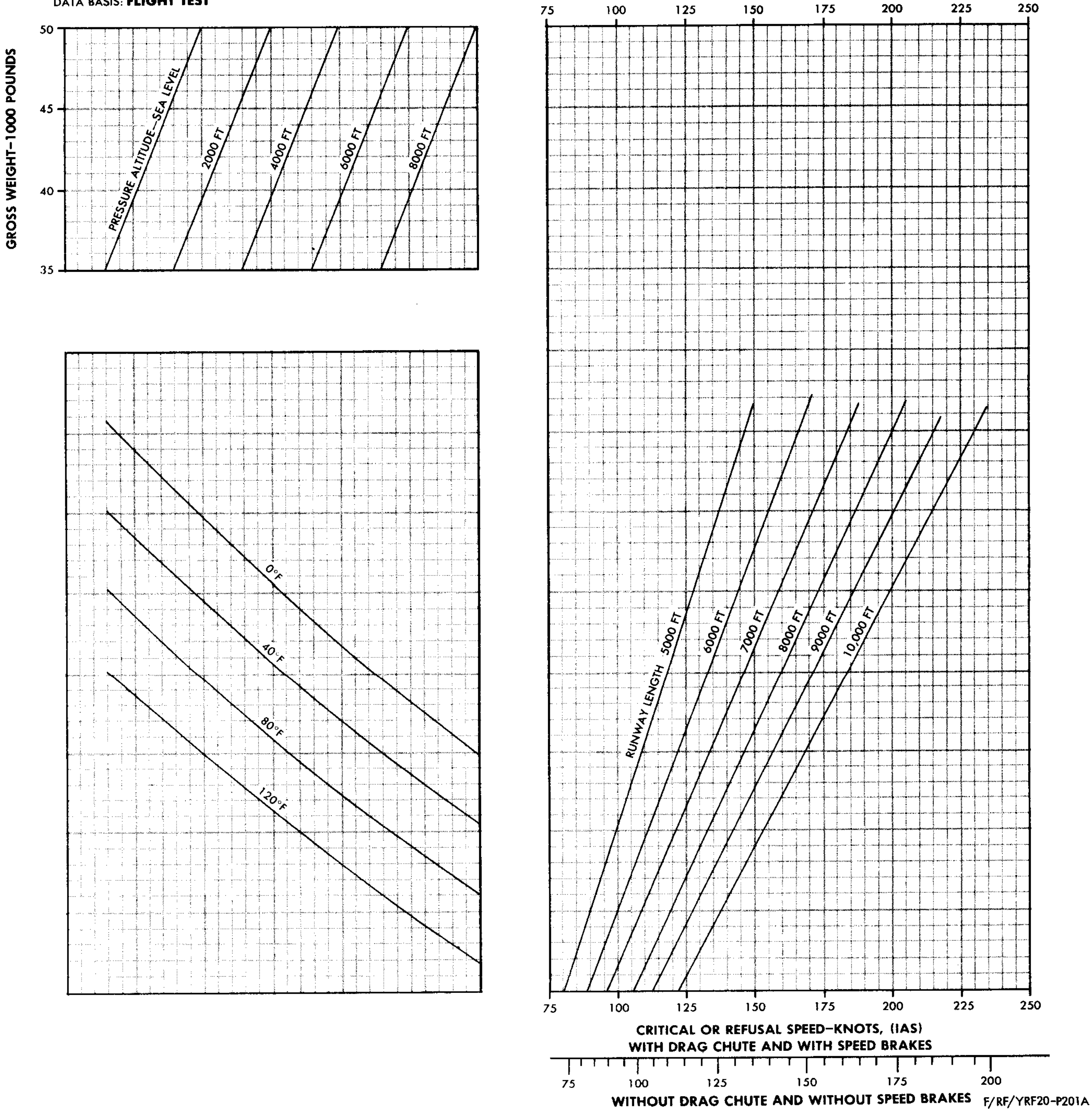
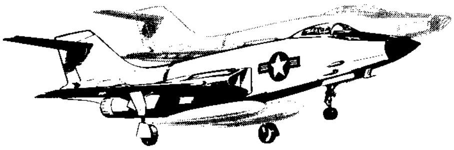


Figure A2-3

MAXIMUM REFUSAL SPEEDS OR CRITICAL ENGINE FAILURE SPEEDS

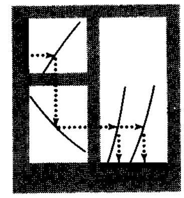
MILITARY THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



REMARKS
SINGLE ENGINE FAILURE

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

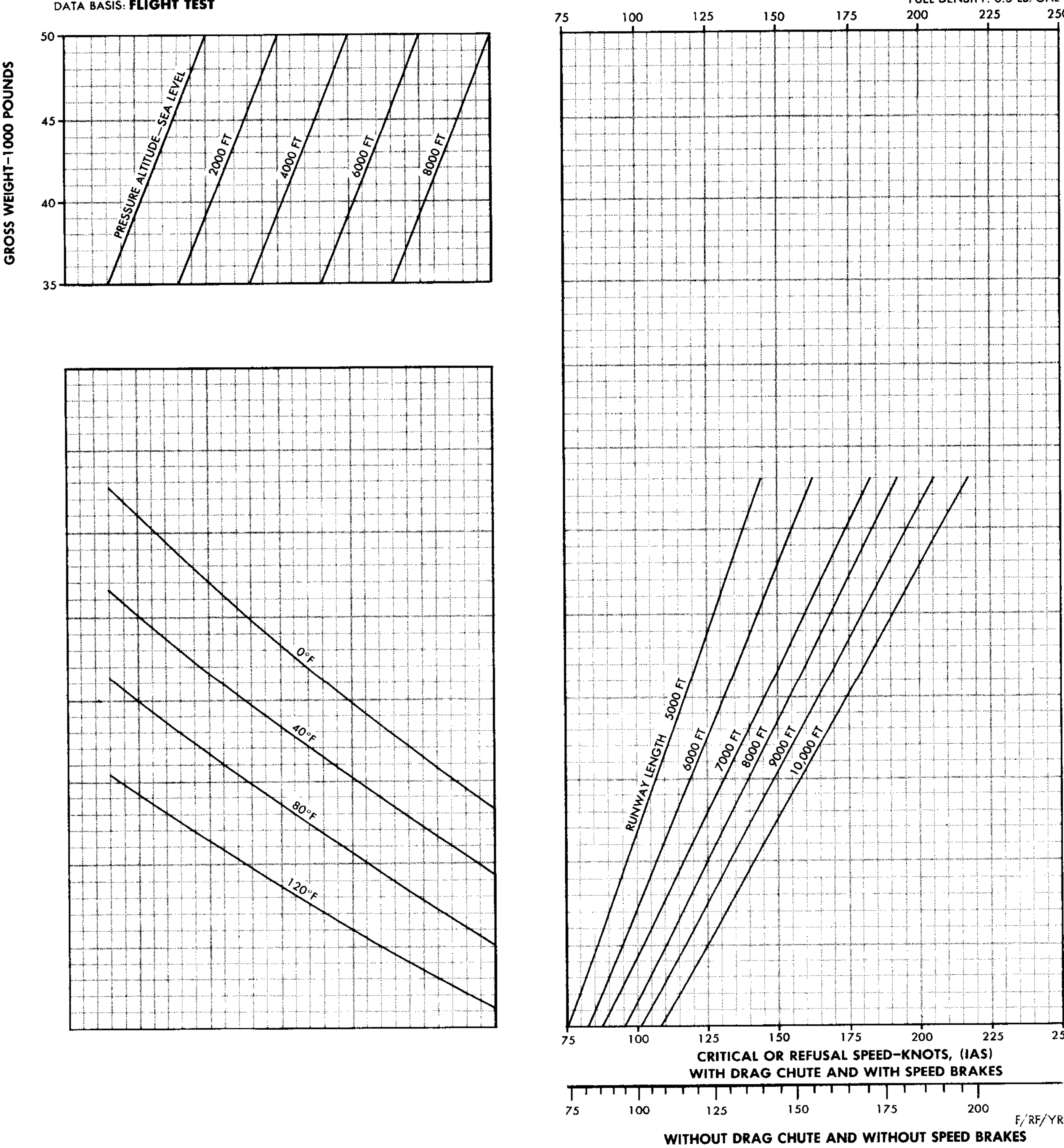


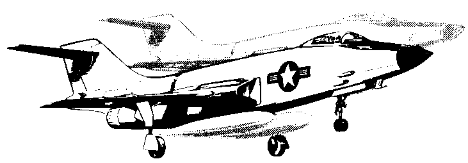
Figure A2-4

TAKE-OFF DISTANCE

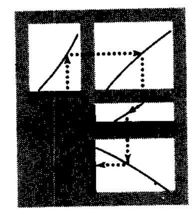
MAXIMUM THRUST
HARD DRY RUNWAY

REMARKS
ENGINE(S): (2) J57-P-13

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN

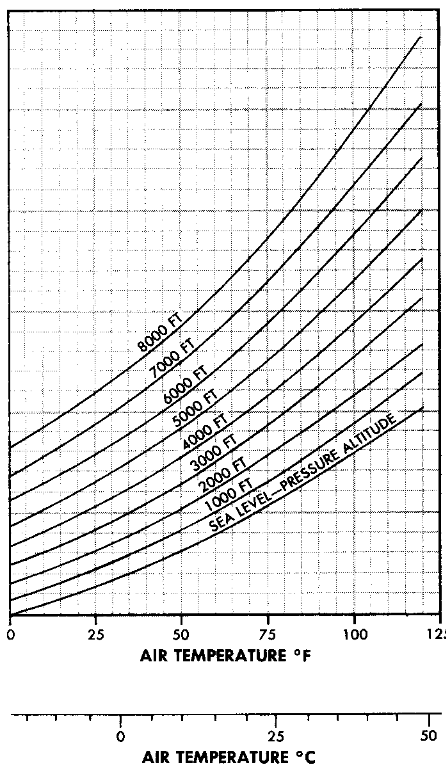


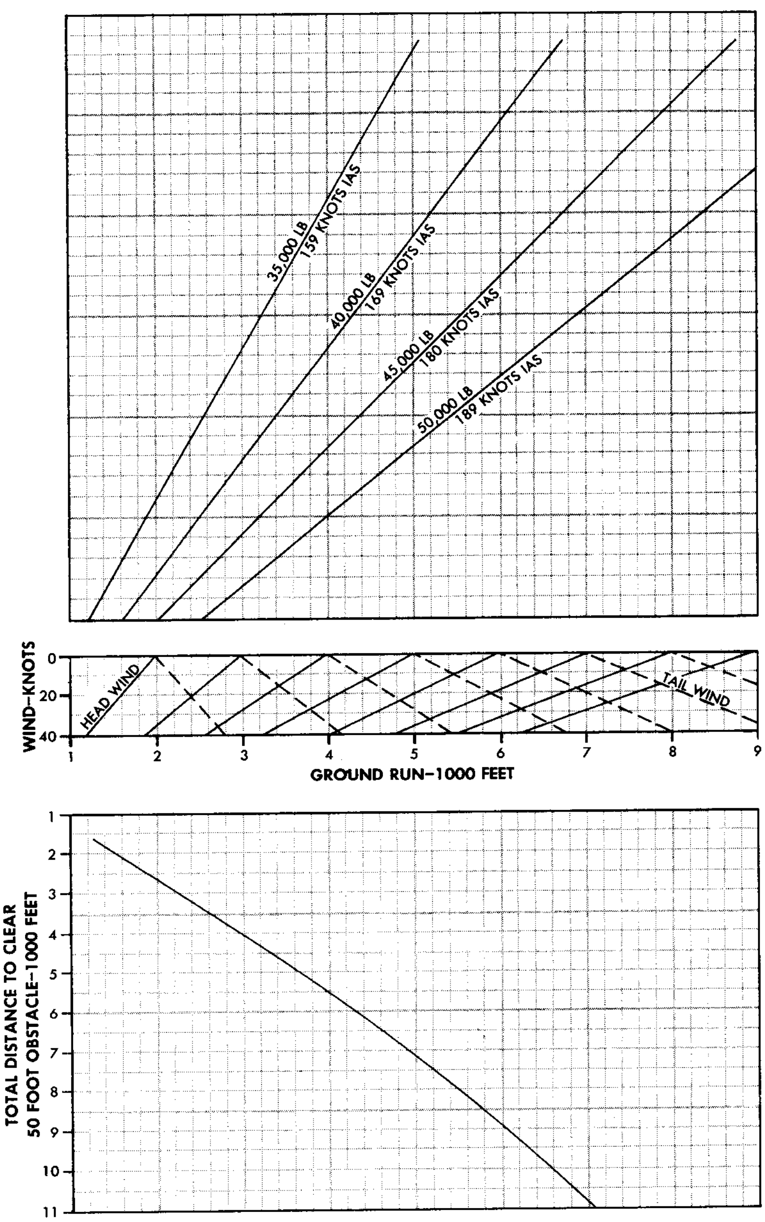
GUIDE



DATE: 1 MARCH 1956
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





NOTE
FUEL FLOW VALVES VARY FROM 73,000 PPH TO 45,500 PPH DEPENDING ON SPEED, TEMPERATURE, AND ALTITUDE.

F/RF/YRF20-P209A

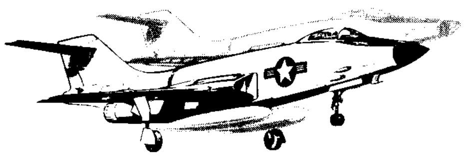
Figure A2-5

TAKE-OFF DISTANCE

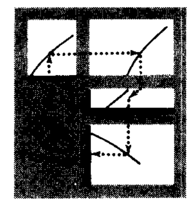
MILITARY THRUST
HARD DRY RUNWAY

REMARKS
ENGINE(S): (2) J57-P-13

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN

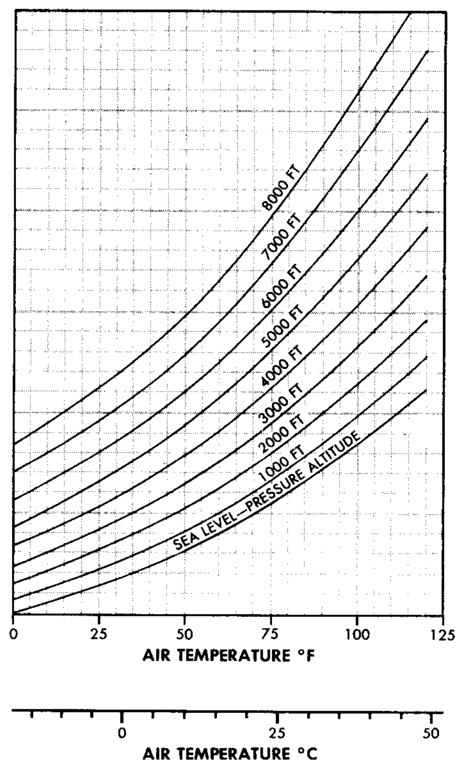


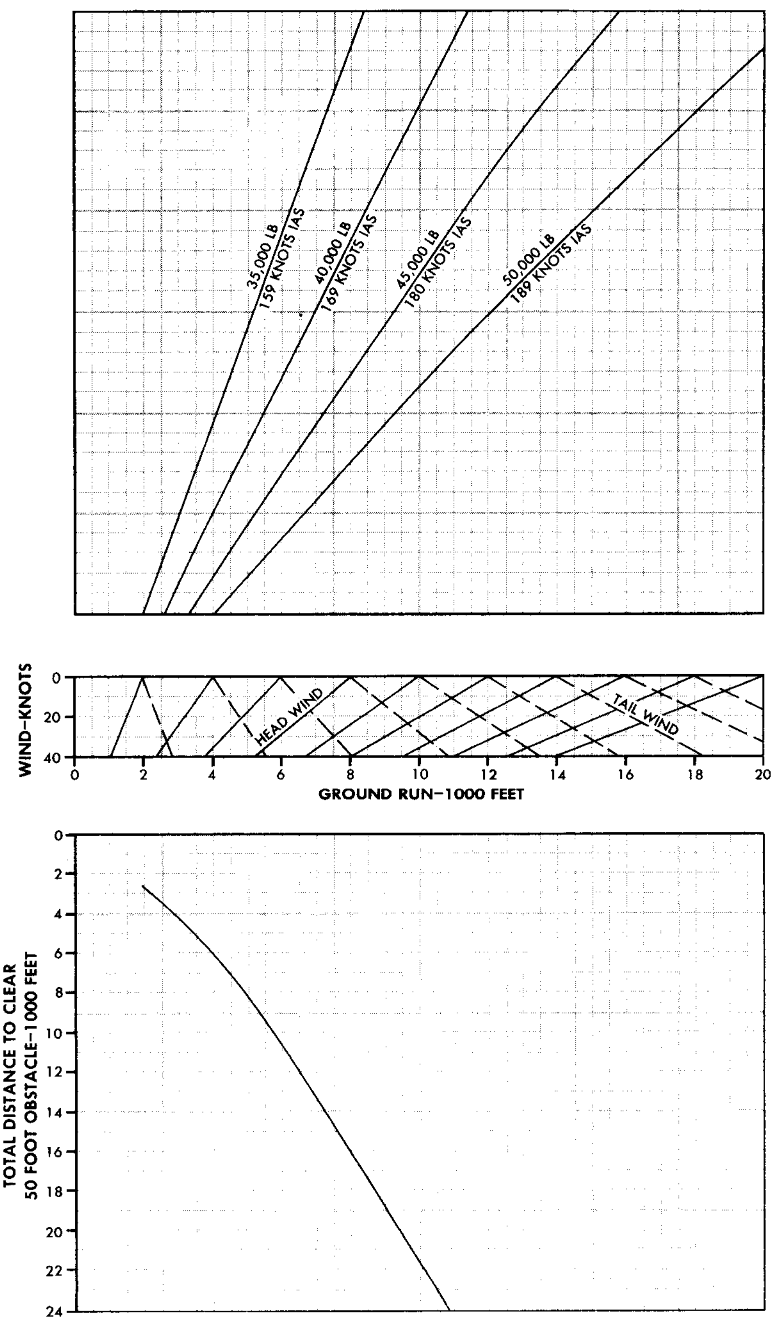
GUIDE



DATE: 1 MARCH 1956
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





NOTE

FUEL FLOW VALVES VARY FROM 21,000 PPH TO 12,500 PPH DEPENDING ON SPEED TEMPERATURE AND ALTITUDE.

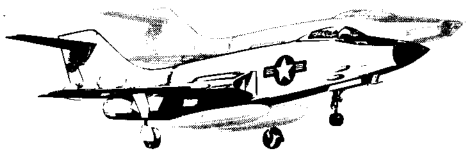
F/RF/YRF20-P210A

Figure A2-6

VELOCITY DURING TAKE-OFF GROUND RUN

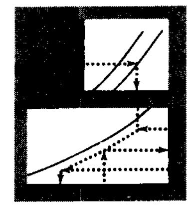
(GO-NO GO LINE CHECK)
MAXIMUM THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



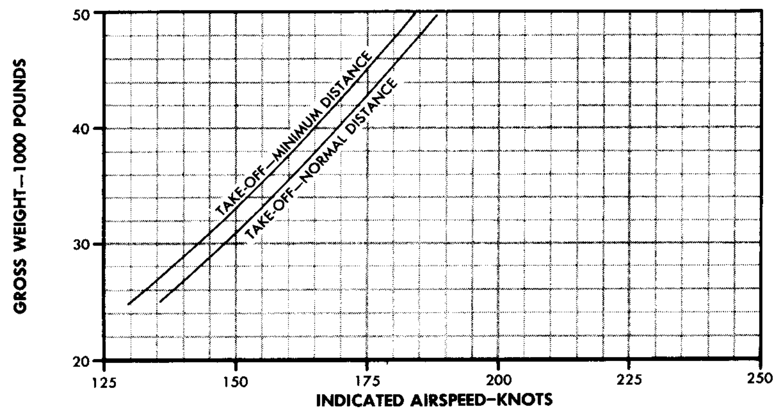
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

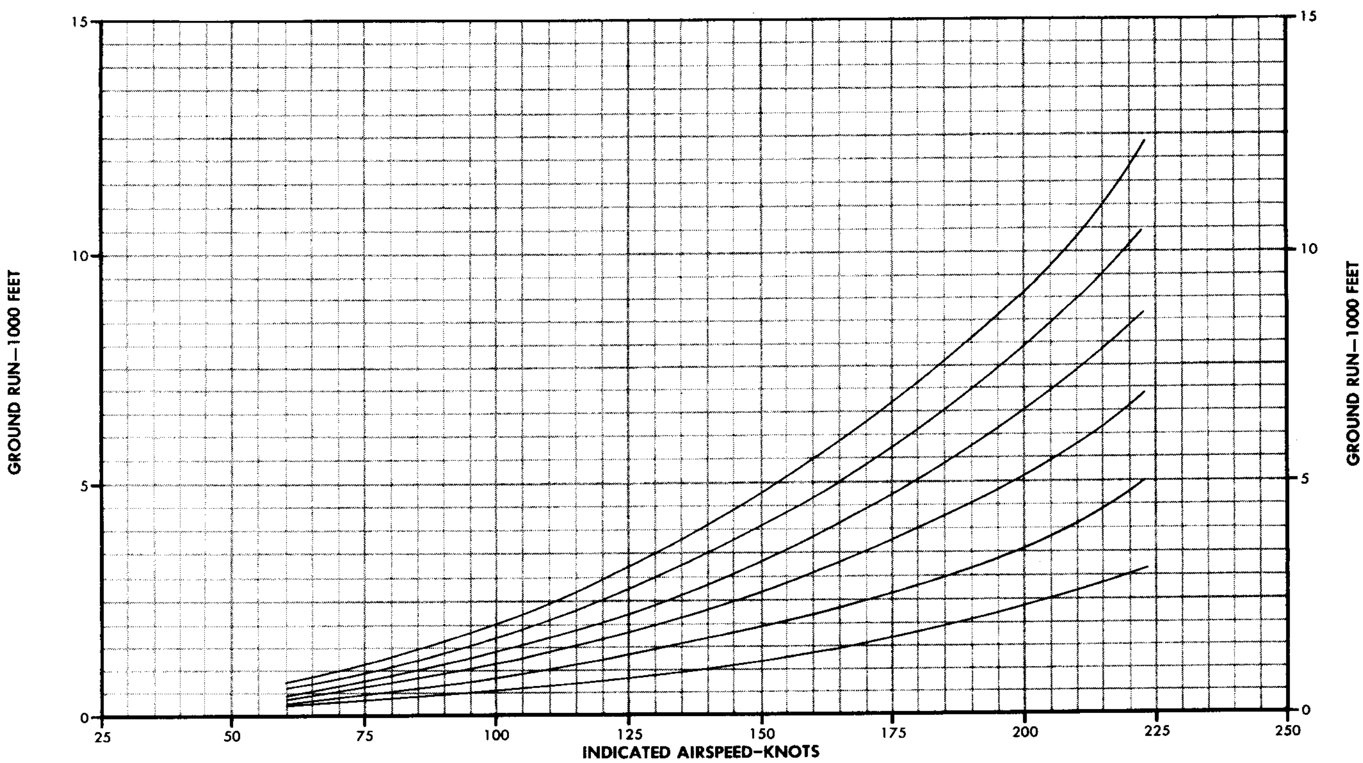
GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





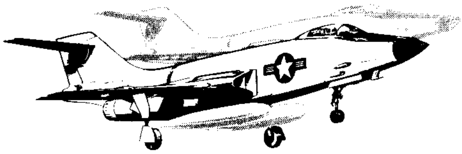
F/RF/YRF20-P207A

Figure A2-7

VELOCITY DURING TAKE-OFF GROUND RUN

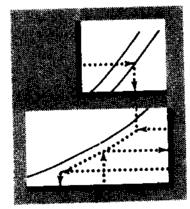
(GO-NO GO LINE CHECK)
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



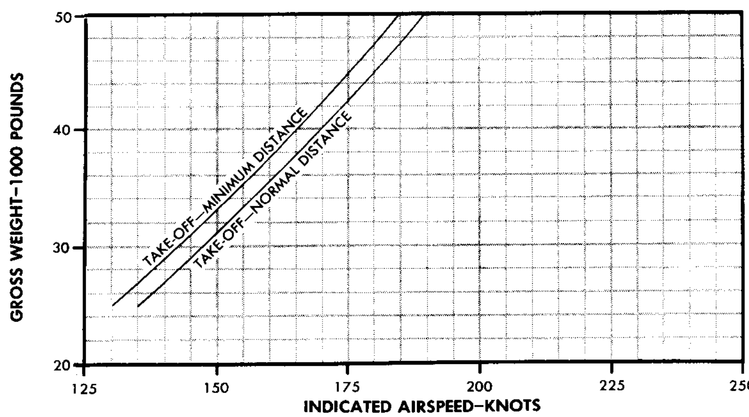
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

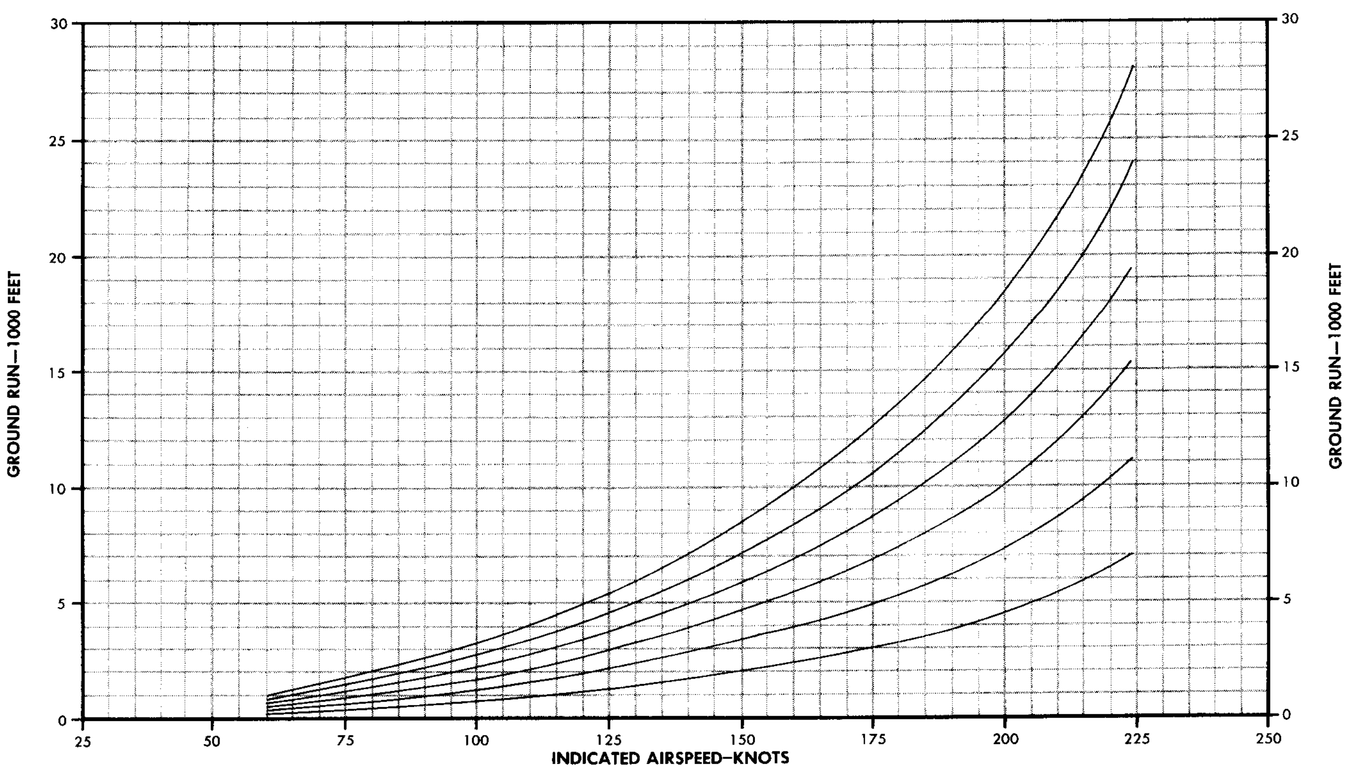
GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





F/RF/YRF20-P208A

Figure A2-8

climb part 3

CLIMB CHARTS

Climb charts (figures A3-1 through A3-10) are provided for both emergency single-engine and normal two-engine operation. These charts, based on recommended climb speeds, are plotted for Maximum and Military thrust and present several airplane configurations. Time and distance are plotted vs. gross weight with guide lines to show the reduction in gross weight during climb as fuel is consumed. Ceilings and optimum cruise altitude are superimposed on the graph.

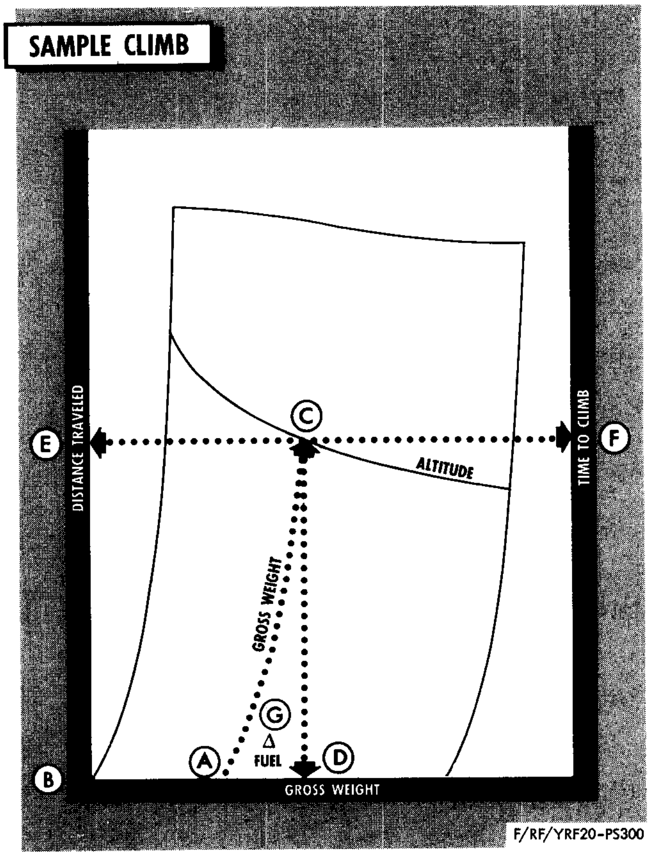
USE

To obtain the climb data, enter the proper climb chart at gross weight and altitude at start of climb. From initial altitude, parallel a guide curve until it intersects the desired altitude at the end of climb. Read the time (right scale), distance (left scale), and gross weight. The difference between initial and completed time is the elapsed time (Δ time) required to climb. The difference between initial and completed values for distance and for gross weight gives, respectively, the distance traveled (Δ distance) and fuel used (Δ weight, change in gross weight = pounds of fuel used) to climb. Time and distance are zero at sea level, therefore both may be read directly for climbs starting at sea level. The example shows fuel used, distance traveled, and time to climb.

SAMPLE PROBLEM

Configuration: Maximum Thrust Climb With (2) 450 Gallon Tanks

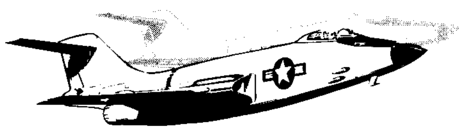
A. Gross Weight At Start of Climb	45,000 Lbs.
B. Altitude at Start of Climb	Sea Level
C. Altitude at End of Climb	35,000 Ft.
D. Gross Weight at End of Climb	43,495 Lbs.
E. Distance Traveled (Nautical Miles)	16 Mil.
F. Time Required	1.8 Min.
G. Fuel Used During Climb (A. - D.)	1,505 Lbs.



F/RF/YRF20-PS300

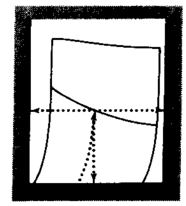
MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



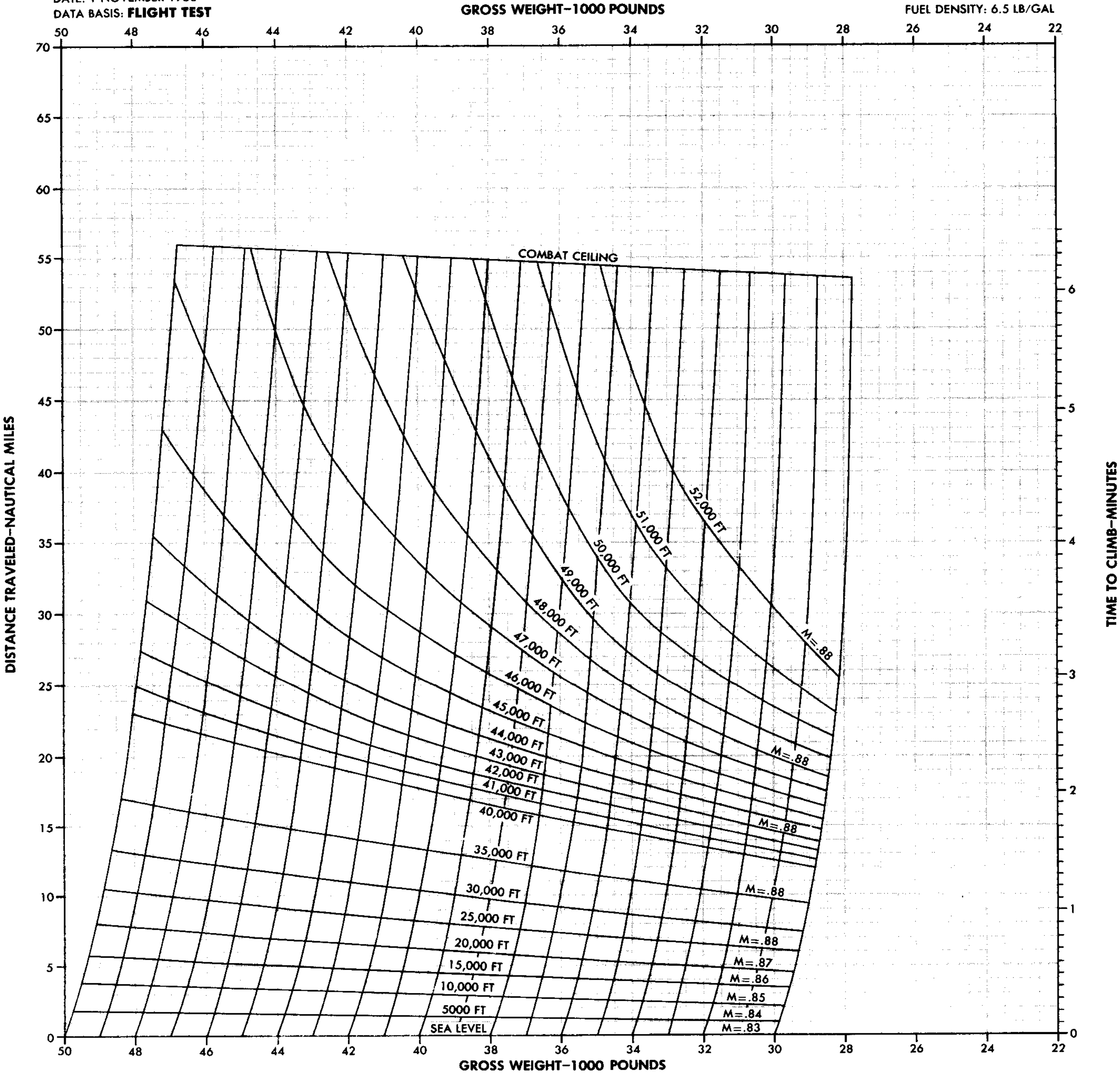
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±10,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 35,000 FT

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

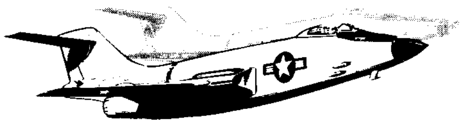


F/RF/YRF20-P312A

Figure A3-1

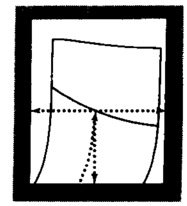
MILITARY THRUST CLIMB

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



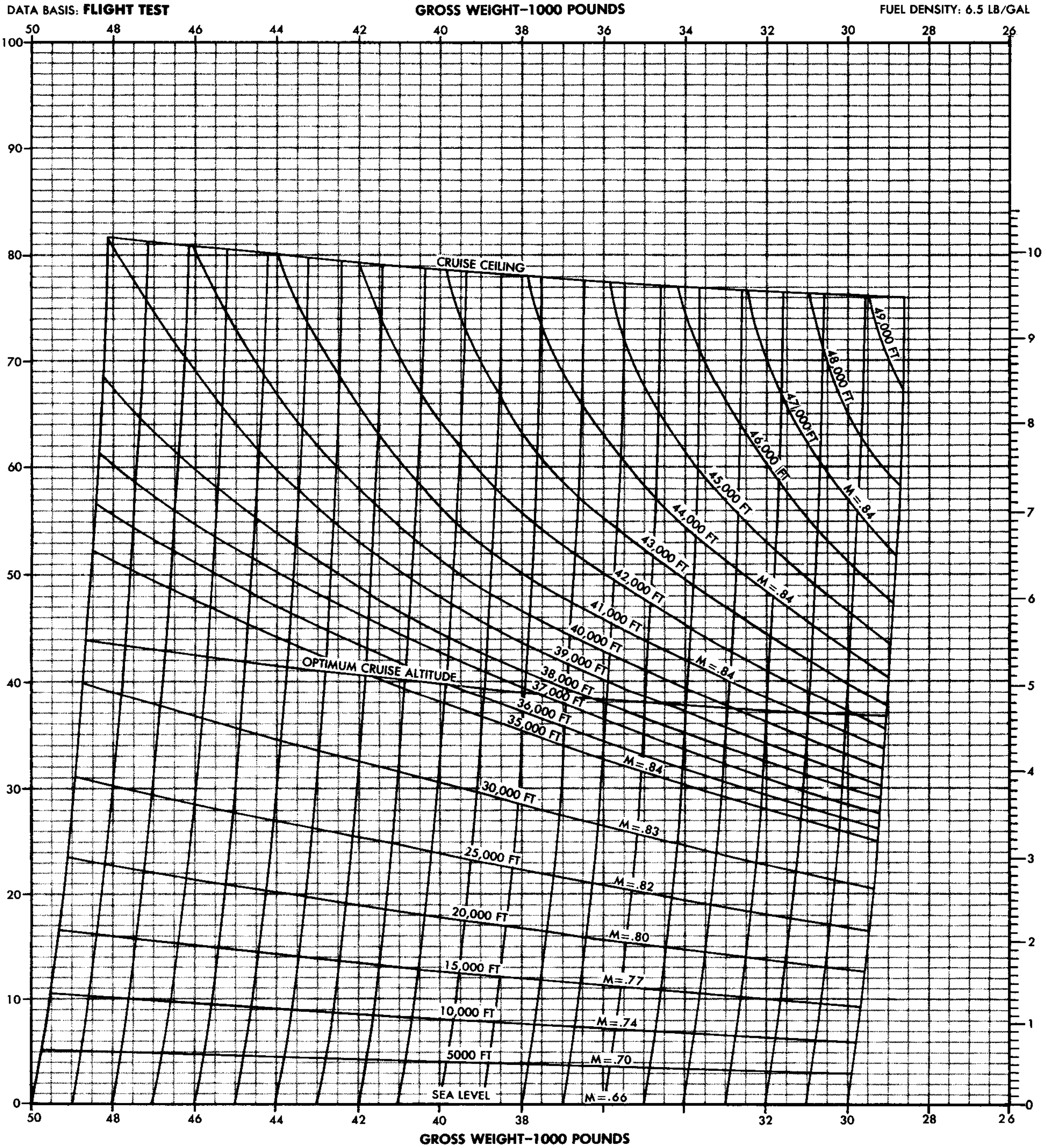
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±15,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 25,000 FT

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

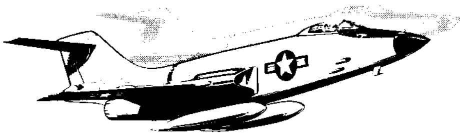


F/RF/YRF20-P313A

Figure A3-2

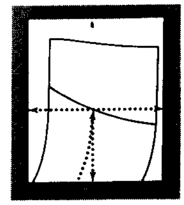
MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



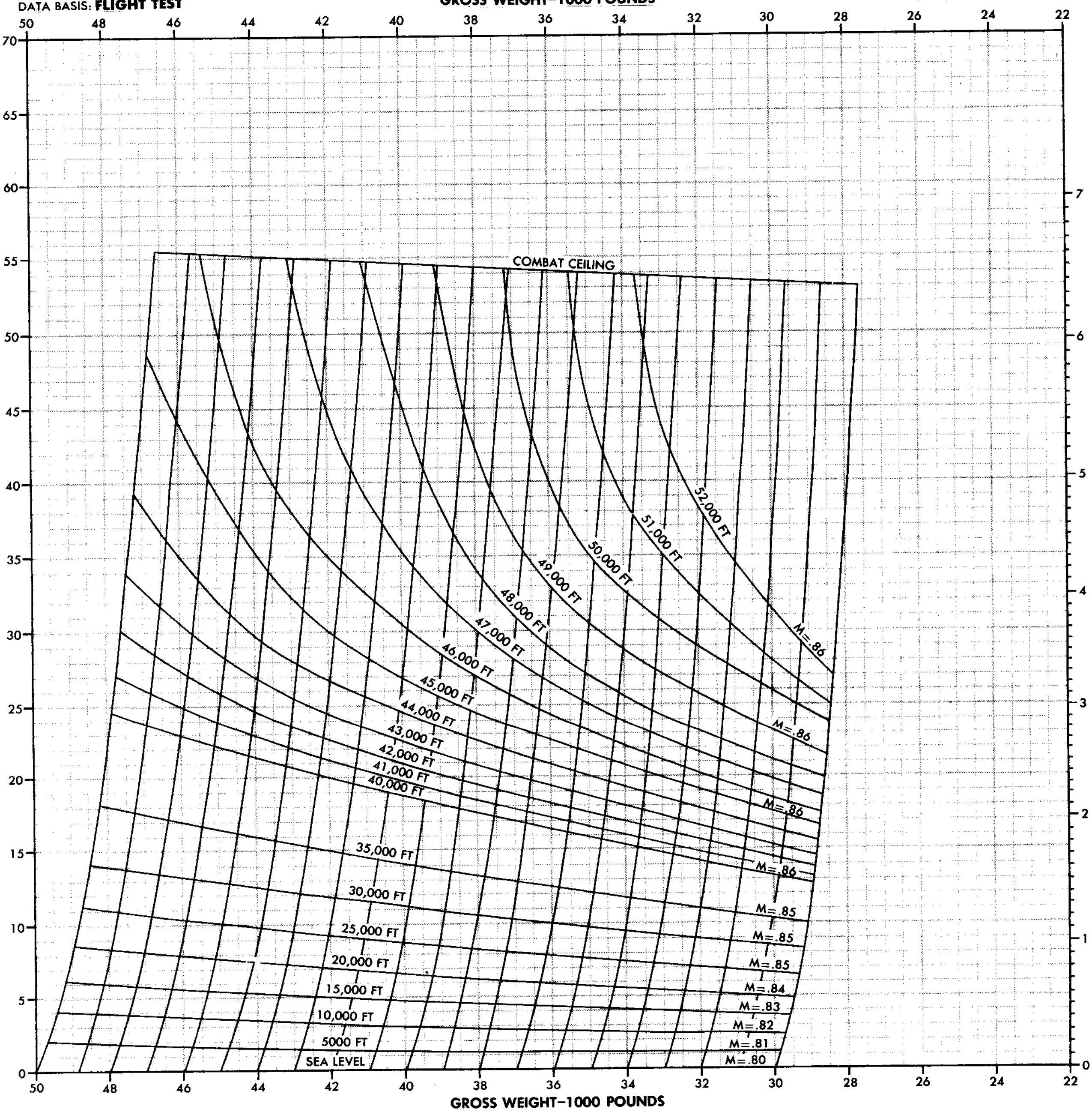
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±10,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 35,000 FT

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

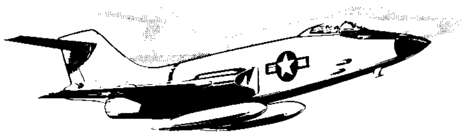


F/RF/YRF20-P314A

Figure A3-3

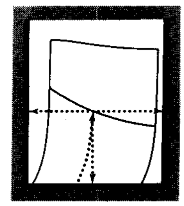
MILITARY THRUST CLIMB

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



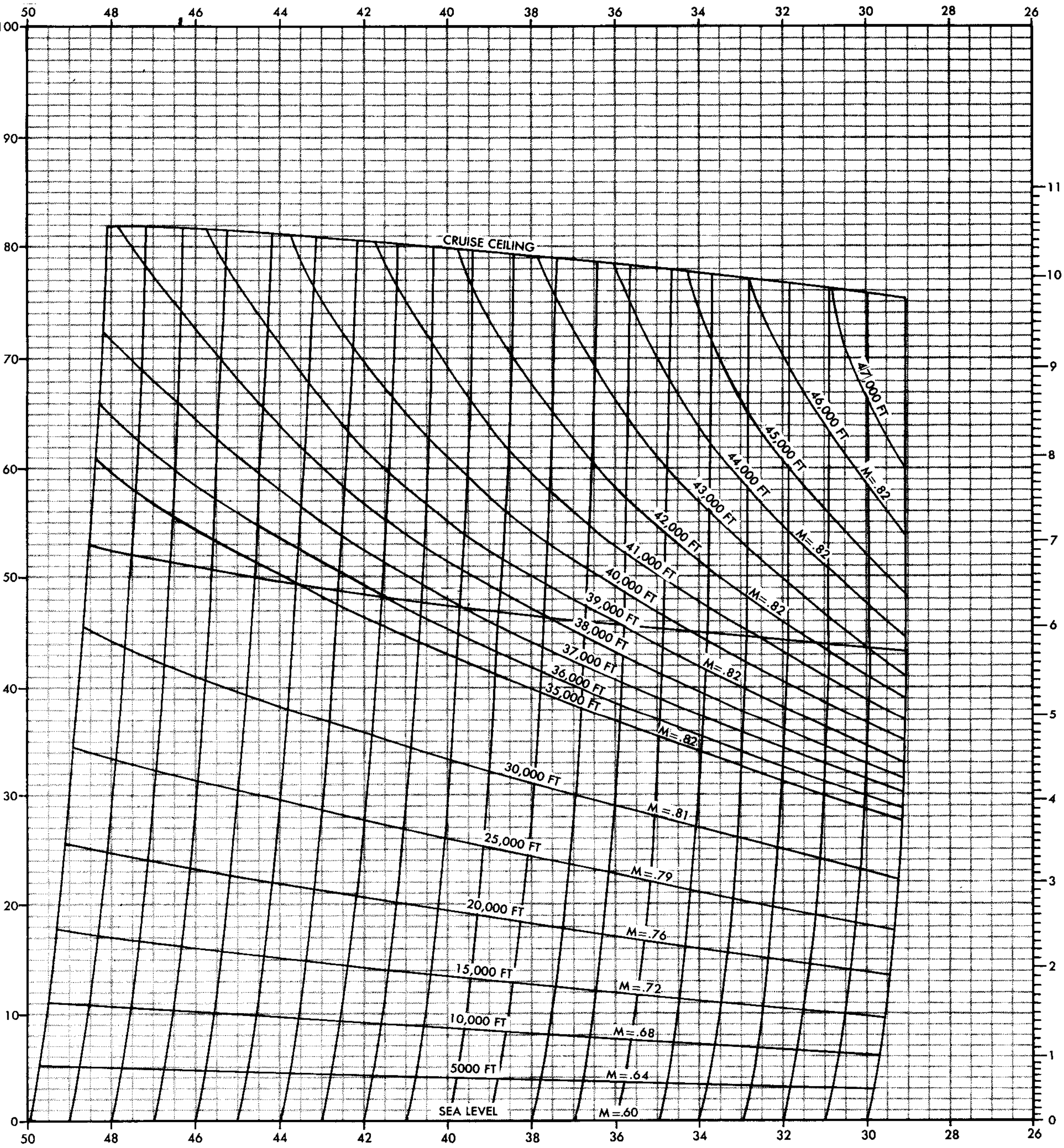
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±15,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 25,000 FT

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

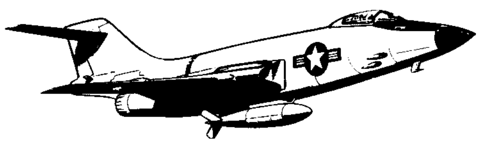


F/RF/YRF20-P315A

Figure A3-4

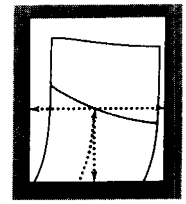
MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
F-101A: MK-7



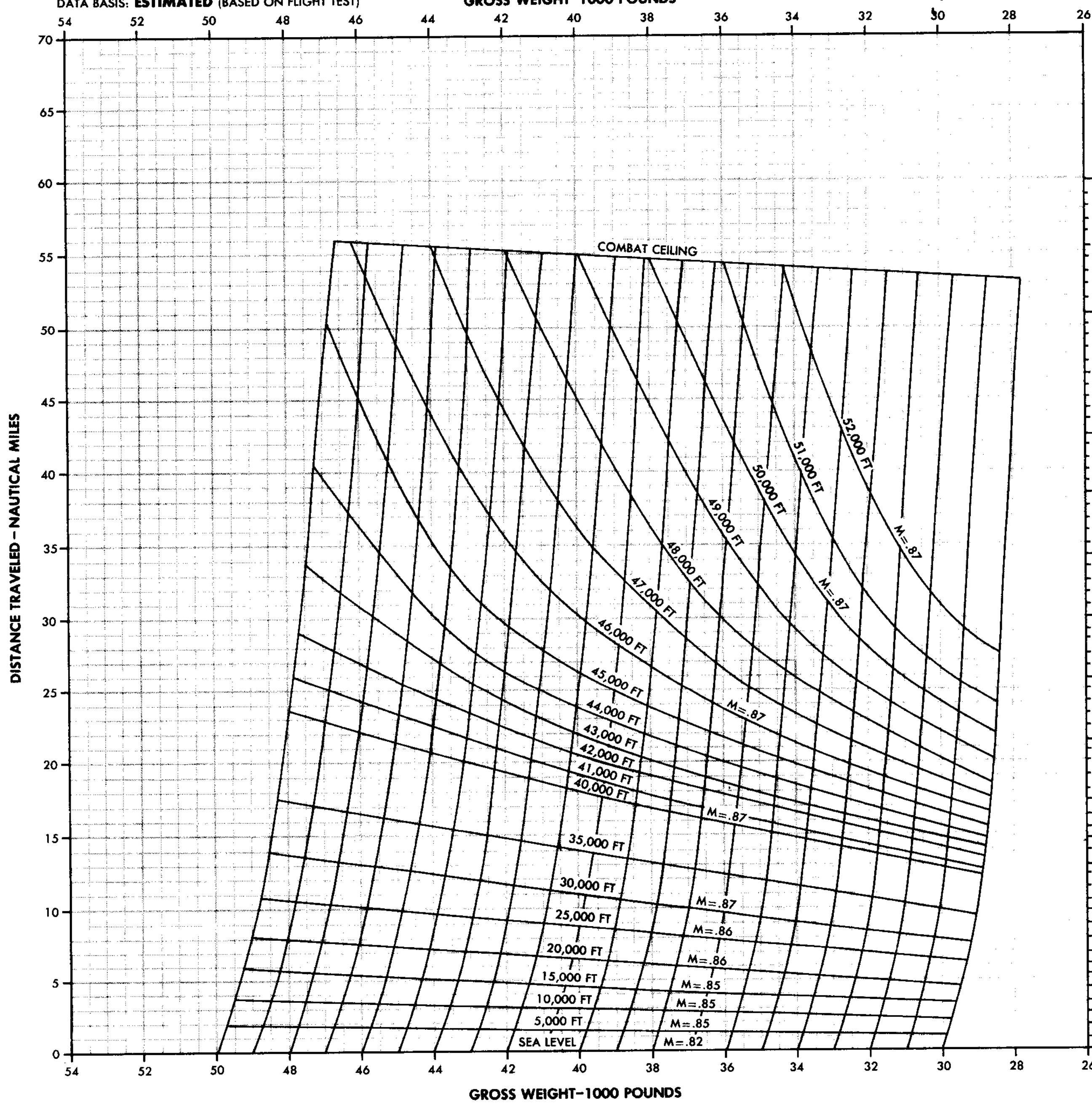
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±10,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 35,000 FT

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

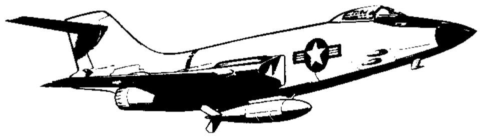


FA20-P316A

Figure A3-5

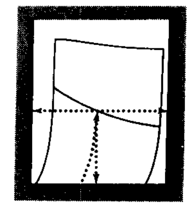
MILITARY THRUST CLIMB

AIRPLANE CONFIGURATION
F-101A: MK-7



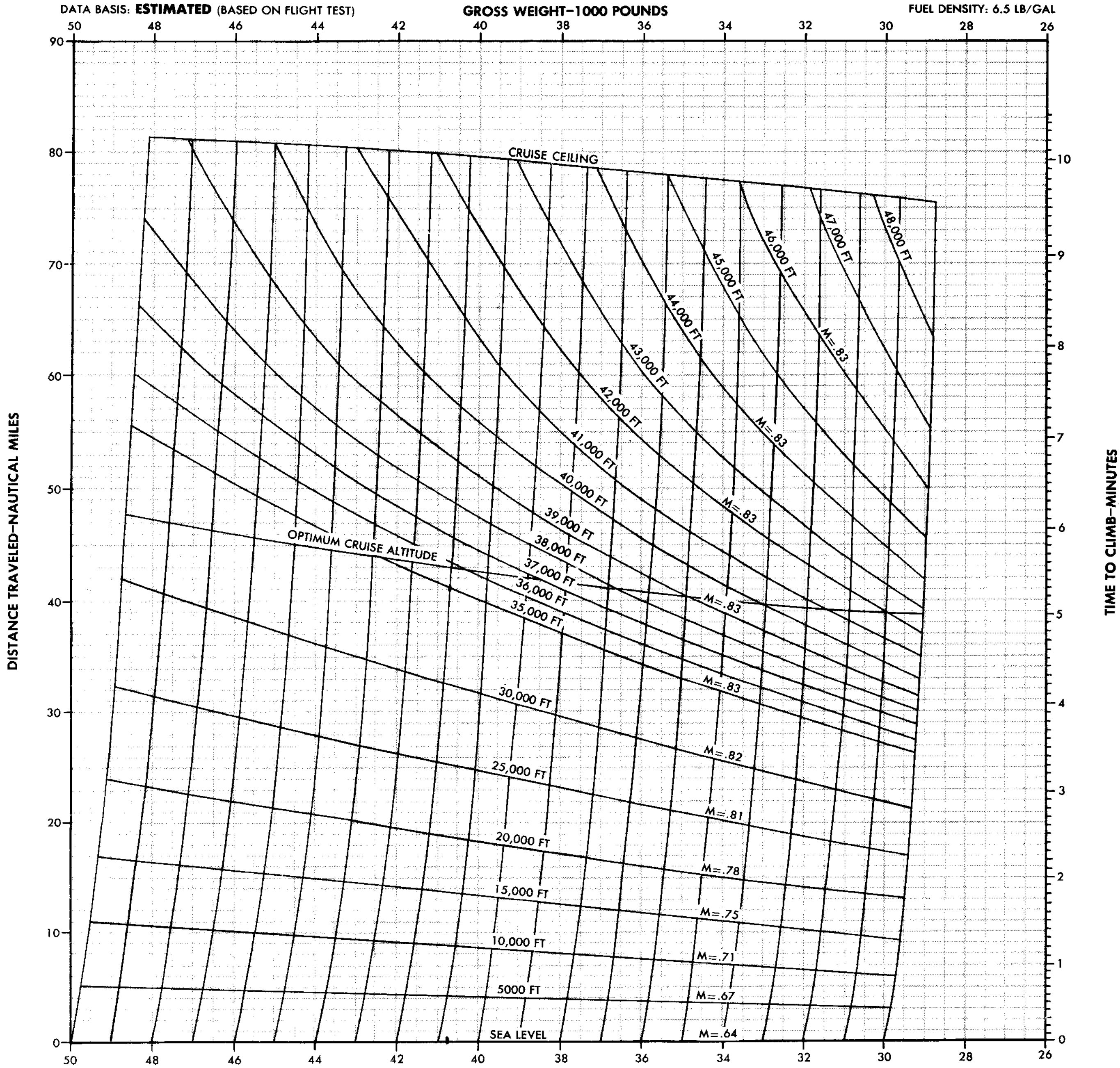
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±15,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 25,000 FT.

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

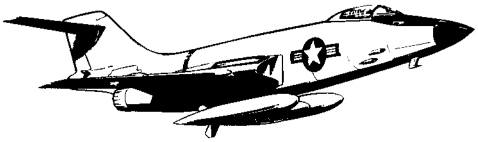


FA20-P317A

Figure A3-6

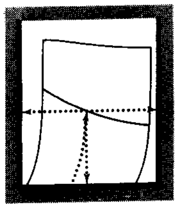
MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



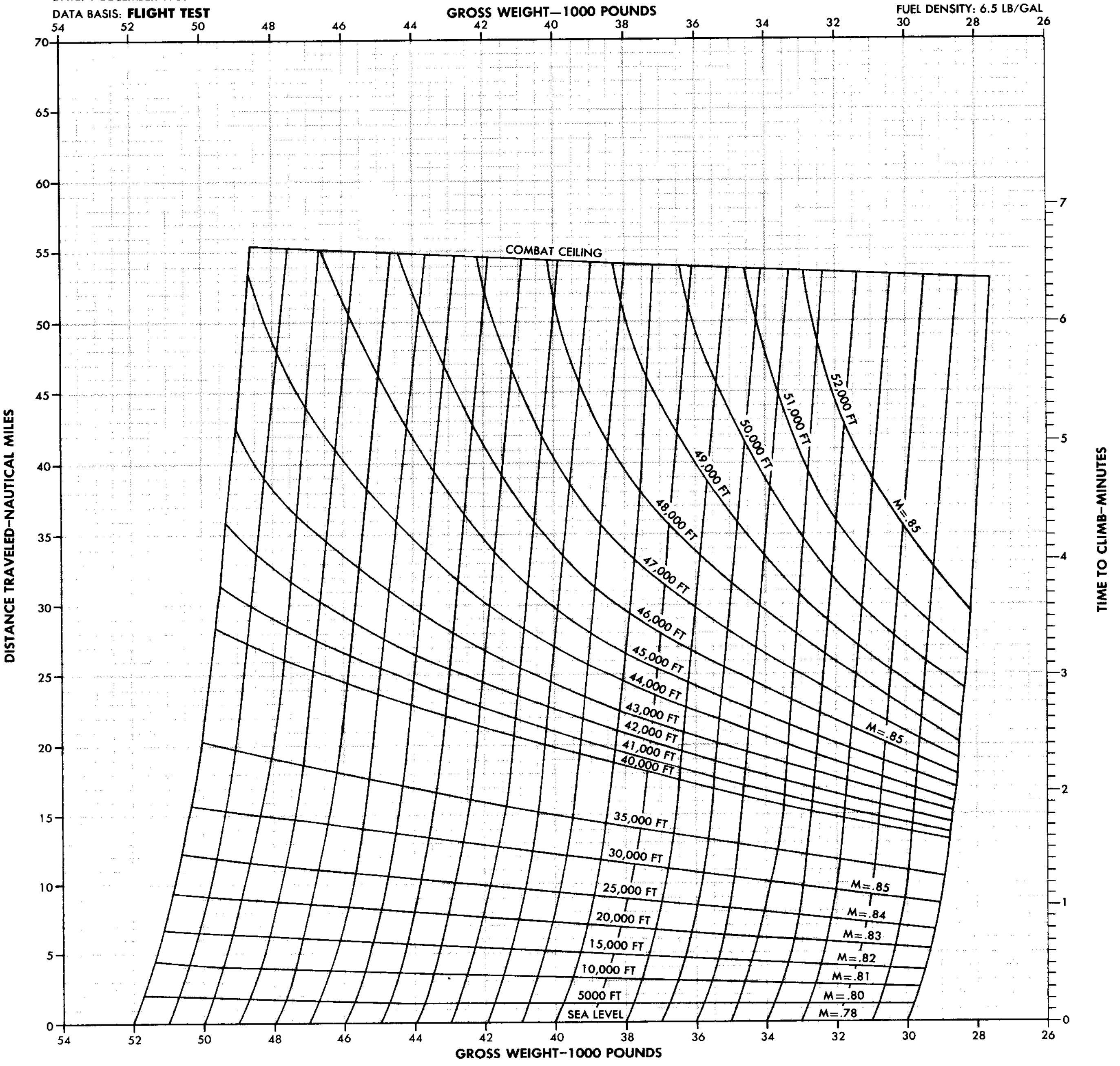
REMARKS
ENGINE(S) (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±10,000 LB. GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 35,000 FT.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

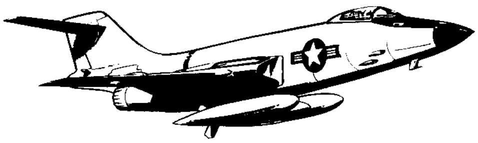


FA20-P318B

Figure A3-7

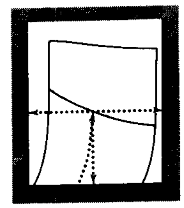
MILITARY THRUST CLIMB

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



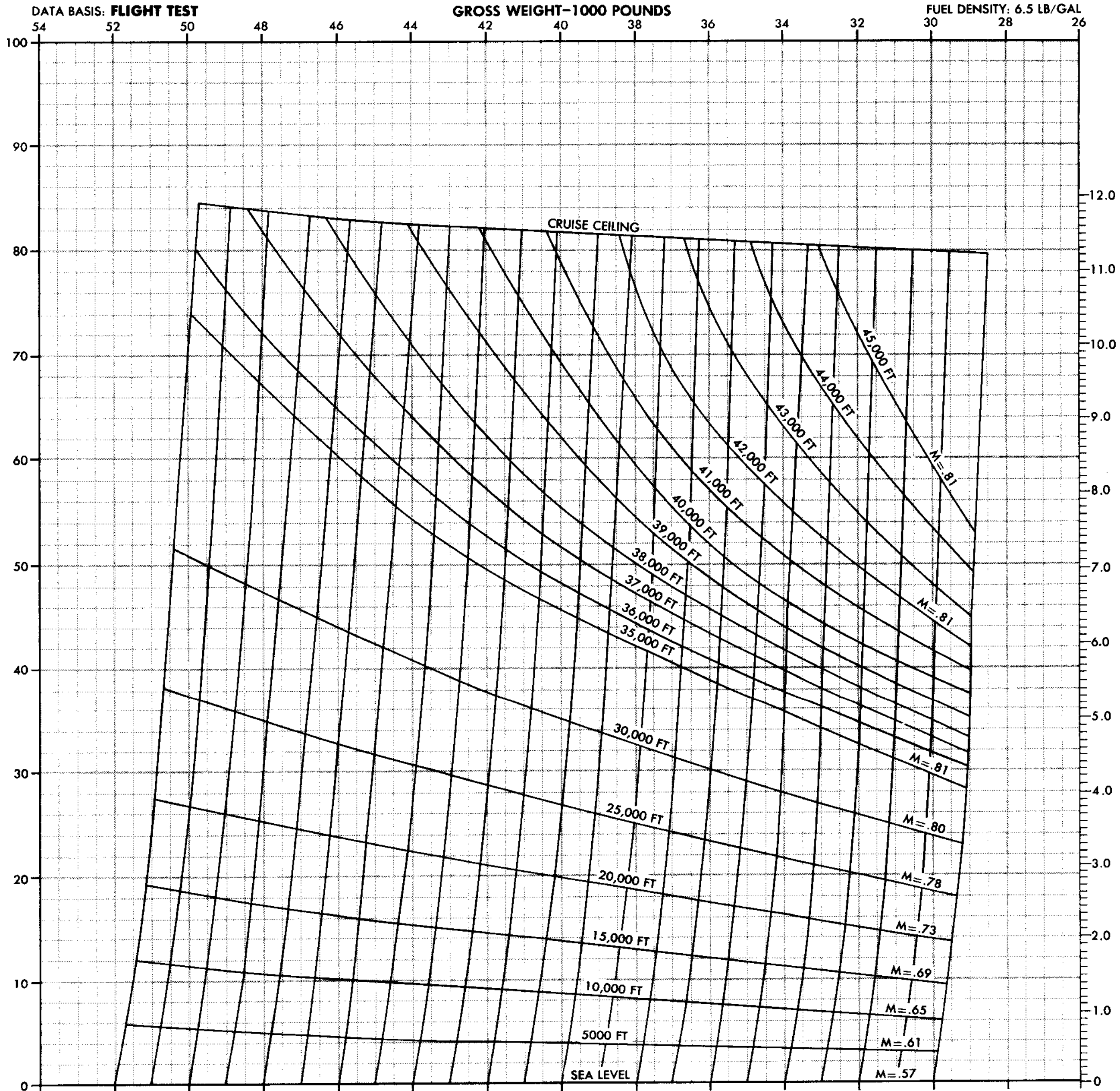
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±15,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 25,000 FT.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



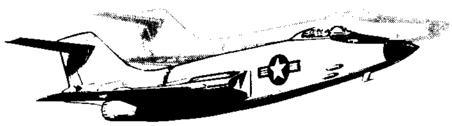
FA20-P319B

Figure A3-8

MAXIMUM THRUST CLIMB

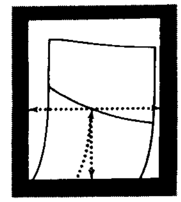
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



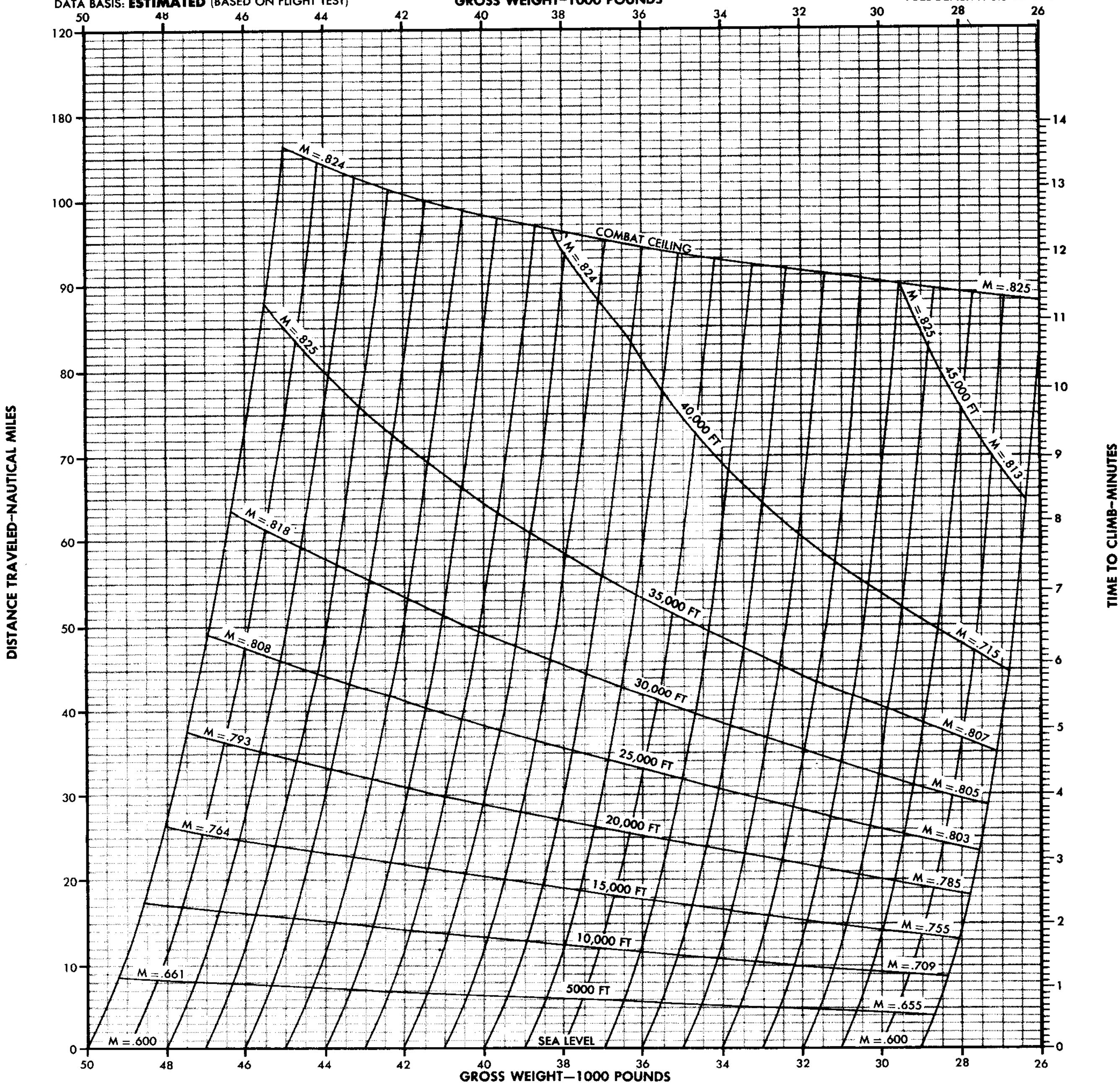
REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ±10,000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 35,000 FT

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

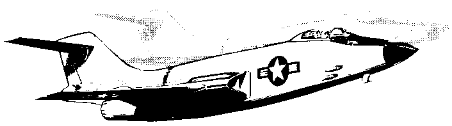


F/RF/YRF20-P320A

Figure A3-9

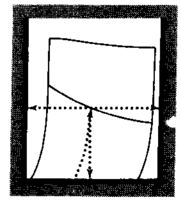
MILITARY THRUST CLIMB
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



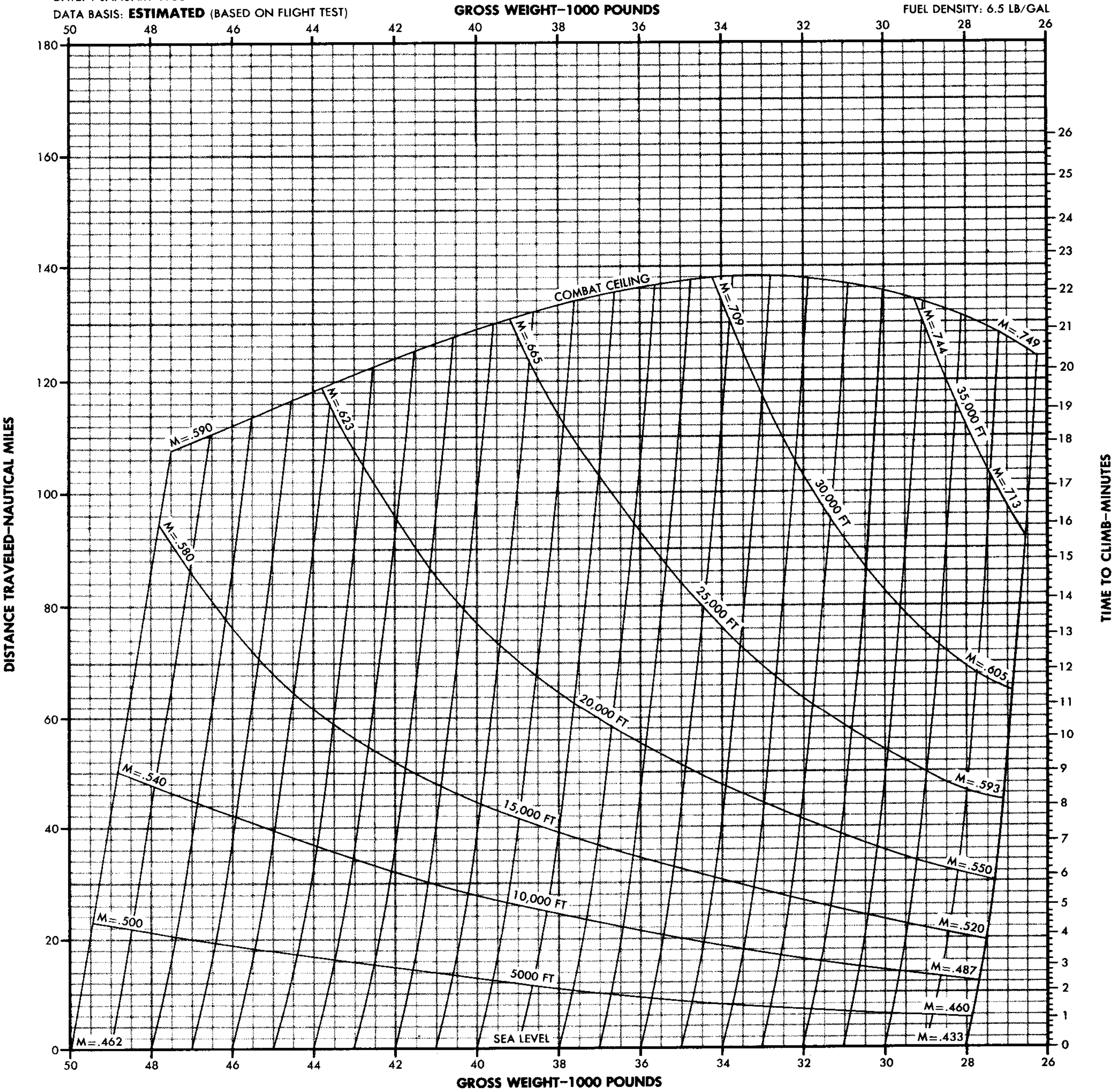
REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
A ±10°C TEMPERATURE CHANGE CORRESPONDS TO A ± 6000 LB GROSS WEIGHT CHANGE AT AN AVERAGE ALTITUDE OF 15,000 FT

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



F/RF/YRF20-P321A

Figure A3-10

range part 4

NAUTICAL MILES PER POUND OF FUEL CHARTS

The Nautical Miles Per Pound of Fuel charts (figures A4-1 through A4-38) graphically present cruise data throughout the speed range from maximum endurance to Military thrust. Several weights for each configuration and operating condition (emergency single-engine and normal two-engine operation) are given at altitudes of sea level, 5,000, 15,000, 25,000, 30,000, 40,000, and 45,000 feet. Each chart includes specific range (nautical miles per pound), fuel flow, and power settings (pressure ratio). Also included are curves of recommended cruise Mach number, maximum endurance, and Military thrust. Specific range is plotted vs. Mach number, with subscales of calibrated airspeed (CAS) and true airspeed (TAS).

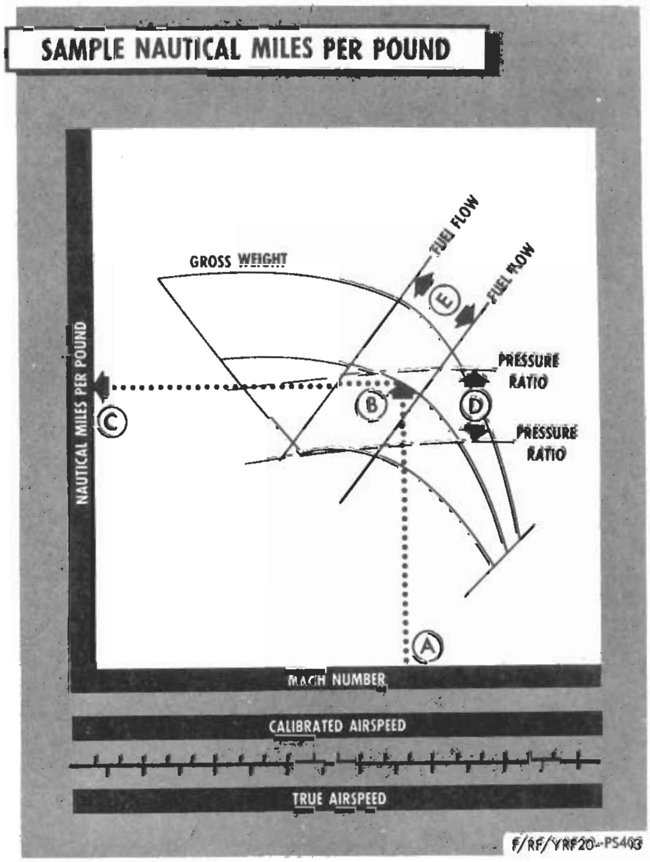
USE

Enter the chart at the desired Mach number and proceed vertically to the gross weight curve. Proceed to the left scale and read the nautical miles per pound. At the intersection of Mach number and gross weight, interpolate thrust setting and fuel flow.

SAMPLE PROBLEM

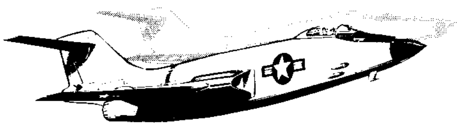
Configuration: Airplane With (2) 450 Gallon Tanks (35,000 Feet)

A. Mach Number	.85
B. Gross Weight	35,000 Lbs.
C. Nautical Miles Per Pound (Specific Range)	.107
D. Thrust Setting	1.91 P.R.
E. Fuel Flow	2320 PPH



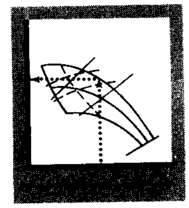
NAUTICAL MILES PER POUND
SEA LEVEL

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



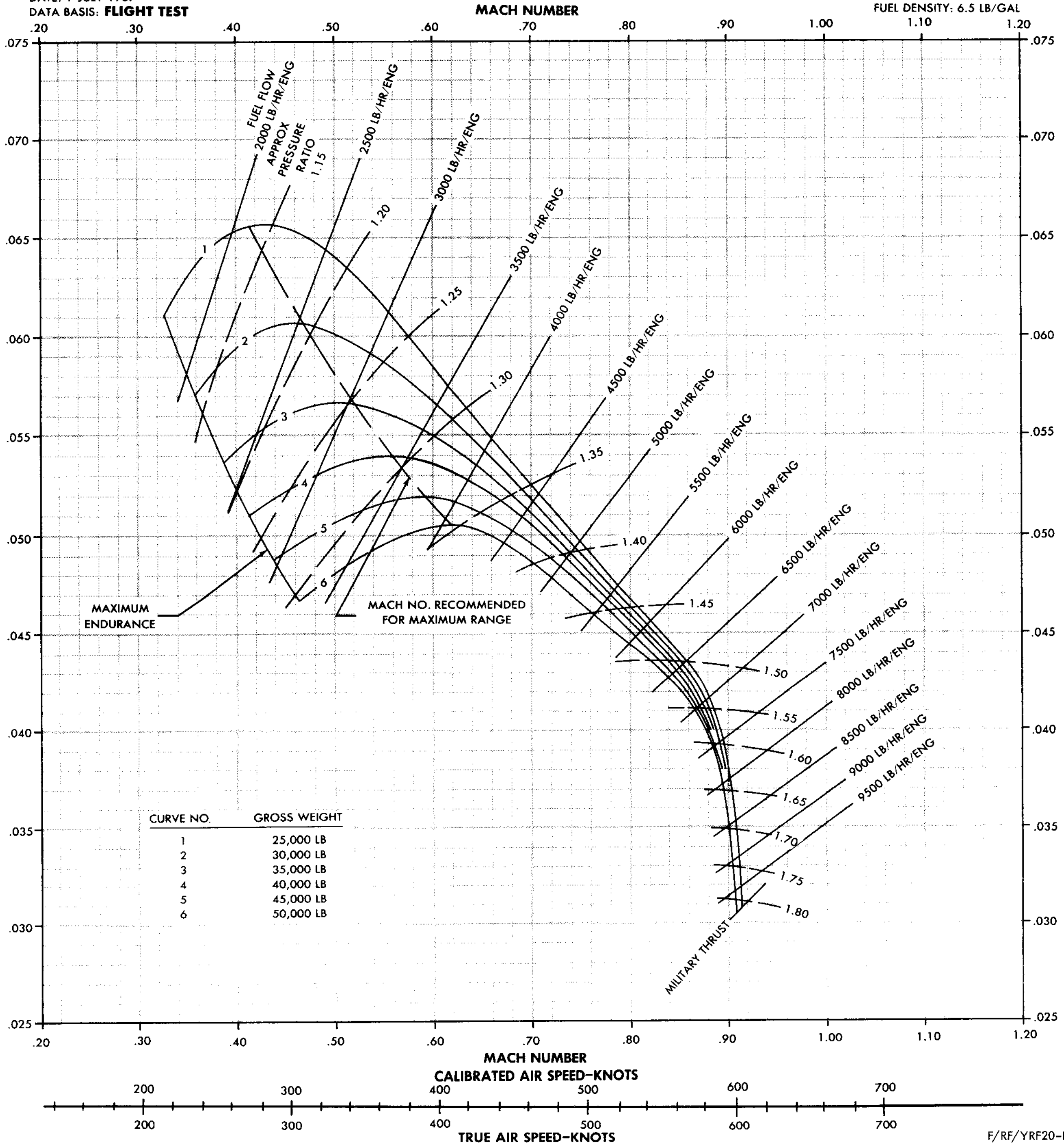
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 14%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



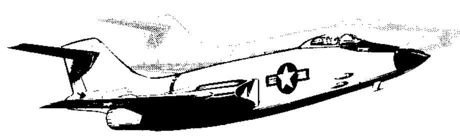
F/RF/YRF20-P429

Figure A4-1

NAUTICAL MILES PER POUND

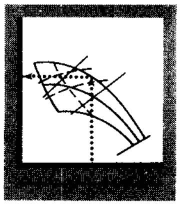
5000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



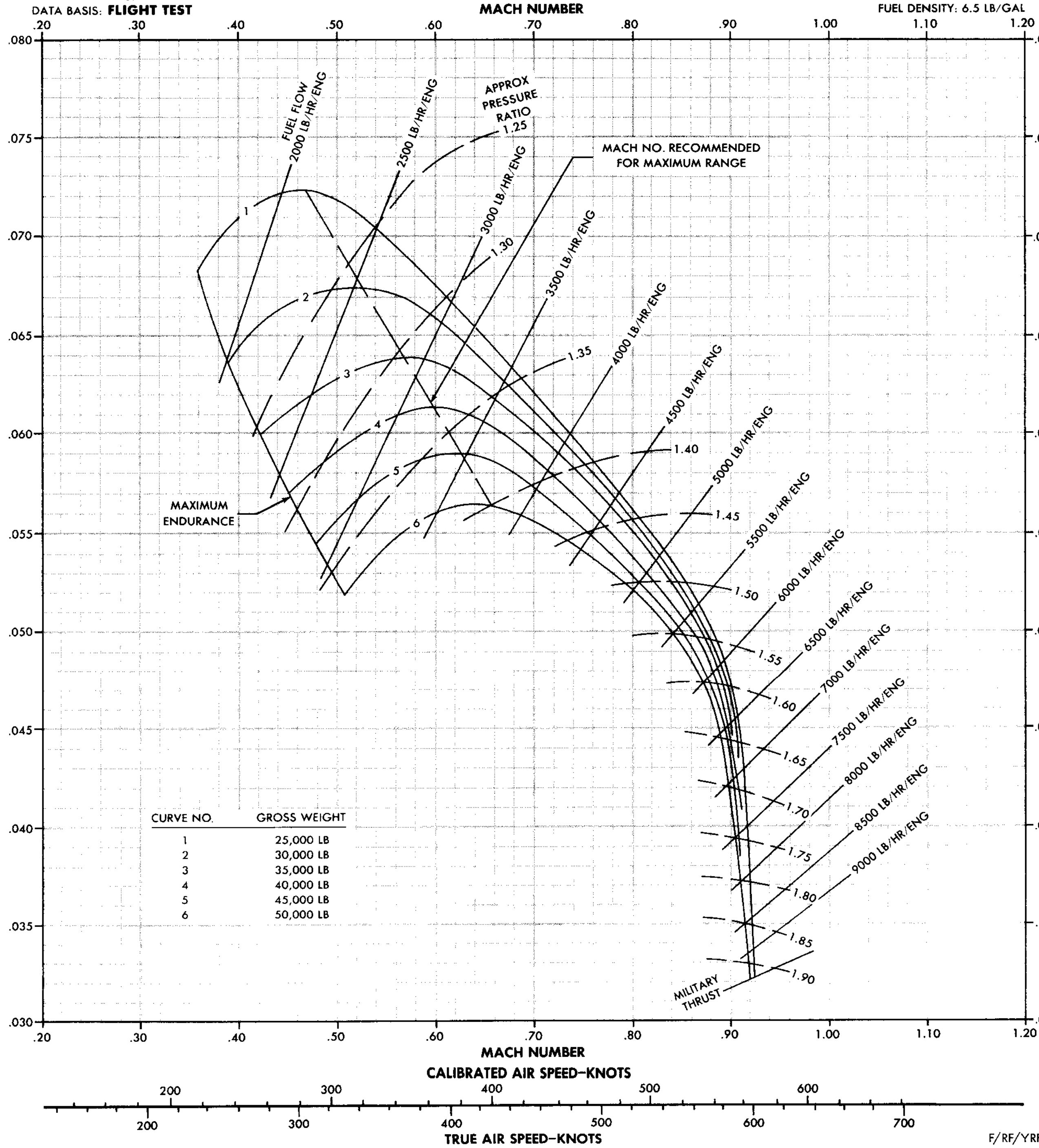
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 13%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

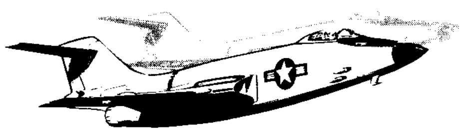


CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-2

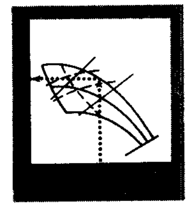
NAUTICAL MILES PER POUND
15,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



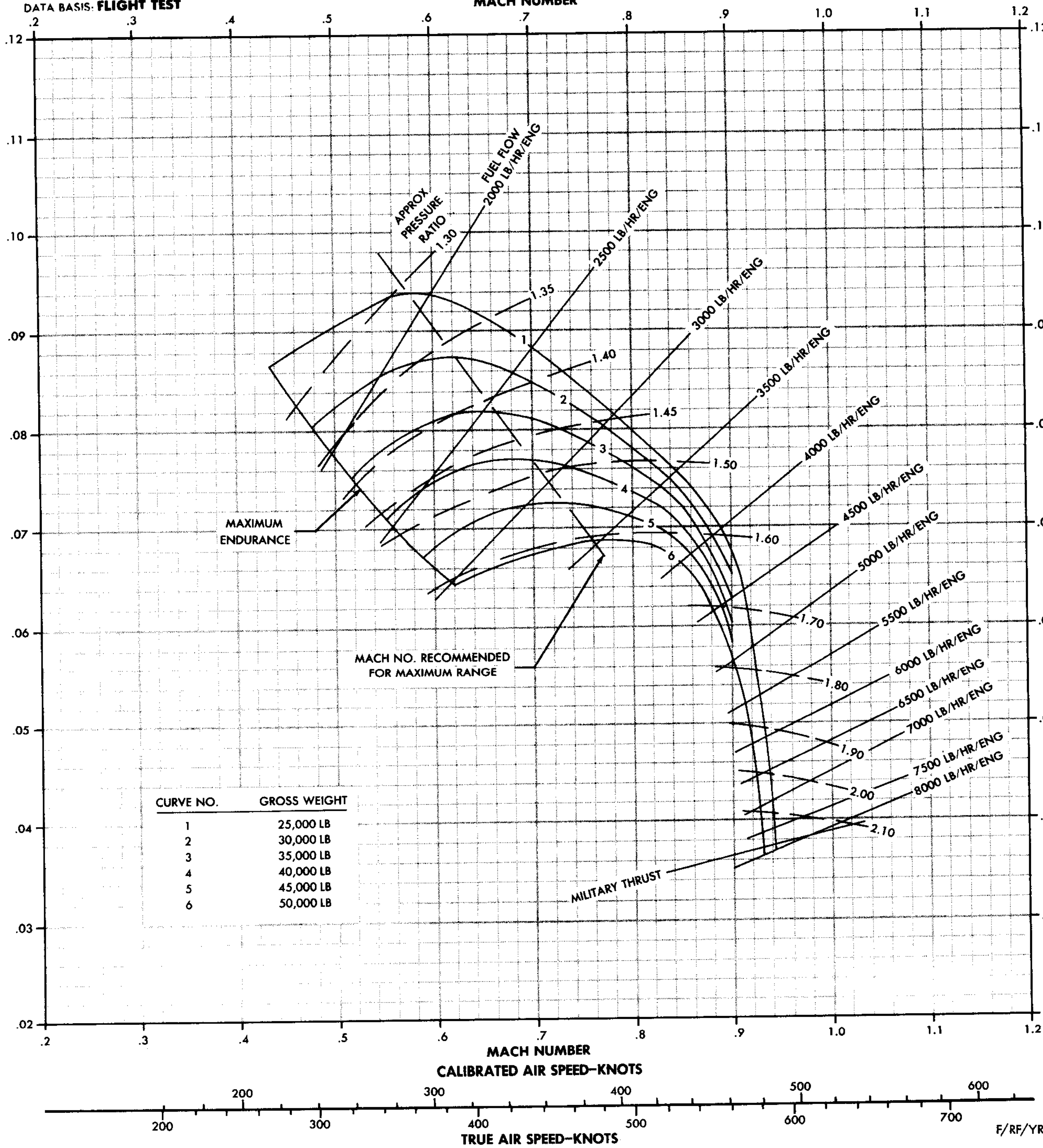
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH
NUMBER REMAINS THE SAME.
RANGE DECREASES 12%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



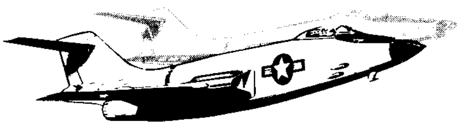
CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-3

NAUTICAL MILES PER POUND

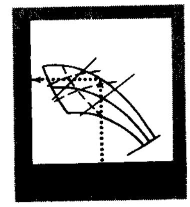
25,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



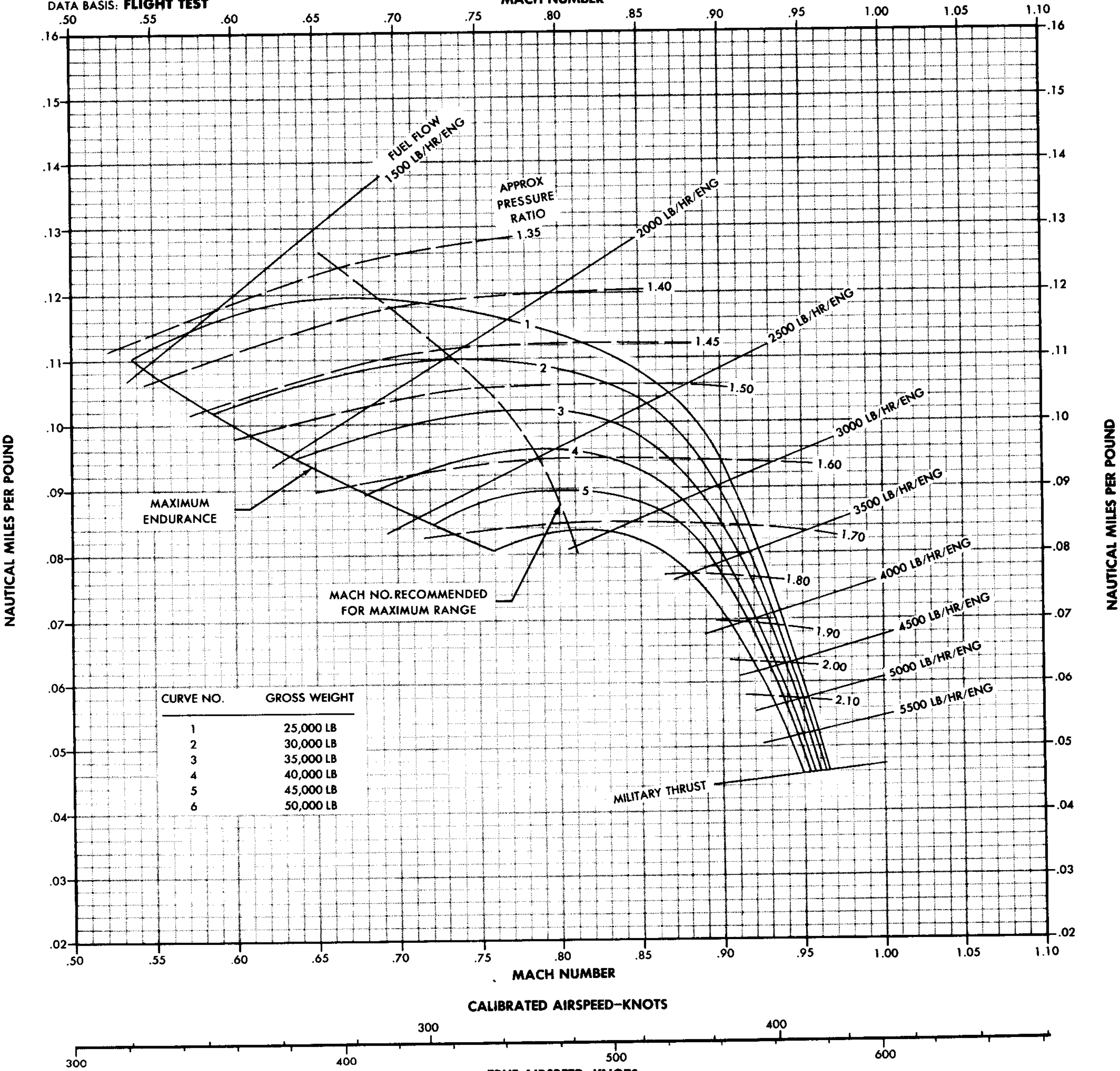
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOTS HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

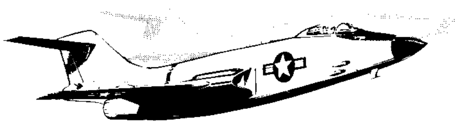
F/RF/YRF20-P432

Figure A4-4

NAUTICAL MILES PER POUND

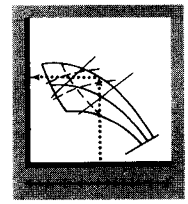
30,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

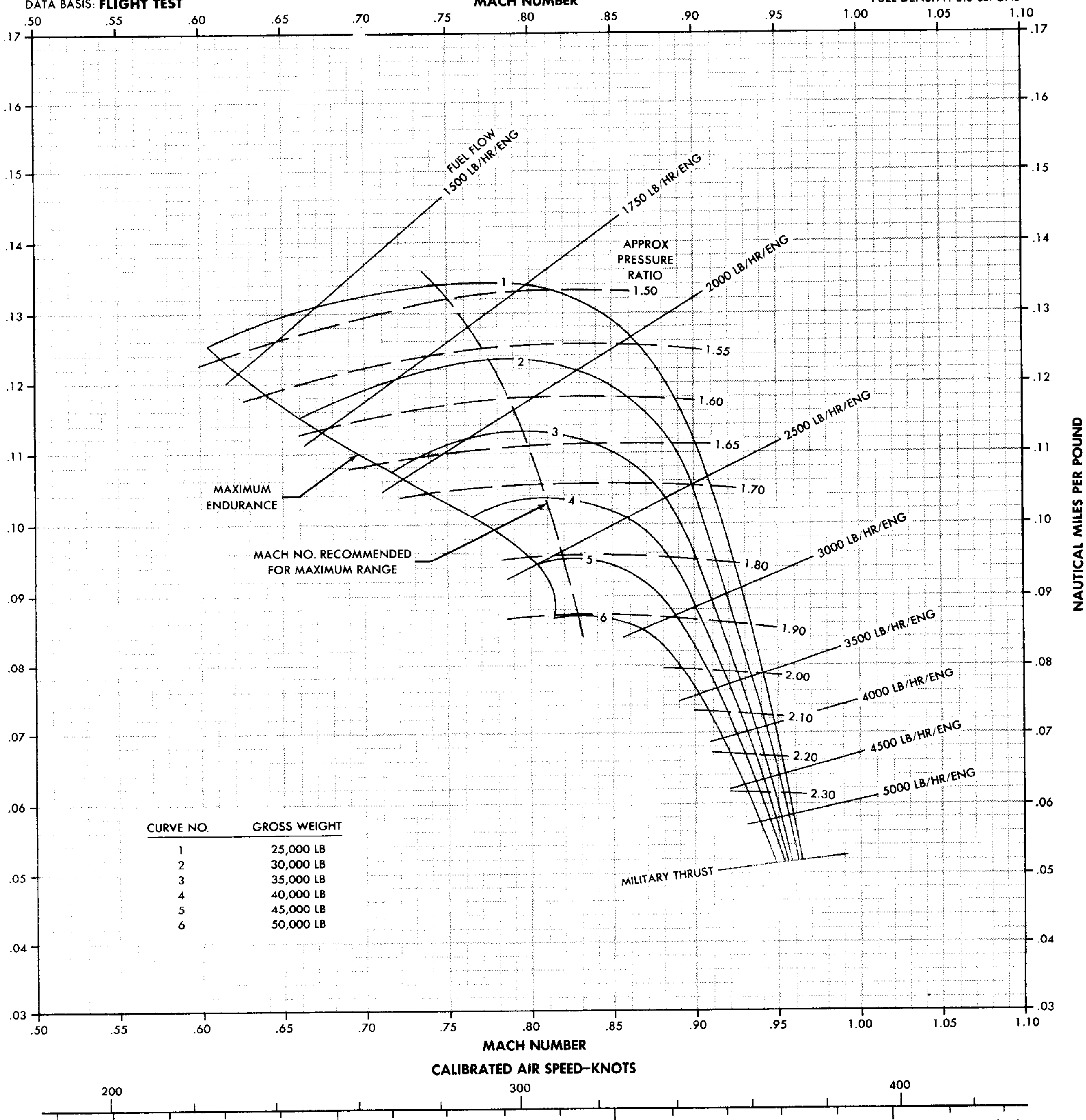
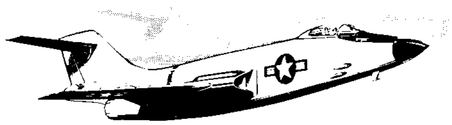


Figure A4-5

NAUTICAL MILES PER POUND

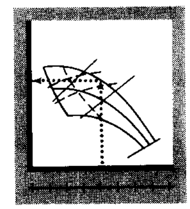
35,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



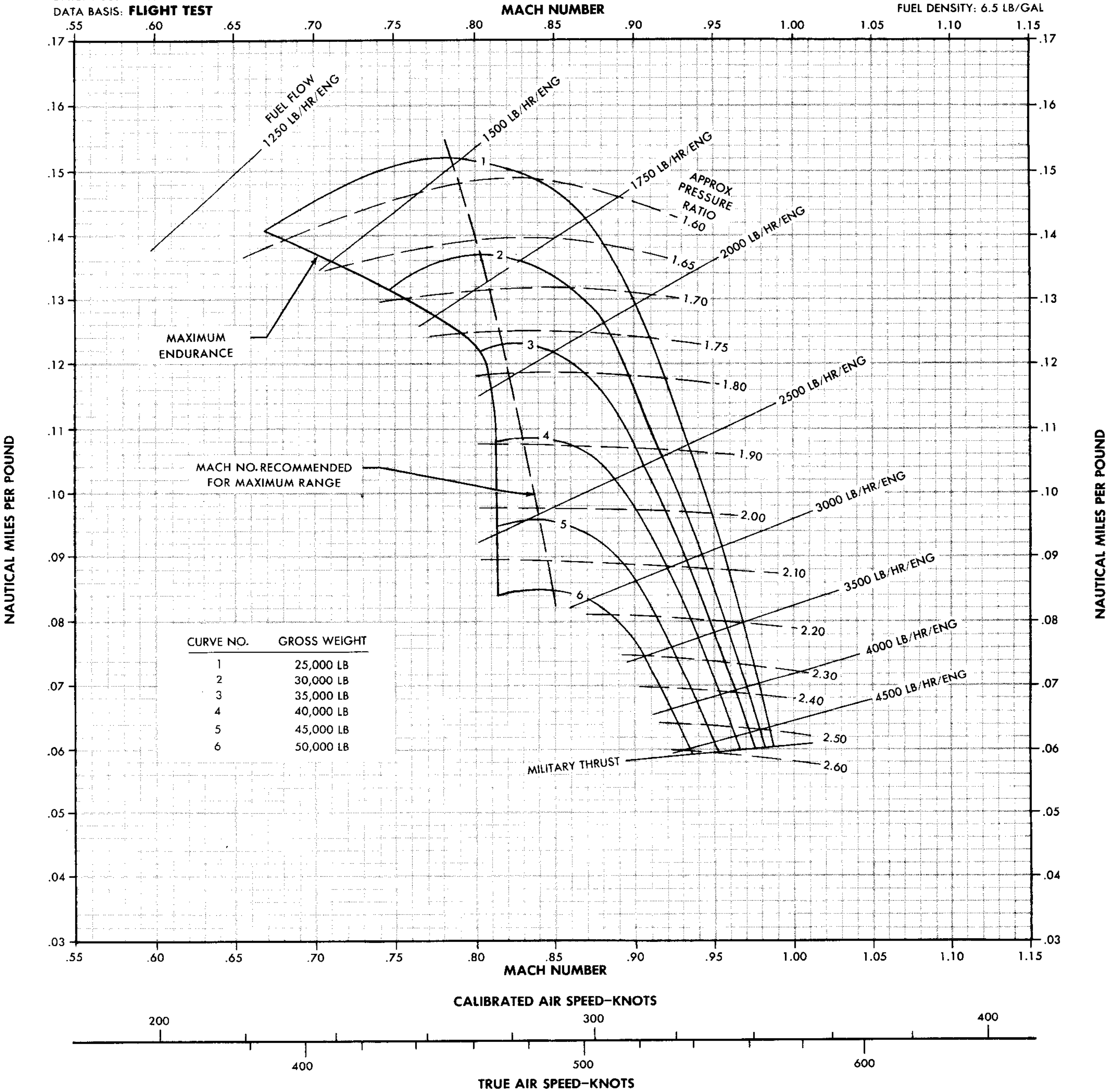
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

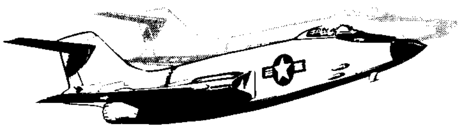
F/RF/YRF20-P434

Figure A4-6

NAUTICAL MILES PER POUND

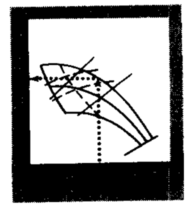
40,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



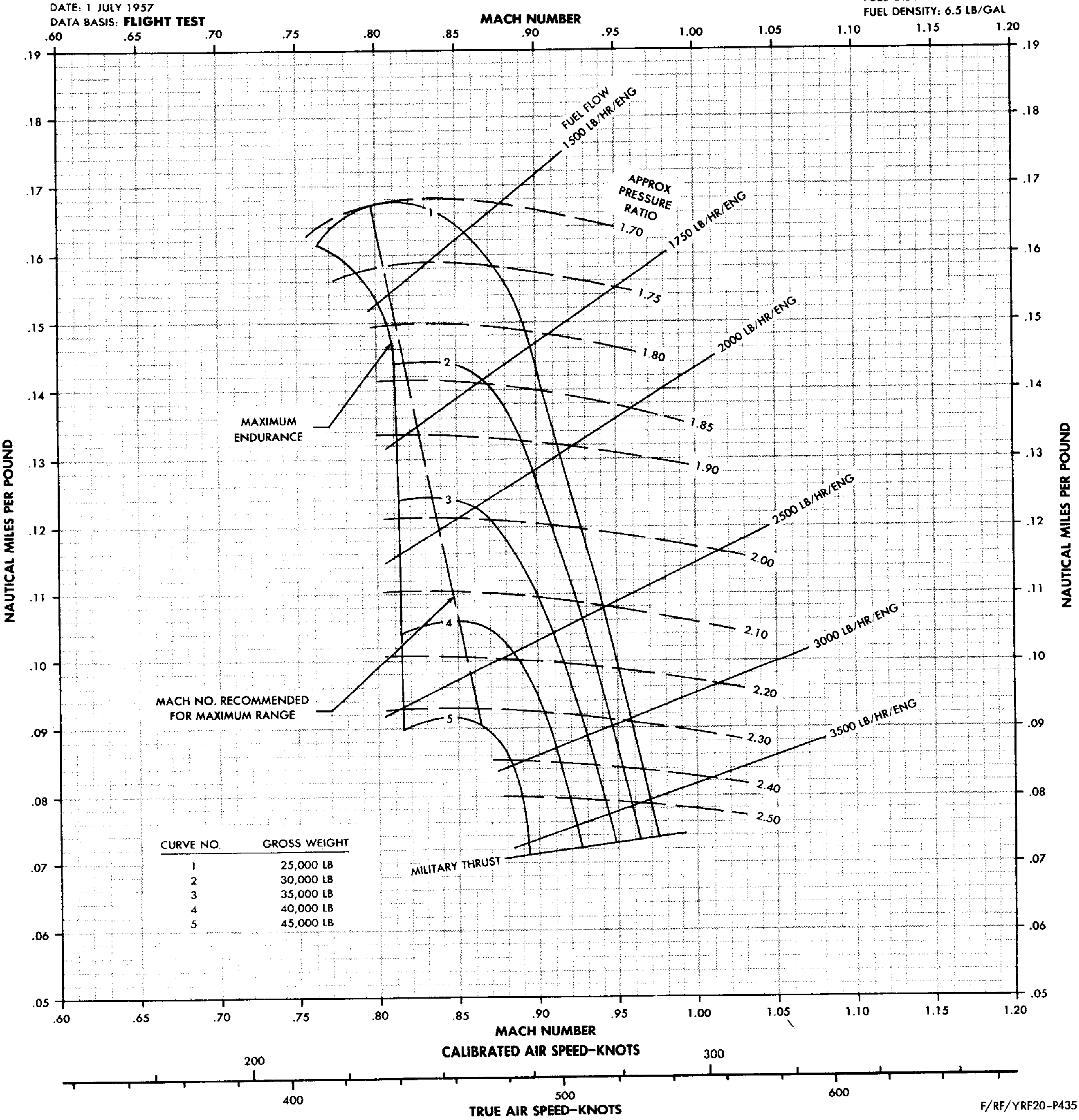
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 10%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



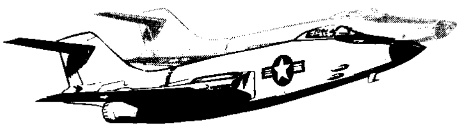
F/RF/YRF20-P435

Figure A4-7

NAUTICAL MILES PER POUND

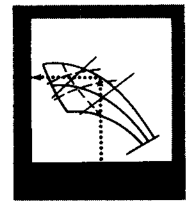
45,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 10%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

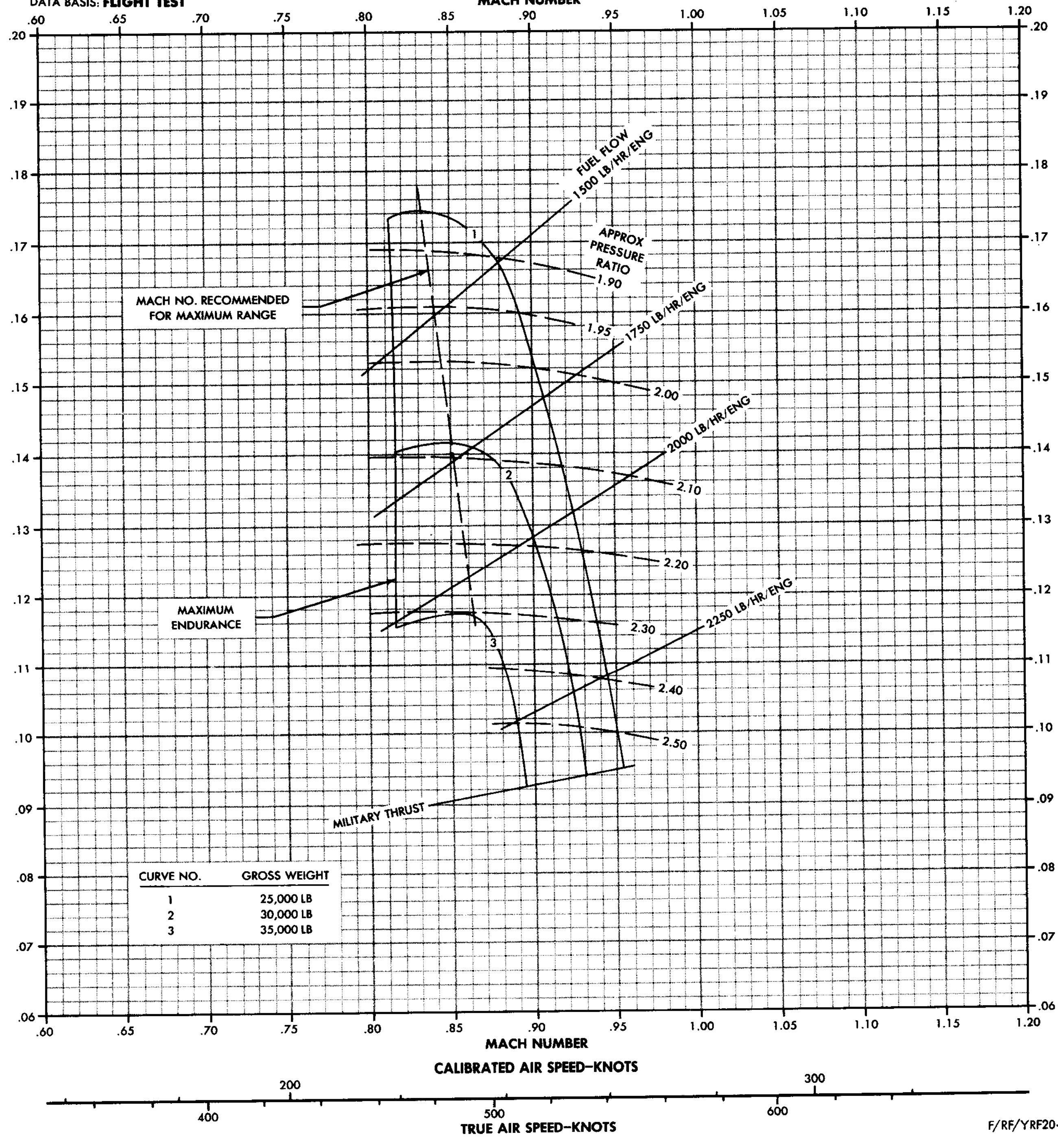
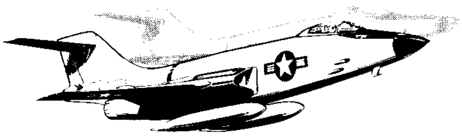


Figure A4-8

NAUTICAL MILES PER POUND

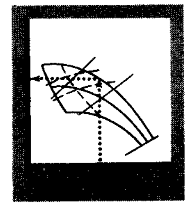
SEA LEVEL

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



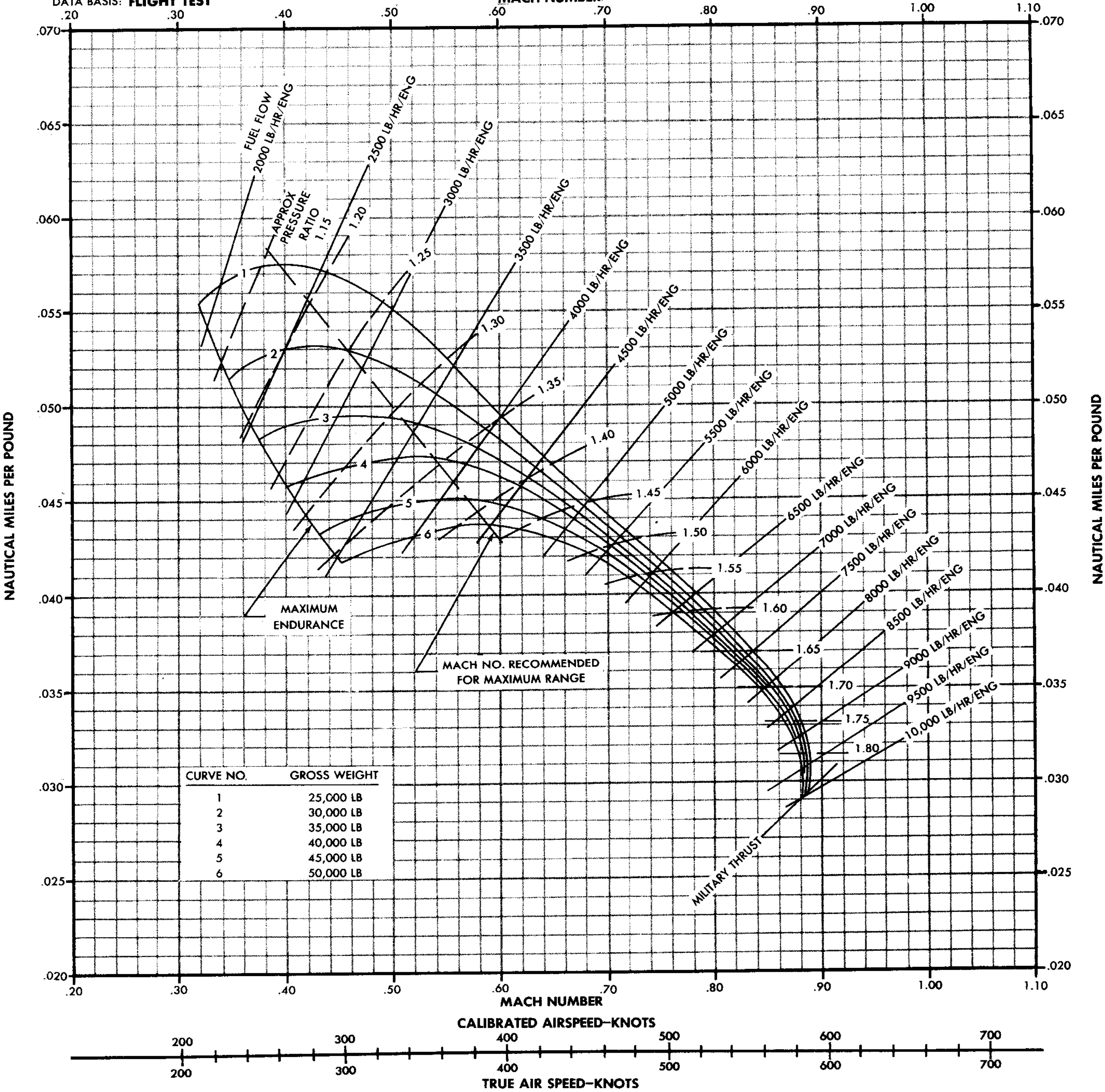
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 15%

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



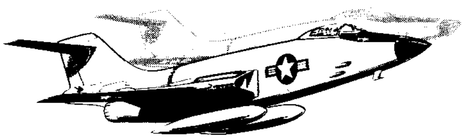
F/RF/YRF20-P437

Figure A4-9

NAUTICAL MILES PER POUND

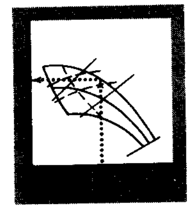
5000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



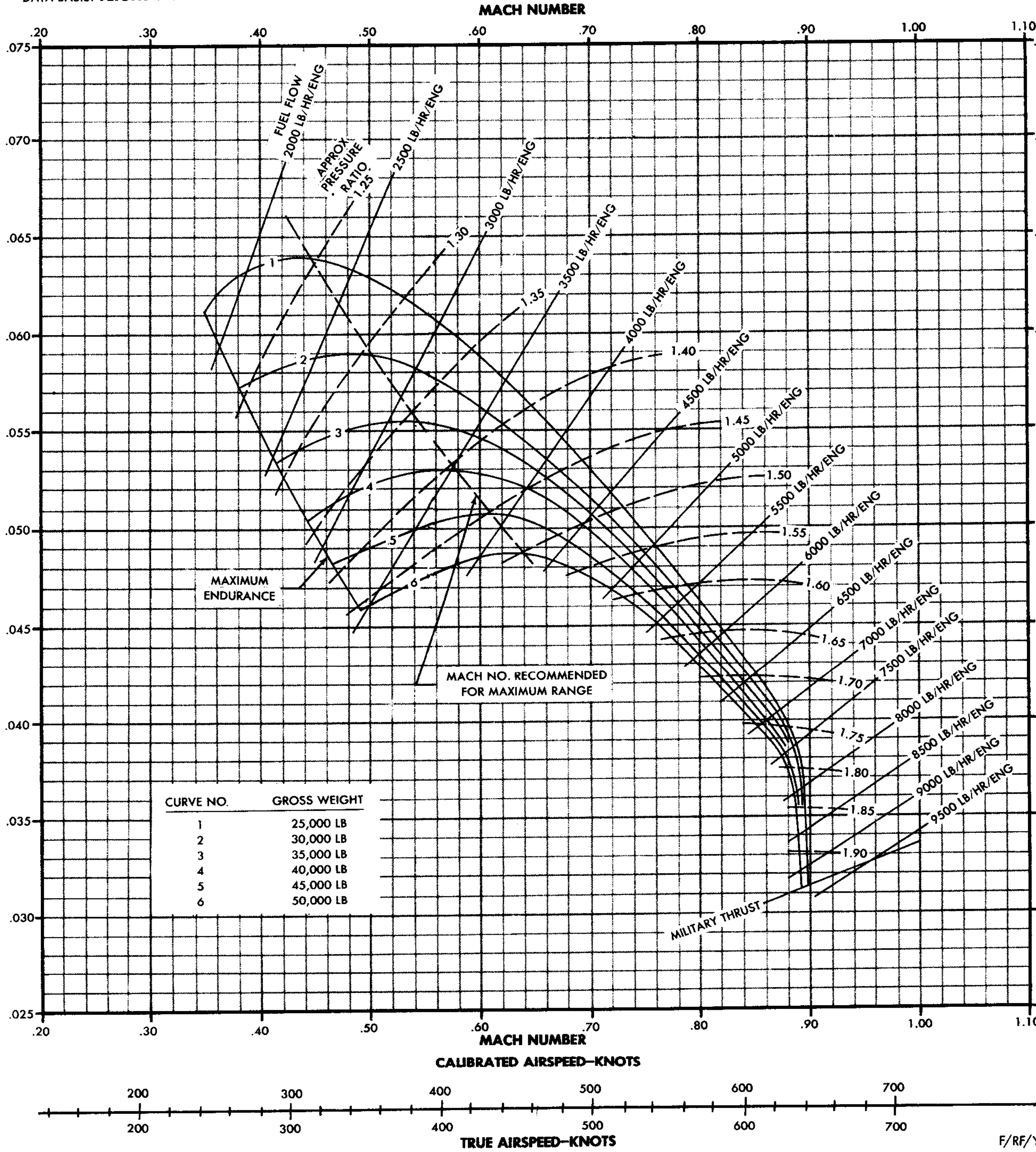
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOTS HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 14%

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

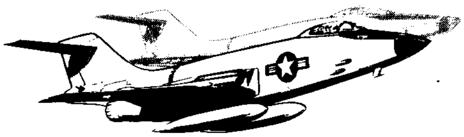
F/RF/YRF20-P438

Figure A4-10

NAUTICAL MILES PER POUND

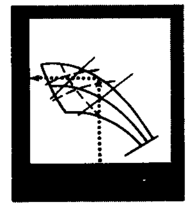
15,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 12%

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

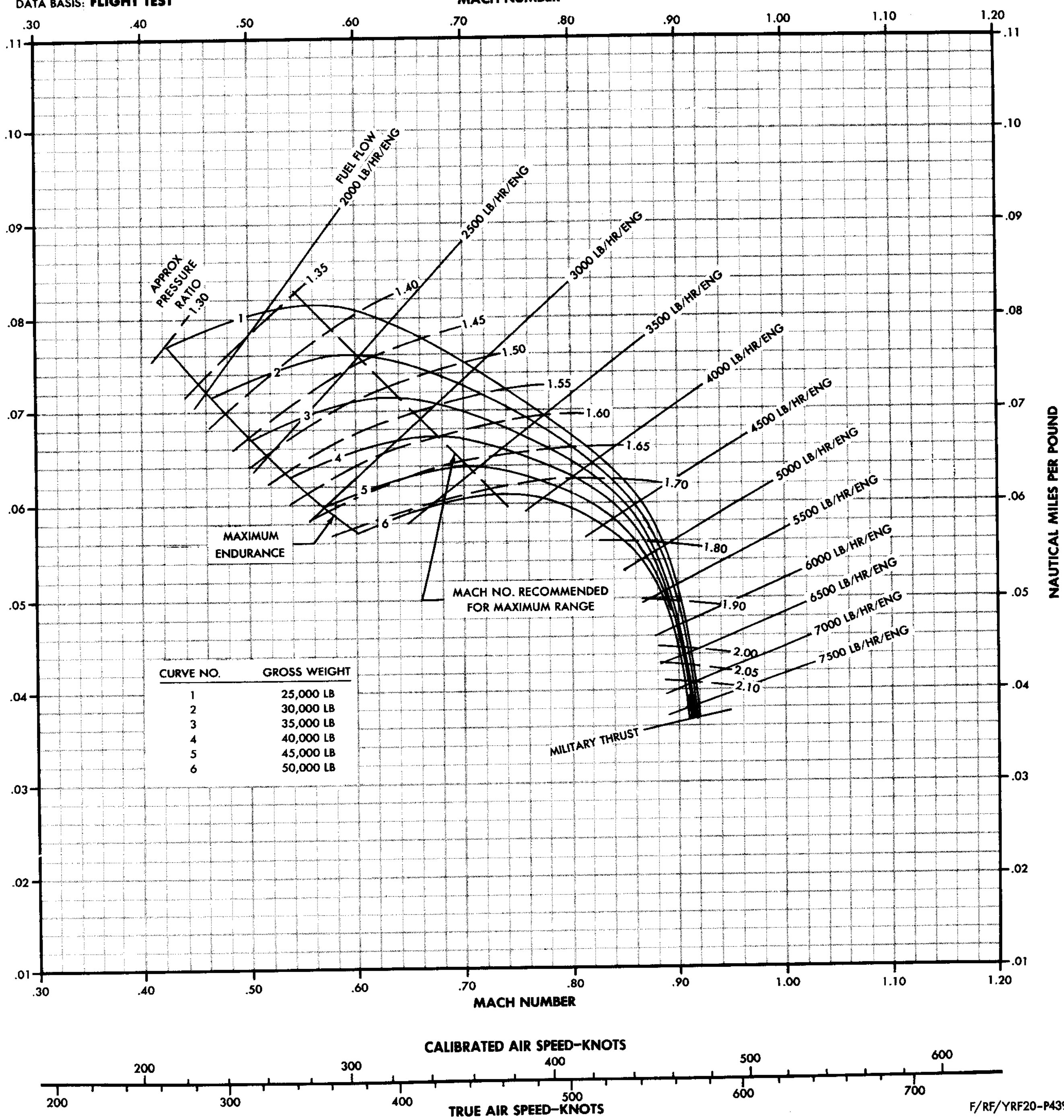
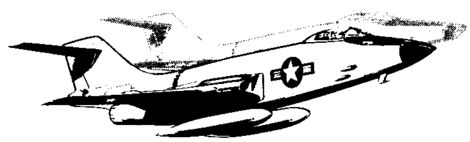


Figure A4-11

NAUTICAL MILES PER POUND

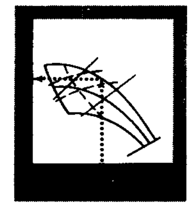
25,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



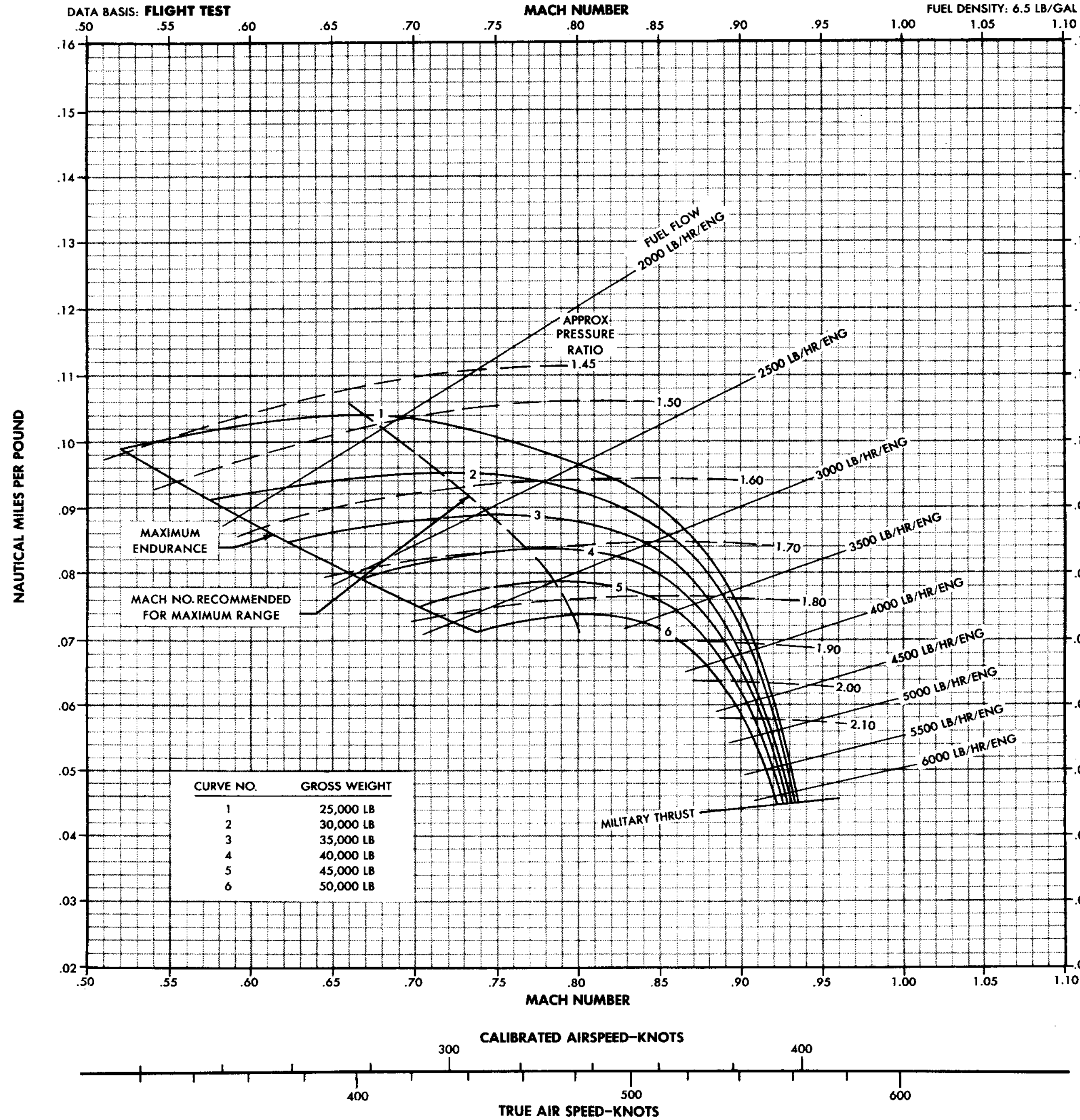
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



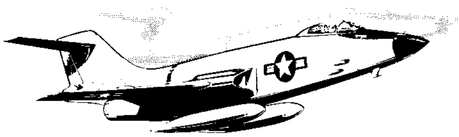
F/RF/YRF20-P440

Figure A4-12

NAUTICAL MILES PER POUND

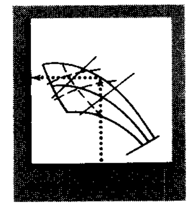
30,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



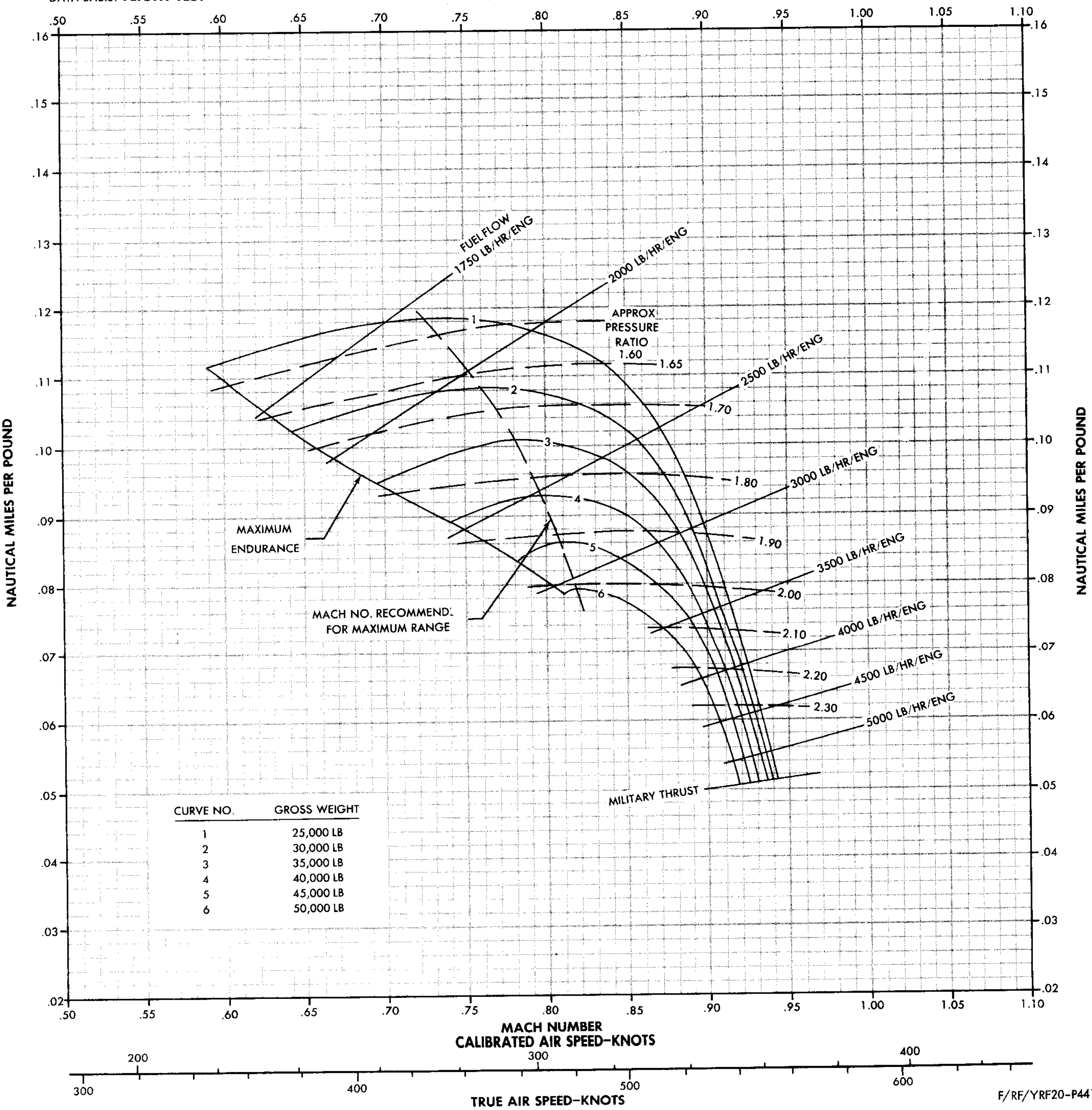
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME. RANGE DECREASES 11%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



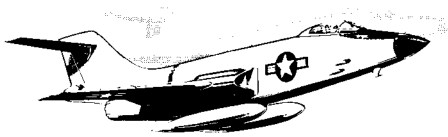
F/RF/YRF20–P441

Figure A4-13

NAUTICAL MILES PER POUND

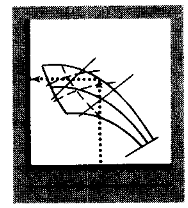
35,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



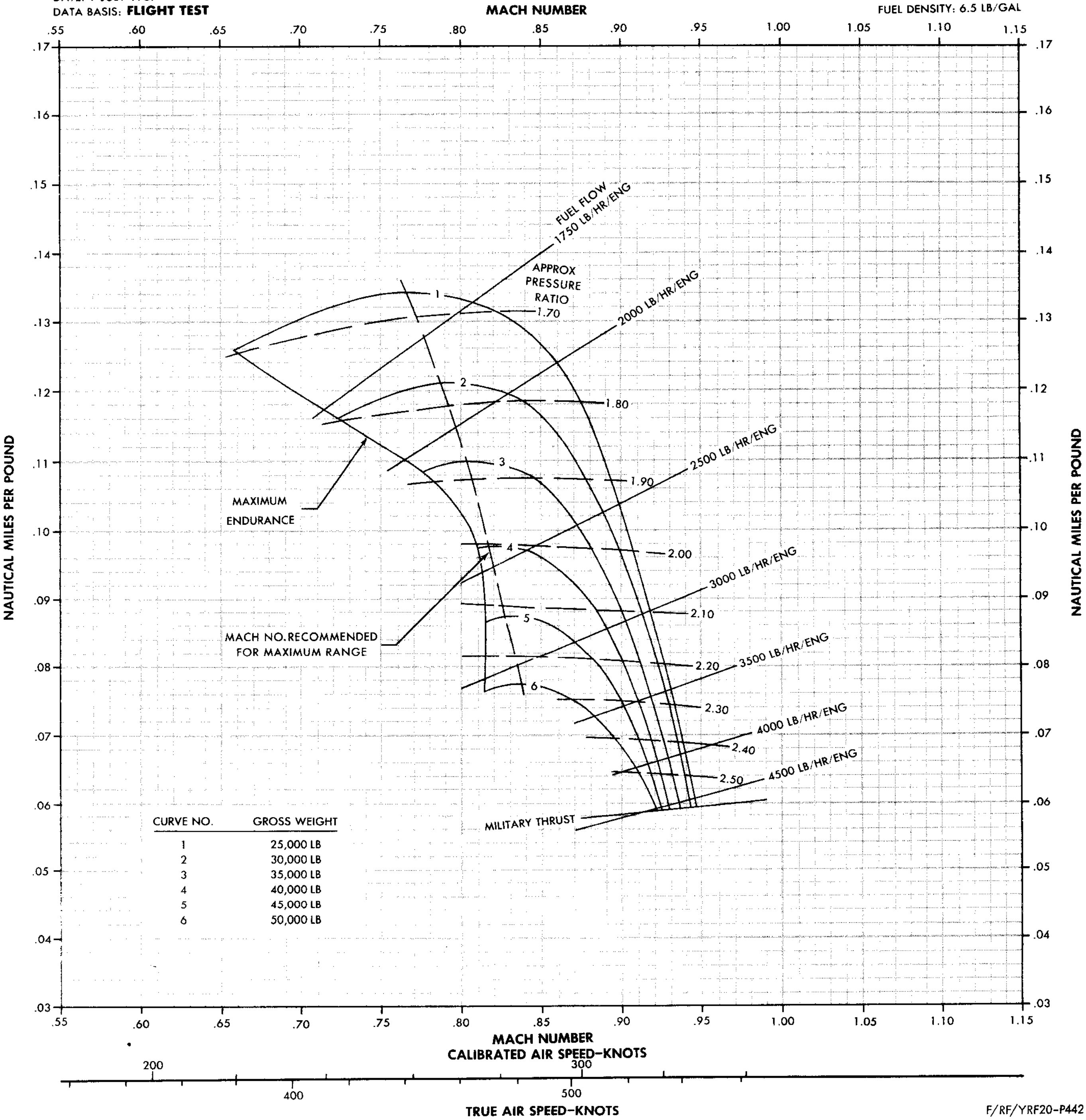
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



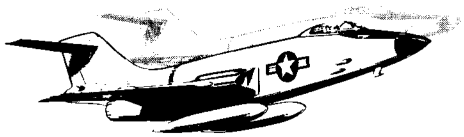
F/RF/YRF20-P442

Figure A4-14

NAUTICAL MILES PER POUND

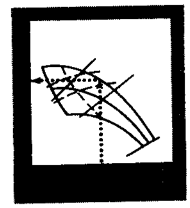
40,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

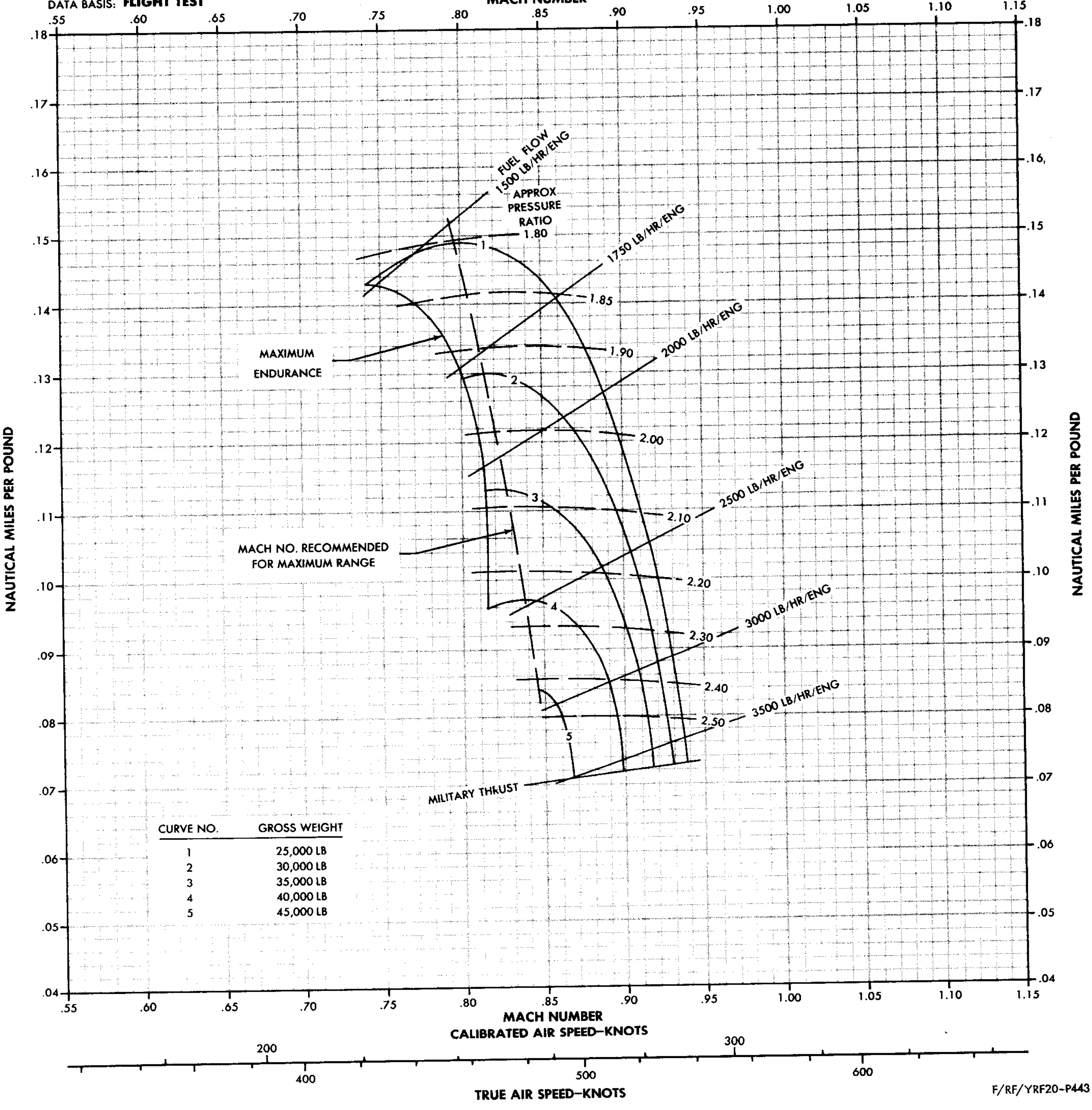
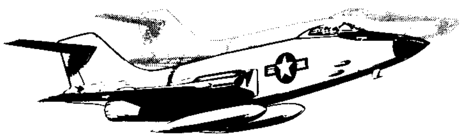


Figure A4-15

NAUTICAL MILES PER POUND

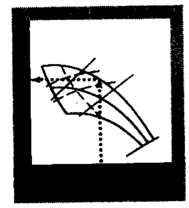
45,000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



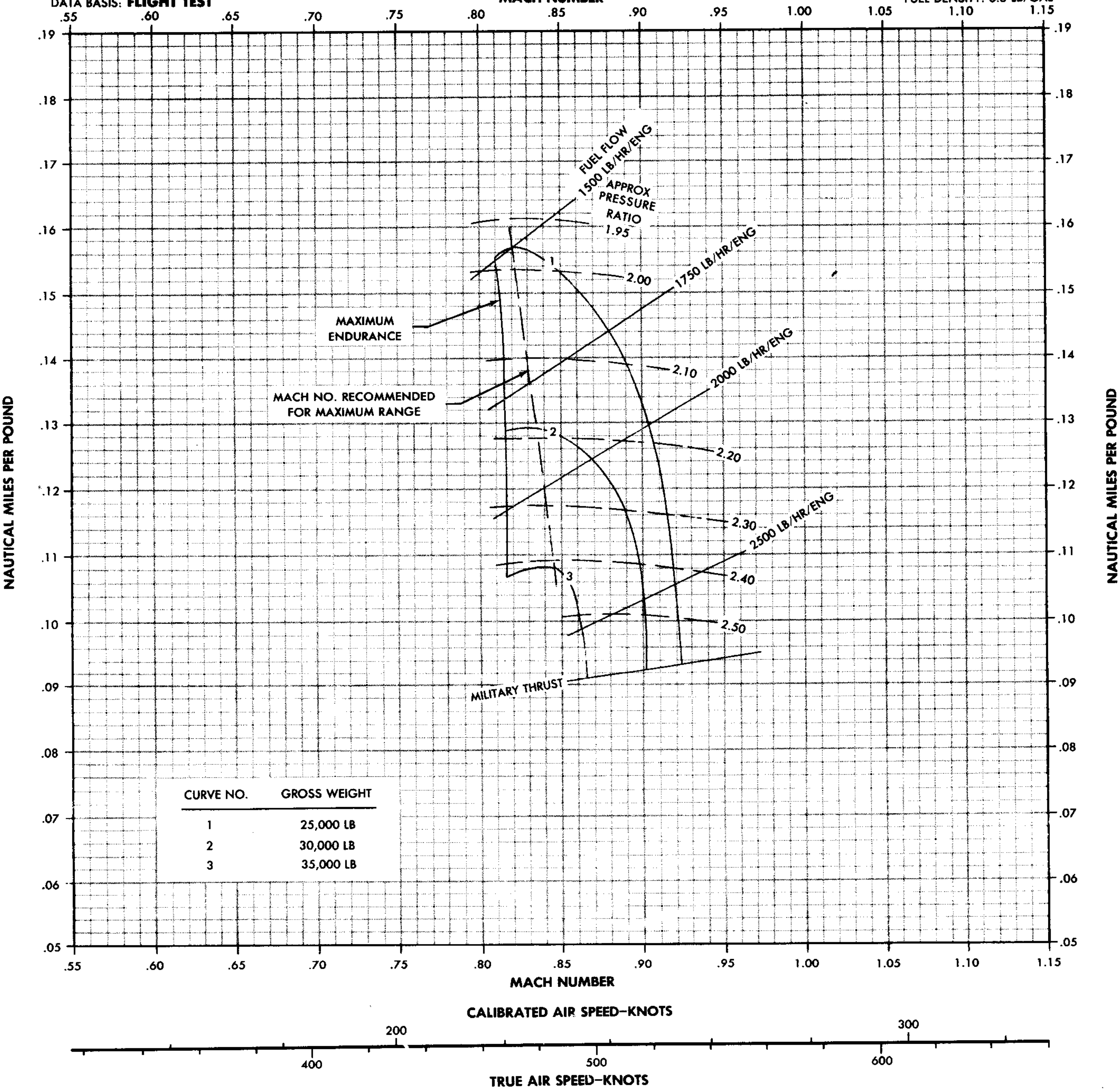
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 10%.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



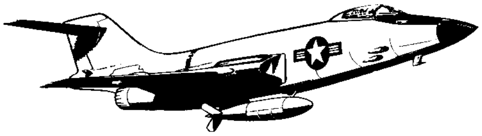
F/RF/YRF20-P444

Figure A4-16

NAUTICAL MILES PER POUND

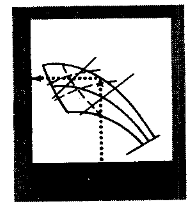
SEA LEVEL

AIRPLANE CONFIGURATION
F-101A: MK-7



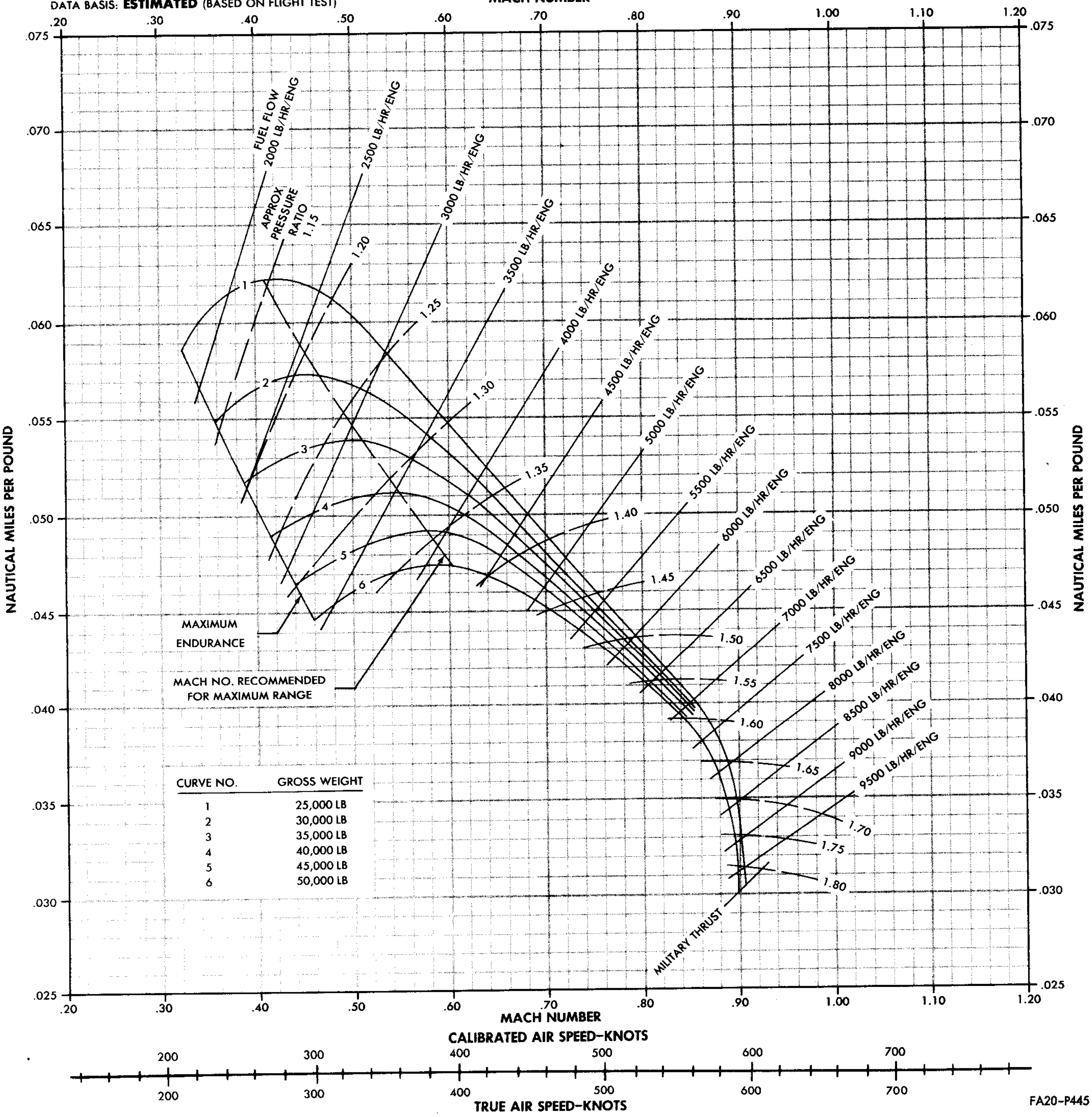
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 15%.

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



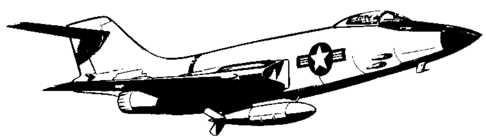
FA20-P445

Figure A4-17

NAUTICAL MILES PER POUND

5000 FEET

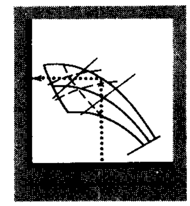
AIRPLANE CONFIGURATION
F-101A: MK-7



REMARKS

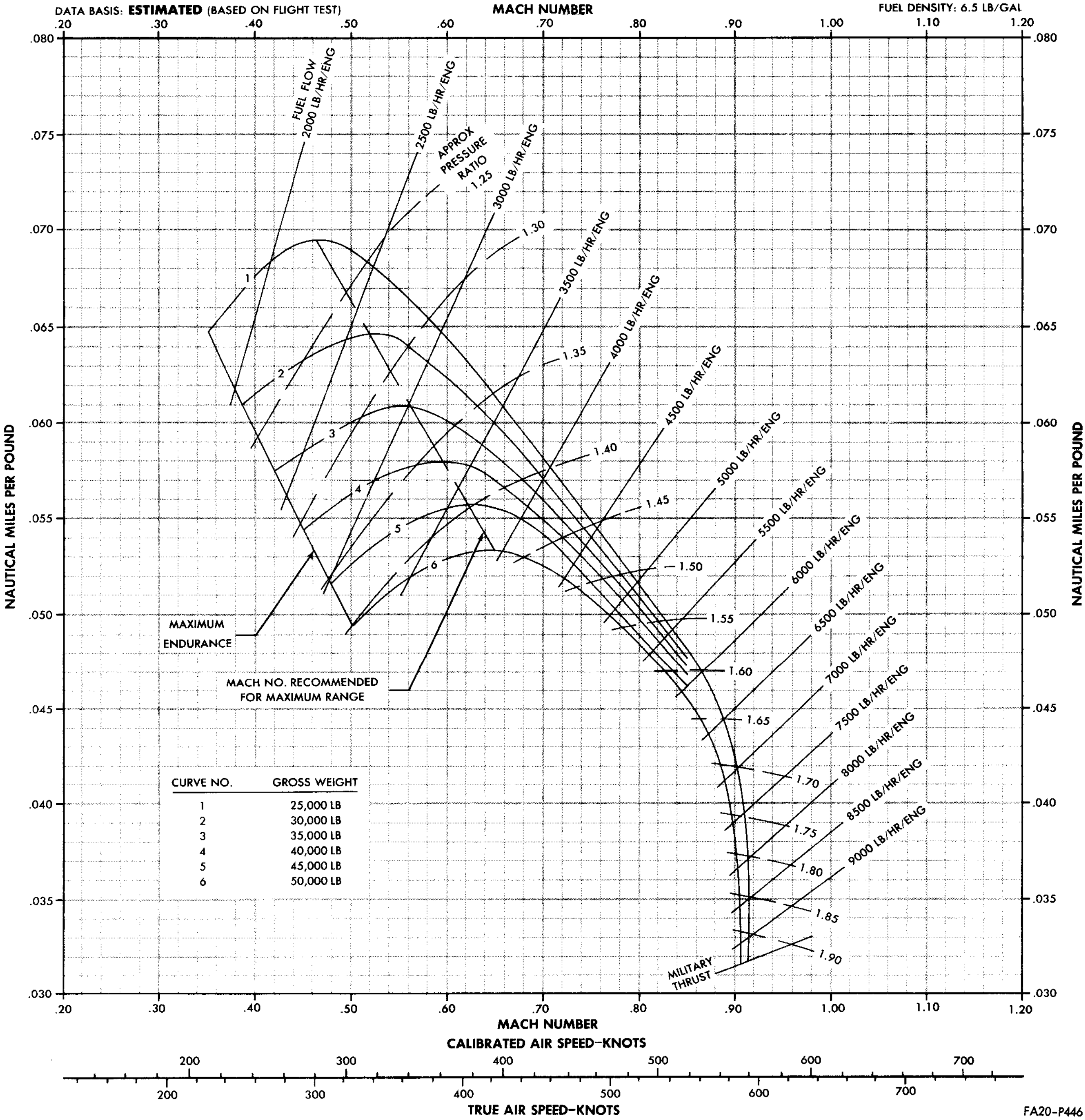
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 14%.

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



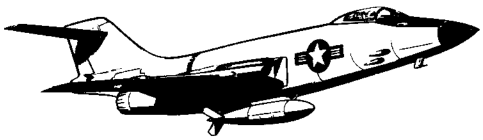
FA20-P446

Figure A4-18

NAUTICAL MILES PER POUND

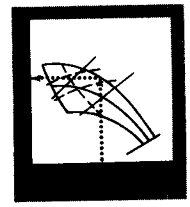
15,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7



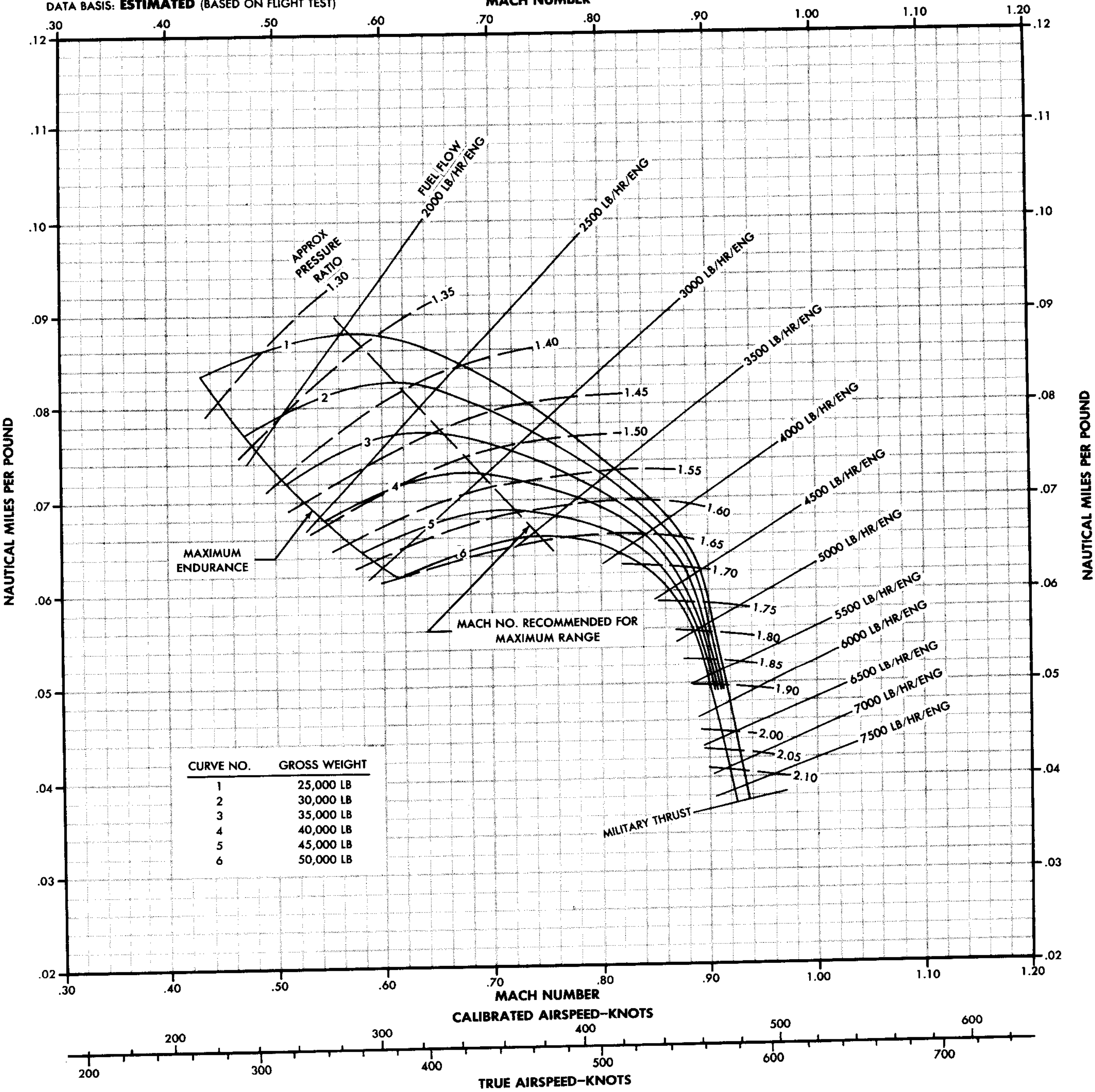
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 12%

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



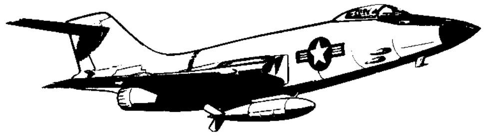
FA20-P447

Figure A4-19

NAUTICAL MILES PER POUND

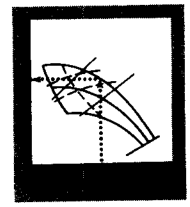
25,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 JANAURY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

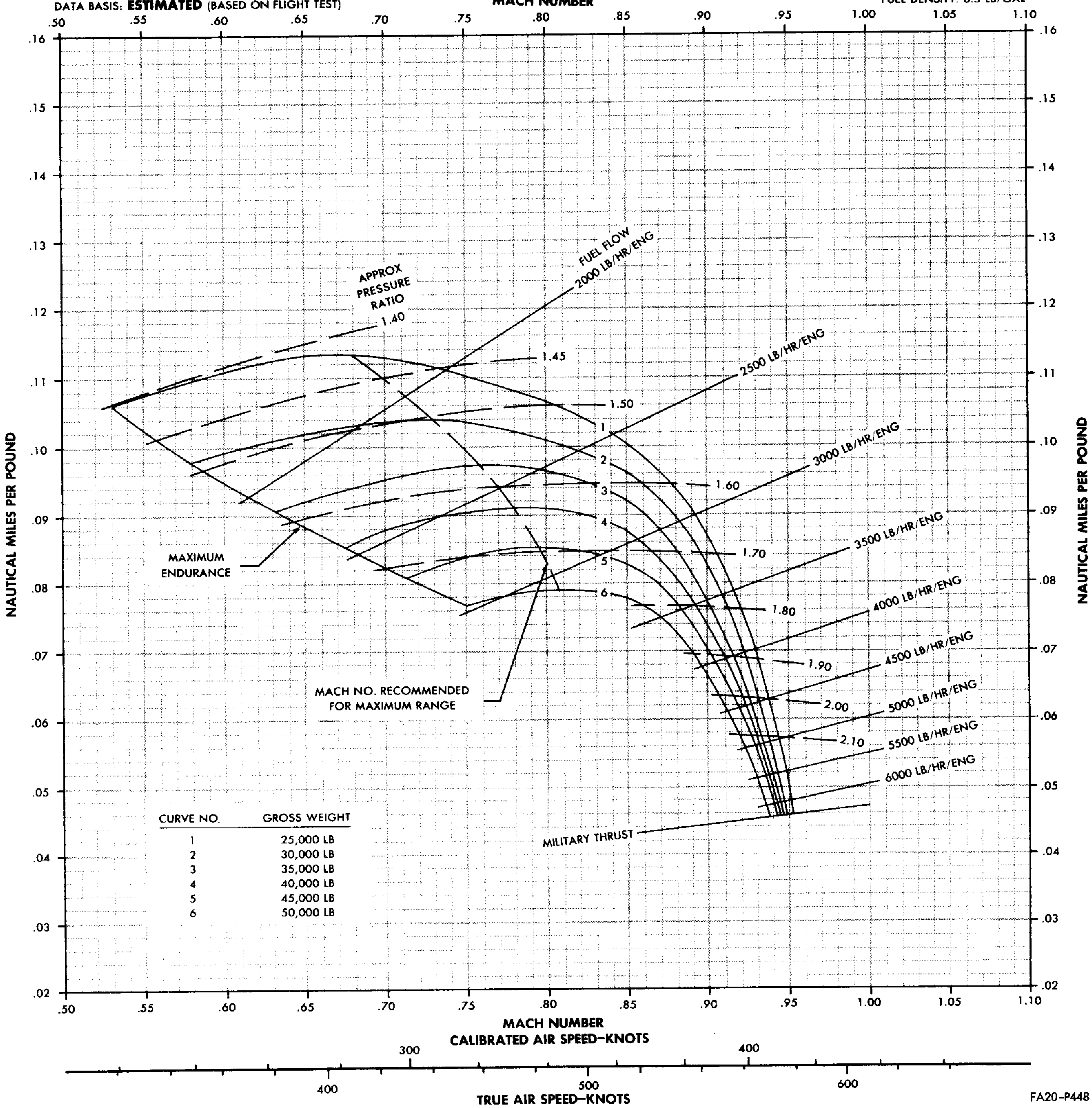
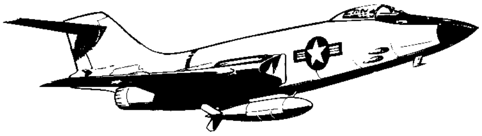


Figure A4-20

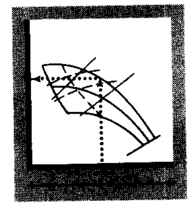
NAUTICAL MILES PER POUND
30,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7



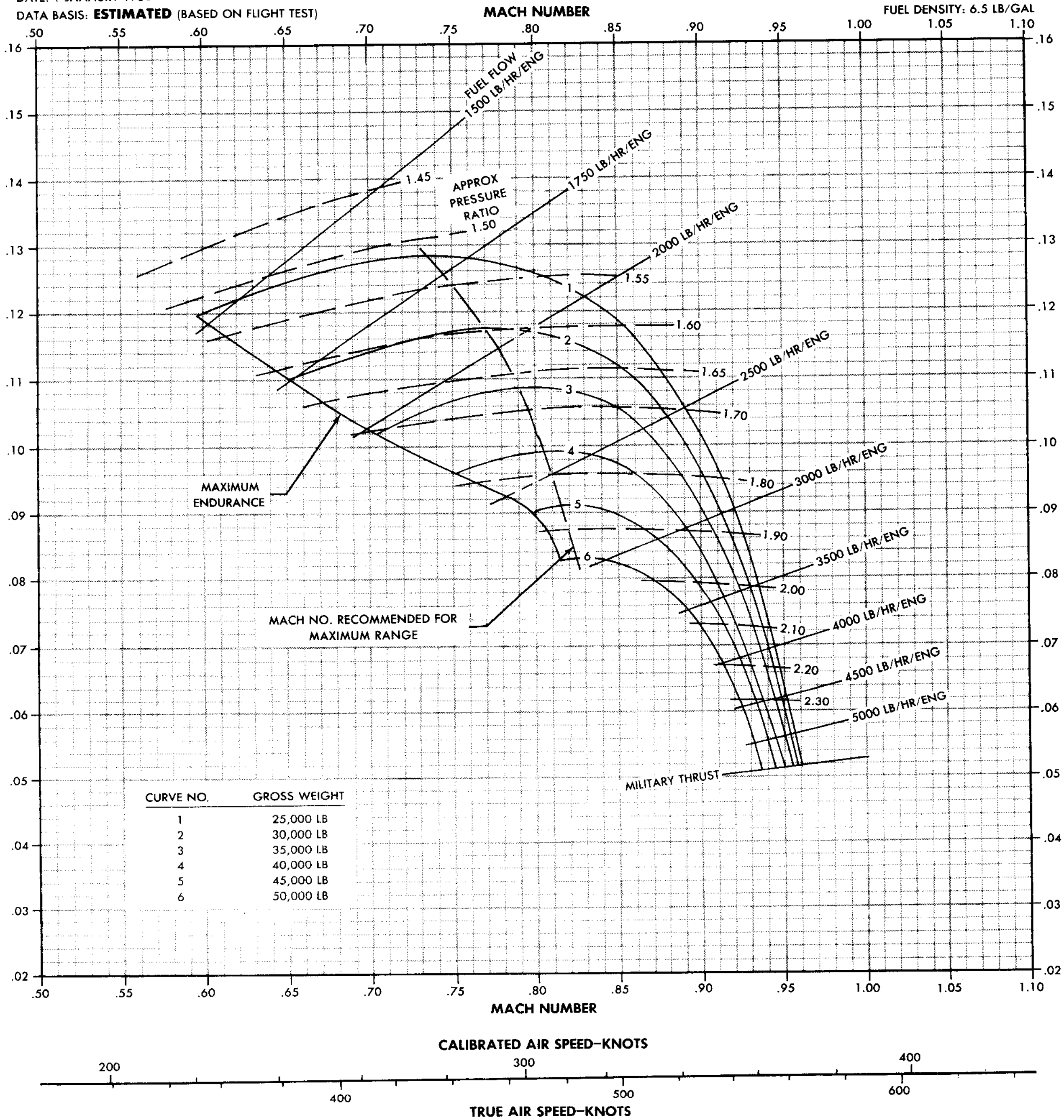
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME. RANGE DECREASES 11%.

GUIDE



DATE: 1 JANAURY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

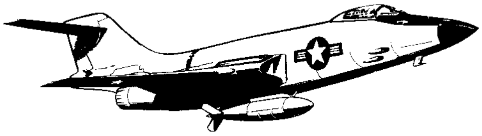
FA20-P449

Figure A4-21

NAUTICAL MILES PER POUND

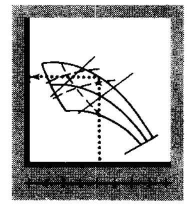
35,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7



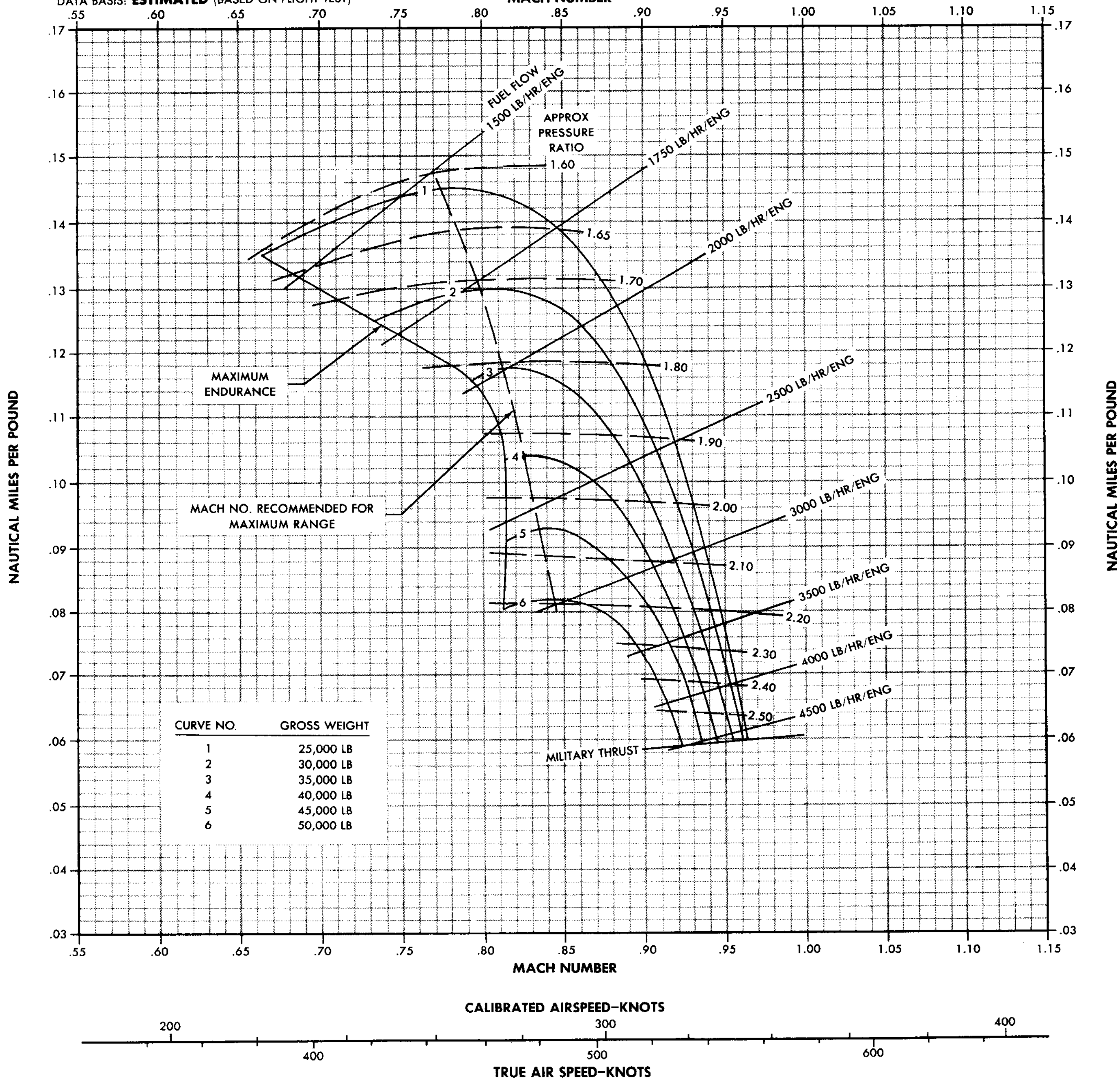
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME. RANGE DECREASES 11%.

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



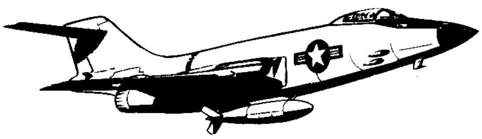
FA20–P450

Figure A4-22

NAUTICAL MILES PER POUND

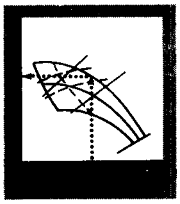
40,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7



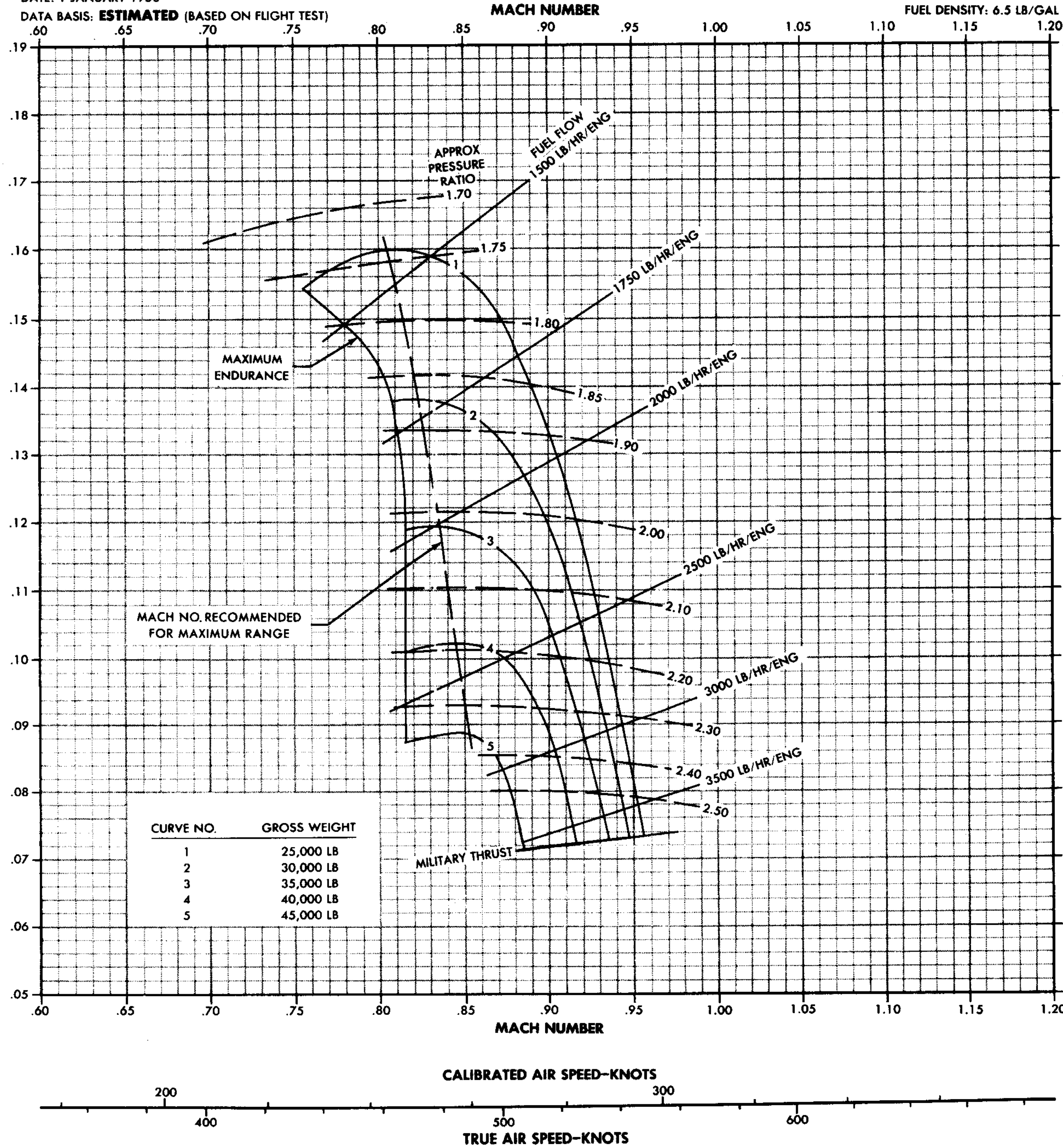
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 10%.

GUIDE



DATE: 1 JANUARY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



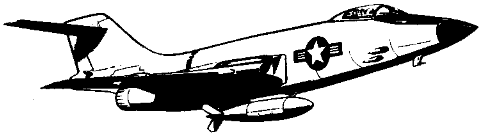
FA20-P451

Figure A4-23

NAUTICAL MILES PER POUND

45,000 FEET

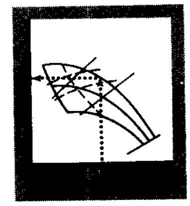
AIRPLANE CONFIGURATION
F-101A: MK-7



REMARKS

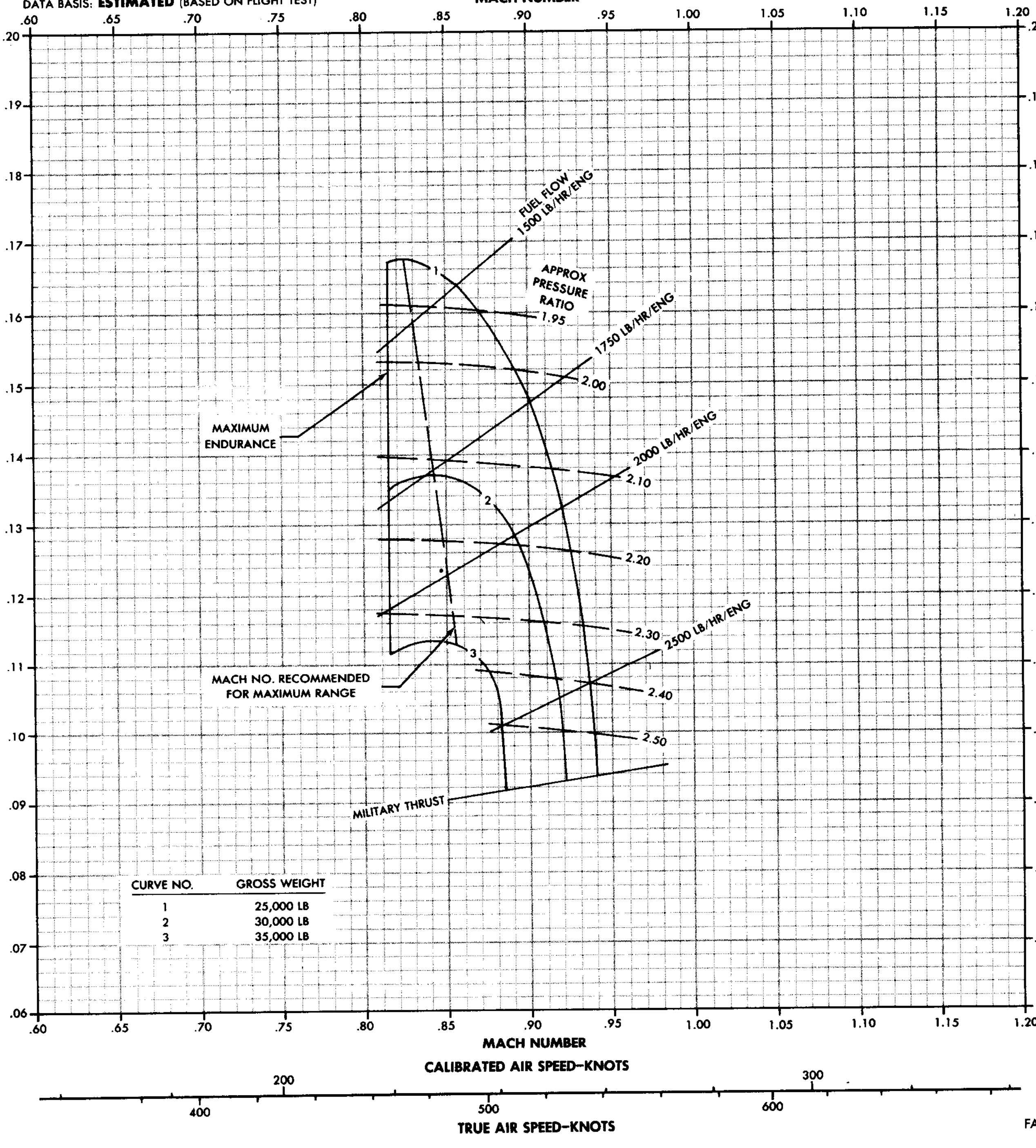
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 10%.

GUIDE



DATE: 1 JANAURY 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB

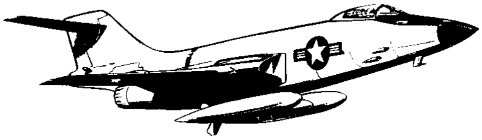
FA20-P452

Figure A4-24

NAUTICAL MILES PER POUND

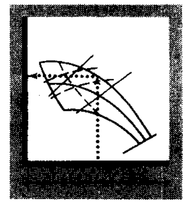
SEA LEVEL

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



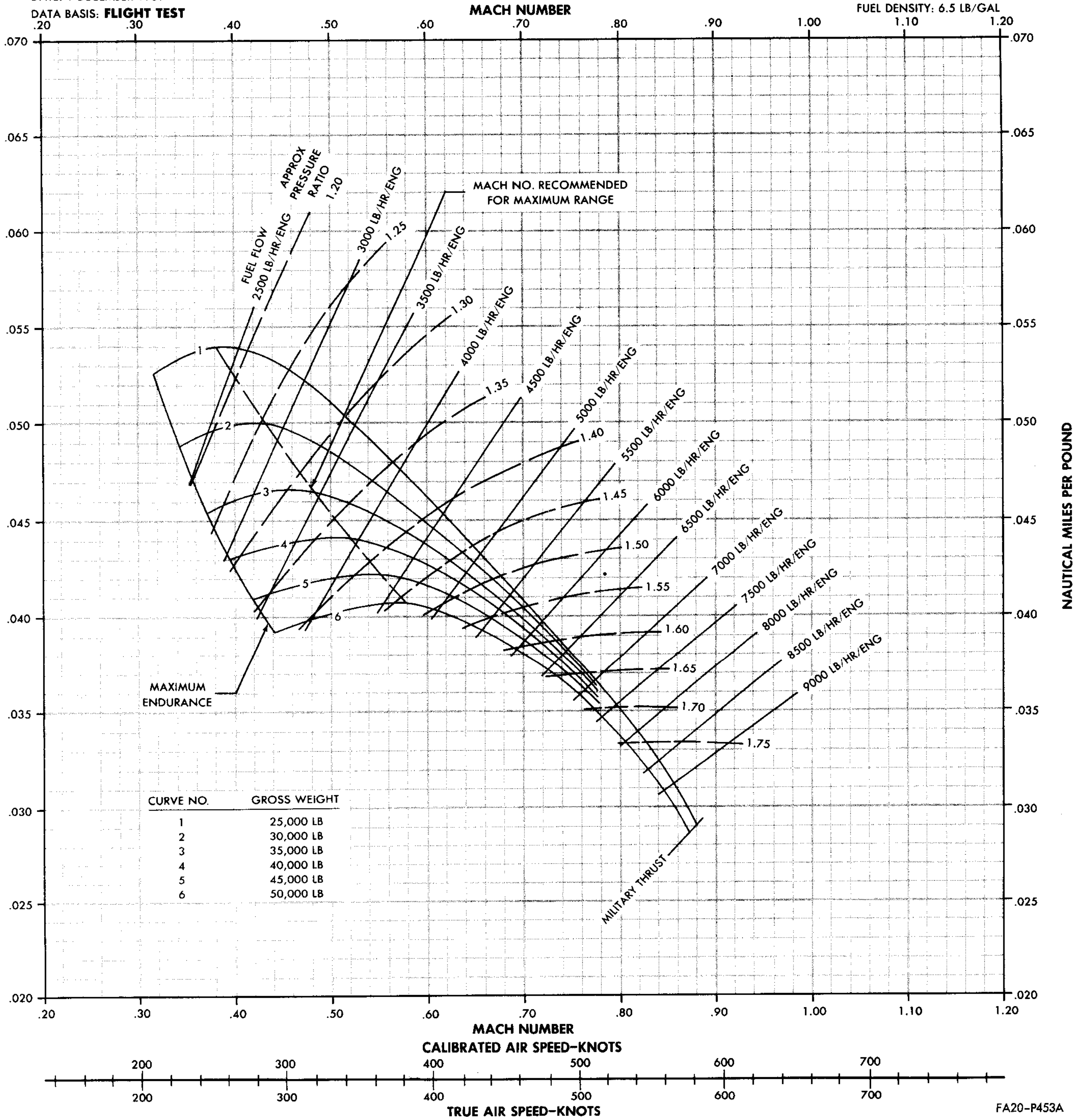
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME. RANGE DECREASES 16%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



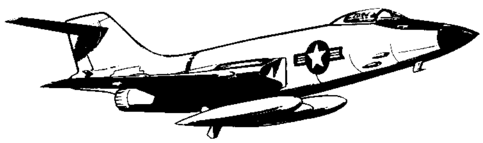
CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-25

NAUTICAL MILES PER POUND

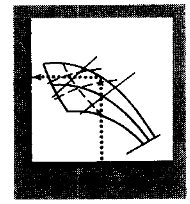
5000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 14%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

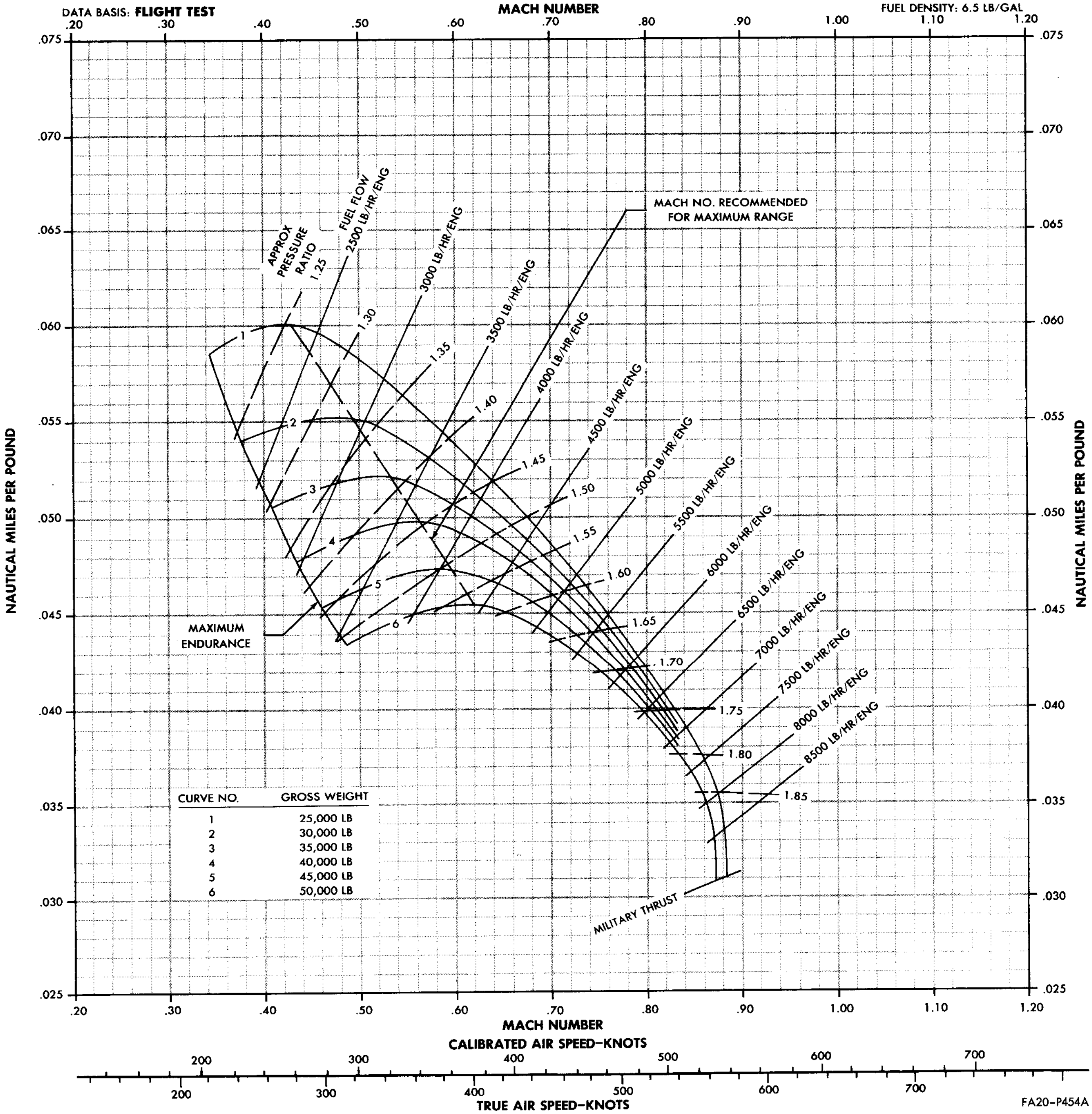
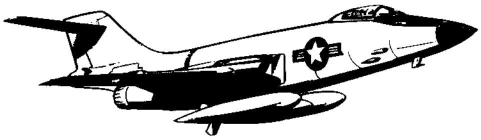


Figure A4-26

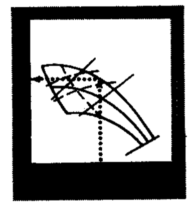
NAUTICAL MILES PER POUND
15,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 13%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

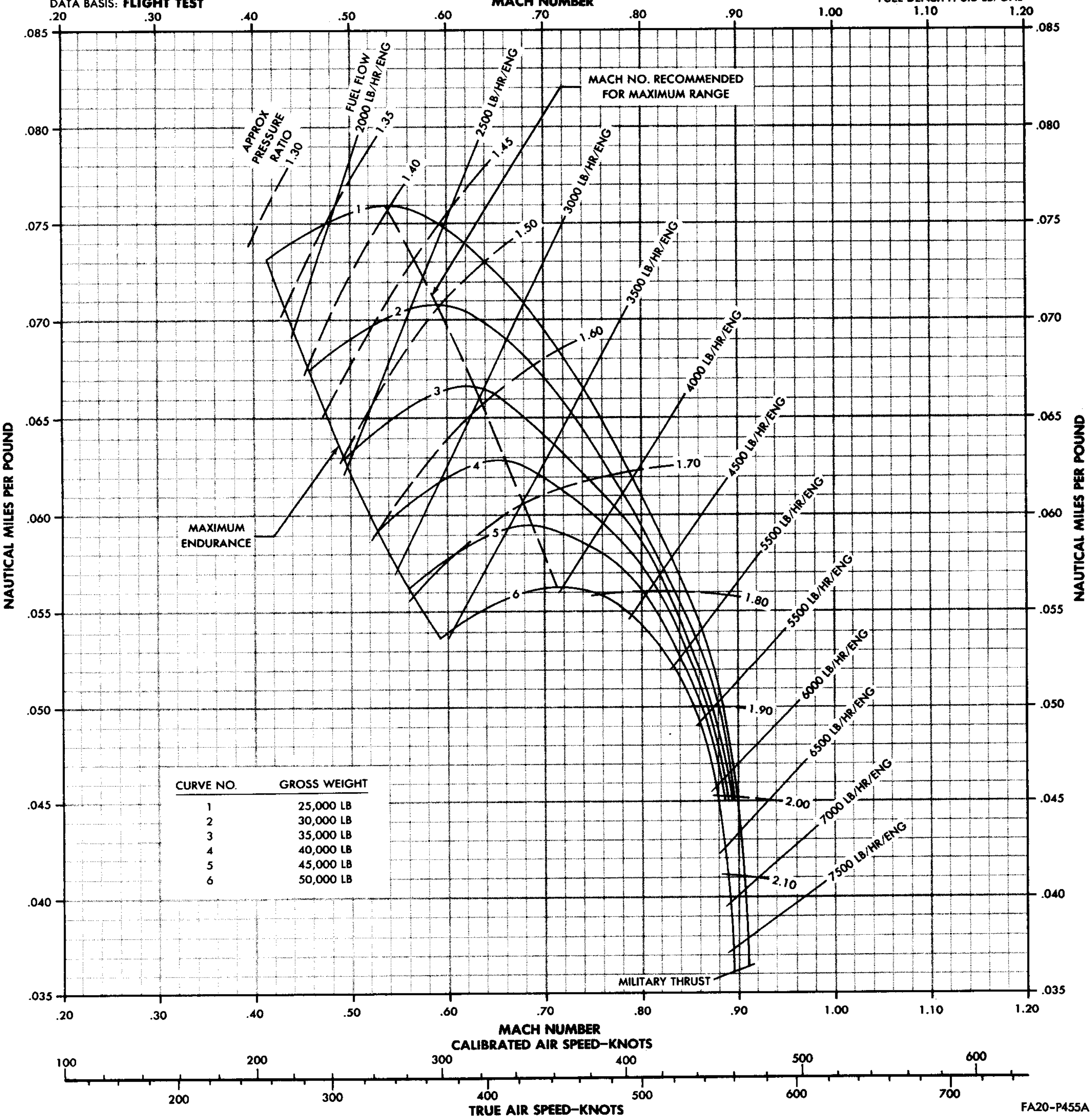
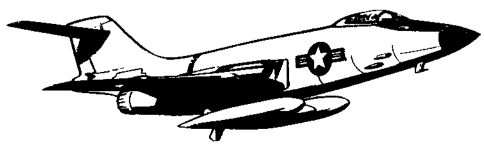


Figure A4-27

NAUTICAL MILES PER POUND

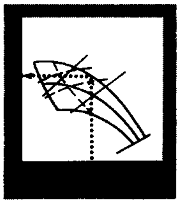
25,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



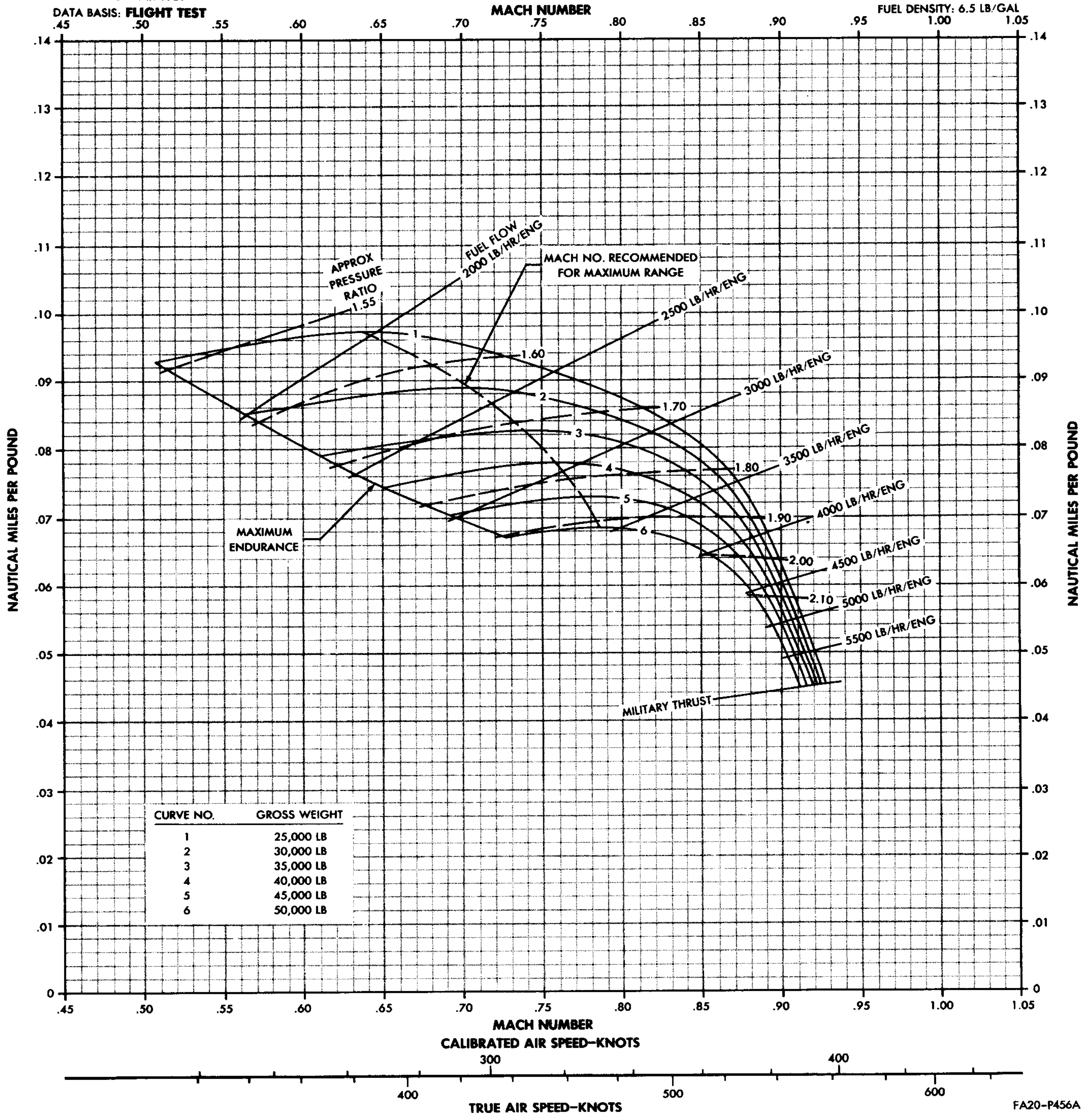
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



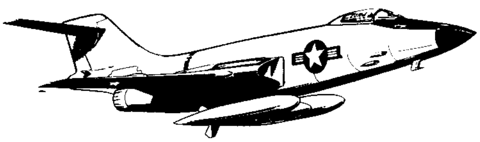
CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-28

NAUTICAL MILES PER POUND

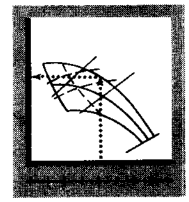
30,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



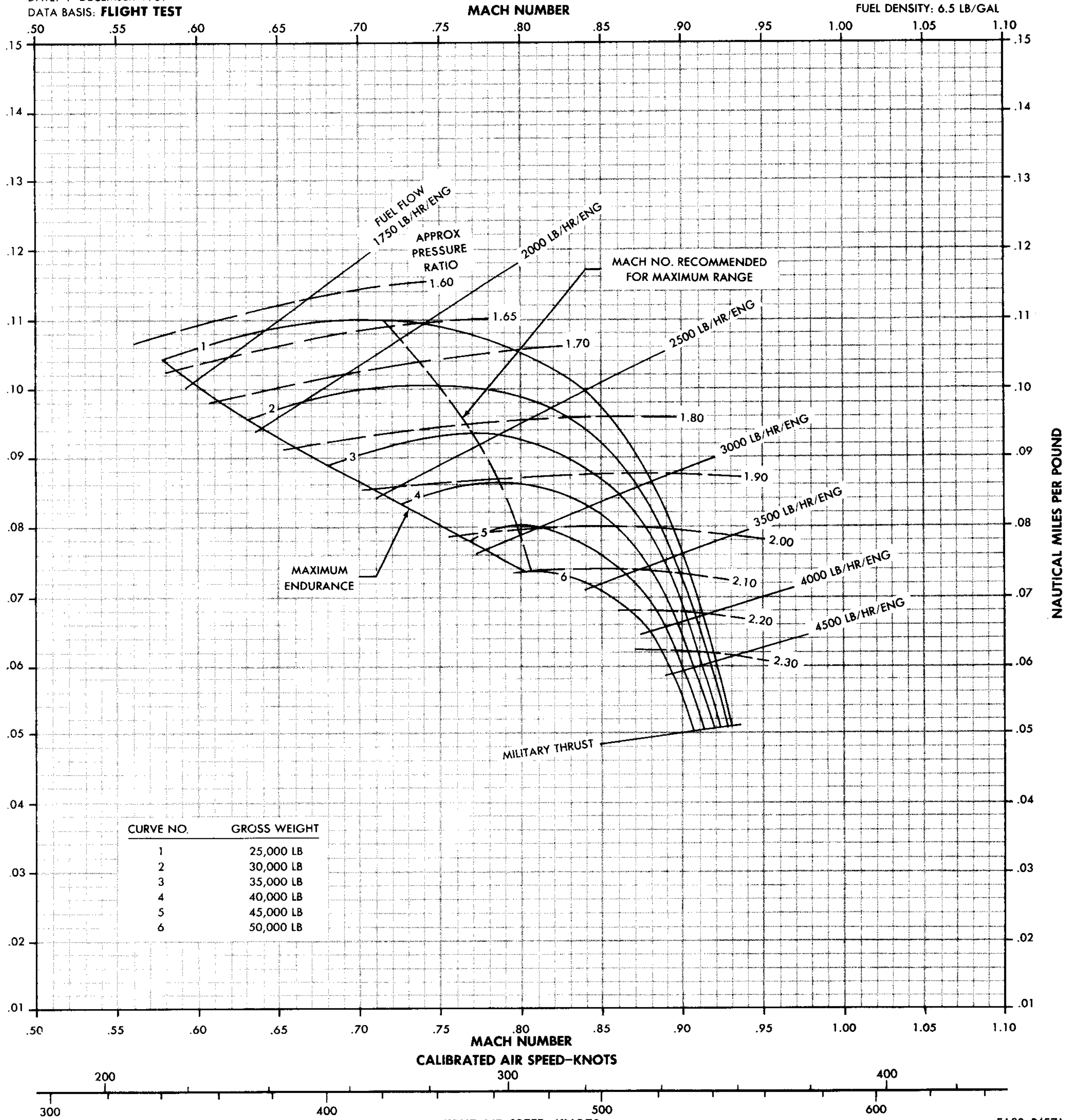
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



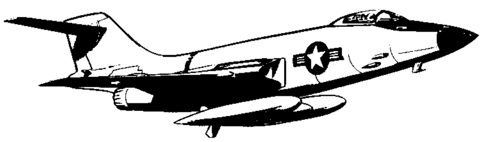
CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-29

NAUTICAL MILES PER POUND

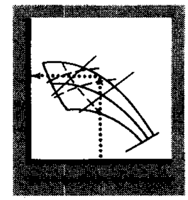
35,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



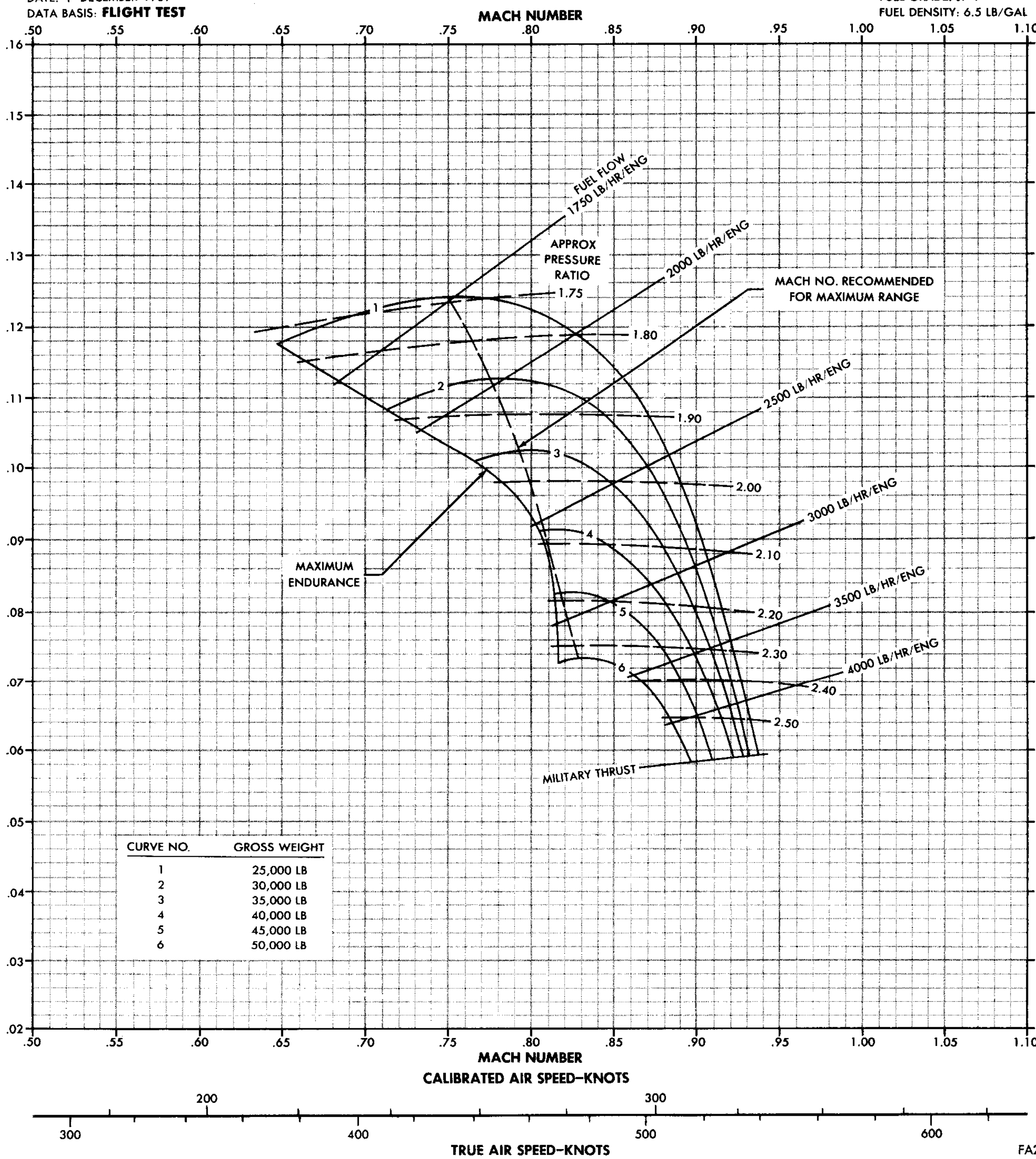
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



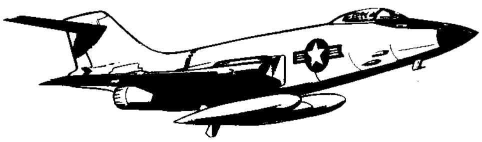
CURVE NO.	GROSS WEIGHT
1	25,000 LB
2	30,000 LB
3	35,000 LB
4	40,000 LB
5	45,000 LB
6	50,000 LB

Figure A4-30

NAUTICAL MILES PER POUND

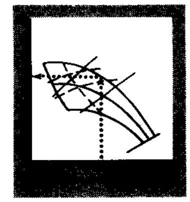
40,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



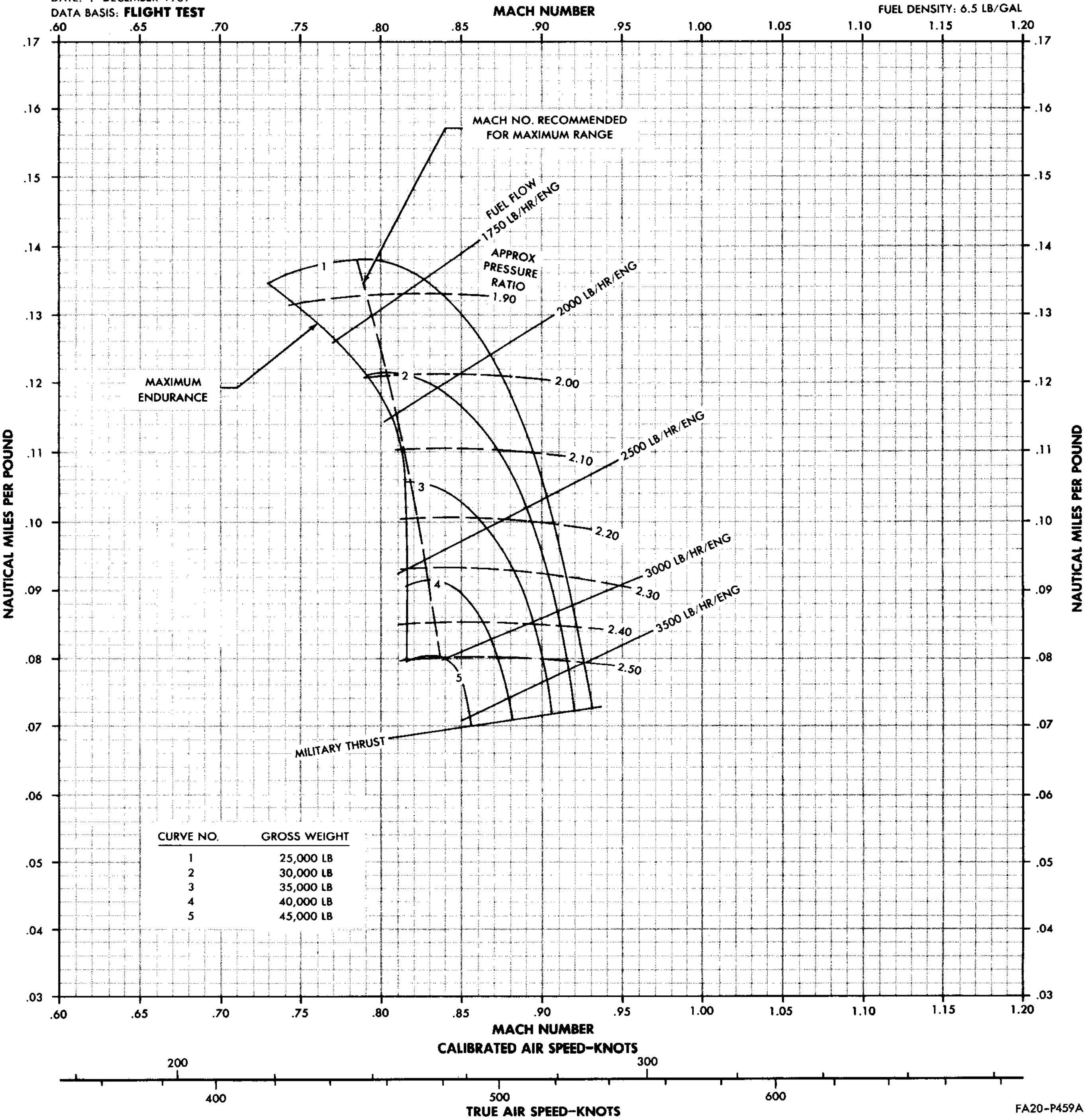
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

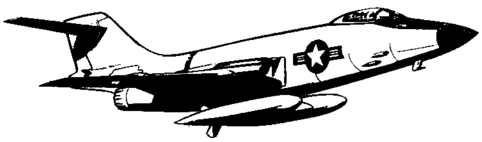


FA20-P459A

Figure A4-31

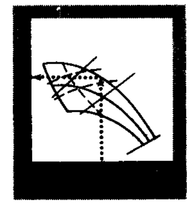
NAUTICAL MILES PER POUND
45,000 FEET

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION: RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME. RANGE DECREASES 11%.

GUIDE



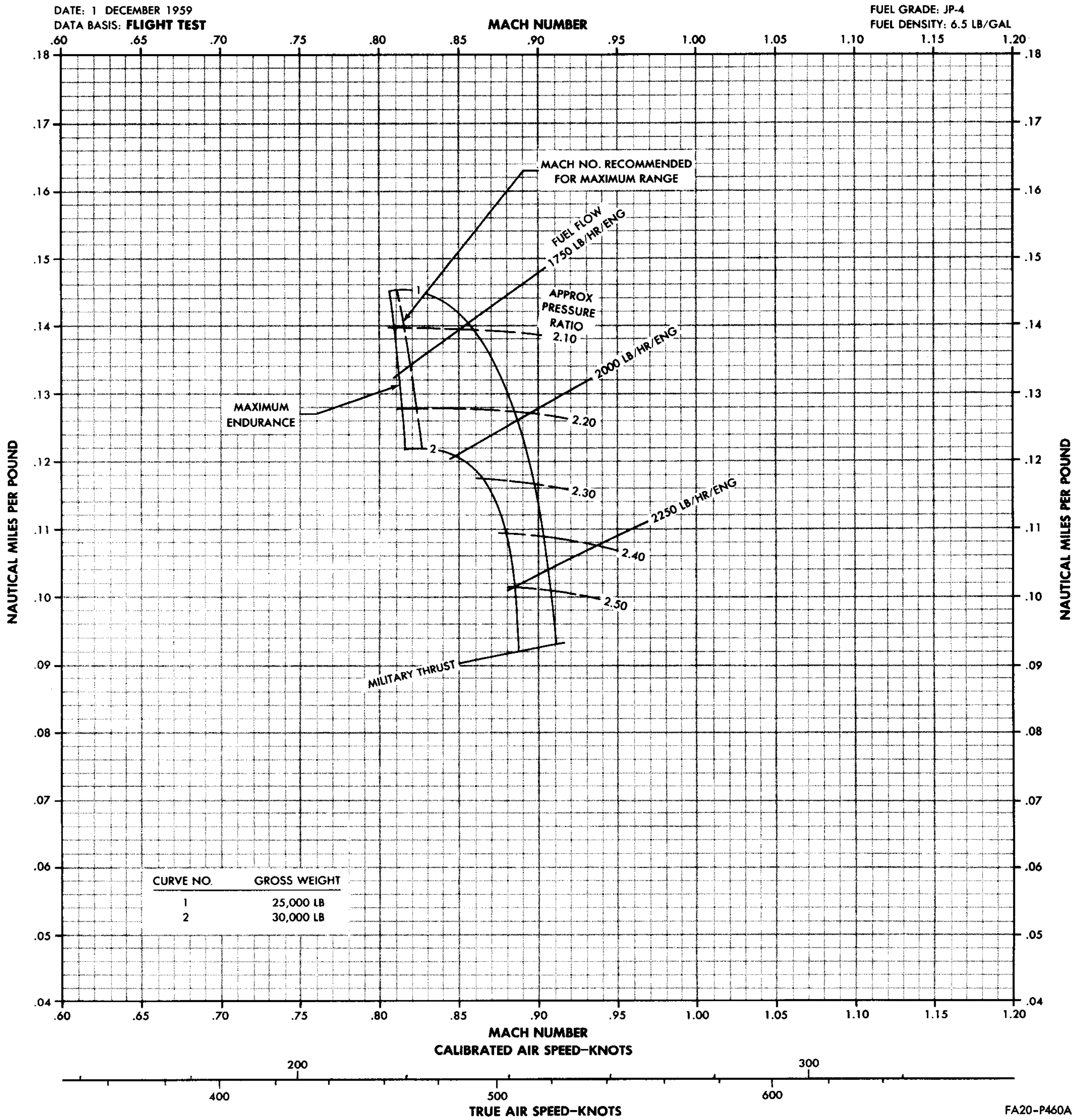
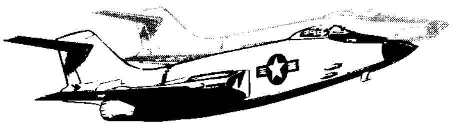


Figure A4-32

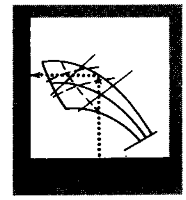
NAUTICAL MILES PER POUND
ONE ENGINE OPERATING
SEA LEVEL

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 14%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

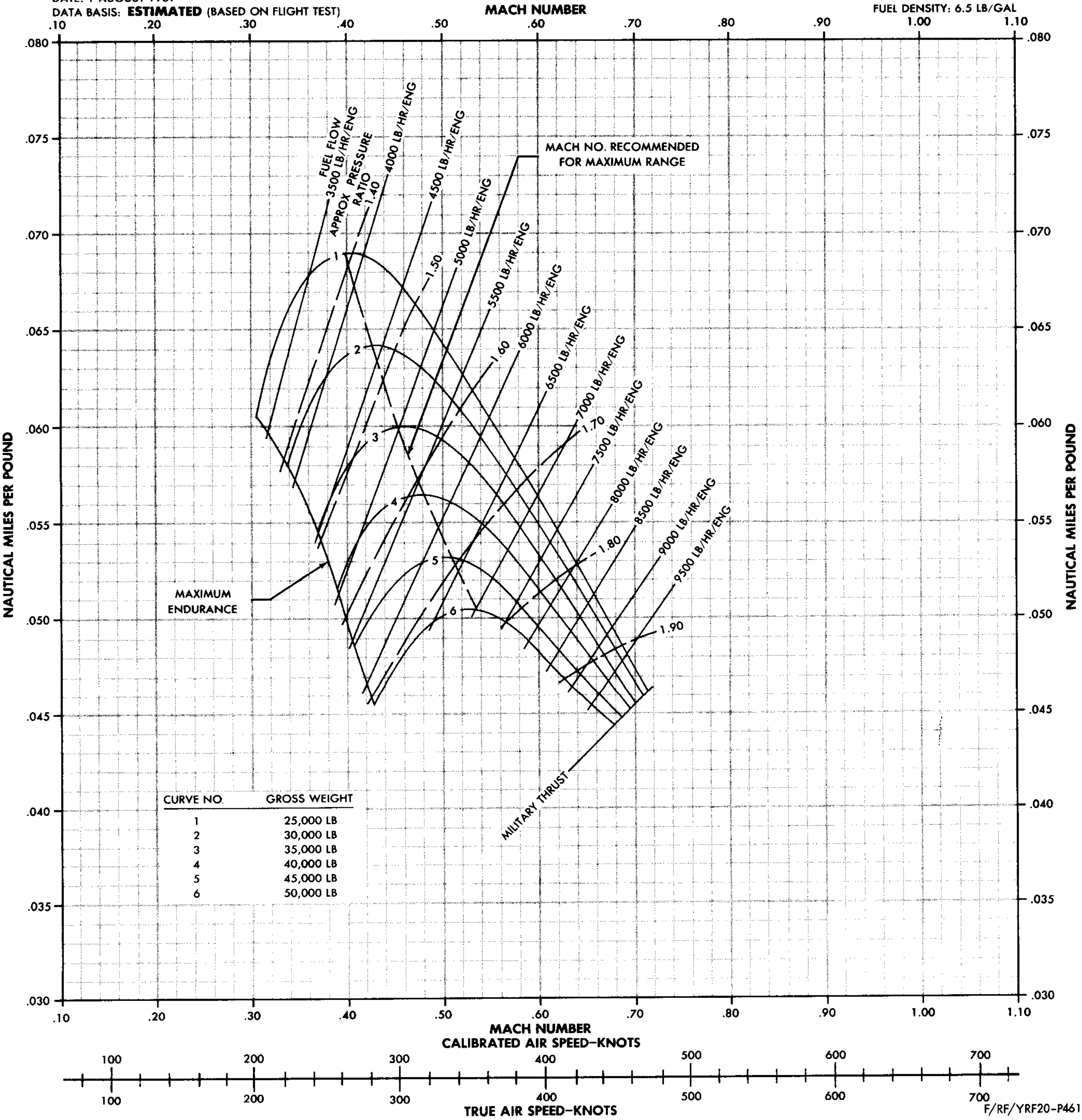
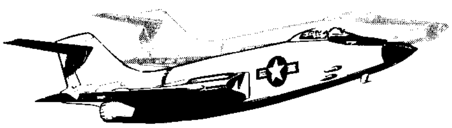


Figure A4-33

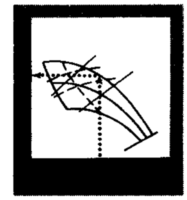
NAUTICAL MILES PER POUND
ONE ENGINE OPERATING
5000 FEET

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH
NUMBER REMAINS THE SAME.
RANGE DECREASES 13%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

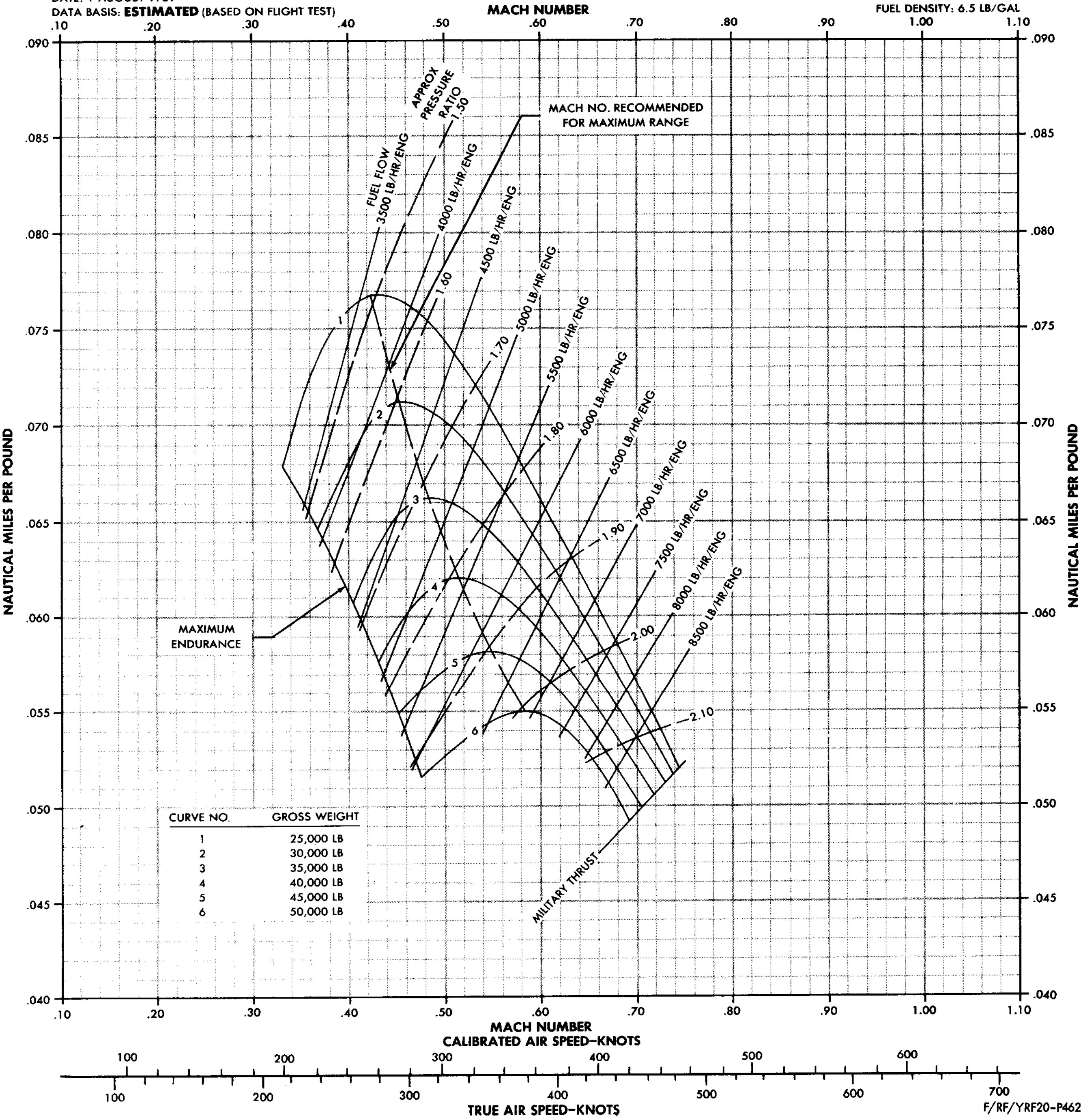
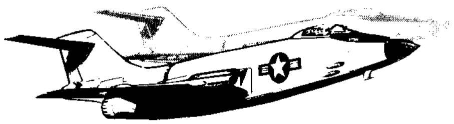


Figure A4-34

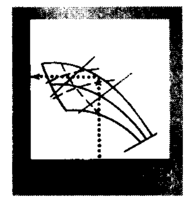
NAUTICAL MILES PER POUND
15,000 FEET
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 12%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

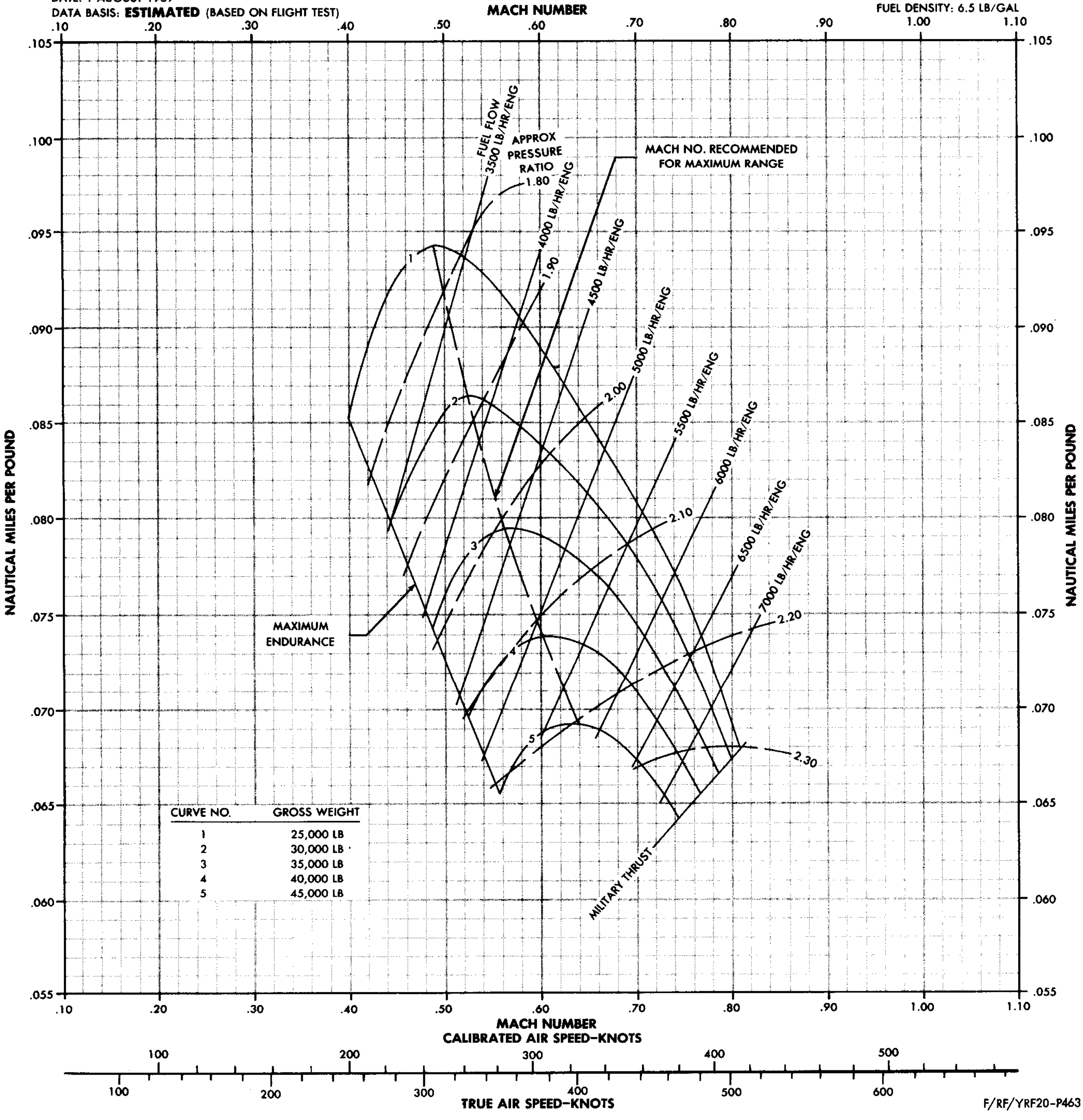
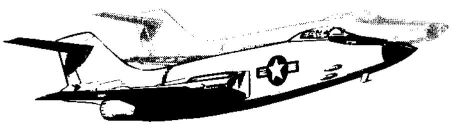


Figure A4-35

NAUTICAL MILES PER POUND

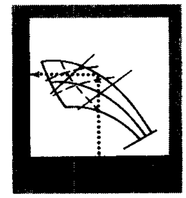
25,000 FEET
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

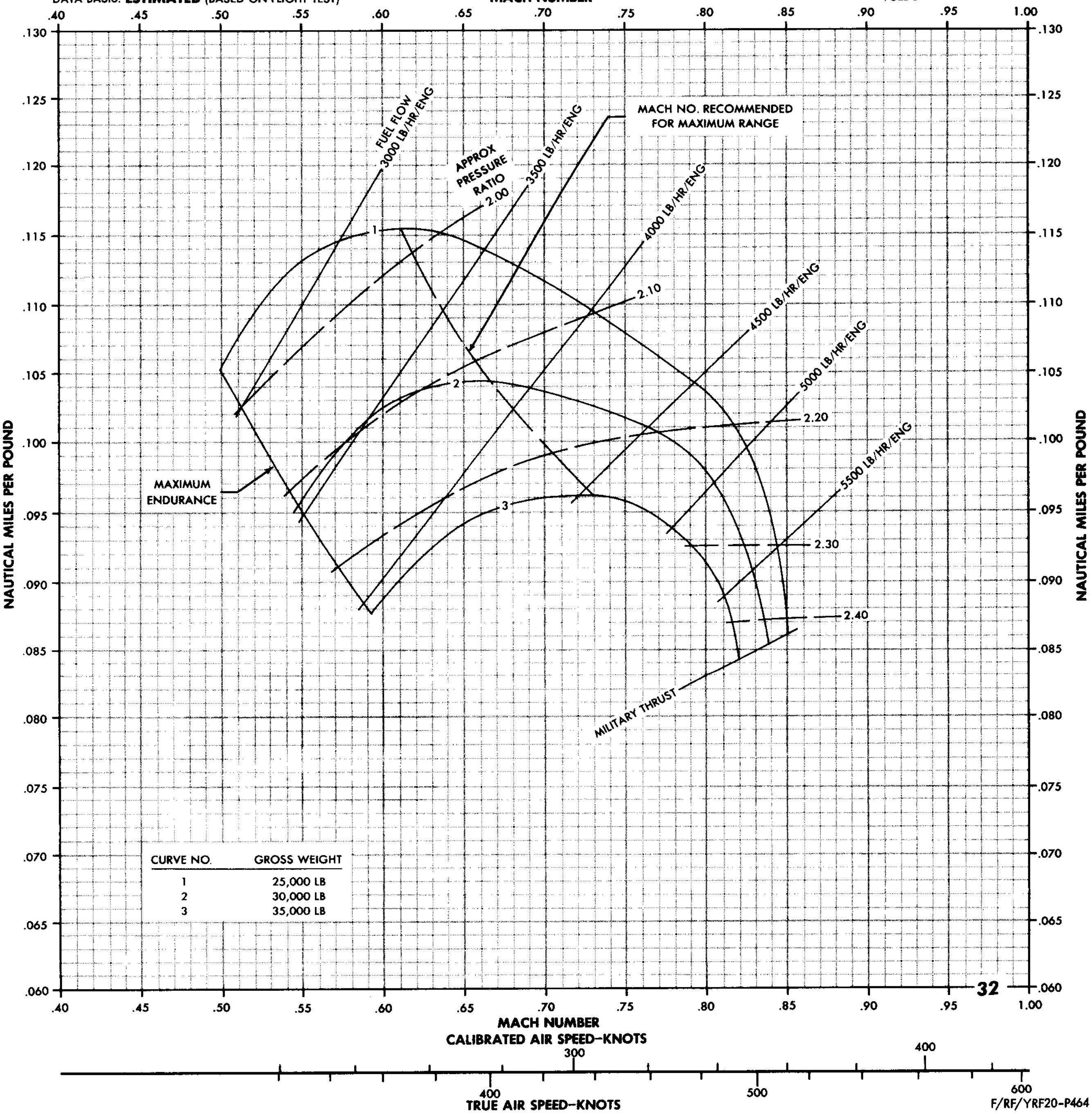


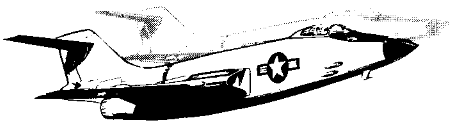
Figure A4-36

NAUTICAL MILES PER POUND

30,000 FEET

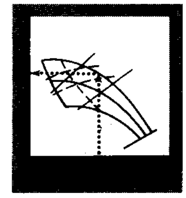
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



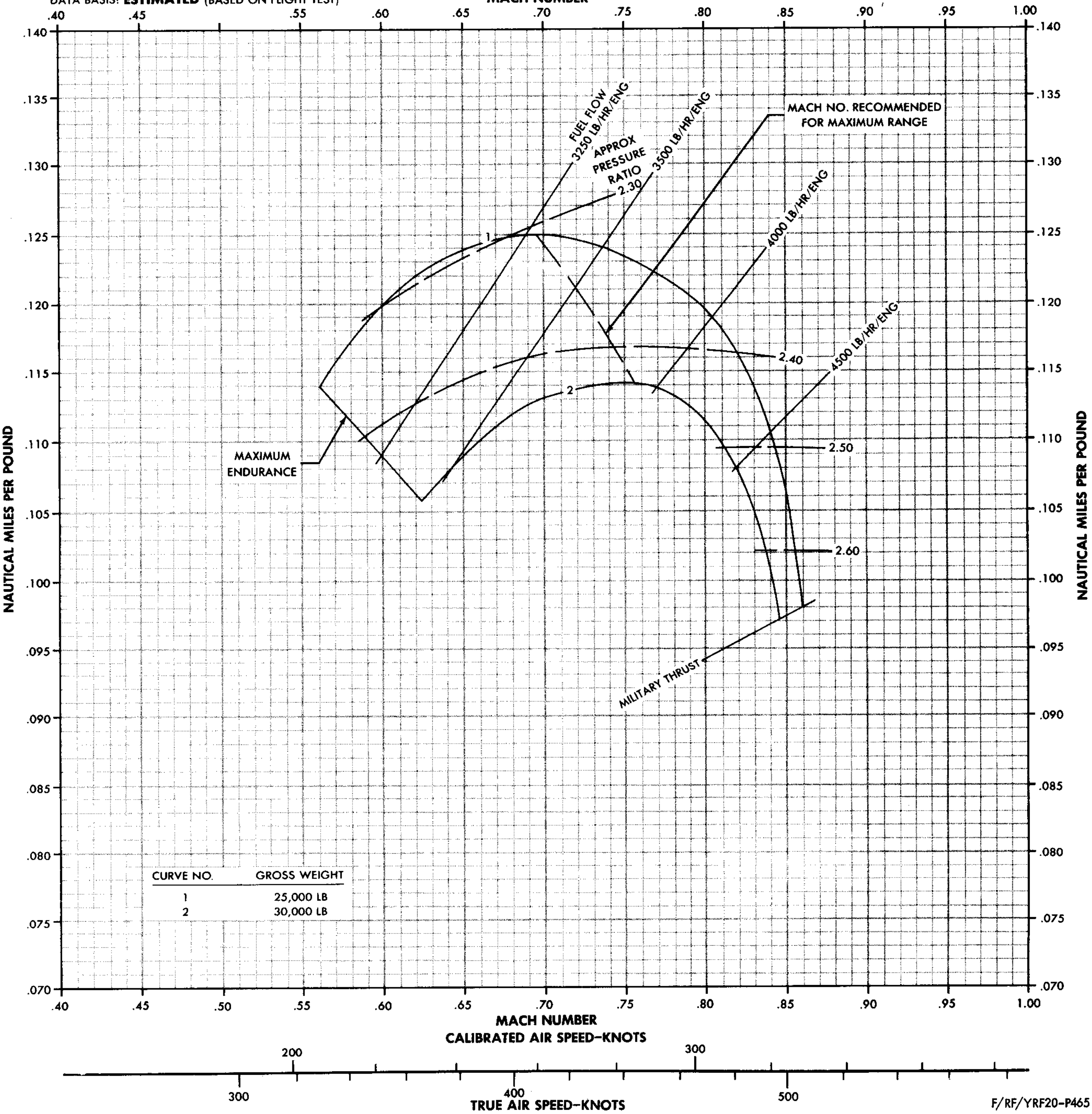
REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



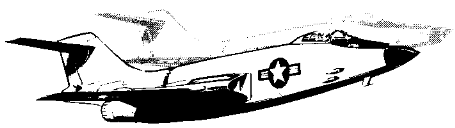
F/RF/YRF20-P465

Figure A4-37

NAUTICAL MILES PER POUND

35,000 FEET
ONE ENGINE OPERATING

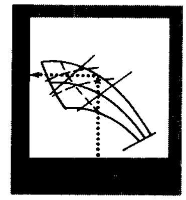
AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



REMARKS

ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY
50 KNOT HEADWIND CONDITION:
RECOMMENDED CRUISE MACH NUMBER REMAINS THE SAME.
RANGE DECREASES 11%.

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

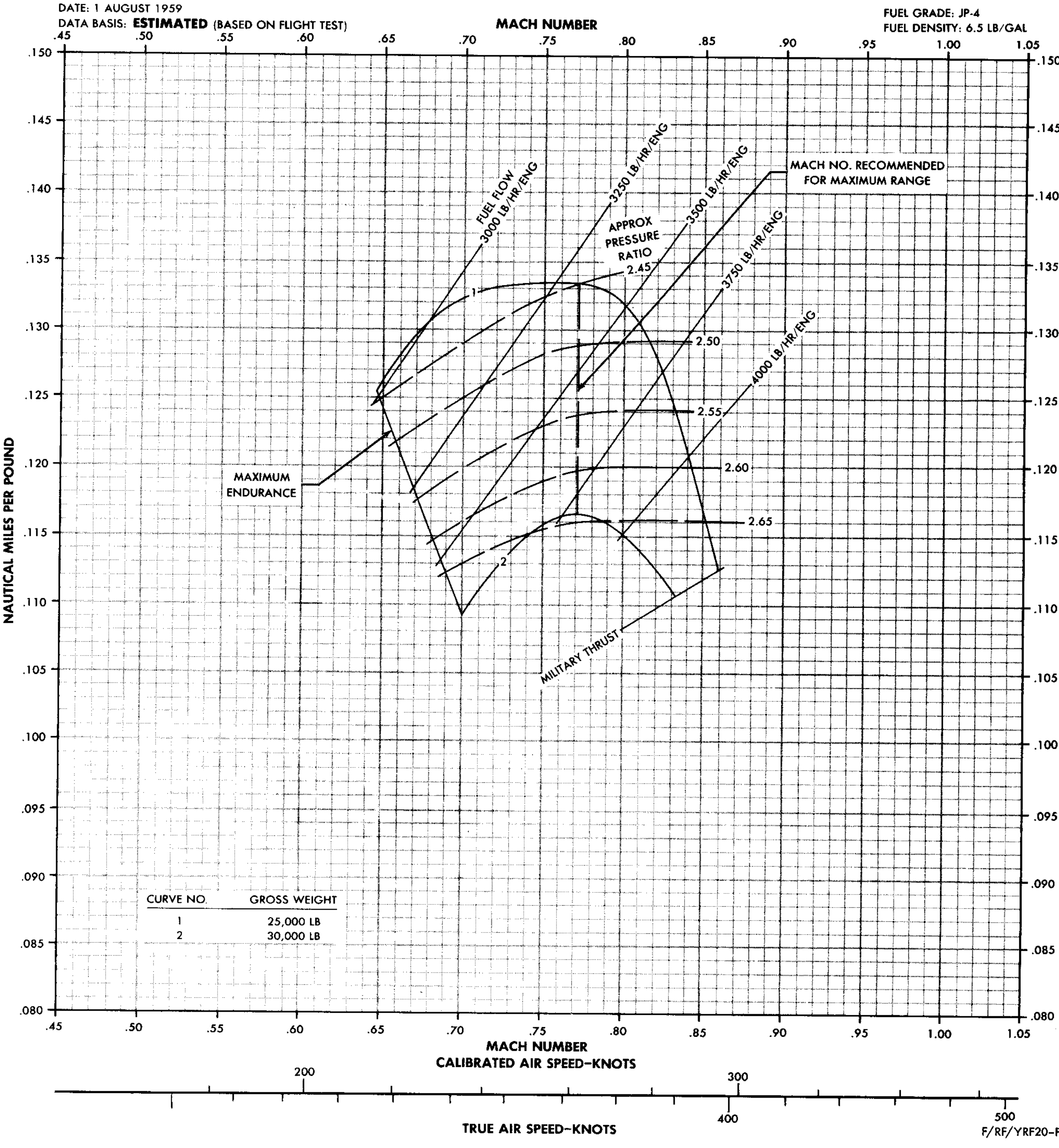


Figure A4-38

endurance part 5

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Charts

COMBAT ALLOWANCE CHART

The Combat Allowance Chart (figure A5-1) shows the relationship between time and fuel with changes in altitude at Maximum and Military thrust settings. Combat time or fuel may be determined from this chart for a given thrust setting. The time limitations, for both Maximum and Military thrust settings, are included on the chart.

USE

Enter the chart at the combat altitude and proceed horizontally to intersect the allotted fuel, descend to time scale and read the time available. Enter at combat altitude and time available for combat and read fuel required.

SAMPLE PROBLEM

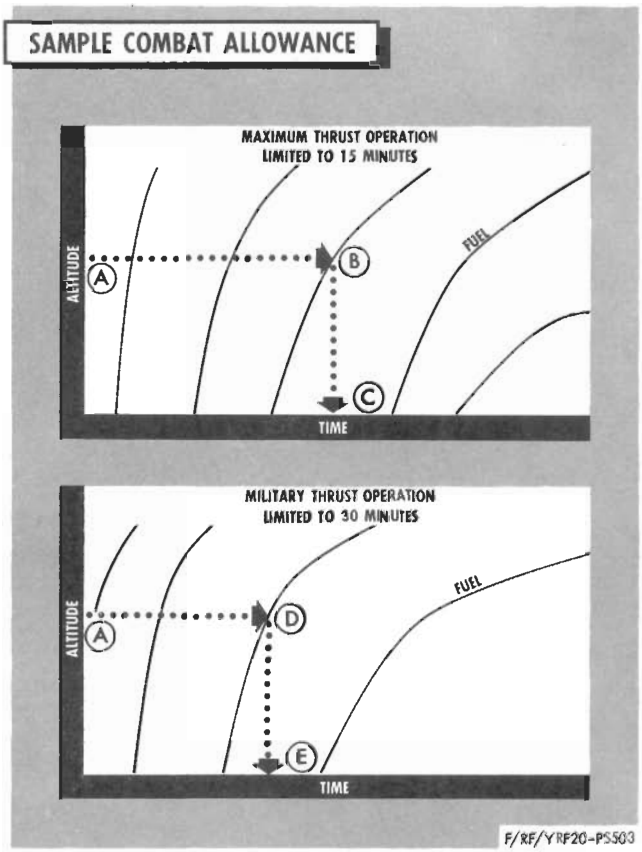
A. Altitude	30,000 Ft.
B. Combat Fuel (Maximum Thrust)	6,000 Lbs.
C. Combat Time (Maximum Thrust)	9 Mins.
D. Combat Fuel (Military Thrust)	5,000 Lbs.
E. Combat Time (Military Thrust)	29 Mins.

MAXIMUM CONTINUOUS THRUST FUEL ALLOWANCE CHART

This chart (figure A5-2) shows the relationship between time and fuel, with changes in altitude, for single-engine operation with maximum continuous thrust.

SAMPLE PROBLEM

A. Altitude	30,000 Ft.
B. Fuel	4,500 Lbs.
C. Time	30 Mins.



COMBAT ALLOWANCE

MODEL: F/RF/YRF-101A
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

CONFIGURATION: CLEAN

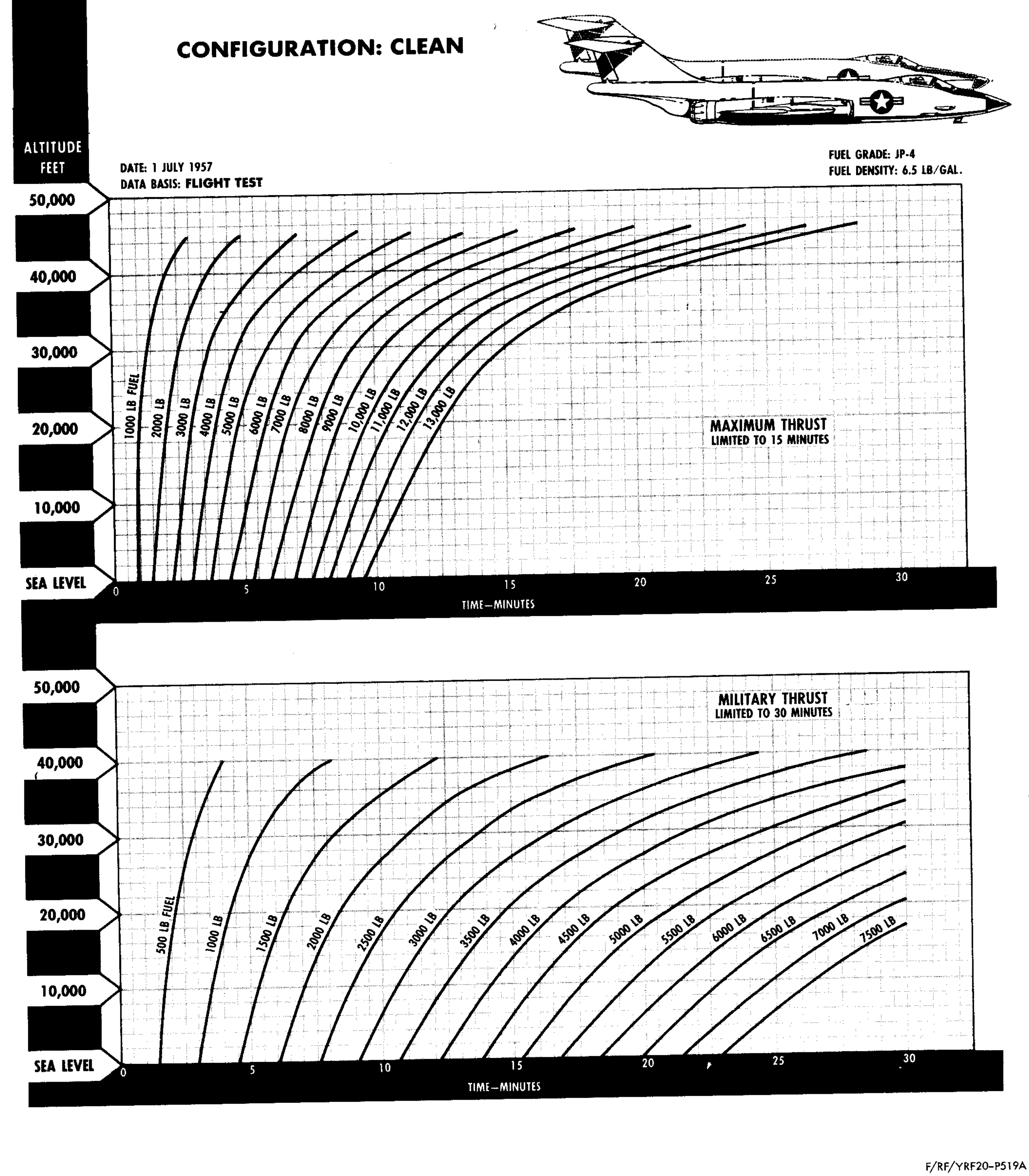
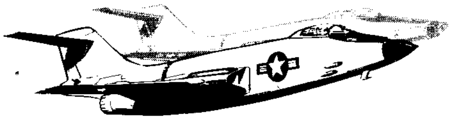


Figure A5-1

MAXIMUM CONTINUOUS THRUST FUEL ALLOWANCE

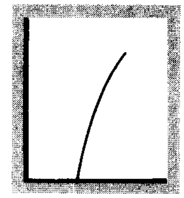
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



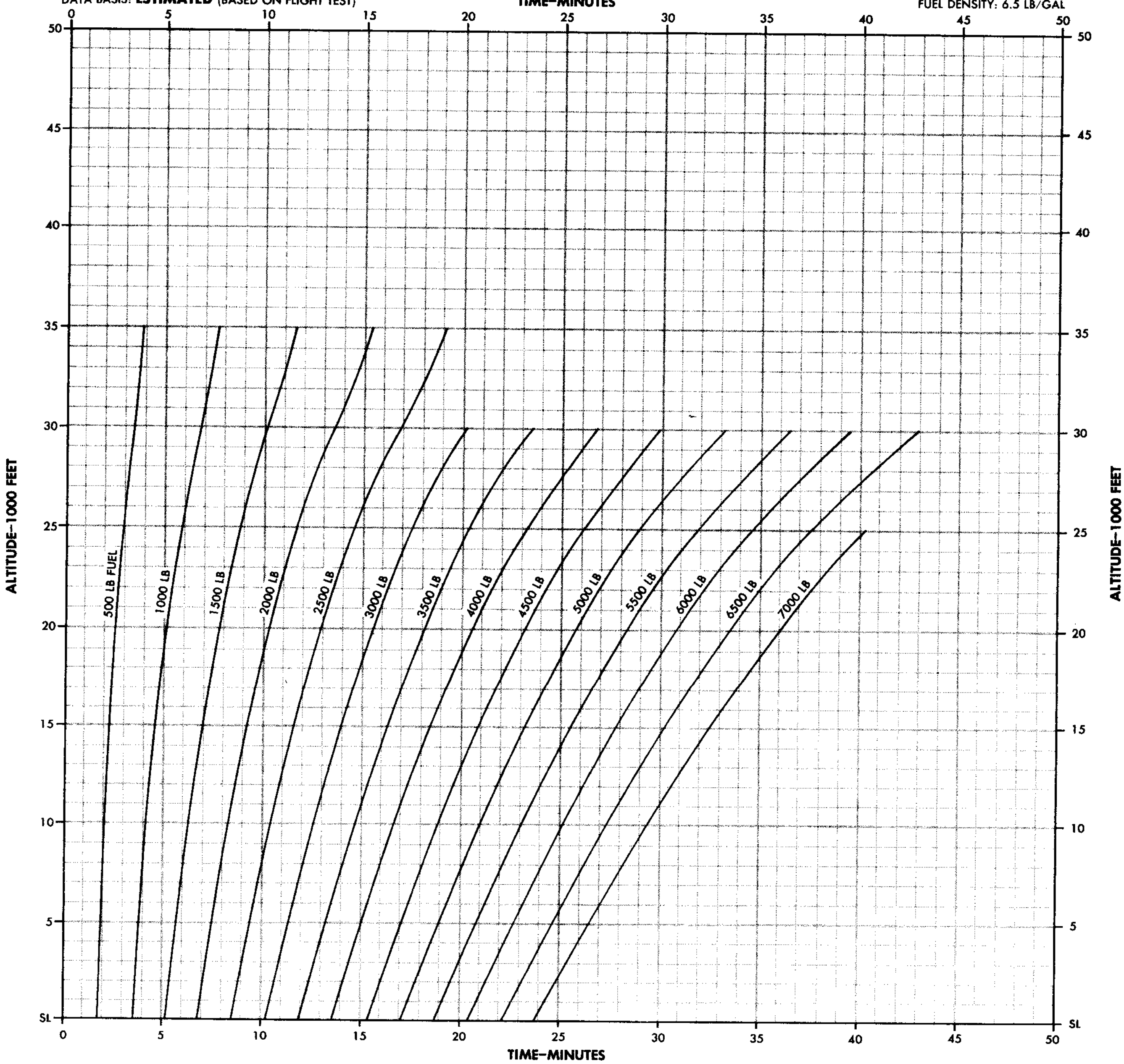
REMARKS
ENGINE(S): (2) J57-P-13
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

GUIDE



DATE: 1 DECEMBER 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



F/RF/YRF20-P527

Figure A5-2

air refueling part 6

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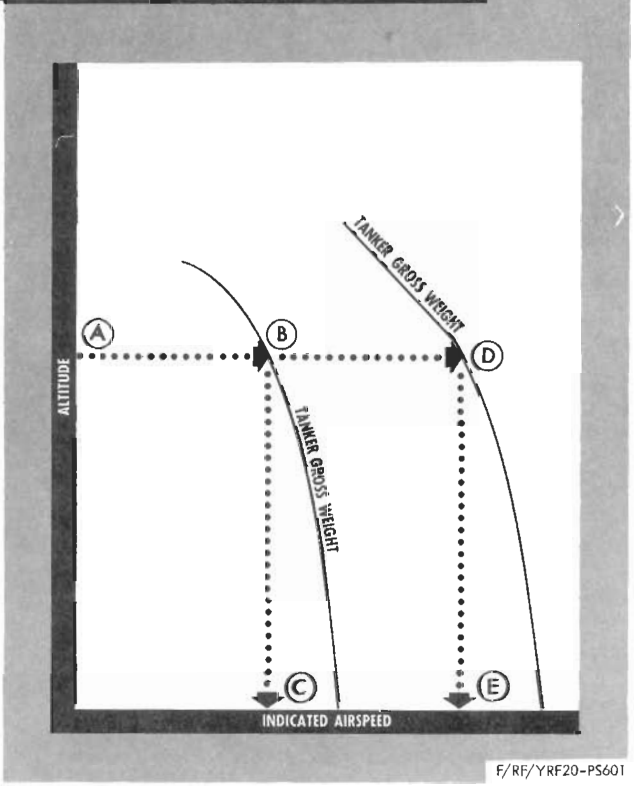
Charts

SAMPLE MAXIMUM FORMATING SPEEDS



F/RF/YRF20-PS601

MAXIMUM FORMATING SPEED CHARTS

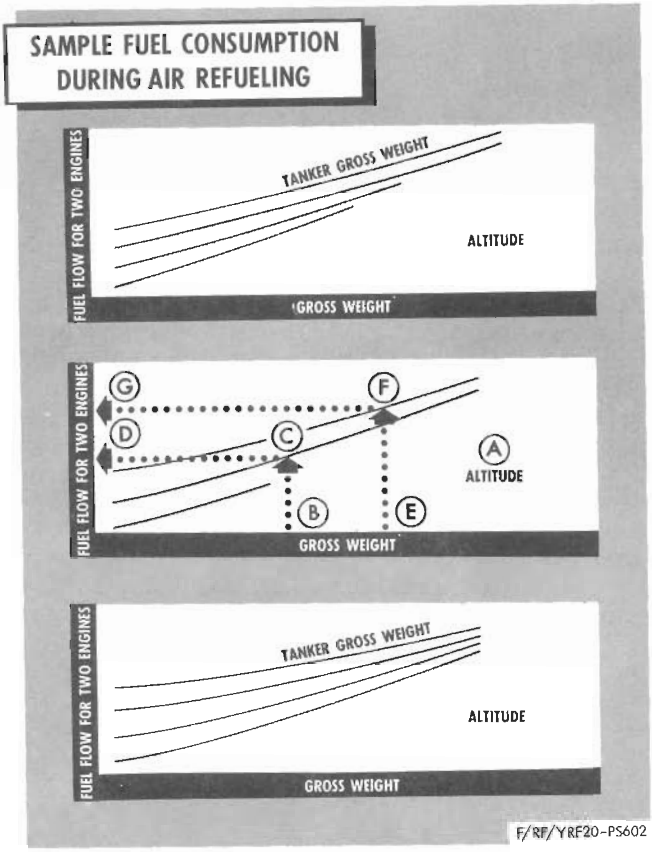
These charts (figures A6-1 through A6-10) present the altitude and speed capability during air refueling (with boom in contact position) for the complete weight ranges of the receiver airplane and the KB-50J, KC-97E, KC-97G and KC-135A tankers. The refueling flight envelopes shown, present tanker level flight high speeds with maximum continuous thrust. With an established rate of descent, the speed capabilities of the tanker can be increased in accordance with the figures presented in the tanker Flight Manual. The speed at the beginning of refueling can be read for a constant refuel altitude from the interpolated initial refuel weight of the tanker. The final refueling speed can be read for the post refuel weight of the tanker.

USE

Enter the chart at the established refueling altitude and proceed horizontally to the weights of the tanker at the beginning and at the end of refueling. Descend to the base of the chart and read the speeds at the beginning and end of refueling for the corresponding tanker weights.

SAMPLE PROBLEM

A. Formating altitude	20,000 Ft.
B. Initial tanker weight	100,000 Lbs.
C. Initial refueling speed	224 Kts.
D. Final tanker weight	89,685 Lbs.
E. Final refueling speed	227 Kts.
F. Average refueling speed $\frac{(C. + E.)}{2}$	226 Kts.



F/RF/YRF20-PS602

FUEL CONSUMPTION DURING AIR REFUELING CHARTS

These charts (figures A6-11 through A6-20) present the fuel flow of the receiver airplane for the tanker's maximum continuous thrust high speeds for the complete weight range of the KB-50J, KC-97E, KC-97G and KC-135A tankers and the receiver airplane. Three formating altitude graphs are given for each airplane configuration.

USE

Enter the base of the chart at initial receiver airplane weight and proceed vertically to intersect the initial tanker weight on the applicable formating altitude graph. Proceed horizontally to the left scale and read the initial fuel flow. Re-enter the base of the chart at the final receiver airplane's weight and proceed vertically to intersect the final tanker's weight on the applicable formating altitude graph. Proceed horizontally to the left scale and read the final fuel flow during refueling.

SAMPLE PROBLEM

A.	Formating Altitude	20,000 Ft.
B.	Initial receiver weight	37,481 Lbs.
C.	Initial tanker weight	100,000 Lbs.
D.	Initial fuel flow during refueling	132 Lbs./Min.
E.	Final receiver weight	46,589 Lbs.
F.	Final tanker weight	89,685 Lbs.
G.	Final fuel flow during refueling	153 Lbs./Min.
H.	Average fuel flow during refueling	143 Lbs./Min.

DESCENT FROM OPTIMUM CRUISE ALTITUDE TO REFUEL ALTITUDE CHARTS

These charts (figures A6-22 and A6-23) present the receiver airplane time, fuel, and distance required to descend from optimum cruise altitude to the established refueling altitude. Three configurations are presented on the same chart.

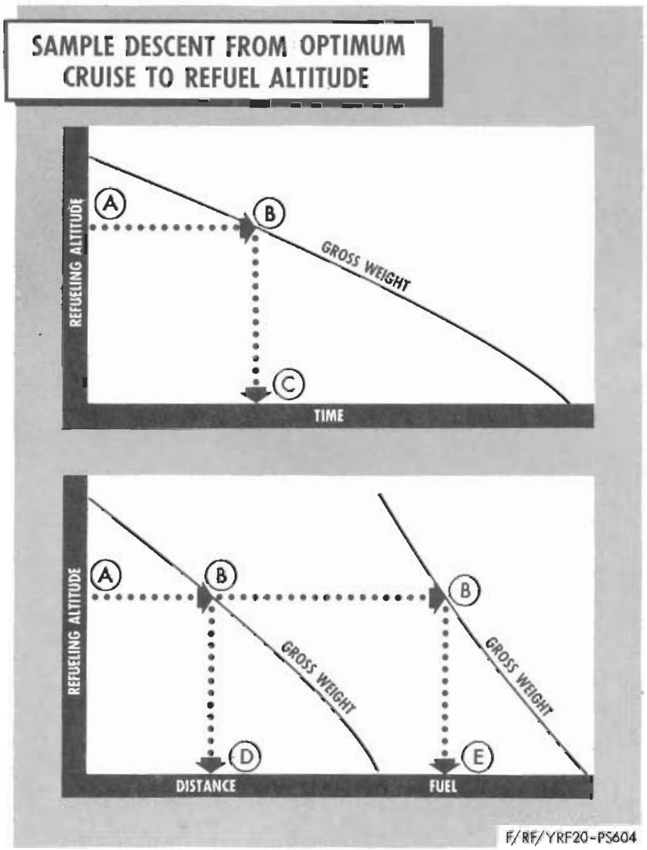
USE

Enter the chart at the established refueling altitude and proceed horizontally to the interpolated weight of the receiver airplane at the beginning of refueling. Read the fuel, time, and distance on the appropriate scale.

SAMPLE PROBLEM

Configuration: Airplane With (2) 450 Gallon Tanks

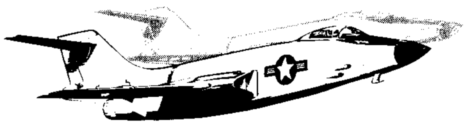
A.	Refueling altitude	20,000 Ft.
B.	Receiver weight at start of refuel	35,000 Lbs.
C.	Time	4.6 Min.
D.	Distance	32 Miles
E.	Fuel	108 Lbs.



F/RF/YRF20-PS604

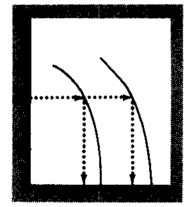
MAXIMUM FORMATING SPEEDS
KB-50J TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



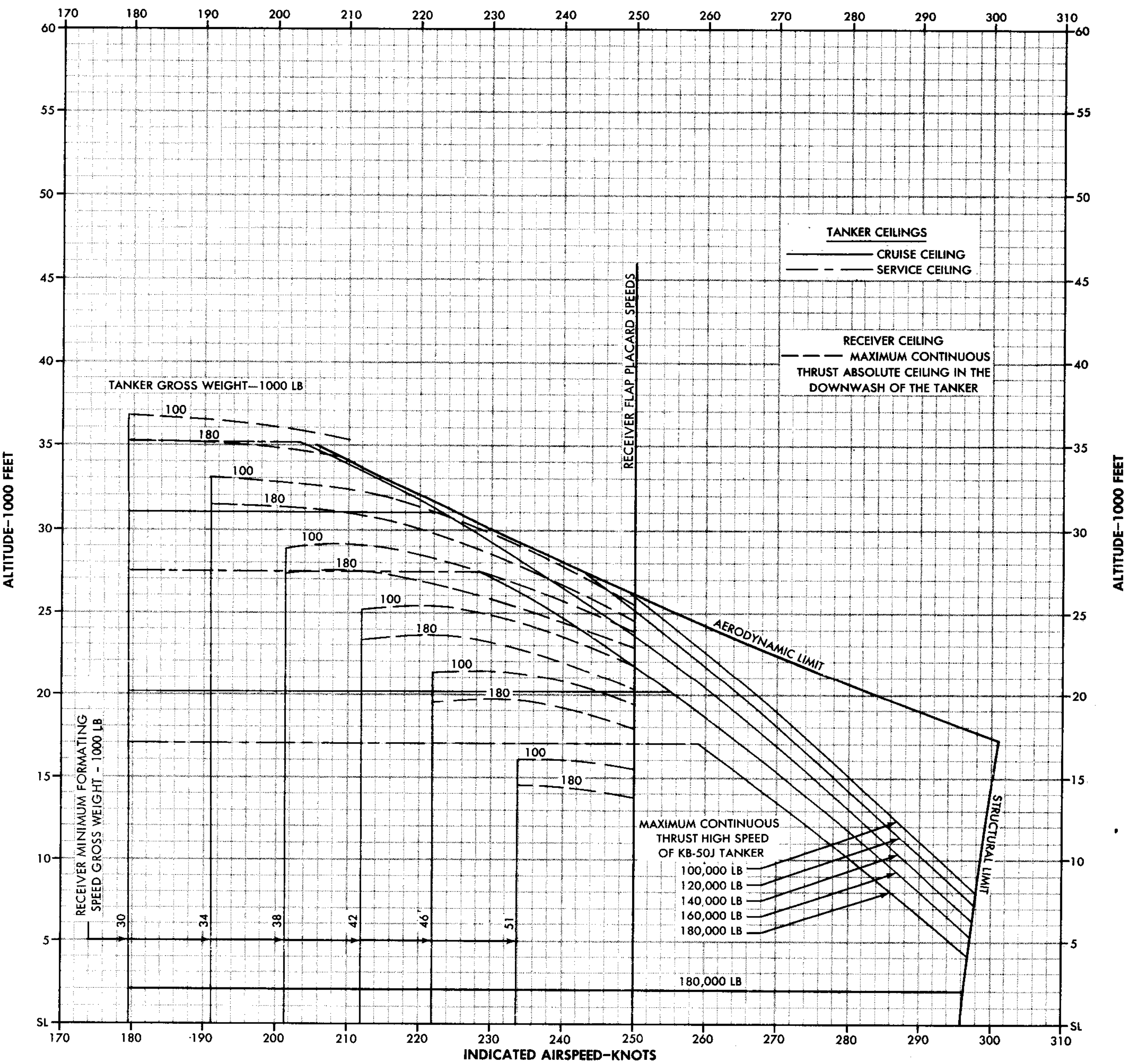
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



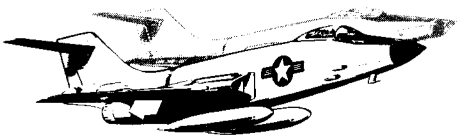
F/RF/YRF20-P645

Figure A6-1

MAXIMUM FORMATING SPEEDS

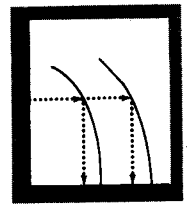
KB-50J TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



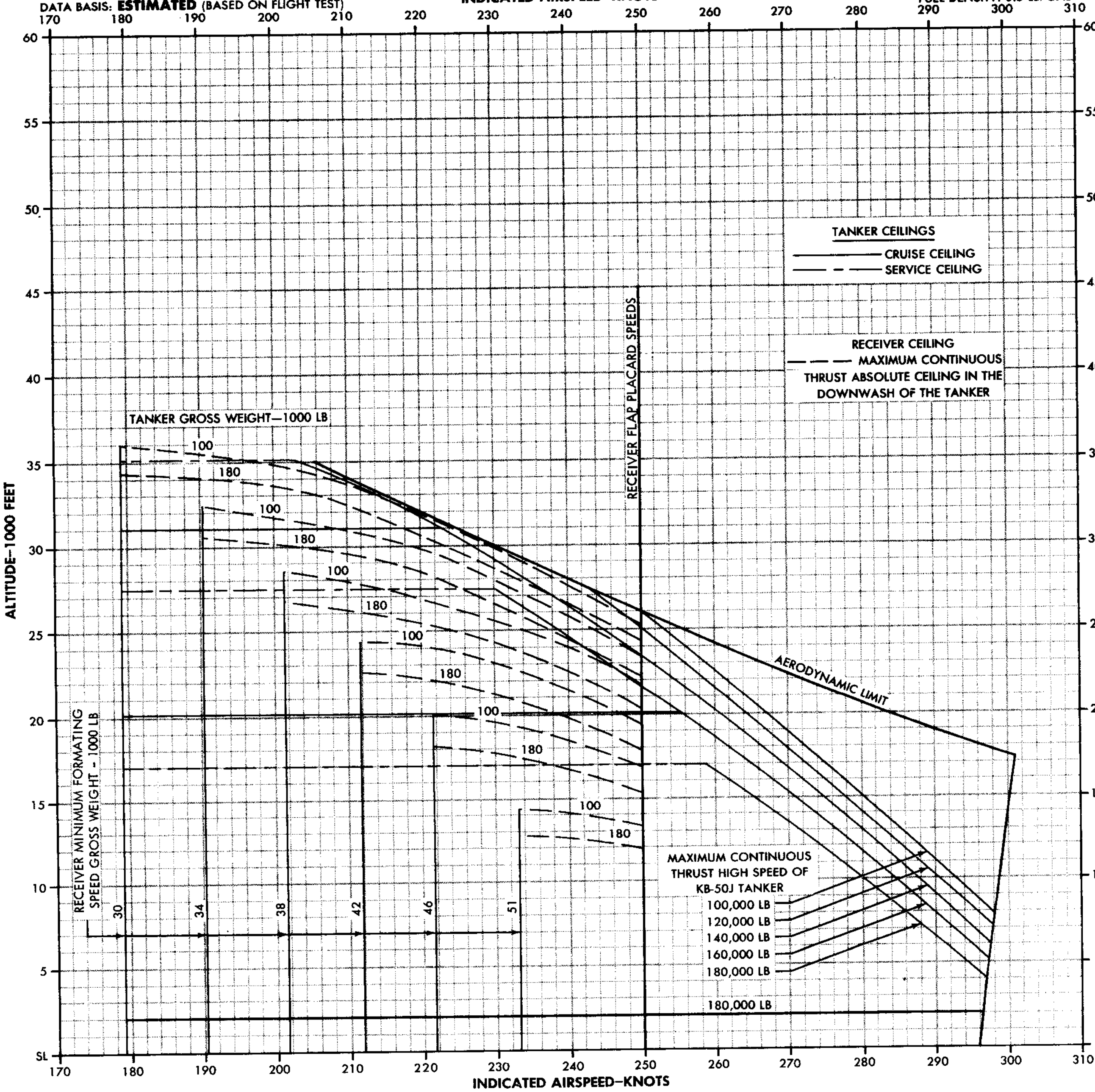
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



F/RF/YRF20-P646

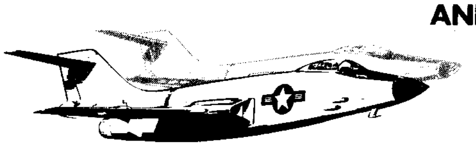
Figure A6-2

MAXIMUM FORMATING SPEEDS

KB-50J TANKER

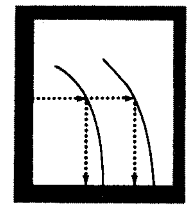
ONE ENGINE MINIMUM AFTERBURNER THRUST AND ONE ENGINE MILITARY THRUST

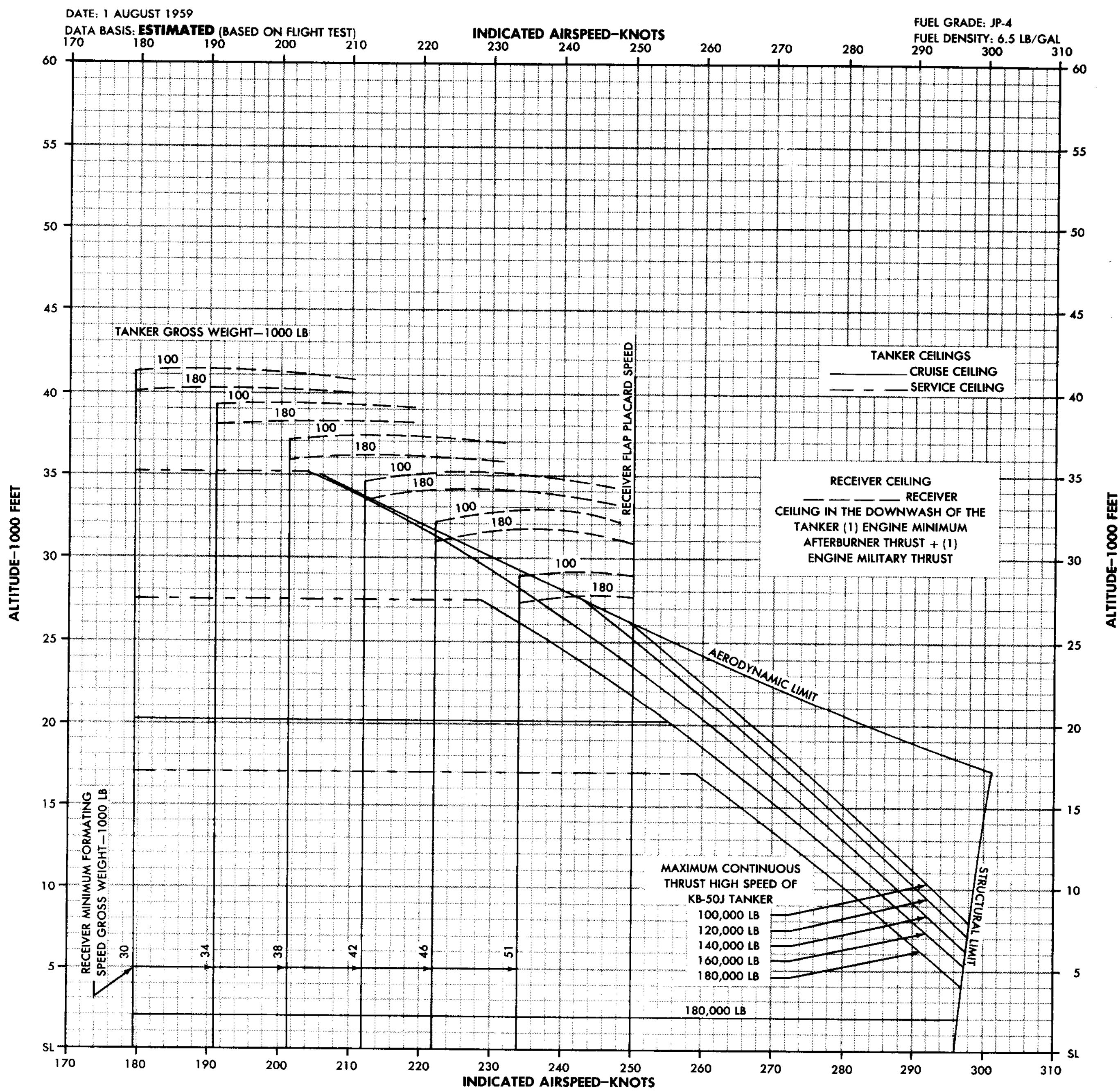
AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



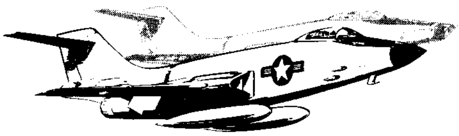


F/RF/YRF20-P651

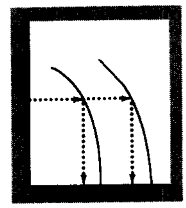
Figure A6-3

MAXIMUM FORMATING SPEEDS
KB-50J TANKER
ONE ENGINE MINIMUM AFTERBURNER THRUST AND ONE ENGINE MILITARY THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



GUIDE



REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

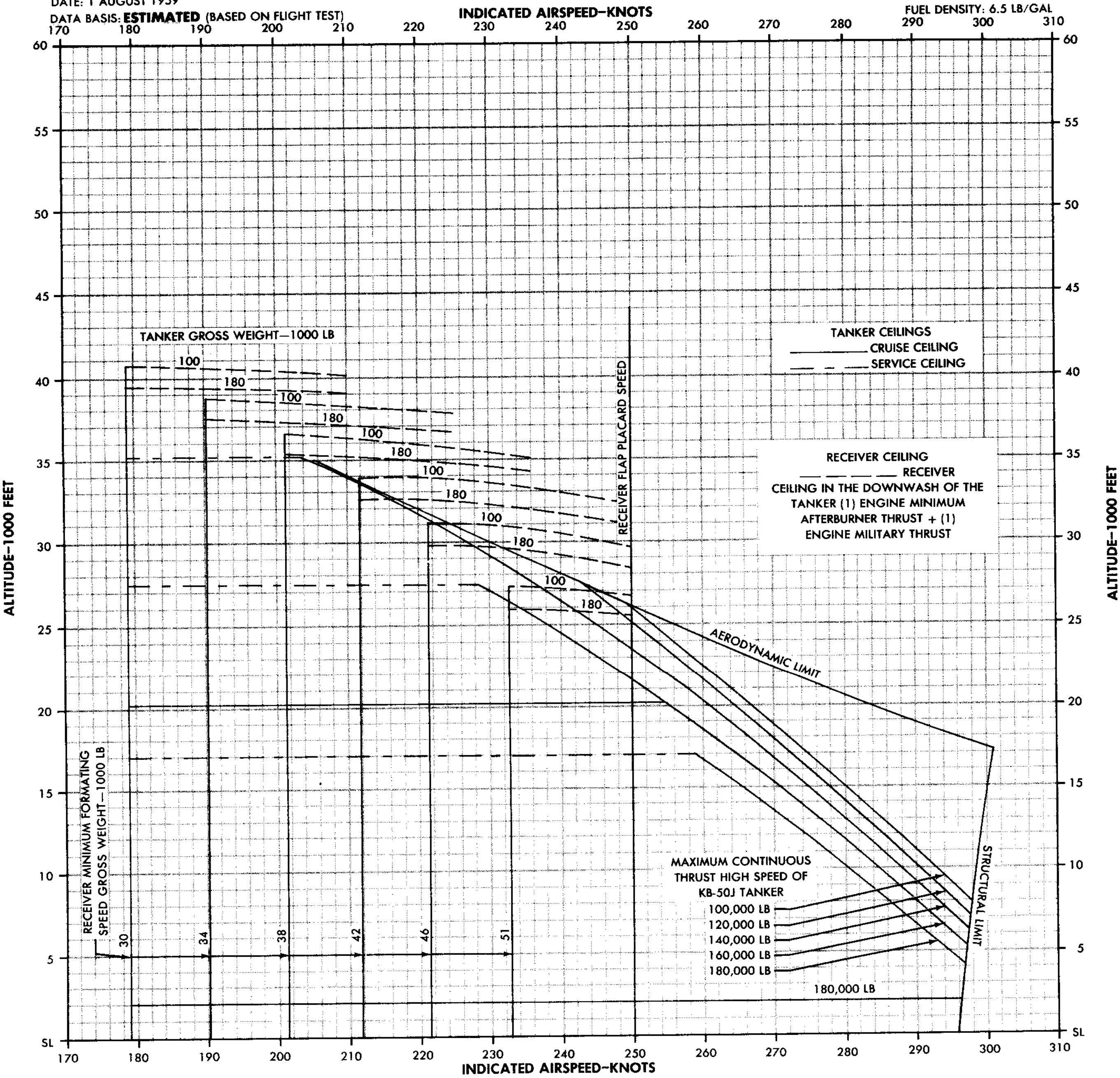
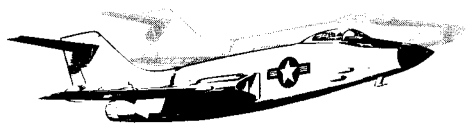


Figure A6-4

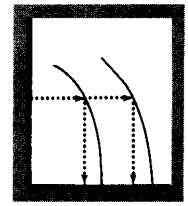
MAXIMUM FORMATING SPEEDS
KC-97E TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



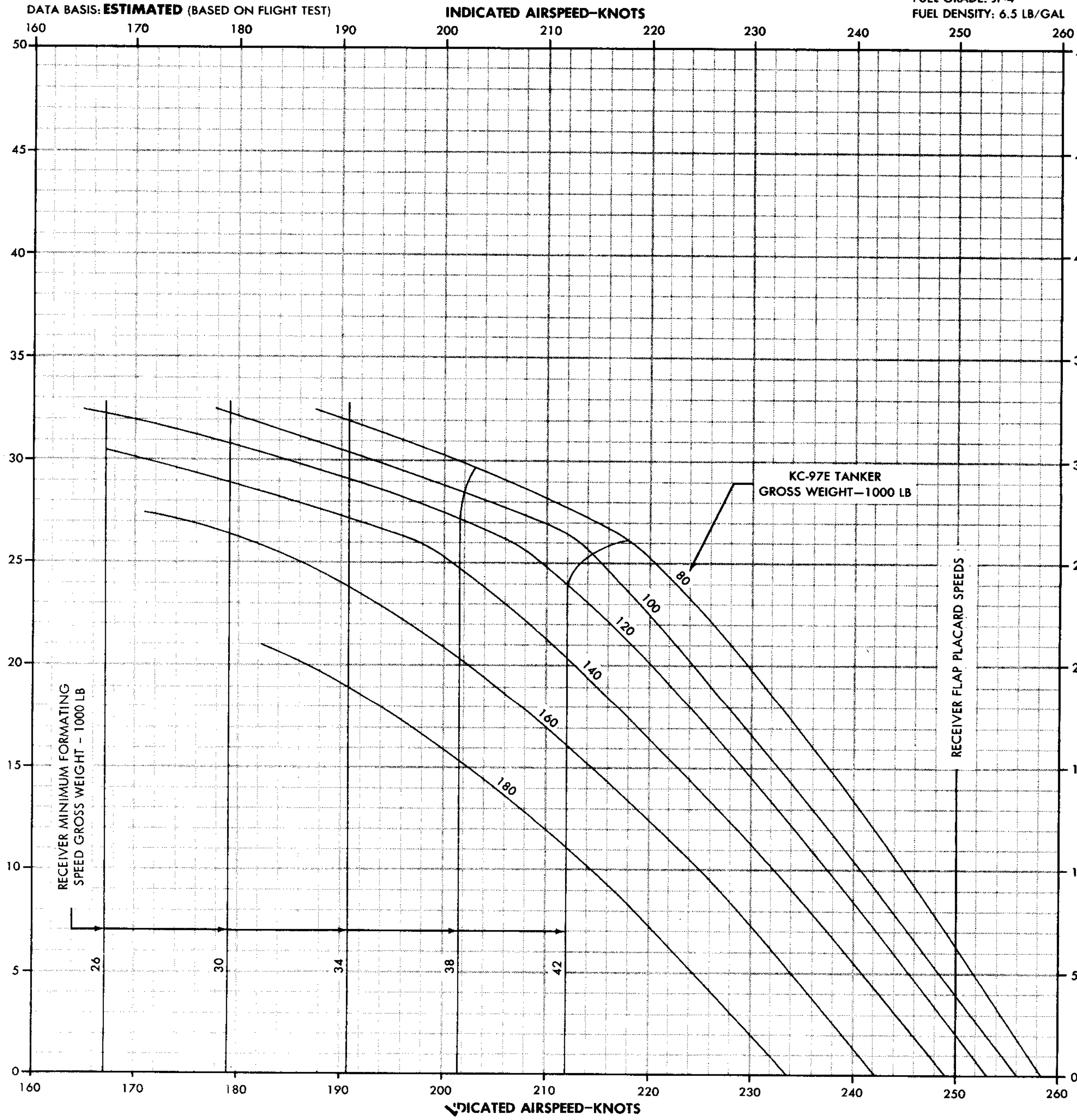
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

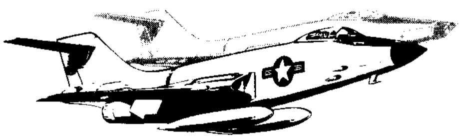


F/RF/YRF20-P617

Figure A6-5

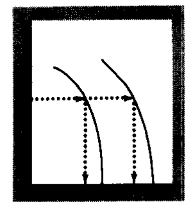
MAXIMUM FORMATING SPEEDS
KC-97E TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



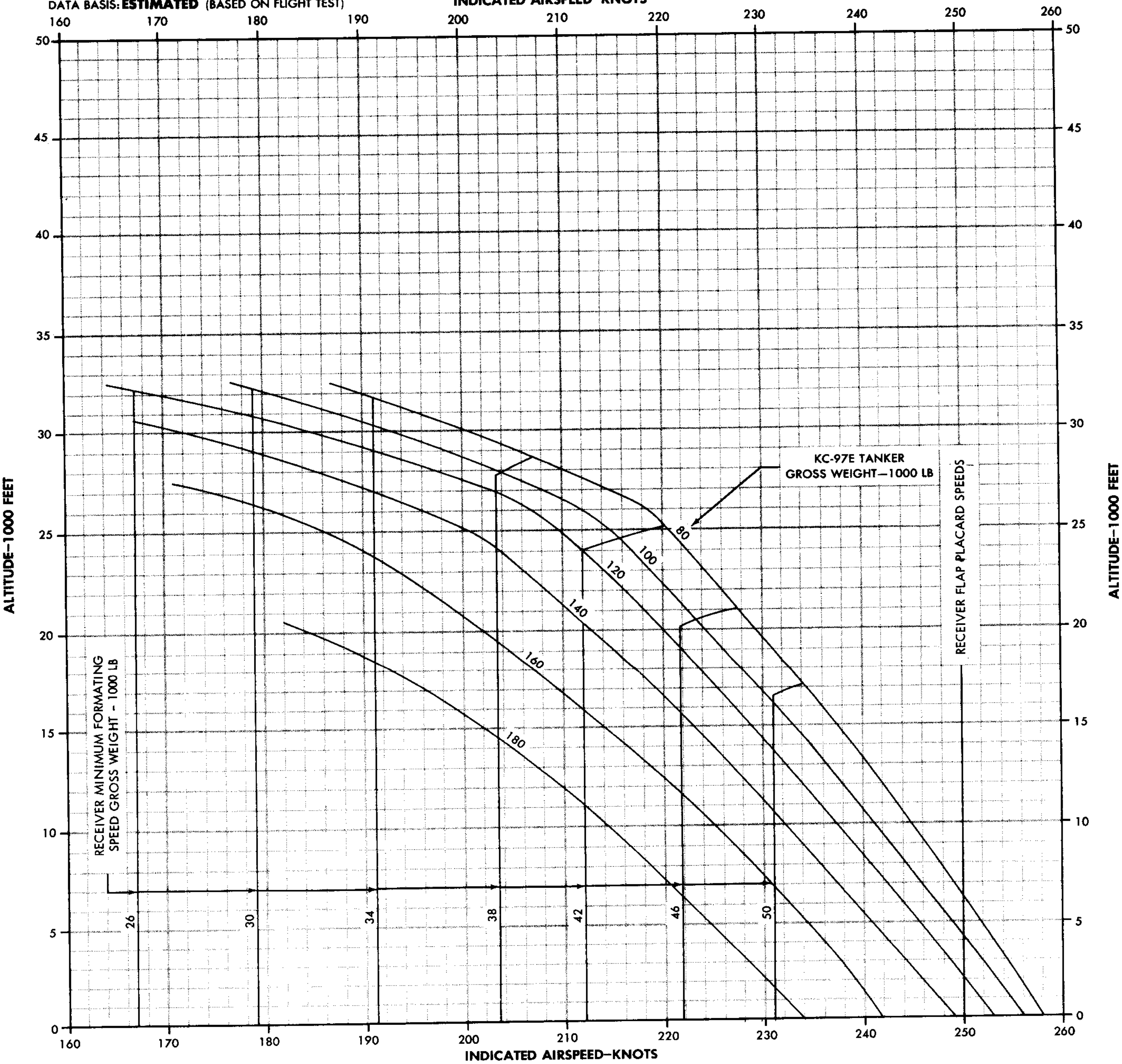
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



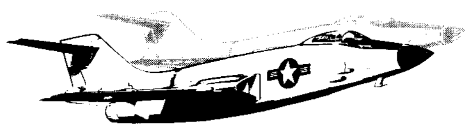
F/RF/YRF20-P618

Figure A6-6

MAXIMUM FORMATING SPEEDS

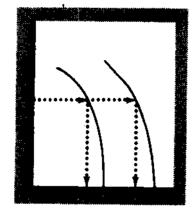
KC-97G TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



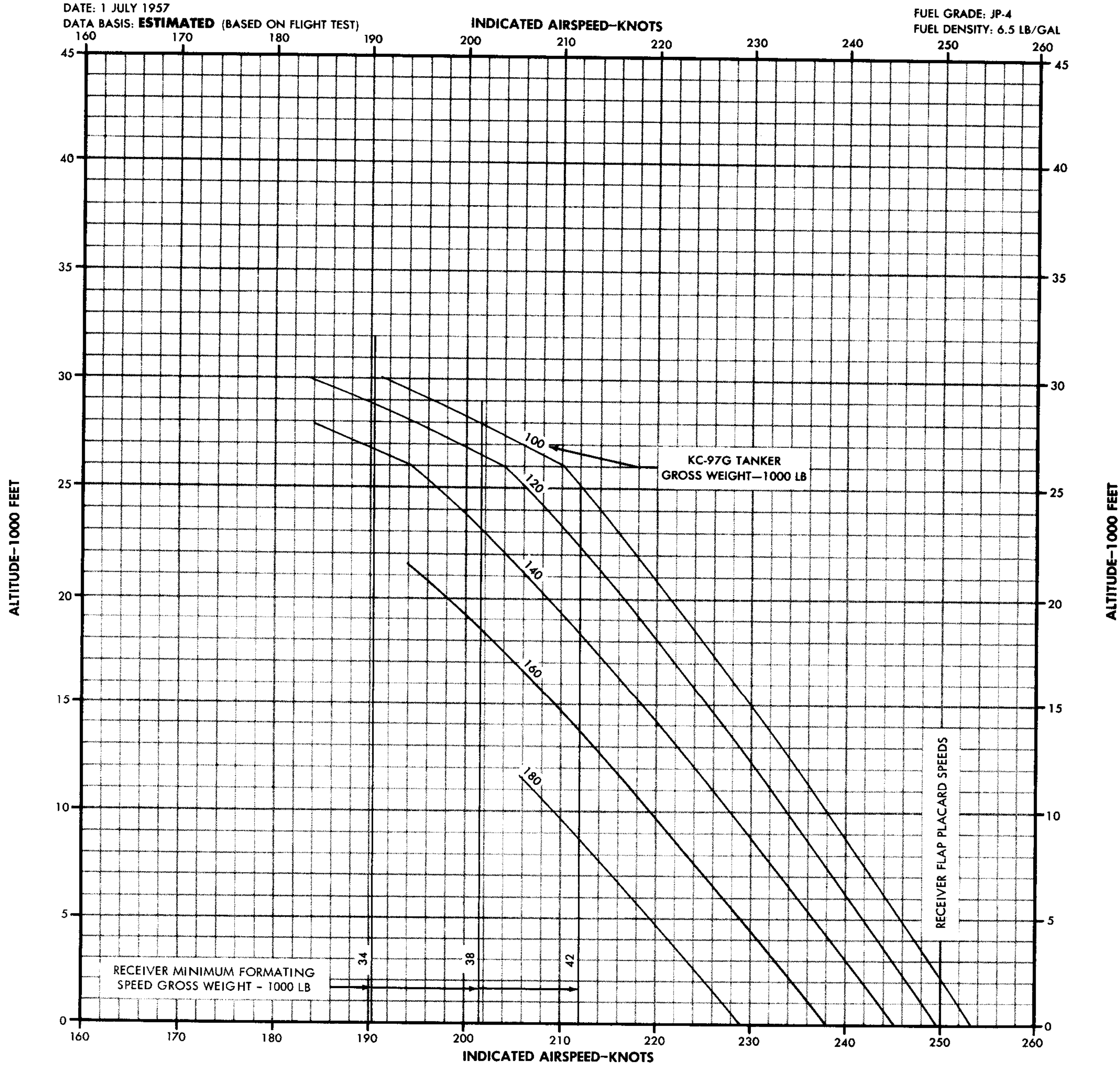
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



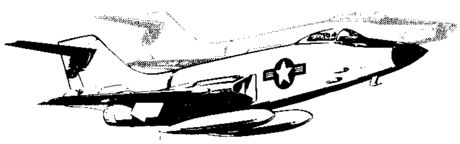
F/RF/YRF20-P619

Figure A6-7

MAXIMUM FORMATING SPEEDS

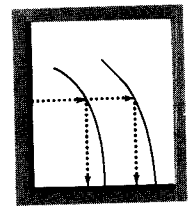
KC-97G TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



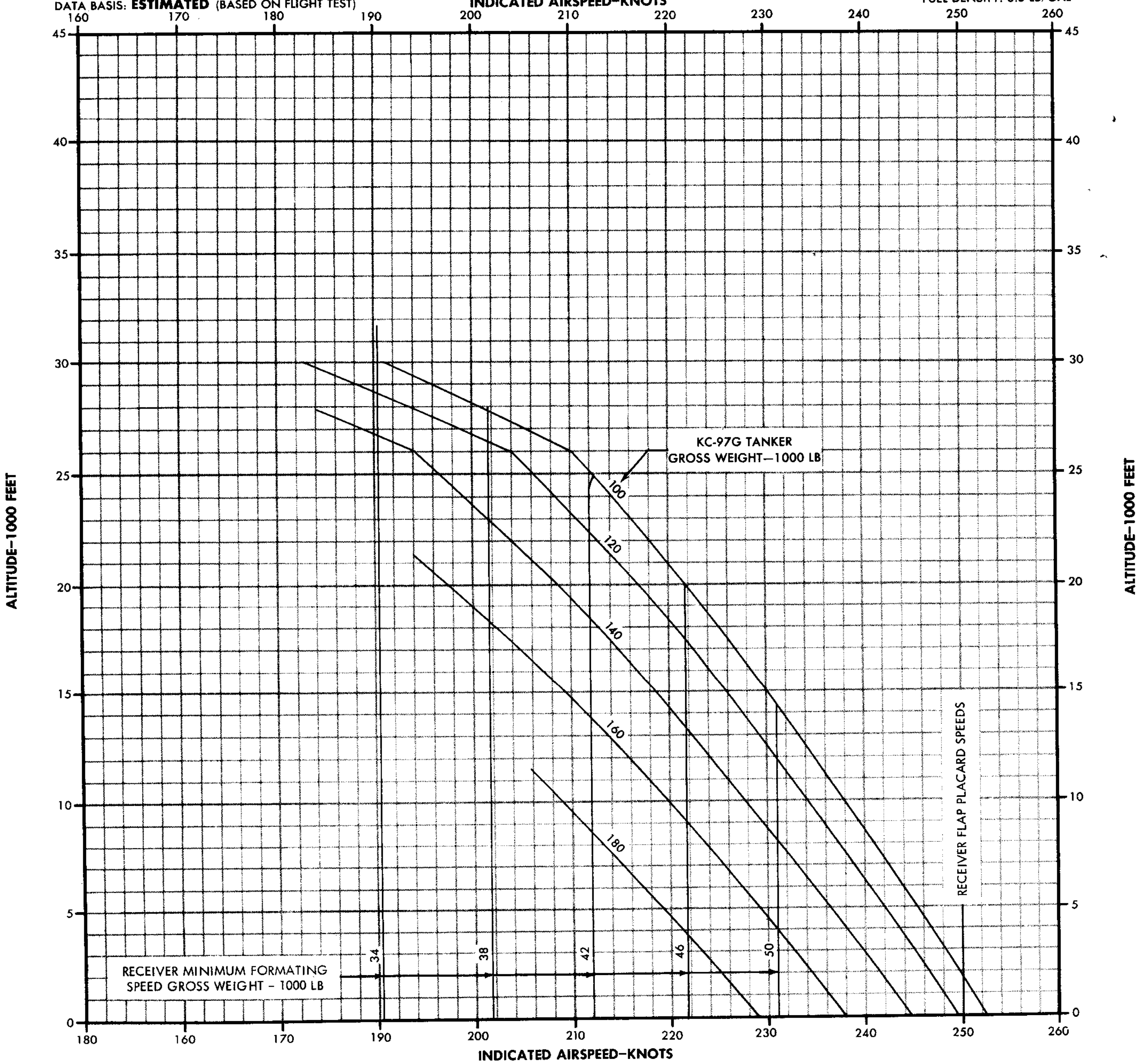
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION.

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



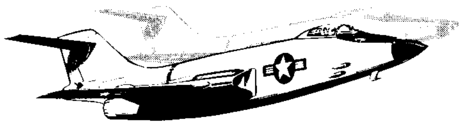
F/RF/YRF20-P620

Figure A6-8

MAXIMUM FORMATING SPEEDS

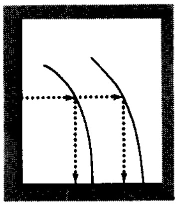
KC-135A TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



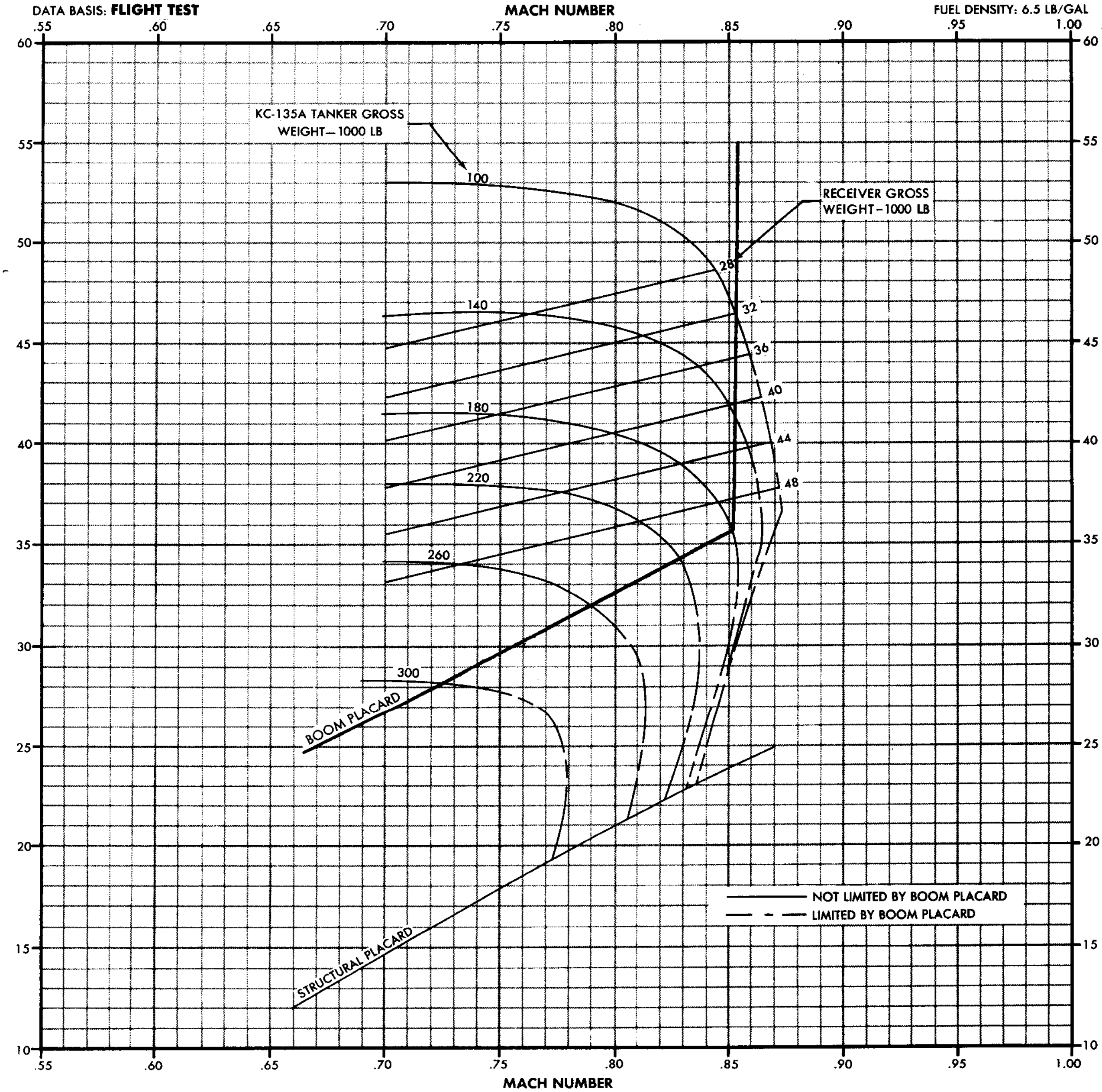
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION .

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



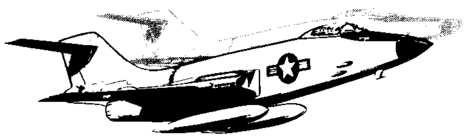
F/RF/YRF20-P621

Figure A6-9

MAXIMUM FORMATING SPEEDS

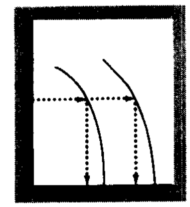
KC-135A TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



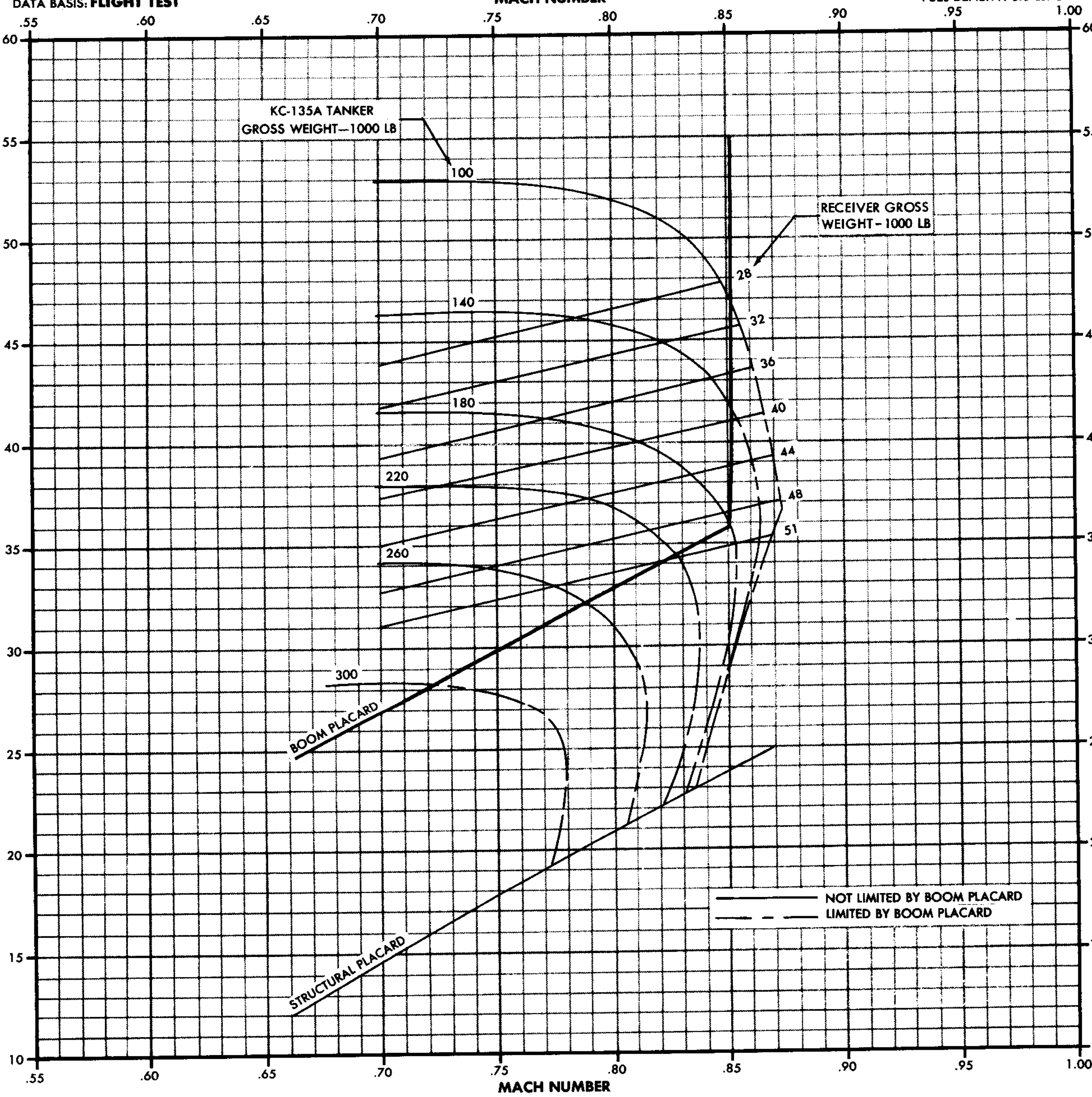
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
REFUEL FLIGHT SPEED IS MAXIMUM CONTINUOUS THRUST HIGH SPEED OF THE TANKER WITH THE BOOM IN CONTACT POSITION .

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



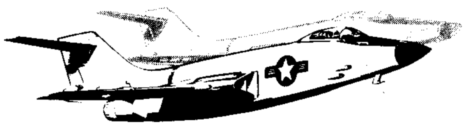
F/RF/YRF20-P622

Figure A6-10

FUEL CONSUMPTION DURING AIR REFUELING

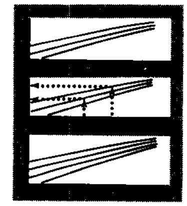
KB-50J TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



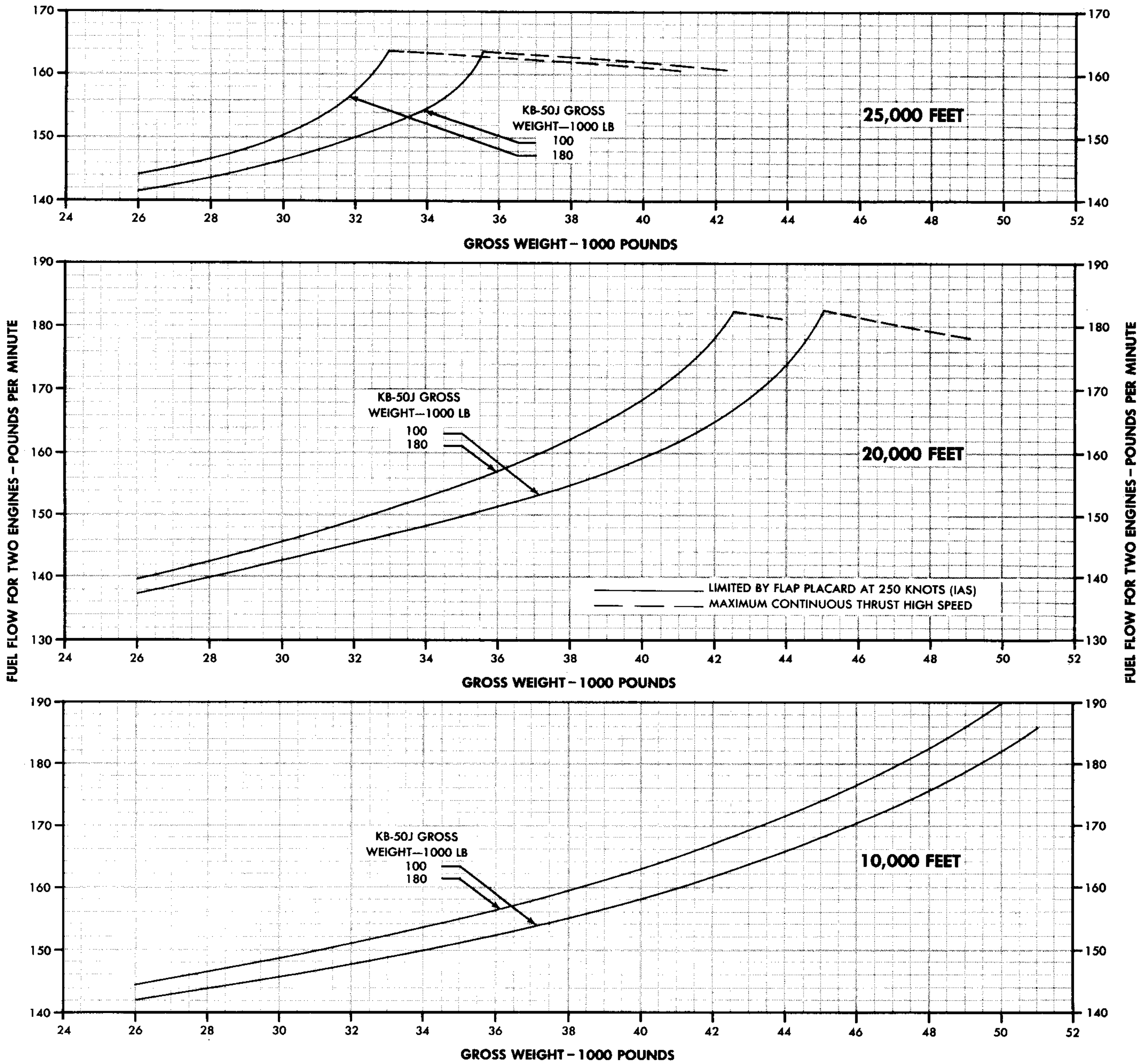
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



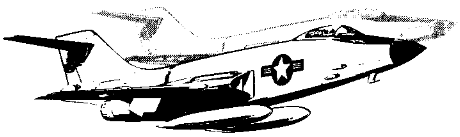
F/RF/YRF20-P647

Figure A6-11

FUEL CONSUMPTION DURING AIR REFUELING

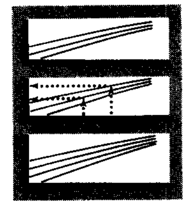
KB-50J TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



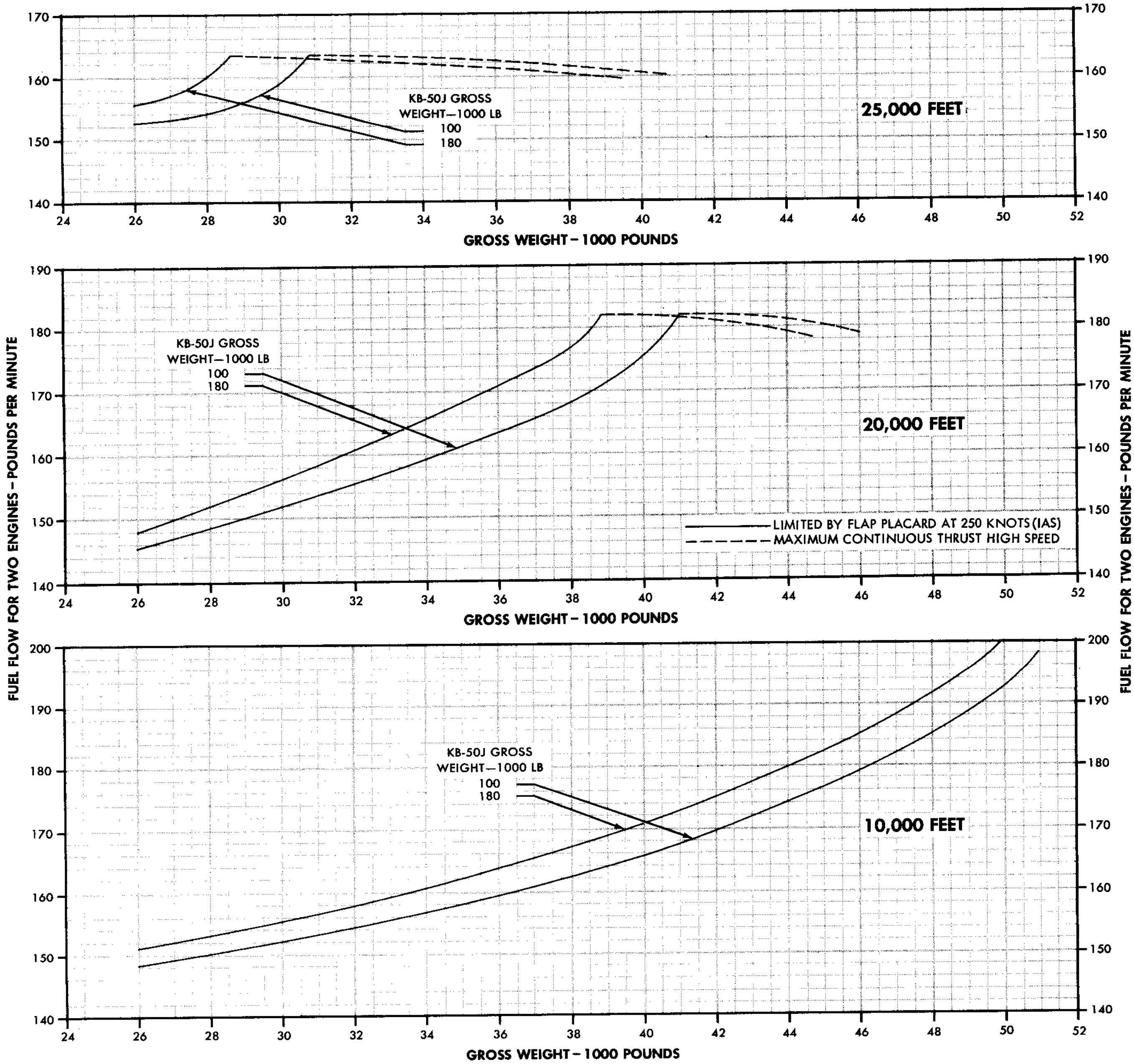
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 NOVEMBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



F/RF/YRF20-P648

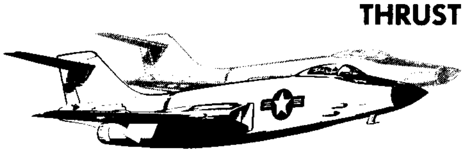
Figure A6-12

FUEL CONSUMPTION DURING AIR REFUELING

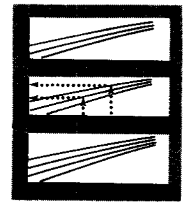
KB-50J TANKER

ONE ENGINE MINIMUM AFTERBURNER THRUST AND ONE ENGINE AT LESS THAN MILITARY THRUST AS REQUIRED TO MAINTAIN ALTITUDE

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



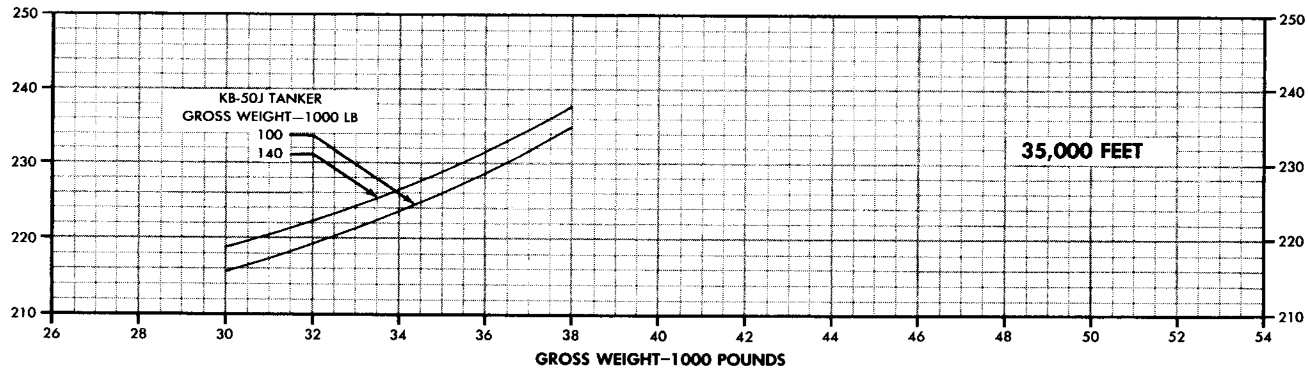
GUIDE

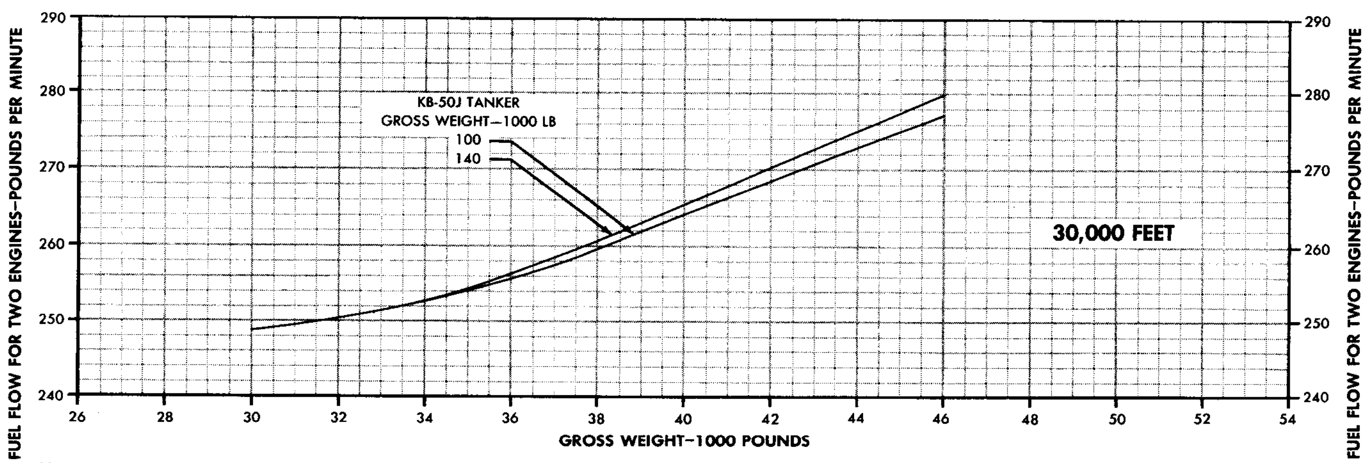


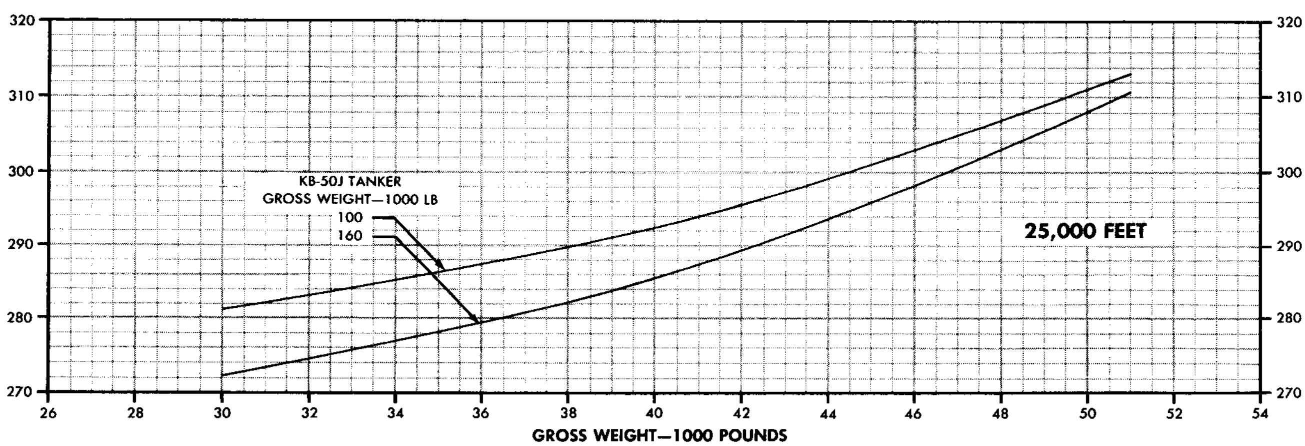
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL







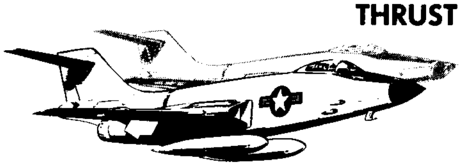
F/RF/YRF20-P653

Figure A6-13

FUEL CONSUMPTION DURING AIR REFUELING

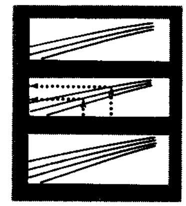
KB-50J TANKER
ONE ENGINE MINIMUM AFTERBURNER THRUST AND ONE ENGINE AT LESS THAN MILITARY THRUST AS REQUIRED TO MAINTAIN ALTITUDE

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



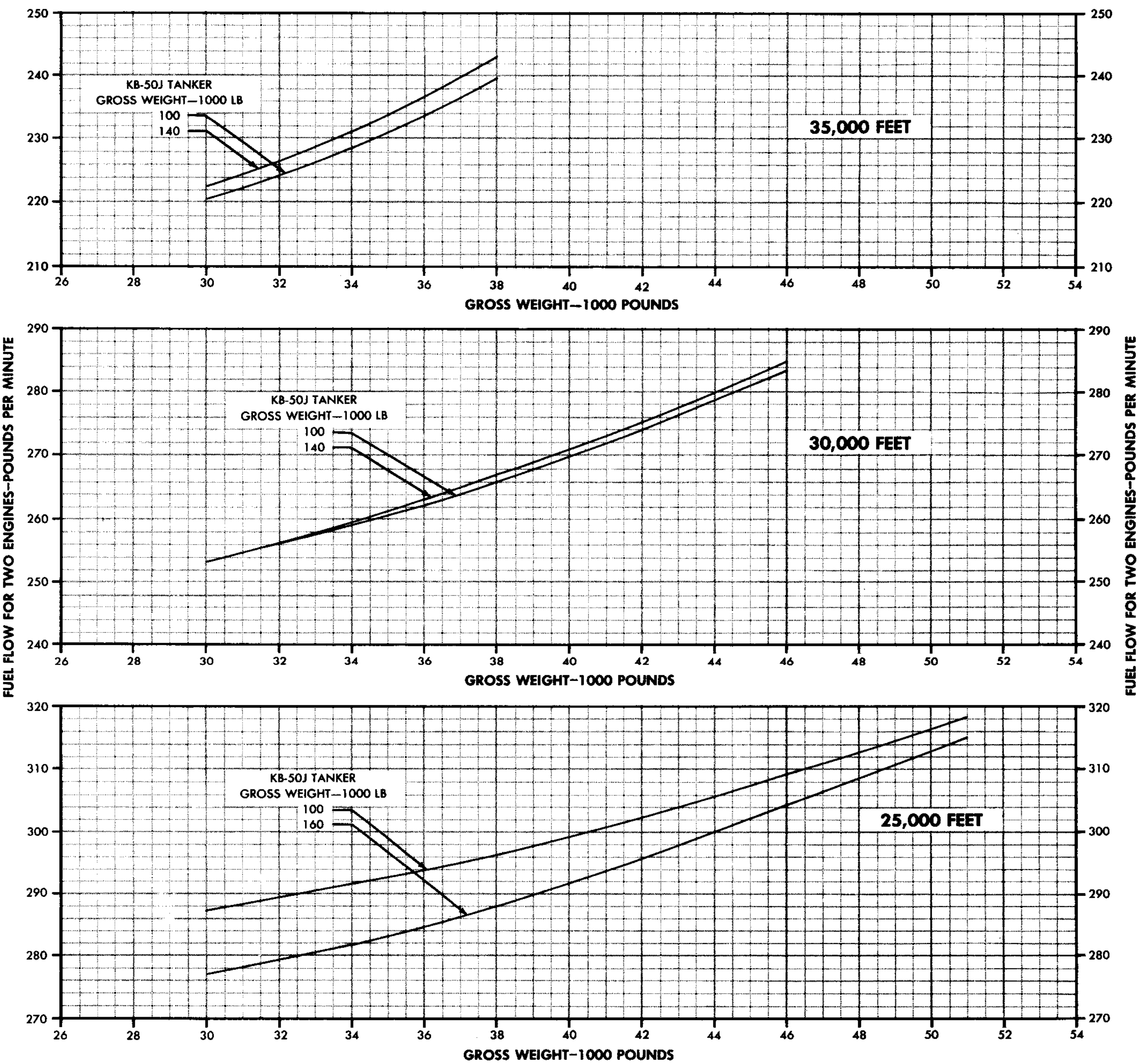
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



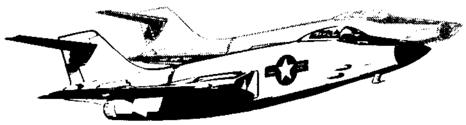
F/RF/YRF20-P654

Figure A6-14

FUEL CONSUMPTION DURING AIR REFUELING

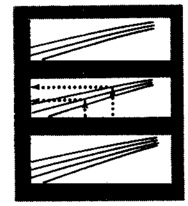
KC-97E TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



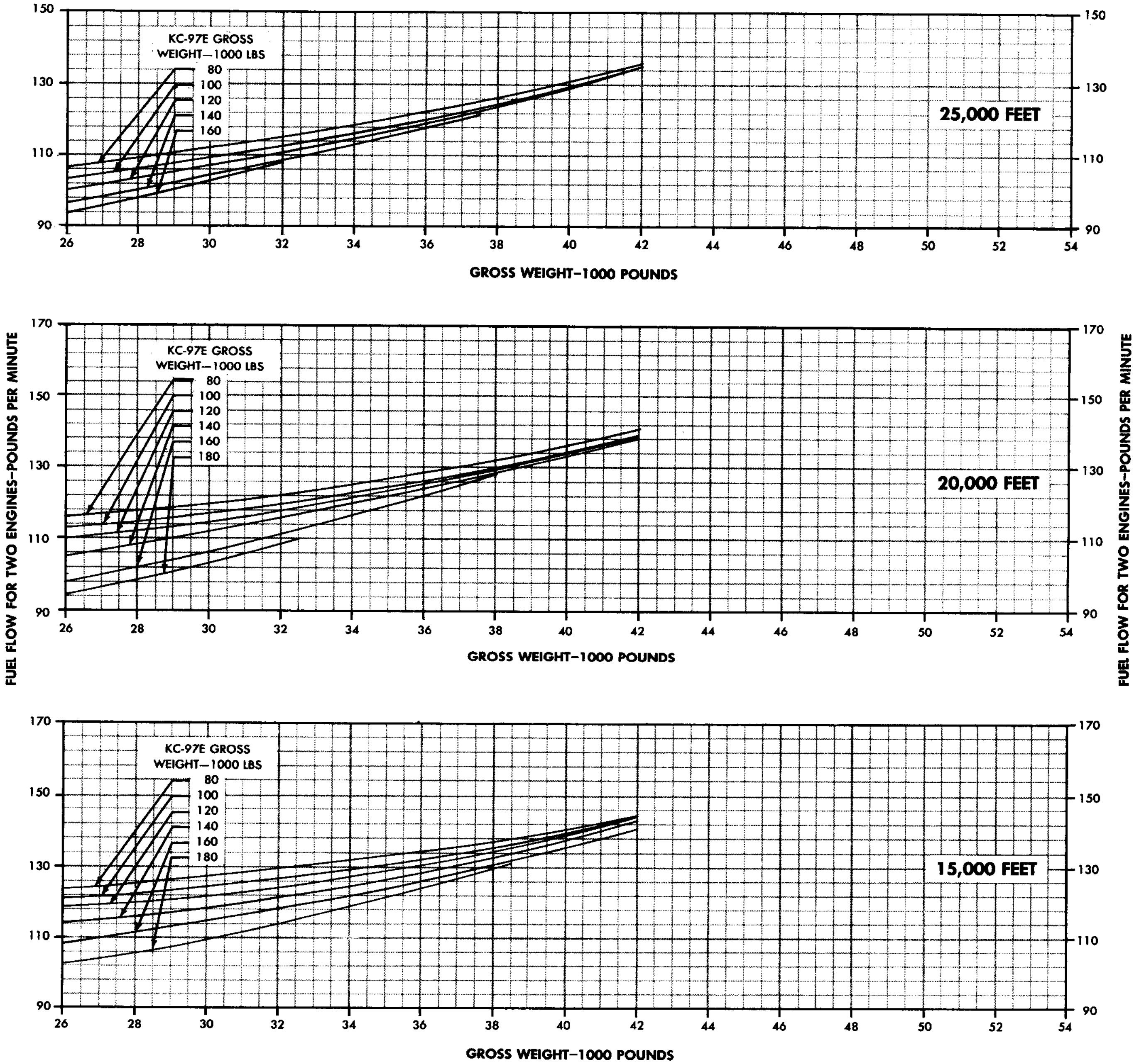
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1956
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



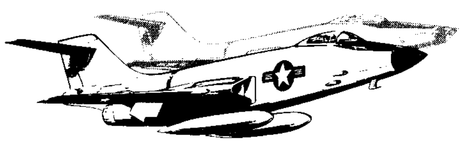
F/RF/YRF20-P623

Figure A6-15

FUEL CONSUMPTION DURING AIR REFUELING

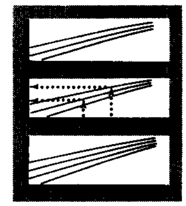
KC-97E TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



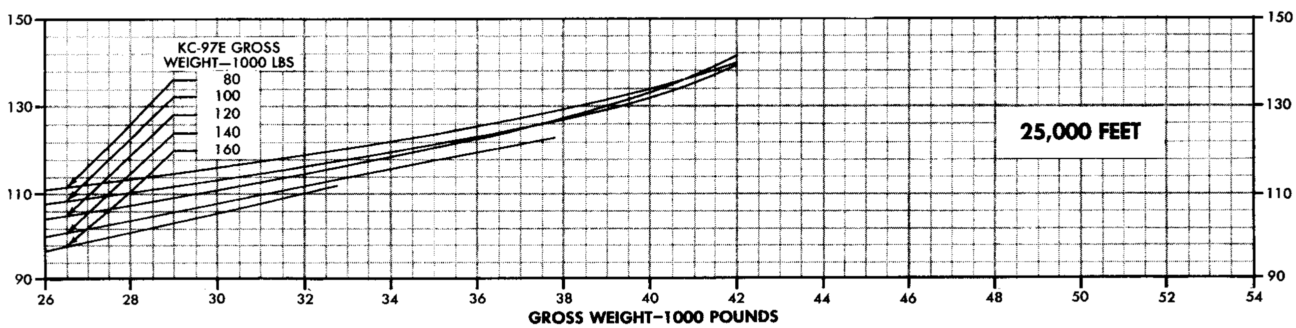
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

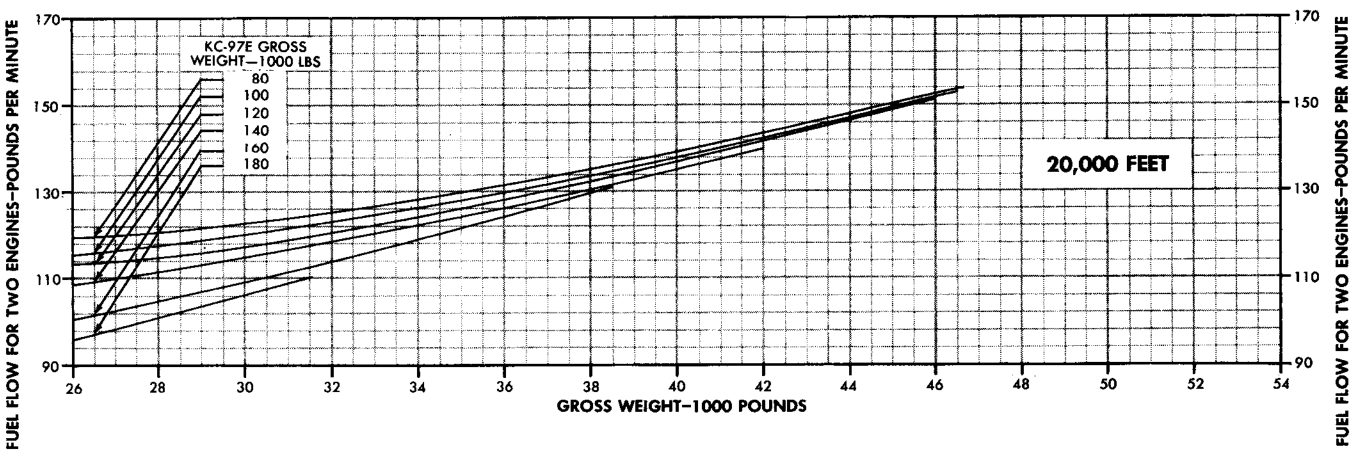
GUIDE

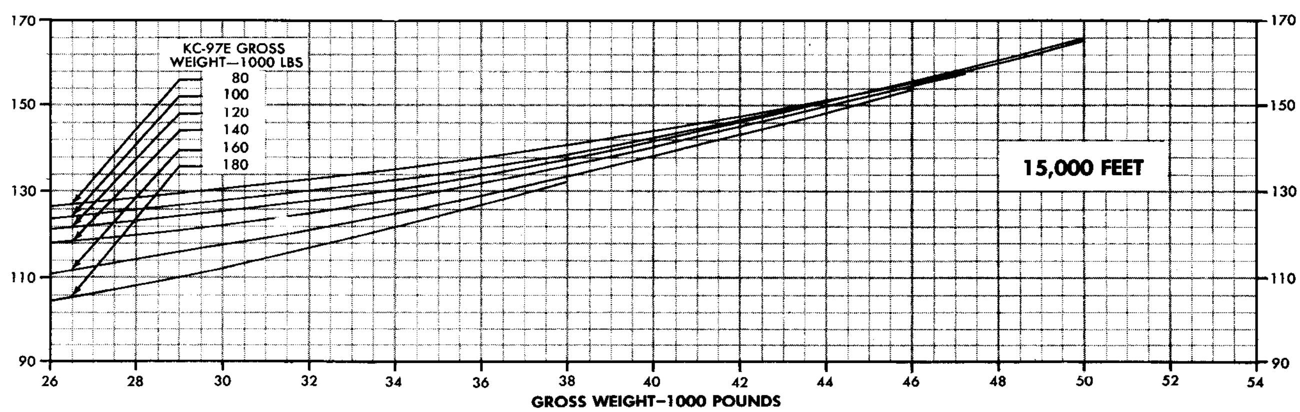


DATE: 1 MARCH 1956
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL







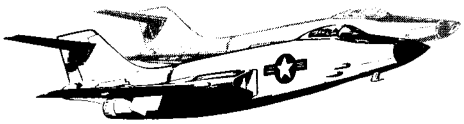
F/RF/YRF20-P624

Figure A6-16

FUEL CONSUMPTION DURING AIR REFUELING

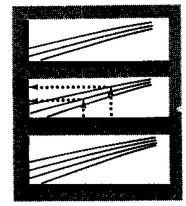
KC-97G TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN
FLAPS EXTENDED



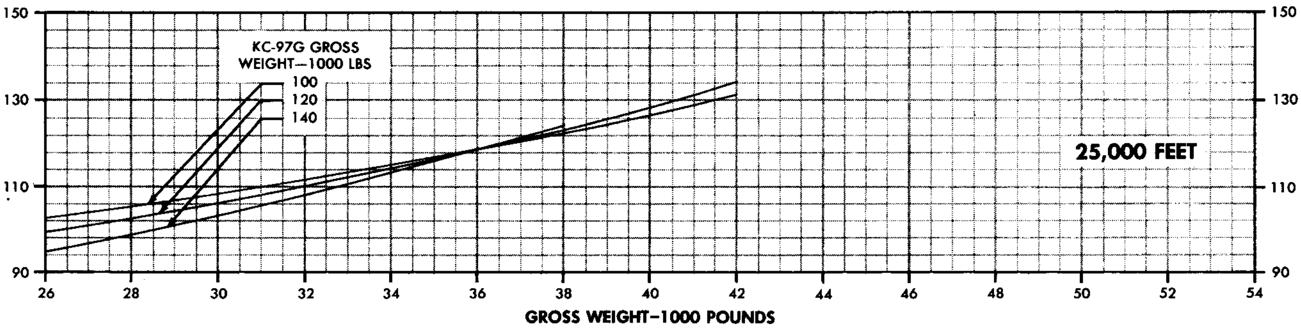
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

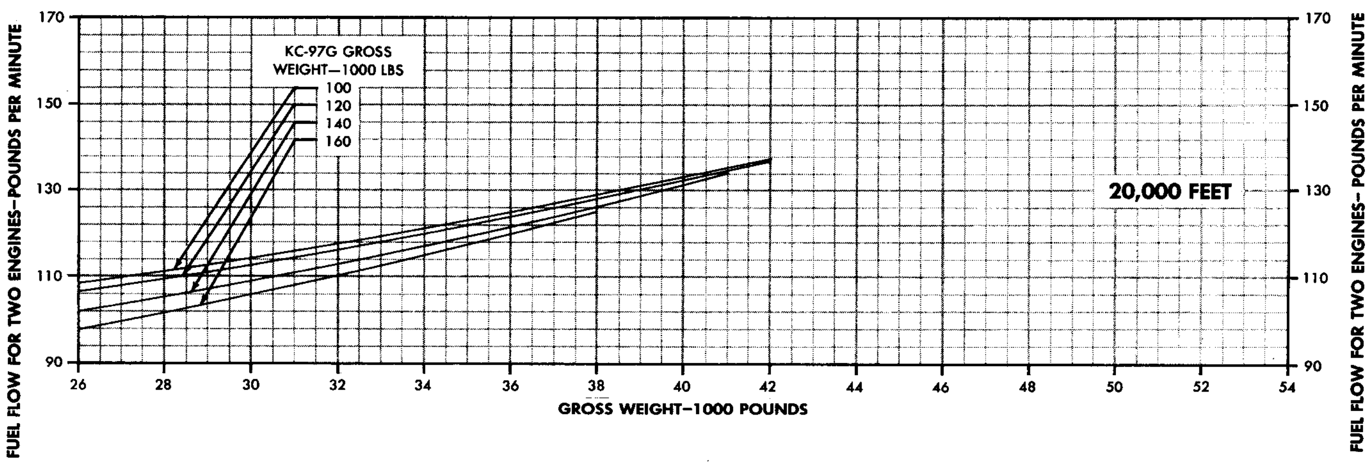
GUIDE

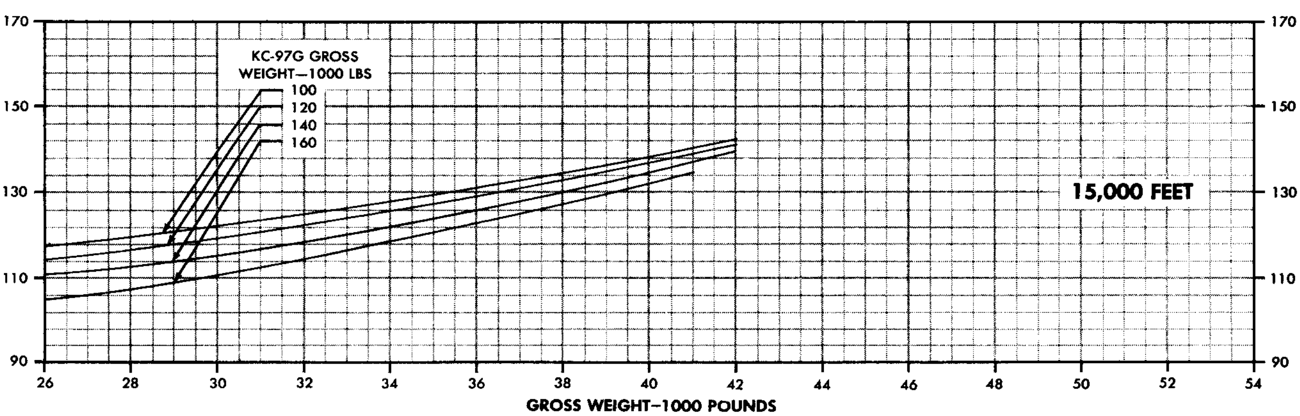


DATE: 1 MARCH 1956
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL







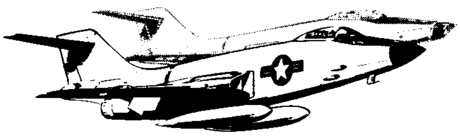
F/RF/YRF20-P625

Figure A6-17

FUEL CONSUMPTION DURING AIR REFUELING

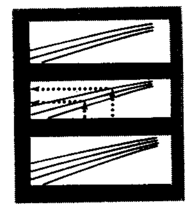
KC-97G TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS
FLAPS EXTENDED



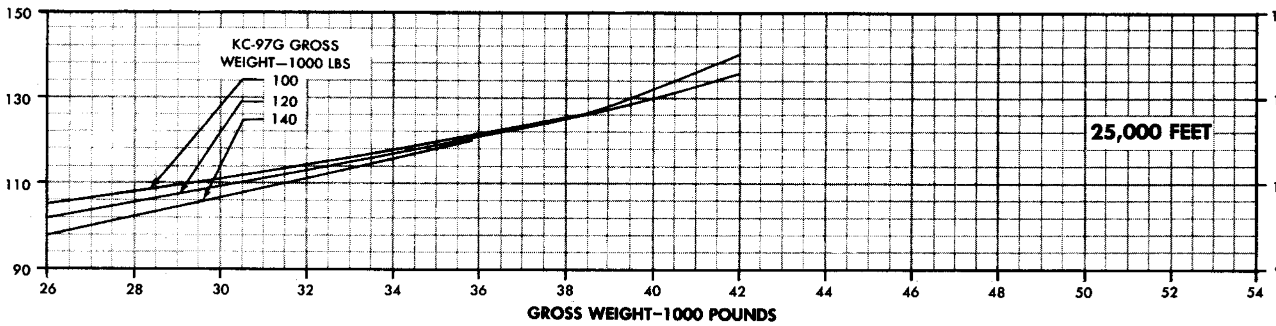
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

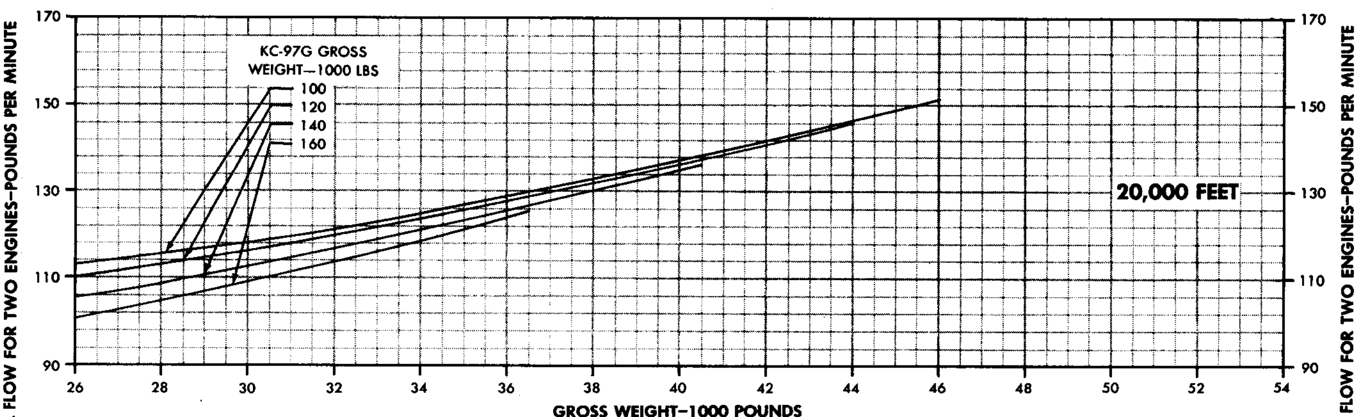
GUIDE

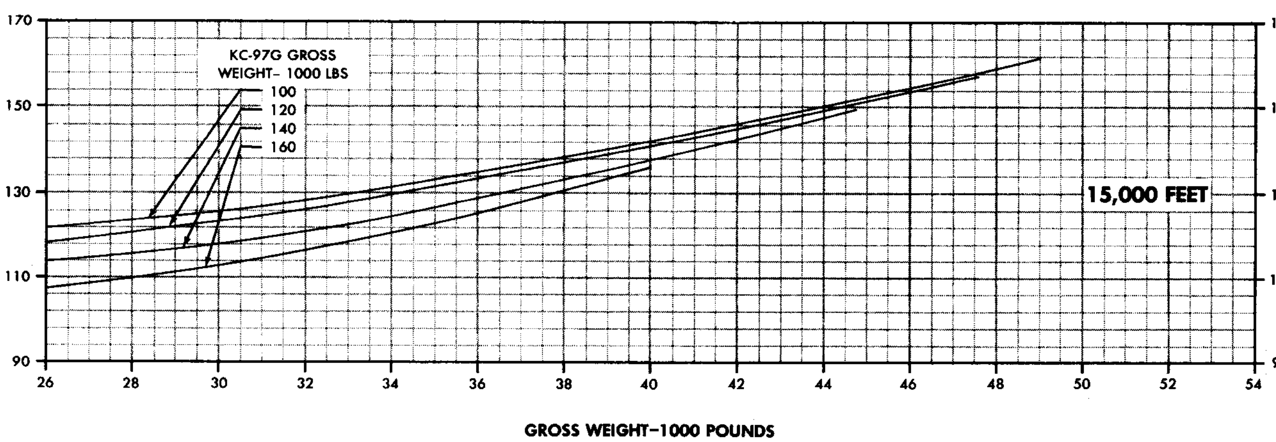


DATE: 1 MARCH 1956
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL







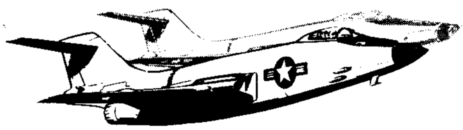
F/RF/YRF20-P626

Figure A6-18

FUEL CONSUMPTION DURING AIR REFUELING

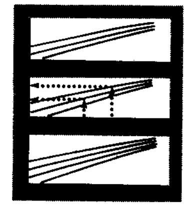
KC-135A TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



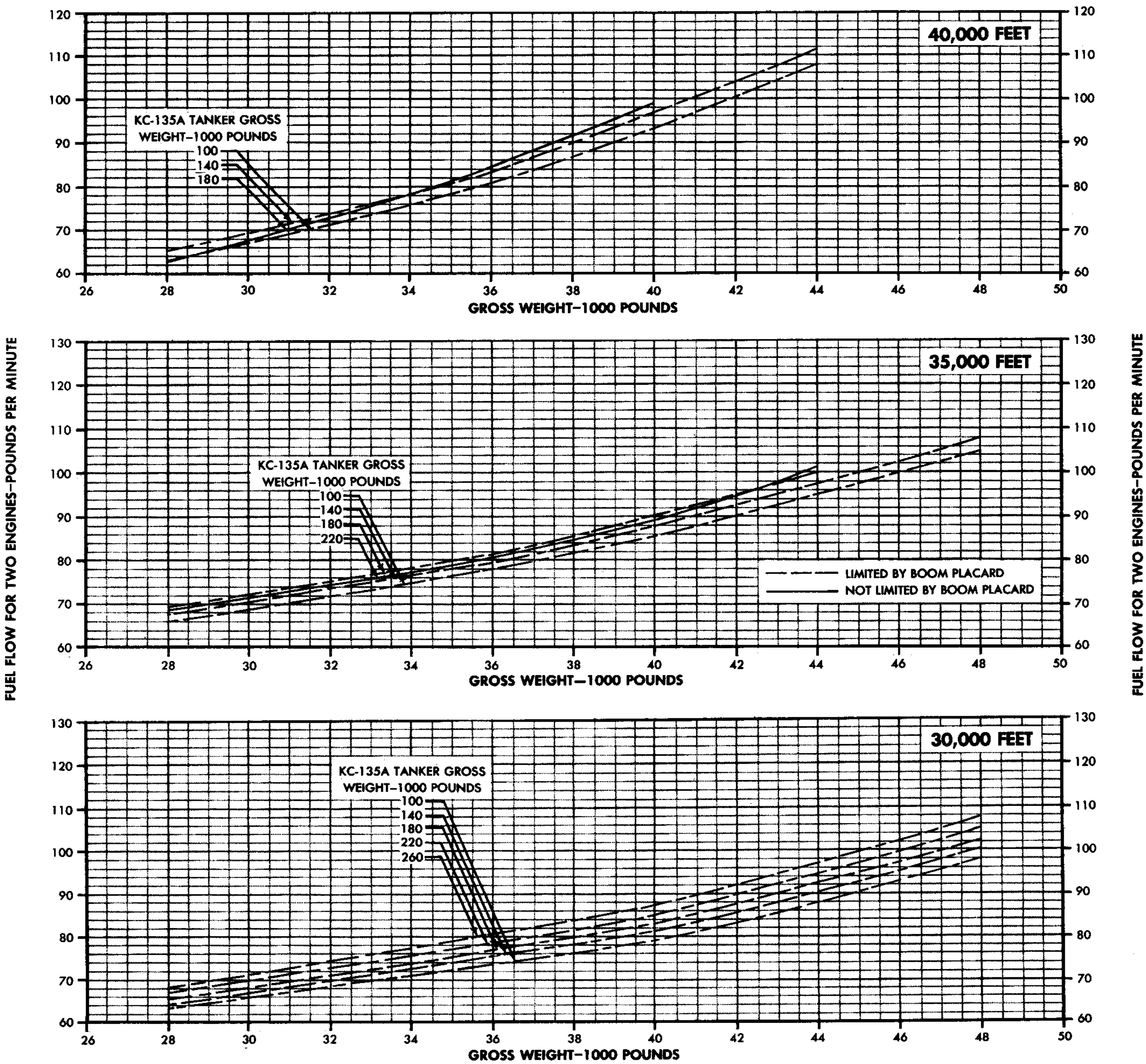
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



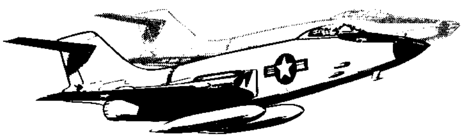
F/RF/YRF20-P627

Figure A6-19

FUEL CONSUMPTION DURING AIR REFUELING

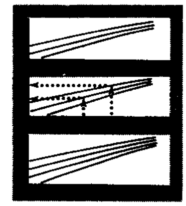
KC-135A TANKER

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



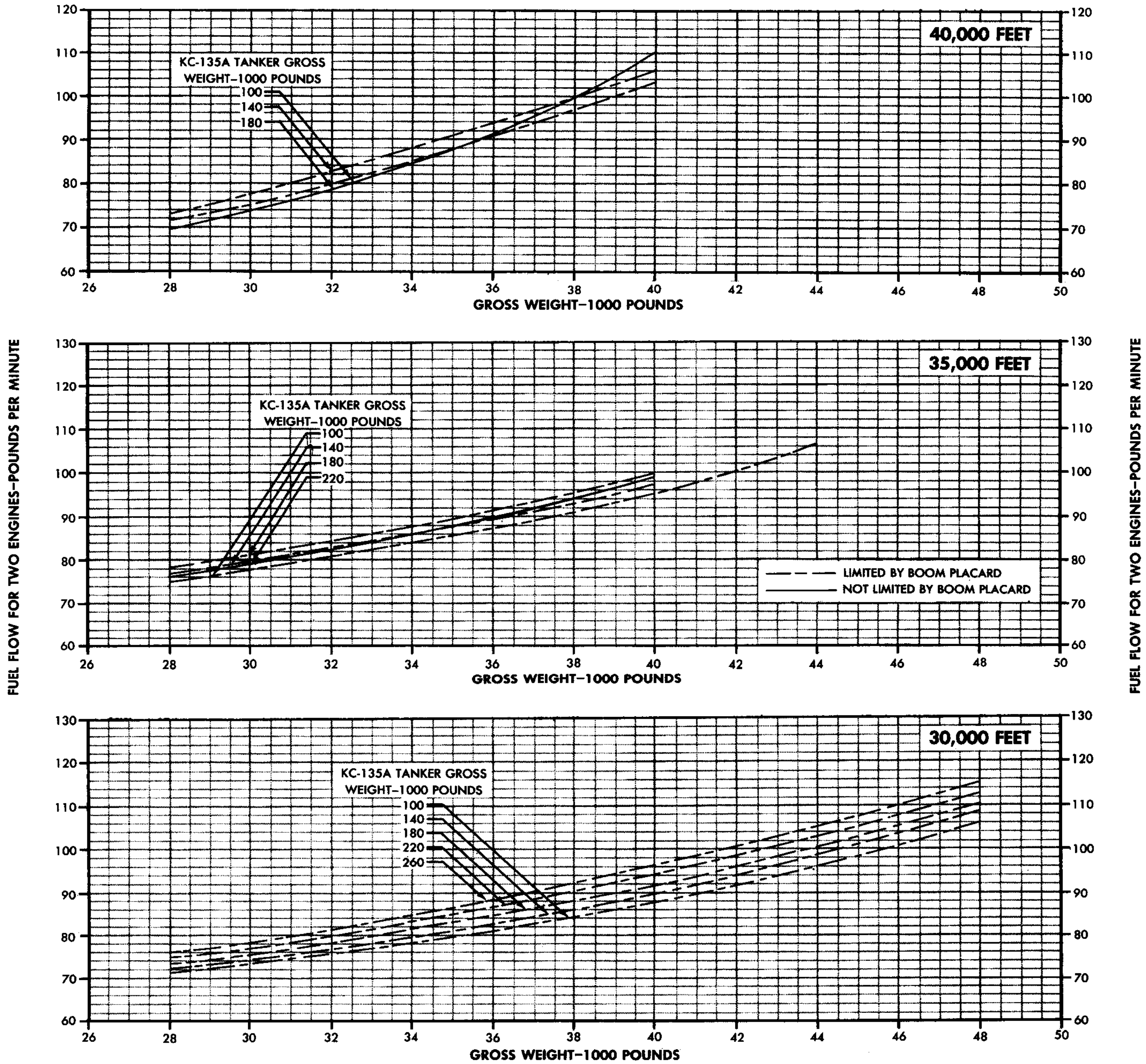
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



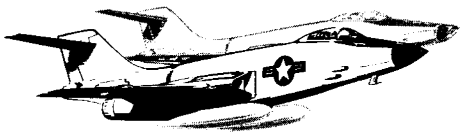
F/RF/YRF20-P628

Figure A6-20

AIR REFUELING TRANSFER TIME

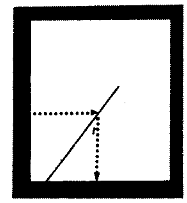
KB-50J, KC-97E, KC-97G AND KC-135A TANKERS

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS



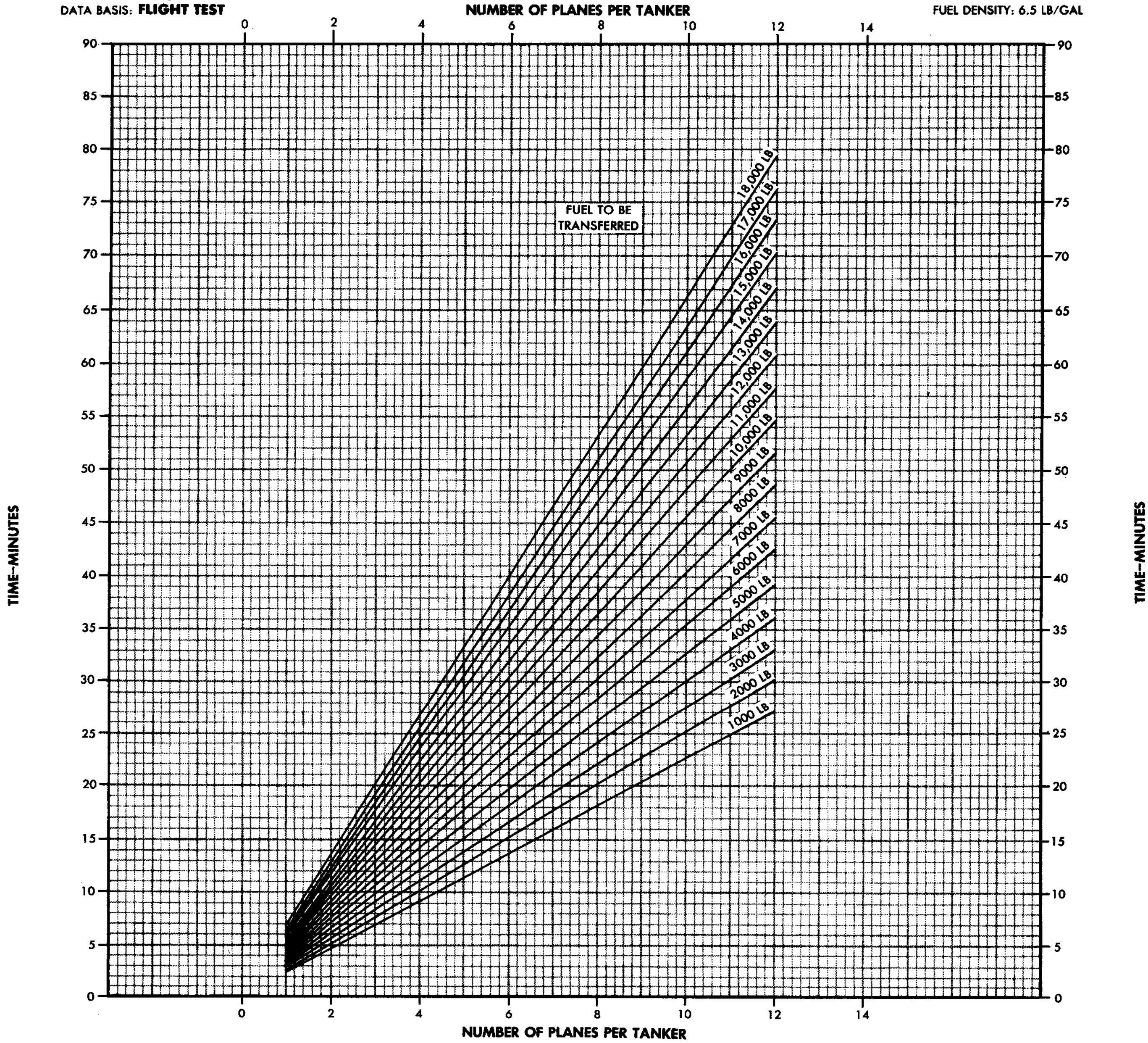
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY
RATE OF TRANSFER IS
600 GALLONS PER MINUTE

GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



F/RF/YRF20-P638

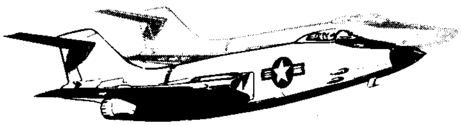
Figure A6-21

DESCENT FROM OPTIMUM CRUISE TO REFUEL ALTITUDE

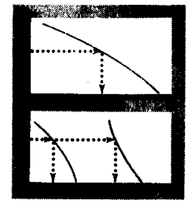
KB-50J, KC-97E, KC-97G AND KC-135A TANKERS

GUIDE

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN

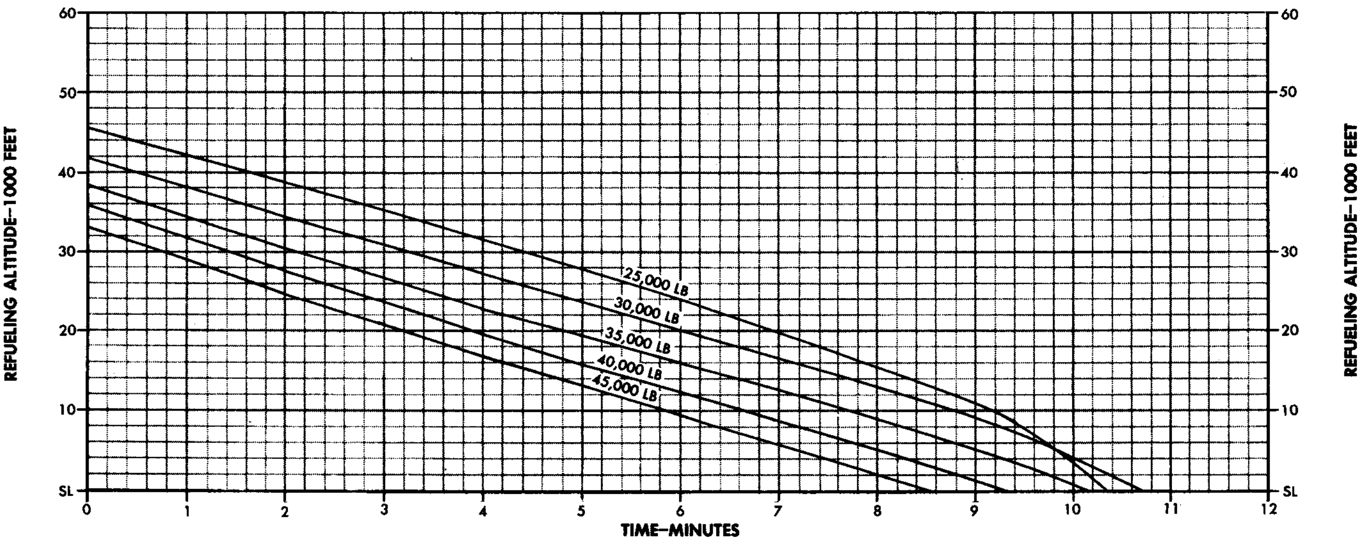


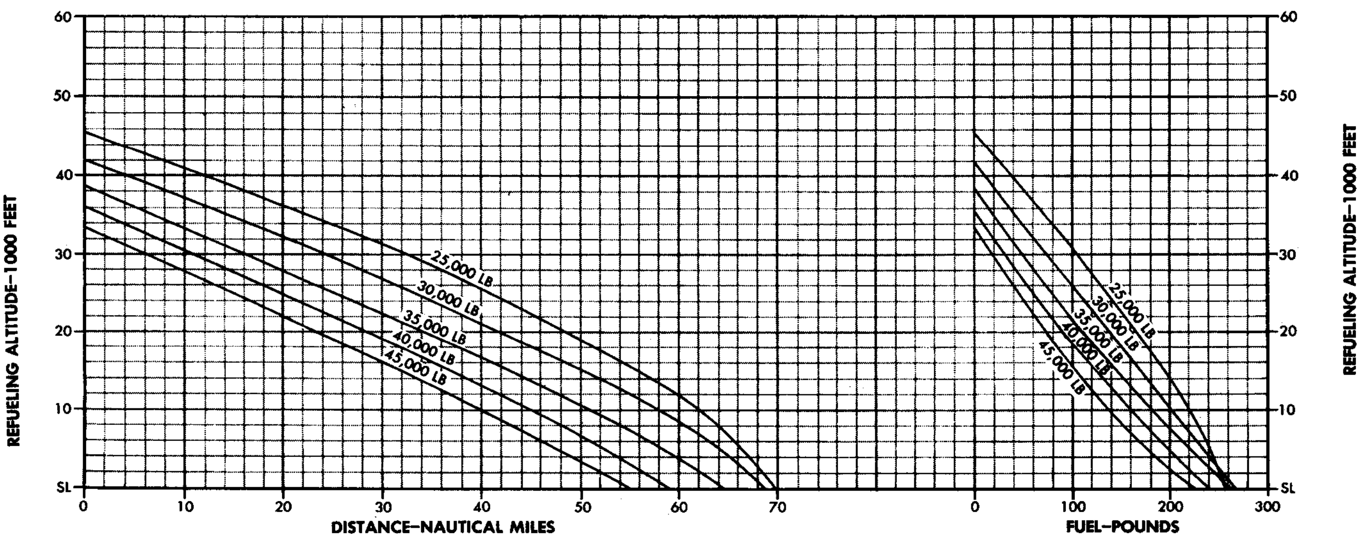
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





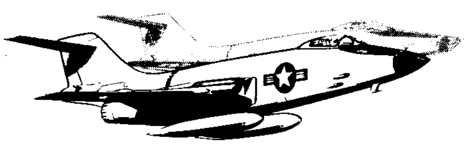
F/RF/YRF20-P639

Figure A6-22

DESCENT FROM OPTIMUM CRUISE TO REFUEL ALTITUDE

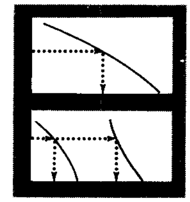
KB-50J, KC-97E, KC-97G AND KC-135A TANKERS

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



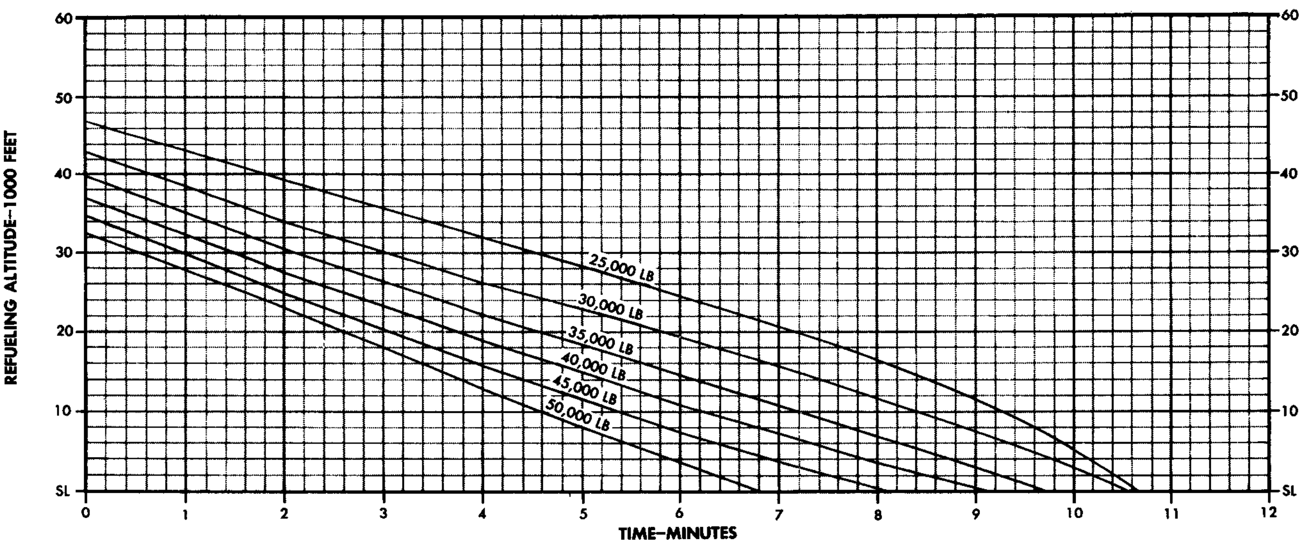
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

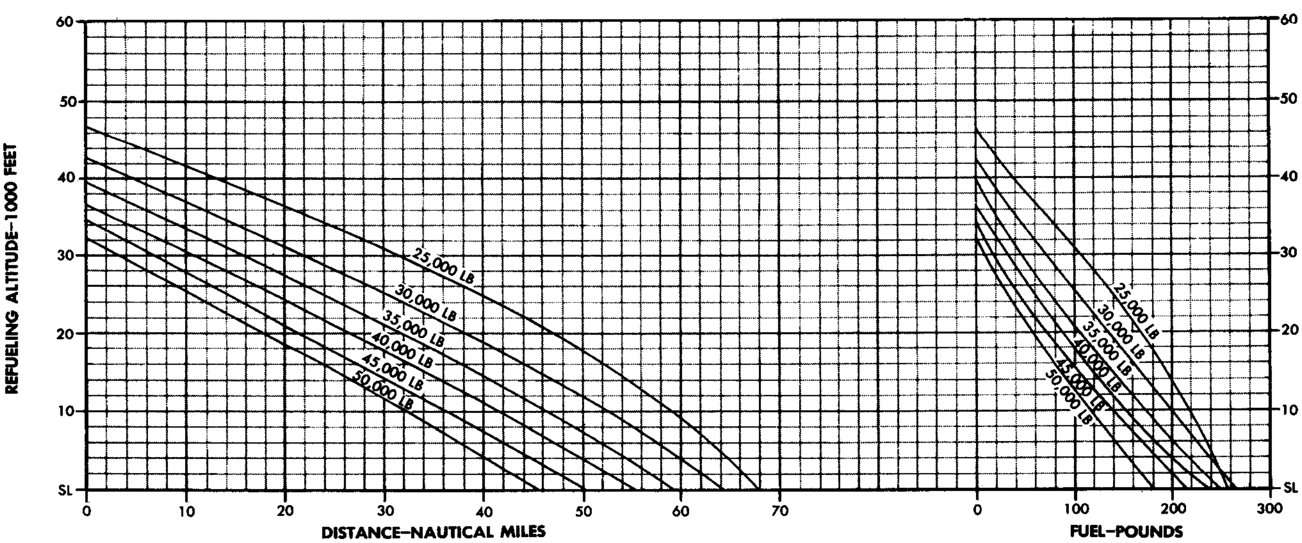
GUIDE



DATE: 1 JULY 1957
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





F/RF/YRF20-P640

Figure A6-23

descent part 7

MAXIMUM RANGE DESCENT CHARTS

The descent schedules presented in figures A7-1 through A7-4 do not correspond to maximum glide angle with idle thrust, but coupled with optimum cruise presents the fuel consumed, time, distance covered, rates of descent, and recommended Mach numbers to obtain maximum range during descent. Recommended descent speeds must be used to realize quoted values.

USE

Enter the top graph at the descent altitude and proceed horizontally to intersect all three reflector lines. From the intersection of the first reflector line, proceed vertically to the base of the graph to read fuel consumption; from the intersection of the second reflector line, proceed vertically to the base of the graph to read rate of descent; from the intersection of the third reflector line, proceed vertically to the base of the graph to read recommended Mach number. Enter the bottom graph at the descent altitude and proceed horizontally to intersect both reflector lines. From the intersection of the first reflector line, proceed vertically to the base of the graph to read time to descend; from the intersection of the second reflector line, proceed vertically to the base of the graph to read distance traveled during descent.

SAMPLE PROBLEM

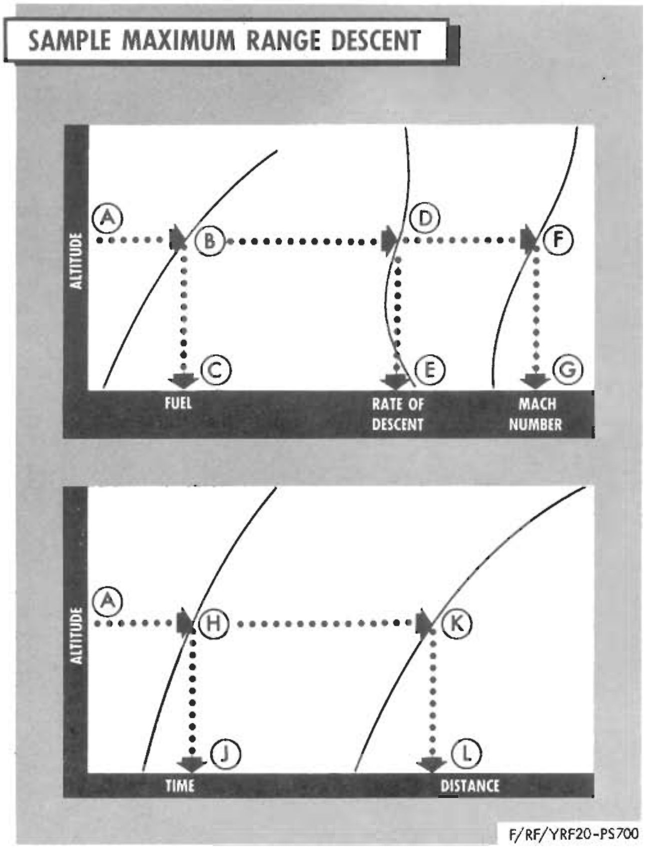
Configuration: Airplane With (2) 450 Gallon Tanks (5,000 Lbs. Fuel Remaining)

A.	Altitude	30,000 Ft.
B.	Reflector Line	
C.	Fuel required for descent	200 Lbs.
D.	Reflector Line	
E.	Initial rate of descent	4,100 fpm
F.	Reflector Line	
G.	Recommended Mach number	.70

Note

For maximum descent, decrease Mach number .01 per 1000 feet until reaching 20,000 feet. Then maintain constant Mach number of .63.

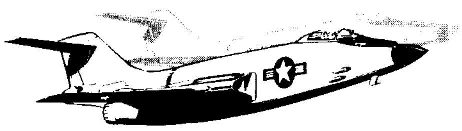
H.	Reflector Line	
J.	Total time required (minutes)	8.7
K.	Reflector Line	
L.	Distance traveled (nautical miles)	44



MAXIMUM RANGE–DESCENT

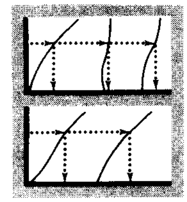
IDLE THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: CLEAN



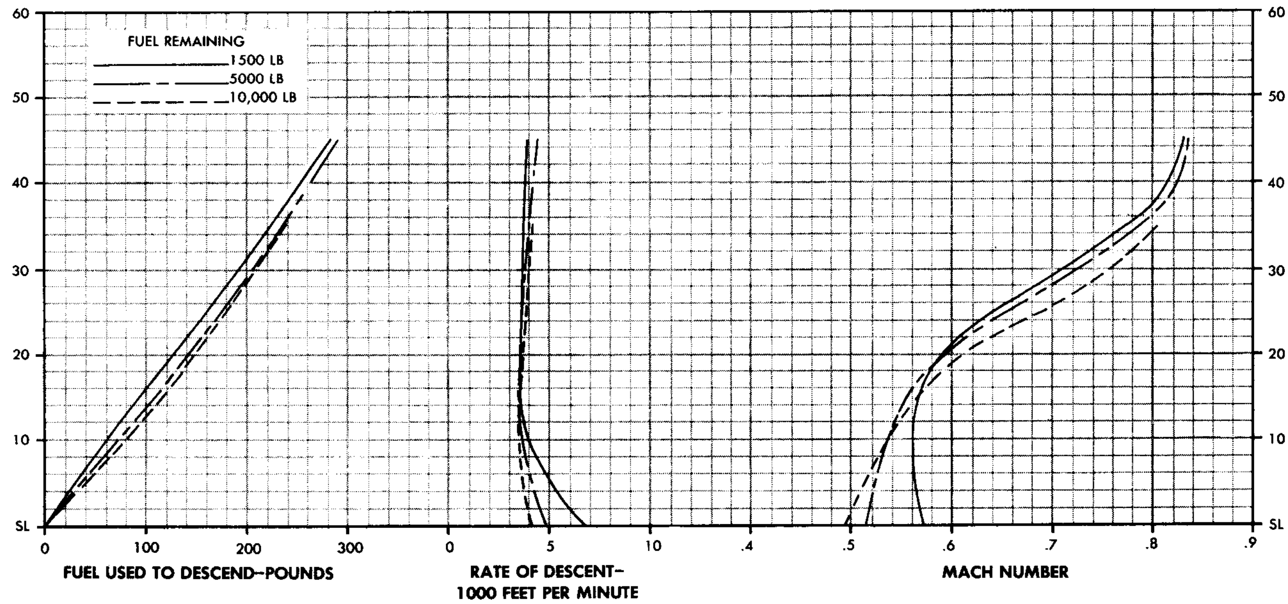
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

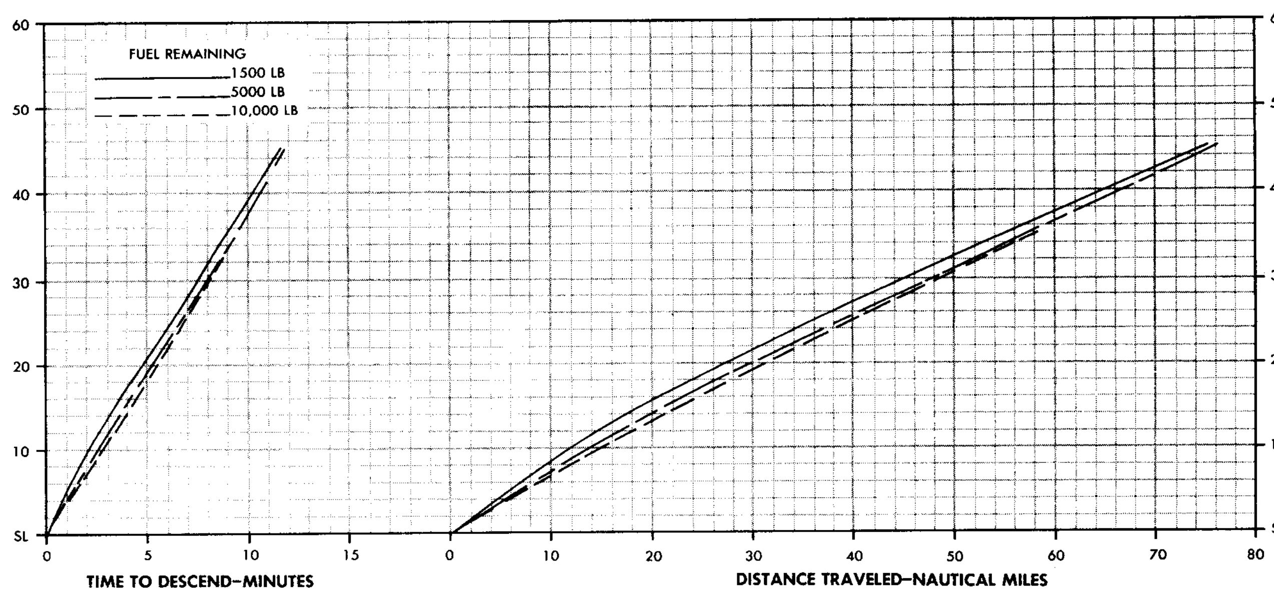
GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



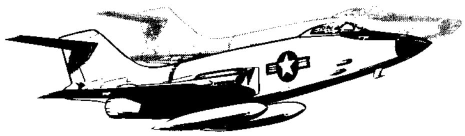


F/RF/YRF20–P702

Figure A7-1

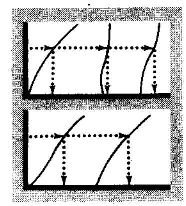
MAXIMUM RANGE–DESCENT
IDLE THRUST

AIRPLANE CONFIGURATION
F/RF/YRF-101A: (2) 450 GALLON TANKS



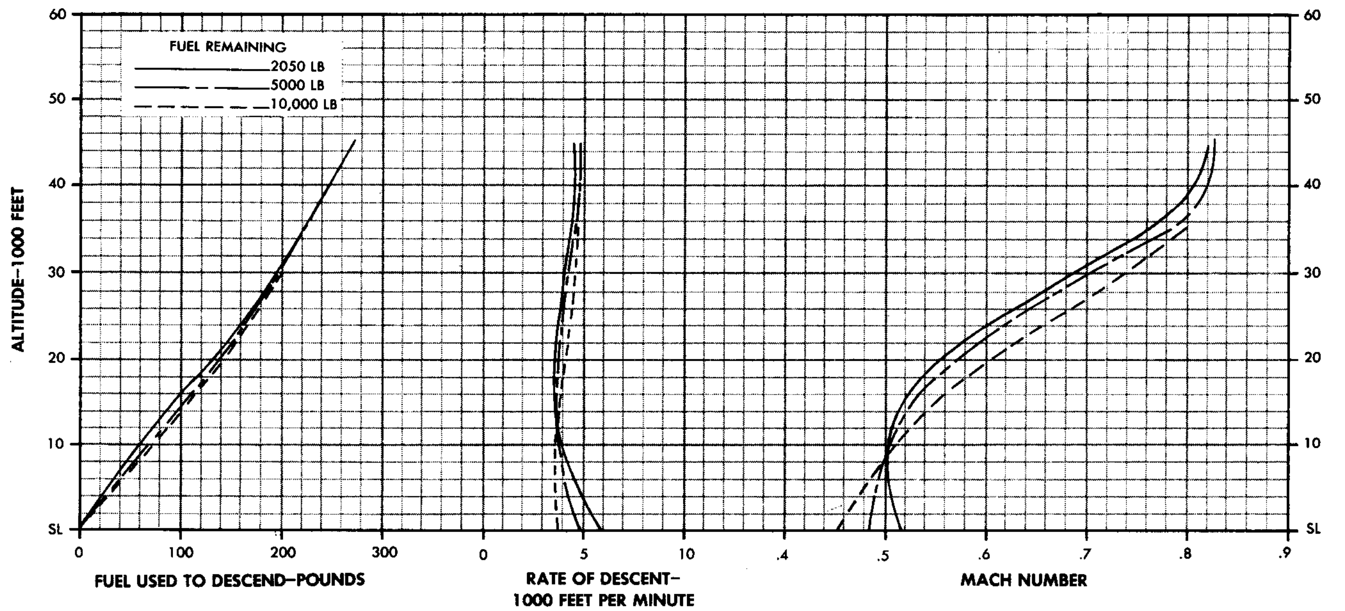
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

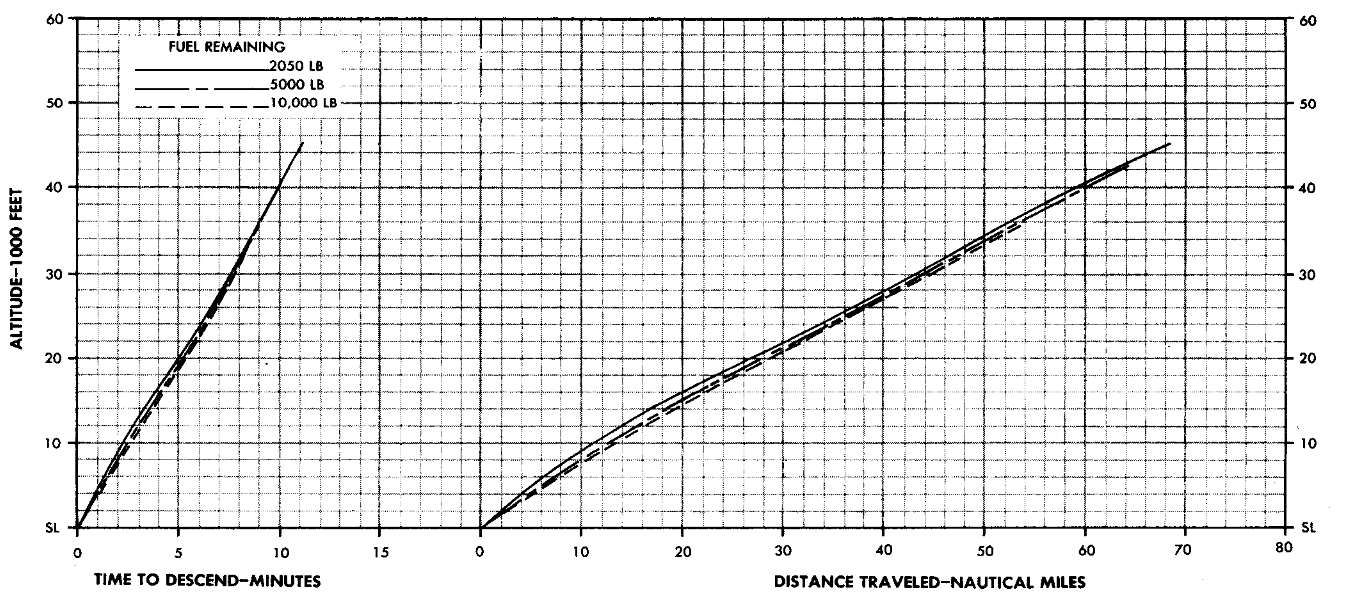
GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





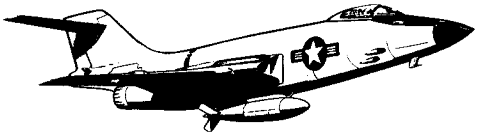
F/RF/YRF20-P703

Figure A7-2

MAXIMUM RANGE—DESCENT

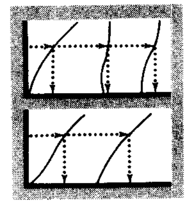
IDLE THRUST

AIRPLANE CONFIGURATION
F-101A: MK-7



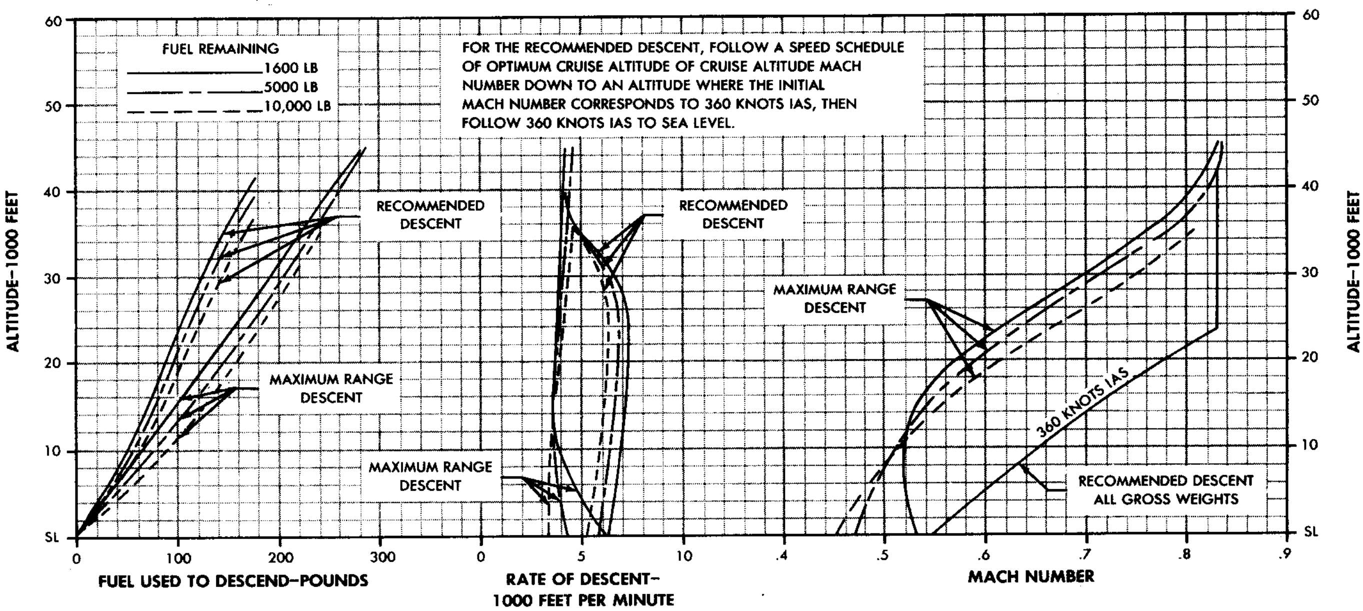
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

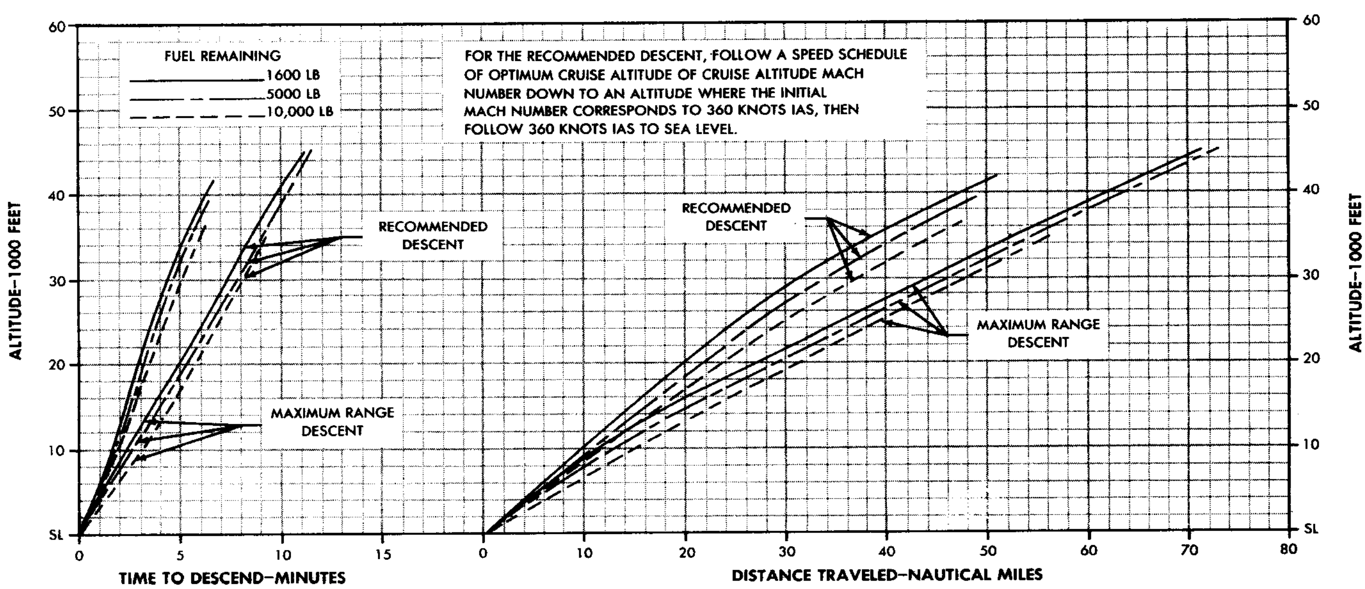
GUIDE



DATE: 1 AUGUST 1959
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



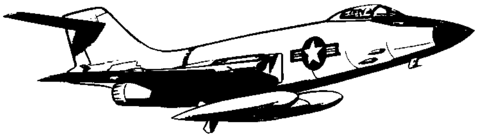


FA20-P704

Figure A7-3

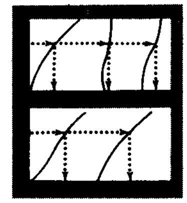
MAXIMUM RANGE–DESCENT
IDLE THRUST

AIRPLANE CONFIGURATION
F-101A: MK-7 + (2) 450 GALLON TANKS



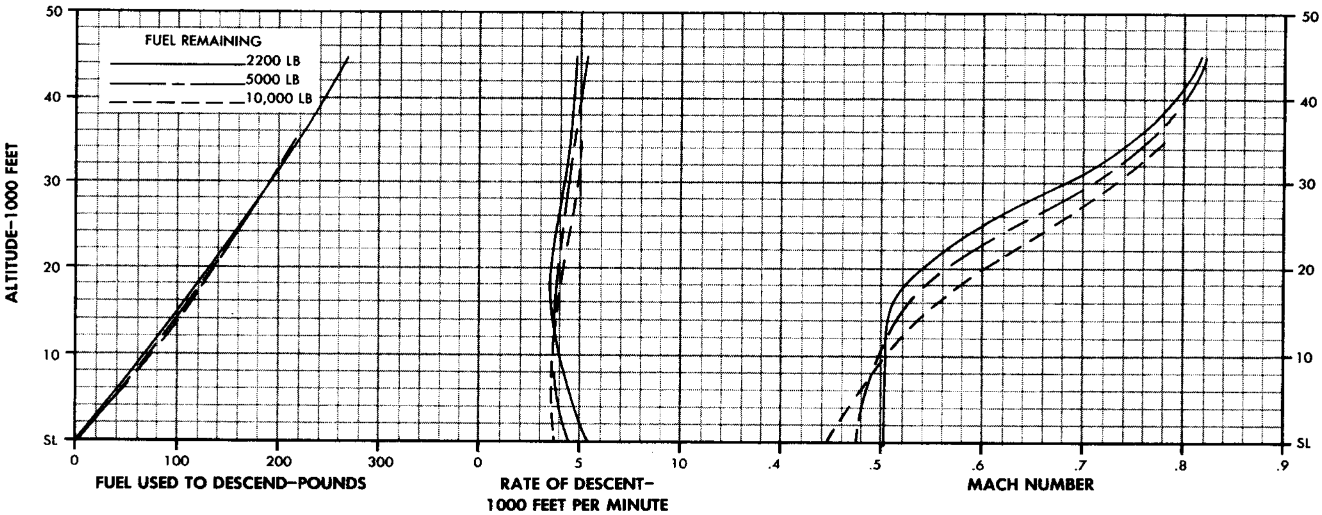
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 15 DECEMBER 1959
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



FA20-P705

Figure A7-4

landing part 8

TABLE OF CONTENTS

Charts

LANDING SPEEDS CHART

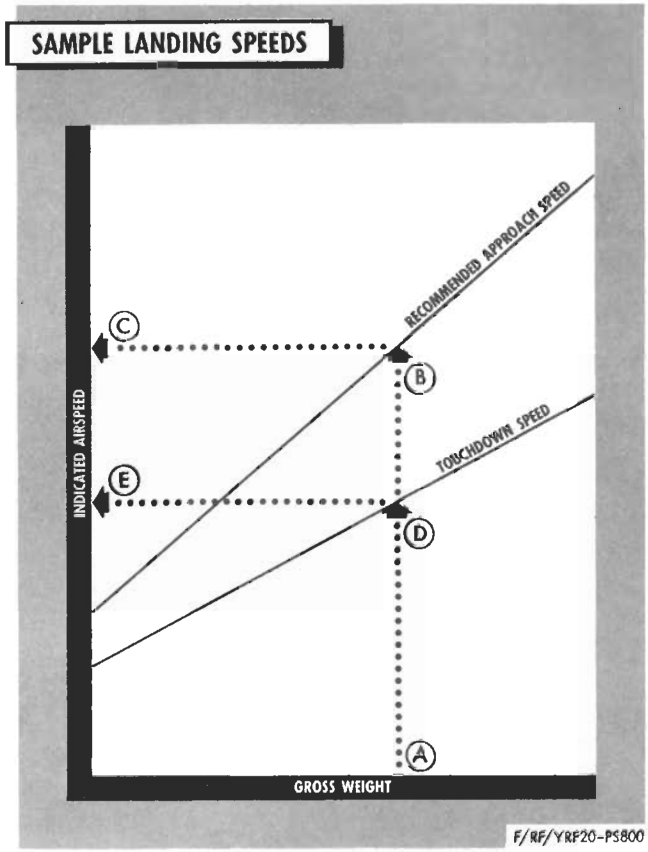
The landing speeds chart (figure A8-1) shows recommended approach speed curves and touchdown speed curves for various airplane gross weights.

USE

Enter the chart at estimated landing gross weight. Proceed vertically to the recommended approach speed reflector line and project horizontally to the left scale to read recommended approach speed. From the intersection of the touchdown speed reflector line, project horizontally to the left scale and read recommended touchdown speed.

SAMPLE PROBLEM

A.	Estimated landing gross weight	30,000 Lbs.
B.	Approach speed reflector line	
C.	Recommended approach speed	168 Kts.
D.	Touchdown speed reflector line	
E.	Recommended touchdown speed	158 Kts.



LANDING DISTANCE CHARTS

Landing distances, ground roll and total distance required to clear a 50-foot obstacle with or without use of the drag chute, are shown in figure A8-2 for a hard dry runway and figure A8-3 for a wet runway. The following conditions are considered; temperature (°F); pressure altitude, sea level through 8000 feet; gross weight 25,000 through 50,000 pounds; head and/or tail winds, 0 to 50 knots. The speeds given are touchdown speeds. Refer to Landing Speeds (figure A8-1) for approach and touchdown speeds.

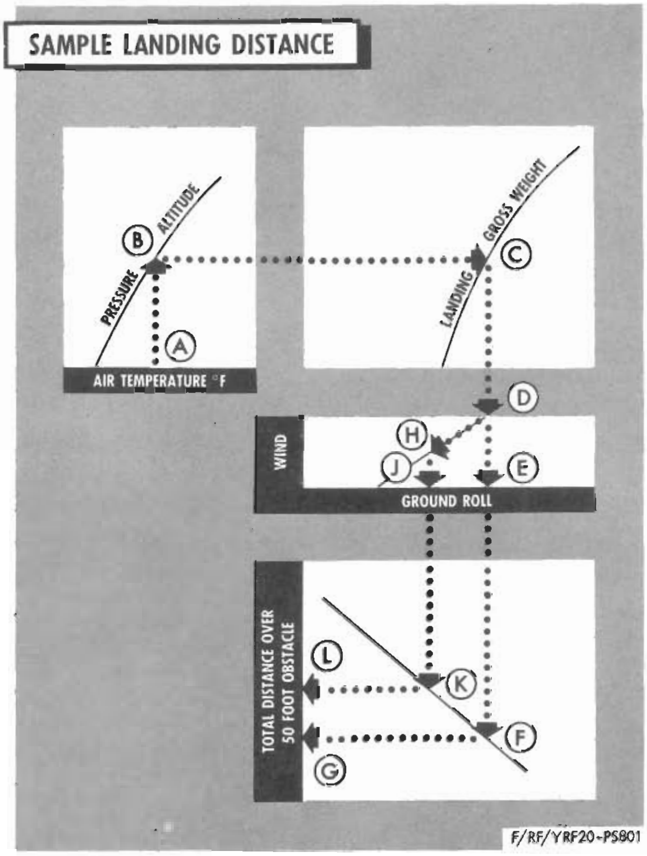
USE

Enter the chart at given surface temperature, proceeding vertically to intersect station pressure altitude. Proceed horizontally to the estimated landing gross weight, read touchdown airspeed. Descend directly to the head or tail wind base line. Move parallel to wind guide lines to effective wind. Descend to ground roll line. Extend reading to intersect the curve, reading 50-foot obstacle distance on left hand scale.

SAMPLE PROBLEM

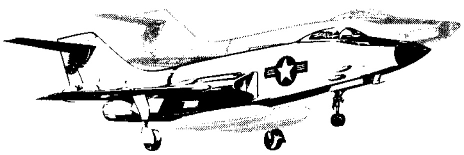
Runway Conditions: Hard Dry Runway

A. Temperature	60°
B. Pressure altitude	Sea Level
C. Estimated landing gross weight	30,000 Lbs.
D. Wind Base Line	
E. Ground Roll (no wind)	3,075 Ft.
F. Reflector Line	
G. Total distance over 50-foot obstacle (no wind)	4,250 Ft.
H. Effective headwind applied	20 Kts.
J. Ground Roll (with wind)	2,475 Ft.
K. Reflector Line	
L. Total distance over 50-foot obstacle (with wind)	3,200 Ft.



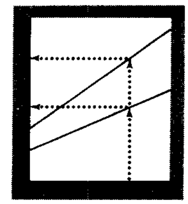
LANDING SPEEDS

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN



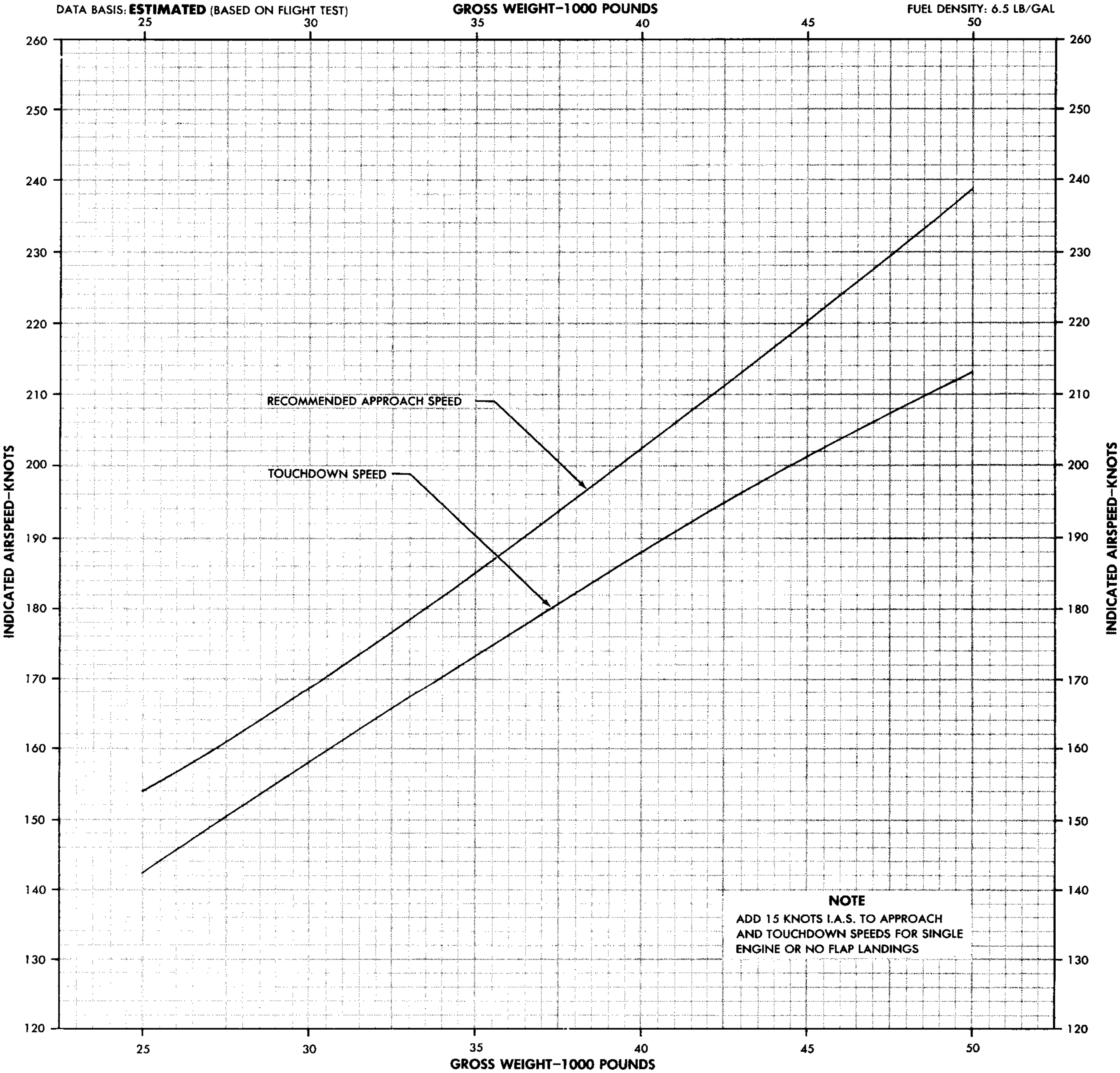
REMARKS
ENGINE(S): (2) J57-P-13
ICAO STANDARD DAY

GUIDE



DATE: 17 OCTOBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



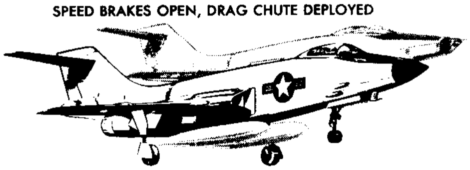
F/RF/YRF20-P800

Figure A8-1

LANDING DISTANCE

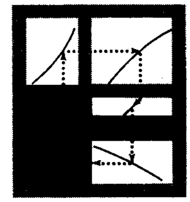
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN
SPEED BRAKES OPEN, DRAG CHUTE DEPLOYED



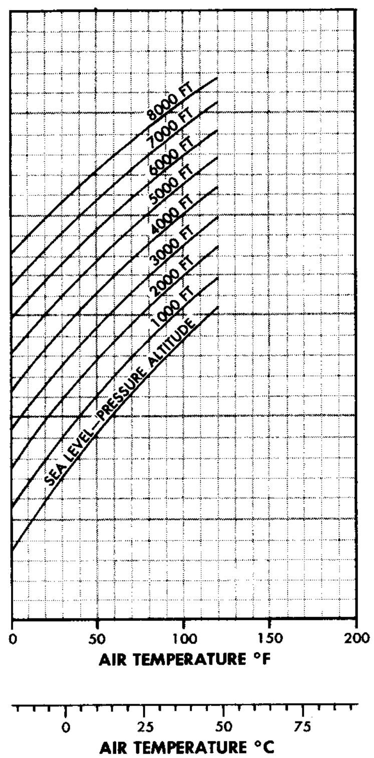
REMARKS
ENGINE(S): (2) J57-P-13

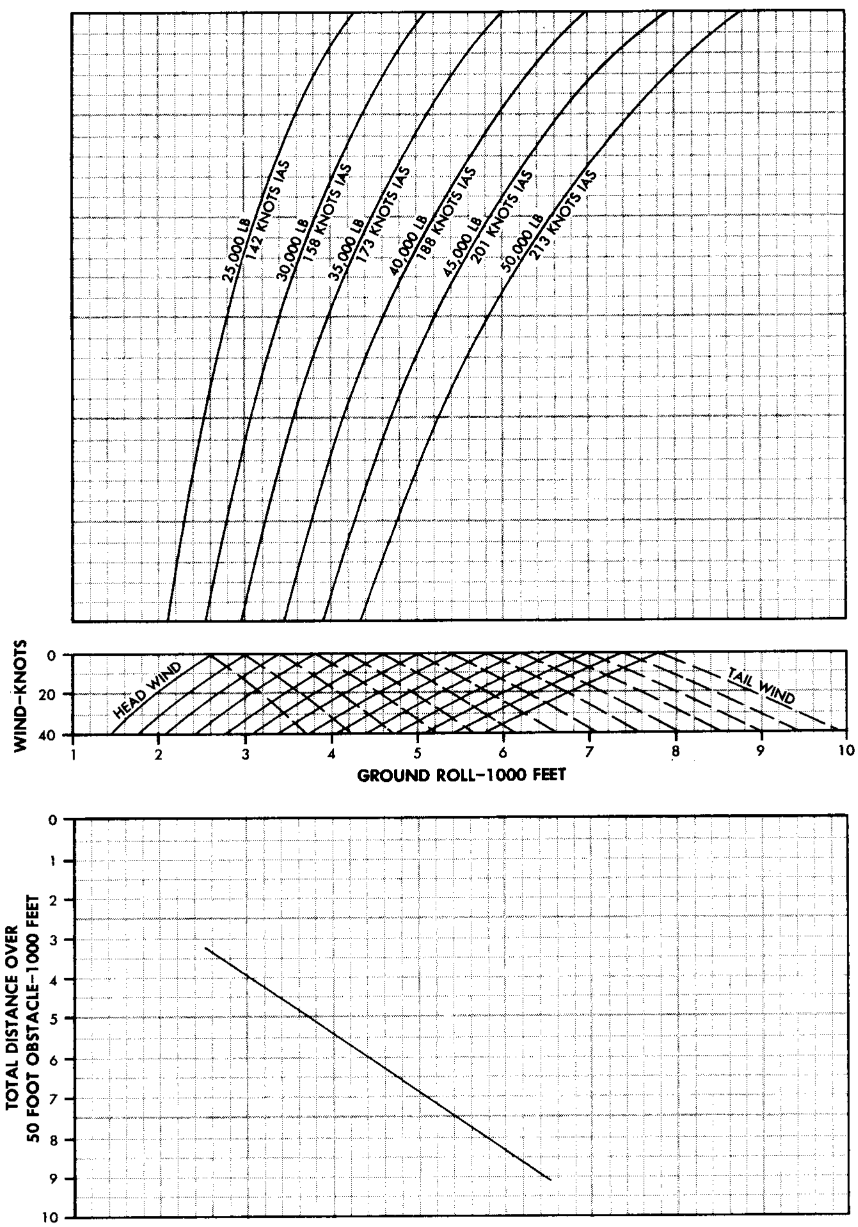
GUIDE



DATE: 17 OCTOBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





NOTES

IF ANY OF THE CONDITIONS GIVEN (1 THRU 4) ARE APPLICABLE, INCREASE THE DISTANCES COMPUTED BY THEIR RESPECTIVE PERCENTAGES.

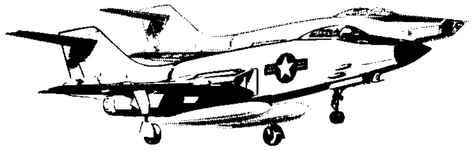
1. LANDING WITHOUT DRAG CHUTE INCREASES THE GROUND ROLL 46% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 36%.
2. LANDING WITHOUT DRAG CHUTE OR SPEED BRAKES INCREASES THE GROUND ROLL 58% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 47%.
3. LANDING WITHOUT DRAG CHUTE, SPEED BRAKES OR FLAPS INCREASES THE GROUND ROLL 88% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 75%.
4. LANDING WITHOUT SPEED BRAKES OR FLAPS INCREASES THE GROUND ROLL 16% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 21%.

F/RF/YRF20-P801

Figure A8-2

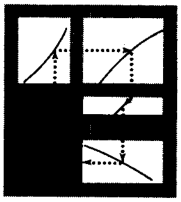
LANDING DISTANCE
WET RUNWAY

AIRPLANE CONFIGURATION
F/RF/YRF-101A: ALL CONFIGURATIONS
FLAPS EXTENDED, GEAR DOWN
SPEED BRAKES OPEN, DRAG CHUTE DEPLOYED



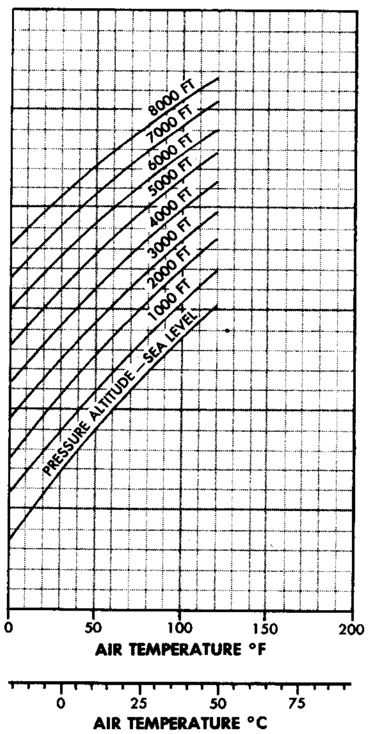
REMARKS
ENGINE(S): (2) J57-P-13

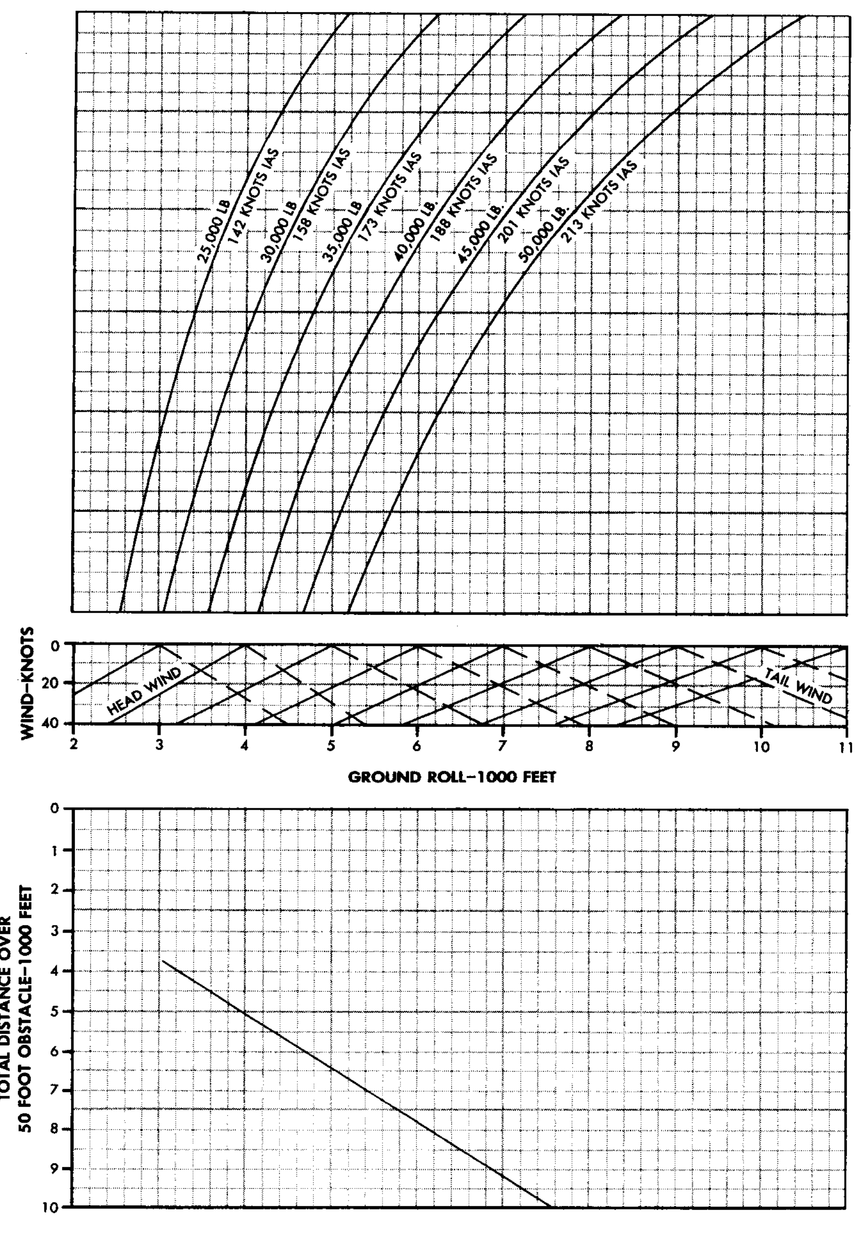
GUIDE



DATE: 17 OCTOBER 1958
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





NOTES

IF ANY OF THE CONDITIONS GIVEN (1 THRU 4) ARE APPLICABLE, INCREASE THE DISTANCES COMPUTED BY THEIR RESPECTIVE PERCENTAGES.

1. LANDING WITHOUT DRAG CHUTE INCREASES THE GROUND ROLL 54% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 41%.
2. LANDING WITHOUT DRAG CHUTE OR SPEED BRAKES INCREASES THE GROUND ROLL 72% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 54%.
3. LANDING WITHOUT DRAG CHUTE, SPEED BRAKES OR FLAPS INCREASES THE GROUND ROLL116% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 95%.
4. LANDING WITHOUT SPEED BRAKES OR FLAPS INCREASES THE GROUND ROLL 20% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 22%.

F/RF/YRF20-P802A

Figure A8-3

mission planning

part 9

TAKE-OFF DATA CARD

The Take-Off Data card is contained in the Section II Condensed Check List and the required parts should be completed during the preflight mission planning phase. The format of the card provides a ready reference of: Known conditions and critical speeds and runway distances (A. through H.); Go-No Go line check and take-off speeds (J. through L.); minimum level flight speeds and landing immediately after take-off data (M. through P.) in the event an emergency occurs immediately after take-off. The Take-Off Data card should be filled out in the following sequence:

1. Steps A. through C. are known conditions and should be compiled prior to filling out the card.
2. Step D. is obtained from the Critical Field Length chart (figure A2-2). Single engine take-off speed is also obtained from this chart and should be noted at this time in order to compute step L. later on.
3. Steps E. and F. are obtained from the Maximum Refusal Speeds chart (figure A2-3 or A2-4).
4. Steps G. and H. are obtained from the Take-Off Distance charts (figure A2-5 or A2-6).
5. Steps J. and K. are obtained from the Velocity During Take-Off Ground Run chart (figure A2-7 or A2-8).
6. Step L. is obtained by adding the single engine take-off speed, as noted while obtaining step D. above, to the normal take-off speed (step K.).
7. Step M. is obtained from the Recommended Minimum Speed line, plotted in red, on the Stall Speeds chart (figure 6-2).
8. Step N. is obtained from the applicable Final Approach Speeds table contained in the Single Engine Landing paragraph in Section III.
9. Step P. is obtained from the Landing Distance chart (figure A8-2 or A8-3).

TAKE-OFF DATA

(A) Runway Length ______ Ft. Field Pressure Alt. ______ Ft. (B)
(C) Temperature ____ °F Critical Eng. Failure Speed* ____ IAS (E)
(F) Refusal Speed* ____ IAS Critical Field Length* ______ Ft. (D)
(G) Take-off Dist......Normal ______ 50 Ft. Obstacle* ______ Ft. (H)

(J) GO-NO GO CHECK.....Dist.* ______ Speed* ____ IAS
(K) NORMAL TAKE-OFF.............................Speed ____ IAS
(L) SINGLE ENGINE TAKE-OFF...................Speed* ____ IAS

MINIMUM LEVEL FLIGHT SPEED

(M) T.O. Config. ____ IAS Clean Config. ____ IAS

LANDING IMMEDIATELY AFTER TAKE-OFF

(N) Approach Speed (Single Engine) ______ IAS
(P) Stopping Distance (No Drag Chute) ______ Ft.

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

F/RF/YRF20-P900A

MB-8 FLIGHT COMPUTER

The MB-8 Flight Computer is designed to solve simple level-flight cruise control problems for jet airplanes. Exclusive use for preflight planning is not recommended since, under normal conditions, the use of the Flight Manual results in far more comprehensive results. The greatest advantage of the computer lies in its simplicity of operation and convenient size. The computer consists of three metal and two plastics discs, of which the three metal discs are standard items, good for any airplane; however, they are useless without the plastic data discs, since they contain individual airplane performance. The following items indicate the potential of the MB-8 that can be accomplished during flight:

Note

When installing the plastic data discs, make sure the proper individual airplane data discs are used to obtain correct information for the airplane concerned.

1. Compute time, fuel, and distance, at selected altitudes for any flight Mach number between maximum range and Military Thrust, as well as recommended loiter conditions.
2. Correct time, fuel, and distance, estimates for errors in navigation, formation flight, variation in engine performance, wind effects, and other cruise variables.
3. Determine time, fuel, and distance, to climb and descend.
4. Establish optimum range performance for specific amounts of fuel at selected altitudes.

The MB-8 has been designed to transmit as much information as accurately as possible and remain simple in operation. Therefore, certain compromises which impose limitations are involved. The computer is designed for an average gross weight. This will result in a lower than indicated miles per pound of fuel, with a subsequent higher rate of fuel flow at the beginning of flight, and a higher than indicated miles per pound, with a subsequent lower rate of fuel flow during the final portion of the flight, giving an average miles per pound as indicated on the computer.

CLIMB AND DESCENT–MAX RANGE

Cruise data appears in the MAX RANGE window listing combinations of fuel remaining at selected pressure altitude. This data can be used as a quick range check for various quantities of fuel remaining at altitude. Range data for both optimum cruise and cruise at constant altitude is given, thereby providing a quick and yet fairly comprehensive picture of the range potential. This data is very similar to the information given in the Optimum Return Profile of the Flight Manual. A second window displays the time, fuel, and distance, required for climb or descent, while a third window frames the recommended altitude-speed schedule for these maneuvers. A black background is used for external fuel configuration, while the white background is used for a clean configuration.

COMPUTATION–RANGE DATA

The opposing "pie shaped" windows allow the center plastic discs to show through and are black and white bordered for the black background and white background data respectively. The window is divided into altitudes, with an index line through the center of the windows. The outer edge of this first (metal disc is divided into a logarithmic scale labeled "FUEL QUANTITY - POUNDS." With this type of scale, the "1000" mark can mean 1, 10, 100, 1000 or 10,000 pounds, etc., depending on the magnitude or other factors in the range problems. Refer to this scale as the "fuel disc." Rotate the fuel disc counterclockwise so that the index line for any selected altitude passes across the speed lines which show through the respective window. The first speed line encountered is the recommended speed for maximum range. Further counterclockwise rotation results in passing over increasing speeds until the maximum speed line in the series is reached. In progressing from speed for maximum range to maximum speed, the index passes over a speed line coded as a solid dot with a vertical line passing through it. This is the computer setting for maximum endurance. The speed for maximum endurance is quoted at the extreme right of the maximum range speed line. This coded point is used together with the quoted speed to obtain maximum endurance information. Another coded speed line (diamond with a vertical line) is maximum speed for Normal Power (Maximum Continuous Thrust).

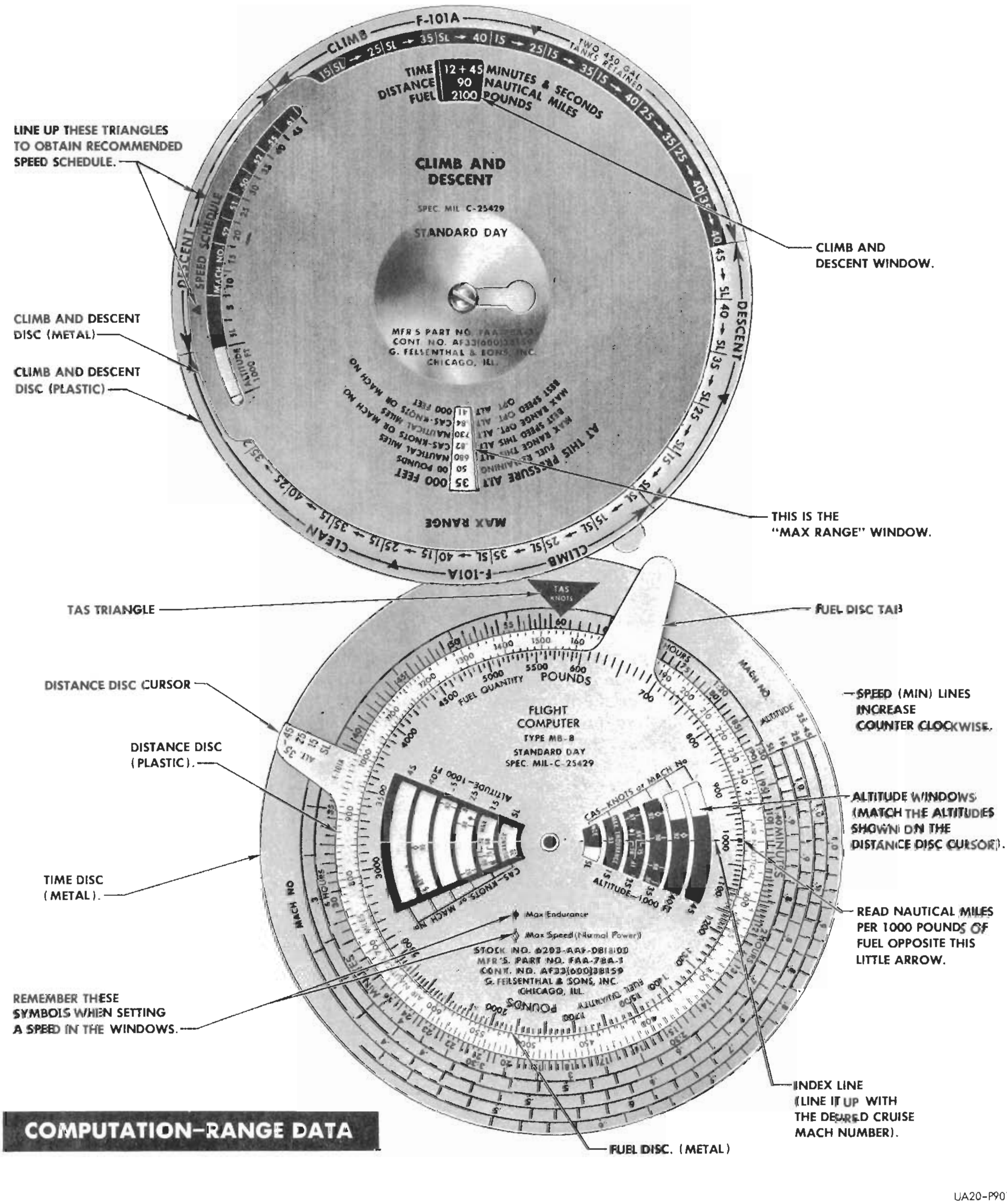
Note

The speeds shown on the MB-8 are CAS or true Mach number; therefore, any indicated speeds should be corrected for installation error before speeds are entered on the computer. (Refer to Appendix I of Flight Manual.)

The second disc (plastic) is a performance data disc around which is placed a logarithmic scale labeled AIR NAUTICAL MILES. Refer to this disc as the "distance disc." The placement of the speed lines described in the previous paragraph maintains the proper relationship between the distance and fuel discs. Any specific relationship between the fuel and distance discs, for a selected speed and altitude, will give the specific range or nautical air miles per pound of fuel, i.e., reading the air miles at the 1000 pound mark is actually nautical air miles per 1000 pounds of fuel. The tab on the distance disc is a special shape with the straight edge of the tab acting as a "wiper" or cursor on the larger (metal) disc. This larger disc on the front face of the computer is referred to as the "time disc." This disc has a series of concentric scales, of which the inner

MB-8 FLIGHT COMPUTER

CLIMB AND DESCENT–MAX RANGE



COMPUTATION–RANGE DATA

Figure A9-1

scale is labeled HOURS - MINUTES. The succeeding scales are speed scales (Mach number or calibrated airspeed) for selected altitudes, i.e., altitudes corresponding to the altitudes listed on the fuel disc.

Note

Make sure, when the computer is assembled, that the time disc displays speed in the terms as the speed appearing in the window of the fuel disc; either Mach number or CAS.

The large black triangle on the time disc is labeled TAS - KNOTS, with the apex at the 60 minute mark of the time scale. For standard atmosphere conditions, true airspeed in knots may be obtained from the distance disc opposite this TAS triangle. That is, when the distance disc cursor is aligned with a speed (Mach No.) on the time disc, at some altitude, the corresponding true airspeed is indicated by the TAS triangle (using the distance scale as a speed scale). This conversion feature is useful in making corrections for wind. The first step is obtaining range information is to establish proper relationship between the fuel disc and distance disc. This is accomplished by selecting an altitude window for proper configuration, and aligning the window index with the desired speed line. If maximum endurance range information is desired, the selected altitude window index is aligned with the speed line coded as a solid dot with a vertical line. Each altitude window has only one such maximum endurance coded speed line. The next and final setting is to rotate the distance disc (without interrupting the previous fuel-distance disc setting), so as to position the altitude cursor on outer disc to correspond with the same speed line value obtained from the altitude window. From here on, direct readings result in range, time enroute, TAS, fuel flow, and nautical miles per pound of fuel. Begin by selecting fuel quantity on the fuel disc. Opposite fuel quantity on distance disc is range; opposite range read time in hours and minutes. To obtain true airspeed, read opposite black triangle (TAS Knots) on the distance (middle) disc. Further toward the center, opposite the black triangle on the fuel disc, read fuel flow in pounds per hour. Nautical miles per pound of fuel appears on distance disc opposite small black arrow on fuel disc. Divide result by 1000 to obtain correct answer.

Wind Corrections

The front face of the computer can be adjusted for wind in the following manner:

1. Do not change the relationship of the fuel disc and the time disc. Hold the fuel disc tab against the outer edge of the time disc. This will still permit rotation of the distance disc.
2. Rotate the distance disc until the ground speed (TAS + wind) on the AIR NAUTICAL MILES scale of the distance disc is aligned with the TAS triangle. The AIR NAUTICAL MILES scale then becomes ground nautical miles, and the fuel required to travel any ground distance is obtained from the fuel disc, while the time is read from the time disc.

WARNING

The Mach numbers now appearing in the window of the fuel disc, and on the time disc under the index cursor, no longer apply. The original Mach number must be maintained in flight.

3. To determine the winds while in flight, a system of check points can be utilized. Rotate the distance disc until the distance between check points is aligned with the elapsed time on the MINUTES scale on the time disc. The ground speed is then read on the distance disc opposite the TAS triangle. The fuel required to travel any selected ground distance is obtained from the time disc. The Mach numbers appearing in the window of the fuel disc no longer apply and should be ignored. The original Mach number must be maintained.

Fuel Flow Corrections

Variations in the fuel consumption characteristics due to battle damage, small changes in configurations, differences in engines, formation flight, etc., may be accounted for in the following manner:

1. Determine the fuel flow from the flowmeter.
2. Do not change the relationship of the distance disc and the time disc (set from ground speed).
3. Rotate the fuel disc until the rate of fuel flow read from the flowmeter is aligned with the TAS triangle.
4. Determine distance and time for selected fuel quantities from the respective discs.

SUMMARY

Variations in rate of fuel flow of an average magnitude of +5 percent of that indicated on the computer can be expected on the initial portion of the flight, and -5 percent on the final portion, when flying at the Mach number recommended for maximum range. These variations show up plainly when the maximum range, shown on the tabulator side of the computer, is compared with the range obtained on the fuel-distance side. The tabulator side will indicate a greater distance because this data considers the change in airplane gross weight as fuel is consumed, whereas the indicated specific range on the fuel-distance side of the computer is an average value, and results in a slightly conservative distance. The true airspeeds presented on the computer are based on standard atmospheric conditions. An allowance for the difference in this true airspeed, and the true airspeed for the actual atmospheric condition, can be made by the wind correction method described previously. The rate of fuel flow is also based on standard atmospheric conditions. However, the difference in fuel flow need not be corrected, since the air range calculated on the flight computer is normally independent of air temperature when the Mach number is properly indexed.

SAMPLE PROBLEM (MB-8)

The following sample problem is based on an intended mission of 950 nautical miles with a no wind condition. Fuel requirements are included for taxi, climb, cruise, let down over destination, one approach (missed approach), and proceeding to alternate 150 nautical miles away at 25,000 feet with maximum endurance thrust settings. The sample problem, however, terminates at altitude over destination. The fuel remaining at this point will be sufficient to accomplish the remainder of the flight as stated above and land at alternate with approximately 4000 pounds fuel remaining.

Configuration: F-101A - Clean + (2) 450 Gallon Tanks, Retained

A. Fuel Remaining — 18,600 Lbs.

Note

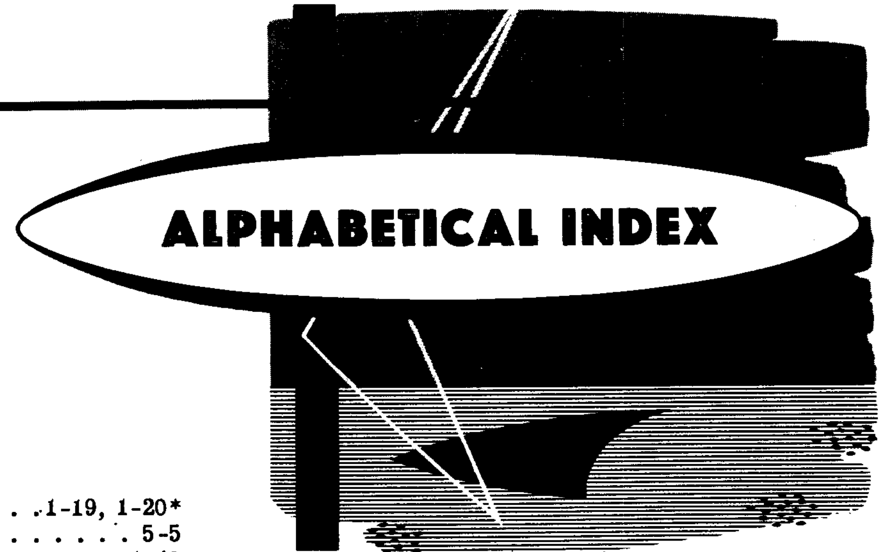
The 18,600 pounds fuel remaining was arrived at by subtracting fuel required for taxi, take-off and Military thrust climb to 35,000 feet from total usable fuel load.

B. Cruise Altitude — 35,000 Ft.
C. Cruise Speed (Mach No.) — .91
D. Distance — 950 Nautical Miles
E. Select proper configuration windows (black) and align the 35,000 feet index line with .91 Mach number. Rotate the distance disc (do not disturb the previously set fuel and distance disc relationship) and position the distance disc cursor on the proper Mach number (.91) at 35,000 feet (35-45).
F. Select 894 nautical miles (950 minus distance covered during climb) on distance disc and read outboard and inboard to obtain time and fuel requirements.
   Time Enroute — 1 Hr. 43 Mins.
   Fuel Required — 11,200 Lbs.

Note

These values do not include time and fuel required for climb. Climb data can be obtained from the reverse side and used to determine total time and fuel required.

G. True airspeed and fuel flow for a standard day is obtained opposite the black "TAS Knots" triangle on the distance disc and fuel disc respectively.
   True Airspeed — 520 Kts.
   Fuel Flow — 6550 PPH.
H. For specific range information or nautical miles per pound of fuel, read opposite small black arrow on fuel disc (1000) nautical miles per pound of fuel on distance disc.
   Nautical Miles Per Pound (Specific Range) — .080



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