T.O. 1B-47E-1

USAF SERIES

flight handbook

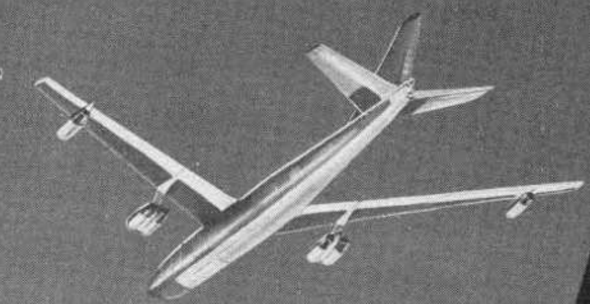
B-47B

(AF 51-2192 thru -2356)

&

B-47E

AIRCRAFT



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30 JUNE 1955

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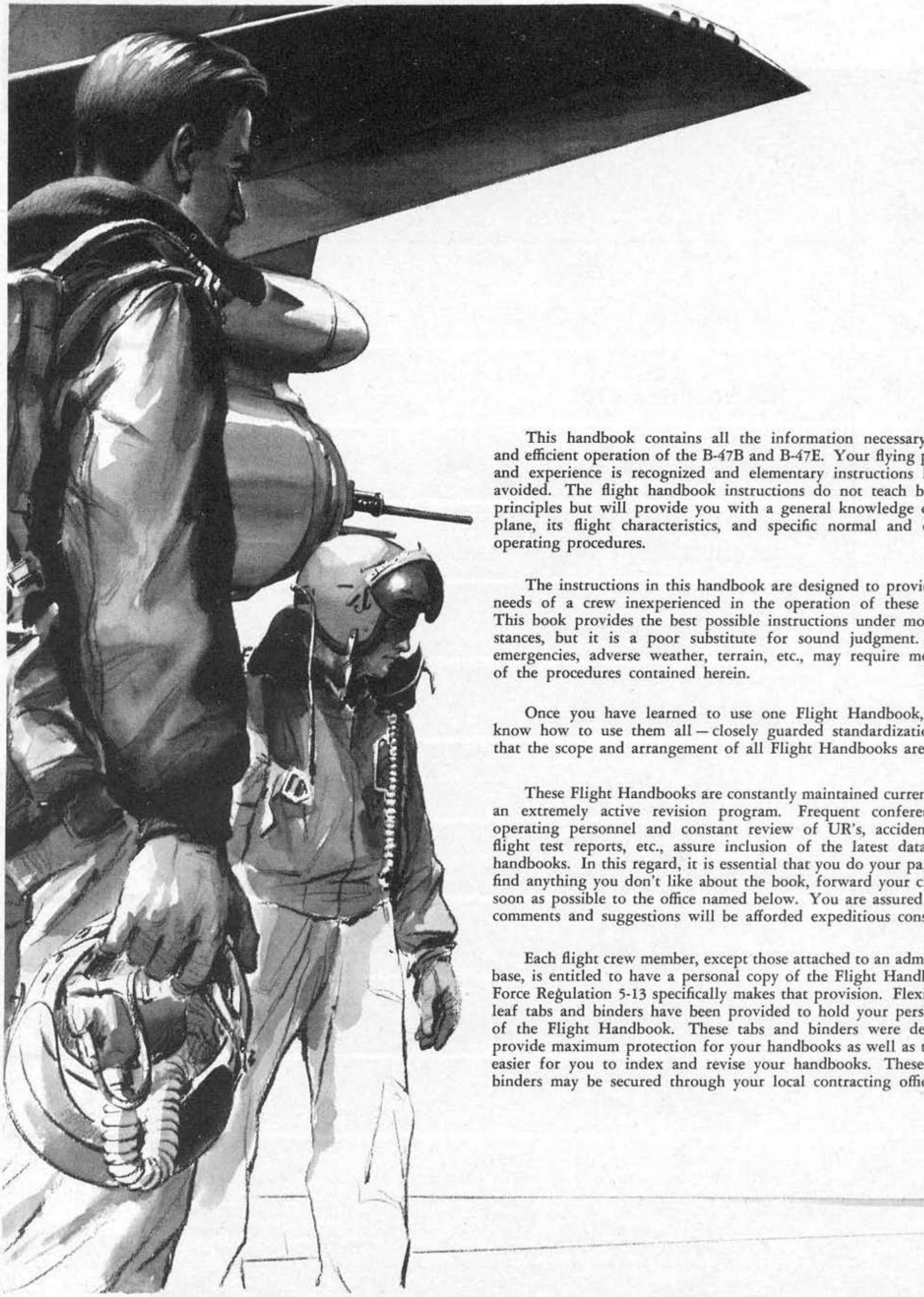
NOTE

Flight Handbook Supplement T.O. 1B-47E-1A contains information specifically applicable to B-47E airplanes modified to the "Blue Cradle" ECM configuration. Flight Handbook Supplement T.O. 1B-47E-1B contains information specifically applicable to B-47E airplanes while carrying the ECM (Phase V) Capsule. Portions of this handbook that are applicable to those airplanes are not repeated in the supplements; therefore, to obtain complete information on those airplanes both this handbook and the applicable supplement are required.



This handbook contains all the information necessary for safe and efficient operation of the B-47B and B-47E. Your flying proficiency and experience is recognized and elementary instructions have been avoided. The flight handbook instructions do not teach basic flight principles but will provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures.

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

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

These Flight Handbooks are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these handbooks. In this regard, it is essential that you do your part! If you find anything you don't like about the book, forward your criticism as soon as possible to the office named below. You are assured that your comments and suggestions will be afforded expeditious consideration.

Each flight crew member, except those attached to an administrative base, is entitled to have a personal copy of the Flight Handbook. Air Force Regulation 5-13 specifically makes that provision. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Handbook. These tabs and binders were designed to provide maximum protection for your handbooks as well as to make it easier for you to index and revise your handbooks. These tabs and binders may be secured through your local contracting officer.

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It will be noted that "Warnings," "Cautions," and "Notes" are found throughout this handbook. To avoid possible misinterpretation, the following definitions will apply:

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

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

NOTE —— An operating procedure, condition, etc., which is essential to highlight.

Comments and questions regarding any phase of the Flight Handbook program are invited and should be addressed to the Directorate of Weapon Systems Operations, Hq. ARDC, Wright-Patterson Air Force Base, Ohio, Attention: RDZ-1SOH.

NOTE

Flight Handbook Supplement T.O. 1B-47E-1A contains information specifically applicable to B-47E airplanes modified to the "Blue Cradle" ECM configuration. Flight Handbook Supplement T.O. 1B-47E-1B contains information specifically applicable to B-47E airplanes while carrying the ECM (Phase V) capsule. Portions of this handbook that are applicable to those airplanes are not repeated in the supplements; therefore, to obtain complete information on those airplanes both this handbook and the applicable supplement are required.

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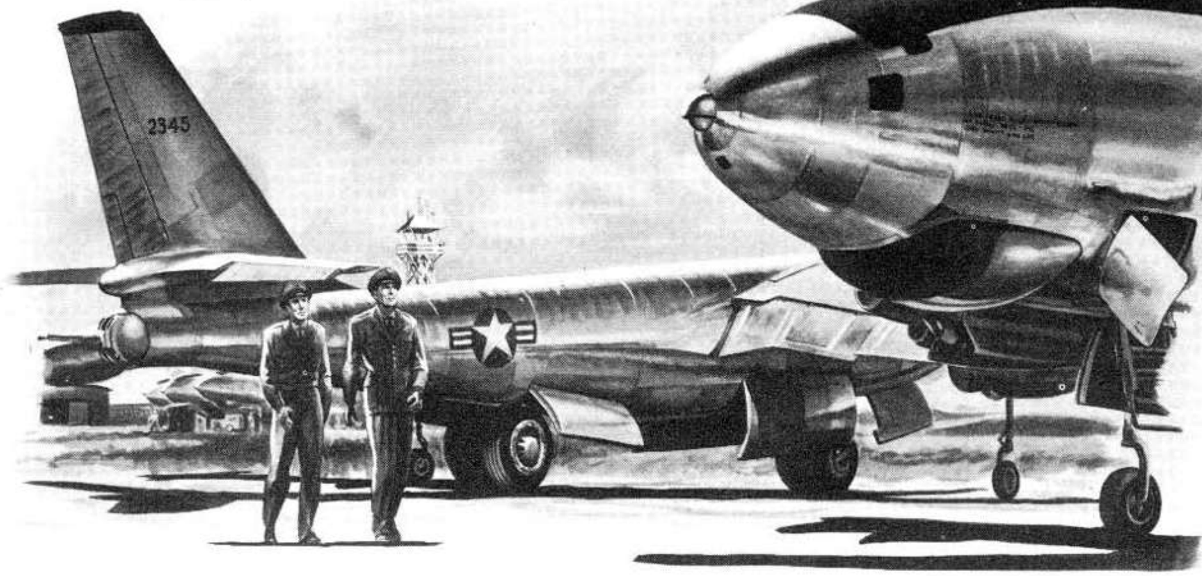
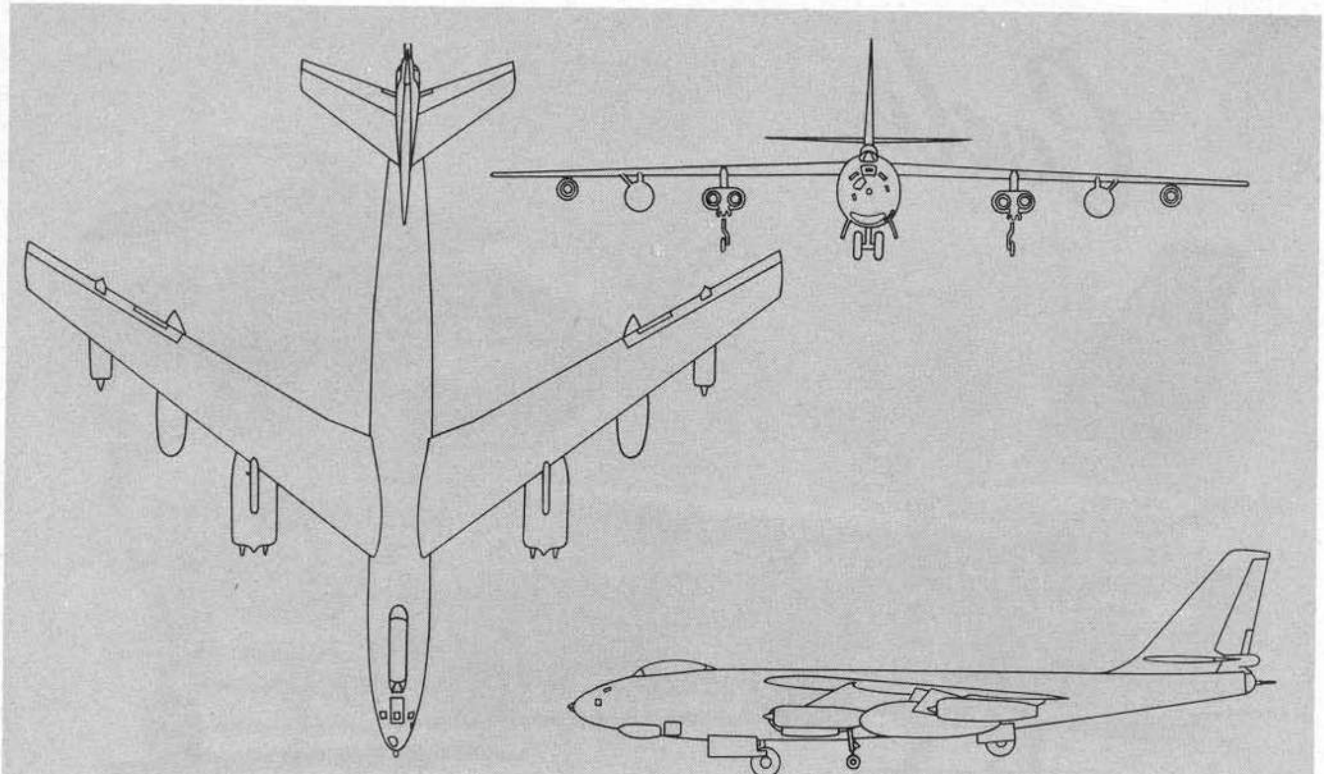


The information contained in this handbook is applicable to all groups of B-47E airplanes manufactured by the Boeing Airplane Company, the Douglas Aircraft Company, and the Lockheed Aircraft Corporation, and a group of modified B-47B airplanes (AF 51-2192 through -2356). A number in parentheses will be used throughout the text of this handbook to differentiate information pertaining to one group of airplanes from that pertaining to another group of airplanes. The number in parentheses will refer to a footnote having the same number on the same page and will identify those airplanes to which the information applies. When a number appears at the top right-hand corner of a paragraph, note, caution, warning, or a procedure step, the information found therein applies only to that group of airplanes given in the footnote. When a number appears at the top right or on the same line as a major heading, all subsequent information related to that major heading applies only to the group of airplanes given in the footnote. In some cases, asterisks will be used within a sentence following an item to designate that that item applies only to certain airplanes which are given in a footnote at the bottom of the page.

When necessary, illustrations, charts, and diagrams may carry their own notations designating the effectivity of information pertinent to the various groups of airplanes.

All effectivities are made up of the affected B-47B and B-47E airplane Air Force serial numbers arranged numerically. Airplane serial number blocks are given only when required to differentiate between blocks of airplanes having or not having the applicable information. When the term "thru" is used, the information applies to all B-47 series airplanes between the Air Force serial numbers given. When the term "and on" is given, the information applies to all B-47 series airplanes subsequent to the Air Force serial number given just before. When there is no number code or any notation having any relationship to text or illustrations, as given above, the information contained therein is applicable to all B-47E series airplanes and modified B-47B airplanes (AF 51-2192 through -2356).



B-47B (AF 51-2192 thru -2356) & B-47E

stratojet

50008WB

description

section I

table of contents

AIRPLANE

The Boeing B-47 "Stratojet" airplane is a land-based six-engine, jet-propelled medium bomber capable of long range flight at high speeds and high altitudes. It has a single tail, high swept-back wings, and underslung engines.

AIRPLANE DIMENSIONS

Wing Span (Some airplanes)	116 feet
(Other airplanes)	116 feet 4 inches
Overall Length	107 feet 1.5 inches
Height (to top of fin in taxi attitude)	28 feet
Tread (between outriggers)	44 feet 4 inches

GROSS WEIGHTS

Design Gross Weight	125,000 pounds
Maximum Gross Takeoff Weight (with 24-ply tires)	185,000 pounds
(Some airplanes with 32-ply tires)	200,000 pounds
(Other airplanes with 32-ply tires)	221,000 pounds
Maximum Flight Gross Weight (with external tanks) (all airplanes)	221,000 pounds
Design Landing Gross Weight	125,000 pounds

Refer to section V for additional information.

FUNCTION

The airplane is designed as a bomber for short and medium range assignments as well as for long range strategic destruction of land and naval materiel objectives.

CREW

The normal flight crew consists of a pilot, copilot, and observer. The copilot also acts as gunner. The observer's duties are navigation, bombing and operation of radar equipment. All regular crew duties are executed in a pressurized compartment which extends from a pressure bulkhead aft of the copilot's station forward to the nose. The pilot and copilot are seated

main differences table

FEATURES (FRONT TO REAR)	B-47A	TB-47B B-47B	YRB-47B	B-47B* B-47E	RB-47E	RB-47H
Long Nose With Camera Window					✓	
Solid Nose						✓
Solid Nose With Bomb Sight Protuberance		✓	✓	✓		
Transparent Nose	✓					
Air Refueling		✓	✓	✓	✓	✓
Ejection Seats	✓			✓	✓	✓
Bomb Bay Photographic Pod			✓			
Bomb Bay Tanks		✓		✓	✓	✓
Camera Compartment With Small Photo Flash Bomb Bay Doors					✓	
ECM Protuberances on Under Side of Fuselage						✓
Long Bomb Bay Doors	✓			✓		
Short Bomb Bay Doors		✓		✓		
External Wing Tanks		✓	✓	✓	✓	✓
Single Point Ground Refueling		✓	✓	✓	✓	✓
Tail Turret		✓	✓	✓	✓	✓

* AF 51-2192 thru 51-2356

50101WC-1

Figure 1-1.

in tandem in the cockpit, while the observer is seated in a compartment situated in the nose section. Although movement of the crew will not generally be required for normal flight operations, a walkway is provided on the left side of the pressure compartment from the observer's station aft to the copilot's station. It is also possible during flight to gain access to the bomb bay by means of a door located in the airplane entrance passage and leading into a crawlway just to the left of the forward main wheel well. Since this necessitates depressurization of the crew compartment however, such passage will be avoided, particularly at high altitudes. (See figure 1-3).

WARNING

The skin area of the main entrance door is not designed to withstand the weight of a crew member. If a misstep is made in the skin area of the door with a sharp blow, there is a possibility of going through the door. On some airplanes a nonskid step is installed on the door to be used by crew members when going through the crawlway in flight. (1)

Provisions for a "fourth crew member" are located in the walkway on the floor step to the left of the copilot's station.

CHARACTERISTICS AND FEATURES

The outstanding characteristics of this airplane are the single swept-back tail and the high swept-back wings. A total of six turbojet engines are installed in underslung engine pods mounted below the wings. The two inboard engines on each wing are enclosed in a single suspended pod hanging well forward of the wing leading edge. The single outboard engines are suspended from the lower wing surfaces near the wing tips. The bicycle-type main landing gear has a lateral supporting outrigger gear located in each inboard engine nacelle. Some airplanes are equipped with racks for 18 internally mounted assist takeoff units (rockets), while other airplanes are equipped with an external jettisonable rack accommodating 33 assist takeoff units. Provisions are made for the installation of a drop tank under each wing just inboard of the outboard engine. In addition, the airplane features a specially designed receptacle for air refueling with a boom-equipped tanker and a single point ground refueling receptacle for ground refueling. Armament consists of an uninhabited remote-controlled tail turret. All flight controls are operated normally by a hydraulic surface power control system incorporating an artificial "feel" system. Although the bomb bay is designed for a basic bomb load of 10,000 pounds, alternate and special arrangements are possible which will carry various bomb and bomb bay fuel loads up to and including a single 22,000-pound bomb. A jettisonable bubble-type canopy is located well forward on top of the fuselage. Catapult-type ejection seats are installed at all crew stations. During bailout emergencies, the pilot and copilot can eject themselves upward from the cockpit while the observer can eject himself downward from his station.

(2)

Provisions are installed in the bomb bay for the installation of an inhabited capsule which provides additional ECM facilities. For information concerning the ECM capsule, refer to Flight Handbook Supplement T.O. 1B-47E-1B.

ENGINES

The airplane is powered by six J47-25 or J47-25A axial flow turbojet engines, each having a guaranteed sea level static performance of 5970 pounds of thrust at 100% (7950) rpm. This engine has electrically operated retractable screens in the airguide section of the engine and a water injection system as an integral part of the engine.

NOTE (3)

The engine screens are inoperative. All the screens are in a stationary open position.

All frontal areas of the engine are anti-iced. The J47-25A engine is interchangeable with the -25 engine and has identical performance characteristics and features. When the airplane is viewed in the direction of flight, the engines are numbered from left to right with the left outboard engine being No. 1. The conventional jet controls and accessories are provided.

ENGINE FUEL CONTROL SYSTEM

The throttle is the major control for the engine fuel system. The supply of fuel in the necessary quantities to the combustion chambers of the engine is controlled by the pilot's or copilot's throttle. Initial movement of a throttle out of CUTOFF starts to open a stopcock (primarily an open and close valve) which remains fully open for any position past the idle position. Continued movement of the throttle mechanically actuates the fuel regulator which governs the engine speed by establishing the main fuel pressure through the fuel control valve. Fuel is supplied from the airplane fuel system through a filter to an engine-driven constant displacement fuel pump and then through an engine fuel filter and oil cooler in which the fuel serves as a cool-

(1) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
(2) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on
(3) AF 51-2192 thru -2356, 52-035 thru -093, -095, -096, -100, -102, -108, -112, -113, -115, -116, -118 thru -151, -161, -169, -199, -312 thru -393, -456, -461, -462, -464 thru -507, -516, -519 thru -620, -3343 thru 53-1972, -2028, -2261 & on

throttle positions chart

WITH ENGINE THROTTLE IN CUT-OFF

FUEL SELECTOR SWITCH ON —		FUEL TANK VALVES AND BOOST PUMPS WILL BE —	ENGINE MANIFOLD VALVE WILL BE —	IGNITION WILL BE —	FUEL FIRE SHUTOFF VALVE WILL BE —
	TE	Closed and off	Closed		
①▶	TME	Open and operating	Open	Not Available	Open unless fire shut-off switch is pulled
	ME	Closed and off	Open		
	TE	Closed and off	Closed		
②▶	TME	Open and operating	Open	Not Available	Closed
	ME	Open and off	Open		

WITH ENGINE THROTTLE ADVANCED APPROXIMATELY 2°

	TE	Open and operating	Closed		
	TME	Open and operating	Open		
①▶	ME	Closed and off	Open	Available	Open unless fire shut-off switch is pulled
②▶	ME	Open and off	Open		

When throttle is advanced approximately 3°, fuel stopcock starts to open.

When throttle is advanced approximately 12°, fuel stopcock is fully open.

When throttle is in START detent, engine operates 13% to 15% rpm.

When throttle is advanced to the IDLE detent, surface controls must be unlocked for further movement.

When throttle is advanced to approximately 50% rpm*; 63% rpm** landing gear and low speed warning horn switches will be actuated.

When throttle is advanced to approximately 96% rpm, water injection system may be utilized if desired.

①▶ Airplanes not included in ②▶
②▶ Airplanes having T.O. 1B-47-483 accomplished and AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on
* AF 51-2357 thru -7077, -15804 thru -15812, 52-019 thru -041, -202 thru -223
** AF 51-2192 thru -2356, -7078 thru -7083, -17368 thru -17386, 52-042 thru -201, -224 & on

Figure 1-2.

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ant for absorbing heat from engine oil. The fuel continues through the flow divider to the engine fuel nozzles, which atomize the fuel into the combustion chambers in a quantity established by the fuel regulator. This fuel regulator is the governing mechanism of the fuel control system and determines the fuel pressure in accordance with three factors: throttle setting; conditions of altitude, airspeed, and temperature; and allowable operating limits of the engine. To help prevent engine compressor stalls which are most common during throttle bursts at low temperatures, the engines are equipped with one of two methods of controlling fuel flow during rapid engine acceleration. Some airplanes have an engine stall prevention switch on the pilot's instrument panel which electrically controls a solenoid valve for bleeding air pressure from the fuel regulator pressure sensing line of each engine. Airplanes not equipped with the switch have a compressor discharge pressure bleed line for each engine which may be capped or uncapped manually prior to flight to control the engine acceleration rate in the same manner as the switch operation. See "Compressor Stalls," section VII for engine operating characteristics with various configurations of the above engine stall prevention devices.

ENGINE CONTROLS

THROTTLES

The pilot has six throttles (5, figure 1-10) on his control stand which are interconnected with six throttles (2, figure 1-20) on the copilot's control stand. Each throttle quadrant has three marked positions, CUTOFF, START, and 100% RPM. The CUTOFF position is a stop position and is located at the aft end of the quadrant. Placing a throttle in CUTOFF position closes the fuel shutoff valve (stopcock) on the respective engine. The START position is a stop located at approximately one-third of the advanced throttle position and is provided primarily as a reference for altitude and ground starts, allowing engine operation at approximately 13% to 15% rpm. The 100% RPM position is located at the forward end of the quadrant. There is also an unmarked "idle" stop set at approximately 40% rpm. These stops prevent the throttle from being inadvertently advanced out of CUTOFF position or being retarded below the "idle" position. A throttle must be lifted to be advanced out of CUTOFF or past START position or to be retarded below the "idle" position. To preclude the possibility of taking off while the control surfaces are locked, a mechanical lock prevents the throttle from being advanced beyond the idle stop when surface lock lever (4, figure 1-10) is in LOCK position. The throttles are mechanically operated and their principal function is to control fuel pressure through the fuel regulators to maintain the desired engine rpm. Throttle movement actuates microswitches to provide partial automatic electrical control of engine operation and warning horn circuits as shown on chart in figure 1-2.

(1)
Placing a throttle in CUTOFF position closes the fuel fire shutoff valve for the corresponding engine.

(1) Airplanes having T.O. 1B-47-483 accomplished and AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on

THROTTLE LOCK LEVER

The throttles are prevented from creeping by an ON--OFF throttle lock lever (6, figure 1-10) on the pilot's control stand. Advancing the lever towards the ON position applies an increasing amount of friction in order to hold the throttles in the desired position.

FIRE SHUTOFF SWITCHES

Six two-position pull-push "Light On - Pull for Emergency Stop" fire shutoff switches (19, figure 1-8 and 14, figure 1-9) on the pilot's instrument panel control engine fire shutoff. Each switch has a red push-to-test fire warning light in the end of the knob which indicates an engine overheat condition by illumination. Pulling the fire shutoff switch closes the fuel, oil, and hydraulic (engines No. 3 and 4) shutoff valves, trips the generator field relays, and deenergizes the alternators (engines No. 1 and 6 only). Shutdown condition of the engine will exist until the fire shutoff switch is again pushed in, restoring the above systems to normal with the exception of the generator field relay and the alternators. The generator field relay may be restored to normal by placing the generator switch momentarily in RESET and then to ON position. Restoring the alternators to normal operation is accomplished on airplanes with variable speed alternators by placing the alternator power switches to RH ALT RESET and LH ALT RESET and then to NORMAL position and on airplanes with constant speed alternators by placing the alternator control switches to RESET position momentarily. On some airplanes★ throttle position has no effect on fire shutdown operation; however, it is advisable to move the throttle into or near CUTOFF position before pulling the fire shutoff switch. On other airplanes★★ moving a throttle to CUTOFF position closes the fuel shutoff valve on the corresponding engine but has no effect on oil and hydraulic shutoff valves or generator and alternator field relays. DC power for shutdown of various systems is supplied through circuit breakers on the upper and lower DC power panels.

ENGINE SCREEN SWITCH

Engine screens are provided in eight sections in the air inlet section of each engine. The screens are electrically opened and closed by a three-position CLOSE--OPEN--AUTOMATIC switch (18, figure 1-11) on the pilot's switch panel. CLOSE position will extend the screens and OPEN position will retract the screens. In AUTOMATIC position, the landing gear safety switch will automatically open the screens on takeoff and close the screens on landing. When the exterior surfaces anti-icing switch is turned on and the screens are in closed position, the screens will automatically open. It is estimated that the gross thrust of the engine will be decreased by 4% with the screens closed. Control power for the engine screens is supplied through a circuit breaker on the lower DC power panel.

NOTE (1)

The engine screens are inoperative. All the screens are in a stationary open position.

ENGINE STALL PREVENTION SWITCH (2)

An engine stall prevention switch (1, figure 1-8 and 12, figure 1-9) is located on the pilot's instrument panel. This switch has ON--OFF positions and should be in the OFF position except when flying below 10,000 feet with an OAT of 15° C (59° F) or below. The switch should be ON for air refueling, formation flying, and unusual maneuvers such as practice stalls, regardless of altitude. Placing the switch in ON position deenergizes a solenoid which opens a valve to allow bleeding of air pressure from the pressure sensing line between the engine compressor section and the fuel regulator of each engine. This bleeding of air pressure affects the engine acceleration time, as governed by the fuel regulator, by lowering the actual pressure to be sensed by the fuel regulator. This causes a slower engine acceleration and aids in preventing engine compressor stalls which may be caused by throttle manipulation. If the switch is left in ON position at higher altitudes, a loss of rpm may be encountered (maximum obtainable rpm may be as low as 93%). If the switch is left in the ON position at an OAT of 16° C (60° F) or above engine acceleration time of up to approximately 30 seconds from idle to 100% rpm may be encountered on a 100° F day. The same conditions may exist in the event of DC failure to the air bleed valve solenoid since the valve is held closed by electrical power when the switch is in OFF position. Circuit breakers for the system are on the lower DC power panel.

ENGINE INDICATORS

ENGINE FUEL PRESSURE GAGES (3)

Six fuel pressure gages (31, figure 1-8) (one for each engine) are located on the pilot's instrument panel. The gages indicate electrically the engine fuel pressure in psi to the combustion chamber nozzles. Fuel pressure gages are remote indicating, power being supplied by the secondary bus of the regulated AC power system. Circuit protection for the fuel pressure indicating system is provided by fuses in the main AC power shield.

★ Airplanes not included in ★★

★★ Airplanes having T.O. 1B-47-483 accomplished and AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on

(1) AF 51-2192 thru -2356, 52-035 thru -093, -095, -096, -100, -102, -108, -112, -113, -115, -116, -118 thru -151, -161, -169, -199, -312 thru -393, -456, -461, -462, -464 thru -507, -516, -519 thru -620, -3343 thru 53-1972, -2028, -2261 & on

(2) AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on

(3) AF 51-2357 thru 52-071, -202 thru -246

crew movement and compartments

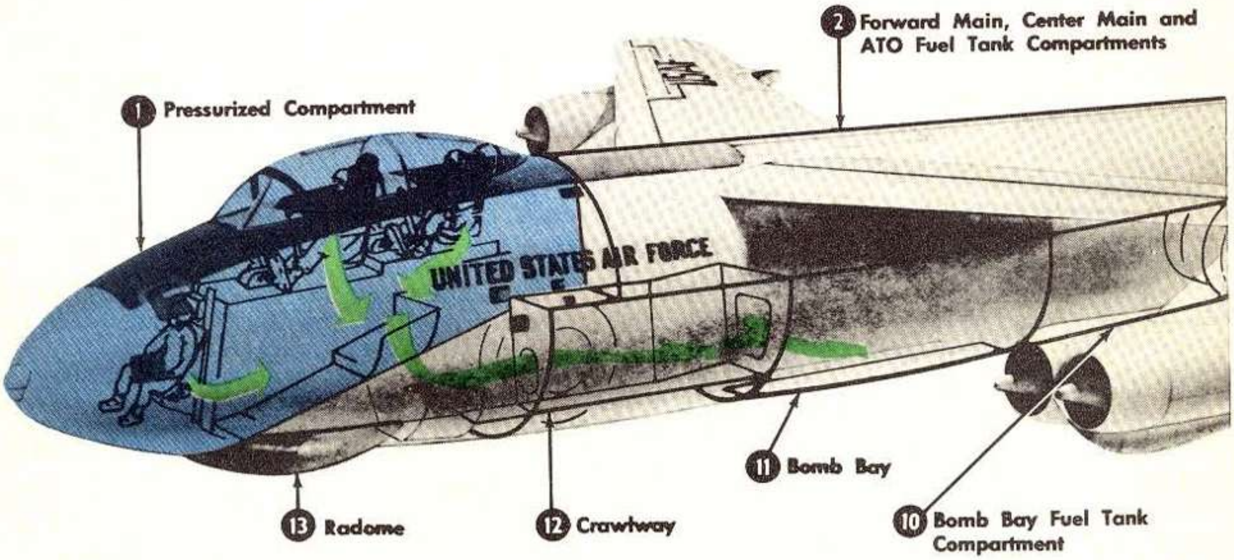


Figure 1-3.

ENGINE FUEL FLOWMETERS (1)

Six fuel flowmeters (31, figure 1-8 and 26, figure 1-9) (one for each engine) are located on the pilot's instrument panel. The gages indicate electrically pounds per hour of fuel flow to the engines. The flowmeters are remote indicating, power being supplied by the DC system and the secondary bus of the regulated AC power system, or the constant speed alternator system. Circuit protection for the fuel flowmeter system is provided by the circuit breakers on the lower DC power panel and circuit breakers in the main AC power shield, or fuses in the forward AC power shield.

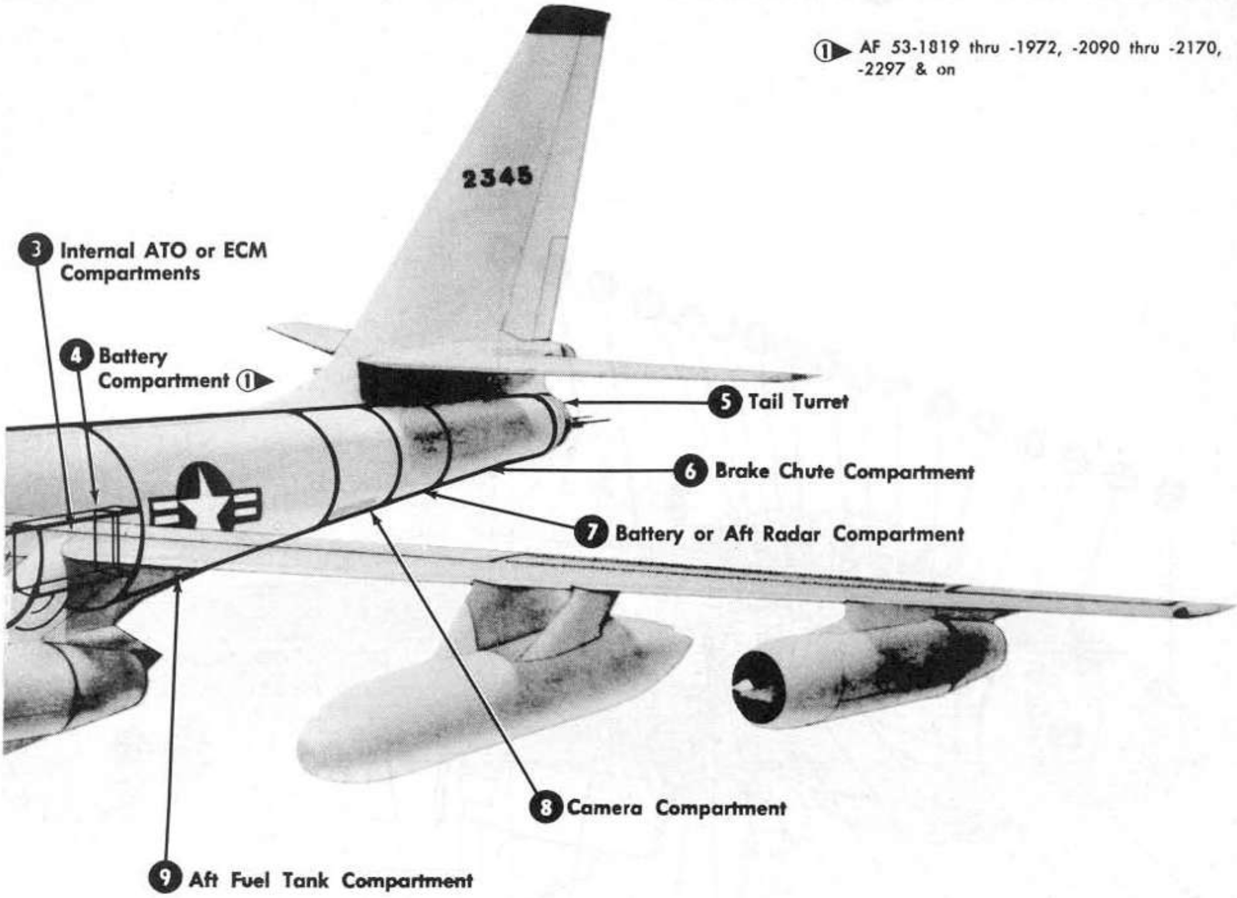
TACHOMETERS

Engine speed in percentage of maximum rated rpm (7950) is indicated by tachometers, six of which are on the pilot's instrument panel (27, figure 1-8 and 25, figure 1-9) and six on the copilot's instrument panel (20, figure 1-8; 16, figure 1-19; and 17, figure 1-19A). The tachometer is remote indicating, receiving power from a tachometer generator geared to the engine-rotor shaft, thereby operating independently of the airplane electrical system.

EXHAUST TEMPERATURE GAGES

The temperature of the engine exhaust gases in degrees Centigrade is indicated by six (one for each engine) exhaust gas temperature gages (30, figure 1-8 and 28, figure 1-9) on the pilot's instrument panel. The gage is a self-generated electrical unit not requiring power from the airplane electrical system. Gage indications are received from probe-type thermocouples mounted in the engine tailpipe section measuring the temperature of engine exhaust gages. This exhaust gas temperature is commonly referred to as the "EGT" or "tailpipe temperature."

(1) AF 51-2192 thru -2356, 52-072 thru -201, -247 & on



OIL PRESSURE GAGES

Six oil pressure gages (42, figure 1-8 and 38, figure 1-9) (one for each engine) are located on the pilot's instrument panel and indicate electrically the engine oil pressure in pounds per square inch. Remote indicating power is supplied by the secondary bus of the regulated AC power system, or the constant speed alternator system. Fuses for the oil pressure indicating system are located on the main AC power shield, or the forward AC power shield.

WATER INJECTION SYSTEM

NOTE

(1)
The engine water injection system is inoperative at present.

A water injection system is incorporated to provide additional thrust at or above 96% rpm throttle setting. This additional thrust results from the pump injection of a water-alcohol mixture into the combustion chambers of each engine thereby increasing the mass flow of gases from the exhaust nozzle. This brings about a resultant increase in thrust. Since the injection of this mixture tends to cause a slight decrease in exhaust gas temperature, a tab is inserted automatically into the exhaust stream during the injection process to reduce that area, thus maintaining the desired temperature. A 300 US gallon tank comprised of three cells is located in each inboard wing. Each tank supplies the three engines on that respective side with a water-alcohol mixture which is pumped into the engine combustion chamber by an individual air-driven pump for each engine. In the event of failure of the water injection system on one engine, the water-alcohol supply can be used by the operative systems on the side of the failed system. This enables the engines re-

(1) AF 51-2357 thru 52-151, -202 thru -321

general arrangement

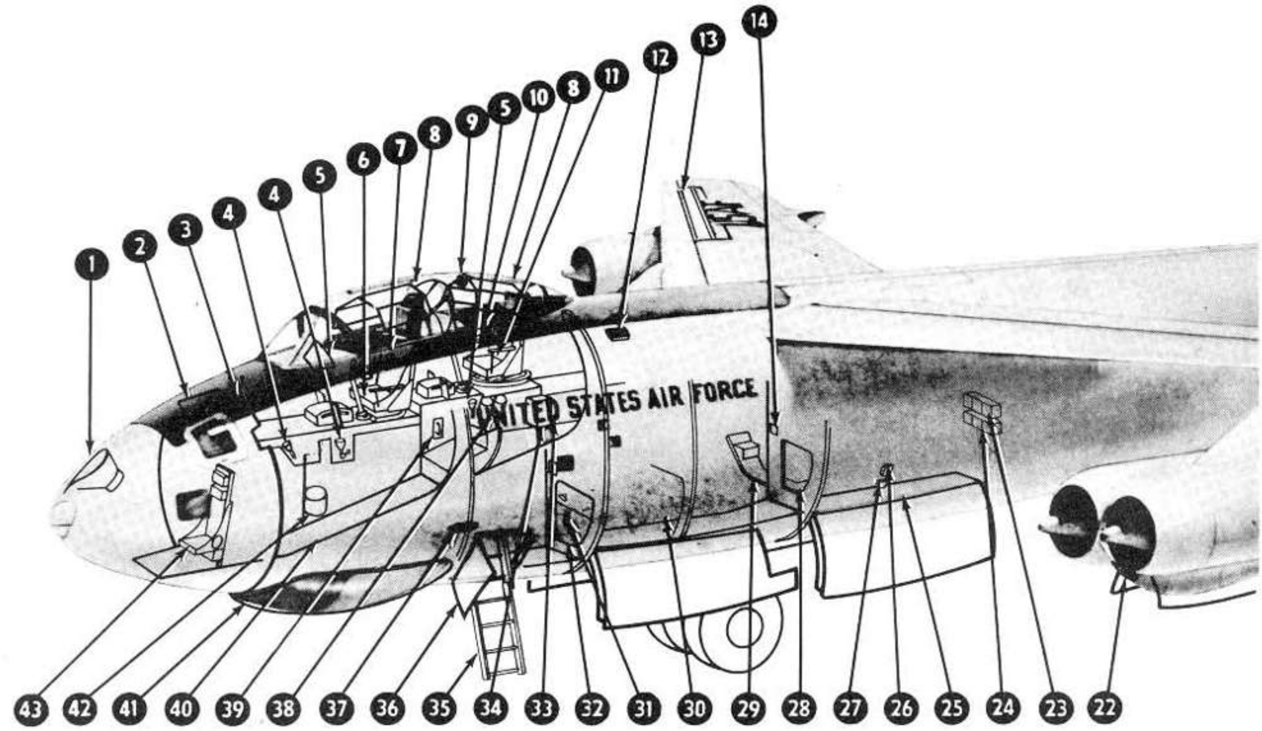


Figure 1-4.

ceiving water-assist to continue at a high thrust for a longer period of time, compensating in part for the loss of thrust from the engine or engines not receiving water. A power circuit fault of one system on one side will render the power circuit inoperative for the corresponding system on the opposite side, thus preventing the existence of an unbalanced thrust condition. For example, if a power circuit fault occurs on the No. 1 engine water injection system, the power circuit for the No. 6 engine water injection system will be rendered inoperative. See figure 1-54 for water-alcohol specification.

(1)
The water-alcohol mixture is injected at a "low flow" rate of approximately 450 ppm with a resultant thrust increase of approximately 17% for approximately 100 seconds.

(2)
The water-alcohol mixture is injected at a "medium flow" rate of approximately 650 ppm with a resultant thrust increase of approximately 23% for approximately 74 seconds.

WATER INJECTION SYSTEM CONTROLS

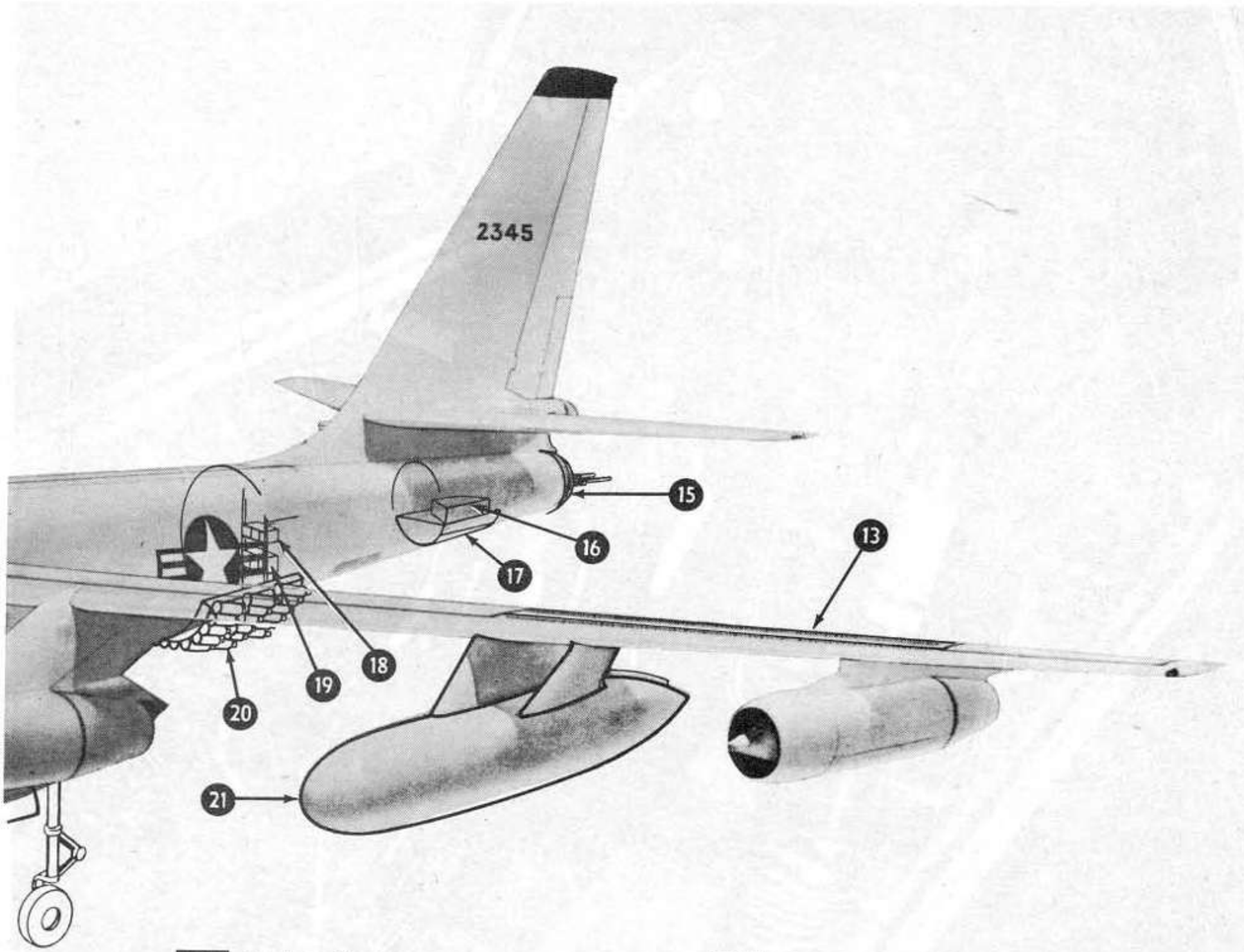
WATER INJECTION ARM SWITCH

NOTE **(3)**

The water injection arm switch is inoperative.

(4)
A two-position ON--OFF switch (3, figure 1-12) located on the ATO control panel arms the water injection system circuit. ON position of the arm switch

(1) AF 52-322 thru -333, -394 thru -408, -427 thru -507
(2) AF 51-2192 thru -2356, 52-152 thru -201, -334 thru -393, -409 thru -426, -508 & on
(3) Some airplanes
(4) AF 51-2192 thru -2356, 52-152 thru -201, -322 & on



1.	Air Refueling Receptacle
2.	Anti-Glare Curtain
3.	Yaw String
4.	Crew Relief Tube
5.	Clear Vision Panel ①
6.	Pilot's Station
7.	Pilot's Check List
8.	Canopy Sun Curtain
9.	Periscopic Sextant Mount ②
10.	Copilot's Check List Panel
11.	Copilot's Station
12.	Wing Illumination Lights
13.	Vortex Generators
14.	Bomb Loading Chart
15.	Tail Turret
16.	Approach Chute ③
17.	Brake Chute
18.	Outrigger Landing Gear Locks (Stowed)
19.	Main Landing Gear Locks (Stowed)
20.	External ATO Rack ④
21.	External Wing Tanks
22.	Landing Lights
23.	Wing Jack Pads (Stowed)
24.	Mooring Eyes (Stowed)
25.	Bomb Bay Walkway
26.	Oxygen Regulator Panel
27.	Interphone
28.	Bomb Bay Access Opening
29.	Bomb Bay Platform
30.	Ground Heat Access Panel
31.	Crawlway
32.	Crawlway Access Door
33.	Canopy Ground Lock ⑤
34.	Periscope Sextant (Stowed)
35.	Entrance Ladder
36.	Entrance Door
37.	Pilot Head
38.	Food Warming Cup
39.	Thermos Bottle and Drinking Cup Dispenser
40.	Walkway
41.	Radome
42.	Chemical Toilet (Some Airplanes)
43.	Observer's Station

① AF 52-593 & on

② AF 51-2192 thru -2356, 52-612 & on

③ AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

④ AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

⑤ AF 51-2192 thru 52-611

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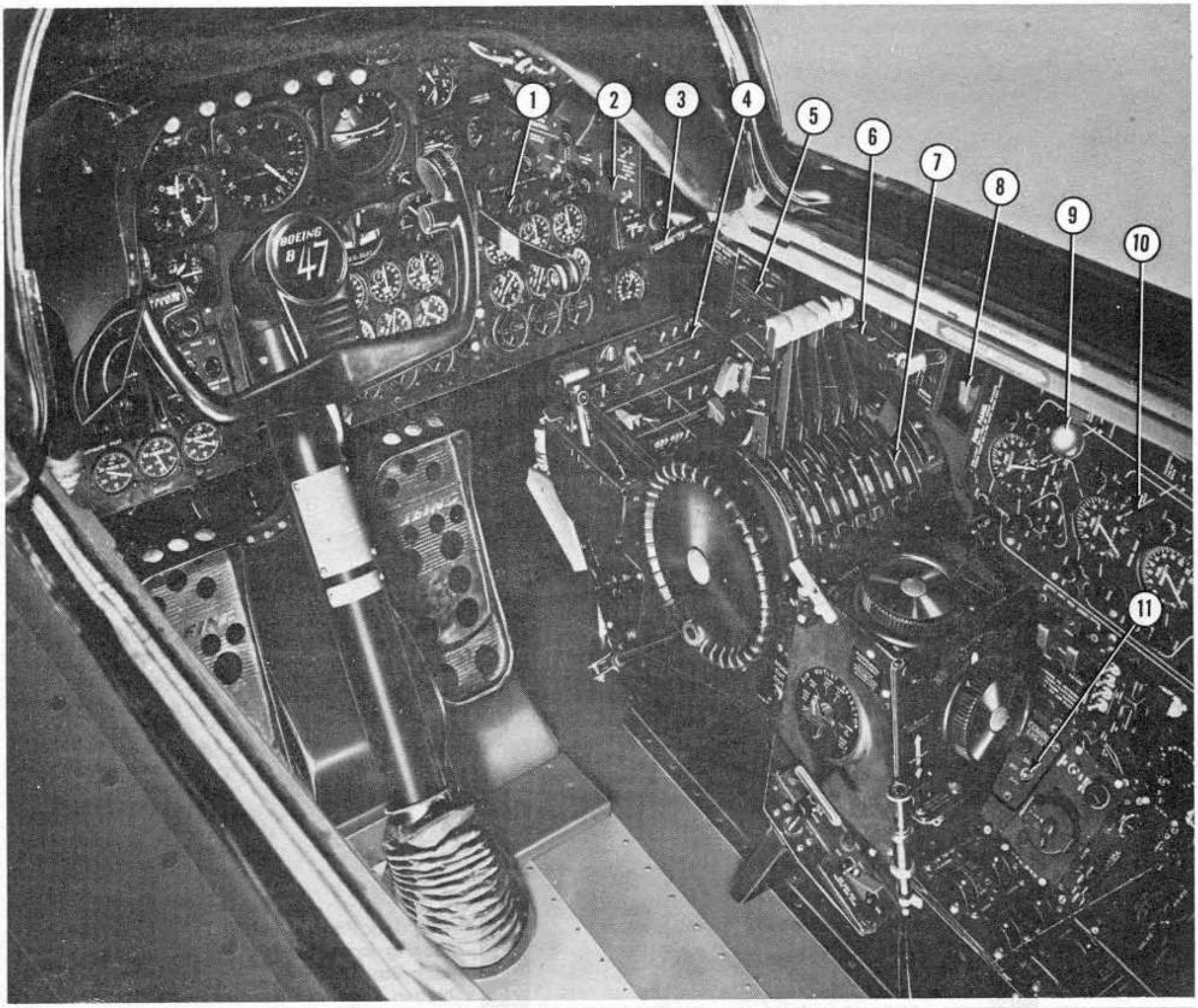

1. Instrument Panel
2. Surface Power Control Panel
3. Brake Chute Deployment Handle
4. Pilot's Switch Panel
5. Fire Warning Test Panel
6. Ignition Switch Panel
7. Pilot's Control Stand
8. Bomb Salvo Switch
9. Canopy Lock Lever
10. Fuel Control Panel
11. Standby Compass Light Switch (1)▶

pilot's station

(1)▶ AF 51-2192 thru -2356, 52-158 thru -201, -331 thru -393, -451 & on

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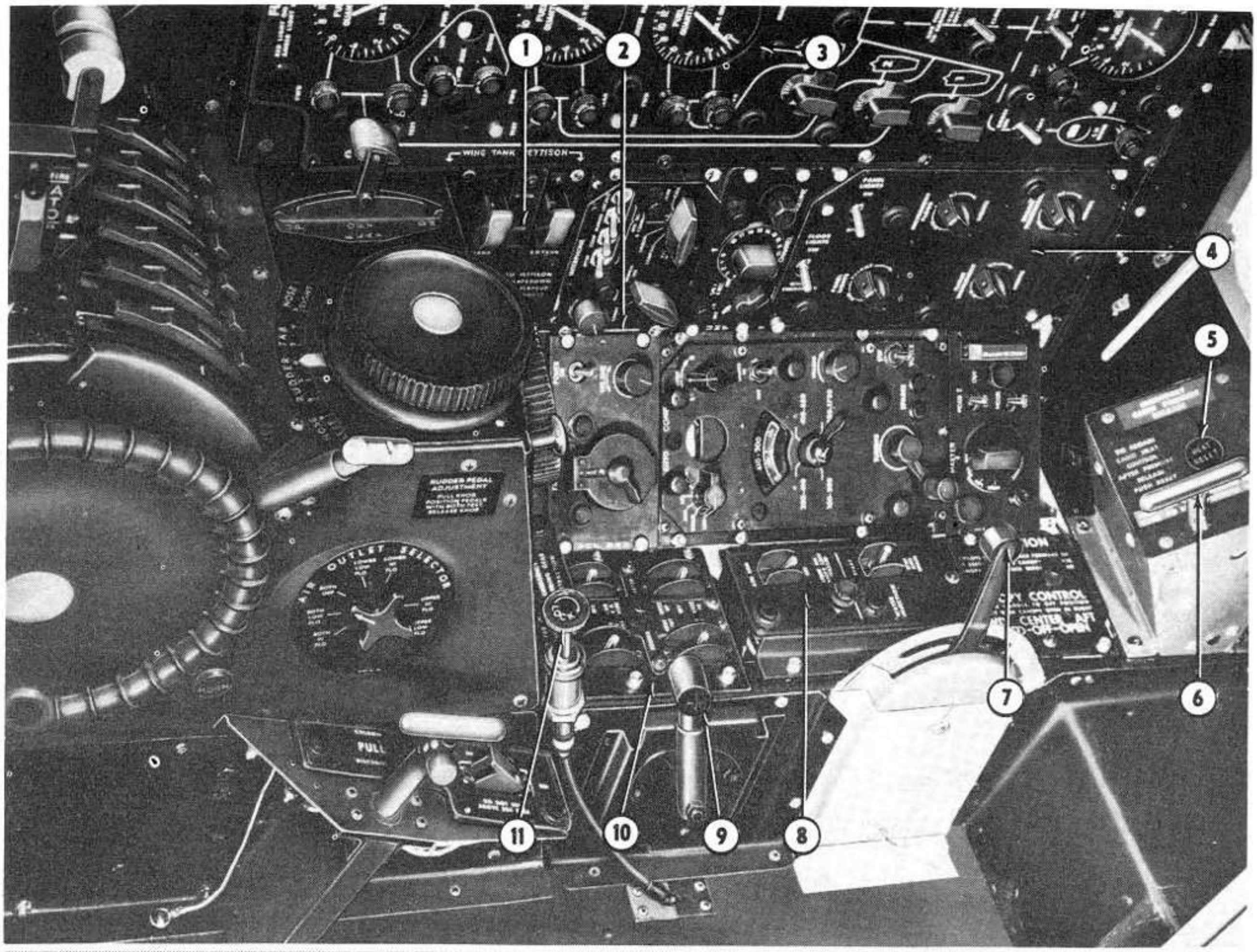
Figure 1-5.

supplies power to the system switch and to the indicator lights. OFF position deenergizes the system switch and the indicator lights.

WATER INJECTION SYSTEM SWITCH (1)

The water injection system switch (4, figure 1-12) is inoperative.

(1) AF 51-2357 thru 52-151, -202 thru -321



1. Wing Tank Jettison Switches
2. Radio Panel
3. Fuel Control Panel
4. Lighting Control Panel
5. Cabin Heat Reset Button
6. Emergency Cabin Pressure Release Handle
7. Canopy Control Lever (1)▶
   Canopy Latch Control Lever (2)▶
8. Water Injection and ATO Control Panel
9. Cabin Heat Distribution Lever (Some Airplanes)
10. Trim Coordination Switch Panel
11. Cabin Heat Distribution Knob (Some Airplanes)

pilot's station — aft right side

(1)▶ AF 51-2192 thru 52-611
(2)▶ AF 52-612 & on

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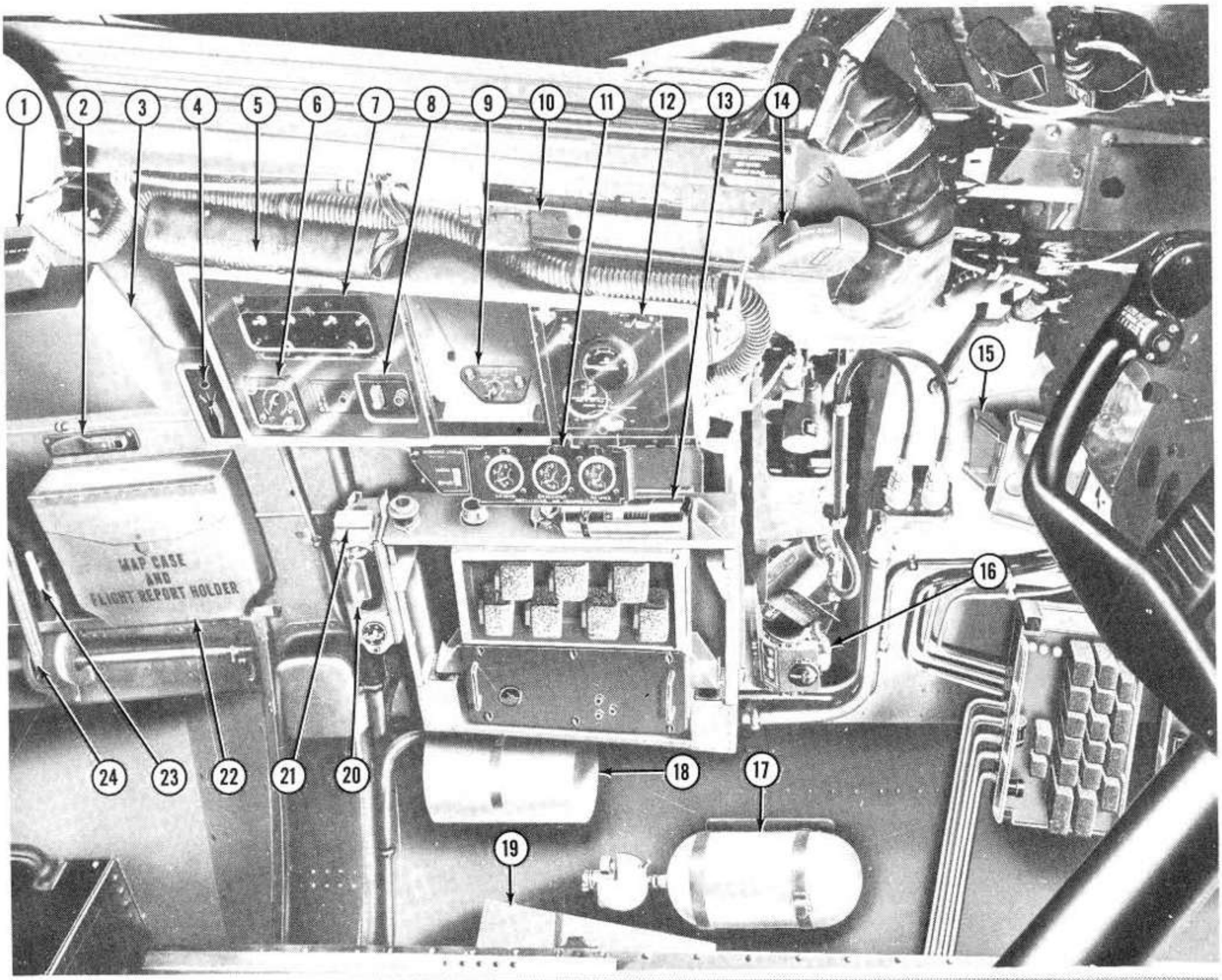
Figure 1-6.

(1)
A three-position START--off--STOP AND DRAIN switch (4, figure 1-12), spring-loaded from the START position, is located on the ATO control panel. The switch is guarded in such a manner that movement of the switch from off to START can be done while the guard is closed. The guard has to be lifted to permit movement of the switch to STOP AND DRAIN. Momentary START position energizes the water injection system provided the water injection arm switch is ON and the throttles have been advanced beyond 96% rpm. When water-alcohol pressure diminishes, the system pumps are automatically turned off by pressure

(1) AF 51-2192 thru -2356, 52-152 thru -201, -322 & on



1. First Aid Kit
2. Emergency Knife
3. Blood Plasma Kit
4. Intercommunication System Filter Switch ①▶
5. Crash Station Harness ②▶
6. Map Light Panel
7. Position Light Panel
8. Emergency Keyer Panel
9. Windshield Wiper Control Panel ③▶
10. Airplane Check List
11. Anti-Icing Air Temperature Panel
12. Oxygen Regulator Panel
13. Fire Extinguisher
14. Canopy Emergency Jettison Handle
15. Spare Amplifiers Rack
16. Automatic Pilot Controller and Support
17. Portable Oxygen Bottle
18. Observer's Anti-Exposure Suit
19. Observer's Ditching Harness ④▶
20. Food Warming Cup
21. Rear View Mirror
22. Map Case and Flight Report Holder (Some Airplanes)
23. Bailout Control Handle
24. Pressure Door Release Handle

pilot's station — left side

①▶ AF 51-2412 thru -17386, 52-029 & on

②▶ AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

③▶ AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

④▶ AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314

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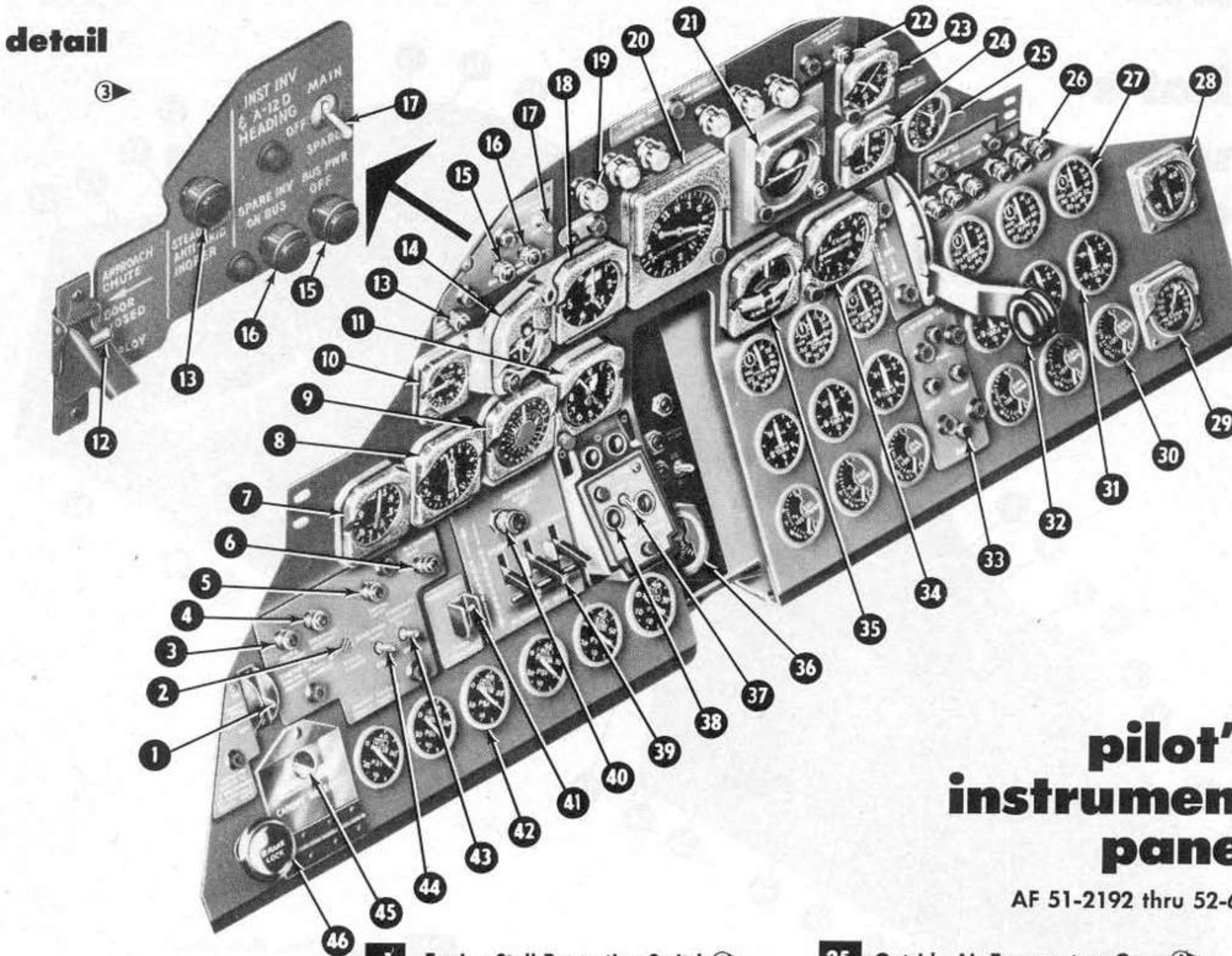
Figure 1-7.



pilot's instrument panel

AF 51-2192 thru 52-611

1. Engine Stall Prevention Switch①
2. Bomb Doors Position Indicator
3. Wing Overheat Warning Light
4. Empennage Overheat Warning Light
5. Bombs Away Indicator Light
6. N-1 Compass Inoperative Light②
7. Machmeter
8. Radio Magnetic Course Indicator (RMI)
9. Data Indicator
10. Accelerometer
11. Altimeter
12. Approach Chute Deployment Switch③
13. Anti-Skid Inoperative Light
14. ID-249 Course Indicator
15. Instrument Inverter Indicator Light — Bus Power Off
16. Instrument Inverter Indicator Light — Spare Inverter On
17. Instrument Inverter Switch
18. Maximum Allowable Airspeed Indicator
19. Fire Shut-Off Switches
20. Remote Compass Repeater Indicator
21. Vertical Gyro Indicator
22. Air Refueling Ready-for-Contact Light
23. Clock
24. Wing Flap Position Indicator
25. Outside Air Temperature Gage④
    Cabin Pressure Altitude Gage⑤
26. Water Injection Indicator Lights
27. Tachometers
28. Cabin Pressure Altitude Gage④
29. Cabin Air Temperature Gage④
    Outside Air Temperature Gage⑤
30. Exhaust Temperature Gages
31. Engine Fuel Pressure Gages⑥
    Engine Fuel Flowmeters⑦
32. Landing Gear Lever
33. Landing Gear Position Indicators
34. Rate-of-Climb Indicator
35. Turn-and-Bank Indicator
36. IFM Control Box
37. Master Oxygen Warning Control Switch
38. Oxygen Warning Lights
39. Automatic Pilot Engaging Switches
40. Automatic Pilot Off Light
41. Turn Control Transfer Switch
42. Oil Pressure Gages
43. Directional Damper Switch
44. Alternate Bomb Door Switch
45. Canopy Emergency Release Handle
46. Brake Lock Knob

① AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 thru -611

② AF 51-2192 thru -7083, -17368 thru -17386, 52-059 thru -201, -293 thru -611

③ AF 51-2192 thru -2356, 52-071 thru -201, -248 thru -611

④ AF 51-2357 thru 52-111, -202 thru -311, -394 thru -507

⑤ AF 51-2192 thru -2356, 52-112 thru -201, -312 thru -393, -508 thru -611

⑥ AF 51-2357 thru 52-071, -202 thru -246

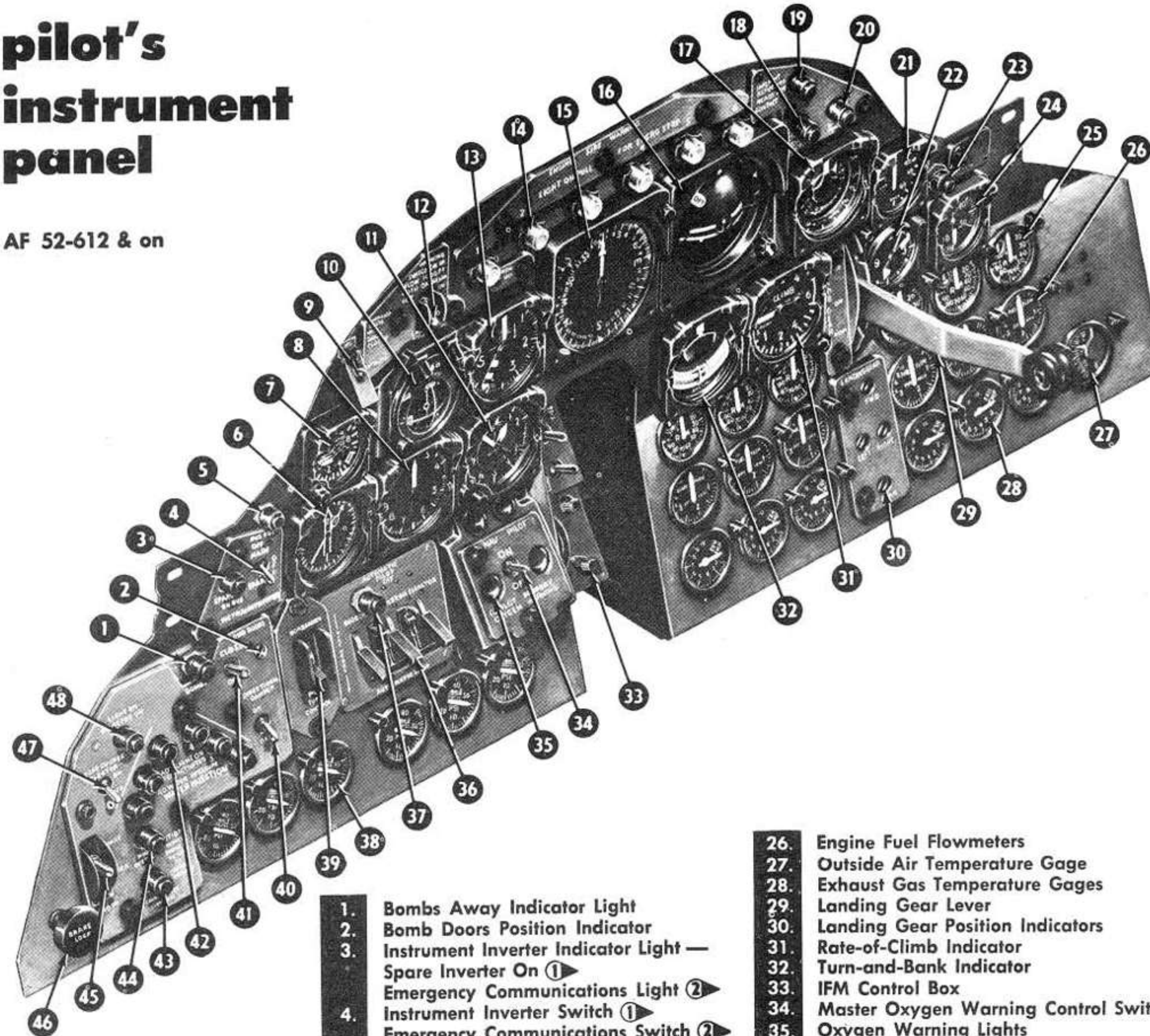
⑦ AF 51-2192 thru -2356, 52-072 thru -201, -247 thru -611

56 09WB-1

Figure 1-8.

pilot's instrument panel

AF 52-612 & on



1. Bombs Away Indicator Light
2. Bomb Doors Position Indicator
3. Instrument Inverter Indicator Light — Spare Inverter On (1)
   Emergency Communications Light (2)
4. Instrument Inverter Switch (1)
   Emergency Communications Switch (2)
5. Instrument Inverter Indicator Light — Bus Power Off (1)
6. Radio Magnetic Course Indicator (RMI)
7. Accelerometer
8. Machmeter
9. Approach Chute Deployment Switch
10. ID-249 Course Indicator
11. Altimeter
12. Engine Stall Prevention Switch
13. Maximum Allowable Airspeed Indicator
14. Fire Shutoff Switches
15. Remote Compass Repeater Indicator
16. Vertical Gyro Indicator
17. Data Indicator
18. N-1 Compass Inoperative Light
19. Air Refueling Ready-for-Contact Light
20. Instrument AC Power Off Light (3)
21. Wing Flap Position Indicator
22. Clock
23. Anti-Skid Inoperative Light
24. Cabin Pressure Altitude Gage
25. Tachometers
26. Engine Fuel Flowmeters
27. Outside Air Temperature Gage
28. Exhaust Gas Temperature Gages
29. Landing Gear Lever
30. Landing Gear Position Indicators
31. Rate-of-Climb Indicator
32. Turn-and-Bank Indicator
33. IFM Control Box
34. Master Oxygen Warning Control Switch
35. Oxygen Warning Lights
36. Automatic Pilot Engaging Switches
37. Automatic Pilot Off Light
38. Oil Pressure Gages
39. Turn Control Transfer Switch
40. Directional Damper Switch
41. Alternate Bomb Door Switch
42. Water Injection Indicator Lights
43. Empennage Overheat Warning Light
44. Wing Overheat Warning Light
45. Canopy Control Switch
46. Brake Lock Knob (Some Airplanes)
47. ID-249 Course Selector Switch (4)
48. ID-249 Course Selector Indicator Light (4)

(1) AF 52-612 thru -1416, -3343 thru -3373, 53-2261 thru -2278

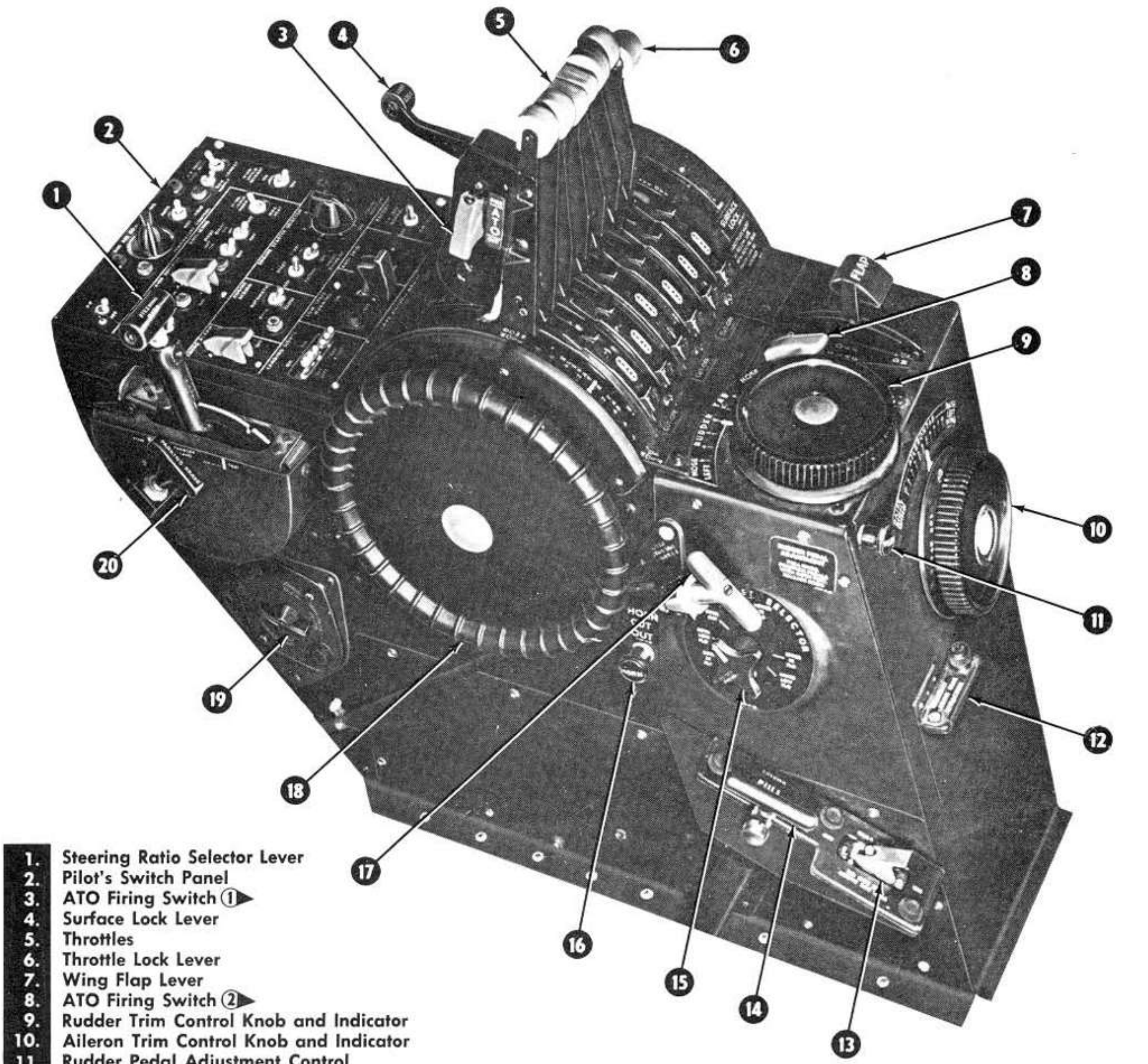
(2) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

(3) AF 52-1417, 53-1819 thru -2170, -2279 & on

(4) AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on

50155WC-1

Figure 1-9.



1. Steering Ratio Selector Lever
2. Pilot's Switch Panel
3. ATO Firing Switch ①▶
4. Surface Lock Lever
5. Throttles
6. Throttle Lock Lever
7. Wing Flap Lever
8. ATO Firing Switch ②▶
9. Rudder Trim Control Knob and Indicator
10. Aileron Trim Control Knob and Indicator
11. Rudder Pedal Adjustment Control
12. Landing Gear Emergency Retraction Switch
13. Drag Control Switch
14. Control Column Disconnect Handle
15. Air Outlet Selector Knob
16. Landing Gear Warning Horn Release Knob
17. Brake Chute Jettison Handle ③▶
    Brake Chute and Approach Chute Jettison Handle ④▶
18. Elevator Trim Control Wheel and Indicator
19. Windshield Wiper Control Panel ⑤▶
20. Brake Lock Handle ⑥▶

pilot's control stand

①▶ AF 51-2192 thru 52-620, 53-2261 thru -2278

②▶ AF 52-1406 thru 53-2170, -2279 & on

③▶ AF 51-2357 thru 52-070, -202 thru -247

④▶ AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

⑤▶ AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507

⑥▶ AF 52-1417, 53-1850 thru -2170, -2315 & on

50114WB

Figure 1-10

Figure 1-11.

switches at the pump discharge port. STOP AND DRAIN position stops system pump operation and opens both engine drain and manifold drain valves. This operation completely drains overboard all water-alcohol from the tank and manifold lines. Retarding the throttles from 96% rpm will stop pumps but will not drain the tanks or open the engine drain valves.

WATER INJECTION SYSTEM INDICATORS

WATER INJECTION SYSTEM WARNING LIGHTS

(1)

The water injection system warning lights are inoperative.

(2)

Six red lights (26, figure 1-8 and 42, figure 1-9), one for each engine, are located on the pilot's instrument panel to provide an indication of water pressure conditions when the system is armed. The lights illuminate when the water injection arm switch is placed in the ON position. When the throttles have been advanced beyond the 96% rpm position and the system switch has been placed in the momentary START position, water pressure builds up and the lights go out, indicating that the system is operating. When the throttles are retarded aft of the 96% rpm position or the water-alcohol supply is exhausted, the lights will illuminate. The lights glow when the system switch is placed in STOP AND DRAIN position. Placing the water injection arm switch in the OFF position causes the lights to go out.

IGNITION SYSTEM

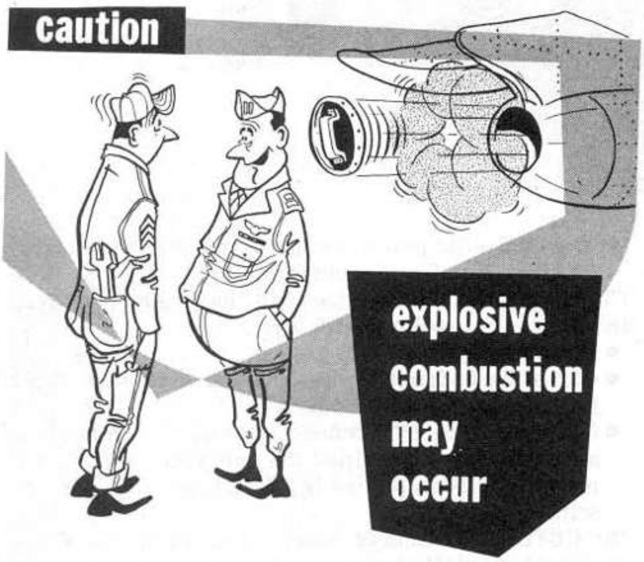
A separate DC ignition system is installed for each engine to start engine combustion. Each system consists of an ignition switch, ignition control relay, throttle operated microswitch, and two ignition units. Ignition is provided by four single electrode-type plugs located two each in the No. 3 and 7 combustion cham-

(1) AF 51-2357 thru 52-151, -202 thru -321
(2) AF 51-2192 thru -2356, 52-152 thru -201, -322 & on

bers of each engine. Power for the ignition system is supplied by the DC power system. Control power for the "normal" phase of ignition is provided by the "Start Control" circuit breaker; control power for the "altitude start or test" phase of ignition is provided by the "Throttle and Engine Control" circuit breaker. These circuit breakers are located on the lower DC power panel.

IGNITION SWITCHES

Six ignition switches (1, figure 1-13) (one for each engine) are located on the ignition switch panel and have three positions, NORMAL--OFF--ALTITUDE START OR TEST. When the switch is placed in NORMAL position, the ignition will occur when a starter switch has been placed in START and the throttle is advanced out of CUTOFF. Normal ignition terminates automatically when either automatic or manual cutoff of the starter occurs. When the switches are in OFF position, the ignition system cannot be energized. On some airplanes when an ignition switch is actuated to the ALTITUDE START OR TEST position, the ignition system is energized continuously until the switch is placed in OFF position to stop ignition. While on other airplanes the ALTITUDE START OR TEST position is a momentary control switch and must be held in position.



CAUTION

Do not place ignition switch for any engine in the ALTITUDE START OR TEST position when air intake and tailpipe closures are installed, because explosive combustion may occur. Possible fuel leakage within the engine under these conditions can result in a combustible mixture. This mixture can be expelled by removing closures and motoring the engine for approximately 30 seconds before making ignition test.

ato control panel

①▶ AF 51-2357 thru 52-088, -202 thru -292
②▶ AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

50111WB

Figure 1-12.

STARTER SYSTEM

Engine starting torque for each engine is provided by a 28-volt DC combination starter-generator unit geared to the engine main rotor. Power is supplied to the starter either by an external power cart or by the airplane batteries. The starter-generator unit is used as a starter motor during engine start, and is then normally used, after engine is started, as a generator for the airplane DC system. Starting current is automatically terminated, when the engine reaches approximately 20% rpm, by a current relay, which senses decreasing load to the starter motor when engine acceleration is being supported by normal combustion. On engines No. 3 and 4, a hydraulic pump pressure release valve opens to relieve load on the engine during starting. After the engine starter drops out, the hydraulic pressure release valve closes and permits hydraulic pressure to build up within the system.

STARTER CONTROLS

STARTER SELECTOR SWITCH. A starter selector

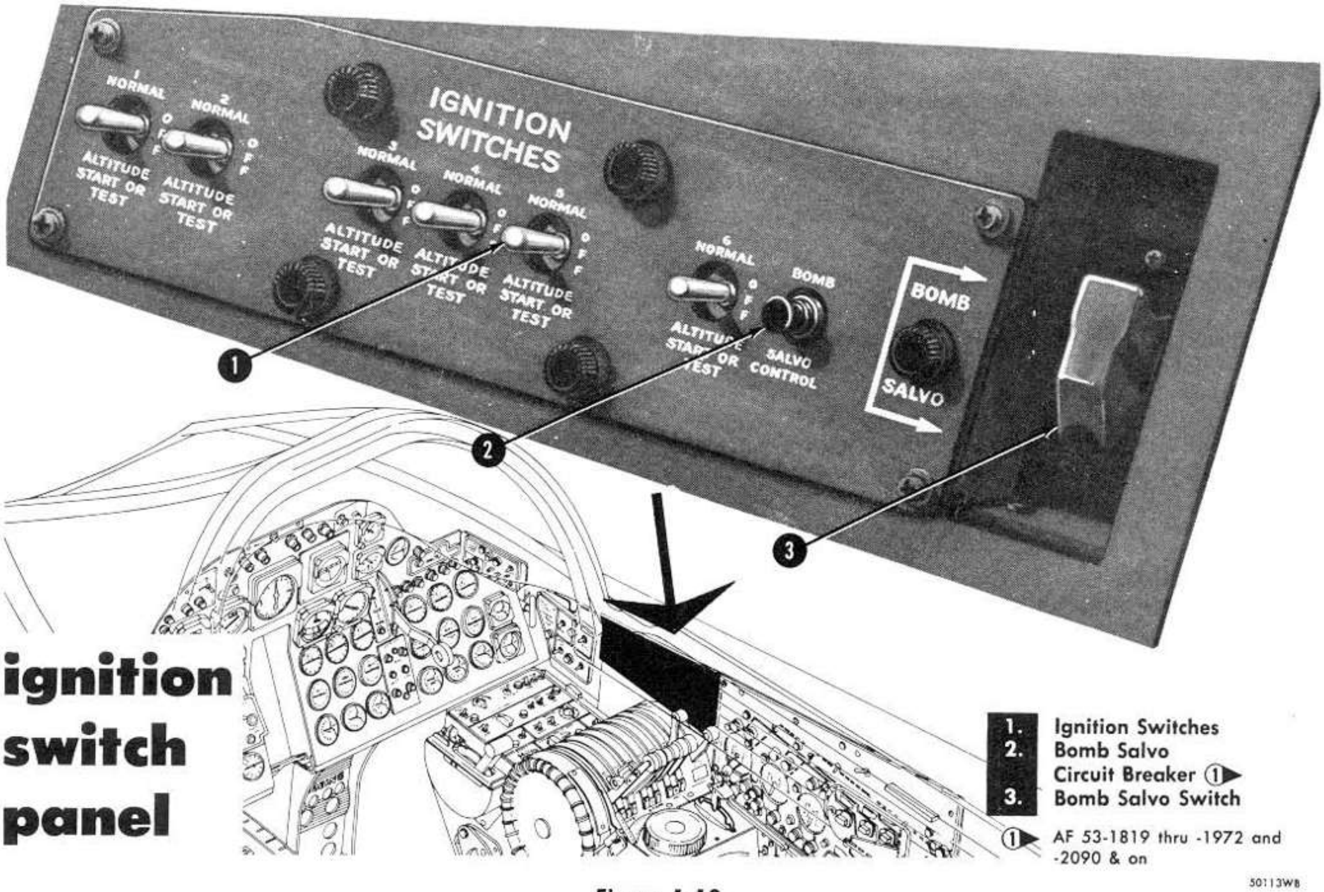


Figure 1-13.

switch (10, figure 1-11) marked OFF--1--2--3--4--5--6 is located on the pilot's switch panel. When the selector switch is in the OFF position, the starter switch cannot be energized. Placing the selector switch to the number of the engine to be started automatically energizes the starter circuits for the respective engine when the starter switch is placed in START position. DC power is supplied to the starter selector switch through the "Start Control" circuit breaker on the lower DC power panel.

ENGINE STARTER SWITCH. A single three-position START--OFF--CUTOFF starter switch (15, figure 1-11) is located on the pilot's switch panel. The switch is spring-loaded to the OFF position. When the starter selector switch is positioned to the engine to be started and the starter switch is moved momentarily to START position, a holding circuit accomplishes the following:

- The starter-generator is motorized for starting.
- The ignition circuit is armed (energized when throttle is advanced to START position provided the ignition switch is in NORMAL position).
- The hydraulic pump pressure release valve opens (engines No. 3 and 4 only).

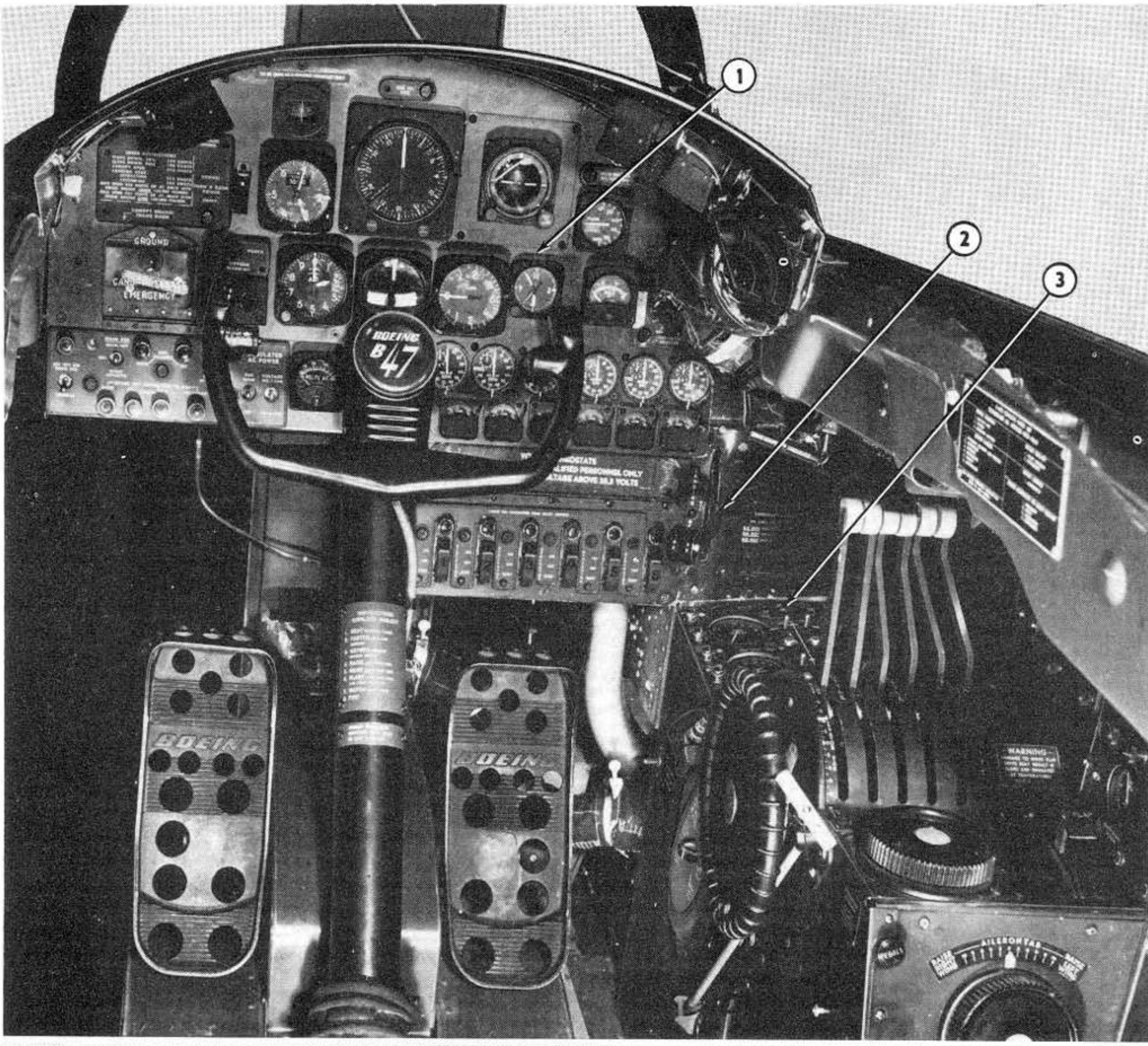
The circuits remain energized until the engine is started and the current relay opens to

- Discontinue ignition.
- Close the hydraulic pump pressure release valve (engines No. 3 and 4 only).
- Change circuits to connect the starter-generator as a generator provided the generator switch has previously been placed in RESET and then ON position.

The CUTOFF position provides a manual means of accomplishing cutoff of a starter in event this relay fails to open. In CUTOFF position, the following will be accomplished:

- Ignition control relay is deenergized.
- Hydraulic pump pressure release valve is closed (engines No. 3 and 4 only).
- Starter control relay is deenergized.

Control circuit breakers for the starter control circuit are on the lower DC power panel.



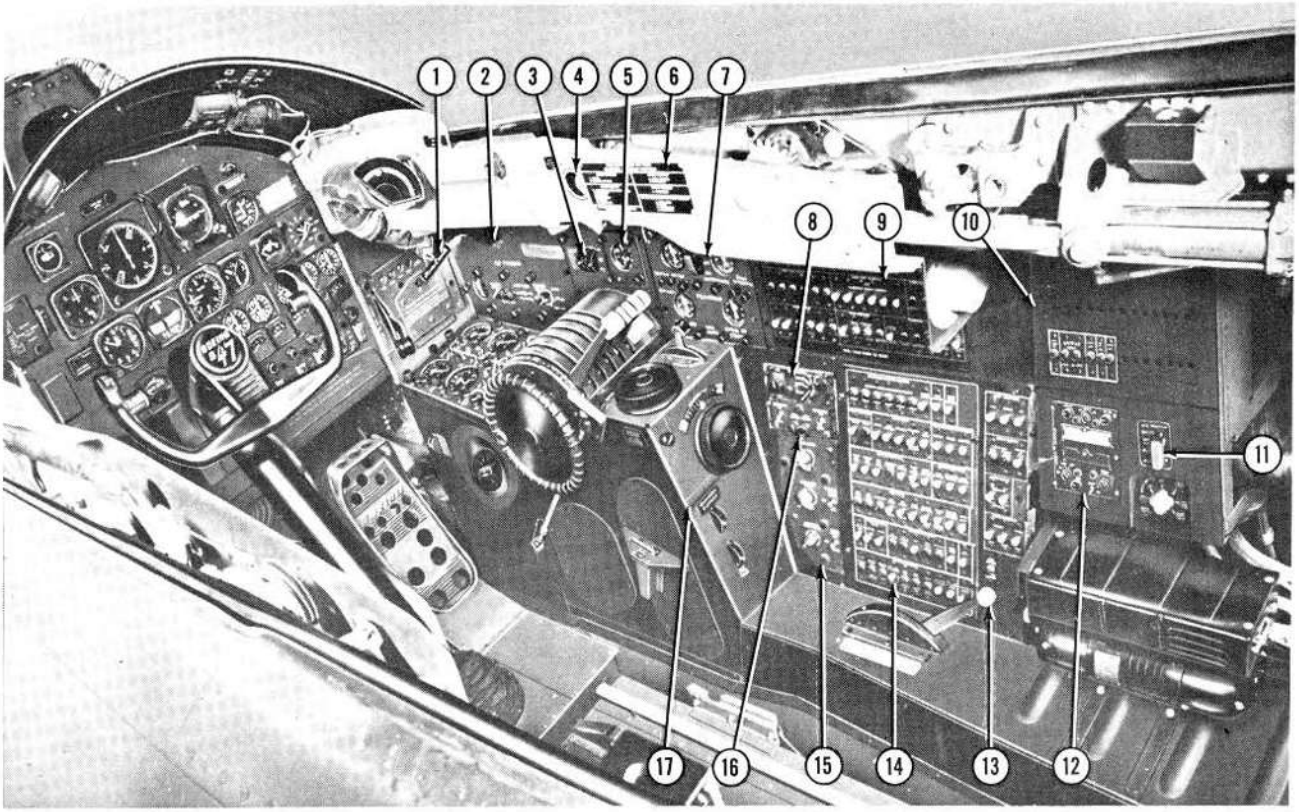
copilot's station

1. Instrument Panel
2. Landing Gear Control Panel
3. Air Refueling Panel

50118WA

Figure 1-14.

STARTER EMERGENCY OVERRIDE SWITCH. A two-position START--OFF starter emergency override switch (11, figure 1-10), spring-loaded to the OFF position, is located on the pilot's switch panel. In START position, the starter bus is connected to the airplane DC system bus. Actuating the starter switch simultaneously with the override switch permits engine starting from the airplane batteries while on the ground. In OFF position, the starter-generators may be motorized only by means of an external power source.



1. Brake Chute Deployment Handle
2. Unregulated AC Power Panel (1)
   Liquid Oxygen Quantity Gage Panel (2)
3. Wing Flap Emergency Switches
4. Canopy Lock Pin Inspection Hole
5. Hydraulic Fluid Quantity Gage
6. Check List
7. Hydraulic System Control Panel
8. Interphone Panel (3)
   Intercom Panel (4)
9. Upper DC Power Panel
10. Aft DC Power Panel (5)
11. DC Bus Selector Switch
12. AN/ARC-21 Liaison Radio Master Panel (6)
13. Air Refueling Valve Lever
14. Lower DC Power Panel
15. Lighting Panel
16. ECM Control Panel (7)
17. Control Stand

copilot's station — right side

(1) AF 51-2357 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2) (Some Airplanes)
(3) AF 51-2192 thru -2411, 52-019 thru -028
(4) AF 51-2412 thru -17386, 52-029 & on
(5) AF 51-2192 thru -2356, -7024 thru -7083, -17368 thru -17386, 52-059 thru -201, -236 & on
(6) AF 51-2192 thru -2356, 52-498 & on
(7) AF 51-2357 thru -2411, 52-019 thru -028

50119WC-1

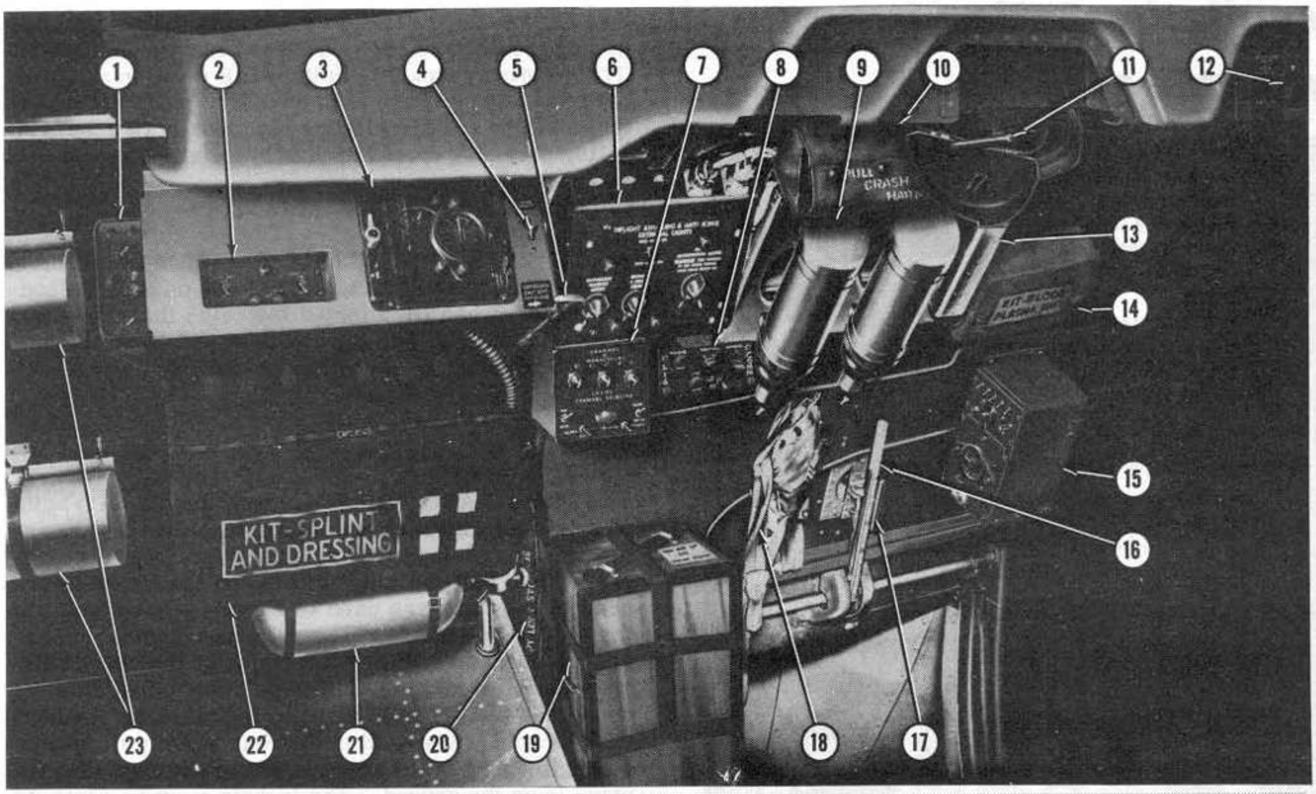
Figure 1-15.

NOTE

This switch must be used for emergency starting when external power is not available and for ground starting when external power is connected to only the normal airplane bus in a portion of the external power receptacle.

ASSIST TAKEOFF (ATO) SYSTEMS

Provisions are made for installing solid fuel ATO units (rockets) which supply additional thrust when it is desired for high gross weight takeoff or to shorten takeoff distance. The systems are DC electrically controlled and operated by the pilot from the water injection and ATO control panel and an ATO firing switch. The units are fired simultaneously and give thrust until the propellant is exhausted. Control and indicator light power circuit breakers are located on the upper and lower DC power panels at the copilot's station. Refer to figure 1-17A for approved ATO units and loading configurations to be used.



1. ECM Control Panel ①▶
2. ECM Control Panel ②▶
3. Oxygen Regulator Panel
4. Dome Light Switch
5. Cabin Air Emergency Shutoff Handle (Some Airplanes)
6. Air Refueling and Anti-Icing External Lights Panel
7. UHF Command Radio Panel
8. AN/ARC-21 Liaison Radio Sub Panel ③▶
9. Thermos Bottles
10. Crash Station Harness ④▶
11. Canopy Emergency Jettison Handle
12. Approach Chute Deployment Switch ⑤▶
13. Cup Dispenser
14. Blood Plasma Kit
15. Fourth Crew Member's Oxygen Regulator and Interphone Panel ④▶
16. Pressure Door Release Handle
17. Bailout Control Handle
18. Parachute Static Line
19. Periscopic Sextant and Case (Some Airplanes)
20. Canopy Ground Lock Stowage ⑥▶
21. Portable Oxygen Bottle
22. Battle Splint and Dressing Kit
23. Anti-Exposure Suits

copilot's station —left side

①▶ AF 51-2412 thru -17386, 52-029 thru -111, -202 thru -241
②▶ AF 52-112 thru -157, -242 thru -311, -508 thru -564
③▶ AF 51-2192 thru -2356, 52-498 & on
④▶ AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on
⑤▶ AF 51-2192 thru -2356, 52-071 thru -201, -248 thru -611
⑥▶ AF 51-2192 thru 52-611

50120WC

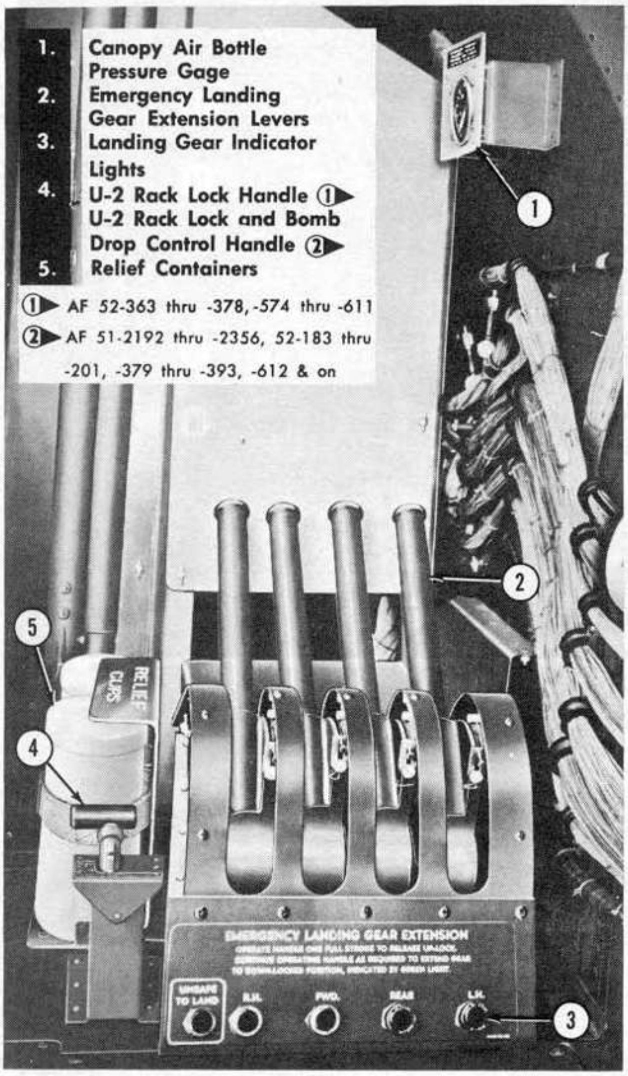
Figure 1-16.

INTERNAL ATO SYSTEM (1)

The internal ATO system incorporates 18 ATO units, 9 in a shroud on each side of the fuselage above the rear main wheel well. A removable ground safety link, located in the rear wheel well, is used to complete the circuit to the ATO unit ignitors. The safety link is manually removed to prevent firing of the units while servicing the airplane. The safety link must be installed if ATO is to be used for takeoff.

(1) AF 51-2357 thru 52-088, -202 thru -292

copilot's station—aft left side



50121WB

Figure 1-17.

INTERNAL ATO SYSTEM CONTROLS

ATO ARMING SWITCH. The ATO control circuits are armed by an ATO ARM--OFF switch (1, figure 1-12) on the ATO control panel. In ATO ARM position electrical power is supplied to the ATO firing switch. In OFF position the ATO control circuits are deenergized.

ATO FIRING SWITCH. A guarded ATO firing switch (3, figure 1-10) is mounted on the pilot's No. 1 engine throttle and has FIRE--OFF position. The switch is guarded to the OFF position which deenergizes the ATO firing control circuits. In the FIRE position and when the ATO arming switch is in ATO ARM position the control circuits are energized to electrically fire the ATO units, providing the safety link is installed.

INTERNAL ATO SYSTEM INDICATORS

ATO-SAFETY-LINK-INSTALLED INDICATOR LIGHT. A green indicator light (2, figure 1-12) on the ATO control panel, when illuminated indicates that the safety link is installed. The light will go out when the airplane landing gear leaves the ground.

EXTERNAL ATO SYSTEM (1)

The external ATO system incorporates 33 ATO units on a jettisonable rack which is attached to the underside of the fuselage just aft of the rear main landing gear. Two pull-out plugs located on the forward corners of the rack are used to complete the circuit to the ATO unit ignitors. The pull-out plugs are manually disconnected to prevent firing of the units while servicing the airplane. The pull-out plugs must be connected if ATO is to be used for takeoff. An ATO rack lockpin is installed in the rear wheel well to prevent jettisoning of the external ATO rack when the airplane is on the ground. The lockpin must be removed before flight.

EXTERNAL ATO SYSTEM CONTROLS

ATO ARM SWITCH. The ATO control circuit is armed through an ATO-ARM--OFF switch (1, figure 1-12) on the water injection and ATO control panel. In ATO-ARM position the circuit is completed to the ATO fire switch. In the OFF position, the ATO firing control circuits are deenergized. DC power is supplied to the ATO arm switch through circuit breakers on the lower DC power panel.

ATO FIRING SWITCH. On some airplanes a two position ATO firing switch (3, figure 1-10) is mounted on the pilot's No. 1 engine throttle while on other airplanes the same type switch (8, figure 1-10) is mounted on the aft end of the pilot's control stand. The switch has FIRE--OFF positions and is guarded in the OFF position. Placing the switch in FIRE position will electrically fire the ATO units, provided both pullout plugs are connected and the ATO arming switch is in ATO ARM position. In the OFF position the firing control circuits are deenergized. DC power is supplied to the ATO fire switch through circuit breakers on the lower DC power panel.

EXTERNAL ATO RACK RELEASE HANDLE. An ATO rack release handle (11, figure 1-20), clipped in a

(1) AF 51-2192 thru -2356, 52-089 thru -201 and -293 & on

ato unit loading chart

TYPE	INTERNAL RACK	EXTERNAL RACK UNMODIFIED	EXTERNAL RACK MODIFIED *
14AS-1000 Mk 2 Mod 3	Max 18 full bottles.	Max 33 full bottles, if less are required, complete loading to 33 with empty 14AS -1000 bottles. No other loading is permitted.	Max 33 full bottles, if less are required load forward end of rack. If less than 22 are required, omit from forward row before any are omitted from center row. It is not necessary to use empty bottles to complete loading.
15KS-1000 Mk 6 Mod 0, 1 & 2	Max 12 full bottles, load only forward and center rows on both sides.	DO NOT USE	Max 19 full bottles, load all locations except aft row, and the 5th, 6th and 7th positions from the left side of the forward row. If less required omit bottles from forward row first. If less than 11 bottles are required, omit bottles from center row symmetrically, starting with the outboard sides. It is not necessary to use empty bottles to complete loading.

- Only the above type bottles are approved for use on this airplane.
- Load racks symmetrically about the centerline of the airplane.
- Use only one type bottle when loading internal and external racks (do not mix).

★ The term "modified" is applicable only to the airplane and rack configuration in which both the airplane and rack are modified to accommodate the rack displacing arms and are properly connected.

NOTE

For further information and restrictions regarding the use of the 14AS-1000 units refer to T. O. 2K-SR-14AS-201D.

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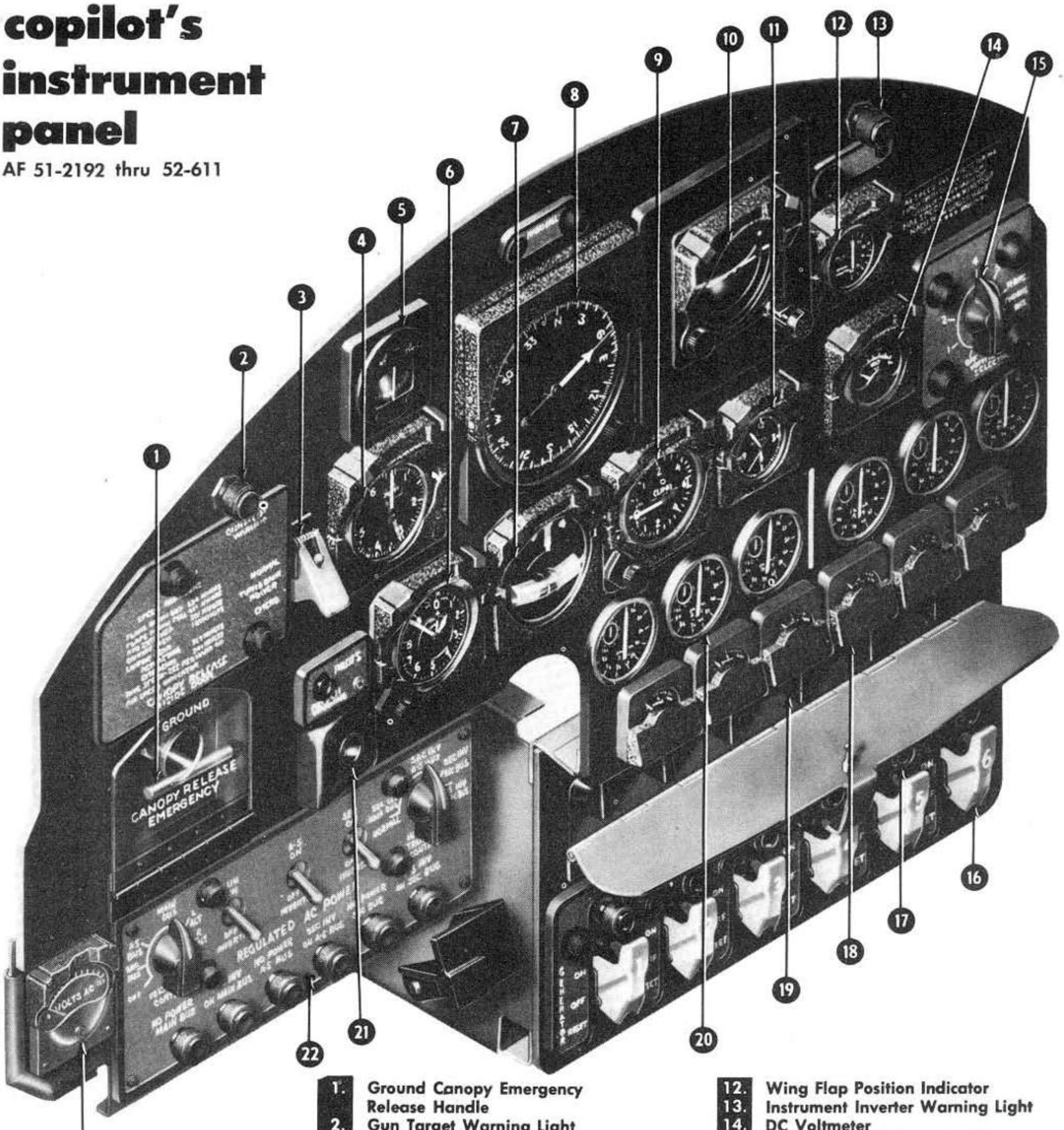
Figure 1-17A.

copilot's instrument panel

AF 51-2192 thru 52-611



1.	Ground Canopy Emergency Release Handle	12.	Wing Flap Position Indicator
2.	Gun Target Warning Light	13.	Instrument Inverter Warning Light
3.	Turn-and-Bank Power Switch	14.	DC Voltmeter
4.	Maximum Allowable Airspeed Indicator	15.	DC Voltmeter Selector Switch
5.	Standby Compass (1)	16.	Generator Switches
6.	Altimeter	17.	Generator Field Trip Warning Lights
7.	Turn-and-Bank Indicator	18.	Generator Loadmeters
8.	Directional Gyro	19.	Generator Voltage Rheostats (2)
9.	Rate-of-Climb Indicator	20.	Tachometers
10.	Attitude Indicator	21.	Pilot's Oxygen Warning Light
11.	Clock	22.	Regulated AC Power Panel
		23.	AC Voltmeter

(1) AF 51-2357 thru 52-157, -202 thru -311, -394 thru -450
(2) Airplanes which do not have T. O. 1B-47-566 accomplished.

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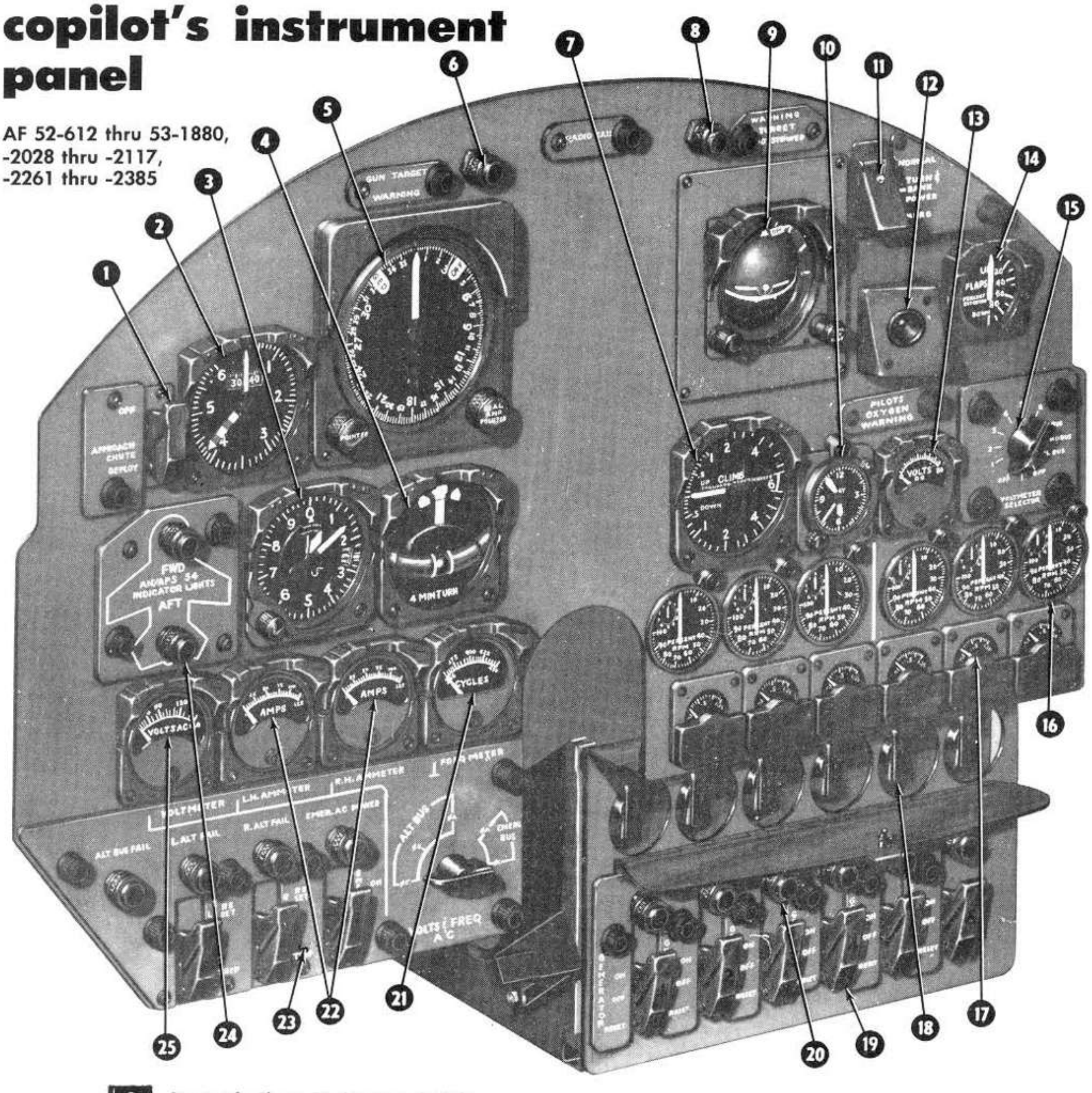
Figure 1-18.

copilot's instrument panel

AF 52-612 thru 53-1880,
-2028 thru -2117,
-2261 thru -2385



1.	Approach Chute Deployment Switch
2.	Maximum Allowable Airspeed Indicator
3.	Altimeter
4.	Turn-and-Bank Indicator
5.	Directional Gyro
6.	Gun Target Warning Light
7.	Rate-of-Climb Indicator
8.	Instrument Inverter Warning Light (1)
	Turret-Not-Stowed Warning Light (2)
9.	Attitude Indicator
10.	Clock
11.	Turn-and-Bank Power Switch
12.	Pilot's Oxygen Warning Light
13.	DC Voltmeter
14.	Wing Flap Position Indicator
15.	DC Voltmeter Selector Switch
16.	Tachometers
17.	Generator Loadmeters
18.	Generator Voltage Rheostats (3)
19.	Generator Switches
20.	Generator Field Trip Warning Lights
21.	Frequency Meter (2)
22.	AC Ammeters (2)
23.	Regulated AC Power Panel (Figure 1-27 & 1-32)
24.	Radar Warning Indicator Lights
25.	AC Voltmeter

(1) AF 52-612 thru -1416, -3343 thru -3373, 53-2261 thru -2278

(2) AF 52-1417, 53-1819 thru -1880, -2028 thru -2117, -2279 thru -2385

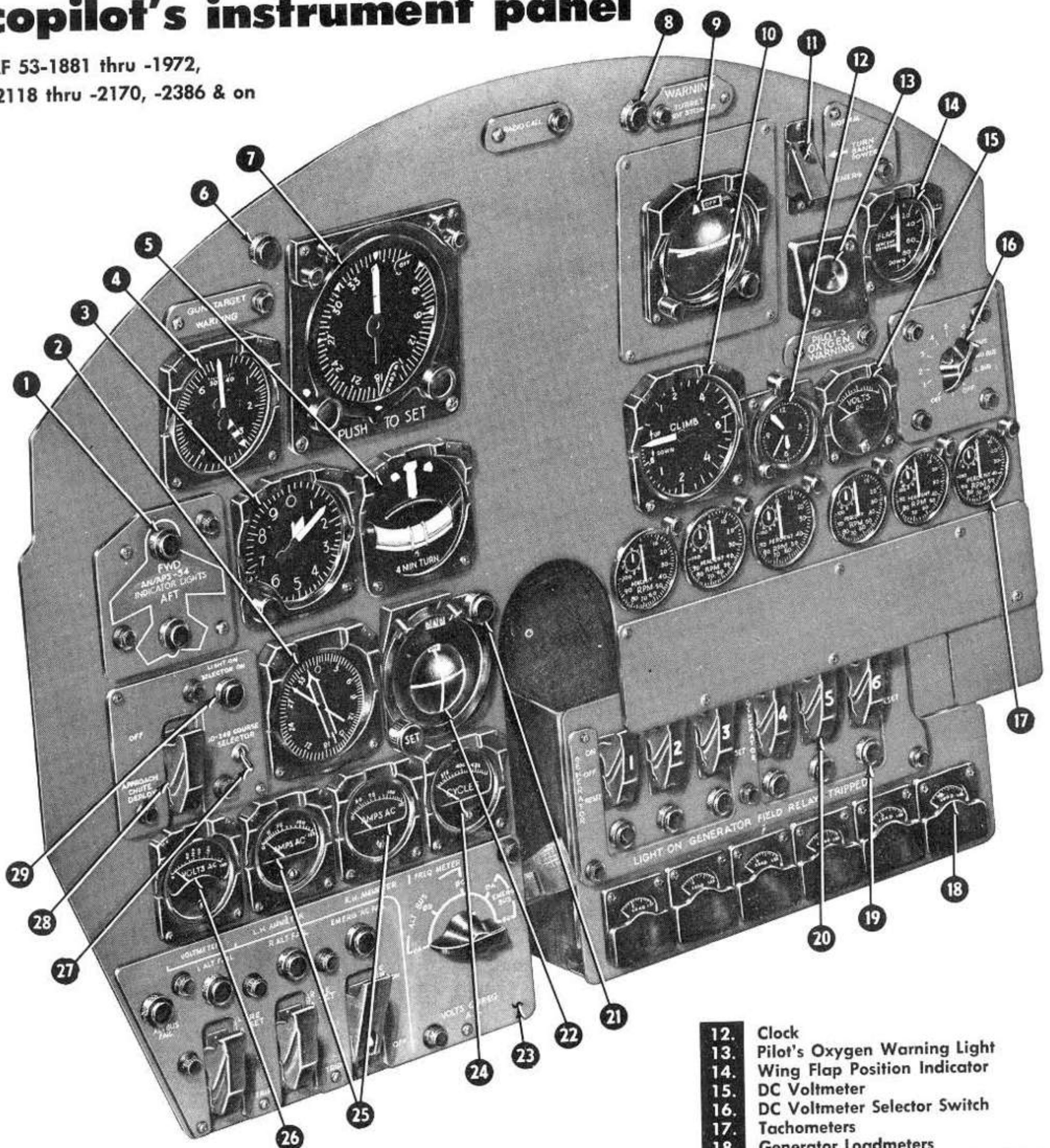
(3) AF 52-612 thru AF 53-1849, -2028 thru -2040, -2261 thru -2331 which do not have T. O. 1B-47-566 accomplished.

50154 WC-1

Figure 1-19.

copilot's instrument panel

AF 53-1881 thru -1972,
-2118 thru -2170, -2386 & on

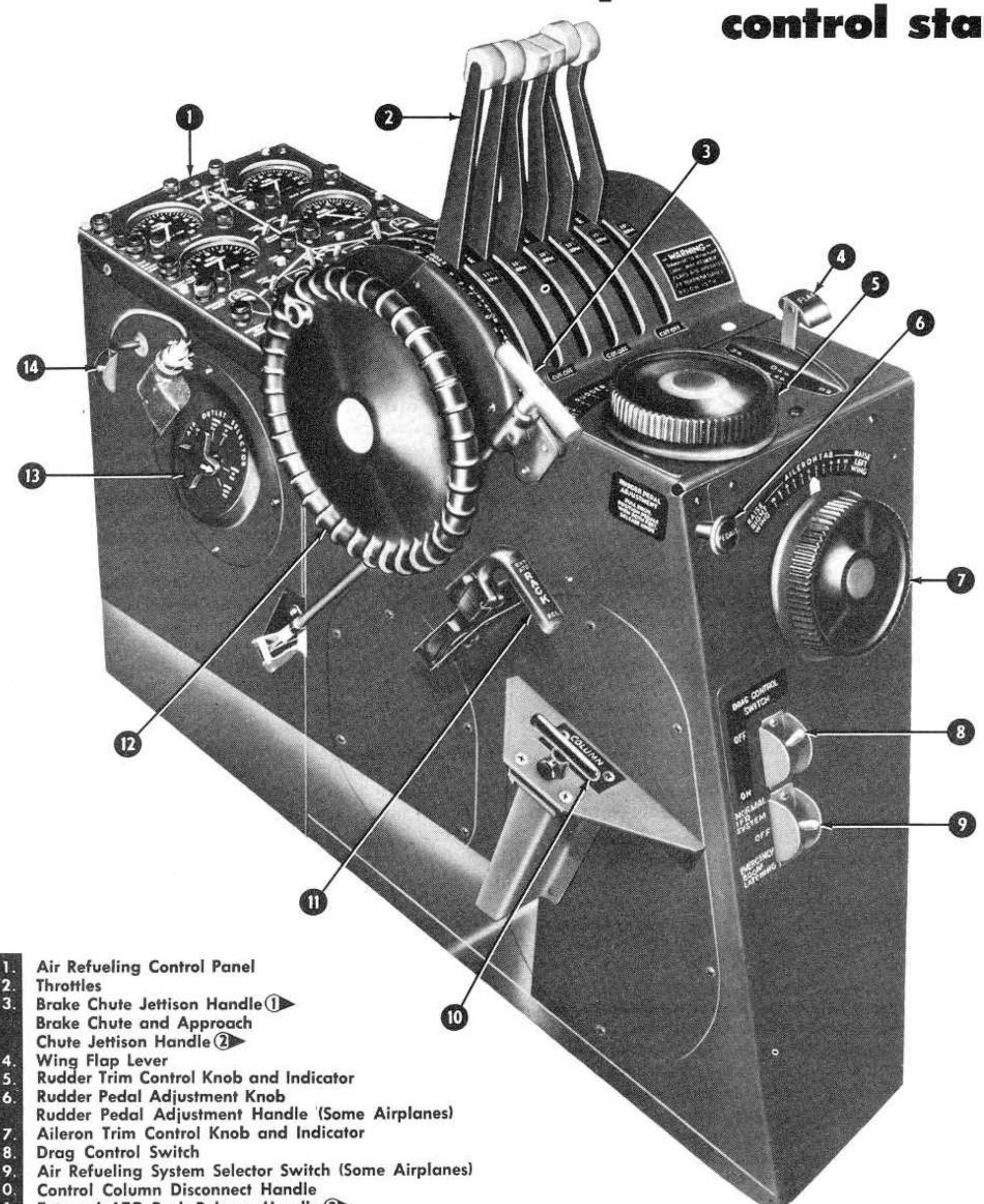


1. Radar Warning Indicator Lights
2. Radio Magnetic Course Indicator (RMI)
3. Altimeter
4. Maximum Allowable Airspeed Indicator
5. Turn-and-Bank Indicator
6. Gun Target Warning Light
7. Directional Gyro
8. Turret-Not-Stowed Warning Light
9. Attitude Indicator
10. Rate-of-Climb Indicator
11. Turn-and-Bank Power Switch
12. Clock
13. Pilot's Oxygen Warning Light
14. Wing Flap Position Indicator
15. DC Voltmeter
16. DC Voltmeter Selector Switch
17. Tachometers
18. Generator Loadmeters
19. Generator Field Trip Warning Lights
20. Generator Switches
21. Marker Beacon Indicator Light
22. ID-249 Course Indicator
23. Regulated AC Power Panel
24. Frequency Meter
25. AC Ammeters
26. AC Voltmeter
27. ID-249 Course Selector Switch
28. Approach Chute Deployment Switch
29. ID-249 Course Selector Indicator Light

50166WC-1

Figure 1-19A.

copilot's control stand



1. Air Refueling Control Panel
2. Throttles
3. Brake Chute Jettison Handle ①▶
   Brake Chute and Approach Chute Jettison Handle ②▶
4. Wing Flap Lever
5. Rudder Trim Control Knob and Indicator
6. Rudder Pedal Adjustment Knob
   Rudder Pedal Adjustment Handle (Some Airplanes)
7. Aileron Trim Control Knob and Indicator
8. Drag Control Switch
9. Air Refueling System Selector Switch (Some Airplanes)
10. Control Column Disconnect Handle
11. External ATO Rack Release Handle ③▶
12. Elevator Trim Control Wheel and Indicator
13. Air Outlet Selector Knob
14. Air Refueling System Selector Switch (Some Airplanes)

①▶ AF 51-2357 thru 52-070, -202 thru -247
②▶ AF 51-2192 thru -2346, 52-071 thru -201, -248 & on
③▶ AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

50126WB

Figure 1-20.

stowed down position, is located on the left side of the copilot's control stand. Pulling the handle up the full travel of approximately 9 inches will mechanically release the external ATO rack and allow it to fall free of the airplane.

EXTERNAL ATO SYSTEM INDICATORS

ATO-READY INDICATOR LIGHT. A green indicator light (2, figure 1-12) on the ATO control panel, when illuminated, indicates that the two pull-out plugs are connected and the ATO electrical control circuits are ready to be fired provided the ATO arm switch is in ARM position. The light will not illuminate if only one pull-out plug is installed. The light will go out when the external rack is jettisoned.

OIL SYSTEM

Each engine is provided with an independent oil system, including an oil tank and two engine-driven oil pumps. Each tank is located in the wing panel adjacent to each engine. On some airplanes each tank has a capacity of 9.4 US gallons and an additional expansion space of 4.6 US gallons while on other airplanes the tank capacity is 8.75 US gallons and the expansion space is 5.25 US gallons. A combination pressure and scavenge pump geared to the accessory section supplies clean oil at the proper lubricating temperature through jet nozzles to all bearings and to the accessory section gears. An additional scavenge pump located in the midframe section is provided to return the oil from the aft bearing sumps to the oil tank. The oil pressure pump also supplies oil to the fuel regulator from which variable control oil is supplied to operate the fuel control valve. For system operating pressures, see figure 5-1. The return oil from the aft sump scavenge pump is cooled by passage through a heat exchanger where heat from the oil is transferred to the fuel passing to the fuel flow divider. For oil specification and grade, see figure 1-54.

OIL SYSTEM CONTROLS

FIRE SHUTOFF SWITCH

An oil system fire shutoff valve is energized to its closed position when the fire shutoff switch (19, figure 1-8 and 14, figure 1-9) on the pilot's instrument panel is pulled for the desired engine to be shut down. The valve is energized to its open position when the fire shutoff switch is reset regardless of throttle position.

FUEL SYSTEM

The fuel system supplies fuel to the engines from three main tanks in the fuselage, three auxiliary tanks in the fuselage, and two external drop tanks which may be attached to the wing between the nacelles. Each main tank is of self-sealing construction and normally supplies two engines. The forward main tank furnishes fuel for engines No. 1 and 6, the center main tank for engines No. 2 and 5, and aft main tank for engines No. 3 and 4. However, an engine manifold system allows the pilot to direct fuel from any main tank to any or all engines. Check valves prevent reverse flow (from engine manifold to main tanks), thereby precluding fuel transfer between main tanks. The auxiliary tanks in the fuselage are as follows: forward auxiliary tank, bomb bay tank, and aft auxiliary (ATO) tank. The external wing tanks are used as an alternate configuration when additional fuel is required for a particular mission. Auxiliary fuel may be used by the engines directly from the auxiliary tanks except that on some airplanes* the forward auxiliary tank transfers directly to the forward and center main tanks. The refueling manifold is connected to the engine manifold by an inter-manifold line thus allowing the auxiliary fuel to flow directly to the engines (figure 1-24). The boost pumps in the auxiliary tanks are of higher capacity than the boost pumps in the main tanks thus allowing an override condition when fuel is being used by the engines direct from the auxiliary tanks with the exception of the forward auxiliary tank on some airplanes* which transfers directly to the forward and center main tanks. Fuel from the auxiliary tanks may also be transferred to any or all main tanks through the refueling manifold except that on some airplanes* the forward auxiliary tank transfers directly to the forward and center main tanks. Fuel cannot be transferred to any auxiliary tank. High-level float switches in each main tank prevent overfilling during fuel transfer operations by closing the DC operated transfer-refueling valves. On some airplanes* the high-level float switches on center and forward main tanks also turn off the boost pumps in the forward auxiliary tank.

(1)
The high-level float switch of the forward auxiliary tank is designed to turn on the refueling manifold scavenge pump when fuel is below the full level of the float switch provided the master refuel switch is in NORMAL position, auxiliary fuel-to-engines switch is in CLOSE position, and there is fuel in the refueling manifold.

(2)
The low-level float switch of the forward auxiliary tank turns on the refueling manifold scavenge pump as soon as the tank is empty provided the master refuel switch is in NORMAL position and there is fuel in the refueling manifold.

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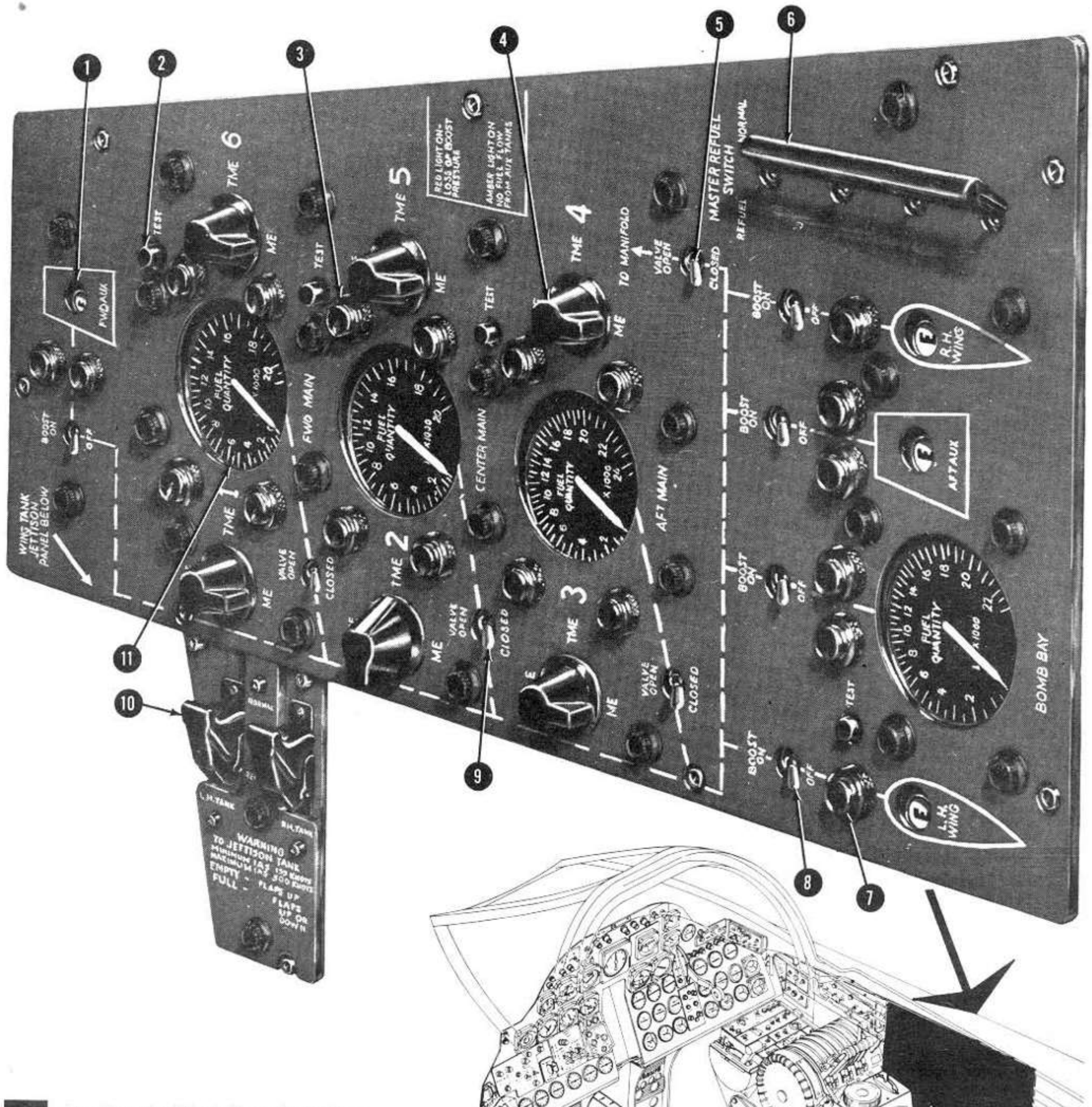
* AF 51-2357 thru 52-564
(1) AF 51-2357 thru 52-182, -202 thru -378, -394 thru -564
(2) AF 52-565 thru -611



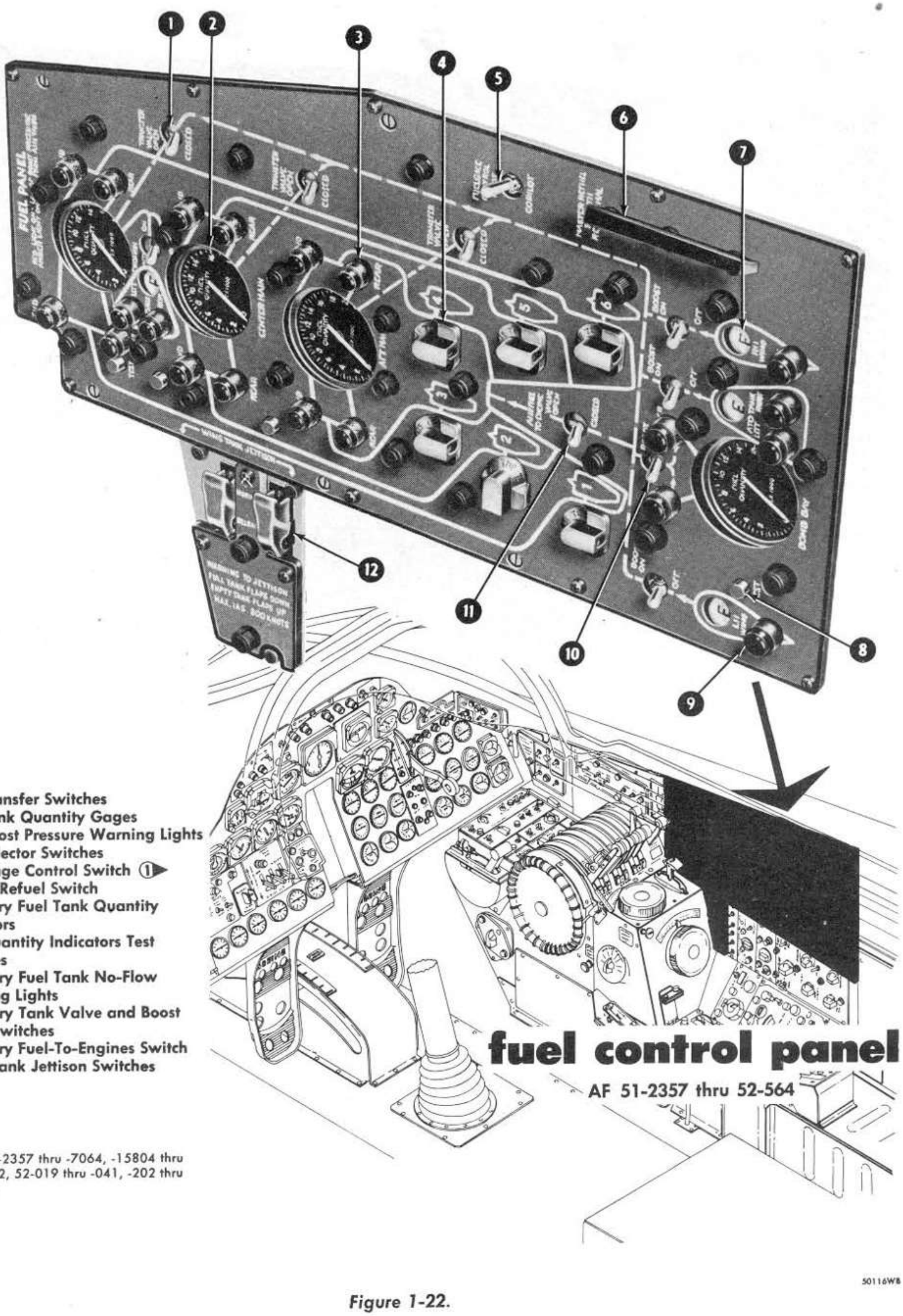
1. Auxiliary Fuel Tank Quantity Indicators
2. Fuel Quantity Indicator Test Switches
3. Fuel Boost Pressure Warning Lights
4. Fuel Selector Switches
5. Auxiliary Fuel-To-Engines Switch
6. Master Refuel Switch
7. Auxiliary Fuel Tank No-Flow Warning Lights
8. Auxiliary Tank Valve and Boost Pump Switches
9. Fuel Transfer Switches
10. Wing Tank Jettison Switches
11. Fuel Tank Quantity Gages

fuel control panel

AF 51-2192 thru -2356

50158WB

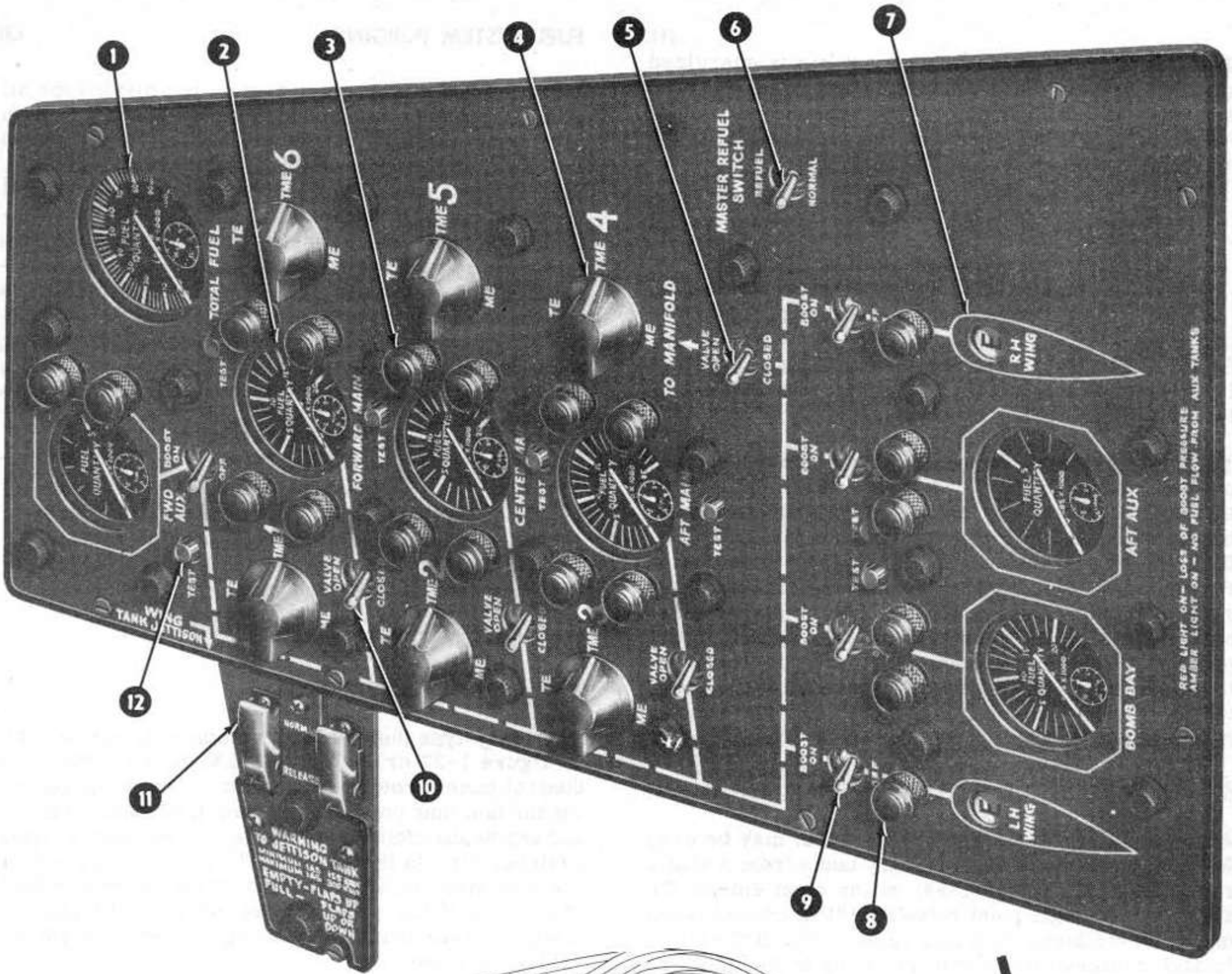
Figure 1-21.

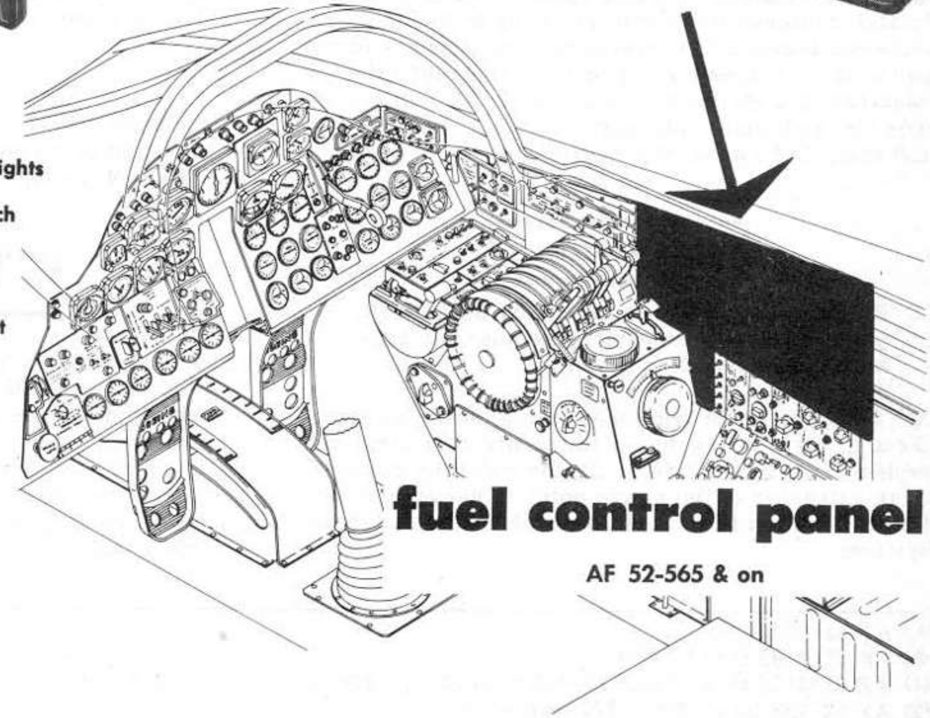


1. Fuel Transfer Switches
2. Fuel Tank Quantity Gages
3. Fuel Boost Pressure Warning Lights
4. Fuel Selector Switches
5. Fuel Gage Control Switch ①▶
6. Master Refuel Switch
7. Auxiliary Fuel Tank Quantity Indicators
8. Fuel Quantity Indicators Test Switches
9. Auxiliary Fuel Tank No-Flow Warning Lights
10. Auxiliary Tank Valve and Boost Pump Switches
11. Auxiliary Fuel-To-Engines Switch
12. Wing Tank Jettison Switches

①▶AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235.

Figure 1-22.





1. Fuel Totalizer Gage
2. Fuel Tank Quantity Gages
3. Fuel Boost Pressure Warning Lights
4. Fuel Selector Switches
5. Auxiliary-Fuel-To-Engines Switch
6. Master Refuel Switch
7. Wing Tank Quantity Indicators
8. Auxiliary Fuel Tank No-Flow Warning Lights
9. Auxiliary Tank Valve and Boost Pump Switches
10. Fuel Transfer Switches
11. Wing Tank Jettison Switches
12. Fuel Quantity Indicator Test Switches

fuel control panel

AF 52-565 & on

50153WB

Figure 1-23.

(1)
The refueling manifold scavenge pump is energized when all auxiliary tank valve and boost pump switches are in the OFF position provided the master refuel switch is in NORMAL position and there is fuel in the refueling manifold.

NOTE (2)

The position of the forward auxiliary tank valve and boost pump switch has no effect on operation of the refueling manifold scavenge pump.

On all airplanes the scavenge pump is turned off by a float switch in the refueling manifold when there is no fuel in the manifold.

The fuel system is controlled from the pilot's fuel control panel (figure 1-21, 1-22 and 1-23). The gages and indicators for the tanks, warning lights for the boost pumps, and fuel selector switches for controlling fuel flow are on this panel. Each gage or indicator represents a fuel tank except for the fuel totalizer gage* (1, figure 1-23) which indicates total fuel in fuselage tanks, each warning light represents a boost pump and, on some airplanes**, each position of the fuel selector switches indicates through which lines fuel is flowing. Refer to section VII for fuel system management.

SINGLE POINT REFUELING (SPR) AND AIR REFUELING

A single point ground refueling system may be used for filling both main and auxiliary tanks from a single receptacle (31, figure 1-54) on the right side of the airplane. A single point refueling (SPR) control panel must be used during SPR operations. The SPR system is also designed to permit defueling of the airplane either by means of an external pumping source or by use of the airplane boost pumps. When defueling is required in a minimum amount of time, both means may be used simultaneously. For fuel specification and grade to be used, see figure 1-54.

CAUTION

Extreme care must be exercised because DC power must be on the airplane when using the single point refueling system.

Air refueling is accomplished with a tanker airplane through a refueling boom to the air refueling receptacle (17, figure 1-54). The air refueling manifold is an extension of the single point refueling system. Refer to section IV for additional information on these systems.

FUEL SYSTEM PURGING (3)

A dry ice fuel tank purging system is provided for all tanks except the external wing tanks. The fuel system purging arrangement consists of 10 electrically heated gas-tight sublimation containers for crushed dry ice. Nine of these containers are located in the aft wheel well and one is in the forward wheel well. The containers automatically discharge CO_2 gas to any fuel tanks from which fuel is being pumped for engine operation and to the air refueling and SPR manifolds when these systems are being scavenged. The external wing tanks are not purged. Control of the purging arrangement is entirely automatic. The containers should be serviced with crushed dry ice within 3 hours prior to flight.

CAUTION

The containers are filled with dry ice only under combat conditions. To prevent excessive operation of the system the circuit breakers are pulled at all other times.

FUEL SYSTEM CONTROLS

FUEL SELECTOR SWITCHES

Six rotary-type fuel selector switches (4, figure 1-21, 4, figure 1-22 or 4, figure 1-23) on the pilot's fuel control panel provide a means of electrically operaing the fuel tank boost pumps, fuel tank shutoff valves, and engine manifold shutoff valves. Operation of these switches directs the supply of fuel to any engine from the corresponding main tank and/or the engine manifold. Positions of the switches are TE (tank-to-engine), TME (tank-to-manifold and engine), and ME (manifold-to-engine).

NOTE

Selection of TME and ME positions from TE position is accomplished by the clockwise rotation of the fuel selector switches.

CAUTION (4)

In airplanes which do not have T.O. 1B-47-483 accomplished all of the fuel selector switches should never be placed in the ME position simultaneously during engine operation when using fuel from the main tanks because the tank valves would be closed and the engine manifold would not be pressurized. As a result all engines would fail due to fuel starvation.

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* AF 52-565 & on
** AF 51-2192 thru 52-564
(1) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on
(2) AF 52-183 thru -201, -379 thru -393
(3) AF 51-2192 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
(4) AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2278

When the switches are in TE position, the DC operated fuel tank valves will be opened and the DC operated boost pumps energized as soon as throttles are advanced out of CUTOFF. In TME position the fuel tank valves are opened, the boost pumps energized, and the engine manifold shutoff valves opened regardless of throttle position. In ME position the engine manifold shutoff valves are opened and on some airplanes* the fuel tank valves are opened regardless of throttle position. DC power is supplied to the fuel selector switches through circuit breakers on the upper DC power panel.

AUXILIARY TANK VALVE AND BOOST PUMP SWITCHES

Five BOOST ON--OFF auxiliary tank valve and boost pump switches (8, figure 1-21; 10, figure 1-22; and 9, figure 1-23) are on the pilot's fuel control panel. BOOST ON position energizes the boost pumps in the affected auxiliary tank and opens the auxiliary tank shutoff valves provided the master refuel switch is in NORMAL position. OFF position deenergizes the boost pumps and closes the auxiliary tank shutoff valves. The external drop tanks have only one boost pump and one tank shutoff valve. Circuit breakers for control circuits of the auxiliary tank valve and boost pump switches are located on the upper DC power panel.

FUEL TRANSFER SWITCHES

Fuel transfer into the main fuel tanks from the refueling manifold is DC controlled by three VALVE OPEN --CLOSED fuel transfer switches (9, figure 1-21; 1, figure 1-22; and 10, figure 1-23) on the pilot's fuel control panel. In VALVE OPEN position, the transfer-refueling valve between each main tank and the refueling manifold is electrically actuated to the open position. High-level float switches in each main tank override the fuel transfer switches to prevent overfilling the tanks. When the fuel transfer switches are in CLOSED position, the motor-driven valves are closed. The transfer-refueling valves are also controlled by the refueling valve switches on the copilot's air refueling panel and the fuel transfer switches are deenergized when the master refuel switch is placed in REFUEL position. Circuit breakers for the fuel transfer switches are located on the upper DC power panel.

AUXILIARY-FUEL-TO-ENGINES SWITCH

A two-position VALVE OPEN--CLOSED auxiliary-fuel-to-engines switch (5, figure 1-21; 11, figure 1-22; and 5, figure 1-23) located on the pilot's fuel control panel controls auxiliary fuel flow to the engine manifold. VALVE OPEN position opens a shutoff valve allowing fuel to flow directly from the bomb bay tank, external drop tanks, aft auxiliary (ATO) tank and on some airplanes** the forward auxiliary tank into the engine manifold. In VALVE OPEN position and the master refuel switch in REFUEL position, the auxiliary-fuel-to-engines switch is deenergized and the shutoff valve is closed, thus preventing high fuel pressures from entering the engine manifold during air refueling. Should the shutoff valve be already closed at the time the master refuel switch is placed in REFUEL position, the shutoff valve is deenergized and cannot be opened until the master refuel switch is placed in NORMAL position. The shutoff valve is then controlled by the auxiliary-fuel-to-engines switch. In CLOSED position, the shutoff valve is closed preventing auxiliary fuel from being directed into the engine manifold. DC power is supplied to the auxiliary-fuel-to-engines switch through a circuit breaker on the upper DC power panel.

MASTER REFUEL SWITCH

The master refuel switch (6, figure 1-21; 6, figure 1-22 and 6, figure 1-23) on the pilot's fuel control panel has REFUEL--NORMAL positions. For air refueling operations this switch is placed in REFUEL position to energize the refueling valve switches on the copilot's air refueling panel. REFUEL position also deenergizes the auxiliary tank boost pumps, deenergizes the auxiliary-fuel-to-engines switch and closes the auxiliary-fuel-to-engines shutoff valve thus preventing high fuel pressures from entering the engine manifold during air refueling. NORMAL position deenergizes the refueling valve switches on the copilot's air refueling panel and power is again supplied to the auxiliary tank boost pumps and auxiliary-fuel-to-engines switch. NORMAL position permits fuel from auxiliary tanks to be transferred to the main tanks or used directly by the engines by means of switches on the pilot's fuel control panel. DC power is supplied to the master refuel switch through a circuit breaker on the upper DC power panel.

(1)
In addition to the functions described above, REFUEL position of the master refuel switch energizes the fuel quantity gages, fuel totalizer gage***, and panel lights on the copilot's air refueling panel, enabling only the copilot to read fuel quantities. NORMAL position

(1) AF 51-2192 thru -2356, -7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on

* Airplanes having T.O. 1B-47-483 accomplished and AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on

** AF 51-2192 thru -2356, 52-565 & on

*** AF 52-565 & on

fuel supply system

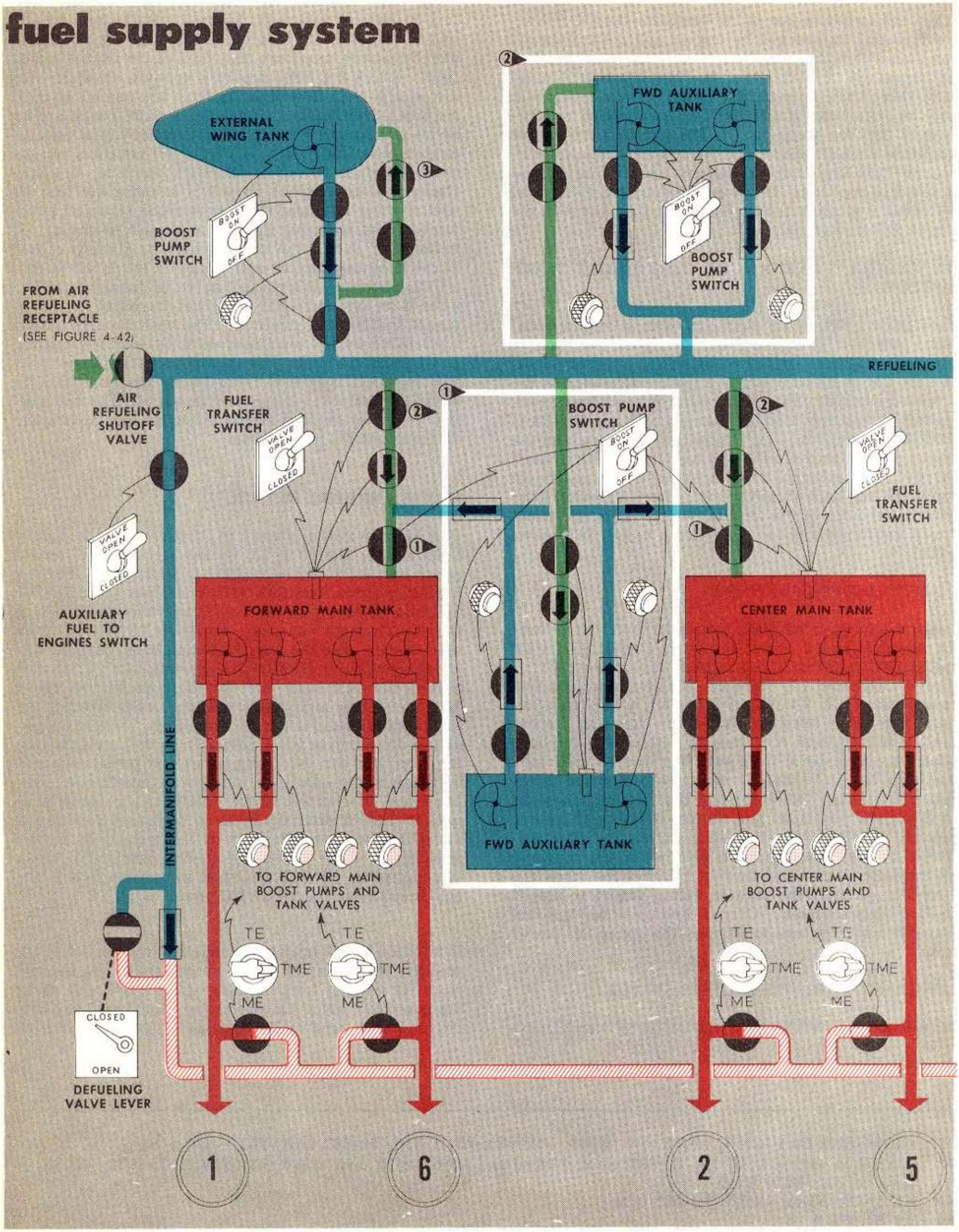
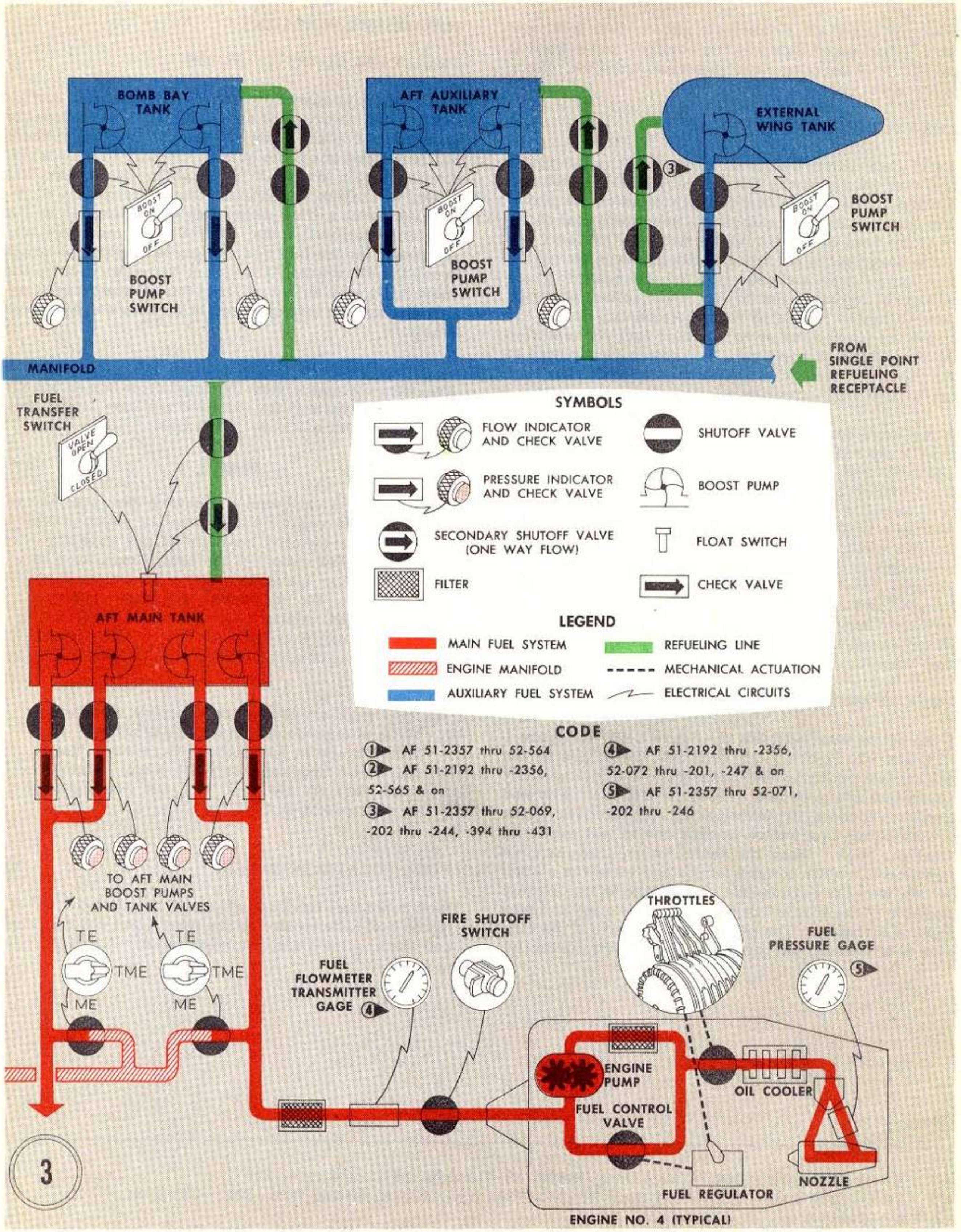


Figure 1-24.


BOMB BAY TANK
AFT AUXILIARY TANK
EXTERNAL WING TANK
BOOST PUMP SWITCH
BOOST PUMP SWITCH
BOOST PUMP SWITCH
MANIFOLD
FROM SINGLE POINT REFUELING RECEPTACLE
FUEL TRANSFER SWITCH
VALVE OPEN
CLOSED
SYMBOLS
FLOW INDICATOR AND CHECK VALVE
SHUTOFF VALVE
PRESSURE INDICATOR AND CHECK VALVE
BOOST PUMP
SECONDARY SHUTOFF VALVE (ONE WAY FLOW)
FLOAT SWITCH
FILTER
CHECK VALVE
LEGEND
MAIN FUEL SYSTEM
REFUELING LINE
ENGINE MANIFOLD
MECHANICAL ACTUATION
AUXILIARY FUEL SYSTEM
ELECTRICAL CIRCUITS
AFT MAIN TANK
CODE
1 AF 51-2357 thru 52-564
2 AF 51-2192 thru -2356, 52-565 & on
3 AF 51-2357 thru 52-069, -202 thru -244, -394 thru -431
4 AF 51-2192 thru -2356, 52-072 thru -201, -247 & on
5 AF 51-2357 thru 52-071, -202 thru -246
TO AFT MAIN BOOST PUMPS AND TANK VALVES
TE
TME
ME
TE
TME
ME
FIRE SHUTOFF SWITCH
FUEL FLOWMETER TRANSMITTER GAGE 4
THROTTLES
FUEL PRESSURE GAGE 5
ENGINE PUMP
FUEL CONTROL VALVE
OIL COOLER
NOZZLE
FUEL REGULATOR
ENGINE NO. 4 (TYPICAL)
3

50106WC

deenergizes the fuel quantity gages, fuel totalizer gage*, and panel lights on the copilot's air refueling panel. Fuel quantities are then read from the pilot's fuel control panel.

FUEL GAGE CONTROL SWITCH (1)

A fuel gage control switch (5, figure 1-22) on the pilot's fuel control panel has PILOT--COPILOT positions. In PILOT position the fuel quantity gages on the pilot's fuel control panel are energized, permitting fuel quantity to be read only at the pilot's station. COPILOT position deenergizes the fuel quantity gages on the pilot's fuel control panel and energizes the fuel quantity gages and panel lights on the copilot's air refueling panel, permitting the copilot to read fuel quantity during air refueling operations or to compute fuel consumption during cruise at any time. DC power is supplied to the fuel gage control switch through a circuit breaker on the upper DC power panel.

(2)

A fuel gage control switch (8, figure 4-41) on the copilot's air refueling panel has NORMAL--COPILOT positions and is spring-loaded to NORMAL position. This switch provides the copilot with control of the fuel quantity gages when the pilot's master refuel switch is in NORMAL position. Holding the fuel gage control switch in the momentary COPILOT position deenergizes the fuel quantity gages on the pilot's fuel control panel plus fuel totalizer gage on some airplanes* and energizes the fuel quantity gages, fuel totalizer gage*, and panel lights on the copilot's air refueling panel. Releasing the switch to NORMAL position transfers control of the gages back to the pilot.

FUEL QUANTITY GAGE TEST SWITCHES

Push button test switches (2, figure 1-21; 8, figure 1-22; and 12, figure 1-23) marked "Test" are on the pilot's fuel control panel adjacent to the fuel quantity gages and are provided to test circuit continuity and gages. On some airplanes having fuel totalizer gages a push button test switch is provided to test each fuel totalizer gage. When the switch is pressed the gage needle will rotate toward empty and when the switch is released the gage needle will return to its original position if the circuit is intact and the gage is functioning correctly. The needle will not move if the circuit is broken and the gage is not functioning correctly.

FUEL SYSTEM INDICATORS

FUEL TANK QUANTITY GAGES

Electronic fuel quantity gages (11, figure 1-21; 2, figure 1-22; 2, figure 1-23 and 2, figure 4-41) are on the pilot's fuel control panel and the copilot's air refueling panel and show the quantity of fuel in pounds for the three main tanks and the bomb bay tank. The fuel quantity readings are obtained from only one set of instruments at a time depending upon position of the master refuel switch and/or fuel gage control switch. AC power for the fuel quantity gages is supplied either from the regulated AC system through fuses in the main AC power shield or from the constant-speed alternator system through fuses in the forward AC power shield.

(3)

Fuel quantity gages show the quantity of fuel in pounds for the three main tanks, forward auxiliary tank, bomb bay tank and aft auxiliary (ATO) tank.

NOTE (3)(4)

- There is an allowable tolerance between the pilot's and copilot's fuel quantity gages of 2% of highest quantity number of the gages involved. For example, the center main tank is marked for quantities up to 20,000 pounds; therefore, the allowable tolerance between pilot's and copilot's center main tank fuel quantity gages is 2% of 20,000 or 400 pounds, regardless of quantity indicated by the needle.

- Fuel gage error may be expected when using 100% of high octane gasoline (115/145). At a temperature of 38° C (100° F), the fuel gages will read approximately 5% high. With the same fuel at -18° C (0° F), the reading will be approximately 2.5% high.

FUEL TOTALIZER GAGES (3)

Electronic fuel totalizer gages (1, figure 1-23 and 17, figure 4-41) are located on the pilot's fuel control panel and the copilot's air refueling panel. The totalizer

(1) AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235
(2) AF 51-2192 thru -2356, -7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on
(3) * AF 52-565 & on
(4) AF 51-2192 thru 52-564

fuel quantity data (u.s. gal.)

For airplanes No. AF51-2357 thru 52-157, -202 thru -311
DATE: 15 AUGUST 1952
DATA BASIS: GROUND TEST

TANKS	NO.	USABLE FUEL (LEVEL FLIGHT ATTITUDE)	FULLY SERVICED (TAXI ATTITUDE)	EXPANSION SPACE	TOTAL VOLUME
FORWARD MAIN	1	2930	2954	76	3030
FORWARD AUXILIARY	1	990	990	70	1060
CENTER MAIN	1	2810	2874	126	3000
ATO	1	510	558	17	575
BOMB BAY	1	3230	3258	132	3390
AFT MAIN	1	3430	3445	105	3550
EXTERNAL WING	2	3390	3400	172	3572

USABLE FUEL TOTALS (LEVEL FLIGHT ATTITUDE)

MAIN TANKS 9170
MAIN TANKS AND FORWARD AUXILIARY TANK 10,160
MAIN TANKS, FORWARD AUXILIARY TANK AND ATO TANK 10,670
MAIN TANKS, FORWARD AUXILIARY TANK, ATO TANK AND BOMB BAY TANK 13,900
MAIN TANKS AND ALL AUXILIARY TANKS 17,290

For airplanes No. AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
DATE: 24 AUGUST 1953
DATA BASIS: GROUND TEST

TANKS	NO.	USABLE FUEL (LEVEL FLIGHT ATTITUDE)	FULLY SERVICED (TAXI ATTITUDE)	EXPANSION SPACE	TOTAL VOLUME
FORWARD MAIN	1	2930	2954	76	3030
FORWARD AUXILIARY	1	990	990	70	1060
CENTER MAIN	1	2810	2874	126	3000
AFT AUXILIARY (ATO)	1	1220	1260	40	1300
BOMB BAY	1	3230	3258	132	3390
AFT MAIN	1	3430	3445	105	3550
EXTERNAL WING	2	3390	3400	172	3572

USABLE FUEL TOTALS (LEVEL FLIGHT ATTITUDE)

MAIN TANKS 9170
MAIN TANKS AND FORWARD AUXILIARY TANK 10,160
MAIN TANKS, FORWARD AND AFT (ATO) AUXILIARY TANKS 11,380
MAIN TANKS, FORWARD AND AFT (ATO) AUXILIARY TANKS, AND BOMB BAY TANK 14,610
MAIN TANKS AND ALL AUXILIARY TANKS 18,000

NOTE

DUE TO MANUFACTURING TOLERANCES OF FUEL TANKS A VARIATION OF ±1.5% MAY EXIST IN INDIVIDUAL TANK CAPACITIES. CONSEQUENTLY THE QUOTED CAPACITIES ARE REPRESENTATIVE ONLY AND SHOULD NOT BE USED AS EXACT VALUES FOR ANY PARTICULAR AIRPLANE.

REMARKS:
LEVEL FLIGHT ATTITUDE — TOP OF FUSELAGE 2° 30' NOSE UP
TAXI ATTITUDE — TOP OF FUSELAGE 5° 15' NOSE UP
"EXPANSION SPACE" AND "TOTAL VOLUME" VALUES ARE CALCULATED

NOTE:
TANKS SERVICED INDIVIDUALLY. IF SINGLE POINT REFUELING IS USED, FUEL QUANTITIES WILL BE APPROXIMATELY THE SAME.

Figure 1-25.

gages show in pounds the total fuel contained in the three main tanks, forward auxiliary tank, bomb bay tank, and aft auxiliary (ATO) tank. The fuel totalizer reading is obtained from only one panel at a time, depending upon position of the master refuel switch or the fuel gage control switch. AC power for the fuel totalizer gages is supplied either from the regulated AC system through a fuse in the main AC power shield or from the constant-speed alternator system through a fuse in the forward AC power shield.

NOTE

- There is an allowable tolerance of 2060 pounds between the pilot's and copilot's fuel totalizer gages regardless of quantity indicated by the needle. (1)
- There is an allowable tolerance of 1030 pounds between the fuel totalizer gage reading and the sum of all individual fuel quantity gage readings.

(1) AF 52-565 thru 53-1849, -2028 thru -2040, -2261 thru -2292, -2294 thru -2331

FUEL BOOST PRESSURE WARNING LIGHTS

Twelve red fuel boost pressure warning lights (3, figure 1-22 and 3, figure 1-23), one for each main fuel tank boost pump, are on the pilot's fuel control panel. The lights will illuminate whenever a low fuel pressure exists in the line. The fuel boost warning lights are energized as soon as DC power is on the airplane. Power is supplied to the warning lights through six circuit breakers on the upper DC power panel.

AUXILIARY FUEL TANK QUANTITY INDICATORS (1)

Four DC operated tab-window type indicators (1, figure 1-21; 7, figure 1-22) on pilot's fuel control panel show by interchangeable tabs the condition of fuel quantity in the forward auxiliary, aft auxiliary (ATO), and external wing tanks. A full tank is indicated by an "F" tab, an empty tank by an "E" tab, and all intermediate quantities by a divided black and white circle tab. The indicating circuits are energized when DC power is on the airplane. Power is supplied to the indicators through a circuit breaker on the upper DC power panel.

WING TANK QUANTITY INDICATORS (2)

Two DC operated tab-window type indicators (7, figure 1-23) on the pilot's fuel control panel show by interchangeable tabs the condition of fuel quantity in the external wing tanks. A full tank is indicated by an "F" tab, an empty tank by an "E" tab, and all intermediate quantities by a divided black and white circle tab. The indicating circuits are energized when DC power is on the airplane. Power is supplied to the indicators through a circuit breaker on the upper DC power panel.

AUXILIARY FUEL TANK NO-FLOW WARNING LIGHTS

Eight amber auxiliary fuel tank no-flow indicator lights (7, figure 1-21; 9, figure 1-22; and 8, figure 1-23), one for each auxiliary tank boost pump, are on the pilot's fuel control panel. The lights will illuminate when the corresponding boost pump is energized and no fuel is flowing in the line. Power is supplied to the warning lights through a circuit breaker on the upper DC power panel.

EXTERNAL WING TANK JETTISON SYSTEM

An external wing tank attached to each wing between the nacelles consists of a fuel system and a tank release system. The tank release system is electrically controlled by the pilot to release and eject the tank tailcone. Release of the tailcone deploys a ribbon-type drag chute. The chute pulls the wing tank aft, causing it to release and jettison. The wing tank and struts then fall free and spring-loaded cover plates rotate to close fuel line openings in the wing skin. The mounting pins retract within the wing flush with the lower wing surface after the tank falls free. On some airplanes a release solenoid releases the tank tailcone while on other airplanes two ballistic thrusters eject the tailcone. On airplanes having the thruster-type jettison system, each tank contains an outboard and an inboard thruster; in case of a malfunction of one of the thrusters the remaining thruster is capable of ejecting the tailcone.

NOTE

The release solenoid-type tanks and thruster-type tanks must not be interchanged.

EXTERNAL WING TANK JETTISON SYSTEM CONTROLS (3)

EXTERNAL WING TANK JETTISON SWITCHES. Two external wing tank jettison switches (10, figure 1-21; 12, figure 1-22; and 11, figure 1-23) on the pilot's fuel control panel are marked "LH Tank" and "RH Tank." Each wing tank jettison switch, guarded to the NORMAL position, has RELEASE--NORMAL positions. In the NORMAL position DC control power is supplied to the boost pump and transfer valves control relay of each wing tank provided the master refuel switch is in the NORMAL position and the transfer switch is in the ON position. Positioning the LH tank or RH tank jettison switch to the RELEASE position with the master refuel switch in NORMAL position energizes a release solenoid in the respective wing tank tailcone and de-energizes the boost pump and transfer valves control relay. The solenoid when energized unloads a spring-loaded cartridge which ejects the tailcone. Circuit breakers for the external wing tank jettison switches are located on the upper DC power panel.

(4)
EXTERNAL WING TANK JETTISON SWITCHES. Two three-position switches (10, figure 1-21; 12, figure 1-22; and 11, figure 1-23) on pilot's fuel control panel are marked "Normal" and "Alt." Each wing tank jettison switch is marked LH TANK and RH TANK at the two extreme positions and is spring-loaded to the center (off) position. A guard is placed over the switch to prevent inadvertent actuation. The alternate wing tank jettison switch is provided in event the normal wing tank jettison switch fails to operate. Momentarily positioning the normal or alternate wing tank jettison switch to the LH TANK or RH TANK position fires a powder charge in the inboard and outboard thrusters of the respective wing tank. On airplanes without constant speed alternators, a circuit breaker on the main

(1) AF 51-2192 thru 52-564
(2) AF 52-565 & on
(3) AF 51-2192 thru 53-1821, -2028 thru -2117, -2261 thru -2367 which do not have T.O. 1B-47-767 accomplished
(4) Airplanes which have T.O. 1B-47-767 accomplished and AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

AC power shield and one on the radar power panel supply AC power to the outboard and inboard thrusters respectively to fire the power charges. On airplanes with constant speed alternators, two circuit breakers on the radar power panel supply AC power from phase A and phase B or C to the inboard and outboard thrusters respectively to fire the powder charges.

ELECTRICAL POWER SUPPLY SYSTEMS

The airplane is provided with a direct current system (battery and generators), a regulated alternating current system (inverters) on some airplanes, an unregulated alternating current system (alternators) on some airplanes and a regulated alternators current system (alternators) on other airplanes to supply power to the various electrically operated equipment. These systems utilize circuit breakers and/or fuses for individual circuit protection, and current limiters for protection of some bus circuits. Direct current, unregulated alternating current (on some airplanes), and regulated alternating current (on other airplanes) may be connected to an external power source for ground operating through external receptacles.

DIRECT CURRENT SYSTEM

Direct current power is provided by six 28-volt 400-ampere engine-driven generators. The generators are combination starter and generator units, acting as starters to turn the rotors until combustion in the engine is self-sustaining (approximately 20% rpm) after which they function as generators. Two 12-volt batteries connected in series are provided for emergency battery starts when external power is not available and for partial voltage stabilization during normal operation. Some systems utilize battery power for emergency operation through circuit breakers in the tail compartment power shield on some airplanes or left aft power shield on other airplanes and may be operated regardless of battery switch position. These systems are: the emergency alarm bell, AN/APX-6 destructor circuit on some airplanes*, and the bomb salvo circuit which is operated by the bomb salvo switches (2, figure 1-13 and 9, figure 4-33) on the pilot's ignition switch panel and the bomb control panel at the observer's station. A circuit breaker for bomb salvo power is also located on the bomb salvo relay shield on some airplanes or on the pilot's ignition switch panel on other airplanes. Emergency power may be used for operation of the pilot and copilot turn-and-bank indicators. Direct current power distribution buses are interconnected by three parallel wires. Each wire is fused at both ends. If a short to the airplane structure occurs on a bus or distribution wire, current limiters and/or fuses will blow and clear the fault. This is known as a fail-safe system. A single ground return system supplies power from the distribution buses to the electrical units. Circuit breakers are provided for individual circuit protection. See figure 1-26 for systems using DC power and power distribution.

DC SYSTEM CONTROLS

BATTERY SWITCH. A battery switch (12, figure 1-11) located on the pilot's switch panel has LH BUS NORMAL--OFF--RH BUS positions. The LH BUS NORMAL position of the switch connects the battery to the DC distribution system through a left-hand bus and is the normal position of the switch. Placing the switch in the OFF position disconnects the battery from the left- or right-hand bus. The RH BUS position of the switch connects the battery to the DC distribution system through a right-hand bus as an alternate transfer.

DC BUS SELECTOR SWITCH. A DC bus selector switch (11, figure 1-15) adjacent to the copilot's DC power panel has SECONDARY--NORMAL--PRIMARY TEST positions, providing a manual means for con-

* AF 51-2192 thru 52-620, 53-2261 thru -2289

trolling DC power to the upper, lower, and aft DC and the radar power panels. With the switch in the NORMAL position, normal operation of the automatic transfer relay in the DC system is permitted. Should a fault occur on the forward main bus, the automatic transfer relay will transfer the DC power panels to the right main bus. The SECONDARY position of the switch connects the DC power panels to the right main bus, and serves as a manual transfer to the right main bus in the event of automatic transfer relay failure. The momentary PRIMARY TEST position connects the DC power panels to the forward main bus as a test of the automatic power transfer relay. Automatic transfer or manual transfer may be observed by a flicker of the indicator lights on the pilot's and copilot's instrument panels.

GENERATOR SWITCHES. Six generator switches (16, figure 1-18; 19, figure 1-19; and 20, figure 1-19A) are located on the copilot's instrument panel. Each switch has ON--OFF--RESET positions. The momentary RESET position of the switch resets the generator field relay to allow turning on or restoring generator operation. When the generator switch is moved to the RESET position, releasing the switch will allow it to return to OFF. Placing the switch in the ON position turns on the generator if the generator field relay is reset. Six indicator lights are provided and will illuminate if the generator field relays are tripped. Resetting will cause the lights to go out. The generator switch guards are stenciled with the number of the respective engine and generator.

(1)

GENERATOR VOLTAGE RHEOSTATS. Six generator voltage rheostats (19, figure 1-18 and 18, figure 1-19), one for each generator, are located behind a hinged cover guard on the copilot's instrument panel. The voltage rheostats are installed primarily as an aid to maintenance personnel in generator paralleling and should not be used by the copilot in an effort to equalize small differences in generator output.

NOTE

> Electrical system failures may be attributed to improper use of the generator voltage rheostats. These rheostats should only be used after the electrical system warmup period has elapsed (15 minutes minimum) and then only to adjust differences in generator loading of over 10%. The voltmeter is not accurate enough to permit small adjustments.

DC VOLTMETER SELECTOR SWITCH. A rotary-type switch (15, figure 1-18; 15, figure 1-19; and 16, figure 1-19A) on the copilot's instrument panel provides a means of obtaining DC bus voltage and generator output voltage readings on a single voltmeter. The switch has OFF--1--2--3--4--5--6--RH BUS--FWD BUS--LH BUS --OFF positions. The OFF positions of the switch disconnect the voltmeter from any source of voltage. Positions 1 through 6 connect the voltmeter to the respective DC generator outputs to give individual voltage readings. When the switch is placed in RH BUS position, the DC voltmeter is connected to measure voltage on the right-hand bus. The FWD BUS position connects the DC voltmeter to measure voltage on the forward bus. The LH BUS position connects the DC voltmeter to measure voltage on the left-hand bus.

DC SYSTEM INDICATORS

GENERATOR FIELD TRIP WARNING LIGHTS. Six generator field trip warning lights (17, figure 1-18; 20, figure 1-19; and 19, figure 1-19A) are provided on the copilot's instrument panel. A red light will illuminate, when the respective generator field relay is tripped, to indicate that the generator is no longer furnishing power to the DC system. The field relays will trip when a malfunction occurs in the system or when an engine fire shutdown is accomplished. The warning lights are protected by throttle and engine control circuit breakers in the lower DC power panel.

DC VOLTMETER. A direct current voltmeter (14, figure 1-18; 13, figure 1-19; and 15, figure 1-19A) on the copilot's instrument panel is used to indicate individual generator or bus voltages. A rotary-type selector switch adjacent to the voltmeter may be positioned to give the desired generator or bus reading on the voltmeter.

GENERATOR LOADMETERS. Six direct current loadmeters (18, figure 1-18; 17, figure 1-19; and 18, figure 1-19A) are located on the copilot's instrument panel to provide indication of DC current load of the individual generators. The loadmeter scale is calibrated in percent of the rated generator load.

REGULATED ALTERNATING CURRENT SYSTEM (2)

SINGLE PHASE INVERTER SYSTEM

Three 115-volt single-phase 400-cycle regulated alternating current inverters supply power to the main, secondary, and A-5 buses. During normal operation the main, secondary, and A-5 inverters supply power to the main, secondary, and A-5 buses respectively. Automatic transfer of secondary inverter and manual transfer of secondary and A-5 inverter are provided for emergency operation. For equipment requiring regulated alternating current, see figure 1-28. The control circuits receive power from three circuit breakers on the lower DC power panel.

NOTE

> MD-4 nomenclature is used instead of A-5 on B-47B airplanes having the MD-4 fire control system.

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(1) AF 51-2192 thru 53-1849, -2028 thru -2040, -2261 thru -2331 which do not have T.O. 1B-47-566 accomplished

(2) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

DC power generation, distribution, and control

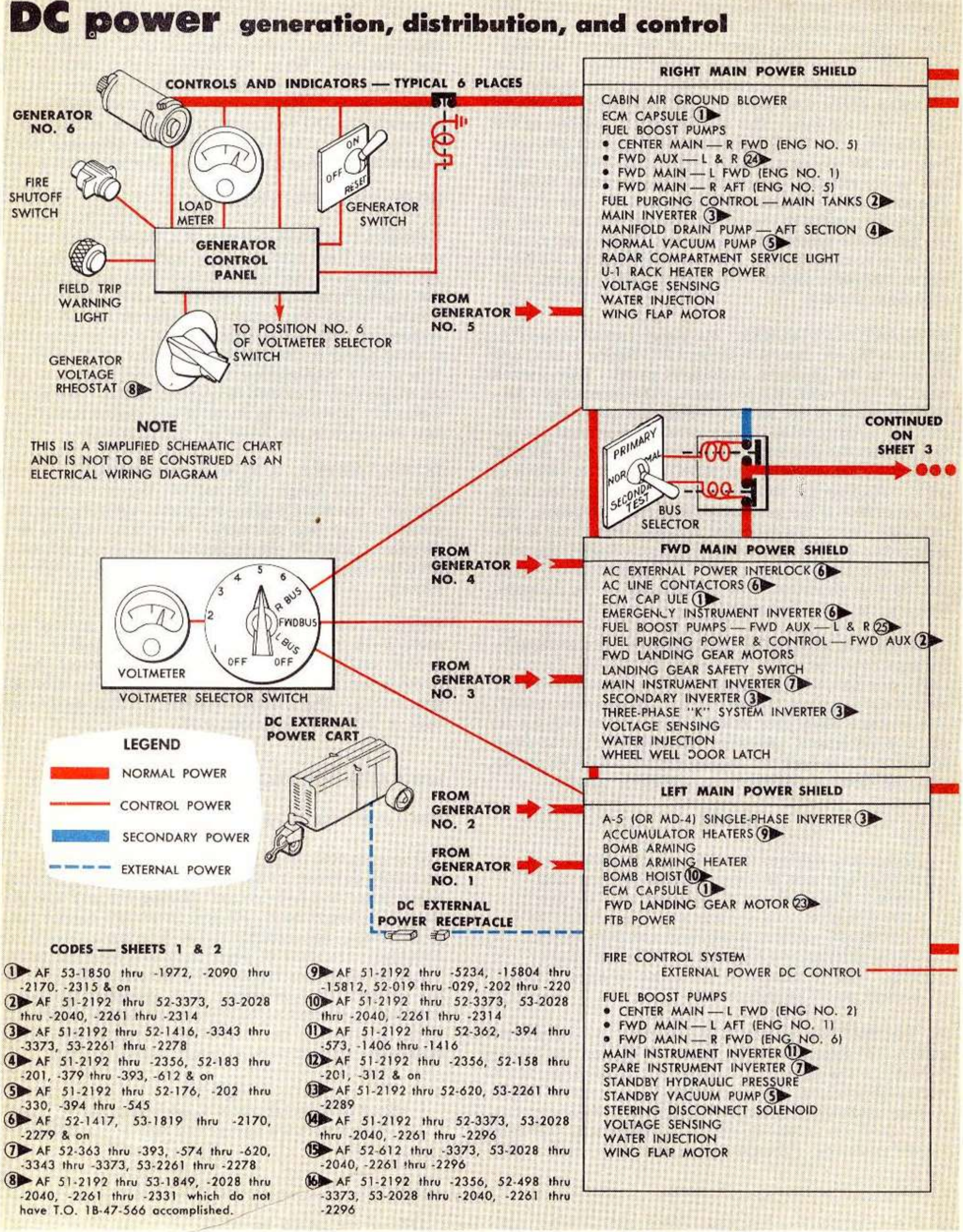


Figure 1-26. (Sheet 1 of 3 Sheets)

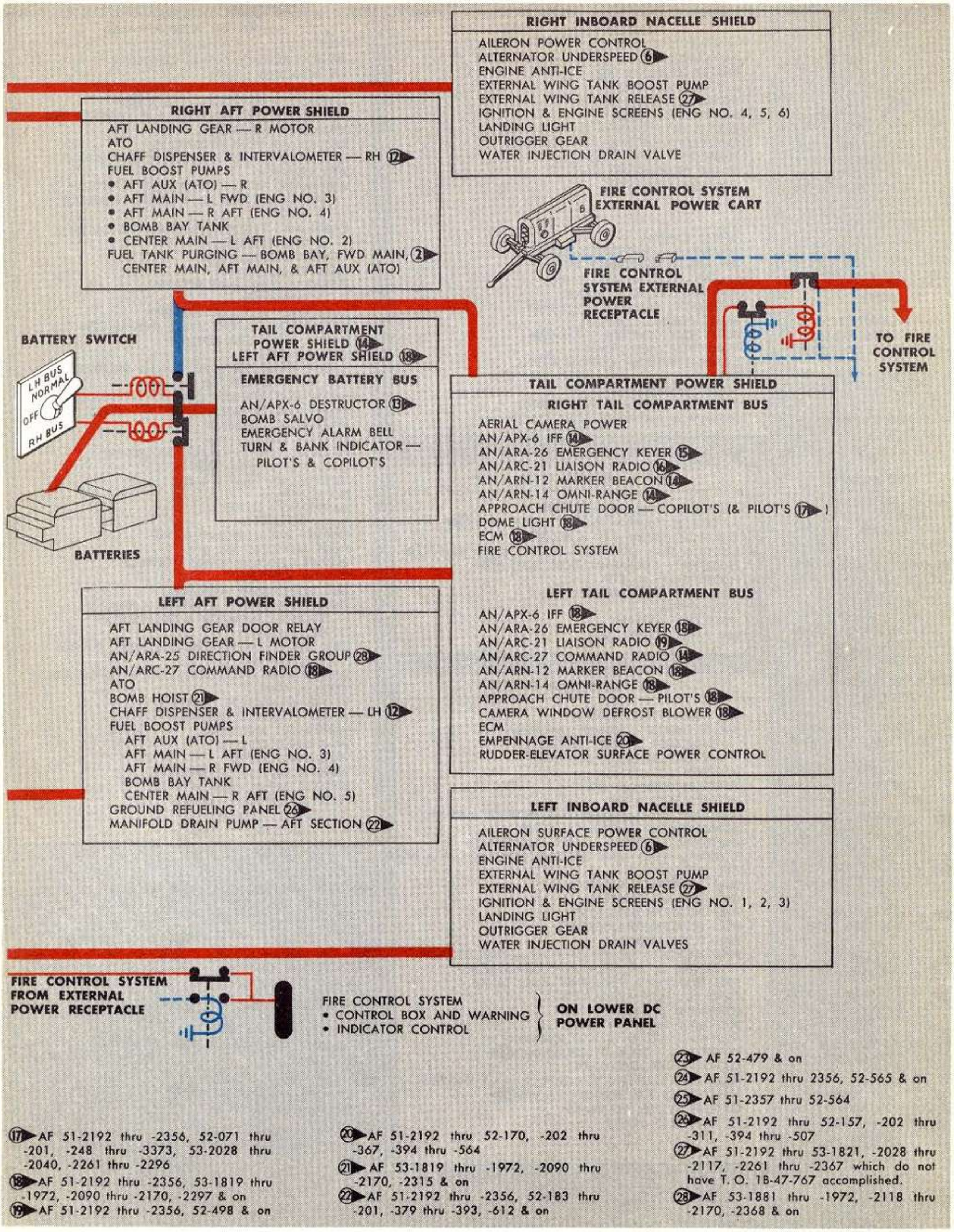
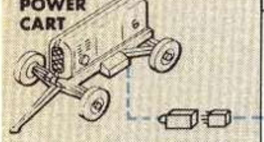


Figure 1-26. (Sheet 2 of 3 Sheets)

RADAR BNS EXTERNAL POWER CART



RADAR BNS EXTERNAL POWER RECEPTACLE

RADAR POWER PANEL

AN/APS-23 OR AN/APS-64 RADAR SYSTEM
BNS AC TRANSFER (10)
BNS HEAT CONTROL
INTERPHONE OR INTERCOM
NOSE DEFROST (1)
O-15 & O-23 CAMERA (& AN/AWA-2)
OBSERVER'S EJECTION SEAT CONTROL
PERISCOPIC SEXTANT (1)
RADAR PRESSURIZING UNIT
TRACKING COMPUTER

AERIAL CAMERA
AN/APN-76 RENDEZVOUS RADAR
AN/ARA-26 EMERGENCY KEYER
AN/ARC-27 COMMAND RADIO
AN/ARN-6 RADIO COMPASS
AN/ARN-18 GLIDE PATH RECEIVER
BOMB ARMING CONTROL
BOMB FUZE CONTROL (T-13) (23)
BOMB INDICATOR LIGHTS
CAMERA WINDOW DEFROST (2)
ECM
FOOD WARMING CUP (1)
INFLIGHT CONTROL & MONITORING
NORMAL & ALTERNATE BOMB CIRCUITS

NOTE:
WHITE BACKGROUND INDICATES CIRCUIT BREAKERS ACCESSIBLE IN FLIGHT

CONTINUED FROM SHEET 1

AFT DC POWER PANEL (3)

AN/ARC-21 LIAISON RADIO (4)
APPROACH CHUTE — PILOT'S & COPILOT'S (5)
CHAFF DISPENSER — LH & RH (6)
EJECTION SEAT CONTROL — PILOT'S & COPILOT'S (7)
EMERGENCY COMMUNICATION LIGHT (8)
FOOD WARMING CUP
LIQUID OXYGEN QUANTITY (22)
NOSE DEFROST
PERISCOPIC SEXTANT
SPR PANEL POWER (9)

UPPER DC POWER PANEL

AC WARNING LIGHTS (10)
AIR REFUELING — SIGNAL AMPLIFIER, INDICATOR LIGHTS, TOGGLE ACTUATOR, DOOR CONTROL
ANTISKID
ANTISKID WARNING LIGHT
ATTITUDE INDICATOR
AUXILIARY FUEL — QUANTITY & INDICATOR LIGHTS
AUXILIARY FUEL-TO-ENGINES VALVE
EMERGENCY RETRACT — MAIN & OUTRIGGER
EXTERNAL WING TANK JETTISON CONTROL — L & R (24)
FIRE DETECTORS
FLAP EMERGENCY CONTROL
FLAP NORMAL CONTROL
FLAP POSITION INDICATOR
FUEL CONTROL TRANSFER (11)
FUEL GAGE TRANSFER
FUEL MANIFOLD SCAVENGE PUMP — FWD SECTION POWER (& AFT SECTION CONTROL (12))
FUEL TRANSFER & REFUELING — ALL TANKS
GEAR POSITION INDICATORS
HYDRAULIC EMERGENCY PUMP
HYDRAULIC QUANTITY GAGE
HYDRAULIC SYSTEM & ATO WARNING
INVERTER & ALTERNATOR WARNING (13)
MAIN & OUTRIGGER GEAR
MAIN FUEL WARNING & CONTROL — ALL ENGINES
MANIFOLD & FIRE SHUTOFF VALVES (14)
OXYGEN SYSTEM WARNING
PRESS-TO-TEST LIGHTS

LOWER DC POWER PANEL

AILERON SURFACE POWER CONTROL — L & R
AIR REFUELING LIGHTS
AIR REFUELING SLIPWAY DOOR ANTI-ICING
ALTERNATOR CONTROL — L & R (10)
ALTERNATOR REGULATORS & BUS SELECTOR (13)
AN/APS-54 RADAR (15)
ANTI-ICE AIR TEMP INDICATORS
ANTI-ICE OVERHEAT CONTROL & WARNING
ATO CONTROL
AUTOMATIC PILOT — AUTOMATIC APPROACH, FILAMENTS, INDICATOR LIGHTS, INTERLOCK & SERVOS
CABIN AIR — VALVES, PRESSURE REGULATOR & TEMP CONTROL
CANOPY CONTROL (16)
DIRECTIONAL DAMPER
ELEVATOR EMERGENCY POWER CONTROL (25)
EMERGENCY AC CONTROL (18)
EMPENNAGE SHUTOFF VALVE (POWER) (17)
ENGINE & NACELLE ANTI-ICE
ENGINE SCREENS
ENGINE STALL PREVENTION — ALL ENGINES (18)
FUEL FLOW METERS (19)
INSTRUMENT INVERTER CONTROL — MAIN (13)
INSTRUMENT INVERTER CONTROL — SPARE (20)
INSTRUMENT VIBRATOR
INTERIOR LIGHTS — ALL
INVERTER SYSTEM — MAIN, SECONDARY & A-5 (OR MD-4) (13)
LANDING LIGHTS — L & R
N-1 COMPASS
NAVIGATION LIGHTS
NOSE DEFROST
OUTSIDE AIR TEMP INDICATORS
PITOT ANTIICING — L & R
RUDDER-ELEVATOR POWER CONTROL
STARTER CONTROL
TAXI LIGHT (SOME AIRPLANES)
THROTTLE & ENGINE CONTROL — IGNITION, STARTER-GENERATOR & FIRE SHUTOFF (ALL ENGINES)
TRIM TAB COORDINATION — AILERON, RUDDER & ELEVATOR
TURN & BANK INDICATOR — PILOT'S & COPILOT'S
VERTICAL GYRO
VORTEX GENERATOR DEICE (21)
WATER INJECTION CONTROL
WINDSHIELD ANTI-ICING
WINDSHIELD DEFROST
WINDSHIELD WIPER
WING & EMPENNAGE ANTI-ICE
WING & EMPENNAGE OVERHEAT
WING ILLUMINATION LIGHTS

CODES — SHEET 3

(1) AF 51-2357 thru -7023, -15804 thru -15812, 52-019 thru -058, -202 thru -235
(2) AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on
(3) AF 51-2192 thru -2356, -7024 thru -7083, -17368 thru -17386, 52-059 thru -201, -236 & on
(4) AF 51-2192 thru -2356, 52-498 & on
(5) AF 51-2192 thru -2356, 52-071 thru -201, -248 & on
(6) AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
(7) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on
(8) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on
(9) AF 52-158 thru -201, -312 thru -393, -508 & on
(10) AF 52-1417, 53-1819 thru -2170, -2279 & on
(11) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on
(12) AF 51-2357 thru 52-182, -202 thru -378, -394 thru -611
(13) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(14) AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2190, -2279 & on
(15) AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
(16) AF 52-612 & on
(17) AF 52-173 thru -201, -368 thru -393, -565 & on
(18) AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on
(19) AF 51-2192 thru -2356, 52-072 thru -201, -247 & on
(20) AF 51-2192 thru 52-362, -394 thru -573, -1406 thru -1416
(21) AF 51-5235 thru -7083, -17368 thru -17386, 52-046 thru -180, -219 thru -385, -395 thru -583
(22) Some modified B-47B airplanes
(23) AF 53-1850 thru -1972, -2104 thru -2170, -2350 & on
(24) AF 51-2192 thru 53-1821, -2028 thru -2117, -2261 thru -2367 which do not have T. O. 1B-47-767 accomplished.
(25) AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

50142WC-1

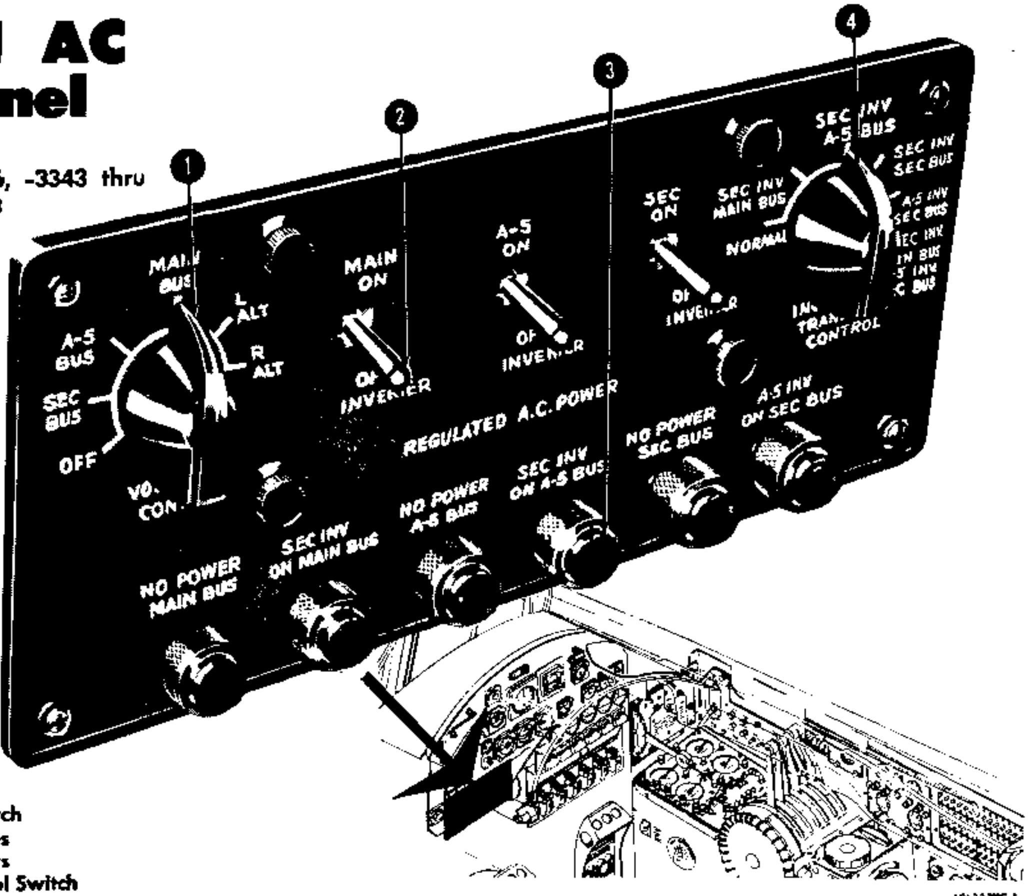
Figure 1-26. (Sheet 3 of 3 Sheets)

regulated AC power panel

AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

NOTE

MD-4 NOMENCLATURE IS USED INSTEAD OF A-5 ON B-47B AIRPLANES HAVING THE MD-4 FIRE CONTROL SYSTEM



1. Voltmeter Control Switch
2. Inverter Power Switches
3. Inverter Indicator Lights
4. Inverter Transfer Control Switch

Figure 1-27.

SINGLE PHASE INVERTER SYSTEM CONTROLS

INVERTER POWER SWITCHES. Three ON--OFF switches (2, figure 1-27) on the regulated AC power panel control the main, secondary, and A-5 inverters. These switches work in conjunction with the inverter transfer control switch as given below.

INVERTER TRANSFER CONTROL SWITCH. A rotary selector switch (4, figure 1-27) on the regulated AC power panel is provided to control transfer of power from the secondary and A-5 inverter. The switch has NORMAL--SEC INV MAIN BUS--SEC INV A-5 BUS--SEC INV SEC BUS--A-5 INV SEC BUS--SEC INV MAIN BUS & A-5 INV SEC BUS* positions. The following condition will exist with selector switch in these positions:

NOTE

The changeover relays will transfer and turn on secondary inverter regardless of the position of the secondary inverter power switch.

NORMAL (all inverter power switches in ON)
- Main inverter supplies power to main bus.
- Secondary inverter supplies power to secondary bus.
- A-5 inverter supplies power to A-5 bus.
- Automatic changeover relays are operative and will transfer the secondary inverter to the main or A-5 bus if an inverter fails on that bus.
- The secondary inverter will transfer to the main bus if both the main and A-5 inverters fail.

SEC INV MAIN BUS (The main inverter power switch can be ON or OFF. The secondary and A-5 inverter power switches must be ON.)
- Main inverter will be inoperative.
- Secondary inverter will supply power to main bus.
- A-5 inverter will supply power to the A-5 bus.
- Main and A-5 changeover relays will be inoperative.

SEC INV A-5 BUS (The main and secondary inverter power switches must be ON. The A-5 power switch can be ON or OFF.)
- Main inverter will supply power to main bus.
- Secondary inverter will supply power to A-5 bus.
- A-5 inverter will be inoperative.
- Main and A-5 changeover relays will be inoperative.

* AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 thru -1416, -3343 thru -3373, 53-2261 thru -2278

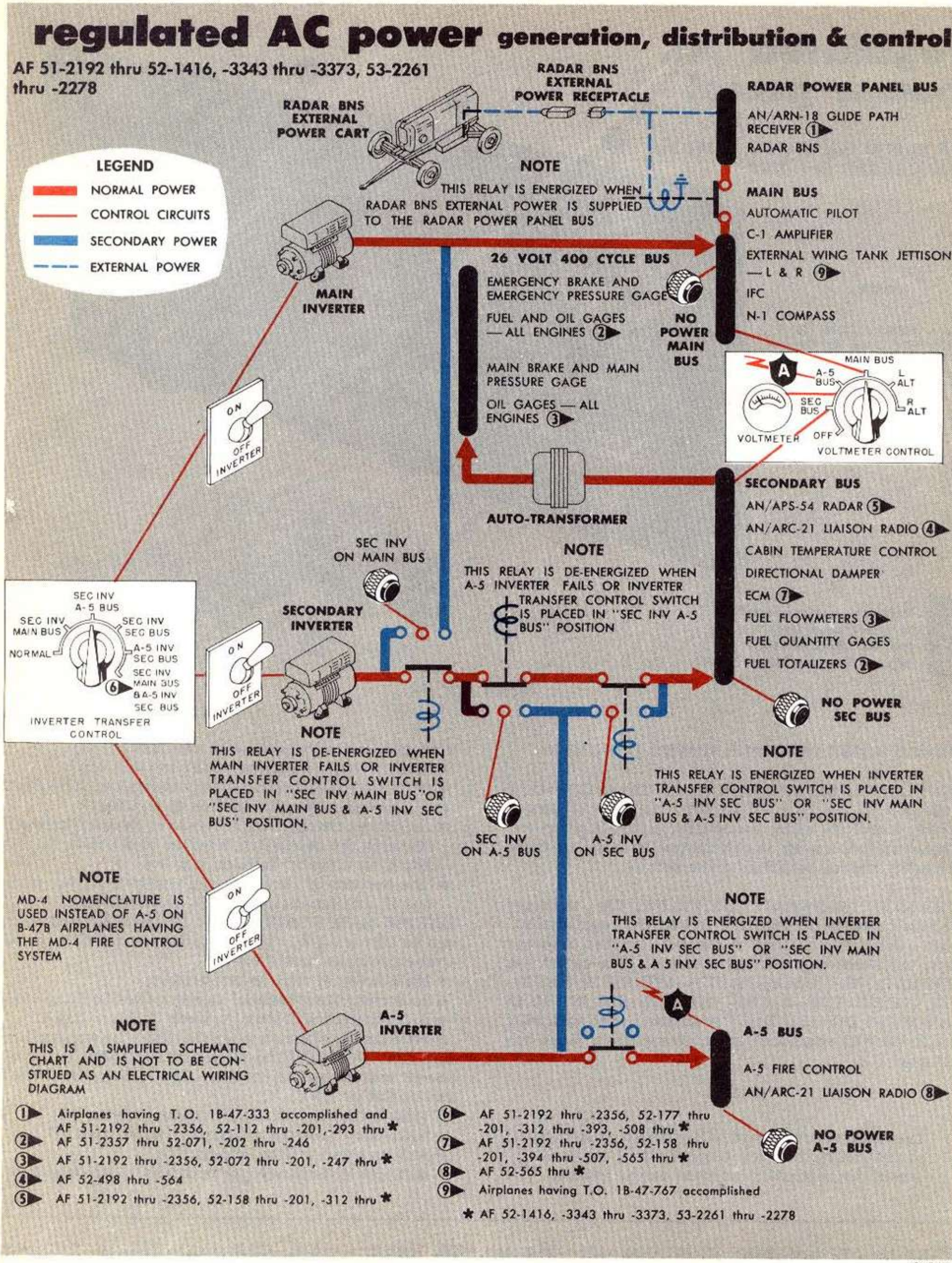

regulated AC power generation, distribution & control
AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
RADAR BNS EXTERNAL POWER CART
RADAR BNS EXTERNAL POWER RECEPTACLE
RADAR POWER PANEL BUS
AN/ARN-18 GLIDE PATH RECEIVER ①
RADAR BNS
LEGEND
NORMAL POWER
CONTROL CIRCUITS
SECONDARY POWER
EXTERNAL POWER
NOTE
THIS RELAY IS ENERGIZED WHEN RADAR BNS EXTERNAL POWER IS SUPPLIED TO THE RADAR POWER PANEL BUS
MAIN BUS
AUTOMATIC PILOT
C-1 AMPLIFIER
EXTERNAL WING TANK JETTISON — L & R ⑨
IFC
N-1 COMPASS
MAIN INVERTER
26 VOLT 400 CYCLE BUS
EMERGENCY BRAKE AND EMERGENCY PRESSURE GAGE
FUEL AND OIL GAGES — ALL ENGINES ②
MAIN BRAKE AND MAIN PRESSURE GAGE
OIL GAGES — ALL ENGINES ③
NO POWER MAIN BUS
MAIN BUS
A-5 BUS
L ALT
SEC BUS
R ALT
OFF
VOLTMETER
VOLTMETER CONTROL
ON
OFF
INVERTER
AUTO-TRANSFORMER
SECONDARY BUS
AN/APS-54 RADAR ⑤
AN/ARC-21 LIAISON RADIO ④
CABIN TEMPERATURE CONTROL
DIRECTIONAL DAMPER
ECM ⑦
FUEL FLOWMETERS ③
FUEL QUANTITY GAGES
FUEL TOTALIZERS ②
NO POWER SEC BUS
SEC INV ON MAIN BUS
NOTE
THIS RELAY IS DE-ENERGIZED WHEN A-5 INVERTER FAILS OR INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "SEC INV A-5 BUS" POSITION
SECONDARY INVERTER
SEC INV A-5 BUS
SEC INV MAIN BUS
SEC INV SEC BUS
NORMAL
A-5 INV SEC BUS
SEC INV MAIN BUS & A-5 INV SEC BUS
INVERTER TRANSFER CONTROL
NOTE
THIS RELAY IS DE-ENERGIZED WHEN MAIN INVERTER FAILS OR INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "SEC INV MAIN BUS" OR "SEC INV MAIN BUS & A-5 INV SEC BUS" POSITION.
SEC INV ON A-5 BUS
A-5 INV ON SEC BUS
NOTE
THIS RELAY IS ENERGIZED WHEN INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "A-5 INV SEC BUS" OR "SEC INV MAIN BUS & A-5 INV SEC BUS" POSITION.
NOTE
MD-4 NOMENCLATURE IS USED INSTEAD OF A-5 ON B-47B AIRPLANES HAVING THE MD-4 FIRE CONTROL SYSTEM
NOTE
THIS RELAY IS ENERGIZED WHEN INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "A-5 INV SEC BUS" OR "SEC INV MAIN BUS & A 5 INV SEC BUS" POSITION.
NOTE
THIS IS A SIMPLIFIED SCHEMATIC CHART AND IS NOT TO BE CONSTRUED AS AN ELECTRICAL WIRING DIAGRAM
A-5 INVERTER
A-5 BUS
A-5 FIRE CONTROL
AN/ARC-21 LIAISON RADIO ⑧
NO POWER A-5 BUS
① Airplanes having T.O. 1B-47-333 accomplished and AF 51-2192 thru -2356, 52-112 thru -201,-293 thru *
② AF 51-2357 thru 52-071, -202 thru -246
③ AF 51-2192 thru -2356, 52-072 thru -201, -247 thru *
④ AF 52-498 thru -564
⑤ AF 51-2192 thru -2356, 52-158 thru -201, -312 thru *
⑥ AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 thru *
⑦ AF 51-2192 thru -2356, 52-158 thru -201, -394 thru -507, -565 thru *
⑧ AF 52-565 thru *
⑨ Airplanes having T.O. 1B-47-767 accomplished
* AF 52-1416, -3343 thru -3373, 53-2261 thru -2278
50143 WC-1

Figure 1-28.

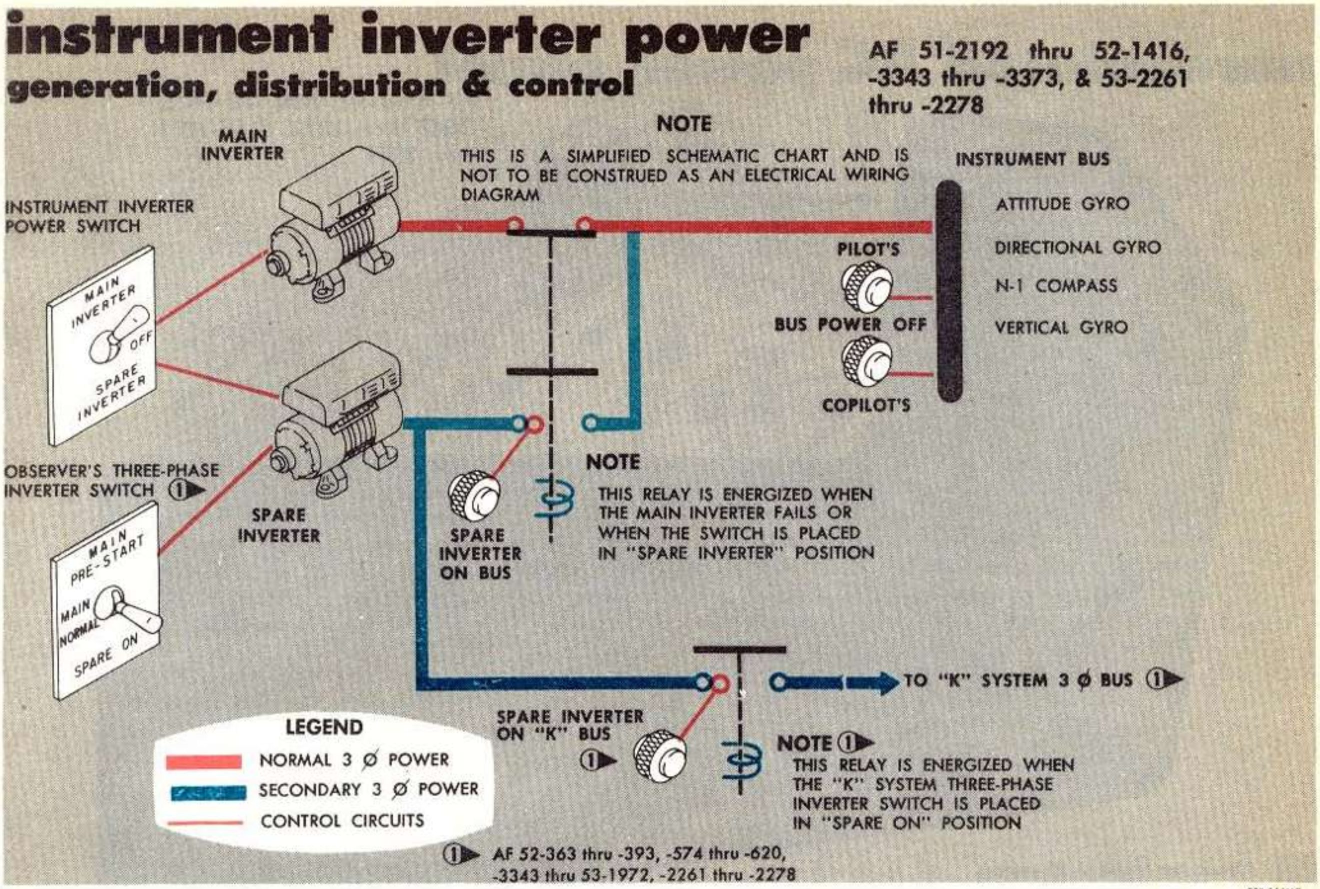


Figure 1-29.

SEC INV SEC BUS (The main, secondary, and A-5 inverter power switches must be ON.)

- Main inverter will supply power to main bus.
- Secondary inverter will supply power to secondary bus.
- A-5 inverter will supply power to the A-5 bus.
- Main and A-5 changeover relays will be inoperative.

A-5 INV SEC BUS (Main and A-5 inverter power switches must be ON. The secondary power switch can be ON or OFF.)

- Main inverter will supply power to the main bus.
- A-5 inverter will supply power to the secondary bus.
- A-5 changeover relay is inoperative.
- Main changeover relay is operative.
- Secondary inverter will be inoperative unless the main inverter changeover relay transfers it to main bus.

SEC INV MAIN BUS & A-5 INV SEC BUS* (main inverter power switch can be OFF or ON. The secondary and A-5 inverter power switches must be ON.)

- Main inverter is inoperative.
- Secondary inverter will supply power to the main bus.
- A-5 inverter will supply power to the secondary bus.
- Main and A-5 inverter changeover relays will be inoperative.

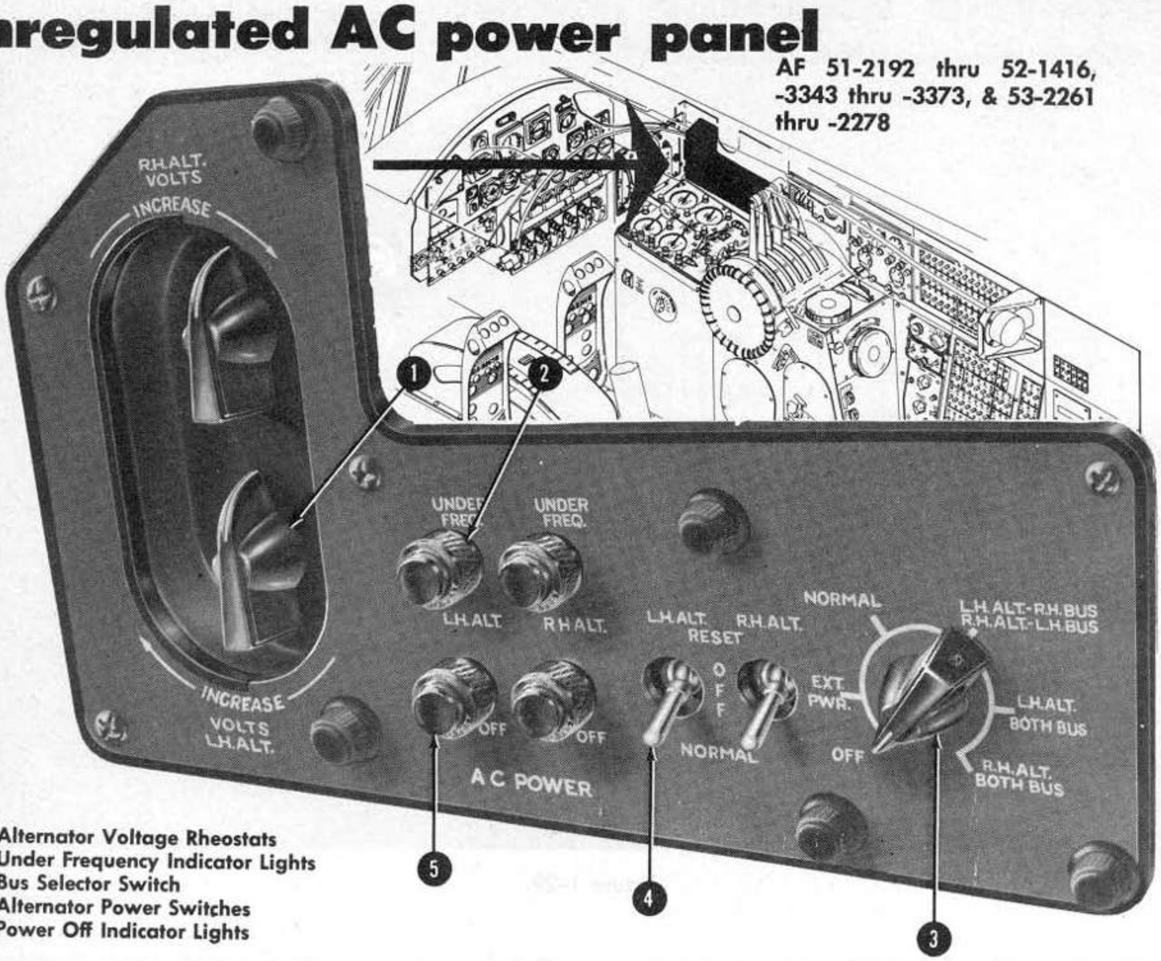
SINGLE PHASE INVERTER SYSTEM INDICATORS

AC VOLTMETER. An AC voltmeter (23, figure 1-18 and 25, figure 1-19) located on the regulated AC power panel provides voltage readings on the main, secondary, and A-5 inverter buses and the left and right alternators or alternator buses. A six-position voltmeter control switch (1, figure 1-27) located on the regulated AC power panel has OFF--SEC BUS--A-5 BUS--MAIN BUS--L ALT--R ALT positions. The switch is used to connect the voltmeter to the inverter buses for reading inverter bus voltage. On some airplanes the R ALT and L ALT positions of the voltmeter control switch connect the voltmeter to the alternator buses for reading alternator bus voltage, while on other airplanes these positions connect the voltmeter to the alternators for reading alternator voltage.

* AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 thru -1416, -3343 thru -3373, 53-2261 thru -2278

unregulated AC power panel

AF 51-2192 thru 52-1416, -3343 thru -3373, & 53-2261 thru -2278



1. Alternator Voltage Rheostats
2. Under Frequency Indicator Lights
3. Bus Selector Switch
4. Alternator Power Switches
5. Power Off Indicator Lights

50125W8

Figure 1-30.

INDICATOR LIGHTS. Six amber warning lights (3, figure 1-27) on the regulated AC power panel are provided for indications of the main, secondary, and A-5 inverter power conditions. Three lights marked "No Power Main Bus," "No Power A-5 Bus" and "No Power Sec Bus" when illuminated indicate no voltage on the respective buses. The "Sec Inv On Main Bus" indicates that secondary inverter output has been transferred, automatically or manually, to the main bus. The "Sec Inv On A-5 Bus" indicates that secondary inverter output has been diverted, automatically or manually, to the A-5 bus. The "A-5 Inv On Sec Bus" indicates that the A-5 inverter output has been diverted manually to the secondary bus. All indicator lights are DC energized and will not illuminate unless the airplane DC system is energized.

INSTRUMENT INVERTER SYSTEM

Regulated 115-volt 400-cycle alternating current is supplied to an instrument bus by two three-phase instrument inverters. One inverter serves as a standby or spare inverter which will automatically operate, or can be manually selected, to supply power to the instrument bus in the event of failure of the main instrument inverter. On some airplanes * the spare inverter can be manually selected by the observer to supply power to the "K" system three-phase bus. DC power for the instrument inverters is supplied through circuit breakers on the lower DC power panel, left main power shield and on some later airplanes on the forward main power shield. For equipment receiving power from this system, refer to figure 1-29.

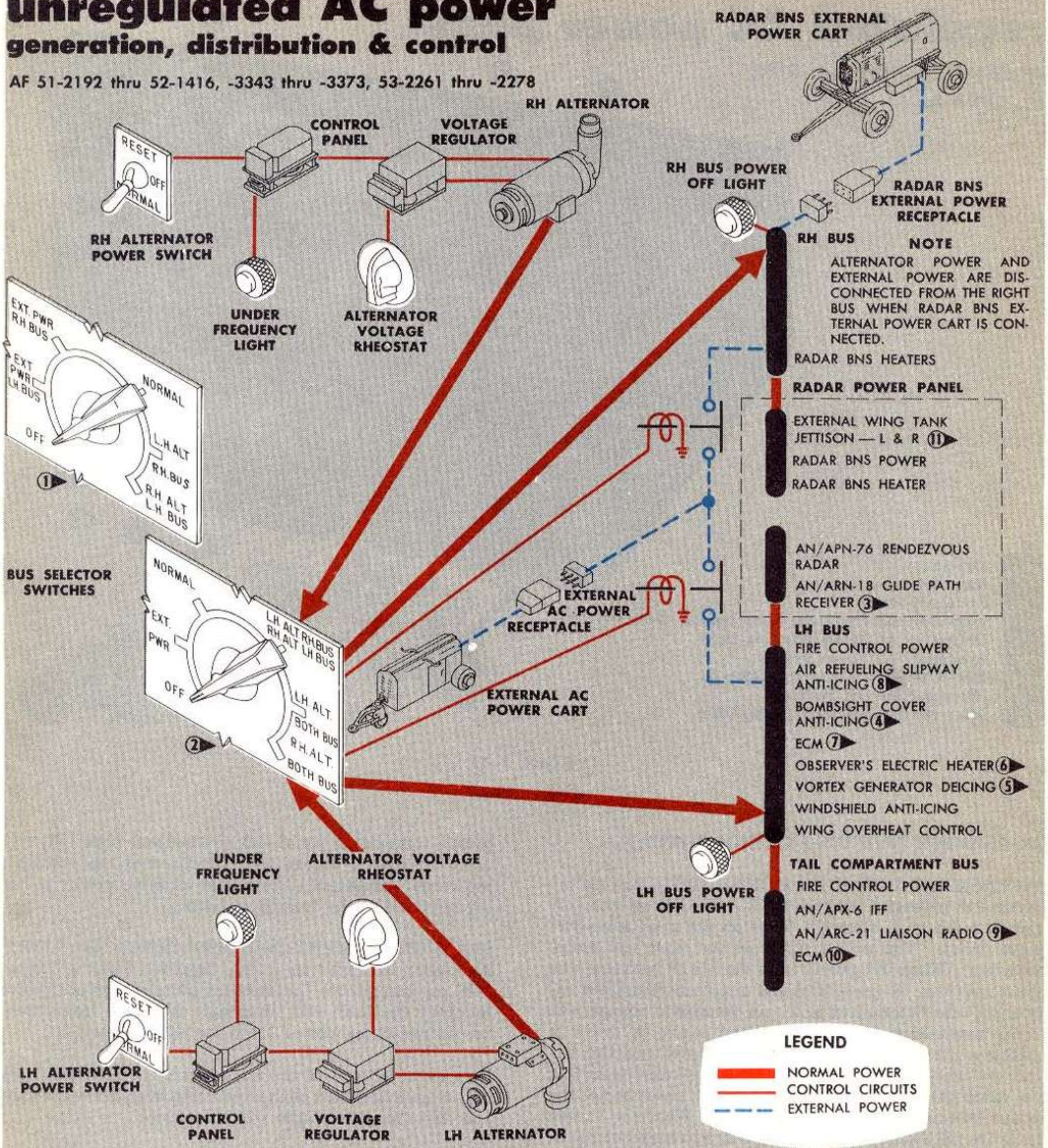
NOTE (1)

On the lower DC power panel the control instrument inverter circuit breakers are both identified as "spare." The forward circuit breaker should be identified as "main" because it controls the main instrument inverter.

* AF 52-363 thru -393, -574 thru -620, -3343 thru 53-1972, -2261 thru -2278
(1) AF 51-2375 thru -2430, -2433, -2441, 52-019 thru -021

unregulated AC power
generation, distribution & control

AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278



(1) AF 51-2357 thru -2411

(2) AF 51-2192 thru -2356, -2412 thru *

(3) AF 51-2357 thru 52-111, -202 thru -292 which do not have T. O. 1B-47-333 accomplished

(4) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru *

(5) AF 51-5235 thru -7083, -17368 thru 17386, 52-046 thru -180, -219 thru -385, -394 thru -583

(6) AF 51-2192 thru -2356, 52-584 thru *

(7) AF 51-2192 thru -2356

(8) AF 51-2357 thru -7083, -17368 thru 52-041

(9) AF 51-2192 thru -2356, 52-498 thru *

(10) AF 51-2357 thru *

(11) Airplanes having T. O. 1B-47-767 accomplished

* AF 52-1416, -3343 thru -3373, 53-2261 thru -2278

NOTE

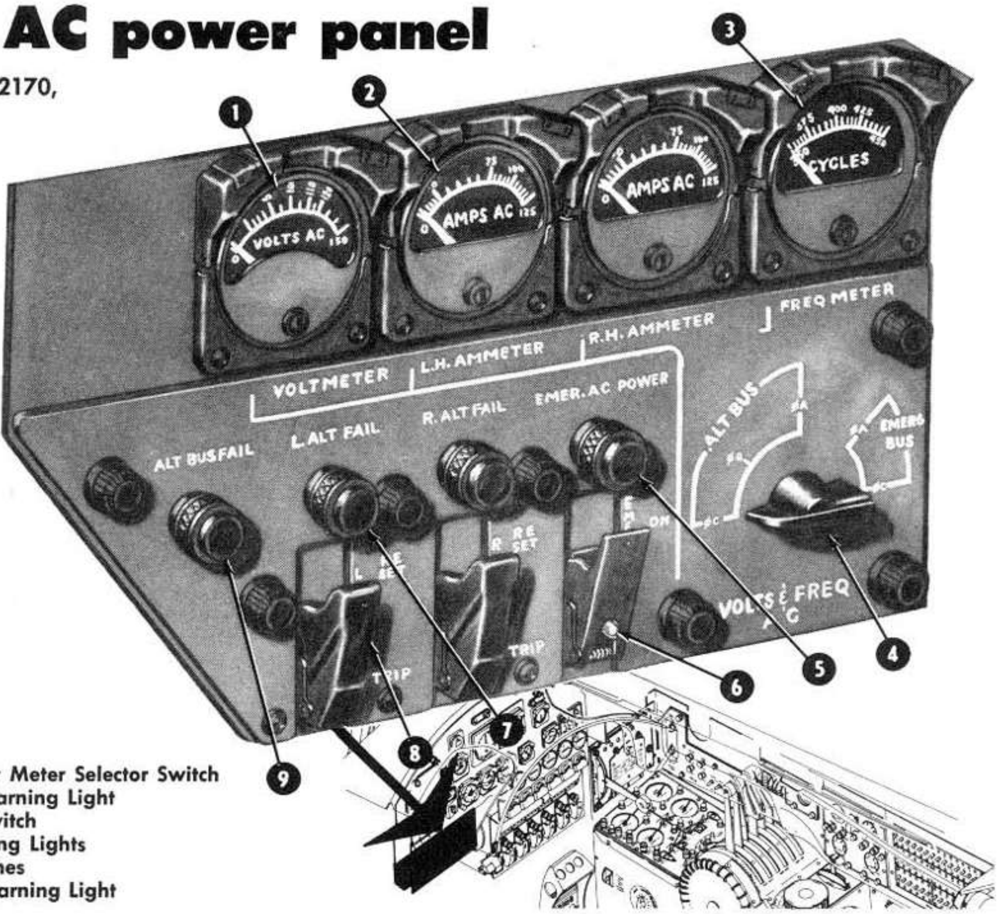
THIS IS A SIMPLIFIED SCHEMATIC CHART AND IS NOT TO BE CONSTRUED AS AN ELECTRICAL WIRING DIAGRAM

51045 WC-1

Figure 1-31.

regulated AC power panel

AF 52-1417, 53-1819 thru -2170,
53-2279 & on



1. Voltmeter
2. Ammeters
3. Frequency Meter
4. Voltmeter and Frequency Meter Selector Switch
5. Emergency AC Power Warning Light
6. Emergency AC Power Switch
7. Alternator Failure Warning Lights
8. Alternator Control Switches
9. Alternator Bus Failure Warning Light

50160WB-1

Figure 1-32.

INSTRUMENT INVERTER SYSTEM CONTROLS

INSTRUMENT INVERTER POWER SWITCH. An instrument inverter MAIN--OFF--SPARE switch (17, figure 1-8 and 4, figure 1-9) is on the pilot's instrument panel. The switch controls the main and spare inverter. When the switch is in the MAIN position, the main inverter is energized and supplies regulated AC power to the instrument bus. An automatic changeover relay automatically energizes the spare inverter in case the main inverter fails. The SPARE position for this switch provides a manual means of disconnecting the main inverter and connecting (and energizing) the spare inverter to the instrument bus. When the switch is in the OFF position, both inverters are deenergized.

INSTRUMENT INVERTER SYSTEM INDICATORS

INSTRUMENT INVERTER POWER OFF WARNING LIGHTS. A red warning light (15, figure 1-8 and 5, figure 1-9) marked "Bus Power Off" located on the pilot's instrument panel and an identical light (13, figure 1-18 and 8, figure 1-19) located on the copilot's instrument panel will illuminate when no power is being supplied to the instrument bus.

SPARE INSTRUMENT INVERTER INDICATOR LIGHT. An amber indicator light (16, figure 1-8 and 3, figure 1-9) on the pilot's instrument panel marked "Spare Inverter On Bus" will illuminate when the instrument bus is receiving power from the spare inverter.

In case of failure of the main inverter the red lights will illuminate until changeover has been accomplished and then the amber light will illuminate.

UNREGULATED ALTERNATING CURRENT SYSTEM (1)

Unregulated frequency 115-volt alternating current is supplied by two engine-driven alternators. The alternator driven by engine No. 1 normally supplies power

(1) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

to a left unregulated AC bus and the alternator driven by engine No. 6 normally supplies power to a right unregulated AC bus. The alternators may also supply the other bus or both buses as controlled by a bus selector switch when necessary. The unregulated alternating current system supplies power for the systems as given in figure 1-28.

NOTE (1)

Systems dependent on unregulated AC power, including the "K" radar system, may be unreliable since the unregulated AC power system is subject to voltage fluctuations and even complete loss of power due to alternator field polarity reversal under conditions where there is a high moisture content in the atmosphere.

UNREGULATED ALTERNATING CURRENT SYSTEM CONTROLS

(2)

BUS SELECTOR SWITCH. A rotary-type selector switch (3, figure 1-30) on the unregulated AC power panel has OFF--EXT PWR LH BUS--EXT PWR RH BUS--NORMAL--LH ALT RH BUS--RH ALT LH BUS positions. This switch controls relays connecting the unregulated AC buses to external power, to their respective alternators, or to each other's alternator. When the switch is in the OFF position, all power is disconnected from the buses. The EXT PWR LH BUS position of the switch connects the left bus to the AC external power receptacle. When the switch is placed in EXT PWR RH BUS position, the right bus is connected to the external AC power receptacle. The NORMAL position operates relays to connect No. 1 engine alternator output power to the left bus, No. 6 engine alternator output power to the right bus, and disconnects the external AC power from both buses. The LH ALT RH BUS position operates relays to connect No. 1 engine alternator output power to the right bus, and disconnects the No. 6 engine alternator power and external AC power simultaneously. The RH ALT LH BUS position operates relays to connect No. 6 engine alternator output power to the left bus, and disconnects the No. 1 engine alternator power and external AC power simultaneously.

(3)

BUS SELECTOR SWITCH. A rotary-type selector switch (3, figure 1-30) on the unregulated AC power panel has OFF--EXT PWR--NORMAL--LH ALT-RH BUS, RH ALT-LH BUS--LH ALT, BOTH BUS--RH ALT, BOTH BUS positions. This switch controls relays connecting the unregulated AC buses to external power or to either or both alternators. In OFF position, all power is disconnected from the buses. EXT PWR position connects the left and right buses to the AC external power receptacle. In NORMAL position, relays operate to connect No. 1 engine alternator output power to the left bus and No. 6 engine alternator output to the right bus. LH ALT-RH BUS, RH ALT-LH BUS position operates relays to switch alternators to opposite buses. LH ALT, BOTH BUS position operates relays to disconnect the right alternator and connect the left alternator to both buses. RH ALT, BOTH BUS position operates relays to disconnect the left alternator and connect the right alternator to both buses.

ALTERNATOR POWER SWITCHES. Two alternator switches (4, figure 1-30) are provided on the unregulated AC power panel and are labeled RH ALT RESET --OFF--NORMAL and LH ALT RESET--OFF--NORMAL. The reset positions reset the alternator control circuits if the alternator circuits have been tripped. The OFF positions make the alternators inoperative. The NORMAL positions energize the alternators to supply unregulated AC power to their respective buses.

(4)

The reset positions of the switches incorporate an alternator field flashing function so that the alternator field may be reset in event of polarity reversal as indicated by alternator voltage surges or complete loss of alternator output. The field flashing function also cuts down on voltage build-up time when the alternators are first turned on.

CAUTION (5)

Alternator power switches should not be held in RESET position for an extended period of time due to the possibility of damaging the alternator during the field flashing sequence.

ALTERNATOR VOLTAGE RHEOSTATS. An "RH Alt Volts" and an "LH Alt Volts" rheostat (1, figure 1-30) is located on the unregulated AC power panel. Rotating either rheostat in a clockwise direction will increase the output voltage for the respective alternator. Conversely, rotating a rheostat in a counterclockwise direction will decrease the alternator voltage output.

UNREGULATED ALTERNATING CURRENT SYSTEM INDICATORS

(6)

AC VOLTMETER. The voltmeter (23, figure 1-18) on the copilot's instrument panel is used to check alternator bus voltage. A six-position voltmeter control switch (1, figure 1-27) on the regulated AC power

(1) AF 51-2357 thru 52-105, -202 thru -296
(2) AF 51-2357 thru -2411
(3) AF 51-2192 thru -2356, 51-2412 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(4) AF 51-2192 thru -2356, 52-106 thru -201, -261 thru -1416, 52-3343 thru -3373, 53-2261 thru -2278
(5) AF 52-394 thru -440
(6) AF 51-2357 thru -2411

regulated AC power generation, distribution, and control

AF 52-1417, 53-1819 thru -2170, -2279 & on

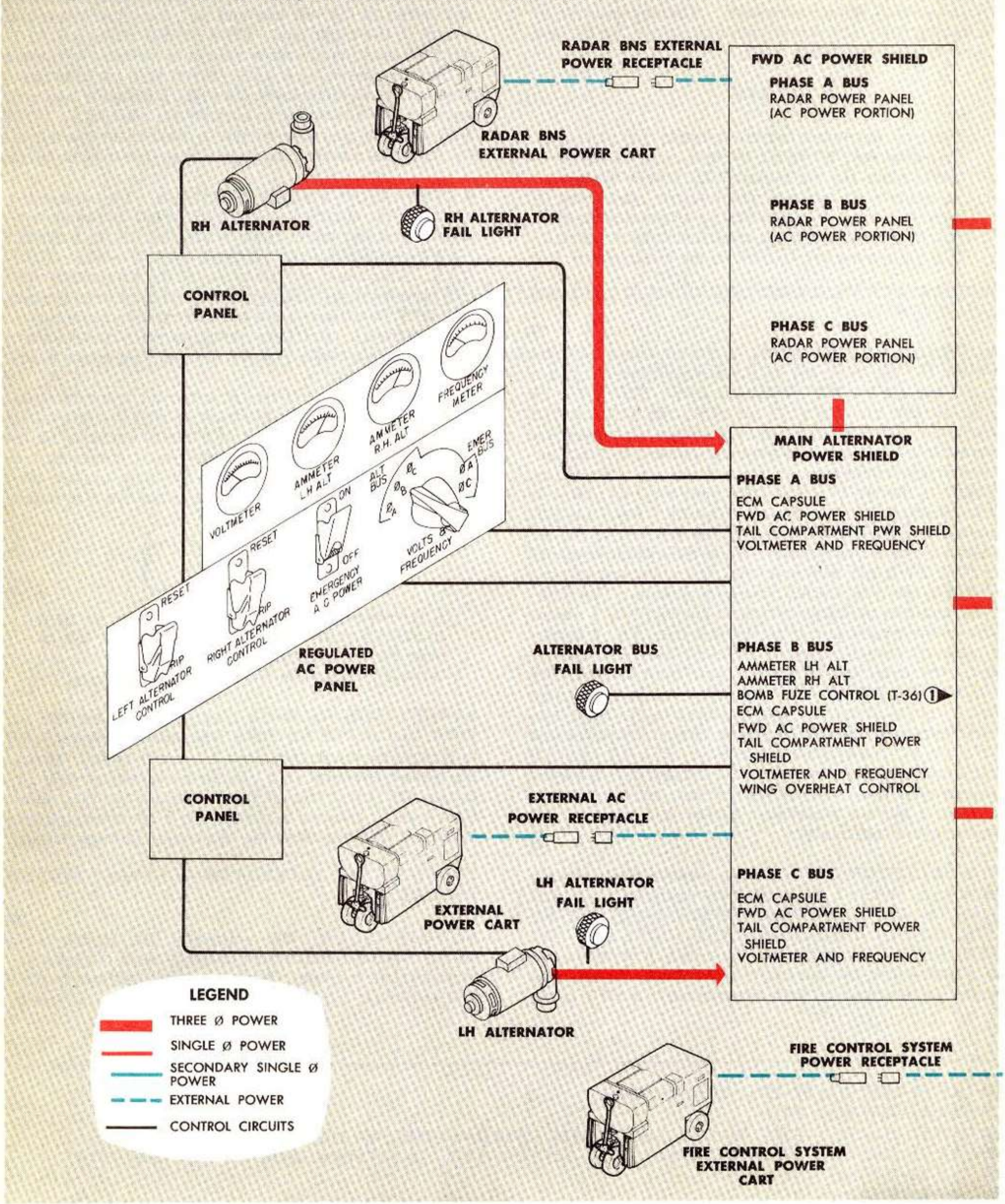
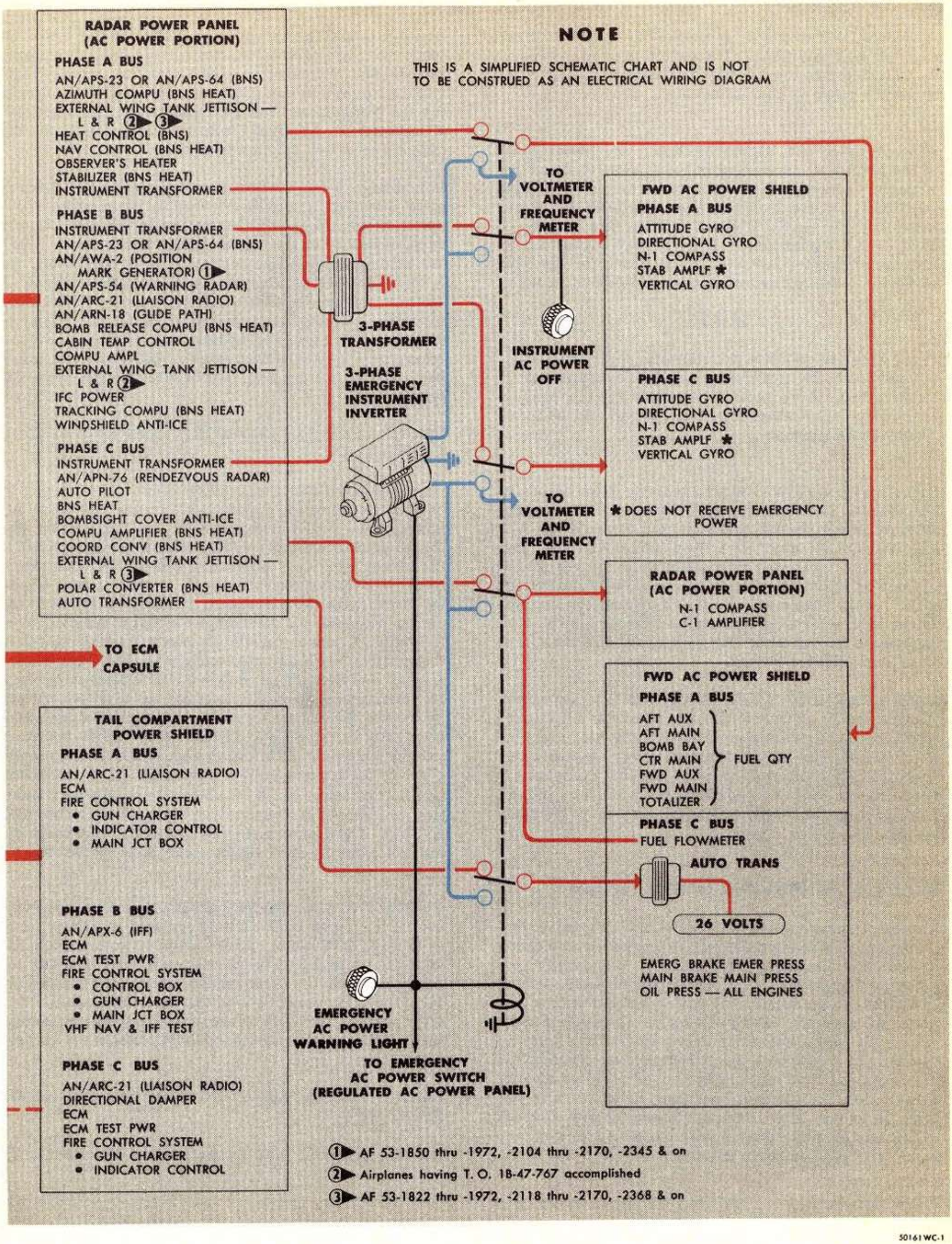


Figure 1-33


NOTE
THIS IS A SIMPLIFIED SCHEMATIC CHART AND IS NOT TO BE CONSTRUED AS AN ELECTRICAL WIRING DIAGRAM
RADAR POWER PANEL (AC POWER PORTION)
PHASE A BUS
AN/APS-23 OR AN/APS-64 (BNS)
AZIMUTH COMPU (BNS HEAT)
EXTERNAL WING TANK JETTISON — L & R 2 3
HEAT CONTROL (BNS)
NAV CONTROL (BNS HEAT)
OBSERVER'S HEATER
STABILIZER (BNS HEAT)
INSTRUMENT TRANSFORMER
PHASE B BUS
INSTRUMENT TRANSFORMER
AN/APS-23 OR AN/APS-64 (BNS)
AN/AWA-2 (POSITION MARK GENERATOR) 1
AN/APS-54 (WARNING RADAR)
AN/ARC-21 (LIAISON RADIO)
AN/ARN-18 (GLIDE PATH)
BOMB RELEASE COMPU (BNS HEAT)
CABIN TEMP CONTROL
COMPU AMPL
EXTERNAL WING TANK JETTISON — L & R 2
IFC POWER
TRACKING COMPU (BNS HEAT)
WINDSHIELD ANTI-ICE
PHASE C BUS
INSTRUMENT TRANSFORMER
AN/APN-76 (RENDEZVOUS RADAR)
AUTO PILOT
BNS HEAT
BOMBSIGHT COVER ANTI-ICE
COMPU AMPLIFIER (BNS HEAT)
COORD CONV (BNS HEAT)
EXTERNAL WING TANK JETTISON — L & R 3
POLAR CONVERTER (BNS HEAT)
AUTO TRANSFORMER
TO ECM CAPSULE
TAIL COMPARTMENT POWER SHIELD
PHASE A BUS
AN/ARC-21 (LIAISON RADIO)
ECM
FIRE CONTROL SYSTEM
• GUN CHARGER
• INDICATOR CONTROL
• MAIN JCT BOX
PHASE B BUS
AN/APX-6 (IFF)
ECM
ECM TEST PWR
FIRE CONTROL SYSTEM
• CONTROL BOX
• GUN CHARGER
• MAIN JCT BOX
VHF NAV & IFF TEST
PHASE C BUS
AN/ARC-21 (LIAISON RADIO)
DIRECTIONAL DAMPER
ECM
ECM TEST PWR
FIRE CONTROL SYSTEM
• GUN CHARGER
• INDICATOR CONTROL
3-PHASE TRANSFORMER
3-PHASE EMERGENCY INSTRUMENT INVERTER
TO VOLTMETER AND FREQUENCY METER
INSTRUMENT AC POWER OFF
TO VOLTMETER AND FREQUENCY METER
FWD AC POWER SHIELD
PHASE A BUS
ATTITUDE GYRO
DIRECTIONAL GYRO
N-1 COMPASS
STAB AMPLF *
VERTICAL GYRO
PHASE C BUS
ATTITUDE GYRO
DIRECTIONAL GYRO
N-1 COMPASS
STAB AMPLF *
VERTICAL GYRO
* DOES NOT RECEIVE EMERGENCY POWER
RADAR POWER PANEL (AC POWER PORTION)
N-1 COMPASS
C-1 AMPLIFIER
FWD AC POWER SHIELD
PHASE A BUS
AFT AUX
AFT MAIN
BOMB BAY
CTR MAIN
FWD AUX
FWD MAIN
TOTALIZER
FUEL QTY
PHASE C BUS
FUEL FLOWMETER
AUTO TRANS
26 VOLTS
EMERG BRAKE EMER PRESS
MAIN BRAKE MAIN PRESS
OIL PRESS — ALL ENGINES
EMERGENCY AC POWER WARNING LIGHT
TO EMERGENCY AC POWER SWITCH (REGULATED AC POWER PANEL)
1 AF 53-1850 thru -1972, -2104 thru -2170, -2345 & on
2 Airplanes having T. O. 1B-47-767 accomplished
3 AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on
50161WC-1

panel has OFF--SEC BUS--A-5 BUS--MAIN BUS--L ALT--R ALT positions. The switch is used to connect the voltmeter to the alternator buses or the inverter buses for reading bus voltages.

(1)

The voltmeter (23, figure 1-18 and 25, figure 1-19) on the copilot's instrument panel is used to check alternator voltage. A six-position voltmeter control switch (1, figure 1-27) on the regulated AC power panel has OFF--SEC BUS--A-5 BUS--MAIN BUS--L ALT--R ALT positions. The switch is used to connect the voltmeter to the alternators or the inverter buses for reading alternator or inverter bus voltage.

NOTE

In order to obtain a reliable alternator voltage indication the alternator should be connected to a bus, there should be a load on the bus, and the alternator power switch should be in NORMAL position.

BUS POWER OFF WARNING LIGHTS. Two amber or red warning lights (5, figure 1-30) are on the unregulated AC power panel and are marked "Pwr Off LH Alt" and "Pwr Off RH Alt." The "Pwr Off LH Alt" and "Pwr Off RH Alt" lights will illuminate when the respective bus power is below rated value of approximately 105 volts. This power failure may be from the engine-driven alternators, an external AC power source during ground operation or due to operation of the alternator bus selector switch.

UNDER FREQUENCY INDICATOR LIGHTS. An amber "Under Freq" indicator light (2, figure 1-30) is provided for each alternator marked "LH Alt" and "RH Alt." These lights will illuminate during alternator operation when the respective alternator frequency is below rated value of approximately 380 cps (50.5% rpm) or the alternator voltage falls below approximately 100 volts.

REGULATED ALTERNATING CURRENT SYSTEM (2)

Regulated three-phase 400-cycle 200/115-volt alternating current is supplied by two engine-driven alternators, one alternator on engine No. 6 and one alternator on engine No. 1. Refer to figure 1-33. These two alternators supply AC power for the entire airplane AC system. Each alternator is coupled to the engine through a hydraulic drive which drives the alternator at a constant speed regardless of conditions of electrical load and engine speed (idle or above). Power from the parallel operating alternators is distributed by the main alternator power shield, forward AC power shield, radar power panel (AC power portion), and tail compartment power shield. One alternator is capable of supplying power to the total bus load. Voltage protection, fault protection, frequency regulation, paralleling, load division, and voltage regulation are accomplished automatically. Power for the controls and indicating lights of this regulated AC system is supplied from circuit breakers on the upper and lower DC power panels.

In addition, a manually controlled emergency instrument inverter is provided to supply three-phase 400-cycle alternating current to the instrument bus in event of failure of the engine-driven alternators. When the emergency instrument inverter is turned on, the instrument bus is disconnected from the alternator system and connected to the emergency instrument inverter. Changeover is a manual operation and no automatic changeover is possible. Control for the emergency instrument inverter is DC operated, power being supplied from a circuit breaker on the lower DC power panel.

REGULATED ALTERNATING CURRENT SYSTEM CONTROLS

ALTERNATOR CONTROL SWITCHES. Two alternator control switches (8, figure 1-32) on the regulated AC power panel are marked RESET and TRIP at the extreme positions respectively and are spring-loaded to the center position. A guard is placed over the switch to prevent inadvertent actuation. During normal engine shutdown with the alternator control switches in the center position, the alternators are disconnected from the main AC bus automatically and will be connected to the main AC bus automatically when the engines are started and brought up to speed. The alternators will be disconnected from the main AC bus and deenergized by moving the respective alternator control switch momentarily to the TRIP position. The RESET positions provide automatic field flashing and reset of the control circuits for its respective alternator. The alternator control switches must be placed in the RESET position to connect its respective alternator to the main AC bus if the alternator is disconnected from the main AC bus by any means other than normal engine shutdown.

EMERGENCY AC POWER SWITCH. A two-position switch (6, figure 1-32) on the regulated AC power panel is labeled OFF--ON. The switch is guarded and the guard must be lifted to move the switch. The ON position turns on the three-phase emergency instrument inverter and connects it to the instrument bus. The OFF position turns the three-phase emergency instrument inverter off and disconnects it from the instrument bus.

REGULATED ALTERNATING CURRENT SYSTEM INDICATORS

AC AMMETERS. Two AC ammeters (2, figure 1-32)

(1) AF 51-2192 thru -2356, -2412 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2) AF 52-1417, 53-1819 thru -2170, -2279 & on

on the regulated AC power panel are provided to measure AC current and to enable the copilot to compare the two indicated load values. The load values should be equal or similar. Due to ammeter sensitivity no indication may appear at low amperage.

AC VOLTMETER AND FREQUENCY METER. An AC voltmeter (1, figure 1-32) and a frequency meter (3, figure 1-32) on the regulated AC power panel are provided to measure phase voltage and phase frequency of the alternator buses and the instrument inverter. A five-position voltmeter and frequency meter selector switch (4, figure 1-32) on the AC power panel has ALT BUS ØA--ØB--ØC--EMER BUS ØA--ØC positions. The switch is used to select which voltage and frequency is to be measured.

ALTERNATOR BUS FAILURE WARNING LIGHT. A red warning light (9, figure 1-32) on the regulated AC power panel is marked "Alt Bus Fail." The light will illuminate when no power is on the main AC bus.

ALTERNATOR FAILURE WARNING LIGHT. Two amber lights (7, figure 1-32) on the regulated AC power panel are marked "L Alt Fail" and "R Alt Fail." Each alternator failure warning light will illuminate when its respective alternator is not connected to the main AC bus.

EMERGENCY AC POWER WARNING LIGHT. A red warning light (5, figure 1-32) on the regulated AC power panel is marked "Emer AC Power," "Emer AC Failure," or "Emer AC Fail." The warning light will illuminate if there is no power on the instrument bus and the emergency power switch is in ON position.

INSTRUMENT AC POWER WARNING LIGHT. A red warning light (20, figure 1-9) on the pilot's instrument panel is marked "Inst AC Power Off." The warning light will illuminate when there is no power on the instrument bus.

CIRCUIT BREAKERS AND FUSES

Individual DC control circuit protection is provided by thermal-type circuit breakers on the copilot's upper, aft, and lower DC power panels (9, 10, and 14, figure 1-15) and the radar power panel (9, figure 1-34). There are two types of circuit breakers; one is called trip-free and the other non-trip-free. These circuit breakers are easy to differentiate since the push-to-reset buttons on the trip-free are yellow and on the non-trip-free are black. Manually holding the trip-free circuit breaker in the depressed position will not complete the circuit if it remains faulty or overloaded thereby reducing fire hazard. The non-trip-free circuit breaker may be found on some early airplanes. On this type circuit breaker, manually holding the reset button in the depressed position will complete the circuit even if it is faulty or overloaded. To reset either type circuit breaker, push the reset button in to the reset position.

NOTE

For more positive action on either type circuit breaker, pull then push the reset button to the reset position.

Most DC operated systems are controlled by two circuit breakers. A circuit breaker on the upper DC, aft DC, lower DC or radar power panel provides protection of a switch-actuated circuit to a relay which, when energized, completes power circuits to the DC operated units. These power circuits are protected by circuit breakers in DC power shields. Current limiters for the DC power distribution system are in main power shields in the front wheel well and in other power shields throughout the airplane. Regulated AC circuits are protected by fuses and circuit breakers in the main AC power shield (8, figure 1-34) and the radar power panel. Unregulated AC circuits are protected by fuses and circuit breakers in the unregulated AC power shield (6, figure 1-34) or the right and left alternator power shields (5 and 6, figure 1-34) and the radar power panel.

EXTERNAL AC AND DC POWER RECEPTACLES

External AC and DC power receptacles (14, figure 1-54) are located on the lower left side of the fuselage aft of the front wheel well. The AC receptacle connects external AC power to the alternator power shield and contains an intercommunications control panel for ground crew to airplane crew communications. A hinged access door is provided as a cover on each receptacle.

(1)

The DC power receptacle has two rows of contact pins. The top row marked "Start" provides a means for connecting an externally controlled current power cart to a start bus which is isolated from the normal airplane DC bus. The bottom row marked "Normal" provides for connection of a regulated voltage from the same power cart to the normal airplane bus for internal airplane equipment which eliminates voltage surges within the airplane DC bus during engine starts. If a controlled current power cart is not available, a regulated voltage power cart will start the engines if connected to the start bus. The external bomb hoist attachment on these airplanes is provided power through the normal pins in the receptacle.

(2)

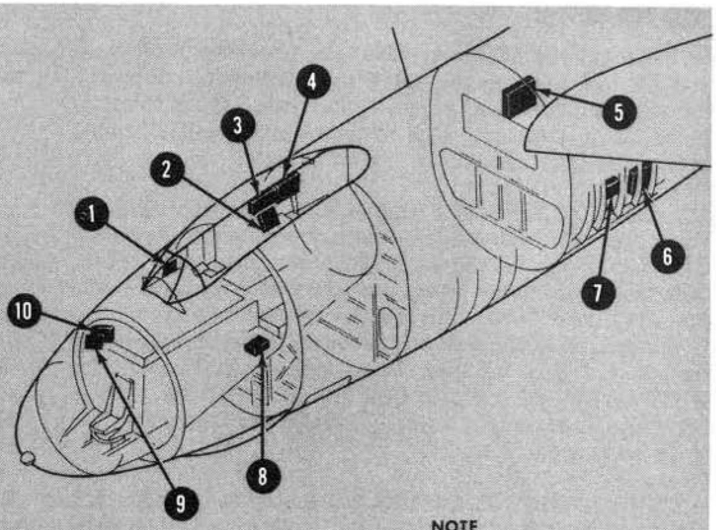
The DC power receptacle has three rows of contact pins. One row of contact pins marked "Start" provides a means for connecting an externally controlled current power cart to the start bus which is isolated from the normal airplane bus. Two rows of contact pins marked "Service" provide a means for connecting external DC power to the normal airplane bus for internal airplane equipment. The external bomb hoist attachment is provided power through one row of contact pins marked "Service and Bomb Hoist."

(1) AF 51-2192 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
(2) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

circuit breaker and fuse locations

1. Pilot's Ignition Switch Panel
2. Lower DC Power Panel
3. Upper DC Power Panel
4. Aft DC Power Panel (1)
5. Right Alternator Power Shield (2)
6. Unregulated AC Power Shield (3)
   Left Alternator Power Shield (2)
7. Bomb Salvo Relay
8. Main AC Power Panel (4)
9. Radar Power Panel
10. Fwd AC Power Shield (5)

(1) AF 51-2192 thru -2356, -7024 thru -7083, -17368 thru -17386, 52-059 thru -201, -236 & on
(2) AF 51-2192 thru -2356, -2412 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(3) AF 51-2357 thru -2411
(4) AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278
(5) AF 52-1417, 53-1819 thru -2170, -2279 & on



NOTE

ONLY THOSE CIRCUIT BREAKERS AND FUSES ACCESSIBLE IN FLIGHT ARE LISTED

CIRCUIT	PANEL
AIR REFUELING SYSTEM	
Disconnect - normal and emergency	3
Fuel manifold scavenge - forward and aft	3
Signal amplifier, fire extinguisher	3
Slipway door control	3
ANTI-ICING AND DEICING SYSTEMS	
Air refueling slipway	2
Air temperature indicator	2
Bombsight cover	6
Engine and nacelle	2
Overheat control	2 and 6 2 and 8
Overheat warning - empennage	2
Overheat warning - wing	2 or 6
Pitot - left and right	2
Slipway door	2
Slipway, door frame, and pressure panel	6
Vortex generator	2 and 6
Windshield	2 and 6, or 2 and 9
Wing, and empennage	2
ATO SYSTEM	
ATO warning	3
ATO motors - aft, center, and forward	2
AUTOMATIC PILOT	
Automatic pilot	2 and 8
BOMB DOOR	
Alternate system	9
BOMBING SYSTEM	
Bomb salvo control	1 or 7
Normal, alternate, door indicator lights and arming	9
BRAKE SYSTEM	
Antiskid and warning	3
CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEM	
Cabin air temperature	2 and 8
Cabin air valves	2
Valves and regulators	2
COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT	
AF combat interphone	9
AIC-10 Intercommunciation system	9
Command radio	9
ECM	9 or 8 and 9
Emergency communication light	4
Emergency keyer	9
Fire control system	2, 6 and 8
Glide path AN/ARN-18	9
IFM and IFC	2, 8, and 9
Liaison radio	4 and 8
Radar beacon AN/APN-76	9
Radar bombing, navigational and computing systems	5, 6, 8 and 9
Radar pressurizing	9
Radar warning	8
Radio compass	9

(CONTINUED)

Figure 1-34.

CIRCUIT	PANEL
DEFROST SYSTEMS	
Nose defrost	2 or 4 or 9
Windshield defrost	2
ELECTRICAL SYSTEM	
AC warning lights	3, 6 and 8
Alternator control	2
Alternator distribution	5, 6 and 9
Alternator regulator, RH & LH	2
Changeover relay - main bus, secondary bus, and A-5 bus (or MD-4)	8
Emergency instrument inverter	2
Instrument inverters	2 and 8
Inverter control - main, secondary, and A-5 (or MD-4)	2
Inverter distribution - main secondary, and A-5 (or MD-4)	8
Radar BNS inverter	9, or 8 and 9
FIRE CONTROL SYSTEM	
Fire control	2, 6 and 8
Turret control	8
FLIGHT CONTROL SYSTEM	
Approach chute control (2)	4
Directional damper	2 and 8
Flap control - emergency	3
Flap control - normal and warning	3
Surface power	2
Trim tab coordination	2
FUEL SYSTEM	
Fuel control - main (engines No. 1, 2, 3, 4, 5, and 6) and warning	3
Fuel transfer and refuel - main and auxiliary	3
Ground refuel	4
Wing tank jettison	3 or 8 and 9 or 9
HYDRAULIC SYSTEM	
Hydraulic oil quantity	3
Hydraulic standby control (emergency pump) and warning	3
INSTRUMENTS	
Auxiliary fuel indicators and indicator light	3
C-1 amplifier	8 or 9
Emergency brake, emergency pressure and main pressure indicators	8 or 10
Flap position indicator	3
Fuel and oil pressure gages	8
Fuel flowmeter	2 and 8, 2 and 10
Fuel gage transfer	3
Fuel quantity gages	8 or 10
Fuel totalizer	8 or 10
Gyros	2 and 8 or 2 and 10

CIRCUIT	PANEL
Hydraulic oil quantity	3
Landing gear position and warning horn	3
N-1 compass	2 and 8 or 2, 8, 9, and 10
Outside air temperature	2
Oil pressure gages	8 or 10
Turn-and-bank - pilot's copilot's	2
Voltmeter - AC	10
Voltmeter - regulated AC	8
Voltmeter - unregulated AC	6 or 5 and 6
LANDING GEAR SYSTEM	
Landing gear - main, outrigger	3
Landing gear - retraction, emergency	3
LIGHTING — EXTERIOR	
Air refueling and wing illumination	2
Flash and steady position	2
Left and right landing	2
Navigation lights	2
LIGHTING — INTERIOR	
Bomb bay and tunnel dome	2
Entrance and walkway	2
Panel - pilot's copilot's, and observer's	2
Periscopic sextant	2 or 4 or 9
Pilot's map	2
Press-to-test power	3
Sidewall - pilot's, copilot's, and observer's	2
Standby compass	2
Table, and flood	2
MISCELLANEOUS EQUIPMENT	
Approach chute - pilot's and copilot's	4
Canopy control	2
Chaff dispensers - control	4
Ejection seat control	9, or 4 and 9
Fire detection	3
Food warming cup	2 or 4 or 9
Oxygen system warning	3
Vibrators - instrument panel	2
Warning horn	3
Windshield wiper	2
PHOTOGRAPHIC EQUIPMENT	
Camera control	9
POWER PLANT	
Engine screen control	2
Engine stall prevention	2
Fire detection warning	3
Oil and hydraulic fire shutoff	2
Starter control	2
Throttle and engine control	2
Water injection control	2

circuit breakers
which perform more than a single function

CIRCUIT BREAKER	FUNCTIONS
LOWER DC POWER PANEL	
LIGHTING INTERIOR INST PILOT AND COPILOT	Supplies power to pilot's and copilot's instrument panel lights.
	(1)► Supplies power to N-1 compass inoperative light.
	(1)► Controls C-1 amplifier transfer.
THROTTLE AND ENG CONTROL ENG NO 1 AND 6	Controls oil fire shutoff valve.
	Provides power to trip or reset generator.
	Provides air start control power.
THROTTLE AND ENG CONTROL ENG NO 2 AND 5	Controls oil fire shutoff valve.
	Provides power to trip or reset generator.
	Provides air start control power.
	Controls emergency anti-ice shutoff valve, nacelle.
THROTTLE AND ENG CONTROL ENG NO 3 AND 4	Controls oil fire shutoff valve.
	Provides power to trip or reset generator.
	Provides air start control power.
	Controls emergency anti-ice shutoff valve, nacelle.
	Controls hydraulic shutoff valves.
RADAR POWER PANEL	
AN/ARC-27 (2)►	If the AN/ARC-27 circuit breaker opens, the command radio and the emergency keyer become ineffective.
AN/ARC-21 (3)►	If the AN/ARC-21 circuit breaker opens, the liaison and the emergency keyer become ineffective.
NORMAL BOMB	Provides power for the normal bomb system.
	Provides power for the "Bombs Away" light.

(1)► AF 51-2192 thru -2356, -2360 thru -2362, -2364 thru -2399, -2401 thru -7083, -17368 thru -17386, 52-059 thru -201, -293 thru -3373, 53-1819 & on

(2)► AF 51-2357 thru 52-611

(3)► AF 51-2192 thru -2356, 52-612 thru -620, -3343 thru 53-1972, -2090 thru -2319, -2332 & on

CIRCUIT BREAKER	FUNCTIONS
UPPER DC POWER PANEL	
HYD & ATO WARNING	Provides power for right and left aileron, rudder and elevator boost hydraulic pressure warning light, and on some ★ airplanes the elevator emergency pressure light. Provides power for LH and RH pump not operating light. ④▶ Provides power for the "Safety Link Installed" light and the "Arm Switch On" light. ⑤▶ Provides power for the "ATO Ready" light and the "ATO Armed" light.
LANDING GEAR — MAIN GEAR	Provides control power for normal main landing gear actuation and drag control.
LANDING GEAR — OUTRIGGER	Provides control power for normal outrigger landing gear actuation and drag control.
LANDING GEAR WARN HORN — POS IND	Provides power for the landing gear and flap warning horn. Provides power for landing gear position indicator lights.
MAIN FUEL CONTROL 'ENGS NO. 1, 2, 3, 4, 5 AND 6	Controls fuel selectors. ⑥▶ Controls fuel fire shutoff valve.

★ AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

④▶ AF 51-2357 thru 52-088, -202 thru -292

⑤▶ AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

⑥▶ AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2278

Figure 1-34A.

RADAR BNS EXTERNAL POWER RECEPTACLE

(1)

An external power receptacle and shield (22, figure 1-54) is provided for ground operation of the radar bombing and navigation system. The receptacle is located just aft of the lower radar access door on the right side of the airplane. This receptacle is protected by an access door and mates with the BNS external power adapter cart plug to furnish single- and three-phase regulated and unregulated 115-volt AC power and 28-volt DC power to the shield. A ground blower is automatically energized, and relays in the shield prevent airplane bus power from being applied to the BNS circuits when external power is connected.

(2)

External power receptacles and a shield (21, figure 1-54) are provided for ground operation of the radar bombing-navigation system. The receptacles are located just aft of the lower radar access door on the right side of the airplane. The external power receptacles are protected by an access door. The AC power receptacle connects external 200/115-volt regulated 400-cycle three-phase AC power to the BNS external power shield for the bombing-navigation system. The DC power receptacle connects external 28-volt DC power to the BNS external power shield for the bombing-navigation system. A ground blower is automatically energized and relays in the forward AC power shield prevent airplane bus power from being applied to the radar bombing-navigation system when external power is connected.

FIRE CONTROL SYSTEM EXTERNAL POWER RECEPTACLE

(1)

An external power receptacle (36, figure 1-54) is provided for ground operation of the A-5 or MD-4 fire control system. The receptacle is located on the inner right side of the fuselage in the battery compartment. When the receptacle is mated with the plugs of the external power cart, unregulated 115-volt AC power, single-phase regulated 115-volt AC power, and 28-volt DC power are furnished to the A-5 or MD-4 fire control system. Relays in the external A-5 or MD-4 power shield prevent airplane bus power (except the three-phase A-5 or MD-4 inverter power) from being applied to the A-5 or MD-4 fire control system when external power is connected.

(2)

External power receptacles (36, figure 1-54) are provided for ground operation of the A-5 or MD-4 fire control system. The receptacles are located in the rear of the battery compartment. The AC power receptacle connects external 200/115-volt regulated 400-cycle three-phase AC power to the tail compartment power shield for the fire control system. The DC power receptacle connects external 28-volt DC power to the tail compartment power shield for the fire control system. The constant frequency inverter receptacle connects external 115-volt regulated 400 (±1)-cycle single-phase AC power to the fire control system. Relays in the tail compartment power shield prevent airplane bus power being applied to the fire control system when external power is connected.

HYDRAULIC POWER SUPPLY SYSTEMS

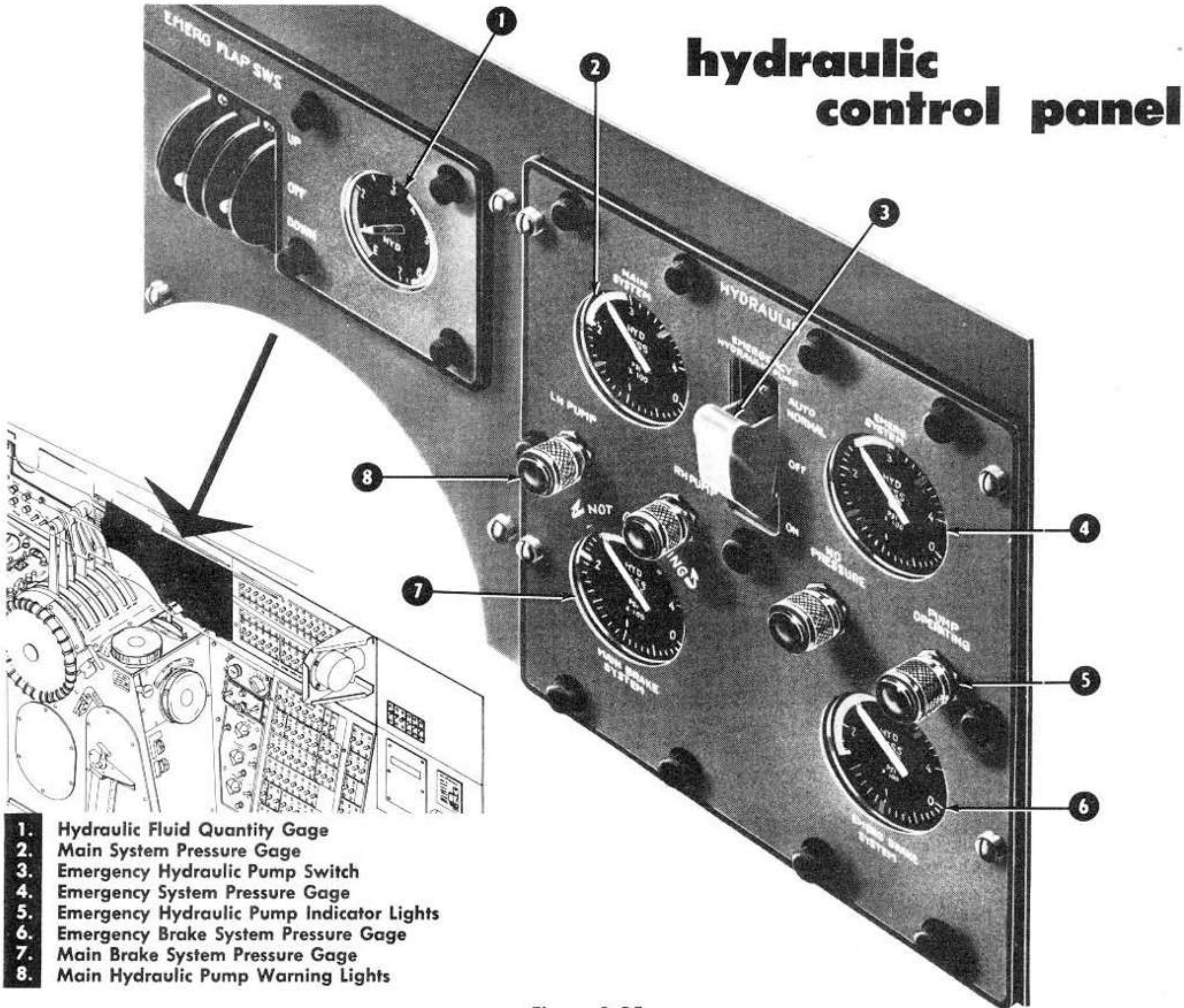
Hydraulic power is supplied to various actuating units throughout the airplane by either a main or an emergency hydraulic system (figure 1-36). The main and emergency systems are normally operated at 3000 psi and are interconnected by a series of shuttle valves in such a manner that the affected actuating units will automatically be supplied by the emergency system in the event the main system pressure should fall below emergency system pressure. Manually operated service valves located in the crawlway are accessible in flight as well as for ground servicing. The valves have two positions ON and OFF and are lockwired in the OFF position for all normal operation of the system. In some sections of hydraulic lines requiring intermittent flow (close and open pressure for canopy system, main and emergency pressure for air refueling system), hydraulic fuses are installed as a safety feature to seal off the line in the event a rupture should occur. These fuses will automatically close when a break in the downstream line allows more than the calibrated rate of flow (40 cu in./min), thus preventing the loss of an excessive quantity of hydraulic fluid.

MAIN HYDRAULIC SYSTEM

A pressurized main system reservoir, installed in the forward wheel well, supplies hydraulic fluid to two engine-driven hydraulic pumps, one each at engines No. 3 and 4. Each pump delivers a fluid flow of 3 to 4 gallons per minute at 2600 psi and 1500 rpm, the flow decreasing to zero when the normal operating pressure of 3000 psi is attained. This pressure is maintained generally by means of a pressure regulator contained within the pump; however, a pressure relief valve, which allows the fluid to return to the reservoir at 3450 (±150) psi, is incorporated to guard against surge pressures. The return port of this valve has a minimum allowable closing pressure of 3100 psi when the pressure is dropping. Although the pumps run continuously, enough fluid is bypassed through the pumps for necessary lubrication and cooling. Check valves in the pressure line from each pump prevent the output of one pump from entering the other pump in the event either should fail. A solenoid operated bypass valve is located in a line that connects the pressure side of the pump with the supply side. When the starter is energized, the bypass valve opens allowing free return of the fluid, thereby reducing the torque load on the engine starter. When the starter relay cuts out, the valve will close, allowing the pump to build up normal hydraulic pressure. A hydraulic fire shutoff valve is located in the wing adjacent to the

(1) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2) AF 52-1417, 53-1819 thru -2170, -2279 & on

hydraulic control panel



1. Hydraulic Fluid Quantity Gage
2. Main System Pressure Gage
3. Emergency Hydraulic Pump Switch
4. Emergency System Pressure Gage
5. Emergency Hydraulic Pump Indicator Lights
6. Emergency Brake System Pressure Gage
7. Main Brake System Pressure Gage
8. Main Hydraulic Pump Warning Lights

Figure 1-35.

50128WA

pressure release valve. The fire shut-off valve will close when the corresponding fire switch on the pilot's instrument panel is pulled out, and will open when that switch is pushed back to its normal position.

MAIN HYDRAULIC SYSTEM CONTROLS

HYDRAULIC SERVICE VALVES. Manually operated service valves located in the crawlway are accessible in flight as well as for ground servicing. The valves have two labeled positions ON and OFF and are lock-wired in the OFF position for all normal operation of the system. Opening the forward service valve opens the emergency lines to the main system lines. This allows the main hydraulic system to be energized with the emergency system pump for ground servicing or, in case of main system pump failure, eliminates the necessity of operating engines when functional tests and other ground operations are being performed on the main or emergency hydraulic systems. Opening the aft service valve opens the emergency lines to the return lines to bleed down emergency pressure thus depressurizing the emergency system.

MAIN SYSTEM INDICATORS

MAIN SYSTEM PRESSURE GAGE. A pressure transmitter connected directly to the main system pressure line transmits electrically an indication of main system pressure to a main system pressure gage (2, figure 1-35) located on the copilot's hydraulic control panel.

HYDRAULIC FLUID QUANTITY GAGE. A fluid quantity gage (1, figure 1-35) located on the hydraulic control panel indicates the fluid level in the main system reservoir. The transmitter for this gage is located at the top of the reservoir, and circuit protection is

hydraulic power supply system

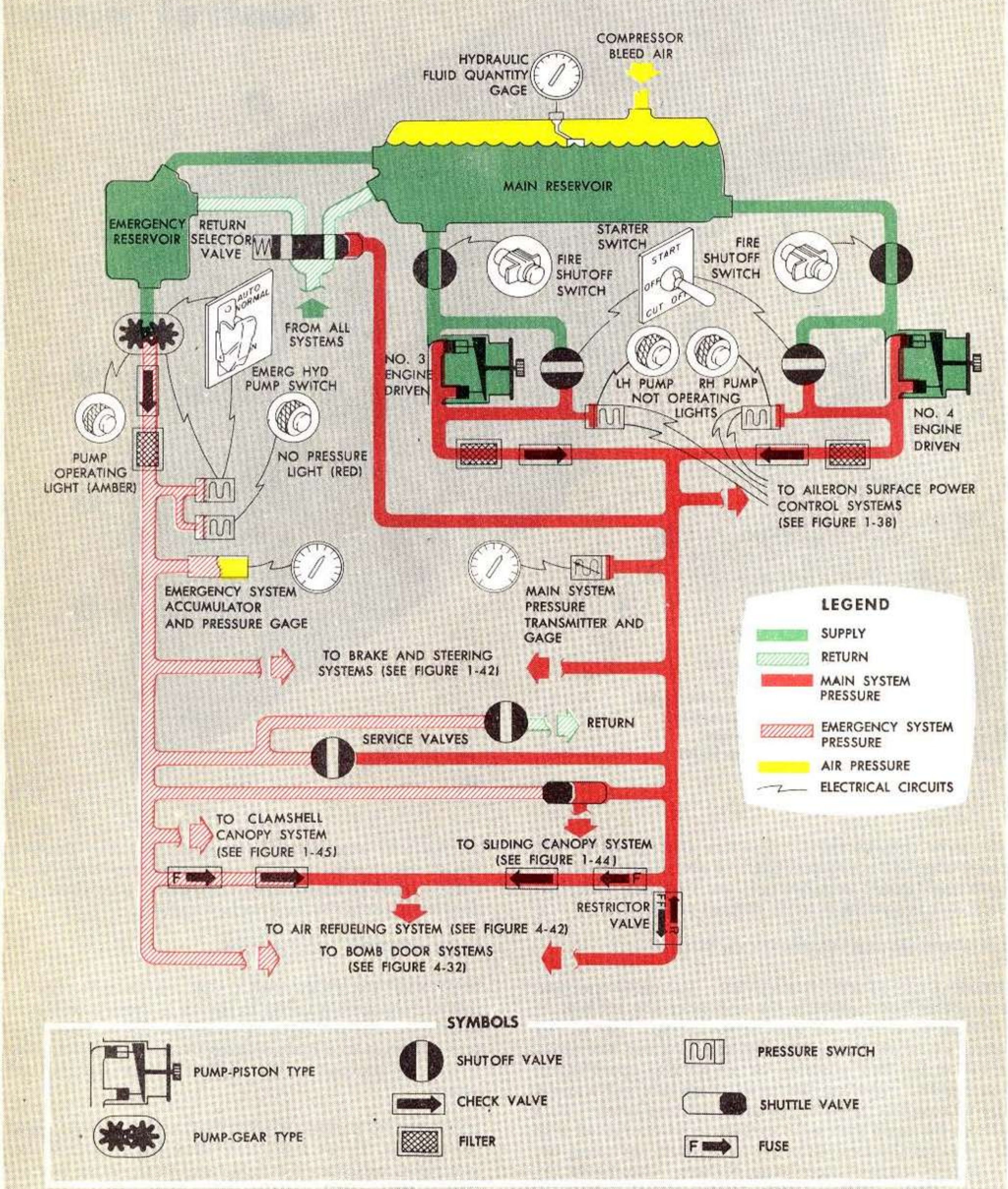


Figure 1-36.

provided by a circuit breaker on the upper DC power panel. A fluid level sight gage is also provided on the main system reservoir in the forward wheel well. (See "Servicing," 27, figure 1-54.)

MAIN HYDRAULIC PUMP WARNING LIGHTS. A low-pressure warning switch is located in the pressure line from each engine-driven hydraulic pump. When the pressure at either pump falls below 950 (±100) psi, the low pressure warning switch for that pump will close, causing a warning light (8, figure 1-35) marked either "LH Pump Not Operating" or "RH Pump Not Operating" on the hydraulic control panel to illuminate.

EMERGENCY HYDRAULIC SYSTEM

The emergency hydraulic system, through independent lines and an electrically driven pump, provides emergency pressure for all of those actuators served by the main system except the aileron surface power control systems. The emergency pump is operated by a DC motor capable of 20 minutes continuous duty with a 35-minute cooling period. The pump motor is energized by a switch on the copilot's hydraulic control panel and a pressure switch installed adjacent to the pump in the front wheel well. The pressure switch contacts are normally open and will close to start pump operation when the pressure drops to 2700 (±150) psi. When the pressure increases to 3000 (±150) psi, the switch opens the circuit to deenergize the control relay to stop pump operation. Fluid is supplied to the pump from an emergency hydraulic reservoir located in the forward wheel well. This reservoir is not filled directly, but receives overflow from the main reservoir when the main reservoir is more than approximately one-third full. Fluid flow is also automatically diverted to the emergency reservoir by the return selector valve at any time the main system pressure falls to 100 psi The emergency reservoir is pressurized to approximately 13 psi by main reservoir pressurization and a connecting line. A check valve located at the inlet side of the emergency filter prevents reverse flow into the pump when the pump is inoperative. Another check valve at the inlet side of the emergency relief valve isolates the emergency brake accumulator in order that emergency brake accumulator pressure may be utilized only for emergency brake application. The emergency relief valve opens into the return line at 3450 (±150) psi and will close when pressure drops to a minimum of 3100 psi.

EMERGENCY SYSTEM CONTROLS

EMERGENCY HYDRAULIC PUMP SWITCH. A guarded AUTO NORMAL--OFF--ON switch (spring-loaded to OFF from ON) (3, figure 1-35) on the copilot's hydraulic control panel electrically controls the emergency hydraulic pump. When in AUTO NORMAL, the emergency pump maintains the emergency system pressure between 2700 (±150) and 3000 (±150) psi, as controlled by the pressure switch. Holding the switch in ON position bypasses the pressure switch and allows the pump to build up the pressure to 3450 (±150) psi before the relief valve opens.

CAUTION

To prevent excessive pressures in the system the switch should be released when or before pressure reaches 3450 psi. Holding the switch in ON position after pressure has reached 3450 psi will allow pressure to build as high as 3750 psi. This condition could cause excessive heating of the hydraulic oil and damage the pump.

In OFF position, the pump motor is deenergized. The emergency pump circuit breaker is located on the upper DC power panel.

EMERGENCY SYSTEM INDICATORS

EMERGENCY SYSTEM PRESSURE GAGE. A pressure gage (4, figure 1-35) is located on the copilot's hydraulic control panel to indicate the pressure available in the emergency system. The gage is electrically connected to a pressure transmitter located on the air-side of the emergency accumulator and will read accumulator pressure.

NOTE

Pressure readings below 1500 psi are accumulator air pressures and hydraulic pressure may be zero.

EMERGENCY HYDRAULIC PUMP INDICATOR LIGHTS. Two emergency pump indicator lights marked "No Pressure" and "Pump Operating" (5, figure 1-35) are located on the copilot's hydraulic control panel to indicate pump operation and emergency system pressure condition. The circuit of the amber light marked "Pump Operating" is closed by the same relay that energizes the emergency pump, thereby indicating that the pump is operating. The circuit of the red light marked "No Pressure" is operated by a pressure switch adjacent to the pump pressure switch, and causes the light to come on when emergency system pressure drops to a minimum of 2000 psi.

FLIGHT CONTROL SYSTEMS

The rudder, elevator and ailerons are operated by rudder pedals and a control column and wheel. In normal operation, movement of the controls at the pilot's or copilot's station causes a conventional cable control system to position the metering arms in hydraulic actuators located at the control surfaces. Hydraulic pressure supplied through surface power control systems is metered to the actuators which move the control surfaces. Hydraulic actuation is provided to lighten the cockpit control pressures required to maneuver the airplane. To prevent the pilot from causing structural damage by unmonitored movement of the metering arms at high indicated airspeeds, light artificial control force, or "feel," is induced in the surface power control systems. Artificial feel for the ailerons

surface power control panel

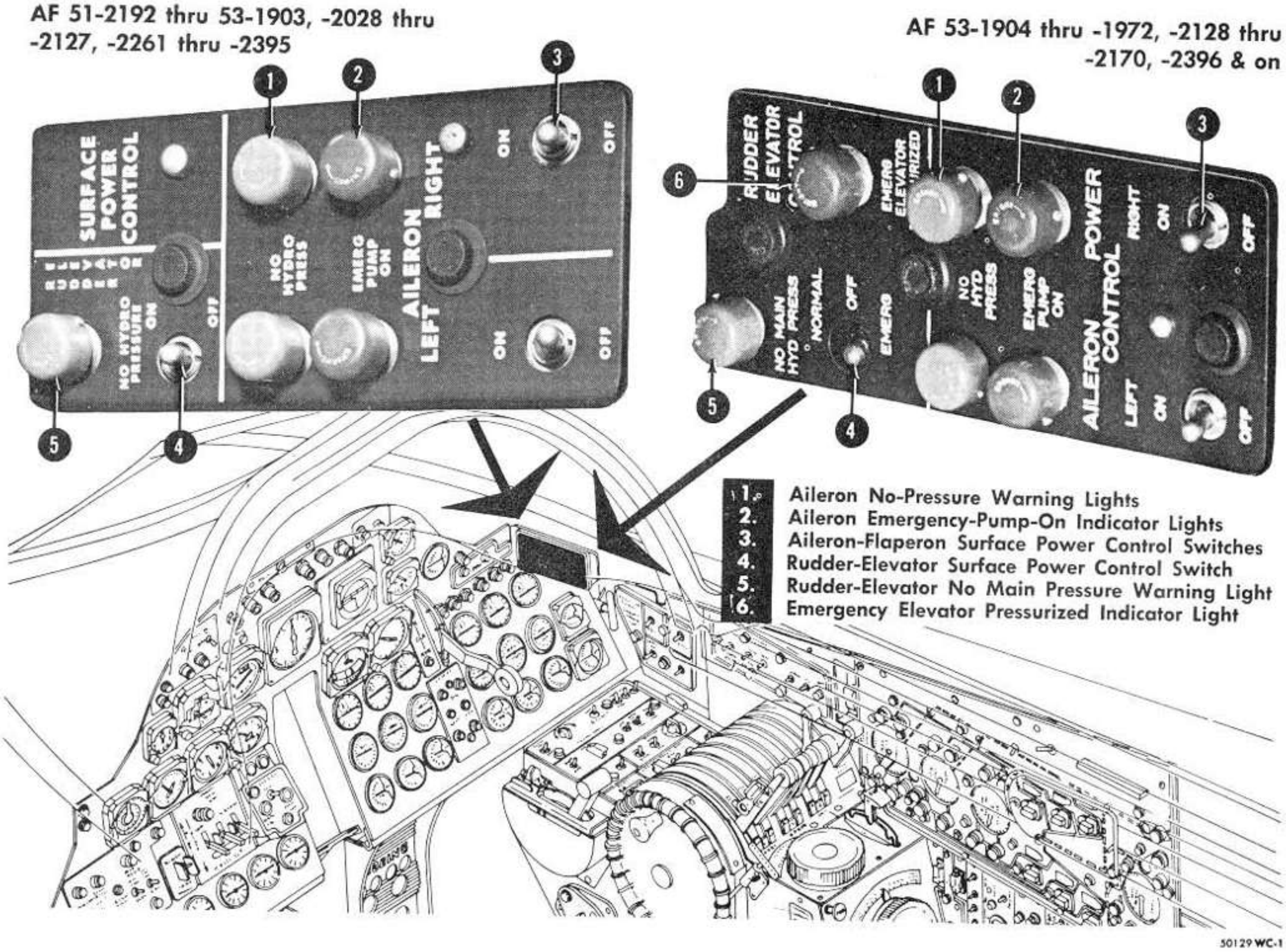


Figure 1-37.

is provided by a torsional centering spring located beneath the left aileron bus drum. When control wheel operation from the cockpit causes the bus drum to move, the centering spring shaft is rotated by the drum and winds a torsional coil spring in the selected direction from neutral position. The coil spring resists control wheel movement out of neutral thereby creating control feel for the pilot. In addition, the coil spring centers the ailerons when the control wheel is released. Artificial feel for the rudder and elevator is provided by ram air bellows assemblies known as "Q" springs. The "Q" spring for the rudder operates in the same manner as the elevator "Q" spring. With rudder-elevator power controls operating, a hydraulically actuated valve opens and allows ram air pressure from a vertical fin inlet to enter the bellows chambers of the "Q" springs. When the rudder and elevator torque tubes are turned by cable operation from the cockpit controls, they are required to compress the bellows assemblies against incoming ram air pressure which opposes rotation of the torque tubes. The resistance encountered provides artificial feel which is proportional to torque tube rotation representing surface deflection. Ram air pressure induces control force by increasing directly with indicated airspeed. When rudder-elevator power controls are inoperative, the hydraulically actuated valve shuts off ram air supply to the bellows, rendering artificial feel inoperative. To augment lateral control at low indicated airspeeds, the outboard flap section, or "flaperon," on each wing is designed to move with the corresponding aileron, provided the wing flaps are extended fully and aileron power controls are operating. With hydraulic power controls inoperative, the control surfaces are moved directly by the cable system. Control pressures are increased considerably but the pilot is aided by the action of trim tabs and a system of internal balance bays in each control surface. In addition to the stabilizing action of the trim tabs and balance bays, directional stability at low to medium indicated airspeeds is augmented by a directional damper unit in the rudder control system. All control surfaces are operated automatically when the automatic pilot is engaged. For a complete discussion of Flight Control Characteristics refer to section VI.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM (1)

A hydraulic power control system located in the empennage supplies pressure to operate the rudder and elevator. This power control system is entirely independent of the main and emergency hydraulic system and has a separate fluid reservoir, electrically driven hydraulic pump, surface actuators and controls. No alternate or emergency source of power is incorporated in this sytem. Actuation of the rudder and/or elevator control surfaces is accomplished through a corresponding motion of the pilot's and copilot's flight controls transmitted through the conventional cable control system to the surface actuators. The rudder-elevator power control system is energized by a toggle switch on a surface power control panel (figure 1-37) at the pilot's station. Normal operating pressure of the system is 1500 psi. If hydraulic pressure is below 350 (±55) psi, a red indicator light warns the pilot that hydraulic pressure is insufficient to operate the rudder and elevator. To protect the rudder and elevator surfaces, the power control system is turned off by a microswitch any time the control surface-lock lever is out of the full forward UNLOCK detent. DC power for the rudder-elevator power control system is supplied through a circuit breaker on the tail compartment power shield.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM CONTROLS

RUDDER-ELEVATOR SURFACE POWER CONTROL SWITCH. A two-position toggle switch (4, figure 1-37) marked ON--OFF (NORM--OFF on some airplanes) is located on the surface power control panel at the pilot's station. ON (NORM) position of the switch operates an electrically driven pump which supplies hydraulic pressure for actuation of the rudder and elevator. OFF position deenergizes the rudder-elevator power control system and turns off the electrically driven pump. The rudder and elevator then must be operated by direct control cable movement. A circuit breaker for the rudder-elevator power control circuit is located on the lower DC power panel.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM INDICATORS

RUDDER-ELEVATOR NO-PRESSURE WARNING LIGHT. A red warning light (5, figure 1-37) marked "No Hydro Pressure" is provided on the surface power control panel to illuminate whenever hydraulic pressure is below 350 (±55) psi in the rudder-elevator power control system. The light warns the pilot that hydraulic pressure is insufficient to operate the rudder and elevator. The rudder and elevator then must be operated by direct control cable movement.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM (2)

A rudder-elevator surface power control system (figure 1-37A) located in the empennage supplies hydraulic pressure to operate the rudder and elevator. This power control system is entirely independent of the airplane main and emergency hydraulic systems and has separate fluid reservoirs, electrically driven hydraulic pumps, surface actuators, and controls. For normal operation a main reservoir supplies hydraulic fluid to a main pump which delivers operating pressure of 1500 psi to both the rudder and elevator actuators. In the event of failure of the main rudder-elevator system, an alternate system incorporating an emergency fluid reservoir and pump is provided to insure continued hydraulic operation of the elevator only. Rudder control will revert to direct cable operation. The emergency elevator system is designed to take over operation of the elevator automatically if main rudder-elevator pressure drops below 450 (+150/-0) psi, or to be turned on manually if automatic changeover fails to take place. A switch and indicator lights for control of the complete rudder-elevator system are located on a surface power control panel (figure 1-37) at the pilot's station. In order to maintain emergency elevator hydraulic fluid at a temperature level to accomplish rapid changeover, a thermostat is included in the emergency elevator system. The thermostat functions automatically when DC power is on the airplane, starting the emergency elevator pump at fluid temperatures below -35° C (-30° F) and stopping the pump at fluid temperatures above -12° C (+10° F). Operation of the pump by thermostat control merely causes the emergency elevator fluid to be warmed by recirculation through a bypass valve back to the reservoir. Thermostat operation does not cause the emergency system to assume control of the elevator and no indication of emergency pump operation is displayed on the surface power control panel. To protect the rudder and elevator surfaces, the power control system is turned off by a microswitch any time the control surface-lock lever is out of the full forward UNLOCK detent. DC power for the rudder-elevator power control system is supplied through a circuit breaker on the tail compartment power shield.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM CONTROLS

RUDDER-ELEVATOR SURFACE POWER CONTROL SWITCH. A three-position toggle switch (5, figure 1-37) marked NORMAL--OFF--EMERG is located on the surface power control panel at the pilot's station. NORMAL position operates an electrically driven hydraulic pump and control valves to supply hydraulic pressure for actuation of both the rudder and elevator.

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(1) AF 51-2192 thru 53-1903, -2028 thru -2127, -2261 thru -2395
(2) AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

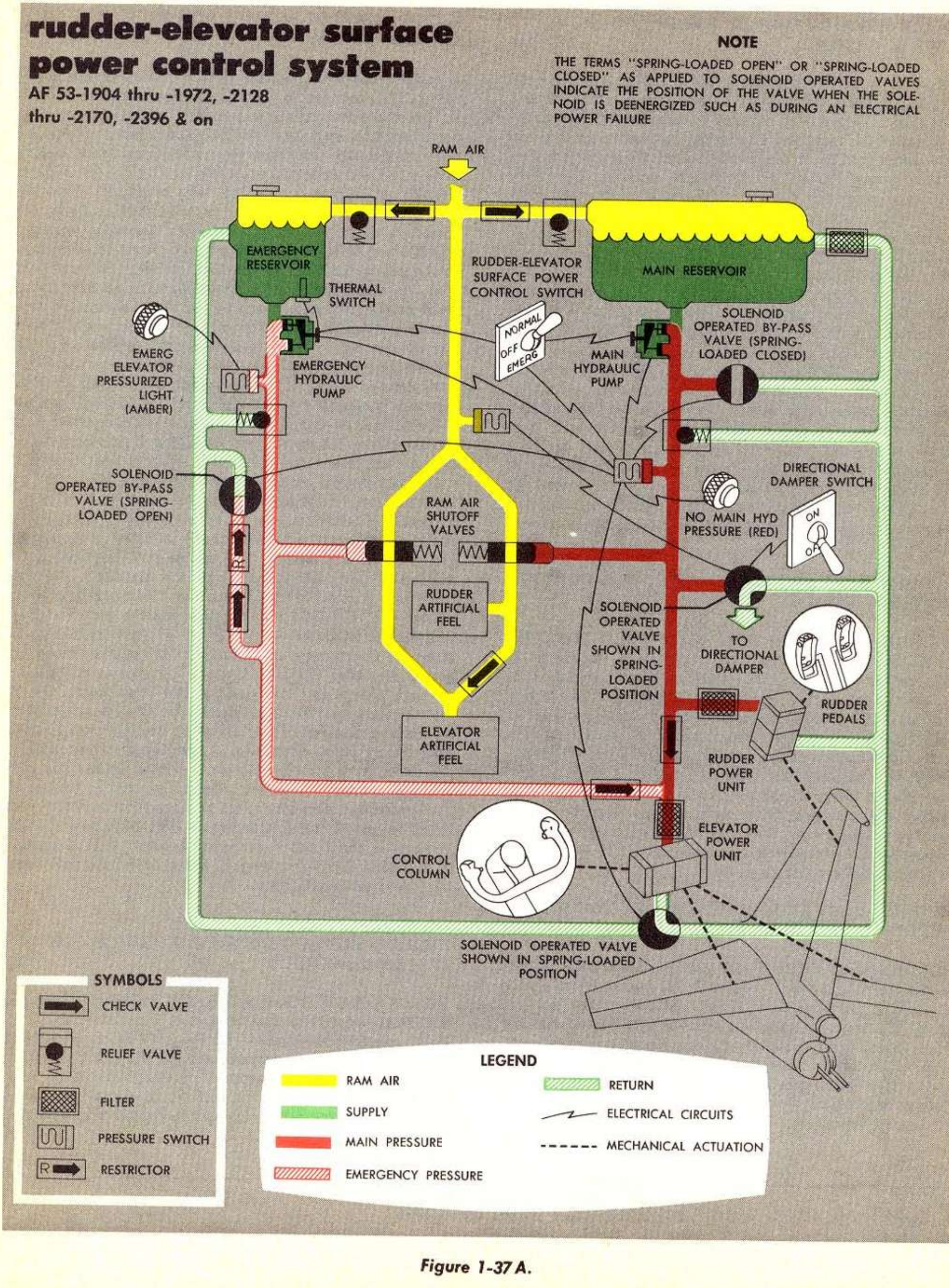
rudder-elevator surface power control system
AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on
NOTE
THE TERMS "SPRING-LOADED OPEN" OR "SPRING-LOADED CLOSED" AS APPLIED TO SOLENOID OPERATED VALVES INDICATE THE POSITION OF THE VALVE WHEN THE SOLENOID IS DEENERGIZED SUCH AS DURING AN ELECTRICAL POWER FAILURE
RAM AIR
EMERGENCY RESERVOIR
THERMAL SWITCH
RUDDER-ELEVATOR SURFACE POWER CONTROL SWITCH
NORMAL
OFF
EMERG
MAIN RESERVOIR
SOLENOID OPERATED BY-PASS VALVE (SPRING-LOADED CLOSED)
EMERG ELEVATOR PRESSURIZED LIGHT (AMBER)
EMERGENCY HYDRAULIC PUMP
MAIN HYDRAULIC PUMP
SOLENOID OPERATED BY-PASS VALVE (SPRING-LOADED OPEN)
RAM AIR SHUTOFF VALVES
DIRECTIONAL DAMPER SWITCH
ON
OFF
NO MAIN HYD PRESSURE (RED)
RUDDER ARTIFICIAL FEEL
SOLENOID OPERATED VALVE SHOWN IN SPRING-LOADED POSITION
TO DIRECTIONAL DAMPER
RUDDER PEDALS
ELEVATOR ARTIFICIAL FEEL
RUDDER POWER UNIT
ELEVATOR POWER UNIT
CONTROL COLUMN
SOLENOID OPERATED VALVE SHOWN IN SPRING-LOADED POSITION
SYMBOLS
CHECK VALVE
RELIEF VALVE
FILTER
PRESSURE SWITCH
R
RESTRICTOR
LEGEND
RAM AIR
SUPPLY
MAIN PRESSURE
EMERGENCY PRESSURE
RETURN
ELECTRICAL CIRCUITS
MECHANICAL ACTUATION

Figure 1-37 A.

aileron-flaperon surface power control system (typical)

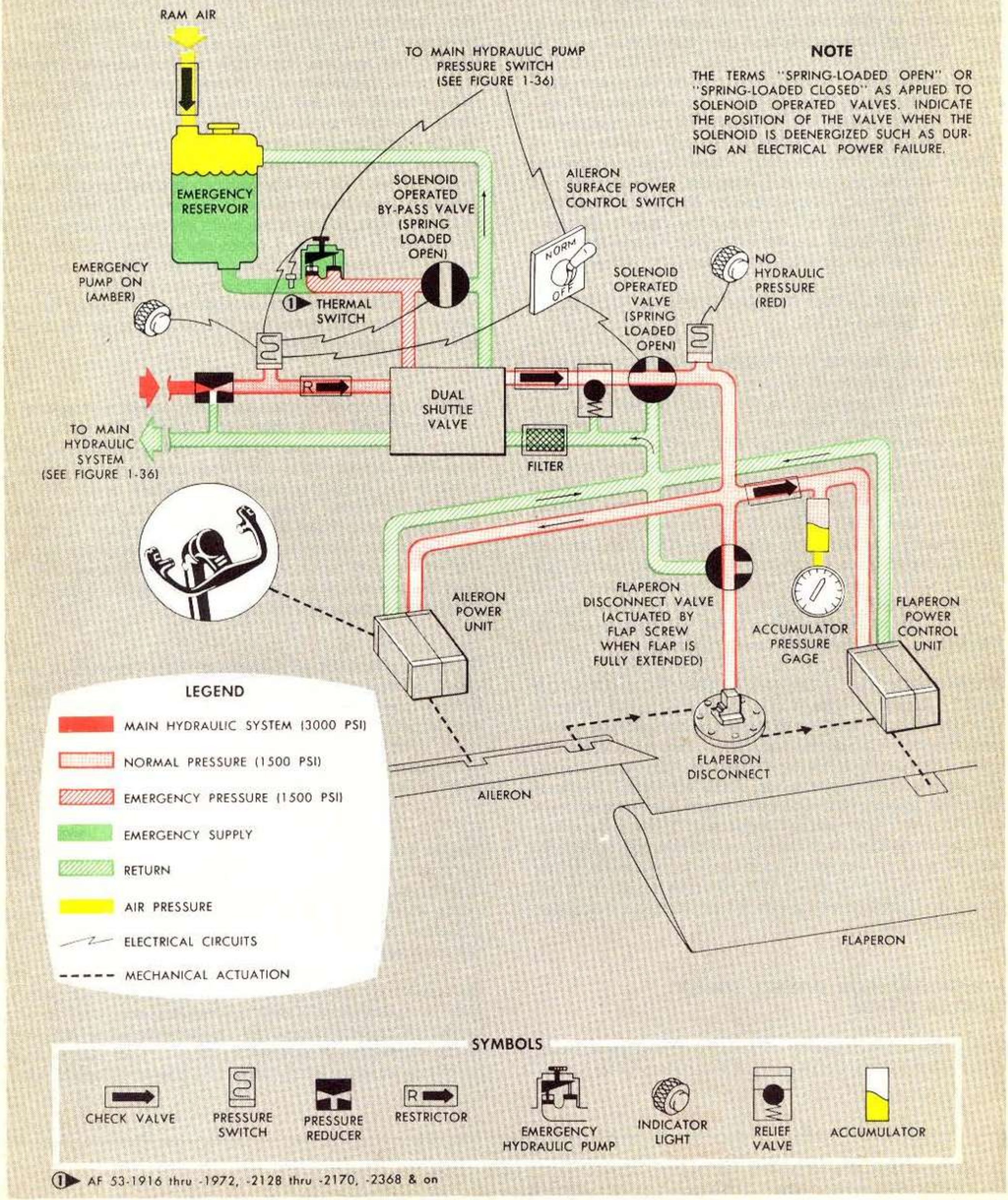

Figure 1-38.

In addition, NORMAL position allows the emergency elevator pump and control valves to be energized automatically and to provide hydraulic actuation of the elevator alone if the main rudder-elevator pressure drops below 450 (+150/-0) psi. When the emergency elevator system is activated, the main rudder-elevator system is cut out completely and the rudder then must be operated by direct cable control. EMERG position permits the pilot to manually turn on the emergency elevator system in case the main rudder-elevator system fails and automatic changeover does not occur. In OFF position, the rudder-elevator power control switch turns off both the main rudder-elevator system and the emergency elevator system. The rudder and elevator then must be operated by direct control cable movement. Circuit breakers for the rudder-elevator power control circuit and the emergency elevator power control circuit are located on the lower DC power panel.

RUDDER-ELEVATOR SURFACE POWER CONTROL SYSTEM INDICATORS

RUDDER-ELEVATOR NO-PRESSURE WARNING LIGHT. A red warning light (5, figure 1-37) marked "No Main Hyd Press" is provided on the surface power control panel to illuminate when main rudder-elevator system hydraulic pressure is below 450 (+150/-0) psi. The light warns the pilot that main rudder-elevator system hydraulic pressure is insufficient to operate the rudder and elevator. When the emergency elevator system builds up above 600 (+150/-0) psi the rudder-elevator no-pressure warning light goes out. This light should be illuminated when the rudder-elevator surface power control switch is in OFF position and DC power is on the airplane. DC power is supplied to the rudder-elevator no-pressure warning light through a circuit breaker on the upper DC power panel.

EMERGENCY ELEVATOR PRESSURIZED INDICATOR LIGHT. An amber light (6, figure 1-37) marked "Emerg Elevator Pressurized" is provided on the surface power control panel to illuminate whenever hydraulic pressure in the emergency elevator system is sufficient to support power control operation of the elevator. Normal operating pressure of the emergency elevator system is 1500 psi. The amber light will illuminate when emergency pressure increases to above 600 (+150/-0) psi and will go out when emergency pressure drops below 450 (+150/-0) psi. DC power is supplied to the indicator light through a circuit breaker on the upper DC power panel.

AILERON-FLAPERON SURFACE POWER CONTROL SYSTEM

A separate surface power control system (figure 1-38) is provided for each aileron. The aileron power control systems also operate their associated flaperons when the wing flaps are extended 100%. Hydraulic pressure to operate both ailerons is supplied through a dual hydraulic pressure system. This dual system normally draws its hydraulic pressure from the airplane main hydraulic system. However, if main hydraulic pressure fails, provisions are made for individual emergency system operation of each aileron system. In normal operation with power controls on, a pressure reducer in each aileron system reduces airplane main hydraulic pressure from 3000 to 1500 psi which is the operating pressure of the aileron systems. Each aileron system incorporates a separate hydraulic reservoir and an electrically driven hydraulic pump as a means to supply emergency pressure. If, during normal operation, the airplane main system pressure drops below 950 (±100) psi, a pressure switch automatically starts the emergency pump for the affected aileron. Emergency pressure builds up and opens the shuttle valves allowing emergency pressure to charge the aileron system and diverting return hydraulic fluid back to the emergency reservoir.

(1)

On some airplane if main hydraulic system pressure is recovered and rises above 950 (±100) psi, the emergency hydraulic pump for the affected aileron system will stop automatically and the airplane main hydraulic system will supply pressure once again to operate the control surfaces. Fluctuations of main system pressure above and below 950 (±100) psi can cause operation of an aileron power control to cycle between the normal and emergency sources. If this condition occurs, it may be necessary to turn off aileron power controls to eliminate erratic operation.

(2)

On other airplanes an automatic "hold" circuit is provided to retain operation of the aileron emergency hydraulic pump once the emergency system has taken over operation of its respective aileron system. This prevents cycling of an aileron system between normal and emergency sources if the airplane main hydraulic pressure is fluctuating above and below 950 (±100) psi.

(3)

Heater blankets are provided on the aileron emergency hydraulic pump to facilitate rapid starting at low air temperatures. An automatic thermal switch on each pump will turn on the heater blankets if air temperature is below -6° (±5°) C (20° (±8°) F) and DC power is on the airplane.

(4)

On some airplanes in order to maintain emergency aileron hydraulic fluid at a temperature level to accomplish rapid changeover, a thermostat is included in the emergency aileron system. The thermostat functions automatically when DC power is on the air-

(1) AF 51-2192 thru 53-1843, -2028 thru -2040, -2261 thru -2331
(2) AF 53-1844 thru -1972, -2090 thru -2170, -2332 & on
(3) AF 51-2192 thru 53-1915, -2028 thru -2127, -2261 thru -2367
(4) AF 53-1916 thru -1972, -2128 thru -2170, -2368 & on

plane, starting the emergency hydraulic pump at a fluid temperature of -37° (±3°) C (-35° (±5°) F) and stopping the pump at fluid temperatures above -15° (±3°) C (5° (±5°) F). Operation of the pump by thermostat control merely causes the emergency aileron fluid to be warmed by recirculation through a bypass valve back to the reservoir. Thermostat operation does not cause the emergency system to assume control of the aileron and no indication of emergency pump operation is displayed on the surface power control panel.

If pressure in the aileron system from either the airplane main hydraulic or the emergency source is below 350 (±55) psi a red indicator light warns the pilot that hydraulic pressure is insufficient to operate the affected aileron system. The aileron-flaperon power controls are controlled by switches on the pilot's surface power control panel (figure 1-37). The systems are supplied DC power through two circuit breakers on the lower DC power panel and two fuses, one on each inboard nacelle shield.

FLAPERONS

The outboard flap on each wing operates as a conventional flap with the additional feature of rotating upward to supplement aileron action. When the flaps are fully extended (100%) and the aileron surface power control system is operating, rotation of an aileron upward from approximately 5° up to full up will result in the corresponding flaperon rotating in an upward direction from the 35° down to the 10° down position. The flaperons are extended to and retracted from the full flap down position by the electrically operated flap motors. However, upward rotation, or "spilling," of the flaperons is done by hydraulic pressure from the aileron-flaperon power control system. This pressure is metered to flaperon actuators which are similar to the aileron actuators. Failure of an aileron power control system while flaps are full down will cause the associated flaperon to return to the full 35° down position and to function thereafter only as a flap. No further movement of the flaperon in conjunction with the aileron will take place. This is accomplished by the flaperon unit metering arm being spring-loaded to the "despilled" position. Since the flaperon accumulator is separated from the main system by a check valve, it will return the flaperon to the full down flap position if the aileron-flaperon power control system becomes inoperative.

AILERON-FLAPERON SURFACE POWER CONTROL SYSTEM CONTROLS

AILERON SURFACE POWER CONTROL SWITCHES. Two toggle switches (3, figure 1-37) marked ON--OFF (NORM--OFF on some airplanes) are located on the surface power control panel at the pilot's station. ON (NORM) position of either switch opens a valve to supply airplane main system hydraulic pressure (reduced to 1500 psi) to the selected aileron-flaperon system and also alerts the emergency pump circuit.

(1)

If main system pressure drops below 950 (±100) psi a pressure switch automatically starts the aileron emergency pump, and hydraulic powered operation of the aileron-flaperon system is sustained. However, if main system pressure subsequently rises above 950 (±100) psi, the emergency pump will stop and the main system will resume charging of the aileron-flaperon system.

(2)

If main system pressure drops below 950 (±100) psi a pressure switch automatically starts the aileron emergency pump to sustain hydraulic powered operation of the affected aileron-flaperon system. A "hold" circuit is energized to maintain emergency pump operation even if main system hydraulic pressure recovers and rises above 950 (±100) psi. The purpose of the "hold" circuit in the emergency system is to insure that a steady pressure will be maintained to the aileron-flaperon system and to guard against cycling of the system between main and emergency sources if the airplane main hydraulic pressure is fluctuating above and below 950 (±100) psi. The "hold" circuit thus eliminates the possibility of erratic aileron-flaperon operation when a main system malfunction exists. If for any reason a number of simultaneous demands upon the main hydraulic system cause main system pressure to drop momentarily below 950 (±100) psi, the emergency pump and "hold" circuit may take over the aileron flaperon operation. If no main system fluctuation or malfunction exists, aileron-flaperon operation may be returned to the main system by moving the corresponding aileron surface power control switch momentarily to OFF and then returning it to ON.

OFF position of either aileron surface power control switch shuts off the supply of hydraulic pressure to the selected aileron-flaperon system, deenergizes the "alert" circuit to the emergency system and bypasses all fluid into return lines. The respective aileron then must be operated by direct control cable movement. The flaperon functions only as a flap when its respective power control is off. Circuit breakers for the aileron surface power control switches are located on the lower DC power panel.

AILERON-FLAPERON SURFACE POWER CONTROL SYSTEM INDICATORS

AILERON EMERGENCY-PUMP-ON INDICATOR LIGHTS. Two amber "Emerg Pump On" indicator lights (2, figure 1-37), one for each aileron surface power control system, are on the surface power control panel. Each light is connected to the control circuit terminal of the respective electrically driven emergency hydraulic pump and, when illuminated, indicates that emergency hydraulic pump is operating.

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(1) AF 51-2192 thru 53-1843, -2028 thru -2040, -2261 thru -2331
(2) AF 53-1844 thru -1972, -2090 thru -2170, -2332 & on

AILERON NO-PRESSURE WARNING LIGHTS. Two red "No Hydro Pressure" warning lights (1, figure 1-37), one for each aileron surface power control system, are on the surface power control panel. Each light is connected to a hydraulic pressure switch located on the actuator side of the system shutoff valve. When system hydraulic pressure falls below 350 (±55), the pressure switch causes the no-pressure light to illuminate and indicates lack of sufficient hydraulic pressure to operate the system. This light also remains illuminated when the respective aileron surface power control switch is placed in OFF.

CAUTION

Out-of-trim forces will be encountered when surface power control system fails.

TRIM CONTROL SYSTEM

Trim tabs are provided on the control surfaces to facilitate trimming the airplane during flight with the surface power control system off. In addition, all trim tabs are linked to their respective control surface in such a manner as to move opposite to the direction of rotation of the control surface. This materially aids in the movement of the control surface by reducing the surface hinge moment.

Lateral trim is obtained through operation of a conventional trim tab in each aileron, while minor directional control for yaw conditions is accomplished by a rudder trim tab. The elevator contains two trim tabs. The right trim tab is operated by the pilot or copilot for normal elevator trim and by the automatic pilot during automatic pilot operation.

(1)
The left tab operates automatically and mechanically with the extension or retraction of the wing flaps to partially compensate for the pitching tendencies during flap operation.

(2)
The left trim tab functions only as a balance tab and reduces the elevator hinge moment.

(3)
The left tab is anchored in the fixed trail position and acts only as a portion of the elevator.

With surface power control on, trim tab surfaces have no effect on control surfaces due to surface power control system hydraulic pressure. Trim is accomplished by positioning the trim controls which reposition centering springs and Q-springs, moving the entire control surface to accomplish the trim. Trim tab surfaces are also moved to corresponding positions (see "Trim Coordination System," section VII) so if loss of power control occurs, no violent trim change will result.

TRIM CONTROL KNOBS AND INDICATORS

Conventional trim control knobs and indicators are on the pilot's and copilot's control stands (9, 10, 18, figure 1-10 and 4, 7, 12, figure 1-20).

TRIM TAB COORDINATION SYSTEM

In order to avoid excessive forces on the airplane structure in the event of surface power control failure, a trim tab coordination system is incorporated in the

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(1) AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247
(2) AF 51-2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -149, -248 thru -311
(3) AF 51-2192 thru -2356, 52-150 thru -201 and -312 & on

flight control system. The trim tab at each flight control surface can be positioned by means of an actuator driven by a DC motor operated by one of four momentary switches on the trim tab coordination switch panel (10, figure 1-6). On the first flight after repairs or adjustments have been made to the flight control system, a trim coordination procedure must be accomplished to establish a coordination between the position of the trim tab and the neutral position of the corresponding centering springs (for ailerons) and Q-springs (for rudder and elevator). Once trim coordination has been satisfactorily established, the actuator motor plugs should be disconnected from their power source receptacle and plugged into dummy receptacles adjacent to the actuators. In this manner, inadvertent trim changes are avoided.

trim tab coordination switch panel

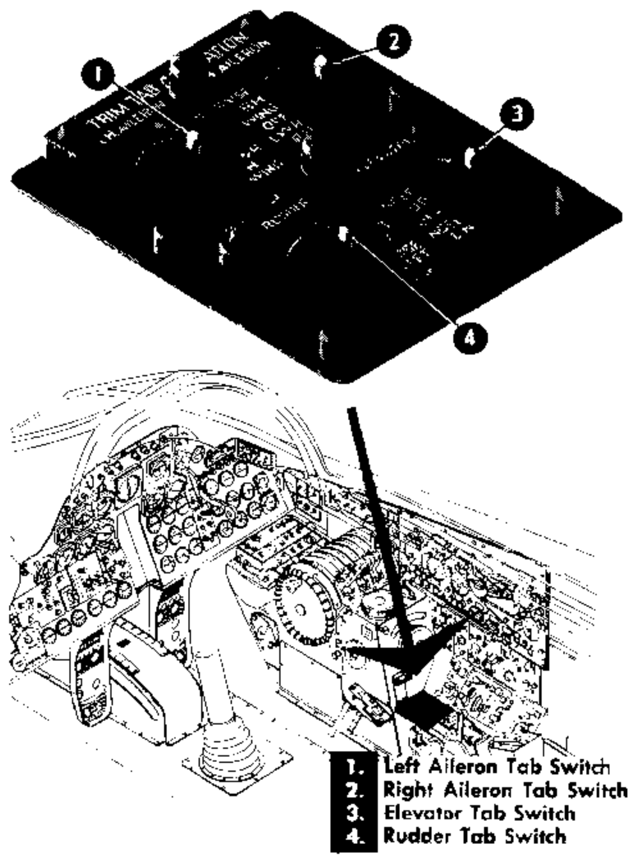

Figure 1-39.

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TRIM TAB COORDINATION CONTROLS

TRIM TAB COORDINATION SWITCHES. Four guarded momentary switches (1, 2, 3, and 4, figure 1-39) located on the trim tab coordination switch panel are provided for operation of trim tab coordination actuators. The left aileron tab switch has RAISE LH WING--OFF--LWR LH WING positions and the wing is lowered or raised by placing the switch in the appropriate position; a similar switch with RAISE RH WING--OFF--LWR RH WING positions is provided for the right aileron tab. The elevator tab switch is marked NOSE UP--OFF--NOSE DN and the airplane nose is trimmed up or down by placing the switch in the appropriate position, or trimmed right or left by the rudder tab switch marked NOSE RIGHT--OFF--NOSE LEFT. When a switch is in OFF, the actuator controlled by that switch is deenergized. Circuit breakers for the trim tab coordination control system are located on the lower DC power panel.

NOTE

> These switches are normally inoperative. In the event the trim tabs become out of coordination with the trim tab indicators, adjustment must be accomplished during a maintenance trim tab doordination control flight. Refer to section VII for coordination procedure.

DIRECTIONAL DAMPER

A directional damper system is provided to dampen automatically any undesirable directional oscillating tendencies (dutch roll) encountered in flight. The directional damper is helpful in rough air conditions such as encountered during landing approach and air refueling and is especially effective during high altitude flight in reducing pilot fatigue resulting from continuous correction of the lateral-directional oscillation. The system is controlled by a directional rate-gyro located in the right side of the bomb bay. During a yaw condition the directional rate-gyro detects the heading deviation and transmits a signal to an amplifier. The strength of the signal is in proportion to the rate of yaw. The amplifier receives the signal, amplifies it, and transmits it to an electric motor. The motor actuates a telescoping rudder control rod and moves the rudder surface through the surface power control system to correct for oscillation. Rudder pedals are not moved by movement of the rudder surface through operation of the directional damper. The rate-gyro operates on regulated AC power. On some airplanes* the gyro remains energized as long as power is being supplied to the secondary inverter bus. On other airplanes** the gyro remains energized as long as the

* AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
** AF 52-1417, 53-1819 thru -2170, -2279 & on

constant speed alternators supply power to the main AC bus. The system is energized provided the following conditions are met: directional damper switch is on, airspeed is below 335 knots IAS (setting of an impact pressure switch), rudder-elevator surface power control is on, and the rudder channel of the automatic pilot is disengaged. If any of these conditions are not met, the rudder control rod is locked in a fixed length and the directional damper system becomes inoperative. However, AC power is still supplied to the system in order that the rate-gyro motor will continue to run at full speed and the amplifier will remain ready for active operation. AC power is supplied through a fuse on the main AC power shield* or through a circuit breaker on the tail compartment power shield**.

DIRECTIONAL DAMPER CONTROLS

DIRECTIONAL DAMPER SWITCH. A directional damper ON--OFF switch (43, figure 1-8 and 40, figure 1-9) is on the pilot's instrument panel. ON position provides DC current to activate the directional damper system provided the airspeed is below 335 knots IAS, the rudder-elevator surface power control system is operating, and the rudder channel of the automatic pilot is disengaged.

RUDDER PEDALS

Both rudder pedals as a unit can be adjusted by pull knobs on the pilot's and copilot's control stands (11, figure 1-10 and 6, figure 1-20). On some airplanes, pull handles are provided in place of knobs. When the knob (or handle) is pulled out, the pedals spring to the aft position. When the pedals are moved to the desired position and the knob (or handle) is released, the pedals are latched in place. Toe pressure on any of the four pedals will actuate all brakes during either normal or emergency braking. On the ground and in flight, fore and aft movement of the rudder pedals will actuate the rudder and also the front gear steering system if the gear is extended and the steering ratio selector lever is in TAXI or in TAKEOFF, LAND. The pedals are used to operate the rudder hydraulically with surface control power on and manually with power off.

CONTROL COLUMN AND WHEEL

A conventional control column and wheel at the pilot's and copilot's stations are used to operate the elevator and ailerons through hydraulic pressure with surface power controls on or mechanically with power controls off. A control column disconnect handle (14, figure 1-10 and 10, figure 1-20) is provided at both the pilot's and copilot's stations to permit column stowage for easy access to the seats. Pulling up a disconnect handle approximately 1 1/2 inches to its fully extended position causes three things to occur at this station: the control wheel disconnects from the ailerons, the control column disconnects from the elevator, and the control wheel locks in center position. The column then may be stowed forward and latched in the instrument panel recess. The control column and wheel are reconnected to the elevator and ailerons by releasing the panel latch, holding the thumb button depressed on the disconnect handle, and pulling the column aft until the following operations take place: the control wheel unlocks from center, the control column reconnects to the elevator, and the control wheel reconnects to the ailerons. When engagement is completed, the disconnect handle will slide down to the fully engaged position.

CAUTION

When reengaging the control column, allow the disconnect handle to slide down into engaged position by itself while holding the thumb button depressed. Do not push down on the handle since damage to the elevator disconnect rod assembly may occur. Verify complete reengagement by checking that controls synchronize with those at the other station.

WARNING

- With either control column stowed (elevator and ailerons disconnected), it is possible to reengage the ailerons alone if the disconnect handle is pushed down accidentally or purposely to the engaged position. In this condition, full deflection of the reengaged control wheel on the stowed column is blocked by the instrument panel, thus restricting wheel throw available to the pilot flying the airplane at the other station. Likewise, any accidental obstruction of the reengaged wheel is transmitted to the control wheel at the other station. If the pilot flying the airplane encounters a blocked control wheel while the column at the other station is stowed, the disconnect handle at the other station should be checked immediately to insure that it is pulled to the fully extended position and remains there. This action alone will disconnect and recenter the aileron control wheel in case it had reengaged accidentally. However, the control column should be unstowed and reengaged in the normal manner following such an incident until the reason for the malfunction can be determined. (1)
- Under certain flight conditions either control column can be forced through the forward structural stop and inadvertently latched in the stowed position. This will necessitate unlatching the control column from the instrument panel in order to regain elevator control.

Automatic pilot release, microphone, MSI, and air refueling disconnect switches are on the control wheels.

AF 51-2193, -2196, -2199, -2206, -2357 thru 52-157, -202 thru -330, -394 thru -516

SURFACE LOCK LEVER

A surface lock lever (6, figure 1-10) with LOCK and UNLOCK positions is located on the pilot's control stand. The surface lock lever mechanically prevents the throttles from being advanced beyond the idle detent position when the surfaces are locked. Also, the surfaces cannot be locked if any throttle is beyond the idle detent position. When the lock lever is moved out of the full UNLOCK position, the rudder-elevator surface power control system is deenergized electrically and is inoperable. The control surfaces are locked by placing the lever in the LOCK position and operating the ailerons, elevator, and rudder until lock plungers seat and the surface controls cannot be moved. Rudder and ailerons are locked in neutral and the elevator is locked full down. With the lever in the full UNLOCK position, all flight controls and the throttles are free to move and the surface power control systems can be energized.

CAUTION

To prevent damage to the throttle lock mechanism, throttles must be in CUTOFF before placing the surface lock lever in the LOCK position.

YAW STRING

The strong interaction between aileron and rudder trim makes it important for the pilot to be able to detect small amounts of yaw. For this purpose, a yaw string (2, figure 1-4) is provided. The forward end of the string is attached to the forward end of the observer's escape hatch on the airplane centerline. The string is wrapped approximately 1 1/2 inches from the aft end to allow a tassel to form in order to stabilize the string during flight. A white line has been painted along the fuselage centerline directly forward of the pilot's windshield to provide a reference from which the amount of yaw may be determined. In normal flight, the yaw string lays along the white reference line, but any yaw will cause the string to move to the corresponding side of the reference line.

WING FLAP SYSTEM

The wing flaps are designed to provide high lift and low drag, and to operate with a minimum of pilot attention. Primary and secondary motors, powered from the DC bus, drive the flaps by connection with a series of torque tubes. The flap motors provide fast flap extension (approximately 20 seconds) with both motors in operation, and a comparatively slow flap retraction (approximately 40 seconds) due to primary motor operation only. The slow retraction allows the airplane to accelerate before the flaps reach the full up position. Limit switches are provided to prevent overrunning of mechanical stops. If the flaps are retracted to the 22.5% position before 195 (+3/-2) knots IAS is reached, a ram air pressure switch in the pitot system will open the flap retraction circuit and prevent further flap retraction until 195 (+3/-2) knots IAS is obtained; this prevents the airplane from settling due to insufficient lift. Landing gear squat switches deenergize the low speed warning and 22.5% stop retraction circuits to allow extension and full retraction of the wing flaps when the airplane is on the ground. To prevent an attempted takeoff with flaps retracted, the warning horn will sound when all throttles are advanced to 50% rpm*, or 63% rpm**, and the flaps are not fully extended. This circuit is energized by the squat switch and throttle-actuated microswitches. There is no provision for silencing the horn when all the throttles are advanced above 50% rpm*, or 63% rpm**, flaps not full down, and the airplane is on the ground.

(1)

The wing flaps also operate the left elevator trim tab mechanically. This coordinated flap-tab action provides automatic trim of the airplane under flight conditions to reduce the trim change resulting from flap extension.

WING FLAP CONTROLS

WING FLAP LEVERS

The wing flaps are normally controlled by levers (7, figure 1-10 and 4, figure 1-20) on the pilot's and copilot's control stands. The handle on each lever is in the shape of a miniature airfoil to facilitate recognition. The pilot's wing flap lever has notched UP--OFF--DN positions and the lever must be lifted out of the notch before it can be moved. The copilot's lever has similar positions. Both wing flap levers are interconnected and controllable from either station. When the lever is in UP, the flaps retract in approximately 40 seconds; when in DN, the flaps extend in approximately 20 seconds. The flaps are held in any intermediate position by placing the lever in OFF.

WING FLAP EMERGENCY SWITCHES

Two guarded DOWN--OFF--UP switches (3, figure 1-15) in front of the copilot's hydraulic control panel control the wing flap primary and secondary motors for emergency operation. These switches by-pass all limit, safety, and control lever switches. When either switch is placed in DOWN, both motors operate and extend the flaps in approximately 20 seconds.

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* AF 51-2357 thru -7077, -15804 thru -15812, 52-019 thru -041, -202 thru -223
** AF 51-2192 thru -2356, -7078 thru -7083, -17368 thru -17386, 52-042 thru -201, -224 & on
(1) AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247

When emergency retraction is desired, either the primary or secondary motor is selected by moving the corresponding switch to UP. Placing one switch to UP retracts the flaps in approximately 40 seconds; placing both switches to UP retracts the flaps in approximately 20 seconds. When the flaps approach either full-up or full-down position through actuation of the emergency switches, caution should be exercised as to not overrun the mechanical stops. It is suggested that the emergency switches be released before either the full-up or full-down position is reached and then flap actuation be continued by intermittent actuation of the switches to either extreme position.

LOW SPEED WARNING SWITCH

A low speed warning switch (14, figure 1-11) on the pilot's switch panel has ON and OFF positions and is guarded to the ON position. With the warning switch in the ON position, a ram air pressure switch in the pitot system will stop flap retraction at 22.5% down if the airspeed is below 195 (+3/-2) knots IAS. With the warning switch in the OFF position and the wing flap lever in the UP position, the flaps will retract completely regardless of airspeed. With the warning switch in the ON position, a warning horn will sound if the airplane airspeed drops to approximately 192 (±3) knots IAS and the flaps are less than 20% down. Lowering the flaps beyond the 20% flaps down position, placing the warning switch in OFF position, or increasing airspeed above approximately 195 (+3/-2) knots IAS will silence the warning horn.

CAUTION

The low speed warning switch should normally be left in ON position, as the OFF position not only silences the warning horn but also permits full flap retraction at dangerously low airspeeds.

WING FLAP INDICATORS

WING FLAP POSITION INDICATORS

DC operated remote indicating wing flap position indicators on the pilot's instrument panel (24, figure 1-8 and 21, figure 1-9) and copilot's instrument panel (14, figure 1-18; 14, figure 1-19; and 14, figure 1-19A) indicate flap position in percent of travel. A circuit breaker for the flap position indicators is located on the upper DC power panel.

LANDING GEAR SYSTEM

DC powered motors operate the landing gear and at temperatures between -29° to 49° C (-20° to 120° F) the gear will normally retract in approximately 11 seconds and extend in approximately 4 seconds.

NOTE

Below -29° C (-20° F) extension time will increase progressively with decrease in temperature. The maximum extension time allowable due to low temperatures is 90 seconds.

Bicycle-type front and rear main landing gear are mounted on the fuselage centerline and retract forward and upward into the fuselage. Lateral supporting outrigger gear are mounted under and retract forward into the inboard nacelles. Steering control of the front main landing gear is hydraulically accomplished by movement of the rudder pedals. The outrigger gear are freecastering up to 28° inboard and 93° outboard. Full swiveling of the outrigger gear for ground handling is accomplished by manually removing the torsion link quick-disconnect pins on each outrigger gear. Two DC motors are provided for each main gear and one for each outrigger gear. Both main gear motors are energized during normal retraction and one during normal extension. The same motors are energized for emergency retraction through a separate electrical system which bypasses all safety and limit switches. Emergency extension of the landing gear is accomplished by a manually operated cable system which unlocks the gear and allows it to free fall. After free fall, complete extension and locking is accomplished by further actuation of the manually operated cable system

The main landing gear wheel well doors are automatically opened and closed by the landing gear. An electrically operated latch which locks the doors in the closed position is installed on both forward and aft wheel well doors. This latch is released by two solenoids when the landing gear lever is placed in the DOWN position. The door actuators, aided by a serrated brake, hold the wheel well doors in the open position. The brake consists of two pairs of matching serrated plates. As the door approaches the full open position, the serrations are meshed together and held by a leaf spring attached to the fuselage structure, thus serving as an anti-buffeting device. The main gear wheel well doors hang open in a nearly vertical position when the landing gear is extended. When the forward main gear is retracted, the doors will open wider during the initial portion of their closing cycle. This is because of the geometric locations of the attaching points of the door actuating arms. The same is true during the later portion of the opening cycle of the forward landing gear wheel well doors. The outrigger doors hang open in a nearly vertical position when that gear is extended. These doors are actuated by a mechanical linkage driven by contact of the shock strut cylinder. To prevent buffeting the doors are locked open by an overcenter position of the actuators.

CAUTION

Prior to flight, the wheel well door-up latches should be inspected to make certain the door latch is in the unlatched position. If the latch is not in the unlatched position, the doors cannot be fully closed when the gears are retracted. Damage may result to the doors due to airloads at high speeds.

LANDING GEAR SYSTEM CONTROLS

LANDING GEAR LEVERS

A landing gear lever on the pilot's instrument panel (32, figure 1-8 and 29, figure 1-9) is interconnected with a landing gear lever on the copilot's landing gear control panel (5, figure 1-40). Each lever has UP--OFF--DOWN positions. Each position of the pilot's lever is fixed by detents. In UP position, the landing gear will retract and the brakes will be applied automatically, provided the front wheels are centered and all wheels are off the ground. In DOWN position, the landing gear will extend and, when in OFF position, the landing gear normal actuating circuits are deenergized. When the landing gear lever (pilot or copilot) is pulled up out of detent (either UP or DOWN position) and then released, the lever should return to OFF position and drop into detent. A landing gear solenoid lock (electrically actuated by the squat switch) prevents the normal landing gear levers from being moved to UP position while the airplane is on the ground. Landing gear control circuit breakers are located on the upper DC power panel.

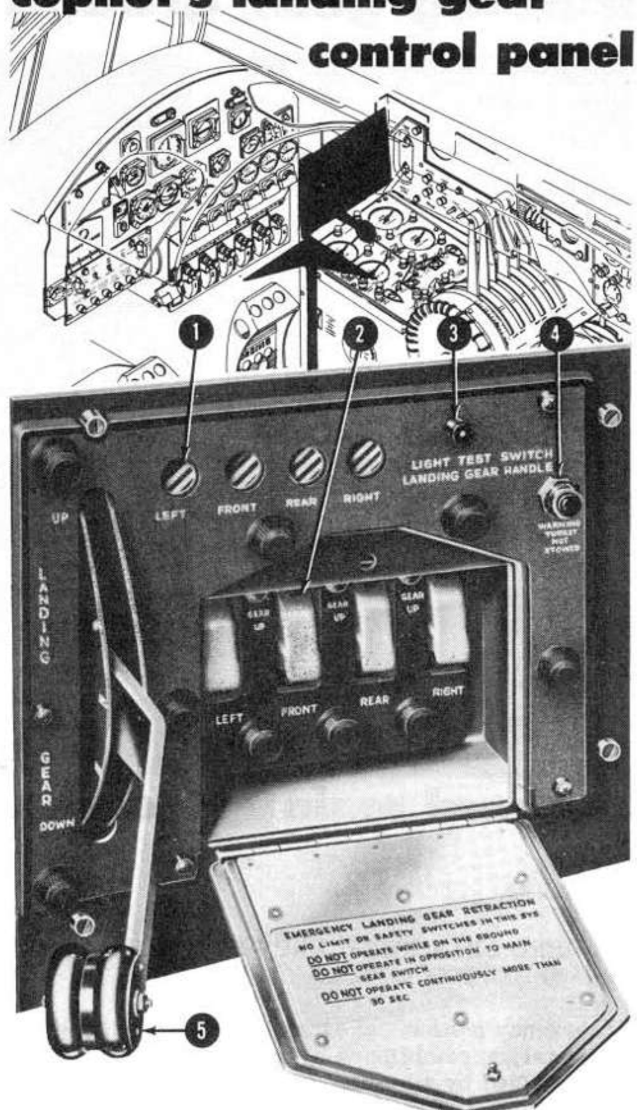
WARNING

The landing gear levers will be left in the DOWN position during takeoff, landing, and ground operation in order to prevent inadvertent collapse of the gear on the ground.

LANDING GEAR EMERGENCY RETRACTION SWITCHES

With DC power on the airplane the pilot can accomplish emergency retraction of all landing gear at one time by lifting a single guarded switch (12, figure 1-10) on the pilot's control stand. Individual emergency retraction of any main or outrigger gear can be accomplished by actuation of one of four guarded GEAR UP switches (2, figure 1-40) on the copilot's landing gear control panel. All landing gear emergency retraction switches will override the ground safety switches (squat switches) to cause retraction of the landing gear either on the ground or in flight.

copilot's landing gear control panel



1. Landing Gear Position Indicators
2. Emergency Retraction Switches
3. Landing Gear Lever Light Test Switch
4. Turret-Not-Stowed Light (1)▶
5. Copilot's Landing Gear Lever

(1)▶ AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278

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Figure 1-40.

landing gear ground locks

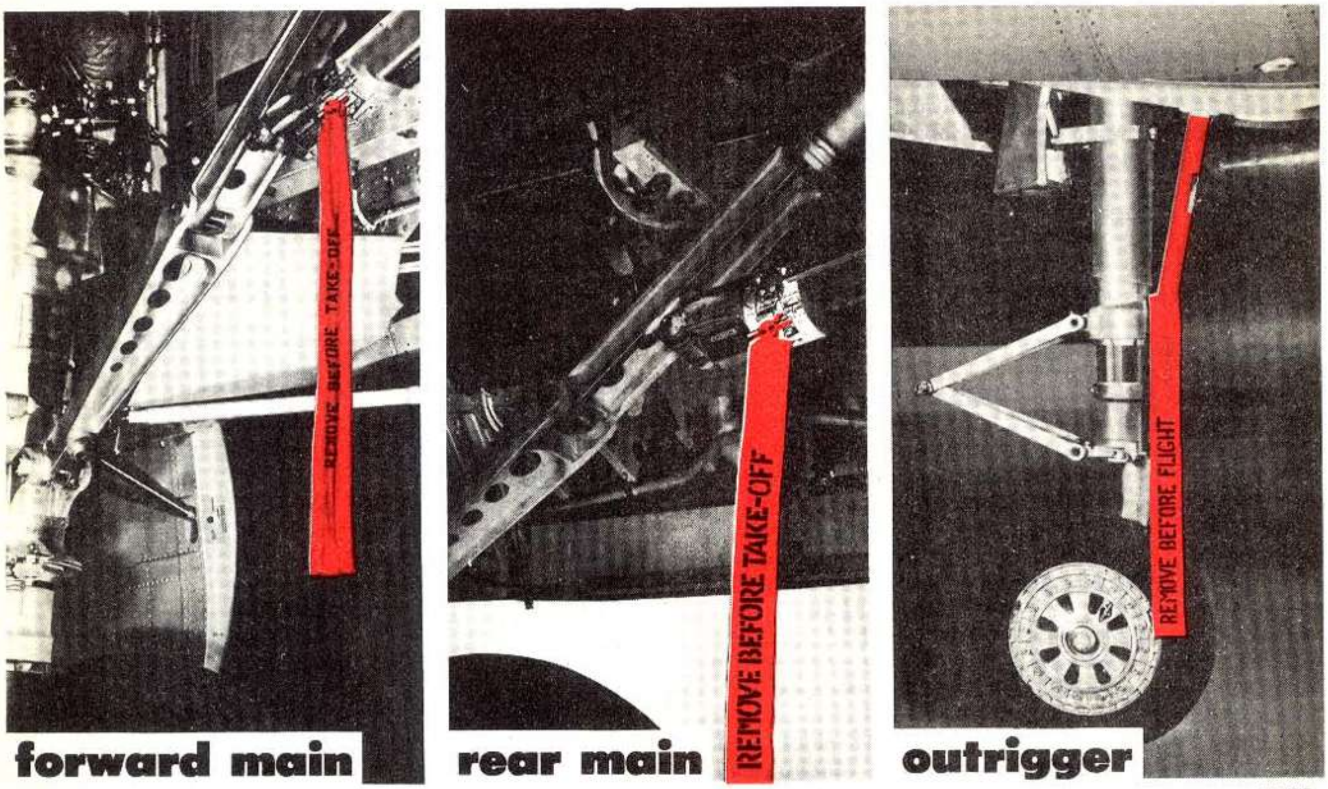

Figure 1-41.

LANDING GEAR EMERGENCY EXTENSION LEVER AND SELECTOR LEVERS

Emergency mechanical extension of all landing gears is largely accomplished by means of gravity forces and is aided by air drag.

An emergency landing gear extension stand with a ratcheting lever (2, figure 1-17) for each landing gear is located at the aft side of the copilot's station. When these handles are ratcheted individually, the corresponding landing gear will be unlocked and the gear will drop to or near the fully extended position. Further actuation of the ratcheting lever is required to fully extend and lock the gear. Actuation of the levers should be continued until there is a noticeable increase in the force required to pull the lever. When the landing gear is down and fully locked, a green indicator light on the forward lower side of the extension stand will glow.

NOTE

When operating ratchet handle to unlock and release landing gear, use full strokes. As many as five full strokes may be necessary to release the up lock.

CAUTION

Allowing a ratchet handle to snap back is likely to result in severe damage to the emergency extension system.

DRAG CONTROL SWITCH

On some airplanes two-position ON--OFF drag control switches (13, figure 1-10 and 8, figure 1-20), one at each station, are located on the pilot's and copilot's control stands. Other airplanes have only one switch which is located on the copilot's control stand. These switches are guarded and spring-loaded to the OFF position. Placing a switch in the momentary ON position extends the aft main and both outrigger gear causing additional drag. For the gear to be completely extended and locked in the full down position, the switch must be in ON position until a down indication appears in the windows of the gear position indicators. The landing gear lever must be in OFF position before the drag control switch will lower the gear.

NOTE

- The drag control switches are inoperative on modified B-47B airplanes not having the bail-out spoiler door installed.
- The copilot's drag control switch is located (1) directly above the air refueling system selector switch. Since both switches are identical, care should be exercised to prevent inadvertent actuation of the wrong switch.

LANDING GEAR GROUND LOCKS

Accidental collapse of the forward and rear main landing gears is prevented by manual insertion of a shear pin type ground lock (figure 1-41) in a hole located in the lower end of each main landing gear retracting screw mechanism. Accidental collapse of the outrigger gears is prevented by installing a strut type ground lock (figure 1-41) between a lug on the forward side of each outrigger gear strut assembly and a boss of each outrigger gear trunnion support. These locks are stowed just inside and forward of the camera access door located in the underside of the fuselage below the dorsal fin. (See 18 and 19, figure 1-4.)

LANDING GEAR INDICATORS

LANDING GEAR POSITION INDICATORS

Four DC operated tab window-type indicators (33, figure 1-8 and 30, figure 1-9) on the pilot's instrument panel and four identical indicators (1, figure 1-40) on the copilot's landing gear control panel show, by interchangeable tabs, the positions of the main and outrigger gears. When the outriggers gears are up and locked and the main gears are up and locked and the door latches in latched position, an UP tab will appear in the window. A gear in an intermediate position or a main gear door latch in an unlatched position will be indicated by a tab with slanting alternate red and white stripes; and a down and locked gear will be indicated by a tab showing a figure of a wheel.

LANDING GEAR INDICATING AND WARNING LIGHTS

One set of lights including one red "Unsafe to Land" light and four green "Gear Down and Locked" lights (3, figure 1-17) are on the emergency landing gear extension stand at the copilot's station. The red "Unsafe to Land" light is on at all times when any of the gears are not in "up and locked" or "down and locked" position. Red "Unsafe to Land" lights, one in each lever, are located in the tip of the pilot's and copilot's landing gear levers. A push-to-test switch (3, figure 1-40) located on the copilot's landing gear control stand is provided to test the lights located in the landing gear levers. Circuit breakers for the landing gear warning system are located on the upper DC power panel.

WARNING HORN

If any one of the landing gears is not down and locked when any throttle is retarded below 50% rpm*, or 63% rpm**, a landing gear warning horn will sound. A landing gear warning horn release knob (16, figure 1-10) is located on the left side of the pilot's control stand on some airplanes, and on the aft end of the control stand below the aileron trim control on other airplanes. Pulling out the knob will silence the warning horn until the throttles are advanced and retarded again below 50% rpm* or 63% rpm**, at which time the horn will automatically sound again if any one landing gear is not down and locked. The warning horn is electrically operated and protected by a circuit breaker on the upper DC power panel.

FRONT GEAR STEERING SYSTEM

The front landing gear is steerable through a hydraulic control system (figure 1-42) operated by the rudder pedals. Hydraulic pressure is supplied by the main or emergency hydraulic system. When the landing gear is retracted the front gear is automatically centered and the steering system is disconnected from the rudder pedals. Extension of the landing gear automatically aligns the front gear to correspond with the position of the rudder pedals after it has cleared the wheel well. Shimmy damping is also provided by the hydraulic steering system.

FRONT GEAR STEERING SYSTEM CONTROLS

STEERING RATIO SELECTOR LEVER

The front gear steering ratio selector lever (1, figure 1-10) on the pilot's control stand, when placed in the TOW position, actuates a hydraulic disconnect valve. The valve hydraulically disconnects the rudder pedals from the front gear steering system. When the selector is in the TAXI or TAKE-OFF, LAND position, the rudder pedals are connected to the steering system in ratios best suited for these operations. TAXI allows a maximum wheel deflection of 60° right or left (a total of 120°) which will permit turning the airplane within an area 160 feet in diameter. TAKE-OFF, LAND position allows a maximum wheel deflection of 6°*** (12°****) right or left for a total of 12°***(24°****).

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* AF 51-2357 thru -7077, -15804 thru -15812, 52-019 thru -041, -202 thru -223
** AF 51-2192 thru -2356, -7078 thru -7083, -17368 thru -17386, 52-042 thru -201, -224 & on
*** AF 51-2357 thru 52-111, -202 thru -311, -394 thru -478
**** AF 51-2192 thru -2356, 52-112 thru -201, -312 thru -393, -479 & on
(1) AF 51-5235 thru -7083, -17368 thru -17386, 52-029 thru -157, -394 thru -497

BRAKE SYSTEM

Hydraulic pressure to operate the brakes is provided by the main or emergency hydraulic systems. Toe pressure on any one of the four rudder pedals will actuate brakes on the front and rear main gear (the outrigger gear are not equipped with brakes). Should the main hydraulic system fail, emergency brakes are applied by depressing the rudder pedals further than necessary for normal braking. Retraction of the main gear automatically operates the brakes to prevent wheel rotation. The pilot's indication of automatic brake valve operation is a downward movement of the pedals as the brakes are automatically applied. In the event of failure of the automatic brake actuation system and the gear is partially retracted, brakes should be applied gradually. Rapid application of brakes with gear in a partially retracted position can impose forces which would overload the gear retraction screw. An antiskid system on each main gear wheel is available to relieve brake pressure when a skid is detected. The only difference between conventional braking and use of antiskid is that with antiskid operative, the brakes can be applied earlier in the landing roll and maximum braking can be maintained without excessive tire wear due to skids. Antiskid is effective only in the main brake system. Emergency brake pressure bypasses the antiskid valves. The antiskid system is DC operated, powered through circuit breakers on the upper DC power panel.

BRAKE SYSTEM CONTROLS

BRAKE LOCK CONTROL

On some airplanes a brake lock knob (46, figure 1-8 and 46, figure 1-9) on the pilot's instrument panel and on other airplanes a brake lock handle (20, figure 1-10) on the left side of the pilot's control stand is provided to set the parking brakes. The brake lock control, spring-loaded to the retracted position, locks the left brake pedal in the depressed position thus maintaining hydraulic pressure in the brake expander tubes. The proper sequence for setting the parking brake is to apply toe pressure on the left rudder pedal, pull out the brake lock control, release the pedal then release the control. With the brake set the control will remain extended approximately 1 inch. The parking brake may be released by depressing the left rudder pedal until the brake lock control retracts, then release the brake pedal.

ANTISKID SWITCH

An antiskid ON--OFF switch (13, figure 1-11) on the pilot's switch panel controls the antiskid system on all main landing gear wheels. ON position electrically energizes the system allowing the antiskid to function. OFF position deenergizes the system, illuminating the antiskid inoperative light (13, figure 1-8) on the pilot's instrument panel. The switch should be ON at all times.

BRAKE SYSTEM INDICATORS

MAIN BRAKE SYSTEM PRESSURE GAGE

A remote indicating pressure gage (7, figure 1-35) on the copilot's hydraulic control panel is connected electrically to the air side of the main system brake accumulator. Normal main system brake pressure is 2000 to 3000 psi (figure 5-1).

ANTISKID INOPERATIVE LIGHT

An amber light (13, figure 1-8 and 23, figure 1-9) on the pilot's instrument panel will go out when the antiskid switch is placed in the ON position. The light will show a steady signal when the antiskid system on any one of the main wheels is inoperative. The design of the antiskid system allows a certain amount of flashing of the light immediately after touchdown. This flashing actually indicates normal operation and is caused by the operation of the fail-safe relay within the system. A separate circuit breaker for the antiskid indicator light circuit permits the light to illuminate to indicate an inoperative condition where a fault in the antiskid system has tripped the antiskid circuit breaker.

EMERGENCY BRAKE SYSTEM PRESSURE GAGE

A remote indicating pressure gage (6, figure 1-35) on the copilot's hydraulic control panel is connected electrically to the air side of the brake accumulator. Emergency brake pressure is not available to the emergency brake metering valve until the pressure in the system has reached normal operating values as indicated on figure 5-1.

BRAKE CHUTE SYSTEM

A Type D-1 32-foot ribbon-type brake chute is installed in the aft section of the fuselage and can be deployed by either the pilot or copilot. The brake chute is provided as a means of applying large decelerating forces over the first part of the landing roll. Brake chute deployment speed is dependent upon modification of the chute. If the chute has not

brake and steering system

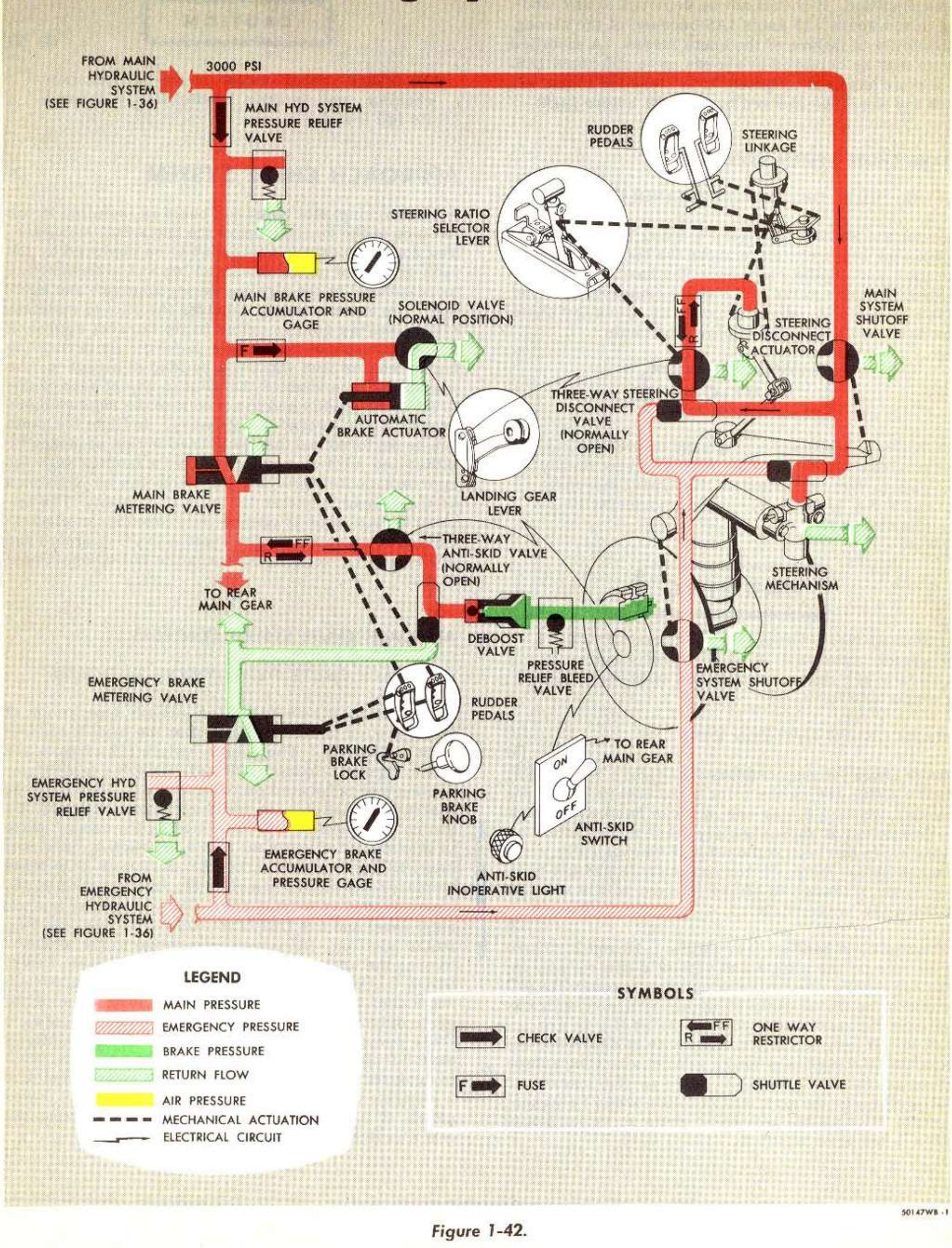

Figure 1-42.

been modified, it should not be deployed at any landing speed above 115 knots IAS because of the strong possibility of failure of the chute risers. A modified chute may be deployed at speeds up to 160 knots IAS. If a chute has been modified, it is stenciled to that effect and should be checked by the pilot before flight.

BRAKE CHUTE SYSTEM CONTROLS

BRAKE CHUTE DEPLOYMENT HANDLES

Deployment handles (3, figure 1-5 and 1, figure 1-15) to open the brake chute are above the control stands at the pilot and copilot stations. The handles are connected by cables to the brake chute compartment, and a pull on either handle mechanically opens the chute compartment doors and deploys the chute.

CAUTION

To insure proper deployment of brake chute, pull deployment handle with an even steady pull to the full extent of its travel (approximately 4 1/2 inches). Hold momentarily at end of travel.

WARNING

Remain clear of brake chute compartment doors during operation of deployment handles as doors are spring-loaded and open with considerable force.

BRAKE CHUTE JETTISON HANDLES

(1)

Brake chute jettison handles (17, figure 1-10 and 3, figure 1-20) are on the pilot's and copilot's control stands. Pulling either one of these handles through its full travel of approximately 5 1/2 inches after the brake chute has been deployed will mechanically jettison the brake chute. If the brake chute has not been deployed, actuation of either jettison handle will not jettison the brake chute.

(2)

Chute jettison handles (17, figure 1-10 and 3, figure 1-20) are on the pilot's and copilot's control stands Pulling either one of these handles through its full travel of approximately 10 inches will mechanically jettison the brake and approach chutes if both are deployed. If only one or neither chute is deployed, the actuation of the jettison handle will not affect the stowed chute or chutes The handles are spring-loaded and will return to the original position when released, thereby allowing the remaining chute to be jettisoned after it has been deployed.

CAUTION (1) (2)

To insure proper action of the jettison mechanism, pull jettison handle slowly through its full travel.

APPROACH CHUTE SYSTEM (2)

A 16-foot ring-slot approach chute is installed in the left side of the fuselage below the horizontal stabilizer. The approach chute is intended to be deployed by the pilot or copilot on the downwind leg and is designed to increase drag on the airplane during approach and landing. The increased drag requires the pilot to maintain higher engine rpm in order to fly correct approach speeds throughout the landing pattern. By permitting higher engine rpm without a buildup of airspeed, the approach chute enables the pilot to adjust rate of descent more readily and to accelerate the engines more rapidly if a go-around is necessary. In flight the chute can be deployed and then jettisoned in that sequence by either the pilot or copilot. After a landing with the approach chute deployed, the chute can be jettisoned on the ground by either the pilot or copilot. The approach chute door is opened and closed by an electrically driven actuator. The system is DC operated and protected by circuit breakers in the tail compartment shield.

APPROACH CHUTE SYSTEM CONTROLS

APPROACH CHUTE DEPLOYMENT SWITCHES

Individual toggle switches for inflight deployment of the approach chute are located at the pilot's and copilot's stations. The pilot's switch (12, figure 1-8 and 9, figure 1-9) has DEPLOY--DOOR CLOSED positions and is located on the upper left corner of the instrument panel. On some airplanes the copilot's switch (12 figure 1-16) is located on the canopy guard to the left and slightly aft of the instrument panel and has DEPLOY--DOOR CLOSED positions. On other airplanes the copilot's switch (1, figure 1-19 and 28, figure 1-19A) is located on the left side of the instrument panel and has DEPLOY--OFF positions. In DEPLOY position, DC power is supplied to the actuator to open the approach chute door and deploy the chute. DOOR CLOSED or OFF position closes the approach chute door after the chute has been jettisoned or if the chute did not deploy. A microswitch in the approach chute compartment prevents the pilot's or copilot's switch from closing the door while the approach chute is deployed. Each deployment switch is provided with a separate control circuit breaker on the aft DC power panel. If a circuit breaker for one switch trips, the other switch remains operable.

(1) AF 51-2357 thru 52-070 and -202 thru -247
(2) AF 51-2192 thru -2356, 52-071 thru -201, -248 and on

EXTERNAL APPROACH CHUTE DOOR SWITCH

A CLOSE--NORM--OPEN toggle switch for external ground operation of the approach chute door is located behind a small access panel in the fuselage just aft of the approach chute door. Holding the switch in OPEN position supplied DC power to open the approach chute door. The door may be stopped at any intermediate position by releasing the switch which is spring-loaded to return to NORM. In NORM position the circuits for external operation are deenergized and the door cannot be operated from the pilot's or copilot's position. Placing the external switch in CLOSE position closes the approach chute door. The switch is guarded in the CLOSE position, but intermediate stopping of the door is possible by returning the switch to NORM. The pilot's and copilot's switches must both be in the DOOR CLOSED or OFF position before the external switch will operate the door. A circuit breaker beside the external switch protects the OPEN circuit but does not protect the CLOSE circuit. To isolate the door actuator circuits completely, two circuit breakers in the tail compartment power shield must be pulled.

APPROACH CHUTE JETTISON HANDLES

Chute jettison handles (17, figure 1-10 and 3, figure 1-20) are on the pilot's and copilot's control stands. Pulling either one of these handles through its full travel of approximately 10 inches will mechanically jettison the brake and approach chutes if both are deployed. If only one or neither chute is deployed the actuation of the jettison handle will not affect the stowed chute or chutes. The handles are spring-loaded and will return to the original position when released, thereby allowing the remaining chute to be jettisoned after it has been deployed.

CAUTION

To insure proper action of the jettison mechanism, pull jettison handle slowly through its full travel.

INSTRUMENTS

Flight instruments are grouped in regulated alternating current, direct current, pitot-static, and miscellaneous classes.

REGULATED ALTERNATING CURRENT INSTRUMENTS

Regulated alternating current instruments include gyro compasses and attitude indicators. On some airplanes* fuses for these instruments are in the main AC power shield, and on other airplanes ** in the forward AC power shield.

ATTITUDE INDICATOR

A Type J-8 attitude indicator (10, figure 1-18; 9, figure 1-19; and 9, figure 1-19A) is installed to provide the copilot with a constant visual indication of the flight attitude of the airplane in pitch and roll. The instrument has complete freedom through 360° of rotation about the roll axis and effective freedom of 360° about the pitch axis. The indicator may be caged manually by means of a gyro centering device operated by pulling the cage knob. The pitch attitude of the airplane is indicated with a range of 27° in climb or dive by displacement of the horizon bar with respect to the adjustable miniature airplane. When the airplane exceeds 27° in pitch, the horizon bar is held in the extreme position and the sphere becomes the new reference. A continued increase of climb or dive angle approaching the vertical attitude is indicated by graduations on the sphere. The attitude of the airplane about the roll axis is shown by the angle between the miniature airplane and the horizon bar and also by the bank index relative to the degree markings on the bezel mask. Because of acceleration forces acting on the erection mechanism of the attitude indicator during a normal airplane turn, errors in pitch and/or bank up to 5° may be noted upon return to straight and level flight. This "turn error" or "lag" will immediately begin to correct once true gravitational forces are sensed. If errors in excess of the aforementioned tolerance are encountered, the instrument should be replaced.

VERTICAL GYRO INDICATOR

A Type B-1 vertical gyro indicator (21, figure 1-8 and 16, figure 1-9) is installed on the pilot's instrument panel to provide the pilot with a constant visual indication of the flight attitude of the airplane in pitch and roll and is operated by a Type K-4 remote vertical gyro control unit installed below the pilot's floor. The vertical gyro is fully aerobatic in that it is not limited by pitch or roll. On some airplanes* the vertical gyro indicator system is supplied AC power by the instrument inverters through two fuses located in the main AC power shield and DC power through a circuit breaker in the lower DC power panel. On other airplanes** the vertical gyro indicator system is supplied AC power by constant speed alternators through two fuses located in the forward AC power shield and DC power through a circuit breaker in the lower DC power panel. Complete AC or DC power failure will deenergize the gyro system and cause "OFF" warning flag to appear within the indicator. However, a slight reduction in AC or DC power, or failure of certain electrical components will not cause the "OFF" flag to appear even though the system is not functioning properly. The flag will disappear in approximately 2 minutes after power is again restored to the system.

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* AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

** AF 52-1417, 53-1819 thru -2170, -2279 & on

WARNING

If is possible that a malfunction of the vertical gyro might be determined only by checking it with the N-1 compass and the turn-and-bank indicator.

(1)

NOTE

On some airplanes an erroneous indication may still exist even though the warning flag has disappeared after power has been restored following a power failure to the B-1 vertical gyro indicator. Inverter changeover or loss of AC power to the B-1 vertical gyro indicator results in the gyro being locked about the roll axis; if the airplane was banked during this "power off" condition, the gyro could be displaced from vertical to the extent of the airplane roll. During this time the "power off" warning flag would be visible. Upon reapplication of power, the quick erection cycle will occur for 2 1/2 minutes maximum and at the end of this period the "power off" warning flag will disappear. However, the error may be so large that it will persist after 2 1/2 minutes and will be removed by the slow erection rate of approximately 4° per minute.

The lower sensitivity limit of the turn error compensating mechanism in the K-4 remote vertical gyro is 40° per minute. Performance of turn maneuvers below this rate will result in turn errors seen on other conventional instruments. These errors can reach a maximum value equal to the angle of bank of the airplane. After the airplane has leveled out and is flying straight and level at constant speed, the error will be erected out at an erection rate between the limits of 3° or 6° per minute. Performance of turn maneuvers above 40° per minute will provide turn errors compensation. The system is not compensated for fore and aft accelerations and errors at the rate of 3° to 6° per minute will be induced as a result of accelerations or decelerations.

WARNING

A slight amount of pitch error in the indication of the vertical gyro indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run when using water injection and/or ATO. At this time, a climb indication error of approximately one and one-half bar widths will normally be observed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

DIRECT CURRENT INSTRUMENTS

Direct current instruments include turn-and-bank and outside air temperature indicators. Circuit breakers for these indicators are on the lower DC power panel.

DIRECT CURRENT INSTRUMENT CONTROLS

A turn-and-bank power switch (3, figure 1-18; 11, figure 1-19; and 11, figure 1-19A) with NORMAL--EMERGENCY positions is located on the copilot's instrument panel. This switch when placed in the NORMAL position energizes the pilot's and copilot's turn-and-bank indicators from the airplane DC power bus. When the switch is placed in the EMERGENCY position, the indicators receive power directly from the airplane batteries regardless of battery switch position. The switch is guarded in the NORMAL position. Separate circuit breakers for the pilot's and copilot's turn-and-bank indicators are located on the lower DC power panel for normal power. Circuit breakers for emergency power are on the emergency battery bus in the tail compartment power shield on some airplanes and in the left aft power shield on other airplanes.

PITOT-STATIC INSTRUMENTS

Pitot and static air pressures operate the airspeed indicators, Machmeter, altimeters, and rate-of-climb indicators. Two independent pitot pressure systems supply pitot pressure for instrument and equipment operation. The right pitot tube supplies pitot pressure to the copilot's and observer's airspeed indicators, bombing-navigation system, the flap warning switch, and the automatic pilot. The left pitot tube supplies pitot pressure to the pilot's Machmeter and airspeed indicator only. There are four separate static systems which operate from six static ports; three ports are located on either side of the fuselage aft of the canopy. Refer to figure 1-42A.

NOTE

(2)

On airplanes having the Y-4 bomb sight retractable cover, the pilot's airspeed indicator may read as much as 15 knots slower than the copilot's airspeed indicator when the cover is partially or fully opened and the pilot's airspeed indicates between 160 and 195 knots. Fluctuations of the pilot's airspeed needle may exceed the above error by approximately ±10 knots. The duration and frequency of the fluctuations are inconsistent and variable in nature. Therefore, it is recommended that the bomb sight cover be kept fully closed when not in use.

(1) AF 51-2192 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
(2) AF 51-2192 thru 53-1876, -2028 thru -2117, -2261 thru -2367

pitot-static system

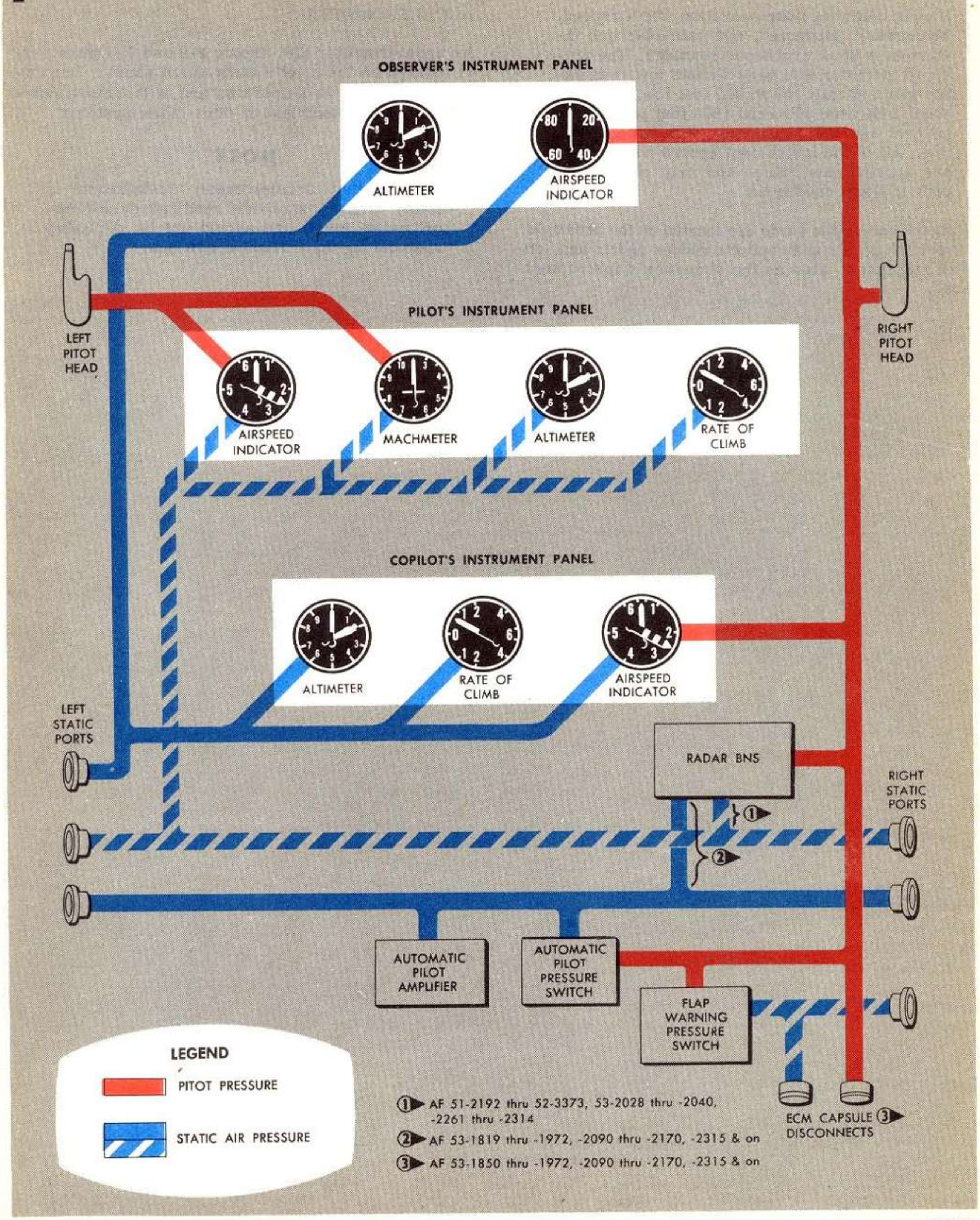

Figure 1 - 42 A.

NOTE

During bomb bay door operation, the airspeed, Machmeter, altimeter, and rate-of-climb instruments show erroneous readings. The airspeed indicator will read 5 knots low, altimeter will indicate 150 to 200 feet low, rate-of-climb indicator will read 1500 feet per minute descent and the Machmeter will indicate .02 low. All of the instrument errors noted above are approximate values and may vary under certain flight conditions.

Altimeter correction cards are located on the pedestals between the pilot's and copilot's rudder pedals and, on later airplanes, also on the observer's instrument panel.

MISCELLANEOUS INSTRUMENTS

ACCELEROMETER

An accelerometer (10, figure 1-8 and 7, figure 1-9) is located on the pilot's instrument panel. The accelerometer is self-operated and is therefore independent of the electrical or pitot-static systems.

NOTE

The present accelerometer installation is likely to give unreliable readings during coordinated turns and should not be depended upon during these flight conditions.

STANDBY COMPASS

(1)

A standby compass (5, figure 1-18) is located on the copilot's instrument panel.

NOTE

> The standby compass may exceed the allowable compensated deviation of 5° due to the magnetic influence of ejection seat catapults, control columns, and other metal objects in the immediate area, and should not be depended upon during flight.

(2)

A standby compass is located on the pilot's right windshield retainer.

Standby compass correction cards are located on the pedestals between the pilot's and copilot's rudder pedals.

CLOCKS

A clock is provided at each crew station. The pilot's and copilot's clocks are located on their respective instrument panels. On some airplanes* the clocks incorporate an elapsed time feature with a sweep second needle and a minute totalizer needle. The elapsed time mechanism is controlled by a knob at the upper right corner of the clock face with a three-push sequence to start, stop, and return the needles to starting position (12 o'clock).

INSTRUMENT PANEL VIBRATORS

Due to the low vibration level of the airplane, instrument panels are not shock-mounted and vibrators are installed to induce sufficient vibration to prevent indicator points from sticking. A circuit breaker for the vibrators is on the lower DC power panel.

EMERGENCY EQUIPMENT

HAND-OPERATED FIRE EXTINGUISHERS

A stored pressure chlorobromomethane-type fire extinguisher (13, figure 1-7) is installed on the walkway sidewall at the pilot's station. A trigger-type handle located on top of the extinguisher permits the extinguisher to be operated by one hand.

WARNING

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

EMERGENCY ALARM BELLS

One emergency alarm bell is located on the pilot's floor beam immediately aft of the observer's seat and the other on the left side in the forward portion of the bomb bay. Both are used to warn crew members of dangerous airplane operating conditions or failures and as an aid in initiating emergency procedures. A guarded ON--OFF switch (19, figure 1-11) on the pilot's switch panel controls the bells. In ON position power is supplied directly from the battery to ring the bells, and in OFF position the pilot's switch circuit is deenergized. The bells are also operated by release of the cabin air emergency depressurization door and will continue to operate regardless of the pilot's switch position. However, this type of operation is not to be construed as a bailout signal. For standard emergency alarm bell signals refer to figure 3-4. The emergency alarm bells are DC operated and receive power through a circuit breaker in the tail compartment power shield on some airplanes and through a circuit breaker in the left aft power shield on other airplanes directly from the battery bus to ring the bells.

FIRST AID KITS

An aeronautic first aid kit is installed on the left sidewall opposite and forward of the pilot's instrument panel; a blood plasma kit (3, figure 1-7) is installed on the left sidewall above the pressure door; and a battle splint and dressing kit (17, figure 1-16) is installed on the left sidewall opposite the copilot's seat.

EMERGENCY KNIFE

An emergency knife (2, figure 3-1) is installed on the forward walkway sidewall.

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* AF 52-177 thru -201, -363 thru -393, -546 and on
(1) AF 51-2357 thru 52-157, -202 thru -311, -394 thru -450
(2) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -451 & on

HAND AXE

On some airplanes a hand axe (5, figure 3-1) is stowed on the face of the step just aft of the pressure door. On other airplanes, where the step is equipped as a ditching station, the hand axe is stowed on the left sidewall of the walkway just forward of the pressure door.

ANTIEXPOSURE SUITS

Antiexposure suits (11, figure 3-1) are stowed on the left sidewall between the pilot's and observer's stations and on the left sidewall aft of the copilot's station.

SURVIVAL KIT

Space is provided in the bottom of each crew member's seat for a seat-type survival kit (3, figure 3-1). The survival kit may include a sleeping bag, life raft, tent, rifle-shot gun, rain coat, and many small items depending on the type of survival kit used for a particular mission.
The survival kit may be made an integral part of the parachute by stringing the leg straps of the parachute harness through the slots in the top of the survival kit. Some survival kits have snaps for attaching the kit to the accessory rings of the parachute harness.

FOUR MAN LIFERAFT (1)

A Mark IV four-man liferaft is provided for crew survival after ditching at sea. The raft is stowed in a liferaft compartment located below the cable well on the upper right side of the fuselage near the wing root.

The compartment door is opened and the raft inflated by a single pull of the quick release tee handle located just aft of the canopy on top of the fuselage. To gain access to the tee handle the door to the tee handle well must be opened by releasing the thumb release latch on top of the door.

A single pull of the tee handle of approximately 7 inches releases the liferaft compartment door, and a further pull of approximately 7 inches discharges the CO_2 bottle inflating and extending the raft. A mooring line attaches the raft to the airplane to prevent it from being swept away after inflation.

The raft contains three water distillation kits, three cans of sunburn preventative, a fishing kit, oral tube, 100 feet of nylon cord, and a sea anchor for crew survival.

This equipment is to be used in conjunction with the seat-type survival kit normally carried by each crew member.

DITCHING-CRASH LANDING STATIONS

(2)

An observer's ditching station is provided in the walkway opposite the pilot's station. Tie-down fittings for attaching a ditching harness (14, figure 3-1) are stowed on the left sidewall. When in position on the floor, the ditching harness supports the observer in a sitting position facing aft.

If the observer's ditching harness is not installed in the walkway, the observer must remain in his seat during crash landing or ditching operations. Refer to "Crash Landing" or "Ditching" in section III.

(3)

A ditching-crash landing station is located at the floor step to the left of the copilot's station. A hinged seat back is installed to make a continuous surface with the step riser and rests on the top surface of the floor when stowed. A shoulder harness and a safety belt tie-down strap are stowed in a compartment within the step and the safety belt is stowed against the walls on each side of the step seat. To use the station the folding seat back is raised and the shoulder harness and tie-down strap are hooked to attaching points on the floor and seat. The equipment is fastened in a conventional manner and supports the occupant in a sitting position facing forward. The purpose of the tie-down strap is to hold the safety belt in position and to prevent the occupant from sliding under the safety belt during deceleration. This position is for use of the observer if there are no other crew members in the airplane except the pilot and copilot. If a "fourth crew member" is aboard he will use this position, therefore requiring the observer to remain in his seat or utilize the ditching-crash landing harness described below, if installed. This position will be used by an ECM operator when the ECM capsule is installed unless a "fourth crew member" is aboard. This position may also be used during takeoff and landing operations.

(4)

Two ditching-crash landing stations are provided in the walkway opposite the pilot's station. The forward position is located just forward of the entrance door and has four fittings to which a ditching harness (5, figure 1-7) is attached. This ditching harness is permanently attached to the airplane by an upper fitting on the canopy beam but must be hooked at the bottom to two fixed fittings, one on each side of the walkway

(1) AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 & on
(2) AF 51-2192 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
(3) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
(4) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

floor. Two harness side straps are hooked to two retractable fittings, one at each side of the walkway floor approximately one foot forward of the entrance door step. The aft position is located on the step directly over the entrance door and has four fittings to which a ditching harness (10, figure 1-16) is attached. This ditching harness is permanently attached to the airplane by an upper fitting on the canopy beam but must be hooked at the bottom to two fixed fittings on the forward edge of the entrance door step. Two harness side straps are hooked to fixed fittings, one at the upper aft edge of the main entrance door opening and the other on the outboard edge of the pilot's floor. The occupant will face aft when seated in each of these harnesses. The aft station will be used by an ECM operator when the ECM capsule is installed. The forward station will be used by the observer when the ECM capsule is installed and there is no "fourth crew member" aboard. When the ECM capsule is installed and there is a "fourth crew member" aboard, the forward station will be used by an ECM operator. These positions may also be used during takeoff and landing operations.

OBSERVER'S EMERGENCY ESCAPE HATCH

WARNING

The observer's emergency escape hatch is for emergency exit and entrance on the ground only, and should not be used in flight.

(1)
An emergency escape hatch is installed above the observer's seat forward of the pilot's windshield. An emergency hatch release lever (2, figure 4-28) is located on the sidewall at the forward left corner of the hatch.

NOTE

The release lever for the observer's emergency escape hatch is safety-wired in the locked position to prevent inadvertent release of the hatch.

Moving this lever inboard releases the latching dogs holding the hatch, enabling the observer to push the hatch clear of the airplane. The hatch can be released from outside the airplane (figure 3-7) by means of a pull-handle which is accessible through a small hinged door in the left side of the fuselage outboard of the hatch. Pulling this handle releases the hatch in the same manner as does the observer's hatch release lever. A spring-loaded actuator raises the forward left side of the hatch, thereby exposing the edge of the hatch which provides a handhold for removing the hatch from the airplane.

(2)
A window-type emergency escape hatch (39, figure 4-28) is installed above and to the left of the observer's position. An emergency hatch release handle (38, figure 4-28) is located on the sidewall directly below the center of the hatch. The hatch may be released by raising the clear plastic cover marked "Emergency Ground Exit Release," grasping the handle and pulling it down its full limit of travel, approximately 6 inches. This action withdraws the latch bolts holding the hatch, enabling the observer to push out the bottom of the hatch thus permitting it to fall clear of the airplane. The hatch may be released from the outside of the airplane (figure 3-7) by means of a pull handle which is accessible through a small hinged door in the left outboard side of the fuselage just below the center of the hatch. Pulling this handle releases the hatch in the same manner as does observer's release handle. The compression of the hatch seal will extend the bottom of the hatch out far enough to allow a handhold for removing the hatch.

OBSERVER'S DOWNWARD EJECTION HATCH

A downward ejection hatch is installed in the floor of the observer's station beneath the observer's ejection seat. The hatch is provided to allow the observer's ejection seat to be catapulted downward out of the airplane. Jettisoning of the hatch is controlled by a D-ring handle on the ejection seat. A static line from the hatch to the seat catapult arms the catapult as the hatch is jettisoned, thereby preventing premature catapulting of the ejection seat before the hatch is jettisoned. An inspection window is provided in the observer's downward ejection hatch for visually checking the engagement of the hatch lock pin prior to flight.

CABIN AIR EMERGENCY DEPRESSURIZATION DOOR

A cabin air emergency depressurization door located in the right side of the fuselage at the pilot's station is installed to permit emergency cabin depressurization. The door can be released from the pilot's, copilot's, and observer's stations by actuation of the left handgrip control on the pilot's and copilot's seats and the leg braces on the observer's seat. An electric switch installed on the door locking mechanism sounds the alarm bell as the door is jettisoned. An initiator attached to each of the three seats contains an explosive cartridge which supplies the required pressure to unlock the locking mechanism on the door, and cabin pressure then blows out the door.

(1) AF 51-2357 thru 52-041, -202 thru -235
(2) AF 51-2192 thru -2356, 52-042 thru -201, -236 & on

BAILOUT SPOILER AIR BOTTLE (1)

An emergency air bottle (17, figure 1-54) located in the entranceway actuates the bailout spoiler. A pressure gage located in the cabin entranceway indicates air pressure available.

ENTRANCE DOOR EMERGENCY ESCAPE PROVISIONS (1)

Emergency escape through the entrance door is facilitated by provision for mechanically jettisoning of the door and ladder and extension of a bailout spoiler to deflect the airstream around the doorway. An entrance door bailout control handle (17, figure 1-16) is located in the walkway just above the pressure door. Pulling this handle out approximately 14 inches accomplishes the following in the order named: releases entrance door safety strap, jettisons entrance door, jettisons ladder, unlatches bailout spoiler, and opens a valve on a spoiler actuation air bottle to extend the spoiler.

WARNING

Once the entrance door is jettisoned and the spoiler extended, the differential pressure created makes it impossible to open the pressure door.

CAUTION

Pull the bailout control handle with an even steady pull to insure proper sequence of operation.

When the pressure door is closed and locked, a pressure door locking pin extends into the entrance door bailout control handle and prevents its use until the pressure door is manually unlocked and open.

NOTE

This arrangement does not eliminate the possibility of pulling the bailout control handle prematurely, since the bailout control handle can be pulled as soon as the pressure door is unlocked and starts to open. However, this arrangement does serve as a reminder that the pressure door must be unlocked and fully opened before pulling the bailout control handle.

WARNING (1)

As the bailout spoiler extends with considerable force, stand clear of area during any operational check of system.

ENTRANCE DOOR EMERGENCY ESCAPE PROVISIONS (2)

Emergency escape through the entrance door is facilitated by provision for mechanically jettisoning of the door and ladder. An entrance door bailout control handle (17, figure 1-16) is located in the walkway just above the pressure door. Pulling this handle out approximately 14 inches accomplishes the following: releases entrance door safety strap, jettisons entrance door and jettisons the ladder.

CAUTION

Pull the bailout control handle with an even steady pull to insure proper sequence of operation.

WARNING

A bailout spoiler is not installed; therefore, it is necessary that airspeed be reduced as low as possible prior to using the escape chute for bailout. If the airplane is controllable, the airspeed should be reduced definitely below 195 knots IAS by lowering the landing gear and wing flaps, then raising the gear just prior to bailout.

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(1) AF 51-2192, -2194, -2195, -2197, -2198, -2200 thru -2205, -2207 thru -2211, -2213 thru -2219, -2221 thru -2224, -2227 thru -2229, -2231, thru -2233, -2235 thru -2239, -2241 thru -2245, -2247 thru -2250, -2252, -2255, -2256, -2258, -2259, -2261, -2262, -2264, -2266, -2268, -2270, -2274, -2275, -2279, -2280, -2281. -2285, -2286, -2288 thru -2290, -2292, -2293, -2295 thru -2357, -2359, -2361, -2363 thru -2387, -2400, -2410, -2412 thru -15810, -17368 thru 52-041, -177 thru -201, -1406 thru 53-2170, -2297 & on

(2) All AF numbers not included in coverage of (1)

PARACHUTE

On some airplanes provisions are made for the installation of an emergency chest pack parachute in the aft end of the crawlway (10, figure 3-1).

PARACHUTE STATIC LINES

Parachute static lines for emergency bailout of injured personnel are mounted on the wall above the pressure door (12, figure 3-1) and, on some airplanes, in the aft end of the crawlway (9, figure 3-1).

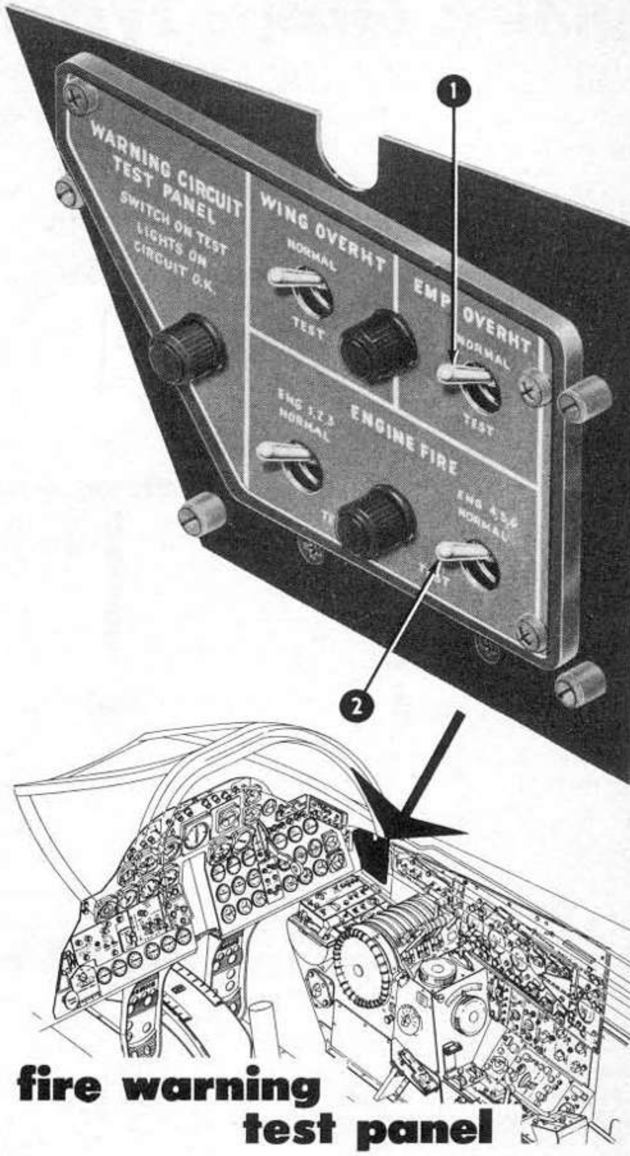
FIRE WARNING SYSTEM

ENGINE FIRE WARNING

Thermally actuated fire detector units are mounted in the accessory section, airguide section, compressor section, and tailcone section of each engine nacelle and the nacelle strut of each inboard nacelle. Six red fire warning lights (19, figure 1-8 and 14, figure 1-9), one for each engine, are on the pilot's instrument panel and are an integral part of the fire shutoff switches. When any one fire detector unit is thermally actuated, the warning light for the affected engine is illuminated. Two TEST--NORMAL engine fire warning circuit test switches (2, figure 1-43) are on the fire warning circuit test panel. The left switch is for engines No. 1, 2, and 3 and the right for engines No. 4, 5, and 6. When a switch is in TEST position, illumination of the warning lights indicates that the warning light circuits have continuity. Conversely, failure of the lights to illuminate indicates that the circuits are broken providing the bulbs glow on press-to-test. When a switch is in NORMAL position, the circuits are armed for fire warning and, as a safety factor in the event of an open circuit or wire breakage, an alternate circuit for each engine is connected to the fire detector units through the switches. The lights will be bright if the panel lights are off and dim if the panel lights are on. A circuit breaker for the fire warning lights is on the upper DC power panel.

WING AND EMPENNAGE OVERHEAT WARNING

Two red lights (3, 4, figure 1-8 and 43, 44, figure 1-9) are installed on the pilot's instrument panel. One light is labeled "Wing Overheat" and the other "Empennage Overheat." When an overheat condition is detected by either a left or right wing thermal switch or an empennage thermal switch, the affected warning light will be illuminated. Two NORMAL--TEST wing and empennage overheat warning circuit test switches (1, figure 1-43) are on the fire warning circuit test panel. These switches are spring-loaded to the NORMAL position. When either switch is placed in TEST position, illumination of the affected warning light indicates that the warning light circuits have continuity. Conversely, failure of the affected light to illuminate indicates that the circuits are broken providing the bulbs glow on press-to-test. When the switches are in the NORMAL position, the circuits are armed for overheat warning.



fire warning test panel

1. Wing and Empennage Overheat Warning Circuit Test Switches
2. Engine Fire Warning Circuit Test Switches

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Figure 1-43.

sliding canopy system

AF 51-2192 thru 52-611

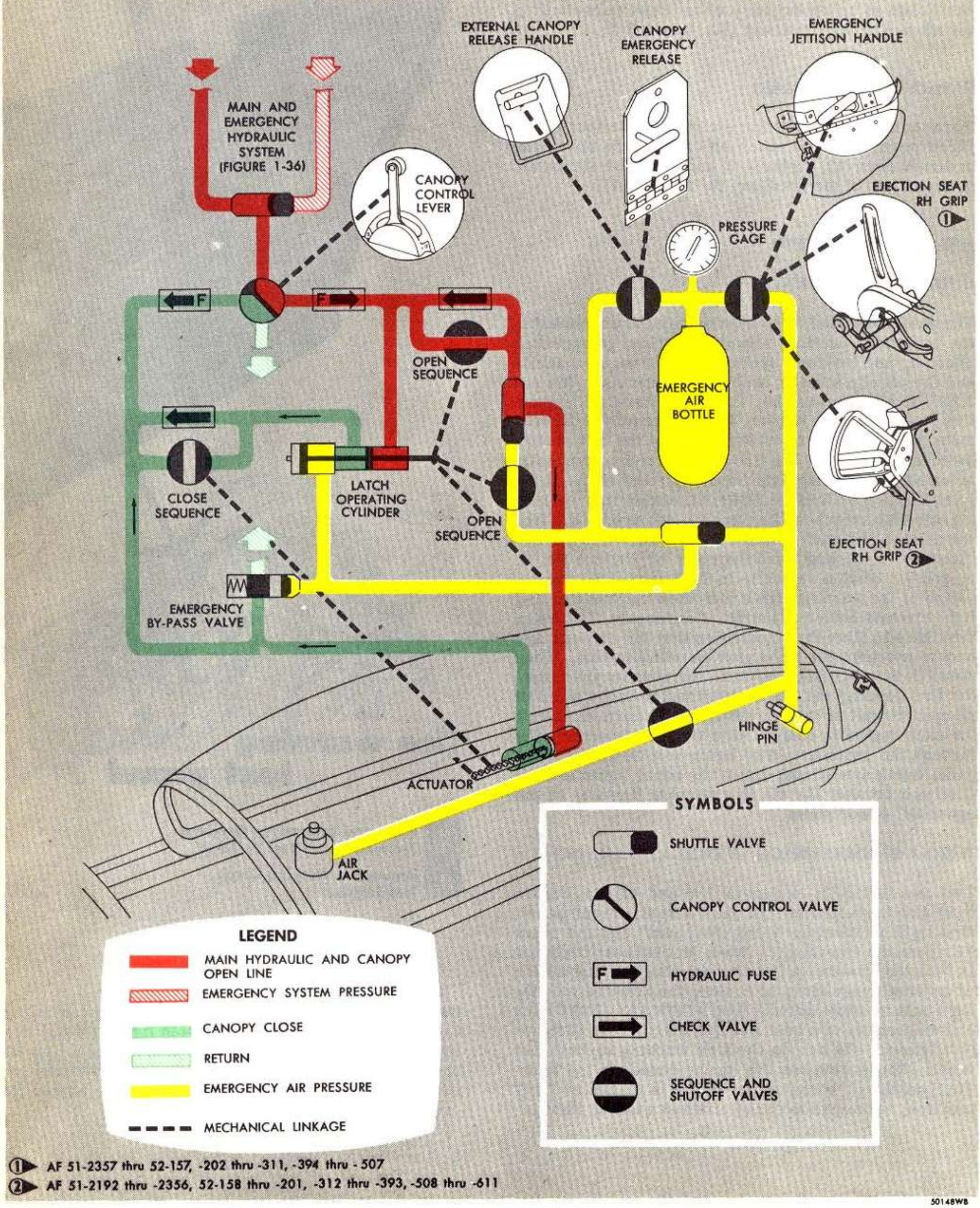

Figure 1-44.

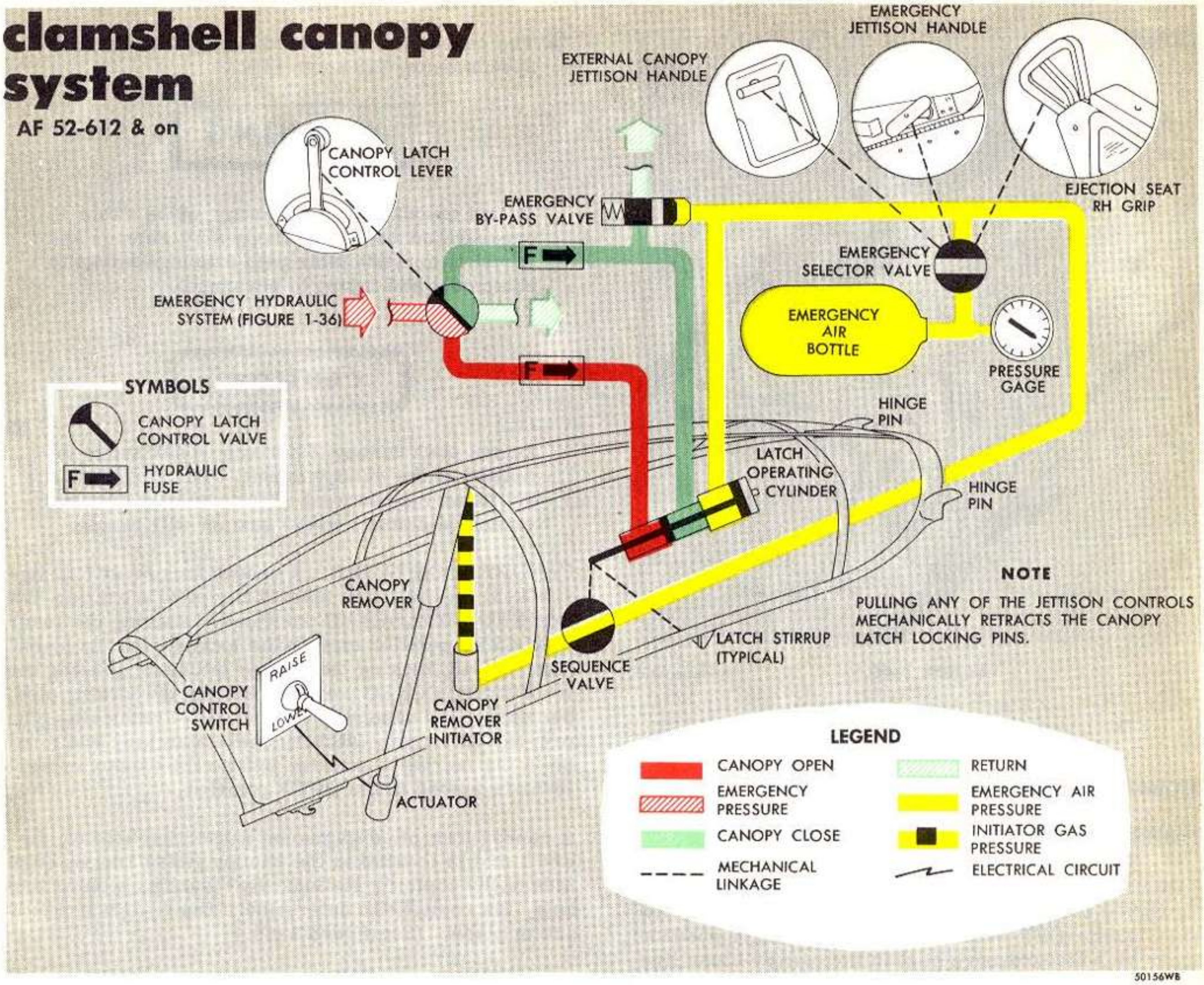

Figure 1-45.

CANOPY SYSTEMS

There are two types of canopy systems: sliding and clamshell. Both types of canopies are designed to be jettisoned in flight and are constructed so that the ejection seats cannot be ejected through them. The sliding type canopy utilizes tracks and rollers to slide aft approximately 14 inches to the open position. Normal opening of the canopy is accomplished by hydraulic pressure from the main or emergency hydraulic system. Refer to figure 1-44. A canopy emergency air bottle is installed which provides pneumatic pressure to jettison the canopy in flight or to open and release the canopy while on the ground. In flight jettisoning is automatically initiated by seat ejection controls prior to ejection of the pilot's or copilot's seat. A separate control is provided for emergency jettisoning independent of seat action. The clamshell type canopy, found on later airplanes, is hinged at the aft end and during normal opening the front end may be raised a maximum of 14 inches by a DC powered electric actuator. Limit switches are incorporated to deenergize the actuator when the canopy reaches the maximum open or closed position. Normal unlatching of the canopy is accomplished by hydraulic pressure from the emergency hydraulic system. Refer to figure 1-45. During canopy jettisoning pneumatic pressure unlatches the canopy and fires a ballistics cartridge that jettisons the canopy. Canopy jettisoning is normally initiated by seat ejection controls. A seperate control is provided for emergency jettisoning independent of seat action.

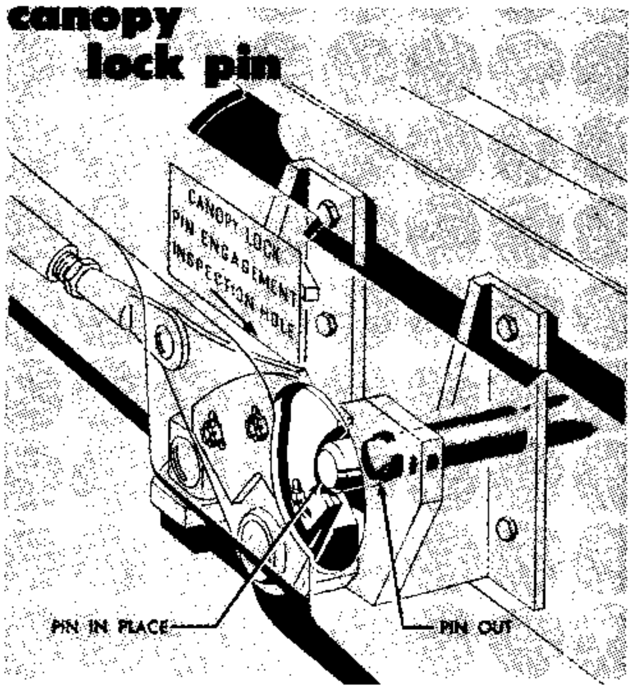

Figure 1-46. 50136WA-4

SLIDING CANOPY SYSTEM (1)

SLIDING CANOPY SYSTEM CONTROLS

CANOPY CONTROL LEVER. A canopy control lever (7, figure 1-6) on the right side of the pilot's station has CLOSE--OFF--OPEN positions. CLOSE position opens both the pressure port in the canopy close line and the return port in the canopy open line which hydraulically closes and latches the canopy. OPEN position opens both the pressure port in the canopy open line and the return port in the canopy close line which hydraulically unlatches and opens the canopy. In OFF position the return ports are opened in both canopy open and canopy close lines so that no pressure is directed to the canopy actuating cylinders. The lever is left in CLOSE position except with canopy open in flight. The lever is placed in OFF position when airplane is parked.

NOTE

- If the canopy fails to open or close after actuation of the canopy control lever while the airplane is parked, operation of any part of the hydraulic system will allow the canopy to resume normal operation. Usually application of the brakes is sufficient.
- The canopy can be opened during flight at airspeeds below 215 knots IAS.

WARNING

Do not unlock or open canopy while cabin is pressurized because canopy may release and travel an unpredictable path causing damage to equipment and injury to personnel.

CAUTION (2)

Do not open canopy if periscopic sextant is installed in the canopy mount. The sextant will not clear the headrest of the copilot's seat and extensive damage to the sextant will result.

CANOPY LOCK LEVER. A canopy lock lever (10, figure 1-5) on the right side of the pilot's station has LOCKED--UNLOCKED positions. Placing the lever in LOCKED position extends the locking pins "in place" (figure 1-46) locking the canopy latches. Placing the lever in UNLOCKED position retracts the locking pins, permitting the canopy to be opened. The locking pins prevent the canopy latches from unlatching and must be in the retracted position before the canopy control lever is moved to the OPEN position.

A canopy lock pin engagement inspection hole (4, figure 1-15) is located in the canopy guard rail on each side of the copilot's station. By visually checking this hole, the copilot can determine if the canopy lockpins are in place. (See figure 1-46.)

CANOPY EMERGENCY RELEASE HANDLES (GROUND). Canopy emergency release handles, one at each station, are on the pilot's and copilot's instrument panels (45, figure 1-8 and 1, figure 1-18) and on the outside of the airplane (figure 3-7) on the left side of the fuselage just ahead of the pilot's windshield. Pulling out a handle approximately 12 inches mechanically disconnects the canopy actuating mechanism, removes the lock pins from the latches, and opens an air bottle. Pneumatic pressure unlatches and opens the canopy; the canopy is then free to be lifted manually from the airplane.

WARNING

The canopy emergency release is for emergency release on the ground only. Do not use in flight.

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(1) AF 51-2192 thru 52-611
(2) AF 51-2192 thru -2356

CANOPY EMERGENCY JETTISON HANDLES (IN FLIGHT). Canopy emergency jettison handles, one at each station, (14, figure 1-7 and 8, figure 1-16) are located on the left canopy sidewall opposite the pilot's and copilot's stations. Pulling a handle out approximately 3 inches mechanically retracts the canopy latch lock pins, disconnects the canopy actuating mechanism, and opens the canopy air bottle. Pneumatic pressure inserts a hinge pin at the aft end of the canopy, unlatches the canopy, and actuates air jacks which push the front of the canopy up into the airstream. As the canopy is lifted up into the airstream, the hinge pin releases allowing the canopy to jettison. Static lines attached to the canopy pull out safety pins in the pilot's and copilot's seat ejection catapult, readying seat ejection triggers for firing. This sequence of operation prevents seats from being ejected before canopy is jettisoned.

NOTE

Depressurize cabin before attempting to jettison canopy with canopy emergency jettison handle. There is a possibility that the canopy latches may fail to release when the cabin is pressurized. A maximum of 12 seconds may be required for depressurization to take place.

WARNING

Do not jettison canopy while in the open position since the canopy hinge will not engage the hinge pin and the canopy will travel an unpredictable path. This will endanger the pilot and copilot since there is a possibility of being incapacitated by the unguided jettisoned canopy.

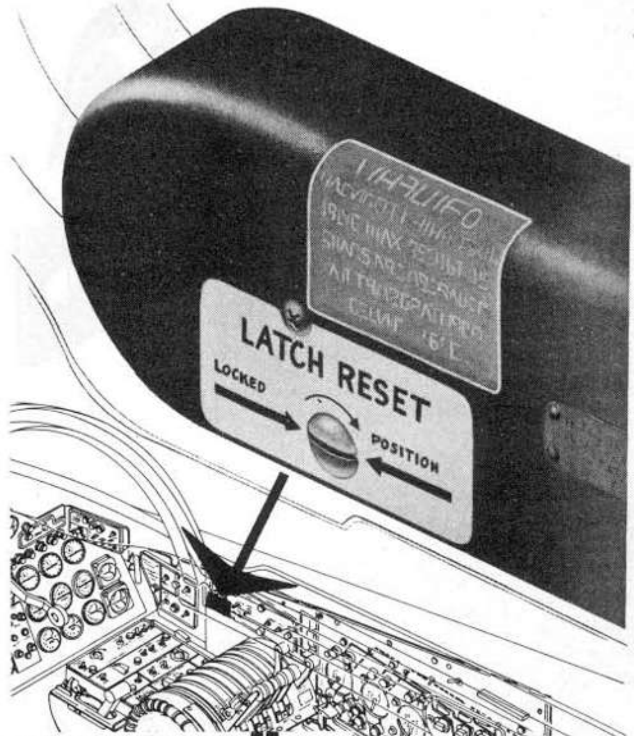
CANOPY GROUND LOCK. A canopy ground lock is provided for securing the canopy in the open position while the airplane is on the ground. The lock is stowed at the aft end of the walkway to the left of the copilot's seat (35, figure 1-4).

SLIDING CANOPY CONTROL SYSTEM INDICATORS

CANOPY ROLLER LOCK INDICATOR. A roller lock indicator (figure 1-47) decaled "Latch Reset" is provided to permit a visual check of the position of the forward roller lock. This lock is installed to permit the canopy to be detached from the airplane for replacement or maintenance purposes only and should be in the LOCKED POSITION (horizontal) at all other times.

WARNING

Check that the canopy roller lock indicator is in the LOCKED POSITION (horizontal) prior to each flight. If a flight were made with the roller unlocked (vertical) the canopy could release in flight if opened, and travel an unpredictable path. This would endanger the pilot and copilot since there is a possibility of being incapacitated by the unguided canopy.



canopy roller lock indicator

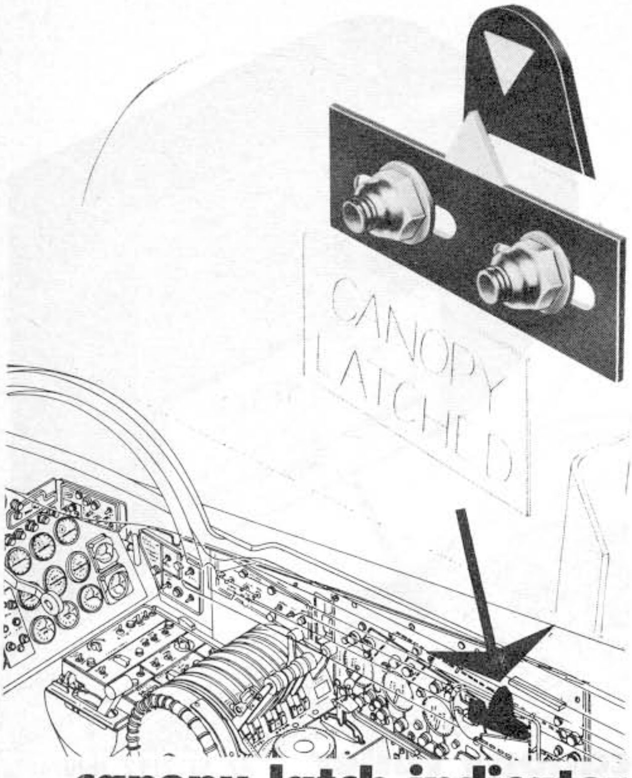
AF 51-2192 thru 52-611

50137WE

Figure 1-47.

CANOPY LATCH INDICATOR. A canopy latch indicator (figure 1-48) located on each side of the canopy guard rail at the pilot's station, provides the pilot with additional means of visually checking the canopy for being closed and latched. A decal marked "Canopy Latched" is located beneath the indicator. For the canopy to be in the latched position, the pointer on the canopy latch arm must align with the canopy latch indicator.

CANOPY EMERGENCY AIR BOTTLE PRESSURE GAGE. A pressure gage (1, figure 1-17) on the left sidewall above the emergency landing gear extension stand indicates air pressure available for emergency canopy jettison or canopy ground release actuation. The normal pressure is 2000 psi.



canopy latch indicator
AF 51-2192 thru 52-611

Figure 1-48.

50138W8

CLAMSHELL CANOPY SYSTEM (1)

CLAMSHELL CANOPY SYSTEM CONTROLS

CANOPY CONTROL SWITCH. A canopy control switch (45, figure 1-9) on the lower left corner of the pilot's instrument panel, has RAISE--off--LOWER positions. When the switch is positioned to RAISE the canopy is raised to the open position by a DC powered electrical actuator. In LOWER position the canopy is lowered to the closed position by the actuator. The canopy may be stopped in any intermediate position desired by releasing the switch. The switch is spring loaded to the off position and must be held in the RAISE or LOWER position until the desired canopy travel is completed. Power is supplied to the actuator through a circuit breaker on the lower DC power panel.

NOTE

- Normal canopy opening is for ground use only at speeds below the maximum opening speed of 100 knots IAS.
- In order to allow proper cooling of the actuator, the switch must be in the off position for a period of 30 minutes after a continuous operation of two complete cycles.

CAUTION

To prevent possible damage to the canopy, the copilot's seat must be in the forward or aft facing position when opening or closing the canopy.

CANOPY LATCH CONTROL LEVER. A canopy latch control lever (7, figure 1-6) on the right side of the pilot's station has LATCHED--OFF--UNLATCHED positions. When the canopy is closed, placing the lever in LATCHED position hydraulically latches the canopy in the closed position. Before opening the canopy this lever must be placed in the UNLATCHED position to unlatch the canopy. A limit switch prevents energizing the canopy actuator with the canopy latches in the latched position. In the OFF position pressure from the latch actuators is directed to the return lines. The OFF position will be used only when the airplane is parked.

WARNING

Do not unlatch canopy while cabin is pressurized because canopy may release causing damage to equipment and injury to personnel.

CANOPY LOCK LEVER. A canopy lock lever (10, figure 1-5) on the right side of the pilot's station has LOCKED--UNLOCKED positions. Placing the lever in the UNLOCKED position extends the lock pins "in place" (figure 1-46) locking the canopy latches in the latched position. Placing the lever in the UNLOCKED position retracts the lock pins, permitting the canopy to be unlatched. This lever must be in the UNLOCKED position before the canopy latch control lever is placed in the UNLATCHED position.

CAUTION

Do not place the canopy latch control lever in UNLATCHED position with the canopy lock lever in LOCKED position since to do so could damage and jam the latch operating mechanism thus preventing proper operation of canopy latches and possibly preventing opening or jettisoning of the canopy.

(1) AF 52-612 & on

canopy remover disconnect handle

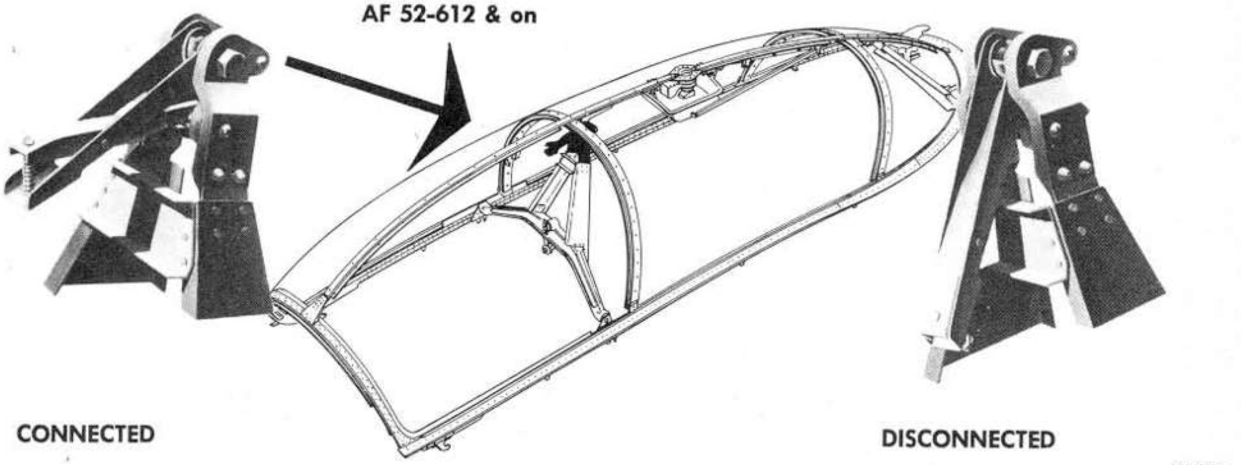


Figure 1 - 48 A.

A canopy lock pin engagement inspection hole (4, figure 1-15) is located in the canopy guard rail on each side of the copilot's station. By visually checking this hole, the copilot can determine if the lockpins are in place. (See figure 1-46.)

CANOPY EMERGENCY JETTISON HANDLES. Canopy emergency jettison handles (13, figure 1-7 and 1, figure 1-18) are located on the left canopy sidewall, one opposite the pilot's station, and one opposite the copilot's station. A third handle (figure 3-7) is located on the outside of the airplane on the left side of the fuselage just ahead of the pilot's windshield. Pulling out a handle approximately 3 inches mechanically retracts the canopy latch lock pins and opens an air bottle. Pneumatic pressure opens an emergency bypass valve releasing hydraulic pressure from the close side of the canopy latch actuator, then opens the latches. The remaining pneumatic pressure fires an initiator which in turn fires the canopy remover cartridge, jettisoning the canopy. Static lines attached to the canopy pull out safety pins in the pilot's and copilot's seat ejection catapult initiators, reading seat ejection triggers for firing. This sequence of operation prevents seats from being ejected before canopy is jettisoned. Canopy emergency jettisoning will remove the canopy either in flight or on the ground.

NOTE

Depressurize cabin before attempting to jettison canopy with canopy emergency handle. There is a possibility that the canopy latches may fail to release when the cabin is pressurized. A maximum of 12 seconds may be required for depressurization to take place.

INITIATOR SAFETY PIN AND STREAMER. An initiator pin accompanied by a red streamer is provided for use on the canopy jettison initiator. This initiator is located on the left side of the A-frame that is attached to the canopy between the pilot's and copilot's station. The safety pin is inserted through the top of the initiator to prevent inadvertent firing on the ground. This pin must be removed and stowed before each flight and replaced on the initiator immediately after parking the airplane.

GROUND DISCONNECT HANDLES. Two disconnect handles are provided to allow removal of the canopy for maintenance purposes. These handles may also be used by the flight crew in an emergency as given in section III. A canopy remover disconnect handle (figure 1-48A) protrudes forward from the top of the canopy remover. When squeezed and pulled down, this handle disconnects the remover from the canopy and disconnects the pressure line from the remover to prevent inadvertent firing of the remover cartridge. This handle is approximately perpendicular to the remover when in the normal connected position. The other handle is located just inside the aft end of the canopy. A detent fixes this handle in the "pins extended" position. Lifting this handle out of detent and moving it toward the opposite side of the airplane retracts two bearing plate guide pins releasing the aft end of the canopy. These handles should be in their engaged positions at all times.

CLAMSHELL CANOPY SYSTEM INDICATORS

CANOPY EMERGENCY AIR BOTTLE PRESSURE GAGE. A pressure gage (1, figure 1-17) on the left sidewall above the emergency landing gear extension stand indicates air pressure available for emergency canopy jettison. The normal pressure is 2000 psi.

CANOPY EMERGENCY AIR BOTTLE

An emergency air bottle (15, figute 1-54) is located in the crawlway. On the sliding canopy, this air bottle serves as a power source for emergency exit or entrance on the ground or canopy jettisoning in flight. On the clamshell canopy, this air bottle serves as the power source for unlatching the latches and firing the initiator that fires the canopy remover cartridge.

EJECTION SEATS

Catapult-type ejection seats are installed at all crew stations. Seats are normally used as standard seats; however, in emergencies, they provide an effective and expedient meand for bailout at all speeds. B-47 ejection seats are designed for use with the 5-inch back-style parachutes only. A shelf is provided at the bottom rear of the seat to support the parachute pack in flight. In some seats this shelf is all metal while on others, 2 inches of the forward side of the shelf is made of sponge rubber. Seats with all metal shelves are provided with a 2-inch parachute spacer to be used behind a thin-packed parachute. The spacer keeps the seat occupant from contacting the metal shelf. Where sponge rubber cushion is provided on the shelf, no spacer is required. Space is sufficient in all crew seats for a seat-type survival kit. A cushion is provided to be used in this space except when a survival kit is used. On some airplanes the parachute spacer cushion on the observer's ejection seat is deleted and a new parachute shelf is installed. The parachute shelf is beveled to prevent contact with the crew member's body.

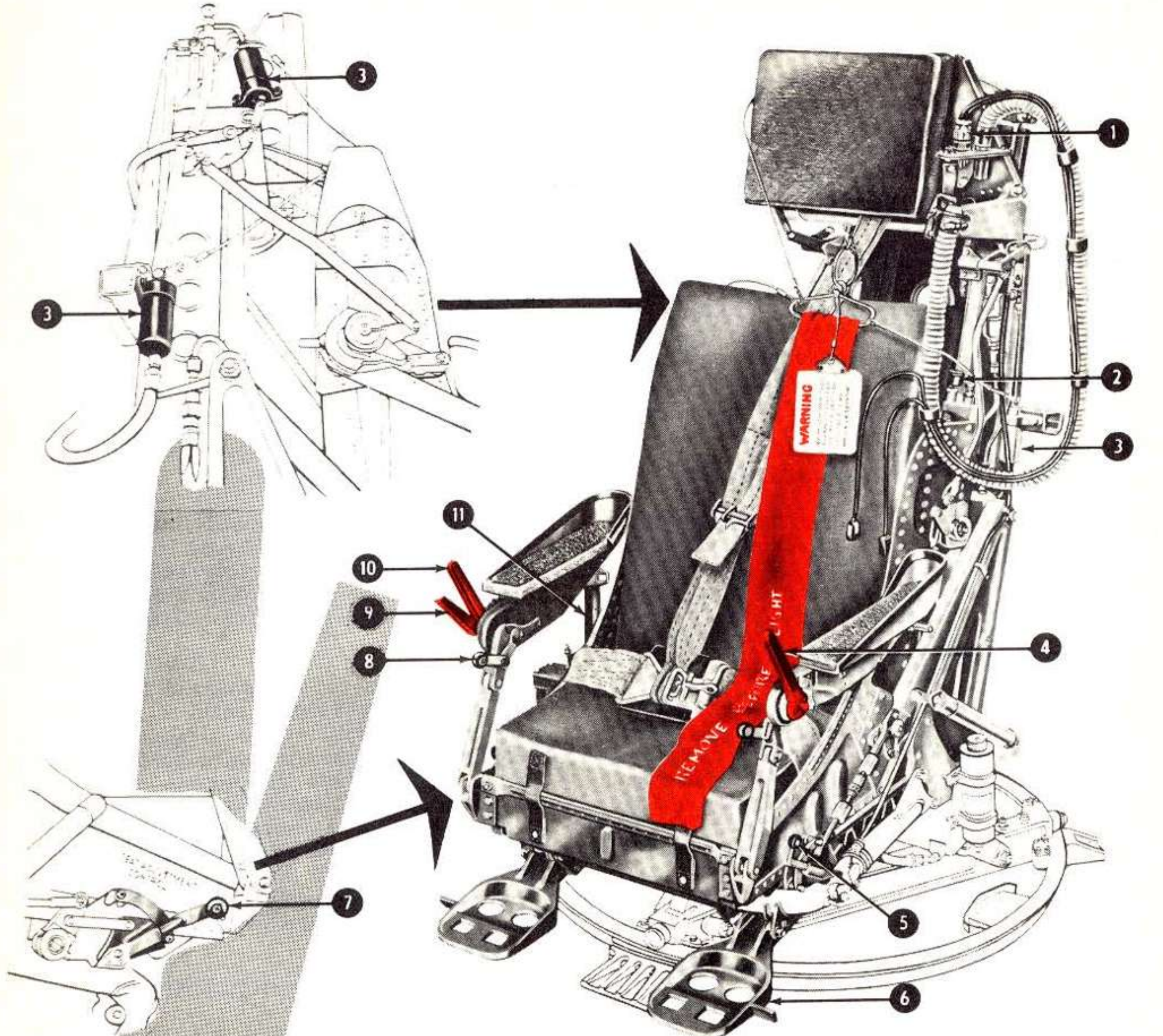
WARNING

The A-5 seat cushion should not be left in the pilot's or copilot's seat if the C-2A liferaft is being carried. Sitting on both of these items does not provide added comfort but actually creates a definite injury hazard and may position the pilot where it is difficult to reach controls. Chance of vertebral injury is increased considerably by the pilot sitting on a thick, compressible mass, such as the combination of the liferaft and A-5 seat cushion. When utilizing the ejection seat in this circumstance it will not exert a direct force on its occupant until the seat has moved 2 or 3 inches upward. After this amount of travel, the seat has gathered such momentum that excessive impact is produced when the seat initially lifts the pilot. However, if additional height in the seat is needed, a solid filler block may be used in conjunction with the C-2A pack, provided the combined thickness does not exceed 5 inches.

Each seat is equipped with a shoulder harness. On some airplanes each seat is equipped with a conventional safety belt while on other airplanes each seat is equipped with an automatic opening safety belt. Footrests and headrests are provided with each seat to aid the crew member in maintaining proper posture during ejection. The seats have emergency quick-disconnect plugs containing electrical and oxygen connections which automatically release at the time of ejection. Refer to "Miscellaneous Equipment" in section IV for description of the observer's ejection seat.

PILOT'S AND COPILOT'S EJECTION SEATS

The pilot and copilot are provided with catapult-type upward ejection seats. The seats are equipped with initiators which are explosive cartridges to provide a high pressure force to fire the catapults and eject the seats in a forward-facing position. Ejection is controlled by ejection handgrips and catapult firing triggers. Handgrip actuation automatically prepares the seat and airplane for ejection, while closing the firing trigger fires the catapult, ejecting the seat and occupant from the airplane. Pilot's and copilot's ejection seats (figures 1-49 and 1-50) of two different designs, manufactured by separate manufacturers are installed in these airplanes. Republic-type seat handgrips are painted red while Weber-type seat handgrips are painted yellow. Differences in controls and functions are given in the following paragraphs.



pilot's and copilot's ejection seat

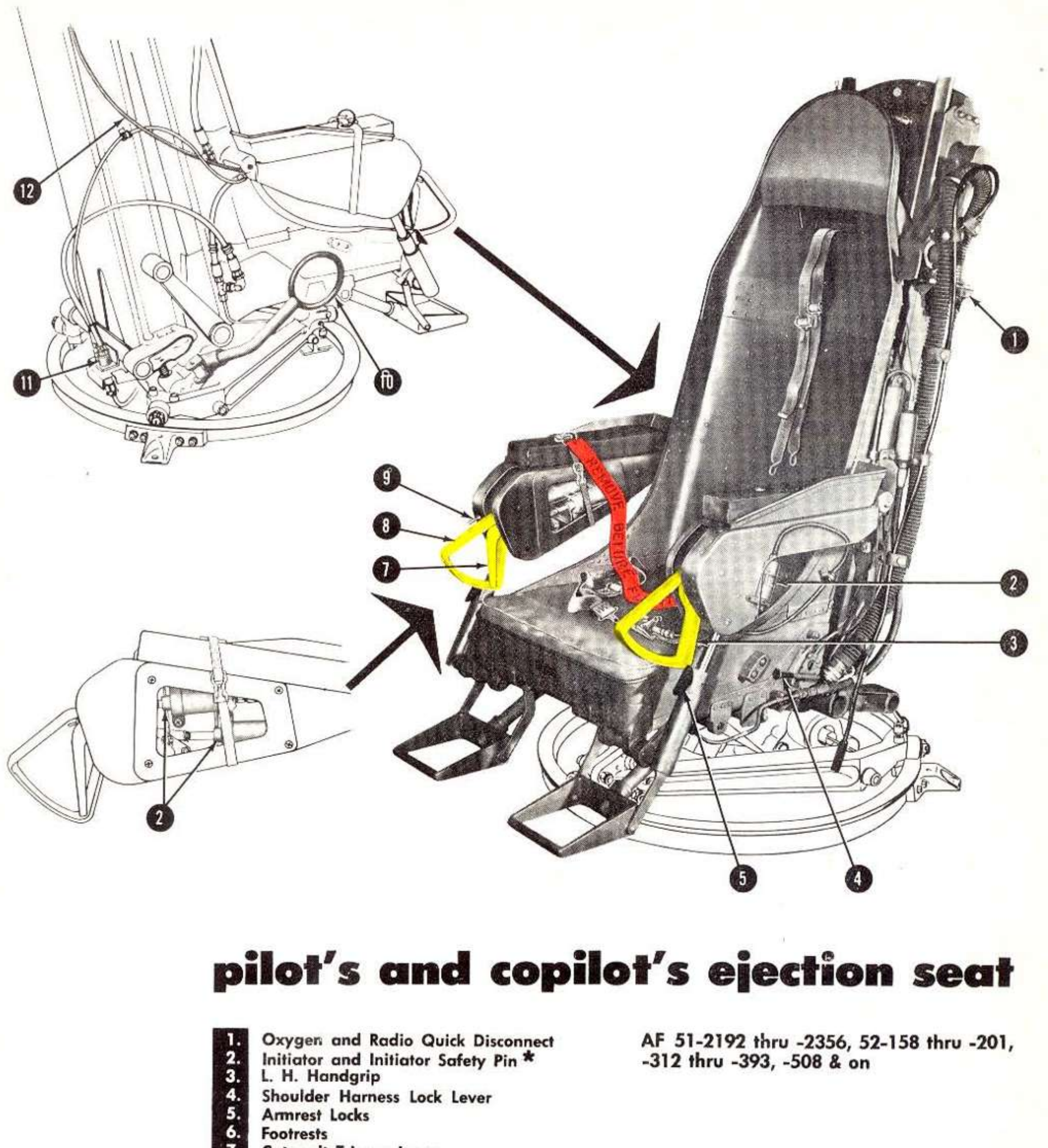
AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507

1. Emergency Quick Disconnect
2. Ejection Seat Air Pressure Gage
3. Initiator
4. Ejection Handgrip (L.H.)
5. Shoulder Harness Lock Lever
6. Footrests
7. Seat Adjustment Lever
8. Armrest Lever
9. Catapult Firing Trigger
10. Ejection Handgrip (R.H.)
11. Seat Tilt and Rotation Handle *

* Copilot's Seat Only

50139WB

Figure 1-49.



pilot's and copilot's ejection seat

1. Oxygen and Radio Quick Disconnect
2. Initiator and Initiator Safety Pin *
3. L. H. Handgrip
4. Shoulder Harness Lock Lever
5. Armrest Locks
6. Footrests
7. Catapult Trigger Lever
8. R. H. Handgrip
9. Seat Adjustment Switch
10. Seat Tilt and Rotation Handle **
11. Electrical Quick Disconnect
12. Catapult Initiator Release Cable

*Safety belt initiator does not use safety pin.

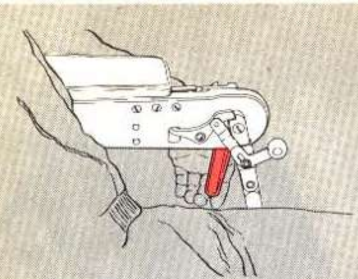
**Copilot's seat only

AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

50152 WC-1

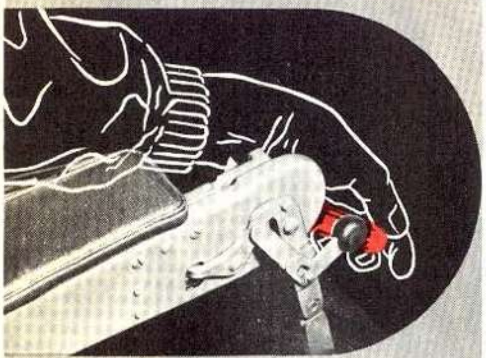
Figure 1-50.

pilot's and copilot's



LEFT HANDGRIP

1st ADVANCE



1 Movement from stowed position through an arc of 65° to the first advance position is free travel and removes slack from the linkage.

2nd ADVANCE

2 Movement through an arc of 35° to the second advance position causes the following to happen:

1. Copilot's foot rests extend.
2. Free travel of the pilot's handgrip.

FINAL

3 Movement through an additional arc of 35° to the final position causes the following to happen:

1. Cabin air emergency depressurization door unlocks releasing cabin pressure.
2. Emergency alarm bell sounds.
3. Shoulder harness inertia reel is prepared for locking.
4. Right handgrip becomes unlocked.
5. Handgrip locked in final position.

NOTE

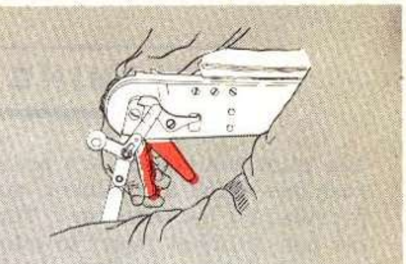
The first advance, second advance, and final positions are not determined by notches or detents but are given only to show what occurs during each phase of movement of the handgrips.

Figure 1-51. (Sheet 1 of 2 Sheets)

ejection seat controls

AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507

RIGHT HANDGRIP



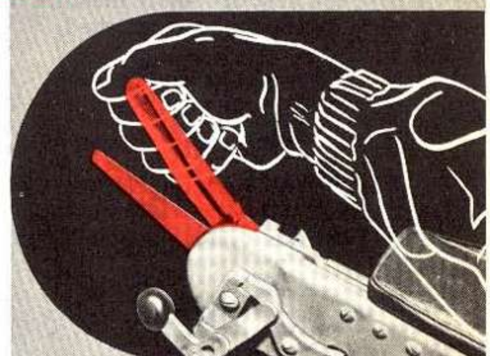
POSITION 4

Movement from stowed position through an arc of 65° to the first advance position is free travel and removes slack from the linkage. The trigger (being interlocked with the right handgrip) maintains 25° lag until the handgrip reaches final position.

POSITION 5

Movement through an arc of 45° to the second advance position causes the following to occur:

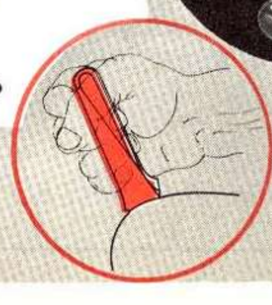
1. Seat locking mechanism unlocks.
2. Seat is power driven to bottom position.
3. Shoulder harness inertia reel locks (when seat is in bottom position).
4. Unlocks linkage which allows 25° additional handgrip rotation.



POSITION 6

Movement through an arc of 25° to the final position causes the following to occur:

1. Control column spring cartridge disconnects and stows control column and centers wheel.
2. Canopy spring cartridge actuates air bottle valve which unlocks and unlatches the canopy, engages the hinge pin and extends the air jacks to jettison the canopy.
3. Jettisoning canopy removes safety pin from ejection delay stop, which allows the trigger to be rotated.
4. Unlocks the catapult trigger interlock.
5. Locks handgrip in final position.
6. Rotating the trigger through an arc of 25° to final position fires the catapult.



50130WB

Figure 1-51. (Sheet 2 of 2 Sheets)

WARNING (1)

The pilot and copilot are provided with seat cushions which are thicker than the cushion provided for the observer. This is to prevent the possibility of injury to pilot or copilot as a result of either crew member's head slipping under his respective headrest during ejection. Consequently, the observer's cushion should never be used in the pilot's or copilot's seat.

Footrests on the pilot's seat are fixed to the bottom of the seat assembly, while the copilot's footrests are stowed beneath the seat assembly and are extended automatically by handgrip actuation. Also, each seat has armrests that may be stowed to give the pilot and copilot more freedom while getting in or out of the seat. Vertical and horizontal adjustment is accomplished simultaneously. In addition, the copilot's seat rotates to facilitate use of additional equipment not readily accessible from the normal seat position. Due to restricted clearance between the copilot's seat and the canopy, the seat assembly must be tilted forward before rotation can be accomplished.

CAUTION

To prevent damage to the canopy, the copilot's seat should not be untilted (normal position) when in any position other than facing forward or aft.

NOTE

In the event it is impossible or impractical for the copilot to return his seat to the forward facing position for ejection, it is possible, but not recommended, to eject himself while facing aft. Ejection from any position other than full forward or full aft will cause serious injury.

WARNING

The copilot should ascertain that the seat is in the normal (untilted) position prior to ejection since the seat may be ejected while in the tilted position and any portion of the rotation arc, thereby causing serious injury to the copilot and possible seat failure.

A turtledeck is provided aft of the copilot to reduce buffeting of the copilot during ejection at high speeds.

PILOT'S AND COPILOT'S EJECTION SEAT CONTROLS (REPUBLIC) (1)

SEAT EJECTION HANDGRIPS. Two ejection handgrips (4 and 10, figure 1-49) installed on each seat are used to prepare the seat for ejection. Each handgrip is stowed beneath the armrest and rotates forward through 205° to a mechanical stop. For a detailed description of ejection handgrip operation, refer to figure 1-51.

CATAPULT FIRING TRIGGER. A catapult firing trigger (9, figure 1-49) is attached to the right ejection handgrip on the pilot's and copilot's seat. The trigger is interlocked with the right handgrip and maintains a 25° lag as the handgrip is moved to the mechanical stop. The trigger is locked and cannot be actuated until the canopy is jettisoned. Pulling the trigger through the 25° will fire the catapult and eject the seat.

NOTE

In the event that any of the operations listed below malfunction during the ejection procedure, the pilot or copilot can use the normal control for that operation as an emergency override:

1. Release cabin pressure
2. Bottom Seat
3. Disengage and stow control column and center wheel.
4. Lock shoulder harness inertia reel.
5. Jettison canopy.

WARNING

The canopy must be jettisoned before the seat catapult can be fired

SEAT ADJUSTMENT LEVER. A two-position seat adjustment lever (7, figure 1-49) located on the right side of the pilot's and copilot's seats locks and unlocks the seat adjustment mechanism allowing the seat to be adjusted from a lower-aft to an upper-forward position. Maximum seat adjustment is 4 inches vertically and 3 inches horizontally, giving a total diagonal seat travel of 5 inches. The seat may be locked at either extremity of the travel or in any of four intermediate positions. The seat adjustment lever has two positions: the forward position locks the seat adjustment mechanism and the aft position unlocks the mechanism. Each po-

(1) AF 51-2357 thru 52-157, -202 thru -311, and -394 thru -507

sition is detented and the lever is spring-loaded to the forward (locked) position. The adjustment lever has no intermediate positions.

NOTE

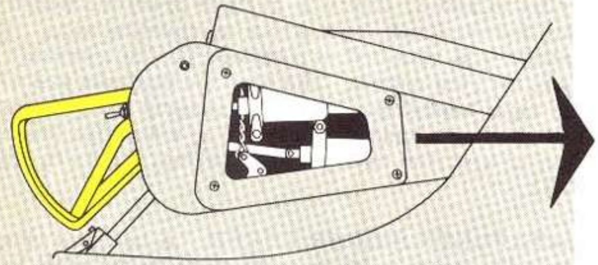
Care should be exercised when unlocking the seat adjustment lever while seat is in the upper-forward position since the seat may suddenly bottom and restrict the visibility of the occupant. After seat adjustment has been accomplished, place the seat adjustment lever manually to the full forward seat locked position (do not rely on the spring to return the lever to the locked position). It may be necessary to joggle the seat to permit moving the lever forward to the locked detent. If the lever is not in the full forward and locked position, the seat may unexpectedly drop to the lowest position.

WARNING

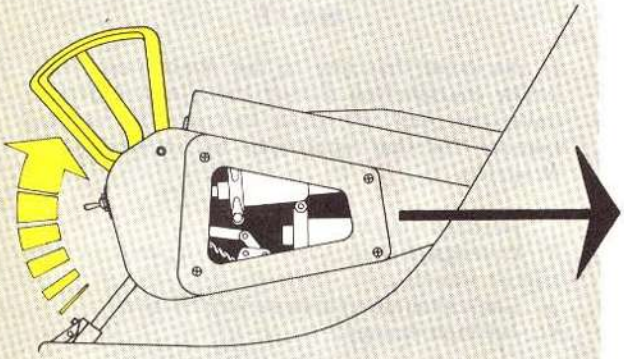
When it is necessary for the pilot flying the airplane to make a seat adjustment, control of the airplane will be given the other pilot until after adjustment has been made.

pilot's and copilot's ejection seat controls

AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on.

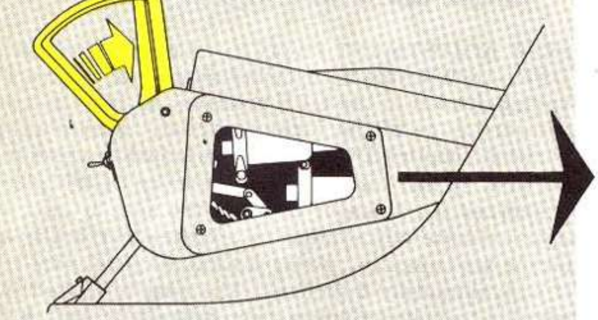


Ejection controls are all in the right handgrip.



Raising the right handgrip to the mechanical stop causes the following to occur:

1. Cabin air emergency depressurization door unlocks releasing cabin pressure.
2. Emergency alarm bell sounds.
3. Electric seat actuator is disconnected and seat is power driven to bottom position.
4. Shoulder harness inertia reel locks.
5. Copilot's foot rests extend.
6. Control column spring cartridge disconnects and centers wheel and stows control column.
7. Canopy spring cartridge unlocks canopy and actuates air bottle valve. On airplanes with sliding canopy pneumatic pressure unlatches canopy, engages hinge pin, and extends air jacks to jettison canopy. On airplanes with clam shell canopy pneumatic pressure unlatches canopy and fires initiator which fires canopy remover to jettison canopy.
8. Jettisoning canopy unlocks catapult trigger lever by removing safety pin from catapult initiator.



Squeezing the catapult trigger lever fires the catapult.

NOTE

- The left handgrip has no connection with jettison controls and is raised and used as a handgrip only.
- Both handgrips lock automatically in ejection position.

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Figure 1-52.

ARMREST LEVER. An armrest lever (8, figure 1-49) located below each armrest on the pilot's and copilot's seats serves to unlock the armrest allowing it to be stowed in the down position for freedom of movement in or out of the seat. When the armrests are raised to an extended position, they lock automatically and serve as leg braces for seat ejection.

COPILOT'S SEAT TILT AND ROTATION HANDLE. A seat tilt and rotation handle (11, figure 1-49) located on the right side of the copilot's seat is a manual control for a self-contained hydraulically operated tilting mechanism which is provided to tilt the seat assembly forward and aft, and the rotation mechanism which allows it to be rotated through an arc of 180° left of forward. A knob located on top of the handle may be rotated clockwise or counterclockwise. Rotating the knob clockwise allows the seat to be tilted forward through fore-and-aft actuation of the handle and permits the seat to be rotated. Turning the knob counterclockwise permits the seat to be tilted back to the normal position following seat rotation.

NOTE

When seat reaches the aft-facing position it is locked against rotation. The seat must be fully untilted (normal position) and returned to the tilted position to unlock seat for rotation back to forward-facing position.

INITIATOR SAFETY PINS AND STREAMERS. Initiator safety pins (3, figure 1-49) accompanied by a red streamer are provided with each seat. The safety pins are inserted through the top of the initiators to prevent inadvertent firing while the airplane is on the ground. The pilot's and copilot's seats each require three initiator safety pins which attach to the cabin air emergency depressurization door, control column disconnect, and seat catapult initiators. The pins must be removed and stowed in containers at each crew station before every flight and replaced immediately after parking the airplane.

PILOT'S AND COPILOT'S EJECTION SEAT INDICATORS (REPUBLIC) (1)

EJECTION SEAT AIR PRESSURE GAGE. The pilot's and copilot's seats are each equipped with an air pressure gage (2, figure 1-49) located on the left side of the seat below the headrest. The gage indicates air pressure in the seat bottoming air bottle. Normal pressure is 950 psi and minimum pressure is 850 psi.

PILOT'S AND COPILOT'S EJECTION SEAT CONTROLS (WEBER) (2)

SEAT EJECTION HANDGRIPS. Two ejection handgrips (3 and 8, figure 1-50) are provided which rotate forward and upward to a mechanical stop. Each handgrip is retained in a stowed position beneath the armrest by a detent. The ejection controls are all in the right handgrip. The left handgrip is to be raised and used as a handgrip only. For a detailed description of ejection handgrip operation, refer to figure 1-52.

CATAPULT TRIGGER LEVER. A catapult trigger lever (7, figure 1-50) is located inside the right handgrip on the pilot's and copilot's seats. The trigger lever is secured by a lock which is released when the canopy is jettisoned. Squeezing the trigger lever fires the catapult and ejects the seat.

NOTE

In the event that any of the operations listed below malfunction during the ejection procedure, the pilot or copilot can use the normal control for that operation as an emergency override.

1. Release cabin pressure.
2. Disengage and stow control column and center wheel.
3. Lock shoulder harness inertia reel.
4. Jettison canopy.

WARNING

The canopy must be jettisoned before the seat catapult can be fired.

SEAT ADJUSTMENT SWITCH. A three-position UP--OFF--DOWN seat adjustment switch (9, figure 1-50), spring-loaded to the OFF position, is installed on the forward edge of the right armrest. Momentary UP position supplies DC power to an actuator which moves the seat up and forward. Momentary DOWN position energizes the actuator to move the seat aft and down. Approximate adjustment is 5 inches vertically and 3 inches horizontally, giving a total diagonal seat travel of approximately 6 inches. The seat is locked in any position throughout adjustment range with switch OFF. Circuit breakers for the pilot's and copilot's seat adjustment electrical circuits are located on the aft DC power panel.

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(1) AF 51-2357 thru 52-157, -202 thru -311, -393 thru -507
(2) AF 52-158 thru -201, -312 thru -393, and -508 & on

NOTE

In order to allow proper cooling of the actuator, the switch must be in OFF position for a period of 30 minutes after a continuous operation of two complete cycles.

ARMREST LOCK. An armrest lock (5, figure 1-50) located on the armrest extension rod below each armrest serves to unlock the armrest allowing it to be stowed in the down position for freedom of movement in or out of the seat. When the armrests are raised to an extended position they lock automatically and serve as leg braces for seat ejection.

COPILOT'S SEAT TILT AND ROTATION HANDLE. A seat tilt and rotation handle (10, figure 1-50) located on the right side of the copilot's seat is provided which allows the seat to be tilted and rotated 180° left of forward. Pulling the handle in toward the seat unlocks the seat for tilting purposes. Pushing the handle out away from the seat locks the seat in either the tilted or normal position. Pulling the handle aft allows the seat to be moved forcefully to the tilted position. Pulling the handle forward allows the seat to be moved forcefully to the normal position. Tilting the seat unlocks the rotation restraint allowing the seat to be rotated.

INITIATOR SAFETY PINS AND STREAMERS. Initiator safety pins (2, figure 1-50) accompanied by red streamers are provided for use with each seat. The safety pins are inserted through the top of the initiators to prevent inadvertent firing while the airplane is on the ground. Each seat requires only one initiator safety pin which attaches to an initiator inside the right armrest. The pin must be removed and stowed in containers at each crew station before every flight and replaced on the seats immediately after parking the airplane.

SAFETY BELT AND SHOULDER HARNESS

On some airplanes ejection seats are provided with a conventional seat safety belt and shoulder harness while on other airplanes the ejection seats are provided with a conventional shoulder harness on an automatic opening cartridge-operated safety belt. This automatic safety belt releases the occupant from the seat at the earliest safe moment after the seat is jettisoned. After the catapult has fired and a lapse of approximately 2 seconds occurs the safety belt initiator fires which opens the safety belt. In the event the automatic feature of the safety belt fails, it can be opened manually.

SHOULDER HARNESS INERTIA REEL LOCK HANDLE

A handle with LOCKED and RELEASED positions is located on the left side of each crew member's seat. A latch is provided for positively retaining the handle at either position of the quadrant. By pressing down on the top of the handle the latch is released and the handle may then be moved freely from one position to the other. When the handle is in RELEASED position the reel harness cable will extend to allow the crew member to lean forward; however, the reel harness cable will automatically lock when an impact force of two or three "g's" is encountered. When the reel is locked in this manner it remains locked until the handle is moved to the LOCKED position and then returned to RELEASED position. In LOCKED position the reel harness cable is manually locked so the crew member is prevented from bending forward. The LOCKED position is used for seat ejection bailout or when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock. Forward and up rotation of pilot's or copilot's left handgrip on some airplanes * or right handgrip on other airplanes** will automatically lock the shoulder harness if the seat is in the full down position.

AUXILIARY EQUIPMENT

The following equipment and its operation is described in section IV, "Description and Operation of Auxiliary Equipment":

- Cabin Heating, Ventilating, and Pressurizing System
- Defrosting Systems
- Anti-Icing and Deicing Systems
- Communication and Associated Electronic Equipment
- Radar Pressurization System
- Lighting Equipment
- Oxygen System
- Automatic Pilot
- Navigational Equipment
- Bombing System
- Fire Control System
- Photographic Equipment
- Air Refueling System
- Single Point Ground Refueling System
- Miscellaneous Equipment

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* AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507
** AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

Figure 1-53 Deleted.

servicing

SERVICING MATERIALS

TO SERVICE	USE	SPECIFICATION
• All Fuel Tanks	Fuel	MIL-F-5624 JP-4 (Recommended) MIL-F-5572 Any Grade (Alternate)
• All Engine Oil Tanks (See Note 1)	Oil	MIL-O-6081 Grade 1010 (Recommended) MIL-O-6081 Grade 1005 (Alternate) (See Note 2)
NOTE 1 ①▶ Carefully inspect O-ring on each oil tank cap prior to reinstallation each time oil tanks are serviced. A damaged or worn O-ring will permit loss of oil during flight.	NOTE 2 For temperatures below -29° C (-20° F), only Specification MIL-O-6081 grade 1005 oil will be used.	
• Surface Power Control Fluid Reservoirs • Hydraulic System Fluid Reservoirs	Hydraulic Fluid	MIL-O-5606
• Fuel Tank Purging Dry Ice Containers • ATO Racks	Crumbled Dry Ice ATO Units ②▶	
• Hydraulic Accumulators • Flaperon Accumulators	Clean Dry Air	
• Oxygen Filler Valve • Oxygen Filler Panel	Oxygen Liquid Oxygen	AN-O-1, Type 1 Grade A AN-O-1, Type 2 ③▶
• Batteries	Add distilled water to cover plates	
• Air Refueling CO_2 Fire Extinguisher System (must be removed to service)	Replace any bottle used or deficient by weight	
• Pneumatic Bomb Release Storage Tanks • A-5 Fire Control System Air Tanks • Spoiler and Canopy Air Bottles • Downward Ejection Hatch Air Bottle • Seat Bottoming Air Bottle	Clean dry air at approximately 21° C (70° F)	
• Water Injection System (See Note 3)	Recommended	Methyl Alcohol O-M-232 (Grade A) 26% *(28%**) ±1% by Volume Water (minimum solids content available) 74% *(72%**) ±1% by volume
NOTE 3 Water injection system will not be used at temperatures below -7° C (+20° F).	Alternate	Ethyl Alcohol (MIL-A-6091) 22.5%* (24%**) ±1% by Volume Water (minimum solids content available) 77.5% *(76%**) ±1% by Volume
	To be used with both Recommended and Alternate Mixtures	Oil Emulsive, corrosion preventive (MIL-C-4339) .66% by Volume Wetting Agent (MIL-W-16791) 1 quart per 1000 gallons of Water Alcohol mixture.

①▶ AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru -5256, -15804 thru -15812, 52-019 thru -069, -202 thru -244

②▶ For approved ATO units and loading configurations, refer to "Assist Take-Off (ATO) Systems," this section.

③▶ Some modified B-47B airplanes and AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

* 450 ppm flow system

** 650 ppm flow system

(CONTINUED)

Figure 1-54. (Sheet 1 of 3 Sheets)

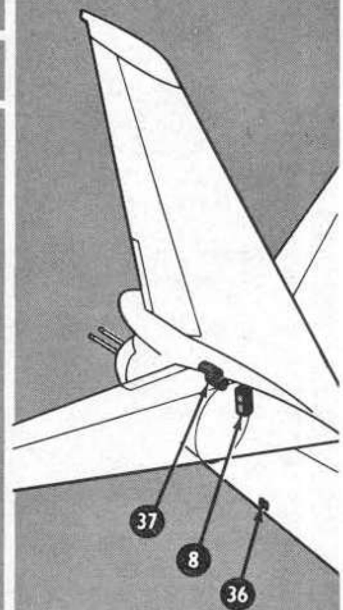
servicing (CONTINUED)

AIR PRESSURES FOR HYDRAULIC ACCUMULATORS OR AIR BOTTLES

The following table shows the proper pressure for accumulators and air bottles used in the hydraulic and pneumatic systems at various stabilized ambient temperatures. The air pressure should be within ±20 psi of the pressure indicated in the table for any given ambient temperature.

STABILIZED TEMPERATURE		PSI AT VARIOUS TEMPERATURES				
°C	°F	500	1000	1500	1750	2000
71	160	604	1202	1830	213	2450
65	150	592	1180	1793	209	2400
60	140	581	1158	1756	2051	2350
55	130	570	1135	1718	2008	2300
49	120	558	1113	1680	1965	2250
43	110	547	1091	1644	1922	2200
38	100	535	1068	1608	1879	2150
32	90	523	1046	1572	1836	2100
26	80	512	1023	1536	1793	2050
21	70	500	1000	1500	1750	2000
16	60	489	977	1464	1707	1950
10	50	478	955	1428	1664	1900
5	40	466	932	1392	1621	1850
−1	30	454	910	1356	1578	1800
−7	20	442	887	1320	1535	1750
−12	10	430	865	1284	1492	1700
−18	0	419	842	1248	1449	1650
−24	−10	408	819	1212	1406	1600
−29	−20	396	796	1176	1363	1550
−34	−30	384	773	1138	1320	1500
−40	−40	373	750	1100	1277	1450
−45	−50	361	728	1063	1234	1400
−51	−60	350	705	1026	1191	1350
−54	−65	344	694	1008	1169	1325*

*Due to the retarding effect of low temperatures on the observer's downward ejection hatch jettisoning mechanism, 1350 psi is considered minimum safe jettison bottle pressure at −54° C (−65° F). The hatch will jettison in 1 to 2 seconds under these conditions. 1325 psi will jettison the hatch at −54° C (−65° F) but will require an additional 1 to 2 seconds.



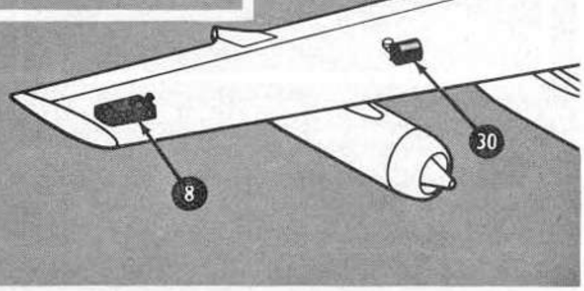
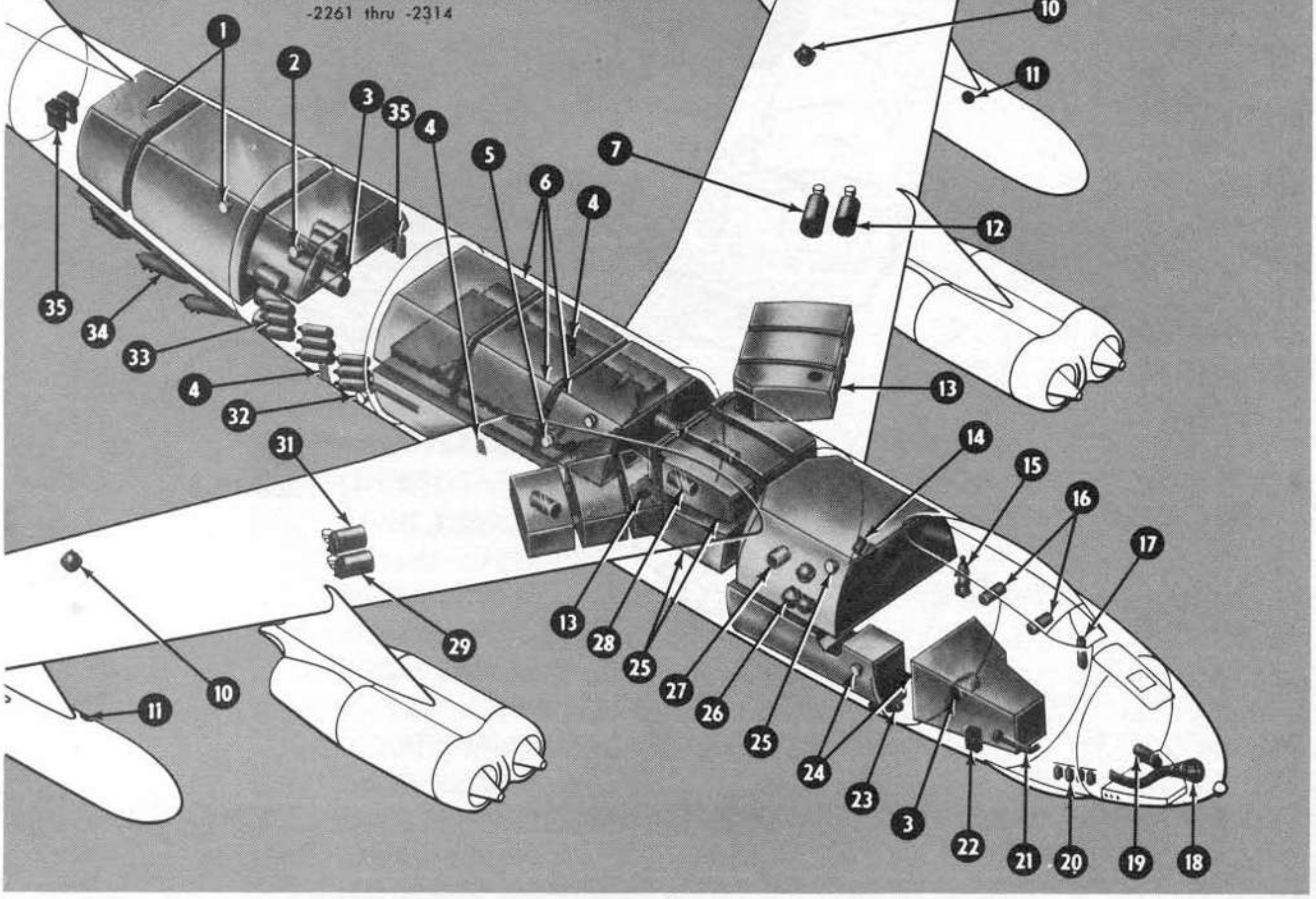


Figure 1-54. (Sheet 2 of 3 Sheets)

1. Aft Main Fuel Tank
2. ATO (Aft Auxiliary) Tank
3. Fuel Tank Purging Dry Ice Containers (9)
4. Liquid Oxygen Filler Panel (1)
5. Bomb Bay Fuel Tank
6. Center Main Fuel Tank
7. No. 3 Engine Oil Tank
8. Surface Power Control Fluid Reservoir
9. No. 1 Engine Oil Tank
10. Flaperon Accumulator
11. External Wing Fuel Tank
12. No. 2 Engine Oil Tank
13. Water Injection System Tank
14. External Power Receptacles
15. Canopy Emergency Air Bottle
16. Seat Bottoming Air Bottle (2)
17. Bailout Spoiler Air Bottle (3)
18. Air Refueling Receptacle
19. Downward Ejection Hatch Air Bottle
20. Air Refueling CO_2 Fire Extinguisher Bottles (4)
21. Oxygen Filler Valve (5)
22. Radar BNS External Power Receptacle
23. Oxygen Filler Valve (6)
24. Forward Auxiliary Fuel Tank
25. Forward Main Fuel Tank
26. Hydraulic Accumulators
27. Hydraulic System Fluid Reservoir
28. Pneumatic Bomb Release Storage Tanks
29. No. 5 Engine Oil Tank
30. No. 6 Engine Oil Tank
31. No. 4 Engine Oil Tank
32. Single Point Ground Refueling Receptacle
33. Internal ATO System Bottles (7)
34. External ATO System Bottles (8)
35. Batteries
36. Fire Control System External Power Receptacle
37. Fire Control System Air Tanks

(1) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on
(2) AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507
(3) If Bailout Spoiler Is Installed
(4) Some Airplanes
(5) AF 51-15804 thru -15812, 52-019 thru -081, -202 thru -292
(6) AF 51-2192 thru -7083, -17368 thru -17386, 52-082 thru -201, -293 & on
(7) AF 51-2357 thru 52-088, -202 thru -292
(8) AF 51-2192 thru -2356, 52-089 thru -201, -293 & on
(9) AF 51-2192 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314



50141 WC

Figure 1-54. (Sheet 3 of 3 Sheets)

normal procedures

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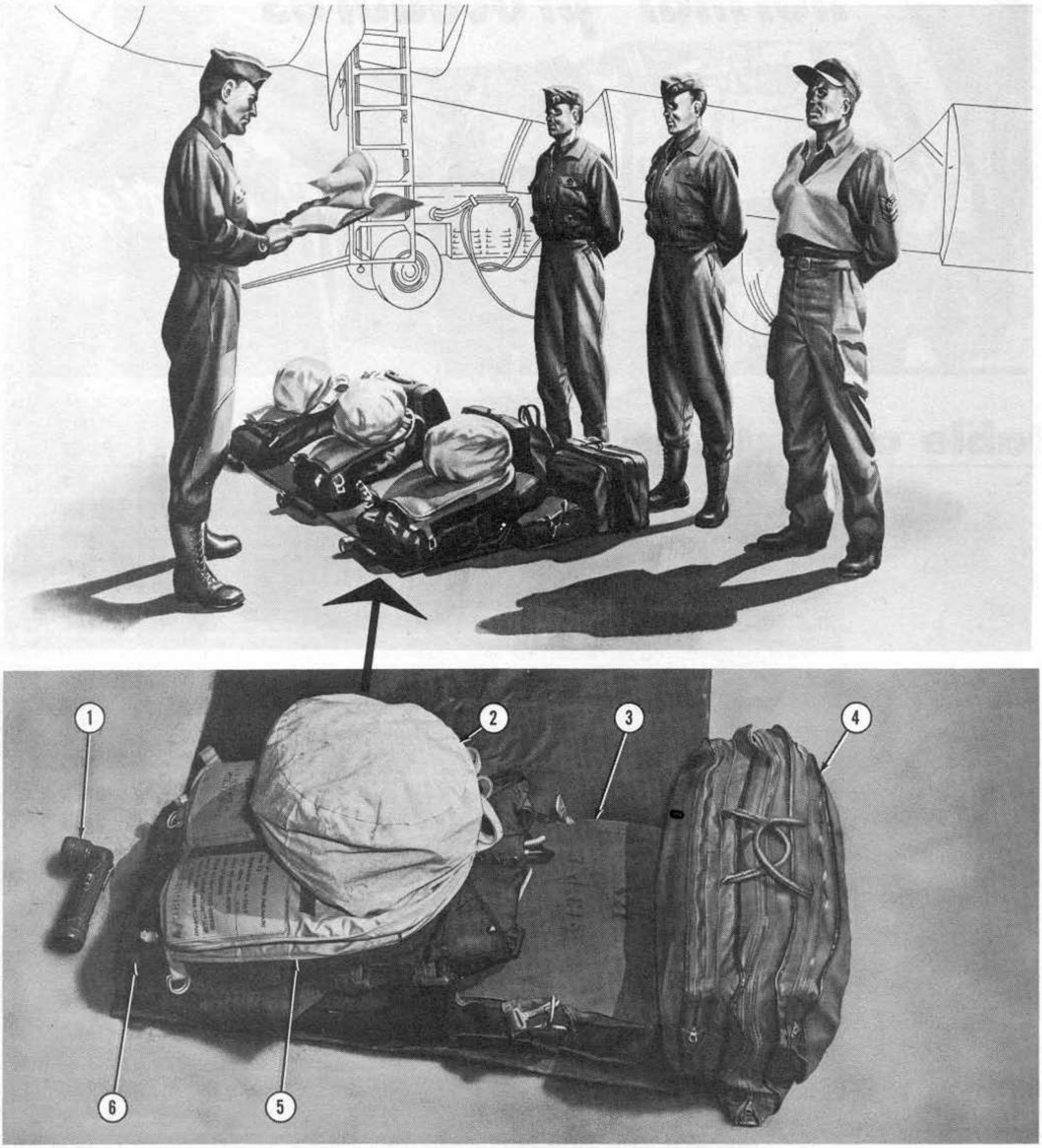
crew inspection



1.	Flashlight
2.	Helmet & Oxygen Mask
3.	One-Man Dinghy
4.	Professional Equipment
5.	Mae West
6.	Parachute

50223WC

Figure 2-1.

STATUS OF THE AIRPLANE

FLIGHT RESTRICTIONS

Refer to section V for information concerning the restrictions imposed on the airplane in flight.

FLIGHT PLANNING

Jet aircraft require special emphasis on mission planning and cruise control because of the inherently high fuel consumption of jet engines and the wide range of speeds and altitudes attainable. To successfully complete any mission, it will be necessary for the pilot to become familiar with the operating data charts in the appendix to determine the required fuel quantity, takeoff distance, ATO requirements, and power settings for climb and cruise control. A mission flight plan (figure A11-2) is presented in the appendix to aid the pilot in cruise control. A Takeoff and Landing Data Card ("Takeoff and Initial Climb," this section, and figure A11-1) will be completed and used for every mission. For instructions on the use of the above forms, see part 11 of the appendix.

WEIGHT AND BALANCE

Refer to "Weight and Balance Data" handbook (T.O. 1-1B-40) for detailed loading information. A load adjuster has been stowed in the pilot's data drawer.

a. Check that required amounts of fuel, oil, water, ATO bottles (if required), and bombs have been loaded.
b. Obtain the takeoff and anticipated landing gross weights and estimated cg locations.
c. Check weight and balance clearance (Form F) for completion of entries and for proper clearance.

NOTE

Refer to section V for further information concerning the weight and cg limitations of this airplane.

NOTE

- The flight crew's preflight inspection is based on the assumption that maintenance personnel have completed the maintenance preflight contained in the Handbook of Inspection Requirements (T.O. 1B-47A-6). Discrepancies noted during the flight crew's preflight will be recorded in DD Form 781 and cleared by authorized maintenance personnel prior to takeoff.
- The following checklists are accomplished by the copilot calling off the items to the crew. For identification purposes, all responses made by the pilot are noted in CAPITAL letters; those made by the copilot are noted in lower case letters; those by the observer are shown in *italics*; and those by the groundobserver will be identified by lower case letters in parentheses ( ).

BEFORE INTERIOR INSPECTION

1. ATO Safety Devices - AS REQUIRED
   If internal ATO is installed, pilot insures that ATO safety link has been removed.
   If external ATO is installed, pilot insures that ATO pullout plugs (two) have been disconnected and external ATO rack lockpin has been installed.
2. Stations Inspection - COMPLETED
   Station time (normally 2 hours prior to scheduled takeoff) is established at the operations briefing. At station time all flight crew members assemble at the airplane with the airplane crew chief and receive a time hack from the observer. At this time flight crew members will have their equipment arranged in the following manner (figure 2-1):
   a. Parachute - Cushion down with loose straps tucked under. Top of parachute toward rear of airplane.
   b. Mae West - On top of parachute, leather parts up, neck hole to the rear, and strap stowed.
   c. One-Man Dinghy (when carried) - Placed under top of parachute, carrying handle toward rear, and hooks up.
   d. Helmet and Oxygen Mask - Placed at top of Mae West in protective bag.
   e. Professional Kits - Placed directly behind parachute.
   f. Flashlight - Placed directly forward of parachute.

(CONTINUED ON NEXT PAGE)

BEFORE INTERIOR INSPECTION

(CONTINUED)

3. Briefing - COMPLETED
   Pilot checks DD Form 781 for airplane status and discrepancies. Pertinent write-ups will be brought to the attention of the flight crew. Pilot asks crew chief for the maintenance preflight inspection worksheet for examination by the flight crew. Pilot reviews emergency procedures and factors pertinent to the mission. Pilot also briefs the flight crew and crew chief on any special instructions for preflight and start.

4. Equipment Check - COMPLETED
   Pilot insures that each crew member has checked his personal equipment for completeness and proper condition; ascertains that all necessary professional equipment is on hand. Pilot announces the time for final boarding of the airplane prior to takeoff. Personal and professional equipment may be placed aboard the airplane following crew inspection and briefing.

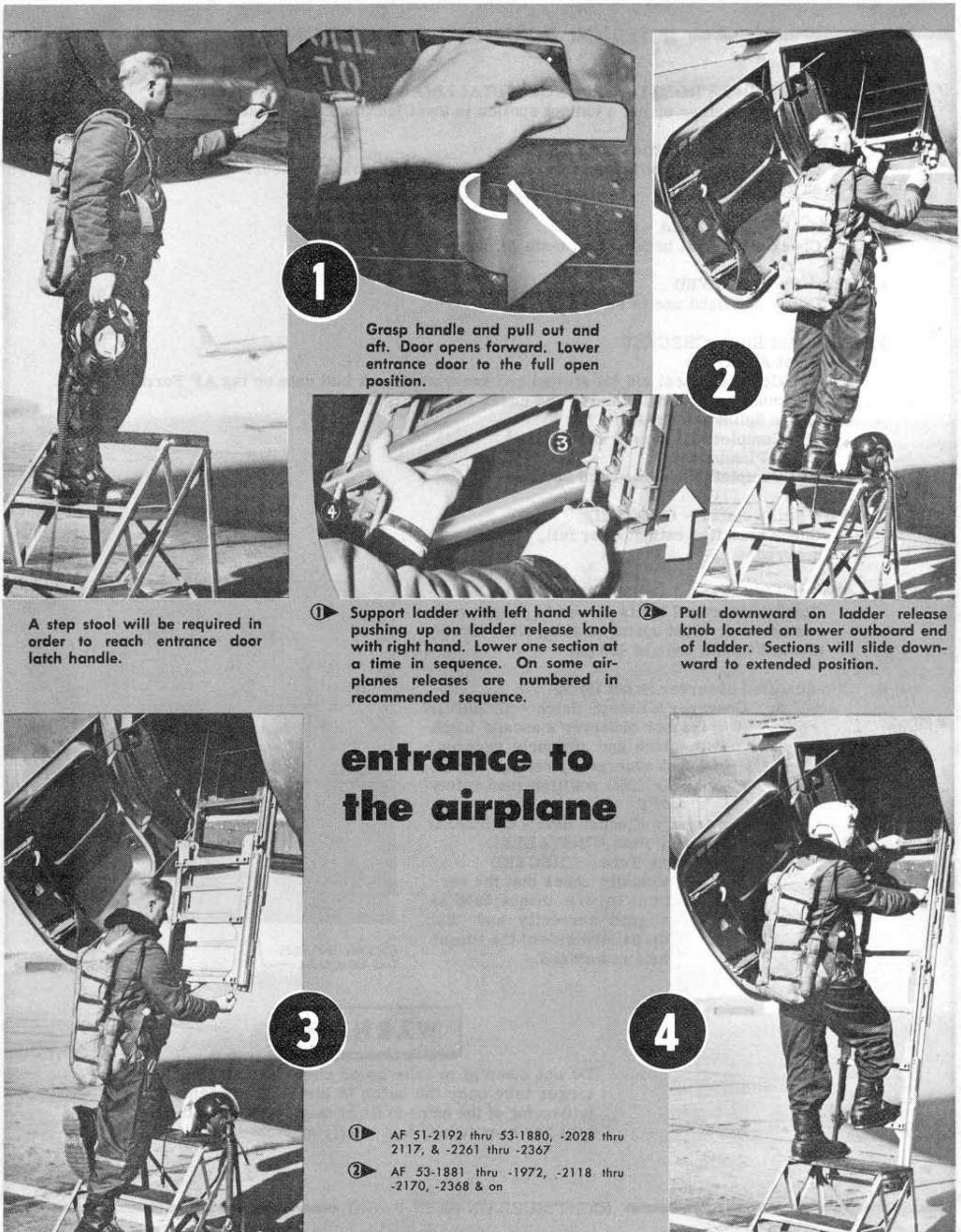
(1)► 5. Liferaft - CHECKED
   If over-water flight is to be made, pilot checks with crew chief to insure that Mark IV four-man liferaft has been properly installed.

6. External Power - OFF
   Pilot insures that external power units are off the line.

ENTRANCE

Entrance into the airplane (figure 2-2) is made through a door in the lower left side of the fuselage just aft of the radome. A small stepladder is needed to reach the entrance door handle and to release the entrance ladder.

(1)► AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 & on



A step stool will be required in order to reach entrance door latch handle.

Grasp handle and pull out and aft. Door opens forward. Lower entrance door to the full open position.

(1) Support ladder with left hand while pushing up on ladder release knob with right hand. Lower one section at a time in sequence. On some airplanes releases are numbered in recommended sequence.

(2) Pull downward on ladder release knob located on lower outboard end of ladder. Sections will slide downward to extended position.

entrance to the airplane

(1) AF 51-2192 thru 53-1880, -2028 thru 2117, & -2261 thru -2367

(2) AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on

50201 WC-1

Figure 2 - 2.

INTERIOR PREFLIGHT INSPECTION

1. Bailout Spoiler - INSTALLED or NOT INSTALLED
   Observe whether or not a bailout spoiler is installed for possible future emergencies.

2. Bailout Spoiler Air Bottle - CHECKED
   Check spoiler air bottle pressure gage; should read correct pressure in figure 1-54 based on 2000 psi.

①► 3. Main AC Power Shield - CHECKED
   Check all circuit breakers on main AC power shield in.

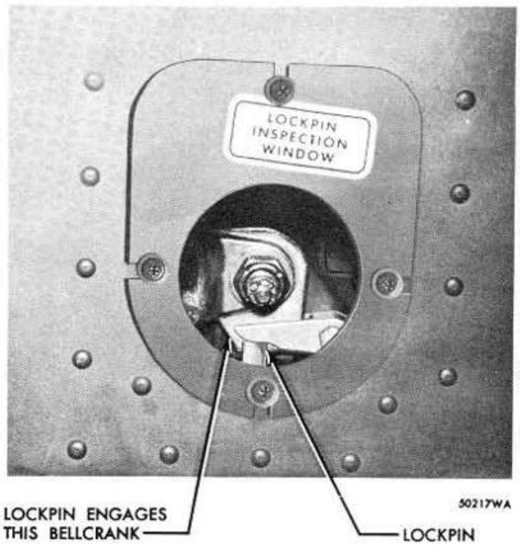
4. Hand Axe - STOWED
   Check that hand axe is stowed and secure.

5. First Aid Kits - CHECKED
   - First Aid Kit:
     Complete first aid kit stowed and secured, check last date on tag AF Form 50 (date must be within 180 days) and check for seal intact.
   - Battle Splint and Dressing Kit:
     Complete kit stowed and secured.
   - Blood Plasma Kit:
     Complete kit stowed and secured.

6. Fire Extinguisher - CHECKED
   Check hand fire extinguisher full, stowed, and secured.

7. Forward Walkaround Bottle - CHECKED
   Check walkaround bottle stowed in proper rack and secured. Test spring clothing clip. Bottle charged to minimum of 400 psi.

8. If a qualified observer is not flying:
   a. Observer's Escape Hatch - SECURED
      Inspect observer's escape hatch in place and properly secured. Check emergency release handle in LOCKED position (and safety wired*).
   b. Observer's Ejection Seat - CHECKED
      (1) Safety Pins - INSTALLED
      (2) Torque Tube - CHECKED
          Visually check that the vertical square torque tube is aligned correctly and that the painted side of the torque tube is forward.



WARNING

Do not attempt to take up or check for slack in the torque tube once the hatch is installed. Accidental jettisoning of the hatch in flight may occur if the torque tube has been turned to a nearly unlatched position.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
* AF 51-2357 thru 52-041, -202 thru -235

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

(3) Initiators - CHECKED
Check that initiator caps have not rotated on cylinders (a setscrew is provided in each cap to secure cap to cylinder). Check all initiator sear pins; make sure that sear pin safety pin groove is not visible outside the initiator housing.

(4) Whiffletree - ENGAGED
Check that whiffletree engages right and left initiator sear pins.

(5) Catapult Initiator Safety Pin - INSTALLED
Check that safety pin attached to the hatch static cable is installed in the catapult initiator.

(6) Hatch Static Cable - CONNECTED
Check hatch static cable connected to the downward ejection hatch.

(7) Downward Ejection Hatch - LOCKPIN IN PLACE, PRESSURE CHECKED
Check downward ejection hatch for proper installation and hatch lockpin engaged by looking through lockpin inspection window. Lockpin should extend approximately 0.30 inch into bellcrank cutout. Check hatch air pressure gage inspection window; gage should read correct pressure in figure 1-54 based on 2000 psi.

(8) Seat Rotation Locks & Leg Braces - FULL DOWN, CHECKED
Check that seat rotation locks and leg braces containing the latch triggers are full down and trigger springs are installed correctly.

(9) Restraint Cable - CHECKED
Check that swaged balls at each end of restraint cable are in retaining clips in both left and right leg brace latch triggers.

(10) Leg Guard Torque Tube - CHECKED
Check that D-ring cable is snug, correctly installed on center pulley of leg guard torque tube, and that leg retainers are stowed.

(11) D-Ring Retaining Clip - IN PLACE
Check D-ring stowed in downward position. Clip should overlap D-ring to the point where sides of clip touch or come within 1/8 inch of D-ring.

(12) Quick-Disconnect - CHECKED
Check correct installation of lanyard from hook to personal leads quick-disconnect mounting.

(13) Shoulder Harness & Inertia Reel - CHECKED
Manually check shoulder harness and inertia reel for correct operation.

(14) If observer's seat is to be unoccupied:
Safety Belt & Shoulder Harness - BUCKLED
Buckle safety belt and shoulder harness together to prevent flopping around in flight.

(15) Seat Rotation - CHECKED
Check rotation of seat.

c. Rendezvous Radar AN/APN-76 Switches - OFF
Check AN/APN-76 master power and standby switches OFF.

d. Radar Computer Function Switch - OFF

e. Radar Power Control Switches - OFF

f. Observer's Oxygen Panel - CHECKED & OFF
Place oxygen supply lever ON and check for minimum pressure reading of 400 psi for conventional oxygen system or 300 psi for liquid oxygen system. Return supply lever to OFF. Check diluter lever on NORMAL OXYGEN and check oxygen warning system switch OFF.

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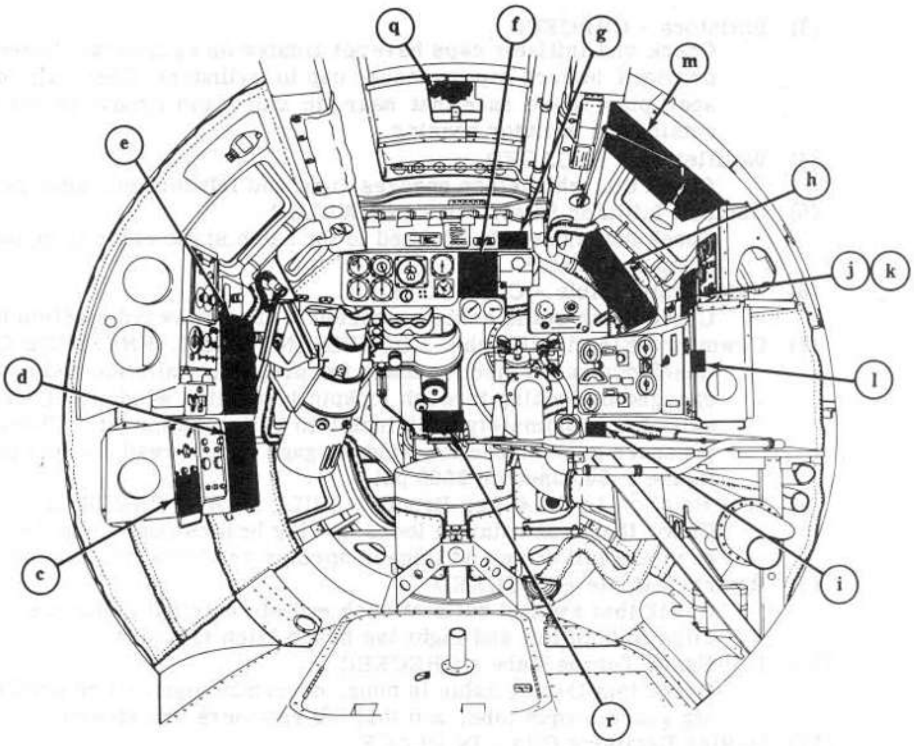
INTERIOR PREFLIGHT INSPECTION

(CONTINUED)



CAUTION

Due to the automatic pressure flow feature of the regulator, a continuous flow of oxygen will occur at high cabin altitude if the supply lever is left ON. This will cause a rapid loss of oxygen.

①► g. Three-Phase Inverter Switch - OFF (MAIN NORMAL)
Check three-phase inverter switch on radar power monitoring panel in OFF on some airplanes or in MAIN NORMAL on other airplanes.

h. Salvo & Master Bomb Control Switches - OFF
Check bomb control selector switch in NORMAL, salvo control switch in OFF, and both switch guards closed. Master bomb control power and indicator light switches OFF.

②► i. Bombsight Cover & Heat Switch - CLOSED & OFF
Check bombsight cover crank indicator fully closed and heat switch in OFF position.

j. Camera Master Switch - ON (IF VERTICAL CAMERA INSTALLED)

③► k. Camera Window Defrost Switch - OFF

l. ④►Observer's Lower Air Heater Switch - OFF
⑤►Observer's Lower Air Shutoff Knob - OFF

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278
②► AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
③► AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on
④► AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on
⑤► AF 52-363 thru -393, -584 thru -620, -3343 thru 53-1849, -2261 thru -2314

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

m. BNS Heat & Light Switches - OFF
   Check BNS system heating, light control, and nose defrost switches OFF.

①▶ n. Observer's Air Outlet Selector - BOTH OFF
   Position observer's air outlet selector knob to BOTH OFF position.

o. Circuit Breakers - IN
   Check circuit breakers pushed in on radar power panel.

p. Radar Pressurizing Control Switch - OFF

q. Periscopic Port - CLOSED

②▶ r. Observer's Upper Air Shutoff Valve - OFF
   Check that the shutoff valve on the observer's upper air outlet is off.

s. Loose Equipment - SECURED

9. Let-Down Books & Facility Charts - checked
   Check data case for the following:
   - Radio Facility Charts (LF/MF and VOR Editions)
   - Supplementary Flight Information
   - Pilot's Handbook East Jet and Pilot's Handbook West Jet
   - Pilot's Handbook ILS-VOR
   - "Weight and Balance Data" handbook, T.O. 1-1B-40.

10. Aft Walkaround Oxygen Bottle - checked
   Copilot checks walkaround oxygen bottle stowed in proper rack and secured. Test spring clothing clip. Bottle charged to a minimum of 400 psi.

③▶ 11. Ditching-Crash Landing Station - checked
   Copilot checks safety belt installed on each side of step seat; shoulder harness and tiedown strap stowed in step compartment. Raises seat back and checks for a continuous surface of the seat back and step riser. Stows seat back and checks shoulder harness attaching ring available in floor. On airplanes with an oxygen regulator installed at this station, copilot places supply lever ON and checks minimum pressure reading of 300 psi. Copilot returns supply lever to OFF and checks diluter lever on NORMAL OXYGEN.

12. ECM Switches - off
   Copilot checks ECM transmitter control switches OFF.

④▶ 13. Chaff Dispenser Switches - off
   Copilot checks both chaff dispenser switches OFF.

14. Canopy Emergency Jettison Air Bottle - checked
   Copilot checks canopy emergency jettison air bottle; gage should read correct pressure in figure 1-54 based on 2000 psi.

15. G-Files & Loose Equipment - checked
   Copilot checks G-File for the following tech orders of latest issue:
   - Flight Handbook, T.O. 1B-47E-1
   - Handbook Erection and Maintenance Instructions, T.O. 1B-47B-2
   - Parts Catalog, T.O. 1B-47B-4
   - Inspection Requirements, T.O. 1B-47A-6

   Checks all equipment in area for security; loose equipment removed.

16. Gunnery System - switch off & safe
   Copilot checks selector switch OFF and gun safety switch SAFE.

(CONTINUED ON NEXT PAGE)

①▶ AF 51-2357 thru 52-362, -394 thru -583
②▶ AF 52-177 thru -201, -331 thru -393, -527 & on
③▶ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
④▶ AF 51-2192 thru -2356, 52-158 thru -201, -312 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

①► 17. ARC-21 Antenna Coupler Insulator - checked
Copilot checks the pressurized glass insulator intact and undamaged.

WARNING

Treat vicinity of the pressurized glass insulator with extreme care. An impact may cause the insulator to explode, exposing personnel to flying glass. The danger increases with altitude because of the greater pressure differential, particularly upon loss of cabin pressure.

18. Gunner's Air Outlet - both off
Copilot places gunner's air outlet selector to BOTH OFF.

19. Circuit Breakers - checked
Copilot checks all circuit breakers pushed in on upper, lower, and aft (some airplanes) DC power panels, turret control, and indicator panels.

②► 20. Canopy Initiator Pin, Ballistics Tubing, Remover Disconnect Handle - in place, secure - CONNECTED
Copilot checks canopy initiator safety pin installed with streamer attached and hand checks tubing from initiator connected securely to canopy remover. Pilot checks canopy remover disconnect handle in full up, connected position.

21. Ejection Seats - CHECKED - checked
Pilot and copilot check their individual seats (Republic) as follows:
   a. Check left and right handgrips in full down position.
   b. Copilot checks ejection footrests stowed under seat.
   c. Copilot checks seat hydraulic system for oil level and leaks.
   d. Check static line lanyard secured to canopy, connected to safety pin, and safety pin installed on catapult.
   e. Check ejection seat initiators (three on each seat) for safety pins installed and streamers attached.
   f. Check all initiator sear pins; make sure the sear pin safety pin groove is not visible outside the initiator housing.
   g. Check ejection seat air pressure gage for 850 to 950 psi.
   h. Manually check shoulder harness and inertia reel operation.
   i. Check seat adjustment handle operation.

Pilot and copilot check their individual seats (Weber) as follows:
   a. Check left and right handgrips in full down position.
   b. Copilot checks ejection footrests stowed under seat.
   c. Check armrest window for safety pin installed in upper forward initiator.
   d. Check all initiator sear pins; make sure the sear pin safety pin groove is not visible outside the initiator housing.
   e. Check static line lanyard secured to canopy and to disconnect on seat back. Inspect routing of static line lanyard to make certain it is not fouled on any part of the seat structure and that routing of the lanyard is such to remove all possibility of its becoming fouled in flight.
   f. Manually check shoulder harness and inertia reel operation.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2356, 52-518 & on
②► AF 52-612 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

22. Top of Engines, Wings & Fuselage - CHECKED - checked
    Pilot and copilot check engine nacelle latches, and tops of wings and fuselage for loose panels, caps, and buckling.

    ①► Copilot checks liferaft T-handle and liferaft compartment doors closed and secure.

23. Canopy, Windshield & Yaw String - CHECKED
    Pilot checks canopy and windshield for cracks, crazing, defects, or damage; windshield and canopy clean for good vision; latch reset horizontal (on airplanes with sliding canopy); and yaw string installed.

②► 24. Periscopic Port - closed
    Copilot checks periscopic sextant mount shutter lever in CLOSED position.

25. Emergency Turn & Bank - CHECKED - checked & normal
    Copilot places turn-and-bank power switch in EMERGENCY. Pilot and copilot check operation of turn-and-bank as evidenced by sound of electric motor within instrument. When pilot confirms, copilot returns power switch to NORMAL and closes switch guard.

26. Emergency Keyer - OFF & SAFETIED
    Pilot checks emergency keyer switch OFF, switch guard closed, and safety wire intact.

③► 27. Approach Chute Deployment Switches - DOOR CLOSED - door closed (or off)
    Pilot and copilot check approach chute deployment switches in the guarded DOOR CLOSED or OFF position.

28. Gear Lever - down - DOWN
    Copilot and pilot check landing gear levers DOWN.

29. Steering Ratio Selector - TOW DETENT
    Pilot checks steering ratio selector lever in TOW detent.

30. Alarm Bell - CHECKED & OFF - ok - *ok*
    Pilot places emergency alarm bell switch ON; when copilot and observer report "OK," pilot returns switch to OFF and closes switch guard.

31. Engine Screens - OPEN
    Pilot checks engine screen switch in OPEN position unless screens are inoperative.

32. Ignition Switches - OFF
    Pilot checks all (six) ignition switches OFF.

33. Bomb Salvo Switch - OFF & SAFETIED
    Pilot checks bomb salvo switch in OFF position; switch guard closed and safetied. On some airplanes check circuit breaker pushed in.

34. Throttles - cutoff - CUTOFF
    Copilot checks all throttles (six) in CUTOFF position. Pilot checks throttle lock lever OFF and all throttles (six) in CUTOFF.

35. Flap Lever - off - OFF
    Copilot checks wing flap lever and wing flap emergency switches (two) OFF. Pilot checks wing flap lever-OFF and in detent.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 & on
②► AF 51-2192 thru -2356, 52-612 & on
③► AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

36. ①▶ Tank Jettison Switches - NORMAL
Pilot checks tank jettison switches (two) NORMAL and switch guards closed.

②▶ Tank Jettison Switches - OFF
Pilot checks tank jettison switches (two) off (center position) and switch guards closed.

37. Emergency Gear Retraction Switches - off - OFF
Copilot checks landing gear retraction switches (four) OFF and switch guards closed. Pilot checks emergency gear retraction switch OFF (spring-loaded to lower switch position) and switch cover closed.

38. ③▶ Canopy Control Lever - OFF
Pilot checks canopy control lever OFF.

④▶ Canopy Latch Control Lever - OFF
Pilot checks canopy latch control lever OFF.

39. Battery - ON - checked
Pilot positions battery switch to LH BUS NORMAL. Copilot positions DC voltmeter selector switch to L BUS, FWD BUS, and R BUS and reads voltage at each position to pilot. Pilot changes battery switch to RH BUS; copilot positions DC voltmeter selector switch to L BUS, FWD BUS, and R BUS and reads voltage at each position to pilot. Minimum acceptable voltage reading is 18 volts.

40. DC Bus Selector - checked, normal
   a. Copilot checks bus selector switch in NORMAL; DC lights in cockpits should remain illuminated and should not flicker.
   b. Copilot holds bus selector switch in PRIMARY TEST, then releases switch to NORMAL; DC lights should not flicker or go out.
   c. Copilot places bus selector switch to SECONDARY; DC lights should flicker off as switch is moved, then remain illuminated with switch in SECONDARY, indicating that power transfer has occurred.
   d. Copilot returns bus selector switch to NORMAL; DC lights should flicker off as switch is moved, then remain illuminated with switch in NORMAL.
   e. Copilot closes switch guard and informs pilot, "Bus selector checked and switch normal."

NOTE

Failure of either bus to take the DC load will be grounds for a mandatory abortion of the mission.

41. Connect External DC Power - (on the line)
Copilot calls "Ground crew from copilot, connect external DC power." Ground crew replies "On the line."

42. Battery - OFF
Pilot positions battery switch OFF.

43. Oxygen & Interphone - Crew Reports
Pilot turns master oxygen warning control switch ON. All crew members accomplish the following oxygen check (fourth crew member's warning light system is inoperative):
   a. Check oxygen supply shutoff lever OFF and bleed pressure from regulator by depressing emergency toggle lever; pressure should drop to zero and remain at zero when emergency toggle lever is released.

(CONTINUED ON NEXT PAGE)

①▶ Airplanes which do not have T.O. 1B-47-767 accomplished
②▶ Airplanes which have T.O. 1B-47-767 accomplished & AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on
③▶ AF 51-2357 thru 52-611
④▶ AF 52-612 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

b. Position oxygen supply shutoff lever ON and check system pressure (400 to 450 psi), except with the liquid oxygen system, the pressure in the system is constant (300 psi) until the liquid oxygen is depleted.
c. Place warning system switch ON; oxygen warning light at that station will come on bright (steady or blinking).
d. Place diluter lever to NORMAL OXYGEN first and then to the 100% OXYGEN to check oxygen regulator as follows: Blow gently into end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a leak or malfunction.
e. With the regulator diluter lever at 100% OXYGEN, move emergency toggle lever to emergency position (left or right) to flush the regulator hose; oxygen flow blinker should indicate continuous flow and warning light at that station should momentarily blink and go dim, then return to bright.
f. With emergency toggle lever still in EMERGENCY position, block regulator hose tightly with the hand; blinker should indicate no flow and warning light at that station should continue on bright. A hissing of the regulator or a flow indication will indicate a ruptured regulator diaphragm or other pressure leak. Check hose and hose fitting.
g. Return emergency toggle lever to center (off) position. Plug in oxygen mask. Check quick-disconnect fitting (fitting should separate with a 10- to 15-pound pull).
h. Connect mike cord, adjust mask on face, and check blinker operation during normal breathing; warning light should go dim and remain dim.
i. Deflect emergency toggle lever to right or left. A positive pressure should be supplied to mask. Return emergency toggle lever to center position.
j. Depress emergency toggle lever straight in to TEST MASK. A positive pressure should be applied to mask. Hold breath to determine if there is a leakage around mask; if no leakage, blinker should indicate no flow. After approximately 10 seconds or less, warning light should come on bright (12 seconds after a 5-minute warmup period during regulator use). A pressure leak will be indicated by a flow indication or a hissing of the regulator. Release emergency toggle lever; positive pressure should cease.
k. Return diluter lever to NORMAL OXYGEN.
l. Report over interphone "Oxygen check complete,_____psi, warning switch ON."

(1)▶ 44. Liquid Oxygen Quantity Gages - checked
Copilot checks that liquid oxygen quantity gages each read approximately 8 liters.

45. All Lights & Push-to-Test Lights - CHECKED - checked
Pilot and copilot make the following checks where applicable:
- Floodlights - Test cabin floodlights on both RED and WHITE.
- Instrument Lights, Panel Lights, and Side Panel Lights - Test and inspect for bulbs not lighting.
- Compass Light - Test compass light on BRIGHT and DIM.
- Landing and Taxi Lights - Test individually (maximum duration of test is 5 seconds).
- Position Lights - Test and verify lighting with ground observer.
- Fire Warning Lights - Pilot tests engine fire warning lights by pressing each fire shutoff switch until light illuminates.
- Landing Gear Lever Lights - Copilot checks landing gear lever lights by depressing test switch.
- Push-to-Test Lights - Test all push-to-test lights and set for bright or dim as required.

(CONTINUED ON NEXT PAGE)

(1)▶ Some B-47B airplanes & AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

46. ①► Inverters - CHECKED & ON - checked & on

Pilot checks instrument inverters in the following manner:

a. With main and spare instrument inverters OFF, red warning light labeled "Bus Power Off" will be on.
b. Places instrument inverter switch on SPARE; red light will go out and amber light labeled "Spare Inverter On Bus" will come on.
c. Places inverter switch on MAIN; both indicator lights should be out.
d. Leaves switch on MAIN.

Copilot checks inverters as follows:

a. Checks red instrument inverter warning light out.
b. Moves main, A-5 (or MD-4), and secondary inverter power switches to ON.
c. Moves inverter transfer control switch to NORMAL.
d. Checks all inverter indicator lights out.
e. Checks main, A-5 (or MD-4), and secondary bus voltmeter readings between 110 to 120 volts.

②► Emergency Instrument Inverter - CHECKED - checked

Pilot checks red "Inst AC Power Off" light illuminated. Copilot checks red emergency AC power warning light out. Copilot then places the emergency AC power switch ON. The red "Inst AC Power Off" light should go out and the red emergency AC power warning light flicker momentarily and go out. Copilot places the voltmeter and frequency meter selector switch to EMERG BUS ØC and checks voltage approximately 115 volts and frequency approximately 400 cycles, then places switch to EMERG BUS ØA and checks voltage and frequency as in EMERG BUS ØC position. Copilot returns emergency AC power switch to OFF. The red "Inst AC Power Off" light on the pilot's instrument panel should illuminate and the red emergency AC power warning light on the regulated AC power panel should remain out.

②► 47. Connect External AC Power - (on the line)

Copilot calls "Ground crew from copilot, connect external AC power." Ground crew replies "On the line."

48. Fuel System & Panel - CHECKED - checked

Pilot and copilot make the following fuel system and panel checks:

a. Pilot places all fuel selector switches on ME and checks that all fuel boost pressure warning lights (12) are illuminated.

NOTE

> If any lights are not illuminated, release pressure on the manifold by momentarily depressing any one fire shutoff switch and lifting the corresponding throttle out of CUTOFF momentarily.

b. Pilot places all fuel selector switches on TME; all fuel boost pressure warning lights should go out.
c. Pilot momentarily depresses fire shutoff switches to pressurize fuel system to engine nose sections.
d. Copilot moves refueling valve lever to OPEN; "Manifold not Purged" (or "Manifold not Drained") light should illuminate.
e. Pilot places all main tank transfer switches to VALVE OPEN and momentarily places each auxiliary tank boost pump switch ON; each auxiliary fuel tank no-flow warning light should illuminate momentarily.
f. Pilot returns all fuel selector switches to ME.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
②► AF 52-1417, 53-1819 thru -2170, -2279 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

g. Pilot places all main tank transfer switches CLOSED, all auxiliary tank boost pump switches OFF, and auxiliary-fuel-to-engines switch CLOSED. Depresses test button adjacent to each fuel quantity gage and totalizer gage (if installed); indicator should start moving toward zero if circuits are OK.

h. (1)► Pilot places fuel gage control switch on COPILOT. Copilot reads off fuel quantities and tests each of the fuel quantity gages by depressing test button adjacent to each fuel quantity gage; indicator should start moving toward zero if circuits are OK. Pilot returns fuel gage control switch to PILOT.

(2)► Copilot holds fuel gage control switch in COPILOT position, then reads off fuel quantities and tests each of the fuel quantity gages by depressing test button adjacent to each gage; indicator should start moving toward zero if indicator circuits are OK. On completion, copilot releases fuel gage control switch to NORMAL.

NOTE

On airplanes with totalizers, a difference of over 1000 pounds should not exist between the total of fuel gage readings and totalizer reading, nor a difference of over 2000 pounds between pilot's and copilot's totalizer readings.

49. Hydraulic System - checked & on

Copilot makes the following system check: Assures emergency pump switch is OFF and bleeds brake system. Checks air preload pressures and fluid quantity.

a. Main brake system, correct pressure in figure 1-54 based on 1500 psi.
b. Emergency system, correct pressure in figure 1-54 based on 1500 psi.
c. Emergency brake system, correct pressure in figure 1-54 based on 1000 psi.
d. Main system, 0 psi.
e. Red "LH Pump & RH Pump Not Operating" lights on and red "Emergency System No Pressure" light on.
f. Fluid quantity, 6.5 to 7 US gallons.

Copilot places emergency pump switch ON to build up emergency pressure to 2200 (+0/-200) psi at which time the red "No Pressure" light goes out. While emergency pump is operating, the amber "Pump Operating" light is on. Copilot places emergency pump switch in AUTO NORMAL and checks pressure buildup to 3000 (±150) psi; emergency pump cuts out as indicated by amber "Pump Operating" light going out.

NOTE

- Main system pressure should be zero until starter dropout occurs on engine No. 3 or 4, at which time the hydraulic bypass valve on the engine will close and allow the pump to build up pressure in the main system.
- If the main system becomes pressurized when the emergency pump is turned on, the manually operated forward service valve (interconnect) in the crawlway is open. If neither system becomes pressurized, the aft service valve in the crawlway may be open.

50. Air Refueling (pilot reads checklist):

a. Refueling Valve Switches - closed

Copilot checks all refueling valve switches (eight) CLOSED.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235
(2)► AF 51-2192 thru -2356, -7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

b. Master Refuel Switch - REFUEL - green light on
Pilot moves master refuel switch to REFUEL. Copilot checks green "Master Refuel Switch On" light illuminated on the air refueling panel.

(1)▶ c. Fuel Gage Control - COPILOT
Pilot moves fuel gage control switch to COPILOT.

d. Windshield Wiper Circuit Breaker - pulled
Copilot checks all circuit breakers at copilot's station pushed in with exception of windshield wiper circuit breaker.

e. Refueling Selector Switch - normal
Copilot checks refueling selector switch at NORMAL IFR SYSTEM.

* f. Emergency Slipway Door - CLEAR - ***checked & off*** - (door open, closed)
Pilot warns outside assistant on interphone, then has observer move the air refueling door emergency control handle (under aft end of observer's table) to OPEN; slipway door should open. At pilot's request, observer moves door emergency control handle to CLOSED; slipway door should close. At pilot's request, observer moves handle to OFF.

WARNING

Advise assistant on interphone and receive signal that he is clear before operating door emergency control handle.

g. Air Refueling Accumulator Gage - ***checked***
Observer checks air refueling accumulator for correct pressure in figure 1-54 based on 2000 psi.

h. Air Refueling Amplifiers (2) - ***checked***
Observer checks air refueling amplifiers (two) stowed and secure.

i. Air Refueling Panel Lights - checked
Copilot checks green "Master Refuel Switch On" light illuminated and tests all push-to-test lights.

* j. Fire Extinguisher Selector (some airplanes) - off
Copilot checks fire extinguisher selector switch OFF and CO_2 discharge discs not ruptured.

k. Emergency Fire Extinguisher Switch (some airplanes) - checked
Copilot holds emergency fire extinguisher switch to EMERGENCY ON; the amber "Power On Fire Extinguisher" light should illuminate. Copilot releases switch to EMERG EXTING NORMAL position and amber light should go out.

* l. Slipway Door Clear to Open - (clear) - open
Copilot warns outside assistant on interphone, then moves slipway door switch to SLIPWAY DOOR OPEN; amber "Slipway Door not Locked" light should illuminate. When slipway door is open fully, the amber "Ready for Contact" light should illuminate.

WARNING

Advise assistant on interphone and receive signal that he is clear before moving slipway door switch.

(CONTINUED ON NEXT PAGE)

* Check required on all missions
(1)▶ AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

m. Signal Switch Plunger - ***depressed*** - (toggles latched)
Pilot requests observer to depress and hold signal switch plunger located to right of receptacle; green "Contact Made" light should illuminate, receptacle toggles should latch, and amber "Ready for Contact" light should go out. Outside assistant reports action of toggles.

n. Signal Switch Plunger - ***released*** - (toggles unlatched)
Pilot requests observer to release signal switch plunger; signal system should advance to disconnect, green "Contact Made" light should go out, toggles should unlatch, and amber "Power On Fire Extinguisher" light (some airplanes) should illuminate. Outside assistant reports action of toggles.

o. Return-to-Ready Button - depressed
Copilot presses return-to-ready-for-contact button; amber "Ready for Contact" light should illuminate and amber "Power On Fire Extinguisher" light (some airplanes) should go out.

p. Signal Switch Plunger - ***depressed*** - (toggles latched)
Pilot requests observer to depress and hold signal switch plunger; green "Contact Made" light should illuminate, toggles should latch, and amber "Ready for Contact" light should go out. Outside assistant reports action of toggles.

q. Pilot's Disconnect Switch - DEPRESSED - (toggles unlatched)
Pilot presses disconnect switch on control wheel; toggles should unlatch, green "Contact Made" light should go out, and amber "Power On Fire Extinguisher" light (some airplanes) should go out.

r. Signal Switch Plunger - ***released***
Pilot requests observer to release signal switch plunger.

s. Return-to-Ready Button - depressed
Copilot presses return-to-ready-for-contact button; amber "Ready for Contact" light should illuminate and amber "Power On Fire Extinguisher" light (some airplanes) should go out.

t. Signal Switch Plunger - ***depressed*** - (toggles latched)
Pilot requests observer to depress and hold signal switch plunger; green "Contact Made" light should illuminate, receptacle toggles should latch, and amber "Ready for Contact" light should go out. Outside assistant reports action of toggles.

u. Copilot's Disconnect Switch - depressed - (toggles unlatched)
Copilot presses disconnect switch on control wheel; toggles should unlatch, green "Contact Made" light should go out, and amber "Power On Fire Extinguisher" light (some airplanes) should illuminate. Outside assistant reports action of toggles.

v. Signal Switch Plunger - ***released***
Pilot requests observer to release signal switch plunger.

★ w. Selector Switch to Emergency Boom Latching - (toggles latched)
Copilot moves air refueling selector switch to EMERGENCY BOOM LATCHING; toggles should latch and amber "Power On Fire Extinguisher" light (some airplanes) should go out. Outside assistant reports action of toggles.

★ x. Pilot's Disconnect Switch - DEPRESSED - (toggles unlatched)
Pilot depresses and holds disconnect switch; toggles should unlatch. Outside assistant reports action of toggles.

★ y. Pilot's Disconnect Switch - RELEASED - (toggles latched)
Pilot releases disconnect switch; toggles should latch. Outside assistant reports action of toggles.

z. Receptacle Fuel & Hydraulic Lines - ***checked***
Observer visually checks the receptacle fuel and hydraulic lines in the observer's compartment for leaks; checks sliding valve switch actuator cannot be pushed away from signal switch plunger, and wiring connected to signal switch.

(CONTINUED ON NEXT PAGE)

★ Check required on all missions

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

★ aa. Refueling Selector Switch - off
Copilot moves air refueling selector switch to OFF; amber "Power On Fire Extinguisher" light (some airplanes) should go out.

ab. Slipway for Condition - (checked)
Outside assistant inspects slipway for cleanliness, no grease, and no damage.

ac. Receptacle CO_2 Outlets (some airplanes) - (checked)
Outside assistant checks receptacle CO_2 outlets clean and free of obstructions.

ad. Receptacle Drain - (checked)
Outside assistant checks receptacle drain clean and free of obstructions.

ae. Toggles - (checked)
Outside assistant checks toggles slightly below flush relative to receptacle sidewalls.

af. Induction Coil - (checked)
Outside assistant checks induction coil for visible damage.

ag. Slipway Door Lights - on bright - (checked) - off
Copilot moves slipway door lights rheostat on copilot's panel to BRIGHT. Outside assistant checks lights for operation, condition, and security. When check is complete, copilot moves rheostat to OFF.

★ ah. Slipway Door Clear to Close - (clear) - closed - (closed)
Copilot checks that outside assistant is clear of slipway door, then places slipway door switch to CLOSED. Assistant checks that door closes properly. Amber "Slipway Door not Locked" light should go out.

WARNING

Advise assistant on interphone and receive signal that he is clear before moving slipway door switch to CLOSED.

ai. Refueling Valve Switches - closed
Copilot checks all refueling valve switches (eight) CLOSED.

aj. Master Refuel Switch - NORMAL - green light out
Pilot moves master refuel switch to NORMAL; green "Master Refuel Switch On" light should go out.

①► ak. Fuel Gage Control - PILOT
Pilot moves fuel gage control switch to PILOT.

51. Refueling Valve Lever - closed
Copilot moves air refueling valve lever to CLOSED; "Manifold not Purged" (or "Manifold not Drained") light should go out within 10 minutes.

52. Controls - ENGAGED - engaged
Pilot and copilot unlatch control columns at the instrument panel, and then engage control columns. Use the following procedure for engaging the control columns:
   a. Unlatch the control column from the instrument panel with the left hand and unlock the disconnect handle with the right hand by holding the thumbbutton depressed.
   b. Pull the control column aft with the left hand while holding the thumbbutton depressed until the elevator and ailerons engage and the disconnect handle slides down into engaged position by itself.

(CONTINUED ON NEXT PAGE)

★ Check required on all missions
①► AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

CAUTION

Do not push the disconnect handle down when reengaging the control columns. Forcing the handle may cause damage to the elevator disconnect rod assembly resulting in dangerous flight conditions.

53. Surface Control Lock - FORWARD, UNLOCK DETENT
    Pilot moves control lock lever to full forward UNLOCK detent and checks that detent lip is not rounded.

NOTE

Rudder-elevator surface power controls cannot be energized until surface control lock lever is in the full forward detent.

54. Power Controls - ON, LIGHTS CHECKED
    Pilot places rudder-elevator power control switch to ON (or NORM) for airplanes without emergency elevator power control and NORMAL for airplanes with emergency elevator power control. Pilot places aileron power control switches (2) to ON (or NORM); all red "No Pressure" warning lights go out and aileron amber "Emerg Pump On" lights should illuminate.

55. Automatic Pilot - CHECKED & OFF
    Pilot makes the following check:
    a. Extend the automatic pilot support, check automatic approach switch in AUTOMATIC PILOT, turn knob in detent, altitude control to OFF, turn control transfer switch to PILOT, and bank angle limiter selector (some airplanes) to MAX.
    b. Center trim tabs and flight controls, place automatic pilot master switch ON, then place all three engaging switches to ENGAGE.
    c. Rotate the pitch knob in the "Climb" direction; the control column should move aft and the elevator trim tab wheel should rotate in the nose-up trim direction. Rotate the pitch knob in the "Glide" direction; the control column should move forward and the elevator trim tab wheel should rotate in the nose-down direction. Return the pitch knob to neutral; the control column and elevator trim tab wheel should center.
    d. Rotate turn knob to the left; the control wheel rotates counterclockwise as the left rudder travels forward. When the aileron limit switch is contacted, the automatic pilot disengages. Center the rudder pedals, reengage automatic pilot, and repeat check with right turn.

NOTE

The automatic pilot does not disengage when contact is made with limit switches on airplanes equipped with the bank angle limiter selector.

    e. Reengage automatic pilot and have copilot push his release button. Reengage automatic pilot and check the release button on the pilot's wheel.
    f. Check all switches OFF and stow automatic pilot support.

56. Flaps - checked & down - (checked & down)
    Copilot calls "Ground from copilot, check wing flaps." Ground observer notifies copilot when flaps move or stop (and the action of the left elevator trim tab during flap operation*). Starting with flaps fully extended, copilot proceeds as follows:
    a. Retracts flaps to approximately 80% with normal flap lever.
    b. Retracts flaps approximately 10% with each emergency switch.
    c. Retracts flaps to full up with normal flap lever.
    d. Extends flaps to approximately 10% with normal flap lever.

(CONTINUED ON NEXT PAGE)

* AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

e. Extends flaps approximately 10% with each emergency switch.
f. Extends flaps to full down with normal flap lever and returns lever to OFF.

CAUTION

Use care during flap operation with the emergency flap switches as there are no limit switches incorporated in the emergency system.

57. Trim Tabs - CHECKED - (checked)
Pilot calls "Ground from copilot, stand by to check trim tabs."
a. Pilot does not call out trim settings but neutralizes all flight controls, positions trim controls as follows, and checks that the correct tab position is reported by ground observer:

TRIM CONTROL POSITION	TAB POSITION
Aileron Trim Full Left	Left Aileron Tab Down Right Aileron Tab Up
Aileron Trim Full Right	Left Aileron Tab Up Right Aileron Tab Down
Aileron Trim Zero	Aileron Tabs Neutral
Rudder Trim Full Left	Rudder Tab Right
Rudder Trim Full Right	Rudder Tab Left
Rudder Trim Zero	Rudder Tab Neutral
Elevator Trim Full Down	Right Elevator Tab Up
Elevator Trim Full Up	Right Elevator Tab Down
Elevator Trim Zero	Right Elevator Tab Neutral

NOTE

①▶ Left elevator tab should remain up throughout check if elevator is held neutral.

②▶ Left elevator tab should remain neutral throughout check if elevator is held neutral.

③▶ Left elevator tab is fixed in the faired trail position and should not move.

b. Copilot checks trim indicators on zero.

58. Flight Controls - CHECKED, POWER ON & OFF
Pilot calls "Ground from pilot, stand by to check flight controls."
a. Pilot does not call out control movements but positions controls as follows and checks that the correct surface position is reported by ground observer:

(CONTINUED ON NEXT PAGE)

①▶ AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247
②▶ AF 51-2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -149, -248 thru -311
③▶ AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

COCKPIT CONTROL POSITION	SURFACE POSITIONS
Control Wheel Full Left	Left Aileron Up Left Trim Tab Down Left Flaperon Spilled Right Aileron Down Right Trim Tab Up Right Flaperon in Flap Position
Control Wheel Full Right	Left Aileron Down Left Trim Tab Up Left Flaperon in Flap Position Right Aileron Up Right Trim Tab Down Right Flaperon Spilled
Left Pedal Fully Depressed	Rudder Left Trim Tab Right
Right Pedal Fully Depressed	Rudder Right Trim Tab Left
Column Full Forward	Elevator Down (1)► (2)► Both Trim Tabs Up (3)► Left Trim Tab Neutral Right Trim Tab Up
Column Full Back	Elevator Up (1)► (2)► Both Trim Tabs Down (3)► Left Trim Tab Neutral Right Trim Tab Up
Wheel, Column & Pedals Neutral	All Surfaces Neutral Flaperons in Flap Position

b. Pilot places all surface power control switches to OFF and repeats the complete flight control check with the ground observer. With aileron power controls off, flaperons should stay in the full flap-down position at all times. All other surface positions should correspond to the positions in "a" above.

59. Controls - LOCKED, STOWED - stowed
Pilot places surface lock lever in LOCK, then neutralizes and moves ailerons and rudder until lock falls into place. Pilot moves control column forward until elevator locks. Pilot and copilot disengage and stow control columns.

60. Instruments - CHECKED - checked
Pilot and copilot make the following checks where applicable to their station:
a. Clock running and set for time.
b. Attitude indicators erecting.
c. Standby compass on proper heading.
d. Remote compass indicator and RMI indicating same heading and approximately same as standby compass.
e. Fuel pressure or fuel flowmeters, oil pressure, EGT, and tachometers all reading zero.
f. Rate-of-climb, airspeed, Machmeter, and turn-and-bank indicate proper static conditions.
g. Altimeters, free air temp, cabin temperature gage, and cabin pressure altitude gage readings correspond approximately with pressure and weather conditions.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247
(2)► AF 51-2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -149, -248 thru -311
(3)► AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

61. Fire Warning & Overheat Lights - TESTED
Pilot holds engine fire warning test switch for engines No. 1, 2, and 3 in TEST; fire warning lights for engines No. 1, 2, and 3 should glow if circuits are OK. Holds test switch for engines No. 4, 5, and 6 in TEST; warning lights for engines No. 4, 5, and 6 should glow if circuits are OK. Holds wing and empennage overheat test switches in TEST; wing and empennage overheat warning lights on instrument panel should glow if circuits are OK. Check that all switches return to NORMAL and lights go out.

NOTE

If instrument panel lights are on, engine fire warning lights should glow dimly when the test switches are held in TEST.

62. Synchronize N-1 Compass Master Indicator - synchronized
If the observer is not flying, the copilot synchronizes the N-1 compass master indicator in the following manner:
a. Rotates the latitude correction knob counterclockwise until the latitude correction pointer indicates OFF.
b. Engages and rotates the synchronizer control knob in the direction indicated by the annunciator pointer; clockwise if the annunciator pointer indicates "R" and counterclockwise if it indicates "L" until the annunciator pointer is on its center index.

CAUTION

Do not synchronize on the unstable null; i.e., 180° from the correct magnetic heading.

63. Radios - CHECKED, OFF - checked, off
a. Copilot places UHF master switch ON and liaison "take" control ON. Pilot turns on the radio compass and omni-range.
①► b. Pilot sets interphone selector on MIX SIG AND COMMAND and "Inter," "Comp," and "Localiz" mixer toggles in up position.
②► b. Pilot sets intercom selector on COMM and "Inter," "Comm," "ADF," and "Local" mixer toggles in up position.
c. Pilot performs radio compass check:
(1) Tunes on ANT and identifies station.
(2) Switches to CW, checks for carrier tone, and returns switch to VOICE.
(3) Selects LOOP and rotates No. 1 needle right and left.
(4) Selects COMP and checks that No. 1 needle points toward station.
(5) Places function switch to OFF.
d. Pilot performs omni receiver check:
(1) Selects and identifies station.
(2) Checks that OFF flag disappears from crosspointer window of the ID-249 (glide path will still indicate OFF).
(3) Checks that the No. 2 needle points to appropriate bearing.
(4) Rotates course selector knob until vertical needle is centered and TO or FROM tab appears in window. Cross-checks with the No. 2 needle.
(5) Places the omni power switch OFF.
e. Copilot performs UHF check:
(1) Checks channelization and selects proper channel. Calls the tower for radio check.
(2) Places UHF master switch OFF.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2411, 52-019 thru -028
②► AF 51-2412 thru -17386, 52-029 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

①► f. Copilot performs liaison check:
(1) Places interphone or intercom selector to LIA position.
(2) Selects appropriate channel and calls the tower for radio check.
(3) Places "take" control OFF.

②► 64. Inverters - OFF - as required
Pilot turns off instrument inverter. Copilot turns off inverters unless a radar BNS system external power cart is not connected and the inverters are needed for the radar BNS system preflight.

③► 65. External AC Power - as required
If external AC power is not required for radar BNS checkout, copilot calls, "Ground crew from copilot, disconnect external AC power."

66. Seat Adjustment Switches - CHECKED - checked
Pilot and copilot check operation of seat vertical adjustment switches, if installed. If a qualified observer is not flying, the pilot proceeds to the observer's station and checks operation of the seat adjustment switch. Pilot lowers the seat to full bottom position, and checks the automatic safety belt hook alignment on some airplanes.

67. Copilot Seat Rotation - checked
Copilot checks seat in normal sitting position, to full forward tilt, through 180° rotation, and in aft-facing normal sitting position.

CAUTION

- The copilot's seat should not be rotated while the periscopic sextant is installed in the canopy mount, since the top of the seat may damage the sextant.
- To prevent damage to the canopy, the copilot's seat should not be placed in normal sitting position in any position other than facing forward or aft.

68. ELGE System - checked
Copilot checks ELGE ratchet handles stowed full aft on the stand. Checks lights set dim or bright as required. Tests red push-to-test light.

④► 68A. Canopy Hinge Pin Release Handle - in detent
Copilot checks canopy hinge pin release handle in detent.

69. Gunnery Interior Preflight - complete
While in aft-facing position, copilot performs preflight check of fire control system as contained in section VIII. On completion of check, copilot returns seat to forward-facing normal sitting position.

70. Crawlway - clear
Copilot checks that there is no loose equipment in crawlway area.

71. Refrigeration Unit Oil Level - checked
Copilot checks oil level in refrigeration unit; oil level should be between index marks on sight gage.

72. Left Forward Main Fuel Boost Pump - checked
Copilot checks fuel boost pump and fuel lines for leaks; no burnt wiring in the area.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2356, 52-518 & on
②► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
③► AF 52-1417, 53-1819 thru -2170, -2279 & on
④► AF 52-612 & on

INTERIOR PREFLIGHT INSPECTION

(CONTINUED)

73. Service & Interconnect Valves - safetied off
    Copilot checks service and interconnect valves safetied in OFF position.

74. Bulkhead & Crawlway Doors - closed
    Copilot closes bulkhead and crawlway doors.

75. Main Entry Door Release Mechanism - locked
    Copilot checks main entry door release mechanism for positive locking position (bellcranks against their respective stops).

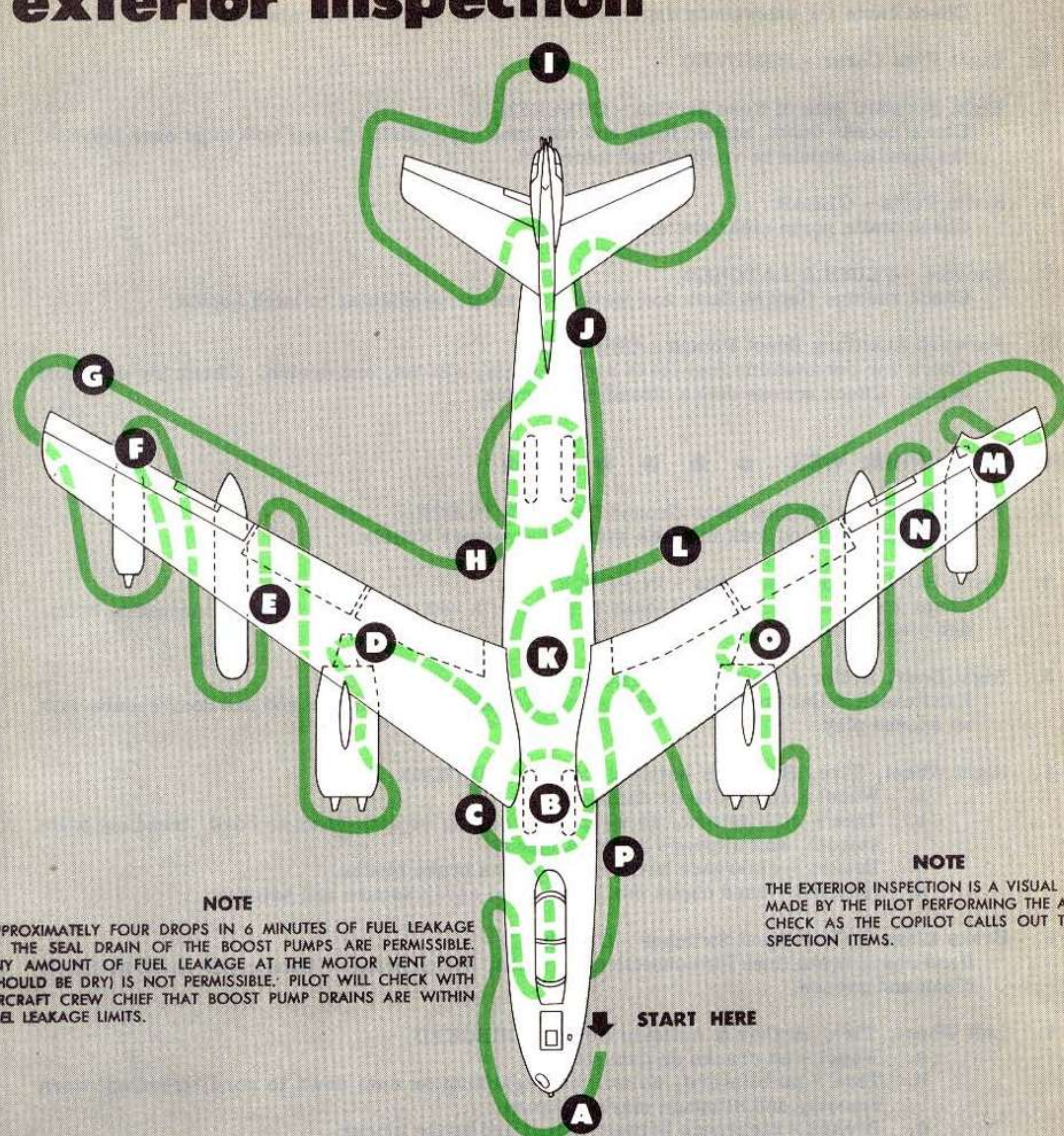
EXTERIOR INSPECTION

Upon completion of the Interior Preflight Inspection, the pilot will return to the ground and perform the visual Exterior Inspection as shown on figure 2-3. On airplanes with engine stall prevention switch decaled inoperative or the switch not installed, capping or uncapping of the compressor discharge pressure bleed line on each engine must be accomplished on the ground prior to flight. If OAT is 15° C (59° F) or below under 10,000 feet, or if air refueling, formation flying, or unusual maneuvers such as practice stalls are to be accomplished at any altitude, the pilot will check with the crew chief to insure the bleed line is uncapped; otherwise, the line should be capped.

CAUTION

Any operation uncapped above 15° C (59° F) will result in excessive acceleration times and should be considered by the pilot before ordering uncapped operation. In addition, uncapped operation will result in large amounts of rpm dropoff at altitude.

exterior inspection



NOTE

APPROXIMATELY FOUR DROPS IN 6 MINUTES OF FUEL LEAKAGE AT THE SEAL DRAIN OF THE BOOST PUMPS ARE PERMISSIBLE. ANY AMOUNT OF FUEL LEAKAGE AT THE MOTOR VENT PORT (SHOULD BE DRY) IS NOT PERMISSIBLE. PILOT WILL CHECK WITH AIRCRAFT CREW CHIEF THAT BOOST PUMP DRAINS ARE WITHIN FUEL LEAKAGE LIMITS.

NOTE

THE EXTERIOR INSPECTION IS A VISUAL CHECK MADE BY THE PILOT PERFORMING THE ACTUAL CHECK AS THE COPILOT CALLS OUT THE INSPECTION ITEMS.

A NOSE SECTION

1. External DC Power - AS REQUIRED
2. Left Pitot Cover - REMOVED
3. Observer's Downward Ejection Hatch - FLUSH, HANDLE STOWED
4. Nose Window & Bombsight - CLEAN & UNBROKEN
   Check nose window and bombsight protuberance clear, clean, and undamaged. On airplanes having retractable bombsight cover, check that it is fully closed.

Figure 2-3 (Sheet 1 of 12 Sheets).

5. Cabin Air Emergency Depressurization Door - FLUSH
   Check cabin air emergency depressurization door flush with airplane skin.

6. Right Pitot Cover - REMOVED

7. Right Forward Side of Nose Section - CHECKED
   Check access doors latched flush and fuel tank caps flush. If fuel tank caps have handles, the handles should be vertical and folded aft.

8. Static Ports - CLEAR
   Check static ports clear and unobstructed.

9. Radome - FLUSH & LATCHED
   Check radome flanges flush and locking screw perpendicular to latch handle.

10. Forward Auxiliary Boost Pumps - CHECKED
    Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access doors closed and secure.

B FORWARD WHEEL WELL ● ● ● ● ● ●

1. Wheel Chocks & Landing Gear Ground Lock - IN PLACE
   Check gear ground lock in place with red streamer visible.

2. Bomb Bay Door Ground Locks - IN PLACE
   Check bomb bay door ground locks in place with red streamers visible. Actuating cylinder pins locked.

3. Right Door, Roller & Actuator - CHECKED
   Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play.

4. Right Wheel, Tire, Brakes & Antiskid Cover - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.
   c. Brakes - clearance between wheel and brake blocks.
   d. Antiskid - hand check mechanism and cover secure and safetied.

5. Brake Lines & Gear Squat Switches - CHECKED
   Hand check brake lines for connection, no leaks, and no breaks. Hand check squat switches clean and secure.

6. Left Wheel, Tire, Brakes & Antiskid Cover - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.
   c. Brakes - clearance between wheel and brake blocks.
   d. Antiskid - hand check mechanism and cover secure and safetied.

7. Oleo Strut - PROPER EXTENSION, NO LEAKS
   Check strut for seal leaks and proper extension. Extension should measure 14.60 (±0.25) inches between torsion link pins with gross weight under 200,000 pounds or 13.81 (±0.25) inches between pins with gross weight over 200,000 pounds.

8. Centering Switch - SECURE
   Hand check centering switch clean and secure.

Figure 2-3 (Sheet 2 of 12 Sheets).

9. Hydraulic System - CAP SECURE, NO LEAKS
   a. Black pointer of yellow disc on top of filler cap lined up with black dot on rim of cap. Lift up on cap to check security.
   b. Main reservoir fluid level 6 1/2 gal ons with all systems depressurized.
   c. Emergency reservoir fluid covering sight gage completely.
   d. Check hydraulic lines, fittings, and lower wheel well for leaks and fluid accumulations.

10. Left & Right Power Shield Covers - SECURE
    Hand check left and right power shield covers secure and all fasteners latched.

11. Right Forward Main Boost Pump - CHECKED
    Open access door in upper right panel of wheel well. Check for permissible fuel leaks around seals, elbows, and drains. Close and latch access door.

12. Left Door, Actuator & Roller - CHECKED
    Hand check actuator rod and door secure with no excess play. Hand check roller free and bracket secure.

13. Forward Power Shield Covers (3) - SECURE
    Hand check three forward power shield covers secure and fasteners latched.

14. Gear Motors & Cannon Plugs - CHECKED
    Hand check motors bolted securely and cannon plugs fastened and safetied to receptacles.

15. Gear Door Uplatches - UNLATCHED
    Check gear door uplatches unlatched (latches deflected slightly downward and link arms forming a "V").

C FORWARD RIGHT SIDE FUSELAGE ● ● ● ●

1. Forward Right Side Fuselage & Fuel Drains - CHECKED, NO LEAKS
   Check forward right side of fuselage for dents, cracks, and buckling. Check fuel drains for leaks.

2. Wing & Strut Access Panels - SECURE, NO LEAKS
   Check wing and strut access panels closed and secure. Check for fluid leaks around panels.

D INBOARD NACELLE ● ● ● ● ● ● ●

1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED
   Check aft nacelle fairing condition, turbine blades intact, and no holes and cracks in cones and tailpipes. Check four EGT probes intact in each tailpipe and no pooling of fluid in tailpipes.

2. Strut Fairing & Torsion Links - CHECKED
   Hand check strut fairing not binding. Check for wrinkles around points at which strut is attached to nacelle. Check strut perpendicular to ground and nacelle. Check torsion links connected, crossbars in slots, and bolts seated.

3. Oleo Strut, Extension & Seals - NO LEAKS
   Check for at least 4 inches strut extension. Check for fluid seepage and leaks around cylinder seal.

4. Wheel & Tire - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.

Figure 2-3 (Sheet 3 of 12 Sheets).

5. Ground Lock - IN PLACE
   Check outrigger gear ground lock in place with red streamer visible.

6. Outrigger Doors & Actuators - CHECKED
   Exert pressure inward and outward on doors to check door mechanism and attachment. Inspect actuators for damage. Check condition of phenolic block.

7. Nacelle Panel Latches (8) & Locks (4) - SECURE
   Check each individual latch and lock for security.

8. Left Nacelle Panels - SECURE, NO LEAKS
   Check fore and aft edges of panels flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check upper hooks safetied. Check entire bottom surface of nacelle for fluid leaks.

9. Air Intakes & Accessory Domes - CHECKED, SECURE
   Check all island fairings secure. Check for fluid leaks, particularly around accessory domes. Check for foreign objects in air intakes. Check rotor and stator blades for nicks, dents, and damage. Hand check dome latches fastened and secure. Exert pressure on domes to test security.

10. Right Nacelle & Strut Panels - SECURE, NO LEAKS
   Check fore and aft edges of panel flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check for upper hooks safetied, strut panels closed, and for fluid leaks around panels. Check entire bottom surface of nacelle for fluid leaks.

11. Wing Access Panels - SECURE, NO LEAKS
   Check wing access panels closed and secure. Check for fluid leaks around panels.

E EXTERNAL WING TANK ● ● ● ● ● ●

(1)▶ 1. Red Indicator Flag - CHECKED

2. Vent Line - NO OBSTRUCTIONS

(2)▶ 3. Bridle Snap Hook - CHECKED
   Through inspection hole on top of tailcone visually check that bridle snap hook is properly attached to pulloff bar.

(2)▶ 4. Initial Release Cable - CHECKED
   Through inspection hole on top of aft end of tank visually check that the initial release cable is attached to release strap and that cable connector is against stop bracket.

(2)▶ 5. Thrusters - CHECKED
   Through inspection holes on each side of aft end of tank visually check that the receptacle of each thruster has an electric plug completely inserted and lockwired.

6. Electrical Disconnects - CHECKED
   Through inspection hole in aft end of main strut check that electrical disconnects are completely inserted and wire bundles are seated in pulley grooves.

   (2)▶ Check that aft wire bundle pulley shackle is inserted in notch under spring clamp.

(2)▶ 7. Main Strut Tensiometer - CHECKED
   Through inspection window just above main strut fairing visually check the following:
   a. Blue band on tensiometer is showing through sight holes.
   b. Tensiometer is lockwired.
   c. Shear pin is inserted between trigger and latch arm and is closed.
   d. Spring-loaded latch pin is at bottom of slot.

(1)▶ Airplanes which do not have T.O. 1B-47-767 accomplished
(2)▶ Airplanes which have T.O. 1B-47-767 accomplished & AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

Figure 2-3 (Sheet 4 of 12 Sheets).

8. Main Strut Lever Arm - CHECKED
   Direct a light through the main strut inspection hole; if light is visible through the strut, the lever arm is in the correct position.

9. Fuel Quantity & Filler Neck - CHECKED, SECURE

10. Fairing, Access Panels, Nose Cone - CHECKED, SECURE

11. Side Strut Latch Pin - CHECKED
    Through side strut inspection holes visually check that the red latch pin is positioned in yellow slot with center of pin below top of slot.

    (1)▶ Check that shear pin is inserted between latch arm and trigger and is closed.

(1)▶ 12. Side Strut Tensiometer - CHECKED
    Through inspection window at aft end of side strut visually check that tensiometer has blue band showing through sight holes and is lockwired.

F OUTBOARD NACELLE ● ● ● ● ● ● ●

1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS
   Check aft nacelle fairing condition, turbine blades intact, and no holes and cracks in cone and tailpipe. Check four EGT probes intact in tailpipe and no pooling of fluid in tailpipe. Check for leaks from aileron power control unit at points where nacelle and wing fairing meet.

2. Left Nacelle Panels - SECURE, NO LEAKS
   Check hooks seated, latches fastened, and edges of panels flush. Check entire bottom surface of nacelle for fluid leaks.

3. Air Intake & Accessory Dome - CHECKED, SECURE
   Check all island fairings secure. Check for fluid leaks, particularly around accessory dome. Check for foreign objects in air intake. Check rotor and stator blades for nicks, dents, and damage. Hand check dome latch fastened and secure. Exert pressure on dome to test security.

4. Right Nacelle Panels - SECURE
   Check hooks seated, latches fastened, and edges of panels flush.

G RIGHT WING ● ● ● ● ● ● ● ●

1. Aileron Power Control Unit - CHECKED
   Check circuit breakers in. Check fluid level; if low, have reserviced. Reservoir cap pointers aligned with dot. Lift up on cap to check security. Check reservoir and lines for leaks.

2. Wing Access Panels - SECURE, NO LEAKS
   Check wing access panels closed and secure (panels are fastened when dzus fastener slots are parallel to perimeter of panel). Check for fluid leaks around panels.

3. Oil Tank Caps - FLUSH
   Check oil tank caps installed and flush.

4. Aileron & Trim Tab - CHECKED
   Check condition of aileron skin and trailing edge. Place aileron in center position and check trim tab approximately 1/4 inch up.

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(1)▶ Airplanes which have T.O. 1B-47-767 accomplished and AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

Figure 2-3 (Sheet 5 of 12 Sheets).

5. Fuel Tank Caps - CHECKED
Check fuel tank caps flush with airplane. If fuel tank caps have handles, the handles should be vertical and folded aft.

6. Wing Trailing Edge - CHECKED
While walking beneath wing, check flap well area. Visually check for fluid leaks. Check flaperon accumulator pressure gage for 1500 psi.

NOTE

Due to allowable internal leakage of the flaperon power control unit, the pressure may be lower than 1500 psi. However, pressure should not be lower than the correct accumulator preload pressure in figure 1-54 based on 500 psi.

Check flap assemblies, rollers, tracks, and actuators. Check torque tube for bends or breaks. Inspect trailing edge and top surface of flap and flaperon.

H AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS

1. Center Main Boost Pump - CHECKED
Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access panel closed and secure.

2. Right Fuselage - CHECKED
Check all panels on right side of fuselage flush and secure. Check for fluid leaks around vent openings in skin and for cracks and buckling.

3. Right Aft Auxiliary (ATO) Boost Pump - CHECKED
Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access panel closed and secure.

4. Single Point Refueling Cap - SECURE
Hand check single point refueling cap flush and secure.

5. Wheel Chocks & Landing Gear Ground Lock - IN PLACE
Check gear ground lock in place with red streamer visible.

6. Right Door, Roller & Actuator - CHECKED
Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play.

7. Right Wheel, Tire, Brake & Antiskid Cover - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.
   c. Brakes - clearance between wheel and brake blocks.
   d. Antiskid - hand check mechanism secure and safetied.

8. Brake Lines & Gear Squat Switch - CHECKED
Hand check brake lines for connection, no leaks, and no breaks. Hand check squat switch clean and secure.

9. Left Wheel, Tire, Brake & Antiskid Cover - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.
   c. Brakes - clearance between wheel and brake blocks.
   d. Antiskid - hand check mechanism secure and safetied.

10. Oleo Strut - PROPER EXTENSION, NO LEAKS
Check strut for seal leaks and proper extension. Extension should measure 13.25 (±0.25) inches between torsion link pins with gross weight under 200,000 pounds or 12.50 (±0.25) inches between pins with gross weight over 200,000 pounds.

Figure 2-3 (Sheet 6 of 12 Sheets).

11. Hydraulic Lines, Fuel Lines & Shutoff Valves - NO LEAKS
    Check all hydraulic lines, fuel lines, fittings, and shutoff valves for leaks. Check for pooling of fluid in wheel well.

①► 12. ATO Rack Pin Indicators (6) - LOCKED
    Check ATO rack pin indicators (three on each side of wheel well) in locked position.

13. ATO Control Shield - CIRCUIT BREAKERS IN, COVER SECURE
    Check ATO circuit breakers all in and cover secure.

14. Left Door, Actuator & Roller - CHECKED
    Hand check actuator rod and door secure with no excess play. Hand check roller free and bracket secure.

15. Aft Power Shield Covers - SECURE, CIRCUIT BREAKERS IN
    Check aft power shield circuit breakers in unless "tagged." Hand check shield covers secure and fasteners latched.

16. Cables, Motors & Cannon Plugs - CHECKED
    Hand check motors boltes securely, cannon plugs and related wiring fastened, and cannon plugs safetied to receptacles. Check ELGE cables.

17. Gear Door Uplatches - UNLATCHED
    Check gear door uplatches unlatched (latches deflected slightly downward and link arms forming a "V").

18. Aft Main Boost Pumps (4) - CHECKED
    Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access doors closed and secure.

②► 19. External ATO Rack - CHECKED
    If external ATO rack is used, accomplish the following:
    a. Check that external ATO rack is securely fastened to airplane suspension hooks.
    b. Check by looking through inspection holes that release mechanism is locked when crank stop bolts are bottomed.
    c. Check for proper type bottles installed (figure 1-17A).
    d. Check that the four extension arms on the rack are properly installed in the housings on the fuselage.

NOTE

Some airplanes may not have the housing installed to accommodate the extension arms. In this case the forward arms should be lashed down and the aft arms removed.

    e. Check that excess slack of the igniter leads is secured to the rack. On some airplanes, clamps are provided to secure the leads.

WARNING

If a takeoff were made with the excess slack of the igniter leads not secure to the rack, wind loads and vibration during takeoff could cause the leads to pull loose and result in misfire of the ATO bottles.

20. Camera Compartment - CHECKED
    Open camera compartment door. Check for any fumes. Check camera secure (if installed). Check all cables for security and close and lock doors.

①► AF 51-2357 thru 52-088, -202 thru -292
②► AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

Figure 2-3 (Sheet 7 of 12 Sheets).

21. Battery Compartment or Aft Radar Compartment - CHECKED
Open battery compartment or aft radar compartment and hand check security of radio equipment, battery cover, and cover on tail compartment power shield. On some airplanes★ reset the "AN/APX-6 Detonator" circuit breaker. Check air control valve for hydraulic leaks. Check compartment door closed and flush.

22. Rudder-Elevator Power Control - CHECKED
Fluid level visible in sight gage. If not visible, have reserviced. Reservoir cap pointer aligned with dot. Lift up on cap to check security. Check complete power unit and lines for evidence of leaks.

23. Ammunition Cans - SAFETIED
Check ammunition cans installed and safetied.

①► 24. Turret Safety Switch - AS REQUIRED

25. Gunnery Exterior Inspection - complete
Copilot performs preflight check of fire control system as contained in section VIII. Armament and electronics maintenance personnel will be present at this time.

②► 26. Approach Chute - CHECKED, INSTALLED, DOOR FLUSH
  a. Check pilot chute bridle attached to deployment bag bridle.
  b. Check approach chute ripcord pins inserted from rear to front.
  c. Check release link attached to yoke shackle.
  d. Check risers in accordion fold at forward end of chute pack. The release link must be placed so the yoke shackle depresses microswitch to permit closing of door.
  e. Check pilot chute held in sling by deploy pin.
  f. Open approach chute switch panel and check circuit breaker in. Place switch in CLOSE position until door is nearly closed, then move switch to NORM.
  g. Through gap remaining, manually connect the pilot chute deploy pin cable to the slotted retainer in the approach chute door.
  h. Move switch to CLOSE once again and close cover guard over switch. Close and latch switch panel door.
  i. Check approach chute door fully closed and flush.

27. Brake Chute - MECHANISM CHECKED, INSTALLED, PILOT CHUTE DEPLOY PINS & CABLE REMOVED, DOORS FLUSH
  a. Check brake chute cables (two) for spring tension.
  b. Check brake cord through loops of chute pack.
  c. Check pilot chute bridle attached to main chute pack, brake chute ripcord pins inserted from rear to front, zipper fastened, and pilot chute held in place by three deploy pins.
  d. Check chute deploy doors closed and flush.
  e. Withdraw pilot chute deploy pins and cable, and carry aboard airplane.
  f. Check shear bolt installed with washers on the locknut side only.
  g. Check drag link secured in release clevis.
  h. Check tail compartment access door closed; all leading edges flush. No edge should extend into slipstream in excess of thickness of door skin.
  i. Check handle flush and safety screw perpendicular to handle.

I EMPENNAGE ● ● ● ● ● ● ● ● ●

1. Empennage & Tail Turret - CHECKED
Check condition of all surfaces and turret. Check for hydraulic leaks on vertical stabilizer. Check elevator in down position and trim tab up approximately 1 1/2 to 2 inches at trailing edge.

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①► Some airplanes
②► AF 51-2192 thru -2356, 52-071 thru -201, -248 & on
★ AF 51-2192 thru 52-620, 53-2261 thru -2289

Figure 2-3 (Sheet 8 of 12 Sheets).

2. Left Side Vertical Stabilizer - CHECKED, AIR DUCTS OPEN
   Check general condition of surfaces; ram air ducts on dorsal fin unobstructed.

J AFT LEFT SIDE FUSELAGE ● ● ● ● ● ●

①► 1. Emergency Elevator Reservoir - CHECKED
   Through access door just aft of the aft radome check emergency elevator power control hydraulic reservoir serviced and cap secure.

②► 2. Aft Radome - CHECKED
   Check aft radome undamaged and secure.

③► 2A. Battery Compartment - CHECKED
   Open battery access panel and check security of equipment and battery cover fastened. Check access panel closed and secure.

2B. Left Aft Auxiliary (ATO) Boost Pump - CHECKED
   Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access panel closed and secure.

3. Center Main Boost Pump - CHECKED
   Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access panel closed and secure.

4. Left Fuselage - CHECKED
   Check all panels on left side flush and secure. Check for fluid leaks around vent openings in skin and for cracks and buckling.

5. Bomb Bay Tank Boost Pumps - CHECKED
   Check for permissible fuel leaks around seals, elbows, and drains. Check for scorched areas. Check access panel closed and secure.

K BOMB BAY ● ● ● ● ● ● ● ● ●

1. Left Bomb Bay Fuel Lines & Boost Pumps - CHECKED

2. Junction Box Covers - SECURE
   Check junction box covers secure and all fasteners latched.

3. Oxygen Supply Lever - OFF

4. Interphone Cord - STOWED

5. Bomb Bay Light - OFF

6. Bomb Door Accumulator - CHECKED
   Check bomb door accumulator charged to correct preload in figure 1-54 based on 1750 psi. No evidence of leaks.

7. Bomb Door Uplatches & Microswitch - UNLATCHED & CHECKED
   Check bomb door uplatches unlatched (latches in receiving position and link arms forming a "V"). Check microswitch clean and secure.

8. Spoiler Door Gage - CHECKED
   Check bomb bay spoiler accumulator charged to correct preload in figure 1-54 based on 1000 psi.

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①► AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on
②► AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on
③► Some airplanes

Figure 2-3 (Sheet 9 of 12 Sheets).

9. Spoilers & Spoiler Depressurizing Valve - CHECKED, SAFETIED OFF
   Check spoilers. Check spoiler depressurizing valve safetied off and no leaks.

10. Right Bomb Bay Fuel Lines & Boost Pumps - CHECKED

L LEFT WING ● ● ● ● ● ● ● ● ●

1. Flap Motors, Solenoids & Wiring - SECURE
   Check flap motors secure and cannon plugs safetied. Solenoids and wiring secure. No burnt wiring.

2. Wing Trailing Edge - CHECKED
   While walking beneath wing, check flap well area. Visually check for fluid leaks. Check flaperon accumulator pressure gage for 1500 psi.

   NOTE

   Due to allowable internal leakage of the flaperon power control unit, the pressure may be lower than 1500 psi. However, pressure should not be lower than correct accumulator preload in figure 1-54 based on 500 psi.

   Check flap assemblies, rollers, tracks, and actuators. Check torque tube for bends or breaks. Inspect trailing edge and top surface of flap and flaperon.

3. Oil Tank Caps - FLUSH
   Check oil tank caps installed and flush.

4. Aileron & Trim Tab - CHECKED
   Check condition of aileron skin and trailing edge. Place aileron in center position and check trim tab approximately 1/4 inch up.

5. Aileron Power Control Unit - CHECKED
   Check circuit breakers in. Check fluid level; if low, have reserviced. Reservoir cap pointers aligned with dot. Lift up on cap to check security. Check reservoir and lines for leaks.

6. Wing Access Panels - SECURE, NO LEAKS
   Check wing access panels closed and secure (panels are fastened when dzus fastener slots are parallel to perimeter of panel). Check for fluid leaks around panels.

M OUTBOARD NACELLE ● ● ● ● ● ● ●

1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS
   Check aft nacelle fairing condition, turbine blades intact, and no holes and cracks in cone and tailpipe. Check four EGT probes intact in tailpipe and no pooling of fluid in tailpipe. Check for leaks from aileron power control unit at points where nacelle and wing fairing meet.

2. Left Nacelle Panels - SECURE, NO LEAKS
   Check hooks seated, latches fastened, and edges of panels flush. Check entire bottom surface of nacelle for fluid leaks.

3. Air Intake & Accessory Dome - CHECKED, SECURE
   Check all island fairings secure. Check for fluid leaks, particularly around accessory dome. Check for foreign objects in air intake. Check rotor and stator blades for nicks, dents, and damage. Hand check dome latch fastened and secure. Exert pressure on dome to test security.

4. Right Nacelle Panels - SECURE
   Check hooks seated, latches fastened, and edges of panels flush.

Figure 2-3 (Sheet 10 of 12 Sheets).

N EXTERNAL WING TANK ● ● ● ● ● ●

(1)▶ 1. Red Indicator Flag - CHECKED

2. Vent Line - NO OBSTRUCTIONS

(2)▶ 3. Bridle Snap Hook - CHECKED
Through inspection hole on top of tailcone visually check that bridle snap hook is properly attached to pulloff bar.

(2)▶ 4. Initial Release Cable - CHECKED
Through inspection hole on top of aft end of tank visually check that the initial release cable is attached to release strap and that cable connector is against stop bracket.

(2)▶ 5. Thrusters - CHECKED
Through inspection holes on each side of aft end of tank visually check that the receptacle of each thruster has an electric plug completely inserted and lockwired.

(2)▶ 6. Side Strut Tensiometer - CHECKED
Through inspection window at aft end of side strut visually check that tensiometer has blue band showing through sight holes and is lockwired.

7. Side Strut Latch Pin - CHECKED
Through side strut inspection holes visually check that the red latch pin is positioned in yellow slot with center of pin below top of slot.

(2)▶Check that shear pin is inserted between latch arm and trigger and is closed.

8. Fairing, Access Panels, Nosecone - CHECKED, SECURE

9. Fuel Quantity & Filler Neck - CHECKED, SECURE

10. Main Strut Lever Arm - CHECKED
Direct a light through the main strut inspection hole; if light is visible through the strut, the lever arm is in the correct position.

(2)▶11. Main Strut Tensiometer - CHECKED
Through inspection window just above main strut fairing visually check the following:
a. Blue band on tensiometer is showing through sight holes.
b. Tensiometer is lockwired.
c. Shear pin is inserted between trigger and latch arm and is closed.
d. Spring-loaded latch pin is at bottom of slot.

12. Electrical Disconnects - CHECKED
Through inspection hole in aft end of main strut check that electrical disconnects are completely inserted and wire bundles are seated in pulley grooves.

(2)▶Check that aft wire bundle pulley shackle is inserted in notch under spring clamp.

O INBOARD NACELLE ● ● ● ● ● ● ●

1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED
Check aft nacelle fairing condition, turbine blades intact, no holes and cracks in cones and tailpipes. Check four EGT probes intact in each tailpipe and no pooling of fluid in tailpipes.

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(1)▶ Airplanes which do not have T.O. 1B-47-767 accomplished
(2)▶ Airplanes which have T.O. 1B-47-767 accomplished & AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

Figure 2-3 (Sheet 11 of 12 Sheets).

2. Strut Fairing & Torsion Links - CHECKED
   Hand check strut fairing not binding. Check for wrinkles around points at which strut is attached to nacelle. Check strut perpendicular to ground and nacelle. Check torsion links connected, crossbars in slots, and bolts seated.

3. Oleo Strut, Extension & Seals - NO LEAKS
   Check for at least 4 inches strut extension. Check for fluid seepage and leaks around cylinder seal.

4. Wheel & Tire - CHECKED
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, tread not worn smooth, and slippage marks aligned.

5. Ground Lock - IN PLACE
   Check outrigger gear ground lock in place with red streamer visible.

6. Outrigger Doors & Actuators - CHECKED
   Exert pressure inward and outward on doors to check door mechanism and attachment. Inspect actuators for damage. Check condition of phenolic block.

7. Nacelle Panel Latches (8) & Locks (4) - SECURE
   Check each individual latch and lock for security.

8. Left Nacelle & Strut Panels - SECURE, NO LEAKS
   Check fore and aft edges of panels flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check for upper hooks safetied, strut panels closed, and for fluid leaks around panels. Check entire bottom surface of nacelle for fluid leaks.

9. Air Intake & Accessory Domes - CHECKED, SECURE
   Check all island fairings secure. Check for fluid leaks, particularly around accessory domes. Check for foreign objects in air intakes. Check rotor and stator blades for nicks, dents, and damage. Hand check dome latches fastened and secure. Exert pressure on domes to test security.

10. Right Nacelle & Strut Panels - SECURE, NO LEAKS
    Check fore and aft edges of panel flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check for upper hooks safetied, strut panels closed, and for fluid leaks around panels. Check entire bottom surface of nacelle for fluid leaks.

11. Wing Access Panels - SECURE, NO LEAKS
    Check wing access panels closed and secure. Check for fluid leaks around panels.

P FORWARD LEFT SIDE FUSELAGE ● ● ● ●

1. Forward Left Side Fuselage & Fuel Drains - CHECKED, NO LEAKS
   Check forward left side of fuselage for dents, cracks, and buckling. Check fuel drains for leaks. Check air intake and exhaust port dust plugs removed and ports unobstructed. Check static ports clear.

2. Bomb Door Switch - OFF
   Check that bomb bay door switch located in external power receptacle is OFF.

10302 WC-1

Figure 2-3 (Sheet 12 of 12 Sheets).

BEFORE STARTING ENGINES

After completion of the Exterior Inspection, the crew will board the airplane and perform the Before Starting Engines check.

FUEL SPECIFICATION AND GRADE

The fuel used in this airplane shall conform to Specification MIL-F-5624A Grade JP-4 (recommended); or Specification MIL-F-5572, any grade aviation gasoline (alternate).

NOTE

- Fuel gage error may be expected when using 100% of high octane gasoline (115/145). At a temperature of 38° C (100° F), the fuel gages will read approximately 5% high. With the same fuel at -18° C (0° F), the reading will be approximately 2.5% high.
- The operating limits are identical for the recommended and alternate fuel grades (section V).

CAUTION

- When practicable, start and run up engines with airplane on clean concrete or other paved surface to minimize possibility of dirt or other objects being drawn into engine compressor and damaging engines.
- Position the airplane so that consideration can be given to other aircraft, personnel, and ground installation when engines are started.

WARNING

If airplane is to be operated under possible conditions of carbon monoxide contamination, such as during "runup" or taxiing directly behind another operating jet airplane, or during "runup" with its tail into the wind, crew members will don oxygen masks before starting engines and place diluter lever at the 100% OXYGEN position. After takeoff and/or when contamination is no longer suspected, place the diluter lever at the NORMAL OXYGEN position. The use of 100% OXYGEN through a long flight will so deplete the oxygen supply as to be hazardous to the flight crew.

BEFORE STARTING ENGINES

1. Ejection Seat & Canopy Safety Pins - Crew Reports
   a. Copilot removes safety pin from canopy jettison initiator* and stows with attached streamer in bag provided.
   b. Pilot and copilot remove ejection seat safety pins and stow with attached streamers in bags provided.
   c. For observer's ejection seat check, see section VIII.
   d. Crew reports "Streamers and pins removed."

2. Safety Belt & Shoulder Harness - FASTENED - fastened
   Pilot and copilot adjust and fasten safety belt and shoulder harness. Check shoulder harness for a snug fit and check inertia reel lever in UNLOCK position.

WARNING

- Pilot should check whether or not he can reach necessary controls with shoulder harness locked. This will aid correct planning if crash landing or ditching becomes necessary. (Refer to section III.)
- If safety belt is removed in flight or on the ground while changing pilots, be careful that the belt is not thrown over the right side of the seat as the belt end may inadvertently turn off some switches.
- Care must be taken to prevent inadvertent actuation of automatic safety belt initiators if installed.

(CONTINUED ON NEXT PAGE)

* AF 52-612 & on

BEFORE STARTING ENGINES

(CONTINUED)

3. Battery - OFF
   Pilot checks battery switch OFF.

4. External DC Power - on the line
   Copilot calls for external DC power and reports when voltmeter indicates power on the line.

5. Seats & Pedals - ADJUSTED - adjusted

6. Controls - ENGAGED - engaged
   Pilot and copilot unlatch control columns at instrument panel and engage control columns. Use the following procedure for engaging the control columns:
   a. Unlatch the control column from the instrument panel with the left hand and unlock the disconnect handle with the right hand by pressing on the thumbbutton.
   b. Pull the control column aft with the left hand. The control column will engage and the disconnect handle will slide down into engaged position by itself.

CAUTION

Do not push the disconnect handle down because damage to the disconnect rod assembly may occur with subsequent control difficulty in flight.

7. Mike Cord, Mask & Bailout Bottle - CONNECTED - connected - *connected*
   Crew members connect mike cords, then plug in oxygen masks as follows:
   a. Attachment strap on mask male connector should be attached to parachute chest strap by routing the connector strap under the chest strap as close to center as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector.
   b. Plug the mask male connector into the mask-to-regulator tubing, listen for click, and check that the sealing gasket is only half exposed.
   c. Attach alligator clip to end of the mask male connector strap.
   d. Route bailout bottle tubing underneath chute harness up to mask tubing and connect bayonet fitting to mask hose connector.

8. Takeoff & Landing Data Card - completed
   Copilot enters takeoff data on card.

9. Lights - SET - set
   Pilot and copilot set all interior and exterior light controls as required.

10. Emergency Keyer - SAFETIED OFF
    Pilot checks emergency keyer switch OFF, switch guard closed, and safety wire intact.

11. Overheat Control - NORMAL
    Pilot places anti-icing overheat control switch in NORMAL and switch guard closed.

12. Oxygen Check - Crew Reports
    Pilot turns master oxygen warning system switch ON. Each crew member accomplishes the following check:
    a. Moves oxygen supply lever to ON and checks system pressure.
    b. Moves warning system switch to ON.
    c. Checks oxygen flow blinker and hose connections.
    d. Reports over interphone, "Oxygen check complete; pressure normal and warning switch on."

(CONTINUED ON NEXT PAGE)

BEFORE STARTING ENGINES

(CONTINUED)

13. Canopy Jettison Handles - IN PLACE - in place
    Pilot and copilot check canopy jettison handles in place and covers closed.

14. Parking Brakes - SET
    Pilot depresses left pedal and sets parking brakes.

NOTE

- If left pedal remains down, this indicates parking brakes are set. If pedal returns up, push pedal in and repeat procedure.
- Parking brakes may not be effective until engine No. 3 or 4 has been started and main hydraulic pressure is available.

(1)► 15. Canopy Release Handles - IN PLACE - in place
    Pilot and copilot check canopy release handles in place and doors closed.

(2)► 16. ESP Switch - OFF
    Pilot checks engine stall prevention switch OFF, regardless of OAT, to obtain maximum thrust on takeoff.

17. Bomb Door Switch - OFF
    Pilot checks bomb door switch OFF.

18. Directional Damper Switch - OFF
    Pilot checks directional damper switch OFF.

(3)► 19. Approach Chute Deployment Switches - DOOR CLOSED - door closed (or off)
    Pilot and copilot check approach chute deployment switches in the guarded DOOR CLOSED or OFF position.

20. (4)► Inverter Switches - MAIN, LIGHTS OUT - on, voltages & lights checked
    a. Pilot moves instrument inverter switch to MAIN and checks red "Bus Power Off" light out and amber "Spare Inverter on Bus" light out.
    b. Copilot checks red instrument "Bus Power Off" light out.
    c. Copilot sets inverter transfer control switch on NORMAL.
    d. Copilot places main and secondary inverter switches ON and checks respective red "Bus Power Off" lights out. Copilot positions A-5 or MD-4 inverter power switch as required.
    e. Copilot checks main, A-5 or MD-4, and secondary bus voltages between 110 to 120 volts.

(5)► External AC Power - (on the line)
    Copilot calls for external AC power. Ground crew reports "On the line."

21. Fire Shutoff Switches - DEPRESSED
    Pilot resets all six fire shutoff switches.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2357 thru 52-611
(2)► AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on
(3)► AF 51-2192 thru -2356, 52-071 thru -201, -248 & on
(4)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(5)► AF 52-1417, 53-1819 thru -2170, 53-2279 & on

BEFORE STARTING ENGINES

(CONTINUED)

22. Gear Lever, Indicators & ELGE Lights - LEVER & FOUR DOWN - four green, four down
    Pilot and copilot check gear levers DOWN lights out in lever tips, and four down indicators showing on instrument panels. Copilot checks ELGE stand for four green lights on and red light out.

23. Remove Bomb Door Locks, Gear Locks & Grounding Wire - (roger)
    Copilot calls to ground crew, "Remove bomb door locks, gear locks, and grounding wire." Ground assistant acknowledges and proceeds with removal.

24. Master Air Conditioning Switch - ON
    Pilot checks master air conditioning switch ON.

①► 25. Emergency Hot Air Shutoff Handle - depressed
    Copilot checks that the emergency hot air shutoff handle on the lower edge of the oxygen panel is fully depressed.

②► 26. Water Separator - OFF
    Pilot checks water separator switch OFF.

27. Heat Selector - AUTOMATIC, RHEOSTAT SET
    Pilot places heat selector switch in AUTO and sets rheostat at 12 o'clock position.

28. Cabin Air Selector Switch - COMPRESSOR
    Pilot checks cabin air selector switch in AIR COMP.

NOTE

If BNS equipment is not being used or is not installed, cabin ventilation may be had during hot weather by placing this switch to RAM SUPPLY.

29. Cabin Pressure Switch - NORMAL
    Pilot checks cabin pressure switch in PRESS NORMAL.

30. Windshield Defrost - SET
    Pilot checks operation of windshield defrost blower and sets as desired.

31. Slipway, Exterior & Pitot Heat - SET
    Pilot checks slipway anti-icing, exterior surfaces anti-icing, and pitot heat switches OFF.

32. Windshield Anti-Ice - NORMAL
    Pilot checks windshield anti-ice switch in NORMAL.

33. Engine Screen Switch - AUTOMATIC
    Pilot checks engine screen switch in AUTOMATIC unless screens are inoperative.

34. Low Speed Warning Switch - ON
    Pilot checks low speed warning switch ON.

35. Antiskid - ON, LIGHT OUT
    Pilot checks antiskid switch ON. (If antiskid switch has been ON, place switch OFF to test amber light. The amber light will not glow until switch has been off for 2 or 3 seconds. Return switch to ON.) Pilot checks amber light out.

(CONTINUED ON NEXT PAGE)

①► Some airplanes
②► AF 52-158 thru -176, -312 thru -362, -394 thru -564

BEFORE STARTING ENGINES

(CONTINUED)

36. Throttles - CUTOFF - cutoff
    Pilot and copilot check throttles in CUTOFF.

37. Surface Control Lock - FORWARD, UNLOCK DETENT
    Pilot moves surface control lock lever to full forward detent and checks that detent lip is not rounded.

NOTE

Rudder-elevator surface power controls cannot be energized until surface control lock lever is in the full forward UNLOCK detent.

38. ATO Switches - BOTH OFF
    Pilot checks ATO arming switch and ATO firing switch both OFF and switch guard closed on firing switch.

39. Water Injection Switches - OFF
    Pilot checks water injection arm switch OFF with guard closed and water injection system switch guard closed.

40. (1)► Canopy Control Lever - OFF
    Pilot checks canopy control lever OFF.

(2)► Canopy Latch Control Lever - OFF
    Pilot checks canopy latch control lever OFF.

41. Cabin Pressure Release Handle - DEPRESSED
    Pilot checks emergency cabin pressure release handle pushed down.

42. Radios & IFF - ON, CHECKED & STANDBY
    Pilot turns on all radios for warmup. Pilot turns IFF selector switch to STANDBY.

43. Fuel Control Panel - SET
    Pilot checks master refuel switch in NORMAL position and all other switches off. Using the following information, pilot places all fuel selector switches as required:
    - With cg aft of 34% MAC, engines No. 3 and 4 in TME position, and all others in ME position.
    - With cg forward of 34% MAC, all engines in TE position except No. 2 which will be in TME position.

44. Bomb Door Locks & Gear Locks - IN SIGHT, STOW
    Pilot checks bomb door locks and gear locks displayed in sight on the ramp to left of airplane and instructs ground crew to stow the locks.

45. Generators - reset & off
    Copilot sets all generator switches (six) to RESET, then to OFF.

NOTE

Placing the generator switches to RESET and then OFF resets the field trip relays to regain generator and starter control which was lost at the time of engine shutdown when the fire shutoff switches were pulled.

(3)► 46. Alternators - reset & off
    Copilot places both alternator switches to RESET, then to OFF. If external AC power is connected for "K" system preflight, bus selector switch will be positioned to EXT PWR RH BUS* or EXT PWR** position. If external AC power is not required, bus selector switch will be OFF.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2357 thru 52-611
(2)► AF 52-612 & on
** (3)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
* AF 51-2357 thru -2411

BEFORE STARTING ENGINES

(CONTINUED)

CAUTION

①► Alternator power switches should not be held in RESET position for an extended period of time due to the possibility of damaging the alternator during the field flashing sequence.

47. Emergency Hydraulic Switch - auto normal, pressure & quantity checked
Copilot checks emergency hydraulic switch in AUTO NORMAL, emergency system pressure 3000 (±150) psi, amber "Pump Operating" light out, and quantity checked.

48. Circuit Breakers - in
Copilot rechecks all circuit breaker panels to insure all circuit breakers are in and none have tripped.

49. N-1 Compass - *synchronized*
Observer synchronizes the N-1 compass master indicator in the following manner:
    a. Rotates the latitude correction knob counterclockwise until the latitude correction pointer indicates OFF.
    b. Engages and rotates the synchronizer control knob in the direction indicated by the annunciator pointer: clockwise if the annunciator pointer indicates "R" and counterclockwise if it indicates "L," until the annunciator pointer is on its center index.

CAUTION

Do not synchronize on the unstable null, i.e., 180° from the correct magnetic heading.

50. Radio Call - COMPLETED
Pilot calls tower, gives position, and asks for taxi instructions.

51. Brake Chute Deploy & Jettison Handles - BOTH CHECKED - both checked
Pilot and copilot check brake chute deploy and jettison T-handles undamaged, seated properly on cable tubes, and attached to cables.

②► 52. ATO Rack Release Handle - in place
Copilot checks external ATO rack release handle properly seated.

53. ATO Safety Device - AS REQUIRED
If ATO takeoff is to be made, pilot instructs ground crew to accomplish the following:
- ③► Install ATO safety link; "ATO Safety Link Installed" indicator light will come on when ATO link is installed.
- ②► Install ATO pullout plugs and remove safety pins. "ATO Ready" light on ATO control panel will illuminate when pullout plugs are installed.

WARNING

ATO firing area must be clear of all ground personnel when ATO safety link is installed or the ATO pullout plugs are connected.

①►AF 52-394 thru -440
②►AF 51-2192 thru -2356, 52-089 thru -201, -293 & on
③►AF 51-2357 thru 52-088, -202 thru -292

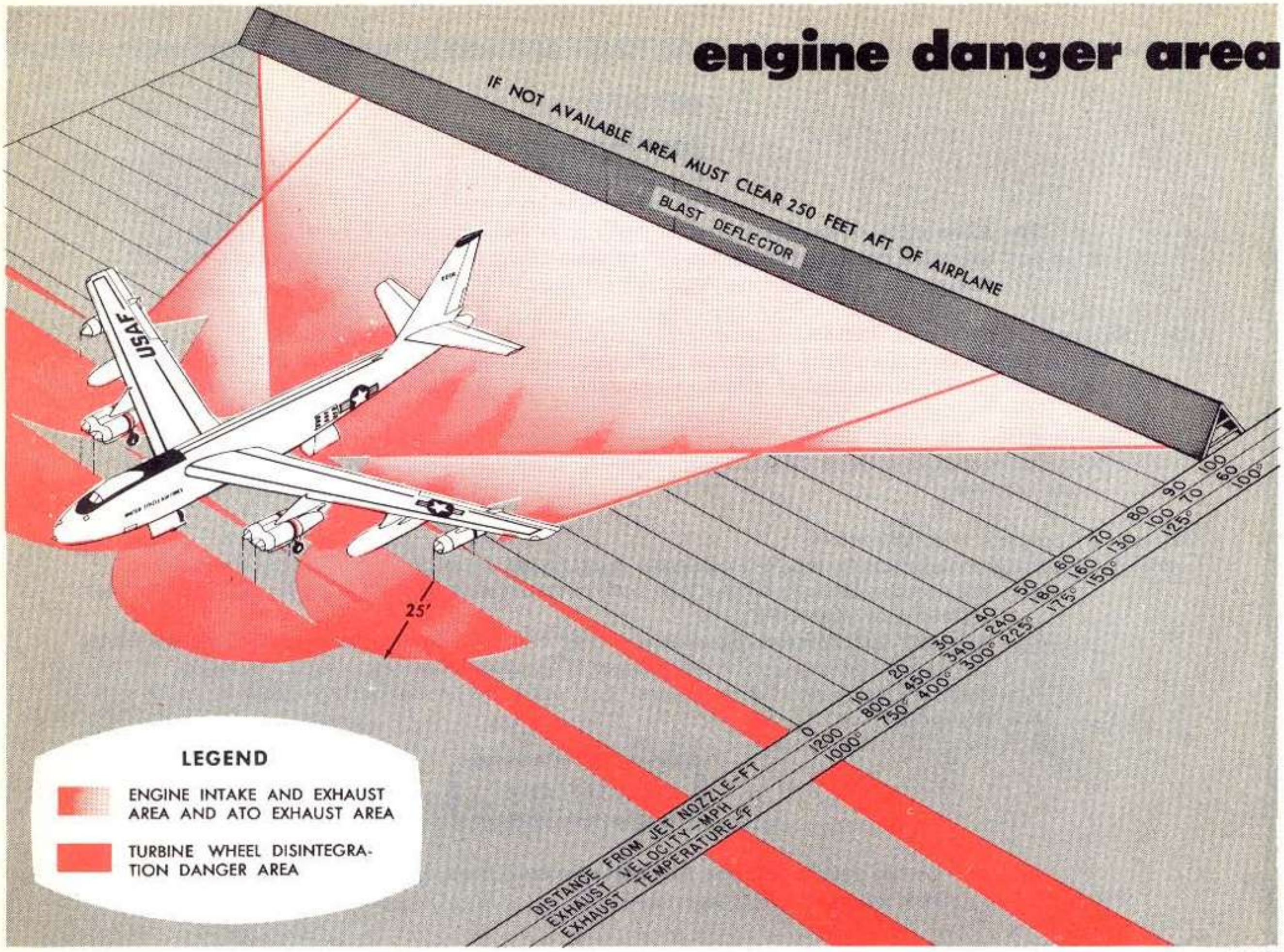

Figure 2-4.

STARTING ENGINES

A Starting Engines checklist is provided for the proper method of starting the engines; however, prior to starting engines, the pilot should become familiar with the Engine Fire During Starting procedure in section III in case of an engine fire while or after starting an engine. The following additional precautions should also be observed.

WARNING

Prior to starting engines and during engine operation, be sure the engine danger areas around air intake ducts and exhaust jet nozzles shown on figure 2-4 are clear of personnel, aircraft, and vehicles; air intake suction is sufficient to kill or seriously injure personnel if drawn into or suddenly against the air intake; danger in rear of exhaust jet is created by high exhaust temperature and velocity.

NOTE

Engines should be started and run up with the airplane headed into or at right angles to the wind since a tailwind may increase exhaust gas temperatures.

STARTING ENGINES

NOTE

Engine starting sequence 4, 5, 6, 3, 2, and 1.

1. Ignition Switches - NORMAL
   Pilot checks all ignition switches (six) in NORMAL.

2. Ready to Start Engines - READY - ready - (ready)
   Pilot notifies crew and crew chief, "Stand by to start engines." Crew chief confirms with "Clear to start and fire guard on No. 4." Copilot positions DC voltmeter selector to engine being started and informs pilot.

①► NOTE

MD-3 power carts should be used when external ground power is used for starting. If the MD-3 power cart is not available see "Emergency Ground Starting with External Power" in section III.

3. Start Engines
   The procedure for engine start is as follows:
   a. Pilot places starter selector switch to engine to be started. Holds starter switch in START position for approximately 2 seconds and releases. Copilot reports voltage rise.
   b. Copilot informs pilot when engine rpm reaches 6%. At 6% rpm, pilot advances throttle to START position and watches tailpipe temperature for indication of combustion. When combustion occurs the EGT should be watched to ensure it does not exceed the limits. If EGT tends to exceed limits the throttle should be lifted from START position and moved as required to maintain EGT within limits. Fuel pressure fluctuation should not exceed ±35 psi at stabilized rpm. If no fuel pressure is noted, retard the throttles to CUTOFF and repeat the starting procedure. Fuel flowmeter fluctuations shall be considered as normal on engine start. Fuel flowmeter indicator shall be steady at stabilized rpm.

CAUTION

- If combustion does not occur when engine speed reaches 9.5% or if the engine speed has not reached 9.5% within 40 seconds after the starter switch is placed in START, momentarily position the starter switch to CUTOFF and close the throttle to discontinue the start. Allow combustion chambers to drain and starter to cool for at least 3 minutes before attempting another start. The starter should not be used to turn the engine for longer than 1 minute without the assistance of combustion: starter is limited to three runs of 1-minute duration during any 30-minute period. Allow starter to cool 30 minutes before using again.

- After opening the throttle with the starter engaged, do not change the position of the fuel selector switches or turn on the ignition switch if forgotten previously, or explosive combustion may occur. If improper settings are noted during the start, shut off engine as described above and allow engine to drain. Repeat starting procedure after making sure ignition switch is in NORMAL position and fuel selector switches are properly positioned.

   c. When combustion is indicated by a rise in EGT, allow EGT to stabilize momentarily with the throttle at START position, then increase rpm to idle (40% rpm) using EGT to govern rate of throttle advance. While advancing throttle to idle, maintain EGT between 600° and 690° C to obtain the most satisfactory starts.

(CONTINUED ON NEXT PAGE)

①► AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

STARTING ENGINES

(CONTINUED)

Do not exceed 715° C. As the engine accelerates, copilot checks for starter "dropout" at 15% to 25% rpm by observing a brief voltage drop followed by a return to normal on the DC voltmeter. If the engine is held to an rpm less than 25% or if the starter has not "dropped out" of the circuit at 25% rpm, copilot notifies pilot. Pilot momentarily places the starter switch in CUTOFF to insure that the starter is off.

NOTE

- If a false start (no combustion) occurs during a start attempt, retard the throttle to CUTOFF. On the next start attempt, advance the throttle past the START detent. Do not advance the throttle past idle detent position. Monitor EGT gage and retard throttle as soon as engine fires to control EGT. After EGT has stabilized momentarily, advance throttle to idle maintaining EGT between 600° and 690° C.
- The time for the engine to accelerate from 0% rpm to idle rpm varies from about 1 minute on cool days to about 2 minutes on hot days.

CAUTION

- An EGT in excess of 715° C shall not be maintained for longer than 20 seconds.
- Engine inspections for overtemperature conditions will be made prior to flight in accordance with the following schedule:

CONDITION	OCCURRENCES	ACTION PRIOR TO FLIGHT
715° C or higher for over 20 seconds OR 870° C or higher for any period	Five	Overtemperature Inspection per T.O. 2J-J47-358
	Ten	Overtemperature Inspection per T.O. 2J-J47-358 PLUS Removal & Replacement of the Turbine Rotor Assembly
1000° C or higher for any period OR 720° C or higher steady indication for any period after EGT stabilizes at a given throttle setting	Once	Overtemperature Inspection per T.O. 2J-J47-358 PLUS Removal & Replacement of the Turbine Rotor Assembly

(CONTINUED ON NEXT PAGE)

STARTING ENGINES

(CONTINUED)

- Engine overspeed exceeding 104% of rated rpm, either with or without overtemperature, requires removal and overhaul of the engine.
- The extent and duration of EGT exceeding 1000°, 870°, 720°, or 715° C (for over 20 seconds), plus extent and duration of all overspeeds, shall be recorded in DD Form 781.

d. When starter dropout occurs on engine No. 4, copilot checks that the red hydraulic "Pump Not Operating" light goes out and main hydraulic system pressure builds up to normal. Copilot checks that the remaining red "Pump Not Operating" light goes out when No. 3 starter drops out.

e. Allow engine to stabilize at idle rpm and check all engine instruments before accelerating to a higher rpm.

CAUTION

If no rise in oil pressure is noted by the time idle rpm is reached, increase rpm until a definite rise in oil pressure becomes apparent. If no pressure increase is noted before 80% rpm is reached or before 60 seconds after reaching idle rpm, shut down and investigate the cause for lack of pressure.

f. Check for positive oil pressure rise during acceleration.

NOTE

During cold weather starts, oil pressure may exceed maximum limits until the oil temperature reaches normal.

g. As soon as starter dropout occurs, pilot starts remaining engines as above.

4. Starter & Ignition Switches - OFF
   Pilot checks all ignition switches (six) OFF, starter selector switch OFF, and starter switch OFF.

ENGINE GROUND OPERATION

No warmup period is required for jet engines other than a time allowance to stabilize the exhaust gas temperature. Normally, as soon as the EGT stabilizes at idling speed, the throttles may be advanced to full open. Rapid forward movement of the throttles must be avoided at all times. Generator rated output is attained at 41% rpm.

CAUTION

On airplanes equipped with "medium flow" (650 ppm) water injection, engines should be warmed up at idle rpm for at least 10 minutes before the start of water injection operation. Occasional throttle manipulations above idle will not interfere with satisfactory warmup. Therefore, the warmup period can be accomplished while taxiing out to takeoff position. In addition, it is permissible to operate engines No. 1 and 6 at 52% rpm or slightly higher to maintain alternator output on airplanes equipped with an unregulated AC system.

(1)

If alternator power is required, the alternator switches must be placed in RESET prior to starting engines No. 1 and 6. If this procedure is not followed (alternators reset prior to starting engines), a long delay may be necessary before alternator output will be available to the bus system, or flashing of the alternator field may be necessary to restore alternator operation.

(1) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

BEFORE TAXIING

1. Hydraulic Pressure & Quantity - checked
   Copilot checks main hydraulic system and main brake system pressures within operating range and both red "Pump Not Operating" lights out. Checks hydraulic quantity within operating limits.

2. (1)► Engines No. 1 & 6 - 52% RPM - bus selector normal, alternators normal, voltages checked
   If alternator power is required, pilot adjusts throttles No. 1 and 6 to maintain 52% rpm. Copilot places both alternator power switches to NORMAL; as soon as both amber "Under Freq" lights go out, places unregulated AC bus selector switch to NORMAL. Both amber "Power Off" lights should go out. (If external AC power cart is connected to the external (AC) power receptacle, "Power Off" lights will have been out and should remain out when power source is transferred from the external power cart to airplane alternators.) On some airplanes, copilot checks voltages on left and right unregulated AC buses between 110 to 120 volts. On other airplanes, the check for 110 to 120 volts provides a reading of left and right alternator voltages.

CAUTION

- To avoid damage to electronic equipment receiving alternator power, do not retard throttle No. 1 or 6 below 52% rpm.
- If either "Power Off" light comes on or fails to go out, the copilot may reset the affected alternator once. If the lights continue to come on, no further resets should be made until the fault is corrected.

(2)► Engines No. 1 & 6 - 40% rpm, alternators on bus, voltages checked
   Copilot checks left and right amber alternator failure lights out. If either or both lights remain lit after idle rpm is attained, copilot may hold the respective alternator control switches momentarily in RESET and then release the switches to neutral position. This should put out the alternator failure lights.

CAUTION

On a normal engine start, the alternators should connect to the main AC bus automatically when engines reach idle rpm. If resetting is necessary to put out either alternator failure light, the reason may be a system fault or a previous movement of the control switch to TRIP. It may be impossible to determine if the failure to connect automatically is merely the result of a manual trip. Therefore, whenever a reset becomes necessary, the copilot should monitor the alternator failure lights closely thereafter. If the lights stay on or come on again, no further resets should be made until the fault is corrected by maintenance personnel.

   Copilot checks voltages and frequencies by placing voltmeter and frequency meter selector switch to ALT BUS ØA, ØB, and ØC positions, and checks voltage between 110 to 120 volts and frequency approximately 400 cycles in each position.

3. Entrance Door - closed & locked - (closed & latched)
   Copilot insures that the pressure door is up with hook seated. Ground crew reports when ladder is stowed and outside door is closed and latched.

4. Clear Bomb Doors - (clear) - CLOSED - (closed)
   Pilot checks with ground observer that bomb doors are clear to close. Positions bomb door switch to CLOSE; a LOCK tab will appear in the bomb door position indicator when doors are closed. Requests ground crew to confirm "Doors closed and latched."

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2)► AF 52-1417, 53-1819 thru -2170, -2279 & on

BEFORE TAXIING

(CONTINUED)

5. Battery - LH BUS NORMAL
   Pilot places battery switch on LH BUS NORMAL.

6. Generators - on
   Copilot positions all generator switches (six) to ON.

7. Windshield Defrost, Anti-Ice & Pitot Heat - SET
   Pilot checks windshield defrost switch ON, windshield anti-ice switch in NORMAL, and pitot heat as desired.

8. External Power, Chocks & Interphone - REMOVED & IN SIGHT
   Pilot requests ground crew to remove external power and wheel chocks, disconnect ground interphone, and place equipment forward, to the left, and clear of the airplane where visible to the pilot.

9. Generator Loads & Voltages - checked
   Copilot checks that all generators (six) are charging by placing DC voltmeter selector switch on each generator position and checking voltage. Checks loadmeters to ensure each generator is taking a load.

   NOTE

   Voltage rheostats are normally used for ground adjustments of the generator system and should not be used by the flight crew for minor load adjustments. Loadmeters may give an erroneous reading until generator system is allowed to warm up approximately 15 minutes.

10. Power Controls - ON, LIGHTS OUT
    Pilot places rudder-elevator power control switch to ON (or NORM) for airplanes without emergency elevator power control and NORMAL for airplanes with emergency elevator power control. Pilot places aileron power control switches (2) to ON (or NORM); all power control panel lights should go out and remain out.

    NOTE

    If red rudder-elevator no-pressure warning light stays on, recheck surface control lock lever in full forward UNLOCK detent.

11. Steering Ratio Selector - TAXI DETENT
    Pilot places steering ratio selector lever in TAXI detent.

    NOTE

    Prior to moving lever, neutralize rudder pedals as forward main gear will assume a position corresponding to the position of the rudder pedals.

12. IFF - SET
    Pilot sets IFF panel in accordance with communications briefing.

13. Clear to Taxi on Crew Chief's Signal - READY TO TAXI
    Pilot signals crew chief when ready to taxi and obtains clearance to roll. Releases parking brakes.

minimum turning radius

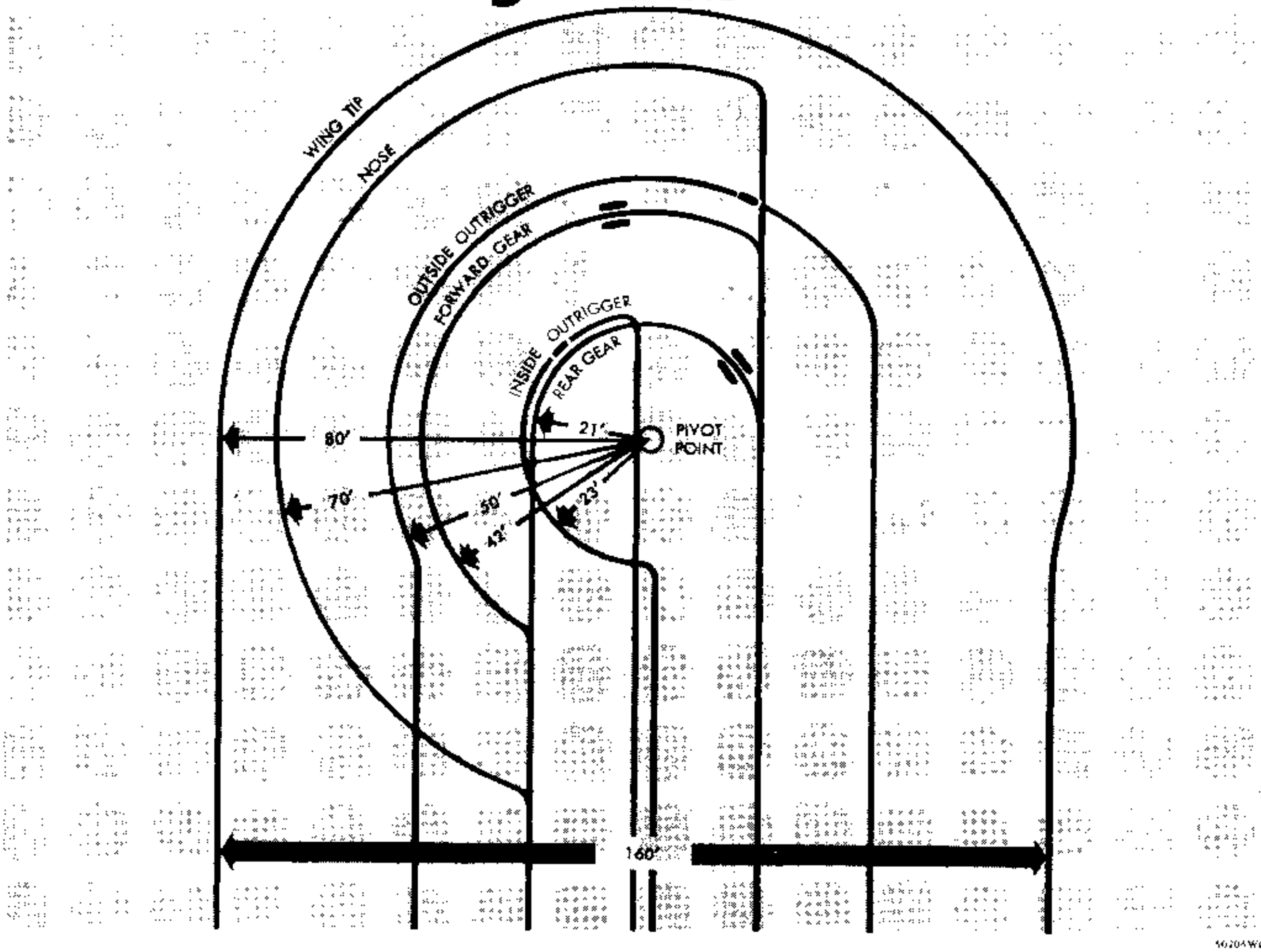

Figure 2-5.

TAXIING INSTRUCTIONS

CAUTION

At gross weights over 185,000 pounds on airplanes having 32-ply tires installed, it is necessary to restrict taxi speed to a maximum of 25 knots in order to minimize heat buildup rate in the tires.

All steering during taxiing is accomplished by use of the front gear steering system. Differential braking is not possible with the bicycle-type landing gear; and differential thrust with the engines is ineffective. The airplane must be in motion before executing turns; use the largest turning radius possible to minimize tire wear and landing gear stress. For minimum turning radius, see figure 2-5. Taxi the airplane with engines operating at idle rpm or more as needed. Use the brakes as little as possible.

NOTE

If the steering system is inoperative when the aircraft is taxied from the parked position, move the steering ratio selector rapidly from TAXI to TOW and back to TAXI position. If the malfunction is caused by a sticking disconnect valve plunger this procedure may free the plunger and return the steering system to normal operation.

CAUTION

If the airplane is stopped while executing a turn, do not change directional position of the forward main gear prior to putting the airplane in motion again. Any radical change in the steering direction while stopped could cause damage to an outrigger gear when taxiing is resumed.

CAUTION

With the steering ratio selector in TAXI position, extremely hard and rapid movement of the rudder pedals in one direction can cause steering to reverse and turn the airplane in the opposite direction. This results from the cam followers overriding the cam on the steering disconnect unit. Pedal movements rapid enough to cause this condition are never required since the front gear cannot turn quickly enough to match extremely fast pedal throw. Therefore, hard and rapid deflection of pedals should be avoided.

CAUTION

High speed will be held to a minimum while taxiing in order to prevent possible damage to the airplane systems in case bottoming of the landing gear struts is encountered on rough taxiways.

WHILE TAXIING

1. Brakes & Steering - CHECKED
   Pilot checks steering and brake operation by slight turns left and right and light brake applications.

2. Hydraulic Pressure & Quantity - CHECKED
   Copilot checks main hydraulic system pressure, main brake system pressure, and hydraulic quantity gage at regular intervals while taxiing (30-second intervals in congested areas).

3. Turn & Bank - CHECKED - checked
   Pilot and copilot check turn-and-bank indicators for proper turn indications while taxiing.

4. Directional Gyro - checked
   Copilot checks directional gyro for correct indications in turns.

5. Accelerometer - CHECKED
   Pilot resets accelerometer before takeoff.

6. Steering Ratio - CHECKED
   In a clear area, the pilot moves steering ratio selector to TAKEOFF LAND detent, checks for proper range of steering, then returns lever to TAXI detent.

NOTE

Rudder pedals should be neutralized before selector is placed in TAXI.

BEFORE LINEUP

1. Brakes - SET
   Pilot sets parking brakes to prevent airplane from moving during Before Lineup check.

2. Flight Instruments - CHECKED - checked
   Pilot and copilot check attitude indicators; if gyro has not erected properly at this time, cage it momentarily. Check that standby compass and RMI indicate approximate airplane heading; rate-of-climb, turn-and-bank, airspeed, and Machmeter read zero or the normal static reading.

(CONTINUED ON NEXT PAGE)

BEFORE LINEUP

(CONTINUED)

3. Power Controls - ON, LIGHTS OUT
   Pilot checks rudder-elevator power control switch ON (or NORM) for airplanes without emergency elevator power control and NORMAL for airplanes with emergency elevator power control. Checks aileron power control switches ON (or NORM) and all panel lights out.

①► NOTE

> If one or both aileron emergency-pump-on lights are illuminated, it is possible that some momentary heavy demand on the main hydraulic system caused one or both aileron emergency power control systems to be energized and kept in operation by their respective "hold" circuits. If a check of the main hydraulic system indicates normal steady operating pressures, the affected aileron power control may be returned to the main hydraulic system by moving the respective control switch to OFF momentarily and then returning it to ON.

4. Cabin Air Selector Switch - COMPRESSOR
   Pilot checks cabin air selector switch in AIR COMP position.

5. Flaps - FULL DOWN - full down
   Pilot and copilot check flap position indicators for 100% flaps.

6. Flight Controls - ENGAGED - engaged
   With both control columns engaged, the copilot holds his column in a fixed position while the pilot exerts pressure fore and aft to determine if controls are engaged. Pilot then moves column full forward and full aft to check freedom of travel.

7. Flaperons - CHECKED
   Pilot moves aileron control wheel full left and full right and visually checks flaperons for normal operation.

8. Trim Tabs - SET
   Pilot rechecks aileron and rudder trim on zero and positions elevator trim for cg location in accordance with figure 2-7.

9. Fuel Control Panel - SET, LIGHTS OUT
   Pilot checks No. 2 fuel selector switch on TME, all others on TE, and all warning lights out. If takeoff is to be made with one or more of the main tanks less than half full, pilot places all fuel selector switches on TME and checks all warning lights out.

   ②► Pilot checks auxiliary-fuel-to-engines switch CLOSED, then moves the switches to BOOST ON positions for all auxiliary tanks intended to be used in flight with the exception of the forward auxiliary tank. After reaching cruise altitude, all auxiliary tank switches should be turned OFF except as needed to begin normal auxiliary fuel feed to engines.

   ③► Pilot checks auxiliary-fuel-to-engines switch CLOSED, then moves the switches to BOOST ON positions for all auxiliary tanks intended to be used in flight. After reaching cruise altitude, all auxiliary tank switches should be turned OFF except as needed to begin normal auxiliary fuel feed to engines.

(CONTINUED ON NEXT PAGE)

①► AF 53-1844 thru -1972, -2090 thru -2170, -2332 & on
②► AF 51-2357 thru 52-564
③► AF 51-2192 thru -2356, 52-565 & on

BEFORE LINEUP

(CONTINUED)

10. Canopy - CLOSED, LATCHED, LOCKED - pins & hooks in place

①▶ Before closing canopy, pilot checks canopy lock lever in UNLOCKED position. Copilot checks that lockpins are out and notifies pilot "Clear to close." Pilot calls, "Closing canopy." After canopy closes, pilot checks canopy latch indicators on "Canopy Latched," leaves control lever in CLOSE position, and moves lock lever to LOCKED position. Copilot checks locking pins in place. If canopy has been closed, check "Canopy Latched," canopy lock lever LOCKED, visible hooks in place, and control lever in CLOSE position. Copilot checks canopy locking pins in place.

②▶ Before closing canopy, pilot checks canopy lock lever in UNLOCKED position and canopy latch control lever in OPEN position. Copilot checks that lockpins are out and notifies pilot "Clear to close." Pilot calls, "Closing canopy." Pilot holds canopy control switch in LOWER position. When canopy seats, pilot places canopy latch control lever to the LATCHED position and moves lock lever to LOCKED position. Copilot checks locking pins in place.

①▶ 11. Canopy Latch Reset - HORIZONTAL
Pilot checks canopy latch reset in LOCKED position (slot horizontal).

WARNING

If a flight were made with the latch reset unlocked (slot vertical) the canopy (if opened in flight) could release, travel an unpredictable path and strike the pilot and copilot, thus incapacitating them.

12. Circuit Breakers - checked
Copilot checks that all circuit breakers on DC power panels are in and none have tripped.

13. Bombsight Retractable Cover - *closed*
Observer checks bombsight retractable cover fully closed.

14. Landing Lights (Night) - ON
Pilot checks landing light switches (two) ON for all night takeoffs.

15. Radio Call - COMPLETED
Pilot gets takeoff instructions, altimeter setting, and final radio clearance from the tower before taking runway. Advises crew of altimeter setting.

BEFORE TAKEOFF

1. Brakes - HOLDING
Pilot aligns the airplane with the runway and holds brakes while performing "Before Takeoff" checklist.

(CONTINUED ON NEXT PAGE)

①▶ AF 51-2192 thru 52-611
②▶ AF 52-612 & on

BEFORE TAKEOFF

(CONTINUED)

2. Compass Repeater Indicator - CHECKED
   Pilot checks that the remote compass repeater indicates approximate runway heading.

3. Engine Screens - OPEN
   Pilot checks engine screen switch OPEN unless screens are inoperative.

NOTE

Engine screens will be placed in OPEN position to obtain all available thrust. If screens are inoperative they will be fixed in open position.

4. Steering Ratio Selector - TAKEOFF LAND DETENT
   Pilot moves steering ratio selector lever to TAKEOFF LAND detent.

CAUTION

Do not place the steering ratio selector lever in TOW at any time during flight (except during emergency procedure for "Landing with Front Gear Steering Failure" in section III) since the plunger in the steering disconnect valve may stick and cause a malfunction in the steering system during landing.

5. ATO Arming Switch - AS REQUIRED
   If an ATO takeoff is to be made, pilot places ATO arming switch in ATO ARMED position.

6. Takeoff Data - CHECKED
   Copilot reads line speeds, refusal speed, ATO firing speed, and takeoff speed to the pilot. Pilot acknowledges receipt of information.

6A. Water Injection Warmup - AS REQUIRED
   If water injection is to be used on airplanes with "medium flow" (650 ppm) water injection installed, the pilot insures that the 10-minute engine warmup period has been completed as given under "Engine Ground Operation," this section.

7. Throttles Open - OIL, FUEL, EGT OK, 100% - alternators & generators checked
   Pilot slowly moves all throttles to 100% RPM. Checks all tachometers for engines at 100% rpm. Checks oil and fuel pressure (fuel flow on some airplanes) within operating limits. Checks EGT for all engines at 100% rpm. (See figure 2-6 for correct takeoff EGT.) Copilot checks generator loads and alternator output.

CAUTION

Watch carefully for engine overspeed or excessive tailpipe temperature.

8. Nacelles - CHECKED - checked
   Pilot and copilot visually check condition of engine nacelles at 100% RPM.

(1)▶ 9. Water Injection - AS REQUIRED
   If water injection takeoff is to be made, pilot places water injection arm switch ON and the system switch momentarily to START. On airplanes with "medium flow" (650 ppm) water injection installed, the system switch should be moved to START within 30 seconds after obtaining 100% rpm on all engines whenever possible. Normally the EGT will rise to approximately 690° C under this condition and should cause no concern. Pressurization of the water injection system is indicated by the six red "No Pressure" indicator light going out.

(1)▶ AF 51-2192 thru -2356, 52-152 thru -201, -322 & on

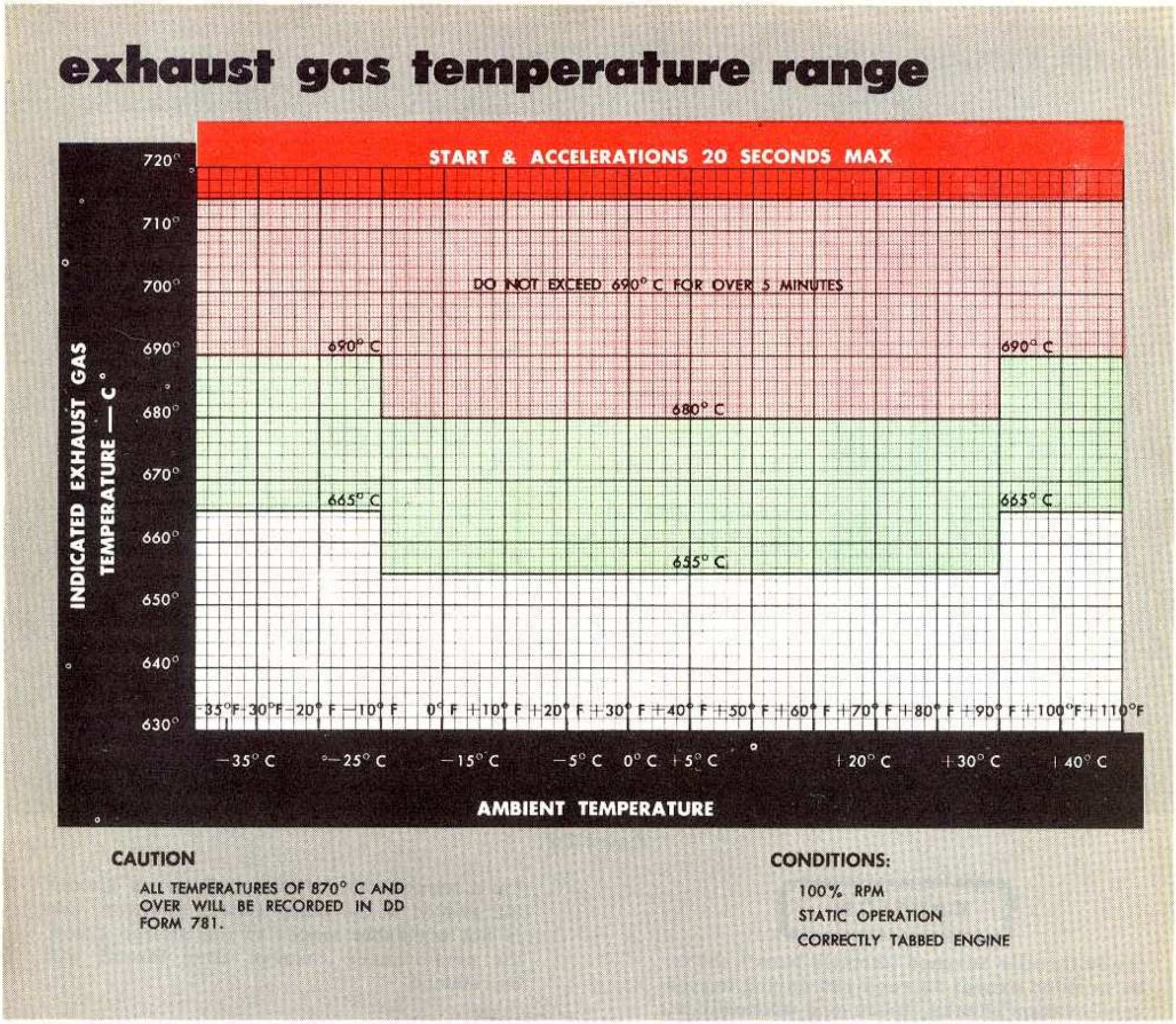

Figure 2-6.

TAKEOFF

NOTE

The techniques as outlined herein are those required to produce the results illustrated in the takeoff charts in the appendix.

Close attention should be given to the correct takeoff procedure on this airplane, since differences from reciprocating engine bombers appreciably affect ground roll. The principal new factors are:

- Jet engine thrust which is nearly constant throughout takeoff.
- Bicycle-type landing gear assures that the pilot will attain a correct attitude for takeoff.
- ATO units (assisted takeoff by solid rockets) which shorten takeoff distances.
- Thrust augmentation by water injection which permits higher gross weights during takeoff and shortens takeoff distances.

TAKEOFF THRUST

On this airplane the minimum takeoff distance is attained by maintaining takeoff rated power; therefore, all takeoffs are to be made at 100% rpm. Thrust at this setting varies with exhaust gas temperature and outside air temperature.

CAUTION

Engine temperatures will not stabilize until the engine has been operating at least 8 to 10 minutes. If stabilization is not attained at this time, it is evident that the engine is malfunctioning internally. A temperature of 690° C with an overshoot of 25° C or a maximum of 715° C for 20 seconds is permissible as indicated in figure 2-6.

trim required for takeoff

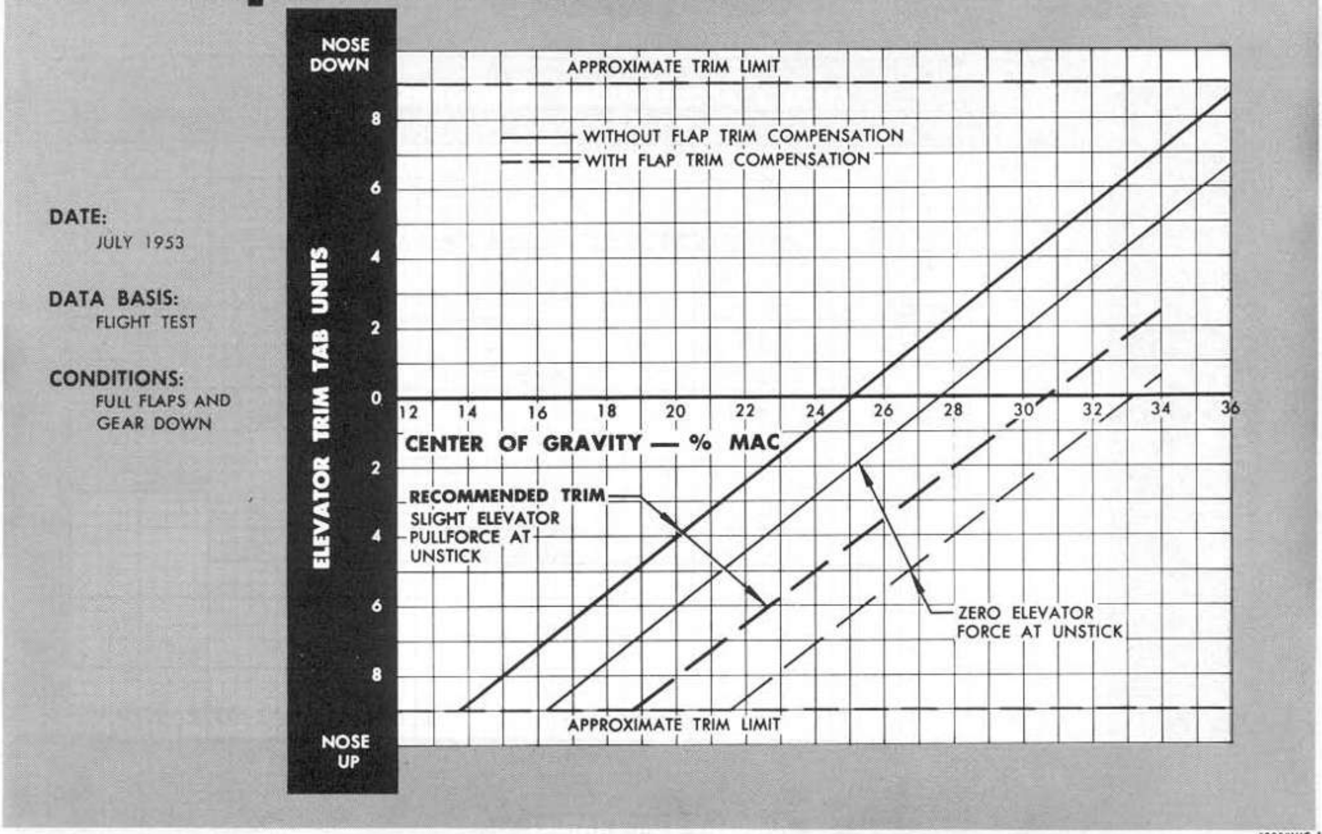

Figure 2-7.

CAUTION

Rapid throttle advance (throttle burst) should be avoided except as required during engine acceleration checks, touch-and-go landings, or emergencies. When rapid throttle advance is required, 870° C EGT must not be exceeded.

NOTE

Takeoff will require about 1 1/2% more runway for each 10° C that the engine tailpipe temperatures for all six engines are below the correct temperature for properly "tabbed" engines (figure 2-6). Therefore, it is important that the temperature indicating instruments be accurate.

NORMAL TECHNIQUE — TAKEOFF

To preclude any possibility of stalling and to obtain optimum control and climb after takeoff, hold light elevator back pressure during ground roll and allow the airplane to fly off the ground with both gears leaving simultaneously.

NOTE

The takeoff run can be shortened approximately 7% by pulling the airplane off the ground with the elevators at a lower speed than that for a normal takeoff with both gears leaving the ground at the same time. However, this is not advisable since, at the slower speed, the performance reserve after takeoff will be reduced.

The amount of elevator trim required for takeoff is dependent upon cg location. In order to obtain the most desirable trim conditions under various cg conditions, refer to figure 2-7.

It should be realized that takeoff performance can be accurately estimated, particularly since the bicycle landing gear practically fixes the airplane attitude at takeoff, thereby eliminating the usually large factor of pilot technique on elevator control. To accurately determine takeoff distance and optimum procedures, the pilot should ascertain the following data and apply it.

- Gross weight
- Outside air temperature (OAT) at time of takeoff
- Field length and pressure altitude
- Wind direction and velocity
- Exhaust gas temperature (EGT); estimate from figure 2-6 and check on engine runup.

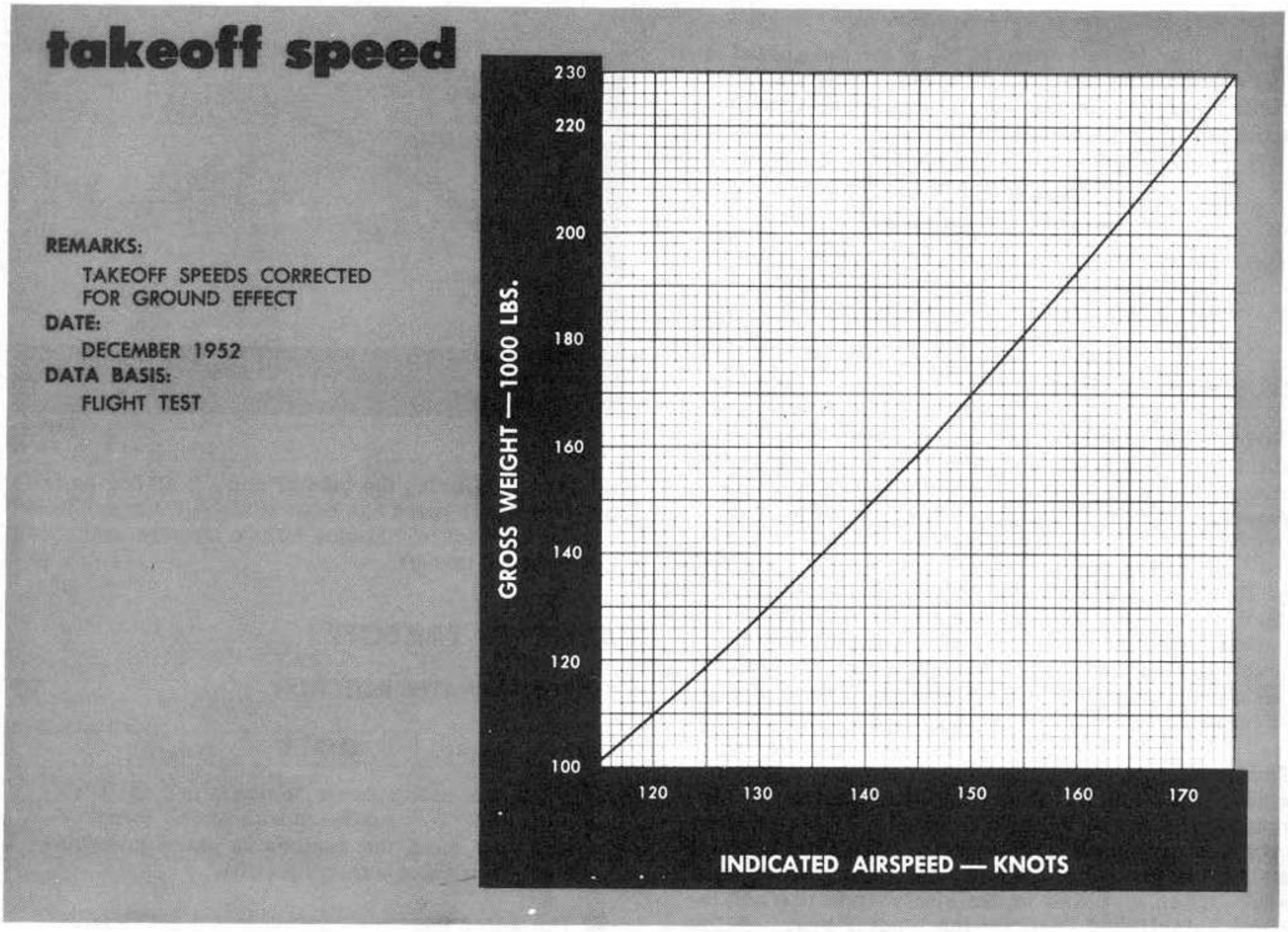

Figure 2-8.

The following chart will illustrate the relative importance of the above factors for a takeoff, using an example weight of 160,000 pounds at sea level:

A CHANGE OF	CHANGES TAKEOFF DISTANCE BY APPROXIMATELY	
	NO ATO (FEET)	18 ATO (FEET)
1000 pounds in weight at 60° F	100	80
1000 feet in altitude at 60° F	675	500
10° C tailpipe temperature (6 engines)	100	70
10° F on 100° F day	330	300
10 mph wind	750	650

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Relative humidity, which appreciably affects reciprocating engine power, has a negligible effect on turbojet thrust and takeoff distances.

NOTE

If the anti-icing system is operating during takeoff, takeoff distance will be increased approximately 5% due to the hot air removed from the engine compressor section to operate the anti-icing system.

EFFECT OF HEADWIND — TAKEOFF

The effect of headwind is to reduce the minimum required length of runway. To determine headwind corrections for the takeoff distance and refusal speeds, see part 2 of the appendix.

OBSTACLE CLEARANCE

When a maximum obstacle clearance is necessary, apply a slight pull force on the control column so that both front and rear gear leave the ground simultaneously. Retract the gear as soon as possible, but leave flaps fully extended. The optimum climb speed for maximum obstacle clearance will be the same as the takeoff speed. However, as the airplane leaves the ground, allow the airspeed to increase approximately 6 knots greater than takeoff speed to allow for the ground effect error in the indicated airspeed. When the obstacle is cleared, increase the airspeed approximately 15 knots and begin flap retraction.

WARNING

No maximum obstacle clearance takeoff (minimum distance takeoff) should be attempted at center of gravity locations aft of 34%.

CROSSWIND TAKEOFF

During a crosswind takeoff, use full aileron deflection at the beginning of the ground roll to lower the upwind wing and maintain as nearly a wing-level attitude as possible.

NOTE

If crosswind is of a large enough magnitude, it may cause the airplane to "heel" over on the downwind outrigger, but this differential loading is not detrimental as the outrigger gear is designed with a long stroke shock strut and is amply stressed for such loads.

The amount of aileron wheel deflection required to keep a wing-level attitude will diminish as the airspeed increases to the takeoff speed. As the airplane becomes airborne, obtain the proper crab angle to maintain a ground track down the center of the runway. When airplane is definitely airborne and the climb established, retract the landing gear. Allow airplane to accelerate approximately 15 knots and start flap retraction.

NIGHT TAKEOFF

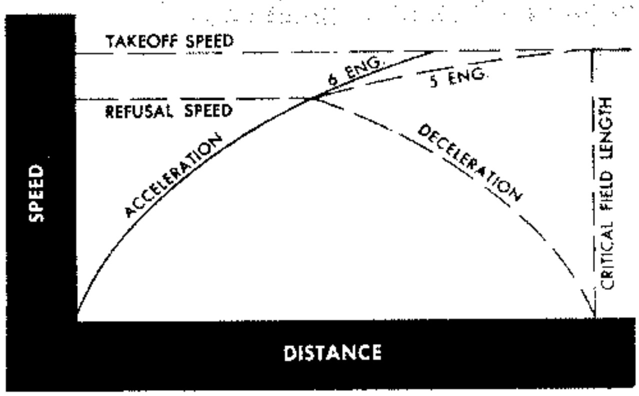
When making a night takeoff, use the same procedure as for a day takeoff with the following exceptions: In order to maintain proper ground clearance and as an aid in judging the climb angle, both landing lights should be on throughout the ground roll and takeoff until airplane is airborne, the climb established, and obstacles cleared.

TAKEOFF SPEED

The gross weight of the airplane is the important factor in determining the takeoff speed. To estimate the takeoff indicated airspeed, see figure 2-8.

TAKEOFF — NO ATO

Refer to parts 2, 3, and 4 of the appendix for takeoff performance charts. The possibility of an engine failure during the takeoff run influences takeoff procedure and should in all cases be considered. With an engine failure, the pilot must be able either to stop or take



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off safely. During the takeoff roll, if an engine fails before refusal speed has been attained, stopping is the correct procedure. Engine failure after refusal speed commits the takeoff.

ASSISTED TAKEOFF

TAKEOFF — WATER INJECTION (1)

NOTE

- When air atmospheric temperature is below 0° C (32° F) usually enough added thrust is available from the engines to make possible takeoffs without water injection.
- The water injection system is not serviced or used at temperatures below -7° C (20° F).

CAUTION

- To prevent damage to the water injection system, takeoff should be conducted in such a manner that the system is drained before ambient air temperatures of -7° C (20° F) or less are encountered.
- On airplanes with "medium flow" (650 ppm) water injection installed the engines are susceptible to compressor stall and excessive EGT when operated without sufficient warmup prior to using water injection. To prevent these conditions and obtain guaranteed thrust, engines should be warmed up at idle rpm for at least 10 minutes before the start of water injection operation. Occasional throttle manipulation above idle will not interfere with satisfactory warmup. Therefore, the warmup period can be accomplished while taxiing out to takeoff position. In addition, it is permissible to operate engines No. 1 and 6 at 52% rpm or slightly higher to maintain alternator output on airplanes equipped with an unregulated AC system.

(1) AF 51-2192 thru -2356, 52-152 thru -201, -322 & on

WATER INJECTION SYSTEM WARNING LIGHTS

When a water injection takeoff is anticipated, an operational check of the six water injection system red warning lights on the pilot's instrument panel must be made before engines are started. This is accomplished by placing the water injection arm switch in the ON position and noting all six red lights are illuminated. Each light should then be adjusted to "bright" or "dim" depending on day or night operations.

TAKEOFF OPERATION

When ready for takeoff, all six throttles are advanced to the 100% RPM position, and each engine rpm and EGT indicators are checked for proper limits. The water injection system switch, which is spring-loaded from START position, is then held in START position until all six red lights go out. This normally take approximately 3 seconds. The system switch should be moved to START within 30 seconds after obtaining 100% rpm on all engines whenever possible. Normally, the EGT will rise to approximately 690° C under this condition and should cause no concern. After each engine rpm and EGT indicators are again checked for proper limits, the brakes are released for the takeoff. An approximate change of 0.5% indicated rpm can be expected during water injection operation of an engine if the proper water-alcohol mixture is used. Normal throttle adjustments should be used to reduce rpm or EGT if these indications are exceeding proper limits but, because of individual throttle switches, an engine water injection operation may be stopped if rpm is reduced below approximately 96%. Water injection operation can be resumed by advancing the throttle and again holding the water injection system switch in START position until the red lights remain out. Slight variations in EGT readings may be encountered during takeoff roll and initial climb.

CAUTION

The acceleration of the airplane is increased considerably during the initial climb-out when using water injection, and it is necessary to increase the climbing attitude of the airplane slightly after takeoff to prevent exceeding the flap placard speed.

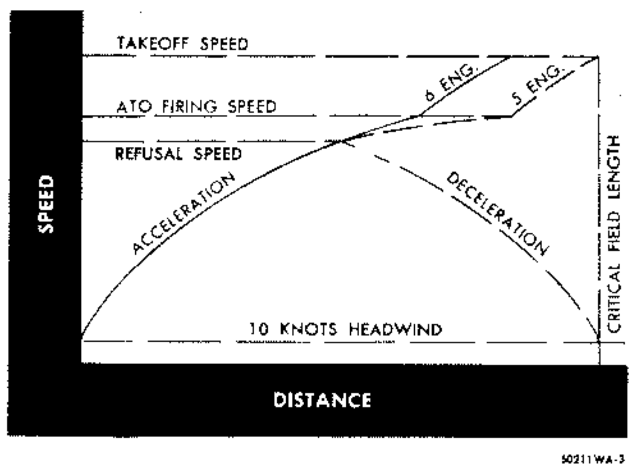
Because only three engines on one side of the airplane are supplied water from one tank, there is a possibility, during a normal water runout of water injection stopping on one side 3 or 4 seconds before it stops on the other side. This condition will produce a negligible amount of yaw, and does not present a control problem even under instrument conditions. It is not desirable to have water injection on one side of the airplane for a longer period of time than the other due to unbalanced thrust. When one side cuts out it is recommended that the water injection system switch be placed in STOP & DRAIN position. After the water supply is exhausted, the six "No Pressure" indicator lights should illuminate. The water injection system switch is then placed in STOP & DRAIN position. A thin stream of water-alcohol mixture, coming from each engine and manifold drain, can be seen aft of the wing trailing edge for approximately 3 minutes if a normal water runout has been made. The six "No Pressure" indicator lights may then be extinguished by placing the water injection arm switch in OFF position.

TAKEOFF — ATO

NOTE

The techniques as outlined herein are those required to produce the results illustrated in the operating data charts of the appendix.

The recommended procedure is to fire the ATO approximately 10 seconds before takeoff since ATO thrust for a short time after takeoff is very desirable. This gives somewhat higher ground run distances but permits partial retraction of the gear to decrease drag in the event an engine fails during takeoff. For minimum ground run, the rockets should be fired 15 seconds before takeoff so they expire just as the airplane takes off. In tactical operation, it may be desirable to use only the number of ATO bottles required for safe takeoff operation. The appendix contains charts for this purpose. The consideration of engine failure during takeoff is equally important when using ATO. As in the no-ATO case, the pilot should be able to stop or take off in the event of engine failure during the takeoff run. If an engine fails before refusal speed is reached, the airplane can be stopped in the remaining runway distance. If failure occurs above refusal speed, takeoff must be continued with one engine out and the rockets fired at the recommended firing speed which is the same whether or not an engine fails. This is shown in the following chart.



Refer to parts 2 and 3 of the appendix for recommended firing speeds, charts illustrating takeoff distances with ATO, NO ATO, and refusal speeds. If more than the minimum required number of ATO rockets are used, the firing speed should remain the same.

CAUTION

- If external ATO rack cannot be jettisoned, discontinue the mission since flight with external ATO rack installed will appreciably reduce range. See section III for emergency landing with external ATO rack.
- In making ATO takeoffs, particular care must be taken to maintain sufficient airspeed at all times. Airplane climb angle should be decreased slightly before termination of ATO thrust to prevent excessive loss of airspeed.

NOTE

External ATO racks should be jettisoned as soon as possible after rockets have been exhausted since the drag imposed by the external equipment will appreciably affect the airspeed and performance. Type of terrain must be considered, making sure to avoid populated areas before jettisoning the racks.

TAKEOFF — FLAP TECHNIQUE

CAUTION

When operating the wing flaps at low temperatures, the flap position indicator should be closely observed for positive movement. If the flaps should stall, immediately place the flap lever in OFF position to prevent damage to the motor.

Minimum takeoff distance is attained with flaps fully extended throughout the takeoff run. This increases the lift and consequently shortens the ground roll; also, it improves the lateral control since the flaperons are effective only when the flaps are fully extended and aileron surface power controls are operating. Lowering the flaps during the roll instead of at the start, as is sometimes done to achieve more rapid acceleration, is of no benefit because of the low drag characteristics of the flaps. Flaps are more important on this airplane than on previous airplanes; therefore, full extension is always used for takeoff and no partial flap positions are recommended. On takeoff, the flap retraction time (approximately 40 seconds) is slow enough so that airplane acceleration will keep the speed well above the stall point; also, as a rule, the flaps retract fast enough so that the flap structural speed is never reached. However, it is entirely possible under certain conditions for the airplane to accelerate to speeds above the flap structural limit during flap retraction. Under these conditions the best procedure is to establish a rate of climb which is high enough to prevent the airplane from accelerating to speeds above the flap structural limit. This practice of soaking up surplus power after takeoff by varying the rate of climb is feasible since there is seldom a ceiling on initial climb-out altitude.

NOTE

On some airplanes*, the elevator trim mechanism is coordinated with the flaps to automatically compensate for trim changes during the flap transition; while on other airplanes**, nose up elevator trim has to be introduced manually during flap retraction to compensate for the trim changes. The flap structural limit speeds and the speed changes during flap operation in level flight are shown in figure 5-1A. The flap retraction curves are for takeoff power with gear up. Loss of one engine or failure of the gear to retract will reduce acceleration but not sufficiently to cause a stall.

CAUTION

During operation at low gross weights and particularly at low ambient temperatures, the airplane accelerates very rapidly and care should be taken so as not to exceed the speed limitations during flap retraction.

* AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247
** AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -201, -248 & on

TAKEOFF & INITIAL CLIMB

TAKEOFF DATA

CRITICAL FIELD LENGTH ________ TO DIST ______
MIN ATO REQ ________ ELEVATOR SET ______

LINE .... IAS ____
REFUSAL SPEED .... IAS ____
FIRE ATO .... IAS ____
TAKEOFF .... IAS ____
CLIMB .... IAS ____

CONDITIONS

GW ________ FLD PA ______
RUNWAY LENGTH ________ OAT ______
LINE DIST ________ % MAC ______

LANDING DATA

STOP DIST ________

START FINAL .... IAS ____
BEST FLARE .... IAS ____

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1. Copilot Calls Line Speed, Refusal Speed, ATO Firing Speed & Takeoff Speed
   At 70 knots pilot and copilot cross-check their indicated airspeeds. Copilot calls off each speed giving the pilot approximately 10 knots warning. Example: "Line speed ____ knots - ready, ready, now." The word "now" will be given as the actual speed is reached. Pilot will check his position in relation to the line and will check airspeed to decide whether to stop or go.

2. GEAR UP - gear up
   As soon as the airplane is definitely airborne, pilot notifies copilot to retract the gear. Copilot places landing gear lever to UP on pilot's command.

CAUTION

- If the landing gear position indicators show any of the gear in an intermediate position the airplane should be flown at speeds below 215 knots IAS until a complete gear-up indication is obtained. If recycling of the gear fails to obtain a gear-up indication the flight should be discontinued since the landing gear doors may be unlatched and a hazardous flight condition may result at higher airspeeds.

- (1)► If landing gear doors remain open in flight for extended periods of time, such as during training flight, the buffeting encountered will cause cracking of the bulkhead skin at the rear of the aft landing gear compartment.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2367

TAKEOFF & INITIAL CLIMB

(CONTINUED)

①► NOTE

Automatic brake application is retarded if pilot applies a restraining force at the heel of the rudder pedals. For this reason, such a restraining force should not be applied.

3. FLAPS UP - flaps up
   At approximately 15 knots IAS above takeoff speed, pilot notifies copilot to retract flaps. On pilot's command, copilot places flap lever in UP position and keeps hand on flap lever until it is returned to OFF.

NOTE

- Do not retract flaps above 50% until the landing gear is full up.
- Be sure the flaps are fully retracted prior to establishing climb speed to avoid damage to the flaps and flap mechanism.
- ②► During flap retraction, nose up elevator trim has to be introduced to compensate for the trim changes which occur during flap transition.

③► 4. External ATO Rack - jettisoned
   As soon as ATO rockets are exhausted and the airplane is clear of any populated area, the copilot jettisons the external ATO rack.

5. Gear & Flaps - levers off
   Copilot checks gear and flap indicators to assure all four gears and flaps are up. Then places gear and flap levers OFF.

6. Climb Speed - CLIMB POWER SET
   As best climb speed is reached, pilot sets climb power.

④► 7. Water Injection - As Required
   If water injection was used for takeoff, pilot lifts switch and places water injection system switch in STOP & DRAIN when water supply becomes exhausted as indicated by illumination of the six indicator lights. After system has drained, place water injection switch in OFF and the arm switch in OFF.

(CONTINUED ON NEXT PAGE)

①► AF 51-15804 thru -15812, 52-019 thru -025, -202 thru -207
②► AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -201, -248 & on
③► AF 51-2192 thru -2356, 52-089 thru -201, -293 & on
④► AF 51-2192 thru -2356, 52-152 thru -201, -322 & on

TAKEOFF & INITIAL CLIMB

(CONTINUED)

8. Guns to Warmup & Standby - checked
   Copilot places power selector switch in WARMUP for at least 10 minutes, then to STANDBY for 20 minutes prior to firing. Radar adjustments may be started after 5 minutes in STANDBY.

9. Oxygen - As Required
   If 100% OXYGEN was used throughout takeoff because of cockpit contamination, crew members should move diluter lever to NORMAL OXYGEN as soon as contamination is gone.

WARNING

The oxygen regulator diluter levers must be returned to NORMAL OXYGEN as soon as possible because the use of 100% OXYGEN throughout a long mission will so deplete the oxygen supply as to be hazardous to the crew.

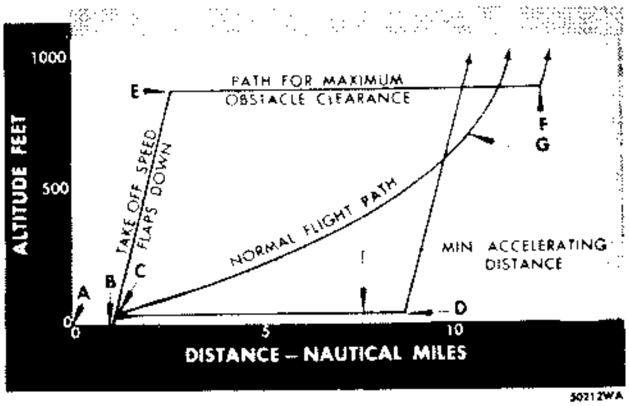
10. Crew Station Check - Crew Reports (10,000 feet & level off)
    At 10,000 feet and level off, the copilot calls for a station check. Crew members reply as follows:
    a. Extra Crew Member
       - Pressure____pounds
       - Regulator NORMAL
       - On (or Off) oxygen
    b. Observer
       - Pressure____pounds
       - Blinker operating
       - True airspeed____knots
    c. Copilot
       - Left wing & engines checked
       - Pressure____pounds
       - Blinker operating
       - Flight instruments checked, airspeed____knots, altitude____feet
       - Inverter voltages checked
       - Alternator voltages checked
       - Generator loads checked
       - Hydraulic pressure & quantity checked
       - Circuit breakers in
       - Right wing, engines & empennage checked
    d. Pilot (transfers control of airplane to copilot or monitors automatic pilot)
       - Pressure____pounds
       - Blinker operating
       - Oxygen warning indicators checked
       - Flight instruments checked, airspeed____knots, altitude____feet
       - Engine instruments checked
       - OAT____degrees
       - Cabin altitude____feet
       - Power controls on, lights out
       - Fuel panel set as needed, lights out

AFTER TAKEOFF

NOTE

Whenever a change of crew positions is necessary, climb to a safe altitude and area before the change is made. Change of seats will not be made with only two pilots aboard the airplane.

Flight procedure immediately after takeoff will depend primarily on local terrain and operating conditions. Limiting techniques prior to attaining the optimum rate of climb speed are illustrated below. The difference in the amounts of fuel and time involved in reaching a 1000-foot altitude is so small that it is not a determining factor in the choice of flight paths.



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A - Start takeoff roll at takeoff rated rpm, flaps 100%.
B - Takeoff point. Start gear retraction for all conditions.
C - Minimum desired altitude for path CD Start flap retraction if path CD is being used.
D, F, G - Point at which optimum rate of climb speed is obtained. Optimum climbing speeds are given in the Appendix.
E - Maximum desired altitude for clearing obstacle. Path CE should be at or above takeoff speed with flaps fully extended. Start flap retraction at point E.

NORMAL FLIGHT PATH

Assuming no high obstacles, this path is the one that will most generally be used by pilots as it provides a reasonable altitude for turns and maneuvers as well as a fairly rapid acceleration. The gear should be retracted immediately after takeoff, and flap retraction should begin as soon as possible. With no initial climb, the flap retraction time is such that the airspeed will remain well above the stall and below the structural limit. With an initial climb, a slight delay in retracting the flaps will maintain this margin above the stall, the amount of delay being determined by the steepness of the climb. A good procedure is to allow the airplane to accelerate approximately 15 knots in a slight climb before starting flap retraction. Any prolonged delay without an accompanying steepening of the climb angle may result in exceeding flap structural limits.

MINIMUM ACCELERATING DISTANCE

NOTE

This is not a normal or recommended procedure and is to be used only under special conditions.

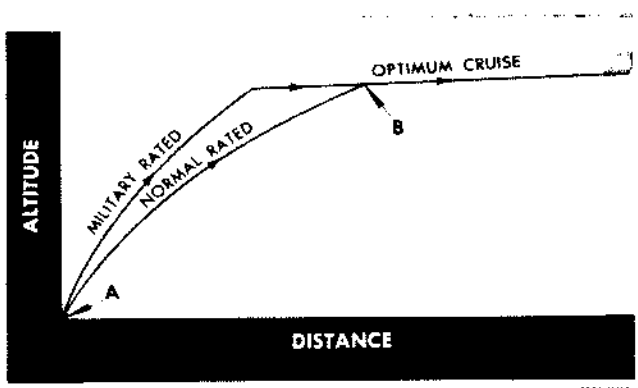
When the pilot desires to maintain a minimum altitude above the ground in order to accelerate to climb speed as quickly as possible, both the gear and flaps should be retracted immediately after takeoff. Care must be exercised not to exceed the structural limits of the flaps. The limiting speeds with flaps extended are shown on figure 5-1A.

MAXIMUM OBSTACLE CLEARANCE

When it is necessary to clear an obstacle in a short distance, the gear should be retracted immediately after takeoff, with the climb from C to E in the previous chart at not less than takeoff speed to prevent stalling and to provide a reasonable margin of lift for maneuverability. For the same reason, flap retraction should not begin until point E is reached.

CLIMB

Either military rated or normal rated rpm may be used for climb. Full climb data is presented in part 5 of the appendix. Varying speeds ±10 knots from the optimum will not materially affect performance. Referring to the following sketch, the fuel consumption and time from point A to point B are only slightly less for a climb at military rated than at normal rated rpm. The differences for a climb to the optimum cruising altitude are approximately 500 pounds of fuel and 1 minute. Full anti-icing during a climb at military rated rpm may overheat the airplane structure. Climbs at less than normal rated rpm will result in a loss of range because of the excessive time spent in climbing.



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FLIGHT CHARACTERISTICS

Refer to section VI for information regarding flight characteristics.

SYSTEMS OPERATION

Refer to section VII for information regarding systems operation.

BEFORE DESCENT

1. Radio Call - COMPLETED, ALTIMETER SET - altimeter set - *altimeter set*
   Pilot calls control tower for landing information, instructions, and altimeter setting. Pilot notifies crew of altimeter setting. Crew confirms.

2. Safety Belt & Shoulder Harness - FASTENED - fastened - *fastened*
   Crew adjusts and fastens safety belts and shoulder harnesses. Checks inertia reel levers in UNLOCK position. Copilot checks his seat in normal sitting position.

3. Bombsight Retractable Cover - *closed*
   Observer checks bombsight retractable cover fully closed.

(1)► 4. Engine Stall Prevention Switch - AS REQUIRED
   Pilot places engine stall prevention switch ON when passing through 10,000-foot altitude if OAT is 15° C (59° F) or below.

5. Directional Damper - OFF
   Pilot checks directional damper switch OFF.

6. Temperature Rheostat - ADJUSTED
   Pilot adjusts temperature control rheostat as required to minimize interior fogging.

7. Windshield Anti-Ice & Defrost - SET
   Pilot places windshield anti-ice switch in MAX HEAT in sufficient time prior to descent to prevent fogging or frosting of the windshield during descent. Pilot assures windshield defrost switch is ON and operating normally.

8. Steering Ratio Selector - TAKEOFF LAND DETENT
   Pilot checks steering ratio selector lever in TAKEOFF LAND detent.

9. Engine Screens - OPEN
   Pilot checks engine screen switch OPEN unless screens are inoperative.

10. Low Speed Warning Switch - ON
    Pilot checks low speed warning switch ON and switch guard closed.

11. Power Controls - ON, LIGHTS OUT
    Pilot checks rudder-elevator power control switch ON (or NORM) for airplanes without emergency elevator power control and NORMAL for airplanes with emergency elevator power control. Checks aileron power control switches ON (or NORM) and all panel lights out.

12. Fuel Panel - SET, LIGHTS OUT
    Pilot checks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE. If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. Checks all fuel boost pressure warning lights out and transfers fuel quantity gage readings to copilot.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on

BEFORE DESCENT

(CONTINUED)

13. Landing Data Card Completed, Gross Weight ____, Best Flare Speed ____ Knots
    Copilot takes fuel quantity readings, computes airplane gross weight, determines best flare speed, and completes landing data card. Calls pilot and gives "Gross weight ____ and best flare speed ____ knots." Pilot returns fuel quantity gage control to his panel.

BEST FLARE SPEEDS
80,000 - 115
85,000 - 119
90,000 - 122
95,000 - 125
100,000 - 128
105,000 - 131
110,000 - 134
115,000 - 137
120,000 - 140
125,000 - 143
130,000 - 146
135,000 - 149
140,000 - 151
145,000 - 154
150,000 - 156
160,000 - 161

14. Generators - checked
    Copilot checks that generator loads are approximately equal by comparing loadmeter readings.

15. Circuit Breakers - checked
    Copilot checks all circuit breakers on DC power panels to insure all are in and none have tripped.

16. Hydraulic Pressures & Quantity - checked
    Copilot checks hydraulic system pressures are within operating range, fluid quantity is up, and all lights are out. Checks emergency hydraulic pump switch in AUTO NORMAL.

17. Landing Gear Lever - DOWN, FOUR DOWN - four down, four green
    Pilot reduces airspeed below 305 knots IAS and extends landing gear by moving gear lever to DOWN. Checks landing gear position indicators showing four wheels down and locked. Leaves landing gear lever DOWN. Copilot checks lever down, indicators showing four wheels down and locked, and four green lights illuminated on ELGE stand.

18. Antiskid - ON, LIGHT OUT
    Pilot checks antiskid switch ON and amber light out. Checks push-to-test indicator to ensure bulb is operative.

(1)► **CAUTION**

If alternators are required for anti-icing or "K" equipment, maintain engines No. 1 and 6 at 52% rpm or more until alternator power is no longer required.

DESCENT

The high cruising altitude near the end of the mission can be converted into a small range extension by correct descent procedure. The general rule to follow is to AVOID EARLY DESCENT. Since jet engine fuel consumption is excessive at low altitude, even at idling rpm, a premature descent will result in a loss in range. Descent performance is presented in part 8 of the appendix.

WARNING

Crew members should cross-check altimeter readings frequently during descent to prevent misreading of altitudes.

(1)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

NORMAL DESCENT — GEAR DOWN

This is the recommended procedure for all letdowns where there is no range emergency.

a. Reduce speed to 305 knots IAS and actuate landing gear lever to lower landing gear.

b. Retard all throttles to the idle stop. The regulators will govern minimum rpm to prevent burner blowout. Sufficient generator output will be available for normal electrical loads during descent.

CAUTION

- When retarding throttles, the pulling motion should follow an arc to match the contour of the control stand as it has been found possible to inadvertently retard the throttles past the idle position into CUTOFF by pulling the throttles in a horizontal plane.

(1)

- Before reducing power on engines No. 1 and 6 below 52% rpm, turn off all equipment using alternator power and turn off both alternators. If alternator power is required for Nesa windshield or "K" system operation, maintain engines No. 1 and 6 at 52% rpm or more.

c. Above 31,000 feet, the descent is made at Mach .81, the practical limit to avoid buffeting with the gear down. Below 31,000 feet, the descent is made at 305 knots IAS, which is the gear down structural limit. Using the above procedure results in the following:

- Maximum rate of descent
- Shortest distance during descent
- Minimum fuel consumption during descent.

ALTERNATE DESCENT PROCEDURE — GEAR UP

a. Maintain cruising altitude until about 350 nautical miles from the landing base.

b. Cut engines No. 2 and 5 and retard the other throttles to the minimum idle stop.

CAUTION

- When retarding throttles, the pulling motion should follow an arc to match the contour of the control stand as it has been found possible to inadvertently retard the throttles past the idle position into CUTOFF by pulling the throttles in a horizontal plane.

(1)

- Before reducing power on engines No. 1 and 6 below 52% rpm, turn off all equipment using alternator power and turn off both alternators. If alternator power is required for Nesa windshield or "K" system operation, maintain engines No. 1 and 6 at 52% rpm or more.

c. Descend at 185 knots IAS to about 10,000-foot altitude.

d. Restart the two engines at about 10,000 feet, lower the gear and continue the descent at 305 knots IAS with all six engines idling.

The alternate descent gives:

- Minimum rate of descent
- Maximum time of descent
- High fuel consumption and descent distance because of the long time involved
- Approximately the same fuel reserve if two engines are cut as the normal descent

BEFORE LANDING

NOTE

During approaches for landings, including instrument approaches, the pilot assisting in the landing will monitor the airspeed, altimeter, attitude gyro, and rate of climb indicators and visually check the terrain in order to insure immediate recognition of a dangerous condition. In addition, he will advise the pilot making the approach and landing whenever the angle of bank exceeds 30°, the airspeed falls below the computed airspeeds, or whenever visual and altimeter cross-check indicates the airplane is dangerously low to the ground or obstructions.

1. Guns - stowed 45° up
   Copilot stows guns 45° up and 180° azimuth.

NOTE

With the guns stowed in the 45° up position, the "Warning - Turret Not Stowed" light will illuminate when the landing gear is down and locked.

(CONTINUED ON NEXT PAGE)

(1) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

BEFORE LANDING

(CONTINUED)

2. Landing Gear - FOUR DOWN, LEVER DOWN - four down, four green
   Pilot and copilot make the following checks where applicable to their stations:
   a. Landing gear lever DOWN and landing gear lever red light off.
   b. Landing gear position indicators show gear down and locked.
   c. The four green gear-down-and-locked lights on the ELGE stand are illuminated.
   d. The red unsafe-to-land light on the ELGE stand is out.

   Should there be no indication that the forward main gear is in the full-down and locked position a visual inspection should be made by looking through the heat access panel on the inboard side of the crawlway to assure the gear down limit switches are in contact with the striker. Refer to "Visual Inspection of Forward Main Landing Gear" in section III.

3. Flaps - FULL DOWN
   Pilot reduces speed to 230 knots IAS and requests copilot to extend flaps to 50%. When speed is reduced to 195 knots IAS, pilot requests copilot to extend flaps to 100%. Copilot keeps hand on flap lever during extension until lever is returned to OFF.

   ①► NOTE

   During flap extension, nose down trim has to be introduced to compensate for the trim changes which occur during flap transition.

4. Fuel Panel - SET, LIGHTS OUT
   Pilot rechecks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE. If any one main tank has 4000 pounds or less, pilot will place all fuel selector switches to TME. Checks all fuel boost pressure warning lights out and transfers fuel quantity gage readings to copilot.

5. Landing Data Card - checked & complete, best flare speed_____knots
   Copilot recomputes gross weight and data card information, then relays to pilot pertinent data on best flare speed and stopping distance.

6. Steering, Braking & Hydraulic System - checked
   Copilot checks hydraulic system pressures within operating range, fluid quantity up, and all lights out. Checks steering by alternately depressing left and right rudder pedals to actuate steering system. Steering action is indicated by a momentary drop in the main hydraulic system pressure of approximately 300 to 500 psi. Checks brake action by depressing brake pedals; the main brake system pressure should momentarily drop 100 to 150 psi.

7. Radar, Alternators & Automatic Pilot - AS REQUIRED - as required - ***as required***
   Pilot checks automatic pilot master switch OFF, automatic approach switch in AUTOMATIC PILOT, and stows automatic pilot control panel unless automatic approach is to be made. Pilot checks omni-range and glide path off unless instrument approach is to be made.

   ②► Copilot checks with observer that "K" system is turned off before turning alternators off. Copilot turns alternators OFF unless power is needed.

   ②► NOTE

   If units requiring alternator power are to be used, engines No. 1 and 6 must be operated at a minimum of 52%.

(CONTINUED ON NEXT PAGE)

①► AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -201, -248 & on

②► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

BEFORE LANDING

(CONTINUED)

①► 8. Engine Stall Prevention Switch - AS REQUIRED
Pilot rechecks engine stall prevention switch. If OAT is below 15° C (59° F), switch should be placed ON.

WARNING

If engine stall prevention switch is ON for landing and OAT is above 15° C (59° F), the longer acceleration time is such that go-around may be marginal.

②► 9. Approach Chute - as required
If approach chute is to be used, pilot requests copilot to deploy the approach chute at a speed not to exceed 195 knots IAS on the downwind leg.

10. Airspeed & Altimeters - ____knots, ____feet - ____KNOTS, ____FEET
Copilot and pilot check and compare simultaneous readings of airspeed and altitude.

APPROACH AND LANDING

Although the airplane is not a difficult airplane to land, it does have some characteristics that differ from piston engine aircraft and it is essential that the pilot of the airplane have a thorough knowledge of these characteristics in order to be able to accomplish landings with the greatest degree of precision and safety under all runway and weather conditions. Flight experience to date has yielded the following recommended results as stated in the landing charts in the appendix.

PATTERN

A normal landing pattern can be used provided the high-speed, slow deceleration, and relatively flat gliding angles of the airplane are taken into consideration. In a normal takeoff and landing, a stall warning will never be encountered. However, it should be kept in mind that the speed margin above first stall warning will be considerably less than with many earlier type airplanes. Therefore, large scale corrective maneuvering should be avoided during the final stages of the approach, as excessive altitude loss will result if stall is induced at that time. IAS at which stall is induced increases very rapidly above bank angles of 25° to 35°. Figure 2-9 clearly shows the tendency of the stall curves as the angle of bank is increased. Also the load factor in "g's" for various angles of bank during coordinated turns or pullups is given. The flap down structural limit represents the maximum angle of bank at the various gross weights which will not exceed the flaps down structural limitation. A desirable approach pattern for normal conditions is shown on figure 2-12. Modification may be required to meet individual requirements. The normal approach (figure 2-12) avoids large or sudden changes of power and should be flown by gradually decreasing rpm, airspeed, and altitude from the downwind leg to the runway. Maintain approximately 30 knots above the best flare speed on the downwind leg (minimum of 150 knots IAS). The airspeed should be gradually decreased in a continuous 20° to 25° banked turn by reducing power so that, as the airplane rolls out on the final approach, the airspeed will be 15 knots above the flare speed. From this point, a gradual reduction, or "bleed off," of airspeed should be made so that the airplane is at best flare speed when final rotation to the touchdown attitude is started.

①► AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on
②► AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

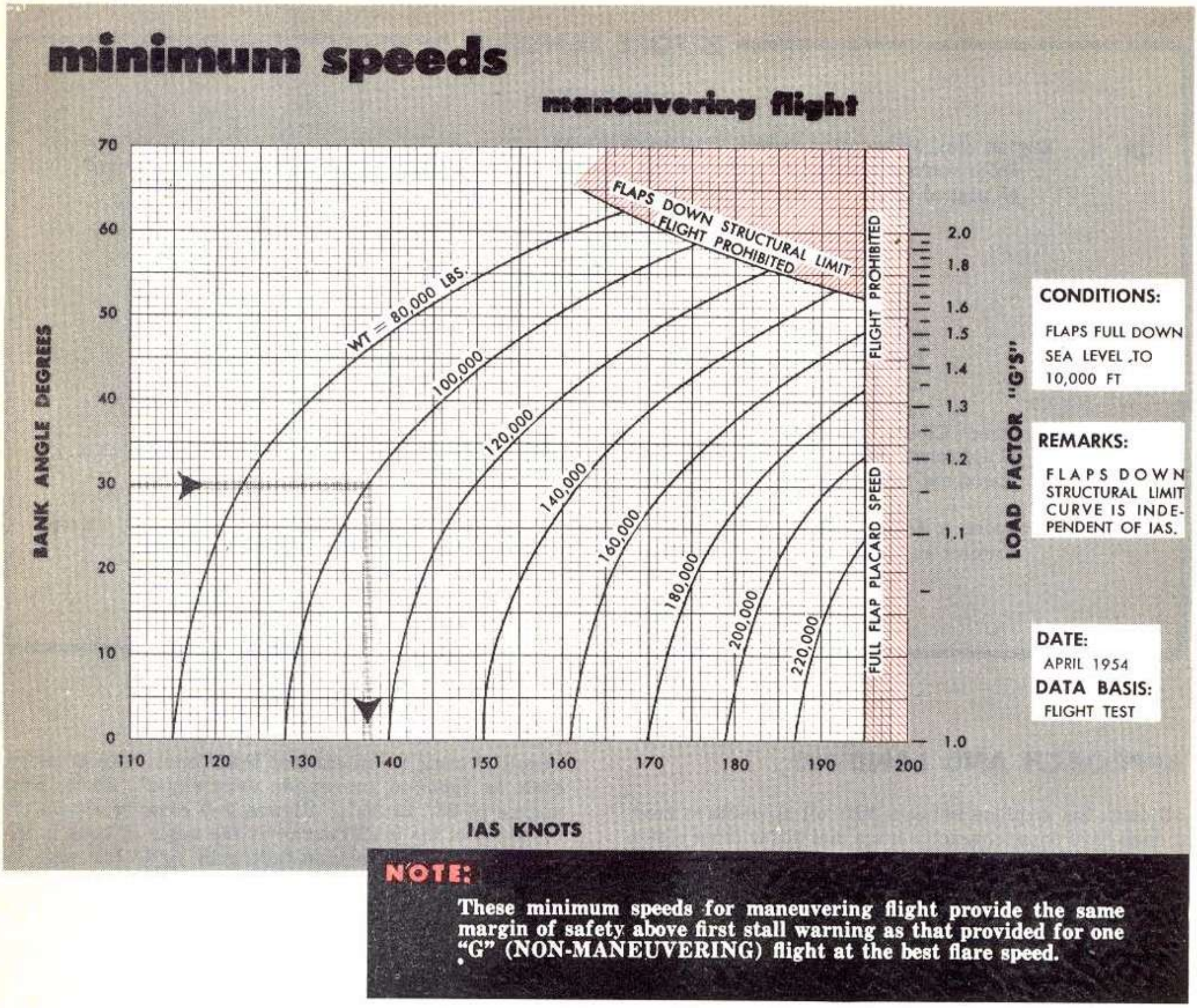


Figure 2-9.

APPROACH SPEEDS

In time past, approach speeds for heavy transport and bomber-type aircraft have been in the order of 30% above stall speed. Example: Stall speed, 100 knots; approach speed would be 130 knots, giving a 30-knot margin to take care of maneuver loads, error in instrument readings, etc. Because of the high drag, rapid change of airspeed with change of attitude, and the steep approach angles, such a margin was desirable and was quickly dissipated during the flare. This airplane has very low drag, does not change airspeed rapidly with slight changes of attitude, and has a flat glide path calling for only slight flare at the end of approach. Consequently, such a wide spread between stall speed and flare speed is not only undesirable because of the long float required to dissipate excess speed, but under normal conditions is not necessary.

An ideal approach for airplane to a short runway in smooth air would place speed approximately 6 knots above a stall. This is "touchdown speed." Example: Gross weight, 100,000 pounds; first stall warning, 114 knots; touchdown speed, 120 knots; and margin above first stall warning, 6 knots. This touchdown speed will place the airplane in simultaneous touchdown attitude if sufficient power is retained to give zero rate of descent. Although the airplane flies extremely well and has adequate control response at speeds 6 knots above first stall warning, such approach speeds leave little margin to compensate for permissible instrument and fuel gage tolerances, unreported small gusts, and maneuver loads. (An acceleration of 1/10 "g" would increase the stall speed of a 10,000-pound airplane by 6 knots.) Consequently, use of this touchdown speed is not considered desirable except in an extreme condition requiring touchdown on the first few feet of runway. When this is necessary, the airplane may first be stalled at 15,000 feet, gear and flaps down, as a check of the accuracy of airspeed and fuel quantity gage indications. ***Speed should not be reduced to touchdown until reaching the runway threshold at an altitude not to exceed 5 or 6 feet.*** Adding 8 knots to the touchdown speed will give a spread of 13 to 15 knots above first stall warning and is considered "best flare" speed because it provides a safe margin for the airplane under normal approach and landing conditions without resulting in excessive float for runways on which the airplane is normally landed. However, this margin may not be adequate for surface conditions which produce sudden accelerations on the airplane. Accelerations of this kind may result from "thermals" or "jet wash" close to the ground, as well as from gusty wind conditions regardless of wind direction. When gusty winds exist, a correction factor should be added to best flare speed to compensate for maneuver loads which the pilot may impose on the airplane while correcting for gusts. The gust correction factor is determined by taking two-thirds of the reported gust velocity, that is, two-thirds of the amount the wind is gusting over the constant wind. For example, if the wind is reported as 30 knots with gusts to 42 knots, the gust velocity would be 12 knots. Two-thirds of 12 is 8, which is the gust correction in knots that should be added to best flare speed. The maximum gust correction that should be added is 15 knots. The procedure for using gust correction is as follows: Fly the traffic pattern at the recommended airspeeds, adding 30 knots to best flare speed for the downwind leg with a gradual reduction to best flare speed plus 15 knots at the start of the final approach. From that point, however, "bleed off" only enough airspeed so the airplane is at best flare speed plus the gust correction when final rotation to the touchdown attitude is started. Gust correction, therefore, is introduced only on the final approach and is not applied throughout the landing pattern.

NOTE

Use of a correction factor for gusts or other accelerations which may affect the airplane should be undertaken with consideration of all the factors involved. If a correction is required to compensate for a given gust velocity, the value of the correction must be the same regardless of wind direction. This is true because the objective is to provide a safety margin for maneuver loads while flying the airplane through a series of accelerations. The accelerations can be equally severe whether they are produced by headwind, crosswind, or tailwind. However, since a pilot cannot estimate the frequency or timing of gusts with practical accuracy, it is possible for the airplane to arrive at the flare point with gust correction added during an interval when gusts have stopped momentarily. Under such conditions, the distance consumed dissipating excess airspeed could move the touchdown point further down the runway than planned. Therefore, whenever a correction factor is added for gusts or other accelerations, the pilot must be prepared to accept a corresponding higher flare speed with the possibility of increased landing distance. If stopping distance available beyond the maximum estimated touchdown point is marginal, the pilot should select a longer runway or proceed to an alternate base.

ENGINE POWER SETTINGS

When approaching with a piston-engine airplane with the throttles at idle, almost instant acceleration is available when needed in an emergency. Probably all pilots have had the experience of "flying" an airplane through unexpected down drafts, gusts, or an approaching stall by an immediate application of power. However, the J47 engines used on this airplane have very slow acceleration characteristics when at idle, requiring from 12 to 20 seconds to accelerate from idle to 100%. This is obviously too much time to effect recovery from an approaching stall at low altitude. Most of the time required for acceleration is from idle to 60%, but from idle to 55%, there is little gain in thrust. However, from 55% on, there is a very considerable increase in thrust for each slight increase in rpm. Necessary power reductions to correct for a high or fast condition should be accomplished during the first part of final while still above 200 feet.

CAUTION (1)

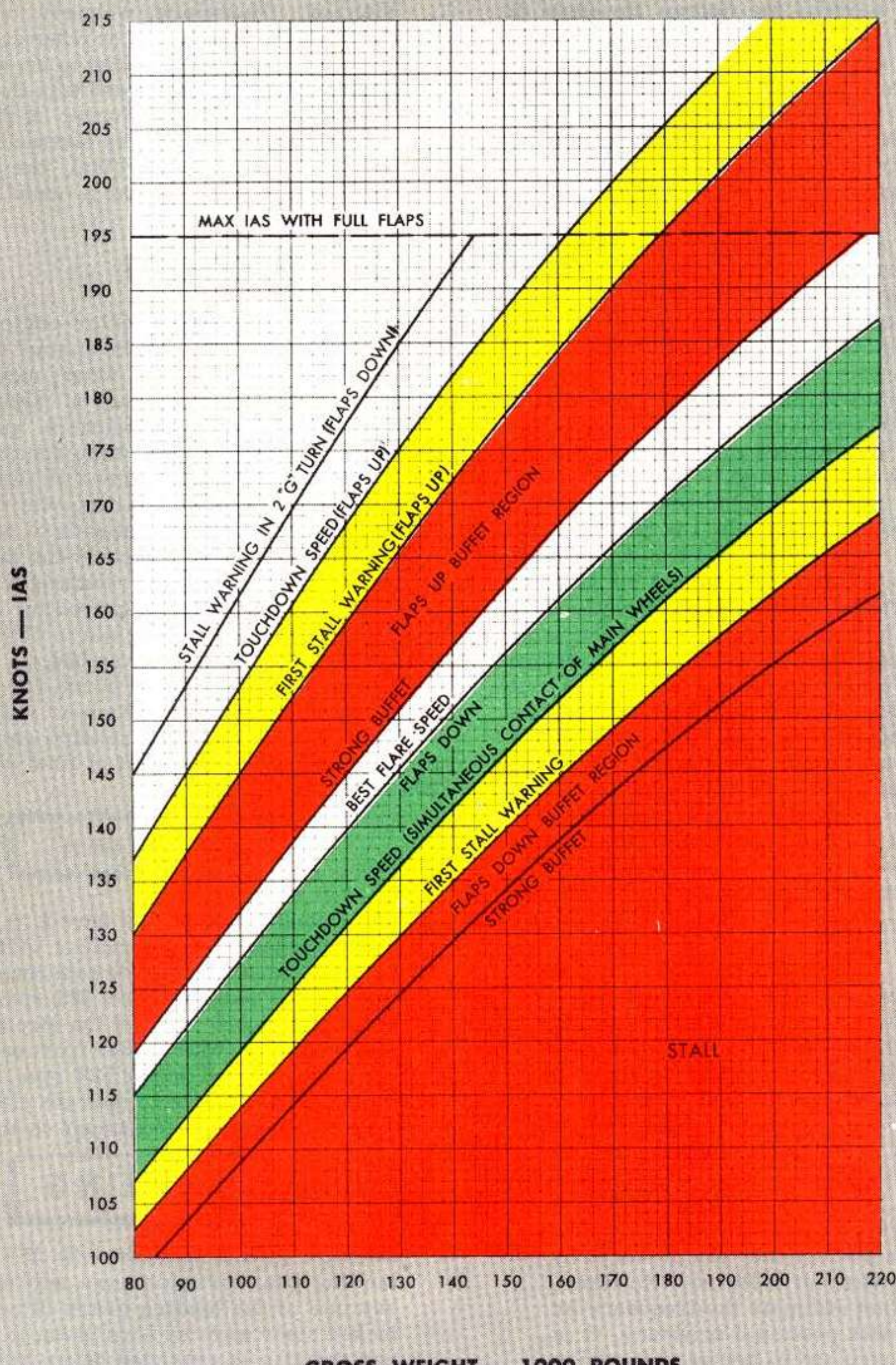
On airplanes which do not have T.O. 1B-47-333 accomplished, if an instrument approach is being executed using the glide path receiver, power must not be reduced below 52% rpm on engines No. 1 and 6 until flight of the airplane is taken over visually. When power from engines No. 1 and 6 is reduced below 52% rpm, alternator power is inadequate to operate glide path receiver and may cause damage to equipment.

WARNING (2)

During a normal approach with 55% power, the landing gear warning horn may not sound if any one of the landing gears is not down and locked since warning horn is set to sound when any throttle is retarded below 50% rpm with gear up.

(1) AF 51-2357 thru 52-111, -202 thru -292
(2) AF 51-2357 thru -7077, -15804 thru -15812, 52-019 thru -041, -202 thru -223

minimum speeds
non-maneuvering flight—one "G" load factor



DATE DECEMBER 1952
DATA BASIS: FLIGHT TEST
CONDITIONS: SEA LEVEL TO 10,000 FT

50220WC

Figure 2-10

Gliding with a minimum of 55% power will result in a flat approach which is also favorable inasmuch as considerably less rotation of the airplane is required to complete the flare since the flat approach attitude is nearer the landing attitude.

NOTE

Because of the comparatively light elevator control forces, it is possible to impose sizeable accelerations on the airplane with minimum effort. An acceleration of 0.2 "g" would increase the stall speed of a 100,000-pound airplane by 12 knots. Therefore, when trimmed for low speed flight, care must be taken not to attempt abrupt flares or pullups in order to prevent accelerated stalls. Special care must be exercised during night landings to avoid rapid elevator motions since under some circumstances the ground suddenly appears to be much closer than it did a moment before and can result in a startled reaction of pulling up elevator.

If the airspeed is too high and the landing appears to be too long, decide on a go-around before decreasing the engine rpm below 55%. A speed of 10 knots IAS too high will increase the required runway length by approximately 1700 feet.

CAUTION

If power is reduced below 55% rpm at altitudes under 150 feet and a go-around is decided upon, the airplane may still touch the runway even though power is increased immediately.

ROLL DUE TO YAW

Although most aircraft exhibit a certain degree of roll as a result of yaw, this tendency is much more pronounced in this airplane due to its swept wing design. Because of the geometry of this wing design, airflow over the advancing wing during a yawed condition becomes more chord-wise, resulting in increased lift for that wing, while flow over the retreating wing becomes more span-wise thus resulting in loss of lift and, at very low speeds, perhaps a stall for that wing. This characteristic will result in considerable unwanted roll if the rudder is overcontrolled. However, it also makes the rudder a very effective control for raising a low wing and, at speeds approaching the stall, it may be impossible to recover a dropping wing rapidly unless ample rudder is applied with aileron. Since rudder is a very effective lateral control at low speeds, good coordinated use of all controls is essential.

TOUCHDOWN

With the bicycle landing gear, the landing attitude of the airplane is fixed so that the speed for simultaneous touchdown of both gears is a safe margin above stall. The attitude is always the same at the touchdown speed corresponding to the actual landing gross weight. The front gear is well forward of the cg and if it is allowed to touch first, a bounce is almost certain to occur. This usually is the result of too much speed. The recommended touchdown is with the rear gear first about 3 knots below the touchdown speed. This allows an adequate flare and prevents a bounce. However, the airplane should not be held off too long, since drag is low next to the ground and the floating distance will be long. Also, if the front gear is too high when the rear gear touches, it will strike the ground hard and give an uncomfortably rough landing. Deployment of the brake chute or application of brakes prior to touchdown is not recommended. If the brake chute is deployed during the flare, while the airplane is still floating, there is a tendency for the airplane to drop in due to the rapid deceleration caused by the chute. Therefore, the chute should be deployed only on or after touchdown provided the airplane has decelerated below brake chute maximum deployment speed. Normally the pilot will deploy the brake chute. However, if the pilot decides that safety may be impaired by his attempting to deploy the chute, the copilot may deploy the chute upon prearranged signal from the pilot. If brakes are applied before the airplane has settled firmly on both main gears, subsequent "skip" or "bounce" can permit the antiskid system to apply brakes with wheels in the air and to contact the ground with "locked" wheels.

NORMAL LANDING RUN

All landings should be planned and conducted as though the brake chute were not installed. Use of the chute should be considered only as an aid to prevent excessive wear of brakes and tires. The deceleration effect of the brake chute drops off very rapidly as speed decreases. For most effective use, the chute should be fully open at touchdown or as soon as possible thereafter.

CAUTION

- Unmodified brake chutes should not be deployed at speeds above 115 knots IAS since chute failure may occur.
- Modified brake chutes should not be deployed at speeds above 160 knots IAS since failure of the attachment safety bolt may occur.
- For the type chute installed, consult the crew chief and DD Form 781.

NOTE

To insure proper deployment of brake chute, pull deployment handle with an even steady pull to the full extent of travel. Hold momentarily at end of travel.

For any landing, the runway length available beyond the planned touchdown point should be compared with "Stopping Distances - Brakes Only" in part 10 of the appendix. If the required stopping distance is longer than the runway available after touchdown, the safety of the landing is conditioned by reliance on the brake chute. Should the airplane float beyond the planned touchdown point, an unexpected reliance on the brake chute may be introduced at the last moment. If either situation develops, the pilot should start a go-around at once and should proceed to an alternate base with longer runways or initiate a new approach with special attention to correct approach speeds. If for any reason a landing requiring reliance on the brake chute becomes absolutely necessary, the procedure given in "Landing with Reliance on Brake Chute" in section III should be followed. In any landing situation, brakes should be applied by the pilot as needed to meet the demands of the prevailing conditions. With antiskid operating, brake application may be started as soon as the weight of the airplane has settled firmly on both main gears and the tendency to "skip" or "bounce" has been terminated. The load on the rear gear can be increased by applying slight back pressure to the control column. With antiskid operating, maximum braking is obtained by depressing and holding the pedals to maintain slow (2 or 3 seconds) cycling of the antiskid. This can be recognized by intermittent slight lurching of the airplane each time the antiskid system "releases" the brakes. Heavier pedal pressure will cause inefficient cycling of the antiskid or may cause pedal travel into the emergency braking range where antiskid protection is not provided. Either misuse will increase the distance required to stop. The only difference between conventional braking and antiskid operation is that antiskid allows brake application earlier in the landing roll and maximum braking can be maintained without excessive tire wear from skids. Nevertheless, the pilot must realize that skill in achieving proper cycling of the antiskid is essential if the shortest landing roll is to be obtained. Considering the operational runways normally available to the airplane, it is possible to reduce brake wear under favorable conditions by allowing the brake chute to slow the airplane and by applying brakes at a fairly low speed in the landing roll. However, this procedure should be employed only where sufficient stopping distance is available considering gross weight and other performance conditions of the situation. A reasonable compromise considering the runways available at most operating bases is a combination of brake chute deployed just below the maximum deployment speed and brakes applied at 40 knots. The speed of 40 knots is cited merely as a reference for controlling brake wear and does not restrict the pilot from applying brakes at higher speeds. Brakes may be applied consistently as high as 80 knots before significant wear will occur. If necessary, the pilot should not hesitate to apply the brakes above 80 knots as soon as the airplane has settled firmly on both main gears. Brake wear may be increased at the higher speed but proper use of antiskid will produce effective braking well within the capability of the system. Prior to using the procedure of brake chute plus brakes at 40 knots, the pilot should consult the "Normal Stopping Distances" chart in part 10 of the appendix and compare the stopping distance required with the actual runway length available and the length that will remain beyond the planned touchdown point. It must be emphasized that stopping distances required in a given situation should not be accepted merely because they are less than total runway available. In all cases, they should be compared to the runway which will remain beyond the planned touchdown point. If the planned touchdown point cannot be made good, the airplane should be taken around and reestablished on a correct approach. A minimum of 15 minutes should elapse between landings to allow enough time for cooling between brake applications when the landing gear is extended, while a minimum of 30 minutes should elapse between landings to allow enough time for cooling between brake applications when the landing gear is retracted. If a check of stopping distances indicates that adequate runway will be available, the normal landing roll with brake chute plus brakes at 40 knots will help to reduce brake wear. Whenever possible, the full length of runway available should be used. In many cases, it will be obvious to the pilot that the brake chute alone is sufficient to slow the airplane without brake application prior to turning off the runway. However, the pilot should never delay brake application under marginal conditions of weather, at night, or when sensory illusions impair his judgment of the runway remaining in front of the airplane. Brakes should be used soon enough to stop the airplane as desired and, except in an emergency, landings should not be attempted when it is known that the airplane cannot be stopped on the runway by the use of brakes only.

NOTE

Operation of auxiliary hydraulic equipment should be kept at a minimum during landing in order to reserve the full hydraulic system capacity for brakes and steering. Idle power must be kept on engines No. 3 and 4 to maintain hydraulic pressure.

CAUTION

Under no circumstances should the copilot aid the pilot on the brakes when adequate main system braking is available with normal effort nor should the brakes be applied by either the pilot or copilot placing their feet on the high side or top of the brake pedals as the additional pedal force can result in overriding the main system, activating the emergency system and locking the wheels.

MINIMUM LANDING RUN

Minimum landing run is obtained with antiskid operating by placing engines No. 1, 2, 5, and 6 in CUTOFF at touchdown and by deploying the brake chute as soon as the airplane has decelerated below the maximum deployment speed (115 knots IAS for unmodified chute; 160 knots IAS for modified chute). Brakes should be applied as soon as the airplane has settled firmly on both main gears and should be held to maintain optimum (2 or 3 seconds) cycling of antiskid throughout the landing roll. The load on the rear gear can be increased by applying a slight back pressure to the control column.

CHUTE GROUND HANDLING

It is recommended that the brake and approach chutes be jettisoned as soon as possible after turning off the active runway. Request a ground crew to stand by to retrieve the chutes as they are jettisoned, or jettison the chutes in a designated drop area as determined by local procedure. Excessive taxiing with the chutes deployed will cause undue wear. Jettison is accomplished by pulling the chute jettison handle through full travel. The copilot can check visually to insure that the chutes have detached.

CROSS WIND LANDING

Satisfactory crosswind landings can be accomplished in winds which have 90° crosswind components up to 25 knots (20 knots with approach chute deployed) provided proper technique is used. The curve in figure 2-11 shows wind angles and velocities relative to the runway which produce 90° crosswind components of 25 knots.

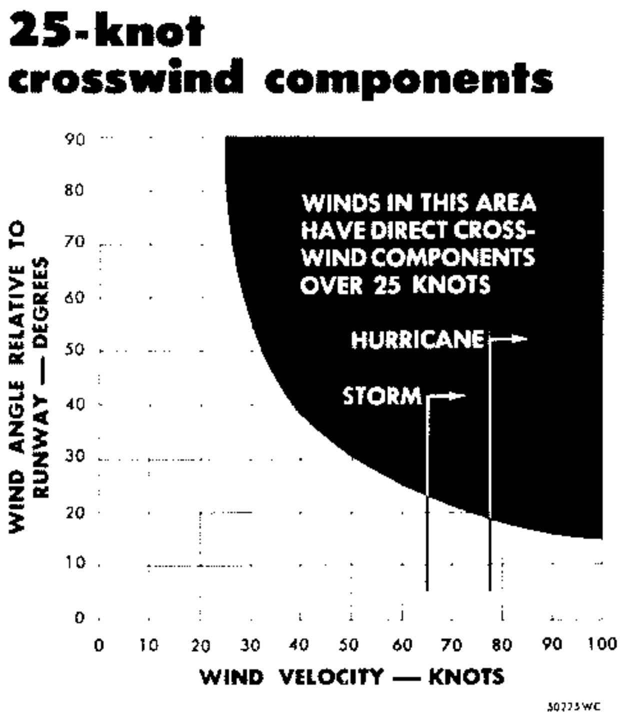


Figure 2-11.

In making crosswind landings, it is more desirable to utilize a crab condition rather than a slip condition on the final approach. To maintain proper track with a slip approach may require holding as much as 50% of available aileron and a considerable amount of rudder. This condition appreciably reduces the control available to compensate for gusts and turbulence. The crab angle established during the final approach should be modified to a wing low attitude just prior to touchdown. The upwind wing may be lowered slightly and the crab removed before touchdown. The maneuver from crab to slip at the same time of flare-out should be smooth and coordinated. Front-gear-first contact should be avoided since it will cause a hard bounce which may result in a stalled condition with the airplane out of control. This could be exceptionally serious in a crosswind. Touchdown should be accomplished in a normal landing attitude, but with the upwind wing lowered to assist in maintaining airplane track. Excessive slip is not normally required at this point to prevent drift. Touching an outrigger gear first is not serious because the outrigger shock struts are designed with unusually long strokes and are free-castering to facilitate the most severe crosswind landing conditions. Some airplanes* possess front gear steering authority of 12° right or left in TAKEOFF, LAND position, which is normally sufficient to afford crosswind steering control. Other airplanes** incorporate steering authority of only 6° right or left in the TAKEOFF, LAND position, which may not be adequate for full steering control in a strong crosswind. If it appears after touchdown with either type steering that a greater range of front gear deflection is required, the steering ratio selector may be moved to TAXI position immediately after the weight of the airplane has settled onto both main gears.

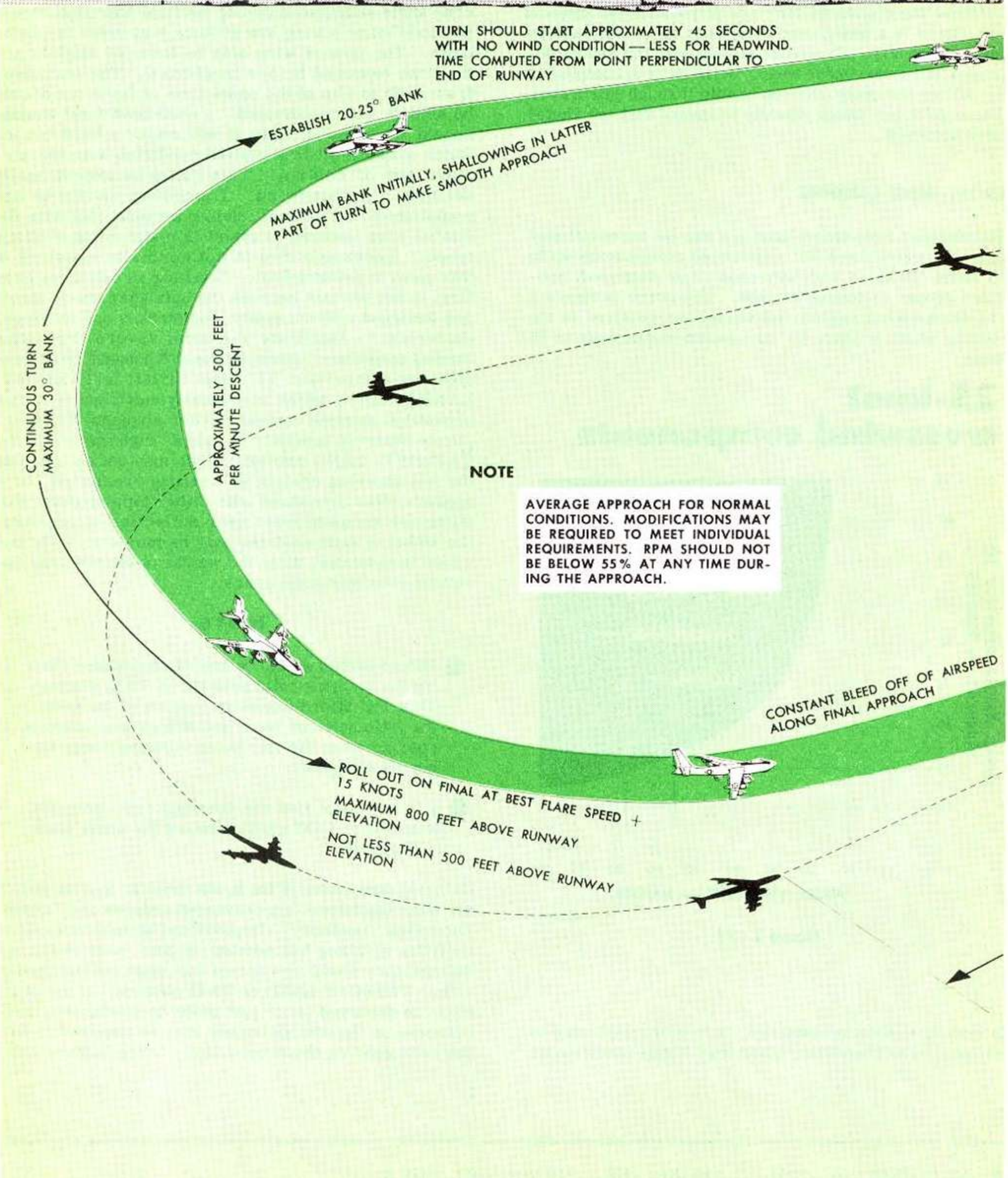
NOTE

- Rudder pedals should be neutralized before moving the steering ratio selector to TAXI position. This will afford easier movement of the steering ratio selector lever and will prevent sudden veering when the increased steering range becomes effective.
- It is essential that the steering ratio selector be moved to TAXI position before the brake chute is deployed.

Delaying deployment of the brake chute as long as possible after touchdown in a crosswind reduces any "weathercocking" tendency. Deployment should be delayed until the airplane has settled on both main gears and satisfactory steering control has been established in either TAKEOFF LAND or TAXI position. If the brake chute is deployed on or just prior to touchdown, back pressure on the control column may be required to hold the rear gear on the ground early in the landing roll.

* AF 51-2192 thru -2356, 52-112 thru -201, -312 thru -393, -479 & on
** AF 51-2357 thru 52-111, -202 thru -311, -394 thru -478

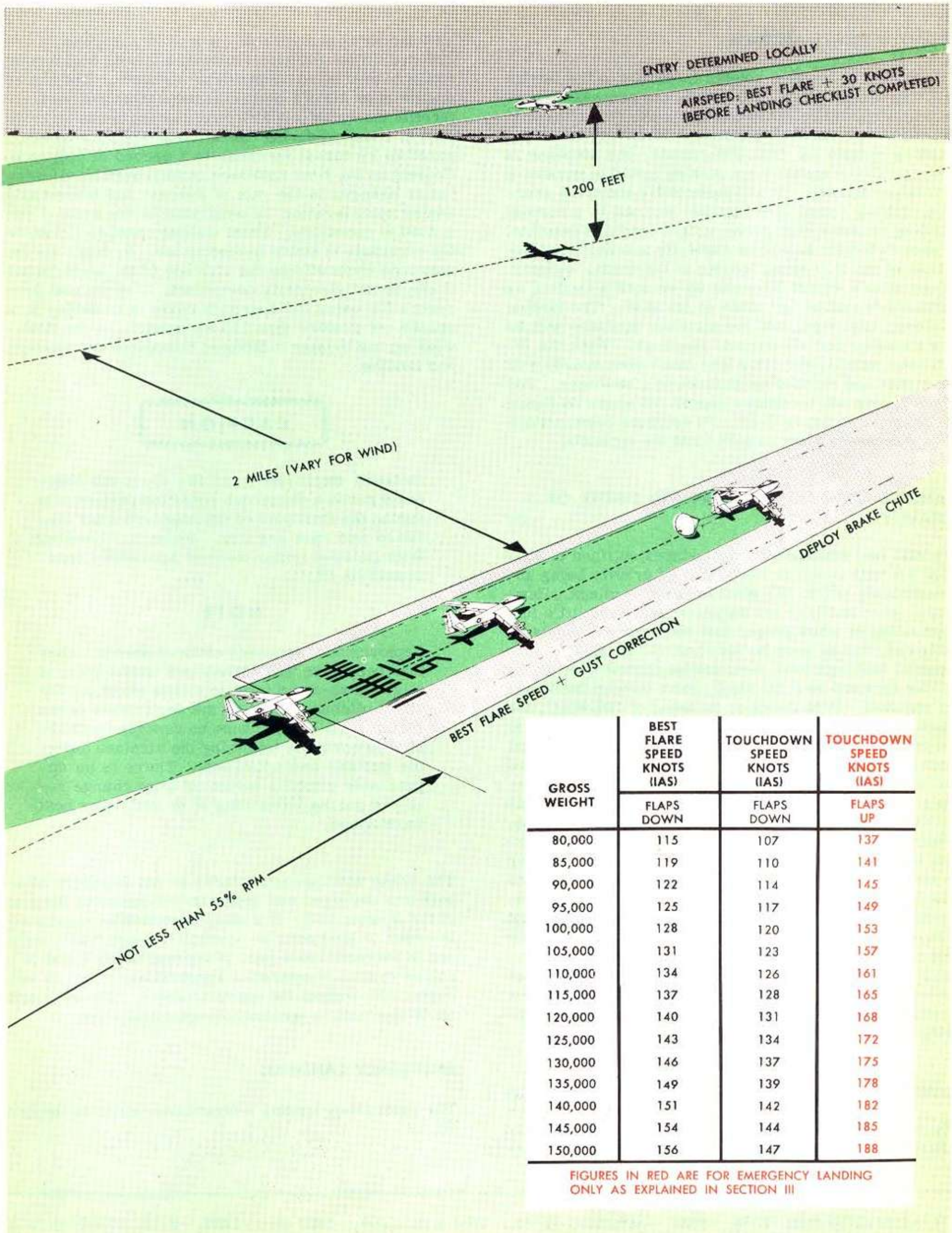
landing pattern diagram (typical)



NOTE

AVERAGE APPROACH FOR NORMAL CONDITIONS. MODIFICATIONS MAY BE REQUIRED TO MEET INDIVIDUAL REQUIREMENTS. RPM SHOULD NOT BE BELOW 55% AT ANY TIME DURING THE APPROACH.

Figure 2 - 12.



GROSS WEIGHT	BEST FLARE SPEED KNOTS (IAS)	TOUCHDOWN SPEED KNOTS (IAS)	TOUCHDOWN SPEED KNOTS (IAS)
	FLAPS DOWN	FLAPS DOWN	FLAPS UP
80,000	115	107	137
85,000	119	110	141
90,000	122	114	145
95,000	125	117	149
100,000	128	120	153
105,000	131	123	157
110,000	134	126	161
115,000	137	128	165
120,000	140	131	168
125,000	143	134	172
130,000	146	137	175
135,000	149	139	178
140,000	151	142	182
145,000	154	144	185
150,000	156	147	188

FIGURES IN RED ARE FOR EMERGENCY LANDING ONLY AS EXPLAINED IN SECTION III

50215WC

HEAVY WEIGHT LANDINGS

If landings with gross weights in excess of the Design Landing Weight of 125,000 pounds are necessary, precautions should be taken to reduce the rate of sink at touchdown as much as possible. However, even at a landing weight of 180,000 pounds, the airplane is structurally adequate for a sinking speed in excess of 6 feet per second. This is sufficiently above the average sinking speed of 4 feet per second in a normal landing to make high gross weight landings feasible. Power reduction should be carefully accomplished because of the increased inertia at the higher weights. Make every effort to make as smooth a landing as possible to reduce "g" loads on the gear. The landing pattern, approach, and the airplane attitudes will be the same as for all normal landings. With the increased weight, the flare and touchdown speeds will be higher and the landing distance will be longer. For flare speeds and touchdown speeds not shown on figure 2-12, refer to figure 2-10. To estimate runway stopping distances, refer to part 10 of the appendix.

LANDING WITH EXTREME FORWARD CENTER OF GRAVITY (1)

Normal fuel management procedures outlined in section VII will result in the center of gravity being approximately 12% to 18% MAC for most landings. However, when landings are required with very little fuel remaining or when proper fuel management cannot be followed, the cg may be forward of 10% MAC. Successful landings have been accomplished with the cg as far forward as 6.5% MAC, but a special technique is required. With the cg at or ahead of 10% MAC, the landing approach should be planned to establish as flat an approach angle as the terrain will permit. This flat approach will reduce the amount of elevator required to flare. It will be noted in figure A10-1 that full nose-up elevator trim will be required to trim the airplane on the downwind leg for extreme forward cg conditions. Pull force will be required to control the airplane during the entire approach and landing. Engine power has a marked effect on the elevator required for trim and flare. When power is reduced, the nose drops; conversely, the nose rises when power is applied. Abrupt reduction of power should be avoided during the approach because of the large amount of elevator required to counteract such a change. Power should be held right down to touchdown. The reduction of power should follow the touchdown with normal brake chute deployed and stopping technique being employed.

LANDING WITH APPROACH CHUTE DEPLOYED (2)

On some airplanes an approach chute is installed to increase drag during approach and landing. The increased drag provides an improved response to decreased thrust and also requires a higher engine rpm while maintaining a normal final approach. The higher engine rpm allows better acceleration response to throttle movement. A 20% thrust increase can be realized in 1 second during operation at 70% rpm as compared to 2% thrust increase in 1 second at 55% rpm. Control on the final approach is improved by allowing faster changes in the rate of descent and more rapid engine acceleration is available in the event a go-around is necessary. From stalling speed to 195 knots the parachute is stable in smooth air. In rough air the approach chute affects the stability of the airplane but it can be satisfactorily controlled. The normal procedure for using the approach chute is to deploy it at speeds not greater than 195 knots while on the downwind leg and to leave it deployed throughout the approach and landing.

CAUTION

Delayed deployment of the approach chute could cause a dangerous condition particularly during the final part of the approach when airspeed and rpm are low. Refer to "Landing With Delayed Deployment of Approach Chute" in section III.

NOTE

Deployment of approach chute at speeds higher than best flare will necessitate introduction of slight nose-down trim to compensate for the slight pitchup caused by the deployment of the chute. This should cause no concern since the pilot is normally trimming the airplane during the pattern and approach. There is no appreciable pitching action or trim change required during jettisoning at or very near best flare speed.

The brake and approach chutes do not interfere when both are deployed and both are jettisoned at the end of the landing roll. If a steep approach is necessary in order to land over an obstacle the approach angle can be increased to a ratio of approximately 8:1 at 55% engine rpm as compared to approximately 16:1 at 55% engine rpm without the approach chute. The approach chute also aids in deceleration after touchdown.

EMERGENCY LANDINGS

For emergency landing instructions, refer to section III.

(1) AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -201, -248 & on
(2) AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

NIGHT LANDINGS

Night landings will be the same as normal day landings.

TOUCH-AND-GO LANDINGS

Touch-and-go landings will be the same as normal takeoff and landing except that 1) the brake chute will not be deployed after touchdown, 2) for the running takeoff all fuel selector switches will remain as set during the "Touch-and-Go Landings" checklist on the downwind leg, and 3) after takeoff the landing gear lever must be placed in OFF and then returned to DOWN. This will return the antiskid system to the armed condition to facilitate the operation of this system during the next subsequent landing.

WARNING

The antiskid system must be returned to the armed condition to prevent hydraulic pressure from being fed to the brakes inadvertently prior to touchdown during the next landing.

TOUCH-AND-GO LANDINGS

NOTE

This checklist will be accomplished after rollout on downwind leg and when airplane is straight and level.

1. Generators - checked
   Copilot checks loadmeter readings.

2. Hydraulic System - pressure & quantity checked
   Copilot rechecks hydraulic system pressures within operating range, fluid quantity within limits, and all lights out. Checks emergency hydraulic pump switch in AUTO NORMAL.

3. Antiskid - REARMED, GEAR LEVER DOWN, LIGHT OUT
   Pilot places gear lever OFF and then DOWN to rearm antiskid system. Checks antiskid switch ON and amber light out. Checks push-to-test indicator to ensure light is operative.

4. Landing Gear - FOUR DOWN - four down, four green
   Pilot and copilot make the following checks where applicable to their station:
   a. Landing gear lever is DOWN and landing gear lever red light out.
   b. Landing gear position indicators show gear down and locked.
   c. The four green gear-down-and-locked lights on the ELGE stand are illuminated.
   d. The red unsafe-to-land light on the ELGE stand is out.

5. Fuel Panel - SET, LIGHTS OUT
   Pilot rechecks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE. If any one main tank has 4000 pounds or less, pilot will place all fuel selector switches to TME. Checks all fuel boost pressure warning lights out and transfers fuel quantity gage readings to copilot.

6. Landing Data Card - checked & complete, best flare speed_____knots
   Copilot recomputes gross weight and data card information, then relays to pilot pertinent data on best flare speed and stopping distance.

GO-AROUND

To make a go-around, open the throttles and retract the landing gear as soon as possible after it is certain that the airplane will not touch the ground. Go-around decisions should be made as early as possible since jet engine acceleration time is high and approach speeds are relatively close to touchdown speeds; hence, initial settling is more pronounced than on propeller-driven airplanes.

NOTE

Allow approximately 7 minutes and 2700 pounds of fuel for a normal approach pattern plus a go-around.

GO-AROUND WITH APPROACH CHUTE DEPLOYED (1)

Jettisoning of the approach chute is not recommended on normal go-around or when practicing touch-and-go landings. In the event of an emergency wherein immediate acceleration and increase in altitude is needed the rate of climb may be approximately doubled by jettisoning approach chute at start of go-around.

AFTER LANDING

CAUTION

When landing behind another B-47, do not taxi over a jettisoned brake chute as it may be sucked into an engine.

1. Brake Chute - DEPLOYED
   Pilot deploys brake chute when airplane decelerates below brake chute maximum deployment speed.

2. Hydraulic Pressures - checked
   Copilot checks main hydraulic system and main brake system pressures periodically during landing roll and at 30-second intervals while taxiing in congested areas.

3. Steering Ratio Selector - TAXI DETENT
   Pilot places steering ratio selector in TAXI detent before turning off runway.

NOTE

Rudder pedals should be neutralized before selector is placed in TAXI.

4. Brake Chute & Approach Chute - JETTISONED
   While turning off the runway, pilot uses sufficient throttle on engines No. 3 and 4 to prevent brake chute and approach chute from contacting the runway. After turning off the runway, pilot jettisons chutes in designated drop area.

5. Brakes - SET
   Pilot sets parking brakes after turning off the runway.

6. Flaps - FLAPS UP
   Pilot places flap lever in UP position. When flaps have retracted fully, pilot returns lever to OFF.

7. Engine Screens - CLOSED
   Pilot places engine screen switch in CLOSE position unless screens are inoperative.

8. Bomb Doors - OPEN, OFF
   Pilot places bomb door switch OPEN; bomb door position indicator will show bomb doors fully open by an "open" tab. Places switch OFF.

9. Cabin Pressure Release Handle - PULLED
   Pilot pulls cabin pressure release handle.

(CONTINUED ON NEXT PAGE)

(1) AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

AFTER LANDING

(CONTINUED)

10. Canopy - AS REQUIRED

①▶ Pilot positions canopy as desired.

②▶ Pilot positions canopy as desired and leaves canopy latch control lever in UNLATCHED position.

③▶ 11. Emergency AC Power Switch - as required
Copilot places emergency AC power switch ON just prior to cutting engines No. 1 and 6 on airplanes equipped with constant speed alternators. This will provide power to hydraulic pressure gages, fuel gages, and engine instruments until the airplane is parked.

12. Cut Engines 1, 2, 5 & 6 Prior to Entering Parking Area
Prior to entering parking area, pilot will operate engines No. 1, 2, 5, and 6 for a minimum of 1 to 2 minutes at idle stop before retarding throttles to CUTOFF.

CAUTION

Post-shutdown fire, static oil leakage, or shroud ring rub may be encountered during shutdown and possibly may be prevented by operating the engines at 70% rpm for 1 to 2 minutes prior to placing throttles to CUTOFF provided the area permits operation at such rpm.

AFTER PARKING

1. Brakes - SET
Pilot sets parking brakes.

④▶ 2. Inverters - OFF - off
Pilot positions instrument inverter switch to OFF: "Bus Power Off" red light illuminates. Copilot places main, secondary, and A-5 or MD-4 inverter power switches OFF; main, secondary, and A-5 or MD-4 "Bus Pwr Off" red indicator lights should illuminate.

3. Windshield Defrost & Anti-Ice - OFF
Pilot moves windshield defrost and anti-ice switches to OFF.

4. Antiskid - OFF
Pilot moves antiskid switch to OFF.

5. Steering Ratio Selector - TOW DETENT
Pilot moves steering ratio selector lever to TOW detent.

(CONTINUED ON NEXT PAGE)

①▶ AF 51-2192 thru 52-611
②▶ AF 52-612 & on
③▶ AF 52-1417, 53-1819 thru -2170, -2279 & on
④▶ AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

AFTER PARKING

(CONTINUED)

6. Engines 3 & 4 - CUTOFF
   Pilot will operate engines No. 3 and 4 for a minimum of 1 to 2 minutes at idle stop before retarding throttles to CUTOFF.

CAUTION

Post-shutdown fire, static oil leakage, or shroud ring rub may be encountered during shutdown and possibly may be prevented by operating the engines at 70% rpm for 1 to 2 minutes prior to placing throttles to CUTOFF provided the area permits operation at such rpm.

NOTE

This holding period permits the engine to scavenge the oil system properly and the engine to cool properly, preventing seizure of the shroud ring.

7. Controls - LOCKED & STOWED - stowed
   Pilot places surface lock lever in LOCK position, then neutralizes and moves ailerons and rudder until lock falls into place. Pilot moves control column forward until elevator locks. Pilot and copilot disengage controls and stow columns.

8. Surface Power Controls - OFF
   Pilot places all surface power control switches OFF.

9. Fuel Selectors - TANK TO ENGINE
   After engines are cut, pilot sets all fuel selector switches to TE.

10. Emergency Hydraulic Pump - off
    Copilot places emergency hydraulic pump switch OFF.

(1)► 11. Emergency AC Power Switch - off
    Copilot places emergency AC power switch OFF.

12. Chocks in Place - BRAKES OFF
    After ground crew indicates chocks are in place, pilot releases brakes.

13. Fire Shutoff Switches - PULLED
    Pilot checks rpm zero on all engines, then pulls all fire shutoff switches.

14. Oxygen Regulators - NORMAL, OFF, MASTER WARNING OFF - normal, off - ***normal, off***
    Pilot checks diluter lever on NORMAL OXYGEN, supply lever OFF, and master oxygen warning control switch OFF. Copilot and observer check diluter levers on NORMAL OXYGEN and supply levers OFF.

(CONTINUED ON NEXT PAGE)

(1)► AF 52-1417, 53-1819 thru -2170, -2279 & on

AFTER PARKING

(CONTINUED)

15. Radios & IFF - OFF - off
    Pilot and copilot turn off all radios and IFF.

16. Ejection Seats - Crew Reports
    Pilot, copilot, and observer install all initiator safety pins with streamers attached.

(1)▶ 17. Canopy Initiator Streamer & Pin - installed
    Copilot installs canopy initiator safety pin with streamer attached.

18. Lights - OFF - off - *off*
    Pilot, copilot, and observer check all interior and exterior lights turned off.

19. Battery - OFF
    Pilot moves battery switch to OFF.

POSTFLIGHT INSPECTION

1. ATO Safety Devices - AS REQUIRED
   Pilot places ATO arm switch OFF. On airplanes equipped with internal ATO system, pilot checks that the ATO safety link has been removed. On airplanes equipped with external ATO system, if external ATO rack has not been dropped due to refused takeoff or an aborted flight, pilot checks that the ATO pullout plugs have been removed and the ATO lockpin has been installed.

2. Ground Locks - IN PLACE
   Pilot insures that ground locks have been installed on the forward main, aft main, both outrigger gears, and bomb doors.

3. Visual Inspection - COMPLETED
   Pilot and copilot complete a visual inspection of the airplane exterior.

4. Pilot Chute Deploy Pins & Cable - TO CREW CHIEF or REINSTALLED
   If brake chute was deployed, the pilot returns the deploy pins and cable to the crew chief. If brake chute was not used, pilot insures that the deploy pins and cable are reinstalled to retain the pilot chute in place when deploy doors are opened for maintenance.

(CONTINUED ON NEXT PAGE)

(1)▶ AF 52-612 & on

POST FLIGHT INSPECTION

(CONTINUED)

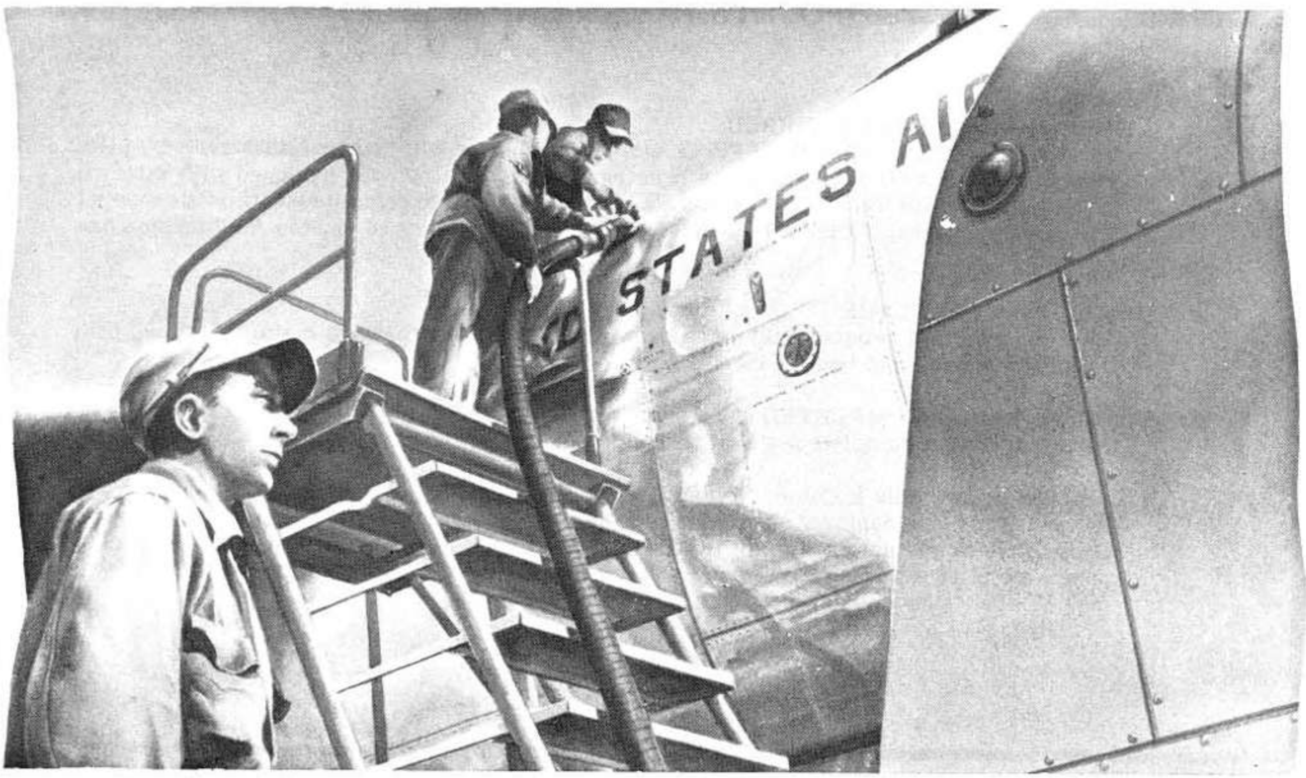
①► 5. AN/APX-6 Detonator Circuit Breaker - OUT

Open battery compartment and pull the "AN/APX-6 Detonator" circuit breaker when at friendly bases.

6. DD Form 781 - COMPLETED & SIGNED

The pilot completes DD Form 781 and notes any discrepancies about the airplane. Signs form when completed.

①► AF 51-2192 thru 52-620, 53-2261 thru -2289



CUT ON BLACK LINE

B-47B & B-47E CONDENSED CHECK LIST

The following checklist is a condensed version of the airplane checklist. This checklist is accomplished by the copilot calling off the items to the crew. For identification purposes, all responses made by the pilot are noted in CAPITAL letters and those made by the copilot are noted in lower case letters. Responses made by the observer are shown in *Italics* and responses made by the ground observer will be identified by lower case letters in parentheses ( ).

AIRPLANE SERIAL REFERENCES

(1)► AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 & on

(2)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

(3)► AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278

(4)► AF 51-2192 thru -2356, 52-158 thru -201, -312 & on

(5)► AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on

(6)► AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on

(7)► AF 52-363 thru -393, -584 thru -620, -3343 thru 53-1849, -2261 thru -2314

(8)► AF 51-2357 thru 52-362, -394 thru -583

(9)► AF 52-177 thru -201, -331 thru -393, -527 & on

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(10) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

(11) AF 51-2192 thru -2356, 52-518 & on

(12) AF 52-612 & on

(13) AF 51-2192 thru -2356, 52-612 & on

(14) AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

(15) AF 51-2357 thru 52-611

(16) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

(17) AF 52-1417, 53-1819 thru -2170, -2279 & on

(18) AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235

(19) AF 51-2357 thru 52-088, -202 thru -292

(20) AF 51-2192 thru -2356, 52-089 thru -201, -293 & on

(21) Some airplanes

(22) Airplanes which do not have T. O. 1B-47-767 accomplished

(23) Airplanes which have T. O. 1B-47-767 accomplished and AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

(24) AF 51-2192 thru -7083, -17368 thru -17386, 52-029 thru -201, -221 & on

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(25)▶ AF 52-158 thru -176, -312 thru -362, -394 thru -564

(26)▶ AF 51-2192 thru 52-611

(27)▶ AF 51-2192 thru -2356, 52-152 thru -201, -322 & on

(28)▶ AF 51-2192 thru 52-620, 53-2261 thru -2289

(29)▶ AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

(30)▶ AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on

BEFORE INTERIOR INSPECTION

1 ATO Safety Devices - AS REQUIRED
2. Stations Inspection - COMPLETED
3. Briefing - COMPLETED
4. Equipment Check - COMPLETED
(1)▶ 5. Liferaft - CHECKED
6. External Power - OFF

INTERIOR PREFLIGHT INSPECTION

1. Bailout Spoiler - INSTALLED or NOT INSTALLED
2. Bailout Spoiler Air Bottle - CHECKED
(2)▶ 3. Main AC Power Shield - CHECKED
4. Hand Axe - STOWED
5. First Aid Kits - CHECKED
6. Fire Extinguisher - CHECKED
7. Forward Walkaround Bottle - CHECKED
8. If a qualified observer is not flying:
   a. Observer's Escape Hatch - SECURED
   b. Observer's Ejection Seat - CHECKED
      (1) Safety Pins - INSTALLED
      (2) Torque Tube - CHECKED
      (3) Initiators - CHECKED
      (4) Whiffletree - ENGAGED
      (5) Catapult Initiator Safety Pin - INSTALLED
      (6) Hatch Static Cable - CONNECTED
      (7) Downward Ejection Hatch - LOCKPIN IN PLACE, PRESSURE CHECKED
      (8) Seat Rotation Locks & Leg Braces - FULL DOWN, CHECKED
      (9) Restraint Cable - CHECKED

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(10) Leg Guard Torque Tube - CHECKED
(11) D-Ring Retaining Clip - IN PLACE
(12) Quick Disconnect - CHECKED
(13) Shoulder Harness & Inertia Reel - CHECKED
(14) If observer's seat is to be unoccupied:
(a) Safety Belt & Shoulder Harness - BUCKLED
(15) Seat Rotation - CHECKED

c. Rendezvous Radar AN/APN-76 Switches - OFF
d. Radar Computer Function Switch - OFF
e. Radar Power Control Switches - OFF
f. Observer's Oxygen Panel - CHECKED & OFF
(3)➤ g. Three-Phase Inverter Switch - OFF
h. Salvo & Master Bomb Control Switches - OFF
(4)➤ i. Bombsight Cover & Heat Switch - CLOSED & OFF
j. Camera Master Switch - ON (if vertical camera installed)
(5)➤ k. Camera Window Defrost Switch - OFF
l. (6)➤ Observer's Lower Air Heater Switch - OFF
(7)➤ Observer's Lower Air Shutoff Knob - OFF
m. BNS Heat & Light Switches - OFF
(8)➤ n. Observer's Air Outlet Selector - BOTH OFF
o. Circuit Breakers - IN
p. Radar Pressurizing Control Switch - OFF
q. Periscopic Port - CLOSED
(9)➤ r. Observer's Upper Air Shutoff Valve - OFF
s. Loose Equipment - SECURED

9. Let-Down Books & Facility Charts - checked
10. Aft Walkaround Oxygen Bottle - checked
(10)➤ 11. Ditching-Crash Landing Station - checked
12. ECM Switches - off
(4)➤ 13. Chaff Dispenser Switches - off
14. Canopy Emergency Jettison Air Bottle - checked
15. G-Files & Loose Equipment - checked
16. Gunnery System - switch off & safe
(11)➤ 17. ARC-21 Antenna Coupler Insulator - checked
18. Gunner's Air Outlet - both off
19. Circuit Breakers - checked
(12)➤ 20. Canopy Initiator Pin, Ballistics Tubing, Remover Disconnect Handle - in place, secure - CONNECTED
21. Ejection Seats - CHECKED - checked
22. Top of Engines, Wings & Fuselage - CHECKED - checked
23. Canopy, Windshield & Yaw String - CHECKED
(13)➤ 24. Periscopic Port - closed
25. Emergency Turn & Bank - CHECKED - checked & normal
26. Emergency Keyer - OFF & SAFETIED
(14)➤ 27. Approach Chute Deployment Switches - DOOR CLOSED - door closed (or off)

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28. Gear Lever - down - DOWN
29. Steering Ratio Selector - TOW DETENT
30. Alarm Bell - CHECKED & OFF - ok - *ok*
31. Engine Screens - OPEN
32. Ignition Switches - OFF
33. Bomb Salvo Switch - OFF & SAFETIED
34. Throttles - cutoff - CUTOFF
35. Flap Lever - off - OFF
36. (22)➤ Tank Jettison Switches - NORMAL
    (23)➤ Tank Jettison Switches - OFF
37. Emergency Gear Retraction Switches - off - OFF
38. (15)➤ Canopy Control Lever - OFF
    (12)➤ Canopy Latch Control Lever - OFF
39. Battery - ON - checked
40. DC Bus Selector - checked, normal
41. Connect External DC Power - (on the line)
42. Battery - OFF
43. Oxygen & Interphone - Crew Reports

(16)➤ 44. Liquid Oxygen Quantity Gages - checked

45. All Lights & Push-to-Test Lights - CHECKED - checked
46. (2)➤ Inverters - CHECKED & ON - checked & on
    (17)➤ Emergency Instrument Inverter - CHECKED - checked

(17)➤ 47. Connect External AC Power - (on the line)

48. Fuel System & Panel - CHECKED - checked
49. Hydraulic System - checked & on
50. Air Refueling (Pilot reads checklist):
    a. Refueling Valve Switches - closed
    b. Master Refuel Switch - REFUEL - green light on
    (18)➤ c. Fuel Gage Control - COPILOT
    d. Windshield Wiper Circuit Breaker - pulled
    e. Refueling Selector Switch - normal
    *f. Emergency Slipway Door - CLEAR - *checked & off* - (door open, closed)
    g. Air Refueling Accumulator Gage - *checked*
    h. Air Refueling Amplifiers (2) - *checked*
    i. Air Refueling Panel Lights - checked
    *j. Fire Extinguisher Selector (some airplanes) - off
    k. Emergency Fire Extinguisher Switch (some airplanes) - checked
    *l. Slipway Door Clear to Open - (clear) - open
    m. Signal Switch Plunger - *depressed* - (toggles latched)
    n. Signal Switch Plunger - *released* - (toggles unlatched)
    o. Return-to-Ready Button - depressed
    p. Signal Switch Plunger - *depressed* - (toggles latched)

*Check required on all missions

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CUT ON BLACK LINE

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q. Pilot's Disconnect Switch - DEPRESSED - (toggles unlatched)
r. Signal Switch Plunger - *released*
s. Return-to-Ready Button - depressed
t. Signal Switch Plunger - *depressed* - (toggles latched)
u. Copilot's Disconnect Switch - *depressed* - (toggles unlatched)
v. Signal Switch Plunger - *released*
*w. Selector Switch to Emergency Boom Latching - (toggles latched)
*x. Pilot's Disconnect Switch - DEPRESSED - (toggles unlatched)
*y. Pilot's Disconnect Switch - RELEASED - (toggles latched)
z. Receptacle Fuel & Hydraulic Lines - *checked*
*aa. Refueling Selector Switch - off
ab. Slipway for Condition - (checked)
ac. Receptacle CO_2 Outlets (some airplanes) - (checked)
ad. Receptacle Drain - (checked)
ae. Toggles - (checked)
af. Induction Coil - (checked)
ag. Slipway Door Lights - on bright - (checked) - off
*ah. Slipway Door Clear to Close - (clear) - closed - (closed)
ai. Refueling Valve Switches - closed
aj. Master Refuel Switch - NORMAL - green light out
(18)► ak. Fuel Gage Control - PILOT
51. Refueling Valve Lever - closed
52. Controls - ENGAGED - engaged
53. Surface Control Lock - FORWARD, UNLOCK DETENT
54. Power Controls - ON, LIGHTS CHECKED
55. Automatic Pilot - CHECKED & OFF
56. Flaps - checked & down - (checked & down)
57. Trim Tabs - CHECKED - (checked)
58. Flight Controls - CHECKED, POWER ON & OFF
59. Controls - LOCKED, STOWED - stowed
60. Instruments - CHECKED - checked
61. Fire Warning & Overheat Lights - TESTED
62. Synchronize N-1 Compass Master Indicator - synchronized
63. Radios - CHECKED, OFF - checked, off
(2)► 64. Inverters - OFF - as required
(17)► 65. External AC Power - as required
66. Seat Adjustment Switches - CHECKED - checked
67. Copilot Seat Rotation - checked
68. ELGE System - checked
(12)► 68A. Canopy Hinge Pin Release Handle - in detent

*Check required on all missions

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69. Gunnery Interior Preflight - complete
70. Crawlway - clear
71. Refrigeration Unit Oil Level - checked
72. Left Forward Main Fuel Boost Pump - checked
73. Service & Interconnect Valves - safetied off
74. Bulkhead & Crawlway Doors - closed
75. Main Entry Door Release Mechanism - locked

EXTERIOR INSPECTION

A. NOSE SECTION
   1. External AC Power - AS REQUIRED
   2. Left Pitot Cover - REMOVED
   3. Observer's Downward Ejection Hatch - FLUSH, HANDLE STOWED
   4. Nose Window & Bombsight - CLEAN & UNBROKEN
   5. Cabin Air Emergency Depressurization Door - FLUSH
   6. Right Pitot Cover - REMOVED
   7. Right Forward Side of Nose Section - CHECKED
   8. Static Ports - CLEAR
   9. Radome - FLUSH & LATCHED
   10. Forward Auxiliary Boost Pumps - CHECKED

B. FORWARD WHEEL WELL
   1. Wheel Chocks & Landing Gear Ground Lock - IN PLACE
   2. Bomb Bay Door Ground Locks - IN PLACE
   3. Right Door, Roller & Actuator - CHECKED
   4. Right Wheel, Tire, Brakes & Antiskid Cover - CHECKED
   5. Brake Lines & Gear Squat Switches - CHECKED
   6. Left Wheel, Tire, Brakes & Antiskid Cover - CHECKED
   7. Oleo Strut - PROPER EXTENSION, NO LEAKS
   8. Centering Switch - SECURE
   9. Hydraulic System - CAP SECURE, NO LEAKS
   10. Left & Right Power Shield Covers - SECURE
   11. Right Forward Main Boost Pump - CHECKED
   12. Left Door, Actuator & Roller - CHECKED
   13. Forward Power Shield Covers (3) - SECURE
   14. Gear Motors & Cannon Plugs - CHECKED
   15. Gear Door Uplatches - UNLATCHED

C. FORWARD RIGHT SIDE FUSELAGE
   1. Forward Right Side Fuselage & Fuel Drains - CHECKED, NO LEAKS
   2. Wing & Strut Access Panels - SECURE, NO LEAKS

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D. INBOARD NACELLE
1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED
2. Strut Fairing & Torsion Links - CHECKED
3. Oleo Strut, Extension & Seals - NO LEAKS
4. Wheel & Tire - CHECKED
5. Ground Lock - IN PLACE
6. Outrigger Doors & Actuators - CHECKED
7. Nacelle Panel Latches (8) & Locks (4) - SECURE
8. Left Nacelle Panels - SECURE, NO LEAKS
9. Air Intakes & Accessory Domes - CHECKED, SECURE
10. Right Nacelle & Strut Panels - SECURE, NO LEAKS
11. Wing Access Panels - SECURE, NO LEAKS

E. EXTERNAL WING TANK
(22) 1. Red Indicator Flag - CHECKED
2. Vent Line - NO OBSTRUCTIONS
(23) 3. Bridle Snap Hook - CHECKED
(23) 4. Initial Release Cable - CHECKED
(23) 5. Thrusters - CHECKED
6. Electrical Disconnects - CHECKED
(23) 7. Main Strut Tensiometer - CHECKED
8. Main Strut Lever Arm - CHECKED
9. Fuel Quantity & Filler Neck - CHECKED, SECURE
10. Fairing, Access Panels, Nosecone - CHECKED, SECURE
11. Side Strut Latch Pin - CHECKED
(23) 12. Side Strut Tensiometer - CHECKED

F. OUTBOARD NACELLE
1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS
2. Left Nacelle Panels - SECURE, NO LEAKS
3. Air Intake & Accessory Dome - CHECKED, SECURE
4. Right Nacelle Panels - SECURE

G. RIGHT WING
1. Aileron Power Control Unit - CHECKED
2. Wing Access Panels - SECURE, NO LEAKS
3. Oil Tank Caps - FLUSH
4. Aileron & Trim Tab - CHECKED
5. Fuel Tank Caps - CHECKED
6. Wing Trailing Edge - CHECKED

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H. AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS

1. Center Main Boost Pump - CHECKED
2. Right Fuselage - CHECKED
3. Right Aft Auxiliary (ATO) Boost Pump - CHECKED
4. Single Point Refueling Cap - SECURE
5. Wheel Chocks & Landing Gear Ground Lock - IN PLACE
6. Right Door, Roller & Actuator - CHECKED
7. Right Wheel, Tire, Brake & Antiskid Cover - CHECKED
8. Brake Lines & Gear Squat Switch - CHECKED
9. Left Wheel, Tire, Brake & Antiskid Cover - CHECKED
10. Oleo Strut - PROPER EXTENSION, NO LEAKS
11. Hydraulic Lines, Fuel Lines & Shutoff Valves - NO LEAKS
12. (19)► ATO Rack Pin Indicators (6) - LOCKED
13. ATO Control Shield - CIRCUIT BREAKERS IN, COVER SECURE
14. Left Door, Actuator & Roller - CHECKED
15. Aft Power Shield Covers - SECURE, CIRCUIT BREAKERS IN
16. Cables, Motors & Cannon Plugs - CHECKED
17. Gear Door Uplatches - UNLATCHED
18. Aft Main Boost Pumps (4) - CHECKED
19. (20)► External ATO Rack - CHECKED
20. Camera Compartment - CHECKED
21. Battery Compartment or Aft Radar Compartment - CHECKED
22. Rudder-Elevator Power Control - CHECKED
23. Ammunition Cans - SAFETIED
24. (21)► Turret Safety Switch - AS REQUIRED
25. Gunnery Exterior Inspection - complete
26. (14)► Approach Chute - CHECKED, INSTALLED, DOOR FLUSH
27. Brake Chute - MECHANISM CHECKED, INSTALLED, PILOT CHUTE DEPLOY PINS & CABLE REMOVED, DOORS FLUSH

I. EMPENNAGE

1. Empennage & Tail Turret - CHECKED
2. Left Side Vertical Stabilizer - CHECKED, AIR DUCTS OPEN

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J. AFT LEFT SIDE FUSELAGE
(29) 1. Emergency Elevator Reservoir - CHECKED
(30) 2. Aft Radome - CHECKED
(21) 2A. Battery Compartment - CHECKED
2B. Left Aft Auxiliary (ATO) Boost Pump - CHECKED
3. Center Main Boost Pump - CHECKED
4. Left Fuselage - CHECKED
5. Bomb Bay Tank Boost Pumps - CHECKED

K. BOMB BAY
1. Left Bomb Bay Fuel Lines & Boost Pumps - CHECKED
2. Junction Box Covers - SECURE
3. Oxygen Supply Lever - OFF
4. Interphone Cord - STOWED
5. Bomb Bay Light - OFF
6. Bomb Door Accumulator - CHECKED
7. Bomb Door Uplatches & Microswitch - UNLATCHED & CHECKED
8. Spoiler Door Gage - CHECKED
9. Spoilers & Spoiler Depressurizing Valve - CHECKED, SAFETIED OFF
10. Right Bomb Bay Fuel Lines & Boost Pumps - CHECKED

L. LEFT WING
1. Flap Motors, Solenoids & Wiring - SECURE
2. Wing Trailing Edge - CHECKED
3. Oil Tank Caps - FLUSH
4. Aileron & Trim Tab - CHECKED
5. Aileron Power Control Unit - CHECKED
6. Wing Access Panels - SECURE, NO LEAKS

M. OUTBOARD NACELLE
1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS
2. Left Nacelle Panels - SECURE, NO LEAKS
3. Air Intake & Accessory Dome - CHECKED, SECURE
4. Right Nacelle Panels - SECURE

N. EXTERNAL WING TANK
(22) 1. Red Indicator Flag - CHECKED
2. Vent Line - NO OBSTRUCTIONS
(23) 3. Bridle Snap Hook - CHECKED
(23) 4. Initial Release Cable - CHECKED
(23) 5. Thrusters - CHECKED

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(23) 6. Side Strut Tensiometer - CHECKED
7. Side Strut Latch Pin - CHECKED
8. Fairing, Access Panels, Nosecone - CHECKED, SECURE
9. Fuel Quantity & Filler Neck - CHECKED, SECURE
10. Main Strut Lever Arm - CHECKED
(23) 11. Main Strut Tensiometer - CHECKED
12. Electrical Disconnects - CHECKED

O. INBOARD NACELLE
1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED
2. Strut Fairing & Torsion Links - CHECKED
3. Oleo Strut, Extension & Seals - NO LEAKS
4. Wheel & Tire - CHECKED
5. Ground Lock - IN PLACE
6. Outrigger Doors & Actuators - CHECKED
7. Nacelle Panel Latches (8) & Locks (4) - SECURE
8. Left Nacelle & Strut Panels - SECURE, NO LEAKS
9. Air Intakes & Accessory Domes - CHECKED, SECURE
10. Right Nacelle & Strut Panels - SECURE, NO LEAKS
11. Wing Access Panels - SECURE, NO LEAKS

P. FORWARD LEFT SIDE FUSELAGE
1. Forward Left Side Fuselage & Fuel Drains - CHECKED, NO LEAKS
2. Bomb Door Switch - OFF

BEFORE STARTING ENGINES

1. Ejection Seat & Canopy Safety Pins - Crew Reports
2. Safety Belt & Shoulder Harness - FASTENED - fastened
3. Battery - OFF
4. External DC Power - on the line
5. Seats & Pedals - ADJUSTED - adjusted
6. Controls - ENGAGED - engaged
7. Mike Cord, Mask & Bailout Bottle - CONNECTED - connected - *connected*
8. Takeoff & Landing Data Card - completed
9. Lights - SET - set
10. Emergency Keyer - SAFETIED OFF
11. Overheat Control - NORMAL
12. Oxygen Check - Crew Reports
13. Canopy Jettison Handles - IN PLACE - in place
14. Parking Brakes - SET
15. Canopy Release Handles - IN PLACE - in place

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(24)➤ 16. ESP Switch - OFF
17. Bomb Door Switch - OFF
18. Directional Damper Switch - OFF
(14)➤ 19. Approach Chute Deployment Switches - DOOR CLOSED - door closed (or off)
20. (2)➤ Inverter Switches - MAIN, LIGHTS OUT - on, voltages & lights checked
(17)➤ External AC Power - (on the line)
21. Fire Shutoff Switches - DEPRESSED
22. Gear Lever, Indicators & ELGE Lights - LEVER & FOUR DOWN - four green, four down
23. Remove Bomb Door Locks, Gear Locks & Grounding Wire - (roger)
24. Master Air Conditioning Switch - ON
(21)➤ 25. Emergency Hot Air Shutoff Handle - depressed
(25)➤ 26. Water Separator - OFF
27. Heat Selector - AUTOMATIC, RHEOSTAT SET
28. Cabin Air Selector Switch - COMPRESSOR
29. Cabin Pressure Switch - NORMAL
30. Windshield Defrost - SET
31. Slipway, Exterior & Pitot Heat - SET
32. Windshield Anti-Ice - NORMAL
33. Engine Screen Switch - AUTOMATIC
34. Low Speed Warning Switch - ON
35. Antiskid - ON, LIGHT OUT
36. Throttles - CUTOFF - cutoff
37. Surface Control Lock - FORWARD, UNLOCK DETENT
38. ATO Switches - BOTH OFF
39. Water Injection Switches - OFF
40. (15)➤ Canopy Control Lever - OFF
(12)➤ Canopy Latch Control Lever - OFF
41. Cabin Pressure Release Handle - DEPRESSED
42. Radios & IFF - ON, CHECKED & STANDBY
43. Fuel Control Panel - SET
44. Bomb Door Locks & Gear Locks - IN SIGHT, STOW
45. Generators - reset & off
(2)➤ 46. Alternators - reset & off
47. Emergency Hydraulic Switch - auto normal, pressure & quantity checked
48. Circuit Breakers - in
49. N-1 Compass - *synchronized*
50. Radio Call - COMPLETED
51. Brake Chute Deploy & Jettison Handles - BOTH CHECKED - both checked
(20)➤ 52. ATO Rack Release Handle - in place
53. ATO Safety Devices - AS REQUIRED

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STARTING ENGINES

1. Ignition Switches - NORMAL
2. Ready to Start Engines - READY - ready - (ready)
3. Start Engines
4. Starter & Ignition Switches - OFF

BEFORE TAXIING

1. Hydraulic Pressure & Quantity - checked
2. (2)➤ Engines No. 1 & 6 - 52% RPM - bus selector normal, alternators normal, voltages checked
   (17)➤ Engines No. 1 & 6 - 40% rpm, alternators on bus, voltages checked
3. Entrance Door - closed & locked - (closed & latched)
4. Clear Bomb Doors - (clear) - CLOSED - (closed)
5. Battery - LH BUS NORMAL
6. Generators - on
7. Windshield Defrost, Anti-Ice & Pitot Heat - SET
8. External Power, Chocks & Interphone - REMOVED & IN SIGHT
9. Generator Loads & Voltages - checked
10. Power Controls - ON, LIGHTS OUT
11. Steering Ratio Selector - TAXI DETENT
12. IFF - SET
13. Clear to Taxi on Crew Chief's Signal - READY TO TAXI

WHILE TAXIING

1. Brakes & Steering - CHECKED
2. Hydraulic Pressure & Quantity - CHECKED
3. Turn & Bank - CHECKED - checked
4. Directional Gyro - checked
5. Accelerometer - CHECKED
6. Steering Ratio - CHECKED

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CUT ON BLACK LINE

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BEFORE LINEUP

1. Brakes - SET
2. Flight Instruments - CHECKED - checked
3. Power Controls - ON, LIGHTS OUT
4. Cabin Air Selector Switch - COMPRESSOR
5. Flaps - FULL DOWN - full down
6. Flight Controls - ENGAGED - engaged
7. Flaperons - CHECKED
8. Trim Tabs - SET
9. Fuel Control Panel - SET, LIGHTS OUT
10. Canopy - CLOSED, LATCHED, LOCKED - pins & hooks in place
11. (26) Canopy Latch Reset - HORIZONTAL
12. Circuit Breakers - checked
13. Bombsight Retractable Cover - *closed*
14. Landing Lights (night) - ON
15. Radio Call - COMPLETED

BEFORE TAKEOFF

1. Brakes - HOLDING
2. Compass Repeater Indicator - CHECKED
3. Engine Screens - OPEN
4. Steering Ratio Selector - TAKEOFF LAND DETENT
5. ATO Arming Switch - AS REQUIRED
6. Takeoff Data - CHECKED

(17) 6A. Water Injection Warmup - AS REQUIRED

7. Throttles Open - OIL, FUEL, EGT OK, 100% - alternators & generators checked
8. Nacelles - CHECKED - checked
9. (27) Water Injection - AS REQUIRED

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CUT ON BLACK LINE

TAKEOFF & INITIAL CLIMB

TAKEOFF DATA

CRITICAL FIELD LENGTH ______ TO DIST ______
MIN ATO REQ ______ ELEVATOR SET ______

LINE.....................IAS____
REFUSAL SPEED.........IAS____
FIRE ATO.................IAS____
TAKEOFF.................IAS____
CLIMB.....................IAS____

CONDITIONS

GW______ FLD PA______
RUNWAY LENGTH______ OAT______
LINE DIST______ %MAC______

LANDING DATA

STOP DIST______

START FINAL..........IAS____
BEST FLARE..........IAS____

1. Copilot Calls Line Speed, Refusal Speed, ATO Firing Speed & Takeoff Speed
2. GEAR UP - gear up
3. FLAPS UP - flaps up
4. (20➤) External ATO Rack - jettisoned
5. Gear & Flaps - levers off
6. Climb Speed - CLIMB POWER SET
7. (27➤) Water Injection - AS REQUIRED
8. Guns to Warmup & Standby - checked
9. Oxygen - As Required
10. Crew Station Check - Crew Reports (10,000 feet & Level Off)

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BEFORE DESCENT

16

1. Radio Call - COMPLETED, ALTIMETER SET - altimeter set - *altimeter set*
2. Safety Belt & Shoulder Harness - FASTENED - fastened - *fastened*
3. Bombsight Retractable Cover - *closed*
4. (24)▶ Engine Stall Prevention Switch - AS REQUIRED
5. Directional Damper - OFF
6. Temperature Rheostat - ADJUSTED
7. Windshield Anti-Ice & Defrost - SET
8. Steering Ratio Selector - TAKEOFF LAND DETENT
9. Engine Screens - OPEN
10. Low Speed Warning Switch - ON
11. Power Controls - ON , LIGHTS OUT
12. Fuel Panel - SET, LIGHTS OUT
13. Landing Data Card Completed, Gross Weight______, Best Flare Speed______ Knots
14. Generators - checked
15. Circuit Breakers - checked
16. Hydraulic Pressures & Quantity - checked
17. Landing Gear Lever - DOWN, FOUR DOWN - four down, four green
18. Antiskid - ON, LIGHT OUT

BEFORE LANDING

1. Guns - stowed 45° up
2. Landing Gear - FOUR DOWN, LEVER DOWN - four down, four green
3. Flaps - FULL DOWN
4. Fuel Panel - SET, LIGHTS OUT
5. Landing Data Card - checked & complete, best flare speed ______ knots
6. Steering, Braking & Hydraulic System - checked
7. Radar, Alternators & Automatic Pilot - AS REQUIRED - as required - *as required*
8. (24)▶ Engine Stall Prevention Switch - AS REQUIRED
9. (14)▶ Approach Chute - as required
10. Airspeed & Altimeters - ______ knots, ______ feet - ______ KNOTS, ______ FEET

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TOUCH-AND-GO LANDINGS

1. Generators - checked
2. Hydraulic System - pressure & quantity checked
3. Antiskid - REARMED, GEAR LEVER DOWN, LIGHT OUT
4. Landing Gear - FOUR DOWN - four down, four green
5. Fuel Panel - SET, LIGHTS OUT
6. Landing Data Card - checked & complete, best flare speed ________ knots

AFTER LANDING

1. Brake Chute - DEPLOYED
2. Hydraulic Pressures - checked
3. Steering Ratio Selector - TAXI DETENT
4. Brake Chute & Approach Chute - JETTISONED
5. Brakes - SET
6. Flaps - FLAPS UP
7. Engine Screens - CLOSED
8. Bomb Doors - OPEN, OFF
9. Cabin Pressure Release Handle - PULLED
10. Canopy - AS REQUIRED
11. (17) Emergency AC Power Switch - as required
12. Cut Engines 1, 2, 5 & 6 Prior to Entering Parking Area

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AFTER PARKING

18

1. Brakes - SET
2. (2) Inverters - OFF - off
3. Windshield Defrost & Anti-Ice - OFF
4. Antiskid - OFF
5. Steering Ratio Selector - TOW DETENT
6. Engines 3 & 4 - CUTOFF
7. Controls - LOCKED & STOWED - stowed
8. Surface Power Controls - OFF
9. Fuel Selectors - TANK TO ENGINE
10. Emergency Hydraulic Pump - off
11. (17) Emergency AC Power Switch - off
12. Chocks in Place - BRAKES OFF
13. Fire Shutoff Switches - PULLED
14. Oxygen Regulators - NORMAL, OFF, MASTER WARNING OFF - normal, off - ***normal, off***
15. Radios & IFF - OFF - off
16. Ejection Seats - Crew Reports
17. (12) Canopy Initiator Streamer & Pin - installed
18. Lights - OFF - off - ***off***
19. Battery - OFF

POSTFLIGHT INSPECTION

1. ATO Safety Devices - AS REQUIRED
2. Ground Locks - IN PLACE
3. Visual Inspection - COMPLETED
4. Pilot Chute Deploy Pins & Cable - TO CREW CHIEF or REINSTALLED
5. (28) AN/APX-6 Detonator Circuit Breaker - OUT
6. DD Form 781 - COMPLETED & SIGNED

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emergency procedures

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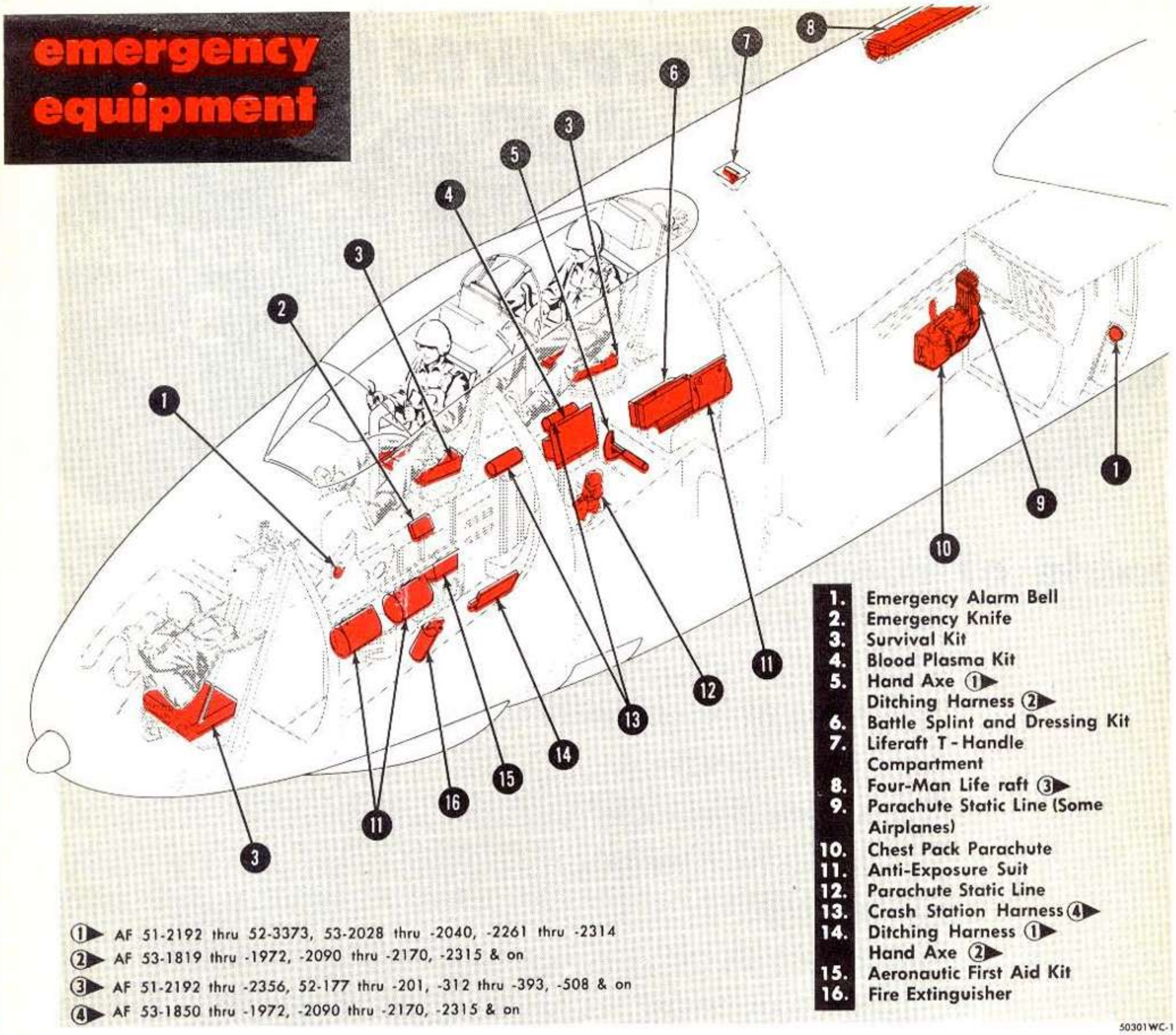


Figure 3-1.

NOTE

The emergency procedures in this section, which are presented in checklist form, should not be construed to be a type of checklist which requires a query by one crew member and a reply by another.

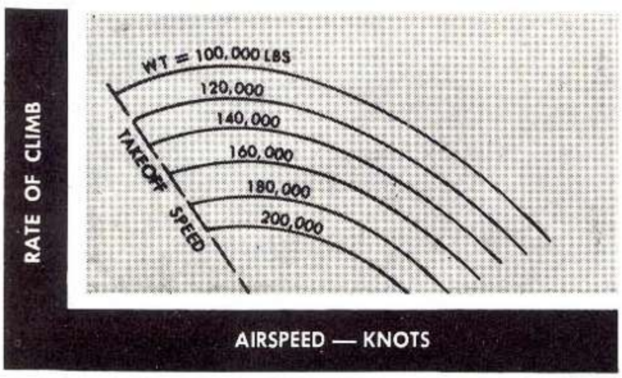
ENGINE FAILURE

The first and most positive indication of engine malfunction will be marked change in the EGT reading whether during takeoff, climb, cruise, or descent. Cases of main bearing failures, broken or missing turbine buckets, main rotor unbalance, or stator and rotor engagement often can be detected by noticeable vibration in the airplane structure. In addition, the failure of one or more engines during takeoff or climb will usually result in a marked reduction in the normal rate of acceleration and the tachometer will show a decrease in percent rpm. However, engine malfunction can occur without loss of rpm and without vibration in which case the only indication of the malfunction will be a change in the EGT reading. In all cases of engine structural malfunction or when engine structural malfunction is suspected, accomplish fire shutdown and record data in DD Form 781. To accomplish fire shutdown, retard throttle to CUTOFF and pull the respective fire shutoff switch. In all cases of engine failure the recommended procedure for engine shutdown is to retard the throttle first followed by pulling the fire shutoff switch. For engine fire this procedure is reversed in that the fire shutoff switch is pulled first followed by retarding the throttle to CUTOFF. See "Fire" this section.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS

ENGINE FAILURE DURING TAKEOFF AND CLIMB

Engine failure, even of an outboard engine just at the point of breaking ground on takeoff, introduces much less yaw and out-of-trim effect than on propeller-driven airplanes. Hence, with surface power control operating, engine failure on this airplane affects directional control less than on propeller-driven airplanes. The most critical condition would be failure after the refusal speed is reached on takeoff with very high gross weights and high outside air temperatures. Under these conditions, acceleration to climb speed would be slow and ability to maintain altitude during acceleration would be marginal. When an engine fails, the pilot must be able to either stop on the runway or continue takeoff safely. If an engine fails before refusal speed has been attained, stopping is obviously the correct procedure. If the engine fails at a higher speed however, the airplane cannot stop in the remaining runway distance and should therefore continue the takeoff. When using ATO these considerations apply and if failure occurs above refusal speed, takeoff must be continued with one engine out and the rockets fired at the recommended firing speed which is the same whether or not an engine fails. For takeoff planning considering engine failure refer to parts 2, 3, and 4 of the appendix. If an engine fails immediately after the takeoff operation, climb performance at high weights is marginal for high temperatures and altitudes until the gear is raised. This is the reason for saving some ATO duration for the initial climb while the gear is starting up. The following sketch shows the effect of airspeed on rate of climb available after takeoff with flaps and gear down.



It shows that, for maximum rate of climb, an airspeed somewhat higher than the takeoff is required. The curves are fairly flat however, indicating that rigid climb speed control is not necessary. Gear drag lowers the rate of climb approximately 300 feet per minute at takeoff speeds with flaps down. An engine failure decreases the rate of climb by approximately 500 feet per minute under the same conditions. Climb performance at takeoff speeds with one engine out and gear and flaps down is shown in part 5 of the appendix.

ENGINE FAILURE DURING CRUISE

Failure of an engine during cruise will not appreciably affect directional control but will cause a decrease in IAS and, depending on the gross weight, make it necessary to select a lower cruise altitude. If the automatic pilot is in operation with altitude control ON and an engine fails, the altitude will be maintained but with a resultant loss in IAS. If the altitude control is OFF, the IAS will be maintained with a resultant decrease in altitude.

MINIMUM CONTROL SPEEDS

Minimum control speeds with various combinations of inoperative engines at low altitudes are shown in figure 3-2.

NOTE

In the event that three engines on one side are rendered inoperative during flight and the remaining three engines are operating at 100% rpm, recommended minimum control speed for failure of aileron or rudder surface power control is 160 knots IAS.

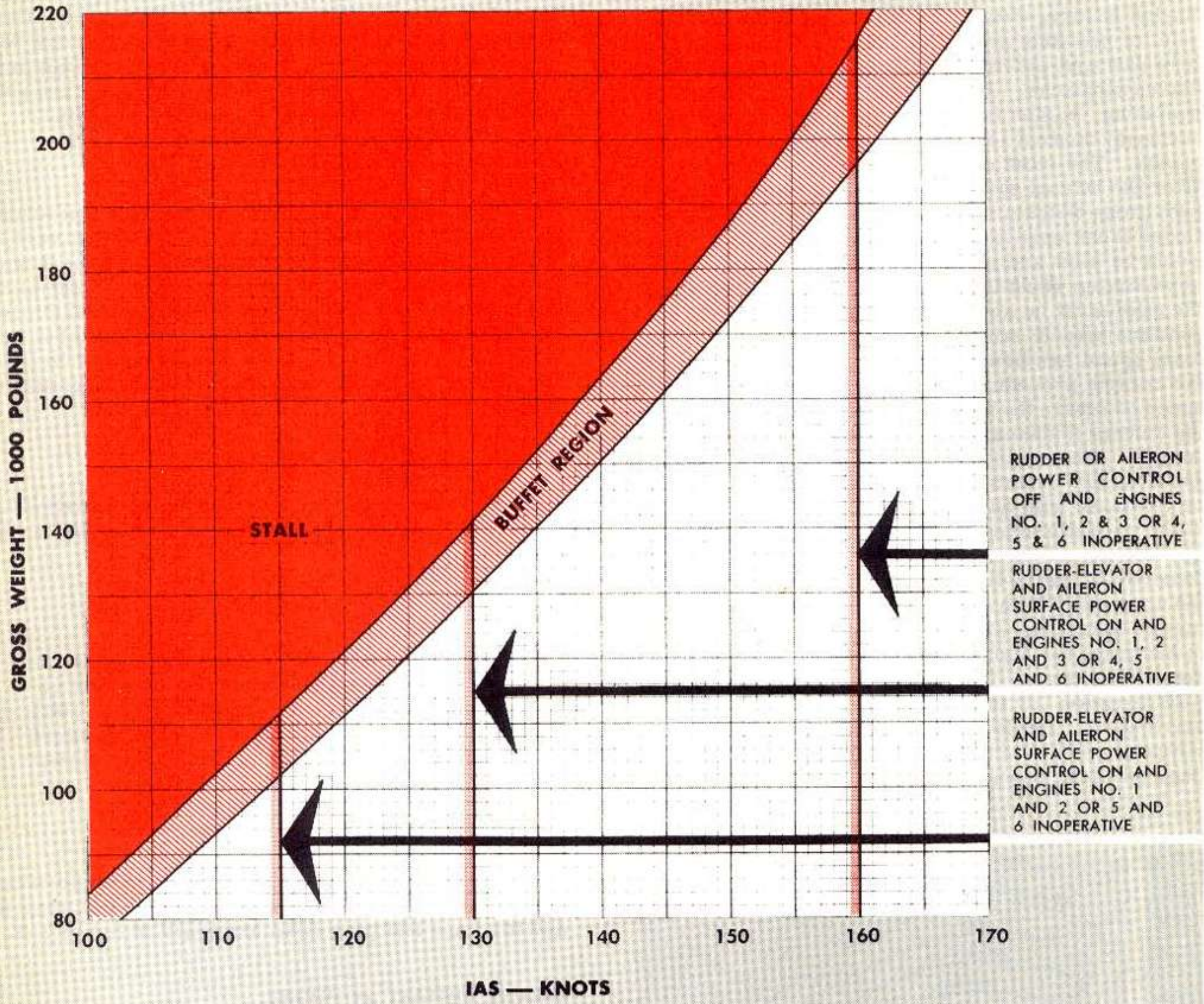
SERVICE CEILINGS

Service ceilings with various number of engines operating at military rated rpm for flaps and gear up and for flaps and gear down are found in figure 3-3.

ENGINE RESTART IN FLIGHT

If conditions permit, engine restarts should be made at lower altitudes (35,000 feet and under) since restarts become progressively hotter and difficult at altitudes over 35,000 feet. Make engine acceleration and decelerations as slowly as practicable at altitude to avoid flame-out or compressor stalls. All restarts should be made at engine windmill rpm of 21% to 25%.

minimum control speeds with inoperative engines



NOTES

1. ALL ENGINES OPERATING AT 100% RPM
2. FLAPS DOWN
3. J47-25 & -25A ENGINES (DRY)
4. MINIMUM CONTROL SPEEDS DECREASE AS ALTITUDE INCREASES
5. MINIMUM CONTROL SPEED DECREASES AS RPM ON OPERATING ENGINES IS REDUCED

DATE: MARCH 1953

DATA BASIS: FLIGHT TEST

CONDITIONS: SEA LEVEL TO 5000 FEET

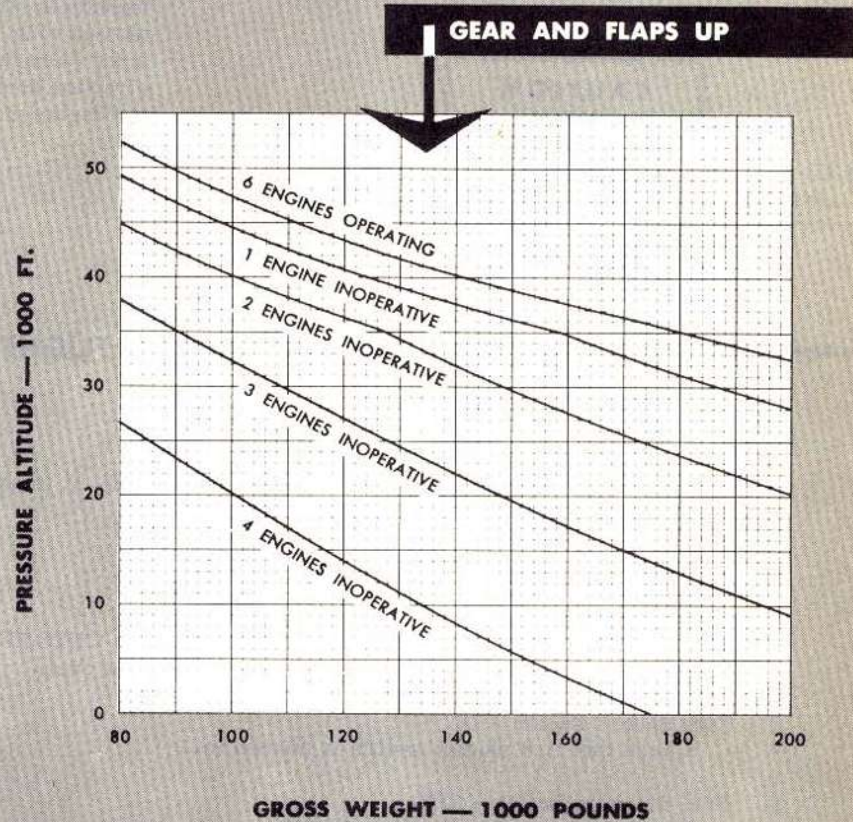
NACA STANDARD DAY

50302WC

Figure 3-2.

service ceilings with inoperative engines

naca standard day



CONDITIONS:

98% RPM ON OPERATING ENGINES

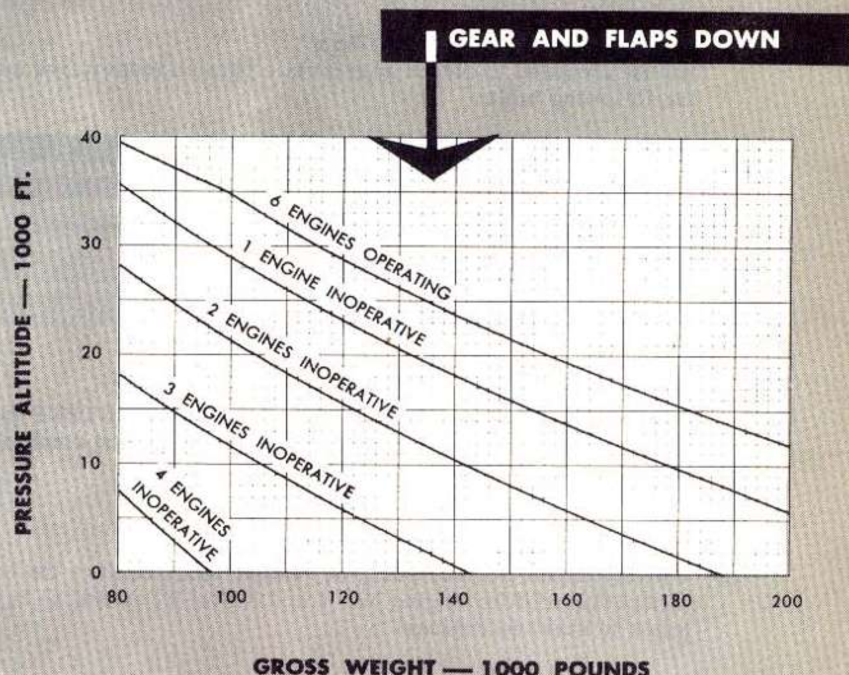
100 FPM RATE OF CLIMB

DATE:

OCTOBER 1952

DATA BASIS:

FLIGHT TEST



50320WC

Figure 3-3.

NOTE

Successful restarts may be made at altitudes up to 40,000 feet provided proper procedures are followed.

CAUTION

- All restarts should be made at minimum safe airspeeds after it has been determined that a restart will be reasonably safe.
- It is inadvisable to practice stopping and restarting the engines. The effect of cooling will cause the shroud ring to contract more rapidly than the turbine wheel. This allows the turbine buckets to strike the inner circumference of the shroud ring, with the likelihood of both parts being damaged extensively. However, in cases of actual emergency, and particularly for fire, the engine must be shut down immediately.

ENGINE RESTART IN FLIGHT

NOTE

Since the airflow will cause the engine to windmill, it is not necessary to use the starter above 150 knots IAS.

1. Throttle - CUTOFF
   On loss of power, immediately retard throttle to CUTOFF. Allow approximately 2 or 3 minutes for airflow to purge engine of accumulated fuel.
2. Fire Shutoff Switch - IN
   Check that fire shutoff switch is pushed in.
3. Fuel Selector Switch - SET
   Check fuel selector is properly set.
4. Adjust Airspeed to Appropriate Rpm
   Adjust airspeed to obtain appropriate rpm on inoperative engine, as related to altitude in the following table:

ALTITUDE (FT)	RPM RECOMMENDED
30,000 TO 40,000	21% and over
25,000 TO 30,000	21%
0 TO 25,000	25%

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5. Ignition - ALTITUDE START OR TEST
   Position ignition switch to ALTITUDE START or TEST approximately 1 minute prior to opening throttle to allow purging the spark plugs and combustion chambers of any residual fuel which may remain.
6. Alternator - RESET

   (1)► If either engine No. 1 or 6 is to be restarted, make sure the corresponding alternator power switch (LH ALT for engine No. 1 and RH ALT for No. 6) is placed in RESET momentarily prior to starting engines.

(CONTINUED ON NEXT PAGE)

(1)► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

ENGINE RESTART IN FLIGHT

(CONTINUED)

①► If either engine No. 1 or 6 is to be restarted, make sure the corresponding alternator control switch is placed to RESET position momentarily prior to engine starting.

7. Throttle - START DETENT
   Move throttle to START detent and watch for evidence of combustion on exhaust gas temperature gage.

NOTE

- At 35,000 feet and higher it is necessary to advance the throttle past the START detent and sometimes to the idle detent with optimum windmilling rpm at 21% or more. It may be necessary to retard the throttle after ignition in order to prevent stalling and/or overtemperature.
- If there is no indication of combustion after 30 seconds, close throttle to CUTOFF, allow 1 or 2 minutes for fuel line drainage, and then repeat restarting procedure.

8. Throttle - IDLE
   Advance throttle to increase fuel pressure and flow as required to maintain an exhaust gas temperature between 450° and 500° C until normal idle rpm for that altitude is obtained.

NOTE

Care should be taken to avoid advancing the throttles too rapidly since rapid throttle movement can cause a compressor stall.

9. Ignition - OFF
   Check ignition switch is OFF.

NOTE

Some ignition system units are likely to become overheated if energized for extended periods. The ignition switch should therefore be allowed to remain in the ALTITUDE START OR TEST position for no longer than 3 minutes at any one time.

②► 10. Alternator - NORMAL
   After 52% engine rpm has been reached, place the alternator power switch to NORMAL. Alternator operation below 52% engine rpm may result in damage to equipment receiving power from the alternator.

11. Adjust Engine to Desired Rpm

ENGINE FAILURE UNDER SPECIFIC CONDITIONS

ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED

If engine failure occurs before refusal speed is reached, proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

(CONTINUED ON NEXT PAGE)

①► AF 52-1417, 53-1819 through -2170, -2279 & on
②► AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED

(CONTINUED)

2. Throttles - IDLE
   Immediately retard all throttles to the idle stop.

3. Brake Chute and Approach Chute - DEPLOYED
   Deploy brake chute. If installed, approach chute should be deployed also.

4. Brakes - APPLIED
   Apply brakes. Maintain maximum braking with antiskid operating by depressing and holding pedals to achieve slow (2 or 3 seconds) cycling of antiskid. This can be recognized by intermittent slight lurching of the airplane each time the antiskid system releases the brakes. Heavier pedal pressure will cause inefficient cycling of the antiskid or may cause pedal travel into the emergency braking range where antiskid protection is not provided. Either misuse will increase distance required to stop. Emergency braking should not be used unless the main brake system is inoperative.

5. Throttles 1, 2, 5 & 6 - CUTOFF
   Retard throttles No. 1, 2, 5, and 6 to CUTOFF.

6. If a Stop Cannot be Made Before Reaching an Obstacle and IAS is not Over 60 Knots:
   a. Steering ratio selector - TAXI

      NOTE

      Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

   b. Ground-loop the airplane
   c. Throttles 3 and 4 - CUTOFF
   d. Fire shutoff switches - PULLED

7. If a Stop or Ground-Loop Cannot be Made Before Reaching an Obstacle:
   a. Landing gear - RETRACTED
      Retract all landing gear with the landing gear emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF position prior to actuation of emergency retraction switch, retraction will be more positive.
   b. Battery - OFF
      Place the battery switch OFF after the landing gear retracts.
   c. Canopy - REMOVED
   d. Abandon airplane
      Leave the airplane as soon as possible. To prevent possible injury caused by leaping from the airplane, use the wing as a ramp or slide down the nose.
   e. Assemble upwind

ENGINE FAILURE OR PARTIAL ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Landing Gear - UP
   Retract the landing gear as soon as airborne.

(CONTINUED ON NEXT PAGE)

ENGINE FAILURE OR PARTIAL ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED

(CONTINUED)

3. Throttle - CUTOFF (vibration or fire)
   If engine failure is accompanied by vibration or fire, retard throttle to CUTOFF.

NOTE

Lesser symptoms of malfunction may permit continued operation of the engine throughout the takeoff, thus allowing utilization of what thrust is being developed until cause of the malfunction can be determined.

4. Fire Shutoff Switch - PULLED
   Pull fire shutoff switch. Check that "Main Fuel Control" and "Main Fuel Warning, Manifold and Fire Shutoff Valves" circuit breakers on the upper DC power panel and "Throttles and Engine Control" circuit breakers on the lower DC power panel are reset in order to insure operation of fire shutdown.

5. Takeoff Speed Plus 15 Knots - RETRACT FLAPS
   Start retracting flaps at approximately 15 knots above takeoff speed. Settling of the airplane is noticeable when the flaps retract beyond the 50% position if the IAS is less than approximately 170 knots. Therefore, care should be exercised in raising the flaps beyond 50% if acceleration is extremely slow.

6. Start Climb at 175 Knots
   Gain a minimum of 175 knots before attempting to climb.

7. Reset Fire Shutoff Switch to Lubricate Engine
   If fire shutdown has been accomplished, the pilot may at his own discretion reset the fire shutoff switch to permit lubrication of the affected engine.

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF, CRASH LANDING

1. Crew - ALERTED
   Give one long sustained ring on the alarm bell and brace-for-crash-landing warning on interphone.

2. Bombs and External Wing Tanks - JETTISONED
   Jettison bombs and external wing tanks (only if containing fuel). Close bomb doors if altitude permits.

3. Flaps - DOWN
   Extend wing flaps to full down and maintain directional control.

4. Landing Gear - UP
   Retract landing gear at pilot's discretion.

5. Canopy - JETTISONED (open)
   Jettison canopy. If sliding canopy cannot be jettisoned safely, open sliding canopy and leave lever in OPEN position. This procedure maintains hydraulic pressure in the actuating cylinder and will prevent the sliding canopy from creeping or slamming closed during crash landing.

(CONTINUED ON NEXT PAGE)

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF, CRASH LANDING

(CONTINUED)

6. Shoulder Harness - LOCKED
   Lock shoulder harness.

7. Throttles - CUTOFF
   Place all throttles to CUTOFF.

8. Land Straight Ahead, Changing Direction Only Enough to Miss Obstacles

9. Prior to Touchdown:
   Fire Shutoff Switches - PULLED

10. Brake Chute - DEPLOYED
    Deploy brake chute on touchdown.

11. After airplane stops:
    a. Battery - OFF
    b. Abandon airplane
       Observer actuates observer's emergency hatch release lever. If canopy has not been jettisoned, proceed as follows: With sliding canopy, pilot or copilot pulls the canopy release handle and lifts the canopy off the airplane; with clamshell canopy, pilot or copilot pulls the canopy emergency jettison handle. If the clamshell canopy will not jettison, the pilot unlocks and unlatches the canopy, then squeezes and pulls down on the canopy remover disconnect handle. The copilot lifts the hinge pin release handle out of detent and moves it toward the opposite side of the airplane. Both pilots lift the canopy off the airplane.
    c. Assemble upwind
       Crew members leave airplane using wing or nose as a ramp to assemble upwind.

ENGINE FAILURE DURING FLIGHT

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Throttle - CUTOFF
   Retard throttle of affected engine to CUTOFF.

3. Fire Shutoff Switch - PULLED
   Pull fire shutoff switch. Check that all circuit breakers on upper and lower DC power panels are in to insure fire shutdown. If engine failure is accompanied by fire, pull fire shutoff switch then retard throttle to CUTOFF.

(CONTINUED ON NEXT PAGE)

ENGINE FAILURE DURING FLIGHT

(CONTINUED)

NOTE

For service ceilings that can be attained with one or more inoperative engines, see figure 3-3.

4. Fuel Selector Switch - SET
   Position affected engine fuel selector switch to TE position.

5. To Lubricate Engine - RESET FIRE SHUTOFF SWITCH.
   The pilot may at his own discretion reset the fire shutoff switch to permit lubrication of the affected engine.

CAUTION

- When a fire shutoff switch is pulled, oil supply to the engine is cut off. However, the engine will continue to windmill and will be damaged by lack of lubrication if allowed to windmill more than 15 minutes without oil. In order to prevent major engine damage, it is recommended that lubrication be restored to the engine when safe within 15 minutes after fire shutoff switch is pulled. This can be done by resetting the fire shutoff switch for the affected engine.

- If lubrication is not advisable or fire warning light remains on, land airplane as soon as possible.

- On airplanes with polished inboard nacelle surfaces, crew members should monitor the reflections of the fuselage after an engine failure. It is possible for particles to be thrown from the affected engine into the fuselage, starting a fire.

MAXIMUM GLIDE

The possibility of a total loss of thrust for any reason other than fuel exhaustion is extremely remote. In the event such a situation should arise, a considerable distance may be obtained from high altitudes if close attention is given to the proper procedure for maximum range gliding. The maximum glide distances will be found in the chart on figure 3-4. As shown on the chart, a glide ratio of approximately 18 to 1 is available with a no-wind condition and with fuel exhausted.

MAXIMUM GLIDE

When a total loss of thrust is experienced, proceed as follows:

1. Gear and Flaps - FULLY RETRACTED
   Check to see that landing gear and flaps are both UP.

2. Maintain Glide of 185 Knots IAS
   Trim airplane to glide at 185 knots IAS.

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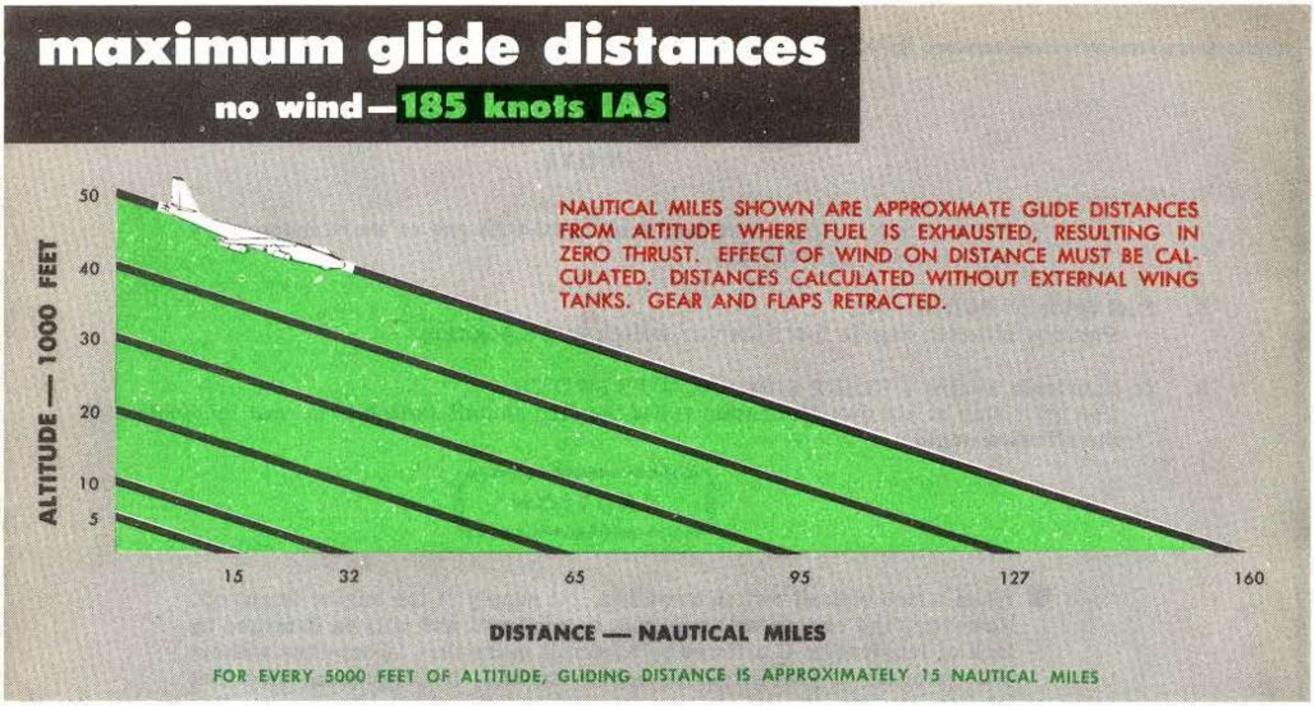

Figure 3-4.

MAXIMUM GLIDE

(CONTINUED)

3. Jettison External Wing Tanks
4. Bomb Bay Doors - CLOSED
5. Use Only Shallow Banked Turns
   Glide straight ahead; any necessary turns should be made with the angle of bank as shallow as possible.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

1. Crash Alert
   Alert tower for crash equipment and alert crew over interphone of existing emergency.

2. Establish Normal Traffic Pattern

NOTE

If three engines are inoperative, maintain at least 160 knots IAS and do not extend gear until after the turn from downwind to final has been started, or until the start of the final approach, and it is certain that the landing area can be reached.

WARNING

Care should be taken with engines out to avoid excessive reduction of speed or altitude until the runway is within range of the reduced power glide.

3. Trim Tabs - SET
   Adjust rudder and aileron trim to remove about one-half of the control force required to hold directional and lateral control. This will lessen sudden heavy control forces if a surface power control fails. Keep the ball and yaw string centered.

4. Landing Gear - DOWN
   If three engines are out on one side, gear should be extended at pilot's discretion during turn from downwind to final or at start of final.

5. Anticipate a Go-Around as Soon as Possible

6. Final
   On final approach, bleed off airspeed to start the flare at best flare speed plus gust correction. Roll out trim gradually along the final approach as rpm is reduced. This will eliminate unbalanced control forces when the remaining operative engines are retarded to idle in the flare.

CAUTION

Any appreciable amount of yaw at low speeds will result in a potentially critical rolling tendency which should be corrected immediately. With a reduction in thrust, or even complete failure of only one engine on one side, it is entirely possible to compensate for yaw by use of the rudder with surface power control on and at normal landing gross weights. However, with a reduction in thrust of more than one engine on a side, care should be exercised that the yaw does not become uncontrollable. When the possibility of such a condition becomes noticeable, retard the throttle for the outboard engine on the side with predominant thrust until it is apparent that the yaw can be controlled with rudder.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

NOTE

Go-around on less than the full number of engines is not recommended. However, if the approach for landing with less than full power available is unsatisfactory, the decision for go-around should be made before descending too low, if possible. The sooner the decision to go-around is made, the better the chances are for a successful one. When weighing the possibilities for a go-around in terms of altitude, airspeed, gross weight, airplane configuration, wind conditions, runway facilities, and visibility, the pilot should also consider the advantages of a controlled crash landing over an unsuccessful go-around, especially if airplane performance is critical or altitude is marginal.

When attempting a landing with one or more engines inoperative and a go-around becomes necessary, it can be accomplished without undue difficulty if proper approach speed and altitude have been maintained and gross weight is limited. Proper directional control will depend on balanced power. If two engines are inoperative on one side, especially if one of them is an outboard engine, it will require considerable pilot technique to maintain directional control with full power on the remaining four engines. During an attempted go-around with unbalanced thrust, the airplane may turn toward the side of deficient thrust. If this turn can be controlled by use of the rudder rather than retarding a throttle on the side of predominant thrust, it will be an advantage to do so. This will allow a more rapid increase in the IAS to a point where more effective directional control can be maintained. If the angle of bank tends to increase the turn beyond the effect of the rudder, a throttle on the high side must be retarded until the wings can be leveled and more complete control regained. Moreover, it may be found advisable to fly with the thrust deficient wing slightly high in order to maintain adequate directional control.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

Assuming that a go-around is to be attempted with one or more engines inoperative on opposite sides and leaving the remaining power equally balanced. the following procedure is recommended:

1. Crew - ALERTED
   Alert crew over interphone of the decision to go-around.
2. Throttles on Operative Engines - 100% RPM
   Advance throttles on all operative engines to 100% RPM and maintain airspeed. If directional control cannot be maintained by use of rudder, reduce power on good outboard engine until directional control is regained.
3. Landing Gear - UP
   When certain that airspeed is sufficient to prevent "mushing" back onto runway, place landing gear lever in UP position.
4. Airspeed - 175 KNOTS
   Attain a minimum of 175 knots before attempting to climb.
5. Establish Normal Traffic Pattern

CAUTION

If thrust is unbalanced due to engine malfunction or failure on one side, it may be necessary to seek a more balanced condition. Any appreciable amount of yaw at low speeds will result in a potentially critical rolling tendency which should be corrected immediately. With a reduction in thrust, or even complete failure of only one engine on one side, it is entirely possible to compensate for yaw by use of the rudder with surface power control on and at normal landing gross weights. With a reduction in the thrust of more than one engine on one side however, care should be exercised that the yaw does not become uncontrollable. When the possibility of such a condition becomes noticeable as throttles are advanced, retard the throttle for the outboard engine on the side with predominant thrust until it is apparent that the yaw can be controlled with rudder.

6. Follow Procedure Under "Landing With One or More Engines Inoperative," This Section.

GO-AROUND AFTER THE BRAKE CHUTE DEPLOY HANDLE HAS BEEN PULLED

WARNING

Due to the hazards involved after the brake chute deploy handle has been pulled, a go-around should be attempted only in an extreme emergency.

In the event a go-around becomes necessary after the brake chute deploy handle has been pulled, the following procedure should be followed: Upon the pilot's order the copilot pulls the brake chute jettison handle and holds a positive pressure until he has determined that the brake chute has been jettisoned or a safe landing is accomplished.

TAKEOFF WITH ONE OR TWO ENGINES INOPERATIVE

For emergency evacuation or similar conditions it may be found necessary to take off with only four or five engines operating. Under such conditions, the takeoff distance can be found by consulting the chart entitled "Four and Five-Engine Takeoff Distance" in part 2 of the appendix. The chart must be entered with the normal six-engine takeoff distance based on water injection and/or ATO if these are available.

CAUTION

Do not attempt to takeoff with more than one engine inoperative on the same side. Minimum safe takeoff is with four engines at normal operation.

TWO-ENGINE ENDURANCE

Maximum endurance at altitudes below approximately 10,000 feet is attained with only two engines operative. Minimum airplane drag and related endurance speeds and altitudes are the prime factors for maximum endurance. To reduce load on the two remaining generators, all electrical equipment such as landing gear and flaps should be actuated before engine shutdown. With two engines operating, thrust available to sustain flight is marginal with either gear or flaps extended and inadequate if both are extended. When it is necessary to remain in the air at low altitudes for holding over destination or other reasons, and fuel supply remaining is critical, proceed as follows:

ALTITUDE	APPROXIMATE RPM PERCENT MAX	NUMBER OF OPERATING ENGINES GROSS WT. — (1000 POUNDS)						
		80	100	120	140	160	180	200
Above 30,000′	85	6	6	6	6	*	*	*
20,000′ to 30,000′	85	4	4	5	5	6	6	6
10,000′ to 20,000′	85	3	3	4	4	5	5	5
S L to 10,000′	85	2	2	3	3	3	3	4

*ALTITUDE NOT PRACTICAL FOR HIGH GROSS WEIGHT

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TWO-ENGINE ENDURANCE

1. Gear and Flaps - RETRACTED
   Check airplane in "clean" condition (landing gear and wing flaps fully retracted).

2. Unnecessary Electrical Equipment - OFF
   Turn off all unnecessary electrical equipment. See "Electrical System Emergency Operation" this section.

3. Throttles 1, 2, 5 & 6 - CUTOFF
   Retard throttles to the idle stop on engines No. 1, 2, 5, and 6; wait at least 30 seconds (60 seconds desired) to allow contraction of shroud ring and turbine wheel to become equalized, then move throttles to CUTOFF. If alternators are required, engines No. 1 and 6 will have to be maintained at a minimum of 52% rpm.

(CONTINUED ON NEXT PAGE)

TWO-ENGINE ENDURANCE

(CONTINUED)

NOTE

- Do not actuate fire shutdown. Allowing the engines to windmill will permit rapid restarts without the use of starters.
- ① If "K" system operation, windshield anti-icing, and/or refueling slipway anti-icing is required, engines No. 1 and 6 must be kept operating at the minimum of 52% rpm to provide alternator power and to maintain symmetrical thrust.

4. Fuel Selector Switches - SET
   Accomplish fuel system management to utilize all fuel and maintain airplane cg within limits by positioning the fuel selector switches for the highest level tank to TME and all other fuel selector switches to ME. Because of electrical load requirements, position fuel selector switches so as to have only four boost pumps operating at any one time.

5. Maintain Best Endurance Speed and Altitude
   Airspeed, altitude, and time are based on gross weights. For endurance at light weights near the end of a mission, use of the "Optimum Endurance at Light Weight" chart in part 7 of the appendix will be most convenient. For example: With a gross weight of 90,000 pounds, an altitude between sea level and 10,000 feet should be maintained at an airspeed of 160 knots IAS. Endurance time under the above conditions is 107 minutes.

CAUTION

Maintain the airplane in clean condition and do not attempt anything but endurance flight while operating on two engines.

6. Engines - RESTARTED
   After endurance flight period is completed and/or before making landing approach, restart remaining four engines.

7. Electrical Equipment - ON
   Turn on additional electrical equipment as desired and proceed as in normal flight.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE

Recommended altitude for practice maneuvers with one engine inoperative is 5000 feet or above; with more than one engine inoperative is 10,000 feet or above. A gross weight within the normal landing weight range (90,000 to 110,000 pounds) is recommended. Under these conditions, such maneuvers as approach and landing and go-around with reduced thrust may be safely practiced. For such operations, it is inadvisable that the engine or engines be shut down completely, but the throttle merely retarded to the idle stop. This reduction in thrust will provide control and maneuverability problems essentially the same as with a complete loss of thrust on an engine. Practice maneuvers may be performed with both power on and power off for the individual control surfaces, but considerable care should be exercised during these maneuvers. The ability of the pilot to hold the airplane in level flight with any surface power control system off will vary with the IAS, the number of engines out on one side, and the amount of thrust maintained on the other side. It is recommended that practice maneuvers with surface power control off be made with only one throttle retarded and at several indicated airspeeds before attempting any further reductions in thrust.

NOTE

In the event that three engines on one side are rendered inoperative during flight and the remaining three engines are operating at 100% rpm, the recommended minimum control speed for failure of aileron or rudder surface power control is 160 knots IAS.

① AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

ENGINE FAILURE — CONDENSED CHECKLIST

ENGINE RESTART IN FLIGHT

1. Throttles - CUTOFF
2. Fire Shutoff Switch - IN
3. Fuel Selector Switch - SET
4. Adjust Airspeed to Appropriate Rpm
5. Ignition - ALTITUDE START OR TEST
6. Alternator - RESET
7. Throttle - START DETENT
8. Throttle - IDLE
9. Ignition - OFF
10. Alternator - NORMAL
11. Adjust Engine to Desired Rpm

ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake Chute and Approach Chute - DEPLOYED
4. Brakes - APPLIED
5. Throttles 1, 2, 5 & 6 - CUTOFF
6. If Stop Cannot Be Made and IAS Not Over 60 Knots:
   a. Steering ratio selector - TAXI
   b. Ground-loop the airplane
   c. Throttles 3 and 4 - CUTOFF
   d. Fire shutoff switches - PULLED
7. If Impossible to Stop or Ground-Loop Before Reaching Obstacle:
   a. Landing gear - RETRACTED
   b. Battery - OFF
   c. Canopy - REMOVED
   d. Abandon airplane
   e. Assemble upwind

ENGINE FAILURE OR PARTIAL ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED

1. Crew - ALERTED
2. Landing Gear - UP
3. Throttle - CUTOFF (vibration or fire)
4. Fire Shutoff Switch - PULLED
5. Takeoff Speed Plus 15 Knots - RETRACT FLAPS
6. Start Climb at 175 Knots
7. Reset Fire Shutoff Switch to Lubricate Engine

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF, CRASH LANDING

1. Crew - ALERTED
2. Bombs and External Wing Tanks - JETTISONED
3. Flaps - DOWN
4. Landing Gear - UP
5. Canopy - JETTISONED (open)
6. Shoulder Harness - LOCKED
7. Throttles - CUTOFF
8. Land Straight Ahead, Changing Direction Only Enough to Miss Obstacles
9. Prior to Touchdown: Fire Shutoff Switches - PULLED
10. Brake Chute - DEPLOYED
11. After Airplane Stops:
    a. Battery - OFF
    b. Abandon Airplane
    c. Assemble Upwind

ENGINE FAILURE DURING FLIGHT

1. Throttle - CUTOFF
2. Fire Shutoff Switch - PULLED
3. Fuel Selector Switch - SET
4. Reset Fire Shutoff Switch to Lubricate Engine

MAXIMUM GLIDE

1. Gear and Flaps - FULLY RETRACTED
2. Maintain Glide of 185 Knots IAS
3. Jettison External Wing Tanks
4. Bomb Bay Doors - CLOSED
5. Use Only Shallow Banked Turns

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

1. Crash Alert
2. Establish Normal Traffic Pattern
3. Trim Tabs - SET
4. Landing Gear - DOWN
5. Anticipate a Go-around as Soon as Possible
6. Final
   a. Bleed off to BFS plus gust correction
   b. Roll out trim

(CONTINUED ON NEXT PAGE)

ENGINE FAILURE — CONDENSED CHECKLIST

(CONTINUED)

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

1. Crew - ALERTED
2. Throttles on Operative Engines - 100% RPM
3. Landing Gear - UP
4. Airspeed - 175 KNOTS
5. Establish Normal Traffic Pattern
6. Follow Procedure Under "Landing With One or More Engines Inoperative" This Section

TWO-ENGINE ENDURANCE

1. Gear and Flaps - RETRACTED
2. Unnecessary Electrical Equipment - OFF
3. Throttles 1, 2, 5 & 6 - CUTOFF
4. Fuel Selector Switches - SET
5. Maintain Best Endurance Speed and Altitude
6. Engines - RESTARTED
7. Electrical Equipment - ON

FIRE

NOTE

No engine fire extinguishing system is installed in this airplane.

ENGINE FIRE ON THE GROUND

1. Visible Fire, Throttles on Side of Fire - CUTOFF
   When fire is visible on an engine, retard all engine throttles on that side to CUTOFF. If smoke is the only physical evidence of fire, retard all operating engine throttles on that side to idle and the smoking engine to CUTOFF.
2. If Taxiing, STOP AND SET BRAKES

   NOTE

   If burning fuel or raw fuel is running from engine on fire, move airplane if possible to avoid accumulation of fuel under wing.
3. Tower & Crew - ALERTED
   Call control tower giving position of the airplane and the existing emergency condition. Alert crew over interphone.
4. Circuit Breakers - IN
   Check that "Main Fuel Control" and "Main Fuel Warning, Manifold and Fire Shutoff Valves" circuit breakers on upper DC power panel and "Throttle and Engine Control" circuit breakers on lower DC power panel are in to insure fire shutdown.

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ENGINE FIRE ON THE GROUND

(CONTINUED)

5. If Fire Shutdown of Affected Engine Has Not Been Accomplished:
    a. Place starter selector switch to the affected engine.
    b. Momentarily actuate starter switch and emergency override switch to motor the engine.

6. If Fire Shutdown of Affected Engine Has Been Accomplished:
    a. Reset fire shutoff switch.
    b. Actuate generator switch to the affected engine.
    c. Place starter selector switch to the affected engine.
    d. Momentarily actuate starter switch and emergency override switch to motor engine.

7. Fire Shutoff Switches - PULLED

8. Throttles - CUTOFF
   Pull fire shutoff switch.

NOTE

If fire or smoke continues, advise ground personnel, if available, to use fire extinguisher through knockout panel in the cowl panel of affected engine.

9. Battery Switch - OFF

10. Abandon Airplane
    Give one long ring on alarm bell and spoken warning "Abandon the airplane" over interphone; shut off all switches.

11. Assemble Upwind
    Crew abandon airplane by the safest means and assemble upwind.

ENGINE FIRE DURING TAKEOFF

ENGINE FIRE DURING TAKEOFF — TAKEOFF REFUSED

In case a fire warning light illuminates or an engine fire occurs during takeoff at or below refusal speed, abort takeoff and proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.
2. Throttles - IDLE
   Immediately retard all throttles to the idle stop.

3. Brake and Approach Chutes - DEPLOYED
   Deploy the brake chute and approach chute if installed.

(CONTINUED ON NEXT PAGE)

ENGINE FIRE DURING TAKEOFF — TAKEOFF REFUSED

(CONTINUED)

4. Brakes - APPLIED
   Apply brakes. Maintain maximum braking with antiskid operating by depressing and holding pedals to achieve slow (2 or 3 seconds) cycling of antiskid. This can be recognized by intermittent lurching of the airplane each time the antiskid system releases the brakes. Heavier pedal pressure will cause inefficient cycling of the antiskid or may cause pedal travel into the emergency braking range where antiskid protection is not provided. Either misuse will increase distance required to stop. Emergency braking should not be used unless the main brake system is inoperative.

NOTE

Idle power must be kept on engines No. 3 and 4 to maintain hydraulic pressure.

5. Throttles 1, 2, 5 & 6 - CUTOFF
6. Fire Shutoff Switches 1, 2, 5 & 6 - PULLED
   Pull fire shutoff switches for engines No. 1, 2, 5, and 6.
7. If a Stop Cannot be Made Before Reaching an Obstacle and IAS is Not Over 60 Knots:
   a. Steering ratio selector - TAXI

NOTE

Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

   b. Ground-loop the airplane
   c. Throttles 3 and 4 - CUTOFF
   d. Fire shutoff switches - PULLED
8. If a Stop or Ground-Loop Cannot be Made Before Reaching an Obstacle:
   a. Landing gear - RETRACTED
      Retract all landing gear with the landing gear emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF position prior to actuation of emergency retraction switch, retraction will be more positive.
   b. Battery - OFF
   c. Canopy - REMOVED
   d. Abandon airplane
      Leave the airplane as soon as possible. To prevent possible injury caused by leaping from the airplane, use the wing as a ramp or slide down the nose.
   e. Assemble upwind

ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED

In case a warning light illuminates or an engine fire occurs during takeoff above refusal speed, takeoff will be continued as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

(CONTINUED ON NEXT PAGE)

ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED

(CONTINUED)

2. Landing Gear - UP
   Retract the landing gear as soon as airborne.

3. Throttle - IDLE
   Retard affected engine throttle to idle.

NOTE

If, after retarding throttle, the light goes out and indications are normal, advance the throttle to climb power setting.

4. Fire Shutoff Switch - PULLED (if any of the following occurs)
   a. Warning light illuminates again after throttle is advanced.
   b. Warning light remains illuminated.
   c. EGT is high.
   d. Visible evidence of fire.

   Check that "Main Fuel Control" and "Main Fuel Warning, Manifold and Fire Shutoff Valves" circuit breakers on the upper DC power panel and the "Throttle and Engine Control" circuit breakers on the lower DC power panel are reset in order to insure operation of fire shutdown.

5. Throttle - CUTOFF
   Retard throttle to CUTOFF after pulling fire shutoff switch.

6. Fuel Selector - SET
   Position fuel selector switch to TE.

7. Takeoff Speed Plus 15 Knots - RETRACT FLAPS
   Start retracting flaps at approximately 15 knots above takeoff speed. Settling of the airplane is noticeable when the flaps retract beyond the 50% position if the IAS is less than approximately 170 knots. Therefore, care should be exercised in raising the flaps beyond 50% if acceleration is extremely slow.

8. Start Climb at 175 Knots
   Gain a minimum of 175 knots before attempting to climb.

9. Reset Fire Shutoff Switch to Lubricate Engine
   After the fire has been eliminated, the pilot may at his own discretion reset the fire shutoff switch to permit lubrication of the affected engine.

10. Do Not Restart Engine

ENGINE FIRE DURING FLIGHT

In case a fire warning light illuminates or an engine fire occurs during flight, proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

(CONTINUED ON NEXT PAGE)

ENGINE FIRE DURING FLIGHT

(CONTINUED)

2. Fire Shutoff Switch - PULLED
   Pull fire shutoff switch for affected engine.

3. Throttle - CUTOFF

4. Fuel Selector - SET
   Position fuel selector for engine on fire to TE.

5. Circuit Breakers - IN
   During engine fire shutdown the copilot checks that the "Main Fuel Control" and "Main Fuel Warning, Manifold and Fire Shutoff Valves" circuit breakers on the upper DC power panel and the "Throttle and Engine Control" circuit breakers on the lower DC power panel are reset in order to insure operation of fire shutdown.

6. If Fire is Located in an Inboard Nacelle and Fire Continues Actuate Fire Shutdown on the Adjacent Engine.

NOTE

On airplanes with polished inboard nacelle surfaces, crew members should monitor the reflections of the fuselage during and after an engine fire. It is possible for particles to be thrown from the affected engine into the fuselage, starting a fire.

7. If Fire is Uncontrollable - ABANDON AIRPLANE
   If fire is uncontrollable, abandon airplane by giving warning with three short rings on alarm bell, spoken word on interphone, bailout signal by one long ring on alarm bell, and bailout order on interphone. See "Bailout" this section.

8. Reset Fire Shutoff Switch to Lubricate Engine
   The pilot may, at his own discretion, reset the fire shutoff switch to permit lubrication of the affected engine.

CAUTION

- When a fire shutoff switch is pulled, oil supply to the engine is cut off. However, the engine will continue to windmill and will be damaged by lack of lubrication if allowed to windmill more than 15 minutes without oil. In order to prevent major engine damage, it is recommended that lubrication be restored to the engine when safe within 15 minutes after the fire shutoff switch is pulled. This can be done by resetting the fire shutoff switch for the affected engine.

- If lubrication is not advisable or fire warning light remains on, land airplane as soon as practicable.

9. Do Not Attempt to Restart Engine

CREW COMPARTMENT FIRE

A hand fire extinguisher is provided to flight crew compartment fires. The following procedure is recommended:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Oxygen - 100%
   All crew members put on oxygen masks, position oxygen regulator diluter levers to 100% OXYGEN, and place oxygen emergency toggle levers in EMERGENCY position.

3. Cabin Pressure Emergency Release Handle - PULLED
   Pull cabin pressure emergency release handle and push heat reset button (optional).

4. Unnecessary Electrical Equipment - OFF
   Turn off all unnecessary electrical equipment.

5. Extinguish Fire
   Copilot or observer will locate fire and apply minimum extinguishing agent at the base of the flame.

WARNING

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

6. If Cabin Does Not Clear, Accomplish One of the Following:
   a. Canopy (sliding type only) - OPEN
      Reduce speed to 215 knots IAS and open the canopy. See "Canopy Emergency Operation During Flight" this section.
   b. Clear Vision Panel - OPEN
      On airplanes equipped with clear vision panel, open the panel to clear cabin of smoke or fumes.

7. Cabin Pressure Emergency Release Handle - PUSH
   When fire is out and smoke dissipated, repressurize cabin by pushing the cabin pressure emergency release handle down.

8. Oxygen - NORMAL
   Notify crew to position diluter levers to NORMAL OXYGEN position and emergency toggle lever off.

9. If Fire is Uncontrollable - ABANDON AIRPLANE
   If fire is uncontrollable, abandon airplane by giving warning with three short rings on alarm bell, spoken word on interphone, bailout signal by one long ring on alarm bell, and bailout order on interphone. See "Bailout" this section.

WING FIRE

Since no fire extinguisher system is installed to combat a wing fire, the following procedure is recommended:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.
2. Oxygen - 100%
   All crew members put on oxygen masks, position oxygen regulator diluter levers to 100% OXYGEN, and place oxygen emergency toggle levers in EMERGENCY position.
3. Fuel Selector Switches (opposite side of fire) - SET
   Set the fuel selector switches as necessary for engines on opposite side of the fire to keep all remaining engines operating.
4. Engines on the Side of the Fire:
   a. Fuel selector switches - TE
      Place fuel selector switches for the engines on the side of the fire to TE to allow closing of the tank and manifold valves thus preventing fuel from entering the wing and also allowing unrestricted selection of fuel management on the engines opposite the side of the fire.
   b. Throttles - CUTOFF
      Place the affected throttles to CUTOFF.

NOTE

For a wing fire outboard of either engine No. 1 or 6, only the engine nearest the fire need be shut down.

   c. Circuit breakers - IN
      Check that all circuit breakers are in on the upper and lower DC power panels to insure fire shutdown.
   d. Fire shutoff switches - PULLED
      Pull fire shutoff switches for the affected engines.

CAUTION

To assure fuel being cut off to the fire area, do not move throttles out of CUTOFF or attempt restarting the engines until it is ascertained the fire is completely out.

5. Unnecessary Electrical Equipment - OFF
   Turn off all unnecessary electrical equipment in affected area.
6. Aileron Surface Power Control - OFF (if necessary)
   If both the red and amber aileron surface power control lights are on indicating a hydraulic leak, turn the affected aileron power control OFF.

CAUTION

If the airplane is operating greatly above or below the crossover point of aileron trim forces, considerable aileron control force may be required to maintain level flight until the airplane can be trimmed to lessen the control wheel forces.

(CONTINUED ON NEXT PAGE)

WING FIRE

(CONTINUED)

7. If Fire is Uncontrollable - ABANDON AIRPLANE
   If fire is uncontrollable and continued flight is hazardous, abandon airplane by giving three short rings on alarm bell, spoken word on interphone, bailout signal by one long ring on alarm bell, and bailout order on interphone. See "Bailout" this section.

NOTE

> If bailout is necessary, the aileron surface power control switch for the wing on fire should be placed in ON because the automatic pilot cannot maintain level flight with one aileron surface power control system inoperative. However, if the surface power control system is rendered inoperative by fire, both aileron surface power control systems should be turned off and the ailerons trimmed to load the automatic pilot servo slightly. This will improve control by removing the effect of the control surface "lost motion."

FUSELAGE AND/OR EMPENNAGE FIRE

NOTE

> Possibility of fuselage fire may be visually checked by looking at reflection of underside of fuselage in the polished inboard nacelle surfaces provided on some airplanes.

Since no fire extinguishing system is installed to combat a fuselage or empennage fire, the following procedure is recommended:

a. If fire is uncontrollable, abandon airplane by giving bell warning with three short rings on alarm bell, spoken warning over interphone, bailout signal by one long ring on alarm bell, and bailout order over interphone. See "Bailout" this section.

NOTE

> Check that the rudder-elevator surface power control switch is ON and engage the automatic pilot. However, if the power control system is rendered inoperative by fire, it should be turned OFF and control surfaces should be trimmed to load the automatic pilot servo slightly. This will improve control by removing the effect of the control surface "lost motion."

FIRE — CONDENSED CHECKLIST

ENGINE FIRE ON THE GROUND

1. Visible Fire, Throttles on Side of Fire-CUTOFF
2. If Taxiing, STOP AND SET BRAKES
3. Tower & Crew - ALERTED
4. Circuit Breakers - IN
5. If Fire Shutdown of Affected Engine Has Not Been Accomplished:
   a. Starter selector to affected engine.
   b. Starter & override together.
6. If Fire Shutdown of Affected Engine Has Been Accomplished:
   a. Fire shutoff switch - IN
   b. Generator - RESET
   c. Starter selector - SET
   d. Starter & override - TOGETHER
7. Fire Shutoff Switches - PULLED
8. Throttles - CUTOFF
9. Battery Switch - OFF
10. Abandon Airplane
11. Assemble Upwind

ENGINE FIRE DURING TAKEOFF — TAKEOFF REFUSED

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake and Approach Chutes - DEPLOYED
4. Brakes - APPLIED
5. Throttles 1, 2, 5 & 6 - CUTOFF
6. Fire Shutoff Switches 1, 2, 5 & 6 - PULLED
7. If a Stop Cannot be Made Before Reaching an Obstacle and IAS is Not Over 60 Knots:
   a. Steering - TAXI
   b. Ground-loop.
   c. 3 & 4 - CUTOFF
   d. Fire Shutoff Switches - PULLED
8. If a Stop or Ground-Loop Cannot be Made Before Reaching an Obstacle:
   a. Gear - UP
   b. Battery - OFF
   c. Canopy - REMOVED
   d. Abandon airplane.
   e. Assemble upwind.

(CONTINUED ON NEXT PAGE)

FIRE — CONDENSED CHECKLIST

(CONTINUED)

ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED

1. Crew - ALERTED
2. Landing Gear - UP
3. Throttle - IDLE
4. Fire Shutoff Switch - PULLED (if any of the following occurs):
   a. Warning light illuminates again after throttle is advanced.
   b. Warning light remains illuminated.
   c. EGT is high.
   d. Visible evidence of fire.
5. Throttle - CUTOFF
6. Fuel Selector - SET
7. Takeoff Speed Plus 15 Knots - RETRACT FLAPS
8. Start Climb at 175 Knots
9. Reset Fire Shutoff Switch to Lubricate Engine
10. Do Not Restart Engine

ENGINE FIRE DURING FLIGHT

1. Crew - ALERTED
2. Fire Shutoff Switch - PULLED
3. Throttle - CUTOFF
4. Fuel Selector - SET
5. Circuit Breakers - IN
6. If Fire is Located in an Inboard Nacelle and Fire Continues, Actuate Fire Shutdown on the Adjacent Engine.
7. If Fire is Uncontrollable - ABANDON AIRPLANE
8. Reset Fire Shutoff Switch to Lubricate Engine.
9. Do Not Attempt to Restart Engine

CREW COMPARTMENT FIRE

1. Crew - ALERTED
2. Oxygen - 100%
3. Cabin Pressure Emergency Release Handle - PULLED
4. Unnecessary Electrical Equipment - OFF
5. Extinguish Fire
6. If Cabin Does Not Clear, Accomplish One of the Following:
   a. Canopy (sliding type only) - OPEN
   b. Clear vision panel - OPEN
7. Cabin Pressure Emergency Release Handle - PUSH
8. Oxygen - NORMAL
9. If Fire is Uncontrollable - ABANDON AIRPLANE

WING FIRE

1. Crew - ALERTED
2. Oxygen - 100%
3. Fuel Selector Switches (opposite side of fire) - SET
4. Engines on the Side of the Fire:
   a. Fuel selectors - TE
   b. Throttles - CUTOFF
   c. Circuit breakers - IN
   d. Fire shutoff switches - PULLED
5. Unnecessary Electrical Equipment - OFF
6. Aileron Surface Power Control - OFF (if necessary)
7. If Fire is Uncontrollable - ABANDON AIRPLANE

SMOKE OR FUMES ELIMINATION

If smoke or fumes are detected in the pressurized crew compartment, the following procedure should be followed:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.
2. Oxygen - 100%
   All crew members put on oxygen masks, position oxygen regulator diluter levers to 100% OXYGEN, and place oxygen emergency toggle levers in EMERGENCY position.
3. Cabin Pressure Emergency Release Handle - PULLED
   Pull cabin pressure emergency release handle.

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SMOKE OR FUMES ELIMINATION

(CONTINUED)

4. If Smoke or Fumes are not in the Air Conditioning System and Smoke or Fumes Remain in the Crew Compartment:
   a. Heat reset button - PUSH
   b. Locate and eliminate cause of the smoke or fumes.

5. If it is Suspected That the Smoke or Fumes are Caused by the Engines:
   a. Heat reset button - PUSH
   b. Retard throttles.
      Retard throttles in sequence on engines No. 3, 2, 1, and 4, 5, and 6 at 15-second intervals to determine engine causing smoke or fumes Crew member removes oxygen mask momentarily as each throttle is retarded to check with smell test for engine causing smoke or fumes.
   c. When engine is determined:
      (1) Throttle - CUTOFF
         Place the affected throttle to CUTOFF.
      (2) Fire shutoff switch - PULLED
         Pull fire shutoff switch for the affected engine. Check that "Main Fuel Control" and "Main Fuel Warning, Manifold and Fire Shutoff Valves" circuit breakers on the upper DC power panel and the "Throttle and Engine Control" circuit breakers on the lower DC power panel are reset in order to insure operation of fire shutdown.

NOTE

- For more rapid dissipation of smoke and/or fumes, open clear vision panel (some airplanes) or reduce speed and open sliding canopy (some airplanes).
- Pilot and copilot should lower themselves in the cockpit prior to opening the sliding canopy. It is possible for the canopy, if opened in flight, to release and travel in an unpredictable path causing serious injury to crew members.

6. Fire Shutoff Switch - PUSH (optional)
   Lubricate the engine by resetting fire shutoff switch.

7. Cabin Pressure Emergency Release Handle - PUSH
   When smoke and/or fumes have dissipated, repressurize crew compartment by pushing cabin pressure emergency release handle.

SMOKE OR FUMES ELIMINATION — CONDENSED CHECKLIST

SMOKE OR FUMES ELIMINATION

1. Crew - ALERTED
2. Oxygen - 100%
3. Cabin Pressure Emergency Release Handle - PULLED
4. If Smoke or Fumes are not in the Air Conditioning System and Smoke or Fumes Remain in the Crew Compartment:
   a. Heat reset button - PUSH
   b. Eliminate fire source.
5. If it is Suspected that the Smoke or Fumes are Caused by the Engines:
   a. Heat reset button - PUSH
   b. Retard throttles one at a time.
   c. Engine isolated:
      (1) Throttle - CUTOFF
      (2) Fire shutoff switch - PULLED
6. Fire Shutoff Switch - PUSH (optional)
7. Cabin Pressure Emergency Release Handle - PUSH

TAKEOFF EMERGENCIES

NOTE

- For takeoff emergencies involving engine failure refer to "Engine Failure Under Specific Conditions," this section.
- For takeoff emergencies involving engine fire refer to "Engine Fire During Take-off," this section.

REFUSED TAKEOFF

If for any reason a decision is made to refuse takeoff, proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.
2. Throttles - IDLE
   Immediately retard all throttles to the idle stop.
3. Brake Chute and Approach Chute - DEPLOYED
   Deploy brake chute. If installed, approach chute should be deployed also.
4. Brakes - APPLIED
   Apply brakes. Maintain maximum braking with antiskid operating by depressing and holding pedals to achieve slow (2 or 3 seconds) cycling of antiskid. This can be recognized by intermittent slight lurching of the airplane each time the antiskid system releases the brakes. Heavier pedal pressure will cause inefficient cycling of the antiskid or may cause pedal travel into the emergency braking range where antiskid protection is not provided. Either misuse will increase distance required to stop. Emergency braking should not be used unless the main brake system is inoperative.
5. Throttles 1, 2, 5 & 6 - CUTOFF
   Retard throttles No. 1, 2, 5, and 6 to CUTOFF.
6. If Stop Cannot be Made Before Reaching an Obstacle and Speed is not Greater than 60 Knots:
   a. Steering ratio selector - TAXI

   NOTE

   Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

   b. Ground-loop the airplane
   c. Throttles 3 & 4 - CUTOFF
   d. Fire switches - PULLED
7. If a Stop or Ground-Loop Cannot be Made Before Reaching an Obstacle:
   a. Landing gear - RETRACTED
      Retract all landing gear with the landing gear emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF position prior to actuation of emergency retraction switch, retraction will be more positive.
   b. Battery - OFF
   c. Canopy - REMOVED
   d. Abandon airplane
      Leave the airplane as soon as possible. To prevent possible injury caused by leaping from the airplane, use the wing as a ramp or slide down the nose.
   e. Assemble upwind

TAKEOFF EMERGENCIES — CONDENSED CHECKLIST

REFUSED TAKEOFF

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake Chute and Approach Chute - DEPLOYED
4. Brakes - APPLIED
5. Throttles 1, 2, 5 & 6 - CUTOFF
6. If Stop Cannot be Made Before Reaching an Obstacle and Speed is not Greater than 60 Knots:
   a. Steering ratio selector - TAXI
   b. Ground-loop.
   c. 3 & 4 - CUTOFF
   d. Fire shutoff switches - PULLED
7. If Stop or Ground-Loop Cannot be Made Before Reaching an Obstacle:
   a. Landing gear - RETRACTED
   b. Battery - OFF
   c. Canopy - REMOVED
   d. Abandon airplane.
   e. Assemble upwind.

LANDING EMERGENCIES

CRASH LANDING

See figure 3-6.

LANDING WITH FLAPS UP

With flaps up, bank angles in the traffic pattern should be limited to those shown in figure 2-12. Therefore, the traffic pattern must be larger than normal so the continuous banked turn from downwind to final can be made without steepening the bank over 25° to line up with the runway. Pattern altitudes should be held as shown in figure 2-12. The approach chute should be used if available, since it will aid decleration after touchdown. From the start of the final approach, bleed off airspeed by a very gradual but continuous raising of the nose so the airplane contacts the runway just as touchdown speed and touchdown attitude are reached. This touchdown attitude will be somewhat nose-high with the front gear about 2 feet off the runway as the rear gear contacts the ground. Elevator control will be sufficient to prevent the front gear from striking the ground too hard. It is important to note that the flaps-up landing procedure does not include a best flare speed. This is because the objective is to put the airplane on the end of the runway at the lowest speed possible and thus reduce the stopping distance. Therefore, rotation of the airplane to touchdown attitude is a gradual process accomplished over the entire length of the final approach. It should be completed just as ground contact is made and touchdown speed is reached.

LANDING WITH FLAPS UP

A flaps-up landing should be made as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Reduce Gross Weight
   Reduce gross weight as much as possible.

3. Crash Alert
   Alert tower for crash equipment and advise crew.

4. Pattern
   Establish a traffic pattern with downwind leg at flaps-up touchdown speed plus 35 knots. Start final approach at flaps-up touchdown speed plus 15 knots.

LANDING WITH BRAKE FAILURE

If it appears that the main hydraulic system has failed and if no emergency braking can be obtained by further depression of the rudder pedals, proceed as follows:

1. Emergency Hydraulic Pump - OFF
   Turn emergency hydraulic pump off.

2. Reduce Gross Weight
   Reduce gross weight as much as possible.

3. Crash Alert
   Alert tower for crash equipment and alert crew over interphone of existing emergency.

4. Normal Pattern
   Establish a normal traffic pattern.

5. Approach Chute - DEPLOYED
   Use approach chute if one is installed.

6. Emergency Hydraulic Pump - AUTO (on final)
   Place emergency hydraulic pump in AUTO NORMAL on final approach.

7. Throttles - IDLE (at touchdown)
   On touchdown, immediately retard all throttles to idle stop.

8. Throttles 1, 2, 5 & 6 - CUTOFF (at touchdown)
   Place throttles No. 1, 2, 5, and 6 to CUTOFF.

9. Brake Chute - DEPLOYED
   Deploy brake chute as soon as the airplane has decelerated below the brake chute maximum deployment speed.

10. Brakes - APPLIED
    Apply brakes in normal manner to test possible effectiveness still remaining. If normal application is ineffective, test pedals in emergency braking range.

11. Engines 1, 2, 5 & 6 - FIRE SHUTOFF
    Pull fire shutoff switches for engines No. 1, 2, 5, and 6.

12. Ground-Loop
    If a stop cannot be made before reaching an obstacle and speed is 60 knots or slower, move steering ratio selector lever to TAXI and ground-loop the airplane.

NOTE

Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

13. Crash Procedure
    If a stop or ground-loop cannot be made before reaching an obstacle, pull remaining fire shutoff switches, move landing gear lever to OFF, and retract the gear with the landing gear emergency retraction switch. Cut the battery switch after the gear is up, remove the canopy, and abandon the airplane. To prevent injury in leaving the airplane, use the wing as a ramp or slide down the nose. Assemble upwind.

LANDING WITH FRONT GEAR STEERING FAILURE

BRAKE OR TIRE FAILURE

If front gear steering authority is lost or appears to diminish at any point in the landing roll while brakes are applied, release the brakes momentarily and reestablish the desired steering angle before reapplication of brakes is attempted. It is possible for these symptoms to exist if for any reason one wheel of the front gear loses its braking effectiveness or blows a tire. Either one of these malfunctions might not be identified immediately by the pilot. The effect would be such that if the front gear then were deflected to a given steering angle and the brakes applied, it might be impossible to move the front gear back in the direction of the unbraked wheel so long as the brakes continued to be applied. If such a situation is encountered, the pilot should make every effort to reestablish required steering control by momentarily releasing the brakes during the landing roll.

STEERING SYSTEM FAILURE

The front gear steering system should be checked as noted in the Before Landing checklist in section II. If steering is operating properly, alternate movement of the rudder pedals with the landing gear down will cause a momentary pressure drop of about 300 to 500 psi on the main hydraulic system pressure gage. If no drop shows on the main hydraulic system gage but instead the drop occurs on the emergency hydraulic system gage, this indicates that steering is being operated by the emergency hydraulic system.

LANDING WITH FRONT GEAR STEERING FAILURE

If neither hydraulic pressure gage shows a drop when steering is checked, proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Crawlway Check
   At 10,000 feet or lower, depressurize the crew compartment and have the observer check the operation of the front gear by looking through the ground heat access panel in the crawlway while the pilot moves the rudder pedals. If movement is observed, check whether or not the front gear moves in the proper direction.

3. Chase Check
   Call for a chase airplane, if available, to observe whether or not the front gear moves when the rudder pedals are moved. If movement is observed, check whether or not the front gear moves in the proper direction.

4. Steering Selector - TOW & back to TAKEOFF LAND
   If both the chase pilot and crawlway observer report no movement, place the steering ratio selector to TOW momentarily and then return the lever to TAKEOFF LAND detent. If the malfunction is caused by a sticking disconnect valve plunger, this may free the plunger.

5. Steering Selector - TAKEOFF LAND DETENT
   If there is still no movement reported, recheck the steering ratio selector lever in TAKEOFF LAND detent.

6. Normal Pattern - AVOID CROSSWIND
   Establish a normal traffic pattern and land into the wind as nearly as possible to minimize crosswind difficulties.

7. Landing Roll - PEDALS NEUTRAL, STEERING TO TAXI
   If steering control is marginal or ineffective during landing roll, neutralize rudder pedals momentarily and move steering ratio selector to TAXI.

8. Ailerons & Bicycle
   Use ailerons to steer airplane as much as possible through bicycling.

9. Steer with Engines 1 & 6
   Use asymmetrical thrust from engines No. 1 or 6, if needed, to aid steering.

10. Jettison Chute if Necessary
   The brake chute will keep the airplane straight during the first part of the landing roll. If the brake chute and approach chute tend to swing the airplane off the runway, pull the chute jettison handle.

LANDING WITH ASYMMETRICAL FUEL LOADING IN EXTERNAL WING TANKS

If a landing must be made with asymmetrical fuel loading in external wing tanks, proceed as follows:

1. Landing Configuration - 20,000 FEET
   Immediately before landing, establish the airplane in landing configuration at least 20,000 feet above terrain.

2. Trim - CHECKED AT TOUCHDOWN IAS
   Reduce speed to touchdown IAS, noting the amount of aileron trim and control wheel position needed to keep wings level.

3. Full Aileron Trim + Over 1/2 Wheel Throw - JETTISON
   If full trim is needed and control wheel position exceeds one-half of total throw available, wing tanks should be jettisoned before landing. Drop the heavy tank first to balance the airplane. If the heavy tank will not jettison, keep the light tank to maintain at least the existing balance. For jettison procedures, see "External Wing Tank Jettison" under "Fuel System Emergency Operation," this section.

4. Acceptable Trim - LAND WITH TANKS
   If combined trim and control wheel position is less than stated above, a safe landing can be made with external wing tanks attached.

5. Crosswind - HEAVY WING UPWIND
   If there is a crosswind, choose landing direction to land with the heavy wing on the upwind side.

6. Standard Pattern Speeds
   Fly the traffic pattern at standard recommended margins above best flare speed. Enlarge the pattern to enable shallow turns and complete rollout on final approach at least 3 miles from the planned touchdown point. This will allow good alignment with the runway before getting too close to the ground.

7. Touchdown - AILERONS & RUDDER
   On touchdown, full aileron may be inadequate to hold up the heavy wing. It may be necessary to hold about one-fourth rudder deflection to keep a straight landing roll.

LANDING WITH ONE EXTERNAL WING TANK

If a landing must be made with one external wing tank still attached, proceed as follows:

1. Landing Configuration - 20,000 FEET
   Immediately before landing, establish the airplane in landing configuration at least 20,000 feet above terrain.

2. Touchdown IAS or Minimum Control IAS - CHECK FIRST TO OCCUR
   Reduce speed to touchdown IAS or to the lowest speed at which lateral and directional control can be maintained, whichever speed occurs first.

(CONTINUED ON NEXT PAGE)

LANDING WITH ONE EXTERNAL WING TANK

(CONTINUED)

3. Compute Speed from Minimum Control IAS
   If a minimum control speed occurs first, add 10 knots to the speed thus determined to find a desirable touchdown speed. To the new touchdown speed, add 8 knots to find best flare speed.

4. Crosswind - HEAVY WING UPWIND
   If there is a crosswind, choose landing direction to land with the heavy wing on the upwind side.

5. Standard Pattern Speeds
   Fly the traffic pattern at standard recommended margins above the normal best flare speed or above the new best flare speed if a minimum control speed was encountered. Enlarge the pattern to enable shallow turns and complete rollout on final approach at least 3 miles from the planned touchdown point. This will allow good alignment with the runway before getting too close to the ground.

6. Touchdown - AILERONS & RUDDER
   On touchdown, full aileron may be inadequate to hold up the heavy wing. It may be necessary to hold about one-fourth rudder deflection to keep a straight landing roll.

LANDING WITH LANDING GEAR FAILURE

If electrical extension of the landing gear with the normal system fails, emergency extension will normally be accomplished by the copilot, utilizing the emergency extension levers.

If emergency extension of the landing gear is impossible, one of the following procedures should be used in conjunction with "Crash Landing" or "Bailout" procedure this section:

- If only both main gear will extend and lock, a normal landing should be made. Hold wings level with ailerons as long as possible. Airplane will probably remain upright if no strong crosswind exists.
- If only the front main gear will extend and lock, a normal approach and flare should be made. (If the outrigger gear will extend and lock, a slightly improved balance condition will result.) Hold the wings level and tail up as long as possible. As speed decreases allow tail to contact runway as easily as possible.
- If front main gear will not extend and lock, it is recommended that all gear be retracted and, at the discretion of the pilot, a belly landing or a controlled bailout be accomplished.

LANDING WITH EXTERNAL ATO RACK

If external ATO rack cannot be jettisoned after takeoff, mission will be aborted. Landing should be delayed however, in order to consume fuel and reduce gross weight of airplane. Landing should be made as flat and gently as possible considering the possibility that jettisoning may have been attempted and rack may no longer be secure. If immediate landing is necessary, follow procedure for heavy weight landings in section II.

CAUTION

If external ATO rack has not been jettisoned during a flight or because of a refused takeoff, ATO pullout plugs must be disconnected and ATO rack lockpin be reinserted after flight.

LANDING WITH RELIANCE ON BRAKE CHUTE

All landings should be planned and conducted as though the brake chute were not installed. Use of the chute should be considered only as an aid to prevent excessive wear of brakes and tires. If, at any time during the approach and landing, factors of weather, runway, or airspeed indicate that a safe stop cannot be made on the runway by brake application alone, a go-around should be started at once. Under such conditions, it is imperative that the decision to go around be made before the brake chute deployment handle is pulled. Once the handle is pulled, a number of alternate situations may endanger the landing. If the chute fails to deploy, brakes alone may be insufficient to stop the airplane on the remaining runway. On the other hand, the runway remaining may be insufficient to permit takeoff after the time lost awaiting deployment and then accelerating the engines to full power. If the chute does deploy but fails to assist deceleration enough for a safe stop, the pilot may be faced with the need for a go-around further complicated by possible difficulty in jettisoning the chute. In most cases conditions which cause reliance on the brake chute to stop the airplane are recognizable prior to the time of brake chute deployment and should be accepted as sufficient reasons for starting a go-around at once. For any landing, the runway length available beyond the planned touchdown point should be compared with "Stopping Distances - Brakes Only" in part 10 of the appendix. If the required stopping distance is longer than the runway available after touchdown, the safety of the landing is conditioned by reliance on the brake chute. The same condition may result from excessive approach speeds which move the touchdown point further down the runway than planned. If wet, icy, or obstructed runways complicate the stopping problem, every attempt should be made, commensurate with fuel remaining, to select a favorable alternate base.

LANDING WITH RELIANCE ON BRAKE CHUTE

Should a landing requiring reliance on the brake chute become absolutely necessary, proceed as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.
2. Reduce Gross Weight
3. Practice Approach
   If conditions permit, make a practice approach to the landing runway, observing terrain, overruns, and obstacles.
4. Brake Chute Deploy Speed - CHECKED
   Reaffirm the maximum deployment speed for the type brake chute installed (115 knots IAS for unmodified chute; 160 knots IAS for modified chute).
5. Normal Pattern
   Establish a normal pattern with strict adherence to the correct approach speeds. Approach chute should be used in the normal manner, if available, since it will aid deceleration after touchdown.
6. Touchdown - THROTTLES IDLE & 1, 2, 5 & 6 CUTOFF
   On touchdown, immediately retard all throttles to the idle stop and simultaneously place throttles No. 1, 2, 5, and 6 to CUTOFF.

NOTE

Idle power must be kept on engines No. 3 and 4 to maintain hydraulic pressure.

7. Brake Chute - DEPLOYED
   Deploy brake chute as soon as the airplane decelerates below brake chute maximum deployment speed. If the chute fails to deploy, allow the handle to reseat momentarily, insure that the jettison handle was not selected by mistake, and then pull the deployment handle evenly through full travel once again.
8. Brakes - APPLIED
   Apply brakes to obtain optimum (2 or 3 seconds) cycling of the antiskid. Slight back pressure on the control column will increase the load on the rear wheels and produce more effective braking early in the landing roll.
9. 1, 2, 5 & 6 - FIRE SHUTOFF
   Pull fire shutoff switches for engines No. 1, 2, 5, and 6.
10. Ground-Loop
    If a stop cannot be made before reaching an obstacle and speed is not greater than 60 knots IAS, position steering ratio selector to TAXI and ground-loop the airplane.

(CONTINUED ON NEXT PAGE)

LANDING WITH RELIANCE ON BRAKE CHUTE

(CONTINUED)

NOTE

Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

11. Crash Procedure
    If a stop or ground-loop cannot be made before reaching an obstacle, pull remaining fire shutoff switches and retract all landing gear with the landing gear emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF position prior to actuation of emergency retraction switch, retraction will be more positive. Cut battery switch after the landing gear retracts. Remove canopy and leave the airplane. Assemble upwind.

emergency alarm bell signals

6 SHORT RINGS	Prepare for ditching or crash landing
3 SHORT RINGS	Prepare for bailout
1 LONG RING	Bail out
1 LONG SUSTAINED RING	Brace for ditching or crash landing

50304 WC-1

Figure 3-5.

① LANDING WITH DELAYED DEPLOYMENT OF APPROACH CHUTE

If the approach chute deployment switch is moved to DEPLOY position on the downwind leg and the chute fails to deploy fully by the time of reaching base leg, the following procedure will be followed to prevent unexpected deployment of the chute:

1. Approach Chute - DOOR CLOSED or OFF
   Move the approach chute deployment switch to DOOR CLOSED or OFF position.

2. Wait 10 Seconds
   Wait 10 seconds to give the door sufficient time to close.

(CONTINUED ON PAGE 202)

① AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

crash landing

Provided the terrain and other conditions are favorable to a successful crash landing, the following technique will be employed:

NOTE

If time permits use up fuel from all but center main tank. Land with minimum fuel in center main tank. Prior to landing position center main tank to TME, all other engines to ME.

preparation for crash landing

pilot

1. Give prepare-to-crash-land warning by six short rings on alarm bell and spoken warning over interphone.

2. Start emergency radio and/or emergency keyer operation.

copilot

1. Acknowledge prepare-to-crash land warning.

①▶ **2.** Set up command radio for pilot to start emergency radio procedure.

observer

1. Acknowledge prepare-to-crash land warning.

2. Transmit position report to pilot.

Pilot accomplishes the following procedure calling for aid from copilot where necessary; copilot stands by for orders.

3. Jettison external wing tanks only if containing fuel.

NOTE

Empty external tanks will tend to cushion shock of landing and will also ease impact damage to airplane and crew.

4. Fully extend wing flaps.

5. Salvo bombs making sure bomb bay doors are closed after salvo.

6. Pull cabin pressure emergency release handle.

7. Check landing gear fully retracted.

pilot

8. Unbuckle parachute, check shoulder harness and safety belt fastened.

9. Give "standby for canopy jettison" order. Jettisons canopy if conditions permit. If sliding canopy cannot be jettisoned safely, open it and leave control lever in OPEN position.

copilot

3. Unbuckle parachute, check shoulder harness and safety belt fastened.

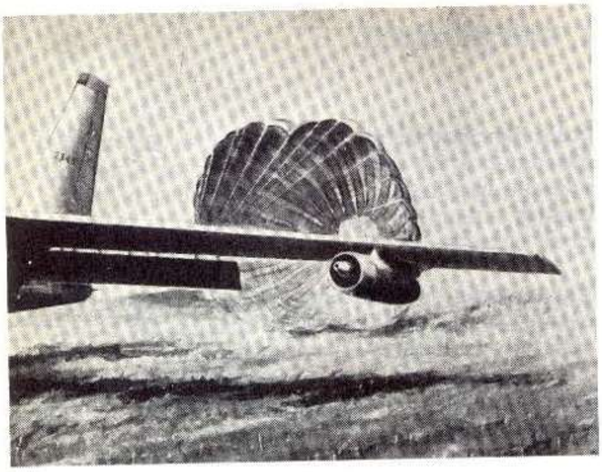
observer

②▶ **3.** Unbuckle parachute, check shoulder harness and safety belt fastened, and remain in seat.

③▶ Proceed to ditching-crash landing station beside copilot. Unbuckle parachute, raise seat back, and fasten shoulder harness, tiedown strap, and safety belt. If a fourth crew member is aboard, proceed to forward ditching-crash landing station in walkway opposite pilot. Unbuckle parachute, lower ditching harness and secure to tiedown fittings, and sit facing aft in harness cradle.

①▶ AF 51-2357 thru 52-611
②▶ AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
③▶ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

Figure 3-6 (Sheet 1 of 3 Sheets).



ABANDONING THE AIRPLANE

crash landing technique

fourth crew member

1. Acknowledge prepare-to-crash-land warning.

(1)▶
2. If not already in ditching-crash-landing station, proceed to seat and unbuckle parachute, fasten shoulder harness, tiedown strap, and safety belt.

3. Unbuckle parachute, check shoulder harness and safety belt fastened.

1. Establish normal approach.

2. At point in approach where throttles would normally be retarded to the idle position pull all fire shutoff switches.

3. Crew members check and lock safety belt and shoulder harness.

CAUTION

The crew member is prevented from bending forward when the shoulder harness inertia reel is LOCKED; therefore, all switches not readily accessible should be properly positioned prior to locking shoulder harness.

4. Before contacting ground give one long sustained ring on alarm bell and brace-for-crash-landing warning over interphone.

5. Deploy brake chute upon contact.

6. Make contact with ground in normal landing attitude at lowest possible airspeed and rate of descent consistent with safe control of airplane. Do not stall in.

(1)▶ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

Figure 3-6. (Sheet 2 of 3 Sheets).

abandoning the airplane

Remain in position until the airplane stops. As soon as the airplane stops, unbuckle safety belt and parachute harness and cut battery switch.

If the canopy has not been jettisoned proceed to remove canopy as follows:

SLIDING CANOPY

Pilot or copilot pulls canopy emergency release handle and working together manually push the canopy up approximately 1/2 inch and then aft sufficiently to allow crew egress.

CLAMSHELL CANOPY

Pilot pulls the canopy emergency jettison handle. In case the canopy does not jettison, the pilot moves canopy lock lever to UNLOCKED, places canopy latch control lever to UNLATCHED, and pulls the remover disconnect handle. The copilot disengages the canopy pins with the hinge pin release handle and working together pilot and copilot manually push the canopy off, allowing crew egress.

The observer makes exit through the observer's escape hatch (alternate exit through the canopy opening, following pilot and copilot). On airplanes with crash landing station beside the copilot, observer exits through canopy opening (alternate exit through escape hatch).

In case it is impossible to release the canopy, pilot and copilot may use the observer's escape hatch as an alternate exit.

To prevent possible injury caused by leaping from the airplane use nose or wing as a ramp to the ground and assemble upwind.

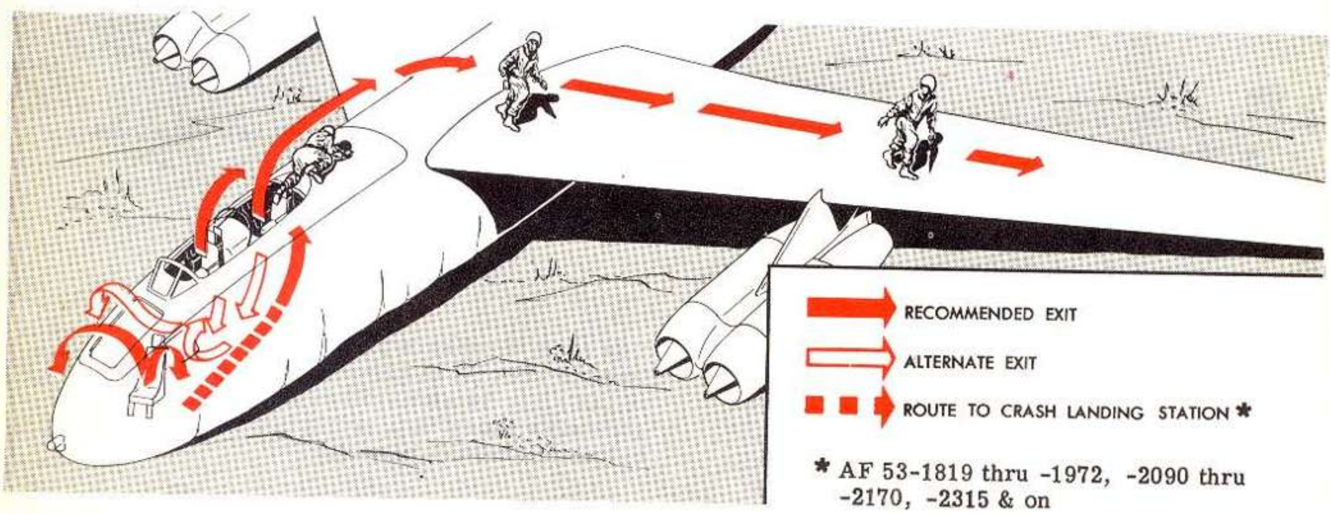


Figure 3-6. (Sheet 3 of 3 Sheets).

① LANDING WITH DELAYED DEPLOYMENT OF APPROACH CHUTE

(CONTINUED)

3. Pull Jettison Handle

   Pull the approach chute jettison handle so the chute will jettison in case of delayed blossoming.

NOTE

Placing the switch in DOOR CLOSED or OFF position will close the door if the approach chute has not moved in the compartment. If the chute has moved partly out of the compartment or completely out of the compartment and is streaming, pulling the jettison handle will position the attachment link to jettison the chute in case of delayed blossoming.

① AF 51-2192 thru -2356, 52-071 thru -201, -248 & on

LANDING EMERGENCIES — CONDENSED CHECKLIST

LANDING WITH FLAPS UP

1. Crew - ALERTED
2. Reduce Gross Weight
3. Crash Alert
4. Pattern
   a. Downwind - FLAPS-UP TOUCHDOWN IAS + 35
   b. Start final - FLAPS-UP TOUCHDOWN IAS + 15

LANDING WITH BRAKE FAILURE

1. Emergency Hydraulic Pump - OFF
2. Reduce Gross Weight
3. Crash Alert
4. Normal Pattern
5. Approach Chute - DEPLOYED
6. Emergency Hydraulic Pump - AUTO (on final)
7. Throttles - IDLE (at touchdown)
8. 1, 2, 5 & 6 - CUTOFF (at touchdown)
9. Brake Chute - DEPLOYED
10. Brakes - APPLIED
11. 1, 2, 5 & 6 - FIRE SHUTOFF
12. Ground-Loop
13. Crash Procedure
    a. 3 & 4 - FIRE SHUTOFF
    b. Gear lever - OFF
    c. Emergency gear - UP
    d. Canopy - REMOVED
    e. Assemble upwind

LANDING WITH FRONT GEAR STEERING FAILURE

1. Crew - ALERTED
2. Crawlway Check
3. Chase Check
4. Steering Selector - TOW & back to TAKE-OFF LAND
5. Steering Selector - TAKEOFF LAND DETENT
6. Normal Pattern - AVOID CROSSWIND
7. Landing Roll - PEDALS NEUTRAL, STEERING TO TAXI
8. Ailerons & Bicycle
9. Steer with Engines 1 & 6
10. Jettison Chute if Necessary

LANDING WITH ASYMMETRICAL FUEL LOADING IN EXTERNAL WING TANKS

1. Landing Configuration - 20,000 FEET
2. Trim - CHECKED AT TOUCHDOWN IAS
3. Full Aileron Trim + Over 1/2 Wheel Throw - JETTISON
   a. Heavy tank first.
   b. If heavy tank will not jettison, keep both.
4. Acceptable Trim - LAND WITH TANKS
5. Crosswind - HEAVY WING UPWIND
6. Standard Pattern Speeds
   a. Shallow turns.
   b. Start final 3 miles.
7. Touchdown - AILERONS & RUDDER

LANDING WITH ONE EXTERNAL WING TANK

1. Landing Configuration - 20,000 FEET
2. Touchdown IAS or Minimum Control IAS - CHECK FIRST TO OCCUR
3. Compute Speeds from Minimum Control IAS
   a. Touchdown IAS = Control IAS + 10
   b. BFS = Touchdown IAS + 8
4. Crosswind - HEAVY WING UPWIND
5. Standard Pattern Speeds
   a. Shallow turns.
   b. Start final 3 miles.
6. Touchdown - AILERONS & RUDDER

LANDING WITH RELIANCE ON BRAKE CHUTE

1. Crew - ALERTED
2. Reduce Gross Weight
3. Practice Approach
4. Brake Chute Deploy Speed - CHECKED
5. Normal Pattern
   a. Approach chute - DEPLOYED
6. Touchdown - THROTTLES IDLE & 1, 2, 5 & 6 CUTOFF
7. Brake Chute - DEPLOYED
8. Brakes - APPLIED
9. 1, 2, 5 & 6 - FIRE SHUTOFF
10. Ground-Loop
11. Crash Procedure
    a. 3 & 4 - FIRE SHUTOFF
    b. Gear lever - OFF
    c. Emergency gear - RETRACTED
    d. Battery - OFF
    e. Canopy - REMOVED
    f. Abandon airplane
    g. Assemble upwind

LANDING WITH DELAYED DEPLOYMENT OF APPROACH CHUTE

1. Approach Chute - DOOR CLOSED or OFF
2. Wait 10 Seconds
3. Pull Jettison Handle

EMERGENCY ENTRANCE

Refer to figure 3-7.

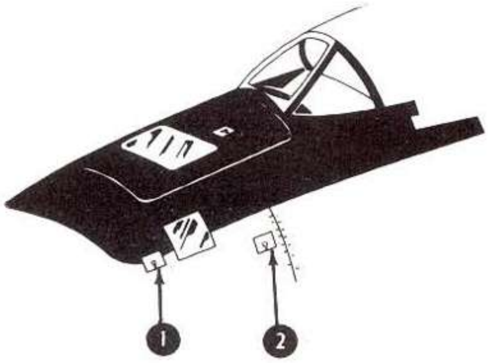
DITCHING

Refer to figure 3-8.

emergency entrance

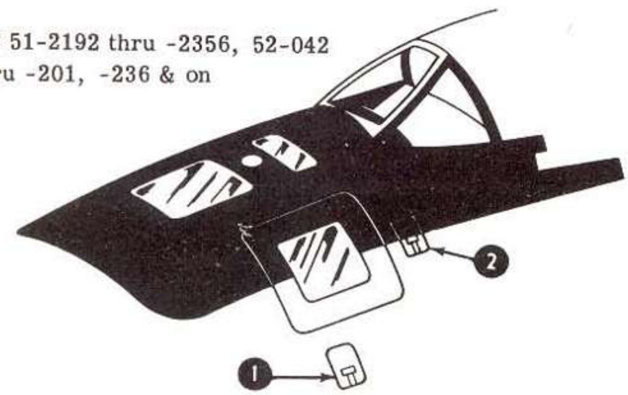
1. Entrance into the airplane may be gained through three openings. These openings are the observer's escape hatch, the canopy, and the regular entrance door. For method of gaining entrance using regular door, refer to figure 2-1. As a wheel-up or crash landing will probably make the regular entrance door inaccessible, the emergency release facilities must be used for observer's escape hatch ❶ and canopy ❷ .

AF 51-2357 thru 52-041, -202 thru -235



2. Release facilities are located on the upper left side of the nose section ahead of the windshield. To gain access to the release handle, press button in center of access panel and remove panel.

AF 51-2192 thru -2356, 52-042 thru -201, -236 & on



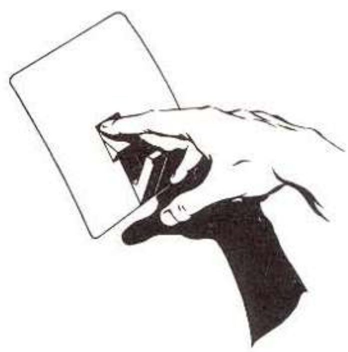
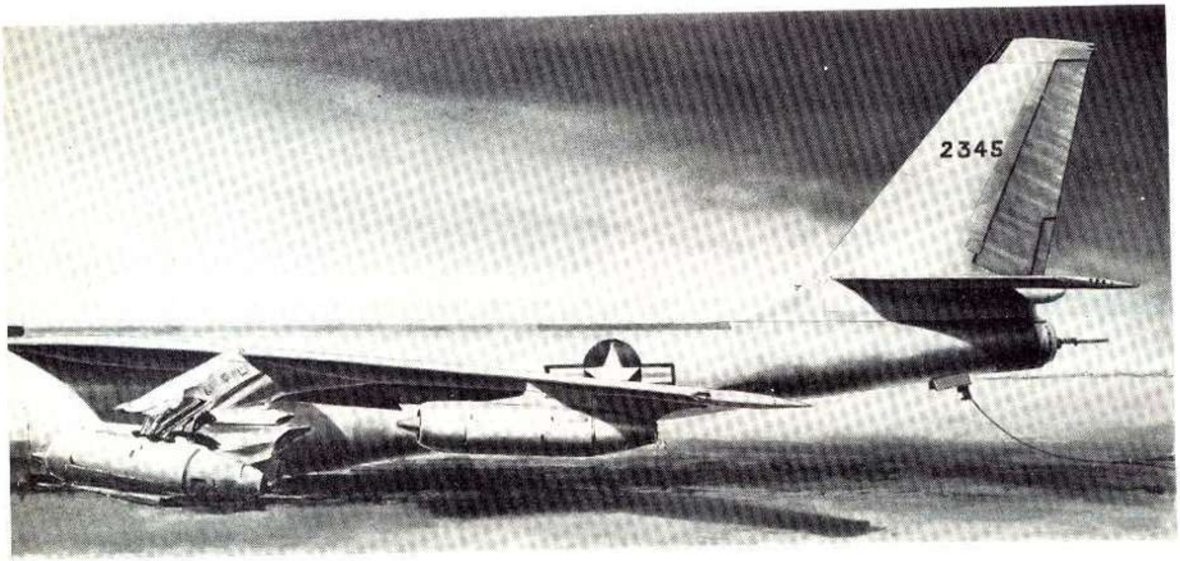


Figure 3 - 7.



3. If canopy has not been jettisoned, gain entrance to the airplane in the following manner:

CANOPY

①▶ **WARNING**

To prevent possible serious injury to ground crew personnel due to the jettisoning action of the clamshell canopy the external emergency canopy release handle will not be pulled when anyone is positioned near or aft of the canopy.

①▶ To release the clamshell canopy pull the emergency release T-handle down firmly and slowly approximately 12 inches. This action fires a ballistics charge that impels the canopy up and aft in an arc. The canopy should fall clear of the airplane permitting full access to the canopy opening.

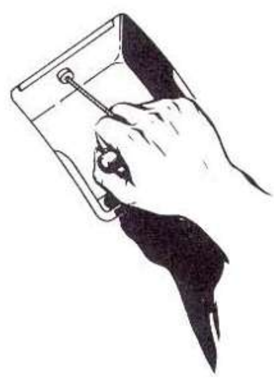
②▶ To release the sliding canopy pull the canopy emergency release T-handle down firmly and slowly approximately 12 inches. This action releases the canopy locks and rollers and opens the canopy. The canopy may then be manually lifted from the airplane.

OBSERVER'S ESCAPE HATCH

To release the observer's escape hatch, grasp hatch emergency release T-handle and pull down firmly and slowly to the full travel. As this action only releases the hatch locks, the hatch must be manually lifted from the airplane.

③▶ A spring-loaded actuator raises the forward left side of the observer's escape hatch thereby providing a hand hold for lifting the hatch from the airplane.

4. On some airplanes emergency access to the batteries is provided on either side of the fuselage near the tail while on other airplanes access is provided only on the left side of the fuselage near the tail. The area in which emergency access to the batteries may be gained is stenciled with yellow paint on all airplanes. To gain access, cut through the skin in the prescribed area.



①▶ AF 52-612 & on
②▶ AF 51-2357 thru 52-611
③▶ AF 51-2357 thru 52-041, -202 thru -235

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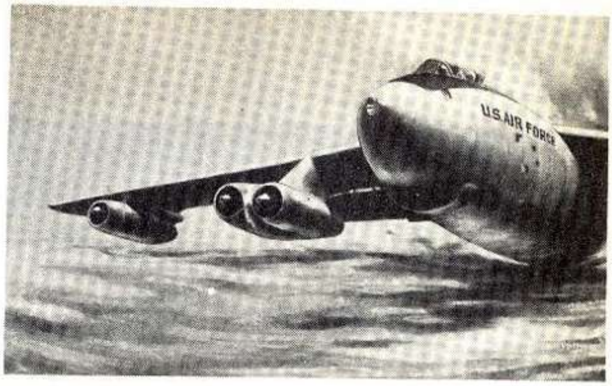
ditching

In a properly executed ditching, the airplane pressurized compartment and fuselage fuel tanks should permit the fuselage to remain afloat long enough to allow crew members to abandon the airplane. However, the high wing position, underslung engine pods, lack of internal wing tanks for buoyance, and the bomb bay opening all combine to make careful handling extremely important during the ditching operation.

NOTE

Empty external tanks should be retained for buoyancy reasons.



preparation for ditching

pilot

1. Give prepare-to-ditch warning by six short rings on alarm bell and spoken warning over interphone.

2. Start emergency radio and/or emergency keyer operation.

copilot

1. Acknowledge prepare-to-ditch warning.

2. ① Set up command radio for pilot to start emergency radio procedure.

observer

1. Acknowledge prepare-to-ditch warning.

2. Transmit position report to pilot.

Pilot accomplishes the following procedure calling for aid from copilot where necessary; copilot stands by for orders.

3. Jettison external wing tanks only if containing fuel.

4. Fully extend wing flaps.

5. Salvo bombs making sure bomb bay doors are closed after salvo.

6. Pull cabin pressure emergency release handle.

7. Check landing gear fully retracted.

Pilot

8. Unbuckle parachute, check safety belt and shoulder harness fastened and check lifevest.

9. Give "standby for canopy jettison" order. Jettisons canopy if conditions permit. If sliding canopy cannot be jettisoned safely, open it and leave control lever in OPEN position.

Copilot

3. Unbuckle parachute, check safety belt and shoulder harness fastened and check lifevest.

Observer

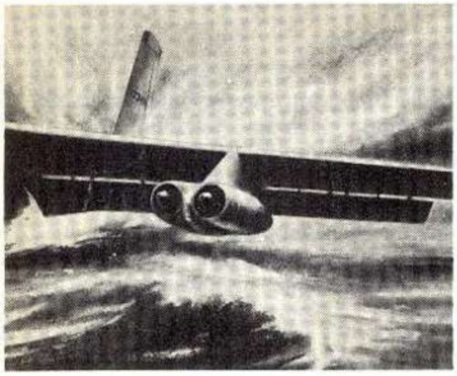
3. ② Unbuckle parachute, check shoulder harness and safety belt fastened, and check lifevest. Remain in seat.

③ Proceed to ditching-crash landing station beside copilot. Unbuckle parachute, raise seat back, fasten shoulder harness, tie down strap, and safety belt, and check lifevest. If a "fourth crew member" is aboard, proceed to forward ditching-crash landing station in walkway opposite pilot. Unbuckle parachute and lower ditching harness and secure to tiedown fittings. Check lifevest and sit facing aft in harness cradle.

① AF 51-2357 thru 52-611
② AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2314
③ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

WARNING do not inflate lifevest until out of the airplane.

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



ABANDONING THE AIRPLANE

fourth crew member

1. Acknowledge prepare-to-ditch warning.

2. If not already in ditching-crash landing station, proceed to seat and unbuckle parachute, fasten shoulder harness, tie down strap, and safety belt, and check lifevest.

ditching technique

All crew members will provide parachute, antiexposure suit, survival kit, and lifevest. Chances for survival and rescue will be greatly enhanced if antiexposure suits are worn by the crew members. Approximately 3 minutes are required to don a suit; therefore, if flight over water is known, antiexposure suits should be donned prior to reaching the water area. If for any reason it is impossible for a crew member to don his suit before the airplane is actually ditched, he should do so after reaching the water if at all possible.

If crew member is unable to immediately escape due to any number of factors, it is possible to survive under water with oxygen equipment until he can free himself and escape. The A-13A pressure demand type oxygen mask and the diluter demand type oxygen regulator are suitable under-water breathing devices when the regulator is set on 100% OXYGEN. It is essential that the mask be in place and tightly strapped and that the regulator is set at 100% OXYGEN. The bailout bottle cannot be used under water.

1. Establish normal approach. Choose direction of ditching run carefully. If uniform wave or swell pattern exists, best results will be achieved by ditching parallel to waves or swells. Try to touch down on crest or just after crest passes. If wind is more than 25 knots or surface is irregular, approach into the wind and touch down on the falling side of a wave.

2. Crew members check and lock shoulder harness.

CAUTION

The crew member is prevented from bending forward when the shoulder harness inertia reel is LOCKED; therefore, all switches not readily accessible should be properly positioned prior to locking shoulder harness.

3. At point in approach where throttles would normally be retarded to the idle position, pull all fire shutoff switches.

4. Approximately 5 seconds before contacting water, give brace-for-ditching warning by one long ring on alarm bell and spoken warning over interphone.

5. Flare out just over water and touch down in a medium nose-high attitude (near 10°) and keep wings level.

6. Make contact at lowest possible airspeed and keep rate of descent consistent with safe control of airplane. Do not stall in.

Figure 3-8 (Sheet 2 of 3 Sheets)

abandoning the airplane

Remain in position until the airplane stops. Unbuckle safety belt and shoulder harness. Primary exit for all crew members is through the canopy opening. In case it is impossible to release the canopy the crew members should use the observer's escape hatch as an alternate exit.

If the canopy has not been jettisoned proceed to remove the canopy as follows:

SLIDING CANOPY

Pilot or copilot pulls the canopy emergency release handle and working together manually push the canopy up approximately 1/2 inch and then aft sufficiently to allow crew egress.

CLAMSHELL CANOPY

Pilot pulls the canopy emergency jettison handle. In case the canopy does not jettison, the pilot moves canopy lock lever to UNLOCKED, places canopy latch control lever to UNLATCHED and pulls the remover disconnect handle. The copilot disengages the canopy pins with the hinge pin release handle and working together pilot and copilot manually push the canopy off allowing crew egress.

If airplane is floating, gather all emergency equipment and prepare to inflate liferaft(s) but remain with the airplane as long as it floats.

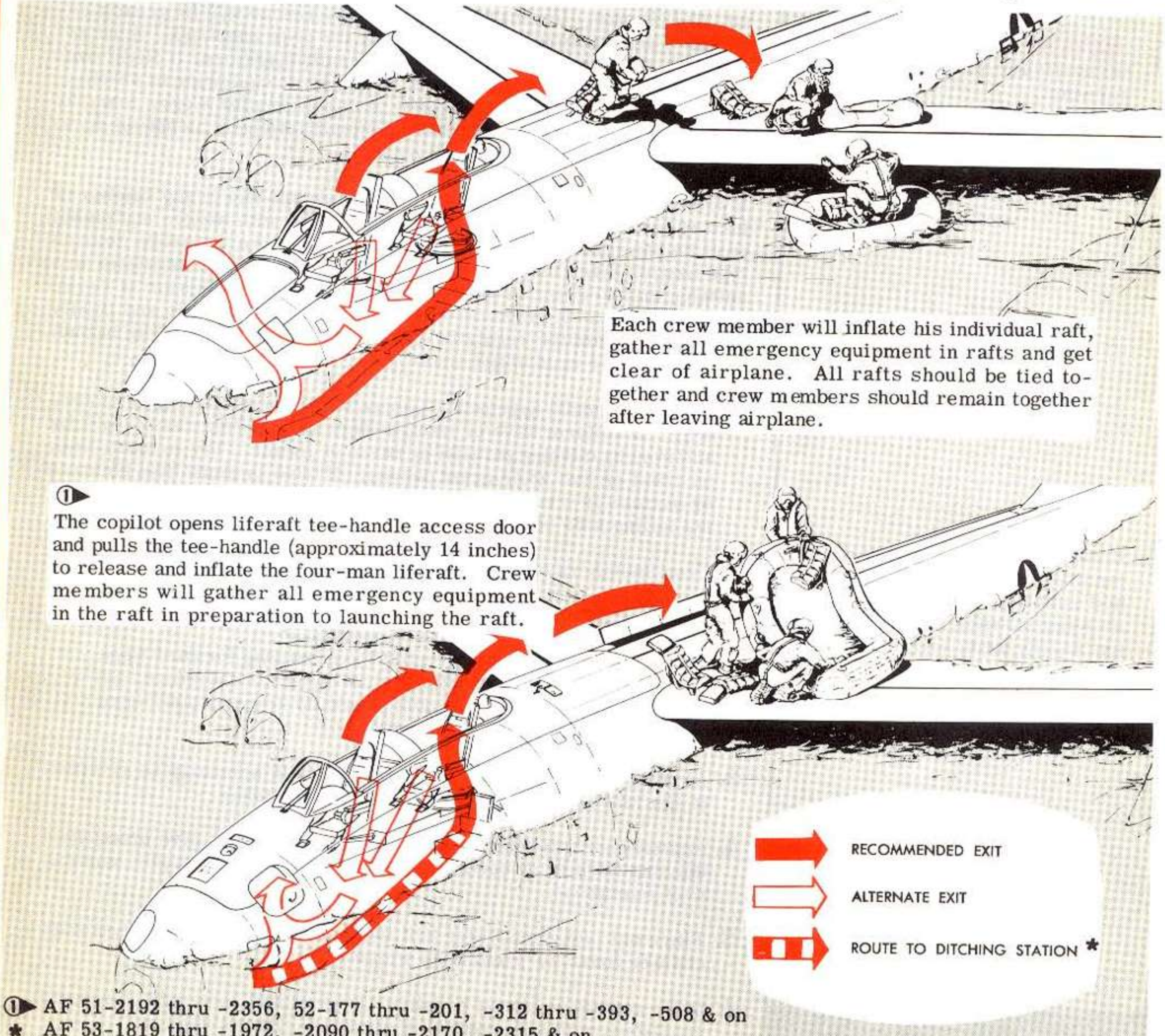


Figure 3-8. (Sheet 3 of 3 Sheets)

BAILOUT

CONTROLLABLE FLIGHT

The methods of bailout are listed below in order of preference:

- Ejection Seats (except as noted below)
- Escape Chute - Spoiler extended
- Observer's Downward Ejection Hatch Opening (Pilot and Copilot only)
- Escape Chute - Spoiler not extended

EJECTION SEATS

Whenever possible, bailout should be made by using the ejection seats (figure 3-9). Minimum IAS for jettisoning canopy is 190 knots IAS for sliding canopies and 180 knots IAS for clamshell canopies. If time and conditions permit and if terrain clearance is 2000 feet or below, pilot and copilot will unfasten safety belts to aid in rapid separation from seat after ejection; this action is not necessary with automatic opening safety belts.

WARNING

Do not use observer's downward ejection seat with safety belt unbuckled.

ESCAPE CHUTE - SPOILER EXTENDED

If for any reason the ejection seats are inoperable or not installed, the escape chute with spoiler extended is the most desirable means of egress. The airplane should be trimmed for level flight and the drag gear extended to reduce speed as much as possible (definitely below 280 knots IAS) to insure proper spoiler extension and to eliminate possible parachute malfunction. All gear should be raised prior to bailout. Refer to figure 3-10.

OBSERVER'S DOWNWARD EJECTION HATCH OPENING

The observer's downward ejection hatch opening may also be used for egress by the remaining crew after the observer has ejected. Maximum speed for safe egress is 195 knots IAS. Forward gear should be retracted. Refer to figure 3-11.

ESCAPE CHUTE - SPOILER NOT EXTENDED

The escape chute (without spoiler extended) can be used; however, airspeed should be reduced as much as possible (maximum 195 knots IAS for safe egress) and all gear raised prior to bailout (figure 3-10).

ALTERNATE BAILOUT

UNCONTROLLABLE FLIGHT

The methods of bailout are listed below in order of preference:

- Ejection Seats
- Jettison Canopy - over the side

EJECTION SEATS

If the ejection seats are operative regardless of structural condition, they should be used to abandon the airplane. Ejection should be performed in the same manner as in a controllable airplane (figure 3-9).

CANOPY OPENING

If the ejection seats are inoperative and there are no other means of abandoning the airplane, the canopy can be jettisoned and the crew egress made through the opening and over the side as a last resort (figure 3-13).

EMERGENCY GROUND STARTING ON BATTERIES

If external power is not available for starting, proceed as follows:

1. DC Electrical Equipment - OFF
   Turn off all equipment requiring DC power.

NOTE

No fuel, oil or hydraulic indications will be shown during engine starts.

2. Battery - LH BUS NORMAL
3. Generators - RESET & OFF
   Place all generator switches to RESET momentarily, then release them to OFF.

(CONTINUED ON NEXT PAGE)

bailout ejection seats

Pilot reduces airspeed to allow fourth crew member to egress (maximum IAS 195 knots without spoiler extended, with spoiler extended maximum IAS 280 knots). Maximum IAS 195 knots if fourth crew member elects to egress through the observer's downward ejection hatch opening.

pilot

1. Give bailout order by one long ring on alarm bell and spoken order "bailout-ejection seats" over interphone.
2. Rotate left handgrip forward from stowed position until reaching mechanical stop.

①▶ **NOTE**

The left handgrip has no connection with the ejection controls and is raised and used as a handgrip only.

3. Rotates right handgrip forward from stowed position until reaching mechanical stop.

WARNING

- Crew member should keep head back against headrest; elbows in place, and feet on footrests.
- On sliding canopy, if opened, pilot and copilot should lower themselves in the cockpit, prior to jettisoning the canopy.

4. Fires seat catapult by squeezing catapult trigger (right handgrip).

copilot

1. Acknowledge bailout order.*Position seat facing forward and return seat from forward tilted position back to normal ejection position.
2. Rotate left handgrip forward from stowed position until reaching mechanical stop.
3. Rotates right handgrip forward from stowed position until reaching mechanical stop.
4. Fires seat catapult by squeezing catapult trigger (right handgrip).

observer

1. Acknowledge bailout order. Position seat facing forward.
2. Raise leg braces from stowed position to locked position by pulling either or both triggers and rotating leg braces forward.

WARNING

Alarm bell rings as result of leg braces being raised. This is no indication of pilot's initiated bailout signal.

3. Grasps D-ring with both hands and pulls once, approximately 1 inch.
4. Fires seat catapult by pulling a second time approximately 1 inch (maintains grip on D-ring during ejection).

WARNING

Retain grip on D-ring until clear of the airplane to prevent arms from being forced upward and extending beyond the ejection envelope. Keep elbows close to body to prevent injury.

* If time and/or circumstances prevent copilot from positioning seat facing forward, an aft facing ejection may be made.

①▶AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

Figure 3 - 9.

IF TIME AND CONDITIONS PERMIT OBSERVE THE FOLLOWING PRECAUTIONS:

1. Pilot gives bailout warning by three short rings on alarm bell and spoken word over interphone.
2. If at an altitude of 2000 feet or below, pilot and copilot unfasten safety belts to aid in separation from seats after ejection.

NOTE

This action is unnecessary if automatic opening safety belts are installed.

3. If above 10,000 feet altitude, each crew member rechecks bailout oxygen bottle for proper connection and pulls release. Release should not be pulled until the last possible moment.
4. Pilot positions IFF to EMERGENCY and HF tone ON.
5. (2)▶ Copilot sets command radio transfer switch in REMOTE.
6. Pilot starts emergency keyer operation.
7. Lower helmet visor.
8. Pilot adjusts airspeed to optimum ejection speed after fourth crew member's bailout, trims airplane for level flight, and engages automatic pilot.

NOTE

Optimum ejection speed is approximately 300 knots IAS. Lower airspeeds (below 275 knots IAS) are not as favorable due to rapid rotation of ejection seats after firing.

9. Fourth crew member, observer, copilot, and pilot is the desired order of bailout when escape chute is used by fourth crew member. If observer's downward ejection hatch opening is used by fourth crew member the desired order of bailout is observer, fourth crew member, copilot, and pilot.

NOTE

If manually operated safety belt is installed, unfasten safety belt and kick free of seat as soon as possible. Delay opening parachute as long as possible.

WARNING

Crew member should be absolutely sure he is completely free of the seat before deploying the parachute.

(2)▶ AF 51-2357 thru 52-611

fourth crew member

1. Acknowledge bailout order. Unfasten safety belt and shoulder harness.
2. Unlock and open pressure compartment door. Pull entrance door bailout control handle to full travel.
3. Check parachute, bail out feet first, facing aft.

   If bailout is made through observer's downward ejection hatch opening, egress after observer has ejected and before canopy is jettisoned.

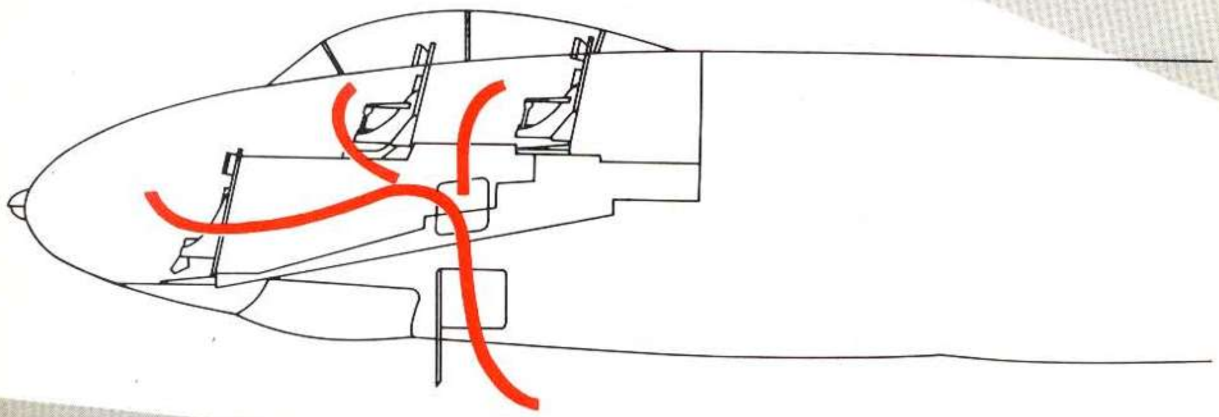
MINIMUM SAFE EJECTION ALTITUDES

UPWARD EJECTION		DOWNWARD EJECTION	
Manual belt and chute	2000 ft	Manual belt and chute	2300 ft
Automatic belt and manual chute	1000 ft	Automatic belt and manual chute	1300 ft
Automatic belt and chute	500 ft	Automatic belt and chute	800 ft

50308 WC

bailout

escape chute



pilot

1. Give bailout warning by three short rings on alarm bell and "prepare-to-bailout-escape chute" warning over interphone. Pull emergency cabin release handle.
2. Use flaps and drag gear to reduce airspeed as much as possible (maximum IAS 195 knots without spoiler; or forward gear down and/or bomb doors open. With spoiler extended maximum IAS 280 knots), trim airplane for level flight and engage automatic pilot, stows control column.
3. Check landing gear retracted and bomb doors closed. Give abandon-airplane signal by one long ring on alarm bell and spoken order over interphone. Unfasten safety belt and shoulder harness.
4. Check parachute, bail out feet first facing aft.

copilot

1. Unfasten safety belt and shoulder harness.
2. Stow control column.
3. Proceed to bailout escape hatch.
4. Check parachute, bail out feet first facing aft.

observer

1. Unfasten safety belt and shoulder harness.
2. If no fourth crew member is aboard. Unlock and open pressure compartment door.
3. Pull entrance door bailout control handle to full travel.
4. Check parachute, bail out feet first facing aft.

Figure 3-10.

OBSERVE THE FOLLOWING PRECAUTIONS:

NOTE

- With three crew members aboard, the observer, copilot, and pilot will bail out in the order named.
- With four crew members aboard, the fourth crew member, observer, copilot and pilot will proceed in the order named through the pressure compartment and utilize either of the following procedures for abandoning the airplane.

fourth crew member

1. Unfasten safety belt and shoulder harness.

2. Unlock and open pressure compartment door.

3. Pull entrance door bailout control handle to full travel.

4. Check parachute, bail out feet first facing aft.

Stand just forward of the entrance door facing aft and jump feet first straight through the escape chute, using hands to stabilize body. Position back as close to the bailout spoiler as possible while passing through escape chute in order to insure maximum protection by the spoiler. Lower head slightly during fall to reduce the change of the head hitting the spoiler.

Should any crew member be injured so as to prevent his bailout normally, assist crew member to pressure compartment door opening, connect parachute static line to ripcord, lower crew member head first facing aft through pressure compartment opening and drop him through escape chute.

IF TIME AND CONDITIONS PERMIT

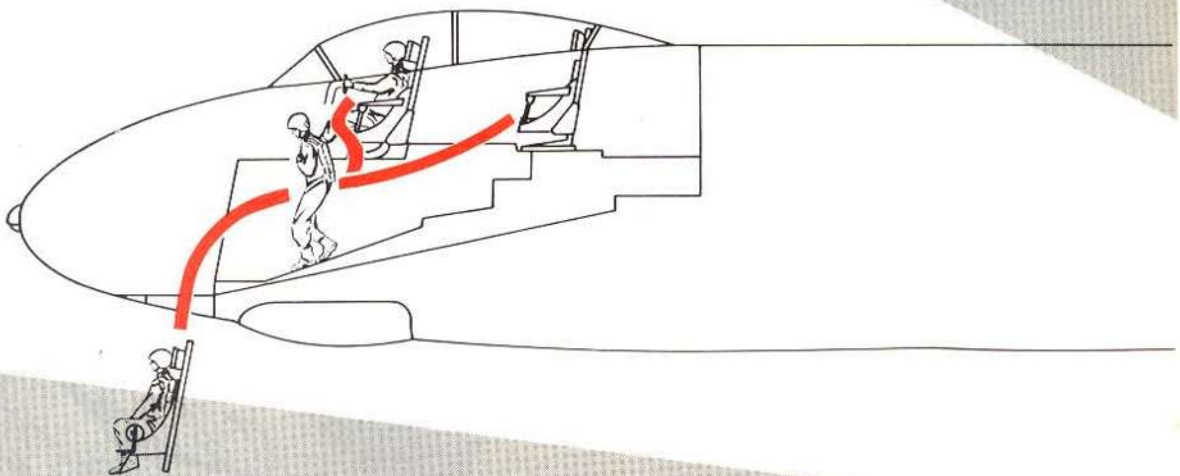
1. Pilot positions IFF to EMERGENCY and HF tone ON.
2. Pilot starts emergency keyer operation.
3. Copilot sets command radio transfer switch in REMOTE. (1)
4. If above 10,000 feet altitude, all crew members recheck bailout oxygen bottle for proper connection and pull release. Release should not be pulled until last possible moment.

(1) AF 51-2357 thru 52-611

50309WC

bailout

observer's downward ejection hatch opening



pilot

1. Give bailout warning by three short rings on the alarm bell and spoken warning "Bail out observer's hatch opening" over interphone.
2. Use flaps and gear to reduce airspeed as much as possible (maximum 195 knots IAS). Trim airplane for level flight and engage automatic pilot. Stow control column.
3. Give abandon-airplane signal by one long ring on alarm bell and spoken warning over interphone. Unfasten safetybelt and shoulder harness.
4. Check parachute and bail out through observer's downward ejection hatch opening.

copilot

1. Unfasten safety belt and shoulder harness.
2. Stow control column and stands by for observer's ejection.
3. After observer's ejection, proceed forward. Check parachute and bail out through observer's downward ejection hatch opening.

observer

1. Position seat facing forward, check safety belt and shoulder harness to insure properly fastened.
2. Raise leg braces from stowed to locked position by pulling either or both triggers and rotating leg braces forward. Grasp D-ring with both hands and pull once approximately 1 inch.
3. On bailout order fire seat catapult by pulling D-ring a second time, approximately 1 inch (maintains grip on D-ring during ejection).

WARNING

- Retain grip on D-ring until clear of airplane to prevent arms from being forced upward and extending beyond the ejection envelope.
- Delay opening parachute until completely free of the seat.

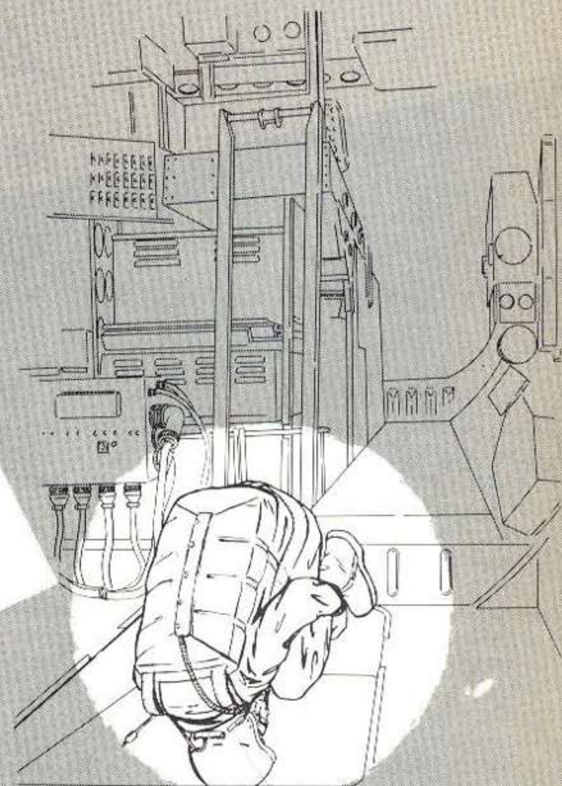
Figure 3-11

OBSERVE THE FOLLOWING PRECAUTIONS

1. Pilot should reduce airspeed as much as possible (minimum 145 knots IAS).
2. If gear is used to reduce speed, all gear should be raised prior to bailout.
3. Fourth crew member, copilot, and pilot is the desired order of bailout following observer's ejection.
4. Crew members should crouch at left side of observer's downward ejection hatch opening and roll, head first, out the opening.

fourth crew member

1. Unfasten safety belt and shoulder harness.



2. After observer's ejection, proceed forward. Check parachute and bail out through observer's downward ejection hatch opening.

IF TIME AND CONDITIONS PERMIT

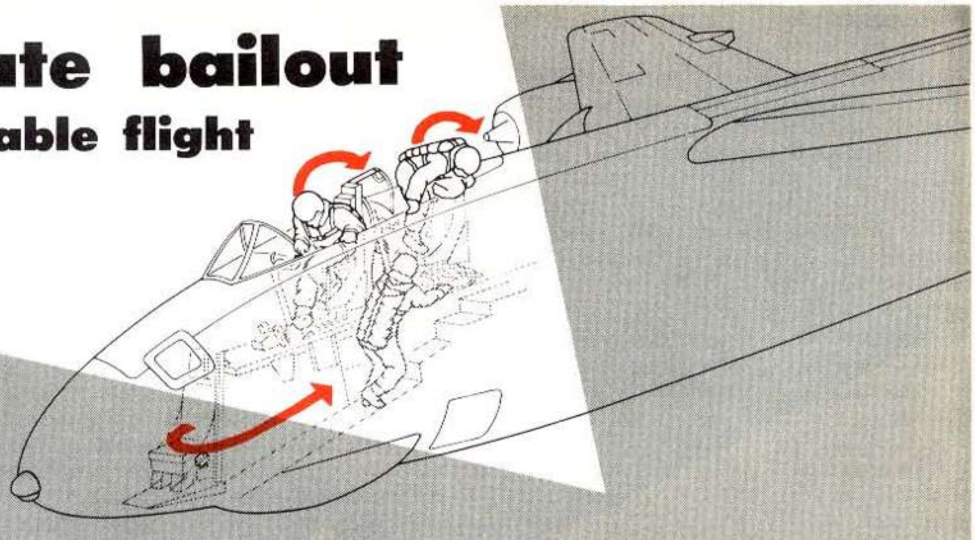
1. Position IFF to EMERGENCY and HF tone ON.
2. Pilot starts emergency keyer.
3. (1) Copilot sets command transfer switch in REMOTE.
4. If above 10,000 feet altitude, all crew members recheck bailout oxygen bottle for proper connection and pull release. Release should not be pulled until last possible moment.

(1) AF 51-2357 thru 52-611

50318 WC

* alternate bailout

uncontrollable flight



pilot

1. Give abandon airplane order by one long ring on alarm bell; "bail out over the side" order on interphone and give "jettison canopy" order.

2. Unfasten safety belt and shoulder harness. Bail out through cockpit opening, over the side of airplane.

copilot

1. Pull canopy emergency jettison handle.

2. Unfasten safety belt and shoulder harness. Bail out through cockpit opening, over the side of airplane.

observer

1. Unfasten safety belt and shoulder harness. Proceed aft in walkway to position near copilot.

2. Bail out through cockpit opening, over the side of airplane.

*** THIS METHOD OF BAILOUT TO BE USED ONLY IF NO OTHER EXIT CAN BE UTILIZED.**

Figure 3-12

EMERGENCY GROUND STARTING ON BATTERIES

(CONTINUED)

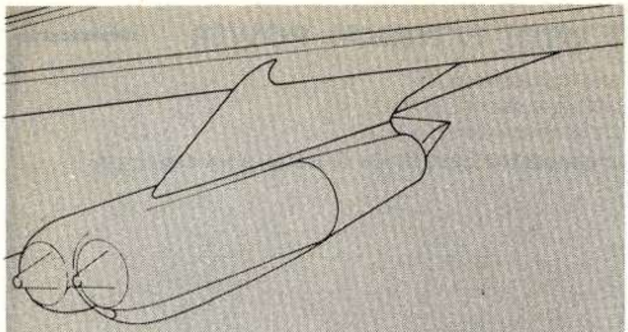
4. No. 2 Engine TME, All Others ME
   Place fuel selector switch for No. 2 engine on TME and all other fuel selector switches on ME.

5. Starter Selector - SET
   Set starter selector switch to engine to be started.

6. Starter & Override - START
   Hold starter switch and emergency override switch in START positions simultaneously, then release.

7. Start Sequence - 4, 5, 6, 3, 2, & 1
   Use normal start procedure after starter engagement.

(CONTINUED ON NEXT PAGE)



fourth crew member

1. Unfasten safety belt and shoulder harness.

2. Bail out through cockpit opening, over the side of airplane.

50319WC

EMERGENCY GROUND STARTING ON BATTERIES

(CONTINUED)

8. Engines 4 & 5 Started - ALL GENERATORS ON, BATTERY OFF
   After starting engines No. 4 and 5, place all generator switches ON and battery switch OFF. Operate engines No. 4 and 5 at a minimum speed of 60% rpm. Start engine No. 6 on DC generator power from the two operating engines. After starting engine No. 6, the engines may be operated at a minimum speed of idle position (40% rpm). Start the remaining engines on DC generator power from the operating engines. Each DC generator will be connected automatically to the main DC bus as its engine comes up to speed.

9. Battery - LH BUS NORMAL
   After all engines are started, place the battery switch to LH BUS NORMAL.

10. DC Electrical Equipment -.ON
    Turn on equipment requiring DC power as necessary.

EMERGENCY GROUND STARTING WITH EXTERNAL POWER

If rectifier power cart (500-amp capacity) or a motor generator cart (800- to 1000-amp capacity) is available, proceed as follows:

1. DC Electrical Equipment - OFF
   Turn off all equipment requiring DC power.

NOTE

No fuel, oil, or hydraulic indications will be shown during engine start.

2. Battery - OFF
3. Connect External Power to:
   "Normal" Receptacle (some airplanes)
   "Service" Receptacle (other airplanes).
4. Generators - RESET & OFF
   Place all generator switches to RESET momentarily, then release them to OFF.
5. No. 2 Engine TME, all Others ME
   Place fuel selector switch for No. 2 engine on TME and all other fuel selector switches on ME.
6. Starter Selector - SET
   Set starter selector switch to engine to be started.
7. Starter and Override - START
   Hold starter switch and emergency override switch in START positions simultaneously, then release.
8. Start Sequence - 4, 5, 6, 3, 2 & 1
   Use normal start procedure after starter engagement.
9. Engines 4 & 5 Started - ALL GENERATORS ON
   After starting engines No. 4 and 5, place all generator switches ON. Start remaining engines.
10. Battery - LH BUS NORMAL
    After all engines are started, place battery switch to LH BUS NORMAL.
11. DC Electrical Equipment - ON
    Turn on equipment requiring DC power as necessary.

EMERGENCY GROUND STARTING — CONDENSED CHECKLIST

EMERGENCY GROUND STARTING ON BATTERIES

1. DC Electrical Equipment - OFF
2. Battery - LH BUS NORMAL
3. Generators - RESET & OFF
4. No. 2 Engine TME, all Others ME
5. Starter Selector - SET
6. Starter & Override - START
7. Sequence - 4, 5, 6, 3, 2 & 1
8. Engines 4 & 5 Started - ALL GENERATORS ON, BATTERY OFF
   a. Engines 4 & 5 - 60% RPM
   b. Engine 6 Started - ALL ENGINES 40%
   c. Start Remaining Engines
9. Battery - LH BUS NORMAL
10. DC Electrical Equipment - ON

EMERGENCY GROUND STARTING WITH EXTERNAL POWER

1. DC Electrical Equipment - OFF
2. Battery - OFF
3. Connect External Power to:
   a. "Normal" Receptacle (some airplanes).
   b. "Service" Receptacle (other airplanes).
4. Generators - RESET & OFF
5. No. 2 Engine TME, all Others ME
6. Starter Selector - SET
7. Starter & Override - START
8. Sequence - 4, 5, 6, 3, 2 & 1
9. Engines 4 & 5 Started - ALL GENERATORS ON
10. Battery - LH BUS NORMAL
11. DC Electrical Equipment - ON

EMERGENCY TAXIING

In case of front gear steering failure, directional control of the airplane cannot be maintained during taxiing. Discontinue taxiing and request to be towed. With the rudder-elevator surface power control inoperative and crosswinds above 15 knots, taxiing should not be attempted since control of the rudders may be impossible. If the rudder-elevator surface power control system fails while taxiing under the above conditions, stop the airplane and request a tow.

In the event an outrigger gear slips off the runway into mud or soft dirt during taxiing, the pilot will shut down the engines and request the assistance of a tow vehicle. This will prevent structural damage to the outrigger wheel and inboard nacelle strut which may occur if a further attempt at taxiing were made.

FUEL SYSTEM EMERGENCY OPERATION

Since the main tank fuel boost pressure warning lights are energized by low-pressure switches downstream from the tank boost pumps, low pressure in the lines from any cause will illuminate the warning lights. A broken fuel line could cause the warning lights to come on even though the boost pumps were functioning normally. Boost pump failure will also illuminate the warning lights. The variables, such as the location and degree of break, make it impossible to positively differentiate between a broken fuel line and boost pump failure. If the break restricts the flow of fuel enough to allow some pressure to be maintained in the fuel line, the boost pump pressure warning lights may not illuminate. An excessive consumption of the fuel in the tank affected may be the only indication in this case. A fuel line break between the check valve near the tank and the boost pump could cause the warning light for the affected line to illuminate but have no immediate effect on normal engine operation. Since the possibility of fuel line breaks should be very remote in normal noncombat operations, illumination of a fuel boost pump pressure warning light should be treated as boost pump failure while also considering the possibility of a fuel line break. If any indication of a fuel line break is noted, the affected engine should be shut down to try to isolate the break from its source of fuel supply. If all fuel selector switches were placed in TE position, a break in the engine manifold would be isolated. A break between the manifold valve and the check valve at the tank should be indicated either by loss of engine, reduction in rpm, or illumination of the fuel boost pressure warning lights when all fuel selector switches are in TE position. By shutting down the engine affected, the break would be isolated.

NOTE

On later airplanes the fuel selector switch must be in TE position and the throttle in CUTOFF when the engine is shut down before the tank valves will close.

OPERATION WITH BOOST PUMP FAILURE

The consideration of a boost pump failure in flight does not propose a serious problem, particularly so during auxiliary fuel usage as the auxiliary boost pump capacity is sufficient to sustain flight when no main boost pumps are operating and auxiliary fuel is being routed to the engine manifold. However, in the event both boost pumps for an engine fail the following emergency countermeasures should be established:

1. Fuel selector switch for engine opposite the malfunctioning engine to TME.
2. Fuel selector switch for malfunctioning engine to ME.
3. Reposition No. 2 engine fuel selector switch to TE. This will maintain equal fuel consumption from main tanks during flight.
4. If the boost pumps for No. 2 engine fail, position the fuel selector switch for No. 5 engine to TME and position the fuel selector switch for No. 2 engine to ME.

NOTE

When one engine is shut down in flight, a change in fuel management may be required in order that the cg limits of the airplane are not exceeded.

WARNING

All nonessential electrical power should be shut off to preclude possible fire.

EMERGENCY TANK EMPTYING

In case it becomes necessary to empty one main tank rapidly, use the following procedure:

1. Position fuel selector switches for the engines using fuel from the tank to be emptied to TME.
2. Position two other fuel selector switches to ME and leave the remaining two engines on TE.
3. When the tank is nearly empty, reposition the two engines that are on ME to TE.
4. Reposition one of the switches now on TE to TME.
5. When all four boost pressure warning lights for the tank being emptied remain on, reposition fuel selector switches for engines being supplied by that tank to ME.

WARNING

- When emergency emptying of any main fuel tank is being performed, care must be exercised that the cg limits are not exceeded.
- All nonessential electrical power should be shut off to preclude possible fire.

OPERATION WITH ASYMMETRICAL FUEL LOADING IN EXTERNAL WING TANKS

During transfer of fuel from external wing tanks, both the fuel panel and lateral trim should be monitored periodically. If it appears that the tanks are feeding unevenly, lateral trim should be checked continuously to insure that both tanks are feeding. If lateral trim or an amber no-flow light indicates that one tank is not transferring fuel, it may be advisable to turn both external wing tank switches OFF. This will prevent the asymmetrical condition from becoming worse. If it is necessary to use the fuel despite the asymmetrical condition, follow the procedure in "Landing with Asymmetrical Fuel Loading in External Wing Tanks" under "Landing Emergencies," this section.

EXTERNAL WING TANK JETTISONING

Before jettisoning the external wing tanks, the tank capacity, flap position, and airspeed should be considered:

Full Tanks - Flaps up or down
Empty Tanks - Flaps up only
Minimum IAS - 155 knots
Maximum IAS - 300 knots

Observe flap structural limit speed. When it is necessary to jettison external wing tanks, the following procedure should be accomplished:

(1)
Position both tank jettison switches to RELEASE to jettison both tanks since a switch is provided for each tank.

(1) AF 51-2192 thru 53-1821, -2028 thru -2117, -2261 thru -2367 which do not have T. O. 1B-47-767 accomplished

fuel system emergency operation

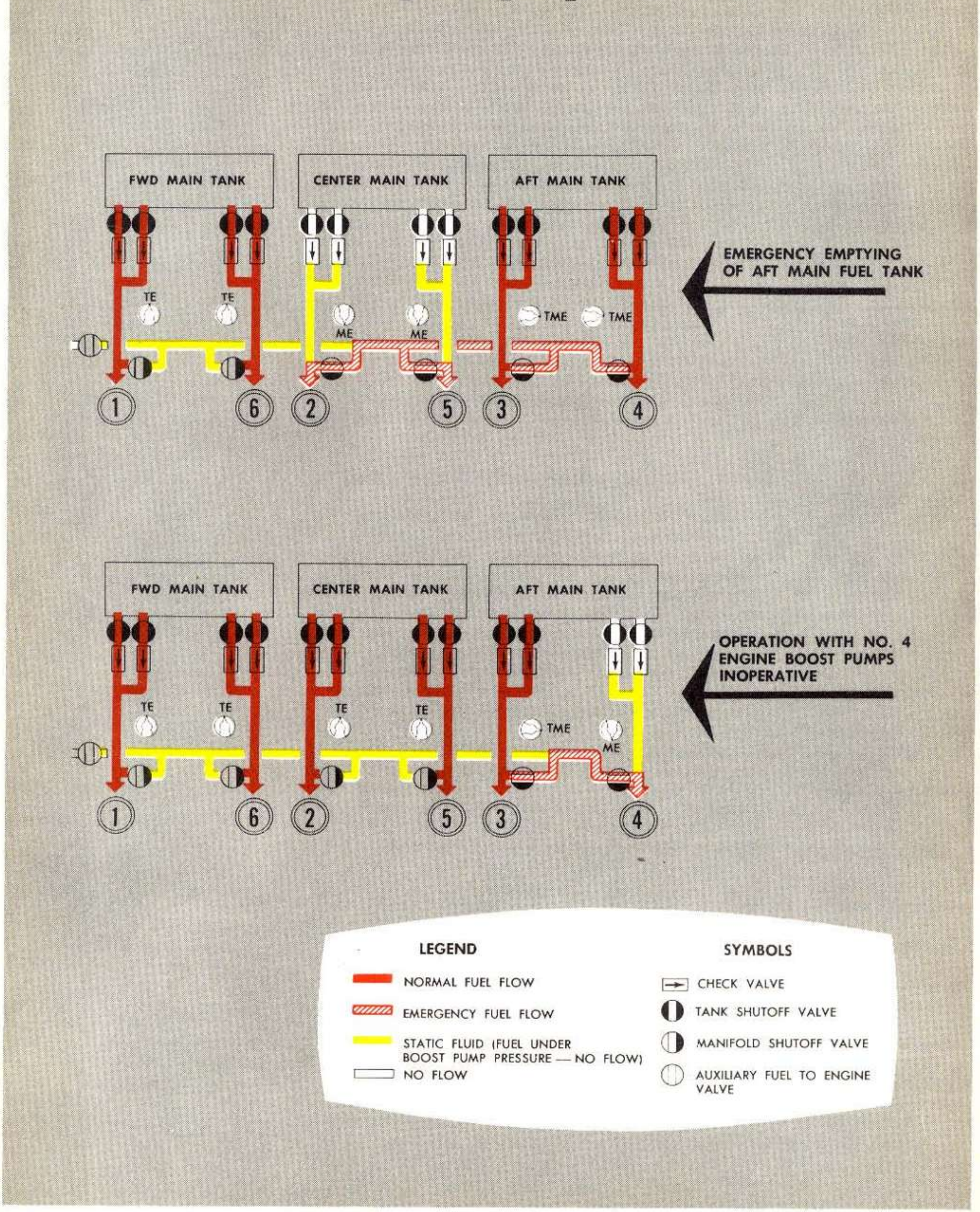


Figure 3-13.

NOTE

Excessive time delay may occur for the external wing tanks to jettison after the wing tank jettison switch has been placed in RELEASE position. This is caused by the parachute failing to deploy immediately upon actuation of the wing tank jettison switch. Maximum time delay has been as high as 10 minutes.

(1) Momentarily position the normal wing tank jettison switch to the tank position of the tank desired to be jettisoned first; then momentarily position the normal wing tank jettison switch to the other tank position. If the normal wing tank jettison switch fails to function properly, the alternate wing tank jettison switch may be used in the same manner.

CAUTION

Due to structural limitations of wing, landing with full external tanks is not recommended.

ELECTRICAL SYSTEM EMERGENCY OPERATION

DC SYSTEM

GENERATOR MALFUNCTION

Conditions of the loadmeter that may indicate a malfunction of the generator are as follows: no loadmeter reading, large fluctuating reading, and noticeable differences in loadmeter readings. The generator field trip warning light will glow when the generator has tripped off the line. When this occurs the generator may be reset by positioning the generator switch to RESET position. In event that a malfunction should occur, place the voltmeter selector switch to the affected generator and check for correct voltage. The generator switch should first be placed in the RESET position, then to the ON position. If the generator continues to function improperly, adjust the rheostat control. If the above steps do not correct the generator malfunction, place the generator switch in the OFF position.

GENERATOR FAILURE

If two or more generators become inoperative, a careful check of the load on the remaining generators should be made. Many electrical loads are not absolutely essential and may be momentarily or permanently removed from the line during emergency conditions. The table in figure 3-14 shows the approximate power requirements for the main electrical loads. Each generator is rated at 400 amperes with an overload rating of 600 amperes for a 5-minute period. Total the loads for any operation and check against the power available to determine if any loads must be removed from the line. The most critical partial generator operation likely to be encountered is for two-engine endurance; the detailed procedure is given as follows:

NOTE

Any tabulation of electrical loads must be an approximation or an average because loads vary with existing conditions and with the age of the equipment.

OPERATION WITH TWO GENERATORS

Operation with only two generators, as encountered during two-engine endurance flight (see "Two-Engine Endurance" in this section), requires careful consideration of the limited electrical power available. However, if all nonessential electrical equipment is turned off, sufficient electrical power is available from the remaining two generators to operate essential equipment. In addition, should one of these generators fail, the overload capacity (600 amperes for 5 minutes) of the remaining generator is sufficient to operate the essential equipment until another engine can be restarted.

The following tabulation is taken from the chart in figure 3-14 and lists the essential electrical loads and the standby loads for two-engine endurance and their average amperage requirements. This equipment must be operating or electrical power must be availabel for operation at all times:

ITEM	AMPERES (Approx)
Automatic Pilot	20
Battery Charging	15

(1) Airplanes which have T. O. 1B-47-767 accomplished and AF 53-1822 thru -1972, -2118 thru -2170, -2368 & on

Fuel Boost Pumps (4)	90
Generator Field and Control	23
Hydraulic Accumulator Heat *	13
Instrument Inverter **	25
Instruments and Instrument Panel Vibrators	5
Lighting	11
Main Inverter **	(Max) 152
Pitot Heat	9
Radio Equipment (Interphone or Intercom, Command Radio, and Radio Compass)	36
Surface Power Control System	100
Windshield Defrost	5
Total Essential and Standby Load	504
Two-Engine Generator Capacity	800
Single Engine Generator Overload Capacity (50% Overload for 5 Minutes)	600

A study of the complete listing of major electrical equipment items (figure 3-14 will show that the operation of unnecessary fuel booster pumps, radar BNS, wing flaps, landing gear, and hydraulic equipment must be avoided during two-engine flight. However, certain other equipment, such as the nose defroster, may be operated if the need is urgent and the total amperage load is kept to a minimum. It is recommended that the total amperage of equipment operated should not be allowed to exceed the 600-ampere overload capacity of a single generator.

FAILURE OF FORWARD MAIN BUS

Should a fault occur on the forward main bus which will deenergize all equipment served from the upper, lower, and aft DC power panels and the radar power panels, an automatic changeover relay will transfer the power panels to the right main bus. If the changeover relay does not immediately restore power to the upper, lower, and aft DC power panels and the radar power panel, place the bus selector switch in SECONDARY position. This procedure will manually transfer power to the right main bus.

REGULATED AC SYSTEMS (1)

INVERTER FAILURE

In case of failure of either the main or A-5 inverter, automatic changeover relays will transfer the secondary inverter output to the failed bus. In case of failure of both the main and A-5 inverters, automatic changeover relays will transfer the secondary inverter to the main bus only. The secondary inverter will transfer and be turned on regardless of the position of secondary inverter switch. The inverter indicator lights will indicate which inverter is supplying power to which bus. It is necessary for the main inverter and A-5 inverter switches to be in ON position for automatic changeover relays to operate; therefore, if the main inverter fails and the secondary inverter automatically transfers to the main bus, do not place the main inverter switch in OFF position.

If the main and/or A-5 inverter fails and the automatic changeover relays fail to operate, the secondary inverter output may be manually transferred to the desired bus by placing the inverter transfer control switch in either SEC INV MAIN BUS or SEC INV A-5 BUS position.

In case both main and A-5 inverters have failed and secondary inverter is on the main bus, place inverter transfer control switch in SEC INV SEC BUS position when secondary bus voltage is momentarily required. No power will be on the main and A-5 buses during this operation.

In case the secondary inverter has failed or has been automatically transferred to the main bus and secondary bus power is required when A-5 bus power is not required or of less importance, place the inverter transfer control switch in A-5 INV SEC BUS position. No power will be on the A-5 bus during this operation.

(2) In case of erratic operation of main inverter or failure of main bus automatic changeover relay and power is needed on both the main and secondary buses, place the inverter transfer control switch in the SEC INV MAIN BUS AND A-5 INV SEC BUS position. The indicator lights will indicate this transfer. No power will be on A-5 bus during this operation.

INSTRUMENT INVERTER FAILURE

In the event the main instrument inverter fails, an automatic changeover relay will energize the spare inverter to supply the instrument bus. In case the main instrument inverter fails and the automatic changeover relay fails to function, place the instrument inverter switch in the SPARE position.

UNREGULATED AC SYSTEM (1)

A voltmeter on the regulated AC power panel and four indicator lights on the unregulated AC power panel will provide an indication of malfunctions of the alternators and buses. The bus power off light will illuminate when the bus power is below rated value of approximately 105 volts. The underfrequency light will illuminate when the alternator frequency is below rated value of approximately 380 cps (50.5% rpm) or the alternator voltage falls below approximately 100 volts.

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* AF 51-2192 thru -5234, -15804 thru -15812, 52-019 thru -029, -202 thru -220
(1) ** AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2) AF 51-2192 thru -2356, 52-177 thru -201, -312 thru -393, -508 thru -1416, -3343 thru -3373, 53-2261 thru -2278

ALTERNATOR MALFUNCTIONS

If the bus power off light or underfrequency light should illuminate, place the voltmeter selector switch to the alternator that is not functioning properly. Place the alternator power switch of the malfunctioning alternator to the RESET position. If the alternator still fails to operate properly, adjust the rheostat corresponding to that alternator. Should the alternator still not function properly after rheostat adjustment, place the bus selector switch to the LH ALT BOTH BUS or RH ALT BOTH BUS, depending on which alternator is functioning properly.

NOTE (1)

Since it is impossible to connect a single alternator to two buses, it will be necessary to turn off all equipment which requires power for control or operation from the bus which will not be supplied power.

Place the alternator power switch of the alternator that is not functioning properly in OFF position.

BUS MALFUNCTIONS

If the alternators are functioning properly as indicated by the voltmeter and the underfrequency lights and the buses or bus have no power, place the bus selector switch to the LH ALT-RH BUS, RH ALT-LH BUS position.

NOTE (1)

It is possible only to place the left alternator on the right bus or the right alternator on the left bus.

If the buses or bus still do not have power, place the alternator power switch in OFF position and turn off all equipment which requires unregulated AC power for control or operation.

INSTRUMENT FAILURE

If electrical power is lost to any or all of the following instruments, these instruments may deceptively continue to give indications of the conditions that existed prior to the power failure:

- Engine fuel pressures gages
- Engine oil pressure gages
- Fuel quantity gages
- Hydraulic quantity gages
- Hydraulic pressure gages
- Flap position indicators
- Engine fuel flowmeters
- N-1 compass master indicator
- Vertical gyro indicator
- N-1 compass repeater (pilot's)

REGULATED AC SYSTEM (2)

A voltmeter, frequency meter, two ammeters, voltmeter and frequency meter selector switch, four indicator lights on the copilot's instrument panel, and one indicator light on the pilot's instrument panel will provide an indication of malfunctions at the alternators, buses, and emergency instrument inverter. The alternator bus fail light on the copilot's instrument panel will illuminate when no power is on the main AC bus. The instrument AC power warning light on the pilot's instrument panel will illuminate when no power is on the instrument bus. The emergency AC power warning light on the copilot's instrument panel will illuminate when no power is on the instrument bus and the emergency AC power switch is on. If one or both alternator failure lights should illuminate, place the respective alternator control switch to the reset position momentarily. If an alternator continues to trip after it has been reset, leave the alternator tripped as one alternator is capable of supplying entire AC bus load. If both alternators fail, place the emergency AC power switch on and power will be supplied to the instrument bus by the three-phase emergency instrument inverter. If the instrument AC power warning light should illuminate and the alternator or alternators are functioning properly, it is possible to turn on the emergency instrument inverter with one or both alternators operating; however, this is a very abnormal condition. The rudder axis of the automatic pilot should be disengaged prior to turning on the emergency instrument inverter because simultaneous operation of one or both alternators and the emergency instrument inverter may result in erratic operation of the rudder axis.

HYDRAULIC SYSTEM EMERGENCY OPERATION

Whenever main system pressure falls below emergency system pressure, shuttle valves are automatically actuated causing the emergency system to supply most of the actuating units. In the event this situation occurs the following check should be made to ascertain the source of malfunction:

Check emergency hydraulic system pressure and main and emergency brake accumulator pressures. If both emergency system pressure and emergency brake accumulator pressures are at 3000 psi, shut off emergency pump and do not use any components that work off the hydraulic system.

NOTE

If main system pressure stays above 100 psi, all fluid used by emergency system operation will return to main tank and it is then possible for the main pumps to pump it overboard if there is a leak.

As long as there is main and emergency brake accumulator pressure, there is adequate fluid in each for three complete brake applications. Turn pump to AUTO NORMAL just prior to landing. This should give steering authority on landing.

(1) AF 51-2357 thru -2411
(2) AF 52-1417, 53-1819 thru -2170, -2279 & on

major dc electrical loads

EQUIPMENT	TAKEOFF CLIMB	CRUISE	CRUISE COMBAT	DESCENT LANDING
ARMAMENT AND BOMBING				
Bomb Arming Control		13	13	
Fire Control System		17	214	
Inflight Control (IFC)	25	25	25	25
U-2 Rack		7.6	7.6	
Vacuum Pump (Some Airplanes)	20			
CONTROL SURFACES				
Automatic Pilot		20	20	
Flaps - Extend				135
Flaps - Retract	127			
Rudder-Elevator Surface Power Control	100	100	100	100
ELECTRICAL POWER				
Battery Recharge	121	91	60	30
Generator Field and Control	69	69	69	69
Inverter - A-5	80	115	175	
Inverter - Instrument	25	25	25	25
Inverter - Main	152	152	148	67
Inverter - Radar	20	25	25	
Inverter - Secondary	65	142	142	65
ENGINE CONTROLS				
Water Injection	72			
FUEL				
Aft Aux (ATO) Tank Boost	105	105		
Bomb Bay Tank Boost	105	105		
Forward Aux Boost	105	105		
Main Tanks Boost	274	274	274	274
Tank - Purging Heaters (Some Airplanes)	21	88	21	21
Wing Tank Boost	105	105		
HEAT, VENT, AND ANTI-ICE				
Accumulator Heat ①▶	13	13	13	13
Engine Anti-Icing Valve		11	11	
Exterior Surfaces Anti-Icing System	30			30
Food Warming Cup		20		
Nose Defrost	23	18	18	23
Windshield Defrost	5	5	5	5
HYDRAULIC				
Emergency Hydraulic Pump (140 amps)				
INSTRUMENTS				
Instruments and Vibrators	5	5	5	5

GENERATOR CAPACITY
NORMAL: SIX GENERATORS AT 400 AMPS EACH, 2400 AMPS.
OVERLOAD (5 MIN.): SIX GENERATORS AT 600 AMPS EACH, 3600 AMPS.
NOTE: FIGURES INDICATE LOAD IN AMPS
RED FIGURES INDICATE ESSENTIAL LOADS

①▶ AF 52-2192 thru -5234, -15804 thru -15812, 52-019 thru -029, -202 thru -220

Figure 3-14.

major dc electrical loads

EQUIPMENT	TAKEOFF CLIMB	CRUISE	CRUISE COMBAT	DESCENT LANDING
LANDING GEAR				
Aft Main - Retract	346			
All Gear - Extend				Negligible
Forward Main - Retract	266			
Outriggers - Retract	252			
LIGHTS				
Landing Lights	43			43
Navigation	9	9		9
Panel	11	11	11	11
Wing Illumination		18		
PHOTOGRAPHIC EQUIPMENT				
Aerial Camera and Controls			16	
Radar Recording Camera		8	8	
Vacuum Pump		10	10	
RADAR				
AN/APN-76 Rendezvous Radar		1		
AN/APS-54 Warning Radar		4	4	
AN/APX-6 IFF	1	1		1
ECM		20	20	
Radar BNS	24	24	24	
RADIO				
AN/AIC Interphone	3	3	3	3
AN/AIC-10 Intercommunication Equipment	11	11	11	11
AN/ARC-21 Liaison Radio		37	37	
AN/ARC-27 UHF Command	20	20	20	20
AN/ARN-6 Radio Compass		4.5		4.5
AN/ARN-12 Marker Beacon		1.5		1.5
AN/ARN-14 Localizer and Omni-Range		8		8
AN/ARN-18 Glide Path				1

GENERATOR CAPACITY

NORMAL: SIX GENERATORS AT 400 AMPS EACH, 2400 AMPS.
OVERLOAD (5 MIN.): SIX GENERATORS AT 600 AMPS EACH, 3600 AMPS.
NOTE: FIGURES INDICATE LOAD IN AMPS
RED FIGURES INDICATE ESSENTIAL LOADS

50312WC

If emergency system pressure is below 2550 psi, the circuit breaker in, and the "Pump Operating" light is not "on" when the emergency hydraulic pump switch is in AUTO NORMAL, hold the switch ON. In ON position, the pressure switch is bypassed.

CAUTION

To prevent excessive pressures in the system the switch should be released when or before pressure reaches 3450 psi. Holding the switch in ON position after pressure has reached 3450 will allow pressure to build as high as 3750 psi. This condition could cause excessive heating of the hydraulic oil and damage the pump.

Main hydraulic system (two pumps) is adequate for all normal operation of aileron surface power control. On airplanes equipped with the long bomb door system, the aileron standby systems will energize momentarily during the bomb door closing cycle.

One main pump operating is sufficient to supply both surface power control systems at cruise throttle setting. However, one engine pump is not adequate to supply both surface power systems at landing throttle setting. A pressure switch installed in the pressure line from the engine pump senses low pressure and turns on the emergency pump if a line rupture or other similar failure occurs.

(1)
On some airplanes if a slow leak occurs, it may cause only partial loss of pressure and a cycling condition will occur. Cycling of the aileron shuttle valve will result in an overflow of oil through the wing reservoir. If cycling occurs, the amber light on the pilot's surface power control panel will blink. When this condition is noted, the aileron switch for the particular wing should be turned off. After approximately 15 minutes the aileron switch may be turned on. If the cycling condition has not cleared, the switch should be turned off for the remainder of the flight.

(2)
On other airplanes when the emergency aileron system is activated it will remain operating until the aileron surface power control switch has been placed to the OFF position.

SURFACE POWER CONTROL SYSTEMS INOPERATIVE

With the surface power control systems inoperative, the controls are manually actuated through a cable control system. The design of the cable control system is such that each control may be moved a short distance in either direction from the neutral position before actually causing a movement of the control surface. This "dead motion" however is of negligible magnitude since the lost motion forces are extremely light in comparison to the forces required to move the surfaces. The control forces to fly the airplane will be heavy and vary with the airspeed.

WARNING

Very high Mach number flight and very high indicated airspeed flight should not be attempted with surface power control inoperative because irregular control characteristics and high control forces will be encountered.

If one or more of the surface power controls fail, retrim the airplane and position the switch for the malfunctioning system to OFF.

The recommended minimum control speed for failure of aileron or rudder-elevator surface power control, with three engines inoperative on one side and the remaining engines operating at 100% rpm, is 160 knots IAS at low altitude.

NOTE

- If the surface power control systems are inoperative, the automatic pilot may be used to alleviate pilot fatigue during sustained flight. Oscillatory motion of the airplane during flight can be minimized by manually trimming the surfaces involved to load the automatic pilot servo slightly. This will improve control by removing the effect of the control surface "lost motion."
- After sustained flight using the automatic pilot with surface power control inoperative, the pilot should record in DD Form 781 length of time of this operation and the axes involved. This will serve as a notice to the ground crew for any damage caused by the heat generated while applying the continuous loads to the servo motors.

CAUTION

The trim of the control surfaces should be checked frequently to prevent the loads as indicated by the trim meters from becoming excessive because if the automatic pilot would disengage or fail, the control loads would be imposed on the pilot.

(1) AF 51-2357 thru 53-1843, -2028 thru -2040, -2261 thru -2331
(2) AF 53-1844 thru -1972, -2090 thru -2170, -2332 & on

ELEVATOR OPERATION WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

(1)

Failure of rudder-elevator power control with the control switch in NORMAL position is signaled by illumination of a red "No Main Hyd Pressure" warning light whenever primary rudder-elevator pressure drops below 450 (+150/-0) psi. Under these conditions the emergency elevator pump should start automatically and furnish hydraulic pressure to operate the elevator power control only. The amber "Emerg Elevator Pressurized" light should illuminate when emergency pressure increases to above 600 (+150/-0) psi and the red "No Main Hyd Pressure" warning light should go out. If rudder-elevator power control fails and automatic changeover to emergency elevator does not take place, the pilot can turn on the emergency elevator system by moving the rudder-elevator power control switch to EMERG. The rudder then must be operated by direct control cable movement.

Loss of elevator power control at speeds near the maximum indicated airspeeds or Mach numbers will result in a pitch-up of the airplane. The resulting airplane acceleration will depend upon altitude, gross weight, and center of gravity, but sufficient elevator control is available to recover.

(2)

On airplanes without revised elevator balance bays, buffeting will result when elevator surface power control fails during flight at high Mach numbers. Above 34,000 feet altitude, stall will occur before the limit load factor is attained. Below 34,000 feet, airplane limit load factor will not be attained in the resulting pitch-up so long as the Mach number limitations are observed.

(3)

On airplanes with revised elevator balance bays, the pitch-up resulting from elevator surface power control failure at high Mach numbers is decreased appreciably. While control of the airplane is still marginal and control wheel forces are heavy, the resulting airplane acceleration is of sufficiently less magnitude that limit load factor will not be attained regardless of altitude, gross weight, and center of gravity combinations.

LANDING WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

A landing with rudder-elevator surface power control inoperative should be made as follows:

1. Circuit Breaker In
2. Surface Lock - Forward UNLOCK Detent
   Check that the surface control lock lever is in full forward UNLOCK detent.
3. Normal Pattern
   Establish a normal traffic pattern.
4. Elevator Trim - 20 Pounds
   Adjust elevator trim so that a pull force of about 20 pounds is required to maintain the desired angle of approach. In this manner, corrections in pitch may be made by relaxing or increasing back pressure on the control column, thereby avoiding column movement through the dead-motion zone with the resultant tendency to overcontrol. A 20-pound back pressure on the approach will call for about a 30-pound pull to complete the flare.

NOTE

For forward cg landings, full nose-up trim will be required in the initial approach and additional pull force will be required for the last part of the final approach and landing. Maximum pilot effort will be required for any landing with a maximum allowable forward cg.

5. Crosswind Landing
   a. Steering - TAKEOFF LAND
      If a crosswind landing must be made, recheck the steering ratio selector lever in TAKEOFF LAND detent.
   b. No approach chute
      Do not use the approach chute.

(CONTINUED ON NEXT PAGE)

(1) AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on
(2) AF 51-2357 thru -7083, -17368 thru -17386, 52-054 thru -149, -245 thru -311
(3) AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

LANDING WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

(CONTINUED)

c. Rudder pedals neutral - Steering TAXI
As soon as the airplane has touched down firmly on both main gears, decide whether or not steering control is adequate. If a greater range of steering is needed, neutralize the rudder pedals momentarily, move the steering ratio selector lever to TAXI and deploy the brake chute as soon as satisfactory steering control is established in TAXI.

NOTE

- Neutralizing the rudder pedals before moving the steering ratio selector lever to TAXI will make lever movement easier and will prevent sudden veering when the increased steering range becomes effective.
- It is essential to withhold deployment of the brake chute until after the steering ratio selector lever is moved to TAXI.

The increased steering range in TAXI position aids in maintaining directional control during the landing roll since the airplane may have a "weathercocking" tendency due to the crosswind and brake chute. Overall steering control is simplified if the brake chute is not used or if deployment is delayed as long as possible.

6. Wind Over 15 Knots - Stop Taxiing
After landing, discontinue taxiing if the wind exceeds 15 knots.

AILERON OPERATION WITH SURFACE POWER CONTROL INOPERATIVE

At or near the speed where no trim is necessary when an aileron power control unit fails, the aileron floats in the midposition of the "lost motion." Control wheel movements in either direction will result in operation of the operative boost and the light forces of power control on operation will be present. Movement of the control wheel beyond the lost motion will result in much higher forces as the aileron with the inoperative power control unit is moved. With both aileron power control units inoperative and at this same speed, the lost motion will be present, but as speed is decreased to the speeds at or near those used for approach and landing, the lost motion is not present because of the tendency for both ailerons to float up. The control forces initially felt will be those of one aileron until the control wheel motion is great enough to operate the opposite aileron at which time the control forces will be quite heavy.

CAUTION

- If aileron trim is necessary during operation with one aileron surface power control inoperative, return the airplane to level flight by moving the control wheel, then operate the trim tab control to reduce control wheel forces to zero.
- With both aileron power controls inoperative, it may not be possible with maximum pilot effort to obtain full control wheel deflection.
- Abrupt pitch-down will occur when flying at high indicated airspeeds in the event of simultaneous failure of both aileron power controls.

When airflow separation occurs on the wing in the vicinity of the aileron balance cavity, the normal aerodynamic balance of the aileron is destroyed. This loss of aerodynamic balance results in aileron "overbalance." The airflow separation which occurs on the wing in the high speed buffeting and at the low speed stall region causes this overbalance.

CAUTION

Because of aileron overbalance, practice stalls should not be attempted with one or both aileron power control units inoperative. Flight at or near first stall warning with one or both power control units inoperative should be avoided.

With vortex generators installed, sufficient lateral control is available in the event of an aileron power control failure while flying in the high-speed buffeting region. Aileron buffeting will be experienced if flight is continued on into the high-speed buffeting region with aileron power control unit off.

In the event of one aileron power control failure while in the approach for landing or immediately after take-off, position both aileron power control switches to OFF. This will result in zero trim being required and the maneuvers can then be completed with no large out-of-trim conditions occurring.

(1)

On some airplanes, fluctuation of the airplane main system hydraulic pressure above and below 950 (±100) psi will cause operation of the aileron power controls to cycle between the main system and the aileron emergency hydraulic systems. Each time airplane main system hydraulic pressure drops below 950 (±100) psi, the aileron emergency hydraulic pumps start and take over operation of the ailerons. Whenever main system pressure recovers and rises above 950 (±100) psi, the emergency pumps stop and aileron operation is returned to the main system. If a main hydraulic system malfunction causes cycling of this kind, it is recommended that both aileron power control switches be placed in OFF position to eliminate erratic aileron control forces.

(2)

On other airplanes, an automatic "hold" circuit maintains operation of the aileron emergency hydraulic pumps once they take over operation of the aileron power controls. Subsequent recovery of main system hydraulic pressure has no effect on the aileron emergency pumps, which continue to operate the ailerons, thus, eliminating cycling between systems when intermittent main system operation occurs. It is possible for a momentary heavy demand on the main hydraulic system to cause one or both aileron emergency pumps to be started and kept in operation by their respective "hold" circuits. If a check of the main hydraulic system reveals normal steady operating pressures, the affected aileron power control may be returned to the main hydraulic system by moving the appropriate control switch to OFF momentarily and then returning it to ON.

CAUTION

If the red no-pressure warning light and the amber emergency pump-on indicator light for an aileron system are illuminated simultaneously, a leak in the aileron power control system is indicated. The corresponding control switch should be placed in OFF position to prevent loss of airplane main system hydraulic fluid.

LANDING WITH AILERON SURFACE POWER CONTROL INOPERATIVE

1. Both Inoperative
   With both aileron power controls inoperative, the lateral control forces will be quite heavy. Turn both aileron power control switches OFF and fly a normal pattern. Flaperons will be inoperative with a resultant lower rate of roll. However, the airplane will be trimmed at zero for lateral forces, thus eliminating any sudden change in trim during the approach. A nose-high attitude should be avoided on touchdown.

2. One Inoperative (No Crosswind)
   If only one aileron power control is inoperative and there is no crosswind, turn both aileron power control switches OFF and fly a normal pattern.

3. One Inoperative (Crosswind)
   If a crosswind prevails, leave the operative aileron power control switch ON and turn the inoperative aileron power control switch OFF. Fly a normal pattern and land with the operative aileron power control on the upwind side.

4. Guard Trim
   With only one aileron power control operating, it may be necessary to turn the aileron trim control knob fully toward the operative side in order to keep the wings level at approach speeds. For this reason, it is imperative that both the pilot and copilot guard the controls and the aileron trim knob closely throughout the approach and landing. If the operative aileron power control unit were to fail suddenly, immediate corrective action would be required to prevent a roll in the direction of trim.

NOTE

With one aileron power control operative, the lateral control forces will be lighter, full aileron control wheel deflection can be obtained, and one flaperon will be operative to provide a greater rate of roll.

(1) AF 51-2192 thru 53-1843, -2028 thru -2040, -2261 thru -2331
(2) AF 53-1844 thru -1972, -2090 thru -2170, -2332 & on

ARTIFICIAL FEEL SYSTEM INOPERATIVE

If ram air pressure to the rudder-elevator Q-spring is lost because of icing of the ram air intake on the fin leading edge or if a mechanical failure were to occur within the system, a loss of "feel" on the rudder-elevator axis and an apparent control "sloppiness" will be experienced. The impression of loss of elevator effectiveness results from the extreme ease with which the rudder and elevator can be moved. With these light forces, the control surface can be deflected at a rate which is considerably above the normal rate and faster than the airplane can respond. This condition will be particularly apparent at low airspeeds and will make the airplane control feel sluggish. At high airspeeds the reverse condition will exist; that is, the airplane response will increase and be extremely sensitive to control motions. There is no actual change in control effectiveness under this condition. Automatic pilot operation remains satisfactory. Care should be taken not to make abrupt or exaggerated control motions on rudder and elevator when the control forces become extremely light in order to prevent overstressing the airplane at high speeds.

CAUTION

Because of lack of control forces when the Q-spring is inoperative, there is a tendency to neglect using the elevator trim tab. This fact coupled with the possible pitching tendencies of the airplane if surface power control fails when the airplane is out of trim could result in a hazardous condition. Therefore, the airplane should be kept in trim at all times. To accomplish trim, the surface power control must be turned OFF. The airplane must be retrimmed for each new flight condition caused by raising or lowering gear and flaps and changes in airspeed or flight altitude. Periodic trim checks should be accomplished during normal flight to compensate for changes in cg caused by fuel consumption.

SURFACE POWER CONTROL SYSTEMS INOPERATIVE — CONDENSED CHECKLIST

LANDING WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

1. Circuit Breaker In
2. Surface Lock - Forward UNLOCK Detent
3. Normal Pattern
4. Elevator Trim - 20 Pounds
5. Crosswind Landing
    a. Steering - TAKEOFF LAND
    b. No approach chute
    c. Steering - TAXI (at touchdown)
6. Wind Over 15 Knots - Stop Taxiing

LANDING WITH AILERON SURFACE POWER CONTROL INOPERATIVE

1. Both Inoperative
    a. Both aileron power controls - OFF
    b. Normal pattern.
2. One Inoperative (No Crosswind)
    a. Both aileron power controls - OFF
    b. Normal pattern.
3. One Inoperative (Crosswind)
    a. Operative power control - ON
    b. Inoperative power control - OFF
    c. Normal Pattern.
    d. Land with operative power control on upwind side.
4. Guard Trim

LANDING GEAR EMERGENCY OPERATION

EMERGENCY RETRACTION OF LANDING GEAR

The landing gear can be retracted by a landing gear emergency retraction switch at the pilot's station or by individual landing gear emergency retraction switches at the copilot's station. Except in an extreme emergency where it is necessary to retract the gear immediately, use the individual retraction switches at the copilot's station. Place the individual retraction switches OFF as soon as gear retraction is completed.

visual landing gear check

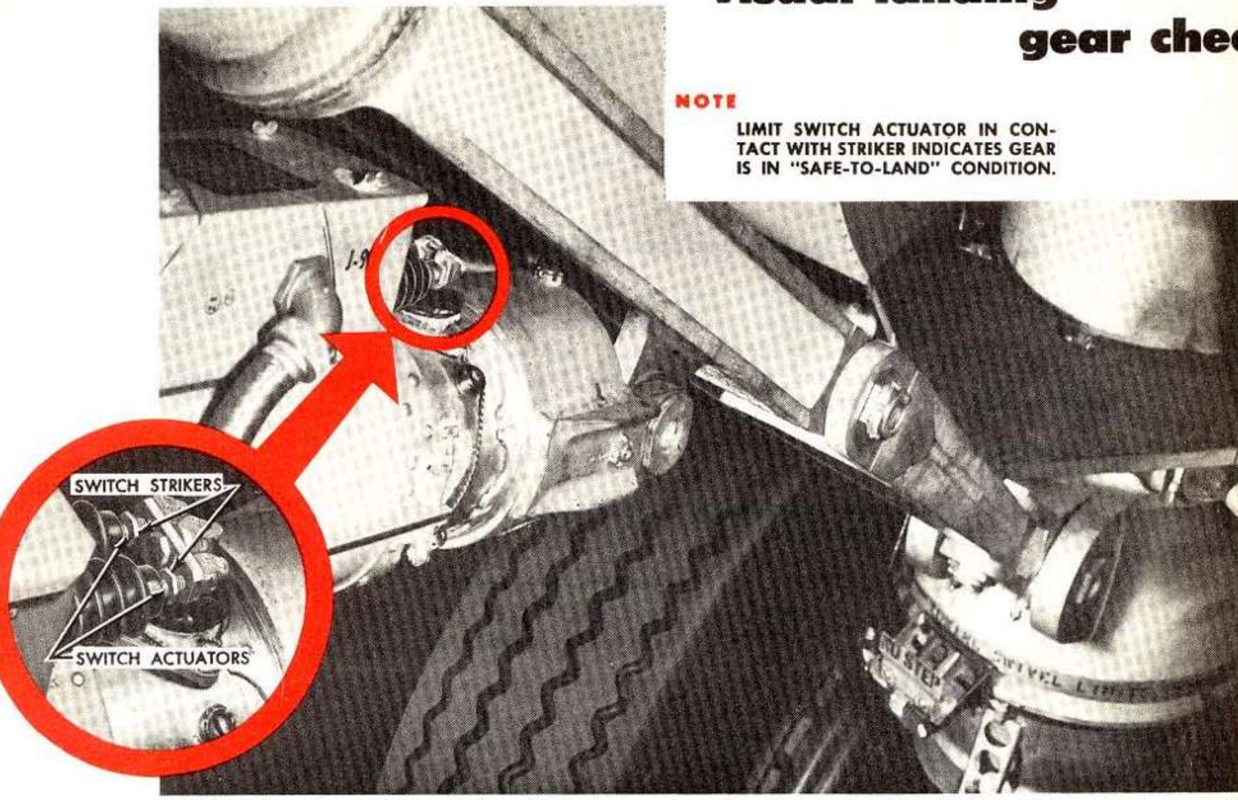


Figure 3-15.

CAUTION

Landing gear emergency retraction switches bypass all limit switches. Release switches from "GEAR UP" position immediately when the UP tab appears in the window of the gear position indicators.

CAUTION

Do not use emergency landing gear retraction switches unless landing gear lever is in OFF position.

EMERGENCY EXTENSION OF LANDING GEAR

In case the landing gear fails to extend, accomplish the following:

CAUTION

Before any emergency landing gear extension operation, the normal landing gear operating lever must be in OFF position so that electrical actuation of the gear cannot take place during emergency extension operation.

①▶ Do not attempt extension of the landing gears with the emergency landing gear extension levers at speeds above 200 knots IAS. Speeds in excess of 200 knots IAS could cause a failure of the ratchet pawls which could result in jamming of the landing gear thus preventing further operation of the gear in either direction by any means.

(CONTINUED ON NEXT PAGE)

①▶ AF 51-2357 thru 52-167, -202 thru -292, -394 thru -460 which do not have T.O. 1B-47-458 accomplished

EMERGENCY EXTENSION OF LANDING GEAR

(CONTINUED)

1. Reduce Airspeed
   Reduce airspeed to 305 (200*) knots IAS or below.

2. Gear Lever - OFF
   Check that the normal landing gear operating lever is in OFF position.

3. ELGE System - ACTUATED
   Select emergency extension lever for gear to be extended; make one full stroke and immediately return the lever to the aft position. Wait 3 to 4 seconds for gear to free fall. If uplocks do not release and allow the gear to free fall, repeat the procedure until the gear has released and extended.

NOTE

As each lever operates independently of the others, two levers may be operated simultaneously.

CAUTION

If the extension handle is not in the "Normal" (aft) position during free fall of the gear, the ratchet pawls may be damaged or broken and could result in jamming of the landing gear thus preventing further operation of the gear in either direction by any means. Do not allow ratchet handle to snap back as this may result in damage to the emergency extension system.

4. Landing Gear - CHECKED DOWN
   After completion of the free fall portion of the landing gear extension cycle, operate the emergency extension lever with full strokes fore and aft until gear is down and locked. When gear is fully down and locked, an indicator light (green) on the forward side of the extension stand will glow and gear down tabs will appear at pilot's and copilot's stations.

NOTE

The number of strokes to unlock the gear and the number of strokes required after free fall vary considerably with the conditions under which the system is operated. The length of stroke will vary with each operator, thus the total number of strokes required will vary with each operator. The amount of free fall will vary with airplane attitude, airspeed, and temperature, thus the number of strokes required to extend the gear from the free fall position to the "Down and Locked" position will vary with these conditions. The "Down and Locked" position, as indicated by the green light, is usually reached with maximum effort of approximately 75 pounds when the lock is engaged. There is a perceptible change in the load required to pull the handle when the "Down and Locked" position is reached since the operating loads immediately prior to this point are in the range of 10 to 25 pounds. In all cases requiring the use of the emergency extension levers, continue the stroking action until position indicators show a "Down and Locked" position and a definite change in handle operating loads is encountered.

5. Extend Remaining Gear
   When one gear is down and locked, continue to extend remaining gear.

(CONTINUED ON NEXT PAGE)

* AF 51-2357 thru 52-167, -202 thru -292, -394 thru -460 which do not have T.O. 1B-47-458 accomplished

EMERGENCY EXTENSION OF LANDING GEAR

(CONTINUED)

NOTE

If the landing gear fails to free fall when using the emergency system, longitudinal rocking of the airplane may assist in breaking it loose.

6. In Case it is Impossible to Lower all Landing Gear, Follow Required Emergency Landing Procedure.

7. Emergency Extension Lever - STOWED
   Place the emergency extension lever to the "Stowed" position.

8. Complete the "Before Landing Checklist."

VISUAL INSPECTION OF FORWARD MAIN LANDING GEAR

A ground heat access panel (31, figure 1-4) is provided on the inboard side of the crawlway. If landing gear lights and position indicators are inoperative and any doubt exists as to whether the forward main landing gear is in full-down position, a visual inspection can be made by opening this access panel and visually checking the gear-down limit switches. The switch actuators and switch striker are located on the upper aft end of the retracting mechanism (figure 3-15). When the switch actuators are in contact with the switch striker, the gear is in full-down position, indicating a "safe to land" condition. The visible absence of switch contact is a positive indication of an unlocked gear; further effort should be made to assure full extension and locking of the forward main landing gear retracting mechanism. To insure a full interior locking of the gear mechanism, use emergency extension handles until force required to operate handle indicates a locked condition.

NOTE (1)

Approximate position of both main landing gears may be visually checked by looking at reflection of underside of fuselage in polished inboard nacelles of engines No. 3 and 4.

LANDING GEAR EMERGENCY OPERATION — CONDENSED CHECKLIST

EMERGENCY EXTENSION OF LANDING GEAR

1. Reduce Airspeed
2. Gear Lever - OFF
3. ELGE System - ACTUATED
4. Landing Gear - CHECKED DOWN
5. Extend Remaining Gear
6. In Case it is Impossible to Lower all Landing Gear, Follow Required Emergency Landing Procedure.
7. Emergency Extension Lever - STOWED
8. Complete the "Before Landing Checklist."

(1) AF 52-082 thru -201, -261 thru -393, -432 & on

WING FLAP EMERGENCY OPERATION

The wing flaps when extended provide a minimum of drag and their only limiting effect on the airplane is the flap limit speed. The flaps are retracted or extended in an emergency by actuating the emergency flap switches. Slow retraction is accomplished by placing either switch, primary or secondary motor, to UP. Rapid retraction is accomplished by simultaneously placing both switches to UP. Rapid extension is always provided regardless of which switch is placed in DOWN. The wing flap emergency switches bypass all limit switches and must be released to OFF when the flaps reach their full travel.

WARNING

Normally retract the wing flaps with only one emergency switch at a time. The use of both emergency switches simultaneously results in considerable loss of lift and the airplane will settle rapidly.

CAUTION

The wing flap lever should be in OFF position before actuation of flap emergency switches. This will safeguard against sudden reversal and possible damage to flap drive motor.

SPLIT-FLAP OPERATION

DURING RETRACTION

If a rolling tendency accompanies flap retraction during takeoff or in flight, proceed as follows:

1. Flap Lever - OFF
   Immediately return the flap lever to OFF.
2. Trim - SET
   Trim the airplane to maintain lateral control.
3. Power Controls - CHECKED
   Check surface power control panel to eliminate power control malfunction as cause for rolling.
4. Flap Indicator - FLAP POSITION CHECKED
5. Flap Limit Speed - POWER SET
   Stop airplane acceleration before wing flap maximum IAS is exceeded. Refer to figure 5-1A for the flap structural limit speed for the flap position noted on the indicator.
6. Chase Airplane - REQUESTED
   Call for a chase airplane if available to assist evaluation of the flap configuration.
7. Attempt Extension
   If there is no evidence of structural damage to the flaps or retraction mechanism or if a chase airplane is not available, an attempt may be made at pilot's discretion to extend the flaps. Reduce airspeed below 195 knots IAS after insuring first that gross weight is reduced enough to afford sufficient margin for maneuvering above first stall warning. As the flap lever is moved to DN, both pilots should be prepared to hold the wings level and to retrim as needed.

WARNING

If rolling recurs, return the flap lever to OFF at once and abandon further attempts to operate the flaps.

(CONTINUED ON NEXT PAGE)

SPLIT-FLAP OPERATION

(CONTINUED)

Lower the flaps in small increments (about 5% at a time) with the chase pilot observing if extension is causing the flaps to come to the same position. If an attempted extension does not result in improved lateral trim, the extension should be discontinued. If an extension is successful, it should be stopped when all lateral mistrim is removed even though the flaps may not be full down.

8. Full Extension - NORMAL LANDING
   If full extension is made, leave the flaps down, return the flap lever to OFF, and land as soon as an acceptable landing gross weight is attained.

9. Check Minimum Control Speed
   If flap damage is suspected or extension proves impossible, fly the airplane until an acceptable landing gross weight is attained. Immediately prior to landing, establish the airplane in a landing configuration at least 20,000 feet above terrain. Place ESP switch ON. Retard throttles to idle and decrease airspeed to first stall warning or to the lowest speed at which lateral and directional control can be maintained, whichever speed occurs first. Use normal stall recovery.

10. Landing Procedure
    To the airspeed thus established add 10 knots to find the desirable touchdown speed. Add 8 knots to the new touchdown speed to get best flare speed. Fly the traffic pattern at standard margins above the new best flare speed. Enlarge the pattern enough to avoid exceeding the bank angle of 25° recommended for the continuous turn from downwind to final. Complete roll-out on final at least 3 miles from the planned touchdown point. This will allow good alignment with the runway before getting too close to the ground.

WARNING

If a speed required for safe lateral control was encountered before first stall warning, it may be necessary to decrease speed for a simultaneous gear touchdown by holding the airplane just off the runway and deploying the brake chute prior to touchdown. In all cases, a front gear first landing should be avoided. If the safe lateral control speed in such a case exceeds brake chute maximum deployment speed or, in the pilot's judgment, is too fast for effective ground control, the advantages of a controlled bailout should be considered.

DURING EXTENSION

If a rolling tendency accompanies flap extension during flight or in the landing pattern, proceed as follows:

1. Flap Lever - OFF
   Immediately return the flap lever to OFF.

2. Trim - SET
   Trim the airplane to maintain lateral control.

3. Power Controls - CHECKED
   Check surface power control panel to eliminate power control malfunction as cause for rolling.

4. Flap Indicator - FLAP POSITION CHECKED

(CONTINUED ON NEXT PAGE)

SPLIT-FLAP OPERATION

(CONTINUED)

5. Flap Limit Speed - POWER SET
   Maintain airspeed for best control without exceeding the flap structural limit speed in figure 5-1A for the flap position noted on the indicator.

6. Chase Airplane - REQUESTED
   Call for a chase airplane if available to assist evaluation of the flap configuration.

7. Attempt Retraction
   If there is no evidence of structural damage to the flaps or retraction mechanism or if a chase airplane is not available, an attempt may be made at pilot's discretion to retract the flaps. As the flap lever is placed to UP, both pilots should be prepared to hold the wings level and to retrim as needed. As flaps retract, airspeed should be increased sufficiently to maintain an adequate control margin above stall warning with flaps up.

   WARNING

   If rolling recurs, return the flap lever to OFF at once and abandon further attempts to operate the flaps.

   Raise the flaps in small increments (about 5% at a time) with the chase pilot observing if retraction is causing the flaps to come to the same position. If an attempted retraction does not result in improved lateral trim the retraction should be discontinued. If retraction is successful, it should be stopped when all lateral mistrim is removed even though the flaps may not be full up.

8. Full Retraction - FLAPS UP LANDING
   If full retraction is made, leave the flaps up, return the flap lever to OFF, and continue the flight until an acceptable landing gross weight is attained. Perform the landing as recommended in "Landing Emergencies - Landing with Flaps Up," this section.

9. Check Minimum Control Speed
   If flap damage is suspected or retraction proves impossible, fly the airplane until an acceptable landing gross weight is attained. Immediately prior to landing, establish the airplane in a landing configuration at least 20,000 feet above terrain. Place ESP switch ON. Retard throttles to idle and decrease airspeed to first stall warning or to the lowest speed at which lateral and directional control can be maintained, whichever speed occurs first. Use normal stall recovery.

10. Landing Procedure
   To the airspeed thus established add 10 knots to find the desirable touchdown speed. Add 8 knots to the new touchdown speed to get best flare speed. Fly the traffic pattern at standard margins above the new best flare speed. Enlarge the pattern enough to avoid exceeding the bank angle of 25° recommended for the continuous turn from downwind to final. Complete rollout on final at least 3 miles from the planned touchdown point. This will allow good alignment with the runway before getting too close to the ground.

   WARNING

   If a speed required for safe lateral control was encountered before first stall warning, it may be necessary to decrease speed for a simultaneous gear touchdown by holding the airplane just off the runway and deploying the brake chute prior to touchdown. In all cases a front gear first landing should be avoided. If the safe lateral control speed in such a case exceeds brake chute maximum deployment speed or, in the pilot's judgment, is too fast for effective ground control, the advantages of a controlled bailout should be considered.

SPLIT-FLAP OPERATION — CONDENSED CHECKLIST

DURING RETRACTION

1. Flap Lever - OFF
2. Trim - SET
3. Power Controls - CHECKED
4. Flap Indicator - FLAP POSITION CHECKED
5. Flap Limit Speed - POWER SET
6. Chase Airplane - REQUESTED
7. Attempt Extension:
   a. Gross weight - CHECKED
   b. 195 knots IAS max
   c. Extend - 5% INCREMENTS
   d. Mistrim removed - STOP EXTENSION
8. Full Extension - NORMAL LANDING
9. Check Minimum Control Speed:
   a. Landing configuration - 20,000 feet
   b. ESP - ON
   c. Throttles - IDLE
   d. Stall recovery at first to occur: First stall warning IAS or minimum control IAS
10. Landing Procedure:
   a. Touchdown IAS = Stall or Control IAS + 10
   b. BFS = Stall or Control IAS + 18
   c. Crash alert & crash station
   d. Downwind at BFS + 30
   e. Start final at BFS + 15
   f. Start flare at BFS + gust correction
   g. High minimum control IAS:
      Hold just above runway
      Deploy brake chute
      Avoid front gear first

DURING EXTENSION

1. Flap Lever - OFF
2. Trim - SET
3. Power Controls - CHECKED
4. Flap Indicator - FLAP POSITION CHECKED
5. Flap Limit Speed - POWER SET
6. Chase Airplane - REQUESTED
7. Attempt Retraction:
   a. Gross weight - CHECKED
   b. Extend - 5% INCREMENTS
   c. Increase IAS for control
   d. Mistrim removed - STOP RETRACTION
8. Full Retraction - FLAPS-UP LANDING
9. Check Minimum Control Speed
   a. Landing configuration - 20,000 feet
   b. ESP - ON
   c. Throttles - IDLE
   d. Stall recovery at first to occur: First stall warning IAS or minimum control IAS
10. Landing Procedure:
   a. Touchdown IAS = Stall or Control IAS + 10
   b. BFS = Stall or Control IAS + 18
   c. Crash alert & crash stations
   d. Downwind at BFS + 30
   e. Start final at BFS + 15
   f. Start flare at BFS + gust correction
   g. High minimum control IAS:
      Hold just above runway
      Deploy brake chute
      Avoid front gear first

BRAKE SYSTEM EMERGENCY OPERATION

LOSS OF MAIN BRAKE SYSTEM PRESSURE

Hydraulic pressure for emergency operation of the brakes is automatically supplied by the emergency hydraulic system. Emergency brakes are applied by depressing the rudder pedals farther than is normally necessary. Emergency brake action is conventional with no antiskid protection.

INSUFFICIENT BRAKING WITH MAIN BRAKE SYSTEM

There is the remote possibility of a condition existing where main system pressure has not failed but, due to some other malfunction, it is impossible to maintain adequate braking with the main brake system. It is then necessary for the copilot to aid the pilot in depressing the rudder pedals past the normal brake range. This action will override the main brake system, including antiskid, and apply the emergency brakes.

PARTIAL BRAKE FAILURE

If one wheel of the front gear loses its braking effectiveness or blows a tire, it is possible for front gear steering authority to be reduced whenever brakes are applied. The symptoms would be such that if the front gear were deflected to a given steering angle as brakes were applied, it might be impossible to move the front gear back in the direction of the affected wheel so long as brakes continued to be applied. If such a situation is encountered, the pilot can regain the required steering control by releasing the brakes momentarily and correcting the steering angle before applying brakes again.

The effect of front or rear brake failure on stopping distance is tabulated in the following chart.

STOPPING DISTANCE BRAKE FAILURE

CONDITIONS	LANDING ROLL EQUALS APPROX	
	BRAKE CHUTE	NO BRAKE CHUTE
NO BRAKE FAILURE	3950 FT	6650 FT
75% BRAKES	4250 FT	7650 FT
50% BRAKES	5000 FT	9200 FT
25% BRAKES	6750 FT	11,800 FT
COMPLETE FAILURE	9350 FT	21,450 FT OR OVER

CONDITIONS

GROSS WEIGHT 135,000 LB
60° F AT 1000 FT ALTITUDE
DRY CONCRETE RUNWAY
BRAKE FAILURE AT TOUCHDOWN
TWO ENGINES 40%, ALL OTHERS CUT

50321W8

CANOPY EMERGENCY OPERATION DURING FLIGHT

SLIDING CANOPY (1)

OPENING THE CANOPY IN FLIGHT

Do not open canopy in flight unless it is required to improve the safety of operating the airplane. Such cases would include those where opening is required for removal of smoke or heat in cockpit or for use as a clear vision panel under adverse landing conditions.

OPENING CANOPY IN FLIGHT — SLIDING TYPE

If it is deemed necessary to open the canopy in flight, use the following procedure:

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
   Pilot will alert crew that canopy is to be opened. All crew members check oxygen masks on and regulators on 100% oxygen.

2. Cabin Pressure Release Handle - PULLED
   Pull cabin pressure release handle and make certain that cabin is fully depressurized.

WARNING

Do not unlock or open canopy while cabin is pressurized as canopy may release and travel an unpredictable path, causing serious injury to the pilot and copilot and extensive damage to exposed equipment.

NOTE

Under the most adverse conditions, a maximum of 12 seconds may be required after actuating the cabin pressure release handle for the cabin to become fully depressurized.

3. Airspeed - 215 KNOTS IAS OR LOWER
   Indicated airspeed must not exceed 215 knots and, when feasible, a lower airspeed is desirable.

4. Pilot and Copilot:
   a. Lower seats to bottom position.
   b. Bend forward (get head and shoulders as low as possible).

5. The Airplane Should be Flown in an Unyawed Condition

(CONTINUED ON NEXT PAGE)

(1) AF 51-2357 thru 52-611

OPENING CANOPY IN FLIGHT — SLIDING TYPE

(CONTINUED)

6. Canopy - OPEN
   The canopy may then be opened by the pilot by moving the lock lever to UNLOCK and the control lever to OPEN.

EMERGENCY CANOPY JETTISONING — SLIDING CANOPY

If for some reason it is necessary to jettison the canopy in flight with the canopy emergency jettison handle, use the following procedure:

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
   Pilot will alert crew that canopy is to be jettisoned. All crew members check oxygen masks on and regulators 100% oxygen.

2. Cabin Pressure Release Handle - PULLED
   Pull cabin pressure release handle and make certain that the cabin is fully depressurized since the canopy may fail to release if the cabin is pressurized.

3. Airspeed - 190 KNOTS IAS OR ABOVE
   Check airspeed above 190 knots IAS which is the recommended minimum speed to allow the canopy to clear the empennage.

4. The Airplane Should be Flown in an Unyawed Condition

5. Canopy - JETTISONED
   The canopy may then be jettisoned by pulling the canopy emergency jettison handle at either the pilot's or copilot's station.

EMERGENCY CANOPY JETTISONING — CLAMSHELL CANOPY

①► **WARNING**

Do not unlatch or open canopy in flight since the canopy may release and hazardous or uncontrollable conditions may result.

If for some reason it is necessary to jettison the canopy in flight with the canopy emergency jettison handle, the following procedure should be used:

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
   Pilot alerts crew that canopy is to be jettisoned. All crew members check oxygen masks on and regulators 100% oxygen.

(CONTINUED ON NEXT PAGE)

①► AF 52-612 & on

EMERGENCY CANOPY JETTISONING — CLAMSHELL CANOPY

(CONTINUED)

2. Cabin Pressure Release Handle - PULLED
   Pull cabin pressure release handle and make certain that the cabin is fully depressurized since the canopy may fail to release if the cabin is pressurized.

3. Airspeed - 180 KNOTS IAS OR ABOVE
   Check airspeed above 180 knots IAS which is the recommended minimum speed to allow canopy to clear empennage.

4. The Airplane Should be Flown in an Unyawed Condition

5. Canopy - JETTISONED
   The canopy may then be jettisoned by pulling the emergency jettison handle at either the pilot's or copilot's station.

6. If the Canopy Fails to Jettison Using the Canopy Emergency Jettison Handle, the Pilot May, as a Last Resort, Accomplish the Following:
   a. Unlock the canopy by placing canopy lock lever in UNLOCKED position.
   b. Unlatch the canopy by placing canopy latch control lever in UNLATCHED position.
   c. Raise canopy into the airstream by placing canopy control switch in RAISE position. The canopy will be separated from the airplane.
   d. In event the electrical actuator fails to raise the canopy into the airstream, the pilot may squeeze and pull down on the canopy remover disconnect handle and manually push the canopy up into the airstream.

WARNING

The copilot must not move the hinge pin release handle from the detent since to do so would result in the canopy releasing and traveling an unpredictable path.

CANOPY EMERGENCY OPERATION DURING FLIGHT — CONDENSED CHECKLIST

OPENING CANOPY IN FLIGHT — SLIDING CANOPY

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
2. Cabin Pressure Release Handle - PULLED
3. Airspeed - 215 KNOTS IAS OR LOWER
4. Pilot and Copilot:
   a. Lower seats to bottom position
   b. Bend forward (get head and shoulders as low as possible)
5. Fly Airplane in Unyawed Condition
6. Canopy - OPEN

EMERGENCY CANOPY JETTISONING — SLIDING CANOPY

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
2. Cabin Pressure Release Handle - PULLED
3. Airspeed - 190 KNOTS IAS OR ABOVE
4. Fly Airplane in Unyawed Condition
5. Canopy - JETTISONED

EMERGENCY CANOPY JETTISONING — CLAMSHELL CANOPY

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
2. Cabin Pressure Release Handle - PULLED
3. Airspeed - 180 KNOTS IAS OR ABOVE
4. Fly Airplane in Unyawed Condition
5. Canopy - JETTISONED
6. If Canopy Fails to Jettison Accomplish the Following:
   a. Unlock canopy
   b. Unlatch canopy
   c. Raise canopy
   d. If canopy fails to raise, pull remover disconnect handle and push canopy up.

description and operation of auxiliary equipment

section 4

table of contents

CABIN HEATING, VENTILATING AND PRESSURIZING SYSTEM

Some of the high pressure hot air bled from the final compressor stage of operating engines provides the energy to pressurize and air condition the crew compartment (figures 4-1 and 4-3). Part of the bleed air supplied the system is cooled by a refrigeration unit operated by energy exchanged during the heat transfer cycle. The remaining hot bleed air is valved through a bypass around the refrigeration unit into a mixing chamber to be blended with the cooled air as required to produce or maintain the cabin air temperature selected by the pilot. The conditioned air is discharged into the cabin through an upper and lower outlet at each crew station at the rate of flow selected by the crew member. The air is then exhausted from the cabin by automatic operation of the cabin pressure regulators during pressurized flight or by the cabin pressure relief valve serving as a dump valve during depressurization.

(1)
A common high pressure supply duct collects hot air under high pressure through a check valve from the final compressor stage of each operating engine for delivery to systems requiring heated pressurized air. The cabin heating, ventilating, and pressurizing system may then receive pressurized heated air from any one or all six engines.

(2)
There is a separate high pressure supply duct in each wing collecting hot air from the operating engines of that wing. These ducts supply different systems, and each terminates at an empennage pressure duct shutoff valve. These valves open and provide a crossover connecting the ducts when the exterior surfaces anti-icing switch is ON. When the exterior surfaces anti-icing switch is OFF the ducts remain separate, and the cabin heating, ventilating, and pressurizing system may then receive pressured heated air from the left hand duct, collected from only the No. 1, 2, and 3 engines.

Part of the bleed air is led from the high pressure supply duct to shutoff valves in the lower left side of the forward wheel well. On some airplanes a manual emergency hot air shutoff valve (figure 4-1) actuated by a push-pull handle (5, figure 1-16) at the lower forward corner of the copilot's oxygen panel is a safety feature providing positive control of all the high presure hot air supply in the forward portion of the fuselage. Bleed air, after passing through the cabin hot air shutoff valve, is directed as desired or selected through a refrigeration unit for cooling. On some airplanes, at all altitudes below 25,000 feet, the cooled air is passed through a water separator to remove moisture which might come from the crew air outlets as snow or fog. Cabin temperature control, whether automatic through the electronic regulator or manual through the pilot's switch panel controls, operates a motor driven butterfly-type bypass valve to increase or decrease the flow of bleed air around the refrigeration unit into a mixing chamber for blending with cooled air from the refrigeration unit. The conditioned air is ducted to the cabin and is discharged through an upper and lower outlet at each crew station. On some airplanes★, an electric heater blanket is installed on the observer's lower air outlet duct which provides the observer with an auxiliary source of cabin heat and consequently better control of air temperatures at that crew station.

(3)
An automatic centrifugal-type water separator having bypass provisions is installed downstream of the refrigerator unit to remove moisture and fog precipitated by the refrigerator. Below 25,000 feet flight altitude a bypass solenoid valve is electrically closed by an aneroid switch allowing the water separator to function. The refrigerator unit is restricted to cooling air only to 35° F to prevent freezing of the separator. At altitudes above 25,000 feet the aneroid switch deenergizes the bypass solenoid valve which opens the separator bypass valve allowing refrigerated air to bypass the separator.

Provisions are made for a constant supply of ambient air for ventilation of the radar equipment. During flight, ram air is picked up by an outside air inlet and ducted to the radar compartment. During ground operations with the DC power distribution system energized, a supplemental ram air blower, actuated by the landing gear squat switch, operates to keep a continuous supply of ram air flowing to the radar compartment. When desired, part of this ram air can be routed into the cabin air supply ducts for cabin ventilation during ground operations as long as radar equipment is not being operated and during unpressurized flight.

CAUTION

Ram air should not be used for cabin ventilation during ground operations with any portion of the radar equipment turned on. Use of ram air under these conditions prevents the radar equipment from receiving an adequate supply of ventilating air and damage to the equipment from overheating is apt to result.

(1)AF 52-173 thru -201, -368 thru -393, -565 & on
(2)AF 51-2192 thru 52-172, -202 thru -367, -394 thru -564
(3)AF 51-2192 thru -2356, 52-177 thru -201, -363 thru -393, -565 & on
★ AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on

cabin heating, ventilating, and pressurization system

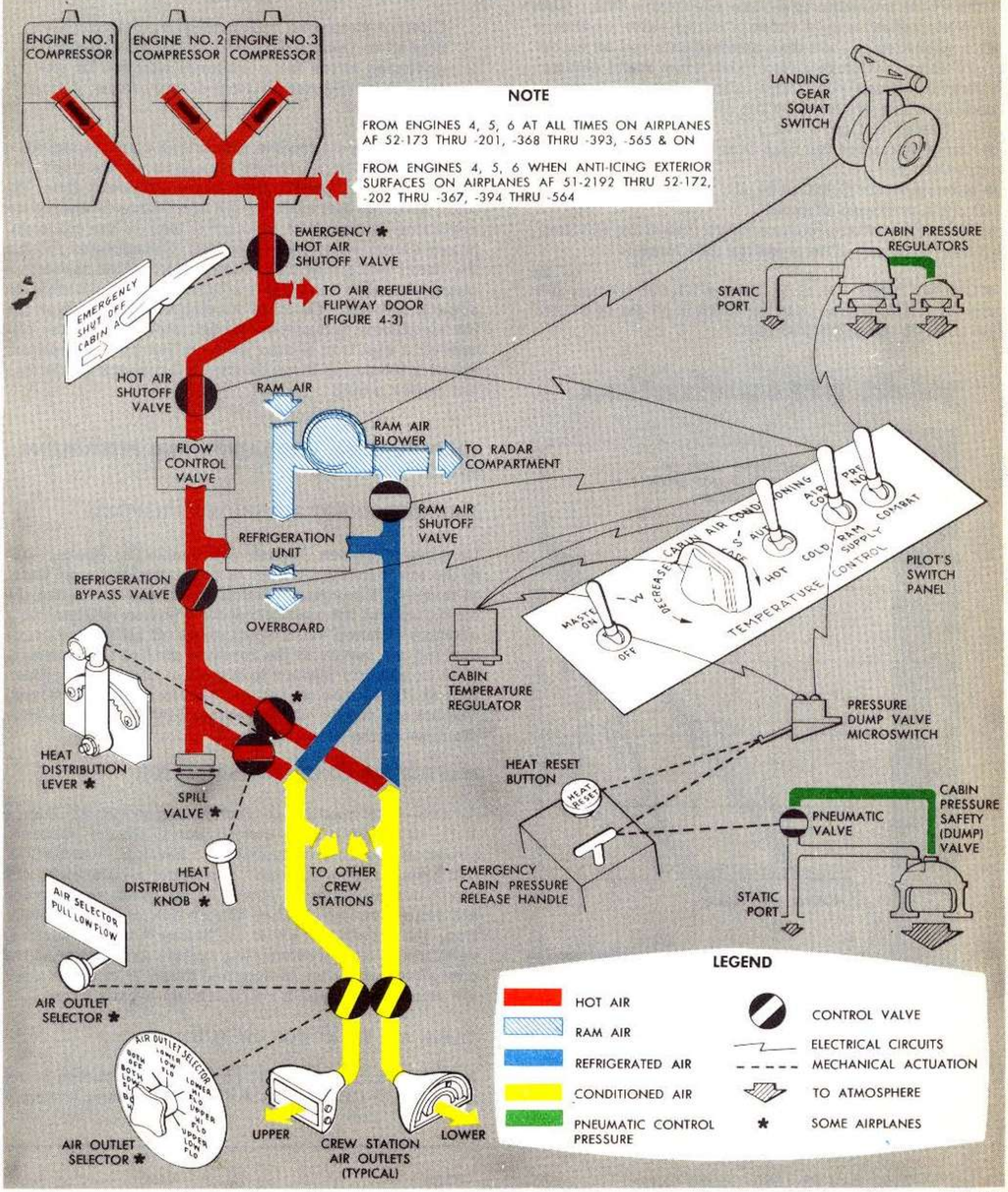


Figure 4-7

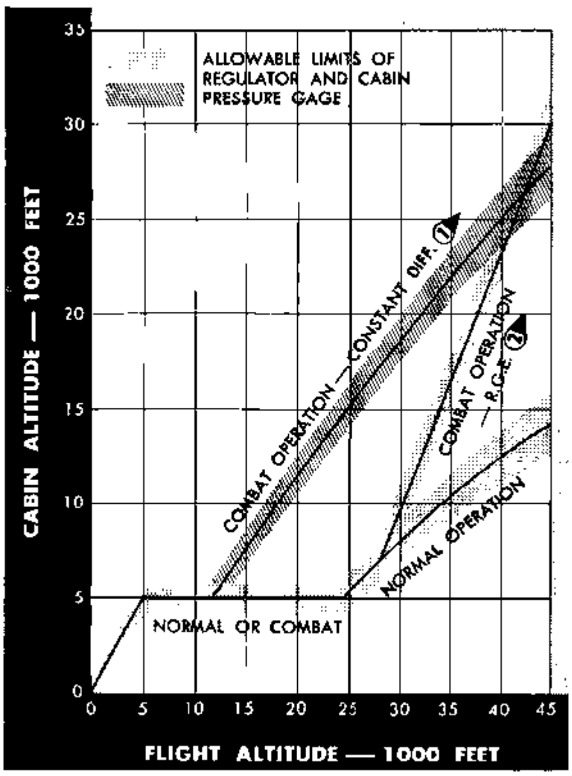
Cabin pressurization is maintained by cabin pressure regulators on the left aft and lower forward sides of the pressure section which control the escape of cabin air to the atmosphere. A cabin pressure safety valve relieves cabin pressure at 7.12 psi pressure differential in the event the cabin pressure regulators fail. This valve also serves as a vacuum relief valve whenever cabin pressure is less than atmospheric and an emergency cabin pressure dump valve when rapid depressurization is desired. The following cabin pressure conditions are provided by the cabin pressure regulators: (Refer to figure 4-2.)

- Atmospheric range (sea level to 5000 feet), cabin unpressurized.
- Isobaric range (5,000 to 24,100 feet), constant 5,000-foot cabin pressure altitude.
- High differential pressure range (above 24,100 feet), constant 6.55 psi cabin pressure differential.

(1)

- Combat range - R.G.E. (above 27,600 feet), cabin pressure differential varying from 6.55 psi at 27,600 feet to 2.05 psi at 45,000 feet.

cabin pressurization



(1) AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on
(2) AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2385

50401WC-1

Figure 4-2.

(2)

- Combat range (above 11,750 feet), constant 2.75 psi low cabin pressure differential.

NOTE

Combat pressure differential values are designed to insure that maximum safe decompression rates for personnel will not be exceeded should explosive decompression of the cabin occur.

The system is controlled electrically and is supplied DC power through circuit breakers on the copilot's lower DC power panel. Regulated AC power from the main inverter bus used by the electronic temperature regulator is supplied through a fuse in the main AC power shield on some airplanes. Unregulated AC for the observer's electric heater is supplied through a circuit breaker in the left alternator power shield on some airplanes. On other airplanes the AC power for the electronic temperature regulator and for the observer's electric heater is supplied by the constant speed alternators through circuit breakers on the radar power panel.

CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEM CONTROLS

EMERGENCY HOT AIR SHUTOFF HANDLE

On some airplanes, a push-pull handle (5, figure 1-16) at the lower forward corner of the copilot's oxygen panel is marked "Emergency Shutoff Cabin Air." Pulling the handle up and out approximately 4 inches mechanically actuates a shutoff valve which shuts off all the hot pressurized air supply to the forward part of the fuselage. This is a safety feature in the event of air contamination at its source or failure of other control valves. The hot air supply can be restored by pushing the handle down to the stop.

MASTER AIR CONDITIONING SWITCH

An ON--OFF master air conditioning switch (1, figure 1-11) is on the pilot's switch panel. In ON position, power is supplied to operate the heating, ventilating, and pressurizing system. On some airplanes*, ON position also supplies power to the observer's lower air heater switch. When the switch is in OFF position, the observer's lower air heater* and the heating, ventilating, and pressurizing system are rendered inoperative and power is supplied directly to close a hot air shutoff valve and a refrigeration bypass valve.

CABIN AIR SELECTOR SWITCH

A switch (5, figure 1-11) on the pilot's switch panel marked AIR COMP--RAM SUPPLY is used to select

(1) AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2385
(2) AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on
* AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on

engine compressor air for cabin heating, ventilating, and pressurizing or ram air for cabin ventilating. When the switch is in AIR COMP position, DC power is supplied to the heat selector switch for cabin heating control. When the switch is in RAM SUPPLY position, the cabin heating control system is deenergized, and power is supplied to close the hot air shutoff valve and, as soon as cabin pressure is substantially dissipated, open the ram air shutoff valve.

HEAT SELECTOR SWITCH

A four-position switch (4, figure 1-11) on the pilot's switch panel is marked AUTO--HOT--COLD, with the off or center position unmarked. The switch is spring-loaded to return to the center or off position from either HOT or COLD position. AUTO position gives temperature control to an electronic cabin temperature regulator. The electronic regulator automatically switches the refrigeration bypass valve toward open or closed in maintaining a set temperature. HOT or COLD positions are held momentarily from the center or off position to reposition the refrigeration bypass valve toward open for increased temperature or toward closed for decreased temperature.

CABIN TEMPERATURE SELECTOR RHEOSTAT

A rheostat (3, figure 1-11) on the pilot's switch panel marked DECREASE--INCREASE is used to vary the temperature setting for automatic air conditioning. With the heat selector switch in AUTO position, turning the knob toward DECREASE or INCREASE signals the cabin temperature regulator to lower or to raise the automatically maintained cabin air temperature.

CABIN PRESSURE REGULATION SELECTOR SWITCH

A PRESS NORMAL--COMBAT switch (6, figure 1-11) on the pilot's switch panel is used to select the type of cabin pressure regulation desired. When the switch is in PRESS NORMAL position, the cabin pressure regulators function to provide atmospheric, isobaric, or high (6.55 psi) pressure differential regulation of cabin pressure, depending on the altitude. When the switch is in COMBAT position, the cabin pressure regulators function to provide normal pressure regulation up to 27,600 feet; however, above 27,600 feet, pressure differential is gradually reduced, becoming 2.05 psi at 45,000 feet.

WATER SEPARATOR SWITCH (1)

A two-position toggle switch (2, figure 1-11) installed on the pilot's switch panel has NORMAL--OFF positions.

NOTE (1)

The water separator system is inoperative; consequently, the water separator switch is not used.

EMERGENCY CABIN PRESSURE RELEASE HANDLE (DUMP VALVE)

A push-pull handle (6, figure 1-6) located just aft of the pilot's control stand provides a means for rapid cabin pressure release. When the handle is pulled up (approximately 2 inches) mechanical and pneumatic action opens the cabin pressure safety valve, dumping air into the crawlway. Pulling up the handle also actuates a pressure dump valve switch. When the pressure dump valve switch is actuated, the cabin heating control system is deenergized and DC power is supplied to close the hot air shutoff valve and, as soon as cabin pressure is substantially dissipated, to open the ram air shutoff valve. Cabin pressurizing and heating can be restored by pushing the handle down.

CABIN HEAT RESET BUTTON

A button (5, figure 1-6) located just outboard of the emergency cabin pressure release handle at the pilot's station is used to restore heating after the cabin has been depressurized by pulling up the emergency cabin pressure release handle. The button is spring-loaded to the up position and when depressed will reset the pressure dump valve switch to supply DC power to close the ram shutoff valve, open the hot air shutoff valve, and reenergize the cabin heating control system. Once depressed, the button has no further control function until the emergency cabin pressure release handle has been pushed down and again pulled up.

CABIN HEAT DISTRIBUTION KNOB (2)

A push-pull knob (11, figure 1-6) marked HEAT DECREASE UPPER OUTLETS--HEAT DECREASE LOWER OUTLETS on the pilot's control stand is used to control the relative temperature of air being supplied to the upper and lower crew outlets. Pulling the knob in the HEAT DECREASE UPPER OUTLETS direction mechanically actuates a cabin heat distribution valve to decrease the upper outlet duct temperature and increase the lower outlet duct temperature. Pushing the knob in the HEAT DECREASE LOWER OUTLETS direction mechanically actuates the cabin heat distribution valve to decrease the lower outlet duct temperature and increase the upper outlet duct temperature. The knob can be locked in any desired position by turning in a clockwise direction and released by turning in a counterclockwise direction.

(1) AF 52-158 thru -176, -312 thru -362, -394 thru -564
(2) AF 51-2357 thru -7083, -15804 thru -15812, 52-019 thru -058, -202 thru -260

CABIN HEAT DISTRIBUTION LEVER (1)

A lever and quadrant (9, figure 1-6) marked HEAT DECREASE UPPER OUTLETS--HEAT DECREASE LOWER OUTLETS is located immediately aft of the pilot's control stand. The lever is provided for controlling the relative temperature of air being supplied to the upper and lower crew outlets. To move the lever, the handle must be depressed; when released, it will lock in a detent on the quadrant. Moving the lever in the HEAT DECREASE UPPER OUTLETS direction mechanically actuates a cabin heat distribution valve to decrease the upper outlet duct temperature and increase the lower outlet duct temperature. Moving the lever in the HEAT DECREASE LOWER OUTLETS direction mechanically actuates the cabin heat distribution valve to decrease the lower outlet duct temperature and increase the upper outlet duct temperature.

CABIN AIR DISTRIBUTION KNOB (1)

A push-pull knob marked HEAT DECREASE UPPER OUTLETS is used on some airplanes in place of the cabin heat distribution handle (9, figure 1-6). As the knob is pulled, a butterfly valve is moved to decrease the amount of high pressure hot air to the upper crew station outlets while directing an increased amount to the lower crew station outlets.

AIR OUTLET SELECTORS

An air outlet selector knob (15, figure 1-10) is located at the pilot's, copilot's, and observer's★ stations to provide each crew member with a means of controlling the airflow at his station. Each knob is marked BOTH HI FLO--BOTH LOW FLO--BOTH OFF--LOWER LOW FLO--LOWER HI FLO--UPPER HI FLO--UPPER LOW FLO and, when positioned accordingly, mechanically actuates a flow valve to provide high flow, low flow, or shutoff conditions at either the upper or lower outlet or both as desired. When positioning of the selector knobs limits the total airflow, on some airplanes, a spill valve will discharge the excess air into the cabin to maintain the proper airflow for pressurization.

On some airplanes the rotary knob is replaced by a push-pull knob placarded "Pull - Low Flow," which may be positioned as desired between the in and out limits to control airflow at the crew station.

NOTE

If the valve should stick, it is probably frozen but will thaw upon increasing cabin heat.

OBSERVER'S LOWER AIR SHUTOFF KNOB

(2)

An ON--OFF lower air shutoff knob (20, figure 4-28) on the observer's right sidewall is used to manually control the airflow from the observer's lower air outlet.

(3)

On some airplanes, an ON--OFF lower air shutoff knob, identical to that described above, is located on the air outlet duct below and outboard of the aerial camera intervalometer panel. The knob is used to manually control the airflow from the observer's lower air outlet.

OBSERVER'S LOWER AIR HEATER SWITCH (4)

A three-position toggle switch on the lower air heater control panel (20, figure 4-28) has HIGH--OFF--LOW positions and is used to control electric heating of the air flowing from the observer's lower outlet. With the switch in HIGH position, temperature is automatically maintained in the lower air outlet duct at 200° F. With the switch in LOW position, temperature in the duct is automatically maintained at 150° F. OFF position turns off the heater. In the event the system reaches an overheat condition, a thermoswitch will automatically energize an overheat lockout relay which will turn off the heater. In this case, OFF position will also reset the overheat lockout relay so that further operation of the heater can be resumed.

NOTE (3)

The observer's lower air heater switch is inoperative.

AIR OUTLET DIFFUSER KNOBS

A small push-pull knob located on the pilot's and copilot's upper and lower air outlets, on the observer's upper air outlet★★, and on the observer's lower air outlet★ permits control of airflow from the outlet. The knob may be pulled out to diffuse the airflow or may be pushed in to cause a more concentrated direct flow of air.

(1) Some airplanes
(2) AF 52-363 thru -393
(3) AF 52-584 thru -620, -3343 thru 53-1849, -2261 thru -2314
(4) AF 51-2192 thru -2356, 52-584 & on
★ AF 51-2357 thru 52-362, -394 thru -583
★★ AF 51-2357 thru 52-176, -202 thru -330, -394 thru -526

(1)
On some airplanes, airflow from the observer's upper air outlet is controlled by a manually operated butterfly-type shutoff valve and controllable vanes on the outlet.

CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEM INDICATORS

CABIN AIR TEMPERATURE GAGE (2)

A cabin air temperature gage (29, figure 1-8) on the right side of the pilot's instrument panel is a conventional bimetallic-type free air temperature gage. It indicates cabin air temperature in degrees Centigrade. The gage, a self-contained mechanical unit, does not require power from any source.

CABIN PRESSURE ALTITUDE GAGE

A cabin pressure altitude gage (25 or 28, figure 1-8 and 20, figure 1-9) is located on the right side of the pilot's instrument panel. This gage is a small aneroid altimeter vented to cabin atmosphere and indicates cabin pressure altitude in increments of 1000 feet. The cabin pressure altitude gage, a self-contained unit, requires no external power source.

OBSERVER'S OVERHEAT LOCKOUT WARNING LIGHT (3)

An amber "Overheat Lockout" warning light on the lower air heater control panel (20, figure 4-28) will illuminate when an overheat condition exists in the observer's lower air electric heater indicating that the overheat condition exists and that the system is automatically turned off. The light will remain illuminated until the lower air heater switch is placed in OFF position at which time the overheat lockout relay will be reset readying the heater for continued operation.

NOTE (4)

The observer's overheat lockout warning light is inoperative.

NORMAL OPERATION OF CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEM

CABIN HEATING

a. Check that the emergency hot air shutoff valve handle and the emergency cabin pressure release handle is pushed down or, if heating without pressurization is desired, pull up the emergency cabin pressure release handle and depress the heat reset button.
b. Place cabin air selector switch in AIR COMP.
c. Place the master air conditioning switch in ON.
d. Place the heat selector switch in AUTO position.
e. Turn the cabin temperature selector rheostat in the DECREASE or INCREASE direction as required to obtain the desired cabin temperature.
f. Position the cabin heat distribution knob or lever as desired.
g. Position air outlet selector knobs as desired.

(5)
h. If additional heating is desired by the observer, turn on the electric heater by placing the lower air heater switch in LOW or HIGH position as required.

NOTE

- Cabin heating is off whenever the emergency hot air shutoff handle has been pulled to shutoff position, the master air conditioning switch is in OFF position, the cabin air selector switch is in RAM SUPPLY position, or the emergency cabin pressure release handle is pulled up without the heat reset button being depressed.
- Cabin heating is possible without pressurization but pressurization is not possible without temperature-controlled operation.

RAM AIR CABIN VENTILATING (BELOW 5000 FEET)

With the master air conditioning switch ON, place the cabin air selector switch in RAM SUPPLY position or pull the emergency cabin pressure release handle. The latter procedure is recommended when it is planned to continue on ram air ventilation after reaching 5000 feet.

RAM AIR CABIN VENTILATING (5000 FEET AND ABOVE)

With the master air conditioning switch ON, pull the emergency cabin pressure release handle.

NOTE

Since the cabin pressure regulator will close at 5000 feet, this procedure must be used at that altitude and above to open the safety (dump) valve and insure an adequate flow of ram air.

CABIN PRESSURIZING

a. Check that the canopy and the pressure compartment door are closed.
b. On some airplanes, check that emergency hot air shutoff handle is pushed in.

(1) AF 51-2192 thru -2356, 52-177 thru -201, -331 thru -393, -527 & on
(2) AF 51-2357 thru 52-111, -202 thru -311, -394 thru -507
(3) AF 51-2192 thru -2356, 52-584 & on
(4) AF 52-584 thru -620, -3343 thru 53-1849, -2261 thru -2314
(5) AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on

c. Place cabin air selector switch in AIR COMP.
d. Place the cabin pressure regulation selector switch in PRESS NORMAL position.
e. Place the master air conditioning switch in ON.
f. When combat is imminent, place the cabin pressure regulation selector switch in COMBAT position to provide reduced cabin pressure differentials above 27,600 feet.
g. For rapid depressurization, pull up the emergency cabin pressure release handle. To restore heating, if desired while depressurized, depress the heat reset button.

NOTE

> Cabin pressurizing will be off whenever the emergency hot air shutoff handle has been pulled to shutoff position, the master air conditioning switch is in OFF position, the cabin air selector switch is in RAM SUPPLY position, or the emergency cabin pressure release handle is pulled up.

EMERGENCY OPERATION OF CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEM

CABIN HEATING

When the desired cabin air temperature cannot be maintained with the heat selector switch in AUTO position, place the switch in "off" position and then actuate the switch to HOT or COLD position as necessary to obtain and maintain the cabin temperature desired. When overheat conditions cannot be controlled by placing the switch in COLD position, place the master air conditioning switch in OFF position, or on some airplanes, pull the emergency hot air shutoff handle. Alternate the master air conditioning switch between ON and OFF (or operate the emergency hot air shutoff handle in and out) to control temperature thereafter. Excessive heat can be removed either by pulling up on the emergency cabin pressure release handle or by placing the cabin air selector switch in RAM SUPPLY position if below 5000 feet altitude. Additional relief from excessive cabin temperatures may be gained by opening the canopy in flight* as given in "Canopy Emergency Operation During Flight" in section III or by opening the clear vision panel**.

(1)

In case an overheat condition arises in the observer's electric heater system as indicated by illumination of the amber "Overheat Lockout" warning light, place the lower air heater switch in OFF position to reset the heater control circuits. Allow sufficient time for system cooling and then resume heater operation. If repeated overheating occurs in either of the two heater switch positions, heater operation may possibly be continued by switching to the other position.

CABIN PRESSURE FLUCTUATION

Pressure fluctuations uncomfortable to the ears of the crew may occur upon malfunction of the cabin temperature control system. To stop the pressure fluctuations, take the heat selector switch out of AUTO position. Then control temperature as noted under "Emergency Operation of Cabin Heating, Ventilating, and Pressurizing System - Cabin Heating."

FOG ACCUMULATION IN THE CABIN

Under certain atmospheric conditions, it is possible for fog to accumulate in the cabin while pressurized and seriously restrict visibility. If this occurs, immediately turn the cabin temperature selector rheostat to the full INCREASE position (if operating under manual temperature control, hold the seat selector switch in HOT position). After the cabin has cleared, reposition the cabin temperature selector rheostat (if operating under manual temperature control, actuate the heat selector switch to COLD position) to obtain a cabin air temperature sufficiently higher than the original to prevent recurrence of the fog condition. If a comfortable temperature cannot be maintained without fogging, depressurize the cabin until an area with more favorable atmospheric conditions is entered.

DEFROSTING SYSTEMS

The defrosting system for the aerial camera window is covered under "Photographic Equipment."

WINDSHIELD DEFROSTING

The windshield anti-icing system should be used in conjunction with the defroster to prevent frost or fog on the inside of the main windshield panel especially prior to a maximum rate of descent. Since the main windshield panel is very thick and therefore has a high resistance to temperature change, the windshield anti-icing system should be on at all times. During operation, approximately 95% of the heat flow is to the outer surface with the remainder flowing through the thick glass panel

* AF 51-2192 thru 52-611
** AF 52-593 & on
(1) AF 51-2192 thru -2356, 52-1406 thru -1417, 53-1850 thru -2170, -2315 & on

to the inner surface. This requires that a period of operation at maximum heat be allowed prior to descent in order to prevent formation of frost and fog under the extreme conditions encountered in a descent to warm humid air. The preheat times (windshield anti-icing switch on MAX HEAT prior to maximum rate descent) are given in the following chart:

DESCENT			PREHEAT TIME
ABOVE 25,000 FT	TO	BELOW 5000 FT	40 MINUTES
		ABOVE 5000 FT	15 MINUTES
BELOW 25,000 FT	TO	BELOW 5000 FT	15 MINUTES
		ABOVE 5000 FT	0 MINUTES

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(1)
The main and side windshields are defrosted by forced airflow of cabin air across the inner surface from a motor-driven blower. The defroster blower is controlled by an ON--OFF switch (7, figure 1-11) located on the pilot's switch panel. The defroster motor is DC operated and supplied power through a circuit breaker on the lower DC power panel. The defroster is more effective when used to prevent frost and fogging than to remove it.

(2)
The side windshield panels and the canopy in the area of the pilot, but not the main (forward) windshield panel, are defrosted by air from a blower. The blower picks up cabin air forward of the pilot's rudder pedals and passes it through a duct which may be heated by a DC heater. The duct delivers the air to spray tubes routed under the inside edges of the areas to be defrosted. Operation is controlled by a three-position switch on the pilot's switch panel marked "Windshield Defrost" with NORMAL--OFF--BLOWER ONLY positions. NORMAL position connects DC power to both blower and heater. A thermal switch is installed in the heater case as a safety control to disconnect heater power at approximately 94° C (200° F). Switch OFF stops operation of the system. BLOWER ONLY position allows the blower to operate while the heater is shut off. DC power for the blower is supplied through the "Windshield Defrost" circuit breaker on the lower DC power panel. DC power for the heater is supplied through the "Canopy Defrost" circuit breaker in the forward main power shield.

NOSE WINDOWS DEFROSTING

The observer's station windows are defrosted by a forced airflow of cabin air across the inner surface from a motor-driven blower. The defroster blower is controlled by an ON--OFF switch located on the observer's lighting panel. The defroster motor is DC operated. See figure 1-34 for circuit breaker location. When possible, the need for defrosting the observer's windows should be anticipated and the defroster operated to prevent frost formation. This procedure will be more effective than waiting until the windows become frosted.

CANOPY DEFROSTING

Canopy defrosting provisions, as such, are not provided. However, the pilot's, copilot's, and gunner's upper air outlets are located so that when properly controlled by means of the air outlet selectors and the heat distribution control, these outlets assist in defrosting the canopy. On some airplanes, canopy defrosting is accomplished in the pilot's area by operation of the windshield defrost switch.

ANTI-ICING AND DEICING SYSTEMS

Anti-icing systems prevent ice formation while deicing systems remove ice after it has formed. Hot compressed air bled from the engine compressors is used mainly in the anti-icing systems covering large areas while electrical heating elements are used on small units to be anti-iced. Wing, empennage, engines, air refueling slipway, and nacelles are all anti-iced by means of engine compressor air. Pitot heads, air refueling slipway, and windshield are anti-iced electrically. Vortex generators are deiced by electrical power supplied for a short duration on some airplanes.

WINDSHIELD ANTI-ICING SYSTEM

The 1 3/4-inch thick laminated bullet-resistant center panel of the windshield is heated for anti-icing by passing AC power across an electrical conductive film between the outer two layers of glass. The conductive film functions as a heating element with two rates of heating under control of the windshield anti-icing switch. Temperature of the glass is automatically prevented from exceeding 43° C (110° F) by an AC operated electronic overheat control unit. AC power circuits to the heating element are controlled by DC power furnished through a circuit breaker on the lower DC power panel. AC power for the heating element and the overheat control unit on some airplanes is supplied from the left unregulated AC bus through a circuit breaker in the alternator power shield. On airplanes with constant speed alternators, the AC is supplied through a circuit breaker on the radar power panel.

WINDSHIELD ANTI-ICING SWITCH

A windshield anti-icing switch (8, figure 1-11) located on the pilot's switch panel has NORMAL--OFF--MAX HEAT positions. In NORMAL position, AC voltage is

(1) AF 51-2192 thru 53-1849, -2028 thru -2103, -2261 thru -2349
(2) AF 53-1850 thru -1972, -2104 thru -2170, -2350 & on

applied to the conductive film as necessary to automatically maintain a windshield temperature sufficiently high to prevent icing under most conditions. In MAX HEAT position, the necessary higher AC voltage is supplied to automatically maintain the windshield temperature so icing will be prevented under the most severe conditions. OFF position turns off windshield anti-icing.

NORMAL OPERATION OF WINDSHIELD ANTI-ICING SYSTEM

Windshield anti-icing should be on NORMAL before starting each flight. This will insure an ice-free windshield under most conditions and permit maximum windshield anti-icing to be turned on immediately when severe conditions are encountered. Operating procedure is as follows:

a. Check that alternator bus voltage is 110 to 120 volts.

CAUTION

On airplanes not having constant speed alternators, operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is required for windshield anti-icing operation.

b. Place windshield anti-icing switch in NORMAL position (normally this is accomplished before "Starting Engines").

c. If windshield panel will not remain free of ice, place switch in MAX HEAT position.

CAUTION

Do not place the windshield anti-icing switch in MAX HEAT position without allowing the windshield to warm up with the switch in NORMAL for a period of approximately 5 to 10 minutes; otherwise the windshield nesa panel may be damaged.

d. Turn off windshield anti-icing by placing switch in OFF position.

EMERGENCY OPERATION OF WINDSHIELD ANTI-ICING SYSTEM

There is no emergency operating procedure for the windshield anti-icing system.

PITOT ANTI-ICING

The left and right airspeed pitot tubes are heated for anti-icing by electric heating elements in the pitot heads. Each pitot tube heater is controlled by an ON--OFF switch (9, figure 1-11) on the pilot's switch panel. Pitot anti-icing switches should be ON whenever icing conditions are anticipated in flight. An automatic temperature control within the head will control current flow to prevent damage by overheating or to overcome extremely cold temperatures. The pitot heaters use DC power protected by two circuit breakers on the lower DC power panel.

EXTERIOR SURFACES ANTI-ICING SYSTEM

Thermal anti-icing of all leading edges, where accumulation of ice would constitute a hazard to safety of flight or engine operation, is accomplished by extraction of heated air from the final stage of each engine compressor (figure 4-3). A common high-pressure supply duct delivers high-pressure air to wing and empennage DC controlled shutoff and pressure regulating valves which, when energized, distribute low-pressure air through the leading edge ducts and double skin areas. A check valve downstream from each engine prevents reverse airflow to an inoperative engine. After heat is transferred to the anti-iced areas the air is exhausted overboard. The compressor of each engine supplies the anti-icing air for that engine and nacelle through solenoid-actuated shutoff valves. The engine inlet guide vanes and front frame struts are anti-iced continuously during engine operation. The engine anti-ice valve controls airflow through a manifold to the engine island fairings and nose dome double skin area where it is exhausted into the compressor section of the engine through pressure relief valves. The nacelle anti-ice valve controls airflow into the nose cowl nacelle lip double skin area which is protected from excessive pressures by relief valves. Ducts deliver anti-icing air from the inboard nacelle nose cowls to the inboard nacelle struts. When an inboard engine throttle is moved to CUTOFF, a safety switch causes the nacelle anti-ice valve on that engine to close which prevents reverse airflow from the nose cowl of an adjacent operative engine. Warning circuits are provided to show when a structural overheat condition is reached in either wing or empennage. Automatic overheat control is provided by two separate systems, depending upon whether the airplane is on the ground or in flight. The system in use is determined by the position of the landing gear squat switch. When either system actuates the overheat control, electrical circuits cause shutoff valves to stop hot airflow to wing, empennage, and nacelle anti-icing areas. The shutoff valves use supply duct air pressures, directed by self-contained solenoid-operated valves, to open or close or assist in opening or closing. Both automatic overheat control systems may be bypassed in order to use manual control in event of their failure. Control circuits for the exterior surfaces anti-icing system are protected by circuit breakers on the lower DC power panel. Regulated AC power* from the main or secondary inverter bus supplied through a circuit breaker in the main AC power shield, or unregulated AC power**

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* AF 51-2357 thru -2411

** AF 51-2192 thru -2356, -2412 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278 from the left alternator bus supplied through a circuit breaker in the left alternator power shield, or regulated AC power ★from constant speed alternators through a circuit breaker in the main alternator power shield, is utilized by the flight overheat control system.

WARNING (1)

Do not operate the exterior surfaces anti-icing system except in an emergency since operation for an extended period of time may result in rupture of the empennage anti-icing ducts.

EXTERIOR SURFACES ANTI-ICING SYSTEM CONTROLS

EXTERIOR SURFACES ANTI-ICING SWITCH. A guarded ON--OFF exterior surfaces anti-icing switch (20, figure 1-11) is on the pilot's switch panel. ON position supplies power to circuits which cause the wing, empennage, nacelle, and engine shutoff valves to open. This allows compressor hot air to enter the leading edge areas of the wing, empennage, nacelles, inboard nacelle struts, engine nose domes, and island fairings. ON position also supplies power to the vortex generator de-icing system and retractable bombsight cover anti-icing system when that equipment is installed. Also, ON position removes power from the engine screen control circuit causing screens to open and remain open during operation of exterior surfaces anti-icing system. OFF position removes power from opening circuits, which causes wing, empennage, nacelle, and engine shutoff valves to close and stop the anti-icing airflow. OFF position also turns off the vortex generator de-icing system and retractable bombsight cover anti-icing system when that equipment is installed. Also, OFF position restores normal operation of the engine screens by replacing power to the engine screen control circuit.

WING, NACELLE, AND EMPENNAGE OVERHEAT CONTROL SWITCH. A wing, nacelle, and empennage overheat control switch (1, figure 4-4) is located below the pilot's oxygen and rheostat panel on the left sidewall. The switch has NORMAL--BYPASS positions and is guarded to NORMAL position. In NORMAL position, an automatic overheat control system will control temperatures of the low pressure hot air to prevent overheating and consequent damage to the structure. When on the ground, an overheat system is used which is controlled by thermal switches in the wing low pressure hot air ducts. When in flight, an electronic overheat control system utilizing AC power is used which is actuated by sensing elements in the wing leading edge. When an overheat condition is detected by either overheat system, the wing, nacelle, and empennage shutoff valves are closed. When temperatures cool, the valves are opened and anti-icing system operation resumes. In BYPASS position, the automatic overheat control systems are cut out, and this position should be used only in an emergency. Control of the system then must be accomplished by use of the exterior surfaces switch and the anti-icing air temperature gages.

EXTERIOR SURFACES ANTI-ICING SYSTEM INDICATORS

WING AND EMPENNAGE OVERHEAT WARNING LIGHTS. Wing and empennage overheat warning lights (red) (3 and 4, figure 1-8 and 43 and 44, figure 1-9) are located on the pilot's instrument panel and will illuminate only when a structural overheat condition is detected in either the left or right side of the wing or in the empennage.

NOTE

It is possible in dry air to have a high temperature in the anti-icing area which would wrinkle the leading edge skins but would not damage internal structure nor illuminate the overheat warning lights.

Continuity of the warning light circuits may be tested by actuating the wing and empennage overheat test switches (1, figure 1-43) to TEST position. Illumination of the warning lights then indicates circuits are satisfactory. The overheat warning lights are DC powered through a circuit breaker on the lower DC power panel and will indicate overheat conditions at all times when DC power is available in the airplane.

ANTI-ICING AIR TEMPERATURE GAGES. Temperature gages (2, 3, and 4, figure 4-4) showing air temperatures in the low pressure anti-icing ducts for each wing and the empennage are installed below the pilot's oxygen and rheostat panel. The gages read in degrees Centigrade and are marked as given in figure 5-1. The gages are DC powered through a circuit breaker on the lower DC power panel and will indicate duct temperatures whenever DC power is available in the airplane.

NOTE

Since the gages measure only the temperatures in the low pressure anti-icing ducts, they are not positive indication of structural overheat; therefore, the overheat warning lights must be relied on for such indications.

NORMAL OPERATION OF EXTERIOR SURFACES ANTI-ICING SYSTEM

GROUND OPERATION. The exterior surfaces anti-icing system may be used for ground defrosting of the wing, empennage, and nacelle surfaces and continued anti-icing of the surfaces by accomplishing the following procedure during engine operation:

a. Check wing and empennage overheat circuits by using wing and empennage overheat test switches to check that overheat warning lights will illuminate.

★ AF 52-1417, 53-1819 thru -2170, -2279 & on
(1) AF 52-165, -167 thru -185

exterior surfaces anti-icing system

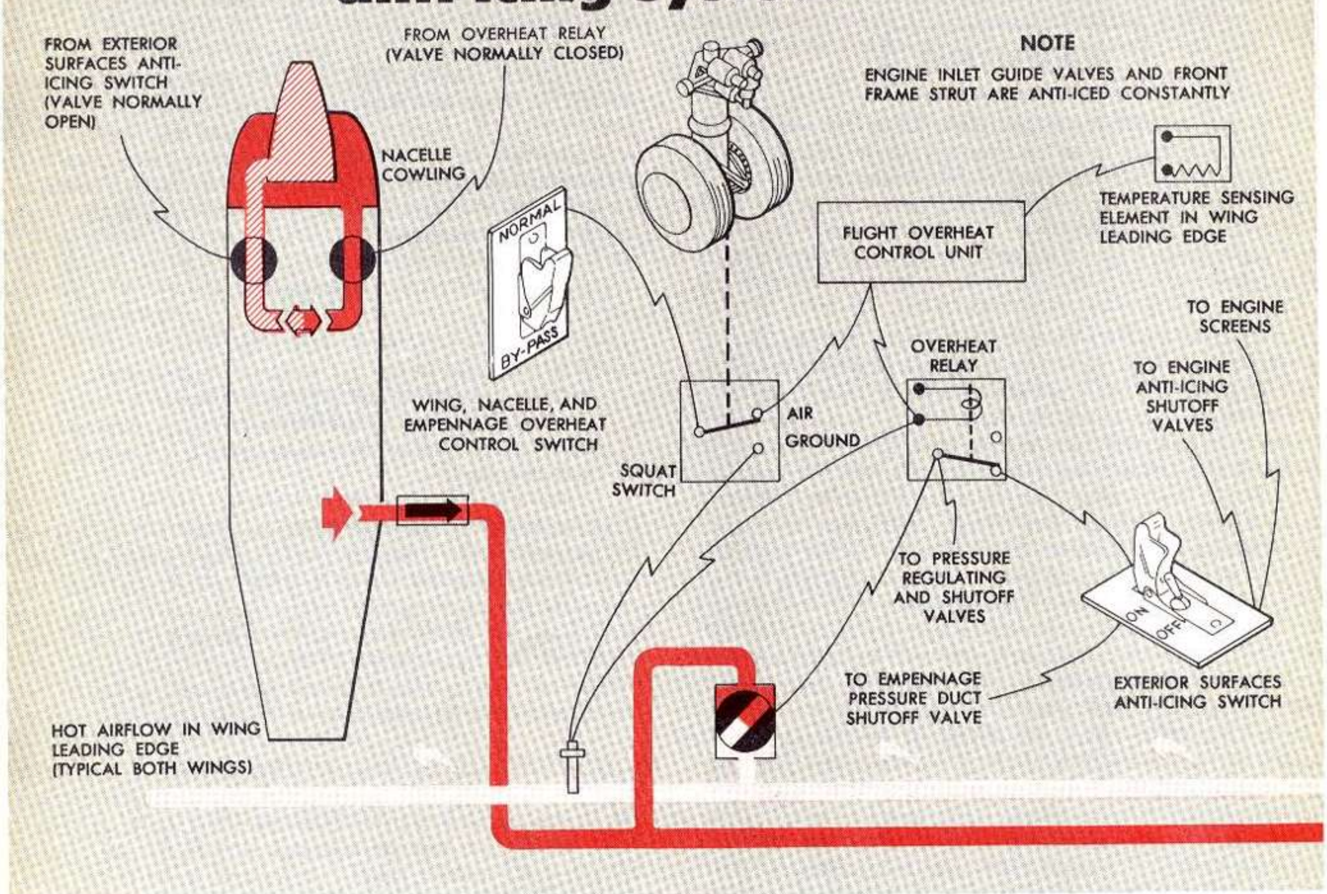

Figure 4-3. (Sheet 1 of 2 Sheets)

b. Lift the exterior surfaces anti-icing switch guard and place switch in ON position. Check that the wing, nacelle, and empennage overheat control switch is in the guarded NORMAL position.

c. For optimum ground defrosting on all surfaces, adjust engine power so that anti-icing air temperature gages read in the green arc (between 50° and 80° C). Operation of the anti-icing system with the temperature gages reading in the red arc (between 80° and 105° C) should not be attempted. This red arc indicates the temperature range within which damaging temperatures can occur in the wing leading edge during ground operation. Also the empennage will not defrost satisfactorily if the anti-icing system is permitted to cycle in the red overheat range. Engine speeds will be approximately 60% rpm for best operation with six engines.

NOTE

Operation may be satisfactorily accomplished with a minimum of one engine operating on each wing; however, care must be taken to maintain air temperatures within the green arc (50° to 80° C) on the anti-icing air temperature gages by means of throttle adjustment.

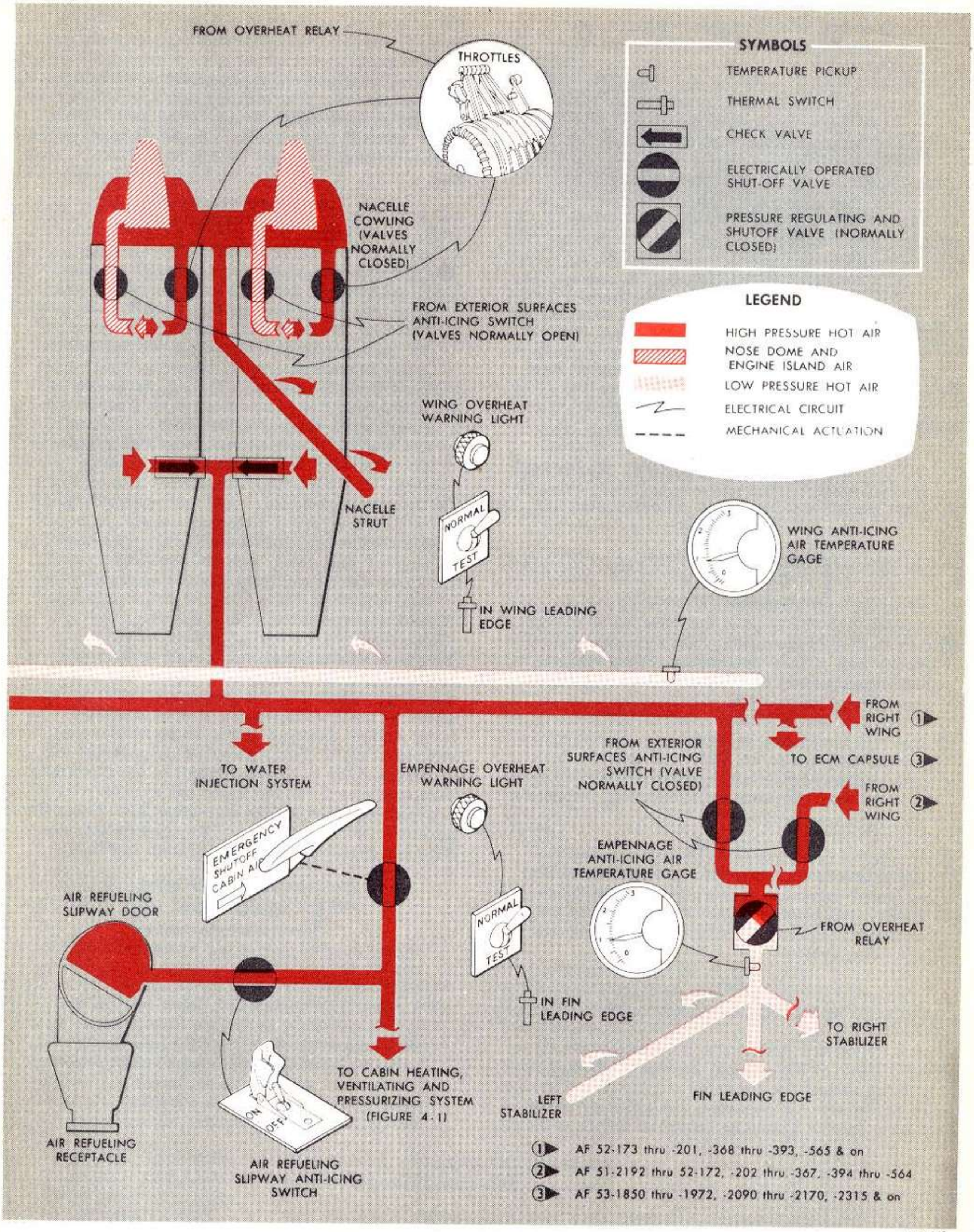

Figure 4-3. (Sheet 2 of 2 Sheets)

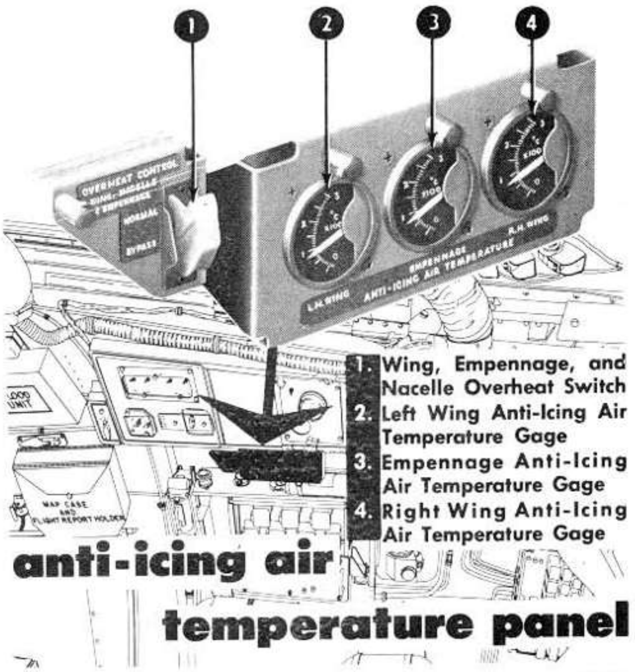

Figure 4-4.

CAUTION

- Do not attempt operation of the anti-icing system by use of only one engine. Two engines (one on each side) is the minimum for ground operation of the system. (1)
- Overheat temperatures during two-engine operation may occur at high rpm and the low duct pressures available may not permit the overheat control system to pneumatically close the wing shutoff valve. (1)
- In event of severe overheat conditions, reduce engine power immediately. Due to the slow action of valve actuators, structural damage to the wing leading edges could result by attempting to reduce overheat by shutting off anti-icing system.

d. Turn off exterior surfaces anti-icing system by placing exterior surfaces anti-icing switch in OFF position.

FLIGHT OPERATION. Wing, nacelle, and empennage anti-icing should be operated only as required for icing conditions. If possible, the exterior surfaces anti-icing system should be turned on before entering the icing area as there is a delay for anti-icing surfaces to warm up. Use the following procedure:

a. Check wing and empennage overheat circuits by actuating wing and empennage overheat test switches to check that overheat warning lights will illuminate.

b. Lift exterior surfaces anti-icing switch guard and place switch in ON position. Check that wing, nacelle, and empennage overheat switch is in NORMAL position.

CAUTION

- Continuous flight in icing conditions should not be attempted. Normally all the water which impinges on the leading edges would be evaporated by the anti-icing system. However, if the icing conditions are so severe that all the water is not evaporated, the water which runs back from the leading edge will freeze on the wing, resulting in a loss of aerodynamic efficiency and a corresponding loss in performance and range. Run-back ice can probably be first detected near the tips of the wings. (2)
- Operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power from left alternator bus is required for proper operation of anti-icing system overheat control. Failure of power from the left alternator bus will result in failure of the overheat control and consequent damage to the wing.

c. Check that the overheat control system is working by noting that anti-icing air temperature gages show a cycling reading in the green arc (105° to 216° C) which is the normal range of operation of the anti-icing system during flight. Temperatures over the red radial (216° C) are permissible provided they are cycling and the overheat lights are not illuminating. Temperatures below the lower red arc (80° to 105° C) are inadequate for inflight anti-icing; see "Under-Temperature Operation" under "Emergency Operation of Exterior Surfaces Anti-Icing System in Flight."

CAUTION (1)

Do not operate anti-icing system unless icing conditions are known to exist as the leading edges of the wing may be damaged. There is a possibility during anti-icing system operation in non-icing conditions at low engine rpm that temperatures in the wing leading edge will exceed allowable temperatures and pressures in the ducts will not be sufficient to close the wing shutoff valve. This condition may occur during descent into warmer air.

(1) AF 51-2192 thru 52-192, -202 thru -611, -3343 thru -3348
(2) AF 51-2412 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

NOTE

- If increased anti-icing is required, engine power should be increased or altitude reduced so as to increase duct temperatures. It is more economical, performancewise, to reduce altitude than to increase rpm excessively.
- Due to limitations of the anti-icing system it is necessary that the pilot attempt to maintain an engine rpm higher than 80% to 85% whenever flying in atmospheric conditions which are conducive to icing.

d. If the overheat control fails and a warning light comes on or if the overheat control fails, overheat warning lights fail, and excessively high air temperatures are shown on the anti-icing air temperature gages, place the exterior surfaces anti-icing switch in OFF position and see "Emergency Operation of Exterior Surfaces Anti-Icing System."

e. Turn off exterior surfaces anti-icing system by placing exterior surfaces anti-icing switch in OFF position.

EMERGENCY OPERATION OF EXTERIOR SURFACES ANTI-ICING SYSTEM IN FLIGHT

OVERHEAT CONTROL FAILURE. In event of automatic overheat control failure, the anti-icing system can be cycled manually to maintain temperatures below 216° C. Such a failure can be detected by illumination of overheat warning lights or continued anti-icing temperature over the 216° C red radial. Manual operation can be accomplished by the following procedure:

a. Place exterior surfaces anti-icing switch in OFF position.

NOTE (1)

Check that alternator power is available on the left alternator bus since failure of that power will result in overheat control failure and damage to the wing. If power has failed on that bus, secure power on that bus from the right alternator as given in "Electrical System Emergency Operation" in section III and resume normal operation. If power is available and the overheat control has failed for other reasons, proceed as follows:

b. Lift wing, nacelle, and empennage overheat control switch guard and place switch in BYPASS position; this cuts out the automatic overheat control system. Control then must be accomplished by use of the exterior surfaces anti-icing switch and the anti-icing air temperature gages.

c. When the overheat warning light goes out, place exterior surfaces anti-icing switch in ON position until the temperature reaches the upper part of the upper green arc on the temperature gages, then place switch in OFF position.

d. Continue operation by maintaining the temperatures within the upper green arc on the gages.

CAUTION

Place exterior surfaces anti-icing switch in OFF position whenever an overheat warning light illuminates since the temperature gages are not positive indications of structural overheat.

OVERHEAT WARNING LIGHT FAILURE. During operation of exterior surfaces anti-icing system, if overheat warning lights were to fail and overheat control were operating, no overheat would occur. However, if a high steady temperature reading, above the red radial (216° C), was observed on the anti-icing air temperature gages, the following procedure should be accomplished:

a. Check warning light for failure by actuating overheat circuit test switches and pushing press-to-test lens.

b. If warning light has failed, accomplish steps "a" through "d" under "Overheat Control Failure."

SHUTOFF VALVE FAILURE. After the exterior surfaces anti-icing switch has been placed in OFF position, if continued high temperatures above the red radial (216° C) are noted, or an overheat warning light is illuminated, a shutoff valve has failed to close. Reducing engine power may allow the overheat warning lights to go out and reduce overheat damage.

CAUTION

Structural overheat damage will not cause loss of the airplane but may reduce the strength of the affected area.

UNDER-TEMPERATURE OPERATION. Temperatures on the anti-icing air temperature gages in or below the lower red arc (80° to 105° C) are inadequate for in flight anti-icing. Failure of the circuit energizing the landing gear safety switch relay No. 3 by means of the squat switches would prevent the in flight automatic overheat control system from taking over control from the ground overheat control system. The remedy is to establish manual operation as follows:

a. Lift wing, nacelle, and empennage overheat control switch guard and actuate switch to BYPASS position.

(1) AF 51-2412 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

b. Manually cycle the exterior surfaces anti-icing switch ON and OFF as necessary to maintain temperatures within the upper green arc on the gages and without causing illumination of the red overheat warning lights.

AIR REFUELING SLIPWAY ANTI-ICING

The air refueling slipway door is anti-iced by hot compressed air obtained from the engines (figure 4-3) which, after passing through a DC operated shutoff valve, is ducted directly to the door hinge and, after passing through the hinge and circulating within the door, is discharged overboard at the door edges to remove ice if the door is frozen closed.

(1)

Electrically heated electric blankets receiving power from the left alternator bus are installed for anti-icing the air refueling slipway receptacle, door frame, and pressure pan areas.

AIR REFUELING SLIPWAY ANTI-ICING SWITCH

An ON--OFF slipway anti-icing switch (21, figure 1-11) located on the pilot's switch panel controls the hot air shutoff valve and controls the power supplied to the heater blankets. This switch is guarded on later airplanes. Air refueling slipway anti-icing should be used as given in section VII under "Air Refueling."

VORTEX GENERATOR DEICING SYSTEM (2)

A vortex generator deicing system is installed to deice the vortex generators during flight in icing conditions. The system operates in conjunction with the exterior surfaces anti-icing system. Each vortex generator has an individual electric heating element as an integral part. When in flight and the exterior surfaces anti-icing switch is placed in ON position, the vortex generator deicing system is energized and unregulated AC power is supplied intermittently to different groups of vortex generators as determined by an automatic sequence switch. A landing gear squat switch deenergizes the circuits when the airplane is on the ground. The system is deenergized when the exterior surfaces anti-icing switch is placed in OFF position. Control circuits for the vortex generator deicing system are protected by circuit breakers on the lower DC power panel. Unregulated AC power is protected by circuit breakers in the left alternator power shield.

BOMBSIGHT RETRACTABLE COVER ANTI-ICING (3)

A protective cover is provided for the optical dome of the Y-4 bombsight. This bombsight retractable cover is anti-iced by electrical heaters installed within the cover. The temperature of the heaters is automatically controlled by a thermal switch within the heaters which prevents the unit from overheating during operation. The heaters are controlled by an ON--OFF switch on the bombsight cover heater switch panel (23, figure 4-28). ON position connects unregulated AC power to the electrical heaters. OFF position deenergizes the bombsight cover heaters.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

All electronic equipment used for communication, navigation, and identification is listed in the chart shown in figure 4-5. Radio equipment is connected to the interphone or intercommunication system for use by the crew members. On some airplanes, power for the communications, radar, and electronic equipment is supplied by the airplane DC system, regulated AC (inverters) system, and an unregulated AC (alternators) system. On other airplanes, power is supplied by the airplane DC system and the regulated AC (constant speed alternators) system.

INTERPHONE SYSTEM (AN/AIC) (4)

A combat interphone system with controls at all crew stations is provided. The interphone receives audio from individual radio equipment and provides distribution to all crew members, intercommunication between crew members, and microphone connection to VHF or UHF command transmitting equipment, and microphone connection to liaison radio transmitting equipment on some airplanes*. The copilot's and observer's interphone panels are identical. The pilot's interphone panel is provided with the main controls limiting operation facilities from the copilot's or observer's panels. Interphone outlets are provided in the external AC power receptacle, bomb bay, and aft wheel well. The system is turned on when the DC power distribution system is energized. An interphone circuit breaker is located on the radar power panel.

INTERPHONE SYSTEM CONTROLS

INTERPHONE FILTER SWITCH. A three-position rotary switch (22, figure 4-6) on the pilot's radio panel has RANGE ONLY, VOICE ONLY, and NORMAL USE positions. Filtered reception of radio range signals is provided in RANGE ONLY and VOICE ONLY positions. The NORMAL USE position eliminates the audio filter.

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* AF 51-2192 thru -2356
(1) AF 51-2357 thru -7083, -17368 thru 52-041
(2) AF 51-5235 thru -7083, -17368 thru -17386, 52-046 thru -180, -219 thru -385, -394 thru -583
(3) AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
(4) AF 51-2192 thru -2411, 52-019 thru -028

table of communication and associated electronic equipment

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
①▶ INTERPHONE EQUIPMENT	AN/AIC	To provide a means for distributing audio to the crew from command radio, marker beacon, radio compass, ILS, and on some airplanes, radar warning and liaison radio. Provides intercommunication between crew members. Provides audio to modulate the command transmitter and on some airplanes, the liaison radio	Pilot	Crew stations within the airplane	Control panel at each crew member station, head set and mike outlets in aft wheel well and external power receptacle
②▶ INTERCOMMUNICATION EQUIPMENT	AN/AIC-10		Pilot and Copilot	Crew stations within the airplane	Control panel at each crew member station and in bomb bay, aft wheel well, and external power receptacle
UHF COMMAND RADIO	AN/ARC-27	Short range, two-way voice communication and tone modulated transmission by copilot only	Pilot and Copilot	Line of sight	Pilot's station right side, copilot's station left side
EMERGENCY KEYER	AN/ARA-26	Automatically keys command or liaison radio equipment	Pilot		Pilot's station
③▶ LIAISON RADIO	AN/ARC-21	Long range two-way voice and CW communication	Copilot	250 to 2000 miles depending on operating frequency and time of day	Master controls on copilot's aft right sidewall. Subcontrols on copilot's left sidewall
RADIO COMPASS	AN/ARN-6	For low frequency homing and bearing, also receives voice and code signals	Pilot	Up to 200 miles depending on operating frequency and time of day	Pilot's station right side
④▶ DIRECTION FINDER GROUP	AN/ARA-25	For homing and bearing on UHF command frequencies	Pilot	Line of sight	Pilot's station right side

①▶ AF 51-2192 thru -2411, 52-019 thru -028
②▶ AF 51-2412 thru -17386, 52-029 & on
③▶ AF 51-2192 thru -2356, 52-498 & on
④▶ AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on

Figure 4-5. (Sheet 1 of 3 Sheets).

table of communication and associated electronic equipment

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
LOCALIZER AND OMNI-DIRECTIONAL RANGE	AN/ARN-14	Provides information for navigation and instrument low approach	Pilot	Localizer approximately 45 miles and omni-directional 100 miles, depending on altitude of airplane	Pilot's station right side
MARKER BEACON SET	AN/ARN-12	Receives location marker signal on navigational beam	——	Low altitude	Automatic
GLIDE PATH APPROACH CONTROL	AN/ARN-18	Indicates glide angle for automatic approach	Pilot	Approximately 25 miles	Receiver automatically operated by operation of AN/ARN-14 control panel
IFF SET	AN/APX-6	Identifies airplanes as friend or foe	Pilot	Line of sight	Pilot's station right side
RENDEZVOUS RADAR	AN/APN-76	Serves as radar beacon to facilitate air refueling rendezvous	Observer	Line of sight	Observer's station left side
RADAR BOMBING-NAVIGATION SYSTEM	①► "K" system with AN/APS-23. ②► MA-7A system with AN/APS-64 and AN/AWA-2 position mark generator.	Bombing-navigation and rendezvous	Observer	Line of sight	Observer's station

①► Airplanes not included in ②►

②► AF 51-2194, -2198, -2207, -2222, -2249, -2250, -2252, -2255, -2259, 53-1850 thru -1972, -2104 thru -2170, -2345 & on

Figure 4-5. (Sheet 2 of 3 Sheets).

table of communication and associated electronic equipment

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
GUN LAYING RADAR	AN/APG-32	Provides information and control for tail turret for bomber defense	Copilot	Short Range 300 to 8000 yards Long Range 24,000 yards maximum	Gunner's station (Copilot's station aft)
① CHAFF DISPENSER SYSTEM	AN/ALE-1	Confuses enemy radar equipment	Copilot		Copilot's station left side
① RADAR WARNING SYSTEM	AN/APS-54	Receives radar signals	Copilot		Copilot's station aft
ECM TRANSMITTERS	AN/APT-5A ② AN/APT-9 ③ AN/APT-16( ) ③ AN/ALT-6 ③ AN/ALT-7 ③ AN/ALT-8 ③	Jams Enemy radar equipment	Copilot		Copilot's station left side

① AF 51-2192 thru -2356, 52-158 thru -201, -312 & on

② AF 51-2357 thru 52-157, -202 thru -311, -508 thru -564

③ AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -507, -565 & on

50406 WC-1

Figure 4-5. (Sheet 3 of 3 Sheets).

PILOT'S SELECTOR SWITCH. An interphone selector switch (3, figure 4-6) on the pilot's radio panel has PVT INTER, COMPASS, LIAISON, MIX SIG & COMMAND, INTER, and CALL positions. PVT INTER and LIAISON positions are not used in this interphone installation. COMPASS position of the switch allows for reception of the radio compass signals. MIX SIG & COMMAND position of the switch allows reception of any or all signals that are fed into the interphone system with respect to the position of the four interphone mixer toggle switches (2, figure 4-6) and operation of the command radio. INTER position of the switch allows for normal interphone communication between crew members. A momentary CALL position of the switch disconnects all radio facilities from the interphone system, and allows pilot communication to all crew members simultaneously.

(1)
On some airplanes, LIAISON position of the pilot's selector switch allows the pilot to receive and transmit over the liaison radio. The functions of all other switch positions remain the same.

INTERPHONE MIXER TOGGLE SWITCHES. Four mixer toggle switches (2, figure 4-6) on the pilot's radio panel are marked "Inter," "Comp," "Marker," and "Localiz." The off (aft) position of each toggle switch disconnects its associated auxiliary equipment from the interphone panel output. Any one or more of the above auxiliary equipment facilities may be heard through the interphone system at the same time if the interphone selector switch is placed in MIXED SIG & COMMAND position and mixer toggle switches are placed in on (forward) position. The on position of the "Inter" toggle switch connects the normal interphone system to the pilot's panel for normal crew communication. The on position of the "Comp" toggle switch connects radio compass output to the interphone panel. The on position of the "Marker" toggle switch connects marker beacon receiver output to the interphone panel. The on position of the "Localiz" toggle switch connects output from the localizer receiver to the interphone panel.

VOLUME KNOBS. A volume knob (23, figure 4-6 and 1, figure 4-7) is located on the pilot's, copilot's and observer's interphone panels. Each volume knob adjusts the volume level of the interphone output on its respective panel.

COPILOT'S AND OBSERVER'S SELECTOR SWITCHES. An interphone selector switch (2, figure 4-7) on the copilot's and observer's interphone panels has PVT INTER, COMPASS, LIAISON, COMMAND, INTER, and CALL positions. PVT INTER and LIAISON positions are not used in this interphone installation. COMPASS position connects the output of the radio compass receiver to the interphone panel. COMMAND position allows the copilot to transmit and receive over the command set and the observer only to receive. INTER position connects the normal interphone system to the copilot's or observer's panel for normal crew communication. A momentary CALL position allows the copilot or observer to call all crew members at the same time, disconnecting all radio facilities from the interphone system.

(1)
On some airplanes, PVT INTER position of the copilot's selector switch is replaced with an AN/APS-54 position which allows the copilot to receive audio signals from the warning radar set. LIAISON position of the copilot's selector switch allows the copilot to receive and transmit over the liaison radio. PVT INTER and LIAISON positions on the observer's panel are inoperative. The functions of all other switch positions remain the same.

CONTROL WHEEL MIKE SWITCHES. An interphone mike switch (1, figure 4-11) is located on the pilot's and copilot's control wheels and has momentary MIXED SIGNALS INTER--MIC positions. When either the pilot's or copilot's switch is moved to the MIC position, the pilot's and copilot's mikes are connected to the interphone system. When either switch is moved to MIXED SIGNALS INTER position, all radio facilities are disconnected from the interphone and allow calls to all stations regardless of interphone panel switch positions.

MIKE FOOT SWITCHES. A foot-operated mike switch is mounted on the floor at the observer's station and one is mounted on the floor at the gunner's station to facilitate use of the crew member's mikes. When the foot switch is depressed, transmission is made possible only through the equipment indicated by the interphone or intercom selector switch.

(1)
Some airplanes have two foot switches at the observer's station.

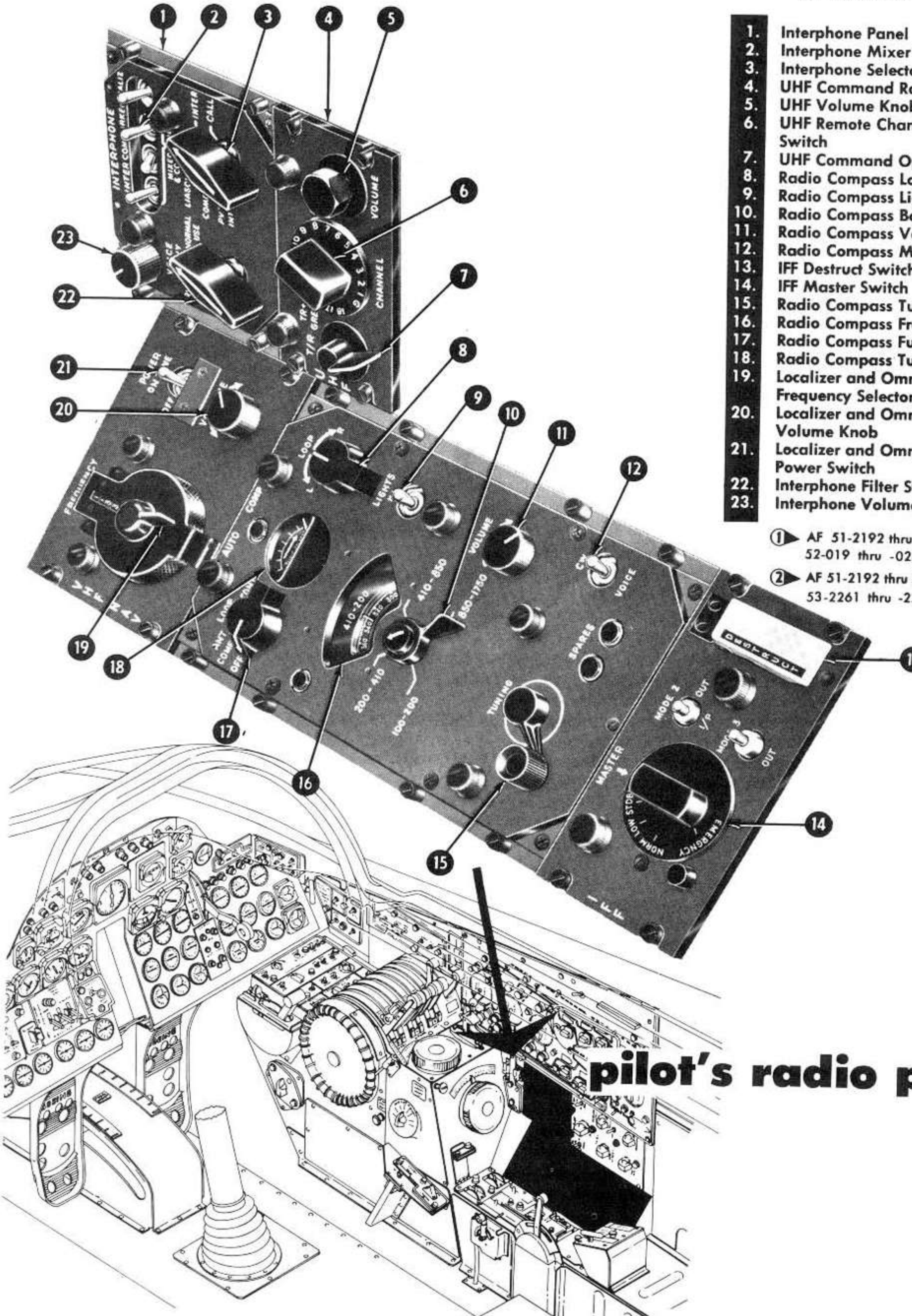
NORMAL OPERATION OF INTERPHONE SYSTEM

Normal operation of the interphone system may be accomplished as follows:

a. For normal communication between crew members, place selector switch in INTER position and the pilot places mixer toggle switches in off position. To use mikes, pilot and copilot move control wheel mike switches to MIC position and observer and gunner depress foot switches.

b. To transmit and receive on command radio, pilot places selector switch in MIX SIG & COMMAND position; copilot and observer use COMMAND position.

(1) AF 51-2192 thru -2356



1. Interphone Panel ①▶
2. Interphone Mixer Toggle Switches
3. Interphone Selector Switch
4. UHF Command Radio Panel
5. UHF Volume Knob
6. UHF Remote Channel Selector Switch
7. UHF Command Operation Switch
8. Radio Compass Loop Switch
9. Radio Compass Light Switch
10. Radio Compass Band Switch
11. Radio Compass Volume Knob
12. Radio Compass Mode Switch
13. IFF Destruct Switch ②▶
14. IFF Master Switch
15. Radio Compass Tuning Crank
16. Radio Compass Frequency Dial
17. Radio Compass Function Switch
18. Radio Compass Tuning Meter
19. Localizer and Omni-Range Frequency Selector Switch
20. Localizer and Omni-Range Volume Knob
21. Localizer and Omni-Range Power Switch
22. Interphone Filter Switch
23. Interphone Volume Knob

①▶ AF 51-2192 thru 51-2411, 52-019 thru -028

②▶ AF 51-2192 thru 52-620, 53-2261 thru -2289

pilot's radio panel

50407WB-1

Figure 4-6.

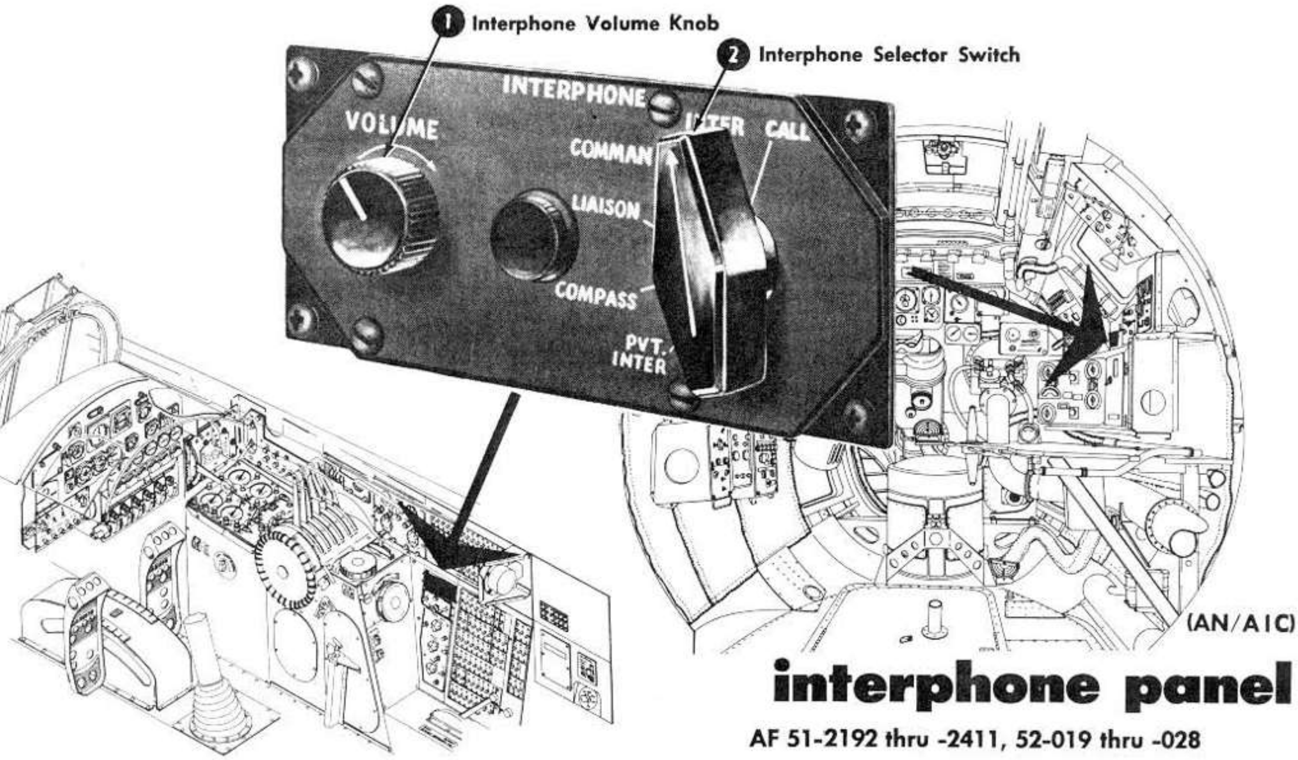


Figure 4-7.

c. To receive radio compass signals, place selector switch in COMPASS position.

d. Pilot may filter radio range signals by means of the filter switch; RANGE ONLY position filters voice and allows tone signals to be predominant. VOICE ONLY position permits voice reception to be predominant. For normal operation of the interphone system, place the filter switch in NORMAL USE position.

e. Call all crew members by holding the selector switch in CALL position. Pilot and copilot may also place control wheel mike switches to MIXED SIGNALS INTER position, regardless of the selector switch position, to make a call to all crew members.

f. Pilot may simultaneously receive the command radio (if operating) and any or all of the following auxiliary radio equipment by placing selector switch in MIX SIG & COMMAND position and placing the mixer toggle switch for the desired equipment in on position. (1)

g. To transmit and receive over the liaison radio, pilot and copilot place their respective selector switch in LIAISON position. (1)

h. To receive warning radar signals, copilot places selector switch in AN/APS-54 position.

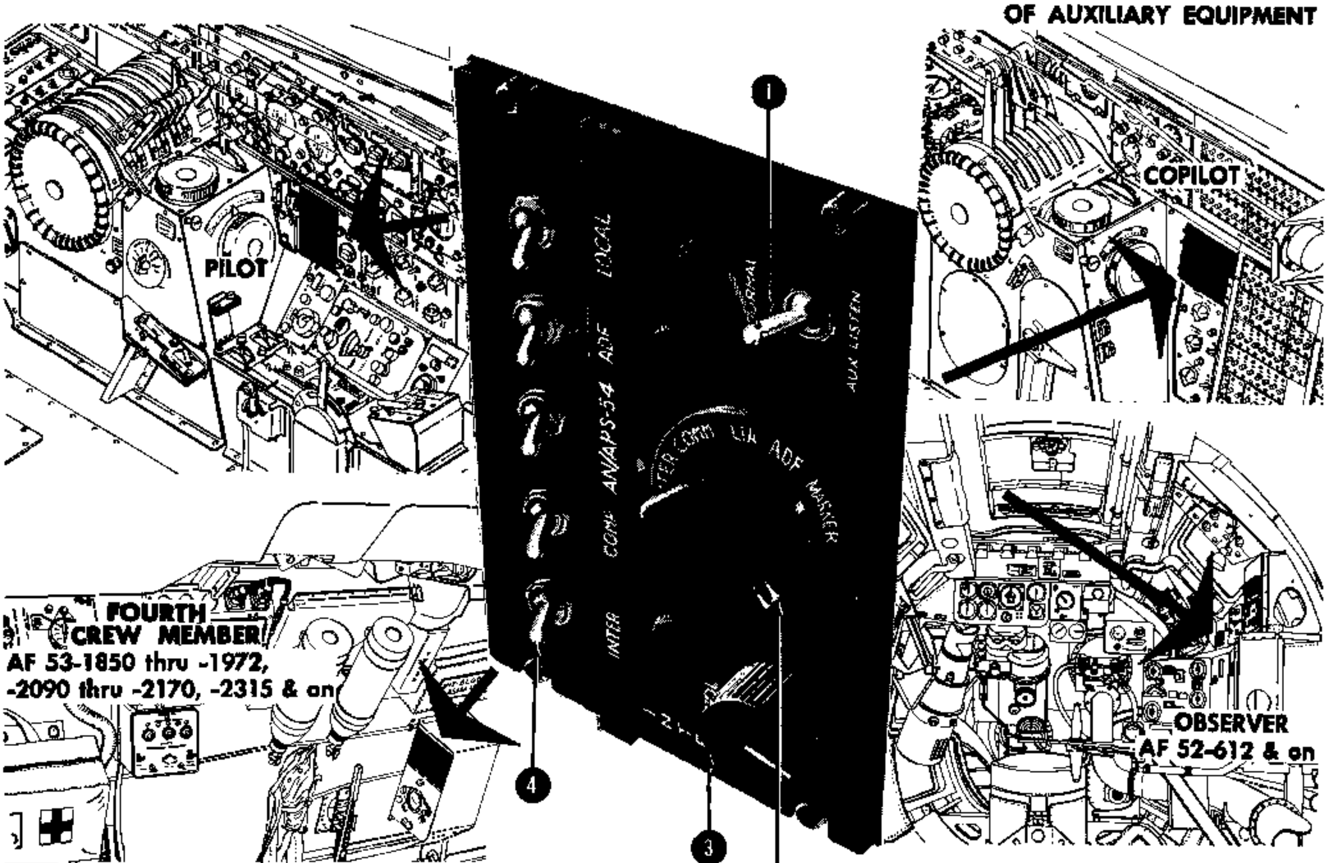
EMERGENCY OPERATION OF INTERPHONE SYSTEM

If all stations are to be contacted, in case of emergency, hold the interphone selector switch in the spring-loaded CALL position, or hold in the MIXED SIGNALS INTER switch on the pilot's or copilot's control wheel. Operation of either switch will disconnect all radio facilities from the interphone system.

INTERCOMMUNICATION SYSTEM (AN/AIC-10) (2)

An intercommunication (intercom) system is provided with controls at all crew stations. The intercom system receives audio from individual radio equipment for distribution to all crew members, provides communication between crew members, and provides microphone connection to radio transmitting equipment. The pilot's and copilot's intercom panels are identical and are provided with the main controls. On some airplanes the observer's intercom panel has only limited operation facilities, while on other airplanes the observer's and fourth crew member's intercom panels have facilities approximately equal to the pilot's and copilot's. Auxiliary intercom panels and outlets are

(1) AF 51-2192 thru -2356
(2) AF 51-2412 thru -17386, 52-029 & on



1. Normal-Auxiliary Listen Switch
2. Selector Switch
3. Volume Knob
4. Mixer Toggle Switches

(AN/AIC-10)

intercom panel

AF 51-2412 thru -17386, 52-029 & on

Figure 4-8.

90415 WC

provided in the bomb bay, external DC power receptacle, and the aft wheel well. Controls other than on the panels are located on the pilot's and copilot's control wheels, pilot's left sidewall, observer's and gunner's floors, and microphone cordage. The system is operative when the DC power distribution system is energized. The intercom system circuit breakers are located on the radar power panel.

INTERCOMMUNICATION SYSTEM CONTROLS

NORMAL-AUXILIARY LISTEN SWITCH. A normal-auxiliary listen switch (1, figure 4-8) located on the pilot's, copilot's, observer's, fourth crew member's, and each auxiliary station intercom panel has NORMAL--AUX LISTEN positions. The switch is safety wired in NORMAL position. This position allows complete use of all facilities through the intercom system at that station. AUX LISTEN position allows use of only one facility at a time and should be used only as an emergency measure when signals from all facilities are unintelligible. If, on the pilot's and copilot's panels, all of the mixer toggle switches are in off position, the facility selected by the selector switch will be heard. If the mixer toggle switches are placed in on position, the facility provided by the farthest left toggle switch in on position will be heard through the intercom. On all panels, the volume knob will not affect the volume level while the switch is in AUX LISTEN position.

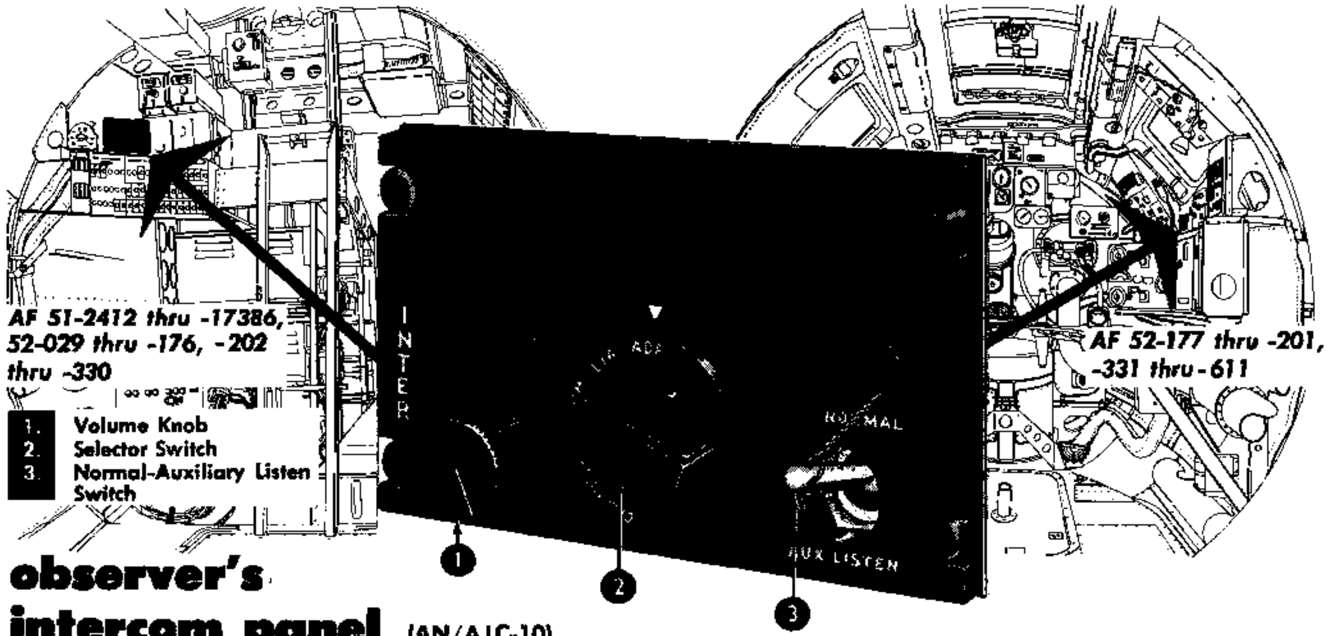


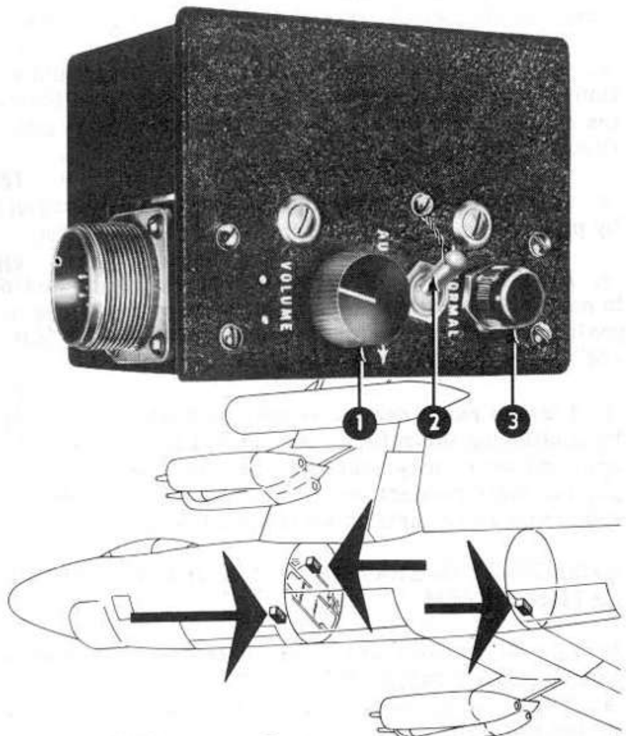
Figure 4-9.

SELECTOR SWITCH. A rotary selector switch (2, figure 4-8 and 2, figure 4-9) on the pilot's, copilot's, fourth crew member's, and observer's panels has CALL--INTER--COMM--LIA--ADF positions. On some airplanes* the pilot's and copilot's panels have an additional MARKER position. Placing the selector switch in CALL position allows all stations to be contacted simultaneously, regardless of their selected switch positions, and without pressing the mike switch to talk. INTER position allows communication between all crew stations. COMM position allows the pilot and copilot to receive UHF and transmit when his respective mike switch is pressed and allows the observer and fourth crew member only to receive UHF. On some airplanes**, LIA position allows each crew member to receive liaison radio signals and to transmit when his respective mike switch is depressed. ADF position permits reception of audio signals from the radio compass. MARKER position* allows reception of audio signals from the marker beacon receiver.

MIXER TOGGLE SWITCHES. Five mixer toggle switches (4, figure 4-8) on the pilot's and copilot's intercom panels (and, on some airplanes, the observer's and the fourth crew member's intercom panels) are marked "Inter," "Comm," "Marker"• or "AN/APS-54," *"Adf," and "Local." When the normal-auxiliary listen switch is in NORMAL position, the on (forward or up) position of each toggle switch mixes the audio signal from the respective equipment separately or simultaneously with the audio output from the selector switch. This allows the crew member to monitor incoming audio signals from equipment without changing the selector switch position. On position of the "Inter" toggle switch allows monitoring of audio signals from the intercom line. On position of the "Comm" toggle switch allows monitoring of audio signals from the command receiver. On position of the "Marker" toggle switch allows monitoring of audio signals from the marker beacon receiver. On position of the "AN/APS-54" toggle switch allows monitoring of audio signals from the warning radar receiver. On position of the "Adf" toggle switch allows monitoring of audio signals from the radio compass receiver. On position of the "Local" toggle switch allows monitoring of audio signals from the localizer receiver. When the normal-auxiliary listen switch is in AUX LISTEN position, only one audio signal from auxiliary equipment may be monitored. If more than one toggle switch is in on position, the audio signal from the equipment connected to the farthest left toggle switch will be monitored. The off (aft or down) position of each toggle switch disconnects its associated auxiliary equipment audio signal from the respective intercom panel output.

* AF 52-158 thru -201, -312 & on
**AF 52-498 & on
• AF 51-2412 thru -17386, 52-029 thru -157, -202 thru -311

VOLUME KNOB. A volume knob (3, figure 4-8) on each intercom panel allows regulation of volume level received at that station. The volume knob is ineffective when the normal-auxiliary listen switch is in AUX LISTEN position. The counterclockwise limit of the knob gives minimum volume operation. The maximum volume before peak clipping is obtained with the knob at approximately the midposition. Advancing the knob beyond this point results in clipping the speech peaks and increasing the average power of a speech signal when needed to overcome noise at a listener's station. (Peak clipping excludes sharp sound pressures from the ear of a listener during high average output; however, the greater power makes more noticeable the electrical background noise in the system.) Normally the volume control should be set to midposition except on the auxiliary intercom panels which normally should be set to maximum clockwise position. The volume levels of the various equipment working into the system should then be set for comfortable listening using the individual equipment volume controls.



auxiliary intercom panel

(AN/AIC-10)

1. Volume Knob
2. Normal-Auxiliary Listen Switch
3. Call Button

50417WA-4

Figure 4-10.

control wheel switches

1. Mike Switch
2. Air Refueling Disconnect and Automatic Pilot Release Switch

50418WA

Figure 4-11.

CALL BUTTON. A call button (3, figure 4-10) is located on the auxiliary station intercom panels. Pressing the call button disconnects all radio facilities from the intercom system and allows use of the crew member's mike at that station to call all other intercom stations without pressing the mike switch to talk.

CONTROL WHEEL MIKE SWITCHES. An intercom mike switch (1, figure 4-11), located on the pilot's and copilot's control wheels, has MIC--MIXED SIGNALS INTER positions. When either switch is moved to the MIC position, the respective crew member's mike is connected to the intercom system. When either switch is moved to MIXED SIGNALS INTER position, the crew member's mike is connected to the interphone line regardless of control panel switch positions. This switch allows crew member to listen and talk over interphone line without removing hands from control wheel to operate switches on the control panel.

MIKE FOOT SWITCHES. A foot-operated mike switch is mounted on the floor at the gunner's station and a switch (28, figure 4-28) is mounted on the floor at the observer's station to facilitate use of the crew member's mike. Some airplanes* have two foot switches at the observer's station. When a foot switch is depressed, transmission is made possible only through the equipment indicated by the intercom selector switch.

AUXILIARY STATION MIKE SWITCHES. A mike switch located on the headset and mike cordage assembly at each auxiliary station as well as the fourth crew

* AF 52-158 thru -201, -312 thru -393, -508 & on

member's station is used in conjunction with the auxiliary intercom panel at that station for normal intercommunication. Pressing the switch connects the respective crew member's mike with the intercom system.

RADIO COMPASS FILTER SWITCH. A three-position rotary filter switch, located on the aft side of the pilot's oxygen and rheostat panel, has ADF RANGE--ADF VOICE--BOTH positions. ADF RANGE position of the switch allows radio compass range signals to be heard at their full volume level and the voice signals reduced to a lower level. ADF VOICE position allows the voice signals to be heard at their full intensity while the range signals are reduced. BOTH position disconnects the filter and allows both radio compass range and voice signals to be heard at equal intensity.

NORMAL OPERATION OF THE INTERCOMMUNICATION SYSTEM

INTERCOMMUNICATION. Communication between crew members may be accomplished as follows:

a. Place the normal-auxiliary listen switch in NORMAL and move the selector switch to INTER position. On the pilot's and copilot's panels move all of the mixer toggle switches to the off position. The system is now set up for normal intercommunication between crew members.

b. Pilot or copilot may communicate with the other intercom stations by actuating his control wheel mike switch to the MIC position. The observer or gunner may use his foot switch to permit use of his mike. Volume of signals received may be regulated by the volume knob.

c. Call all crew members from the pilot's or copilot's station by moving the control wheel mike switch to MIXED SIGNALS INTER or by placing the selector switch in CALL position. Call by the observer, fourth crew member, or gunner may be made by positioning the selector to CALL position. Call from the auxiliary stations in the bomb bay, aft wheel well, or the external power shield may be made by pressing the call button on that panel. While the system is on "call," all of the auxiliary equipment facilities are disconnected from the intercom system.

FACILITY INTERCOMMUNICATION. Operation of the radio facilities in conjunction with the intercommunication system may be accomplished as follows:

a. Command radio as well as intercommunication between crew members may be heard by placing the mixer toggle switch marked "Comm" in on position. The pilot and copilot may transmit over command radio by positioning their respective selector switches to COMM position and using their mike and mike switch. When transmitting, the crew member will hear a sidetone in his headphones. Each crew member may receive command by placing his selector switch in COMM position. The pilot and copilot (and, on some airplanes, the observer and the fourth crew member) may also listen to the other facilities while receiving command radio (selected by the selector switch in COMM position) by positioning the desired mixer toggle switch in on position.

b. Radio compass signals may be heard along with other communication facilities by placing the mixer toggle switch marked "Adf" in on position. The radio compass may be used separately by positioning the selector switch in ADF position. The pilot may select reception of both range and voice signals by positioning the filter switch in BOTH position. When positioned to ADF-1 VOICE or ADF-1 RANGE, reception of the selected signal will be more predominant. The crew member may also listen to the other facilities while listening to radio compass (selected by the selector switch in ADF position) by placing the desired mixer toggle switches in on position.

c. Localizer reception may be heard in conjunction with other communication facilities by positioning the mixer toggle switch marked "Local" to on position.

(1)
d. Marker beacon reception may be heard in conjunction with other communication facilities by positioning the mixer toggle switch marked "Marker" in on position.

(2)
d. Marker beacon reception may be heard separately by placing the selector switch in MARKER position.

(2)
e. AN/APS-54 warning radar signals may be heard in conjunction with other communication facilities by positioning the mixer toggle switch marked "AN/APS-54" to on position.

(3)
f. Liaison radio reception may be heard separately by positioning the selector switch in LIA position. All crew members may transmit over the liaison radio by placing their respective selector switches to LIA position and using their mike and mike switch.

EMERGENCY OPERATION OF THE INTERCOMMUNICATION SYSTEM

In case all stations are to be contacted in an emergency, place a call as follows:

a. The pilot or copilot may position his selector switch in CALL.

b. Observer, fourth crew member, or gunner moves his selector switch to CALL.

c. A crew member at an auxiliary station presses his call button.

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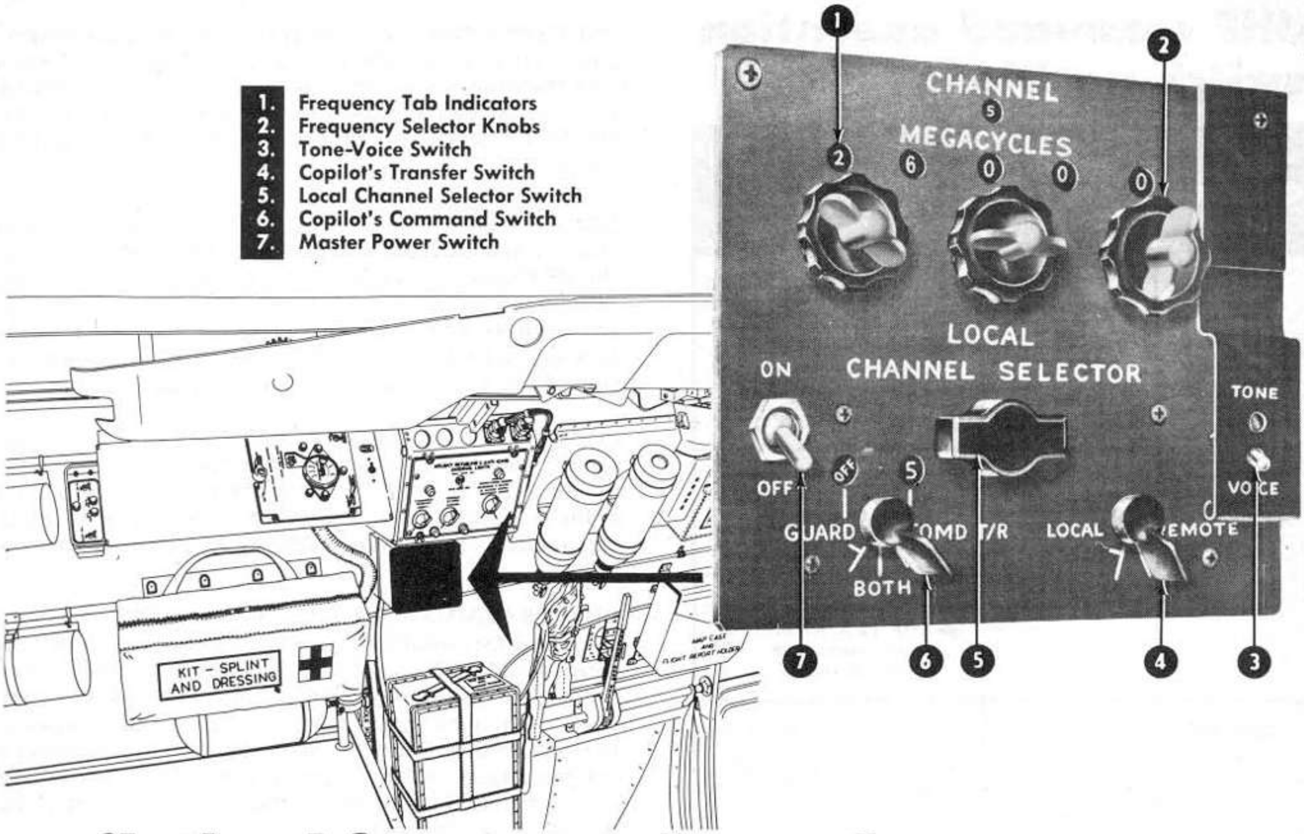
(1) AF 51-2412 thru -17386, 52-029 thru -176, -202 thru -311
(2) AF 52-156 thru -201, -312 & on
(3) AF 52-498 & on

1. Frequency Tab Indicators
2. Frequency Selector Knobs
3. Tone-Voice Switch
4. Copilot's Transfer Switch
5. Local Channel Selector Switch
6. Copilot's Command Switch
7. Master Power Switch



copilot's uhf command panel

(AN/ARC-27)

50408WA

Figure 4-12.

In event of amplifier failure in the intercommunication system as evidenced by intercom silence or unintelligible signals from all facilities, proceed as follows:

a. Place normal-auxiliary listen switch in AUX LISTEN position. (This will necessitate breaking of the safety wire.)

b. Place all mixer toggle switches in off position and turn selector switch to the desired listening facility.

c. If the desired listening facility cannot be selected on the selector switch turn on the appropriate mixer toggle switch. If more than one mixer toggle switch is on, the facility heard will be that of the farthest left toggle switch in on position.

NOTE

If the intercom panel at a crew member's station becomes inoperative, the panel at another station may be used since the pilot's panel receives power from one dynamotor and the copilot's and observer's panels receive power from another dynamotor.

UHF COMMAND (AN/ARC-27)

A UHF command radio provides voice or modulated code communication from plane to plane or plane to ground. A guard receiver is used to facilitate constant monitoring of a frequency channel other than the channel being used by the main receiver and transmitter. The copilot's command radio control panel is located on his left sidewall, and the pilot's command radio panel is a part of the pilot's radio panel. The equipment operates from DC power, provided power by a circuit breaker in the tail compartment shield and a circuit breaker in the radar power panel. For antenna location, see figure 4-21.

UHF COMMAND RADIO CONTROLS

MASTER POWER SWITCH. A master power switch (7, figure 4-12) located on the copilot's radio panel has ON--OFF positions. ON position supplies power to operate the command radio equipment. OFF position deenergizes the equipment.

UHF command operation switch positions

OPERATOR	OPERATION SWITCH POSITION	EQUIPMENT OPERATION
PILOT	OFF	Primary power off (if copilot's transfer switch is in REMOTE).
	T/R	Transmitter on in standby, main receiver on. ①▶ADF on in standby.
	T/R + G REC	Transmitter on in standby, main receiver on, guard receiver on. ①▶ADF on in standby.
	ADF	②▶Switch position not used. ①▶ADF (AN/ARA-25) antenna connected, ADF operation ready.
COPILOT	GUARD	Transmitter on guard channel in standby. Main receiver on guard channel. Guard receiver off.
	COMD T/R	Transmitter on in standby. Main receiver on. Guard receiver in standby.
	BOTH	Transmitter on in standby. Main receiver on, guard receiver on.

①▶AF 53-1881 thru -1972, 2118 thru -2170, -2368 & on
②▶AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2367

30409WC-1

Figure 4-13.

MANUAL FREQUENCY SELECTOR KNOBS. The UHF command panel is provided with three frequency knobs (2, figure 4-12) to allow manual selection of 1750 different operating frequencies.

TONE-VOICE SWITCH. A tone-voice switch on the UHF command panel (3, figure 4-12) has two positions TONE and VOICE for selecting tone or voice operation of the command transmitter. On some airplanes, a spring switch guard has been installed and must be lifted to free the switch action in either position.

NOTE

To use manual tone, the copilot's transfer switch must be in LOCAL position.

PILOT'S VOLUME KNOB. A volume knob (5, figure 4-6) provides means for adjusting the audio output from the command receiver to the interphone or intercom system.

COPILOT'S TRANSFER SWITCH. A two-position copilot's transfer switch (4, figure 4-12) allows for control transfer of the command set to the pilot. LOCAL position allows control only by the copilot's panel. REMOTE position transfers control to the pilot's panel.

LOCAL CHANNEL SELECTOR SWITCH. A local channel selector switch (5, figure 4-12) is located on the UHF command panel. This switch has channel positions numbered from 1 to 18 providing selection of any of these preset channel frequencies. An M position of the switch is also provided to allow for operation of the manual frequency selector knobs.

COPILOT'S COMMAND OPERATION SWITCH. A copilot's command three-position operation switch (6, figure 4-12) selects different conditions of operation of the transmitter and receivers. See figure 4-13 for explanation of command radio operation switch positions.

PILOT'S COMMAND OPERATION SWITCH. A pilot's command four-position operation switch (7, figure 4-6) selects different conditions of operation of the transmitter and receivers. On some airplanes when the switch is placed in the ADF position the ADF antenna is connected in place of the communications antenna and the directional finder group (AN/ARA-25) is turned on. See figure 4-13 for explanation of command radio operation switch positions.

REMOTE CHANNEL SELECTOR SWITCH. A remote channel selector switch (6, figure 4-6) is located on the pilot's remote panel. This switch has channel positions numbered from 1 to 18 providing selection of any of these preset channel frequencies. Position "G" (guard) of the switch is also provided to allow selection of the guard receiving channel.

UHF COMMAND RADIO INDICATORS

FREQUENCY TAB INDICATORS. Five frequency tab indicator windows are located on the UHF command panel (1, figure 4-12). The tabs indicate the frequency of the main receiver and transmitter operation.

NORMAL OPERATION OF UHF COMMAND RADIO

The UHF command radio may be operated at either the pilot's or copilot's position, depending upon the position of the copilot's transfer switch. In the LOCAL position the UHF command radio is operated from the copilot's UHF command panel. In the REMOTE position the radio is operated from the pilot's UHF command panel.

Copilot operation (transfer switch in LOCAL) is as follows:

a. Place the master power switch (7, figure 4-7) in the ON position.
b. Place the appropriate interphone or intercom controls to the desired positions for command radio operation (see "Interphone System" or "Intercommunication System," this section).

c. Select mode of operation at the copilot's command switch. See figure 4-13 for possible modes.
d. Select channel desired at local channel selector switch. Preset frequency will appear on frequency tab indicators. Channel number selected will also appear in window above frequency tab indicators.
e. If some frequency other than those preset is desired, select M on the local channel selector switch. Turn frequency selector knobs until desired frequency appears on frequency tab indicators.
f. In normal operation the tone voice switch is in VOICE position. In TONE position the radio set will transmit a continuous tone modulated signal.

Pilot operation (transfer switch in REMOTE) is as follows:
a. Select mode of operation desired at pilot's command operation switch.
b. Select any one of 18 preset channels at remote channel selector switch. This switch also has a G position which sets transmitter and main receiver to guard frequency.
c. Adjust volume control to desired level.

NOTE

Tone modulation is not available from pilot's panel.

If the command radio is to be turned off, turn pilot's command switch to OFF if copilot's transfer switch is in REMOTE position. Turn master power switch to OFF if copilot's transfer switch is in LOCAL position.

EMERGENCY OPERATION OF UHF COMMAND RADIO

If an obstruction has caused the defective operation of a desired channel, place the remote channel selector switch to a different frequency and return immediately to the desired channel. This will often correct the difficulty. A crystal failure on one frequency will not affect all frequencies. Try operation at a different frequency. In case pilot's remote channel selector switch becomes inoperative, the equipment may be operated using the local channel selector switch at the copilot's station. If neither channel selector switch functions properly, the copilot should turn the local selector switch to M and adjust the knobs to the desired frequency.

EMERGENCY KEYER (AN/ARA-26)

An emergency keyer may be used to broadcast an automatic "SOS." The message is in International Morse Code. The "SOS" is sent three times, then the last four figures of the airplane serial number are sent three times followed by six tone signals; the tone signals each last 4 seconds and are spaced 1 second apart. The automatic broadcast is repeated as long as the keyer receives power or until stopped by use of the keyer ON--OFF power switch. The keyer is operated by DC power through a circuit breaker on the radar power panel.

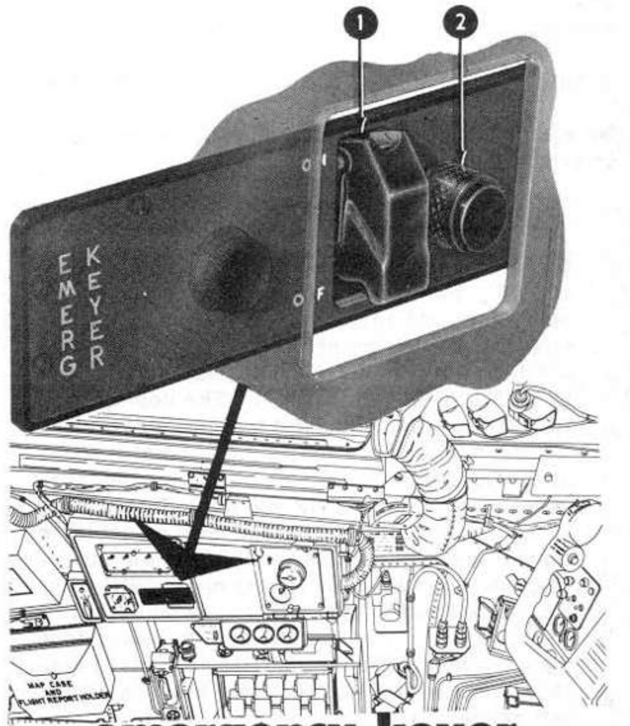
(1)
The keyer broadcasts over the command radio (ARC-27) if the copilot's transfer switch is in REMOTE position and the keyer power switch is ON.

(2)
The keyer broadcasts over the liaison radio (ARC-21) automatically when the keyer power switch is ON.

(3)
An incomplete installation makes the keyer inoperable.

EMERGENCY KEYER CONTROLS

KEYER POWER SWITCH. A power switch (1, figure 4-14) located on the emergency keyer panel has two positions ON--OFF, normally guarded in the OFF position. ON position of the switch starts keyer operation. Operation of the keyer continues until the power switch is placed in OFF position.



emergency keyer panel (AN/ARA-26)

1. Keyer Power Switch
2. Keyer Operating Light

50420WA

Figure 4-14.

(1) AF 51-2357 thru 52-611
(2) AF 51-2192 thru -2356, 52-612 thru -620, -3343 thru 53-1972, -2090 thru -2319, -2332 & on
(3) AF 52-1406 thru -1417, 53-2028 thru -2040, -2320 thru -2331

EMERGENCY KEYER INDICATORS

KEYER OPERATING LIGHT. An amber indicator light (2, figure 4-14) on the emergency keyer panel will illuminate approximately 10 seconds after the keyer power switch is placed in ON position. The indicator light will continue to illuminate until the keyer power switch is placed in OFF position which stops keyer operation.

NORMAL OPERATION OF EMERGENCY KEYER

(1)
Emergency keyer operation is obtained by the following procedure:
a. Copilot places transfer switch on his command radio panel in REMOTE position.
b. Pilot lifts switch guard on emergency keyer power switch and places switch in ON position.
c. To stop keyer operation, place the keyer power switch in OFF position.

(2)
The emergency keyer is made operative by lifting the switch guard and placing the keyer power switch in ON position. To stop keyer operation, place keyer power switch in OFF position and close switch guard.

EMERGENCY OPERATION OF EMERGENCY KEYER

No means for emergency operation of emergency keyer is provided.

NOTE

If the emergency keyer fails to operate, turn it OFF. Failure to operate is indicated by the operating light remaining off and by no audible sound of keying being noted in the headphone sidetone when the interphone selector is turned to COMMAND* or LIA**. The copilot may then key the UHF command transmitter by placing the set in operation in the normal manner at the frequency desired and operating the tone-voice switch to the TONE position. If time permits, the tone-voice switch may be actuated (keyed) as required to manually transmit intelligence on CW. The keying of the UHF command transmitter may also be accomplished by the observer operating the bomb scoring tone switch manually from the CUTOFF position to INITIATE position as required to transmit intelligence on CW.

LIAISON RADIO (AN/ARC-21) (3)

No provisions for CW and teletypewriter operation are installed in the present configuration.

(4)
Not all components necessary for an operable system are installed; consequently, the liaison radio is inoperative.

A low-frequency liaison radio provides long-range CW, voice, and teletypewriter communication from plane to plane and plane to ground. The liaison radio operates over a frequency range of 2 to 23.9995 megacycles with any one of 20 preset channels available for use. Receiver and transmitter tuning is fully automatic.

NOTE (5)

- Certain transmitter frequencies may not be usable in some airplanes when operating on high power, but can be used for transmissions by switching to low power. The maximum number of frequencies incapable of high power transmissions is estimated to be approximately 4,000 out of a total of 44,000 frequencies available to the operator and will lie in the following ranges:
  - 5.3 to 6.3 megacycles
  - 10.5 to 12.2 megacycles
  - 16.5 to 18.2 megacycles
  - 22.5 to 24.0 megacycles

  The frequencies used for emergency transmission are not affected, nor is the receiver portion of the set.

- Undesired transmissions may sometimes occur on a limited number of frequencies as a result of the transmitter staying keyed after the microphone switch has been released. Inflight correction can be accomplished by pulling the "Antenna Coupler" circuit breaker located on the copilot's aft DC power panel or by changing channels and then returning to the channel on which the trouble was encountered.

The liaison radio is controlled by the copilot from a master panel located on the copilot's aft right sidewall and a subpanel on the copilot's left sidewall. A wire-type antenna (figure 4-21) for the liaison radio extends from the fuselage aft of the canopy to the leading edge of the vertical stabilizer. A safety disconnect is provided at the aft end of the antenna which automatically disconnects the antenna from the airplane if it breaks during flight. A lead-in extends from the antenna forward mast to the terminal on the right end of the automatic antenna coupler. This is a high voltage terminal electrically isolated by a large pressurized glass insulator. The coupler is located just below the A-5 indicator control panel aft of the copilot's seat (8, figure 4-34 and 8, figure 4-34A).

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* (1) AF 51-2357 thru 52-611
** (2) AF 51-2192 thru -2356, 52-612 & on
(3) AF 51-2192 thru -2356, 52-498 & on
(4) AF 52-498 thru -517
(5) AF 51-2192 thru -2356, 52-498 thru 53-1830, -2028 thru -2097, -2261 thru -2350

WARNING

Treat vicinity of the pressurized glass insulator with extreme care. An impact may cause the insulator to explode, exposing personnel to flying glass. The danger increases with altitude because of the greater pressure differential, particularly upon loss of cabin pressure.

On some airplanes★, a shield is installed in front of the antenna coupler to protect the coupler from damage and personnel from injury in the event of explosions. On some airplanes, the equipment uses DC power supplied through circuit breakers on the aft DC power panel, unregulated AC power supplied through a circuit breaker on the left alternator bus, and regulated AC power supplied through a circuit breaker on the main AC power shield. On other airplanes, the equipment uses DC power supplied through circuit breakers on the aft DC power panel and regulated AC power supplied through a circuit breaker on the radar power panel.

LIAISON RADIO CONTROLS

"TAKE" CONTROL KNOB. A two-position ON--OFF rotary knob (2, figure 4-15 and 2, figure 4-16), one on the liaison radio master panel and one on the liaison radio subpanel, is used to turn the equipment on and also to secure control of the equipment. When the "take" control knob on one panel is placed in ON position, the radio is energized and control is acquired at that panel. Turning the "take" control knob on the other panel to ON position will then secure control at that panel; the "take" control knob on the panel initially controlling the radio will automatically cycle to OFF position. Placing the "take" control knob on the operative panel in OFF position deenergizes the liaison radio.

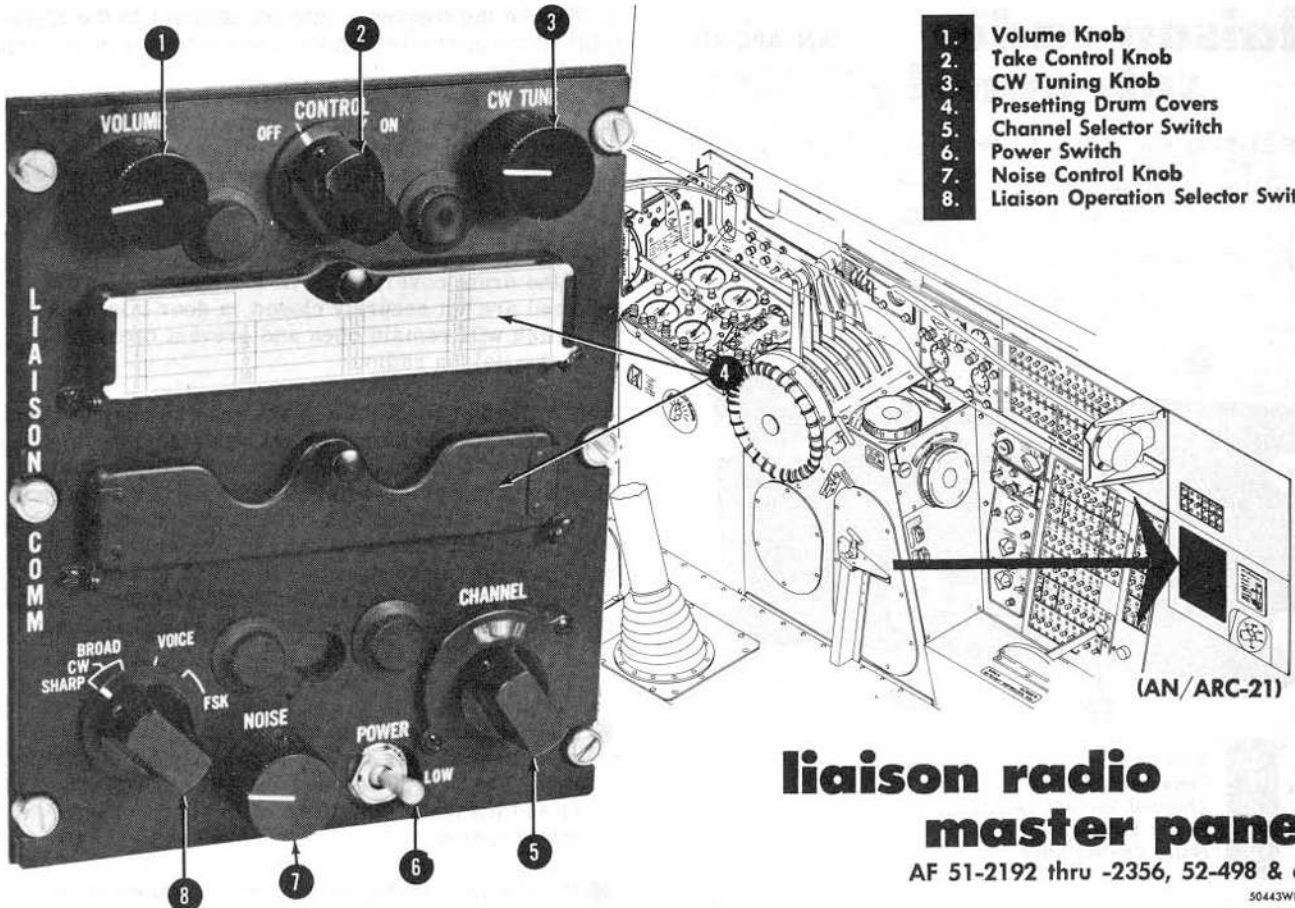
VOLUME KNOB. A volume knob (1, figure 4-15 and 1, figure 4-16) on both the master and subcontrol panels provides a means for adjusting the audio output during voice operation and signal sensitivity during CW operation from the liaison radio to the interphone or intercom system.

CHANNEL SELECTOR SWITCH. A channel selector switch (5, figure 4-15 and 3, figure 4-16) is located on both the master and subcontrol panels. This switch has channel positions numbered from 1 to 20 providing selection of any of the preset channel frequencies.

POWER SWITCH. A two-position switch (6, figure 4-15 and 4, figure 4-16) marked "Power" is located on both the master and subcontrol panels. The switch has HI--LOW positions and provides a means of selecting the power output in a 10 to 1 proportion. HI position will normally be used when maximum range transmissions are desired. LOW position is used when shorter range transmissions are desired.

★ AF 53-1831 thru -1972, -2104 thru -2170, 53-2351 & on

1. Volume Knob
2. Take Control Knob
3. CW Tuning Knob
4. Presetting Drum Covers
5. Channel Selector Switch
6. Power Switch
7. Noise Control Knob
8. Liaison Operation Selector Switch



liaison radio master panel

AF 51-2192 thru -2356, 52-498 & on

50443WB

Figure 4-15.

NOISE CONTROL KNOB. A knob (7, figure 4-15 and 5, figure 4-16) marked "Noise" is located on both the master and subcontrol panels. The knob allows adjustment of the background noise level of the receiver during voice operation. The knob should be adjusted for best reception of voice signals.

PRESETTING DRUMS. Two presetting drums located in the master control panel provide means for manually presetting the frequency of each channel as selected by the channel selector switch. Each drum is protected by a hinged cover (4, figure 4-15). A special tool for the presetting operation is stowed inside the top drum cover. A card mounted on the face of the top drum cover is used to record frequency values of each channel as the presetting operation is accomplished.

CW TUNING KNOB. A CW tuning knob (3, figure 4-15) on the master control panel is used to adjust the CW beat frequency.

LIAISON OPERATION SELECTOR SWITCH. A rotary-type selector switch (8, figure 4-15) located on the master control panel has CW SHARP--CW BROAD--VOICE--FSK positions and is used to select the type of liaison radio operation desired. CW SHARP position provides CW operation with a narrow band width to increase intelligibility of signals. CW BROAD provides CW operation with a 7 kilocycle band width for general operation. VOICE position allows voice transmission and reception of the liaison radio. FSK position is used for operation of the teletypewriter.

NOTE

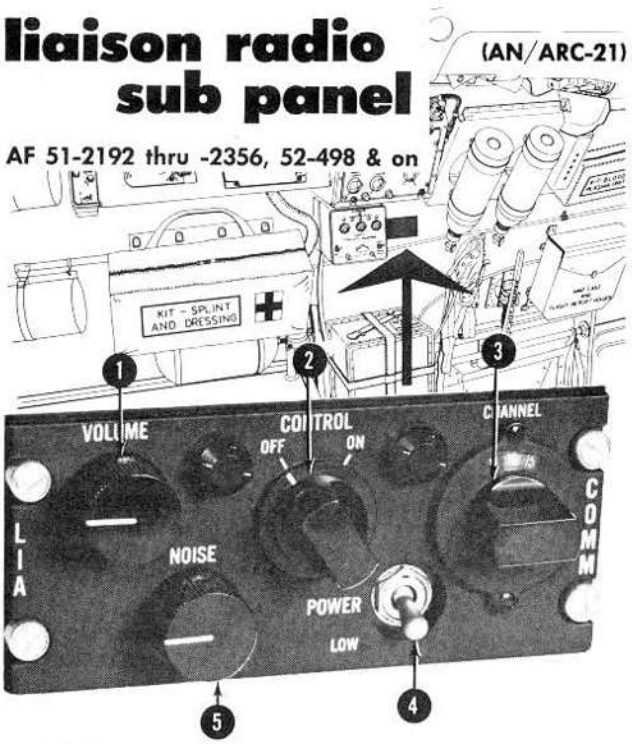
No provisions for CW or teletypewriter operation are installed in the present configuration.

NORMAL OPERATION OF LIAISON RADIO

FREQUENCY PRESETTING. The frequency presetting operation is accomplished on the master control

liaison radio sub panel (AN/ARC-21)

AF 51-2192 thru -2356, 52-498 & on



1. Volume Knob
2. Take Control Knob
3. Channel Selector Switch
4. Power Switch
5. Noise Control Knob

50444WB

Figure 4-16.

panel with the equipment turned off. Normally, all presetting operations will be performed before flight; however, if presetting during flight is necessary, the operation can be accomplished as follows:

a. Loosen the two screws holding the drum covers in position and open the covers.
b. Remove the presetting tool from the clip inside the top drum cover.
c. Place the channel selector switch to the number of the channel to be preset.
d. Using the presetting tool, move the four buttons, one at a time, to a position under the respective numbers. This is done by sliding the socket-end of the tool over the buttons and moving them along the drum to coincide with the desired numbers.
e. Move the top drum left-hand button to coincide with the figure representing thousands of kilocycles.
f. Move the top drum right-hand button to coincide with the figure representing hundreds of kilocycles.
g. Move the bottom drum left-hand button to coincide with the figure representing tens of kilocycles.
h. Move the bottom drum right-hand button to coincide with the figure representing units and halves of kilocycles.
i. Record the frequency just set adjacent to the applicable channel number on the card mounted on the top drum cover.
j. Turn the channel selector switch to the next channel number to be preset and repeat steps "d" through "i." Preset remaining channels in the same manner.
k. Close drum covers and retighten holding screws.

NOTE

If the drum cover doors on the master control panel are not securely closed, a door interlock switch will remain open and prevent operation of the liaison radio.

VOICE COMMUNICATION. The master control panel has controls necessary for all types of liaison radio operation while the subpanel has only those controls necessary for voice communication. Liaison radio voice communication can be accomplished on either control panel by the following procedure.

a. Place the intercom selector switch in LIA position to receive and transmit liaison radio signals.
b. Place the "take" control switch in ON position.

NOTE

- A 40-second period is required after turning on equipment before the radio is ready for operation. The first 30 seconds allow for tube warm-up and the remaining 10 seconds allow for automatic tuning.
- If automatic tuning is not accomplished in the normal 40-second period, the "take" control switch will go to OFF position and must be returned to ON position.

c. Turn the channel selector switch to the channel of the desired frequency and "rock" the knob slightly to feel the switch "click" into its seat. The channel in use will be shown by the middle figure in the selector window.
d. Rotate the liaison operation selector switch to VOICE position.
e. Place the power switch in HI or LOW position depending on desired range of transmissions.

NOTE

Should the air pressure within the equipment be reduced by leakage or other means, an aneroid switch will automatically shift the equipment to low power to reduce the possibility of electrical arcing within the equipment. There is no indication when this occurs.

f. Depress the mike switch to transmit and release to receive. Adjust the volume control for proper audio level and the noise control for a slight background noise in absence of signals. A sidetone will be heard in the headset when talking if the transmitter is on the air.

g. To transfer control of the radio from one panel to the other, turn the "take" control knob on the inoperative panel to ON position. The "take" control knob on the panel originally controlling the equipment will automatically cycle to OFF position.

NOTE

When the equipment is operating and control is changed from one panel to the other, the equipment will repeat the 40-second warmup cycle if the channel selector switch is not properly detented.

h. Turn the equipment off by rotating the "take" control knob on the operative panel to OFF position.

EMERGENCY OPERATION OF LIAISON RADIO

When a frequency selection cycle is not completed in the normal time interval, causing the "take" control switch to return to OFF position, a second try preferably on another channel is recommended. If tuning is normal, return to the initially selected channel.

Malfunction within the equipment is indicated by the "take" control knob moving to OFF position. If damage to the equipment is less important than getting the message through, transmission or reception can be resumed by holding the knob in ON position. If no sidetone is heard when attempting to transmit, the transmitter is not on the air.

RADIO COMPASS (AN/ARN-6)

A low frequency radio compass is provided as a navigational aid for the pilot. The radio compass may be used for automatic direction finding or as a homing device on any signal transmitted at a frequency from 100 to 1750 kilocycles. This installation is also used as a receiver for low frequency range reception. An azimuth indicator is located on the pilot's instrument panel and, on some airplanes, on both the pilot's and copilot's instrument panels. The controls are on the pilot's radio panel. The loop antenna is installed at the copilot's station and the sense antenna is incorporated in the upper arc of the canopy on some airplanes*. On other airplanes**, the loop antenna is installed in the forward auxiliary fuel cell door and the sense antenna is installed in the walkway on top of the fuselage. See figure 4-21 for antenna locations. The radio compass is operated by DC power supplied through a circuit breaker on the radar power panel.

NOTE

The radio compass should not be used as a navigational aid until the loop has been compensated.

RADIO COMPASS CONTROLS

RADIO COMPASS FUNCTION SWITCH. A function switch (17, figure 4-6) on the pilot's radio panel has OFF--COMP--ANT--LOOP--CONT positions. CONT position is inoperative since this installation contains only one control panel. OFF position of the switch turns the equipment off. COMP position of the switch provides homing and automatic direction finding operation. ANT position of the switch connects the sense antenna to the receiver for receiver operation only. LOOP position of the switch is used for aural-null direction finding and receiver operation.

RADIO COMPASS LOOP SWITCH. A loop switch (8, figure 4-6) on the pilot's radio panel has L and R positions. These positions have reference to the direction of rotation of the loop antenna. Both L and R positions of the switch are spring-loaded, and must be held in the desired position until the aural-null position finding operation is complete.

RADIO COMPASS TUNING CRANK. A tuning crank (15, figure 4-6) on the pilot's radio panel selects the desired station, the frequency of which is indicated on the calibrated dial.

RADIO COMPASS LIGHT SWITCH. An indicator light control switch on the pilot's radio panel is provided with HI--OFF--LO positions (9, figure 4-6). HI and LO positions vary the indicator light intensity. OFF position turns off the lights.

RADIO COMPASS BAND SWITCH. A band switch on the pilot's radio panel (10, figure 4-6) selects any one of four receiver operating band of frequencies. The switch positions are 100 to 200 kilocycles, 200 to 410 kilocycles, 410 to 850 kilocycles, and 850 to 1750 kilocycles. When a band is selected, the dial calibration is selected accordingly.

RADIO COMPASS VOLUME KNOB. A volume knob on the pilot's radio panel (11, figure 4-6) is provided as a means for adjustment of the audio level to the interphone system.

RADIO COMPASS MODULATION SWITCH. A switch with CW-VOICE positions on the pilot's radio panel (12, figure 4-6) will select either code or voice reception.

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* AF 51-2192 thru 52-564
** AF 52-565 & on

RADIO COMPASS INDICATORS

RADIO COMPASS TUNING METER. A tuning meter (18, figure 4-6) is provided on the pilot's radio panel to indicate maximum signal indication during the process of tuning in a station.

RADIO COMPASS FREQUENCY DIAL. A dial scale (16, figure 4-6) on the pilot's radio panel shows the frequency to which the radio compass is tuned.

RADIO MAGNETIC INDICATOR. The ID-250 radio magnetic indicator (RMI) (8, figure 1-8 and 6, figure 1-9) on the pilot's instrument panel, used with the omnirange receiver and the AN/ARA-25 direction finder group, is also the indicator for the radio compass. On some airplanes*, an additional ID-250 radio magnetic indicator is located on the copilot's instrument panel (2, figure 1-19A). The indicator receives heading reference information from the N-1 compass system with the result that the circular compass card rotates so that the heading of the airplane will always be under the reference index at the top of the instrument. The No. 1 pointer is the azimuth indicator for the radio compass and indicates the direction to the bearing station from the airplane as measured from magnetic north when the N-1 compass system is in magnetic slaved operational mode or measured from the preselected gyro heading datum when the N-1 system is in directional gyro mode.

NOTE

When the N-1 compass system is inoperative, as shown by the N-1 compass inoperative light being illuminated, the compass card rotates to read zero degrees and the No. 1 pointer will indicate radio bearings as measured from the airplane heading.

NORMAL OPERATION OF RADIO COMPASS

The radio compass is made operative by the following procedure:

a. Place the function switch on ANT position.

NOTE

This avoids the possibility of the loop being on a "null" position and avoids damage caused by loop homing on various stations as a selected station is tuned in.

b. Place the appropriate interphone or intercom controls to the desired positions for audio-reception of the radio compass receiver. (See "Interphone System" or "Intercommunication System," this section.)

NOTE

(1)
Excessive noise may be experienced during reception of the radio compass when the oxygen warning light (1, figure 4-34) in the gunner's station is on "steady bright" or "bright blinking" cycle. This radio noise can be eliminated by the copilot placing his individual oxygen warning system switch to OFF or taking measures to return his oxygen system warning light to "steady dim" cycle. (See "Oxygen System," this section.)

c. Select desired frequency band and use tuning crank to tune station and obtain maximum swing of tuning meter.

d. Place function switch in desired (type of operation) position.

e. Turn off equipment by placing function switch in OFF position.

EMERGENCY OPERATION OF RADIO COMPASS

(1)
In the event of failure of the ID-250 indicator or indicator circuits, which prevent a compass reading, bearings may be taken from the azimuth scale at the bottom of the loop assembly. These readings however will only indicate direction to the station as measured from the airplane heading.

(2)
Emergency operating procedure does not differ from normal operating procedure.

DIRECTION FINDER GROUP (AN/ARA-25) (3)

The direction finder group is provided to indicate the relative bearing of and to "home" on radio signals (amplitude modulated or unmodulated) in the frequency range of 225 to 400 megacycles. The signals are received by the AN/ARC-27 command radio set using the direction finder group antenna. The group is controlled from the pilot's command radio panel by means of the command operation switch. The ID-250 radio magnetic indicator, on the pilot's and on some airplanes*, the copilot's instrument panel, used with the radio compass and the omni-range receiver is also the indicator for the AN/ARA-25 direction finder group. The bearing of the signal source relative to the airplane heading is indicated by the No. 1 pointer on the ID-250 radio magnetic indicator. The direction finder group receives DC power through a circuit breaker on the left aft power shield.

* AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on
(1) AF 51-2192 thru 52-564
(2) AF 52-565 & on
(3) AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on

NORMAL OPERATION OF DIRECTION FINDER GROUP

The direction finder group (AN/ARA-25) is made operative by the following procedure.

a. Rotate pilot's command operation switch to the ADF position.

b. Select the desired frequency with the UHF remote channel selector switch.

c. Allow 3 minutes warm up period if the command radio operation switch was in the OFF position.

d. If the direction finder group is being used for "homing," fly the airplane to keep the single bar pointer of the course indicator ID-250 under the reference index at the top of the instrument.

e. If the direction finder group is being used for direction finding observe the direction of signal arrival (relative bearing of source) as indicated on the azimuth scale under the arrow of the single bar of the course indicator.

f. Turn off the equipment by placing the operation switch in the OFF position. This will turn off the direction finder group AN/ARA-25 and also the command radio AN/ARC-27. Stand-by operation of the direction finder group is achieved by placing the operation switch in the T/R or T/R + G REC position.

LOCALIZER AND OMNI-RANGE RECEIVER (AN/ARN-14)

A localizer and omni-range receiver provides navigation information and comprises a portion of the instrument low-approach system (ILS) as discussed in section IX. An ID-249 course indicator and an ID-250 radio magnetic indicator are provided on the pilot's instrument panel and on some airplanes★ on the copilot's instrument panel. The ID-249 indicator provides visual course and heading indication with respect to the localizer beam or selected omni-bearing. If a localizer or omni-range signal is being received, a small warning flag at the end of the vertical bar will disappear from view to provide positive indication of station reception. The radio magnetic indicator (ID-250) indicates bearing to the omni-station. The receiver (DC operated) utilizes the interphone system to distribute received audio signals to the crew. The localizer and omni-range panel is located on the pilot's radio panel (figure 4-6).

LOCALIZER AND OMNI-RANGE RECEIVER CONTROLS

LOCALIZER AND OMNI-RANGE FREQUENCY SELECTOR SWITCH. A large and a small frequency selector switch (19, figure 4-6) located on the pilot's radio panel provide a manual means for tuning the localizer and 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 glide path receiver will automatically be tuned to the proper glide path channel when the selectors are turned to a selected localizer frequency. The frequency selectors may be rotated either clockwise or counterclockwise.

LOCALIZER AND OMNI-RANGE POWER SWITCH. The receiver is turned on and off by a switch (21, figure 4-6) on the pilot's radio control panel, which has three positions, ON TONE--OFF--PHASE. ON TONE position of the switch provides operation of the tone comparison localizer and omni-range operation, OFF position turns off the equipment. PHASE position is not used.

(1)

On some airplanes, this same switch is replaced by a two-position ON--OFF switch having same functions.

LOCALIZER AND OMNI-RANGE VOLUME KNOB. A volume knob (20, figure 4-6) is provided on the pilot's radio panel and is used to adjust the receiver audio to the interphone or intercom system.

ID-249 COURSE SELECTOR TRANSFER SWITCH. Two-position toggle switches (47, figure 1-9 and 29, figure 1-19A) are located on the pilot's and the copilot's instrument panels and are identified "ID-249 Course Selector." Moving either switch to its opposite position transfers control of bearing selection from the course set knob of the ID-249 indicator on one instrument panel to the course set knob of the ID-249 on the other instrument panel. A green indicator light above each switch will glow when control of bearing selection is at the course set knob of the ID-249 on that instrument panel.

COURSE SET KNOB. A course set knob located on the ID-249 course indicator (14, figure 1-8 and 10, figure 1-9) is used to set the magnetic bearing of a desired course on three tab indicators.

LOCALIZER AND OMNI-RANGE RECEIVER INDICATORS

ID-249 COURSE INDICATOR. The ID-249 course indicator is a composite display of VHF navigation information. An ID-249 indicator (14, figure 1-8; 10, figure 1-9; and 22, figure 1-19A) is located on the pilot's instrument panel and, on some airplanes★, on the copilot's instrument panel. Localizer beam or omni-range station relationship to the airplane position is shown by information in tab windows and movement of a vertical bar. A horizontal bar shows information from a glidepath receiver. The two bars remain parallel to their rest positions and are always at right angles to each other. A heading pointer shows

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★ AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on

(1) AF 52-082 thru -201, -261 thru -393, -432 & on

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. An amber indicator light at the upper right hand corner shows information from a marker beacon receiver. Magnetic bearing selection is controlled by the course set knob and indicated in the "Course" window. On some airplanes*, bearing selection is controlled by the ID-249 course set knob on the instrument panel on which the green ID-249 course selector indicator light glows; however, the vertical bars of both ID-249's will indicate with reference to the course selected on the one with the operative set knob. 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 or the desired inbound bearing of the localizer beam when flying the localizer. 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 set knob is TO or FROM the omni-range station. The "To-From" window will show blank during localizer operation or upon failure of an omni-range signal during omni-range operation. A warning flag at the bottom of the indicator will move out of sight when a localizer or omni-range signal of dependable strength is being received.

NOTE

- The ID-249 heading pointer receives heading reference information from the N-1 compass system and will only perform the above functions when the N-1 compass system is operating in the magnetic slaved operational mode. When the N-1 system is in directional gyro operational mode the heading pointer will give only heading referenced to a preselected gyro datum and will be of no use for localizer and omni-range operations unless synchronized with magnetic compass data.
- When the N-1 compass system is inoperative, as indicated by the N-1 compass inoperative light being illuminated, the ID-249 heading pointer will be driven to and remain at the vertical index.

ID-249 COURSE SELECTOR INDICATOR LIGHT. Green lights (48, figure 1-9 and 29, figure 1-19A) are located on the pilot's and the copilot's instrument panels just above the associated ID-249 course selector transfer switch. One light or the other will glow whenever the ARN-14 localizer and omni-range receiver is operating. The light glowing indicates that the ID-249 course set knob on that instrument panel has control of bearing selection. When either course selector transfer switch is actuated, the light previously glowing goes out and the other one goes on indicating the transfer of bearing selection to the other instrument panel.

ID-250 RADIO MAGNETIC INDICATOR. The ID-250 radio magnetic indicator (RMI) is a composite display of airplane heading, radio compass (ADF) station bearing, and omni-range station bearing. An ID-250 RMI (8, figure 1-8; 6, figure 1-9; and 2, figure 1-19A) is located on the pilot's instrument panel and, on some airplanes*, on the copilot's instrument panel. The indicator receives heading reference information from the N-1 compass with the result that the circular compass card rotates so that the heading of the airplane will always be under the reference index at the top of instrument. The No. 2 pointer is the azimuth indicator for the omni-range receiver and indicates the direction to the omni-station from the airplane as measured from north when the N-1 compass system is in magnetic slaved operational mode or measured from the preselected gyro heading datum when the N-1 system is in directional gyro mode.

NOTE

When the N-1 compass system is inoperative, as shown by the N-1 compass inoperative light being illuminated, the compass card rotates to read zero degrees and the No. 2 pointer will indicate omni-bearings as measured from the airplane heading.

NORMAL OPERATION OF LOCALIZER AND OMNI-RANGE RECEIVER.

The localizer or omni-range receiver is made operative by placing the power switch in ON TONE (ON) position, and inoperative by placing the power switch in OFF position.

(1)

Bearing selection by an ID-249 indicator course set knob depends upon the course selector transfer switch position as indicated by the course selector indicator light being on.

EMERGENCY OPERATION OF LOCALIZER AND OMNI-RANGE RECEIVER

In the event of failure of the C-1 amplifier, magnetic heading indication, omni-directional indication, directional indication from the direction finder group AN/ARA-25, and radio compass indication from the radio magnetic indicator (RMI) (ID-250) will not be available. Such a failure will prevent heading reference information from feeding into the ID-250 indicator which will cause an erratic reading of the compass card. Consequently, the No. 1 and No. 2 pointers will not give correct readings even though they are receiving information from the localizer and omni-range (AN/ARN-14), radio compass (AN/ARN-6), or the direction finder group (AN/ARA-25) receivers.

*(1) AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on

Under the above conditions, course information from the omni-directional range radio may be obtained from the course indicator (ID-249) by rotating the counter knob on the indicator until the vertical cross-pointer is centered. Directional information is then obtained by observing the TO-FROM indicator and the counter reading.

GLIDE PATH RECEIVER (AN/ARN-18)

A glide path receiver utilizes a ground station signal to comprise a portion of the ILS. Glide path signals are also used by the automatic pilot during an automatic approach. (See "Automatic Approach," section IX.) On-off control and frequency selection of the glide path receiver are automatically accomplished by operation of the localizer and omni-range power switch and frequency selector. See figure 4-21 for antenna location. The equipment receives DC power through a circuit breaker on the radar power panel.

(1)

On airplanes which do not have T.O. 1B-47-333 accomplished, the glide path receiver also uses unregulated AC power supplied through a circuit breaker on the radar power panel.

(2)

The glide path receiver also uses regulated AC power, from the main inverter bus on some airplanes or from the constant speed alternators on other airplanes, supplied through a circuit breaker on the radar power panel.

GLIDE PATH RECEIVER INDICATOR

A glide path horizontal needle in the ID-249 indicator (14, figure 1-8 and 10, figure 1-9) provides indication of airplane position relative to the glide path beam. The horizontal needle will be centered on the indicator if the airplane is flying on the beam during an approach. A warning flag on the left side of the indicator moves out of sight when a glide path signal is being received.

NORMAL OPERATION OF GLIDE PATH RECEIVER

The glide path receiver is automatically turned on and off for operation by means of the localizer and omni-range power switch (21, figure 4-6) and will operate when DC power is on in the airplane and when the appropriate AC power is available.

NOTE

(1)

On airplanes which do not have T.O. 1B-47-333 accomplished, operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is required for glide path receiver operation.

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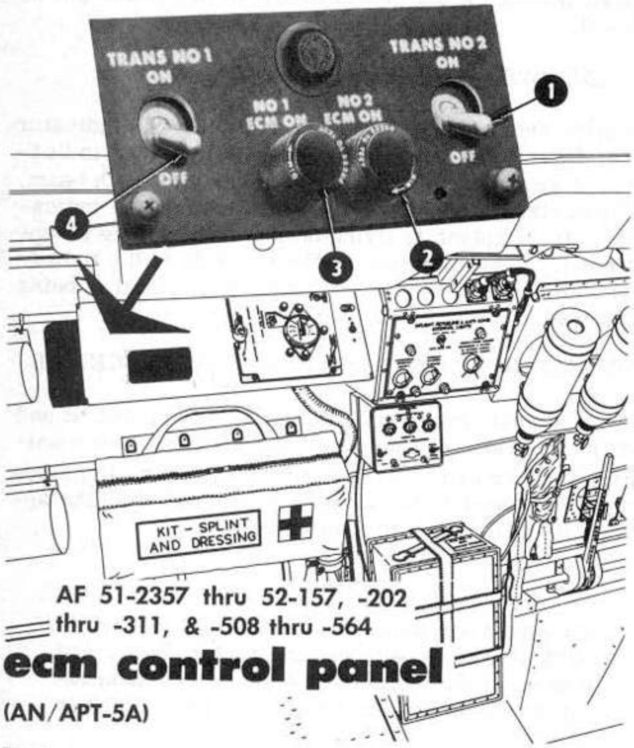
(1) AF 51-2357 thru 52-111, -202 thru -292
(2) Airplanes which have T. O. 1B-47-333 accomplished and AF 51-2192 thru -2356, 52-112 thru -201, 293 & on



AF 51-2357 thru 52-157, -202 thru -311, & -508 thru -564

ecm control panel

(AN/APT-5A)

1. ECM Transmitter No. 2 Power Switch
2. Transmitter No. 2 On Indicator Light
3. Transmitter No. 1 On Indicator Light
4. ECM Transmitter No. 1 Power Switch

50413WC

Figure 4-17.

EMERGENCY OPERATION OF GLIDE PATH RECEIVER

Emergency operation does not differ from normal operating procedure.

MARKER BEACON RADIO (AN/ARN-12)

A marker beacon receiver is used as a navigational and landing aid. When flying over a beacon, the signal may be heard through the interphone or intercommunication system and is shown visually by an amber marker beacon indicator light installed on the ID-249 indicator (14, figure 1-8 and 10, figure 1-9) located on the pilot's instrument panel. The receiver is automatically operated by DC power and will operate continuously as long as power is available on the DC power distribution system.

ECM (AN/APT-5A) (1)

AN/APT-5A noise modulated transmitting equipment is utilized to jam enemy radar signals. The equipment is used only in flight for tactical purposes. An ECM control panel, located on the copilot's right sidewall on early airplanes and on the left sidewall on later airplanes, allows the copilot to operate two different jamming transmitters. A circuit breaker on the radar power panel provides protection for the control circuits.

ECM CONTROLS

TRANSMITTER POWER SWITCHES. Two transmitter switches (1 and 4, figure 4-17) are provided on the ECM control panel. Both switches have ON and OFF positions to turn on and off two respective ECM transmitters.

ECM INDICATORS

TRANSMITTER INDICATOR LIGHTS. An amber indicator light (2 and 3, figure 4-17) is provided for each transmitter power switch. If transmitters No. 1 and 2 are operating, its respective indicator light will illuminate.

NORMAL OPERATION OF ECM TRANSMITTERS

NOTE

Operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is necessary for ECM operation.

The ECM transmitters are made operative and inoperative by the following procedure:

a. Place the ECM transmitter power switches in ON position. After a delay of 2 minutes, the transmitters will be operative. The amber indicator light or lights will illuminate.

b. To turn off the equipment, place the power switches in OFF position. The amber indicator light or lights will go out.

EMERGENCY OPERATION OF ECM TRANSMITTERS

The equipment operating frequency is preset prior to flight for operation at a desired frequency. The power switch must be placed in ON position a few minutes before operation of the equipment is desired.

(1) AF 51-2357 thru 52-157, -202 thru -311, -508 thru -564

ECM TRANSMITTERS (NO. 1 & 2) **(1)**

Two transmitters are installed in the ECM compartment in various configurations (see "Table of Communication and Associated Electronic Equipment," figure 4-5) for jamming enemy radar. Refer to figure 4-21A for antenna locations. The ECM transmitter control panel located on the copilot's left sidewall provides control of the No. 1 and 2 ECM transmitters. Circuit breakers on the radar power panel provide protection for the control circuits. On some airplanes the transmitters use DC power, regulated AC power from the secondary inverter bus, or unregulated AC power from the left alternator bus; on other airplanes they use DC power and regulated AC power from the constant speed alternators. Power use is dependent on the type of transmitters installed.

NOTE **(2)**

When the ECM capsule is installed the ECM control panel at the copilot's station will be inoperative.

ECM TRANSMITTER CONTROLS

ECM TRANSMITTER CONTROL SWITCHES. Two four-position rotary switches on the No. 1 and 2 ECM transmitter control panel are marked OFF--STANDBY--TRANSMIT--RESET. The OFF position deenergizes the equipment. STANDBY position provides warmup voltage to the transmitter. The TRANSMIT position provides operation of the transmitter. The momentary RESET position resets the overload circuit.

ECM TRANSMITTER INDICATORS

ECM TRANSMITTER OPERATION INDICATOR LIGHTS. Two green lights on the No. 1 and 2 ECM transmitter control panel are marked "Reset No. 1" and "Reset No. 2." The indicator light will illuminate when its respective transmitter is operating.

NORMAL OPERATION OF ECM TRANSMITTERS

The ECM transmitters are made operative and inoperative by the following procedure:

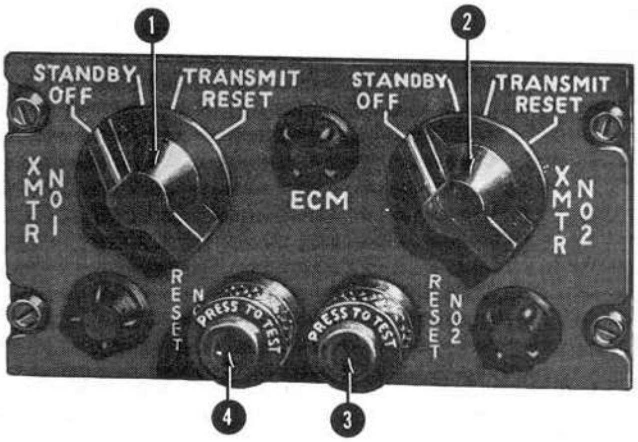
a. Place the ECM transmitter control switch on the ECM transmitter control panel to STANDBY position. Allow 5 minutes for warmup and the transmitter will be ready for instantaneous transmission.

b. Place the ECM transmitter control switch to the TRANSMIT position; the green light should illuminate and the transmitter should transmit.

c. Turn off the transmitters by placing the ECM transmitter control switch in OFF position; the indicator light will go out.

ecm control panel (No. 1 & 2)

AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -507, -565 & on



1. ECM Transmitter No. 1 Control Switch
2. ECM Transmitter No. 2 Control Switch
3. ECM Transmitter No. 2 Indicator Light
4. ECM Transmitter No. 1 Indicator Light

50449 WC

Figure 4-17A.

EMERGENCY OPERATION OF ECM TRANSMITTERS

Should the ECM transmitter indicator light go out during normal operation, place the transmitter control switch in RESET position for approximately 5 seconds. The ECM transmitter indicator light should illuminate when the ECM transmitter control switch is in RESET position. After the 5-second interval, the ECM transmitter indicator light should continue to illuminate with the ECM transmitter control switch in TRANSMIT position. If the indicator light fails to illuminate, check that appropriate electrical power is available. If power loss was evident, repeat the above procedure after obtaining power; if power is available and the light fails to illuminate, turn the malfunctioning transmitter off.

CAUTION

Do not hold the ECM transmitter control switch in RESET position for more than approximately 5 seconds as damage to the equipment may result.

(1) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -507, -565 & on
(2) AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

The transmitter control switch may be held in RESET position in a tactical emergency although serious damage to the equipment may result.

RADAR WARNING SYSTEM (AN/APS-54) (1)

Provisions for radar warning system are installed which will receive radar signals. Indicators are located on the copilot's instrument panel and controls aft of the copilot. A DC circuit breaker on the lower DC power panel and an AC circuit breaker on the main AC power shield on some airplanes * and on the radar power panel on other airplanes ** provide circuit protection of the equipment.

CHAFF DISPENSER SYSTEMS (AN/ALE-1) (1)

Provisions for two chaff dispenser systems, which provide for confusing enemy radar, are installed in the ECM compartments on each side of the fuselage at the rear wheel well. Controls for the chaff dispenser systems are located on the copilot's left sidewall. The equipment is DC operated. Two circuit breakers on the aft DC power panel provide protection for the control circuits.

NOTE (2)

Due to an improper circuit breaker in both the left and right aft power shields, the chaff dispenser systems are inoperative.

IFF (AN/APX-6)

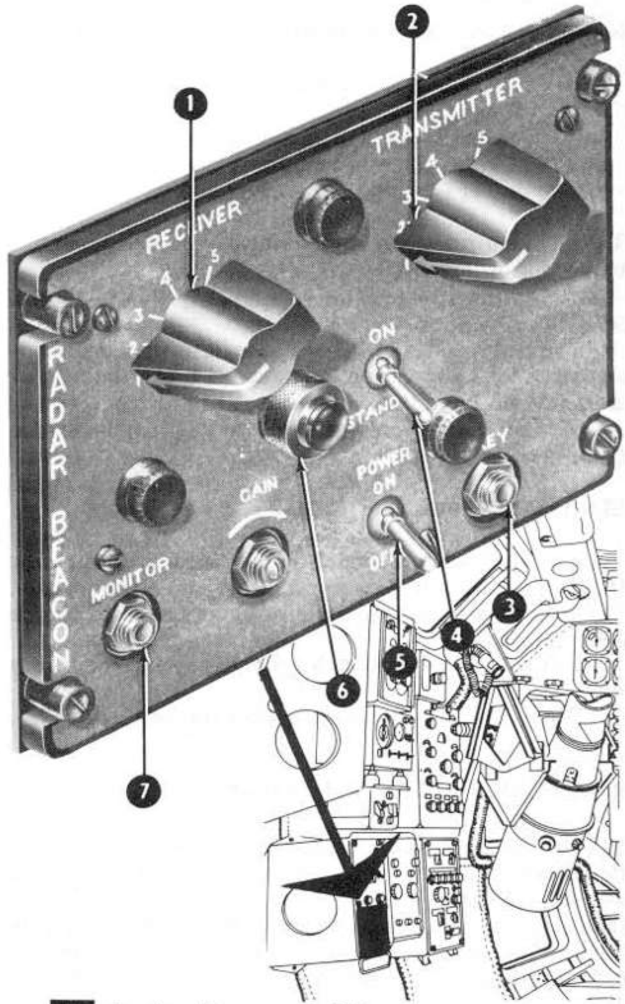
A radar transponder provides electronic identification and recognition between plane and plane (or planes) and plane and ground. Circuit breakers in the tail compartment relay shield provide circuit protection for the equipment. All controls are located on the pilot's radio panel (figure 4-6).

IFF CONTROLS (3)

IFF DESTRUCT SWITCH. An IFF destruct switch (13, figure 4-6) is provided to destroy the equipment prior to abandoning the airplane. A switch guard is safety wired to prevent inadvertent operation.

NOTE (4)

An impact switch is provided in the system for automatic destruction of the equipment.



1. Receiver Frequency Switch
2. Transmitter Frequency Switch
3. Key Jack
4. Receiver Standby Switch
5. Master Power Switch
6. AC Power Indicator Light
7. Monitor Jack

(AN/APN-76)

rendezvous radar control panel

50412WA

Figure 4-18.

(1) AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
(2) AF 51-2192 thru -2356, 52-190 thru -201, -363 thru -393, -509, -612 thru 53-1853, -2028 thru -2103, -2261 thru -2340 which do not have T.O. 1B-47-729 accomplished
(3) AF 51-2192 thru 52-620, 53-2261 thru -2289
(4) AF 51-2192 thru 52-058, -202 thru -231, -394 thru -440
* AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -1416, -3343 thru -3373, 53-2261 thru -2278
** AF 52-1417, 53-1819 thru -2170, -2279 & on

NORMAL OPERATION OF IFF

NOTE

(1)
Operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is necessary for IFF operation.

The IFF equipment is made operative and inoperative by the following procedure:

a. Place the IFF master switch (14, figure 4-6) in STBY position.
b. Further settings of the IFF master switch and mode switches will depend on the tactical situation and/or instructions from the communications officer.
c. To turn off the equipment, place IFF master switch in OFF position.

EMERGENCY OPERATION OF IFF

The destruct switch should be operated only when the IFF equipment is in danger of falling into enemy hands. The following manual procedure should be used to fire destructors:

a. Lift destructor switch guard by breaking the safety wire.
b. Place toggle switch in forward (or on) position.

RENDEZVOUS RADAR (AN/APN-76)

The AN/APN-76 radar equipment is used as a navigational aid to air refueling. The equipment consists of an SB-215/APN-76A control panel, (figure 4-18) a transponder, and two antennas. The control panel is located on the observer's left sidewall. The transponder is located in the upper radar compartment. The receiving antenna is mounted on the fuselage bottom centerline forward of the aft landing gear. The transmitting antenna is installed on the fuselage bottom centerline forward of the forward landing gear. (See figure 4-21.) On some airplanes, the rendezvous radar equipment uses DC power and unregulated AC power from the left alternator bus supplied through circuit breakers on the radar power panel. On other airplanes, the equipment uses DC power and regulated AC power from the constant speed alternators, both supplied through circuit breakers on the radar power panel.

RENDEZVOUS RADAR CONTROLS

MASTER POWER SWITCH. A power switch (5, figure 4-18) on the control panel has ON--OFF positions. ON position of the switch supplies power to the rendezvous radar equipment. OFF position removes power from the equipment.

RECEIVER STANDBY SWITCH. A receiver standby switch (4, figure 4-18) on the control panel has ON--STANDBY positions. If the master power switch is on, placing the receiver standby switch in the STANDBY position makes the receiver ready for instant use but inoperative. Placing the receiver standby switch in the ON position renders the receiver in normal operating condition.

TRANSMITTER FREQUENCY SWITCH. A transmitter frequency switch (2, figure 4-18) on the SB-215/APN-76A control panel has channel positions 1 through 8. The transmitter switch positions are the same frequency as those of the receiver frequency switch.

NOTE

Because of antenna frequency limitations, channels 1, 2, and 3 of the transmitter and receiver should not be used.

(2)
Due to a deficiency in the transmitter, it may be impossible to tune one channel (which channel cannot be determined in advance). Inability to tune the one channel results in non-use of that channel only and does not otherwise impair utilization of the other four channels.

RECEIVER FREQUENCY SWITCH. A receiver frequency switch (1, figure 4-18) on the control panel has channel positions 1 through 8. The receiver switch positions are the same frequency as those of the transmitter frequency switch.

KEY JACK. A key jack (3, figure 4-18) on the control panel is used to connect an external key to the transmitter for manual keying.

MONITOR JACK. A monitor jack (6, figure 4-18) on the control panel provides a headphone connection to allow monitoring of the equipment during operation.

RENDEZVOUS RADAR INDICATORS

AC POWER INDICATOR LIGHT. An amber indicator light (6, figure 4-18), located on the control panel, will illuminate when unregulated AC power is available for the equipment.

NORMAL OPERATION OF AN/APN-76 RENDEZVOUS RADAR

NOTE

(1)
Operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is necessary for rendezvous radar operation.

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(1) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2) AF 51-17384 thru 52-157, -202 thru -330, -394 thru -488

The radar equipment is made operative and inoperative by the following procedure:

a. Place the master power switch in ON position.

b. Allow approximately 3 minutes for warmup and place the receiver standby switch in ON position.

c. To make inoperative, place the master power switch in OFF position and the receiver standby switch in STANDBY.

EMERGENCY OPERATION OF AN/APN-76 RENDEZVOUS RADAR

No special emergency operating procedures are provided other than manual keying of the transmitter.

GUN-LAYING RADAR (AN/APG-32) (1)

Gun-laying radar is used to direct the tail turret. Controls and indicators for the radar and turret equipment are installed at the gunnery station. On some airplanes, the system uses DC power, supplied through circuit breakers on the lower DC power panel; regulated AC power from the A-5 or MD-4 bus, supplied through a circuit breaker on the main AC power shield; and regulated AC power, supplied through a circuit breaker in the left alternator power shield and on the control panels for the fire control system. On other airplanes, the system uses DC power, supplied through circuit breakers on the lower DC power panel and regulated AC power from the constant speed alternators, supplied through circuit breakers in the tail compartment power shield. See figure 1-34 for circuit breaker location. An air system is installed to pressurize the modulator, RF head, and wave guide. The air storage tanks must be replenished prior to each mission. See figure 1-54 for servicing information. Refer to "Fire Control System," this section, for further discussion of the gun-laying radar system.

RADAR BOMBING-NAVIGATION SYSTEM

A radar bombing-navigation system (BNS) provides automatic computation for bombing and navigation. See "Table of Communications and Associated Electronic Equipment" for components. Main operating controls are located at the observer's station. A data indicator (9, figure 1-8 and 17, figure 1-9) is located on the pilot's instrument panel, and three data indicators (5, 9, and 10, figure 4-30) are located on the observer's instrument panel. On some airplanes★ a red warning light on the observer's lighting panel marked "K-4 Inverter Power Off" will glow when either the "A" or "C" phase of the three-phase "K" inverter fails.

(2)

The radar BNS uses power from the DC distribution system, regulated single-phase AC power from the main inverter bus, unregulated single-phase AC from the right unregulated AC bus, and regulated three-phase AC from the three-phase radar power bus for the BNS gyros. Circuit breakers are located on the lower DC power panel, radar power panel, and right alternator power shield (figure 1-29).

(3)

The radar BNS uses power from the DC distribution system, and single-phase and three-phase AC power from the constant speed alternators. Circuit breakers are located on the lower DC power panel and on the radar power panel (figure 1-29).

RADAR COMPONENT HEATING SYSTEM

Heaters are provided to maintain operating temperatures of BNS components. The heaters on equipment located within the pressurized section are controlled by a switch marked "Cockpit Area" while those on other equipment are controlled by a switch marked "Radar Compt." Both switches are located on observer's lighting control panel (15, figure 4-28) and have three positions, decaled NORMAL--OFF--PREHEAT. NORMAL position provides for automatic control of the heaters through the radar bombing-navigation system. OFF position turns off power to the heaters. PREHEAT position provides connections which allow preheating the equipment before operating the radar BNS.

(2)

The heaters use unregulated single-phase AC from the right unregulated AC bus. Circuit breakers are on the radar power panel.

(3)

The heaters use regulated AC power from phase A of the constant speed alternators with circuit breakers on the radar power panel.

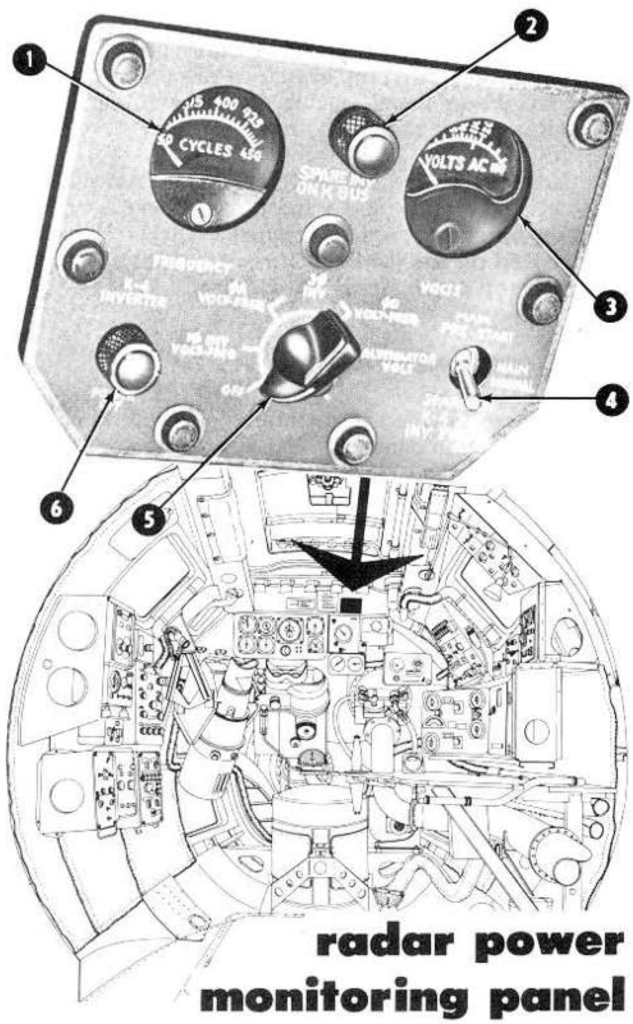
RADAR POWER MONITORING SYSTEM (4)

A radar power monitoring panel (figure 4-19 and 8, figure 4-28) near the observer's instrument panel provides meters and connections for checking AC power supplies to radar BNS equipment before and during BNS operation. On some airplanes★★ equipped with a radar power monitoring panel, the spare instrument inverter is made available as a spare source of three-phase power for the radar BNS in order to permit completion of a mission should failure of main "K" inverter occur.

RADAR POWER MONITORING SYSTEM CONTROLS

RADAR POWER MONITOR SELECTOR SWITCH. A five-position rotary selector switch (5, figure 4-19) is installed on the radar power monitoring panel and

(1) AF 51-2192 thru -2356, -2358, -2360, -2361, -2363 thru -2399, -2401 thru -2409, -2411 & on
(2) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(3) AF 52-1417, 53-1819 thru -2170, -2279 & on
(4) AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278
★ AF 51-2357 thru 52-081, -202 thru -235
★★ AF 52-363 thru -393, -574 thru -620, -3343 thru -3373, 53-2261 thru -2278



radar power monitoring panel

AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278

1. Frequency Meter
2. Spare-Inverter-on-K-Bus Indicator Light (1)▶
3. Voltmeter
4. Three-Phase Inverter Switch
5. Radar Power Monitor Selector Switch
6. "K" System Inverter Warning Light

(1)▶ AF 52-363 thru -393, -574 thru -620, -3343 thru -3373, 53-2261 thru -2278

50437WB

Figure 4-19

permits checking power condition of the regulated AC system, "K" system three-phase inverter, and the unregulated AC system. The switch has OFF--1Ø INV VOLT-FREQ--3Ø INV ØA VOLT-FREQ--3Ø INV ØC VOLT-FREQ--ALTERNATOR VOLT positions. OFF position deenergizes the frequency meter and voltmeter. 1Ø INV VOLT-FREQ position connects the frequency meter and voltmeter to the main regulated AC power bus. 3Ø INV ØA VOLT-FREQ position connects frequency meter and voltmeter to the "A" phase of the "K" system inverter. 3Ø INV ØC VOLT-FREQ position connects frequency meter and voltmeter to the "C" phase of the "K" system inverter. ALTERNATOR VOLT position connects only the voltmeter to the right alternator power bus. On some airplanes, the radar power monitor selector switch position 3Ø INV ØC VOLT-FREQ is incorrectly identified 3Ø INV ØB (phase "B" is ground). Operation is unaffected.

THREE-PHASE INVERTER SWITCH. An ON--OFF "K" system three-phase inverter switch (4, figure 4-19) is located on the radar power monitoring panel. With the switch in ON position, the three-phase inverter can be operated and tested without turning on the "K" radar equipment. With switch in OFF position, control of three-phase inverter is within the "K" system. On some airplanes *, the on-off positions are identified MAIN PRE-START--MAIN NORMAL, with function unchanged; and a third position, SPARE ON, is incorporated to provide connections for energizing the "K" system from the spare instrument inverter. Refer to figure 1-29.

RADAR POWER MONITORING SYSTEM INDICATORS

"K" SYSTEM INVERTER WARNING LIGHT. A red warning light (6, figure 4-19) located on the radar power monitoring panel identified "K-4 Inverter Power Off" will be illuminated when three-phase power is off the "K" bus for any reason, including failure of one of the phases of the inverter connected to the bus. The light is extinguished when three-phase power is on the "K" bus.

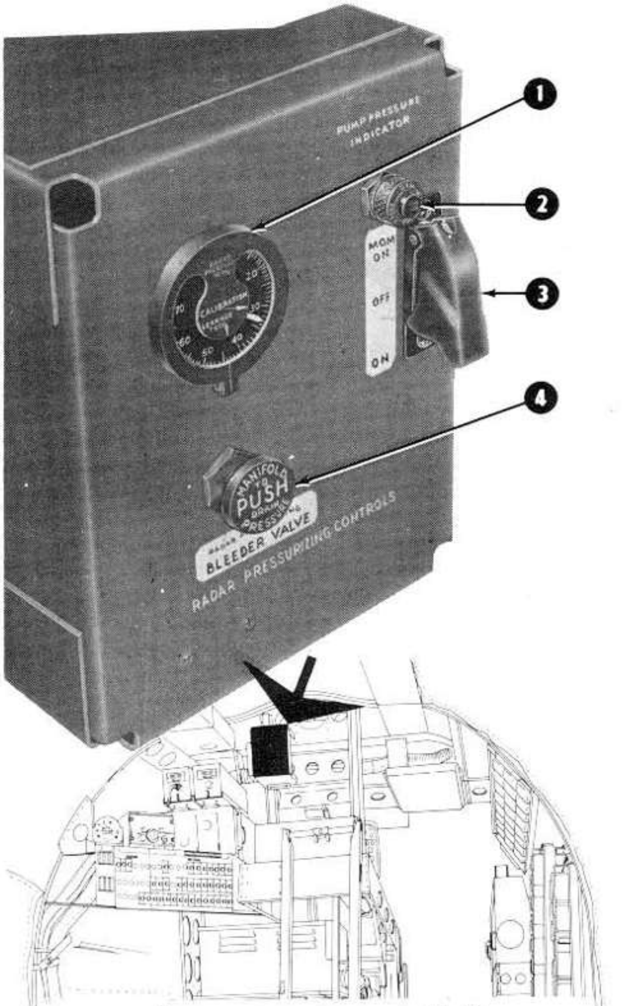
(1)

SPARE-INVERTER-ON-K-BUS INDICATOR LIGHT. An amber light (2, figure 4-19) located on the radar power monitoring panel identified "Spare Inv On K Bus," will be illuminated when the three-phase inverter switch is placed in SPARE ON position to restore three-phase power to the "K" bus.

FREQUENCY METER. A frequency meter (1, figure 4-19) is installed on the radar power monitoring panel to show frequency of power on the buses as determined by the power monitor selector switch.

VOLTMETER. A voltmeter (3, figure 4-19) is installed on the radar power monitoring panel to show voltage of power on the buses as determined by the power monitor selector switch.

(1)*AF 52-363 thru -393, -574 thru -620, -3343 thru -3373, 53-2261 thru -2278



radar pressurizing control panel

1. Radar Pressure Gage
2. Pump Pressure Indicator Light
3. Radar Pressurizing Control Switch
4. Radar Pressurizing Bleeder Valve Knob

50419WA

Figure 4-20.

RADAR PRESSURIZING SYSTEM

To insure proper operation of radar BNS equipment at all altitudes, the modulator and transceiver units are pressurized. The radar pressurizing system is controlled from a radar pressurizing control panel (figure 4-20) located above the observer's seat. The system is energized by DC power and protected by two circuit breakers on the radar power panel.

RADAR PRESSURIZING SYSTEM CONTROLS

RADAR PRESSURIZING CONTROL SWITCH. A control switch (3, figure 4-20) marked ON--OFF--MOM -ON is on the radar pressurizing control panel. When the switch is in the guarded ON position, power is supplied to a pressure regulator switch which functions automatically to control operation of a compressor and maintain the desired pressure. When the switch is in the momentary MOM-ON position, the pressure regulator switch is overridden and power is supplied directly to operate the compressor. When the switch is in the OFF position, the radar pressurizing system is deenergized.

RADAR PRESSURIZING BLEEDER VALVE KNOB. A knob (4, figure 4-20) on the radar pressurizing control panel marked "Push To Drain," when pushed in, mechanically actuates a valve to discharge system compressed air into the cabin. The bleeder valve knob is spring-loaded to the extended (bleeder valve closed) position.

RADAR PRESSURIZING SYSTEM INDICATORS

PUMP PRESSURE INDICATOR LIGHT. A green indicator light (2, figure 4-20) on the radar pressurizing control panel, when illuminated, indicates that the compressor is operating.

RADAR PRESSURE GAGE. A radar pressure gage (1, figure 4-20) on the radar pressurizing control panel indicates system air pressure in inches of mercury. A mask assembly with red and green range markings and leakage test and calibration marks is fitted over the face of the indicator. The leakage test and calibration marks are used only for ground and flight test of the system after maintenance work has been accomplished.

NORMAL OPERATION OF RADAR PRESSURIZING SYSTEM

The radar pressurizing system must be turned on whenever radar BNS equipment is to be operated and left on throughout the operation of this equipment. At all other times, radar pressurizing should be off.

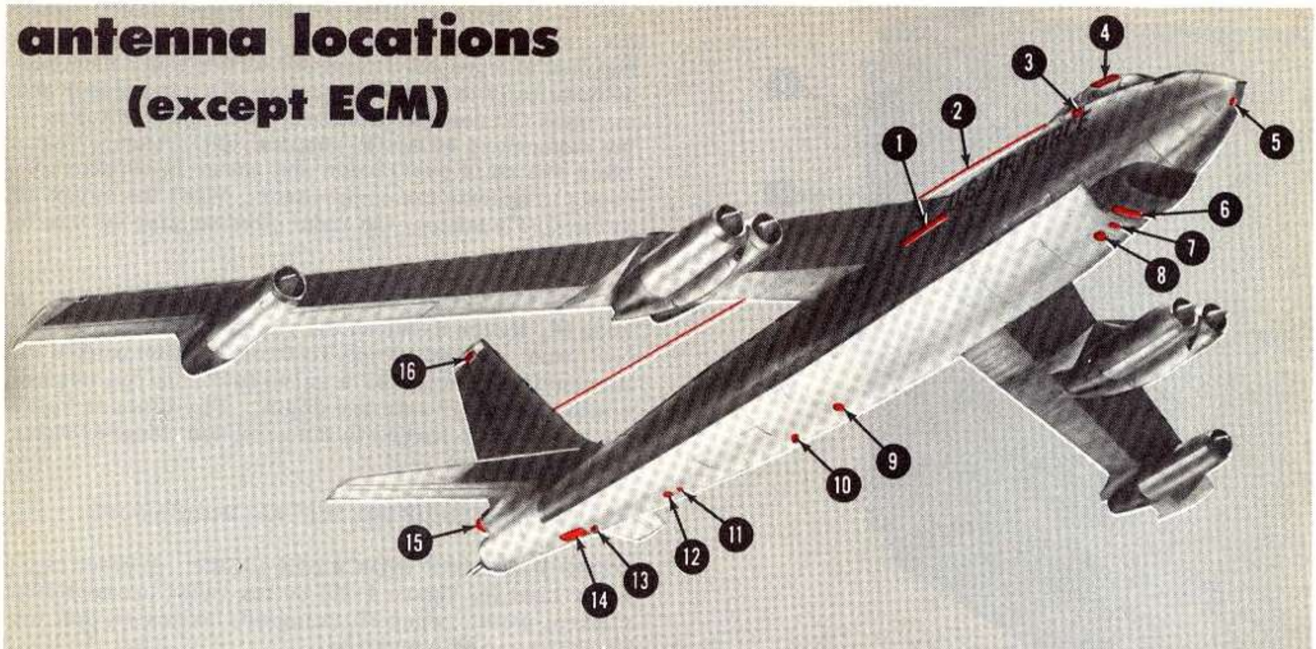
a. Place the radar pressurizing control switch in the ON position. The pump pressure indicator light should come on and remain on until pressure builds up to within the green operating range on the radar pressure gage. When pressure stabilizes within the green operating range, radar BNS equipment may be turned on.

b. After radar BNS equipment has been turned off, place the radar pressurizing control switch in the OFF position.

EMERGENCY OPERATION OF RADAR PRESSURIZING SYSTEM

FAILURE OF AUTOMATIC PRESSURE REGULATION. In the event the pressure regulator switch malfunctions or fails and continued operation of radar BNS equipment is essential, radar pressurizing may be maintained by manual control.

a. Place the radar pressurizing control switch in the OFF position.



1. Radio Compass Sense Antenna (Top of Fuselage) ①▶
2. Liaison Radio Antenna ②▶
3. Radio Compass Loop Antenna ③▶
4. Radio Compass Sense Antenna ③▶
5. Glide Path Antenna
6. Radar Bombing-Navigation System Antenna
7. Rendezvous Radar Transmitting Antenna
8. Radio Compass Loop Antenna ①▶
9. Rendezvous Radar Receiving Antenna
10. Command Radio Mast Antenna ④▶
11. IFF Antenna
12. Command Radio Flush Antenna ⑤▶
13. Command Radio Mast Antenna ⑥▶
14. Marker Beacon Antenna
15. Gun Laying Radar Antenna
16. Localizer and Omni-Range Antenna

①▶ AF 52-565 & on

②▶ AF 51-2192 thru -2356, 52-498 & on

③▶ AF 51-2192 thru 52-564

④▶ AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on

⑤▶ AF 51-2357 thru 52-088, -202 thru -292

⑥▶ AF 51-2192 thru -2356, 52-089 thru -201, -293 thru -3373, 53-2028 thru -2040, -2261 thru -2296

50421WC-1

Figure 4-21.

b. Bring pressure within green operating range on the radar pressure indicator either by holding the pressurizing control switch in the MOM-ON position or by pushing and holding in the pressure bleed valve knob.

c. Whenever the pressure drops to the low limit of the green operating range, hold the radar pressurizing control switch in the MOM-ON position until the pressure builds up to the high limit. Repeat this procedure as necessary to maintain the pressure within the limits of the green operating range.

NOTE

In an extreme emergency only, when pressure cannot be maintained in the green operating range but can be kept within the upper and lower limits of the red (marginal) range on the radar pressure indicator, radar BNS equipment may be kept in operation by manual tuning of the units.

INABILITY TO MAINTAIN PRESSURE. If failure of the compressor, broken lines, or similar difficulty makes it impossible to maintain proper pressure either by automatic or manual means, proceed as follows:

a. Place the radar pressurizing control switch in the OFF position.

b. Turn off radar BNS equipment.

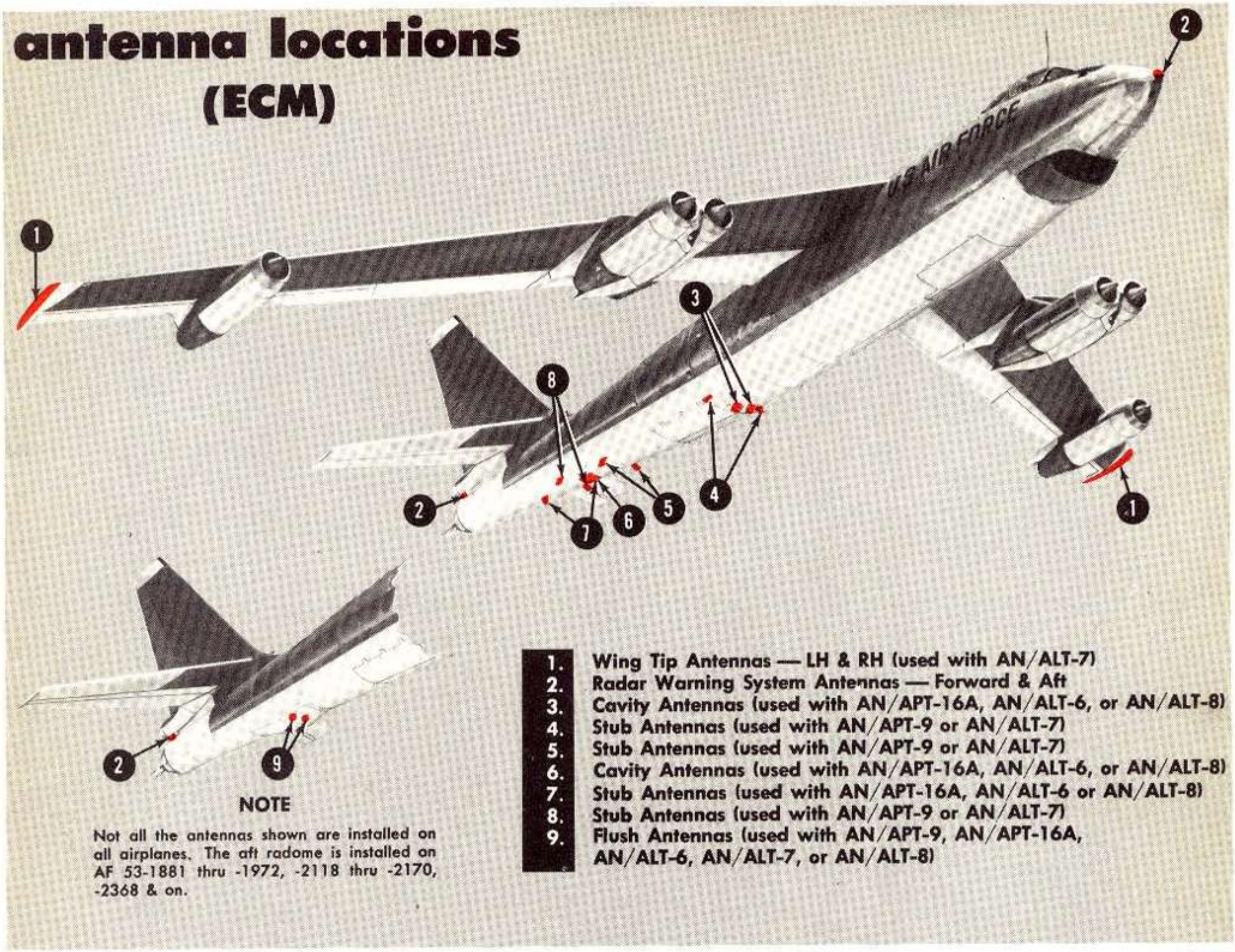

antenna locations
(ECM)
1
2
3
4
5
6
7
8
9
1. Wing Tip Antennas — LH & RH (used with AN/ALT-7)
2. Radar Warning System Antennas — Forward & Aft
3. Cavity Antennas (used with AN/APT-16A, AN/ALT-6, or AN/ALT-8)
4. Stub Antennas (used with AN/APT-9 or AN/ALT-7)
5. Stub Antennas (used with AN/APT-9 or AN/ALT-7)
6. Cavity Antennas (used with AN/APT-16A, AN/ALT-6, or AN/ALT-8)
7. Stub Antennas (used with AN/APT-16A, AN/ALT-6 or AN/ALT-8)
8. Stub Antennas (used with AN/APT-9 or AN/ALT-7)
9. Flush Antennas (used with AN/APT-9, AN/APT-16A, AN/ALT-6, AN/ALT-7, or AN/ALT-8)
NOTE
Not all the antennas shown are installed on all airplanes. The aft radome is installed on AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on.
50454 WC-1

Figure 4-21A

CAUTION

Continued operation of radar BNS equipment after failure of the radar pressurizing system is likely to result in damage to the radar BNS modulator and transceiver units.

LIGHTING EQUIPMENT

The lighting equipment is composed of two groups, the exterior lights and the interior lights. All lights are DC operated and protected by circuit breakers on the lower DC power panel. Operation of these lights is accomplished by switches located near each crew member.

EXTERIOR LIGHTING

LANDING LIGHTS

Fixed landing lights in the inboard engine nacelles (22, figure 1-4) are turned on and off by means of ON--off switches (17, figure 1-11) on the pilot's switch panel.

TAXI LIGHT

On some airplanes, a taxi light is mounted on the forward main landing gear and is turned on and off by means of an ON--OFF switch (16, figure 1-11) on the pilot's switch panel.

NOTE

(1)

The switch is installed but is inoperative.

POSITION AND NAVIGATION LIGHTS

Position and navigation lights system consists of a red light on the left-hand wing tip, a green light on the right-hand wing tip, a yellow light and a white light on top of the vertical fin and, two white fuselage position lights, one on top and one on the bottom. This system is used to indicate the position and direction of motion of the airplane during night flights.

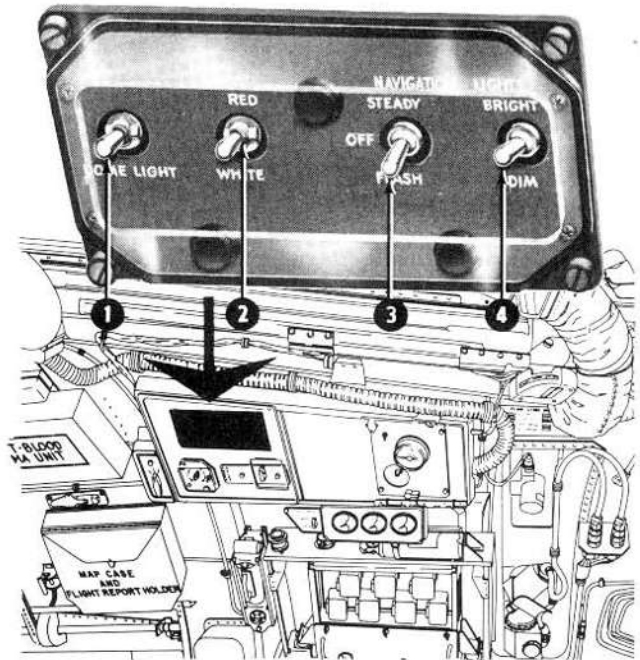
Two switches on the pilot's position light panel control all the airplane navigation lights. A flash switch (3, figure 4-19) has three positions, STEADY--OFF--FLASH. The STEADY position provides for constant illumination of all lights, and OFF position turns off all lights. The FLASH position provides flashing of the wing and tail lights while the fuselage lights remain steady. A navigation lights dimming switch (4, figure 4-19) has BRIGHT and DIM positions to facilitate dimming of all navigation lights simultaneously.

WING ILLUMINATION LIGHTS

A light is installed on each side of the fuselage forward and above the wings and is directed to provide illumination of the airplane wings. The lights may be used to observe the condition of the wings during night flights especially during icing conditions. The wing illumination lights may also be used during air refueling operations at night to facilitate rendezvous with tanker airplanes. The lights are controlled by an ON--OFF switch and a rheostat on the copilot's air refueling and anti-icing external lights panel (5, figure 1-16).

AIR REFUELING LIGHTS

Three white lights, two in the refueling receptacle and one in the slipway, are provided for illuminating the refueling receptacle, slipway, and slipway door during air refueling operations at night. These lights are controlled by a "Slipway Door Lts" rheostat on the copilot's air refueling and anti-icing external lights panel (5, figure 1-16). Also on this panel is a rheostat decaled "Nav Window Lights" which controls two observer window spotlights which, when illuminated, aid rendezvous with tanker airplanes during night air refueling operation.



pilot's position light panel

1. Dome Light Switch
2. Dome Light Color Selector Switch
3. Navigation Lights Flash Switch
4. Navigation Lights Dimming Switch

50422WA

Figure 4-22.

(1) AF 52-032, -044 and -067

INTERIOR LIGHTING

PILOT'S STATION

Switches and rheostats for lighting the pilot's flight, navigational, and engine instruments, instrument panels and equipment and flight controls, are located on the pilot's lighting panel. The pilot's lighting panel (4, figure 1-6) provides for edge lighting, local and general flood lighting (both red and white). Spotlights with integral switches are provided for the pilot's use. (1)

A BRIGHT--OFF--DIM switch (11, figure 1-5) located on the pilot's right sidewall controls the lighting of the standby compass.

The pilot is provided with map light switches on the map light panel (5, figure 1-7) which control map lights located below the pilot's light shield.

COPILOT'S STATION

Switches and rheostats for lighting the copilot's flight, navigational and engine instruments, instrument panels and equipment and flight controls are located on the copilot's lighting panel. The copilot's lighting panel (14, figure 1-15) provides for edge lighting, local and general flood lighting (both red and white). Spotlights with integral switches are provided for the copilot's use.

OBSERVER'S STATION

Switches and rheostats for lighting the observer's flight, navigational, and bombing instruments, instrument panels and equipment are located on the observer's lighting panel (15, figure 4-28). Spotlights with integral switches are provided for the observer's use.

GUNNER'S STATION

Rheostats on the right-hand side of the gunner's station control the gunner's work light and gunner's control panel lights. Spotlights with integral switches are provided for the gunner's use.

BOMB BAY STATION

Front, rear, and center, left and right bomb bay lights are controlled by switches on the front left-hand side of the bomb bay. There is also a spotlight with an integral switch over the bomb bay oxygen panel.

WALKWAY AND ENTRANCEWAY

Switches (1, figure 4-19 and 4, figure 1-16) for the walkway and entranceway lights are located on the pilot's position lights panel, the copilot's oxygen panel, and at the entranceway.

Switches for passageway, dome, and floodlights are located on the observer's lighting panel (15, figure 4-28).

OXYGEN SYSTEM

GENERAL

Type D-1 or D-2 oxygen regulator units (these regulators are identical in operational characteristics) combining the functions of an oxygen flow indicator, pressure gage, and pressure demand regulator are installed at each crew station and in the bomb bay. On some airplanes*, an oxygen regulator unit is provided for a fourth crew member. Pressure demand type oxygen masks must be used with the regulator units. An electrically operated warning system is incorporated within the regulator units to warn the pilot and crew members whenever a crew station system is not functioning properly. However, warning lights for the fourth crew member have been omitted. The warning system is DC operated and its circuit breaker is located on the upper DC power panel. Two Type A-1 or MA-1 portable oxygen units are installed, one each on the pilot's and copilot's left sidewalls. A bracket for storing an oxygen bottle is installed on the aft inboard side of the crawlway or, on some airplanes, in the bomb bay. The Type A-1 portable units when fully charged to 400 psi will each deliver oxygen for about 30 minutes of normal activity at approximately 25,000 feet altitude. The Type MA-1 units will each supply positive pressure to the oxygen mask at altitudes above 35,000 feet. Recharging facilities for the portable units are provided at the pilot's, copilot's, and bomb bay stations.

The B-47 oxygen system is supplied from gaseous oxygen storage cylinders or from liquid oxygen converters. For combat safety, each station is supplied from two distribution lines through automatic check valves. Check valves in the distribution lines will prevent back pressures and leaks that would deplete oxygen supply if any distribution line should be broken or any oxygen source should fail. As far as crew members are concerned, operation of the oxygen system will be the same whether supplied with liquid oxygen or gaseous oxygen, except that oxygen duration will be greater with the liquid supply. The approximate duration of the oxygen system is given in figure 4-23.

GASEOUS OXYGEN SUPPLY SYSTEM (2)

The low pressure oxygen distribution system is supplied by gaseous oxygen cylinders which give a normal

* AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on
(1) AF 51-2192 thru -2356, 52-158 thru -201, -331 thru -393, -451 & on
(2) AF 51-2192, -2193, -2195 thru -2197, -2199 thru -2206, -2208 thru -2212, -2214 thru -2217, -2219, -2220, -2224 thru -2227, -2230 thru -2232, -2234, -2237, -2240 thru -2244, -2246, -2251, -2253, -2254, -2256 thru -2258, -2260 thru -2280, -2282 thru 53-1849, -2028 thru -2040, -2261 thru -2314

pressure of 400 to 450 psi when the cylinders are fully charged. The system pressure will decrease as the supply is used.

NOTE

As an airplane ascends to high altitudes where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100° F decrease in temperature in the cylinders the gage pressure can be expected to drop 20%. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there and, as the airplane descends to warmer altitudes, the pressure will tend to rise again so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight or while it is descending is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

On some airplanes* the system is supplied from four Type G-1 and two Type F-1 oxygen cylinders and may be serviced from a single filler valve located in a service hatch on the right side of the fuselage ahead of the forward wheel well. On other airplanes** the system is supplied from four Type G-1 and six Type F-1 or six Type G-1 and two Type F-1 oxygen cylinders and may be serviced through a single filler valve located in a hatch on the right side of the forward wheel well. For servicing information, see figure 1-54.

LIQUID OXYGEN SUPPLY SYSTEM (1)

On some airplanes a liquid oxygen supply system is used. This system has a pressure range of 295 to 315 psi, which remains constant until exhausted, as compared to 400 to 450 psi with the variable pressure gaseous oxygen supply system. Equipment included in the liquid oxygen supply system consists of two 8-liter liquid oxygen converters, one on each side of the aft end of the bomb bay; provisions in the right ECM compartment on B-47E airplanes and on the right side in the battery compartment on modified B-47B airplanes for installation of a third 8-liter converter; three filler valves on the outside skin of the airplane, one within 10 feet of each converter; a vent and buildup valve near each filler valve; and liquid oxygen quantity gages or gage located at the copilot's station. Each converter is serviced individually. For servicing information, see figure 1-54.

OXYGEN SYSTEM CONTROLS

REGULATOR DILUTER LEVER

A NORMAL OXYGEN--100% OXYGEN diluter lever (3, figure 4-24) is provided on each regulator unit. When the lever is in the NORMAL position, the regulator unit will function to provide automatic mixing of air and oxygen in sea-level oxygen concentration at all altitudes. When the lever is in the 100% OXYGEN position, the automatic air-oxygen mixing feature is bypassed and 100% oxygen is supplied for emergencies regardless of altitude.

OXYGEN SUPPLY SHUTOFF LEVER

An ON--OFF oxygen supply shutoff lever (4, figure 4-24) is provided on each regulator unit. When the lever is in the ON position, system oxygen is supplied to the regulator unit. When the lever is in the OFF position, the oxygen supply to the regulator is shut off to prevent any flow of oxygen from that unit when not in use.

CAUTION

Due to the automatic pressure breathing feature of the regulator, a continuous flow of oxygen at altitude will result if the regulator is not being used and the supply shutoff lever is left ON. This condition will cause a rapid loss of oxygen.

EMERGENCY TOGGLE LEVER

An emergency toggle lever (5, figure 4-24) is provided on each regulator for manually supplying a positive oxygen pressure to the mask for emergency use. The toggle lever has EMERGENCY--off--EMERGENCY positions. When the lever is in EMERGENCY position (either to the right or left of center) oxygen is supplied at continuous positive pressure to the oxygen mask for emergency use. In the normal center off position, oxygen flow is controlled automatically by the regulator unit. The lever may be pushed in to supply a positive oxygen pressure to the mask which may be used for testing the oxygen mask fit at any altitude. The positive pressure of oxygen to the mask is automatically shut off when the lever is released.

MASTER OXYGEN WARNING CONTROL SWITCH

An ON--OFF oxygen warning switch (37, figure 1-8 and 34, figure 1-9) is on the pilot's instrument panel.

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* AF 51-15804 thru -15812, 52-019 thru -081, -202 thru -292

** AF 51-2192, -2193, -2195 thru -2197, -2199 thru -2206, -2208 thru -2212, -2214 thru -2217, -2219, -2220, -2224 thru -2227, -2230 thru -2232, -2234, -2237, -2240 thru -2244, -2246, -2251, -2253, -2254, -2256 thru -2258, -2260 thru -2280, -2282 thru -7083, -17368 thru -17386, 52-082 thru -201, -293 thru 53-1849, -2028 thru -2040, -2261 thru -2314

(1) AF 51-2194, -2198, -2207, -2213, -2218, -2221 thru -2223, -2228, -2229, -2233, -2235, -2236, -2238, -2239, -2245, -2247 thru -2250, -2252, -2255, -2259, -2281, 53-1850 thru -1972, -2090 thru -2170, -2315 & on

oxygen duration

CREW MEMBER OXYGEN DURATION IN HOURS

AF 51-15804 thru -15812, 52-019 thru -081, -202 thru -292

3 CREW MEMBERS

CABIN ALTITUDE FEET	GAGE PRESSURE — P.S.I. 400	350	300	250	200	150	100	BELOW 100
40,000	9.8 9.8	8.4 8.4	7.0 7.0	5.6 5.6	4.2 4.2	2.8 2.8	1.4 1.4	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	9.8 9.8	8.4 8.4	7.0 7.0	5.6 5.6	4.2 4.2	2.8 2.8	1.4 1.4	
30,000	7.3 7.3	6.2 6.2	5.2 5.2	4.2 4.2	3.1 3.1	2.1 2.1	1.0 1.0	
25,000	5.8 6.9	5.0 5.9	4.2 4.9	3.3 3.9	2.5 3.0	1.7 2.0	0.8 1.0	
20,000	4.7 7.8	4.0 6.7	3.4 5.6	2.7 4.5	2.0 3.3	1.3 2.2	0.7 1.1	
15,000	3.7 9.4	3.2 8.1	2.6 6.7	2.1 5.4	1.6 4.0	1.1 2.7	0.5 1.3	
10,000	3.2 9.4	2.7 8.1	2.3 6.7	1.8 5.4	1.4 4.0	0.9 2.7	0.5 1.3	

CYLINDERS: 4 TYPE G-1, 2 TYPE F-1

AF 51-2192, -2193, -2195 thru -2197, -2199 thru -2206, -2208 thru -2212, -2214 thru -2217, -2219, 2220, -2224 thru -2227, -2230 thru -2232, -2234, 2237, -2240 thru -2244, -2246, -2251, 2253, -2254, -2256 thru -2258, -2260 thru -2280, -2282 thru -7083, -17368 thru -17386, 52-082 thru -201, -293 thru 53-1849, -2028 thru -2040, -2261 thru -2314

3 CREW MEMBERS

	400	350	300	250	200	150	100	BELOW 100
40,000	13.7 13.7	11.8 11.8	9.8 9.8	7.8 7.8	5.9 5.9	3.9 3.9	1.9 1.9	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	13.7 13.7	11.8 11.8	9.8 9.8	7.8 7.8	5.9 5.9	3.9 3.9	1.9 1.9	
30,000	10.2 10.2	8.7 8.7	7.3 7.3	5.9 5.9	4.3 4.3	2.9 2.9	1.4 1.4	
25,000	8.1 9.7	7.0 8.3	5.9 6.9	4.6 5.5	3.5 4.2	2.4 2.8	1.1 1.4	
20,000	6.6 10.9	5.6 9.4	4.8 7.8	3.8 6.1	2.8 4.6	1.8 3.1	0.9 1.5	
15,000	5.2 13.2	4.5 11.3	3.6 9.4	2.9 7.6	2.2 5.6	1.5 3.8	0.7 1.8	
10,000	4.5 13.2	3.8 11.3	3.2 9.4	2.5 7.6	1.9 5.6	1.3 3.8	0.7 1.8	

CYLINDERS: 4 TYPE G-1, 6 TYPE F-1 OR
6 TYPE G-1, 2 TYPE F-1

NOTE:
BLACK FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"
RED FIGURES INDICATE DILUTER LEVER "100% OXYGEN"

(In each cell above, the upper value is the red figure and the lower value is the black figure.)

Figure 4-23. (Sheet 1 of 3 Sheets)

CREW MEMBER LIQUID OXYGEN DURATION IN HOURS

CABIN ALTITUDE FEET	TOTAL GAGE QUANTITY — LITERS 24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	BELOW 1
40,000 (red: 100% oxygen)	40.1	38.4	36.7	35.0	33.4	31.7	30.1	28.4	26.7	25.0	23.3	21.7	20.0	18.3	16.7	15.0	13.3	11.6	10.0	8.3	6.6	4.9	3.2	1.6	EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
40,000 (black: normal oxygen)	40.1	38.4	36.7	35.0	33.4	31.7	30.1	28.4	26.7	25.0	23.3	21.7	20.0	18.3	16.7	15.0	13.3	11.6	10.0	8.3	6.6	4.9	3.2	1.6	
35,000 (red: 100% oxygen)	40.1	38.4	36.7	35.0	33.4	31.7	30.1	28.4	26.7	25.0	23.3	21.7	20.0	18.3	16.7	15.0	13.3	11.6	10.0	8.3	6.6	4.9	3.2	1.6	
35,000 (black: normal oxygen)	40.1	38.4	36.7	35.0	33.4	31.7	30.1	28.4	26.7	25.0	23.3	21.7	20.0	18.3	16.7	15.0	13.3	11.6	10.0	8.3	6.6	4.9	3.2	1.6	
30,000 (red: 100% oxygen)	29.8	28.6	27.3	26.1	24.8	23.6	22.4	21.1	19.9	18.6	17.4	16.1	14.9	13.6	12.4	11.1	9.9	8.6	7.4	6.1	4.9	3.6	2.4	1.1	
30,000 (black: normal oxygen)	29.8	28.6	27.3	26.1	24.8	23.6	22.4	21.1	19.9	18.6	17.4	16.1	14.9	13.6	12.4	11.1	9.9	8.6	7.4	6.1	4.9	3.6	2.4	1.1	
25,000 (red: 100% oxygen)	23.7	22.7	21.7	20.7	19.7	18.8	17.8	16.8	15.8	14.8	13.8	12.8	11.8	10.8	9.8	8.9	7.8	6.9	5.9	4.9	3.9	2.9	1.9	0.9	
25,000 (black: normal oxygen)	28.2	27.0	25.8	24.6	23.5	22.3	21.1	19.9	18.8	17.6	16.4	15.2	14.1	12.9	11.7	10.5	9.4	8.2	7.0	5.8	4.7	3.5	2.3	1.1	
20,000 (red: 100% oxygen)	19.2	18.4	17.6	16.8	16.0	15.2	14.4	13.6	12.8	12.0	11.2	10.4	9.6	8.8	8.0	7.2	6.4	5.6	4.8	4.0	3.2	2.4	1.6	0.8	
20,000 (black: normal oxygen)	31.6	30.3	29.0	27.7	26.4	25.1	23.7	22.4	21.1	19.7	18.4	17.1	15.7	14.5	13.1	11.8	10.5	9.2	7.8	6.5	5.2	3.9	2.6	1.2	
15,000 (red: 100% oxygen)	15.1	14.5	13.9	13.0	12.6	11.9	11.4	10.7	10.1	9.5	8.8	8.2	7.6	6.9	6.3	5.7	5.1	4.4	3.8	3.1	2.5	1.9	1.2	0.6	
15,000 (black: normal oxygen)	38.4	36.8	35.2	33.6	32.0	30.4	28.8	27.2	25.6	24.0	22.4	20.8	19.2	17.6	16.0	14.4	12.7	11.1	9.5	7.9	6.4	4.8	3.2	1.6	
10,000 (red: 100% oxygen)	13.1	12.5	12.0	11.4	10.9	10.3	9.8	9.2	8.7	8.1	7.6	7.1	6.4	5.9	5.2	4.8	4.1	3.6	3.2	2.5	2.0	1.6	0.9	0.4	
10,000 (black: normal oxygen)	38.4	36.8	35.2	33.6	32.0	30.4	28.8	27.2	25.6	24.0	22.4	20.8	19.2	17.6	16.0	14.4	12.7	11.1	9.5	7.9	6.4	4.8	3.2	1.6	

NOTE:

BLACK FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"
RED FIGURES INDICATE DILUTER LEVER "100% OXYGEN"

NOTE

The above values are a temporary calculation and should be used only as an estimate. Additional information will be furnished when available.

CONVERTERS: 8-LITER TYPE

3 CREW MEMBERS

AF 51-2194, -2198, -2207, -2213, -2218, -2221 thru -2223, -2228, -2229, -2233, -2235, -2236, -2238, -2239, -2245, -2247 thru -2250, -2252, -2255, -2259, -2281, 53-1850 thru -1972, -2090 thru -2170, -2315 & on

Figure 4-23. (Sheet 2 of 3 Sheets)

CREW MEMBER LIQUID OXYGEN DURATION IN HOURS

CABIN ALTITUDE FEET	TOTAL GAGE QUANTITY — LITERS 24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	BELOW 1
40,000	30.0	28.8	27.5	26.2	25.0	23.7	22.5	21.3	20.0	18.7	17.4	16.2	15.0	13.7	12.5	11.2	9.9	8.7	7.5	6.2	4.9	3.6	2.4	1.2	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	30.0	28.8	27.5	26.2	25.0	23.7	22.5	21.3	20.0	18.7	17.4	16.2	15.0	13.7	12.5	11.2	9.9	8.7	7.5	6.2	4.9	3.6	2.4	1.2	
35,000	30.0	28.8	27.5	26.2	25.0	23.7	22.5	21.3	20.0	18.7	17.4	16.2	15.0	13.7	12.5	11.2	9.9	8.7	7.5	6.2	4.9	3.6	2.4	1.2	
	30.0	28.8	27.5	26.2	25.0	23.7	22.5	21.3	20.0	18.7	17.4	16.2	15.0	13.7	12.5	11.2	9.9	8.7	7.5	6.2	4.9	3.6	2.4	1.2	
30,000	22.3	21.4	20.4	19.5	18.6	17.7	16.8	15.8	14.9	13.9	13.0	12.0	11.2	10.2	9.3	8.3	7.4	6.4	5.5	4.5	3.6	2.7	1.8	0.8	
	22.3	21.4	20.4	19.5	18.6	17.7	16.8	15.8	14.9	13.9	13.0	12.0	11.2	10.2	9.3	8.3	7.4	6.4	5.5	4.5	3.6	2.7	1.8	0.8	
25,000	17.7	17.0	16.2	15.5	14.7	14.1	13.7	12.6	11.9	11.1	10.3	9.6	8.8	8.1	7.3	6.6	5.8	5.1	4.4	3.6	2.9	2.1	1.4	0.6	
	21.1	20.2	19.3	18.4	17.6	16.7	15.8	14.9	14.1	13.2	-12.3	11.4	10.5	9.6	8.0	7.8	7.0	6.1	5.2	4.3	3.5	2.6	1.7	0.8	
20,000	14.8	13.8	13.2	12.6	12.0	11.4	10.8	10.2	9.6	9.0	8.4	7.8	7.2	6.6	6.0	5.4	4.8	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
	23.7	22.7	21.7	20.7	19.8	18.8	17.7	16.8	15.8	14.7	13.8	12.8	11.7	10.8	9.8	8.8	7.8	6.9	5.8	4.8	3.9	2.9	1.9	0.9	
15,000	11.6	10.8	10.4	9.7	9.4	8.9	8.5	8.0	7.5	7.1	6.6	6.1	5.7	5.1	4.7	4.2	3.8	3.3	2.8	2.3	1.8	1.4	0.9	0.4	
	28.8	27.6	26.4	25.2	24.0	22.8	21.6	20.4	19.2	18.0	16.8	15.6	14.4	13.2	12.0	10.8	9.5	8.3	7.1	5.9	4.8	3.6	2.4	1.2	
10,000	9.8	9.4	9.0	8.5	8.2	7.7	7.3	6.9	6.5	6.0	5.7	5.3	4.8	4.4	3.9	3.6	3.0	2.7	2.4	1.8	1.5	1.2	0.6	0.3	
	28.8	27.6	26.4	25.2	24.0	22.8	21.6	20.4	19.2	18.0	16.8	15.6	14.4	13.2	12.0	10.8	9.5	8.3	7.1	5.9	4.8	3.6	2.4	1.2	

NOTE:

BLACK FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"
RED FIGURES INDICATE DILUTER LEVER "100% OXYGEN"

NOTE

The above values are a temporary calculation and should be used only as an estimate. Additional information will be furnished when available.

CONVERTERS: 8-LITER TYPE

4 CREW MEMBERS

AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

50425WB-1

Figure 4-23. (Sheet 3 of 3 Sheets)

oxygen regulator panel

1. Oxygen Warning System Switch
2. Oxygen Flow Indicator and Pressure Gage
3. Regulator Diluter Lever
4. Oxygen Supply Shutoff Lever
5. Oxygen Emergency Toggle Lever

50423W8-1

Figure 4 - 24.

When the switch is in the ON position, oxygen warning light circuits are completed to each regulator unit. When the switch is in the OFF position, the oxygen warning light circuits are inoperative.

OXYGEN WARNING SYSTEM SWITCHES

An ON--OFF oxygen warning system switch (1, figure 4-24) is provided on each regulator unit. When the switch is in the ON position, power is supplied to the warning light circuits for that crew station. When the switch is in the OFF position, the warning light circuits for that crew station are deenergized.

OXYGEN SYSTEM INDICATORS

OXYGEN PRESSURE GAGES

An oxygen pressure gage (2, figure 4-24) provided on each regulator unit indicates oxygen system pressure in psi when the oxygen supply shutoff lever is in ON position. The pressure gage has an allowable reading tolerance of ±35 psi.

LIQUID OXYGEN QUANTITY GAGES (1)

On B-47E airplanes three liquid oxygen quantity gages are located on a panel (2, figure 1-15) forward of the copilot's throttle quadrant. The gages indicate liquid oxygen quantity in liters. The gages decaled "LH" and "RH" indicate quantity in the two converters installed in the aft end of the bomb bay. The gage decaled "AFT" is inoperative until such time as the converter for the right ECM compartment is installed. The gages operate from the pressure caused by the head of liquid in the converter. The gas pressure is balanced out by a separate connection to the gage.

On modified B-47B airplanes a single electrically operated liquid oxygen quantity gage and a three-position rotary selector switch, having LH--RH--AFT positions, are located on a panel just aft of the copilot's oxygen regulator. When the selector switch is placed in the desired position, the gage indicates liquid oxygen quantity in that particular converter. The gage receives DC power through a circuit breaker located in the aft DC power panel. The AFT position of the selector switch is inoperative until such time as the converter for the battery compartment is installed. Each liter of liquid oxygen is approximately equal to 24.5 cubic feet of gaseous oxygen.

OXYGEN FLOW INDICATORS

A blinker-type oxygen flow indicator (2, figure 4-24) is provided on each oxygen regulator unit. Black and luminescent segments alternately appear through four slots in the indicator face with each breath taken by the crew member.

OXYGEN WARNING LIGHTS

An oxygen warning light for each crew station is on the pilot's instrument panel and, in addition, an individual oxygen warning light is located at each of the other crew stations. The lights for any one crew station will illuminate only when the master oxygen warning control switch and the oxygen warning switch on the applicable crew station regulator are in ON positions. The lights will be bright, dim, or blinking bright indicating the condition of operation of oxygen at each crew station (figure 4-25).

(1) Some modified B-47B airplanes and AF 53-1850 thru -1972, -2090 thru -2170, -2315 & on

A pilot's monitor oxygen warning light (21, figure 1-18; 11, figure 1-19; and 13, figure 1-19A) is installed on the copilot's instrument panel. This light functions in the same manner as the other oxygen warning lights and enables the copilot to observe that the pilot is using oxygen.

NOTE

At cabin altitudes below 10,000 feet with the oxygen regulator operating and the mask being used, the lights may blink brightly. Since this condition is peculiar mostly to low altitudes, it should not cause undue concern. At flight altitude below 10,000 feet the oxygen system may be turned off since the possibility of hypoxia is only critical at high altitudes.

NORMAL OPERATION OF OXYGEN SYSTEM

PREFLIGHT

Check oxygen system and mask as follows:

a. Check to see that the oxygen shutoff valves are off by bleeding pressure from the regulator with the emergency toggle lever. The pressure should drop to zero and remain at zero when the pressure lever is returned to off.

NOTE

Insure that all oxygen regulators not in use are shut off.

b. At the station to be checked, place the oxygen supply shutoff lever in ON position. Check the indicated system pressure which should be 400 to 450 psi, except with the liquid oxygen system, the pressure in the system is constant (300 psi) until the liquid oxygen is depleted.

c. Place master oxygen warning control switch and crew station oxygen warning system switch in ON position; a bright continuous illumination of the warning lights should result.

d. Place regulator diluter lever first to NORMAL OXYGEN position and then move to 100% OXYGEN position. Blow gently into the end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a leak or malfunction.

e. With the regulator diluter lever still in 100% OXYGEN position, move the emergency toggle lever to EMERGENCY position (left or right) to flush the regulator hose; the oxygen flow blinker will indicate continuous flow and the warning light should go dim momentarily, then bright continuously.

f. With the emergency toggle lever still in EMERGENCY position, block the regulator hose tightly with the hand; the blinker should indicate no flow and warning lights should continue on bright. A hissing of the regulator or a flow indication will indicate a ruptured regulator diaphragm or other pressure leaks. Check the hose and hose fittings.

g. Return emergency toggle lever to center (off) position. Plug in the oxygen mask and check the quick-disconnect fitting. (The fitting should separate with a 10- to 15-pound pull.)

h. Plug in oxygen mask by the following method:

(1) The attachment strap on the mask male connector should be attached to the parachute chest strap by routing the connector strap under the chest strap as close to the center as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector.

(2) Connect the mask-to-regulator tubing female disconnect to the mask male connector, listen for the click, and look to see that the sealing gasket is only half exposed.

(3) Attach the alligator clip to the end of the mask male connector strap.

i. Adjust the mask on the face and check blinker operation during normal breathing; the warning light should go dim and remain dim.

j. Deflect emergency toggle lever to right or left. A positive pressure should be supplied to mask. Return emergency toggle lever to center position.

k. Depress emergency toggle lever straight in to TEST MASK position and hold breath approximately 15 seconds; blinker should indicate no flow, warning lights should blink brightly and, after 10 seconds or less, should show steady bright illumination. A positive pressure should be applied to the mask and there should be no leakage around the mask. A pressure leak will be indicated by a flow indication or a hissing of the regulator. Release emergency toggle lever; positive pressure should cease.

l. Return the diluter lever to NORMAL OXYGEN position. The system is now ready for use.

BEFORE STARTING ENGINES

If the airplane is to be operated under possible conditions of carbon monoxide contamination, such as during runup or taxiing directly behind another operating jet airplane or during runup with its tail into the wind, the following procedure shall be accomplished by all crew members:

a. Place oxygen supply shutoff lever in ON position.

b. Put on oxygen mask and connect mask tube to regulator.

c. Place regulator diluter lever in 100% OXYGEN position.

NOTE

Whenever the cabin is suspected of being contaminated, 100% oxygen shall be used during all ground operations and during takeoff.

d. Place master oxygen warning control switch and crew station oxygen warning system switch in ON position.

e. After contamination is no longer suspected, return regulator diluter lever to NORMAL OXYGEN position.

oxygen warning lights

Operation with master oxygen warning control switch and crew member's oxygen warning switch in the ON position

STEADY DIM (intermittent oxygen flow)	BLINKING BRIGHT	STEADY BRIGHT (no oxygen flow)	STEADY BRIGHT (continuous oxygen flow)
Crew member breathing normally with mask connected to regulator.	Transition from normal breathing to no oxygen flow.	Mask on and crew member not breathing or Oxygen supply depleted or Mask off at low altitude or Oxygen supply lever OFF	Oxygen mask off at high cabin altitude (28,000 ft. and up) or Large leak in regulator or between regulator and crew member at high cabin altitude or Emergency toggle lever in EMERGENCY position

NOTE: Red indicates emergency condition

50424WC

Figure 4-25.

WARNING

The oxygen regulator diluter lever must be returned to NORMAL OXYGEN position as soon as possible because the use of 100% oxygen throughout a long mission will so deplete the oxygen supply as to be hazardous to the crew.

IN FLIGHT

The pressure regulator diluter lever should always be in the NORMAL OXYGEN position except when operating under emergency conditions. When going on oxygen, proceed as follows:

a. Place oxygen supply shutoff lever in the ON position.

b. Check regulator diluter lever in the NORMAL OXYGEN position.

c. Place master oxygen warning control switch and crew station oxygen warning system switch in the ON position. The warning lights should illuminate brightly.

d. Put on mask and connect mask tube to regulator unit. As breathing through the mask is commenced, the warning lights should change to a dim continuous glow, and the oxygen flow indicator should start functioning. The proper flow of oxygen will be automatically maintained by the regulator unit.

NOTE

Pressure demand masks, when used at altitudes exceeding 30,000 feet, will occasionally produce a distinct vibration in the mask that can be identified by a "wheezing" sound. This condition may be overlooked in that operational qualities are not disturbed in any manner.

EMERGENCY OPERATION OF OXYGEN SYSTEM

With symptoms of anoxia or if smoke or fumes should enter the cabin, immediately put on oxygen mask and place the regulator diluter lever in the 100% OXYGEN position and place emergency toggle lever in the EMERGENCY position.

CAUTION

When the regulator diluter lever is placed in the 100% OXYGEN position or the emergency lever placed in the EMERGENCY position, inform the pilot immediately as these actions will reduce the oxygen duration of the airplane. When the danger is over, return the diluter lever to NORMAL and the emergency toggle lever to off.

In the event of accidental loss of cabin pressure, immediately go on oxygen in the same manner as for in-flight normal operation. If oxygen is being used prior to the accidental loss of cabin pressure, no action is required as the regulator unit will automatically compensate for the increased cabin altitude.

If a regulator unit becomes inoperative or the oxygen system is suspected of being contaminated, disconnect mask and connect it to a portable oxygen cylinder. If an adequately filled cylinder is not available, pull the cord on the H-2 emergency oxygen cylinder.

WARNING

When use of H-2 emergency oxygen cylinder becomes necessary, inform the pilot immediately so that he can descend to an altitude at which oxygen is not required.

AUTOMATIC PILOT

Automatic flight control consists of an A-12D automatic pilot, an automatic approach system, an N-1 compass system, and provisions for coordination with the radar bombing and navigation system.

NOTE

If the N-1 compass fails, as indicated by the N-1 compass inoperative light on the pilot's instrument panel, the automatic pilot will no longer control the heading of the airplane.

An altitude control is also provided to maintain constant barometric pressure altitude. Servo motors to operate the rudder, ailerons, elevators, and elevator trim are connected to the flight control system cables. This airplane is designed to be flown normally with surface power control on and the automatic pilot will operate most satisfactorily with the airplane in this normal condition. The automatic pilot can be used to fly the airplane with surface power control off; however, this is not the normal procedure and should not be attempted except in an emergency. For operation with surface power control off, see "Surface Power Control Inoperative" in section III. The automatic pilot automatically and continuously synchronizes itself to the changing attitudes of the airplane while the automatic pilot is disengaged and the automatic pilot master switch is in ON position. This allows the automatic pilot to be engaged throughout the present range of allowable cg's, at any speeds below the present limiting airspeeds and Mach numbers, and in any normal flight attitude except a turn. During operation the automatic pilot provides automatic elevator trim to assure a portion of the load and cg shift compensation. Automatic pilot controls are on a stowable control panel at the left side of the pilot's station, on the left side of the pilot's instrument panel, at the observer's station, and on the pilot's and copilot's control wheels. Automatic pilot and automatic approach circuits use DC power and regulated AC power from the main inverter bus supplied through circuit breakers on the lower DC power panel and main AC power shield. On some airplanes * automatic pilot and automatic approach circuits use DC power and regulated AC power from the constant speed alternators and radar power panel respectively. The automatic pilot electrical units are energized and gyros erected when AC and DC power is available. Failure of AC or DC power will cause the automatic pilot to disengage, turn off, and remain locked off until power is available. When power is again restored, a delay of approximately 3 minutes may be expected before the master switch will become unlocked and can be placed in ON position.

AUTOMATIC PILOT CONTROLS

AUTOMATIC PILOT ENGAGING SWITCHES

Three switches (39, figure 1-8 and 36, figure 1-9) on the pilot's instrument panel have ENGAGE and DISENGAGE positions. ENGAGE position of the switch provides individual engaging of the rudder, aileron, elevator, and elevator trim tab servos. If the directional damper is operating and the rudder engage switch is placed in ENGAGE position, the directional damper is rendered inoperative. DISENGAGE position of the switches disengages the servos from control of surface cables. On some airplanes the engaging switches are edge-lighted and respectively marked RUD, AIL, and EL for the three surface controls: rudder, aileron, and elevator. The engaging direction for the three switches is also marked. The switches function the same as stated above. While servos are engaged, if a control surface on any axis reaches its full allowed travel as determined by a limit switch, the servos for all axes will become disengaged and engaging switches will automatically trip to DISENGAGE position. The master switch will not be tripped to OFF but the automatic-pilot-off light will blink.

CAUTION (1)

When directional control of the automatic pilot is being controlled by the radar bombing-navigation system, the aileron limit switches are inoperative. Therefore, during bomb run only, the automatic pilot will not automatically disengage in the event a hard-over signal is received in the aileron channel.

AUTOMATIC PILOT RELEASE SWITCHES

Release switches are provided on both the pilot's and copilot's wheels (2, figure 4-11). Pressing one of these pushbutton switches disengages all automatic pilot servo motors, thereby eliminating automatic pilot control and turns the automatic pilot master switch to OFF position. On some airplanes the automatic-pilot-off light is turned off by pressing either the pilot's or copilot's automatic pilot release switch.

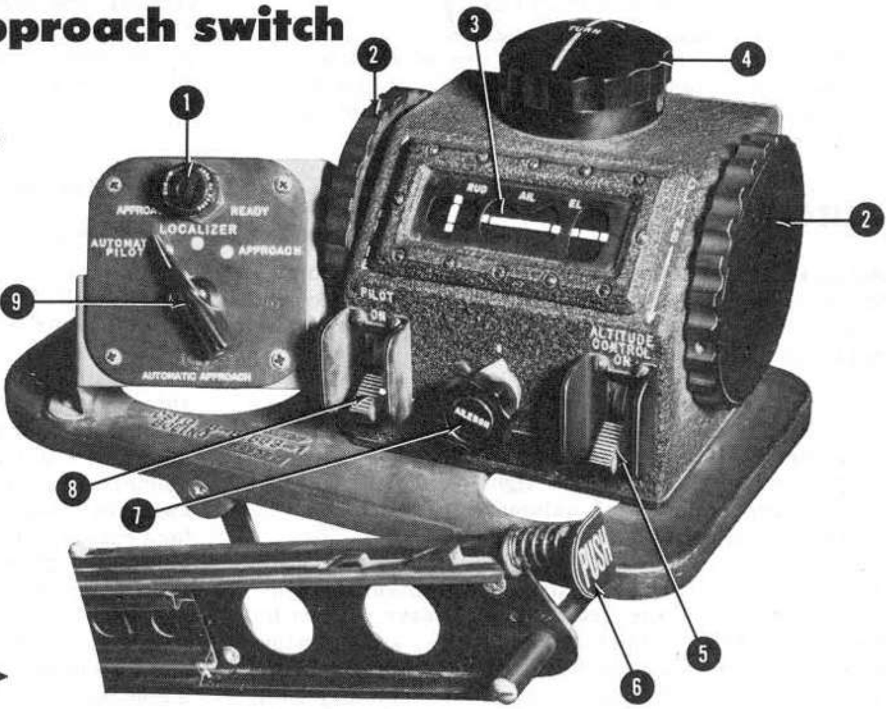
CONTROLLER SUPPORT ACTUATOR SWITCH (2)

The automatic pilot controller support may be ex-

(1) AF 52-603 & on
(2) AF 51-2357 thru -5234, -15804 thru -15812, 52-019 thru -049, -202 thru -220
* AF 52-1417, 53-1819 thru -2170, -2279 & on

automatic pilot controller and automatic approach switch

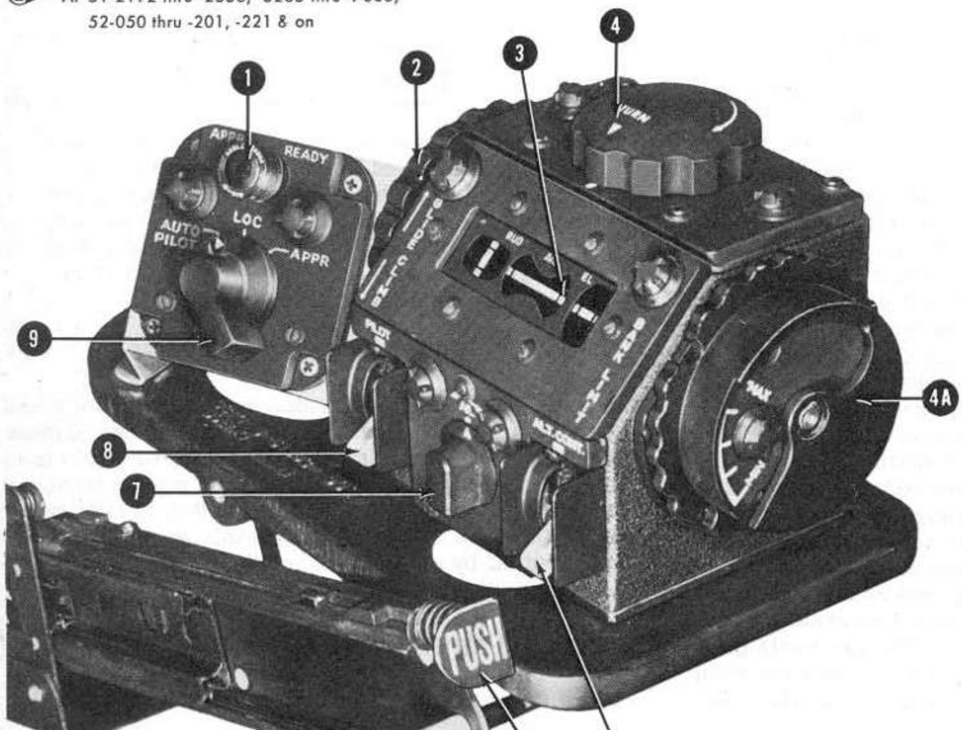
AF 51-2192 thru 53-1849, -2028 thru -2103, -2261 thru -2331



1. Automatic Approach Ready Light
2. Pitch Knob
3. Trim Indicators
4. Turn Knob
4A. Bank Angle Limiter Selector ①▶
5. Altitude Control Switch
6. Controller Support Release Button ②▶
7. Aileron Trim Knob
8. Automatic Pilot Master Switch
9. Automatic Approach Switch

①▶ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

②▶ AF 51-2192 thru -2356, -5235 thru -7083, 52-050 thru -201, -221 & on



AF 53-1850 thru -1972, -2104 thru -2170, -2332 & on

50426WB-1

Figure 4-26.

tended into the walkway in reach of the pilot by actuating a two-position switch located below the canopy rail and above the pilot's oxygen regulator panel. When the switch is placed in extend position, a DC operated actuator motor drives the support and controller from the stowed position to a position within reach of the pilot's left hand. Two limit switches within the actuator stop the motor when support is extended or retracted. When the switch is placed in retract position the actuator moves the support to its stowed position in a recess in the cockpit sidewall.

WARNING

Under emergency conditions the automatic pilot controller should be stowed as soon as possible for two reasons: 1) the support cannot be stowed after electrical power has failed and 2) the extended support will definitely limit the pilot and observer in bailout or under ditching conditions. The automatic pilot can be used to control the flight of the airplane even though the controller is in the stowed position.

When the actuator switch is placed in the extend position, the automatic pilot off light becomes operative. When the actuator switch is placed in the retract position, the automatic pilot off light becomes inoperative.

CONTROLLER SUPPORT RELEASE BUTTON (1)

A controller support release button decaled "Push" (6, figure 4-26) is located on the lower aft side of the automatic pilot controller support. When the release button is pushed, the controller support assembly is free to swing down. When the button is pushed again, the assembly is released and can be extended into the walkway and locked in position. To stow the controller assembly, push the release button and slide the controller support assembly in, then swing it up until it locks in the stowed position.

AUTOMATIC PILOT CONTROLLER

The pilot's automatic pilot controller (figure 4-26) on the pilot's controller support provides a means for maneuvering the airplane from the pilot's position when the automatic pilot system is engaged.

MASTER SWITCH. An automatic pilot master switch (8, figure 4-26) on the front of the controller has ON and OFF positions. ON position of the switch permits the signal system to be synchronized to changing attitudes of the airplane and permits ready engagement of the servos.

NOTE

The master switch is prevented from being placed in ON position if any of the following conditions exist:

- Time delay (3-minute warmup) not completed
- Turn knob not centered (in detent)
- Automatic approach switch not in AUTOMATIC PILOT position.

OFF position of the switch allows the electrical units to be warm and the gyros to be erected when power is on in the airplane; however, the signal system is not synchronized and the servos cannot be engaged.

ALTITUDE CONTROL SWITCH. An altitude control switch on front of the controller (5, figure 4-26) has ON and OFF positions. When the switch is placed in ON position, the pitch knobs are disengaged and the elevator servos are controlled by a barometric pressure control unit, providing constant pressure altitude flight. When the switch is placed in OFF position, the constant altitude control is made inoperative.

NOTE

The altitude control unit may not be installed, thus rendering this portion of the automatic pilot inoperative; the altitude control switch will be lockwired in the OFF position.

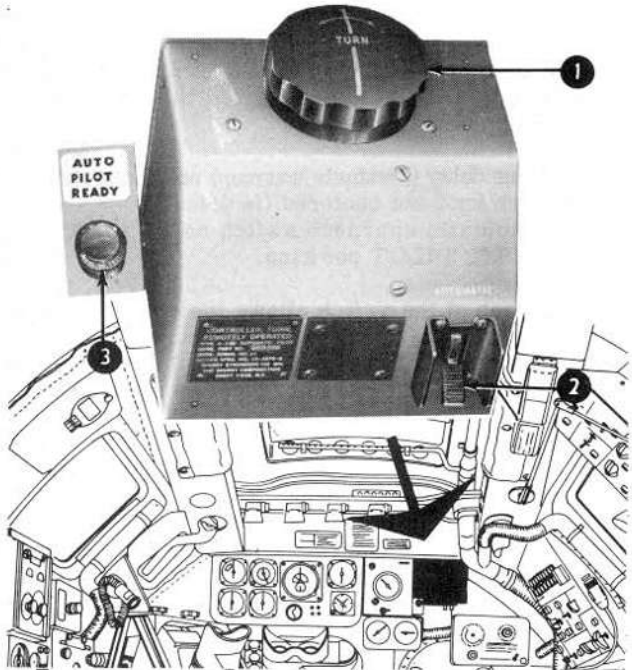
PITCH KNOBS. Two large pitch knobs (2, figure 4-23) on either side of the controller are interconnected by a common shaft. The pitch knobs control the elevators for climb or glide. Forward rotation of the knobs results in descent; aft rotation results in climb. The degree of rotation is proportional to the airplane degree of dive or climb. The pitch knob potentiometer wiper is returned to zero whenever the automatic pilot master switch is turned off. The pitch knobs are rendered inoperative whenever the altitude control is turned on or whenever the automatic approach switch is placed in APPROACH position. On airplanes having the bank angle limiter, only a single pitch knob is provided on the left side of the controller.

TURN KNOB. A pilot's turn knob (4, figure 4-26) on top of the controller provides coordinated turns for all airspeeds. When the knob is not being used, it should be placed in detent or the center position of total knob rotation. Turning the knob approximately 140° in either direction gives a maximum bank of approximately 40°.

BANK ANGLE LIMITER SELECTOR (2)

The bank angle limiter selector (4A, figure 4-26) is located on the right side of the pilot's automatic pilot

(1) AF 51-2192 thru -2356, -5235 thru -7083, 52-050 thru -201, -221 & on
(2) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on



observer's remote turn controller

1. Observer's Turn Knob
2. Observer's Control Switch
3. Automatic Pilot Ready Light

AF 51-2357 thru 52-176, -202 thru -330 and -394 thru -535

50427WA-2

Figure 4-27.

controller. Full travel of the knob clockwise and counterclockwise is read through the cutaway window on the knob as MAX and MIN positions respectively. MAX position denotes the maximum bank angle permissible when the airplane is on automatic pilot. At any time the turn knob is out of detent and selector is in MIN position, the largest bank angle obtainable with the turn knob is approximately 5°. The bank angle limiter selector is effective only when the automatic approach switch is in AUTOMATIC PILOT position. Pilot's control of the bank angle limiter selector is variable and used to keep the airplane out of buffeting when making automatic turns. The bank angle established with the selector is maintained as a maximum limit for further use of the automatic pilot. If the bank angle is established early in the mission, a recheck later in the mission will result in a different setting. (Refer to figure 5-3.)

AILERON TRIM KNOB. An aileron trim knob (7, figure 4-26) on front of the controller provides aileron trim correction if the automatic pilot is energized and the airplane is not level about the roll axis. Out of trim forces, as indicated by trim indicator being displaced from center reference while automatic pilot is engaged, should be trimmed by disengaging the automatic pilot on that axis and trimming the airplane by means of the airplane manual trim knobs.

TURN CONTROL TRANSFER SWITCH

(1)

A turn control transfer switch (41, figure 1-8) on the pilot's instrument panel has BOMBARDIER--PILOT positions. BOMBARDIER position transfers directional control (rudder and ailerons) of the airplane to the observer's station provided the pilot's and observer's turn knobs are in detent position. PILOT position gives directional control of the airplane exclusively to the pilot's controller.

(2)

On some airplanes, the turn control transfer switch (41, figure 1-8 and 39, figure 1-9) on the pilot's instrument panel has K BOMB AUTOMATIC--PILOT MANUAL positions. K BOMB AUTOMATIC position transfers directional control of the airplane to the radar bombing and navigation system. PILOT MANUAL position allows directional control of the airplane from the pilot's controller.

Methods of returning control of the automatic pilot from the observer or the radar bombing-navigation system to the pilot are as follows:

a. The pilot's turn knob can be manually rotated out of detent; this automatically returns the turn control transfer switch to PILOT or PILOT MANUAL position.
b. The pilot can manually switch the turn control transfer switch to PILOT or PILOT MANUAL position.
c. The pilot may press the release button (2, figure 4-11) on the control wheel which returns all engaging switches to the DISENGAGE position, thus requiring the automatic pilot to be reengaged on all axes.
d. On some airplanes* when the radar bombing-navigation system completes its bomb release cycle, the switch automatically returns to PILOT MANUAL position.

NOTE

The turn control transfer switch cannot be placed in BOMBARDIER or K BOMB AUTOMATIC position unless the following conditions exist:

- Master switch in ON position
- Automatic approach switch in AUTOMATIC PILOT position
- Aileron and rudder servo engaging switches in ENGAGE position
  Pilot's turn knob in detent
- Observer's turn knob in detent.

OBSERVER'S CONTROLLER

(1)

An automatic pilot turn controller (10, figure 4-28) is installed at the observer's station and has the controls to allow the observer to fly the airplane directionally by means of coordinated turns. The controller is energized when the pilot's turn control transfer switch is placed in BOMBARDIER position.

(2)

On some airplanes, the automatic pilot turn controller is installed under the pilot's floor and is inaccessible during flight. Manual directional control of the airplane cannot be accomplished by the observer.

(1) AF 51-2357 thru 52-176, -202 thru -330, -394 thru -535
(2)* AF 51-2192 thru -2356, 52-177 thru -201, -331 thru -393, -536 & on

(1)

OBSERVER'S TURN KNOB. A turn knob (1, figure 4-27) located on top of the controller functions in the same manner as the pilot's turn knob and is energized to permit the observer to make turns when the turn control transfer switch is in BOMBARDIER position. The knob should be in the detent or center position when not in use.

(2)

On some airplanes, the observer's turn knob is not used for directional control of the airplane. The knob shall always be in detent or center position to allow radar bombing and navigation system control of the airplane.

(1)

OBSERVER'S CONTROL SWITCH. A control switch (2, figure 4-27) on the observer's controller has AUTOMATIC and MANUAL positions. AUTOMATIC position transfers control of the automatic pilot to the radar bombing and navigation system. The switch will automatically move to MANUAL position when the pilot's or observer's turn knob is rotated out of detent or when the radar system completes the bomb release cycle. MANUAL position provides turn control operation from the observer's turn knob.

(2)

On some airplanes, the observer's control switch is locked in AUTOMATIC position enabling the radar bombing and navigation system to directionally control the airplane whenever the pilot places his turn control transfer switch in K BOMB AUTOMATIC position.

AUTOMATIC APPROACH SWITCH

An automatic approach switch (9, figure 4-26) on the pilot's automatic pilot controller support has AUTOMATIC PILOT--LOCALIZER--APPROACH positions. The normal position of the switch is AUTOMATIC PILOT. LOCALIZER position of the switch controls the lateral position of the airplane after the localizer beam has been intersected. The APPROACH position controls both the lateral and vertical positions of the airplane after the glide path beam has been intercepted. Placing the switch in APPROACH position automatically trips the altitude control switch to OFF. On some airplanes the automatic approach switch panel is edge-lighted and has AUTOPILOT--LOC--APPR positions. The abbreviated switch positions represent automatic pilot, localizer, and approach positions and have the same function as stated above.

AUTOMATIC PILOT INDICATORS

TRIM INDICATORS

Three trim indicators (3, figure 4-26) located on the front of the pilot's automatic pilot controller provide a visual indication that rudder, aileron, or elevator axes are in-trim or out-of-trim while the automatic pilot is engaged. Needle deflection while automatic pilot is engaged indicates that servos are exerting force against out-of-trim forces. Deflection of the needles before the automatic pilot is engaged indicates automatic pilot malfunction since normally the automatic pilot is synchronized with the changing attitudes of the airplane.

AUTOMATIC-APPROACH-READY LIGHT

A green automatic-approach-ready light (1, figure 4-26) is located above the automatic approach switch on the automatic pilot controller support. The light will illuminate when the localizer and omni-range receiver is turned on and tuned to a localizer frequency and when the automatic pilot master switch is ON. The light will go out when the automatic approach switch is placed in APPROACH position.

AUTOMATIC-PILOT-OFF LIGHT

A red automatic-pilot-off light (40, figure 1-8 and 37, figure 1-9) above the engaging switches will blink whenever the automatic pilot is disengaged on all three axes.

(3)

The automatic-pilot-off light will go out when the controller support actuator switch is placed in stow position.

(4)

The automatic-pilot-off light will go out when the controller support is locked in the stowed position.

(5)

The pilot or copilot can turn off the automatic-pilot-off light at his discretion by depressing his automatic pilot release switch on the control wheel.

NOTE

Automatic-pilot-off light is inoperative on some airplanes and is indicated by a placard on the pilot's instrument panel adjacent to the automatic pilot engaging switches and automatic-pilot-off light.

AUTOMATIC PILOT READY LIGHT

A green light marked "Autopilot Ready" is located adjacent to the observer's oxygen regulator. The light will illuminate when the pilot's turn control transfer switch is placed in BOMBARDIER or K BOMB AUTOMATIC position to indicate that directional control transfer has been accomplished.

NORMAL OPERATION OF THE AUTOMATIC PILOT

Normal operation of the automatic pilot may be accomplished by the following procedure:

(3)

a. Place the controller support actuator switch in extend position to extend the automatic pilot support and controller within reach.

(1) AF 51-2357 thru 52-176, -202 thru -330, -394 thru -535
(2) AF 51-2192 thru -2356, 52-177 thru -201, -331 thru -393, -536 thru 53-1849, -2028 thru -2117, -2261 thru -2349
(3) AF 51-2357 thru -5234, 52-019 thru -049, -202 thru -220
(4) AF 51-2192 thru -2356, -5235 thru -7083, 52-050 thru -201, -221 & on
(5) AF 53-1850 thru -1972, -2104 thru -2170, -2350 & on

(1)

Press the controller support release button and extend the automatic pilot support and controller within reach.

b. Trim the airplane with the manual trim controls for hands-off flight. An airplane that is not trimmed properly will impose an unnecessary load on the automatic pilot and produce undesirable flight characteristics.

NOTE

Out of trim condition is evidenced by one or more of the trim indicator needles, on the pilot's controller, being steadily displaced from center reference.

c. Check that all servo engaging switches are in DISENGAGE.

d. Check turn control transfer switch in PILOT or PILOT MANUAL.

e. Check automatic pilot controller for:

- Turn knob in detent
- Bank angle limiter selector ★★ in MIN position
- Aileron trim knob centered
- Automatic pilot master switch OFF

f. Check automatic approach switch on AUTOMATIC PILOT.

WARNING

The automatic approach switch must be in AUTOMATIC PILOT position during all normal automatic flights. If the switch were inadvertently left in one of the other positions during normal automatic flight, there is a possibility of violent control action if the airplane were to pass over an omni-range station.

g. Check that N-1 compass inoperative light★ is not illuminated.

h. Place automatic pilot master switch ON.

i. Check that trim indicators are in center reference position.

WARNING

If any trim indicator needle is not in center reference position before engaging servos, malfunction of the automatic pilot is indicated and the servo for this axis should not be engaged. To do so may result in a violent maneuver when that servo is engaged.

j. Place servo engaging switches in ENGAGE.

NOTE

Servos may be engaged when in a normal climb or descent and the airplane will continue to fly in that attitude until the pilot moves his pitch knob.

CAUTION

Do not engage automatic pilot when in a turn.

k. The airplane is now under automatic control on all three axes.

NOTE

When using the automatic pilot during the dropping of the heavier sling-suspended special purpose bomb, the elevator axis should be disengaged. Refer to "Short Bomb Bay Configuration" in "Bombing System" this section for procedure to be used.

(2)

l. Set the bank angle limiter selector as follows:

(1) Rotate the turn knob full travel right or left.

(2) Rotate the bank angle limiter selector toward MAX until buffeting is detected.

(3) Retard the selector until buffeting is no longer detected (hold this position).

(4) Return turn knob to center.

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(1) AF 51-2192 thru -2356, -5235 thru -7083, 52-050 thru -201, -221 & on
(2) ★★ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
★ AF 51-2192 thru -7083, -17368 thru -17386, 52-059 thru -201, -293 & on

NOTE

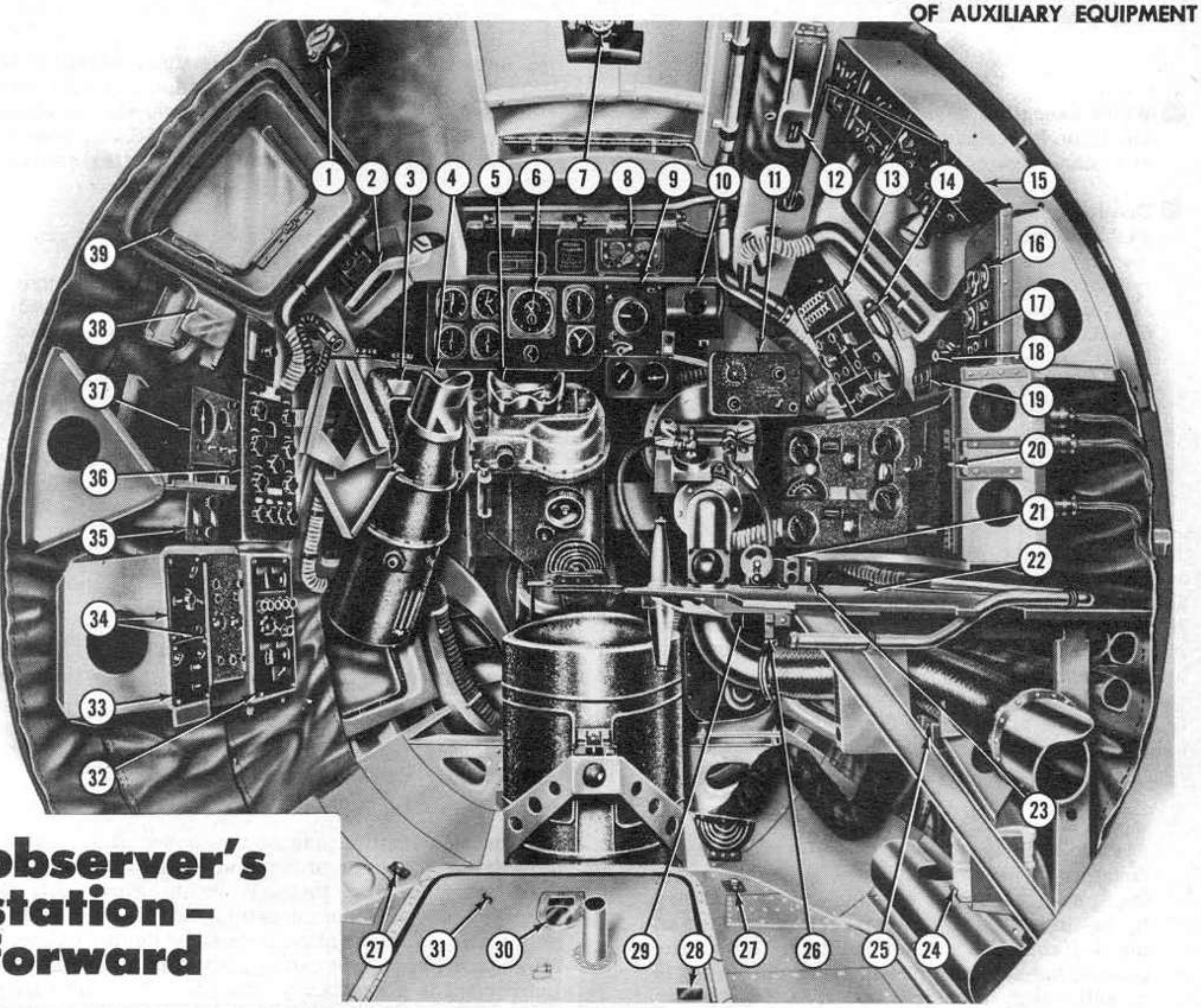
If the bank angle is established early in the mission, a recheck later in the mission will result in a different setting. (Refer to figure 5-3).

NOTE

- Any airplane axis may be flown manually by placing the servo engaging switch for that axis in DISENGAGE.
- The automatic pilot should be disengaged on the rudder axis when the N-1 compass inoperative light★ is illuminated which indicates the automatic pilot will be unable to hold a heading.
- (1) The automatic pilot rudder axis should also be disengaged whenever the heading pointer in the N-1 compass master indicator oscillates or moves erratically since a malfunction is indicated in the N-1 system. The rudder axis will be disengaged automatically if the N-1 compass system were to give the automatic pilot a hard-over signal.
- On airplanes having constant speed alternators, the rudder axis of the automatic pilot should be disengaged prior to turning on the emergency instrument inverter because simultaneous operation of one or both alternators and the emergency instrument inverter may result in erratic operation of the rudder axis.

m. Standard maneuvers may be executed with the pitch and turn knobs. Climb and descent are accomplished with the pitch knob; turns are made with the turn knob. A climbing or descending turn is made with a combination of the two knobs.

★ AF 51-2192 thru -7083, -17368 thru -17386, 52-059 thru -201, -293 & on
(1) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on



observer's station – forward

1. Emergency Bomb Arming Safe Handle
2. Emergency Escape Hatch Release Lever (1)
3. Radar Camera
4. Radar Scope
5. Bombsight
6. Observer's Instrument Panel
7. Periscopic Sextant Mount
8. Radar Power Monitoring Panel (2)
9. Oxygen Regulator Panel
10. Observer's Remote Turn Controller (3)
11. Bomb Release Interval Control Panel
12. Emergency Bomb Release
13. Bomb Control Panel
14. Manual Bomb Release Switch
15. Lighting Control Panel
16. Aerial Camera Intervalometer
17. Aerial Camera Control Panel
18. Oxygen Warning Light
19. Interphone Panel (4) Intercom Panel (5)
20. Lower Air Shutoff Knob (6)
    Lower Air Heater Control Panel (7)
21. Bombsight Cover Retracting Crank (8)
22. Observer's Work Table
23. Bombsight Cover Heater Switch Panel (8)
24. Relief Containers
25. Air Refueling Accumulator Pressure Gage
26. Air Refueling Emergency Door Handle
27. Microphone Foot Switch
28. Downward Ejection Hatch Pressure Gage
29. Observer's Data Drawer (9)
30. Lockpin Inspection Window
31. Downward Ejection Hatch
32. Navigation — Computer Control Panel
33. Rendezvous Radar Control Panel
34. Radar Camera Control Panels
35. T-35 IFC Unit
36. Radar Control Panel
37. T-19 IFC Unit
38. Emergency Escape Hatch Release Handle (10)
39. Emergency Escape Hatch (10)

(1) AF 51-2357 thru 52-041, and -202 thru -235

(2) AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, and 53-2261 thru -2278

(3) AF 51-2357 thru 52-176, -202 thru -330 and -394 thru -535

(4) AF 51-2192 thru -2411 and 52-019 thru -028

(5) AF 52-177 thru -201 and -331 & on

(6) AF 52-363 thru -393

(7) AF 51-2192 thru -2356 and 52-584 & on

(8) AF 51-2192 thru -2356, 52-158 thru -201, and -312 & on

(9) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, and -508 & on

(10) AF 51-2192 thru -2356, 52-042 thru -201, and -236 & on

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Figure 4-28.

NOTE

- While executing any of the above maneuvers the trim indicators will deflect momentarily and center again.
- Due to the effects of gimbal error in the compass system heading reference gyro, wing-low and skidding may sometimes result immediately after rolling out of a medium to steeply banked turn. This uncoordinated condition, after rollout at high speeds, may sometimes be severe enough to cause disengagement of the rudder axis. These effects can be minimized and the turn recoveries considerably improved by starting the rollout early and returning the turn knob to detent slowly after the bank angle has been reduced to approximately 5° to 10°.

n. During flight, check that trim indicators are in center position. The elevator trim tab servo will automatically trim the airplane about the pitch axis. If the aileron or rudder trim indicator is steadily displaced from center, that axis must be trimmed manually. Disengage and trim airplane about the axis. If a low wing condition is encountered and the aileron trim needle is aligned, the condition may be corrected by use of the automatic pilot aileron trim knob.

NOTE

Erratic heading control may sometimes be encountered, particularly on a northerly heading. A more stable heading can be obtained by setting the latitude correction pointer of the N-1 compass master indicator to the latitude of the airplane position and operating in directional gyro mode.

o. When it is desirable to maintain a specific pressure altitude, place the altitude control switch ON. The airplane will fly at a constant pressure altitude and pitch control is inoperative. Place the altitude control switch in OFF and the airplane will return to the pitch attitude flown before the switch was turned on.

CAUTION

A pitch change will occur if the altitude control switch is placed in OFF position after

- Changing airspeed more than 50 knots from initial controller engage speed - flaps up
- Reducing airspeed below 145 knots - flaps down
- Changing wing flap settings
- The weight of the airplane has been decreased appreciably.

p. Automatic pilot control may be disconnected at any time by pressing the pilot's or copilot's disconnect switches on the respective control wheels, by placing the servo engaging switches in DISENGAGE position, or by placing the automatic pilot master switch in OFF.

NOTE

While master switch is ON and servos are disengaged the signal system is synchronized to changing attitudes of the airplane and the automatic pilot is ready for engagement. When the master switch is OFF the signal system is not synchronized, but the electrical units are still warm and the gyros are erected.

q. Place master switch OFF before stowing controller and controller support.

(1)

r. Stow controller and controller support by placing actuator switch in the retract position.

(2)

Stow controller and controller support by pushing release button and moving controller support to stowed position.

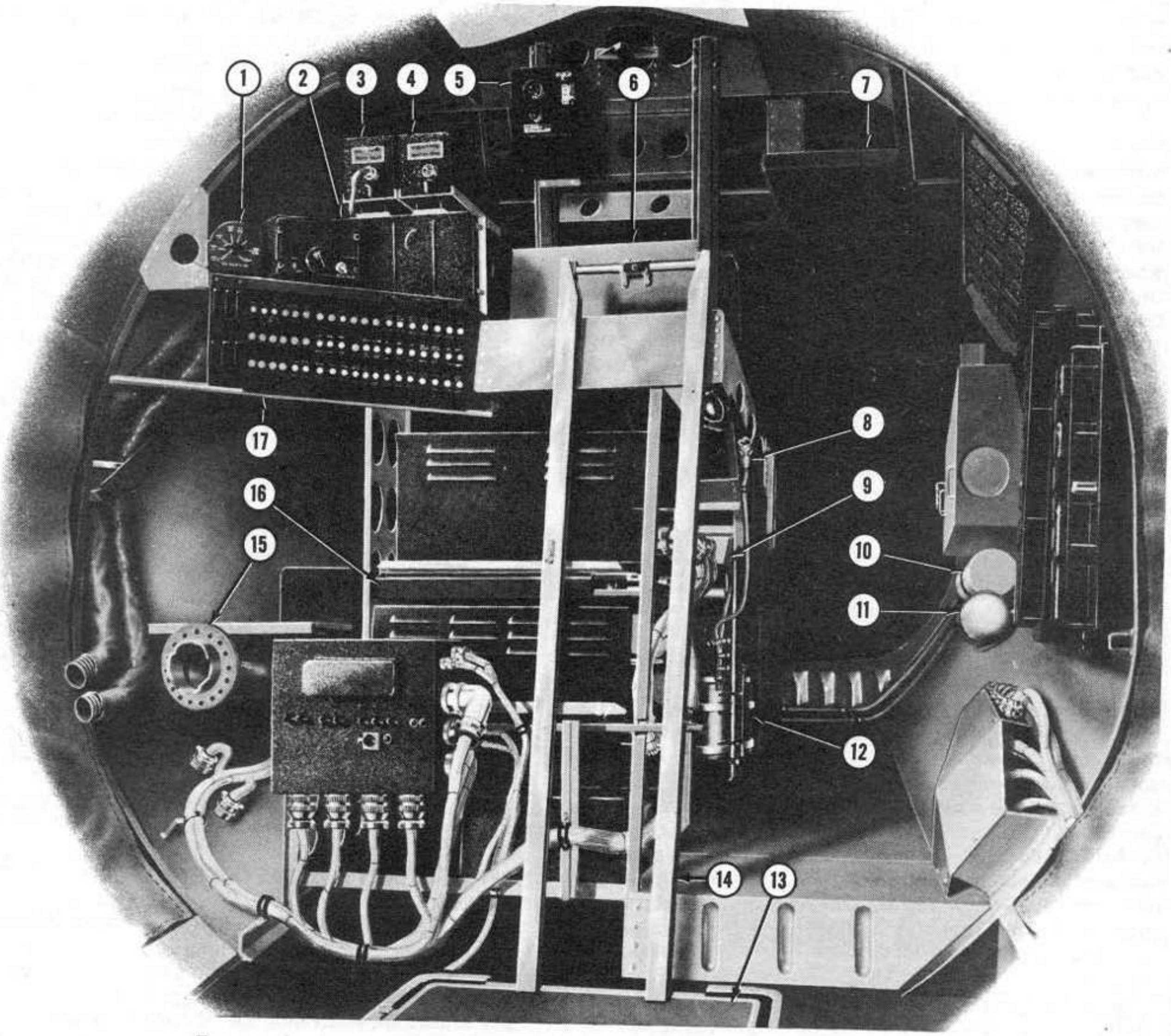
EMERGENCY OPERATION OF AUTOMATIC PILOT

The automatic pilot may be overpowered manually at any time. If failure of automatic pilot control on any axis is encountered, that axis should be manually disengaged allowing the remaining axes to be used. If automatic pilot operation is desired during bailout or any emergency operation requiring crew member movement in the walkway, the controller and support assembly may be stowed while the automatic pilot is operating and operation will continue unaffected. Automatic pilot control may be discontinued at any time by the pilot or copilot depressing his automatic pilot release switch on his control wheel.

NAVIGATION EQUIPMENT

An observer's station is installed in the nose (figures 4-28 and 4-29). The observer's seat is centrally located and may be swiveled to the left and right to facilitate use of the adjacent navigation, bombing, and radar equipment. Celestial navigation windows are installed above the observer's seat and in each sidewall. No driftmeter is provided as the bombsight may be used to take drift readings. Navigation equipment arranged within reach of the observer when seated includes remote turn controller*, instrument panel,

(1) AF 51-2357 thru -5234, 52-019 thru -049, -202 thru -220
(2) AF 51-2192 thru -2356, -5235 thru -7083, 52-050 thru -201, -221 & on
* AF 51-2357 thru 52-176, -202 thru -330, -394 thru -535



observer's station—aft

1. Cabin Air Outlet Selector (1)
2. Observer's Intercom Panel (2)
3. Air Refueling Signal Amplifier
4. Spare Air Refueling Signal Amplifier
5. Radar Pressurizing Control Panel
6. Spare Light Bulb Stowage Box
7. Pilot's Data Drawer
8. Observer's Relief Horn (3)
9. Relief Containers
10. Observer's Anti-Exposure Suit
11. Portable Oxygen Bottle
12. Chemical Toilet (Some Airplanes)
13. Downward Ejection Hatch
14. Ejection Seat Rails
15. Air Refueling Manifold
16. Observer's Pencil Box
17. Radar Power Panel

(1) AF 51-2357 thru 52-362 and -394 thru -583

(2) AF 51-2412 thru -17386, 52-029 thru -176, -202 thru -330

(3) AF 52-593 & on

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Figure 4-29.

worktable with pencil box, navigation-computer control panel, radar control panel, radar scope, horizontal bombsight, radar bombing-navigation system control panels, and polar navigation units.

(1)

The optical dome of the Y-4 bombsight is protected by a retractable cover which is controlled by a handcrank on the observer's table (21, figure 4-28). Approximately eleven turns clockwise of the handcrank opens the cover and approximately eleven turns counterclockwise retracts the cover. Facility of operation may be impaired at speeds in excess of 350 knots since airloads tend to cause binding of the retractable portion of the cover. The retractable cover should be closed at all times during flight at low altitudes and during climbs to and descent from cruising altitude. The bombsight cover is anti-iced by electric heaters installed within the cover. See "Anti-Icing and Deicing Systems," this section.

PERISCOPIC SEXTANT

A Type MS-20811 periscopic sextant is provided in the airplane and is stowed in a case (19, figure 1-16) mounted on the walkway step just aft of the pressure door. On some airplanes stowage brackets for the sextant case are provided on the left sidewall of the walkway just forward of the pressure door. On some airplanes ★another Type MS-20811 periscopic sextant (8A, figure 4-34) is provided and stowed in a case on the right sidewall aft of the copilot's seat. A periscopic sextant mount for use by the observer is located above the observer's seat and, on some airplanes★★, a mount for use by the copilot is installed in the aft end of the canopy. The periscopic sextant and sextant mounts contain lights which are supplied power through a circuit breaker on the radar power panel on some airplanes and the aft DC power panel on other airplanes.

CAUTION

Exercise extreme care in handling or operating the sextant to prevent possible damage to the operating or adjusting controls and optical components. The control limits must not be exceeded or forced under any conditions or sextant damage may result.

N-1 COMPASS SYSTEM

The N-1 compass system is a remote-indicating compass system having a directional gyro which provides the directive force to position and stabilize the heading indication at all times. The system has "magnetic slaved" or "directional gyro" operational modes which provide an accurate directional reference for all latitudes. Operation as a magnetic slaved compass may be used in any locality except near the magnetic poles or areas where severe magnetic distortion occurs. When in magnetic slaved operation, the system is slaved to a remote compass transmitter. Operation as a directional gyro may be used in any latitude but is especially useful where the magnetic field is weak or distorted or when used for grid navigation in the polar regions. When in directional gyro operation, the system operates free of magnetic influence as a directional gyro having an arbitrary gyro heading reference as selected by the observer. The heading indication is latitude corrected for apparent gyro drift due to the earth's rotation. The N-1 compass system supplies directional reference control to the automatic pilot system and directional reference information to the radio compass and localizer and omni-range indicators. A master indicator having the operational controls is installed on the observer's instrument panel and a repeater indicator is installed on the pilot's instrument panel.

(2)

On some airplanes the N-1 compass system receives power from the main instrument inverter bus, main inverter bus, and the DC system, and is operating at all times when power is available on those buses. Equipment is protected by fuses and circuit breakers in the main AC power shield and on the lower DC power panel.

(3)

On other airplanes the N-1 compass system receives power from the constant speed alternators and DC system. Equipment is protected by fuses and circuit breakers in the radar power panel, forward AC power shield, and lower DC power panel.

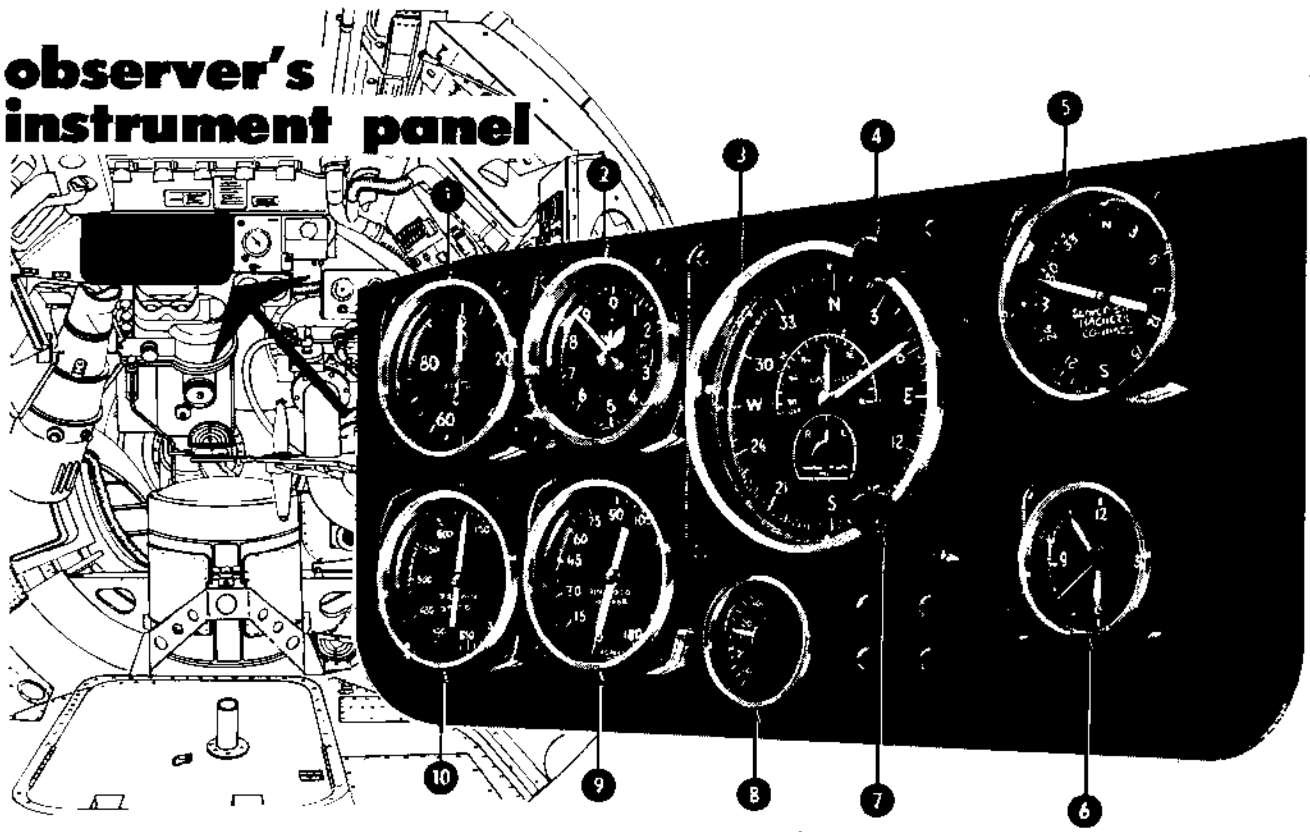
N-1 COMPASS SYSTEM CONTROLS

LATITUDE CORRECTION KNOB. A latitude correction knob (4, figure 4-30) located on the upper right side of the master indicator provides selection of the magnetic slaved or directional gyro operational modes. The knob also positions the latitude correction pointer and latitude correction mechanism to correct the heading indication for the apparent drift of the gyro while the system is in the directional gyro mode.

SYNCHRONIZER KNOB. A synchronizer knob (7, figure 4-30) located on the lower right side of the indicator provides a manual means to rapidly synchronize the heading pointer to the correct magnetic heading when the system is in magnetic slaved operation or to set the heading pointer to the desired gyro heading datum when in directional gyro operation. The synchronizer knob should be used in conjunction with the annunciator on the master indicator when in magnetic slaved operation.

DIAL KNOB. A dial knob on the pilot's repeater indicator provides a means of manually rotating the dial

★ AF 53-1835 thru -1972, -2090 thru -2170, -2332 & on
★★ AF 51-2192 thru -2356, 52-612 & on
(1) AF 51-2192 thru -2356, 52-158 thru -201, -312 & on
(2) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(3) AF 52-1417, 53-1819 thru -2170, -2279 & on



1. Indicated Airspeed Indicator ①
   True Airspeed Indicator ②
2. Altimeter
3. N-1 Compass Master Indicator
4. N-1 Compass Latitude Correction Knob
5. "K" System Compass Indicator ③
6. Clock
7. N-1 Compass Synchronizer Knob
8. Free Air Temperature Gage
9. "K" System Time-to-Go Indicator
10. "K" System Airspeed Indicator

① AF 51-2357 thru -7040, -15804 thru -15812, 52-019 thru -058, -202 thru -210

② AF 51-2192 thru -2356, -7041 thru -7083 -17368 thru -17386, 52-059 thru -201,-211 & on

③ AF 51-2357 thru 52-362 and -394 thru -583

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Figure 4-30.

through 360° without changing the indication of the pointer.

N-1 COMPASS SYSTEM INDICATORS

MASTER INDICATOR. A master indicator (3, figure 4-30) located on the observer's instrument panel provides control of the N-1 compass system and provides airplane heading information and indication of system operational modes. The heading pointer and scale indicate the correct magnetic heading of the airplane when the system is in slaved magnetic operation and give the airplane heading reference to the preselected gyro heading datum when the system is in directional gyro operation.

NOTE

> Erratic movement or oscillation of the heading pointer indicates that there is a malfunction in the N-1 compass system and the master and repeater indicators cannot be relied upon. The automatic pilot rudder axis should be disengaged if operating.

A latitude correction scale has OFF and 90° N through 0° to 90° S markings and is graduated in 2° increments. When the latitude correction pointer indicates OFF, the system is operating as a magnetic slaved compass system. When the pointer is out of OFF position and is indicating a latitude, the system is operating in the directional gyro mode. The latitude indicated is the latitude for which correction is applied to the heading pointer due to apparent drift of the gyro. An annunciator scale and pointer indicate the direction in which to rotate the heading pointer to synchronize it while in magnetic slaved operation. The heading is synchronized when the annunciator is on the center index mark.

REPEATER INDICATOR. A repeater indicator (20, figure 1-8 and 15, figure 1-9) is installed on the pilot's instrument panel and contains a scale and heading pointer which give the same reading as given by the master indicator.

(1)

N-1 COMPASS INOPERATIVE LIGHT. An amber N-1 compass inoperative light (6, figure 1-8 and 18, figure 1-9) is located on the pilot's instrument panel. When illuminated the light indicates that the entire N-1 compass system is inoperative and therefore the master and repeater indicators cannot be relied upon, that directional reference information will no longer be supplied to the radio compass and localizer and omnirange indicators, and that directional reference control is no longer supplied to the automatic pilot rendering it unable to hold a heading.

NOTE

When the N-1 compass inoperative light is illuminated, the compass card on the ID-250 RMI indicator and the heading pointer in the ID-249 localizer indicator will be rotated to the 0° position. The RMI will indicate bearing from the airplane; the heading pointer will be inoperative.

NORMAL OPERATION OF N-1 COMPASS SYSTEM

On some airplanes* the N-1 compass system is operating when the power is available from the instrument inverter bus, main inverter bus, and the DC system. On other airplanes** the N-1 compass system is operating when the power is available from the constant speed alternators and DC system.

Operation of the N-1 compass system is controlled by the observer as given by the following procedures:

MAGNETIC SLAVED OPERATION

a. If magnetic slaved operation is desired, rotate the latitude correction knob until the latitude correction pointer reads OFF.

NOTE

The system should be synchronized before use as a magnetic slaved compass since airplane movement on the ground without power may cause the system to be out of synchronization. The system will automatically synchronize itself, but only at a slow rate which may consume a large amount of time if far out of synchronization. Manual synchronization eliminates the time required.

b. Synchronize the master indicator by engaging and rotating the synchronizer knob until the annunciator pointer is on the center index. The synchronizer knob must be rotated counterclockwise when the annunciator pointer is in the L area of the scale and clockwise when the annunciator pointer is in the R area of the scale.

c. Check the heading pointer reading with the copilot's standby compass to assure that the system synchronization was not attempted on the 180° from correct heading. Once the system is correctly synchronized, the heading pointer will indicate the magnetic heading of the airplane continuously. During automatic pilot operation, the system will hold the airplane on a constant magnetic heading.

NOTE

- During turns, the annunciator pointer may swing to the L or R area of its scale indicating a normal condition requiring no correction. Do not attempt to reposition the master indicator heading pointer during or immediately after turns since the system will remain in synchronization during and after the turn.
- When on automatic pilot operation, rotation of the synchronizer knob from the synchronized position will cause the airplane to alter course at approximately 3° per minute and assume the new heading set on the master indicator heading pointer.

DIRECTIONAL GYRO OPERATION

a. If directional gyro operation is desired, rotate the latitude correction knob clockwise until the latitude correction pointer indicates the latitude of the airplane position. The system is then independent of the magnetic compass equipment and latitude correction for apparent gyro drift is given to the heading pointer.

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* AF 51-2192 thru 52-1416,-3343 thru -3373, 53-2261 thru -2278
** AF 52-1417, 53-1819 thru -2170, -2279 & on
(1) AF 51-2192 thru -7083, -17368 thru -17386, 52-059 thru -201, -293 & on

NOTE

As the airplane changes latitude in flight, the latitude correction pointer should be reset (at approximately 2° intervals) to the new latitude.

b. Set the master indicator heading pointer to the desired gyro heading datum by means of the synchronizer knob. The gyro reference datum is not referenced to a geographical coordinate system and, if a constant heading is flown, the path of the airplane will be a great circle course under a no-wind condition.

NOTE

- Repositioning the heading pointer by means of the synchronizer knob will cause only a change in the heading datum and will not cause the airplane to change heading whether on automatic pilot operation or not.
- The synchronizer knob should not be rotated without checking or recording the old and new headings on the master indicator; otherwise, the basic heading datum may be lost.

EMERGENCY OPERATION OF THE N-1 COMPASS SYSTEM

There are no provisions for emergency operation of the N-1 compass system. In case of failure of the system, the standby compass or the radar bombing-navigation system may be used to obtain directional information.

BOMBING SYSTEM

The structure of the airplane provides a bomb bay section approximately 26 feet long extending from the forward to the aft wheel well. The design provides for five different bomb bay configurations; four short bomb bay configurations and one long bomb bay configuration. The short bomb bay configurations include a bomb load in only the front half of the available bomb bay area; the rear half being taken up by a built-in fuel tank. The fuel tank is not droppable and no bomb bay doors are provided in that area. The bomb load of the airplane is normally released by the normal bomb release system which can be operated either manually by manipulation of controls in the observer's station or automatically in conjunction with the radar bombing-navigation system. Manual operation of the normal bomb release system provides for unaimed selective, train, or salvo release and operation of bomb doors. Automatic operation of the normal bomb release system provides for bomb aiming, automatic selective, train, or salvo release and automatic operation of the bomb doors. The bomb doors are hydraulically operated and electrically controlled. In event of failure of the hydraulically operated door opening mechanism, the bomb doors may be unlatched by a manual cable release operated from the observer's station. Safety locks to prevent inadvertent closing of the bomb doors on the ground and wide-open support tools to hold the bomb doors in the extreme open (horizontal) position for loading bombs are provided and are stowed in the flyaway tool kit.

NOTE

Make sure all bomb door switches are placed in OFF position before installing bomb door wide-open support tools.

To prevent buffeting within the bomb bay when the bomb bay doors are open, three spoiler doors are installed on the underside of the fuselage ahead of the bomb bay. Either salvo, radar BNS, or normal bomb door switch operation, or alternate bomb door switch operation on some airplanes * will provide hydraulic actuation to automatically open the spoiler doors into the airstream, thereby deflecting the air in such a manner as to preclude buffeting in the bomb bay which would otherwise occur. The spoiler hydraulic system incorporates a hydraulic accumulator to provide pressure isolated from the main system to insure that pressure is available for retracting spoilers. The accumulator is equipped with a pressure gage which is located in the forward end of the bomb bay and shows spoiler system pressure or air preload pressure if spoilers have been operated and hydraulic pressure is bled down. A spoiler depressurizing valve is located in the bomb bay which allows the spoiler system to be bled down by maintenance personnel. Spoiler doors will retract automatically when any switch is used to close the bomb doors.

WARNING

(1)
Removing electrical power from the airplane or deenergizing the spoiler system while the spoilers are extended will cause the spoiler doors to retract with considerable speed and force.

NOTE

(2)
The spoiler door electrical control circuit is wired through the landing gear squat switch; therefore, the spoiler doors will not open during bomb door operation on the ground.

(1) AF 52-019 thru -028
(2)* AF 51-2192 thru -17386, 52-029 & on

Bombing system controls and indicators are located in the observer's station and on the pilot's instrument panel. The bomb release, bomb arming, and bomb door control systems are all DC powered with circuit breakers located on the radar power panel, the left main power shield, and the upper DC power panel; on later airplanes, the bomb arming control system receives regulated AC power from the main alternator power shield. Salvo power is obtained directly from the battery bus and is protected by a circuit breaker on the bomb salvo relay shield on some airplanes or on the pilot's ignition switch panel on other airplanes.

SHORT BOMB BAY CONFIGURATION

(1)

On some airplanes, the basic configuration of the airplane consists of a short bomb bay with provisions for a hook-suspended special purpose bomb. This configuration utilizes a Type U-2 bomb rack mounted in the top center of the bomb bay. Normal release of the U-2 rack is accomplished by electrically controlled pneumatic pressure supplied from two air bottles located in the bomb bay. Emergency release of the U-2 rack is accomplished by a manual cable system operated from the observer's station. On some airplanes, the U-2 rack can be locked and unlocked by a cable system manually operated from the copilot's station. Built-in bomb hoist beams in the bomb bay permit ready attachment of a bomb hoist for bomb loading operations. In addition, a crew station, platform, walkway, lights, bomb tools, manual arming knob, and vacuum system ★ are among items included in the bomb bay to facilitate inflight servicing of the bomb.

NOTE

The nomenclature U-1 and U-2 are used interchangeably and refer to the U-2 bomb rack.

(2)

On other airplanes, the basic configuration of the airplane consists of a short bomb bay with provisions for a sling-suspended special purpose bomb. This configuration utilizes a single sling used in conjunction with a Type U-2 bomb rack which is mounted in the top left side of the bomb bay. As in the hook-suspended configuration, the U-2 rack is normally released by electrically controlled pneumatic pressure, manually released by a manual cable system, and manually locked and unlocked from the copilot's station. An auxiliary service control bomb arming mechanism located in the bomb bay is provided to select drop characteristics of the sling-suspended special purpose bomb. The arming mechanism can be controlled electrically from the observer's station or manually from the copilot's station on some airplanes; on other airplanes the arming mechanism is controlled manually from the copilot's station. Ground bomb loading equipment must be employed as no built-in provisions for attachment of a bomb hoist are provided. The procedure recommended for automatic pilot operation when dropping the heavier sling-suspended special purpose bomb is to disengage the automatic pilot elevator axis and introduce the anticipated trim error as nose down trim just prior to the drop. The pilot must hold against the control column (pull force) enough to maintain level flight. Then at the instant of release, the pilot relaxes force or reverses column load as required, and makes such small trim change as necessary to eliminate any residual trim error.

NOTE

On airplanes having the sling-suspended special purpose bomb configuration, the hook-suspended special purpose bomb configuration is considered as an alternate. Items of equipment necessary for an operable hook-suspended configuration are stowed in the flyaway equipment box to readily permit conversion to that configuration.

In addition to the configurations as stated above, two master kits are supplied to provide the necessary racks and accessories in the basic short bomb bay area to accommodate an alternate low density general purpose bomb bay configuration and, on some airplanes, an alternate maximum density general purpose bomb bay configuration (figure 4-31). Incorporation of these alternate configuration master kits requires removal of the U-2 bomb rack, bomb hoist beams, platform, and accessories as noted on loading charts located on the inside of the bomb bay. On some airplanes★★the selection of arming and detonating settings of general purpose bombs can be made from the observer's station at any time up to the time of release. Release of the various alternate configuration bomb loads is accomplished electrically. No provisions for manual release are provided. Ground bomb loading equipment must be employed as no built-in provisions for attachment of a bomb hoist are provided.

LONG BOMB BAY CONFIGURATION

Provisions are also made on some airplanes for master kits providing the necessary racks and accessories to accommodate a special maximum density bomb bay configuration (figure 4-31). Incorporation of the special maximum density bomb bay configuration master kits involves removal of the bomb bay fuel tank and supporting structure, replacement of the basic bomb doors with bomb doors extending the full length of the bomb bay section, installation of additional bomb door actuators, and installation of fairing structure at the rear end of the bomb bay. As in the alternate configurations, release of the bombs is accomplished electrically and no built-in provisions for attachment of a bomb hoist are provided.

★ AF 51-2192 thru 52-176, -202 thru -330, -394 thru -545
★★ AF 53-1850 thru -1972, -2104 thru -2170, -2350 & on
(1) AF 51-2357 thru 52-182, -202 thru -378, -394 thru -611
(2) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on

BOMBING SYSTEM CONTROLS

BOMBSIGHT COVER RETRACTING CRANK

A handcrank on the observer's table (21, figure 4-28) controls the Y-4 retractable bombsight cover approximately eleven clockwise turns of the handcrank open the cover and approximately eleven counterclockwise turns retract the cover. Facility of operation may be impaired at speeds in excess of 350 knots since airloads tend to cause binding of the retractable portion of the cover. The retractable cover should be closed at all times during flight at low altitudes and climbs to and descent from cruising altitude.

NOTE

Effects of the extended bombsight cover on airspeed indicators are discussed in "Pitot-Static Instruments," section I.

INDICATOR LIGHTS SWITCH

An ON--OFF indicator lights switch (8, figure 4-33) on the bomb control panel serves as a master bomb control switch. When the switch is in the ON position, power is supplied to a bomb control power switch, a nose fuse arming switch, a bomb door and release control switch, a special arming control heater, and bomb indicator lights. When the switch is in the OFF position, these circuits are deenergized.

BOMB CONTROL POWER SWITCH

An ON--OFF bomb control power switch (9, figure 4-33) is on the bomb control panel. When the switch is in the ON position, DC power is supplied to the power circuits in the bombing system and to the bomb arming control switch, and the bomb release control circuit is partially completed. When the switch is in the OFF position, these circuits are deenergized.

BOMB DOOR AND RELEASE SWITCH

A MANUAL--K2 AUTO switch (3, figure 4-33) on the bomb control panel is used to select either manual or automatic operation of the bombing system. When the switch is in the MANUAL position, the radar bombing-navigation system bomb door and bomb release circuits are disconnected from the bombing system, DC power is supplied to the normal bomb door control switch, and the bomb release control circuit is energized. When the switch is in the K2 AUTO position, the radar bombing-navigation system bomb door and release circuits are connected to the bombing system and the normal bomb door control switch and the bomb release control circuits are deenergized.

NOTE (1)

The U-2 rack lock handle must be placed in RACK UNLOCKED detent before radar bombing-navigation system release of the special purpose bombs can be accomplished.

NORMAL BOMB DOOR SWITCH

An OPEN--OFF--CLOSE switch (2, figure 4-33), spring-loaded to the OFF position, is on the bomb control panel. When the switch is actuated to the OPEN position, power is supplied to a bomb door valve which directs main hydraulic system pressure to open the bomb doors. When the switch is actuated to the CLOSED position, main hydraulic system pressure is similarly employed to close the bomb doors. When the switch is in the OFF position, the bomb door control circuit is deenergized.

ALTERNATE BOMB DOOR SWITCHES

An OPEN--OFF--CLOSE switch (5, figure 4-33) is on the bomb control panel and a similar switch (44, figure 1-8 and 41, figure 1-9) is on the pilot's instrument panel. When in the CLOSE position, the switches are spring-loaded to OFF. When either switch is in the OPEN position, power is supplied to operate the emergency hydraulic pump and actuate an alternate bomb door valve which directs emergency hydraulic pressure to open the bomb doors. When either switch is held in the CLOSE position, emergency hydraulic pressure is similarly employed to close the bomb doors. When the switches are in the OFF position, the emergency hydraulic pump and bomb door control circuits are deenergized.

(2) Operation of the alternate door switches will also actuate the spoiler doors in flight.

CAUTION

All alternate bomb doors switches must be placed in OFF position when not in use while bomb door wide-open support tools are installed. If a switch were left in OPEN position after installing bomb door wide-open support tools and power were restored to the airplane, the bomb doors would be damaged.

A third alternate bomb door switch is provided on the external AC power receptacle for use during ground operation. This switch has fixed OPEN, OFF, and momentary CLOSE positions. OFF and CLOSE positions are the same as the other alternate switches. When the switch is in fixed OPEN position, it prevents closing of bomb doors from any other location in the airplane.

U-1 ARMING SWITCH

A U-1 arming switch (19, figure 4-33) on the bomb control panel has ARM--off--SAFE positions. The switch is spring-loaded to the off position. When actuated to the ARM position, power is supplied to arm the special purpose bombs and illuminate a U-1 armed indicator light. SAFE position of the switch deenergizes the arming circuit and U-1 armed indicator light.

(1) AF 51-2192 thru -2356, 52-183 thru -201, -363 thru -393, -574 & on
(2) AF 51-2192 thru -17386, 52-029 & on

bomb loading chart

SHORT BOMB BAY (with bomb bay fuel tank)

BASIC CONFIGURATION	ALTERNATE CONFIGURATION	MAXIMUM DENSITY CONFIGURATION	
(1)▶ 1 — HOOK-SUSPENDED SPECIAL PURPOSE BOMB (2)▶ 1 — SLING SUSPENDED SPECIAL PURPOSE BOMB **NOTE** THE HOOK-SUSPENDED BOMB CONFIGURATION IS AN ALTERNATE FOR AIRPLANES HAVING THE SLING-SUSPENDED BOMB CONFIGURATION	1 — 4000 LB. GENERAL PURPOSE BOMB OR 3 — 2000 LB. GENERAL PURPOSE BOMBS OR 4 — 1000 LB. GENERAL PURPOSE BOMBS WITH LONG FINS OR 8 — 1000 LB. GENERAL PURPOSE BOMBS WITH BOX FINS OR CONICAL FINS	3 — 2000 LB. CONICAL FIN BOMBS OR 6 — 1000 LB. CONICAL FIN BOMBS OR 6 — 750 LB. CHEMICAL CLUSTERS OR	7 — 750 LB. GENERAL PURPOSE BOMBS OR 13 — 500 LB. CONICAL FIN BOMBS

LONG BOMB BAY (no bomb bay fuel tank)

SPECIAL MAXIMUM DENSITY CONFIGURATION		
1 — 12,000 LB. BOMB WITH 30 INCH LUGS OR 1 — 10,000 LB. GENERAL PURPOSE BOMB OR 4 — 5000 LB. GENERAL PURPOSE BOMBS OR	4 — 3000 LB. GENERAL PURPOSE BOMBS OR 6 — 2000 LB. CONICAL FIN BOMBS OR 18 — 1000 LB. CONICAL FIN BOMBS OR	21 — 750 LB. CHEMICAL CLUSTERS OR 21 — 750 LB. GENERAL PURPOSE BOMBS OR 28 — 500 LB. CONICAL FIN BOMBS

(1)▶ AF 51-2357 thru 52-182, -202 thru -378, -394 thru -611
(2)▶ AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on

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Figure 4-31.

U-2 ARMING KNOB

A PUSH-ARM--PULL-SAFE knob is provided on the arming control in the bomb bay for use in the event the U-1 arming switch is inoperative. When the knob is in the retracted position (pushed in), the special purpose bombs are armed manually, an ARMED marking adjacent to the knob is exposed, and the U-1 armed indicator light is illuminated. When the knob is in the extended (pulled out) position, the special purpose bombs are manually disarmed, a tab marked SAFE covers the ARMED marking, and the U-1 armed indicator light circuit is deenergized.

EMERGENCY BOMB ARMING SAFE HANDLE

A pull handle (1, figure 4-28) on the left sidewall of the observer's station just aft of the astral window provides an emergency means of disarming the special purpose bombs in the event that the U-1 arming switch is inoperative. When the handle is pulled, the U-2 arming knob on the bomb arming control in the bomb bay is moved to the SAFE position, disarming the bomb.

U-2 RACK LOCKING AND COCKING TOOLS

On some airplanes*, a combination L-shaped locking and cocking wrench is stowed on the tank deck in the immediate vicinity of the U-2 rack. Other airplanes** utilize a locking pin and a speed-type cocking wrench

* AF 51-2357 thru 52-058, -202 thru -235
** AF 51-2192 thru -2356, 52-059 thru -201, -236 & on

bomb door system

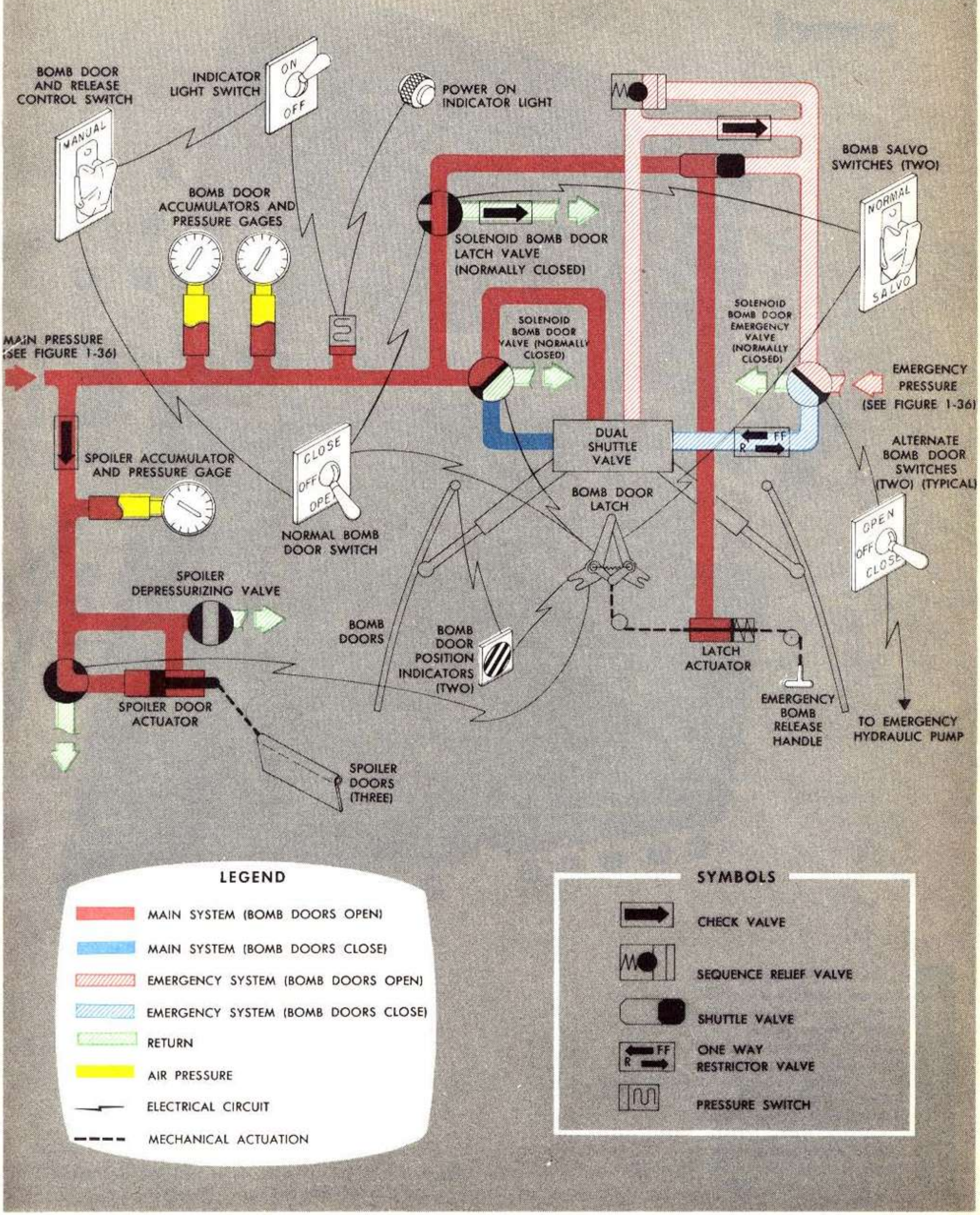

Figure 4-32.

bomb control panel

1. Bomb Indicator Lights
2. Normal Bomb Door Switch
3. Bomb Door and Release Switch
4. Bomb Release Switch
5. Alternate Bomb Door Switch
6. Bomb Door Position Indicator
7. Bomb Control Power and Indicator Light
8. Indicator Lights Switch
9. Bomb Control Power Switch
10. Bomb Salvo Switch
11. Bomb Control Selector Switch
12. Bomb Scoring Tone on Indicator Light
13. U-1 Rack Warning Light
14. Bomb Scoring Tone Switch
15. Drop Control Switch ①▶
16. Nose Fuse Arming Switch
17. Nose Fuse Armed Indicator Light
18. U-1 Air Pressure Low Warning Light
19. U-1 Arming Switch
20. Drop Control Indicator Light ①▶
21. U-1 Armed Indicator Light
22. Bomb Indicator Card Holder

①▶ AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 thru 53-1889, -2032 thru -2131, -2315 thru -2394

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Figure 4-33.

which are located in the immediate vicinity of the U-2 rack.

The U-2 rack is locked by probing the locking hole above the end of the emergency bomb release disconnect link with the pointed end of the combination wrench or the locking pin. Locking is required for engines in transit or when stores are being loaded.

The U-2 rack is cocked by placing the socket end of the combination wrench or the speed-type locking arm shaft on the bomb rack. By turning counterclockwise, the locking shaft will engage with the notch in the locking arm. Cocking is usually accomplished prior to flight and is required prior to release of store.

U-2 RACK LOCK HANDLE (1)

A T-handle (4, figure 1-17) with RACK LOCKED--RACK UNLOCKED positions is located on the copilot's aft left side adjacent to the ELGE stand. With the handle in RACK LOCKED position, the U-2 rack is locked preventing accidental release of the hook-suspended special purpose bomb. With the handle in RACK UNLOCKED position, the U-2 rack is unlocked and ready for normal release of the bomb. The handle is spring-loaded in the RACK LOCKED position with detents at both positions.

U-2 RACK LOCK AND BOMB DROP CONTROL HANDLE (2)

A T-handle (4, figure 1-17) with RACK LOCKED--RACK UNLOCKED--FREE FALL positions is located on the copilot's aft left side adjacent to the ELGE stand. With the handle in RACK LOCKED position, the U-2 rack is locked preventing accidental release of the sling-suspended special purpose bomb. With the handle in RACK UNLOCKED position, the U-2 rack is unlocked and ready for normal release of the bomb. FREE FALL position manually disarms the auxiliary service control bomb arming mechanism allowing the bomb to drop "free fall." The handle is spring-loaded to the RACK LOCKED position with detents at all three positions.

NOSE FUSE ARMING SWITCH

A circuit breaker type ARM--SAFE nose fuse arming switch (16, figure 4-33) is on the bomb control panel. When the switch is in the ARM position, power is supplied to arm the nose fuse of the general purpose bombs and illuminate the nose fuse armed indicator light. When the switch is in the SAFE position, the nose fuse arming and nose fuse armed indicator light circuits are deenergized.

WARNING

Armed salvo of general purpose bombs during high speed flight at low altitude could result in endangering the airplane due to premature explosion caused by turbulence in the bomb bay.

BOMB CONTROL SELECTOR SWITCH

A NORMAL--SALVO switch (11, figure 4-33) guarded in the NORMAL position is on the bomb control panel. When the switch is in the NORMAL position, the number of bombs to be dropped is determined by the setting on a bomb intervalometer. When the switch is in the SALVO position, all bombs will be dropped upon pressing the bomb release switch or upon impulse from the radar bombing-navigation system.

WARNING

When the airplane is on the ground with bomb bay doors open, actuation of any salvo switch to the SALVO position will salvo the bomb or bombs. The salvo circuit is wired directly from the battery and is independent of all other circuits.

BOMB RELEASE INTERVAL CONTROL SWITCH

A bomb release control switch on the bomb release interval control (11, figure 4-28) has SEL--TRAIN positions. SEL position of the switch allows general purpose bombs to be dropped singly. TRAIN position of the switch allows general purpose bombs to be dropped in train. One minute of warmup time should be allowed before train release.

BOMB RELEASE INTERVAL CONTROL COUNTER

A bomb release control counter on the bomb release interval control (11, figure 4-28) indicates the number of general purpose bombs to be released or not released. The counter is manually set to total bombs to be dropped.

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(1) AF 52-363 thru -378, -574 thru -611
(2) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on

BOMB RELEASE INTERVAL CONTROL GROUND SPEED AND SPACING DIAL

A ground speed and spacing dial on the bomb release interval control panel (11, figure 4-28) controls bomb interval timing. The dials are calibrated in ground speed mph and interval between bombs in feet.

BOMB RELEASE SWITCH

A push-button type bomb release switch (4, figure 4-33) attached to a flexible cable is stowed on the side of the bomb control panel. When the button is depressed with the bomb doors open, bombs as controlled by the intervalometer selector switch and/or the salvo control selector switch are released. General purpose bombs will be dropped tail-armed and nose-armed when the salvo selector switch is in NORMAL position and the nose fuse arming switch is in ARM position. With the salvo control selector switch in SALVO, the general purpose bombs will be dropped safe unless the nose fuse arming switch is in ARM position.

BOMB SALVO SWITCH

A SALVO--OFF bomb salvo switch (10, figure 4-33) is on the bomb control panel and a similar ON--OFF bomb salvo switch (3, figure 1-13) is on the pilot's ignition switch panel. Both switches are guarded and spring-loaded to the OFF position. When either switch is actuated to SALVO or ON position, control power is supplied directly from the battery to open the bomb doors and release the bomb load. Bombs will be dropped safe unless armed by the U-1 arming switch, U-2 arming knob, or nose fuse arming switch.

BOMB SALVO CIRCUIT BREAKER (1)

A conventional push-to-reset circuit breaker (2, figure 1-13) for the bomb salvo control circuit is located on the ignition switch panel. This circuit breaker enables the pilot to immediately determine if salvo power is available in the event salvo operation is necessary.

EMERGENCY BOMB RELEASE

A pull handle (12, figure 4-28) on the observer's right sidewall just above the observer's lighting panel provides a manual means for releasing the special purpose bombs. When the handle is pulled, cables unlatch the bomb doors and release the bomb. On some airplanes*, actuation of the pull handle will also unlock the U-2 rack.

CAUTION

The emergency bomb release is not intended for use with long bomb doors. Since the manual cable release does not unlatch the rear latch used with long doors, actuation of the pull handle will cause unpredictable damage to the bomb doors.

NOTE

(2)

The U-2 rack locking handle must be placed in RACK UNLOCKED detent before manual release of the special purpose bombs can be accomplished by the emergency bomb release handle.

BOMB BAY VACUUM PUMP SWITCHES (3)

Standby and normal ON--OFF switches are on the forward bomb bay bulkhead dome light bracket. When either switch is placed in the ON position, power is supplied to a normal or alternate vacuum pump which supplies vacuum for a bomb bay vacuum system used with the hook-suspended special purpose bomb.

BOMB SCORING TONE SWITCH

A bomb scoring tone switch (14, figure 4-33) mounted on the bomb control panel provides for initiation and manual cutoff of a D/F tone from the UHF command radio. Placed in the INITIATE position, the amber TONE ON indicator light (12, figure 4-33) illuminates and the tone continues until the first intervalometer release impulse occurs, when the tone is automatically interrupted and the light goes out. The tone may be manually stopped after initiation by placing the switch in CUTOFF position. The switch is spring-loaded to OFF position from both INITIATE and CUTOFF positions.

DROP CONTROL SWITCH (4)

A drop control switch (15, figure 4-33) on the bomb control panel has DELAY--off--FREE positions. The switch is spring-loaded to the center of off position. With the switch in DELAY position, the auxiliary service control bomb arming mechanism will be armed and the sling-suspended special purpose bomb will drop "delayed fall." With the switch in FREE position, the auxiliary service control bomb arming mechanism will be disarmed and the sling-suspended bomb will drop "free fall."

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(1) AF 53-1819 thru -1972, -2090 & on
(2) Some B-47B airplanes and AF 52-363 thru -378, -574 thru -611 which do not have T.O. 1B-47-241 accomplished
(3) AF 51-2357 thru 52-176, -202 thru -330, -394 thru -545
(4) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 thru 53-1819
* AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on

(1)

A drop control switch (15, figure 4-33) on the bomb control panel has DELAY--FREE positions.

NOTE (1)

> The drop control switch is inoperative. The auxiliary service control can be operated manually by the rack lock and bomb drop control handle.

BOMBING SYSTEM INDICATORS

BOMB RELEASE INTERVAL CONTROL INDICATOR LIGHT

An amber indicator light on the bomb release interval control panel (11, figure 4-28) illuminates whenever the instrument is set to pass single release impulses or timed impulses for train release of general purpose bombs.

BOMB INDICATOR LIGHTS

Amber bomb indicator lights (1, figure 4-33), one for each bomb position, are mounted at the top of the bomb control panel. Each light illuminated indicates a bomb in place on the bomb racks. When each bomb is released, its respective indicator light goes out. A bomb indicator card for each size of bomb is provided which, when placed in a holder mounted in front of the indicator lights, permits only the applicable lights for the respective bomb size to be visible. The bomb indicator cards are stowed in a holder mounted below the observer's work table or in observer's data drawer.

NOTE

(2)

> The indicator light for the U-2 rack cannot be relied upon for indication that a bomb is in place or has been released, since the bomb hook may assume an intermediate position other than fully open after the bomb has been released, thereby causing false indication. However, the indicator light will go out momentarily as the bomb is released.

U-1 RACK LOCKED WARNING LIGHT

A red light (13, figure 4-33) on the bomb control panel when illuminated indicates that the rack for the special purpose bomb is manually locked and must be unlocked manually before the bomb can be dropped.

BOMB CONTROL POWER ON INDICATOR

A green indicator light (7, figure 4-33) on the bomb control panel when illuminated, indicates that power is supplied to the bomb door and bomb release control circuits and that sufficient main hydraulic system pressure is available for bomb door operation.

U-1 ARMED INDICATOR LIGHT

An amber light (21, figure 4-33) on the bomb control panel when illuminated indicates that the bomb is armed.

DROP CONTROL INDICATOR LIGHT (3)

A red light (20, figure 4-33) marked "Free Fall" is located on the bomb control panel. The light when illuminated indicates that the sling-suspended special purpose bomb will drop "free fall."

NOSE FUSE ARMED INDICATOR LIGHT

An amber light (17, figure 4-33) on the bomb control panel when illuminated indicates that the nose fuses of the general purpose bombs are armed.

BOMB RELEASE AIR PRESSURE GAGE

Pressure indicators mounted in the bomb bay ceiling just aft of the forward bomb bay bulkhead, indicate U-2 bomb rack release air pressure in psi.

AIR PRESSURE LOW WARNING LIGHT

A red light (18, figure 4-33) on the bomb control panel when illuminated indicates that air pressure is insufficient for normal release of the special purpose bombs.

BOMBS AWAY INDICATOR LIGHT

An amber light (5, figure 1-8 and 1, figure 1-9) on the pilot's instrument panel will illuminate momentarily each time a bomb is released, except during salvo operation by using either salvo switch or the emergency manual bomb release.

BOMB DOOR POSITION INDICATORS

A Type C-1 bomb door position indicator (6, figure 4-33) on the bomb control panel and a similar indicator (2, figure 1-8 and 2, figure 1-9) on the pilot's instrument panel show positions of the bomb doors by means of interchangeable tabs which appear in the indicator window. When the bomb doors are closed and

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(1) AF 53-1820 thru -1889, -2032 thru -2131, -2315 thru -2394
(2) AF 51-2357 thru -5234
(3) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on

locked, a LOCK tab appears in the window; when the bomb doors are fully open, an OPEN tab appears; and when the doors are in any intermediate position, an alternately black and white striped tab appears.

NORMAL OPERATION OF BOMB DOORS

Bomb doors are normally operated by door switches at the pilot's or observer's station, or by radar BNS control.

CAUTION (1)

Spoiler doors will not extend when alternate bomb door switches are used to open the bomb doors and buffeting in the bomb bay may occur.

PILOT'S STATION

a. To open the bomb doors, place the pilot's alternate bomb door switch in the OPEN position. The bomb door position indicators will show an intermediate tab while doors are opening and an OPEN tab when the doors are fully open.

b. To close the bomb doors, hold the pilot's alternate door switch in the CLOSE position. The bomb door position indicators will show an intermediate tab while the doors are closing and will show a LOCK tab when the doors are fully closed and latched. When the LOCK tab appears, release the switch to the OFF position.

OBSERVER'S STATION

When the observer's station is occupied and sufficient main system hydraulic pressure is available, the bomb doors should be controlled by the normal bomb door switch.

a. Place the indicator lights and bomb control power switches in the ON position and check that the bomb control "Power On" indicator light illuminates.

b. Place the bomb door and release control switch in the MANUAL position.

c. To open bomb doors, actuate the normal bomb door switch to the OPEN position. The bomb door position indicator will show an intermediate tab while doors are opening and an OPEN tab when the doors are fully open.

d. To close the bomb doors, actuate the normal bomb door switch to the CLOSE position. The bomb door position indicator will show an intermediate tab while the doors are closing and a LOCK tab when the doors are fully closed and locked.

EMERGENCY OPERATION OF BOMB DOORS

In the event the normal bomb door control circuit is inoperative, the observer may control the bomb doors with the alternate bomb door switch. Operation is identical with that for the pilot's alternate bomb door switch. The bomb salvo switches and the U-2 emergency bomb release provide additional means for emergency opening of the bomb doors.

NOTE (2)

The approximate position of bomb doors may be visually checked by looking at the reflection of the underside of the fuselage in the polished inboard nacelle surfaces of engines No. 3 and 4.

FIRE CONTROL SYSTEM

A-5 FIRE CONTROL SYSTEM (3) (5)

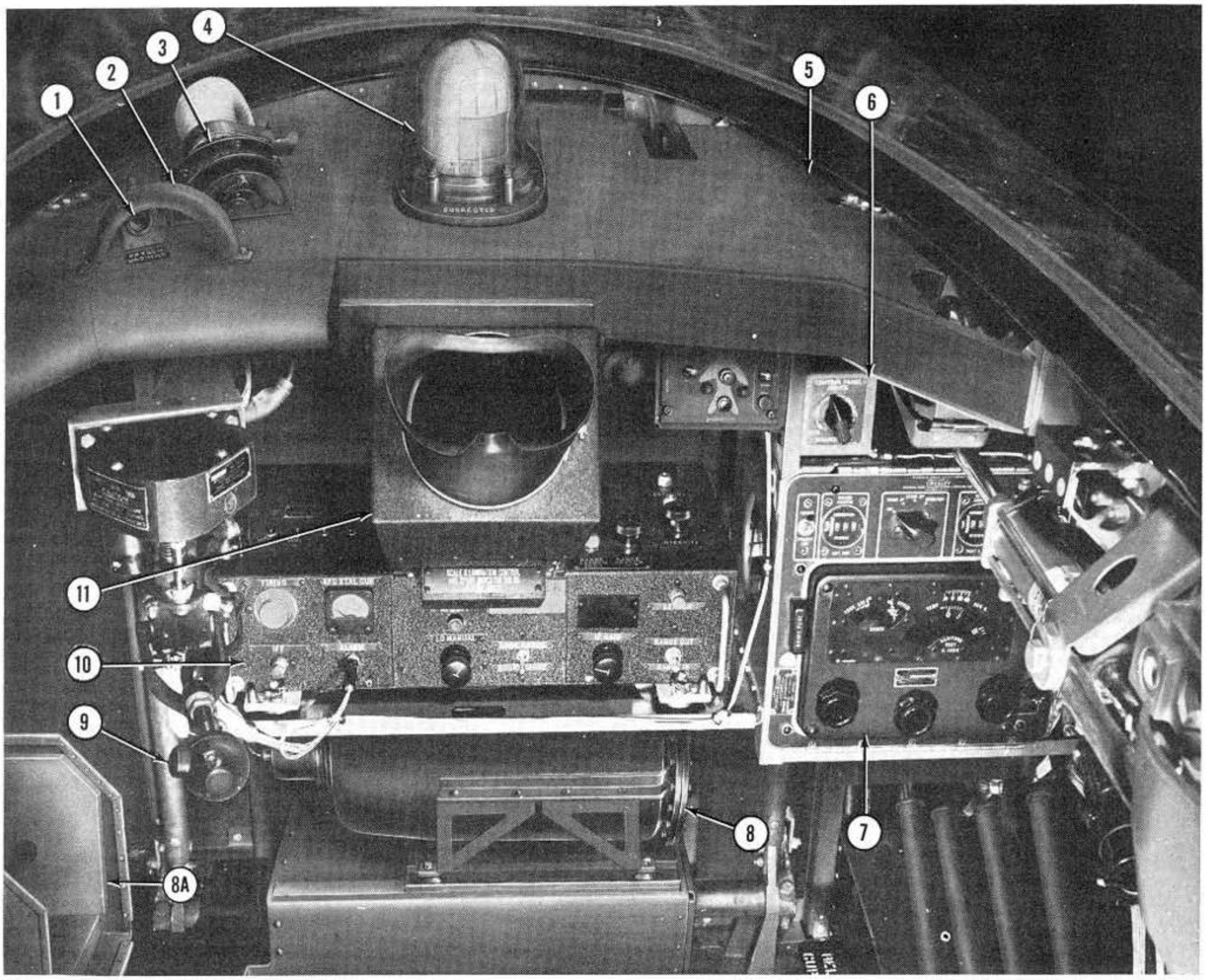
A Type A-5 fire control system provides the airplane with fire protection against pursuing hostile aircraft. To achieve this tail defense, the system performs the following functions:

- Automatically detects pursuing aircraft by means of radar and warns the copilot who also serves as gunner.
- Enables the gunner (copilot) to select the most dangerous of pursuing aircraft as a target for tracking by radar.
- Tracks automatically, by means of radar, the target selected by the gunner, continuously furnishing target position information for gun-positioning purposes.
- Continually corrects, by means of an electric computing network, the target position data to allow for parallax, ballistic, and lead errors.
- Continuously controls, during attack, the direction of the two turret mounted guns located in the tail of the airplane.

(4) (5)

A three-phase inverter, supplying 200-volt AC power to the system, is provided for and controlled by the A-5 fire control system. The system also uses DC power supplied through circuit breakers on the lower DC power panel; regulated single phase 115-volt AC power, supplied through circuit breakers in the main AC power shield; and unregulated single phase 115-volt AC power, supplied through a fuse in the unregulated AC power shield or the left alternator power shield and a fuse in the tail compartment power shield. A-5 external power receptacles are located in the battery compartment. These receptacles provide means for connecting external AC and DC power to the A-5 system for ground checking of the system.

(1) AF 52-019 thru -028
(2) AF 52-082 thru -201, -261 thru -393, -432 & on
(3) AF 51-2357, -2358, -2360, -2361, -2363 thru -2399, -2401 thru -2409, -2411 & on
(4) AF 51-2357 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(5) AF 51-2192, -2193, -2195 thru -2197, -2199 thru -2206, -2208 thru -2221, -2223 thru -2237, -2240 thru -2244, -2246, -2251, -2253, -2254, -2256 thru -2258, -2260 thru -2356



gunner's station (copilot's station—aft)

(A-5 FIRE CONTROL SYSTEM)

1. Oxygen Warning Light
2. Assist Handle
3. Upper Air Outlet
4. Radio Compass Loop Antenna (1)
5. Baffle Plate
6. Panel Lights Rheostat
7. A-5 Turret Control Panel
8. ARC-21 Antenna Coupler (2)
8A. Periscope Sextant Stowage (3)
9. A-5 Manual Antenna Control Handle
10. A-5 Indicator Control Panel
11. A-5 Gun-Laying Radar Scope

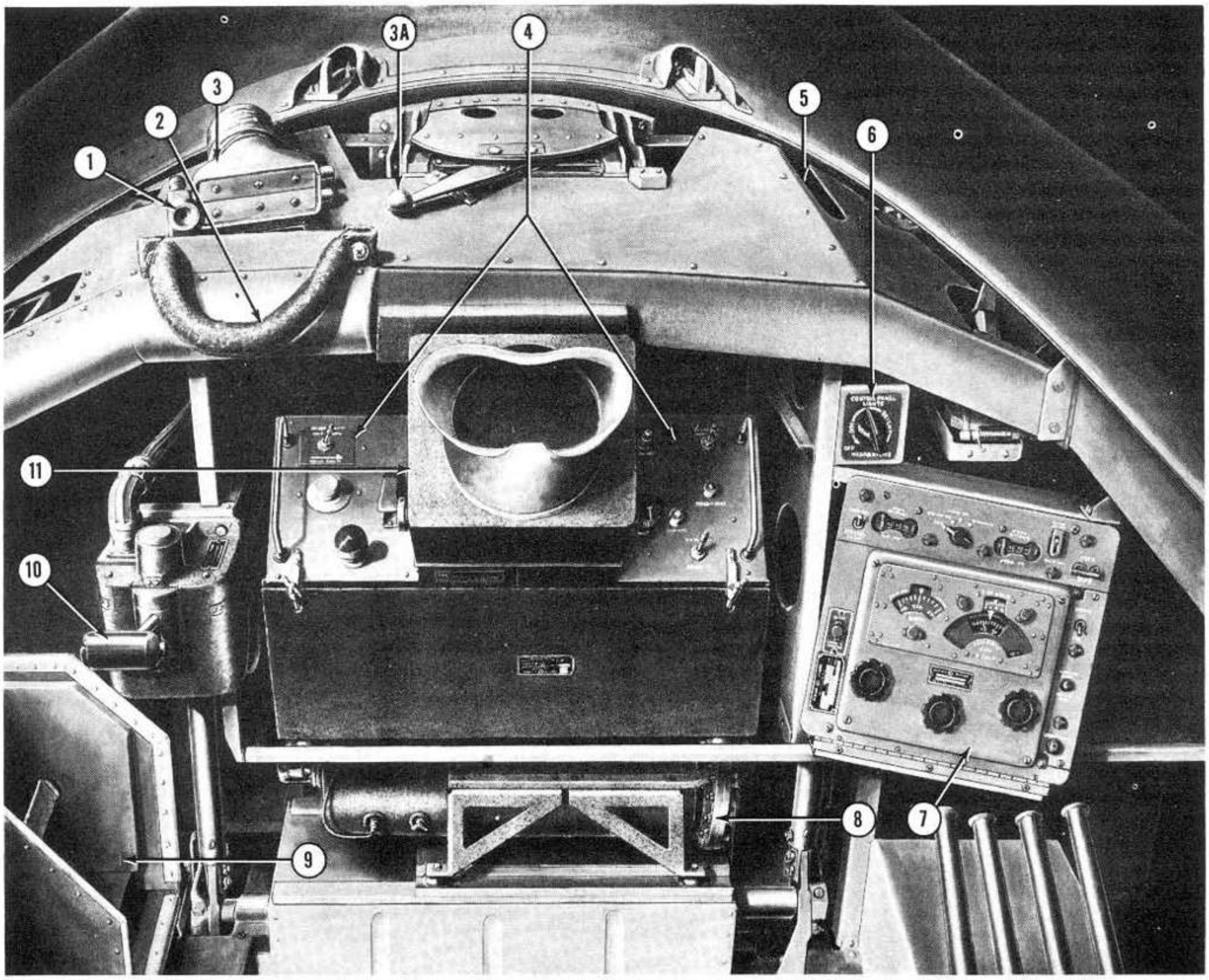
(1) AF 51-2192 thru 52-564

(2) AF 51-2192 thru -2356, 52-518 & on

(3) AF 53-1835 thru -1972, -2090 thru -2170, -2332 & on

50431WC-1

Figure 4-34.



gunner's station
(copilot's station—aft)

(MD-4 FIRE CONTROL SYSTEM)

①▶ AF 52-612 & on

1. Oxygen Warning Light
2. Assist Handle
3. Upper Air Outlet

3A. Canopy Hinge Pin Release Handle ①▶

4. MD-4 Indicator Control Panel
5. Baffle Plate
6. Panel Lights Rheostat
7. MD-4 Turret Control Panel
8. ARC-21 Antenna Coupler
9. Periscope Sextant Stowage
10. MD-4 Manual Antenna Control Handle
11. MD-4 Gun-Laying Radar Scope

50451 WC-1

Figure 4-34 A.

(1)

The system uses DC power supplied through circuit breakers on the lower DC power panel and single-phase 115-volt and three-phase 200-volt regulated AC power from the constant speed alternators supplied through circuit breakers in the tail compartment power shield. An A-5 external power receptacle is located in the battery or aft radar compartment. This receptacle provides means for connecting DC and three-phase AC to the A-5 system during ground checking of the system. An additional single-phase inverter is also provided for supplying constant frequency AC power to the A-5 system when precision testing of the equipment is necessary. The single-phase inverter is housed in a portable case and carried as flyaway equipment.

In addition, the fire control system is protected by additional circuit breakers and fuses located in the gunner's station. Six circuit breakers (2, figure 4-36) are thermally operated to protect the radar equipment from overload. A circuit breaker (7, figure 4-35) marked "DC Control Power" is located on the turret control panel and protects the DC control circuits in the turret control. A fuse (8, figure 4-35) marked "Fire Control Power" is located on the turret control panel and protects the AC gun firing circuits. A spare fuse (10, figure 4-35) for fire control power is located in a holder on the left side of the turret control panel.

A-5 FIRE CONTROL SYSTEM CONTROLS

All controls for the operation of the tail turret and gun-laying radar are located in the gunnery station aft of the copilot (figure 4-34). Many of the fire control system functions are performed automatically by the equipment. However, the gunner is required to place the system in operation; set altitude, airspeed, and air temperature functions into the computing system; manually select a specific target for tracking; monitor the tracking operation; and fire the guns when the radar scope indicates that the target is within range.

SELECTOR SWITCH. A selector switch (3, figure 4-35) is located on the turret control panel. The switch has OFF--WARMUP--STANDBY--OPERATE positions. In WARMUP position, power is supplied to the heaters in the gun and feed mechanism, and the heaters in the computer, gyro drive unit, and resolver input unit. In STANDBY position, power is supplied to energize most of the remaining equipment. A timing circuit introduces a 3 3/4-minute delay in application of power to some of the radar circuits. In OPERATE position, all equipment is energized providing the 3 3/4-minute delay has elapsed since the switch was placed in STANDBY, and the system is available for search, hand control, and track operation. OFF position turns off all equipment.

GUN SAFETY SWITCH. A two-position switch (5, figure 4-35) located on the turret control panel has FIRE--SAFE positions. FIRE position arms the AC and DC gun firing circuits. SAFE position disarms the gun firing circuits.

MANUAL HOLDBACK SWITCH. A two-position switch (4, figure 4-35) located on the turret control panel has HOLDBACK--RELEASE positions and is guarded in both positions. HOLDBACK position pulls back and holds back the gun bolts, provided the selector switch is in STANDBY or OPERATE position, which lessens the possibility of accidental firing by keeping the guns free of a chambered live round. RELEASE position releases the gun bolts to battery position, readying the guns for firing.

WARNING

HOLDBACK position will not prevent the guns from firing in the event the gun safety switch is in FIRE position and the firing button is depressed.

FIRING BUTTON. A firing button (1, figure 4-36) marked "Firing" is located on the left side of the indicator control panel. When actuated, the firing button energizes the firing circuit to fire the guns. Actuating the firing button will fire the guns only when the gun safety switch is in FIRE and the system is in hand control or automatic track.

INTENSITY KNOB. A knob (10, figure 4-36) on top of the A-5 indicator control can be turned clockwise for bright scope and counterclockwise for reduced scope brilliance. The scope is bright enough when the display pattern is visible.

CAUTION

The scope (cathode ray tube) brilliance should not be too bright for very long since scope damage will result.

RANGE SEARCH LIMIT KNOB. The "Range Search Limit" knob (7, figure 4-36) on top of the A-5 indicator control provides a means of adjusting the maximum range to which the range gate sweeps during hand control operation. The knob has no function in either search or track operation. The knob can be turned clockwise and counterclockwise; in full counterclockwise position there is a detent. When the knob is turned full clockwise the range gate should sweep from zero to 8000 yards on the scope. When the knob is turned full counterclockwise to the limit of control (not to detent) the

(1) AF 52-1417, 53-1819 thru -2170, -2279 & on

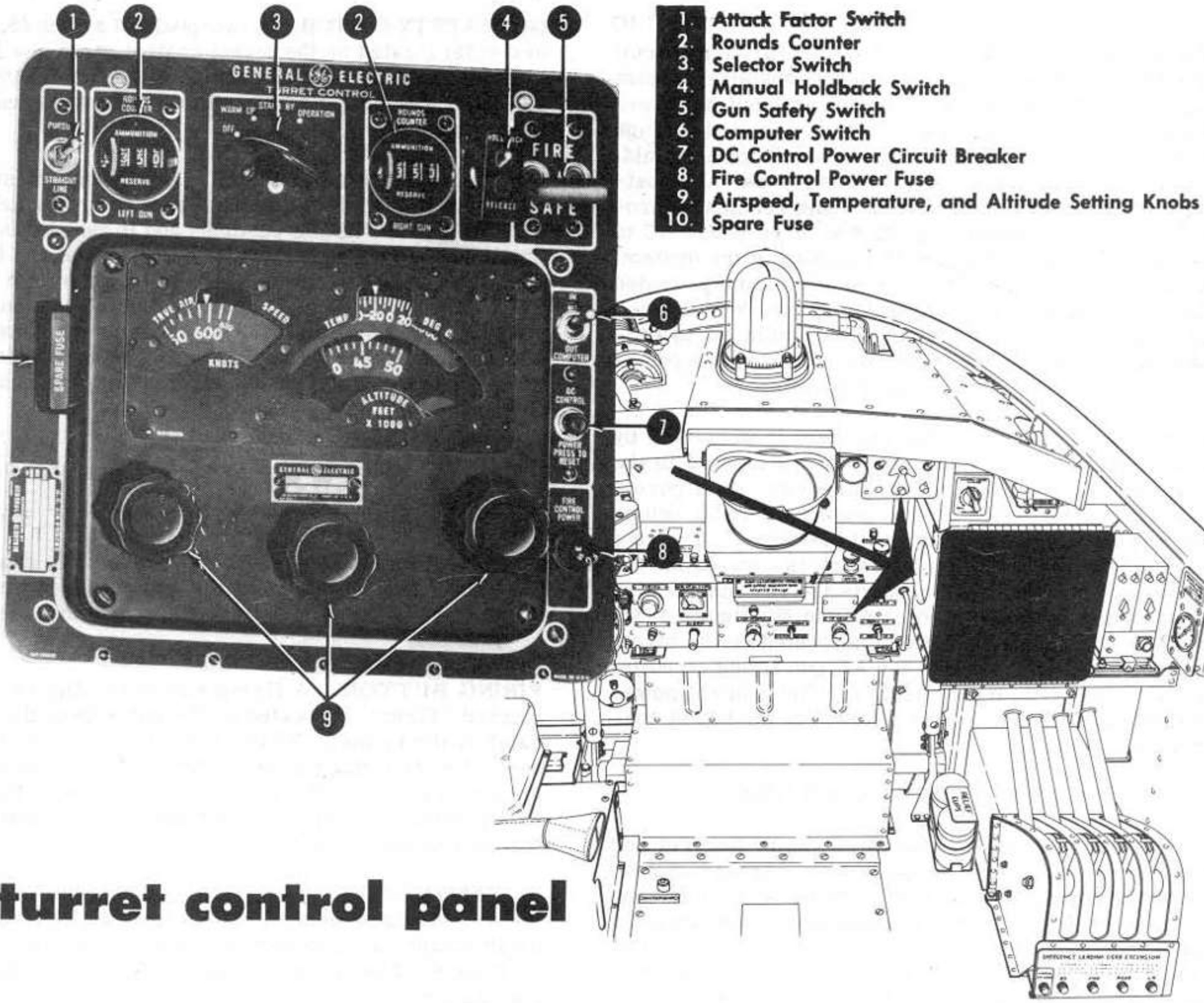


Figure 4-35.

range gate should sweep from zero to 2000 yards on the scope. By turning the knob further counterclockwise to detent the range gate sweeps out beyond 8000 yards and disappears.

ADJUSTMENT SCREWS. Three adjustment screws marked "Range Search Zero," "Centering," and "Focus" (6, 8, and 9, figure 4-36) located on top of the A-5 indicator control are used for scope adjustments. These adjustment screws are not to be unlocked and adjusted by operating personnel but only by authorized maintenance personnel.

(1)

RANGE RATE MEMORY SWITCH. A two-position switch (13, figure 4-36) marked "Range Rate Memory" is on the face of the A-5 indicator control panel. The switch controls range rate memory system operation. The switch is spring-loaded to down position which allows normal tracking operation. When held in the up position, the range rate memory system is put into operation. The range rate memory system allows the system radar to continually supply target range information to the A-5 computer during the time electronic countermeasures are employed.

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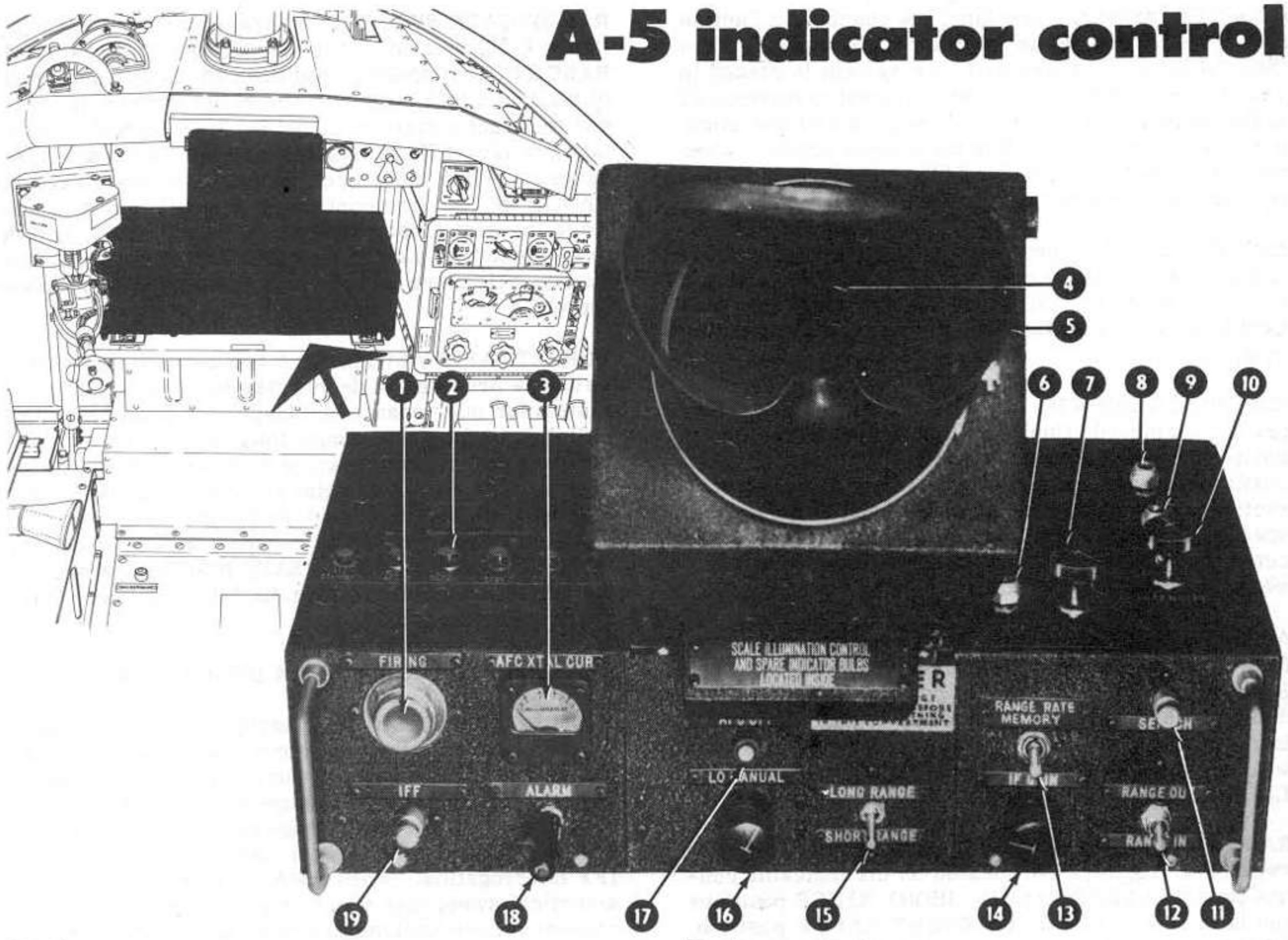
(1) AF 53-1822 thru -1860, -2090 thru -2109, -2326 thru -2354

A-5 indicator control



1. Firing Button
2. Circuit Breakers
3. Automatic Frequency Control Crystal Current Meter
4. Scope
5. Viewing Hood
6. Range Search Zero Screw
7. Range Search Limit Knob
8. Centering Screw
9. Focus Screw
10. Intensity Knob
11. Search Push Button
12. Range Gate Switch
13. Range Rate Memory Switch (1)
14. IF Gain Knob
15. Range Selector Switch
16. Local Oscillator Manual Tuning Knob
17. AFC - Off Lamp
18. Target Warning Alarm Jack
19. IFF Push Button

(1) AF 53-1822 thru -1860, -2090 thru -2109, -2326 thru -2354

50442WC

Figure 4-36.

IFF PUSHBUTTON. A pushbutton (19, figure 4-36) marked "IFF" is located on the indicator control panel. Actuation of the pushbutton enables the gunner to identify each target on the indicator scope.

NOTE

The IFF pushbutton is inoperable until wiring to the IFF system is connected.

SEARCH PUSHBUTTON. A pushbutton (11, figure 4-36) marked "Search" is located on the indicator control panel. Momentary pressing of the button will place the system in search operation.

MANUAL ANTENNA HANDLE. A manual antenna handle (9, figure 4-34) located to the left of the indicator control panel enables the gunner to manually control the position of the antenna beam and to manually select a specific target for tracking. A pushbutton "action switch" is located on the antenna control handle. When the pushbutton is depressed, the system is placed in hand control and the antenna will respond to movements of the antenna control handle. The guns will also come out of stow position and follow the antenna motion. When the action switch is released (after range gate "locks on" target), the system is in automatic track.

SETTING KNOBS. Three setting knobs (9, figure 4-35) are provided on the turret control panel to enable the gunner to enter true airspeed, temperature (degrees Centigrade), and altitude functions into the computing system.

COMPUTER SWITCH. A two-position switch (6, figure 4-35) marked "Computer" is located on the turret control panel. The switch has IN--OUT positions. IN position energizes circuits to introduce computer correction into the fire control system and is the normal operating position. OUT position segregates computer correction information from the system and is used only while making tests and adjustments to the equipment.

ATTACK FACTOR SWITCH. A two-position switch (1, figure 4-35) located on the turret control panel has PURSUIT--STRAIGHT LINE positions. The switch determines the type of correction that the computer introduces into the fire control system. The switch will normally be positioned in PURSUIT. STRAIGHT LINE position is used for a "straight line" attack.

RANGE SELECTOR SWITCH. A two-position toggle switch (15, figure 4-36) located on the indicator control panel has LONG RANGE--SHORT RANGE positions and is spring-loaded to the SHORT RANGE position. SHORT RANGE position is the normal position and allows the fire control system to search at short range (8000 yards). Moving the switch momentarily to LONG RANGE extends the range to 24,000 yards for brief checks and also turns on the IFF so that the gunner can make target identification.

IF GAIN KNOB. A control knob (7, figure 4-36) marked "IF Gain" is located on the indicator control panel. Turning the knob clockwise decreases the sensitivity of the system as well as the sensitivity of the target image on the scope. The normal position of the knob during operation is approximately one-fourth turn clockwise from the extreme counterclockwise position.

LOCAL-OSCILLATOR MANUAL TUNING KNOB. A control knob (9, figure 4-36) marked "LO Manual" is located on the indicator control panel. Turning the knob to the extreme counterclockwise position operates a switch to cut out manual control and place the system in automatic-frequency-control (AFC). Turning the knob clockwise deenergizes AFC and the "AFC Off" light (10, figure 4-36) will illuminate. Further clockwise turning of the knob manually tunes the local-oscillator. The normal position of this knob is in the fully counterclockwise position with the switch actuated as indicated by the "AFC Off" light being out.

RANGE GATE SWITCH. A three-position switch (6, figure 4-36) located on the indicator control panel has RANGE OUT--RANGE IN positions and is spring-loaded to the center (off) position. The switch enables the gunner to select a specific target for tracking when more than one target is on the same azimuth but at different ranges. When the switch is momentarily placed in RANGE IN, the fire control system will move to and track the next closer range target. When the switch is momentarily placed in RANGE OUT position, the system will move to and track the next longer range target.

TURRET SAFETY SWITCH. A two-position ON--SAFE switch is provided to deenergize the A-5 fire control system for maintenance and inspection purposes. The switch is located in a compartment on the left side exterior of the tailcone on some airplanes; on other airplanes, it is on the auxiliary junction box inside the tailcone. ON position arms the DC gun firing circuits, supplies power for turret control, and releases the turret drive motor brakes. SAFE position deenergizes the turret and gun firing circuits and actuates the turret drive motor brakes.

A-5 FIRE CONTROL SYSTEM INDICATORS

OSCILLOSCOPE. An oscilloscope (scope) (4, figure 4-36) is located on the indicator control panel. A viewing hood (4, figure 4-36) is installed over the scope to keep out light glare. The scope indicates azimuth and range of targets, presents range gate (searching in hand control, "locked on" in track), and shows responses to IFF interrogation. When the A-5 system is operating, a vertical sweep line which is interconnected with the antenna moves horizontally back and forth in smooth cycles across the face of the scope. Jizzle is detected in the vertical sweep line as a widening or sidewise oscillation. The range gate appears as a horizontal notch beside and to the left of the vertical sweep line and moves from bottom to top. The range gate appears in hand control and track operations. Targets detected are shown on the scope as a bright spot on the vertical sweep line at the correct scope range position. When the system is "locked on" the target, the sweep line and range gate automatically track the target as it moves across the face of the scope.

RADAR TARGET INDICATION LIGHTS. A red "Gun Target Warning" indication light (2, figure 1-18) is located on the copilot's instrument panel. This light is electrically connected to the target warning alarm jack (18, figure 4-36) on the indicator control panel. A second red target indication light is mounted inside the viewing hood and to the right of the radar scope. These lights illuminate soon after a target is detected by the fire control system.

NOTE

(1)

The red radar target indication light on the copilot's instrument panel is inoperative due to incomplete wiring.

(1) AF 51-2361, -2363 thru -2394, -2412 thru -7075, -15804 thru -15812, 52-019 thru -081, -202 thru -260

NOTE (1)

The red radar target indication light on the copilot's instrument panel will not illuminate when the "Press to Test" is actuated.

ROUNDS COUNTERS. Two counters (2, figure 4-36) are located on the turret control panel. The counters indicate the number of rounds of reserve ammunition in each of the two guns.

ANTENNA ELEVATION INDICATOR LIGHTS. An amber "Up" light and a green "Down" light mounted to the left of the scope under the viewing hood indicate the elevation of the radar antenna. The "Up" light when illuminated signifies elevation above 20°. The "Down" light when illuminated signifies elevation below -19°. Both lights dark signify elevation between 20° and -19° when the system is in hand control or "track" operations.

AFC OFF LIGHT. An amber light (17, figure 4-36) marked "AFC Off" is located on the indicator control panel. The light when illuminated indicates that the "LO Manual" control is turned to a position for manual tuning of the local oscillator. The light out indicates that the automatic frequency control is operating.

TARGET WARNING ALARM JACK. The alarm jack (18, figure 4-36) is provided for connecting the "Gun Target Warning" light (2, figure 1-18) on the copilot's instrument panel. The target warning alarm jack can also be used to connect a bell or other device to warn when a target is encountered during automatic search. The gun target warning light, bell, or other warning device is inoperative when the jack is removed from the indicator control.

TURRET-NOT-STOWED WARNING LIGHT. A red light (4, figure 1-40) on the copilot's emergency landing gear control panel on some airplanes and (8, figure 1-19) on the copilot's instrument panel on other airplanes is marked "Warning - Turret Not Stowed." The light illuminates when the turret is not in stowed (trailing) position and the forward main landing gear is down and locked.

NOTE

The turret will be in stowed position at all times when not in use. With the turret not in stowed position, a strong possibility exists that the brake chute when deployed on the landing roll will foul with the gun barrels resulting in loss of brake chute deceleration forces.

AUTOMATIC FREQUENCY CONTROL CRYSTAL CURRENT METER. A meter (3, figure 4-36) marked "AFC XTAL CUR" on the A-5 indicator control provides an indication of the signal strength in milliamps of the AFC crystal mixer. Normal operating limits for use of the A-5 fire control system are 0.7 to 0.9 ma for ground operation and 0.5 to 0.9 ma for flight operation. When the local oscillator manual tuning knob is turned in either direction, the AFC crystal current meter readings will vary.

NORMAL OPERATION OF FIRE CONTROL SYSTEM

Normal operation of the fire control system can be accomplished as follows:

a. Check for availability of DC power to the fire control system equipment.

(2)

b. Check that unregulated AC power is on the left unregulated AC bus.

(2)

c. Check that regulated AC power is on the A-5 bus.

(3)

c. Check for availability of regulated AC power.

d. Check that the manual holdback switch is in RELEASE position.

e. Check that the gun safety switch on the turret control panel is in SAFE position. This assures that the guns are in a safe condition before turning on the equipment.

f. Turn the selector switch on the turret control panel to WARMUP position 30 minutes prior to firing.

NOTE

The warmup time is a function of the climate in which the airplane operates. Consequently, the period of warmup should be in accordance with instructions from the base from which the airplane operates.

g. Turn the selector switch to STANDBY position.

NOTE

Wait approximately 5 minutes for radar circuits to preheat before proceeding to the next operation.

h. Turn the selector switch to OPERATE position. The equipment is now ready to place in automatic search, hand control, or tracking operation.

NOTE

- If the sweep does not appear immediately, use emergency procedure No. 2 (figure 4-36A): if jizzle does not appear, turn the selector switch to STANDBY and follow emergency procedure No. 1 (figure 4-36A).
- After radar warmup, the AFC crystal current meter should read between 0.5 and 0.9 ma; however, if it does not, use the LO-Manual knob to adjust for normal operating range.

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(1) AF 51-2357 thru 52-081, -202 thru -260, -394 thru -431
(2) AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(3) AF 52-1417, 53-1819 thru -2170, -2279 & on

i. To fire the guns, place the gun safety switch in FIRE position, place the manual holdback switch in RELEASE position, and depress the firing button. (The guns will not fire except in hand control or track.)

NOTE

- All firing activities shall be conducted with the manual holdback switch in RELEASE position.
- The manual holdback switch shall not be placed in HOLDBACK position during takeoff and flight to the firing area except when the guns have been fired prior to takeoff and not otherwise cleared of a chambered live round.
- The manual holdback switch shall not be used to accomplish charging cycles. Misfired rounds are cleared by automatic charging of the guns.
- The manual holdback switch should be placed in HOLDBACK position only after firing of the guns has been concluded.

j. To turn the system off, place the system in search operation to stow the guns, place the gun safety switch in SAFE position, the manual holdback switch to HOLDBACK position, and turn the selector switch to OFF.

NOTE

In the event that the system is in automatic track previous to shutdown of the equipment, return the system to search operation before turning off the system. This will allow the turret to move to the stow position.

EMERGENCY OPERATION OF FIRE CONTROL SYSTEM

Emergency procedures for operation of the fire control system are given in figure 4-36A. If the trace is lost from the scope and a bright line appears along the bottom of the scope moving left to right and right to left, it indicates a safety feature built into the system and is known as a modulator kick-out. When this indication occurs move the selector switch to STANDBY and back to OPERATE. If the trace is not regained put the switch back in STANDBY, leave for 2 or 3 minutes, and return to OPERATE. If this procedure does not eliminate the trouble after having tried it for two or three times the probability that the system will operate is remote.

MD-4 FIRE CONTROL SYSTEM (1) (2)

A Type MD-4 fire control system provides the airplane with fire protection against pursuing hostile aircraft. The functions performed by the system essentially are the same as those performed by the A-5 fire control system.

(1)

A three-phase inverter, supplying 200-volt AC power to the system, is provided for and controlled by the MD-4 fire control system. The system also uses DC power supplied through circuit breakers on the lower DC power panel; regulated single phase 115-volt AC power, supplied through circuit breakers in the main AC power shield; and unregulated single phase AC power, supplied through a fuse in the left alternator power shield and a fuse in the tail compartment power shield. MD-4 external power receptacles are located in the battery compartment. These receptacles provide a means for connecting external AC and DC power to the MD-4 system for ground checking of the system.

(2)

The system uses DC power supplied through circuit breakers on the lower DC power panel, the left main power shield, and single-phase 115-volt and three-phase 200-volt regulated AC power from constant speed alternators supplied through circuit breakers on the tail compartment power shield. MD-4 external power receptacles are located in the aft radar compartment. These receptacles provide means for connecting DC and three-phase AC to the MD-4 system during ground checking of the system. An additional single-phase inverter is also provided for supplying constant frequency AC power to the MD-4 system when precision testing of the equipment is necessary. The single-phase inverter is housed in a portable case and carried as flyaway equipment.

MD-4 FIRE CONTROL SYSTEM CONTROLS

All controls for the operation of the tail turret and gun-laying radar are located in the gunnery station aft of the copilot (figure 4-34A). Many of the fire control system functions are performed automatically by the equipment. However, the gunner is required to place the system in operation; set altitude, airspeed, and air temperature functions into the computing system; manually select a specific target for tracking; monitor the tracking operation; and fire the guns when the radar scope indicates that the target is within range.

MD-4 FIRE CONTROL SYSTEM INDICATORS

RADAR TARGET INDICATION LIGHT. A red "Gun Target Warning" indication light (2, figure 1-18, 6,

(1) AF 51-2194, -2198, -2207, -2222, -2238, -2239, -2245, -2247 thru -2250, -2252, -2255, -2259
(2) AF 53-1861 thru -1972, -2110 thru -2170, -2355 & on

indications	probable cause	procedure	results
[illegible]	[illegible]	[illegible]	[illegible] ...s possible ...by A&E.
[illegible]	[illegible]	[illegible]	[illegible] ...operational if ...s; if not, no ...possible until ...A&E.
[illegible]	[illegible]	[illegible]	[illegible] ...quires continuous ...on. For effective... emergency pro... must be used. ...p will not move ...hand control, an... control amplifier ...cked on a limit ...ill prevent both ...rom firing. This ...corrected by ...nance personnel.
[illegible]	[illegible]	[illegible]	[illegible] ...maximum effec... but requires fre... attention, and ad... of "LO Manual".

Figure 4-36A (Sheet 1 of 3 Sheets)

indications	probable cause	procedure	results
5. DETERMINING ELEVATION WITHOUT LIGHTS			
Elevation "Up" and "Down" lights do not operate and replacing bulbs does not correct this.	Failure of relays or wiring in circuit.	a. Vertical sweep moves right when antenna is up and moving right ("Up" light normally on). b. Vertical sweep moves left when antenna is down and moving left ("Down" light normally on). c. Target return from both sweeps indicates target positioned ±4° elevation.	Equipment is still fully effective.
6. OPERATION WITHOUT TARGET LIGHT			
"Target" light does not light. a. When IF gain is turned to maximum (full counterclockwise). b. When ground return is visible on scope. c. When target appears on scope.	"Target" light circuit failure or bulb failure.	a. Replace bulb. b. If replacing bulb does not remedy light failure, but alarm jack is working, set may be operated normally until "lock-on" is accomplished by watching return blip. c. Close attention during automatic tracking necessary to insure radar set stays "locked on" target.	Light is an additional target warning signal and radar set may be operated efficiently without it.
7. FAILURE TO TRACK			
Radar set may be locked on but repeatedly loses target although it is within tracking limits.	a. Failure of the AFC circuit in the RF head. b. Automatic tracking circuit failure.	a. Use emergency procedure No. 4 if "AFC XTAL CUR" meter reading is out of tolerance (0.5 to 0.9 ma). b. Manually track target with antenna control handle using as smooth operation as possible. c. All other functions, operate normally.	a. Set is operational. b. Accuracy of aiming guns depends on operator's skill in smoothly tracking target.
8. RANGE-IN CIRCUIT FAILURE			
Range gate cannot be unlocked from target with range gate switch.	Range gate circuit failure.	a. Reduce IF gain clockwise until range gate loses target ("Target" light goes out). b. Move antenna control handle a few degrees left or right. c. Return IF gain to normal position immediately and attempt to lock on new target.	Equipment is operational.

Figure 4-36A (Sheet 2 of 3 Sheets)

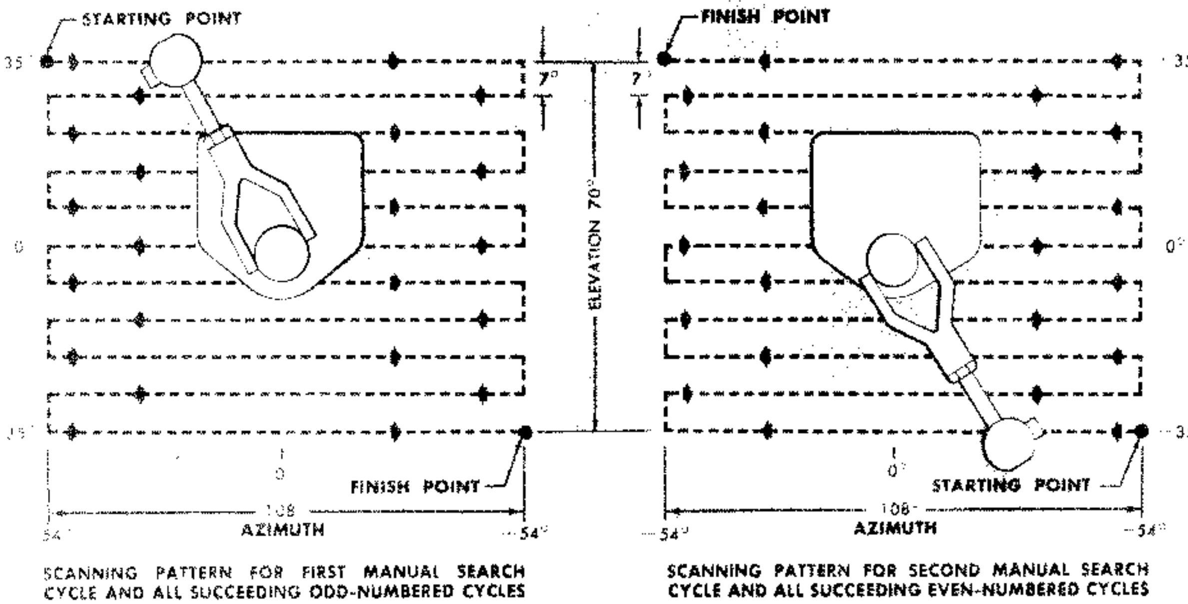
(CONTINUED)

indications	probable cause	procedure	results
9. GUNS RELEASE A[illegible]			
a. Rounds counter continues to turn over. b. Vibration of guns firing.	a. [illegible] b. [illegible]	[illegible] safety switch [illegible] [illegible] full clockwise. [illegible] search button. [illegible] begins normal [illegible] operation, return [illegible] to its normal [illegible] [illegible] to free firing [illegible] [illegible] above steps fail, turn [illegible] switch to OFF. **NOTE** [illegible] not put set into [illegible] operation un[illegible] trouble has been [illegible] rected.	a. If guns quit firing when search push button pressed, set may be used for search operation. Search push button or gun safety switch used to control guns firing. b. If guns do not stop firing, set must be turned OFF and is completely inoperative.
10. AMMUNITION BELTS JA[illegible]			
		[illegible] turret through azi[illegible] elevation limits, [illegible] return turret to [illegible] stow position [illegible] attempt to fire a [illegible] burst to determine [illegible] observing rounds [illegible] and vibrations [illegible] aircraft) if both [illegible] are working. [illegible] both weapons fail to [illegible] check "Fire Control [illegible]" fuses and DC [illegible] control power cir[illegible] breaker, on A-5 con[illegible] panel. [illegible] and b. did not cor[illegible] stoppage, move [illegible] holdback switch [illegible] HOLDBACK for 4 [illegible] then to RE[illegible]ASE. Attempt firing [illegible] burst again (to [illegible] mine if either or [illegible] weapons are fir[illegible]) **NOTE** [illegible] only one weapon [illegible] operating after [illegible] second consecutive actuation of manual [illegible] holdback switch do [illegible] continue use of [illegible] switch or you will [illegible] feeder torque [illegible] both weapons.	

Figure 4-36A (Sheet 3 of 3 Sheets)

60450WC

A-5 emergency manual search operation



DETAILED INSTRUCTIONS

1. Squeeze action-switch button and hold button down throughout all manual search.
2. Set antenna-control (hand-control) handle initially at upper-left-limit position.
3. Move control handle smoothly to upper-right-limit position at same rate as cathode ray tube sweep moves in azimuth during automatic search.
4. Hold on right limit, move control handle down approximately 7°, then sweep horizontally to extreme left limit.
5. Continue this scanning procedure, lowering control handle approximately 7°, at end of each horizontal sweep, until handle reaches lower-right-limit position at end of 11th sweep. This completes the first cycle of manual search.
6. With control handle starting from lower-right-limit position, begin second manual-search cycle by moving handle smoothly to lower-left-limit position.
7. Holding on left limit, move control handle up approximately 7°, then sweep horizontally to extreme right limit.
8. Continue this scanning procedure, raising control handle approximately 7°, at end of each horizontal sweep, until handle reaches upper-left-limit position at end of 11th sweep. This completes the second cycle of manual search.
9. Repeat steps 3 through 5 above for third and all succeeding odd-numbered manual search cycles. Repeat steps 6 through 8 above for fourth and all succeeding even-numbered manual search cycles.

NOTE

- Avoid jerky motion of the control handle. Move the control handle at a steady rate equivalent to the speed of the cathode ray tube movement in azimuth during automatic search. When this proper rate is maintained, each manual-search cycle will entail 15 to 17 seconds of time.
- "UP" elevation light should be lit during the top three scanning sweeps.
- "Down" elevation light should be lit during the bottom three scanning sweeps.
- Neither elevation light should be lit during other sweeps.

50446 WC

Figure 4-36B.

figure 1-19; and 6, figure 1-19A) is located on the copilot's instrument panel. This light will illuminate when a target is detected by the fire control system.

TURRET-NOT-STOWED WARNING LIGHT. A red light (4, figure 1-40) on the copilot's emergency landing gear control panel on some airplanes and (8, figure 1-19 and 8, figure 1-19A) on the copilot's instrument on other airplanes is marked "Warning-Turret Not Stowed." The lights illuminate when the turret is not in stowed (trailing) position and the forward main landing gear is down and locked.

NOTE

The turret will be in stowed position at all times when not in use. With the turret not in stowed position, a strong possibility exists that the brake chute when deployed on the landing roll will foul with the gun barrels resulting in loss of brake chute deceleration forces.

OPERATION OF MD-4 FIRE CONTROL SYSTEM

Normal and emergency operation of the MD-4 fire control system will be included when that information is available.

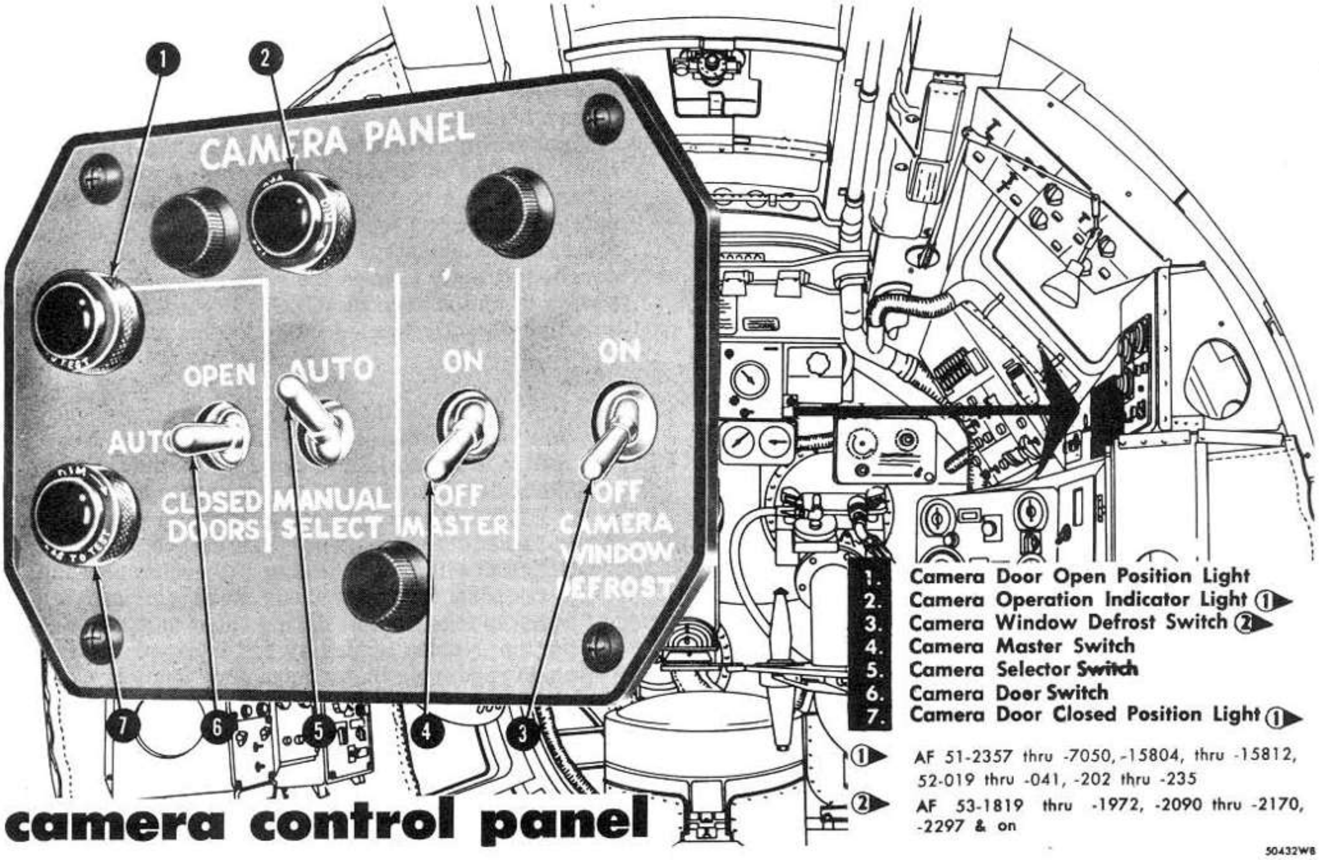


Figure 4 - 37.

PHOTOGRAPHIC EQUIPMENT

AERIAL CAMERA

Provisions are made for the vertical mounting of a Type K-17C, K-22A, K-37, or K-38 aerial camera in the bottom of the fuselage directly below the fin leading edge. The K-38 camera is permanently installed.

WARNING

The following equipment is nonexplosion proof and shall not be installed in the camera compartment where the possibility of an explosive atmosphere exists:

- Type K-37 camera
- Type K-22A camera
- Type K-17C camera (below Serial No. 51-416)
- Type K-38 camera (below Serial No. 50-016)
- Type A-9A magazine
- Type A-9 magazine
- Type A-5A magazine

The aerial camera may be used automatically in conjunction with the bombing system to record and determine the accuracy of the bomb drop or may be used independently for photo reconnaissance. A camera control panel (17, figure 4-28) is on the observer's right sidewall. A remote initiation circuit, working in conjunction with the bomb release system, provides automatic strike camera operation. Automatic vacuum and heating systems are provided for the camera. Defrosting of the camera window is accomplished on some airplanes* by ram air duct from the fin leading edge and on other airplanes** by a defroster blower which forces compartment air through ducts to defrost the window.

AERIAL CAMERA CONTROLS

CAMERA MASTER SWITCH

An ON--OFF master switch (4, figure 4-37) is on the camera control panel. When the switch is in the ON position, power is supplied to energize the camera heating, camera control, camera door control, and the remote initiation circuits. When the switch is in the OFF position, these circuits are deenergized.

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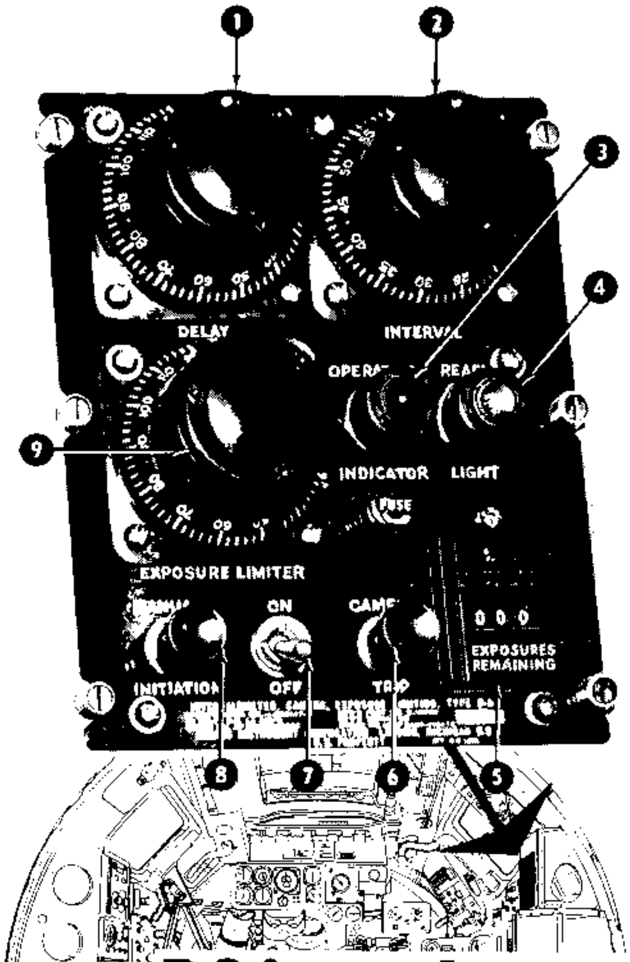
* AF 51-2192 thru 52-3373, 53-2261 thru -2296
**AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on



B-8 intervalometer panel

1. Delay Control Knob
2. Interval Control Knob
3. Camera Operation Indicator Light
4. Intervalometer Ready Light
5. Exposures Remaining Counter
6. Camera Trip Switch
7. Intervalometer Power Switch
8. Manual Initiation Switch
9. Exposure Limiter Control Knob

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Figure 4-38.

CAMERA WINDOW DEFROST SWITCH (1)

An ON--OFF toggle switch (3, figure 4-37) is located on the camera control panel. Actuating the switch to ON or OFF positions controls the defroster blower for defrosting of the aerial camera window.

CAMERA DOOR SWITCH

An OPEN--AUTO--CLOSED switch (6, figure 4-37), spring-loaded to the AUTO position, is on the camera control panel. When the switch is in the AUTO position, opening of the camera doors is automatically controlled by a bomb door latch limit switch and the camera doors will open with the bomb doors. When the switch is actuated to the OPEN position, power is supplied directly to open the camera doors. When the switch is actuated to the CLOSED position, power is supplied directly to close the camera doors.

NOTE (2)

On some airplanes when the bomb doors are open it is impossible to close the camera doors. Momentary actuation of the camera door switch to CLOSED will cause the doors to close but immediately open again. Holding the switch in CLOSED will cause the doors to cycle resulting in the possibility of tripping the circuit breaker which is inaccessible during flight thus rendering the system inoperative. In order to preclude rendering the camera door system inoperative and to insure that doors are closed, it is necessary to close the camera doors after the bomb doors are closed.

CAMERA SELECTOR SWITCH

An AUTO--MANUAL switch (5, figure 4-37), spring-loaded to the AUTO position on some airplanes and guarded in the AUTO position on other airplanes, is on the camera control panel. When the switch is in the AUTO position, the camera is controlled through a camera intervalometer. When the switch is actuated to the MANUAL position, power is supplied directly to operate the camera at its runaway cycling rate.

CAMERA INTERVALOMETER

A Type B-8 intervalometer (figure 4-38), or on some airplanes a Type B-7 intervalometer (figure 4-38A), is installed on the right sidewall above the observer's table and provides means for manual and automatic initiation and control of the aerial camera. The intervalometer may be used independently or in conjunction with the radar bombing navigational system. The intervalometer utilizes DC power and the power supply circuit is protected by a circuit breaker in the radar power panel.

B-8 INTERVALOMETER CONTROLS

Controls provided on the B-8 intervalometer are as follows:

INTERVALOMETER POWER SWITCH. A two-position

---

(1) AF 53-1819 thru -1972, -2090 thru -2170, -2297 & on
(2) AF 51-2192 thru -7050, -15804 thru -15812, 52-019 thru -041, -202 thru -235

ON--OFF toggle switch (7, figure 4-38) on the camera intervalometer panel controls power within the intervalometer for automatic operation of the camera. When the power switch is placed in ON position, the intervalometer is ready for initiation and control of the aerial camera. When the switch is placed in OFF position, the intervalometer will automatically reset for automatic sequence cycling.

MANUAL INITIATION SWITCH. A push-button type switch (8, figure 4-38) located on the intervalometer panel is used to manually start normal camera operation when photographic operation independent of the radar bombing navigation system is desired. The manual initiation switch, when pressed, will take an initial picture; however, this initial picture will not be counted by the limiter.

CAMERA TRIP SWITCH. A push-button type switch (6, figure 4-38) located on the intervalometer panel is used to operate the cameras. When the switch is depressed, any automatic preselected interval time is overriden and the camera will operate at its runaway cycling rate. The exposures remaining counter and operation indicator light will operate when the camera is pulsed by the trip switch.

DELAY CONTROL. A knob (1, figure 4-38) marked "Delay" is located on the intervalometer panel. This knob is used to control the elapsed time between the instant of manual or automatic initiation and the instant of the initial camera operating pulse. After the preselected delay period has elapsed, the delay control will originate a signal to the camera and camera operation will begin. The delay knob has OFF and 1-second through 120-second intervals with detents at 1-second intervals. The numbered positions indicate the length of the delay period. When the knob is in OFF position, camera operation will start immediately when the manual initiation switch is pressed.

INTERVAL CONTROL. A knob (2, figure 4-38) located on the intervalometer panel is used to control the time interval between each successive exposure of the aerial camera. The knob has OFF and 1/2- through 60-second positions with detents at 1/2-second intervals. The numbered positions indicate time intervals. With the knob in OFF, the interval control will not send signals to the camera, thus preventing normal automatic operation.

EXPOSURE LIMITER CONTROL. A knob (9, figure 4-38) located on the intervalometer panel is used to limit the number of operating pulses sent to the camera. The knob has OFF and 1- through 120-unit positions with detents at 1-unit intervals. The numbered positions indicate the number of camera exposures that will be taken before camera operation is stopped. With the knob in OFF position, an unlimited number of camera operate pulses will be initiated by the interval control. The limiter will not count the initial picture whether initiated by the manual initiation switch or automatically by the radar bombing navigational system.

B-7 intervalometer panel

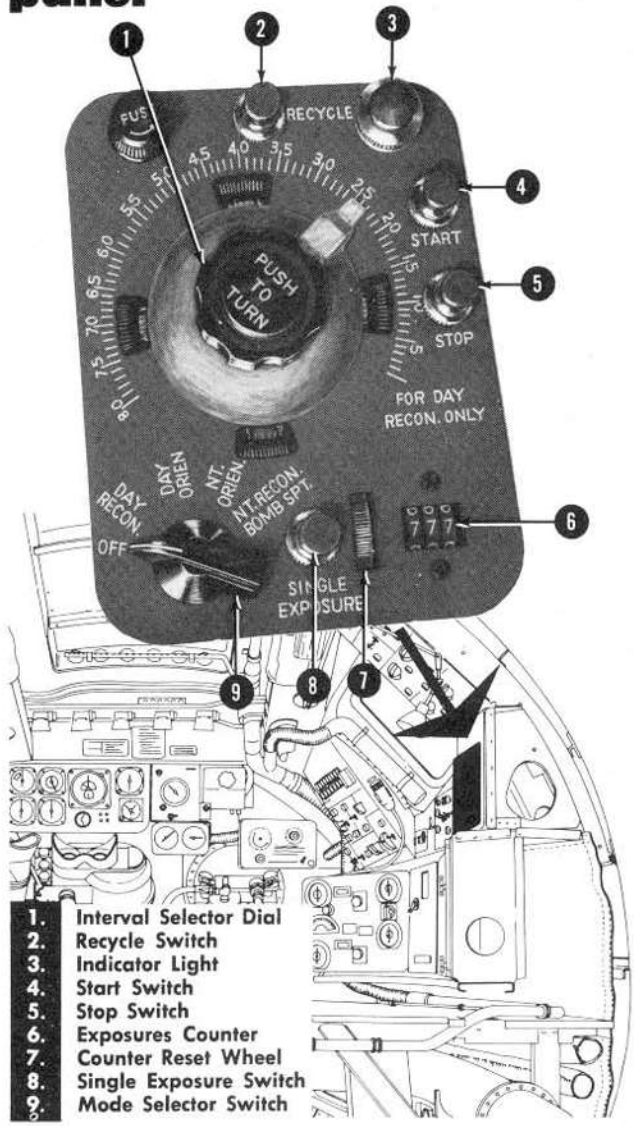

Figure 4-38A.

NOTE (1)

The exposure limiter is inoperative.

B-7 INTERVALOMETER CONTROLS

Controls provided on the B-7 intervalometer are as follows:

(1) AF 51-2357 thru -7050, -15804 thru -15812, 52-019 thru -041, -202 thru -235

INTERVAL SELECTOR DIAL. This control dial and pointer (1, figure 4-38A) is used to select the desired time interval for any one of the various modes of operation. Any point on its range of 1 to 80 seconds is selected by pushing in on the knob, turning the pointer to a desired time and then releasing the knob.

INTERVALOMETER MODE SELECTOR SWITCH. The mode selector switch (9, figure 4-38A) has five positions: OFF, DAY RECON., DAY ORIEN., NT. ORIEN., and NT. RECON. BOMB SPT. The OFF position de-energizes and resets the intervalometer. In DAY RECON. position, the intervalometer sends tripping pulses to the camera at regular intervals as predetermined by the interval control. In DAY ORIEN. position, the intervalometer sends a continuous pulse to the camera causing the camera to operate at runaway speed. The length of the pulse is determined by the interval control. In NT. ORIEN. position, two pulses are sent to the camera; one pulse before and one after the interval determined by the interval control. In NT. RECON. BOMB SPT. position, the intervalometer sends a continuous pulse to the camera causing the camera to operate at runaway speed.

START SWITCH. The start switch (4, figure 4-38A) provides a means for initiation of intervalometer operation independent of bomb release.

STOP SWITCH. The stop switch (5, figure 4-38A) stops camera operation and resets the intervalometer.

SINGLE EXPOSURE SWITCH. This switch (8, figure 4-38A) overrides the automatic preselected sequence set in the intervalometer and allows the camera to operate at runaway speed.

RECYCLE SWITCH. This switch (2, figure 4-38A) provides a means of interrupting intervalometer operation during a cycle and starting a new cycle.

AERIAL CAMERA INDICATORS

CAMERA DOOR POSITION LIGHTS

An amber door position indicator light (1, figure 4-37) on the camera control panel will illuminate when the camera doors are in the full-open position.

(1)

A red door position indicator light (7, figure 4-37) on the camera control panel will illuminate when the camera doors are in the full-closed position.

CAMERA OPERATION INDICATOR LIGHTS

(1)

A green indicator light (3, figure 4-38) on the B-8 intervalometer panel illuminates each time the camera operates.

NOTE

(1)

The camera operation indicator light on the intervalometer panel is inoperative.

(1)

A green indicator light (2, figure 4-37) on the camera control panel when illuminated indicates that the camera is in operation.

B-8 INTERVALOMETER READY LIGHT

An amber indicator light (4, figure 4-38) on the intervalometer panel will illuminate when the intervalometer power switch is placed in the ON position and power is supplied to the intervalometer. The light will go out during normal operation of the camera.

B-7 INTERVALOMETER WARNING LIGHT

A white indicator light (3, figure 4-38A) glows two seconds before each tripping pulse in day reconnaissance mode of operation and in all other modes of operation the light glows when the intervalometer is ready for initiation.

B-8 EXPOSURES REMAINING COUNTER

An exposures remaining counter (5, figure 4-38) on the B-8 intervalometer panel provides visual indication of exposures remaining in the camera magazines. The counter will be reduced by one unit each time the camera operates. The counter may be reset by raising the hinged cover and rotating the number wheels to indicate the number of exposures available.

NOTE

(1)

The exposures remaining counter is inoperative.

B-7 EXPOSURES COUNTER

An exposures counter (6, figure 4-38A) provided on the B-7 intervalometer records the number of all tripping pulses sent to the camera. The counter may be reset by turning the thumb wheel accessible from the front of the panel.

NORMAL OPERATION OF AERIAL CAMERA

PHOTO RECONNAISSANCE. For operation independent of the bombing system, proceed as follows:

a. Place the camera master switch on the camera control panel in ON position prior to entering area to be photographed in order to allow the camera to be preheated.

b. Place the camera selector switch on the camera control panel in AUTO position. (This switch will normally be in AUTO position.)

c. Place the B-8 intervalometer power switch in ON position; the amber ready light on the intervalometer panel will illuminate or place the B-7 intervalometer mode selector switch in a position other than OFF.

d. Hold the camera door switch on the camera control panel in OPEN position; the amber door open indicator light on the camera control panel will illuminate when the doors are fully open.

(1) AF 51-2357 thru -7050, -15804 thru -15812, 52-019 thru -041, -202 thru -235

1. Camera Selector Switch
2. Camera Power Switch
3. Selector Scan Switch
4. PPI Rheostat

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Figure 4-39.

e. Adjust the B-8 intervalometer delay, interval, and exposure limiter ** controls to the desired values or adjust the B-7 intervalometer controls to the desired values.

f. To start camera operation, press the manual initiation switch on the B-8 intervalometer panel or press the START switch on the B-7 intervalometer. Camera operation is indicated by illumination of the green camera operation indicator light on the intervalometer** or on the camera control panel*.

g. To stop camera operation, place the B-8 intervalometer power switch in OFF position or press the stop switch on the B-7 intervalometer.

h. Hold the camera door switch to CLOSED position until the red door closed indicator light * illuminates.

BOMB SPOTTING. For automatic camera operation through the radar bombing navigational system, proceed as follows:

a. Place the camera master switch on the camera control panel in ON position prior to entering target area in order to allow camera to be preheated.

b. Place the camera selector switch on the camera control panel in AUTO position. (The switch will normally be in AUTO position.)

c. Place the B-8 intervalometer power switch in ON position; the amber ready light on the B-8 intervalometer will illuminate, or place the B-7 intervalometer mode selector switch in NT. RECON. BOMB SPT. position; the white indicator light will illuminate.

d. Adjust the B-8 intervalometer delay, interval, and exposure limiter ** controls to the desired values or adjust the B-7 intervalometer controls to the desired values.

e. Camera doors will open and the camera will operate automatically through the radar bombing navigational system. The camera door position light and green operation indicator light will indicate opening of the camera doors and operation of the camera respectively.

f. To stop camera operation, place the B-8 intervalometer power switch in OFF position or press the STOP switch on the B-7 intervalometer.

g. The camera doors must be closed manually upon completion of photography by holding the camera door switch on the camera control panel in CLOSED position until red door closed indicator light * illuminates.

MANUAL OPERATION OF AERIAL CAMERA. Manual operation of the aerial camera can be accomplished by the following procedure:

a. Place the camera master switch on the camera control panel in ON position.

b. Place the camera selector switch on the camera control panel in AUTO position. (This switch will normally be in this position.)

c. Press the B-8 intervalometer camera trip switch or press the single exposure switch on the B-7 intervalometer; the camera will operate at its runaway cycling rate. Camera operation will be determined by observing the camera operation indicator light on the camera control panel on some airplanes * or by observing the camera operation indicator light or warning light and exposures remaining counter or exposures counter on the intervalometer on other airplanes**.

EMERGENCY OPERATION OF AERIAL CAMERA

In event of failure of circuits in the intervalometer, the camera may be operated as follows:

a. Place the camera master switch on the camera control panel in ON position.

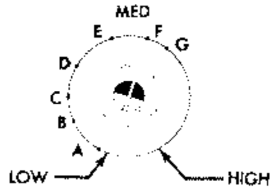
b. Place the camera selector switch in MANUAL position; the camera will operate at its run-away cycling rate. Camera operation will be determined on some airplanes* by illumination of the camera operation indicator light on the camera control panel; there will be no indication of operation on other airplanes.

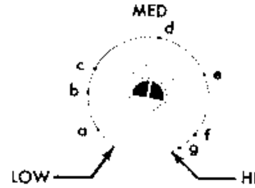
O-15 RADAR RECORDING CAMERA

An O-15 camera is provided to make photographic records of the luminous images appearing on the screen of the radar indicator. A filter assembly, visor adapter, and periscope adapter are attached on the indicator to accommodate the camera installation. The camera is operated by the observer and is protected by a DC circuit breaker on the radar power panel. Control of the system is provided by a remote exposure frequency control panel to the left of the observer.

* AF 51-2357 thru -7050, -15804 thru -15812, 52-019 thru -041, -202 thru -235
** AF 51-2192 thru -2356, -7051 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on

0-15 camera recording chamber chart





PPI. OPERATION RHEOSTAT SETTINGS

ANTENNA RPM	TIME OF CYCLE IN SECONDS (RADAR)	SECOND EXPOSURE	RHEOSTAT SETTING	DIAPHRAGM SETTINGS
4	15.0	1.5	"A"	f4
7	8.6	8.6	"B"	f4
10	6.0	6.0	"C"	f4
12	5.0	5.0	"D"	f4
16	3.7	3.7	"E"	f4
24	2.5	2.5	"F"	f4
28	2.1	2.1	"G"	f4

SECTOR SCAN OPERATION RHEOSTAT SETTINGS

SCAN CYCLES PER MINUTE	TIME OF CYCLE IN SECONDS (RADAR)	SECOND EXPOSURE	RHEOSTAT SETTING	DIAPHRAGM SETTINGS
10	6.0	3.0	"a"	f4
12	5.0	2.5	"b"	f4
15	4.0	2.0	"c"	f4
20	3.0	1.5	"d"	f4
30	2.0	1.0	"e"	f4
60	1.0	0.5	"f"	f4
100	0.6	0.3	"g"	f4

NOTE:

ABOVE FIGURES ARE BASED ON 27.5 — VOLT SUPPLY AND AVERAGE SCOPE BRILLIANCE, USING FILM OF WESTON SPEED 100. DK-50 DEVELOPER, STANDARD DEVELOPING.

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Figure 4-40.

O-15 CAMERA CONTROLS

CAMERA POWER SWITCH. An OFF--ON power switch (2, figure 4-39) located on the control panel is used to turn the equipment on or off.

CAMERA SELECTOR SWITCH. A selector switch (1, figure 4-39) on the control panel provides selection of frequency of operation of the camera. Actual time between the exposures is dependent on antenna scan pulses in the radar system. The selected frequencies are: EVERY SCAN--EVERY OTHER--1 EVERY 4 --1 EVERY 12.

PPI RHEOSTAT. A PPI control (4, figure 4-39) is provided to regulate the illumination in the data chamber of the camera body during PPI operation of the radar set. Lettered rheostat settings for this type of operation are shown in figure 4-40.

SECTOR SCAN RHEOSTAT. Adjacent to the PPI rheostat, a "Sector Scan" rheostat (3, figure 4-39) is provided to regulate the illumination in the data chamber of the camera body during sector scan operation of the radar set. Lettered rheostat settings for this type of operation are shown in figure 4-40.

NORMAL OPERATION OF RADAR CAMERA

The recording camera is made operative and inoperative by the following procedure:

a. Adjust rheostat (PPI or sector scan) to the correct position as indicated in the chart (figure 4-40) for the type of radar operation.

NOTE

The lettered sector scan and PPI rheostat settings shown in the chart (figure 4-40) are only an approximate setting and not actual decal positions.

b. Place the power switch in ON position.
c. To turn off the equipment, place the power switch in OFF position.

EMERGENCY OPERATION OF RADAR CAMERA

There are no emergency operating procedures for the O-15 radar camera.

AIR REFUELING SYSTEM

The airplane is equipped with an air refueling system to receive fuel from boom-equipped tanker airplanes. Sequence of the refueling operation is controlled automatically by an inductive-coupled electronic signal system. A receiver receptacle for the tanker boom nozzle is mounted in a slipway at the right side of the nose section. The slipway is normally closed by a flush door which, when open, forms an integral part of the slipway. When the boom nozzle is seated in the receptacle and held by the hydraulic actuated receptacle latching toggles, fuel is pumped from the tanker into the receiver refueling manifold. Rate of fuel flow is controlled by the tanker crew. In the receiver, fuel flows from the refueling manifold into the tanks as directed by refueling valves which are operated by switches on an air refueling panel at the copilot's station. When a tank is filled, a high level float switch automatically closes the tank refueling valve. When all refueling valves are closed, pressure builds up in the refueling manifold to cause an automatic disconnect. An automatic disconnect is also caused by the boom exceeding its envelope limits (figure 7-4). A voluntary disconnect can be initiated by the pilot or copilot of the receiver airplane or by the tanker boom operator. As the boom withdraws from the receptacle, the windshield wiper will operate at its maximum speed until the system is returned to "Ready for Contact" condition during normal operation or until the disconnect switches are released during emergency operation. The refueling manifold is also used for transfer of fuel from auxiliary to main tanks and for single point ground refueling. To prevent static discharge in the form of sparks in the slipway when the boom separates from the receptacle, some airplanes are equipped to automatically hook a static line to the boom. This static line remains attached to the boom until it has been withdrawn approximately 3 feet, then pulls loose and is automatically reeled into the receptacle. Some airplanes also have a fire extinguishing system that automatically discharges CO_2 into the slipway area when the boom withdraws from the receptacle. Since tests have indicated that any fire starting in the slipway would be quickly extinguished by the high wind velocities with no damage to the airplane, the static disconnect unit and CO_2 fire extinguishing system have been removed from some airplanes. Circuit breakers for the air refueling system are located on the upper DC power panel.

AIR REFUELING SYSTEM CONTROLS

MASTER REFUEL SWITCH

The master refuel switch (6, figure 1-21; 6, figure 1-22; and 6, figure 1-23) on the pilot's fuel control panel has REFUEL--NORMAL positions. For air refueling operations, this switch is placed in REFUEL position to energize the refueling valve switches on the copilot's air refueling panel. NORMAL position of the switch permits transfer of fuel from auxiliary and bomb bay tanks to the main tanks by means of switches on the pilot's fuel control panel.

(1)

The master refuel switch, when placed in REFUEL position, will also energize the fuel quantity gages and indicators on the air refueling panel at the copilot's station and supply power to the copilot's air refueling panel lights. The intensity of the air refueling panel lights is controlled, along with the copilot's panel lights, by the rheostat located on the copilot's lighting panel (15, figure 1-15) decaled "Panel Lts." The master refuel switch, when placed in the NORMAL position, deenergizes the fuel quantity gages and indicators and panel lights on the copilot's air refueling panel. The fuel quantities are then read from the pilot's fuel control panel.

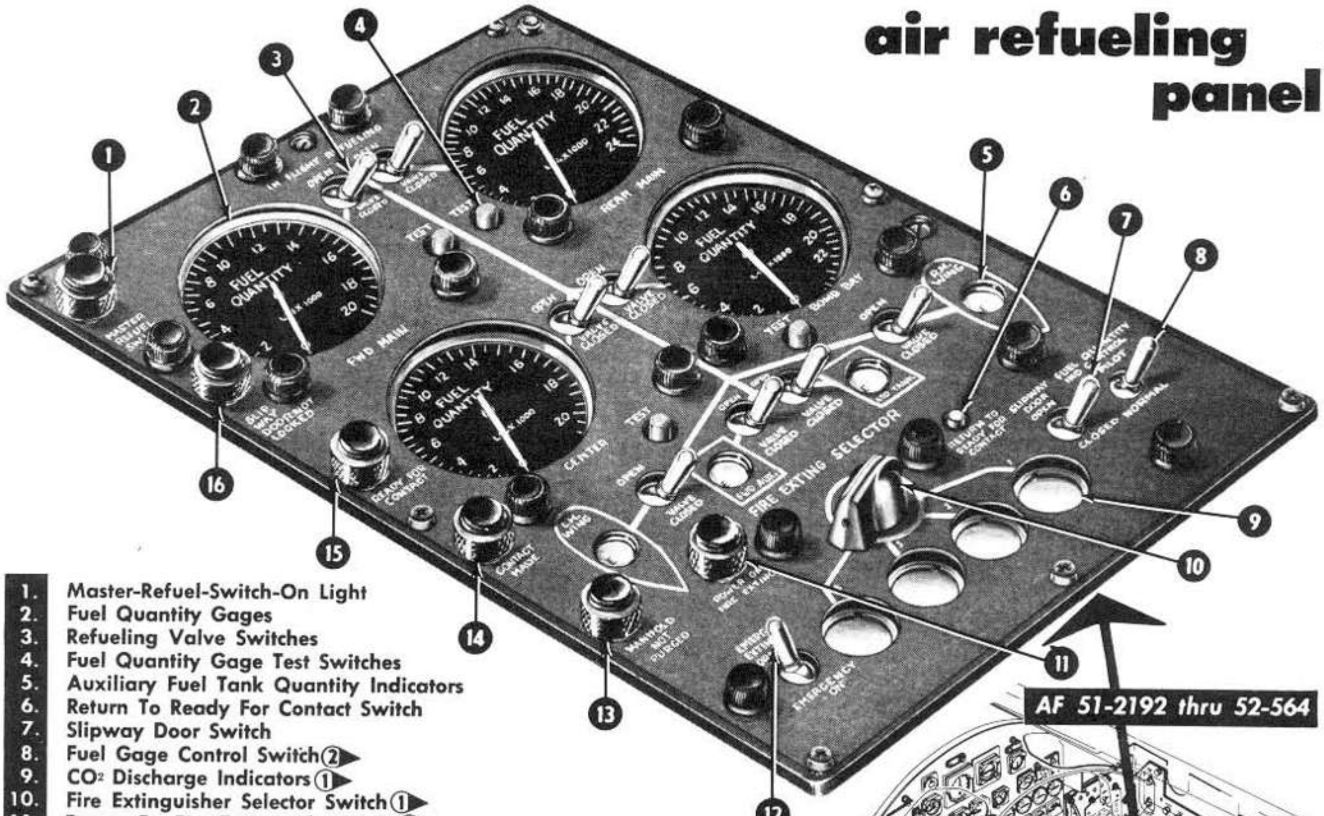
FUEL GAGE CONTROL SWITCH

(2)

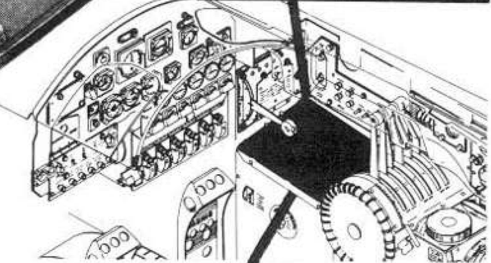
A fuel gage control switch (5, figure 1-22) on the pilot's fuel control panel has COPILOT--PILOT positions. This switch, when placed in the COPILOT position, will deenergize the fuel quantity gages and indicators on the pilot's fuel control panel and energize the fuel quantity gages and indicators on the copilot's air refueling panel (figure 4-41) and supply power to the copilot's air refueling panel lights. The intensity of the air refueling panel lights is controlled,

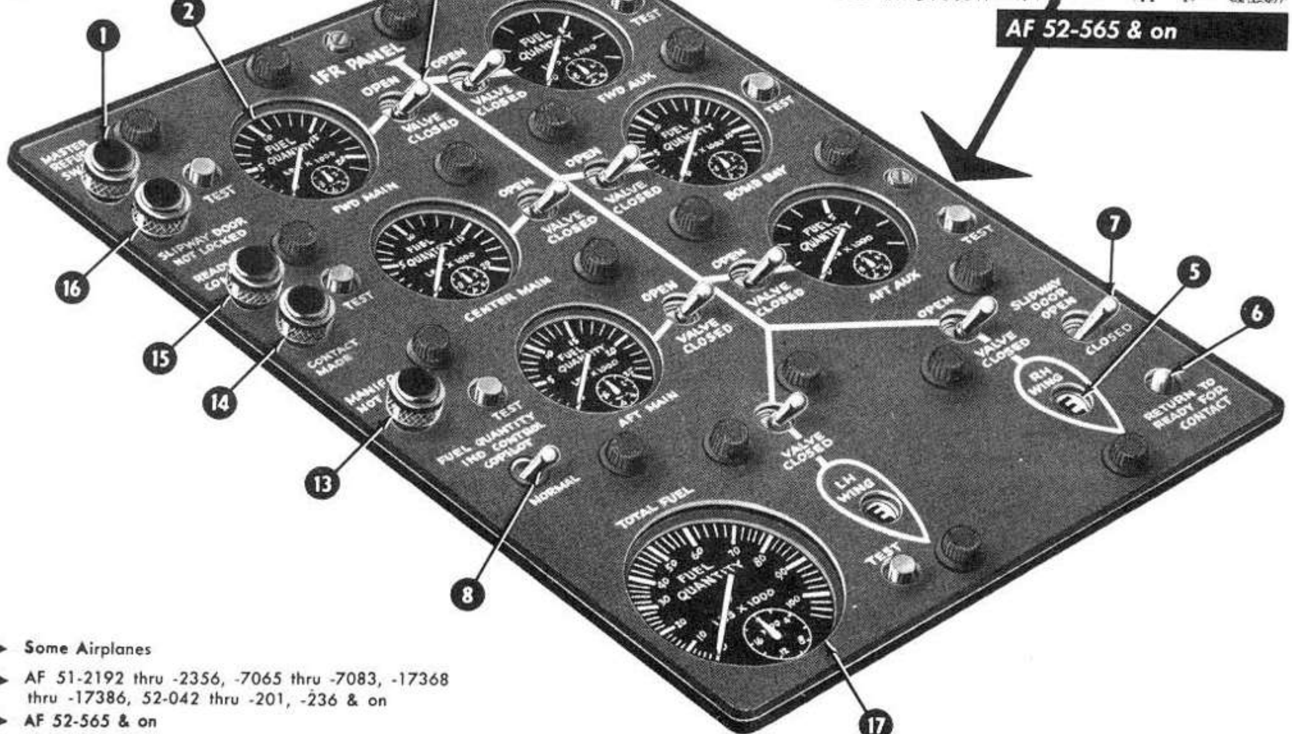
(1) AF 51-2192 thru -2356, -7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on
(2) AF 51-2357 thru -7064, -15804 thru -15812, 52-019 thru -041, -202 thru -235

air refueling panel



1. Master-Refuel-Switch-On Light
2. Fuel Quantity Gages
3. Refueling Valve Switches
4. Fuel Quantity Gage Test Switches
5. Auxiliary Fuel Tank Quantity Indicators
6. Return To Ready For Contact Switch
7. Slipway Door Switch
8. Fuel Gage Control Switch ②
9. CO_2 Discharge Indicators ①
10. Fire Extinguisher Selector Switch ①
11. Power On Fire Extinguisher Light ①
12. Emergency Fire Extinguisher Switch ①
13. Manifold Not Purged Light
14. Contact Made Light
15. Ready For Contact Light
16. Slipway Door Not Locked Light
17. Fuel Totalizer Gage ③





① Some Airplanes

② AF 51-2192 thru -2356, -7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on

③ AF 52-565 & on

Figure 4-41.

50435WB

along with the copilot's panel lights by the rheostat located on the copilot's lighting panel (14, figure 1-15) decaled "Panel Lts." The COPILOT position permits the copilot to read fuel quantity during air refueling operations or to compute fuel consumption during cruise at any time. The fuel gage control switch, when placed in the PILOT position, deenergizes the copilot's fuel quantity gages, indicators, and panel lights. Fuel quantities are then determined from the pilot's fuel control panel.

(1)

A fuel gage control switch (8, figure 4-41) on the copilot's air refueling panel has momentary COPILOT--NORMAL positions. This switch enables the copilot to obtain momentary control of the fuel gages and indicators at any time. Providing the pilot's master refuel switch is in NORMAL position, COPILOT position energizes the copilot's fuel gages and indicators and the air refueling panel lights and deenergizes the pilot's fuel gages and indicators and the pilot's fuel panel lights. Release of the switch to NORMAL position transfers control back to the pilot.

AIR REFUELING SYSTEM SELECTOR SWITCH

A system selector switch (9 and 14, figure 1-20) on the forward left side of the copilot's control stand on some airplanes and on the aft side of the copilot's control stand under the drag control switch on other airplanes has NORMAL IFR SYSTEM--OFF--EMERGENCY BOOM LATCHING positions. The switch controls the electronic signal system and the actuation of the holding toggles which latch the boom in the receptacle. NORMAL IFR SYSTEM position of the switch energizes the electronic signal system which automatically controls operation of the latching toggles. EMERGENCY BOOM LATCHING position deenergizes the electronic signal system and directly controls the actuation of the latching toggles. OFF position of the switch deenergizes the electronic signal system and latching toggle circuits.

NOTE

On some airplanes the copilot's drag control switch is located directly above the air refueling system selector switch. Since both the switches are identical, care should be exercised to prevent inadvertent actuation of the wrong switch.

AIR REFUELING VALVE LEVER

A lever (13, figure 1-15) having OPEN--CLOSED positions is provided at the copilot's station to mechanically open or close a shutoff valve in the refueling manifold leading to the receptacle. OPEN position opens the shutoff valve to permit fuel flow from the receptacle into the refueling manifold. CLOSED position closes the shutoff valve, and the portion of the manifold in the pressurized compartment is isolated from the rest of the fuel system. When the shutoff valve is closed, a limit switch is actuated which starts a manifold drain pump and operates manifold purging equipment which continues operating until the manifold is drained.

REFUELING VALVE SWITCHES

Shutoff valves in the refueling manifold leading to the main and auxiliary fuel tanks are controlled by eight OPEN--VALVE CLOSED switches (3, figure 4-41) on the air refueling panel. When a switch is placed in OPEN, the refueling valves for the corresponding tank will open. The valve is closed by placing the switch in the VALVE CLOSED position. A high-level float switch in each tank overrides the refueling valve switch and automatically closes the corresponding refueling valve when the tank becomes full.

FIRE EXTINGUISHER SELECTOR SWITCH (2)

A rotary-type selector switch (10, figure 4-41) on the air refueling panel provides individual selection of four CO_2 bottles to be discharged into the slipway area. The switch has OFF--1--2--3--4 positions; a bottle is selected by placing the switch in the appropriate position. When the switch is in the OFF position, no CO_2 will be discharged.

EMERGENCY FIRE EXTINGUISHER SWITCH (2)

CO_2 can be discharged into the slipway area at any time by positioning an emergency fire extinguisher switch to EMERGENCY ON. This switch (12, figure 4-41) on the air refueling panel has EMERGENCY ON --EMERG EXTING NORMAL positions and is spring-loaded to NORMAL position. When the switch is in EMERG EXTING NORMAL, CO_2 is automatically discharged at the time the boom disconnects, if the fire extinguisher selector switch is positioned to a charged bottle.

RETURN-TO-READY-FOR-CONTACT SWITCH

A push-button switch (6, figure 4-41) on the air refueling panel when depressed resets the electronic signal amplifier after a disconnect has been accomplished; the air refueling system is then ready for another contact and windshield wiper operation will stop.

SLIPWAY DOOR SWITCH

A slipway door switch (7, figure 4-41) on the air refueling panel has SLIPWAY DOOR OPEN--CLOSED

(1) AF 51-2192 thru -2356, 51-7065 thru -7083, -17368 thru -17386, 52-042 thru -201, -236 & on
(2) Some airplanes

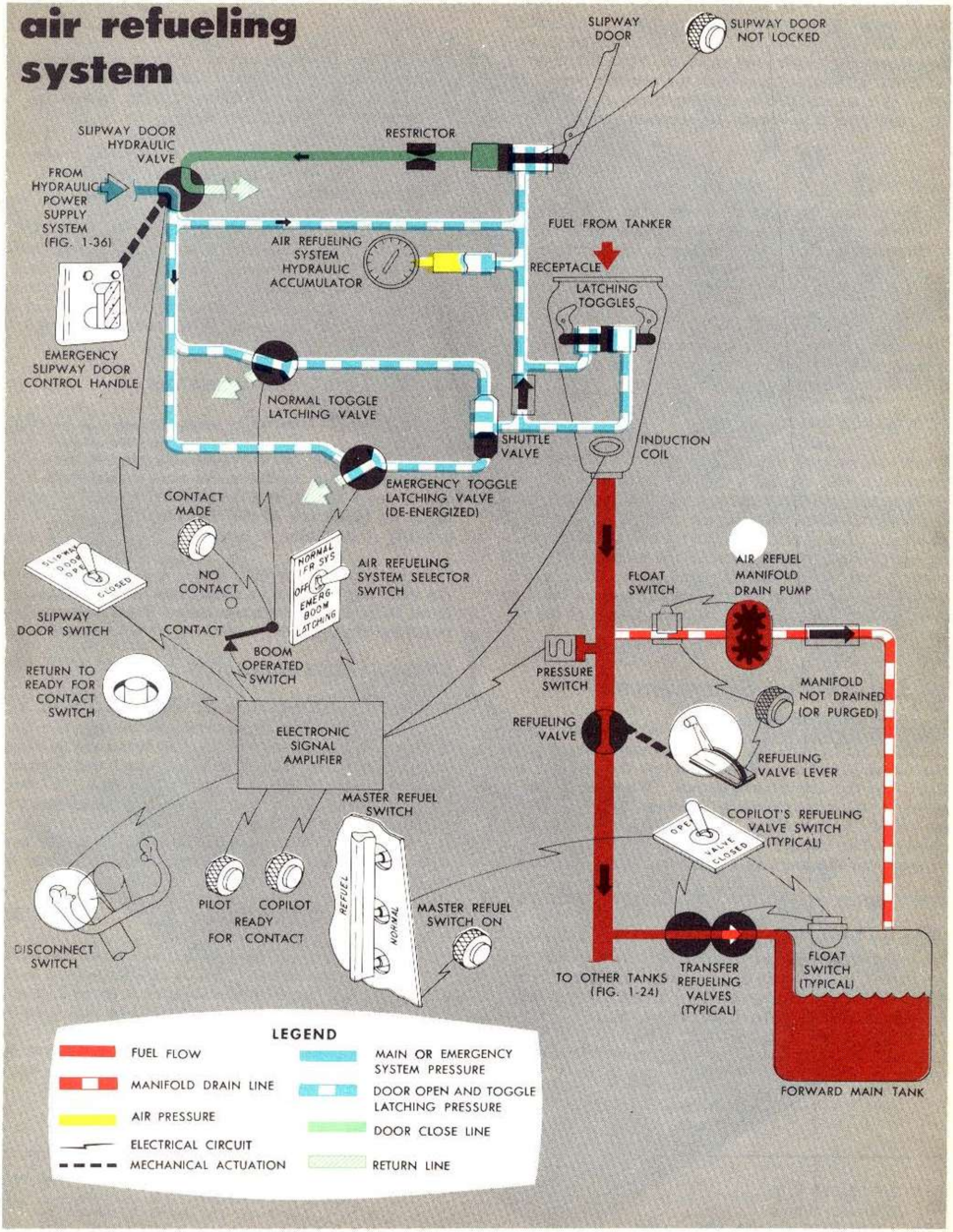

air refueling system
SLIPWAY DOOR
SLIPWAY DOOR NOT LOCKED
SLIPWAY DOOR HYDRAULIC VALVE
RESTRICTOR
FROM HYDRAULIC POWER SUPPLY SYSTEM (FIG. 1-36)
FUEL FROM TANKER
AIR REFUELING SYSTEM HYDRAULIC ACCUMULATOR
RECEPTACLE
LATCHING TOGGLES
EMERGENCY SLIPWAY DOOR CONTROL HANDLE
NORMAL TOGGLE LATCHING VALVE
SHUTTLE VALVE
INDUCTION COIL
EMERGENCY TOGGLE LATCHING VALVE (DE-ENERGIZED)
CONTACT MADE
NO CONTACT
AIR REFUELING SYSTEM SELECTOR SWITCH
NORMAL IFR SYS
OFF
EMERG. BOOM LATCHING
AIR REFUEL MANIFOLD DRAIN PUMP
FLOAT SWITCH
SLIPWAY DOOR SWITCH
CLOSED
CONTACT
BOOM OPERATED SWITCH
PRESSURE SWITCH
RETURN TO READY FOR CONTACT SWITCH
MANIFOLD NOT DRAINED (OR PURGED)
REFUELING VALVE
ELECTRONIC SIGNAL AMPLIFIER
REFUELING VALVE LEVER
MASTER REFUEL SWITCH
COPILOT'S REFUELING VALVE SWITCH (TYPICAL)
OPEN
VALVE CLOSED
REFUEL
NORMAL
PILOT
COPILOT
READY FOR CONTACT
MASTER REFUEL SWITCH ON
DISCONNECT SWITCH
TO OTHER TANKS (FIG. 1-24)
TRANSFER REFUELING VALVES (TYPICAL)
FLOAT SWITCH (TYPICAL)
FORWARD MAIN TANK
LEGEND
FUEL FLOW
MANIFOLD DRAIN LINE
AIR PRESSURE
ELECTRICAL CIRCUIT
MECHANICAL ACTUATION
MAIN OR EMERGENCY SYSTEM PRESSURE
DOOR OPEN AND TOGGLE LATCHING PRESSURE
DOOR CLOSE LINE
RETURN LINE
50438WC

Figure 4-42.

positions. When the switch is placed in SLIPWAY DOOR OPEN position, DC power is supplied to open the slipway door hydraulic valve and hydraulic system pressure will unlock and open the slipway door. DC power is also supplied to the electronic signal amplifier rendering it in "ready-for-contact" condition.

NOTE

The slipway door switch should be in SLIPWAY DOOR OPEN position during operation utilizing the emergency slipway door control handle to open the slipway door in order to supply power to the signal amplifier and illuminate ready-for-contact lights.

Placing the slipway door switch in CLOSED position hydraulically closes the slipway door and deenergizes the electronic signal amplifier.

DISCONNECT SWITCHES

A push-button type switch (2, figure 4-11) located on the pilot's and copilot's control wheels is marked "IFR Boom Auto-Pilot Release." The switch is used to cause a disconnect during air refueling operation or automatic pilot operation. During normal air refueling operation, pressing the switch momentarily will cause a disconnect. During emergency latch operation of the air refueling system the switch must be pressed and held until it has been seen that the refueling boom has been disconnected.

FUEL QUANTITY GAGE TEST SWITCHES

Push-button switches (4, figure 4-41) marked "Test" are adjacent to each fuel quantity gage on the air refueling panel and are provided to test the circuit continuity of the individual gages. When a switch is pressed, the gage needle will rotate toward empty if the circuit is intact and the gage is functioning correctly. The needle will not move if the circuit is broken and the gage is not functioning correctly.

EMERGENCY SLIPWAY DOOR CONTROL HANDLE

A red and white striped handle (26, figure 4-28) under the observer's table provides emergency manual operation of the slipway door hydraulic control valve. The handle has OPEN--OFF--CLOSE positions and must be pulled forward to be turned. OPEN position of the handle positions the hydraulic valve to supply hydraulic pressure to unlock and open the slipway door and to permit actuation of the latching toggles.

NOTE

- The handle must be left in OPEN position during the entire emergency operation of the door in order to continuously provide hydraulic pressure for toggle actuation.
- The slipway door switch must be in ON position during emergency operation in order to supply power to the signal amplifier and the ready-for-contact light.

CLOSE position of the handle positions the hydraulic valve to hydraulically close and lock the slipway door. OFF is the normal position of the handle and permits opening and closing of the slipway door by means of the slipway door switch on the air refueling panel.

AIR REFUELING SYSTEM INDICATORS

FUEL QUANTITY GAGES

Conventional fuel quantity gages (2, figure 4-41) for the forward main, center main, rear main, bomb bay, and on some airplanes * the forward auxiliary and aft auxiliary tanks are on the air refueling panel. Fuel quantity is indicated in pounds.

(1)

A fuel totalizer gage (17, figure 4-41) located on the air refueling panel indicates the total quantity of fuel in all tanks except the wing tanks. Total fuel quantity is indicated in pounds.

FUEL QUANTITY INDICATORS

Tab-window type indicators (5, figure 4-41) on the air refueling panel show by interchangeable tabs the condition of the fuel quantity in the wing tanks and on early airplanes ** the ATO (aft auxiliary) tank and forward auxiliary tank. A full tank is indicated by an "F" tab, an empty tank by an "E" tab, and all intermediate quantities by a divided black and white circle tab. The tab window indicators are operated by DC power and will show fuel quantity at all times when DC power is on in the airplane.

CO_2 DISCHARGE INDICATORS (2)

Four yellow discs (9, figure 4-41) on the air refueling panel provide an indication of CO_2 discharge from each of the four CO_2 bottles provided for slipway fire extinguishing. A discharged bottle will be indicated by an ejected or torn disc. Four red discs on the right side of the airplane fuselage aft of the radome provide an indication of thermal discharge of CO_2 from each

(1) * AF 52-565 & on
(2) Some airplanes
** AF 51-2192 thru 52-564

of the four CO_2 bottles provided for slipway fire extinguishing. A discharged bottle will be indicated by an ejected or torn disc.

MASTER-REFUEL-SWITCH-ON LIGHT

A green light marked "Master Refuel Sw On" (1, figure 4-41) on the air refueling panel illuminates when the air refueling panel controls are energized by placing the master refuel switch (6, figure 1-21; 6, figure 1-22; and 6, figure 1-23) in REFUEL position.

SLIPWAY-DOOR-NOT-LOCKED LIGHT

An amber light marked "Slipway Door Not Locked" (16, figure 4-41) on the air refueling panel illuminates when the slipway door is not closed and locked.

READY-FOR-CONTACT-LIGHTS

An amber light marked "Ready for Contact" (15, figure 4-41) on the air refueling panel illuminates when the slipway door is fully open and the automatic electrical circuits are armed. When contact is made, the light will go out.

A green "Ready for Contact" light (22, figure 1-8 and 19, figure 1-9) is located on the pilot's instrument panel and functions in the same manner.

CONTACT-MADE LIGHT

A green light (14, figure 4-41) marked "Contact Made" on the air refueling panel illuminates when the refueling boom is seated in the nozzle and indicates that electrical power is being supplied to the toggle latching valve to hydraulically latch the toggles and that the receiver signal amplifier is in "Contact" condition.

NOTE

- The light does not necessarily mean that the tanker signal system is in "Contact" condition.
- Illumination of the contact-made light simultaneously with the ready-for-contact light indicates signal amplifier malfunction.

MANIFOLD-NOT-PURGED (or MANIFOLD-NOT-DRAINED) LIGHT

An amber light (13, figure 4-41) marked "Manifold Not Purged" or "Manifold Not Drained" is located on the air refueling panel. The light is controlled by the position of the air refueling valve lever and by a float switch located in the air refueling manifold. The light will illuminate when the air refueling valve lever is placed in OPEN position. When the valve lever is moved to CLOSED at the completion of an air refueling contact, the light will remain illuminated as long as fuel remains in the manifold. When the manifold has drained, the float switch breaks a circuit which turns out the light. The light receives DC power through a circuit breaker on the upper DC power panel.

POWER-ON-FIRE-EXTINGUISHER LIGHT (1)

An amber light marked "Power On Fire Exting" (11, figure 4-41) on the air refueling panel is illuminated whenever electrical power is being supplied to discharge a CO_2 bottle. The light will illuminate during a refueling disconnect or whenever the emergency fire extinguisher switch (12, figure 4-41) is placed in EMERGENCY ON position.

AIR REFUELING SYSTEM OPERATION

For operation of the air refueling system, refer to section VII.

SINGLE POINT GROUND REFUELING SYSTEM

A single point ground refueling (SPR) system may be used to fill both main and auxiliary tanks through a single receptacle to reduce the time and amount of equipment required during fuel servicing of the airplane. Single point servicing of the fuel system is a semi-automatic operation which requires use of a single point ground refueling receptacle and ground refueling control panel in addition to some of the fuel components used during fuel transfer and air refueling operations. The single point system is also used for defueling the airplane or transferring fuel from one airplane to another by use of a single connection between the refueling receptacles of the two airplanes. The airplane can be defueled by the use of an external pumping source or by the airplane boost pumps. When defueling is desired in a minimum amount of time, both means may be used simultaneously. The single point ground refueling receptacle is located on the right side of the airplane between the rear wheel well and bomb bay doors. The filler port consists of a nozzle adapter and a connector which connects the adapter to the refueling manifold. A spring-loaded valve in the nozzle adapter is opened by the fuel nozzle and seals the filler port when the nozzle is withdrawn. The ground refueling control panel provides electrical valve controls to regulate and direct fuel flow from the single point fuel intake of the various tanks. The ground refueling control panel contains a main power switch, primary and secondary valve switches, test switches for the float switches, and circuit breakers for the panel internal circuits.

(1) Some airplanes

(1)
The ground refueling control panel contains fuel quantity gages and indicators and when in use is attached to the rear wheel well door near the single point refueling receptacle. Electrical connection to the airplane electrical system is accomplished by plugging the control panel electrical connections into the receptacles located inside the aft wheel well directly above the landing gear motor.

(2)
The ground refueling control panel contains no fuel quantity gages and utilizes the fuel quantity gages and indicators on the copilot's refueling panel. When in use the control panel is either held in the operator's lap at the copilot's station or set in any convenient place. Electrical connection to the airplane electrical system is accomplished by plugging the control panel electrical connections into the receptacles located below the copilot's floor. DC power is supplied through a circuit breaker on the copilot's aft DC power panel.

MISCELLANEOUS EQUIPMENT

OBSERVER'S EJECTION SEAT

The observer is provided with a catapult-type ejection seat (figure 4-43) that ejects downward through an ejection escape hatch at the observer's station. The seat is equipped with leg braces which serve to hold the observer's legs in place, and leg retainers to keep the feet down on the footrests during the ejection thrust. On some airplanes * a safety belt tiedown strap is installed which restrains the upward motion of the safety belt. Vertical adjustment of the seat is controlled by an electrically operated screw jack which is supplied power through a circuit breaker located on the radar power panel. Rotational adjustment is accomplished by manually rotating the seat between its limits which are at 20° to the left and 90° (58° on some airplanes) to the right of forward. The seat is automatically locked in either of the two extreme positions or at an intermediate position of 45° right of forward.

OBSERVER'S EJECTION SEAT CONTROLS (Figure 4-44)

SEAT ROTATION LOCKS AND LEG BRACES. Two leg braces (1, figure 4-43) are located on the observer's seat and serve as normal and emergency controls. A latch trigger (2, figure 4-43) is located within each leg brace loop. Squeezing either latch trigger releases both leg braces for emergency use. On some airplanes the upper half of the leg brace loop is shielded to insure that the latch trigger will be grasped without difficulty during emergency use. For normal operation, the braces are used for rotating the seat. The seat can be rotated 20° left or 90° (58° on some airplanes) right of forward position by pushing down on either leg brace. The seat can also be locked in an intermediate position of 45° right of forward. For emergency operation when the leg braces are in the upright locked position, the leg braces serve as an aid in maintaining proper position during ejection. As the leg braces are raised from the stowed position to the locked position, the following occurs simultaneously:

1. Initiator on right rail will fire and unlock the cabin air emergency depressurization door.
2. Cabin air pressure will blow out the door.
3. Emergency alarm bell will ring when depressurization door is jettisoned.
4. Shoulder harness will lock.
5. Leg retainers will be moved to the open position.
6. Safety belt tiedown strap will tighten.
7. D-ring is released from the retainer and springs to the upright position.

OBSERVER'S EJECTION D-RING. An ejection D-ring (6, figure 4-43) located on the forward edge of the observer's seat operates with a "two-pull" sequence. Pulling the D-ring once (approximately 1 inch) unlocks and jettisons the observer's downward ejection hatch. As the hatch is jettisoned the seat catapult initiator is armed by means of a static line attached to the hatch. Pulling the D-ring the second time (approximately 1 inch) fires the seat catapult. On some airplanes total travel is approximately 2 inches; on other airplanes total travel is approximately 5 1/2 inches.

WARNING

No pull force should be applied to the D-ring unless ejection from the airplane is desired because partial travel of the D-ring may cause the ejection hatch release initiator to fire.

NOTE

No vertical adjustment of the observer's seat is necessary prior to ejection.

OBSERVER'S VERTICAL SEAT ADJUSTMENT SWITCH. A three-position UP--OFF--DOWN switch (8, figure 4-43) located at the lower right side of the seat is provided to control vertical seat adjustment. This switch is spring-loaded to the center OFF position. Vertical adjustment of the seat is accomplished by placing the switch in either UP or DOWN position until the desired seat position is reached, at which time releasing the switch allows it to return to OFF, thereby stopping the seat travel. Three inches of vertical adjustment in any rotated position is provided with limit switches stopping the seat at its extremes of travel. A circuit breaker for the seat adjustment switch is located on the radar power panel.

(1) AF 51-2192 thru 52-157, -202 thru -311, -394 thru -507
(2) AF 52-158 thru -201, -312 thru -393, -508 & on
* Some modified B-47B airplanes and AF 52-3356 thru -3373, 53-1819 thru -1972, -2028 thru -2040, -2090 thru -2170, -2316 & on

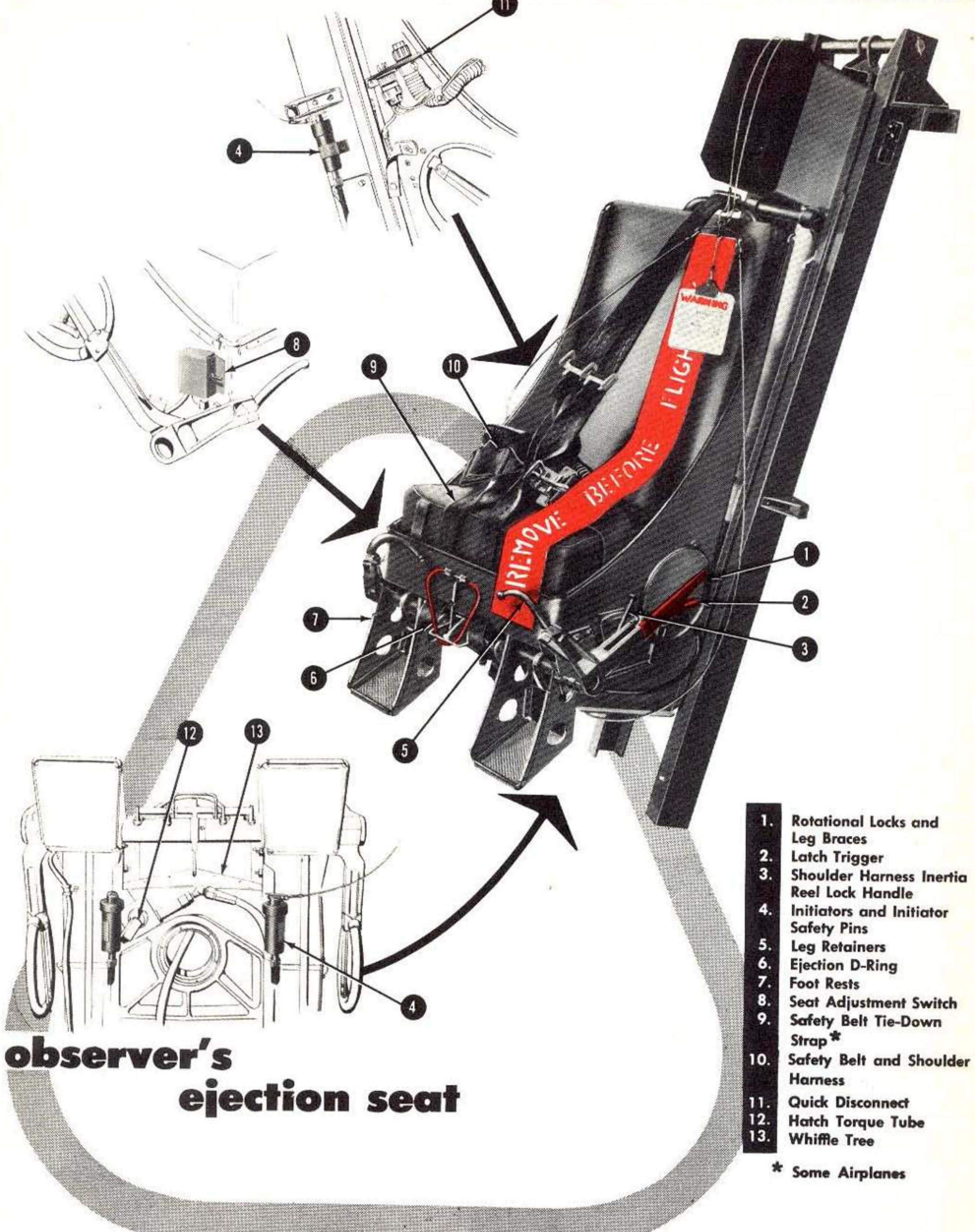
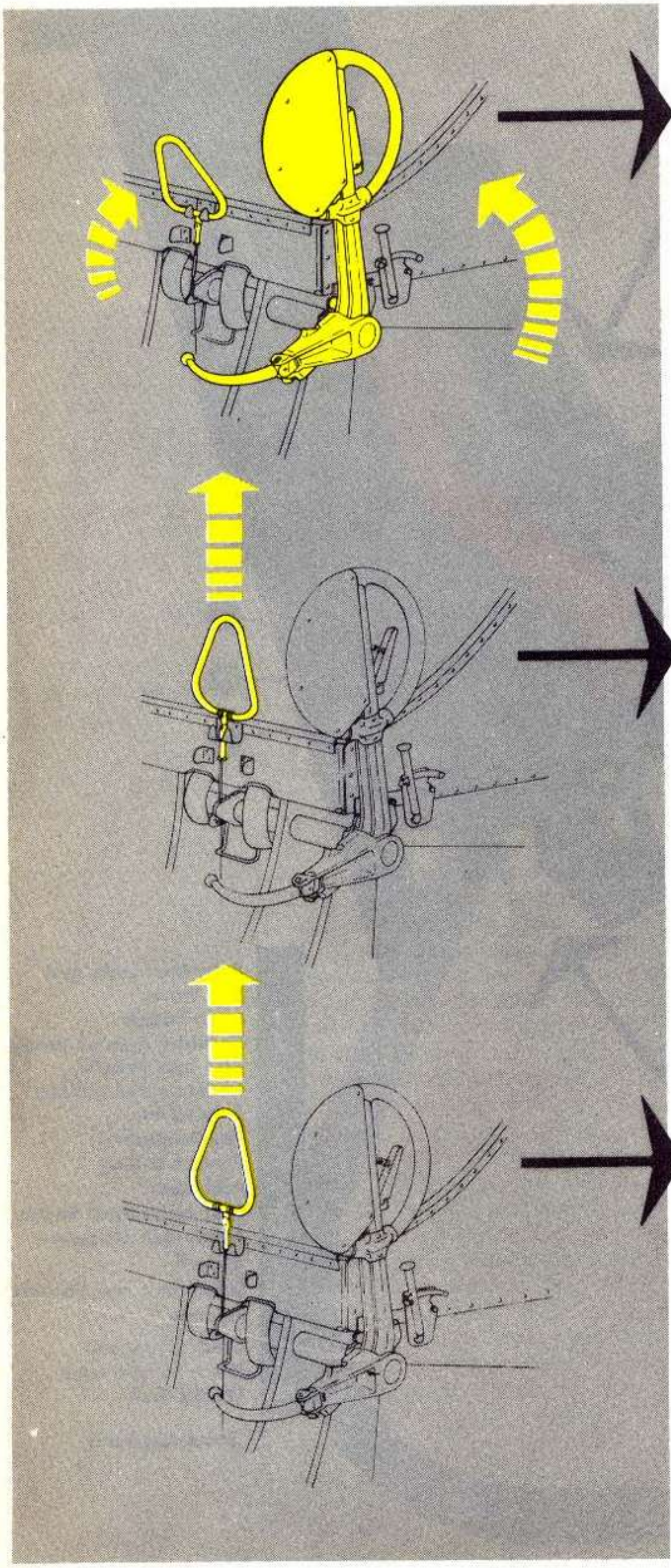

11
4
8
9
10
REMOVE BEFORE FLIGHT
WARNING
1
2
3
7
6
5
12
13
4
observer's
ejection seat
1. Rotational Locks and Leg Braces
2. Latch Trigger
3. Shoulder Harness Inertia Reel Lock Handle
4. Initiators and Initiator Safety Pins
5. Leg Retainers
6. Ejection D-Ring
7. Foot Rests
8. Seat Adjustment Switch
9. Safety Belt Tie-Down Strap*
10. Safety Belt and Shoulder Harness
11. Quick Disconnect
12. Hatch Torque Tube
13. Whiffle Tree
* Some Airplanes
50448WC

Figure 4-43.

observer's ejection seat controls



Raising the leg braces from the stowed position to the locked position causes the following to occur:

1. Cabin air emergency depressurization door unlocks releasing cabin pressure.
2. Emergency alarm bell rings.
3. Shoulder harness will lock.
4. Leg retainers will be moved to the open position.
5. Safety belt tiedown strap will tighten.
6. D-ring is released from the retainer and springs to the upright position.

The ejection D-ring located on the forward edge of seat operates with a "two pull" sequence.

1. One pull (approximately 1 inch) unlocks and jettisons observer's downward ejection hatch.
2. Second pull fires seat catapult.

50447 WC

Figure 4-44.

INITIATOR SAFETY PINS AND STREAMERS. Initiator safety pins (4, figure 4-43) accompanied by a red streamer are provided with the seat. The safety pins are inserted through the top of the initiators to prevent inadvertent firing while the airplane is on the ground. The observer's seat requires two safety pins which attach to the air emergency depressurization door and the downward ejection hatch initiators. The pins must be removed and stowed in a container under the observer's worktable before every flight and replaced immediately after parking the airplane.

OBSERVER'S EJECTION SEAT INDICATORS

DOWNWARD EJECTION HATCH AIR PRESSURE GAGE. An air gage (29, figure 4-28) is installed in the forward portion of the observer's downward ejection hatch to show the pressure charge of the hatch air cylinder. The normal pressure is 2000 psi.

OBSERVER'S SAFETY BELT AND SHOULDER HARNESS

On some airplanes observer's ejection seats are provided with a conventional seat safety belt and shoulder harness while on other airplanes ** the observer's ejection seats are provided with a conventional shoulder harness on an automatic opening cartridge-operated safety belt. This automatic safety belt releases the occupant from the seat at the earliest safe moment after the seat is jettisoned. After the catapult has fired and a lapse of approximately 2 seconds occurs, the safety belt initiator fires which opens the safety belt. In the event the automatic feature of the safety belt fails, it can be opened manually.

OBSERVER'S SHOULDER HARNESS INERTIA REEL LOCK HANDLE

A handle (3, figure 4-43) with LOCKED and RELEASED positions is located on the left side of the observer's seat. A latch is provided for positively retaining the handle at either position of the quadrant. By pressing down on the top of the handle the latch is released and the handle may then be moved freely from one position to the other. When the handle is in RELEASED position the reel harness cable will extend to allow the crew member to lean forward; however, the reel harness cable will automatically lock when an impact force of two or three "g's" is encountered. When the reel is locked in this manner it remains locked until the handle is moved to the LOCKED position and then returned to RELEASED position. In LOCKED position the reel harness cable is manually locked so the crew member is prevented from bending forward. The LOCKED position is used for seat ejection bailout or when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock. Raising the leg braces of the observer's seat to the full upright position will lock the shoulder harness regardless of the vertical position of the seat.

FLIGHT REPORT HOLDERS

Combination flight report holders and map cases are mounted on the left sidewall opposite the pilot's and copilot's stations.

AIRPLANE CHECK LIST

A check list is mounted on the left canopy guard at the pilot's station (10, figure 1-7) and on the right canopy guard at the copilot's station (6, figure 1-15).

PILOT'S DATA DRAWER

A data drawer for the pilot (7, figure 4-29) is installed immediately below the left side of the pilot's instrument panel.

LOAD ADJUSTER

On some airplanes a load adjuster and case is stowed in the pilot's data drawer. The load adjuster is used in finding the airplane cg for different loading conditions. Instructions for using the load adjuster are found in the "Weight and Balance Data" handbook (T.O. 1-1B-40).

COPILOT'S DATA CASE

A data case (1, figure 4-34) for the copilot is installed behind the copilot's seat below the fire control indicator.

ASH TRAYS

Ash trays are mounted on the aft side of the control column for the pilot's and copilot's stations, on the observer's worktable, and on the gunner's baffle.

RELIEF EQUIPMENT

RELIEF HORNS

Some airplanes* are equipped with only one relief horn located at the left of the pilot's seat. On other

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* AF 51-2192 thru 52-592
** AF 51-2192 thru -2356, 52-112 thru -201, -293 thru -497, -508 & on

airplanes three relief horns (5, figure 1-4 and 8, figure 4-29) are provided, two of which are installed for use of the pilot and copilot without leaving their seats The third horn is located just above the chemical toilet and requires the observer to leave his seat and use while standing in walkway.

CHEMICAL TOILET

A chemical toilet (42, figure 1-4 and 12, figure 4-29) is stowed beneath the pilot's floor and may be swung into the walkway for use. The toilet may be locked in either the stowed or extended position by means of a spring-loaded lock actuated by a knob located adjacent to toilet support post. To unlock toilet, lift knob and rotate toilet in the direction desired until lock snaps in place. A toilet paper holder is installed under the pilot's floor directly above the chemical toilet.

NOTE

Some airplanes are not equipped with a chemical toilet.

RELIEF CONTAINERS

Relief container holders (5, figure 1-17; 24, figure 4-28; and 9, figure 4-29) with two 1-quart containers each are installed at the pilot's station just beneath the pilot's floor, on the floor aft of the copilot's seat, and near the floor beneath the observer's worktable.

DRINKING CONTAINERS

Thermos bottles and a drinking cup dispenser (9 and 13, figure 1-16) are installed in the walkway opposite the copilot's seat.

FOOD WARMING CUP

A food warming cup (20, figure 1-7) for warming food in flight is installed on the left sidewall opposite the pilot's seat. A timer is provided for its control and an amber light indicates when it is operating. The timer and light are mounted on the warming cup supporting bracket. A circuit breaker on the lower DC power panel protects the equipment.

ENTRANCE LADDER

The airplane is provided with a five-section interlocking ladder to facilitate normal entrance and exit. The ladder is installed in the main entrance way (35, figure 1-4), and folds up to stow within the fuselage. Under emergency bailout conditions, the ladder is jettisoned into the airstream upon actuation of the bailout spoiler mechanism and the entrance-way is left clear of dangerous obstructions.

(1)

The four bottom sections of the ladder are extended by operating the individual push-to-release latch knobs located at the base of each section, (see figure 2-2). The sections latch automatically as they are extended or retracted.

(2)

The ladder is extended from outside the airplane by operating the pull knob located on the lower outboard end of the ladder. When the knob is pulled the ladder sections slide downward, each section unlatching the succeeding section as it extends. From inside the airplane operating the push knob, located on the end of the ladder, unlatches the first section which unlatches the other sections in succession as it slides downward to the extended position. The ladder is retracted by grasping the bottom section and pushing upward. As the sections slide upward to the stowed position inside the fuselage they automatically latch together.

EXTERNAL ENTRANCE DOOR

The external or main entrance door is located on the forward left side of the airplane below the cockpit (36, figure 1-4). A door handle is located at the lower right-hand corner of the door and the door is opened by grasping and pulling the handle (1, figure 2-2). A similar interconnecting handle is located on the inside of the door and is operated in a like manner. In case of emergency bailout, the door is automatically jettisoned into the airstream when the emergency bailout handle is pulled.

PRESSURE DOOR

The pressure door, which provides entrance to the pressurized compartment, is located within the airplane fuselage in alignment with the main entrance door. The door is of the sliding-type and is opened from the outside by pulling out on the external pressure door release handle located above the pressure door. An interconnected internal handle (16, figure 1-16) is located on the inside of pressurized compartment above the door. The pressure door is closed from inside the airplane by pulling down the internal pressure door handle and sliding the door to the closed position - until the latches engage. The door handle is then raised, lifting the door into the sealed position. From inside the pressurized compartment, the pressure door is opened by pulling down the internal pressure door handle, and allowing it to slide down and open.

ESCAPE CHUTE DOOR

The escape chute door located in the crawlway immediately aft of the main entrance way (32, figure 1-4)

(1) AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2367
(2) AF 53-1881 thru -1972, -2118 thru -2170, -2368 & on

and serves to separate the escape chute from the crawlway. The door is provided with similar interconnecting handles located near the top inboard side of the door and the door is marked to show the "LATCH" and "UNLATCH" positions.

COVERS

Canopy, fuselage nose, pitot tube, and engine nacelle covers are stowed in the flyaway tool kit.

MOORING PROVISIONS

Demountable mooring eyes for providing a tie-down point on the lower surface of each wing are stowed on the left-hand side of the bomb bay. A combination towing and tie-down ring is provided on the aft main gear (figure 1-4).

TOOLS

A flyaway tool box containing flyaway tools and equipment is installed in the bomb bay. Handtools and a carrying case are installed on the bomb bay platform and special bomb handling tools are installed on the forward bulkhead of the bomb bay on some airplanes.

BLACKOUT CURTAIN

A curtain is installed immediately aft of the observer's station to prevent nose compartment lighting from interfering with pilot vision. Additional curtains are provided for the observer's windows.

(1)

On some airplanes curtains are provided to completely black out the pilot's, copilot's, and observer's stations. The curtains for the canopy consist of seven movable and two fixed curtains. The fixed curtains are positioned prior to flight and removable as desired in flight. Curtains in the aft canopy section (aft of copilot) are unrolled to center, zipped up the center, and snapped to the framework. Roller-type curtains on the left and right of the copilot are extended up and hooked. The windshield curtain pulls up and clips. The forward canopy curtain pulls up and is tab-fastened. Two overhead roller-type curtains in the pilot's station are extended down and snap-fastened. To facilitate hasty blackout the following sequence of closing curtains should be observed:

(1) Copilot extends the aft canopy curtains to center, zips up the middle, and snap-fastens curtain to framework.

(2) Copilot pulls roller-type curtains up and secures to hooks on the framework.

(3) Pilot pulls forward canopy curtain aft and snap-fastens to frame.

(4) Pilot extends overhead roller-type curtains down and snap-fastens to frame.

(5) Pilot pulls windshield curtain up and clips.

The observer's curtains can be drawn and snap-fastened to the respective window frames.

CAUTION

Special care must be taken to keep from soiling or damaging curtains.

CANOPY SUN CURTAINS

Roller-type sun curtain units (8, figure 1-4), each containing a left and right curtain, are installed on the inside of the canopy above the pilot's and copilot's seats. Each curtain may be pulled out to a fully extended or intermediate position and secured to hooks on the canopy. The curtains are not to be removed.

(2)

The curtains may be removed for stowing by pulling back a spring-loaded knob on the forward underside of each curtain and allowing that end to drop down. On some airplanes the sun curtain units may be stowed on the left sidewall at the copilot's station and on other airplanes on the walkway overhead between the pilot's and observer's stations.

WINDSHIELD WIPER

A windshield wiper is provided to clear the main windshield during adverse weather conditions and air refueling operations.

(3)

The electrically operated windshield wiper is controlled by a knob (19, figure 1-10) on the windshield wiper control panel on the side of the pilot's control stand. The knob has START--FAST to SLOW--off--PARK positions. When in PARK position the knob is spring-loaded to the off position. To operate the wiper, place the knob in START position and then adjust counterclockwise to the desired speed of the wiper.

(4)

The electrically operated windshield wiper is controlled by a rotary switch on the windshield wiper control panel (9, figure 1-7) on the left side of the pilot's

(1) AF 51-2192 thru -2356, 52-183 thru -201, -379 thru -393, -612 & on
(2) AF 51-2357 thru52-041, -202 thru -235
(3) AF 51-2357 thru 52-157, -202 thru -311, -394 thru -507
(4) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

station. The switch has PARK--OFF--LOW--MED--HIGH positions and when in PARK position it is spring-loaded to OFF. To operate the wiper rotate the switch clockwise to the desired position.

CAUTION

Do not operate wiper on dry glass since the windshield surface may be damaged.

When wiper operation is no longer desired, rotate the knob counterclockwise and hold in PARK position. The wiper blade will be driven to its parked position at the left side of the windshield. When the knob is released it will return to off. The windshield wiper is automatically operated by the air refueling system at the time of disconnect. When the air refueling system selector switch is in NORMAL IFR SYSTEM position and the air refueling system is in the "Disconnect" condition, the windshield wiper will operate at a maximum speed, regardless of the knob position. When the air refueling system selector switch is placed in OFF or the slipway door switch placed in CLOSED, the windshield wiper will stop; when the return-to-ready-for-contact switch is pressed, the wiper will return to its parked position. When the air refueling system selector switch is in EMERGENCY BOOM LATCHING position, the windshield wiper will operate at maximum speed as long as the pilot or copilot presses the disconnect switch on his control wheel. When the switch is released, the wiper will stop but will not necessarily return to its parked position. If not parked, the pilot must hold the wiper knob in PARK position until the wiper blade moves to the parked position. The windshield wiper is DC operated and the circuit breaker is located on the lower DC power panel.

REAR VIEW MIRRORS

Three rear view type mirrors are installed; one located on the left side of the forward canopy frame, another on the left side of the pressurized compartment in the vicinity of the main entry door, and a third on the aft end of the canopy jettison guide forward of the copilot's instrument panel. The pilot's mirror and the bulkhead mirror allow a visual check between pilot and copilot, while the copilot's mirror affords visual reference aft.

On later airplanes, the copilot's rear view mirror is attached to the right side of the copilot's windshield frame.

OBSERVER'S DATA DRAWER (1)

An observer's data drawer (29, figure 4-28) is provided under the observer's worktable. The drawer is spring-loaded to keep it closed when not in use. Bomb indicator cards are stowed within the drawer.

(1) AF 51-2192 thru -2356, 52-158 thru -201, -312 thru -393, -508 & on

operating limitations

section 5

table of contents

GENERAL

As with all mechanical instruments, this airplane possesses certain well-defined limitations which must be observed if safety and efficiency are to be attained. Its high performance features compel a more rigid adherence to these limitations than would normally be required, for they mean that normal operations will approach these limiting factors more closely than in most airplanes. This is true of the engines and some of the auxiliary equipment, as well as of the airplane itself. It is therefore important that you study this section carefully to familiarize yourself with these limitations as shown herein by illustrations and explanatory text. The knowledge thus gained will result in more proficient operation of the airplane.

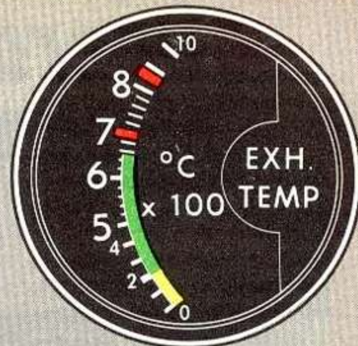
MINIMUM CREW REQUIREMENTS

The minimum crew requirements for this airplane are a pilot and copilot. Additional crew members as required will be added at the discretion of the Commander.

instrument markings

TACHOMETER

(green)	85% TO 95% RPM	BEST CRUISING
(red)	98% RPM	MILITARY RATING — 30 MINUTES
(red)	100% RPM	MAXIMUM TAKEOFF — 5 MINUTES



EXHAUST GAS TEMPERATURE
SOME AIRPLANES

(yellow)	0°C TO 200°C	OPERATION AT LOW POWER SETTINGS
(green)	200°C TO 655°C	CONTINUOUS OPERATION
(red)	690°C	MAXIMUM FOR FLIGHT
(red)	870°C	MAXIMUM DURING STARTING & ACCELERATION ONLY

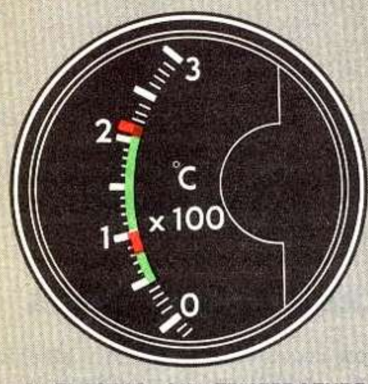
OIL PRESSURE

(yellow)	2 TO 8 PSI	OPERATION BELOW 88% RPM
(red)	8 PSI	MINIMUM FOR CONTINUOUS OPERATION ABOVE 88% RPM
(green)	8 TO 18 PSI	CONTINUOUS OPERATION
(yellow)	18 TO 22 PSI	OPERATION AT 100% RPM
(red)	22 PSI	MAXIMUM FOR 100% RPM

APPLICABLE TO ANY GRADE OF FUEL

EXHAUST GAS TEMPERATURE
SOME AIRPLANES

(yellow)	0°C TO 200°C	OPERATION AT LOW POWER SETTINGS
(green)	200°C TO 655°C	CONTINUOUS OPERATION
(red)	690°C	MAXIMUM FOR FLIGHT
(red)	870°C	MAXIMUM DURING STARTING & ACCELERATION ONLY



ANTI-ICING AIR TEMPERATURE

(green)	50° C TO 80° C	NORMAL GROUND OPERATION
(red)	80° C TO 105° C	MAXIMUM GROUND OPERATION
(green)	105° C TO 216° C	SAFE OPERATING RANGE FOR MANUAL OPERATION IN FLIGHT
(red)	216° C	MAXIMUM FOR MANUAL OPERATION IN FLIGHT

FUEL PRESSURE

(red)	AF 51-2357 THRU 52-071, -202 THRU -246	
(green)	40 PSI	MINIMUM FOR FLIGHT
(red)	40 TO 400 PSI	CONTINUOUS OPERATION

Figure 5-1. (Sheet 1 of 3 Sheets)

WARNING

ACCUMULATOR AIR PRELOAD PRESSURE SHOULD BE 1500 PSI. INDICATIONS AS LOW AS THE ABOVE VALUE RESULTS IN ZERO SYSTEM PRESSURE AS READINGS ARE TAKEN FROM THE AIR SIDE OF THE ACCUMULATOR.

MAIN HYDRAULIC SYSTEM PRESSURE

2000 PSI	MINIMUM
2500 TO 3000 PSI	NORMAL
3450 PSI	MAXIMUM

EMERGENCY HYDRAULIC SYSTEM PRESSURE

1500 PSI	MINIMUM
2500 TO 3100 PSI	NORMAL
3450 PSI	MAXIMUM

WARNING

ACCUMULATOR AIR PRELOAD PRESSURE SHOULD BE 1500 PSI.

ACCUMULATOR AIR PRELOAD PRESSURE SHOULD BE 1000 PSI.

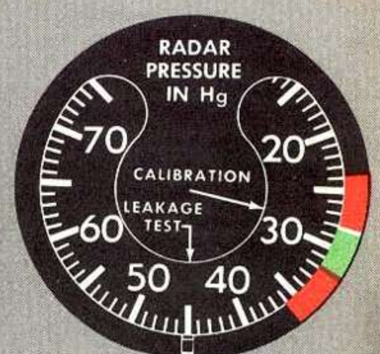
INDICATIONS AS LOW AS THE ABOVE VALUES RESULTS IN ZERO SYSTEM PRESSURE AS READINGS ARE TAKEN FROM THE AIR SIDE OF THE ACCUMULATOR.

BRAKE SYSTEM MAIN HYDRAULIC PRESSURE

1500 PSI	MINIMUM
2000 TO 3000 PSI	NORMAL
3450 PSI	MAXIMUM

BRAKE SYSTEM EMERGENCY HYDRAULIC PRESSURE

1000 PSI	MINIMUM
1700 PSI	ONE BRAKE APPLICATION REMAINING
1700 TO 3000 PSI	NORMAL
3450 PSI	MAXIMUM



HYDRAULIC OIL QUANTITY

2.5 GALS.	MINIMUM FOR SAFE FLIGHT
2.5 TO 3 GALS.	MARGINAL OPERATION
3 TO 7 GALS.	NORMAL OPERATION
7 GALS.	MAXIMUM WITH ALL ACCUMULATORS DISCHARGED

RADAR PRESSURE

24 TO 28 IN. HG.	MARGINAL OPERATION
28 TO 32 IN. HG.	CONTINUOUS OPERATION
32 TO 36 IN. HG.	MARGINAL OPERATION

The above values assume sea level calibration of the system. Actual values will vary with the operating field elevation.

Figure 5-1. ***(Sheet 2 of 3 Sheets)***

AIRSPEED INDICATOR

AF 51-15804 thru -15812, 52-019 thru -053, -202 thru -244

195 Knots — Full Flaps

The instrument setting is such that the red pointer will move to indicate the limiting airspeed of 310 knots or the airspeed representing the limiting Mach No. of .815, whichever is less.

MACHMETER

AF 51-2357 thru 52-149, -202 thru -311

.815 Maximum

AIRSPEED INDICATOR

AF 51-2357 thru -7083, -17368 thru -17386, 52-054 thru -149, -245 thru -311

195 Knots — Full Flaps

The instrument setting is such that the red pointer will move to indicate the limiting airspeed of 425 knots or the airspeed representing the limiting Mach No. of .76, whichever is less.

NOTE

.76 Mach is limiting Mach number only below 20,000 feet altitude.

AIRSPEED INDICATOR

AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

195 Knots — Full Flaps

The instrument setting is such that the red pointer will move to indicate the limiting airspeed of 425 knots or the airspeed representing the limiting Mach No. of .86, whichever is less.

NOTE

Maximum Speed — 425 knots IAS or initial buffet.

MACHMETER

AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

.86 Maximum

ACCELEROMETER

2 g MAXIMUM AT MAXIMUM GROSS WEIGHT

3 g MAXIMUM AT DESIGN GROSS WEIGHT

50501WC-1

Figure 5-1. (Sheet 3 of 3 Sheets)

ENGINE LIMITATIONS

Engine inspections for overtemperature conditions will be made prior to flight in accordance with the following schedule:

CONDITION	OCCURRENCES	ACTION PRIOR TO FLIGHT
715° C or higher for over 20 seconds OR 870° C or higher for any period	Five	Overtemperature Inspection per T.O. 2J-J47-358
	Ten	Overtemperature Inspection per T.O. 2J-J47-358 PLUS Removal & Replacement of the Turbine Rotor Assembly
1000° C or higher for any period OR 720° C or higher steady indication for any period after EGT stabilizes at a given throttle setting	One	Overtemperature Inspection per T.O. 2J-J47-358 PLUS Removal & Replacement of the Turbine Rotor Assembly

Engine overspeed exceeding 104% of rated rpm, either with or without overtemperature, requires removal and overhaul of the engine. The extent and duration of EGT exceeding 1000°, 870°, 720°, or 715° C (for over 20 seconds), plus extent and duration of all overspeeds, shall be recorded in DD Form 781.

Maximum Takeoff (5 min)	100% (±1%) rpm
Military Rated (30 min)	98% rpm
Normal Rated (no time limit)	96% rpm or less

CAUTION

Throttles should be advanced cautiously to avoid compressor stall. (See section VII.)

OIL PRESSURE

During cold weather the oil pressure may exceed the maximum limits until the oil temperature reaches normal. During stabilized flight conditions an increase or decrease in excess of 5 psi from a previous reading is an indication of a clogged or broken oil line and the engine should be shut down, even if the pressure is within limits.

CAUTION

The engine oil pressure should be closely observed during flight at high speeds.

FUEL

The operating limits are identical for either the recommended or alternate fuel grades.

AIRSPEED LIMITATIONS

See figure 5-1 for limits other than those listed below.

LANDING GEAR

Maximum IAS for raising landing gear - 215 knots.

CAUTION

During gear retraction, gear actuating motors must lift the weight of the gear and overcome the drag caused by the gear retracting forward. Speeds above 215 knots IAS could impose loads that would damage or burn out the actuating motors.

Maximum IAS for landing gear extended - 305 knots.
Maximum IAS for extending landing gear - 305 knots.

(1) Maximum IAS for extending landing gear by emergency landing gear extension system (ELGE) - 200 knots.

WING FLAPS

Wing flaps should not be extended at indicated airspeeds above 230 knots. Once the flaps are set at a given position, the airplane may be flown not to exceed the in-

(1) AF 51-2357 thru 52-167, -202 thru -292, -394 thru -460 which do not have T.O. 1B-47-458 accomplished

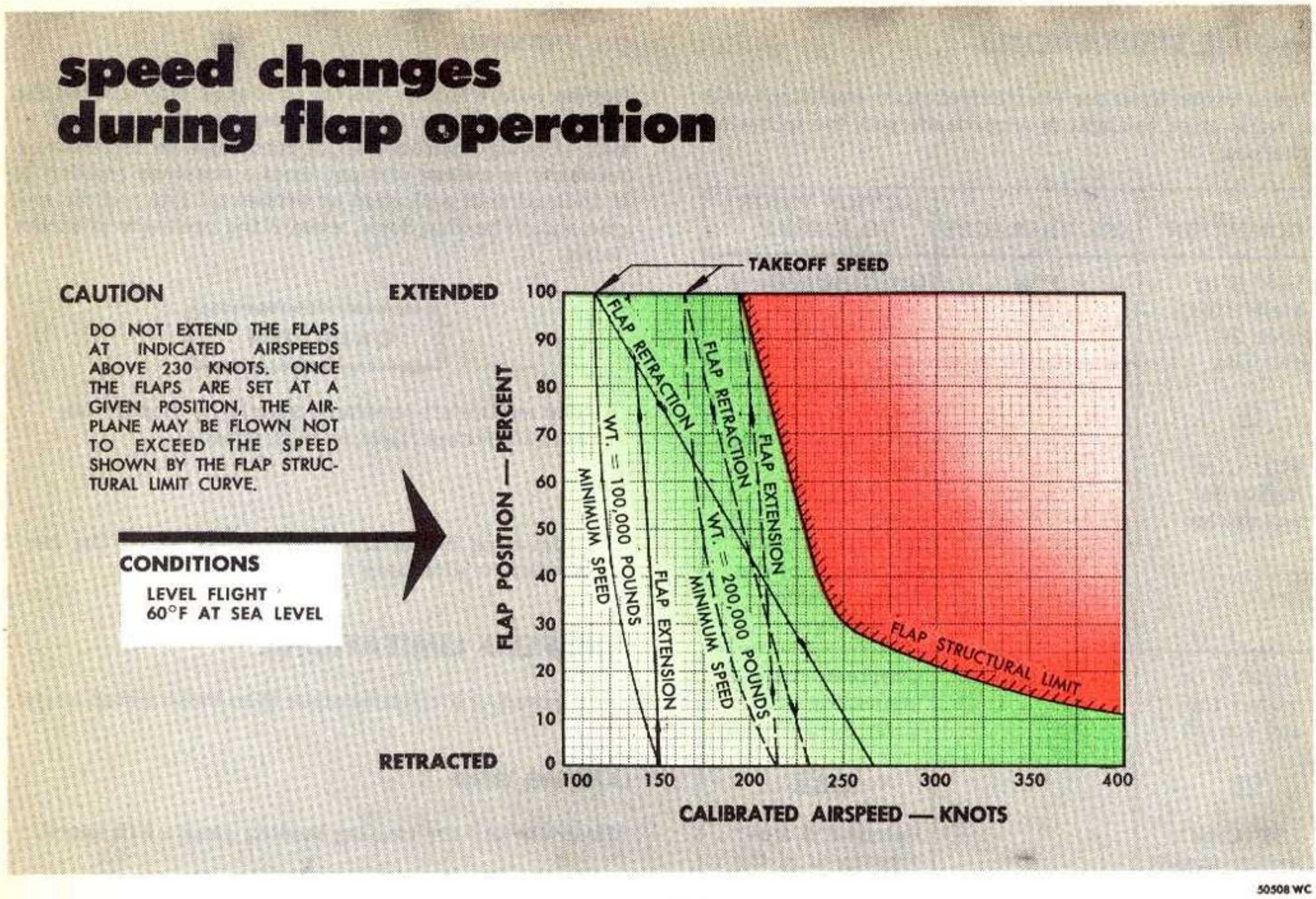
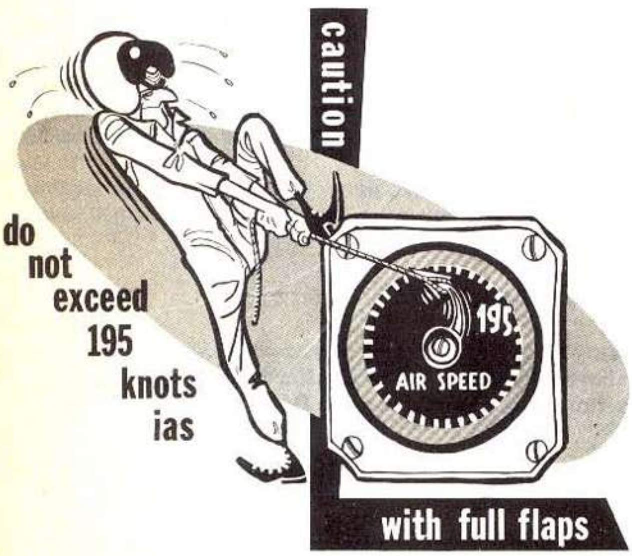


Figure 5-1A.

dicated airspeed shown by the flap structural limit curve in figure 5-1A.



EXTERNAL WING TANKS

For speed restrictions with external wing tanks installed, refer to "Flutter," this section.

The following limitations are applicable when jettisoning the external wing tanks:

Minimum IAS	155 knots
Maximum IAS	300 knots
Empty Tank	Flaps up only
Full Tank	Flaps up or down

BOMB DOORS

(1)

Maximum IAS for bomb doors open and for opening or closing operations 310 knots

(2)

Because bomb bay spoilers do not extend when bomb doors are opened by the alternate system, operation of the bomb doors by the alternate system at speeds in excess of 217 knots IAS should be avoided to prevent excessive bomb bay buffeting and bomb door damage as a result of buffeting.

(1) AF 51-2357 thru 52-176, -202 thru -362, & -394 thru -573
(2) AF 52-019 thru -028

Airplanes equipped with long bomb doors are restricted to 360 knots IAS for actuation of bomb doors by the alternate system due to excessive yaw which is induced by slow actuation rate and unsymmetrical door operation.

CANOPY

(1)

The sliding canopy must not be opened during flight except to improve safety of operating the airplane. If it is deemed necessary to open the canopy in flight, the airspeed should not exceed 215 knots IAS. When jettisoning the canopy to prevent possible collision of the canopy with the vertical stabilizer, the canopy should be jettisoned at speeds above 190 knots IAS.

(2)

The maximum speed with clamshell canopy open is 100 knots IAS. The open canopy condition is for ground operations only; do not open during flight. When jettisoning the clamshell canopy to prevent possible collision of the canopy with the vertical stabilizer, the canopy should be jettisoned at speeds above 180 knots IAS.

BRAKE CHUTE

Maximum IAS for deployment of Type D-1 brake chute is as follows:

Modified chute	160 knots IAS
Unmodified chute	115 knots IAS

It should be determined before takeoff which chute is installed. The modified chute pack is stenciled "modified" for identification.

APPROACH CHUTE

Maximum IAS for deployment of approach chute	195 knots

AUTOMATIC PILOT

(3)

Operation of automatic pilot at speeds above 208 knots IAS and at altitudes below 34, 000 feet is permitted only if pilot is prepared to take over control of airplane immediately in event of automatic pilot malfunction. There are no automatic pilot restrictions at any speed at altitudes above 34, 000 feet.

(4)

Operation of automatic pilot at speeds above 310 knots IAS or Mach .70, at altitudes below 34, 000 feet, the pilot should be prepared to take over immediate control of the airplane in the event of automatic pilot malfunction. There are no automatic pilot restrictions at any speed at altitudes above 34, 000 feet.

ELEVATOR SURFACE POWER CONTROL

(5)

Sudden failure of elevator surface power control may cause loss of control at a speed in excess of the following: 425 knots or Mach .76, whichever is lower, up to 20, 000 feet altitude. Between 20, 000 and 34, 000 feet altitude, the limit is a maximum of Mach .81. Above 34, 000 feet altitude the limit is the point of initial buffet.

FLUTTER

Because of wing flutter, do not exceed the following indicated airspeeds and Mach numbers under the following conditions:

- Without External Wing Tanks:

  Below 150, 000 pounds gross weight, do not exceed 456 knots IAS or Mach .86, whichever occurs first.

  Above 150, 000 pounds gross weight, do not exceed 440 knots IAS or Mach .86, whichever occurs first.

- With External Wing Tanks installed and empty or not completely full:

  Below 140, 000 pounds gross weight, do not exceed 456 knots IAS or Mach .86, whichever occurs first.

  Between 140, 000 and 180, 000 pounds gross weight, do not exceed 390 knots IAS or Mach .85, whichever occurs first.

  Above 180, 000 pounds gross weight, do not exceed 370 knots IAS or Mach .80, whichever occurs first.

- With External Wing Tanks installed and full:

  At any gross weight, do not exceed 456 knots IAS or Mach .86, whichever occurs first.

---

(1) AF 51-2192 thru 52-611
(2) AF 52-612 & on
(3) AF 51-2357 thru -2359, -2361 thru -2400
(4) AF 51-2192 thru -2356, -2360, -2401 & on
(5) AF 51-2357 thru 52-149, -202 thru -311

mach number limit

DATE: APRIL 1954
DATA BASIS: FLIGHT TEST

REMARKS: BUFFET CURVES ARE FOR LEVEL FLIGHT IN STABLE AIR

LEGEND

ENGINE FAILURE LIMITATION

FLIGHT RESTRICTED ABOVE 310 KNOTS IAS OR M.815 WHICHEVER OCCURS FIRST ON AIRPLANES AF 51-15804 THRU -15812, 52-019 THRU -053, -202 THRU -244.

ELEVATOR SURFACE POWER CONTROL FAILURE LIMITATION

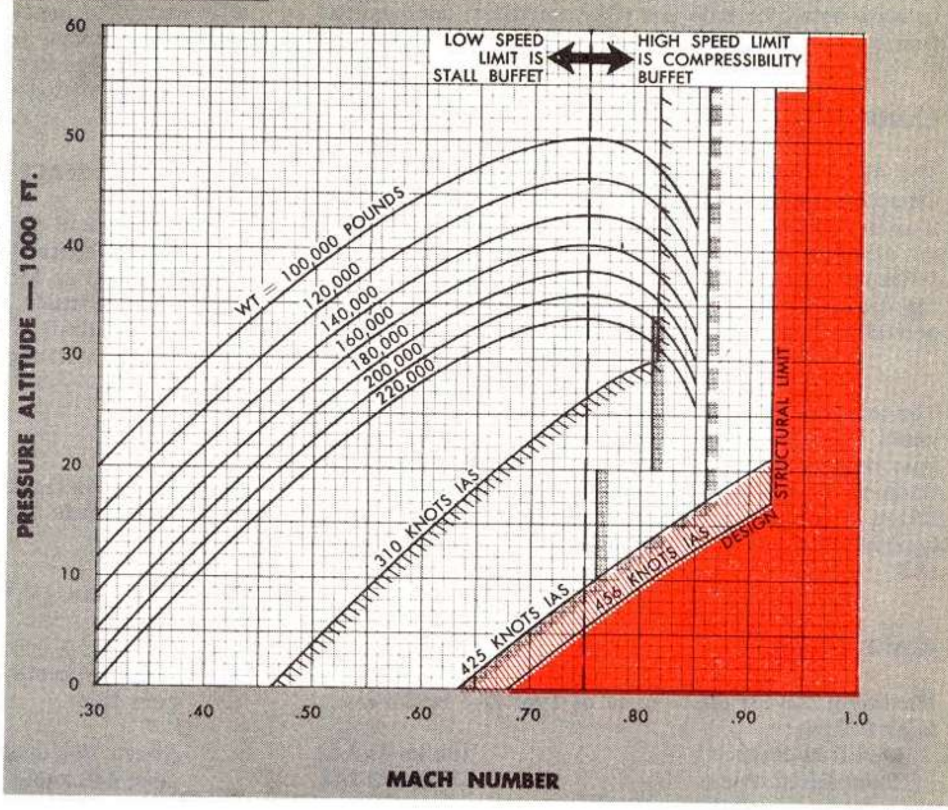
FLIGHT RESTRICTED ABOVE 425 KNOTS IAS OR M .76, WHICHEVER OCCURS FIRST, UP TO 20,000 FT. OR M .81 FROM 20,000 FT. TO 34,000 FT. OR INITIAL BUFFET ABOVE 34,000 FT. ON AIRPLANES AF 51-2357 THRU -7083, -17368 THRU -17386, 52-054 THRU -149, -245 THRU -311.

LATERAL CONTROL AND BUFFET LIMITATION

FLIGHT RESTRICTED ABOVE 425 KNOTS IAS OR INITIAL BUFFET OR M .86, WHICHEVER OCCURS FIRST, ON AIRPLANES AF 51-2192 THRU -2356, 52-150 THRU -201, -312 AND ON.

FLIGHT PROHIBITED ABOVE LATERAL CONTROL LIMIT OF 425 KNOTS IAS.

FLIGHT PROHIBITED ABOVE DESIGN STRUCTURAL LIMIT.



50503 WC-1

Figure 5-2.

WARNING

The airspeeds and Mach numbers shown above are limitations for flutter only. The airplane maximum speed and lateral control limits given in this section should be observed at all times unless emergencies require that they be exceeded. If it becomes necessary to exceed the airplane maximum speed or lateral control limits, the flutter limitations shown above should be observed in relation to the gross weight of the airplane. Particular attention should be given to the flutter limits of 390 knots IAS or Mach .85 and 370 knots IAS or Mach .80 as shown above. Performance airspeeds taken from the appendix for climb and range should be reduced if necessary to remain below these limits.

LATERAL CONTROL

Because of aileron ineffectiveness at higher indicated airspeeds, the airplane is restricted to a maximum of 425 knots IAS. Lateral control characteristics at high indicated airspeeds are described in section VI.

MAXIMUM SPEEDS

(1)

Pending modification of engine oil systems and cowlings, the airplane will be restricted to a maximum indicated airspeed of 310 knots or Mach .815, whichever is lower. Sudden seizure of an engine could result in loss of the engine, thereby creating sufficient yaw to structurally damage the vertical fin.

(2)

The maximum speed is 425 knots IAS or Mach .76, whichever is lower, up to 20,000 feet altitude. Between 20,000 and 34,000 feet altitude, the limit is a maximum of Mach .81. Above 34,000 feet altitude, the limit is the point of initial buffet. The maximum Mach number indicator has been set at .76, since this is the first critical Mach number to be reached and is applicable below an altitude of 20,000 feet. Before exceeding Mach .76, it shall be necessary to check the altitude. If the altitude is above 20,000 feet, then it is permissible to proceed to a maximum of Mach .81 until an altitude of 34,000 feet has been reached above which the Mach number reading need not be watched.

---

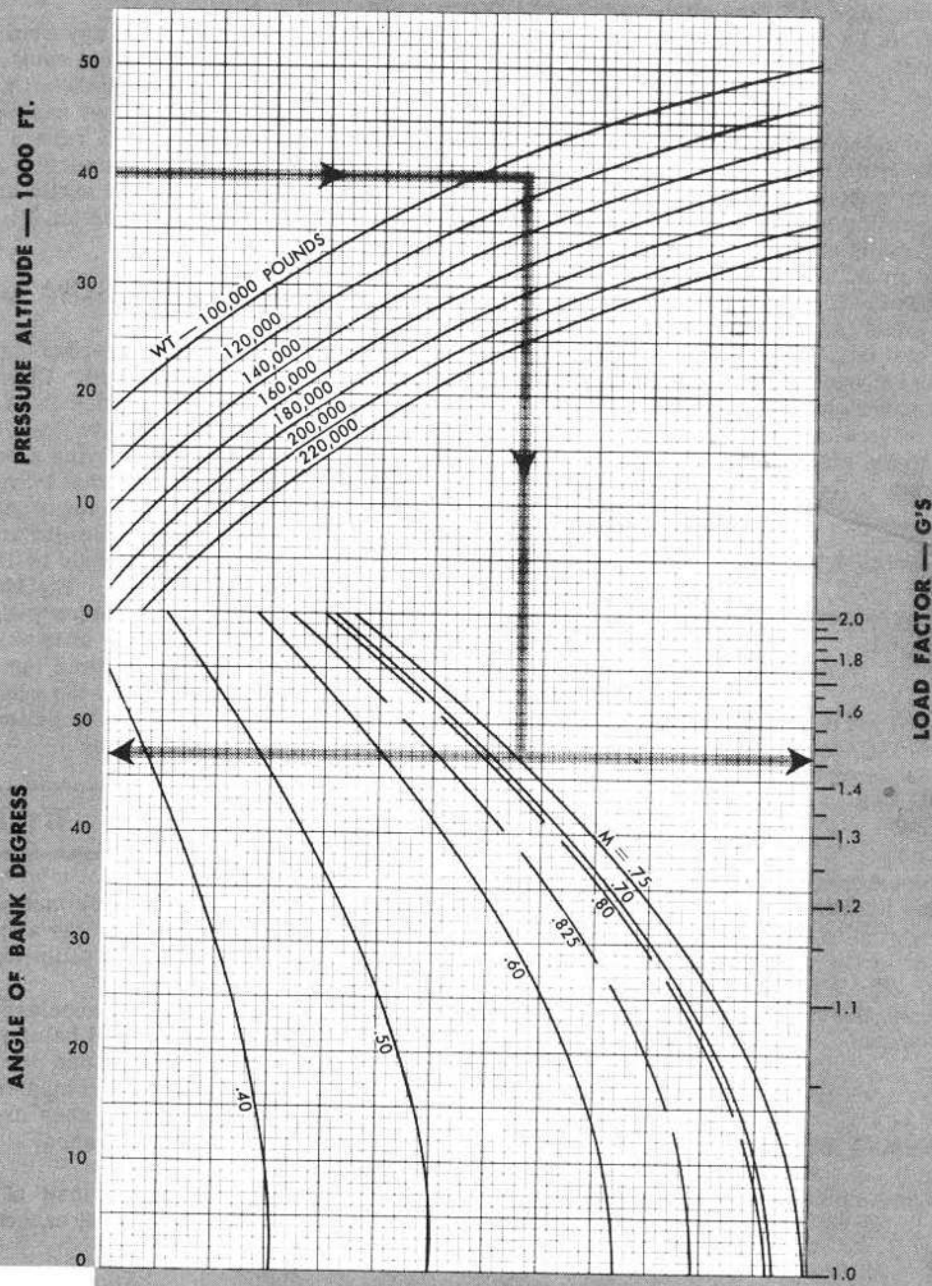
(1) AF 51-15804 thru -15812, 52-019 thru -053, -202 thru -244
(2) AF 51-2357 thru -7083, -17368 thru -17386, 52-054 thru -149, and -245 thru -311

bank angle limits for initial buffeting

EXAMPLE:

When flying at 40,000 feet altitude at a gross weight of 110,000 pounds and at Mach .75, at what angle of bank and load factor will initial buffeting be encountered?

Following through the chart as illustrated, we find that the angle of bank for initial buffet is 47° at a load factor of approximately 1.46 "g's."



DATE:
OCTOBER 1952
DATA BASIS:
FLIGHT TEST

50502 WC-1

Figure 5-3.

Loss of elevator surface power control at speeds near the maximum indicated airspeeds or Mach numbers will result in pitch-up of the airplane. The resulting airplane acceleration will depend upon altitude, gross weight, and center of gravity, but sufficient elevator control is available to recover. Above 34,000 feet altitude, stall will occur before the limit load factor is attained. Airplane limit load factor will not be obtained in the resulting pitch-up below 34,000 feet altitude, as long as the Mach number limitations are observed.

(1)

The maximum speed is 425 knots IAS, Mach .86, or initial buffeting, whichever occurs first. These limitations should be closely observed, however, if flight in buffeting is necessary for emergency reasons, the airplane is controllable and can be flown to the design structural limit of Mach .92 or 456 knots, whichever is lower. It should be noted that speeds in excess of 425 knots IAS will cause loss of aileron effectiveness. Careful inspection of the airplane should be conducted after extended periods of time in buffeting. These airplanes have modified elevator balance bays. The modified bays eliminate the pitch-up that otherwise could cause the airplane to reach its limit load factor if the elevator surface power control failed.

EXTERNAL ATO RACK

Do not exceed 305 knots IAS with the external ATO rack installed.

(2)

Do not jettison external ATO rack in excess of 200 knots IAS. The ATO rack may collide with the lower surfaces of the fuselage at speeds in excess of 200 knots IAS.

(3)

If the external ATO rack has been modified by the addition of four extension arms it may be jettisoned at speeds up to 260 knots IAS. If the rack has not been modified it may be jettisoned at speeds up to 200 knots IAS. The ATO rack may collide with the lower surfaces of the fuselage if jettisoned above these indicated airspeeds.

MINIMUM SPEEDS

For minimum speeds during approach and landing refer to figure 2-10.

PERISCOPIC BOMBSIGHT COVER

To prevent possible difficulty during opening and closing operation of the periscopic bombsight cover, the maximum IAS is 350 knots.

PROHIBITED MANEUVERS

Acrobatics of any kind are strictly prohibited, including intentional spins, excessively nose high stalls, flight into the stall buffet region, and steep dives, as well as any other maneuver resulting in abrupt accelerations. In case a spin is entered accidentally, use normal recovery procedure to regain normal flight. Normal stalls and very shallow dives will be discussed in section VI.

ACCELERATION LIMITATIONS

During all high speed operations, abrupt accelerations must be avoided. Operation at high Mach numbers and high altitudes is essential for utilizing the performance advantages of this airplane. However, this will result in flying close to the buffeting limits. It is more likely that buffeting and pitch-up will be encountered while maneuvering the airplane at high altitude than in straight and level flight. The normal acceleration should be limited to that at which buffeting is first felt. The Mach number at which buffeting and pitch-up begins will vary with altitude and gross weight. A plot of bank angle limits is shown in figure 5-3. The time lag involved in establishing flow separation from the wing often enables a higher number of "g's" to be pulled in a quick pull-up than in a steady maneuver.

WARNING

- Any maneuver that will impose a negative acceleration on the airplane shall be avoided because of the following potential hazards:
- A negative acceleration on the airplane may result in fuel being forced out through the fuel vent system and possible entry of fuel into the aft fuselage compartments which are low pressure areas, thus creating a possible fire or explosion hazard.

(4)

- Temporary loss of rudder-elevator surface power control caused by hydraulic pump star-

(1) AF 51-2192 thru -2356, 52-150 thru -201, -312 & on
(2) AF 52-089 thru -166, -293 thru -311, -394 thru -479, -508 thru -537
(3) AF 51-2192 thru -2356, 52-167 thru -201, -312 thru -393, -480 thru -507, -538 & on
(4) AF 51-2192 thru 52-157, -202 thru -311, -394 thru -497

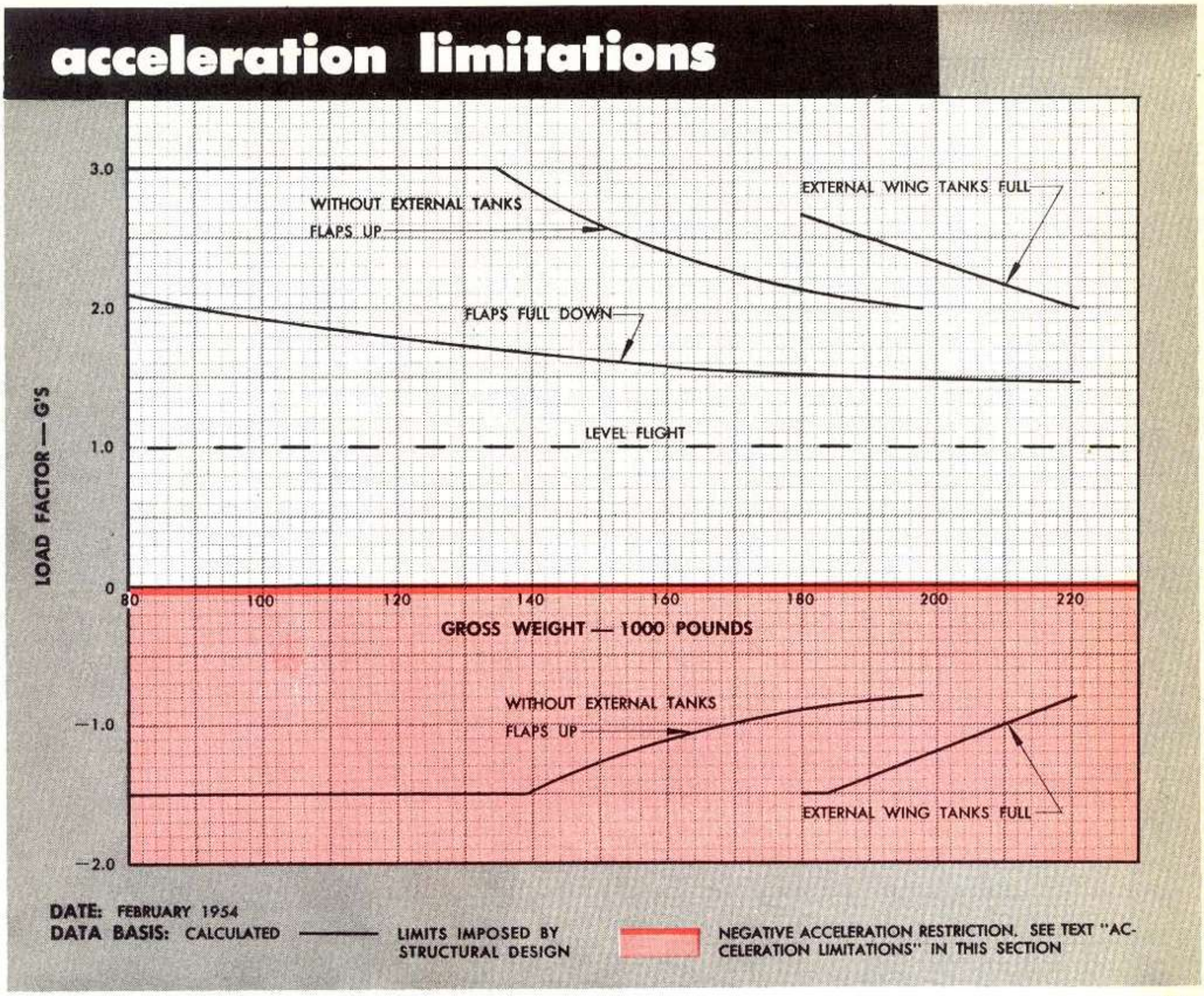


Figure 5-4.

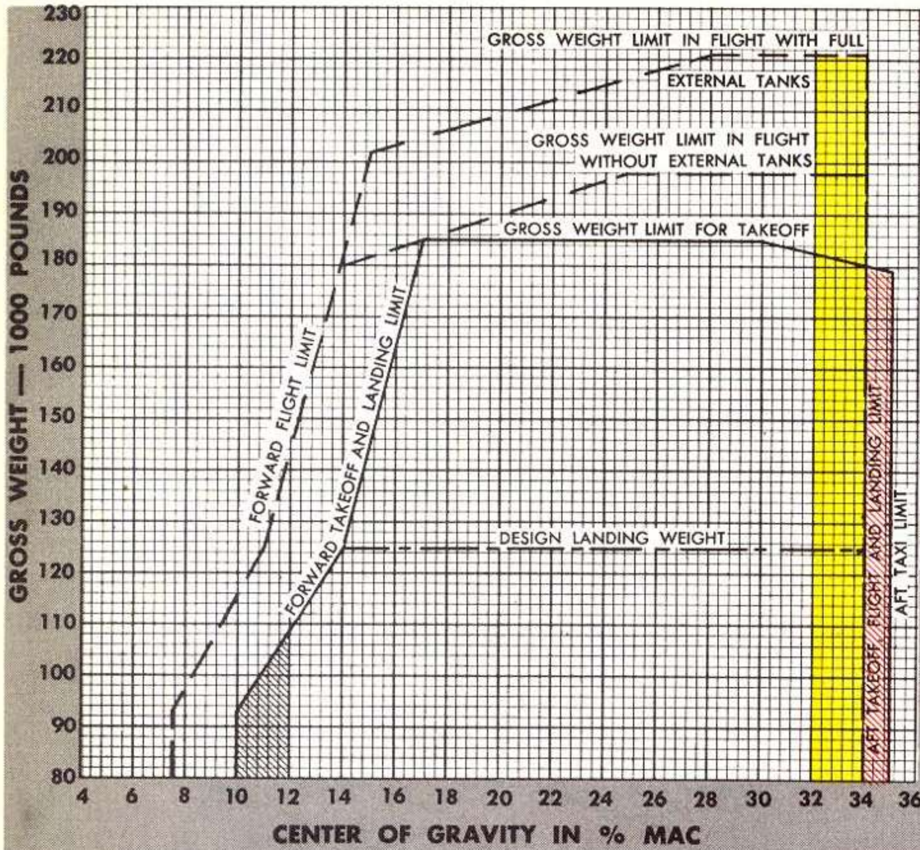
vation could result in structural damage due to 1) excessive speeds which would result from inability to recover promptly from an unusual airplane attitude and/or 2) unanticipated reapplication of surface power control at the time high elevator forces were being applied to effect a recovery from the unusual attitude.

Refer to the chart in figure 5-4 for a plot of the limitation imposed on the maneuvering "g's" by the structural design of the airplane.

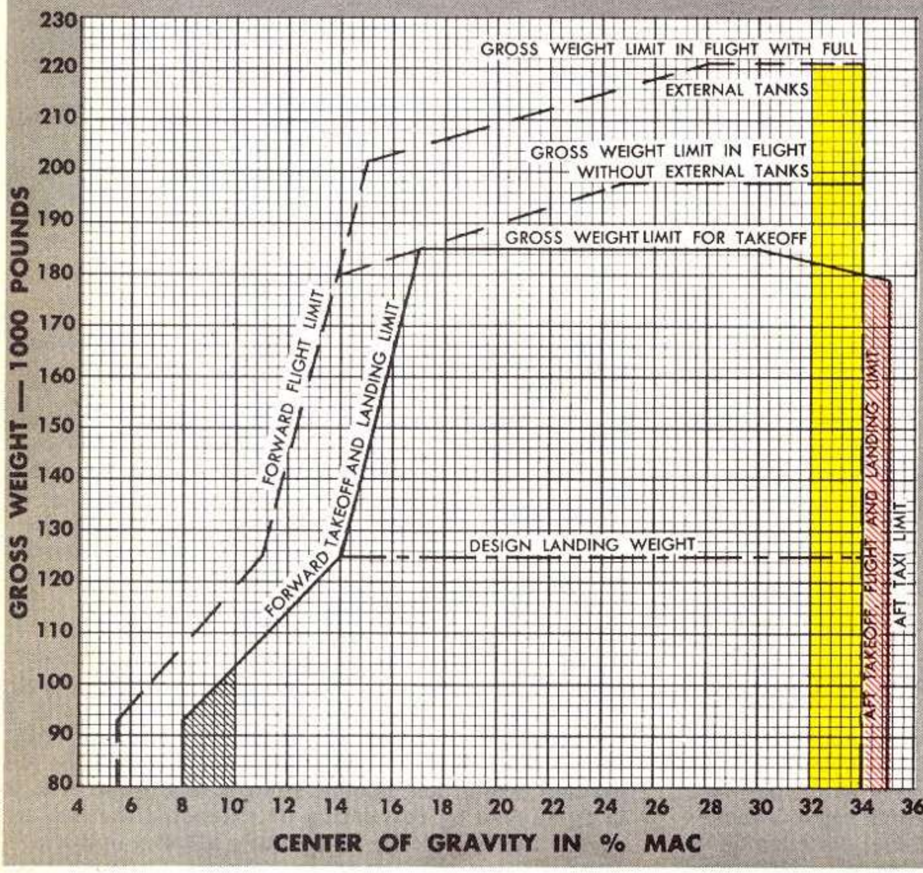
CENTER OF GRAVITY LIMITATIONS

The possibility of rapid cg changes over a wide range is a basic feature of the airplane fuel system. This allows cg to be controlled precisely by proper fuel management. However, it also permits rapid development of undesirable cg locations if fuel distribution is not monitored closely. The allowable cg range shown in figure 5-5 protects the airplane from unsafe conditions. In general, the aft cg limits provide a minimum stability margin. Loaded aft of these limits, the airplane will tend to wander from trim altitude and airspeed. The elevator will be disturbingly light and sensitive. Extreme aft loadings may result in porposing, pitchup, or tuck-under. At gross weights above 95,000 pounds, the forward cg limits is set by structural considerations. Loadings ahead of the forward limit will result in excessive tail loads during maneuvering flight. Below 95,000 pounds, the forward limit is set by limitations of the elevator during low speed flight such as landing approach and flare. If the cg is forward of this limit there will not be enough up-elevator control to complete a flare. A hard landing on the front gear first may result, especially if elevator power control is inoperative. The difference between the allowable flight forward limit and the allowable takeoff and landing limit is due to the change in cg caused by retracting or extending the landing gear. The wide range of cg limits allowed in the airplane provides for the range of loadings required for the operational use of the airplane. The completely

cg and gross



AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru -5245, -15804 thru -15812, 52-019 thru -070, -202 thru -247



AF 52-071 thru -081, -248 thru -260

DATA BASIS:
FLIGHT TEST

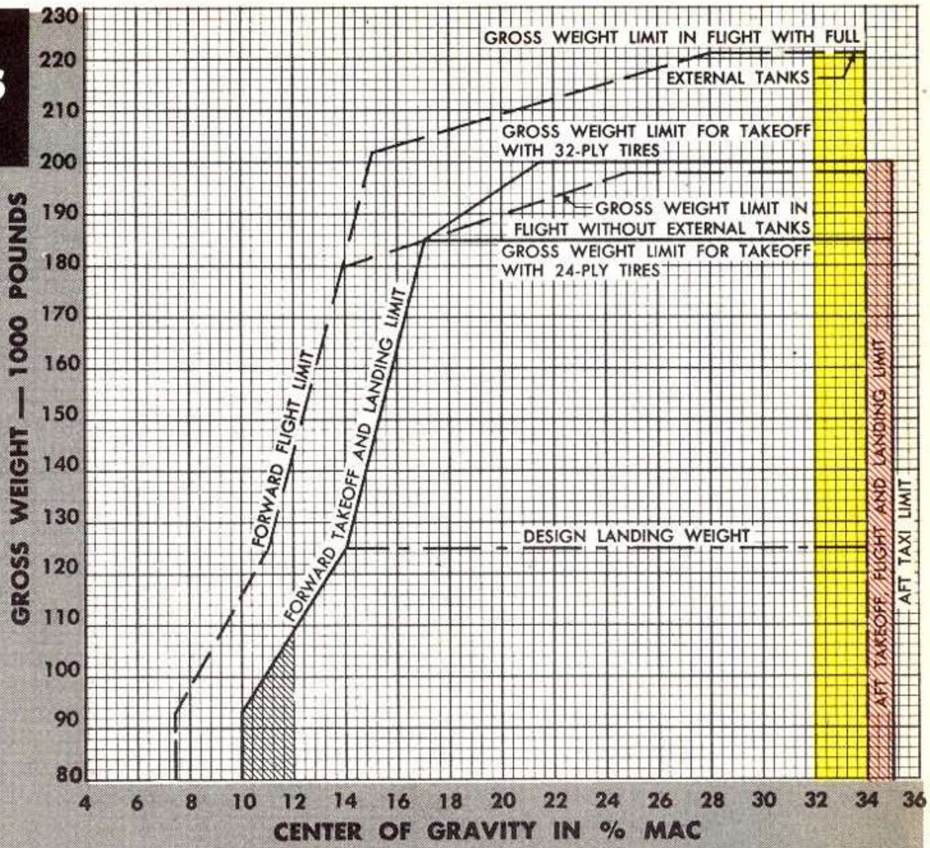
REMARKS:

LENGTH OF MAC — 155.9 INCHES
POSITION OF MAC — LEADING EDGE OF MAC AT BODY STATION 584.8

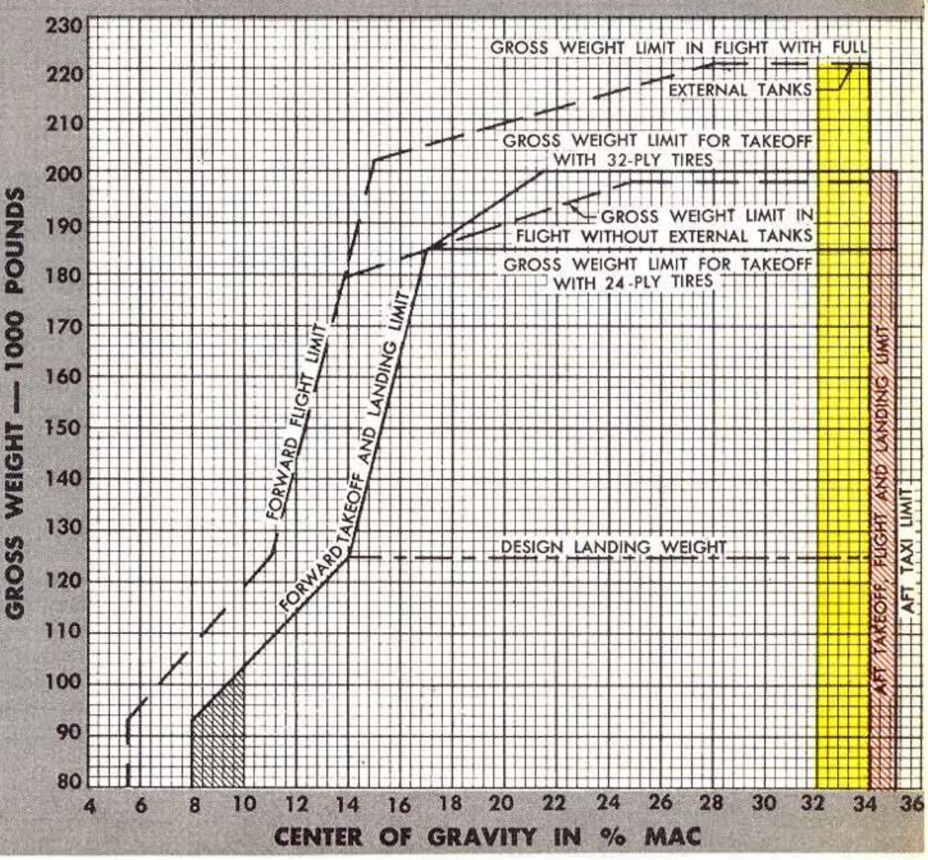
Figure 5-5. (Sheet 1 of 4 Sheets)

weight limits

AF 51-5246 thru -7083, -17368 thru -17386



AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-082 thru -196, -198 thru -201, -261 thru -1405, -1407, -1408, -1410 thru -3369, -3371, 53-1973 thru -2040, -2261 thru -2278



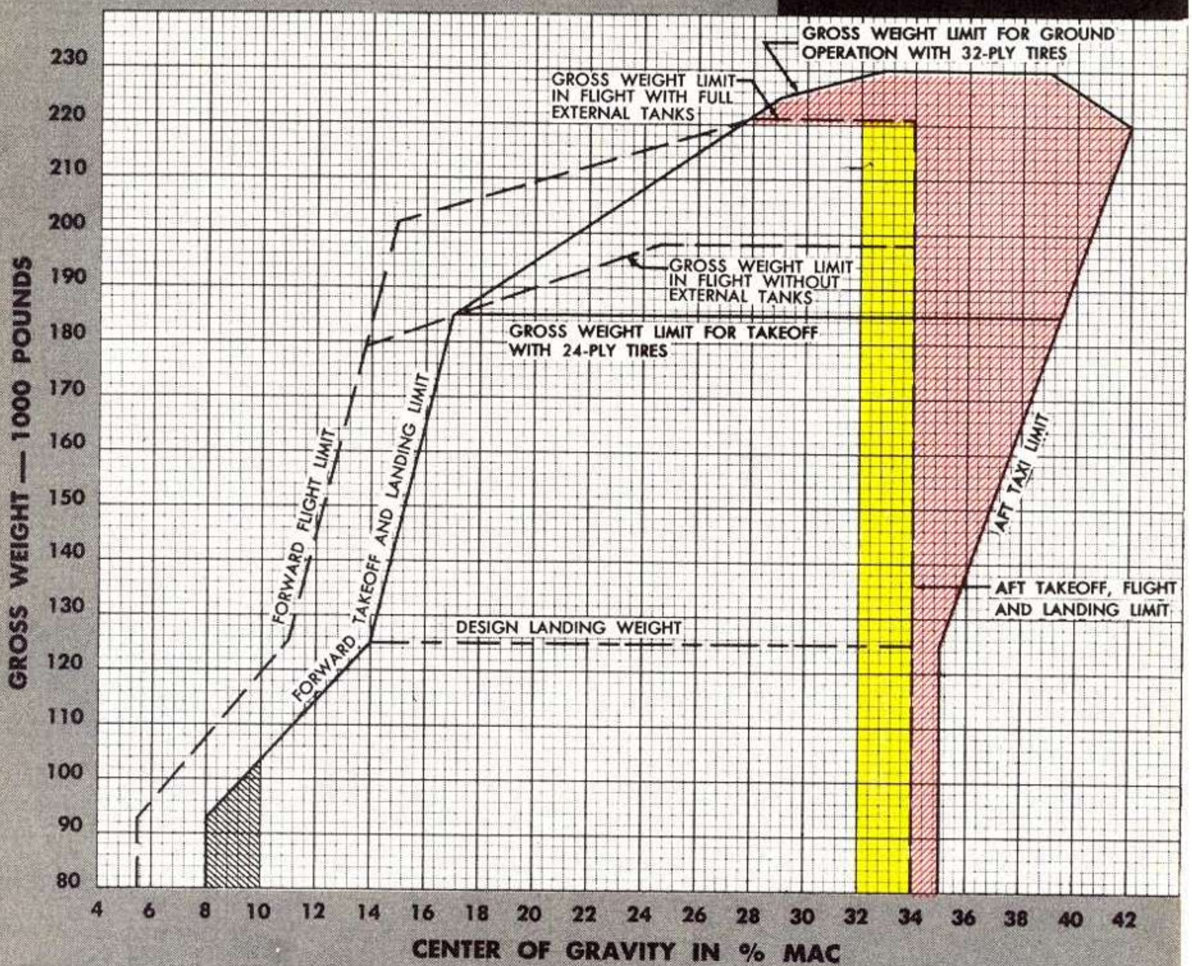
(hatched) GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH C.G. IN THIS AREA.

(yellow) WHENEVER CG FALLS IN THIS AREA FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA. MACH .76 SHALL NOT BE EXCEEDED WHILE IN THIS AREA.

(red hatched) CG MAY EXIST IN THIS AREA DURING TAXI OPERATIONS ONLY.

Figure 5-5. (Sheet 2 of 4 Sheets)

cg and gross



GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH CG IN THIS AREA.

WHENEVER CG FALLS IN THIS AREA FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA. MACH .76 SHALL NOT BE EXCEEDED WHILE IN THIS AREA.

CG MAY EXIST IN THIS AREA DURING GROUND OPERATIONS ONLY.

AF 52-197, -1406, -1409, -3370, -3372 thru 53-1903, -2090 thru -2127, -2279 thru -2395

Figure 5-5. (Sheet 3 of 4 Sheets)

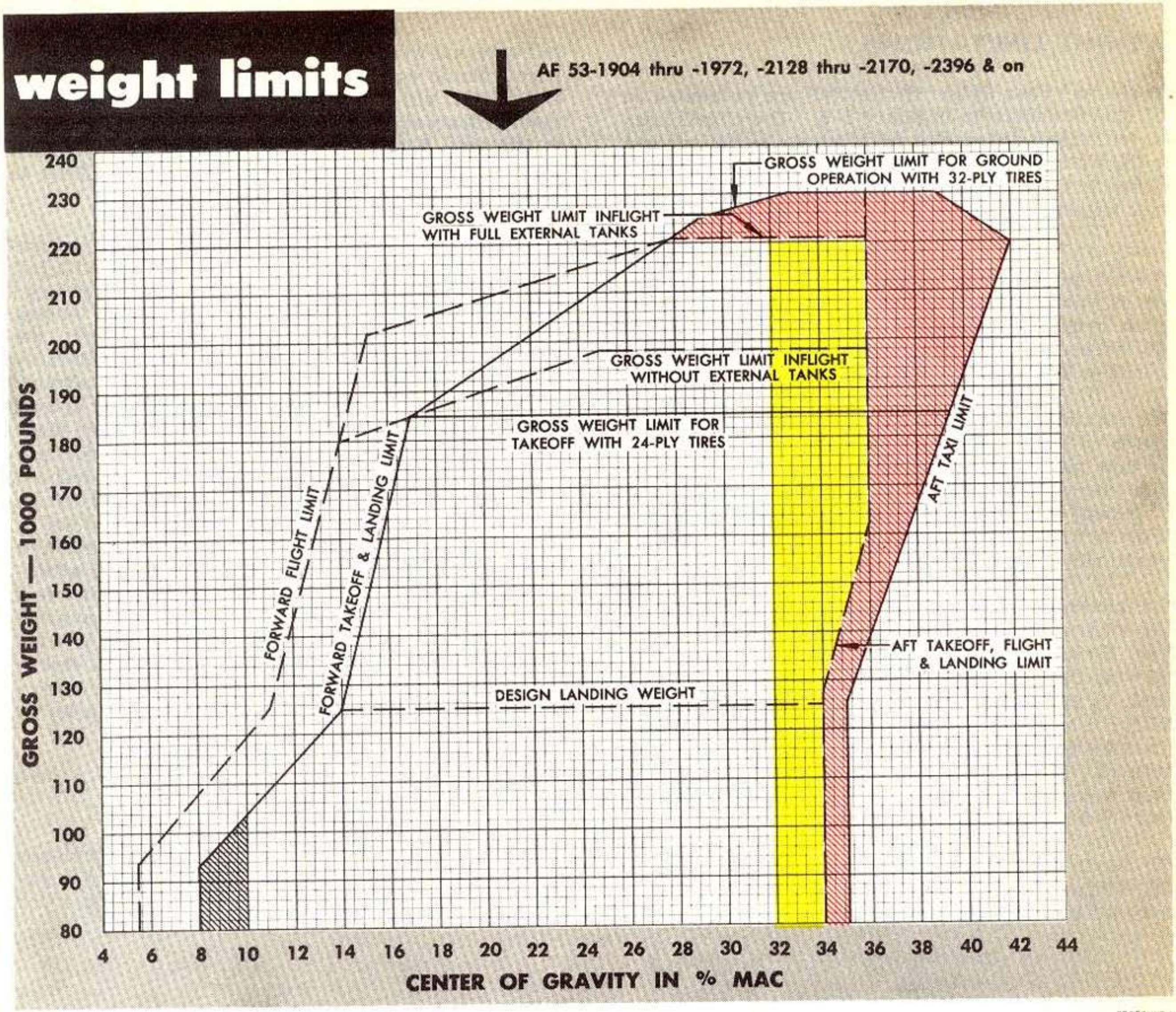


Figure 5-5. (Sheet 4 of 4 Sheets)

loaded airplane usually has a cg near the aft limit. The empty airplane has a cg near the forward limit. It is generally true that the airplane has its greatest structural safety margin and is easiest to fly when the cg is at an intermediate position between the limits. Therefore, the pilot should manage his fuel so that his cg is near the middle range whenever it is reasonable to do so. Exceptions to this are at takeoff when heavily loaded, when the fuel is nearly exhausted, and conditions which require frequent fuel selector changes to keep the cg near the middle range. Another factor in this choice of load distribution is trim drag. During cruise conditions, a forward cg causes a download on the tail. This results in increased wing lift and, therefore, increased drag. Moving the cg aft will decrease drag by reducing the down tail load, but if the cg is allowed to approach the aft limit another inefficiency appears due to the constant retrimming and porpoising flight path accompanying low stability. The optimum cg with regard to cruise efficiency is between 25% and 29% MAC. The drag is approximately 2% higher with the cg at 15% MAC than it is with cg in the optimum range. Since this penalty is not large there is not a strong need to stay continuously within the range of optimum efficiency. Brief forward movements of the cg such as accompany normal fuel management will have only a small effect on overall range performance. Refer to figure 5-5 for the permissible range of cg positions in flight and during taxi, takeoff and landing. If the total fuel required is greater than the total capacity of the main tanks, consult the "Weight and Balance Data" handbook, T.O. 1-1B-40, for chart on loading procedure. For "Fuel System Management," refer to section VII.

WEIGHT LIMITATIONS

Maximum gross weight limitations are presented on the charts contained in figure 5-5. The charts presented reflect different configurations as determined by the basic design and structural or rigging modifications to the airplane. To aid in presenting the maximum weight capabilities the following is given:

(1)

The maximum gross weight for takeoff is 185,000 pounds with a cg range of 17% to 30% MAC. Maximum gross weight for takeoff is lowered aft of 30% MAC to 180,000 pounds at an aft cg limit of 34% MAC (179,000 pounds at 35% MAC for taxi operations).

(2)

The maximum gross weight for takeoff is 185,000 pounds with a cg range of 17% to 34% MAC (35% MAC for taxi operations) when 24-ply tires are installed. With 32-ply tires installed the maximum gross weight for takeoff is raised to 200,000 pounds with cg travel limits of 21.5% MAC to 34% MAC (35% MAC for taxi operations).

(3)

The maximum gross weight for ground operation is 230,000 pounds when 32-ply tires are installed; however, the gross weight limit for flight operations with full wing tanks is 221,000 pounds with an aft aerodynamic cg limit of 34% MAC. The aft cg limit of 34% MAC will be the determining factor for the maximum gross weight allowable at the time takeoff speed is attained. With 24-ply tires installed the maximum gross weight for takeoff is 185,000 pounds. Refer to figure 5-5 for detailed limitations.

(4)

The maximum gross weight for ground operation is 230,000 pounds when 32-ply tires are installed; however, the gross weight limit for flight operations with full external wing tanks is 221,000 pounds with an aft aerodynamic cg limit of 36% MAC. The aft cg limit of 36% MAC will be the determining factor for the maximum gross weight allowable at the time takeoff speed is attained. With 24-ply tires installed, the maximum gross weight for takeoff is 185,000 pounds. Refer to figure 5-5 for detailed limitations.

The maximum inflight gross weight is 198,000 pounds without external tanks and 221,000 pounds with full external tanks. This gross weight may be attained through the use of air refueling. The design landing gross weight is 125,000 pounds. At this weight, the airplane is designed for sinking speeds considerably in excess of those associated with a "normal" landing. (Sinking rates up to approximately 9.5 feet per second should cause no difficulties whereas the average sinking rate in a normal landing will be less than 4 feet per second.) The maximum allowable sinking rate reduces for increasing landing weights. Accordingly, landings at weights in excess of 125,000 pounds should not be considered for routine operation. However, even at a landing weight of 180,000 pounds, the airplane is structurally capable for a sinking rate in excess of 6 feet per second which is sufficiently above the average singing rate of 4 feet per second in a normal landing to make landings at high gross weights a good risk in emergencies as compared to continued flight under emergency conditions merely to decrease weight prior to landing.

TAXIING LIMITATIONS

At gross weights over 185,000 pounds on airplanes having 32-ply tires installed, it is necessary to restrict taxi speed to a maximum of 25 knots in order to minimize heat buildup rates in the tires.

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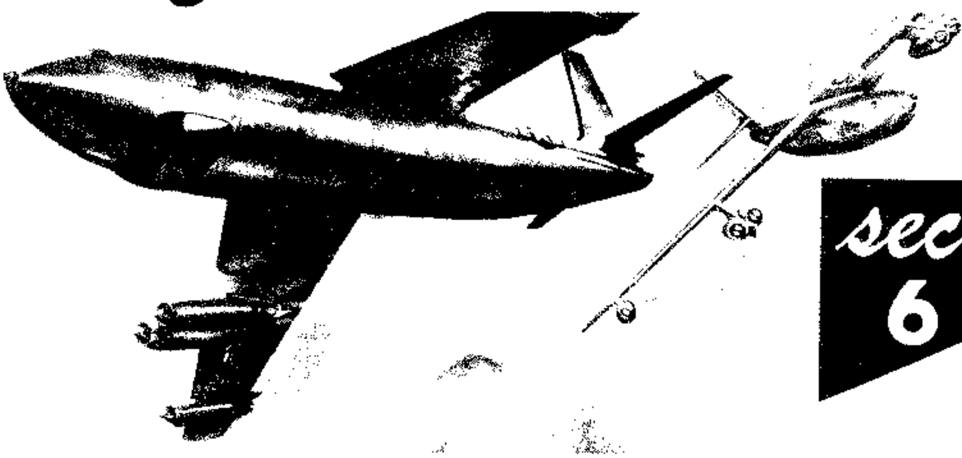
(1) AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru -5245, -15804 thru -15812, 52-019 thru -081, -202 thru -260

(2) AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, -5246 thru -7083, -17368 thru -17386, 52-082 thru -196, -198 thru -201, -261 thru -1405, -1407, -1408, -1410 thru -3369, -3371, 53-1973 thru -2040, -2261 thru -2278

(3) AF 52-197, -1406, -1409, -3370, -3372 thru 53-1903, -2090 thru -2127, -2279 thru -2395

(4) AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

flight characteristics



section 6

table of contents

GENERAL

The airplane was designed as a high performance jet bomber having the best possible flight characteristics for a good operational airplane. Special emphasis was placed on safety features and aircraft handling qualities in the air and on the ground. Innovations such as thin-swept surfaces and the bicycle landing gear make high performance possible with no appreciable sacrifice in flying qualities. Only through complete familiarity with the airplane can full advantage of its high performance and special features be gained.

STALLS

CHARACTERISTICS

The stall characteristics of the airplane are very satisfactory and are preceded by ample stall warning, starting with a mild vibration about 10 knots above the stall and increasing to strong buffeting at the stall. (See figure 2-10.) At normal "cg's" there is no tendency to pitch until buffeting is very strong, then the airplane will pitch downward and sink at a high rate. Recovery is normal. At aft "cg's," a slight tendency to pitch up will be noticed just as the buffeting becomes strong. However, there is sufficient elevator control to prevent a severe pitch-up. Pitching tendencies are similar for both flaps up or down. The ailerons are effective throughout the stall but rolling may occur if corrective action is not prompt.

CAUTION

Complete stalls should not be conducted because severe buffeting may damage the airplane.

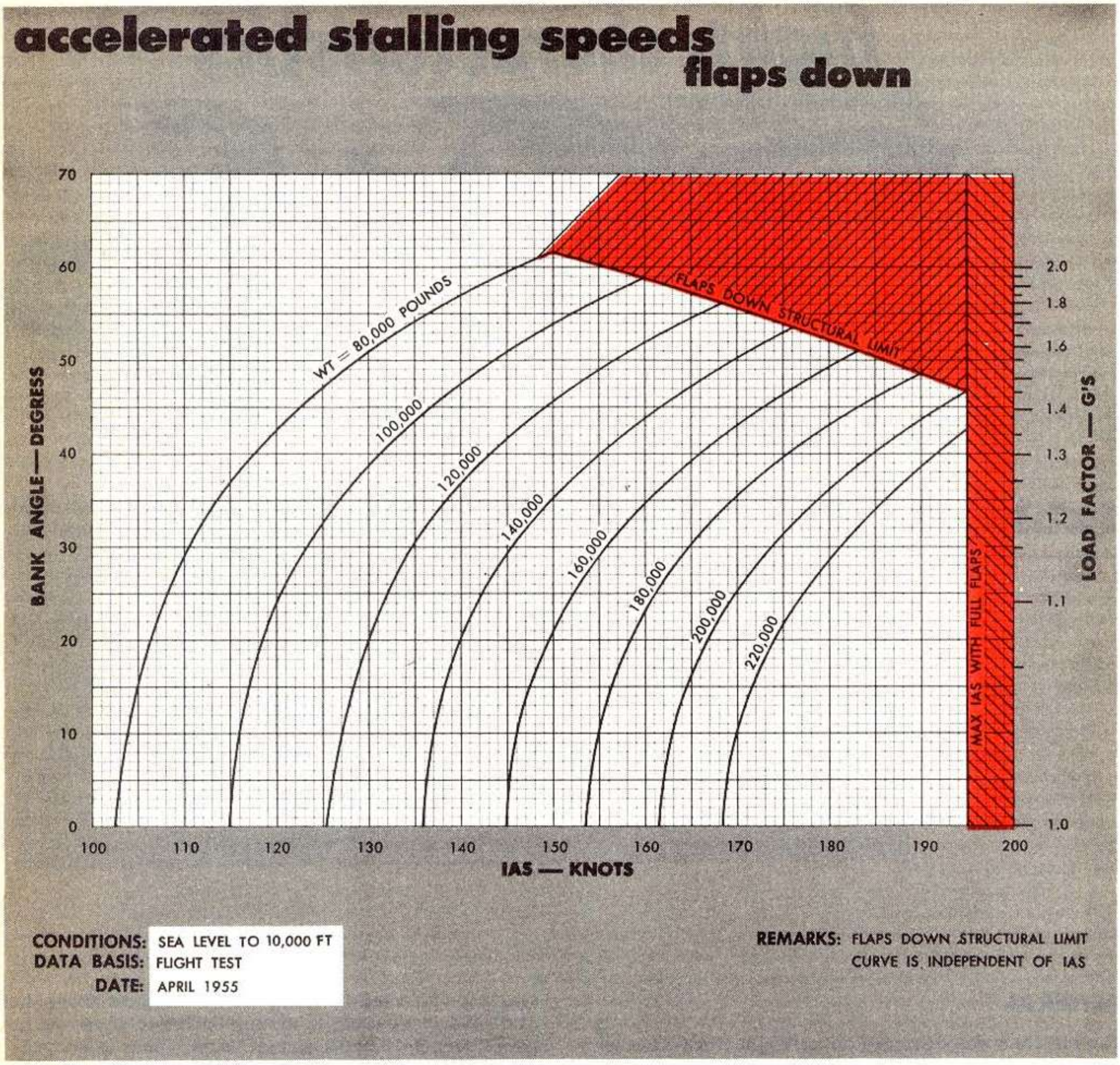


Figure 6-1.

Flight test experience has shown that stall warning will never be encountered during a normal takeoff or landing. However, it should be kept in mind that the speed margin above first stall warning, during approach at speeds as specified for B-47, will be considerably less than with many earlier types of airplanes. Therefore, large scale corrective maneuvering should be avoided during the final stages of an approach, as excessive altitude loss will result if stall is induced at that time. IAS at which stalling is encountered increases very rapidly above bank angles of 25 to 35 degrees. Figure 6-1 clearly shows the tendency of the stall curves as the angle of bank is increased. Also the load factor in "g's" for various angles of bank during coordinated turns or pull-ups are given. The flaps down structural limit represents the maximum angle of bank at the various gross weights which will not exceed the flaps down structural limitation.

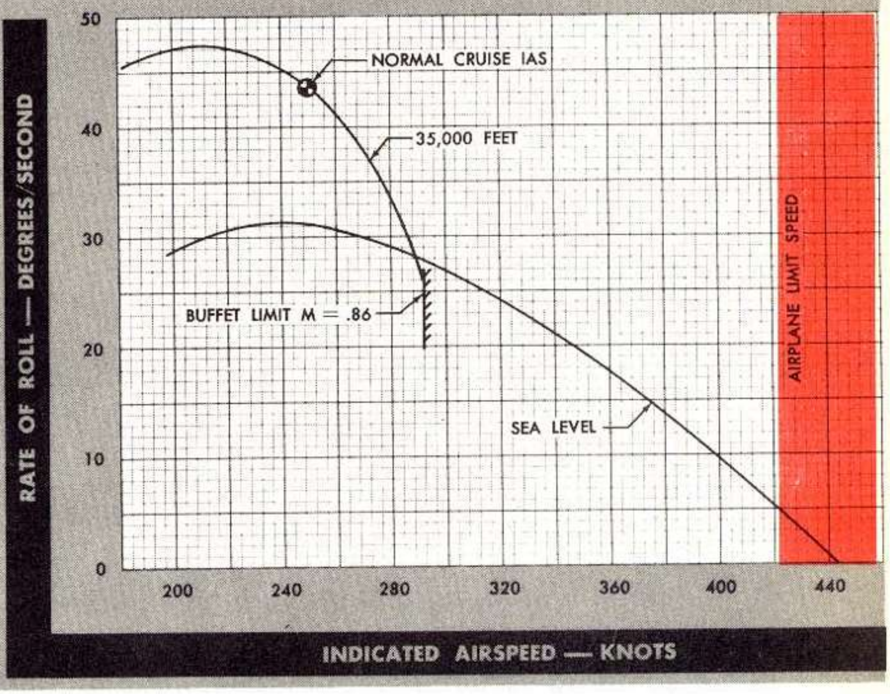
PRACTICE STALLS

No difficulty will be encountered in the execution of practice stalls provided the following procedure is observed:

rate of roll

CONDITIONS:
FULL AILERON DEFLECTION (COORDINATED TURN)
SURFACE POWER CONTROLS OPERATING
FLAPS UP

DATE: NOVEMBER 1954
DATA BASIS: FLIGHT TEST



50607 WC

Figure 6-1A.

CAUTION

- Practice stalls with gross weights in excess of 125,000 pounds should not be conducted.
- Practice stalls with flaps up should be terminated after mild buffeting is encountered to prevent airplane damage from severe buffeting.

a. As a safety measure, an altitude of 15,000 feet or more should be used.
b. When executing practice stalls or other unusual maneuvers the ESP switch should be ON regardless of altitude or temperature.
c. Use the minimum obtainable rpm (for the stall altitude) and the minimum rate of approach to the stall (approximately 1 knot per second). This procedure will result in a nose-high attitude of approximately 10°. Abrupt entry or excessive nose-high attitudes will result in severe buffeting. Stall warning is adequate and will occur 8 to 12 knots prior to the complete stall depending on the approach rate (figure 2-10).
d. Recovery from stalls is normal. However, the loss in altitude at high weights will be great.
e. Stalls out of turns can be executed without the occurrence of abnormal rolling moments, provided the turn is well coordinated. Stalls out of uncoordinated turns will result in increased rolling moments although sufficient lateral control is available for recovery.

SPINS

Intentional spins are prohibited. In case a spin is entered accidentally, use normal recovery procedure to regain normal flight.

FLIGHT CONTROLS

The design of the control system and surfaces, while generally similar to that on past large airplanes, incorporates a number of new features intended to give the best possible flying characteristics. The pilot should understand the normal operation with powered controls and the emergency operation with direct cable-operated controls. Powered controls are used on all three movable surfaces to give light forces and high maneuverability. Control power-off results in high forces but is acceptable for emergency operation, the surfaces then being operated directly by the pilot.

ELEVATORS

Elevator control forces are sufficiently light with surface power control operative so the pilot does not become fatigued in maneuvers and long turns, but heavy enough to prevent inadvertently imposing excessive structural loads. It is impossible to make the elevator control forces heavy enough to prevent structural damage and yet light enough for normal maneuvering and landings with a forward cg. Therefore, in rapid maneuvers, refer to the accelerometer. Flight characteristics with the surface power control off are described in section III.

AILERONS AND LATERAL CONTROL

With surface power controls operating, the aileron control forces are very light with only a small centering action. This provides maneuverability and ease of flying. Power output of the aileron power control system is designed to protect the aileron structure at the design high speed of the airplane. At low indicated airspeeds with flaps fully extended, very positive lateral control results from the combined operation of ailerons and flaperons. The ailerons are very effective at high altitude and at moderate to low indicated airspeeds. However, effectiveness decreases as indicated airspeed increases until, at approximately 440 knots IAS, the rate of roll available from ailerons is reduced to zero. This loss of aileron effectiveness is due to wing flexibility and is the basis for the current maximum limit of 425 knots IAS. At higher indicated airspeeds where the ailerons become ineffective, the only way the airplane can be controlled laterally is by applying rudder. Lateral trim at high indicated airspeeds should be maintained by small rudder deflections rather than large aileron deflections. Rolling maneuvers can also be performed using the rudder. At altitudes above approximately 15,000 feet, natural warning in the form of buffeting is encountered before indicated airspeeds are reached where the ailerons become ineffective. At low altitudes, however, high indicated airspeeds can be reached before the onset of buffeting. Therefore, close attention to airplane attitude and indicated airspeed is required when flying at high speed or high engine rpm at low altitude. Under such conditions, even a shallow dive will cause the airplane to accelerate rapidly to or beyond the maximum limit of 425 knots IAS. If the airplane is allowed to roll inadvertently in this condition, recovery with ailerons will be difficult or impossible and a spiral dive may result. If corrective action is started soon enough, application of top rudder will be sufficient to roll the airplane back to a wings level attitude. If a spiral dive has been established, lateral control should be restored by reducing airspeed through reduction of power to

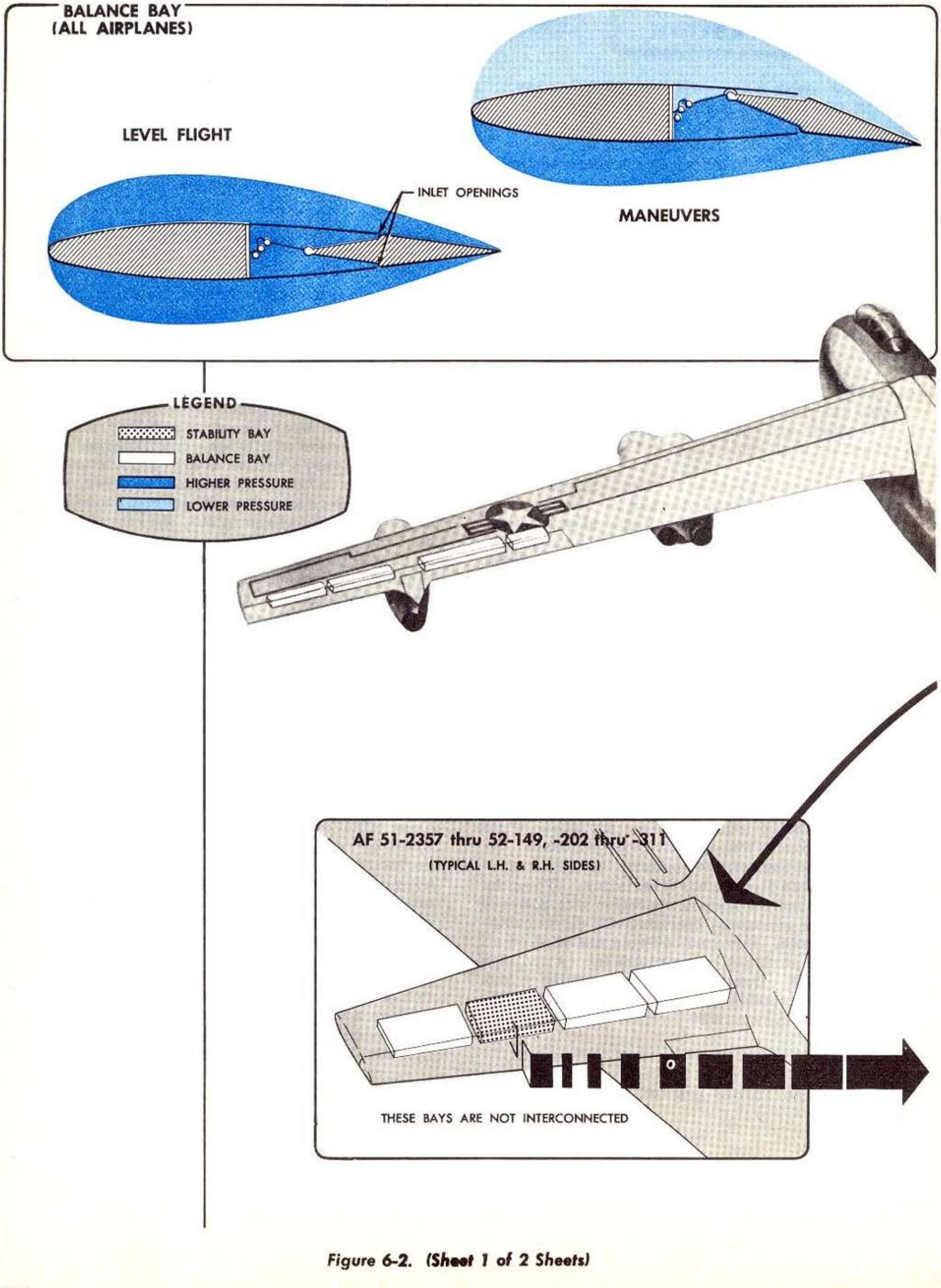


Figure 6-2. (Sheet 1 of 2 Sheets)

control surface balance bays

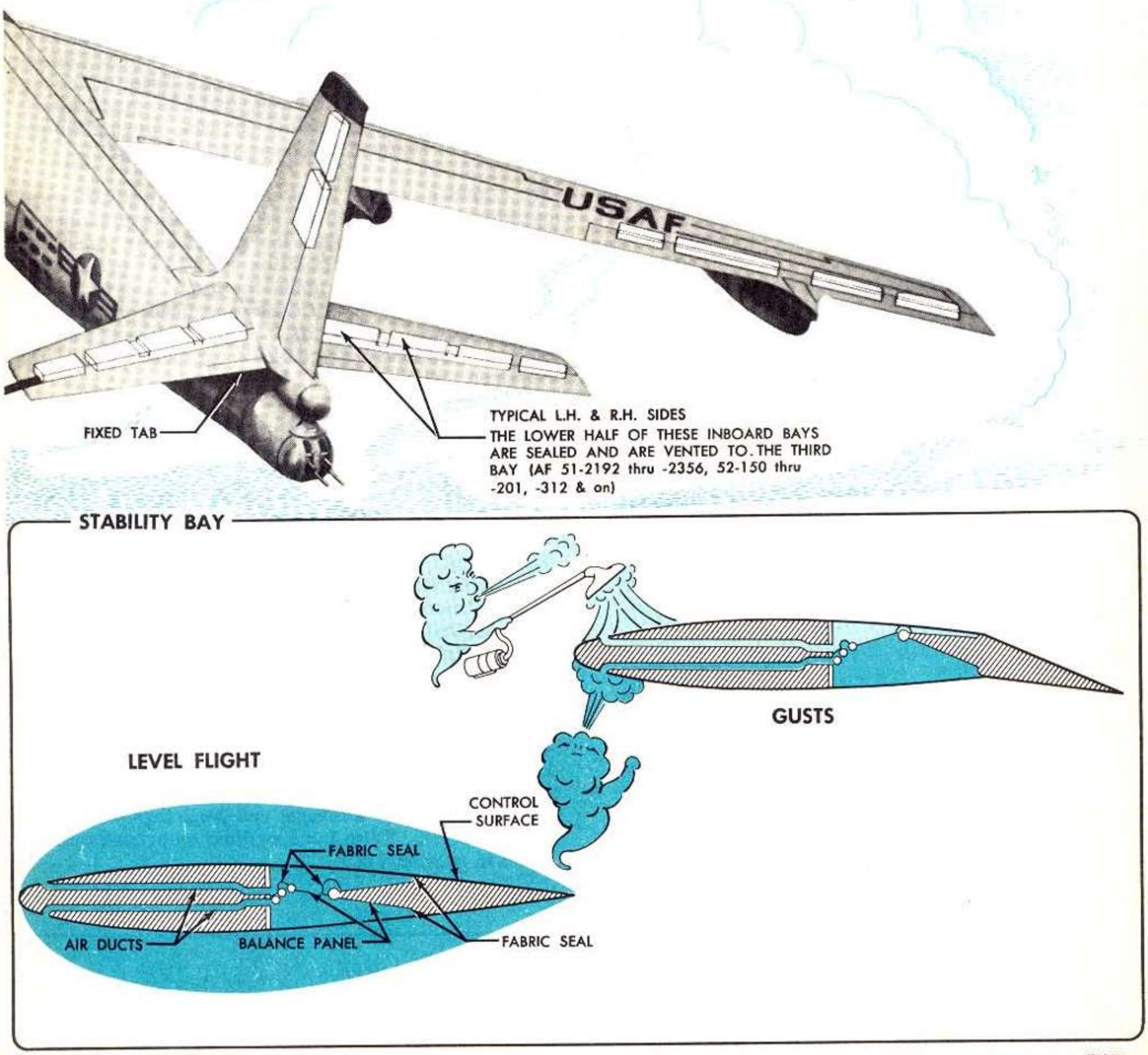


Figure 6-2. (Sheet 2 of 2 Sheets)

idle rpm and application of back pressure on the elevator control column. Indications between 2 and 3 "g's" on the accelerometer may be pulled in this recovery depending on gross weight (figure 5-4). Accurate determination of gross weight obviously is not possible under these conditions and is not considered necessary because a safety margin exists above the values shown in figure 5-4. As indicated airspeed diminishes, aileron effectiveness will be restored and the wings may be leveled. If reduced power and heavy back pressure on the control column fail to produce readily perceptible reduction in speed, the landing gear may be extended.

WARNING

Possible damage to landing gear and gear doors may be expected. If this procedure has been followed, no attempt should be made to retract the landing gear prior to landing. If available, a chase airplane should be requested to observe the condition of the landing gear.

Flight procedures and characteristics with the aileron surface power controls inoperative are described in section III.

RUDDER

Rudder control forces are moderate and are intended to protect the airplane structure from excessive yaw. The rudder is sufficiently powerful to counteract unsymmetrical power from a dead outboard engine with maximum rpm on all other engines and at all airspeeds down to the takeoff and approach speeds. At high indicated airspeeds, zero yaw should be maintained as closely as possible with the rudder because very small yaw angles produce lateral mistrim requiring large aileron deflections. By the same token, existing lateral mistrim at high speeds should be taken out by small rudder deflections rather than large aileron deflections. Flight characteristics with the rudder surface power control inoperative are discussed in section III.

TRIM TABS

Trim tabs are provided on the control surfaces to facilitate trimming the airplane during flight with the surface power control system off. In addition, all trim tabs are linked to their respective control surface in such a manner as to move opposite to the direction of rotation of the control surface. This materially aids in the movement of the control surface by reducing the surface hinge moment.

Lateral trim is obtained through operation of a conventional trim tab in each aileron, while minor directional control for yaw conditions is accomplished by a rudder trim tab. The elevator contains two trim tabs. The right trim tab is operated by the pilot or copilot for normal elevator trim and by the automatic pilot during automatic pilot operation.

(1)
The left elevator tab operates automatically and mechanically with the extension or retraction of the wing flaps to partially compensate for the pitching tendencies during flap operation.

(2)
The left elevator tab functions only as a balance tab and reduces the elevator hinge moment.

(3)
The left tab is anchored in the fixed trail position and acts only as a portion of the elevator.

With surface power control on, trim tab surfaces have no effect on control surfaces due to surface power control system hydraulic pressure. Trim is accomplished by positioning the trim controls which reposition centering springs and Q-springs, moving the entire control surface to accomplish the trim.

The ailerons, rudder, and elevator are each balanced by internal balance seals. These balance seals are designed in such a manner that movement of a primary surface from the trail position will result in differential pressures acting about the hinge line to aid the pilot in movement of that control surface. Thus, with surface power control off, the airplane may be controlled sufficiently at moderate airspeeds to execute required maneuvers.

Trimming is done through pilot's conventional trim wheels for both control power-on and power-off trim. Failure of power controls may result in the airplane being out of trim. Check your airplane frequently to make sure that the trim forces are not excessive when the power is turned off. Initial checks should be made during flight at low speeds to prevent the trim forces from being too high. If large forces are experienced, an adjustment should be made. The trim tab on each flight control surface can be positioned by means of an actuator driven by a DC motor operated by one of four momentary switches on the trim tab coordination switch panel. On the first flight after repairs or adjustments have been made to the flight control system, a trim coordination procedure must be accomplished to establish a coordination between the position of the trim tab and the neutral position of the corresponding centering springs (for ailerons) and Q-springs (for rudder and elevator). Trim tab coordination procedures are found in section VII.

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(1) AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru 52-070, -202 thru -247
(2) AF 51-2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-071 thru -149, -248 thru -311
(3) AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

CONTROL SURFACES BALANCE SYSTEM

DESCRIPTION

The control surfaces on this airplane are designed with an internal balance system contained within the contour of the airfoil to which the individual surface is attached. The aft section of the airfoil (wing, vertical and horizontal stabilizers) contains an open cavity, or bay. Each bay is divided into an upper and lower chamber by a balance panel which extends forward from the control surface hinge line. The primary chambers are sealed from each other completely by a fabric seal between the forward edge of the balance panel and the aft face of the airfoil spar. Small openings into each chamber are provided at the upper and lower aft edge of the airfoil, just forward of the control surface hinge line.

(1)

The balance bays described in the above paragraph are applicable to all primary control surfaces. In addition, pitch stability of the airplane is aided by a "stability" bay in each horizontal stabilizer. These stability bays differ from the balance bays chiefly in that they are sealed at the aft edges. However, an opening at the upper and lower side of the horizontal stabilizer leading edge transmits pressure which is ducted to the upper and lower stability bay chambers, respectively. When a gust or normal maneuvering changes the angle of attack of the airplane, a corresponding change of aerodynamic pressure will occur at the top and bottom of the leading edge. When this pressure differential is ducted into the upper and lower chamber of the stability bay, it acts on the balance panel in such a direction as to return the airplane to its trim angle of attack condition once it has been disturbed either by gust or maneuver.

(2)

The two inboard balance bays of the horizontal stabilizer are sealed along the trailing edge of the lower chambers. The lower chambers of these bays are interconnected with each other and with the third bay, which is vented along the trailing edge of both lower and upper chambers. Shock waves which occur at high speeds on the lower inboard side of the stabilizer are not detected by the balance bays with the above arrangement. This enables the pilot to maintain pitch control in the event of elevator surface power control failure at speeds up to the limiting IAS or Mach number.

OPERATION

When the control surface is in a trail position, the pressure of the air entering the opposing cavities will be equal, and hence no force will be present on the balance panel. When the control surface is deflected by the pilot, however, the pressures in the opposing cavities become unbalanced. For instance, deflecting the elevator down increases camber which increases velocity over the upper surface, resulting in lower surface pressures. Since the upper part of the balance cavity is vented to the upper surface at the hinge line, the pressure in the upper cavity drops, creating a pressure differential across the balance panel. Reference to figure 6-2 will show, then, how this differential in balance bay pressures acts on the balance panel to reduce the control surface hinge moment. This system compensates for approximately 80% of the normal air load on the control surfaces, the remaining 20% being overcome by the pilot during normal maneuvering. During normal flight maneuvers, the pilot is further aided by the balance action of the surface control trim tab.

A careful consideration of the principles involved in this control surface balance system will reveal the underlying causes for the condition known as "aileron overbalance." When buffeting occurs at high Mach number flight or at high angles of attack, separation of the airflow over the wing in the vicinity of the openings into the upper chamber of the balance bay creates an unbalanced pressure across the aileron balance cavities. It is therefore possible, when such a condition prevails, for the ailerons to move abruptly to a new position. This aileron overbalance will not occur, however, with surface power control on and may be avoided if the recommended flight procedures for surface power control off are followed.

ACROBATICS

WARNING

Acrobatics of any kind are strictly prohibited.

BUFFETING

The speed and maneuverability of the airplane at high altitude is limited by separation of airflow over the wing. This separation occurs irregularly causing the airplane to buffet. This effect is expressed as the "buffet boundary" and is shown in figure 6-3. Smooth stabilized flight can be conducted in the area below the curve but, as the airplane approaches the buffet boundary, it is more likely that buffeting will be encountered because of gusts or slight airplane accelerations caused by maneuvering. Flight above the applicable curve would be in buffeting. The two types of buffeting encountered at high altitudes are 1) low speed stall buffeting and 2) high Mach number buffeting. The low speed stall occurs on the curve to the left of the apex of the curve, whereas high Mach number buffeting occurs to the right of the apex of the curve.

The conditions under which buffeting can be expected to be encountered can best be presented by reference to figure 6-3 using the following conditions: An airplane weighing 110,000 pounds gross weight, cruising

(1) AF 51-2357 thru 52-149, -202 thru -311
(2) AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

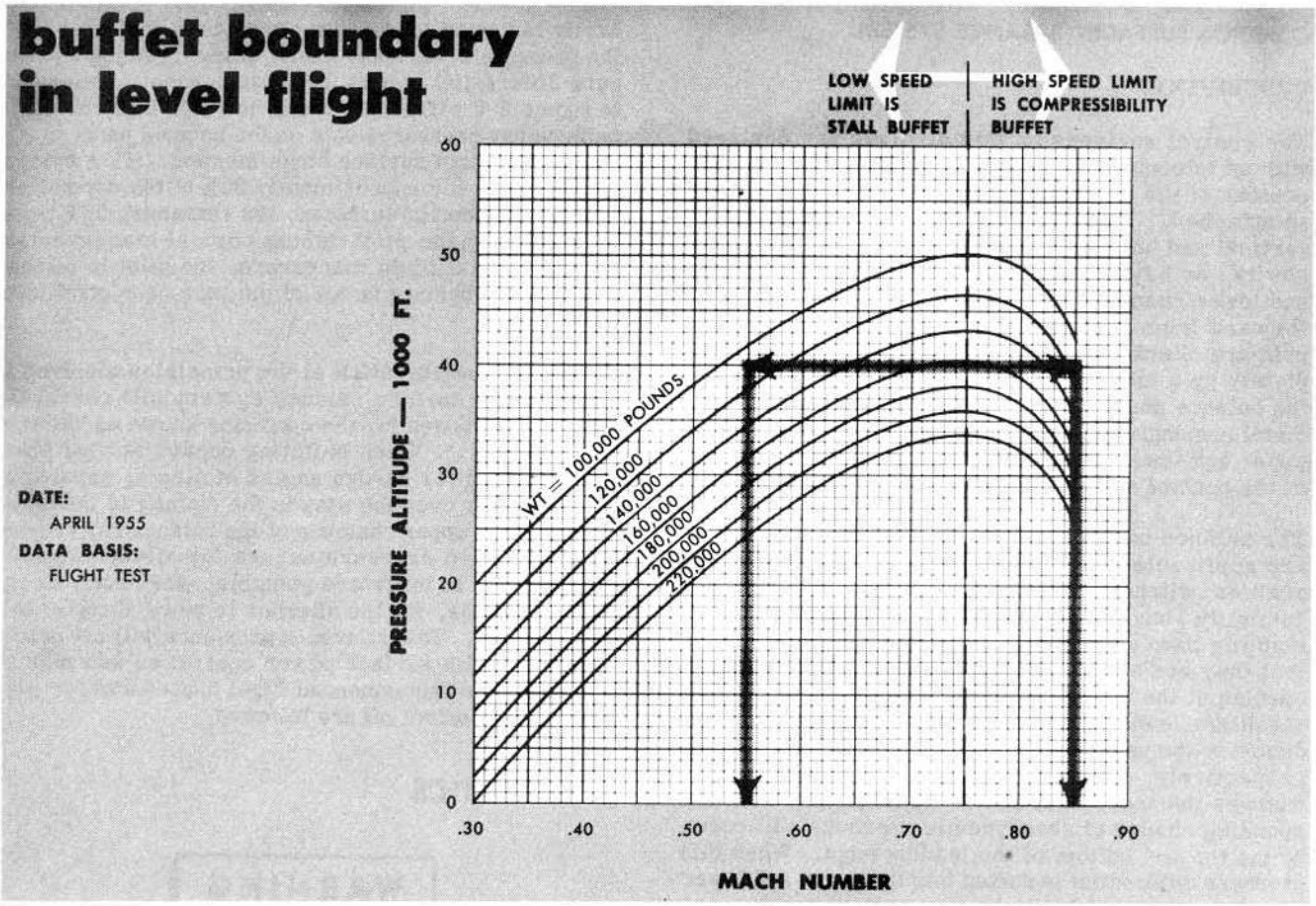


Figure 6-3.

at Mach .75 at 40,000 feet altitude. If the speed is decreased far enough at constant altitude, buffeting will be encountered at Mach .56. The buffeting at this point is low speed stall buffeting, and is substantially the same in nature as that described in "Stalls," this section. The only difference between high altitude low-speed buffeting and that described under "Stalls" is that at high altitude, buffeting occurs at higher indicated airspeeds.

If the airspeed is increased at constant altitude, buffeting will be encountered at Mach .85. At this altitude the airplane can be flown to Mach. .85 in level flight at 100% engine rpm. Initial high Mach number buffeting is noted by a very slight shaking of the airplane which increases in magnitude as the speed is increased.

WARNING

No rolling moments are encountered during buffeting; however, the separation resulting from operation at high Mach number occurs on the wing aft of the airplane center of gravity. This loss of lift causes the airplane to pitch up slightly. This condition is very unstable since the pitch-up causes further separation, hence more pitch-up. The pitch-up can be controlled with the elevator for a limited range of Mach numbers but, as the Mach number is increased, the condition becomes uncontrollable.

High Mach number buffeting should be avoided because the irregular air loads cause damage to the wing trailing edge structure, flaps, flaperons, and ailerons. This same damage occurs to the structure to a lesser degree during flight in low speed stall buffeting with the flaps up. If flight in buffeting is necessary for emergency descent or evasive action, the airplane is controllable and can be flown to the structural design limit, which is Mach .92 or 456 knots IAS, whichever occurs first. Careful inspection of the airplane should be conducted after extended periods of time in buffeting.

WARNING

Speeds in excess of 425 knots IAS will cause loss of aileron effectiveness. Refer to "Ailerons and Lateral Control," this section.

When extreme high Mach number buffeting is encountered in level flight at high altitude, it is necessary to appreciably increase the drag or decrease the thrust. Recovery from the buffeting range in level flight may be accomplished by reducing power to the idle stop and waiting for the airplane to decelerate. Under extreme conditions, extending the landing gear (with the drag switch) is recommended to increase the drag, while reducing power is recommended to decrease thrust. Care should be exercised to avoid reducing thrust, increasing drag, or increasing acceleration to a point where a low speed stall is encountered. A good rule to remember when any buffeting is encountered is to first reduce any positive acceleration, then increase or decrease the airspeed to obtain .75 Mach number. It is more likely that buffeting will be encountered while maneuvering the airplane at high altitude than in straight and level flight. The effect of positive accelerations caused by coordinated turns or pull-ups is to increase the load factor which has the same effect as adding weight to the airplane. The angle of bank is therefore limited by buffeting since the increased load factor moves the airplane closer to buffeting. Using the previous example of 110,000 pounds gross weight at 40,000 feet with a speed of Mach .75, it is shown on figure 5-3 that initial buffet will be encountered at approximately 47% angle of bank with a load factor of approximately 1.46 "g's." The greatest margin below buffeting exists at or near the best cruising Mach number, thus this region is the best for maneuvering at high altitude. The velocity curves on figure 5-3 clearly show the rapid decrease of allowable angle of bank due to either an increase or decrease of speed from Mach .75. The buffeting encountered during accelerated flight is essentially the same as that encountered at high Mach numbers and the same precautions should apply. Recovery from buffeting is best made by reducing the acceleration, either by rolling out of the turn or relaxing back pressure slightly, or both.

Operation near the buffeting region must be conducted with caution because of the following:

a. A reduction in airspeed is difficult to accomplish at altitude due to the high minimum obtainable rpm (see Fuel Regulator Minimum RPM Chart in part 8 of the Appendix), and due to the aerodynamic cleanness of the airplane.

b. A very slight nose-down attitude will result in increasing airspeed and will amplify the buffeting condition.

c. Positive accelerations as small as 1.1 or 1.2 "g's" caused by turbulence or maneuvering can produce considerable buffeting.

VORTEX GENERATORS

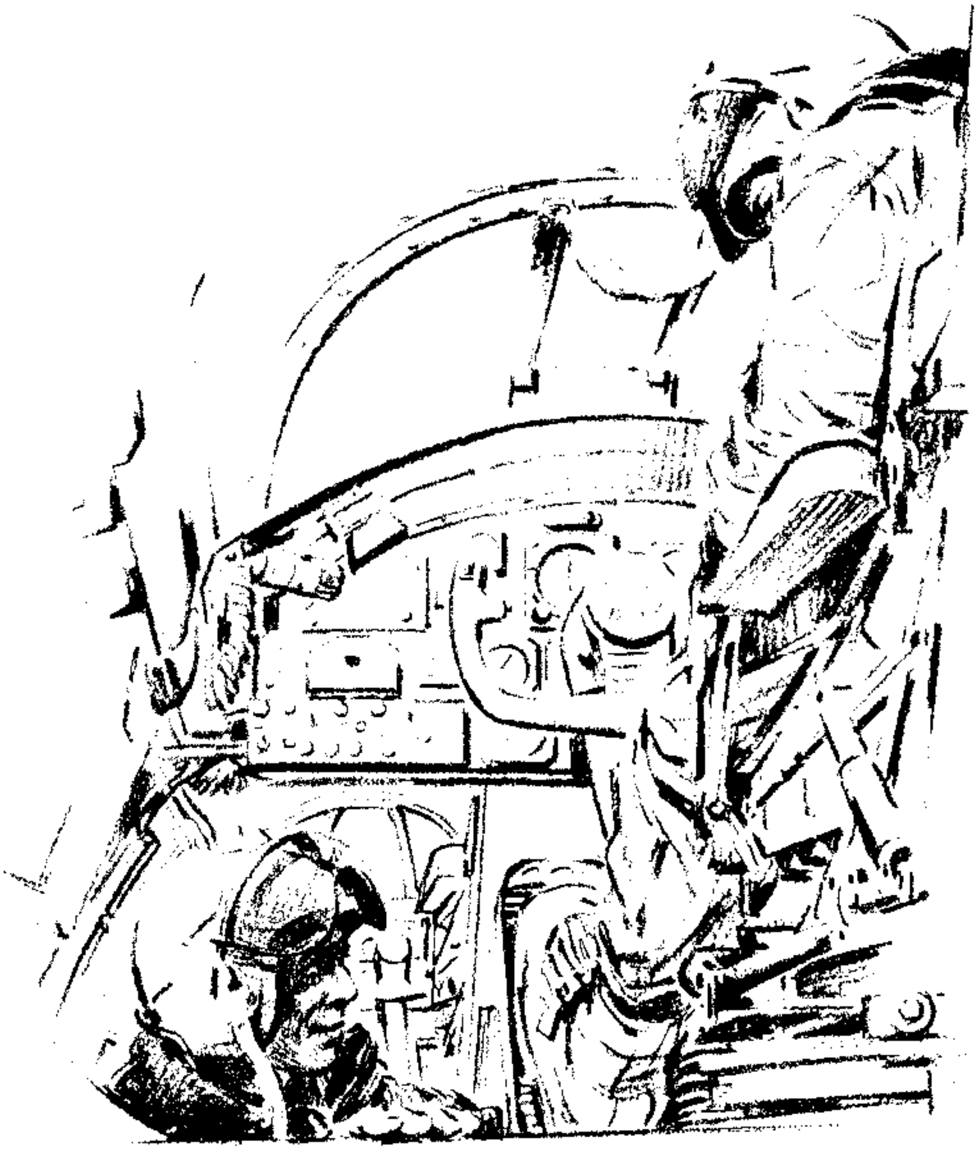
Swept-back wings on this airplane are an important aid in attaining high performance. Yet, this swept-back design presents a major problem in maintaining stability at high speeds and altitudes. The wings created a "pitch-up" of the airplane and it was discovered that this tendency is caused by separation of the air boundary layer on the upper wing surfaces which results in a loss of lift. The outboard portion of the wing has a higher loading per unit of area than the inboard portion. This means that the outboard portion will have a larger pressure difference and the local air velocities will be greater over this portion of the wing than over the inboard portion. Consequently the shock waves and separation will occur first on the outboard portion of the wing. Because the wings are swept-back, the outboard section is aft; therefore, a loss of lift on the outboard section causes the center of pressure (the point at which all of the wing lift may be considered as concentrated) to move forward as it moves inboard. The resulting pitch-up of the airplane, if unrestricted by the pilot, could cause structural damage to airplane at high airspeeds. As the airplane is allowed to increase the angle of attack, the separation is aggravated and will result in a stall. Vortex generators are used to retard this separation and decrease this pitch-up tendency at high speed. Vortex generators are small vertical airfoils with low aspect ratio (span divided by chord) which are installed in two rows on that portion of the wing most susceptible to boundary separation. These tiny airfoils are set at an angle of attack to the local airflow direction, thus forming a high pressure area on one side of the generator and a low pressure area on the other side. The air, after passing one of these generators, will begin to flow from the high pressure zone to the low pressure zone. In doing this, a spiral airflow (or tip vortex) is formed. This tip vortex contains some high energy air from outside the boundary layer and transfers it to the boundary layer by virtue of its rotational motion. The added energy will make the boundary layer more capable of overcoming the positive pressure gradients and thereby delay separation. In this matter, separation of the boundary layer over the upper surface of the wing is retarded and longitudinal stability is restored at speeds which would otherwise result in unstable flight. Recovery from buffeting is best accomplished by reducing the load factor and/or speed.

FLUTTER

Flutter is briefly defined as a vibration caused by the coupling of aircraft elastic inertia and aerodynamic loadings. Flutter, as opposed to buffeting, is usually associated with changes in airloads caused by structural deflections rather than airflow separation.

DIVING

The extreme cleanness of this airplane with the landing gear up, and the fact that it is operating near the buffeting range in level flight at high altitudes, limit it to very shallow dives which must be executed with extreme care. As with all high-speed operation, abrupt accelerations must be avoided. Steeper dives and rapid descents can be made by lowering the landing gear and decreasing power to the minimum obtainable rpm.



systems operation

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ENGINE OPERATION

COMPRESSOR STALL

HOT STALL

During some phases of J47-25 and -25A engine operation, the engine compressor may develop a partial stall. This condition is primarily caused by rapid forward movement of the throttle and results in upsetting the balance between fuel flow and engine air flow. Rapid throttle advancement, attempting to accelerate engine rpm beyond its normal rate of acceleration, causes a stall of several middle stages of the compressor. A stalled condition causes an immediate change of airflow through the engine which the fuel regulator cannot detect in time to decrease fuel flow to prevent a rich mixture. The additional fuel being ignited in the combustion chambers results in an increase of pressure which the fuel regulator senses as an increase of airflow. The fuel regulator, sensing this condition, adds still more fuel in an attempt to achieve the rpm called for by the throttle. The burning of additional fuel further increases the combustion chamber pressure, thus aggravating this condition. This condition is commonly known as a "hot stall." If the engine is allowed to continue operation in a stalled condition, the temperatures of the burning gases will increase until serious damage to the turbine section occurs, resulting in engine failure. Compressor stall is characterized by a mild vibration, the rpm stopping at approximately 70% rpm, and the EGT continuing to rise as the throttle is advanced. When this condition is observed, the throttle should be retarded immediately. After the EGT has returned to a normal level, another attempt may be made with the throttle being advanced more slowly. Compressor stalls may also occur when operating during cold weather at low altitudes or on the ground. In such a case, the same procedure should be followed.

COLD STALL

A compressor stall, which is more common on this airplane engine installation, resulting in fuel flow equalizing in proper proportion with the reduced air flow is known as a "cold stall." A rapid increase of EGT is not noticed with a cold stall condition. Engine vibration or buffeting, however, is noticeable along with a level off or slight drop in engine rpm and a constant EGT.

In the event of a compressor stall, the corresponding throttle should be immediately retarded, thus eliminating the compressor stall. The throttle may then be advanced slowly.

To help prevent engine compressor stalls, one of two fuel regulator sensing pressure bleed systems are provided for controlling the rate of engine acceleration. Some airplanes are equipped with an engine stall prevention switch located on the pilot's instrument panel. With this switch in ON position, engine acceleration time is increased because pressure is bled from the sensing line between the engine compressor section and the fuel regulator of each engine. The switch should be placed in ON position for air refueling, formation flying, or unusual maneuvers such as practice stalls at any altitude and when flying below 10, 000 feet with an OAT of 15° C (59° F) or below. With the switch in ON position at higher altitudes, a loss of rpm may be encountered (maximum obtainable rpm may be as low as 93%). With the switch in ON position at an OAT of 16° C (60° F) or above, engine acceleration time of up to approximately 30 seconds from idle to 100% rpm may be encountered on a 100° F day.

Airplanes not equipped with the switch have a compressor discharge pressure bleed line for each engine which may be capped or uncapped to regulate the engine acceleration rate in the same manner as the switch operation. Capping or uncapping of the line must be accomplished on the ground prior to flight in accordance with the ambient OAT. The line should be uncapped if OAT is 15° C (59° F) or below under 10, 000 feet or if air refueling, formation flying, or unusual maneuvers such as practice stalls are to be accomplished, regardless of altitude. With the line uncapped at higher altitudes, a loss of rpm may be encountered (maximum obtainable rpm may be as low as 88%). With the line uncapped at an OAT of 16° C (60° F) or above, engine acceleration time of up to approximately 28 seconds from idle to 100% rpm may be encountered on a 100° F day.

FLIGHT CHECK FOR ENGINE COMPRESSOR STALL

The following engine compressor stall check should be performed on the first flight after engine overhaul or engine change:

a. While flying at 25,000 feet at 200 to 220 knots IAS with engine stall prevention switch ON, no engine stall or "flame out" should occur with throttle burst.

b. While flying at altitudes above 25, 000 feet and up to 35, 000 feet at 230 to 250 knots IAS with engine stall prevention switch ON, no unrecoverable engine stall or "flame out" should occur during slow advance of the throttle. Engines which exhibit unrecoverable compressor stall or those engines which cannot be advanced to full power from idle detent or other power settings with slow throttle advance. These engines normally require a reduction in altitude to accomplish rpm advance. Slow throttle advance is defined as gradually advancing the throttles from idle position to the 100% position in a time lapse of 10 to 20 seconds.

NOTE

In event engine stall occurs, the throttle may again be retarded and advanced in such a manner as to avoid engine stall; however, any engine that requires a reduction in altitude to avoid stall during slow throttle advance is not considered acceptable.

If an engine fails to meet the requirement of the above check, further ground checking of the engine acceleration schedule should be accomplished.

ENGINE "CHOO-CHOO"

The occurrence of engine "choo-choo" may be identified principally by the following abnormal characteristics:

- The entire airplane is subjected to an unusual vibration which all crew members can readily recognize.
- An unusual sound emits from the "choo-chooing" engine. The sound resembles the sound of a steam locomotive and may or may not be audible by the crew members, particularly if all engines are operating.
- The fuel pressure gage on the subject engine becomes erratic and undergoes rapid fluctuations, sometimes over the entire range of pressures. Fuel flowmeters will give no perceptible indications during "choo-choo."

Engine "choo-choo" is usually experienced during engine starting and runup, most likely occurring between 30% and 70% rpm. However, it may occur during flight as a result of throttle cut-back from military rated to cruise rpm. "Choo-choo" is caused by pulsation of the fuel within the fuel lines supplying the affected engine. Changing the tank boost pump-engine fuel pump combination or changing the fuel flow to the affected engine will usually eliminate the fuel pulsation and the resulting "choo-choo." This can be done by changine engine rpm or fuel tank selection for the affected engine. Also, pulling the main fuel control circuit breaker on some airplanes * or placing the fuel selector switch to ME position on other airplanes**, may eliminate the "choo-choo." Either of these two methods accomplishes the same effect; that is, stopping the tank boost pumps with the tank valves open.

* Airplanes not included in ** coding

** (1) Airplanes having T.O. 1B-47-483 accomplished & AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on

NOTE (1)

If for any reason, changing the fuel selector switch to ME position is not desirable, it is possible to pull the applicable circuit breaker (depending on the setting of the fuel selector switch for the corresponding engine) and thereby stop the tank boost pump with the tank valves remaining open. The fuel tank boost pumps receive power through the main fuel warning, manifold, and fire shutoff valve circuit breaker when the fuel selector switch is in TE position and from the main fuel control circuit breaker when in TME position.

CAUTION

Pulling the main fuel control circuit breaker on some airplanes * or the main fuel warning, manifold, and fire shutoff valves circuit breaker on other airplanes ** will render the fuel fire shutoff valve for the corresponding engine inoperative.

If "choo-choo" occurs during runup, the antipulsating fuel line found on some engines should be checked for presence of fuel. (Some engines incorporate an antipulsating accumulator which greatly reduces the frequency of engine "choo-choo.") Uncontrollable "choo-choo" during flight may make it desirable to shut down the affected engine as continued operation may result in damage to the engine or equipment.

FUEL FLOWMETER FLUCTUATIONS

Air trapped in or passing through the fuel flowmeter transmitter will produce erratic fuel flow indications. This is quite noticeable during fuel selection changes in flight when the fuel selector positions are changed on one or more engines to use fuel from the auxiliary tanks. This condition results when the single point refueling manifold is empty or contains air or purge gas. The air or gas is forced along through the line by the fuel and becomes trapped in the flowmeter transmitter. However, air trapped in the fuel flowmeter transmitter does not prevent fuel flow to the engine. On the ground, the trapped air can be purged from the transmitter by 100% rpm fuel flow; in flight it is possible to flush the trapped air by raising that wing which encloses the transmitter having the air entrapped. Satisfactory engine operation will be indicated by the rpm and EGT gage.

ENGINE ICING

During engine operation at airspeeds below approximately 200 knots TAS and at high power settings (as in a climb or go-around), the intake air will be sucked instead of rammed into the engine compressor inlet. This suction causes a decrease of air temperature. Under these conditions, air at an ambient temperature above freezing may be reduced to subfreezing temperatures as it enters the engine. Free moisture in the air may become supercooled and cause engine icing while no external surface icing would be evident. The maximum temperature drop which can occur on most current engines is approximately 5° C (9° F). The greatest temperature drop occurs at high rpm on the ground and decreases with decreasing engine rpm and/or increasing airspeed. Ice formation in the engine inlet restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in exhaust gas temperature. As the air flow decreases, the fuel-air ratio increases which in turn raises the temperature of the gases going into the turbine. Complete turbine failure from extreme overtemperature may occur in a matter of seconds after ice builds up in the engine inlet. Even without inlet screens, serious blocking of the air passages between the inlet guide vanes can still occur in 4 minutes or less. The following operations of non-anti-iced engines are recommended:

a. Avoid atmospheric icing conditions whenever feasible.

b. If possible, avoid takeoff when the temperature is between -10° to 5° C (14° to 41° F) if fog is present or the dew point is within 4° C (7° F) of the ambient temperature. These are conditions under which jet engine icing can occur without wing icing. However, if takeoff is necessary, retractable inlet screens should be retracted prior to takeoff.

c. If the ambient temperature is in the range of 0° to 5° C (32° to 41° F), the speed of the airplane should be maintained at 250 knots or above to prevent inlet duct icing.

d. If icing conditions are encountered at freezing atmospheric temperatures, immediate action should be taken as follows:

1. Change altitude rapidly by climb or descent in layer clouds or vary course as appropriate to avoid cloud formations.

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* Airplanes not included in ** coding

** (1) Airplanes having T.O. 1B-47-483 accomplished and AF 51-2192 thru -2356, 53-1819 thru -1972, -2090 thru -2170, -2279 & on

2. Reduce airspeed to minimize rate of ice build-up.

3. Maintain close watch of exhaust gas temperature and reduce engine rpm as necessary to prevent excessive tailpipe temperature.

RPM DROP-OFF AT ALTITUDE

Due to fuel regulator characteristics maximum obtainable rpm at altitude may be expected to be as low as 97%.

FUEL SYSTEM MANAGEMENT

GENERAL

A fuel management system is provided to enable the pilot to control fuel distribution with a minimum amount of attention. Due to the location of the fuel cells along the longitudinal axis, proper fuel management is imperative to maintain a nominal center of gravity position. It is generally true that the airplane has its greatest structural margin and is easiest to fly when the cg is at an intermediate position between the limits. This can be accomplished by fuel management whenever it is reasonable to do so. Exceptions to this are at takeoff at high gross weights, when fuel is nearly exhausted, and conditions which would require unusually frequent fuel selection changes to keep the cg near the middle range. The optimum cg with regard to cruise efficiency is between 25% and 29%. However, drag is approximately only 2% higher with the cg at 15% than it is with cg in the optimum range. Since the drop penalty is not large there is not a strong requirement to stay within the range of optimum efficiency. Brief forward excursions of the cg such as accompany normal fuel management will have a trivial effect on overall range performance. The load adjuster should be used to determine the exact cg location. The following fuel management procedures enable the pilot to drop a 10,000-pound bomb from the forward bomb bay any time after external wing tanks are empty. When all auxiliary fuel has been consumed, the fuel in the forward, center, and aft main tanks should be equalized. Fuel should continue to be used equally from all main tanks. Prior to landing the fuel should be used in such a manner to allow approximately 3000 pounds more fuel to remain in the aft main tank than either of the other main tanks. This procedure is recommended so that at light gross weights, the cg will be in a more favorable position for landing than it would be if equal quantities of fuel remain in all main tanks. If it becomes necessary to operate the airplane with a bomb load in the forward bomb bay and a total fuel load below 28,000 pounds, the aft main tank should contain approximately 5,000 pounds more fuel than either of the other main tanks to keep a favorable cg location. Operation from reserve fuel in the aft main tank, after the forward and center main tanks are empty, will result in the airplane cg moving forward very rapidly.

NOTE

Fuel gage error may be expected when using 100% high octane gasoline (115/145). At a temperature of 100° F, the fuel gages will read approximately 5% high. With the same fuel at 0° F, the reading will be approximately 2.5% high.

Since many replacement boost pumps do not have the electrical arcing hazard eliminated, the possibility of an explosion occurring during boost pump restarts, with less than 5 inches of fuel above the pump mounting flange, still exists. This condition results from an electrical arc on the pump during starting which could ignite fuel vapors if the fuel level were below the point of arcing and all other conditions necessary for combustion prevailed. To establish the safest procedure the following warning should be observed on all airplanes.

Figure 7-1 Deleted.

WARNING

- The minimum amount of fuel in pounds, necessary in the tanks for safe restarts of the boost pumps while on the ground and in cruise, is as follows:

	On Ground (pounds)	In Cruise (pounds)
Forward main	3930	1876
Center main	3292	743
Aft main	2266	3363
Bomb bay	1558	1062
Forward auxiliary *	600	400
Aft auxiliary *	2600	2200

- Since there are no fuel quantity gages in the auxiliary tanks, it is necessary that once boost pumps are started, they be operated continuously until the fuel quantity indicators show "E" or empty tab, or until the fuel flow indicating light comes on during transfer operation. If it is necessary to stop boost pump operation during fuel transfer, the pump should not be restarted if the "intermediate" tab on the fuel quantity indicator is showing.

- The direction of rotation of the fuel selector switches should be closely observed before making fuel selections since on some model airplanes the direction of rotation is counterclockwise and is therefore directly opposite to the direction of rotation on other model airplanes which is clockwise.

FUEL SYSTEM OPERATION

The fuel system provides an interconnection of the refueling manifold with the engine manifold through an inter-manifold line. The inter-manifold line allows fuel usage directly from all auxiliary tanks except that on some airplanes** the forward auxiliary tank transfers directly to the forward and center main tanks.

NOTE

Auxiliary tank to main tank transfer (except forward auxiliary fuel on some airplanes**) should not be accomplished with this system except in an emergency since transfer increases the possibility of fuel spillage overboard through the vents and fuel entry into the aft fuselage compartments. Also fuel transfer is not necessary for normal operation of fuel system and may result in cg difficulties and time-consuming fuel management problems. However, if for some reason, transfer of auxiliary fuel to the main tanks is necessary, it can be accomplished by use of the fuel transfer valve switches.

START ENGINES AND TAXI

Set up the fuel system in accordance with the normal operating procedures in section II. No auxiliary fuel usage is accomplished during ground operation. The following procedures should be used as determined by the cg location in % MAC:

- With the cg forward of 34% MAC, fuel selector switches for all engines will be in TE position except No. 2 which will be in TME position in order to maintain fuel pressure in the engine manifold. This selection is used so that fuel will be used evenly from all main tanks.

- With the cg aft of 34% MAC, fuel selector switches for engines No. 1, 2, 5, and 6 will be in ME position and engines No. 3 and 4 will be in TME position. This selection supplies fuel to all engines from the aft main tank and is used in order to move the cg forward as much as possible before takeoff and climb.

TAKEOFF AND CLIMB

Fuel normally contains a certain amount of absorbed air. The amount of air varies with the atmospheric pressure. More air will be found in the fuel at high pressures than at low pressures. This means that the fuel will normally contain more absorbed air at low altitudes than at high altitudes. As the airplane climbs to altitude this air will normally be released from the fuel gradually; however, if the ascent is smooth and the fuel is not agitated in some manner the air may not be released and the fuel will become supersaturated with air. Then, after reaching cruise altitude, if the fuel is agitated by turning on the boost pumps or by any other means, the air will escape rapidly, causing a boiling action of the fuel which forces it out through the vents and hence back into the aft fuselage compartments. Fuel spillage caused by the rapidly releasing air can be eliminated by operating the boost pumps from takeoff to cruise altitude thus agitating the fuel and allowing the air to release gradually during climb. The following procedures should be used for takeoff and climb.

1. Set up the fuel system in accordance with normal operating procedures in section II. Fuel selector switches for all engines will be in TE position except that No. 2 will be in TME position in order to maintain fuel pressure in the engine manifold.

* AF 52-565 & on
** AF 51-2357 thru 52-564

(1)
2. Before takeoff turn on boost pumps for all auxiliary tanks that are intended to be used in flight with the exception of the forward auxiliary. The auxiliary-fuel-to-engine valve switch is to be in CLOSED position. After reaching cruise altitude turn off all auxiliary tank boost pumps except as necessary to begin normal auxiliary fuel feed to engines.

(2)
Before takeoff turn on boost pumps for all auxiliary tanks that are intended to be used in flight. The auxiliary-fuel-to-engines switch is to be in CLOSED position. After reaching cruise altitude turn off all auxiliary tank boost pumps except as necessary to begin normal auxiliary fuel feed to engines.

NOTE

- In the event a takeoff is to be made with one or more of the main tanks less than half full, fuel selector switches for all engines will be in TME so that all engines may be fed through the engine manifold. With any one of the main tanks less than half full, the forward boost pumps may possibly be uncovered in event of a nose-high attitude resulting from severe climb-out conditions. Therefore, a single boost pump failure could possibly cause a flame-out on the engine being supplied by that boost pump. The engine-driven fuel pump is not capable of supplying sufficient fuel to the engine from a fuel tank in which one boost pump is "sucking" air as a result of becoming uncovered and the submerged boost pump has become inoperative. Consequently, when all fuel selector switches are in TME position, multiple fuel boost pump failures could occur even during a sharp climb-out with no danger of engine flame-out due to lack of fuel.
- No auxiliary fuel transfer or usage is accomplished during ground operation or takeoff and climb.

WARNING (3)

On airplanes which do not have T. O. 1B-47-483 accomplished, all of the fuel selector switches should never be placed in the ME position simultaneously during engine operation when using fuel from the main tanks because the tank valves would be closed and the engine manifold would not be pressurized. All of the engines would fail due to fuel starvation.

DURING CRUISE

NOTE

Due to refueling rates, when an outbound flight requires air refueling, fuel should be used from main tanks and bomb bay tank first prior to refueling. (See "Air Refueling-Fuel Management," this section.)

As soon as possible after reaching cruise altitude, place all fuel selector switches on TME, place auxiliary-fuel-to-engines switch in OPEN, and select first auxiliary tank in sequence and place the respective tank valve and boost pump switch in BOOST ON. Recommended sequence of use of auxiliary tank fuel for normal loadings (except for 18,000 pound store) is as follows:

With CG Forward of 32%
1. External wing tanks
2. ATO (aft auxiliary) tank
3. Bomb bay tank
4. Forward auxiliary tank

With CG 32% or Aft
1. ATO (aft auxiliary) tank
2. External wing tanks
3. Bomb bay tank
4. Forward auxiliary tank

NOTE (1)

Fuel is transferred from the forward auxiliary to the forward and center main tanks, after using bomb bay fuel.

Fuel will then be supplied from the selected auxiliary tank to all engines through the manifold system. Due to the larger capacity of the auxiliary tank boost pumps, the auxiliary boost pressure overrides the main tank boost pressure and fuel flows from the auxiliary tanks. If, for some reason, auxiliary fuel boost pressure should drop, main fuel boost pressure will supply fuel to all engines from the main tanks. As soon as the "no-flow" warning lights for the auxiliary tank being used illuminates, select next auxiliary tank in sequence and place its tank valve and boost pump switch to BOOST ON and position the empty tank switch to OFF.

(1) AF 51-2357 thru 52-564
(2) AF 51-2192 thru -2356, 52-565 & on
(3) AF 51-2357 thru 52-3373, 53-2028 thru -2040, -2261 thru -2278

NOTE

- If either of the external tanks empties before the other, position the empty tank valve and boost pump switch to OFF. Do not turn the next auxiliary tank on until the other external tank "no-flow" light is on. If the second "no-flow" light does not come on in approximately 10 minutes, assume a malfunction, select the auxiliary tank next in sequence, and place the external tank switch OFF.
- One boost pump in the bomb bay tank may override the other in the tank causing its "no-flow" warning light to illuminate. This is not an unusual condition and occurs because of pump performance variations. If this condition occurs, check for a boost pump malfunction as follows: Place any fuel transfer switch in VALVE OPEN; if both lights go out the pumps are functioning satisfactorily.

Continue using fuel from the auxiliary tanks in tne proper sequence until all auxiliary fuel (which may be used directly by the engines) is used, then set all fuel selector switches except that for No. 2 engine on TE. In order to maintain fuel pressure in the engine manifold, maintain No. 2 engine fuel selector switch on TME.

NOTE

(1)

Begin transfer of forward auxiliary fuel to the forward and center main tanks by positioning the forward auxiliary fuel tank valve and boost pump switch to ON. After transfer of forward auxiliary fuel is complete, position the tank valve and boost pump switch to OFF.

Monitor fuel gages as necessary to insure even fuel usage from all three main tanks. If any tank shows a higher rate of fuel usage than the others, correct the condition by selecting ME on that tank and TME on the other two tanks. Prior to landing equalize fuel in forward and center main tanks until the aft main tank contains approximately 3000 pounds more fuel than each of the other two main tanks.

BEFORE LANDING

If 4000 pounds of fuel or more remain in each main tank, set up the fuel system in accordance with normal operating procedures in section II. Place No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE.

If less than 4000 pounds of fuel remain in any one main tank, place all fuel selector switches on TME. This will insure maximum fuel flow and pressure to all engines in case of emergency or low fuel quantities.

FUEL MANAGEMENT WITH 18,000-POUND STORE

For airplanes carrying an 18,000-pound store there is a forward cg condition which makes it necessary to alter normal fuel management procedures during cruise prior to dropping the store in order to keep the cg within the allowable flight limits. Consideration must be given to the fact that the cg will shift aft approximately 10% to 15% when the store is dropped. It is necessary to retain 3000 pounds more fuel in the aft main tank than in either of the other main tanks prior to dropping the store in order to assure that the cg will not move out of the forward limit before the store is dropped. However, the cg must be forward far enough to prevent it from moving beyond the aft limit when the store is dropped. Recommended sequence of use of auxiliary tank fuel for these conditions is as follows:

1. External wing tanks
2. Forward auxiliary tank
3. Aft auxiliary tank
4. Bomb bay tank

If it becomes necessary to operate the airplane with an 18,000-pound store and a total fuel load below 33,000 pounds, the aft main tank should contain 5000 pounds more fuel than either of the other main tanks in order to keep a favorable cg location. This will keep the airplane cg within limits only until 20,000 pounds of fuel remain. At that time, if the airplane has not been landed, one or more of the following must be accomplished immediately in order to keep the cg within the allowable forward limit:

- Refuel
- Alter fuel management by using fuel from forward or center main tanks only
- Drop the store.

ALTERNATE FUEL GRADE OPERATING LIMITS

The operating limits are identical for the recommended and alternate fuel grades.

AIR REFUELING

The air refueling information contained in this handbook has been compiled as an aid to accomplishment of air refueling of B-47 receiver aircraft with boom-equipped KC-97E, KC-97F, and KC-97G tanker aircraft. To avoid repetition, the following paragraphs are primarily concerned with recommended techniques and procedures for accomplishing air refueling. In addition to this information, section IV contains a detailed description of the air refueling system, controls, and indicators. Also part 9 of the Appendix should be utilized to obtain performance data for mission planning.

(1) AF 51-2357 thru 52-504

fuel system management

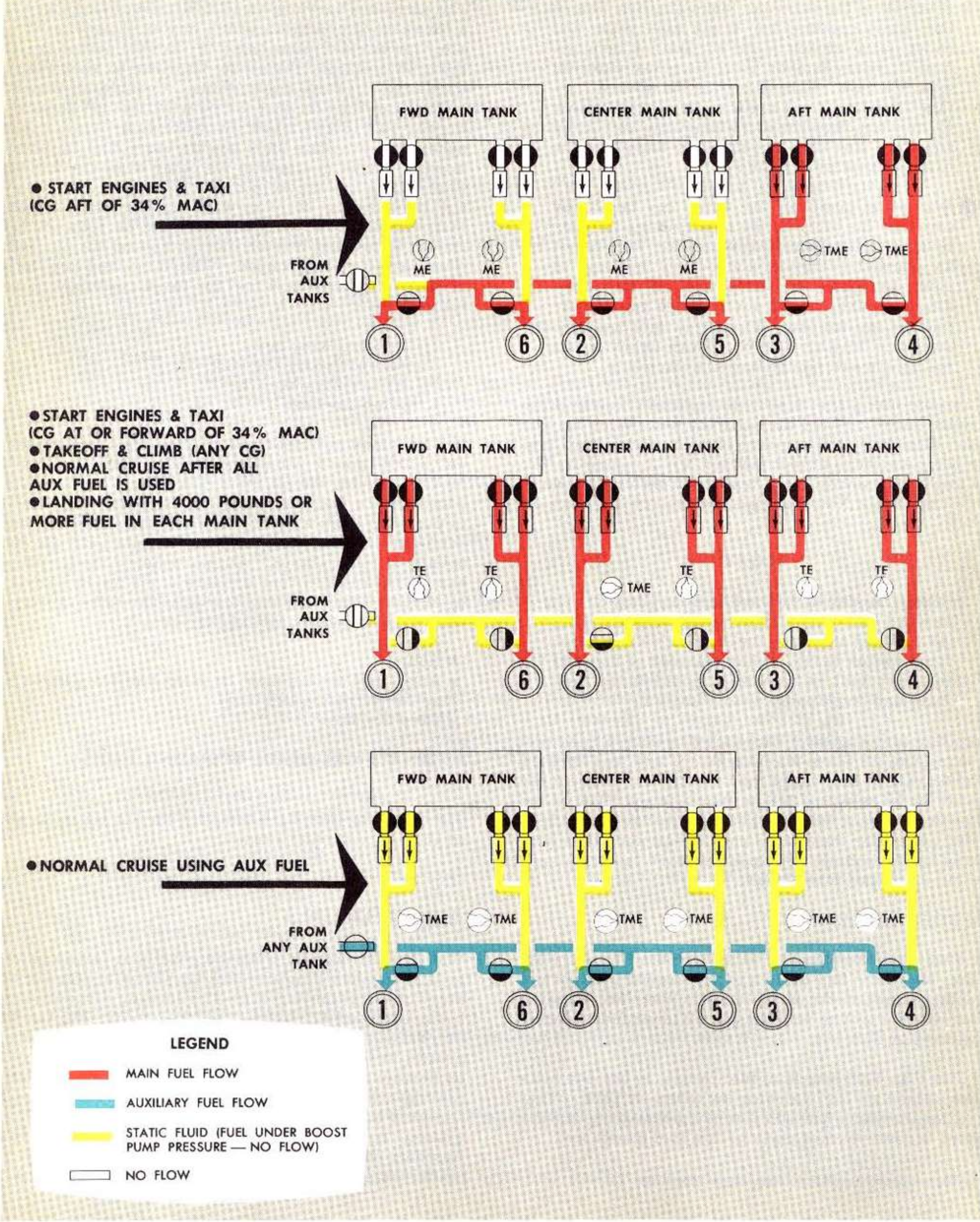


Figure 7-2 (Sheet 1 of 2 Sheets)

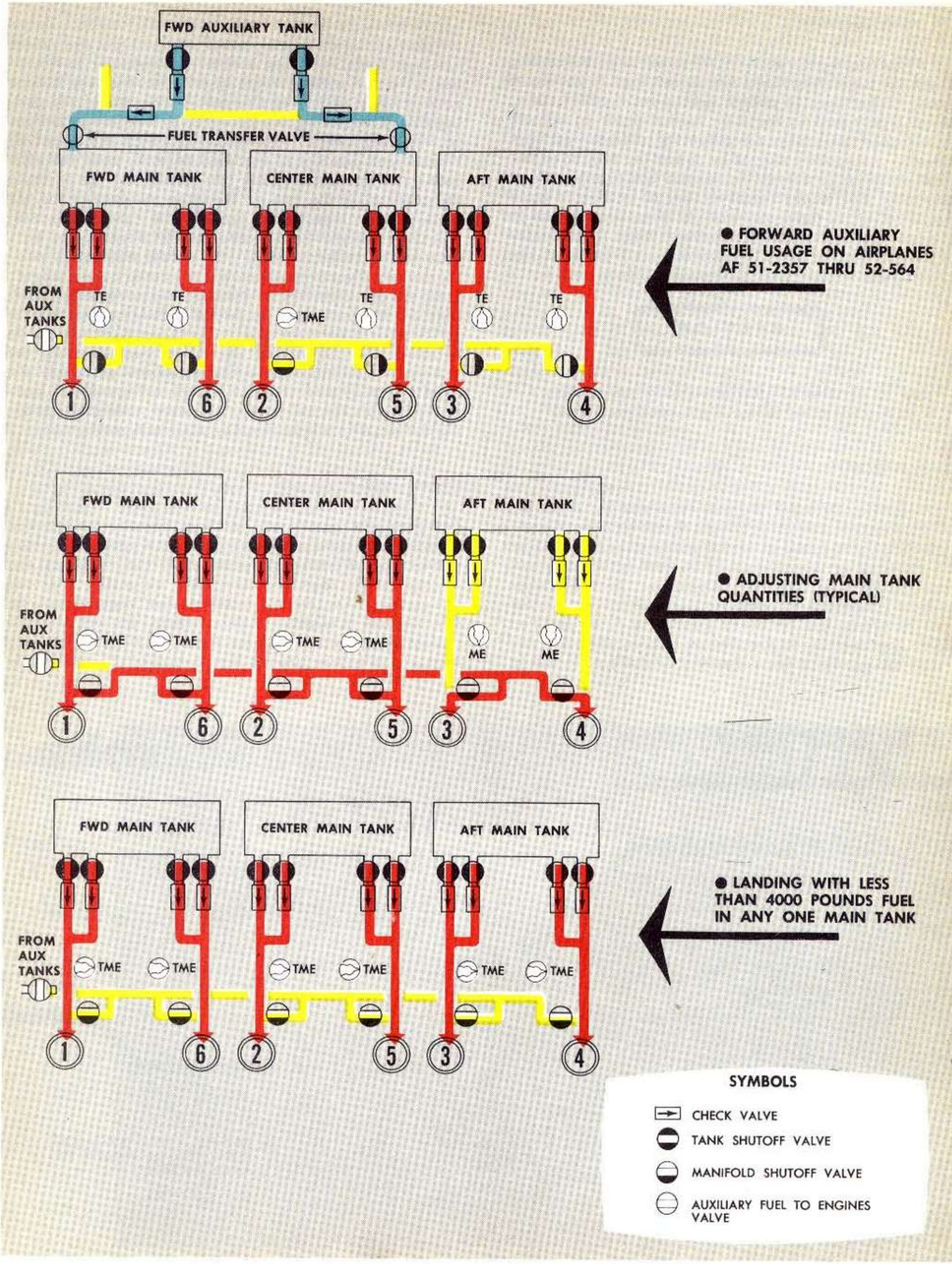


Figure 7-2 (Sheet 2 of 2 Sheets)

FUEL MANAGEMENT

The refueling flow rates to all auxiliary fuel tanks, except the bomb bay tank, are lower than to the main tanks; therefore, to obtain minimum contact time, the auxiliary tanks should be loaded prior to takeoff and not used until after air refueling has been accomplished. Allowance should be made for fuel used out of the main tanks during the takeoff and climb to rendezvous. Sufficient reserve fuel to return to base should be left in the main tanks in case rendezvous is unsuccessful and mission aborted. Fuel from auxiliary tanks can be used to augment main tanks if return to base without making contact is required.

CAUTION

Due to structural limitation of wing, landing with full external tanks is not recommended.

RENDEZVOUS

Air refueling of a jet engine receiver by a reciprocating engine tanker presents the problems of noncompatibility because of performance characteristics. The existing problems should be kept in mind to accomplish the most effective refuelings. In most cases the best procedure to refuel in flight is for the tanker to orbit along the receiver course and, as the receiver approaches, to proceed on course while the receiver descends to the refueling altitude. To aid in accomplishing rendezvous, especially when a large altitude variation exists, rendezvous radar equipment has been installed which enables the receiver to transmit a beacon signal which is triggered by the tanker rendezvous radar equipment. The tanker is then capable of vectoring the receiver to within visual contact of each other. The point at which the receiver rendezvous descent is initiated depends upon the altitude variation between the two airplanes, the velocity differential of the two or the time necessary for the receiver to close on the tanker, the rate of descent, and the receiver time to decelerate at refueling altitude to the tanker speed. To obtain maximum performance, the receiver should not depart prematurely from its optimum cruise altitude to the refueling altitude as the penalties imposed will be great in both time and fuel consumption. Conversely, if descent is delayed, the tanker will extend its range beyond the previously established refueling check point and the receiver may overrun the tanker. Figure 7-3 presents a typical rendezvous problem, illustrating the major steps to accomplish an efficient rendezvous.

READY FOR CONTACT

Once visual contact has been made, the tanker will establish straight and level flight at a planned altitude and airspeed with boom extended; the receiver and tanker crews then prepare their refueling systems for contact. On training missions that require several dry contacts in addition to wet contacts, the wet contacts should be spaced at regular intervals between the dry contacts to insure proper lubrication of the receptacle

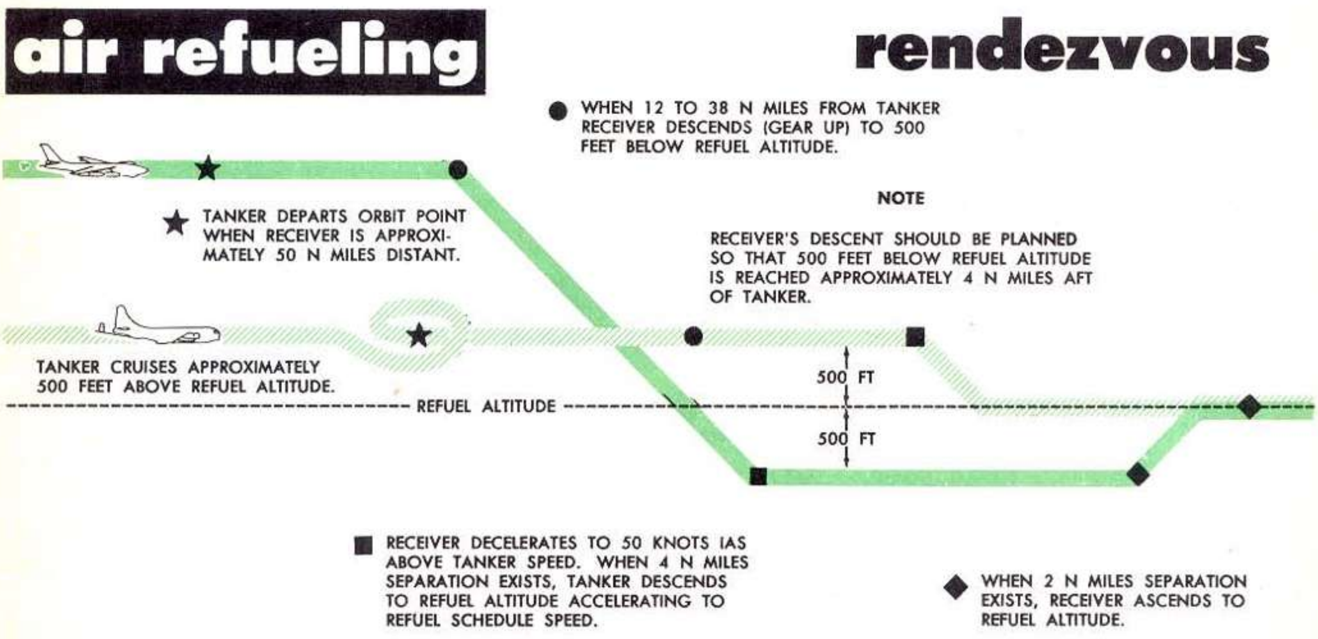


Figure 7-3.

valve. The fuel passing through this valve is the only lubrication provided and prolonged dry contacts will sometimes cause the valve to bind resulting in a system malfunction. Due to the comparatively low maximum speed of the tanker and high minimum speed of the receiver at high gross weights, it is necessary to lower the flaps 20% to maintain stability without causing a large increase in drag.

NOTE

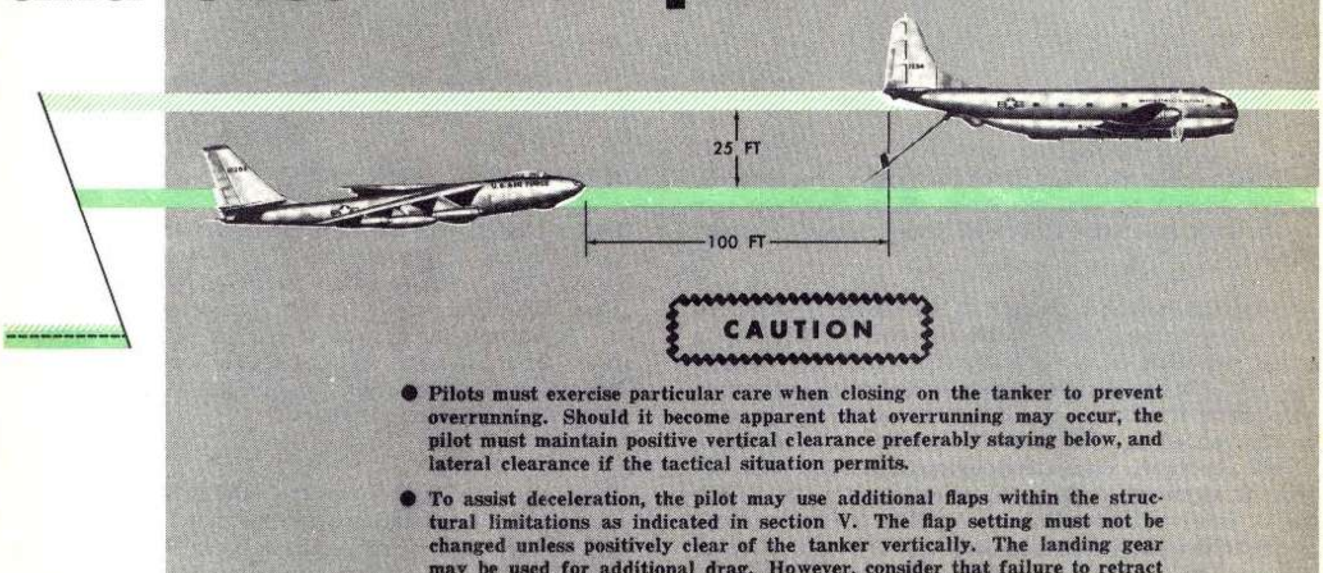
> Practice (dry) contacts with low gross weights may be made without use of flaps if desired.

The refueling formation is best initiated by the receiver closing in from behind, in trail with the tanker, being careful to maintain sufficient vertical clearance. The receiver should close on the tanker until it is 100 feet aft and 25 feet below. This is known as the observation position. See figure 7-3. When both crews are notified that their respective systems are "Ready for Contact" the receiver pilot should proceed forward and upward simultaneously to a position at the proper elevation but approximately 30 feet aft of the contact position. The pilot should then move straight forward into the contact position. Since acceleration is rapid and deceleration is slow, caution should be observed not to overrun the tanker. It is important that the pilot disregard the indications of the pilot-director lights on the tanker until contact has been established. However, when in the near-contact position, the director lights should be seen beneath the left ruddevator and in this manner may be used as a reference for pitch and yaw.

CONTACT MADE

The air space known as the "contact envelope" (figure 7-4) is defined by limit switches connected to the boom. As long as the receiver is positioned inside these limits, contact can be held despite rolling, yawing, or pitching. The envelope limits are set well within the mechanical limits of the boom so that disconnect can take place before any structural damage occurs, even though the limits are approached at a relatively high velocity. The boom operator will extend the boom into the slipway and as soon as the nozzle seats in the receptacle, the receptacle toggles will secure the nozzle, and the airplane is then ready for refueling. Pilot director lights are provided on the lower side of the tanker to aid the receiver pilot maintaining correct formation while in contact. The pilot-director lights are actuated by movements of the boom and therefore provide assistance only while in contact. The center light has a plain green lens and remains illuminated as long as the boom remains in the nominal position. The other four lights have red lenses that read from forward to aft UP--AFT--FWD--DWN

and observation position



CAUTION

- **Pilots must exercise particular care when closing on the tanker to prevent overrunning. Should it become apparent that overrunning may occur, the pilot must maintain positive vertical clearance preferably staying below, and lateral clearance if the tactical situation permits.**
- **To assist deceleration, the pilot may use additional flaps within the structural limitations as indicated in section V. The flap setting must not be changed unless positively clear of the tanker vertically. The landing gear may be used for additional drag. However, consider that failure to retract would jeopardize the mission.**

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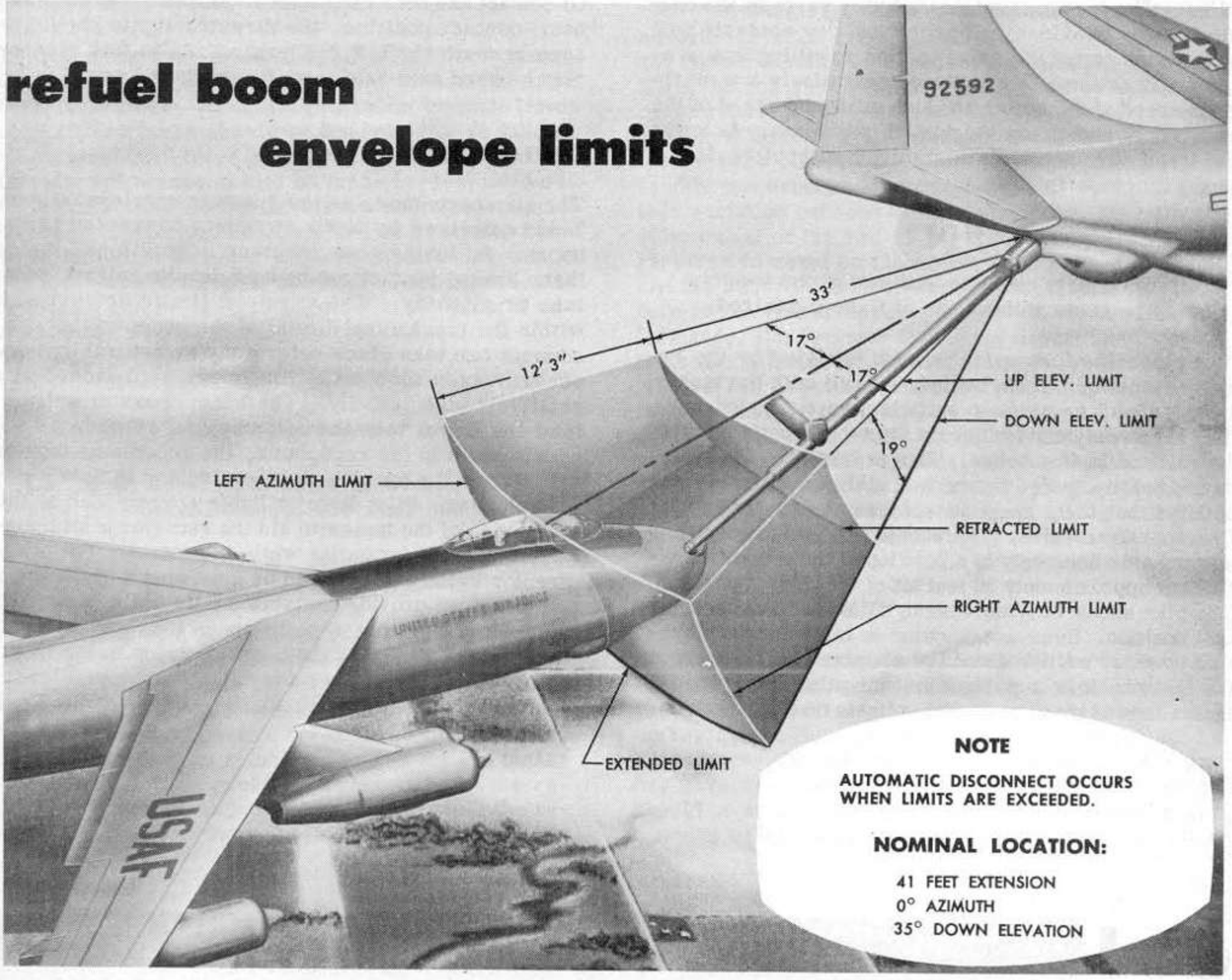

Figure 7-4.

to indicate the correction necessary to restore the airplane to the nominal position. Also, the boom may be used for extension reference once contact is established.

To maintain a stable margin of maneuvering airspeed above the stalling speed of the receiver, the refueling speed schedule must be maintained as fuel is transferred. This should be accomplished with a sacrifice of altitude if necessary. If the formation airspeed is not increased in relation to the gross weight increase of the receiver, then a borderline condition control-wise is apparent as the pilot notes more pitching than usual, intermittent buffeting, or when power required approaches 100% throttle stop. If this condition is approached, the receiver pilot may find it necessary to request the tanker pilot to increase the rate of airspeed change to maintain pitch stability.

RECEIVER PILOT TECHNIQUE

Do not skid or yaw the airplane excessively to accomplish lateral displacement. The roll due to yaw in a swept wing tends to cause overcontrolling if this is done. The best way to fly this formation is to "drive" it. Accentuate the aileron, using the rudder to dampen yaw. Find the angle of bank that allows the receiver to remain in the nominal contact position without the necessity of rudder pressure.

In all corrections, control the rate of motion between the airplane in an anticipatory manner that is positive and timely. Do not stare at the boom; but use it constantly, checked against pilot-director lights. Primary reference is well forward on the tanker and, in rough air, is as far forward as the vertical axis.

NOTE

The word "Breakaway" has been established and reserved for use as a code word to indicate an emergency condition. At any time during the contact-made condition, any crew member of the tanker or receiver can call his respective call sign and "Breakaway" three times when he feels that the circumstances are hazardous to the safety of the airplane or malfunction of equipment warrants rapid disconnect. On the word "Breakaway" every crew member who has a disconnect switch should immediately operate that switch without delay or question. The receiver pilot, in such a situation, will immediately reduce power and, if necessary, lower the landing gear.

ENGINE FAILURE

A tanker engine failure is more serious than a receiver engine failure. A receiver engine failure will result in extension of the boom and probable separation; however, a tanker engine failure will probably cause the receiver to overrun the tanker. In the event of tanker engine failure, the formation accomplishes the "Breakaway" procedure.

DISCONNECT

There are two major classifications of disconnects; namely planned and inadvertent. Planned disconnects may be initiated by either the receiver pilot, copilot, or the tanker boom operator operating their respective disconnect switches. Inadvertent disconnects may be caused by exceeding the refuel boom envelope limits. A pressure disconnect switch located aft of the refueling receptacle will cause a disconnect by pressure surges initiated either from using too high a transfer pressure or when the selected tanks become full and the high level float switches close. Upon disconnect, the boom will automatically retract, except when the tanker system is in manual override or the receiver system is in emergency boom latching condition. When the boom is clear the tanker is pulled up and the receiver pilot lowers his airplane nose, drops back, descends enough to clear the tanker, and then cleans up the airplane and accelerates to best climb speed.

NORMAL OPERATION

The preflight and postflight inspections are presented in section II and should be accomplished whenever air refueling missions occur. The following text covers in detail the procedures for in-flight, day and night, emergency, and radio silence operations.

IN-FLIGHT OPERATION

NOTE

- During training missions, air refueling will not be attempted in turbulence exceeding the classification of light turbulence or under conditions of atmospheric electrical discharge.
- All crew members will remain alert and watchful during refueling operations and notify the pilot of the position of other aircraft in the proximity of the refueling formation.

INFLIGHT AIR REFUELING CHECKLIST

NOTE

The following checklists are accomplished by the copilot calling off the items to the crew. For identification purposes, all responses made by the pilot are noted in CAPITAL letters and those by the copilot in lower case. Responses made by the observer are shown in ***italics***

RENDEZVOUS AND PREDESCENT

As the rendezvous and refueling area is approached, the following checklist should be completed.

1. Rendezvous Equipment - ***on***
   Observer turns on the rendezvous radar equipment when approximately 350 nautical miles from the tanker.

2. Altimeter 29.92 - set - SET - ***set***
   All crew members set altimeters to 29.92.

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INFLIGHT AIR REFUELING CHECKLIST

(CONTINUED)

3. Descent Range - ______ miles
   Copilot computes descent range from appropriate charts.

4. Gross Weight - ______ pounds. Contact Speed - ______ knots
   Copilot computes gross weight and then refueling contact speed from appropriate charts.

5. Slipway Heat - ON
   Prior to descent, pilot places air refueling slipway anti-icing switch to ON position.

6. ESP Switch - ON
   Pilot places engine stall prevention switch ON for air refueling regardless of altitude or temperature.

7. Directional Damper - AS REQUIRED
   Pilot places directional damper switch as required.

8. Trim, Seats & Pedals - ADJUSTED
   Pilot checks trim, seats, and rudder pedals. Seat should be positioned so that pilot will have an unobstructed view of his formation reference points on the tanker airplane and of the boom extremity near the ruddevator.

9. Fuel Panel - SET
   Pilot sets fuel panel as desired to use fuel from the main tanks only.

10. Master Refuel Switch - REFUEL
    Pilot places master refuel switch to REFUEL position.

11. Fuel Gage Control Switch - COPILOT
    On airplanes having fuel gage control switch, pilot places fuel gage control switch to COPILOT position.

NOTE

Energizing the copilot's fuel quantity gages illuminates the air refueling panel and allows the panel edge lights intensity to be regulated by the rheostat on the copilot's lighting panel. However, on some airplanes there is no means of dimming the indicator lights.

12. Refueling Panel Lights - tested
    Copilot tests all push-to-test lights that are not illuminated on the air refueling panel.

13. Fuel Quantity Indicators - checked
    Copilot checks for satisfactory operation of fuel quantity indicators by depressing test switches and noting a drop in indication.

14. Tanks to be Refueled - selected valves open
    Copilot places desired refueling valve switches in OPEN position; all others should be in VALVE CLOSED position.

15. CO_2 Selector - as desired
    On airplanes having slipway fire extinguisher system, copilot sets fire extinguisher selector switch as desired.

16. Air Refueling Selector Switch - normal
    Copilot places air refueling system selector switch to NORMAL IFR SYSTEM position.

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INFLIGHT AIR REFUELING CHECKLIST

(CONTINUED)

17. Air Refueling Valve Lever - open
    Copilot moves air refueling valve lever to OPEN position; "Manifold not Purged" ("Manifold not Drained") light should illuminate.

18. Circuit Breakers - checked
    Copilot checks that all circuit breakers at his station are pushed in.

NOTE

To prevent operation of the windshield wiper during disconnect on dry or dirty glass, it will be necessary to pull the windshield wiper circuit breaker located on the lower DC power panel. This is especially desirable during practice (dry) contacts.

19. Air Refueling Lights (Night) - on
    For night refueling contacts, turn air refueling door and receptacle light rheostat, navigator's window lights rheostat, and wing illumination light switch ON and adjust light intensity as desired.

20. Radio - command - COMMAND - ***command***
    When directed by pilot, all crew members switch to and monitor COMMAND throughout the refueling operation.

NOTE

At descent range, pilot retards throttles to idle and begins descent. On airplanes not having constant speed alternators, copilot monitors No. 1 and 6 engines above 52% rpm. Crew cross-checks altimeters during descent.

DECELERATION

At refueling altitude less 500 feet, accomplish the following:

1. Periscopic Sextant - ***removed***
   Observer removes periscopic sextant from mount and checks port closed.

2. Automatic Pilot - OFF
   Pilot places automatic pilot OFF. The automatic pilot will not be used during air refueling operations by either the receiver or tanker airplanes.

3. No Smoking - no smoking - NO SMOKING - ***no smoking***
   Crew members acknowledge "No Smoking" requirements.

4. Slipway Door - open
   Copilot opens slipway door after making sure the airspeed is not in excess of 250 knots IAS. The "Slipway Door not Locked" light should illuminate and, when the door is fully open, the "Ready for Contact" light should illuminate.

NOTE

During icing conditions where formating for an air refueling contact is still possible, icing within the receptacle cavity can be prevented by keeping the door closed until just prior to the contact.

(CONTINUED ON NEXT PAGE)

INFLIGHT AIR REFUELING CHECKLIST

(CONTINUED)

5. Slipway Heat - OFF
   Pilot places air refueling anti-icing switch OFF.

6. Flaps - 20%
   At pilot's request, copilot extends wing flaps to 20% down position.

PRECONTACT

Since it may not be desirable to observe radio silence during most training missions, the boom operator will talk the receiver pilot into position when both airplanes are ready to establish contact and will continue to instruct him during contact.

NOTE

Changing pilots during air refueling training missions must not be accomplished unless three pilots are aboard the airplane. One pilot will remain at the controls at all times maintaining visual contact with the tanker airplane. Prior to changing seats the receiver pilot will notify the tanker pilot, then drop back so as to fly a safe position at least 1000 feet behind, 500 feet below, and with wing span clearance in relation to the tanker airplane. After completing the seat changes the receiver pilot will notify the tanker pilot prior to moving into contact position.

1. Unnecessary Electrical Equipment - off - OFF - *off*
   Pilot turns off omni, radio compass, and IFF. Copilot turns off liaison radio, ECM, and fire control equipment. Observer places APS-23 to STANDBY and turns off APN-76.

2. Fuel Panel - RECHECKED
   Pilot rechecks fuel panel.

3. Air Refueling Lights - adjusted
   Copilot adjusts air refueling lights as required for close range operation.

4. Checklist Complete - ready for contact
   When receiver is stabilized in observation position, copilot states over radio "Receiver ready for contact."

CONTACT AND REFUELING

PILOT PROCEDURES

1. After observing that the boom is lowered and extended, move slowly into contact position as directed by the boom operator. Caution should be used to avoid overrunning tanker. Recommended closure procedure is to move forward and upward simultaneously to a position at the proper elevation, but about 30 feet aft of the contact position, then move straight forward from that position. The receiver pilot will rely primarily upon his visual observations to move into position, and he will obtain confirmation of his visual observations from the boom

COPILOT PROCEDURES

1. After nozzle is inserted in receptacle, check that "Contact Made" light illuminates and "Ready for Contact" light goes out. State over radio "Receiver contact made."
2. Fill tanks in accordance with weight and balance requirements.

NOTE

Fuel will be received at a normal rate of approximately 4000 pounds per minute.

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INFLIGHT AIR REFUELING CHECKLIST

(CONTINUED)

operator's verbal instructions. Since the pilot-director lights are actuated solely by movements of the boom, their indications should be disregarded until actual contact has been established. At night, rate of closure should be slower than for a day contact.

2. When the receiver is stabilized in the optimum position, the boom operator will extend the boom and make the contact. The receiver pilot should then hold the contact position by utilizing the pilot-director lights and the boom operator's verbal instructions to supplement his visual observations. Since rate of acceleration is fast and deceleration is rather slow, it is imperative that any "creeping forward" or "sliding back" be recognized instantly by the receiver pilot and power adjustments made accordingly.
3. The pilot should ask the tanker pilot to increase speed or start a letdown if the receiver control or power is becoming marginal.
4. For all disconnects, planned or inadvertent, the pilot will actuate his disconnect switch.
5. Notify copilot to depress the return-to-ready-for-contact switch as soon as windshield is wiped clean.
6. Disconnects may be made automatically when receiver fuel tanks are full. Disconnects may be initiated by the receiver if less than a full load is required, if a malfunction is suspected, or for training purposes. If a prearranged quantity of fuel is to be transferred, the disconnect will be initiated by the tanker boom operator after the transfer of the planned amount of fuel and the receiver pilot is notified.
7. When fuel transfer is complete and a normal disconnect occurs, the receiver pilot will drop down and back to get well clear of the tanker before proceeding on course.

CAUTION

To prevent an inadvertent stall, the receiver pilot should maintain an airspeed at least 20 knots above stalling speed for that configuration at time of disconnect.

3. Observe fuel quantity indicators and as soon as each tank reaches approximately 1000 pounds from full the copilot advises the pump operator in tanker to reduce refueling pressure to 35 psi. Before each tank is filled, place the corresponding refueling valve switch in VALVE CLOSED position.

CAUTION

The copilot will closely monitor fuel quantity indicators during air refueling. Before each individual tank is filled, the copilot should stop fuel flow to that tank by placing the respective refueling valve switch to VALVE CLOSED position rather than relying on the high level float shutoff system. If high level float switches were to fail it is possible that fuel may be syphoned from the fuel cell and/or failure of affected cell may result. Also the safety factor may not be available if the float switches were to fail.

NOTE

An automatic disconnect will occur as a result of high pressure when all refueling valves are closed.

4. In case of an inadvertent disconnect, the air refueling panel is reset to ready-for-contact by depressing the return-to-ready-for-contact switch. Wait until pilot reports that the windshield is wiped clear; the "Ready for Contact" light should illuminate. In case of a brute force pullout or any other abnormal condition, the copilot will actuate his disconnect switch immediately.
5. For all disconnects, planned or inadvertent, the copilot will actuate his disconnect switch immediately.
6. After all disconnects, the copilot will state over radio "Receiver Disconnect."

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INFLIGHT AIR REFUELING CHECKLIST

(CONTINUED)

POST REFUELING

1. Tanker Clear - CLEAR
   Pilot notifies crew when clear of tanker.

2. Slipway Door - closed
   Copilot places slipway door switch to closed position.

NOTE

During icing conditions, the slipway door and receptacle cavity may accumulate considerable ice; however, the receptacle and slipway door are heated sufficiently to melt the ice and, after a short delay, the door will melt its way closed and the "Slipway Door not Locked" light will go out.

3. Flaps - UP - lever off
   At pilot's request, copilot retracts wing flaps to full up position closely observing flap indicator for complete retraction, then places flap control handle to OFF position.

4. All Refueling Switches - off
   Copilot places all refueling valve switches to VALVE CLOSED position.

5. Air Refueling Selector Switch - off
   Copilot places air refueling system selector switch to OFF position.

6. Air Refueling Valve Lever - closed
   Copilot places air refueling valve lever to CLOSED position.

7. Air Refueling Lights (Night) - off
   If under night conditions, copilot turns air refueling light switches to OFF position.

8. Master Refuel Switch - NORMAL
   Pilot places master refuel switch to NORMAL position.

9. Fuel Gage Control - PILOT
   On airplanes having fuel gage control, pilot places fuel gage control switch to PILOT position.

10. Altimeters - reset - RESET - *reset*
    All crew members reset altimeters.

11. ESP Switch - OFF
    Pilot places engine stall prevention switch to OFF position.

12. Manifold-Not-Purged (Manifold-Not-Drained) Light
    If the "Manifold not Purged" ("Manifold not Drained") light does not go out within 10 minutes after the air refueling valve lever has been placed in CLOSED position, copilot pulls air refueling signal amplifier circuit breaker on the upper DC power panel.

13. Checklist - complete
    Copilot notifies crew upon completion of checklist.

EMERGENCY OPERATION

DISCONNECT SWITCH

After contact is made, it is possible that the tanker signal system may go to disconnect while the receiver system stays in contact-made, thus pulling the receiver in as the boom retracts. In this case, the retraction limit switch on the tanker will not free the receiver. The receiver pilot's or copilot's disconnect switch must be actuated to free the nozzle from the receptacle. When signal coil wire on the tanker boom nozzle is broken or for some other reason the receiver contact-made signal does not reach the tanker, the tanker will remain in "ready for contact" condition when the receiver advances to "contact." For these and other emergencies which might occur, the receiver pilot must be prepared at all times to push his disconnect switch instantly.

BREAKAWAY

The airplane call sign plus the word "Breakaway" three times is used to declare an emergency condition in either the tanker or receiver airplane, and may be announced by any crew member in either airplane. At any time "Breakaway" is announced over the radio, the following action will be accomplished immediately by the crew members as listed:

- Tanker pilot--increase power and climb straight ahead.
- Tanker boom operator--actuate the disconnect switch on tanker boom operator's ruddevator control stick and move boom away from receiver when nozzle is released from receptacle.
- Receiver pilot--actuate disconnect switch on control wheel and reduce power. Drop down and aft of tanker until entire tanker airplane is in sight and receiver airplane is clear of boom. The receiver pilot should use caution not to overrun the tanker. If overrunning does occur, under no conditions should a turn, either right or left, be made.

CAUTION

> To prevent an inadvertent stall, the receiver pilot should maintain an airspeed at least 20 knots above stalling speed for the existing configuration at time of disconnect.

- Receiver copilot--actuate disconnect switch on control wheel and, upon pilot's request, move gear lever to DOWN position to lower gear.

AIR REFUELING SYSTEM

After normal preparation, if the boom nozzle is placed in receptacle and receptacle toggles do not automatically lock the nozzle in place, receiver pilot should drop back to the observation position and copilot should check the air refueling signal system for proper operation and, if necessary, have the observer connect the spare amplifier. If toggles do not lock nozzle in receptacle automatically on the next attempt and it is deemed necessary to make contact, the receiver pilot will advise the boom operator that emergency boom latching will be used. He will request him to hold the nozzle in the receptacle on the next contact. The receiver pilot will then notify the receiver copilot to move the air refueling system selector switch to EMERGENCY BOOM LATCHING when nozzle is in receptacle. Disconnect from emergency boom latching is made by depressing and holding the disconnect switch on the pilot's or copilot's control wheel until the boom nozzle is seen to leave the receptacle. Depressing this switch with the air refueling selector switch in EMERGENCY BOOM LATCHING will cause the windshield wiper to operate at maximum speed until the switch is released. The boom operator is unable to disconnect the receiver toggles during emergency latching.

CAUTION

- Boom position instruments and communications between airplanes must be working properly before emergency operations are attempted.
- With air refueling system selector switch in EMERGENCY BOOM LATCHING, the receiver signal system is bypassed. Holding in the receiver pilot's or copilot's switch will release the receiver toggles, but will not pulse the tanker signal system to "Disconnect." The boom operator must retract his boom independently of receiver action after the receiver toggles are released. Actuation of boom operator's disconnect switch will not release receptacle toggles.
- It is possible to cause structural damage to the air refueling boom and slipway by severe relative movement between the two airplanes when operating with the emergency air refueling system as the limit switches are then deactivated.

SLIPWAY DOOR

In event of failure of electrical circuits controlling hydraulic actuation of slipway door, the slipway door hydraulic valve may be operated manually by means of the emergency slipway door control lever at the observer's station. To open the door, place lever in OPEN position. The lever should be left in OPEN position during the refueling operation since the door valve also controls hydraulic pressure used for the latching toggles.

NOTE

The slipway door switch should be left in SLIPWAY DOOR OPEN position during the refueling operation since that switch also controls the power to the electronic signal amplifier. The switch should be placed in CLOSED prior to manual closing of door.

To close the door, place lever in CLOSE position. When door is fully closed and latched, as indicated by the slipway-door-not-locked light going out, place lever in OFF position.

AIR REFUELING SIGNAL AMPLIFIER FAILURE

In event of failure of the installed air refueling signal amplifier (4, figure 4-26), the electrical connector and cable should be disconnected, the amplifier replaced with the spare air refueling signal amplifier (5, figure 4-26) located on the radio rack behind the observer, and the connector and cable reconnected. The system will automatically be returned to "ready for contact" upon restoration of power.

FUEL OR HYDRAULIC LEAKS

In the event of a fuel or hydraulic leak in the air refueling system of the receiver airplane, a disconnect should be initiated immediately. The flight crew will determine the source of the leak and, if possible, make immediate repairs. If the trouble cannot be remedied, no further contacts will be made.

SLIDING VALVE STICKING

In the event that the sliding valve in the receptacle sticks open, holding the signal switch plunger depressed, the signal system will advance to "contact made" as soon as the return-to-ready-for-contact switch is depressed. The following steps should be taken:

a. Depress disconnect switch and have the observer check that toggles are unlatched. (This is to insure that toggles will be unlatched when boom is inserted.)
b. Move in to contact position and have copilot depress and hold return-to-ready-for-contact switch. Then have boom operator hold nozzle in receptacle. As soon as boom is in receptacle, have copilot release return-to-ready-for-contact switch. Both tanker and receiver systems should advance to "contact made."
c. Using above procedure will permit normal disconnects from tanker and receiver.

RADIO SILENCE

During air refueling operations, tanker and receiver crews normally transmit necessary information by use of radio; however, radio silence refueling can be conducted provided the following precautions and procedures are followed:

a. Both crews must be experienced in normal air refueling procedures.
b. The method, time, and place of rendezvous and the amount of fuel to be transferred must be covered in the briefing of each crew.
c. When using this procedure, radio silence will not be broken except in event of an emergency, or when dropping back to change seats.
d. Radio equipment on both airplanes must be operative and crews on both airplanes must monitor the same frequency during refueling procedures.
e. All precontact air refueling equipment checks will be completed prior to rendezvous. When visual contact is established, both crews will prepare refueling equipment for contact.
f. The receiver will move into observation position as soon as possible. From this position, the receiver pilot can observe any signal given by the boom operator and proceed as indicated:

- Up and down movement of the boom ending in trail position extended 10 feet means that the tanker is ready for contact. The receiver crew should check the signal system and move into contact position. When the receiver is stabilized in normal contact position, the boom operator will make contact by extending the boom and seating nozzle in receptacle.
- Up and down movement of the boom ending in stowed position indicates that there is a malfunction in the tanker that will be fixed shortly. The receiver will remain in the observation position until malfunction is corrected or the receiver pilot deems it necessary to depart.
- Side to side movement of the boom ending in trail position indicates that the tanker is fully operative and requests that the receiver check the air refueling system.
- Side to side movement of the boom ending with the boom in the stowed position indicates that the tanker air refueling system is completely inoperative.

g. After each disconnect, the receiver pilot will hold or return to the normal contact position and watch for any signal given by the boom operator.

- Side to side movement of the boom ending with the boom in the trail position with the nozzle retracted indicates that the prescribed fuel load has been accomplished.
- Upon completion of prescribed fuel transfer (briefed amount of fuel to be transferred or maximum amount the receiver can receive), the boom operator will display to the receiver a white card (18" x 12") indicating the amount of fuel transferred in 100-pound increments.
- After the receiver has been notified (by the white card) of the amount of fuel transferred, the receiver will drop back to clear the tanker before continuing on the assigned mission.

h. Should it become necessary for the tanker to use emergency override, the following signals will be used:

- Boom operator will fully extend boom.
- Receiver pilot will acknowledge by flashing both landing lights.
- Boom operator will retract boom into "Ready" position and stand by for contact.

i. Should it become necessary for the receiver to use emergency boom latching, the following signals will be used:

- Receiver pilot will flash both landing lights.
- Boom operator will acknowledge by fully extending boom, then returning it to "Ready" position.
- Receiver pilot will move into contact position.

NOTE

- If the receiver system is functioning normally, it is not necessary to use emergency boom latching with the tanker in emergency override.
- Except in case of an emergency, emergency override and emergency boom latching procedures will not be conducted without voice contact being established.

j. The need for emergency breakaway by the tanker will be indicated by:

- Tanker increasing power rapidly to maximum and climbing.
- Rapid flashing on and off of pilot director lights.
- Receiver pilot will immediately initiate disconnect.

CAUTION

Receiver pilot must initiate all disconnects during emergency override and emergency boom latching conditions since limit switches and boom operator's disconnect switch will be inoperative.

k. Should the receiver pilot desire breakaway, he will initiate the disconnect, reduce power to idle, and drop behind the tanker.

TRIM COORDINATION SYSTEM

The airplane is trimmed by conventional control knobs and wheels at the pilot's and copilot's stations, regardless of whether surface control power is on or off. Operation of a trim control knob under either condition, however, produces the trim effect in a somewhat different manner. With the control power off, movement of any trim control knob will result in a conventional trim tab being repositioned to give the desired trim. With control power on, hydraulic pressure of 1500 psi is utilized to move the control surfaces. This pressure holds the surface in the position to which it is moved by pilot control, thereby rendering the mechanical trim tab totally ineffective since such a pressure is considerably in excess of the aerodynamic deflection forces exerted by the trim tab. Nevertheless, movement of a trim control knob will trim the airplane by positioning a centering mechanism (called Q-springs for the rudder and elevator and centering spring for ailerons). This mechanism functions just as the name implies: it tends to center the control at any time the pilot may move it from the neutral position. For instance, when the pilot moves the control column aft, a conventional cable system from the control column moves the elevator centering mechanism from its neutral position. (The tendency of the centering mechanism to resist this motion provides the pilot with artificial feel on the flight controls.) The cable motion is transmitted indirectly through the centering mechanism to a metering valve, which admits the necessary hydraulic pressure into a cylinder and linkage arrangement. The cylinder is moved by the hydraulic pressure to reposition the elevator. When the pilot relaxes the back pressure on the control column, the centering mechanism moves the cable system back to neutral, thus centering the control column and the elevator. Since the elevator trim tab will be ineffective with power on, pitch-trim will be determined by the neutral position of the elevator itself, as established by the neutral position of the centering mechanism. Movement of the elevator trim control wheel changes the neutral position of the centering mechanism, and the elevator will move in relation to any new neutral position of the centering mechanism. Such a repositioning of the elevator will, of course, result in a new pitch-trim attitude of the airplane. As the pilot moves the elevator trim control wheel to retrim the elevator during power-on flight, the trim tab also moves but has no effect. But if the surface control power system were suddenly to fail or to be turned off, the trim tab would become effective immediately to position the elevator. Now, if any appreciable difference existed between the original position to which the tab would trim the elevator and that to which the centering mechanism would trim the elevator, the transition from power on to power off would result in a rapid and violent reaction. This would occur as the elevator moved to the new position determined by the trim tab. (The principles of control surface operation as described here for the elevator are essentially the same for each aileron and the rudder.) In order to avoid such a hazardous condition, a trim coordination system is employed to establish the closest possible relationship between the positions of a control surface as determined by either its centering mechanism or its trim tab. The system consists of four electric motor-driven actuators, each controlled by a switch at the pilot's station. The problems of production and maintenance make it virtually impossible to perform this coordination through ground calculations and adjustments. It is therefore necessary that a flight trim coordination procedure be accomplished not only during production test flights, but also after any flight control rigging, adjustment, or other change has been made. This coordination of

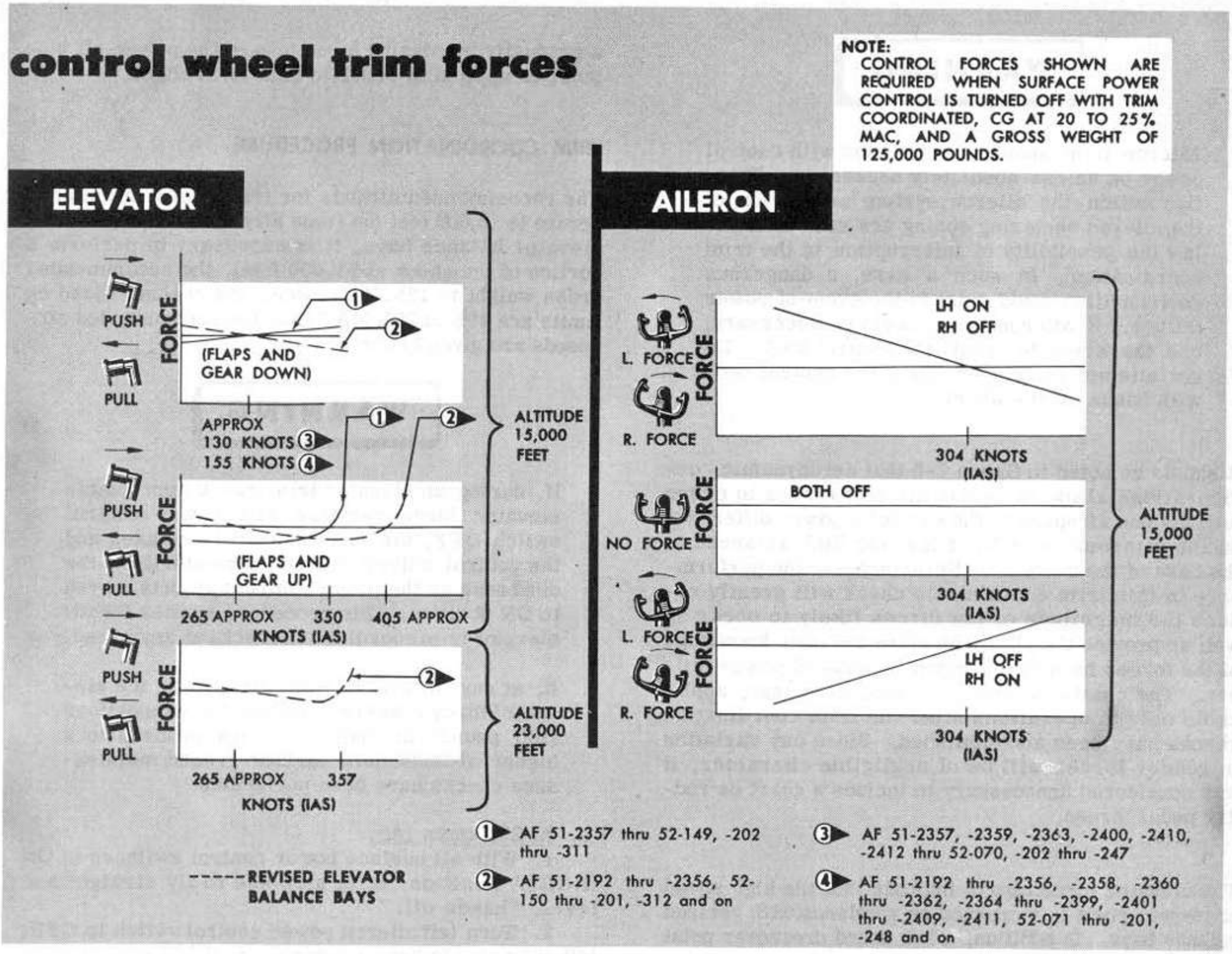

Figure 7-5.

trim tab and centering mechanism is achieved by means of the trim coordination switches. Once the desired trim has been established for control power on, the power control system for each control surface is turned off for individual trimming. Then, by positioning the corresponding trim coordination switch for the desired direction of trim, the actuator is energized to reposition its trim tab, but without affecting the position of that trim tab control knob or centering mechanism.

NOTE

The trim tab coordination actuators allow a movement of 2° in each direction on airplanes without revised elevator balance bays. On airplanes with revised elevator balance bays, the movement available is 4° in each direction. In most cases, this range will be quite adequate to reach a suitable coordination between tab and spring. In some instances however, it may be found that forces remain unequal at the limit of travel of the actuator and at the recommended airspeed. In such an event, trim may be completed with manual control, but it is especially important that the pilot record the units of control knob movement required to complete the trim. With this information, it will be possible for maintenance personnel to make the necessary adjustment for more effective coordination.

When this coordination has been completed for each control surface, the trim tab and centering mechanism will be in such a relationship as to maintain the control surface in the same approximate position, whether control power is on or off. In this manner, excessive forces on the control surfaces are avoided when control power changes are made.

WARNING

Aileron trim should not be used with control power on unless absolutely necessary. Friction within the aileron system and action of the aileron centering spring are such as to allow the possibility of interruption to the trim coordination. In such a case, a dangerous roll condition could exist in the event of power failure. If aileron trim should be necessary, use the wheel to "lead" the control knob. Do not attempt to trim by using the control knob with hands off the wheel.

It should be noted in figure 7-5 that aerodynamic considerations allow an equalization of forces to occur for only one airspeed in the case of a power difference on the ailerons, and for a low and high airspeed in the case of the elevator. Nevertheless, the performance of this trim coordination check will greatly reduce the magnitude of the forces likely to occur as well as provide the pilot with more accurate knowledge of the forces he may anticipate in case of power failure. The charts in figure 7-5 are, of course, applicable only to operations after the trim coordination checks have been accomplished. Since any variation in rudder forces will be of negligible character, it was considered unnecessary to include a chart on rudder pedal forces.

The elevator force charts indicate that the high speed crossover point is increased on airplanes with revised balance bays. In addition, a low speed crossover point has been introduced by this revision. The exact value of the low crossover speed will vary among airplanes. However, the value and variation among airplanes are not considered important because trim coordination is not performed at the low crossover speed and out-of-trim forces at the low crossover speed are small.

Loss of elevator power control during air refueling will not cause excessive pitching of the airplane regardless of the elevator balance bay configuration. Under normal air refueling conditions with flaps extended 20%, the low speed crossover point is decreased and resulting out-of-trim forces are light.

From the aileron charts, it may be seen that at low to medium airspeeds, the loss of control power on one side will result in a wing heavy condition on that side. A force in a direction away from the side on which the power loss has occurred will be required to hold a level flight attitude. This force gradually diminishes until the aileron trim forces crossover point of approximately 304 knots IAS is reached, at which time the aileron forces will become zero if power fails on one side only. Above the crossover point, the wing on the power-off side becomes lighter, and a gradually increasing force toward the power-off side must be applied in order to hold level flight.

TRIM COORDINATION PROCEDURE

The recommended altitude for trim coordination procedure is 15,000 feet (on some airplanes having revised elevator balance bays, it is necessary to perform a portion of the check at 23,000 feet), the recommended gross weight is 125,000 pounds, the recommended cg limits are 20% to 25% MAC, and the recommended airspeeds are given below:

WARNING

If, during an elevator trim check appreciable elevator force remains with power control switch OFF, the force should be relaxed and the control column moved momentarily to the dead zone as the power control switch is moved to ON position. This procedure applies for all elevator trim coordination checks at any speed.

If, at any of the following airspeeds, the elevator forces assume excessive proportions (100 pounds or more), do not proceed to a higher altitude until further ground maintenance checks have been performed.

a. At 250 knots IAS:

1. With all surface power control switches in ON (NORM) position, trim airplane to fly straight and level, "hands off."

2. Turn left aileron power control switch to OFF; left wing should have a control wheel force of 10 to 20 pounds or less (estimated) to raise left wing. If force appears to be greater than 20 pounds or less than 10 pounds, move left aileron tab coordination switch to RAISE or LOWER LH WING position until force is adjusted to approximately 20 pounds (estimated), and turn left aileron power control switch back to ON (NORM).

3. Turn right aileron power control switch to OFF; right wing should have a control wheel force of 10 to 20 pounds or less (estimated) to raise right wing. If force appears to be greater than 20 pounds, move right aileron tab coordination switch to RAISE or LOWER RH WING position until force is adjusted to approximately 20 pounds (estimated) (figure 7-5).

4. Turn left aileron power control switch OFF. With both aileron power control systems off, forces will be zero if properly equalized in steps "2" and "3" above.

NOTE

The ailerons should not be trimmed individually to zero force at this time. The purpose of a check at this airspeed is to ascertain that no uncontrollable forces exist before going to higher airspeeds.

5. Record rudder and elevator trim with rudder-elevator power control switch in ON (NORM), then switch to OFF position. On airplanes without revised elevator balance bays, the elevator force may be zeroed at a lower airspeed or the pull force (20 to 30 pounds) may be allowed to remain. On airplanes with revised elevator balance bays, the elevator force should be zeroed with the elevator trim coordination switch. Rudder trim coordination switch will be used to trim out any yaw tendencies.

b. At 304 knots IAS:

1. With all surface power control switches in ON (NORM) position, trim airplane to fly straight and level, "hands off." Make certain no yaw tendencies are evident. Check to see that thrust is equal on both sides since unequal thrust would affect lateral trim. Shake all controls slightly to eliminate effect of cable friction and to insure accurate trim.

2. Turn left aileron power control switch to OFF, use left aileron tab coordination switch to zero any force which might be present, and turn power control switch back to ON (NORM).

3. Turn right aileron power control switch to OFF and use right aileron tab coordination switch to zero any force which might be present.

NOTE

If unable to attain satisfactory trim with full travel of actuator, continue trimming procedure with aileron trim tab control knob. In such a case, be sure to record number of trim tab control knob units required to complete trimming.

4. Turn left aileron power control switches to OFF. With both aileron power control systems off, forces should be equal. If any force should be noticeable on control wheel to hold wings level, repeat steps "2" and "3" above until zero force is obtained with both aileron power control switches OFF.

NOTE

- Any out-of-trim condition which remains if steps "2" and "3" have been properly completed will probably be due to inaccurate trim with power control on.
- Tolerance on aileron trim indicator reading for trimmed condition is ±1 unit of trim with power control system on.

When forces are neutralized, turn aileron power control switches back to ON (NORM); aileron forces should be zero with either or both aileron power control systems on or off at this speed only.

WARNING

If it appears impossible to zero any particular control force, additional maintenance checks should be made before proceeding to higher speeds for such forces may prove to be uncontrollable. In questionable cases, forces may be checked at successive 25-knot increments until more definite characteristics can be recognized. It will generally be possible however, to zero all forces by using the normal procedure.

5. Check rudder and elevator as previously instructed and trim out any yaw force with rudder trim coordination switch. Elevator may be trimmed out with 10 to 20 pounds pull-force left on.

c. At 350 knots IAS: (1)

CAUTION (2)

Due to a flight limitation of 310 knots maximum IAS, the rudder-elevator trim coordination flights should be performed at 26,500 (±100) feet rather than 15,000 feet, and at 310 knots IAS rather than 350 knots IAS. The forces present on the rudder and elevator at 26,500 (±100) feet and 310 knots IAS will be the same as those present at 15,000 feet and 350 knots IAS. With the exception of these differences, the normal trim procedure may be followed.

Check elevator forces as previously instructed; at this speed, they should be equalized (figure 7-5). If force is experienced with control power off, it should be trimmed out by means of elevator tab coordination switch. If it becomes necessary to use manual trim in addition to that provided by trim tab actuator, record number of trim tab control wheel units required.

NOTE

Tolerance on rudder trim indicator reading for trimmed condition is ±1/2 unit of trim with power control system on.

c. At 357 knots IAS: (3)

This rudder and elevator check is performed at 23,000 feet. Use same procedure as outlined in step "c" above (350 knots IAS).

(1) AF 51-2357 thru 52-149, -202 thru -311
(2) AF 51-15804 thru -15812, 52-019 thru -053, -202 thru -244
(3) AF 51-2192 thru -2356, 52-150 thru -201, -312 & on

d. When proper trim coordination has been established, each actuator motor power plug must be removed from the power source and plugged into dummy receptacle adjacent to actuator. This measure will preclude possibility of inadvertent variations in trim coordination during normal flight operation.

AUTOMATIC PILOT

GROUND CHECK OF THE AUTOMATIC PILOT

The following check should be coordinated with a qualified ground observer prior to the first flight after any adjustment or replacement of automatic pilot components has been accomplished.

a. Connect external DC power to the airplane. (1)

Connect external AC power to the airplane.

b. Streamline controls.

c. Extend automatic pilot controller support.

d. Place turn knob in detent, automatic approach switch on AUTOMATIC PILOT position, turn control transfer switch on PILOT or PILOT MANUAL position, and bank angle limiter selector* in MAX position. (2)

Place main inverter switch in ON position. Place inverter transfer switch in the NORMAL position and place the main inverter switch ON.

e. Within approximately 3 minutes after the inverter is on the automatic pilot master switch becomes unlocked and can be turned to ON. On some airplanes* this warmup period is 4 minutes after AC power is on the airplane. On these same airplanes check the time delay bypass by momentarily pulling the automatic pilot circuit breaker which is supplying AC voltage to the automatic pilot. This will disengage the automatic pilot and lock the automatic pilot master switch in the OFF position. Depress circuit breaker and as soon as the AC power is restored it shall be possible to move the master switch to the ON position if the AC power has not been off for more than 15 seconds.

f. The rudder, aileron, and elevator engage switch levers will now be unlocked and can be engaged. Note that trim indicators are zeroed and move levers to ENGAGED position.

NOTE

The N-1 compass system is operating when the appropriate AC and DC power is available, however the system should be allowed approximately 10 minutes warmup before use.

g. If magnetic slaved operation of the N-1 compass is desired, rotate the latitude correction knob until the latitude correction pointer reads OFF.

NOTE

The system should be synchronized since airplane movement on the ground without power may cause the system to be out of synchronization. The system will automatically synchronize itself, but only at a slow rate which may consume a large amount of time if very far out of snychronization. Manual synchronization eliminates the time required.

h. Engage and rotate the synchronizer knob until the master indicator heading pointer moves approximately 5° clockwise. Observe the action of the rudder pedals of the airplane. The right rudder pedal shall move forward evenly but very slowly (as much as 2 inches of travel in 5 minutes). Observe any erratic action of the rudder until master indicator synchronizes. Repeat for counterclockwise direction of the master indicator heading pointer.

NOTE (3)

In performing steps "g" and "h," the bank angle limiter selector located on the automatic pilot controller shall be in MAX position.

i. Clockwise rotation of the pilot's (or observer's**) turn knob shall cause the aileron wheel to rotate clockwise as the right aileron moves up and the right rudder pedal to move forward as the rudder turns slowly to the right. Return the turn knob to detent; the aileron wheel centers as the aileron returns to neutral. The rudder pedal stops moving forward and neither the rudder pedal nor rudder will return to center automatically. Check both turn knobs on some airplanes**.

j. Counterclockwise rotation of either the pilot's (or observer's**) turn knob shall cause the aileron wheel to rotate counterclockwise as the left aileron moves up and the left rudder pedal to move forward as the rudder turns slowly left. Return the turn knob to detent; the aileron wheel centers as the aileron returns to neutral. The rudder pedal stops moving forward and neither the rudder pedal nor rudder will return to center automatically. Check both turn knobs on some airplanes**.

k. Clockwise rotation of the aileron trim knob shall cause the aileron wheel to rotate clockwise as the right aileron moves up. Center aileron trim knob; aileron wheel should center as the aileron returns to neutral. Repeat for counterclockwise rotation.

l. Rotation of the pitch knob in the "Climb" direction shall cause the control column to move aft and the elevator trim tab wheel to rotate in the nose-up trim direction as the elevator moves up. Returning pitch knob to neutral causes the control column and elevator trim tab wheel to return to center as the elevator returns to neutral.

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(1) AF 52-1417, 53-1819 thru -2170, 53-2279 & on
(2) AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-226 thru -2278
(3) * AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
* * AF 51-2357 thru 52-176, -202 thru -330 and -394 thru -535

m. Rotating the pitch knob in the "Glide" direction shall cause the control column to move forward and the elevator trim tab wheel to rotate in the nose-down direction as the elevator moves down. Returning pitch knob to neutral causes the control column and elevator trim tab wheel to return to center as the elevator returns to neutral.

n. With flaps down, pull back on the control column and hold pressure until the elevator trim tab wheel stops at approximately 4 units (for 7 units★) of nose-down trim. To save time, disengage the elevator engage switch and manually rotate the elevator trim wheel to approximately 3 units of nose-down trim. Reengage the elevator and again pull back on the control column.

o. While the flaps are down, move the control column forward holding pressure until the trim tab wheel rotates in the nose-up direction. The trim tab wheel should continue to rotate when the elevator trim meter shows approximately one needle-width deflection. The trim tab wheel should stop at approximately 8 units of nose-up trim. To save time, disengage the elevator engage switch and manually rotate the elevator trim wheel to approximately 6 units of nose-up trim. Reengage the elevator and again move the control column forward.

p. With rudder trim zero and pedals at neutral, rotate the pilot's turn knob quickly in the clockwise direction to its maximum displacement concurrently restraining the aileron from hitting the aileron limit switch. The bank angle limiter selector ★★ shall be in MAX position. The right rudder pedal shall drive forward until the rudder limit switch is reached and the automatic pilot disengaged. Repeat for a counterclockwise rotation of the turn knob.

NOTE

The time to reach the rudder limits in one direction has no correlation with the time to reach the rudder limits in the opposite direction. The rudder may not drive to the limits in a reasonable amount of time, but observe that the rudder deflects initially in the above indicated direction.

(1)

q. Rotate the pilot's turnknob clockwise displacing the aileron wheel approximately 80°. Position the bank angle limiter selector to its minimum position and note that the aileron wheel displacement decreases. Repeat for a counterclockwise rotation of the turn knob. Return the bank angle limiter selector to its maximum position. With the automatic pilot turned on but not engaged, move all control surfaces 5° to 10° from neutral and then engage. There should be no perceptible control surface movement. Disengage and return control surfaces to neutral.

r. Reengage and manually overpower each servo. It is not necessary to overpower to the limit switches.

s. Check limit switch action as follows:

(1) Disengage each axis.

(2) Rotate aileron wheel clockwise to approximately 100° of wheel travel and try to engage the aileron axis; the engaging switch should be locked in DISENGAGE position. Move wheel back to less than 100° of wheel travel; the engaging switch can be moved to ENGAGE position. With the automatic pilot engaged and the automatic approach switch in the AUTOMATIC pilot position overpower the aileron wheel through 100° of wheel travel and the automatic pilot shall not disengage. Return wheel to neutral position and disengage the aileron axis. Repeat in the counterclockwise direction.

(3) Push right rudder pedal forward to approximately 4.5 inches of travel and try to engage the rudder axis; the engaging switch should be locked in DISENGAGE position. Return pedal to less than approximately 4.5 inches; the engaging switch can now be moved to ENGAGE position. Disengage the rudder axis and repeat in the left rudder direction.

(4) With flaps full down, pull control column aft to the full travel position and try to engage the elevator axis; the engaging switch should be locked in DISENGAGE position. Move control column forward just less than full column travel; engaging switch can be moved to ENGAGE position. Disengage the elevator axis and repeat in the full forward direction.

(5) Retract flaps to full up. (Up-elevator limit switch positions vary with elevator trim. Down-elevator limit switch position is fixed at approximately 4° down elevator, approximately 3 inches control column travel, and does not vary with elevator trim.)

(a) Zero the pilot's pitch trim wheel and reengage the elevator axis.

(b) Pull aft on the control column; the engage switch should drop to DISENGAGE position at approximately 2 inches of control column travel and should remain locked in DISENGAGE position until the column is moved forward.

(c) Reengage the elevator axis and push forward on the control column; the engage switch should drop to DISENGAGE position at approximately 3 inches of control column travel and should remain locked in DISENGAGE position until the column is moved aft.

(d) Set the elevator trim indicator at four units nose-up direction. The up-elevator limit becomes noticeably greater. The down-elevator limit remains unchanged.

(6) Leave flaps in the full-up position.

t. Turn on the ARN-14 radio and tune to the frequency of the local ILS or omni-range station. The green "Ready" light on the approach controller will illuminate only in localize frequencies. (The localizer needle of the crosspointer on the ID-249 will probably indicate a full fly-right or fly-left if the local station is operating.)

★ AF 51-2192 thru -2356, 52-071 thru -201, -261 thru -393, -462 & on
(1)★★ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

(1) Turn on the automatic pilot master switch and then engage each servo; also engage the altitude control switch. (The elevator may show some slight movement of either fly up or fly down within approximately 5 seconds after engaging the altitude control switch.) With the altitude control engaged, movement of the climb-glide knob shall produce no elevator motion.

(2) Switch to the LOCALIZER position on the approach controller; the aileron and rudder will move in the direction indicated by the ID-249. With the aileron wheel displaced appreciably by the ID-249 signal, move the bank angle limiter selector from MAX to MIN and the aileron wheel position should not be affected.

(3) Switch to the APPROACH position; the altitude control switch will drop to OFF and the aileron travel will be reduced from that for the LOCALIZER position. In the APPROACH position, movement of the glide-climb knob will produce no motion of the elevator.

(4) In the APPROACH position, disengaging any axis or rotating the turn knob out of detent will disengage and turn off the automatic pilot.

(5) In the LOCALIZER position, the elevator axis may be disengaged without causing the automatic pilot to turn OFF. Disengaging either the aileron or rudder or rotating the turn knob out of detent will cause the automatic pilot to disengage and turn OFF.

u. With automatic pilot master switch ON, all axes engaged, and the pilot's and observer's turn knob in detent, the turn control transfer switch may be moved to BOMBARDIER or K BOMB AUTOMATIC position. The following checks may be made:

(1)
- The operation of the observer's turn knob should be the same as that obtained with the pilot's turn knob.

(1)
- The observer may switch to automatic directional control by the "K" bombing and navigation system when the observer's turn knob is in detent by moving the control switch to AUTOMATIC position. The observer's turn control transfer will drop to the MANUAL position when the "K" bombing and navigation system completes its bomb release cycle or when the observer's turn knob is rotated out of detent.

(2)
- The observer's control switch is locked in AUTOMATIC position so that automatic directional control of the automatic pilot by the "K" bombing and navigation system is obtained upon moving the turn control transfer switch to K BOMB AUTOMATIC position. The turn control transfer switch will drop to PILOT MANUAL when the "K" system completes the bomb release cycle.

NOTE (1) (2)

The pilot can always take control of the automatic pilot, regardless of the configuration at the observer's station, by placing the turn control transfer switch to PILOT or PILOT MANUAL position or by rotating the turn knob out of detent.

v. With the automatic pilot ON and engaged, depressing of the pilot's or copilot's release button should cause the automatic pilot to disengage all servos and trip the master switch to OFF.

w. Position automatic pilot master switch to OFF and stow controller support.

FLIGHT CHECK OF THE AUTOMATIC PILOT

The following check should be performed on the first flight after any adjustment or replacement of automatic pilot components has been accomplished:

a. After takeoff, trim airplane for "hands off" flight using the airplane trim tab control. Check that N-1 compass is synchronized for magnetic slaved operation. (Refer to Normal Operation procedure of the N-1 Compass System, section IV.)

b. Turn automatic pilot master switch ON and engage all servos, then press the release button on the pilot's control wheel. The automatic pilot master switch should move to OFF and the engaging switches should move to DISENGAGE.

c. Manually check the controls to ascertain that the automatic pilot has disconnected.

d. Turn automatic pilot master switch ON and engage all servos, then press the release button on the copilot's control wheel. The automatic pilot master switch should move to OFF and the engaging switches should move to DISENGAGE.

e. While flying a normal cruising speed with the automatic pilot ON and servos ENGAGED (and bank angle limiter selector ✱ in MAX position), manually apply transients of 5° and 15° to the roll axis, 3° and 5° to the pitch axis, and 3° and 5° to the yaw axis on both sides of the indicator axes. Check each axis separately, starting with the smaller transients in each case. Response to the smaller transients should be "deadbeat." Response to the larger transients may show a slight overshoot which should not exceed 1° or 2°. There should be no continuous oscillation, hunting, or indication of jitter at any time.

f. Rotate the turn knob to the left and to the right into several positions and during alternately low and high airspeeds. Regardless of the combination of airspeed and bank angle produced, there should be no

(1) AF 51-2357 thru 52-176, -202 thru -330 and -394 thru -535
(2) AF 51-2192 thru -2356, 52-177 thru -201, -331 thru -393, -536 & on
✱ AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on

slipping or skidding characteristics. The ball in the bank-and-turn indicator should remain centered.

g. Rotate the turn knob in either direction a sufficient amount to produce a 20° bank. Manually overpower the ailerons in a direction to increase the bank angle to 35° and hold the airplane in that bank for 10 to 20 seconds; then overpower the ailerons to decrease the bank to 5° and hold for the same period. The ball should remain centered in both tests. Return the turn knob to detent.

(1)

Check the bank angle limiter selector by rotating the selector to MIN position. Rotate the turn knob full travel right or left. The bank angle should be approximately 5°. Rotate the bank angle limiter selector toward MAX position until buffeting is detected. Retard the selector until buffeting is no longer detected.

h. On airplanes* allowing observer manual control place the turn control transfer switch in the BOMBARDIER position and make several turns in each direction, utilizing the turn knob at the observer's station. The turns should be smooth and well coordinated, and the ball remain centered. Place the turn control transfer switch in the PILOT position.

i. Check the operation of the pitch knob and the aileron knob on the flight controller. The return to the normal flight attitude should be deadbeat in all cases.

j. Place the altitude control switch in the ON position (engage only after stabilizing in level flight).

k. Hold the manual elevator trim tab wheel and manually overpower the elevator to cause the airplane to gain (or lose) approximately 200 feet.

l. Release the controls slowly; the airplane should return to the reference altitude.

CABIN PRESSURIZATION SYSTEM

FLIGHT CHECK OF CABIN PRESSURIZATION SYSTEM

The functioning of the cabin pressurization system may be checked during flight. The trend of cabin pressure may be obtained from the chart in section IV under "Cabin Heating, Ventilating and Pressurizing System." Compare the steps listed below with the chart.

DEPRESSURIZATION AND ISOBARIC PRESSURE SCHEDULE CHECK

This check should be performed at 10,000 feet indicated airplane altitude:

a. Pull emergency cabin pressure release handle to full-up position and note cabin and airplane altitudes equalize to 10,000 (±900) feet.

b. A decrease in air velocity and volume from the crew outlets should indicate that ram air system is operating.

c. Push emergency cabin pressure release handle to full-down position and note restoration of cabin altitude to 5000 (±900) feet.

NORMAL PRESSURE SCHEDULE CHECK

Climb to an indicated altitude of 26,500 feet and note that the cabin altitude is 6300 (±900) feet and on airplanes which do not have altimeter correction cards, note that cabin altitude is 6300 (±1500) feet.

NORMAL-TO-COMBAT PRESSURE SCHEDULE CHECK

a. Climb again and establish level flight at an indicated airplane altitude of 35,000 feet and note that when on normal pressure schedule (cabin pressure regulation selector switch in NORMAL), cabin altitude is 10,250 (±1200) feet and for airplanes without altimeter correction cards 10,250 (±2050) feet.

(2)

Place cabin pressure regulation selector switch in COMBAT position and note that cabin altitude rises to 16,900 (±1400) feet (airplanes with no altimeter correction cards 16,900 (±2150) feet).

(3)

Place cabin pressure regulation selector switch in COMBAT position and note that cabin altitude rises to 22,000 (±1400) feet (on altimeter with no correction card 22,000 (±2050) feet).

b. Move the cabin pressure regulation selector switch back to NORMAL and note a decrease in cabin altitude after 10 minutes to 10,250 (±1200) feet (no altimeter correction card is 10,250 (±2050) feet).

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* AF 51-2357 thru 52-176, -202 thru -330 and -394 thru -535
(1) AF 53-1819 thru -1972, -2090 thru -2170, -2315 & on
(2) AF 51-2192 thru 53-1880, -2028 thru -2117, -2261 thru -2385
(3) AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on

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GENERAL

Each flight crew member has alternate duties, other than primary functions, which must be performed to insure successful accomplishment of a mission. The pilot's and copilot's preflight inspections and duties are covered in "Normal Procedures," section II. The observer's and gunner's preflight inspections and duties are covered in this section. Additional duties and responsibilities of flight crew members are assigned in the following text.

CREW COORDINATION

WARNING

Due to the location of the crew stations in the B-47 airplane, actions performed by one crew member are not readily visible to other crew members. Since aileron effectiveness decreases rapidly at high indicated airspeeds, it is possible for a dangerous flight condition to quickly develop with improper monitoring of the airplane attitude. It is imperative that positive measures be taken to insure that safety of personnel and airplane are not jeopardized. Flight attitude of the airplane must be carefully monitored by either pilot or copilot at all times. Prior to accomplishment of any of the following, verbal coordination between applicable crew members will be required when:

- Control of the airplane is transferred between pilot and copilot.
- Control column of either the pilot or copilot is disconnected or reengaged.
- Fuel panel settings or primary control of fuel gages is changed. Prior to changing fuel panel configuration, the pilot will advise the copilot of his intentions.
- A crew member leaves position or goes off interphone or airplane oxygen system.
- Automatic pilot is being engaged or disengaged.
- Automatic pilot control of aircraft is transferred between the observer and pilot.
- Any electrical power source is changed.
- It is necessary for the pilot flying the airplane to make an oxygen check, tune radios, change fuel panel configurations, adjust seat or divert his attention within the cockpit. Control of the airplane then will be given to the other pilot.

All applicable crew members will acknowledge that intended course of action is understood prior to actual accomplishment and will conduct themselves accordingly.

WARNING

- Whenever a change of crew position is necessary, climb to a safe altitude and area before the change is made. Change of seats will not be made with only two pilots aboard the airplane.
- If safety belt is removed in flight or on the ground while changing pilots, be careful that the belt is not thrown over the right side of the seat as the belt end may inadvertently turn off some switches. Care must be taken to prevent inadvertent actuation of automatic operated safety belt.

PILOT	COPILOT	OBSERVER
The pilot (aircraft commander) is responsible for the issuance of instructions governing all phases of flight operation. In addition to his regular function, the pilot will perform the following:	The copilot assists the pilot in the proper flight of the airplane and also acts as gunner. (Refer to gunner's duties, this section.) In addition to his regular function, the copilot will perform the following:	The observer performs all navigation, bombing, photographic, and radar rendezvous functions of the aircrew in coordination with the pilot and copilot. This is accomplished by operation of the radar bombing and navigation system, photographic equipment, radar rendezvous equipment and, in some cases, the periscopic sextant.

NOTE

Among the following checklists, procedures are given for checking the "K" radar bombing-navigation system components such as the AN/APS-23 installed on some airplanes. On other airplanes*, the "K" system with AN/APS-23 is replaced by the MA-7A radar bombing-navigation system with AN/APS-64 for which an operational checklist will be included when available.

MISSION PREPARATION

PILOT	COPILOT	OBSERVER
Attends general briefing.	Attends general briefing.	Attends general briefing.
Coordinates with other crew members on routes, charts, navigation procedures, and targets and supervises the completion of various forms, including Performance Data.	Assists pilot.	Accomplishes flight planning in coordination with copilot, including route planning, celestial precomputation, bombing precomputation, and radar rendezvous planning. Refer to Mission Planning Observer's checklist.
Completes Form 175. Compiles the latest information relative to the flight in order to brief the crew at crew inspection.	Prepares weight and balance form for pilot's signature.	
Attends specialized briefing: Communications, ECM data, gunnery, air refueling, and weather.	Attends specialized briefing with pilot.	Accomplishes target study on assigned targets.
		Attends specialized briefings when applicable.

* AF 51-2194, -2198, -2207, -2222, -2249, -2250, -2252, -2255, -2259, 53-1850 thru -1972, -2104 thru -2170, -2345 & on

CREW INSPECTION

PILOT	COPILOT	OBSERVER
Conducts crew inspection.	Attends crew inspection.	Attends crew inspection.
		Gives time hack and briefs crew on any necessary changes in flight plan.

PREFLIGHT

PILOT	COPILOT	OBSERVER
Enters airplane and performs Interior Preflight Inspection.	Assists pilot.	Upon arrival at the airplane, the observer performs the following: • Exterior inspection. • Interior inspection. • Accomplishes complete preflight of all observer equipment in accordance with checklist. • Reports result of preflight to pilot.
Completes Interior Preflight Inspection. Air refueling system checked if applicable.	Reads to the pilot and observes the checklist on the pilot's command, including the air refueling system if applicable.	
Performs Exterior Inspection.	Assists the pilot with Exterior Inspection.	
Performs Before Starting Engines checklist.	Reads Before Starting Engines checklist.	

BEFORE TAXIING

PILOT	COPILOT	OBSERVER
Starts engines.	Assists in starting engines.	Performs final exterior check, if required, in accordance with Before Engine Start checklist.
Communicates with ground crew during starting of engines to assure that area is clear and fire guards posted.	On airplanes not having constant speed alternators, advances throttles No. 1 and 6 to 52% then resets alternators and notes light out.	
Queries observer to assure entrance door is closed and locked.	Visually checks entrance door.	Checks entrance door to assure that it is closed and locked.
Performs Before Taxiing checklist.	Assists in the Before Taxiing checklist.	Completes check of "K" bombing-navigation system on aircraft power. Refer to Aircraft Power checklist.

BEFORE TAKEOFF

PILOT	COPILOT	OBSERVER
After being cleared by crew chief, obtains taxi clearance from tower and taxies airplane. Performs While Taxiing checklist.	Checks hydraulic pressures. Indicates ready to taxi. Calls out hydraulic pressures and quantities. Helps clear airplane while taxiing.	Accomplishes Pretakeoff checklist.
Performs Before Lineup checklist.	Assists in Before Lineup checklist.	Fastens safety belt and locks shoulder harness.
Performs Before Takeoff checklist.	Assists in Before Takeoff checklist.	
Obtains tower and instrument flight rules clearance if applicable. Lines up and advances throttles to 100%; checks instruments.	Externally checks engines at 100% and checks proper loads and voltages. Takes fuel reading after engines have stabilized and then makes sure control of fuel gages is returned to pilot.	

TAKEOFF

PILOT	COPILOT	OBSERVER
Accomplishes takeoff. Checks for positive airspeed indication, 100% flaps, and engine instruments in proper operation range.	Calls takeoff data speeds.	Records takeoff time; after climb established, notifies pilot of time. Gives initial heading.
Calls for "Gear up." Calls for "Flap up."	Raises gear. Raises flaps and completes Takeoff and Climb checklist. Maintains visual reference and follows through on the controls until 500 feet above the terrain.	

CLIMB

PILOT	COPILOT	OBSERVER
Informs copilot and observer when on initial heading. Gives reading of altimeter and airspeed indicators. Performs oxygen and instrument checks.	Visually checks engines and wings. Performs oxygen and instrument checks.	Places navigation equipment in full operating condition. Monitors aircraft position to make good desired track. Performs oxygen and instrument checks.

LEVEL OFF

PILOT	COPILOT	OBSERVER
Levels off at altitude. Makes appropriate power settings. Starts fuel transfer.	Records engineering data and computes power settings.	Resets BNS for route navigation in accordance with checklist. Records navigational data. Performs oxygen check.

CRUISE

PILOT	COPILOT	OBSERVER
Monitors navigation to keep aware of the airplane position at all times.	Records flight log data and makes necessary position reports.	Performs required navigation and records all navigation data necessary to reconstruct the mission.
Monitors crew's oxygen warning lights and calls for periodic oxygen and instrument checks.	Performs oxygen checks. Makes periodic checks of electrical and hydraulic systems.	Performs necessary inflight maintenance on all navigation and bombing equipment when possible. Provides pilot with necessary data for position reporting.
Communicates with copilot and observer to exchange observations and arrive at decisions.	Assists the pilot in managing airplane.	During instrument flight, uses BNS to monitor weather activity.
Controls cg of airplane by managing fuel. Compares fuel remaining with flight plan prediction.	Assists the pilot in fuel management; records fuel data.	

BEFORE PRE-IP

PILOT	COPILOT	OBSERVER
Pilot or copilot establishes communications as required.		Performs before pre-IP procedures and accomplishes pre-IP checklist in coordination with pilot and/or copilot.
Accomplishes operational check of automatic pilot and makes thorough check of instruments and fuel panel. Coordinates with observer to complete bombing equipment check.		
Pilot or copilot calls out Pre-IP checklist to observer.		
Levels out (if applicable) and maintains stable platform.		
Notes IAS necessary to maintain desired TAS.		
Centers and follows PDI to the pre-IP.		
Makes procedure turn at pre-IP.		

BEFORE IP

PILOT	COPILOT	OBSERVER
Pilot or copilot calls out IP checklist to observer.		Performs IP procedures and accomplishes IP checklist in coordination with pilot and/or copilot.
Maintains constant altitude and airspeed.		
Monitors UHF.		
Recenters PDI when requested by observer and maintains resultant heading until automatic pilot is placed in second station.		

BOMB RUN CHECK

After completing turn over IP and leveling out on bomb run heading, crew members perform the following checklist.

PILOT	COPILOT	OBSERVER
Pilot or copilot reads the bomb run procedure checks to the observer.		Performs bomb run procedures and accomplishes bomb run checklist in coordination with pilot and/or copilot.

AFTER RELEASE

Pilot or copilot coordinates Bombs Away checklist with observer.

PILOT	COPILOT	OBSERVER
Holds bomb release heading until cleared to turn by the observer.		Performs Bombs Away check and post release procedures in coordination with pilot and/or copilot.
Places airplane on new heading.		

CELESTIAL

PILOT	COPILOT	OBSERVER
Transfers automatic pilot to second station on request of observer when PDI is centered.		Performs celestial navigation procedures in coordination with copilot as prescribed in checklist.
Monitors position of airplane at all times.		

AIR REFUELING

PILOT	COPILOT	OBSERVER
Calls for Air Refueling checklist. (Refer to section VII.)	Completes checklists.	Operates radar rendezvous equipment and directs airplane as necessary to effect air refueling rendezvous.
	During refueling, monitors rpm to foresee possible compressor stall.	Monitors airplane position during refueling.
	Checks cg by monitoring elevator trim setting.	Operates emergency refueling equipment if required.

DESCENT

PILOT	COPILOT	OBSERVER
Calls for Before Descent and Before Landing checklists.	Completes Before Descent and Before Landing checklists.	Monitors, by radar, letdown and approach.
		Performs airborne radar letdown and approach, if required, in accordance with checklist.

BEFORE LANDING

PILOT	COPILOT	OBSERVER
Rechecks completion of Before Landing checklist.	Insures completion of Before Landing checklist.	Performs APS-23 turnoff procedure in accordance with checklist at pilot's discretion.
		Fastens and locks safety belt and shoulder harness.

AFTER LANDING

PILOT	COPILOT	OBSERVER
Calls for After Landing checklist.	Completes After Landing checklist.	Completes turnoff and landing checklist.

POSTFLIGHT

PILOT	COPILOT	OBSERVER
Completes Postflight checklist.	Completes Postflight checklist.	Completes Postflight checklist.

OBSERVER'S CHECKLIST

MISSION PLANNING

- BRIEFING . . . . ATTENDED
- GENERAL PLANNING . . . . ACCOMPLISHED
  - WEATHER . . . . CHECKED
  - CHARTS . . . . SELECTED
  - ROUTES . . . . PLOTTED
    - DOG LEGS . . . . PLOTTED
    - TURNS . . . . PLOTTED
    - EMERGENCY FIELDS . . . . ANNOTATED
    - REPORTING POINTS . . . . ANNOTATED
    - CONTROL & DANGER AREAS . . . . ANNOTATED
    - COORDINATES . . . . ANNOTATED
  - SAC FORM I (FLIGHT PLAN) . . . . COMPLETED
- BOMBING PLANNING . . . . ACCOMPLISHED
  - RANGES & SITES . . . . DETERMINED
    - TARGETS & TIMES . . . . DETERMINED
  - TARGET STUDY . . . . ACCOMPLISHED
    - ROUTE STUDY . . . . ACCOMPLISHED
    - COMPLEX STUDY . . . . ACCOMPLISHED
  - TARGET WEATHER . . . . CHECKED
  - SAC FORM I (BOMB DATA) . . . . COMPLETED
  - OFFSET . . . . CHECKED OR COMPUTED
- RADAR PLANNING . . . . ACCOMPLISHED
  - ROUTES . . . . PLOTTED
  - CHART . . . . ANNOTATED
- CELESTIAL PLANNING . . . . ACCOMPLISHED
  - ROUTES . . . . PLOTTED
  - CHART . . . . ANNOTATED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

ASSUMED POSITIONS . . . . PLOTTED

PRECOMPUTATIONS . . . . COMPLETED

GRID PLANNING

CHART . . . . SELECTED

ROUTE . . . . PLOTTED

GRID . . . . CONSTRUCTED AND/OR LABELED

CHART . . . . ANNOTATED

GYRO-GRAPH . . . . PREPARED

PRESSURE PLANNING

SINGLE HEADING . . . . DETERMINED

RENDEZVOUS PLANNING . . . . ACCOMPLISHED

PRIMARY TYPE EQUIPMENT . . . . DETERMINED

TYPE RENDEZVOUS . . . . DETERMINED

ALTERNATE PLANS . . . . DETERMINED

EQUIPMENT SETTINGS . . . . DETERMINED

DESCENT RANGE . . . . DETERMINED

CHART . . . . ANNOTATED

AIRBORNE RADAR APPROACH PLANNING . . . . COMPLETED

APPROACH INFORMATION . . . . OBTAINED

LETDOWN AND GCA PATTERN . . . . STUDIED

PREFLIGHT

RELEASE SYSTEM CHECK — U-2

PRELOADING

GUARDS . . . . POSTED

DD FORM 781 . . . . CHECKED

RINGOUT CERTIFICATES . . . . CHECKED

FUEL LOADING . . . . CHECKED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

TIRES & STRUTS	INFLATION CHECKED
TOWBAR & TUG	IN PLACE
EXTERNAL POWER UNIT	POSITIONED
FIRE EXTINGUISHER	IN PLACE
FIRE GUARD	POSTED
K-2 SLINGS, BOMB DOOR SUSPENSION DEVICE & CURTAIN	IN PLACE
CIRCUIT BREAKERS	CHECKED
BOMB SALVO	IN
SALVO CONTROL	IN
K-2 DOOR CONTROL	IN
BOMB ARMING HEATER CONTROL	IN
U-2 RACK HEATER	IN
RADAR POWER	IN
IFC	OUT
BOMB INDICATOR LIGHT	IN
BOMB ARMING	IN
NORMAL BOMB	IN
ALTERNATE BOMB	IN
IFC (FOUR)	OUT
BOMB PANEL SWITCHES	CHECKED
ALT BOMB DOOR SWITCH	OFF
NORMAL BOMB DOOR SWITCH	OFF
BOMB DOOR RELEASE SWITCH	MANUAL
INDICATOR LIGHT SWITCH	OFF
BOMB POWER SWITCH	OFF
BOMB SALVO SWITCH	OFF
BOMB CONTROL SELECTOR SWITCH	NORMAL

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

PILOT'S SALVO SWITCH	CHECKED OFF
EXTERNAL POWER	CONNECTED
MAIN INVERTER*	ON MAIN
VOLTAGES	CHECKED
"K" SYSTEM	ON
FUNCTION SWITCH	STAB
ALTITUDE SWITCH	OFF
BOMB BAY CONFIGURATION	CHECKED
AIR PRESSURE	CHECKED 1250 PSI
ARMING CONTROL	CHECKED
POSITION	CHECKED
SUPPORTING BOLTS	SECURE
ELECTRICAL CONNECTIONS	SECURE & SAFETIED
U-1 MANUAL ARM KNOB	CHECKED
SAFETYING CABLE	CHECKED
PULLOUT CABLES	INSTALLED & SECURE
U-2 RACK	CHECKED
POSITION	CHECKED
SUPPORTING BOLTS	SECURE
ELECTRICAL CONNECTION	SECURE & SAFETIED
FREEDOM OF OPERATION	CHECKED
RACK	COCKED
RACK	LOCKED
SWAY BRACES	INSTALLED, SAFETIED & RETRACTED
C-9 HOISTS & BEAMS	INSTALLED & SAFETIED
POWER CABLES & CONTROL BOX	IN PLACE & DISCONNECTED
HOIST CHAIN	CHECKED

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

IFI TOOLBOX . . . . INSTALLED, TDC STRAPS ATTACHED

NOSE PLATE STORAGE BRACKET . . . . INSTALLED

BOMB BAY INTERPHONE MIKE . . . . TAPED "HOT"

U-2 RELEASE SYSTEM OPERATIONAL CHECK

POSITION & INTERPHONE CHECK . . . . COMPLETED

OBSERVER . . . . CREW POSITION - ON INTERPHONE

PILOT . . . . CREW POSITION - ON INTERPHONE

COPILOT . . . . BOMB BAY PLATFORM - ON INTERPHONE

SAFETY OBSERVER . . . . IN POSITION - ON INTER-PHONE

GROUND OR LOADING CREW MEMBER . . . . COPILOT'S SEAT - ON INTER-PHONE

(Underlined items indicate action performed)

PILOT COMMAND	COPILOT (or as indicated) RESPONSE	OBSERVER RESPONSE
Alarm Bell in Bomb Bay	OK	
Arm U-1	Arming Control Armed	Armed - Light On
Emergency Bomb Arming Safe Handle	Arming Control Safe	Pulled - Light Out
Arm U-1	Arming Control Armed	Armed - Light On
Safe U-1	Arming Control Safe	Safed - Light Out
Manually Arm U-1	Armed - Arming Control Armed	Light On
Manually Safe U-1	Safed - Arming Control Safe	Light Out
Door Indicator Open		Door Indicator Open
Indicator Light Switch		ON - #3 Indicator Light On Rack Locked Light On Low Pressure Warning Light Off
Locking Wrench	Remove & Stowed	Rack Locked Light Out

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

PILOT	COPILOT (or as indicated) RESPONSE	OBSERVER RESPONSE
Bomb Power Switch		ON
Sec Bric		SELECT & 10 BOMBS - Light On
D-2 Bomb Release Switch	Hook Open	Depressed - #3 Indicator Light Out
Cock U-2 Rack	Cocked	#3 Indicator Light On
External Bomb Door Switch	OPEN (Safety Observer)	
Bomb Door Down Locks	Removed (Safety Observer)	
External Bomb Door Switch	OFF (Safety Observer)	
Hydraulic Interconnect Valve	Open	
Emergency Hydraulic Pump Switch	AUTO NORMAL - Pressure Builds to 3000 Psi (Copilot's Seat)	Bomb Control Power Light Comes On at 2200 Psi
Normal Bomb Door Switch Indicator Locked	Doors Closed	CLOSED - Indicator Locked
D-2 Bomb Release Switch	Hook Remains Closed	Depressed - #3 Indicator Light Remains On
Check That Doors Open Each Time Before Hook Releases	Roger	
Bomb Control Selector Switch		SALVO
D-2 Bomb Release Switch	Doors Open & Hook Open	Depressed
Door Indicator Open		Door Indicator Open
Release Light OK		#3 Indicator Light Out
Bomb Doors Closed Door Indicator Locked	Doors Closed	Door Indicator Locked
Bomb Control Selector Switch		NORMAL
U-2 Rack	Cocked	#3 Bomb Indicator Light On
Salvo Switch SALVO Bomb Door Indicator Open Bomb Release OK	Doors Open & Hook Open	Door Indicator Open #3 Indicator Light Out
U-2 Rack	Cocked	#3 Indicator Light On

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

PILOT COMMAND	COPILOT (or as indicated) RESPONSE	OBSERVER RESPONSE
Alternate Door Switch Door Indicator Locked	Doors Closed	CLOSED Door Indicator Locked
Salvo Switch Door Indicator Open Release Light OK	Doors Open & Hook Open	SALVO Door Indicator Open #3 Indicator Light Out
U-2 Rack	Cocked	#3 Indicator Light On
Bomb Door Closed Door Indicator Locked	Doors Closed	Door Indicator Locked
Set Up for BNS Release		Function Switch NAV Sighting Switch OB Door & Release Switch K-2 AUTO Wind Dials Zeroed ATF 15 SECONDS Trail Zero Forward Sighting Switch Depressed Set for Release
Perform BNS Release PDI Indicator Light On		Function Switch BOMB
Center PDI		Centered
Bombs Away Bomb Release Light OK Door Indicators Checked	Doors Open Hook Open Doors Closed	#3 Indicator Light Out Door Indicators Checked
Bomb Door & Release Switch		MANUAL
U-2 Rack	Cocked	#3 Indicator Light On
Perform BNS Release PDI Centered		Forward Sighting Switch Depressed Function Switch BOMB
TG Zero No Bomb Release Lights Door Indicator Locked	Doors & Hook Remain Closed	Release Light OK #3 Indicator Light On Door Indicator Locked
BNS Off		Function Switch OFF (or STAB)
Emergency Bomb Releases Door Indicator Intermediate	Doors Unlatched & Hook Open	Pulled Door Indicator Intermediate #3 Indicator Light Out
Normal Door Switch Door Indicator Open	Doors Open	OPEN Door Indicator Open

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

PILOT COMMAND	COPILOT (or as indicated) RESPONSE	OBSERVER RESPONSE
Bombing Controls Off Salvo Switch OFF		Bric TRAIN & ZERO Indicator Light Switch OFF Bomb Power Switch OFF Salvo Switch OFF Bomb Control Selector Switch NORMAL
Emergency Hydraulic Pump	OFF (Copilot's Seat)	
External Door Switch	OPEN (Safety Observer)	
Install Locks (or Disconnect Doors)	Installed or Disconnected (Safety Observer)	
External Door Switch	OFF (Safety Observer)	
Spoiler Depressurizing Valve	Open - Preload Pressure	
Hydraulic Interconnect Valve U-2 Air Pressure Proceed with Loading	Closed & Safetied 1200 to 1500 Psi Roger	 Roger

RELEASE SYSTEM CHECK (CONVENTIONAL)

POWER OFF INSPECTION

- DD FORM 781 . . . . CHECKED
- BOMB DOOR LOCKS . . . . INSTALLED
- SPOILER DOOR ACCUMULATOR . . . . 1000 (±100) PSI
- SPOILER DEPRESSURIZING VALVE . . . . OFF
- BOMB DOOR ACCUMULATOR . . . . 1750 (±175) PSI
- HYDRAULIC INTERCONNECT VALVE . . . . OPEN
- CIRCUIT BREAKERS . . . . CHECKED
  - SALVO POWER CONTROL . . . . IN
  - K-2 DOOR CONTROL . . . . IN
- POWER CABLE TO RACKS . . . . CONNECTED
- RACK & SHACKLES . . . . CHECKED
  - BOMB RACKS . . . . SECURE
  - A-5 RELEASES . . . . SECURE
  - SHACKLES . . . . CHECKED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

- CARRYING HOOKS . . . . CHECKED
- TAIL COMPARTMENT . . . . CHECKED
  - BATTERY . . . . CONNECTED
  - SALVO POWER CIRCUIT BREAKER . . . . IN
- POWER ON INSPECTION
  - EXTERNAL AC & DC POWER . . . . CONNECTED
  - INTERPHONE CHECK . . . . COMPLETED
  - RADAR POWER PANEL CIRCUIT BREAKER . . . . CHECKED
    - BOMB INDICATOR LIGHT . . . . IN
    - BOMB ARMING . . . . IN
    - NORMAL BOMB . . . . IN
    - ALTERNATE BOMB . . . . IN
  - BOMB CONTROL PANEL . . . . CHECKED
    - DOOR & RELEASE CONTROL . . . . MANUAL
    - ALTERNATE DOOR CONTROL . . . . OFF
    - NORMAL DOOR CONTROL . . . . OFF
    - BOMB CONTROL SELECTOR SWITCH . . . . . NORMAL
    - BOMB SALVO SWITCH . . . . OFF
    - BOMB CONTROL POWER SWITCH . . . . ON
    - INDICATOR LIGHT SWITCH . . . . ON
  - BRIC . . . . SELECT 10 BOMBS
  - INDICATOR LIGHTS . . . . PUSH TO TEST
  - MAIN INVERTER* . . . . ON - OR MAIN
  - UNREGULATED AC SELECTOR SWITCH* . . . . . . EXTERNAL POWER OR EXTERNAL RH BUS
  - DC VOLTMETER . . . . 26 to 29 V
  - AC VOLTMETER . . . . 110 to 120 V
  - UNREGULATED AC POWER LIGHT* . . . . OUT

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

EMERGENCY HYDRAULIC PUMP . . . . AUTO NORMAL

K-SYSTEM FUNCTION SWITCH . . . . STAB

ALTITUDE SWITCH . . . . OFF

BOMB BAY DOORS . . . . CLEAR

SALVO RELEASE CHECK

BOMB BAY DOORS . . . . CLOSED WITH EXTERNAL SWITCH

A-5 RELEASES . . . . COCKED

OBSERVER'S SALVO SWITCH . . . . SALVO FOR 5 SECONDS

BOMB DOORS . . . . OPEN

A-5 RELEASES . . . . FIRE SAFE

BOMB BAY DOORS . . . . CLOSED (OBSERVER'S ALTERNATE SWITCH)

A-5 RELEASES . . . . COCKED

PILOT'S SALVO SWITCH . . . . SALVO FOR 5 SECONDS

BOMB DOORS . . . . OPEN

A-5 RELEASES . . . . FIRED SAFE

BOMB BAY DOORS . . . . CLOSED (PILOT'S SWITCH)

NORMAL RELEASE CHECK

A-5 RELEASES . . . . COCKED

D-2 BOMB RELEASE SWITCH . . . . DEPRESSED

BOMB DOOR . . . . CLOSED

A-5 RELEASES . . . . NOT FIRED

NORMAL BOMB DOOR SWITCH . . . . OPEN BOMB BAY

BOMB DOOR INDICATOR . . . . OPEN

D-2 BOMB RELEASE SWITCH . . . . DEPRESSED

A-5 RELEASES . . . . ONE LOWER RELEASE FIRED

NORMAL BOMB DOOR SWITCH . . . . CLOSED BOMB BAY

K-RELEASE . . . . INITIATED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

ATF	15 SECONDS
TRAIL	ZERO
WIND DIALS	ZEROED
FORWARD SIGHTING SWITCH	DEPRESSED
FUNCTION SWITCH	BOMB
BOMB DOOR & RELEASE SWITCH	K-2 AUTO (AT TG 20)
RELEASE	CHECKED AT TG ZERO
BOMB DOORS	OPEN
RELEASE LIGHTS	ON, MOMENTARILY
TG METERS	BOTH ZERO
A-5 RELEASES	OTHER LOWER RELEASE FIRES
BOMB DOORS	CLOSED
BRIC	TRAIN & MIN INTERVAL
FORWARD SIGHTING SWITCH	DEPRESSED
FUNCTION SWITCH	BOMB
RELEASE	CHECKED
BOMB DOORS	OPEN
A-5 RELEASES	REMAINING RELEASES FIRE IN SEQUENCE
BOMB DOORS	CLOSE
A-5 RELEASES	COCKED
BRIC	SELECT & 10 BOMBS
BOMB CONTROL SELECTOR SWITCH	SALVO
FORWARD SIGHTING SWITCH	DEPRESSED
FUNCTION SWITCH	BOMB
RELEASE	CHECKED
BOMB DOORS	OPEN
A-5 RELEASES	ALL RELEASES FIRE SIMULTANEOUSLY

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMB DOORS	REMAIN OPEN
FUNCTION SWITCH	OFF
BOMB CONTROL PANEL SWITCHES	OFF OR NORMAL
BRIC	TRAIN & ZERO
BOMB DOOR SAFETY LOCKS	INSTALLED
HYDRAULIC INTERCONNECT VALVE	CLOSED
EMERGENCY HYDRAULIC PUMP	OFF
BOMB RACK POWER CABLES	DISCONNECTED

STATIONS & CREW INSPECTION

EQUIPMENT	DISPLAYED
FORM DD781	CHECKED
TIME HACK	GIVEN
EMERGENCY PROCEDURES	COVERED
EQUIPMENT	LOADED

EXTERIOR INSPECTION

EXTERNAL POWER	FUEL & VOLTAGE CHECKED
PERISCOPE DOME	CLEAN & CHECKED
EJECTION HATCH HANDLE	FLUSH
RADOME	CHECKED
RADAR COMPARTMENT	
CONSTANT SPEED METER SWITCH	ON
TAS CORRECTION	SET
STAB-UNSTAB SWITCH	STAB
CANNON PLUGS	SECURE
ACCESS DOORS	SECURE & HANDLES FLUSH

NOTE

In hot weather, leave lower radar compartment open to cool main inverter on some airplanes.

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMB BAY

SAFETY LOCKS · · · · · · · · · · · · · · · · · · · INSTALLED

SPOILER ACCUMULATOR · · · · · · · · · · · · · 1000 (±100) PSI

BOMB BAY ACCUMULATOR · · · · · · · · · · · 1750 (±175) PSI

RACK POWER CABLE · · · · · · · · · · · · · · · DISCONNECTED

RACK INSTALLATION · · · · · · · · · · · · · · · SECURE

A-5 RELEASES · · · · · · · · · · · · · · · · · · SECURE & COCKED

SHACKLES · CHECKED, PINS IN

BOMBS, FUSES & PINS · · · · · · · · · · · · · · CHECKED, PINS IN

CAMERA COMPARTMENT

CAMERA MAGAZINE · · · · · · · · · · · · · · · · INSTALLED

DARK SLIDE & LENS COVER · · · · · · · · · · · REMOVED

CIRCUIT BREAKERS · · · · · · · · · · · · · · · · IN

CAMERA DOORS · · · · · · · · · · · · · · · · · · OPEN

LENS AND WINDOW · · · · · · · · · · · · · · · · CLEAN

INTERIOR CHECK

WALKWAY

COORDINATE CONVERTER · · · · · · · · · · · · FUSES & AMPLIFIERS CHECKED

STAB UNIT POWER SWITCH · · · · · · · · · · · · ON

INSTRUMENT INVERTER* · · · · · · · · · · · · · ON MAIN, LIGHT OUT

FORWARD WALKAROUND BOTTLE · · · · · · · 400 PSI MINIMUM

SPARE FUSES · · · · · · · · · · · · · · · · · · · CHECKED

SAU & CAU · AMPLIFIERS & CABLES SECURE

SPARE AMPLIFIERS · · · · · · · · · · · · · · · · QUANTITY, TYPE & SECURITY

SPARE BULBS · · · · · · · · · · · · · · · · · · · ADEQUATE SUPPLY

PRESSURE PUMP · · · · · · · · · · · · · · · · · · DESICCANT SERVICEABLE
PRESSURE TO 37"

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

CABLES . . . . SECURE

EJECTION SEAT . . . . CHECKED

a. SAFETY PINS & STREAMER - CHECKED, PINS IN

The automatic opening safety belt initiator does not require a safety pin.

b. LEG BRACES & LATCH TRIGGERS - CHECKED

Check each leg brace lock spring securely installed in each latch trigger handle. Check cable restraint swaged balls in both right and left latch trigger. Check D-ring wire retainer on leg brace torque tube holding D-ring securely in place. The wire retainer should overlap to the point where the sides of the retainer touch or come within 1/8 inch of the D-ring.

c. TORQUE TUBES - CHECKED

Visually check that torque tubes are properly aligned and that the painted side of the torque rod is forward.

WARNING

Do not attempt to take up or check for slack in the torque tubes once the hatch is installed. Inadvertent jettisoning of the hatch during flight may result if the torque tubes have been turned to a nearly unlatched position.

d. INITIATORS - CHECKED

Check all initiator sear pins; make sure the sear pin safety pin groove is not visible outside the initiator housing.

e. WHIFFLETREE - ENGAGED

Check to see that whiffletree engages right and left initiator sear pins.

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

f. CATAPULT INITIATOR SAFETY PIN - INSTALLED

Check that safety pin attached to the hatch static cable is properly installed in the catapult initiator.

g. HATCH STATIC CABLE - ATTACHED

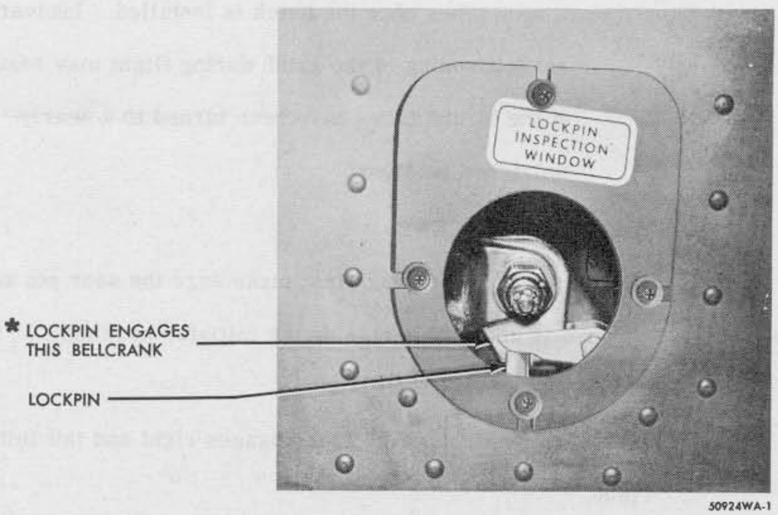
Check hatch static cable secured to the downward ejection hatch.

h. QUICK DISCONNECT - CHECKED

Check proper installation of lanyard from hook to personal leads quick-disconnect mounting.

i. DOWNWARD EJECTION HATCH - LOCKPIN ENGAGED, PRESSURE CHECKED

Check downward ejection hatch for proper installation and hatch lockpin engaged by looking through lockpin inspection window; lockpin should be checked for an extension of about 0.30 inch into the bellcrank cutout.* Check hatch air pressure gage by looking through pressure gage inspection window; gage should read 2000 psi.



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OBSERVER'S CHECKLIST

(CONTINUED)

j. SHOULDER HARNESS AND INERTIA REEL - CHECKED

Manually check shoulder harness and inertia reel for proper operation.

k. SEAT ADJUSTMENT - CHECKED

Check rotation and vertical operation of seat.

(1)► l. AUTOMATIC SAFETY BELT LANYARD HOOK AND EYE - ALIGNED

Position seat facing forward, bottom seat and check that automatic safety belt lanyard hook on the aft left side of the seat is aligned with eye on rail so that hook will engage eye when seat is fired.

m. REPORT TO PILOT - COMPLETED

After completion of ejection seat check report to pilot. "Ejection seat inspection completed."

ESCAPE HATCH . . . . LOCKED

STATION

INTERPHONE CORD . . . . CONNECTED

INTERPHONE JACKBOX . . . . INTER

INTERPHONE MIXER SWITCH . . . . ON, IF APPLICABLE

ALARM BELL . . . . CHECKED

OXYGEN SYSTEM . . . . CHECKED

a. Pilot turns the master oxygen warning control switch ON; then the observer performs the following oxygen check.

b. Check oxygen supply shutoff lever in OFF position and bleed pressure from regulator by depressing emergency toggle lever; pressure should drop to zero and remain at zero when emergency toggle lever is released (returned to neutral).

(CONTINUED ON NEXT PAGE)

(1)►Some B-47B airplanes and AF 52-112 thru -201, -293 thru -497, -508 thru 53-1849, -2028 thru -2103, -2261 thru -2344

OBSERVER'S CHECKLIST

(CONTINUED)

c. Position oxygen supply shutoff lever to ON and check system pressure (400 to 450 psi), except with the liquid oxygen system, the pressure in the system is constant (300 psi) until the liquid oxygen is depleted.

d. Place warning system switch ON; oxygen warning light at that station should come on bright (steady or blinking).

e. Place diluter lever in NORMAL OXYGEN position first and then to 100% OXYGEN position to check oxygen regulator as follows: Blow gently into end of oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a leak or malfunction.

f. With the regulator diluter lever in 100% OXYGEN position; move emergency toggle lever to EMERGENCY position (left or right) to flush the regulator hose; oxygen flow blinker should indicate continuous flow and warning light at that station should momentarily blink and go dim, then return to bright.

g. With emergency toggle lever still in EMERGENCY position, block regulator hose tightly with the hand; blinker should indicate no flow and warning light at that station should continue on bright. A hissing of the regulator or a flow indication will indicate a ruptured regulator diaphragm or other pressure leak. Check hose and hose fitting.

h. Return emergency toggle lever to center (off) position. Plug in oxygen mask. Check quick-disconnect fitting (fitting should separate with a 10- to 15-pound pull).

i. Connect mike cord, place mask on face, and check blinker operation during normal breathing; warning light should go dim and remain dim.

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

j. Deflect emergency toggle lever to right or left. A positive pressure should be supplied to mask. Return emergency toggle lever to center position.

k. Depress emergency toggle lever straight in to TEST MASK position. A positive pressure should be applied to mask. Hold breath approximately 15 seconds to determine if there is a leakage around mask; if no leakage, blinker should indicate no flow. After approximately 10 seconds or less, warning light should come on bright (12 seconds after a 5-minute warmup period during regulator use). A pressure leak will be indicated by a flow indication or a hissing of the regulator. Release emergency toggle lever; positive pressure should cease.

l. Return diluter lever to NORMAL OXYGEN and place oxygen supply shutoff lever and oxygen warning system switch to the OFF positions.

BRIC . . . . TRAIN, ZERO, LIGHT OUT

BOMB DOOR & RELEASE SWITCH . . . . MANUAL

NORMAL BOMB DOOR SWITCH . . . . OFF

ALTERNATE BOMB DOOR SWITCH . . . . OFF

BOMB POWER SWITCH . . . . OFF

INDICATOR LIGHT SWITCH . . . . OFF

SALVO SWITCH . . . . OFF, SAFETIED

BOMB CONTROL SELECTOR SWITCH . . . . . NORMAL, SAFETIED

K-2 HEATER CONTROL SWITCH . . . . NORMAL

TABLE, DOME & INSTRUMENT LIGHTS . . . . CHECKED

NOSE DEFROST . . . . CHECKED

CABIN AIR OUTLET . . . . AS DESIRED

RPP CIRCUIT BREAKERS . . . . CHECKED

30 INVERTER SWITCH* . . . . OFF OR MAIN NORMAL

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

DC VOLTAGE	CONNECTED, CHECKED
REGULATED AC VOLTAGE*	MAIN BUS, CHECKED
UNREGULATED AC VOLTAGE*	RH BUS, CHECKED
APN-76	CHECKED AND ON
UHF	ON
EMERGENCY SLIPWAY DOOR	OFF, OPEN, CLOSE, OFF
RECEPTACLE, FUEL & HYDRAULIC LINES	CHECKED FOR LEAKS
AR ACCUMULATOR PRELOAD	2000 PSI
AR AMPLIFIERS	CHECKED AND SECURE
SIGNAL SWITCH PLUNGER	CHECKED
APN-76	CHECKED WITH GROUND STATION, OFF
N-1 COMPASS	CHECKED & SYNCHRONIZED
AERIAL CAMERA	
CIRCUIT BREAKERS	CHECKED IN
INTERVALOMETER	FUSES & COUNTERS CHECKED
MASTER SWITCH	ON
CAMERA DOORS	OPEN, LIGHT ON
MANUAL OPERATION	CHECKED
INTERVALOMETER POWER SWITCH	ON
MANUAL INITIATION SWITCH	ON, OPERATION CHECKED
INTERVALOMETER POWER SWITCH	OFF
MASTER SWITCH	LEFT ON (FOR HEATERS)
D-2 PERISCOPIC SEXTANT & MOUNT	
TIME DIAL ACCURACY	CHECKED
ALTITUDE AVERAGER ACCURACY	CHECKED
BUBBLE	ADJUSTED
MOUNT AZIMUTH COUNTER ALIGNMENT	CHECKED

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru 52-1416, 52-3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

SEXTANT . . . . INSERTED IN MOUNT & EXTENDED

POWER CABLES . . . . CONNECTED

ILLUMINATION SWITCH . . . . ON, ILLUMINATION CHECKED

MOUNT ALIGNMENT . . . . CHECKED

SEXTANT . . . . RETRACTED (STOWED), PORT CLOSED

MOUNT . . . . DRAINED

EMERGENCY BOMB ARMING SAFE HANDLE . . . . IN PLACE, DOOR CLOSED

EMERGENCY BOMB RELEASE "T" HANDLE . . . . IN PLACE, GUARD CLOSED

K-SYSTEM PREFLIGHT (COMPLETE *AND* MINIMUM PREFLIGHTS)

NOTE

For Minimum Preflight complete Before Engine Start section (Exterior Check), then start this section 20 minutes before scheduled taxi time.

POWER APPLICATION CHECKS

FUNCTION SWITCH . . . . STAB

RADAR POWER SWITCH . . . . STANDBY

RADAR POWER MONITORING PANEL . . . . . . ALL VOLTAGES & FREQUENCIES CHECKED

AC VOLTAGE . . . . WITH AC BLOCK

+26.5 VOLTAGE . . . . DC BLOCK + 1 DIV

30 INVERTER WARNING LIGHT . . . . OUT

COORDINATE CONVERTER . . . . LIGHT ON, NEEDLE CENTERED

SAU TELL-TALE LIGHTS . . . . OUT

MAG VAR CHECK . . . . ZERO, 10E, 10W, SET

PREOPERATIONAL CHECK

LINE OF SIGHT CONTROL . . . . AZ, ZERO DRIFT, 60° SA

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

VARIAC	75 DIV
O-15 POWER SWITCH	OFF
O-23 POWER SWITCH	OFF
METER SWITCH	MAG I
CONTRAST	FULL CCW
RECEIVER GAIN	FULL CCW
ANTIJAM	OFF
TUNING FUNCTION SWITCH	RADAR AFC
SWEEP DELAY	FULL CCW & DEPRESSED
TILT	ZERO
RANGE DIAL	40 NM
OFFSET SWITCH	OUT
RADAR ALTITUDE SWITCH	OFF
SIGHTING SWITCH	PPI
RANGE MARK-CROSSHAIR SWITCH	RANGE MARKS
BIAS	FULL CCW
VIDEO GAIN	FULL CCW
BRILL MARKS	FULL CCW
SECTOR AMPLITUDE	FULL CW, IN DETENT
PERISCOPE DESICCATOR PUMP	OPERATING, DESICCANT SERVICEABLE
RAI POWER SWITCH	ON
RAI BRILLIANCE	FULL CCW
RETICLE LIGHT SWITCH	OFF (DAY), ON (NIGHT)
RETICLE LIGHT RHEOSTAT	FULL CCW (DAY), FULL CW (NIGHT)
POWER CHANGE CONTROL	4X, IN DETENT (OR AS DESIRED)
BOMBSIGHT COVER (CLAMSHELL)	OPEN

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

AUTOPILOT TURN CONTROL ★ . . . . IN DETENT

AUTOPILOT CONTROL SWITCH ★ . . . . MANUAL

LAT & LONG SETTING CONTROLS . . . . IN DETENT

REFERENCE POINT SWITCH . . . . PLANES POSITION

NAVIGATION METHOD SWITCH . . . . NORMAL

POLAR ANGLE DIAL . . . . ZERO

POLE SWITCH . . . . NORTH POLE

TF DIAL . . . . 73.15 SEC

TRAIL DIAL . . . . 4,000 FEET

BOMBING MODE SWITCH . . . . LOS

N-S OFFSET DIAL . . . . ZERO

E-W OFFSET DIAL . . . . ZERO

NOTE

For Minimum Preflight, proceed now to Aircraft Power Check.

APS-23 OPERATIONAL CHECK (COMPLETE PREFLIGHT ONLY)

RADAR POWER SWITCH . . . . SCAN FAST (AFTER 5 MIN)

VARIAC . . . . CW FOR 4.6 MAG I

C-413 METER . . . . VOLTAGES CHECKED

BIAS . . . . CW FOR PAINT SWEEP

VIDEO GAIN . . . . 1/3 TO 1/2 CW

BRILL MARKS . . . . CW AS REQUIRED

SWEEP AMPLITUDE . . . . ADJUST END SWEEP AT PERIPHERY

FOCUS . . . . ADJUSTED

VERT & HORIZ CENTER . . . . ADJUSTED

HEADING MARKER . . . . 360° (±2°)

RANGE LIGHTS . . . . CHECKED, SET

SCALE ILLUMINATION . . . . CHECKED, SET

(CONTINUED ON NEXT PAGE)

★ AF 51-2357 thru 52-176, -202 thru -330, -394 thru -535

OBSERVER'S CHECKLIST

(CONTINUED)

RANGE DIAL	6 NM
BRILL MARKS	FULL CCW
VIDEO GAIN	PED AMP CHECKED, MID POINT
RECEIVER GAIN	CW FOR OPTIMUM
BRILL MARKS	CW AS DESIRED
TUNING FUNCTION SWITCH	RADAR MANUAL
TUNING CONTROL	TUNED FOR OPTIMUM
TUNING FUNCTION SWITCH	RADAR AFC, AFC CHECKED
SECTOR AMPLITUDE	CHECKED (040° to 180°)
SECTOR POSITION	CHECKED THRU 360°
SECTOR AMPLITUDE	FULL CW, IN DETENT
TILT CONTROL	OPERATION CHECKED, RESET
CONTRAST	OPERATION CHECKED, RESET
ANTIJAM	OPERATION CHECKED, OFF

COMPUTER OPERATIONAL CHECK (AFTER FIRST TIMING PERIOD)

POWER APPLICATION

BORESIGHT SWITCH	NORMAL
BOMBING MODE SWITCH	SYNC
RANGE MARKS-CROSSHAIR SWITCH	CROSSHAIR
FUNCTION SWITCH	NAV, TAS INDICATOR CHECKED
CAU/FUSE BOX TELL-TALE LIGHTS	OUT
ALTITUDE CORRECTION CONTROL	20,000 FEET
TRACKING CONTROL	XE & XN DIALS CHECKED, NORMAL SLEW
TRACKING CONTROL	PPI CROSSHAIRS CHECKED, NORMAL SLEW
FIX DIALS	N-O, E-15 OR MORE

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

FUNCTION SWITCH . . . . TRACK

SECTOR WIDTH . . . . 60°

SECTOR VERTEX . . . . 270° (±2°), POSITION NOTED

AZIMUTH MARKER . . . . 90° (±3°), SINGLE AZ MARK NO BACKLASH

CROSSHAIR BALANCE . . . . CHECKED/ADJUSTED

FIX DIALS . . . . N-O, W-15 OR MORE

HORIZ CENTERING . . . . CHECKED/ADJUSTED

FIX DIALS . . . . N-15 OR MORE, E-O

FIX DIALS . . . . S-15 OR MORE, E-O

VERTICAL CENTERING . . . . CHECKED/ADJUSTED

RADAR ALTITUDE CHECK

RADAR ALTITUDE SWITCH . . . . ON, LIGHT ON, OPTICS SA ZERO, VERTEX CENTER OF PPI

RADAR ALTITUDE SWITCH . . . . OFF, LIGHT OFF, OPTICS AND VERTEX NORMAL

FUNCTION SWITCH . . . . NAV

PERISCOPE, FORWARD SIGHTING & LOS CONTROL CHECK

SIGHTING SWITCH . . . . OB

FILTER SELECTOR . . . . CHECKED & CLEAR

RETICLE LIGHT SWITCH . . . . CHECKED NORMAL & SPARE (NIGHT ONLY)

RETICLE COLOR CONTROL . . . . CHECKED RED & WHITE (NIGHT ONLY)

TRACKING CONTROL . . . . C-1 AZ DIAL 030°, SA DIAL 080°

OPTICS FOCUS CONTROL . . . . ADJUSTED

POWER CHANGE CONTROL . . . . AS DESIRED

FORWARD SIGHTING SWITCH . . . . DEPRESSED, OPTICS MOVEMENT CHECKED, AZ DIAL ZERO (±3°), SA DIAL 060° (±6°)

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMBING MODE SWITCH . . . . LOS

CROSSHAIRS . . . . FOLLOW DRIFT & SA CONTROLS

BOMBING MODE SWITCH . . . . SYNC

OFFSET SIGHTING CHECK

FORWARD SIGHTING SWITCH . . . . DEPRESSED

OFFSET SWITCH . . . . IN, LIGHT ON, NO MOVEMENT OF CROSSHAIR

OFFSET SWITCH . . . . OUT, LIGHT OUT

SIGHTING SWITCH . . . . PPI

RANGE DIAL . . . . 15 NM

OFFSET DIALS . . . . 30, 400 N; 30, 400 E

FIX DIALS N-5, E-5

PPI CROSSHAIRS . . . . AZIMUTH & RANGE NOTED

OFFSET SWITCH . . . . IN

PPI CROSSHAIRS . . . . AZIMUTH SAME, RANGE + 7 NM

OFFSET SWITCH . . . . OFF, CROSSHAIRS RETURN

OFFSET DIALS . . . . 30, 400 S; 30, 400 W

FIX DIALS S-5, W-5

OFFSET SWITCH . . . . IN, CROSSHAIRS CHECKED

OFFSET SWITCH . . . . OUT

NAVIGATION CONTROL UNIT & HEADING UNIT CHECK

LAT & LONG COUNTERS . . . . DRIVE CHECKED

LAT & LONG SETTING CONTROLS . . . . CHECKED & RESET LOCAL

MAG VAR . . . . SET LOCAL

FUNCTION SWITCH . . . . TRACK

WIND DETERMINATION SWITCH . . . . MEMORY POINT, LIGHT ON

WIND DIALS . . . . ZEROED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

FUNCTION SWITCH	NAV
RANGE MARKS-CROSSHAIR SWITCH	RANGE MARKS
SIGHTING SWITCH	OB
TRUE HEADING TRANSMITTER	At RECORDED
HEADING MARKER	CHECKED (At ±2°)
RANGE MARK-CROSSHAIR SWITCH	CROSSHAIR
FORWARD SIGHTING SWITCH	DEPRESSED
AZ MARKER	CHECKED WITH HEADING MARKER ±3°

DOUBLE VRM CHECK

TRACKING CONTROL	SLEW FORWARD TO MAX RANGE
FUNCTION SWITCH	TRACK
TRACKING CONTROL	ZERO RANGE, NO DOUBLE VRM
FUNCTION SWITCH	NAV

POLAR NAV UNIT CHECK

POLAR ANGLE DIAL	005°
NAVIGATION METHOD	POLAR, CHECK AT INC 5° (±1/2°)
NAVIGATION METHOD SWITCH	POST POLAR, CHECK At RETURNS TO ORIGINAL VALUE IN 2 MIN
NAVIGATION METHOD SWITCH	NORMAL
POLAR ANGLE DIAL	090°
NAVIGATION METHOD SWITCH	POLAR, CHECK At, HEADING MARKER, TARGETS, C-1 AX DIAL, AND STAB UNIT YOKE MOVE 90° CW. AZ MARK DOES NOT MOVE
POLAR ANGLE DIAL	SET At 360°. CHECK MOVEMENT OF HEADING MARK, TARGETS, AZ DIAL, AND YOKE. CHECK POLAR ANGLE (360° - ORIG At)

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

WIND DETERMINATION CHECK

FORWARD SIGHTING SWITCH	DEPRESSED
OPTICAL CROSSHAIRS	POSITIONED ON TARGET
FUNCTION SWITCH	TRACK
WIND DETERMINATION SWITCH	MEMORY POINT
TRACKING CONTROL	SYNCHRONIZED
WIND DIALS	CHECKED, E-ZEROED, N-TAS ±5K
FUNCTION SWITCH	NAV

RAI CHECK

PPI CROSSHAIR	ON ISOLATED TARGET
RECEIVER GAIN	FULL CCW
FUNCTION SWITCH	TRACK
RAI BRILLIANCE	ADJUST CROSSHAIR
RAI FOCUS	ADJUST CROSSHAIR
HORIZ & VERT CENTER	ADJUST CROSSHAIR
AZ MARK SIZE & RNG MARK SIZE	BALANCED CROSSHAIR
RECEIVER GAIN	OPTIMUM ON RAI
RAI	CHECKED
RADAR POWER SWITCH	SCAN OFF
BOMBING MODE SWITCH	LOS
RAI AZIMUTH SWEEP SIZE	CHECKED
BOMBING MODE SWITCH	SYNC
RADAR POWER SWITCH	SCAN FAST

PPI SWEEP LENGTH ADJUSTMENT

FUNCTION SWITCH	BOMB
FIX DIALS	N-15, E-O
RANGE MARK-CROSSHAIR SWITCH	RANGE MARKS

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

SWEEP LENGTH ADJUSTED	SIXTH 5-MILE FRM AT END OF SWEEP
SWEEP AMPLITUDE	SIXTH 5-MILE FRM AT EDGE OF SCOPE
RANGE MARK-CROSSHAIR SWITCH	CROSSHAIR
FIX DIAL ALIGNMENT (OPTIONAL)	
FIX DIALS	N-3, E-O
TRACKING CONTROL	XN TO ZERO. CHECK APEX MOVES IN AT 2-1/2NM. STOP AT CROSSOVER (OPTICS)
FUNCTION SWITCH	NAV
FIX DIALS	CHECKED ZERO ±.1
BOMBING ACCURACY CHECK (OPTIONAL)	
OFFSET DIALS	N-20,000; E-ZERO
FUNCTION SWITCH	TRACK
WIND DETERMINATION SWITCH	MEMORY POINT
WIND DIALS	SOUTH FOR GS 180K (VA+WS)
WIND DETERMINATION SWITCH	DISPLACEMENT
TRACKING CONTROL	N-5, E-O FIX
At	CHECKED/SET 360°
FUNCTION SWITCH	BOMB: NAV AT RELEASE
FIX DIALS	Xn 3NM ±.1
SIGHTING ANGLE CONTROL (LOS)	42.36°
BORESIGHT SWITCH	SA
BOMBING MODE SWITCH	LOS, CHECK NO MOVEMENT OPTICAL CROSSHAIR. ADJUST SA AS REQUIRED ±1°
SIGHTING ANGLE CONTROL	62.39°
OFFSET SWITCH	IN
BOMBING MODE SWITCH	SYNC-LOS CHECKED NO MOVEMENT CROSSHAIR ±1°

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BORESIGHT SWITCH	NORMAL
OFFSET SWITCH	OUT
BOMBING MODE SWITCH	SYNC

GYRO RANDOM DRIFT CHECK (OPTIONAL EXCEPT ON ACCEPTANCE OK)

TRUE HEADING UNIT	DOUBLE PRECESSION IN 30 MIN
LOCAL APPARENT PRECESSION	COMPUTED, 14.35 - (15 SIN LAT)
RANDOM DRIFT	COMPUTED AND RECORDED

CONSTANT SPEED MOTOR CHECK

FUNCTION SWITCH	TRACK
WIND DETERMINATION SWITCH	MEMORY POINT, START WATCH
WIND DIALS	ZEROED
WIND DETERMINATION WARNING LIGHT	TIME & CHECKED AGAINST TAGGED TIME (4-1/2 MIN ±6 SEC)
WIND DETERMINATION SWITCH	DISPLACEMENT AUTOMATICALLY
FUNCTION SWITCH	NAV

BALLISTICS, BOMB RELEASE & AUTOPILOT CHECK

AUTOPILOT	ON & ENGAGED
UHF	ON, UNUSED CHANNEL
INDICATOR LIGHT SWITCH	ON
BOMB CONTROL POWER SWITCH	ON
BOMB DOOR & RELEASE SWITCH	MANUAL
BRIC	TRAIN & ZERO, LIGHT OUT
FORWARD SIGHTING SWITCH	DEPRESSED
FUNCTION SWITCH	BOMB
TG METER	CHECKED
PDI	CHECKED, CENTERED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

POLAR ANGLE CONTROL	CHECK PDI AND At FOLLOW CHANGES, RETURN At TO AIRCRAFT TRUE HEADING
NAVIGATION METHOD SWITCH	NORMAL
PDI	CENTERED
AUTOPILOT	K-SYSTEM AUTO CONTROL
PDI & AIRCRAFT CONTROLS	FOLLOW TRACKING CONTROL
TRAIL	INC, CHECK TG INC. DEC TO 4,000, CHECK TG DEC
ATF	INC, CHECK TG DEC. DEC TO 73.15, CHECK TG INC
TONE	INITIATE At 20 SEC TG, CHECK LIGHT AND TONE
RELEASE CHECK	TONE & LIGHT OFF. TURN CONTROL SWITCH MANUAL. BOMB RELEASE LIGHT ON. PDI BOMB LIGHT OUT. FUNCTION SWITCH TRACK.
INDICATOR LIGHT SWITCH	OFF
BOMB CONTROL POWER SWITCH	OFF
FUNCTION SWITCH	NAV
SIGHTING SWITCH	PPI
RANGE MARKS SWITCH	RANGE MARKS
AUTOPILOT	OFF & STOWED
UHF RADIO	OFF
RANGE DIAL	10 NM
ALTITUDE DIAL	INCREASE. CHECK FRM DISAPPEARS AT 30,400 ±1,500
RADAR ALTITUDE SWITCH	ON, LIGHT ON, CHECK FRM
ALTITUDE DIAL	RESET 30,400
RANGE MARK-CROSSHAIR SWITCH	CHECK COINCIDENCE FRM & CROSSHAIR RNG MK, LEAVE IN CROSSHAIR

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

ALTITUDE DIAL	RESET 5,000 (IF NO RADAR RANGE CHECK)
RADAR ALTITUDE SWITCH	OFF (IF NO RADAR RANGE CHECK)
RADAR RANGING & BORESIGHT CHECK	
BOMBING MODE SWITCH	LOS
DRIFT KNOB	PPI AZ MK THRU TGT
SIGHTING ANGLE	SET 090°
ALTITUDE CORRECTION CONTROL	PPI RNG MK THRU TGT
SECTOR AMPLITUDE & SECTOR POSITION	SECTOR ABOUT TGT
RAI CROSSHAIR	POSITION REFINED
ALTITUDE DIAL	CHECK SURVEYED RANGE ±90 FEET
OPTICAL CROSSHAIR	ON TARGET IN AZIMUTH ±6 MILS
BOMBING MODE SWITCH	SYNC
RADAR ALTITUDE SWITCH	OFF
ALTITUDE DIAL	RESET
SECTOR AMPLITUDE	FULL CW, IN DETENT
LONG RANGE, SWEEP DELAY & BEACON OPERATIONAL CHECKOUT	
VARIAC	CCW TO 75
RANGE DIAL	80 - 200 NM
VARIAC	CW TO 10.0 ma MAG I. CHECK FOR ARCING
RANGE LIGHTS & FIXED RANGE MARKS	VALUE & SPACING CHECKED
SWEEP DELAY CONTROL	CW, CHECK SD PIP. PULL OUT, CHECK OPERATION & ARCING
RANGE LIGHTS	CHECK SD LIGHT
VARIAC	CCW TO 75
SWEEP DELAY CONTROL	FULL CCW & DEPRESSED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

TUNING FUNCTION SWITCH	BEACON AFC
VARIAC	CW TO 10.0 ma MAG I. CHECK FOR ARCING
XTAL I & TARGETS	XTAL I .1 TO 1.0, RECEPTION NORMAL
VARIAC	CCW TO 75
TUNING FUNCTION SWITCH	RADAR AFC
RADAR DIAL	6 NM
VARIAC	CW FOR 4.6 ma MAG I
C-413 METER	ALL VOLTAGES CHECKED NORMAL
XTAL I & TARGETS	CHECKED NORMAL
O-15 CAMERA PREFLIGHTS	
MAGAZINE	CHECKED & INSTALLED
DIAPHRAGM SETTING	AS BRIEFED (2.8 TO 5.6)
DATA PLATE	COMPLETED, WATCH WOUND & SET (GMT)
FUNCTION SWITCH	NAV
O-15 SELECTOR SWITCH	EVERY OTHER
O-15 POWER SWITCH	ON & OPERATION CHECKED
FUNCTION SWITCH	TRACK, O-15 OPERATION CHECKED
FUNCTION SWITCH	BOMB, O-15 OPERATION CHECKED
O-15 SELECTOR SWITCH	1:4, O-15 OPERATION CHECKED
FUNCTION SWITCH	TRACK, O-15 OPERATION CHECKED
FUNCTION SWITCH	NAV, O-15 OPERATION CHECKED
RECORDING CHAMBER LIGHTS	CHECKED
DATA PLATE	INSTALLED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

O-15 SELECTOR SWITCH	AS BRIEFED (1:4)
O-15 POWER SWITCH	OFF
O-23 CAMERA PREFLIGHT	
MAGAZINE	CHECKED & INSTALLED
DATA PLATE	REMOVED
INTERIOR EXPOSURE COUNTERS	ZEROED
DATA PLATE	COMPLETED, WATCH WOUND & SET (GMT)
EXTERIOR EXPOSURE COUNTERS	ZEROED
MODE SELECTOR SWITCH	RADAR
FUNCTION SWITCH	BOMB
O-15 POWER SWITCH	ON
O-23 POWER SWITCH	ON, OPERATION CHECKED
O-23 POWER SWITCH	OFF
MODE SELECTOR SWITCH	RADAR-OPTICAL
O-23 POWER SWITCH	ON, OPERATION CHECKED
O-23 POWER SWITCH	OFF
MODE SELECTOR SWITCH	OPTICAL
O-23 POWER SWITCH	ON, OPERATION CHECKED
RECORDING CHAMBER LIGHTS	CHECKED
O-23 POWER SWITCH	OFF
O-15 POWER SWITCH	OFF
O-23 MODE SELECTOR SWITCH	RADAR-OPTICAL OR AS BRIEFED
DATA PLATE	REPLACED
SHUTTER SPEED DIAL	AS BRIEFED (1/200)
FUNCTION SWITCH	NAV
K-SYSTEM TURN OFF (OR STANDBY)	
PPI PRESENTATION	CHECKED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

RAI BRILLIANCE	FULL CCW
FUNCTION SWITCH	TRACK
WIND DETERMINATION SWITCH	MEMORY POINT
WIND DIALS	SET TO CLIMB WIND
LAT-LONG COUNTERS	FIELD COORDINATES
FUNCTION SWITCH	OFF OR STAB
MAG VAR	SET TO LOCAL VARIATION
RADAR POWER SWITCH	SCAN SLOW
RADAR POWER SWITCH	SCAN OFF, WHEN TRACE AT 180°
BIAS	FULL CCW
VIDEO GAIN	FULL CCW
RECEIVER GAIN	FULL CCW
VARIAC	CCW TO 75
RADAR POWER SWITCH	OFF OR STANDBY
RADAR PRESSURIZATION UNIT	CHECKED, PRESSURE BLED, SWITCH ON

BEFORE ENGINE START

PERISCOPE DOME	CHECKED
RADAR COMPARTMENT ACCESS DOORS	CLOSED, SECURED, HANDLES FLUSH
BOMB SAFETY PINS	REMOVED
SHACKLE PINS	REMOVED
BOMB RACK POWER CABLE	CONNECTED
BOMB BAY	CLEARED
INDICATOR LIGHT SWITCH	ON, LIGHTS CHECKED

AIRCRAFT POWER CHECK

UNREGULATED AC VOLTAGE (C-413)	CHECKED/ADJUSTED
METER SWITCH	MAG I

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

FUNCTION SWITCH	NAV
RADAR POWER SWITCH	SCAN FAST
VARIAC	CW FOR 4.6 MA MAG I
BIAS	CW TO DESIRED INTENSITY
VIDEO GAIN	CW TO DESIRED SETTING
RECEIVER GAIN	CW FOR OPTIMUM
PPI PRESENTATION	EVALUATED
TRACKING CONTROL	CROSSHAIRS & FIX DIALS CHECKED
FUNCTION SWITCH	TRACK
WIND DETERMINATION SWITCH	MEMORY POINT
WIND DIALS	CHECK/SET CLIMB WIND
LAT-LONG COUNTERS	RESET TO FIELD COORDINATES
FUNCTION SWITCH	STAB, IMMEDIATELY
K-SYSTEM STATUS	REPORTED TO PILOT
BIAS	FULL CCW
RECEIVER GAIN	FULL CCW
VARIAC	CCW TO 75
RADAR POWER SWITCH	STANDBY
MAG VAR	CHECKED/SET TO LOCAL VARIATION
CAMERA MASTER SWITCH	CHECKED ON
CAMERA DOORS	CLOSED, AFTER BOMB DOORS

PRE-TAKEOFF CHECK

OFFSET SWITCH	OUT
RADAR ALTITUDE SWITCH	OFF
RANGE MARK-CROSSHAIR SWITCH	CROSSHAIR

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

SIGHTING SWITCH	PPI
ANTIJAM SWITCH	OFF
SWEEP DELAY CONTROL	FULL CCW & DEPRESSED
RANGE DIAL	30 MILES
OPTICS POWER CHANGE CONTROL	AS DESIRED
FILTER SELECTOR SWITCH	CLEAR
RETICLE LIGHT SWITCH	AS DESIRED
BOMB SIGHT COVER (CLAMSHELL)	CLOSED
BORESIGHT SWITCH	NORMAL
NAVIGATION METHOD SWITCH	NORMAL
BOMBING MODE SWITCH	SYNC
OFFSET DIALS	SET FOR FIRST TARGET
TF DIAL	SET FOR FIRST TARGET
TRIAL DIAL	SET FOR FIRST TARGET
CAMERA MASTER SWITCH	ON, IF CAMERA INSTALLED WHETHER PHOTOGRAPHY SCHEDULED OR NOT
CAMERA DOORS	CHECKED CLOSED

OXYGEN CHECK - OBSERVER REPORTS

a. Oxygen supply shutoff lever - ON

b. Warning switch - ON

c. Don oxygen mask by the following method:

(1) The attachment strap on the mask male connector should be attached to the parachute chest strap by routing the connector strap under the chest strap as close to the center as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector.

(2) Connect the mask-to-regulator tubing female disconnect to the mask male connector, listen for the click, and look to see that the sealing gasket is only half exposed.

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

(3) Attach the alligator clip to the end of the mask male connector strap.

d. Bailout Bottle - CONNECTED

e. Check oxygen flow blinker and hose connections.

f. Report over interphone, "Oxygen check complete; system pressure and warning switch on."

N-1 ORIENTATION & SYNCHRONIZATION . . . . CHECKED

INDICATOR LIGHT SWITCH . . . . CHECKED ON

INTERPHONE JACKBOX . . . . INTER

EJECTION SEAT PINS & STREAMERS . . . . REMOVED

SEAT . . . . ADJUSTED

SAFETY BELT & SHOULDER HARNESS . . . . FASTENED

SHOULDER HARNESS . . . . LOCKED

FUNCTION SWITCH . . . . NAV, 20 SEC PRIOR TO TAKEOFF

INFLIGHT

TAKEOFF TIME . . . . HACKED AND RECORDED

CLIMB

RADAR . . . . RETUNED

D-2 SEXTANT . . . . EXTENDED

ALTITUDE . . . . SET APPROXIMATELY

POSITION . . . . MONITORED

LEVEL OFF

TIME . . . . RECORDED

POSITION . . . . ESTABLISHED

ALTITUDE . . . . MEASURED

WIND . . . . DETERMINED

NAV COUNTERS . . . . RESET

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

DEAD RECKONING

CHART	ANNOTATED
POSITIONS & FIXES	RECORDED
AIRSPEED (TAS)	MONITORED OR COMPUTED
TURN ALLOWANCE	COMPUTED

RADAR NAVIGATION

ALTITUDE	MEASURED
WIND	DETERMINED
FIX (RADAR)	ACCOMPLISHED
FIXING (BEACON)	ACCOMPLISHED
VARIAC	CCW TO 75
TUNING FUNCTION SWITCH	BEACON AFC
VARIAC	CW FOR MAG I OF 10.0 MA
SWEEP DELAY RANGE	SET
FIX POSITION	DETERMINED
STATION KEEPING	
REFERENCE CROSSHAIR	SET UP
BOMBING MODE SWITCH	LOS
BORESIGHT SWITCH	NORMAL
DRIFT CONTROL	SET BEARING OF REF AIRCRAFT
FUNCTION SWITCH	NAV
RADAR ALTITUDE SWITCH	ON
ALTITUDE CORRECTION CONTROL	SET RANGE OF REF AIRCRAFT
RG MK CROSSHAIR SWITCH	CROSSHAIR
APS-23	TUNED
AIRCRAFT	POSITIONED
STATION	MAINTAINED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

CELESTIAL NAVIGATION

- COMPUTATIONS . . . . ACCOMPLISHED
- AIRCRAFT STEERING . . . . SET UP
  - N-1 . . . . UNSLAVED
- ALTITUDE (Ho) . . . . DETERMINED
  - PRECOMP ALTITUDE . . . . SET
  - PRECOMP AZ . . . . SET
  - COLLIMATION . . . . MAINTAINED
- TH (D-2) . . . . DETERMINED
  - AZIMUTH . . . . SET IN AZIMUTH COUNTER
  - BODY . . . . COLLIMATED
  - TH . . . . READ
- SIGHTING ERRORS . . . . DETERMINED
- FIXES . . . . EVALUATED
- MPP'S . . . . EVALUATED

GRID NAVIGATION

- BEGINNING POLAR NAVIGATION
  - POLAR ANGLE DIAL . . . . SET
  - POLAR SWITCH . . . . SET
  - NAV METHOD CONTROL . . . . POLAR
  - GRID HEADING . . . . CHECKED
  - POSITION COUNTERS . . . . SET TO GRID
  - COMPASS . . . . UNSLAVED
  - WIND DIALS & POSITION COUNTERS . . . . SET TO GRID
  - GRID HEADING . . . . RECHECKED
- DURING POLAR NAVIGATION
  - WIND RUNS . . . . ACCOMPLISHED
  - HEADING CHECKS . . . . ACCOMPLISHED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

LAT CONTROL (N-1) . . . . RESET

GYROS . . . . RATED

ENDING POLAR NAVIGATION

EXIT POINT . . . . DETERMINED

COMPASS . . . . SLAVED

POSITION COUNTERS . . . . RESET

POLAR ANGLE . . . . RESET

NAV METHOD SWITCH . . . . POST POLAR

WIND DIAL & POSITION COUNTERS . . . . RESET

TRUE HEADING . . . . CHECKED

GYRO GRAPH . . . . MAINTAINED

PRESSURE PATTERN NAVIGATION

PLOPS

ZN . . . . DETERMINED

PLOPS . . . . PLOTTED

BELLAMY DRIFT

DRIFT . . . . DETERMINED

RADIO AIDS TO NAVIGATION

CONSOL

DR POSITION . . . . ESTABLISHED

LOP NUMBER . . . . DETERMINED

LOP . . . . PLOTTED ON CHART

NOTE

If bombs have been carried visually check bomb bay before first RBS or camera run.

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMBING

BEFORE PRE-IP PROCEDURE

BOMB EQUIPMENT CHECK

- SAFETY CHECK . . . . COMPLETED
- BOMB DOOR & RELEASE SWITCH . . . . MANUAL
- BRIC . . . . TRAIN & ZERO (LIGHT OUT)
- BOMB CONTROL SELECTOR SWITCH . . . . WIRED NORMAL
- BOMB SALVO SWITCH . . . . WIRED OFF
- SIGHTING SWITCH . . . . OB
- FORWARD SIGHTING SWITCH . . . . DEPRESSED
- FUNCTION SWITCH . . . . BOMB
- TG METER . . . . CHECKED
- ATF SETTING CONTROL . . . . CHECKED
- TRAIL SETTING CONTROL . . . . CHECKED
- PDI . . . . CENTERED
- AUTO PILOT CONTROL . . . . AUTOMATIC
- PDI & AUTOPILOT . . . . CHECKED
- INDICATOR LIGHT SWITCH . . . . CHECKED ON
- BOMB POWER SWITCH . . . . ON
- UHF RADIO . . . . UNUSED CHANNEL
- TONE CONTROL . . . . ON
- RELEASE CHECK . . . . COMPLETED
  - RELEASE LIGHT . . . . ON, (MOMENTARILY)
  - TONE . . . . OFF, LIGHT OUT
  - AUTOPILOT CONTROL SWITCH . . . . MANUAL
  - FUNCTION SWITCH . . . . TRACK
  - PDI LIGHT . . . . OFF
  - BOMB POWER SWITCH . . . . OFF

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

AUTOPILOT CONTROL	TO PILOT
FUNCTION SWITCH	NAV
CROSSHAIRS	SET
OFFSET SWITCH	IN - OUT
RADAR RECEPTION	RETUNED
ALTITUDE	MEASURED
WIND RUN	COMPLETED
IAS ON BOMB RUN	DETERMINED
SAC FORM I	COMPLETED
BALLISTICS	SET
OFFSET COMPONENTS	SET
HOMING ON PRE-IP	ACCOMPLISHED
PROCEDURE TURN	COMPUTED
HOMING ON PRE-IP	REFINED
WIND RUN ON PRE-IP	ACCOMPLISHED
NAV COUNTERS	SET ON PRE-IP
PROCEDURE TURN	COMPLETED
MAG VAR	SET
PRE-IP CHECK LIST	CALLED OVER INTERPHONE

PILOT AND/OR COPILOT	OBSERVER
COMPASS	UNSLAVED
CAMERA DATA PLATES	COMPLETED
AERIAL CAMERA INTERVALOMETER & DOORS	SET & OPEN
OXYGEN CONTROL	100%
LOCAL VARIATION	SET ________
LAT & LONG COUNTERS	RESET
ALTITUDE	MEASURED & COMPUTED
TAS CHECK	HOLD ________ IAS

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BALLISTICS	TF__________SEC
	TRAIL________FT
OFFSET DATA	(N-S)__________FT
	(E-W)__________FT
BOMBING MODE SWITCH	SYNC
O-15 CAMERA	ON 1:4 (50 NM FROM IP)

IP PROCEDURE

WIND RUN ON IP . . . . ACCOMPLISHED

POSITION COUNTERS . . . . RESET

IP TURN . . . . COMPLETED

MAG-VAR . . . . CHECKED

IP CHECK LIST . . . . CALLED OVER INTERPHONE

PILOT AND/OR COPILOT	OBSERVER
BRIC	SELECT AND 10 BOMBS
BOMB POWER SWITCH	ON
INDICATOR LIGHT SWITCH	CHECKED ON
U-2 LOW PRESSURE LIGHT	OUT
DROP CONTROL SWITCH	DELAY
U-1 ARMING SWITCH	ARMED
U-2 RACK LOCK HANDLE	UNLOCKED BY COPILOT
OBSERVER'S TURN CONTROL	IN DETENT
OFFSET SWITCH	OUT
TRUE HEADING	CHECKED
O-15 CAMERA SELECTOR SWITCH	1:4
O-23 MODE SELECTOR SWITCH	AS BRIEFED
VERTICAL CAMERA INTERVAL	SET AS REQUIRED
BOMBING ALTITUDE	SET__________FT

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMB RUN PROCEDURE

INITIAL LINEUP . . . . ACCOMPLISHED

CALL AT 50 MILES . . . . 50 MILES OUT

BOMB RUN CHECK LIST . . . . CALLED OVER INTERPHONE

PILOT AND/OR COPILOT	OBSERVER
OFFSET SWITCH	CHECKED OUT
BOMBING ALTITUDE	OK (OR ______ FT HIGH OR LOW)
FINAL LINEUP	ACCOMPLISHED
CROSSHAIRS	POSITION
CALL AT 25 MILES	25 NM CENTER PDI - GIVE ME SECOND STATION
PDI CENTER, YOUR AIRCRAFT	ROGER - AUTOMATIC
O-23 POWER SWITCH	ON
OFFSET SWITCH	IN OR OUT
SYNCHRONIZATION	STARTED
FINAL SYNCHRONIZATION	STARTED
120 TG	ROGER (OPTIONAL)
90 TG	ROGER (OPTIONAL)
60 TG	ROGER (OPTIONAL)
30 TG	ROGER (OPTIONAL)
20 TG TONE ON AND BOMB DR & RELEASE SWITCH AUTO	ROGER, TONE ON AND RELEASE SWITCH AUTO

NOTE

The bomb door or release switch will be left in MANUAL for RBS runs on airplanes which do not have the static port modification.

CALLS BOMBS AWAY	BOMBS AWAY

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

BOMBS AWAY CHECK

TONE & TONE LIGHT	OFF
RELEASE LIGHT	ON, MOMENTARILY
FUNCTION SWITCH	DROPS TO TRACK
AUTOPILOT CONTROL SWITCH	DROPS TO MANUAL
RECEIVER GAIN	FULL CW
SAC FORM 1	COMPLETED
AUTO PILOT CONTROL	TO PILOT

POST RELEASE PROCEDURE

BOMB POWER SWITCH	OFF
BOMB DOOR & RELEASE SWITCH	MANUAL
BRIC	TRAIN & ZERO (LIGHT OUT)
APS-23	RETUNED
O-15 & O-23 CAMERAS	OFF & LAST FRAME RECORDED
CAMERA DOORS	CLOSED
OXYGEN	NORMAL
OFFSET	OUT
POSITION COUNTERS	RESET
FUNCTION SWITCH	NAV
SAC FORM 1	COMPLETED

RENDEZVOUS

APN-76	ON
RECEIVER-STANDBY SWITCH	STANDBY
MASTER POWER SWITCH	ON
TRANS FREQUENCY SWITCH	AS BRIEFED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

- RECEIVER FREQUENCY SWITCH . . . . AS BRIEFED
- RECEIVER STANDBY SWITCH . . . . ON
- GAIN CONTROL . . . . SET

APN-69 . . . . ON

- OFF STANDBY OPERATE SWITCH . . . . STANDBY
- OFF STANDBY OPERATE SWITCH . . . . ON
- CODE . . . . SET

ETA TO RENDEZVOUS POINT . . . . RELAYED TO TANKER

APS-23 . . . . TUNED FOR BEACON

- VARIAC . . . . CCW TO 75
- RANGE DIAL . . . . SET
- TUNING FUNCTION SWITCH . . . . BEACON AFC
- VARIAC . . . . CW TO 10 MA
- TILT & GAIN . . . . ADJUST FOR OPTIMUM
- RANGE MARK-CROSSHAIR SWITCH . . . . RANGE MARK

TANKER BEACON SIGNAL . . . . IDENTIFIED & CONFIRMED

HOMING ON TANKER . . . . ACCOMPLISHED

TANKER RANGE . . . . MONITORED & RELAYED

PERISCOPIC SEXTANT . . . . RETRACTED AND PORT CLOSED

DESCENT RANGE . . . . COMPUTED

DESCENT . . . . INITIATED

ALTITUDE DIAL . . . . SET TO 12,160 FEET

RADAR ALTITUDE SWITCH . . . . ON (AT APPROX 5 NM)

RANGE DIAL . . . . MINIMUM RANGE

RANGE MARK - CROSSHAIR SWITCH . . . . CROSSHAIR (3 NM)

APN-76 . . . . OFF

- RECEIVER STANDBY SWITCH . . . . STANDBY
- MASTER POWER SWITCH . . . . OFF

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

APN-69	OFF
OFF-STANDBY OPERATE SWITCH	OFF
APS-23	TUNED FOR RADAR SEARCH
ALTITUDE	MEASURED
REFUELING WIND	DETERMINED OR SET
NAVIGATION COUNTERS	RESET
APS-23	STANDBY (PRIOR TO CONTACT)
REFUELING DATA	RECORDED
APS-23	TUNED FOR RADAR SEARCH (AFTER DISCONNECT)
POSITION	RELAYED TO TANKER
RECEPTACLE & LINES	CHECKED FOR LEAKS
CLIMB WIND	SET IN

AIRBORNE RADAR APPROACH

PREPARATION

ATF DIAL	15 SECONDS
TRIAL DIAL	SET
OFFSET DIAL	SET
ALTITUDE	REMEASURED
WIND RUN	ACCOMPLISHED
POSITION COUNTERS	RESET
MAG VAR	CHECKED
PPI CENTERING	CHECKED
SAFETY CHECK LIST	COMPLETED
BOMBSIGHT COVER (CLAM SHELL)	CLOSED
PENETRATION & TRAFFIC PATTERNS	REVIEWED

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

PENETRATION

INITIAL POINT	MADE GOOD
SYNCHRONIZATION	INITIATED
CROSSHAIRS	POSITIONED
FUNCTION SWITCH	BOMB
WIND DETERMINATION SWITCH	MEMORY POINT
PENETRATION	INITIATED
SYNCHRONIZATION	CONTINUED

APPROACH

TRAFFIC PATTERN	DIRECT PILOT AS REQUIRED
PDI	CENTERED ON FINAL
FINAL DESCENT	INITIATED AT TG 100
RATE OF DESCENT	CHECKED AT TG 60
APPROACH	DISCONTINUED
APPROACH	EVALUATED
LETDOWNS & APPROACHES	MONITORED

TURNOFF AND LANDING

RAI BRILLIANCE	FULL CCW
RADAR SWITCH (RAI)	OFF
FUNCTION SWITCH	STAB
RADAR POWER SWITCH	SCAN SLOW
RADAR POWER SWITCH	SCAN SLOW, WHEN TRACE AT 180°
BIAS	FULL CCW
VIDEO GAIN	FULL CCW
RECEIVER GAIN	FULL CCW

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

VARIAC	CCW TO 75
TILT	+5
RADAR POWER SWITCH	OFF
INFORM PILOT EQUIPMENT IS OFF	
BOMB SIGHT COVER (CLAM SHELL)	CLOSED
SAFETY BELT AND SHOULDER HARNESS	FASTENED AND LOCKED
FUNCTION SWITCH	OFF, AFTER TOUCHDOWN
K-2 HEATER SWITCHES	OFF
CAMERA MASTER SWITCH	OFF, BEFORE OPENING BOMB DOORS
3Ø INVERTER SWITCH *	OFF, OR MAIN NORMAL
EJECTION SEAT	PINS INSTALLED

POSTFLIGHT

K-SYSTEM SWITCHES	CHECKED OFF
BORESIGHT SWITCH	AZ
DRIFT DIAL	0°
SIGHTING ANGLE DIAL	60°
VARIAC	75 DIVISIONS
O-15 CAMERA POWER SWITCH	OFF
O-23 CAMERA POWER SWITCH	OFF
METER SWITCH	AC
CONTRAST	FULL CCW
RECEIVER GAIN	FULL CCW
ANTIJAM	OFF
TUNING FUNCTION SWITCH	RADAR AFC
SWEEP DELAY	FULL CCW AND DEPRESSED
RANGE DIAL	40 NM

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

RADAR POWER SWITCH	OFF
FUNCTION SWITCH	OFF
OFFSET SWITCH	OUT
RADAR ALTITUDE SWITCH	OFF
SIGHTING SWITCH	PPI
RANGE MARK-CROSSHAIR SWITCH	RANGE MARKS
BIAS	FULL CCW
VIDEO GAIN	FULL CCW
BRILL MARKS	FULL CCW
SECTOR AMPLITUDE	FULL CW & IN DETENT
RAI RADAR POWER SWITCH	OFF
RAI BRILLIANCE	FULL CCW
RETICLE LIGHT SWITCH	OFF
RETICLE LIGHT RHEOSTAT	FULL CCW
POWER SETTING KNOB	4X & IN DETENT
BOMBSIGHT COVER	CLOSED
TURN CONTROL	IN DETENT
CONTROL SWITCH	MANUAL
LAT & LONG SETTING CONTROLS	IN DETENT
PLANES POSITION-REFERENCE POINT SWITCH	PLANES POSITION
NAVIGATION METHOD SWITCH	NORMAL
POLAR ANGLE DIAL	ZERO
POLE SWITCH	NORTH POLE
TF	73.15 SECONDS
TRAIL	4,000 FEET
BOMBING MODE SWITCH	LOS
N-S OFFSET	ZERO
E-W OFFSET	ZERO

(CONTINUED ON NEXT PAGE)

OBSERVER'S CHECKLIST

(CONTINUED)

STAB UNIT POWER SWITCH . . . . OFF, IF APPLICABLE

3Ø INVERTER SWITCH*. . . . . OFF OR MAIN NORMAL

EJECTION SEAT PINS & STREAMERS . . . . INSTALLED AND/OR CHECKED IN

OXYGEN REGULATOR . . . . CHECKED

SUPPLY SHUTOFF LEVER . . . . OFF

EMERGENCY TOGGLE LEVER . . . . NEUTRAL

WARNING SYSTEM SWITCH . . . . OFF

BRIC . . . . TRAIN & ZERO BOMBS

BOMB DOOR & RELEASE SWITCH . . . . MANUAL

NORMAL BOMB DOOR SWITCH . . . . OFF

ALTERNATE BOMB DOOR SWITCH . . . . OFF

BOMB POWER SWITCH . . . . OFF

INDICATOR LIGHT SWITCH . . . . OFF

SALVO SWITCH . . . . OFF & SAFETIED

BOMB CONTROL SELECTOR SWITCH . . . . NORMAL

K-2 HEATER SWITCH . . . . OFF

ALL LIGHT SWITCHES . . . . OFF

NOSE DEFROST . . . . OFF

APN-76 CONTROL BOX (SB-215)

RECEIVER STANDBY SWITCH . . . . STANDBY

GAIN CONTROL . . . . FULL CCW

POWER SWITCH . . . . OFF

EMERGENCY SLIPWAY DOOR SWITCH . . . . OFF, IN DETENT

LATITUDE CORRECTION POINTER . . . . OFF

CAMERA MASTER SWITCH . . . . OFF

AERIAL CAMERA INTERVALOMETER

POWER SWITCH . . . . OFF

(CONTINUED ON NEXT PAGE)

* AF 51-2192 thru -2356, 52-082 thru -201, -236 thru -1416, -3343 thru -3373, 53-2261 thru -2278

OBSERVER'S CHECKLIST

(CONTINUED)

PERISCOPIC SEXTANT & MOUNT

- POWER CABLE . . . . REMOVED AND STOWED
- SEXTANT . . . . REMOVED
- SEXTANT PORT . . . . CLOSED
- BUBBLE . . . . REDUCED TO MINIMUM
- SEXTANT . . . . STOWED

STATION . . . . CLEANED

DD FORM 781 . . . . COMPLETED

BOMB BAY . . . . CLEARED

- BOMB RACK POWER CABLE . . . . DISCONNECTED
- BOMB FUSE PINS AND SHACKLE PINS . . . . . INSTALLED, IF APPLICABLE

PERSONAL EQUIPMENT . . . . TURNED IN

NECESSARY FORMS . . . . COMPLETED & DELIVERED TO PROPER SECTION

- SAC FORM 1 & CHART
- CELESTIAL COMPUTATION FORMS (SAC FORM 289)
- RADAR OPERATOR'S REPORT (SAC FORM 252)
- MALFUNCTION REPORT (SAC FORM 190), IF APPLICABLE
- CAMERA LOGS (SAC FORM 284 OR 285)
- MISSION ACCOMPLISHMENT REPORT

GUNNER'S CHECKLIST

In addition to his regular duties, the copilot serves as gunner and performs the following:

(1)▶ NOTE

On some airplanes the MD-4 fire control system is installed. An operational checklist will be included when available.

PREFLIGHT CHECKS

INTERIOR INSPECTION (COCKPIT)

1. DD Form 781 - CHECKED
2. (2)▶ Circuit Breakers in AC Power Shield (3) - IN
3. Circuit Breakers on Copilot's Circuit Breaker Panel (2) - IN
4. Circuit Breakers on Indicator Control (6) - IN
5. Circuit Breaker on Turret Control Panel (1) - IN
6. Fire Control Power Fuse and Spare (serviceable) (2) - IN PLACE
7. Selector Switch - OFF
8. Manual Holdback Switch - RELEASE
9. Gun Safety Switch - SAFE
10. Intensity Knob - FULL COUNTERCLOCKWISE
11. LO Manual Knob - FULL COUNTERCLOCKWISE
12. IF Gain Knob - FULL CLOCKWISE
13. Range Search Limit Knob - FULL CLOCKWISE
14. Ammunition Rounds Counters - SET
    This is to indicate amount of ammunition loaded per respective weapon.
15. Computer Switch - OUT
16. Spare Bulbs (4) - IN PLACE
    Bulbs in bracket under indicator hood should be white, red, and amber which are used for "Up," "Down," target, scope illumination, and "AFC Off" bulb replacements.

EXTERIOR INSPECTION (TAIL COMPARTMENT)

1. Ammunition Can Lockpins - ENGAGED, SECURE
2. Turret Safety Switch - ON
   This switch must be in SAFE position whenever someone is working on turret or weapons.

(CONTINUED ON NEXT PAGE)

(1)▶ AF 51-2194, -2198, -2207, -2222, -2238, -2239, -2245, -2247 thru -2250, -2252, -2255, -2259, 53-1861 thru -1972, -2110 thru -2170, -2355 & on
(2)▶ AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278

GUNNER'S CHECKLIST

(CONTINUED)

3. Guns Stowed and Secure - CHECKED

4. Turret Drive Motor Brakes - ENGAGED
   Check by attempting to move turret using 20mm tube as a lever; these brakes will withstand 100 pounds pressure.

5. Turret Cowling Secure - CHECKED

6. A & E personnel confirm following:
   a. Air Pressure System - CHECKED 1500 PSI
      A minimum of 1500 psi should be available prior to takeoff with no leaks in the system (or within A & E approved leakage limits), thereby insuring that 3 psi air pressure above normal sea level atmospheric pressure will be available for RF head, modulator, and waveguide systems during operation above 7000 feet altitude, otherwise electrical malfunction may occur.
   b. Selector Valve - PRESSURE APPLIED
      This valve also has a bleed position which is not used for inflight operation since it cuts off air pressure for "a" above.
   c. Gun Chargers Holdback-Release Switches - NEUTRAL
   d. Link and Spent Case Ejection Chutes - CLEAR
      This will insure no obstructions exist in the ejection hopper.
   e. System Ready for Gunnery Mission - READY
      This confirmation is to insure that sufficient ammunition has been loaded and torqued into feeder mechanism and that the gunnery systems have been given a complete ground check in accordance with A & E maintenance directives and found satisfactory.

INFLIGHT PROCEDURES

POWER SUPPLY

The system requires power from the airplane electrical equipment in addition to the DC power system as follows:

1. 28-volt DC from airplane power supply

(1)▶ 2. Regulated AC (115 volts) from the A-5 bus of the A-5 inverter system

(1)▶ 3. Normally, unregulated AC (115 volts) on left unregulated AC bus from the left alternator; in emergency, from the right alternator. A stable alternator power is necessary for efficient operation of the A-5 system. The system should be immediately turned off if the low frequency light illuminates.

(2)▶ 4. Regulated AC (115 volts) on AC power panel, phases A, B, and C

PREPARE TO FIRE

NOTE

The preceding and following procedures will assure that when the system is turned on, the guns will be in a safe condition, the systems circuit will receive power, and the cathode ray tube screen will not be damaged by a too brilliant luminous spot.

(CONTINUED ON NEXT PAGE)

(1)▶ AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2)▶ AF 52-1417, 53-1819 thru -2170, 53-2279 thru -2354

GUNNER'S CHECKLIST

(CONTINUED)

1. Place selector switch on turret control panel in WARMUP position for 10 minutes (longer in cold climates).

2. After 10 minutes, place selector switch in STANDBY position at least 20 minutes prior to firing so that gun, feeder, and system heaters can effectively preheat.

NOTE

The selector switch must be in STANDBY position after turning on for at least 5 minutes before proceeding with radar gun laying adjustments as follows: (to be accomplished by ground crew on preflight of system or by co-pilot in flight).

3. LO Manual Fully Counterclockwise - CHECKED or ADJUSTED
   With AFC off lamp unlighted it indicates system is in automatic frequency control for local oscillator tuning. Milliammeter should register between 0.3 and 0.5 ma (needle oscillating). It will normally require 3 3/4 minutes for the radar to time in before getting crystal current on the milliammeter.

4. Selector Switch to Operation
   After radar has timed in with system in standby (approximately 3 3/4 minutes) and upon switching to operation, the AFC crystal current should read 0.5 to 0.9 ma on the milliammeter with the needle steady. If this reading is not present, then adjustment of LO manual in clockwise direction (manual tuning) is necessary until desired crystal current is obtained.

5. IF Gain Control - ADJUSTED
   Normal position is 1/4 turn from full counterclockwise (or until scope target light goes out). Adjustment of this control depends on desired brilliance, and range of return echo; or for use in compensating for jamming interference.

6. Scope Illumination - ADJUSTED
   Adjust in spare light compartment for desired brilliance of scope and scale range marker lines.

7. Intensity Control - ADJUSTED
   Upon advancing system to operation, adjust the intensity control clockwise until sweep appears, but avoid too brilliant a sweep since it reduces scope sensitivity and may damage the cathode ray tube screen.

8. Range Selector Switch - ADJUSTED
   The travel of the range gate is to be set according to local briefings and tactics; however, normal setting is 8000 yards in short range search.

With all the above controls properly adjusted, the radar scope return should be within the following limitations; otherwise refer to figure 4-36A.

SCOPE ANNOTATION

1. During Search
   - Vertical Sweep - Extends from 0 to 8000 yards; jizzle 3/8 inch wide.
   - Motion of Sweep - Horizontal movement; left to right then right to left in 3 seconds.
   - Range Gate - Not present in search.
   - Target Indications - Appear on an average of every 3 seconds for each target encountered, except when target is within antenna lap over area.

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST

(CONTINUED)

- "Target" Light (Indicator Panel) - Lights each time target encountered.
- "Up" Light - Lights when the vertical sweep is moving to the right, and antenna position is at least 20° up.
- "Down" Light - Lights when the vertical sweep is moving to the left, and antenna position is at least 19° down.

2. During Hand Control
   - Vertical Sweep - Extends from 0 to 8000 yards; jizzle 1/8 inch wide.
   - Motion of Sweep - Horizontal movement in accordance with movement of antenna control handle.
   - Range Gate - Searches from bottom to top of vertical trace until on the target. Remains "locked on" when action switch is released.
   - Target Indications - Appears on vertical trace when antenna is directed at target. Remains when antenna is "locked on."
   - "Target" Light (Indicator Panel) - Lights when antenna is directed at target. Remains
   - lighted when antenna is "locked on."
   - "Up" Light - Lights when antenna control handle raised above 20°.
   - "Down" Light - Lights when antenna control handle lowered below -19°.

3. During Track
   - Vertical Sweep - Extends from 0 to 8000 yards; jizzle 1/8 inch wide.
   - Motion of Sweep - Moves horizontally as target moves.
   - Range Gate - Centered on target; moves up or down as the target moves in range.
   - Target Indications - On vertical trace; remain during track.
   - "Target" Light (Indicator Panel) - Remains lighted while on target.
   - "Up" Light - Lights while target is above 20°.
   - "Down" Light - Lights while target is below -19°.
   - Rounds Counter - Turns over as guns fire; stops as trigger is released.

TO FIRE GUNS

NOTE

The maximum effective firing range of the guns is 1500 yards; they may be fired at any time during hand control or track operation. In addition to the above, except when performing emergency procedure No. 10 (figure 4-36A) or due to combat necessity, while in hand control turret should not be slewed into turret mechanical stops, otherwise damage to turret and/or stops may result.

1. Handset - ADJUSTED
   Set computer handset to nearest pressure altitude, corrected outside temperature (° C), and true airspeed in knots; reset every 20 minutes during normal cruise, or when the following changes occur.
   - Altitude - ±500 ft
   - Airspeed - ±5 knots
   - Temperature - ±5° C

2. Computer Switch - IN

3. Attack Factor Switch - AS NEEDED
   The copilot will determine the type of fighter attacks, (straight line, or pursuit curve), by studying the target return closing attitudes.

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST

(CONTINUED)

OVER RANGE FIRING AREA

4. Clearance to Fire from Pilot - CHECKED
   This procedure to be followed during training missions only.

5. Manual Holdback Switch - HOLDBACK-RELEASE
   With old configuration 20mm bolt position switches installed, the use of the firing button to breech the first round of ammunition is undesirable because of excessive charging, loss of feeder torque, and insufficient time for feeder mechanism to align first round for breeching. Therefore, pending receipt of new bolt position switches, the following procedures will be followed: Actuate manual-holdback switch to holdback for 4-seconds prior to positioning this switch to release and firing of the initial burst.

6. Gun Safety Switch - FIRE

7. Burst Control, Cooling and Safety Procedures - PRACTICED
   According to local procedures and tactics. (If weapon malfunction stoppages occur, refer to emergency procedure No. 10, figure 4-36A.)

AFTER FIRING GUNS

1. Gun Safety Switch - SAFE

2. Computer Switch - OUT

3. Manual Holdback Switch - HOLDBACK

4. Intensity Knob - FULL COUNTERCLOCKWISE

5. LO Manual Knob - FULL COUNTERCLOCKWISE

6. IF Gain Knob - FULL CLOCKWISE

7. Range Search Limit Knob - FULL CLOCKWISE

8. Stow Guns 180° Aft and Elevation Full Up - COMPLETED
   Close action switch and position antenna control full up so the turret is straight aft, then while still holding antenna and action switch in this condition, perform next step.

9. Selector Switch - OFF
   Turn selector switch with quick decisive motion, otherwise slipstream may force guns down before turret drive motor brakes can engage.

10. Prior to Landing, Notify __________ Control that Aircraft is Returning from Gunnery Mission - ACCOMPLISHED

POSTFLIGHT PROCEDURES

1. Gunnery Logs - COMPLETED

2. DD Form 781 - COMPLETED

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST

(CONTINUED)

3. Link and Spent Case Ejection Chutes - CLEAR
   If malfunction stoppages occurred in flight while firing, there are frequently spent cases and links still in the ejection chutes; therefore, the copilot should notify the base operations officer so that the runway and taxi ways can be checked to preclude accidents due to the possibility of these cases and links having fallen out upon landing or taxiing.

STRANGE FIELD POSTFLIGHT PROCEDURES (Qualified weapons personnel not available)

NOTE

If ammunition is not torqued into guns, then only items denoted with a star (★) need be accomplished. If ammunition has been torqued into guns, then all of the following must be accomplished:

★ 1. Power OFF; Turret, Controls, and Switches Positioned the Same as for (normal) "Inflight" After Firing Guns - ACCOMPLISHED

★ 2. Fire Control Power Fuse - REMOVED & STORED

★ 3. Turret Safety Switch - SAFE

4. Turret Cowling - REMOVED

5. Unlock Elevation Turret Drive Motor Brakes and Depress Guns (to horizontal) - ACCOMPLISHED

6. Feeder Winders - DISENGAGED

7. Feeder Mechanism - UNTORQUED

8. Break Ammunition Belt by Separating Links in Bell Mount Adaptor - ACCOMPLISHED

9. Ammunition Chutes (at bell mount adaptor) - DISCONNECTED & INSPECTED

10. Bell Mount Adaptors - REMOVED & INSPECTED

11. Feeder Mechanism Removed, Cleared of Ammunition, and Inspected - ACCOMPLISHED

12. Weapons (visually) Cleared of Ammunition - CHECKED

13. Link and Spent Case Ejection Chutes - CLEAR

14. Booster Motors Cleared of Ammunition & Inspected - ACCOMPLISHED

15. Feeder Mechanism - REPLACED

16. Bell Mount Adaptors - REPLACED

17. Ammunition Chutes - REPLACED

18. Feeder Winders - ENGAGED

19. Air Pressure Selector Valve - BLEED POSITION

20. Turret Stowed (by stow marks) (horizontal & straight aft) - ACCOMPLISHED

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST

(CONTINUED)

21. Elevation Turret Drive Motor Brakes - LOCKED & CHECKED

22. Turret Cowling - REPLACED & SECURE

★ 23. Warning Signs (HOT GUNS) - AS REQUIRED

★ 24. DD Form 781 - COMPLETED

STRANGE FIELD PREFLIGHT PROCEDURES (Qualified weapons personnel not available)

NOTE

If ammunition is not torqued into guns, then all the following items must be accomplished; however, only items denoted with a star (★) must be accomplished if ammunition has been torqued into guns.

POWER OFF

★ 1. DD Form 781 - CHECKED

★ 2. Turret, Controls Fuses, Circuit Breakers, and Switches Positioned or Checked the Same as for (normal) Preflight Cockpit Checks - ACCOMPLISHED

3. Turret Safety Switch - SAFE

4. Turret Cowling and Panels - REMOVED

5. Azimuth and Elevation Turret Drive Motor Brakes - UNLOCKED

6. Freedom of Turret Movement (manually) - CHECKED

7. Azimuth and Elevation Turret Drive Motor Brakes - LOCKED

8. Weapons Mounting and Security - CHECKED

9. Feeder Winder - DISENGAGED

10. Power ON, (to position breechblock to release for ammunition torquing) - ACCOMPLISHED
    a. Turret Clear of Personnel and Obstructions - CHECKED
    b. Turret Safety Switch - ON
    c. Selector Switch (allowing radar time in) - WARMUP - STANDBY - OPERATION
    d. Manual Holdback Switch - RELEASE
    e. Selector Switch - OFF
    f. Turret Safety Switch - SAFE
    g. Gun and Feeder Heaters (finger tip touched) - CHECKED

11. Ammunition Inspected and Loaded if Applicable - ACCOMPLISHED

12. Pull Ammunition Through Chutes, Booster Motors, and Bell Mount Adaptors to Feeder Mechanism - ACCOMPLISHED

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST

(CONTINUED)

13. Torque Ammunition Through Feeder Mechanism - ACCOMPLISHED
14. Link and Spent Case Ejection Chutes Clear - CHECKED
15. Feeder Winder - ENGAGED
★ 16. Air Pressure Gage (min 1500 psi) - CHECKED or RECHARGED
★ 17. Selector Valve (apply pressure position) - CHECKED
18. Turret Stowed - CHECKED
19. Azimuth and Elevation Turret Drive Motor Brakes - LOCKED & CHECKED
★ 20. Cowling and Panels - REPLACED & SECURE
★ 21. Ammunition Can Lockpins - ENGAGED & SECURE
★ 22. Turret Safety Switch - ON
23. Ammunition Rounds Counters - SET
24. Warning Signs (HOT GUNS) (as required) - IN PLACE
25. DD Form 781 - COMPLETED

GUNNER'S CHECKLIST (CONDENSED)

PREFLIGHT CHECKS

INTERIOR INSPECTION (COCKPIT)

1. DD Form 781 - CHECKED
2. Circuit Breakers in AC Power Shield (3) - IN
3. Circuit Breakers on Copilot Circuit Breaker Panel (2) - IN
4. Circuit Breakers on Indicator Control (6) - IN
5. Circuit Breaker on Turret Control Panel - IN
6. Fire Control Power Fuse and Spare - IN PLACE
7. Selector Switch - OFF
8. Manual-Holdback Switch - RELEASE
9. Gun Safety Switch - SAFE
10. Intensity Knob - FULL CCW
11. LO Manual Knob - FULL CCW
12. IF Gain Knob - FULL CW
13. Range Search Limit Knob - FULL CW
14. Ammunition Rounds Counters - SET
15. Computer Switch - OUT
16. Spare Bulbs - IN PLACE

EXTERIOR INSPECTION (TAIL COMPARTMENT)

1. Ammunition Can Lockpins - ENGAGED & SECURE
2. Turret Safety Switch - ON
3. Guns Stowed and Secure - CHECKED
4. Turret Drive Motor Brakes - ENGAGED
5. Turret Cowling Secure - CHECKED

(CONTINUED ON NEXT PAGE)

GUNNER'S CHECKLIST (CONDENSED)

(CONTINUED)

6. A & E personnel confirm:
   a. Air Pressure System - CHECKED 1500 PSI
   b. Selector Valve - PRESSURE APPLIED
   c. Gun Charger Holdback-Release Switch - NEUTRAL
   d. Link and Spent Case Ejection Chutes - CLEAR
   e. System Ready for Gunnery Mission - READY

INFLIGHT PROCEDURES

POWER SUPPLY

1. 28 Volts on DC Bus - CHECKED
2. (1)▶ Regulated AC (115 volts) on A-5 Bus - CHECKED
3. (1)▶ Unregulated AC (115 volts) Normal or RH Alternator Both Bus Positions - CHECKED
4. (2)▶ Regulated AC (115 volts) on AC Power Panel; Phases A, B, and C - CHECKED

PREPARE TO FIRE

1. Selector Switch - WARMUP
2. For 10 Minutes, Then to - STANDBY for 20 Minutes Prior to Firing (after 5 minutes)
3. LO Manual Fully CCW - CHECKED or ADJUSTED
4. Selector Switch to - OPERATION
5. IF Gain Control - ADJUSTED
6. Scope Illumination - ADJUSTED
7. Intensity Control - ADJUSTED
8. Range Selector Switch - ADJUSTED
9. Search Operation - CHECKED
10. Hand Control Operation - CHECKED

TO FIRE GUNS

1. Handset - ADJUSTED
2. Computer Switch - IN
3. Attack Factor Switch - AS NEEDED
4. Clear to Fire from Pilot - CHECKED
5. Manual Holdback-Release Switch - HOLD-BACK-RELEASE
6. Gun Safety Switch - FIRE
7. Burst Control, Cooling and Safety Procedure - PRACTICED

AFTER FIRING GUNS

1. Gun Safety Switch - SAFE
2. Computer Switch - OUT
3. Manual Holdback Switch - HOLDBACK
4. Intensity Knob - FULL CCW
5. LO Manual Knob - FULL CCW
6. IF Gain Knob - FULL CW
7. Range Search Limit Knob - FULL CW
8. Stow Guns 180° Aft and Full up Elevation - COMPLETED
9. Selector Switch - OFF
10. Notify__________Control that Aircraft is Returning from a Gunnery Mission - ACCOMPLISHED

POSTFLIGHT PROCEDURES

1. Gunnery Logs - COMPLETED
2. DD Form 781 - COMPLETED
3. Link and Spent Case Ejection Chutes - CLEAR
4. Warning Signs (HOT GUNS) - IN PLACE

(1)▶ AF 51-2192 thru 52-1416, -3343 thru -3373, 53-2261 thru -2278
(2)▶ AF 52-1417, 53-1819 thru -2170, -2279 thru -2354

all weather operation

section 9

table of contents

introduction

Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ or are in addition to the normal operating instructions covered in section II. Any discussions relative to operation are covered in section VII.

instrument flight procedures

GENERAL

Flying the B-47 in weather conditions requires instrument proficiency and conscientious preflight planning on the part of all crew members. A standard operating procedure should be used by the pilot and copilot during all phases of instrument flight. Performance data, techniques, and procedures recommended are based on a standard B-47 airplane. Approach procedures are applicable for a midcenter of gravity position at gross weights of 110,000 pounds or less.

All airspeeds recommended should be adhered to during instrument flight, especially during the final part of any instrument procedure and/or approach. During landing approaches, the airplane is being operated in the sensitive portion of the power curve and an approach at speeds below those recommended will result in poor response to power corrections. An approach at speeds exceeding those recommended will result in overshooting, because the airspeed cannot be reduced quickly owing to the low drag characteristics of the airframe. In flight at low altitudes, angles of bank may be made up to 60°, depending upon the airspeed; however, from the standpoint of pilot comfort and precise maneuvering, 30° banking turns are recommended. At high altitudes, single needle width bank turns are recommended; however, do not exceed a 30° bank. Turns during standard instrument procedures and approaches should be made at the standard rate of 3° per second.

PREFLIGHT

The following preflight checks should be made prior to instrument flight:

a. Complete normal preflight inspection and accomplish the checklist.
b. Check attitude indicator for proper operation.
c. N-1 compass - Check for proper synchronization.
d. UHF - Check all channels which will be required for the flight.
e. Marker beacon - Push to test marker beacon light.
f. Vertical speed indicator - Check pointer at zero (set if necessary).
g. Radio compass - Check "Antenna," "Compass," and "Loop" positions and set to desired frequency.
h. Omni range receiver - Check operation and set to desired frequency.
i. ILS receiver (omni receiver) - Check operation.
j. Automatic pilot - Check operation.
k. Pitot heaters - Turn on and have ground crew member check heads for heating.
l. Wing and tail anti-icing - Check operation.
m. Defrosters - Check operation.
n. Windshield anti-icing (Nesa glass) - Check operation.
o. Altimeter - Check against field elevation with proper setting.
p. Windshield wiper - Check operation.

CAUTION

Do not operate wiper on dry glass since the windshield surface may be damaged.

TAXI

Check heading indicators and turn and bank indicators during turns while taxiing. Check ILS when crossing ILS runway.

BEFORE TAKEOFF

a. Align the airplane visually on the runway.
b. Attitude indicator - Adjust the horizon bar one bar width below the horizon reference point.
c. Directional indicator - Set indicator needle to top of the dial.
d. Wing anti-icing - Off unless required.
e. Pitot heaters - On.
f. Windshield anti-icing - Normal or as required.
g. Set takeoff power, check instruments, and release brakes.

INSTRUMENT TAKEOFF AND INITIAL CLIMB

a. The initial part of the takeoff is the same as a normal VFR takeoff. The airplane should be lined up on the runway visually and the heading should be maintained visually until the airplane leaves the ground.
b. Retract the landing gear as soon as the airplane is airborne and the vertical speed indicator and altimeter show a definite climb. Retract the flaps after the airplane has reached 170 knots and is accelerating. When the flaps are fully retracted, allow the airspeed to build up to recommended best climbing speed. A slight sinking of the airplane will occur as the flaps are retracting. This "sink" is most apparent during the last 20° of retraction. A slight pull force is required to correct this condition.

INSTRUMENT CLIMB

Maintain recommended best climbing speeds and procedures. From the standpoint of pilot comfort and precise maneuvering, one needle width climbing turns are recommended; however, a 30° bank should not be exceeded.

INSTRUMENT CRUISING FLIGHT

Cruising flight under instrument conditions is no different than cruising flight under visual conditions.

DESCENTS

Descents to traffic pattern altitude should be executed in the same manner as during VFR flight conditions with landing gear extended and power to idle. It is recommended that letdowns from high altitudes be made at Mach .81 to avoid buffeting with the gear down. Mach .81 should be maintained until an indicated airspeed not to exceed 305 knots is reached. The remainder of the letdown should be conducted at an indicated airspeed not in excess of 305 knots.

NOTE

Windshield anti-icing should be turned to the MAX HEAT position and defrosting should be ON prior to starting the descent. If descent is made through icing conditions it will be necessary to maintain a high enough engine rpm to provide adequate hot air for the anti-icing systems.

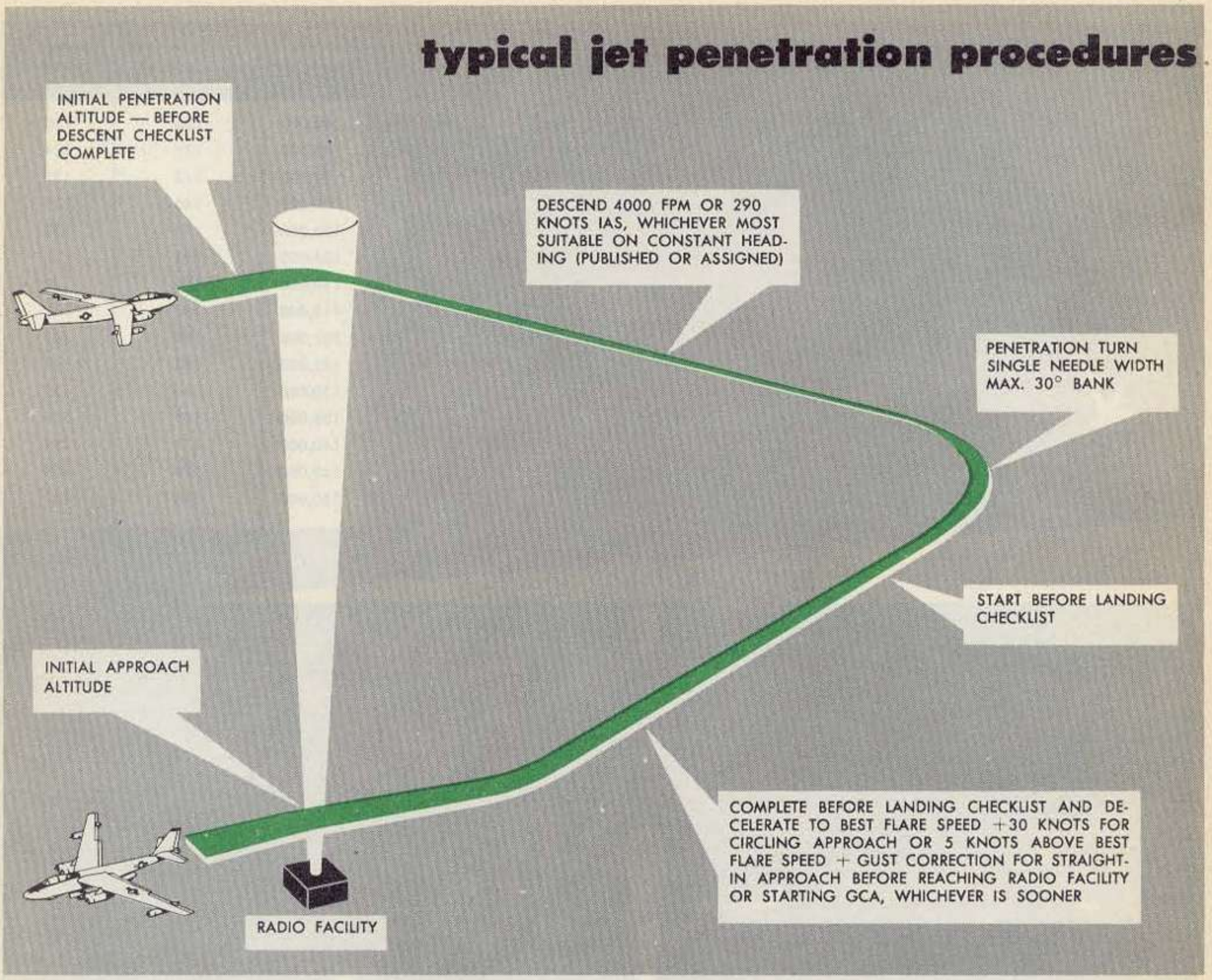


Figure 9-1.

TYPICAL JET PENETRATION PROCEDURES

The primary purpose of a jet penetration is to permit jet aircraft to execute an instrument approach with the least possible delay in time and a minimum number of turns. For a typical jet penetration procedure, see figure 9-1.

1. INITIAL PENETRATION ALTITUDE. Last altitude assigned by ATC or published altitude in East and West Jet Pilot's Handbooks at which airplane reports over radio facility for beginning penetration procedure. Prior to beginning penetration, the Before Descent checklist should be completed.

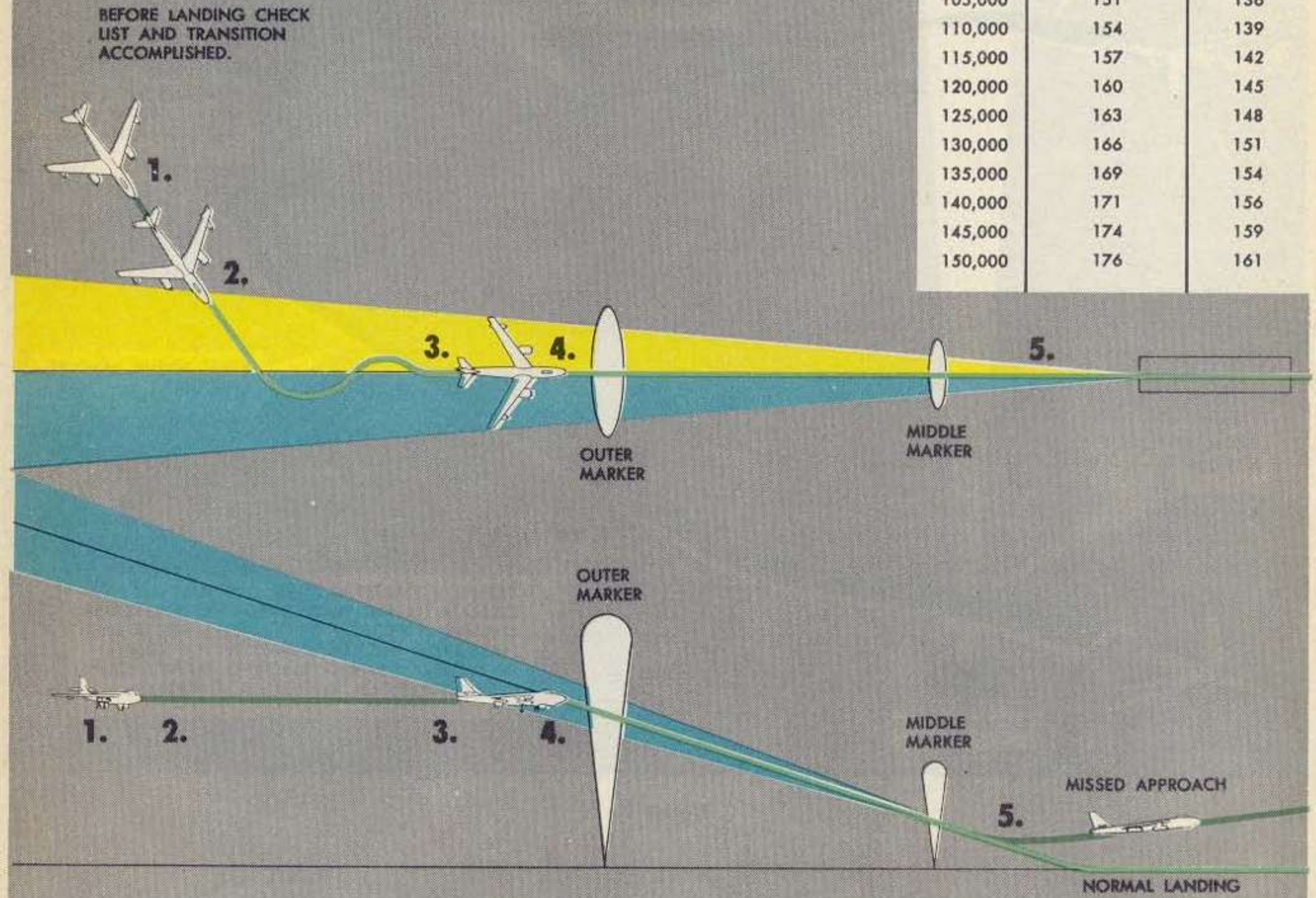
2. DESCENT. In a typical jet penetration, descent should be started normally when over the radio facility or an assigned or published heading. Descend at a constant rate of approximately 4000 feet per minute or 290 knots IAS, whichever is more suitable.

3. PENETRATION TURN. The penetration turn should be started normally when approximately one-half of the difference between initial penetration altitude and initial approach altitude is lost. The penetration turn should be a single needle width turn (1 1/2° per second) and bank not to exceed 30°. When the penetration turn is complete, start the Before Landing checklist and track inbound on the published magnetic course. In any case the initial approach altitude must be reached before return to radio facility and/or before entering any control zone or area.

4. INITIAL APPROACH ALTITUDE. The initial approach altitude will be shown in the East and West Jet Pilot's Handbooks for the standard instrument procedure. Complete Before Landing checklist and decelerate before reaching radio facility or starting GCA, whichever is sooner.

automatic approach

GROSS WEIGHT	LOCALIZER INTERCEPTION AIRSPEED	GLIDE PATH AIRSPEED
80,000	135	120
85,000	139	124
90,000	142	127
95,000	145	130
100,000	148	133
105,000	151	136
110,000	154	139
115,000	157	142
120,000	160	145
125,000	163	148
130,000	166	151
135,000	169	154
140,000	171	156
145,000	174	159
150,000	176	161



Transition

- **a** See applicable ILS procedure chart for automatic approach information.
- **b** Airspeed 20 knots above best flare speed.
- **c** Automatic pilot engaging switches to ENGAGE.
- **d** Altitude control switch ON.
- **e** ILS receiver ON.
- **f** "Approach Ready" light illuminated.
- **g** Automatic approach switch in AUTOMATIC PILOT (AUTO PILOT).

Operation

1. Intercept localizer beam at any angle up to 45° from runway heading.
2. When the vertical localizer needle makes a positive departure from stop position, move the automatic approach switch to LOCALIZER (LOC) position.
3. After initial bracketing of localizer beam turn off the altitude control switch and reduce airspeed to approximately 5 knots above best flare speed plus gust correction. Use pitch knob to maintain altitude. Adjust power to maintain the new IAS. Stabilize airspeed and turn on the altitude control switch.
4. Switch to APPROACH (APPR) position when the horizontal glide path needle reaches center. Adjust power to maintain 5 knots above best flare speed plus gust correction on the glide path.
5. At minimum altitude disengage automatic pilot and land or accomplish missed approach manually.

50901WC

Figure 9-1A.

AUTOMATIC APPROACH

Automatic approach equipment directs ILS received signals through the automatic pilot to guide the airplane along an approach path which is established by directional localizer and glide path transmitters. Recommended using boundaries extend from the interception of the localizer beam to 5 seconds after passing the middle marker. The pilot must be familiar with the ILS and automatic approach equipment in section IV to achieve desired results. The automatic approach is accomplished as follows (see figure 9-1A).

1. TRANSITION. Accomplish normal transition as specified in the appropriate ILS procedure chart. Set the localizer and omni-range frequency selector switch to the frequency of the airfield localizer station.

NOTE

After approximately 2 minutes warmup, observe that both the localizer OFF and glide path OFF warning flags disappear from view especially if the airplane is within range of the localizer beam or glide path beam. Failure of either to do so indicates no signal is received and is cause to discontinue the automatic approach until a check can be made on the system.

Make the selection on both the interphone selector switch and interphone mixer toggle switches. Extend full wing flaps and lower the landing gear. Airspeeds established are based on gross weight. Trim for straight and level flight, then engage the automatic pilot engaging switches. Turn on the altitude control switch after speed and altitude are stabilized. Deploy the approach chute at the pilot's discretion.

CAUTION

- With the automatic pilot in operation, turn off the altitude control switch prior to raising or lowering flaps or varying airspeed more than 50 knots.
- Do not reduce the airspeed below 145 knots when the altitude control switch is ON and flaps are down.
- The automatic approach switch must be in AUTO PILOT (AUTOMATIC PILOT) position whenever the airplane passes directly over the localizer station. There is possibility of erratic control action if the automatic approach switch is in LOC (LOCALIZER) position.

NOTE

On airplanes with altitude control units inoperative, control altitude during the localizer phase of the automatic approach with the automatic pilot pitch knob.

Intercept the localizer beam inbound at any angle up to 45° and far enough from the outer marker to stabilize the flight path prior to intercepting the glide path.

CAUTION

The green "Approach Ready" light should illuminate when the automatic approach switch is in AUTO PILOT (AUTOMATIC PILOT) position and the ARN-14 set is on and tuned to an ILS station. If the light does not illuminate, the system may be malfunctioning and the automatic approach should not be attempted.

2. INTERCEPTING LOCALIZER BEAM. When the vertical needle of the ID-249 indicator makes a positive departure from full "Fly Right" or "Fly Left" (depending on the direction of approach for interception) the airplane is intercepting the outer edge of the localizer beam. Position the automatic approach switch to LOC (LOCALIZER); the "Approach Ready" light will remain illuminated. The airplane automatically brackets the localizer inbound heading. Observe the initial automatic turn to insure an inbound localizer heading. It is possible that the airplane may turn to the outbound localizer heading if the automatic approach switch is prematurely moved to LOC (LOCALIZER) position.

3. AFTER INITIAL BRACKETING OF LOCALIZER BEAM. Prior to intercepting the glide path, turn off the altitude control switch and reduce the airspeed to approximately 5 knots above best flare speed plus gust correction. The pitch knob is used to maintain altitude. Adjust power to maintain the new IAS. Stabilize airspeed then turn on the altitude control switch.

CAUTION (1)

On airplanes which do not have T.O. 1B-47-333 accomplished, do not reduce rpm below 52% on engines 1 and/or 6 as the glide path receiver depends on engine-driven alternator operation.

4. INTERCEPTING GLIDE PATH. When the horizontal needle of the ID-249 indicator reaches center position, move the automatic approach switch to APPR (APPROACH) position.

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(1) AF 51-2357 thru 52-111, -202 thru -292

NOTE

If the automatic approach switch is moved to APPR (APPROACH) position before the horizontal needle of the ID-249 indicator reaches center position, the airplane will pitch up.

The altitude control unit is automatically deenergized and the airplane will be guided by the ID-249 indicator along the glide path. Power must be adjusted to maintain 5 knots above best flare speed plus gust correction on the glide path. This additional airspeed is required as a reserve to allow an emergency pull-up for missed approach plus allowance for the 12° maximum bank angle during approach. After the airspeed and steady rate of descent on the glide path are reasonably established, check the automatic pilot trim indicator needles alignment prior to automatic pilot disconnect.

CAUTION

If a large out-of-center alignment occurs on the automatic trim indicator, discontinue the automatic approach and disconnect the automatic pilot with firm manual control of the airplane. Manual control must be continued until the source of the out-of-trim condition is located and corrected.

5. DISCONNECTING AUTOMATIC PILOT. Continue the approach until visual contact is made with the runway or descend to the minimum altitude (specified on the respective ILS procedure chart), then disconnect the automatic pilot by pressing the control wheel button and complete the landing with manual control of the airplane.

NOTE

If visual contact is not made with the runway by the time the descent minimum altitude is reached, disconnect the automatic pilot and initiate a standard missed-approach procedure, flying the airplane manually. The automatic pilot should be disconnected not later than 5 seconds after passing the middle marker to prevent passing over the glide path transmitter with the automatic pilot engaged.

INSTRUMENT LOW-APPROACH SYSTEM (ILS)

The ILS is the Air Force system of instrument approach which makes use of radio transmitting equipment on the ground and receiving equipment in the airplane to provide you with a visually indicated path to the runway. ILS approaches can be made with this airplane. ILS equipment provided is described in section IV. The ILS approach and subsequent landing under instrument conditions are outlined in figure 9-1B.

AUTOMATIC FLIGHT

WARNING

The automatic approach switch must be in AUTO PILOT (AUTOMATIC PILOT) position during normal flight. Do not use the automatic pilot for automatic flight to or from omni-range stations for the following reasons:

- Control action in response to omni-range signals is more violent than desired for normal azimuth corrections.
- Violent aileron action will result when the airplane passes over the omni-range station.
- The usable range of signals from omni-range stations is confined to line-of-sight which results in short usage while flying at high speeds.

GROUND CONTROLLED APPROACH (GCA)

The ground controlled approach is accomplished by teamwork between the pilot and a GCA crew on the ground. The crew located in a mobile radar station near the runway tracks the airplane by radar from the time of entering the control zone until the runway is reached. When visual reference with the runway is made, the pilot initiates a normal flare-out and landing procedure. The pilot maintains constant radio contact with the GCA crew and receives complete approach instructions which should be followed exactly and promptly to insure close coordination.

Two types of traffic patterns are most commonly specified by GCA traffic director. One is a conventional rectangular pattern and the other is a straight-in approach from a distance of 10 miles or more. Regardless of the pattern flown, the complete approach procedure is divided into four phases:

1. INITIAL APPROACH. The initial approach is the pattern, including identification vectoring, up to the final approach. The GCA traffic director will instruct the pilot during this phase of the approach.
2. FINAL APPROACH. The final controller takes over radio contact usually on a different frequency at a range of about 7 miles from the end of the runway and continues to the instant the airplane breaks through the overcast and visual reference to the ground is established. The final controller will talk to the pilot almost continually, giving instructions and information on the position of the airplane in relation to the course. The steady flow of conversation does two things; it helps the pilot make the smaller but more numerous corrections necessary during the final approach, and it gives the pilot immediate warning of any failure of radio communication. If no transmission is received during any 5-second period of the final approach, the pilot should initiate a missed approach following standard missed approach procedures for the field location.
3. PRELANDING. That portion of the pattern flown after breaking out of the overcast until just before contact is made with the runway. There should be no hesitancy to "go-around" if visual contact is not made by the time the GCA minimum altitude is reached. The prelanding phase is the period of transition from instrument flying to visual flying. During change-over, the pilot should continue to follow instructions from the final controller until it is very evident that he will not lose visual contact with the ground.
4. TOUCHDOWN AND LANDING ROLL. The final controller notifies the pilot when the airplane is over the end of the runway. The pilot makes the touchdown and landing by visual reference to the runway.

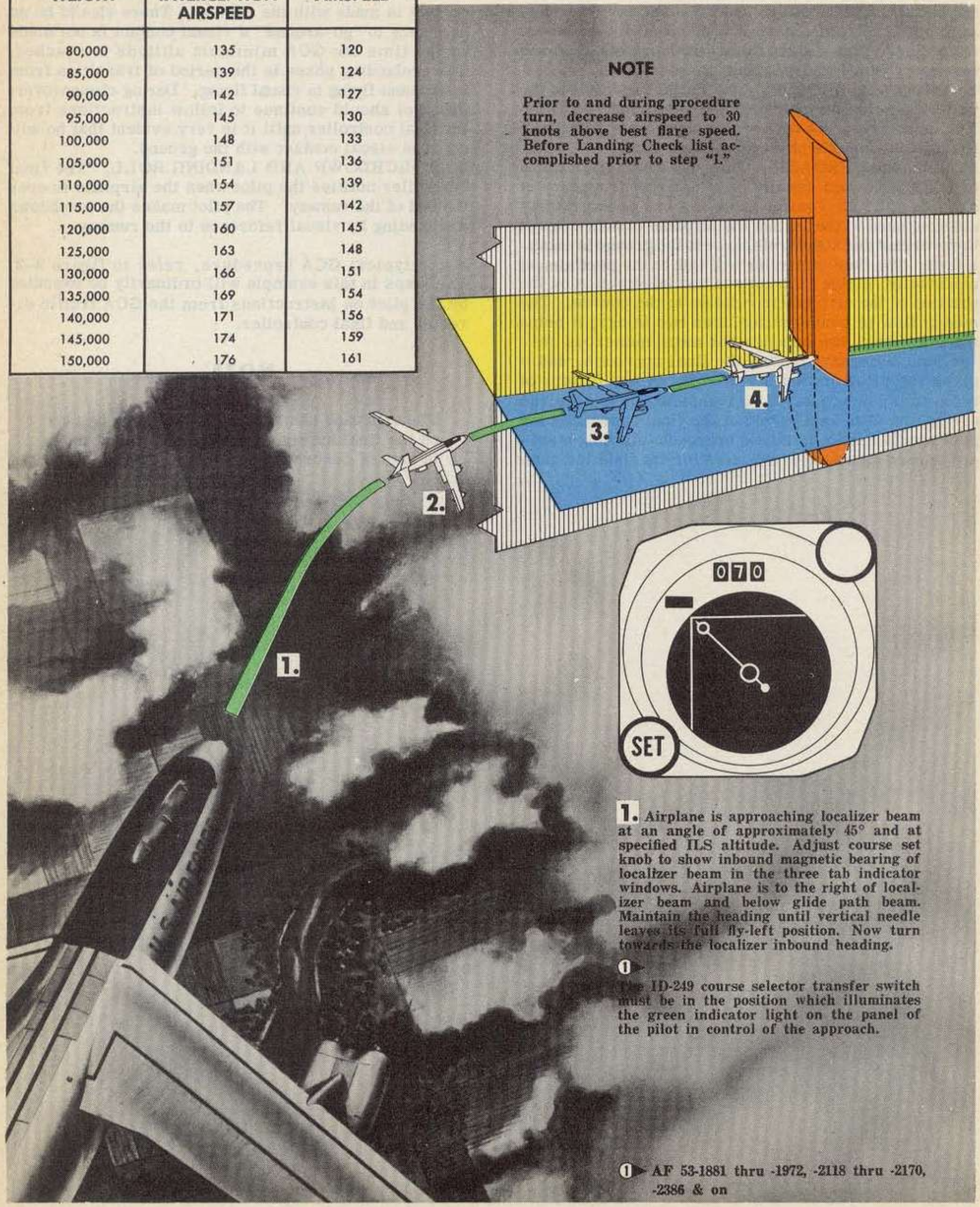
For a typical GCA procedure, refer to figure 9-2. The steps in this example will ordinarily be executed by the pilot on instructions from the GCA traffic director and final controller.

NOTE

The approach chute, if installed, may be used on the final approach to obtain faster changes in rate of descent.

instrument low

GROSS WEIGHT	LOCALIZER INTERCEPTION AIRSPEED	GLIDE PATH AIRSPEED
80,000	135	120
85,000	139	124
90,000	142	127
95,000	145	130
100,000	148	133
105,000	151	136
110,000	154	139
115,000	157	142
120,000	160	145
125,000	163	148
130,000	166	151
135,000	169	154
140,000	171	156
145,000	174	159
150,000	176	161



NOTE

Prior to and during procedure turn, decrease airspeed to 30 knots above best flare speed. Before Landing Check list accomplished prior to step "1."

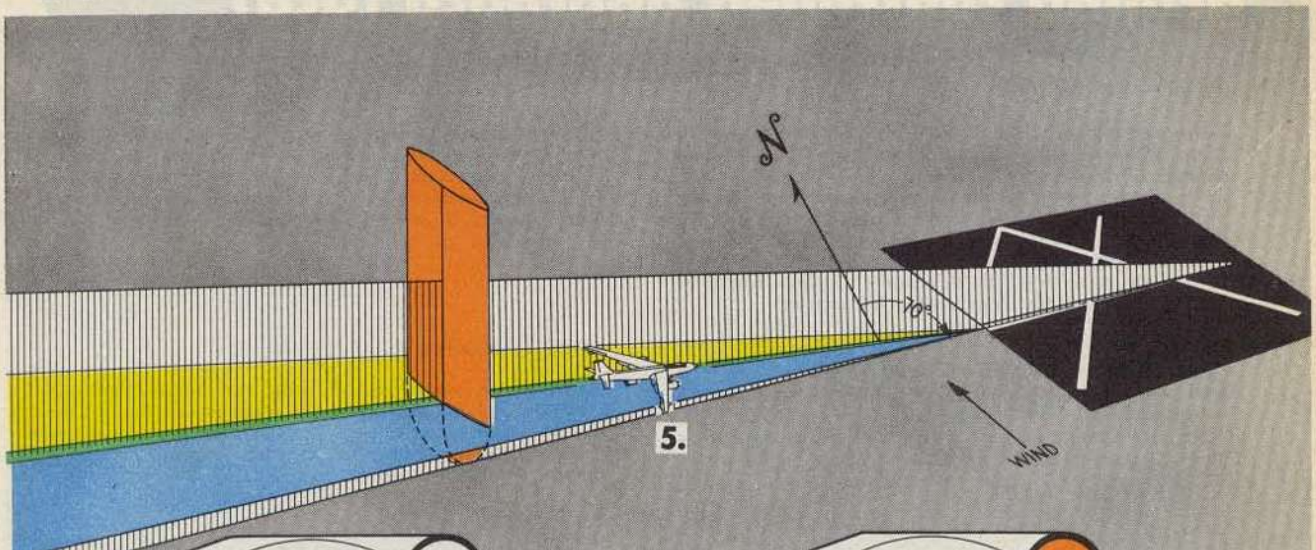
1. Airplane is approaching localizer beam at an angle of approximately 45° and at specified ILS altitude. Adjust course set knob to show inbound magnetic bearing of localizer beam in the three tab indicator windows. Airplane is to the right of localizer beam and below glide path beam. Maintain the heading until vertical needle leaves its full fly-left position. Now turn towards the localizer inbound heading.

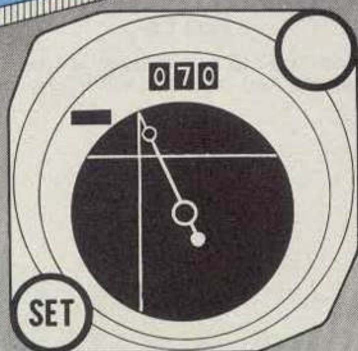
①▶ The ID-249 course selector transfer switch must be in the position which illuminates the green indicator light on the panel of the pilot in control of the approach.

①▶ AF 53-1881 thru -1972, -2118 thru -2170, -2386 & on

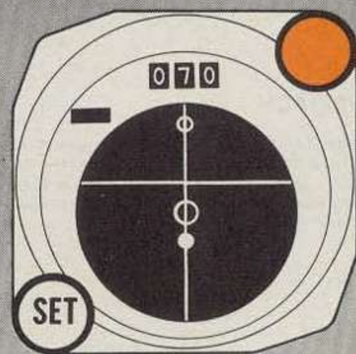
Figure 9-1B

approach system (ILS)

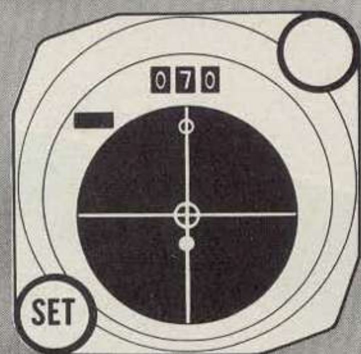




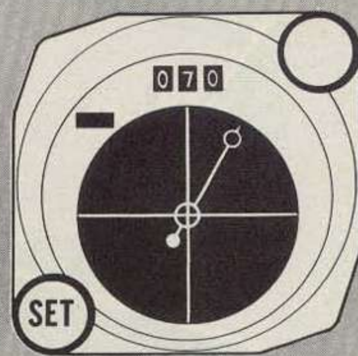
2. Adjust the rate of turn to keep the heading pointer aligned with the end of the vertical needle. This will result in smooth interception of the localizer beam since the rate of turn will be gradually reduced as the localizer beam is approached. Reduce airspeed to that given in "Localizer Interception Airspeed" column of the table.



3. Airplane is now on localizer beam and is heading directly toward the runway. The glide path is just above the airplane. Make gradual power reduction to intercept glide path smoothly without over shooting.



4. Airplane is on glide path and localizer beam and its heading is the same as that of the localizer beam. Reduce airspeed to that given in "Glide Path Airspeed" column of the table plus gust correction.



5. The airplane heading has been changed to the right in order to correct for a crosswind. Maintain position on localizer and glide path beam until visual contact is established with the runway or until ILS minimum altitude is reached.

50908WC

ground controlled approach (gca)

INITIAL APPROACH

1. Contact approach control at destination for release to GCA. When cleared by approach control, contact GCA on appropriate frequency. The local GCA traffic director will instruct the pilot to fly one or more headings so the airplane can be identified on the radar screen. After positive identification has been made, the pilot will be directed into the traffic pattern. The pilot will normally receive information on the latest weather, direction of landing, length of runway and other pertinent landing information.

2. Perform the "Before Landing" check.

3. Trim for straight and level flight at approximately 30 knots above best flare speed. (For example, 100,000 pounds, approximately 158 knots IAS.)

4. Prior to turning on final approach, decrease airspeed to 20 knots above best flare speed.

FINAL APPROACH

5. Select channel for final controller frequency and establish radio contact with final controller. After completion of turn on final approach, decrease airspeed to 5 knots above best flare speed plus gust correction preparatory to intersecting glide path.

6. Upon instructions from final controller, reduce power to give desired rate of descent along glide path. (At 100,000 pounds gross landing weight and with six engines operating, approximately 60% to 65% rpm will be required, varying to some degree with direction and velocity of wind.)

PRE-LANDING

7. Establish visual contact with runway and gradually change over to visual flying. If visual contact has not been made when reaching GCA minimums, follow the missed-approach procedure for the particular field and contact the tower for further instructions.

NOTE

When reaching GCA minimum altitude during approach, the final controller will inform the pilot.

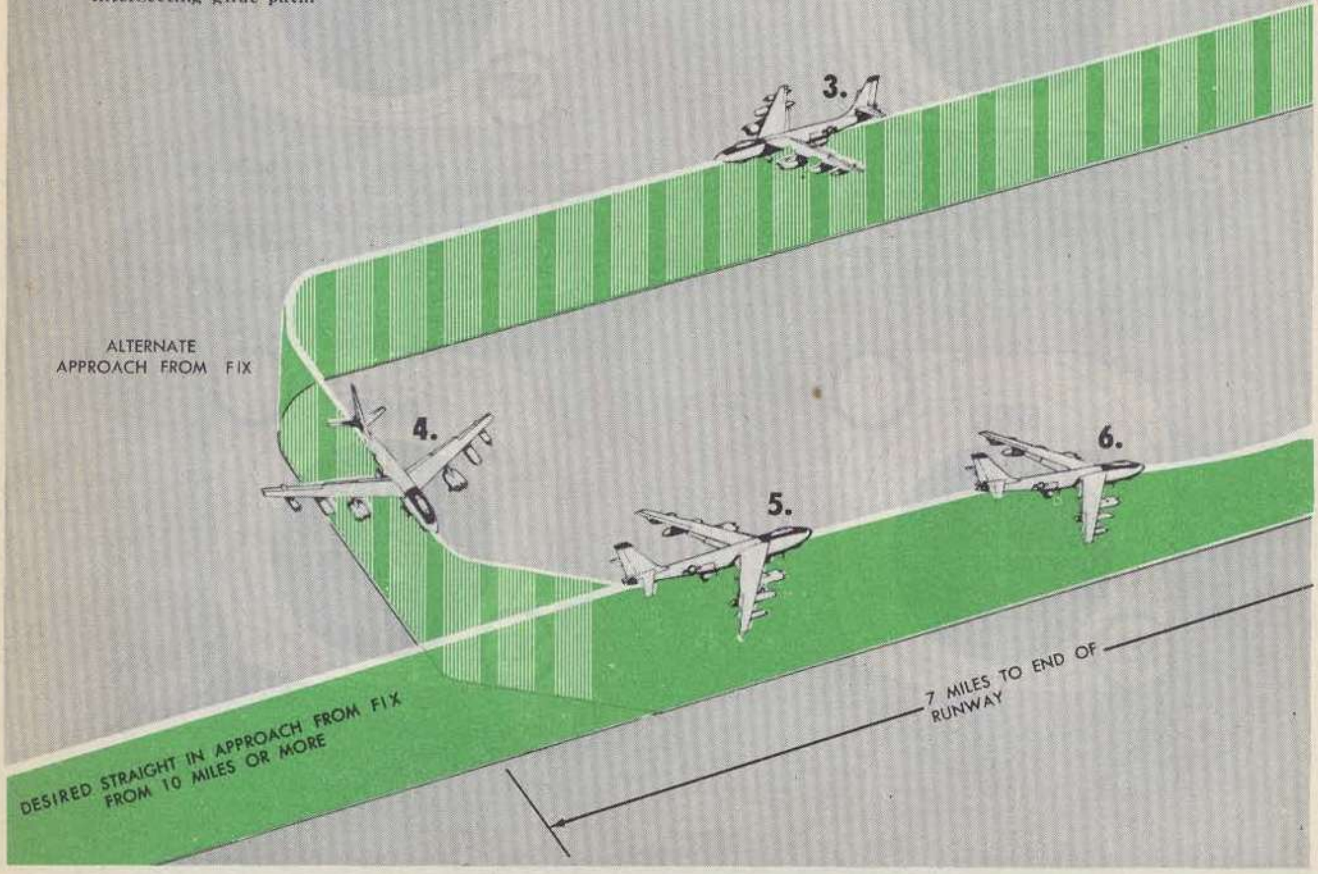


Figure 9-2 (Sheet 1 of 2 Sheets).

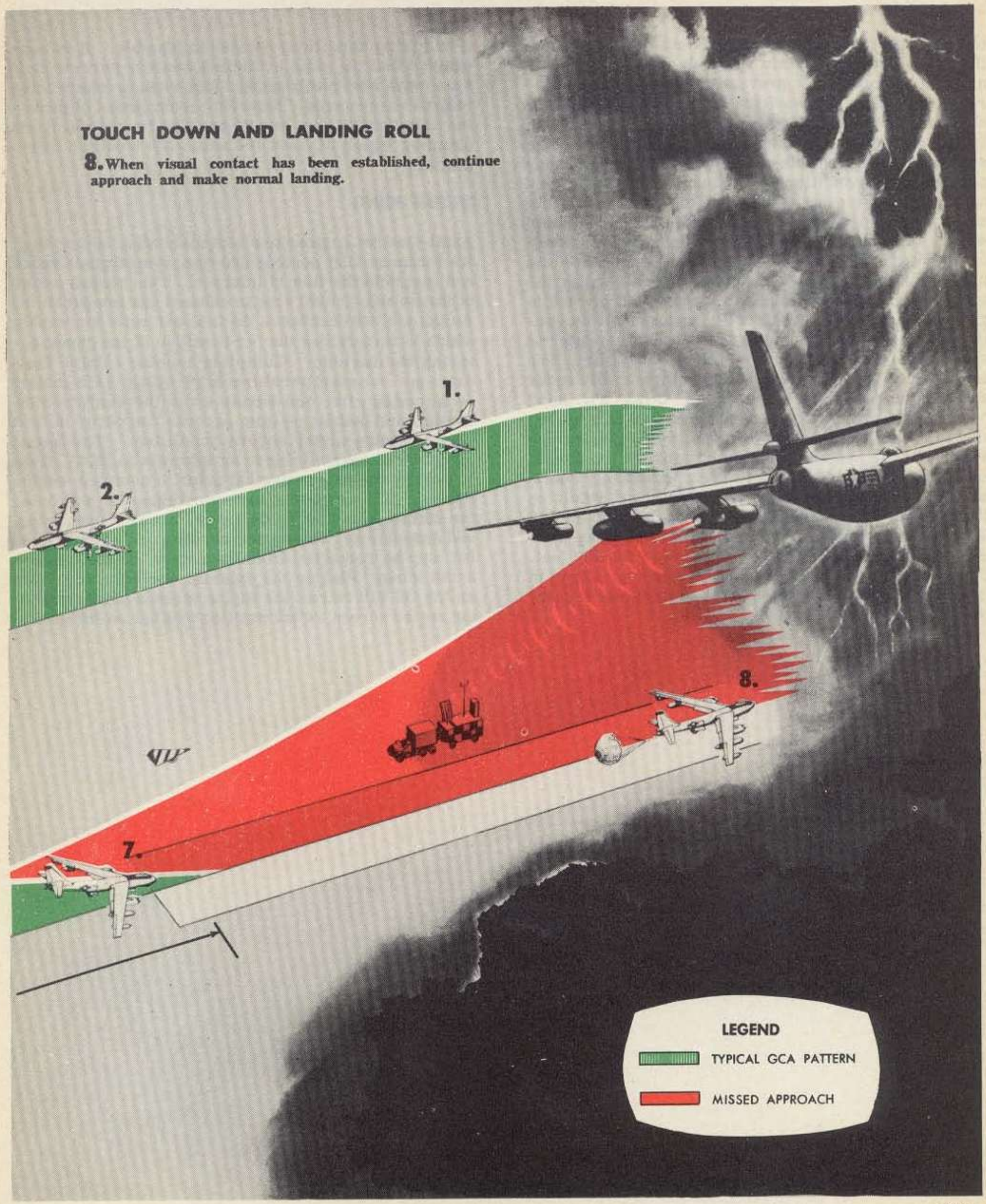


Figure 9-2 (Sheet 2 of 2 Sheets).

ice and rain

Ice and rain may be encountered both in flight and on the ground during certain weather conditions. This airplane is equipped to prevent ice formation in critical areas and to remove frost from the windshield and observer's windows. Freezing rain may not be handled by the anti-icing equipment as an operable anti-icing system is not a guarantee of effective anti-icing under adverse icing conditions. Ordinary rain should give no appreciable trouble, other than to restrict visibility and cause incorrect airspeed readings. Windshield wipers are not effective in heavy rain during takeoff and landing. Protection of the airplane from ice and rain while on the ground can be accomplished by the use of covers designed for that purpose. Their use is covered under "Cold Weather Procedures," this section. Icing occurs because of supercooled water in visible moisture such as fog, clouds, or rain. The most severe type of ice formation will generally occur at temperatures of approximately -5° C (23° F). Icing conditions usually will not be encountered at altitudes above 25,000 feet, except in cumuliform clouds such as thunderstorms. In such formations the horizontal extent of icing conditions will be comparatively short, but normally will have the heaviest icing and should be avoided if at all possible. Between 15,000 and 25,000 feet, the performance of the thermal anti-icing system will not be as critical as it is below 15,000 feet. Consequently, the greatest concern when operating in icing conditions is narrowed to the climb and descent phases of a mission.

Avoid icing conditions whenever feasible. It is recognized that the most proficient weather service cannot always accurately predict just when or where icing may be encountered. However, many areas of probable icing conditions can be avoided by careful flight planning which utilizes the available weather information.

ENGINE ICING

Axial-flow jet engines are seriously affected by icing. Ice forms on inlet screens and compressor guide vanes and restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in exhaust gas temperature. As the airflow decreases the fuel-air ratio increases, which in turn raises the temperature of the gases entering the turbine. Complete turbine failure from extreme overtemperature may occur in a matter of seconds after ice builds up in the engine inlet. Critical ice buildup on inlet screens can occur in less than 1 minute under severe conditions. The initial symptom of engine icing is an increase in EGT. This is usually the only indication prior to complete engine failure. All six engines have provisions for anti-icing the struts, air inlet guide vanes, nacelle, cowl ring, and nose dome. The engine screens are not anti-iced but may be retracted from the engine air passages to avoid icing. Placing the exterior surfaces anti-icing switch ON will retract the engine screens independent of the engine screen switch position whether on the ground or in the air. For additional information on engine icing, refer to section VII.

NOTE

- If icing conditions cannot be avoided, anti-icing system should be turned on prior to entering the icing area. Adjust airspeed if possible to maintain a free air temperature reading above 5° C. Ice may accumulate on the nacelle lips and nose cone during engine operation at constant power settings. Ice buildup about the engine inlet will not affect engine performance greatly unless large amounts of ice (greater than 1 inch) are allowed to accumulate. The possibility of ice buildups breaking off and entering the engine present a potential hazard that may result in almost immediate engine failure when operating at high power settings. Large pieces of ice breaking off the nacelle lips and nose cone have caused severe damage to engine compressor sections with engine screens open. After leaving icing conditions, the exterior anti-icing should be turned off, and the engine screens should be closed manually prior to increasing engine power since increased engine power will provide additional heat and speed to break off pieces of any accumulated ice. With engine screens closed, ice pieces breaking loose will shatter in small pieces against the screens before entering the engine. Engine screens should not be closed during flight in icing conditions because of engine icing and subsequent thrust loss and possible engine damage. (1)
- The engine screens on these airplanes are inoperative and positioned open. (2)
- Inadequate anti-icing is apt to occur on the lower surface of any engine accessory nose dome or on the left side of the inboard nacelles if engine rpm is below 80% to 85% due to poor distribution of the anti-icing air in these components.

OPERATIONS UNDER ICING CONDITIONS

GROUND OPERATION

Operate the exterior surfaces anti-icing system as given in section IV.

If icing is forecast, the engine inlet screens should be opened prior to starting engines so that a visual ground check can be made to assure that all sections of the screens are retracted. Possible malfunction of the engine inlet screen retraction system during (or prior to) takeoff may allow sections of the inlet screens to be partially extended. If icing is encountered, partial blockage of the engine inlet air may occur as detected by a subsequent increase in the tailpipe temperature or a loss in thrust. Consequently, the EGT gages must be monitored whenever icing is anticipated. If a rise in tailpipe temperature is detected, retard the throttle until the temperature begins to decrease below the maximum allowable. The throttle may then be advanced cautiously until the normal operating temperature is reached. Care should be taken not to aggravate the condition as engine failure may occur.

NOTE

- In order to obtain anti-icing protection during the takeoff run the anti-icing surfaces must be ground heated prior to takeoff due to the delay for warming up the anti-icing surfaces. At takeoff, the ground overheat control system will be deenergized by a squat switch on the landing gear and the flight overheat control system will be energized.
- If the anti-icing system is operating during takeoff, takeoff distance will be increased approximately 5%.

If icing conditions are anticipated during takeoff and climb, place in operation the following additional anti-icing systems just prior to the takeoff run:

a. Place left and right pitot anti-icing switches to ON.
b. Place windshield anti-icing switch to MAX HEAT if necessary.

(3)
c. In the event of, or to preclude ice, snow, rain or fogging on the windshield which may restrict visibility, open the clear vision panel.

(1) AF 51-2192 thru -2356, 52-035 thru -093, -095, -096, -100, -102, -108, -112, -115, -116, -118 thru -151, -161, -169, -172, -199, -312 thru -393, -456, -461, -462, -464 thru -507, -516, -519 thru -620, -3343 thru 53-1972, -2028, -2261 & on
(2) AF 51-2192 thru 52-043, -202 thru -218
(3) AF 52-593 & on

turbulent air penetration—allowable flight envelopes

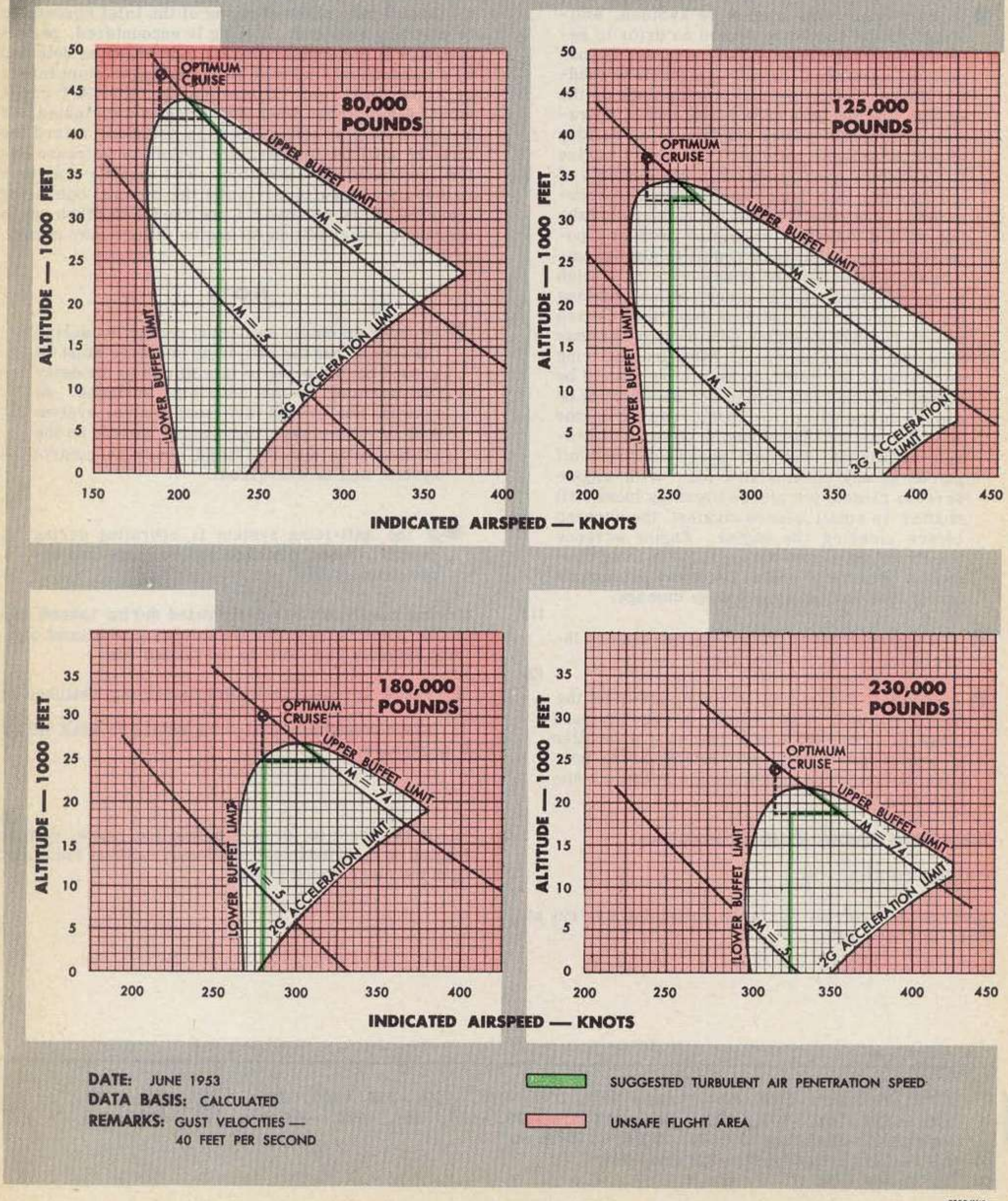


Figure 9- 3.

NOTE

With the relatively high power settings used during the climb phase of a mission, there will be maximum heat to all components of the thermal anti-icing system and protection will be assured even in heavy icing.

DURING FLIGHT

If sudden icing conditions are encountered, the anti-icing systems should be turned on at the first sign of icing, as outlined above.

NOTE

If anti-icing performance at altitude is inadequate due to low bleed air temperatures, it is more economical to improve anti-icing performance by decreasing altitude than to increase rpm excessively.

CAUTION

Continuous flight in icing conditions should not be attempted. Normally all the water which impinges on the leading edges would be evaporated by the anti-icing system. However, if the icing conditions are so severe that all water is not evaporated, the water which runs back from the leading edge will freeze on the wing, resulting in a loss of aerodynamic efficiency and a corresponding loss in performance and range. Runback ice can probably first be detected near the tips of the wings.

In the event icing of vortex generators occurs; it will not create a hazardous flight condition. Ice formed on vortex generators can possibly be removed by one of the following methods:

- Accelerating the airplane to a higher airspeed and burning off the ice by aerodynamic heating
- Mechanical removal by wing flexing
- By subliming the ice to the atmosphere after the icing zone is passed
- By solar heating of the airplane surfaces after the cloud layer has been exceeded.

NOTE

If extremely heavy ice should persist on the generators after an icing encounter, the mission should be aborted due to the large increase in drag and resulting large loss of range at cruise condition, reducing the probability of the airplane completing the mission.

DESCENT

Prior to descending through icing conditions, the following should be accomplished:

a. Determine the altitudes of each icing layer from available weather advisories.
b. Place the exterior surfaces anti-icing switch ON.
c. Check that the engine inlet screen switch is in OPEN position and that the screens are open.

During the descent, monitor the free air temperature gage for indications of the most probable icing temperatures, ±5° C at 305 knots IAS. Adjust throttles to maintain the following power schedule at least 10,000 feet above the highest icing level in order to provide adequate "warmup" time:

ALTITUDE	INDICATED FREE AIR TEMPERATURE	POWER SETTING
20,000 feet or higher	-18° C	83% rpm
15,000 feet	-12° C	79% rpm
10,000 feet	- 7° C	76% rpm
5,000 feet	- 3° C	72% rpm
Sea level	0° C	68% rpm

This power schedule will provide adequate protection through moderate conditions of icing and will result in a rate of descent near 4000 feet per minute with the gear down. Additional heat may be obtained for anti-icing by increasing the power settings.

If a rise in tailpipe temperature is noted during the descent (with the engine inlet screens retracted), ice has probably formed on the inlet guide vanes of the engine. To remove engine ice, use the following safe and approved method. It will furnish hot air to the inlet guide vanes of each engine since the anti-icing air flow to these components is not controlled by the exterior surfaces switch. The burst of hot air will clear the inlet guide vanes by melting the ice bonds and allowing the ice to slide aft into the engine and be consumed in minute particles.

a. If ice is visible on the nacelle lips or nose cone, turn off the thermal anti-icing system. Leave the anti-icing ON if no ice is visible.
b. Immediately advance the throttles to 100% rpm, then retard to the original setting.

c. Monitor the tailpipe temperature until a decrease in temperature is noted. If the temperature continues to rise 30 seconds after retarding the throttles to the original settings, retard the throttle to idle. There will be an increase in tailpipe temperature associated with each throttle burst; however, it should never become excessive.

NOTE

This throttle burst technique will generally be employed only once during a descent because of the high rates of descent used and the realtively thin vertical extent (normally less than 5000 feet) of icing conditions to which jet engines are most susceptible.

CAUTION

If the engine inlet screens are not completely retracted, advancing the throttle may only aggravate the condition and cause possible engine failure.

If there is visible ice and it becomes necessary to turn off the anti-icing system during throttle burst, it may be turned on at the completion of the procedure; however, the nacelles and nose domes should be observed periodically for possible ice ingestion, particularly after reaching the warmer levels of air at low altitude. If ice begins to break off about the engine inlet, throttles should be retarded to the minimum setting necessary to maintain anti-icing and a practical altitude.

NOTE

In the event the anti-icing system malfunctions during descent, any descent technique resulting in maximum vertical speeds at or below 305 knots IAS may be employed when it becomes necessary to penetrate a region of icing during a letdown.

LANDING

(1)

In the event visibility is restricted because of ice, snow, rain or fogging on the windshield, open the clear vision panel.

If a landing must be made on a wet or icy runway, proceed as follows:

a. If weather permits, make a practice visual approach to the landing runway, observing surface, overruns, and obstacles. Secure tower advice or pilot reports on braking condition of the runway. Check "Stopping Distances - Brakes Only" chart in part 10 of the appendix, using the wet concrete curves to insure that adequate stopping distance will be available after touchdown without reliance on the brake chute.

b. Reaffirm the maximum deployment speed for the type brake chute installed (115 knots IAS for unmodified chute; 160 knots IAS for modified chute).

c. Establish a normal approach with strict adherence to the correct approach speeds. Approach chute should be used in the normal manner if available since it will aid deceleration after touchdown.

d. On touchdown, immediately retard all throttles to the idle stop and simultaneously place throttles No. 1, 2, 5, and 6 to CUTOFF.

NOTE

Idle power must be kept on engines No. 3 and 4 to maintain hydraulic pressure.

e. Deploy brake chute as soon as the airplane decelerates below brake chute maximum deployment speed.

WARNING

When making a crosswind landing on a wet or icy runway, do not deploy the brake chute until positive directional control has been established. Premature deployment may pull the airplane off the runway and cause loss of control.

f. Depress and hold brake pedals to maintain optimum (2 or 3 seconds) cycling of the antiskid until the airplane is brought to a full stop. Slight back pressure on the control column will increase the load on the rear gear and produce more effective braking early in the landing roll.

g. If runway or ramps present a taxi hazard, the pilot should request a tow.

turbulence and thunderstorms

The swept wing on this airplane is thin and therefore naturally flexible. It will withstand a movement arc at the tip of more than 17 feet. This means a smoother and safer ride under turbulent conditions as the wing tends to absorb much of the shock. Zero geometric twist and dihedral is built into this airplane. Since the wing supports the body in flight, wing bending causes positive dihedral. This dihedral on a swept wing "washes out" or decreases the angle of attack at the tips. This washout delays tip stall and allows aileron control throughout the airplane stall. At high indicated airspeeds, the center of pressure moves inboard, thus decreasing this tip washout effect. Make a thorough analysis of the general weather situation to determine the thunderstorm areas and prepare a

(1) AF 52-593 and on

flight plan which will enable you to avoid flight through thunderstorms if at all possible. On the other hand, if circumstances require flight through severe turbulence, familiarization with the techniques recommended for such flight is essential.

The most turbulent area in a thunderstorm is usually found at altitudes between 10,000 and 20,000 feet with high gusts occurring most frequently in the vicinity of 15,000 feet near the freezing level. Hail and lightning also are most likely to be encountered at the freezing level. Consequently, this level should be avoided whenever possible. Minimum turbulence will be found at the extreme upper and lower altitude limits. Icing conditions are most prevalent at the top of such storms. For flight procedures in icing conditions, refer to "Ice, Snow, and Rain" in this section.

When flight in turbulence is anticipated, it is imperative that the airplane be prepared prior to entering the turbulent area. A penetration speed must be established which will give assurance that the airplane will neither reach limit load factor nor enter stall or high speed buffet regions. Power settings and pitch attitudes are the keys to proper flight techniques in maintaining this safe penetration speed once the turbulent zone is entered. If a constant power setting and pitch attitude is maintained throughout the storm, a more nearly constant airspeed will result regardless of any false readings of the airspeed indicator.

TURBULENT AIR PENETRATION AT OPTIMUM CRUISE ALTITUDE

During optimum cruise conditions at optimum cruise altitude, determination of a safe turbulent air penetration speed and altitude is a simple computation. Figure 9-3 graphically presents the allowable flight envelope for four weight conditions during flight in severe turbulence. These charts have been computed for 40 feet per second gusts which are the probable maximum sharp-edge gusts which can be expected; however, these charts will apply for all gust conditions below 40 feet per second. By reference to these charts, a definite relationship can be seen between optimum cruise altitude and Mach number and the recommended penetration speed. As a result of this relationship, the following simple rule can be stated. The best penetration altitude and speed can be established by descending approximately 3000 to 5000 feet below optimum cruise altitude and maintaining Mach .74 cruise. Example: Gross weight, 125,000 pounds.

turbulent air penetration speeds

OPTIMUM CRUISE ALTITUDE

THE BEST PENETRATION ATTITUDE AND SPEED CAN BE ESTABLISHED BY DESCENDING APPROXIMATELY 3,000 TO 5,000 FEET BELOW OPTIMUM CRUISE ALTITUDE AND MAINTAINING .74 CRUISE MACH NUMBER.

REMARKS:

GUST VELOCITIES — 40 FEET PER SECOND

DATE: JUNE 1953
DATA BASIS: CALCULATED

OFF ALTITUDES

- AT ALTITUDES ABOVE OR A FEW THOUSAND FEET BELOW OPTIMUM CRUISE ALTITUDE USE ABOVE PROCEDURE.
- AT LOWER ALTITUDES USE FOLLOWING CHART.

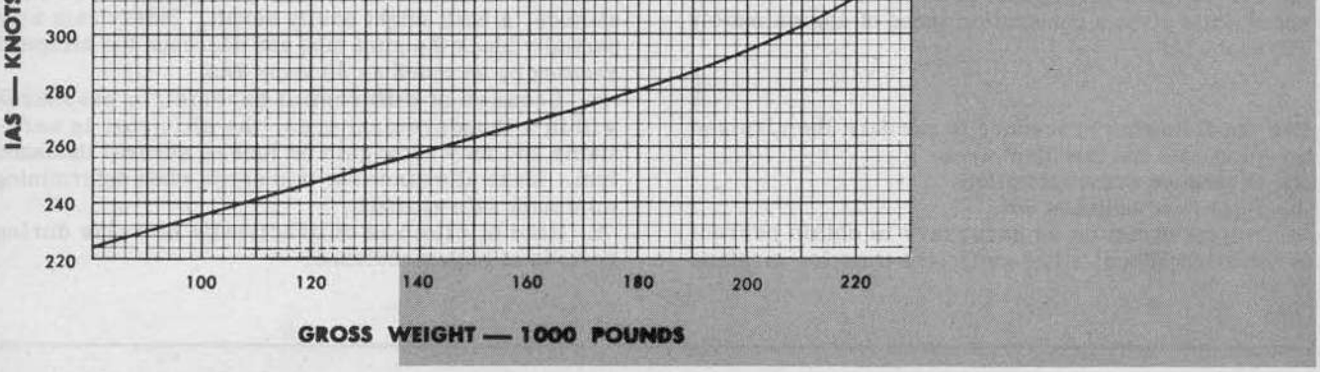


Figure 9-4.

What is a safe penetration speed and altitude when flying at optimum cruise? By reference to the example on the 125,000-pound chart in figure 9-3, dropping 5000 feet vertically from optimum cruise altitude to the 32,500-foot level and then moving horizontally to Mach .74 will give a penetration speed that is well within the allowable flight envelope for gust conditions and within the green recommended penetration speed area.

WARNING

Do not attempt to climb over a storm unless certain that the airplane can remain clear of turbulent areas and still retain safe margins from both low and high speed buffet (figure 9-3). At altitudes corresponding to optimum cruise altitude or higher, the addition of any appreciable load factor of more than the normal 1 "g" will result in buffeting.

TURBULENT AIR PENETRATION AT OFF ALTITUDES

When flying at altitudes higher than optimum cruise altitude, it is readily seen that adherence to the above rule (for flight at optimum cruise altitude) is mandatory when determining penetration speeds. It is recommended in order to obtain best range and performance that this rule also be used when flying at altitudes reasonably below optimum cruise altitude. For lower altitudes on down to sea level, reference to the flight envelopes (figure 9-3) shows that a singular safe speed for each gross weight, independent of altitude, will satisfy the requirements for penetration of areas of maximum turbulence and will remain well within the allowable flight envelope. For penetration speeds at these lower altitudes, a speed-gross weight curve (figure 9-4) is presented for all gross weight conditions. Consult this curve to find the turbulent air penetration speed for a given gross weight. Example: Gross weight, 160,000 pounds. What is the recommended safe penetration speed while flying at 10,000 feet? Referring to figure 9-4, read 160,000 pounds gross weight on chart and move vertically to the curve. Comparing this point on the curve to the speed scale gives a penetration speed of approximately 269 knots IAS.

Use the following procedure to prepare the airplane for entry into the turbulent area.

a. Disengage automatic pilot.
b. Pitot heat switches ON.
c. Adjust throttles as necessary to obtain correct penetration speed; allow sufficient time for airplane to assume this speed before the turbulence is encountered.
d. Check gyro instruments.
e. Safety belt tightened (notify crew).

(1)

f. Turn off all electrical equipment dependent upon alternator operation, if possible. High moisture content in the atmosphere may cause loss of unregulated AC power.
g. Turn off any radio equipment rendered useless by static.
h. Turn volume down on any radio equipment in use to avoid possibility of being momentarily stunned by acoustic shock.
i. At night, turn on white flood lights to minimize blinding effect of lightning.
j. Do not lower landing gear or wing flaps either before or after entering a turbulent area as they merely decrease the aerodynamic efficiency of the airplane.

In order to maintain safe flight after entering a storm, certain procedures are necessary as outlined below:

a. If wet snow or freezing rain is encountered, place the exterior surfaces anti-icing switch in ON and wing, nacelle, and empennage overheat control switch in NORMAL position. Place windshield anti-icing switch in MAX HEAT position.
b. Maintain power settings and pitch attitude (established before entering the storm) throughout the storm. If these are held constant, airspeed will remain constant regardless of airspeed indicator reading.
c. Devote all attention to flying the airplane.
d. Concentrate principally on holding level attitude.
e. Use as little elevator control as possible to maintain attitude in order to minimize stresses imposed on the airplane.
f. Operation of turn-and-bank indicator can be relied on regardless of the attitude of the airplane; in severe turbulence however, the needle will fluctuate rapidly and ball travel will be excessive.

In addition, it should be considered that certain instruments are unreliable in severe turbulence, as listed below:

a. Do not chase the airspeed indicator; doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while airplane is in a nose-high attitude, a stall might easily result. Heavy rain may partially block the pitot tube and decrease the airspeed reading by as much as 60 knots IAS.
b. Because of differential barometric pressures within a thunderstorm area, the altimeter is unreliable and may show gain or loss of several thousand feet. Make allowance for this error when determining minimum safe altitude.
c. Rate of climb is of practically no value during periods of high turbulence.

(1) AF 51-2357 thru 52-105, -202 thru -296

night flying

On entering airplane, turn on interior lighting. Adjust light rheostats to provide illumination of all necessary controls and panels. Lights should be as dim as possible so that the crew members' night vision will not be affected or limited. Before night taxiing, place right and left landing light switches to ON; or place taxi light switch to ON, if installed. Place navigation light dimming switch to BRIGHT. Place navigation lights flash switch to FLASH. During night takeoff, use the same procedure as for day takeoff with the following exceptions: Place taxi light switch to OFF. Place right and left landing light switches to ON. Both landing lights should remain on throughout the ground roll and takeoff until the airplane is airborne, the climb established, and obstacles cleared in order to maintain proper ground clearance.

NOTE

Under conditions of restricted visibility such as haze and smoke, landing lights may or may not be used.

After takeoff, place right and left landing light switches to OFF. Turn off all unnecessary interior lights. Before landing, place right and left landing light switches to ON.

cold weather procedures

The majority of cold weather operating difficulties are encountered on the ground. The following instructions are intended to supplement the normal operating instructions in section II, and should be followed where applicable as arctic-type weather is encountered. Extreme diligence on the part of both the ground and flight crews is the answer to successful arctic operation. Icing conditions during flight will not be considered here, as they have been covered under the heading of "Instrument Flight Conditions."

BEFORE ENTERING THE AIRPLANE

Even though preflight has been accomplished by the ground crew, the flight crew should make a number of checks in addition to the procedure in section II.

a. Check that the pressurized compartment has been preheated at temperatures below -18° C (0° F); no preheating of engines is necessary if adequate power source for starting is available.

b. See that all protective covers have been removed from the airplane and all closures removed from engine air intake ducts and tailpipes.

c. Check bottom section of front stator blades for evidence of ice.

NOTE

Engine heat on shutdown melts ice accumulated on previous flight and the moisture will refreeze in the lower sections of the front stator and rotor blades. An attempted engine start will result in starter failure. If engine is not free to rotate external heat must be applied to forward engine sections to produce thawing. Start the engines as soon as possible after the application of heat in order to remove all moisture before refreezing can recur.

d. Inspect pitot tubes and have ice removed if present.

e. Check all oil tank and fuel tank vents for free passage; have any traces of ice or frost removed.

f. Check to see that ground crew has drained all fuel and oil sumps.

g. Check entire airplane for freedom from frost, snow, and ice; brush off light snow or frost, and have all ice removed by a direct flow of heated air from portable ground heater. Insure that water resulting from ice removal by application of heat does not refreeze on the aircraft surfaces, especially on the control surface hinge line.

CAUTION

- To chip or scrape ice may damage airplane.
- Snow or ice on the balance seals will limit flexibility and cause deterioration; therefore, a thorough check should be accomplished in these areas.

NOTE

A light coating of deicing alcohol (isopropyl) applied to wing and empennage surfaces after all snow and frost is removed will help prevent additional accumulation of ice and frost prior to takeoff. Isopropyl has no adverse effect on balance seals.

CAUTION

Use extreme care to prevent isopropyl from coming in contact with plexiglass canopy or any plexiglass or plastic operational equipment because isopropyl tends to craze or soften these materials.

h. See that all dirt or ice has been removed from landing gear shock struts, actuating cylinder pistons, and limit switches.

i. On airplanes having bomb bay vacuum pumps, the main and standby pumps should be checked to assure satisfactory operation.

j. Check that all flap and landing gear limit switch plungers are free.

k. Camera vacuum pump should be checked to assure satisfactory pump operation.

l. Check that fuel filter elements have been removed and inspected to assure that elements have not iced and ruptured. Ascertain that batteries are fully charged.

ON ENTERING THE AIRPLANE

NOTE

At low temperatures the reduction of air bottle pressure from the normal is in proportion to temperature reduction. The minimum safe air bottle pressure for jettisoning the observer's hatch at -54° C (-65° F) is 1350 psi.

a. Check for stowage of anti-exposure suits.

b. Check for stowage of seat-type survival kits. Survival kits should be type designed for cold or very cold climates, depending on weather and terrain over which mission is to be flown.

c. Carefully check surface controls and trim tabs for proper operation.

d. Operate all surface controls several times to determine if operation is normal and not hampered by ice in hinge joints, which could not be seen during visual check of airplane.

WARNING

(1) When the airplane has been cold soaked at temperatures below -29° C (-20° F) for an extended period of time, the elevator balance seals tend to stiffen causing high elevator control forces to be experienced by the pilot in event of surface power failure or with surface power off. Takeoff should not be attempted until the elevator balance seals have been ground warmed sufficiently so the elevator can be readily actuated through its full travel with the surface power control system off.

BEFORE STARTING ENGINES

a. Check that external power source is connected.

b. Make sure that wheel chocks are placed securely so danger of slipping will be minimized during engine start and warm-up.

c. Operate brakes several times with increasing pressures before setting parking brakes.

d. Set cabin air selector switch at AIR COMP.

e. If temperature is from -18° to -54° C (0° to -65° F) and ATO is to be used for takeoff, ATO bottles which have been stored as instructed in a temperature range from -18° to 54° C (0° to 129° F) should be installed in airplane just prior to engine start to minimize cooling period before use.

STARTING ENGINES

a. Heating of jet engines is seldom required; however, if an external power source of 28.5 volts is not available for starting, preheat engine to reduce starter loads.

b. Start engines in normal manner. If a start is not accomplished, the attempt should be discontinued On the next start attempt, advance the throttle past the START detent. Do not advance the throttle past idle detent position. Monitor EGT gage and retard throttle as soon as engine fires to control EGT. After EGT has stabilized momentarily, advance throttle to idle maintaining EGT between 600° and 690° C.

c. If there is no oil pressure after 30 seconds running, or if pressure drops after few minutes ground operation, shut down and check for blown oil lines. A normal oil pressure drop can occur in cold weather when the pressure relief valves open. If such a pressure drop occurs, retard the throttles to the idle position until the oil warms and pressure rises; then advance the throttles again. A sudden loss of oil pressure in cold weather, other than a drop caused by a relief valve opening, is usually due to a broken oil line.

NOTE

During cold weather starts, oil pressure may temporarily exceed maximum limits until oil temperature reaches normal.

WARM-UP AND GROUND TESTS

a. Inspect all instruments for normal operation.

WARNING

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

(1) AF 51-2357 thru 52-149, -202 thru -311

NOTE

No warm-up is required if the oil pressure remains below 22 psi at full throttle. A temporary high pressure of above 22 psi at temperature below -18° C (0° F) is not dangerous, but takeoff should be delayed until the pressure drops below 22 psi.

CAUTION

Do not turn on unneeded electrical equipment until generators show output.

b. Special attention during preflight must be given to hydraulic systems. Energize the emergency system and surface power control systems before flight in order to build up proper pressure and to insure proper operation of systems. Brakes, front gear steering, canopy, bomb doors, air refueling slipway doors, and surface power controls should all be operated several times to assure free and/or positive movement.

CAUTION

When operating the wing flaps at low temperatures, the flap position indicator should be closely observed for positive movement. If the flaps should stall, immediately place the flap lever in OFF position to prevent damage to the motor.

c. If precipitation is present, or if icing conditions are anticipated during or immediately following takeoff, place exterior surface anti-icing switch to ON position.

TAXIING INSTRUCTIONS

a. Reduce speed and increase normal taxi interval time between airplanes on ice or snow covered area. Be especially careful in maneuvering near other craft as down blast of the B-47 engines develops a great deal of ice on the ramp and takeoff area of the runway and blows snow and slush which freezes into ice on contact.
b. Avoid taxiing in deep snow or slush as steering will be more difficult and brakes, gear, and flaps are likely to freeze after takeoff.

NOTE

Taxi time on snow and ice will be longer than under normal conditions, so plan the shortest possible route to takeoff point to conserve fuel and reduce the amount of ice fog generated by jet engines. This fog may delay takeoff by lowering the visibility below takeoff minimum.

CAUTION

Use extreme caution when taxiing over ice-covered taxiways or runways, as excessive speed or high crosswinds may start a skid. Attempt all turns at reduced speed. Remember brakes are ineffective on ice.

BEFORE TAKEOFF

a. Make sure that all loose snow is either removed from runway or firmly packed; if snow has been removed from runway, see that it is not piled into banks parallel with and too close to runway for safe takeoff.

TAKEOFF

a. If precipitation is present, or if icing conditions are anticipated during or immediately following takeoff, place pitot anti-icing switches (left and right) to ON just prior to beginning takeoff run.
b. Apply brakes and advance throttles to full OPEN position. If airplane starts to slide on ice or snow before full power is reached, release brakes immediately and begin takeoff run. Continue engine check and run-up during early part of takeoff run. If takeoff cannot be accomplished due to engine malfunction, cut engines and bring airplane to normal stop.

WARNING

Do not attempt to takeoff with a badly frosted windshield or with snow, ice, or frost on wings and control surfaces.

CAUTION

At low temperatures, it is possible tc exceed maximum allowable EGT at less than 96% rpm.

AFTER TAKEOFF

a. After takeoff from a snow or slush covered field, operate landing gear and wing flaps through several cycles to prevent their freezing in the up position.

CAUTION

- When operating the wing flaps at low temperatures, the flap position indicator should be closely observed for positive movement. If the flaps should stall, immediately place the flap lever in OFF position to prevent damage to the motor.
- Wing flaps may not retract at speeds above 175 knots IAS during prolonged exposures at temperatures between -40° C (-40° F) and -54° C (-65° F).

b. If windshield anti-icing is not adequate with switch in NORMAL position, place switch in MAX HEAT position.
c. Watch closely for ice formation on critical areas; position exterior surfaces anti-icing switch to ON as soon as detected, and turn off as soon as conditions improve.

CLIMB

Follow normal procedure for climb.

NOTE

Keep in mind that many flight instruments may be unreliable at extremely low temperatures; moreover, since low OAT will cause a considerable increase in jet-engine thrust, the airplane operating limitations may be reached with somewhat lower power settings.

DURING FLIGHT

NOTE

A gain in endurance will be obtained on a very cold day over normal temperature conditions.

a. Adjust cabin temperature selector rheostat to give required cabin heat.
b. Under certain atmospheric conditions, it is possible for fog to accumulate in the cabin while pressurized, and seriously restrict visibility. If this occurs, immediately turn cabin temperature selector rheostat to full INC position (if operating under manual temperature control, hold heat selector switch in HOT position).
c. After cabin has cleared, reposition cabin temperature selector rheostat (if operating under manual temperature control, move heat selector switch to COLD position) to obtain cabin air temperature sufficiently higher than original to prevent recurrence of fog condition. If comfortable temperature cannot be maintained without fogging, depressurize cabin until an area with more favorable atmospheric conditions is entered.

DESCENT

If conditions are such that windshield frosting is anticipated on descent to lower altitude, operate the windshield anti-icing system as instructed under "Windshield Defrosting" in section IV.

NOTE

- Severe icing conditions will require such high engine rpm in order to provide adequate hot air to the wing and nacelle anti-icing systems that only a gear down descent will be possible.
- In the temperature range of -29° C (-20° F) and below, extension time of the landing gear will be progressively greater. However, the maximum extension time allowable for these temperatures in 90 seconds.

LANDING

For landings on ice- and snow-covered runways use the procedure given for "Landing" under "Ice and Rain," this section.

STOPPING ENGINES

Use normal procedure to stop engines.

POST FLIGHT

a. Have wheel chocks in place so parking brakes can be released; if moisture has entered brake assembly around brake shoes, leaving parking brakes released will forestall possibility of brakes freezing in position.
b. On some airplanes*, due to the great contraction coefficient of the plastic canopy when exposed to very low temperatures, the canopy will not seat properly and the latches will not engage. During extreme cold weather, the canopy should be left in a closed and locked position except when the airplane is placed in a heated hangar.

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* AF 51-15804 thru -15812 and 52-202 thru -235

c. Have airplane serviced with fuel and oil and drain all sumps before condensates reach freezing point.
d. See that wing, empennage, aft fuselage, nose fuselage, canopy, and pitot tube covers are installed; if there is the slightest possibility of blowing or drifting snow, have both main landing gear wheel well covers, cooling air intake, cooling air exhaust, and inverter duct shields installed.
e. Check that all engine protective covers and intake and tailpipe closures are installed.
f. Have all dirt and ice cleaned from shock struts.
g. If layover of several days is anticipated during zero temperatures, have batteries removed; if temperature is -7° C (21° F), batteries should be removed when layover of 4 hours or more is expected. (Batteries should be kept at maximum specific gravity at all times.)
h. See that airplane is moored securely.

hot weather procedures

Successful hot weather operation will require additional attention and preparation other than the normal operating instructions in section II. Proper protection of the aircraft while on the ground is your assurance of future successful missions.

BEFORE ENTERING THE AIRPLANE

a. Check tires and shock struts for proper inflation; overinflation is often encountered during high temperatures.
b. Check to see that electrical equipment is completely dry; in locations where high humidity is encountered, equipment will be subject to malfunctions due to corrosion, fungus, and moisture absorption by non-metallic materials.
c. Check for hydraulic leaks as heat and moisture may cause valves and packings to swell.
d. Cool the cabin by application of an A-1 portable cooler.

ON ENTERING THE AIRPLANE

a. Place master air conditioning switch in ON position and cabin air selector switch in RAM SUPPLY position for cabin ventilation.

CAUTION

With the bombing-navigation system on, ram air supply should not be used.

b. If high humidity has caused instruments and cabin controls to become covered with moisture, heat with flow of warm air from portable ground heater if necessary to dry thoroughly.
c. Check for stowage of seat-type survival kits. If mission calls for flight over tropic or jungle areas, kits should be type designed for hot climate.

BEFORE STARTING ENGINES

a. Operate all movable control surfaces through several complete cycles in order to be sure that operation is free and easy.
b. Check takeoff distances by use of charts in appendix.

STARTING ENGINES

a. Complete as much of preflight as possible prior to starting engines; they should never be run on the ground any longer than necessary.
b. Start engines by normal procedure.

NOTE

Engines will accelerate to idle rpm on a hot day much more slowly than on a normal or cold day.

TAXIING INSTRUCTIONS

Use brakes as little as possible since cooling will be retarded by high temperatures.

TAKEOFF

CAUTION

Required takeoff distances with normal temperatures show a marked increase during hot weather operation. It should be noted however, that the total impulse provided by ATO units is not affected by temperature variations and, when assist is used, the required takeoff distance increase due to high temperature is considerably shortened.

CLIMB

Follow normal climb pattern for conditions prevailing.

NOTE

The fuel in the tanks is warm and more susceptible to vaporization losses with rapid climbs to altitude; therefore, the rate-of-climb should be held as low as practicable. Also, the effect of OAT on climb performance is such that for each 10° F that the OAT deviates upward from the NACA standard temperature (60° F), the rate of climb decreases 5%; time to climb increases 6%; climb range increases 6%, and climb fuel consumption increases 2%. This loss in performance can be overcome by increasing power. On a very hot day, a climb at military rated power will give approximately the same rate-of-climb as normal rated power on a standard day.

DURING FLIGHT

Under high temperature conditions, it will be necessary to increase rpm to establish the desired Mach number-altitude combination for best range. Refer to the chart, "Optimum RPM for .74 Mach" in part 6 of the appendix.

NOTE

The endurance is reduced by approximately 6% on an extremely hot day (120° F at sea level).

DESCENT

Use normal descent procedure.

APPROACH TO PATTERN

During extreme high temperatures, there is more reason for strict adherence to normal landing procedures than at other times because the true airspeed is higher for the same indicated airspeed, thus causing the true touchdown speed to be higher.

LANDING

Use normal landing technique and anticipate longer ground roll in hot weather.

STOPPING ENGINES

a. Stop engines by using suggested normal procedure.
b. As soon as parking position has been reached, have wheel chocks securely placed and release parking brakes at once to forestall possible damage to brake shoes and expander tubes because of excess heat generated during taxiing.

POSTFLIGHT

a. Have engine intake and tailpipe closures, and canopy, nose fuselage, and tire covers installed for protection from sun.
b. Leave canopy and doors open for ventilation.
c. Have fuel and oil tanks serviced.

NOTE

If fuel tanks are topped off, fuel expansion due to high temperature may cause considerable overflow, presenting a fire hazard.

desert procedures

High temperatures, together with blowing sand and dust, make desert operations considerably more difficult than normal conditions which are covered by operating instructions in section II. Considerable damage to both airplane and engines can occur if extra precautions covered in this section are not observed.

BEFORE ENTERING THE AIRPLANE

a. All possible ground checks should be made before starting engines.
b. Check tires and shock struts for proper inflation; overinflation is often encountered during high temperatures.

CAUTION

Position the airplane so that consideration can be given to other aircraft, personnel, and ground installations when engines are started. Sand blown by operating engines of one airplane can add hours to the maintenance problems of other airplanes, or do bodily harm to personnel.

c. Inspect all movable control surface hinges for sand and/or excess dust and have cleaned away if present.
d. Check for sand on shock strut pistons or other hydraulic pistons and in area where piston touches cylinder seal; if sand is evident, have it removed.
e. Have all protective covers and engine closures removed before entering airplane.

ON ENTERING THE AIRPLANE

a. Check for excessive dust accumulation on instrument dials and blown sand on and around movable flight controls, dials, and switches, and have cleaned.
b. Place master air conditioning switch in ON position and cabin air selector switch in RAM SUPPLY position for cabin ventilation.

CAUTION

With the bombing-navigation system on, ram air supply should not be used.

c. Check for stowage of seat-type survival kits. Survival kits should be type designed for operations in desert areas.

BEFORE STARTING ENGINES

a. Operate all movable control surfaces through several complete cycles in order to be certain that operation is free and easy.

b. Check takeoff distances by use of charts in appendix.

STARTING ENGINES

a. Complete as much of preflight as possible before starting engines; they should never be operated on ground any longer than necessary.
b. Start engines by normal procedure.

NOTE

Engines will accelerate to idle rpm on a hot day much more slowly than on a cold day.

CAUTION

Get the airplane into the air as soon as possible after the engines have been started so that dust and blowing sand will not be drawn through the engines with resultant damage to internal parts.

WARMUP AND GROUND TESTS

a. To prevent damage by sand blasting, be certain that airplane is clear of other airplanes during all ground operations.
b. Only normal warm-up period is required to allow stabilization of exhaust gas temperatures.

TAXIING INSTRUCTIONS

a. Use brakes as little as possible since cooling will be retarded by high temperatures.
b. When taxiing, keep adequate distance between airplanes to prevent engine blast from blowing sand on and into following airplanes.

BEFORE TAKEOFF

Unless absolutely necessary, do not take off during sand or dust storms; head airplane into wind, stop engines, and have all protective covers and closures installed.

TAKEOFF

CAUTION

Required takeoff distance with normal temperatures show a marked increase during hot weather operation. It should be noted, however, that the total impulse provided by ATO units is not affected by temperature variations; when assist is used, the required takeoff distance due to high temperature is considerably shortened.

Be prepared for sudden gusts of wind during takeoff run.

CLIMB

NOTE

The effect of OAT on climb performance is such that for each 10° F that the OAT deviates upward from the NACA standard temperature (60° F), the rate-of-climb decreases 5%; time to climb increases 6%; climb range increases 6%, and climb fuel consumption increases 2%. This loss in performance can be overcome by increasing power. On a very hot day, a climb at military rated power will give approximately the same rate-of-climb as normal rated power on a standard day. Also, the fuel in the tanks is warm and more susceptible to vaporization losses with rapid climbs to altitude; therefore, the rate-of-climb should be held as low as practicable.

Follow normal climb procedure for conditions prevailing.

DURING FLIGHT

CAUTION

Avoid flying through dust storms if possible; excessive dust and grit in the air will cause considerable damage to internal engine parts.

NOTE

The endurance is reduced by approximately 6% on an extremely hot day (120° F at sea level).

Under high temperature conditions, it will be necessary to increase rpm to establish the desired Mach number-altitude combination for best range.

DESCENT

Use normal descent procedure.

APPROACH TO PATTERN

During extreme high temperatures, there is more reason for strict adherence to and compliance with normal landing procedures than at other times because the true airspeed is much higher for the same indicated airspeed, thus causing the true touchdown speed to be higher.

LANDING

Use normal landing technique and anticipate longer ground roll in hot weather.

STOPPING ENGINES

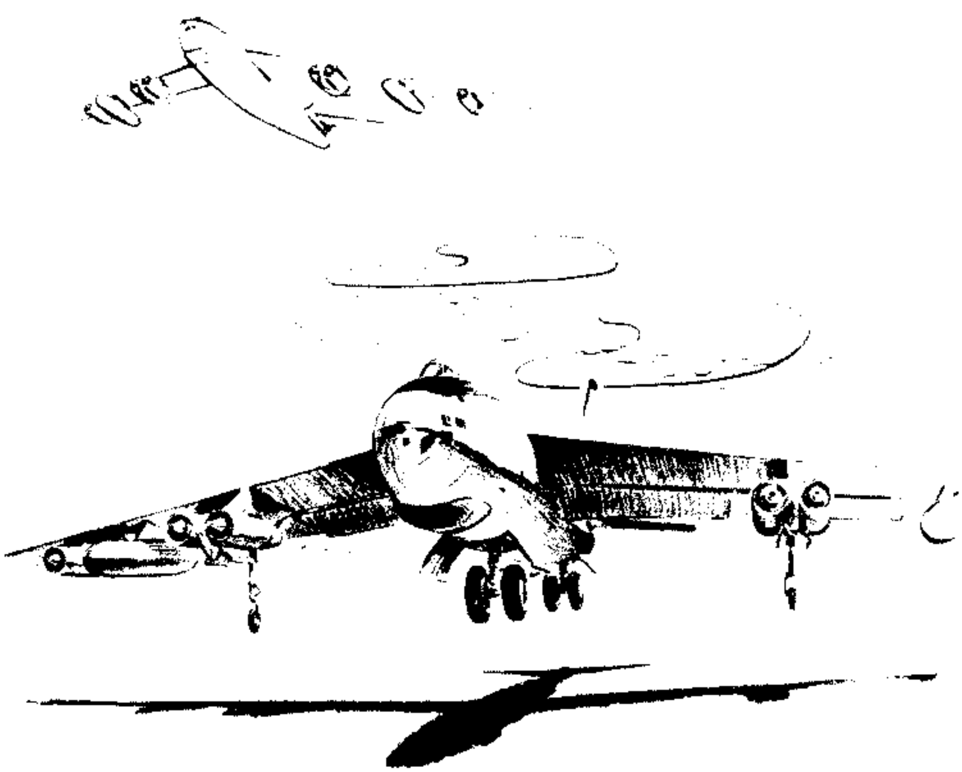
a. As soon as airplane is taxied to parking position, stop engines at once.
b. Have dust covers and closures installed immediately to prevent blowing sand and dust from entering engines.
c. Have wheel chocks securely placed and release parking brakes immediately to forestall possible damage to brake shoes and expander tubes because of excess heat generated during taxiing.

POSTFLIGHT

a. See that all ducts and openings are covered; have both forward and aft main landing gear wheel well, fuselage nose, pitot tube, and canopy covers installed.
b. Leave canopy and entrance door partly open for ventilation; at the first indication of windblown sand or dust, close canopy and entrance door.
c. Have shields placed in cooling air intake, cooling air exhaust, and inverter ducts.

NOTE

- In extreme dusty locations where it is necessary to leave hatches or doors open for ventilation, all equipment in the cabin should be covered with dust proof covers where possible to keep out dust and blowing sand.
- If fuel tanks are topped off, fuel expansion due to high temperature may cause considerable overflow, presenting a fire hazard.



performance data

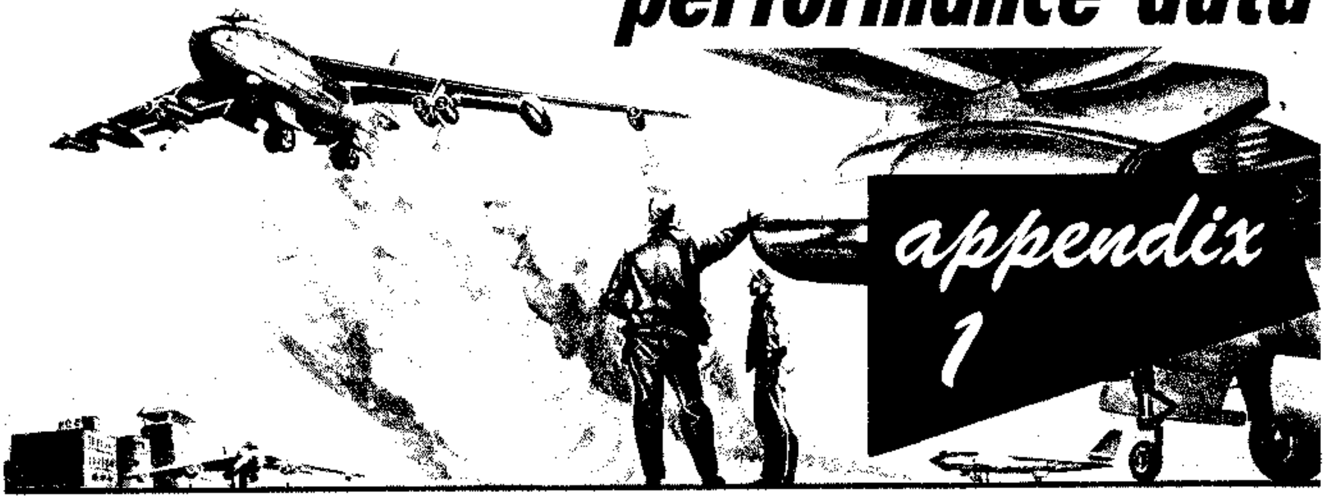


table of contents

Part 1 introduction

INTRODUCTION

All performance in this book is based on an NACA standard day (temperature = 59° F at sea level, decreasing uniformly to -67° F at 35,332 feet) unless other temperatures are stated. For a plot of NACA standard day temperature variation with altitude, see figure A13-13.

Performance data for all flight operations, including takeoff and landing using J47-25 and -25A engines is contained in this Appendix.

SYMBOLS AND DEFINITIONS

Symbols and definitions used throughout the Appendix are explained in the chart below, figure A1-1.

AIRSPEED AND ALTIMETER INSTALLATION CORRECTIONS

Flight tests have shown that there is an airplane attitude and flap-down effect on the static pressure source which introduces slight discrepancies in the airspeed and altimeter readings. All curves which show indicated airspeed include information to this effect.

Above 100 feet with the flaps down and at final approach speed the altimeter consistently indicates about 15 feet higher than the true altitude. Below 100 feet, an opposing ground effect begins to offset the error caused by the flaps until at about a 20-foot altitude the instrument reads correctly. Below 20 feet, the ground effect continues to grow stronger, causing the altimeter to start reading low. At touchdown, altimeter indication is about 40 feet less than the runway altitude. Figure A1-2 illustrates this point.

The indicated airspeed follows a similar pattern. Above 100 feet with the flaps down, the airspeed indicator reads about 1 knot too high. Below 100 feet, ground effect begins to neutralize the error until at 20-foot altitude the indicator reads correct values. The ground effect continues to grow until at touchdown the instrument reads about 4 knots low. Figure A1-3 illustrates the airspeed indicator error.

During final approach in low visibility, the flaps-down effect should be kept in mind. The transition of instrument readings near the ground should cause no difficulty, since visual reference, rather than instrument readings, will be relied upon.

SYMBOLS AND DEFINITIONS

SYMBOLS	DEFINITIONS	SYMBOLS	DEFINITIONS
IAS	Indicated Airspeed - Airspeed indicator reading uncorrected *	R/C	Rate of Climb
CAS	Calibrated Airspeed - Indicator airspeed corrected for instrument and position error	OAT	Outside Air Temperature
		OAT Gage	Outside Air Temperature Gage - Reading during flight uncorrected *
TAS	True Airspeed - Actual velocity	V ground	Ground Speed
ALT	Pressure Altitude	TH°	True Heading (degrees)
ATO	Assist Takeoff - Solid fuel rockets	TC°	True Course (degrees)
EGT	Exhaust Gas Temperature - Indicated	T-O	Takeoff
M	Mach Number	V	Velocity (true airspeed)
M max	Limiting Mach Number	WT	Weight

NOTE *Where these symbols are used on performance charts mechanical error in the instrument is assumed to be zero. However, it is possible for a mechanical error of several units to exist in the instrument. For accurate performance control, this error should be accounted for to convert chart values to instrument readings or instrument readings to chart values.

50801WA.2

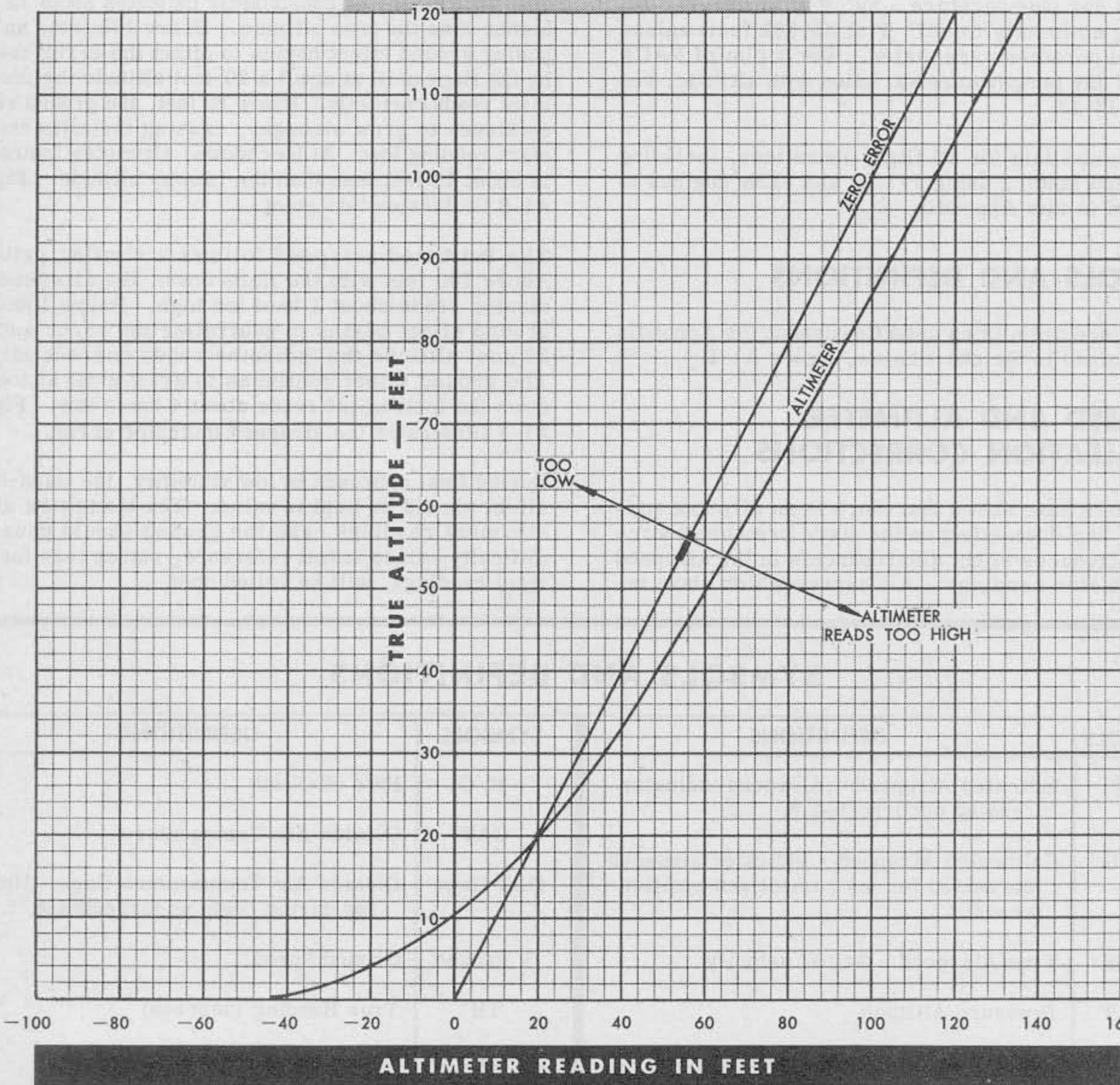
Figure A1-1.

ALTIMETER READING-GROUND EFFECT

FLAPS DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

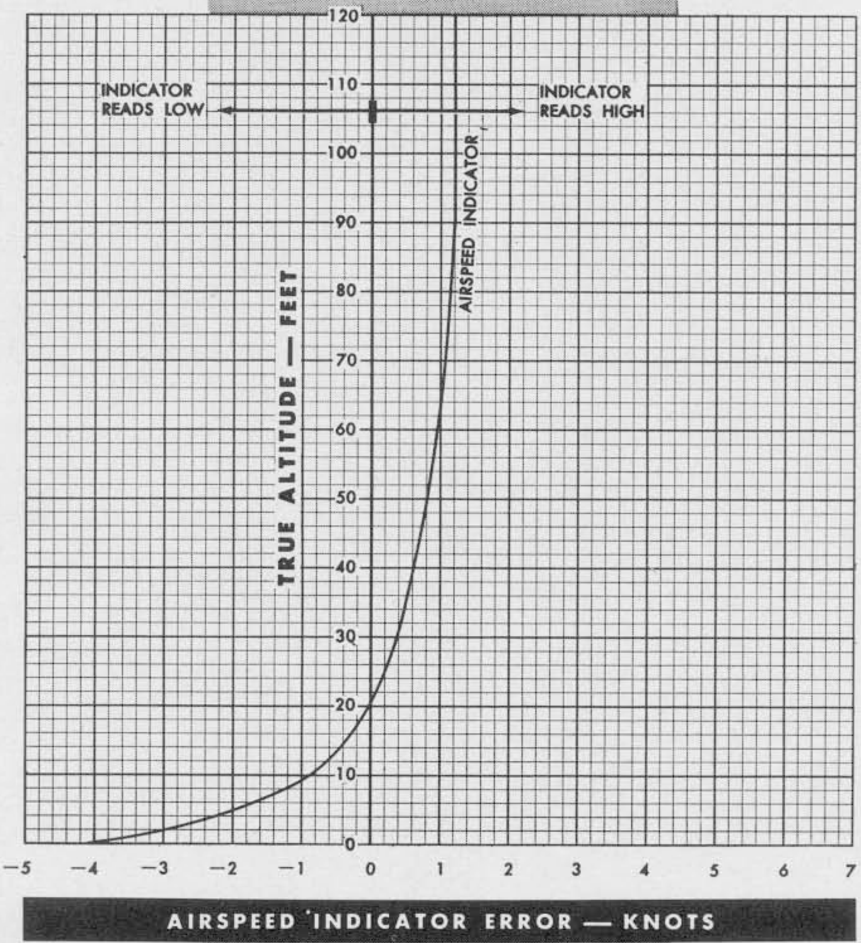
CONDITIONS:
ANGLE OF ATTACK FOR TOUCHDOWN

101C-1

Figure A1-2.

AIRSPEED INDICATOR POSITION ERROR
FLAPS DOWN

MODEL: B-47B & B-47E
ENGINES: J47-25 & -25A



DATE: DECEMBER 1952
DATA BASIS: FLIGHT TEST

CONDITIONS:
FLAPS DOWN

REMARKS:
ANGLE OF ATTACK FOR TOUCHDOWN

102C-1

Figure A1-3.

Part 2 takeoff — no ATO

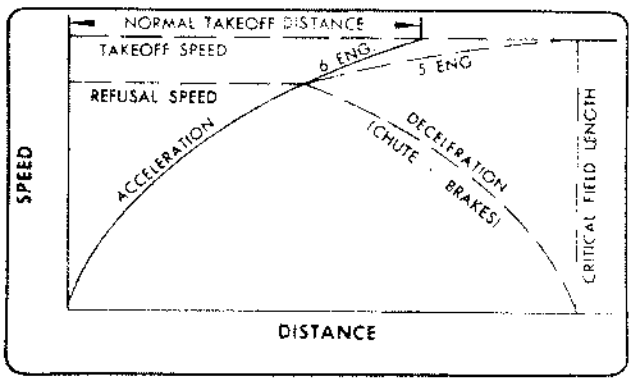
This part contains takeoff performance charts for J47 -25 and -25A engines. Also, presented in this part are charts for the determination of takeoff speed, trim required for takeoff, line speed, takeoff headwind correction, takeoff distance over a 50-foot obstacle, and takeoff distance with four or five engines operative.

GENERAL

Section II contains normal procedures to be followed to obtain the performance as presented on the takeoff charts. The possibility of an engine failure during takeoff influences takeoff procedures and should be considered in all takeoffs. With an engine failure the pilot must be able to either stop or take off safely. The following definitions and explanations will assist in presenting the takeoff conditions.

CRITICAL FIELD LENGTH

The critical field length is the length of runway required for an airplane to accelerate on six engines to a particular speed and at that speed be able to either take off on five engines or stop in the same distance as required for takeoff. This is illustrated in the following sketch:



50804WA-3

To perform a safe takeoff, the critical field length should be less than or equal to the actual runway available.

TAKEOFF DISTANCE

Takeoff distance is the actual length of runway used from the start of ground roll until the airplane becomes airborne. The takeoff distance can be shortened approximately 7% by pulling the airplane off the ground with the elevators at a lower speed than that for a normal takeoff with both gears leaving the ground at the same time. However, this is not advisable since, at a lower speed, the performance reserve after takeoff and airplane stability will be reduced.

TAKEOFF SPEED

If the airplane is allowed to fly off the ground in taxi attitude, takeoff speeds will be consistent and predictable for a given set of conditions. Takeoff attitude is determined by elevator trim setting and pilot's effort on the elevator controls. The takeoff speed is not affected by takeoff assist devices such as firing of ATO bottles. As explained in part 1, ground effect causes the airspeed indicator to read approximately 4 knots low. However, the takeoff speed chart has been corrected for ground effect and the speeds shown represent actual indicator readings.

TRIM REQUIRED FOR TAKEOFF

The required elevator trim settings are shown on figure A2-8. The recommended trim settings provide slight nose-down forces during takeoff, requiring a slight pull force at the proper unstick speed to become airborne. This nose-down force aids in prevention of front gear first takeoffs and the associated drag, instability, and reduced directional control due to ineffective front gear steering. The latter is particularly important in the event of asymmetric engine thrust.

REFUSAL SPEED

Refusal speed is the highest speed to which the airplane can be accelerated and still be stopped on the remaining runway. When the rules for critical field length are observed, a takeoff on five engines will always be possible if the engine failure occurs at or above the refusal speed. In the case where actual runway length is equal to the critical field length, a five-engine takeoff may be made in the same distance required to stop from refusal speed.

In the event the refusal speed is higher than the takeoff speed, the takeoff speed is considered to be the refusal speed.

LINE SPEED

Critical field length, takeoff distance, and refusal speed as presented above are based on the assumption of standard engine thrust and airplane drag and accurately known ambient conditions. The line speed chart shows the correct relationship of speed and distance and is to be used to check the assumption. If this is not accomplished, the above assumptions and additional factors such as a change of wind velocity or direction, additional drag (i.e., dragging brakes), or a partial loss of thrust may not be detected in time to successfully stop or take off on the remaining runway. The most practical means of ascertaining that all conditions are favorable during a takeoff is by making an acceleration check at a preselected check point during the ground roll before takeoff is committed.

DISTANCE OVER A 50-FOOT OBSTACLE

Since the distance from the takeoff point to a 50-foot obstacle depends to a large extent upon pilot technique, the chart values on figure A2-11 can serve only as an approximation. The chart assumes that flaps and gear remain extended, power remains at 100% rpm, and the airplane is pitched up to a point just short of initial stall warning, resulting in slightly more than one-tenth "g" above normal acceleration at takeoff speed. This is maximum performance of the airplane and will not be achieved during normal operation.

FOUR- AND FIVE-ENGINE TAKEOFF DISTANCE

For emergency evacuation or similar conditions it may be found necessary to take off with only four or five engines operating. The chart in figure A2-12 can be used to predict the takeoff distance required with only four or five engines operating during the entire takeoff. To find four- or five-engine takeoff distance it is necessary to enter the chart with the six-engine takeoff distance calculated with or without water injection and/or ATO as the situation demands, move up to the appropriate engines operating curve and then left to the revised takeoff distance.

DATA BASIS

This information is included to assist operating personnel in a better understanding of the conditions for which the takeoff performance charts have been determined. It is considered that all takeoffs will be made in accordance with normal operating procedures as presented in section II of this handbook; therefore, charts are based on the following conditions throughout the takeoff:

1. 100% rpm on six specified engines
2. Properly tabbed engines
3. Engine screens retracted
4. 100% wing flap extension
5. Level runway and dry concrete
6. No wind
7. Simultaneous takeoff of both main gears
8. No additional drag (i.e., low tire inflation, dragging brakes)
9. All charts reflecting IAS data have been corrected for ground effect
10. Six seconds total time to reduce power and apply brakes and brake chute for a refused takeoff.

WATER INJECTION

Takeoff with water injection requires observance of the same procedures as for dry takeoff; that is, the critical field length, takeoff distance, trim required for takeoff, line speed, refusal speed, takeoff speed, and ATO firing speed when applicable should be determined prior to starting engines.

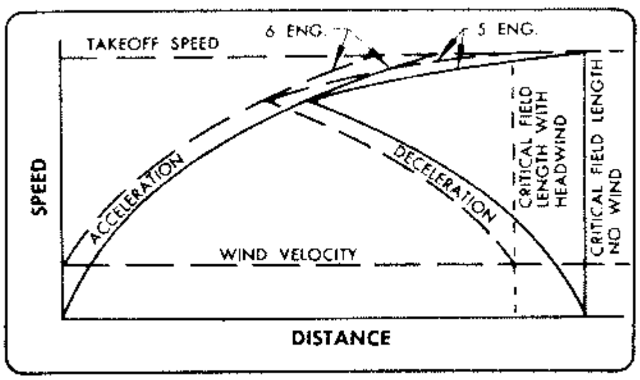
The effect of water injection on line speed is to increase the rate of acceleration which decreases takeoff distance. Therefore, when water injection is used, compute the data values for takeoff distance with water injection.

VARIABLES AFFECTING TAKEOFF PERFORMANCE

Since prevailing conditions are usually not the same as the conditions the charts are based upon, it will be necessary in those instances to correct the chart values to determine accurate takeoff performance and optimum procedures.

EFFECT OF HEADWIND

The effect of headwind may be considered as one of two effects: Either to reduce the takeoff distance and the critical field length, or to effectively increase the available runway length. Ordinarily the effect of headwind during takeoff should be disregarded, thus leaving any benefits which may be derived from the headwind as an added safety margin.



50808 WA-3

In general, the headwind experienced by an airplane on the runway is less than the headwind reported by traffic control towers which are mounted high above the runway. If headwind corrections are to be considered for a marginal takeoff, one-half the reported tower wind velocity should be used for the corrections to takeoff performance, and the available runway length must be corrected before the charts can be used. Figure A2-10, the headwind correction chart, can be used for converting no-wind distances to the equivalent distance with headwind. To find effective (no wind) runway length available, the horizontal scale (ground distance with headwind) is used for the true runway length and the vertical scale (ground distance with no wind) for the effective runway length. For other applications such as finding the takeoff distance with headwind when the no-wind distance is known, the chart is used in reverse manner. Caution must be exercised in considering headwind corrections. The summary chart at the end of this text provides an index of the changes that headwinds make to various takeoff parameters.

The headwind effectively reduces the takeoff and stopping distances. Therefore, a higher speed can be reached before refusing the takeoff than would be possible with no wind.

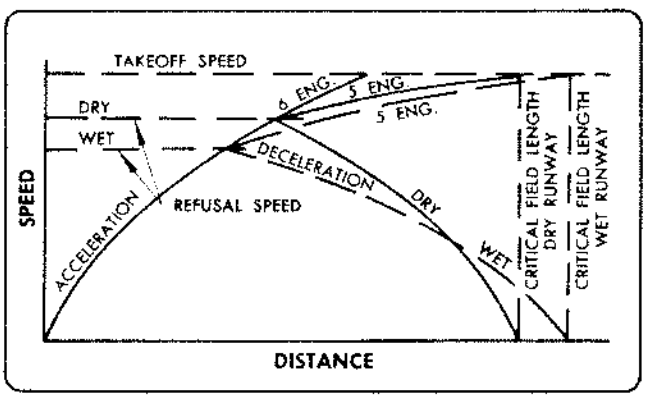
To correct line speed for the effects of headwind, first compute the no-wind line speed, then take one-half the reported tower wind velocity and add directly to the no-wind line speed.

EFFECT OF WET RUNWAYS

The effect of wet runways is to increase the required stopping distance in the event of refused takeoff. The speed at which the takeoff must be refused is lowered, and the minimum runway required is increased as shown by the sketch below. For wet concrete runways, decrease the refusal speed 10 knots and increase the critical field length 25 feet for every 1000 feet of runway required (2.5%). The sketch below illustrates the effect of a wet runway on the estimated critical field length.

NOTE

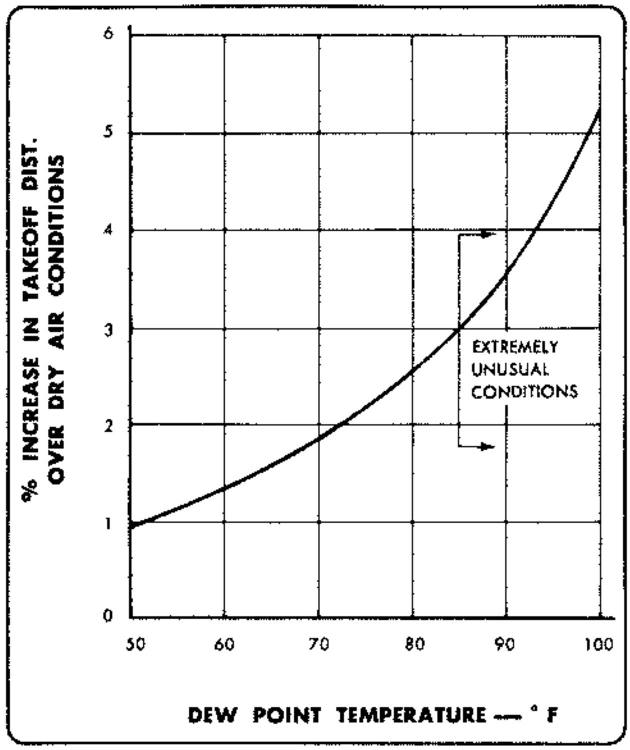
Pools of water on the runway will decrease the acceleration rate. Since there is no practical method of accurately predicting the amount and distribution of water on the pavement, care should be exercised when the takeoff is marginal. Calculations indicate that .15 inch of water evenly distributed throughout the entire takeoff run would increase the takeoff distance of the airplane with a gross weight of 180,000 pounds by 500 feet. Similarly, an inch of water would be required to increase the takeoff distance of the airplane with a gross weight of 100,000 pounds by 500 feet.



Refer to the summary chart at the end of this text as a guide for the corrections due to wet runways.

EFFECT OF HUMIDITY

Relative humidity, which appreciable affects reciprocating engine power, has a negligible effect on turbojet thrust except in cases of high ambient temperatures accompanied by extremely high humidity. The following chart shows the percent increase of takeoff distance as compared to the dew point temperature.



RUNWAY GRADE CORRECTION

If the airplane takes off on a slight uphill grade, the takeoff distance will be longer than normal. The increase in takeoff distance may be obtained approximately by multiplying the takeoff distance (hundreds of feet) by the grade (feet of elevation per 1000 feet of distance). If a runway has a 7.5-foot per 1000-foot grade and normal takeoff distance is 5000 feet, the increase in takeoff distance due to grade is 50 x 7.5 or 375 feet if the airplane takes off uphill. The takeoff distance is decreased by the same amount if the airplane takes off downhill.

ANTI-ICING SYSTEM

If the anti-icing system is operating during takeoff, takeoff distance will be increased approximately 5%.

Refer to the summary chart at the end of this text as a guide for the corrections due to this system being operated.

ENGINE AIR INLET SCREENS

Normally, engine inlet screens are retracted before takeoff; however, if the screens are extended the critical field length and takeoff distance will be increased approximately 4%.

LOW EXHAUST GAS TEMPERATURE

Takeoff will require about 1.5% more runway for each 10° C that all six engines are below the correct temperature for a properly tabbed engine.

WING TANKS

The effect of external wing tanks on takeoff performance is negligible.

SUMMARY — TAKEOFF CORRECTIONS

The following chart may be used as a guide in determining the overall effect of several conditions which will change the takeoff performance. The corrections, where values are given, are approximate and must be used only as an index to judge whether a given set of conditions results in a greater or lesser safety margin of takeoff performance.

TAKEOFF PLANNING

To determine accurate takeoff performance and optimum procedures it is necessary for the pilot to know:

1. Gross weight
2. Runway air temperature (OAT) at time of takeoff
3. Field length and pressure altitude
4. Wind direction and velocity
5. Tailpipe temperature (check on engine runup)

Determine the critical field length and compare with the actual runway available. If the runway available is shorter than critical field length, water injection and/or ATO should be used or gross weight reduced. Next determine the takeoff distance and takeoff speed which will be used as a guide and to determine line speed.

The line speed chart on figure A2-9 contains a speed vs distance curve which may be used to predict a certain speed during takeoff for a given distance traveled.

To use this chart the predicted takeoff speed and the takeoff distance (without ATO) including those performance variables which will affect the acceleration rate (i.e. effective wind, runway grade, anti-icing on, etc) must be known. Variables of minor nature may be considered on a marginal takeoff only. The speeds

SUMMARY OF TAKEOFF PERFORMANCE VARIABLES

TAKEOFF PARAMETERS	CORRECTIONS					
	HEAD-WIND	WET RUNWAY	RUNWAY UPGRADE	ANTI-ICING ON	INLET SCREENS EXTENDED	LOW EGT — 10° ON 6 ENGS
TAKEOFF SPEED	NONE	NONE	NONE	NONE	NONE	NONE
NORMAL TAKEOFF DISTANCE	DECREASED (SEE CHART)	NONE	INCREASED (SEE TEXT)	INCREASED 5%	INCREASED 4%	INCREASED 1½%
CRITICAL FIELD LENGTH	DECREASED (SEE TEXT)	INCREASED 2½%	INCREASED (SEE TEXT)	INCREASED 5%	INCREASED 4%	INCREASED 1½%
EFFECTIVE RUNWAY LENGTH	INCREASED	DECREASED	DECREASED	DECREASED	DECREASED	DECREASED
	(SHOWN FOR REFERENCE ONLY, AND WILL ALWAYS BE OPPOSITE TO THE CHANGE IN CRITICAL FIELD LENGTH. DO NOT CORRECT BOTH.)					
REFUSAL SPEED	INCREASED (SEE TEXT)	DECREASED 10 KNOTS	INCREASED	DECREASED	DECREASED	DECREASED
ATO FIRING SPEED	NONE	NONE	NONE	NONE	NONE	NONE

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as determined from the line speed chart are airspeed indicator reading, assuming no instrument error. Since this chart presents percentage of takeoff speed vs percentage of takeoff distance, the line speed will be automatically corrected for those values of gross weight, pressure altitude and outside air temperature, from which the takeoff distance and speed have been computed. The method of headwind correction for line speed is contained in the discussion of effects of headwind. It should be noted that if the line speed is not corrected for a headwind, then the line speed will not be an accurate value.

The refusal speed should be determined from the chart in part 4. Further discussion of refusal speeds is contained in part 4.

After completion of the required takeoff data it should be recorded on the Takeoff and Landing Data Card which is contained in part 11.

USE OF CHARTS

As an aid in showing the proper use of the various takeoff charts the following example is given for no ATO problems.

EXAMPLE:

The charts listed below contain an example of the takeoff problem with the following conditions:

Gross Weight = 150,000 pounds
Pressure Altitude = 2000 feet
OAT = 80° F
Runway Available = 8500 feet
Reported Tower Wind = 20 knots
Effective Wind = 10 knots
Line Check = 3000 feet
Engines = six J47-25
Center of Gravity = 25% MAC

CRITICAL FIELD LENGTH

Considering the conditions of the example and referring to figure A2-1, the critical field length for no wind is 8450 feet.

TAKEOFF DISTANCE

The no-wind takeoff distance for the above example is 7300 feet as found on figure A2-2.

TAKEOFF SPEED

Reference to figure A2-7 indicates that takeoff speed should be 141 knots IAS.

TRIM REQUIRED FOR TAKEOFF

The recommended trim setting as found on figure A2-8 is 4 units nose up with a cg of 25%.

LINE SPEED

Referring to the chart on figure A2-9 the ratio of no-wind takeoff distance and line distance is entered on the chart with a result of 97 knots IAS (no wind) at the check point. To correct for headwind, add 10 knots to the no-wind line speed, resulting in 107 knots IAS.

DISTANCE OVER A 50-FOOT OBSTACLE

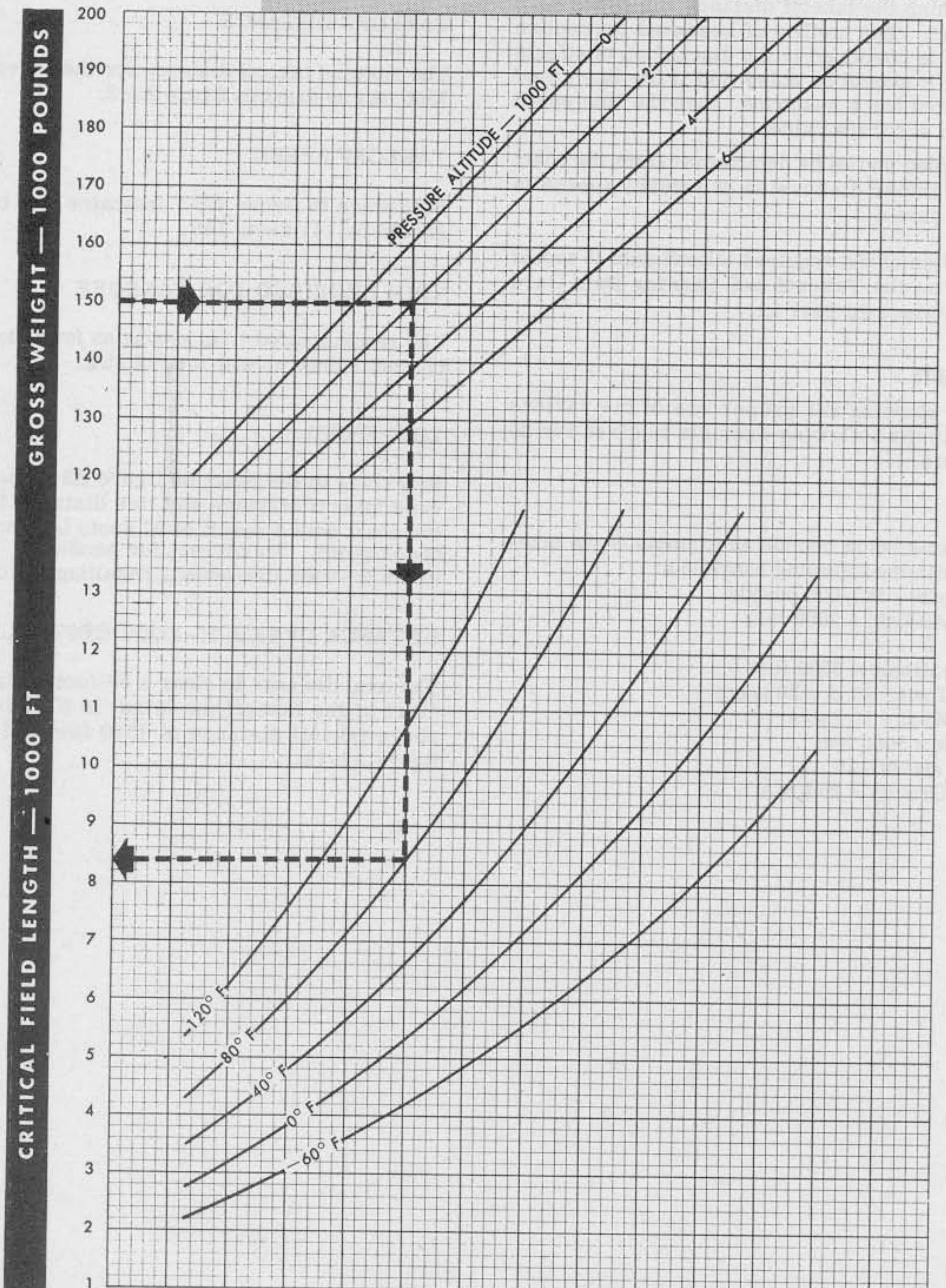
The total distance to clear a 50-foot obstacle from the start of the takeoff (no-wind) is 8750 feet using the above takeoff distance of 7300 feet and referring to figure A2-11.

CRITICAL FIELD LENGTH

NO ATO — NO WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: FLIGHT TEST

201C-1

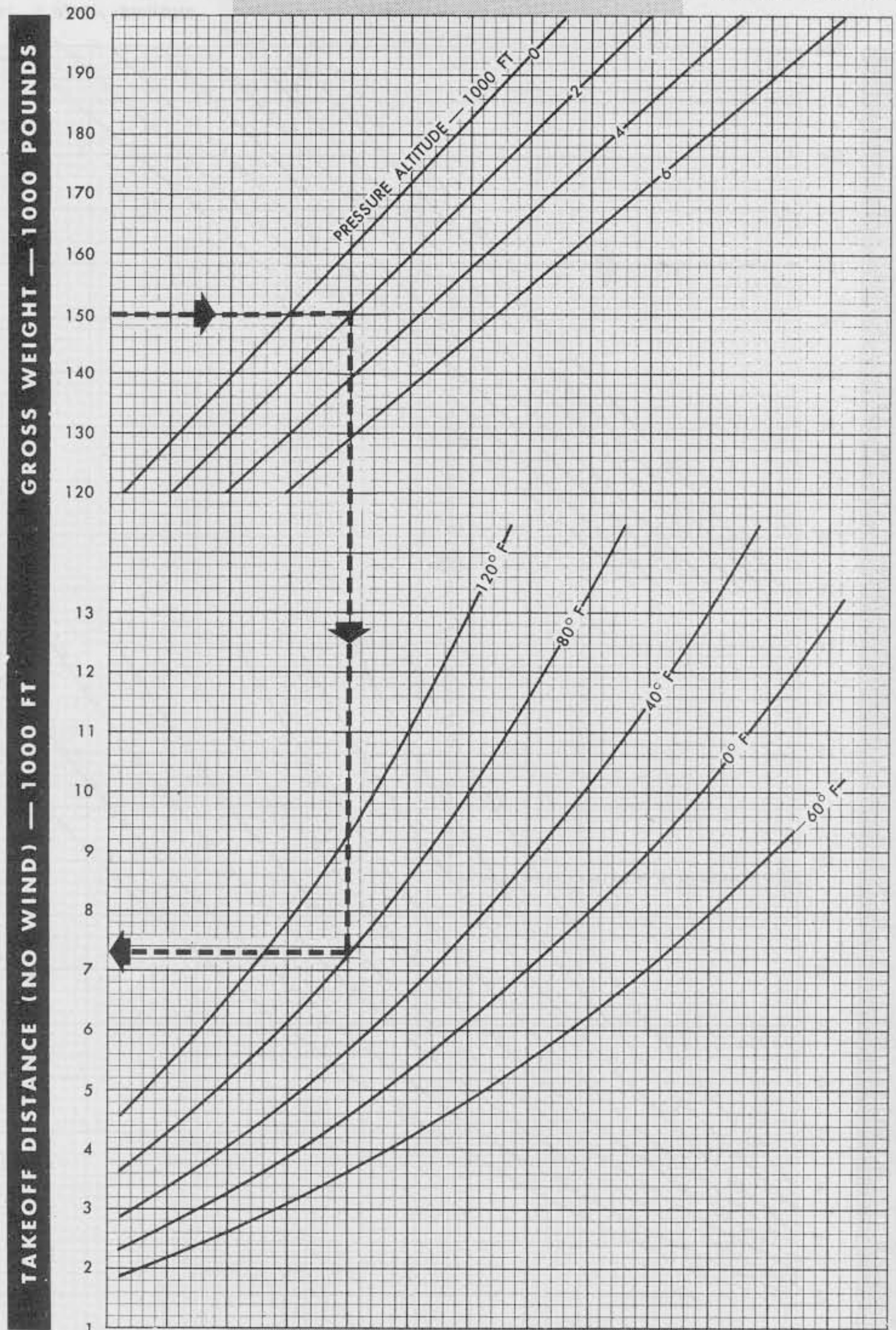
Figure A2-1.

TAKEOFF DISTANCE

NO ATO — NO WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

202C-1

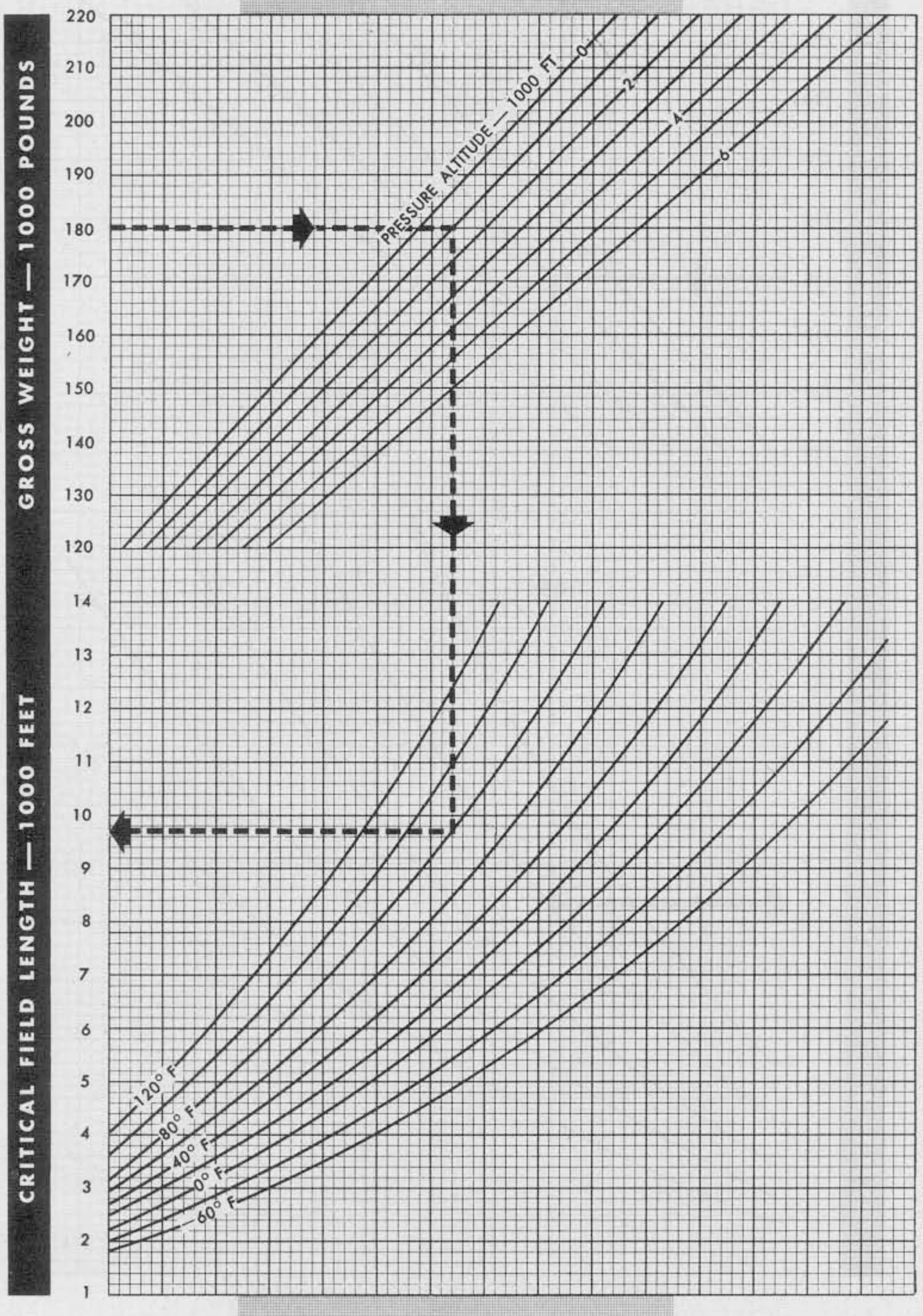
Figure A2-2.

CRITICAL FIELD LENGTH

NO ATO — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

50827W C-1

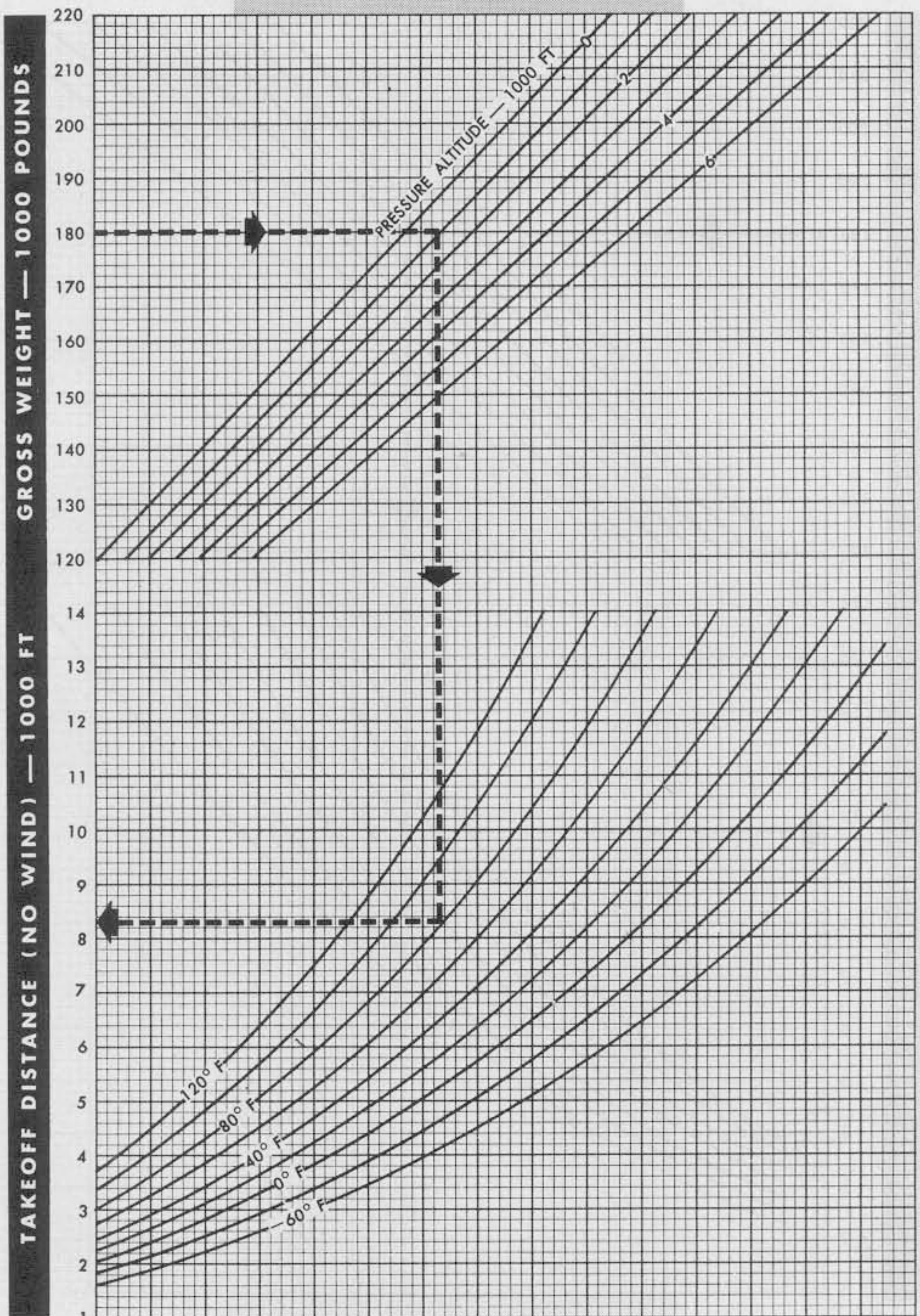
Figure A2-3.

TAKEOFF DISTANCE

NO ATO — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

50828

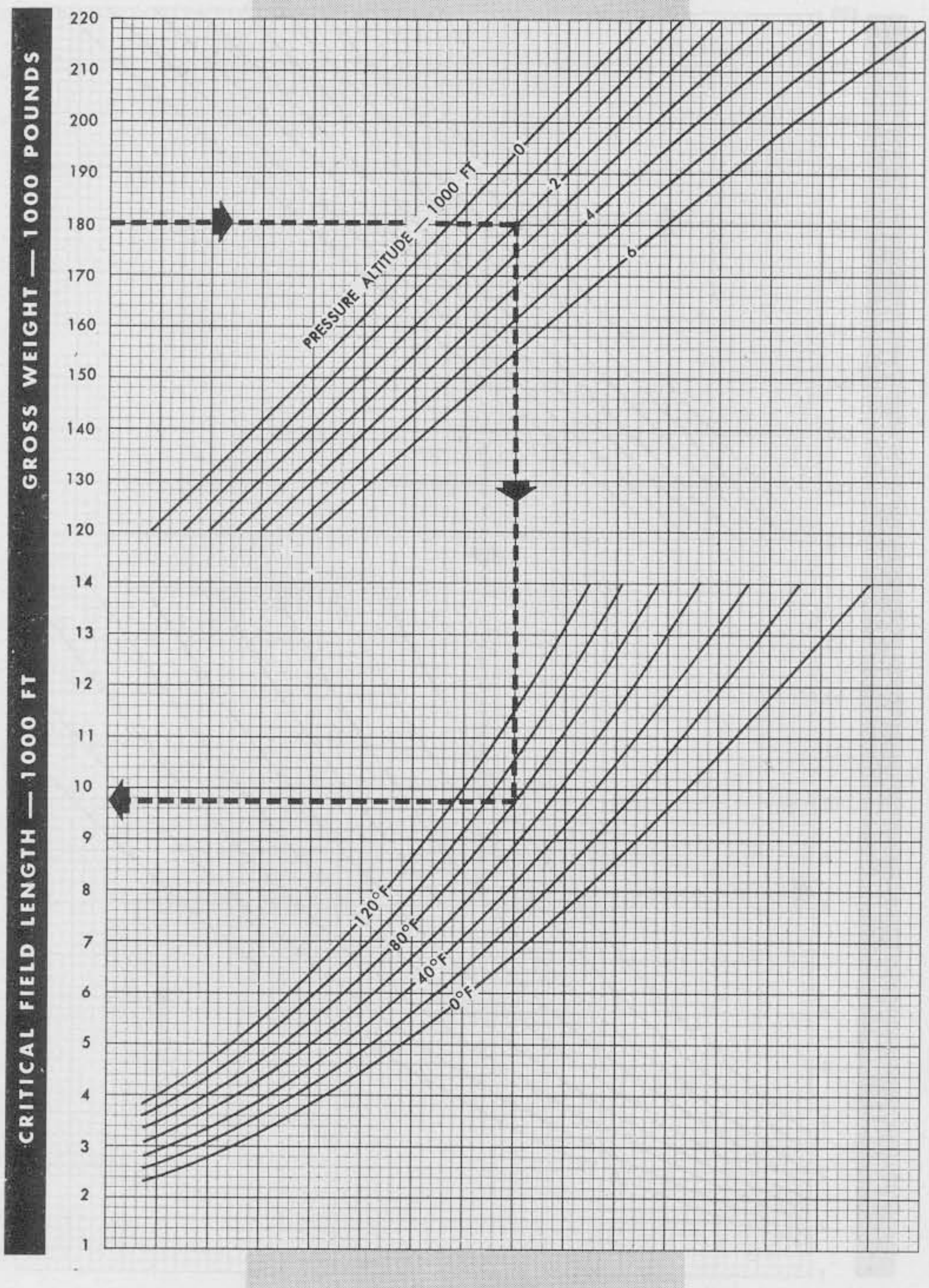
Figure A2-4.

CRITICAL FIELD LENGTH

NO ATO — MEDIUM FLOW WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

203C-1

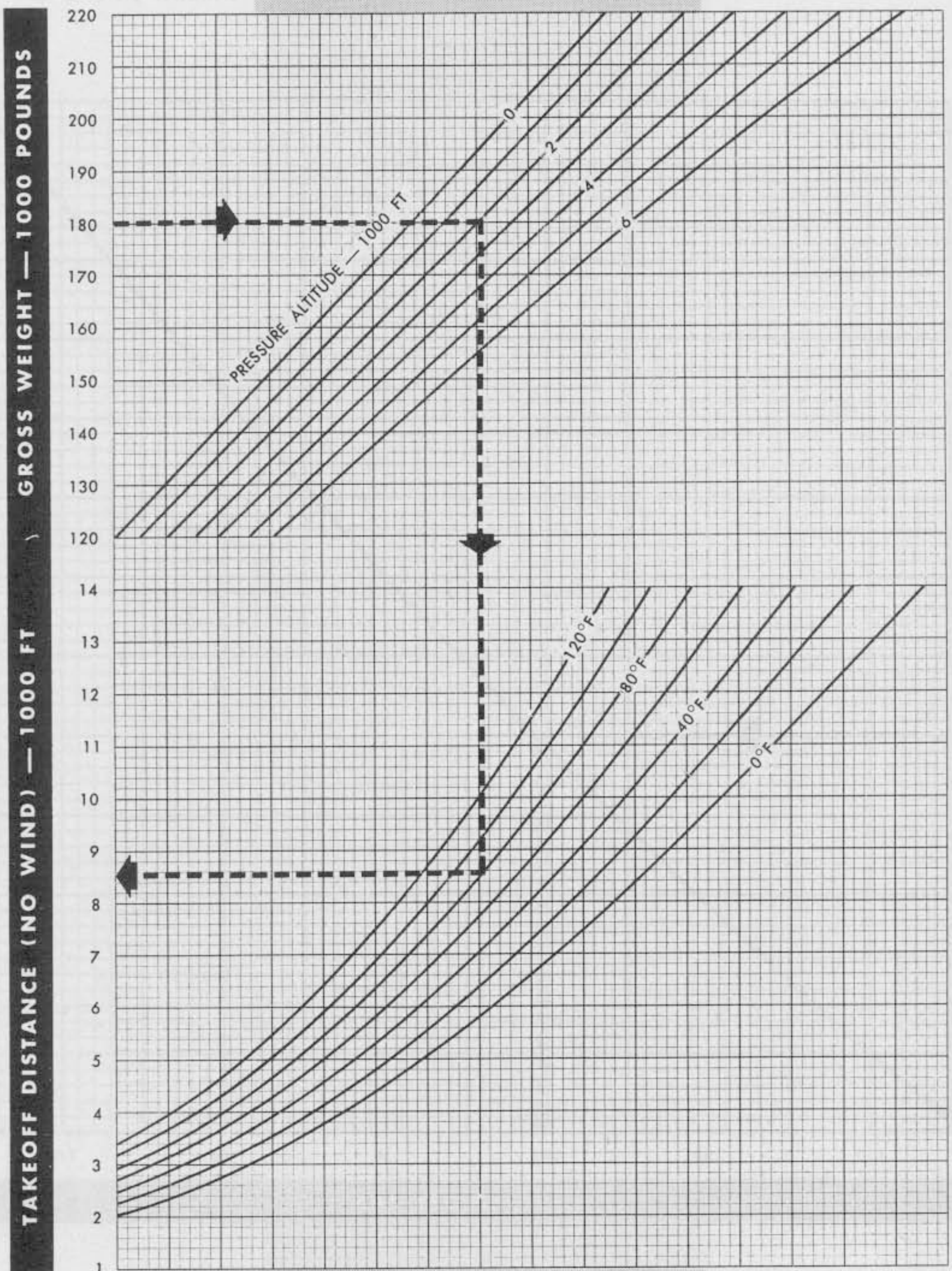
Figure A2-5.

TAKEOFF DISTANCE

NO ATO — MEDIUM FLOW WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

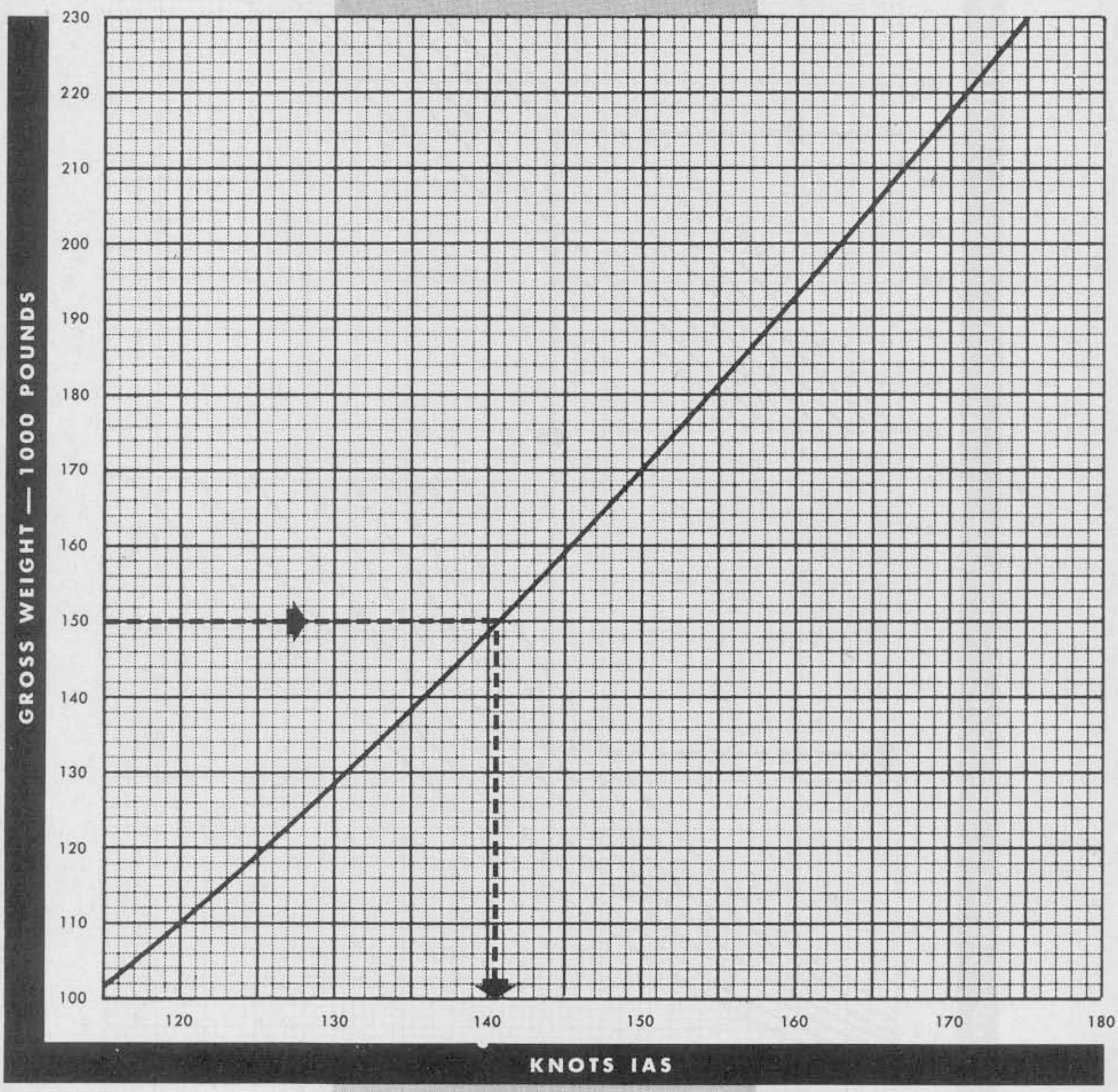
204C-1

Figure A2-6.

TAKEOFF SPEED

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

FLAPS FULL DOWN

REMARKS:

AIRSPEED CORRECTED FOR GROUND EFFECT

DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

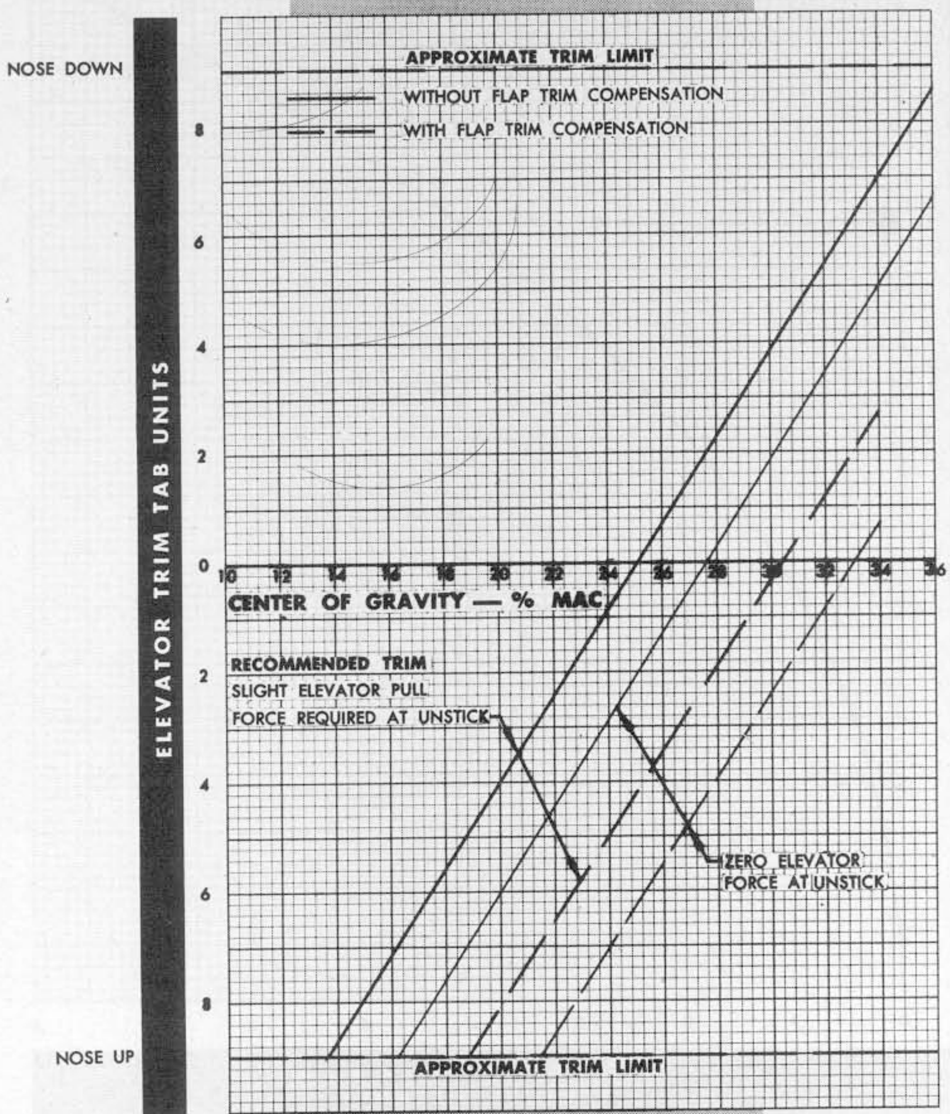
205C-1

Figure A2-7.

TRIM REQUIRED FOR TAKEOFF

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:
FLAPS FULL DOWN
GEAR DOWN

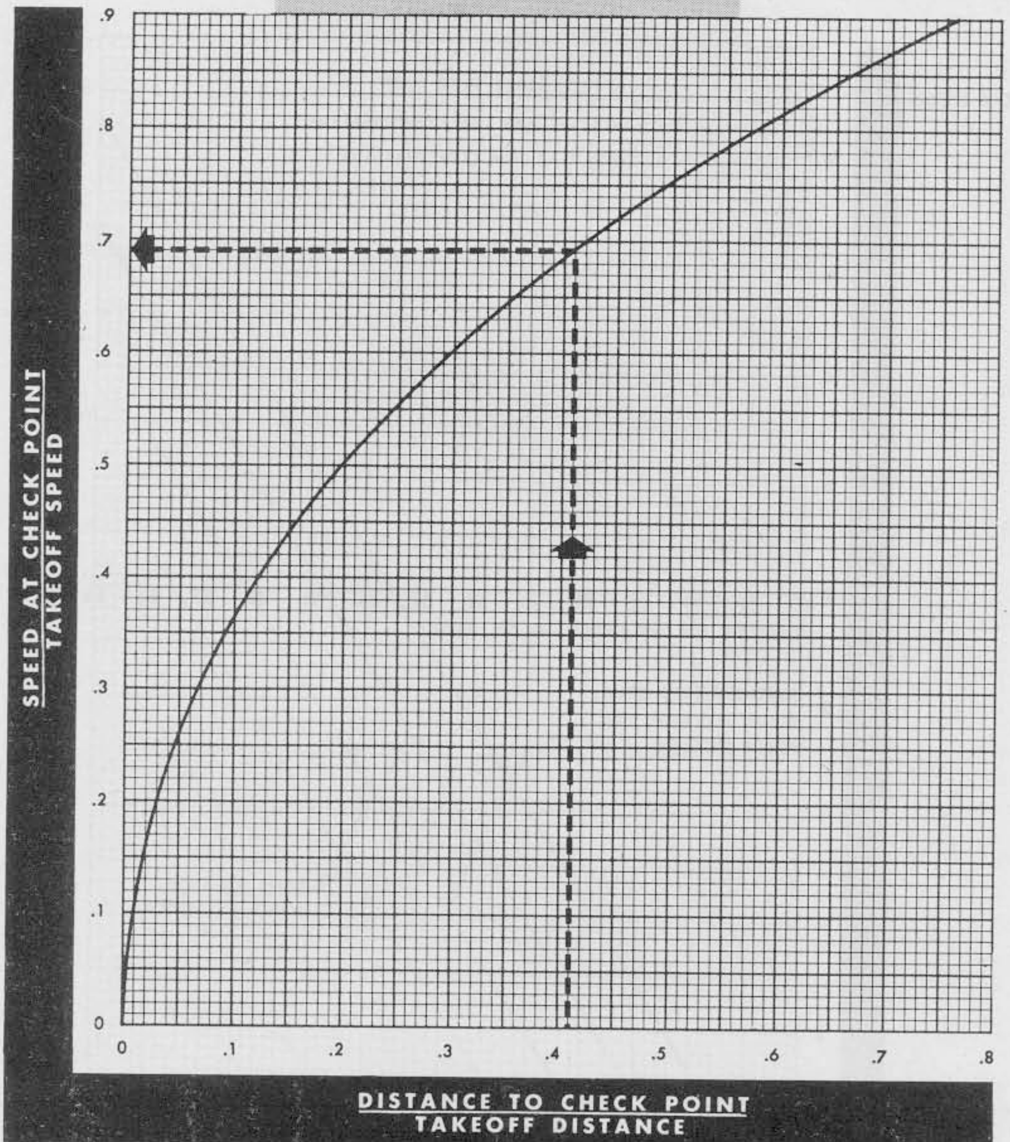
206C-1

Figure A2-8.

TAKEOFF ACCELERATION CHECK

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MAY 1952

DATA BASIS: CALCULATED

REMARKS:

FOR HEADWIND CORRECTION ADD ½ REPORTED TOWER WIND VELOCITY TO NO-WIND LINE SPEED

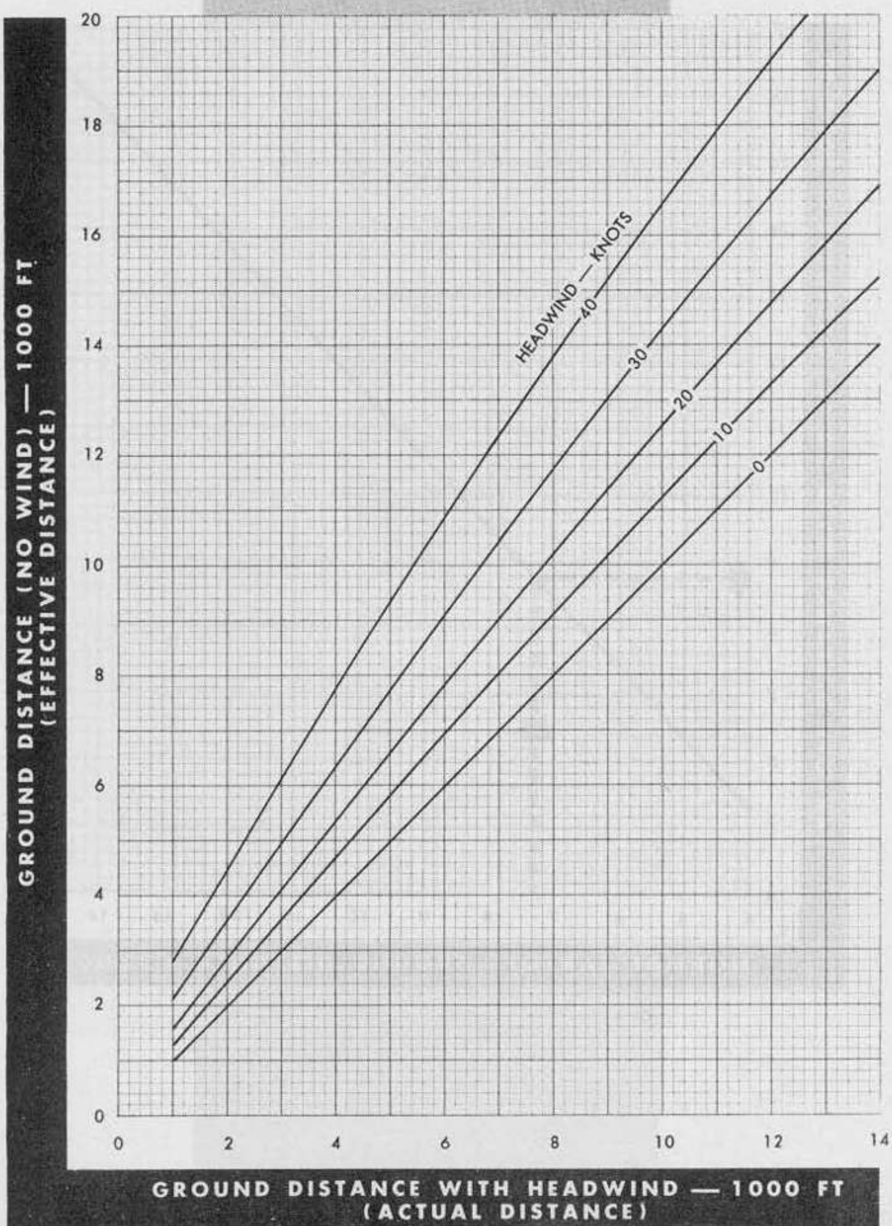
207C-1

Figure A2-9.

TAKEOFF HEADWIND CORRECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: AUGUST 1951

DATA BASIS: CALCULATED

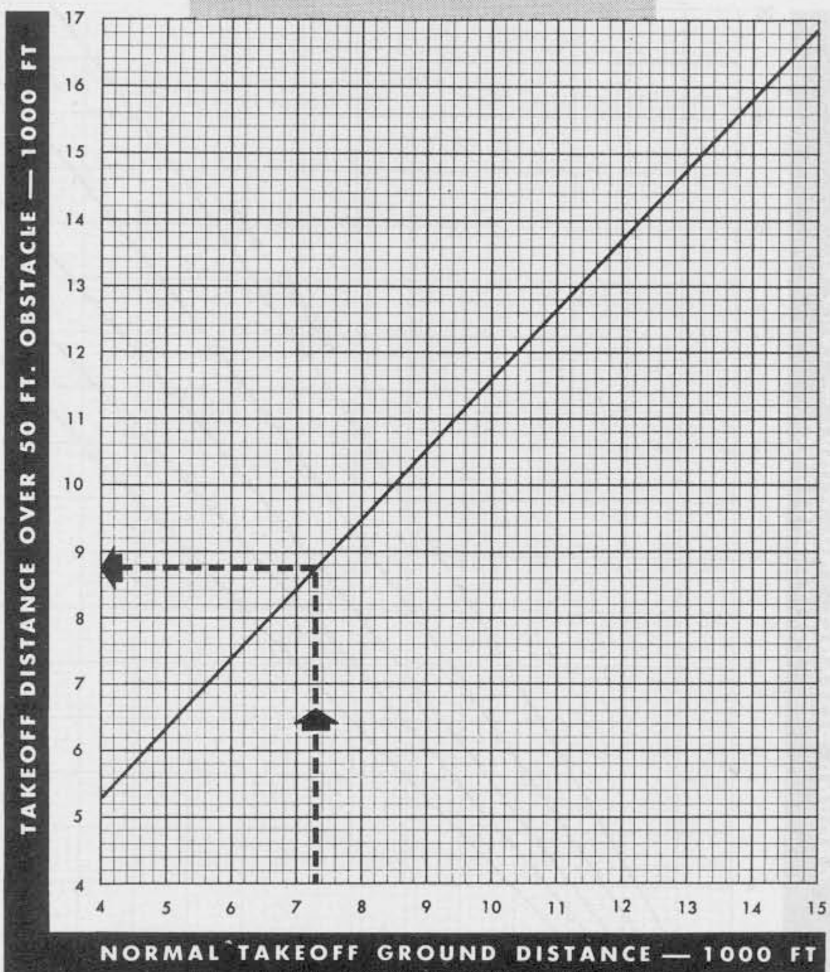
208C-1

Figure A2-10.

TAKEOFF DISTANCE OVER 50 FT OBSTACLE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



REMARKS:

TEMP RANGE: −60° F TO 120° F

ALT RANGE: SEA LEVEL TO 6000 FT

ATO FIRED 10 SECONDS BEFORE T-O WHEN USED

209C-1

DATE: SEPTEMBER 1953

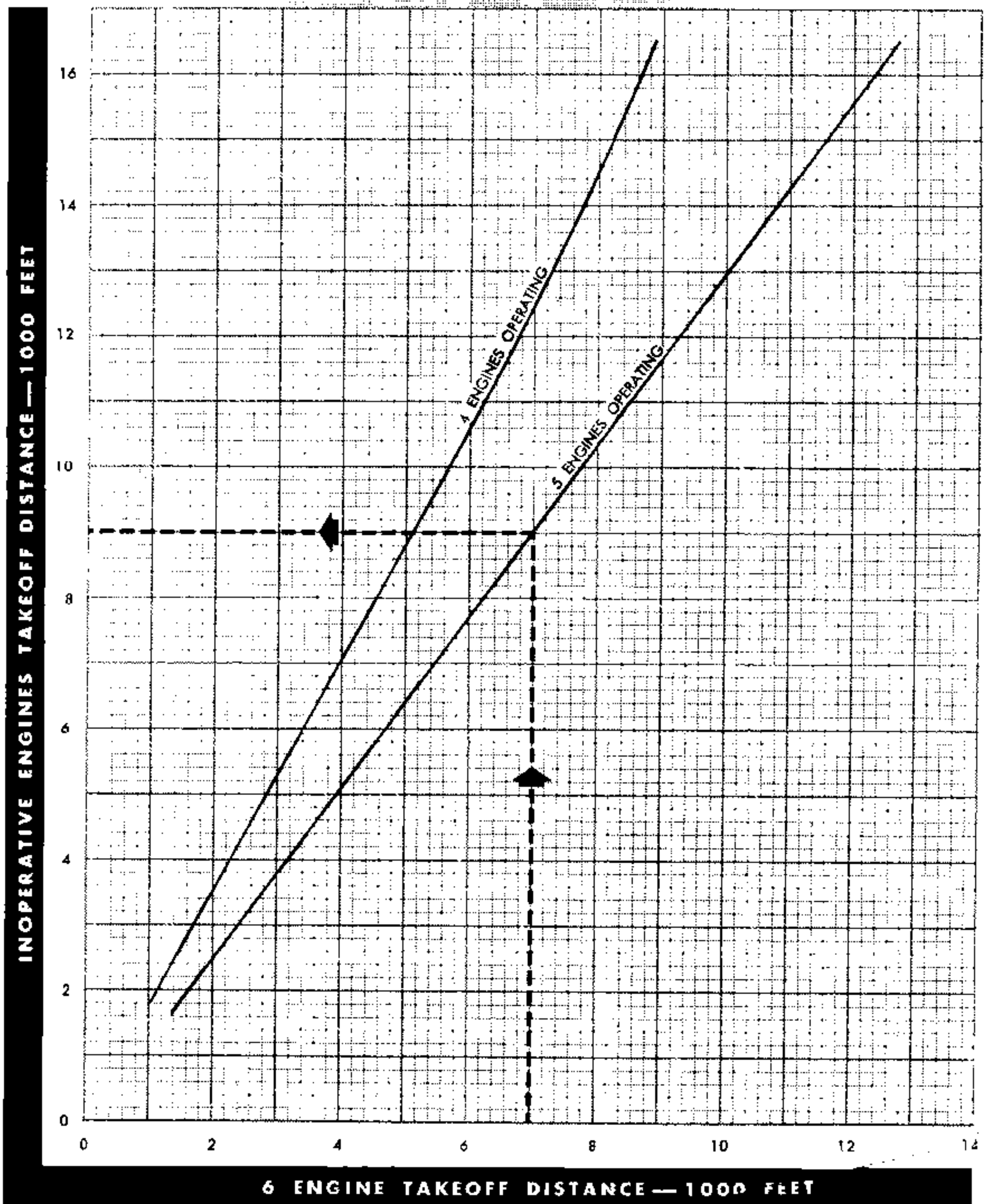
DATA BASIS: CALCULATED

Figure A2-11.

4 & 5-ENGINE TAKEOFF DISTANCE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



REMARKS:

DATA VALID WHETHER OR NOT INOPERATIVE ENGINES ARE REMOVED FROM AIRPLANE.

CONDITIONS:

DATA APPLIED FOR ALL CONDITIONS OF ALTITUDE, TEMPERATURE, WATER INJECTION, AND/OR ATO, AND GROSS WEIGHT.

DATE: JULY 1955

DATA BASIS: FLIGHT TEST

2100-1

Figure A2-12.

Part 3 takeoff — ATO

This part contains takeoff performance charts for J47 -25 and -25A engines with the addition of 18 or 33 ATO bottles. Reference should be made to the preceding part for data concerning takeoff speed, trim required for takeoff, line speed, takeoff headwind correction, takeoff distance over a 50-foot obstacle, and four- or five-engine takeoff distance which are valid with ATO as well as without.

GENERAL

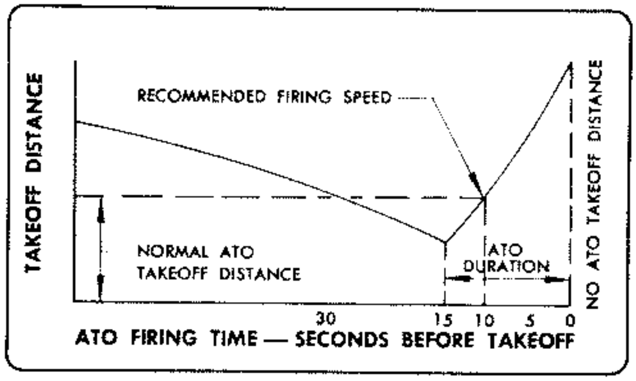
Section II contains normal procedures to be followed to obtain the performance as presented on the takeoff charts. The possibility of an engine failure during takeoff influences takeoff procedures and should be considered in all takeoffs. With an engine failure, the pilot must be able to either stop or take off safely. The basic definitions and explanations of critical field length, takeoff distance, refusal speed, takeoff speed, trim required for takeoff, line speed, and distance over a 50-foot obstacle, and four- or five-engine takeoff distance are contained in part 2. In addition, the following will assist in presenting the takeoff conditions with ATO.

MINIMUM ATO REQUIRED

In tactical operations, it may be desirable to use only the number of ATO bottles required for safe takeoff operations. The consideration of engine failure during takeoff is equally important when using ATO. As in the no-ATO case, the pilot should be able to either stop or take off in the event of engine failure during the takeoff run. Therefore, the minimum ATO required is the number of bottles necessary to make the critical field length equal to the runway available. The determination of the minimum number of ATO bottles required can be accomplished by interpolation of the 18 and 33 ATO bottle charts for critical field length, takeoff distance, and ATO firing speed. The method of interpolation of these charts is presented in example 2 in this part.

ATO FIRING SPEED

The recommended procedure is to fire the ATO approximately 10 seconds before takeoff since ATO thrust for a short time after takeoff is very desirable. The normal ATO duration is 15 seconds; therefore, the above procedure will give the additional thrust during gear retraction which is desirable in the event of engine failure. For minimum takeoff distances, the rockets should be fired so they expire just as the airplane takes off. This minimum takeoff distance procedure should be used only for emergencies where runway lengths are too short for normal recommended operations. The effect of early or late firing on takeoff distances is illustrated below:



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If an engine failure occurs above the refusal speed and below the ATO firing speed, the takeoff should be continued and the rockets fired at the recommended speed.

The recommended firing speed is the same whether or not an engine fails. Since the ATO, once fired, cannot be extinguished, the takeoff is committed once the bottles have been fired. Consequently, if for a particular takeoff the refusal speed is found to be higher than the ATO firing speed, the ATO firing speed then becomes the refusal speed.

As explained in part 1, ground effect introduces about a 4-knot error in the airspeed indicator reading during takeoff. All ATO firing speed charts have been corrected for this error and therefore represent actual indicator readings.

DATA BASIS

The data basis for the takeoff performance charts with ATO is the same as that stated in part 2 with the addition of 18 or 33 ATO bottles being fired 10 seconds prior to takeoff speed.

VARIABLES AFFECTING TAKEOFF PERFORMANCE

Reference should be made to part 2 for a discussion and summary of the variables which will affect takeoff performance. These variables should be considered when using ATO when applicable.

TAKEOFF PLANNING

The basic planning as established in part 2 should be followed. In addition, the following applies when ATO is to be used:

For computing line speed, follow the procedures outlined in part 2, noting that the no-ATO takeoff distance should be used since the acceleration rate up to refusal speed is without ATO.

The refusal speed should be determined from part 4. Since the refusal speed cannot be greater than the ATO firing speed, then refusal speed is considered to be the same as the no-ATO case.

After completion of the required takeoff data, it should be recorded on the Takeoff and Landing Data Card which is contained in part 11.

USE OF CHARTS

As an aid in showing the proper use of the various takeoff charts, the following example is given for ATO problems.

EXAMPLE 1:

The charts listed below contain an example of the takeoff problem with the following conditions:

Gross Weight = 180,000 pounds
Pressure Altitude = 2000 feet
OAT = 80° F
Runway Available = 10,000 feet
Reported Tower Wind = 10 knots
Effective Wind = 5 knots
Check Point = 3000 feet
Engines = six J47-25
ATO = 18 internal bottles

CRITICAL FIELD LENGTH

Considering the conditions of the example and referring to figure A3-1, the critical field length for no wind is 9800 feet.

TAKEOFF DISTANCE

The no-wind takeoff distance for the above example is 9000 feet as found on figure A3-2.

ATO FIRING SPEED

Referring to figure A3-3, the recommended ATO firing speed is 120 knots IAS for the above example.

TAKEOFF SPEED

Referring to figure A2-7, the takeoff speed is 154 knots IAS. This chart does not contain the above example.

LINE SPEED

Reference should be made to figure A2-9 for line speed. Enter the ratio of no-wind takeoff distance and distance to check point which results in a line speed of 97 knots (no wind). To correct for headwind, add 5 knots which results in a line speed of 102 knots IAS. This chart does not contain this ATO example.

DISTANCE OVER A 50-FOOT OBSTACLE

The total distance to clear a 50-foot obstacle from the start of the takeoff is 10,500 feet using the above takeoff distance of 9000 feet and referring to figure A2-11.

EXAMPLE 2:

The charts referenced below contain an example of the takeoff problem for interpolation of the 18 and 33 ATO bottle performance charts without water injection to determine minimum ATO requirements.

Gross Weight = 180,000 pounds
Pressure Altitude = 2000 feet
Runway Available = 8500 feet
OAT = 80° F
No Wind

CRITICAL FIELD LENGTH

Considering the conditions listed above, the critical field length for 18 ATO bottles (figure A3-1) is 9700 feet. This exceeds the runway available by 1700 feet so it will be necessary to use the 33 ATO bottle chart (figure A3-4). The critical field length for 33 ATO bottles is 7600 feet. To find the minimum number of bottles required for this problem, it will be necessary to interpolate between the two charts. The difference between the two charts is 15 bottles and 2100 feet or 140 feet per bottle. The critical field length for 33 ATO bottles is 900 feet less than the runway available; therefore, at 140 feet per bottle, approximately 6 bottles less than 33 or 27 ATO bottles is the minimum required for the above conditions.

TAKEOFF DISTANCE

The takeoff distance as found on figure A3-2 for 18 ATO bottles is 9000 feet. Figure A3-5 gives a takeoff distance of 7100 feet for 33 ATO bottles. Interpolating again, there is a 1900-foot difference for 15 bottles or approximately 127 feet per bottle. Using the same conditions, a total of 762 feet for 6 bottles removed from the 33 ATO bottle configuration gives a takeoff distance of 7100 feet plus 762 feet or 7862 feet for 27 ATO bottles.

ATO FIRING SPEED

Referring to figure A3-3, the ATO firing speed is 120 knots for 18 ATO bottles. Figure A3-5 gives a firing speed of 106 knots for 33 ATO bottles. Interpolate again for a 15 bottle difference. Each bottle less than 33 raises that speed approximately 1 knot. Therefore, for 27 bottles the firing speed would be 106 knots plus 6 knots or 112 knots.

TAKEOFF DISTANCE OVER 50-FOOT OBSTACLE

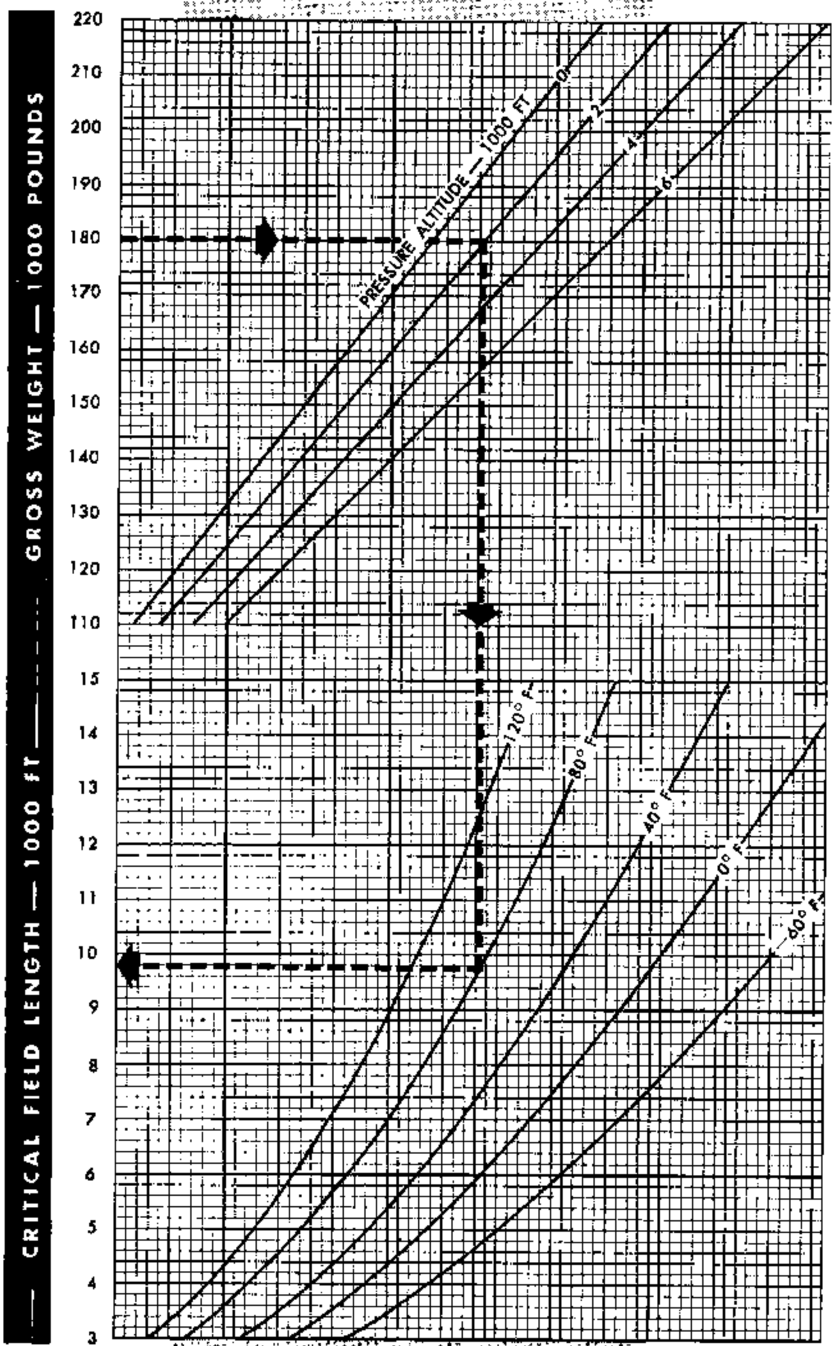
The total distance to clear a 50-foot obstacle from the start of the takeoff is found to be 9350 feet by using the above takeoff distance of 7862 feet and referring to figure A2-11.

CRITICAL FIELD LENGTH

18 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: APRIL 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:

ATO FIRED 10 SECONDS BEFORE TAKEOFF

301C-1

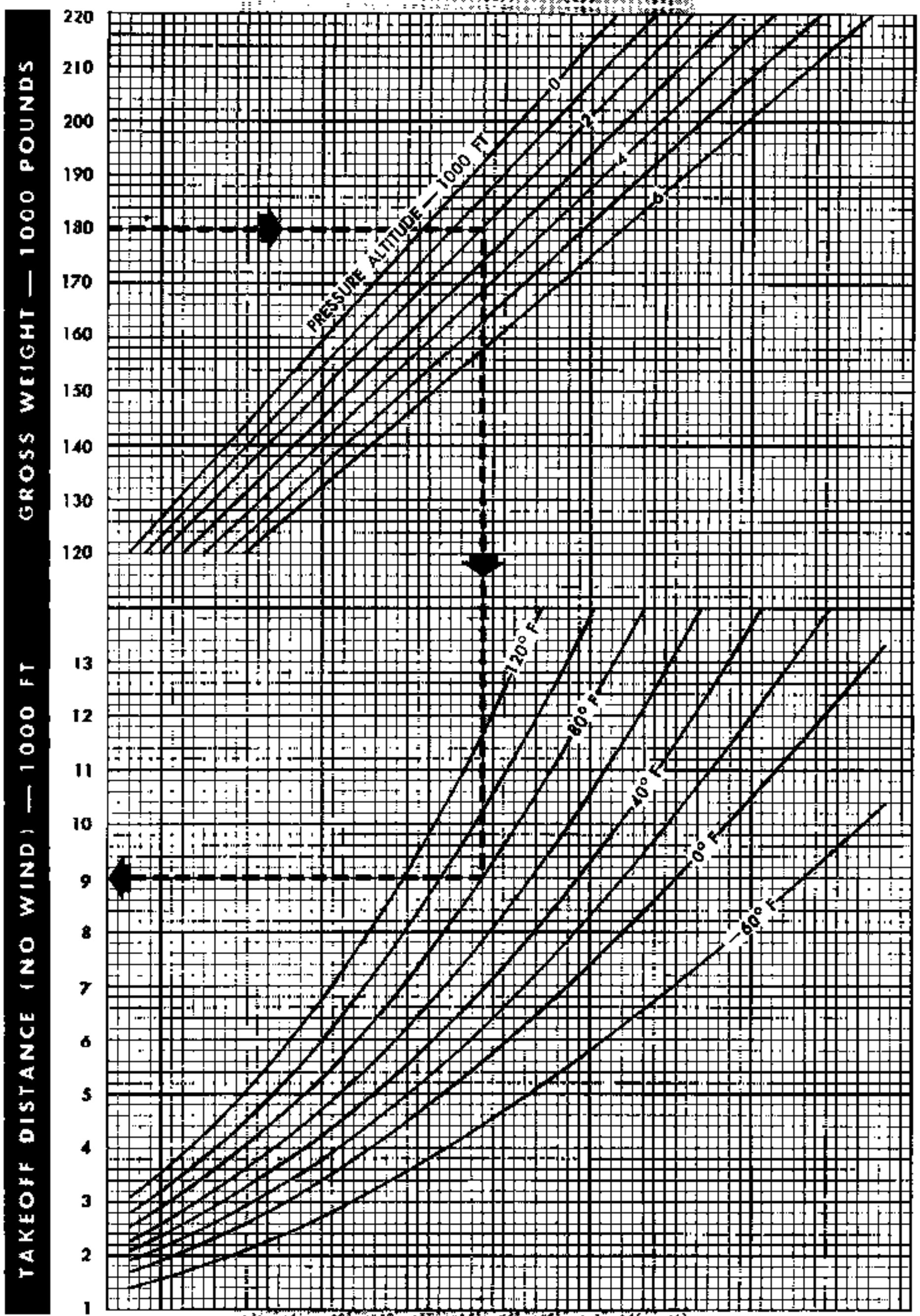
Figure A3-1.

TAKEOFF DISTANCE

18 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

362C-1

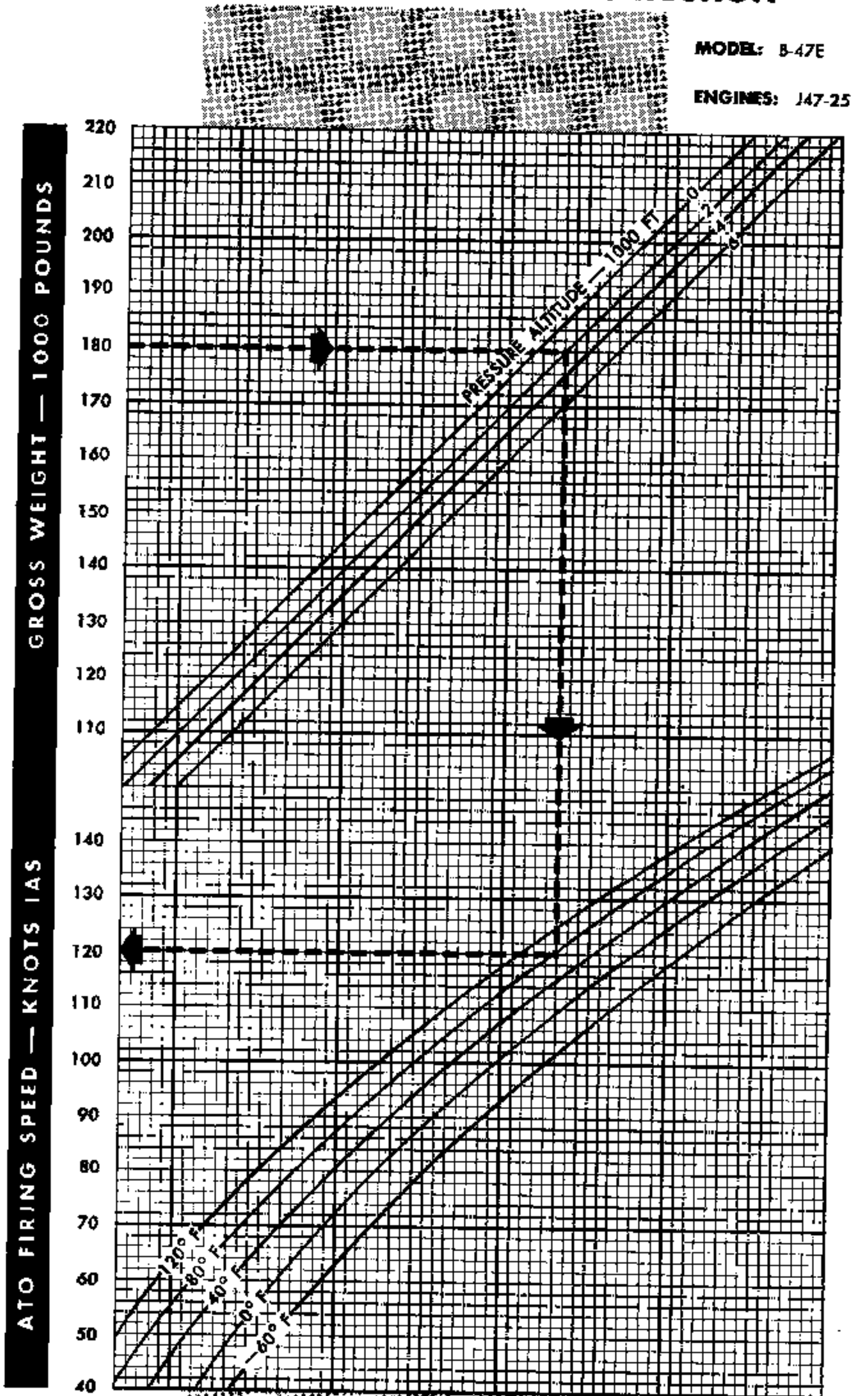
Figure A3-2.

ATO FIRING SPEED

18 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

303C-1

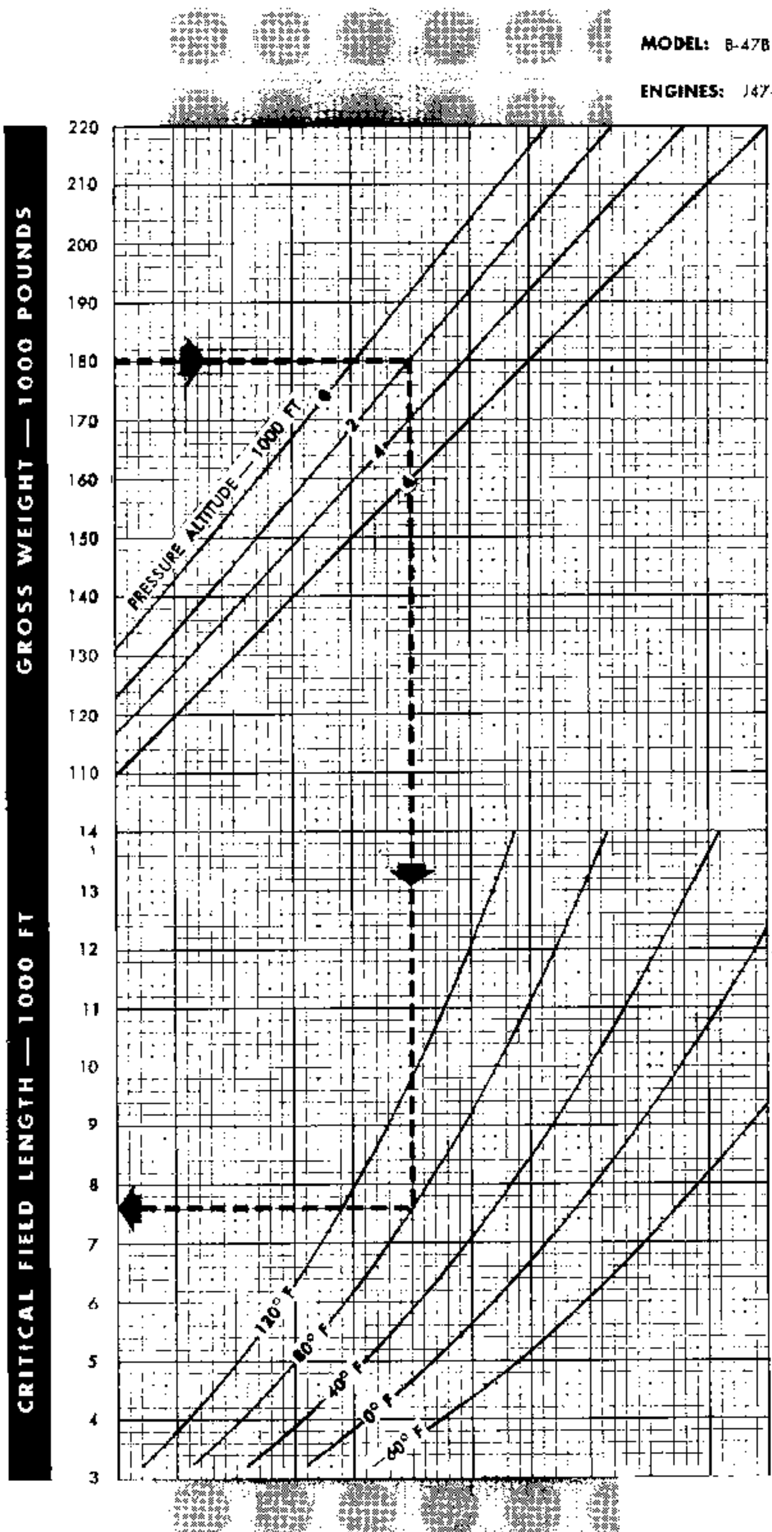
Figure A3-3.

CRITICAL FIELD LENGTH

33 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:

ATO FIRED 10 SECONDS BEFORE TAKEOFF

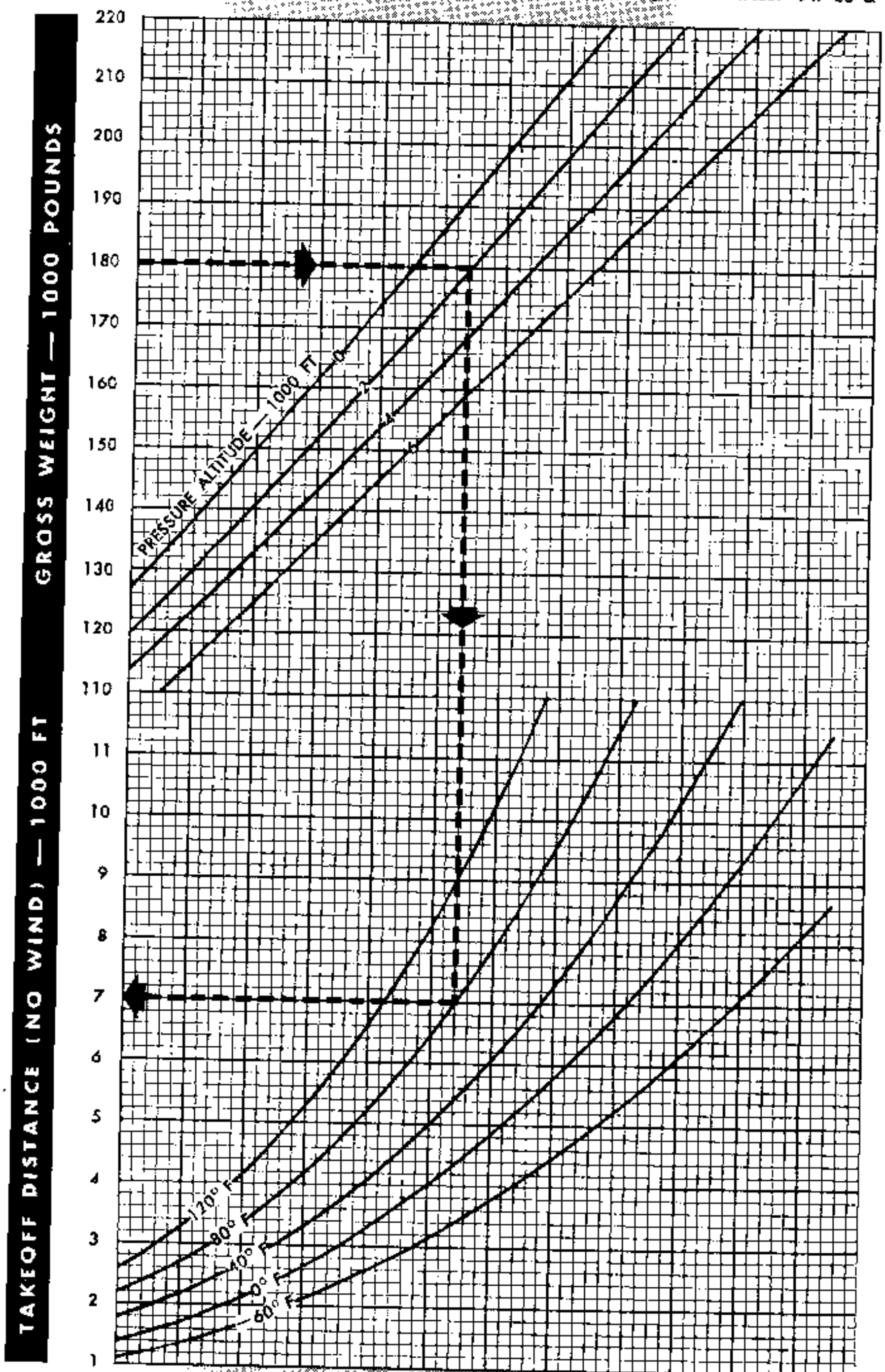
304C-1

Figure A3-4.

TAKEOFF DISTANCE
33 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

305C-1

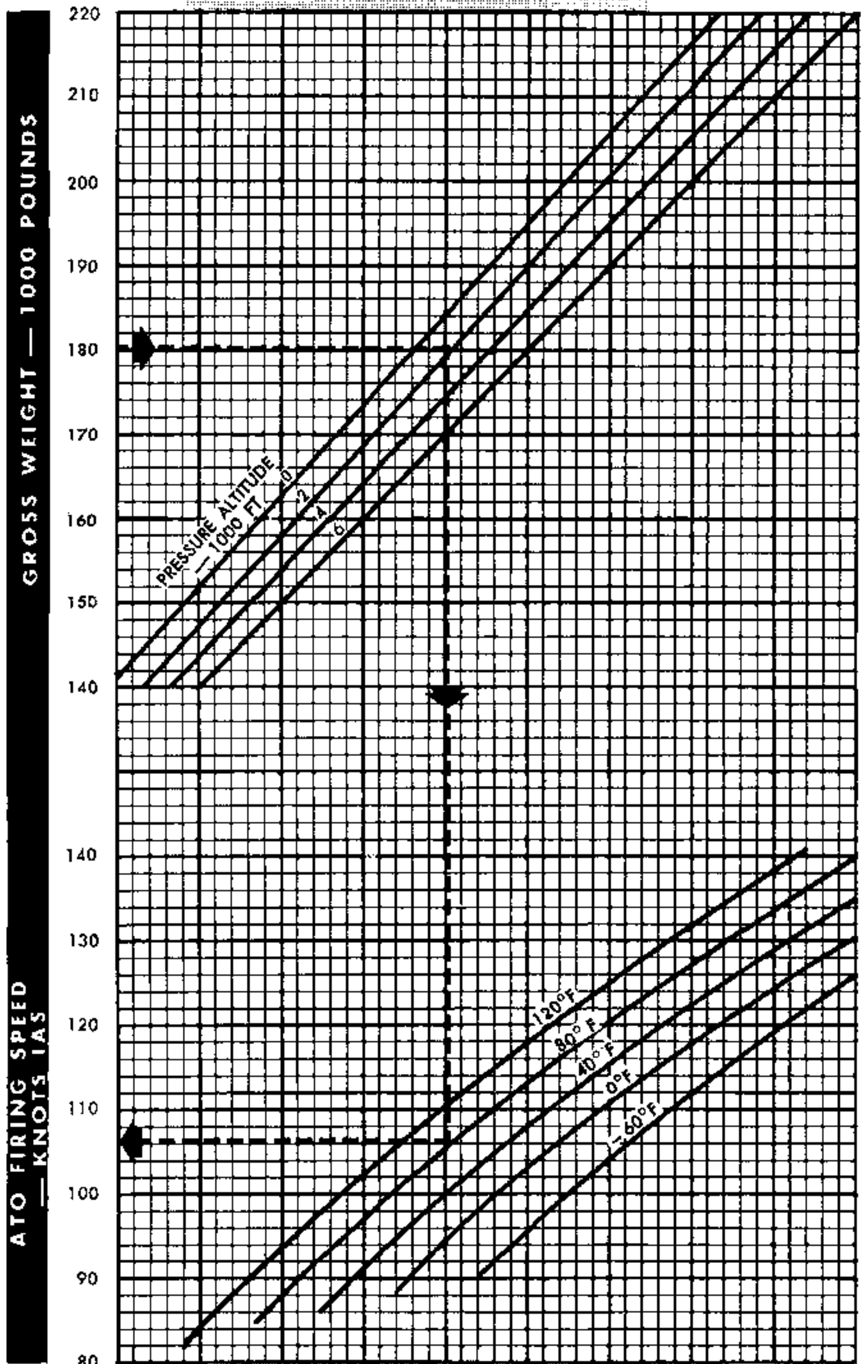
Figure A3-5.

ATO FIRING SPEED

33 ATO BOTTLES — NO WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MAY 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:

ATO FIRED 10 SECONDS BEFORE TAKEOFF

REMARKS:

AIRSPEED CORRECTED FOR GROUND EFFECT

306C-1

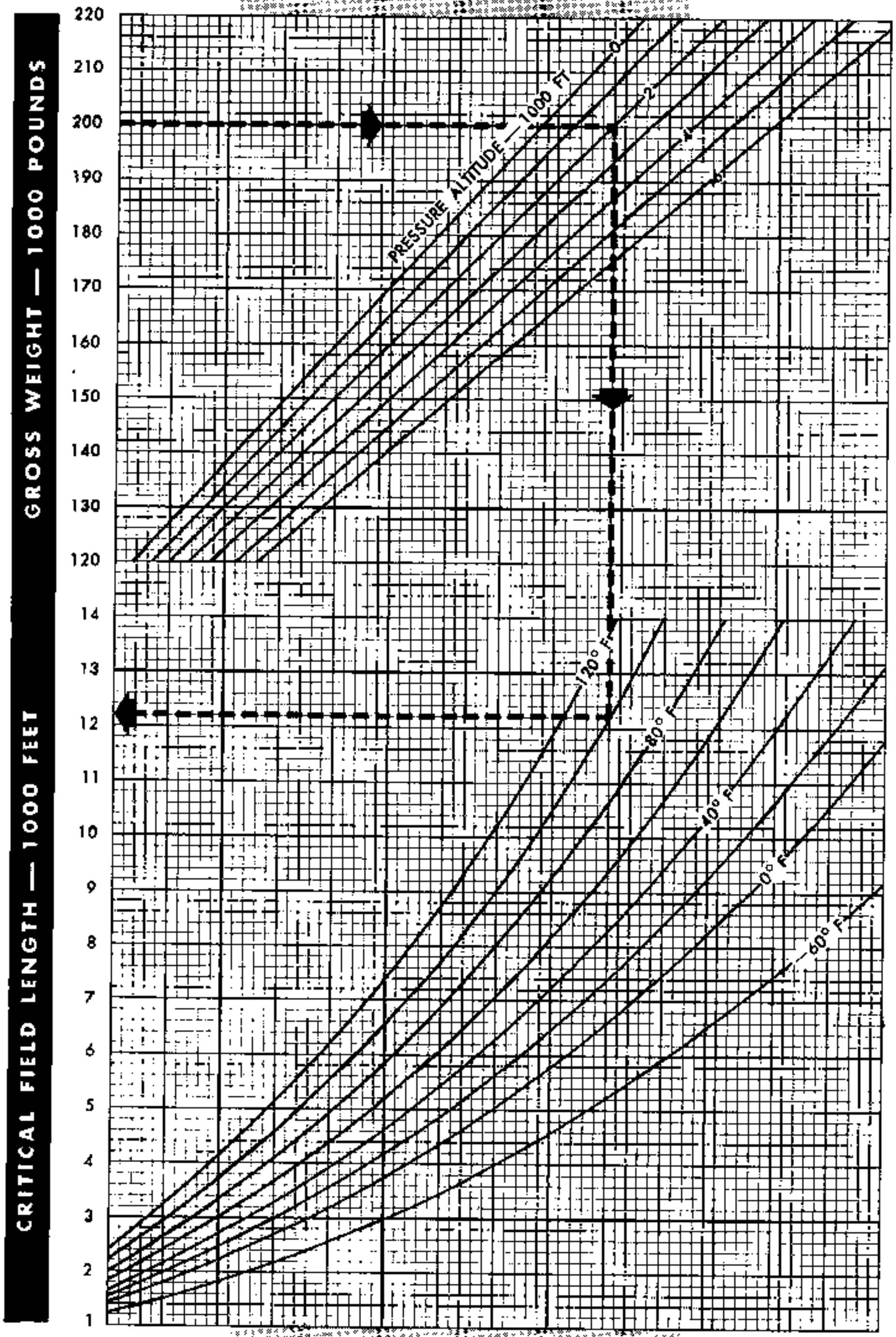
Figure A3-6.

CRITICAL FIELD LENGTH

18 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953
DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

50B30WC-1

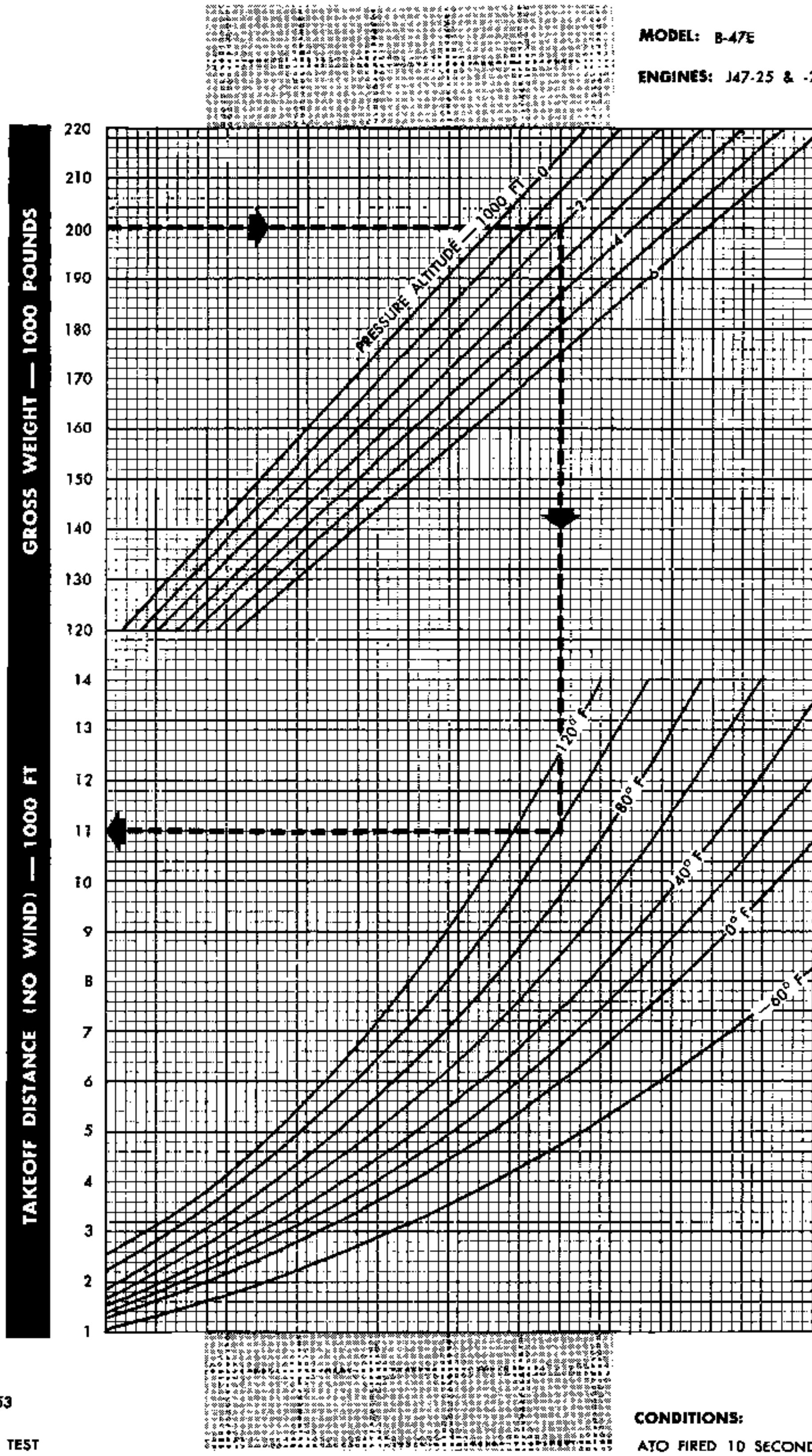
Figure A3-7.

TAKEOFF DISTANCE

18 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:

ATO FIRED 10 SECONDS BEFORE TAKEOFF

50831WC-1

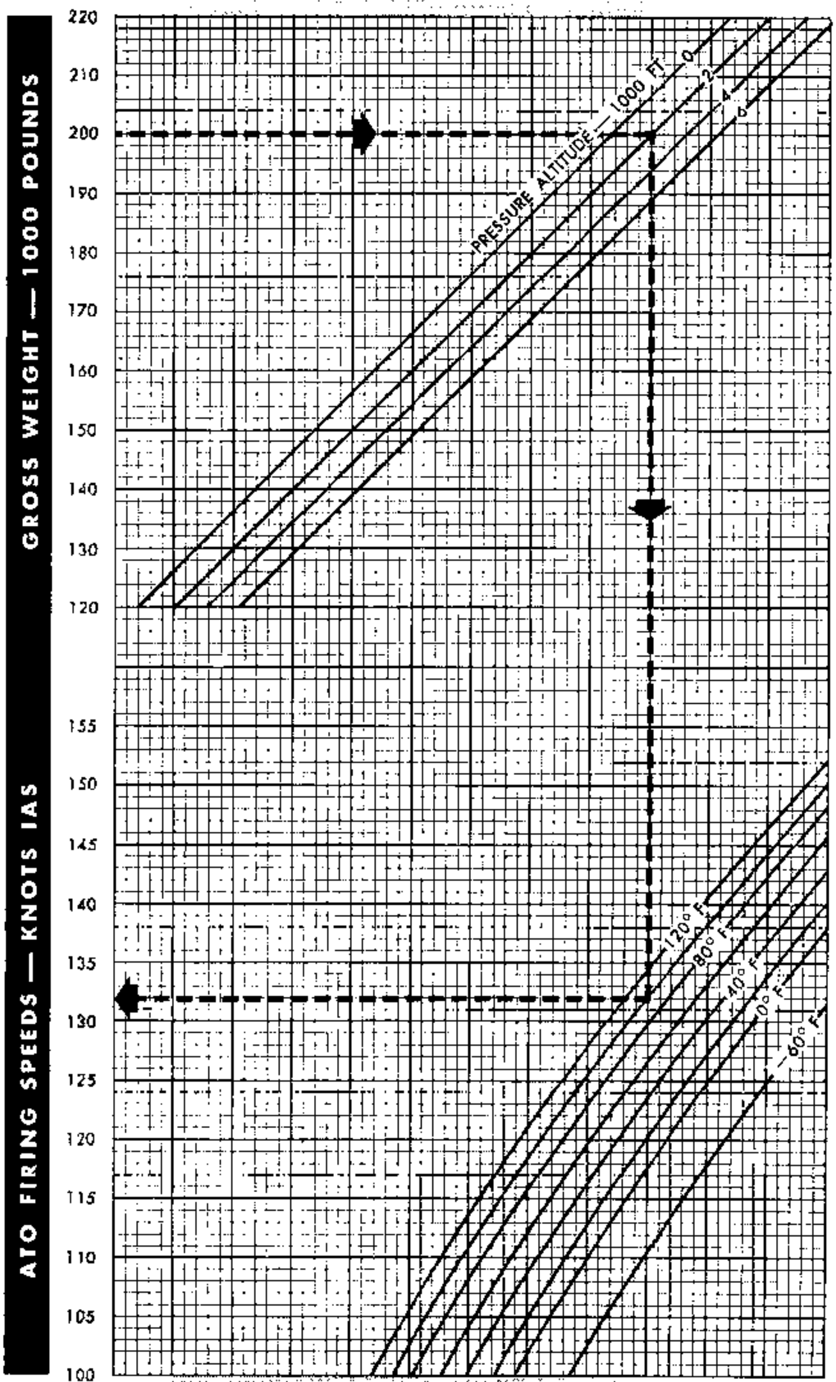
Figure A3-8.

ATO FIRING SPEED

18 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

50833WC-1

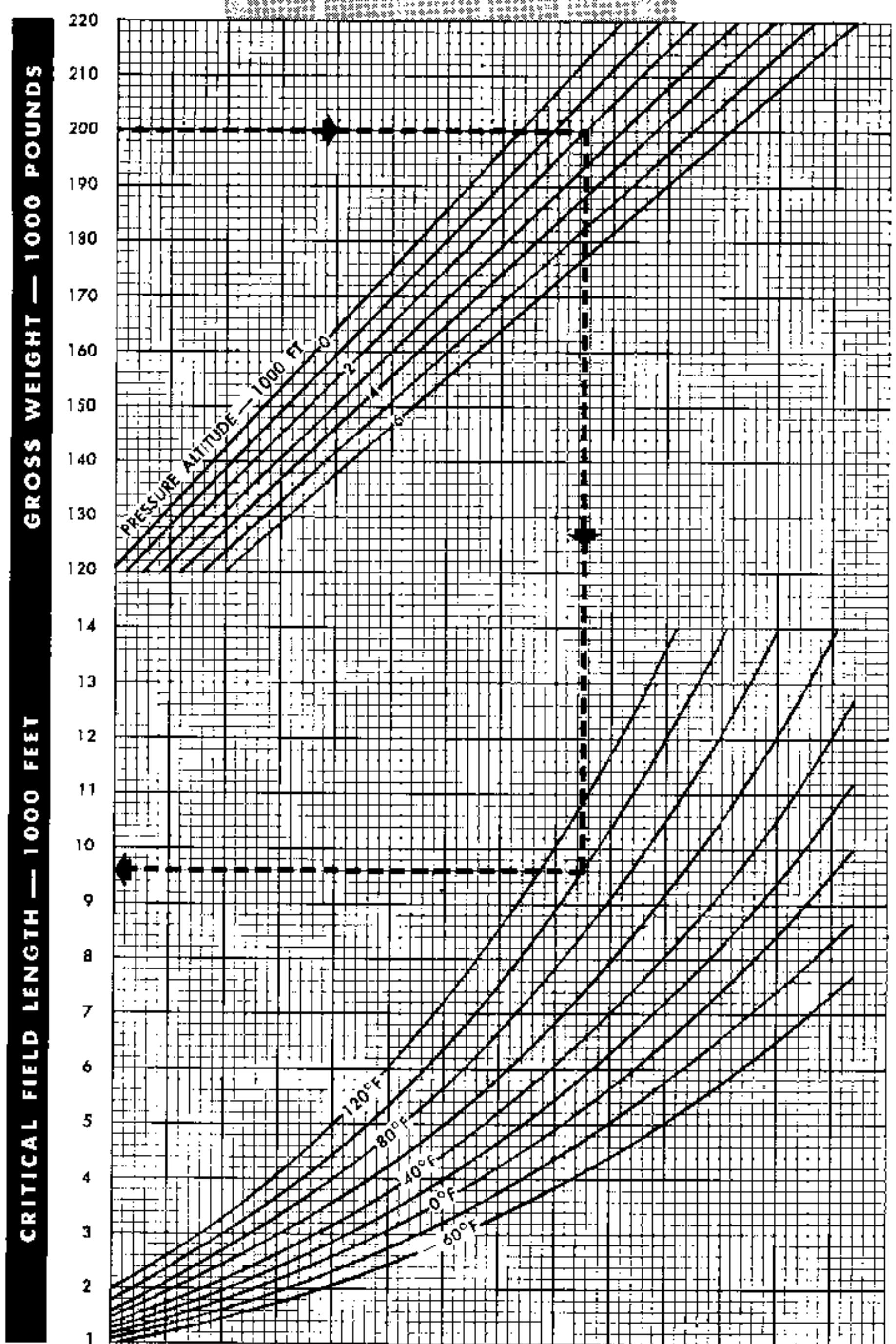
Figure A3-9.

CRITICAL FIELD LENGTH

33 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:

ATO FIRED 10 SECONDS BEFORE TAKEOFF

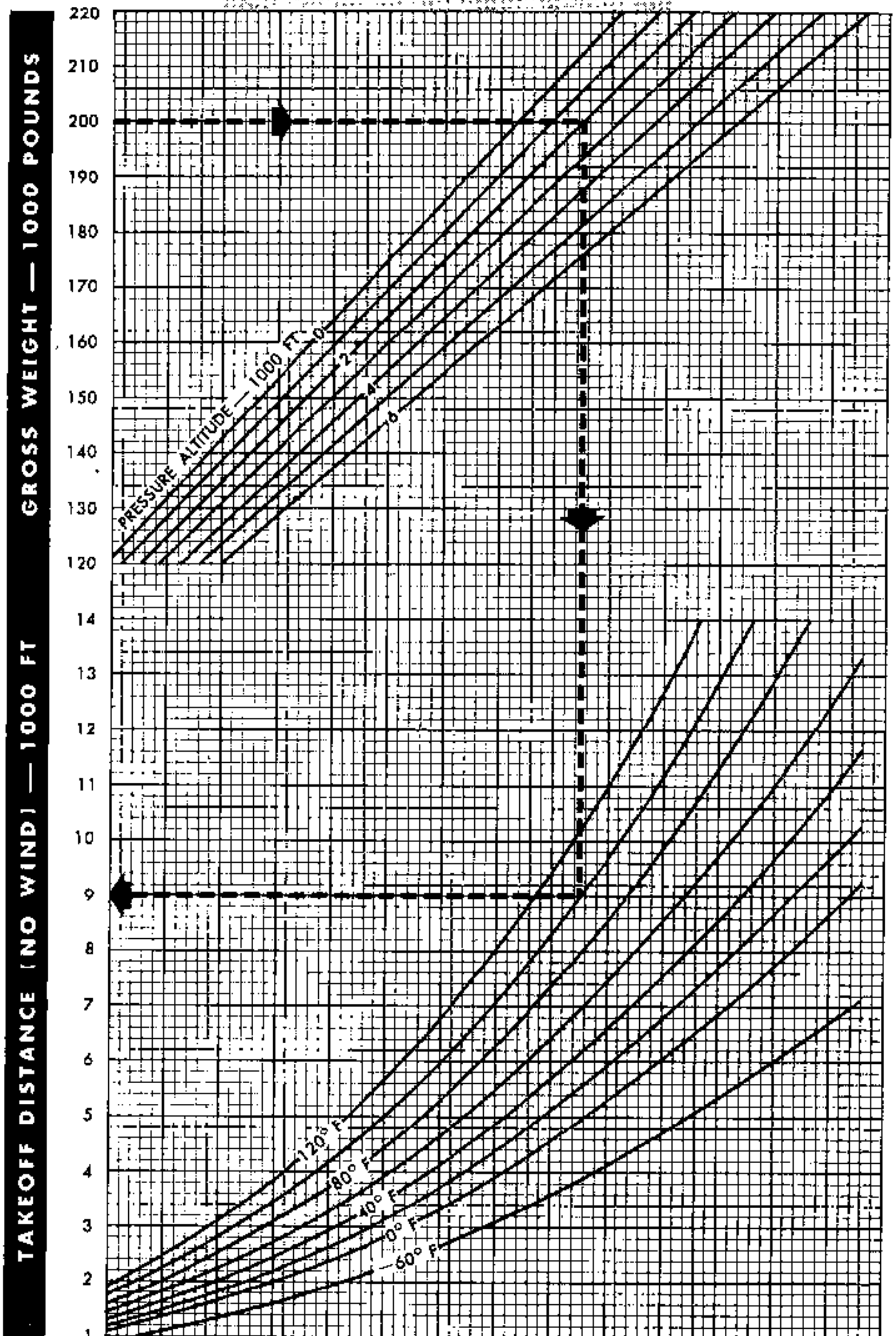
Figure A3-10.

TAKEOFF DISTANCE

33 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

50835WC-1

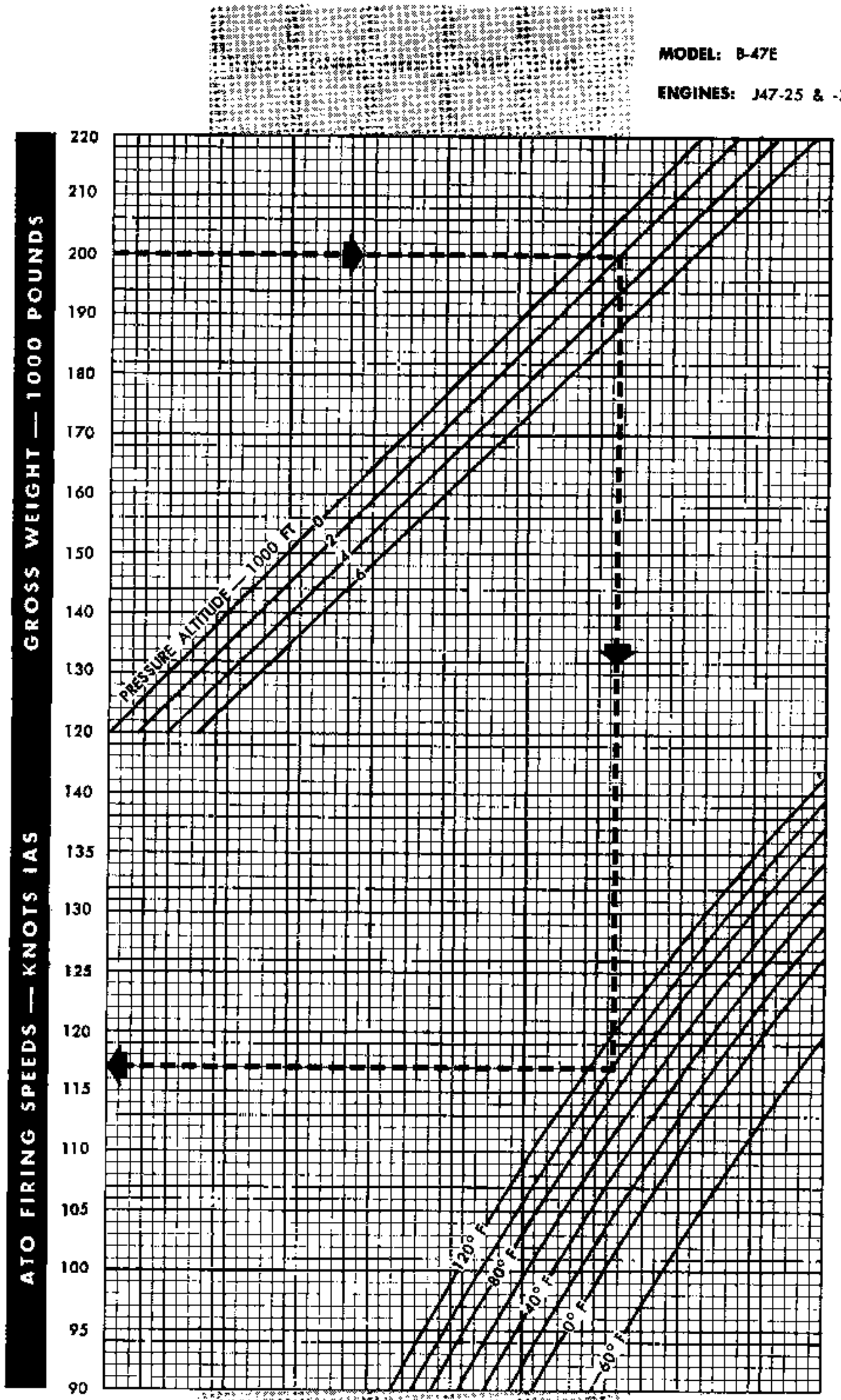
Figure A3-11.

ATO FIRING SPEED

33 ATO BOTTLES — LOW FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

CONDITIONS:
ATO FIRED 10 SECONDS BEFORE TAKEOFF

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

30837WC-1

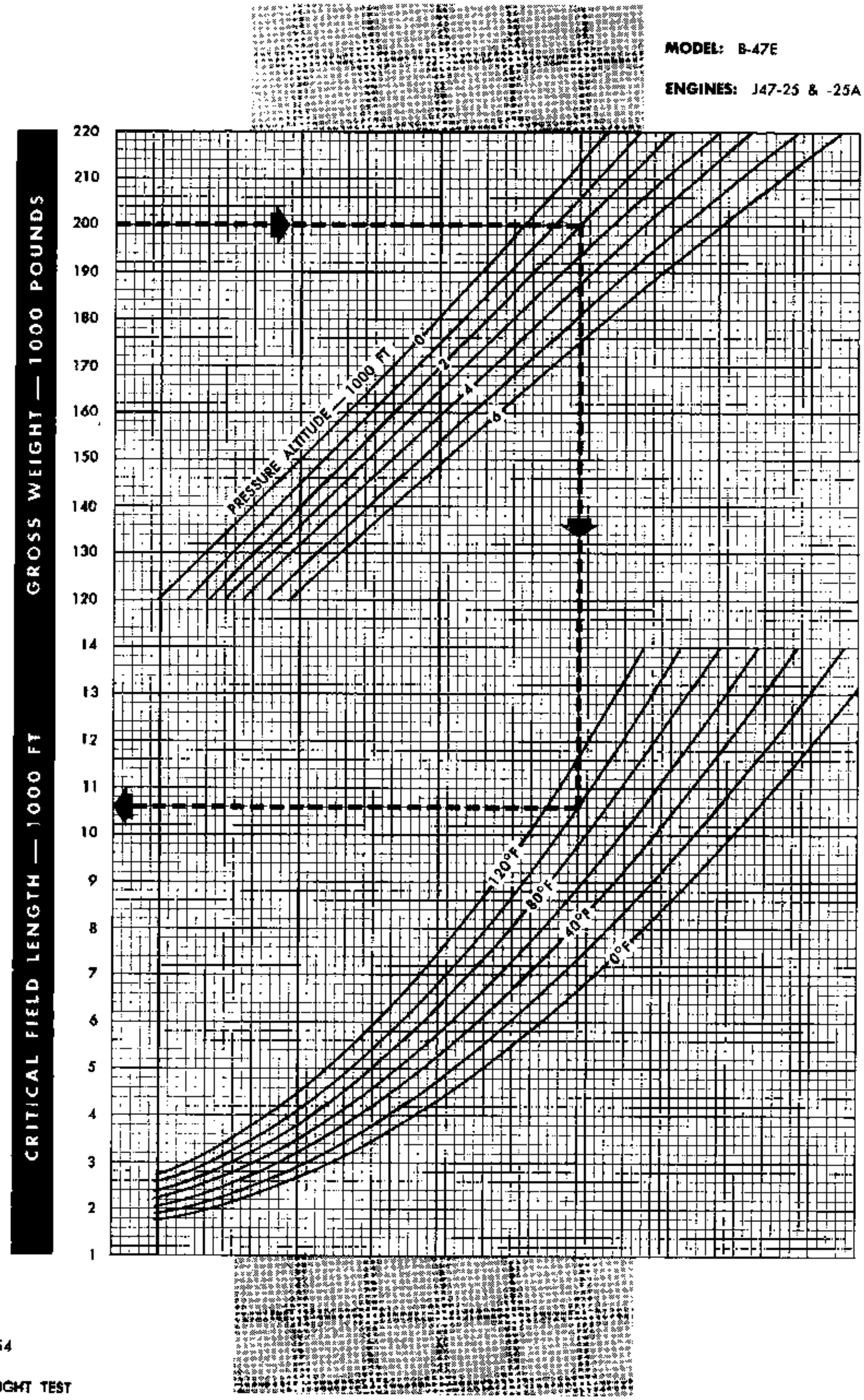
Figure A3-12.

CRITICAL FIELD LENGTH

18 ATO BOTTLES — MEDIUM FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

307C-1

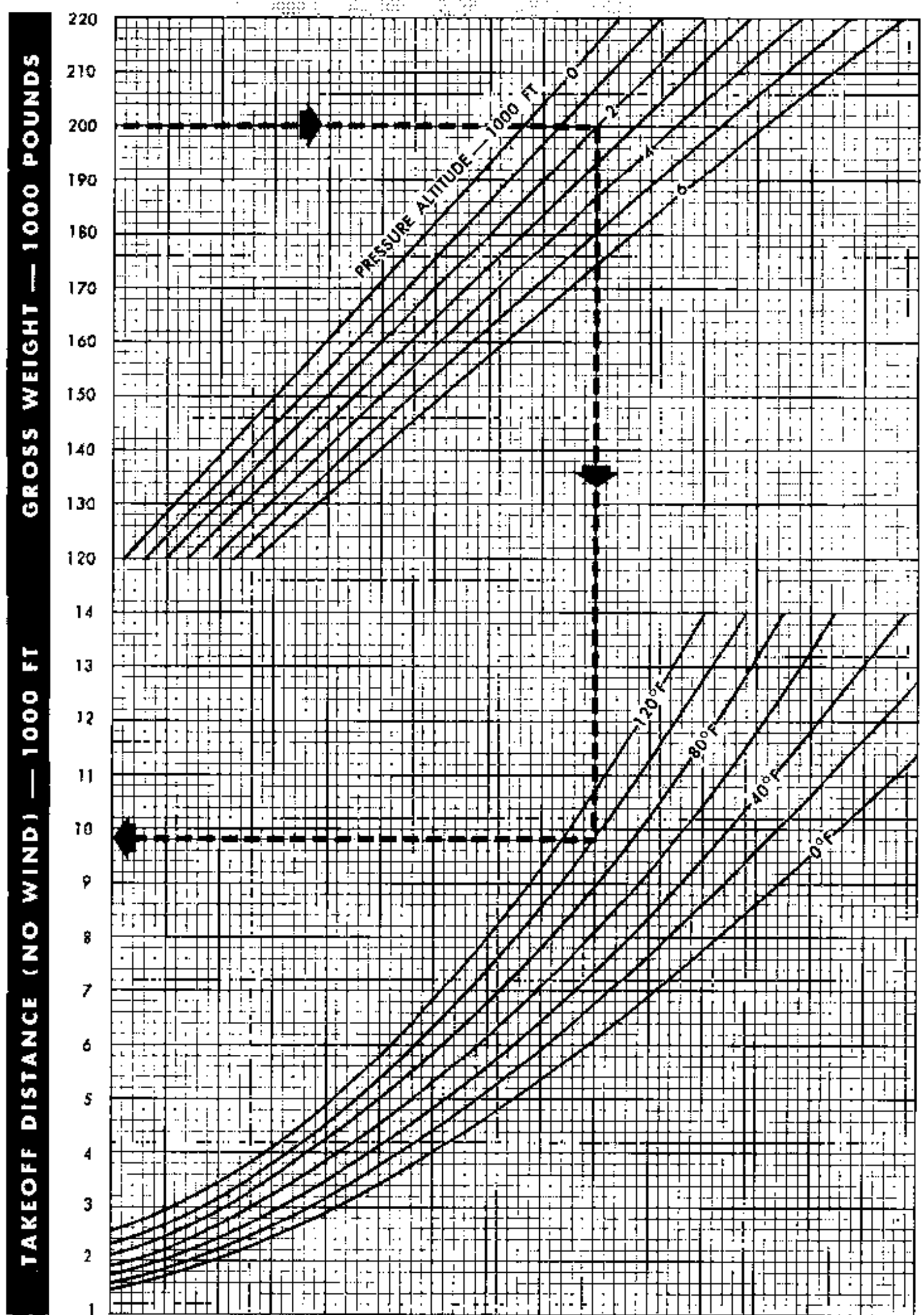
Figure A3-13.

TAKEOFF DISTANCE

18 ATO BOTTLES — MEDIUM FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

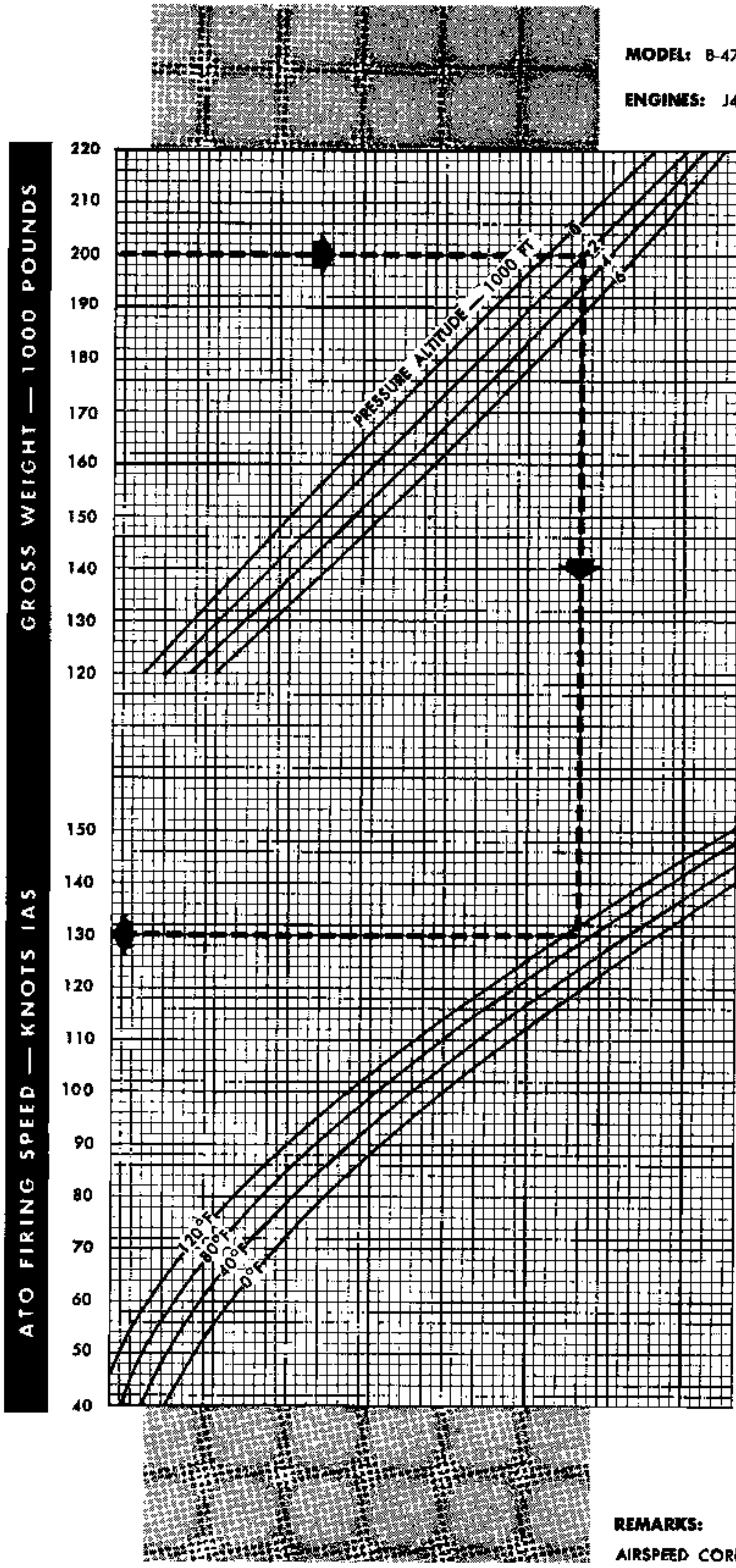
Figure A3-14.

ATO FIRING SPEED

18 ATO BOTTLES — MEDIUM FLOW WATER INJECTION

MODEL: B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

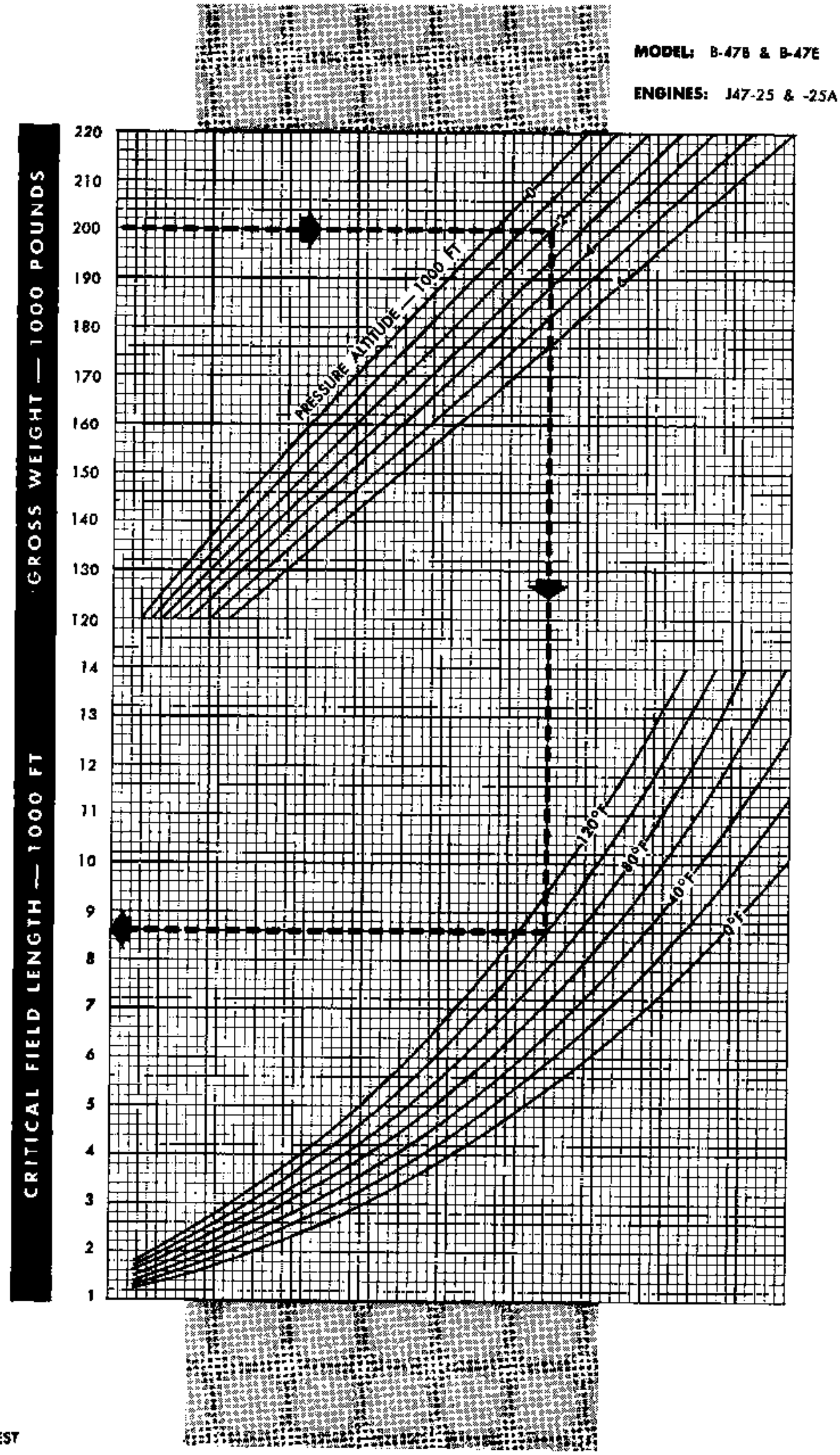
REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

309C-1

Figure A3-15.

CRITICAL FIELD LENGTH

33 ATO BOTTLES — MEDIUM FLOW WATER INJECTION



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

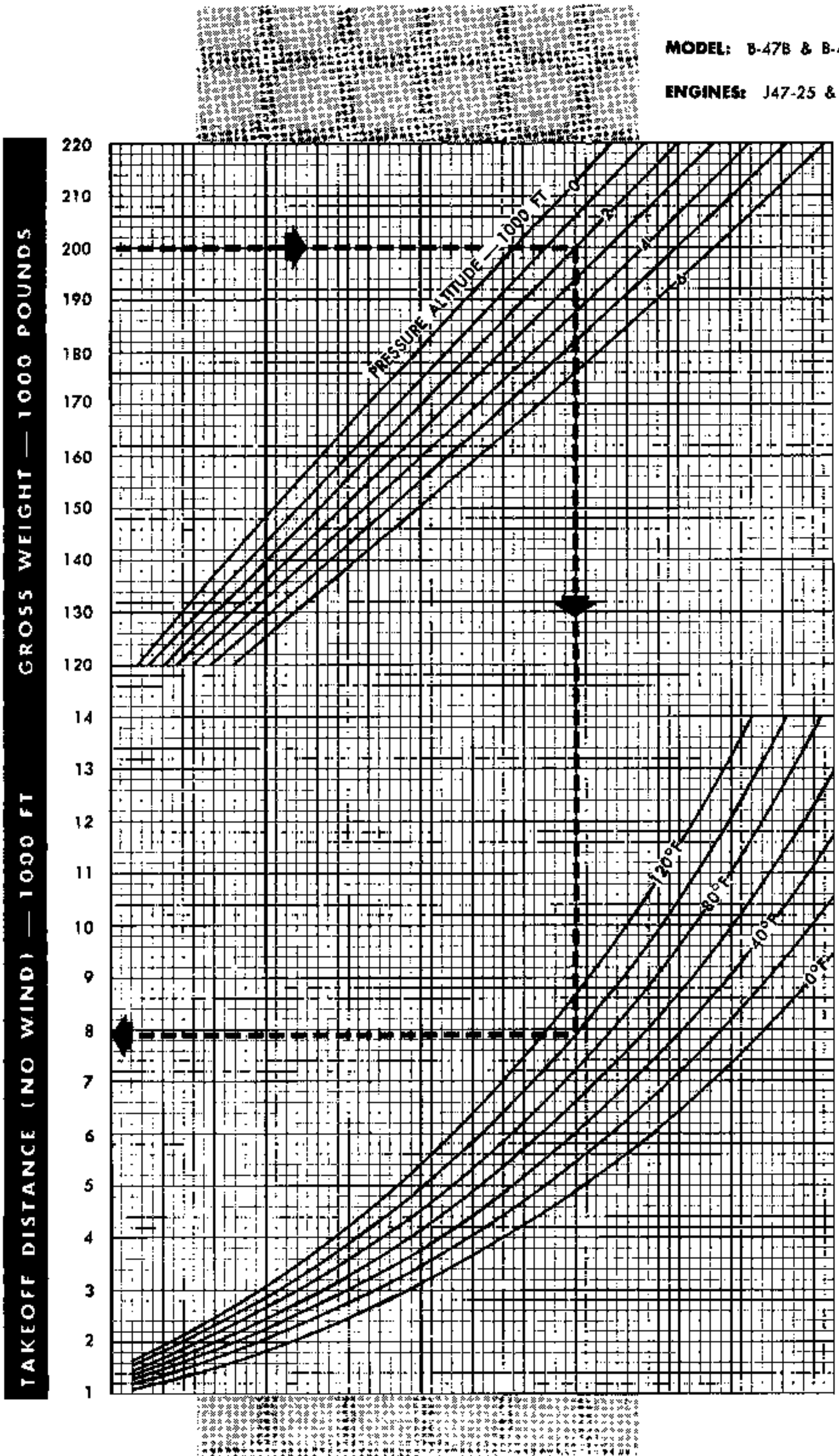
Figure A3-16.

TAKEOFF DISTANCE

33 ATO BOTTLES — MEDIUM FLOW WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

311C-1

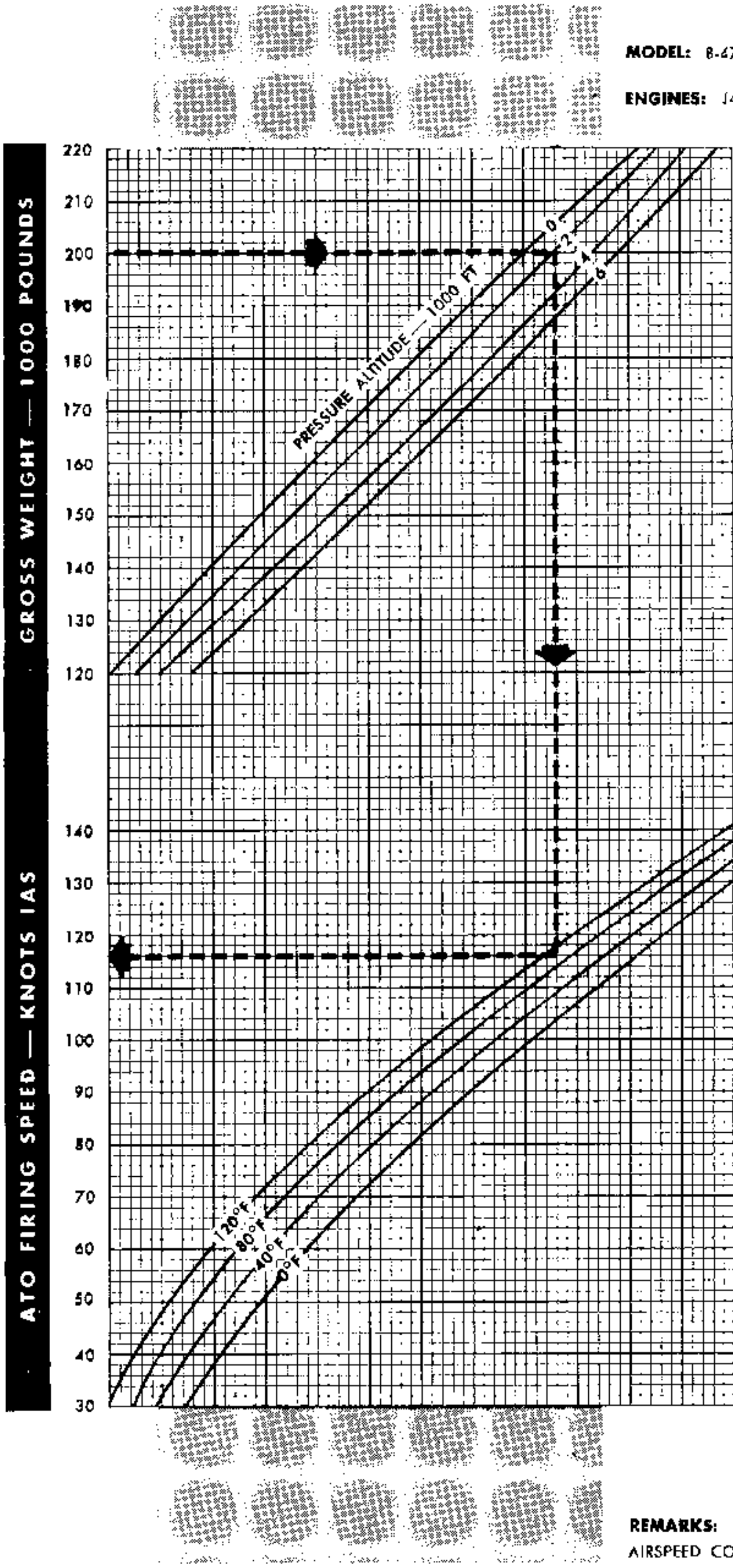
Figure A3-17.

ATO FIRING SPEED

33 ATO BOTTLES — MEDIUM FLOW WATER INJECTION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

312C-1

Figure A3-18.

Part 4 refused takeoff

This part is intended to be used in addition to either part 2 or 3 depending on whether or not ATO is to be used.

Refusal speed is the highest speed to which the airplane can be accelerated and still be stopped on the remaining runway. When the rules for critical field length are observed, a takeoff on five engines will always be possible if the engine failure occurs at or above the refusal speed. In the case where actual runway length is equal to the critical field length, a five-engine takeoff may be made in the same distance required to stop from refusal speed.

For a takeoff at low gross weight on a long runway, it may be found that the refusal speed given on the chart will be greater than the takeoff speed. If this is the case, then takeoff speed should be the refusal speed. The charts on figures A4-1, A4-2, and A4-3 present data for determining the refusal speed for a takeoff during which an emergency stop becomes necessary. These charts are to be used with both the no-ATO and the ATO takeoff parts and are based on the following:

1. Maximum performance during acceleration
2. Three seconds for pilot reaction time
3. Three seconds to deploy brake chute and apply brakes.

As explained in part 1, ground effect introduces about a 4-knot error in the airspeed indicator reading during takeoff. The refusal speed charts have been corrected for this error and represents actual indicator readings.

EXAMPLE:

The chart on figure A4-1 contains an example of the takeoff problem with the following conditions:

Gross Weight = 150,000 pounds
Pressure Altitude = 2000 feet
OAT = 80° F
Runway Available = 8500 feet
No ATO
No Water Injection

To determine refusal speed, enter figure A4-1 with gross weight, field elevation, OAT, and runway available, then read no-wind refusal speed.

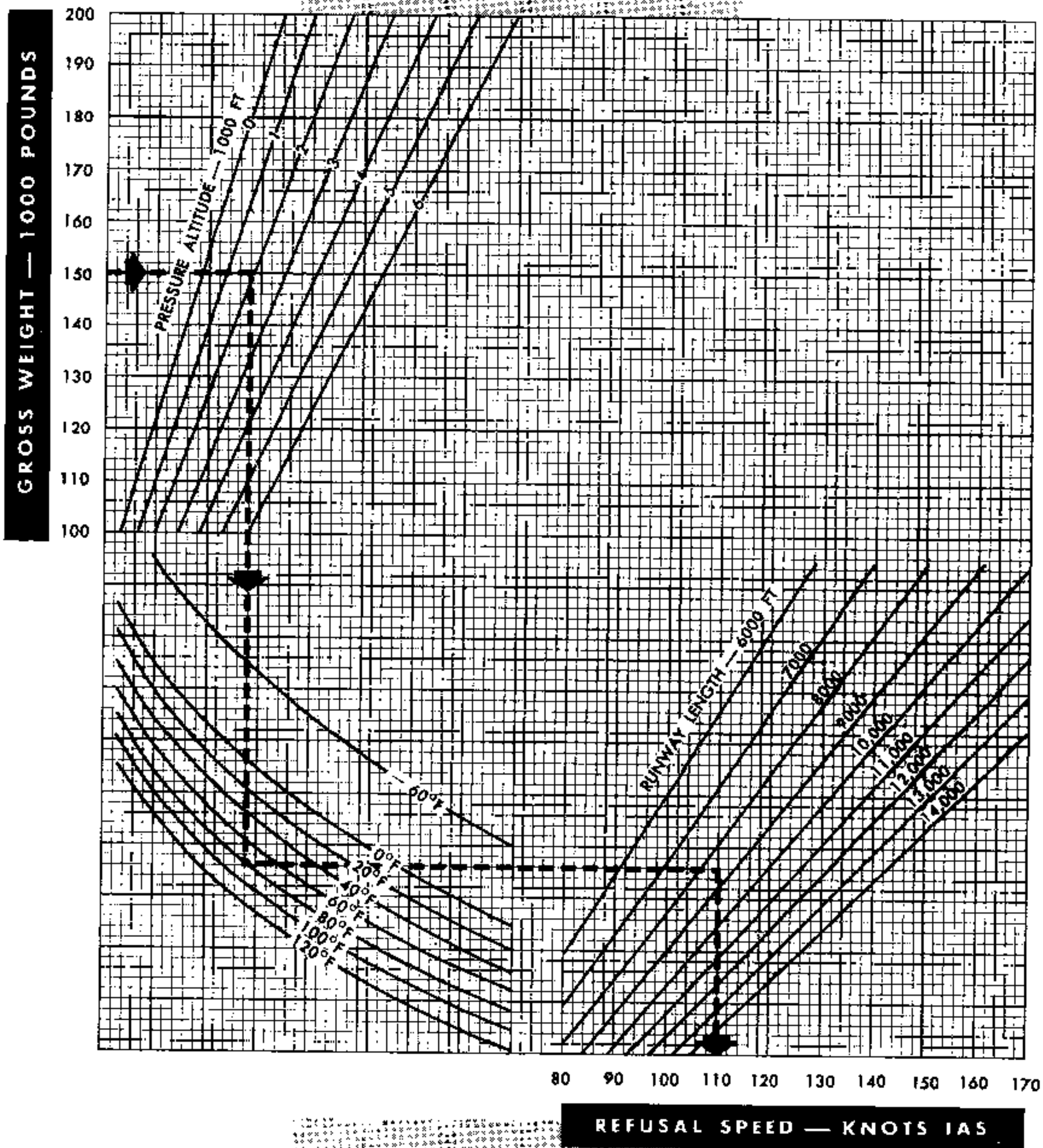
REFUSAL SPEED

NO WATER INJECTION

6000-14,000 FT RUNWAYS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

401C-1

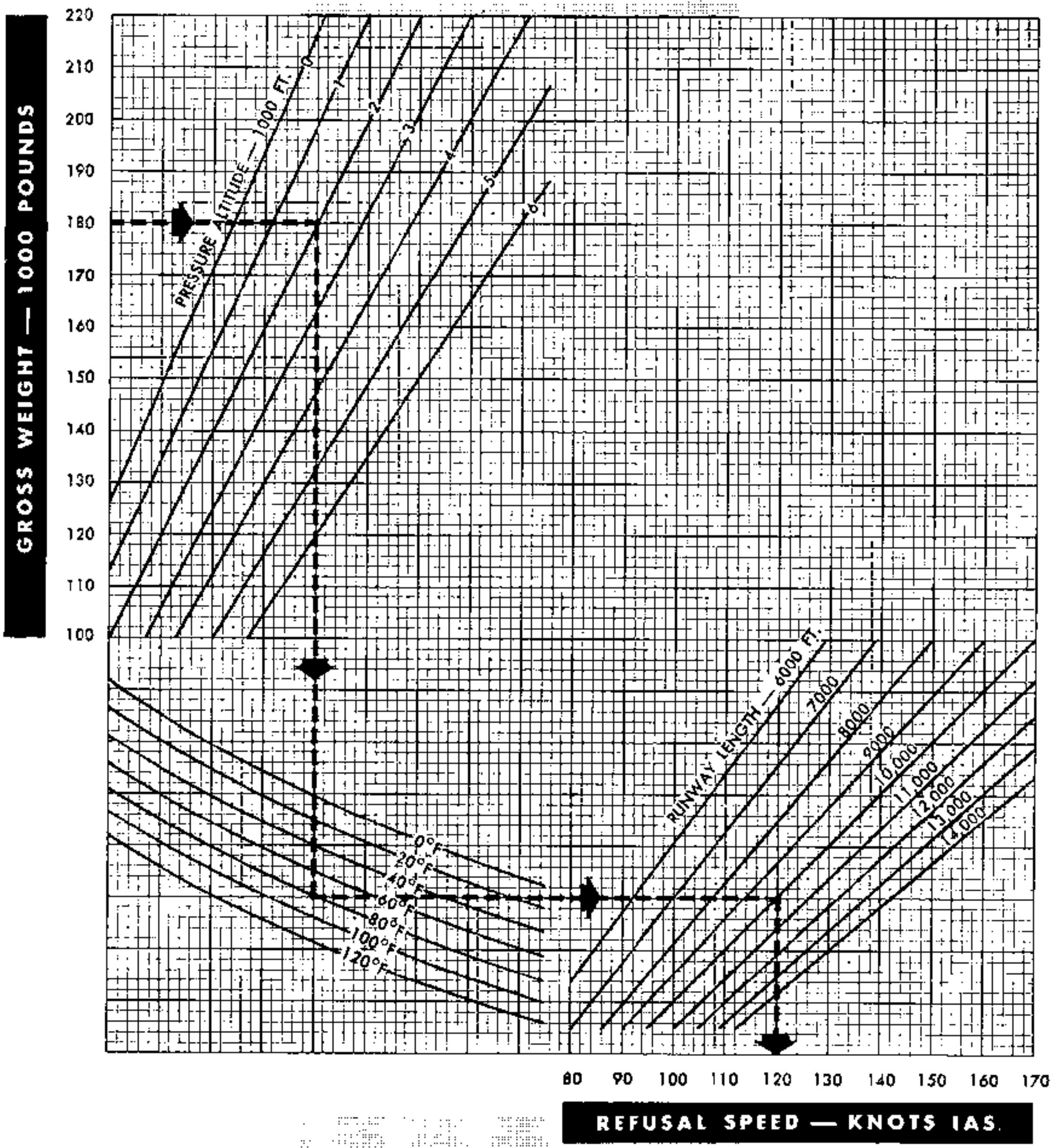
Figure A4-1.

REFUSAL SPEED

LOW FLOW WATER INJECTION 6000-14,000 FT RUNWAYS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1953

DATA BASIS: FLIGHT TEST

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

50724WC-1

Figure A4-2.

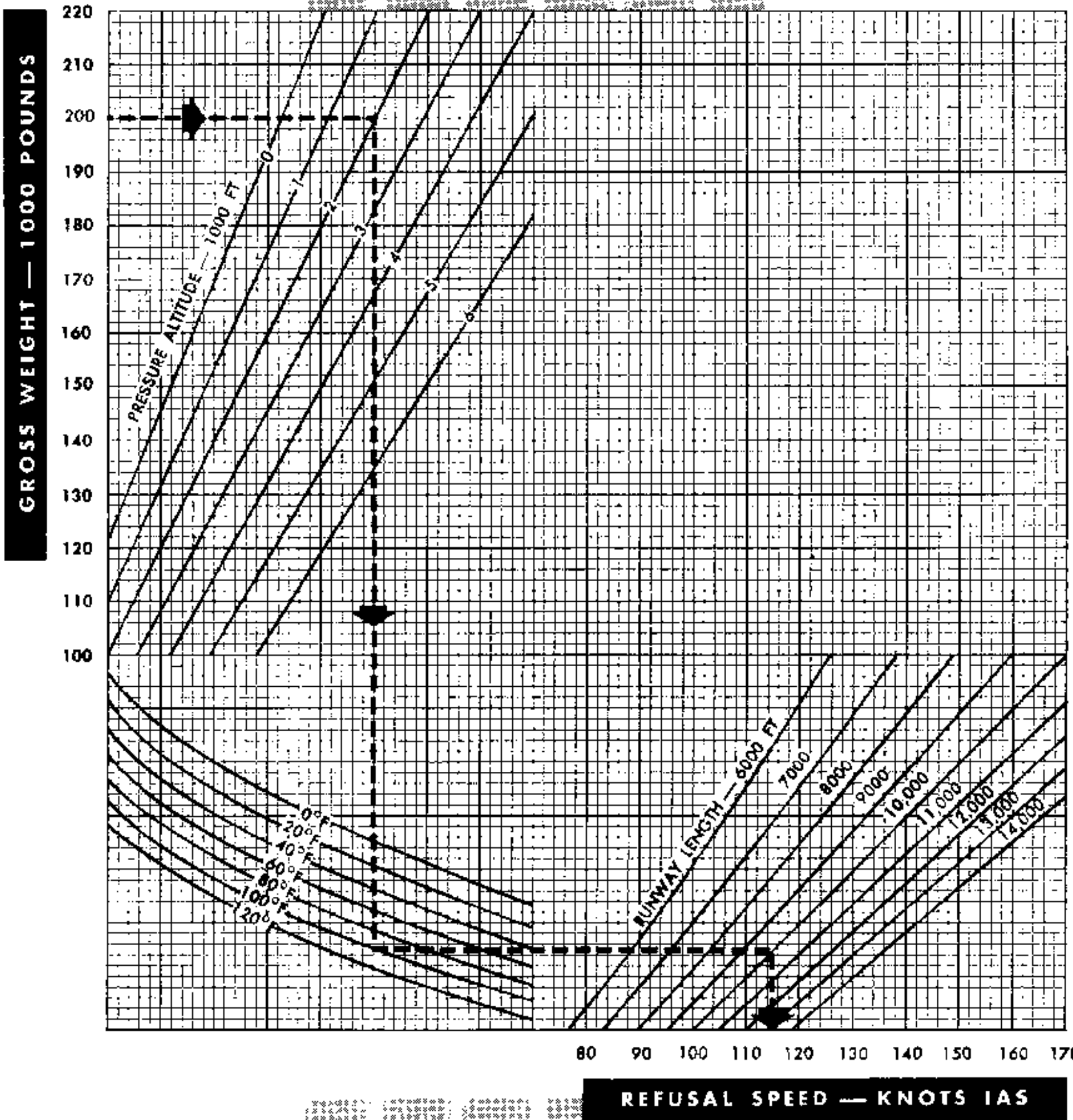
REFUSAL SPEED

MEDIUM FLOW WATER INJECTION

6000-14,000 FT RUNWAYS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1954

DATA BASIS: FLIGHT TEST

REMARKS:
AIRSPEED CORRECTED FOR GROUND EFFECT

402C-1

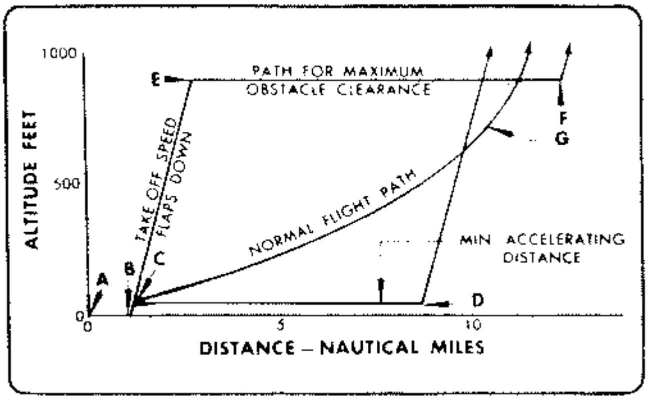
Figure A4-3.

Part 5 climb

CLIMB

FLIGHT PROCEDURES AFTER TAKEOFF

Flight procedure immediately after takeoff will depend primarily on local terrain and operating conditions. Limiting techniques prior to attaining the optimum R/C speed are illustrated below. The difference in the amounts of fuel and time involved in reaching a 1000-foot altitude is so small that it is not a determining factor in the choice of flight paths.



A - Start takeoff roll at takeoff rpm flaps down.
B - Takeoff point. Start gear retraction for all conditions.
C - Minimum desired altitude for path CD. Start flaps retraction if path CD is used.
D, F, G - Point at which optimum rate of climb speed is obtained.
E - Maximum desired altitude for clearing obstacle. Path CE should be at or above takeoff speed with flaps fully extended. Start flap retraction at point E.

NORMAL FLIGHT PROCEDURES

Assuming no high obstacles, the normal flight path is the one which will usually be used, as it provides a reasonable altitude for turns and maneuvers as well as a fairly rapid acceleration. The gear should be retracted immediately after takeoff and flap retraction should begin as soon as possible. With no initial climb, the flap retraction time is such that the airspeed will remain well above the stall and below the structural placard. With an initial climb, a slight delay in retracting the flaps will maintain this margin above the stall, the amount of delay being determined by the steepness of the climb. A good procedure is to allow the airplane to accelerate approximately 15 knots in a slight climb before starting flap retraction. Any prolonged delay without an accompanying steepening of the climb angle may result in exceeding flap structural limits.

MINIMUM ACCELERATING DISTANCE

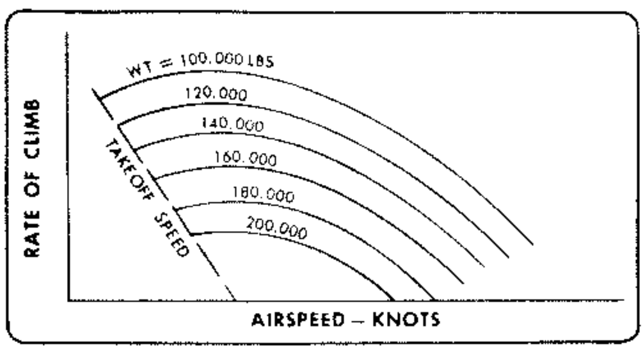
This procedure is feasible when the terrain is flat and the pilot desires to maintain a minimum altitude above the ground in order to accelerate to climb speed as quickly as possible. Under this condition, both gear and flaps should be retracted immediately after takeoff. Care must be exercised not to exceed the structural limit speeds of the flaps presented in section V.

MAXIMUM OBSTACLE CLEARANCE

When it is necessary to clear an obstacle in a short distance, this procedure can be used. The gear should be retracted immediately after takeoff, with the climb from C to E at not less than takeoff speed, to prevent stalling and provide a reasonable margin of lift for maneuverability. For the same reason, flap retraction should not begin until point E is reached.

EMERGENCY PERFORMANCE AFTER TAKEOFF

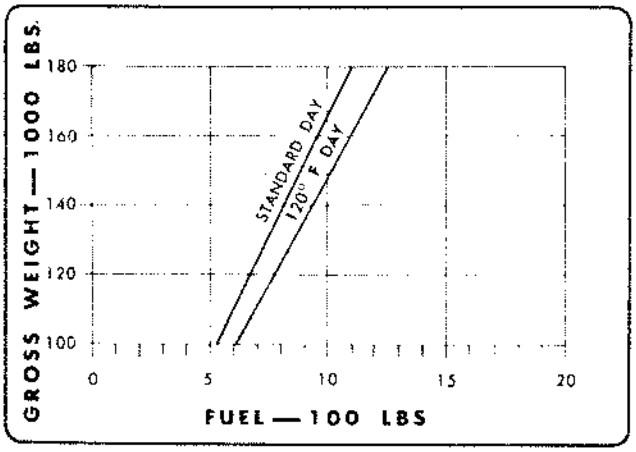
If an engine fails during the takeoff operation, climb performance at high weights is marginal for high temperatures and altitudes until the gear is raised. This is the reason for saving some ATO duration for the initial climb while the gear is starting up. The following sketch shows the effect of airspeed on rate of climb available after take off with flaps and gear down.



It shows that, for maximum rate of climb, an airspeed somewhat higher than the takeoff is required. The curves are fairly flat however, indicating that rigid climb speed control is not necessary. Gear drag lowers the rate of climb approximately 300 feet per minute at takeoff speeds with flaps down. An engine failure decreases the rate of climb by approximately

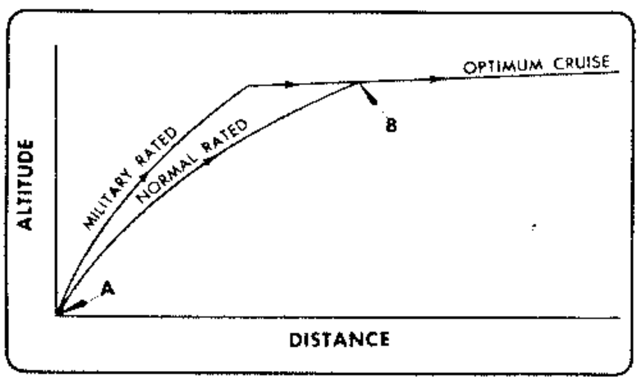
500 feet per minute under the same conditions. Climb performance at takeoff speeds with one engine out and gear and flaps down is shown on figure A5-15.

As previously mentioned, fuel consumption is not a factor in choice of flight paths after takeoff. However, to allow for fuel consumption during the acceleration period after takeoff, the following plot will give fuel required for a range of gross weights for sea level standard and 120° F day. It will be satisfactory to assume that 10 nautical miles and 2 minutes are required. These figures are based on using all excess thrust after takeoff for acceleration.



CLIMB PERFORMANCE

On the following pages are the charts for optimum climb performance at both military (98%) and normal (96%) rpm. Referring to the following sketch, the fuel consumption and time from point A to point B are only slightly less for a climb at military rated than at normal rated rpm. The differences for a climb to optimum cruising altitude are approximately 500 pounds of fuel and 1 minute. Full anti-icing during a climb at military rated rpm may overheat the airplane structure. Climbs at less than normal rated rpm will result in a loss of range because of excessive time spent in climbing.



During the climb speeds, ±10 knots from optimum will not materially affect performance. The effect of OAT on climb performance is considerable, and the NACA standard day performance presented in this section should be corrected for temperature. For each 10° F that the OAT deviates from the NACA standard temperature, the average climb performance at either normal or military rated power changes approximately as follows:

TEMPERATURE	PERFORMANCE	CHANGE
EACH 10° F (5½° C) ABOVE STANDARD TEMPERATURE	RATE OF CLIMB TIME OF CLIMB CLIMB RANGE CLIMB SPEED CLIMB FUEL	DECREASES 5% INCREASES 6% INCREASES 6% INCREASES ½% INCREASES 2%
EACH 10° F (5½° C) COLDER THAN STANDARD TEMPERATURE	RATE OF CLIMB TIME TO CLIMB CLIMB RANGE CLIMB SPEED CLIMB FUEL	INCREASES 5% DECREASES 6% DECREASES 6% DECREASES ½% DECREASES 2%

50847WA

If the usual procedure is to climb at normal rated power on a standard day, but a hot day occurs, the loss in performance can be overcome by increasing the power. On a very hot day, a climb at military rated power will give approximately the same rate of climb as normal rated power on a standard day.

RATES OF CLIMB

A chart of the effect of flaps, gear, OAT, airspeed, and number of engines on rate of climb for a specific set of conditions is on figure A5-13. It is useful as a reference to show the pilot the relative effect of these various factors on his climb performance. Figures A5-14 through A5-17 show rates of climb available with flaps and gear down and with flaps down only. For each configuration, climb rates are shown for climb performed at takeoff speed and for climb performed at the flap structural limit speed. The charts are entered with gross weight of the airplane and take into account the pressure altitude, outside air temperature, and number of engines operating. The charts are provided to assist planning for areas or conditions requiring accurate climb rate information during the immediate post-takeoff phase of flight. Figure A5-19 shows the maximum gross weight at which the airplane may unstick on takeoff and still maintain a climb rate of 200 feet per minute with the climb performed at takeoff speed and with only five engines operating. The chart is entered with pressure altitude and takes into account the effect of outside air temperature. Whenever conditions require a climb rate of at least 200 feet per minute immediately after takeoff, this chart should be checked to determine the maximum allowable gross weight the airplane may have at takeoff and still be able to maintain a climb rate of 200 feet per minute.

RATE OF CLIMB WITH APPROACH CHUTE DEPLOYED

On a go-around with the approach chute deployed, special attention should be given to the rate of climb obtainable under existing conditions. For planning purposes, a go-around with the approach chute deployed should not be attempted unless a 500 feet per minute rate of climb could be made good in the double emergency of an engine failure and failure of the chute to jettison. This climb rate is necessary to provide a margin for variations in climb capability among airplanes. Figure A5-18 shows the rate of climb obtainable for given gross weight, pressure altitude and OAT during go-around with the approach chute deployed. Two curves are given, one showing climb rates available with six engines operating and another showing climb rates with five engines operating. A given climb rate is established by accelerating to, and holding, the correct climb speed shown in the upper right portion of figure A5-18. The primary purpose of the chart is to tell the pilot whether or not he could get a climb rate of 500 feet per minute or better during a go-around in which an engine failed and the approach chute failed to jettison. Of course, for many cases the chart shows that ample climb rates are available with the approach chute attached. However, if a planned five-engine approach is in progress, the approach chute should not be deployed in the first place when the five-engine curve shows that a climb rate of 500 feet per minute or better could not be obtained during a go-around. Under such conditions, failure of the approach chute to jettison would compromise the safety of a climb-out. A normal six-engine approach with chute deployed is subject to the same considerations if an engine should fail just as the throttles are advanced for go-around and the chute cannot be jettisoned. Figure A5-18 shows that an engine failure reduces climb rate by about 600 to 800 feet per minute. Under these conditions, the approach chute should be jettisoned at once unless the pilot is certain that a minimum 500 feet per minute can be made good. Figure A5-18 can be used to preplan a six-engine approach by showing the pilot whether or not the approach chute should be jettisoned if an engine fails during go-around.

EXTERNAL WING TANKS

External wing tanks have no appreciable effect on takeoff other than an increase of gross weight. However, they do increase the time to climb, climb distance, and climb fuel and decrease the rate of climb. Climb performance with external wing tanks installed is presented on figures A5-11 and A5-12. The climb speed charts indicate flutter speed restrictions with wing tanks installed; however, for additional information concerning flutter speed restrictions, refer to section V.

USE OF CHARTS

The following paragraph contains an example condition which is used to describe the use of the various climb performance charts.

Assume a gross weight after takeoff of 120,000 pounds (without external wing tanks) and a climb at normal rated power from sea level to the best cruise altitude for maximum range. Find the climb performance on a standard day.

CLIMB FUEL WEIGHT

The first step is to determine the weight of fuel used during the climb. Use figure A5-1. The curves are for a theoretical climb at constant gross weight but they apply if an average weight is used as follows: At an estimated gross weight of just under 120,000 pounds, a first approximation to the climb fuel is 5400 pounds. Then the average gross weight is $120,000 - \frac{5400}{2} =$ 117,300 pounds and the final gross weight is 114,600 pounds. The cruise altitude for 114,600 pounds is about 40,500 feet. The corrected fuel required to climb is 40,500 feet at an average gross weight of 117,300 pounds is 5200 pounds. The corrected average weight is then 117,400 pounds and the final corrected weight is 114,800 pounds.

CLIMB RANGE

Similarly, using the climb range chart on figure A5-2, the range to 40,500 feet for the average gross weight of 117,400 pounds is 109 nautical miles.

TIME TO CLIMB

From the chart on figure A5-3, the time to climb is 16.5 minutes.

CLIMB SPEED

The correct airspeeds for maximum rate of climb are found on figure A5-4. The indicated airspeed should decrease from 351 knots at sea level to 212 knots at 40,500 feet. Exact speeds are not critical and an airspeed error of ±10 knots will not reduce the rate of climb appreciably.

RATE OF CLIMB

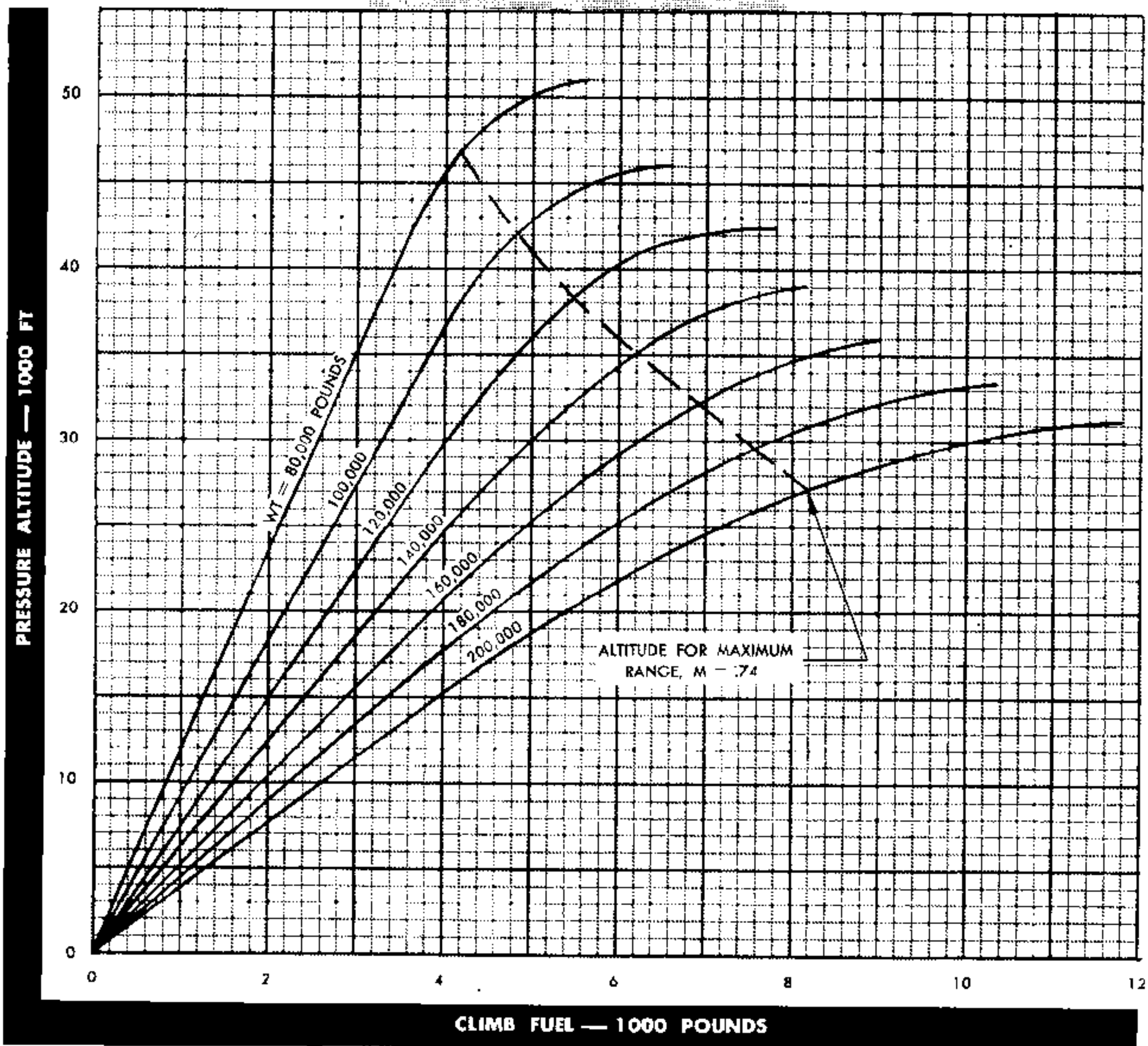
On figure A5-5 is shown the variation with altitude of the maximum rate of climb at normal rated power. At sea level, the initial rate of climb at 120,000 pounds is 4200 feet per minute. At 40,500 feet and 114,800 pounds, the final rate of climb is about 850 feet per minute.

CLIMB FUEL WEIGHT

NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

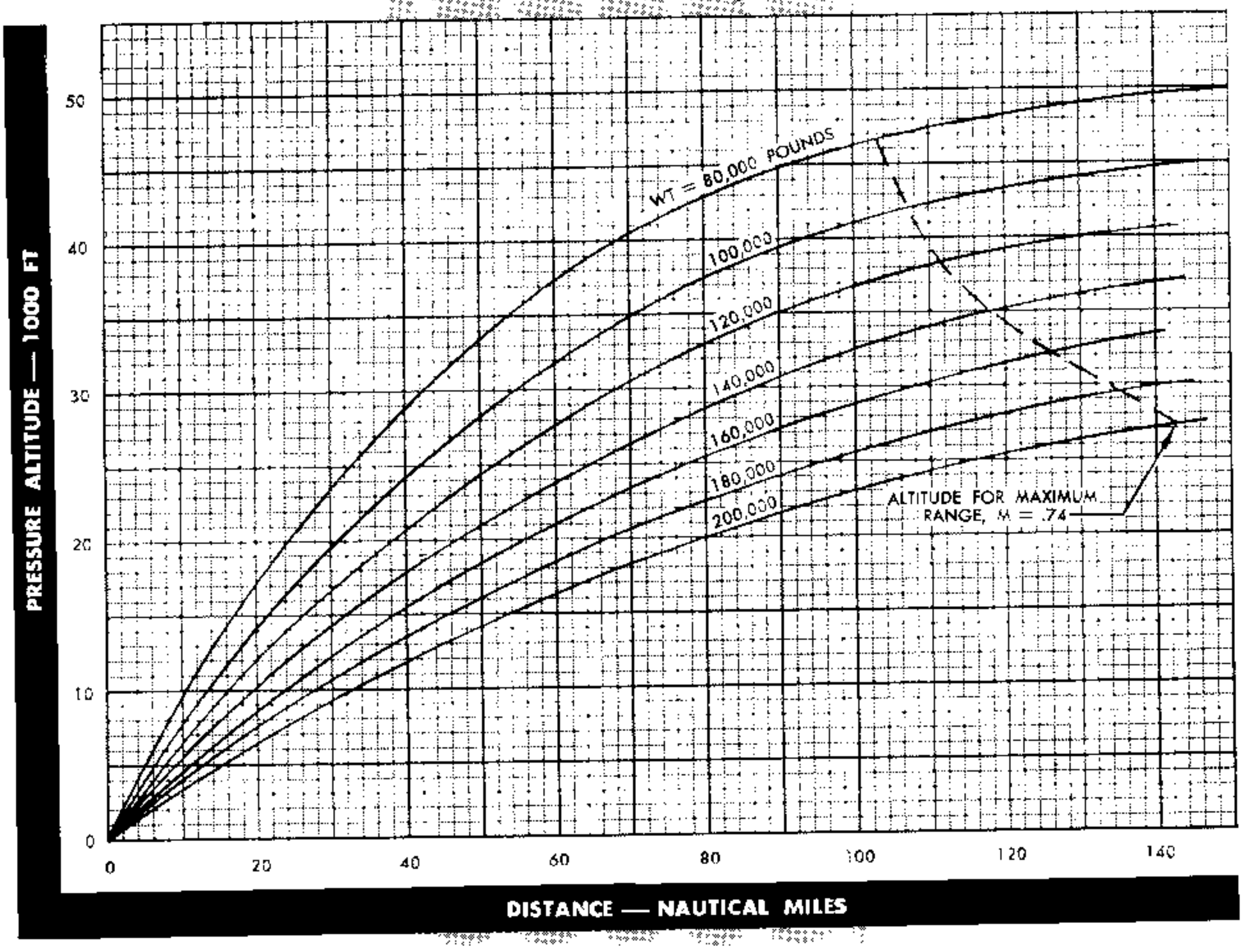
501C-1

Figure A5-1.

CLIMB RANGE
NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

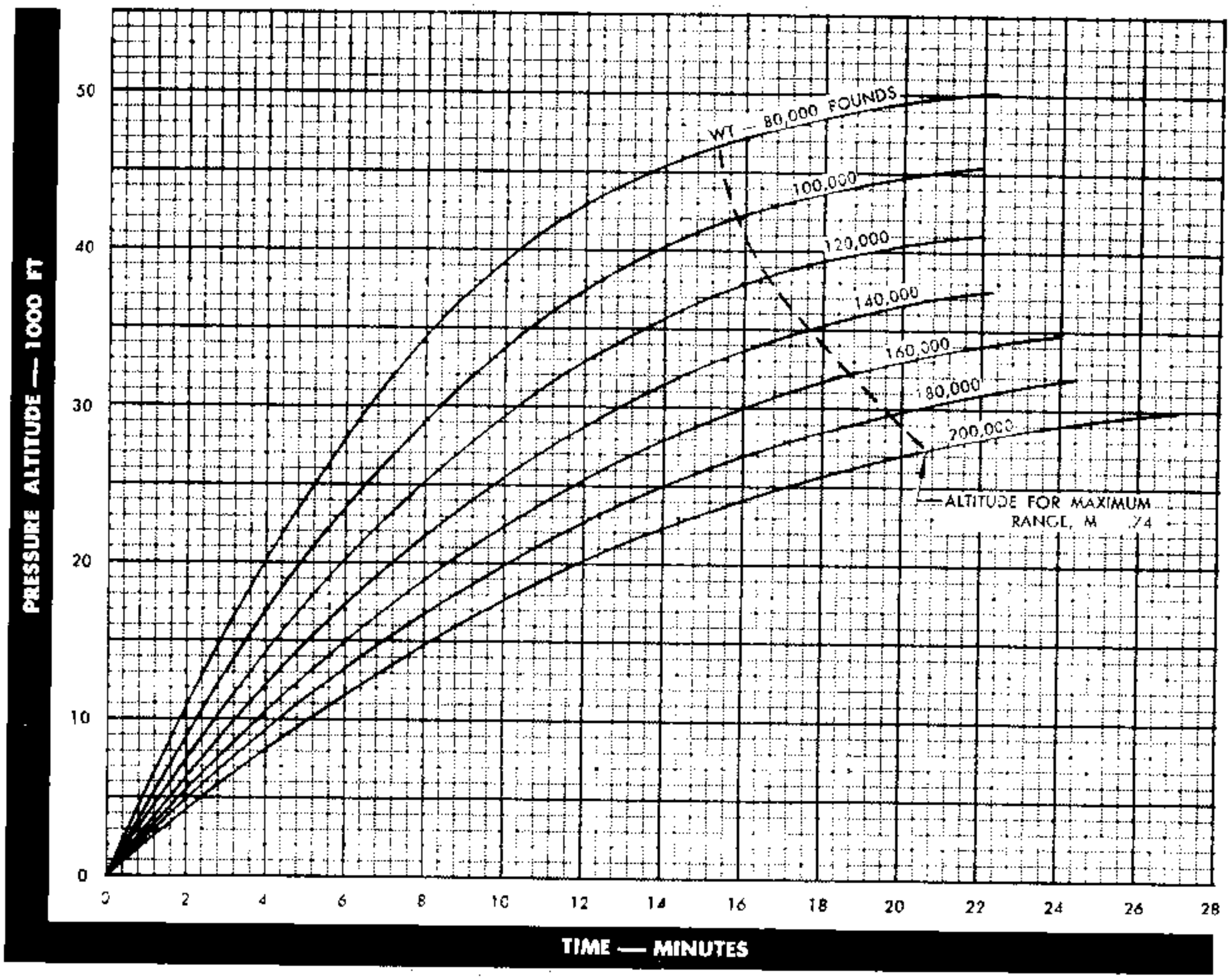
DATA BASIS: FLIGHT TEST

Figure A5-2.

TIME TO CLIMB
NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

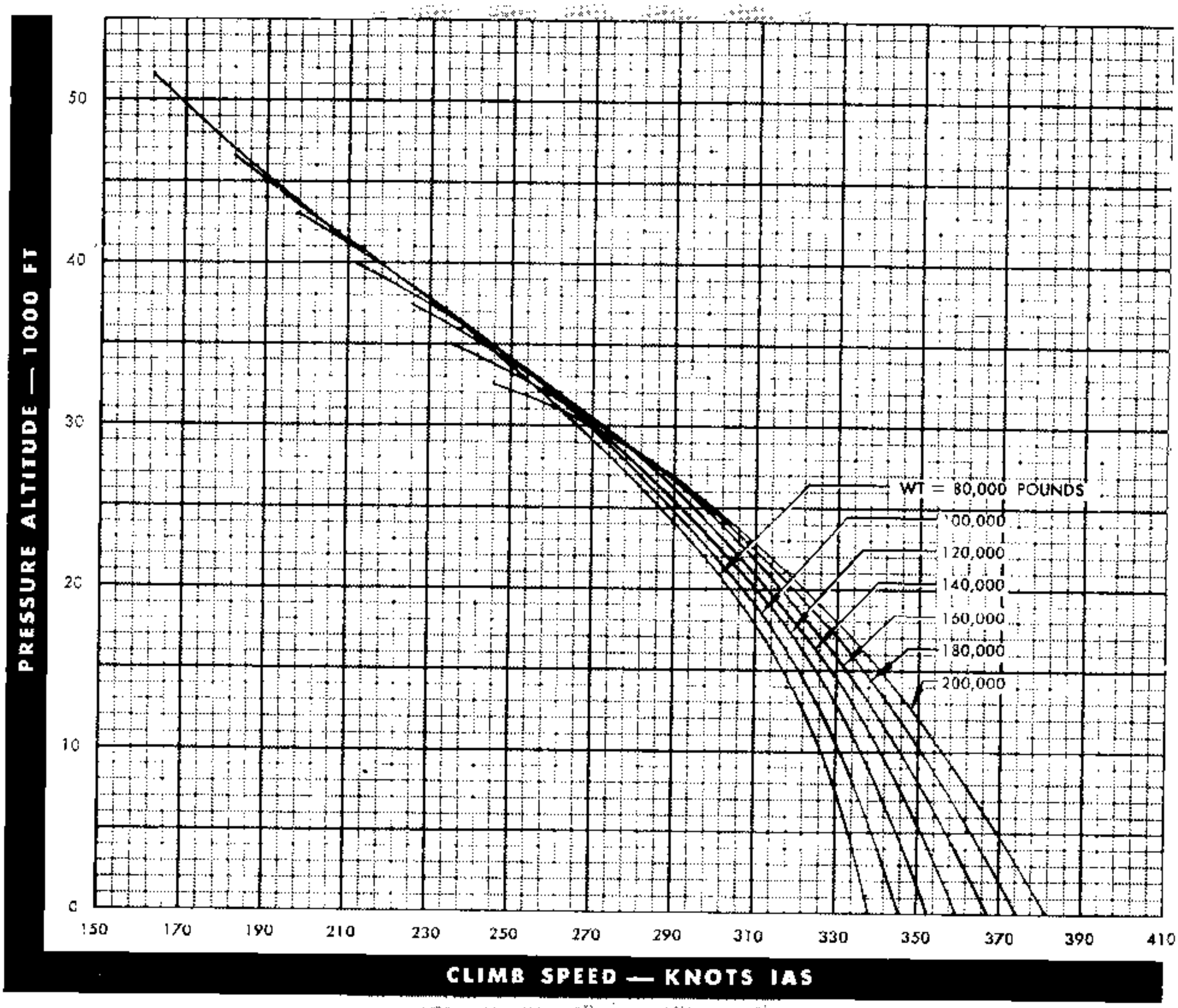
Figure A5-3.

CLIMB SPEED

MAXIMUM RATE OF CLIMB AT NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

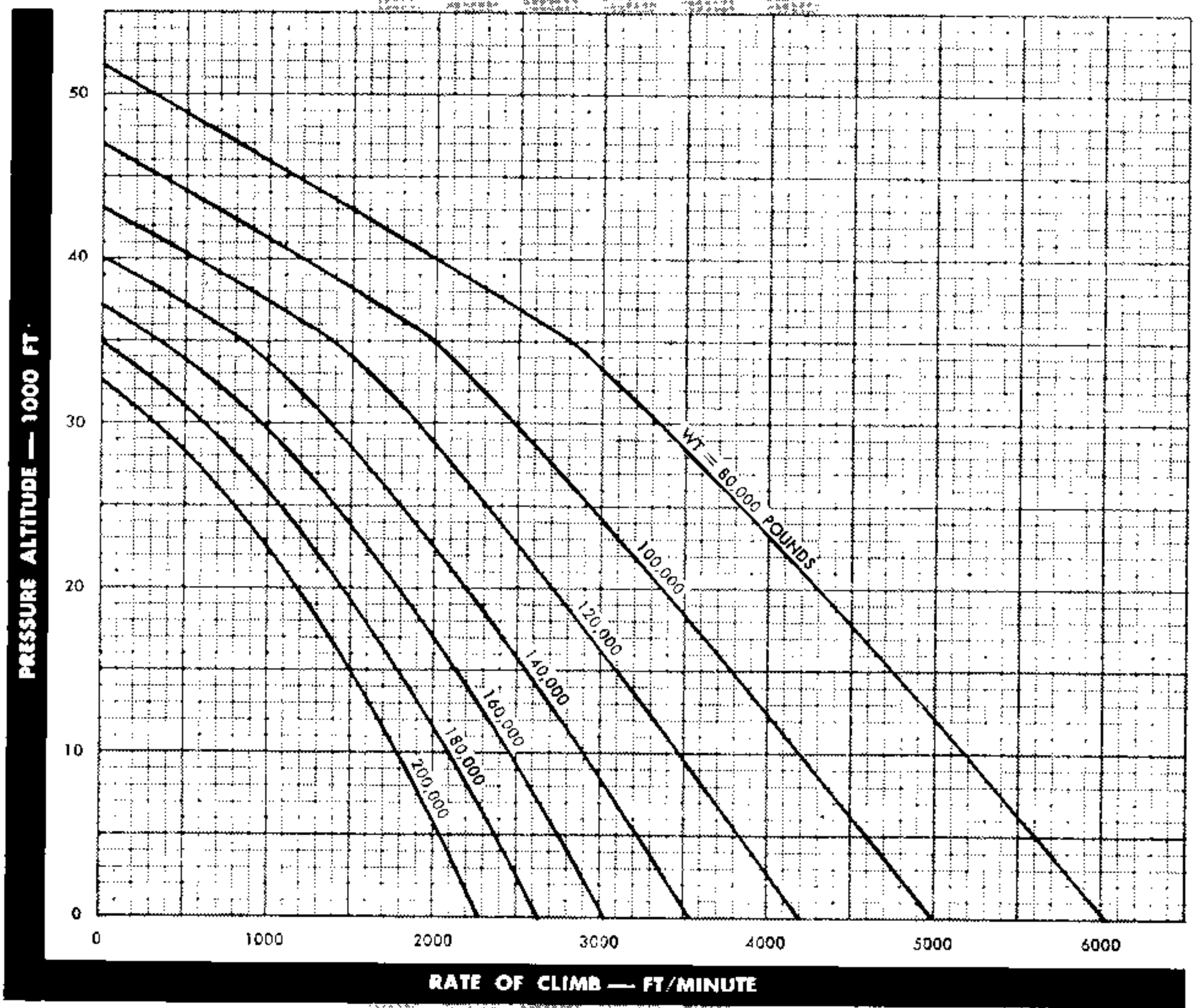
Figure A5-4.

MAXIMUM RATE OF CLIMB

NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

505C-1

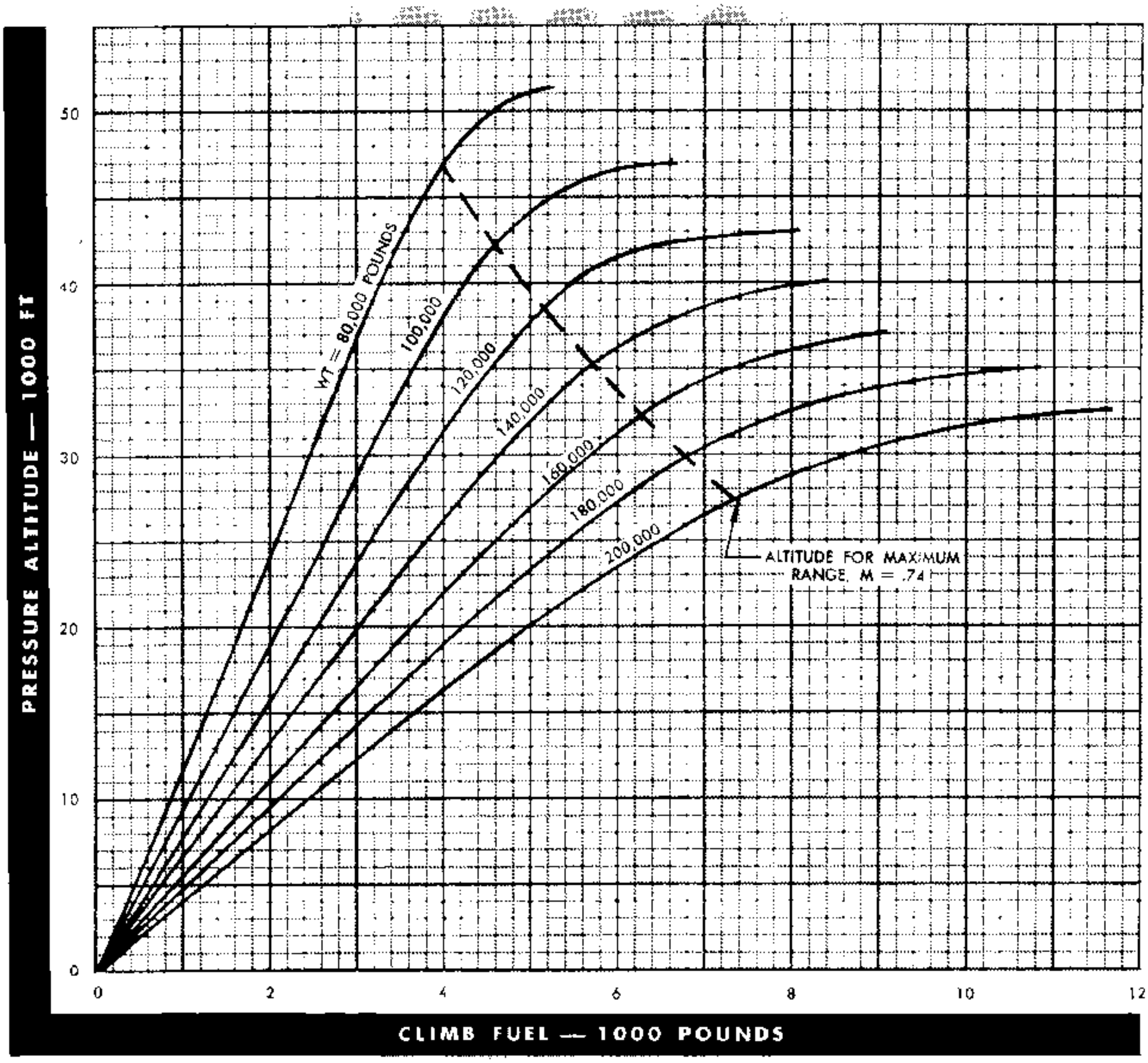
Figure A5-5.

CLIMB FUEL WEIGHT

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

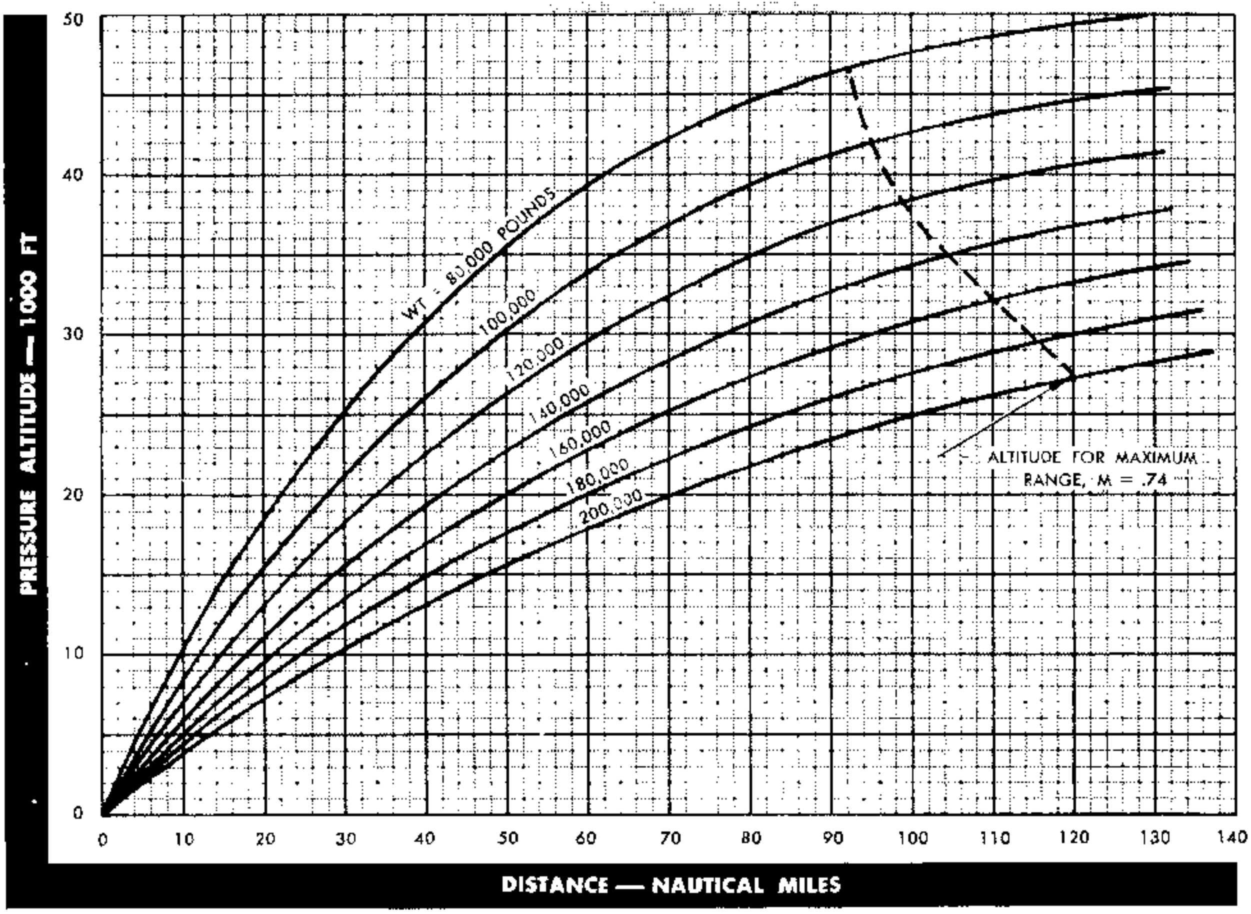
Figure A5-6.

CLIMB RANGE

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

507C-1

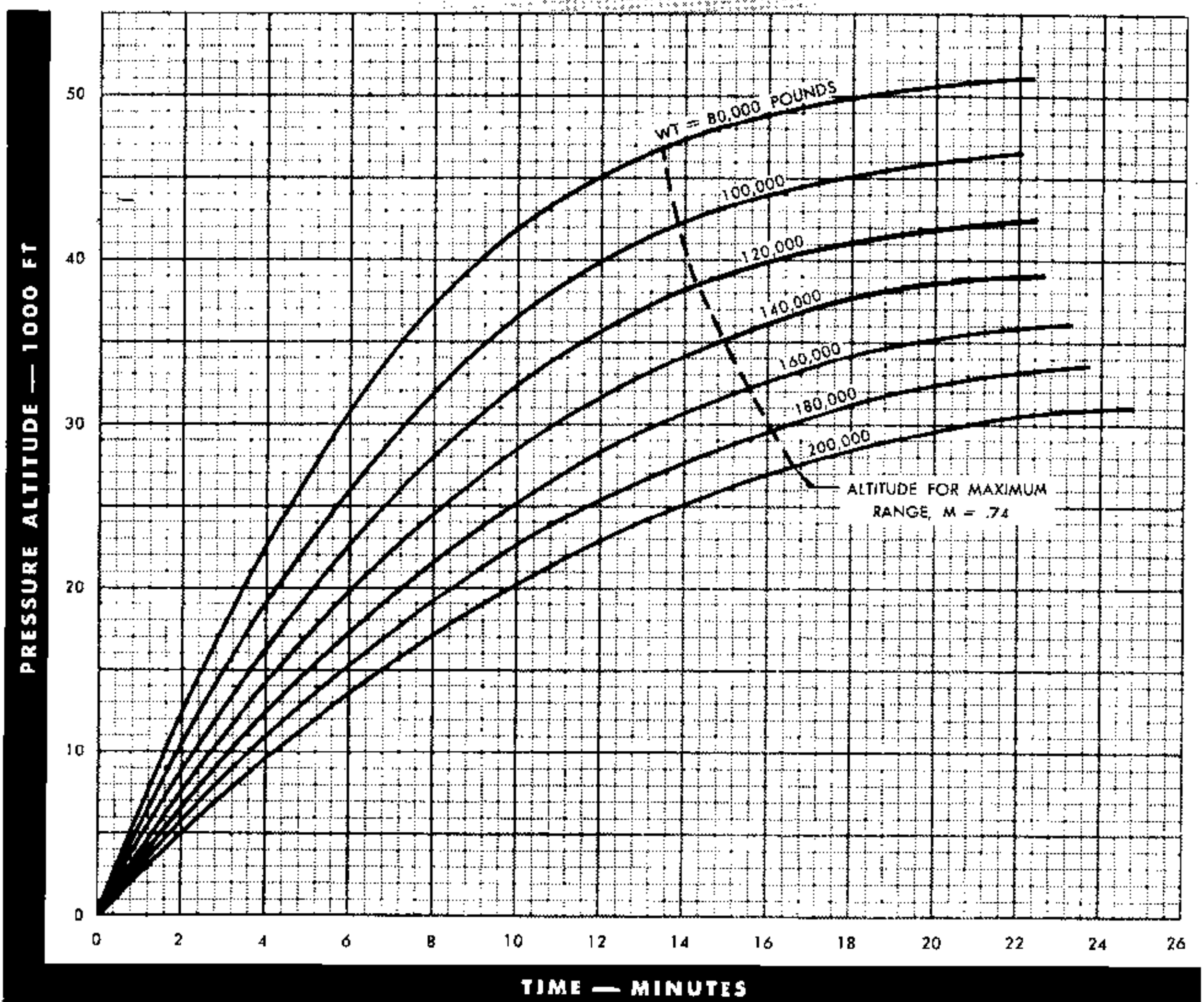
Figure A5-7.

TIME TO CLIMB

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

508C-1

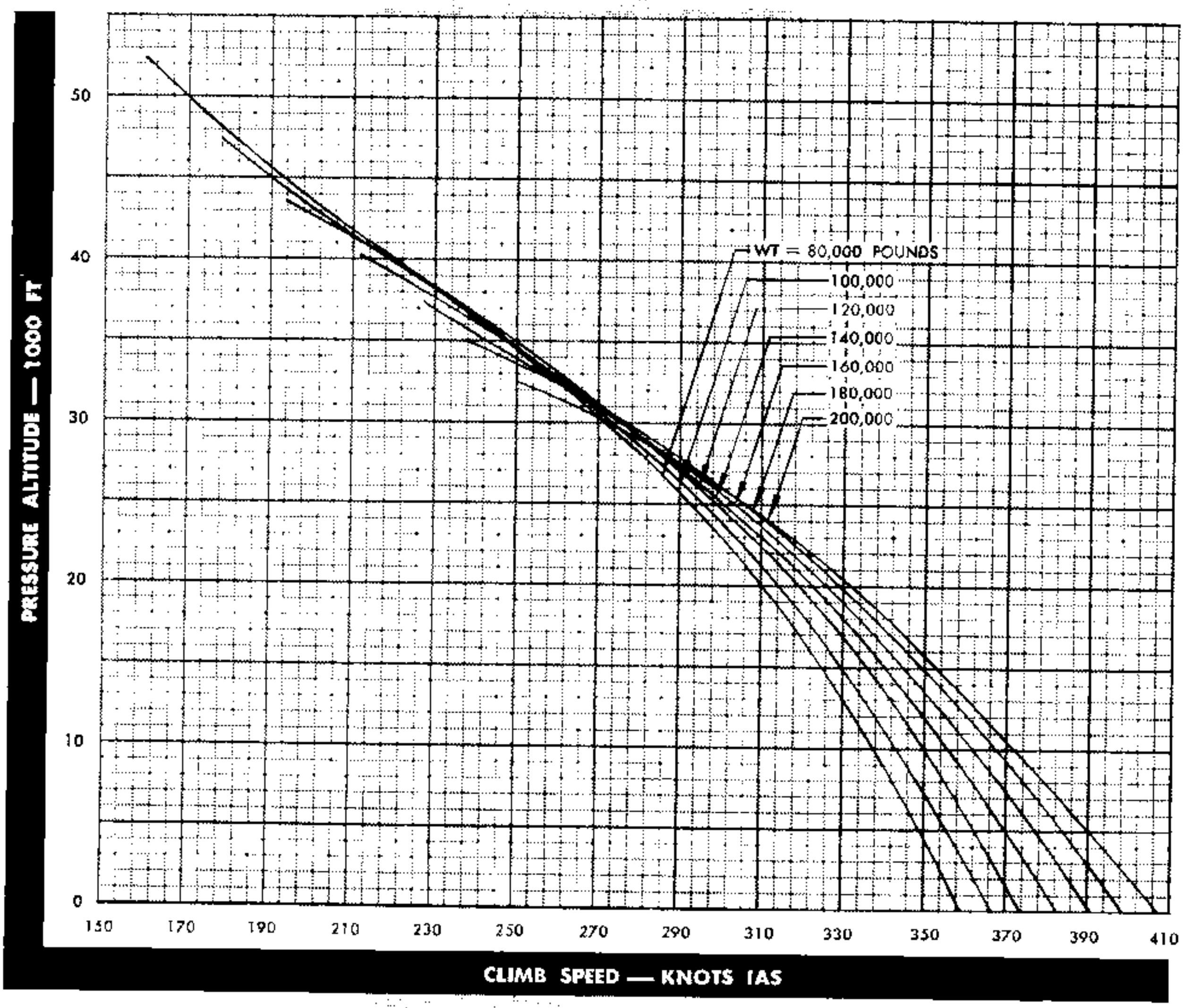
Figure A5-8.

CLIMB SPEED

MAXIMUM RATE OF CLIMB AT MILITARY (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

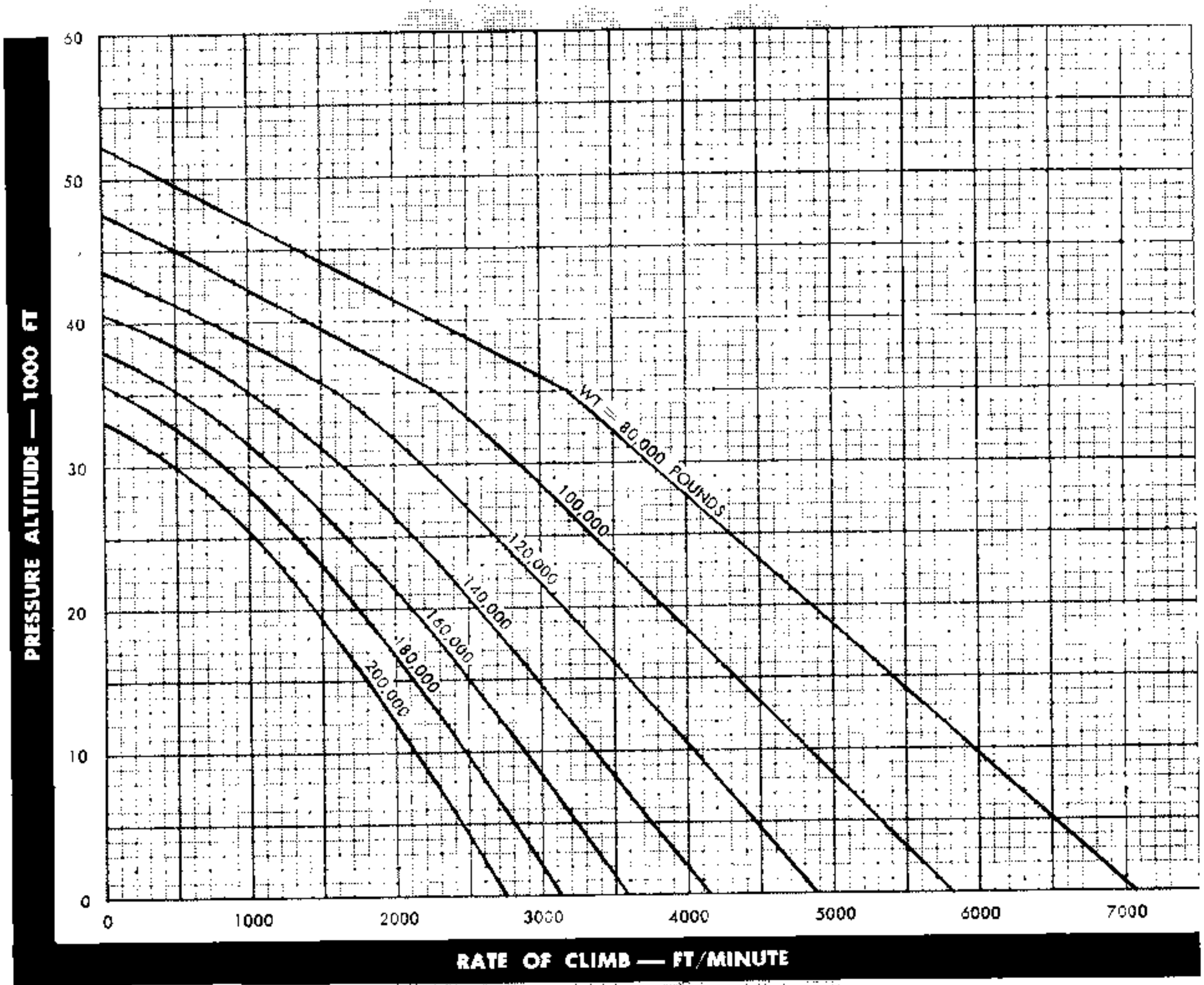
Figure A5-9.

MAXIMUM RATE OF CLIMB

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

510C-1

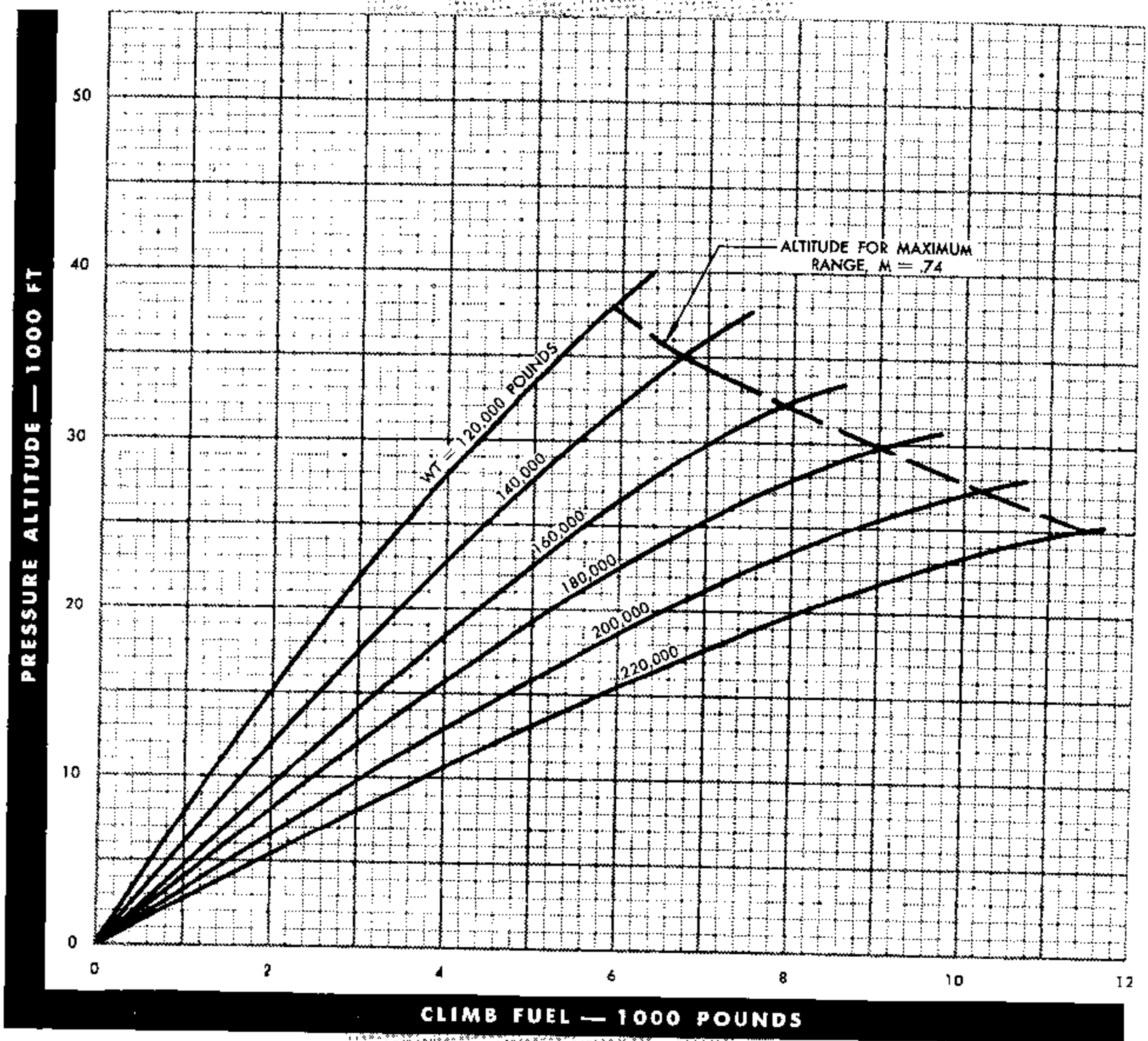
Figure A5-10.

CLIMB FUEL WEIGHT

NORMAL RATED (96%) RPM — WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

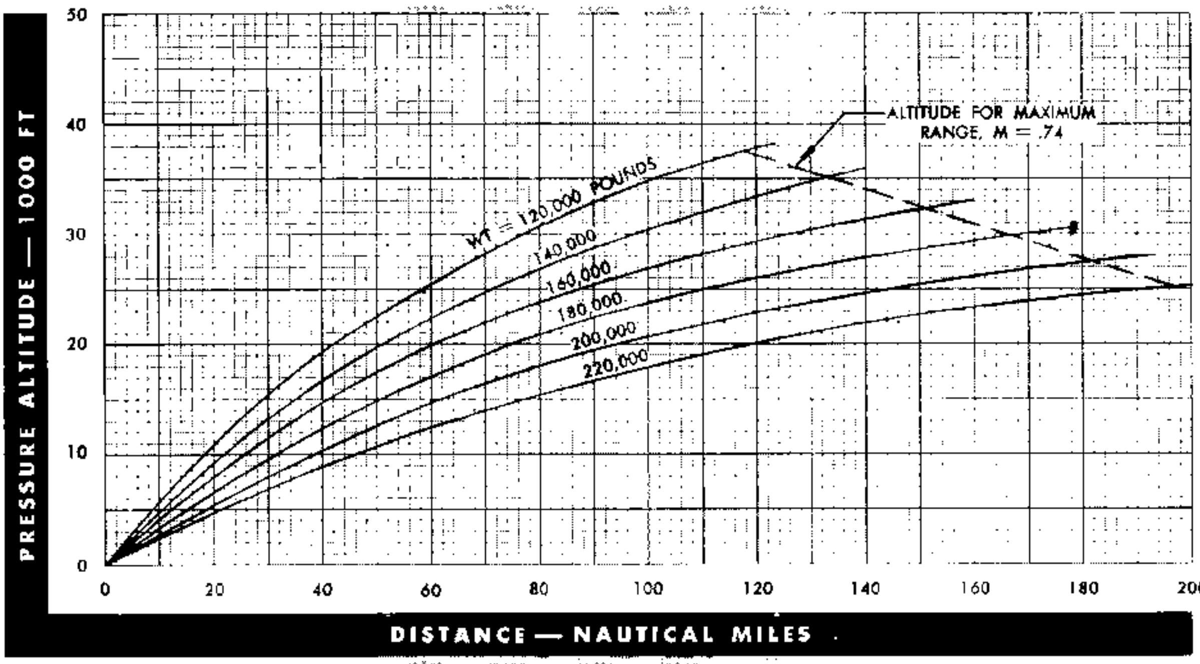
Figure A5-11.

CLIMB RANGE

NORMAL RATED (96%) RPM — WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

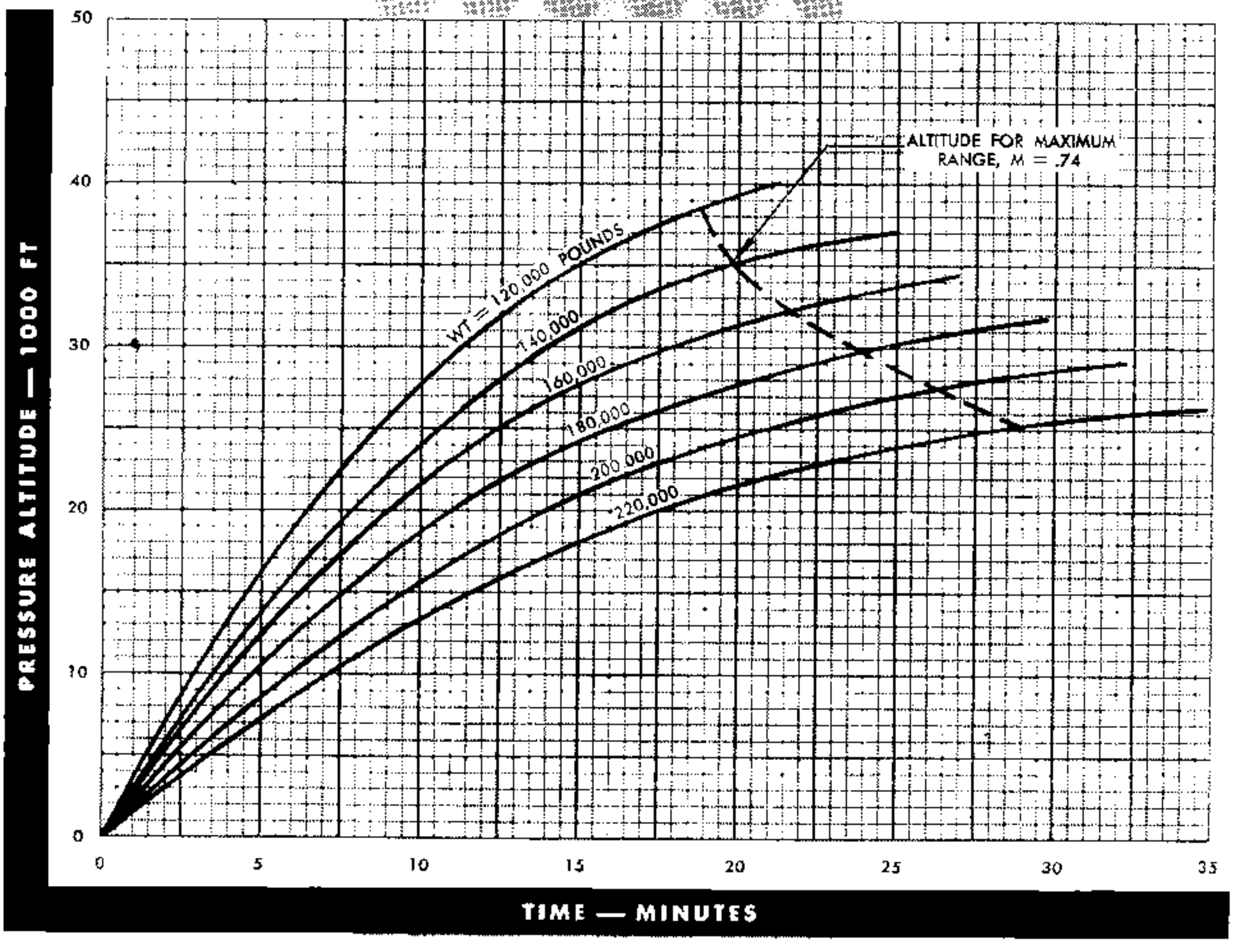
Figure A5-11A.

TIME TO CLIMB

NORMAL RATED (96%) RPM —WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

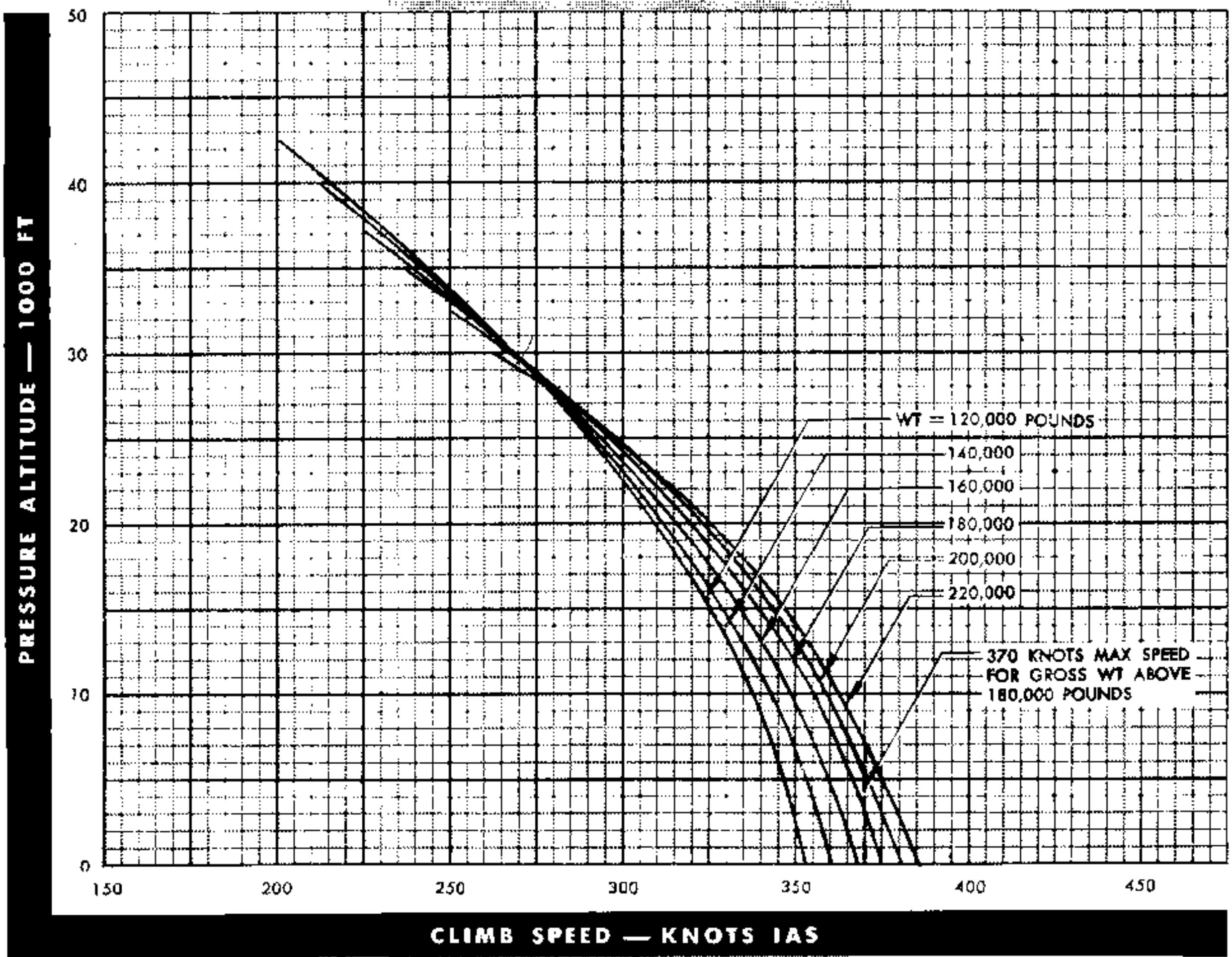
Figure A5-11B.

CLIMB SPEED

MAXIMUM RATE OF CLIMB AT NORMAL RATED (96%) RPM — WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

REMARKS:

SPEED RESTRICTIONS APPLY WITH WING TANKS INSTALLED AND EMPTY OR NOT COMPLETELY FULL

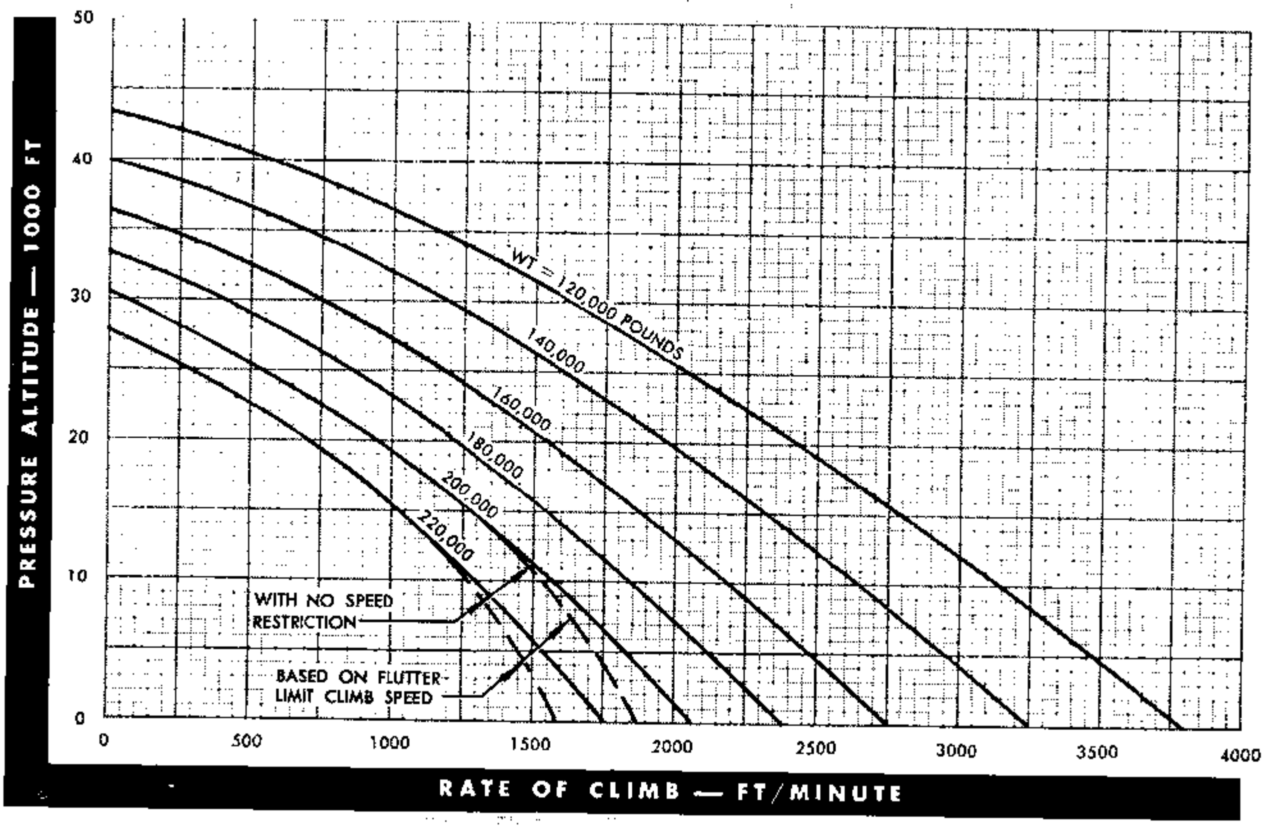
Figure A5-11 C

MAXIMUM RATE OF CLIMB

NORMAL RATED (96%) RPM—WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

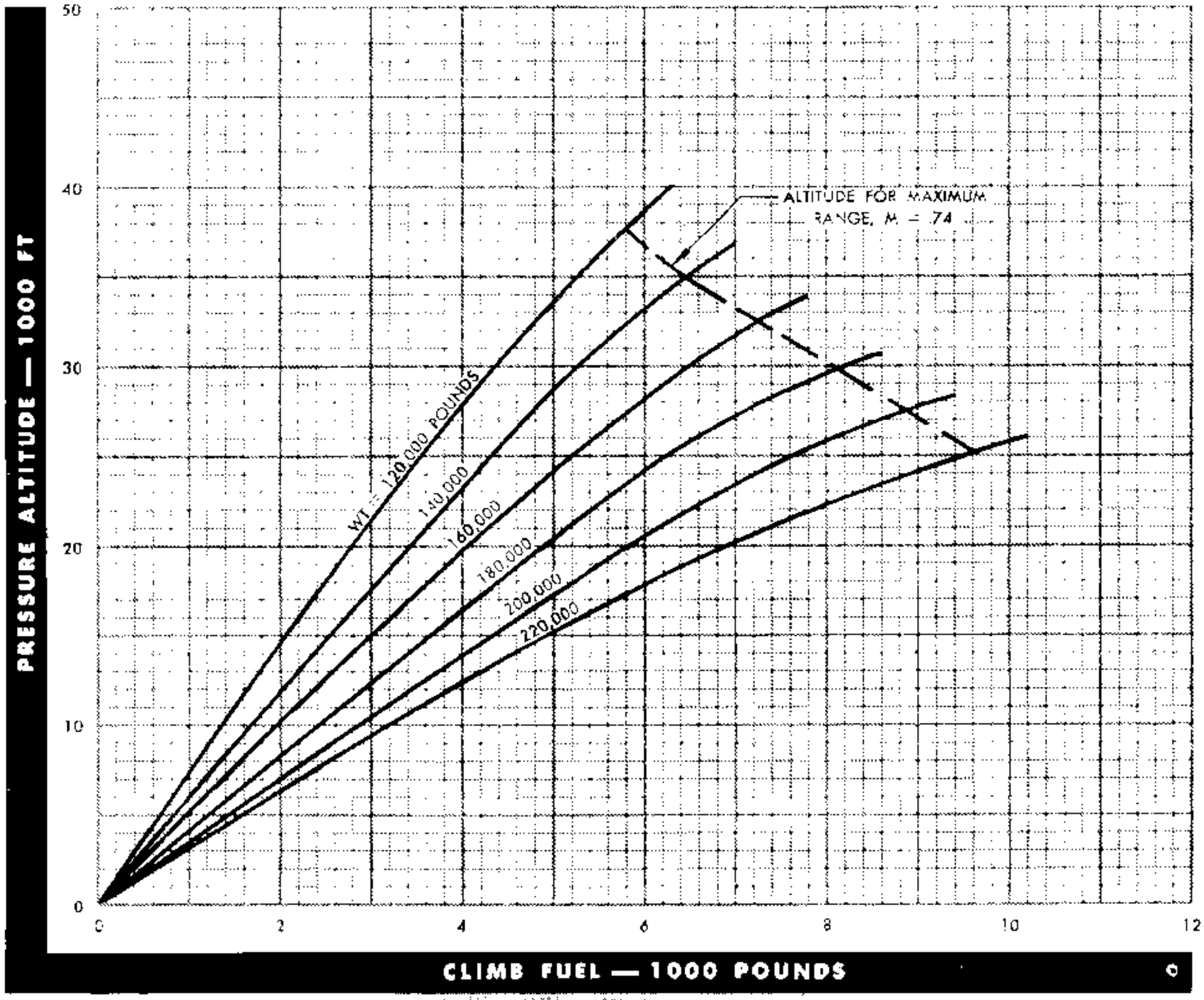
DATA BASIS: FLIGHT TEST

Figure A5-11D.

CLIMB FUEL WEIGHT
MILITARY RATED (98%) RPM —WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

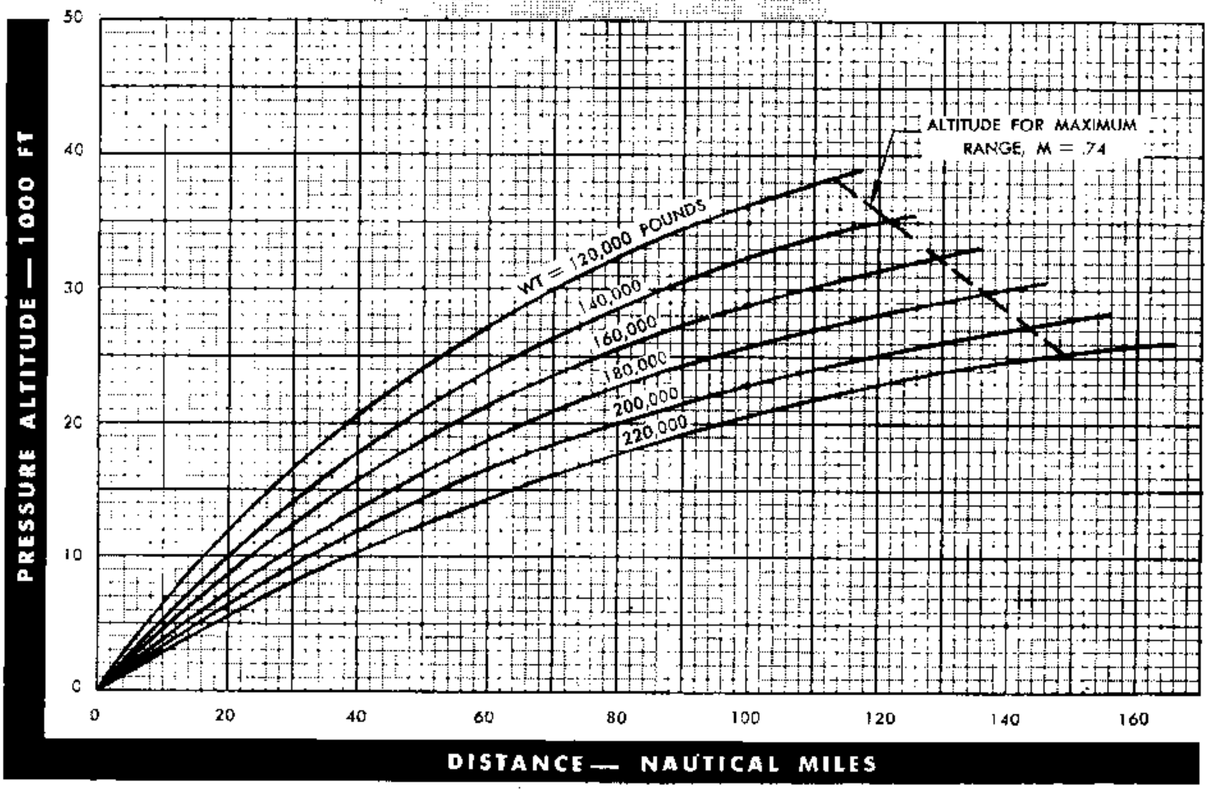
Figure A5-11E.

CLIMB RANGE

MILITARY RATED (98%) RPM —WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

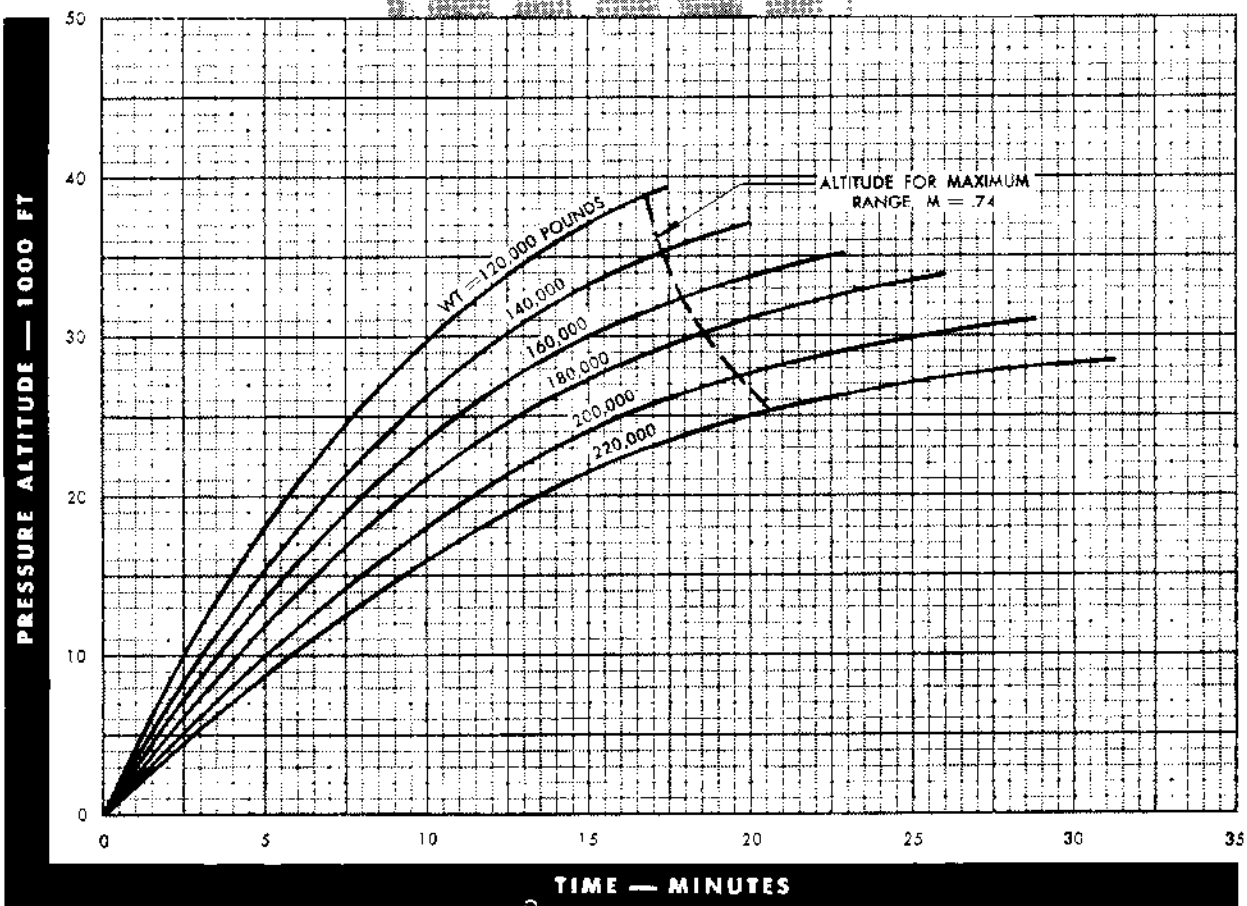
Figure A5-11F.

TIME TO CLIMB

MILITARY RATED (98%) RPM — WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

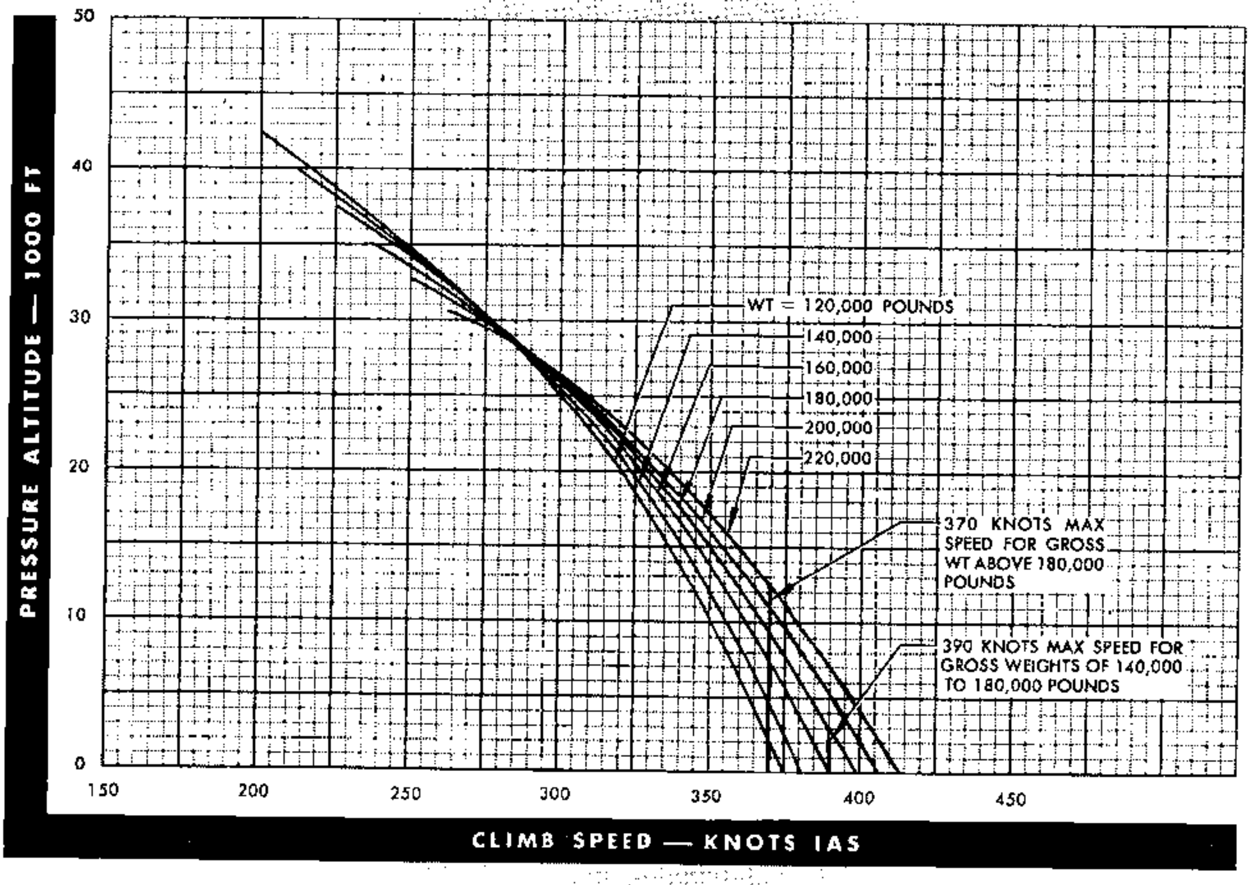
Figure A5-11G.

CLIMB SPEED

MAXIMUM RATE OF CLIMB AT MILITARY RATED (98%) RPM—WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

REMARKS:

SPEED RESTRICTIONS APPLY WITH WING TANKS INSTALLED AND EMPTY OR NOT COMPLETELY FULL

519C-1

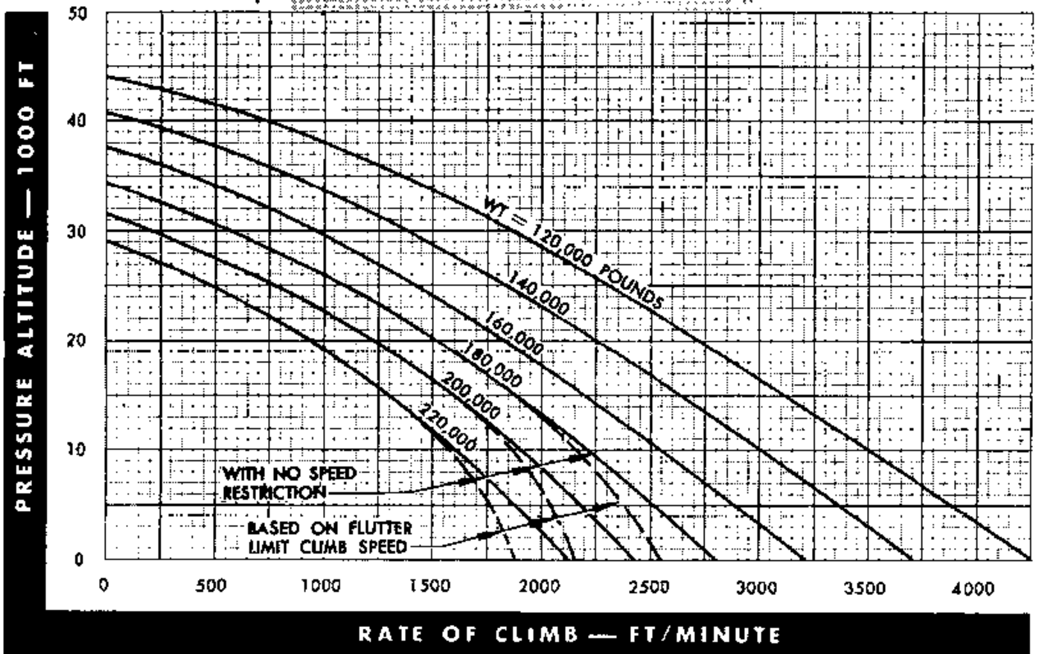
Figure A5-11H.

MAXIMUM RATE OF CLIMB

MILITARY RATED (98%) RPM — WING TANKS ON

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MARCH 1955

DATA BASIS: FLIGHT TEST

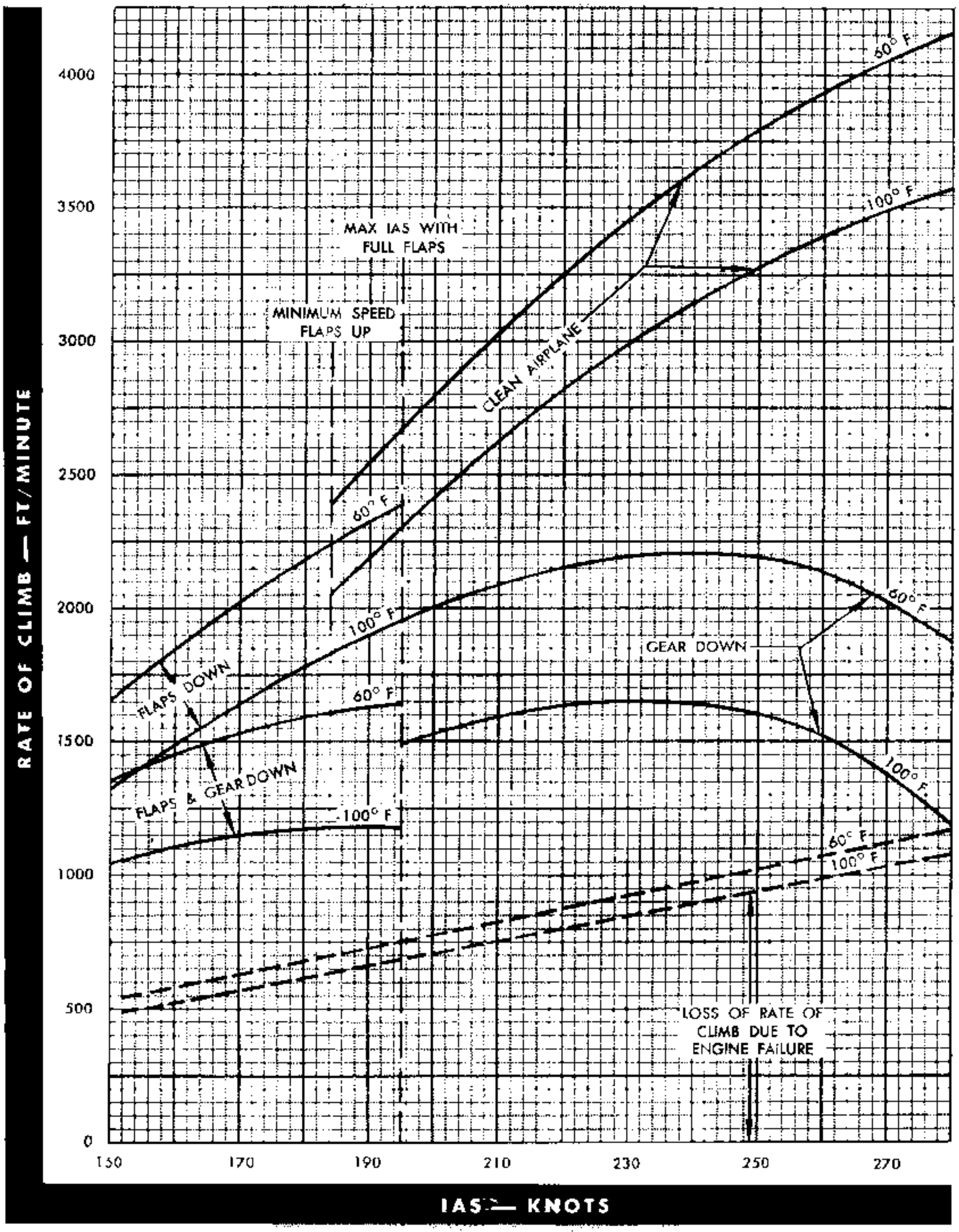
520C-1

Figure A5-12.

CLIMB PERFORMANCE AFTER TAKEOFF

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
SEA LEVEL
GROSS WEIGHT 180,000 POUNDS
TAKEOFF (100%) RPM

521C-1

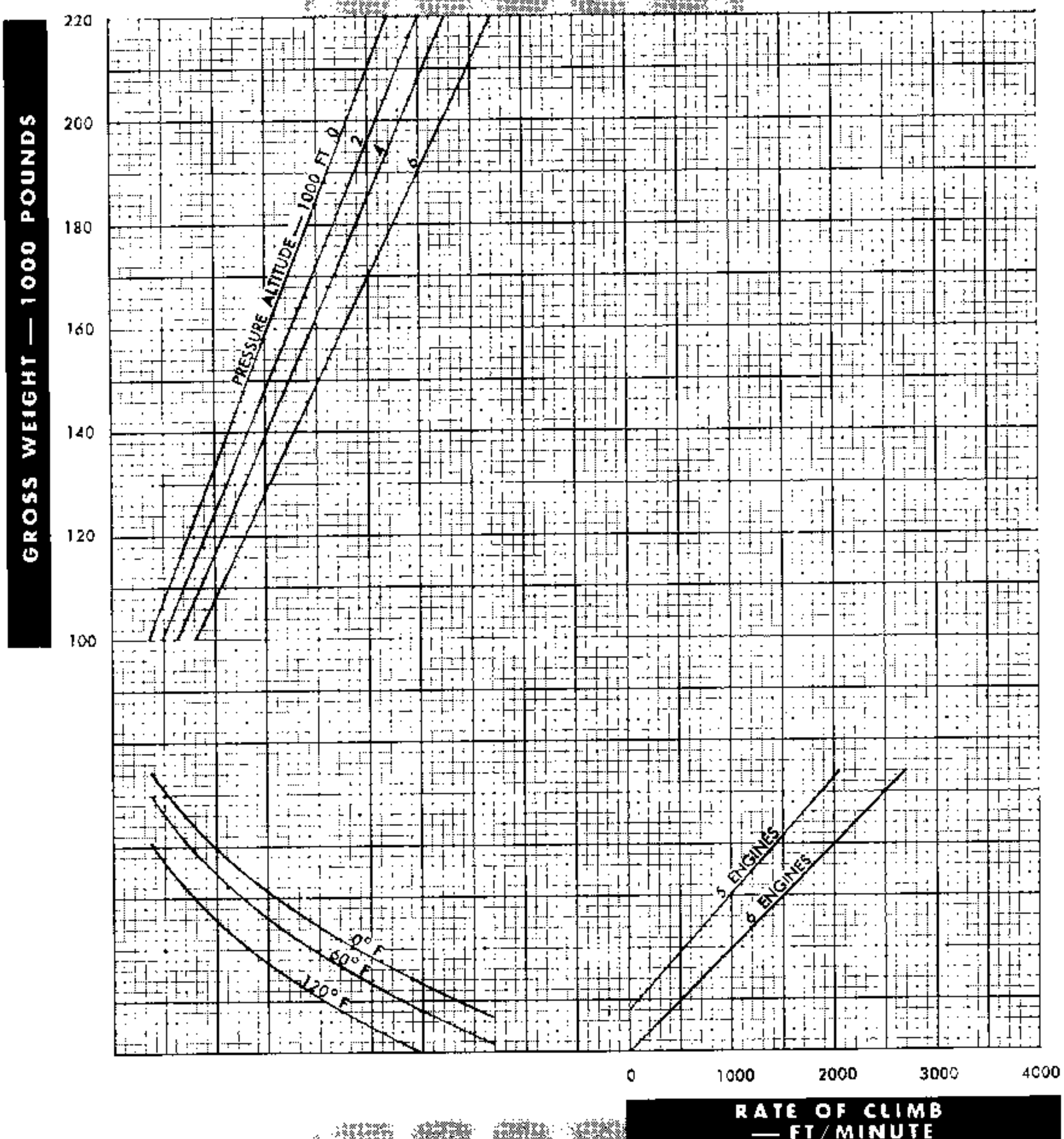
Figure A5-13.

RATE OF CLIMB

TAKEOFF SPEED — FLAPS & GEAR DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

NO ATO
NO WATER INJECTION

REMARKS:

GROUND EFFECT NOT INCLUDED

DATE: JULY 1955

DATA BASIS: CALCULATED

J22C-1

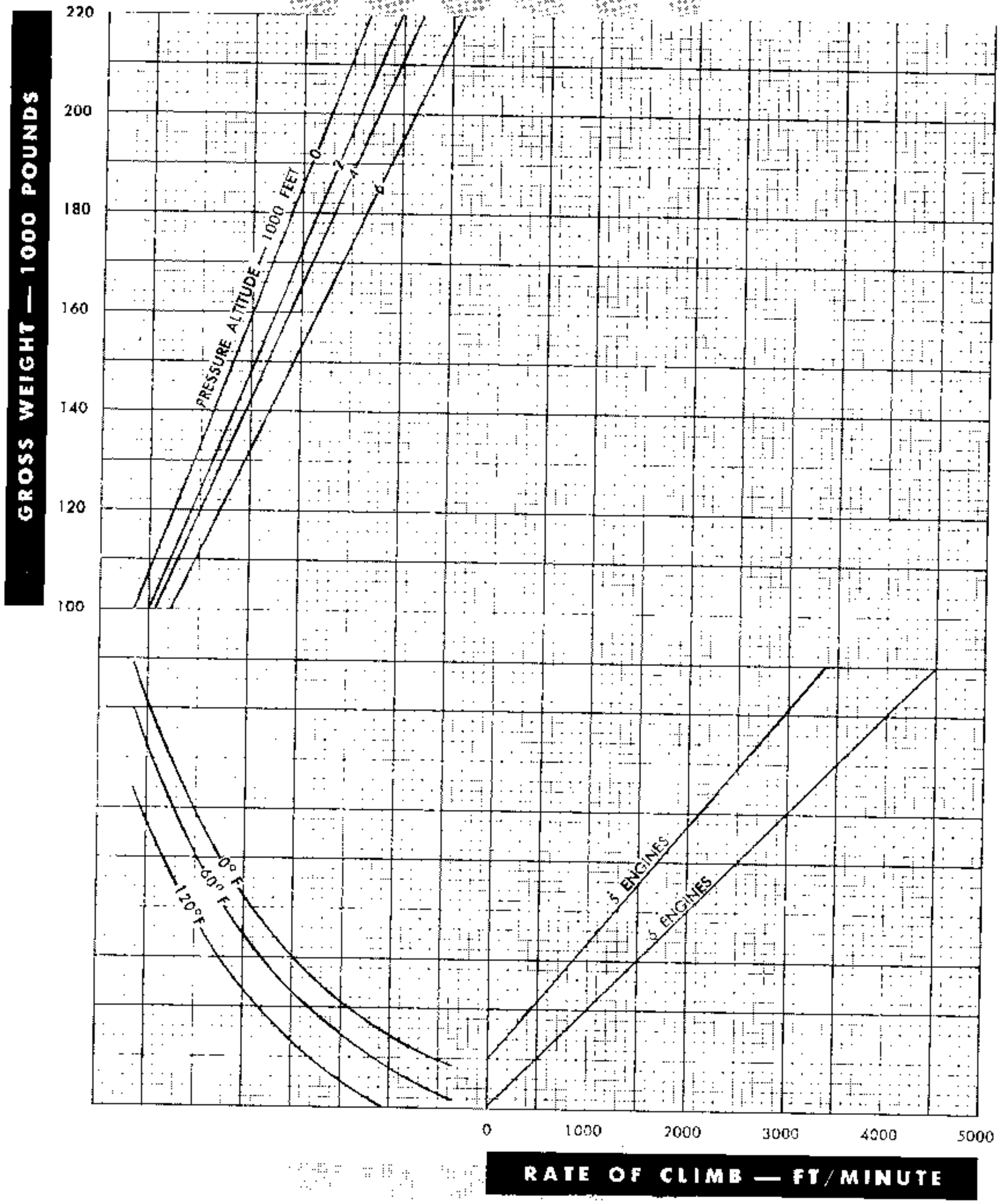
Figure A5-14.

RATE OF CLIMB

FLAP STRUCTURAL LIMIT SPEED — FLAPS & GEAR DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:
NO ATO
NO WATER INJECTION

DATE: JULY 1955

DATA BASIS: CALCULATED

REMARKS:
GROUND EFFECT NOT INCLUDED

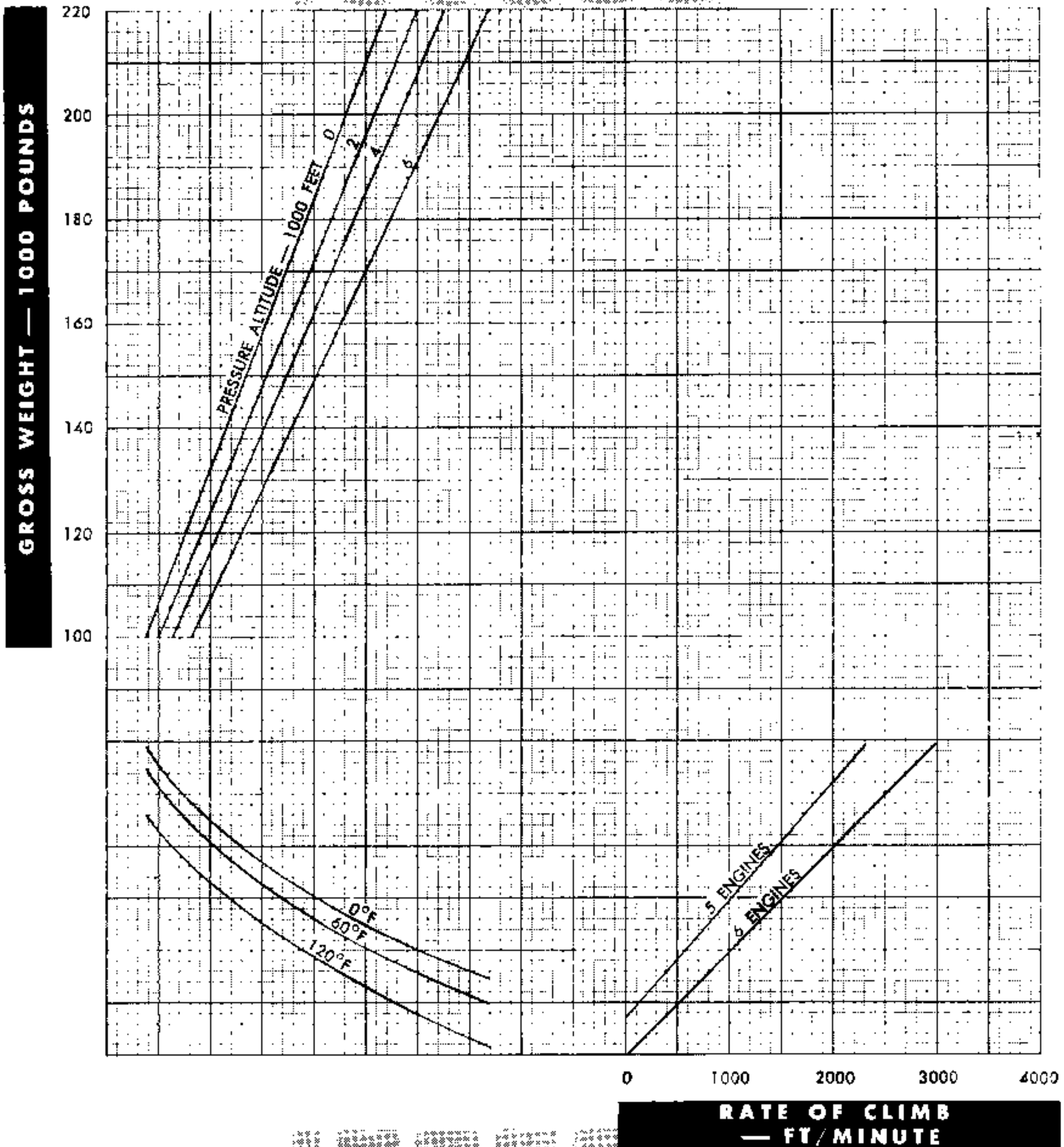
Figure A5-15.

523C-1

RATE OF CLIMB
TAKEOFF SPEED — FLAPS DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & 25A



CONDITIONS:

NO ATO
NO WATER INJECTION

DATE: JULY 1955

DATA BASIS: CALCULATED

REMARKS:

GROUND EFFECT NOT INCLUDED

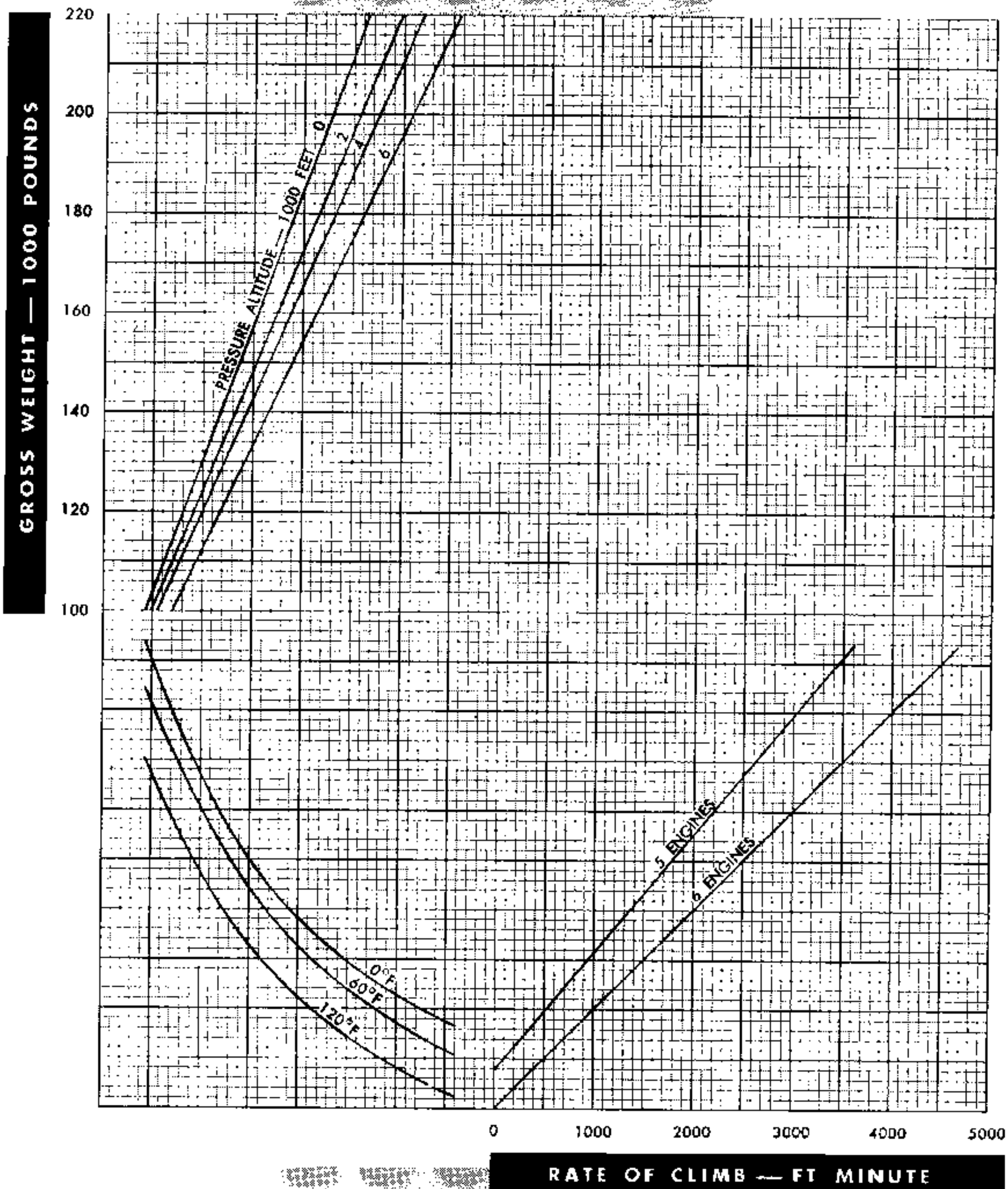
5740-1

Figure A5-16.

RATE OF CLIMB

FLAP STRUCTURAL LIMIT SPEED — FLAPS DOWN

MODEL: B-47B & B-47E
ENGINES: J47-25 & -25A



CONDITIONS:
NO ATO
NO WATER INJECTION

REMARKS:
GROUND EFFECT NOT INCLUDED

DATE: JULY 1955
DATA BASIS: CALCULATED

575C-1

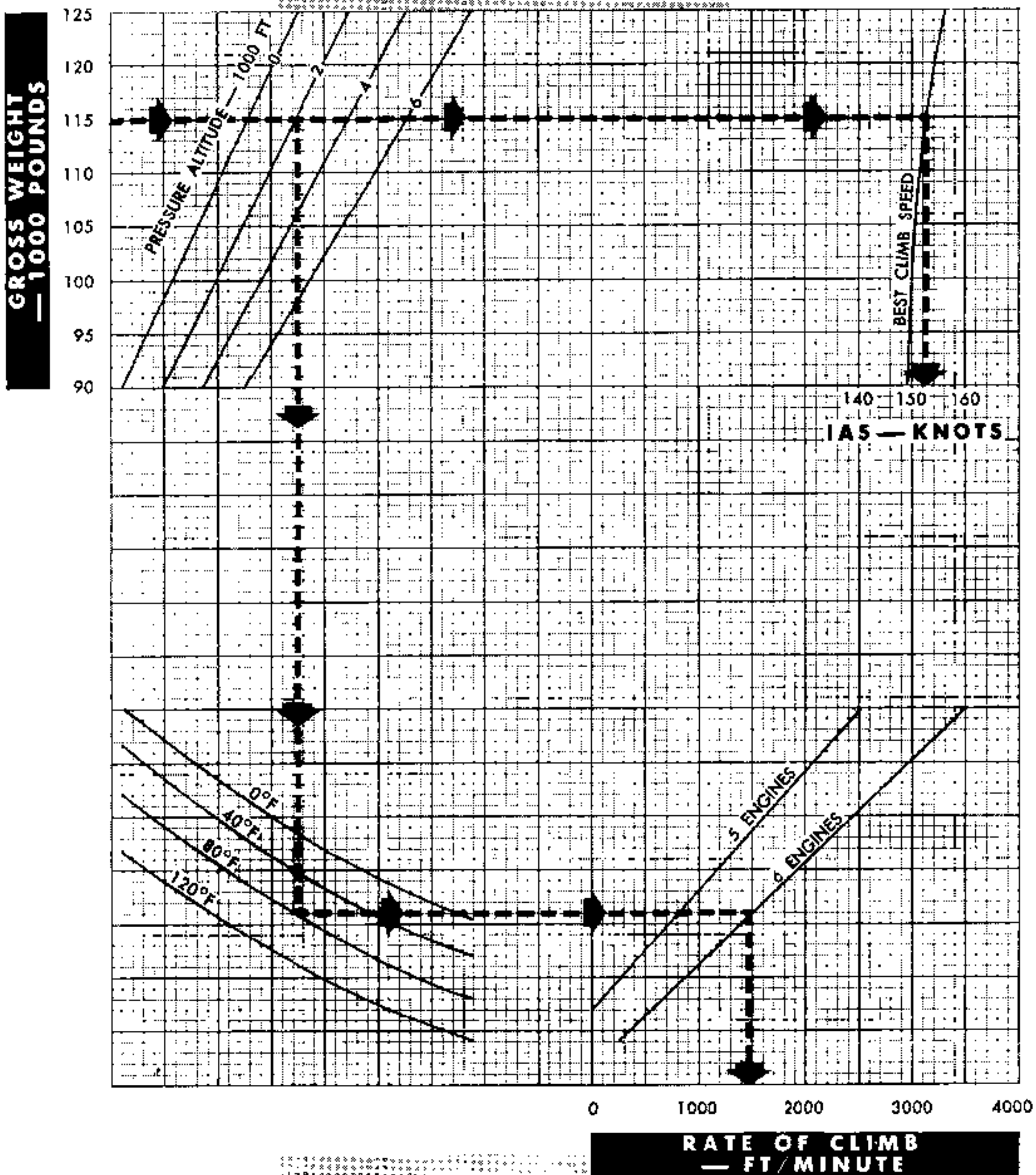
Figure A5-17.

RATE OF CLIMB

APPROACH CHUTE DEPLOYED — FLAPS & GEAR DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1954

DATA BASIS: FLIGHT TEST

CONDITIONS:
100% RPM

52aC-1

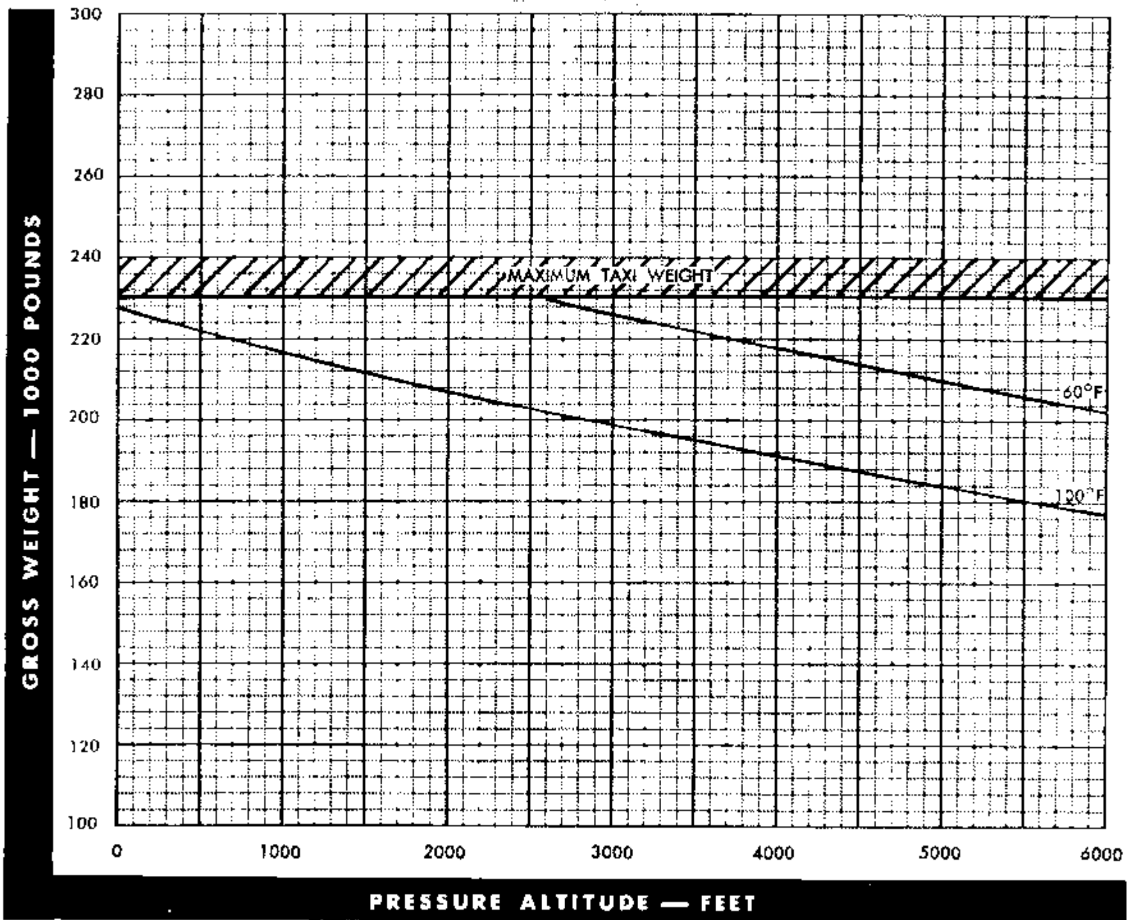
Figure A5-18.

MAXIMUM ALLOWABLE TAKEOFF WEIGHT

200 FPM RATE OF CLIMB

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

EXTERNAL ATO RACK INSTALLED
WING TANKS INSTALLED
NO WATER INJECTION
100% RPM
GEAR UP
FLAPS DOWN
200 FPM CLIMB AVAILABLE AT TAKEOFF SPEED ON 5 ENGINES

REMARKS:

WITHOUT WING TANKS ADD 3000 POUNDS FOR ALL CONDITIONS

WITHOUT ATO RACK ADD 5000 POUNDS FOR ALL CONDITIONS

WITHOUT WING TANKS AND ATO RACK ADD 8000 POUNDS FOR ALL CONDITIONS

DATE: JUNE 1955

DATA BASIS: CALCULATED

327C-1

Figure A5-19.

Part 6 range

RANGE

Using the charts in this section, the range for any cruise portion of the flight can be quickly found. These charts apply only to cruising flight with six engines where the weight change is due entirely to fuel consumption and not to cargo drop. The fuel for takeoff, climb, endurance, descent, etc, must be computed separately as explained in part 11. Part 13 contains charts for converting between Mach number and true or indicated airspeed.

The range charts include no conservatism factor. However, allowance has been made for the effect of standard engine accessories. Additional equipment which may be optional on some airplanes and which reduces engine thrust will obviously reduce range. Factors which may have to be considered in range calculations are:

1. EXTERNAL WING TANKS. If external wing tanks are carried, the range from the charts should be reduced by approximately 7.5% from that given for maximum range operation (Mach .74) for the portion of the mission before tanks are dropped.
2. PROTUBERANCES. The range charts are for a clean airplane. The range has been computed assuming flush antennas only. Surface roughness, ice, dirt, etc, all have a detrimental effect.
3. ENGINE INLET SCREENS. The range charts are based on the thrust and fuel consumption with the engine air inlet screens retracted.
4. ANTI-ICING. Range will be reduced 11% during periods in which anti-icing is on if rpm is increased to compensate for thrust loss. It is recommended that altitude be reduced instead of increasing rpm.
5. ATO - 18 INTERNAL BOTTLES. Range will be reduced approximately 2% when heavy-type bottles are used.
6. ATO - 33-BOTTLE EXTERNAL RACK. Range will be reduced approximately 16% when the external rack and bottles are carried.

The range data are presented in two ways:

1. Integral charts or range versus gross weight for the following types of cruise.
   a. Maximum range using a high altitude climbing flight path.
   b. Maximum altitude at high rpm.
   c. Constant altitude.
2. General miles per pound charts for all types of missions.

Integrated charts of the first type are usually most convenient, particularly over long distances. These charts are on the left-hand pages. Charts of the second type (nautical miles per thousand pounds) are on the right-hand pages.

The cruising range of an airplane is dependent upon the gross weight at the beginning and end of the cruise. All of the range charts use a gross weight of 80,000 pounds as the lower limit, so that if read directly they give only the range available with this as the final weight.

MAXIMUM RANGE OPERATION

Maximum range is obtained by flying at a constant Mach number and an rpm consistent with existing OAT, letting the airplane climb slowly as the weight decreases. Between Mach .71 and .75, the range obtained is maximum and nearly constant. However, cruising at less than Mach .74 is not recommended because the lower drag makes it more difficult to hold the correct combination of speed and altitude along the climbing flight path. At Mach .75 or slightly above, the higher drag makes the airplane easier to fly along the correct path and any range loss due to speed can be predicted.

Both speed and range are reduced by flying at less than Mach .71. Range drops rapidly at greater than Mach .76 but the gain in speed may make such a cruise desirable. The Mach number effect on range at a given gross weight and fuel loading is illustrated below.

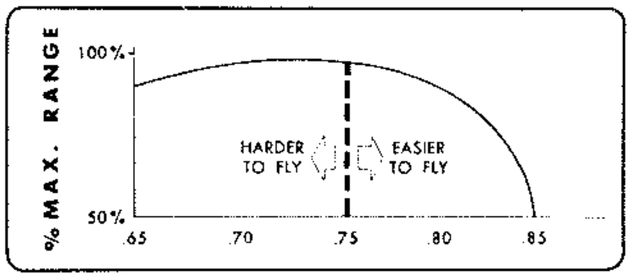


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Figure A6-2 contains a chart of the maximum miles per 1000 pounds of fuel that can be obtained for any weight and speed combination. It is useful for short ranges and small gross weight changes. The altitudes may be found from the top of figure A6-1.

Figure A6-1 is a chart showing the range available if the proper climbing flight path is flown at a constant Mach number. If the flight path follows this chart, maximum range will be obtained. The altitude schedule must be closely observed. Excessive deviation from the chart values will result in a loss of range.

The proper climbing flight path for maximum range at any Mach number is determined as follows:

1. Climb to altitude for best range.
2. Level off and establish rpm for the ambient OAT (see paragraph "Effect of OAT on Range").
3. Establish cruise Mach number. (As the weight decreases, the airplane will climb slightly establishing a climbing flight path.)

Hold constant Mach number for the entire cruise, re-adjusting the rpm whenever the OAT changes.

Experience has shown that the machmeter may not be sensitive enough to accurately control the rate of climb. To prevent loss of range caused by too fast or too slow climb, the altitude should be checked regularly against the gross weight using the proper chart, and the sensitive airspeed indicator should be relief upon more than the machmeter. In part 13 is a chart of Mach number versus indicated airspeed which can be used to compare the two meters. If a marked discrepancy between instruments is discovered, they should be checked for calibration. The importance of instrument accuracy is apparent from the previous range-versus-speed sketch.

For some missions it may be desirable to stack the airplanes so that one plane or group is flying at the optimum Mach number (.71 to .75) while others fly above or below the optimum altitude but still follow the climbing flight plan. Assuming the same true airspeeds are desired, in order to arrive over the target on schedule, the range of the off-altitude airplanes would be decreased as follows:

DEVIATION FROM PROPER ALTITUDE FOR MAXIMUM RANGE CRUISE — FEET	% DECREASE IN RANGE FROM THE MAXIMUM OBTAINABLE
0	0%
+2000	1%
-2000	1/2%
-4000	1%
-6000	3%
-8000	7%

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RANGE AT MAXIMUM ALLOWABLE RPM

These charts on figures A6-5 and A6-6 are to be used only when it is desired to fly at the maximum possible altitude for a specified Mach number. This means a considerable loss in range from that obtainable by the use of the maximum range cruise procedure as shown by the previous chart.

RANGE AT NORMAL (96%) RPM

These charts on figures A6-3 and A6-4 are to be used only when it is desired to fly at the maximum possible altitude for a given Mach number without exceeding normal rated power. This cruise procedure gives better range than does flying at maximum rpm, but it will give considerably less than the maximum obtainable range.

RANGE AT CONSTANT ALTITUDES

These charts on figures A6-7 through A6-22 are for use only when constant altitude operation is required for some special purpose. In general, their use will be confined to short distances since constant altitude cruise results in a loss of range from that obtainable with a high altitude climbing flight path.

Since the optimum cruise at sea level is at very low Mach numbers and gives only about one-third of the range available with a high altitude climbing flight path, this low level operation is not recommended.

COMPARISON OF FLIGHT PROCEDURES

Review of the range charts will show that the range will decrease when:

1. The Mach number is outside the range of .71 to .75.
2. The flight plan follows other than the proper climbing path for the above Mach number range. This is particularly true of low altitude operations where the range penalty is great.

The percentage gain in speed from flying at other than optimum Mach number is small compared to the percentage loss in range. The chart contained in paragraph "Maximum Range Operation" illustrates this point.

EFFECT OF WIND ON RANGE

The gain or loss in range due to wind can be found from the range correction chart on figure A6-23.

As with any airplane, a small gain in range can be obtained with a tailwind by reducing speed and slightly increasing the flight time. Decreasing from M = .74 to M = .71 has a negligible effect with no wind, while with a 100-knot tailwind the range is extended by about 2%. Range begins to drop at less than M = .71.

When flying against a headwind, increasing speed to gain range is not feasible. At the high cruising speed of this airplane, the drag rises so rapidly that a considerable boost in power gives only a small gain in speed and this is offset by the added fuel consumption.

It may be best at times to fly at other than optimum altitude to utilize more favorable winds. The range loss due to flying at "off" altitudes can be estimated from the tabular chart on the preceding page and weighed against the gain due to better wind conditions.

EFFECT OF FUEL ON RANGE

With JP-1, Specification MIL-F-5616, or JP-4, Specification MIL-F-5624A, boil-off at high altitude is negligible and range can be predicted with accuracy.

When Grade 100/130 gasoline, Specification MIL-F-5572, or JP-3, Specification MIL-F-5624, is used, considerable range may be lost through boiling away of fuel. The percentage loss is greater for high fuel temperatures at high altitudes. The table below shows the approximate loss in range due to gasoline boil-off. This does not allow for sloshing of liquid fuel out the vents which may increase the loss considerably. Loss of JP-3 (RVP = 6) through boil-off will be slightly less than the loss for gasoline.

GASOLINE TEMPERATURE AT TAKEOFF	APPROXIMATE PERCENT LOSS IN RANGE
110° F	20%
80° F	10%
50° F	0%

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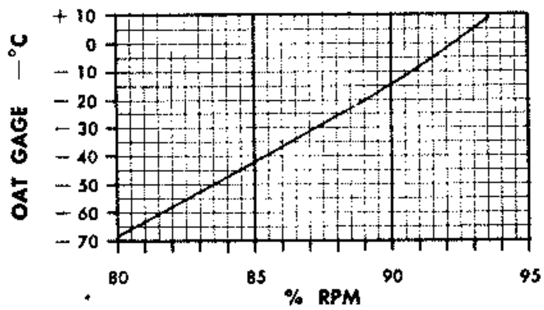
EFFECT OF OAT ON RANGE

Aside from fuel boil-off, the effect of outside air temperature on range is slight. Flight plans should be made on the basis of desired Mach number and altitudes. The range on this basis will be relatively unaffected by OAT. However, under high temperature conditions it will be necessary to increase rpm to establish the desired Mach number-altitude combination. For cold temperatures, the rpm must be reduced. For an extremely hot day (120° F at sea level), the range is only about 1.5% less than for standard conditions. This correction can be applied at all altitudes.

OPTIMUM RPM FOR .74 MACH



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The above OAT chart is based on engines tabbed to optimum thrust. Cold engines with low thrust will result in altitudes slightly lower than that shown on figure A6-1 for a given weight. Such a change in altitude in this condition results in a negligible effect on range.

NOTE

> The above OAT vs RPM chart should be used only as a guide. The airplane should be flown at the proper altitude and Mach number which may require slight power changes which differ from the values of this chart.

The following examples illustrate the use of the range curves for finding cruising data. For more complete mission problems involving fuel for takeoff, climb, bombing, descent, etc, see part 11.

MAXIMUM RANGE OBTAINABLE

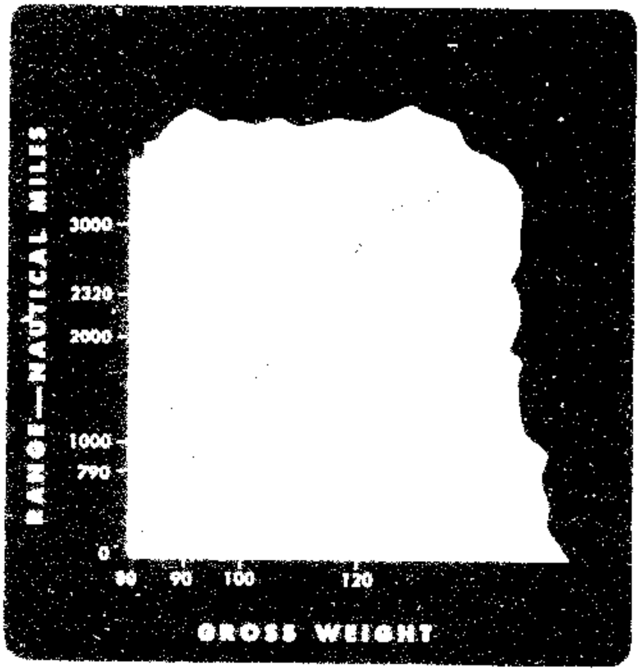
EXAMPLE 1:

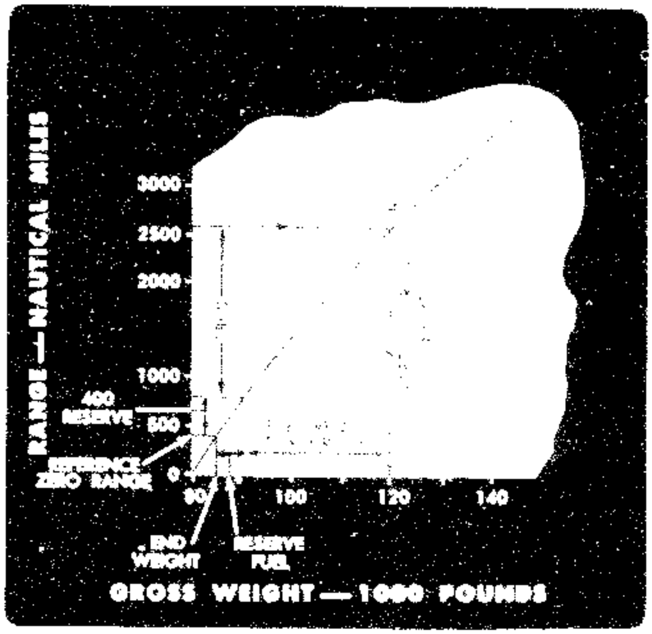
Given:
1. Fuel in tanks = 25,000 pounds
2. No droppable cargo
3. Weight at end of cruise = 90,000 pounds.

Determine:
1. Maximum cruise range obtainable
2. Altitudes for maximum range.

Use the Mach .74 curve on figure A6-1 for maximum range.

The gross weight at the start of the cruise is 90,000 + 25,000 = 115,000 pounds. The range available between 80,000 and 115,000 pounds is 2320 nautical miles. The range available between 90,000 and 80,000 pounds is 790 nautical miles. Then the range between the specified weights is 2320 - 790 = 1530 nautical miles.





CONSTANT ALTITUDE CRUISE

the curve at the point corresponding to 1350 nautical miles range, is about .58. As the airplane flies down the curve, the Mach number decreases until at 85,000 pounds gross weight, it is about .53. From the Mach number-TAS conversion chart the TAS is found to change from 371 knots at the start to 340 knots at the end of the mission. If it is undesirable to fly so slowly, the speed can be increased at the expense of fuel. To fly at Mach .76, corresponding to 425 knots IAS limiting speed, 52,500 pounds of fuel are required for the same distance.

RANGE OVER SHORT DISTANCES

EXAMPLE 4:

At the end of a mission before the descent is begun, it is found that a change in the landing base is necessary due to weather.

Given:
1. Airplane gross weight without fuel = 82,000 pounds
2. Fuel in tanks = 6000 pounds
3. Flight at altitude for maximum range.

Determine:
1. Maximum reserve range remaining
2. Cruise Mach number and altitudes.

For short distances, particularly at low gross weights, the charts of miles per thousand pounds of fuel are most convenient and accurate. Using the chart on figure A6-2 the maximum range is obtainable at Mach .74. At the average gross weight of $82{,}000 + \frac{6{,}000}{2} =$ 85,000 pounds, there are 75 nautical miles obtainable per thousand pounds of fuel. The reserve range at cruise is then $6000 \times \frac{75}{1000} = 450$ nautical miles.

The altitude, from figure A6-1, at the start of the cruise is 45,000 feet and at the end is 47,000 feet.

EXAMPLE 5:

When within 100 nautical miles of the target it is desired to go to the maximum possible altitude for cruise at Mach .76 until the bomb is dropped. After the climb the conditions are as follows:

Gross weight = 130,000 pounds
Altitude = 42,000 feet
Mach = .76

Determine the gross weight and altitudes at the target.

Using the chart on figure A6-6 for maximum allowable rpm, a first estimate is as follows: For a gross weight of 130,000 pounds and Mach .76, 40 nautical miles per thousand pounds are obtained. Then $100 \times \frac{1000}{40} = 2500$ pounds are consumed in flying 100 nautical miles.
Checking by a second approximation, the average gross weight is about $130{,}000 - \frac{2{,}500}{2} = 128{,}750$ pounds. At this average gross weight of 128,750, 40.5 nautical miles per thousand pounds of fuel are obtained. Then $100 \times \frac{1000}{40.5} = 2470$ pounds of fuel are used. For such short ranges, there obviously is no need for going beyond a first approximation. The gross weight at the target is 130,000 - 2,470 = 127,530 pounds. From figure A6-5, the maximum target altitude at Mach .76 is about 43,000 feet.

A chart for simplifying the use of the nautical miles per thousand pound charts has been added on figure A6-25. It can be used in the above examples.

PARTIAL ENGINE OPERATION

FIVE ENGINE OPERATION results in decreased range, but this decrease may be minimized by proper cruise procedure. If a single engine failure occurs during cruise at altitude:

1. Hold Mach .72
2. Maintain an altitude 2000 feet below that specified for six engines at Mach .74 for maximum range operation.

Range will be decreased approximately 3% from that given for six-engine maximum range operation at Mach .74. Any variation from the above Mach number-altitude combination will result in greater range losses.

FOUR ENGINE OPERATION during cruise at altitude requires close observance of recommended procedures or serious penalties in range will result. If a double engine failure occurs during cruise at altitude:

1. Hold Mach .69
2. Maintain an altitude 5000 feet below that specified for six engines at Mach .74 for maximum range operation.

Range will be decreased approximately 9% from that given for six-engine operation at Mach .74. Any divergence from the above Mach number-altitude combination will result in correspondingly greater losses in range.

THREE ENGINE OPERATION results in a considerabel loss in range. To obtain maximum performance:

1. Hold Mach .60
2. Reduce altitude to 15,000 feet below that specified for maximum range at Mach .74 with six engines.

Range will decrease approximately 22% from the maximum obtainable with six engines at M = .74.

"DIRTY" AIRPLANE RANGE OPERATION

For emergency conditions of flight when the bomb bay doors are open, flaps down and/or gear down, and it is impossible to close the doors or retract the flaps and gear, the range performance is shown on figure A6-24. Corresponding cruise speeds and altitudes are also shown on this chart. As only optimum performance conditions are shown, any large deviation from the speeds and altitudes indicated will result in a greater range loss than indicated by the chart.

EXAMPLE:

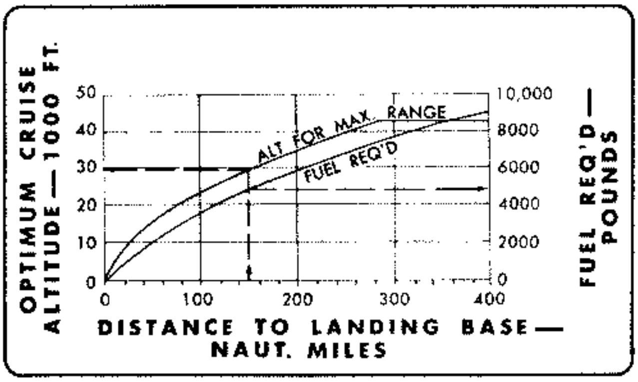
After completing a bomb drop, it is found that the bomb doors cannot be closed. The gross weight is 120, 000 pounds, with the no fuel condition weight equal to 85, 000 pounds and the airplane is 2000 nautical miles from its landing base.

Determine if the airplane should return to its base or land at an alternate base.

From figure A6-24, at a gross weight of 120, 000 pounds the range for bomb bay open is 2100 nautical miles and the range at 85, 000 pounds is 330 nautical miles; therefore, the distance the airplane can fly is 2100 - 330 = 1770 nautical miles. Thus it is evident that an alternate landing base should be selected. Flight to the alternate base should be at Mach .71 starting at 37, 000 feet and increasing altitude as gross weight decreases as shown on figure A6-24.

EFFECT OF EARLY DESCENT ON RANGE

If an early descent must be made to pick up ground reference points, climb back to higher altitude as soon as possible. The fuel consumption of jet engines is so great at low altitudes that less range can be obtained there than by climbing to a higher cruise altitude and then descending to the landing base. The following plot shows the optimum altitude at which to continue cruise to the landing base and total fuel required from start of climb to the landing base. Going to either higher or lower altitude will result in more fuel being used. This chart is based on an initial climb gross weight of 100, 000 pounds.



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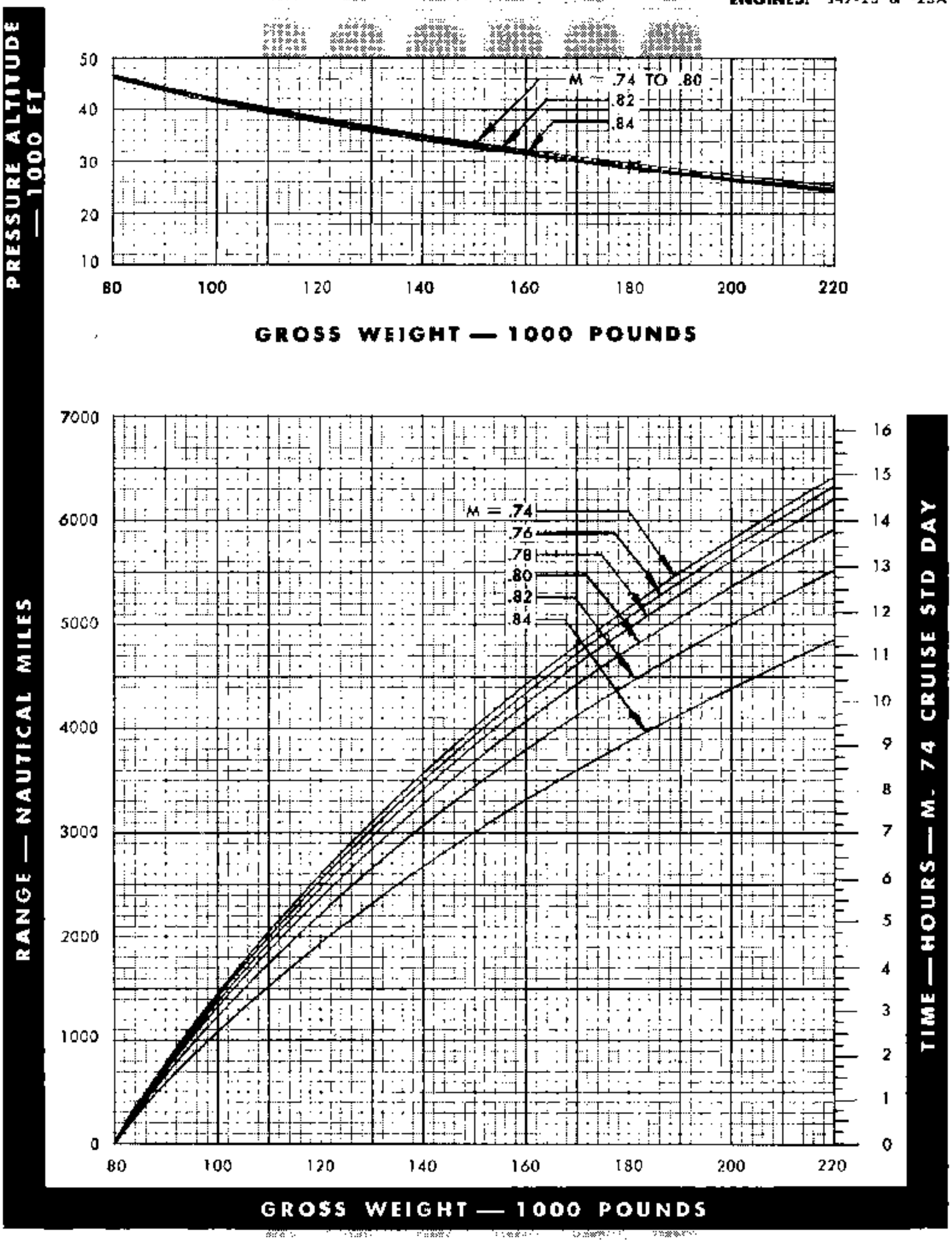
When a visual check of ground position is made at a certain altitude, continue cruise at that altitude or at the one shown by the curve, whichever is higher. The fuel used will then be reduced by the amount saved by not climbing all the way from sea level.

If forced to continue at lower altitude, use the charts in this part.

ALTITUDE & MAXIMUM RANGE AT CONSTANT MACH NUMBER

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

601C-1

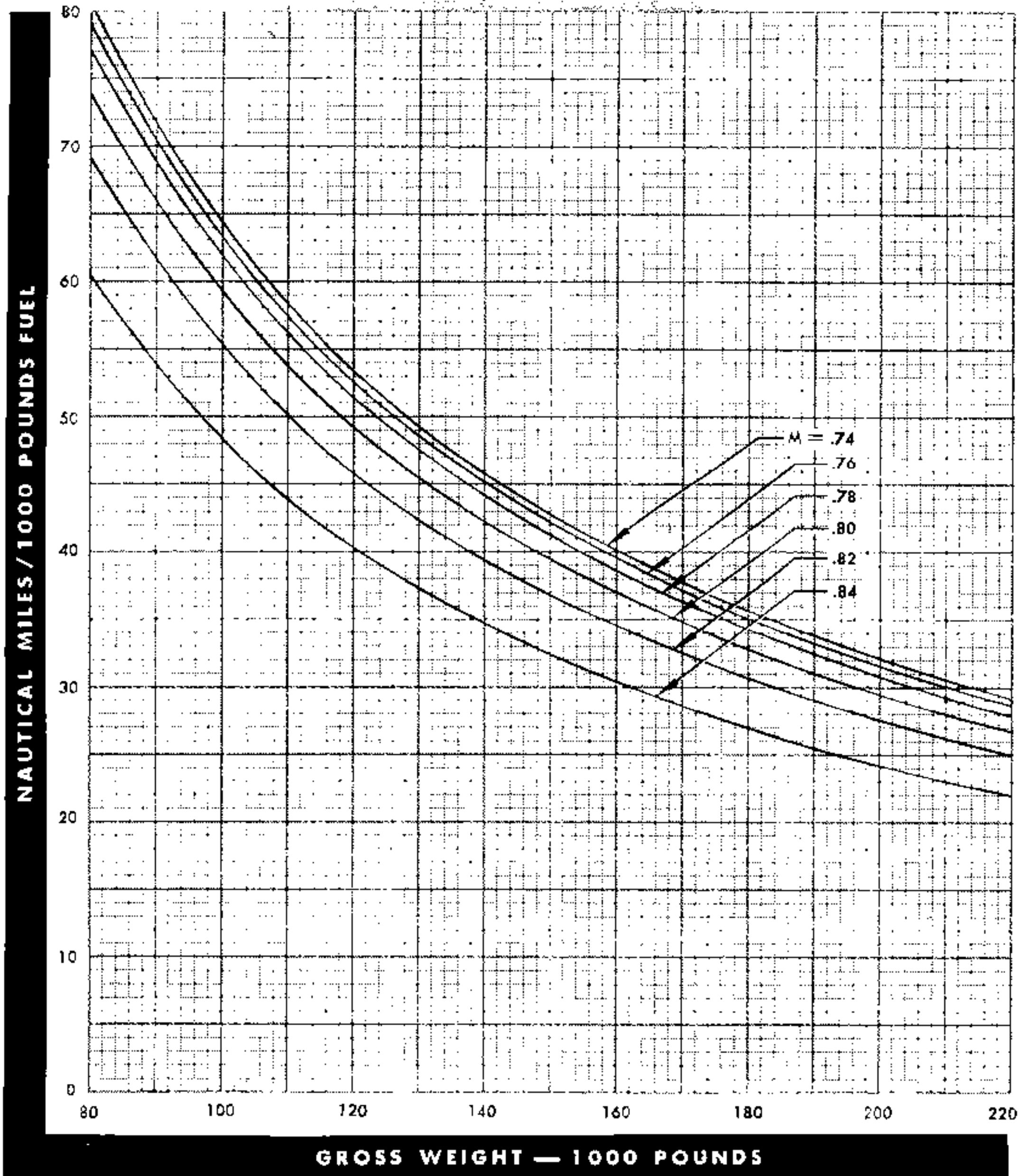
Figure A6-1.

MAXIMUM RANGE OPERATION

NAUTICAL MILES/1000 POUNDS OF FUEL

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

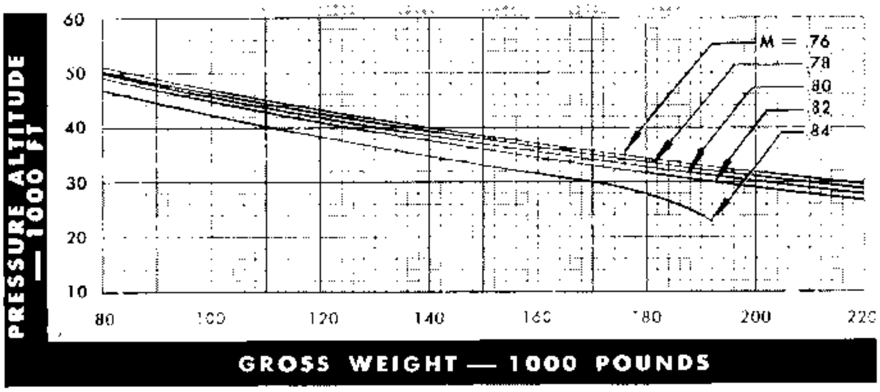
Figure A6-2.

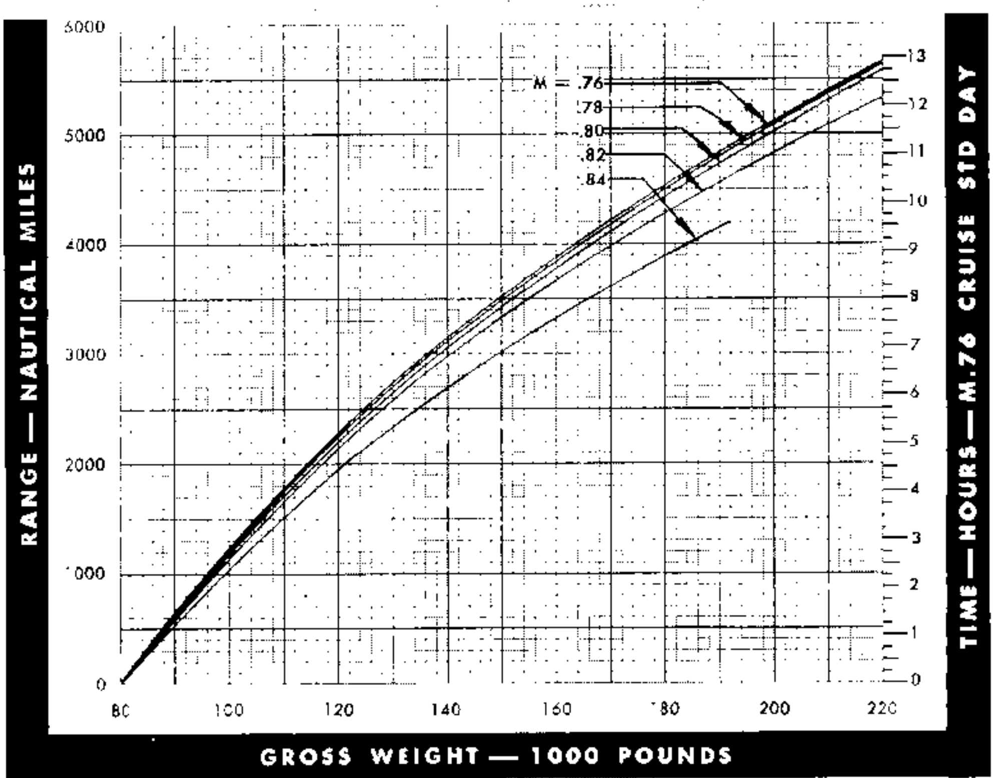
ALTITUDE & RANGE

NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A





DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

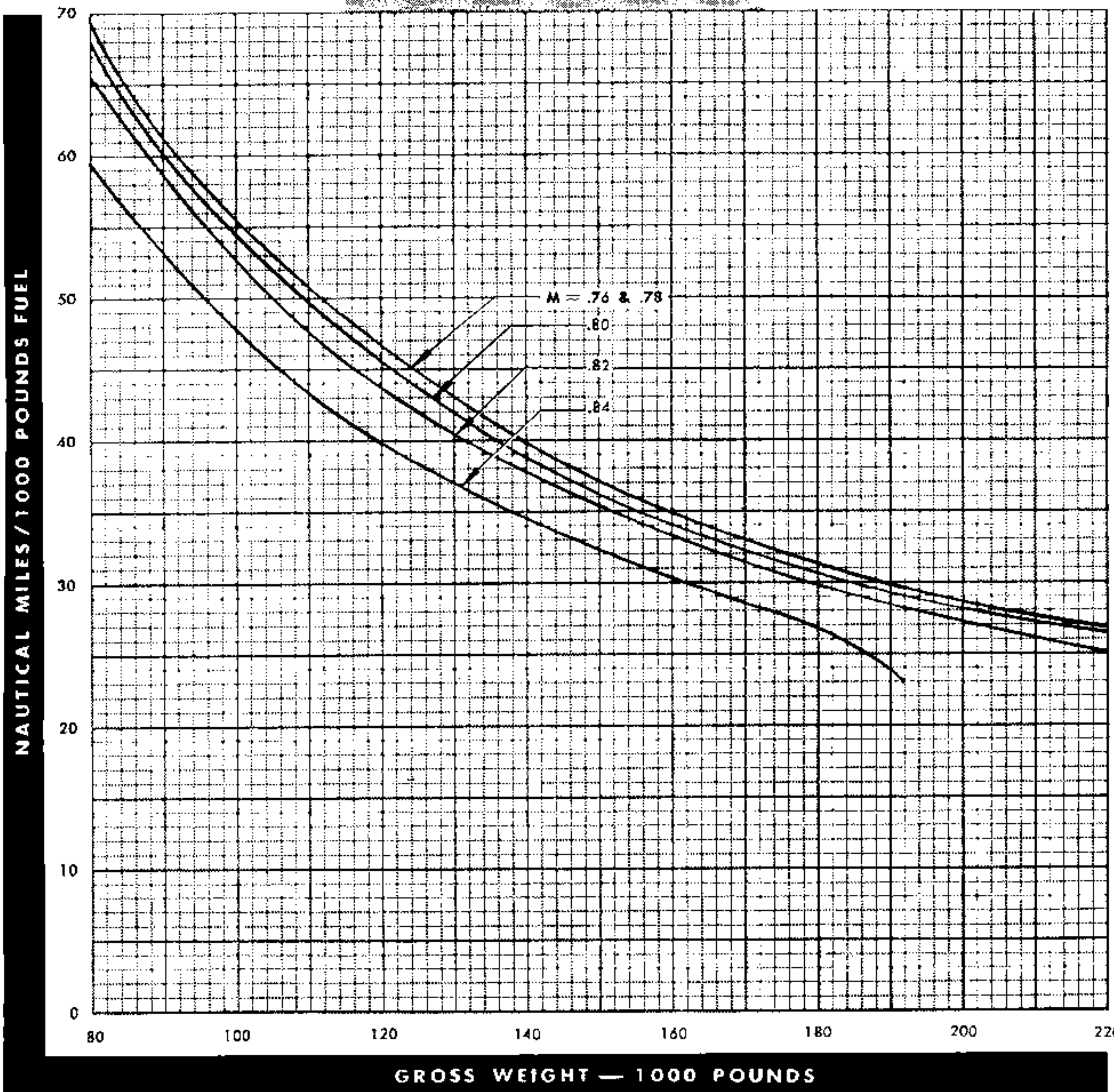
Figure A6-3.

NAUTICAL MILES / 1000 POUNDS OF FUEL

NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

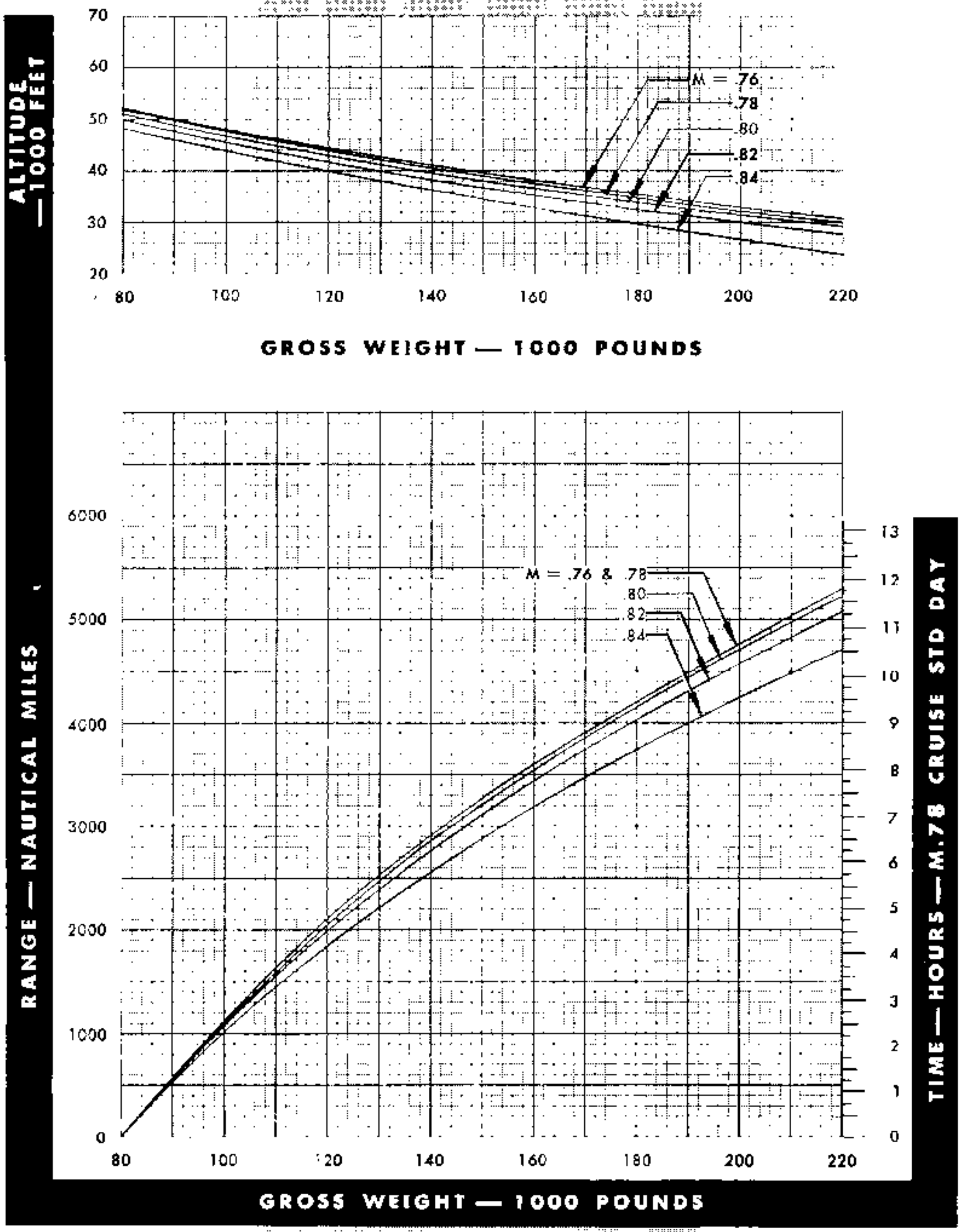
Figure A6-4.

ALTITUDE & RANGE

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

605C-1

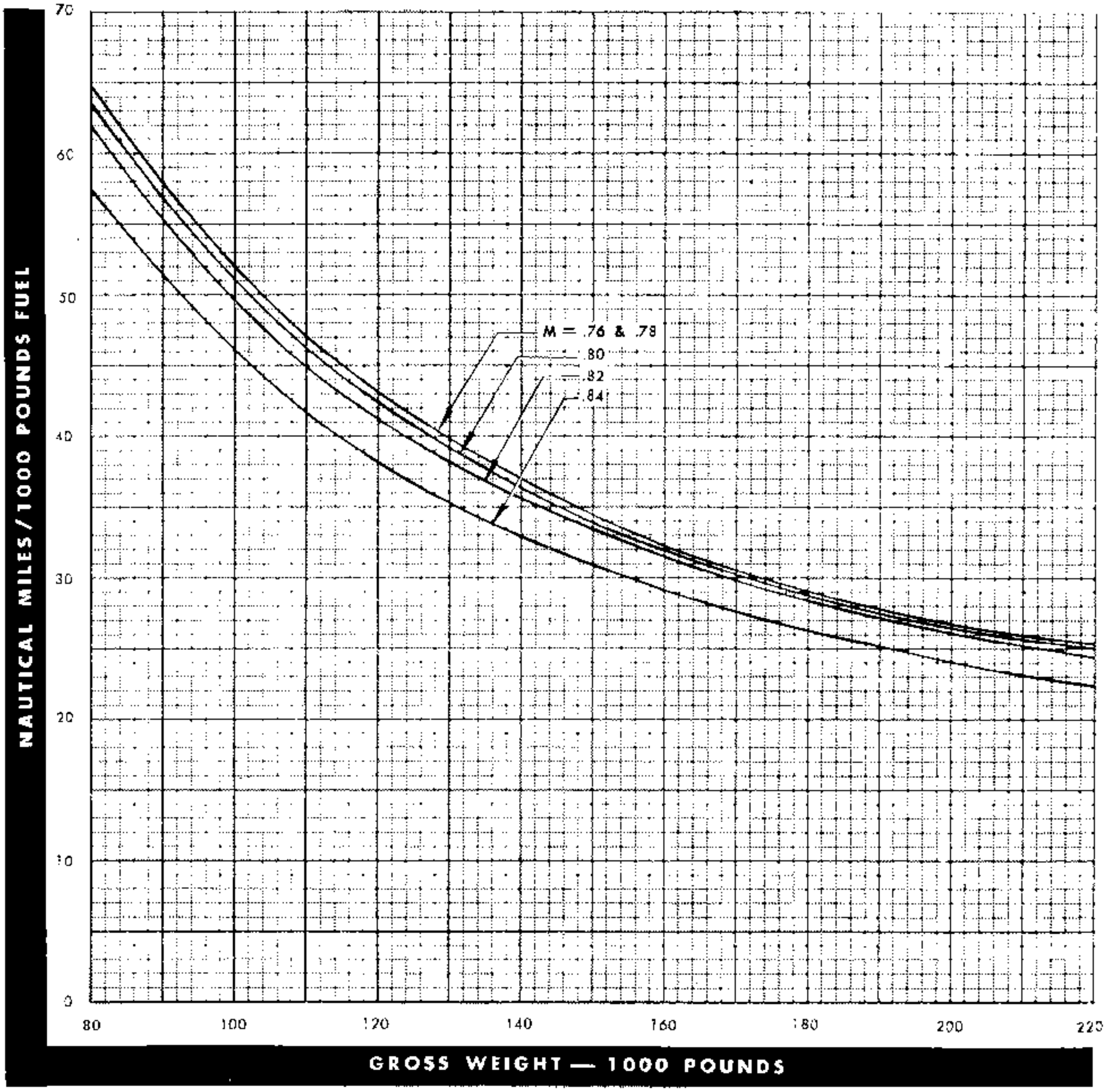
Figure A6-5.

NAUTICAL MILES / 1000 POUNDS OF FUEL

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

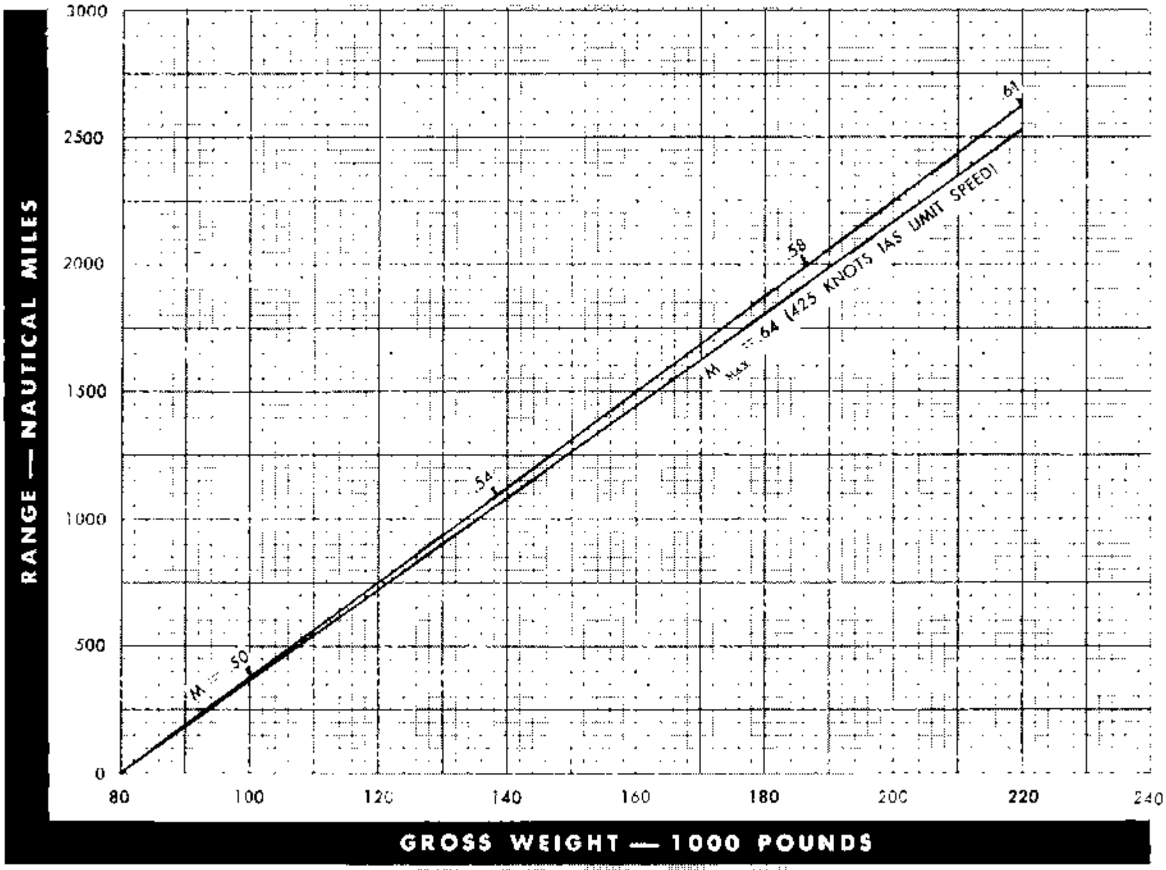
Figure A6-6.

RANGE

SEA LEVEL

MODEL: B-47B & B-47E

ENGINES: J47-25 & 25A



DATE: OCTOBER 1952

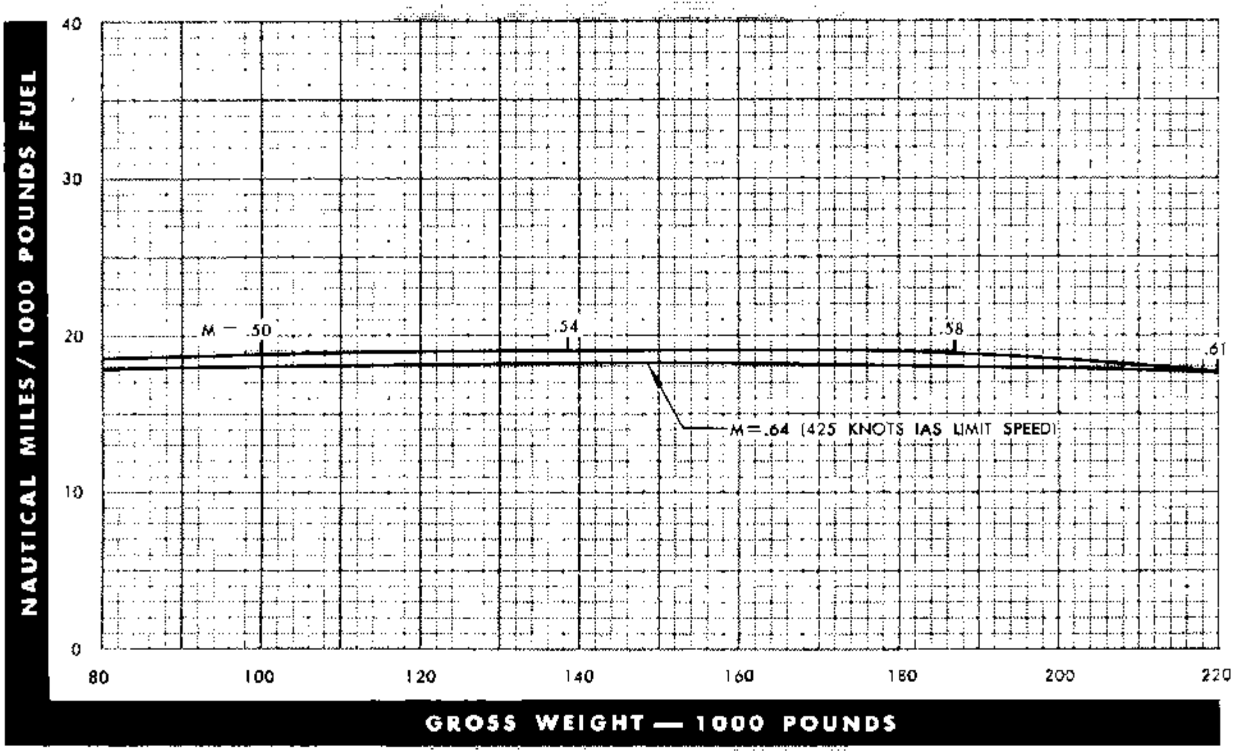
DATA BASIS: FLIGHT TEST

Figure A6-7.

NAUTICAL MILES / 1000 POUNDS OF FUEL
SEA LEVEL

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

608C-1

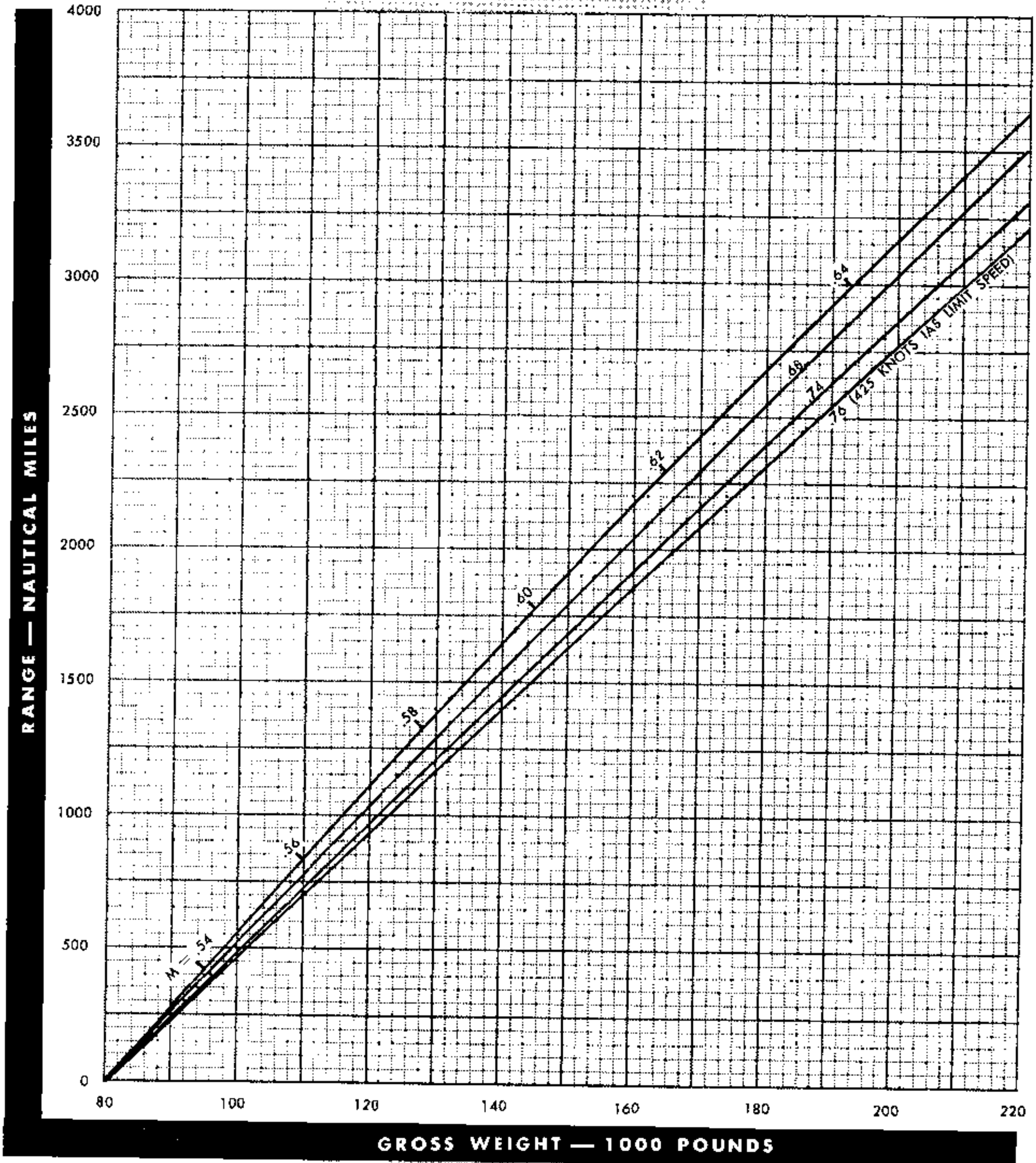
Figure A6-8.

RANGE

10,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

609C-1

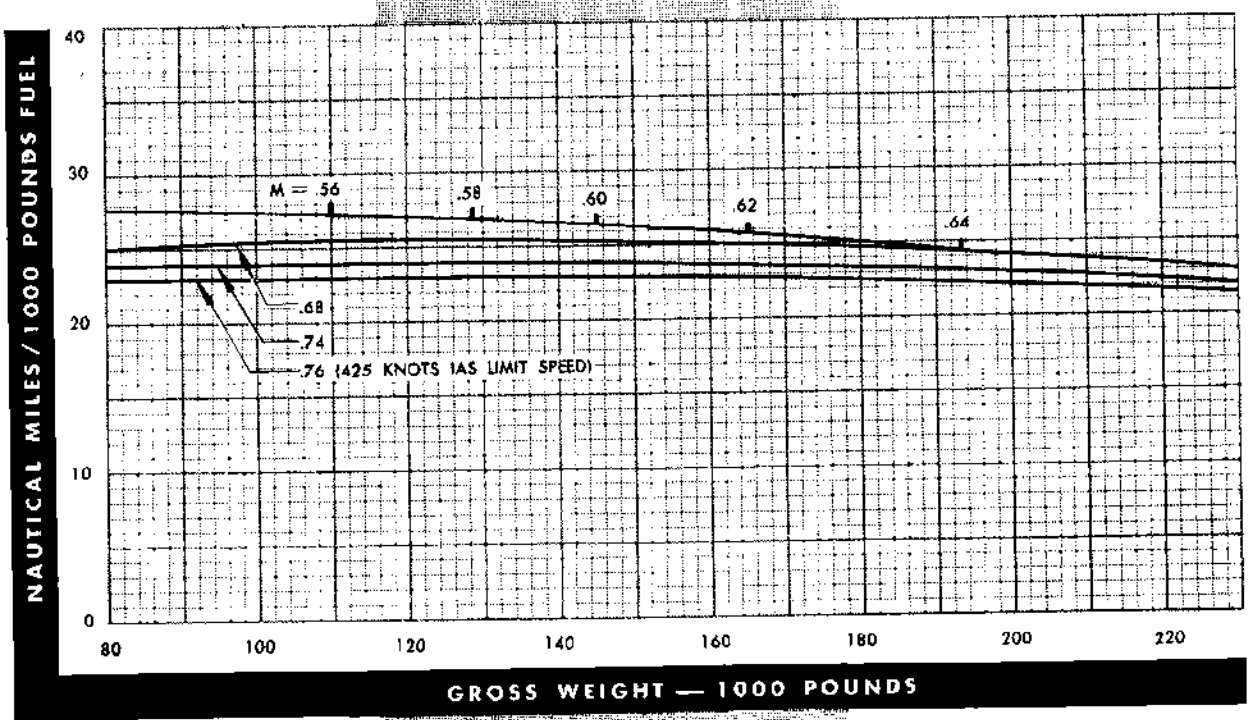
Figure A6-9.

NAUTICAL MILES / 1000 POUNDS OF FUEL

10,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

610C-1

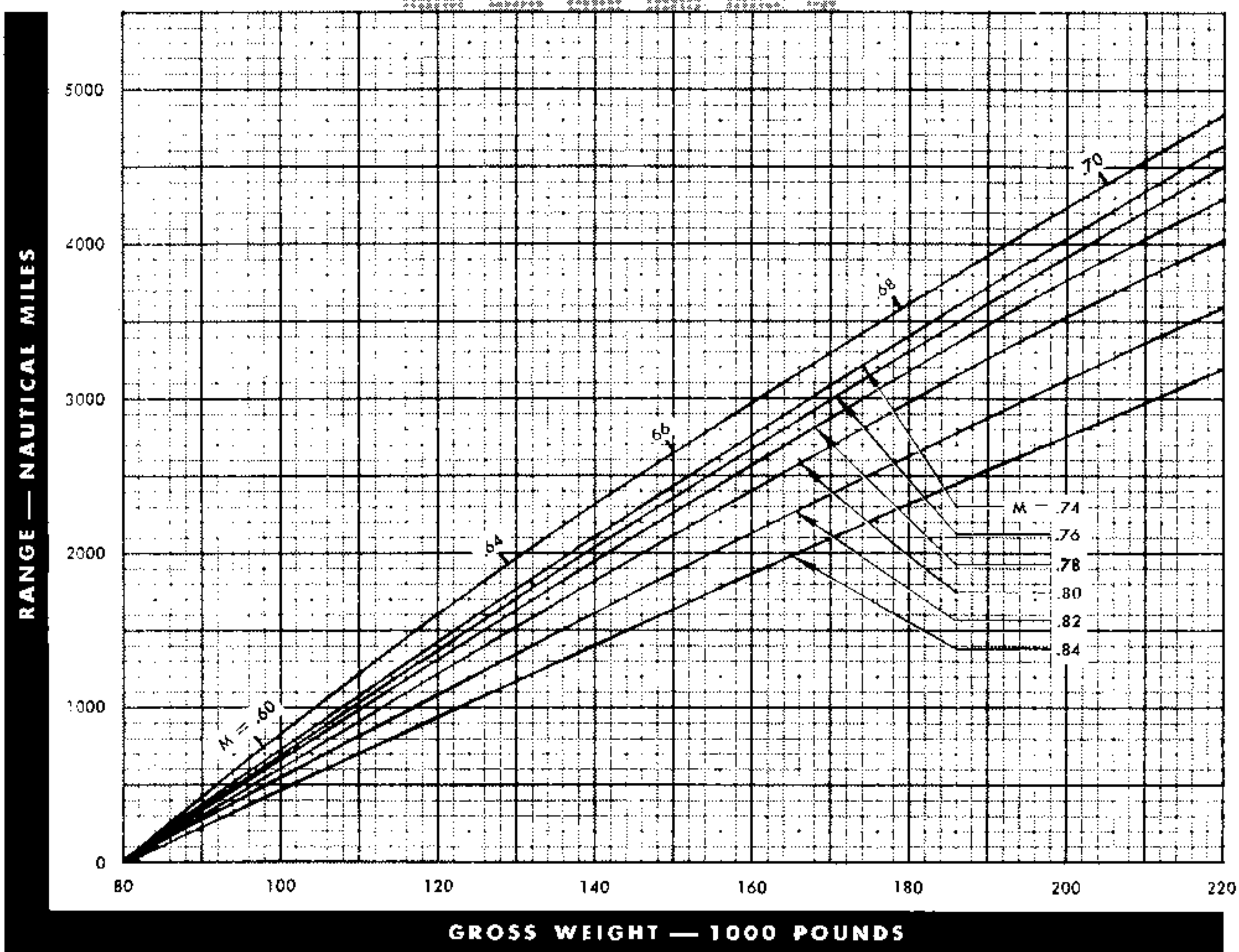
Figure A6-10.

RANGE

20,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

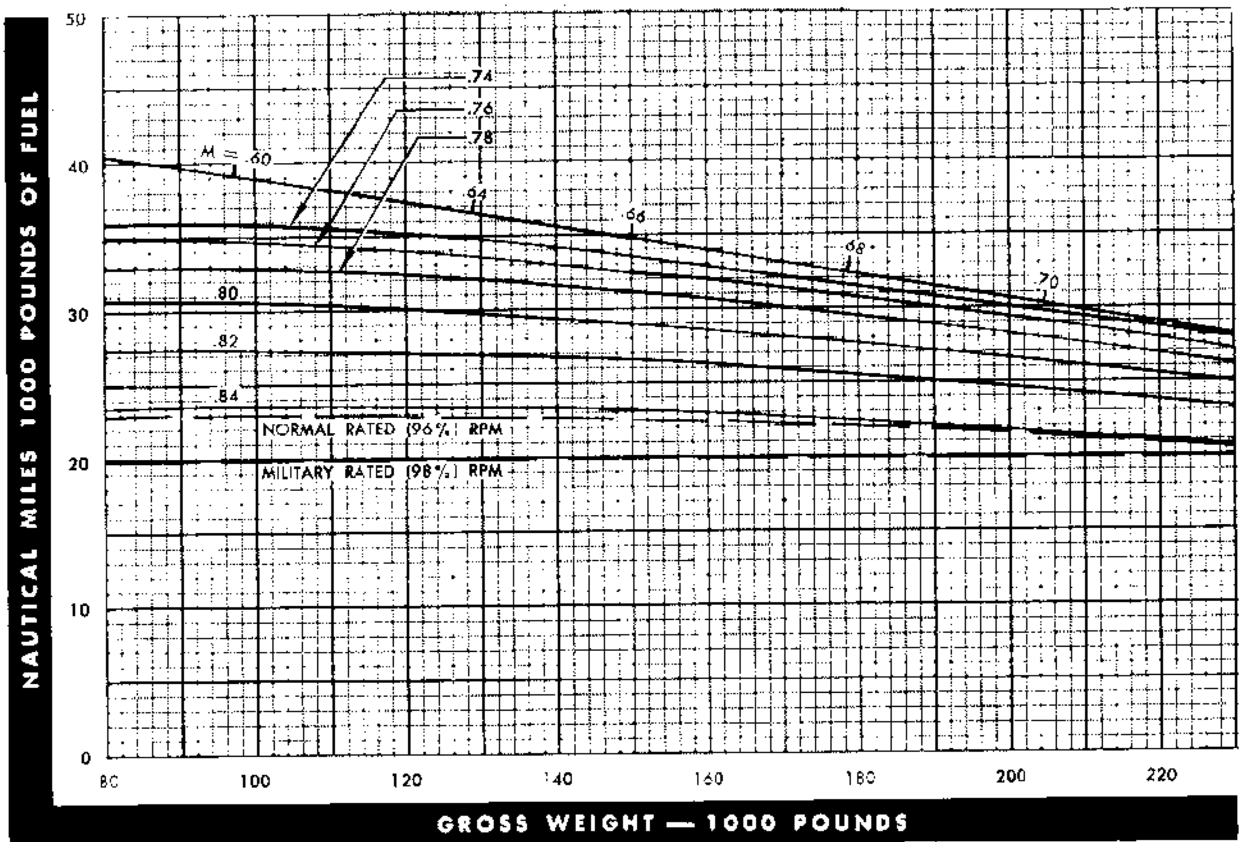
Figure A6-11.

NAUTICAL MILES / 1000 POUNDS OF FUEL

20,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

612C-1

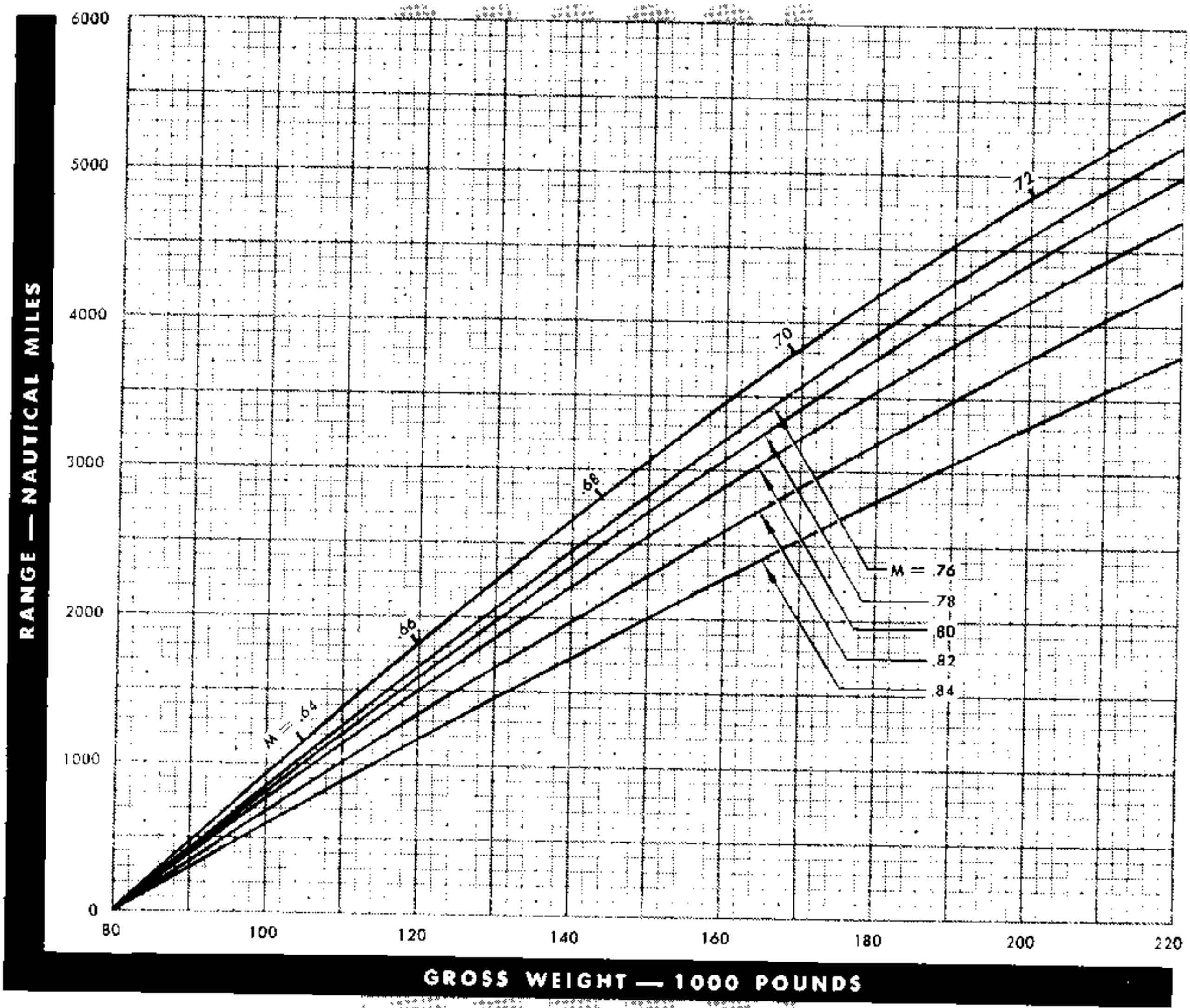
Figure A6-12.

RANGE

25,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47 25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

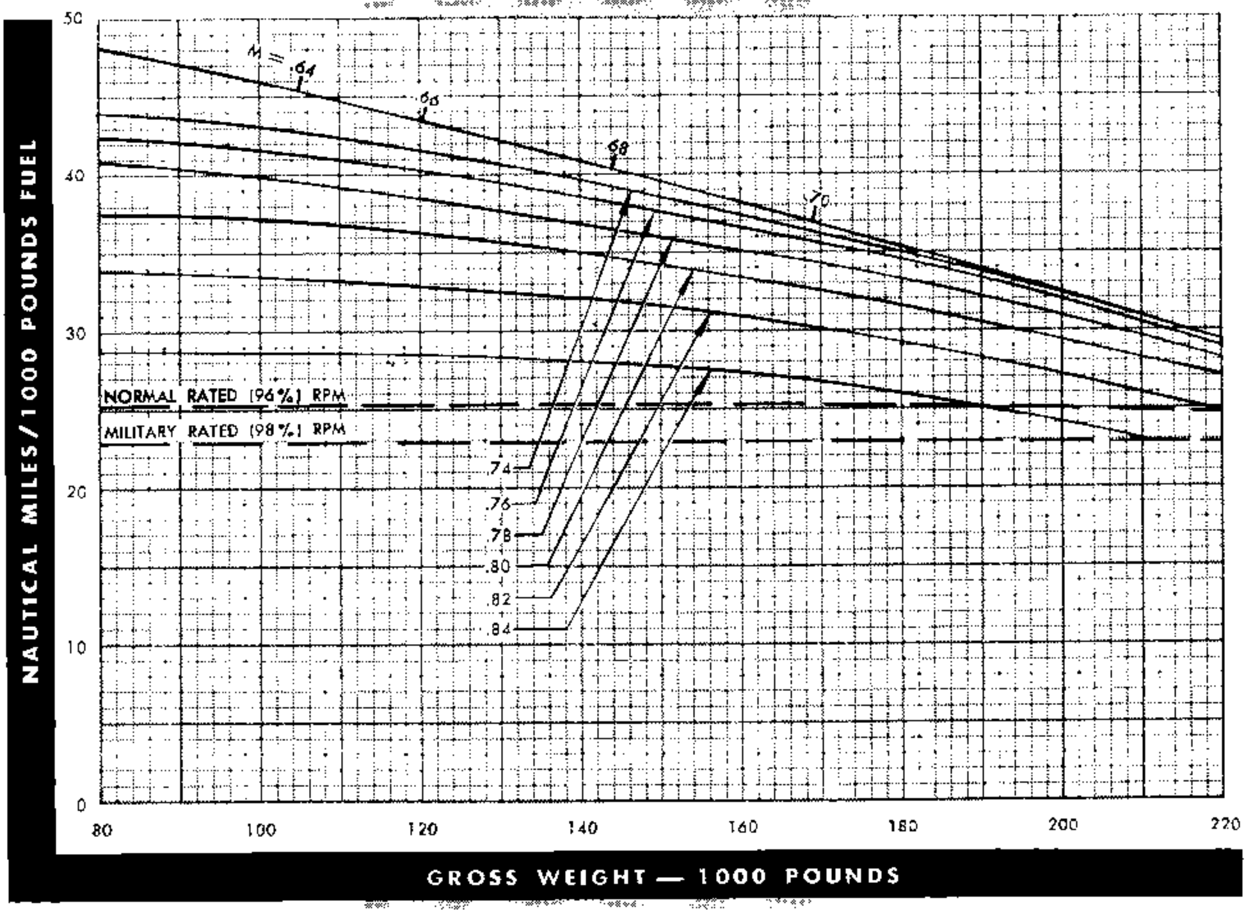
Figure A6-13.

NAUTICAL MILES / 1000 POUNDS OF FUEL

25,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

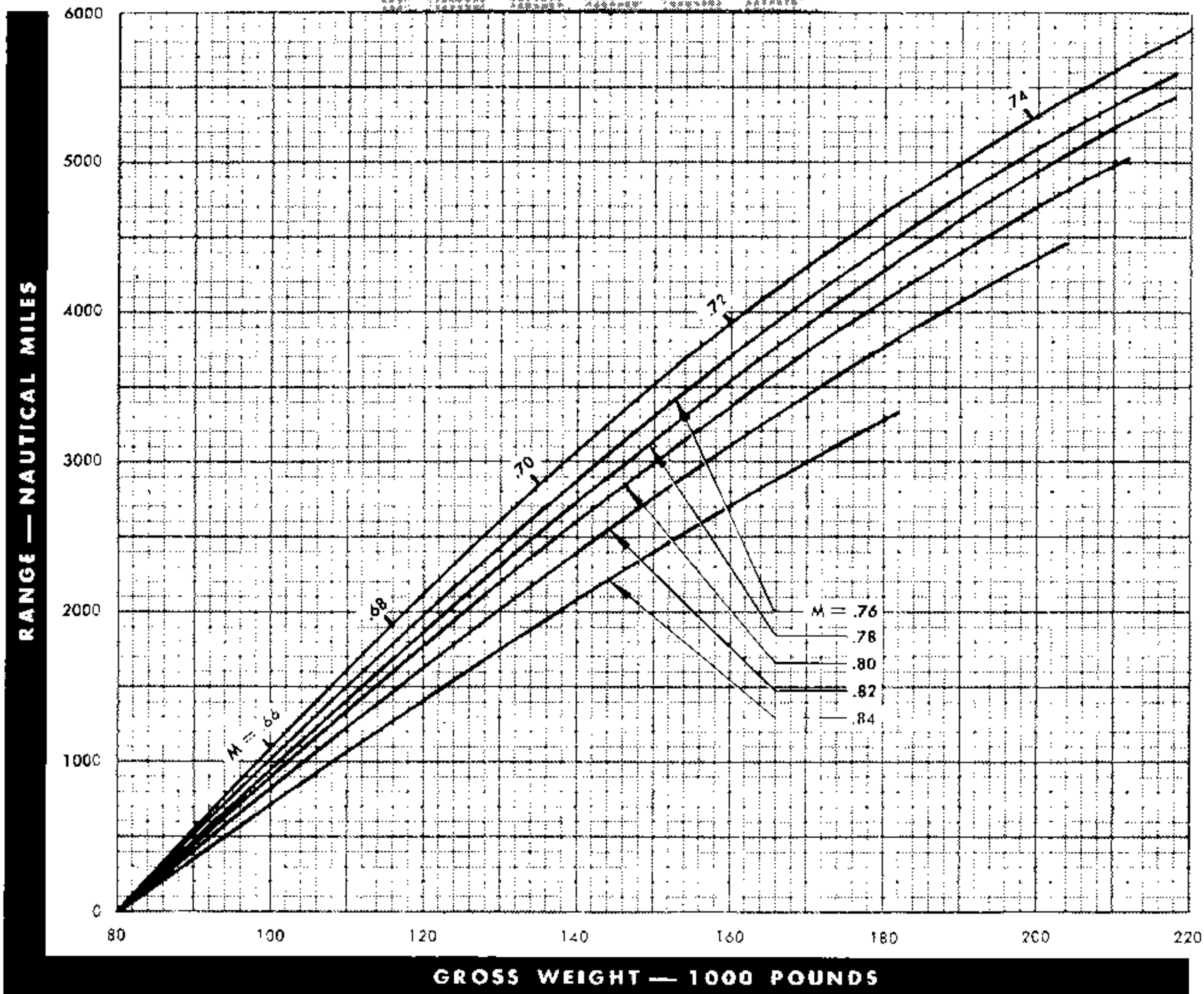
Figure A6-14.

RANGE

30,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

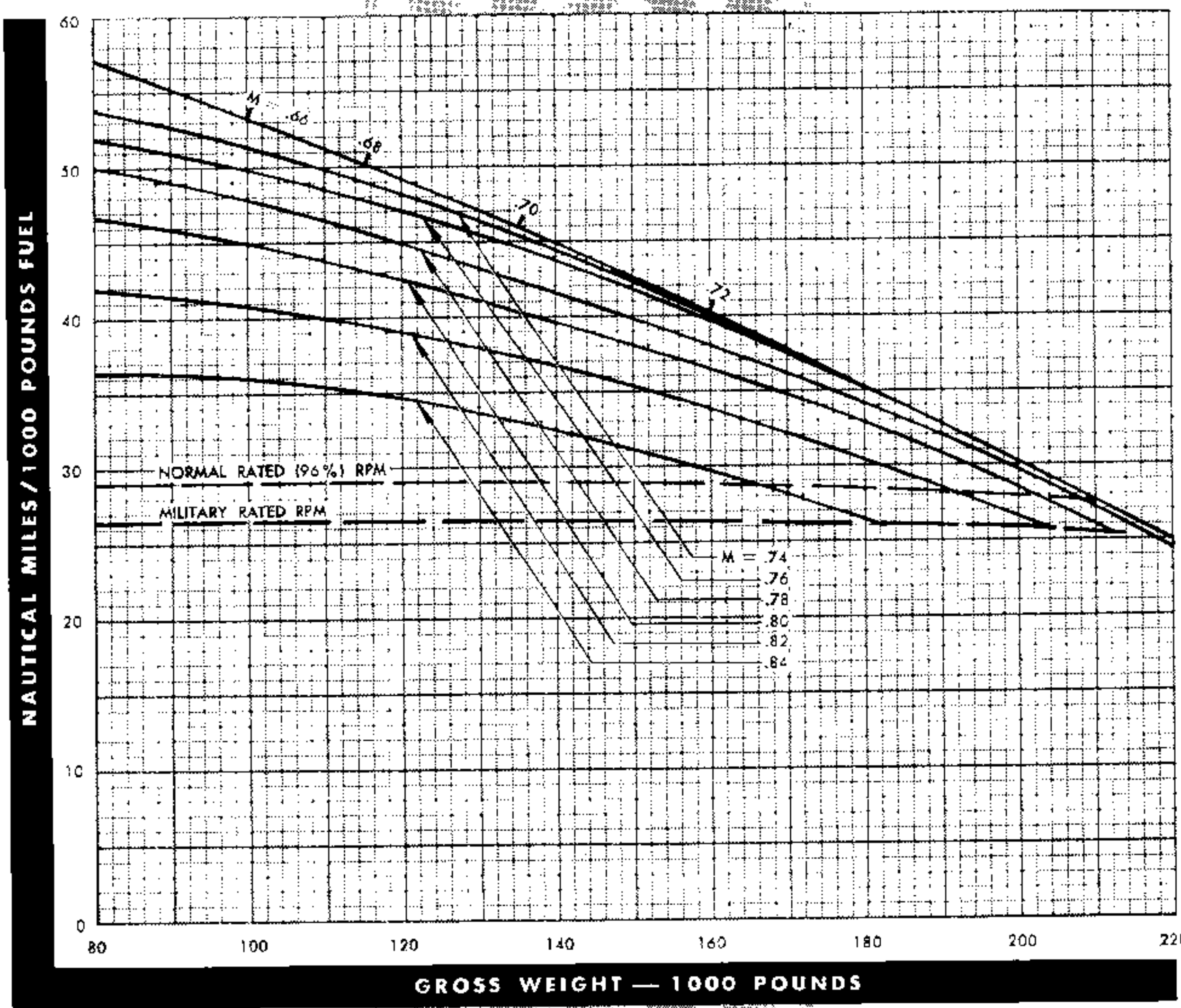
Figure A6-15.

NAUTICAL MILES / 1000 POUNDS OF FUEL

30,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

616C-1

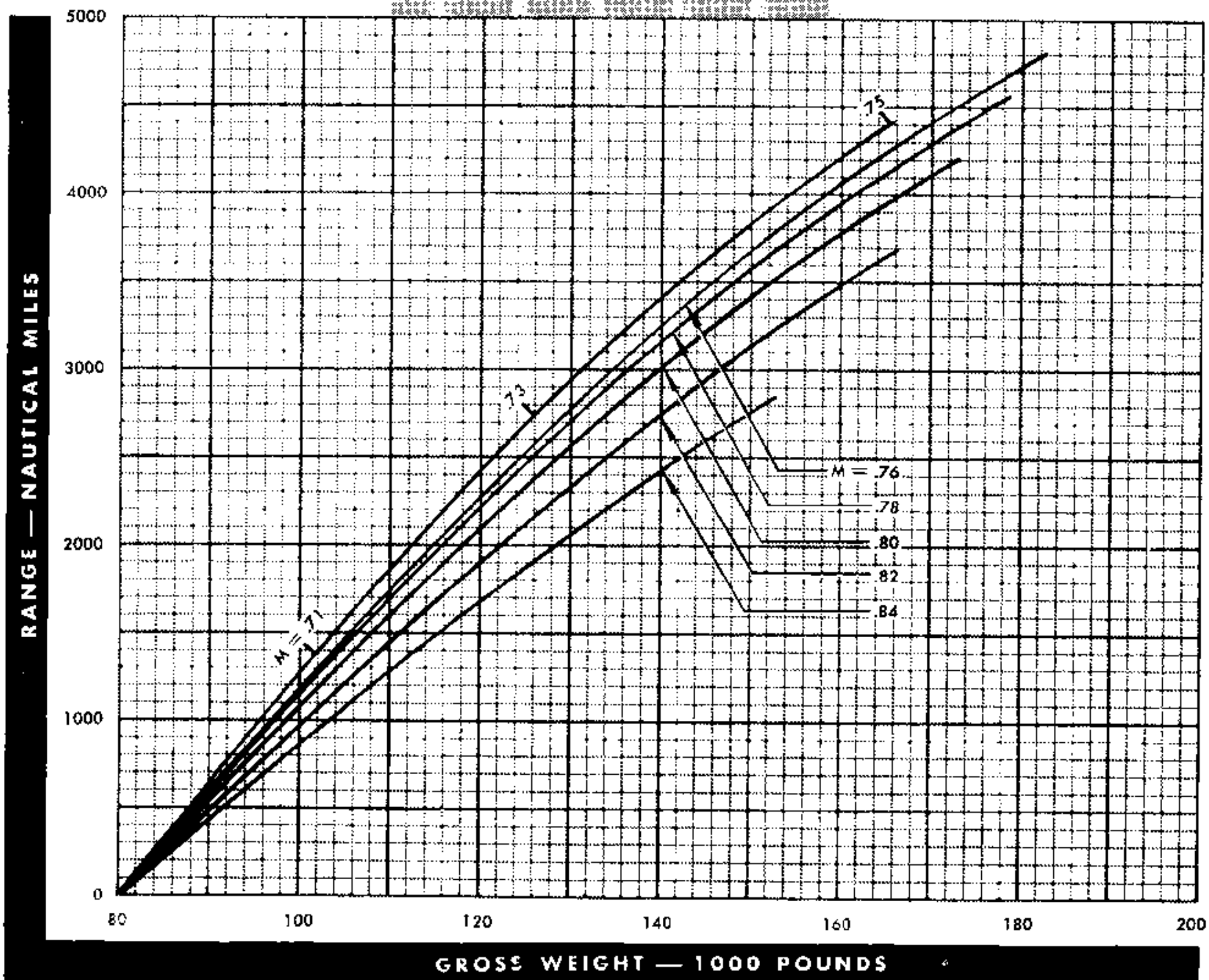
Figure A6-16.

RANGE

35,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

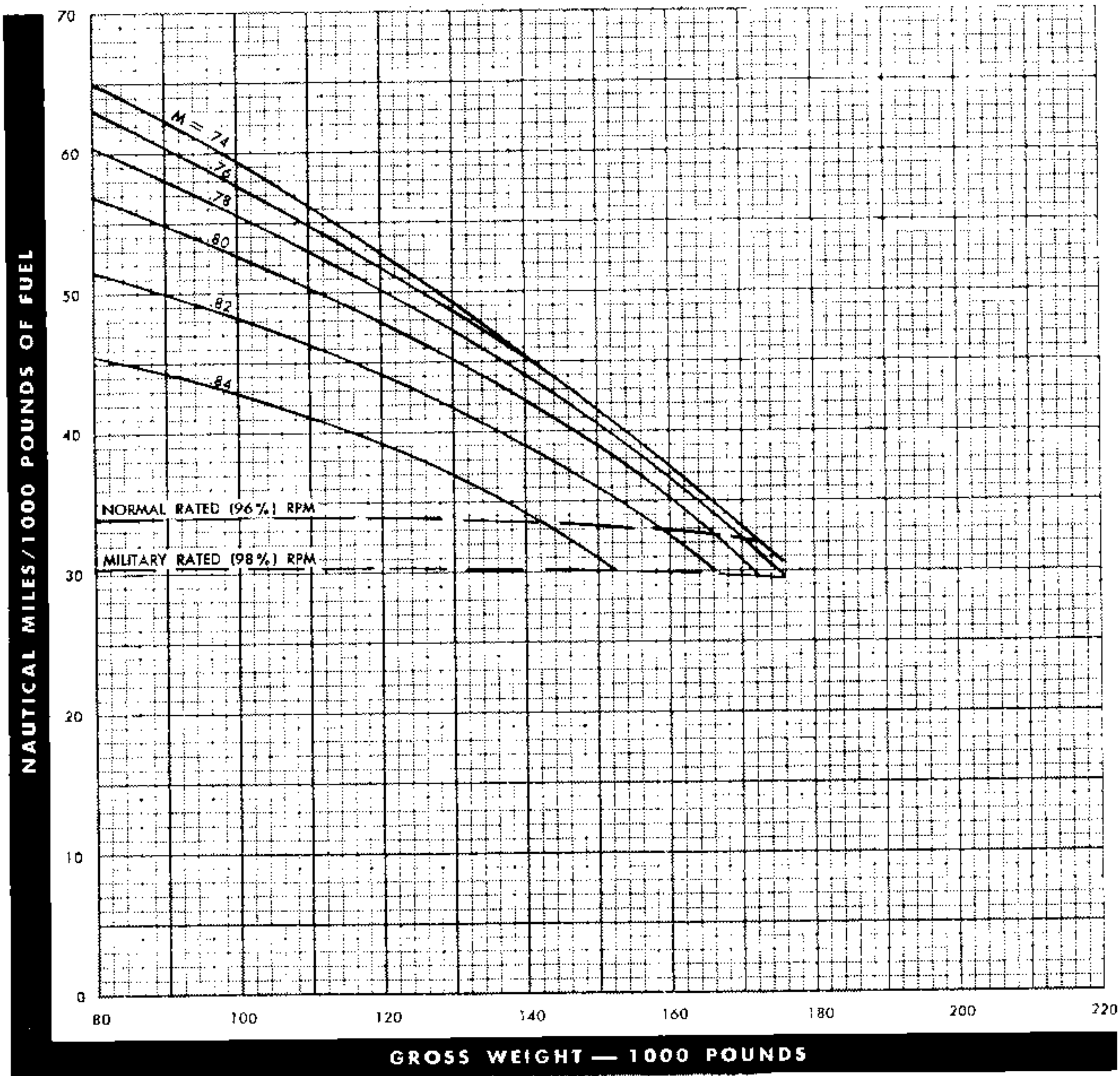
Figure A6-17.

NAUTICAL MILES / 1000 POUNDS OF FUEL

35,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

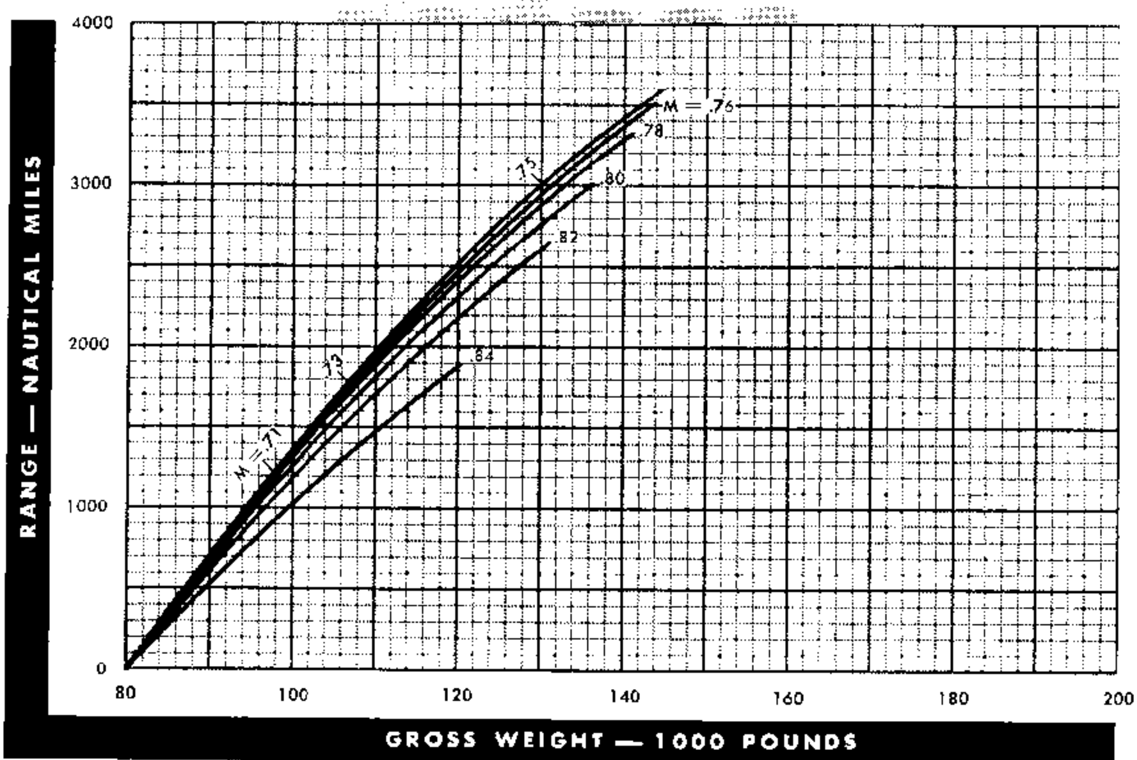
Figure A6-18.

RANGE

40,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

619C-1

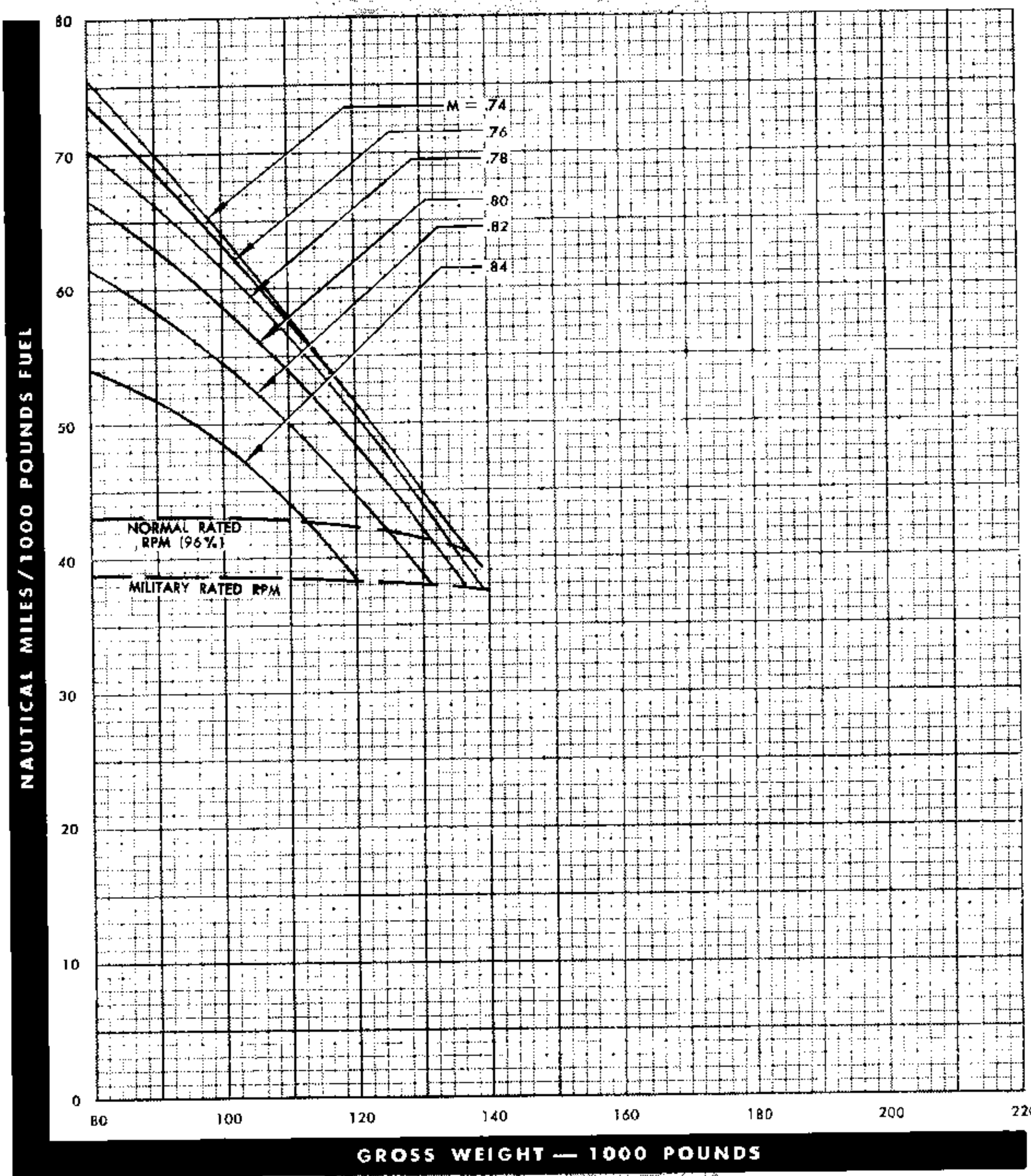
Figure A6-19.

NAUTICAL MILES / 1000 POUNDS OF FUEL

40,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

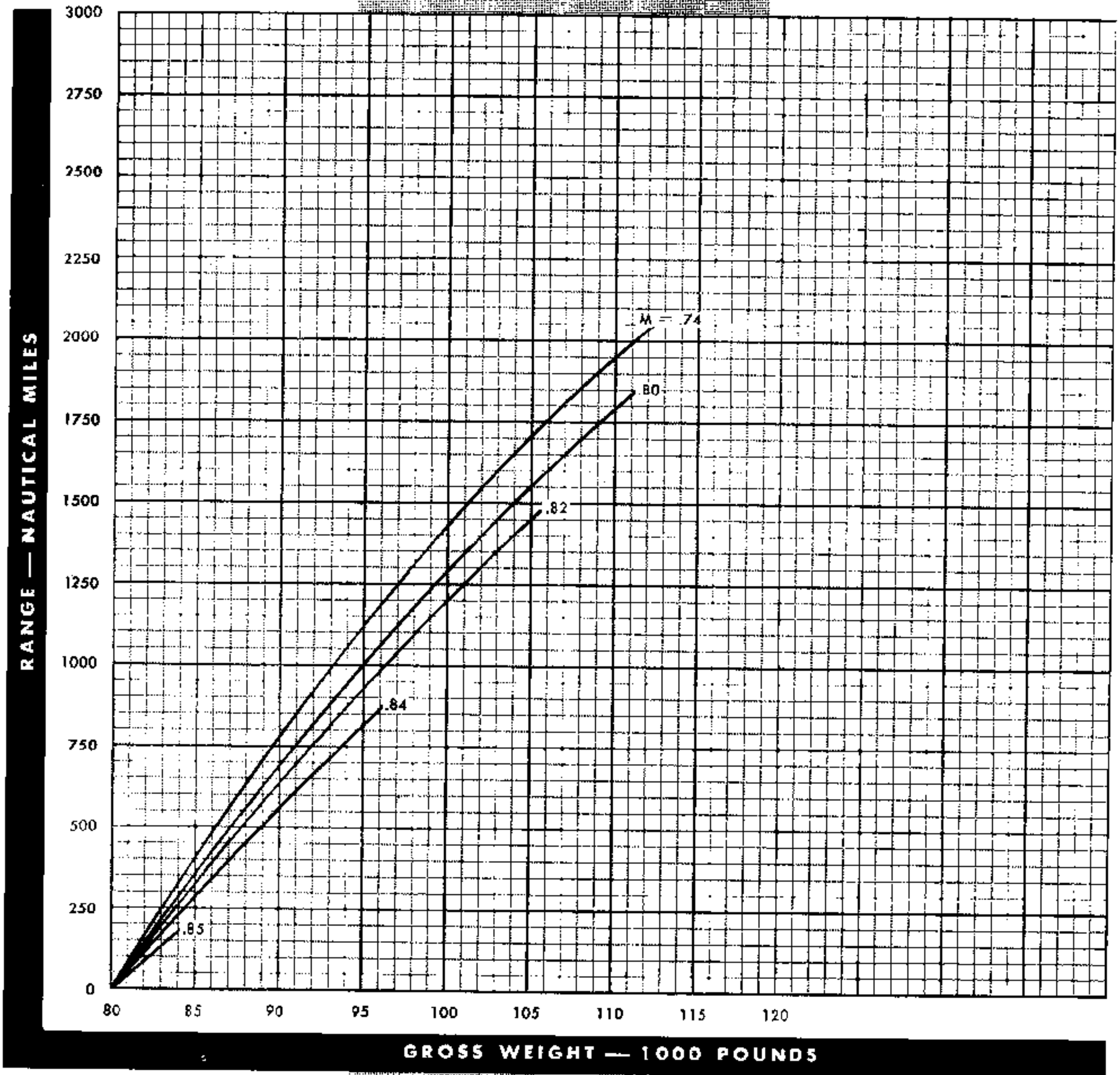
620C-1

Figure A6-20.

RANGE
45,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: APRIL 1953

DATA BASIS: FLIGHT TEST

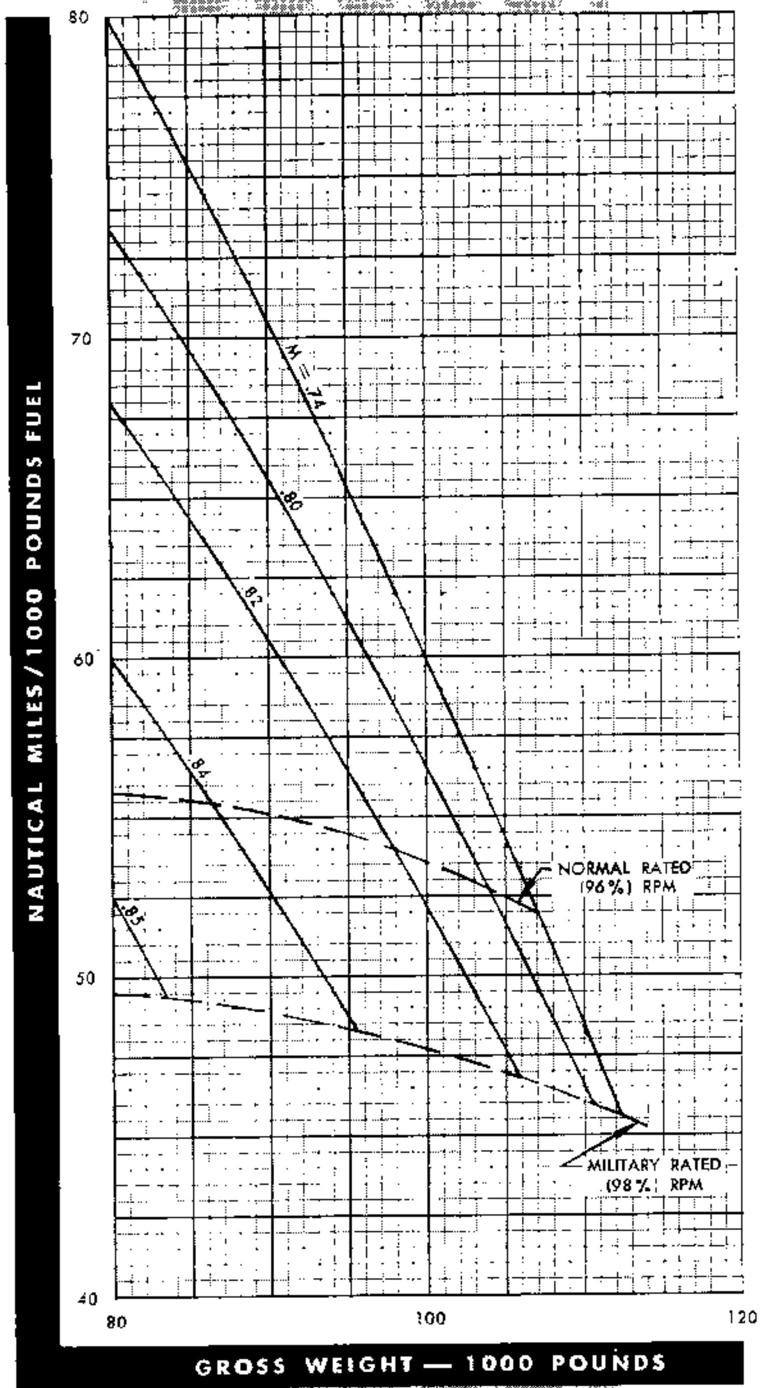
621C-1

Figure A6-21.

NAUTICAL MILES / 1000 POUNDS OF FUEL

45,000 FT ALTITUDE

MODEL: B-47B & B-47E
ENGINES: J47-25 & -25A



DATE: APRIL 1953

DATA BASIS: FLIGHT TEST

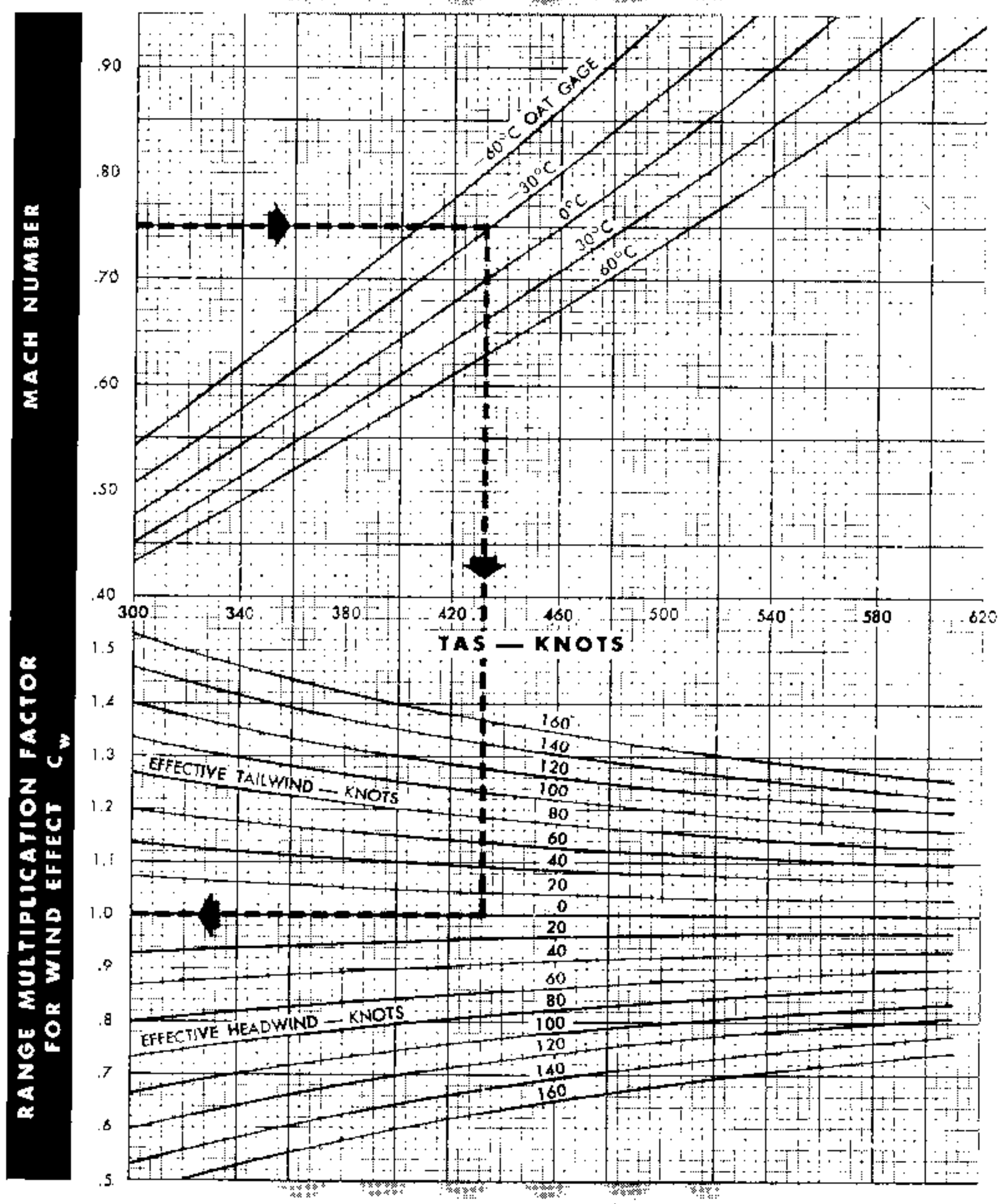
Figure A6-22.

RANGE CORRECTION FOR WIND OVER GIVEN WEIGHT CHANGE

FOR IN-FLIGHT USE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: AUGUST 1951

DATA BASIS: CALCULATED

REMARKS:

$RANGE_{(WIND)} = C_W \times RANGE_{(NO\ WIND)}$

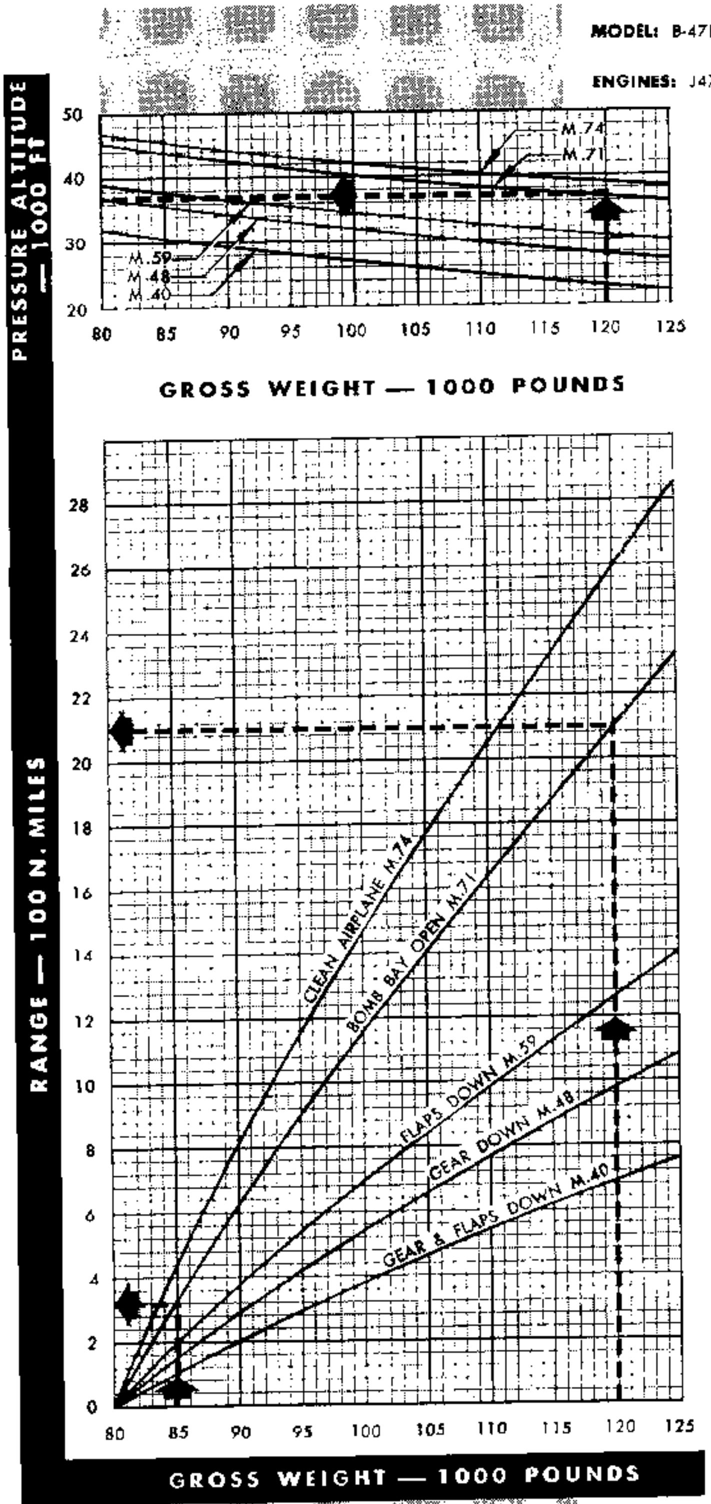
6230-1

Figure A6-23.

MAXIMUM RANGE FOR EMERGENCY OPERATION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: APRIL 1953

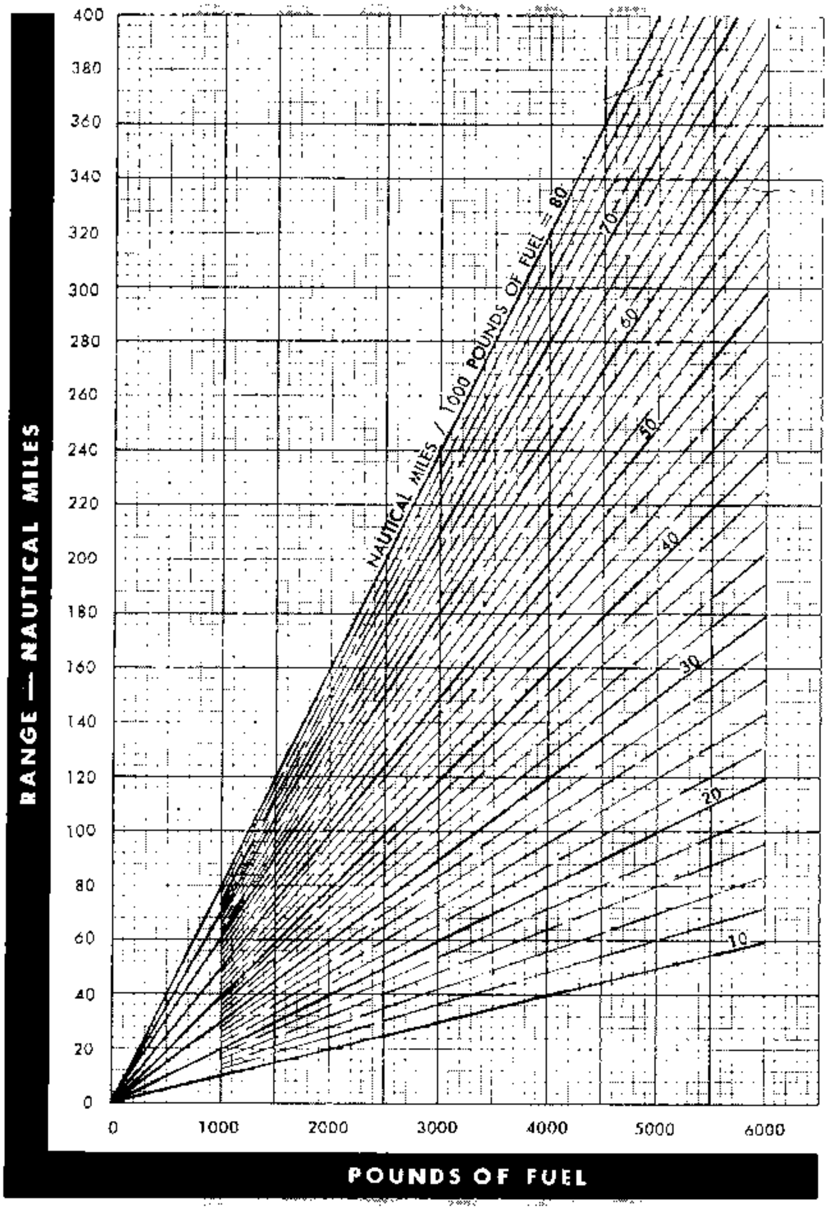
DATA BASIS: FLIGHT TEST

Figure A6-24.

FUEL DISTANCE CONVERSION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1950

DATA BASIS: CALCULATED

625C-1

Figure A6-25.

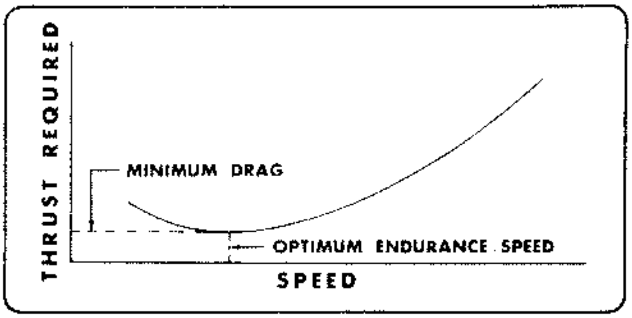
Part 7 endurance

ENDURANCE

Maximum endurance is frequently desired during operational problems such as rendezvous, air traffic clearance, and navigational checks, or to provide time to correct airplane functional difficulties. Maximum endurance may be attained only if recommended airspeeds are observed and the proper number of engines used.

MAXIMUM ENDURANCE

The airspeed for maximum endurance at any weight and altitude is approximately the airspeed at which airplane drag is a minimum. At that airspeed, the engine fuel consumption is minimum because the least thrust is required.



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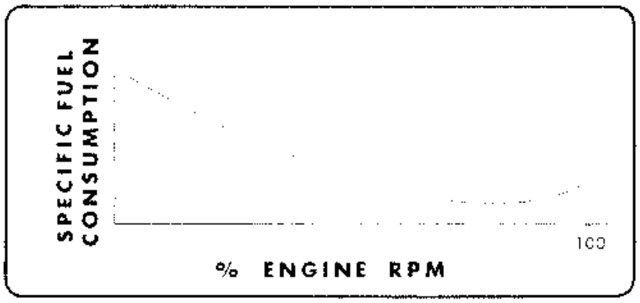
The recommended airspeeds for maximum endurance with flaps and gear up and two, four, or six engines operating are given on figure A7-1.

The number of operating engines required for maximum endurance varies with altitude because of the following:

1. The thrust required to overcome airplane drag, at a given weight and at the correct maximum endurance speed, remains essentially constant at all altitudes.
2. The thrust output of jet engines at a given rpm drops off rapidly with increasing altitudes.
3. The engine rpm must be kept relatively constant (between 80% and 90% rpm) for minimum specific fuel consumption. It is apparent from the following sketch that, if too many engines are running, the rpm on all engines must be low and the fuel consumption then will be high.



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Therefore, for the thrust output to equal the constant thrust required, with the rpm and indicated airspeed fixed for maximum endurance, more engines are required at high than at low altitudes. The number of engines required for maximum endurance at any altitude and weight is given in the following table (all other engines cut).

ALTITUDE	APPROXIMATE RPM PER CENT MAX.	NUMBER OF OPERATING ENGINES GROSS WT. — (1000 POUNDS)						
		80	100	120	140	160	180	200
ABOVE 30,000'	85	6	6	6	6	*	*	*
20,000' TO 30,000'	85	4	4	5	5	6	6	6
10,000' TO 20,000'	85	3	3	4	4	5	5	5
S L TO 10,000'	85	2	2	3	3	3	3	4

*ALTITUDE NOT PRACTICAL FOR HIGH GROSS WEIGHT.

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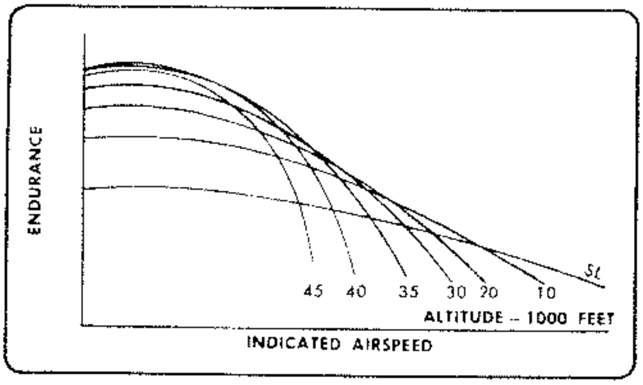
Endurance charts for both mission planning and emergency operation are contained in this section. These charts include no conservative factors or reserves.

The effect of wing tanks will be to reduce the time available from a given fuel quantity by 7.5% with no change in speed.

Endurance, like range, can be estimated from the gross weight at the start and at the end. The best endurance rate in minutes per 1000 pounds of fuel is obtained at light gross weights, high altitude, and at one particular speed for each weight.

OPTIMUM ENDURANCE AT LIGHT WEIGHT

For endurance at light weights near the end of a mission, the integrated chart on figure A7-2 will be most convenient. A curve of the correct indicated airspeed for optimum endurance is also on figure A7-2. The desired endurance can be attained only if the proper speeds are observed within ±10 knots. The effect of speed on endurance is most critical at high altitudes, as shown by the following sketch:



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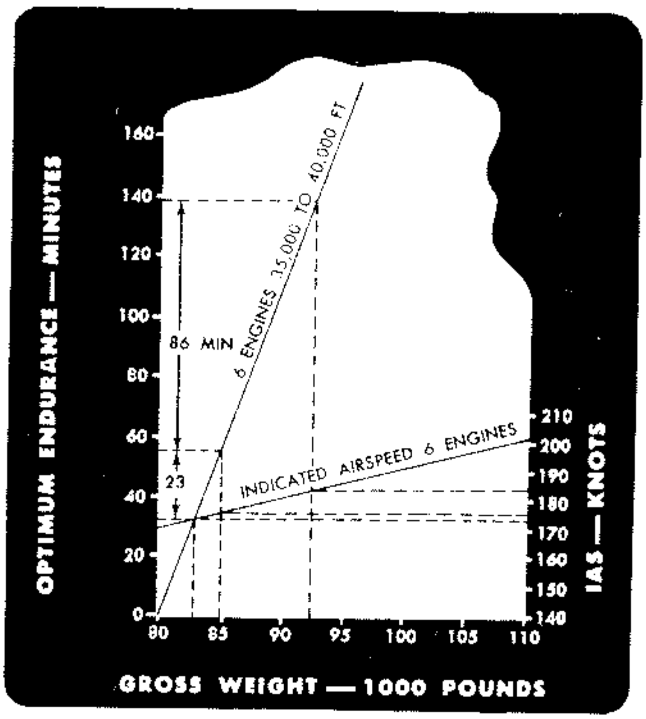
The following example demonstrates the use of the integrated chart:

Find:
1. The number of operating engines
2. The best altitude for endurance
3. The maximum time that the airplane can remain aloft before exhausting its fuel
4. The maximum endurance, allowing 2000 pounds of fuel for descent and landing reserve.



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Use the chart on figure A7-2. When above 35,000 feet, six engines will give the best endurance. The chart on figure A7-1 shows that for six engines, the altitude at the average gross weight should be about 38,700 feet.

The gross weight at the beginning of endurance is 82,500 + 10,000 = 92,500. From the sketch it is apparent that the total available endurance time between the two weights is 109 minutes. With 2000 pounds of fuel reserved for descent and landing, the minimum gross weight is 84,500 pounds and the endurance to the start of descent is 86 minutes.

From the endurance speed curve at the bottom of the chart, the IAS is 184 knots at the start of endurance, 175 knots when only 2000 pounds of fuel remain, and 173 knots at the end of endurance.

ENDURANCE AT OPTIMUM ALTITUDE

The charts on figures A7-3 and A7-4 show the absolute maximum endurance that can be obtained for a given number of operating engines. The correct altitude for any weight is also shown. For very long periods, where cutting engines is not desired, maximum endurance will be obtained by using the climbing flight path indicated in these charts. The same endurance can be obtained at a constant altitude by cutting engines as required. For shorter periods, constant altitude operation will result in the same endurance as obtained by climbing flight path. It will be noted by comparison with the charts on figures A7-5 through A7-7 that varying from the specified altitude by plus or minus 2000 feet will not appreciably affect endurance. On figure A7-1 is a plot of the indicated airspeed required at each gross weight. The following example illustrates the use of the optimum endurance charts:

EXAMPLE:

While cruising, it becomes necessary to hold for 60 minutes over a check point. The fuel gages show 60,000 pounds of fuel in the tanks and the airplane without fuel weighs 82,000 pounds.

Find:
1. The number of operating engines
2. The optimum altitude
3. Minimum fuel expended during endurance
4. The gross weight when cruise is resumed
5. Required airspeed.

From the curves on figure A7-3 it is apparent that at high gross weights, six engines give nearly the same endurance time as four engines, although at a higher altitude. Therefore, if the cruise is at high altitude, less height will have to be lost and regained if the six-engine endurance is used. The fuel gained by using six engines would be slight however, since the extra fuel consumed in climbing back to altitude is nearly offset by that saved during the descent at reduced power.

The gross weight at the start of endurance is 82,000 + 60,000 = 142,000 pounds. On the six-engine curve, at this gross weight the endurance is 6.9 minutes per thousand pounds of fuel at 29,300-foot altitude.

From the curve on figure A7-8, the first approximation to the fuel used (60 minutes at 6.9 minutes per 1000 pounds) is 8,700 pounds. The average endurance weight is then $142,000 - \frac{8,700}{2} = 138,000$ pounds.

The average endurance at this weight, from figure A7-3 is 7.1 pounds per minute at 30,000 feet. The fuel used in 60 minutes is then 8,500 pounds, using figure A7-8 again.

The gross weight when cruise is resumed is then 142,000 - 8,500 = 133,500 pounds. Unless the endurance time is very long and the weight change very large, there is no need for going beyond a first approximation.

The optimum airspeeds are given on figure A7-1. The airspeed decreases from 232 knots IAS at the start of endurance to 224 knots IAS at the end.

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

On figures A7-5, A7-6, and A7-7 are charts showing the minutes per thousand pounds of fuel that are obtainable if the endurance operation must be made at a specified constant altitude. It will be noted that this type of operation gives less than the optimum endurance. The method of using the constant altitude charts is similar to that explained in the last example. The indicated airspeeds, from the chart on figure A7-7, apply to all altitudes.

EFFECT OF OAT ON ENDURANCE

The endurance data is based on an NACA standard day. Higher outside air temperatures tend to decrease the endurance at a given altitude. For an extremely hot day (120° F at sea level) the endurance is reduced by approximately 6%. On a cold day there will be a gain in endurance time.

RULES FOR MAXIMUM ENDURANCE

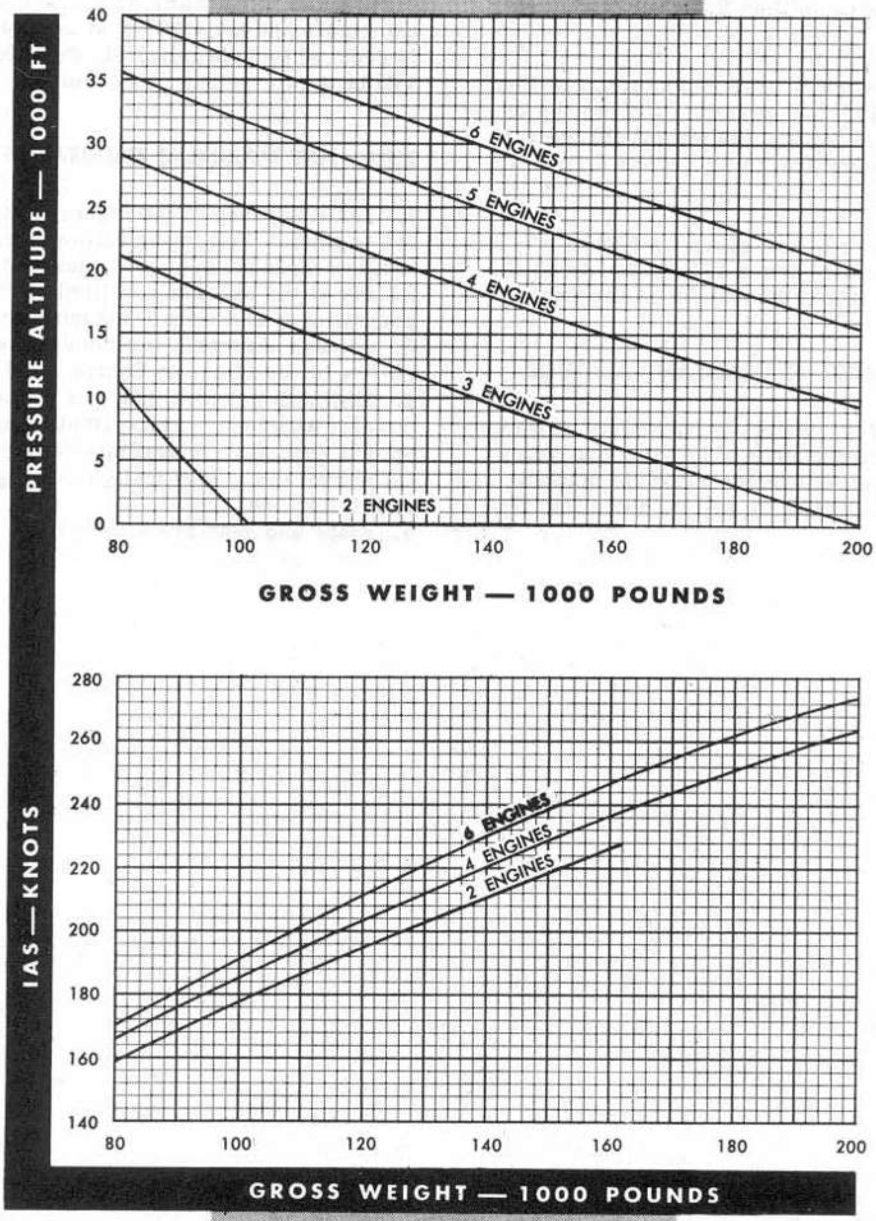
1. For endurance at the highest practical altitude use six engines. For lower altitudes cut enough engines to allow those remaining to operate at 80% to 90% rpm.
2. Fly at the altitude specified on figure A7-1 for the prevailing gross weight and number of engines.
3. Always maintain the correct indicated airspeed shown in the chart on figure A7-1.
4. Maintain between 80% and 90% engine rpm at the correct airspeed. The altitude can be varied somewhat if necessary to accomplish this. Reduce altitude if the rpm is too high and go to a higher altitude if the rpm is too low.
5. Flaps and gear are always up.

BEST ENDURANCE ALTITUDES & ENDURANCE SPEEDS

ALL ALTITUDES

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

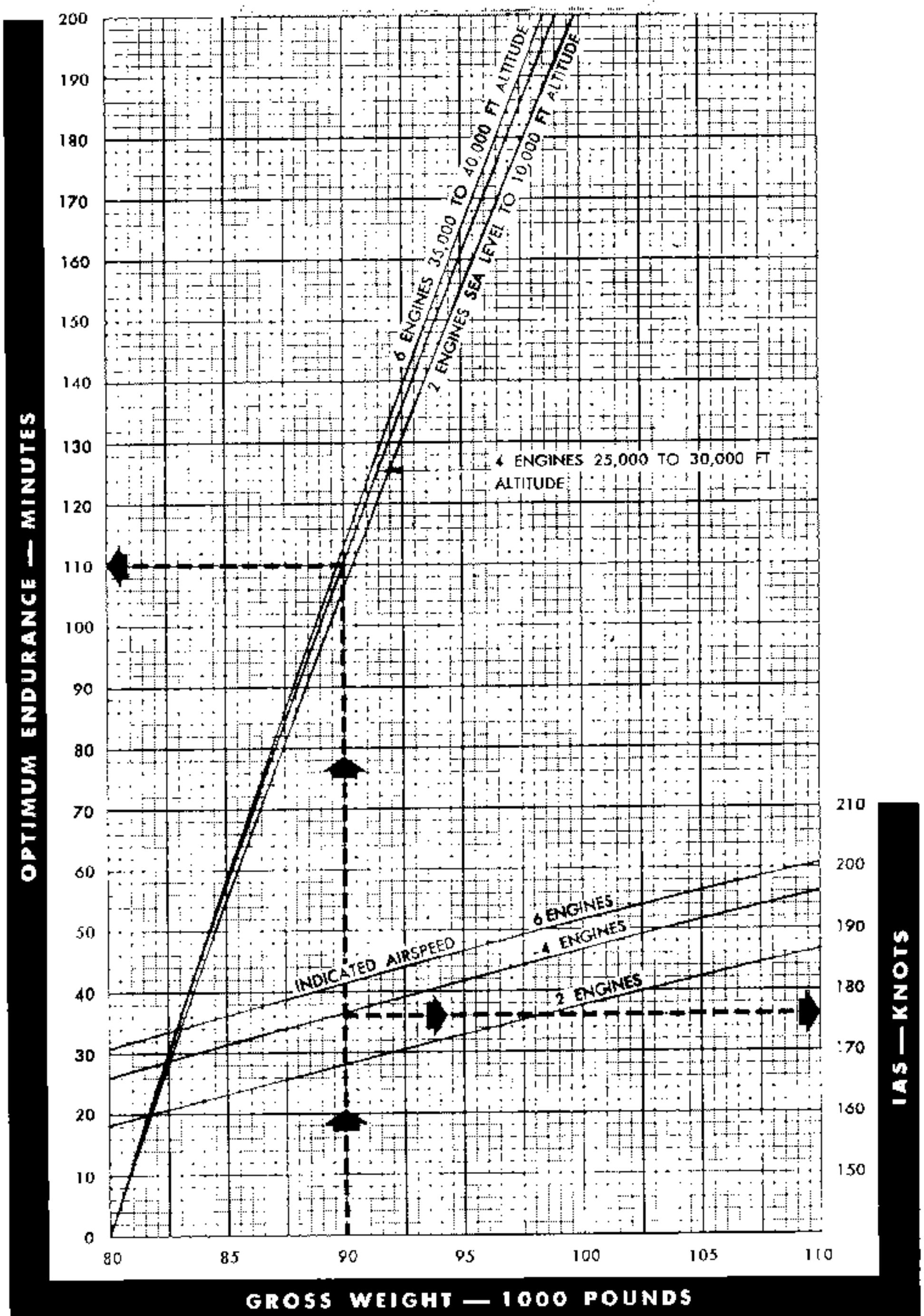
701C-1

Figure A7-1.

OPTIMUM ENDURANCE AT LIGHT WEIGHT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

702C-1

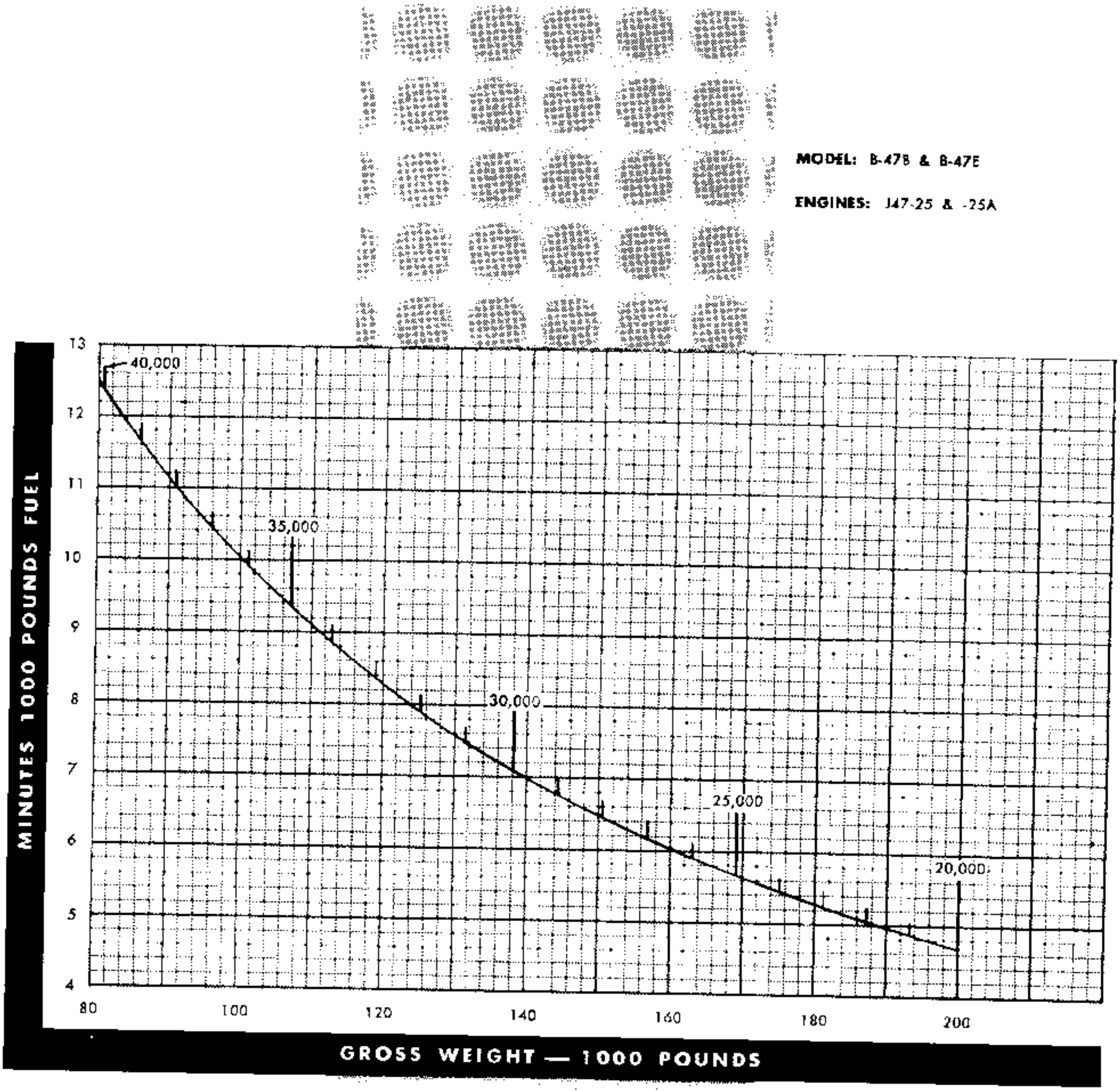
Figure A7-2.

OPTIMUM ENDURANCE

6 ENGINES OPERATING

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

Figure A7-3.

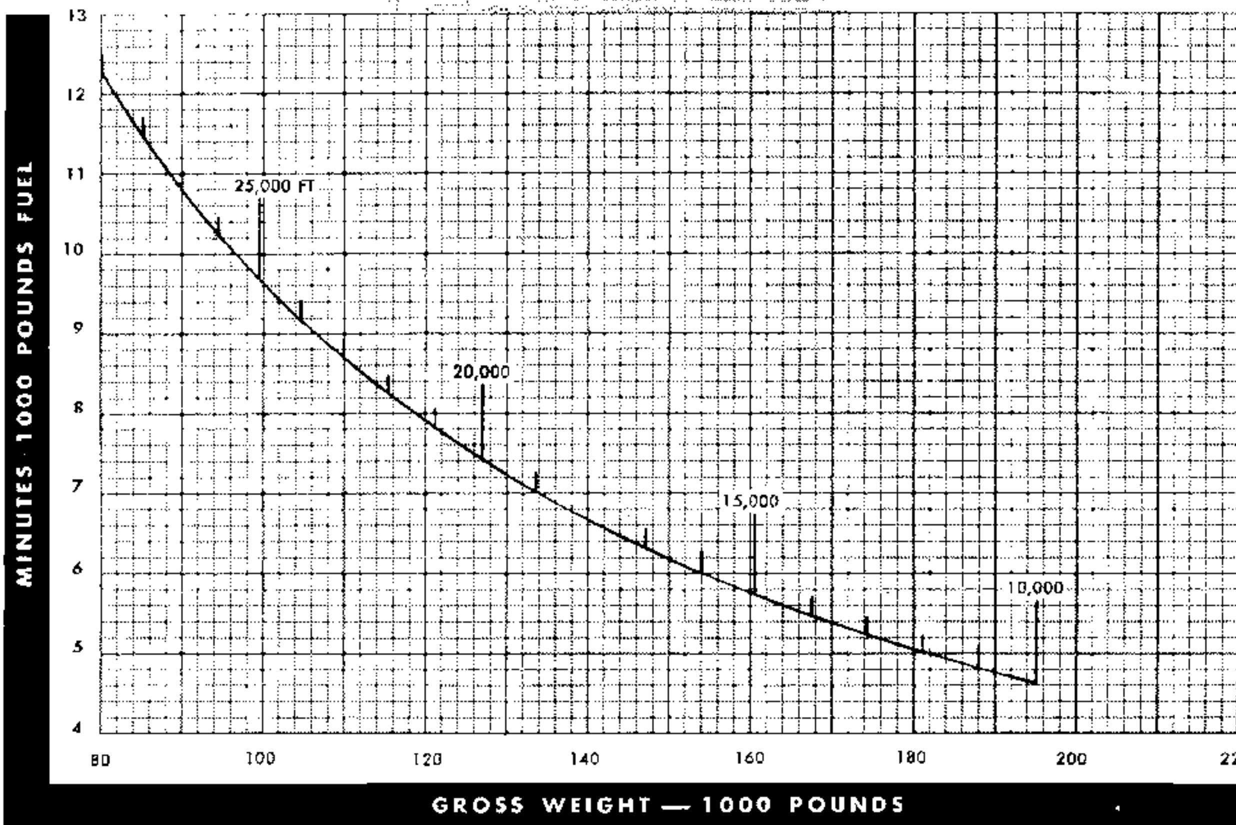
703C-1

OPTIMUM ENDURANCE

4 ENGINES OPERATING

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

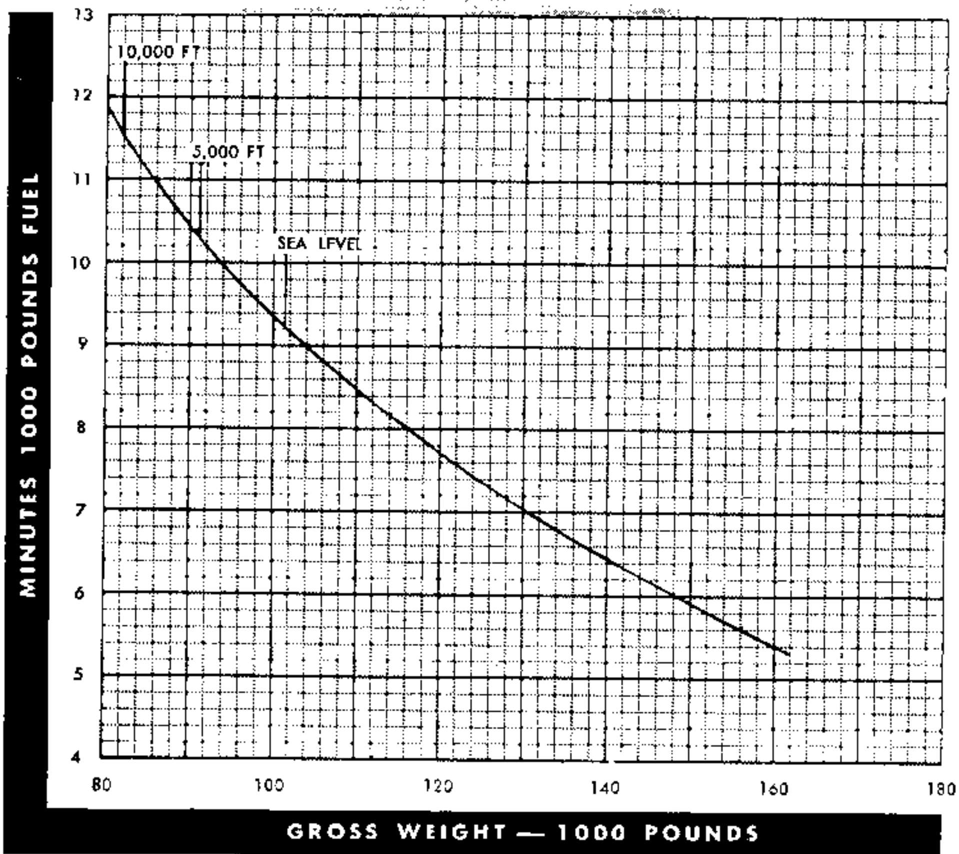
Figure A7-4.

OPTIMUM ENDURANCE

2 ENGINES OPERATING

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

705C-1

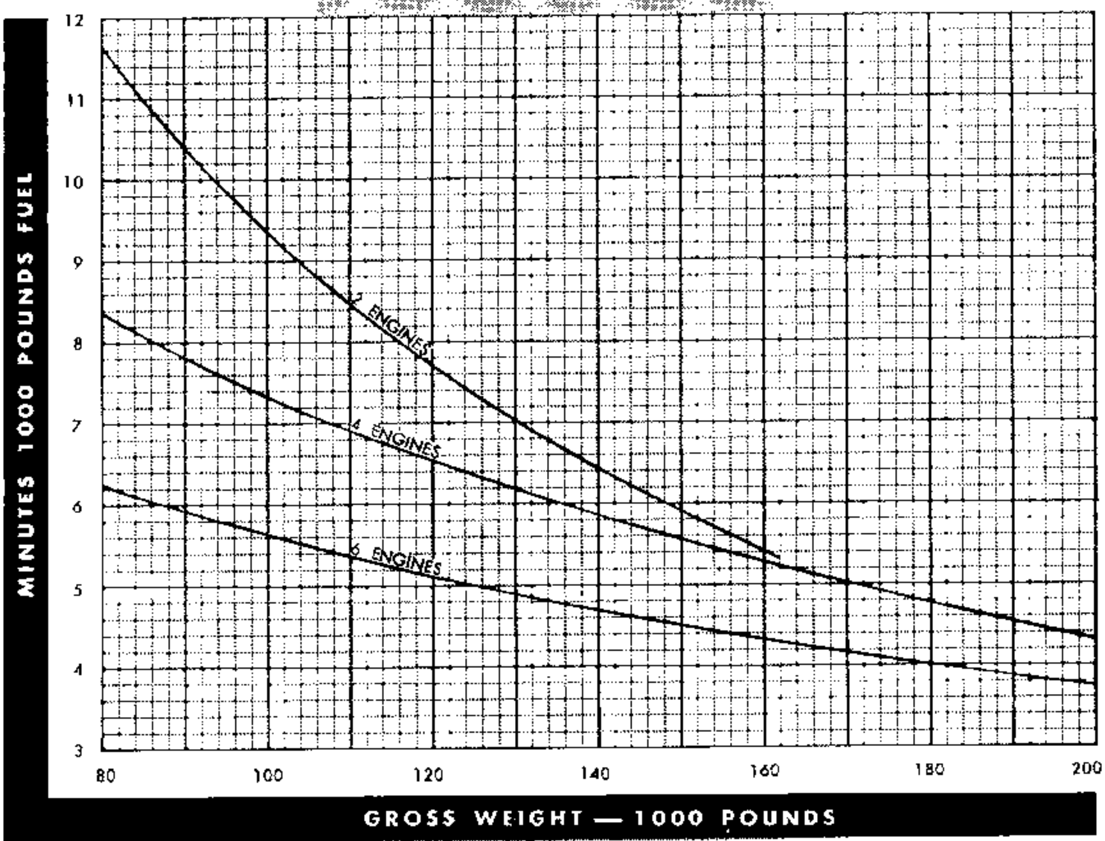
Figure A7-5.

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

SEA LEVEL

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

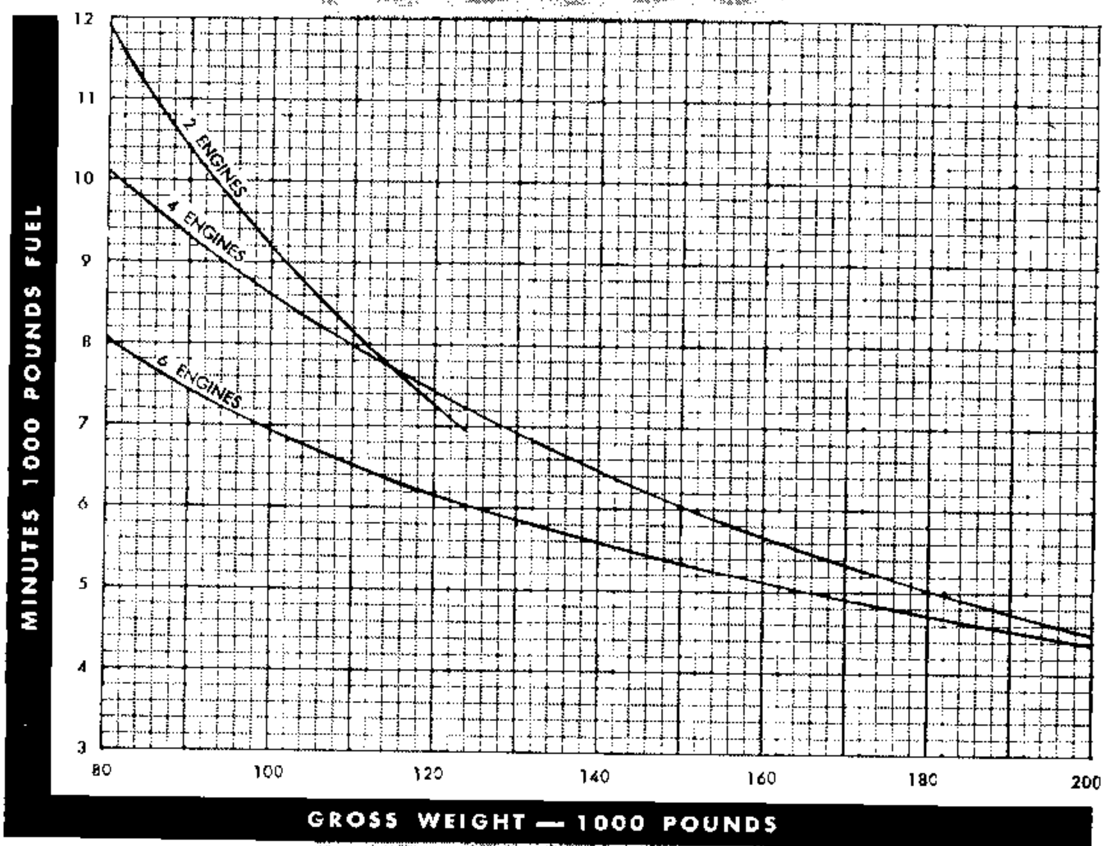
Figure A7-6.

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

10,000 FT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952
DATA BASIS: FLIGHT TEST

Figure A7-7.

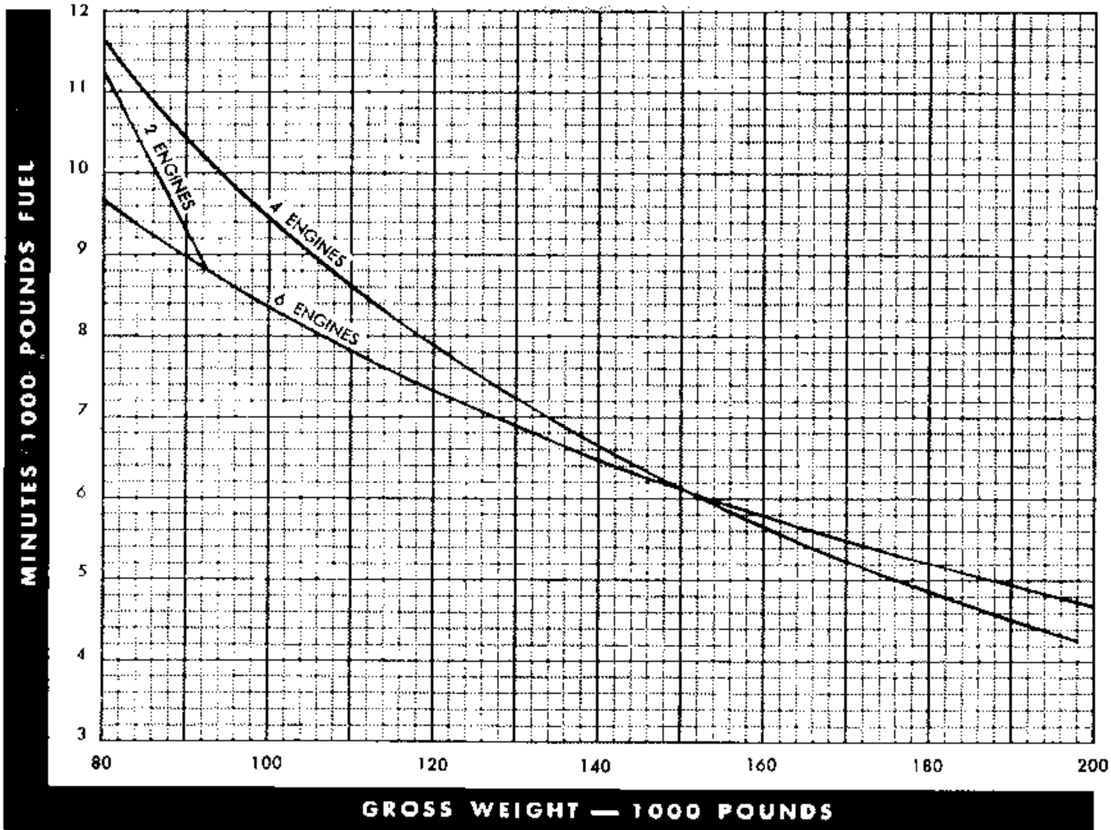
707C-1

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

20,000 FT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

708C-1

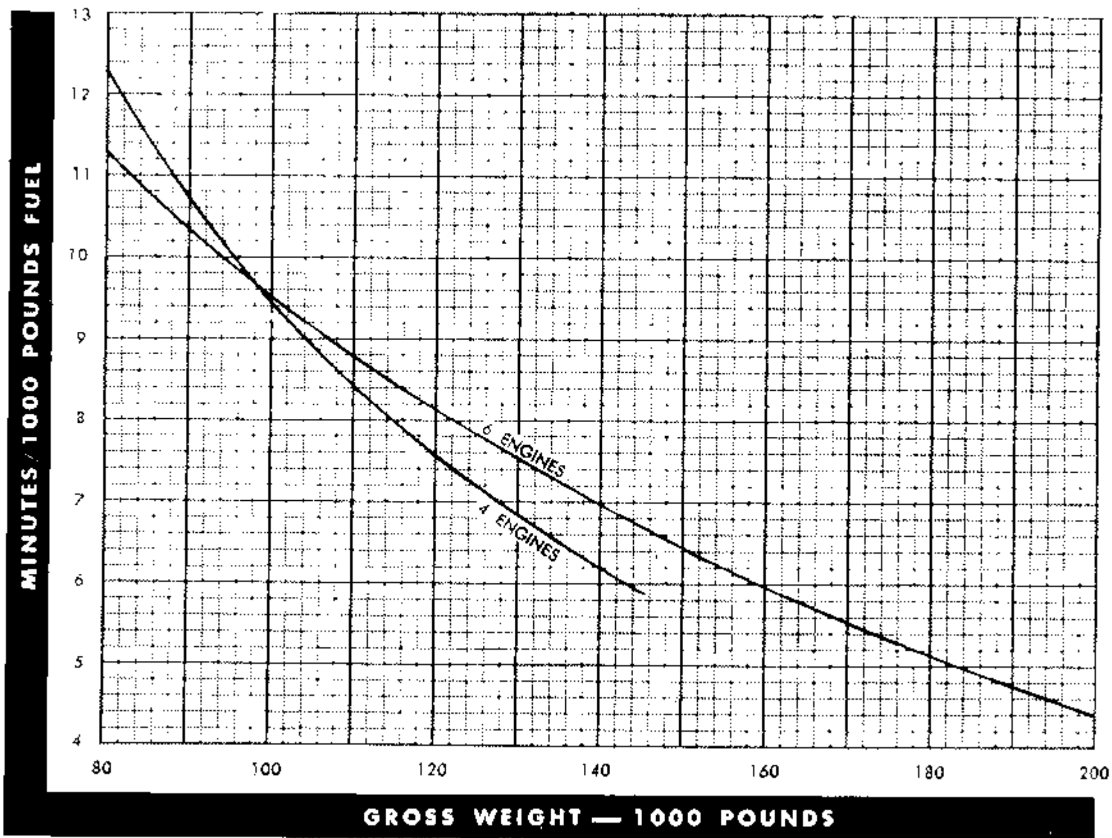
Figure A7-8.

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

30,000 FT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

709C-1

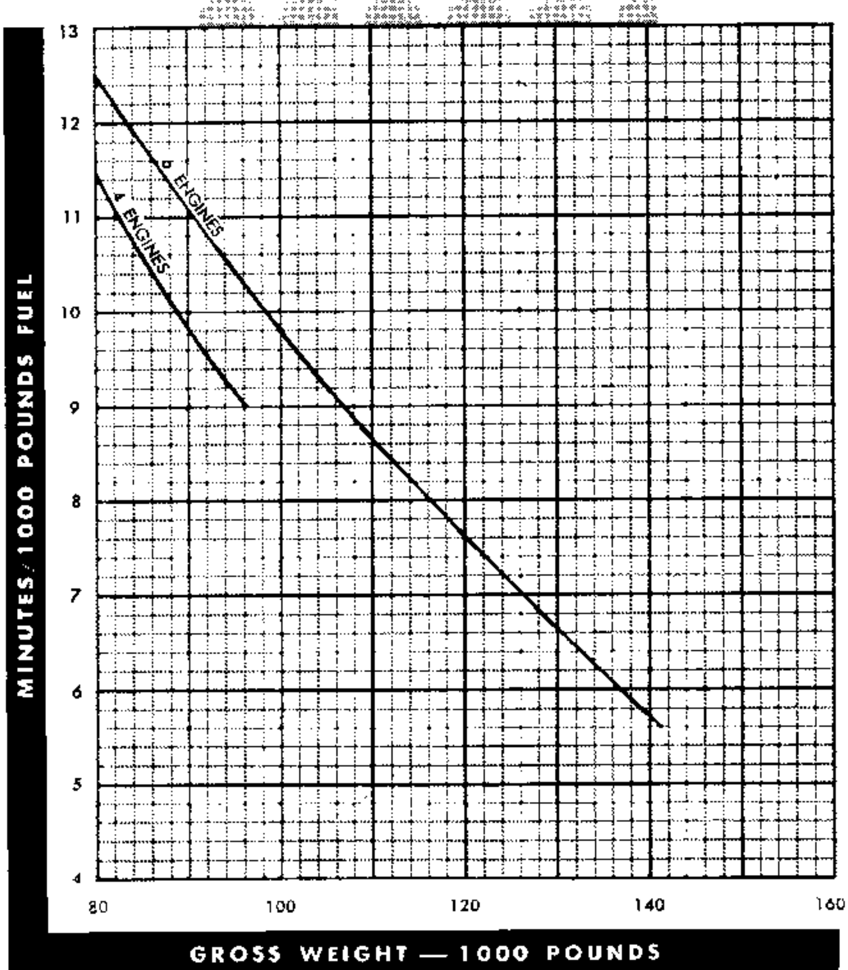
Figure A7-9.

MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

40,000 FT ALTITUDE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

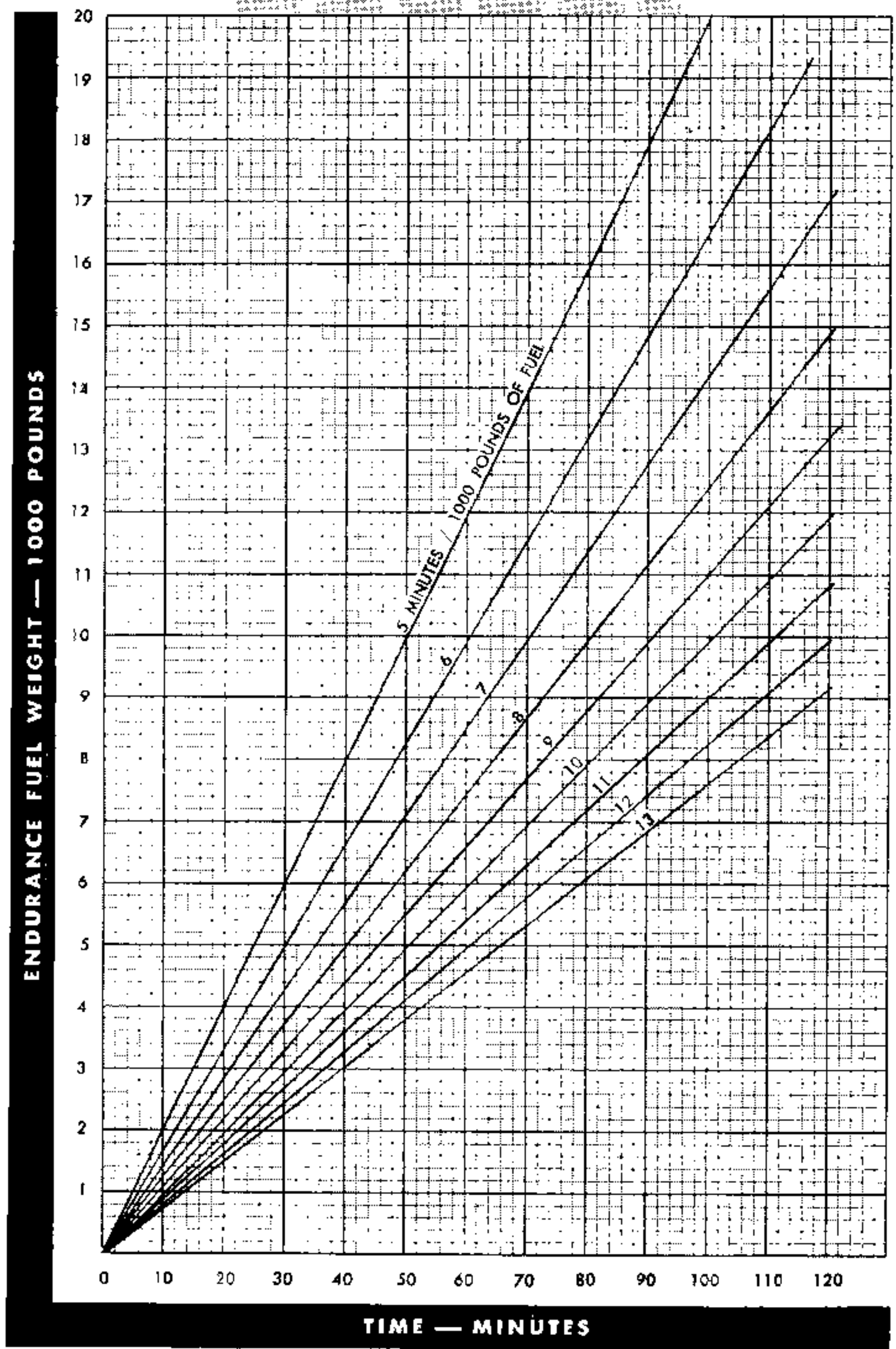
710C-1

Figure A7-10.

ENDURANCE FUEL VS TIME

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: CALCULATED

711C-1

Figure A7-11.

Part 8 descent

DESCENT

The high cruising altitude near the end of the mission can be converted into a small range extension by correct descent procedure. The general rule to follow is to avoid early descent. Since jet engine fuel consumption is excessive at low altitude a premature descent will result in a loss in range.

GEAR DOWN DESCENT

1. Maintain cruising altitude until about 50 nautical miles from the landing base.
2. Extend gear.
3. Retard all engines to minimum idle. The fuel regulators will govern the minimum rpm.
4. Descend at the maximum rate but do not exceed Mach .82 above 31,000-foot altitude, or 305 knots IAS below 31,000 feet.

This is the normal descent and is preferred, as a minimum of time is consumed during descent, all engines are operating and sufficient generator output will be available for normal electrical loads, and the base is within UHF range before the descent is started. Such a descent normally gives the most practical gain in range and reduces the possibility of having to climb back to cruising altitude if a change is made in the landing point.

Above 31,000 feet the descent is made at Mach .82, the practical limit to avoid buffeting with the gear down. Below 31,000 feet the descent is at 305 knots IAS which is the gear-down structural limit.

This normal descent results in the following:

1. Maximum rate of descent
2. Shortest distance during descent
3. Minimum fuel consumption during descent.

This is the recommended procedure for all let-downs where there is no range emergency. Figures A8-5, A8-6, and A8-7 show normal descent performance.

GEAR UP DESCENT

1. Maintain cruising altitude until about 150 nautical miles from the landing base.
2. Cut engines No. 2 and 5 and retard the other throttles to the idle stop.
3. Descent at 185 knots IAS to about 10,000-foot altitude.
4. Restart the two engines at about 10,000 feet, lower the gear, and continue the descent at 305 knots IAS with all six engines idling.

This is the alternate descent (gear up). Because of the low drag, engines must be cut to obtain a practical rate of descent at the best glide angle. All operating engines are at the idle stop. Usually only engines No. 2 and 5 will be cut.

The speed is held at 185 knots IAS; the speed for the best glide angle.

This alternate descent results in the following:

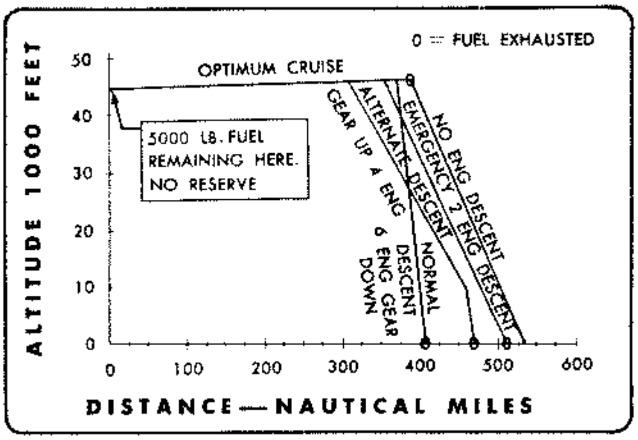
1. Minimum rate of descent
2. Maximum time of descent
3. High fuel consumption and descent distance because of the long time involved
4. Approximately the same fuel reserve, if two engines are cut, as the normal descent.

Figures A8-8, A8-9, and A8-10 show the alternate descent performance.

EMERGENCY MAXIMUM RANGE DESCENT—GEAR UP

1. Maintain cruising altitude until about 160 nautical miles from the landing base.
2. Turn off all possible electrical equipment.
3. Cut engines No. 1, 2, 5, and 6 and retard engines No. 3 and 4 to the idle stop.
4. Descend at 185 knots IAS.

The emergency descent gives maximum all-out range for cases of an extremely low fuel supply. The same gear-up procedure is followed except that engines No. 1, 2, 5, and 6 are cut, with engines No. 3 and 4 retarded to the idle stop. This type of descent is to be avoided except under critical conditions. The reduced generator output is sufficient to operate only a bare minimum of essential equipment. All unnecessary electrical loads must be turned off. This descent will not be feasible under conditions requiring equipment run by the alternators on engines No. 1 and 6. Maintaining hydraulic pressure, fuel boost, and electrical requirements makes cutting four engines during descent undesirable except in a range emergency.



50925WA

From the preceding sketch it is seen that the normal descent is usually the most desirable. For a given range, less fuel will be used by cruising as far as possible at high altitude (where maximum miles per pound of fuel are obtainable) and then making a steep rapid descent with the gear down. Unnecessary time spent in descending means extra fuel consumed.

DESCENT PERFORMANCE

Descent performance is presented similarly to the climb performance in part 5, and is used in the same manner. For descent with the landing gear extended the fuel consumed, distance, and time are given by the charts on figures A8-5 through A8-7. Descent performance with the landing gear retracted is presented on figures A8-8 through A8-10.

The comparison between gear down, gear up, and emergency descent procedures is shown by figures A8-1, A8-2, and A8-3 for a typical descent weight of 90,000 pounds. Maximum rates of descent for these conditions are shown in figure A8-4.

MINIMUM RPM

The fuel regulators govern the minimum rpm at altitude even though the throttles are at the idle stop. The chart on figure A8-11 gives the minimum rpm schedule for descent with the throttles at the idle stop.

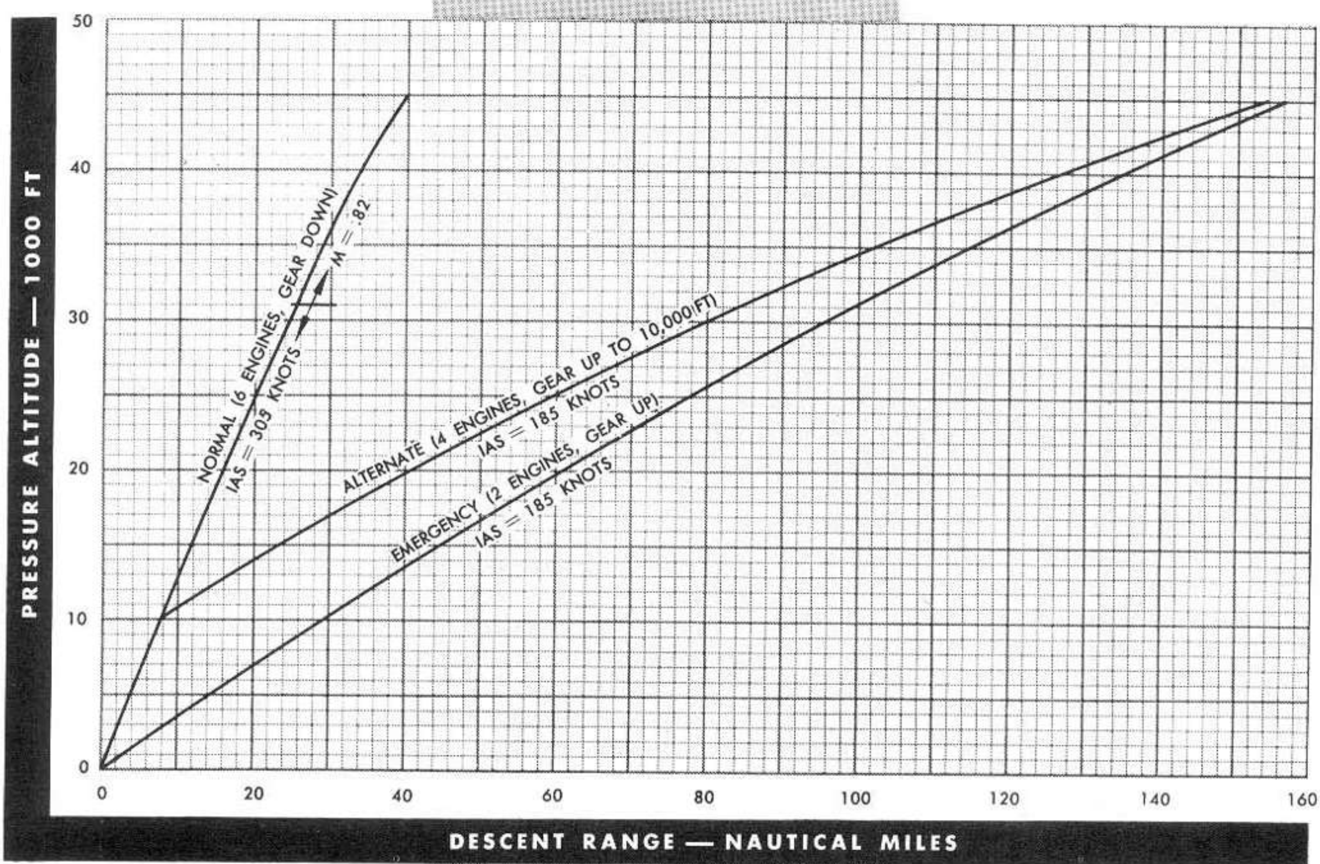
DESCENT RANGE

GROSS WEIGHT 90,000 POUNDS

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: FLIGHT TEST

NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT RANGE BY 10% AT 185 KNOTS WITH GEAR UP, 5% AT 305 KNOTS WITH GEAR DOWN.

Figure A8-1.

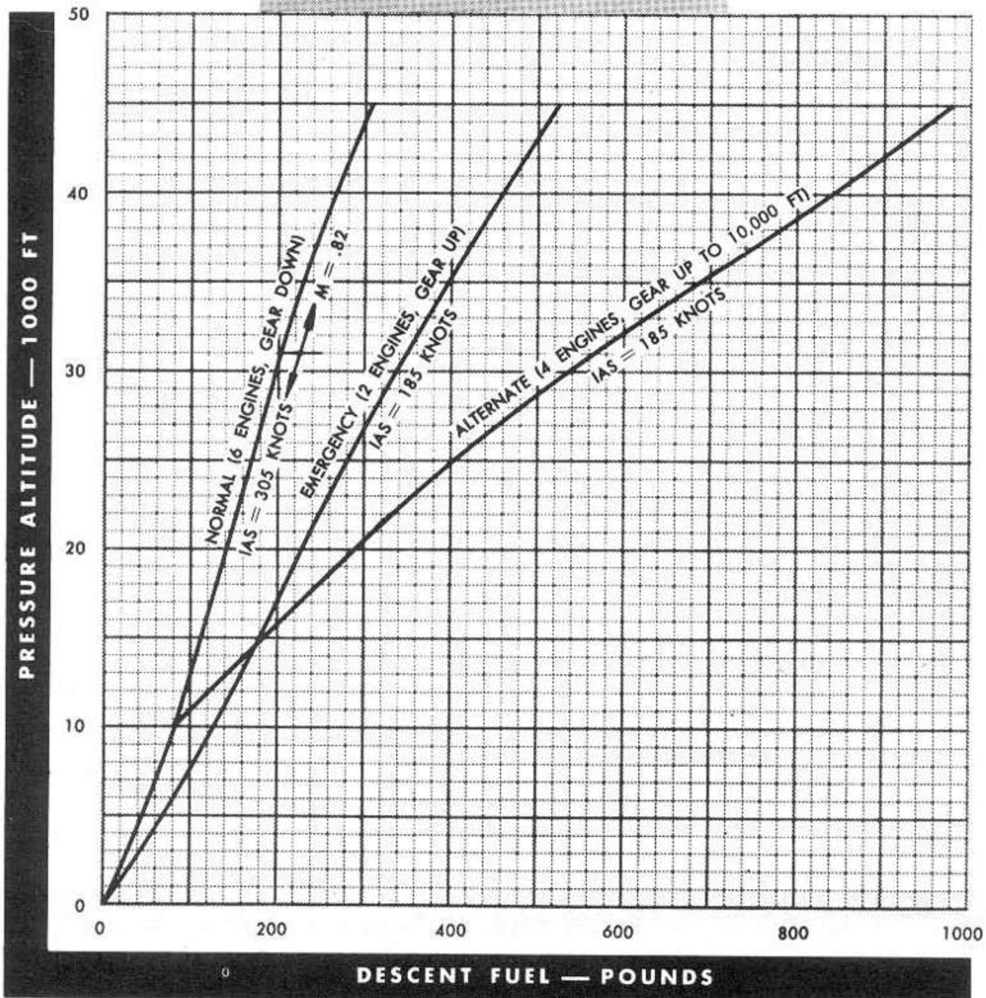
DESCENT FUEL

GROSS WEIGHT 90,000 POUNDS

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: FLIGHT TEST

NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT FUEL BY 10% AT 185 KNOTS WITH GEAR UP, 5% AT 305 KNOTS WITH GEAR DOWN.

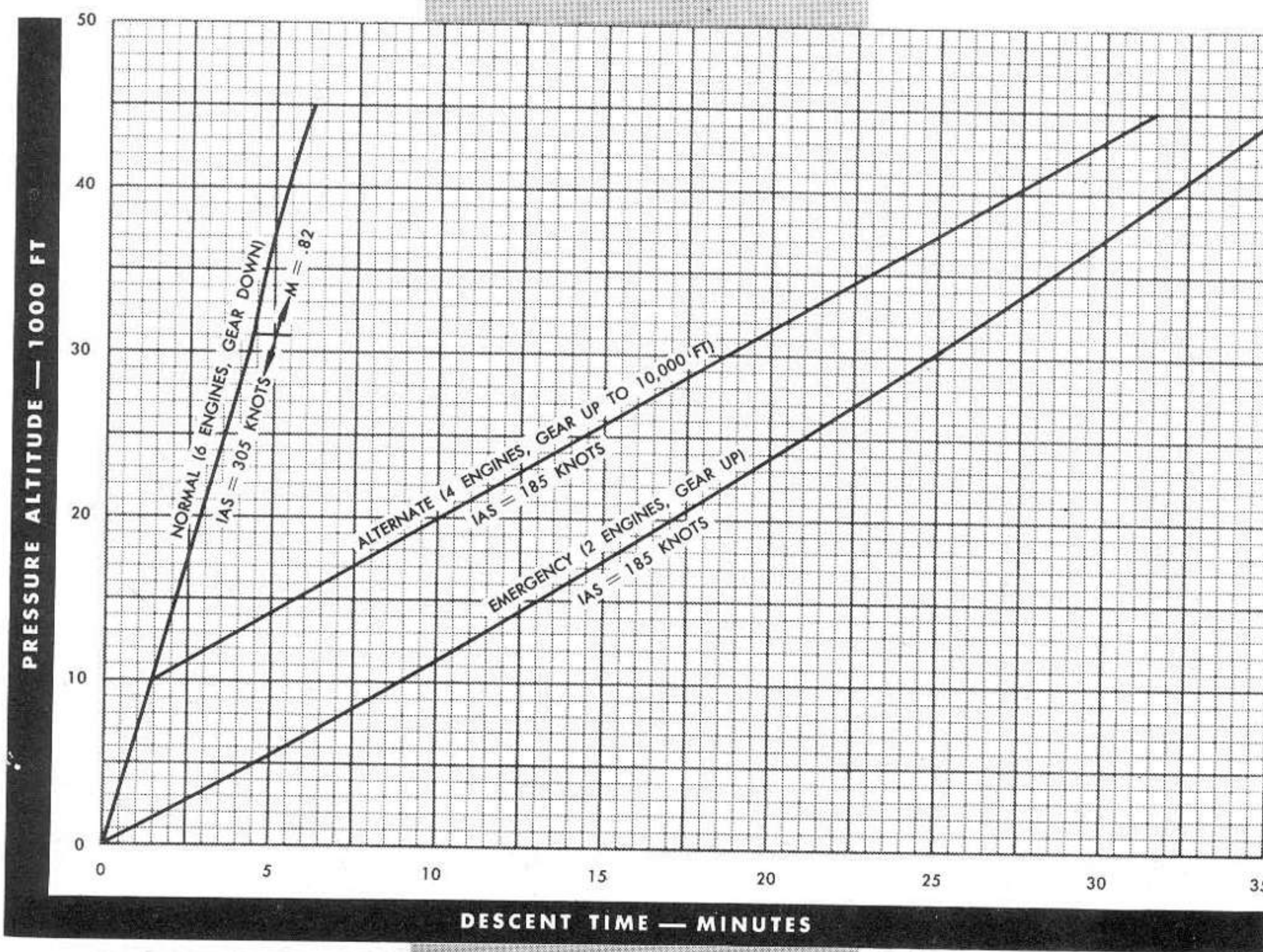
Figure A8-2.

DESCENT TIME

GROSS WEIGHT 90,000 POUNDS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: FLIGHT TEST

NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT TIME BY 10% AT 185 KNOTS WITH GEAR UP, 5% AT 305 KNOTS WITH GEAR DOWN.

Figure A8-3.

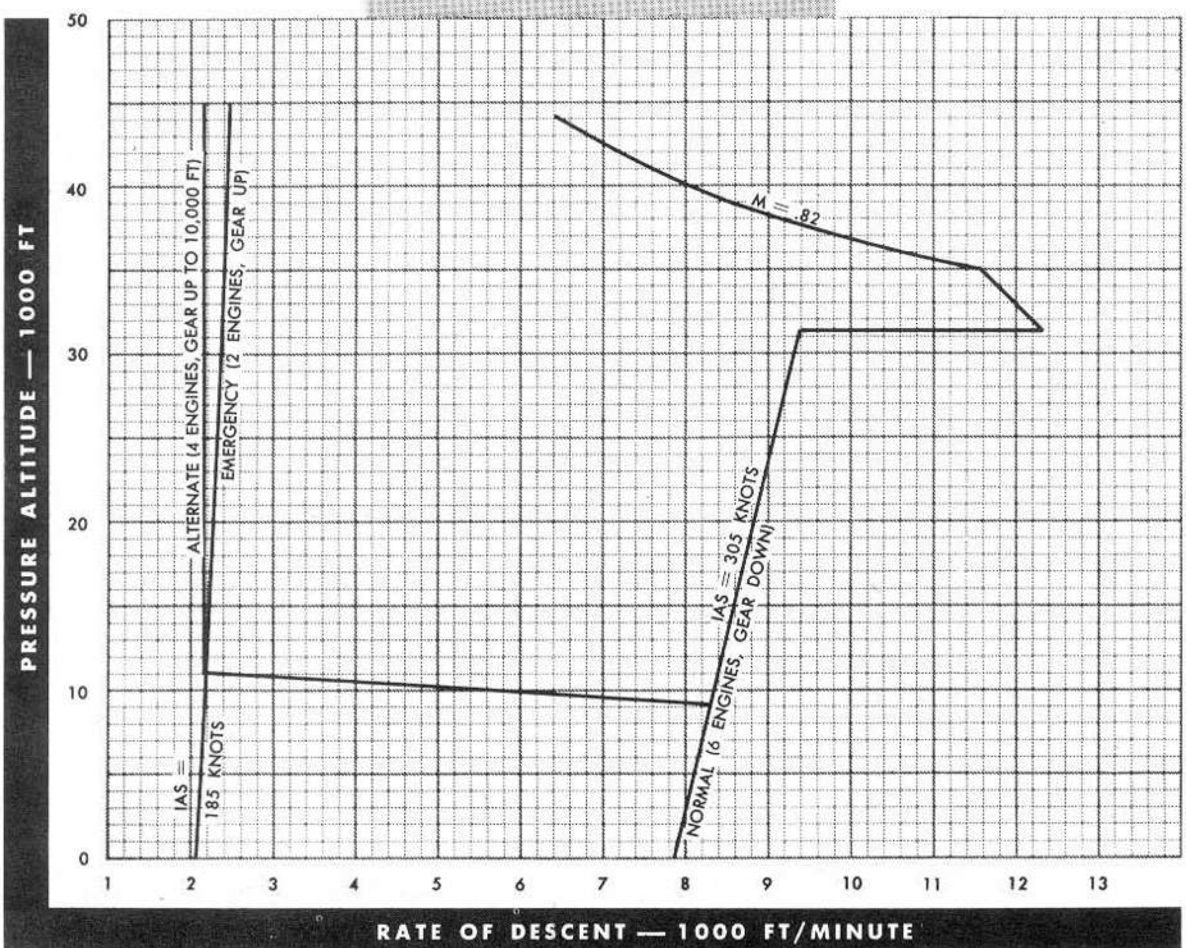
RATE OF DESCENT

GROSS WEIGHT 90,000 POUNDS

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1951

DATA BASIS: FLIGHT TEST

NOTE:

WITH EXTERNAL WING TANKS INSTALLED INCREASE RATE OF DESCENT BY 10% AT 185 KNOTS WITH GEAR UP, 5% AT 305 KNOTS WITH GEAR DOWN.

Figure A8-4.

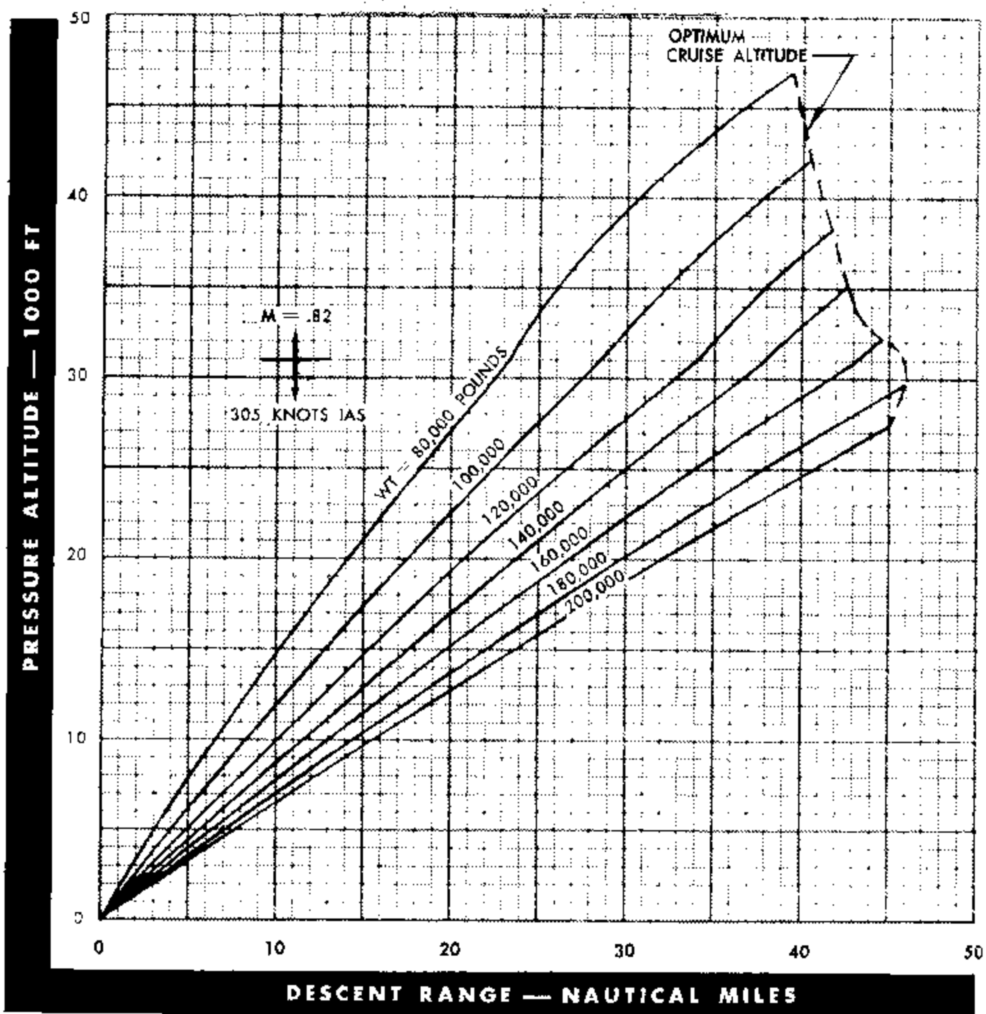
DESCENT RANGE

GEAR DOWN

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT RANGE BY 5%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:

GEAR DOWN

6 ENGINES AT MINIMUM IDLE

REMARKS:

M — .82 ABOVE 31,000 FT

305 KNOTS IAS BELOW 31,000 FT

Figure A8-5

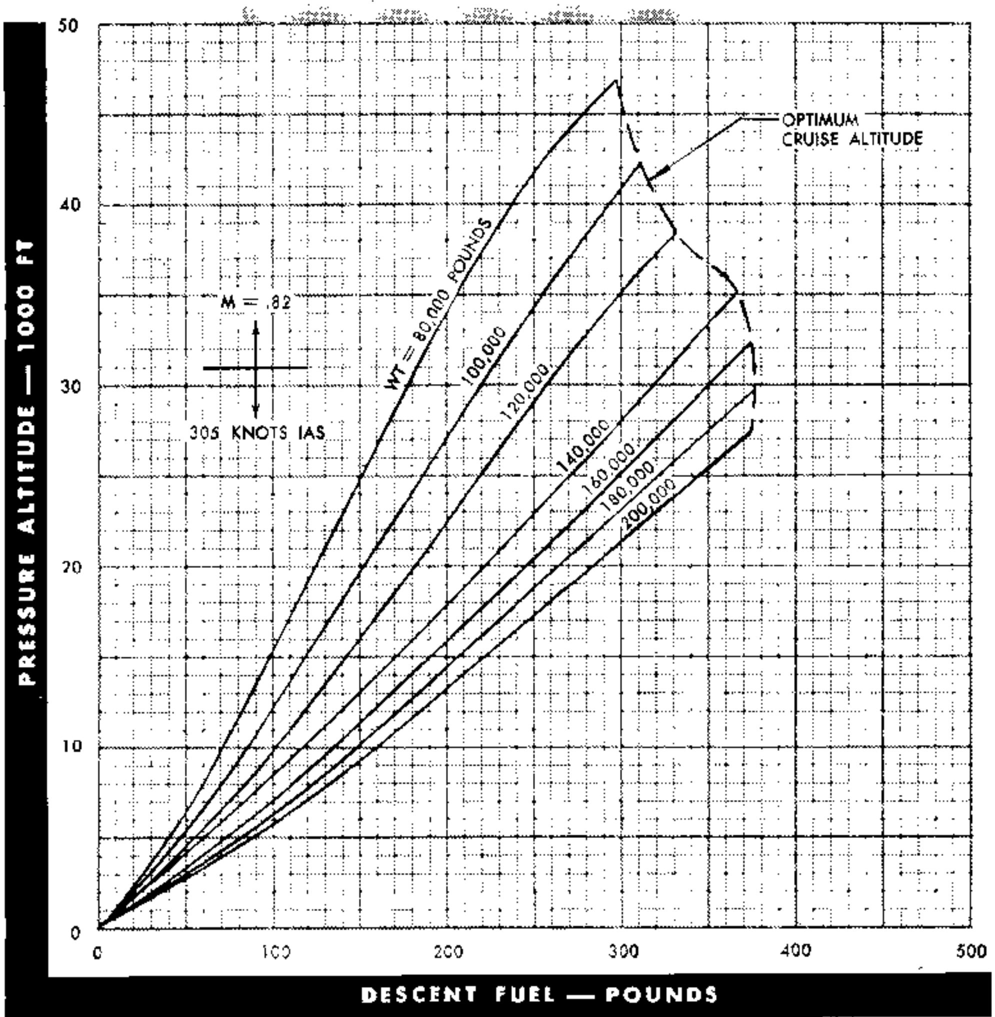
DESCENT FUEL

GEAR DOWN

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:
WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT FUEL BY 5%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:
GEAR DOWN

6 ENGINES AT MINIMUM IDLE

REMARKS:
M — .82 ABOVE 31,000 FT

305 KNOTS IAS BELOW 31,000 FT

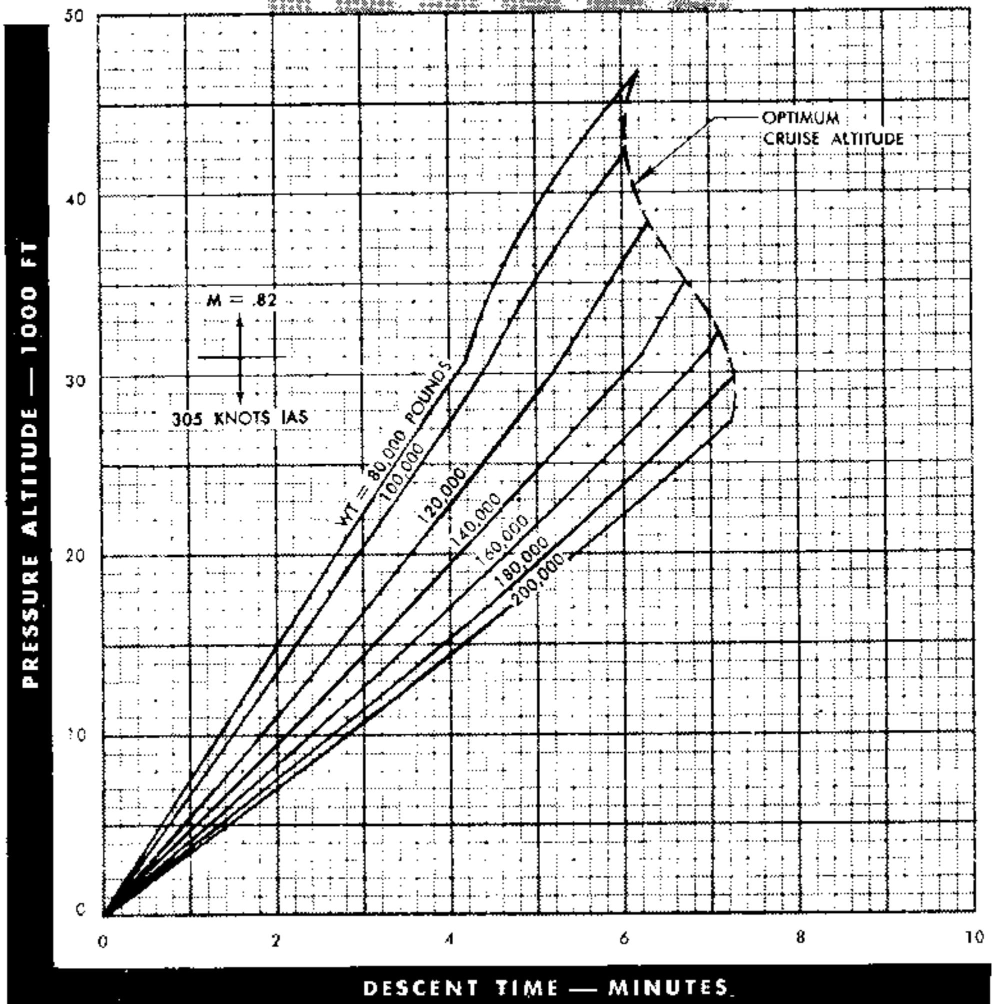
Figure A8-6.

DESCENT TIME
GEAR DOWN

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:
WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT TIME BY 5%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:
GEAR DOWN
6 ENGINES AT MINIMUM IDLE

REMARKS:
M — .82 ABOVE 31,000 FT
305 KNOTS IAS BELOW 31,000 FT

Figure A8-7.

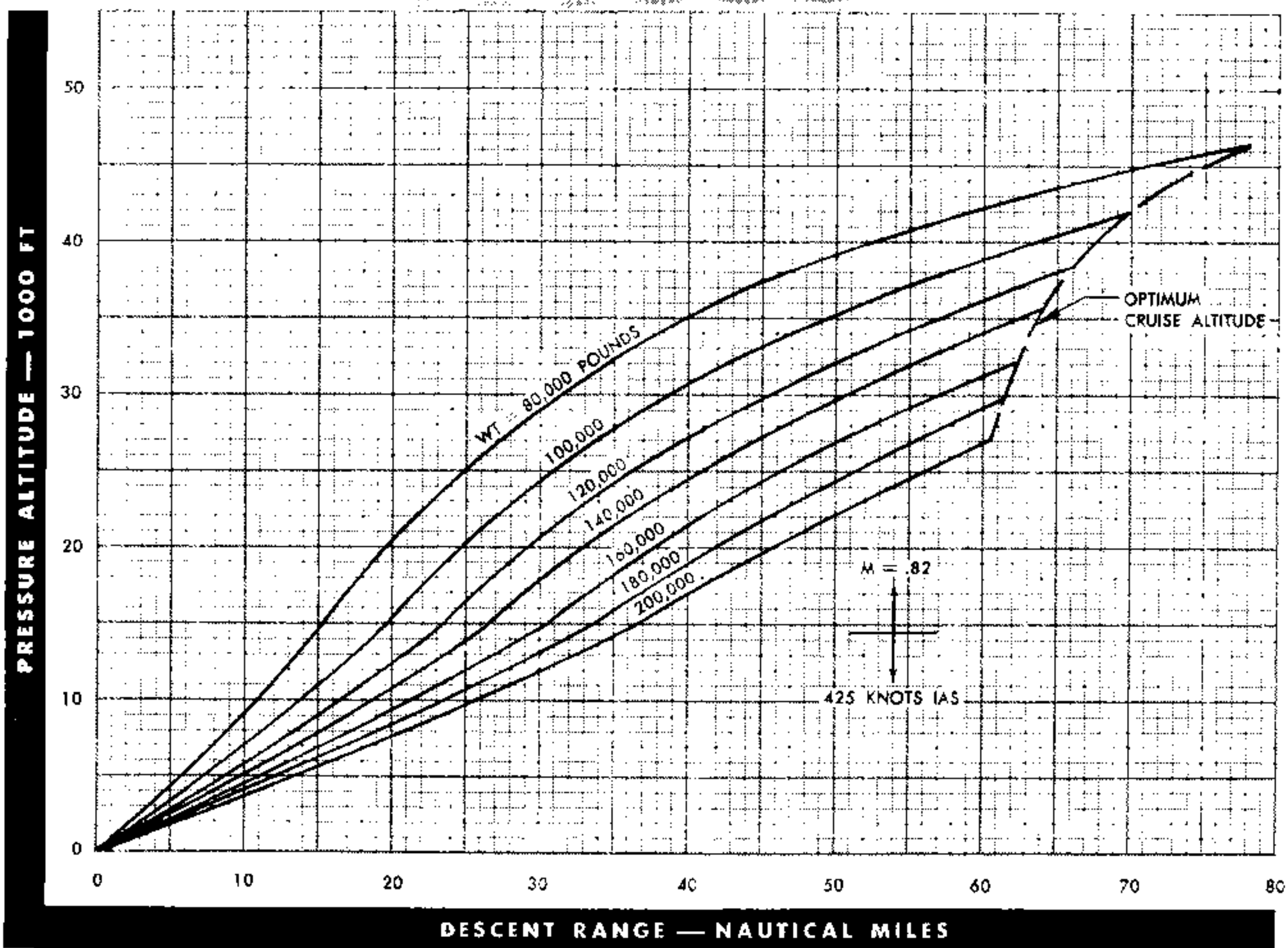
DESCENT RANGE

GEAR UP

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT RANGE BY 15%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:

GEAR UP

6 ENGINES AT MINIMUM IDLE

REMARKS:

M = .82 ABOVE 14,600 FT

425 KNOTS IAS BELOW 14,600 FT

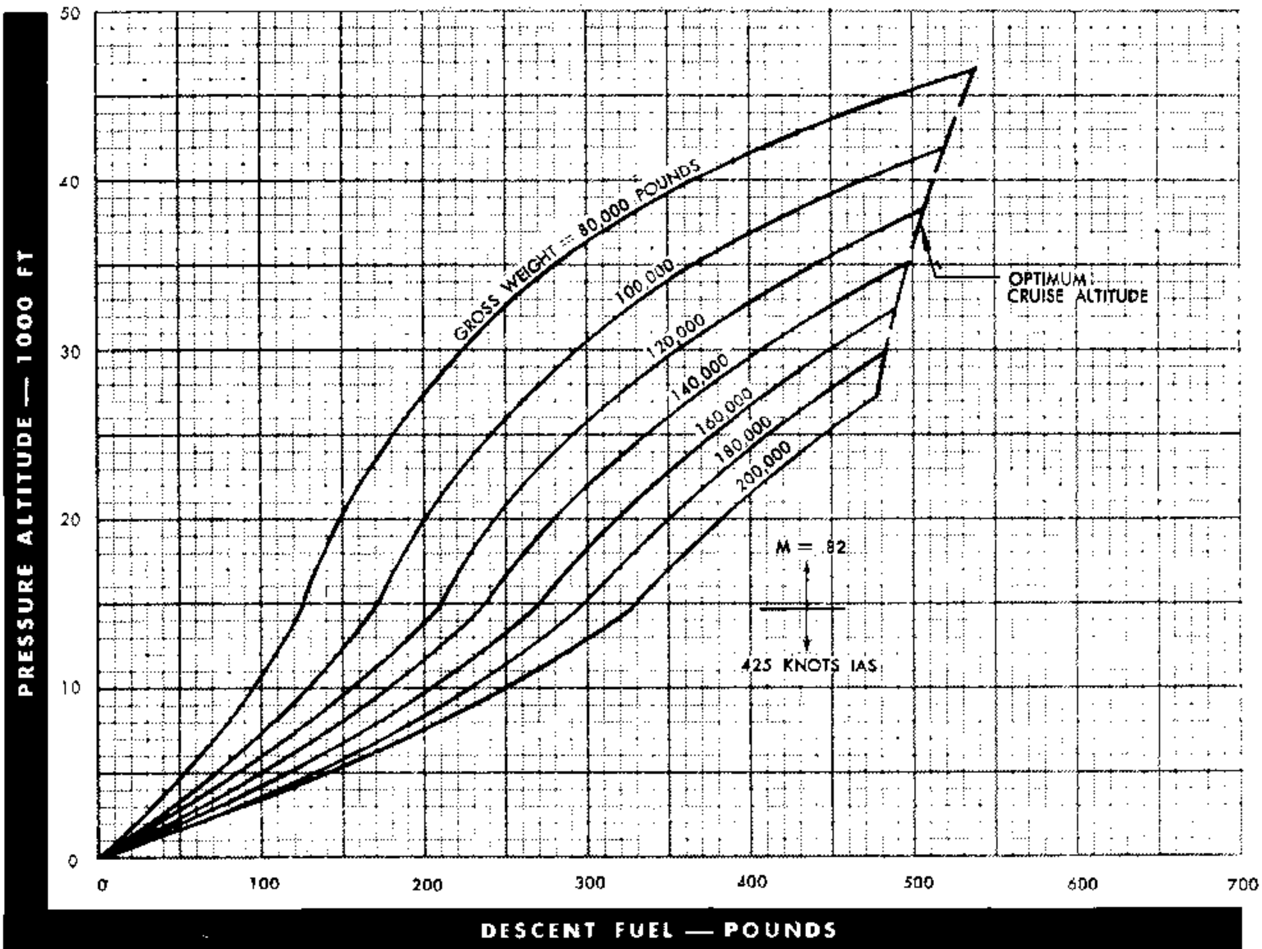
Figure A8-8.

DESCENT FUEL
GEAR UP

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT FUEL BY 15%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:

GEAR UP

6 ENGINES AT MINIMUM IDLE

REMARKS:

M — .82 ABOVE 14,600 FT

425 KNOTS IAS BELOW 14,600 FT

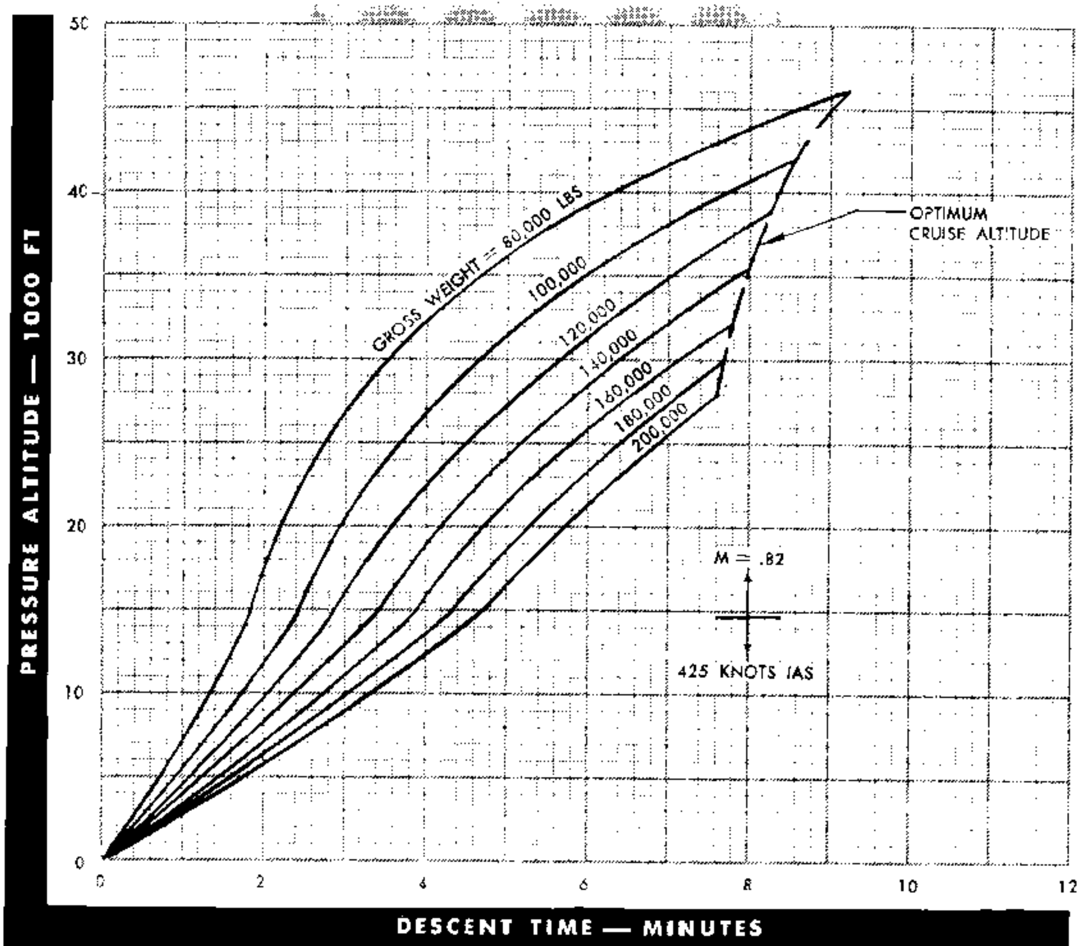
Figure A8-9.

DESCENT TIME

GEAR UP

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



NOTE:

WITH EXTERNAL WING TANKS INSTALLED DECREASE DESCENT TIME BY 15%.

DATE: JULY 1951

DATA BASIS: FLIGHT TEST

CONDITIONS:

GEAR UP

6 ENGINES AT MINIMUM IDLE

REMARKS:

M .82 ABOVE 14,600 FT

425 KNOTS IAS BELOW 14,600 FT

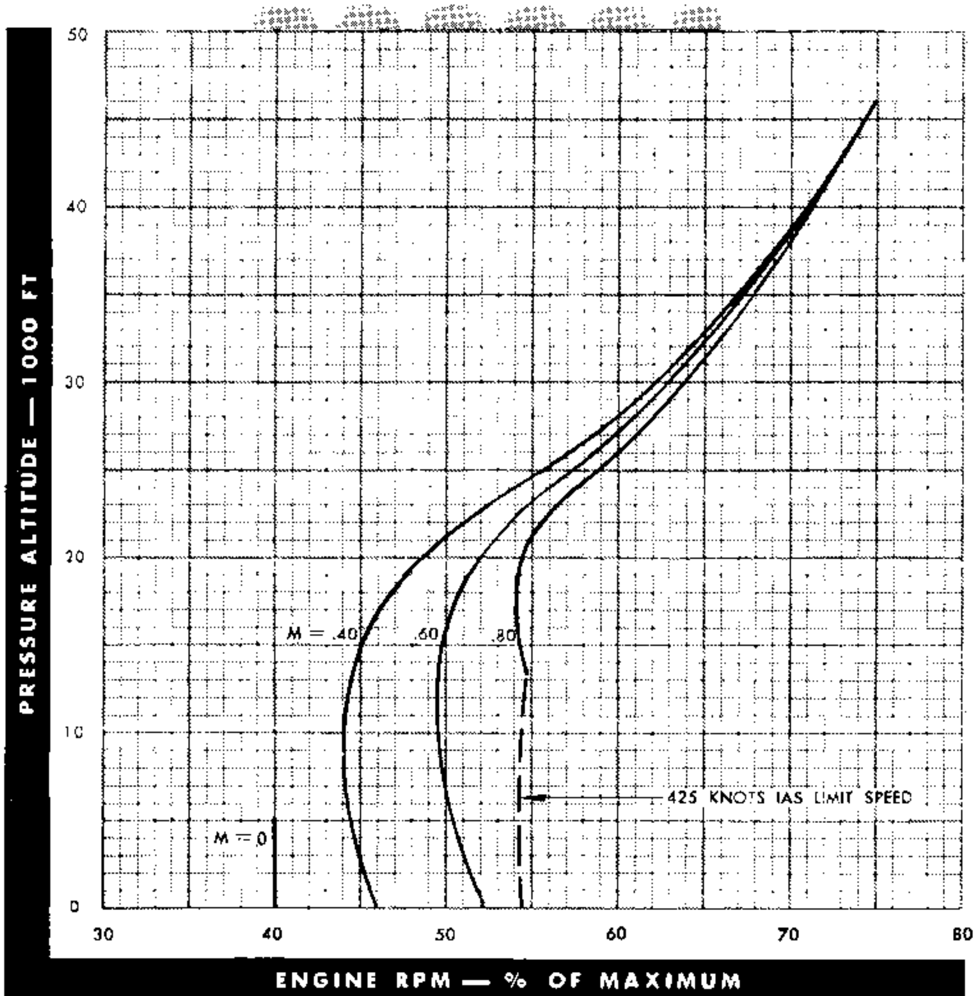
Figure A8-10.

FUEL REGULATOR MINIMUM RPM

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47 25 & 25A



DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

B11C-7

Figure A8-11.

Part 9 air refueling

AIR REFUELING

The data in this section provides information for planning refueling operations with the KC-97G tanker. If KC-97E or -97F tankers are to be used the tanker maximum speeds will be 5 knots faster than for the KC-97G. Performance characteristics of both tanker and receiver limit the altitudes and speeds for refueling. Techniques are different from those in normal cruise operations as tanker speed limitations require refuel operations on the "backside" of the B-47 power curve. Refueling speeds are dependent upon a margin above stall warning in order to have sufficient speed for good control and for corrections necessary in the refuel envelope. The data presented for the B-47 minimum speeds is based on a lift coefficient which is two-thirds of the stall warning lift coefficient. If the recommended speed schedule is followed (that is, maintaining a constant margin above stall) the receiver pilot should experience the same control "feel" or techniques at the various refueling altitudes. Success of refuel operations is dependent upon observing speed schedules and early position corrections when necessary. Techniques and procedures are contained in section VII. High refuel altitudes are desired for minimum deviation from cruise altitudes and to avoid the higher fuel consumption rates at lower altitudes. At times it may be necessary to conduct air refueling at altitudes other than initially planned, due to rough air conditions or cloud layers. Figure A9-12 presents optimum altitudes and airspeeds for rendezvous endurance with five or six engines operating. The chart should be consulted whenever changes in the rendezvous schedule require the receiver to hold under given conditions.

FLAPS

Receiver flaps are lowered 20% (10° deflection) for all air refueling operations with KC-97 tankers. This is done in order to have lower formating speeds which result in higher refueling altitudes. The low drag flaps on the B-47 do not appreciably affect the rpm required at 20% flaps extended, but the reduction in minimum formating speeds is significant. Flaps up refuel may be accomplished; however, the minimum speeds are approximately 10 knots higher than for 20% flaps. Figure A9-13 shows initial stall speeds with 20% flaps at altitudes from sea level to 35,000 feet.

LEVEL FLIGHT FORMATING

Experience to date has indicated the following techniques to be desirable. After visual rendezvous has been accomplished, the tanker establishes the contact speed with the receiver closing to a position of flying formation on the tanker. When the speeds are stabilized the receiver moves slowly into the nominal contact position (figure A9-1). Contact is made by the boom operator and fuel transfer is initiated.

FORMATING IN A DESCENT

To formate for refueling in a descent, the tanker maximum speed in level flight may be less than the B-47 minimum formating speed at the desired altitude as indicated on the charts on figure A9-3, A9-5, A9-7, and A9-9. The tanker initiates a descent on a predetermined heading and accelerates to the desired speed schedule. The receiver follows and slowly moves into the contact position, with the rate of closure kept low in order to prevent overrunning the tanker. Deceleration characteristics of the B-47 are such that rapid deceleration is impossible by throttle changes, therefore rates of closure must be low. In emergency conditions, gear may be lowered to provide rapid deceleration. Contacts have been made at rates of descent as high as 900 feet per minute; however, technique is difficult and the altitude lost in event a contact is not made on first attempt is excessive. The maximum recommended rate of descent is 300 feet per minute.

DURING CONTACT

Pilot technique during transfer is not difficult as long as basic formation rules are observed. Control changes in contact envelope should be made early in order to remain at the desired position and to avoid automatic disconnects. Corrections must be made early and at the proper time to prevent tanker and receiver motions from getting out of phase with each other.

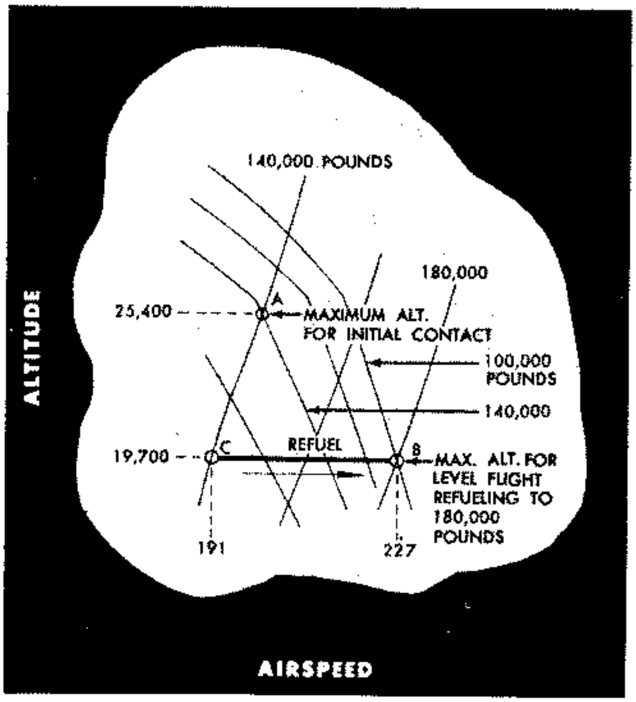
Gentle turns and banks may be made during contact without disconnects, provided no abrupt motions are made by either tanker or receiver if proper speed margin above the stall is maintained. The charts indicate the limitations to refueling altitudes and speeds, not the conditions for starting and ending all refuel operations.

EXAMPLE 1: LEVEL FLIGHT REFUEL

Given:
1. B-47 initial weight = 140,000 pounds
2. KC-97G initial weight = 140,000 pounds
3. B-47 final weight = 180,000 pounds
4. KC-97G final weight = 97,000 pounds

Determine:
1. Maximum level flight altitude
2. Speeds for refuel

Using the chart on figure A9-2, the maximum altitude for contact at initial weights is 25,400 feet, as shown by point A on the example sketch. The maximum altitude and speed for contact at final weights as shown by point B is 19,700 feet and 227 knots IAS. Obviously the maximum altitude for level flight refueling is the lower value (19,700 feet altitude). The initial speed at contact as shown by point C is 191 knots IAS. Point C is the minimum level flight speed for the B-47 at contact weight. Thus the refuel would be conducted at 19,700 feet altitude with an initial speed of 191 knots IAS, increasing during transfer so the ending speed is 227 knots IAS.



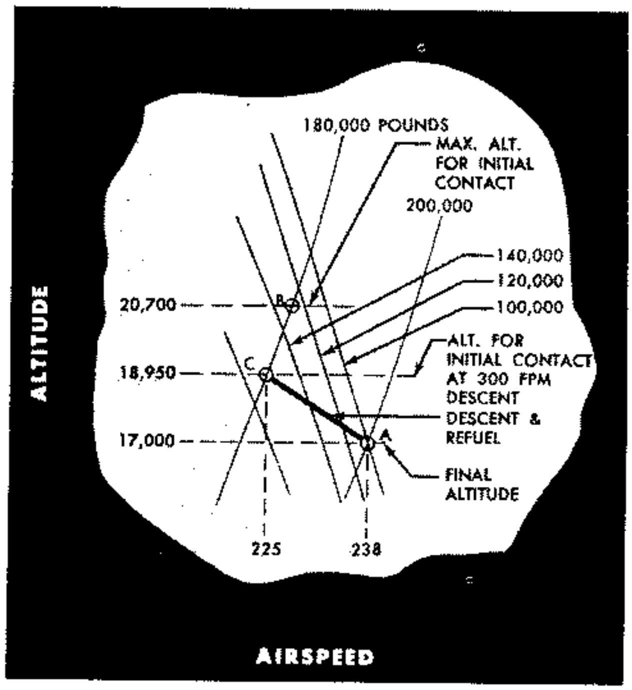
50939WB-1

EXAMPLE 2: DESCENDING REFUEL

Given:
1. B-47 initial weight 180,000 pounds with external tanks on
2. KC-97G initial weight 130,000 pounds
3. Transfer rate of 600 gal/min
4. B-47 final weight 200,000 pounds with external tanks on
5. KC-97G final weight 105,000 pounds

Determine:
1. Maximum refuel altitude
2. Speeds
3. Time
4. Fuel consumed

From the chart on figure A9-5, the maximum altitude for the final weights is 17,000 feet at a speed of 238 knots IAS, as shown by point A of the example sketch. The maximum initial altitude is shown by point B as being 20,700 feet. However, it is necessary to determine the time required to transfer the required fuel, and estimate the altitude for initial contact to allow for descent during transfer. The time to refuel is determined from figure A9-11 as 5 1/2 minutes. Allowing 1 minute to establish contact, the altitude lost during descending refuel at the maximum recommended rate of 300 feet per minute will be 6 1/2 x 300 = 1950 feet. Therefore, the initial altitude will be 17,000 + 1,950 = 18,950 feet. The speed for contact at 18,950 feet is shown by point C on the example sketch as 225 knots IAS. Fuel consumed during transfer is determined from figure A9-10. The average rate of fuel consumption is about 311 pounds per minute. The total fuel used during transfer is then about 2020 pounds.

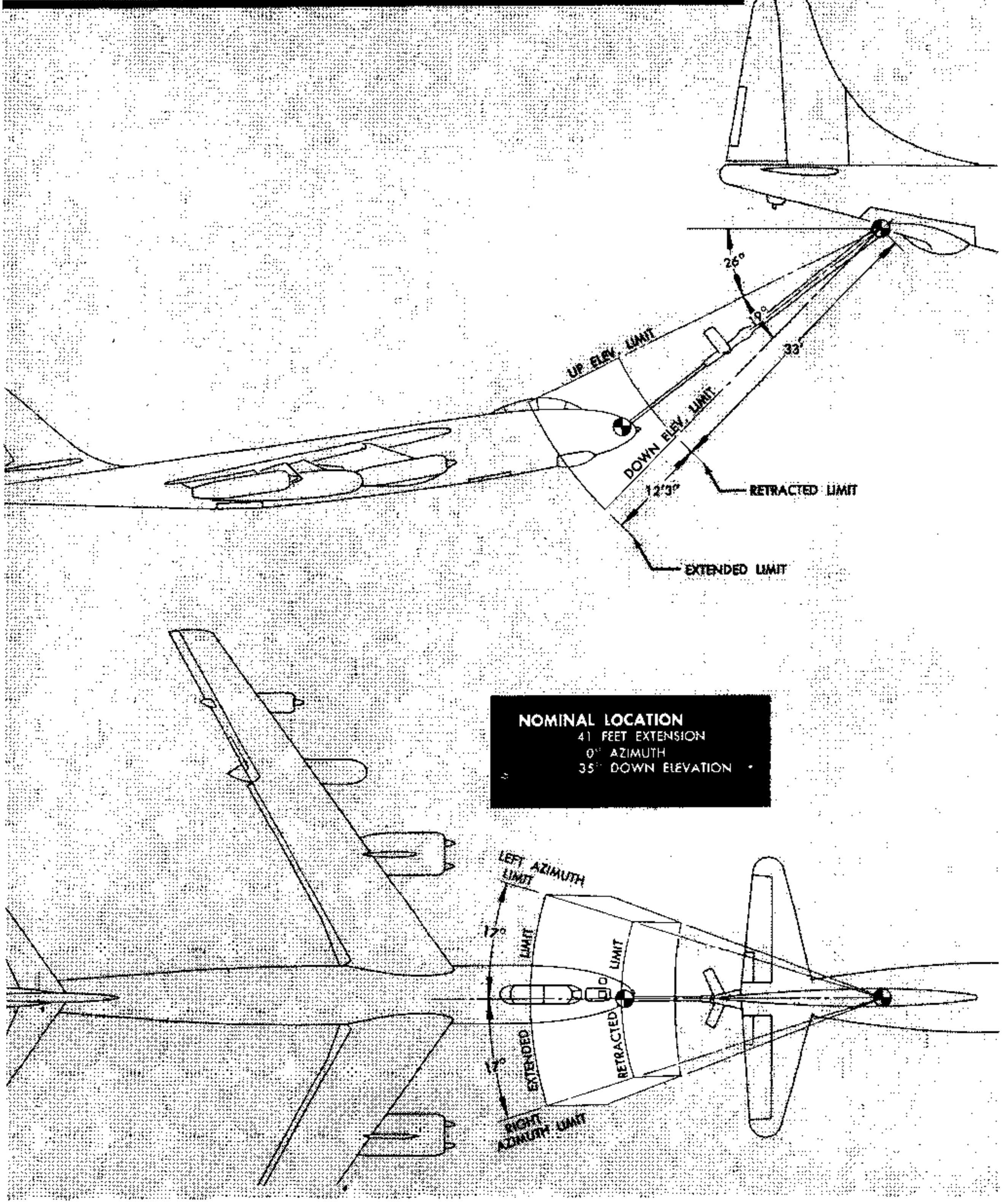


50940WB-1

EFFECT OF OAT ON REFUEL

The variations in OAT encountered will cause a change in the maximum altitudes for refuel when the maximum altitude is performance-limited by the receiver. For performance data with a temperature 40° F above standard, refer to figures A9-6 through A9-9.

REFUEL BOOM ENVELOPE LIMITS



50941WA

Figure A9-1.

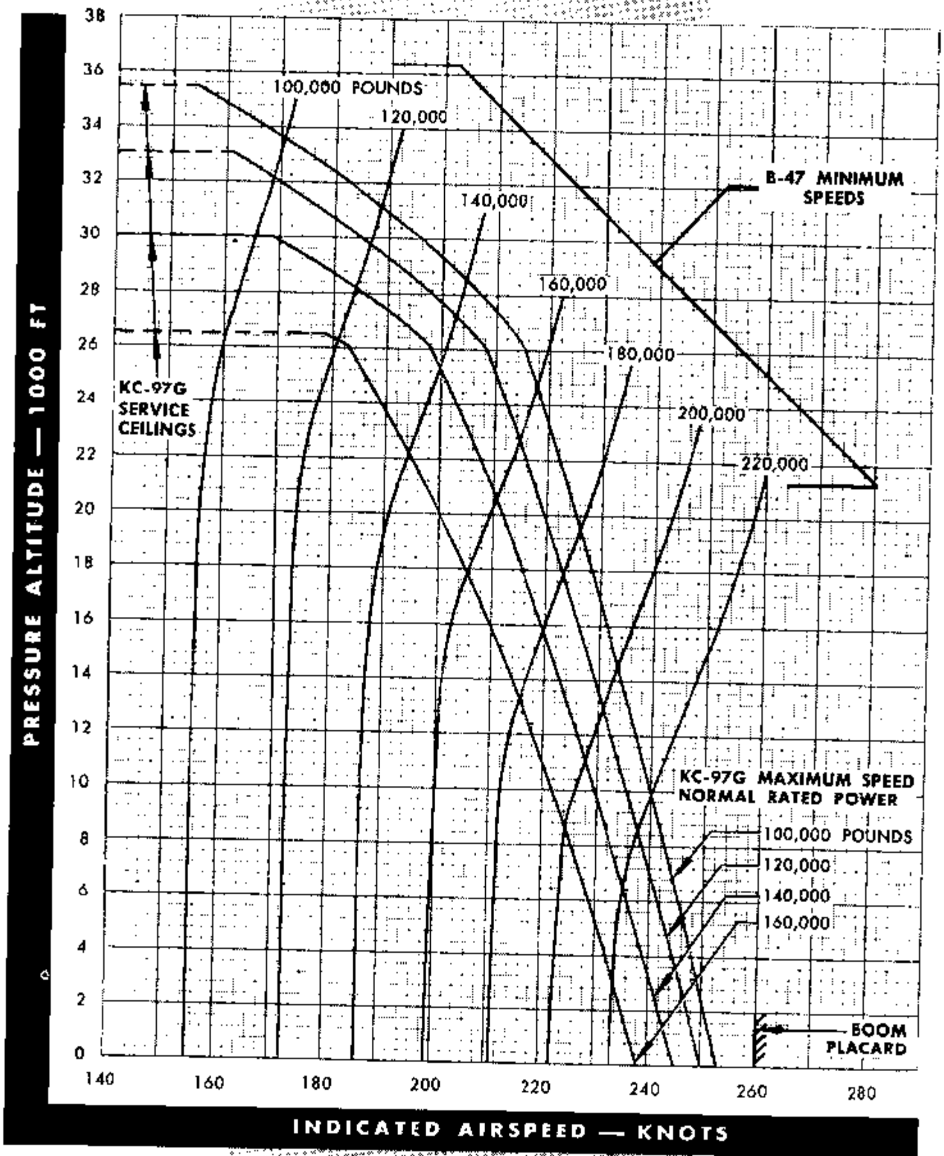
MAXIMUM FORMATING ALTITUDES

LEVEL FLIGHT — NO WING TANKS

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT CO-EFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

901C-1

Figure A9-2.

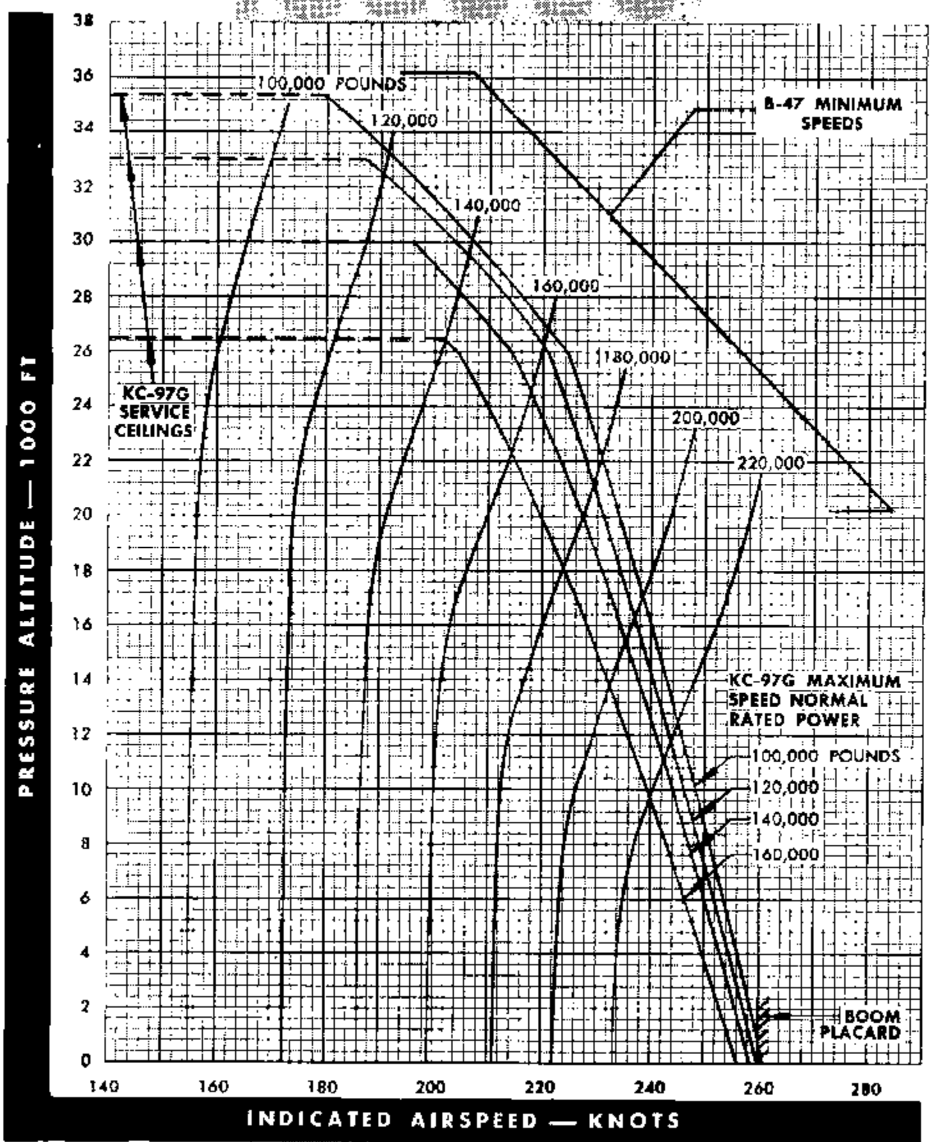
MAXIMUM FORMATING ALTITUDES

300 FPM DESCENT — NO WING TANKS

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

Figure A9-3.

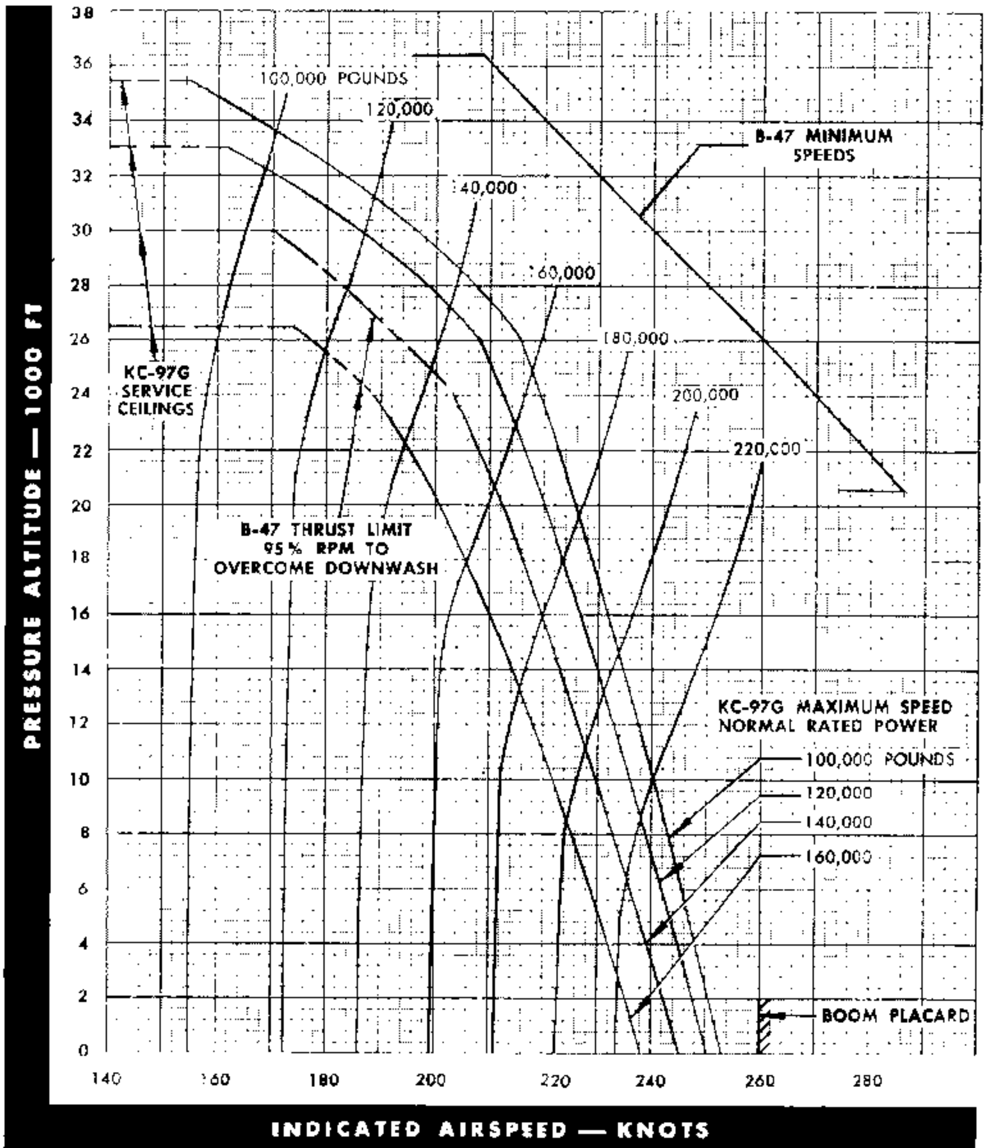
MAXIMUM FORMATING ALTITUDES

LEVEL FLIGHT — WING TANKS ON

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

Figure A9-4.

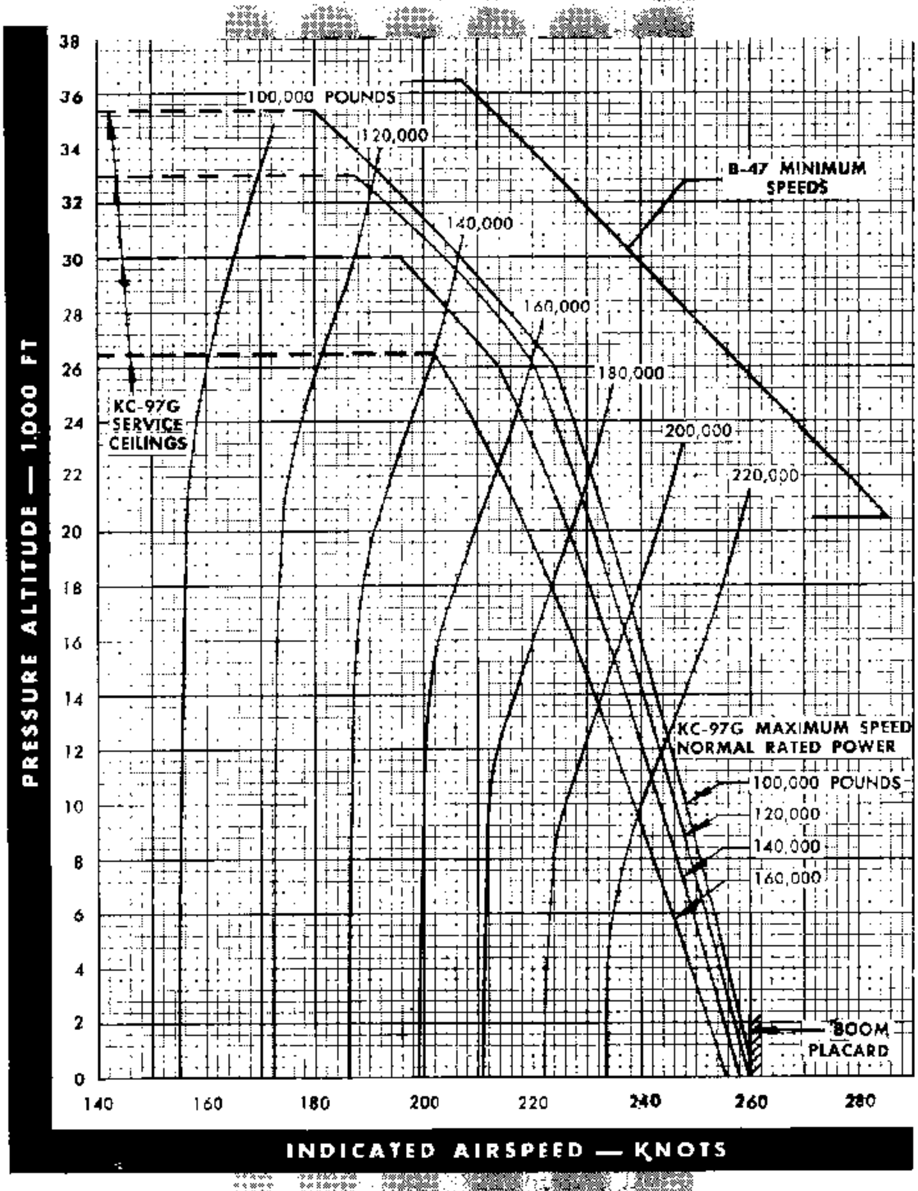
MAXIMUM FORMATING ALTITUDES

300 FPM DESCENT — WING TANKS ON

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

Figure A9-5.

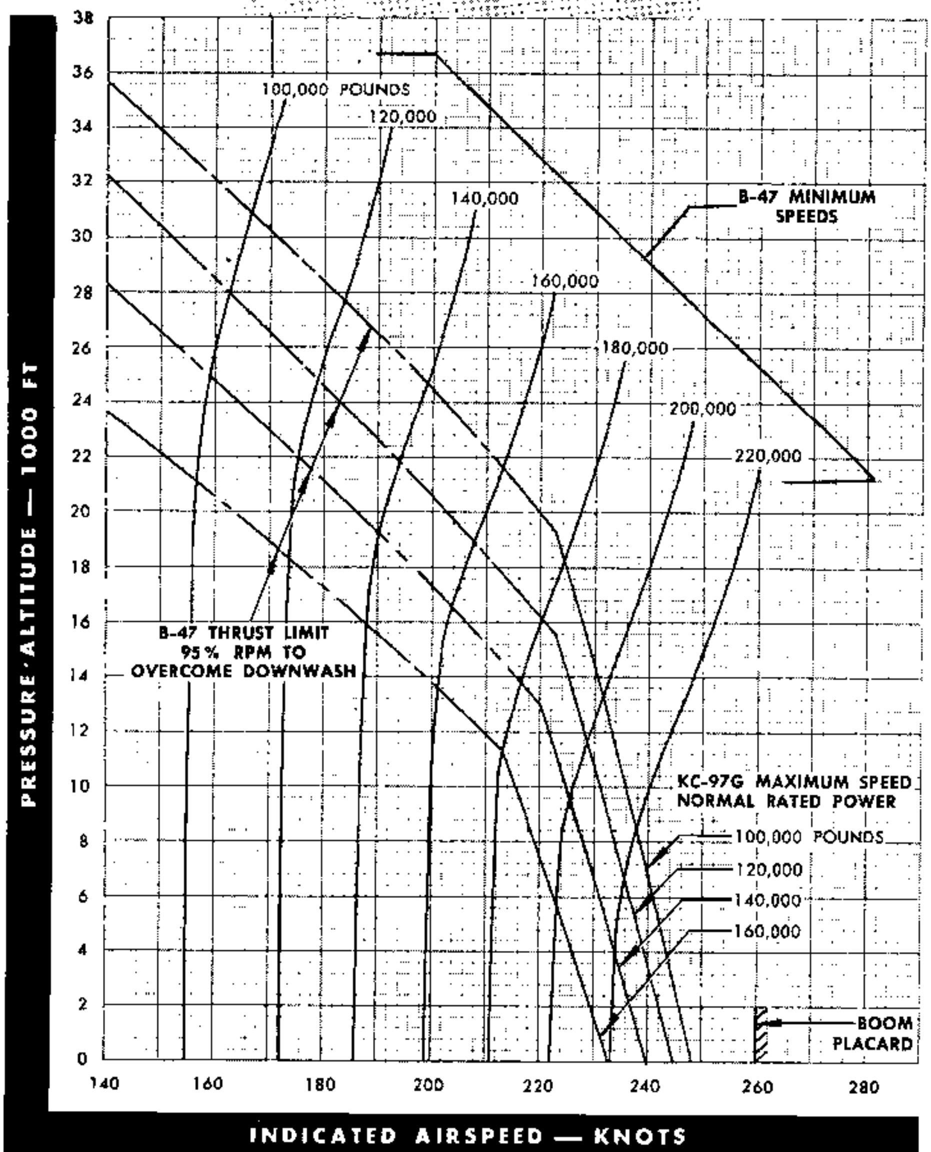
MAXIMUM FORMATING ALTITUDES

LEVEL FLIGHT — NO WING TANKS

ARMY HOT DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT CO-EFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

ARMY HOT DAY 100°F AT SEA LEVEL

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

905C-1

Figure A9-6.

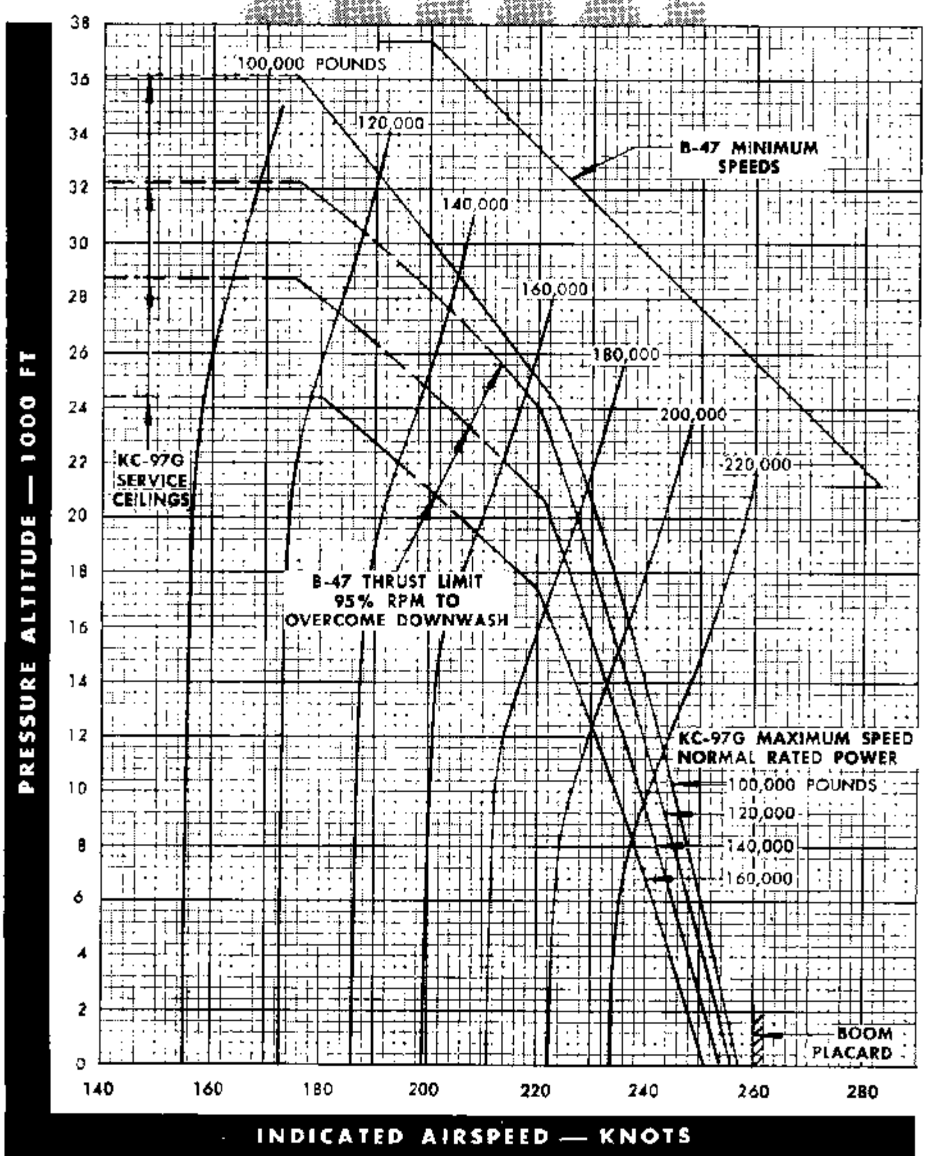
MAXIMUM FORMATING ALTITUDES

300 FPM DESCENT — NO WING TANKS

ARMY HOT DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

ARMY HOT DAY 100°F AT SEA LEVEL

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

906C-1

Figure A9-7.

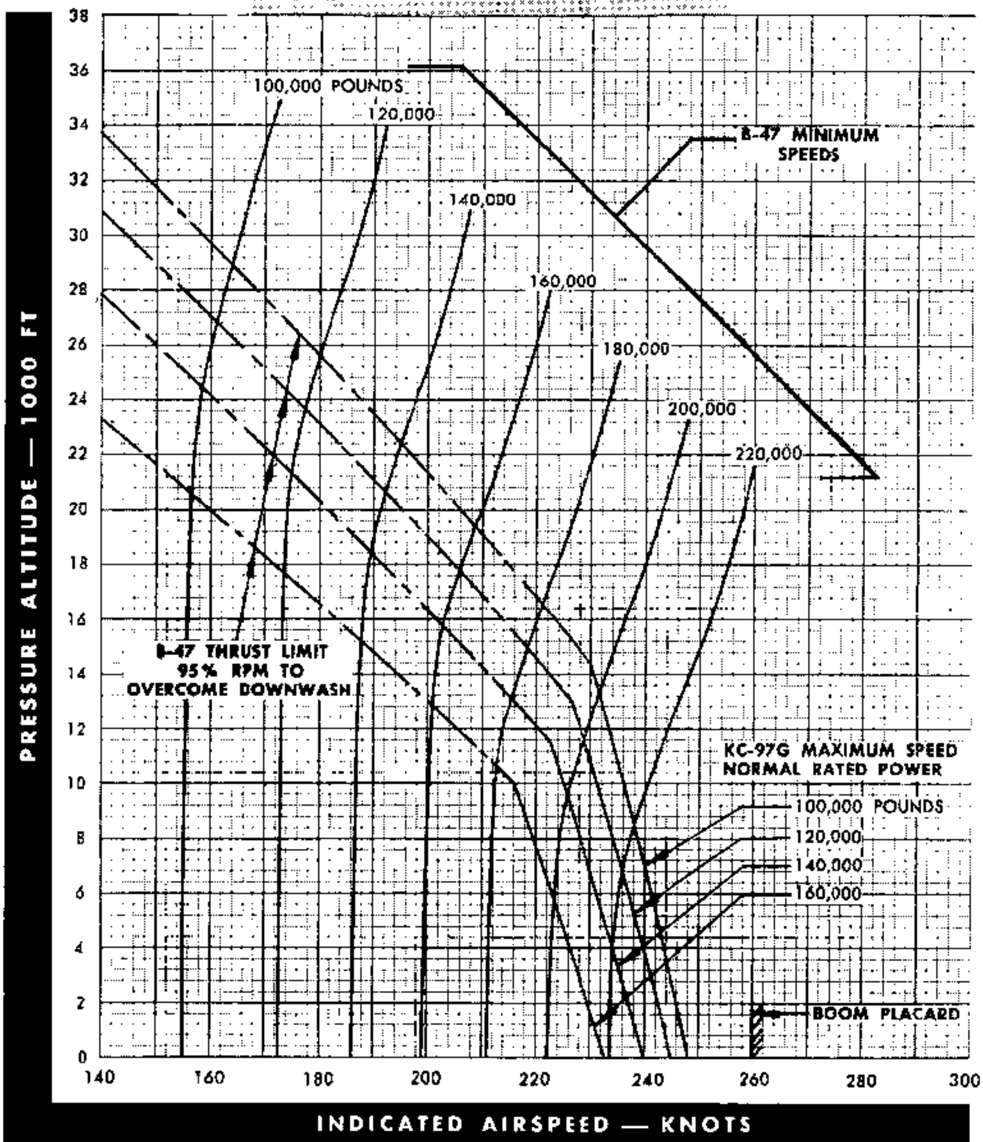
MAXIMUM FORMATING ALTITUDES

LEVEL FLIGHT — WING TANKS ON

ARMY HOT DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

ARMY HOT DAY 100°F AT SEA LEVEL

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

907C-1

Figure A9-8.

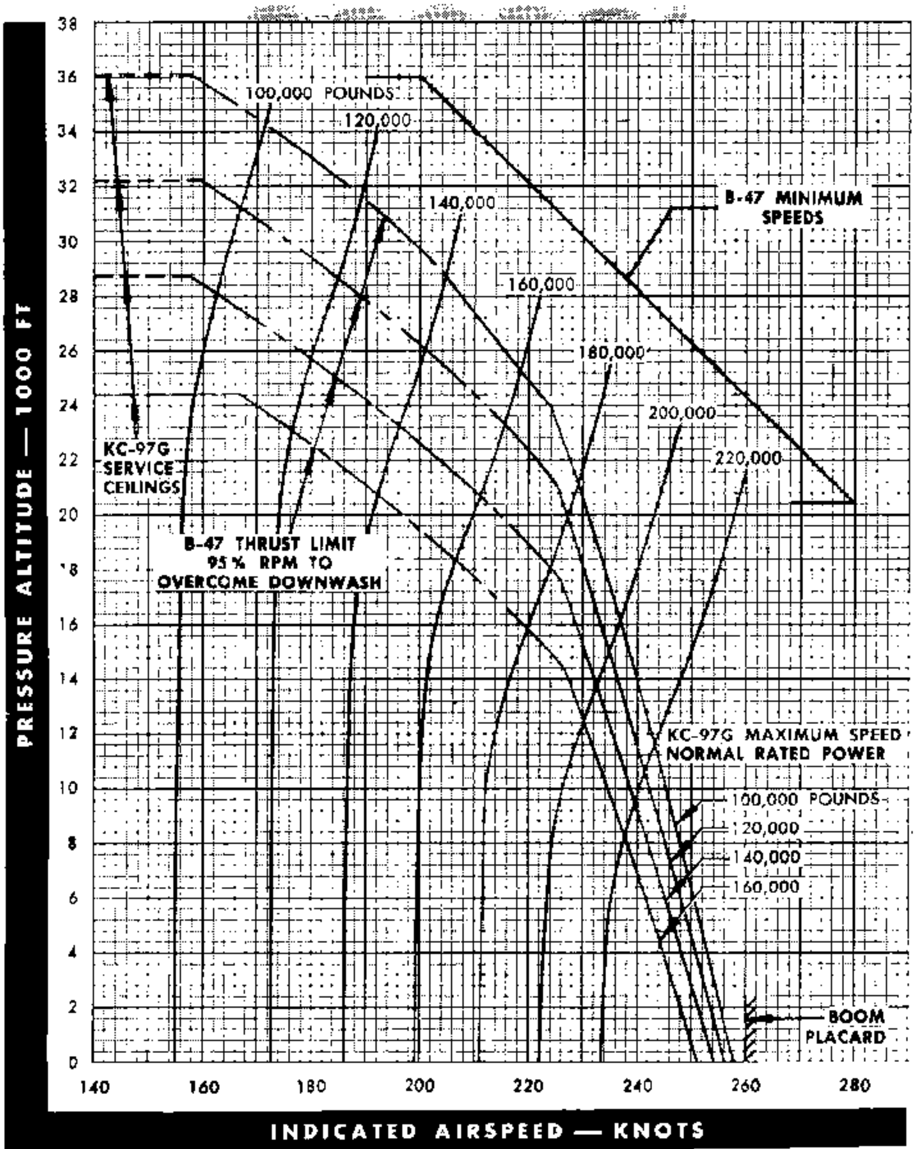
MAXIMUM FORMATING ALTITUDES

300 FPM DESCENT — WING TANKS ON

ARMY HOT DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

B-47 WITH 20% FLAPS DOWN IN TANKER DOWNWASH

6 J47-25 OR -25A ENGINES AT 95% RPM OR LESS

B-47 MINIMUM SPEEDS BASED ON A LIFT COEFFICIENT WHICH IS TWO-THIRDS OF THE STALL WARNING LIFT COEFFICIENT

KC-97G TANKER AT MAXIMUM SPEED WITH NORMAL RATED POWER

ARMY HOT DAY 100°F AT SEA LEVEL

DATE: NOVEMBER 1954

DATA BASIS: FLIGHT TEST

908C-1

Figure A9-9.

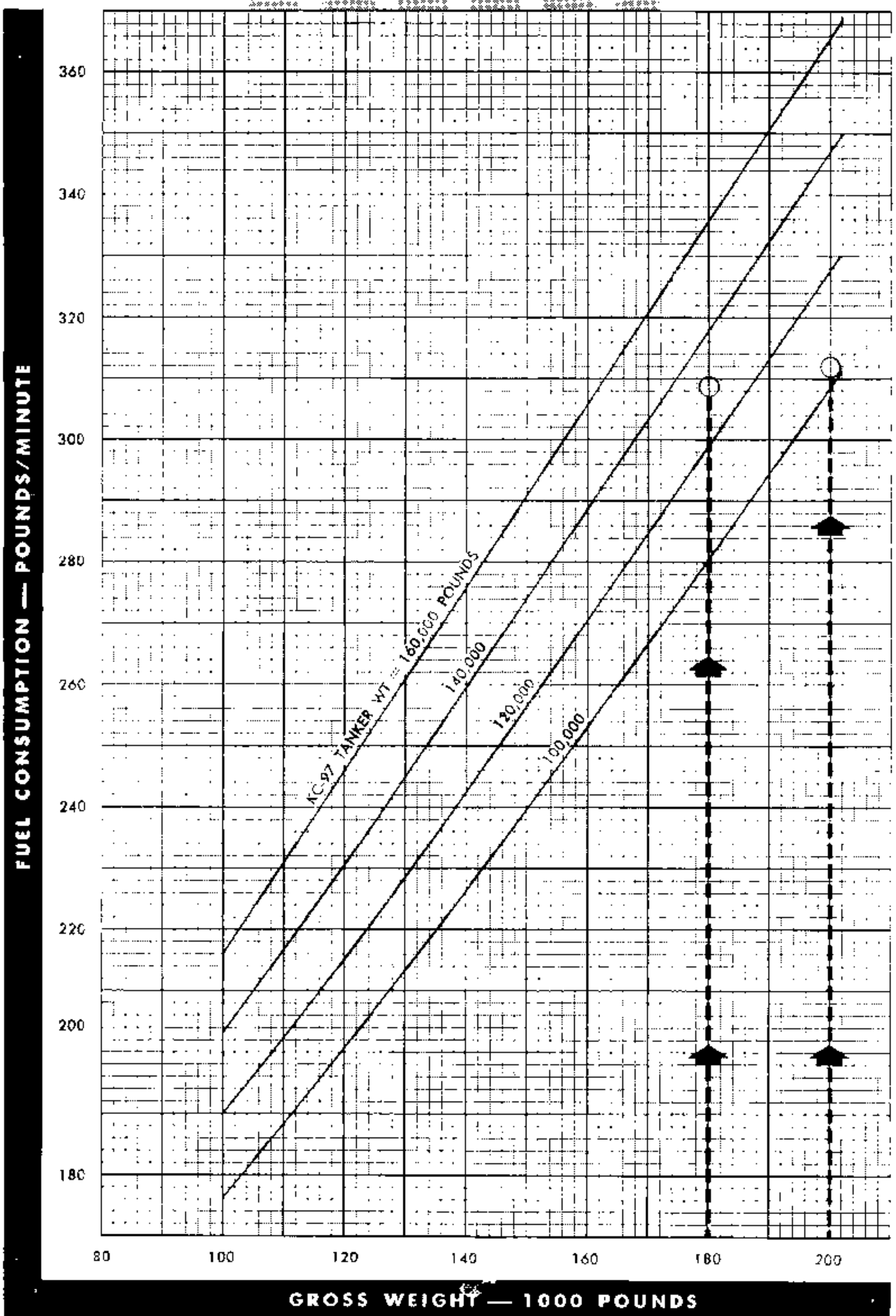
FUEL CONSUMPTION DURING AIR REFUELING

ALL ALTITUDES

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

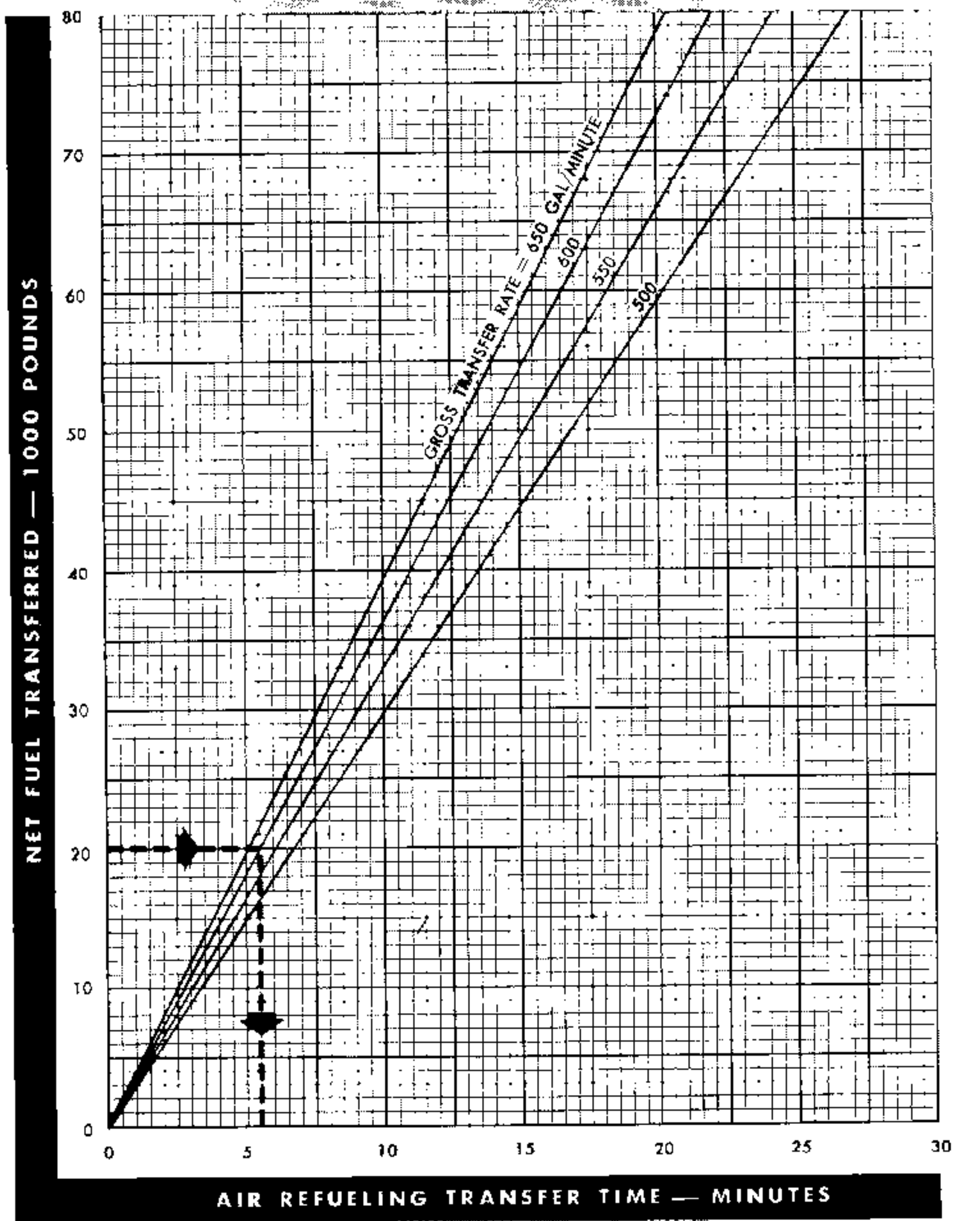
909C-1

Figure A9-10.

AIR REFUELING TRANSFER TIME

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JUNE 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:

BASED ON JP-4 FUEL AT 6.5 POUNDS/GALLON

B-47 FUEL CONSUMPTION RATE OF 300 POUNDS/MINUTE

910C-1

Figure A9-11.

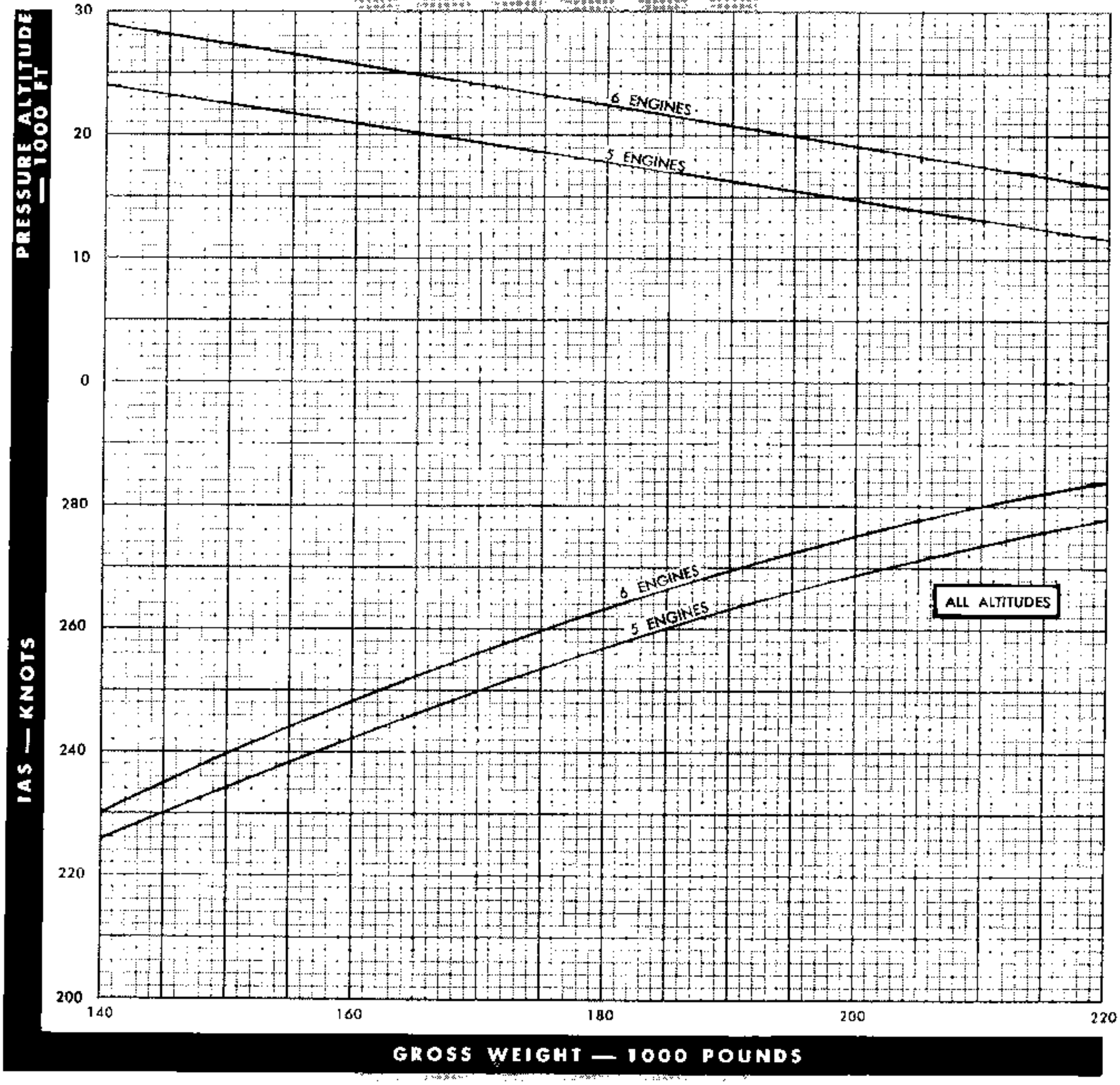
RENDEZVOUS ENDURANCE

OPTIMUM ALTITUDE & SPEED — WING TANKS ON

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & 25A



DATE: FEBRUARY 1955

DATA BASIS: FLIGHT TEST

911C-1

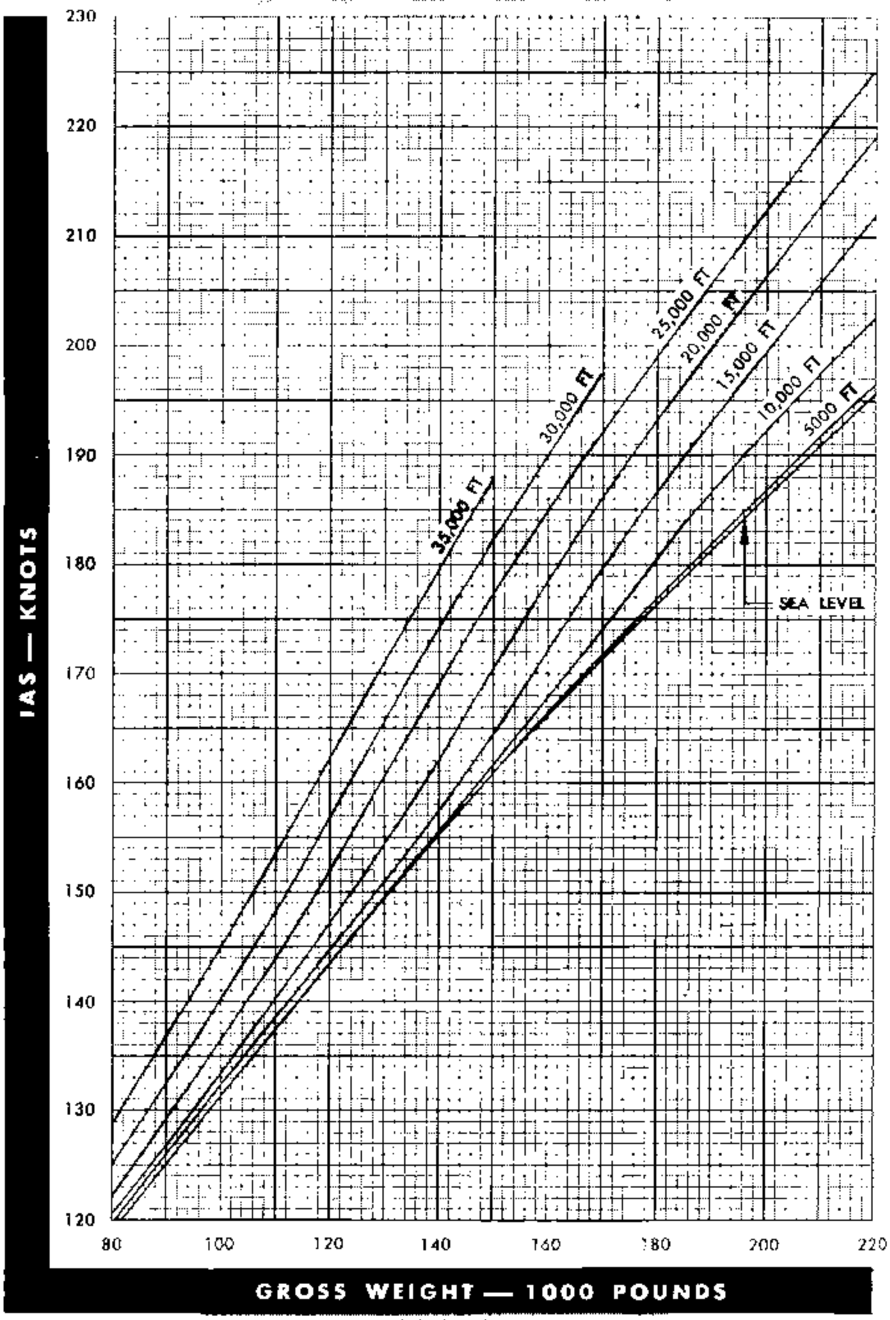
Figure A9-12.

INITIAL STALL SPEEDS

20% FLAPS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: MAY 1955

DATA BASIS: FLIGHT TEST

Figure A9-13.

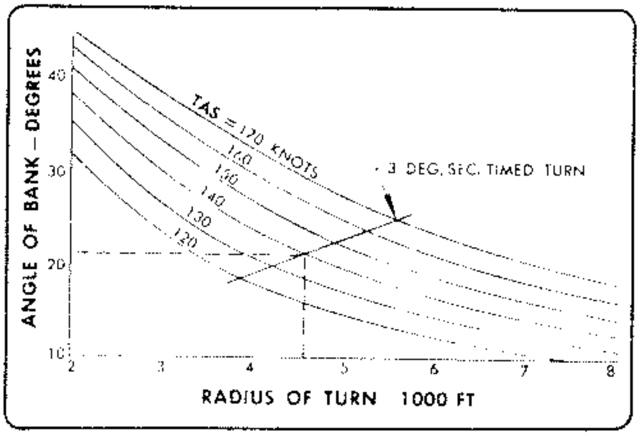
Part 10 approach and landing

APPROACH AND LANDING

This part contains charts which should be used in conjunction with normal operating procedures in section II. The text covers brief explanation of some factors which affect an approach and landing.

PATTERN

The following radius of turn for various speeds and bank angles is given as an aid in establishing a correct pattern. The curve applies to any airplane at any gross weight. The down wind leg for still air, constant bank, constant speed approach would be twice this distance from the runway. For an actual approach, average values can be estimated.

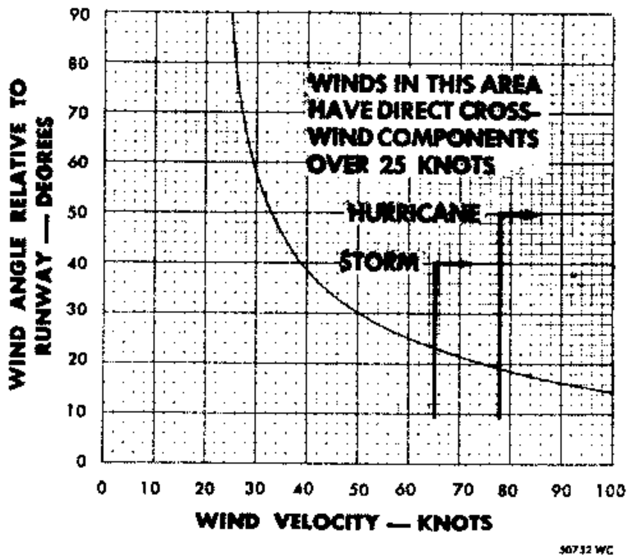


For example, a true airspeed of 140 knots and a double needle width turn (3° per second) will give a bank angle of about 21° and a turn radius of 4600 feet (downwind leg should be approximately 9200 feet from runway).

CROSSWIND LANDING

Satisfactory crosswind landings can be accomplished in winds which have 90° crosswind components up to 25 knots (20 knots with approach chute deployed) provided proper technique is used. Crosswind landing technique is discussed in section II. The following chart shows wind angles and velocities relative to the runway which produce 90° crosswind components of 25 knots.

25-KNOT CROSSWIND COMPONENTS



CG POSITION DURING APPROACH

The charts on figures A10-1 and A10-2 give the cg position for approach conditions enabling the pilot to determine cg during approach. However, the load adjuster, when available, will be used to determine cg in lieu of this chart. Forward cg positions may occur with a low quantity of fuel aboard and should be avoided by proper fuel management previous to approach and landing.

SPEED

The recommended speeds for the unbanked portions of the pattern are shown on figure A10-3. These curves include the position error due to the effects of flaps and airplane attitude on the static pressure source.

During cruise, the airspeed and altimeter have negligible errors due to the location of the static source. However, with flaps down the errors become measurable at the low approach speeds and should be kept in mind during low visibility approaches near the ground. These errors have been included in all operating data charts in this part and indicated airspeeds shown are corrected for static source errors.

Since a turn at constant velocity increases the angle of attack, the speed should be increased slightly during a turn to maintain a constant margin above the stall. (See figure A10-4.) The following values are based on a turn at the recommended approach speed. They need not be applied during a normal approach where the speed is kept high until the approach is nearly completed.

BANK ANGLE — DEGREES	SPEED INCREASE — KNOTS (FOR ALL GROSS WEIGHTS)
15	2
20	4
30	9
40	17

50952WA

FLARE

Figure A10-5 illustrates altitude and distance of flare for various weights. This chart is for a standard day at sea level. Typical heights for start of flare is 50 feet for a 90,000-pound airplane, increasing with gross weight to 100 feet for a 150,000-pound airplane on a standard day. OAT higher than standard tends to increase the height for start of flare.

The chart on figure A10-5 shows landing distance over a 50-foot obstacle and the effect of gross weight on flare and go-around paths. The curve which is exact for a gross weight of 90,000 pounds can be used with reasonable accuracy between 80,000 and 90,000 pounds.

GO—AROUND WITH APPROACH CHUTE DEPLOYED

For rates of climb available during a go-around with the approach chute deployed consult figure entitled "Rate of Climb - Approach Chute Deployed" in part 5.

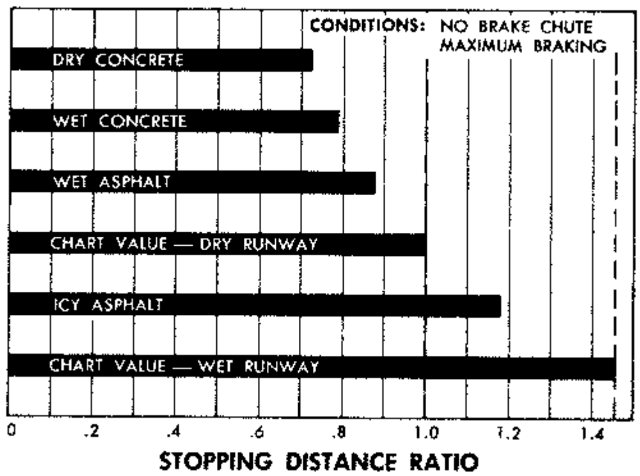
STOPPING DISTANCES

All landings should be planned and conducted as though the brake chute were not installed. The chute should be considered only as an aid to prevent excessive wear of brakes and tires. Prior to all landings the pilot should compare the stopping distance with brakes only in figure A10-8 with the runway distance estimated to be available beyond the planned touchdown point. If the runway estimated to remain after touchdown is less than the stopping distance required with brakes alone, the safety of the landing depends on the brake chute. If such a landing is unavoidable, the procedure given in section III under "Landing with Reliance on Brake Chute" should be followed. When it appears that runway available is sufficient to allow lighter use of the brakes, the pilot may check further by consulting figure A10-6 for the stopping distance with brake chute plus brakes applied from 40 to 0 knots. The distance thus computed may then be compared with the runway estimated to remain after touchdown. If it appears that ample stopping distance will be available, brake application from 40 to 0 knots will help to sustain brake life. However, brake application should never be delayed under marginal conditions of weather, at night, or when sensory illusions impair the pilot's estimate of the runway remaining in front of the airplane. Brakes may be applied consistently as high as 80 knots before significant brake wear will occur. When necessary, the brakes should be applied without hesitation above 80 knots provided the airplane has settled firmly on both main gears. Brake wear may be increased at the higher speed, but proper use of antiskid will provide effective braking well within the capability of the system. The only operational limitation imposed by brake capacity is the number of high weight landings that can be made without the brake chute, as shown in the following table:

GROSS WEIGHT (LBS.)	DESIGN BRAKE CAPACITY (NO CHUTE)
167,000	1 LANDING
148,000	20 LANDINGS
135,000	80 LANDINGS

50953WA

Stopping distances shown on the following pages are for conditions of both dry and wet paved runways. The data is sufficiently conservative that it may be applied to asphalt, macadam, or concrete surface. The following illustration compares the chart value of "Stopping Distances - Brakes Only" with the estimated stopping distance for several different types and conditions of surface.



50733C-1

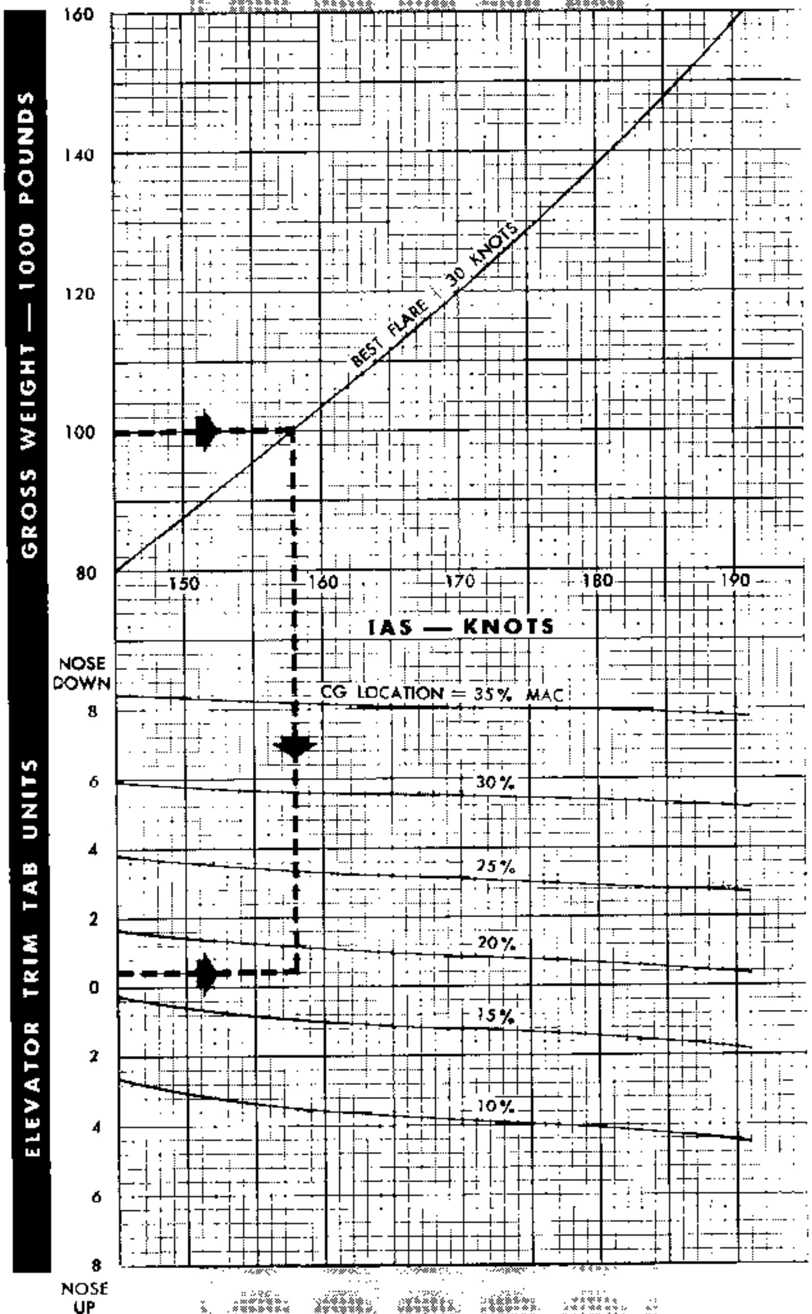
To provide a reference, the dry runway stopping distance, as taken from the "Stopping Distances - Brakes Only" chart, is given unit value of 1.0 on the ratio scale. Further examination then reveals that stopping distance on dry concrete for example would be about 0.72 of the chart value distance for dry runway. On the other hand, stopping distance on icy asphalt would be based on the chart value for wet runway which provides adequate margin over all other paved surface conditions. Thus it can be seen that the stopping distance charts are sufficiently conservative to provide useful planning information for the worst case considered.

APPROACH TRIM WHEEL SETTING

WITHOUT FLAP TRIM COMPENSATION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

SEA LEVEL TO 10,000 FT ALTITUDE

ELEVATOR SURFACE POWER CONTROL ON

FLAPS AND GEAR FULL DOWN

DATE: APRIL 1954

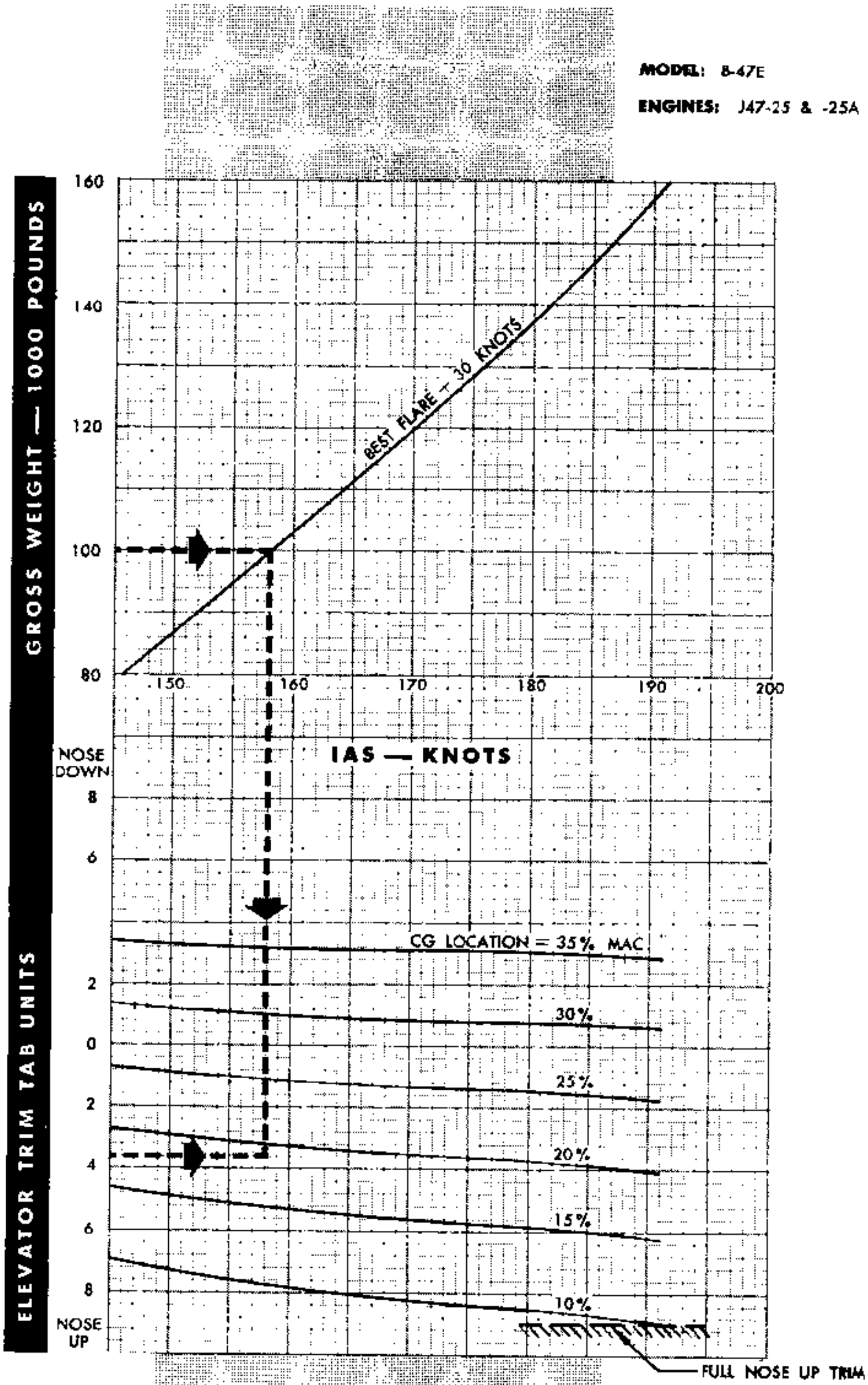
DATA BASIS: CALCULATED

Figure A10-1.

APPROACH TRIM WHEEL SETTING

WITH FLAP TRIM COMPENSATION

MODEL: B-47E
ENGINES: J47-25 & -25A



DATE: APRIL 1954

DATA BASIS: CALCULATED

CONDITIONS:
SEA LEVEL TO 10,000 FT ALTITUDE
ELEVATOR SURFACE POWER CONTROL ON
FLAPS & GEAR FULL DOWN

1008C-1

Figure A10-2.

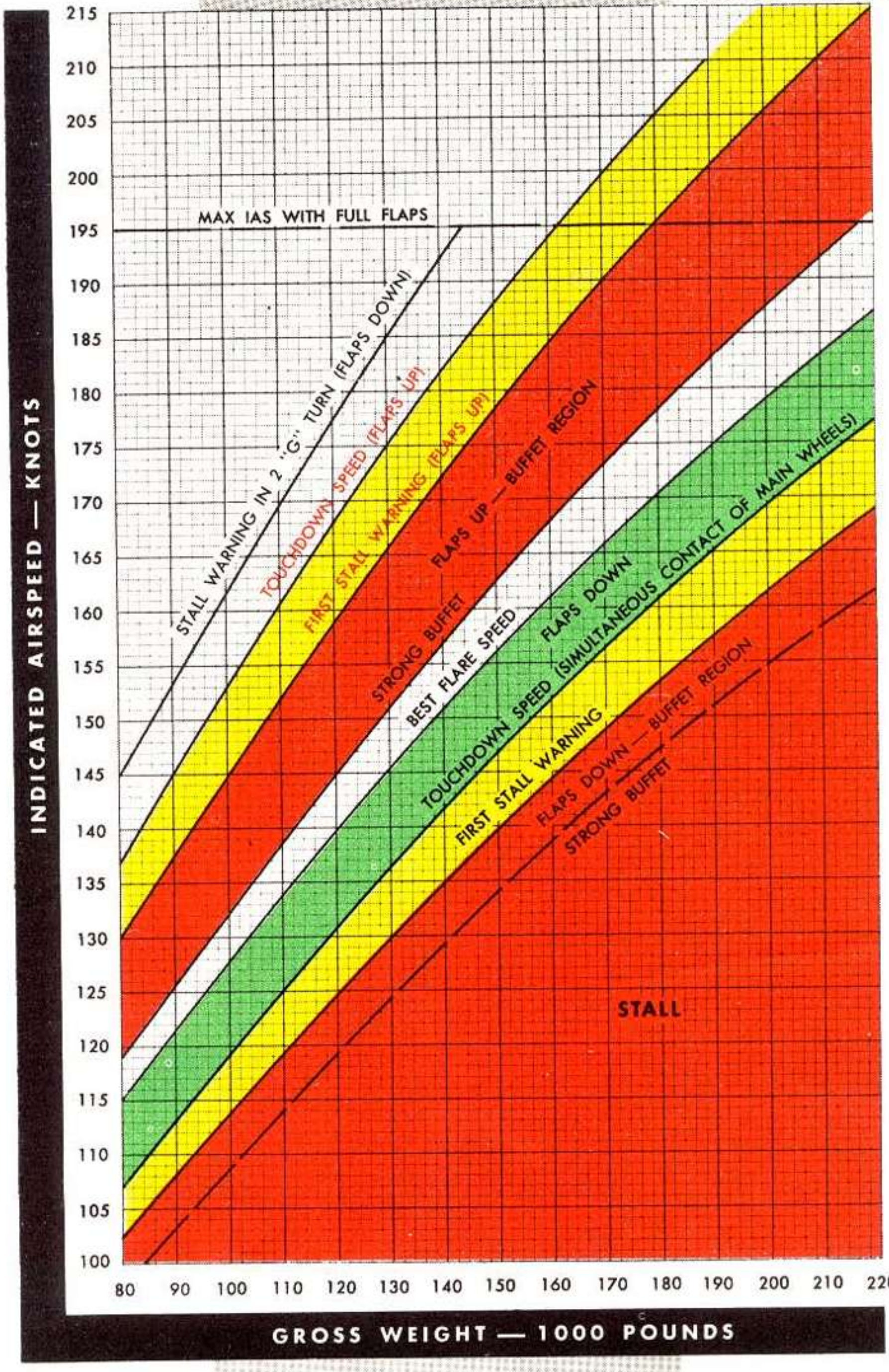
MINIMUM SPEEDS

NON-MANEUVERING FLIGHT

1 "G" LOAD FACTOR

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
SEA LEVEL TO 10,000 FEET

1007C-1

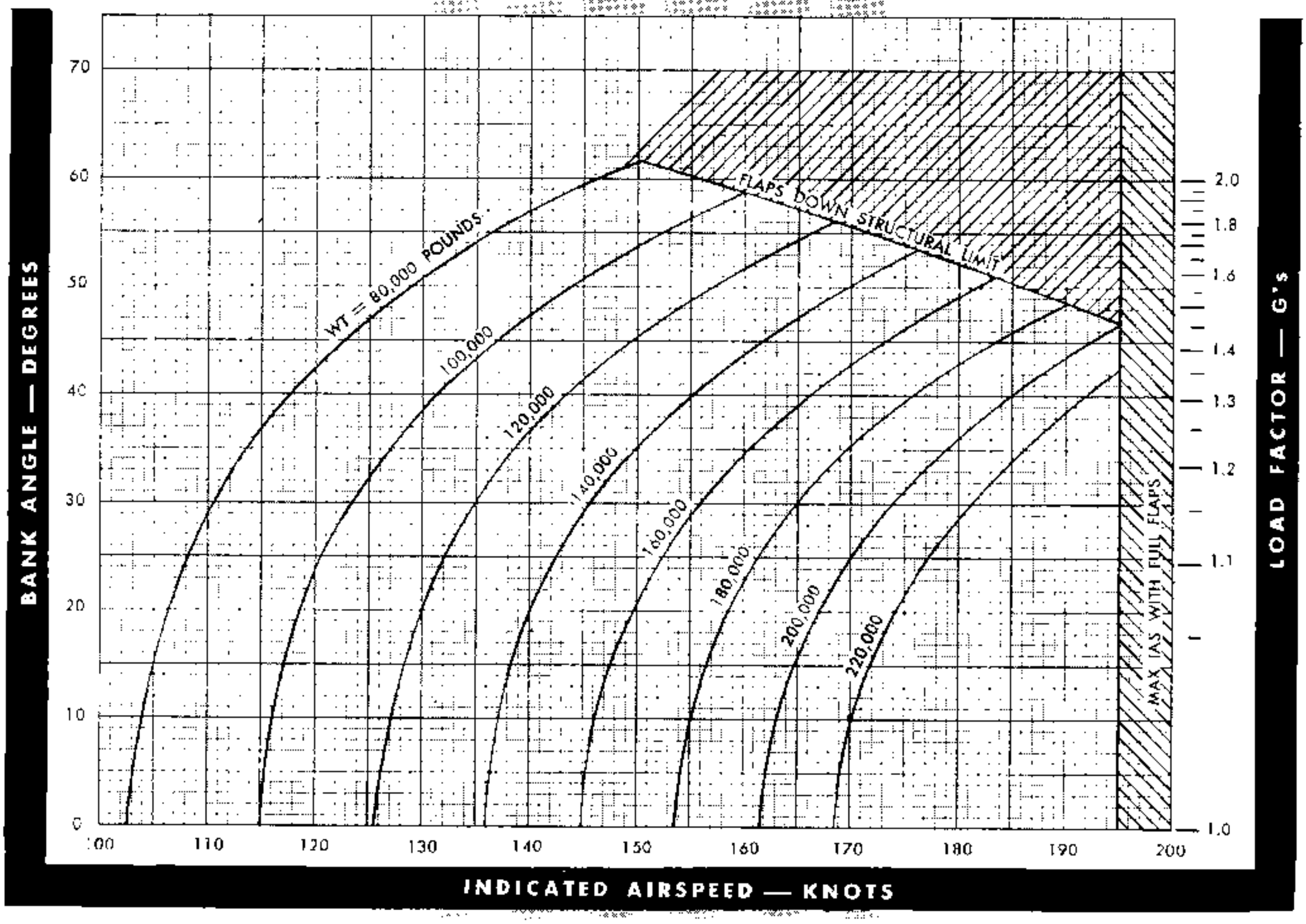
Figure A10-3.

ACCELERATED STALLING SPEEDS

FLAPS DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



CONDITIONS:

SEA LEVEL TO 10,000 FEET

REMARKS:

FLAPS DOWN STRUCTURAL LIMIT CURVE IS INDEPENDENT OF INDICATED AIRSPEED

DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

Figure A10-4.

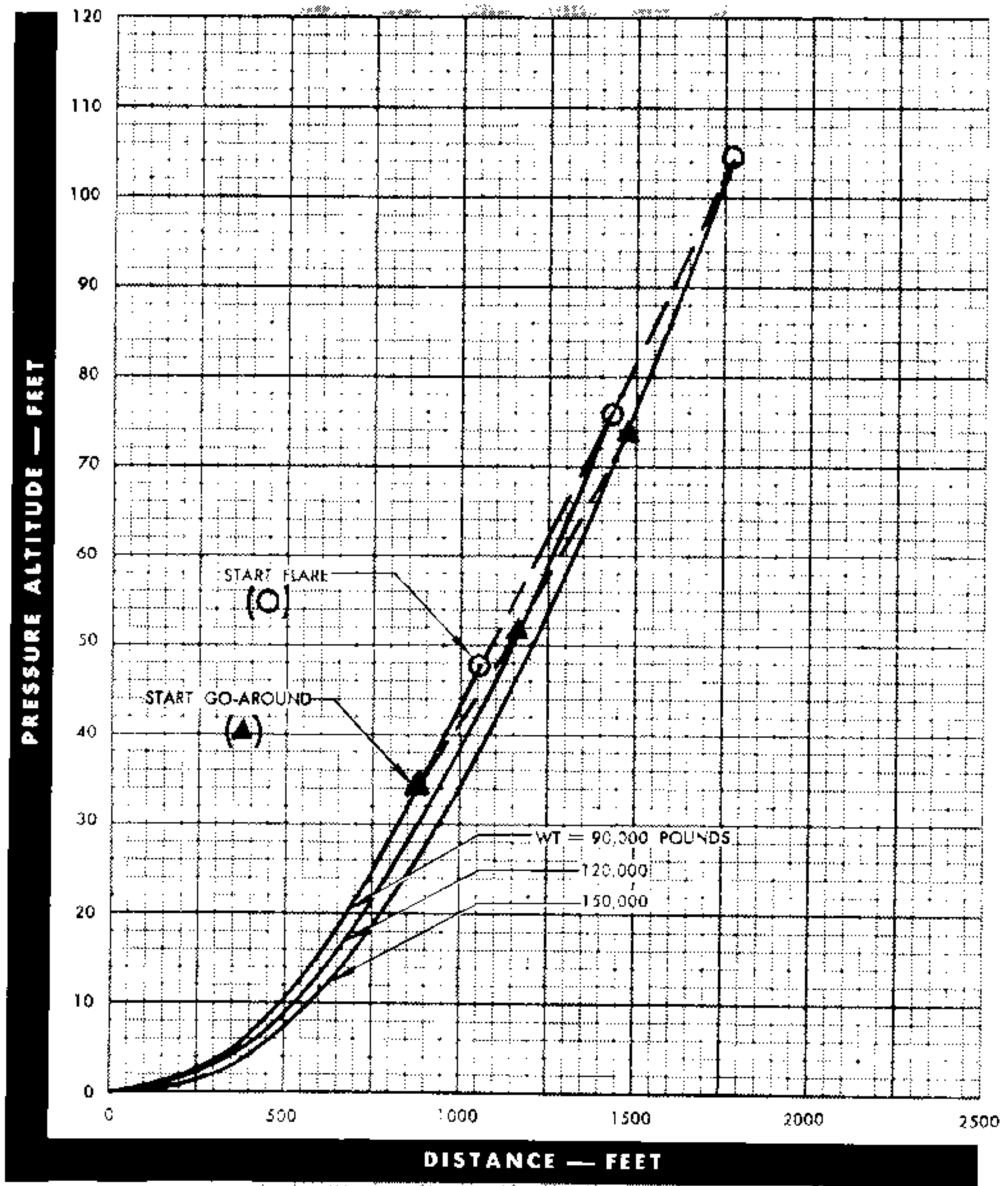
7003C-1

APPROACH & GO-AROUND

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
CONSTANT APPROACH SPEED 55% RPM

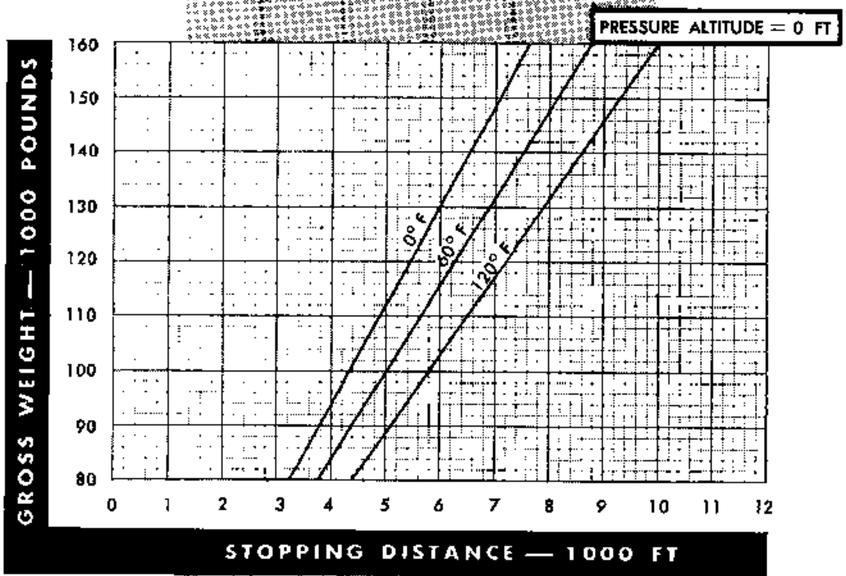
Figure A10-5.

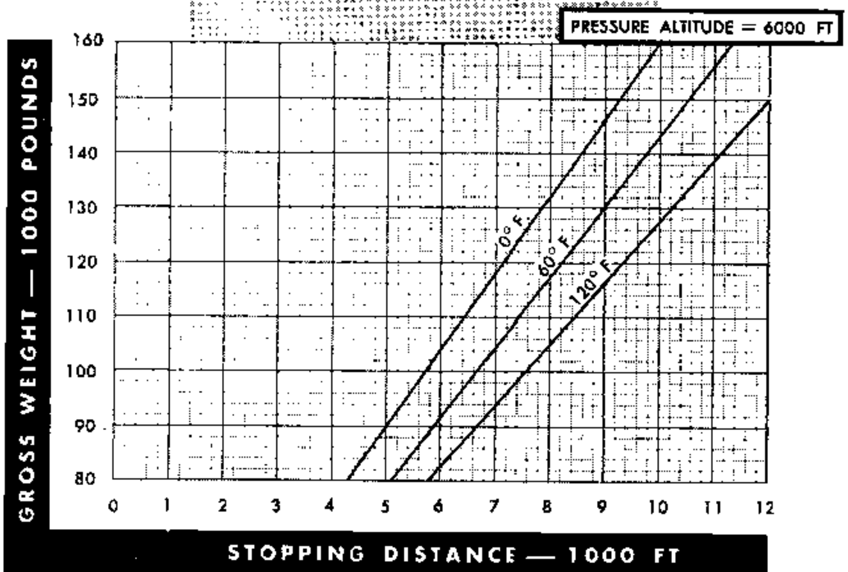
NORMAL STOPPING DISTANCES

CHUTE PLUS BRAKES AT 40-0 KNOTS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A





CONDITIONS:

FLAPS FULL DOWN

ENGINES 1, 2, 5 & 6 IN CUTOFF AT TOUCHDOWN

ENGINES 3 & 4 AT IDLE (40%) RPM AT TOUCHDOWN

BRAKE CHUTE FULL OPEN AT TOUCHDOWN

BRAKES USED ONLY FROM 40 TO 0 KNOTS

NO APPROACH CHUTE

NO WIND

DRY RUNWAY

DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

1005C-1

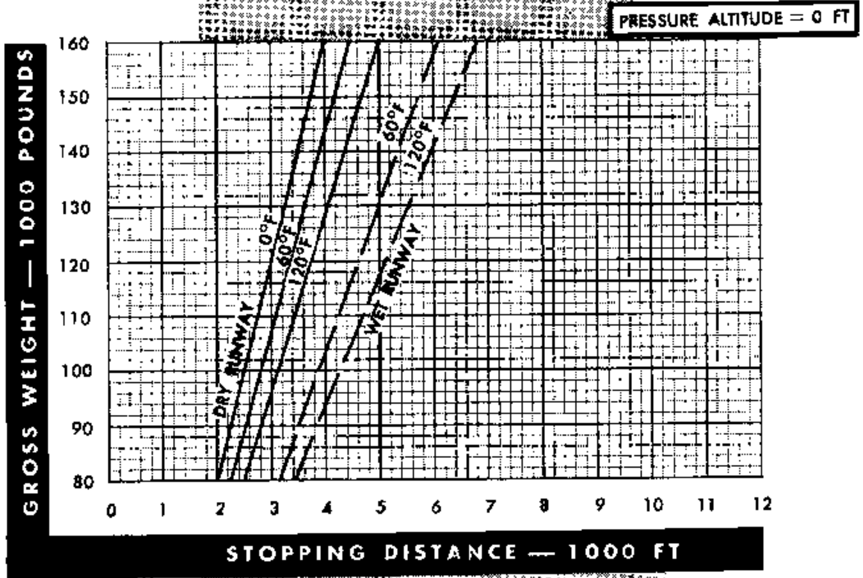
Figure A10-6.

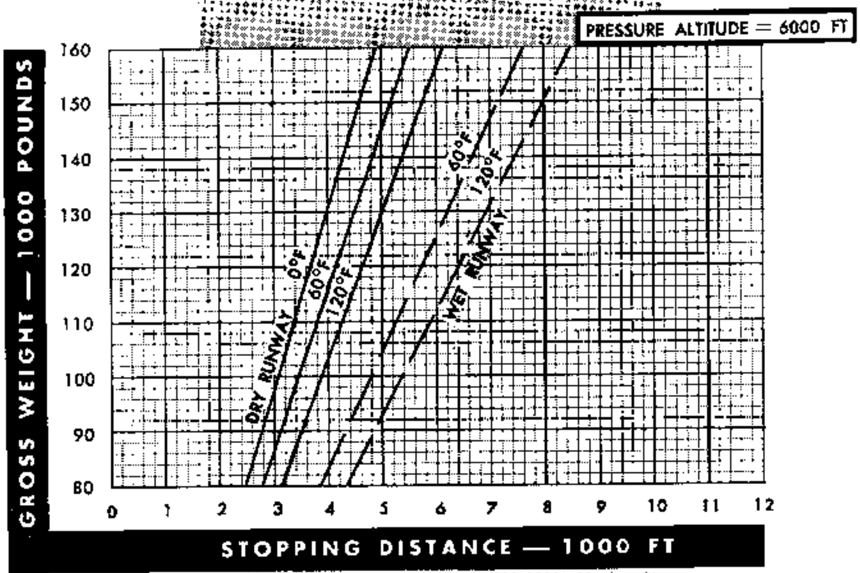
MINIMUM STOPPING DISTANCES

CHUTE PLUS BRAKES

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A





DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:

FLAPS FULL DOWN

ENGINES 1, 2, 5 & 6 IN CUTOFF AT TOUCHDOWN

ENGINES 3 & 4 AT IDLE (40%) RPM AT TOUCHDOWN

BRAKE CHUTE FULL OPEN AT TOUCHDOWN

BRAKES APPLIED AT TOUCHDOWN

NO APPROACH CHUTE

NO WIND

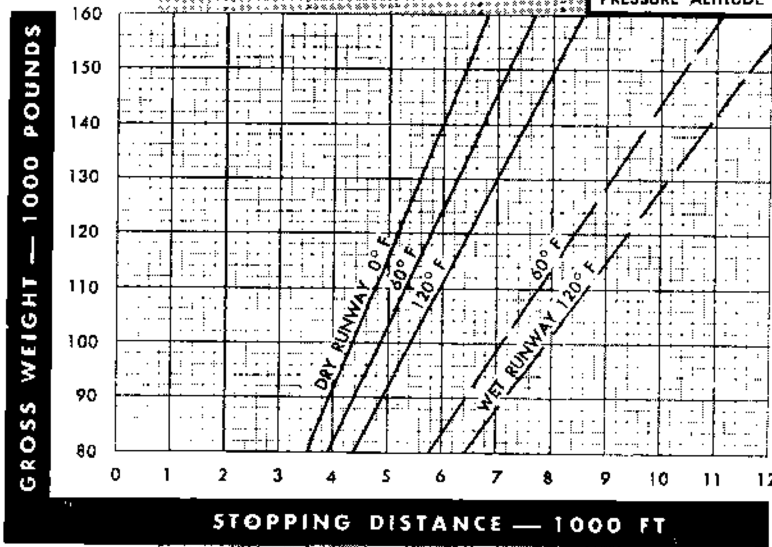
1006C-1

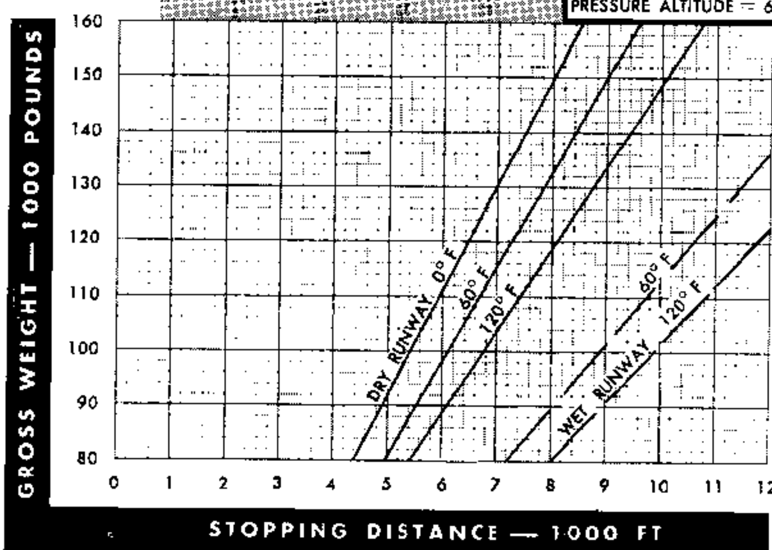
Figure A10-7.

STOPPING DISTANCES -BRAKES ONLY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A





CONDITIONS:

FLAPS FULL DOWN

ENGINES 1, 2, 5 & 6 IN CUTOFF AT TOUCH-DOWN

ENGINES 3 & 4 AT IDLE (40%) RPM AT TOUCH-DOWN

BRAKES APPLIED AT TOUCHDOWN

NO BRAKE CHUTE

NO APPROACH CHUTE

NO WIND

DATE: NOVEMBER 1952

DATA BASIS: FLIGHT TEST

1007C-1

Figure A10-8.

Part 11 mission planning

GENERAL

To obtain optimum use of jet airplanes, mission planning and constant checking of progress against the flight plan is required. The flight plans which are included on the following pages insure safe operating procedures for all phases of the mission and enable better judgment as to the proper course of action should an in-flight emergency occur.

B-47 MODEL

TAKEOFF DATA

CRITICAL FIELD LENGTH ______ TO DIST ______
MIN ATO REQ ______ ELEVATOR SET ______

LINE .... IAS ____
REFUSAL SPEED .... IAS ____
FIRE ATO .... IAS ____
TAKEOFF .... IAS ____
CLIMB .... IAS ____

CONDITIONS

GW ______ FLD PA ______
RUNWAY LENGTH ______ OAT ______
LINE DIST ______ %MAC ______

LANDING DATA

STOP DIST ______

START FINAL .... IAS ____
BEST FLARE .... IAS ____

50961WA-3

Figure A11-1. Takeoff and Landing Data Card

TAKEOFF AND LANDING DATA CARD

Prior to each takeoff, copilot computes all data contained on the Takeoff and Landing Data Card (figure A11-1). This will be checked by the pilot and returned to the copilot. Copilot calls pertinent data to the pilot prior to and during takeoff. Prior to landings, all landing and emergency data will be computed and entered on the card.

NOTE

Completion of both takeoff and landing data is necessary before takeoff in event of an emergency landing soon after takeoff.

DEFINITIONS

The takeoff and landing data card definitions are as follows:

1. CONDITIONS
a. Gross Weight (GW). Gross weight of airplane in pounds at start of takeoff roll or at start of final approach, whichever is applicable.
b. Runway Length. Usable length of runway in feet.
c. Line Distance (Line Dist). Distance from start of takeoff roll to runway acceleration-check marker (figure A2-9).
d. Field Pressure Altitude (FLD PA). Altimeter reading in feet for dial set at 29.92 inches Hg.
e. Outside Air Temperature (OAT). Runway air temperature in degrees Fahrenheit.
f. %MAC. Airplane center of gravity location in percent of mean aerodynamic chord.

2. TAKEOFF DATA
a. Refusal Speed. An indicated airspeed in knots at or above which the airplane can safely become airborne on five engines (with or without ATO as applicable) and at or below which the airplane can be safely stopped within the confines of the remaining runway length. (This is equal to the ATO fire speed if the refusal speed, as calculated under above definition, is greater than the ATO fire speed.) (Refer to part 4.)
b. Critical Field Length. Minimum runway length necessary for takeoff to allow the airplane with one-engine failure at refusal speed either to be safely stopped or to become safely airborne on five engines without ATO. (Refer to part 2.)
c. Minimum ATO Required (Min ATO Req). Minimum number of ATO bottles required for takeoff in the event the critical field length required is greater than runway length to allow above definition for critical field length required to apply with ATO included. (Refer to part 3.)
d. Takeoff Distance (TO Dist). Ground roll in feet to takeoff speed. Normally the wind is considered to be zero, and should be considered only in the event of a tailwind or if, due to extreme operating conditions, a headwind is necessary to become airborne safely within the runway length. (Refer to part 2 or 3.)
e. Elevator Trim Tab Setting (Elevator Set). Elevator trim tab setting for takeoff. (Refer to part 2.)
f. Line Speed (Line IAS). Indicated airspeed in knots that airplane should indicate at a preselected check point down the runway. (Refer to part 2.) Note that when a headwind exists but is not considered when computing line speed, the line IAS should read higher than the computed value. If the no-wind line speed is established as the accepted value, poor acceleration may exist and not be detected.

JET BOMBARDMENT AND RECONNAISSANCE MISSION FLIGHT PLAN	SQUADRON	WING	AIRCRAFT TYPE AND SERIAL NO.	CREW NUMBER	ACFT COMDR (Name and Grade)	OBSERVER (Name and Grade)	CO-PILOT (Name and Grade)

III. PRE-FLIGHT PLAN (Aircraft Performance)

FROM / ROUTE	FLT COND	T.C.	WIND D/V. / DRIFT	T.H.	VAR.	M.H.	TEMP. / ALT	MACH	T.A.S.	G.S.	GRD DIS / ACC. GRD DIS	TIME / ACC. TIME	AIR DIS / ACC. AIR DIS	ETA	FUEL FLIGHT PLAN: PRED. FUEL REMAIN.	FUEL FLIGHT PLAN: GROSS WEIGHT
							°									
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DATE OF TAKE-OFF		
ENGINE START	TAKE-OFF TIME	
LANDING TIME	DURATION OF FLT	
AIRCRAFT BASIC WT		
CREW WT		
OIL WT		
ATO BTL WEIGHT (Empty)		
EXT. TANKS WT (Empty)		
OPERATING WT		
FUEL WEIGHT: F.M.		
FUEL WEIGHT: C.M.		
FUEL WEIGHT: A.M.		
FUEL WEIGHT: FWD AUX		
FUEL WEIGHT: B.B.		
FUEL WEIGHT: ATO		
FUEL WEIGHT: EXT.		
FUEL WEIGHT: TOTAL		
BOMBS WT		
AMMO WT		
ADI. FLUID WT		
INITIAL GROSS WT		
START ENG AND TAXI FUEL ALW		
TAKE-OFF GROSS WT		
RUNWAY		
PRESS. ALT	LENGTH	AIR TEMP.
CRITICAL FIELD LENGTH		
TAKE-OFF		
DISTANCE	SPEED	
SPEED		
REFUSAL	EMERG BEST FLARE	LINE
NO. OF ATO BOTTLES REQUIRED		
ATO PROPELLANT WEIGHT		
ADJUSTED TAKE-OFF WEIGHT		
ADJUSTED TAKE-OFF DISTANCE		
ATO FIRING SPEED		

Figure A11-2. (Sheet 1 of 4 Sheets)

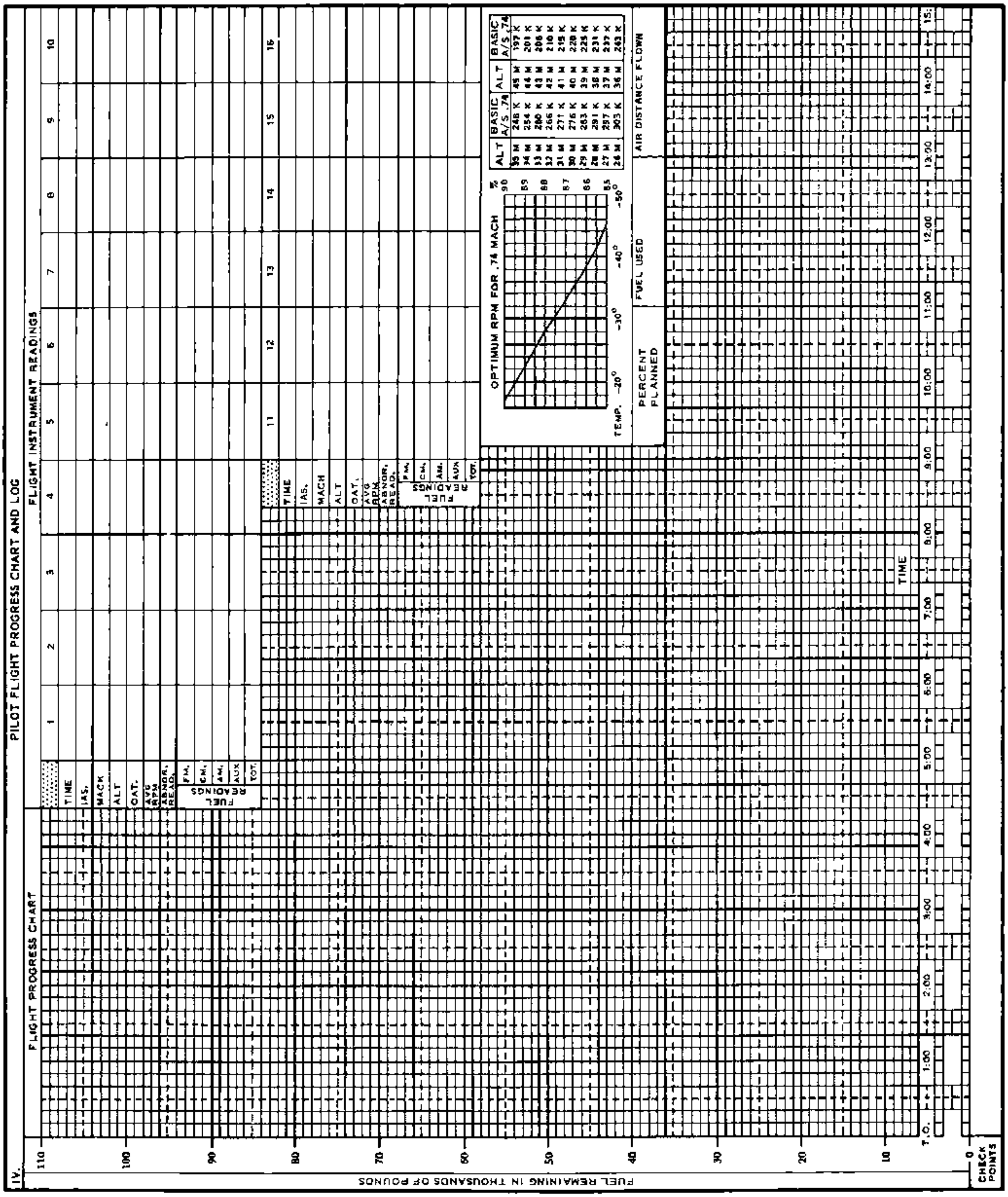

Figure A11-2. (Sheet 2 of 4 Sheets)

JET BOMBARDMENT AND RECONNAISSANCE MISSION FLIGHT PLAN	SQUADRON	WING	AIRCRAFT TYPE AND SERIAL NO.	CREW NUMBER	ACFT COMDR (Name and Grade)	OBSERVER (Name and Grade)	CO-PILOT (Name and Grade)

1\. PRE-FLIGHT PLAN (Navigation)

FROM / ROUTE	FLT COND	T.C.	WIND D/V. / DRIFT	T.H.	VAR.	M.H.	TEMP. / ALT	MACH	T.A.S.	G.S.	GRD DIS / ACC. GRD DIS	TIME / ACC. TIME	AIR DIS / ACC. AIR DIS	ETA	REMARKS & INFLIGHT OBSERVATIONS

DATE OF TAKE-OFF	
ENGINE START	TAKE-OFF TIME
LANDING TIME	DURATION OF FLT

RENDEZVOUS EQUIPMENT SETTINGS & CODES

EQUIPT	RECVR	TANKER
APN-76		
APN-12		
APN-11		
APN-69		

[1] Use the following code to designate Run Type:

X - Record run
O - Practice run
M - Malfunction run
G - Ground position indicator
P - Mining
A - Ground Radar Directed
S - Shoran bombing

[2] Use the following code to designate Run Classification:

0 - Synchronous optical
1 - Radar optical
2 - Fixed angle radar
3 - Coordinated radar
4 - Synchronous (radar direct)
5 - Synchronous (radar offset)
6 - Coordinated (optical)
7 - Fixed angle (optical)
8 - Other radar
9 - Synchronous (radar direct with offset checking)
A - Other visual

Figure A11-2. (Sheet 3 of 4 Sheets)

11. BOMBING DATA

TGT DATA	RUN NO.	1		2		3		4		5	
TGT DATA	NAME										
TGT DATA	A.P. NAME VAR ELEV										
TGT DATA	A.P. LAT LONG										
I.P.	NAME VAR ELEV										
I.P.	LAT LONG										
GPI POINTS	NAME VAR ELEV										
GPI POINTS	LAT LONG										
GPI POINTS	NAME VAR ELEV										
GPI POINTS	LAT LONG										
GPI POINTS	NAME VAR ELEV										
GPI POINTS	LAT LONG										
OFFSET	NAME ELEV										
OFFSET	LAT LONG										
OFFSET	N-S E-W										
IP TO TARGET		PRECOMP	INFLIGHT	PRECOMP	INFLIGHT	PRECOMP	INFLIGHT	PRECOMP	INFLIGHT	PRECOMP	INFLIGHT
IP TO TARGET	T.C.										
IP TO TARGET	DRIFT										
IP TO TARGET	T.H.										
IP TO TARGET	M.H.										
IP TO TARGET	G.S.										
IP TO TARGET	DISTANCE										
IP TO TARGET	TIME / TG	/	/	/	/	/	/	/	/	/	/
ALTITUDE COMPUTATION	POSITION										
ALTITUDE COMPUTATION	ELEVATION										
ALTITUDE COMPUTATION	MEASURED ALTITUDE										
ALTITUDE COMPUTATION	TRUE ALTITUDE										
ALTITUDE COMPUTATION	$D_2 - D_1$										
ALTITUDE COMPUTATION	ADJUSTED TRUE ALTITUDE										
ALTITUDE COMPUTATION	OAP ELEVATION										
ALTITUDE COMPUTATION	ABSOLUTE ALT SETTING										
ALTITUDE COMPUTATION	ADJUSTED TRUE ALTITUDE										
ALTITUDE COMPUTATION	TGT ELEV										
ALTITUDE COMPUTATION	BOMB ALT										
TYPE BOMB											
T.A.S.											
Q FACTOR/INTERVAL											
TRAIL											
A.T.F.											
RELEASE	T.H. / T.A.S.										
RELEASE	WIND NS / EW										
RELEASE	TIME / FRAME#										
RELEASE	RUN TYPE / CLASS										
RELEASE	SCORE CODED / C.E.										
ACFT CONTROL	METHOD OF RELEASE										

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Figure A11-2. (Sheet 4 of 4 Sheets)

g. ATO Fire Speed (Fire ATO IAS). Indicated airspeed in knots at which ATO, if used, is to be fired. (Refer to part 3.)

h. Takeoff Speed (Takeoff IAS). Indicated airspeed in knots at which the main gear leaves the ground. (Refer to part 2.)

i. Best Climb Speed (Climb IAS). Indicated airspeed in knots at start of climb for maximum rate of climb on six engines at applicable climb rpm schedule. (Refer to part 5.)

3. LANDING DATA

a. Stopping Distance - Brakes Only (Stop Distance). Distance in feet from airplane touchdown to full stop using brakes only. (Refer to part 10.)

b. Start Final Approach Speed (Start Final IAS). Recommended indicated airspeed in knots for beginning final approach. Best Flare IAS + 15 knots = Start Final IAS. (Refer to section II.)

c. Best Flare IAS. Recommended indicated airspeed in knots for starting final rotation of the airplane to the touchdown attitude. (Refer to part 10.)

MISSION FLIGHT PLAN

The Mission Flight Plan consists of four sections. Section I is the Navigation Preflight Plan (figure A11-2, sheet 1) to be completed by the observer prior to takeoff, using latest available metro data. Section II, Bombing Data (figure A11-2, sheet 2), is used to record complete precomputed data for bomb runs on five different targets using forecast weather data. It is also to be used in flight to recompute complete bombing data for each target based on latest weather data secured prior to reaching the IP, and to record the necessary information at release. Section III, Aircraft Performance Preflight Plan (figure A11-2, sheet 3), consists in part of a copy of the Navigation Preflight Plan. The form is so arranged that this portion may be completed simultaneously with Section I by use of carbon paper. The remainder of Section III consists of the Aircraft Performance Preflight Plan to be computed by the copilot after completion of the Navigation Preflight Plan. Section IV is the Flight Progress Chart and Log (figure A11-2, sheet 4) and is used by the copilot to record actual performance in flight versus predicted performance.

PRE-FLIGHT PLANS- NAVIGATION AND AIRCRAFT PERFORMANCE

The following portions of the Pre-Flight Plans are filled out in duplicate using carbon paper:

1. All items at the top of the form and along the right side will be filled out completely by the pilot and observer during the preflight planning phase to properly identify the crew and mission concerned.

a. Squadron and Wing	Enter squadron and wing number.
b. Airplane Type and Serial	Enter type and the last four digits of the airplane serial number.
c. Crew Number	Enter the crew number.
d. Acft Comdr	Enter the aircraft commander's name and grade.
e. Observer	Enter the observer's name and grade.
f. Co-Pilot	Enter the copilot's name and grade.
g. Date of Take-Off	Enter local date of takeoff.
h. Engine Start	Enter actual time engines are started.
i. Take-Off Time	Enter actual takeoff time.
j. Landing Time	Enter actual landing time.
k. Duration of Flt	Enter actual flight time.

2. Each line on the flight plan provides for the navigation plan for one leg.

a. Route — Enter departure point in the "FROM" block. The first line will be used to record the total predicted fuel used for starting engines, taxiing, takeoff, and acceleration to climb speed. The second line will be used to plan the initial climb to altitude. The terminal point of each leg will be entered on the appropriate line. The terminal point for the leg will be the departure point for the next leg.

NOTE

Climb level off point will be used as a terminal point.

The initial point of a leg will also be identified by the appropriate abbreviation if it is the beginning of a particular phase of the mission; e.g., Dept (for departure point), LO (level off), TP (turning point), BR (bomb run), BA (bombs away), IFR (air refueling), etc.

b. Flt Cond — Enter an abbreviation to denote the flight condition for the leg:
- CL - Climb
- CR - Cruise
- CC - Cruise-Climb
- DS - Descent
- LD - Landing

c. T.C.	Enter intended true course in three digits.
d. Wind D/V. and Drift	Enter best available metro wind above the hairline and drift correction below the hairline.
e. T.H.	Enter true heading in three digits.
f. Var.	Enter average variation for the leg.
g. M.H.	Enter magnetic heading in three digits.
h. Temp	Enter forecast temperature in degrees Centigrade.

i. Alt	Enter planned pressure altitude for end of leg.
j. Mach	Enter planned Mach number.
k. T.A.S.	Enter planned true airspeed in knots.
l. G.S.	Enter ground speed in knots.
m. Grd Dis	Enter ground distance of leg in nautical miles.
n. Acc. Grd Dis	Enter accumulated total of the ground distance in nautical miles to the end of the leg.
o. Time	Enter time required for the leg.
p. Acc. Time	Enter the accumulated total of time to the end of the leg.
q. Air Dis	Enter air distance of the leg in nautical miles.
r. Acc. Air Dis	Enter accumulated air distance in nautical miles.
s. ETA	Enter estimated time of arrival or control time for the end of the leg.

The preflight plans will then be separated and completed as follows:

3. Navigation Preflight Plan.

a. Remarks	Enter pertinent remarks.
b. APN-76	Enter settings to be used by B-47.
c. APN-12	Enter setting to be used by the tanker.
d. APN-11	Enter code to be transmitted to tanker.
e. APN-69	Enter codes to be transmitted by the B-47.

4. Aircraft Performance Preflight Plan.

The airplane weight and computed takeoff performance data will be recorded in the spaces provided.

a. Aircraft Basic Wt	Enter basic weight of airplane.
b. Crew Wt	Enter weight of crew.
c. Oil Wt	Enter total weight of engine oil.
d. ATO Btl Weight (Empty)	Enter total weight of empty ATO bottles (if applicable).
e. Ext Tanks Wt (Empty)	Enter total weight of empty external wing tanks (if applicable).
f. Operating Wt	Enter sum of items "a" through "e."
g. FM	Enter weight of fuel in forward main tank.
h. CM	Enter weight of fuel in center main tank.
i. AM	Enter weight of fuel in aft main tank.
j. Fwd Aux	Enter weight of fuel in forward auxiliary tank.
k. BB	Enter weight of fuel in bomb bay tank(s).
l. ATO	Enter weight of fuel in ATO (aft auxiliary) tank.
m. Ext	Enter weight of fuel in external tanks.
n. Total	Enter total weight of fuel; sum of items "g" through "m."
o. Bombs Wt	Enter weight of bombs.
p. Ammo Wt	Enter weight of ammunition.
q. ADI Fluid Wt	Enter weight of water injection fluid.
r. Initial Gross Wt	Enter airplane weight before starting engines; sum of items "f," "n," "o," "p," and "q."
s. Start Eng and Taxi Fuel Alw	Enter the predicted fuel to be used for starting engines and taxiing to takeoff position. Refer to part 13 for ground fuel consumption.
t. Take-Off Gross Wt	Enter airplane weight at takeoff; subtract item "s" from "r."
u. Runway Press. Alt, Length, Air Temp	Enter the pressure altitude, length of runway to be used, and runway air temperature in degrees Fahrenheit.
v. Critical Field Length	Enter total length of runway required (no wind) to accelerate on all engines to refusal speed, lose one engine, and then continue takeoff or stop. (Refer to part 2.)
w. Take-Off Distance, Take-Off Speed	Enter normal takeoff ground run (no wind, no engine failure, no ATO) and recommended indicated airspeed at which airplane will become airborne. (Refer to part 2.)
x. Speed	
(1) Refusal	Enter the highest speed to which the airplane can be accelerated and then braked to a stop at the end of the runway. (Refer to part 4.)
(2) Emerg Best Flare	Enter best flare indicated airspeed (flaps down) at takeoff gross weight. This will be used in event of emergency landing immediately after takeoff (figure A10-3.)
(3) Line	Enter indicated airspeed at line distance down runway. (Refer to part 2.)

y. If it is necessary to use ATO for takeoff, enter empty weight of ATO bottles (item "4d"). Recompute operating weight (item "4r") and takeoff gross weight (item "4t"). In addition, complete the following:

(1) Number of ATO Bottles Required	Enter the number of ATO bottles to be used. (Refer to part 3.)
(2) ATO Propellant Weight	Enter total weight of ATO propellant to be used.
(3) Adjusted Takeoff Weight	Enter adjusted takeoff weight obtained by adding items "y(2)" and "4t."
(4) Adjusted Takeoff Distance	Enter takeoff distance required with ATO (no wind, no engine failure). (Refer to part 3.)
(5) ATO Firing Speed	Enter the indicated airspeed at which ATO bottles will be fired. (Refer to part 3.)

z. Pred. Fuel Remain.	(1) Enter predicted total fuel load (before starting engines) in pounds on the first line below the column heading. (2) Each line corresponding to a period of the mission is subdivided by a hairline. Above the hairline, enter predicted fuel used for the period. Below the hairline, enter predicted fuel remaining at the end of the period. (Refer to part 6.)
aa. Gross Weight	(1) Enter the predicted initial gross weight in pounds on the first line below the column heading. (2) Each line corresponding to a period of the mission is subdivided by a hairline. Above the hairline, enter predicted total weight expended during the period (fuel, water injection, ATO, bombs, ammunition, etc). Below the hairline, enter predicted gross weight at the end of the period.

BOMBING DATA

The Bombing Data form (figure A11-2, sheet 2) will be completed by the observer as follows:

1. Fill in the Preflight and Precomp Section of "Bombing Data."

a. Target Data:	
(1) Name	Enter the name of the target complex or range.
(2) A. P.	Enter the aiming point designation (letter, number, DGC), variation, elevation, and exact geographical coordinates (degree, minutes, and seconds).
b. I. P.	Enter name, variation, elevation, and geographical coordinates.
c. GPI Points	Name, variation, elevation, and geographical coordinates of GPI points enroute to Targets.
d. Offset Data:	
(1) Name	Enter name and elevation of each selected offset aiming point.
(2) Lat and Long.	Enter coordinates of offset aiming point in degrees, minutes, and seconds of latitude and longitude.
(3) N-S E-W	Enter the N-S and E-W components of offset from target to aiming point in feet.
e. I. P. to Target:	(PRECOMP COLUMN ONLY)
(1) T. C.	Enter true course from IP to target.
(2) Drift	Enter drift for bomb run.
(3) T. H.	Enter true heading for bomb run.
(4) M. H.	Enter magnetic heading.
(5) G. S.	Enter ground speed in knots.
(6) Distance	Enter distance from IP to target.
(7) Time/T. G.	Enter time required to fly from IP to target, TG (time in seconds from fixed angle bombing table between 10 mile mark and release point).
f. Altitude Computations:	(PRECOMP COLUMN ONLY)
(1) Position	Enter position to be used to measure altitude.
(2) Elevation	Enter elevation of above position.
(3) Measured Altitude	Enter planned calibrated pressure altitude.
(4) True Altitude	Enter planned calibrated pressure altitude plus or minus D1. (Planned true altitude).
(5) D2-D1.	Enter pressure difference between target (D2) and point at which altitude is to be measured (D1).
(6) Adjusted True Altitude	Enter planned true altitude plus or minus (D2-D1).
(7) OAP Elevation	Enter OAP elevation.
(8) Absolute Setting	Enter adjusted true altitude minus OAP elevation.
(9) Adjusted True Altitude	Enter planned true altitude plus or minus D2-D1.
(10) Target Elevation	Enter target elevation.
(11) Bombing Altitude	Enter adjusted true altitude minus target elevation.
g. Type Bomb	Enter type bomb.
h. True Airspeed	Enter planned TAS for bomb run.
i. Q Factor	Enter Q Factor for area.
j. Trail	Enter trail in feet for the Q Factor, bombing altitude, TAS and type bomb used.
k. ATF	Enter computed ATF for Q Factor, bombing altitude, TAS, and type bomb used.

2. Prior to each Pre-IP, recompute the following information and enter it in the INFLIGHT section of the Bombing Data Form.

a. I. P. to Target:	(In Flight)
(1) T. C.	Enter true course from IP to target.
(2) Drift	Enter drift for bomb run.
(3) T. H.	Enter true heading for bomb run.
(4) M. H.	Enter magnetic heading.
(5) G. S.	Enter ground speed in knots.
(6) Distance	Enter distance from IP to target.
(7) Time/T. G.	Enter time required to fly from IP to target, TG (time in seconds from fixed angle bombing table between 10 mile mark and release point).

b. Altitude	(In Flight)
(1) Position	Enter position used to measure altitude.
(2) Elevation	Enter elevation of above position.
(3) Measured Altitude	Enter measured radar altitude.
(4) True Altitude	Enter measured radar altitude plus elevation of position.
(5) D2-D1.	Enter pressure difference between target and point at which altitude was measured.
(6) Adjusted True Altitude	Enter true altitude plus or minus (D2-D1).
(7) OAP Elevation	Enter OAP elevation.
(8) Absolute Setting	Enter adjusted true altitude minus OAP elevation.
(9) Adjusted True Altitude	Enter true altitude plus or minus D2-D1.
(10) Target Elevation	Enter target elevation.
(11) Bombing Altitude	Enter adjusted true altitude minus target elevation.
c. Type Bomb	Enter type bomb.
d. True Airspeed	Enter TAS for bomb run.
e. Q Factor/Interval	Enter Q Factor (if applicable).
f. Trail	Enter trail for bombing altitude and TAS over TGT.
g. ATF	Enter ATF for bombing altitude and TAS over TGT.

CAUTION

Compare bombing altitude and ballistics computed in flight with precomp data. Any major discrepancy should be reconciled before starting bomb runs.

3. Fill out the Release section of the Bombing Data Form after each bomb run.

a. T.H.	Enter T.H. At Release.
b. TAS	Enter TAS At Release.
c. Wind	Enter N-S and E-W components of wind.
d. Time	Enter time of Release (GMT).
e. Frame Number	Enter O-15 and O-23 frame number at release.
f. Run Type	Enter run type coded.
g. Class	Enter run classification coded.
h. Score coded	Enter coded score received from RBS site or range if applicable.
j. CE	Enter circular error.
k. Aircraft Control	Enter Auto or Manual.
l. Method of Release	Enter Auto or Manual.

PILOT FLIGHT PROGRESS CHART AND LOG

Pilot Flight Progress Chart and Log (figure A11-2, sheet 2) will be used by the pilot and copilot to record the actual performance data in flight as follows:

1. Flight instrument readings will be taken over the check points indicated in the mission flight plan or once every hour after takeoff and recorded in the space provided.

a. Time	Record actual time over check point.
b. IAS	Record average indicated airspeed for the period.
c. Mach	Record average Mach number for the period.
d. Alt	Record flight pressure altitude at end of period.
e. OAT	Record the average indicated flight level outside air temperature for the period in degrees Centigrade.
f. Avg RPM	Record the average rpm of the engines for the period.
g. Abnor. Read.	Record any abnormal exhaust gas temperature, fuel, or oil pressure.
h. FM	Record fuel remaining in forward main tank in hundreds of pounds.
i. CM	Record fuel remaining in center main tank in hundreds of pounds.
j. AM	Record fuel remaining in aft main tank in hundreds of pounds.
k. Aux	Record estimated total fuel remaining in all auxiliary tanks in hundreds of pounds.
l. Tot.	Record total fuel remaining by adding items "h" through "k."

2. Charts are included to aid the pilot in determining the required rpm for the indicated OAT to obtain Mach .74 and the basic airspeed for Mach .74 at different altitudes.

3. The percent of planned fuel used from starting engines to shutting down engines and air distance flown will be entered in the spaces provided at the conclusion of the mission.

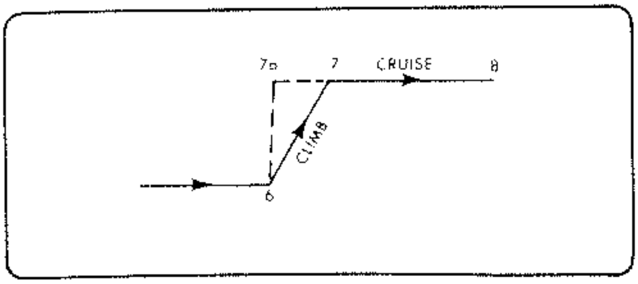
4. The Flight Progress Chart ("Go, No Go" curve) is a plot of fuel remaining vertically against the time horizontally. Information from the preflight plan is plotted upon the graph prior to flight. The resulting curve will be utilized as an in-flight "Go, No Go" curve.

5. In-flight fuel readings will be plotted upon the graph. The actual time and name of check point will be entered in the spaces provided along the bottom. In this manner, flight performance can be analyzed against the predicted fuel curve. This will aid in formulating in-flight decisions.

CLIMB OR DESCENT

If an altitude change is desired, such as just before or after the target, the beginning and end of change are considered as check points.

1. For climbs enroute, it is usually convenient and sufficiently accurate to consider that the cruise is continued over the check point at which the climb starts. Then find the fuel allowance for the climb between the two altitudes from figure A11-3. Add this allowance to the gross weight over the check point to find the actual gross weight at the beginning of the climb. The method is similar to that for climb fuel allowance after takeoff. The following sketch illustrates this point.



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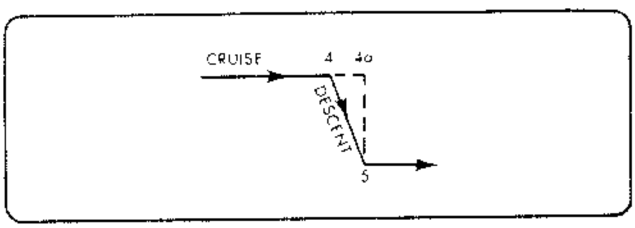
Working backward from check point 8, find the hypothetical weight at step 7a as though the cruise began there. Add to it the climb fuel allowance, from figure A11-3, to obtain the weight at check point 6. Then, if desired, find the true conditions at point 7, using part 5.

2. For a normal six-engine gear-down, or an alternate four-engine gear-up descent enroute, it will be convenient and quite accurate to assume that the same amount of fuel is used during descent as would be used in continuing the high altitude cruise.



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Thus, in the above sketch, the gross weight at the end of descent (check point 5) is the same as that at step 4a, assuming that the cruise is continued to that point. This is true for the gear-down descent because of the high rate of descent and the correspondingly short distance covered. It is also true for the alternate gear-up descent because, although the rate of descent is low and the distance long, only four engines are operating.

CARGO OR BOMB DROP

When the mission has been computed back to the weight at the end of the bomb drop, the bomb load and the evasive action fuel (if any) are added to obtain the weight prior to the bombing. Since the load changes suddenly, the weights just before and just after the drop must be considered as check points.

EVASIVE ACTION

Evasive action is usually considered within the interval of the bomb drop, but may be inserted anywhere in the mission by listing its beginning and end as check points. The fuel consumption curves in part 13 are used for this fuel allowance.

BOMB RUN

The bomb run is considered as a leg, flown at high speed cruise between two check points, with the bomb drop as the end check point. The fuel can be obtained from the fuel consumption curves in part 13 if the run is specified in minutes, or from the nautical miles per 1000 pounds chart in part 6 if the length of the run is given in miles.

The remainder of the mission, back to a point over the takeoff base, is calculated in the manner described above. The gross weight over the takeoff base must then be corrected for the climb, takeoff, and ground fuel allowances.

TAKEOFF BASE CALCULATIONS

1. Acceleration and Climb Fuel Allowance: Using the gross weight and cruise altitude over the takeoff base, refer to figure A11-3 to find the acceleration and climb allowance as described in paragraph "Climb or Descent." For convenience in computing the mission, this fuel allowance, when added to the gross weight at cruising altitude over the takeoff base, gives the true gross weight immediately after takeoff. This allowance is based on a climb at normal rated (96% rpm) power.

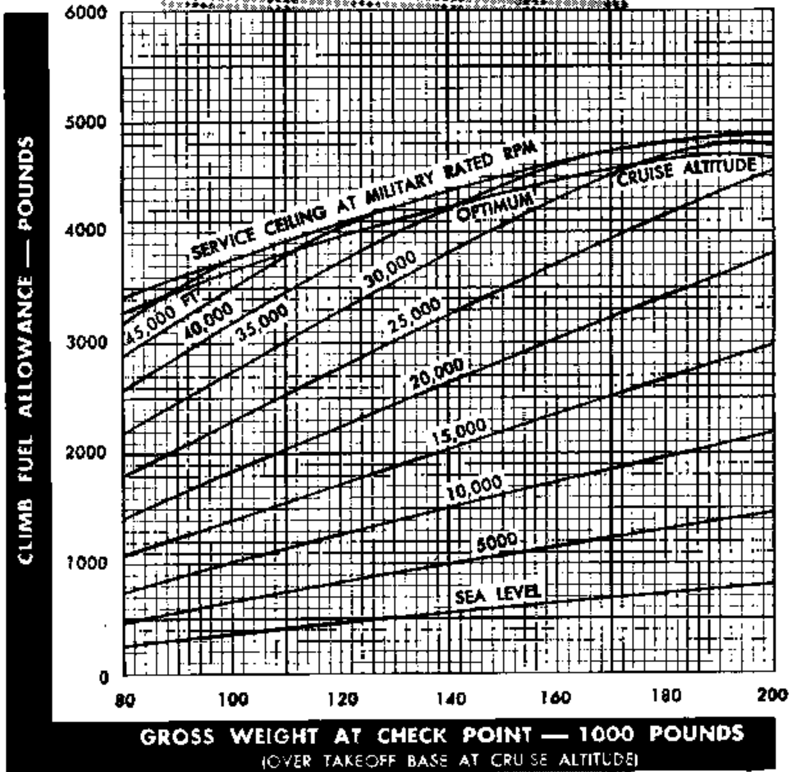
2. Starting, Taxi, Runup, and Takeoff Fuel Allowance: Use the chart for ground operation in part 13. Estimate the time required for each operation and find the total ground fuel used. The fuel load on board and the gross weight before starting engines are obtained by adding this allowance to the previous fuel and gross weight.

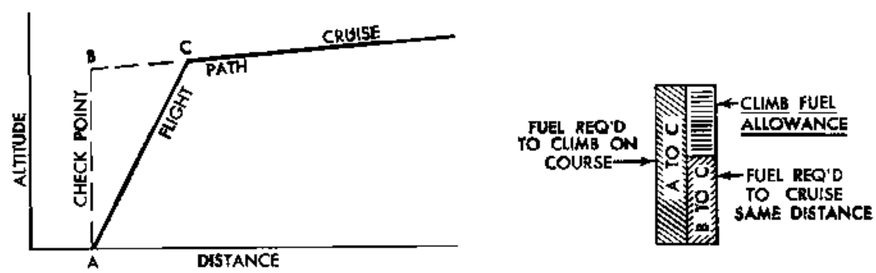
3. If ATO is used, the weight of the fuel charge in each solid fuel rocket is 80 pounds.

ACCELERATION & CLIMB FUEL ALLOWANCE

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A





DATE: SEPTEMBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:

NORMAL RATED RPM BELOW CRUISE ALTITUDE

MILITARY RATED RPM ABOVE CRUISE ALTITUDE

TAKEOFF ON COURSE

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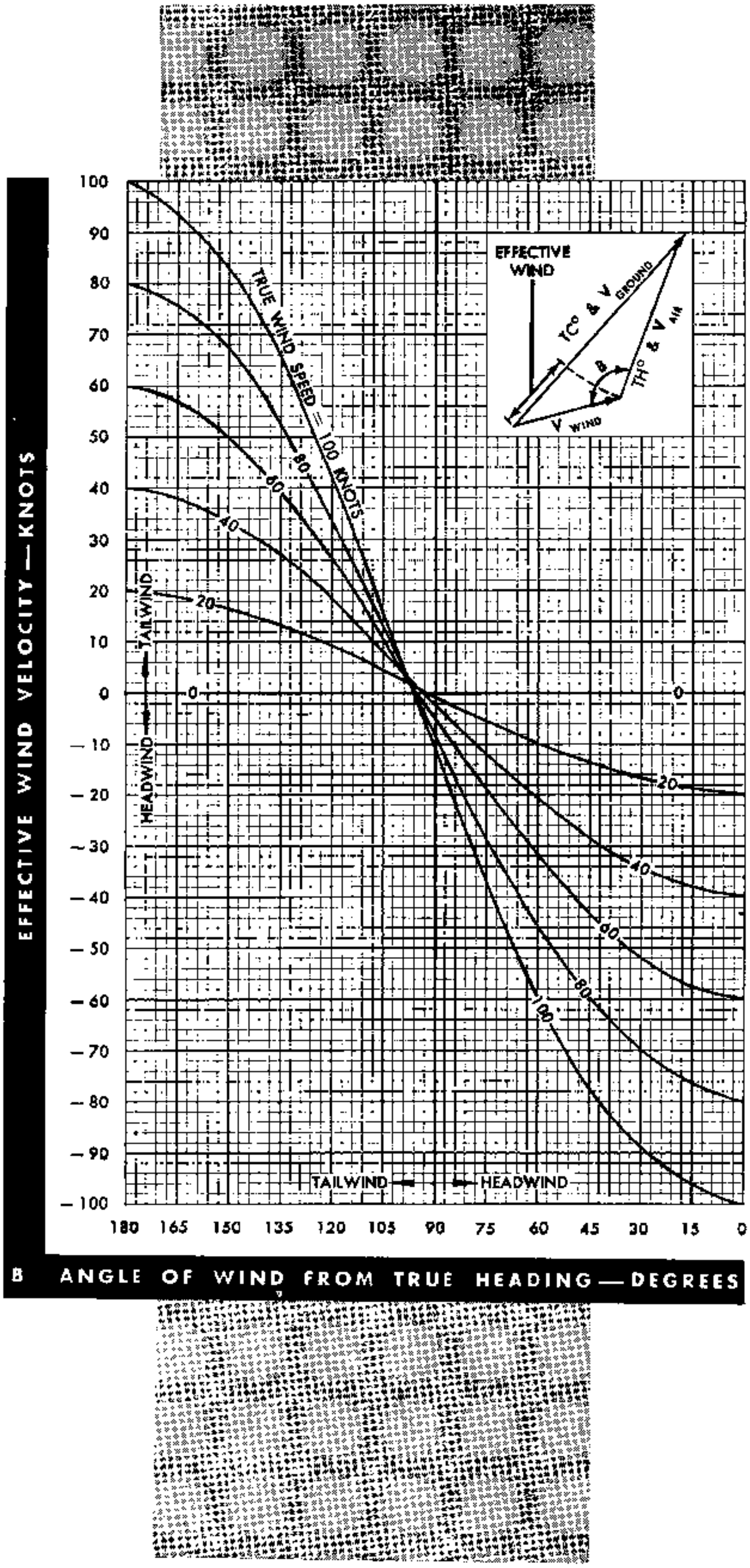
Figure A11-3.

EFFECTIVE WIND



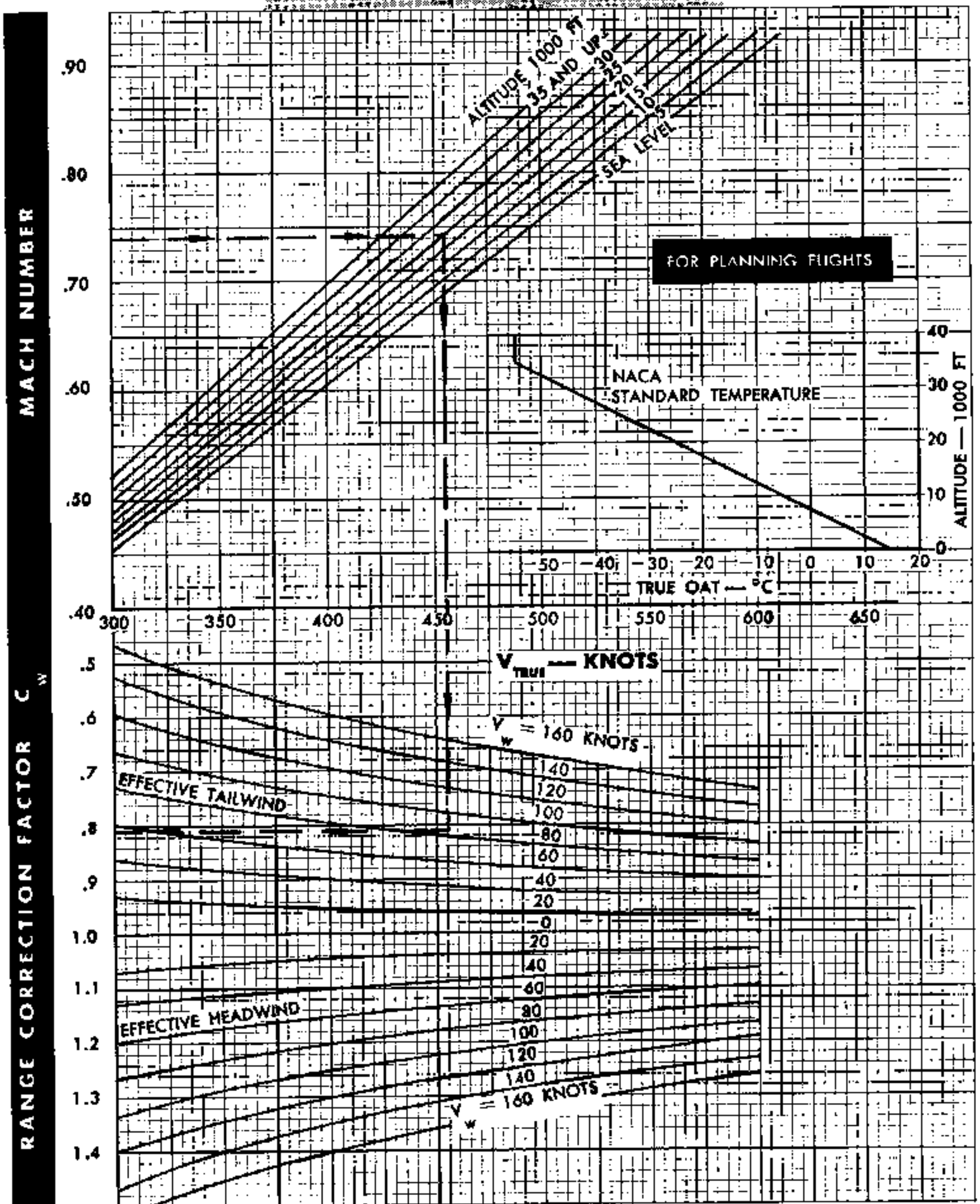
DATE: JUNE 1950

DATA BASIS: CALCULATED

1102C-1

Figure A11-4.

RANGE CORRECTION FOR WIND OVER GIVEN WEIGHT CHANGE



REMARKS:

FACTOR APPLIED TO RANGE WITH WIND GIVES NO-WIND RANGE FOR SAME WEIGHT CHANGE

APPLIES TO ANY JET AIRPLANE

$RANGE_{NO\ WIND} = C_{NW} \times RANGE_{WIND}$

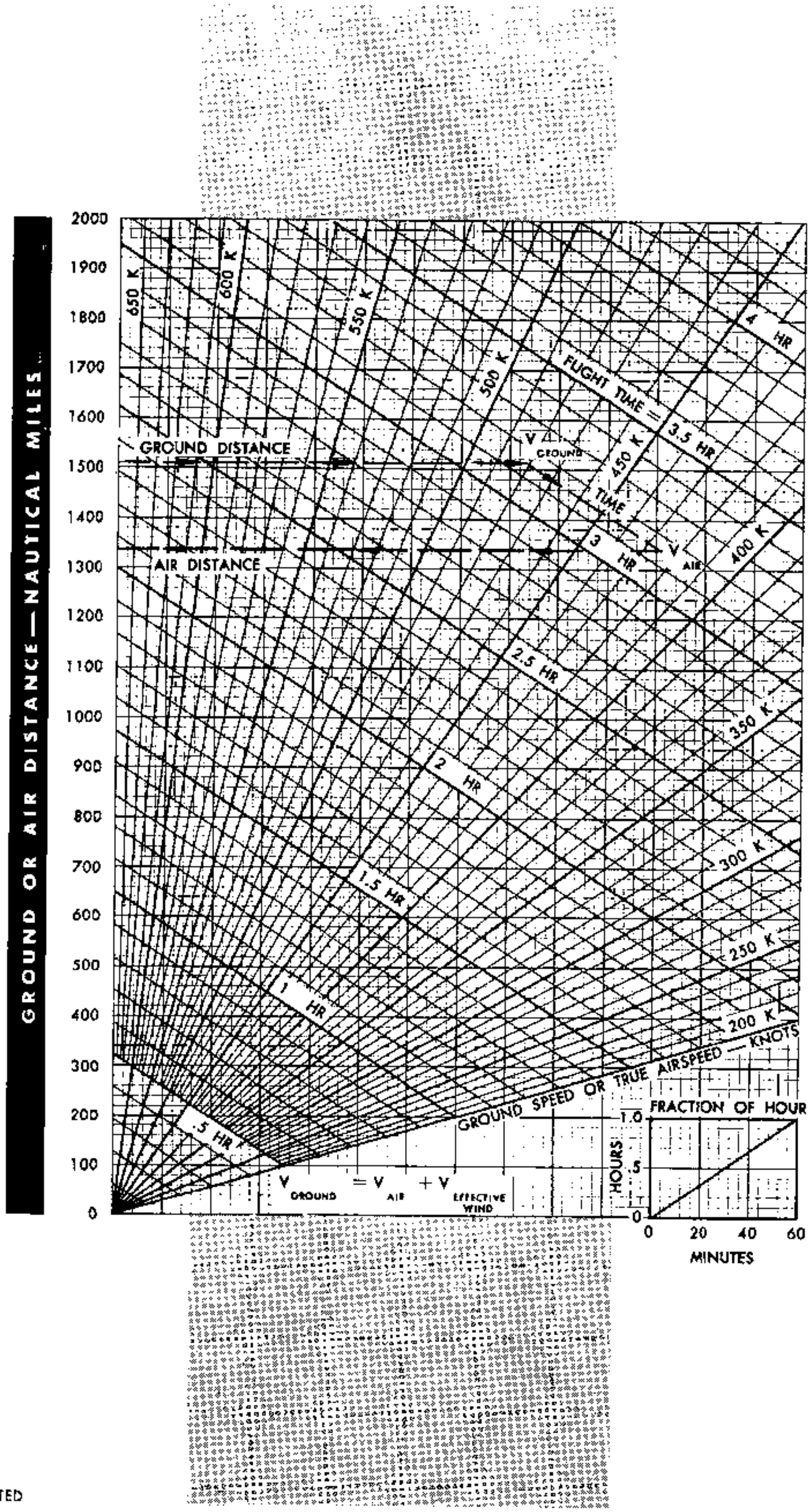
DATE: JUNE 1951

DATA BASIS: CALCULATED

1103C-1

Figure A11-5.

DISTANCE - SPEED - TIME



DATE: JUNE 1950

DATA BASIS: CALCULATED

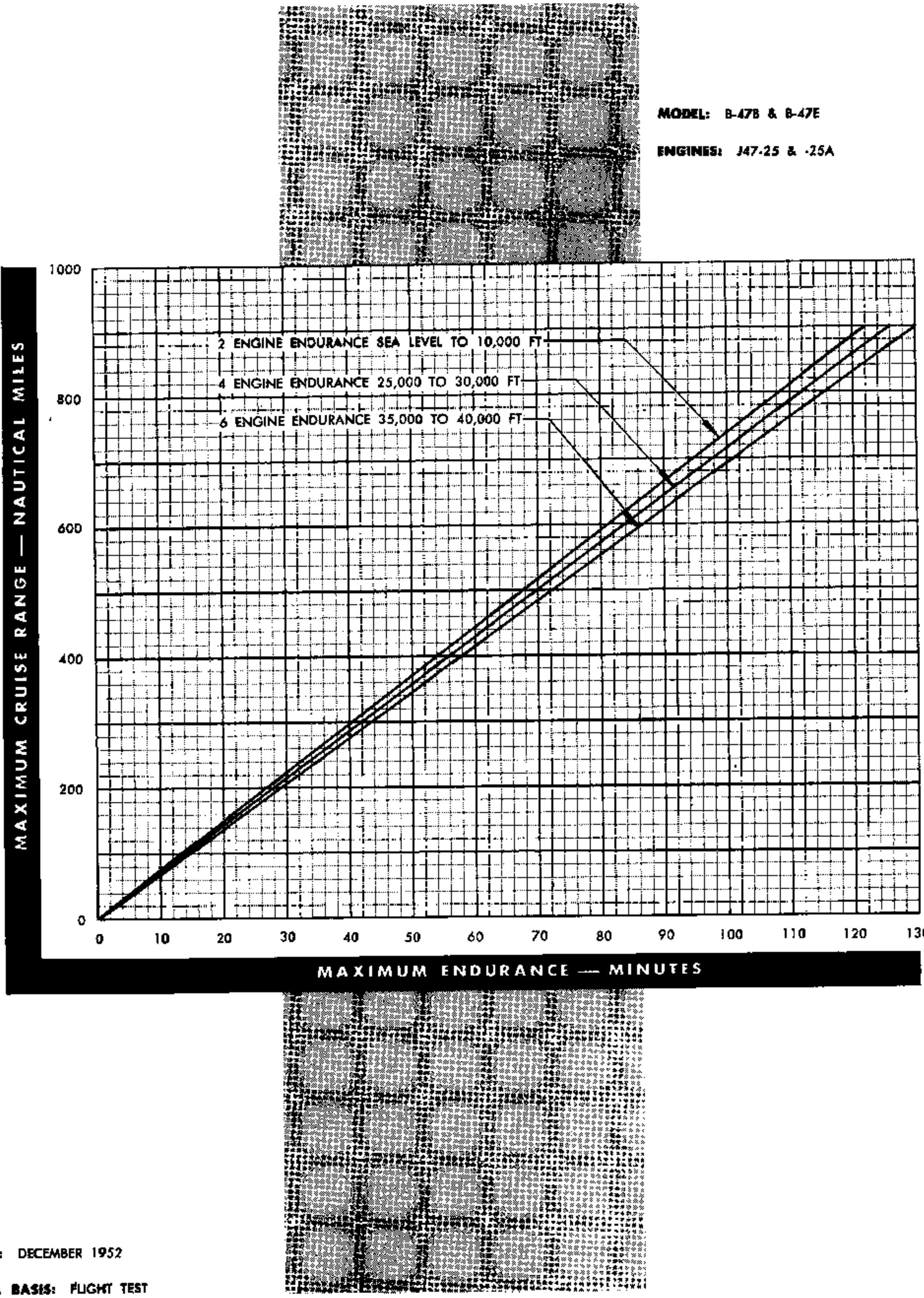
1104C-1

Figure A11-6.

RANGE - ENDURANCE CONVERSION

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

T105C-1

Figure A11-7.

Part 12 flight limitations

This section contains information and recommendations to enable the pilot to obtain the maximum performance and safety from this airplane without exceeding the inherent limitations imposed by structural design, high speed buffeting, or the stall.

BUFFET BOUNDARY IN LEVEL FLIGHT

Mach limitations in level flight are established by gross weight and altitude. Figure A12-1 gives these limitations for speed and altitude. High speed buffeting occurs to the right of the peaks of the curves and low speed buffeting or stall warning occurs to the left of the peaks of the curves. For maneuvering or operation at higher speed, the altitude must be reduced.

ACCELERATION LIMITATIONS

On figure A12-2 is a plot of the limitations imposed on the maneuvering "g's" by the structural design of the airplane. These limitations are established by gross weight for flaps up or flaps down.

BANK ANGLE LIMITS FOR INITIAL BUFFETING

Buffeting and pitch-up is more likely to be encountered while maneuvering the airplane at high altitude than in straight and level flight. The normal acceleration should be limited to that at which buffeting is first noted. The Mach number and angle of bank at which buffeting and pitch-up begins will vary with altitude and gross weight. A plot of bank angle limits is shown on figure A12-3. The time lag involved in establishing flow separation from the wing often enables a higher number of "g's" to be pulled in a quick pull-up than in a steady maneuver.

CG AND GROSS WEIGHT LIMITS

Since the forward and aft center of gravity limits are dependent upon gross weight the charts shown on figure A12-4 should be used to determine the cg limits for all operating conditions.

MACH NUMBER LIMIT

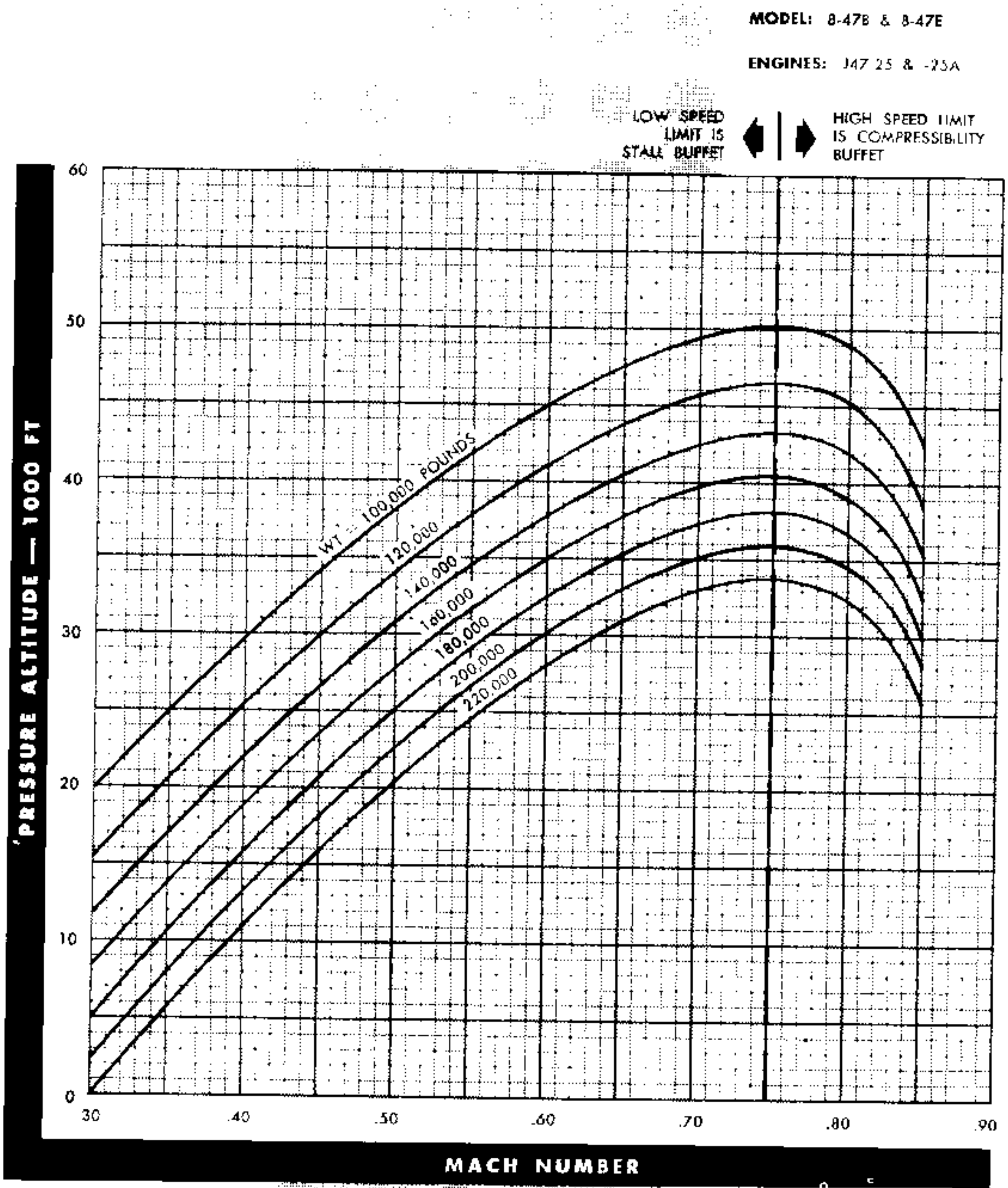
Maximum speed restrictions for airplanes which have the various modifications are presented on figure A12-5. A discussion of these restrictions may be found in section V.

TURBULENT AIR PENETRATION SPEEDS

For detailed discussion of turbulent air penetration recommendations reference should be made to section IX. The chart on figure A12-7 will show the recommended penetration speeds to be used at altitudes below approximately 5000 feet below optimum cruise altitude. During optimum cruise conditions or above the following rule may be used to determine the recommended penetration speed: Descend approximately 3000 to 5000 feet below optimum cruise altitude and maintain Mach .74.

It should be noted that an attempt to climb over a storm should not be made unless it is certain that the airplane can remain clear of turbulent areas and still retain safe margins for both low and high speed buffet.

BUFFET BOUNDARY IN LEVEL FLIGHT



DATE: APRIL 1954

DATA BASIS: FLIGHT TEST

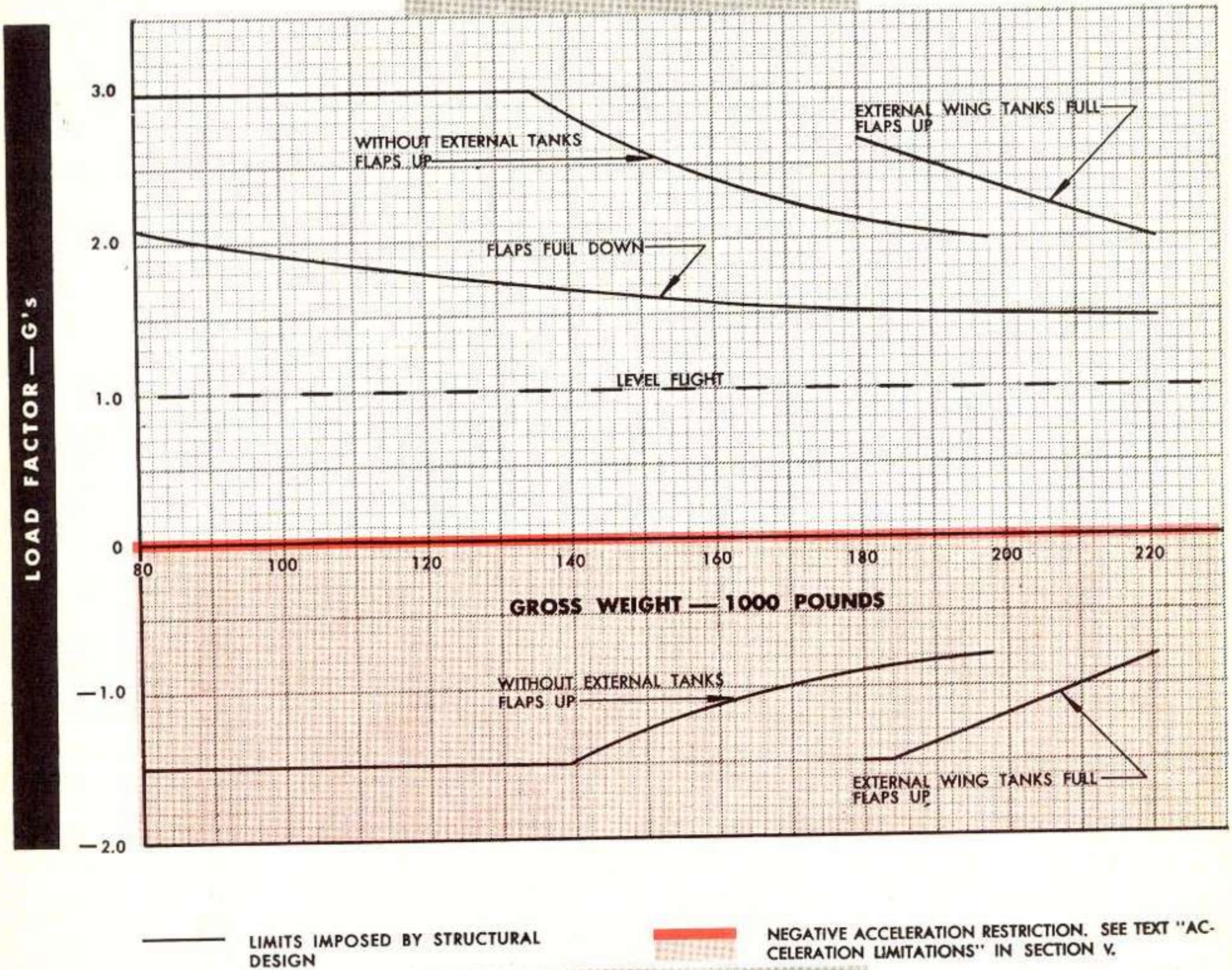
Figure A12-1.

1201C-1

ACCELERATION LIMITATIONS

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: FEBRUARY 1954

DATA BASIS: CALCULATED

1202C-1

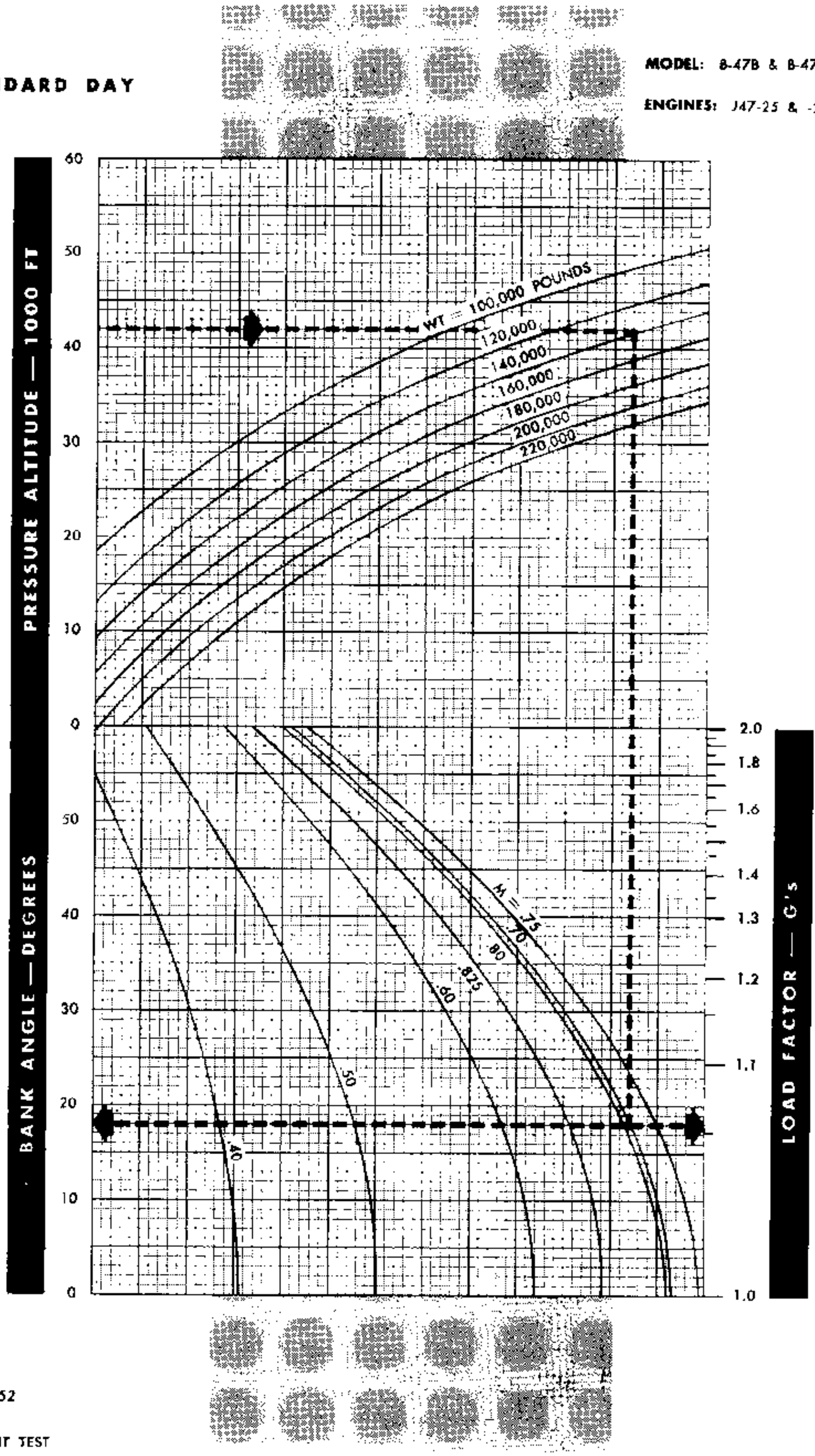
Figure A12-2.

BANK ANGLE LIMITS FOR INITIAL BUFFETING

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



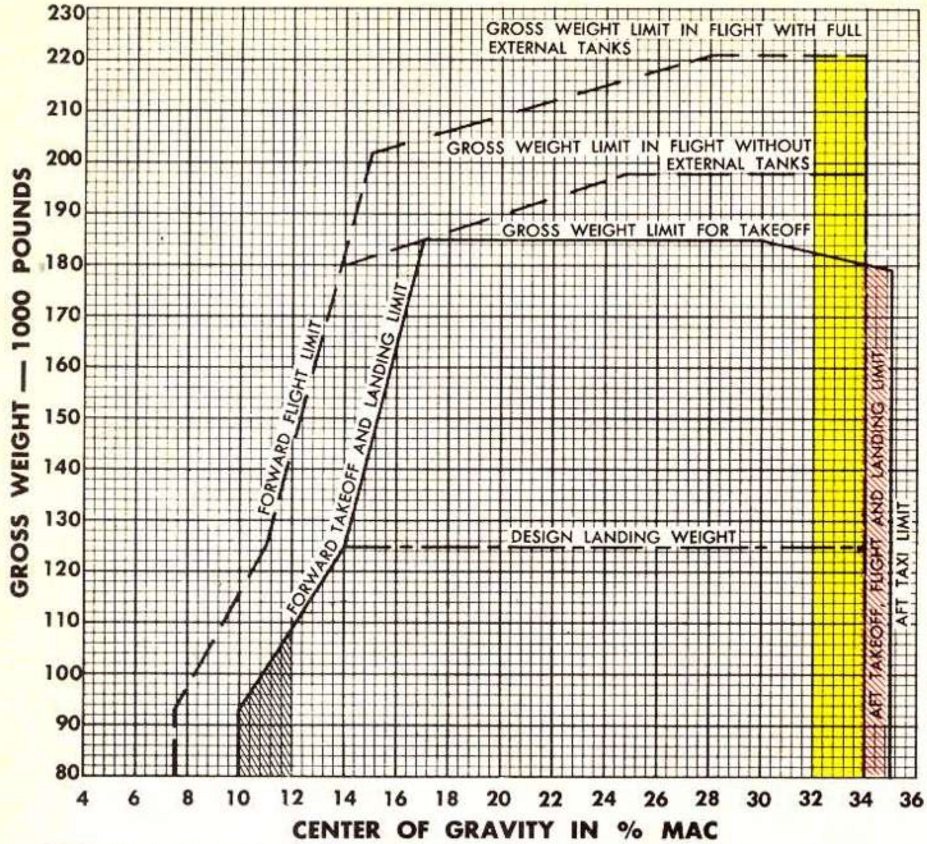
DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

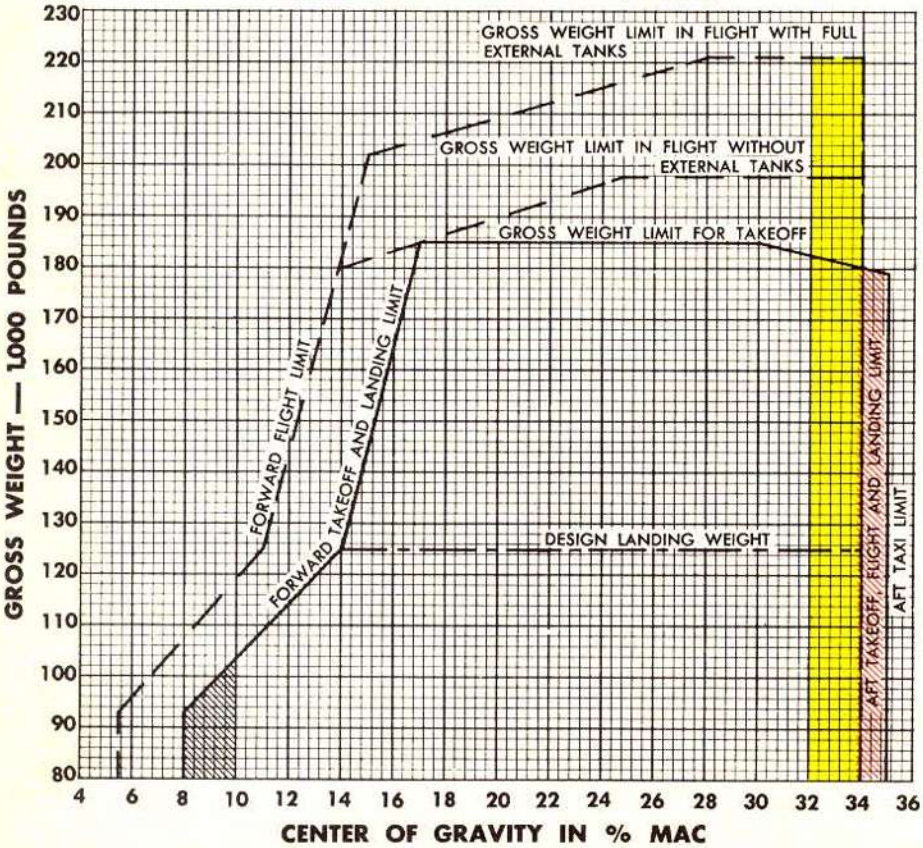
1203C-1

Figure A12-3.

CG & GROSS



AF 51-2357, -2359, -2363, -2400, -2410, -2412 thru -5245, -15804 thru -15812, 52-019 thru -070, -202 thru -247



AF 52-071 thru -081, -248 thru -260

DATE:
FEBRUARY 1954

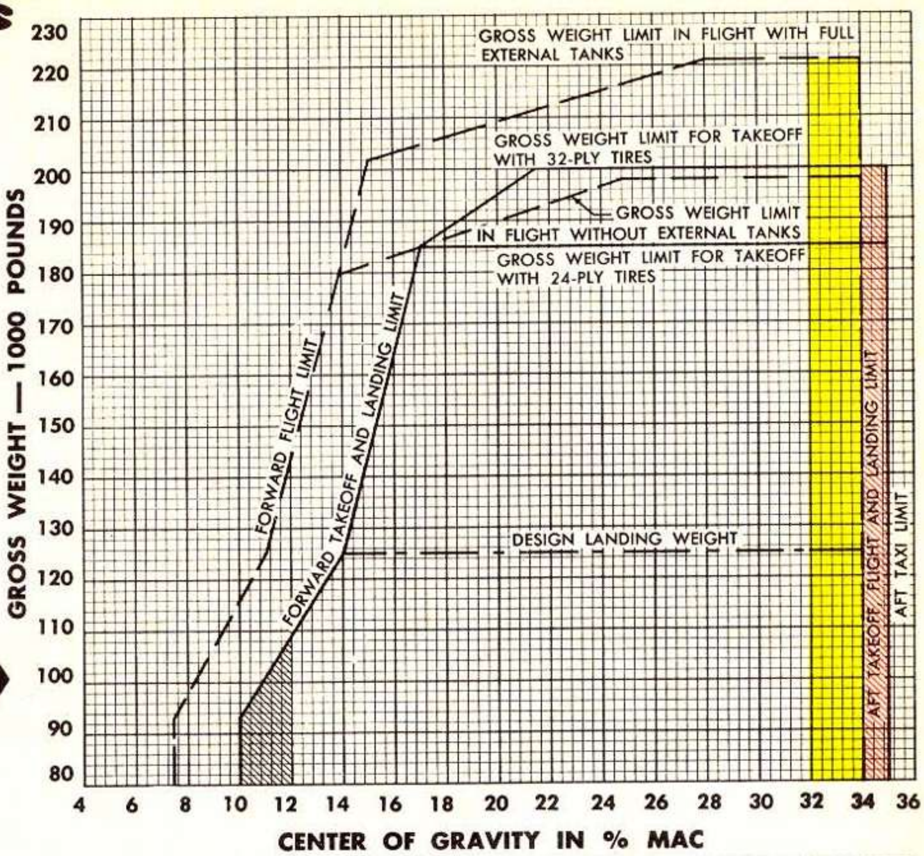
DATA BASIS:
FLIGHT TEST

REMARKS:
LENGTH OF MAC — 155.9 INCHES
POSITION OF MAC — LEADING EDGE OF MAC AT BODY STATION 584.8

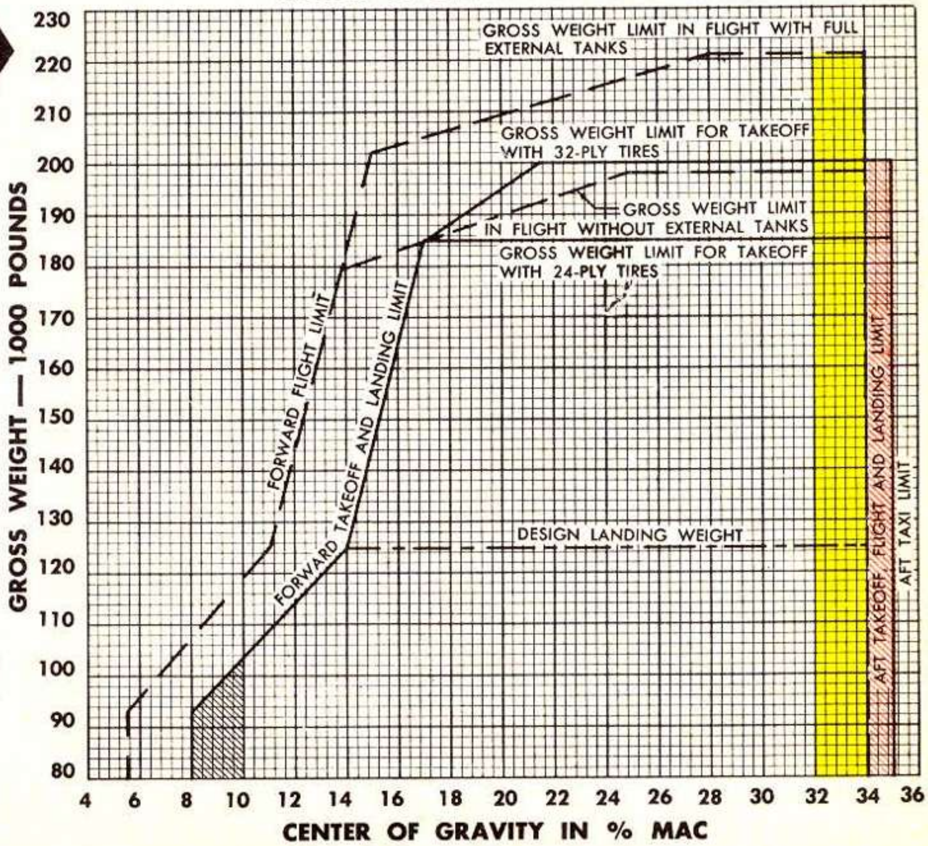
Figure A12-4. (Sheet 1 of 4 Sheets).

WEIGHT LIMITS

AF 51-5246 thru -7083, -17368 thru -17386



AF 51-2192 thru -2356, -2358, -2360 thru -2362, -2364 thru -2399, -2401 thru -2409, -2411, 52-082 thru -196, -198 thru -201, -261 thru -1405, -1407,-1408,-1410 thru -3369, -3371, 53-1973 thru -2040, -2261 thru -2278



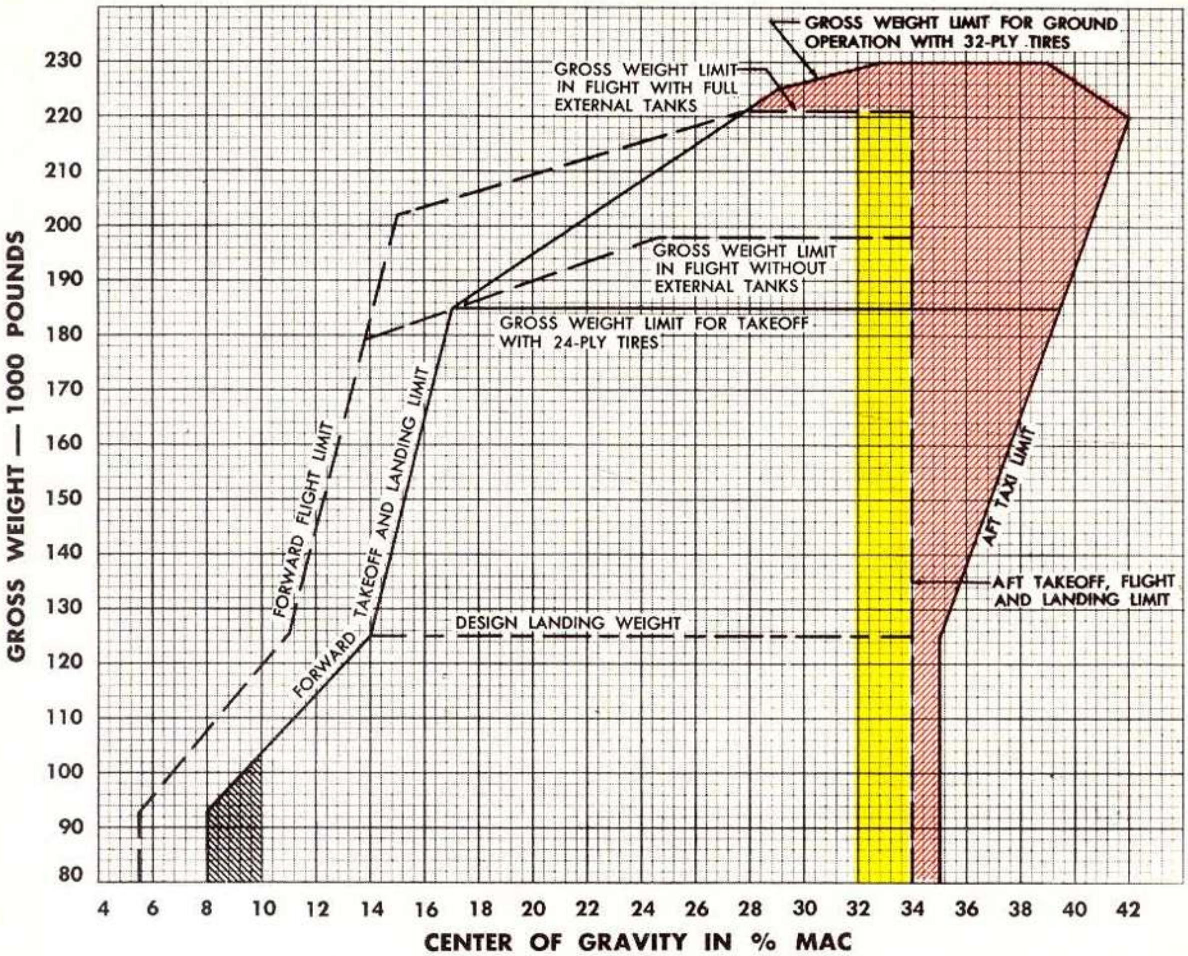
(Hatched) GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH C.G. IN THIS AREA.

(Yellow) WHENEVER CG FALLS IN THIS AREA FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA. MACH .76 SHALL NOT BE EXCEEDED WHILE IN THIS AREA.

(Red hatched) CG MAY EXIST IN THIS AREA DURING TAXI OPERATIONS ONLY.

Figure A12-4. (Sheet 2 of 4 Sheets).

CG & GROSS



GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH CG IN THIS AREA.

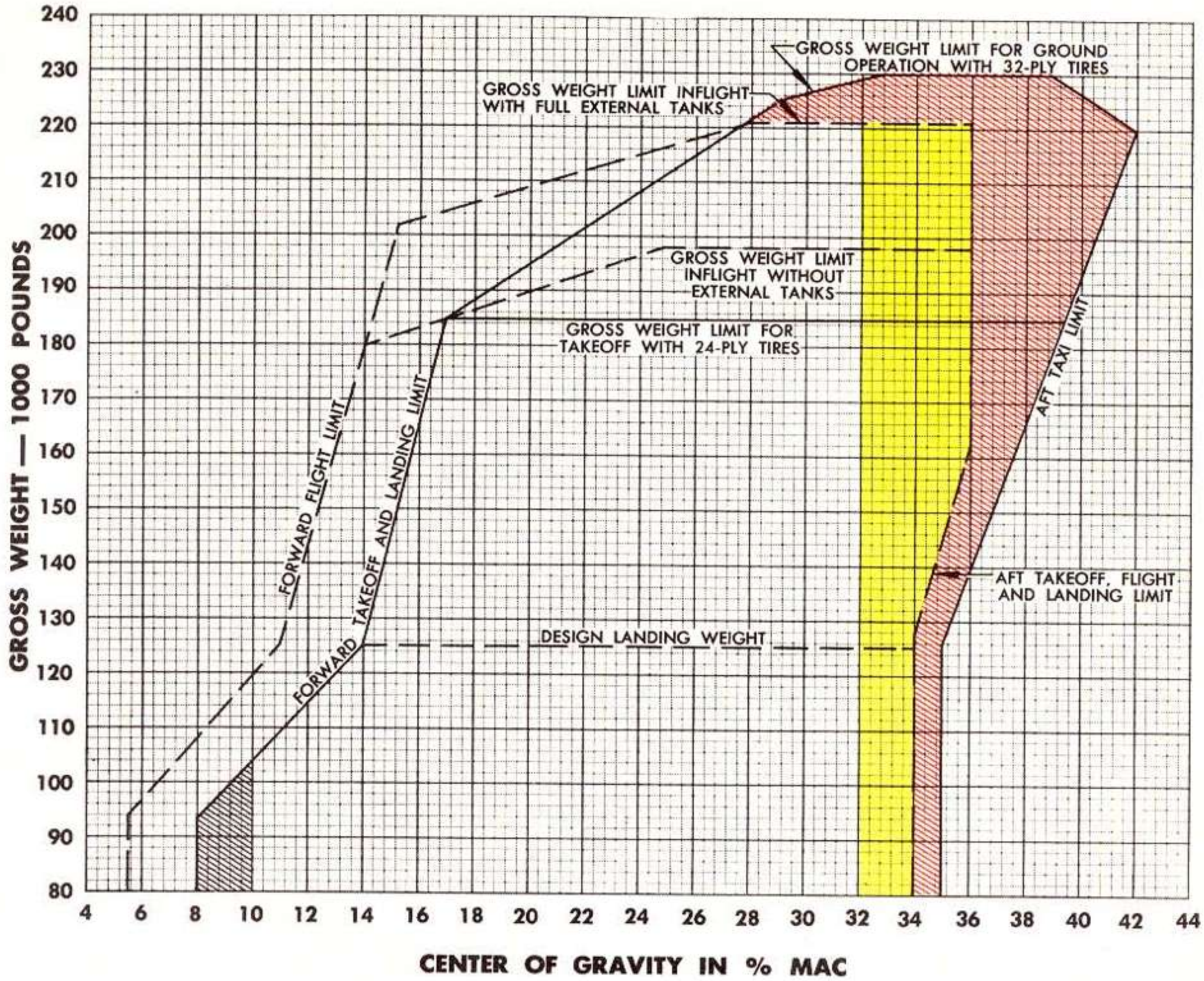
WHENEVER CG FALLS IN THIS AREA FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA. MACH .76 SHALL NOT BE EXCEEDED WHILE IN THIS AREA.

CG MAY EXIST IN THIS AREA DURING GROUND OPERATIONS ONLY.

AF 52-197, -1406, -1409, -3370, -3372 thru 53-1903, -2090 thru -2127, -2279 thru -2395

Figure A12-4. (Sheet 3 of 4 Sheets).

WEIGHT LIMITS



LEGEND

- GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH CG IN THIS AREA.
- WHENEVER CG FALLS IN THIS AREA FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA. MACH .76 SHALL NOT BE EXCEEDED WHILE IN THIS AREA.
- CG MAY EXIST IN THIS AREA DURING GROUND OPERATIONS ONLY.

AF 53-1904 thru -1972, -2128 thru -2170, -2396 & on

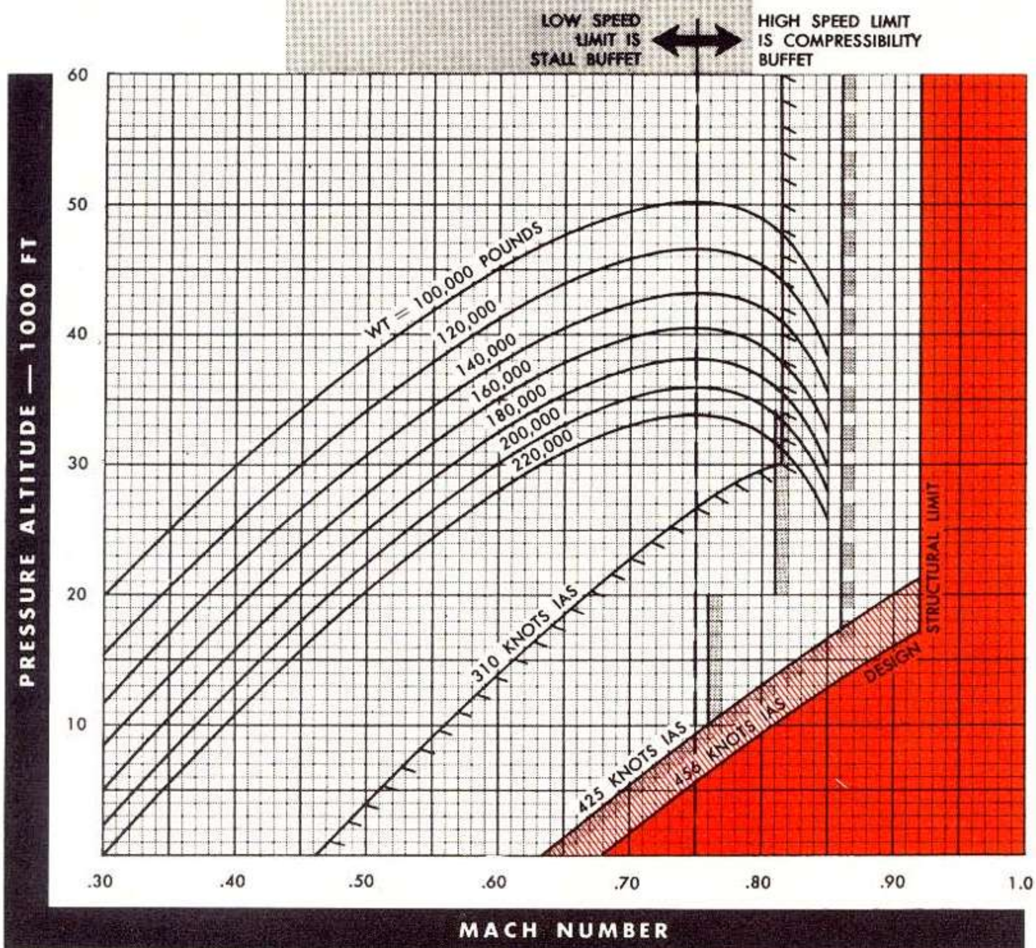
1204C-1

Figure A12-4. (Sheet 4 of 4 Sheets).

MACH NUMBER LIMIT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



ENGINE FAILURE LIMITATION

FLIGHT RESTRICTED ABOVE 310 KNOTS IAS OR M.815 WHICHEVER OCCURS FIRST ON AIRPLANES AF 51-15804 THRU -15812, 52-019 THRU -053, -202 THRU -244.

ELEVATOR SURFACE POWER CONTROL FAILURE LIMITATION

FLIGHT RESTRICTED ABOVE 425 KNOTS IAS OR M .76, WHICHEVER OCCURS FIRST, UP TO 20,000 FT. OR M .81 FROM 20,000 FT. TO 34,000 FT. OR INITIAL BUFFET ABOVE 34,000 FT. ON AIRPLANES AF 51-2357 THRU -7083, -17368 THRU -17386, 52-054 THRU -149, -245 THRU -311.

LATERAL CONTROL AND BUFFET LIMITATION

FLIGHT RESTRICTED ABOVE 425 KNOTS IAS OR INITIAL BUFFET OR M .86, WHICHEVER OCCURS FIRST, ON AIRPLANES AF 51-2192 THRU -2356, 52-150 THRU -201, -312 AND ON.

FLIGHT PROHIBITED ABOVE LATERAL CONTROL LIMIT OF 425 KNOTS IAS.

FLIGHT PROHIBITED ABOVE DESIGN STRUCTURAL LIMIT.

DATE: APRIL 1954

DATA BASIS: FLIGHT TEST

REMARKS:

BUFFET CURVES ARE FOR LEVEL FLIGHT IN STABLE AIR

1205C-1

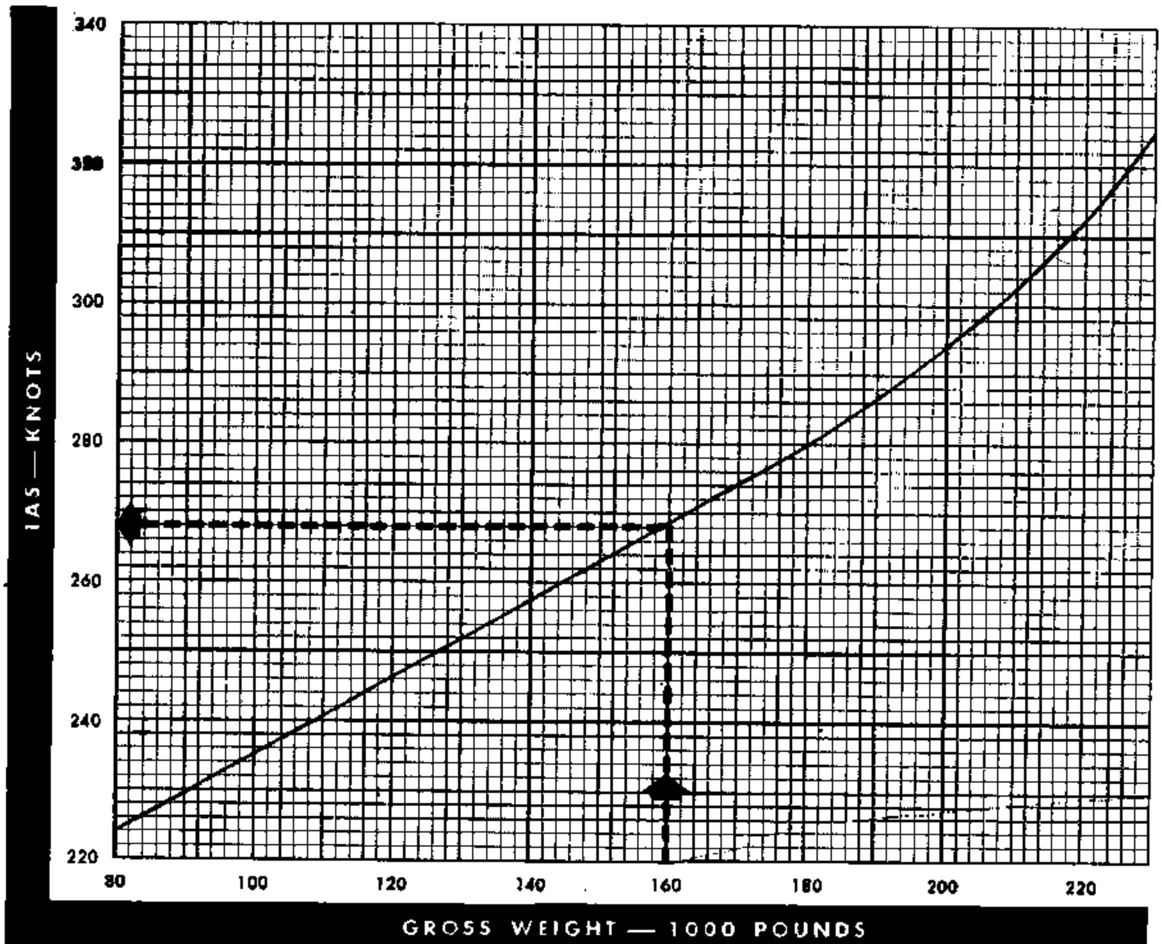
Figure A12-5.

TURBULENT AIR PENETRATION SPEEDS

AT OPTIMUM CRUISE ALTITUDES

THE BEST PENETRATION ALTITUDE AND SPEED CAN BE ESTABLISHED BY DESCENDING APPROXIMATELY 3,000 TO 5,000 FEET BELOW OPTIMUM CRUISE ALTITUDE AND MAINTAINING .74 CRUISE MACH NUMBER

AT LOWER ALTITUDES USE FOLLOWING CHART



DATE: JUNE 1953

DATA BASIS: CALCULATED

REMARKS:
DATA BASED ON GUST VELOCITIES OF 40 FEET PER SECOND

1206C-1

Figure A12-6.

Part 13 miscellaneous charts

MISCELLANEOUS CHARTS

This part contains additional performance data and charts to supplement that in the preceding part.

FUEL CONSUMPTION AT LOW ALTITUDE

On figure A13-1 is a chart giving the fuel flow for six engines at static conditions. It can be used for estimating the fuel allowance for operations such as warm-up, taxi, and takeoff by estimating the time and rpm for these conditions. Also the chart may be used for estimating approach fuel, or for other conditions of low airspeed and low rpm.

FUEL CONSUMPTION AT ALTITUDE

The chart on figure A13-2 presents the fuel flow at the higher rpm and for all altitudes. This plot does not show airplane limitations, therefore care must be taken to ensure that the desired rpm-Mach number-altitude combination can be attained. Fuel consumption for most all flight operations may be estimated from this chart.

FUEL CONSUMPTION IN LEVEL FLIGHT

On figure A13-3 is a chart showing the fuel flows for the more common flight conditions. The steep lines at the left side of the chart show the fuel flows at any altitude for the cruise condition giving best range. The curves peak at absolute ceiling for the weights shown. The broken line indicates the fuel flow at the maximum range climbing flight path condition at Mach .74. Higher gross weights, or above optimum rpm for any gross weight, will cause higher fuel consumption. The curves to the right show the fuel flow at military (98%) rpm and can be used for computing fuel allowances for bomb run, escape, evasive actions, etc.

FUEL GALLONS — POUNDS CONVERSION

On figure A13-4 is a chart for quick conversion between pounds and gallons of fuel at various fuel densities.

BOILING POINT OF FUELS

The chart on figure A13-5 gives the altitude at which fuel boil-off starts for various fuels and temperatures.

MAXIMUM SPEEDS

The maximum level flight speeds at any altitude are shown on figure A13-6. Speeds in level flight at normal rated rpm are given on figure A13-7. To convert to indicated airspeed use figure A13-12.

Below approximately 16,000-foot altitude, the airspeed is limited to 425 knots IAS. The maximum true airspeed below 16,000 feet then follows the 425 knot limit line and decreases from 528 knots at 16,400 feet to 425 knots at sea level.

SERVICE CEILINGS

Plots of the service ceilings with various numbers of engines operating at military rated rpm are on figure A13-8 for flaps and gear up and on figure A13-9 for flaps and gear down.

MACH NUMBER — INDICATED AIRSPEED CONVERSION

The chart on figure A13-10 is used for converting between Mach number and indicated airspeed at any pressure altitude. This chart may be used in connection with a number of others which give only Mach number values. Also it should be useful for checking the airspeed indicator against the machmeter to insure instrument accuracy.

MACH NUMBER — TRUE AIRSPEED CONVERSION

The chart on figure A13-11 is used for converting between Mach number and true airspeed. This chart can be used for both mission planning and inflight use. For mission planning, the OAT lines (true ambient temperature) should be used. For inflight use, the OAT gage curves (indicated temperature) should be used. No correction is necessary on the OAT gage curves as these curves include the temperature rise due to compressibility.

TEMPERATURE

For conversion between Fahrenheit and Centigrade temperature values, the chart on figure A13-12 should be used. If temperatures are beyond the range of the chart the equations given on the chart should be used.

For conversion of in-flight OAT gage reading to true outside air temperature, figure A13-14 may be used. The difference in the two readings is the temperature rise due to compressibility.

NACA STANDARD DAY

The chart on figure A13-13 defines the temperature variation with altitude for a NACA standard day. All charts in the book are based upon this standard atmosphere unless other temperature conditions are specified.

MPH — KNOTS

The chart on figure A13-15 can be used to convert one velocity to the other scale.

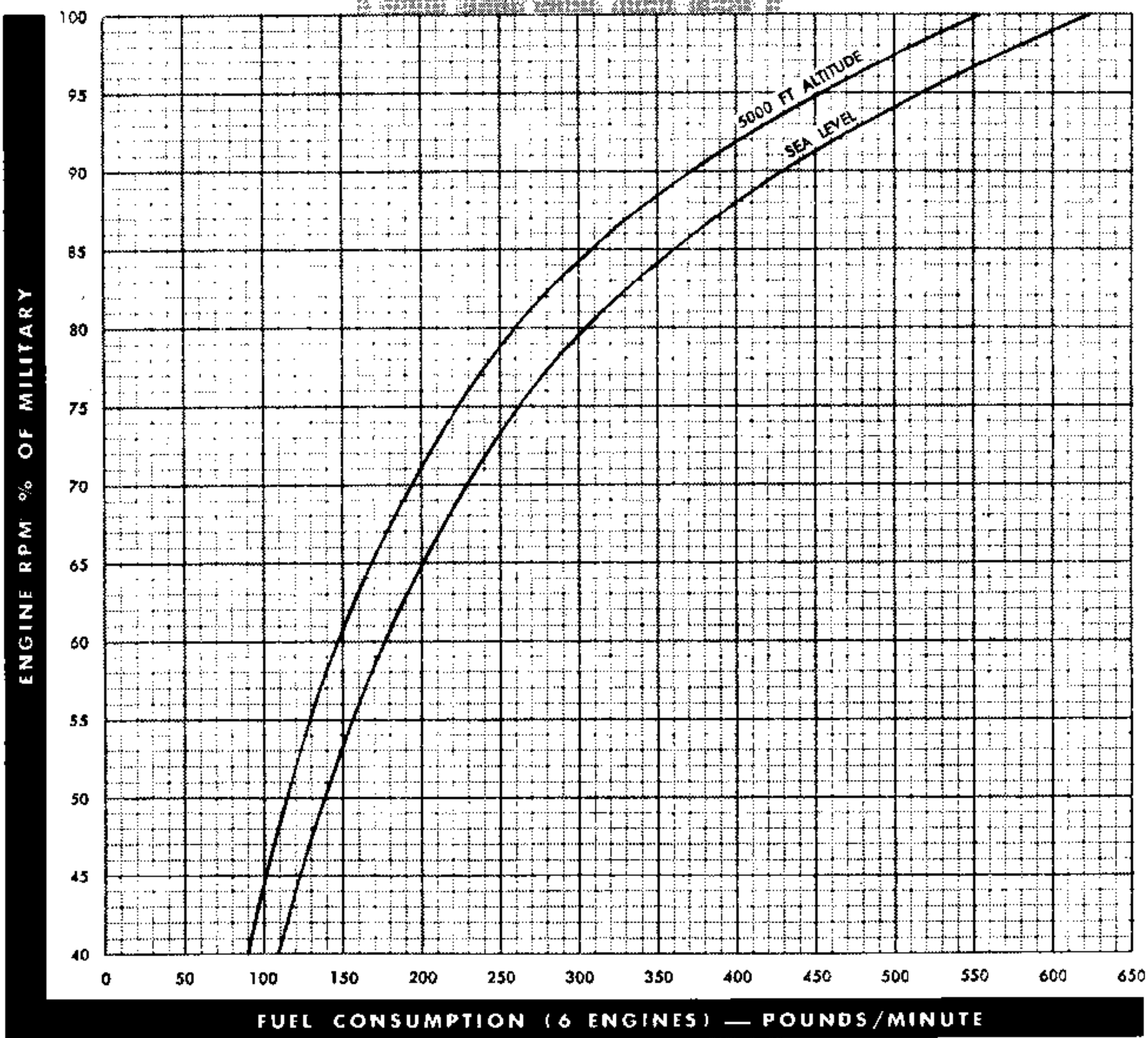
FUEL CONSUMPTION

GROUND OPERATION

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: DECEMBER 1952

DATA BASIS: FLIGHT TEST

1501C-1

Figure A13-1.

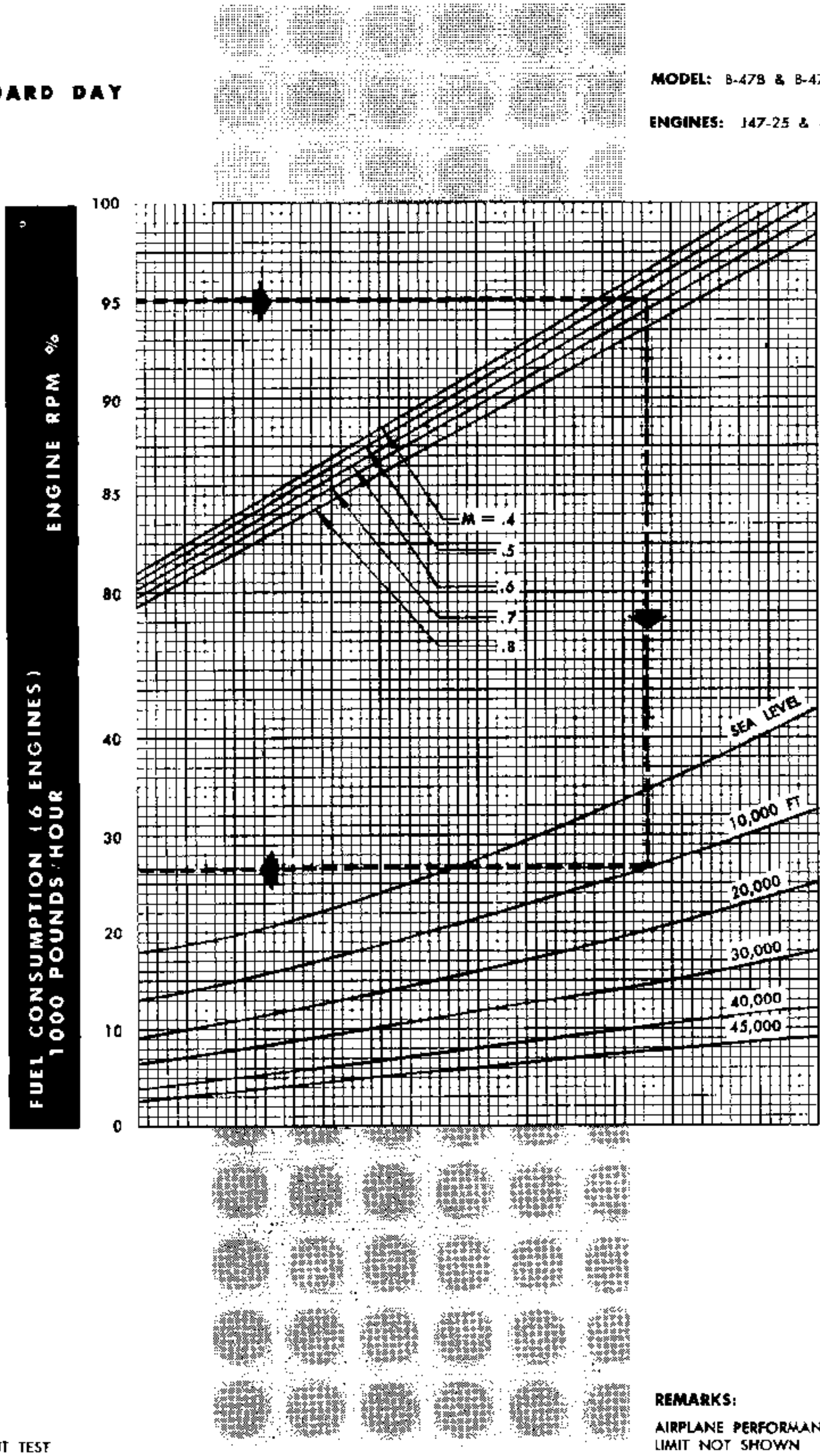
FUEL CONSUMPTION

RPM — MACH NUMBER — ALTITUDE

NACA STANDARD DAY

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: JULY 1952

DATA BASIS: FLIGHT TEST

REMARKS:
AIRPLANE PERFORMANCE LIMIT NOT SHOWN

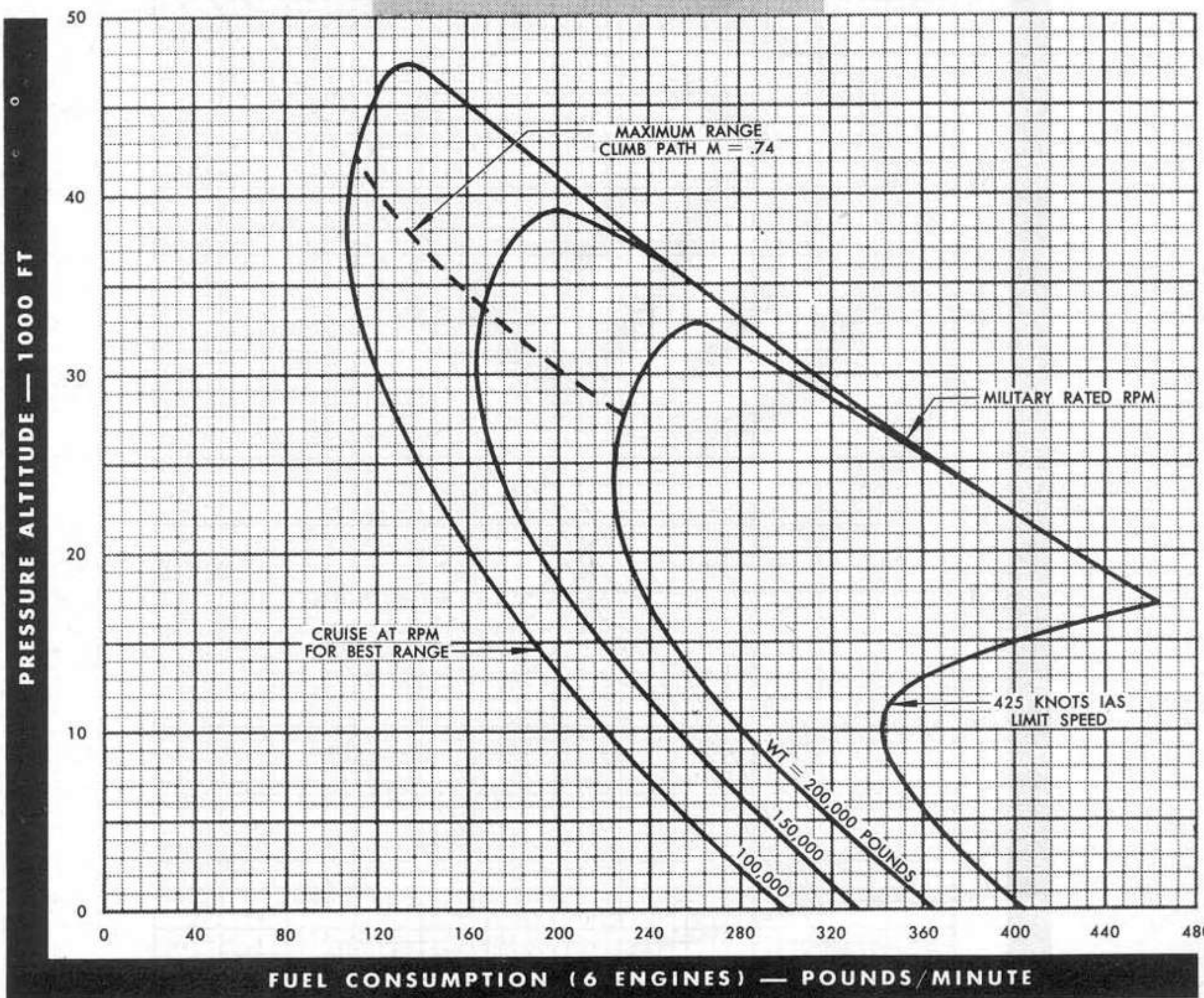
1302C-1

Figure A13-2.

FUEL CONSUMPTION LEVEL FLIGHT

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



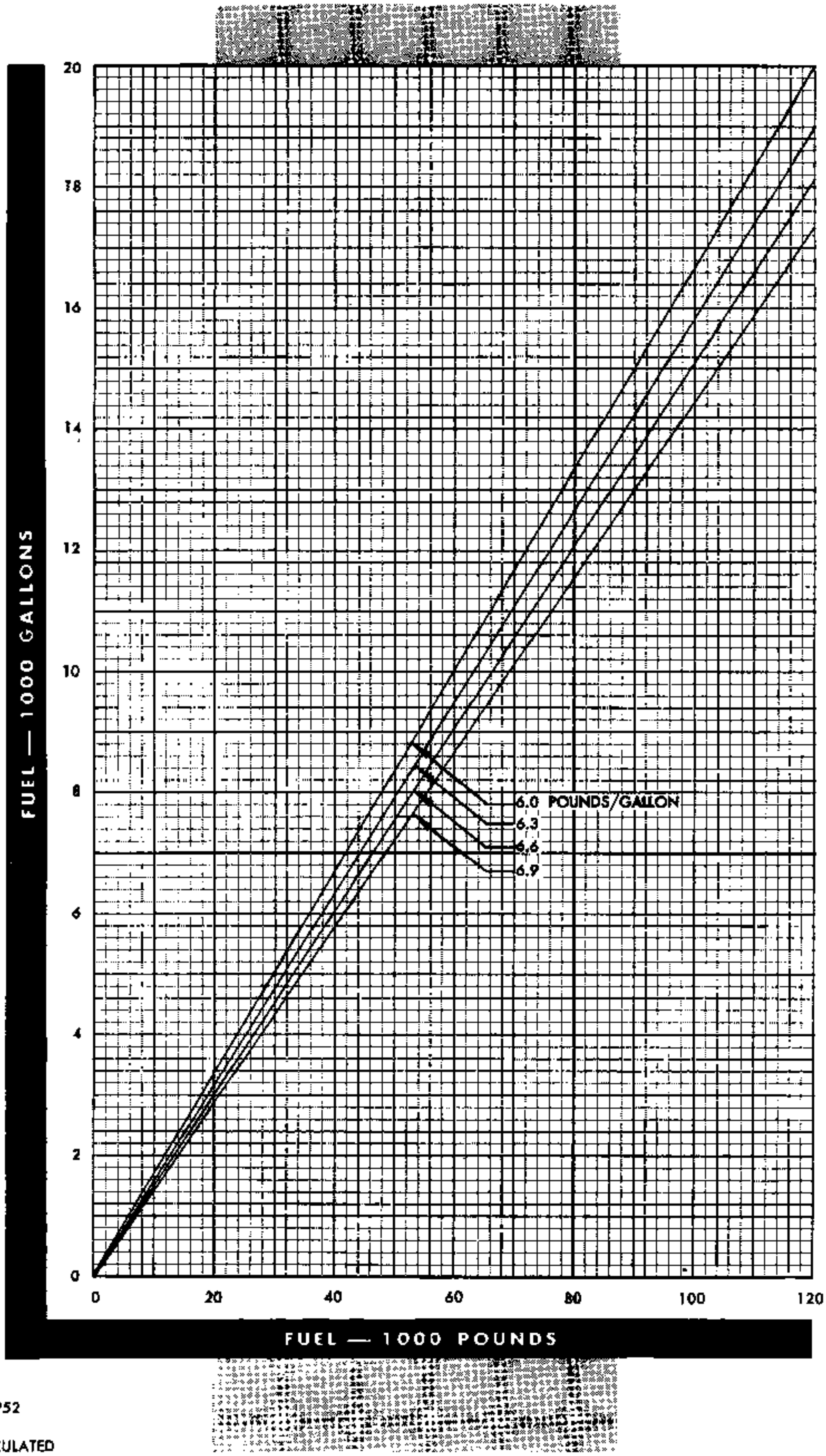
DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

1303C-1

Figure A13-3.

FUEL CONVERSION CHART

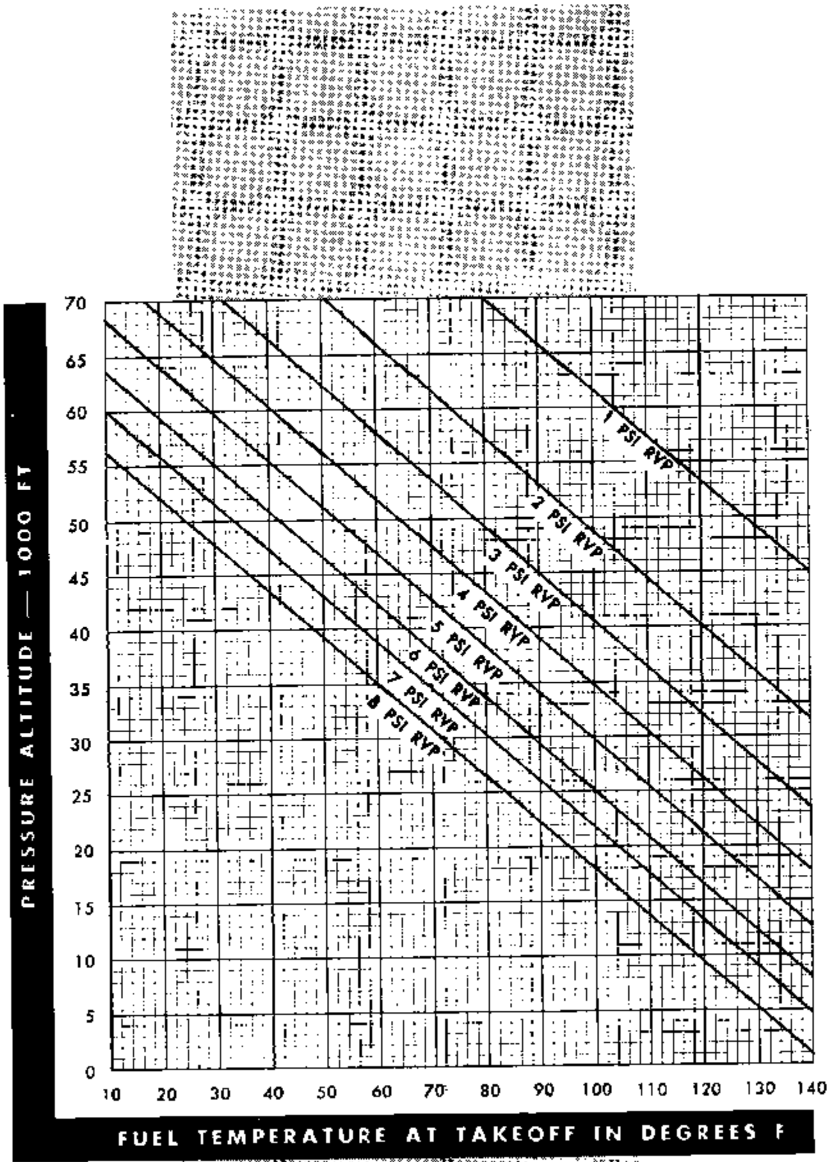


DATE: DECEMBER 1952

DATA BASIS: CALCULATED

Figure A13-4.

BOILING POINT OF FUELS



DATE: DECEMBER 1952

DATA BASIS: CALCULATED

REMARKS:

MIL-F 5624, GRADE JP-4 — 2 to 3 PSI RVP

MIL-F 5572, GRADE 100/130 — 7 PSI RVP MAXIMUM

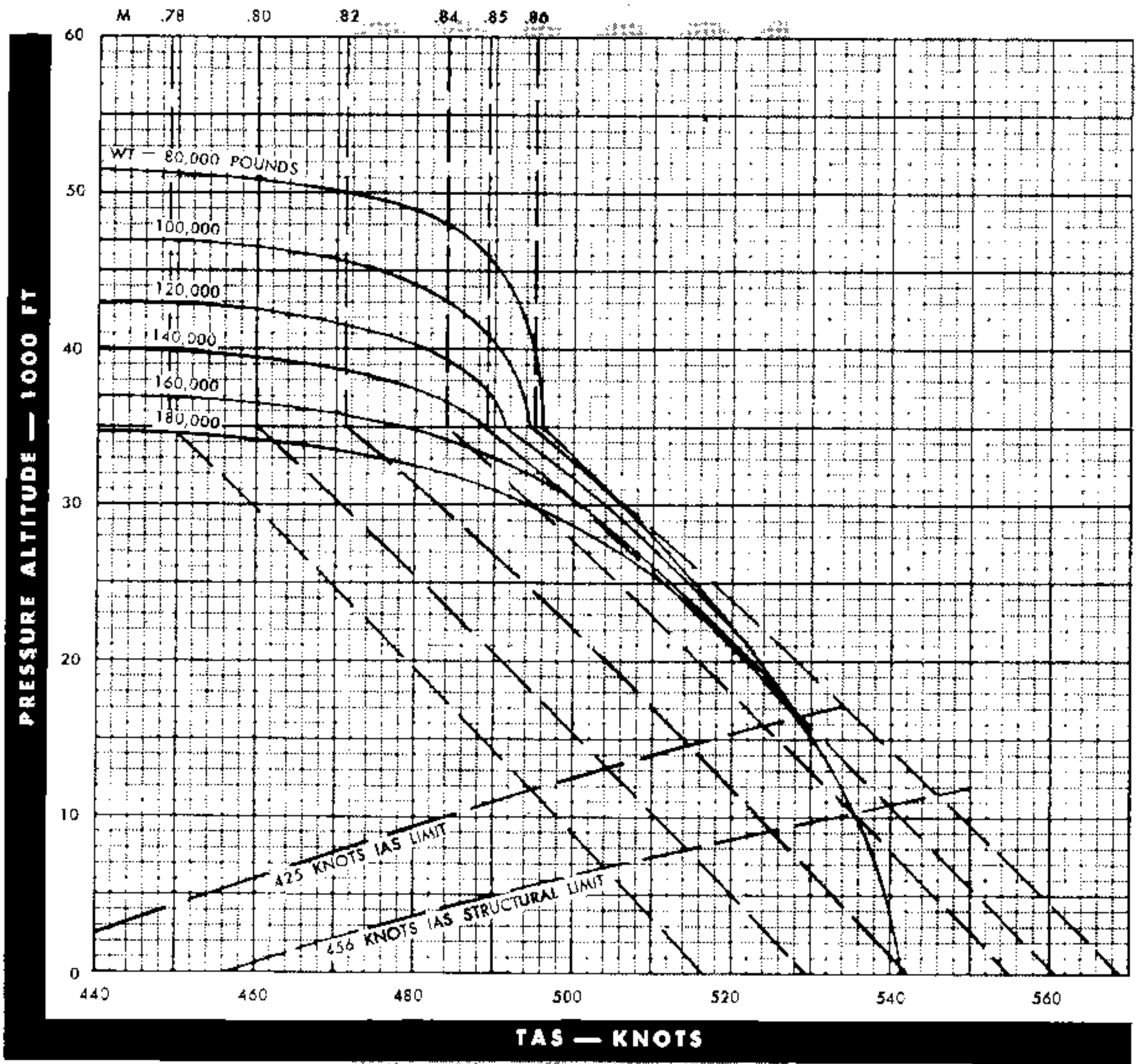
Figure A13-5.

MAXIMUM VELOCITY

MILITARY RATED (98%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: AUGUST 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:

LEVEL FLIGHT GEAR & FLAPS UP

1306C-1

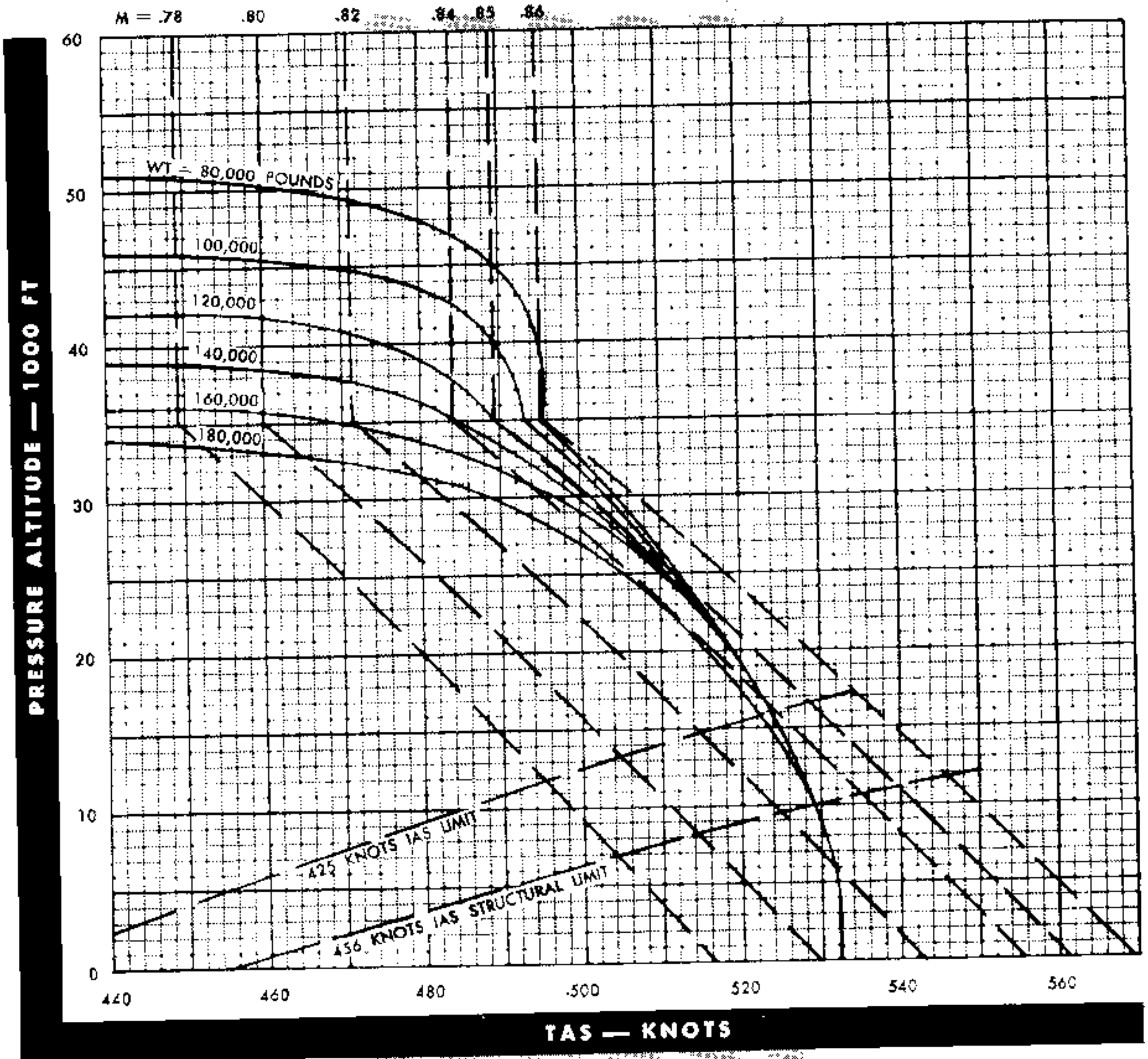
Figure A13-6.

MAXIMUM VELOCITY

NORMAL RATED (96%) RPM

MODEL: B-47B & B-47E

ENGINES: J47-25 & 25A



DATE: AUGUST 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:
GEAR & FLAPS UP
LEVEL FLIGHT

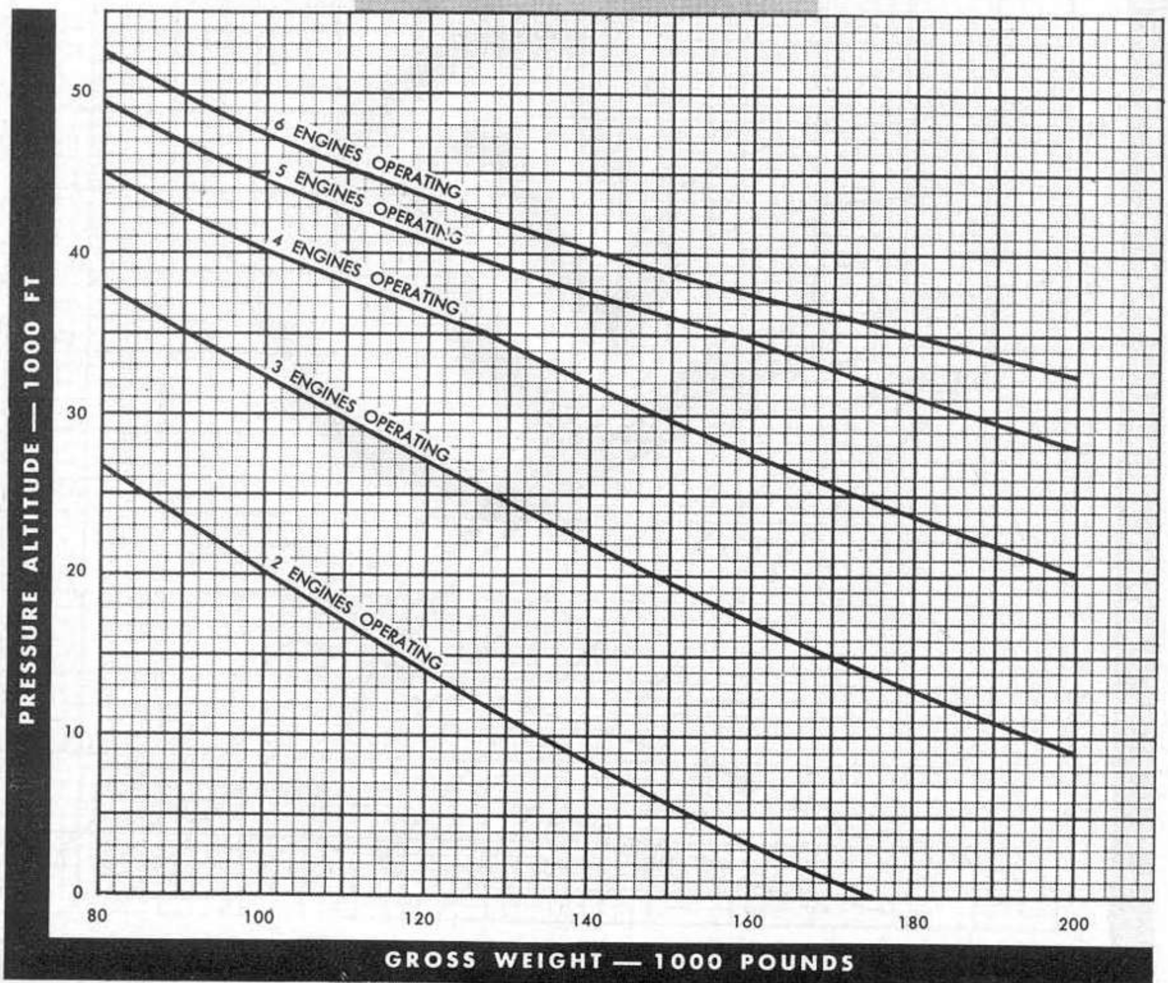
Figure A13-7.

SERVICE CEILINGS

MILITARY RATED (98%) RPM — FLAPS & GEAR UP

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

DATA BASIS: FLIGHT TEST

CONDITIONS:

100 FPM RATE OF CLIMB

1308C-1

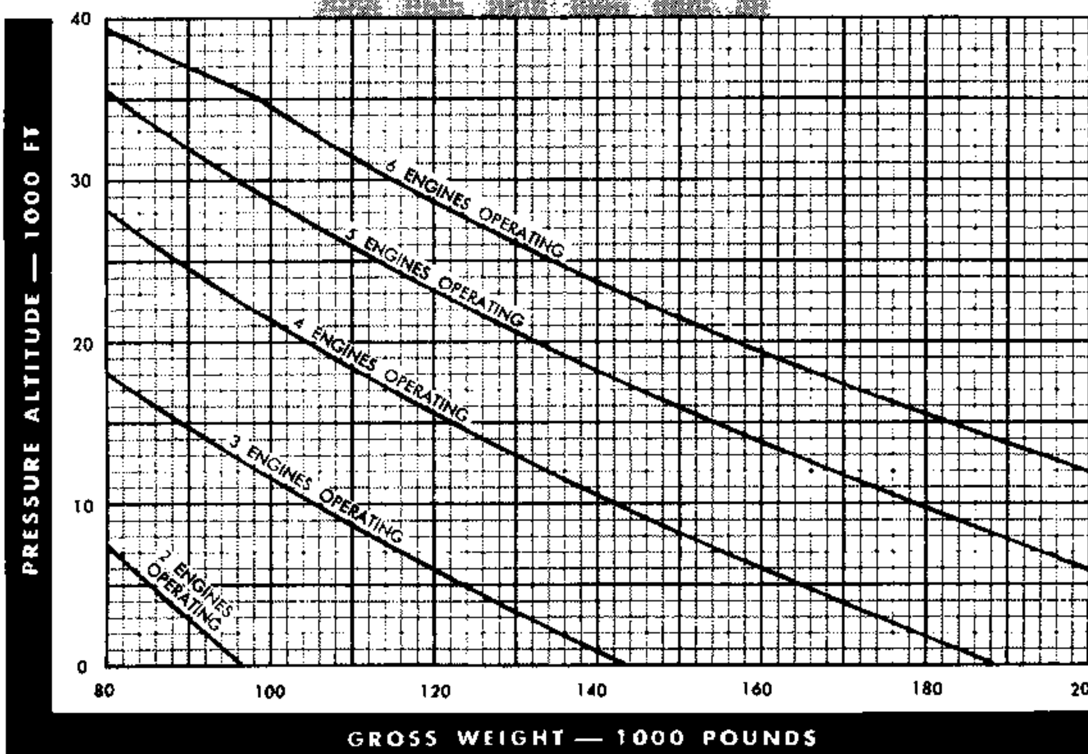
Figure A13-8.

SERVICE CEILINGS

MILITARY RATED (98%) RPM — FLAPS & GEAR DOWN

MODEL: B-47B & B-47E

ENGINES: J47-25 & -25A



DATE: OCTOBER 1952

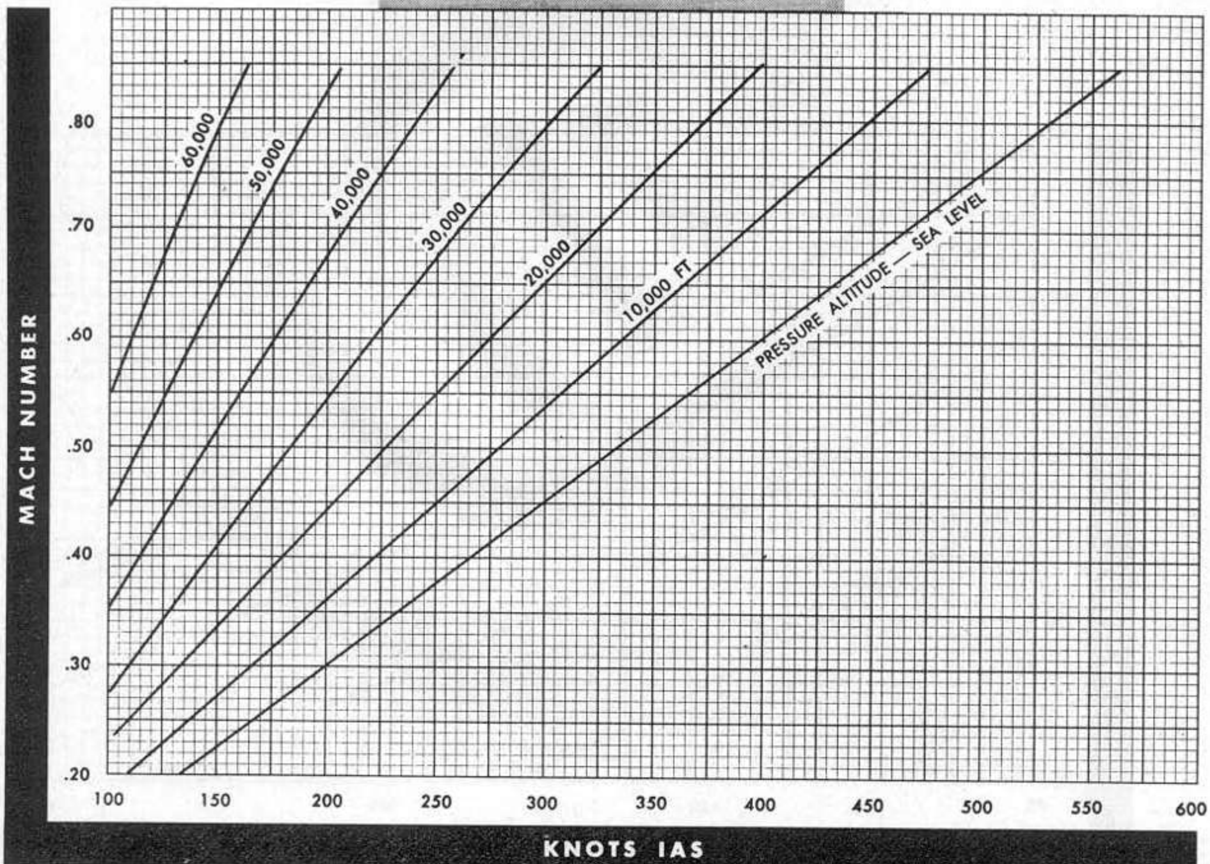
DATA BASIS: FLIGHT TEST

CONDITIONS:
100 FPM RATE OF CLIMB

1309C-1

Figure A13-9.

MACH NUMBER - INDICATED AIRSPEED



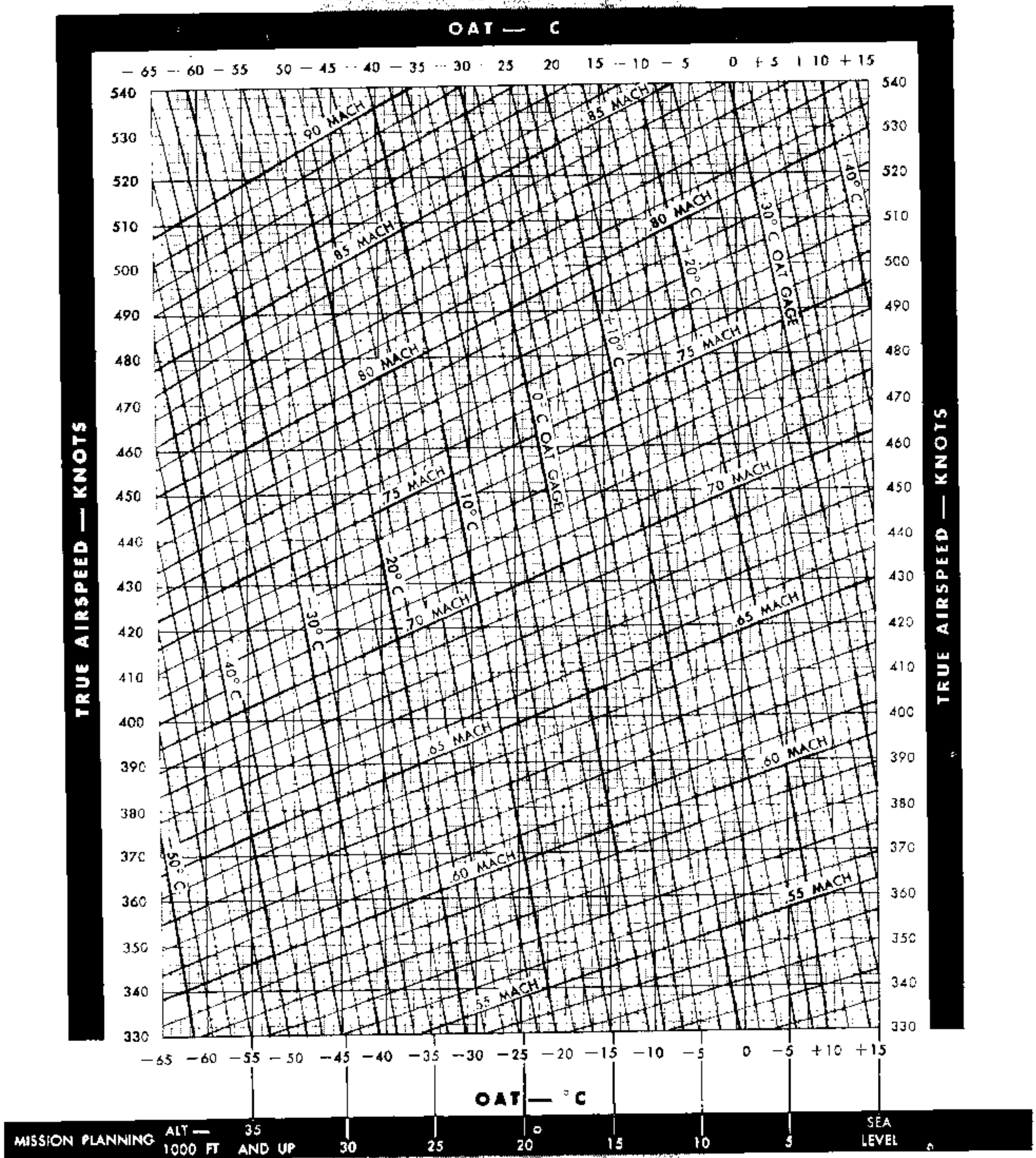
DATE: DECEMBER 1952

DATA BASIS: CALCULATED

1310C-1

Figure A13-10.

MACH NUMBER - TRUE AIRSPEED CONVERSION



REMARKS:

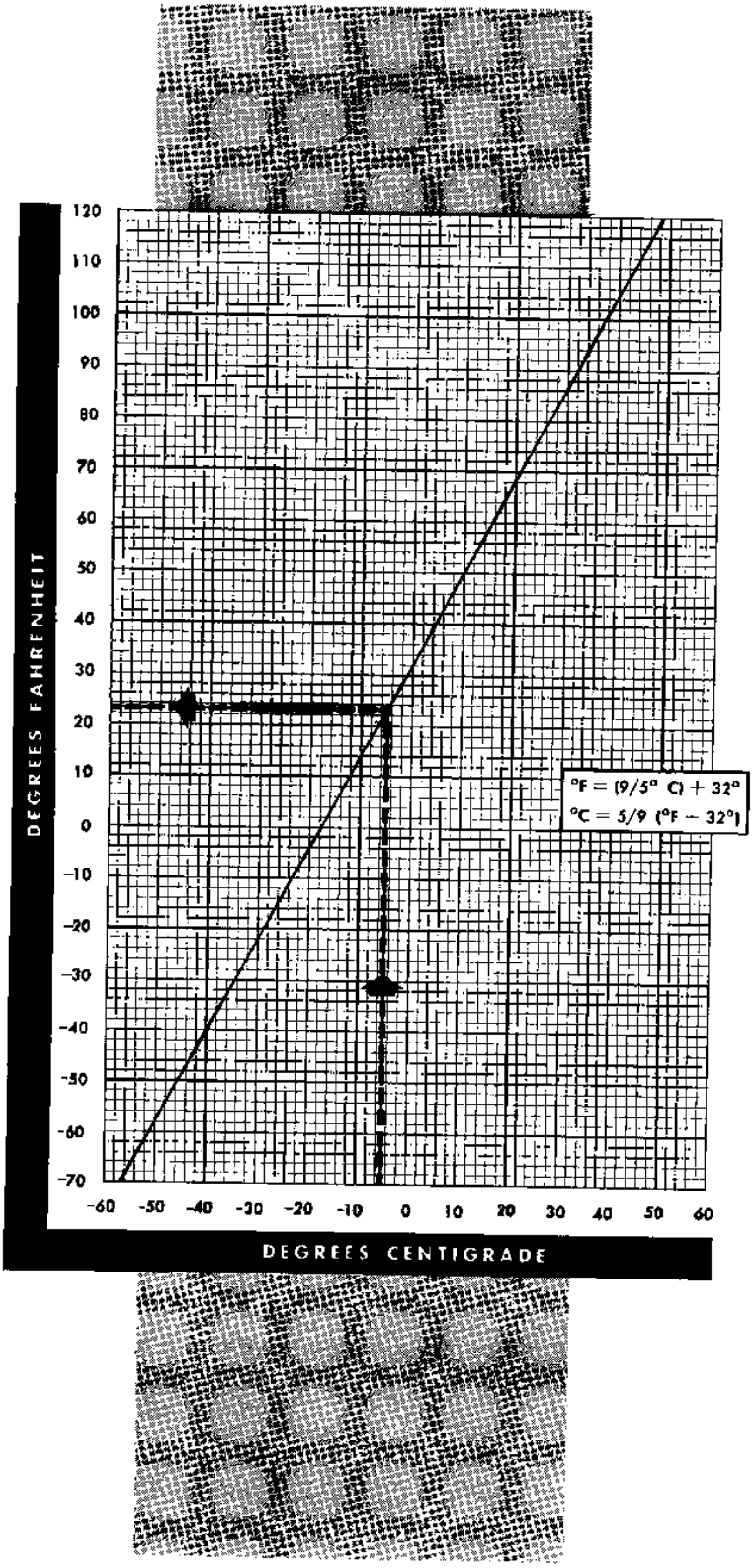
80% RAM RECOVERY FACTOR

NACA STANDARD DAY FOR MISSION PLANNING

DATA BASIS: CALCULATED

Figure A13-11.

TEMPERATURE CONVERSION CHART



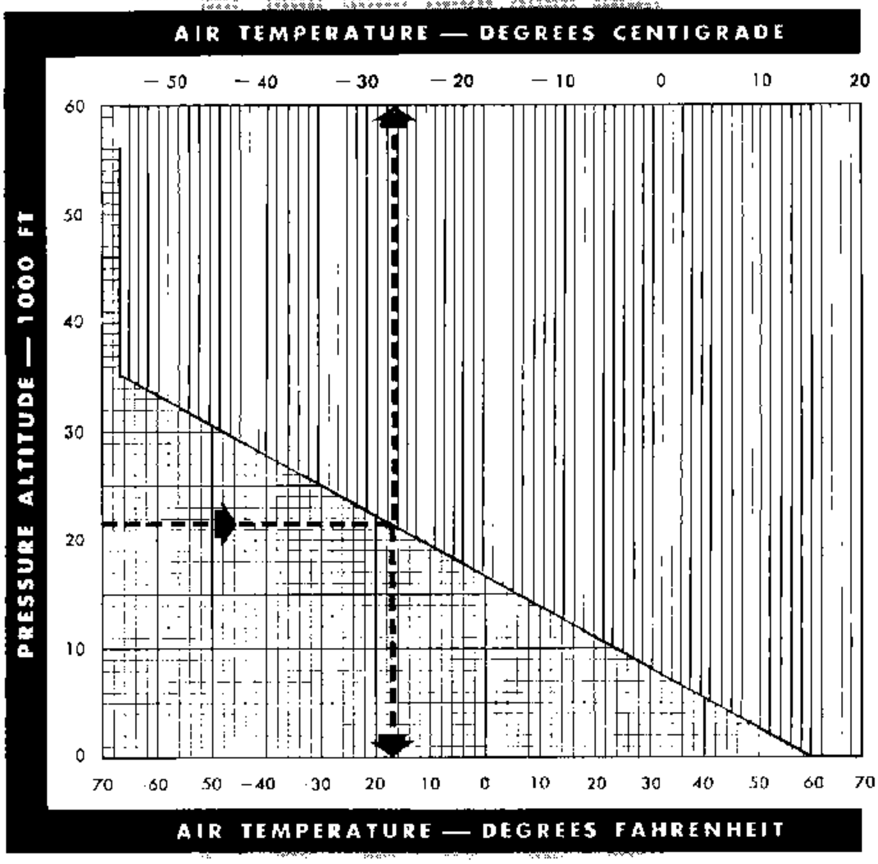
DATE: DECEMBER 1952

DATA BASIS: CALCULATED

1312C-1

Figure A13-12.

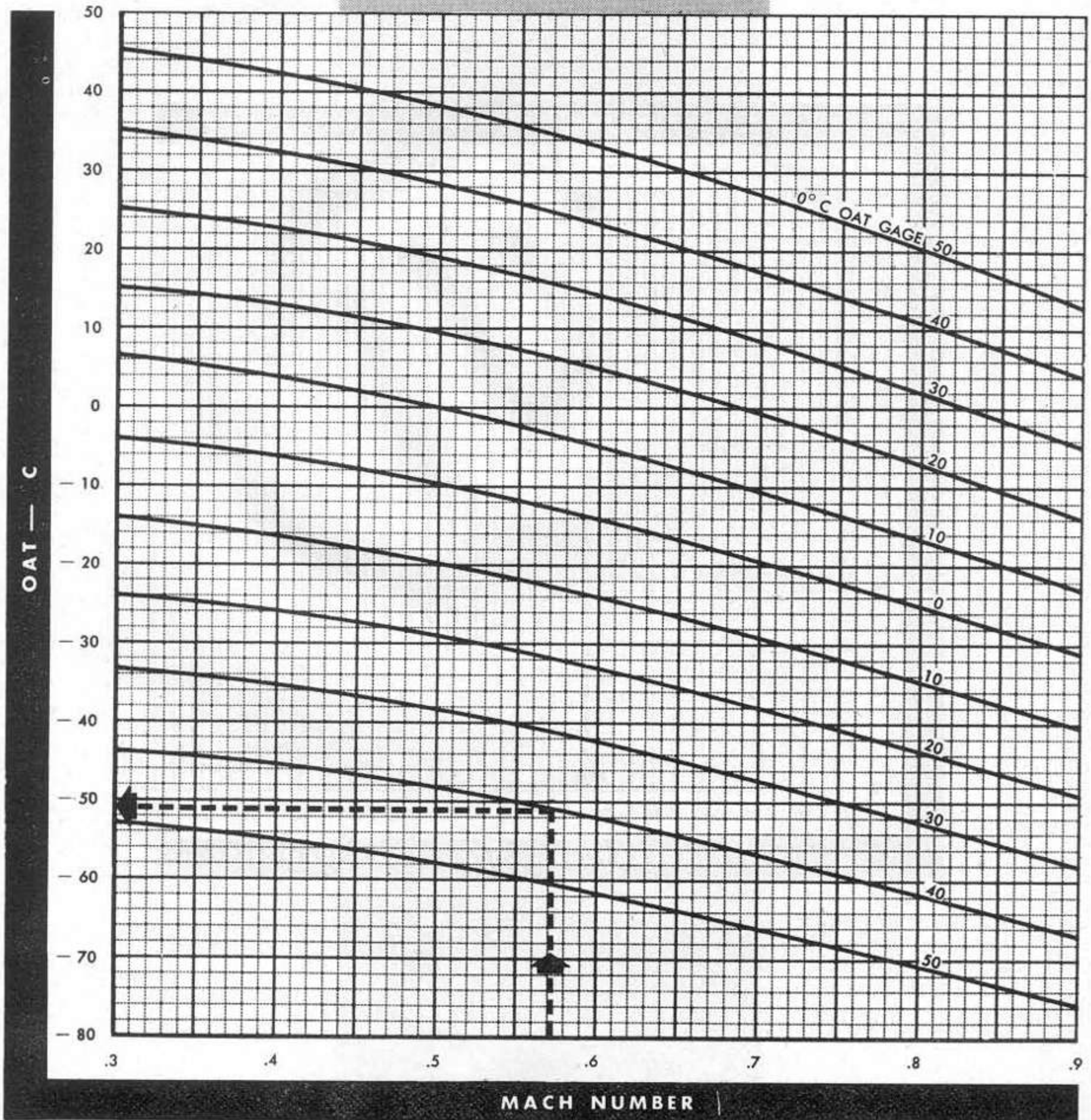
TEMPERATURE ON NACA STANDARD DAY



DATA BASIS: NACA

Figure A13-13.

OAT GAGE VS OAT TRUE



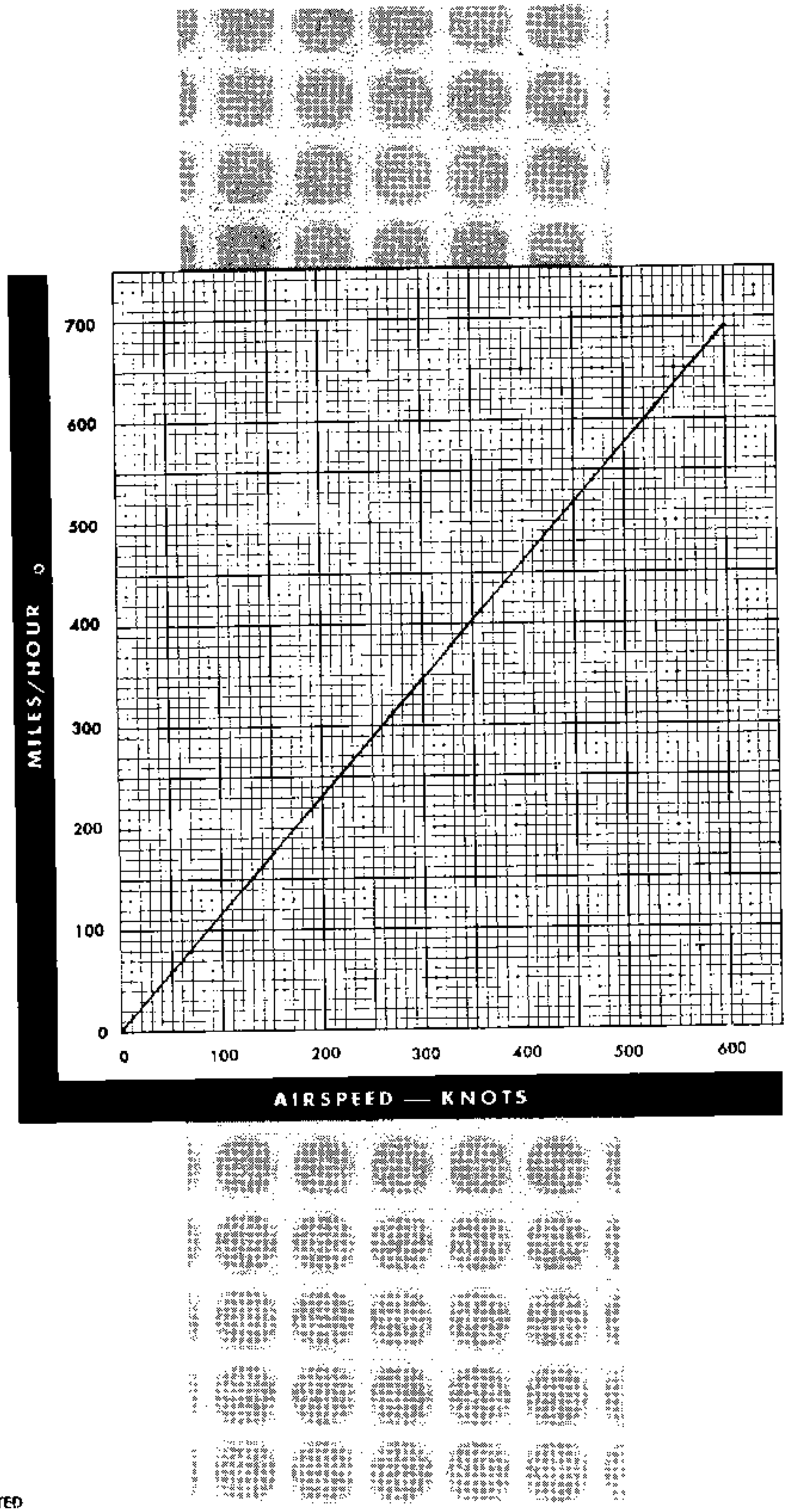
DATA BASIS: CALCULATED

REMARKS:
80% RAM RECOVERY FACTOR

1314C-1

Figure A13-14.

MPH - KNOTS CONVERSION CHART



DATE: JANUARY 1953

DATA BASIS: CALCULATED

Figure A13-15.


TATES AIR FORCE

alphabetical index

A

*Denotes Illustration or Chart

B

*Denotes Illustration or Chart

C

*Denotes Illustration or Chart

D

E

*Denotes Illustration or Chart

*Denotes Illustration or Chart

F

*Denotes Illustration or Chart

*Denotes Illustration or Chart

K

L

M

*Denotes Illustration or Chart

*Denotes Illustration or Chart

R

S

*Denotes Illustration or Chart

T

*Denotes Illustration or Chart

*Denotes Illustration or Chart