# FLIGHT HANDBOOK

## USAF SERIES

# TB-47B

## AIRCRAFT

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

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE.

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AND SAFETY OF FLIGHT SUPPLEMENTS DJ THRU DZ.
SEE WEEKLY INDEX T.O. 0-1-1A FOR CURRENT STATUS OF FLIGHT SUPPLEMENTS.

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| A9-1 thru A9-18 | 31 August 1956 |
| A10-1 thru A10-8 | 31 August 1956 |
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# this is NO BULL

**To gain maximum benefit from this handbook - read the following pages carefully**

SCOPE. This handbook contains all the information necessary for safe and efficient operation of the TB-47B. 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.

SOUND JUDGMENT. 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.

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

STANDARDIZATION. 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.

ARRANGEMENT. The handbook has been divided into 10 fairly independent sections each with its own table of contents. The objective of this subdivision is to make it easy both to read the book straight through when it is first received and thereafter to use it as a reference manual. The independence of these sections also makes it possible for the user to rearrange the book to satisfy his personal taste and requirements. The first three sections cover the minimum information required to safely get the airplane into the air and back down again. Before flying any new airplane these three sections must be read thoroughly and fully understood. Section IV covers all equipment not essential to flight but which permits the airplane to perform special functions. Sections V and VI are obvious. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular airplane in question. The experienced pilot will probably not need to read this section but he should check it for any possible new information. The contents of the remaining sections are fairly obvious.

YOUR RESPONSIBILITY. These Flight 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.

PERSONAL COPIES, TABS, AND BINDERS. 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 materiel staff and contracting officers.

HOW TO GET COPIES. If you want to be sure of getting your handbooks on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 0-5-2 explains how to order Flight Handbooks so that you automatically will get all revisions, reissues, and Safety of Flight Supplements. Basically, the required quantities must be ordered on the publication Requirements Table (T. O. 0-3-1). It is the responsibility of your Senior Material Staff Officer to fulfill your technical order requests. In addition, it is his responsibility to establish a system that will rapidly get the handbooks to the flight crews once handbooks are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS. One more thing—We admit it takes time to revise the Flight Handbooks, and since the time lag is excessive for Safety of Flight information, a program has been put into effect to get such information to you in a hurry. This is done by means of Safety of Flight Supplements which use the same number as your Flight Handbook except for the addition of a suffix letter assigned in alphabetical order. Letters will be assigned in the following order: C through Z, CC through CZ, DC through DZ, etc. Letters A, B, I, and O will not be used as Safety of Flight Supplement suffix letters. Letters A and B are reserved for assignment to standard handbook supplements. Letters I and O will not be used because of possible confusion with numerals. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in approximately 10 working days. And what do you have to do to get these supplements? Absolutely nothing! If you have ordered your flight handbook on the Publications Requirement Table, you will automatically receive all supplements pertaining to your aircraft. Technical Order 00-5-1 covers some additional information regarding these supplements. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T. O. 0-1-1) and the Weekly Supplemental Index (T. O. 0-1-1A). This is the only way you can determine whether or not a supplement has been rescinded. The title page of the Flight Handbook and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements.

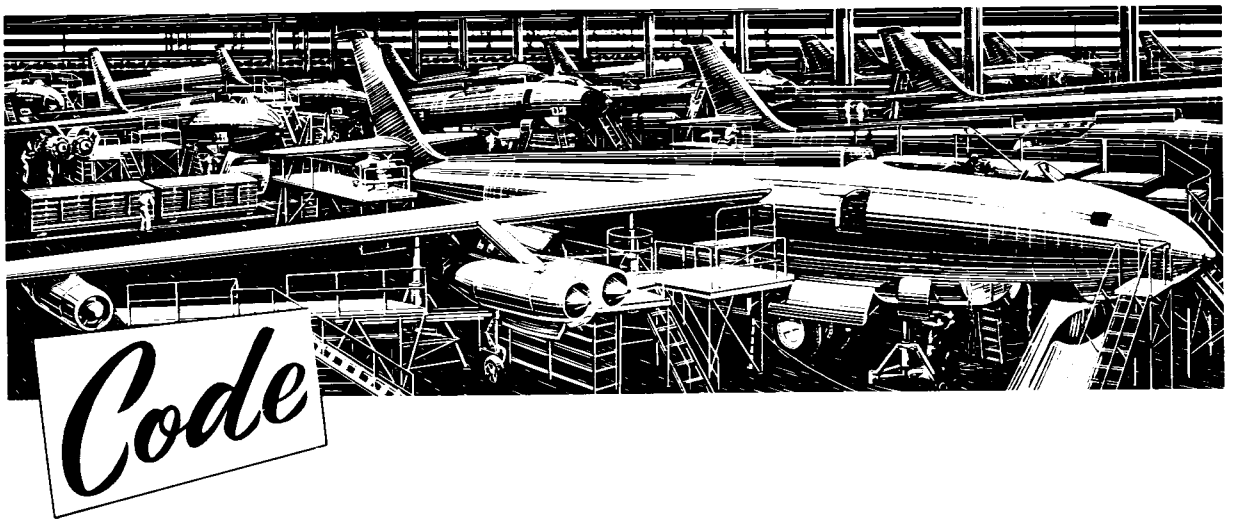
WARNINGS, CAUTIONS, AND NOTES. It will be noted that "Warnings," "Cautions," and "Notes" are found throughout this handbook. To avoid possible misinterpretation, the following definitions will apply:

**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.

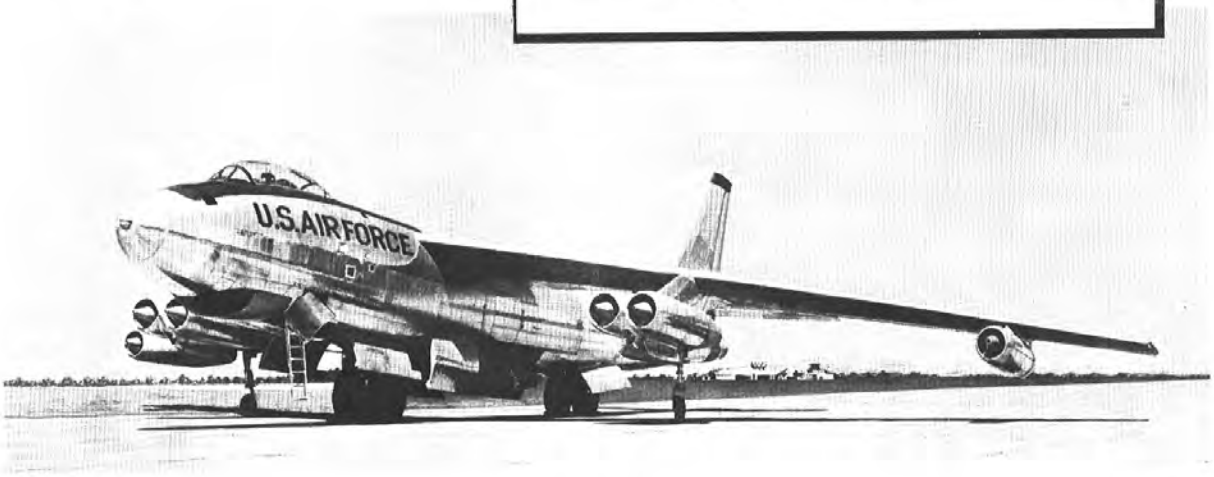
COMMENTS AND QUESTIONS. Comments and questions regarding any phase of the Flight Handbook program are invited and should be addressed to the Commander, Detachment No. 1, Hq, ARDC, Wright-Patterson Air Force Base, Ohio, Attention: RDZSTH.




The information contained in this handbook is applicable to Training Command airplanes AF 49-2642 through 51-2091 which have been modified by the Boeing Airplane Company during the "Ebb Tide" modification program. These trainer modified airplanes have been designated TB-47B aircraft. It should be noted that the "Ebb Tide" modified TB-47B airplanes are not the same configuration as the older "Field Goal" modified TB-47B airplanes. The "Field Goal" airplanes have been included along with older B-47B airplanes in the "Ebb Tide" modification program and all airplanes (AF 49-2642 through 51-2091) have been extensively modified into the new Training Command configuration. All airplanes covered in this handbook do not have identical equipment installed. The specific differences will be pointed out where applicable and the AF serial number for the airplanes having the different installations will be listed. A number in parentheses will be used throughout the text 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 procedural step, only the information found therein applies to serialization 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 to the serialization given in the footnote. In some cases an asterisk will be used within a sentence, wherein only that item applies to the noted serialization. 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 airplane AF 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 AF serial numbers given. When the term "and on" is given, the information applies to all B-47 series airplanes covered by this handbook subsequent to the AF 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 TB-47B series airplanes (AF 49-2642 through 51-2091).

# TB-47B

# Strato Jet

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# DESCRIPTION

section 1

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| FEATURES (FRONT TO REAR) | B-47A | TB-47B | DB-47B | B-47B B-47E | RB-47E RB-47K | RB-47H |
|---|---|---|---|---|---|---|
| LONG NOSE WITH CAMERA WINDOW | | | | | ✓ | |
| SOLID NOSE WITH LARGE RADOME | | | | | | ✓ |
| SOLID NOSE WITH BOMB SIGHT PROTUBERANCE | | ✓ | ✓ | ✓ | | |
| TRANSPARENT NOSE | ✓ | | | | | |
| AIR REFUELING | | | ✓ | ✓ | ✓ | ✓ |
| WHITE THERMAL PROTECTIVE PAINT | | | ✓ | ✓ | | |
| LONG BOMB BAY DOORS | ✓ | | ✓ | ✓ | | |
| SHORT BOMB BAY DOORS | | ✓ | ✓ | ✓ | | |
| PROVISIONS FOR RIGHT SIDE MOUNTING OF MISSILE | | | ✓ | | | |
| CAMERA COMPARTMENT WITH SMALL PHOTO FLASH BOMB BAY DOORS | | | | | ✓ | |
| ECM COMPARTMENT BULGE | | | | | | ✓ |
| BOMB BAY TANKS | | ✓ | ✓ | ✓ | ✓ | ✓ |
| WATER INJECTION & ATO PROVISIONS | | | ✓ | ✓ | ✓ | ✓ |
| EXTERNAL WING TANKS | | | ✓ | ✓ | ✓ | ✓ |
| SINGLE POINT GROUND REFUELING | | ✓ | ✓ | ✓ | ✓ | ✓ |
| RETRACTABLE AFT RADOME | | | ✓ | | | |
| TAIL TURRET | | | ✓ | ✓ | ✓ | ✓ |

049004

*Figure 1-1.*

## AIRPLANE

The Boeing TB-47B stratojet airplane is a land-based six-engine jet-propelled medium bomber trainer 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 | 116 feet |
| Overall Length | 107 feet 1.5 inches |
| Height (to top of fin in taxi attitude) | 28 feet |
| Tread (between outriggers) | 44 feet 4 inches |

Refer to section II for minimum turning radius and ground clearances.

### GROSS WEIGHTS

| | |
|---|---|
| Design Gross Weight | 125,000 pounds |
| Maximum Takeoff Gross Weight | 185,000 pounds |
| Maximum Flight Gross Weight | 185,000 pounds |
| Design Landing Gross Weight | 125,000 pounds |

See section V for additional information.

### FUNCTION

The function of the airplane is to provide six-engine jet bomber transition training.

# THROTTLE POSITIONS CHART

**WITH ENGINE THROTTLE IN CUTOFF**

| 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 | Not Available | Closed |
| TME | Open and operating | Open | | |
| ME | Open and off | Open | | |

**WITH ENGINE THROTTLE ADVANCED APPROXIMATELY 2°**

| | | | | |
|---|---|---|---|---|
| TE | Open and operating | Closed | Available | Open unless fire shutoff switch is pulled |
| TME | Open and operating | Open | | |
| 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 position, surface controls must be unlocked for further throttle movement.

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

049630

*Figure 1-2.*

## CREW

The normal flight crew consists of a pilot, copilot, and observer. Two instructor positions are provided, one for a flight instructor and one for an observer instructor.

## CHARACTERISTICS AND FEATURES

The outstanding characteristics of this airplane are the six turbojet engines installed in underslung engine pods mounted below the wings, a single swept-back tail, and the high swept-back 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 airplane has bicycle-type main landing gear and is laterally supported by outrigger gear located in each inboard engine nacelle. All flight controls are operated by a hydraulic surface power control system incorporating an artificial "feel" system. A jettisonable bubble-type canopy is located well forward on top of the fuselage. Catapult-type ejection seats are installed at the pilot, copilot, and observer 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.

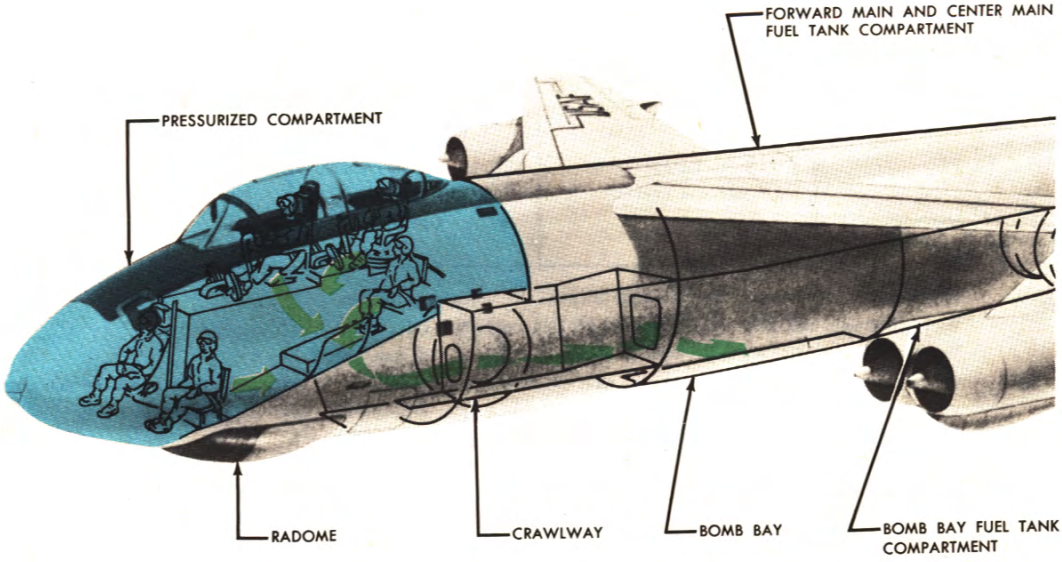
# MOVEMENT OF FLIGHT PERSONNEL

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. Although movement of flight personnel is not generally 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. Access to the bomb bay during flight is possible by means of a door located in the airplane entrance passage and leading into a crawlway (figure 1-3) to the left of the forward main wheel well. Since this necessitates depressurization of the crew compartment, such passage should be avoided, particularly at high altitudes.

**WARNING**

The skin area of the main entrance door is not designed to withstand the weight of a crewmember. 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.

# CREW MOVEMENT AND COMPARTMENTS




## ENGINES

The airplane is powered by six all-weather axial-flow turbojet engines, Type J47-23. Guaranteed sea level static performance of the engine is classified according to thrust rating as follows:

- Maximum Rated Thrust is obtained at 100% (±1%) rpm and produces a thrust of 5880 pounds. The maximum allowable time at this power setting is 5 minutes.
- Military Rated Thrust is obtained at 98% rpm and produces a thrust of 5590 pounds. This power setting is used for rapid climbs to altitude or emergencies and the time limitation is 30 minutes.
- Normal (Continuous) Rated Thrust is obtained at 96% rpm and delivers 5240 pounds; there is no time limitation at this power setting or below.

The engine is comprised of a 12-stage axial-flow compressor, eight direct-flow combustion chambers, and a single stage impulse turbine coupled directly to the compressor. A single engine is mounted in each outboard nacelle and two parallel engines in each inboard nacelle. When 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. In addition, the engines have electrically operated retractable screens in the airguide section. See "Engine Screen Switch," this section, for description and operation. All frontal areas of the engine are anti-iced.

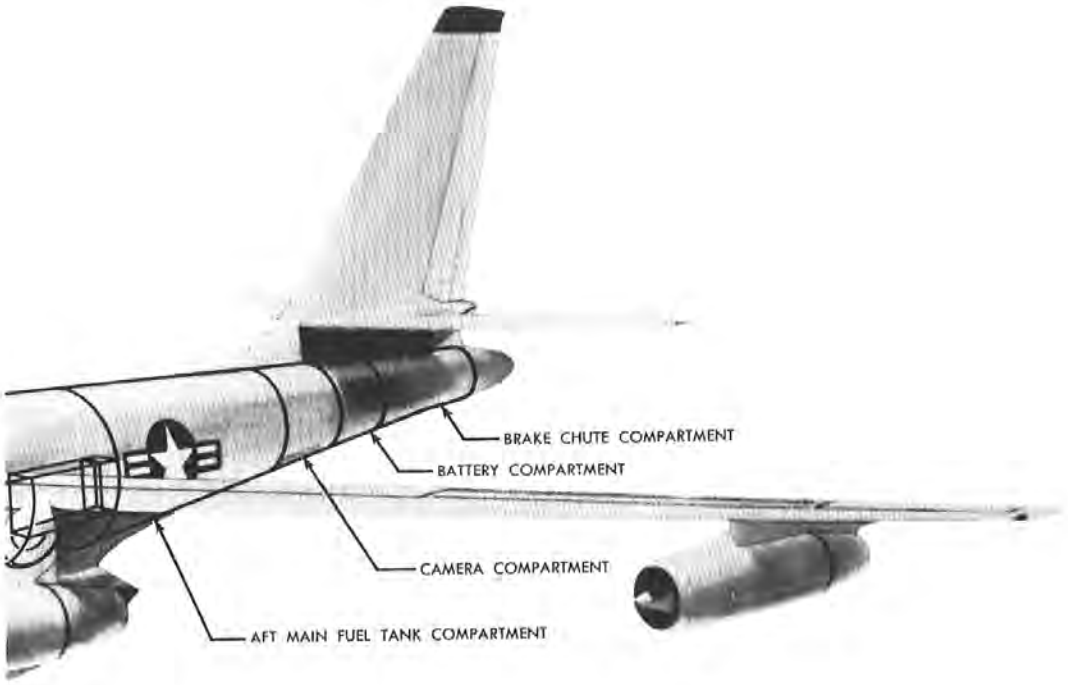



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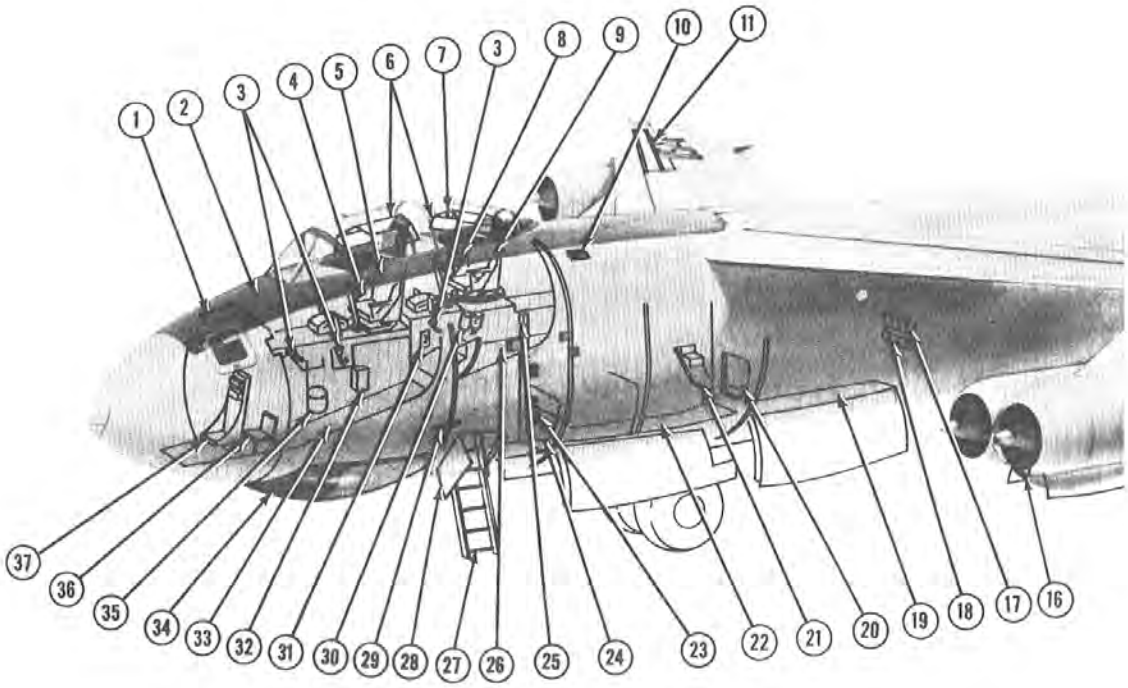
*Figure 1-3.*

## 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 coolant 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.

# GENERAL ARRANGEMENT

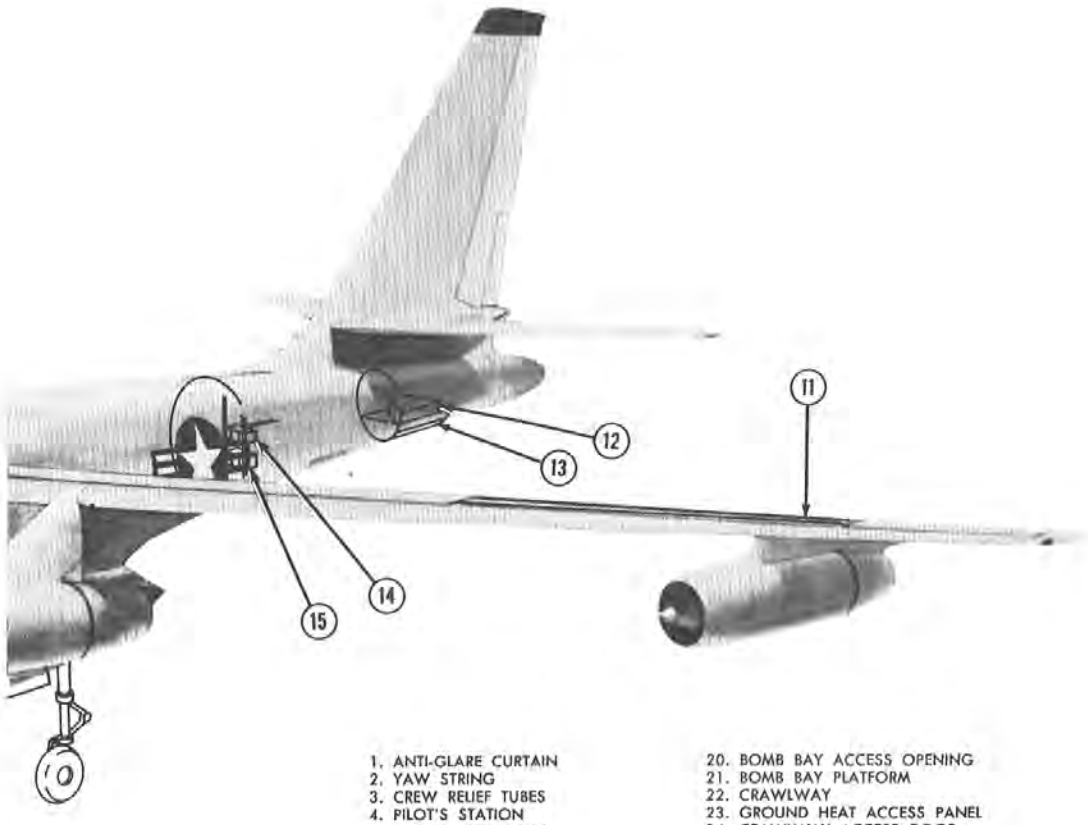



## ENGINE STALL PREVENTION

To help prevent engine compressor stalls which are most common during throttle bursts at low temperatures, the airplane is equipped with 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. See "Compressor Stalls," section VII, for engine operating characteristics with engine stall prevention device.

## THROTTLES

The pilot has six throttles (3, figure 1-9) on his control stand which are interconnected with six throttles (2, figure 1-17) on the copilot's control stand. Each throttle quadrant has three positions marked CUTOFF --START--100% RPM. 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) and the fuel fire shutoff valve for the corresponding engine. START position is a



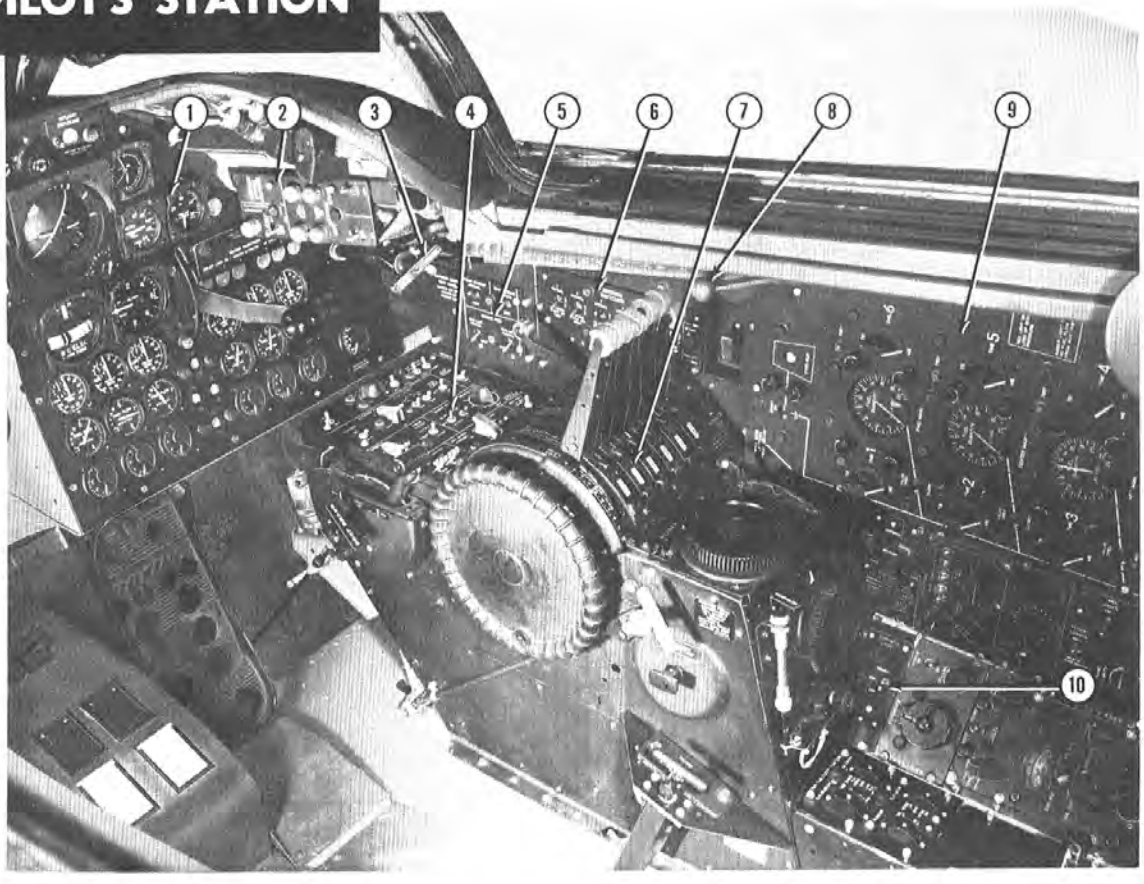

1. ANTI-GLARE CURTAIN
2. YAW STRING
3. CREW RELIEF TUBES
4. PILOT'S STATION
5. PILOT'S CHECK LIST
6. CANOPY SUN CURTAINS
7. PERISCOPIC SEXTANT MOUNT
8. COPILOT'S CHECK LIST PANEL
9. COPILOT'S STATION
10. WING ILLUMINATION LIGHTS
11. VORTEX GENERATORS
12. APPROACH CHUTE
13. BRAKE CHUTE
14. OUTRIGGER LANDING GEAR LOCKS
15. MAIN LANDING GEAR LOCKS
16. LANDING LIGHTS
17. WING JACK PADS
18. MOORING EYE
19. BOMB BAY WALKWAY
20. BOMB BAY ACCESS OPENING
21. BOMB BAY PLATFORM
22. CRAWLWAY
23. GROUND HEAT ACCESS PANEL
24. CRAWLWAY ACCESS DOOR
25. CANOPY GROUND LOCK
26. FLIGHT INSTRUCTOR'S STATION
27. ENTRANCE LADDER
28. ENTRANCE DOOR
29. PITOT HEAD
30. THERMOS BOTTLES AND DRINKING CUP DISPENSER
31. FOOD WARMING CUP
32. PERISCOPIC SEXTANT (STOWED)
33. WALKWAY
34. RADOME
35. CHEMICAL TOILET
36. OBSERVER INSTRUCTOR'S STATION
37. OBSERVER'S STATION

049526

*Figure 1-4.*

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 first 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

## PILOT'S STATION




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. CANOPY LOCK LEVER
9. PILOT'S FUEL PANEL
10. STANDBY COMPASS LIGHT SWITCH

*Figure 1-5.*

049031

beyond the idle stop when surface lock lever (2, figure 1-9) 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 the chart in figure 1-2.

### THROTTLE LOCK LEVER

The throttles are prevented from creeping by an ON--OFF throttle lock lever (4, figure 1-9) on the pilot's control stand. When this lever is in the aft or OFF position, the throttles are free to move. Advancing the lever mechanically applies an increasing amount of friction to hold the throttles in any desired position. The copilot has no throttle lock lever and cannot apply or release the throttle friction.

# PILOT'S STATION—AFT RIGHT SIDE

1. PILOT'S RADIO PANEL
2. PILOT'S FUEL CONTROL PANEL
3. PILOT'S LIGHTING CONTROL PANEL
4. CABIN HEAT RESET BUTTON
5. EMERGENCY CABIN PRESSURE RELEASE HANDLE (DUMP VALVE)
6. CANOPY LEVER
7. TRIM COORDINATION SWITCH PANEL
8. CABIN HEAT DISTRIBUTION KNOB
9. CONTROL COLUMN DISCONNECT HANDLE

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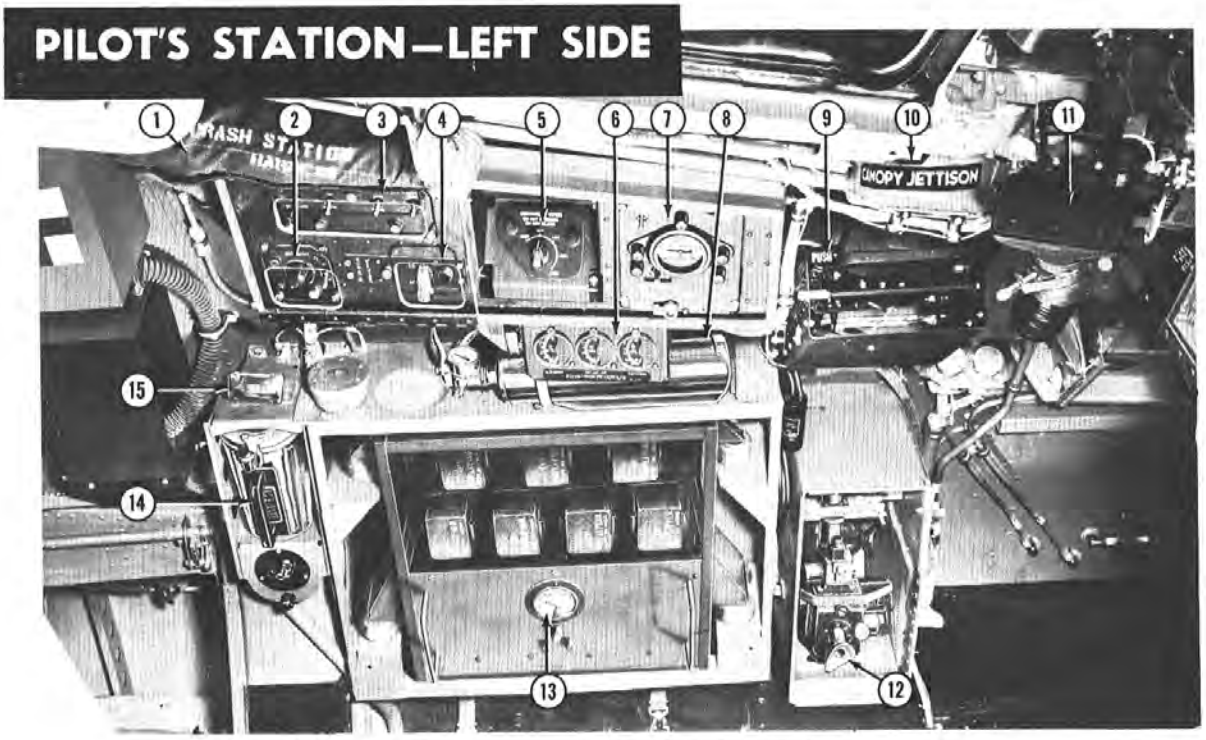
*Figure 1-6.*




1. CRASH STATION HARNESS
2. MAP LIGHT PANEL
3. POSITION LIGHT PANEL
4. EMERGENCY KEYER PANEL
5. WINDSHIELD WIPER CONTROL PANEL
6. ANTI-ICING AIR TEMPERATURE PANEL
7. OXYGEN REGULATOR PANEL
8. FIRE EXTINGUISHER
9. AUTOMATIC PILOT PEDESTAL
10. CANOPY EMERGENCY JETTISON HANDLE
11. UPPER AIR OUTLET
12. PERISCOPIC SEXTANT
13. COORDINATE CONVERTER AMPLIFIER AND POWER SUPPLY
14. FOOD WARMING CUP
15. REAR VIEW MIRROR

049032

*Figure 1-7.*

## FIRE SHUTOFF SWITCHES

Six two-position pull-push "Light On - Pull for Emergency Stop" fire shutoff switches (19, figure 1-8) on the pilot's instrument panel control engine fire shutdown. Each switch has a red press-to-test fire warning light in the end of the knob which, when illuminated, indicates an engine fire or overheat condition. Pulling a switch closes the fuel and oil shutoff valves and trips the generator field relay for the corresponding engine. In addition, when No. 3 or 4 switch is pulled, the respective hydraulic shutoff valve is closed, and when No. 1 or 6 switch is pulled, the respective alternator system is deenergized. Pushing a shutoff switch restores the respective fuel and oil (and hydraulic on No. 3 and 4) systems to normal; however, the generator and alternator circuits must be reset individually to return them to normal. 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 by placing the alternator control switch to the momentary RESET position. Moving a throttle to CUT-OFF position closes the fuel fire shutoff valve on the

respective engine but has no effect on oil and hydraulic shutoff valves or generator and alternator operation. DC power for shutdown of the various systems is furnished through circuit breakers on the upper and lower DC power panels listed as follows:

| SYSTEM | CIRCUIT BREAKER |
|---|---|
| Oil | Throttle & Engine Control (lower DC power panel) |
| Hydraulic | Throttle & Engine Control (lower DC power panel) |
| Direct Current | Throttle & Engine Control (lower DC power panel) |
| Unregulated AC | Alternator Bus Selector & Control (lower DC power panel) |
| Fuel | Main Fuel Warning, Manifold & Fire Shutoff Valves (upper DC power panel) |

## ENGINE SCREEN SWITCH

**NOTE**

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

Engine air inlet screens are provided to prevent debris or other foreign objects from being drawn into the engine during ground operation. The screens are in eight sections and are located in the air inlet section of each engine. The screens are opened and closed electrically by a three-position CLOSE--OPEN--AUTOMATIC switch (15, figure 1-10) on the pilot's switch panel. CLOSE position will extend the screens and OPEN position will retract the screens. In AUTOMATIC position, a landing gear safety switch will automatically open screens on takeoff and close 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. Control power for the engine screen operation circuits is provided through a circuit breaker marked "Engine Screen" located on the "Throttle & Engine Control" portion of the lower DC power panel*.

## ENGINE STALL PREVENTION (ESP) SWITCH

An engine stall prevention switch (1, figure 1-8) on the pilot's instrument panel is used as an aid in preventing engine compressor stalls caused by throttle manipulation. This switch has ON--OFF positions and should be OFF during takeoff. The ESP switch should be ON when flying below 10,000 feet with an OAT at 15° C (59° F) or below. This switch should be ON for air refueling, formation flying, jet penetration, and unusual maneuvers, such as practice stalls, regardless of altitude or temperature. Placing the switch ON 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 time. If the switch is left ON at high altitude, a loss of rpm may be encountered. If the switch is left ON 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 OFF. Circuit breakers for the system are located on the "Engine Stall Prevention" portion of the lower DC power panel. The breakers are marked "Eng 1 & 6," "Eng 2 & 5," and "Eng 3 & 4."

## ENGINE INDICATORS

**NOTE**

The following engine instruments are rotated on the instrument panel so that their pointers will be approximately horizontal (9 o'clock position) at takeoff. This positioning makes any deviation from normal operation at takeoff instantly apparent. At the 9 o'clock position, these instruments will read approximately as follows:

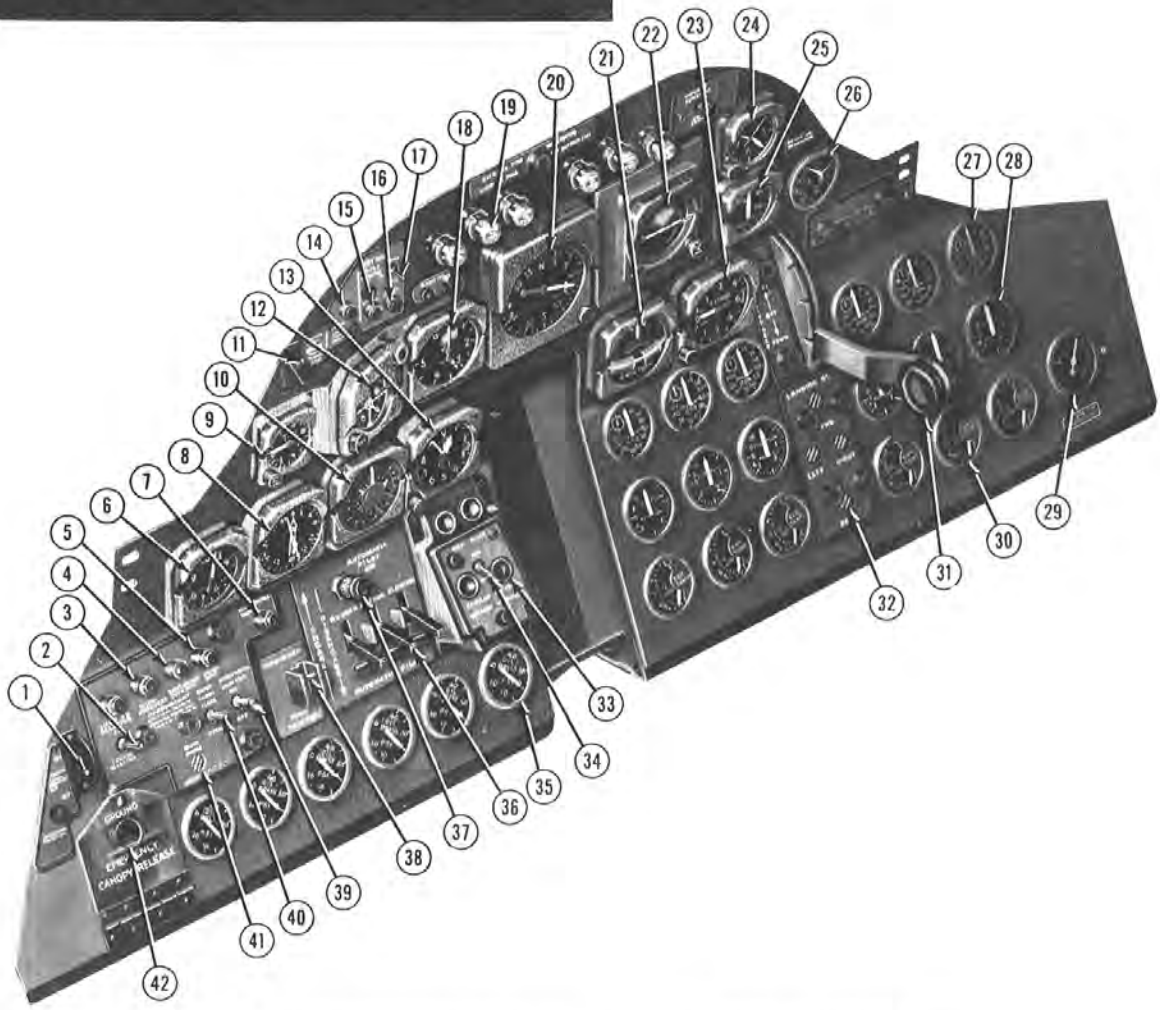
- Tachometer - 100% rpm
- Oil Pressure - 20 psi
- Fuel Flow - 6500 pph
- Exhaust Gas Temperature - 690° C

## ENGINE FUEL FLOWMETERS

Six fuel flowmeters (28, figure 1-8) (one for each engine) located on the pilot's instrument panel electrically indicate 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. Circuit protection for the fuel flowmeter system is protected by a circuit breaker marked "Fuel Flowmeters" located on the lower DC power panel, circuit breaker marked "Fuel Flowmeter" located on the main AC power shield, and fuses in the forward AC power shield.

* AF 51-2045 thru -2091

# PILOT'S INSTRUMENT PANEL

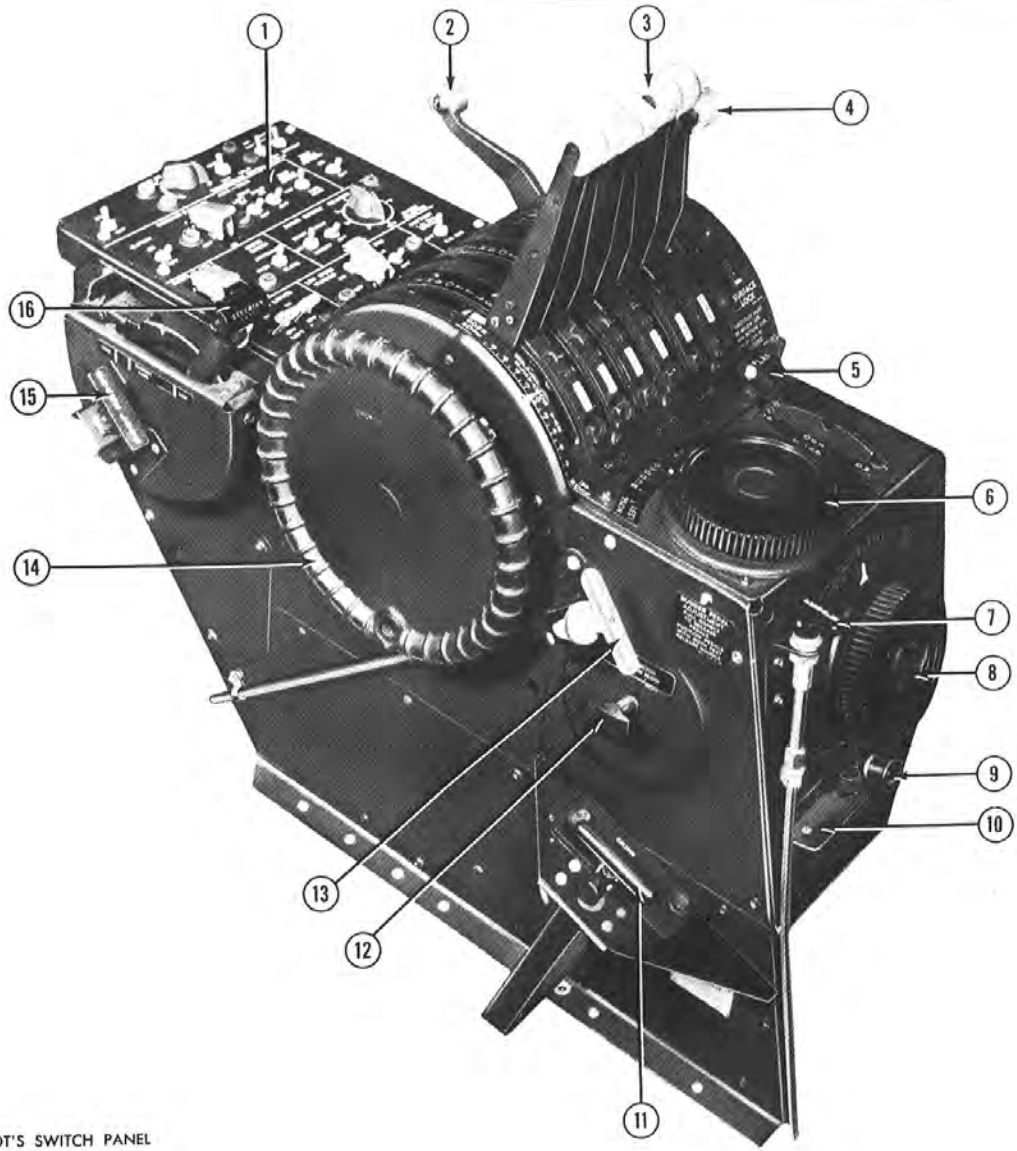



1. ENGINE STALL PREVENTION SWITCH
2. ID-249 COURSE SELECTOR TRANSFER SWITCH
3. WING OVERHEAT WARNING LIGHT
4. EMPENNAGE OVERHEAT WARNING LIGHT
5. BOMBS AWAY INDICATOR LIGHT
6. MACHMETER
7. N-1 COMPASS INOPERATIVE LIGHT
8. ID-250 RADIO MAGNETIC INDICATOR (RMI)
9. ACCELEROMETER
10. DATA INDICATOR
11. APPROACH CHUTE DEPLOYMENT SWITCH
12. ID-249 COURSE INDICATOR
13. ALTIMETER
14. ANTI-SKID INOPERATIVE LIGHT
15. INSTRUMENT INVERTER INDICATOR LIGHT — MAIN
16. INSTRUMENT INVERTER INDICATOR LIGHT — SPARE
17. INSTRUMENT INVERTER SWITCH
18. MAXIMUM ALLOWABLE AIRSPEED INDICATOR
19. FIRE SHUTOFF SWITCHES
20. DIRECTIONAL INDICATOR (N-1 REPEATER)
21. TURN-AND-SLIP INDICATOR
22. ATTITUDE INDICATOR (B-1)
23. VERTICAL VELOCITY INDICATOR
24. CLOCK
25. WING FLAP POSITION INDICATOR
26. CABIN PRESSURE GAGE
27. TACHOMETERS
28. FUEL FLOWMETERS
29. OUTSIDE AIR TEMPERATURE GAGE
30. EXHAUST GAS TEMPERATURE GAGES
31. LANDING GEAR LEVER
32. LANDING GEAR POSITION INDICATORS
33. OXYGEN WARNING LIGHTS
34. MASTER OXYGEN WARNING CONTROL SWITCH
35. OIL PRESSURE GAGES
36. AUTOMATIC PILOT ENGAGING SWITCHES
37. AUTOMATIC PILOT OFF LIGHT
38. TURN CONTROL TRANSFER SWITCH
39. DIRECTIONAL DAMPER SWITCH
40. ALTERNATE BOMB DOOR SWITCH
41. BOMB DOOR POSITION INDICATOR
42. CANOPY EMERGENCY RELEASE HANDLE (GROUND)

049549

*Figure 1 - 8.*

# PILOT'S CONTROL STAND

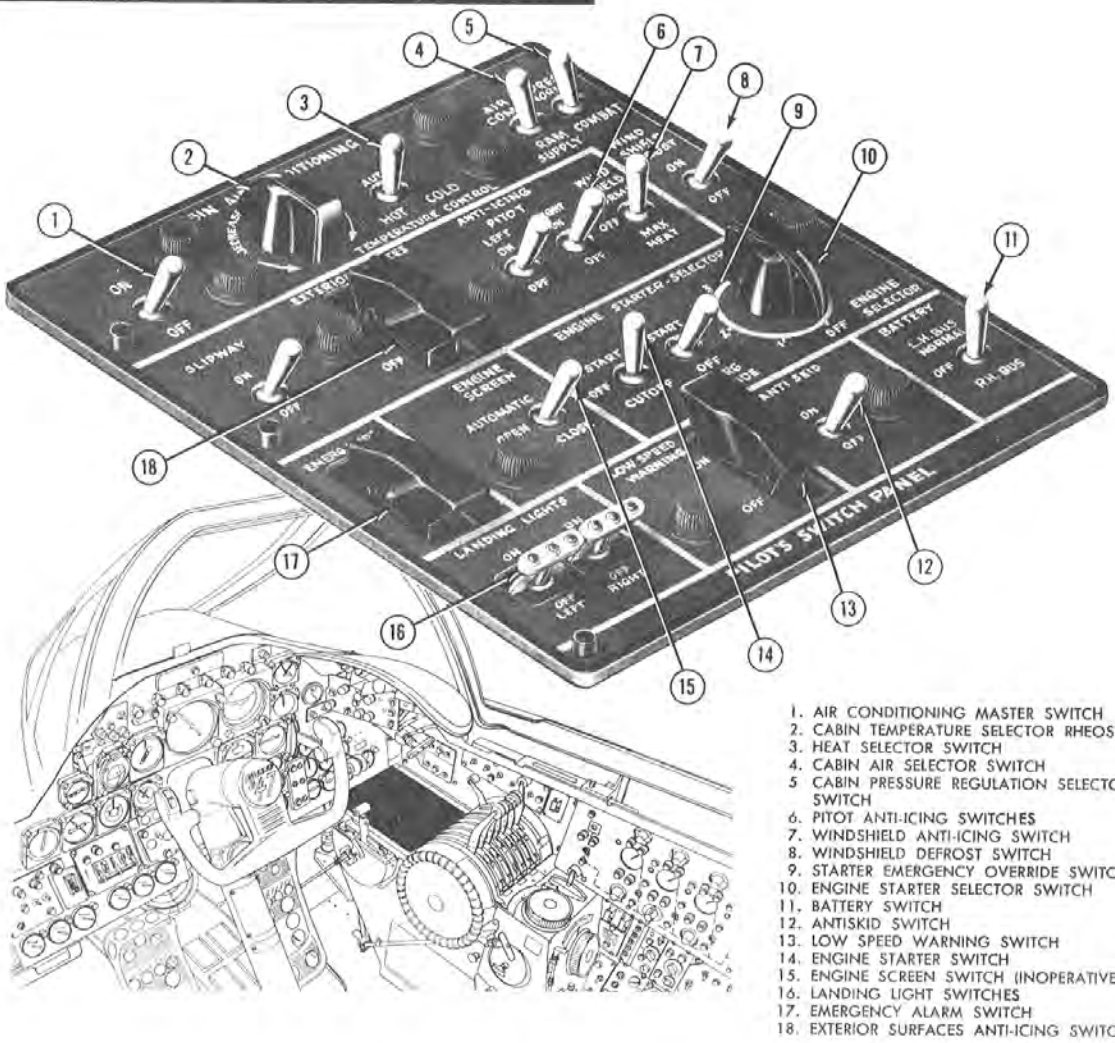



1. PILOT'S SWITCH PANEL
2. SURFACE LOCK LEVER
3. THROTTLES
4. THROTTLE LOCK LEVER
5. WING FLAP LEVER
6. RUDDER TRIM CONTROL WHEEL AND INDICATOR
7. RUDDER PEDAL ADJUSTMENT HANDLE
8. AILERON TRIM CONTROL WHEEL AND INDICATOR
9. LANDING GEAR WARNING HORN RELEASE KNOB
10. LANDING GEAR EMERGENCY RETRACTION SWITCH
11. CONTROL COLUMN DISCONNECT HANDLE
12. AIR SELECTOR KNOB
13. BRAKE CHUTE AND APPROACH CHUTE JETTISON HANDLE
14. ELEVATOR TRIM CONTROL WHEEL AND INDICATOR
15. PARKING BRAKE HANDLE
16. STEERING RATIO SELECTOR LEVER

049037

*Figure 1-9.*

# PILOT'S SWITCH PANEL




1. AIR CONDITIONING MASTER SWITCH
2. CABIN TEMPERATURE SELECTOR RHEOSTAT
3. HEAT SELECTOR SWITCH
4. CABIN AIR SELECTOR SWITCH
5. CABIN PRESSURE REGULATION SELECTOR SWITCH
6. PITOT ANTI-ICING SWITCHES
7. WINDSHIELD ANTI-ICING SWITCH
8. WINDSHIELD DEFROST SWITCH
9. STARTER EMERGENCY OVERRIDE SWITCH
10. ENGINE STARTER SELECTOR SWITCH
11. BATTERY SWITCH
12. ANTISKID SWITCH
13. LOW SPEED WARNING SWITCH
14. ENGINE STARTER SWITCH
15. ENGINE SCREEN SWITCH (INOPERATIVE)
16. LANDING LIGHT SWITCHES
17. EMERGENCY ALARM SWITCH
18. EXTERIOR SURFACES ANTI-ICING SWITCH

049558

*Figure 1-10.*

## OIL PRESSURE GAGES

Six oil pressure gages (35, figure 1-8) (one for each engine) located on the pilot's instrument panel 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. Fuses for the oil pressure indicating system are located in the main 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 six on the copilot's instrument panel (17, figure 1-16). 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 GAS 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 18, figure 1-16) on the pilot's and copilot's instrument panels. 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 gases. This exhaust gas temperature is commonly referred to as the "EGT" or "tailpipe temperature."

## 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 chambers of each engine. Power for the ignition system is supplied by the DC power system. Control power for the "normal" phase of ignition system is provided by the "Start Control" circuit breaker located on the lower DC power panel. Control power for the "altitude start or test" phase of ignition is provided by circuit breakers marked "Engine 1," "Engine 2," "Engine 3," "Engine 4," "Engine 5," and "Engine 6" located on the "Throttle & Engine Control" portion of the lower DC power panel.

### Ignition Switches

Six ignition switches (1, figure 1-11) (one for each engine) located on the ignition switch panel have three positions: NORMAL--OFF--ALTITUDE START OR TEST. In NORMAL position, the ignition will occur when a starter switch has been placed in START and the throttle advanced out of CUTOFF. Normal ignition terminates automatically when either automatic or manual cutoff of the starter occurs. In OFF position, the ignition system cannot be energized. In ALTITUDE START OR TEST position, the ignition system is energized continuously until the switch is placed in OFF position to stop ignition. Control circuit breakers for the ignition control circuits marked "Engine 1," "Engine 2," "Engine 3," "Engine 4," "Engine 5," and "Engine 6" are located on the "Throttle & Engine Control" portion of the lower DC power panel.

**CAUTION**

Do not place ignition switch for any engine in 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.

**NOTE**

Do not energize any ignition circuit longer than 3 minutes continuously during any one start or damage to ignition units may result.

# IGNITION SWITCH PANEL

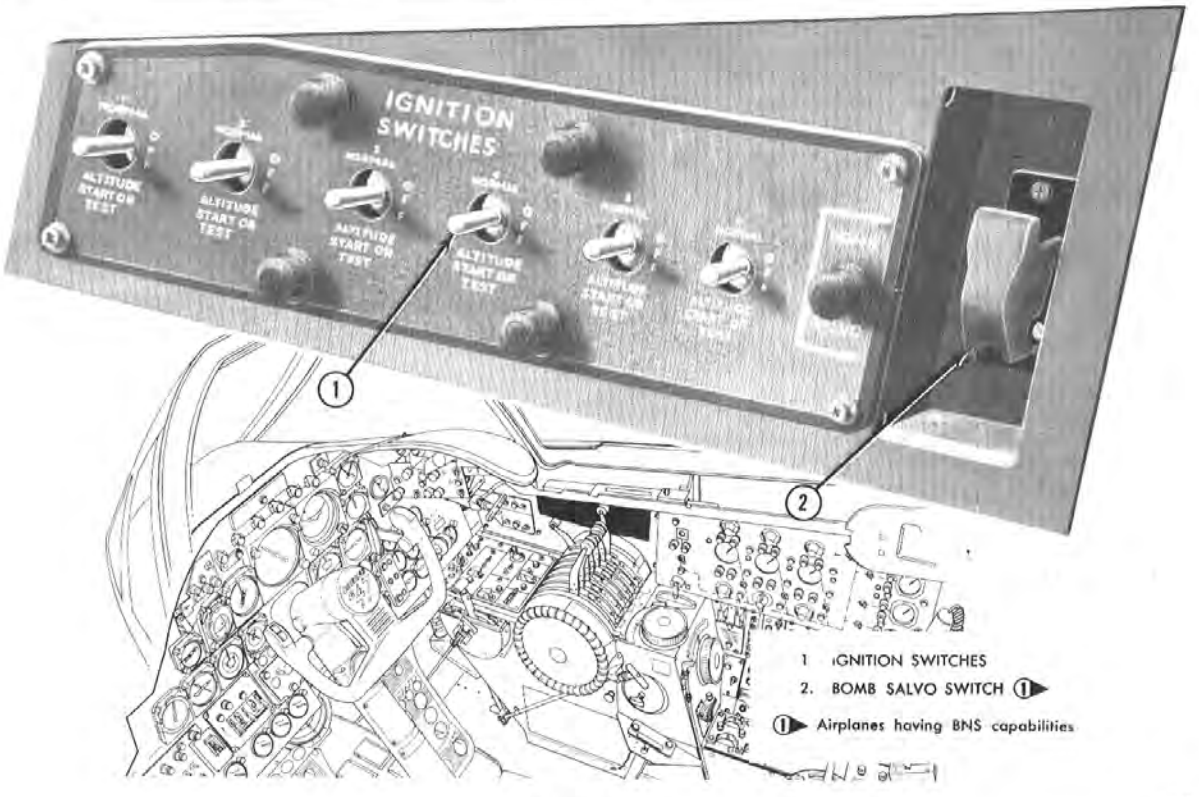


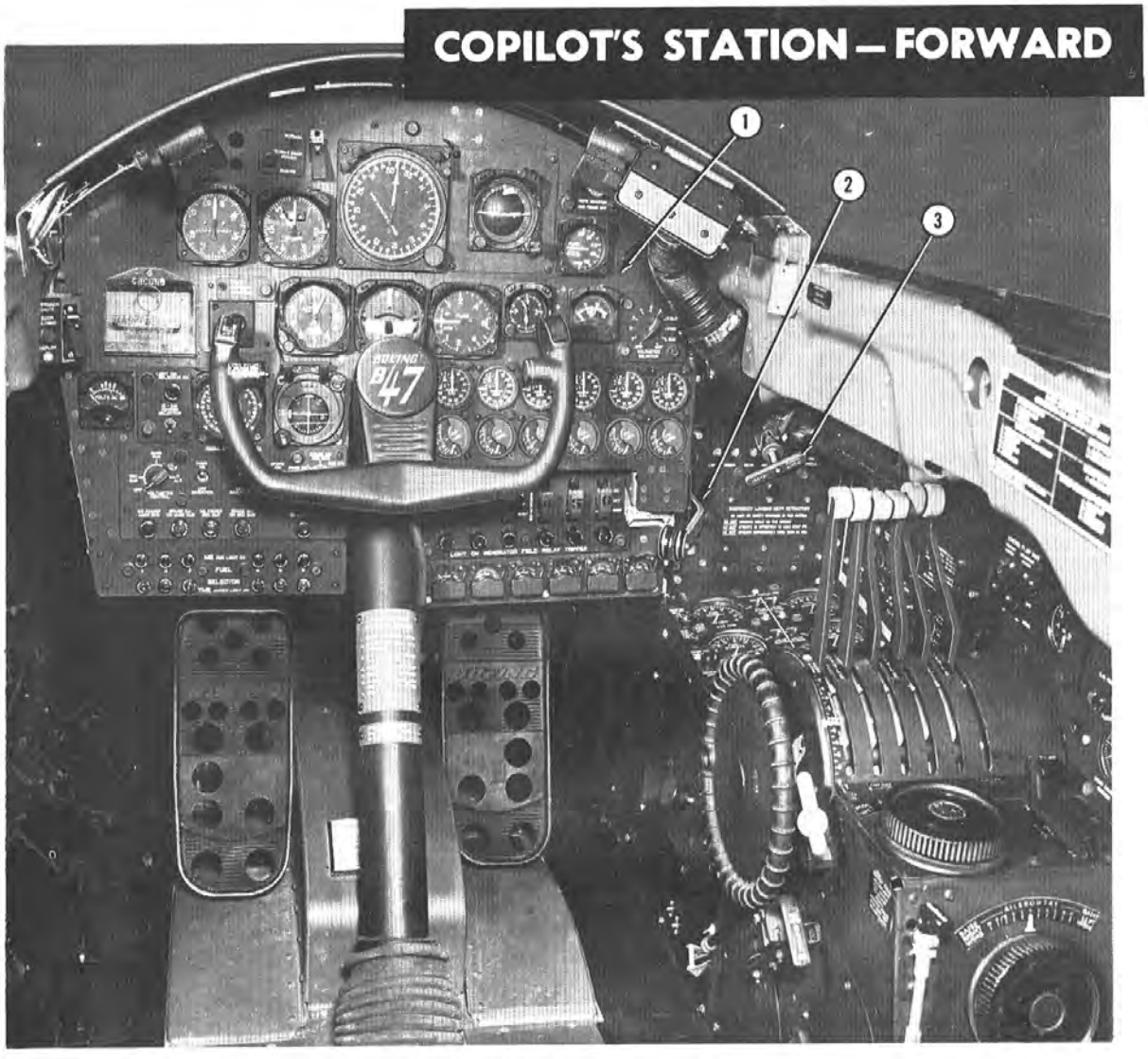

*Figure 1-11.*

## 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, after the 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 hydraulic pump 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.

### Engine Starter Selector Switch

A starter selector switch (10, figure 1-10) marked OFF --1--2--3--4--5--6 is located on the pilot's switch panel. In OFF position, the starter system cannot be energized. Placing the selector switch to the number of the engine to be started arms the starter circuits for that respective engine, and when the starter switch is placed in START position, the starter system is energized. DC power is supplied to the starter selector




1. COPILOT'S INSTRUMENT PANEL
2. COPILOT'S LANDING GEAR CONTROL PANEL
3. BRAKE CHUTE DEPLOYMENT HANDLE

049041

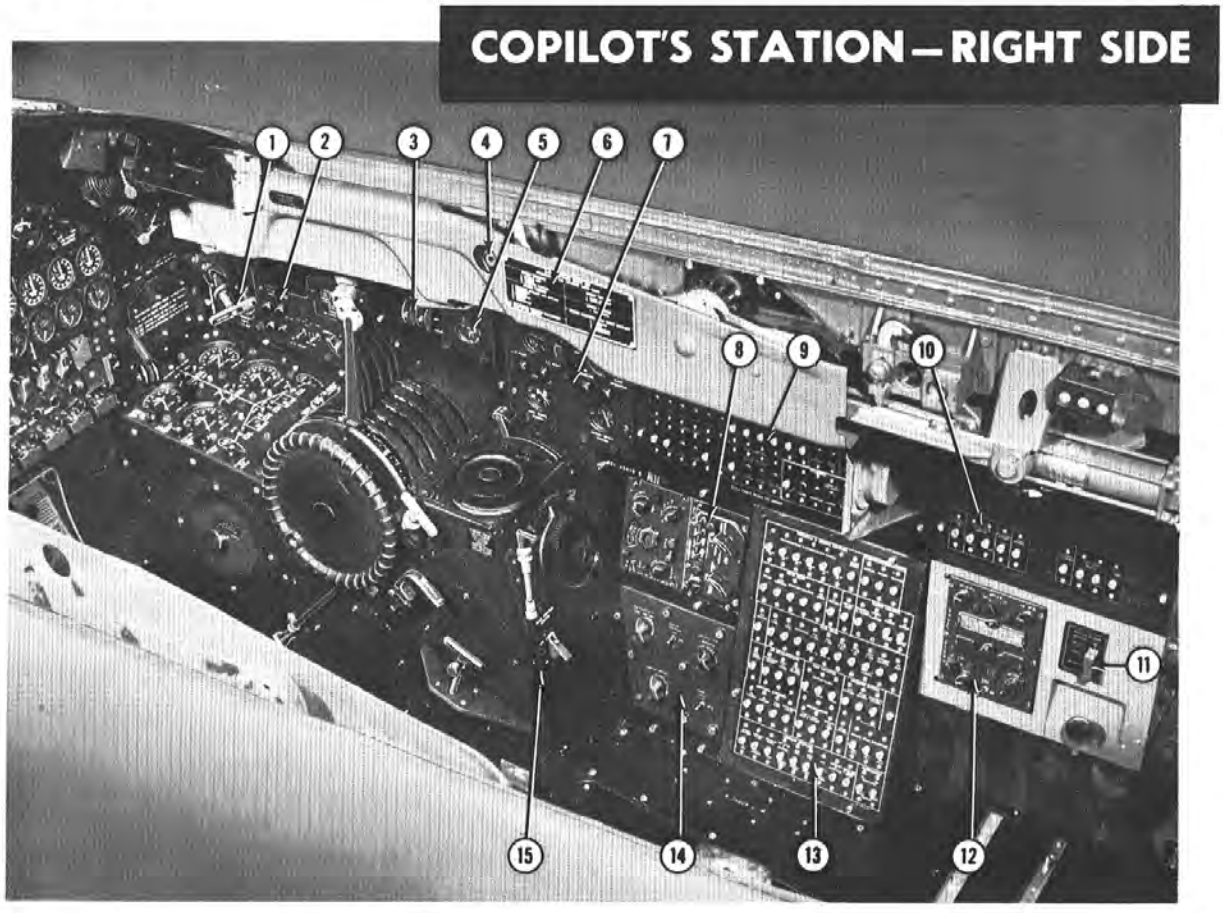
*Figure 1-12.*

switch through a circuit breaker marked "Start Control" located on the lower DC power panel.

**Engine Starter Switch**

A single three-position START--OFF--CUTOFF starter switch (14, figure 1-10) located on the pilot's switch panel is spring-loaded to 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.




1. BRAKE CHUTE DEPLOYMENT HANDLE
2. UNREGULATED AC POWER PANEL
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
9. UPPER DC POWER PANEL
10. AFT DC POWER PANEL
11. DC BUS SELECTOR SWITCH
12. AN/ARC-21 LIAISON RADIO MASTER PANEL
13. LOWER DC POWER PANEL
14. LIGHTING PANEL
15. CONTROL STAND

049042

*Figure 1-13.*

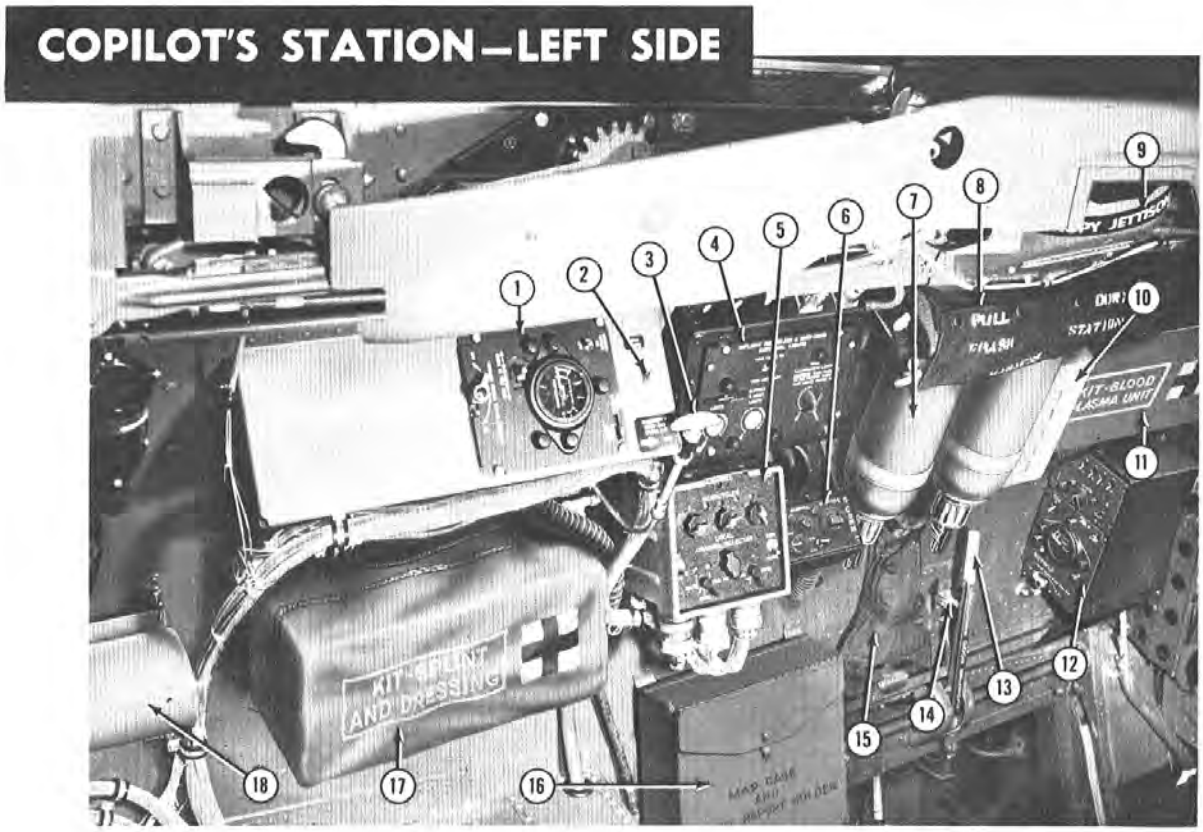
- The ignition circuit is armed (energized when throttle is advanced to START position provided the ignition switch is in NORMAL position).
- The hydraulic pump pressure release valve opens (engines No. 3 and 4 only).

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 is accomplished:

- The ignition control relay is deenergized.
- The hydraulic pump pressure release valve is closed (engines No. 3 and 4 only).




1. OXYGEN REGULATOR PANEL
2. DOME LIGHT SWITCH
3. EMERGENCY HOT AIR SHUTOFF HANDLE
4. ANTI-ICING EXTERNAL LIGHTS PANEL
5. UHF COMMAND RADIO PANEL
6. AN/ARC-21 LIAISON RADIO SUB PANEL
7. THERMOS BOTTLES
8. CRASH STATION HARNESS STOWAGE
9. CANOPY EMERGENCY JETTISON HANDLE (IN FLIGHT)
10. CUP DISPENSER
11. BLOOD PLASMA KIT
12. EXTRA CREW MEMBER'S OXYGEN AND INTERPHONE PANEL
13. PRESSURE DOOR RELEASE HANDLE
14. ENTRANCE DOOR BAILOUT CONTROL HANDLE
15. PARACHUTE STATIC LINES
16. MAP CASE AND FLIGHT REPORT HOLDER
17. BATTLE SPLINT AND DRESSING KIT
18. ANTI-EXPOSURE SUITS

049043

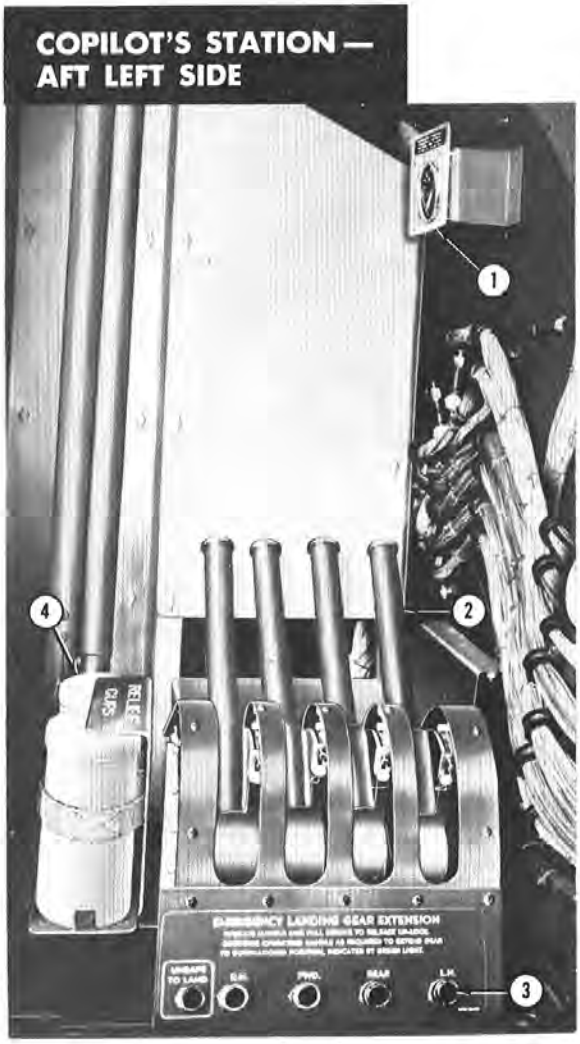
*Figure 1-14.*

• The starter control relay is deenergized.

Control circuit breakers for the starter control circuit are marked "Engine 1," "Engine 2," "Engine 3," "Engine 4," "Engine 5," and "Engine 6" located on the "Throttle & Engine Control" portion of the lower DC power panel.

**Starter Emergency Override Switch**

A two-position START--OFF starter emergency override switch (9, figure 1-10) located on the pilot's switch panel and spring-loaded to OFF position permits engine starting from the airplane batteries. In START position, the starter bus is connected to the airplane DC bus system bus. Actuating the starter switch simultaneously with the override switch permits engine starting from the airplane batteries through the normal airplane bus or from an external power source connected to the normal airplane bus. In OFF position, starter-generators may be motorized by actuating the starter switch with an external power source connected to the start portion of the external DC power receptacle. DC power is supplied to the starter emergency override switch through the "Start Control" circuit breaker on the lower DC power panel.




1. CANOPY AIR BOTTLE PRESSURE GAGE
2. EMERGENCY LANDING GEAR EXTENSION LEVERS
3. LANDING GEAR INDICATOR LIGHTS
4. RELIEF CONTAINERS

049049

*Figure 1-15.*

## OIL SYSTEM

Each engine is provided with an independent oil system, including an oil tank and two engine-driven oil pumps. Each tank, located in the wing panel adjacent to each engine, has a capacity of 9.1 US gallons and has an additional expansion space of 4.9 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 5-2. 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 1-48.

### FIRE SHUTOFF SWITCHES

Six fire shutoff switches (19, figure 1-8) (one for each engine) are located on the pilot's instrument panel. Each switch controls the electrically operated oil shutoff valve for the respective engine. The oil system fire shutoff valve is energized to its closed position when the fire shutoff switch is pulled. The valve is energized to its open position when the fire shutoff switch is reset regardless of the throttle position. The fire shutoff switches are the same as described under "Engines," this section.

## FUEL SYSTEM

**NOTE**

On some airplanes*, provisions are installed for utilization of external wing tanks which have the solenoid-type release system. All external wing tanks have been modified to install the thruster-type release system and cannot be used on airplanes which have not been modified to accommodate them. The provisions installed on these airplanes are not subject to modification and for operational purposes are considered inoperative. For this reason, the external wing tanks, their controls and indicators, are not discussed in this handbook.

The fuel system supplies fuel to the engines from three main tanks and two auxiliary tanks in the fuselage. 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 the aft main tank for engines No. 3 and 4. However, an engine manifold system al-

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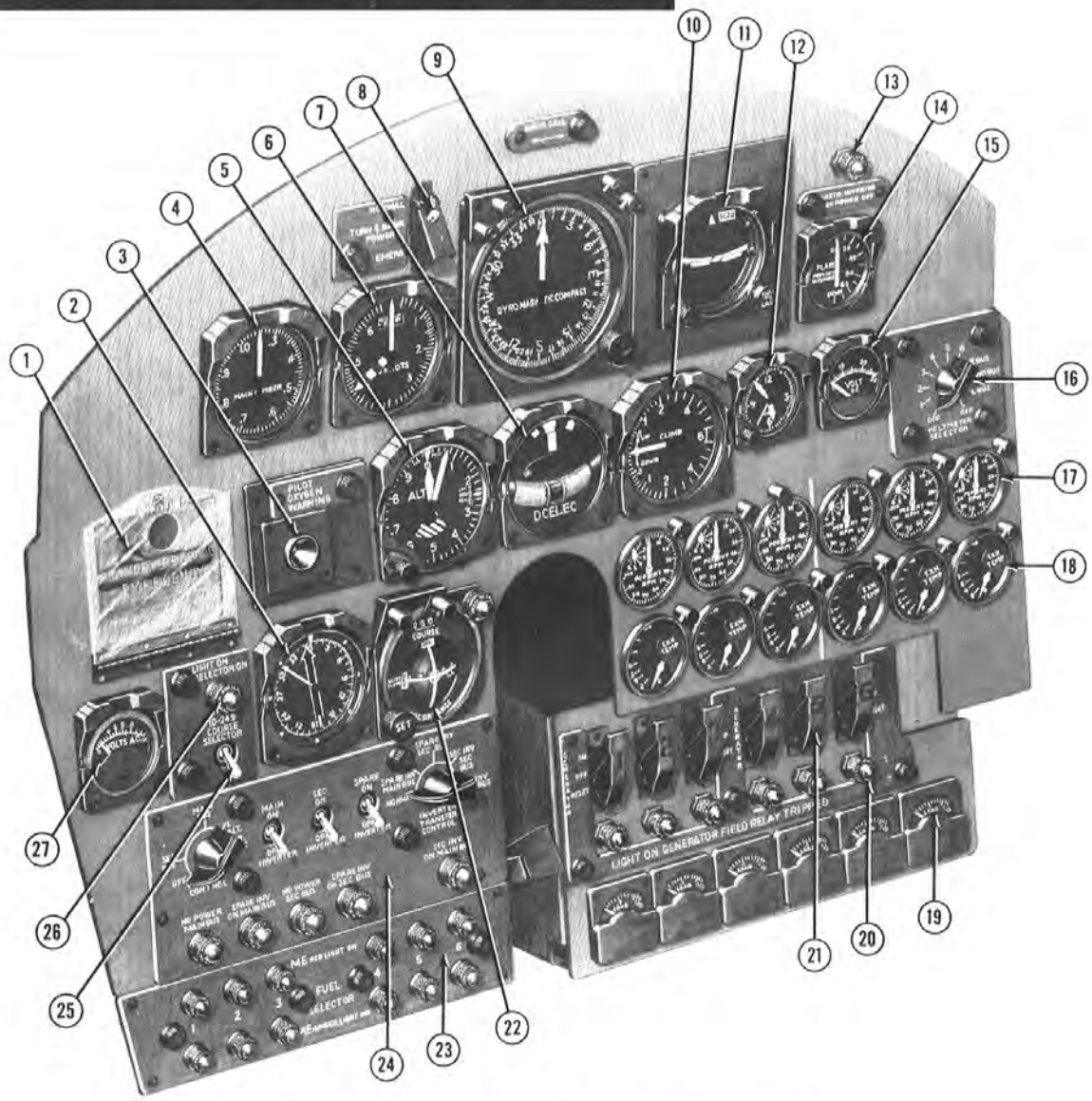
# COPILOT'S INSTRUMENT PANEL

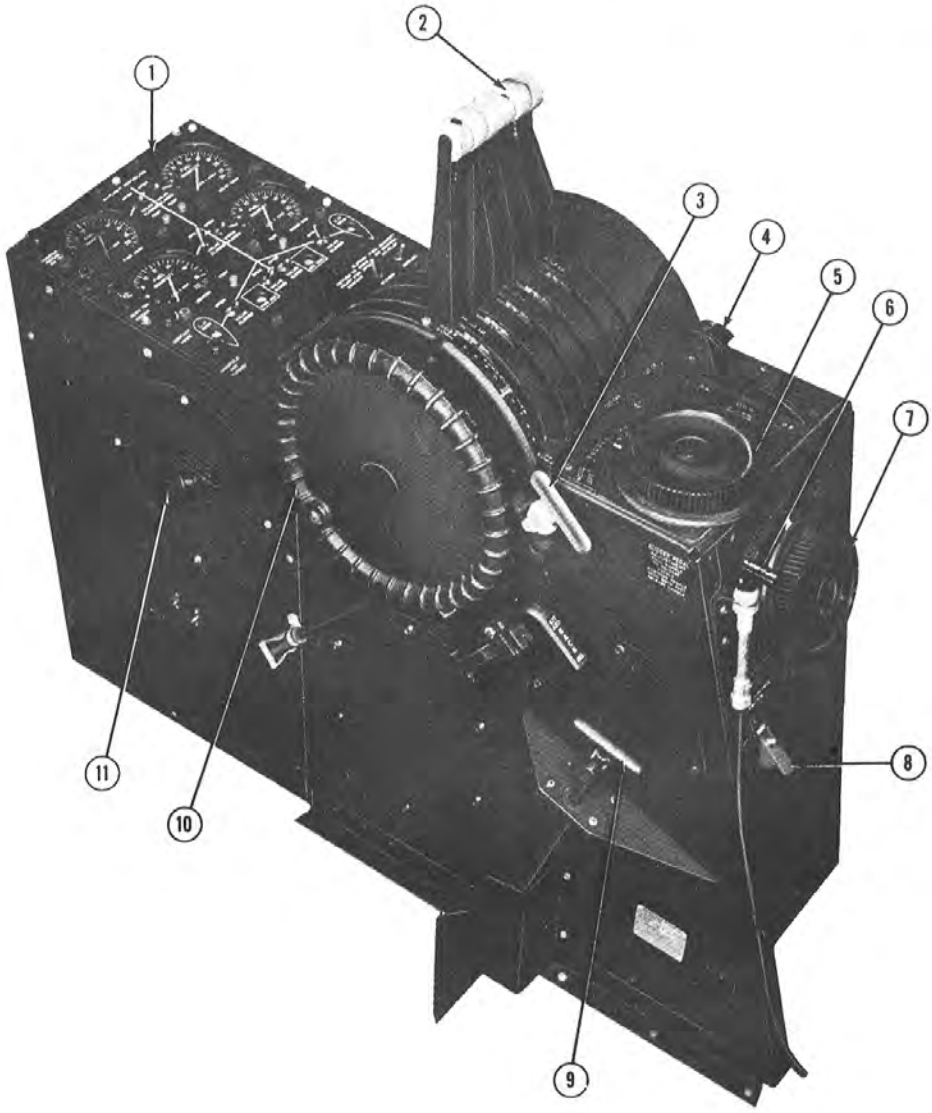



1. CANOPY EMERGENCY RELEASE HANDLE (GROUND)
2. ID-250 RADIO MAGNETIC INDICATOR (RMI)
3. PILOT'S OXYGEN WARNING LIGHT
4. MACHMETER
5. ALTIMETER
6. MAXIMUM ALLOWABLE AIRSPEED INDICATOR
7. TURN-AND-SLIP INDICATOR
8. TURN-AND-SLIP POWER SWITCH
9. DIRECTIONAL INDICATOR (N-1 REPEATER)
10. VERTICAL VELOCITY INDICATOR
11. ATTITUDE INDICATOR (J-8)
12. CLOCK
13. INSTRUMENT INVERTER INDICATOR LIGHT
14. WING FLAP POSITION INDICATOR
15. DC VOLTMETER
16. DC VOLTMETER SELECTOR SWITCH
17. TACHOMETERS
18. EXHAUST GAS TEMPERATURE GAGES
19. GENERATOR LOADMETERS
20. GENERATOR FIELD TRIP WARNING LIGHTS
21. GENERATOR SWITCHES
22. ID-249 COURSE INDICATOR
23. FUEL SELECTOR SWITCH POSITION INDICATOR LIGHTS
24. REGULATED AC POWER PANEL
25. ID-249 COURSE SELECTOR TRANSFER SWITCH
26. ID-249 COURSE SELECTOR INDICATOR LIGHT
27. AC VOLTMETER

049048

*Figure 1-16.*

# COPILOT'S CONTROL STAND




1. COPILOT'S FUEL PANEL
2. THROTTLES
3. BRAKE CHUTE AND APPROACH CHUTE JETTISON HANDLE
4. WING FLAP LEVER
5. RUDDER TRIM CONTROL WHEEL AND INDICATOR
6. RUDDER PEDAL ADJUSTMENT HANDLE
7. AILERON TRIM CONTROL WHEEL AND INDICATOR
8. DRAG SWITCH
9. CONTROL COLUMN DISCONNECT HANDLE
10. ELEVATOR TRIM CONTROL WHEEL AND INDICATOR
11. AIR OUTLET SELECTOR

049028

*Figure 1-17.*

lows 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 are the forward auxiliary tank and the bomb bay tank. Auxiliary fuel should be used by the engines directly from the auxiliary tanks. The refueling manifold is connected to the engine manifold by an intermanifold line thus allowing the auxiliary fuel to flow directly to the engines (figure 1-21). 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. Fuel from the auxiliary tanks may also be transferred to any or all main tanks through the refueling manifold. Fuel cannot be transferred to any auxiliary tank. High level control switches in each main tank prevent overfilling during fuel transfer operations by closing the DC operated transfer-refueling valves.

### FUEL SYSTEM CONTROL

The fuel system is controlled from the pilot's fuel panel (figure 1-18). 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 and each warning light represents a boost pump. See section VII for fuel system management.

### SINGLE POINT GROUND REFUELING (SPR)

A single point ground refueling system may be used for filling both main and auxiliary tanks from a single receptacle (23, figure 1-48) on the right side of the airplane. A single point ground 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 1-48. See section IV for additional information on this system.

**CAUTION**

DC power must be on the airplane when using the single point ground refueling system. Therefore, extreme care must be exercised because of the existing fire hazard.

### FUEL SELECTOR SWITCHES

Six rotary-type fuel selector switches (4, figure 1-18) (one for each engine) on the pilot's fuel panel provide a means of electrically operating the main fuel tank boost pumps, main fuel tank shutoff valves, and engine manifold shutoff valves. Operation of the 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). In TE position the DC operated main fuel tank valves will be opened and the DC operated main tank boost pumps energized as soon as throttles are advanced out of CUTOFF. The DC operated engine manifold shutoff valve will remain closed. This allows fuel to flow from the respective main tank to the respective engine. In TME position the main fuel tank valves are opened, the main tank boost pumps energized, and the engine manifold shutoff valve opened regardless of throttle position. Fuel will then flow from the respective engine and to the engine manifold. In ME position the main tank boost pumps are off, the engine manifold shutoff valve is opened, and the main fuel tank valves are opened regardless of throttle position. This allows any fuel in the engine manifold to flow to the respective engine. DC power is supplied to the fuel selector switches through circuit breakers marked "Engine 1," "Engine 2," "Engine 3," "Engine 4," "Engine 5," and "Engine 6" located on the "Main Fuel Control" portion of the upper DC power panel.

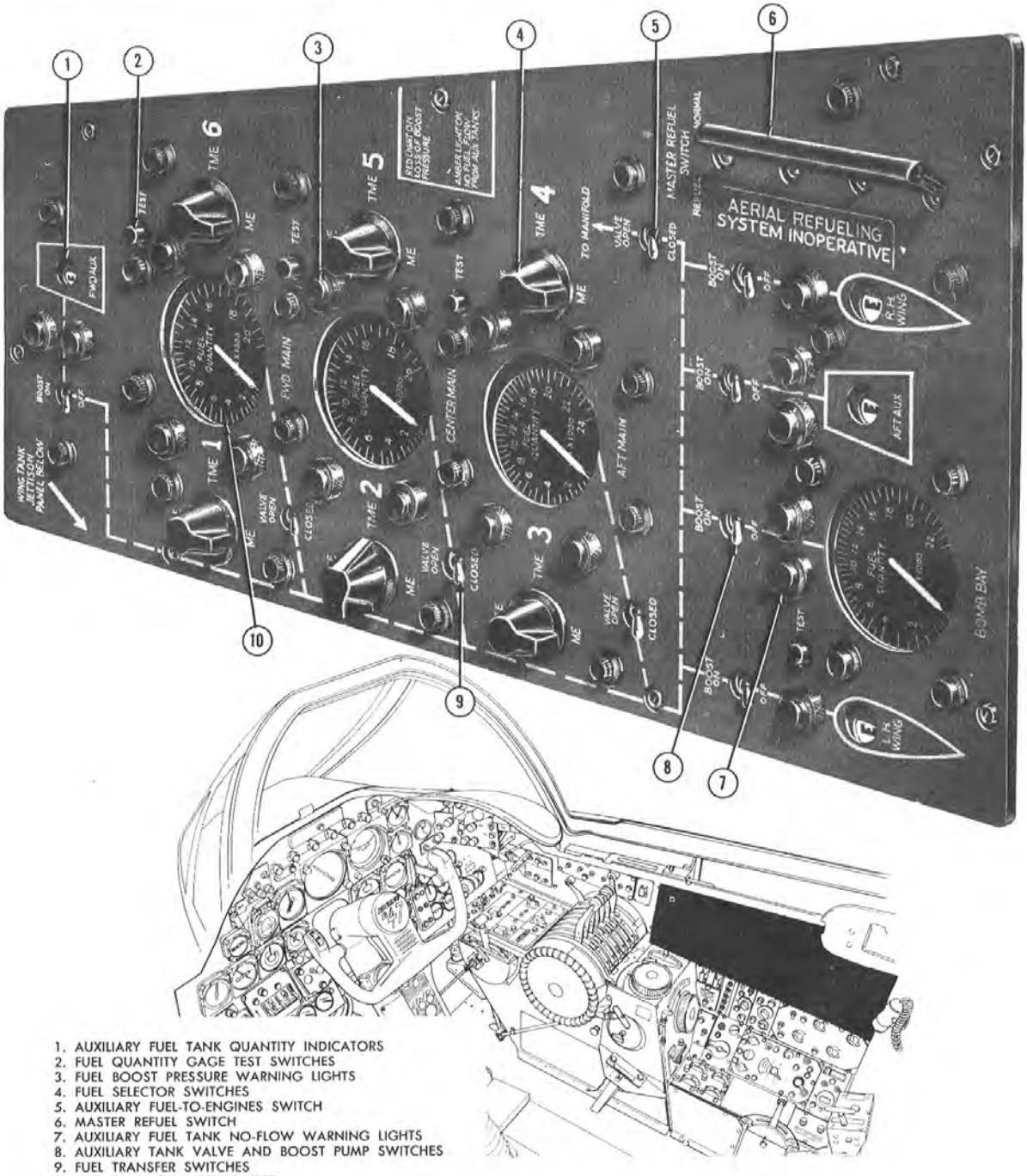
**NOTE**

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

### AUXILIARY TANK VALVE AND BOOST PUMP SWITCHES

Two BOOST ON--OFF auxiliary tank valve and boost pump switches (8, figure 1-18) are on the pilot's fuel 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. Circuit breakers for control circuits of the auxiliary tank valve and boost pump switches are marked "Fwd Aux Tank" and "Bomb Bay Tank" located on the "Fuel Transfer & Refueling" portion of the upper DC power panel.

# PILOT'S FUEL PANEL

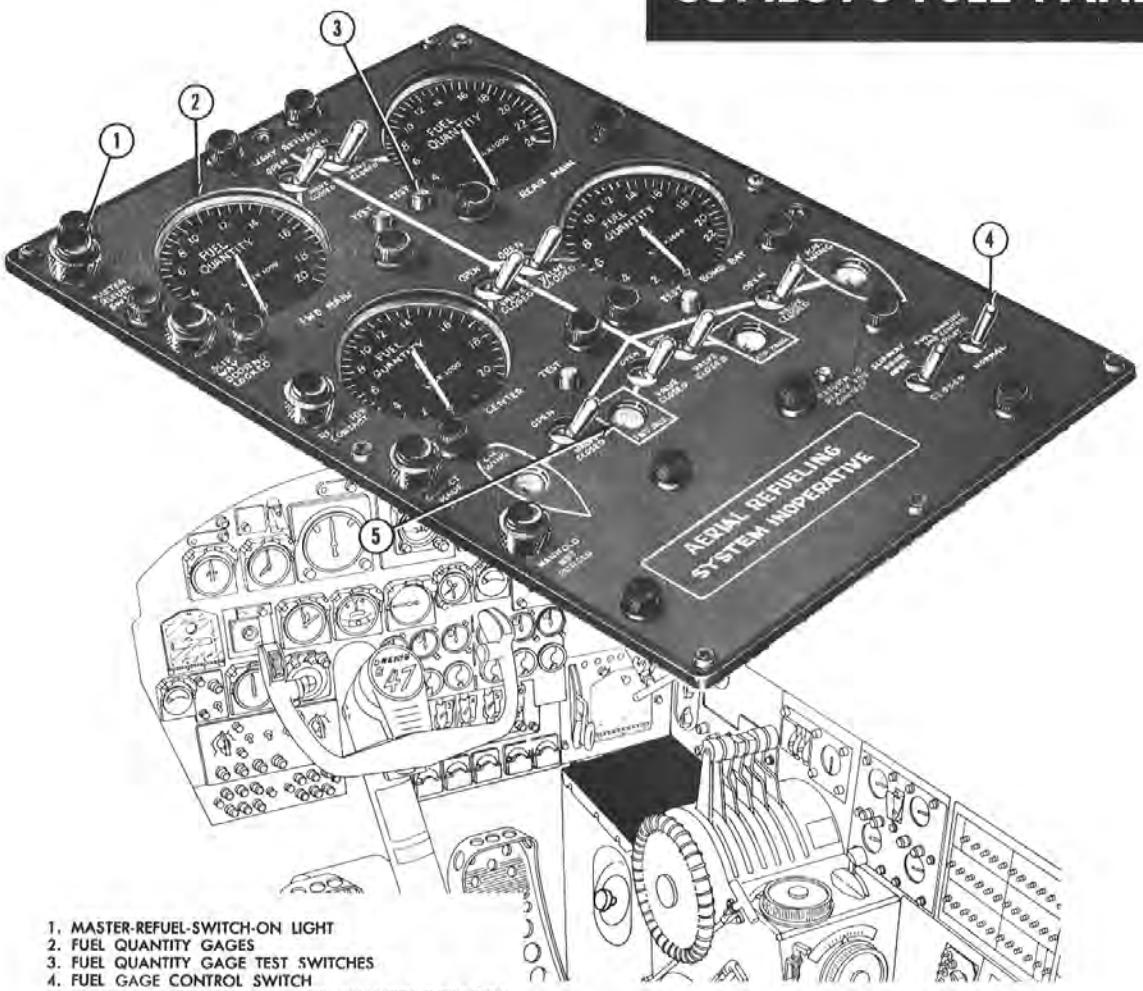



1. AUXILIARY FUEL TANK QUANTITY INDICATORS
2. FUEL QUANTITY GAGE TEST SWITCHES
3. FUEL BOOST PRESSURE WARNING LIGHTS
4. FUEL SELECTOR SWITCHES
5. AUXILIARY FUEL-TO-ENGINES SWITCH
6. MASTER REFUEL SWITCH
7. AUXILIARY FUEL TANK NO-FLOW WARNING LIGHTS
8. AUXILIARY TANK VALVE AND BOOST PUMP SWITCHES
9. FUEL TRANSFER SWITCHES
10. FUEL TANK QUANTITY GAGES

049038

*Figure 1-18.*

# COPILOT'S FUEL PANEL




1. MASTER-REFUEL-SWITCH-ON LIGHT
2. FUEL QUANTITY GAGES
3. FUEL QUANTITY GAGE TEST SWITCHES
4. FUEL GAGE CONTROL SWITCH
5. FORWARD AUXILIARY FUEL TANK QUANTITY INDICATOR

049045

*Figure 1-19.*

## 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 1-18) on the pilot's fuel 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 control switches in each main tank override the fuel transfer switches to prevent overfilling the tanks. In CLOSED position, the motor-driven valves are closed. The fuel transfer switches are deenergized when the master refuel switch is placed in REFUEL position. Circuit breakers for the fuel transfer switches are marked "Fwd Aux Tank" and "Bomb Bay Tank" located on the "Fuel Transfer & Refueling" portion of the upper DC power panel.

# FUNCTIONS OF FUEL SYSTEM CIRCUIT BREAKERS

| WITH FUEL SELECTOR SWITCH POSITION OF | CIRCUIT BREAKER | SUPPLIES POWER TO: TANK VALVE | FUEL FIRE SHUTOFF VALVE | BOOST PUMPS | MANIFOLD VALVE | FUEL BOOST PRESSURE WARNING LIGHTS |
|---|---|---|---|---|---|---|
| TE | Main Fuel Control | ✓ | | | | |
| | Main Fuel Warning Manifold & Fire Shutoff Valve | | ✓ | * ✓ | ✓ | ✓ |
| TME | Main Fuel Control | ✓ | | ✓ | | |
| | Main Fuel Warning Manifold & Fire Shutoff Valve | | ✓ | | ✓ | ✓ |
| ME | Main Fuel Control | ✓ | | | | |
| | Main Fuel Warning Manifold & Fire Shutoff Valve | | ✓ | | ✓ | ✓ |

* With Throttle Advanced

049084

*Figure 1-20.*

### AUXILIARY-FUEL-TO-ENGINES SWITCH

A two-position VALVE OPEN--CLOSED auxiliary-fuel-to-engines switch (5, figure 1-18) located on the pilot's fuel 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 and the forward auxiliary tank into the engine manifold. In VALVE OPEN position and with the master refuel switch in REFUEL position, the auxiliary-fuel-to-engines switch is deenergized and the shutoff valve is closed. 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 flow into the engine manifold. DC power is supplied to the auxiliary-fuel-to-engines switch through a circuit breaker marked "Aux Fuel to Engine Valve" on the upper DC power panel.

### MASTER REFUEL SWITCH

A two-position REFUEL--NORMAL master refuel switch (6, figure 1-18) is located on the pilot's fuel panel. Placing the switch in REFUEL accomplishes the following:

- The fuel transfer switches on the pilot's fuel panel are deenergized.
- The auxiliary tank boost pumps are deenergized.
- The auxiliary-fuel-to-engines switch is deenergized and the auxiliary-fuel-to-engines valve is closed.
- The fuel gages on the copilot's fuel panel are energized and the fuel gages on the pilot's fuel panel are deenergized.
- Power is supplied to the copilot's fuel panel lights.

Placing the switch in NORMAL accomplishes the following:

- The fuel transfer switches are energized.
- Power is supplied to the auxiliary tank boost pumps.
- The auxiliary-fuel-to-engines switch is energized and power is supplied to the valve thus permitting fuel from the auxiliary tanks to be used directly by the engines or transferred to the main tanks by means of the fuel selector switches on the pilot's fuel panel.
- The pilot's fuel gages are energized and the copilot's are deenergized.
- Power is removed from the copilot's fuel panel lights.

### FUEL GAGE CONTROL SWITCH

A fuel gage control switch (4, figure 1-19) on the copilot's fuel 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 and is used to permit the copilot to compute fuel consumption. Holding the fuel gage control switch in the momentary COPILOT position deenergizes the fuel quantity gages on the pilot's fuel panel and energizes the fuel quantity gages and panel lights on the copilot's fuel panel. Releasing the switch to NORMAL position transfers control of the gages back to the pilot. DC power is supplied to the fuel gage control switch through a circuit breaker marked "Fuel Gage Transfer" located on the "Fuel Transfer & Refueling" portion of the upper DC power panel.

**NOTE**

The forward auxiliary fuel tank three-position quantity indicators are energized on both panels at all times whenever the battery switch is on regardless of position of fuel gage control switch or master refuel switch.

### FUEL QUANTITY GAGE TEST SWITCHES

Pushbutton test switches (2, figure 1-18 and 3, figure 1-19) marked "Test" on the pilot's and copilot's fuel panels adjacent to the fuel quantity gages are provided to test circuit continuity and gages. 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 TANK QUANTITY GAGES

Electronic fuel quantity gages (10, figure 1-18 and 2, figure 1-19) on the pilot's and copilot's fuel panels show the quantity of usable 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 the position of the master refuel switch or fuel gage control switch. Regulated AC power for the fuel quantity gages is supplied by inverters through fuses on the main AC power shield.

**NOTE**

- There is an allowable tolerance between the pilot's and copilot's fuel quantity gages of 2% of highest quantity marking of the gages involved.
- 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 (9° F), the reading will be approximately 2.5% high.

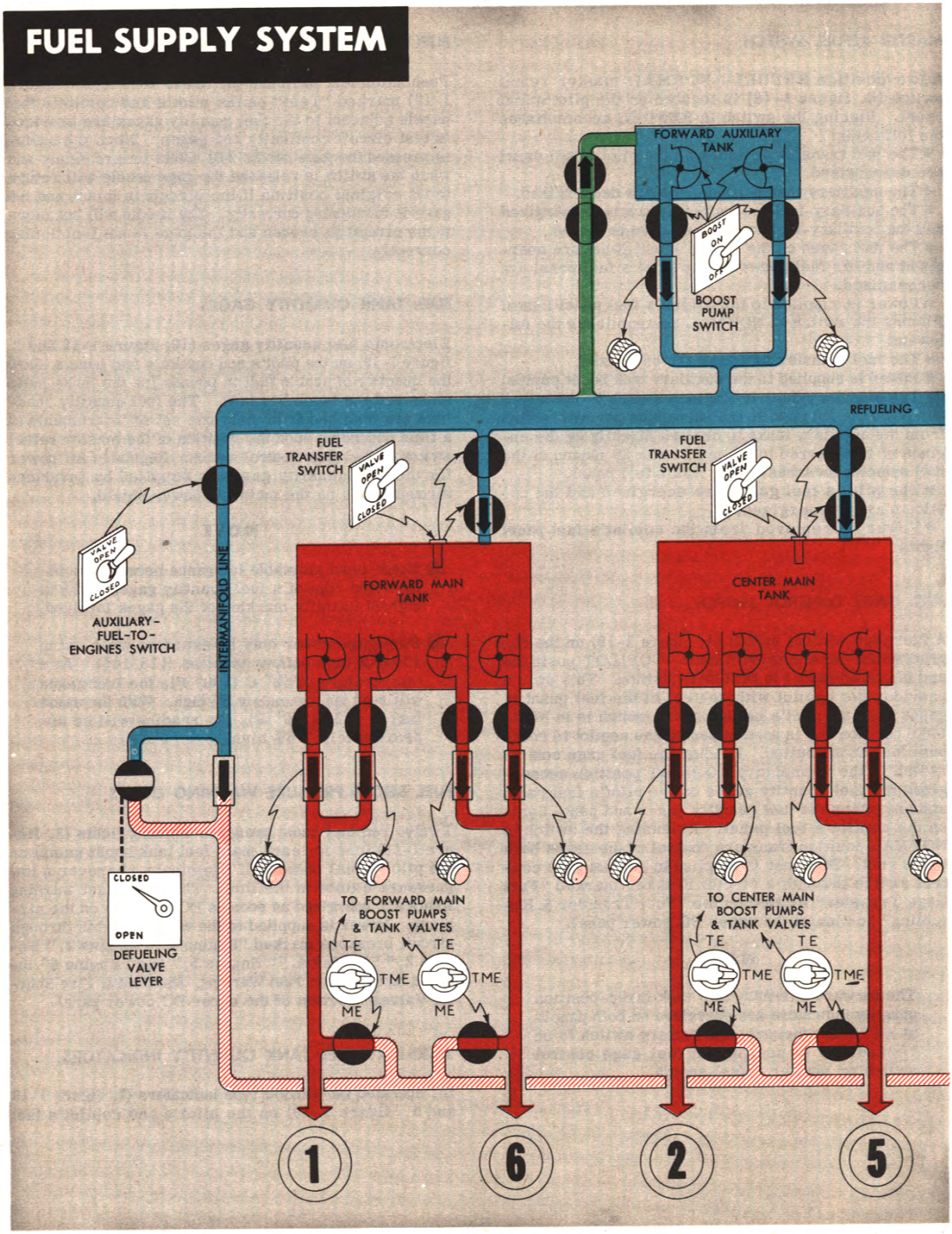
### FUEL BOOST PRESSURE WARNING LIGHTS

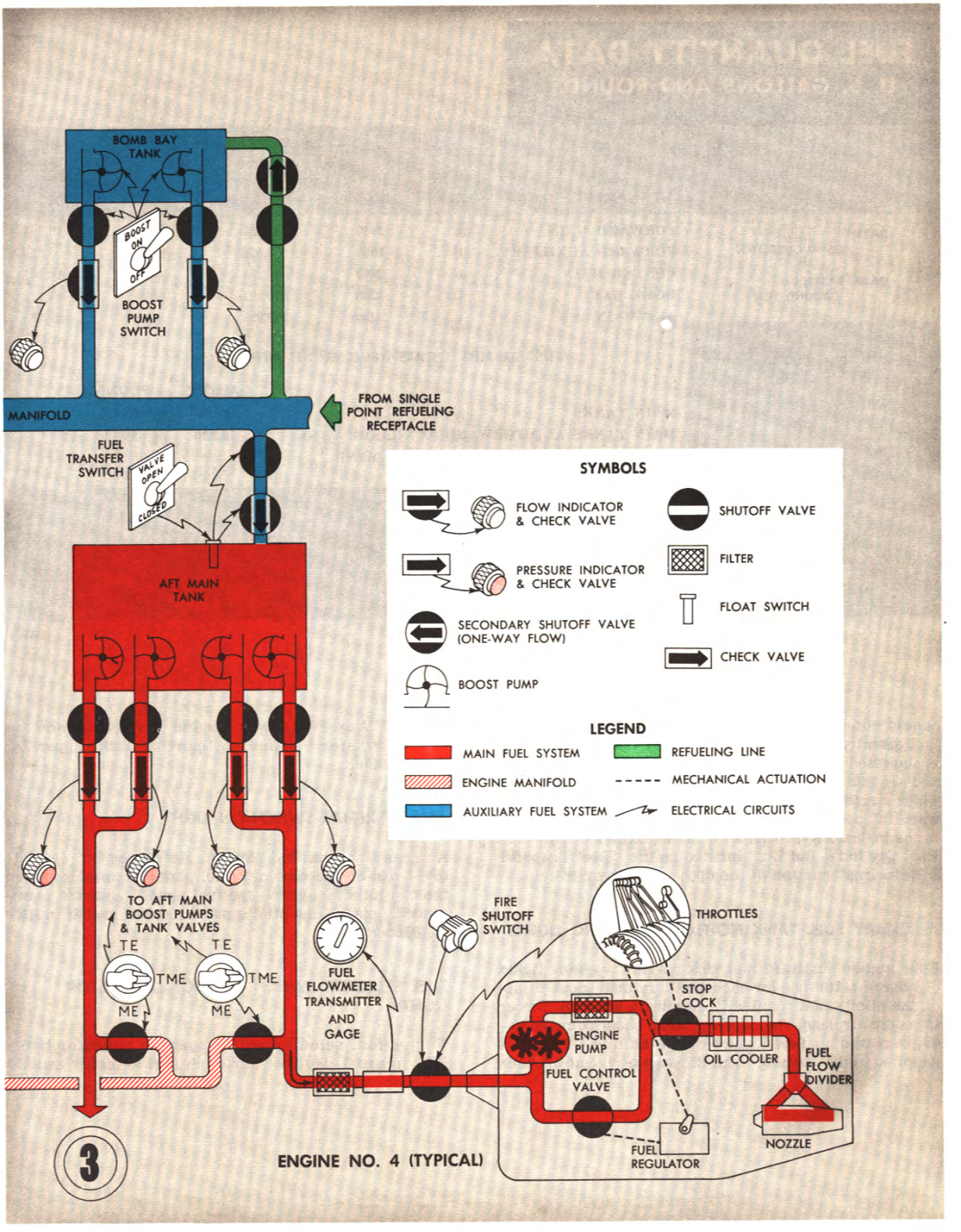
Twelve red fuel boost pressure warning lights (3, figure 1-18) (one for each main fuel tank boost pump) on the pilot's fuel panel will illuminate whenever a low pressure exists in the line. The fuel boost warning lights are energized as soon as DC power is on the airplane. Power is supplied to the warning lights through circuit breakers marked "Engine 1," "Engine 2," Engine 3," "Engine 4," "Engine 5," and "Engine 6" located on the "Main Fuel Warning, Manifold & Fire Shutoff Valves" portion of the upper DC power panel.

### AUXILIARY FUEL TANK QUANTITY INDICATORS

DC operated tab-window type indicators (1, figure 1-18 and 5, figure 1-19) on the pilot's and copilot's fuel

# FUEL SUPPLY SYSTEM






049010

*Figure 1-21.*

# FUEL QUANTITY DATA
## U. S. GALLONS AND POUNDS

DATE:
15 AUGUST 1952

DATA BASIS:
GROUND TEST

| TANKS | NO. | USABLE FUEL (LEVEL FLIGHT ATTITUDE) GALLONS | USABLE FUEL (LEVEL FLIGHT ATTITUDE) POUNDS | * FULLY SERVICED (TAXI ATTITUDE) GALLONS | * FULLY SERVICED (TAXI ATTITUDE) POUNDS |
|---|---|---|---|---|---|
| FORWARD MAIN | 1 | 2930 | 19,015 | 2954 | 19,201 |
| FORWARD AUXILIARY | 1 | 1050 | 6,825 | 1050 | 6,825 |
| CENTER MAIN | 1 | 2810 | 18,265 | 2871 | 18,681 |
| BOMB BAY | 1 | 3230 | 20,995 | 3258 | 21,177 |
| AFT MAIN | 1 | 3130 | 22,295 | 3115 | 22,393 |

REMARKS:

- LEVEL FLIGHT ATTITUDE — TOP OF FUSELAGE 2 30' NOSE UP
- TAXI ATTITUDE — TOP OF FUSELAGE 5 15' NOSE UP
- CONDITIONS — NACA STANDARD DAY WITH FUEL DENSITY OF 6.5 POUNDS PER GALLON.

* TANKS ARE SERVICED INDIVIDUALLY TO FILLER NECK LEVELS AS STENCILLED. IF SINGLE POINT REFUELING IS USED, FUEL QUANTITIES AS CONTROLLED BY PRIMARY CONTROL SWITCHES WILL BE APPROXIMATELY SAME.

USABLE FUEL TOTALS (LEVEL FLIGHT ATTITUDE)

| | GALLONS | POUNDS |
|---|---|---|
| MAIN TANKS | 9,170 | 59,605 |
| MAIN TANKS AND FORWARD AUXILIARY TANK | 10,220 | 66,440 |
| MAIN TANKS, FORWARD AUXILIARY TANK AND BOMB BAY TANK | 13,450 | 87,425 |

**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.

049009

*Figure 1-22.*

panels show by interchangeable tabs the condition of fuel quantity in the 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 indicating circuits are energized when DC power is on the airplane. Power is supplied to the indicators through a circuit breaker marked "Aux Fuel Qty Ind & Ind Lts" located on the "Fuel Transfer & Refueling" portion of the upper DC power panel.

### AUXILIARY FUEL TANK NO-FLOW WARNING LIGHTS

Four amber auxiliary fuel tank no-flow warning lights (7, figure 1-18) (one for each auxiliary tank boost pump) on the pilot's fuel panel will illuminate when DC power is on the airplane, 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 marked "Aux Fuel Qty Ind & Ind Lts" located on the "Fuel Transfer & Refueling" portion of the upper DC power panel.

### MASTER-REFUEL-SWITCH-ON LIGHT

A green light marked "Master Refuel Sw On" (1, figure 1-19) on the copilot's fuel panel illuminates when the copilot's fuel gages and fuel panel lights are energized by placing the pilot's master refuel switch in REFUEL position.

### FUEL SELECTOR SWITCH POSITION INDICATOR LIGHTS

Twelve fuel selector switch position indicator lights (23, figure 1-16) (two for each fuel selector switch)

located on the copilot's instrument panel provide the copilot with an indication of the position of the fuel selector switches on the pilot's fuel control panel. The six upper lights are red and each one will illuminate when DC power is on the airplane and the respective fuel selector switch is in ME position. The six lower lights are amber and each one will illuminate when DC power is on the airplane and the respective fuel selector switch is in TME position. Neither light will illuminate when the respective fuel selector switch is in TE position. Power is provided to the lights through circuit breakers marked "Eng 1," "Eng 2," "Eng 3," "Eng 4," "Eng 5," and "Eng 6" on the "Main Fuel Warning Manifold and Fire Shutoff Valves" portion of the upper DC power panel.

## ELECTRICAL POWER SUPPLY SYSTEMS

The airplane is provided with a direct current system (battery and generators), a regulated alternating current system (inverters), and an unregulated alternating current system (alternators) 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 and unregulated alternating current 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 and may be operated regardless of battery switch position. These systems are the emergency alarm bell, AN/APX-6 destructor circuit, and the bomb salvo circuit* which is operated by the bomb salvo switches on the pilot's ignition switch panel and the bomb control panel at the observer's station. A circuit breaker for bomb salvo control power is also located on the bomb salvo relay shield*. Emergency power may be used for operation of the pilot's and copilot's turn-and-slip 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 1-23 for systems using DC power and power distribution.

#### Battery Switch

A battery switch (11, figure 1-10) located on the pilot's switch panel has LH BUS NORMAL--OFF--RH BUS positions. LH BUS NORMAL position connects the battery to the DC distribution system through a left bus and is the normal position of the switch. OFF position disconnects the battery from the left or right bus. RH BUS position connects the battery to the DC distribution system through a right bus.

#### DC Bus Selector Switch

A DC bus selector switch (11, figure 1-13) adjacent to the copilot's DC power panel has SECONDARY--NORMAL--PRIMARY TEST positions, providing a manual means for controlling DC power to the upper, lower, and aft DC and the radar power panels. In 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. SECONDARY position 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 (21, figure 1-16) located on the copilot's instrument panel have ON--OFF--RESET positions. The momentary RESET position resets the generator field relay to allow turning on or restoring generator operation. RESET position releases the switch and allows it to return to OFF. 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.

#### DC Voltmeter Selector Switch

A rotary-type switch (16, figure 1-16) on the copilot's instrument panel provides a means of obtaining DC bus

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* AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

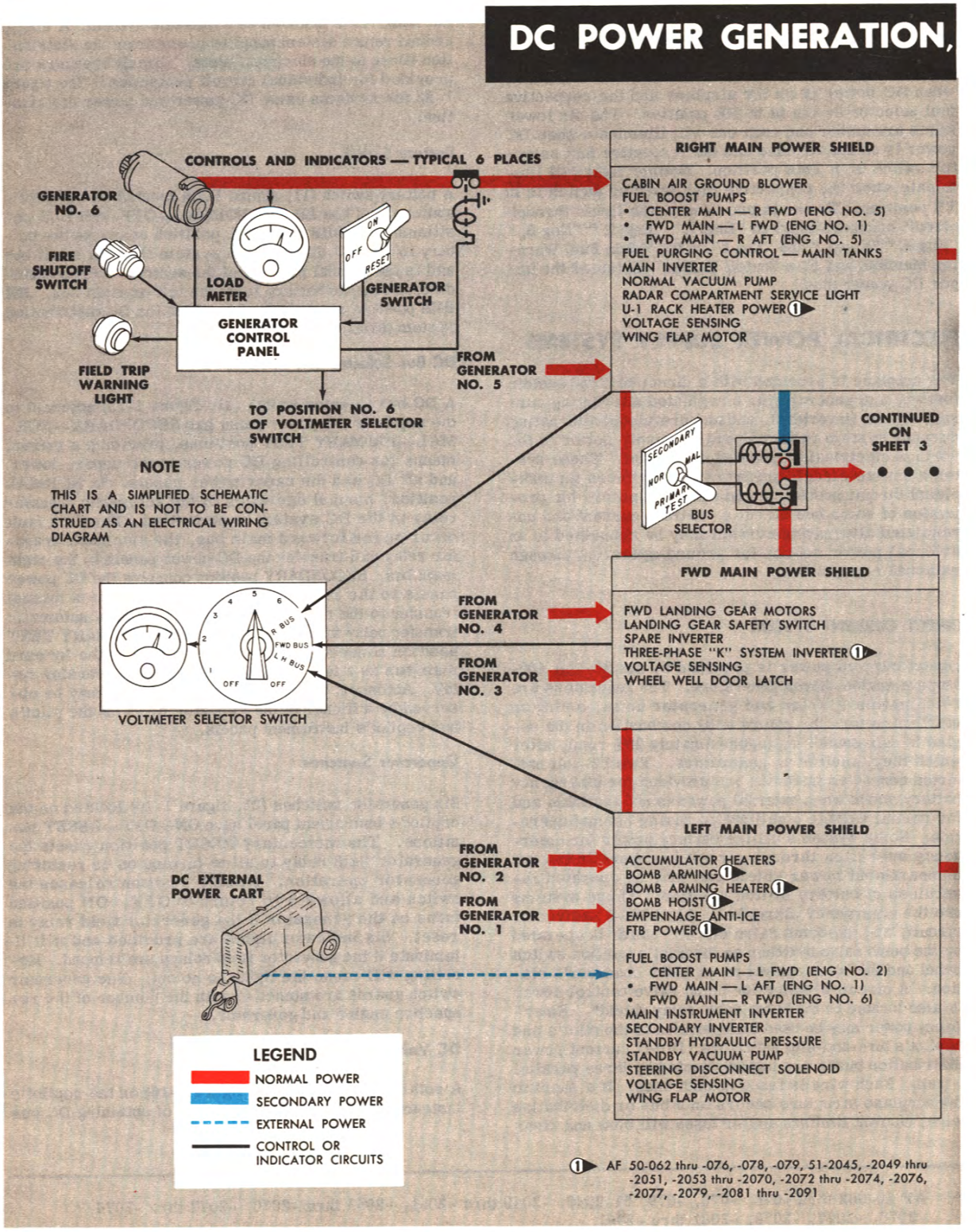


*Figure 1-23. (Sheet 1 of 3 Sheets)*

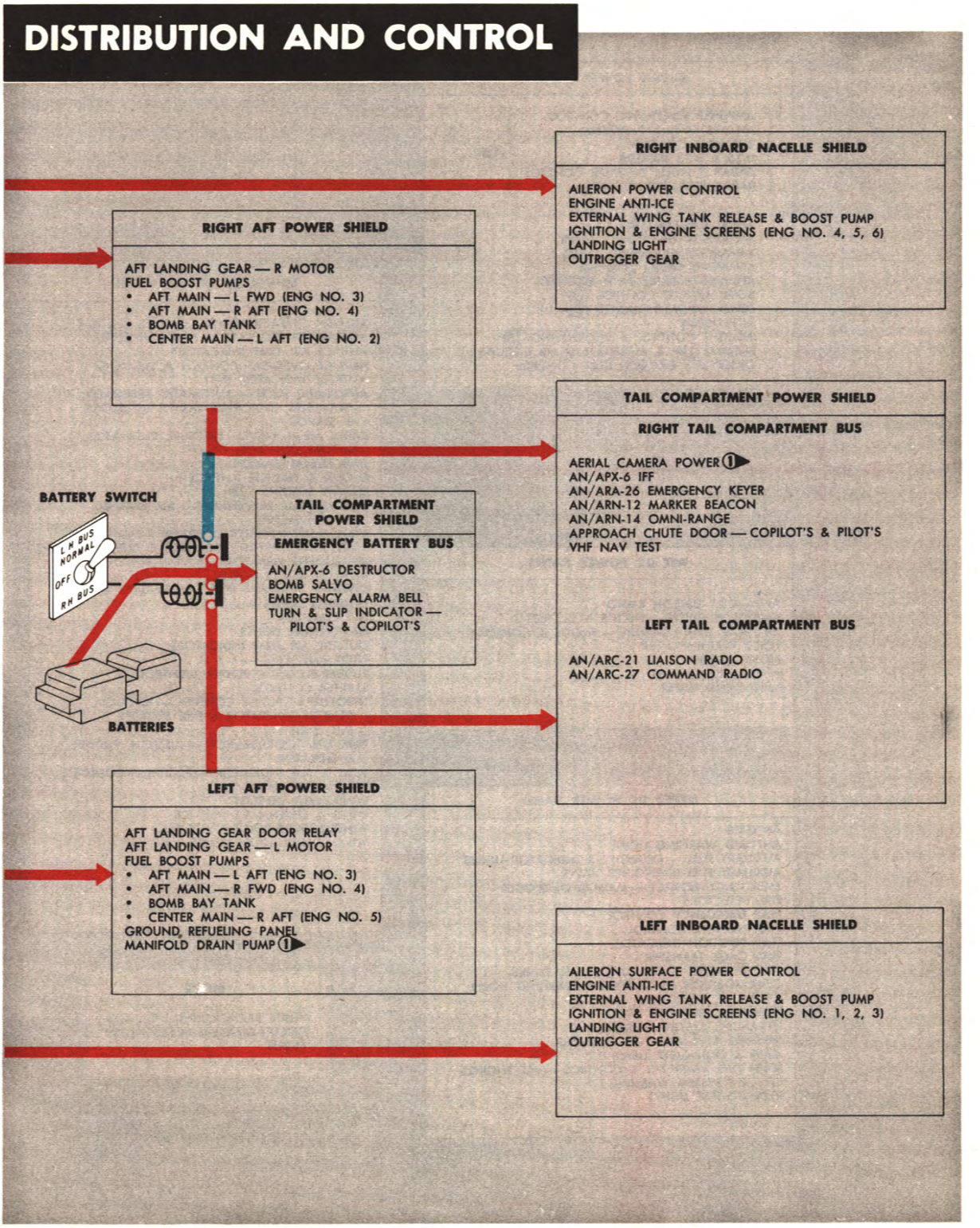


*Figure 1-23. (Sheet 2 of 3 Sheets)*

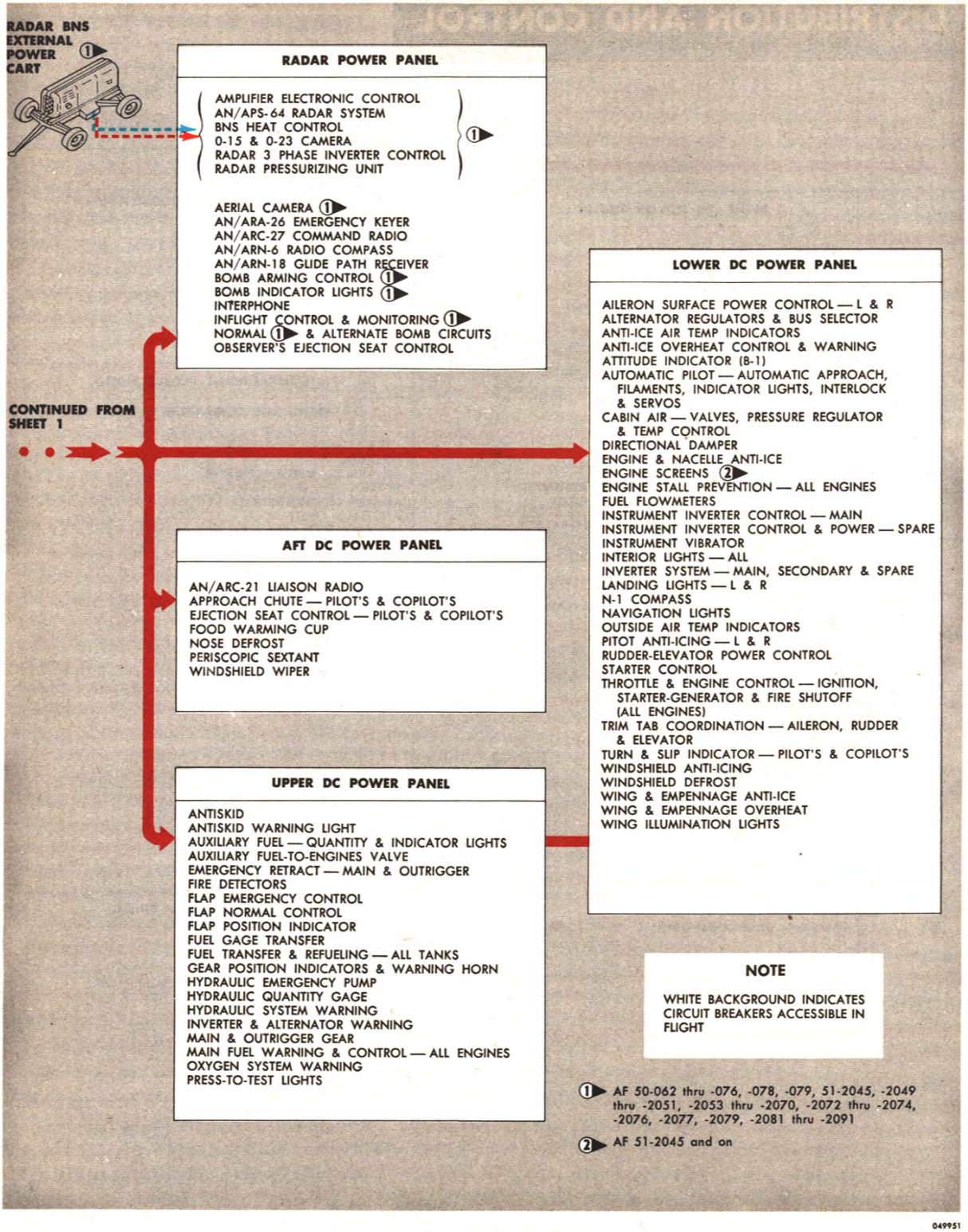


*Figure 1-23. (Sheet 3 of 3 Sheets)*

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. OFF positions 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. In RH BUS position, the DC voltmeter is connected to measure voltage on the right bus; FWD BUS position to measure voltage on the forward bus; and LH BUS position to measure voltage on the left bus.

#### Generator Field Trip Warning Lights

Six generator field trip warning lights (20, figure 1-16) 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.

#### DC Voltmeter

A direct current voltmeter (15, figure 1-16) 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 (19, figure 1-16) 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

#### Single-Phase Inverter System

Regulated 115-volt single-phase 400-cycle alternating current is supplied to the main and secondary buses by three inverters. During normal operation the main and secondary inverters supply power to the main and secondary buses respectively with the spare inverter not operating. Automatic transfer of spare inverter and manual transfer of secondary and spare inverters are provided for emergency operation. For equipment requiring regulated alternating current, see figure 1-25. The control circuits receive power from circuit breakers marked "Control Main," "Control Spare," and "Power Spare" located on the "Inst Inverter" portion of the lower DC power panel.

INVERTER POWER SWITCHES. Three ON-OFF switches (2, figure 1-24) on the regulated AC power panel control the main, secondary, and spare 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 1-24) on the regulated AC power panel is provided to control transfer of power from the secondary and spare inverters. The switch has NORMAL--SPARE INV MAIN BUS--SPARE INV SEC BUS--SEC INV SEC BUS--SEC INV MAIN BUS positions. The following condition will exist with selector switch in these positions:

**NOTE**

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

NORMAL (the main and secondary inverter power switches must be ON. The spare inverter power switch can be ON or OFF).

- Main inverter supplies power to main bus.
- Secondary inverter supplies power to secondary bus.
- Automatic changeover relays are operative and will transfer the spare inverter to the main or secondary bus if an inverter fails on that bus.
- The spare inverter will transfer to the main bus if both the main and secondary inverters fail.

SPARE INV MAIN BUS (the main inverter power switch can be ON or OFF. The secondary and spare inverter power switches must be ON).

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

SPARE INV SEC BUS (the main and spare inverter power switches must be ON. The secondary power switch can be ON or OFF).

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

SEC INV SEC BUS (the main and secondary inverter power switches must be ON. The spare inverter power switch can be ON or OFF).

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

# REGULATED AC POWER PANEL

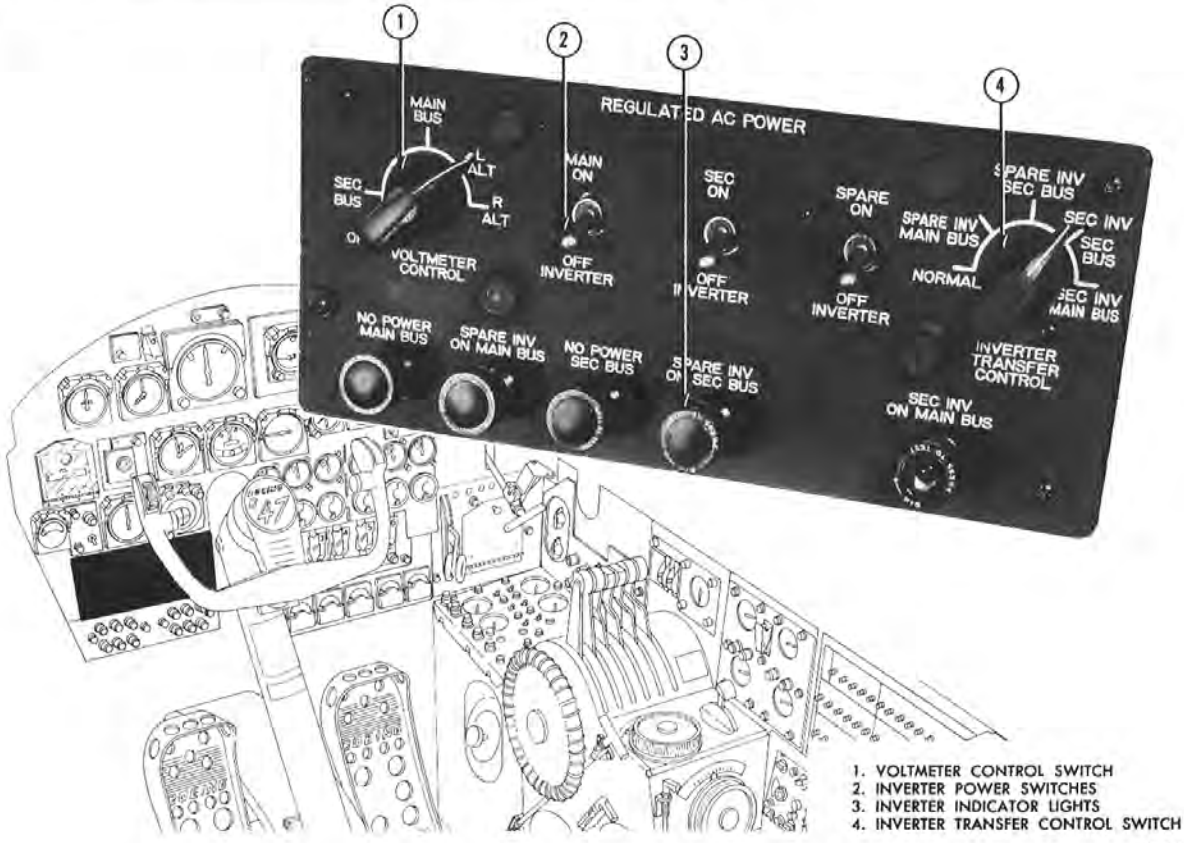


*Figure 1-24.*

SEC INV MAIN BUS (the secondary power switch must be ON. Main and spare inverter power switches can be ON or OFF).

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

AC VOLTMETER. An AC voltmeter (27, figure 1-16) located on the copilot's instrument panel provides voltage readings on the main and secondary inverter buses and the left and right alternators. A five-position voltmeter control switch (1, figure 1-24) located on the regulated AC power panel has OFF--SEC 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 and to the alternators for reading alternator voltage.

INDICATOR LIGHTS. Five warning lights (3, figure 1-24) on the regulated AC power panel are provided for indications of the main, secondary, and spare inverter power conditions. Two lights marked "No Power Main Bus" and "No Power Sec Bus," when illuminated, indicate no voltage on the respective buses. The "Spare Inv On Main Bus" indicates that spare inverter output

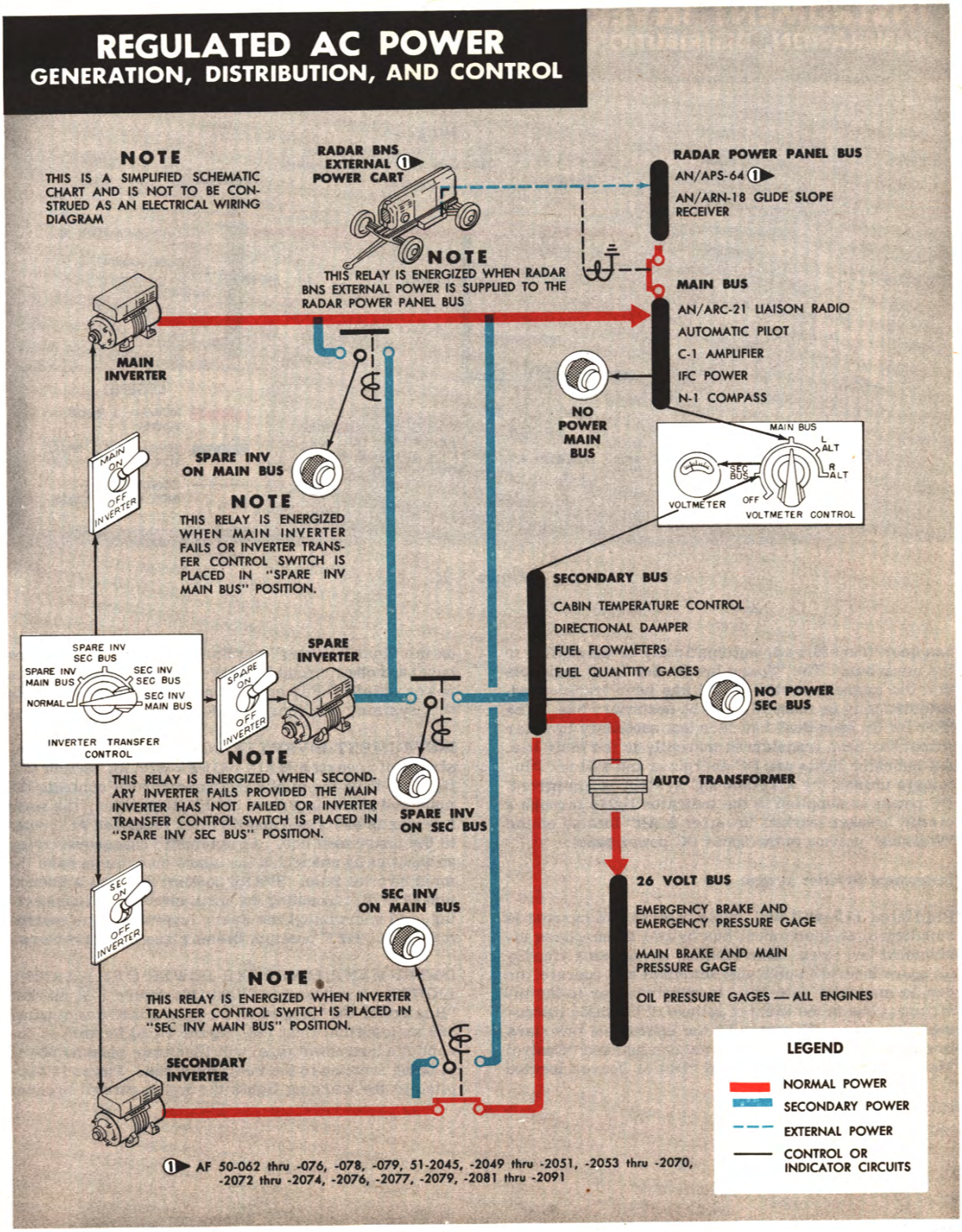
REGULATED AC POWER
GENERATION, DISTRIBUTION, AND CONTROL
NOTE
THIS IS A SIMPLIFIED SCHEMATIC CHART AND IS NOT TO BE CONSTRUED AS AN ELECTRICAL WIRING DIAGRAM
RADAR BNS EXTERNAL POWER CART 1
NOTE
THIS RELAY IS ENERGIZED WHEN RADAR BNS EXTERNAL POWER IS SUPPLIED TO THE RADAR POWER PANEL BUS
RADAR POWER PANEL BUS
AN/APS-64 1
AN/ARN-18 GLIDE SLOPE RECEIVER
MAIN BUS
AN/ARC-21 LIAISON RADIO
AUTOMATIC PILOT
C-1 AMPLIFIER
IFC POWER
N-1 COMPASS
MAIN INVERTER
NO POWER MAIN BUS
MAIN BUS
L ALT
R ALT
SEC BUS
OFF
VOLTMETER
VOLTMETER CONTROL
MAIN ON OFF INVERTER
SPARE INV ON MAIN BUS
NOTE
THIS RELAY IS ENERGIZED WHEN MAIN INVERTER FAILS OR INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "SPARE INV MAIN BUS" POSITION.
SECONDARY BUS
CABIN TEMPERATURE CONTROL
DIRECTIONAL DAMPER
FUEL FLOWMETERS
FUEL QUANTITY GAGES
NO POWER SEC BUS
SPARE INV SEC BUS
SPARE INV MAIN BUS
SEC INV SEC BUS
NORMAL
SEC INV MAIN BUS
INVERTER TRANSFER CONTROL
SPARE ON OFF INVERTER
SPARE INVERTER
NOTE
THIS RELAY IS ENERGIZED WHEN SECONDARY INVERTER FAILS PROVIDED THE MAIN INVERTER HAS NOT FAILED OR INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "SPARE INV SEC BUS" POSITION.
SPARE INV ON SEC BUS
AUTO TRANSFORMER
26 VOLT BUS
EMERGENCY BRAKE AND EMERGENCY PRESSURE GAGE
MAIN BRAKE AND MAIN PRESSURE GAGE
OIL PRESSURE GAGES — ALL ENGINES
SEC ON OFF INVERTER
SEC INV ON MAIN BUS
NOTE
THIS RELAY IS ENERGIZED WHEN INVERTER TRANSFER CONTROL SWITCH IS PLACED IN "SEC INV MAIN BUS" POSITION.
SECONDARY INVERTER
LEGEND
NORMAL POWER
SECONDARY POWER
EXTERNAL POWER
CONTROL OR INDICATOR CIRCUITS
1 AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091
049500

*Figure 1-25.*

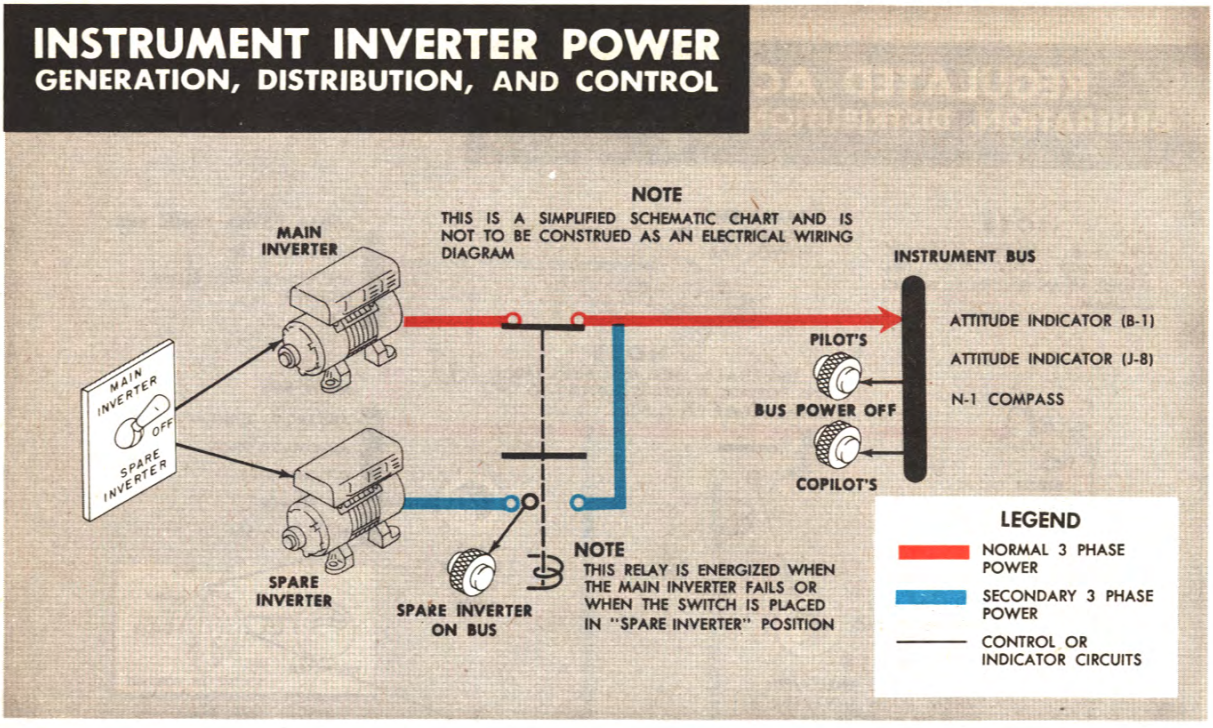


*Figure 1-26.*

has been transferred, automatically or manually, to the main bus. The "Spare Inv On Sec Bus" indicates that the spare inverter output has been transferred, automatically or manually, to the secondary bus. The "Sec Inv On Main Bus" indicates that secondary inverter output has been transferred manually to the main bus. All indicator lights are DC energized and will not illuminate unless the airplane DC system is energized. DC power is supplied to the indicator lights through a circuit breaker marked "Inverter & Alt" located on the "Warning" portion of the upper DC power panel.

**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. DC power for the instrument inverters is supplied through circuit breakers marked "Control Main," "Control Spare," and "Power Spare" located on the "Inst Inverter" portion of the lower DC power panel and other circuit breakers located on the left main power shield. For equipment receiving power from this system, see figure 1-26.

INSTRUMENT INVERTER POWER SWITCH. An instrument inverter MAIN--OFF--SPARE switch (17, figure 1-8) on the pilot's instrument panel controls the main and spare inverter. In 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. SPARE position provides a manual means of disconnecting the main inverter and connecting (and energizing) the spare inverter to the instrument bus. OFF position deenergizes both inverters.

INSTRUMENT INVERTER POWER OFF WARNING LIGHTS. A red warning light (15, figure 1-8) marked "Bus Power Off" located on the pilot's instrument panel and an identical light (13, figure 1-16) located on the copilot's instrument panel will illuminate when no power is being supplied to the instrument bus. Power is supplied to the warning lights through a circuit breaker

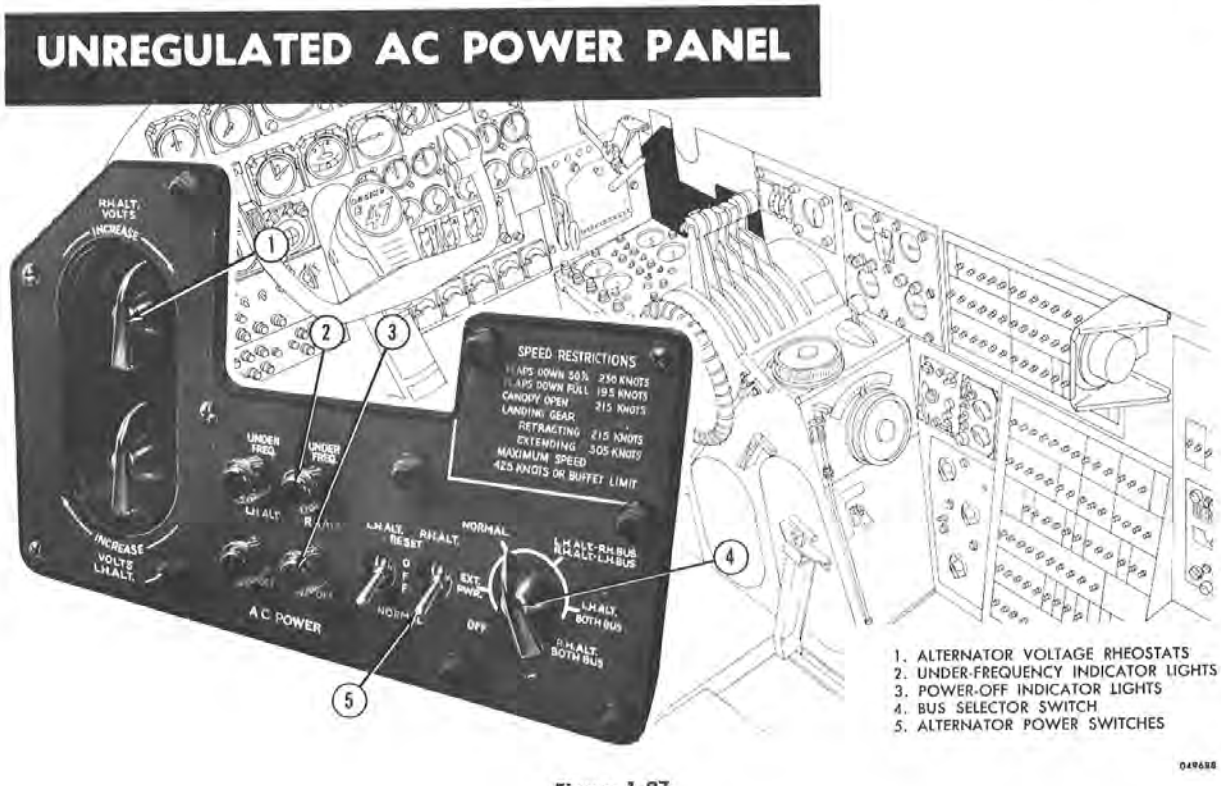


*Figure 1-27.*

marked "Inverter & Alt" located on the "Warning" portion of the upper DC power panel.

SPARE INSTRUMENT INVERTER INDICATOR LIGHT. An amber indicator light (16, figure 1-8) 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. Power is supplied to the indicator light through a circuit breaker marked "Control Spare" located on the "Instr Inverter" portion of the lower DC power panel.

## UNREGULATED ALTERNATING CURRENT SYSTEM

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

### Bus Selector Switch

A rotary-type selector switch (4, figure 1-27) 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

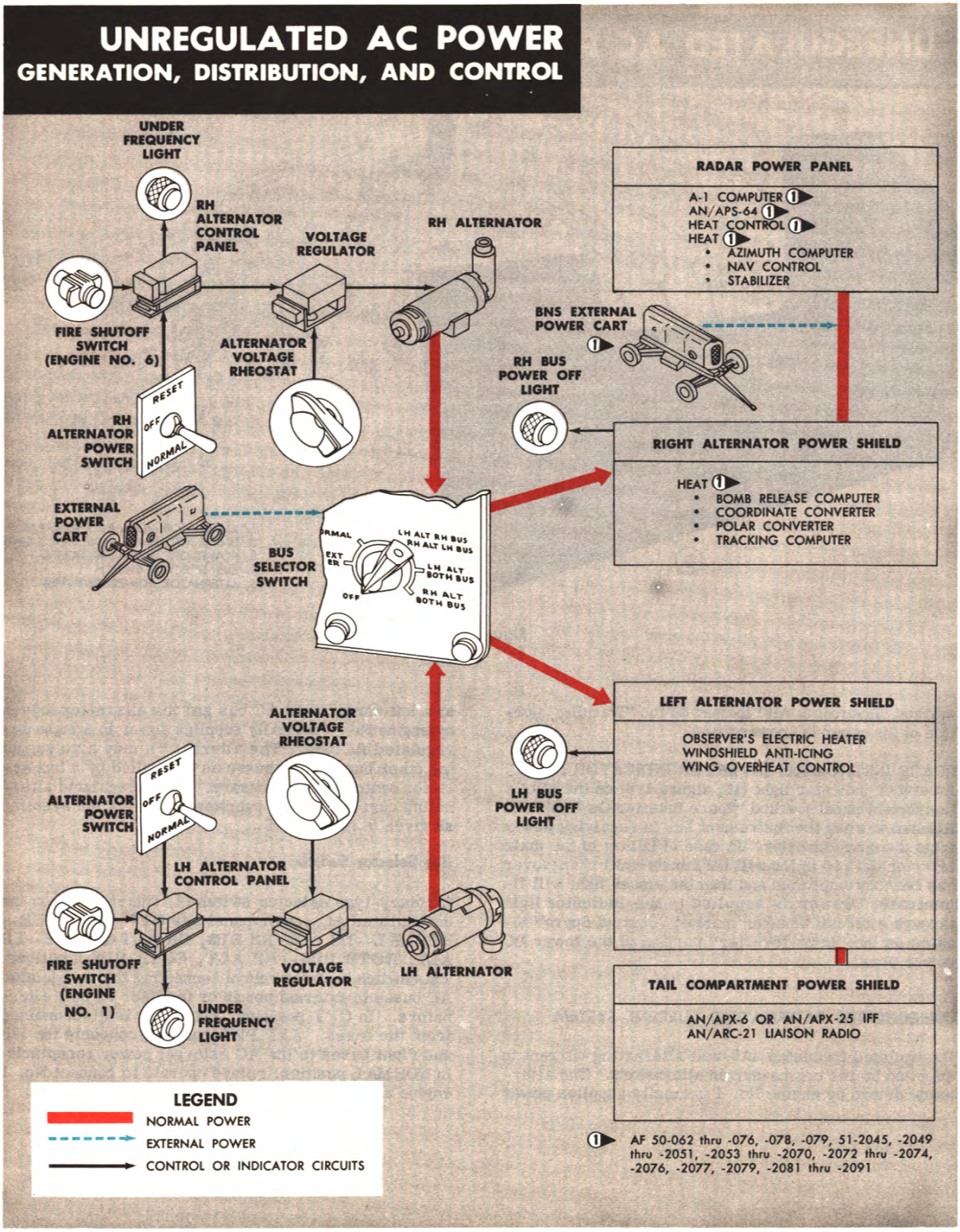
UNREGULATED AC POWER
GENERATION, DISTRIBUTION, AND CONTROL
UNDER FREQUENCY LIGHT
RH ALTERNATOR CONTROL PANEL
VOLTAGE REGULATOR
RH ALTERNATOR
FIRE SHUTOFF SWITCH (ENGINE NO. 6)
ALTERNATOR VOLTAGE RHEOSTAT
RESET
OFF
NORMAL
RH ALTERNATOR POWER SWITCH
EXTERNAL POWER CART
BUS SELECTOR SWITCH
NORMAL
EXT PWR
OFF
LH ALT RH BUS
RH ALT LH BUS
LH ALT BOTH BUS
RH ALT BOTH BUS
RADAR POWER PANEL
A-1 COMPUTER 1
AN/APS-64 1
HEAT CONTROL 1
HEAT 1
• AZIMUTH COMPUTER
• NAV CONTROL
• STABILIZER
BNS EXTERNAL POWER CART 1
RH BUS POWER OFF LIGHT
RIGHT ALTERNATOR POWER SHIELD
HEAT 1
• BOMB RELEASE COMPUTER
• COORDINATE CONVERTER
• POLAR CONVERTER
• TRACKING COMPUTER
ALTERNATOR VOLTAGE RHEOSTAT
ALTERNATOR POWER SWITCH
RESET
OFF
NORMAL
LH ALTERNATOR CONTROL PANEL
FIRE SHUTOFF SWITCH (ENGINE NO. 1)
VOLTAGE REGULATOR
LH ALTERNATOR
UNDER FREQUENCY LIGHT
LH BUS POWER OFF LIGHT
LEFT ALTERNATOR POWER SHIELD
OBSERVER'S ELECTRIC HEATER
WINDSHIELD ANTI-ICING
WING OVERHEAT CONTROL
TAIL COMPARTMENT POWER SHIELD
AN/APX-6 OR AN/APX-25 IFF
AN/ARC-21 LIAISON RADIO
LEGEND
NORMAL POWER
EXTERNAL POWER
CONTROL OR INDICATOR CIRCUITS
1 AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091
049680

*Figure 1-28.*

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 (5, figure 1-27) provided on the unregulated AC power panel are labeled RH ALT RESET--OFF--NORMAL and LH ALT RESET--OFF --NORMAL. The reset positions reset the alternator control circuits and 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 buildup time when the alternators are first turned on. OFF positions make the alternators inoperative. NORMAL positions energize the alternators to supply unregulated AC power to their respective buses. Power is supplied to the alternator power switches through circuit breakers marked "LH Regulator & Bus Select Control" and "RH Regulator & Bus Select Control" located on the "Alternator" portion of the lower DC power panel.

#### Alternator Voltage Rheostats

An "RH Alt Volts" and an "LH Alt Volts" rheostat (1, figure 1-27) is located on the unregulated AC power panel. Rotating either rheostat clockwise will increase the output voltage for the respective alternator. Conversely, rotating a rheostat counterclockwise will decrease the alternator voltage output.

#### AC Voltmeter

The voltmeter (27, figure 1-16) on the copilot's instrument panel is used to check alternator voltage. A five-position voltmeter control switch (1, figure 1-24) on the regulated AC power panel has OFF--SEC BUS--MAIN BUS--L ALT--R ALT positions and 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 warning lights marked "Pwr Off LH Alt" and "Pwr Off RH Alt" (3, figure 1-27) on the unregulated AC power panel 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. Power is supplied to the warning lights through a circuit breaker marked "Inverter & Alt" located on the "Warning" portion of the upper DC power panel.

#### Under Frequency Indicator Lights

An amber "Under Freq" indicator light (2, figure 1-27) is provided for each alternator and 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.

### CIRCUIT BREAKERS & 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 13, figure 1-13) and the radar power panel (8, figure 1-29). 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 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. On the non-trip-free 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

## CIRCUIT BREAKER AND FUSE LOCATIONS

| CIRCUIT | PANEL |
|---|---|
| **ANTI-ICING AND DEICING SYSTEMS** | |
| Air temperature indicator | 1 |
| Engine and nacelle | 1 |
| Overheat control | 1 & 4 |
| Overheat warning - empennage | 1 |
| Overheat warning - wing | 1 |
| Pitot - left and right | 1 |
| Windshield | 1 & 4 |
| Wing and empennage | 1 |
| **AUTOMATIC PILOT** | |
| Automatic pilot | 1 & 7 |
| **BOMB DOOR SYSTEM** | |
| Alternate system | 8 |
| Door indicators | 8 |
| Hydraulic standby control | 2 |
| Normal system | 8 |
| **BOMBING SYSTEM** | |
| Bomb salvo control | 5 |
| Indicator lights and arming | 8 |
| **BRAKE SYSTEM** | |
| Antiskid and warning | 2 |
| **CABIN AIR CONDITIONING SYSTEM** | |
| Cabin air temperature | 1 & 7 |
| Cabin air valve and pressure regulators | 1 |
| **COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT** | |
| AF combat interphone | 8 |
| Command radio (AN/ARC-27) | 8 |
| Emergency keyer (AN/ARA-26) | 8 |
| Glide slope (AN/ARN-18) | 8 |
| IFM and IFC | 7 & 8 |
| Liaison radio (AN/ARC-21) | 3 & 7 |
| Radar bombing, navigational and computing systems | 6, 7 & 8 |
| Radar power panel | 4 & 6 |
| Radar pressurizing | 8 |
| Radio compass (AN/ARN-6) | 8 |

| CIRCUIT | PANEL |
|---|---|
| **DEFROST SYSTEM** | |
| Windshield defrost | 1 & 4 |
| **ELECTRICAL SYSTEM** | |
| AC warning lights | 2, 4 & 6 |
| Alternator distribution | 4 & 6 |
| Alternator regulator, RH & LH | 1 |
| Changeover relay - main, secondary, and spare inverters | 7 |
| Instrument inverters | 1 |
| Inverter and alternator warning | 2 |
| Inverter control - main, secondary, and spare | 1 |
| Inverter distribution - main and secondary | 7 |
| Three-phase inverter (BNS) | 8 |
| **FLIGHT CONTROL SYSTEM** | |
| Approach chute control (2) | 3 |
| Directional damper | 1 & 7 |
| Flap control - emergency | 2 |
| Flap control - normal and warning | 2 |
| Surface power | 1 |
| Trim tab coordination | 1 |
| **FUEL SYSTEM** | |
| Fuel control - main (engines No. 1, 2, 3, 4, 5, and 6) | 2 |
| Fuel transfer and refuel - main and auxiliary | 2 |
| Main fuel warning, manifold and fire shutoff valves | 2 |
| **HYDRAULIC SYSTEM** | |
| Hydraulic oil quantity | 2 |
| Hydraulic standby control (emergency pump) and warning | 2 |
| **INSTRUMENTS** | |
| Attitude Indicator (B-1) | 1 & 7 |
| Attitude Indicator (J-8) | 7 |
| Auxiliary fuel indicators and indicator light | 2 |
| C-1 amplifier | 7 |
| Directional Indicator | 7 |
| Emergency brake, emergency | |

## CIRCUIT BREAKER AND FUSE LOCATIONS

| CIRCUIT | PANEL |
|---|---|
| pressure and main pressure indicators | 7 |
| Flap position indicator | 2 |
| Fuel flowmeter | 7 |
| Fuel gage transfer | 2 |
| Fuel quantity - main and bomb bay | 7 |
| Hydraulic oil quantity | 2 |
| Hydraulic pressure gage | 7 |
| Landing gear position and warning horn | 2 |
| N-1 compass | 1 & 7 |
| Oil pressure gages | 7 |
| Outside air temperature | 1 |
| Turn-and-slip - pilot's and copilot's | 1 |
| Voltmeter - AC | 4, 6 & 7 |
| **LANDING GEAR SYSTEM** | |
| Landing gear - main, outrigger | 2 |
| Landing gear - retraction, emergency | 2 |
| **LIGHTING — EXTERIOR** | |
| Left and right landing | 1 |
| Navigation lights | 1 |
| Wing illumination | 1 |

| CIRCUIT | PANEL |
|---|---|
| **LIGHTING — INTERIOR** | |
| Bomb bay and tunnel dome | 1 |
| Entrance and walkway | 1 |
| Instrument - panel, red, and spot | 1 |
| Periscopic sextant | 3 |
| Pilot's map | 1 |
| Press-to-test power | 2 |
| Sidewall - pilot's, copilot's, and observer's | 1 |
| Table, headband, flood, and compass | 1 |
| **MISCELLANEOUS EQUIPMENT** | |
| Camera | 8 |
| Ejection seat control | 3 & 8 |
| Food warming cup | 3 |
| Oxygen system warning | 2 |
| Vibrators - instrument panel | 1 |
| Warning horn | 2 |
| Windshield wiper | 3 |
| **POWER PLANT** | |
| Engine screen control | 1 |
| Engine stall prevention | 1 |
| Fire detection warning | 2 |
| Oil and hydraulic fire shutoff | 1 |
| Starter control | 1 |
| Throttle and engine control | 1 |

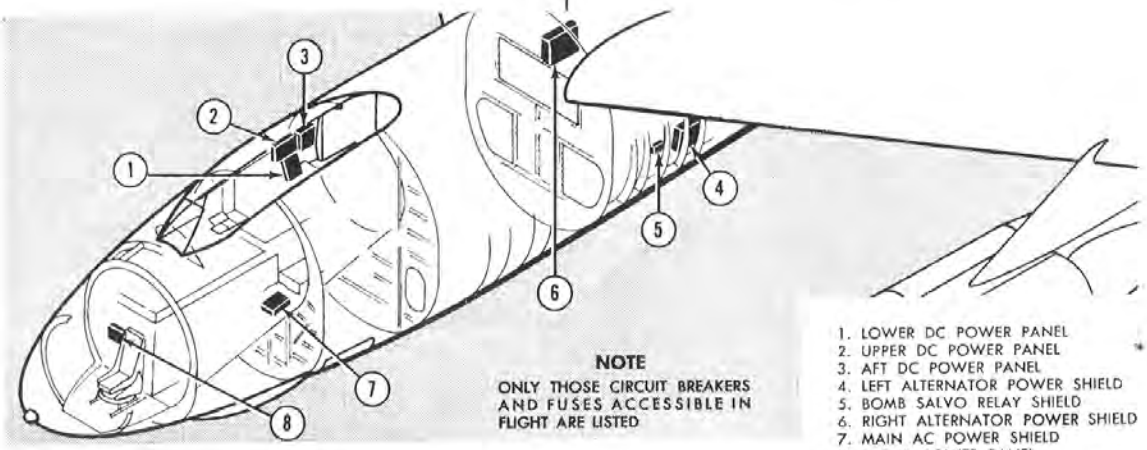


*Figure 1-29.*

## CIRCUIT BREAKERS WHICH PERFORM MORE THAN A SINGLE FUNCTION

| CIRCUIT BREAKER | FUNCTIONS |
|---|---|
| **LOWER DC POWER PANEL** | |
| THROTTLE & ENG CONTROL ENG NO. 1 & 6 (one circuit breaker for each engine) | Engine No. 1 or 6<br><br>Controls oil fire shutoff valve.<br>Provides power to trip or reset generator.<br>Provides air start control power. |
| THROTTLE & ENG CONTROL ENG NO. 2 & 5 (one circuit breaker for each engine) | Engine No. 2 or 5<br><br>Controls oil fire shutoff valve.<br>Provides power to trip or reset generator.<br>Provides air start control power.<br>Controls nacelle emergency anti-ice shutoff valve. |
| THROTTLE & ENG CONTROL ENG NO. 3 & 4 (one circuit breaker for each engine) | Engine No. 3 or 4<br><br>Controls oil fire shutoff valve.<br>Provides power to trip or reset generator.<br>Provides air start control power.<br>Controls nacelle emergency anti-ice shutoff valve.<br>Controls hydraulic shutoff valve. |
| **RADAR POWER PANEL** | |
| NORMAL BOMB ① | Provides power for the normal bomb system.<br>Provides power for the "Bombs Away" light. |
| INTERPHONE | Provides power for interphone.<br>Provides power for radar pressurization unit. |
| **UPPER DC POWER PANEL** | |
| 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.<br>Provides power for the landing gear position indicator lights. |
| MAIN FUEL WARNING, MANIFOLD & FIRE SHUTOFF VALVES ENG NO. 1, 2, 3, 4, 5 & 6 (one circuit breaker for each engine)<br><br>① AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091 | Each engine<br><br>Provides power for the manifold valve.<br>Provides power for the fire shutoff valve.<br>Provides power for the "Fuel Boost Pressure Warning" lights.<br>Provides power for the "Fuel Selector Switch Position Indicator Lights."<br>Provides control power for the boost pumps when the fuel selector switch is in the TE position. |

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*Figure 1-30.*

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 (7, figure 1-29) and the radar power panel. Unregulated AC circuits are protected by fuses and circuit breakers in the right and left alternator power shields (4 and 6, figure 1-29) and the radar power panel.

### EXTERNAL AC & DC POWER RECEPTACLES

(1)

External AC and DC power receptacles (9, figure 1-48) 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. 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.

(2)

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.

#### Radar Bombing-Navigation System (BNS) External Power Receptacle (3)

An external power receptacle and shield (13, figure 1-48) 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 system circuits when external power is connected.

## HYDRAULIC POWER SUPPLY SYSTEMS

Hydraulic power is supplied to the various actuating units throughout the airplane by either the main or emergency hydraulic system (figure 1-32) except for the rudder-elevator surface power control system which utilizes an independent hydraulic system. 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 be supplied automatically by the emergency system in the event the main system pressure should fall below emergency system pressure. In some hydraulic lines requiring intermittent flow (forward camera and canopy system), hydraulic fuses are installed as a safety feature to seal off the line in the event of a rupture. 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 on 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 (±150) 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

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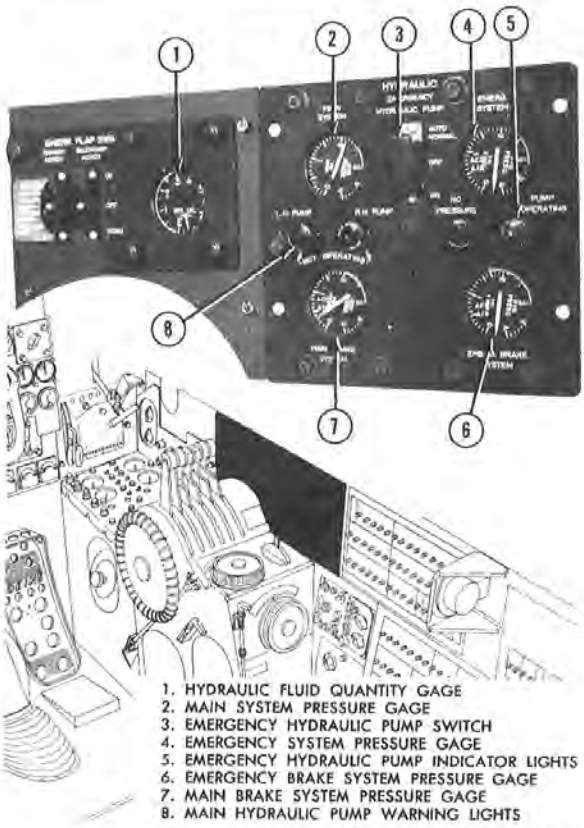
(1) AF 49-2642 thru 50-050
(2) AF 50-051 & on
(3) *AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## 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

049047

*Figure 1-31.*

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 pressure release valve. The fire shutoff 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.

### Hydraulic Service Valves

Manually operated service valves located in the crawlway are accessible in flight as well as for ground servicing. The valves are marked ON--OFF and are lockwired in OFF position for all normal operation of the system. Opening the forward service valve opens the emergency lines to the main system lines which allows the main hydraulic system to be energized with the emergency system pump in case of main system pump failure in flight or, for ground servicing, 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 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 1-31) located on the copilot's hydraulic control panel. AC power is supplied to the main system pressure gage through a fuse marked "Main Brake Main Press" located in the main AC power shield. For main hydraulic system operating pressures, see figure 5-1.

### Hydraulic Fluid Quantity Gage

A fluid quantity gage (1, figure 1-31) 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. Circuit protection is provided by a circuit breaker marked "Oil Quantity" located on the "Hydraulics" portion of 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," figure 1-48.

### 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 1-31) 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, antiskid system, bomb bay spoiler door system, and the automatic braking system. The emergency pump is operated by a DC motor capable of 20 minutes continuous duty with a 35-minute cooling period. Principal control of the pump motor is through

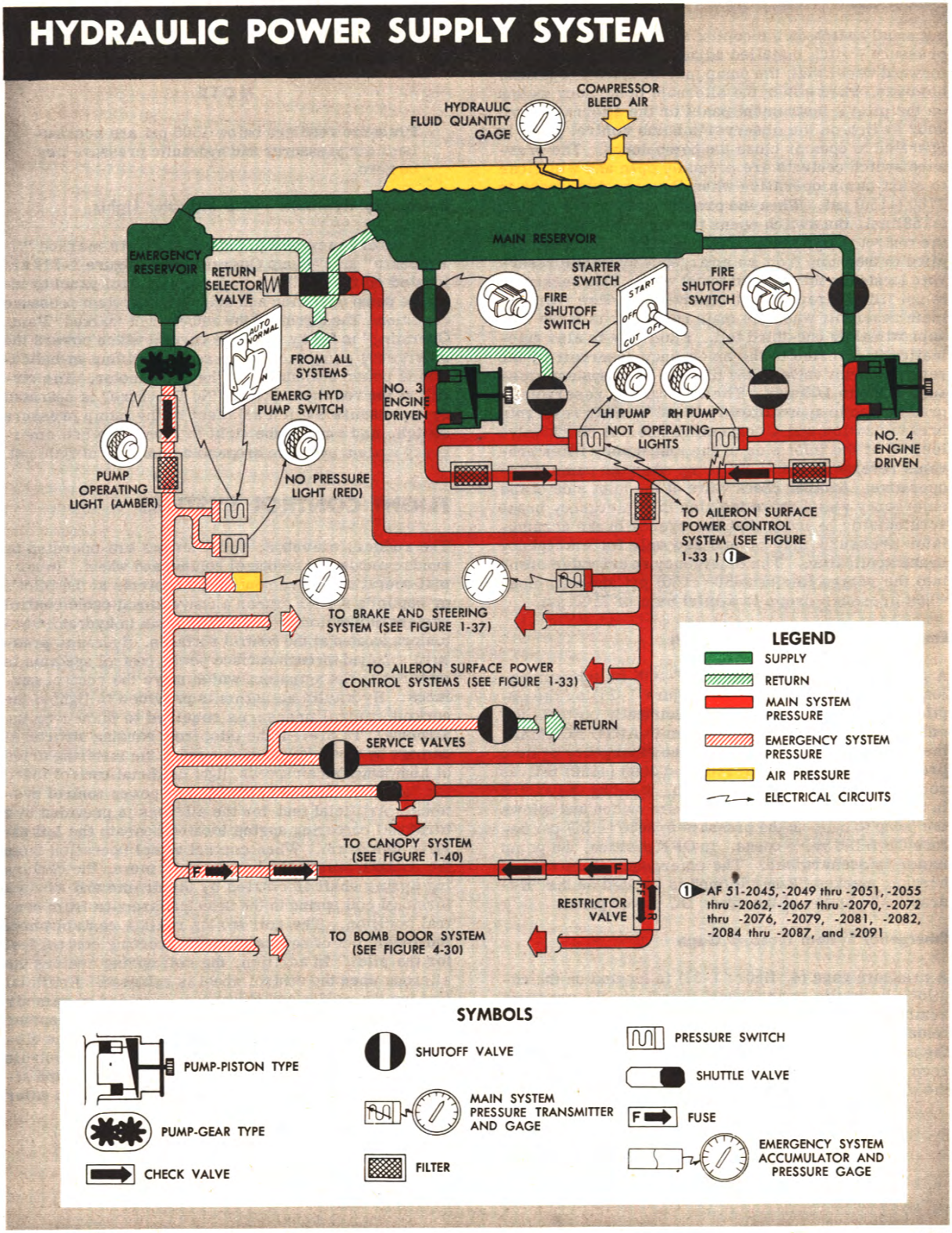

HYDRAULIC POWER SUPPLY SYSTEM
HYDRAULIC FLUID QUANTITY GAGE
COMPRESSOR BLEED AIR
MAIN RESERVOIR
EMERGENCY RESERVOIR
RETURN SELECTOR VALVE
FROM ALL SYSTEMS
EMERG HYD PUMP SWITCH
AUTO NORMAL
STARTER SWITCH
START
OFF
CUT OFF
FIRE SHUTOFF SWITCH
FIRE SHUTOFF SWITCH
NO. 3 ENGINE DRIVEN
LH PUMP
RH PUMP
NOT OPERATING LIGHTS
NO. 4 ENGINE DRIVEN
PUMP OPERATING LIGHT (AMBER)
NO PRESSURE LIGHT (RED)
TO AILERON SURFACE POWER CONTROL SYSTEM (SEE FIGURE 1-33 ) 1
TO BRAKE AND STEERING SYSTEM (SEE FIGURE 1-37)
TO AILERON SURFACE POWER CONTROL SYSTEMS (SEE FIGURE 1-33)
RETURN
SERVICE VALVES
TO CANOPY SYSTEM (SEE FIGURE 1-40)
RESTRICTOR VALVE
TO BOMB DOOR SYSTEM (SEE FIGURE 4-30)
LEGEND
SUPPLY
RETURN
MAIN SYSTEM PRESSURE
EMERGENCY SYSTEM PRESSURE
AIR PRESSURE
ELECTRICAL CIRCUITS
1 AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087, and -2091
SYMBOLS
PUMP-PISTON TYPE
PUMP-GEAR TYPE
CHECK VALVE
SHUTOFF VALVE
MAIN SYSTEM PRESSURE TRANSMITTER AND GAGE
FILTER
PRESSURE SWITCH
SHUTTLE VALVE
FUSE
EMERGENCY SYSTEM ACCUMULATOR AND PRESSURE GAGE
049012

*Figure 1-32.*

a manual switch on the copilot's hydraulic panel and a pressure switch installed adjacent to the pump in the forward wheel well; the pump may be made to operate, however, when either the alternate bomb door switch on the pilot's instrument panel or the alternate bomb door switch on the observer's bomb control panel is operated to open or close the bomb doors. 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 Hydraulic Pump Switch

A guarded AUTO NORMAL--OFF--ON switch (spring-loaded to OFF from ON) (3, figure 1-31) 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. In OFF position, the pump motor is deenergized. The emergency pump circuit breaker marked "Emer Pump" is located on the "Hydraulics" portion of the upper DC power panel.

#### Emergency System Pressure Gage

A pressure gage (4, figure 1-31) 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. AC power is supplied to the emergency system pressure gage through a fuse marked "Emerg Brake Emerg Press" located in the main AC power shield.

**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 1-31) 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 fed by the same current which powers the emergency pump motor, thereby providing an indication of power availability at the pump motor. 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 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 drums 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

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 system. 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 1-33) 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

1. AILERON NO-PRESSURE WARNING LIGHTS (RED)
2. AILERON EMERGENCY PUMP-ON INDICATOR LIGHTS (AMBER)
3. AILERON-FLAPERON SURFACE POWER CONTROL SWITCHES
4. RUDDER-ELEVATOR SURFACE POWER CONTROL SWITCH
5. RUDDER-ELEVATOR NO-PRESSURE WARNING LIGHT (RED)

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*Figure 1-33.*

is supplied through a circuit breaker on the tail compartment power shield.

### Rudder-Elevator Surface Power Control Switch

A two-position toggle switch (4, figure 1-33) marked ON--OFF is located on the surface power control panel at the pilot's station. ON position 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 marked "Rudder & Elevator" is located on the "Flight Control" portion of the lower DC power panel.

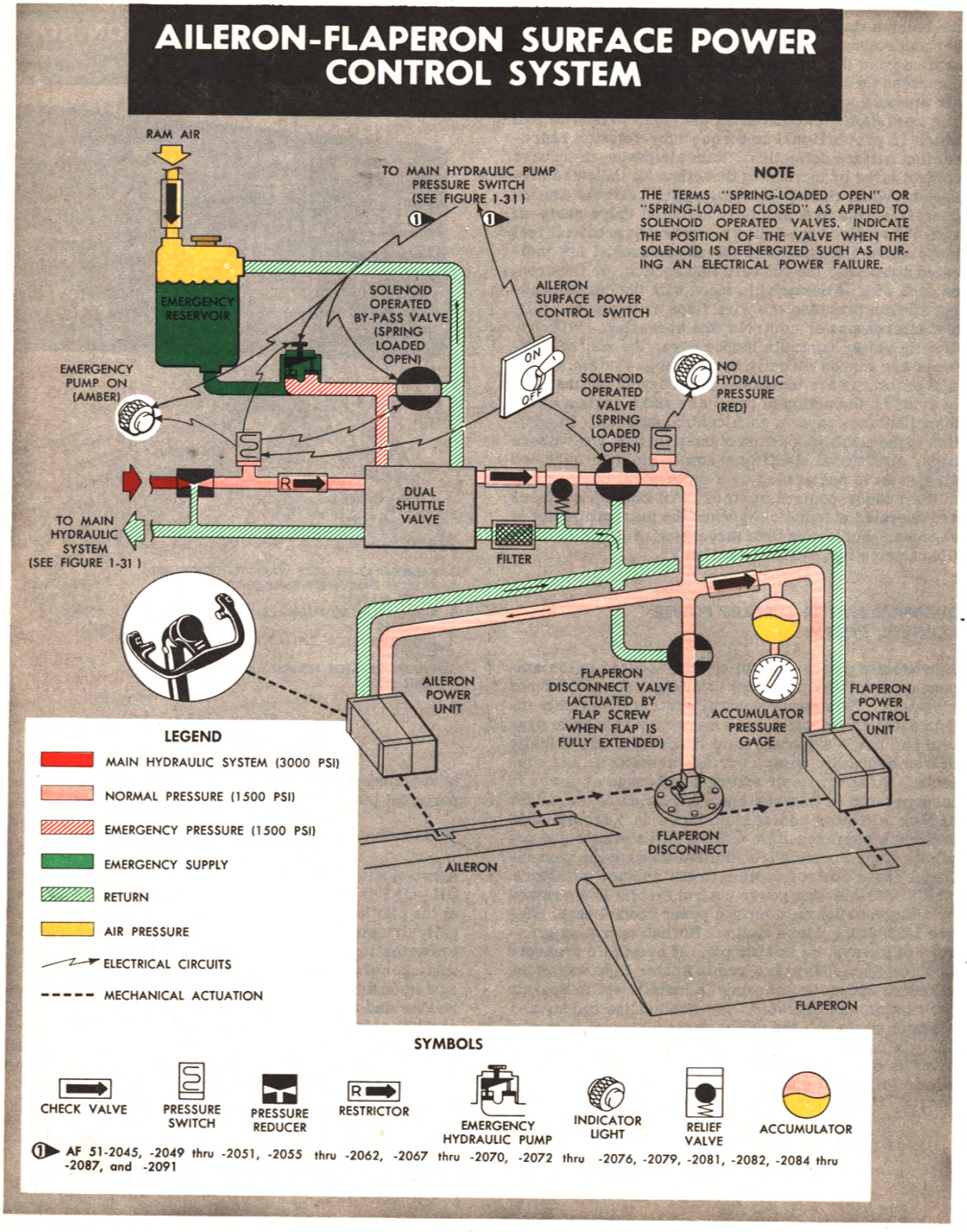
AILERON-FLAPERON SURFACE POWER CONTROL SYSTEM
RAM AIR
TO MAIN HYDRAULIC PUMP PRESSURE SWITCH (SEE FIGURE 1-31)
NOTE
THE TERMS "SPRING-LOADED OPEN" OR "SPRING-LOADED CLOSED" AS APPLIED TO SOLENOID OPERATED VALVES, INDICATE THE POSITION OF THE VALVE WHEN THE SOLENOID IS DEENERGIZED SUCH AS DURING AN ELECTRICAL POWER FAILURE.
EMERGENCY RESERVOIR
SOLENOID OPERATED BY-PASS VALVE (SPRING LOADED OPEN)
AILERON SURFACE POWER CONTROL SWITCH
ON
OFF
EMERGENCY PUMP ON (AMBER)
SOLENOID OPERATED VALVE (SPRING LOADED OPEN)
NO HYDRAULIC PRESSURE (RED)
R
DUAL SHUTTLE VALVE
TO MAIN HYDRAULIC SYSTEM (SEE FIGURE 1-31)
FILTER
AILERON POWER UNIT
FLAPERON DISCONNECT VALVE (ACTUATED BY FLAP SCREW WHEN FLAP IS FULLY EXTENDED)
ACCUMULATOR PRESSURE GAGE
FLAPERON POWER CONTROL UNIT
FLAPERON DISCONNECT
AILERON
FLAPERON
LEGEND
MAIN HYDRAULIC SYSTEM (3000 PSI)
NORMAL PRESSURE (1500 PSI)
EMERGENCY PRESSURE (1500 PSI)
EMERGENCY SUPPLY
RETURN
AIR PRESSURE
ELECTRICAL CIRCUITS
MECHANICAL ACTUATION
SYMBOLS
CHECK VALVE
PRESSURE SWITCH
PRESSURE REDUCER
RESTRICTOR
EMERGENCY HYDRAULIC PUMP
INDICATOR LIGHT
RELIEF VALVE
ACCUMULATOR
1 AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087, and -2091
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*Figure 1-34.*

### Rudder-Elevator No-Pressure Warning Light

A red warning light (5, figure 1-33) 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. Power is supplied to the warning light through a circuit breaker marked "Hydraulic System" located on the warning portion of the upper DC power panel.

## AILERON-FLAPERON SURFACE POWER CONTROL SYSTEM

A separate surface power control system (figure 1-34) 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 hydraulic pressure from the airplane main hydraulic system. However, if main hydraulic pressure fails, provisions are made for individual emergency charging 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. (1)

During normal operation, if the airplane main system pressure drops below 950 (±100) psi, the main pump pressure switch automatically starts the emergency pump for the affected aileron. (2)

During normal operation, if the main system hydraulic pressure downstream of the pressure reducer valve drops below 950 (±100) psi, the emergency aileron 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. (3)

On some airplanes 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 the 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.

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. If pressure to an 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 1-33). The systems are supplied DC power through circuit breakers marked "LH Aileron Surface Power" and "RH Aileron Surface Power" on the "Flight Control" portion of 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

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(1) AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087, & -2091

(2) AF 49-2642 thru 50-080, 51-2047, -2052, -2053, -2063 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088, & -2090

(3) AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087 & -2091

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 Surface Power Control Switches**

Two toggle switches (3, figure 1-33) marked ON--OFF are located on the surface power control panel at the pilot's station. ON 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 marked "LH Aileron Surface Power" and "RH Aileron Surface Power" are located on the "Flight Control" portion of the lower DC power panel.

**Aileron Emergency-Pump-On Indicator Lights**

Two amber "Emerg Pump On" indicator lights (2, figure 1-33), 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.

**Aileron No-Pressure Warning Lights**

Two red "No Hydro Pressure" warning lights (1, figure 1-33), 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. DC power is supplied to the lights through a circuit breaker marked "Hydraulic System" on the "Warning" portion of the upper DC power panel.

**CAUTION**

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

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(1) AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087 & -2091

(2) AF 49-2642 thru 50-080, 51-2047, -2052, -2053, -2063 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088 & -2090

## TRIM CONTROL SYSTEM

Trim tabs are provided on the control surfaces to accomplish trimming of the airplane during flight with the surface power control system off.

### Pitch Trim

The elevator contains two trim tabs. The right trim tab is operated by the pilot or copilot for normal elevator trim and by automatic pilot during automatic pilot operation. The left trim tab is made inoperative and is permanently fixed in a faired (trail) position.

### Lateral Trim

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. In addition, all trim tabs are linked to their respective control surfaces in such a manner as to move opposite to the direction of rotation of the control surface which aids in the movement of the control surfaces by reducing the load on the controls.

### Trim With Surface Power Control

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 to reposition the centering springs and Q-springs which move the entire control surface. 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.

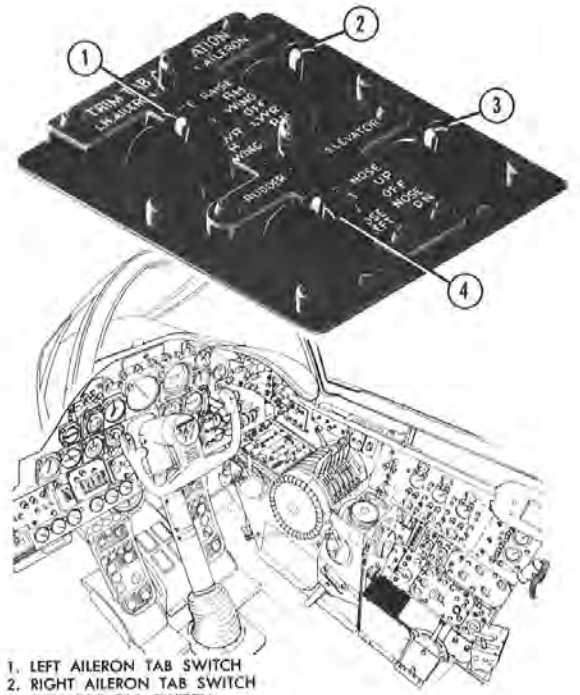
### Trim Control Wheels and Indicators

Conventional trim control wheels and indicators are on the pilot's and copilot's control stands (6, 8, 14, figure 1-9 and 5, 7, 10, figure 1-17).

## 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 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 (figure 1-35). 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**




1. LEFT AILERON TAB SWITCH
2. RIGHT AILERON TAB SWITCH
3. ELEVATOR TAB SWITCH
4. RUDDER TAB SWITCH

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*Figure 1-35.*

### Trim Tab Coordination Switches

Four guarded momentary switches (1, 2, 3, and 4, figure 1-35) 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 marked "Aileron," "Rudder," and "Elevator" are located on the "Trim Tab Coordination" portion of 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 coordination 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 takeoff and landing approach 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. The gyro remains energized as long as power is being supplied to the secondary inverter bus. The system is energized provided the following conditions are fulfilled:

- The directional damper switch is on
- The airspeed is below 335 knots IAS (setting of an impact pressure switch)
- The rudder-elevator surface power control is on
- The rudder channel of the automatic pilot is disengaged.

If any of these conditions are not fulfilled, 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.

### Directional Damper Switch

A directional damper ON--OFF switch (39, figure 1-8) 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. DC power is supplied to the directional damper switch through a circuit breaker marked "Directional Damper" located on the "Flight Control" portion of the lower DC power panel.

## RUDDER PEDALS

Both rudder pedals as a unit can be adjusted by pull handles on the pilot's and copilot's control stands (7, figure 1-9 and 6, figure 1-17). When the handle is pulled out, the pedals spring to the aft position. When the pedals are moved to the desired position and the 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, 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 (11, figure 1-9 and 9, figure 1-17) 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 may then 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 thumbbutton 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 thumbbutton depressed. Do not force the handle since damage to the elevator disconnect rod assembly may occur; however, a slight push force may be necessary to complete engagement. Verify complete reengagement by checking that controls synchronize with those of 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 at the other station flying the airplane. 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.

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

### SURFACE LOCK LEVER

A surface lock lever (4, figure 1-9) marked LOCK--UNLOCK located on the pilot's control stand 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 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 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 forward of the windshield on the airplane centerline. A tassle at the aft end of the string is provided to stabilize the string during flight. A white line along the fuselage centerline provides a reference from which the amount of yaw may be determined. In normal flight, the yaw string is centered along the white reference line. Movement of the string indicates the amount and direction of yaw.

## WING FLAP SYSTEM

The wing flaps on each wing are divided into two sections, an inboard flap and an outboard flap or flaperon.

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 the range of 193 to 208 knots IAS is reached, a ram air pressure switch in the pitot-static system (figure 1-39) will open the flap retraction circuit and prevent further flap retraction until the range of 193 to 208 knots IAS is attained; 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 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 63% rpm, flaps not full down, and the airplane is on the ground.

## WING FLAP LEVERS

The wing flaps are normally controlled by levers (5, figure 1-9 and 4, figure 1-17) 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 but is not notched. Both wing flap levers are interconnected and controllable from either station. In UP position, the flaps retract in approximately 40 seconds; in DN position, the flaps extend in approximately 20 seconds. The flaps are held in any intermediate position by placing the lever in OFF. In order to completely deenergize the flap circuits and to facilitate use of the wing flap emergency switches, the lever is always returned to OFF after the desired flap setting is obtained.

## WING FLAP EMERGENCY SWITCHES

Two guarded DOWN--OFF--UP switches (3, figure 1-13) in front of the copilot's hydraulic control panel control the wing flap primary and secondary motors for emergency operation. These switches bypass 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. 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. Flaps should not be operated to the full-up or full-down position with the emergency switches because limit switches are bypassed and damage to the system may result if flaps are allowed to overrun the mechanical stops. The emergency switches should be released before full-up or full-down position is reached and then continued by intermittent actuation of the switches to either extreme position. DC power is supplied to the wing flap emergency switches through circuit breakers marked "Primary Motor Emer Control" and "Secondary Motor Emer Control" located on the "Flap Control" portion of the upper DC power panel.

## LOW SPEED WARNING SWITCH

A low speed warning switch (13, figure 1-10) on the pilot's switch panel has ON--OFF positions and is guarded to the ON position. With the warning switch in ON position, a ram air pressure switch in the pitot system will stop flap retraction at 22. 5% down if the airspeed is in the range of 193 to 208 knots IAS. With the warning switch in OFF and the wing flap lever in UP position, the flaps will retract completely regardless of airspeed. With the warning switch in ON position, a warning horn will sound if the airplane airspeed drops in the range of 204 to 189 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 the range of 193 to 208 knots IAS will silence the warning horn. This is the same warning horn that is used for the landing gear warning system. (See "Landing Gear Warning Horn," this section.) DC power is supplied to the low speed warning switch through a circuit breaker marked "Normal Control" located on the "Flap Control" portion of the upper DC power panel.

**CAUTION**

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

### WING FLAP POSITION INDICATORS

DC operated remote indicating wing flap position indicators on the pilot's instrument panel (25, figure 1-8) and copilot's instrument panel (14, figure 1-16) indicate flap position in percent of travel. A circuit breaker for the flap position indicators marked "Position Indicator" is located on the "Flap Control" portion of the upper DC power panel.

## DRAG CONTROL SYSTEM

Drag control is accomplished by the rear main gear and both outrigger gears being extended during flight to induce additional drag and reduce speed during flight. The drag gear serves a similar purpose as do speed brakes and is particularly useful during bailout when speed must be reduced and when forward main gear, if extended, would interfere with crew members clearing the airplane.

### DRAG SWITCH

A two-position ON--OFF drag switch (8, figure 1-17) located on the copilot's control stand is guarded and spring-loaded to OFF position. In ON position, both outrigger gears and the aft main gear will extend. For the gear to be completely extended and locked in full-down position, the switch must be held 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 switch will lower the aft main and the outrigger gears. DC power is supplied to the drag switch through circuit breakers marked "Main Gear" and "Outrig Gear" located on the "Landing Gear" portion of 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 accomplished hydraulically by movement of the rudder pedals. Each outrigger gear is free castering 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.

### LANDING GEAR DOORS

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 antibuffeting 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 latter 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.

### LANDING GEAR DOOR LOCKS

The main landing gear wheel well doors are locked in the closed position by an electrically operated door latch. This latch is released by solenoids when the landing gear lever or the drag switch is placed in the DOWN position. The latches are released mechanically when the emergency extension levers are utilized.

**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 gear is retracted. Damage may result to the doors due to airloads at high speeds. In the event the latches have been set to the latched position, pulling down on the emergency landing gear extension cable at a point just below the latch will release the link arm, and the latch arms will be spring-loaded to the unlatched position.

### MAIN LANDING GEAR STRUT SERVICING

There are two types of main landing gear strut servicing configurations, the "soft strut" servicing regardless of weight and the "hard strut" servicing for gross weights near 185,000 pounds.

**NOTE**

Ground roll porpoising tendencies increase with use of the "soft strut" configuration at gross weights near 185,000 pounds. Because of this porpoising, it is recommended that the "hard strut" configuration be used when the gross weight is near 185,000 pounds.

### LANDING GEAR LEVERS

A landing gear lever on the pilot's instrument panel (31, figure 1-8) is interconnected with a landing gear lever on the copilot's landing gear control panel (4, figure 1-36). Each lever has UP--OFF--DOWN positions. Each position of the pilot's lever is fixed by detent. 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. In order to deenergize the normal actuating circuits in flight, the lever is returned to OFF after retracting the landing gear. 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 marked "Main Gear" and "Outrig Gear" are located on the "Landing Gear" portion of the upper DC power panels.

**CAUTION**

The landing gear levers will be left in 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 (10, figure 1-9) 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 (3, figure 1-36) 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. DC power is supplied to the landing gear emergency retraction switches through circuit breakers marked "Emerg Main Retract" and "Emerg Outrig Retract" located on the "Landing Gear" portion of the upper DC power panel.

### LANDING GEAR EMERGENCY EXTENSION LEVERS

Emergency mechanical extension of all landing gear is largely accomplished by means of gravity forces and

# COPILOT'S LANDING GEAR CONTROL PANEL

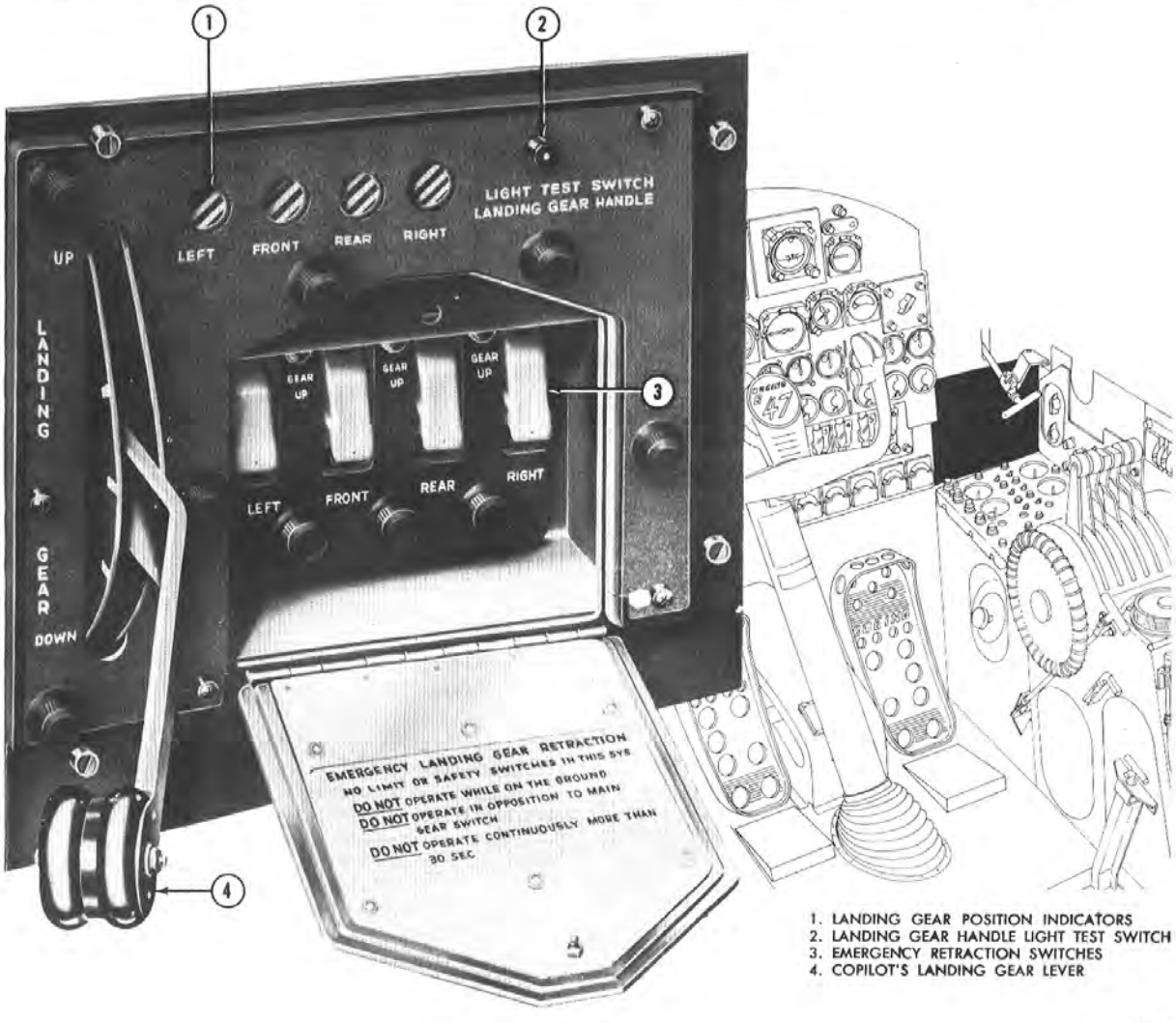
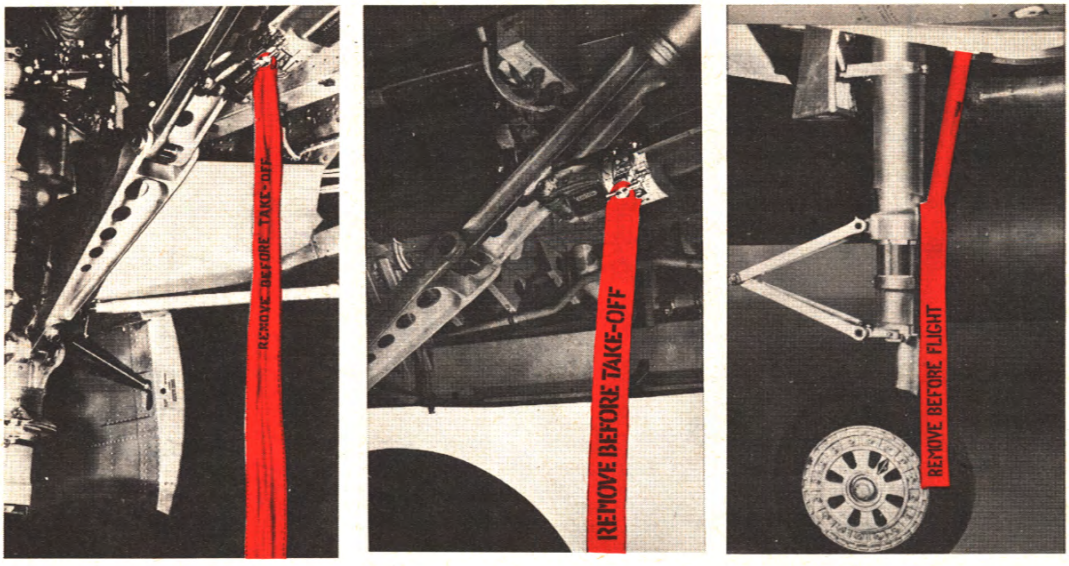



*Figure 1-36.*

is aided by air drag. An emergency landing gear extension stand with a ratcheting lever (2, figure 1-15) 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.

# LANDING GEAR GROUND LOCKS




FORWARD MAIN REAR MAIN OUTRIGGER

049514

*Figure 1-37.*

**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.

## 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 1-37) 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 1-37) 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 (14 and 15, figure 1-4).

## LANDING GEAR POSITION INDICATORS

Four DC operated tab window type indicators (32, figure 1-8) on the pilot's instrument panel and four identical indicators (1, figure 1-36) on the copilot's landing gear control panel show, by interchangeable tabs, the positions of the main and outrigger gears. When any gear is up and locked, 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 1-15) 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 (2, figure 1-35) located on the copilot's landing gear control panel is provided to test the lights located in the landing gear levers. A circuit breaker for the landing gear warning system marked "Warn Horn Position Indicator" is located on the "Landing Gear" portion of the upper DC power panel.

### LANDING GEAR WARNING HORN

If any one of the landing gears is not down and locked when any throttle is retarded below 63% rpm, a landing gear warning horn will sound. A landing gear warning horn release knob (9, figure 1-9) is located on the aft end of the pilot's control stand below the aileron trim control. Pulling out the knob will silence the warning horn until the throttles are advanced and retarded again below 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 marked "Warn Horn Position Indicator" located on the "Landing Gear" portion of the upper DC power panel.

## FRONT GEAR STEERING SYSTEM

The front landing gear is steerable through a hydraulic control system (figure 1-38) operated by the rudder pedals. Hydraulic pressure is supplied by the main or emergency hydraulic system. When the landing gear levers are in UP position a solenoid is energized actuating the steering disconnect valve which relieves hydraulic pressure, thereby disconnecting the rudder pedals from the front gear steering system and allowing the centering springs to center the gear. A centering switch located on the lower forward portion of the front gear shock strut prevents the gear from retracting unless it is within 2° (±1/4°) of center. As the landing gear retracts, shutoff valves are mechanically actuated by cams on the forward landing gear trunnion cutting off main or emergency hydraulic system pressure from the steering system until the gear has been lowered. Shimmy damping is also provided by the hydraulic steering system.

### STEERING RATIO SELECTOR LEVER

A front gear steering ratio selector lever (16, figure 1-9) on the pilot's control stand has three positions, TAXI--TAKEOFF LAND--TOW. Each position of the selector lever is fixed by detents and the lever must be lifted prior to changing to a new position. In TAXI or TAKEOFF LAND position, the rudder pedals are connected to the steering system in ratios best suited for these operations. TAXI position 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. The TAKEOFF LAND position allows a maximum wheel deflection of 12° right or left for a total of 24°. TOW position mechanically actuates the steering disconnect valve which relieves hydraulic pressure, thereby disconnecting the rudder pedals from the front gear steering system.

**NOTE**

- Prior to moving steering ratio selector lever, neutralize rudder pedals as the forward main gear will assume a position corresponding to the position of the rudder pedals. Also, the force applied to reposition the selector lever when rudder pedals are not in neutral is not only much less effective in moving the ratio mechanism, but is applied to the steering metering valve mechanism as well. This causes any bind in the ratio mechanism, steering disconnect unit, differential mechanism, or steering metering valve to resist movement of the ratio selector lever. It may be found that it is even impossible to move the lever under these conditions unless pedals are neutralized.

- A spring-loaded latch at the forward end of the lever quadrant prevents the selector from being placed inadvertently in TOW position. As an additional safety factor, releasing the latch and moving the selector lever to TOW position requires the use of both hands.

## 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 (neither outrigger gear is 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

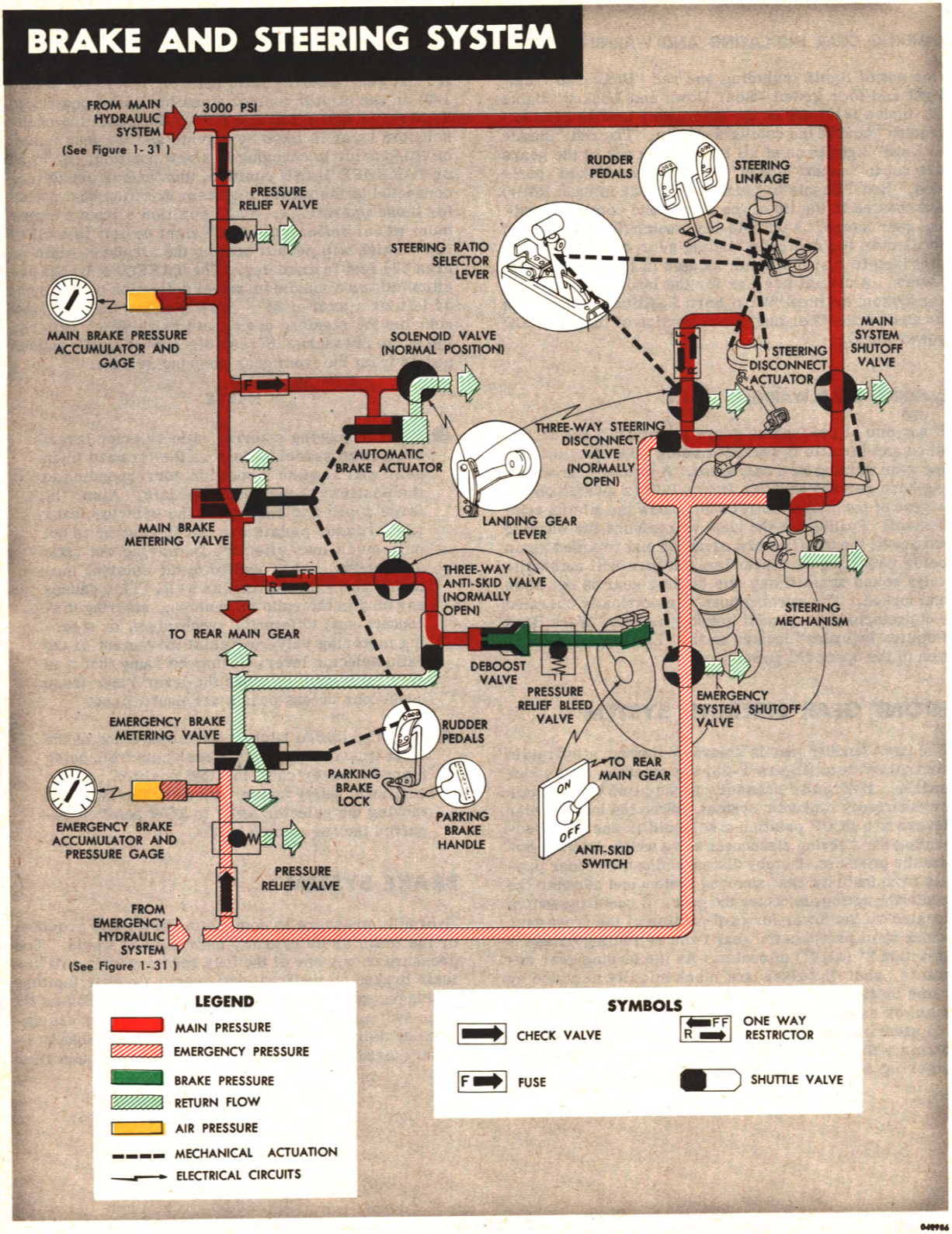

BRAKE AND STEERING SYSTEM
FROM MAIN HYDRAULIC SYSTEM
(See Figure 1-31)
3000 PSI
PRESSURE RELIEF VALVE
MAIN BRAKE PRESSURE ACCUMULATOR AND GAGE
SOLENOID VALVE (NORMAL POSITION)
AUTOMATIC BRAKE ACTUATOR
MAIN BRAKE METERING VALVE
TO REAR MAIN GEAR
RUDDER PEDALS
STEERING LINKAGE
STEERING RATIO SELECTOR LEVER
STEERING DISCONNECT ACTUATOR
MAIN SYSTEM SHUTOFF VALVE
THREE-WAY STEERING DISCONNECT VALVE (NORMALLY OPEN)
LANDING GEAR LEVER
THREE-WAY ANTI-SKID VALVE (NORMALLY OPEN)
STEERING MECHANISM
DEBOOST VALVE
PRESSURE RELIEF BLEED VALVE
EMERGENCY SYSTEM SHUTOFF VALVE
EMERGENCY BRAKE METERING VALVE
RUDDER PEDALS
PARKING BRAKE LOCK
PARKING BRAKE HANDLE
TO REAR MAIN GEAR
ON
OFF
ANTI-SKID SWITCH
EMERGENCY BRAKE ACCUMULATOR AND PRESSURE GAGE
PRESSURE RELIEF VALVE
FROM EMERGENCY HYDRAULIC SYSTEM
(See Figure 1-31)
LEGEND
MAIN PRESSURE
EMERGENCY PRESSURE
BRAKE PRESSURE
RETURN FLOW
AIR PRESSURE
MECHANICAL ACTUATION
ELECTRICAL CIRCUITS
SYMBOLS
CHECK VALVE
ONE WAY RESTRICTOR
FUSE
SHUTTLE VALVE
049986

*Figure 1-38.*

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 and powered through a circuit breaker marked "Antiskid" located on the "Landing Gear" portion of the upper DC power panel.

### PARKING BRAKE HANDLE

A parking brake handle (15, figure 1-9) on the left side of the pilot's control stand is provided to set the parking brakes. The parking brake handle, 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 parking brake handle, release the pedal, and then release the control. With the parking brake set, the handle will remain extended approximately 1 inch. The parking brake may be released by depressing the left rudder pedal until the parking brake handle retracts, then release the brake pedal.

### ANTISKID SWITCH

An antiskid ON--OFF switch (12, figure 1-10) 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 (14, figure 1-8) on the pilot's instrument panel. The switch should be ON at all times. DC power is supplied to the antiskid switch through a circuit breaker marked "Antiskid" located on the "Landing Gear" portion of the upper DC power panel.

### MAIN BRAKE SYSTEM PRESSURE GAGE

A remote indicating pressure gage (7, figure 1-31) 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). AC power is supplied to the main brake system pressure gage through a fuse marked "Main Brake Main Press" located in the main AC power shield.

### ANTISKID INOPERATIVE LIGHT

An amber light (14, figure 1-8) on the pilot's instrument panel will go out when the antiskid switch is placed in 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 marked "Antiskid" located on the upper DC power panel 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 1-31) 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. AC power is supplied to the emergency brake system pressure gage through a fuse marked "Emerg Brake Emerg Press" located in the main AC power shield.

## 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. The chute may be deployed at speeds up to 160 knots IAS.

### BRAKE CHUTE DEPLOYMENT HANDLES

Deployment handles (3, figure 1-5 and 1, figure 1-13) to open the brake chute are above the control stands at the pilot's and copilot's 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

Chute jettison handles (13, figure 1-9 and 3, figure 1-17) 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.

### PILOT CHUTE RETAINING PINS

The pilot chute of the brake chute is held in place by foldover flaps. The flaps are held in place by retaining pins when the brake chute deploy doors are open. On some airplanes the pilot chute flaps use three retaining pins; if T.O. 1B-47-814 has been accomplished on these airplanes, a red streamer will be attached to the pins. On other airplanes the pilot chute flaps use one retaining pin with a red streamer. The pins must be removed prior to flight in order for the brake chute to be deployed.

## APPROACH CHUTE SYSTEM

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 approach chute can be used under all weather conditions. 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 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 (11, figure 1-8) has DEPLOY--DOOR CLOSED positions and is located on the upper left corner of the instrument panel. The copilot's switch is located on the canopy guard to the left and slightly aft of the instrument panel and has DEPLOY--DOOR CLOSED positions. In DEPLOY position, DC power is supplied to the actuator to open the approach chute door and deploy the chute. The DOOR CLOSED 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 circuit breaker marked "Pilot" and "Copilot" located on the "Approach Chute" portion of the aft DC power panel. If a circuit breaker trips, the other switch remains operable.

### 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. In order to operate the door with the external switch, both the pilot's and copilot's deploy switches must be in the DOOR CLOSED position. Holding the external door switch in OPEN position supplies 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 closed from the pilot or copilot position, but the door can be opened by the interior switches. CLOSE position of the external switch 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. A circuit breaker next to the external switch protects the "open" circuit for external operation but does not protect the "closed" circuit for external operation. With this circuit breaker pulled the door cannot be opened but can be closed by the external switch, and the door can be opened or closed by the pilot and copilot deploy switches, provided the external switch is in the CLOSED position. To completely isolate the door actuator circuits, two circuit breakers in the tail compartment power shield must be pulled.

### APPROACH CHUTE JETTISON HANDLES

Chute jettison handles (13, figure 1-9 and 3, figure 1-17) 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

**NOTE**

The instruments covered here are only those which cannot be considered to be a part of a complete system such as fuel system, landing gear system, etc.

### ELECTRICALLY OPERATED INSTRUMENTS

#### Attitude Indicator (J-8)

A Type J-8 attitude indicator (11, figure 1-16) 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. Allow 30 seconds after power is applied to the Type J-8 attitude indicator for the gyro to attain speed, then cage immediately thereafter, to prevent unnecessary torque stresses on the instrument mechanism. The J-8 will be caged 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 tolerances are encountered, the instrument should be replaced. AC power is supplied to the attitude indicator through fuses located in the main AC power shield.

**Attitude Indicator (B-1)**

A Type B-1 attitude indicator (22, figure 1-8) 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 K-4/B-1 system has 360° of freedom in the roll axis. The vertical gyro is equipped with stops on the pitch axis at 82° dive and climb such that when these pitch attitudes are exceeded a controlled precession of the vertical gyro occurs driving the indicator through 180° roll. This controlled precession gives the correct indication with a minimum of induced error. The attitude 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 marked "Vertical Gyro" located on the lower DC power shield. 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.

**WARNING**

It is possible that a malfunction of the attitude indicator might be determined only by cross checking it with the remaining flight instruments.

**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 attitude indicator. Inverter changeover or loss of AC power to the

**NOTE**
(continued)

B-1 attitude indicator results in the indicator being locked about the roll axis; if the airplane was banked during this "power off" condition, the indicator 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° to 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 attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run. 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.

### Turn-and-Slip Indicators

The airplane has two electrically (DC) operated turn-and-slip indicators, one located on the pilot's instrument panel (21, figure 1-8) and one on the copilot's instrument panel (7, figure 1-16).

### Turn-and-Slip Power Switch

A turn-and-slip power switch (8, figure 1-16) with NORMAL--EMERGENCY positions located on the copilot's instrument panel is guarded in NORMAL position. In NORMAL position, this switch energizes the pilot's and copilot's turn-and-slip indicators from the airplane DC power bus. In EMERGENCY position, the indicators receive power directly from the airplane batteries regardless of battery switch position. Separate circuit breakers for the pilot's and copilot's turn-and-slip indicators are located on the "Instrument" portion of the lower DC power panel for normal power, and are marked "Turn and Bank - Pilot" and "Turn and Bank - Copilot." Circuit breakers for emergency power are on the emergency battery bus in the tail compartment power shield.

### Outside Air Temperature Gages

Electrically (DC) operated outside air temperature gages are located on the pilot's instrument panel (29, figure 1-8) and on the observer's instrument panel (6, figure 4-57). Instrument indications are in degrees Centigrade, and power is derived through a circuit breaker marked "Outside Air Temp" on the "Instrument" portion of the lower DC power panel.

## PITOT-STATIC INSTRUMENTS

Pitot and static air pressures operate the airspeed indicators, Machmeter, altimeters, and vertical velocity 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 (figure 1-39).

### Machmeter

The Machmeter (6, figure 1-8 and 4, figure 1-16) located on the pilot's and copilot's instrument panels indicates the airplane speed in terms of a Mach number. Mach number is a function of airspeed and air density and provides an indication of the ratio between the speed of the airplane and the speed of sound of a particular altitude and temperature condition. The Machmeter is scaled from .3 to 1.0 (Mach 1.0 being the speed of sound) in increments of hundredths with a single luminescent pointer. A red radial line is painted on the instrument face glass to indicate maximum allowable Mach number.

### Altimeters

A barometric altimeter (13, figure 1-8; 5, figure 1-16; and 2, figure 4-57) is installed on the instrument panels of the pilot, copilot, and observer. This instrument indicates the altitude of the airplane above sea level and requires a correction card to enable flight personnel to compensate for built-in instrument errors which cannot be corrected by adjustment. These correction cards are located on the housing between the rudder pedals at the pilot's and copilot's station and on overhead instrument panel of the observer. On some airplanes the instrument has three conventional pointers which indicate feet of altitude on a common scale. The large pointer indicates hundreds of feet; the intermediate pointer indicates thousands of feet; and the third pointer indicates tens of thousands of feet. Later model altimeters on other airplanes have a large pointer which indicates hundreds of feet, and an intermediate pointer which indicates thousands of feet. In addition, a small pointer indicating tens of thousands of feet is painted on a black disk with an extension line terminating in a triangular section. This provides a conspicuous indication that is always visible and which can be used to get an approximate altitude at a quick glance. Another feature is the 60° section marked with alternate diagonal fluorescent and black stripes. Since this section is visible only between zero and 17,000 feet, it aids in reducing erroneous interpretation of the altimeter at lower altitudes. On both altimeters the barometric scale, visible through the window in the dial, indicates barometric pressure in inches of mercury ranging from 28.1 to 31.0, and is adjusted by means of a knob on the lower left face. Each instrument is connected to a static line for operating pressure.

### Maximum Allowable Airspeed Indicator

A maximum allowable airspeed indicator (18, figure 1-8 and 6, figure 1-16) on the pilot's and copilot's instrument panels show indicated airspeed knots and Mach number. Airspeed is indicated by a fluorescent pointer which revolves clockwise about a dial graduated in 10-knot increments up to 650 knots. The indicator also has a red Mach number pointer which is moved along the outside rim of the dial where Mach numbers have been interspaced with the regular airspeed graduations and is set at the maximum limiting

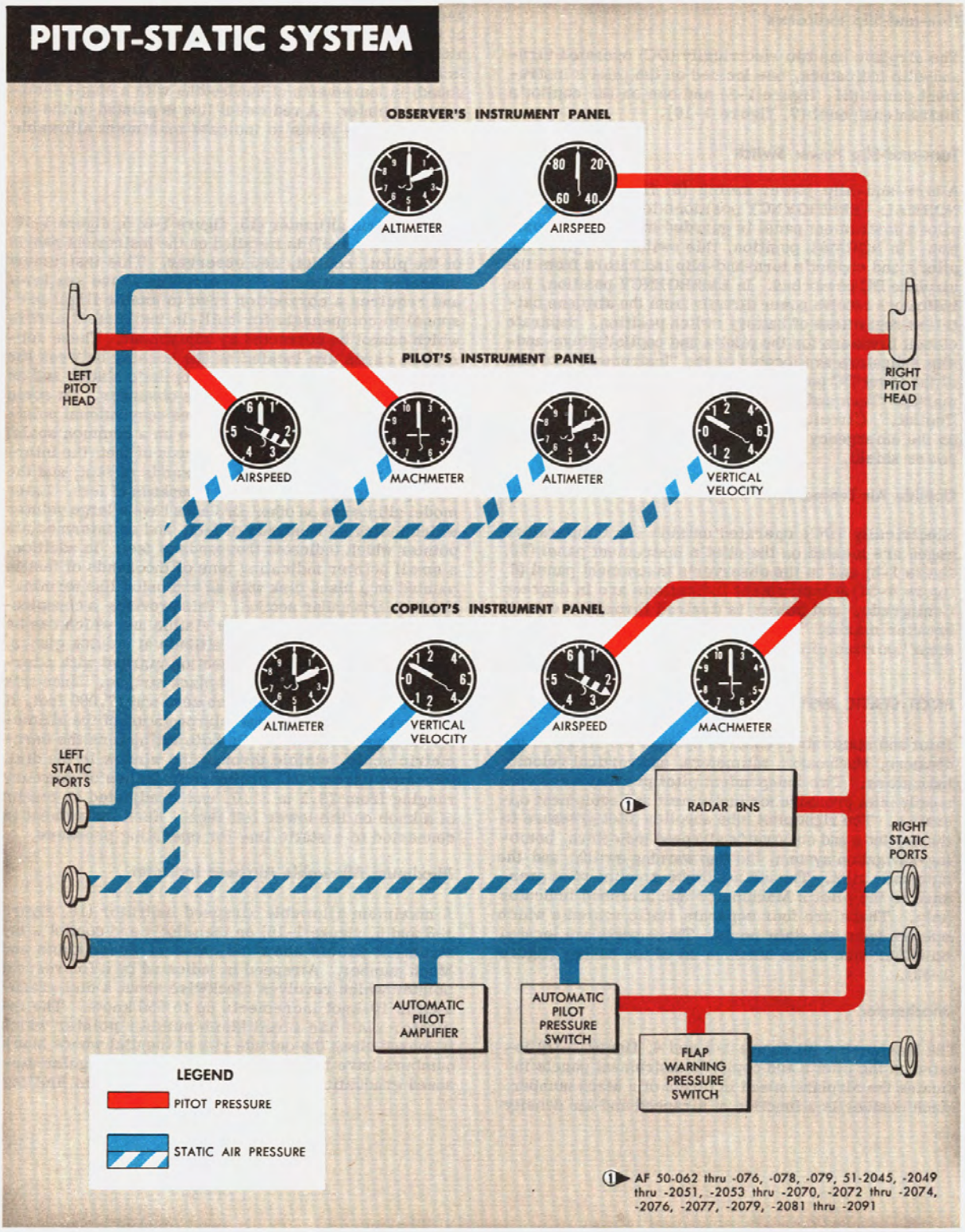

PITOT-STATIC SYSTEM
OBSERVER'S INSTRUMENT PANEL
ALTIMETER
AIRSPEED
LEFT PITOT HEAD
RIGHT PITOT HEAD
PILOT'S INSTRUMENT PANEL
AIRSPEED
MACHMETER
ALTIMETER
VERTICAL VELOCITY
COPILOT'S INSTRUMENT PANEL
ALTIMETER
VERTICAL VELOCITY
AIRSPEED
MACHMETER
LEFT STATIC PORTS
RADAR BNS
RIGHT STATIC PORTS
AUTOMATIC PILOT AMPLIFIER
AUTOMATIC PILOT PRESSURE SWITCH
FLAP WARNING PRESSURE SWITCH
LEGEND
PITOT PRESSURE
STATIC AIR PRESSURE
1 AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091
049007

*Figure 1-39.*

Mach number. Another pointer, red and white striped, (some instruments, black and white diagonal) is preset and moves to indicate the airspeed corresponding to the limit Mach number or limit airspeed, whichever is less, at the existing flight altitude. The angle formed between the fluorescent pointer and the striped pointer gives an indication of approach to limiting airspeed. When the two pointers meet, the airplane is moving at its maximum allowable airspeed or critical Mach number. A yellow radial line is painted on the instrument face to mark any conditional limiting airspeed. A revolving drum visible through the window on the dial face is scaled from 0 to 100 in increments of 2 knots. A vertical velocity indicator (23, figure 1-8 and 10, figure 1-16) is mounted on the instrument panels of the pilot and copilot. This flight instrument measures the rate of change of altitude, either up or down in hundreds of feet per minute, and is used to show the rate at which the airplane is either gaining or losing altitude. The indications of the vertical velocity indicator are reliable only in relatively smooth air, after the airplane has been maintaining a particular performance for an appreciable length of time. In rough air, its indications are erratic and unpredictable. Also, due to the lag which has been built into its pressure system, its indications will lag behind the airplane performance.

**NOTE**

During bomb bay door operation, due to the wake of disturbed air, the airspeed, Machmeter, altimeter, and vertical velocity instruments show erroneous readings. The airspeed indicator will read 5 knots low, altimeter will indicate 150 to 200 feet low, vertical velocity 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.

### SELF-POWERED INSTRUMENTS

#### Accelerometer

An accelerometer (9, figure 1-8) is mounted on the pilot's instrument panel to indicate flight loads imposed on the airplane in terms of "g" factor. The instrument is self-operated and independent of the airplane electrical or pitot-static systems. The main pointer continuously indicates changes in loading. The other two pointers indicate the highest plus and minus "g" load accelerations reached. By means of a knob in the lower left corner, the plus and minus pointers may be reset to normal.

**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

The standby compass is a direct indicating magnetic compass mounted on the pilot's right windshield retainer. The compass is self-operating and indicates the direction the airplane is headed with respect to magnetic north by means of a "floating" graduated card read against a fixed reference point. A correction card is mounted on the pedestal between the rudder pedals at the pilot's station.

#### Clocks

A clock (24, figure 1-8; 12, figure 1-16; and 8, figure 4-58) is provided and located on the instrument panel at each crew station. The clocks are of conventional design and are wound and set by use of the knob in the lower left corner which is spring-loaded to the winding position. On some airplanes these clocks incorporate an elapsed time feature with a sweep second pointer and a minute totalizer pointer. The elapsed time mechanism is controlled by a knob in the upper right corner of the clock. The knob operates in a three-push sequence to start, stop, and return the pointers to the 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 marked "Inst Vibrator" is located on the lower DC power panel.

## EMERGENCY EQUIPMENT

### HAND-OPERATED FIRE EXTINGUISHERS

A stored pressure chlorobromomethane-type fire extinguisher (8, 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 (17, figure 1-10) 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 on some airplanes* or by emergency stowage of the pilot's and copilot's control columns on other airplanes**. In either case the bells 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, see figure 3-6. The emergency alarm bells are DC operated and receive power through a circuit breaker located in the tail compartment power shield.

### 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 (11, figure 1-14) is installed on the left sidewall above the pressure door; and a battle splint and dressing kit (17, figure 1-14) is installed on the left sidewall opposite the copilot's seat.

**NOTE**

The latter two kits may not be installed in the airplane. If not installed, they are available in base supply.

### EMERGENCY KNIFE

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

### HAND AXE

The hand axe (13, figure 3-1) is stowed on the left sidewall of the walkway just forward of the pressure door.

### ANTIEXPOSURE SUITS

Antiexposure suits (9, 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 KITS

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, liferaft, tent, rifle-shot gun, raincoat, 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.

### DITCHING-CRASH LANDING STATIONS

Three ditching-crash landing stations for the observer and two extra crew members are provided in the pilot's walkway. (See "Crash Landing" or "Ditching," section III.)

**NOTE**

Seating arrangement is optional and may be changed at the discretion of the aircraft commander.

One 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 tiedown 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 tiedown 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 tiedown strap is to hold the safety belt in position and to prevent the occupant from sliding under the safety belt during deceleration. Two additional 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 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 each side of the walkway floor. Two harness side straps are hooked to two retractable fittings, one at each side of the walkway floor approximately 1 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 the ditching harness 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

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* AF 50-008, -010 thru -013, -015, -016, -021 thru -025, -029 thru -032, 51-2045, -2046, -2048 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091

** AF 49-2642 thru 50-007, -009, -014, -017 thru -020, -026 thru -028, -033 thru -081, 51-2047, -2052, -2071, -2078, -2080

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 cockpit walkway. The occupants will face aft when seated in these harnesses.

### 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.

A window-type emergency escape hatch is installed above and to the left of the observer's position. An emergency hatch release handle (1, figure 4-58) 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 3-8) 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 the observer's release handle. The compression of the hatch seal will extend the bottom of the hatch 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. The hatch is propelled free of the fuselage by a self-contained pneumatic system. A static cable attached to a fitting on the floor of the hatch links the hatch to a safety pin in the catapult initiator on the seat. When the hatch is jettisoned the static cable withdraws the safety pin from the initiator, thereby preventing premature catapulting of the ejection seat before the hatch is jettisoned. A hatch air cylinder is located on the right side of the ejection hatch interior and is pressurized to 2000 psi. A pressure gage is located in the right rear floor face of the ejection hatch and is visible through an inspection window. 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 right handgrip control on the pilot's and copilot's seats and the leg braces on the observer's seat. On some airplanes* 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.

### BAILOUT SPOILER AIR BOTTLE

An emergency air bottle (11, figure 1-48) 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

Emergency escape through the entrance door is facilitated by provisions for mechanical 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 (14, figure 1-14) 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.

**CAUTION**

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

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* AF 50-008, -010 thru -013, -015, -016, -021 thru -025, -029 thru -032, 51-2045, -2046, -2048 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091

**WARNING**

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

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**

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

### PARACHUTE

On some airplanes provisions are made for the installation of an emergency chest pack parachute in the aft end of the crawlway (8, figure 3-1).

### PARACHUTE STATIC LINES

Parachute static lines for emergency bailout of injured personnel are mounted on the wall above the pressure door (10, figure 3-1) and in the aft end of the crawlway (7, figure 3-1).

### FIRE WARNING SYSTEM

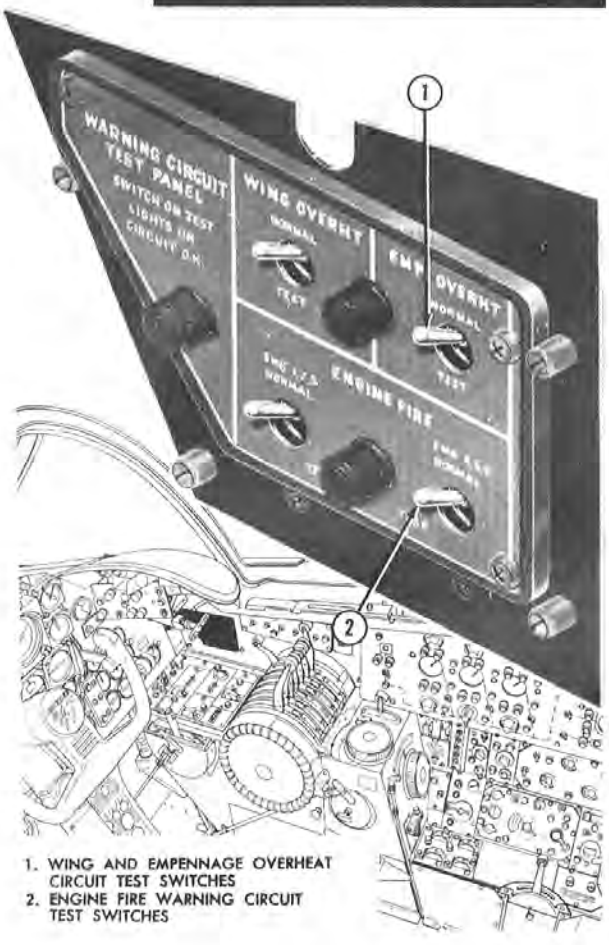
#### Engine Fire Warning

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) (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 1-40) 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. 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 provided the bulbs glow on press-to-test. 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 marked "Fire Detection" is located on the "Warning" portion of the upper DC power panel.

#### Wing and Empennage Overheat Warning

Two red lights (3 and 4, figure 1-8) installed on the pilot's instrument panel are marked "Wing Overheat" and "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 1-40) on the fire warning circuit test panel are spring-loaded to NORMAL position. When either switch is placed in TEST position, illumination of the affected warning light indicates that the

## FIRE WARNING TEST PANEL




1. WING AND EMPENNAGE OVERHEAT CIRCUIT TEST SWITCHES
2. ENGINE FIRE WARNING CIRCUIT TEST SWITCHES

*Figure 1-40.*

warning light circuits have continuity. Conversely, failure of the affected light to illuminate indicates that the circuits are broken provided the bulbs glow on press-to-test. In NORMAL position, the circuits are armed for overheat warning. Power is supplied to the switches through a circuit breaker marked "Wing & Emp Overheat Warning" located on the "Anti-Icing" portion of the lower DC power panel.

## CANOPY SYSTEMS

The airplane is provided with a sliding-type canopy designed to be jettisoned in flight and constructed so that the ejection seats cannot be ejected through it. The 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 (figure 1-41). 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. Inflight 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. Protection for the pilot and copilot during normal canopy jettisoning is provided by a canopy guide located above the copilot's instrument panel and a turtledeck located aft of the copilot. The canopy guide serves to limit the jettisoned canopy movement to an upward direction only, thereby reducing the possibility of the canopy striking a crew member. The turtledeck serves to reduce buffeting of the copilot by the airstream during ejection at high speeds.

### CANOPY LEVER

A canopy lever (6, 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 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.

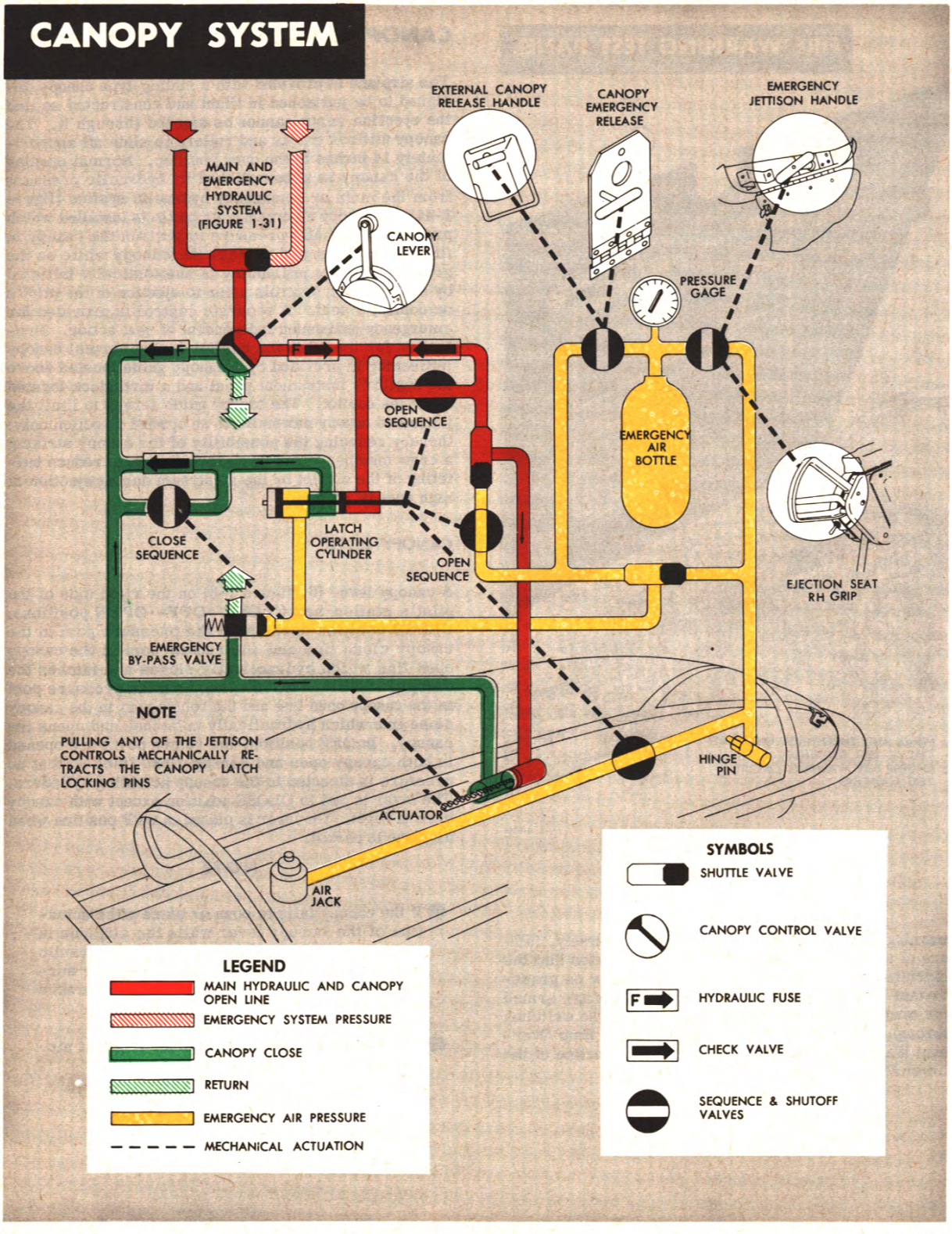

CANOPY SYSTEM
EXTERNAL CANOPY RELEASE HANDLE
CANOPY EMERGENCY RELEASE
EMERGENCY JETTISON HANDLE
MAIN AND EMERGENCY HYDRAULIC SYSTEM (FIGURE 1-31)
CANOPY LEVER
PRESSURE GAGE
OPEN SEQUENCE
EMERGENCY AIR BOTTLE
CLOSE SEQUENCE
LATCH OPERATING CYLINDER
OPEN SEQUENCE
EJECTION SEAT RH GRIP
EMERGENCY BY-PASS VALVE
NOTE
PULLING ANY OF THE JETTISON CONTROLS MECHANICALLY RETRACTS THE CANOPY LATCH LOCKING PINS
HINGE PIN
ACTUATOR
AIR JACK
LEGEND
MAIN HYDRAULIC AND CANOPY OPEN LINE
EMERGENCY SYSTEM PRESSURE
CANOPY CLOSE
RETURN
EMERGENCY AIR PRESSURE
MECHANICAL ACTUATION
SYMBOLS
SHUTTLE VALVE
CANOPY CONTROL VALVE
HYDRAULIC FUSE
CHECK VALVE
SEQUENCE & SHUTOFF VALVES
049987

*Figure 1-41.*

**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**

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 (8, figure 1-5) on the right side of the pilot's station has LOCKED--UNLOCKED positions. LOCKED position extends the locking pins "in place" (figure 1-42), locking the canopy latches. 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 lever is moved to OPEN position. A canopy lockpin engagement inspection hole (4, figure 1-13) 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 (figure 1-42).

**NOTE**

The canopy lock lever must be operated to the full forward position to lock the canopy latches effectively because the locking pins are actuated only by the last few inches of travel of the canopy lock lever.

### CANOPY EMERGENCY RELEASE HANDLES (GROUND)

Canopy emergency release handles (one at each station) are on the pilot's and copilot's instrument panels (42, figure 1-8 and 1, figure 1-16) and 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 12 inches mechanically disconnects the canopy actuating mechanism, removes the lockpins 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.

### CANOPY EMERGENCY JETTISON HANDLES (IN FLIGHT)

Canopy emergency jettison handles (one at each station) (10, figure 1-7 and 9, figure 1-14) 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 lockpins, 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.

**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.

**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.

### 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 (25, figure 1-4).

## CANOPY LOCK PIN

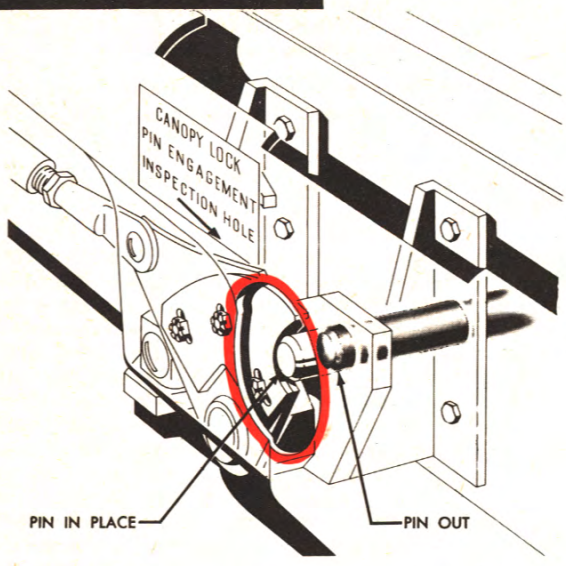



*Figure 1-42.*

### CANOPY ROLLER LOCK INDICATOR

A roller lock indicator (figure 1-43) marked "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 LOCKED POSITION (horizontal) at all other times.

**WARNING**

Check that the canopy roller lock indicator is in 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 LATCH INDICATOR

A canopy latch indicator (figure 1-44) 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 1-15) 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 ROLLER LOCK INDICATOR

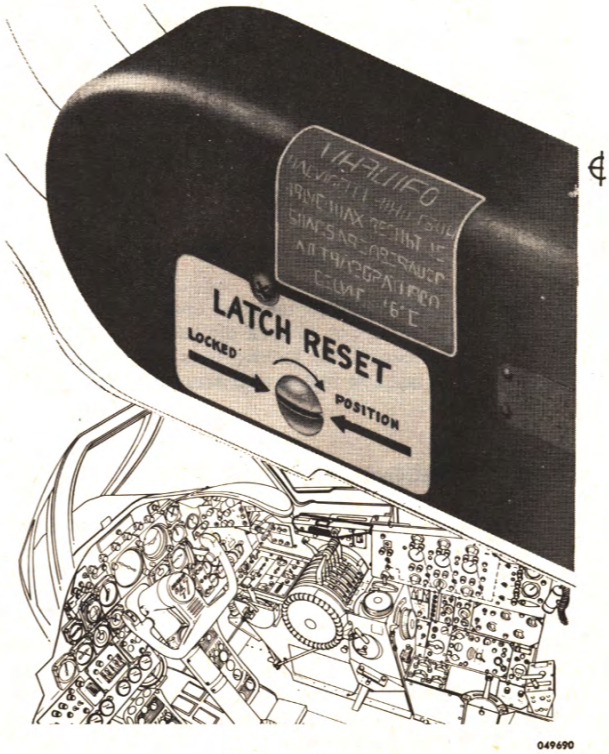



*Figure 1-43.*

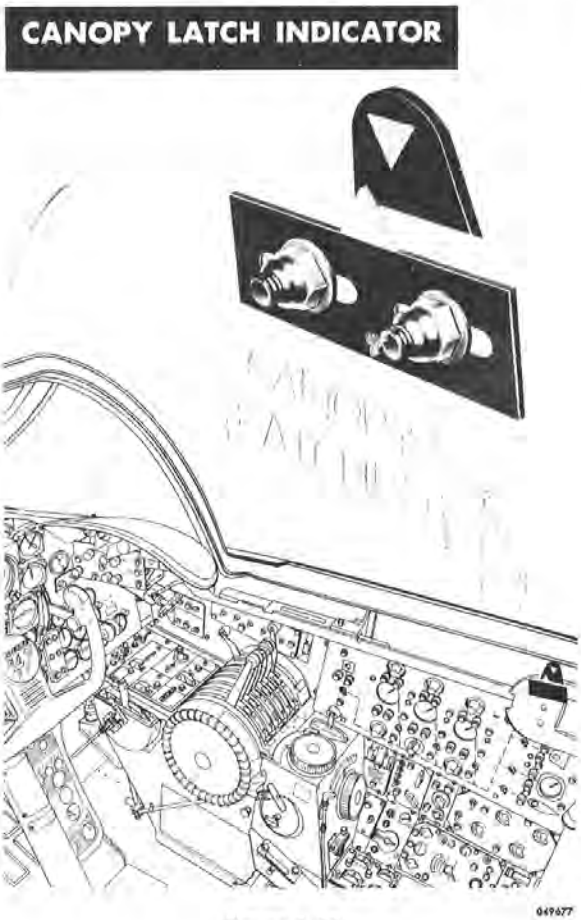



*Figure 1-44.*

### CANOPY EMERGENCY AIR BOTTLE

An emergency air bottle (10, figure 1-48) located in the crawlway serves as a power source for emergency exit or entrance on the ground or canopy jettisoning in flight.

## EJECTION SEAT SYSTEM

Catapult-type ejection seats are installed at pilot's and copilot's stations. Seats are normally used as standard seats; however, in emergencies, they provide an effective and expedient means for bailout at all speeds. B-47 ejection seats are designed for use with the 5-inch back-style parachutes only. A shelf having 2 inches of the forward side made of sponge rubber is provided at the bottom rear of the seat to support the parachute pack in flight. 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.

**WARNING**

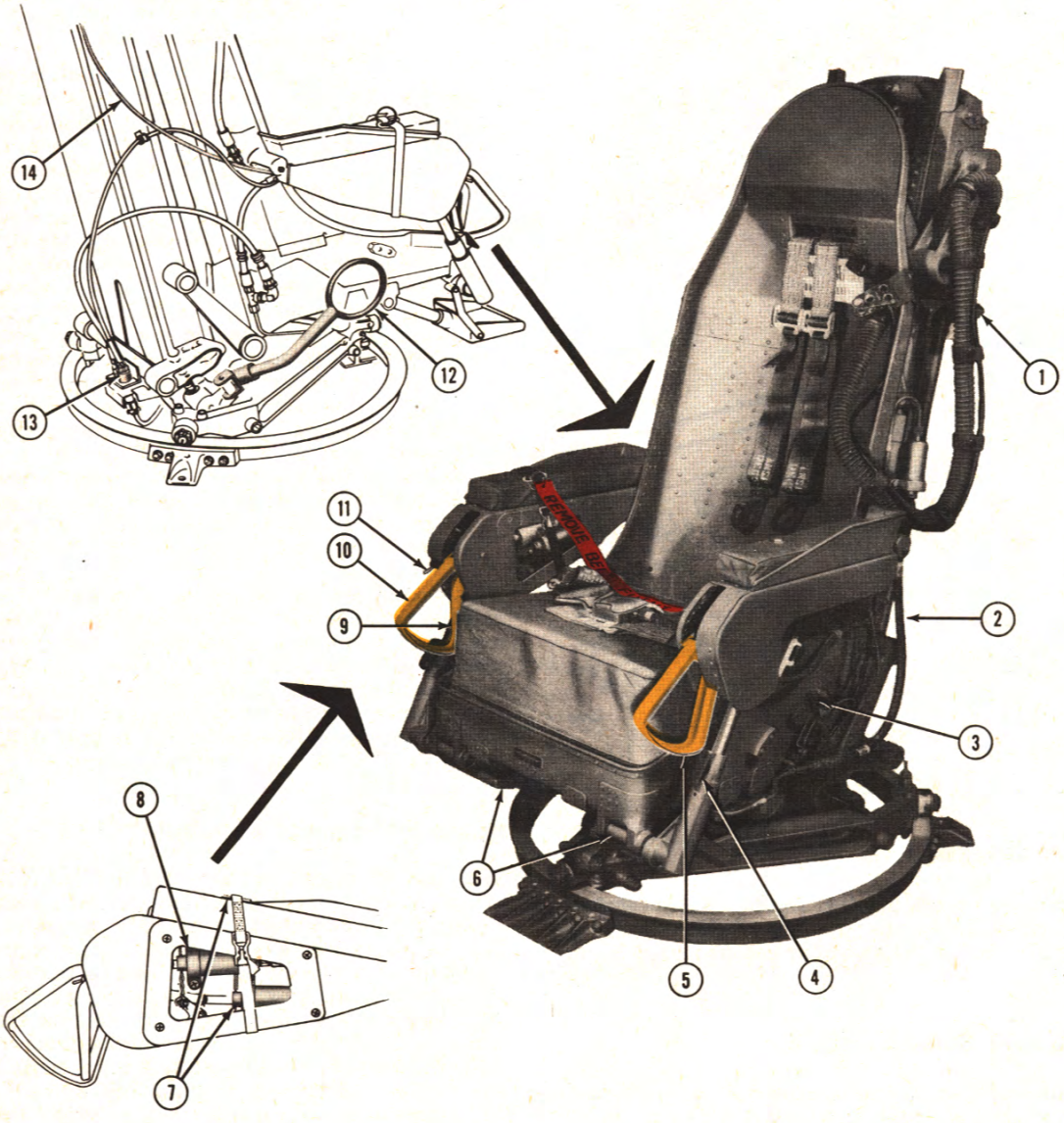
The A-5 seat cushion should not be left in the pilot's or copilot's seat if the C-2A liferaft is being carried. Sitting on both of these items does not provide added comfort but actually creates a definite injury hazard and may position the pilot where it is difficult to reach controls. Chance of vertebral injury during ejection or crash landing 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 and 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. See 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 (figure 1-45). The seats are equipped with initiators, which are explosive cartridges, to provide a high pressure force to fire the catapults which eject the seats. 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. 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 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.

# PILOT'S AND COPILOT'S EJECTION SEAT




1. QUICK DISCONNECT
2. AUTOMATIC OPENING SAFETY BELT INITIATOR (BEHIND SEAT)
3. SHOULDER HARNESS LOCK LEVER
4. ARMREST LOCKS
5. LEFT HANDGRIP
6. FOOTRESTS
7. BALLISTICS SYSTEM INITIATOR AND SAFETY PIN
8. CATAPULT INITIATOR
9. CATAPULT TRIGGER LEVER
10. RIGHT HANDGRIP
11. SEAT ADJUSTMENT SWITCH
12. SEAT TILT AND ROTATION HANDLE*
13. ELECTRICAL QUICK DISCONNECT
14. CATAPULT INITIATOR RELEASE CABLE

*COPILOT'S SEAT ONLY

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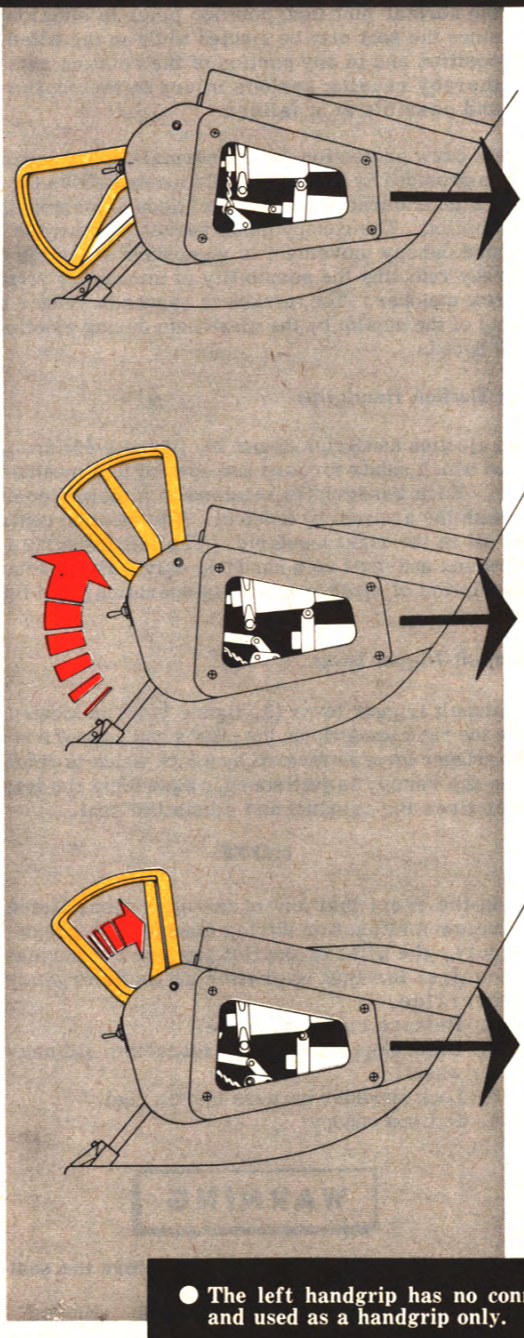
*Figure 1-45.*

# PILOT'S AND COPILOT'S EJECTION SEAT CONTROLS



Ejection controls are all in the right handgrip.

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

- Cabin air emergency depressurization door unlocks releasing cabin pressure.
- Electric seat actuator is disconnected and seat is power driven to bottom position.
- Shoulder harness inertia reel locks.
- Copilot's foot rests extend.
- Control column spring cartridge disconnects and centers wheel and stows control column.
- Emergency alarm bell sounds.
- Canopy spring cartridge unlocks canopy and actuates air bottle valve. Pneumatic pressure unlatches canopy, engages hinge pin, and extends air jacks to jettison canopy.
- 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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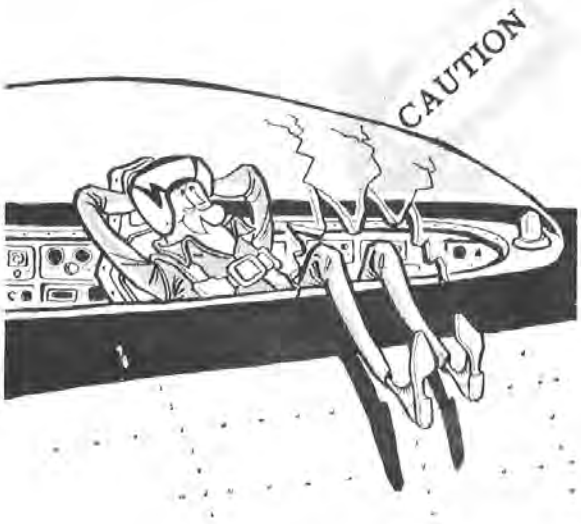
*Figure 1-46.*

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.
- Do not rotate seat without removing periscopic sextant since damage to the sextant, mount, and canopy may result.

**WARNING**

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 in any portion of the rotation arc, thereby causing serious injury to the copilot and possible seat failure.

Flight crew protection during normal canopy jettisoning is provided by a canopy guide located above the copilot's instrument panel and a turtledeck located aft of the copilot. The canopy guide serves to limit the jettisoned canopy movement to an upward direction only thereby reducing the possibility of the canopy striking a crew member. The turtledeck serves to reduce buffeting of the copilot by the airstream during ejection at high speeds.

### Seat Ejection Handgrips

Two ejection handgrips (5 and 10, figure 1-45) 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, see figure 1-46.

### Catapult Trigger Lever

A catapult trigger lever (9, figure 1-45) 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 (11, figure 1-45), 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 marked "Pilot" and "Copilot" are located on the "Ejection Seat" portion of the aft DC power panel.

**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 (4, figure 1-45) 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 (12, figure 1-45) located on the right side of the copilot's seat 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 Pin and Streamer**

An initiator safety pin (7, figure 1-45) accompanied by a red streamer is provided for use with each seat. The safety pin is inserted through the top of the initiator 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 a container at each crew station before every flight and replaced on the seat immediately after parking the airplane.

## SAFETY BELT AND SHOULDER HARNESS

The pilot's and copilot's ejection seats are provided with a conventional shoulder harness and an automatic opening cartridge-operated safety belt (figure 1-47). The shoulder harness is connected to the safety belt by a loop in the end of both shoulder harness straps.

**WARNING**

If the MA-2 belt is installed on the pilot's or copilot's seat, the shoulder harness loops must be connected to the upper strap arm only. If connected otherwise, the occupant may fail to separate from seat after ejection.

When an impact force of 2 or 3 "g's" is encountered, the shoulder harness will lock automatically. The gas-operated automatic opening safety belt provides the pilot and copilot with a positive means of separation from the seat as soon as possible after ejection without requiring manual operation by the crew member. An automatic opening parachute is used in conjunction with the automatic safety belt and automatically opens after the crew member separates from the ejection seat. A delay-type initiator is connected by a flexible hose to the safety belt mechanism. The initiator firing pin is attached to the static cable on the fixed guide rails so that when the seat ejects, the initiator is pulled from the firing pin. After a delay interval of approximately 2 seconds, gas pressure generated by the initiator drives a piston within the safety belt buckle to release the belt and shoulder harness loops. Manual operation of the system can override the automatic features at any time. For example, it is possible to manually open the safety belt even though initiator action has started. The parachute automatic features may likewise be overridden by manual operation even though the automatic parachute ripcord release has been actuated.

**WARNING**

If the safety belt is opened manually, the parachute ripcord must be pulled manually.

**Automatic Opening Safety Belt (Type MA-1, MA-2, MA-3, and MA-4)**

The release of the MA-1, MA-2, MA-3, and MA-4 safety belt (figure 1-47) is accomplished by manual operation of the crew member or by gas pressure from a separate automatically controlled source, the M-4 initiator. This power source supplies approximately 1500 psi pressure through a 36-inch length of high pressure hose which actuates a piston inside the belt, retracting the latch tongue

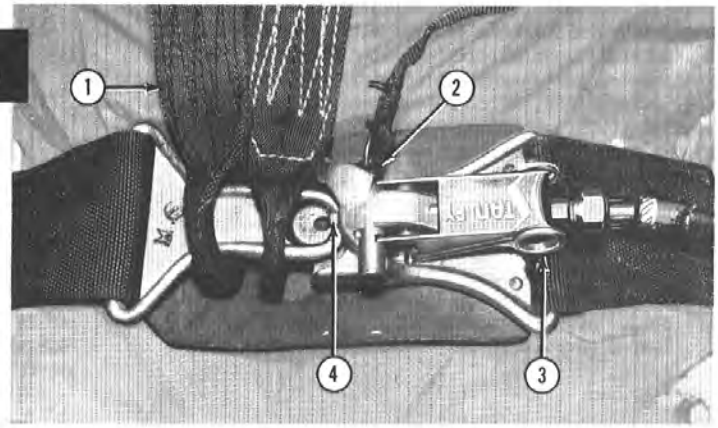
# AUTOMATIC OPENING SAFETY BELTS

## TYPE MA-1

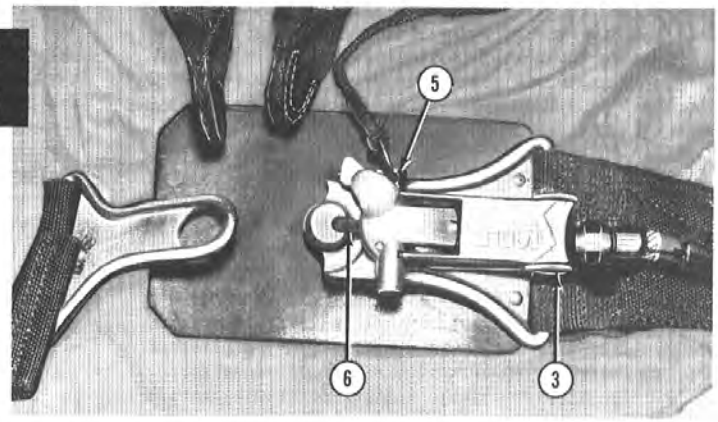
**LOCKED CONDITION**

**NOTE**

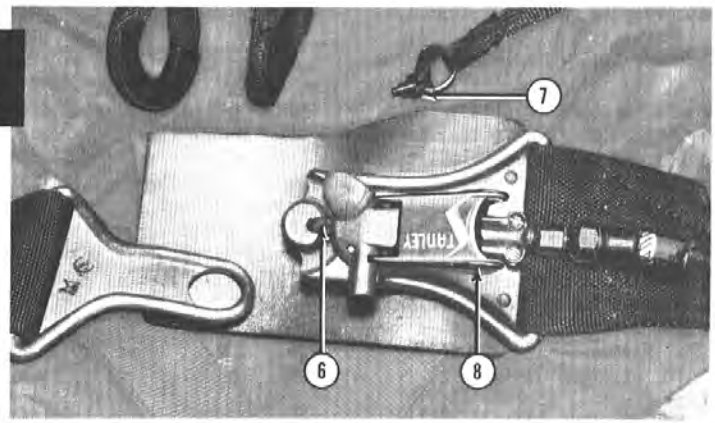
SAFETY BELT AND PARACHUTE LANYARD KEY MUST BE COMPATIBLE FOR COMPLETE AUTOMATIC OPERATION




**AUTOMATIC OPENING CONDITION**




**MANUAL OPENING CONDITION**



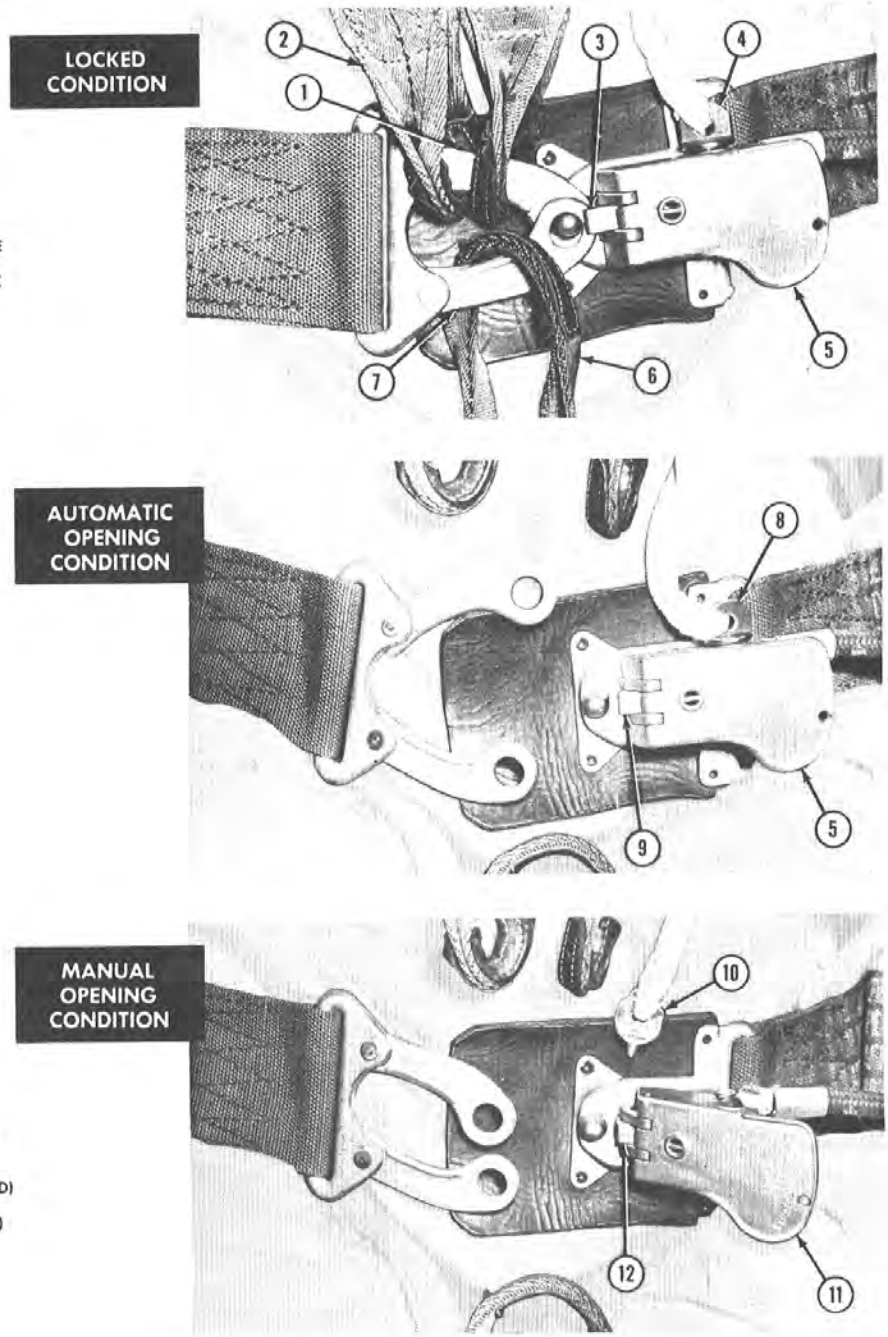

1. SHOULDER HARNESS
2. PARACHUTE LANYARD KEY
3. MANUAL RELEASE LEVER (LOCKED)
4. LATCH EXTENDED
5. PARACHUTE LANYARD KEY (RETAINED)
6. LATCH RETRACTED
7. PARACHUTE LANYARD KEY (EJECTED)
8. MANUAL RELEASE LEVER (RAISED)

*Figure 1-47 (Sheet 1 of 4 Sheets).*

## TYPE MA-2

**NOTE**

SAFETY BELT AND PARACHUTE LANYARD KEY MUST BE COMPATIBLE FOR COMPLETE AUTOMATIC OPERATION



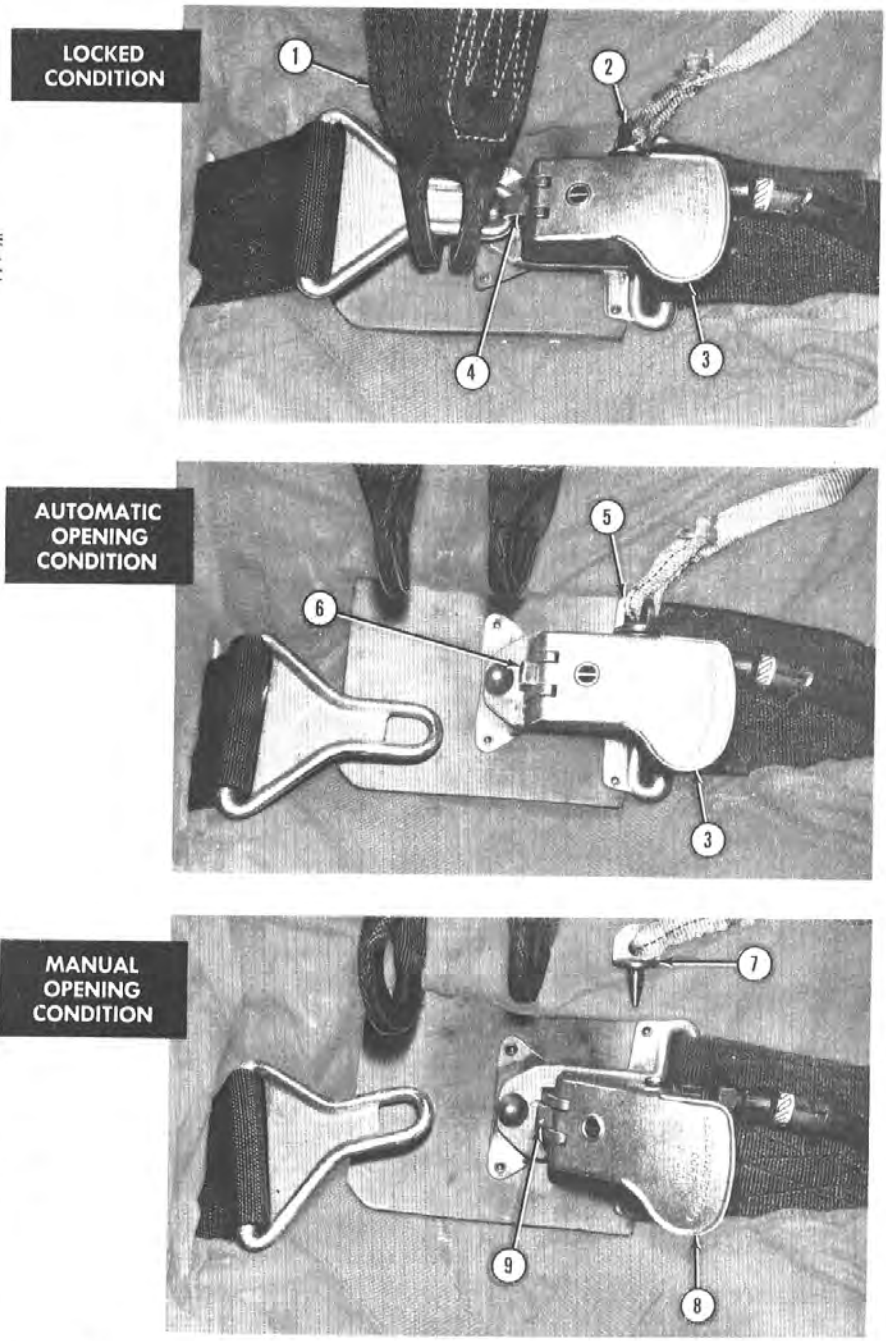

1. UPPER STRAP ARM
2. SHOULDER HARNESS
3. LATCH EXTENDED
4. PARACHUTE LANYARD KEY
5. MANUAL RELEASE LEVER (LOCKED)
6. SAFETY BELT TIEDOWN STRAP
7. LOWER STRAP ARM
8. PARACHUTE LANYARD KEY (RETAINED)
9. LATCH PIVOTED UP
10. PARACHUTE LANYARD KEY (EJECTED)
11. MANUAL RELEASE LEVER (RAISED)
12. LATCH RETRACTED

*Figure 1-47 (Sheet 2 of 4 Sheets).*

## TYPE MA-3 OR -4

**NOTE**

SAFETY BELT AND PARACHUTE LANYARD KEY MUST BE COMPATIBLE FOR COMPLETE AUTOMATIC OPERATION

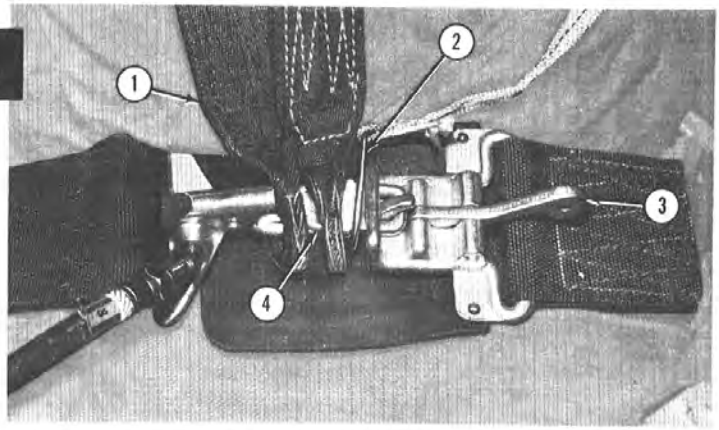



1. SHOULDER HARNESS
2. PARACHUTE LANYARD KEY
3. MANUAL RELEASE LEVER (LOCKED)
4. LATCH EXTENDED
5. PARACHUTE LANYARD KEY (RETAINED)
6. LATCH PIVOTED UP
7. PARACHUTE LANYARD KEY (EJECTED)
8. MANUAL RELEASE LEVER (RAISED)
9. LATCH RETRACTED

*Figure 1-47 (Sheet 3 of 4 Sheets).*

## TYPE MA-5 OR -6

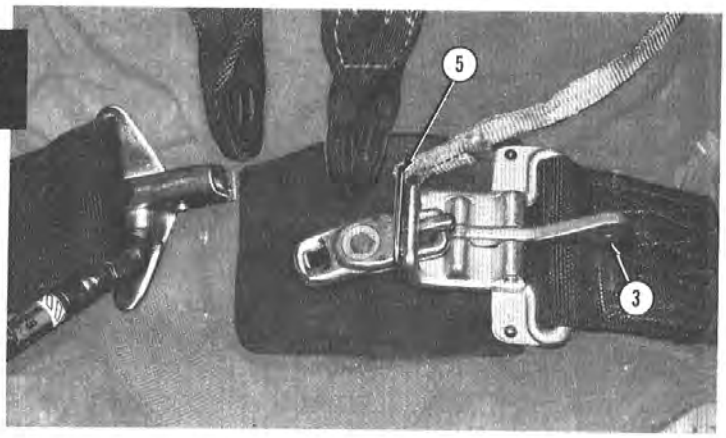
**LOCKED CONDITION**




**NOTE**

SAFETY BELT AND PARACHUTE LANYARD KEY MUST BE COMPATIBLE FOR COMPLETE AUTOMATIC OPERATION

**AUTOMATIC OPENING CONDITION**




**MANUAL OPENING CONDITION**

1. SHOULDER HARNESS
2. PARACHUTE LANYARD ANCHOR
3. MANUAL RELEASE LEVER (LOCKED)
4. SWIVEL LINK
5. PARACHUTE LANYARD ANCHOR (RETAINED)
6. MANUAL RELEASE LEVER (RAISED)
7. PARACHUTE LANYARD ANCHOR (RELEASED)

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*Figure 1-47. (Sheet 4 of 4 Sheets)*

and releasing the link. The release incorporates a key-type link which is attached to a lanyard leading to the automatic ripcord release and provides an anchor for the static line to the timer of the automatic parachute. The release is so designed that the belt cannot be locked until the key link is first inserted into its receptacle. This feature is incorporated in the design so that the crew member will not neglect to tie in the automatic parachute to the system. Use of the key link is necessary for proper operation of the automatic safety belt. If the automatic parachute is used, the key link attached to the parachute lanyard is inserted into the belt receptacle. If the automatic parachute is not used, a spare key link attached to the automatic belt is inserted into the belt receptacle. This spare link is attached to the safety belt by means of a short lanyard. At no time should this spare key link be removed. When the belt is manually opened the key link is ejected automatically so that inadvertent actuation of the automatic parachute will not occur. During automatic operation of the safety belt, the key link remains firmly locked in the belt release thereby causing actuation of the parachute ripcord release as the crew member separates from his ejected seat.

**Automatic Opening Safety Belt (Type MA-5 and MA-6)**

The MA-5 and MA-6 safety belts (figure 1-47) use a parachute lanyard anchor loop instead of a key to actuate the automatic opening parachute. The safety belt swivel link is inserted through the lanyard anchor loop anchoring the lanyard to the belt when the belt is opened automatically. The lanyard anchor loop need not be connected to the swivel link to enable closing the manual release lever; however, it must be connected to insure operation of the automatic parachute.

**WARNING**

Only the Type MB-3 or MB-4 shoulder harness shall be used since earlier types do not have loops large enough to fit over the connecting link of the belt.

**Shoulder Harness Inertia Reel Lock Handle**

A handle with LOCKED--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. 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 2 of 3 "g's" is encountered. When the reel is locked in this manner it remains locked until the handle is moved to 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. 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 co-pilot's right handgrip 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 Air Conditioning 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
Photographic Equipment
Single Point Ground Refueling System
Observer's Ejection Seat
Miscellaneous Equipment

## AIR PRESSURE 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 | 2137 | 2450 |
| 65 | 150 | 592 | 1180 | 1793 | 2094 | 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.

SERVICING

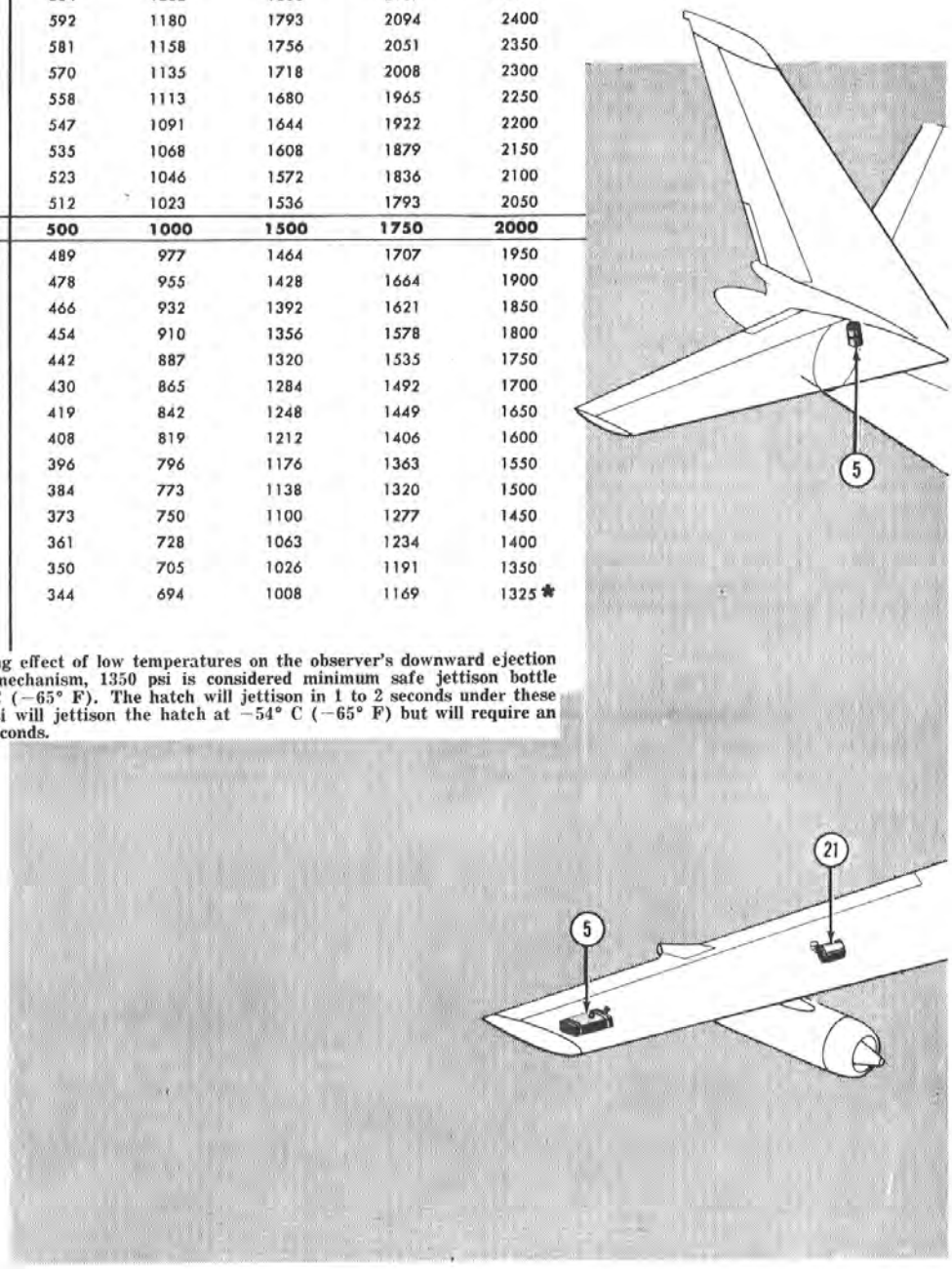


*Figure 1-48 (Sheet 1 of 3 Sheets)*

1. AFT MAIN TANK
2. BOMB BAY FUEL TANK
3. CENTER MAIN FUEL TANK
4. NO. 3 ENGINE OIL TANK
5. SURFACE POWER CONTROL FLUID RESERVE
6. NO. 1 ENGINE OIL TANK
7. FLAPERON ACCUMULATOR
8. NO. 2 ENGINE OIL TANK
9. EXTERNAL POWER RECEPTACLE
10. CANOPY EMERGENCY AIR BOTTLE
11. BAILOUT SPOILER AIR BOTTLE
12. DOWNWARD EJECTION HATCH AIR BOTTLE
13. BNS EXTERNAL POWER RECEPTACLE (1)
14. OXYGEN FILLER VALVE
15. FORWARD AUXILIARY FUEL TANK
16. FORWARD MAIN FUEL TANK
17. HYDRAULIC ACCUMULATORS
18. HYDRAULIC SYSTEM FLUID RESERVE
19. PNEUMATIC BOMB RELEASE STORAGE TANKS (1)
20. NO. 5 ENGINE OIL TANK
21. NO. 6 ENGINE OIL TANK
22. NO. 4 ENGINE OIL TANK
23. SINGLE POINT GROUND REFUELING RECEPTACLE
24. BATTERIES

CONTINUED NEXT PAGE

(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091.

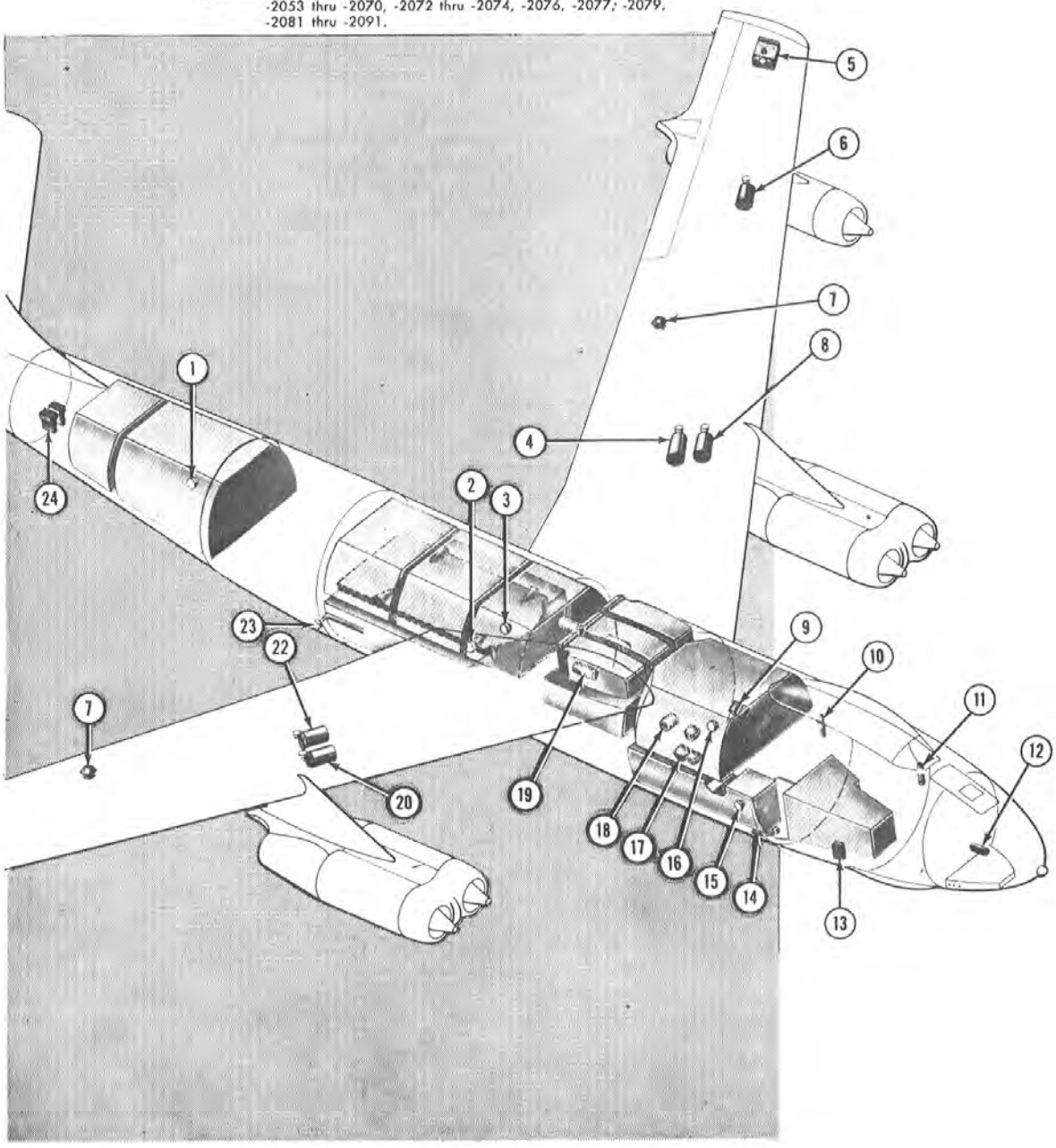


*Figure 1-48 (Sheet 2 of 3 Sheets)*

(CONTINUED)

# SERVICING

## SERVICING MATERIALS

| TO SERVICE | USE | SPECIFICATION | GRADE |
|---|---|---|---|
| All Fuel Tanks | Fuel | MIL-F-5624<br>MIL-F-5572 | JP-4 (Recommended)<br>Any (Alternate) |
| All Engine Oil Tanks | Oil | MIL-O-6081<br>MIL-O-6081 | 1010 (Recommended)<br>1005 (Alternate)<br>See Note I |
| Cabin Refrigeration Unit (Stratos) | Oil | MIL-L-15016A<br>-3042 | |
| Cabin Refrigeration Unit (Airesearch) | Oil | MIL-L-6085 | |
| Pneumatic Bomb Release Storage Tanks | Clean dry air at approximately 70° F | | |
| Surface Power Control Fluid Reservoirs | Hydraulic fluid | MIL-O-5606 | |
| Flaperon Accumulator | Clean dry air | | |
| Hydraulic Accumulators | Clean dry air | | |
| Hydraulic System Fluid Reservoirs | Hydraulic fluid | MIL-O-5606 | |
| Spoiler and Canopy Air Bottle | Clean dry air at approximately 70° F | | |
| Oxygen Filler Valve | Oxygen | BB-O-925, Type 1 | A |
| Batteries | Add distilled water to cover battery plates | | |

NOTE I - For temperatures below -20° C (-5° F), only specification MIL-O-6081A grade 1005 oil will be used.

049008

*Figure 1-48 (Sheet 3 of 3 Sheets)*

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# 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, and power settings for climb and cruise control. A mission flight plan (figure A9-3) is presented in the appendix to aid the pilot in cruise control. A Takeoff and Emergency Landing Data Card ("Takeoff and Initial Climb." this section. and figure A9-1) will be completed and used for every mission. For instructions on the use of the above forms. see part 9 of the appendix.

## WEIGHT AND BALANCE

Refer to Handbook Weight and Balance Data (T. O. 1 -1B-40) for detailed loading information. A basic index is calculated and entered on the "C" chart of T. O. 1-1B-40 when the airplane is weighed. Check the basic index to be sure the index formula of the load adjuster (stowed in pilot's data drawer) aboard the airplane corresponds with that of the "C" chart.

**NOTE**

Use of a load adjuster not designed for the index formula of the "C" chart could result in an error in center of gravity location of approximately 3% to 10% of MAC.

1. Check that required amounts of fuel and oil have been loaded.

**NOTE**

Refer to section VII for further information concerning ground refueling operations and typical Fuel Quantity Data Loading Chart.

2. Obtain the takeoff and anticipated landing gross weights and estimated cg locations.
3. Check weight and balance clearance, DD Form 365F, 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 the airplane cleared for flight by authorized maintenance personnel or a rated pilot serving as a crew member on the airplane concerned prior to takeoff.

- If airplane is parked so that a tailwind component in excess of 20 knots prevails, have airplane turned around prior to starting in order to avoid the possibility of excessive EGT.

- The following checklists are accomplished by the copilot calling off the items to the crew. All responses are shown in capital letters. For identification purposes those responses made by specific crew members are indicated as follows: (P) for pilot, (CP) for copilot, (O) for observer, and (GO) for ground observer.

## BEFORE INTERIOR INSPECTION

1. Briefing - COMPLETED (P)
   Pilot checks DD Form 781 for airplane status and discrepancies. Pertinent writeups will be brought to the attention of the flight crew. Pilot checks fuel loading data. Checks with crew chief that partially filled main tanks and auxiliary tanks have been dipsticked to verify fuel quantities. 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.

2. Equipment Check - COMPLETED (P)
   Pilot ensures 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 briefing.

3. External Power - OFF (P)
   Pilot ensures that proper external power unit is in place and fueled and that external power is off the airplane.

### ENTRANCE

Entrance into the airplane (figure 2-1) is made through a door in the lower left side of the fuselage just aft of the radome. A small stepladder may be needed to reach the entrance door handle and to release the entrance ladder.

# ENTRANCE TO THE AIRPLANE

A small stepladder may be needed to reach the entrance door latch handle.

1

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

2

Support ladder with left hand

Push up on ladder release knob with right hand. Lower one section at a time in sequence. Release knobs are numbered in the recommended sequence.

① ▶ Pull downward on ladder release knob located on lower outboard end of ladder. Sections will slide downward to extended position.

① ▶ AF 49-2642 thru 50-080; 51-2047, -2052, -2071, -2078, -2080.

3

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*Figure 2-1.*

## INTERIOR PREFLIGHT INSPECTION

1. Bailout Spoiler Air Bottle - CHECKED (P)
   Check spoiler air bottle pressure gage; should read temperature corrected pressure in figure 1-48 based on 2000 psi.

2. Main AC Power Shield - CHECKED, CIRCUIT BREAKERS IN (P)

3. First Aid Kit - CHECKED (P)
   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.

4. Aft Extra Seat Oxygen Panel - CHECKED & OFF (P)
   Place oxygen supply lever ON and check for minimum pressure reading of 400 psi. Return supply lever to OFF and bleed regulator; pressure should drop to, and remain at zero. Check diluter lever on 100% oxygen and check oxygen warning system switch OFF.

**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.

**NOTE**

Placing diluter lever to the 100% OXYGEN position prevents contamination of the oxygen regulator.

5. Fire Extinguisher - CHECKED (P)
   Check fire extinguisher pressure 150 psi minimum, stowed, secure, and seal intact.

6. Hand Axe - STOWED (P)

7. Forward Walkaround Bottle - CHECKED (P)
   Check walkaround bottle stowed in proper rack and secured. Check to ensure that the regulator is positioned to NORMAL, and that the recharging hose is disconnected and stowed. Test spring clothing clip. Bottle charged to minimum of 400 psi.

8. Forward Extra Seat Oxygen Panel - CHECKED & OFF (P)
   Place oxygen supply lever ON and check for minimum pressure reading of 400 psi. Return supply lever to OFF and bleed regulator; pressure should drop to, and remain at zero. Check diluter lever on 100% OXYGEN and check oxygen warning system switch OFF.

**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.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

Continued

**NOTE**

Placing diluter lever to 100% OXYGEN position prevents contamination of the oxygen regulator.

9. If a qualified observer is not flying:
   a. Observer's Escape Hatch - SECURED (P)
      Inspect observer's escape hatch in place and properly secured; emergency release handle LOCKED and safety wired.
   b. Periscopic Port - CLOSED (P)
   c. Observer's Ejection Seat
      (1) Initiators, Safety Pins & Streamer - CHECKED, PINS IN (P)
         Check all initiator sear pins; make sure that sear pin safety pin groove is not visible outside the initiator housing. Check that three safety pins are installed, one in each of the following initiators: depressurization door, downward ejection hatch, and automatic opening safety belt.
      (2) Leg Braces & Latch Triggers - CHECKED (P)
         Check each leg brace lock springs 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. Check leg retainers properly stowed. Make certain that no red is showing on retaining horn.
      (3) Torque Tubes - CHECKED (P)
         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.

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

**NOTE**

Check cotter key installed in drilled hole in each end of whiffletree.

      (5) Catapult Initiator & Safety Pin - CHECKED & INSTALLED (P)
         Check initiator sear pin; make sure that sear pin safety pin groove is not visible outside the initiator housing. Check that safety pin attached to the hatch static cable is properly installed in the catapult initiator.
      (6) Hatch Static Cable - ATTACHED (P)
         Check hatch static cable secured to the downward ejection hatch.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

(7) Quick-Disconnect - CHECKED (P)
Check proper installation of lanyard from hook to personal leads quick-disconnect mounting. Check quick-disconnect for proper connection.

(8) Downward Ejection Hatch - LOCKPIN ENGAGED, PRESSURE CHECKED (P)
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 temperature corrected pressure in figure 1-48 based on 2000 psi.

(9) Shoulder Harness & Inertia Reel - CHECKED (P)
Manually check shoulder harness and inertia reel for proper connection.

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

(11) Seat Position - FACING FORWARD (P)
Check seat locked in forward facing position.

① d. Radar Pressurizing Control Switch - OFF (P)

① e. Radar Power Control Switch - OFF (P)

① f. Radar Computer Function Switch - OFF (P)

① g. Three-Phase Inverter Switch - OFF (P)

h. Observer's Oxygen Panel - CHECKED & OFF (P)
Place oxygen supply lever ON and check for minimum pressure reading of 400 psi. Return supply lever to OFF and bleed regulator; pressure should drop to, and remain at zero. Check diluter lever on 100% OXYGEN and check oxygen warning system switch OFF.

**CAUTION**

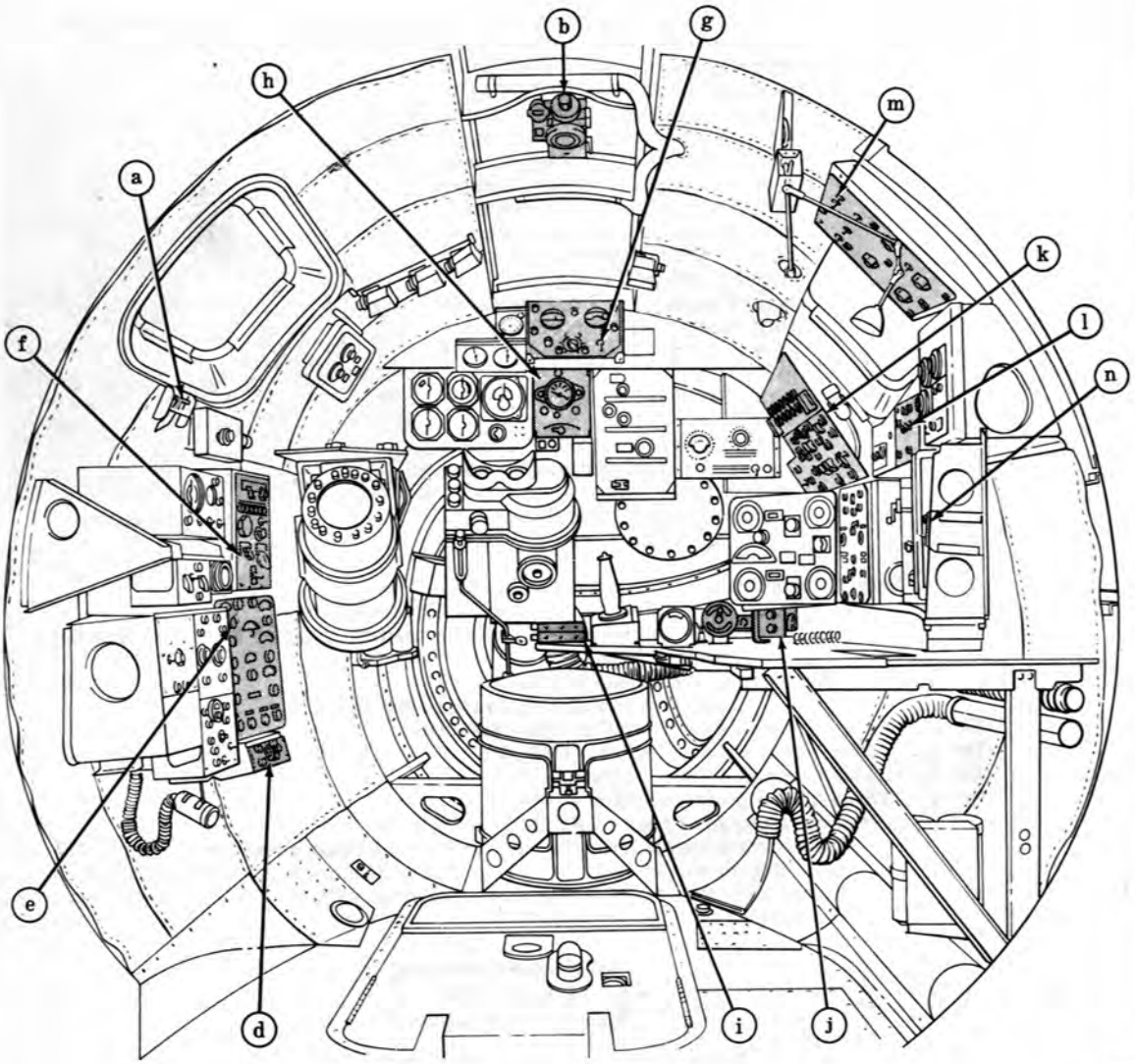
Due to the automatic pressure flow feature of the regulator, a continuous flow of oxygen will occur at high cabin altitude if the supply lever is left ON. This will cause a rapid loss of oxygen.

**Continued On Next Page**

① AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## INTERIOR PREFLIGHT INSPECTION

**Continued**

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## INTERIOR PREFLIGHT INSPECTION

Continued

**NOTE**

Placing diluter lever to 100% OXYGEN position prevents contamination of the oxygen regulator.

i. Observer's Upper Air Selector Lever - CLOSED & OFF (P)
① j. Bombsight Cover & Heat Switch - CLOSED & OFF (P)
① k. Salvo & Master Bomb Control Switches - OFF (P)
Check bomb control selector switch in NORMAL, salvo control switch OFF, and both switch guards closed. Master bomb control power and indicator light switches OFF.
① l. Camera Master Switch - ON (P) (if vertical camera installed)
① m. BNS (K4) Heat & Light Switches - OFF (P)
Check BNS (K4) heating and light control and nose defrost switches OFF.
n. Observer's Lower Air Heater Switch - OFF (P)
o. Circuit Breakers - IN (P)
Check circuit breakers pushed in on radar power panel.
p. Loose Equipment - SECURED (P)

10. Letdown Books & Facility Charts - CHECKED (CP)
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
- Handbook Weight and Balance Data, T.O. 1-1B-40.

11. UHF - SET & OFF (CP)
a. UHF master switch OFF.
b. Set local channel selector to indicate same channel number that appears in channel window.
c. Place transfer switch to LOCAL.

12. Aft Walkaround Bottle - CHECKED (CP)
Check walkaround bottle stowed in proper rack and secured. Check to ensure that the regulator is positioned to NORMAL and that the recharging hose is disconnected and stowed. Test spring clothing clip. Bottle charged to minimum of 400 psi.

13. Aft Extra Seat - CHECKED (CP)
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.

14. Canopy Emergency Jettison Air Bottle - CHECKED (CP)
Copilot checks canopy emergency jettison air bottle; gage should read temperature corrected pressure in figure 1-48 based on 2000 psi.

15. Loose Equipment - CHECKED (CP)
Check all equipment in area for security; loose equipment removed.

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① AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## INTERIOR PREFLIGHT INSPECTION

**Continued**

16. ARC-21 Antenna Coupler Insulator - CHECKED (CP)
    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.

17. Gunner's Air Outlet - SET (CP)
    Copilot pulls air selector knob to LOW FLOW and adjusts upper outlet vanes as desired.

18. Circuit Breakers - CHECKED (CP)
    Copilot checks all circuit breakers pushed in on upper, lower, and aft DC power panels.

19. Ejection Seats
    Pilot and copilot check their individual seats as follows:
    a. Left & Right Handgrips - FULL DOWN (P-CP)
    b. Copilot Ejection Footrests - STOWED (CP)
    c. Safety Pins - INSTALLED (P-CP)
       Check armrest window for safety pins (two) installed (one in rear initiator and one in forward initiator).
    d. Initiator Sear Pins - CHECKED (P-CP)
       Check all initiator sear pins; make sure the sear pin safety pin groove is not visible outside the initiator housing.
    e. Static Line Lanyard - CONNECTED (P-CP)
       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. Quick-Disconnect - CHECKED (P-CP)
       Check proper installation of lanyard from hook to personal leads quick-disconnect mounting. Check quick-disconnect for proper connection.
    g. Shoulder Harness & Inertia Reel - CHECKED (P-CP)
       Manually check shoulder harness and inertia reel for proper operation.

20. Top of Engines, Wings & Fuselage - CHECKED (P-CP)
    Pilot and copilot check engine nacelle latches flush and tops of wings and fuselage for loose panels, caps, and buckling.

21. Canopy, Windshield, Periscopic Port & Yaw String - CHECKED (P-CP)
    Pilot checks canopy and windshield for cracks, crazing, defects, or damage; windshield and canopy clean for good vision; latch reset horizontal; and yaw string installed. Copilot checks periscopic port CLOSED, canopy for cracks, crazing, defects or damage, and clean.

22. Emergency Turn & Slip - CHECKED & NORMAL (P-CP)
    Copilot places turn-and-slip power switch in EMERGENCY. Pilot and copilot check operation of turn-and-slip as evidenced by sound of electric motor within instrument. When pilot confirms, copilot returns power switch to NORMAL and closes switch guard.

**Continued On Next Page**

## INTERIOR PREFLIGHT INSPECTION

**Continued**

23. Emergency Keyer - OFF & SAFETIED (P)

24. Anti-Icing Overheat Control Switch - NORMAL (P)

25. Bomb Door Switch - OFF (P)

26. Approach Chute Deployment Switches - DOOR CLOSED (P-CP)

27. Landing Gear Lever - DOWN (P-CP)

28. Steering Ratio Selector - TOW DETENT (P)

29. Deleted.

30. Ignition Switches (six) - OFF (P)

① 31. Bomb Salvo Switch - OFF & SAFETIED (P)

32. Throttles - CUTOFF (P-CP)
Copilot checks all throttles (six) in CUTOFF. Pilot checks throttle lock lever OFF and all throttles (six) in CUTOFF.

33. Wing Flap Lever & Emergency Switches (two) - OFF (P-CP)
Copilot checks wing flap lever and wing flap emergency switches (two) OFF. Pilot checks wing flap lever OFF and in detent.

34. Emergency Landing Gear Retraction Switches - OFF (P-CP)
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.

35. Canopy Lever - OFF (P)

36. Battery Switch - ON (P) - CHECKED (CP)
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 R BUS, FWD BUS, and L BUS and reads voltage at each position to pilot. Minimum acceptable voltage reading is 18 volts.

37. DC Bus Selector - CHECKED, NORMAL (CP)
    a. Copilot checks bus selector switch in NORMAL.
    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."

**Continued On Next Page**

①▶AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## INTERIOR PREFLIGHT INSPECTION

**Continued**

**NOTE**

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

38. Battery Switch - OFF (P)

39. Alarm Bell - CHECKED & OFF (P-CP-O)
Pilot places emergency alarm bell switch ON; when copilot and observer report "OK," pilot returns switch to OFF and closes switch guard. Crew chief will use this signal to connect external DC power.

40. External Power - ON THE LINE (CP)
Copilot checks that external power is on the line and has proper voltage.

41. Oxygen & Interphone - CREW REPORTS
Pilot turns master oxygen warning control switch ON. All crew members accomplish the following oxygen check.
    a. Check that oxygen supply shutoff lever is in OFF. Bleed pressure from regulator by depressing emergency toggle lever; pressure should drop to zero. Release emergency toggle lever; pressure should remain at zero.
    b. Position oxygen supply shutoff lever ON and check that system pressure is 400 to 450 psi.
    c. Place warning system switch ON; oxygen warning light at that station will come on bright (steady or blinking). (Extra crew members warning light system is inoperative.)
    d. Place diluter lever to NORMAL OXYGEN first and then to 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 (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, block regulator hose tightly with the hand; blinker should indicate no flow and warning light at that station should go dim, then return to 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. 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. Return emergency toggle lever to center position; positive pressure should cease.
    j. Return diluter lever to NORMAL OXYGEN.
    k. Report over interphone, "Oxygen check complete,_____psi, warning switch ON."

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

42. All Lights & Press-to-Test Lights - CHECKED (P-CP)
    Pilot and copilot make the following checks where applicable:
    - Floodlights - Test cabin floodlights on both RED and WHITE.
    - Instrument Lights, Panel Lights & Side Panel Lights - Test and inspect for bulbs not lighting.
    - Compass Light - Test compass light on BRIGHT and DIM.
    - Landing Lights - Test individually
    - Position Lights - Test and verify lighting with ground observer.
    - Wing Illumination Lights - Copilot tests and verifies 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 pressing test switch.
    - Press-to-Test Lights - Test all press-to-test lights and set for bright or dim as desired.

43. Inverters - CHECKED & ON (P-CP)
    Pilot checks instrument inverters in the following manner:
    a. With main and spare instrument inverters OFF, red warning light marked "Bus Power Off" should be on.
    b. Places instrument inverter switch on SPARE; red light should go out and amber light marked "Spare Inverter On Bus" should come on. (Leave on spare approximately 15 seconds.)
    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, secondary, and spare inverter power switches to ON.
    c. Moves inverter transfer control switch to NORMAL.
    d. Checks all inverter indicator lights out.
    e. Checks main and secondary bus voltmeter readings between 110 and 120 volts.
    f. Moves inverter transfer control switch through all positions. Checks spare inverter voltage between 110 and 120 volts when in the "Spare Inverter Main Bus" and "Spare Inverter Secondary Bus" positions. Checks inverter indicator lights operating.

44. Fuel System & Panel - CHECKED (P-CP)
    Pilot and copilot make the following fuel system and panel checks:

**NOTE**

Any boost pump found inoperative on main or auxiliary tanks will be corrected prior to flight.

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

**NOTE**

If any lights are out, check the bulb by "Press to Test." If the bulbs check satisfactorily, use the following procedure:
a. Depress any fire shutoff switch and open corresponding throttle to relieve pressure.
b. Place throttle in CUTOFF and pull fire shutoff switch.
c. If warning lights still remain out, have the system checked for malfunction.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

Copilot checks all red fuel selector switch indicator lights (six) on.

b. Pilot places all fuel selector switches on TME; all fuel boost pressure warning lights (twelve) should go out. Copilot checks all red fuel selector switch position indicator lights (six) are out and all amber fuel selector switch position indicator lights (six) on.
c. Pilot places all fuel selector switches on TE. Copilot checks all fuel selector switch position indicator lights (twelve) are out.
d. Pilot checks that all fuel transfer valve switches are CLOSED, all auxiliary tank boost pump switches are OFF, and auxiliary-fuel-to-engines switch CLOSED.
e. Pilot turns on bomb bay boost pump switch; the no-flow lights should come on momentarily and go out, then back on steady when the system is pressurized. Turns switch OFF.
f. Pilot turns on forward auxiliary boost pump switch; the no-flow lights should come on momentarily and go out, then back on steady when the system is pressurized.
g. Pilot places forward main transfer switch to VALVE OPEN; the no-flow warning lights should go out indicating flow of fuel into the forward main tank. Pilot returns transfer switch to CLOSED; the no-flow warning lights should again illuminate indicating transfer valve is closed and no flow of fuel exists.

**NOTE**

When any or all main tanks are fully serviced, it may not be possible to get an indication of fuel flow to a specific main tank due to the primary and/or secondary float valve action.

h. Pilot makes the same check on center main and aft main tank transfer valves.
i. Pilot turns forward auxiliary boost pump switch OFF.
j. Pilot tests each fuel quantity gage by pushing the test button adjacent to each gage; indicator should start toward zero. Pilot releases the test button and indicator should return to its former position if circuit is satisfactory.
k. Pilot places master refuel switch to REFUEL. Copilot tests each fuel quantity gage in the same manner as the pilot and reads off the quantities in each tank, including auxiliary tanks. Pilot cross-checks these readings with the quantities indicated on his panel and the quantities serviced by the ground crew and noted in part 2 of DD Form 781.

**NOTE**

The maximum allowable tolerance between the pilot's and copilot's fuel gages is 2% of the highest quantity marking on the gages involved. Therefore, the maximum allowable tolerances for the individual gages are as follows:

- Forward main - 420 pounds
- Center main - 400 pounds
- Aft main - 490 pounds
- Bomb bay - 460 pounds

The normal distribution for a 10,000 gallon fuel load is as follows:

- Forward auxiliary - 1000 gallons equals 6,500 pounds
- Forward main - 2830 gallons equals 18,395 pounds
- Center main - 2830 gallons equals 18,395 pounds
- Aft main - 3340 gallons equals 21,710 pounds

If the quantity in any tank varies more than 1500 pounds from normal, the tank should be checked and corrective action taken as required.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

l. Copilot checks refueling valve switches in VALVE CLOSED and records fuel quantities.
m. Pilot places master refuel switch to NORMAL.

45. Hydraulic System - CHECKED & ON (CP)
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, temperature corrected pressure in figure 1-48 based on 1500 psi.
b. Emergency system, temperature corrected pressure in figure 1-48 based on 1500 psi.
c. Emergency brake system, temperature corrected pressure in figure 1-48 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 (±0.5) 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**

- If the emergency system or the emergency brake system will not bleed down when attempting to check preload pressures, check that all alternate bomb door switches are OFF. Any alternate bomb door switch in the OPEN position will cause the emergency hydraulic pump to operate.
- 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.

46. Radios - ON (P-CP)
Pilot and copilot turn on all radios for warmup.

47. Control Column - ENGAGED (P-CP)
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.

**CAUTION**

Do not force the disconnect handle down since damage to the elevator disconnect rod assembly may occur; however, a slight push force may be necessary to complete engagement.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

c. Pilot checks that surface flight controls and flap areas are clear of stands and/or other obstructions prior to unlocking controls.

48. Surface Control Lock - FORWARD, UNLOCK DETENT (P)
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.

49. Power Controls - ON, LIGHTS CHECKED (P)
Pilot places all surface power control switches (three) in ON; all red "No Pressure" warning lights should go out and amber aileron "Emergency Pump On" lights should illuminate.

50. Automatic Pilot - CHECKED & OFF (P)
Pilot makes the following check:
a. Extends the automatic pilot controller, then checks automatic approach switch in AUTOMATIC PILOT, turn knob in detent, altitude control to OFF, and turn control transfer switch to PILOT MANUAL.
b. Centers the trim tabs and flight controls, places automatic pilot master switch ON, then places all three engaging switches to ENGAGE.
c. Rotates 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. Rotates 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. Returns the pitch knob to neutral; the control column and elevator trim tab wheel should center.
d. Rotates turn knob to the left; the control wheel should rotate counterclockwise as the left rudder travels forward. When the aileron limit switch is contacted, the automatic pilot disengages. Centers the rudder pedals, engages automatic pilot, and repeats check with right turn.
e. Engages automatic pilot and has copilot push his release button. Reengages automatic pilot and checks the release button on the pilot's wheel.
f. Checks all switches OFF and stows automatic pilot controller.

51. Wing Flaps - FULL DOWN (P-CP)
Pilot and copilot check wing flap position indicators for flaps full down.

**Continued On Next Page**

## INTERIOR PREFLIGHT INSPECTION

**Continued**

52. Trim Tabs - CHECKED (P-GO)
Pilot calls, "Ground from pilot, 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<br>Right Aileron Tab Up |
| Aileron Trim Full Right | Left Aileron Tab Up<br>Right Aileron Tab Down |
| Aileron Trim Zero | Both Aileron Tabs Slightly Up in Approximately Same Position |
| Rudder Trim Full Left<br>Rudder Trim Full Right<br>Rudder Trim Zero | Rudder Tab Right<br>Rudder Tab Left<br>Rudder Tab Approximately Neutral |
| Elevator Trim Full Down<br>Elevator Trim Full Up<br>Elevator Trim Zero | Right Elevator Tab Up<br>Right Elevator Tab Down<br>Right Elevator Tab Approximately 3° to 6° Up |

**NOTE**

Left elevator tab is fixed in the faired trail position and should not move.

b. Copilot checks trim indicators on zero.

53. Directional Damper Switch - ON (P)

54. Flight Control Operation - CHECKED, POWER ON & OFF (P-GO)
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:

**NOTE**

Since the directional damper is on during the control check, any malfunction of the equipment will be apparent to the ground observer. A hard-over signal will displace the rudder approximately 5° from neutral while the rudder pedals are being held in neutral. Any deviation of the rudder from neutral with the pedals in neutral indicates a possible directional damper malfunction. A malfunction of the directional damper can be verified if the rudder returns to neutral with the pedals in neutral when the directional damper switch is placed in the OFF position.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

**NOTE**

Flight controls may be displaced simultaneously.

| COCKPIT CONTROL POSITION | SURFACE POSITIONS |
|---|---|
| Control Wheel Full Left | Left Aileron Up<br>Left Trim Tab Down<br>Left Flaperon Spilled<br>Right Aileron Down<br>Right Trim Tab Up<br>Right Flaperon in Flap Position |
| Control Wheel Full Right | Left Aileron Down<br>Left Trim Tab Up<br>Left Flaperon in Flap Position<br>Right Aileron Up<br>Right Trim Tab Down<br>Right Flaperon Spilled |
| Left Pedal Fully Depressed | Rudder Left<br>Trim Tab Right |
| Right Pedal Fully Depressed | Rudder Right<br>Trim Tab Left |
| Column Full Forward | Elevator Down<br>Left Trim Tab Neutral<br>Right Trim Tab Up |
| Column Full Back | Elevator Up<br>Left Trim Tab Neutral<br>Right Trim Tab Up |
| Wheel, Column & Pedals Neutral | All Surfaces Neutral<br>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 the 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 step "a" above.

55. Directional Damper Switch - OFF (P)

56. Lock Flight Controls - LOCKED, STOWED (P) - STOWED (CP)
Pilot places surface lock lever in LOCK, then neutralizes and moves ailerons and rudder until lock falls into place, and moves control column forward until elevator locks. Pilot and copilot disengage and stow control columns.

57. Deleted.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

58. Instruments - CHECKED (P-CP)
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.

**NOTE**

If headings are off, it may be necessary to synchronize the N-1 compass master indicator located in the observer's compartment in the following manner:
a. Rotate the latitude correction knob counterclockwise until the latitude correction pointer indicates OFF.
b. Engage the synchronizer control knob and rotate it in the direction indicated by the annunicator 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.

e. Fuel flowmeters, oil pressure, and tachometers all reading zero.
f. Vertical velocity, airspeed, Machmeter, and turn-and-slip indicators showing proper static conditions.
g. EGT, altimeters, free air temperature gage, cabin temperature gage, and cabin pressure altitude gage readings correspond approximately with current station pressure and temperature.

59. Fire Warning & Overheat Lights - TESTED (P)
Pilot moves engine fire warning test switch for engines No. 1, 2, and 3 to TEST; fire warning lights for engines No. 1, 2, and 3 should glow if circuits are OK. Moves test switch for engines No. 4, 5, and 6 to TEST; warning lights for engines No. 4, 5, and 6 should glow if circuits are OK. Moves wing and empennage overheat test switches to 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.

60. Radios - CHECKED, OFF (P-CP)
a. Deleted.
b. Pilot and copilot set interphone selectors on MIX SIG AND COMMAND and "Inter," "Comp," and "Localiz" mixer toggles in forward position.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

c. Pilot and copilot perform radio compass check:
   (1) Pilot places radio compass light switch in HI or LO.
   (2) Pilot places function switch to COMP, ANT, or LOOP to determine whether he has control and, if frequency dial and tuning meter are not illuminated, switches function switch momentarily to CONT to gain control of the radio compass at his panel.
   (3) Pilot switches function switch to ANT, then tunes and identifies station.
   (4) Pilot switches to CW, checks for carrier tone, and returns switch to VOICE.
   (5) Pilot selects LOOP and rotates ID-250 No. 1 needle right and left. (Copilot checks that his ID-250 No. 1 needle slaves with pilot's.)
   (6) Pilot selects COMP and checks that ID-250 No. 1 needle points toward station. (Copilot checks that his ID-250 No. 1 needle slaves with pilot's.)
   (7) Pilot places function switch to OFF.
   (8) Copilot actuates his function switch momentarily to CONT and repeats the above steps (3) through (7) from his radio panel with the pilot checking that his ID-250 No. 1 needle slaves with copilot's.

d. Pilot and copilot perform omni-receiver (VOR) indicator check:
   (1) Pilot selects and identifies station.
   (2) Pilot and copilot each check that OFF flag disappears from lower part of their respective ID-249 course indicators (glide slope flags will still indicate OFF).
   (3) Pilot and copilot each check that the No. 2 needle of their respective ID-250 RMI points to appropriate bearing.
   (4) Pilot actuates ID-249 course selector transfer switch as necessary to light his ID-249 course selector indicator light.
   (5) Pilot rotates his course "set" knob until his vertical bar is centered and TO or FROM tab appears in window of his ID-249 indicator. Copilot's vertical bar slaves to center with pilot's and same flag appears in his TO or FROM window. Pilot cross-checks ID-250 No. 2 needle indication with ID-249 course window indication.
   (6) Copilot actuates his ID-249 course selector transfer switch to light the ID-249 course selector indicator light on his instrument panel.
   (7) Copilot rotates his course "set" knob to center his ID-249 vertical bar and obtain the same TO or FROM indication obtained in step (5). Pilot's ID-249 vertical bar slaves to movements of the copilot's and same TO or FROM is indicated as in step (5). Copilot cross-checks his ID-250 No. 2 needle indication with his ID-249 course window indication.
   (8) Pilot places the omni power switch to 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.
   (3) Places transfer switch to REMOTE.

61. Inverters - OFF (P) - AS REQUIRED (CP)
Pilot turns off instrument inverter. Copilot turns off inverters unless a BNS external power cart is not connected and the inverters are needed for the radar BNS preflight on airplanes having BNS capabilities.

62. ELGE System - CHECKED (CP)
Copilot checks ELGE ratchet handles stowed full aft on the stand. Checks lights set dim or bright as required. Tests red press-to-test light.

Continued On Next Page

## INTERIOR PREFLIGHT INSPECTION

**Continued**

63. Crawlway - CLEAR (CP)
    Copilot checks that there is no loose equipment in crawlway area.

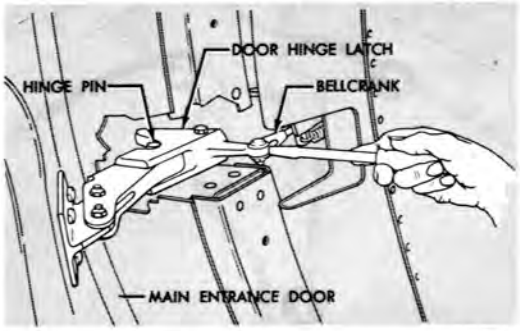
① 64. Refrigeration Unit Oil Level - CHECKED (CP)
    Copilot checks oil level in refrigeration unit; oil level should be between index marks on sight gage.

65. Left Forward Main Fuel Boost Pump - CHECKED (CP)
    Copilot checks fuel boost pump and fuel lines for leaks; no burnt wiring in the area.

66. Service Valves - SAFETIED OFF (CP)

67. Bulkhead & Crawlway Doors - CLOSED (CP)

68. Main Entry Door Release Mechanism - LOCKED (CP)
    Copilot checks main entry door release mechanism for positive locking position. Reach through skin cutouts and apply sufficient pressure to bellcrank to make sure the hinge latches have completed their full forward travel and are fully engaged with the hinge pins.




① Some airplanes

## EXTERIOR INSPECTION

Upon completion of the Interior Preflight Inspection, the Exterior Inspection may be accomplished by either of two methods. The Exterior Inspection is normally accomplished by the copilot calling off the items to the pilot, and the pilot with aid of the crew chief perform the visual Exterior Inspection as shown on figure 2-3. However, in order to expedite completion of the Exterior Inspection, the pilot may, at his discretion, split the Exterior Inspection. If the split method is used, the inspection of the right side of the airplane will be accomplished by the pilot while the copilot is inspecting the left side of the airplane. The pilot and copilot will meet at the empennage section. The checklist items will be called off by qualified ground crew members or other flight crew members during completion of the Exterior Inspection.

# EXTERIOR INSPECTION

**NOTE**

A FUEL DRAIN LEAKAGE METALCAL, LOCATED ON THE LEFT DOOR OF THE FORWARD WHEEL WELL, AIDS IN LOCATING THE POSSIBLE SOURCE OF FUEL LEAKAGE APPEARING AT ANY DRAIN HOLE. THE "D" NUMBERS APPEARING ON THE METALCAL ARE IDENTICAL TO THE DRAIN HOLE NUMBERS STENCILED ON THE AIRPLANE. REFERENCE SHOULD BE MADE FROM AIRPLANE TO METALCAL, NOT FROM METALCAL TO AIRPLANE SINCE METALCALS OFTEN LIST "D" NUMBERS NOT APPLICABLE TO THE PARTICULAR MODEL OF B-47 INVOLVED.

**NOTE**

THE ONLY PERMISSIBLE FUEL LEAKS ARE AT THE SEAL DRAINS OF THE BOOST PUMPS. PILOT WILL CHECK WITH AIRCRAFT CREW CHIEF THAT BOOST PUMP DRAINS ARE WITHIN FUEL LEAKAGE LIMITS OF APPROXIMATELY FOUR DROPS IN 6 MINUTES. ANY AMOUNT OF FUEL LEAKAGE AT THE MOTOR VENT PORT IS NOT PERMISSIBLE (SHOULD BE DRY).

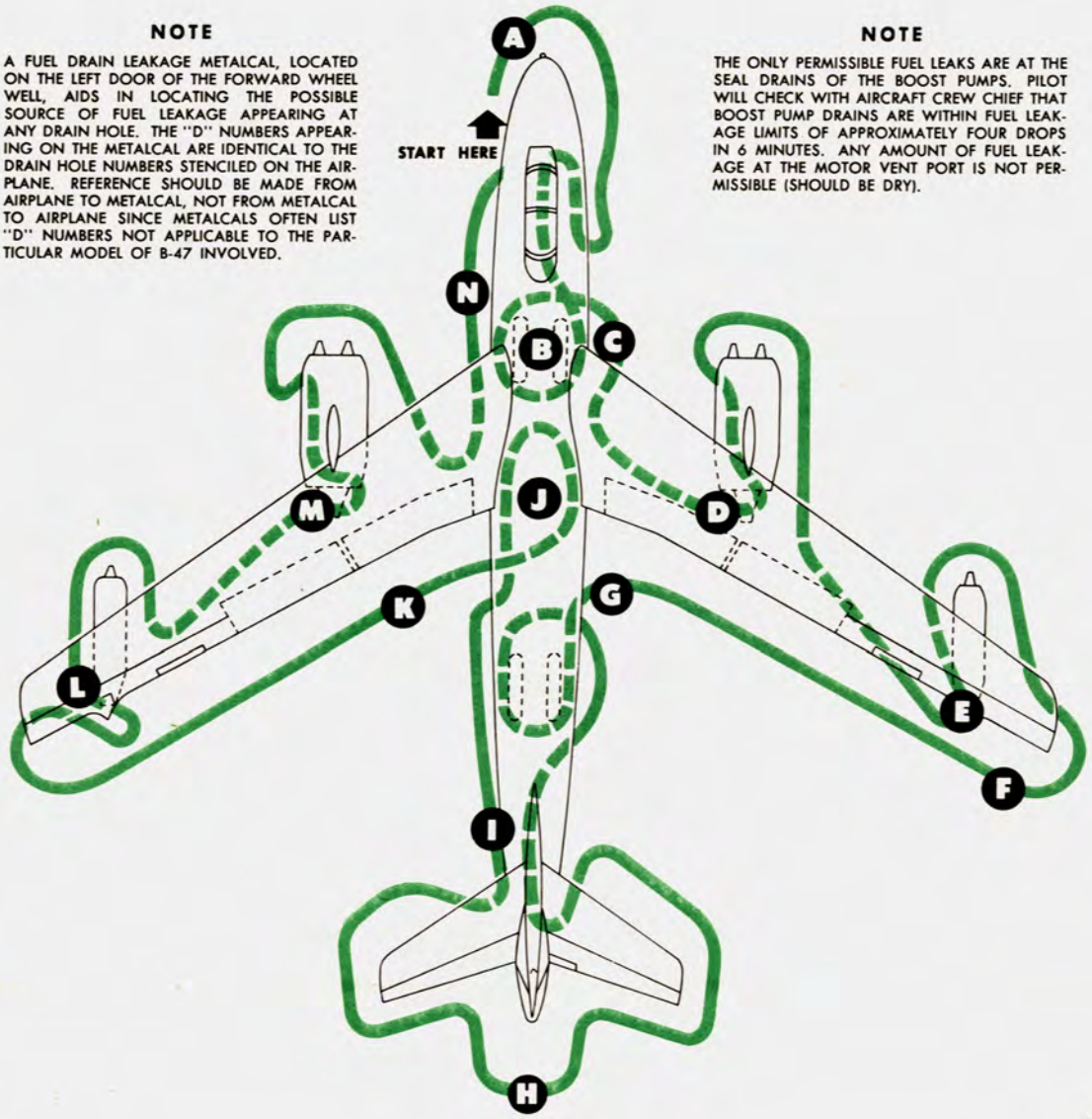



*Figure 2-2.*

## A NOSE SECTION

1. External DC Power - AS REQUIRED (P)
2. Left Pitot Cover - REMOVED (P)

CONTINUED NEXT PAGE

## A NOSE SECTION Continued

3. Nose Window & Bombsight - CLEAN & UNBROKEN (P)
   Check nose window and bombsight protuberance clear, clean, and undamaged. On airplanes having retractable bombsight cover, check that it is fully closed.

4. Cabin Air Emergency Depressurization Door - FLUSH (P)

5. Right Pitot Cover - REMOVED (P)

6. Right Forward Side of Nose Section - CHECKED (P)
   Check access doors latched flush and fuel tank caps flush. If fuel tank caps have handles, the handles should be vertical and folded aft, no leaks around fuel caps, and check bolts installed on electrical access compartment door.

7. Static Ports - CLEAR (P)

8. Observer's Downward Ejection Hatch - FLUSH, HANDLE STOWED (P)

9. Radome - FLUSH & LATCHED (P)
   Check radome flanges flush and locking screw perpendicular to latch handle.

10. Forward Auxiliary Boost Pumps - CHECKED (P)
    Check for fuel leaks around seals, elbows, and drains (leaks are permissible only at the seal drains). Check for scorched areas. Check access doors closed and secure.

## B FORWARD WHEEL WELL

1. Wheel Chocks & Landing Gear Ground Lock - IN PLACE (P)
   Check gear ground lock in place with red streamer visible. Hand check microswitch striker for security and microswitches making contact.

2. Bomb Bay Door Ground Locks - IN PLACE (P)
   Check bomb bay door ground locks in place with red streamers visible; actuating cylinder pins locked.

3. Right Door, Roller & Actuator - CHECKED (P)
   Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play. Check buffet brake for security.

4. Right Wheel, Tire, Brakes & Antiskid Cover - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and tire for proper inflation.
   c. Brakes - clearance between wheel and brake blocks is 0.002 inch minimum to 0.025 inch maximum measured on lower side of drum.
   d. Antiskid - hand check mechanism and cover secure and safetied.

5. Brake Lines & Gear Squat Switches - CHECKED (P)
   Hand check brake lines for connection, no leaks, and no breaks. Hand check squat switches clean and secure.

Continued On Next Page

B **FORWARD WHEEL WELL Continued**

6. Left Wheel, Tire, Brakes & Antiskid Cover - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and tire for proper inflation.
   c. Brakes - clearance between wheel and brake blocks is 0.002 inch minimum to 0.025 inch maximum measured on lower side of drum.
   d. Antiskid - hand check mechanism and cover secure and safetied.

7. Oleo Strut - PROPER EXTENSION, NO LEAKS (P)
   Check strut for seal leaks and proper extension. Check with crew chief to ensure that struts are properly serviced for the particular gross weight configuration. Approximate dimensions for pilot information are as follows: For "soft strut" servicing regardless of weight, 3 1/4 (±1/2) inches of the shiny part of the piston should be visually exposed. For "hard strut" servicing up to and including 200,000 pounds gross weight, 4 3/4 (±1.4) inches should be exposed.

**NOTE**

When forward strut is flat, the shiny part of the piston will be exposed 2 1/2 inches.

8. Spoiler Door Gage - CHECKED (P)
   Check bomb bay spoiler accumulator charged to temperature corrected preload in figure 1-48 based on 1000 psi, or 1000 to 3000 psi if accumulator has not been bled.

**NOTE**

If the accumulator has been depressurized, the hydraulic quantity will be increased in the reservoir up to 0.7 gallons.

9. Steering Mechanism - CHECKED (P)
   Move the steering bar momentarily right and left. Check that the spring returns the bar to center.

**WARNING**

Do not hold the bar over since the steering system will actuate, causing possible injury to personnel in wheel well area.

10. Hydraulic System - CAP SECURE, NO LEAKS (P)
    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. Relieve pressure prior to lifting up on cap.
    b. Main reservoir fluid level should read within half a gallon of the cockpit reading.
    c. Emergency reservoir fluid covering sight gage completely.
    d. Check hydraulic lines, fittings, and lower wheel well for leaks and fluid accumulations.

11. Fuel Lines - CONDITION CHECKED (P)

12. Left & Right Power Shield Covers - SECURE & LATCHED (P)

13. Right Forward Main Boost Pump - CHECKED (P)
    Open access door in upper right panel of wheel well. Check for fuel leaks around seals and elbows. Check for scorched areas. Check access door closed and secure.

Continued On Next Page

## B FORWARD WHEEL WELL Continued

14. Forward Power Shield Covers (three) - SECURE & LATCHED (P)

15. ELGE Cables, Gear Motors & Cannon Plugs - CHECKED (P)
    Hand check motors bolted securely, cannon plugs and ground wires fastened, and cannon plugs safetied to receptacles. Check ELGE cables.

16. Left Door, Actuator & Roller - CHECKED (P)
    Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play. Check buffet brake for security.

17. Gear Door Uplatches - UNLATCHED (P)
    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 (P)
   Check forward right side of fuselage for dents, cracks, and buckling. Check fuel drains for leaks (leaks are permissible only at the seal drains).

2. Wing & Strut Access Panels - SECURE, NO LEAKS (P)

## D INBOARD NACELLE

1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED (P)
   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 (P)
   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 (P)
   Check for at least 4 inches strut extension. Check for fluid seepage and leaks around cylinder seal.

Continued On Next Page

## D INBOARD NACELLE Continued

4. Wheel & Tire - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and tire for proper inflation.

5. Ground Lock - IN PLACE (P)
   Check outrigger gear ground lock in place with red streamer visible.

6. Outrigger Doors & Actuators - CHECKED (P)
   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 (eight) & Locks (four) - SECURE (P)

8. Left Nacelle Panels - SECURE, NO LEAKS (P)
   Check fore and aft edges of panels flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check upper hooks secure and flush with skin. Check entire bottom surface of nacelle for fluid leaks.

9. Air Intakes & Accessory Domes - CHECKED, SECURE (P)
   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, or damage. Hand check dome latches fastened and secure. Exert pressure on domes to test security. Check top of engines for latches secure.

10. Right Nacelle Panels - SECURE, NO LEAKS (P)
    Check fore and aft edges of panels flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check upper hooks secure and flush with skin. Check entire bottom surface of nacelle for fluid leaks.

11. Wing & Strut Access Panels - SECURE, NO LEAKS (P)

## E OUTBOARD NACELLE

1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS (P)
   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 (P)
   Check hooks seated, latches fastened, and edges of panels flush. Check entire bottom surface of nacelle for fluid leaks and any possible damage.

3. Air Intake & Accessory Dome - CHECKED, SECURE (P)
   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, or damage. Hand check dome latch fastened and secure. Exert pressure on dome to test security.

4. Right Nacelle Panels - SECURE (P)
   Check hooks seated, latches fastened, and edges of panels flush.

## F RIGHT WING

1. Aileron Power Control Unit - CHECKED (P)
   Check circuit breakers in. Check fluid level; if low, have reserviced. Reservoir cap pointers aligned with dot. Lift up on cap to check security. Relieve pressure prior to lifting up on cap. Check reservoir and lines for leaks.

2. Wing Access Panels - SECURE, NO LEAKS (P)

3. Top of Wing - CHECKED (P)
   Check oil tank caps installed and flush with wing. Check for bent or missing vortex generators.

4. Aileron & Trim Tab - CHECKED (P)
   Check condition of aileron skin and trailing edge. With aileron in center position, note position of the trim tab to ensure that the tab on the opposite wing is in approximately the same position.

5. Fuel Tank Caps - CHECKED, NO LEAKS (P)
   Check fuel tank caps flush with airplane and no leakage around caps. If fuel tank caps have handles, the handles should be vertical and folded aft.

6. Wing Trailing Edge - CHECKED (P)
   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. The maximum allowable internal leakage tolerance is a 500-pound drop within 5 minutes. However, pressure should not be lower than the temperature corrected accumulator preload pressure in figure 1-48 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.

## G AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS

1. Right Aft Boost Pump, Center Main Tank - CHECKED (P)
   Check for fuel leaks around seals, elbows, and drains (leaks are permissible only at the seal drain). Check for scorched areas. Check access door closed and secure.

2. Right Fuselage - CHECKED (P)
   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. Single Point Refueling Cap - SECURE (P)
   Hand check single point refueling cap flush and secure.

Continued On Next Page

## G AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS Continued

4. Wheel Chocks & Landing Gear Ground Lock - IN PLACE (P)
   Check gear ground lock in place with red streamer visible. Hand check microswitch striker for security and microswitches making contact.

5. Right Door, Roller & Actuator - CHECKED (P)
   Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play.

6. Right Wheel, Tire, Brake & Antiskid Cover - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and the tire for proper inflation.
   c. Brakes - clearance between wheel and brake blocks is 0.002 inch minimum to 0.025 inch maximum measured on lower side of drum.
   d. Antiskid - hand check mechanism secure and safetied.

7. Brake Lines & Gear Squat Switch - CHECKED (P)
   Hand check brake lines for connection, no leaks, and no breaks. Hand check squat switch clean and secure.

8. Left Wheel, Tire, Brake & Antiskid Cover - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and tire for proper inflation.
   c. Brakes - clearance between wheel and brake blocks is 0.002 inch minimum to 0.025 inch maximum measured on lower side of drum.
   d. Antiskid - hand check mechanism secure and safetied.

9. Oleo Strut - PROPER EXTENSION, NO LEAKS (P)
   Check strut for seal leaks and proper extension. Check with crew chief to ensure that struts are properly serviced for the particular gross weight configuration. Approximate dimensions for pilot information are as follows: For "soft strut" servicing regardless of weight, 1.0 (±1/2) inch of the shiny part of the piston should be visually exposed. For "hard strut" servicing up to and including 200,000 pounds gross weight, 2 1/4 (±1/4) inches should be exposed.

**NOTE**

When rear strut is flat, the shiny part of the piston will be exposed 0.06 inch.

10. Hydraulic Lines, Fuel Lines & Shutoff Valves - NO LEAKS (P)
    Check all hydraulic lines, fuel lines, fittings, and shutoff valves for leaks. Check for pooling of fluid in wheel well.

11. Left Door, Actuator & Roller - CHECKED (P)
    Hand check roller free and bracket secure. Hand check actuator rod and door secure with no excess play.

12. Aft Power Shield Covers - SECURE, CIRCUIT BREAKERS IN (P)
    Check aft power shield circuit breakers in unless "tagged." Hand check shield covers secure and fasteners latched.

Continued On Next Page

## G AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS Continued

13. ELGE Cables, Gear Motors & Cannon Plugs - CHECKED (P)
Hand check motors bolted securely, cannon plugs and ground wires fastened, and cannon plugs safetied to receptacles. Check ELGE cables.

14. Gear Door Uplatches - UNLATCHED (P)
Check gear door uplatches unlatched (latches deflected slightly downward and link arms forming a "V").

15. Aft Main Boost Pumps (four) - CHECKED (P)
Check for fuel leaks around seals, elbows, and drain (leaks are permissible only at the seal drains). Check for scorched areas. Check access doors closed and secure.

16. Camera Compartment - CHECKED (P)
Open camera compartment door. Check for any fumes. Check camera secure (if installed). Check any loose equipment stowed. Check all cables for security and close and lock doors.

17. Battery Compartment - CHECKED (P)
Open battery compartment and hand check security of radio equipment, battery cover, and cover on tail compartment power shield. Reset the "AN/APX-6 Detonator" circuit breaker. Check air control valve for hydraulic leaks. Check compartment door closed and flush.

18. Rudder-Elevator Power Control - CHECKED (P)
Fluid level visible in sight gage. If not visible, have reserviced. Reservoir cap pointer aligned with dot. Lift up on cap to check security. Relieve pressure prior to lifting up on cap. Check complete power unit and lines for evidence of leaks.

19. Brake Chute - MECHANISM CHECKED, INSTALLED, PILOT CHUTE RETAINING PIN(S) AND CABLE REMOVED, DOORS FLUSH (P)
    a. Check brake chute cables (two) for spring tension.
    b. Check break cord through loops of chute pack.
    c. Check pilot chute bridle attached to main chute pack and that pilot chute bridle comes out between the corners of the right hand flap and the aft flap, brake chute ripcord pins inserted from rear to front, zipper fastened, and pilot chute held in place by three retaining pins (and streamer on airplanes having T.O. 1B-47-814 accomplished) (a single retaining pin and streamer on some airplanes). If a cord is tied around the pilot chute, ensure that it is removed prior to closing doors.
    d. Ensure that release cam spring is not broken by pressing down on cam and then releasing; cam should return to spring-loaded position.
    e. On airplanes with the pilot chute flap pull cable, partially close deploy doors and insert swaged ball in retaining clip.
    f. Close chute deploy doors and check flush.
    g. Withdraw pilot chute retaining pins and cable (a single retaining pin and streamer on some airplanes) and carry aboard airplane.
    h. Check shear bolt installed with washers on the locknut side only.
    i. Check roller installed on top door.
    j. Check drag link secured in release clevis and check scribe marks for positive locking.
    k. Check tail compartment access door closed; all leading edges flush. No edge should extend into slipstream in excess of thickness of door skin.
    l. Check handle flush and lock screw perpendicular to handle.

Continued On Next Page

## G AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS Continued

20. Approach Chute - CHECKED, INSTALLED, DOOR FLUSH (P)
    a. Check door switch in NORMAL to prevent possible actuation from cockpit switches.
    b. Check pilot chute bridle attached to deployment bag bridle.
    c. Check approach chute ripcord pins inserted from rear to front.
    d. Check release link attached to yoke shackle.
    e. Check risers in accordion fold at forward end of chute pack; release link must be placed so the yoke shackle depresses microswitch to permit closing of door.
    f. Check that pilot chute is held in place by the pilot chute deploy pin inserted through eye end terminal of approach chute retainer cable and the locking cone of pilot chute bag.
    g. Check circuit breaker in. Place switch in CLOSE position until door is nearly closed, then move switch to NORM.
    h. Through gap remaining, manually connect the pilot chute deploy pin cable to the slotted retainer in the approach chute door.
    i. Move switch to CLOSE once again and close cover guard over switch. Pull circuit breaker. Close and latch switch panel door.
    j. Check approach chute door fully closed and flush.

## H EMPENNAGE

1. Empennage - CHECKED (P)
   Check condition of all surfaces. Check for hydraulic leaks on vertical stabilizer. Check elevator in down position and right trim tab up approximately 1 1/2 to 2 inches at trailing edge.

2. Left Side Vertical Stabilizer - CHECKED, AIR DUCTS OPEN (P)
   Check general condition of surfaces; ram air ducts on dorsal fin unobstructed.

## I AFT LEFT SIDE FUSELAGE

1. Left Aft Boost Pump, Center Main Tank - CHECKED (P)
   Check for fuel leaks around seals, elbows, and drains (leaks are permissible only at the seal drain). Check for scorched areas. Check access door closed and secure.

2. Left Fuselage - CHECKED (P)
   Check all panels on left side flush and secure. Check for fluid leaks around vent openings in skin and for cracks and buckling.

3. Bomb Bay Tank Boost Pumps - CHECKED (P)
   Check for fuel leaks around seals, elbows, and drains (leaks are permissible only at the seal drain). Check for scorched areas. Check access door closed and secure.

## J BOMB BAY

1. Left Bomb Bay Fuel Lines & Boost Pumps - CHECKED (P)
   Check left bomb bay fuel lines for leaks (particularly around fittings). Check boost pumps for fuel leaks around seals and elbows. Check for scorched areas.
2. Left Junction Box Covers - SECURE & LATCHED (P)
3. Oxygen Supply Lever & Diluter Lever - OFF & 100% (P)
4. Interphone Cord - STOWED (P)
5. Bomb Bay Light - OFF (P)
6. Bomb Door Accumulator - CHECKED (P)
   Check bomb door accumulator charged to temperature corrected preload in figure 1-46 based on 1750 psi. No evidence of leaks.
7. Bomb Door Uplatches & Microswitch - UNLATCHED & CHECKED (P)
   Check bomb door uplatches unlatched (latches in receiving position and link arms forming a "V"). Check microswitch clean and secure.
8. Spoilers & Spoiler Depressurizing Valve - CHECKED, SAFETIED OFF (P)
   Check spoilers. Check spoiler depressurizing valve safetied off and no leaks.
9. Right Junction Box Covers - SECURE & LATCHED (P)
10. Right Bomb Bay Fuel Lines & Boost Pumps - CHECKED, NO LEAKS (P)

## K LEFT WING

1. Flap Motors, Solenoids & Wiring - SECURE (P)
   Visually check flap motors secure and cannon plugs safetied; solenoids and wiring secure; no burnt wiring.
2. Wing Trailing Edge - CHECKED (P)
   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. The maximum allowable internal leakage tolerance is a 500-pound drop within 5 minutes. However, pressure should not be lower than temperature corrected accumulator preload in figure 1-48 based on 500 psi.

Continued On Next Page

## K LEFT WING Continued

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. Top of Wing - CHECKED (P)
   Check oil tank caps installed and flush with wing. Check for bent or missing vortex generators.

4. Aileron & Trim Tab - CHECKED (P)
   Check condition of aileron skin and trailing edge. With aileron in center position, note position of the trim tab to ensure that the tab on the opposite wing is in approximately the same position.

5. Aileron Power Control Unit - CHECKED (P)
   Check circuit breakers in. Check fluid level; if low, have reserviced. Reservoir cap pointers aligned with dot. Lift up on cap to check security. Relieve pressure prior to lifting up on cap. Check reservoir and lines for leaks.

6. Wing Access Panels - SECURE, NO LEAKS (P)

## L OUTBOARD NACELLE

1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS (P)
   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 (P)
   Check hooks seated, latches fastened, and edges of panels flush. Check entire bottom surface of nacelle for fluid leaks and any possible damage.

3. Air Intake & Accessory Dome - CHECKED, SECURE (P)
   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, or damage. Hand check dome latch fastened and secure. Exert pressure on dome to test security.

4. Right Nacelle Panels - SECURE (P)
   Check hooks seated, latches fastened, and edges of panels flush.

## M INBOARD NACELLE

1. Wing & Strut Access Panels - SECURE, NO LEAKS (P)

2. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED (P)
   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.

3. Strut Fairing & Torsion Links - CHECKED (P)
   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.

4. Oleo Strut, Extension & Seals - NO LEAKS (P)
   Check for at least 4 inches strut extension. Check for fluid seepage and leaks around cylinder seal.

5. Wheel & Tire - CHECKED (P)
   a. Wheel - no cracks or damage.
   b. Tire - no blisters, no weather cracking or cuts down to cord, no portion of fabric showing, slippage marks aligned, and tire for proper inflation.

6. Ground Lock - IN PLACE (P)
   Check outrigger gear ground lock in place with red streamer visible.

7. Outrigger Doors & Actuators - CHECKED (P)
   Exert pressure inward and outward on doors to check door mechanism and attachment. Inspect actuators for damage. Check condition of phenolic block.

8. Nacelle Panel Latches (eight) & Locks (four) - SECURE (P)

9. Left Nacelle & Strut Panels - SECURE, NO LEAKS (P)
   Check fore and aft edges of panels flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check upper hooks secure and flush with skin. Check entire bottom surface of nacelle for fluid leaks.

10. Air Intake & Accessory Domes - CHECKED, SECURE (P)
    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, or damage. Hand check dome latches fastened and secure. Exert pressure on domes to test security. Check top of engines for latches secure.

11. Right Nacelle Panels - SECURE, NO LEAKS (P)
    Check fore and aft edges of panel flush. Three inspection holes are provided to check each latch hooked to nacelle panel. Check upper hooks secure and flush with skin. Check entire bottom surface of nacelle for fluid leaks.

12. Wing & Strut Access Panels - SECURE, NO LEAKS (P)

**(N) FORWARD LEFT SIDE FUSELAGE**

1. Forward Left Side Fuselage & Fuel Drains - CHECKED (P)
   Check forward left side of fuselage for dents, cracks, and buckling. Check fuel drains for leaks (leaks are permissible only at the seal drains). Check air intake and exhaust port dust plugs removed and ports unobstructed. Check static ports clear.

## PRIOR TO BOARDING AIRPLANE

After completion of the Exterior Inspection, the crew will regroup in front of the airplane and accomplish the Prior to Boarding Airplane checklist.

**PRIOR TO BOARDING AIRPLANE**

1. DD Form 781 - COMPLETED (P)
   The pilot reviews and signs name to discrepancies discovered on the preflight. If applicable, he signs the airplane cleared for flight; takes DD Form 781 aboard airplane.

2. Board Airplane, External Power as Desired (P)
   Pilot directs crew to board airplane and informs crew chief to connect external power to the airplane as desired.

## BEFORE STARTING ENGINES

### 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 gage 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 100% OXYGEN. After takeoff and/or when contamination is no longer suspected, place the diluter lever at NORMAL OXYGEN. 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 Safety Pins - CREW REPORTS
   a. Pilot and copilot remove ejection seat safety pins and stow with attached streamers in bags provided.
   b. For observer's ejection seat check, refer to section VIII.
   c. Crew reports, "Streamers and pins removed."

2. Safety Belt & Shoulder Harness - FASTENED (P-CP)
   Pilot and copilot adjust and fasten safety belt and shoulder harness. Check shoulder harness for snug fit and check inertia reel lever in UNLOCK.

**WARNING**

- If Type MA-2 belt is installed on the pilot's or copilot's seat, the shoulder harness loops must be connected to the upper strap arm only. If connected otherwise, the occupant may fail to separate from seat after ejection.
- 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.

Continued On Next Page

## BEFORE STARTING ENGINES

**Continued**

3. Seats & Pedals - ADJUSTED (P-CP)

4. Control Column - ENGAGED (P-CP)
   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 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.

**CAUTION**

Do not force the disconnect handle down since damage to the elevator disconnect rod assembly may occur; however, a slight push force may be necessary to complete engagement.

5. Mike Cord, Mask & Bailout Bottle - CONNECTED (P-CP-O)
   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 attachment strap under the chest strap as close to the chest strap snap as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector.
   b. Pass free end of attachment strap through attachment strap eyelet.

**WARNING**

It is imperative that the attachment strap on the mask male connector not be single looped around the parachute chest strap or attached to the chest strap snap. Failure to double loop the attachment strap around the parachute chest strap will result in the attachment strap slipping into the chest strap snap and inadvertently opening the snap during bailout.

   c. Plug the mask male connector into the mask-to-regulator tubing, listen for click, and check that the sealing gasket is only half exposed.
   d. Attach alligator clip to end of the mask male attachment strap.
   e. Route bailout bottle tubing underneath chute harness up to mask tubing and connect bayonet fitting to mask hose connector.

6. Lights - AS REQUIRED (P-CP)

7. 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. (Pilot places diluter lever to 100% oxygen.)
   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**

8. Canopy Jettison Handles - IN PLACE (P-CP)
   Pilot and copilot check canopy jettison handles in place and covers closed.

9. Canopy Release Handles - IN PLACE (P-CP)
   Pilot and copilot check canopy release handles in place and doors closed.

10. ESP Switch - OFF (P)
    Pilot checks engine stall prevention switch OFF, regardless of OAT, to obtain maximum thrust on takeoff.

11. Inverter Switches - MAIN, LIGHTS OUT (P) - ON, VOLTAGES & LIGHTS CHECKED (CP)
    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.
    e. Copilot checks main and secondary bus voltages between 110 to 120 volts.

12. Fire Shutoff Switches (six) - DEPRESSED (P)

13. Landing Gear Lever, Indicators & ELGE Lights - LEVER & FOUR DOWN (P) - FOUR GREEN, FOUR DOWN (CP)
    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.

14. Parking Brakes - SET (P)
    Pilot depresses left pedal and sets parking brakes.

**NOTE**

- If left pedal remains down, this indicates parking brakes are set. If pedal returns up, repeat procedure.
- Parking brakes may not be effective until engine No. 3 or 4 has been started and main hydraulic pressure is available.

15. Remove Bomb Door Locks, Gear Locks & Grounding Wire - WILCO (GO)
    Copilot calls to ground crew, "Remove bomb door locks, gear locks, and grounding wire." Ground observer acknowledges and proceeds with removal.

16. Emergency Hot Air Shutoff Handle - DEPRESSED (CP)

17. Air Conditioning Master Switch - ON (P)

18. Heat Selector Switch - AUTOMATIC, RHEOSTAT SET (P)
    Pilot places heat selector switch in AUTO and sets rheostat as desired.

19. Cabin Air Selector Switch - AIR COMP (P)

**NOTE**

If BNS equipment is not being used, cabin ventilation on the ground may be had during hot weather by placing this switch to RAM SUPPLY.

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## BEFORE STARTING ENGINES

**Continued**

20. Cabin Pressure Switch - PRESS NORMAL (P)

21. Exterior Surfaces & Pitot Heat Switches - OFF (P)

22. Windshield Anti-Ice Switch - NORMAL (P)

23. Windshield Defrost - CHECKED (P)

24. Deleted

25. Low Speed Warning Switch - ON (P)

26. Antiskid Switch - ON, LIGHT OUT (P)
    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.

27. Surface Control Lock - FORWARD, UNLOCK DETENT (P)
    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.

28. Throttles - CUTOFF (P-CP)

29. Brake Chute Deploy & Jettison Handles - BOTH CHECKED (P-CP)
    Pilot and copilot check brake chute deploy and jettison T-handles undamaged, seated properly on cable tubes, and attached to cables.

30. Wing Flaps - CHECKED & UP (CP-GO)
    Copilot calls, "Ground from copilot, check wing flaps." The ground observer notifies the copilot when the flaps move or stop.
    a. Retract flaps to approximately 70% with the normal flap lever.
    b. Retract flaps approximately 10% with each emergency switch.
    c. Retract flaps to full up with normal flap lever and return lever to OFF (time should be approximately 20 seconds for last 50% retraction).

**CAUTION**

Use care during flap operation with the emergency flap switches as there are no limit switches incorporated in the emergency system.

31. Cabin Pressure Release Handle - DEPRESSED (P)

32. Radios & IFF - ON, STANDBY (P)
    Pilot turns on all radios for warmup. Pilot turns IFF selector switch to STANDBY.

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## BEFORE STARTING ENGINES

**Continued**

33. Fuel Control Panel - SET (P)
    Pilot checks master refuel switch in NORMAL 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 and all others in ME.
    - With cg at or forward of 34% MAC, all engines in TE except No. 2 which will be in TME.

34. Bomb Door Locks & Gear Locks - IN SIGHT, STOW (P)
    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.

35. Generator Switches (six) - RESET & OFF (CP)

**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.

36. Alternator Switches - RESET & OFF (CP)
    Copilot places both alternator switches to RESET, then to OFF. If external AC power is connected for BNS preflight, bus selector switch will be positioned to EXT PWR on airplanes having BNS capabilities. If external AC power is not required, bus selector switch will be OFF.

37. Emergency Hydraulic Pump Switch - AUTO NORMAL, PRESSURE & QUANTITY CHECKED (CP)
    Copilot checks emergency hydraulic pump switch in AUTO NORMAL, emergency system pressure 3000 (±150) psi, amber "Pump Operating" light out, and quantity checked.

38. Circuit Breakers - IN (CP)

39. N-1 Compass - SYNCHRONIZED (O)
    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 the synchronizer control knob and rotates it 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.

40. Radio Call - COMPLETED (P)
    Pilot calls tower and checks for any known traffic delays.

# ENGINE DANGER AREAS

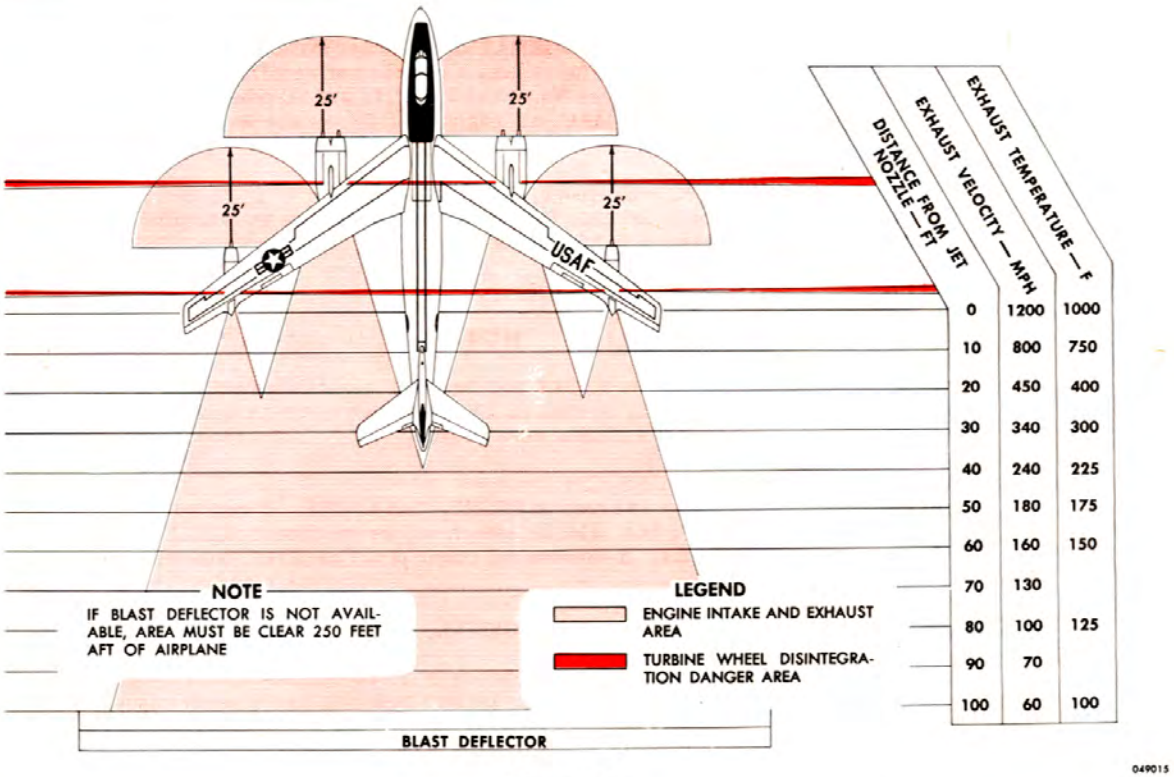



*Figure 2-3.*

## STARTING ENGINES

A Starting Engines checklist is provided for the proper method of starting the engines. The following 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 2-3 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. However, the engines may be started in a tailwind if the tailwind is 20 knots or less. When starting engines in a tailwind of 20 knots or less, the rpm at which the throttles are moved from CUTOFF should be varied according to the tailwind velocity in order to prevent excessive EGT.

## STARTING ENGINES

**NOTE**

Engine starting sequence 4, 5, 6, 3, 2, and 1.

1. Ignition Switches (six) - NORMAL (P)

2. Ready to Start Engines - READY (P-CP-GO)
   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.

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 for approximately 2 seconds and releases. Copilot reports voltage rise.
   b. Copilot informs pilot when engine rpm reaches value as given in following chart:

| Tailwind Component in Knots | RPM to Advance Throttle to START |
|---|---|
| 0-5 | 6% |
| 6-10 | 7% |
| 11-15 | 8% |
| 16-20 | 9% |

Upon notification by copilot, pilot advances throttle to START and watches exhaust gas 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 and moved as required to maintain EGT within limits. Fuel flowmeter fluctuations shall be considered as normal on engine start. Fuel flowmeter indication shall be steady at stabilized rpm.

**CAUTION**

- Discontinue the start under any of the following conditions:
  - Engine speed has not reached 9.5% within 40 seconds after the starter switch is placed in START.
  - Combustion does not occur when engine speed reaches 9.5%.
  - Combustion does not occur within 7 seconds after advancing throttle to START when starting with a tailwind of 5 knots or more.

  To discontinue ignition, momentarily position the starter switch to CUTOFF and close the throttle. 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 and fuel selector switches are properly positioned.

Continued On Next Page

## STARTING ENGINES

**Continued**

c. When combustion is indicated by a rise in EGT, allow EGT to stabilize momentarily with the throttle at START, then increase rpm to idle (40% rpm) using EGT to govern rate of throttle advance. While advancing throttle to idle, maintain EGT between 650° and 690° C to obtain the most satisfactory starts. Observe proper EGT limits. 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 operated momentarily, advance throttle to idle maintaining EGT between 650° 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.

- The following constitute possible engine overtemperature conditions and require appropriate action to be taken:

| CONDITION | ACTION |
|---|---|
| ENGINE STARTS UP TO IDLE RPM (WITHIN 2 MINUTES) | |
| 950° C or above for 2 seconds or more | Pilot must shut down engine and record the degree and duration of overtemperature condition on DD Form 781. Maintenance is required to remove turbine wheel and inspect engine as per T. O. 2J-J47-539. |
| ALL ENGINE OPERATION EXCEPT STARTS | |
| 690° to 750° C for 40 seconds or more<br>OR<br>750° to 800° C for 10 seconds or more<br>OR<br>Above 800° C for 2 seconds or more | Pilot must record the degree and duration of overtemperature condition on DD Form 781* in order that proper maintenance inspection may be accomplished per T. O. 2J-J47-539. |

*For takeoff only, exhaust gas temperatures in the range of 690° to 715° C for a period up to 3 minutes need not be recorded on DD Form 781.

Continued On Next Page

## STARTING ENGINES

**Continued**

**CAUTION**

- Failure to record overtemperature condition could result in turbine failure and possible engine loss.
- Engine overspeed exceeding 104% of rated rpm, either with or without overtemperature, requires removal and overhaul of the engine.

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 operate 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 (P)
   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, except for the oil system when operating under extreme cold weather conditions. Under normal conditions, it is desirable that takeoff be accomplished with a minimum of engine operation at high rpm. Extended periods of high power operation prior to release of brakes for

takeoff does not allow full advantage to be taken of the overshoot in EGT and the resultant overshoot in thrust. Refer to the EGT stabilization chart. Rapid forward movement of the throttles during ground operation must be avoided. Generator rated output is attainable at approximately 55% rpm.

**NOTE**

Avoid unnecessary engine operation in excess of idle rpm. However, occasional throttle advance to 70% rpm or operation above 55% on the outboard engines is not objectionable.

## BEFORE TAXIING

1. Hydraulic Pressure & Quantity - CHECKED (CP)
   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. Engines No. 1 & 6 - 52% RPM (P) - ALTERNATORS NORMAL, BUS SELECTOR NORMAL, VOLTAGE CHECKED (CP)
   If alternator power is required, pilot adjusts throttles No. 1 and 6 to maintain 52% rpm. As soon as both amber "Under Freq" lights go out, copilot moves both alternator power switches to NORMAL; both amber "Power Off" lights should go out. Copilot places unregulated AC bus selector switch to NORMAL. Copilot checks for 110 to 120 volts to provide a reading of left and right alternator voltages.

**CAUTION**

- To avoid damage to electronic equipment receiving alternator power, do not retard throttles No. 1 and 6 below 52% rpm.
- If the "Power Off" light fails to go out, the copilot may reset the alternator once. If the light continues to come on, no further resets should be made until the fault is corrected.

3. Entrance Door - CLOSED & LOCKED (CP) - CLOSED & LATCHED (GO)
   Copilot ensures 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 (GO) - CLOSED (P-GO)
   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."

5. Battery Switch - LH BUS NORMAL (P)

6. Generator Switches (six) - ON (CP)

7. Cabin Air Selector Switch - AIR COMP (P)

8. Windshield Defrost & Pitot Heat - SET (P)
   Pilot sets windshield defrost and pitot heat as desired.

Continued On Next Page

## BEFORE TAXIING

**Continued**

9. Exterior Inspection of Engines, External Power, Chocks & Interphone - ENGINE INSPECTION COMPLETE (GO), REMOVED AND IN SIGHT (P)
   Upon command of the pilot, the ground observer will visually check all engines for abnormal fuel or oil leaks. He will notify the pilot there are no leaks or the type and location of leakage. Abnormal leakage requires engine shutdown and investigation. 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.

10. Generator Loads & Voltages - CHECKED (CP)
    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**

Loadmeters may give an erroneous reading until generator system is allowed to warm up approximately 15 minutes.

11. Power Controls - ON, LIGHTS OUT (P)
    Pilot places all three surface power control switches to ON; all power control panel lights should go out and remain out.

**NOTE**

If rudder-elevator no-pressure warning light stays on, recheck surface control lock lever in full forward UNLOCK detent.

12. Steering Ratio Selector Lever - TAXI DETENT (P)

**NOTE**

Prior to moving lever, neutralize rudder pedals as forward main gear will assume a position corresponding to the position of the rudder pedals.

13. Auxiliary-Fuel-to-Engines Valve - CHECKED (P)
    Pilot checks auxiliary-fuel-to-engines valve operation in the following manner:
    a. Places all fuel selector switches on TME.
    b. Places forward auxiliary boost pump switch to BOOST ON and checks that no-flow warning lights illuminate.
    c. Places auxiliary-fuel-to-engines switch to VALVE OPEN; no-flow warning lights should go out. (This is a positive check that the auxiliary-fuel-to-engines valve is open and forward auxiliary tank fuel is being supplied to the engines.)
    d. Returns fuel selector switches to desired settings.
    e. Returns auxiliary-fuel-to-engines switch to CLOSED; no-flow warning lights should illuminate.
    f. If it was impossible to check operation of any main tank fuel transfer valve during the Interior Preflight Inspection, pilot accomplishes the following procedure for the desired tank or tanks:
       (1) Places desired main tank fuel transfer switch to VALVE OPEN; no-flow warning lights for the forward auxiliary tank should go out indicating transfer valve is open and fuel is flowing into the appropriate main tank. Returns transfer switch to CLOSED; no-flow warning lights should again illuminate indicating transfer valve is closed and no flow of fuel exists.
       (2) Makes the same check as necessary on remaining main tank transfer valves.
    g. Turns forward auxiliary boost pump switch OFF.

Continued On Next Page

## BEFORE TAXIING

**Continued**

**NOTE**

Flight may be made with two transfer valves inoperative provided the auxiliary-fuel-to-engine transfer checked satisfactory.

14. IFF - SET (P)
    Pilot sets IFF panel in accordance with communications briefing.

15. Radio Call - COMPLETED (P)
    Pilot calls tower for taxi and takeoff instructions. If an instrument flight, request IFR clearance and departure route.

16. Clear to Taxi on Crew Chief's Signal - READY TO TAXI (P)
    Pilot signals crew chief when ready to taxi and obtains clearance to roll. Releases parking brakes.

## TAXIING INSTRUCTIONS

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 2-4. 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 airplane 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.

- 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.

- 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 runways.

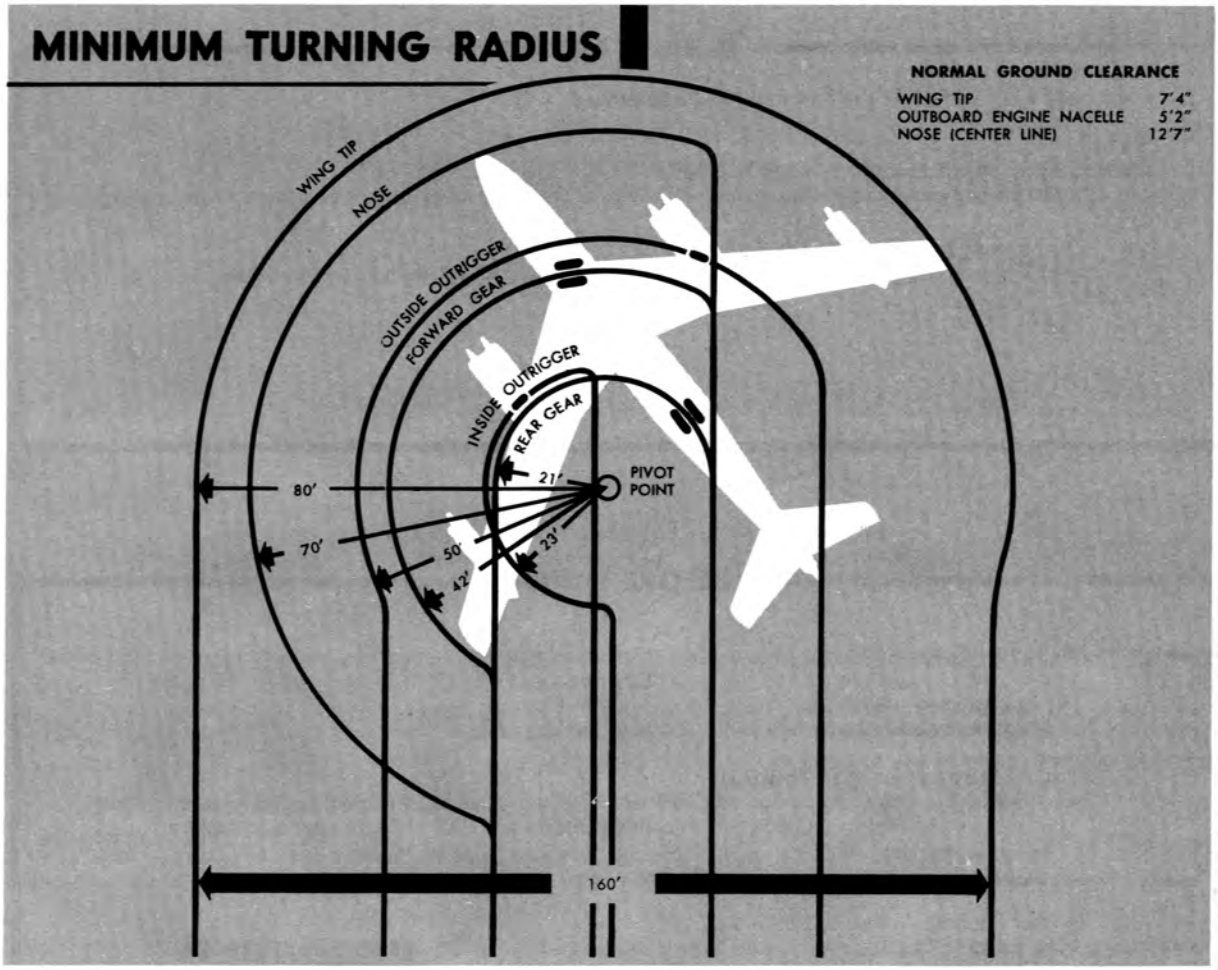



*Figure 2-4.*

## WHILE TAXIING

1. Brakes & Steering - CHECKED (P)
   Pilot checks steering and brake operation by slight turns left and right and brake applications.

2. Hydraulic Pressure & Quantity - CHECKED (CP)
   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).

Continued On Next Page

## WHILE TAXIING

**Continued**

3. Turn & Slip Indicators - CHECKED (P-CP)
   Pilot and copilot check turn-and-slip indicators for proper turn indications while taxiing.

4. Directional Indicator - CHECKED (P-CP)
   Pilot and copilot checks directional indicator for correct indications in turns.

## BEFORE LINEUP

1. Parking Brakes - SET (P)
   Pilot depresses left brake pedal and sets parking brake.

2. Flight Instruments - CHECKED (P-CP)
   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 approximately airplane heading; vertical velocity, turn-and-slip, airspeed, and Machmeter read zero or the normal static reading.

3. Power Controls - ON, LIGHTS OUT (P)
   Pilot checks all three surface power control switches ON 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.

**Continued On Next Page**

① AF 49-2642 thru 50-080, 51-2047, -2052, -2053, -2063 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088, -2090

## BEFORE LINEUP

**Continued**

4. Wing Flaps - CHECKED, FULL DOWN (CP) - FULL DOWN (P)
   a. Copilot extends flaps to approximately 30% with normal flap lever.
   b. Extends flaps 10% with each emergency switch.
   c. Extends flaps to full down from the 50% position with normal flap lever and return lever to OFF. Note time to extend flaps from 50% to 100%. This time should be approximately 10 seconds.
   d. Pilot checks flap indicator for full down indication.

5. Control Column - ENGAGED (P-CP)
   With both control columns engaged, the copilot holds his column in a fixed position while the pilot exerts pressure fore and aft on elevators and left and right on ailerons to determine if controls are engaged. Pilot then moves column full forward and full aft to check freedom of travel.

6. Flaperons - CHECKED (P)
   Pilot rapidly moves aileron control wheel full left and full right and visually checks that flaperons spill at same rate.

7. Trim Tabs - SET (P)
   Pilot rechecks aileron and rudder trim on zero and positions elevator trim for cg location in accordance with figure 2-6.

8. Fuel Control Panel - SET, LIGHTS OUT (P)
   Pilot checks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE.

**WARNING**

If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. This will ensure maximum fuel flow to all engines in case any main tank becomes completely empty.

Pilot checks all fuel boost pressure warning lights out. 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.

**NOTE**

Auxiliary tank no-flow warning lights must remain illuminated or fuel transfer is indicated. Fuel transfer at this time is an indication of malfunction in the system.

9. Canopy - CLOSED, LATCHED, LOCKED (P) - PINS & HOOKS IN PLACE (CP)
   Before closing canopy, pilot checks canopy lock lever in UNLOCKED. 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 lever in CLOSE, and moves lock lever to LOCKED. If canopy has been closed, checks "Canopy Latched," canopy lock lever LOCKED, visible hooks in place, and lever in CLOSE.

Continued On Next Page

## BEFORE LINEUP

**Continued**

10. Canopy Lockpins - ENGAGED (CP)

11. Canopy Latch Reset - HORIZONTAL (P)
    Pilot checks canopy latch reset in LOCKED (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 - IN (CP)

13. Landing Lights (Night) - ON (P)
    Pilot checks landing light switches (two) ON for all night takeoffs.

14. Radio Call - COMPLETED (P)
    Pilot gets takeoff instructions, altimeter setting, temperature, wind direction and velocity, and final radio clearance from tower before taking runway. He advises crew of altimeter setting and asks copilot for adjustments to acceleration check and go-no go check speeds if applicable.

15. Takeoff Data - REVISED (if applicable) (CP) - CHECKED (P)
    Copilot reads corrected takeoff speed data, new acceleration check speed, and go-no go speed.

## BEFORE TAKEOFF

1. Steering Ratio Selector Lever - TAKEOFF LAND DETENT, STEERING CHECKED (P)
   Pilot places steering ratio selector in TAKEOFF LAND and checks the steering in both directions as the airplane rolls into takeoff position.

**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.

2. Brakes - HOLDING (P)
   Pilot aligns the airplane with the runway and holds brakes while performing Before Takeoff checklist.

3. Deleted

4. Throttles Open - OIL, FUEL, EGT OK, 100% (P) - ALTERNATORS & GENERATORS CHECKED (CP)
   Pilot slowly moves all throttles to 100% RPM. Checks all tachometers for engines at 100% rpm. Checks oil pressure within operating limits and fuel flow stabilized. Checks EGT for all engines at 100% rpm. (See figure 2-5 for takeoff EGT.) Copilot checks generator loads and alternator output and takes fuel readings.

**NOTE**

A slight overshoot in engine rpm may be experienced when the throttles are first advanced to 100% RPM and before the EGT has stabilized.

Continued On Next Page

## BEFORE TAKEOFF

**Continued**

**NOTE**

If compressor stall occurs during throttle advance (at temperatures below 60° F) retard throttle on affected engine to idle. Place ESP switch ON and readvance throttle. After 90% rpm is reached, place ESP switch OFF.

5. Engines & Wings - CHECKED (P-CP)
   Pilot and copilot visually check condition of engine nacelles at 100% RPM for loose cowling, oil, and fuel leaks. Copilot checks tops of wings for oil leaks and loose panels.

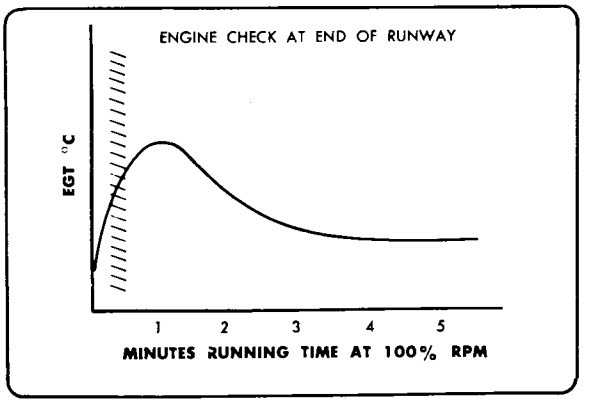
# TAKEOFF

**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.

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### TAKEOFF THRUST

On this airplane the minimum takeoff distance is attained by maintaining maximum rated thrust; therefore, all takeoffs are to be made at 100% rpm. Thrust at this setting varies with exhaust gas temperature (EGT) and outside air temperature (OAT). Shortly after reaching 100% rpm the EGT will peak and maximum thrust will be available (see following chart). Therefore, make engine check and begin takeoff run in order to utilize this additional thrust overshoot. For takeoff EGT limits, see figure 2-5.

**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, see "Engine Limitations" in section V for action to be taken in case of engine overtemperature.

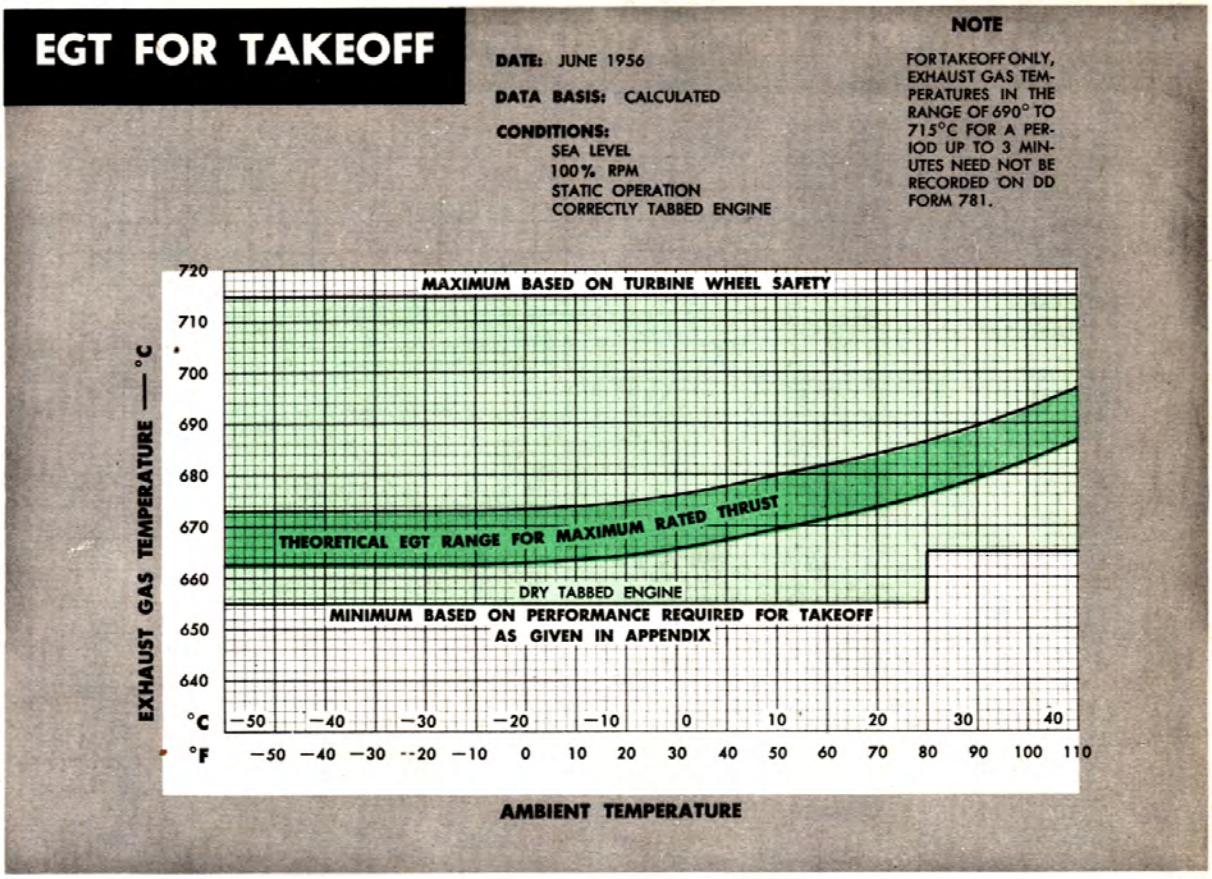



*Figure 2-5.*

**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 2-5). Therefore, it is important that the temperature indicating instruments be accurate.

## NORMAL TECHNIQUE — TAKEOFF

To preclude any possibility of a low altitude stall and to maintain optimum control and climb after takeoff, the following technique will be employed for all takeoffs:

1. Hold a slight push force on the control column during the ground roll until normal takeoff speed is reached.
2. When normal takeoff speed is attained, reduce the forward pressure on the control column and allow the airplane to fly off the ground without large elevator adjustment at the unstick point. Both gear will unstick simultaneously.

**NOTE**

As the airplane approaches normal takeoff speed and forward pressure is reduced completely, it will be necessary to come in smoothly with light back pressure on the control column in order to have the airplane unstick at the normal takeoff speed.

# ELEVATOR TRIM FOR TAKEOFF

**DATE:**
JULY 1953

**DATA BASIS:**
FLIGHT TEST

**CONDITIONS:**
FULL FLAPS AND GEAR DOWN

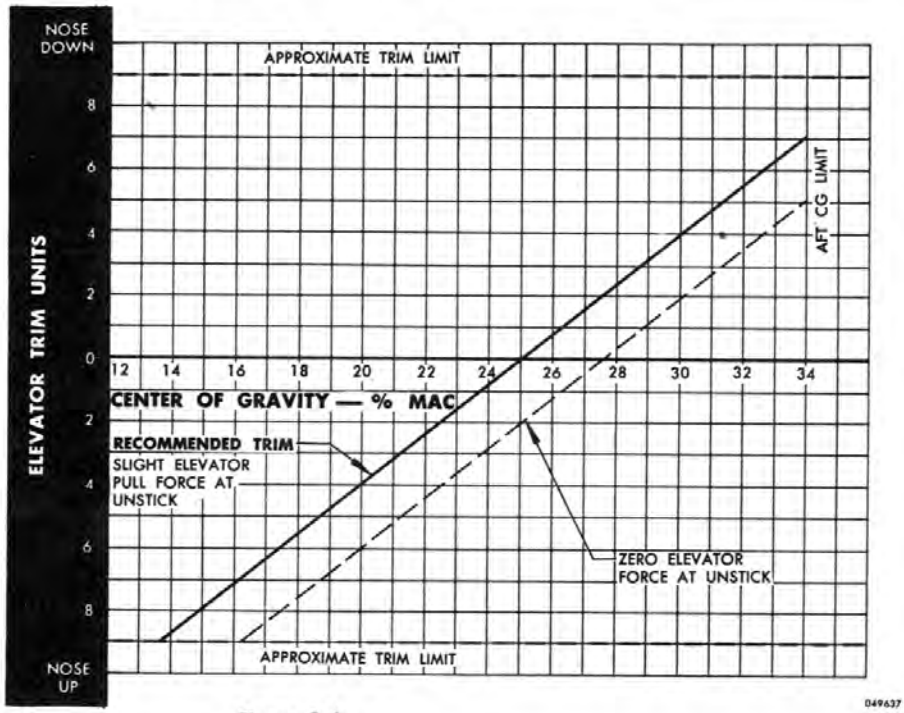



*Figure 2-6.*

3. Avoid forcing the airplane into the air before normal takeoff speed is reached.

**NOTE**

For emergency short field takeoffs or obstacle clearance takeoffs, refer to "Short Field or Obstacle Clearance Takeoff" under "Takeoff Emergencies" in section III.

4. If pitchup is noted at unstick, immediate retraction of gear and flaps and application of nose down elevator will improve the condition. However, should an aborted takeoff appear inevitable, it is better to leave the gear extended to absorb the shock as the airplane settles onto the runway. Refer to "Pitchup During Takeoff" under "Takeoff Emergencies" in section III.

**WARNING**

An inadvertent cg condition aft of 34% on takeoff will create a tendency for the nose to pitch up which could result in a low altitude stall. With the bicycle-type landing gear, there is no natural means of warning the pilot of this inadvertent cg condition until pitchup occurs at the unstick point. For emergency takeoff procedures involving pitchup at unstick, refer to "Takeoff Emergencies," section III. Should a forward cg exist the condition is not considered so hazardous. Then it should be recognized that the airplane is not taking off at the normal takeoff speed and unusual pull force will be required to unstick. In this case, retraction of flaps and gear should be delayed to prevent aggravation of the forward cg condition.

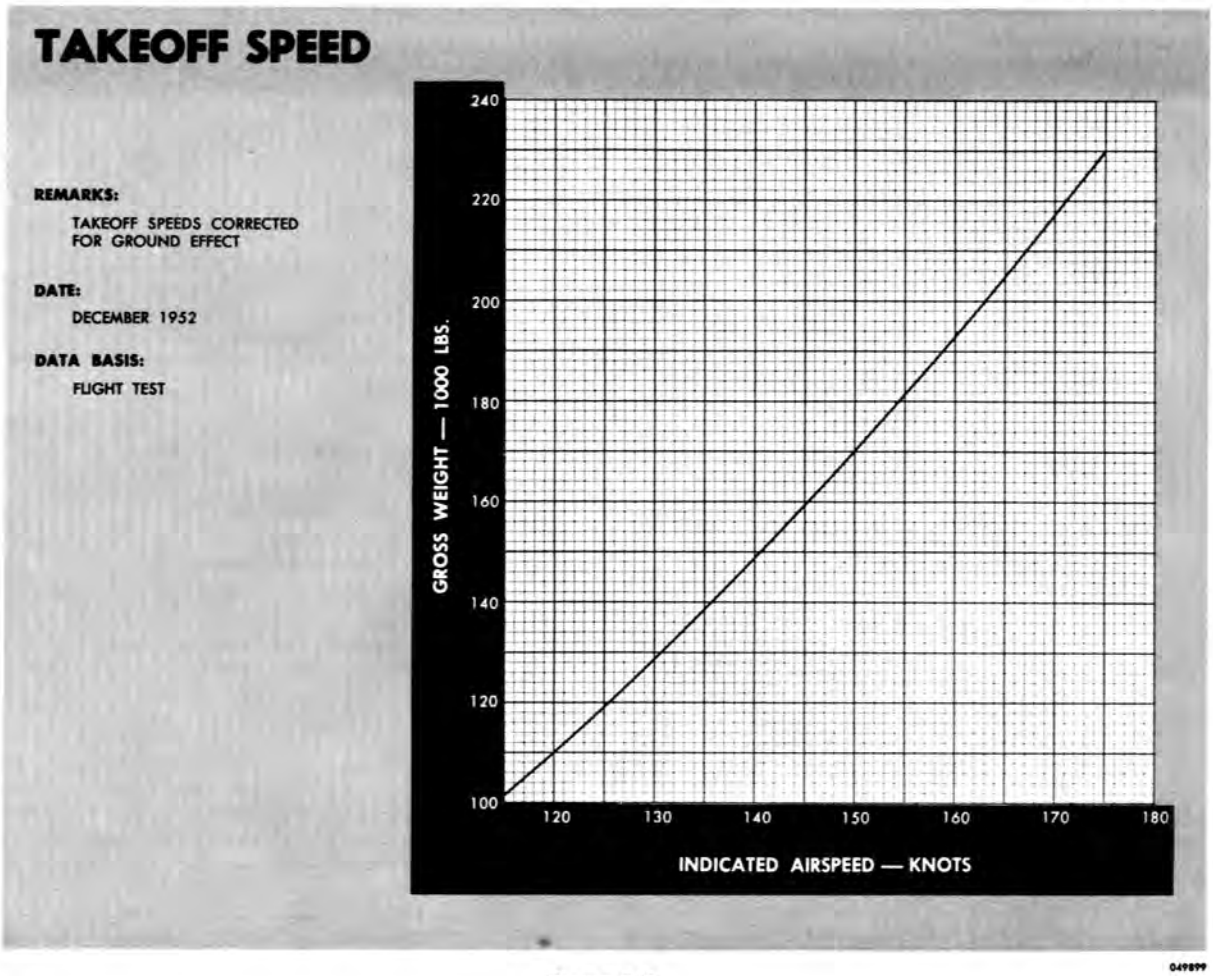



*Figure 2-7.*

## TAKEOFF VARIABLES

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, see figure 2-6. 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 when using the charts in part 2 of the appendix.

- Gross weight
- Outside air temperature (OAT) at time of takeoff
- Field length and pressure altitude
- Wind direction and velocity
- Exhaust gas temperature (EGT); estimate for figure 2-5 and check on engine runup.

To determine headwind corrections for the takeoff distance and go-no go speeds, see part 2 of the appendix. 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. Relative humidity, which appreciably affects reciprocating engine power, has a negligible effect on turbojet thrust and takeoff distances.

## OBSTACLE CLEARANCE

Refer to "Short Field or Obstacle Clearance Takeoff" under "Takeoff Emergencies" in section III.

### 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.

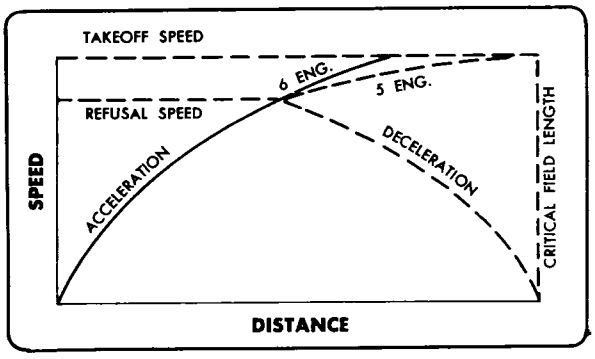
The amount of aileron wheel deflection required to keep a wing-level attitude will diminish as the airspeed increases to the takeoff speed. As the airplane becomes airborne, obtain the proper crab angle to maintain a ground track down the center of the runway. When airplane is definitely airborne and the climb established, retract the landing gear.

### 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 2-7.

### TAKEOFF —TECHNIQUE

See part 2 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 off safely. During the takeoff roll, if an engine fails at or below go-no go speed, stopping is the correct procedure. Engine failure after go-no go speed commits the takeoff. Go-no go speed is the speed attained at the nearest 1000-foot runway marker short of the refusal speed distance.

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### 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. Under conditions of reduced thrust or high gross weights, the airplane may tend to stall as a result of the rapid wing-flap retraction rate as compared to the airplane acceleration rate. The present ram air pressure switch prevents flap retraction beyond 22 1/2% at airspeeds below the range of 193 to 208 knots IAS. This setting is too low to prevent the airplane from stalling when being operated at gross weights above 208, 000 pounds. To prevent this from occurring and to prevent the possibility of exceeding flap placard speeds at light gross weights, the following instructions provide one procedure which can be used for all gross weights and ambient conditions with all six engines operating or after a loss of thrust has been experienced. During flap retraction, the pilot should monitor airspeed and altitude and assure that a positive increase of both is being maintained. If these conditions cannot be maintained, the flaps should be stopped. Retraction should then be continued after the airspeed schedule is attained. Never allow the airspeed to decrease during flap retraction. Normally the flaps will have to be stopped temporarily at 50%, using this procedure when taking off with gross weights of approximately 200, 000 pounds and below.

1. As soon as the airplane is definitely airborne, retract the gear and accelerate to 20 knots above takeoff speed. Continue the climb with flaps down and gear up to a minimum of 300 feet above the terrain while maintaining takeoff speed plus 20 knots.

**CAUTION**

Do not exceed 195 knots IAS with flaps full down because structural damage to the flaps may result.

2. When this altitude is reached, initiate flap retraction and maintain a minimum of 300 feet per minute rate of climb.

3. Maintain a positive increase in airspeed during flap retraction. Stop flap retraction if this increase is not maintained.

4. Stop flap retraction at 50% if the airspeed is below 205 knots IAS. Resume flap retraction when 205 knots IAS is attained.

**CAUTION**

Do not exceed 230 knots IAS with flaps extended 50% because structural damage to the flaps may result.

5. Stop flap retraction at 22 1/2% if the airspeed is below 220 knots IAS. Resume flap retraction when 220 knots IAS is attained.

**CAUTION**

Do not exceed 236 knots IAS with flaps extended 22 1/2% because structural damage to the flaps may result.

6. Continue flap retraction to 0%.

**CAUTION**

- Prior to retracting flaps above 22 1/2%, it should be ascertained that sufficient altitude clearance is provided above local terrain or obstructions.
- Do not exceed 240 knots IAS until flaps are fully retracted, because structural damage to the flaps may result.

**NOTE**

During the retraction from 22 1/2% to 0%, a nose down pitching tendency occurs. The use of nose up trim as the flaps approach 22 1/2% is beneficial in preventing loss of altitude during this time.

7. Continue the climb at a minimum of 300 feet per minute until best climb speed is attained.

## TAKEOFF & INITIAL CLIMB

B RB-47 MODEL

### TAKEOFF DATA

Critical Field Length _____ TO Dist _____

Runway Grade Correction _____

Min ATO Req _____ Elevator Set _____

First Stall Warning (Flaps Up) ..... IAS _____

ACCELERATION CHECK . . . . . Dist _____ IAS ___
GO-NO-GO CHECK . . . . . Dist _____ IAS ___
FIRE ATO . . . . . IAS ___
TAKEOFF . . . . . IAS ___
CLIMB . . . . . IAS ___

Conditions

Runway Gradient _____

GROSS WT _____ FLD PA _____

Runway Length _____ % MAC _____ OAT _____

### EMERGENCY LANDING DATA

Planned Stop Dist (No Brake Chute) _____

START FINAL . . . . . IAS ___
BEST FLARE . . . . . IAS ___

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1. Copilot Calls Acceleration Check Speed and Distance, Go-No Go Check Speed and Distance, and Takeoff Speed

   Before start of takeoff roll, copilot calls off each speed and check point distance. During takeoff the copilot will give the pilot approximately 10 knots warning before each check speed is reached. Example: "Acceleration check 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 check point distance and will check airspeed to decide whether to stop or go.

**NOTE**

At 70 knots, pilot and copilot cross-check their indicated airspeeds. With a steady and direct headwind the maximum allowable variation between the pilot's and copilot's airspeed indicators is 4 knots. Excessive variation is reason to abort the takeoff and have a check made of the pitot-static system and the instruments. However, consideration should be given to the direction and gustiness of the wind at the time the variation is noted.

Continued On Next Page

## TAKEOFF & INITIAL CLIMB

**Continued**

2. Landing Gear - UP (P-CP)

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. Accelerate to 20 knots IAS above takeoff speed. Continue the climb with flaps down and gear up to a minimum of 300 feet above the terrain while maintaining takeoff speed plus 20 knots.

**CAUTION**

- Do not exceed 195 knots IAS with flaps full down because structural damage to the flaps may result.
- 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.

3. Wing Flaps - UP (P-CP)

a. At 20 knots IAS above takeoff speed and at a minimum of 300 feet above terrain, pilot notifies copilot to retract flaps. On pilot's command, copilot places flap lever UP and keeps hand on flap lever until lever is returned to OFF. Maintain a minimum of 300 feet per minute rate of climb and a positive increase in airspeed during flap retraction. Stop flap retraction if this increase is not maintained.

b. Stop flap retraction at 50% if the airspeed is below 205 knots IAS. Resume flap retraction when 205 knots IAS is attained.

**NOTE**

Do not retract flaps above 50% until the landing gear is fully up.

**CAUTION**

Do not exceed 230 knots IAS with flaps extended 50% because structural damage to the flaps may result.

① AF 51-2045, -2051, -2059, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087, -2091

## TAKEOFF & INITIAL CLIMB

**Continued**

c. Stop flap retraction at 22 1/2% if the airspeed is below 220 knots IAS. Resume flap retraction when 220 knots IAS is attained.

**CAUTION**

Do not exceed 236 knots IAS with flaps extended 22 1/2% because structural damage to the flaps may result.

d. Continue flap retraction to 0%.

**CAUTION**

- Prior to retracting flaps above 22 1/2%, it should be ascertained that sufficient altitude clearance is provided above local terrain or obstructions.
- Do not exceed 240 knots IAS until flaps are fully retracted, because structural damage to the flaps may result.

**NOTE**

During the retraction from 22 1/2% to 0%, a nose down pitching tendency occurs. The use of nose up trim as the flaps approach 22 1/2% is beneficial in preventing loss of altitude during this time.

e. Continue the climb at a minimum of 300 feet per minute until best climb speed is attained.

4. Landing Gear & Wing Flaps - LEVERS OFF, ELGE LIGHTS OUT (CP)
   Copilot checks gear and flap indicators to assure all four gear and flaps are up. He also checks the ELGE lights out to assure no trouble is evident in the landing gear system. Then places gear and flap lever OFF.

5. Climb Speed - CLIMB POWER SET (P)

6. Crew Station Check - CREW REPORTS (10,000 FEET & LEVEL OFF)
   At 10,000 feet and level off and approximately every hour thereafter, the copilot calls for a station check. Crew members reply as follows:

**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.

Continued On Next Page

## TAKEOFF & INITIAL CLIMB

**Continued**

a. Extra Crew Members
- Pressure _____ pounds
- Regulator NORMAL
- On (or Off) oxygen

b. Observer
- Pressure _____ pounds
- Blinker operating
- True airspeed _____ knots
- N-1 compass heading
- Circuit breakers in (or as necessary)

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 check, airspeed _____ knots, altitude _____ feet
- Engine instruments checked
- OAT _____ degrees
- Cabin altitude _____ feet
- Power controls on, light out
- Fuel panel set as needed

## AFTER TAKEOFF

**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 ensure 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 in airplane oxygen system.
  - Automatic pilot is being engaged or disengaged.
  - Automatic pilot control of airplane 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 copilot or the pilot monitors the automatic pilot.

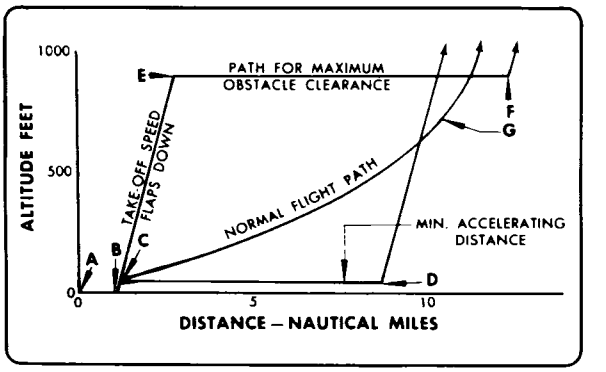
- All applicable crew members will acknowledge that intended course of action is understood prior to actual accomplishment and will conduct themselves accordingly.

- 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.

- In the event decompression or a similar emergency occurs at altitudes above 10, 000 feet, both the pilot and copilot will remain at the controls on 100% OXYGEN until correct functioning of the oxygen system is verified. Any assistance to injured personnel or victims of hypoxia should be rendered by the observer or extra crew members if aboard.

- 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.

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 in the accompanying chart. The difference in the amount 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 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 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 after minimum terrain clearance is reached.

### MINIMUM ACCELERATING DISTANCE

**NOTE**

This is not a normal or recommended procedure and is to be used only under special conditions.

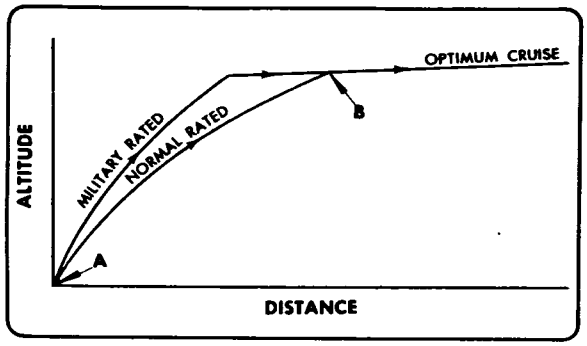
When the pilot desires to maintain a minimum altitude above the ground in order to accelerate to climb speed as quickly as possible, both the gear and flaps should be retracted immediately after takeoff. However, care must be exercised not to exceed the structural limits of the flaps. The limiting speeds with flaps extended are shown on figure 5-2.

### 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 (98%) or normal rated (96%) rpm may be used for climb. Full climb data is presented in part 3 of the appendix. Varying speeds ±10 knots from the optimum will not materially affect performance. Referring to the accompanying chart, 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.




## 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. Safety Belt & Shoulder Harness - FASTENED (P-CP-O)
   Crew adjusts and fastens safety belts and shoulder harnesses. Checks inertia reel levers in UNLOCK. Copilot checks his seat in normal sitting position.
2. Directional Damper - OFF (P)
3. Temperature Rheostat - ADJUSTED (P)
   Pilot adjusts temperature control rheostat as required to minimize interior fogging.

Continued On Next Page

## BEFORE DESCENT

**Continued**

4. Windshield Anti-Ice, Defrost & Pitot Heat Switches - SET (P)
   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 ensures windshield defrost switch is ON and operating normally, and that left and right pitot heat switches are set as required.

5. Low Speed Warning Switch - ON (P)

6. Power Controls - ON, LIGHTS OUT (P)
   Pilot checks all three surface power control switches in ON and all panel lights out.

7. Fuel Control Panel - SET, LIGHTS OUT (P)
   Pilot checks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE. Checks all fuel boost pressure warning lights out and transfers fuel quantity gage readings to copilot.

**WARNING**

If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. This will insure maximum fuel flow to all engines in case of emergency or low fuel quantities.

B/RB-47 Model

### LANDING DATA

**Conditions**

Runway Gradient_____

GROSS WT_____ Fld PA_____

Runway Length_____ % MAC_____ OAT_____

PLANNED STOP DIST (No Brake Chute)_____

START FINAL ..... IAS_____

BEST FLARE ..... IAS_____

**BEST FLARE SPEEDS (FULL FLAPS)**

| | |
|---|---|
| 80,000 — 115 | 120,000 — 140 |
| 85,000 — 119 | 125,000 — 143 |
| 90,000 — 122 | 130,000 — 146 |
| 95,000 — 125 | 135,000 — 149 |
| 100,000 — 128 | 140,000 — 151 |
| 105,000 — 131 | 145,000 — 154 |
| 110,000 — 134 | 150,000 — 157 |
| 115,000 — 137 | 160,000 — 161 |

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Continued On Next Page

## BEFORE DESCENT

**Continued**

8. Landing Data Card - COMPLETED, GROSS WEIGHT_____, BEST FLARE SPEED_____ KNOTS, STOPPING DISTANCE (NO BRAKE CHUTE)_____(CP)
   Copilot takes fuel quantity readings, computes airplane gross weight, determines best flare speed and stopping distance without brake chute, and completes landing data card. Calls pilot and gives "Gross weight_____, best flare speed_____knots, and stopping distance (no brake chute)_____." Pilot returns fuel quantity gage control to his panel.

9. Circuit Breakers - IN (CP)

10. Hydraulic Pressures & Quantity - CHECKED (CP)
    Copilot checks hydraulic system pressures are within operating range, fluid quantity is up, and all lights out. Checks emergency hydraulic pump switch in AUTO NORMAL.

11. Radio Call - ALTIMETER (P-CP)
    Pilot calls for letdown and/or landing information, altimeter setting, and ground temperature. Pilot notifies crew of altimeter setting. Crew confirms.

12. Engine Stall Prevention Switch - SET (P)
    Pilot places engine stall prevention switch ON if OAT is 15° C (59° F) or below.

13. Pilot Calls Drag Gear Down - DOWN (CP)
    Pilot retards throttles to idle and calls for drag gear down (below 305 knots) when ready for descent. Copilot places drag gear switch DOWN and holds switch until drag gear indicates down and locked.

**CAUTION**

If alternators are required for IFF, windshield and wing anti-icing, or BNS equipment, copilot will maintain engines No. 1 and 6 at 52% rpm.

## BEFORE LANDING (SHORT)

**NOTE**

If a landing is not made out of the approach, the crew must accomplish the Before Landing checklist prior to entering the downwind leg.

1. At Low Altitude Before Landing Check - GEAR DOWN, FLAPS FULL DOWN (P) - FOUR DOWN, FOUR GREEN, FLAPS FULL DOWN, HYDRAULIC SYSTEM CHECKED, READY TO LAND (CP)
   During instrument approaches when on the final approach to the radio facilities, the pilot calls for flaps and gear at the proper airspeeds. Immediately after all gear is extended, pilot calls for Before Landing check. Pilot checks all gear and flaps full down, antiskid on, and light out. Copilot checks all four gear down, four green, and no red light on the ELGE stand. Copilot checks hydraulic pressure within operating range, fluid quantity is up, and all lights out; checks emergency hydraulic pump switch in AUTO NORMAL.

**NOTE**

During straight in approaches from descent, this short Before Landing check may be used. If a normal traffic pattern, GCA, or ILS approach is to be made, the regular Before Landing check must be accomplished.

## 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 6 of the appendix.

**WARNING**

Crew members should cross-check altimeter readings frequently during descent to prevent misreading of altitudes.

During minimum idle descent and especially at altitudes between 30,000 and 15,000 feet, a marked rise in cabin altitude may occur under some conditions. The rise in cabin altitude is usually the result of low minimum idle on the engines and not the result of excessive cabin leakage. When cabin pressure is not maintained, advance throttle to increase rpm on No. 3 engine as necessary to maintain cabin pressure. Cases in which the No. 3 engine rpm is increased above 70% in order to hold cabin pressure indicates excessive cabin leakage or a malfunction or improper adjustment of the flow control valve, moisture separator system, or cabin pressure regulator. The thrust increase on No. 3 engine when using this procedure will not appreciably change descent rate of fuel consumption.

### NORMAL DESCENT — ALL GEAR DOWN

This is the recommended procedure for all letdowns where there is no range emergency.

1. Reduce speed to 305 knots IAS and lower landing gear.
2. 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.

**CAUTION**

Before reducing power below 52% rpm on engines No. 1 and 6, turn off all equipment using alternator power and turn off both alternators. If alternator power is required for any reason, maintain engines No. 1 and 6 at 52% rpm or more.

3. 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 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

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 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.

- Before reducing power below 52% rpm on engines No. 1 and 6, turn off all equipment using alternator power and turn off both alternators. If alternator power is required for any reason, maintain engines No. 1 and 6 at 52% rpm or more.

3. Descend 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. 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, and vertical velocity indicators and visually check the terrain in order to ensure 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. Fuel Control Panel - SET, LIGHTS OUT (P)
   Pilot rechecks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE. Checks all fuel boost pressure warning lights out and transfers fuel quantity gage readings to copilot.

**WARNING**

If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. This will insure maximum fuel flow to all engines in case of emergency or low fuel quantities.

2. Landing Data Card - CHECKED & COMPLETE, BEST FLARE SPEED_____KNOTS (CP)
   Copilot recomputes gross weight and data card information, then relays to pilot pertinent data on best flare speed and stopping distance.

3. Landing Gear - FOUR DOWN, LEVER DOWN (P) - FOUR DOWN, FOUR GREEN (CP)
   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.
   e. Visually checks outrigger tires.

4. Wing Flaps - FULL DOWN (P)
   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.

**NOTE**

During flap extension, nose down trim has to be introduced to compensate for the trim changes which occur during flap transition.

5. Antiskid Switch - ON, LIGHT OUT (P)
   Pilot checks antiskid switch ON and amber light out.

6. Hydraulic Pressure & Quantity - CHECKED (CP)
   Copilot rechecks hydraulic pressures within operating range, fluid quantity up, and all lights out; checks emergency hydraulic pump switch in AUTO NORMAL.

Continued On Next Page

## BEFORE LANDING

**Continued**

7. Radar, Alternators & Automatic Pilot - AS REQUIRED (P-CP-O)
   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 slope off unless instrument approach is to be made.

   ① Copilot checks with observer that BNS is turned off before turning alternators off. Copilot turns alternators OFF unless power is needed.

**NOTE**

If units requiring alternator power are to be used, engines No. 1 and 6 must be operated at a minimum of 52%.

8. Airspeed & Altimeters - _____ KNOTS, _____ FEET (P-CP)
   Copilot and pilot check and compare simultaneous readings of airspeed and altitude.

9. Landing Lights On (Night) - AS REQUIRED (P)
   Pilot normally turns landing lights on at a minimum altitude of 500 feet above terrain.

**NOTE**

If weather conditions exist in which use of landing lights further restricts visibility, leave lights off until near runway threshold.

# 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 general procedures. These procedures produce the 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 2-8 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 2-11. Modification may be required to meet individual requirements. The normal approach 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 best 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.

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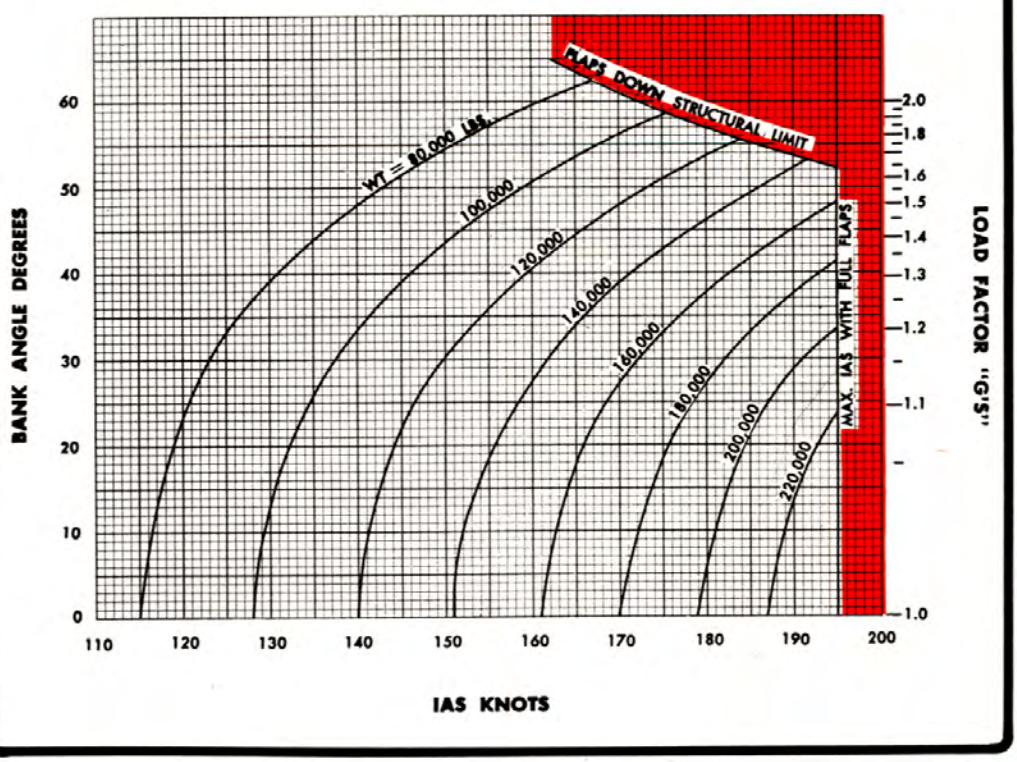
① Airplanes having BNS capabilities

# MINIMUM SPEEDS
## FOR MANEUVERING FLIGHT




**CONDITIONS:**

FLAPS FULL DOWN
SEA LEVEL TO
10,000 FEET

**REMARKS:**

FLAPS DOWN STRUCTURAL LIMIT CURVE IS INDEPENDENT OF IAS.

**DATE:** APRIL 1954

**DATA BASIS:**

FLIGHT TEST

**NOTE**

THESE MINIMUM SPEEDS FOR MANEUVERING FLIGHT PROVIDE THE SAME MARGIN OF SAFETY ABOVE FIRST STALL WARNING AS THAT PROVIDED FOR ONE "G" (NON-MANEUVERING) FLIGHT AT THE BEST FLARE SPEED.

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*Figure 2-8.*

### 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 slope 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 to a short runway in smooth air would be with the 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 an attitude such that the main gear will touch down simultaneously if sufficient power is retained to give almost 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 0.1 "g" would increase the stall speed of a 100,000-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 should first be stalled at 15,000 feet, gear and flaps down, as a check of the accuracy of airspeed and fuel quantity gage indications. (See "Stalls," section VI.) ***Speed should not be reduced to touchdown until reaching the runway threshold at an altitude not to exceed 5 or 6 feet.***

## GUST CORRECTION

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 tne 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 rpm, requiring from 12 to 20 seconds to accelerate from idle to 100% rpm. 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% rpm, but from idle to 55% rpm, 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. 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 chordwise, resulting in increased lift for that wing, while flow over the retreating wing becomes more spanwise 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

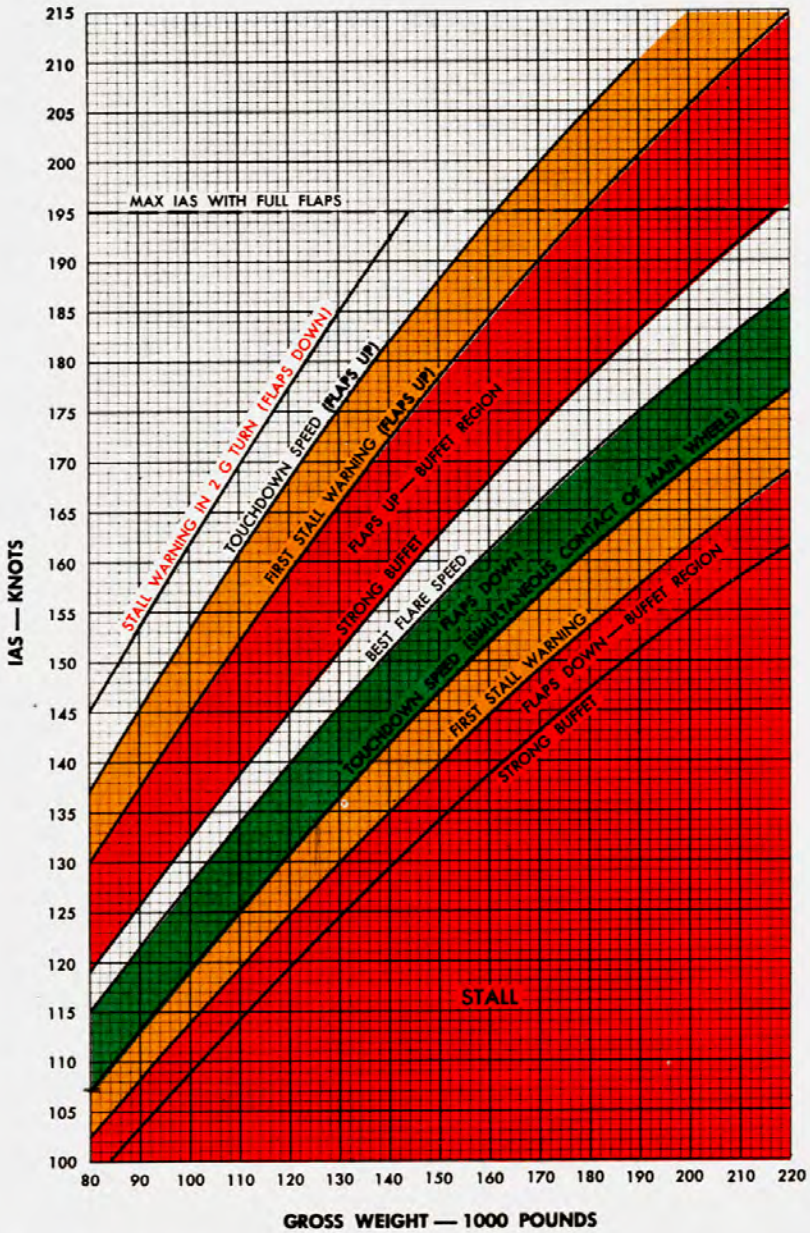
With the bicycle landing gear, the landing attitude of the airplane is fixed so that the speed for simultaneous touchdown of both gears is a safe margin above stall. The attitude is always the same at the touchdown speed corresponding to the actual landing gross weight. The front gear is well forward 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 above 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.

### NORMAL LANDING RUN

All landings except emergencies should be planned 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 and as a safety device in case of brake failure. Special emphasis during the approach should be given to correct approach speeds to ensure that the anticipated touchdown point is made good, rather than relying on the brake chute to correct for any overshooting tendency. Considering the operational runways normally available to the airplane where adequate stopping distance exists, normal landing procedure is to deploy the brake chute immediately after touchdown and to delay application of the brakes until the airplane has decelerated to about 40 knots. This procedure results in a reasonably short stopping distance without excessive wear on brakes and tires and, at the same time, decreases the possibility of a dangerous situation arising in case of brake failure. Whenever possible, the full length of runway available should be used for stopping. In many cases, it will be obvious to the pilot that the brake chute alone is sufficient to

# MINIMUM SPEEDS

NON-MANEUVERING FLIGHT ONE "G" LOAD FACTOR




**CONDITIONS:** SEA LEVEL TO 10,000 FT

**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

049974

*Figure 2-9.*

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 use of brakes only.

### STOPPING DISTANCE

When planning a landing, the estimated runway available (runway length beyond the anticipated touchdown point) should be compared with the "planned" stopping distance computed from the stopping distance charts in part 8 of the appendix. The planned stopping distance provides a criterion for deciding if the actual runway available is adequate for a safe stop without the aid of the brake chute. During normal landing procedures, if the brake chute failed to deploy, the pilot would immediately apply the brakes instead of waiting until 40 knots. Planned stopping distance takes this possibility into account and as such is based on brakes being applied at 80% of the touchdown velocity. This allows the pilot approximately 20 seconds after touchdown in which to recognize the chute failure and to commence braking. Thus, planned stopping distance is a realistic value when brake chute failure is experienced. If the estimated runway available is equal to or longer than the planned stopping distance computed from the chart, a safe stop is assured even though brake chute failure might occur. The normal stopping distance can then be computed and can be used as an indication of the actual distance required to stop when normal landing procedures are accomplished. It must be emphasized that stopping distances required in a given situation should not be accepted merely because they are less than the total runway available. In all cases, they should be compared to the runway which will remain beyond the anticipated touchdown point. If the anticipated touchdown point cannot be made good, the pilot should immediately start a go-around and initiate a new approach with special attention to a correct approach. If the estimated runway available is less than the planned stopping distance, the safety of the landing is conditioned by reliance on the brake chute. In this case, the pilot should, if possible, proceed to an alternate base with longer runways. If such a landing is unavoidable, the pilot should conduct the landing as given in section III under "Landing with Reliance on Brake Chute."

### BRAKE CHUTE DEPLOYMENT

Deployment of the brake chute 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.

**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.

For most effective use, the chute should be fully open at touchdown or as soon as possible thereafter. The deceleration effect of the brake chute drops off very rapidly as speed decreases. Normally, the pilot will deploy the 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.

**NOTE**

To ensure proper deployment of the brake chute, pull deployment handle with an even steady pull to the full extent of travel. Hold momentarily at end of travel.

### BRAKING TECHNIQUE

With antiskid operating, brake application may be started after touchdown as soon as the weight of the airplane has settled firmly on both main gear and the tendency to skip or bounce has been terminated.

**CAUTION**

If brakes are applied before the airplane has settled firmly on both main gear, the 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.

Efficiency of braking at high speed can be increased by applying slight back pressure to the control column, thus increasing the load on the rear gear. 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 "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.

**CAUTION**

Under no circumstances should the copilot aid the pilot on the brakes when adequate main system braking is available with normal effort. The brakes should not be applied by either the pilot or copilot placing his feet on the high side or top of the brake pedals. The additional pedal force can result in overriding the main system, activating the emergency system, and locking the main wheels.

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.

### BRAKE APPLICATION SPEEDS

For a normal landing, the speed of 40 knots for starting brake application is cited merely as a reference for controlling brake wear. In any landing situation, brakes should be applied by the pilot as needed to meet the demands of the prevailing conditions. Brakes may be applied consistently as high as 80 knots before significant wear will occur. If necessary, the pilot should not hesitate to apply brakes at any speed above 80 knots provided the airplane has settled firmly on both main gear. Brake wear may be increased at the higher speed but proper use of antiskid will produce effective braking well within the capabilities of the system.

**NOTE**

Operation of auxiliary 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 or 4 to maintain hydraulic pressure.

### 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 gear 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 chute deployed will cause undue wear. Jettison is accomplished by pulling the chute jettison handle through full travel. The copilot can check visually to ensure that the chutes have detached.

### 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. The curve in figure 2-10 shows wind angles and velocities relative to the runway which produce 90° crosswind components of 25 knots.

**25-KNOT CROSSWIND COMPONENTS**

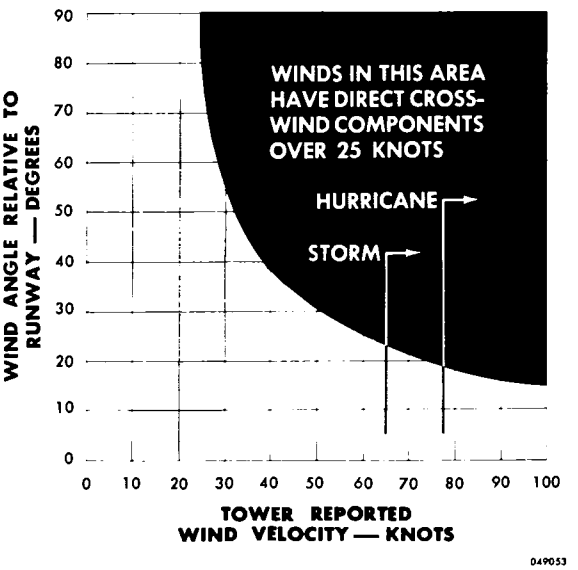



*Figure 2-10.*

### Control Technique

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.

### Steering

If it appears after touchdown that a greater range of front gear deflection is required than is available in TAKEOFF LAND position (12° right or left), 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 gear 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.

## 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 2-11, see figure 2-9. To estimate runway stopping distances, see part 8 of the appendix.

## LANDING WITH EXTREME FORWARD CENTER OF GRAVITY

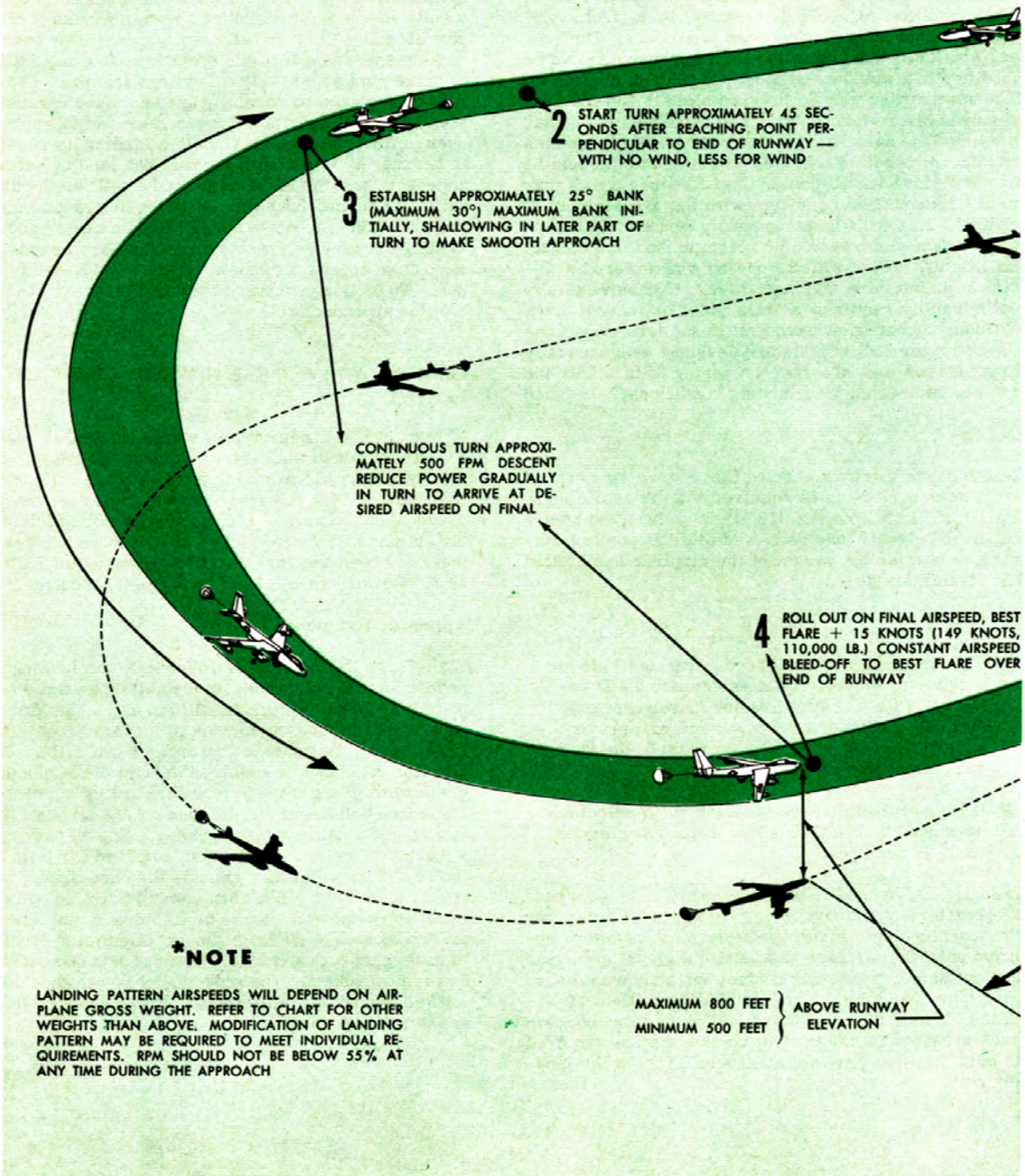
Normal fuel management procedures outlined in section VII will result in the center of gravity being approximately 12% to 18% MAC for most landings. However, when landings are required with very little fuel remaining or when proper fuel management cannot be followed, the cg may be forward of 10% MAC. Successful landings have been accomplished with the cg as far forward as 6.5% MAC, but a special technique is required.

### Approach Technique

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 A8-1 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.

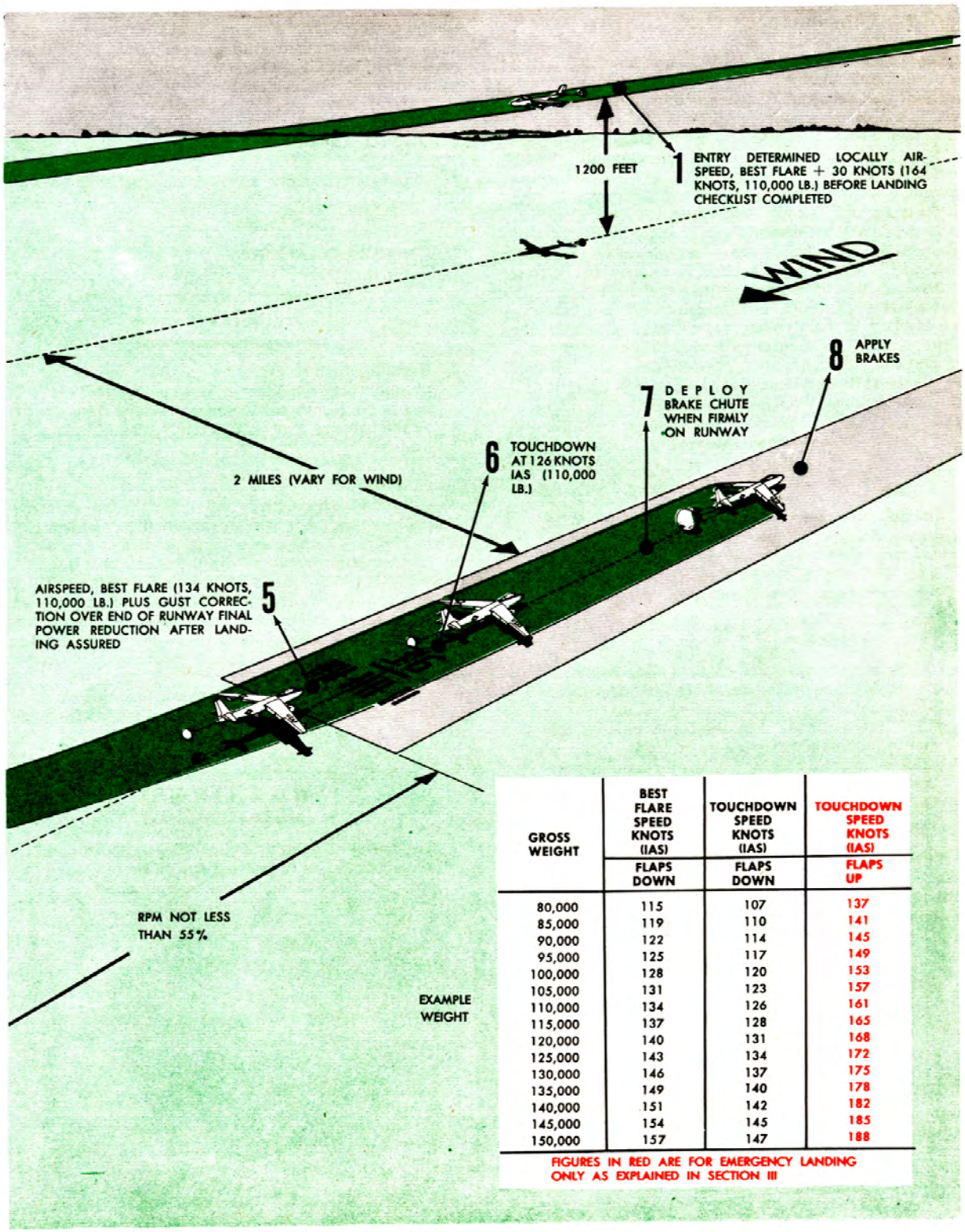
# LANDING PATTERN
*(TYPICAL)*

**(BASED ON AN AVERAGE LANDING GROSS WEIGHT OF 110,000 LB.)***




***NOTE**

LANDING PATTERN AIRSPEEDS WILL DEPEND ON AIRPLANE GROSS WEIGHT. REFER TO CHART FOR OTHER WEIGHTS THAN ABOVE. MODIFICATION OF LANDING PATTERN MAY BE REQUIRED TO MEET INDIVIDUAL REQUIREMENTS. RPM SHOULD NOT BE BELOW 55% AT ANY TIME DURING THE APPROACH




| GROSS WEIGHT | BEST FLARE SPEED KNOTS (IAS) FLAPS DOWN | TOUCHDOWN SPEED KNOTS (IAS) FLAPS DOWN | TOUCHDOWN SPEED KNOTS (IAS) 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 | 140 | 178 |
| 140,000 | 151 | 142 | 182 |
| 145,000 | 154 | 145 | 185 |
| 150,000 | 157 | 147 | 188 |

FIGURES IN RED ARE FOR EMERGENCY LANDING ONLY AS EXPLAINED IN SECTION III

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*Figure 2-11.*

## LANDING WITH APPROACH CHUTE DEPLOYED

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 effects 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," section III.

**NOTE**

Deployment of approach chute at speeds higher then 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.

## TOUCH-AND-GO LANDINGS

**WARNING**

If safety belt is removed in flight or on the ground while changing pilots, be careful that belt is not thrown over the right side of the seat as the belt end may inadvertently turn off some switches.

Touch-and-go landings will be the same as normal takeoff and landing except that 1) touch-and-go landings will not be made if the crosswind component exceeds 25 knots, 2) the maximum gross weight for shooting touch-and-go landings with the approach chute deployed is 115,000 pounds, 3) the brake chute will not be deployed after touchdown, 4) for the running takeoff all fuel selector switches will remain as set during the Touch-and-Go Landings checklist on the downwind leg, and 5) 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 & Inverters - CHECKED (CP)
   Copilot checks generator loadmeters and inverter voltages.

2. Hydraulic System - PRESSURE & QUANTITY CHECKED (CP)
   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 (P)
   Pilot places gear lever OFF and then DOWN to rearm antiskid system. Checks antiskid switch ON and amber light out.

4. Landing Gear - FOUR DOWN (P) - FOUR DOWN, FOUR GREEN (CP)
   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.
   e. Visually checks outrigger tires.

5. Fuel Control Panel - SET, LIGHTS OUT (P)
   Pilot rechecks No. 2 engine fuel selector switch on TME and all other fuel selector switches on TE.

**WARNING**

If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. This will ensure maximum fuel flow to all engines in case any main tank becomes completely empty.

Pilot checks all fuel boost pressure warning lights out.

6. Fuel Gage Control Switch - COPILOT (CP)

7. Landing Data Card - CHECKED & COMPLETE, BEST FLARE SPEED_____KNOTS (CP)
   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.

**WARNING**

In the event of go-around with OAT above 15° C (59° F) the engine stall prevention switch should be turned OFF so that engine acceleration time is not increased.

**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

Jettisoning of the approach chute is not recommended on normal go-around or when practicing touch-and-go landings. However, 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. Refer to part 3 of the appendix for charts presenting this information. 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.

Continued On Next Page

## AFTER LANDING

**Continued**

1. Brake Chute - DEPLOYED (P)
   Pilot deploys brake chute when airplane decelerates below brake chute maximum deployment speed.

2. Hydraulic Pressures - CHECKED (CP)
   Copilot checks main hydraulic system and main brake system pressures periodically during landing roll and at 30-second intervals while taxiing on congested areas.

3. Steering Ratio Selector - TAXI DETENT (P)
   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 (P)
   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. Parking Brakes - SET (P)
   Pilot sets parking brakes after turning off the runway.

6. Flaps - RETRACTED (P)
   Pilot places flap lever in UP. When flaps have retracted fully, pilot returns lever to OFF.

7. Deleted

8. Bomb Door Switch - OPEN, OFF (P)
   Pilot places bomb door switch in OPEN; bomb door position indicator will show bomb doors fully open by an "open" tab. Places switch in OFF.

9. Cabin Pressure Release Handle - PULLED (P)

10. Canopy - AS REQUIRED (P)

11. Throttles 1, 2, 5 & 6 - CUTOFF (P)
    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. During night operation, loadmeters will be monitored to prevent overload.

**CAUTION**

Postshutdown 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.

12. Fire Shutoff Switches 1, 2, 5 & 6 - PULLED (P)

13. Fuel Selector Switches 1, 2, 5 & 6 - TE (P)

## AFTER PARKING

1. Parking Brakes - SET (P)

2. Inverter Switches - OFF (P-CP)
   Pilot positions instrument inverter switch to OFF; "Bus Power Off" red light should illuminate. Copilot places main, secondary, and spare inverter power switches to OFF; main and secondary "Bus Pwr Off" red indicator lights should illuminate.

3. Windshield Defrost, Anti-Ice & Pitot Heat Switches - OFF (P)

4. Steering Ratio Selector Lever - TOW DETENT (P)

5. Throttles 3 & 4 - CUTOFF (P)
   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**

Postshutdown 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. This holding period permits the engine to scavenge the oil system properly and the engine to cool properly, preventing seizure of the shroud ring.

6. Fire Shutoff Switches No. 3 & 4 - PULLED (P)

7. Fuel Selector Switches No. 3 & 4 - TE (P)

8. Controls - LOCKED & STOWED (P) - STOWED (CP)
   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 controls and stow columns.

9. Power Control Switches - OFF (P)

10. Emergency Hydraulic Pump Switch - OFF (CP)

11. Chocks in Place - BRAKES OFF (P)

12. Oxygen Regulators - 100% OXYGEN, OFF, MASTER WARNING OFF (P) - 100% OXYGEN OFF (CP-O)
    Pilot places diluter lever on 100% OXYGEN, supply lever OFF, and master oxygen warning control switch OFF. Copilot and observer place diluter levers on 100% OXYGEN and supply levers OFF.

**NOTE**

Placing diluter lever to the 100% OXYGEN position prevents contamination of the oxygen regulator.

Continued On Next Page

## AFTER PARKING

**Continued**

13. Radios & IFF - OFF (P-CP)

14. Ejection Seats - PINS INSTALLED (P-CP-O)
    Pilot, copilot, and observer install all initiator safety pins with streamers attached.

15. Lights - OFF (P-CP-O)

16. Battery Switch - OFF (P)

## POSTFLIGHT INSPECTION

1. Ground Locks - IN PLACE (P)
   Pilot ensures that ground locks have been installed on the forward main, aft main, both outrigger gears, and bomb doors.

2. Visual Inspection - COMPLETED (P)

3. DD Form 781 - COMPLETED & SIGNED (P)

CUT ON LINE

# TB-47B NORMAL PROCEDURES CONDENSED CHECKLIST

## NOTE

The following checklist is a condensed version of the airplane checklist. This checklist is normally accomplished by the copilot calling off the items to the crew; however, in order to expedite completion of the preflight inspection, the pilot may, at his discretion, split the "Exterior Inspection." If the split method is used, the inspection of the right side of the airplane will be accomplished by the pilot while the copilot is inspecting the left side. The pilot and copilot will meet at the empennage section. The checklist items will be called off by qualified ground crew members or other flight crew members during completion of the "Exterior Inspection" using the split method. All responses are shown in capital letters. For identification purposes those responses made by specific crew members are indicated as follows: (P) for pilot, (CP) for copilot, (O) for observer, and (GO) for ground observer.

## AIRPLANE SERIAL REFERENCES

① AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

② Some airplanes

## BEFORE INTERIOR INSPECTION

1. Briefing - COMPLETED (P)
2. Equipment Check - COMPLETED (P)
3. External Power - OFF (P)

T.O. 1B-47B-1
31 October 1956

1

CUT ON LINE

T.O. 1B-47B-1
31 October 1956

INTERIOR PREFLIGHT INSPECTION

2

1. Ballout Spoiler Air Bottle - CHECKED (P)
2. Main AC Power Shield - CHECKED, CIRCUIT BREAKERS IN (P) ▌
3. First Aid Kit - CHECKED (P)
4. Aft Extra Seat Oxygen Panel - CHECKED & OFF (P)
5. Fire Extinguisher - CHECKED (P)
6. Hand Axe - STOWED (P)
7. Forward Walkaround Bottle - CHECKED (P)
8. Forward Extra Seat Oxygen Panel - CHECKED & OFF (P)
9. If a qualified observer is not flying:
   a. Observer's Escape Hatch - SECURED (P)
   b. Periscopic Port - CLOSED (P)
   c. Observer's Ejection Seat
      (1) Initiators, Safety Pins & Streamer - CHECKED, PINS IN (P)
      (2) Leg Braces & Latch Triggers - CHECKED (P)
      (3) Torque Tubes - CHECKED (P)
      (4) Whifflletree - ENGAGED (P)
      (5) Catapult Initiator & Safety Pin - CHECKED & INSTALLED (P)
      (6) Hatch Static Cable - ATTACHED (P)
      (7) Quick-Disconnect - CHECKED (P)
      (8) Downward Ejection Hatch - LOCKPIN ENGAGED, PRESSURE CHECKED (P)
      (9) Shoulder Harness & Inertia Reel - CHECKED (P)
      (10) If observer's seat is to be unoccupied: Safety Belt & Shoulder Harness - BUCKLED (P)
      (11) Seat Position - FACING FORWARD (P)
   d. Radar Pressurizing Control Switch - OFF (P) ◀
   e. Radar Power Control Switch - OFF (P) ◀
   f. Radar Computer Function Switch - OFF (P) ◀
   g. Three-Phase Inverter Switch - OFF (P) ◀
   h. Observer's Oxygen Panel - CHECKED & OFF (P)
   i. Observer's Upper Air Selector Lever - OFF (P)

CUT ON LINE

① j. Bombsight Cover & Heat Switch - CLOSED & OFF (P)
① k. Salvo & Master Bomb Control Switches - OFF (P)
① l. Camera Master Switch - ON (P) (if vertical camera installed)
① m. BNS (K4) Heat & Light Switches - OFF (P)
n. Observer's Lower Air Heater Switch - OFF (P)
o. Circuit Breakers - IN (P)
p. Loose Equipment - SECURED (P)

10. Letdown Books & Facility Charts - CHECKED (CP)
11. UHF - SET & OFF (CP)
12. Aft Walkaround Bottle - CHECKED (CP)
13. Aft Extra Seat - CHECKED (CP)
14. Canopy Emergency Jettison Air Bottle - CHECKED (CP)
15. Loose Equipment - CHECKED (CP)
16. ARC-21 Antenna Coupler Insulator - CHECKED (CP)
17. Gunner's Air Outlet - SET (CP)
18. Circuit Breakers - CHECKED (CP)
19. Ejection Seats
    a. Left & Right Handgrips - FULL DOWN (P-CP)
    b. Copilot Ejection Footrests - STOWED (CP)
    c. Safety Pins - INSTALLED (P-CP)
    d. Initiator Sear Pins - CHECKED (P-CP)
    e. Static Line Lanyard - CONNECTED (P-CP)
    f. Quick-Disconnect - CHECKED (P-CP)
    g. Shoulder Harness & Inertia Reel - CHECKED (P-CP)
20. Top of Engines, Wings & Fuselage - CHECKED (P-CP)
21. Canopy, Windshield, Periscopic Port & Yaw String - CHECKED (P-CP)
22. Emergency Turn & Slip - CHECKED & NORMAL (P-CP)
23. Emergency Keyer - OFF & SAFETIED (P)
24. Anti-Icing Overheat Control Switch - NORMAL (P)
25. Bomb Door Switch - OFF (P)
26. Approach Chute Deployment Switches - DOOR CLOSED (P-CP)
27. Landing Gear Lever - DOWN (CP-P)
28. Steering Ratio Selector - TOW DETENT (P)
29. Deleted
30. Ignition Switches (six) - OFF (P)
① 31. Bomb Salvo Switch - OFF & SAFETIED (P)
32. Throttles - CUTOFF (CP-P)
33. Wing Flap Lever & Emergency Switches (two) - OFF (CP-P)
34. Emergency Landing Gear Retraction Switches - OFF (CP-P)
35. Canopy Lever - OFF (P)

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CUT ON LINE

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36. Battery Switch - ON (P) - CHECKED (CP)
37. DC Bus Selector - CHECKED, NORMAL (CP) 4
38. Battery Switch - OFF (P)
39. Alarm Bell - CHECKED & OFF (P-CP-O)
40. External Power - ON THE LINE (CP)
41. Oxygen & Interphone - CREW REPORTS
42. All Lights & Press-to-Test Lights - CHECKED (P-CP)
43. Inverters - CHECKED & ON (P-CP)
44. Fuel System & Panel - CHECKED (P-CP)
45. Hydraulic System - CHECKED & ON (CP)
46. Radios - ON (P-CP)
47. Control Column - ENGAGED (P-CP)
48. Surface Control Lock - FORWARD, UNLOCK DETENT (P)
49. Power Controls - ON, LIGHTS CHECKED (P)
50. Automatic Pilot - CHECKED & OFF (P)
51. Wing Flaps - FULL DOWN (P-CP)
52. Trim Tabs - CHECKED (P-GO)
53. Directional Damper Switch - ON (P)
54. Flight Control Operation - CHECKED, POWER ON & OFF (P-GO)
55. Directional Damper Switch - OFF (P)
56. Lock Flight Controls - LOCKED, STOWED (P) - STOWED (CP)
57. Deleted. ▮
58. Instruments - CHECKED (P-CP)
59. Fire Warning & Overheat Lights - TESTED (P)
60. Radios - CHECKED, OFF (P-CP)
61. Inverters - OFF (P) - AS REQUIRED (CP)
62. ELGE System - CHECKED (CP)
63. Crawlway - CLEAR (CP)
② ◀ 64. Refrigeration Unit Oil Level - CHECKED (CP) ▮
65. Left Forward Main Fuel Boost Pump - CHECKED (CP)
66. Service Valves - SAFETIED OFF (CP)
67. Bulkhead & Crawlway Doors - CLOSED (CP)
68. Main Entry Door Release Mechanism - LOCKED (CP)

CUT ON LINE

**EXTERIOR INSPECTION**

A. NOSE SECTION
1. External DC Power - AS REQUIRED (P)
2. Left Pitot Cover - REMOVED (P)
3. Nose Window & Bombsight - CLEAN & UNBROKEN (P)
4. Cabin Air Emergency Depressurization Door - FLUSH (P)
5. Right Pitot Cover - REMOVED (P)
6. Right Forward Side of Nose Section - CHECKED (P)
7. Static Ports - CLEAR (P)
8. Observer's Downward Ejection Hatch - FLUSH, HANDLE STOWED (P)
9. Radome - FLUSH & LATCHED (P)
10. Forward Auxiliary Boost Pumps - CHECKED (P)

B. FORWARD WHEEL WELL
1. Wheel Chocks & Landing Gear Ground Lock - IN PLACE (P)
2. Bomb Bay Door Ground Locks - IN PLACE (P)
3. Right Door, Roller & Actuator - CHECKED (P)
4. Right Wheel, Tire, Brakes & Antiskid Cover - CHECKED (P)
5. Brake Line & Gear Squat Switches - CHECKED (P)
6. Left Wheel, Tire, Brakes & Antiskid Cover - CHECKED (P)
7. Oleo Strut - PROPER EXTENSION, NO LEAKS (P)
8. Spoiler Door Gage - CHECKED (P)
9. Steering Mechanism - CHECKED (P)
10. Hydraulic System - CAP SECURE, NO LEAKS (P)
11. Fuel Lines - CONDITION CHECKED (P)
12. Left & Right Power Shield Covers - SECURE & LATCHED (P)
13. Right Forward Main Boost Pump - CHECKED (P)
14. Forward Power Shield Covers (three) - SECURE & LATCHED (P)
15. ELGE Cables, Gear Motors & Cannon Plugs - CHECKED (P)
16. Left Door, Actuator & Roller - CHECKED (P)
17. Gear Door Uplatches - UNLATCHED (P)

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CUT ON LINE

C. FORWARD RIGHT SIDE FUSELAGE

1. Forward Right Side Fuselage & Fuel Drains - CHECKED (P)
2. Wing & Strut Access Panels - SECURE. NO LEAKS (P)

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D. INBOARD NACELLE

1. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED (P)
2. Strut Fairing & Torsion Links - CHECKED (P)
3. Oleo Strut, Extension & Seals - NO LEAKS (P)
4. Wheel & Tire - CHECKED (P)
5. Ground Lock - IN PLACE (P)
6. Outrigger Doors & Actuators - CHECKED (P)
7. Nacelle Panel Latches (eight) & Locks (four) - SECURE (P)
8. Left Nacelle Panels - SECURE. NO LEAKS (P)
9. Air Intakes & Accessory Domes - CHECKED. SECURE (P)
10. Right Nacelle Panels - SECURE. NO LEAKS (P)
11. Wing & Strut Access Panels - SECURE. NO LEAKS (P)

E. OUTBOARD NACELLE

1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS (P)
2. Left Nacelle Panels - SECURE. NO LEAKS (P)
3. Air Intake & Accessory Dome - CHECKED. SECURE (P)
4. Right Nacelle Panels - SECURE (P)

F. RIGHT WING

1. Aileron Power Control Unit - CHECKED (P)
2. Wing Access Panels - SECURE. NO LEAKS (P)
3. Top of Wing - CHECKED (P)
4. Aileron & Trim Tab - CHECKED (P)
5. Fuel Tank Caps - CHECKED. NO LEAKS (P)
6. Wing Trailing Edge - CHECKED (P)

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G. AFT RIGHT SIDE FUSELAGE, REAR WHEEL WELL & REAR COMPARTMENTS
1. Right Aft Boost Pump, Center Main Tank - CHECKED (P)
2. Right Fuselage - CHECKED (P)
3. Single Point Refueling Cap - SECURE (P)
4. Wheel Chocks & Landing Gear Ground Lock - IN PLACE (P)
5. Right Door, Roller & Actuator - CHECKED (P)
6. Right Wheel, Tire, Brake & Antiskid Cover - CHECKED (P)
7. Brake Lines & Gear Squat Switch - CHECKED (P)
8. Left Wheel, Tire, Brake & Antiskid Cover - CHECKED (P)
9. Oleo Strut - PROPER EXTENSION. NO LEAKS (P)
10. Hydraulic Lines, Fuel Lines & Shutoff Valves - NO LEAKS (P)
11. Left Door, Actuator & Roller - CHECKED (P)
12. Aft Power Shield Covers - SECURE. CIRCUIT BREAKERS IN (P)
13. ELGE Cables, Gear Motors & Cannon Plugs - CHECKED (P)
14. Gear Door Uplatches - UNLATCHED (P)
15. Aft Main Boost Pumps (four) - CHECKED (P)
16. Camera Compartment - CHECKED (P)
17. Battery Compartment - CHECKED (P)
18. Rudder-Elevator Power Control - CHECKED (P)
19. Brake Chute - MECHANISM CHECKED, INSTALLED, PILOT CHUTE RETAINING PIN(S) AND CABLE REMOVED, DOORS FLUSH (P)
20. Approach Chute - CHECKED. INSTALLED, DOOR FLUSH (P)

H. EMPENNAGE
1. Empennage - CHECKED (P)
2. Left Side Vertical Stabilizer - CHECKED, AIR DUCTS OPEN (P)

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CUT ON LINE

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I. AFT LEFT SIDE FUSELAGE
1. Left Aft Boost Pump, Center Main Tank - CHECKED (P) 8
2. Left Fuselage - CHECKED (P)
3. Bomb Bay Tank Boost Pumps - CHECKED (P)

J. BOMB BAY
1. Left Bomb Bay Fuel Lines & Boost Pumps - CHECKED (P)
2. Left Junction Box Covers - SECURE & LATCHED (P)
3. Oxygen Supply Lever & Diluter Lever - OFF & 100% (P)
4. Interphone Cord - STOWED (P)
5. Bomb Bay Light - OFF (P)
6. Bomb Door Accumulator - CHECKED (P)
7. Bomb Door Uplatches & Microswitch - UNLATCHED & CHECKED (P)
8. Spoilers & Spoiler Depressurizing Valve - CHECKED, SAFETIED OFF (P)
9. Right Junction Box Covers - SECURE & LATCHED (P)
10. Right Bomb Bay Fuel Lines & Boost Pumps - CHECKED, NO LEAKS (P)

K. LEFT WING
1. Flap Motors, Solenoids & Wiring - SECURE (P)
2. Wing Trailing Edge - CHECKED (P)
3. Top of Wing - CHECKED (P)
4. Aileron & Trim Tab - CHECKED (P)
5. Aileron Power Control Unit - CHECKED (P)
6. Wing Access Panels - SECURE, NO LEAKS (P)

L. OUTBOARD NACELLE
1. Aft Nacelle Fairing, Turbine, Cone & Tailpipe - CHECKED, NO LEAKS (P)
2. Left Nacelle Panels - SECURE, NO LEAKS (P)
3. Air Intake & Accessory Dome - CHECKED, SECURE (P)
4. Right Nacelle Panels - SECURE (P)

CUT ON LINE

M. INBOARD NACELLE
1. Wing & Strut Access Panels - SECURE, NO LEAKS (P)
2. Aft Nacelle Fairings, Turbines, Cones & Tailpipes - CHECKED (P)
3. Strut Fairing & Torsion Links - CHECKED (P)
4. Oleo Strut, Extension & Seals - NO LEAKS (P)
5. Wheel & Tire - CHECKED (P)
6. Ground Lock - IN PLACE (P)
7. Outrigger Doors & Actuators - CHECKED (P)
8. Nacelle Panel Latches (eight) & Locks (four) - SECURE (P)
9. Left Nacelle & Strut Panels - SECURE, NO LEAKS (P)
10. Air Intake & Accessory Domes - CHECKED, SECURE (P)
11. Right Nacelle Panels - SECURE, NO LEAKS (P)
12. Wing & Strut Access Panels - SECURE, NO LEAKS (P)

N. FORWARD LEFT SIDE FUSELAGE
1. Forward Left Side Fuselage & Fuel Drains - CHECKED (P)

**BEFORE STARTING ENGINES**

1. Ejection Seat Safety Pins - CREW REPORTS
2. Safety Belt & Shoulder Harness - FASTENED (P-CP)
3. Seats & Pedals - ADJUSTED (P-CP)
4. Control Column - ENGAGED (P-CP)
5. Mike Cord, Mask & Bailout Bottle - CONNECTED (P-CP-O)
6. Lights - AS REQUIRED (P-CP)
7. Oxygen Check - CREW REPORTS
8. Canopy Jettison Handles - IN PLACE (P-CP)
9. Canopy Release Handles - IN PLACE (P-CP)
10. ESP Switch - OFF (P)
11. Inverter Switches - MAIN, LIGHTS OUT (P) - ON, VOLTAGES & LIGHTS CHECKED (CP)

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12. Fire Shutoff Switches (six) - DEPRESSED (P)
13. Landing Gear Lever, Indicators & EDGE Lights - LEVER & FOUR DOWN (P) - FOUR GREEN, FOUR DOWN (CP)
14. Parking Brakes - SET (P)
15. Remove Bomb Door Locks, Gear Locks & Grounding Wire - WILCO (GO)
16. Air Conditioning Master Switch - ON (P)
17. Heat Selector Switch - AUTOMATIC, RHEOSTAT SET (P)
18. Emergency Hot Air Shutoff Handle - DEPRESSED (CP)
19. Cabin Air Selector Switch - AIR COMP (P)
20. Cabin Pressure Switch - PRESS NORMAL (P)
21. Exterior Surfaces & Pitot Heat Switches OFF (P)
22. Windshield Anti-Ice Switch - NORMAL (P)
23. Windshield Defrost - CHECKED (P)
24. Deleted
25. Low Speed Warning Switch - ON (P)
26. Antiskid Switch - ON, LIGHT OUT (P)
27. Surface Control Lock - FORWARD, UNLOCK DETENT (P)
28. Throttles - CUTOFF (P-CP)
29. Brake Chute Deploy & Jettison Handles - BOTH CHECKED (P-CP)
30. Wing Flaps - CHECKED & UP (CP-GO)
31. Cabin Pressure Release Handle - DEPRESSED (P)
32. Radios & IFF - ON, STANDBY (P)
33. Fuel Control Panel - SET (P)
34. Bomb Door Locks & Gear Locks - IN SIGHT, STOW (P)
35. Generator Switches (six) - RESET & OFF (CP)
36. Alternator Switches - RESET & OFF (CP)
37. Emergency Hydraulic Pump Switch - AUTO NORMAL, PRESSURE & QUANTITY CHECKED (CP)
38. Circuit Breakers - IN (CP)
39. N-1 Compass - SYNCHRONIZED (O)
40. Radio Call - COMPLETED (P)

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**STARTING ENGINES**

1. Ignition Switches (six) - NORMAL (P)
2. Ready to Start Engines - READY (P-CP-GO)
3. Start engines
4. Starter & Ignition Switches - OFF (P)

**BEFORE TAXIING**

1. Hydraulic Pressure & Quantity - CHECKED (CP)
2. Engines No. 1 & 6 - 52% RPM (P) - ALTERNATORS NORMAL, BUS SELECTOR NORMAL, VOLTAGE CHECKED (CP)
3. Entrance Door - CLOSED & LOCKED (CP) - CLOSED & LATCHED (GO)
4. Clear Bomb Doors - CLEAR (GO) - CLOSED (P-GO)
5. Battery Switch - LH BUS NORMAL (P)
6. Generator Switches (six) - ON (CP)
7. Cabin Air Selector Switch - AIR COMP (P)
8. Windshield Defrost & Pitot Heat - SET (P)
9. Exterior Inspection of Engines, External Power, Chocks & Interphone - ENGINE INSPECTION COMPLETE (GO), REMOVED & IN SIGHT (P)
10. Generator Loads & Voltages - CHECKED (CP)
11. Power Controls - ON, LIGHTS OUT (P)
12. Steering Ratio Selector Lever - TAXI DETENT (P)
13. Auxiliary-Fuel-to-Engines Valve - CHECKED (P)
14. IFF - SET (P)
15. Radio Call - COMPLETED (P)
16. Clear to Taxi on Crew Chief's Signal - READY TO TAXI (P)

**WHILE TAXIING**

1. Brakes & Steering - CHECKED (P)
2. Hydraulic Pressure & Quantity - CHECKED (CP)
3. Turn & Slip Indicators - CHECKED (P-CP)
4. Directional Indicator - CHECKED (P-CP)

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**BEFORE LINEUP**

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1. Parking Brakes - SET (P)
2. Flight Instruments - CHECKED (P-CP)
3. Power Controls - ON. LIGHTS OUT (P)
4. Wing Flaps - CHECKED. FULL DOWN (CP) - FULL DOWN (P)
5. Control Column - ENGAGED (P-CP)
6. Flaperons - CHECKED (P)
7. Trim Tabs - SET (P)
8. Fuel Control Panel - SET. LIGHTS OUT (P)
9. Canopy - CLOSED. LATCHED LOCKED (P) - PINS & HOOKS IN PLACE (CP)
10. Canopy Lockpins - ENGAGED (CP)
11. Canopy Latch Reset - HORIZONTAL (P)
12. Circuit Breakers - IN (CP)
13. Landing Lights (Night) - ON (P)
14. Radio Call - COMPLETED (P)
15. Takeoff Data - REVISED (if applicable) (CP) - CHECKED (P)

**BEFORE TAKEOFF**

1. Steering Ratio Selector Lever - TAKEOFF LAND DETENT. STEERING CHECKED (P)
2. Brakes - HOLDING (P)
3. Deleted
4. Throttles Open - OIL. FUEL. EGT OK. 100% (P) - ALTERNATORS & GENERATORS CHECKED (CP)
5. Engines & Wings - CHECKED (P-CP)

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B/RB-47 MODEL

# TAKEOFF DATA

Critical Field Length_____TO Dist_____

Runway Grade Correction_____

Min ATO Req_____Elevator Set____

First Stall Warning (Flaps Up).....IAS_____

ACCELERATION CHECK . . . . . .Dist_____IAS____
GO-NO-GO CHECK . . . . . .Dist_____IAS____
FIRE ATO . . . . . IAS____
TAKEOFF . . . . . IAS____
CLIMB . . . . . IAS____

Conditions

Runway Gradient_____

GROSS WT_____FLD PA_____

Runway Length_____% MAC_____OAT_____

## EMERGENCY LANDING DATA

Planned Stop Dist (No Brake Chute)_____

START FINAL . . . . . IAS____
BEST FLARE . . . . . IAS____

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**TAKEOFF & INITIAL CLIMB**

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1. Copilot Calls Acceleration Check Speed and Distance, Go-No Go Check Speed and Distance & Takeoff Speed
2. Landing Gear - UP (P-CP)
3. Wing Flaps - UP (P-CP)
4. Landing Gear & Wing Flaps - LEVERS OFF, ELGE LIGHTS OUT (CP)
5. Climb Speed - CLIMB POWER SET (P)
6. Crew Station Check - CREW REPORTS (10,000 FEET & LEVEL OFF)

**BEFORE DESCENT**

1. Safety Belt & Shoulder Harness - FASTENED (P-CP-O)
2. Directional Damper - OFF (P)
3. Temperature Rheostat - ADJUSTED (P)
4. Windshield Anti-Ice, Defrost & Pitot Heat Switches - SET (P)
5. Low Speed Warning Switch - ON (P)
6. Power Controls - ON, LIGHTS OUT (P)
7. Fuel Control Panel - SET, LIGHTS OUT (P)
8. Landing Data Card - COMPLETED, GROSS WEIGHT _____, BEST FLARE SPEED_____KNOTS, STOPPING DISTANCE (NO BRAKE CHUTE)_____(CP)
9. Circuit Breakers - IN (CP)
10. Hydraulic Pressures & Quantity - CHECKED (CP)
11. Radio Call - ALTIMETER (P-CP)
12. Engine Stall Prevention Switch - SET (P)
13. Pilot Calls Drag Gear Down - DOWN (CP)

**BEFORE LANDING (SHORT)**

1. At Low Altitude Before Landing Check - GEAR DOWN, FLAPS FULL DOWN (P) - FOUR DOWN, FOUR GREEN, FLAPS FULL DOWN, HYDRAULIC SYSTEM CHECKED, READY TO LAND (CP)

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B/RB-47 Model

# LANDING DATA

**Conditions**

Runway Gradient_____

GROSS WT_____ Fld PA_____

Runway Length_____ % MAC_____ OAT_____

PLANNED STOP DIST (No Brake Chute)_____

START FINAL ..... IAS_____

BEST FLARE ..... IAS_____

## BEST FLARE SPEEDS (FULL FLAPS)

| | |
|---|---|
| 80,000 — 115 | 120,000 — 140 |
| 85,000 — 119 | 125,000 — 143 |
| 90,000 — 122 | 130,000 — 146 |
| 95,000 — 125 | 135,000 — 149 |
| 100,000 — 128 | 140,000 — 151 |
| 105,000 — 131 | 145,000 — 154 |
| 110,000 — 134 | 150,000 — 157 |
| 115,000 — 137 | 160,000 — 161 |

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**BEFORE LANDING**

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1. Fuel Control Panel - SET, LIGHTS OUT (P)
2. Landing Data Card - CHECKED & COMPLETE, BEST FLARE SPEED _____ KNOTS (CP)
3. Landing Gear - FOUR DOWN, LEVER DOWN (P) - FOUR DOWN, FOUR GREEN (CP)
4. Wing Flaps - FULL DOWN (P)
5. Antiskid Switch - ON, LIGHT OUT (P)
6. Hydraulic Pressure & Quantity - CHECKED (CP)
7. Radar, Alternators & Automatic Pilot - AS REQUIRED (P-CP-O)
8. Airspeed & Altimeters - _____ KNOTS, _____ FEET (P-CP)
9. Landing Lights On (Night) - AS REQUIRED (P)

**TOUCH-AND-GO LANDINGS**

1. Generators & Inverters - CHECKED (CP)
2. Hydraulic System - PRESSURE & QUANTITY CHECKED (CP)
3. Antiskid - REARMED, GEAR LEVER DOWN, LIGHT OUT (P)
4. Landing Gear - FOUR DOWN (P) - FOUR DOWN, FOUR GREEN (CP)
5. Fuel Control Panel - SET, LIGHTS OUT (P)
6. Fuel Gage Control Switch - COPILOT (CP)
7. Landing Data Card - CHECKED & COMPLETE, BEST FLARE SPEED _____ KNOTS (CP)

**AFTER LANDING**

1. Brake Chute - DEPLOYED (P)
2. Hydraulic Pressures - CHECKED (CP)
3. Steering Ratio Selector - TAXI DETENT (P)
4. Brake Chute & Approach Chute - JETTISONED (P)
5. Parking Brakes - SET (P)
6. Flaps - RETRACTED (P)
7. Deleted
8. Bomb Door Switch - OPEN, OFF (P)
9. Cabin Pressure Release Handle - PULLED (P)

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10. Canopy - AS REQUIRED (P)
11. Throttles 1, 2, 5 & 6 - CUTOFF (P)
12. Fire Shutoff Switches 1, 2, 5 & 6 - PULLED (P)
13. Fuel Selector Switches 1, 2, 5 & 6 - TE (P)

**AFTER PARKING**

1. Parking Brakes - SET (P)
2. Inverter Switches - OFF (P-CP)
3. Windshield Defrost, Anti-Ice & Pitot Heat Switches - OFF (P)
4. Steering Ratio Selector Lever - TOW DETENT (P)
5. Throttles 3 & 4 - CUTOFF (P)
6. Fire Shutoff Switches No. 3 & 4 - PULLED (P)
7. Fuel Selector Switches No. 3 & 4 - TE (P)
8. Controls - LOCKED & STOWED (P) - STOWED (CP)
9. Power Control Switches - OFF (P)
10. Emergency Hydraulic Pump Switch - OFF (CP)
11. Chocks in Place - BRAKES OFF (P)
12. Oxygen Regulators - 100% OXYGEN, OFF, MASTER WARNING OFF (P) - 100% OXYGEN OFF (CP-O)
13. Radios & IFF - OFF (P-CP)
14. Ejection Seats - PINS INSTALLED (P-CP-O)
15. Lights - OFF (P-CP-O)
16. Battery Switch - OFF (P)

**POSTFLIGHT INSPECTION**

1. Ground Locks - IN PLACE (P)
2. Visual Inspection - COMPLETED (P)
3. DD Form 781 - COMPLETED & SIGNED (P)

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CUT ON LINE

# PILOT OBSERVER CONDENSED CHECKLIST

**NOTE**

The following checklist is applicable only to BNS airplanes. This checklist is to be read by the pilot or copilot to the observer; all replies are made by the observer.

## ENTRY INTO GRID NAVIGATION

1. Polar Angle Dial - SET
2. Pole Switch - SET
3. Navigation Method Control - POLAR
4. BNS Grid Heading - CHECKED AGAINST N-1
5. Lat-Long Counters - SET TO APPROXIMATE GRID VALUE
6. Wind Dials & Lat-Long Counters - SET TO GRID
7. Grid Heading - CHECKED
8. N-1 Compass - UNSLAVED & SET TO GRID HEADING
9. Aircraft Heading - CORRECTED
10. BNS Heading - CORRECTED

## EXIT FROM GRID NAVIGATION

1. Exit Point - DETERMINED
2. Lat-Long Counters - RESET
3. Polar Angle - RESET
4. Navigation Method Control - POST POLAR
5. Wind Dials & Lat-Long Counters - RESET
6. N-1 Compass - RESET TO MAG HEADING & RESLAVE
7. True Heading - CHECKED

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**BOMBING EQUIPMENT CHECK** **2**

1. Safety Check - COMPLETED
2. Sighting Switch - OB
3. Forward Sighting Switch - DEPRESSED
4. Function Switch - BOMB
5. Tracking Control - TG TO 120, CI AZ CENTERED
6. ATF Setting Control - CHECKED
7. Trail Setting Control - CHECKED
8. PDI - LEFT, RIGHT, CENTERED
9. Auto Pilot Control - AUTOMATIC (if applicable)
10. PDI & Auto Pilot - CHECKED
11. Indicator Light Switch - CHECKED, ON
12. Bomb Power Switch - ON
13. UHF Radio - ON, UNUSED CHANNEL
14. Tone Control - ON
15. Release Check - COMPLETED
16. Bomb Power Switch - OFF
17. Auto Pilot Control - TO PILOT
18. Function Switch - NAV
19. Crosshairs - SET 15 NM
20. Offset Switch - IN, CROSSHAIRS MOVE, OUT
21. Radar Pressure - CHECKED IN GREEN

**PRE-IP (Called for by observer before reaching IP)**

1. Aerial Camera Intervalometer - ON (B-8) OR BOMB-SPOT NIGHT RECON (B-7)
2. Camera Doors - OPEN (if applicable)
3. Bombing Mode Switch - SYNC
4. Offset Data - N-S_____FT, E-W_____FT
5. Ballistics - TR_____SEC, TRAIL_____FT
6. Altitude - MEASURED & COMPUTED
7. Wind Run - ACCOMPLISHED
8. Lat-Long Counters - RESET
9. Mag Var - SET_____°
10. Oxygen Control - 100%
11. TAS - TAS READS_____KNOTS
12. Camera Data Plates - COMPLETED
13. O-15 Camera - ON, 1:4 (50 miles from IP)
14. O-23 Camera - ON, RADAR OPTICAL (or as briefed)
15. Circuit Breakers - IN

T.O. 1B-47B-1
31 October 1956

CUT ON LINE

**IP CHECKLIST (Called for by observer)**

1. BRIC - SELECT & 10 BOMBS, LIGHT ON
2. Bomb Power Switch - ON, LIGHT ON
3. Indicator Light Switch - CHECKED ON
4. U-2 Low Pressure Warning Light - OUT & TESTED
5. U-1 Arming Switch - ARMED
6. T-35 Arming Switch - CHECKED ARMED
7. U-2 Rack - UNLOCKED (by CP if applicable)
8. U-2 Rack Locked Light - OUT & TESTED
9. Offset Switch - OUT OR IN (as desired)
10. True Heading - CHECKED
11. N-1 Compass - UNSLAVED

**BOMB RUN CHECKLIST (Called for by observer)**

1. Bombing Altitude - SET_____FT (Target or OAP)
2. Call at 50 Miles - 50 MILES OUT
3. Function Switch - BOMB
4. PDI Center - CENTER PDI, GIVE ME 2ND STATION
5. Your Aircraft - ROGER, AUTOMATIC
6. Offset Switch - OFFSET IN OR OFFSET OUT
7. 300 TG
8. 250 TG
9. 200 TG
10. 150 TG
11. 120 TG
12. 90 TG
13. 60 TG, Check in Automatic - ROGER, AUTOMATIC
14. 30 TG
15. 20 TG, Tone ON & K-2 Auto - TONE ON, K-2 AUTO
16. Bombs Away (UHF) - BOMBS AWAY, T-HANDLE PULLED

**T.O. 1B-47B-1**
**31 October 1956**

**3**

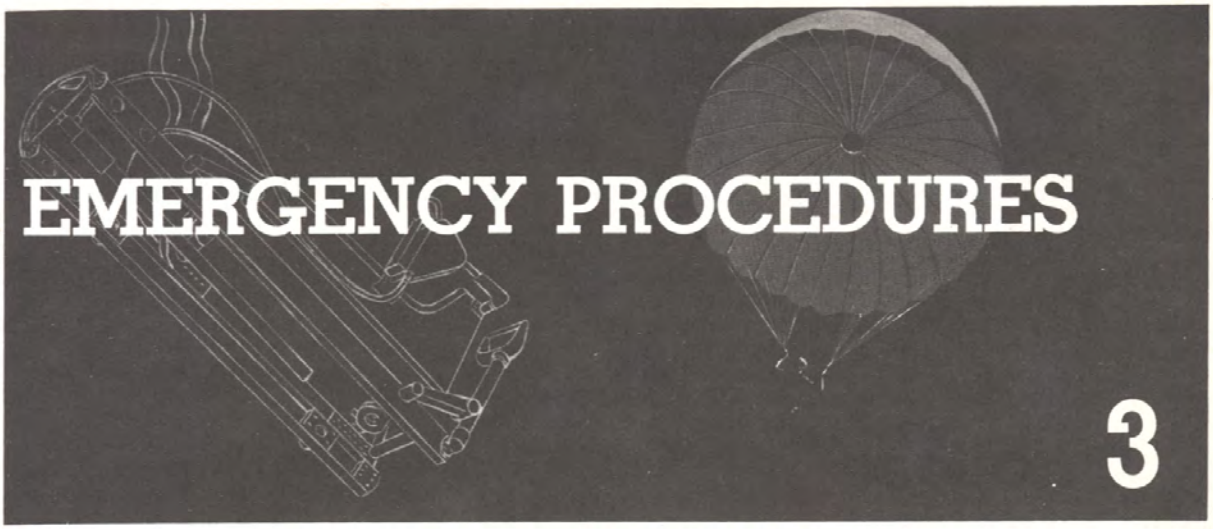
CUT ON LINE

T.O. 1B-47B-1
31 October 1956

**POST RELEASE (Called for by observer)**

4

1. Bomb Doors - CLOSED
2. Radar - RETUNED
3. Offset - OUT
4. Lat-Long Counters - RESET
5. Function Switch - NAV (Impact plus 15 sec)
6. Range Mark-Crosshair Switch - RANGE MARKS
7. Range Dial - 30 NM
8. Bomb Power Switch - OFF
9. Bomb Door & Release Switch - MANUAL
10. BRIC - TRAIN & ZERO BOMBS, LIGHT OUT
11. N-1 Compass - RESLAVED
12. O-15 & O-23 Cameras - OFF. LAST EXP RECORDED
13. Camera Doors - CLOSED
14. Oxygen Control - NORMAL
15. Release Data - RECORDED ON BOMB DATA FORM



# EMERGENCY PROCEDURES

3

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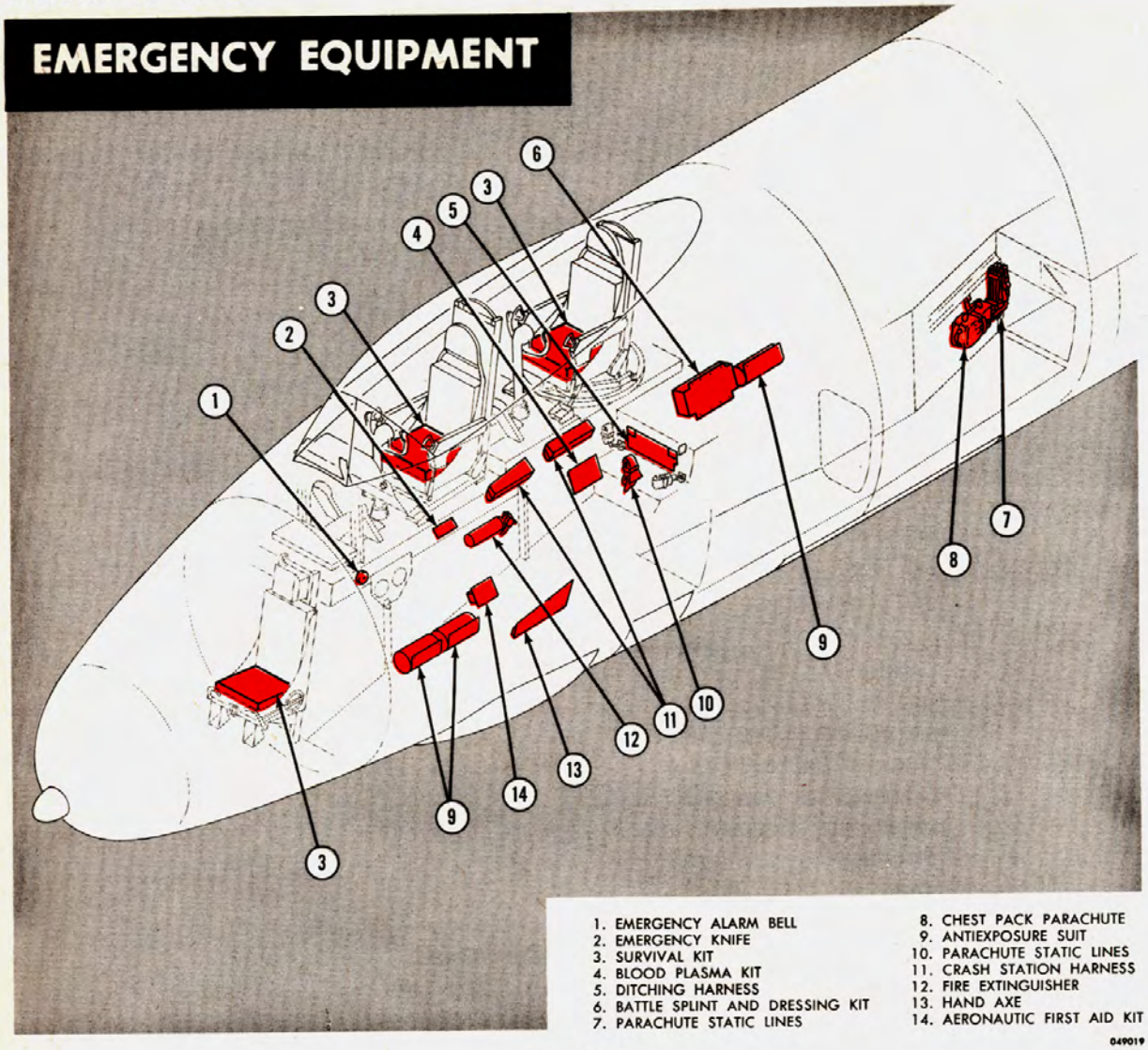



*Figure 3-1.*

**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.

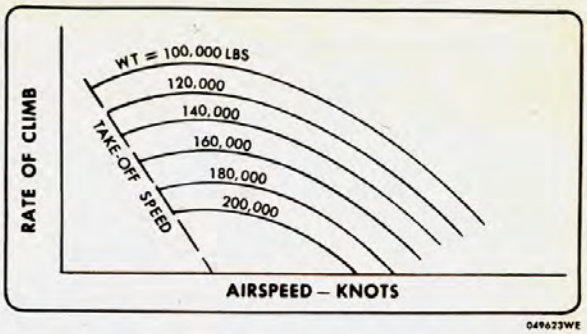
## ENGINE FAILURE

The first and most positive indication of engine malfunction will be a 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 engine shutdown and record data in DD Form 781. In the event of engine failure the recommended procedure for engine shutdown is to retard the throttle to CUTOFF first followed by pulling the fire shutoff switch.

### 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 go-no go speed is reached on takeoff with very high gross weights and high outside air temperature. 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 at or before go-no go speed, 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. For takeoff planning considering engine failure, see part 2 of the appendix. If an engine fails immediately after takeoff, climb performance at high weights is marginal for high temperatures and altitudes until the gear is raised. 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 3 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.

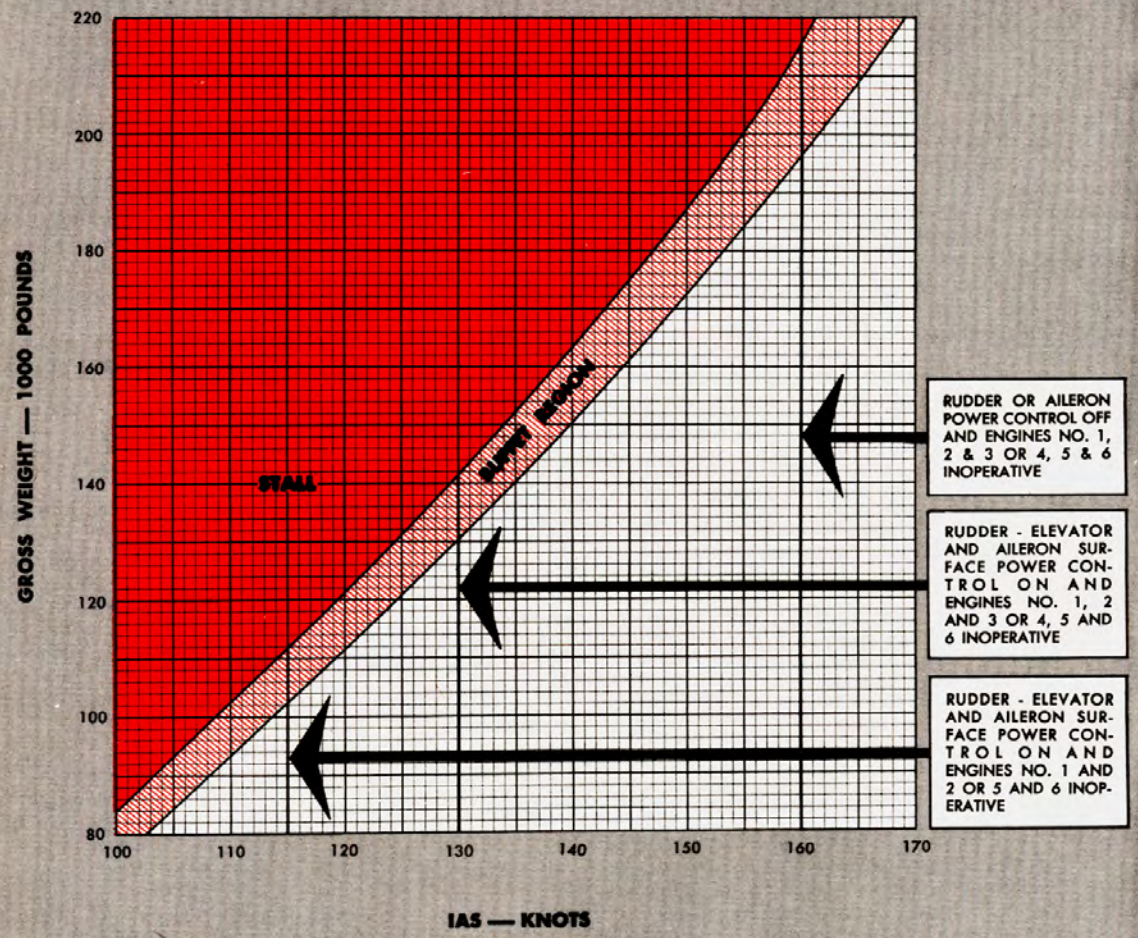
**NOTE**

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.

# MINIMUM CONTROL SPEEDS WITH INOPERATIVE ENGINES




**NOTES**

1. ALL ENGINES OPERATING AT 100% RPM
2. FLAPS DOWN
3. J47-23 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**

049964

*Figure 3-2.*

# SERVICE CEILINGS WITH INOPERATIVE ENGINES

**CONDITIONS:**

- J47-23, — 98% RPM ON OPERATING ENGINES
- 100 FPM RATE OF CLIMB
- NACA STANDARD DAY

**DATE:**

OCTOBER 1952

**DATA BASIS:**

FLIGHT TEST

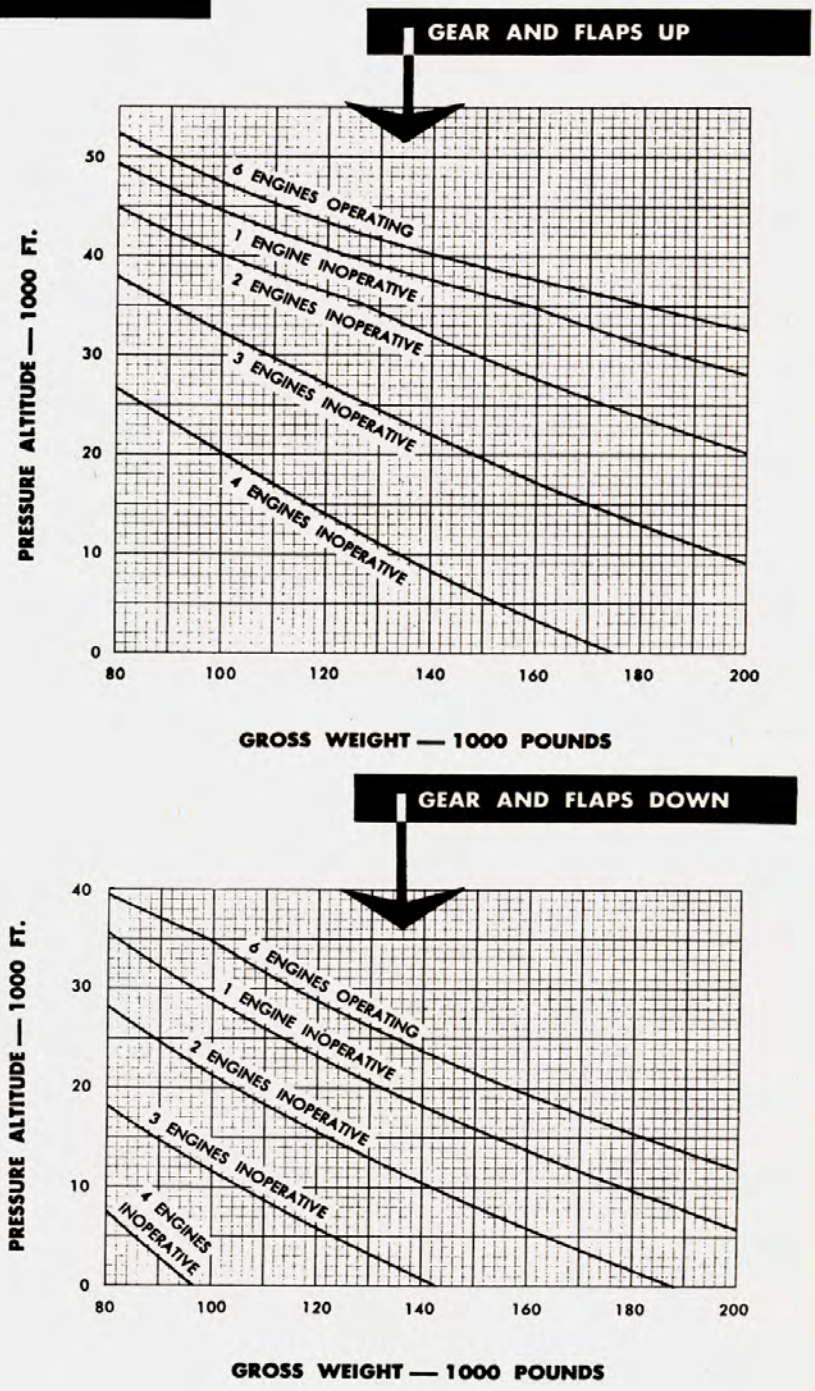



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*Figure 3-3.*

## ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED

If engine failure occurs at or below go-no go speed, 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 & Approach Chute - DEPLOYED

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.

5. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

6. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
   a. Steering Ratio Selector Lever - 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 Shutoff Switches - PULLED

7. If a stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttles 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
      At pilot's discretion, 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.
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. 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.
   g. 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 - RETRACTED
   Retract the landing gear as soon as airborne.

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
   Check that affected engine numbered circuit breaker on the "Main Fuel Control" portion and on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel are in to insure fire shutdown. Check that the affected engine numbered circuit breaker on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

5. Fuel Selector Switch - TE

6. Flaps - RETRACTED
   Retract flaps using normal procedures.

7. Climb Airspeed - MINIMUM 175 KNOTS IAS
   Gain a minimum of 175 knots before attempting to climb.

8. Engine - LUBRICATED
   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.

**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.

## 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 over interphone.

① 2. Bombs - JETTISONED
   Jettison bombs. Close bomb doors if altitude permits.

3. Flaps - FULLY EXTENDED
   Extend wing flaps to full down and maintain directional control.

4. Landing Gear - RETRACTED
   Retract landing gear at pilot's discretion.

5. Canopy - JETTISONED (OPEN)
   Jettison canopy. If canopy cannot be jettisoned safely, open canopy and leave lever in OPEN position. This procedure maintains hydraulic pressure in the actuating cylinder and will prevent the canopy from creeping or slamming closed during a crash landing.

6. Throttles - CUTOFF
   Place all throttles to CUTOFF.

7. Land straight ahead, changing direction only enough to miss obstacles

8. Prior to touchdown:
   a. Fire Shutoff Switches - PULLED
   b. Shoulder Harness - LOCKED

9. Brake Chute - DEPLOYED
   Deploy brake chute on touchdown.

10. After airplane stops:
    a. Battery Switch - OFF
    b. Canopy - REMOVED
    c. 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.
    d. Assemble upwind

① Airplanes having BNS capabilities

## ENGINE FAILURE DURING FLIGHT

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

**NOTE**

If engine is operating under 100% power conditions, the pilot may at his discretion retard throttle to idle position to check if light goes out and indications return to normal. See "Engine Fire During Takeoff, Takeoff Continued," this section.

2. Throttle - CUTOFF
   Retard throttle of affected engine to CUTOFF.

3. Fire Shutoff Switch - PULLED
   Check that affected engine numbered circuit breaker on the "Main Fuel Control" portion and on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel are in to insure fire shutdown. Check that the affected engine numbered circuit breaker on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

**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.

5. Engine - LUBRICATED
   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.

**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, land airplane as soon as possible.

## 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 accelerations and decelerations as slowly as practicable at altitude to avoid flameout or compressor stalls. All restarts should be made at engine windmill rpm of 21% to 25%.

**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 starting 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 that fuel selector is properly set.
4. Airspeed - ADJUSTED
   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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## ENGINE RESTART IN FLIGHT

**Continued**

5. Ignition Switch - 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.

6. Alternator Power Switch - RESET
   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. After 52% rpm has been reached, place the alternator power switch to NORMAL.

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 recommended 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 Switch - OFF
   Check that ignition switch is OFF.

**NOTE**

Some units within the ignition system 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.

10. Adjust engine to desired rpm

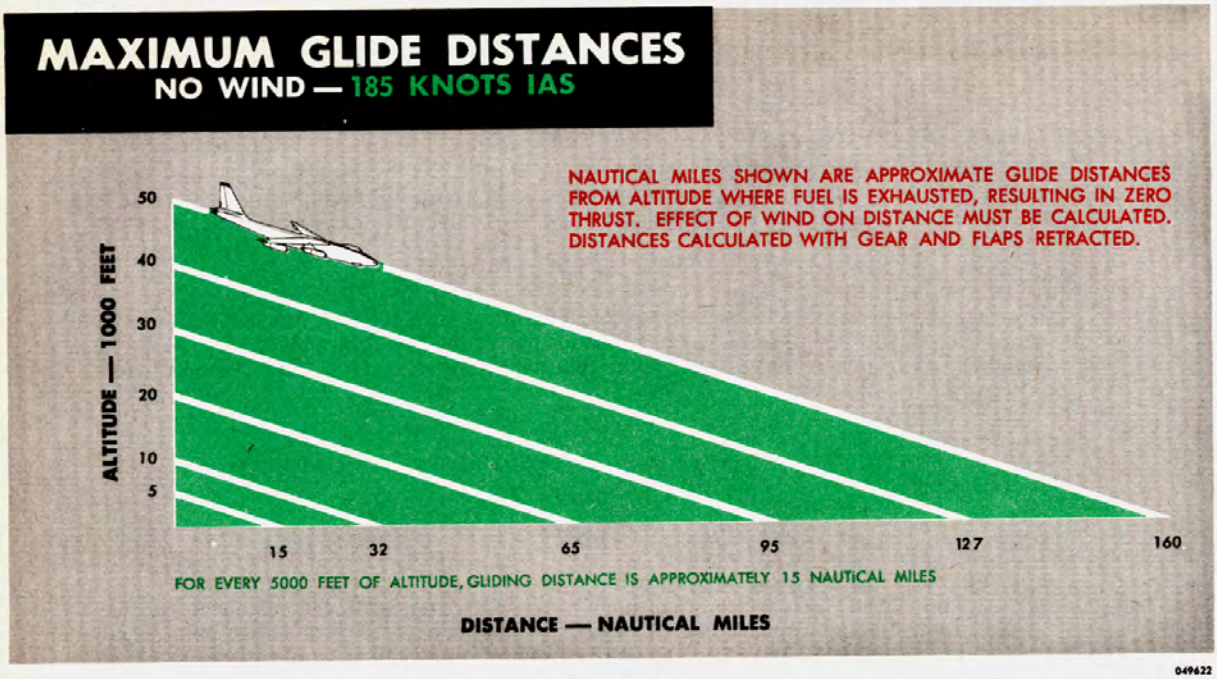


*Figure 3-4.*

## 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 fuel exhausted.

### MAXIMUM GLIDE

When a total loss of thrust is experienced, proceed as follows:

1. Gear & Flaps - RETRACTED
   Check that landing gear and flaps are both fully retracted.
2. Glide Airspeed - 185 KNOTS IAS
   Trim airplane to glide at 185 knots IAS.
3. Bomb Bay Doors - CLOSED
4. Use only shallow banked turns
   Glide straight ahead; any necessary turns should be made with the angle of bank as shallow as possible.

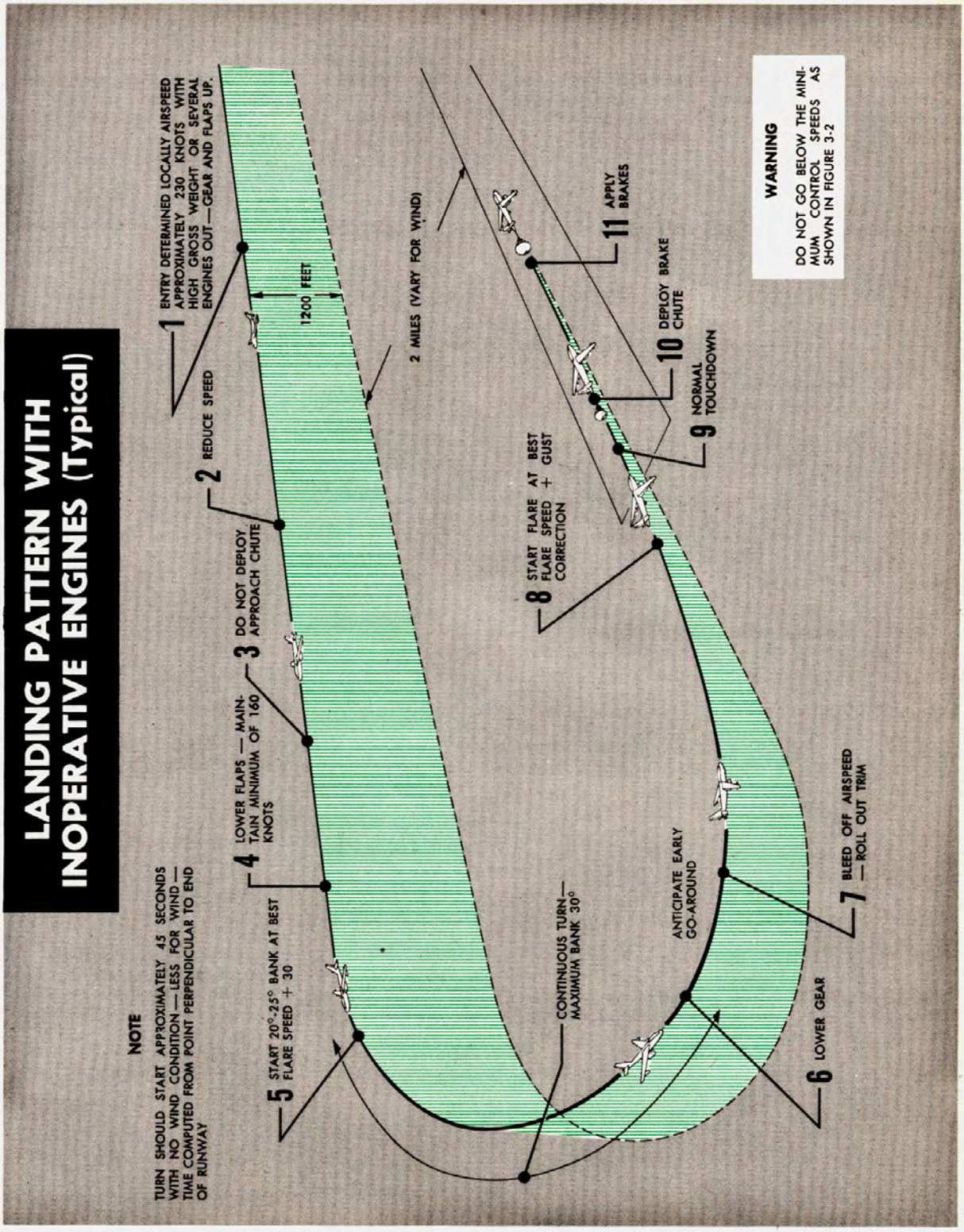
LANDING PATTERN WITH INOPERATIVE ENGINES (Typical)
NOTE
TURN SHOULD START APPROXIMATELY 45 SECONDS WITH NO WIND CONDITION — LESS FOR WIND — TIME COMPUTED FROM POINT PERPENDICULAR TO END OF RUNWAY
1 ENTRY DETERMINED LOCALLY AIRSPEED APPROXIMATELY 230 KNOTS WITH HIGH GROSS WEIGHT OR SEVERAL ENGINES OUT — GEAR AND FLAPS UP.
2 REDUCE SPEED
3 DO NOT DEPLOY APPROACH CHUTE
4 LOWER FLAPS — MAINTAIN MINIMUM OF 160 KNOTS
5 START 20°-25° BANK AT BEST FLARE SPEED + 30
6 LOWER GEAR
7 BLEED OFF AIRSPEED — ROLL OUT TRIM
8 START FLARE AT BEST FLARE SPEED + GUST CORRECTION
9 NORMAL TOUCHDOWN
10 DEPLOY BRAKE CHUTE
11 APPLY BRAKES
1200 FEET
2 MILES (VARY FOR WIND)
CONTINUOUS TURN — MAXIMUM BANK 30°
ANTICIPATE EARLY GO-AROUND
WARNING
DO NOT GO BELOW THE MINIMUM CONTROL SPEEDS AS SHOWN IN FIGURE 3-2
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*Figure 3-5.*

## LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Landing under partial power conditions is accomplished essentially in the same manner as in a normal landing (figure 3-5). However, conditions will vary with the number of engines out, weather conditions, runway facilities, and gross weight. The greater the number of engines out, the more pilot technique is required to maintain directional control and airspeed. For instance, with three engines out on one side, an approach to a landing must be carefully planned as a go-around would be extremely difficult with this unbalanced thrust (figure 3-2).

## LANDING WITH ONE OR MORE ENGINES INOPERATIVE

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Crash alert
   Alert tower for crash equipment.

**NOTE**

Deploying approach chute with more than one engine inoperative is not recommended. However, if pilot elects to deploy approach chute, careful consideration should be given to weather conditions, possible rapid acceleration, and/or a go-around. The airplane should be able to maintain 500 fpm rate of climb with approach chute deployed on a go-around in the event the chute fails to jettison. Refer to "Rate of Climb With Approach Chute Deployed" in part 3 of the appendix.

3. Establish normal traffic pattern

**NOTE**

If three engines are inoperative, maintain at least 160 knots IAS and do not extend gear until it is certain the landing area can be reached. With three engines inoperative on one side and the remaining three at 100% rpm, 160 knots IAS is the recommended minimum control speed for failure of aileron or rudder surface power control.

**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.

4. 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.

5. Landing Gear - EXTENDED
   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.

6. Anticipate a go-around as soon as possible

Continued on Next Page

## LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Continued

7. Final approach

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 existing emergency.

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 - RETRACTED
   When certain that airspeed is sufficient to prevent "mushing" back onto runway, place landing gear lever UP.

4. Climb Airspeed - MINIMUM 175 KNOTS IAS
   Attain a minimum of 175 knots IAS 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.

**WARNING**

Do not attempt to take off 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 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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## TWO-ENGINE ENDURANCE

1. Gear & 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.

**NOTE**

- Do not actuate fire shutdown. Allowing the engines to windmill will permit rapid restarts without the use of starters.
- If BNS operation and/or windshield 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.

Continued on Next Page

## TWO-ENGINE ENDURANCE

**Continued**

4. Fuel Selector Switches - SET
   Accomplish fuel system management to utilize all fuel and maintain airplanes 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 5 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 168 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. Resume normal operation

### 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.

# FIRE

**NOTE**

No engine fire extinguishing system is installed in this airplane.

## ENGINE FIRE ON THE GROUND

In the event of visible fire on the ground, proceed as follows:

1. Throttles - CUTOFF
   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.

   **NOTE**

   If throttle cannot be pulled back to CUTOFF, fire shutoff switch should be pulled.

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.

4. 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.

5. 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 the engine.

6. Throttles - CUTOFF

7. Fire Shutoff Switches - PULLED
   Check that affected engine numbered circuit breaker on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel and on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

   **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.

Continued on Next Page

## ENGINE FIRE ON THE GROUND

**Continued**

8. Battery Switch - OFF

9. Abandon airplane
   Give one long ring on alarm bell and spoken abandon-the-airplane order. Shut off all switches. Crew abandons the airplane by the safest means.

10. 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 go-no go 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 Chute & Approach Chute - DEPLOYED

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.

5. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

6. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
   a. Steering Ratio Selector Lever - TAXI

**NOTE**

Neutralizing the rudder pedals will afford easier movement of the steering ratio selector lever.

**Continued on Next Page**

## ENGINE FIRE DURING TAKEOFF — TAKEOFF REFUSED

**Continued**

b. Ground-loop the airplane
c. Throttles 3 & 4 - CUTOFF
d. Fire Shutoff Switches - PULLED

7. If a stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttles 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
      At pilot's discretion, 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.
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. 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.
   g. Assemble upwind

## ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED

In case a warning light illuminates or an engine fire occurs during takeoff above go-no go speed, takeoff will be continued as follows:

1. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Landing Gear - RETRACTED
   Retract the landing gear as soon as airborne.

3. Throttle - IDLE
   Retard affected engine throttle to idle.

**NOTE**

After retarding throttle, if the light goes out and indications are normal, advance the throttle to climb power setting.

**Continued on Next Page**

## ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED

**Continued**

4. Throttle - CUTOFF (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. Fire Shutoff Switch - PULLED
   Check that affected engine numbered circuit breaker on the "Main Fuel Control" portion and on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel are in to insure fire shutdown. Check that the affected engine numbered circuit breaker on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

6. Fuel Selector Switch - SET
   Position fuel selector switch to TE.

7. Flaps - RETRACTED
   Retract flaps using normal procedures.

8. Climb Airspeed - MINIMUM 175 KNOTS IAS
   Gain a minimum of 175 knots before attempting to climb.

9. Engine - LUBRICATED
   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.

**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 possible.

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.

**NOTE**

If engine is operating under 100% power conditions, the pilot may at his discretion retard throttle to idle position to check if light goes out and indications return to normal. See "Engine Fire During Takeoff, Takeoff Continued," this section.

2. Throttle - CUTOFF

3. Fire Shutoff Switch - PULLED
   Pull fire shutoff switch for affected engine. Check that affected engine numbered circuit breaker on the "Main Fuel Control" portion and on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel are in to insure fire shutdown. Check that the affected engine numbered circuit breaker on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

4. Fuel Selector Switch - SET
   Position fuel selector for engine on fire to TE.

5. If fire is located in an inboard nacelle and fire continues, actuate fire shutdown on the adjacent engine.

6. If fire is uncontrollable - ABANDON AIRPLANE
   Give abandon-airplane 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.

7. Engine - LUBRICATED
   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.

**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.

8. Do not restart engine

## CREW COMPARTMENT FIRE

A hand fire extinguisher is provided to fight 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.

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. Fire - EXTINGUISHED
   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.

Continued on Next Page

## CREW COMPARTMENT FIRE

**Continued**

6. If cabin does not clear, accomplish the following:
   Canopy - OPENED
   If time permits, reduce speed to 215 knots IAS and open canopy. See "Opening Canopy In Flight," this section.
   Canopy - JETTISONED
   If time and conditions do not permit opening the canopy, pull canopy emergency jettison handle. See "Emergency Canopy Jettisoning," this section.

7. If fire is uncontrollable - ABANDON AIRPLANE
   Give abandon-airplane 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.

## 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.

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. Engine 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.

**Continued on Next Page**

## WING FIRE

**Continued**

c. Fire Shutoff Switches - PULLED
Pull fire shutoff switches for the affected engines. Check that affected engine numbered circuit breaker on the "Main Fuel Control" portion and on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel are in to insure fire shutdown. Check that the affected engine numbered circuit breaker on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

**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.

**NOTE**

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.

7. If fire is uncontrollable - ABANDON AIRPLANE
If continued flight is hazardous, give abandon-airplane 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**

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

Since no fire extinguishing system is installed to combat a fuselage or empennage fire, the following procedure is recommended:

1. If fire is uncontrollable, give abandon-airplane 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."

## SMOKE OR FUMES ELIMINATION

If smoke or fumes are detected in the pressurized crew compartment, the following procedure should be followed:

**WARNING**

- If fuel fumes are detected in a crew compartment, only absolutely essential electrical equipment should be used to avoid danger of electrical arcing.
- If the anti-icing system is in operation and the procedure in step "5" is initiated, do not shut off the anti-icing system. Fumes in the wing, nacelles, and empennage will be more quickly vented overboard by continued circulation of anti-icing air.

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.
3. Cabin Pressure Emergency Release Handle - PULLED
   Pull cabin pressure emergency release handle.

**NOTE**

Smoke or fumes continuing to issue from air conditioning outlets after actuating the emergency cabin pressure release handle may be due to malfunctioning of the electrically controlled hot air shutoff valve and, if so, can be eliminated by pulling the emergency hot air shutoff handle on those airplanes so equipped. The emergency hot air shutoff handle must be returned to normal (pushed in) to resume any portion of temperature controlled or pressurized operation.

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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 - PUSHED
   b. Locate and eliminate cause of smoke or fumes

5. If it is suspected that the smoke or fumes are caused by the engines:
   a. Heat Reset Button - PUSHED
   b. Throttles - RETARDED
      Retard in sequence throttles on engines No. 3, 2, and 1 at 15-second intervals and, if exterior surfaces anti-icing is ON, 4, 5, and 6 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 affected engine numbered circuit breaker on the "Main Fuel Warning Manifold and Fire Shutoff Valve" portion of the upper DC power panel and on the "Throttle & Engine Control" portion of the lower DC power panel are in to insure fire shutdown.

6. More rapid dissipation of smoke and/or fumes may be accomplished by the following:
   Canopy - OPENED
   If time permits, reduce speed to 215 knots IAS and open canopy. See "Opening Canopy In Flight," this section.
   Canopy - JETTISONED
   If time and conditions do not permit opening the canopy, pull canopy emergency jettison handle. See "Emergency Canopy Jettisoning," this section.

7. Engine - LUBRICATED (optional)
   Lubricate the engine by resetting fire shutoff switch.

**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 and smoke or fumes remain in the crew compartment, land the airplane as soon as possible.

## 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 Takeoff," this section.

### PITCHUP DURING TAKEOFF

An undetected center of gravity location aft of 34% MAC during takeoff will create a tendency for the nose of the airplane to pitch up. This could result in a low altitude stall. With the bicycle-type landing gear there are no natural means of warning the pilot of an inadvertent aft cg during the takeoff roll. Therefore, the pilot is unable to sense this aft cg condition until pitchup occurs at the unstick point. In some cases, warning occurs by a tendency of the front gear to lift off the runway at less than takeoff speed and to continue rising until the rear gear unsticks and the airplane pitches off the ground below the normal takeoff speed. The severity of pitchup depends on cg, gross weight, and the amount and timing of control pressures. For this reason the procedure given in section II under "Normal Technique - Takeoff" should be used for all normal takeoffs since it will provide an effective control safeguard against an undetected aft cg condition. However, if pitchup occurs despite the recommended takeoff procedure, the pilot should proceed as follows under the conditions noted:

1. If pitchup occurs with the airplane at or below go-no go speed, the takeoff should be refused at once in accordance with procedures given under "Refused Takeoff," this section.
2. If pitchup occurs with the airplane above go-no go speed and the front gear cannot be held on the ground by forward pressure until normal takeoff speed is attained, the takeoff should be refused at once in accordance with procedures given under "Refused Takeoff," this section.
3. If pitchup occurs with the airplane above go-no go speed and the front gear can be held on the ground by forward pressure until normal takeoff speed is attained, the takeoff should be continued with extreme care. Immediate retraction of gear and flaps will improve the condition by moving the cg forward about 1%. Shallow climb attitude should be established. Reaching a safe altitude, level flight should be established and fuel management started to move the cg forward as rapidly as possible.

### SHORT FIELD OR OBSTACLE CLEARANCE TAKEOFF

Under emergency conditions requiring a short field takeoff, the takeoff run can be shortened about 7% by easing the airplane off the ground with the elevator at a lower speed than for a normal takeoff. Shortening the takeoff in this manner requires judicious handling of the elevators. Any abrupt application of pull force on the elevator control may result in the airplane entering a stalled condition. To effect the takeoff, apply a slight pull force on the control column so that the front and rear gear leave the ground simultaneously. Retract the gear as soon as possible but leave the flaps fully extended. The optimum climb speed for maximum obstacle clearance is normal takeoff speed. However, as the airplane leaves the ground, allow the airspeed to increase approximately 6 knots above normal takeoff speed to allow for the ground effect error in the indicated airspeed. When the obstacle is cleared, retract flaps using normal procedures. When performing a short field or obstacle clearance takeoff, airplane center of gravity and fuel distribution should be checked carefully. With the control techniques employed under these conditions, an undetected aft cg of 35% MAC or greater would create a severe hazard during the takeoff roll and at unstick.

**WARNING**

No short field or obstacle clearance takeoff should be attempted at center of gravity locations aft of 34%.

## 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 & Approach Chute - DEPLOYED

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.

5. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

6. If stop cannot be made before reaching an obstacle and speed is not greater than 60 knots:
   a. Steering Ratio Selector Lever - 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 Shutoff Switches - PULLED

7. If a stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttles 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
      At pilot's discretion 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.
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. 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.
   g. Assemble upwind

## LANDING EMERGENCIES

### CRASH LANDING

See figure 3-7.

### LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Refer to "Flight Characteristics Under Partial Power Conditions," this section.

### LANDING WITH FLAPS UP

With flaps up, establish normal traffic pattern (figure 2-11). The approach chute should be used since it will aid deceleration 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. Gross Weight - REDUCED
   Reduce gross weight as much as possible.
3. Crash alert
   Alert tower for crash equipment.
4. Normal pattern
   a. Establish a traffic pattern with downwind leg at flaps-up touchdown speed plus 35 knots
   b. Approach Chute - DEPLOYED
   c. Start final approach at flaps-up touchdown speed plus 15 knots
5. Touchdown - LANDING ASSURED
   a. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

   b. Brake Chute - DEPLOYED
   c. Brakes - APPLIED

## 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. Crew - ALERTED
   Alert crew over interphone of existing emergency.

2. Emergency Hydraulic Pump Switch - OFF
   Turn emergency hydraulic pump off.

3. Gross Weight - REDUCED
   Reduce gross weight as much as possible.

4. Crash alert
   Alert tower for crash equipment.

5. Normal pattern
   Establish a normal traffic pattern.

6. Approach Chute - DEPLOYED

7. Emergency Hydraulic Pump Switch - AUTO NORMAL
   Place emergency hydraulic pump in AUTO NORMAL just prior to touchdown.

8. Throttles - IDLE
   On touchdown, immediately retard all throttles to idle stop.

9. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

10. Brake Chute - DEPLOYED
    Deploy brake chute as soon as the airplane has decelerated below the brake chute maximum deployment speed.

11. Brakes - APPLIED
    Apply brakes in normal manner to test possible effectiveness still remaining. If normal application is ineffective, test pedals in emergency braking range.

12. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
    a. Steering Ratio Selector Lever - 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 Shutoff Switches - PULLED

Continued on Next Page

## LANDING WITH BRAKE FAILURE

**Continued**

13. If a stop or ground-loop cannot be made before reaching an obstacle:
    a. Throttles 3 & 4 - CUTOFF
    b. Fire Shutoff Switches - PULLED
    c. Landing Gear - RETRACTED
        At pilot's discretion retract all landing gear with the landing emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF prior to actuation of emergency retraction switch, retraction will be more positive.
    d. Battery Switch - OFF
    e. Canopy - REMOVED
    f. 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.
    g. Assemble upwind

### LANDING WITH FRONT GEAR STEERING FAILURE

#### Brake or Tire Failure

If front gear steering 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.

Continued on Next Page

## LANDING WITH FRONT GEAR STEERING FAILURE

**Continued**

2. Crawlway check
   At 10,000 feet or lower, depressurize the crew compartment and have the observer or extra crew member 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 Ratio Selector Lever - TOW & BACK TO TAKEOFF LAND
   If both the chase pilot and crawlway observer report no movement, place the steering ratio selector lever 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 Ratio Selector Lever - 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. Approach Chute - DEPLOYED

8. Throttles - IDLE
   On touchdown, immediately retard all throttles to idle stop.

9. Throttles 1, 2, 5 & 6 - CUTOFF

10. Brake Chute - DEPLOYED
    Deploy brake chute as soon as the airplane has decelerated below the brake chute maximum deployment speed.

**NOTE**

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.

11. Brakes - APPLIED

12. Landing Roll - PEDALS NEUTRAL, STEERING TAXI
    If steering control is marginal or ineffective during landing roll, neutralize rudder pedals momentarily and move steering ratio selector lever to TAXI.

13. Allerons & Bicycle
    Use allerons to steer airplane as much as possible through bicycling.

## 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 in 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 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. At any time during the approach and landing, if 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. 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 8 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. Gross Weight - REDUCED
   Reduce gross weight as much as possible.
3. Approach Chute - DEPLOYED
4. Practice approach
   If conditions permit, make a practice approach to the landing runway, observing terrain, overruns, and obstacles.
5. 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).

Continued on Next Page

## LANDING WITH RELIANCE ON BRAKE CHUTE

**Continued**

6. Normal pattern
   Establish a normal pattern with strict adherence to the correct approach speeds.

7. Touchdown - THROTTLES IDLE
   On touchdown, immediately retard all throttles to the idle stop.

8. Throttles 1, 2, 5 & 6 - CUTOFF

**NOTE**

Idle power must be kept on engines No. 3 or 4 or both to maintain hydraulic pressure.

9. 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, ensure that the jettison handle was not selected by mistake, and then pull the deployment handle evenly through full travel once again.

10. 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.

11. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
    a. Steering Ratio Selector Lever - 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 Shutoff Switches - PULLED

12. If a stop or ground-loop cannot be made before reaching an obstacle:
    a. Throttles 3 & 4 - CUTOFF
    b. Fire Shutoff Switches - PULLED
    c. Landing Gear - RETRACTED
       At pilot's discretion, retract all landing gear with the landing emergency retraction switch on the pilot's control stand. If the landing gear lever is placed in OFF prior to actuation of emergency retraction switch, retraction will be more positive.
    d. Battery Switch - OFF
    e. Canopy - REMOVED
    f. 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.
    g. Assemble upwind

## 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 Deployment Switch - DOOR CLOSED or OFF
   Move the approach chute deployment switch to DOOR CLOSED or OFF.

2. Wait 10 seconds
   Wait 10 seconds to give the door sufficient time to close.

3. Approach Chute Jettison Handle - PULLED
   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.

## EMERGENCY ALARM BELL SIGNALS

| 6 SHORT RINGS | 1 LONG SUSTAINED RING | 3 SHORT RINGS | 1 LONG RING |
|---|---|---|---|
| Prepare for Ditching<br><br>Prepare for Crash Landing | Brace-for-Ditching Impact<br>Brace-for-Crash-Landing Impact | Prepare for Bailout | Bailout |

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*Figure 3-6.*

# CRASH LANDING

Provided the terrain and other conditions are favorable to a successful crash landing, the following technique will be employed.

**NOTE**

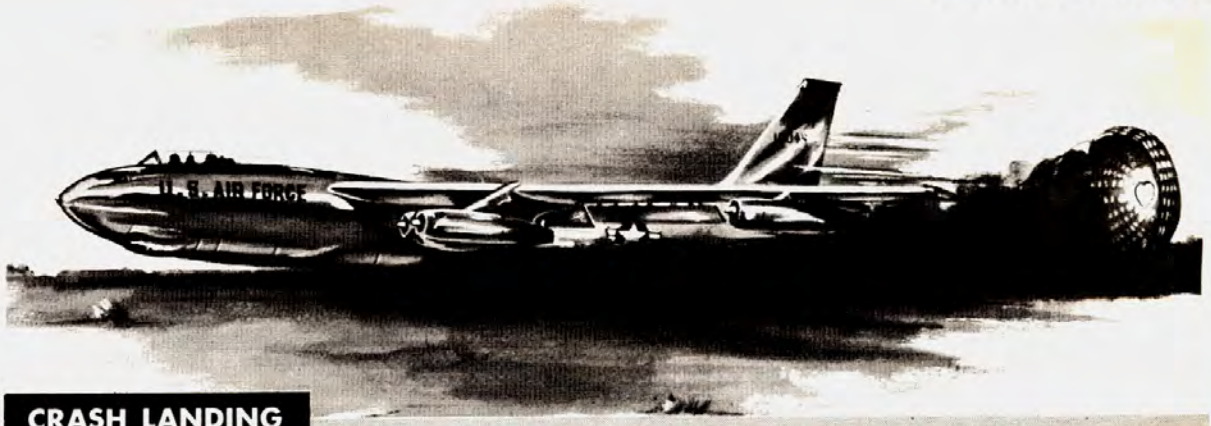
- If time permits, use fuel from all but center main tank. Land with minimum fuel in center main tank. Prior to landing, position center main tank to TME, all other tanks to ME.
- If time and conditions permit, crew members should reinstall ejection seat safety pins prior to crash landing.

## PREPARATION FOR

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give prepare-to-crash-land warning by six short rings on alarm bell and spoken warning over interphone. Pull cabin pressure emergency release handle. | 1. Acknowledge the prepare-to-crash-land warning. | 1. Acknowledge the prepare-to-crash-land warning. |
| 2. Place emergency keyer switch ON. Turn IFF to EMERGENCY. | | 2. Transmit position report to pilot. |
| Pilot accomplishes the following procedure calling for aid from copilot where necessary; copilot stands by for orders. | | |
| 3. Fully extend wing flaps. | | |
| 4. Salvo bombs making sure bomb bay doors are closed after salvo. (1) | | |
| 5. Check landing gear fully retracted. | | |
| 6. Unbuckle parachute; check the safety belt and shoulder harness fastened. | 2. Unbuckle parachute; check the safety belt and shoulder harness fastened. | 3. Proceed to forward ditching-crash landing station in cockpit walkway opposite the pilot. Unbuckle parachute, lower the ditching harness and secure to tiedown fittings, and sit facing aft in harness cradle. If no extra crew members are aboard, proceed to ditching-crash landing station in walkway beside copilot. Unbuckle parachute, raise seat back, fasten shoulder harness, tiedown strap, and safety belt. |
| 7. Give stand-by-for-canopy-jettison order. Jettison canopy if conditions permit. If canopy cannot be jettisoned safely, open it and leave canopy lever in OPEN position. | | |

(1) Airplanes having BNS capabilities

*Figure 3-7 (Sheet 1 of 3 Sheets).*




## CRASH LANDING

### FORWARD EXTRA SEAT

1. Acknowledge the prepare-to-crash-land warning. Stow seat against outboard sidewall.

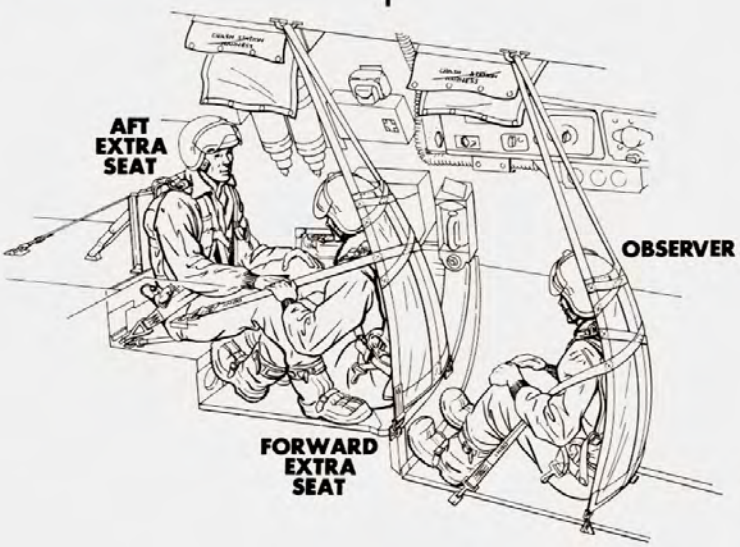
2. Proceed to ditching-crash landing station in cockpit walkway over entrance door. Unbuckle parachute, lower ditching harness and secure to tiedown fittings. Assume crash landing position facing aft in harness cradle.

   If the aft extra seat is not occupied, proceed aft to that seat. Unbuckle parachute, raise seat back, fasten shoulder harness, tiedown strap, and safety belt.

### AFT EXTRA SEAT

1. Acknowledge the prepare-to-crash-land warning.

2. If not already in ditching-crash landing station, proceed to seat and unbuckle parachute, shoulder harness, tiedown strap, and safety belt.




ABANDONING
THE AIRPLANE
NEXT PAGE

*Figure 3-7 (Sheet 2 of 3 Sheets).*

# CRASH LANDING
(CONTINUED)

## CRASH LANDING TECHNIQUE

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 the 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.
7. Turn battery switch OFF after contact.

## ABANDONING THE AIRPLANE

Remain in position until the airplane stops. As soon as the airplane stops, unbuckle safety belt and parachute harness. Crew members abandon airplane at nearest exit.

If the canopy has not been jettisoned, pilot or co-pilot 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.

In case it is impossible to release the canopy, crew members 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.

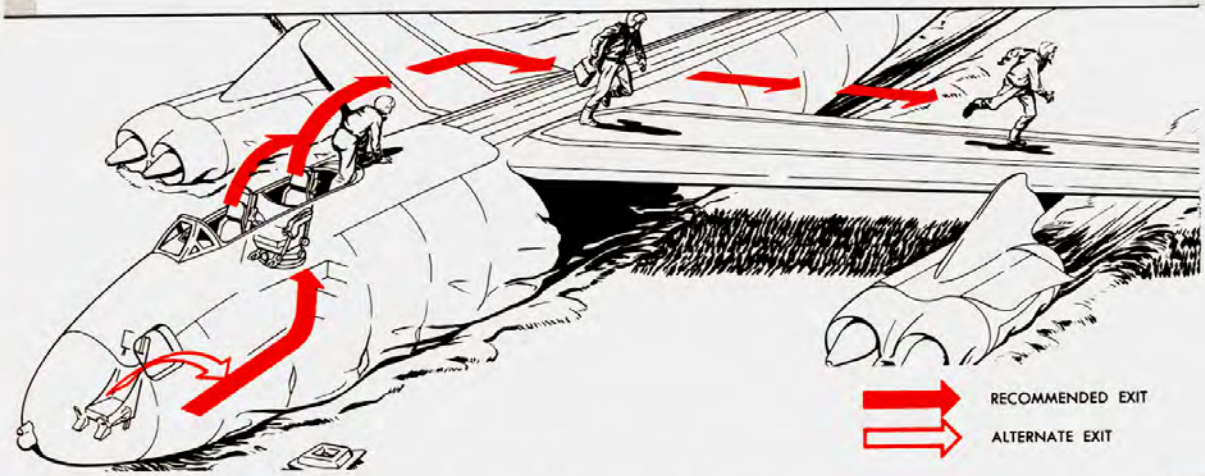
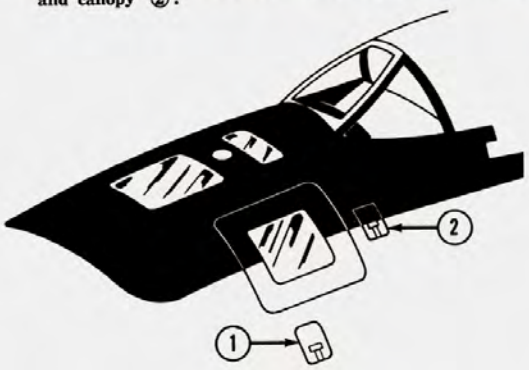



*Figure 3-7. (Sheet 3 of 3 Sheets)*

# 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 2-2. 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 ① and canopy ②.




**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.

**3.** If canopy has been jettisoned, gain entrance to the airplane in the following manner:

### CANOPY

To release the canopy, grasp canopy emergency release T-handle and pull 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.

**4.** On both sides of the fuselage, under the horizontal stabilizer, an area is outlined through which access to the batteries is facilitated in case of emergency. To gain entrance use a hand axe or other suitable instrument and cut through the fuselage skin in this area.

### 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.

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*Figure 3-8.*

# 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**

If time and conditions permit crew members should reinstall ejection seat safety pins prior to ditching.

**PREPARATION FOR**

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give prepare-to-ditch warning by six short rings on alarm bell and spoken warning over interphone. Pull cabin pressure emergency release handle. | 1. Acknowledge prepare-to-ditch warning. | 1. Acknowledge prepare-to-ditch warning. |
| 2. Place emergency keyer switch ON. Turn IFF to EMERGENCY. | | 2. Transmit position report to pilot. |
| Pilot accomplishes the following procedure calling for aid from copilot where necessary; copilot stands by for orders. | | |
| 3. Fully extend wing flaps. | | |
| 4. Salvo bombs making sure bomb bay doors are closed after salvo. (1)▶ | | |
| 5. Check landing gear fully retracted. | | |
| 6. Unbuckle parachute, check the safety belt and shoulder harness fastened, and check lifevest. | 2. Unbuckle parachute, check the safety belt and shoulder harness fastened, and check lifevest. | 3. Proceed to forward ditching-crash landing station in walkway opposite pilot. Unbuckle parachute, lower ditching harness and secure to tiedown fittings. Check lifevest and sit facing aft in harness cradle. If no extra crew members are aboard, proceed to ditching-crash landing station beside copilot. Unbuckle parachute, raise seat back, fasten shoulder harness, tiedown strap, and safety belt, and check lifevest. |
| 7. Give stand-by-for-canopy-jettison order. Jettison canopy if conditions permit. If canopy cannot be jettisoned safely, open it and leave canopy lever in the OPEN position. | | |

(1)▶ Airplanes having BNS capabilities

**WARNING** DO NOT INFLATE LIFEVEST UNTIL OUT OF THE AIRPLANE

*Figure 3-9 (Sheet 1 of 3 Sheets).*

## DITCHING

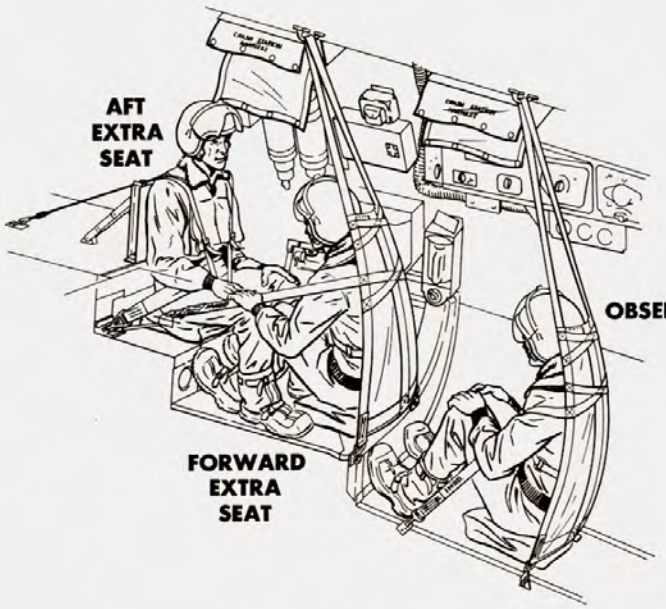
### FORWARD EXTRA SEAT

1. Acknowledge prepare-to-ditch warning. Stow seat against outboard sidewall.
2. Proceed to ditching-crash landing station in walkway over entrance door. Unbuckle parachute and lower ditching harness and secure to tiedown fittings. Check lifevest and assume ditching position facing aft in harness cradle.

   If the aft extra seat is not occupied, proceed to that seat. Unbuckle parachute, raise seat back, fasten shoulder harness, tiedown strap, and check lifevest.

### AFT EXTRA SEAT

1. Acknowledge prepare-to-ditch warning.
2. If not already in ditching-crash landing station, proceed to seat and unbuckle parachute, raise seat back, fasten shoulder harness, tiedown strap, and safety belt, and check lifevest.




ABANDONING
THE AIRPLANE
NEXT PAGE

*Figure 3-9 (Sheet 2 of 3 Sheets).*

# DITCHING
(CONTINUED)

## 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 underwater 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, the 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. 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 shoulder harness.

**CAUTION**

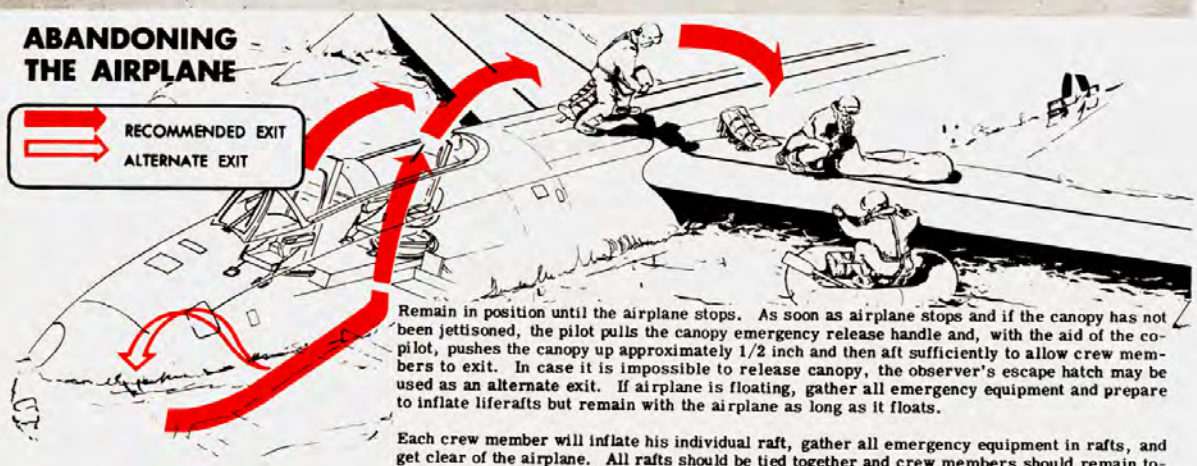
The crew member is prevented from bending forward when the shoulder harness inertia reel is LOCKED; therefore, all switches not readily accessible should be properly positioned prior to locking shoulder harness.

4. 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.

## ABANDONING THE AIRPLANE




Remain in position until the airplane stops. As soon as airplane stops and if the canopy has not been jettisoned, the pilot pulls the canopy emergency release handle and, with the aid of the co-pilot, pushes the canopy up approximately 1/2 inch and then aft sufficiently to allow crew members to exit. In case it is impossible to release canopy, the observer's escape hatch may be used as an alternate exit. If airplane is floating, gather all emergency equipment and prepare to inflate liferafts but remain with the airplane as long as it floats.

Each crew member will inflate his individual raft, gather all emergency equipment in rafts, and get clear of the airplane. All rafts should be tied together and crew members should remain together after leaving the airplane.

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*Figure 3-9 (Sheet 3 of 3 Sheets).*

## EMERGENCY ENTRANCE

See figure 3-8.

## DITCHING

See figure 3-9.

## 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
- Escape Chute - Spoiler not extended
- Bomb Bay

#### Ejection Seats

EJECTION SPEEDS. Whenever possible ejection seats should be used for bailout. Ejection accomplished at airspeeds ranging from stall speed to 525 knots IAS results in relatively minor forces being exerted on the body thus reducing the injury hazard. The crew member will undergo appreciable forces on the body when ejection is performed at airspeeds of 525 to 600 knots IAS, and escape is more hazardous than at lower airspeeds. Above 600 knots IAS ejection is extremely hazardous because of the excessive forces on the body.

LOW ALTITUDE EJECTION. Ejection at low altitudes is facilitated by pulling the nose of the airplane up above the horizon in a "zoom up" maneuver. The trajectory of the ejection seat is not perpendicular to the flight path of the airplane, but rather, is a resultant of the airplane velocity and upward or downward velocity of the ejection seat. Since the ejection seat velocity is very small compared to the airplane velocity, the ejection seat tends to follow a nearly horizontal path. A "zoom up" maneuver will result in the upward ejection trajectory coming closer to the vertical, and the downward trajectory going further from the vertical, thus effecting an increase in altitude. This gain in altitude will increase the time available for separation from the seat and deployment of the parachute.

**WARNING**

In all ejections below 14,000 feet, manually pull the parachute D-ring immediately following separation from the ejection seat. This applies regardless of parachute type (manual or automatic) so as to assure parachute opening.

OPENING OF SAFETY BELTS. The automatic opening safety belt should never be opened manually prior to ejection as the automatic opening feature of the belt requires only 2 seconds to open after ejection. At high airspeeds the deceleration of a crew member alone is considerably greater than that of the crew member and seat together, therefore immediate separation under these conditions could result in serious injury to the crew member. It is also possible under the same conditions for the parachute pack to inadvertently blow open and cause extensive damage to parachute and possible fatal injuries to occupant.

PROCEDURE FOR EJECTION. Procedure for bailout using the ejection seats is given in figure 3-10.

- Whenever circumstances permit, slow the airplane down as much as possible prior to ejection. Minimum IAS for jettisoning canopy is 190 knots IAS.
- Ejection should not be delayed when the airplane is in a descending attitude and cannot be leveled out. The chances of a successful ejection at low altitudes under this condition are greatly reduced.
- When ejecting at low altitudes (below 2000 feet), pull the nose of the airplane above the horizon if at all possible.
- Do not manually open the automatic opening safety belt prior to ejection at any altitude.

**WARNING**

Do not use observer's downward ejection seat with safety belt unbuckled.

# ALTERNATE BAILOUT

## CONTROLLABLE FLIGHT

### 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 (figure 3-11). If forward gear is extended or bomb doors open, maximum IAS is 195 knots.

### 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. All gear should be retracted (figure 3-12).

### 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 3-11).

### Bomb Bay

It is possible, when considerable time is available, to egress through the bomb bay. This method is considered least desirable due to the distance from the crew members' stations and the difficulties encountered crawling through the small passageway to the bomb bay (figure 3-13). Rear gear must be retracted for safe egress. This method of egress may not be possible on airplanes from which the bomb bay platform has been removed.

## 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 3-10).

### 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 3-14).

# BAILOUT EJECTION SEATS

Pilot reduces airspeed to allow extra crew members to egress (maximum IAS 195 knots without spoiler extended, with spoiler extended maximum IAS 280 knots). Maximum IAS 195 knots if extra crew member(s) elect to egress through the observer's downward ejection hatch opening.

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give bailout order by one long ring on alarm bell and spoken bailout-ejection-seats order over interphone. Pull cabin pressure emergency release handle. | 1. Acknowledge the bailout order. *Position seat facing forward and return seat from forward tilted position back to normal ejection position. | 1. Acknowledge the bailout order. Position seat facing forward. |
| 2. Rotate the left handgrip forward from stowed position until reaching mechanical stop for use as a handgrip only. | 2. Rotate the left handgrip forward from stowed position until reaching mechanical stop for use as a handgrip only. | 2. Raise leg braces from stowed position to locked position by pulling either or both triggers and rotating leg braces forward. Check bailout oxygen bottle for proper connection; pull release. |

**WARNING**

Pilot and copilot should not rotate right handgrip (which jettisons the canopy) until the extra crew member(s) have bailed out.

**WARNING**

① ▶ Alarm bell rings as result of leg braces being raised. This is no indication of pilot's initiated bailout signal.

| | | |
|---|---|---|
| 3. Rotate right handgrip from the stowed position until reaching mechanical stop. Check bailout oxygen bottle for proper connection; pull release. | 3. Rotate right handgrip from the stowed position until reaching mechanical stop. Check bailout oxygen bottle for proper connection; pull release. | 3. Grasp D-ring with both hands and pull once, approximately 1 inch. |

**WARNING**

- Crew members should keep head back against headrest; elbows in place, and feet on footrests.
- If canopy is opened, pilot and copilot should lower themselves in the cockpit prior to jettisoning the canopy.

| | | |
|---|---|---|
| 4. Fire seat catapult by squeezing catapult trigger (right handgrip). | 4. Fire seat catapult by squeezing catapult trigger (right handgrip). | 4. Fire seat catapult by pulling D-ring a second time approximately 1 inch (maintain 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 but is not recommended.

① ▶ AF 50-008, -010 thru -013, -015, -016, -021 thru -025, -029 thru -032, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091

The extra crew members, observer, copilot, and pilot is the desired order of bailout when escape chute is used by the extra crew member(s). If observer's ejection hatch opening is used by the extra crew member(s) the desired order of bailout is observer, extra crew members, pilot, and copilot.

| FORWARD EXTRA SEAT | AFT EXTRA SEAT |
|---|---|
| 1. Acknowledge the bailout order. Unfasten safety belt and proceed aft in walkway. | 1. Acknowledge the bailout order. Unfasten safety belt and shoulder harness. |
| 2. Check bailout oxygen bottle connected; pull release. | 2. Check bailout oxygen bottle connected; pull release. Unlock and open pressure compartment door. Pull entrance door bailout control handle to full travel. |

**WARNING**

Bail out through the escape chute or observer's hatch opening prior to the canopy being jettisoned.

| | |
|---|---|
| 3. Check parachute and bail out, feet first, facing aft. | 3. Check parachute and bail out, feet first, facing aft. |

**IF TIME AND CONDITIONS PERMIT OBSERVE THE FOLLOWING PRECAUTIONS . . . . .**

1. Pilot gives bailout warning by three short rings on alarm bell and spoken warning over interphone.
2. Pilot positions IFF to EMERGENCY and HF tone ON.
3. Pilot places emergency keyer switch ON.
4. Lower helmet visor.
5. Pilot trims airplane for level flight and engages automatic pilot.

**WARNING**

Crew member should be absolutely sure he is completely free of the seat before deploying the parachute.

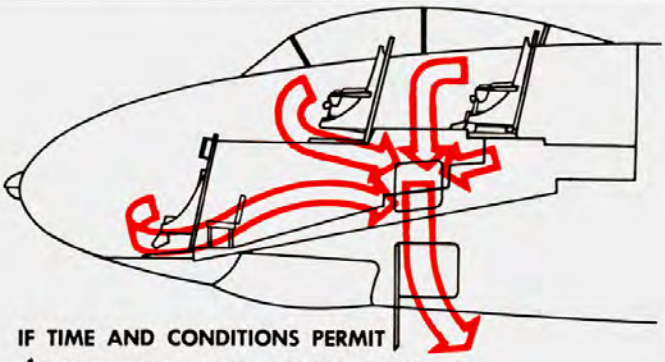
**MINIMUM SAFE EJECTION ALTITUDES (LEVEL FLIGHT)**

| | UPWARD EJECTION | DOWNWARD EJECTION |
|---|---|---|
| Automatic belt and manual chute | 1000 ft | 1300 ft |
| Automatic belt and chute (parachute timer lanyard properly connected to belt) | 500 ft | 800 ft |

049066

*Figure 3-10.*

# ALTERNATE BAILOUT—ESCAPE CHUTE
## (CONTROLLABLE FLIGHT)



**IF TIME AND CONDITIONS PERMIT**

1. Pilot positions IFF to EMERGENCY and HF tone ON.
2. Pilot places emergency keyer switch ON.

Pilot extends flaps and drag gear to reduce airspeed as much as possible, definitely below the following speeds:

Maximum IAS 195 knots if -
- Spoiler not extended
- Forward gear down
- Bomb door open

Maximum IAS 280 knots if -
- Spoiler extended, gear retracted, and bomb doors closed

These are not airplane restrictions but the maximum safe speed necessary to prevent the crew member from contacting the airplane structure during and after the bailout.

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give bailout warning by three short rings on alarm bell and spoken bail-out-escape-chute warning over interphone. Pull emergency cabin pressure release handle. | 1. Acknowledge bailout warning. Unfasten safety belt and shoulder harness. | 1. Acknowledge bailout warning. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release. |
| 2. When airspeed is stabilized retract drag gear and trim airplane for level flight. Engage automatic pilot and stow control column. | 2. Stow control column. | 2. If no extra crew members are aboard; unlock and open pressure compartment door. |
| 3. Give abandon-airplane signal by one long ring on alarm bell and spoken order over interphone. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release and proceed to bail out escape hatch. | 3. Check bailout oxygen bottle for proper connection; pull release and proceed to bail out escape hatch. | 3. Pull entrance door bailout control handle to full travel. |
| 4. Check parachute; bail out feet first facing aft. | 4. Check parachute; bail out feet first facing aft. | 4. Check parachute; bail out feet first facing aft. |

**OBSERVE THE FOLLOWING PRECAUTIONS:**

**NOTE**

There is no required order of bailout; however the recommended order is as follows: extra crew members, observer, copilot, and pilot.

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 chance 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.

## FORWARD EXTRA SEAT

1. Acknowledge bailout warning. Unfasten safety belt and stow seat against outboard sidewall. Check bailout oxygen bottle for proper connection; pull release and proceed to bailout escape hatch.

2. Check parachute; bail out feet first facing aft.

## AFT EXTRA SEAT

1. Acknowledge bailout warning. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection and pull release.

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.

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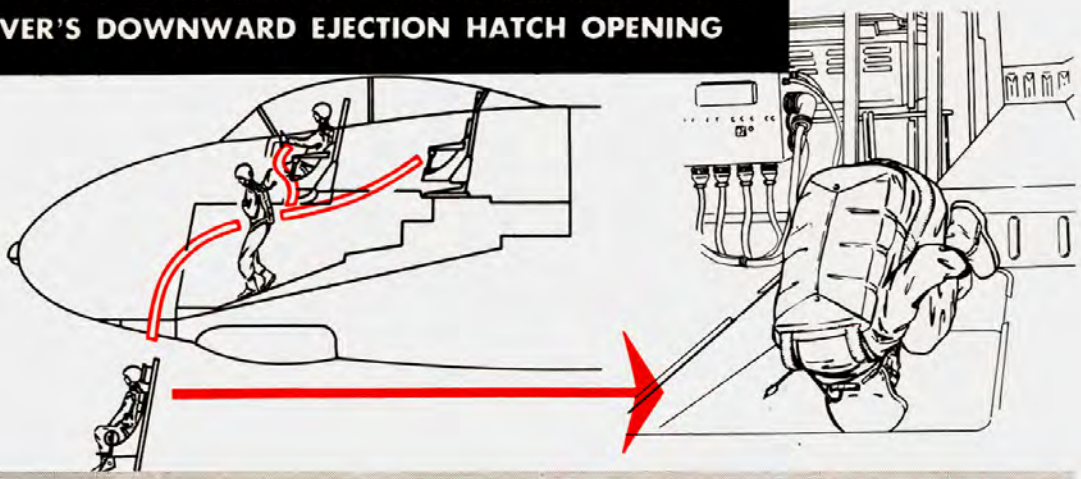
*Figure 3-11.*

# ALTERNATE BAILOUT (CONTROLLABLE FLIGHT)
## OBSERVER'S DOWNWARD EJECTION HATCH OPENING



| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give bailout warning by three short rings on the alarm bell and bail-out-observer's-hatch-opening warning over interphone. | 1. Acknowledge bailout warning. Unfasten safety belt and shoulder harness. | 1. Acknowledge bailout warning. Position seat facing forward, check safety belt and shoulder harness to insure proper fastened. Check bailout oxygen bottle for proper connection; pull release. |
| 2. Extend flaps and drag gear to reduce airspeed as much as possible (max 195 knots IAS) with airspeed stabilized retract drag gear; trim airplane level flight. Engage automatic pilot and stow control column. | 2. Stow control column. Check the bailout oxygen bottle for proper connection; pull release. | 2. Raise leg braces from stowed to locked position by pulling either or both triggers and rotating the leg braces forward. Grasp D-ring with both hands and pull once approximately 1 inch. |
| 3. Give abandon-airplane signal by one long ring on alarm bell and spoken warning over interphone. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release. | 3. After the observer's ejection, check parachute and bail out through observer's downward ejection hatch opening. | 3. On bailout order fire seat catapult by pulling D-ring a second time, approximately 1 inch (maintains grip on D-ring during ejection). |
| 4. Check parachute and bail out through observer's downward ejection hatch opening. | | **WARNING**<br>● Retain grip on D-ring until clear of airplane to prevent the arms from being forced upward and extending beyond the ejection envelope. Keep elbows close to body to prevent injury.<br>● Delay opening parachute until completely free of seat. |

**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. The extra crew members, 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.

| FORWARD EXTRA SEAT | AFT EXTRA SEAT |
|---|---|
| 1. Acknowledge bailout warning. Unfasten safety belt and stow seat against outboard sidewall. Check bailout oxygen bottle for proper connection; pull release. | 1. Acknowledge bailout warning. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release. |
| 2. After observer's ejection, check parachute and bail out through observer's downward ejection hatch opening. | 2. 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 places emergency keyer ON.

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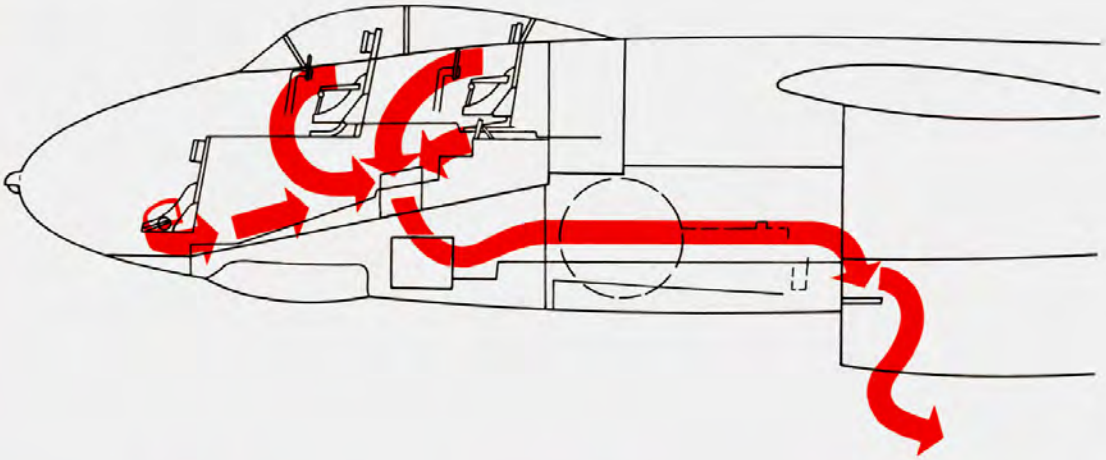
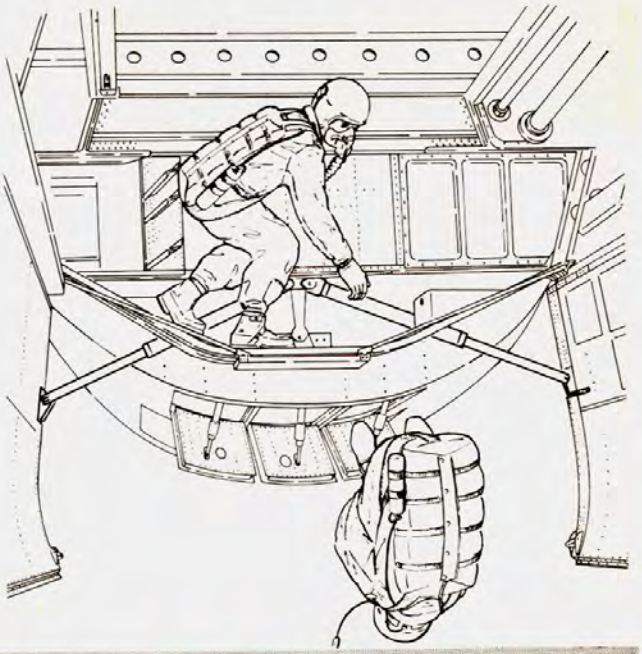
*Figure 3-12.*

# ALTERNATE BAILOUT
## (CONTROLLABLE FLIGHT — BOMB BAY)



| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 1. Give bailout warning by three short rings on the alarm bell and spoken bailout-bomb-bay warning over interphone. Pull emergency cabin release handle. | 1. Acknowledge bailout warning. | 1. Acknowledge bailout warning. |
| 2. Extend flaps and drag gear to reduce airspeed as much as possible (maximum 195 knots IAS). When airspeed is stabilized retract drag gear and trim airplane for level flight. Engage automatic pilot and stow control column. | 2. Stow control column and unfasten safety belt and shoulder harness. | 2. Actuate bomb salvo switch . Unfasten safety belt and shoulder harness. If no extra crew members are on board, open pressure compartment door. |
| 3. Check rear landing gear retracted and bomb doors open. Give abandon airplane signal by one long ring on alarm bell and spoken order over interphone. | 3. Check bailout oxygen bottle for proper connection; pull release and proceed aft to bomb bay platform. | 3. Check bailout oxygen bottle for proper connection; pull release and proceed aft to bomb bay platform. |
| 4. Check bailout oxygen bottle for proper connection; pull release and proceed aft to bomb bay platform and follow copilot in bailout through bomb bay. | 4. Follow the observer in bailout through bomb bay. | 4. Bail out through bomb bay following extra crew members. |



**NOTE**

The extra crew members, observer, co-pilot, and pilot is the desired order of bailout. To bail out, squat on bomb bay platform facing aft with feet at edge of platform, wrap arms around legs, tuck head between knees, and roll forward out the bomb bay.

| FORWARD EXTRA SEAT | AFT EXTRA SEAT |
|---|---|
| 1. Acknowledge bailout warning. Check bailout oxygen bottle for proper connection; pull release. | 1. Acknowledge bailout warning. Check bailout oxygen bottle for proper connection; pull release. |
| 2. Stow seat and proceed to pressure compartment door. | 2. Stow seat and open pressure compartment door. |
| 3. Proceed aft to bomb bay platform. | 3. Proceed aft to bomb bay platform. |
| 4. Bail out second through bomb bay. | 4. Bail out first through bomb bay. |

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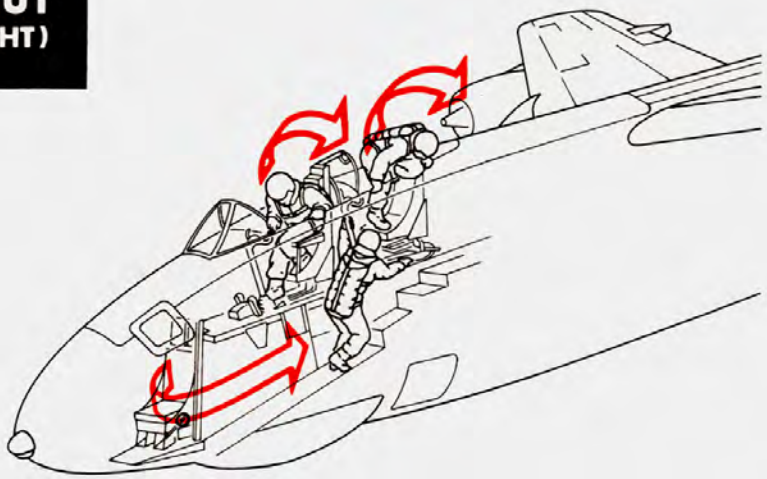
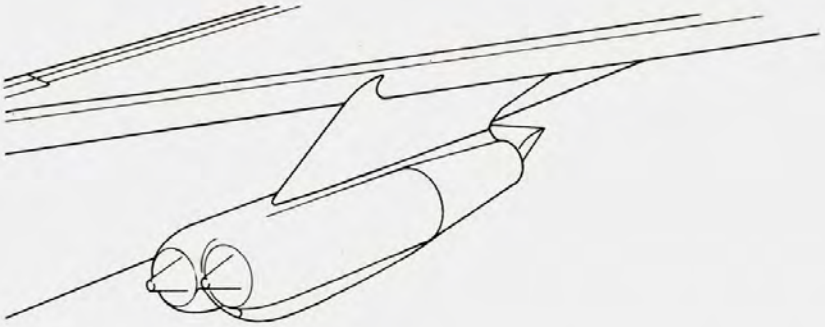
*Figure 3-13.*

# * ALTERNATE BAILOUT
## (UNCONTROLLABLE FLIGHT)



| PILOT | COPILOT | OBSERVER |
|---|---|---|
| 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. | 1. Pull canopy emergency jettison handle. | 1. Unfasten safety belt and shoulder harness. Proceed aft in walkway to position near copilot. |
| 2. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release. Bail out through cockpit opening, over side of airplane. | 2. Unfasten safety belt and shoulder harness. Check bailout oxygen bottle for proper connection; pull release. Bail out through cockpit opening, over side of airplane. | 2. Check bailout oxygen bottle for proper connection; pull the release. 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.**

| FORWARD EXTRA SEAT | AFT EXTRA SEAT |
|---|---|
| *1.* Unfasten safety belt. Proceed aft in walkway to position near copilot. | *1.* Unfasten safety belt and shoulder harness. |
| *2.* Check bailout oxygen bottle for proper connection; pull release. Bail out through cockpit opening, over the side of airplane. | *2.* Check bailout oxygen bottle for proper connection; pull release. Bail out through cockpit opening, over the side of airplane. |

*Figure 3-14.*

## 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 start.

2. Battery Switch - LH BUS NORMAL

3. Ignition Switches - NORMAL

4. Generator Switches - RESET & OFF
   Place all generator switches to RESET momentarily, then release to OFF.

5. Fuel Selector Switches - SET
   Set fuel selector switch for No. 2 engine on TME and all other fuel selector switches on ME.

6. Starter Selector Switch - SET
   Set starter selector switch to engine to be started.

7. Starter & Override Switches - START
   Hold starter switch and emergency override switch in START positions simultaneously, then release.

8. Start Sequence - ENGINES 4, 5, 6, 3, 2 & 1
   Use normal start procedure after starter engagement.

9. Engines 4 & 5 - 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.

10. Ignition Switches - OFF

11. Battery Switch - LH BUS NORMAL
    After all engines are started, place the battery switch to LH BUS NORMAL.

12. DC Electrical Equipment - ON
    Turn on equipment requiring DC power as necessary.

13. Fuel Selector Switches - RESET
    Reset fuel selector switches as follows:
    - With cg at or forward of 34% MAC, No. 2 on TME and all others on TE.
    - With cg aft of 34% MAC, No. 3 and 4 on TME, and 1, 2, 5, and 6 on ME.

## 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 Switch - OFF
3. Ignition Switches - NORMAL
4. Connect external power to "Normal" receptacle.
5. Generator Switches - RESET & OFF
   Place all generator switches to RESET momentarily, then release to OFF.
6. Fuel Selector Switches - SET
   Set fuel selector switch for No. 2 engine on TME and all other fuel selector switches on ME.
7. Starter Selector Switch - SET
   Set starter selector switch to engine to be started.
8. Starter and Override Switches - START
   Hold starter switch and emergency override switch in START positions simultaneously, then release.
9. Start Sequence - ENGINES 4, 5, 6, 3, 2 & 1
   Use normal start procedure after starter engagement.
10. All Engines Started - ALL GENERATORS ON
    After starting all engines, place all generator switches ON.
11. Ignition Switches - OFF
12. Battery Switch - LH BUS NORMAL
    After all engines are started, place battery switch to LH BUS NORMAL.
13. DC Electrical Equipment - ON
    Turn on equipment requiring DC power as necessary.
14. Fuel Selector Switches - RESET
    Reset fuel selector switches as follows:
    - With cg at or forward of 34% MAC, No. 2 on TME and all others on TE.
    - With cg aft of 34% MAC, No. 3 and 4 on TME and 1, 2, 5, and 6 on ME.

## 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 after checking that the main fuel control or main fuel warning circuit breaker is in. Also consider 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 engine flameout, 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**

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 FUEL BOOST PUMP FAILURE AND/OR FUEL LINE FAILURE

If one or two fuel boost pressure warning lights illuminate on an engine with the fuel selector switch on TE, proceed as follows:

1. Opposite Engine Fuel Selector Switch - TME
2. Affected Engine Fuel Selector Switch - ME
3. If after making settings above, loss of pressure occurs on boost pumps now supplying the manifold (indicating fuel line failure), accomplish fire shutdown on original affected engine.
   a. Throttle - CUTOFF
   b. Fire Shutoff Switch - PULLED (if desired)
   c. Fuel Selector Switch - TE
4. Engine - LUBRICATED
   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.

Continued On Next Page

## OPERATION WITH FUEL BOOST PUMP FAILURE AND/OR FUEL LINE FAILURE

Continued

**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, land airplane as soon as possible.

**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.

## MULTIPLE BOOST PUMP ON ENGINES SUPPLIED FROM THE SAME TANK

1. Fuel Selector Switches - ME
   Position fuel selectors to affected engine on ME.
2. All other fuel selector switches - TE
3. Prior to entering traffic pattern:
   Reposition fuel selector switches on TE to TME.

## OPERATION WITH FUEL LEAK IN MANIFOLD

If fuel boost pressure warning lights illuminate on an engine with the fuel selector switch on TME, proceed as follows:

1. Circuit Breakers - IN
   Check that affected numbered circuit breaker on the "Main Fuel Control" portion of the upper DC power panel are in.

2. Fuel Selector Switches - TE
   Place all fuel selector switches to TE.

3. If fuel boost warning lights go out:
   a. Leave all fuel selector switches on TE.
   b. Do not use auxiliary tanks to operate engines as the fuel leak has been established in the manifold. However, auxiliary fuel may be transferred to main tanks, then to engines.

4. If fuel boost warning lights remain on, follow procedure for "Fuel Boost and/or Fuel Line Failure."

**Operation With Fuel Gage Failure**

The balance computer (load adjuster) should be used at all times to determine the exact cg location. However, if fuel gages become inoperative or unreliable, they cannot be used to obtain quantity readings necessary for use of the balance computer. In this case, by using the chart presented in figure 3-16, an approximate center of gravity while cruising at Mach .74 at various altitudes and weights can be determined by reference to the elevator trim setting. Therefore, it is possible by fuel system management to maintain a proper cg location. This chart should not be used unless absolutely necessary and then only for an approximation because incorrect rigging of the elevator trim system and/or tolerances in the airplane structure can cause incorrect center of gravity indications.

## EMERGENCY TANK EMPTYING

In case it becomes necessary to empty one main tank rapidly, use the following procedure:

1. Defective Tank Fuel Selector Switches - TME

2. Two other fuel selector switches - ME

3. When tank is nearly empty:
   a. Reposition fuel selector switches from ME to TE.
   b. Reposition one fuel selector switch on TE to TME.

4. When all four boost pumps for the defective tank remain on:
   a. Position fuel selector switches for that tank on 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.

## 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 RESET, then to ON position. If the above steps do not correct the generator malfunction, place the generator switch in 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 3-17 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**

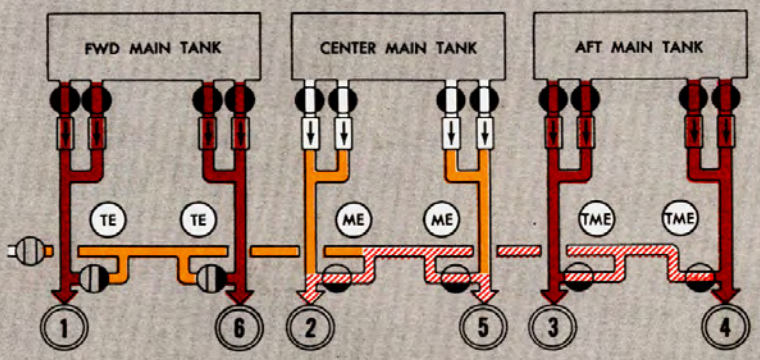
Any tabulation of electrical loads must be an approximation or an average because loads vary with existing conditions and with the age of the equipment.

#### Operation With Two Generators

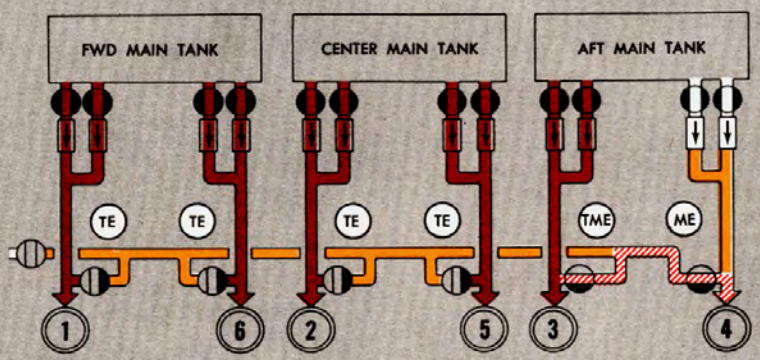
Operation with only two generators, as encountered during two-engine endurance flight (see "Two-Engine Endurance" in this section), requires careful consideration of the limited electrical power available. However, if all nonessential electrical equipment is turned off, sufficient electrical power is 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 lists the essential electrical loads and the standby loads for two-engine endurance and their amperage requirements. This equipment must be operating or electrical power must be available for operation at all times:

| ITEM | AMPERES (Approx) |
|---|---|
| Automatic Pilot | 20 |
| Battery Charging | 15 |
| 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, Command Radio, and Radio Compass) | 28 |
| Surface Power Control System | 100 |
| Windshield Defrost | 5 |
| Total Essential and Standby Load | 446 |
| Two-Engine Generator Capacity | 800 |
| Single Engine Generator Overload Capacity (50% overload for 5 minutes) | 600 |

# FUEL SYSTEM EMERGENCY OPERATION




EMERGENCY EMPTYING OF AFT MAIN FUEL TANK




OPERATION WITH NO. 4 ENGINE BOOST PUMPS INOPERATIVE

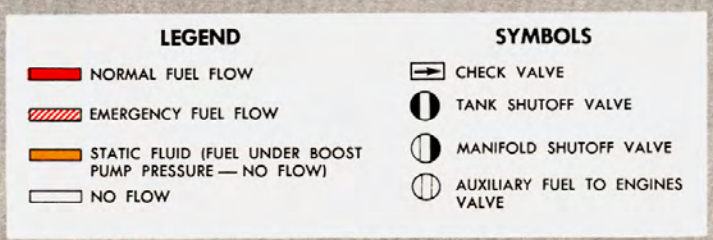



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*Figure 3-15.*

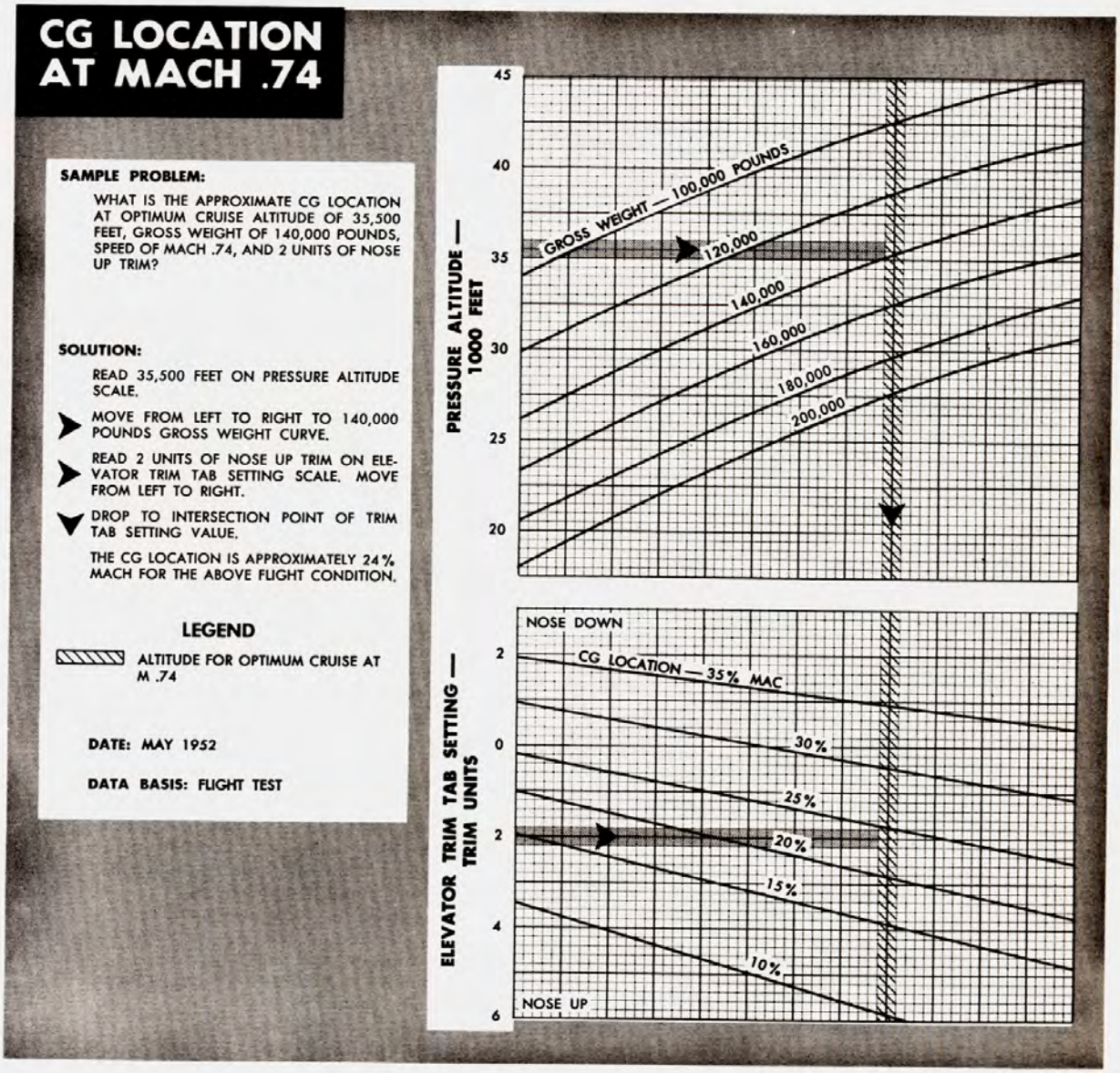


*Figure 3-16.*

A study of the complete listing of major electrical equipment items (figure 3-17) will show that the operation of unnecessary fuel boost 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.

* Airplanes having BNS capabilities

### 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 SYSTEM

### Inverter Failure

In case of failure of either the main or secondary inverter, automatic changeover relays will transfer the spare inverter output to the failed bus. In case of failure of both the main and secondary inverters, automatic changeover relays will transfer the spare inverter to the main bus only. The spare inverter will transfer and be turned on regardless of the position of spare inverter switch. The inverter indicator lights will indicate which inverter is supplying power to which bus. It is necessary for the main inverter and secondary inverter switches to be in ON position for automatic changeover relays to operate; therefore, if the main inverter fails and the spare inverter automatically transfers to the main bus, do not place the main inverter switch in OFF position. If the main and/or secondary inverter fails and the automatic changeover relays fail to operate, the spare inverter output may be manually transferred to the desired bus by placing the inverter transfer control switch in either SPARE INV MAIN BUS or SPARE INV SEC BUS position. If the automatic changeover relays cause the main and/or secondary inverter to malfunction and the spare inverter is inoperative, place the inverter transfer control switch in SEC INV SEC BUS position. In case the spare inverter has failed to transfer to the main bus and secondary bus power is not required or is of less importance, place inverter transfer control switch in SEC INV MAIN BUS position. No power will be on the secondary 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 SPARE position.

## UNREGULATED AC SYSTEM

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 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.

### 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 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 LH ALT BOTH BUS or RH ALT BOTH BUS, depending on which alternator is functioning properly. Place the alternator power switch of the alternator that is not functioning properly in OFF position.

### Bus Malfunction

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 LH ALT-RH BUS, RH ALT-LH BUS position. 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 continue to give indications of conditions that existed prior to power failure, which would be erroneous.

Instruments using DC power only:
- Flap position indicators
- Hydraulic quantity gages

Instruments using AC power from instrument bus:
- Attitude indicator (B-1)
- Attitude indicator (J-8)

Instruments using AC power from main inverter bus:
- N-1 compass system

Instruments using AC power from secondary inverter bus:
- Fuel flowmeters
- Fuel quantity gages
- Engine oil pressure gages
- Hydraulic pressure gages

Instruments using AC and DC power:
- Engine fuelmeters
- N-1 compass directional indicator - pilot's and copilot's

See this section for AC and DC electrical power system emergency operation.

## MAJOR DC ELECTRICAL LOADS

| EQUIPMENT | AMPS (APPROX) |
|---|---|
| ARMAMENT AND BOMBING | |
| In flight control | 25 |
| CONTROL SURFACES | |
| Automatic pilot | 20 |
| Flaps - extend | 181 |
| Flaps - retract | 127 |
| Rudder - elevator surface power control | 100 |
| ELECTRICAL POWER | |
| Battery recharge | 121 (Max) |
| Generator field and control (6 generators) | 69 |
| Inverter - Instrument | 25 |
| Inverter - Main | 152 (Max) |
| Inverter - Radar ① | 25 |
| Inverter - Secondary | 142 (Max) |
| FUEL | |
| Auxiliary tanks (2 pumps in each tank) | 105 (each tank) |
| Main tanks (4 pumps in each tank) | 274 (all tanks) |
| HEAT, VENT, AND ANTI-ICE | |
| Exterior surfaces anti-icing system | 30 |
| Food Warming Cup | 20 |
| HYDRAULICS | |
| Emergency pump | 140 |
| LANDING GEAR | |
| Aft main - retract | 266 |
| Forward main - retract | 346 |
| Landing gear relays | 27 |
| Outriggers - retract | 252 |
| LIGHTS | |
| Landing lights | 43 |
| RADAR | |
| BNS system ① | 32 |
| RADIO | |
| Command Radio (transmit) | 20 |
| Liaison Radio (transmit) | 21 |

**GENERATOR CAPACITY**

**NORMAL:** SIX GENERATORS AT 400 AMPS EACH, 2400 AMPS.

**OVERLOAD (5 MIN):** SIX GENERATORS AT 600 AMPS EACH, 3600 AMPS.

**NOTE:** ONLY EQUIPMENT REQUIRING 20 AMPS OR MORE IS LISTED.

① AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

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*Figure 3-17.*

## 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, 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.

**NOTE**

When emergency system braking is required, apply brakes with one long steady application until the airplane stops. Since antiskid does not function on emergency braking, it is possible to lock wheels and cause destruction of tires by rapid successive pounding of brake pedals.

Turn pump to AUTO NORMAL just prior to landing. This should give steering authority on landing. 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 psi will allow pressure to build up 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. 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. (1)

On some airplanes a pressure switch installed in the pressure line from the engine pump senses low pressure and turns on the emergency aileron pump if a line rupture or other similar failure occurs. Also 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 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 OFF position. The emergency system may have been activated by a number of simultaneous demands upon the main hydraulic system which caused a drop in pressure downstream of the pressure reducer valve. If no main system fluctuation or malfunction exists, aileron-flap-eron 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.

## 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 affecting 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 sea level.

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(1) AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087, and -2091

(2) AF 49-2642 thru 50-080, 51-2047, -2052, -2053, -2063 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088, and -2090

**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 the length of time of this operation and the axes involved. The entry made in DD Form 781 will serve as a notice to the ground crew to check the servo motors and the servo control 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.

**ELEVATOR OPERATION WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE**

Loss of elevator power control at speeds near the maximum indicated airspeeds or Mach numbers will result in a pitchup 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. 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 Breakers - IN
   Copilot checks that the "Rudder & Elevator" circuit breaker on the lower DC power panel is in.

2. Surface Lock Lever - FORWARD UNLOCK DETENT
   Check that the surface control lock lever is in full forward UNLOCK detent.

3. Rudder-Elevator Surface Power Control Switch - OFF
   If it has been determined that the preceding steps have not corrected the malfunction, pilot places rudder-elevator surface power control switch OFF.

4. Normal pattern
   Establish a normal traffic pattern.

Continued On Next Page

## LANDING WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

Continued

5. 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.

6. Crosswind landing

a. Steering Ratio Selector Lever - TAKEOFF LAND

If a crosswind landing must be made, recheck the steering ratio selector lever in TAKEOFF LAND detent.

b. 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 prevent sudden veering when the increased steering range cuts in.
- 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.

7. Wind Over 15 Knots - STOP TAXIING

After landing, discontinue taxiing if the wind exceeds 15 knots.

## AILERON SURFACE POWER CONTROL SYSTEM

**CAUTION**

- If aileron trim is necessary during operation with one aileron surface power control inoperative, trim the airplane to level flight by moving the control wheel, then operate the trim tab control to reduce control wheel forces to zero.
- If both the red and amber lights for one aileron power control system are illuminated simultaneously, a leak in the aileron hydraulic system is indicated. The corresponding control switch should be placed in OFF position to prevent loss of hydraulic fluid.

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, 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.

**NOTE**

With both aileron power controls inoperative, it may not be possible with maximum pilot effort to obtain full control wheel deflection.

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.

**NOTE**

Abrupt pitch-down will occur when flying at high indicated airspeeds in the event of simultaneous failure of both aileron power control units.

In the event of one aileron power control failure while in the approach for landing or immediately after takeoff, 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

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(1) AF 51-2045, -2049 thru -2051, -2055 thru -2062, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084 thru -2087 & -2091

(2) AF 49-2642 thru 50-080, 51-2047, -2052, -2053, -2063 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088 & -2090

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.

## 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
   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
   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.

## ARTIFICIAL FEEL SYSTEM INOPERATIVE

If ram air pressure to the rudder and elevator Q-springs 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 and elevator axes and an apparent control "sloppiness" will be experienced. There is no actual change in control effectiveness under this condition; automatic pilot operation remains satisfactory. The impression of loss of surface effectiveness results from the extreme ease with which the rudder and elevator can be moved. The effect is the same as operation of the control surfaces while parked with surface power control operating. Because of the light forces, as low as approximately 2 to 4 pounds wheel force, 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 seem sluggish. At high airspeeds, the reverse condition will exist; that is, the airplane response will increase and be extremely sensitive to control movements. Abrupt or exaggerated control movements are not normally necessary. Normally, the pilot will still feel the effects of control movements by the "seat of the pants" and the loss of feel on the wheel or rudders should not cause undue concern. It should be recognized that abrupt or exaggerated control movements by the pilot when the control forces become extremely light could result in overstressing and structural failure of the control surface or the airplane at high indicated airspeeds. A principal hazard resultant to failure of the artificial feel system is the lack of means to maintain airplane trim, particularly on the elevator axis. While the surface power control systems are

operating, this is no problem since control forces are light; however, if surface power were to fail, strong control forces and possible pitching tendencies could result in a hazardous condition. To alleviate the hazard relative to maintaining elevator trim, it is recommended that the rudder-elevator surface power control system be turned off when artificial feel system malfunction is encountered. The rudder-elevator surface power control system should be left off for the remainder of the flight, particularly when trim is constantly changing due to changing airspeed, altitude, or center of gravity location. Prior to turning off the rudder-elevator surface power control system, it is essential that proper rudder and elevator trim be established. The rudder trim wheel should be set to zero trim units. The following steps must be accomplished to establish elevator trim:

1. Compute airplane gross weight and center of gravity location.
2. Establish and maintain either Mach .74 at optimum cruise altitude or best flare speed plus 30 knots below 10,000 feet, depending on most practical flight condition to be maintained when trim establishment is being accomplished. If the latter condition is used, gear and flaps should be extended.
3. Refer to either the chart "CG at Mach .74" (figure A4-26) or "Approach Trim Wheel Setting" (figure A8-1), depending on which speed was established above. Enter chart with gross weight, altitude, and center of gravity to determine the elevator trim wheel setting.
4. Set elevator trim wheel to proper units, turn rudder-elevator surface power control switch to OFF, and restrain control wheel.

**NOTE**

It may be advantageous to utilize the rudder-elevator surface power control system during cruise where trim changes are not rapid to alleviate pilot fatigue. It may also aid the pilot during landing under gusty or crosswind conditions, or both. If the pilot elects to operate the rudder-elevator surface power control system, the airplane must be kept in trim by turning off the rudder-elevator power system periodically and retrimming to compensate for center of gravity changes due to fuel consumption. Prior to landing, the surface power off trim should be checked as given in steps "1" through "4."

## DIRECTIONAL DAMPER INOPERATIVE

Failure or malfunction of the directional damper at any time during flight is not considered hazardous when recognized and the directional damper is turned off immediately. The flight characteristics of the airplane after malfunction or failure are readily recognized as these failures usually take one of two forms in which the damper either gives a "hard-over" signal or oscillates. Due to the limited travel of the directional damper control rod, a hard-over signal in which the control rod reaches its extreme travel in one direction results in a maximum of approximately 5° rudder displacement. This displacement of the rudder, even when applied suddenly, is not of sufficient magnitude to have a detrimental effect on the flight of the airplane at medium speeds. The directional damper is inoperative at speeds in excess of 335 knots IAS since a ram air switch automatically disconnects the directional damper above this speed. At low airspeeds, such as during a takeoff and landing, this rudder displacement has the same effect as though the airplane had encountered a strong wind gust except the gust is prolonged. This prolonged gust effect is the recognizable feature of a directional damper failure and when encountered the damper should be turned off. When the damper has been turned off, the false signal will have been removed and the telescoping control rod will return to its center position and lock. Oscillation as a result of directional damper failure is easily recognized as such and, when encountered, the directional damper should be turned off immediately. As in the case of the hard-over signal failure, when the damper has been turned off false signals will be removed and the control rod will center and become locked. The oscillation failure has no set pattern and may oscillate at various frequencies and with varying degrees of rudder displacement, in any event, creates an uncomfortable ride for the crew only as long as it takes to turn the directional damper off. When an oscillation failure is encountered, the directional damper should be turned off immediately as oscillation could possibly increase to a point where structural failure might occur if allowed to continue.

## 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. To use the pilot's emergency retraction switch may damage motors on the retracted gear. Place the individual retraction switches OFF as soon as gear retraction is completed.

**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.
- Do not use emergency landing gear retraction switches unless landing gear lever is in OFF position.

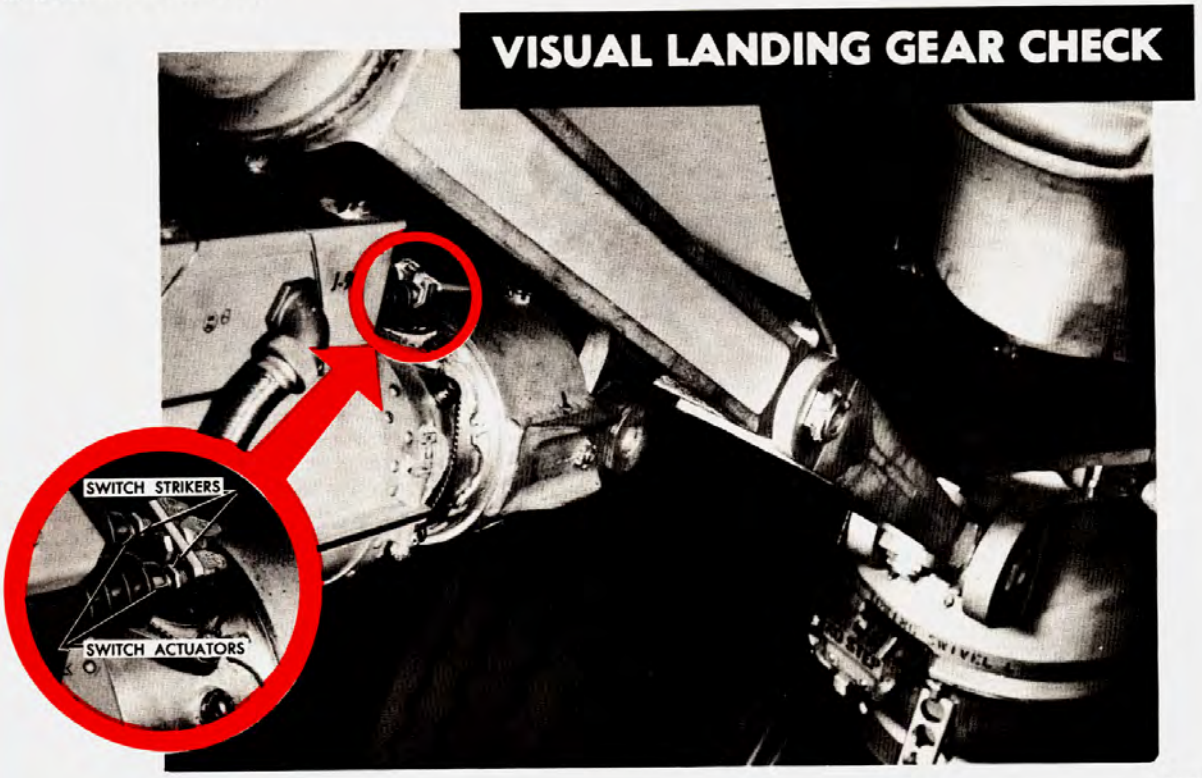


*Figure 3-18.*

## 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. Airspeed - REDUCED
   Reduce airspeed to 305 knots IAS or below.

2. Landing Gear Lever - OFF
   Check that normal landing gear operating lever is in OFF.

Continued On Next Page

## EMERGENCY EXTENSION OF LANDING GEAR

**Continued**

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. Remaining gear - EXTENDED
   When one gear is down and locked, continue to extend remaining gear.

**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.

Continued On Next Page

## EMERGENCY EXTENSION OF LANDING GEAR

**Continued**

6. In case it is impossible to lower all landing gear, follow required emergency landing procedure.
7. Emergency Extension Lever - STOWED
8. Before Landing Checklist - COMPLETED

## INTERMEDIATE LANDING GEAR INDICATION AFTER GEAR RETRACTION

If any of the landing gear position indicators show intermediate after allowing a normal period for landing gear retraction, proceed as follows:

1. Landing Gear Lever - OFF
2. Landing Gear Circuit Breakers - IN
   Copilot will check circuit breakers marked "Main Gear" and "Outrig Gear" on the "Landing Gear" portion of the upper DC power panel pushed in.
3. Wing Flaps - FULL DOWN
   Pilot reduces airspeed to 195 knots IAS and requests copilot to extend flaps to 100%. Copilot keeps hand on flap lever during extension until flap lever is placed to OFF position.
4. ① Door Latches - RESET
   If the intermediate indication is for either of the main gear, select the appropriate emergency landing gear extension lever, make one full stroke, and immediately return the lever to the aft position. Wait 3 to 4 seconds for the 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 free falls.

**NOTE**

Operating the ELGE lever until the gear free falls will ensure resetting of the landing gear door latches.

5. Landing Gear - RECYCLED
   The pilot will recycle the landing gear by placing the landing gear lever to the DOWN position. After the indicators show down and locked place the landing gear lever to UP.

**NOTE**

If one recycling fails to clear the intermediate indication. lower all gear and abort the mission.

① Airplanes which do not have T. O. 1B-47-905 accomplished

## DOWN AND LOCKED GEAR INDICATION AFTER GEAR RETRACTION

If any of the landing gear position indicators show down and locked after allowing a normal period for landing gear retraction, proceed as follows:

1. Landing Gear Lever - OFF

2. Landing Gear Circuit Breakers - IN
   Copilot will check circuit breakers marked "Main Gear" and "Outrig Gear" on the "Landing Gear" portion of the upper DC power panel pushed in.

3. Wing Flaps - FULL DOWN
   Pilot reduces airspeed to 195 knots IAS and requests copilot to extend flaps to 100%. Copilot keeps hand on flap lever during extension until flap lever is placed to OFF position.

4. Actual Gear Position - VISUAL CHECK
   Visually check outrigger gear from cockpit, forward main gear from crawlway, or aft main gear by chase airplane or tower fly-by to determine whether gear is full up and doors appear to be closed and latched.

5. If visual check shows gear full up and doors latched assume an indicator malfunction.
   If it has been determined that all gear have retracted and the doors appear to be closed and latched, the mission may be continued.

6. If visual check shows gear not full up or visual check cannot be made:
   a. Landing Gear - RECYCLED ONCE
      The pilot will recycle the landing gear once by placing the landing gear lever to the DOWN position. After the other gear indicators show down and locked, place the landing gear lever to UP.
   b. If landing gear fails to retract abort mission.

7. Prior to landing:
   a. Landing Gear - DOWN, LEVER OFF
      Place landing gear lever to DOWN. After gear indicates down and locked, return lever to OFF.
   b. ELGE Lever - ACTUATED
      Check actual gear position by actuating the ELGE lever for the gear which malfunctioned until the gear is down and locked, as determined by increased ELGE forces. The down and locked position is usually reached with maximum effort of approximately 75 pounds when the lock is engaged. There is a perceptible change in the force 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.
   c. Remaining Gear - CHECKED DOWN, LEVER DOWN
      Confirm down and locked position of the remaining gear by means of the landing gear position indicators and indicator lights. Place landing gear lever DOWN.
   d. Visual Check - ACCOMPLISHED, IF POSSIBLE
      If possible, accomplish a visual check by a tower fly-by to ensure all gear extended.

### VISUAL INSPECTION OF FORWARD MAIN LANDING GEAR

A ground heat access panel (23, 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 3-18). 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 ensure a full interior locking of the gear mechanism, use emergency extension handles until force required to operate handle indicates a locked position.

## 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 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

If a rolling tendency accompanies either flap extension or flap retraction, 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 Position Indicator - FLAP POSITION CHECKED

5. Flap Limit Speed - POWER SET
   Maintain airspeed for best control without exceeding the flap structural limit speed in figure 5-3 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. Return flaps to original position.
   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 return the flaps to their original position. Retract or extend as necessary, in small increments (about 5% at a time), with the chase pilot observing to see if the flaps return to the same position.

**WARNING**

If lateral trim is not improved, return the flap lever to OFF at once and abandon further attempts to operate the flaps.

Flap retraction or extension should be stopped when all lateral mistrim is removed even though the flaps may not be in the full-up or full-down position.

8. Final flap position
   a. Flaps Up - USE FLAPS UP LANDING PROCEDURE
      If flaps become equalized in the full-up position, follow procedure in "Landing Emergencies - Landing with Flaps Up," this section.
   b. Flaps Down - NORMAL LANDING
      If flaps become equalized in the full-down position, leave flaps full down and make normal landing.
   c. Flaps Intermediate - CHECK MINIMUM CONTROL IAS, USE FOR LANDING BFS
      If flaps remain in the split position or are equalized in an unknown intermediate position:
      (1) Check minimum control speed at least 20,000 feet above terrain.
      (2) Make landing using minimum control speed or first stall warning plus 18 knots for best flare speed.

Continued On Next Page

## SPLIT-FLAP OPERATION

**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.

## 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.

**NOTE**

When emergency system braking is required, apply brakes with one long steady application until the airplane stops. Since antiskid does not function on emergency braking, it is possible to lock wheels and cause destruction of tires by rapid successive pounding of brake pedals.

### 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 WITH BRAKE FAILURE**

| CONDITIONS | APPROXIMATE PERCENT INCREASE IN STOPPING DISTANCE | |
|---|---|---|
| | BRAKE CHUTE | NO BRAKE CHUTE |
| NO BRAKE FAILURE | 0 | 0 |
| 75% BRAKES | 14% | 17% |
| 50% BRAKES | 34% | 43% |
| 25% BRAKES | 70% | 92% |
| COMPLETE FAILURE | 188% | 273% |

**CONDITIONS**

- 6 ENGINES AT IDLE RPM
- DRY RUNWAY
- BRAKE FAILURE AT TOUCHDOWN

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*Figure 3-19.*

# CANOPY EMERGENCY OPERATION DURING FLIGHT

## CRACKING OR CRAZING OF CANOPY OR WINDSHIELD IN FLIGHT

If cracking or crazing of the canopy or cracking of the windshield is evident, use the following procedure:

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
   Pilot will alert crew. All crew members check oxygen masks on and regulators 100% oxygen.
2. Helmet Visors - LOWERED
   Pilot and copilot lower helmet visors to prevent possible injury to the eyes from glass or plastic fragments.
3. Cabin Pressurization Switch - COMBAT (27,000 feet or above)
   Place cabin pressurization switch in COMBAT position to ensure that maximum safe decompression rates for personnel will not be exceeded should explosive decompression of the cabin occur.
4. Airspeed - BEST ENDURANCE SPEED or 200 KNOTS
5. Altitude - DESCENT 30,000 FEET OR BELOW
6. Cabin Pressure Emergency Release Handle - PULLED
7. Heat Reset Button - DEPRESSED
8. Cabin Air Selector Switch - COMPRESSOR
   Place cabin air selector switch in AIR COMP.

### OPENING 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, fumes, or heat in cockpit or for use as a clear vision panel under adverse landing conditions.

## OPENING CANOPY IN FLIGHT

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 Emergency Release Handle - PULLED
   Pull cabin emergency 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
   Airspeed must be 215 knots IAS or lower before canopy is opened in order to prevent canopy from being wrenched from the airplane and traveling an unpredictable path. At high gross weights and low altitudes where flaps-up stall speeds and maximum canopy opening speeds are nearly equal, speed should be reduced and flaps extended consistent with the flap structural limit curve (figure 5-3). Flaps should not be extended to greater than 72% at speeds in excess of 215 knots IAS. Extension to 72% will materially reduce stalling speed permitting better control of the airplane. If time and conditions permit further speed reduction of the airplane, flaps should be further extended. If it is impossible or impractical to reduce airspeed to 215 knots, then the canopy should be jettisoned.

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.

6. Canopy - OPENED
   The canopy may then be opened by the pilot by moving the canopy lock lever to UNLOCK and the canopy control lever to OPEN.

## EMERGENCY CANOPY JETTISONING

If for some reason it is necessary to jettison the canopy in flight with the canopy emergency jettison handle, use the following procedure:

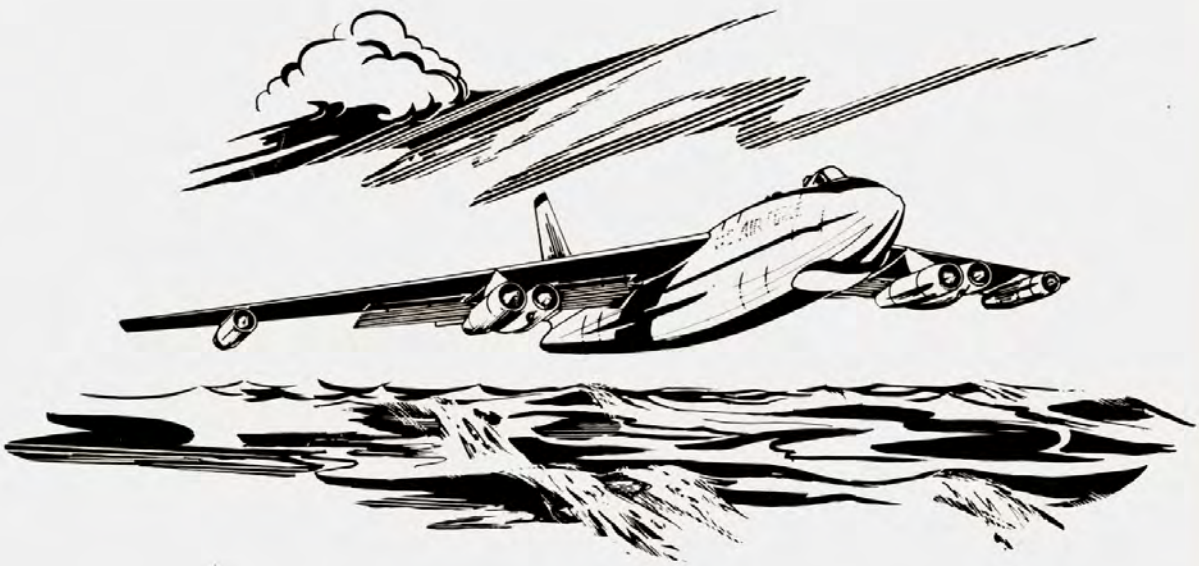
1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
   Pilot will alert crew that canopy is to be jettisoned. All crew members check oxygen masks and regulators on 100% oxygen.

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.



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CUT ON LINE

# TB-47B EMERGENCY PROCEDURES CONDENSED CHECKLIST

**NOTE**

The emergency procedures in this condensed checklist 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

### ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake Chute & Approach Chute - DEPLOYED
4. Brakes - APPLIED
5. Throttles 1, 2, 5 & 6 - CUTOFF
6. If stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
   a. Steering Ratio Selector Lever - TAXI
   b. Ground-loop the airplane
   c. Throttles 3 & 4 - CUTOFF
   d. Fire Shutoff Switches - PULLED
7. If a stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttles 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. Abandon airplane
   g. Assemble upwind

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**ENGINE FAILURE OR PARTIAL ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED** **2**

1. Crew - ALERTED
2. Landing Gear - RETRACTED
3. Throttle - CUTOFF (vibration or fire)
4. Fire Shutoff Switch - PULLED
5. Fuel Selector Switch - TE
6. Flaps - RETRACTED
7. Climb Airspeed - MINIMUM 175 KNOTS IAS
8. Engine - LUBRICATED

**ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF, CRASH LANDING**

1. Crew - ALERTED
2. Bombs - JETTISONED ◀①
3. Flaps - FULLY EXTENDED
4. Landing Gear - RETRACTED
5. Canopy - JETTISONED (open)
6. Throttles - CUTOFF
7. Land straight ahead, changing direction only enough to miss obstacles
8. Prior to touchdown:
   a. Fire Shutoff Switches - PULLED
   b. Shoulder Harness - LOCKED
9. Brake Chute - DEPLOYED
10. After airplane stops:
    a. Battery Switch - OFF
    b. Canopy - REMOVED
    c. Abandon airplane
    d. Assemble upwind

**ENGINE FAILURE DURING FLIGHT**

1. Crew - ALERTED
2. Throttle - CUTOFF
3. Fire Shutoff Switch - PULLED
4. Fuel Selector Switch - SET
5. Engine - LUBRICATED

① ◀ Airplanes having BNS capabilities

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**ENGINE RESTART IN FLIGHT**

1. Throttle - CUTOFF
2. Fire Shutoff Switch - IN
3. Fuel Selector Switch - SET
4. Airspeed - ADJUSTED
5. Ignition Switch - ALTITUDE START OR TEST
6. Alternator Power Switch - RESET
7. Throttle - START DETENT
8. Throttle - IDLE
9. Ignition Switch - OFF
10. Adjust engine to desired rpm

**MAXIMUM GLIDE**

1. Gear & Flaps - RETRACTED
2. Glide Airspeed - 185 KNOTS IAS
3. Bomb Bay Doors - CLOSED
4. Use only shallow banked turns

**LANDING WITH ONE OR MORE ENGINES INOPERATIVE**

1. Crew - ALERTED
2. Crash alert
3. Establish normal traffic pattern
   a. Three engines out on one side
      (1) 160 knots IAS minimum
      (2) Do not extend gear
4. Trim Tabs - SET
5. Landing Gear - EXTENDED
   a. Three engines out on one side
      (1) Extend at pilot's discretion in turn or start of final
6. Anticipate a go-around as soon as possible
7. Final approach
   a. Bleed off to BFS plus gust correction
   b. Roll out trim

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**GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE**

**4**

1. Crew - ALERTED
2. Throttles on operative engines - 100% RPM
3. Landing Gear - RETRACTED
4. Climb Airspeed - MINIMUM 175 KNOTS IAS
5. Establish normal traffic pattern
6. Follow procedure under "Landing with One or More Engines Inoperative," this section

**TWO-ENGINE ENDURANCE**

1. Gear & 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. Resume normal operation

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## FIRE

### ENGINE FIRE ON THE GROUND

1. Visible fire, throttles on side of fire - CUTOFF
   (Smoke only, throttles on that side to IDLE, affected throttle - CUTOFF)
2. If taxiing, STOP AND SET BRAKES
3. Tower & Crew - ALERTED
4. If fire shutdown of affected engine has not been accomplished:
   a. Starter selector switch to affected engine
   b. Starter and override switches together
5. If fire shutdown of affected engine has been accomplished:
   a. Fire Shutoff Switch - IN
   b. Generator Switch - RESET
   c. Starter selector switch to affected engine
   d. Starter and override switches together
6. Throttles - CUTOFF
7. Fire Shutoff Switches - PULLED
8. Battery Switch - OFF
9. Abandon airplane
10. Assemble upwind

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CUT ON LINE

**ENGINE FIRE DURING TAKEOFF, TAKEOFF REFUSED**

**6**

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake Chute & Approach Chute - DEPLOYED
4. Brakes - APPLIED
5. Throttles 1, 2, 5 & 6 - CUTOFF
6. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
   a. Steering Ratio Selector Lever - TAXI
   b. Ground-loop the airplane
   c. Throttles 3 & 4 - CUTOFF
   d. Fire Shutoff Switches - PULLED
7. If a stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttes 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. Abandon airplane
   g. Assemble upwind

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**ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED**

1. Crew - ALERTED
2. Landing Gear - RETRACTED (when airborne)
3. Throttle - IDLE
4. Throttle - CUTOFF (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. Fire Shutoff Switch - PULLED
6. Fuel Selector Switch - SET
7. Flaps - RETRACTED
8. Airspeed - MINIMUM 175 KNOTS IAS
9. Engine - LUBRICATED
10. Do not restart engine

**ENGINE FIRE DURING FLIGHT**

1. Crew - ALERTED
2. Throttle - CUTOFF
3. Fire Shutoff Switch - PULLED
4. Fuel Selector Switch - SET
5. If fire is located in an inboard nacelle and fire continues, actuate fire shutdown on the adjacent engine
6. If fire is uncontrollable - ABANDON AIRPLANE
7. Engine - LUBRICATED
8. Do not restart engine

CUT ON LINE

**CREW COMPARTMENT FIRE**

**8**

1. Crew - ALERTED
2. Oxygen - 100%
3. Cabin Pressure Emergency Release Handle - PULLED
4. Unnecessary electrical equipment - OFF
5. Fire - EXTINGUISHED
6. If cabin does not clear, accomplish the following:
   - Canopy - OPENED

   If time and conditions do not permit opening canopy:
   - Canopy - JETTISONED
7. 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 Selector Switches - TE
   b. Throttles - CUTOFF
   c. Fire Shutoff Switches - PULLED
5. Unnecessary electrical equipment - OFF
6. Aileron Surface Power Control - OFF (if necessary)
7. If fire is uncontrollable - ABANDON AIRPLANE

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CUT ON LINE

## SMOKE OR FUMES ELIMINATION

### 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 - PUSHED
   b. Eliminate fire source
5. If it is suspected that the smoke or fumes are caused by the engines:
   a. Heat Reset Button - PUSHED
   b. Retard throttles one at a time
   c. Engine isolated:
      (1) Throttle - CUTOFF
      (2) Fire Shutoff Switch - PULLED
6. More rapid dissipation of smoke and/or fumes may be accomplished by the following:
   Canopy - OPENED
   If time and conditions do not permit opening the canopy:
   Canopy - JETTISONED
7. Engine - LUBRICATED (optional)

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CUT ON LINE

## TAKEOFF EMERGENCIES

10

### REFUSED TAKEOFF

1. Crew - ALERTED
2. Throttles - IDLE
3. Brake Chute & 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 Lever - TAXI
   b. Ground-loop the airplane
   c. Throttles 3 & 4 - CUTOFF
   d. Fire Shutoff Switches - PULLED
7. If stop or ground-loop cannot be made before reaching an obstacle:
   a. Throttles 3 & 4 - CUTOFF
   b. Fire Shutoff Switches - PULLED
   c. Landing Gear - RETRACTED
   d. Battery Switch - OFF
   e. Canopy - REMOVED
   f. Abandon airplane
   g. Assemble upwind

## LANDING EMERGENCIES

### LANDING WITH FLAPS UP

1. Crew - ALERTED
2. Gross Weight - REDUCED
3. Crash alert
4. Normal pattern
   a. Downwind - FLAPS-UP TOUCHDOWN IAS + 35
   b. Approach Chute - DEPLOYED
   c. Start final - FLAPS-UP TOUCHDOWN IAS + 15
5. Touchdown - ASSURED
   a. Throttles 1, 2, 5 & 6 - CUTOFF
   b. Brake Chute - DEPLOYED
   c. Brakes - APPLIED

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**LANDING WITH BRAKE FAILURE**

1. Crew - ALERTED
2. Emergency Hydraulic Pump Switch - OFF
3. Gross Weight - REDUCED
4. Crash alert
5. Normal pattern
6. Approach Chute - DEPLOYED
7. Emergency Hydraulic Pump Switch - AUTO NORMAL
8. Throttles - IDLE
9. Throttles 1, 2, 5 & 6 - CUTOFF
10. Brake Chute - DEPLOYED
11. Brakes - APPLIED
12. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
    a. Steering Ratio Selector Lever - TAXI
    b. Ground-loop the airplane
    c. Throttles 3 & 4 - CUTOFF
    d. Fire Shutoff Switches - PULLED
13. If impossible to stop or ground-loop before reaching an obstacle:
    a. Throttles 3 & 4 - CUTOFF
    b. Fire Shutoff Switches - PULLED
    c. Landing Gear - RETRACTED
    d. Battery Switch - OFF
    e. Canopy - REMOVED
    f. Abandon airplane
    g. Assemble upwind

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CUT ON LINE

**LANDING WITH FRONT GEAR STEERING FAILURE**

**12**

1. Crew - ALERTED
2. Crawlway check
3. Chase check
4. Steering Ratio Selector Lever - TOW & BACK TO TAKE-OFF LAND
5. Steering Ratio Selector Lever - TAKEOFF LAND DETENT
6. Normal Pattern - AVOID CROSSWIND
7. Approach Chute - DEPLOYED
8. Throttles - IDLE
9. Throttles 1, 2, 5 & 6 - CUTOFF
10. Brake Chute - DEPLOYED
11. Brakes - APPLIED
12. Landing Roll - PEDALS NEUTRAL, STEERING TAXI
13. Ailerons & Bicycle

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CUT ON LINE

**LANDING WITH RELIANCE ON BRAKE CHUTE**

1. Crew - ALERTED
2. Gross Weight - REDUCED
3. Approach Chute - DEPLOYED
4. Practice approach
5. Brake Chute Deploy Speed - CHECKED
6. Normal pattern
7. Touchdown - THROTTLES IDLE
8. Throttles 1, 2, 5 & 6 - CUTOFF
9. Brake Chute - DEPLOYED
10. Brakes - APPLIED
11. If a stop cannot be made before reaching an obstacle and IAS is not over 60 knots:
    a. Steering Ratio Selector Lever - TAXI
    b. Ground-loop the airplane
    c. Throttles 3 & 4 - CUTOFF
    d. Fire Shutoff Switches - PULLED
12. If impossible to stop or ground-loop before reaching an obstacle:
    a. Throttles 3 & 4 - CUTOFF
    b. Fire Shutoff Switches - PULLED
    c. Landing Gear - RETRACTED
    d. Battery Switch - OFF
    e. Canopy - REMOVED
    f. Abandon airplane
    g. Assemble upwind

**LANDING WITH DELAYED DEPLOYMENT OF APPROACH CHUTE**

1. Approach Chute Deployment Switch - DOOR CLOSED or OFF
2. Wait 10 seconds
3. Approach Chute Jettison Handle - PULLED

CUT ON LINE

## CRASH LANDING

14

Time and conditions permitting, use all fuel except center main tank; then land with center main tank on TME, all others ME. Install ejection safety pins prior to landing.

### PILOT

1. Alert crew and depressurize airplane
2. Emergency keyer ON, IFF to EMERGENCY
3. Extend wing flaps
4. Salvo bombs and close bomb doors
5. Retract landing gear
6. Unbuckle chute and fasten safety belt and shoulder harness
7. Jettison canopy. If unable to jettison canopy open and leave lever in open position

### COPILOT

1. Acknowledge warning
2. Stand by to assist pilot, if needed
3. Unbuckle chute and fasten safety belt and shoulder harness

### OBSERVER

1. Acknowledge warning
2. Transmit position report to pilot
3. Assume crash-landing position

THREE-MAN CREW. Beside Copilot - Unbuckle chute, raise seat back, and fasten shoulder harness, tiedown strap, and safety belt.

FOUR-MAN CREW. Forward ditching station. Unbuckle chute, lower ditching harness and secure to tiedown fittings, and sit facing aft in harness cradle.

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**FORWARD EXTRA SEAT**

1. Acknowledge warning and stow seat
2. Assume crash-landing position
   FOUR-MAN CREW - Position beside copilot. Unbuckle chute, raise seat back, and fasten shoulder harness, tiedown strap, and safety belt.
   FIVE-MAN CREW - Position aft ditching station. Unbuckle chute, lower ditching harness, and secure to tiedown fittings. Sit facing aft in harness cradle.

**AFT EXTRA SEAT**

1. Acknowledge warning
2. Assume crash-landing position
3. Remain in seat, unbuckle chute, and fasten safety belt and shoulder harness

**CRASH LANDING TECHNIQUE**

1. Establish normal approach
2. Pull fire shutoff switches at beginning of flare
3. Crew members lock shoulder harness
4. Give brace-for-crash-landing warning
5. Deploy brake chute upon contact
6. Normal landing attitude
7. Battery switch off

**ABANDONING AIRPLANE**

1. Remove canopy (if canopy is not jettisoned)
2. Exit through canopy opening or observer's escape hatch

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CUT ON LINE

**DITCHING** **16**

Install ejection seat safety pins prior to ditching.

**PILOT**

1. Alert crew and depressurize airplane
2. Emergency keyer ON, IFF to EMERGENCY
3. Jettison external wing tanks (only if containing fuel)
4. Extend wing flaps
5. Salvo bombs and close bomb doors
6. Retract landing gear
7. Unbuckle chute and fasten safety belt and shoulder harness. Check lifevest.
8. Jettison canopy. If unable to jettison canopy, open and leave lever in open position.

**COPILOT**

1. Acknowledge warning
2. Stand by to assist pilot, if needed
3. Unbuckle chute and fasten safety belt and shoulder harness. Check lifevest

**OBSERVER**

1. Acknowledge warning
2. Transmit position report to pilot
3. Assume ditching position

THREE-MAN CREW - Beside copilot. Unbuckle chute, raise seat back, and fasten shoulder harness, tiedown strap, and safety belt.

FOUR-MAN CREW - Forward ditching station. Unbuckle chute, lower ditching harness and secure to tiedown fittings, and sit facing aft in harness cradle. Check lifevest.

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CUT ON LINE

**FORWARD EXTRA SEAT**

1. Acknowledge warning and stow seat
2. Assume ditching position
   FOUR-MAN CREW - Position beside copilot. Unbuckle chute, raise seat back, and fasten shoulder harness, tie-down strap, and safety belt. Check lifevest.
   FIVE-MAN CREW - Position aft ditching station. Unbuckle chute, lower ditching harness and secure to tiedown fittings, and sit facing aft in harness cradle. Check lifevest.

**AFT EXTRA SEAT**

1. Acknowledge warning
2. Assume ditching position
3. Remain in seat. Unbuckle chute and fasten safety belt and shoulder harness. Check lifevest

**DITCHING TECHNIQUE**

1. Establish normal approach
2. Pull fire shutoff switches at start of flare
3. Crew members lock shoulder harness
4. Give brace-for-ditching warning
5. Touchdown in medium nose-high attitude (near 10°), wings level
6. Touchdown at lowest airspeed without stalling

**ABANDONING AIRPLANE**

1. When airplane stops, unbuckle safety belt and shoulder harness
2. Remove canopy (if canopy is not jettisoned)
3. Exit through canopy opening or observer's escape hatch

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CUT ON LINE

## BAILOUT — EJECTION SEATS

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Time and conditions permitting.

1. Pilot gives warning
2. IFF - EMERGENCY
3. Emergency Keyer - ON
4. Helmet Visor - LOWERED
5. Reduce speed to allow extra crew members to bail out. Engage automatic pilot

**NOTE**

Maximum IAS 195 knots if extra crew members are to bail out through observer's ejection hatch opening or through escape chute with forward gear down, bomb doors open, or spoiler not extended. Maximum IAS 280 knots with spoiler extended and all gear and bomb bay doors retracted.

**PILOT**

1. Give bailout order and depressurize
2. Rotate left handgrip forward to mechanical stop. Reduce airspeed if extra crew member aboard

**NOTE**

Do not jettison canopy until extra crew members have bailed out.

3. Rotate right handgrip forward to mechanical stop. Check oxygen bottle connected and pull release
4. Squeeze seat catapult trigger

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CUT ON LINE

**COPILOT**

1. Acknowledge bailout order. Position seat facing forward in normal ejection position (untilted)
2. Rotate left handgrip forward to mechanical stop

**NOTE**

Do not jettison canopy until extra crew members have bailed out.

3. Rotate right handgrip forward to mechanical stop. Check oxygen bottle connected and pull release
4. Squeeze seat catapult trigger

**OBSERVER**

1. Acknowledge bailout order. Position seat facing forward
2. Raise leg braces to locked position. Check oxygen bottle connected and pull release
3. Pull D-ring once
4. Fire seat catapult by pulling D-ring again

**FORWARD EXTRA SEAT**

1. Acknowledge bailout order. Unfasten safety belt and stow seat. Check oxygen bottle connected and pull release. Proceed to escape chute
2. Unlock and open pressure compartment door (four-man crew)
3. Pull bailout control handle (four-man crew)
4. Check chute. Abandon airplane (feet first facing aft)

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AFT EXTRA SEAT

20

1. Acknowledge bailout order. Unfasten safety belt and shoulder harness
2. Unlock and open pressure compartment door
3. Pull bailout control handle
4. Check chute. Abandon airplane (feet first facing aft)

NOTE

Forward and aft extra seat crew members may follow observer in this order through observer's escape hatch. Crouch by left side of hatch opening and roll out head first.

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CUT ON LINE

## BAILOUT ESCAPE CHUTE (Controllable Flight)

Time and conditions permitting:

1. IFF - EMERGENCY
2. Emergency Keyer - ON
3. Extend drag gear and flaps to reduce airspeed definitely below the following:

   Maximum IAS 195 knots
   - Spoiler not extended
   - Forward gear down
   - Bomb doors open

   Maximum IAS 280 knots
   - Spoiler extended
   - Gear retracted
   - Bomb doors closed

### PILOT

1. Alert crew and depressurize
2. Stabilize airspeed. Raise gear, trim, engage automatic pilot, and stow control column
3. Give abandon signal. Unfasten safety belt and shoulder harness. Check oxygen bottle connected, pull release, and proceed to escape hatch
4. Check chute. Abandon airplane (feet first facing aft)

### COPILOT

1. Acknowledge warning. Unfasten safety belt and shoulder harness
2. Stow control column
3. Check oxygen bottle connected, pull release, and proceed to escape hatch
4. Check chute. Abandon airplane (feet first facing aft)

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**OBSERVER**

**22**

1. Acknowledge warning. Unfasten safety belt and shoulder harness. Check oxygen bottle connected, pull release, and proceed to escape hatch
2. Unlock and open pressure compartment door (three-man crew)
3. Pull bailout control handle (three-man crew)
4. Check chute. Abandon airplane (feet first facing aft)

**FORWARD EXTRA SEAT**

1. Acknowledge warning. Unfasten safety belt and stow seat. Check oxygen bottle connected, pull release, and proceed to escape hatch
2. Unlock and open pressure compartment door (four-man crew)
3. Full bailout control handle (four-man crew)
4. Check chute. Abandon airplane (feet first facing aft)

**AFT EXTRA SEAT**

1. Acknowledge warning. Unfasten safety belt and shoulder harness. Check oxygen bottle connected and pull release
2. Unlock and open pressure compartment door
3. Pull bailout control handle
4. Check chute. Abandon airplane (feet first facing aft)

**NOTE**

Bail out in the following order: Aft extra seat, forward extra seat, observer, copilot, and pilot.

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## ALTERNATE BAILOUT — OBSERVER'S DOWNWARD EJECTION HATCH OPENING

Time and conditions permitting:
1. IFF - EMERGENCY
2. Emergency Keyer - ON

**PILOT**

1. Alert crew
2. Extend drag gear and flaps to reduce airspeed (maximum IAS 195 knots, minimum IAS 145 knots). Stabilize airspeed. Raise gear, trim, engage automatic pilot, and stow control column
3. Give abandon-airplane signal. Unfasten safety belt and shoulder harness. Check oxygen bottle connected and pull release
4. After observer's ejection, check chute and bail out through observer's downward ejection hatch opening

**COPILOT**

1. Acknowledge warning. Unfasten safety belt and shoulder harness
2. Stow control column. Check oxygen bottle connected and pull release
3. After observer's ejection, check chute and bail out through observer's downward ejection hatch opening

**OBSERVER**

1. Acknowledge warning. Position seat facing forward and fasten safety belt and shoulder harness. Check oxygen bottle connected and pull release
2. Raise leg braces to locked position. Pull D-ring once
3. On bailout order, fire seat catapult by pulling D-ring again

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**FORWARD EXTRA SEAT**

**24**

1. Acknowledge warning. Unfasten safety belt and stow seat. Check oxygen bottle connected and pull release
2. After observer's ejection, check chute and bail out through observer's downward ejection hatch opening

**AFT EXTRA SEAT**

1. Acknowledge warning. Unfasten safety belt and shoulder harness. Check oxygen bottle connected and pull release
2. After observer's ejection, check chute and bail out through observer's ejection hatch opening

**NOTE**

- Bail out in the following order: Observer, forward extra seat, aft extra seat, copilot, and pilot.
- Crew members should crouch at left side of observer's downward ejection hatch opening and roll out head first.

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CUT ON LINE

## ALTERNATE BAILOUT (CONTROLLABLE FLIGHT — BOMB BAY)

Time and conditions permitting:
1. IFF - EMERGENCY
2. Emergency Keyer - ON

**PILOT**

1. Alert crew and depressurize
2. Extend drag gear and flaps. Maximum IAS 195 knots. Stabilize airspeed. Trim airplane, engage automatic pilot, and stow control column
3. Check aft gear up and bomb doors open. Give abandon-airplane signal. Unfasten safety belt and shoulder harness
4. Check oxygen bottle connected and pull release. Proceed to bomb bay, check chute, and bail out through bomb bay after copilot

**COPILOT**

1. Acknowledge warning
2. Stow control column. Unfasten safety belt and shoulder harness
3. Check oxygen bottle connected, pull release, and proceed to bomb bay
4. Check chute and bail out through bomb bay after observer

**OBSERVER**

1. Acknowledge warning
2. Actuate bomb salvo switch. Unfasten safety belt and shoulder harness. If no extra crew members aboard, open pressure compartment door
3. Check oxygen bottle connected, pull release, and proceed to bomb bay
4. Check chute and bail out through bomb bay after extra crew members

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**FORWARD EXTRA SEAT** **26**

1. Acknowledge warning. Check oxygen bottle connected and pull release
2. Stow seat. (With four-man crew, open pressure compartment door.)
3. Proceed aft to bomb bay
4. Check chute and bail out second through bomb bay

**AFT EXTRA SEAT**

1. Acknowledge warning. Check oxygen bottle connected and pull release
2. Stow seat and open pressure door
3. Proceed aft to bomb bay
4. Check chute and bail out first through bomb bay

**NOTE**

- Bail out in the following order: Aft extra seat, forward extra seat, observer, copilot, and pilot.
- To bail out, squat on bomb bay platform facing aft with feet at edge of platform, wrap arms around legs, tuck head between knees, and roll forward out the bomb bay.

CUT ON LINE

## ALTERNATE BAILOUT — UNCONTROLLABLE FLIGHT

(Only to be used as last resort)

**PILOT**

1. Give abandon-airplane order and jettison-canopy order
2. Unfasten safety belt and shoulder harness. Check oxygen bottle connected and pull release. Bail out through cockpit opening

**COPILOT**

1. Pull canopy emergency jettison handle
2. Unfasten safety belt and shoulder harness. Check oxygen bottle connected and pull release. Bail out through cockpit opening

**OBSERVER**

1. Unfasten safety belt and shoulder harness. Proceed to position near copilot
2. Check oxygen bottle connected and pull release. Bail out through cockpit opening

**FORWARD EXTRA SEAT**

1. Unfasten safety belt and shoulder harness. Proceed to position near copilot
2. Check oxygen bottle connected and pull release. Bail out through cockpit opening

**AFT EXTRA SEAT**

1. Unfasten safety belt and shoulder harness
2. Check oxygen bottle connected and pull release. Bail out through cockpit opening

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CUT ON LINE

## EMERGENCY GROUND STARTING

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### EMERGENCY GROUND STARTING ON BATTERIES

1. DC Electrical Equipment - OFF
2. Battery Switch - LH BUS NORMAL
3. Ignition Switches - NORMAL
4. Generator Switches - RESET & OFF
5. Fuel Selector Switches - SET
6. Starter Selector Switch - SET
7. Starter & Override Switches - START
8. Sequence - ENGINES 4, 5, 6, 3, 2 & 1
9. Engines 4 & 5 Started - ALL GENERATORS ON, BATTERY OFF
   a. Engines 4 & 5 - 60% RPM
   b. Engine 6 Started - ENGINES 4, 5 & 6 - 40%
   c. Start remaining engines
10. Ignition Switches - OFF
11. Battery Switch - LH BUS NORMAL
12. DC Electrical Equipment - ON
13. Fuel Selector Switches - RESET

### EMERGENCY GROUND STARTING WITH EXTERNAL POWER

1. DC Electrical Equipment - OFF
2. Battery Switch - OFF
3. Ignition Switches - NORMAL
4. Connect external power to "Normal" receptacle
5. Generator Switches - RESET & OFF
6. Fuel Selector Switches - SET
7. Starter Selector Switch - SET
8. Starter & Override Switches - START
9. Sequence - ENGINES 4, 5, 6, 3, 2 & 1
10. All Engines Started - ALL GENERATORS ON
11. Ignition Switches - OFF
12. Battery Switch - LH BUS NORMAL
13. DC Electrical Equipment - ON
14. Fuel Selector Switches - RESET

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CUT ON LINE

## OPERATION WITH FUEL BOOST PUMP FAILURE AND/OR FUEL LINE FAILURE

One or two fuel boost pressure warning lights on any engine with fuel selector switch - TE

1. Opposite Engine Fuel Selector Switch - TME
2. Affected Engine Fuel Selector Switch - ME
3. If after making settings above, loss of pressure occurs on boost pumps now supplying the manifold (indicating fuel line failure), accomplish fire shutdown on original affected engine.
   a. Throttle - CUTOFF
   b. Fire Shutoff Switch - PULLED (if desired)
   c. Fuel Selector Switch - TE
4. Engine - LUBRICATED (pilot's discretion)

## MULTIPLE BOOST PUMP ON ENGINES SUPPLIED FROM THE SAME TANK

1. Affected Engine Fuel Selector Switches - ME
2. All other fuel selector switches - TE
3. Prior to traffic entry:
   All fuel selector switches - TME

CUT ON LINE

## OPERATION WITH FUEL LEAK IN MANIFOLD 30

If fuel boost pressure warning lights illuminate on an engine with the fuel selector switch on TME:

1. "Main Fuel Control" Circuit Breakers - IN
2. Fuel Selector Switches - TE
3. If fuel boost pump lights go out:
   a. Leave all fuel selector switches on TE
   b. Do not use manifold
4. If fuel boost pump lights remain on, follow procedure for "Fuel Boost and/or Fuel Line Failure."

## EMERGENCY TANK EMPTYING

1. Defective Tank Fuel Selector Switches - TME
2. Two other fuel selector switches - ME
3. When tank is nearly empty:
   a. Reposition fuel selector switches from ME to TE
   b. Reposition one fuel selector switch on TE to ME
4. When all four boost pumps for the defective tank remain on:
   Position fuel selector switches for that tank on ME

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## SURFACE POWER CONTROL SYSTEMS INOPERATIVE

### LANDING WITH RUDDER-ELEVATOR SURFACE POWER CONTROL INOPERATIVE

1. Circuit Breakers - IN
2. Surface Lock Lever - FORWARD UNLOCK DETENT
3. Rudder-Elevator Surface Power Control Switch - OFF
4. Normal pattern
5. Elevator Trim - 20 POUNDS
6. Crosswind landing
   a. Steering Ratio Selector Lever - TAKEOFF LAND
   b. No approach chute
   c. Steering - TAXI (at touchdown)
7. 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

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## LANDING GEAR EMERGENCY OPERATION 32

### EMERGENCY EXTENSION OF LANDING GEAR

1. Airspeed - REDUCED
2. Landing Gear Lever - OFF
3. ELGE System - ACTUATED
4. Landing Gear - CHECKED DOWN
5. Remaining Gear - EXTENDED
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

### INTERMEDIATE LANDING GEAR INDICATION AFTER GEAR RETRACTION

1. Landing Gear Lever - OFF
2. Landing Gear Circuit Breakers - IN
3. Wing Flaps - FULL DOWN
4. Door Latches - RESET
5. Landing Gear - RECYCLED

◀① Airplanes which do not have T.O. 1B-47-905 accomplished

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**DOWN AND LOCKED GEAR INDICATION AFTER GEAR RETRACTION**

1. Landing Gear Lever - OFF
2. Landing Gear Circuit Breakers - IN
3. Wing Flaps - FULL DOWN
4. Actual Gear Position - VISUAL CHECK
5. If visual check shows gear full up and doors latched assume an indicator malfunction
6. If visual check shows gear not full up or visual check cannot be made:
   a. Landing Gear - RECYCLED ONCE
   b. If landing gear fails to retract, abort mission
7. Prior to landing:
   a. Landing Gear - DOWN, LEVER OFF
   b. ELGE Lever - ACTUATED
   c. Remaining Gear - CHECKED DOWN, LEVER DOWN
   d. Visual Check - ACCOMPLISHED, IF POSSIBLE

## WING FLAP EMERGENCY OPERATION

**SPLIT FLAP OPERATION**

1. Flap Lever - OFF
2. Trim - SET
3. Power Controls - CHECKED
4. Flap Position Indicator - FLAP POSITION CHECKED
5. Flap Limit Speed - POWER SET
6. Chase Airplane - REQUESTED
7. Return flaps to original position
8. Final flap position
   a. Flaps Up - USE FLAPS-UP LANDING PROCEDURE
   b. Flaps Down - NORMAL LANDING
   c. Flaps Intermediate - CHECK MINIMUM CONTROL IAS, USE FOR LANDING BFS
      (1) Check minimum control speed at least 20,000 feet above terrain
      (2) Make landing using minimum control speed or first stall warning plus 18 knots for BFS

CUT ON LINE

## CANOPY EMERGENCY OPERATION DURING FLIGHT

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### CRACKING OR CRAZING OF CANOPY OR WINDSHIELD IN FLIGHT

1. Alert Crew - OXYGEN MASKS ON, REGULATORS 100%
2. Helmet Visors - LOWERED
3. Cabin Pressurization Switch - COMBAT (27,000 feet or above)
4. Airspeed - BEST ENDURANCE SPEED or 200 KNOTS
5. Altitude - DESCENT 30,000 FEET OR BELOW
6. Cabin Pressure Emergency Release Handle - PULLED
7. Heat Reset Button - DEPRESSED
8. Cabin Air Selector Switch - COMPRESSOR

### OPENING CANOPY IN FLIGHT

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

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

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# DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

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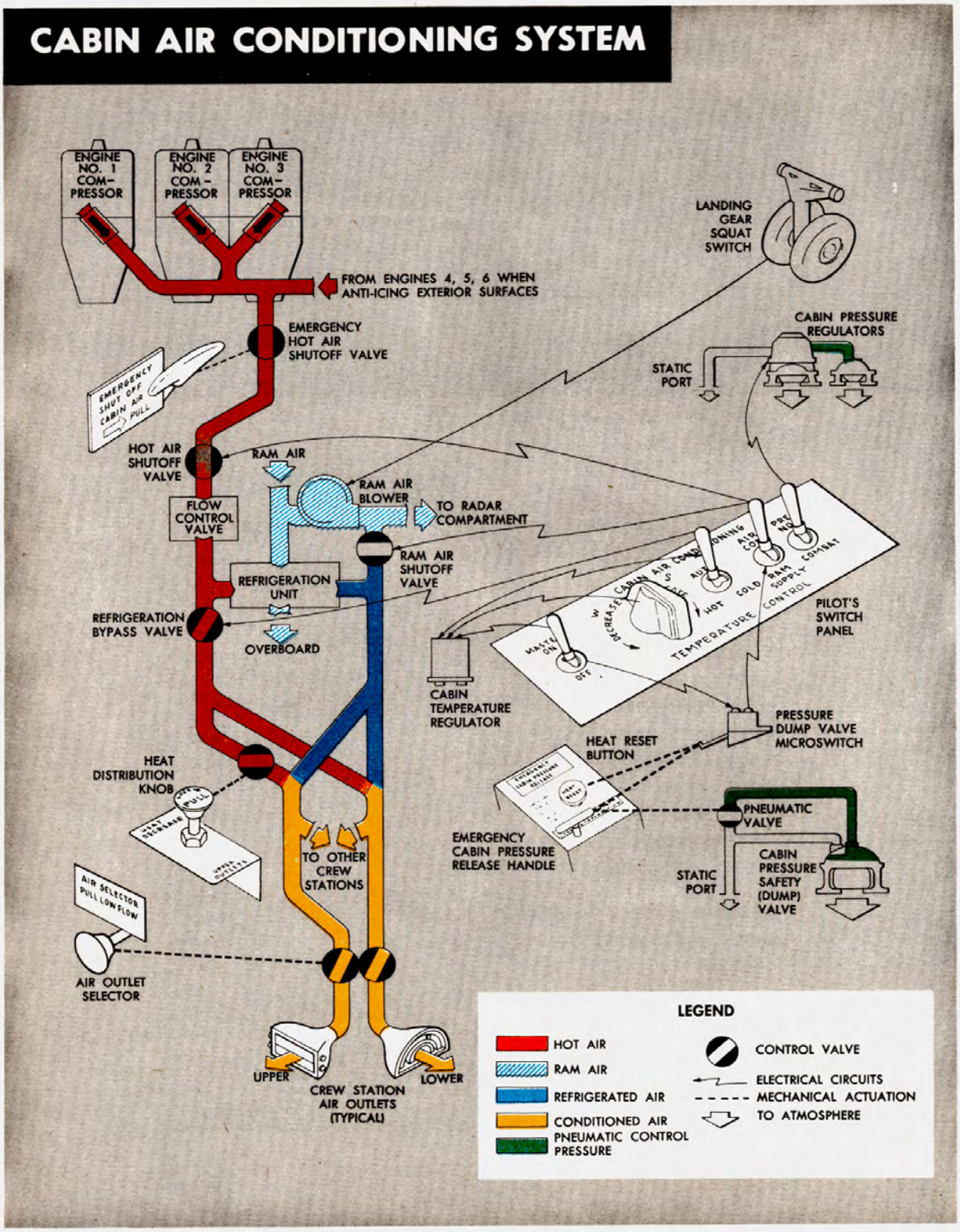
CABIN AIR CONDITIONING SYSTEM
ENGINE NO. 1 COMPRESSOR
ENGINE NO. 2 COMPRESSOR
ENGINE NO. 3 COMPRESSOR
FROM ENGINES 4, 5, 6 WHEN ANTI-ICING EXTERIOR SURFACES
EMERGENCY HOT AIR SHUTOFF VALVE
EMERGENCY SHUT OFF CABIN AIR PULL
HOT AIR SHUTOFF VALVE
RAM AIR
RAM AIR BLOWER
TO RADAR COMPARTMENT
FLOW CONTROL VALVE
RAM AIR SHUTOFF VALVE
REFRIGERATION UNIT
REFRIGERATION BYPASS VALVE
OVERBOARD
LANDING GEAR SQUAT SWITCH
CABIN PRESSURE REGULATORS
STATIC PORT
PILOT'S SWITCH PANEL
CABIN TEMPERATURE REGULATOR
PRESSURE DUMP VALVE MICROSWITCH
HEAT RESET BUTTON
HEAT DISTRIBUTION KNOB
PNEUMATIC VALVE
EMERGENCY CABIN PRESSURE RELEASE HANDLE
CABIN PRESSURE SAFETY (DUMP) VALVE
STATIC PORT
TO OTHER CREW STATIONS
AIR SELECTOR PULL LOW FLOW
AIR OUTLET SELECTOR
UPPER
LOWER
CREW STATION AIR OUTLETS (TYPICAL)
LEGEND
HOT AIR
RAM AIR
REFRIGERATED AIR
CONDITIONED AIR
PNEUMATIC CONTROL PRESSURE
CONTROL VALVE
ELECTRICAL CIRCUITS
MECHANICAL ACTUATION
TO ATMOSPHERE
049927

*Figure 4-1.*

## CABIN AIR CONDITIONING 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 cabln through an upper and lower outlet at each crew station. The rate of flow is controlled by the crew member except at the observer's lower outlet. The air is then exhausted from the cabin, providing ventilation, by automatic operation of cabin pressure regulators during pressurized flight or by a cabin pressure safety (dump) valve during depressurization and unpressurized flight. Ram (outside) air may be supplied for ventilation during unpressurized flight when temperature control is not in use.

### ENGINE BLEED AIR SUPPLY

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 anticing switch is ON. When the exterior surfaces anticing switch is OFF the ducts remain separate, and the cabin air conditioning system may then receive pressurized heated air from the left duct collected from only the No. 1, 2, and 3 engines. Part of the bleed air from the high pressure supply duct is led to shutoff and control valves in the lower left side of the forward wheel well. A manual emergency hot air shutoff valve actuated by a push-pull handle at the lower forward corner of the copilot's oxygen panel is a safety feature providing positive control of all the high pressure hot air supply in the forward portion of the fuselage.

### MOISTURE SEPARATION

Fog or snow blowing from crew station air outlets is prevented by a centrifugal-type water separator removing moisture precipitated by refrigeration of engine bleed air. The separator is installed with an automatically controlled bypass valve downstream of the refrigeration unit. Water collected is drained overboard. The separator is bypassed at flight altitudes greater than 25,000 feet, where air moisture content is low, by action of an aneroid electrical switch. The separator will be bypassed mechanically at lower altitudes as a fail-safe feature if a malfunction or a freeze-up restricts airflow. Freezing of moisture in the separator is normally prevented by automatic control maintaining refrigerated air temperature just above freezing.

### TEMPERATURE REGULATION

Bleed air is admitted into the air conditioning system by the cabin hot air shutoff valve and directed according to control settings on the pilot's switch panel into and around the refrigeration unit as required for cabin temperature control. 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. A mechanically actuated butterfly-type heat distribution valve in the mixing chamber provides a differential control of blending so that the conditioned air ducted to cabin lower air outlets at each crew station can be made warmer or cooler, as desired, than the conditioned air ducted to the crew station upper air outlets. Individual control of conditioned airflow from the outlets is provided at each crew station. 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.

### RAM AIR VENTILATION

Ventilation with outside (ram) air is provided continuously for the radar compartment equipment and for the cabin in unpressurized flight. During flight, the ventilating air is picked up by an outside air inlet and delivered by ram effect. 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.

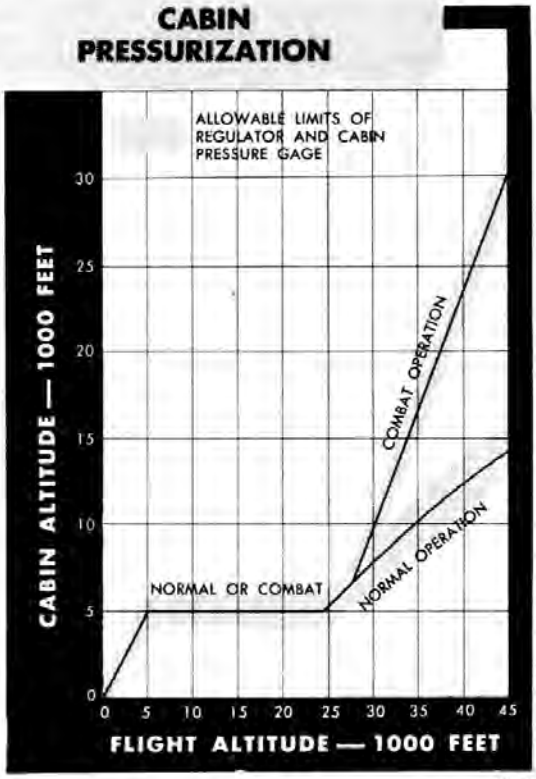


*Figure 4-2.*

## PRESSURIZATION

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 as an emergency cabin pressure dump valve when rapid depressurization is desired. The following cabin pressure conditions are provided by the cabin pressure regulators (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
- Combat range (above 27,600 feet), cabin pressure differential varying from 6.55 psi at 27,600 feet to 2.65 psi at 45,000 feet.

**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.

## CONTROL POWER SUPPLY

The system is controlled electrically and is supplied DC power through circuit breakers marked "Cabin Air Temp Control" and "Cabin Air Valves" on the "Air Conditioning" portion of the lower DC power panel. Regulated AC power from the secondary inverter bus used by the electronic temperature regulator is supplied through a fuse in the main AC power shield. Unregulated AC for the observer's electric heater is supplied through a circuit breaker marked "Navigator Heater" in the left alternator power shield.

## EMERGENCY HOT AIR SHUTOFF HANDLE

A push-pull handle (3, figure 1-14) marked "Emergency Shutoff Cabin Air - Pull" is located at the lower forward corner of the copilot's oxygen panel. Pulling the handle up and out approximately 4 inches mechanically actuates a snap-action shutoff valve which instantly shuts off all the hot pressurized air supply to the forward part of the fuselage. Pushing the handle down to the stop restores the hot air supply to the normal controls of the system. This manually controlled hot air valve is an emergency safety feature in the event of failure of other control valves.

**CAUTION**

Do not use the emergency hot air shutoff handle except during an emergency. Operation of the handle when the refrigeration unit is functioning normally with the cabin pressurized is apt to result in failure of the refrigeration unit turbine due to shock of reverse airloads imposed on the unit when the snap-action valve is actuated to the closed position.

## AIR CONDITIONING MASTER SWITCH

An ON--OFF air conditioning master switch (1, figure 1-10) is on the pilot's switch panel. In ON position,

power is supplied to operate the air conditioning system. ON position also supplies power to the observer's lower air heater switch. In OFF position, the observer's lower air heater and the air conditioning system is 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 (4, figure 1-10) on the pilot's switch panel marked AIR COMP--RAM SUPPLY is used to select engine compressor air for cabin heating, ventilating, and pressurizing or ram air for cabin ventilating. In AIR COMP position, DC power is supplied to the heat selector switch for cabin heating control. 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 (3, figure 1-10) on the pilot's switch panel is used to select automatic or manual temperature regulation and is marked AUTO--HOT--COLD, with the off or center position unmarked. The switch is spring-loaded to return to the center (off) position from either HOT or COLD position. In AUTO position, cabin temperature is controlled by an electronic 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 (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 (2, figure 1-10) 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. Two reference marks provide a choice of initial setting for automatic temperature control according to whether winter or summer clothing is being worn by the crew. A "W" reference is marked above DECREASE at the 45° F position and an "S" reference is marked above INCREASE at the 65° F position.

### CABIN PRESSURE REGULATION SELECTOR SWITCH

A PRESS NORMAL--COMBAT switch (5, figure 1-10) on the pilot's switch panel is used to select the type of cabin pressure regulation desired (figure 4-2). In PRESS NORMAL position, the cabin pressure regulators function to provide atmospheric, isobaric, or high (6.55 psi) differential pressure regulation of cabin pressure, depending on the altitude. In COMBAT position, the cabin pressure regulators function to provide normal regulation up to 27,600 feet; however, above 27,600 feet, pressure differential is gradually reduced, becoming 2.65 psi at 45,000 feet. An automatic dive rate control in the pressure regulator master unit restricts the rate of repressurization to approximately 1 psi per minute to prevent crew discomfort when the switch is changed from COMBAT to NORMAL.

### 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 (4, 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 air 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

A push-pull knob (8, figure 1-6) marked PULL - HEAT DECREASE UPPER OUTLETS is located just aft of the

pilot's control stand. The knob controls the relative temperature of air supplied to all the upper and lower crew station air outlets. With the knob pushed in to the normal position, a butterfly-type cabin air distribution valve is mechanically set to provide somewhat warmer air to the lower than to the upper crew air outlets. Pulling the knob all the way up closes the valve thus providing additional hot air to the lower outlets while only cooled air from the refrigeration unit is supplied the upper outlets. Intermediate positions may be used as desired for crew comfort. Turning the knob in the arrow-indicated "Lock" direction will maintain a desired setting until the knob is unlocked by a twist in the opposite direction.

### AIR OUTLET SELECTOR KNOBS

Two-position push-pull knobs (12, figure 1-9 and 11, figure 1-17) at the pilot's, copilot's, and gunner's stations give individual control of airflow from the crew station air outlets. Each knob is marked "Air Selector Pull - Low Flow" and controls airflow volume from the upper and lower air outlets at a station simultaneously. Detents secure the knobs in for maximum airflow or out for low airflow as desired. Sufficient volume of airflow is maintained for pressurization and/or ventilation at all times since the knobs do not provide a complete shutoff of airflow through the outlets.

**NOTE**

If a valve should stick due to freezing, it will thaw upon increasing cabin heat.

### OBSERVER'S UPPER AIR SHUTOFF LEVER

A lever on the observer's upper air outlet (35, figure 4-58) at the forward inboard corner of the observer's worktable provides control of airflow volume from shutoff (clockwise) to high flow (counterclockwise) as desired. (High flow only, without control, is provided at the lower outlet.)

### OBSERVER'S LOWER AIR HEATER SWITCH

A toggle switch on a heater control panel above the aft outboard corner of the observer's worktable with three positions marked HIGH--OFF--LOW is used to control an AC electric heater for raising the air temperature at the observer's lower air outlet. In HIGH position, temperature in the observer's lower air outlet duct is automatically maintained at 200° F. In LOW position, the automatically maintained temperature is 150° F. OFF position turns off the heater. A DC thermoswitch automatically protects against overheat damage by energizing an overheat lockout relay which turns off the heater and lights a warning light. In case of an overheat lockout, OFF position is used to reset the lockout relay which turns off the "Overheat Lockout" warning light to indicate that further operation of the heater may be resumed. DC control power to the heater switch is furnished only when the air conditioning master switch is ON.

### AIR OUTLET DIFFUSER KNOBS

Twist knobs on the upper air outlets control movable vanes to direct airflow as desired.

### CABIN PRESSURE ALTITUDE GAGE

A cabin pressure altitude gage (26, figure 1-8) located on the right side of the pilot's instrument panel is a small aneroid altimeter vented to cabin atmosphere and indicates cabin pressure altitude in increments of 1000 feet. The gage is a self-contained unit and requires no external power source.

### OBSERVER'S OVERHEAT LOCKOUT WARNING LIGHT

An amber "Overheat Lockout" warning light located on the lower air heater control panel will glow when an overheat condition has caused a relay to turn off the AC powered heater. The light is turned off and the system reset for further operation when the lower air heater switch is moved to OFF.

### NORMAL OPERATION OF CABIN AIR CONDITIONING SYSTEM

#### Cabin Heating

1. Check that the emergency hot air shutoff valve handle and the emergency cabin pressure release handle is pushed down; if heating without pressurization is desired, pull up the emergency cabin pressure release handle and depress the heat reset button.
2. Place cabin air selector switch in AIR COMP.
3. Place air conditioning master switch in ON.
4. Place heat selector switch in AUTO.
5. Turn the cabin temperature selector rheostat in the arrow-indicated DECREASE or INCREASE direction as required to obtain the desired cabin temperature. A "W" is marked above DECREASE and an "S" above INCREASE for reference as an initial setting according to whether winter or summer clothing is being worn by the crew.
6. Position the cabin heat distribution knob or lever as desired.
7. Position air outlet selector knobs as desired.

8. If additional heating is desired by the observer, turn on the electric heater by placing the lower air heater switch in LOW or HIGH as required.

**NOTE**

- Cabin heating is off whenever the emergency hot air shutoff handle has been pulled to shutoff position, the air conditioning master switch is in OFF, the cabin air selector switch is in RAM SUPPLY, 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 air conditioning master switch ON, place the cabin air selector switch in RAM SUPPLY 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 air conditioning master 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**

1. Check that the canopy and the pressure compartment door are closed.
2. Check that emergency hot air shutoff handle is pushed in.
3. Place cabin air selector switch in AIR COMP.
4. Place cabin pressure regulation selector switch in PRESS NORMAL.
5. Place air conditioning master switch in ON.
6. When combat is imminent, place the cabin pressure regulation selector switch in COMBAT to provide reduced cabin pressure differentials above 27,600 feet.
7. 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 air conditioning master switch is in OFF, the cabin air selector switch is in RAM SUPPLY, or the emergency cabin pressure release handle is pulled up.

## EMERGENCY OPERATION OF CABIN AIR CONDITIONING SYSTEM

**Failure of Automatic Temperature Control**

When the desired cabin air temperature cannot be maintained with the heat selector switch in AUTO, place the switch in off position and then actuate to HOT or COLD as necessary to manually control cabin temperature.

**Cabin Overheating**

When overheat conditions cannot be prevented by operation of the heat selector switch, alternate the air conditioning master switch between OFF and ON as necessary to control temperature. A manual emergency hot air shutoff handle may be operated out and in to exclude or admit hot air if the air conditioning master switch fails to provide control of temperature.

**Observer's Electric Heater System Overheating**

In case an overheat condition arises in the observer's lower air 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. If overheating occurs in both switch positions, allow a reasonable time for cooling and switch from OFF to either HIGH or LOW until the light glows again, repeating as desired for emergency operation of the heater.

**Excess Heat Removal**

Relief from excessive cabin temperatures in flight may be gained as follows:
1. Depressurize by pulling the emergency cabin pressure release handle or, if below 5000 feet altitude, place cabin air selector switch in RAM SUPPLY.

2. Open canopy as described in "Canopy Emergency Operation During Flight" in section III to obtain more rapid relief.

### 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 heat 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.

### 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 "Failure of Automatic Temperature Control."

### Loss of Pressurization During Descent

During minimum idle descent, and especially at altitudes between 30,000 and 15,000 feet, a marked rise in cabin altitude may occur under some conditions. The rise in cabin altitude is usually the result of low minimum idle on the engines, and not the result of excessive cabin leakage. When cabin pressure is not maintained, advance throttle to increase rpm on No. 3 engine as necessary to maintain cabin pressure. Cases in which the No. 3 engine rpm is increased above 70% in order to hold cabin pressure indicates excessive cabin leakage or a malfunction or improper adjustment of the flow control valve, moisture separator system, or cabin pressure regulator.

## DEFROSTING SYSTEMS

The defrosting system for the aerial camera window is covered under "Photographic Equipment."

### WINDSHIELD DEFROSTING

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 (8, figure 1-10) located on the pilot's switch panel. The defroster motor is DC operated and supplied power through a circuit breaker marked "Windshield Defrost" on the "Air Conditioning" portion of the lower DC power panel. The defroster is more effective when used to prevent frost and fogging than to remove it. 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 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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### NOSE WINDOW'S 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 "Window Defrost" switch located on the observer's lighting panel (figure 4-51 and 17, figure 4-58). The defroster motor is DC operated through a circuit breaker marked "Nose Defrost" on the copilot's aft DC power panel. 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.

## ANTI-ICING AND DEICING SYSTEMS

Anti-icing systems prevent ice formation while delcing 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, and nacelles are all anti-iced by means of engine compressor air. Pitot heads and windshield are anti-iced electrically.

### 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 marked "Windshield" on the "Anti-Icing" portion of the lower DC power panel. AC power for the heating element and the overheat control unit is supplied from the left unregulated AC bus through a circuit breaker marked "Windshield Deicing" on the left alternator power shield.

#### Windshield Anti-Icing Switch

A windshield anti-icing switch (7, figure 1-10) located on the pilot's switch panel has NORMAL--OFF--MAX HEAT positions. In NORMAL position, AC voltage is 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-iclng 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:

1. Check that alternator bus voltage is 110 to 120 volts.

**CAUTION**

Operate engines No. 1 and 6 above a minimum of 52% rpm since alternator power is required for windshield anti-icing operation.

2. Place windshield anti-icing switch in NORMAL (normally this is accomplished during Before Starting Engines checklist).
3. If windshield panel will not remain free of ice, place switch in MAX HEAT.

**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 panel may be damaged.

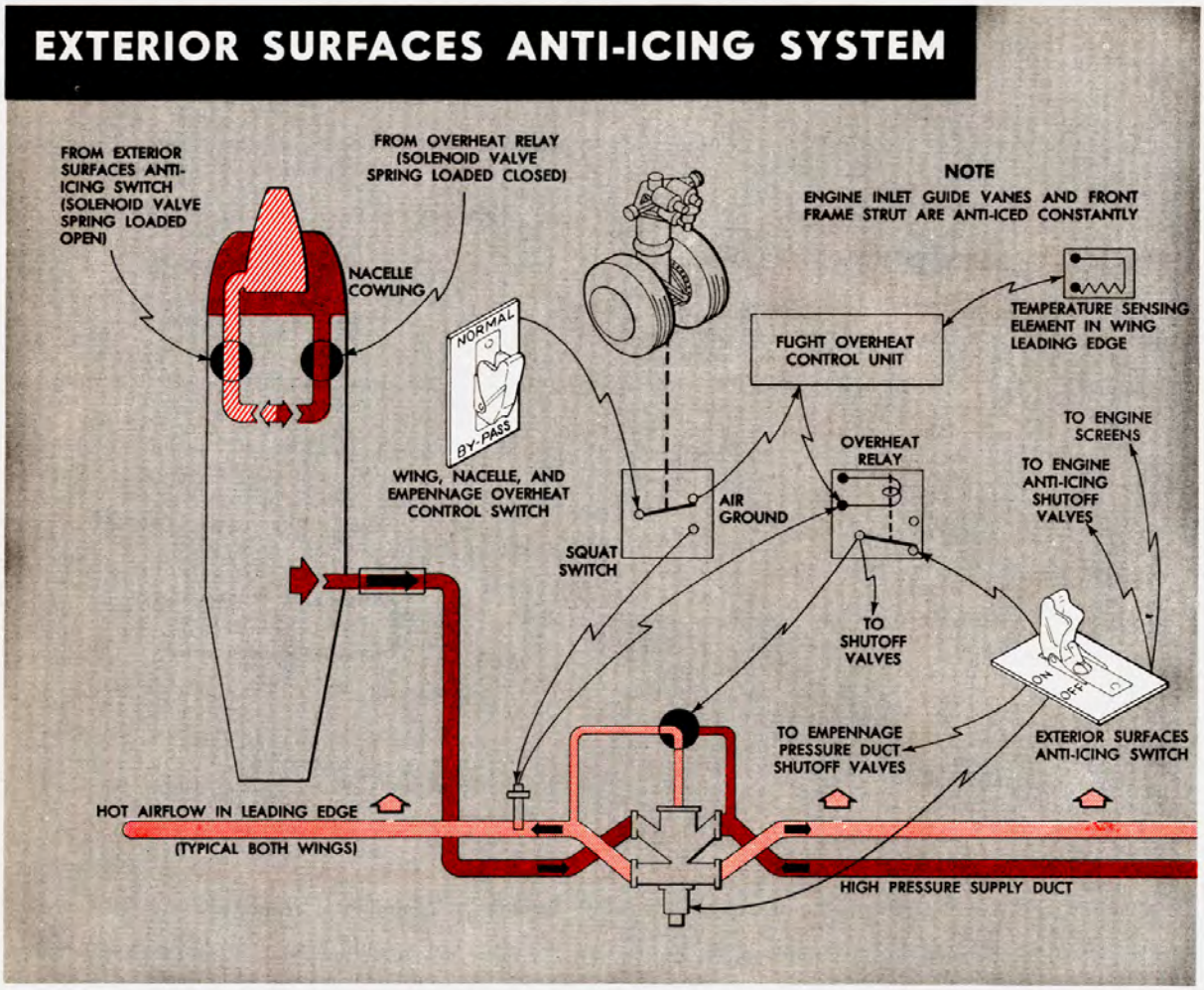
4. Turn off windshield anti-icing by placing switch in OFF.

#### 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 self-contained electric heating elements. Each pitot tube heater is controlled by an ON--OFF switch (6, figure 1-10) 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, except on airplanes with the later type pitot heads which extend out from the skin on 8-inch masts, will control current flow to prevent damage by overheating or to overcome extremely cold temperatures. The pitot heaters use DC power protected by circuit breakers marked "LH Pitot" and "RH Pitot" on the "Anti-Icing" portion of 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 heated air extracted from the final stage of each engine compressor (figure 4-3). A 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

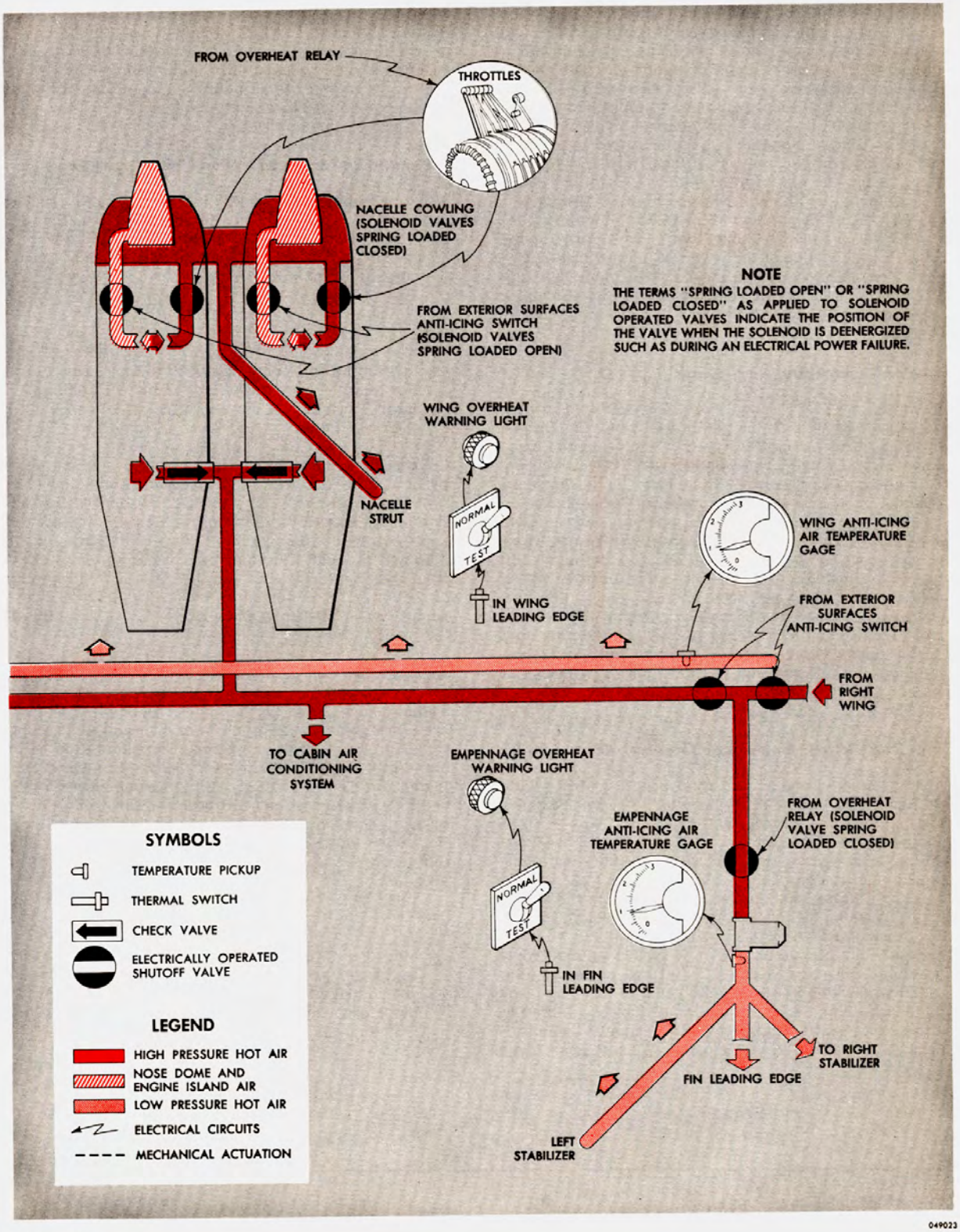

FROM OVERHEAT RELAY
THROTTLES
NACELLE COWLING (SOLENOID VALVES SPRING LOADED CLOSED)
FROM EXTERIOR SURFACES ANTI-ICING SWITCH (SOLENOID VALVES SPRING LOADED OPEN)
NOTE
THE TERMS "SPRING LOADED OPEN" OR "SPRING LOADED CLOSED" AS APPLIED TO SOLENOID OPERATED VALVES INDICATE THE POSITION OF THE VALVE WHEN THE SOLENOID IS DEENERGIZED SUCH AS DURING AN ELECTRICAL POWER FAILURE.
WING OVERHEAT WARNING LIGHT
NORMAL
TEST
NACELLE STRUT
IN WING LEADING EDGE
WING ANTI-ICING AIR TEMPERATURE GAGE
FROM EXTERIOR SURFACES ANTI-ICING SWITCH
FROM RIGHT WING
TO CABIN AIR CONDITIONING SYSTEM
EMPENNAGE OVERHEAT WARNING LIGHT
FROM OVERHEAT RELAY (SOLENOID VALVE SPRING LOADED CLOSED)
EMPENNAGE ANTI-ICING AIR TEMPERATURE GAGE
NORMAL
TEST
IN FIN LEADING EDGE
TO RIGHT STABILIZER
FIN LEADING EDGE
LEFT STABILIZER
SYMBOLS
TEMPERATURE PICKUP
THERMAL SWITCH
CHECK VALVE
ELECTRICALLY OPERATED SHUTOFF VALVE
LEGEND
HIGH PRESSURE HOT AIR
NOSE DOME AND ENGINE ISLAND AIR
LOW PRESSURE HOT AIR
ELECTRICAL CIRCUITS
MECHANICAL ACTUATION
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*Figure 4-3.*

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 the 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 marked "Eng & Nac #2, #3, #6," "Eng & Nac #1, #4, #5," "Wing & Emp #1," "Wing & Emp #2," and "Overheat Control" on the "Anti-Icing" portion of the lower DC power panel. Unregulated AC power from the left alternator bus supplied through a circuit breaker in the left alternator power shield is utilized by the flight overheat control system.

### Exterior Surfaces Anti-Icing Switch

A guarded ON--OFF exterior surfaces anti-icing switch (18, figure 1-10) 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. OFF position removes power from opening circuits which causes wing, empennage, nacelle, and engine shutoff valves to close and stop the anti-icing airflow. Also, on airplanes* which may have operable engine screens, 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, while OFF position restores power to the engine screen control circuit (see "Engine Screen Switch," section I).

### Wing, Nacelle, and Empennage Overheat Control Switch

A wing, nacelle, and empennage overheat control switch (1, figure 4-4) located below the pilot's oxygen and rheostat panel on the left sidewall has NORMAL--BYPASS positions and is guarded to NORMAL. 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; therefore, this position should be used only in an emergency. Control of the system then must be accomplished by use of the exterior surfaces anti-icing switch and the anti-icing air temperature gages.

### Wing and Empennage Overheat Warning Lights

Wing and empennage overheat warning lights (red) (3 and 4, figure 1-8) located on the pilot's instrument panel 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 1-39) to TEST position. Illumination of the warning lights then indicates circuits are satisfactory. The overheat warning lights are DC powered through a circuit breaker marked "Wing & Emp Overheat Warning" on the "Anti-Icing" portion of 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 shown in figure 5-1. The gages are DC powered through a circuit breaker marked "Air Temp" on the "Anti-Icing" portion of 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.

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* AF 51-2045 thru -2091

## ANTI-ICING AIR TEMPERATURE PANEL

1. WING, EMPENNAGE, AND NACELLE OVERHEAT SWITCH
2. LEFT WING ANTI-ICING AIR TEMPERATURE GAGE
3. EMPENNAGE ANTI-ICING AIR TEMPERATURE GAGE
4. RIGHT WING ANTI-ICING AIR TEMPERATURE GAGE

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*Figure 4-4.*

### Normal Operation of Exterior Surfaces Anti-Icing System

**NOTE**

Anytime during normal operation of the exterior surfaces anti-icing system that fuel fumes are introduced into the cabin by the air conditioning system, do not shut off the anti-icing system. Fumes in the wing, nacelles, and empennage will be more quickly vented overboard by continued circulation of anti-icing air while accomplishing procedure for "Smoke or Fumes Elimination" as described in section III.

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:

1. Check wing and empennage overheat circuits by using wing and empennage overheat test switches to check that overheat warning lights will illuminate.
2. Lift the exterior surfaces anti-icing switch guard and place switch in ON. Check that the wing, nacelle, and empennage overheat control switch is in the guarded NORMAL position.
3. 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.

**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.
- 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.
- 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 the anti-icing system.

4. Turn off exterior surfaces anti-icing system by placing exterior surfaces anti-icing switch in OFF.

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:

1. Check wing and empennage overheat circuits by actuating wing and empennage overheat test switches to check that overheat warning lights will illuminate.

2. Lift exterior surfaces anti-icing switch guard and place switch in ON. Check that wing, nacelle, and empennage overheat switch is in NORMAL.

**CAUTION**

- Continuous fllght 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. Runback ice can probably be first detected near the tips of the wings.

- 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.

3. 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 "Undertemperature Operation" under "Emergency Operation of Exterior Surfaces Anti-Icing System in Flight."

**CAUTION**

Do not continue to operate anti-icing system after leaving the icing area, since the leading edges of the wing may be damaged. There is a possibility during anti-icing system operation in nonicing 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.

**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.

4. 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 and see "Emergency Operation of Exterior Surfaces Anti-Icing System."

5. Turn off exterior surfaces anti-icing system by placing exterior surfaces anti-icing switch in OFF.

### 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:

1. Place exterior surfaces anti-icing switch in OFF.

**NOTE**

Check that alternator power is available on the left alternator bus since failure of that power will result in overheat control fallure and damage to the wing. If power has failed on that bus, secure power 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:

2. Lift wing, nacelle, and empennage overheat control switch guard and place switch in BYPASS which 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.

3. When the overheat warning light goes out, place exterior surfaces anti-icing switch in ON until the temperature reaches the upper part of the upper green arc on the temperature gages, then place switch in OFF.
4. 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:
1. Check warning light for failure by actuating overheat circuit test switches and pushing press-to-test lens.
2. If warning light has failed, accomplish steps "1" through "4" 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 or prevent overheat damage.

**CAUTION**

Structural overheat damage will not cause loss of the airplane but may reduce the strength of the affected area.

UNDERTEMPERATURE OPERATION. Temperatures on the anti-icing air temperature gages in or below the lower red arc (80° to 105° C) are inadequate for inflight anti-icing. Failure of the circuit energizing the landing gear safety switch relay No. 3 by means of the squat switches would prevent the inflight automatic overheat control system from taking over control from the ground overheat control system. The remedy is to establish manual operation as follows:
1. Lift wing, nacelle, and empennage overheat control switch guard and actuate switch to BYPASS.
2. 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.

### BOMBSIGHT RETRACTABLE COVER ANTI-ICING (1)

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. ON position connects unregulated AC power to the electrical heaters. OFF position deenergizes the bombsight cover heaters. Power is provided to the system through a circuit breaker marked "Bombsight Cover Anti-Ice" on the left alternator power shield.

## COMMUNICATION 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 system for use by the crew members. 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.

### INTERPHONE SYSTEM (AN/AIC)

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, microphone connection to UHF command transmitting equipment, and microphone connection to liaison radio transmitting equipment. The pilot's and copilot's interphone panels are identical. The observer's, flight instructor's, and observer instructor's interphone panels are identical. 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 marked "Inph" is located on the radar power panel.

#### Filter Switch

A three-position rotary switch (21, figure 4-6) on the pilot's radio panel and a similar switch on the copilot's

(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

| TYPE | DESIGNATION | FUNCTION | PRIMARY OPERATOR | RANGE | LOCATION OF CONTROLS |
|---|---|---|---|---|---|
| INTERPHONE EQUIPMENT | AN/AIC | To provide a means for distributing audio to the crew from command radio, marker beacon, radio compass, ILS, and liaison radio. Provides intercommunication between crew members. Provides audio to modulate the command and liaison radio transmitters. | Pilot and copilot | 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 |
| 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 liaison radio equipment | Pilot | | Pilot's station left side |
| 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 and copilot | Up to 200 miles depending on operating frequency and time of day | Pilot's and copilot's station right side |
| DIRECTION FINDER GROUP | AN/ARA-25 | For homing and bearing on UHF command frequencies | Pilot | Line of sight | Pilot's station right side |
| 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 |

## TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

| TYPE | DESIGNATION | FUNCTION | PRIMARY OPERATOR | RANGE | LOCATION OF CONTROLS |
|---|---|---|---|---|---|
| GLIDE SLOPE RECEIVER | AN/ARN-18 | Indicates glide angle for automatic approach | Pilot | Approximately 25 miles | Receiver automatically operated by operation of AN/ARN-14 control panel |
| MARKER BEACON | AN/ARN-12 | Receives location marker signal on navigational beam | ——— | Low altitude | Automatic |
| IFF | AN/APX-6 ①<br>AN/APX-6A ②<br>AN/APX-25 ③ | Identification friend or foe | Pilot | Line of sight | Pilot's station right side<br>Pilot's station left side |
| RADAR BOMBING-NAVIGATION SYSTEM | MA-7A ④ | Bombing-navigation and rendezvous | Observer | Line of sight | Observer's station |

① AF 51-2045, -2051, -2059, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084, -2087, -2091

② AF 49-2642 thru 50-080, -2047, -2049, -2050, -2052 thru -2058, -2060 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088, -2090

③ AF 50-037, -054, -056, -060 thru -080, 51-2047, -2052, -2071, -2078, -2080

④ AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

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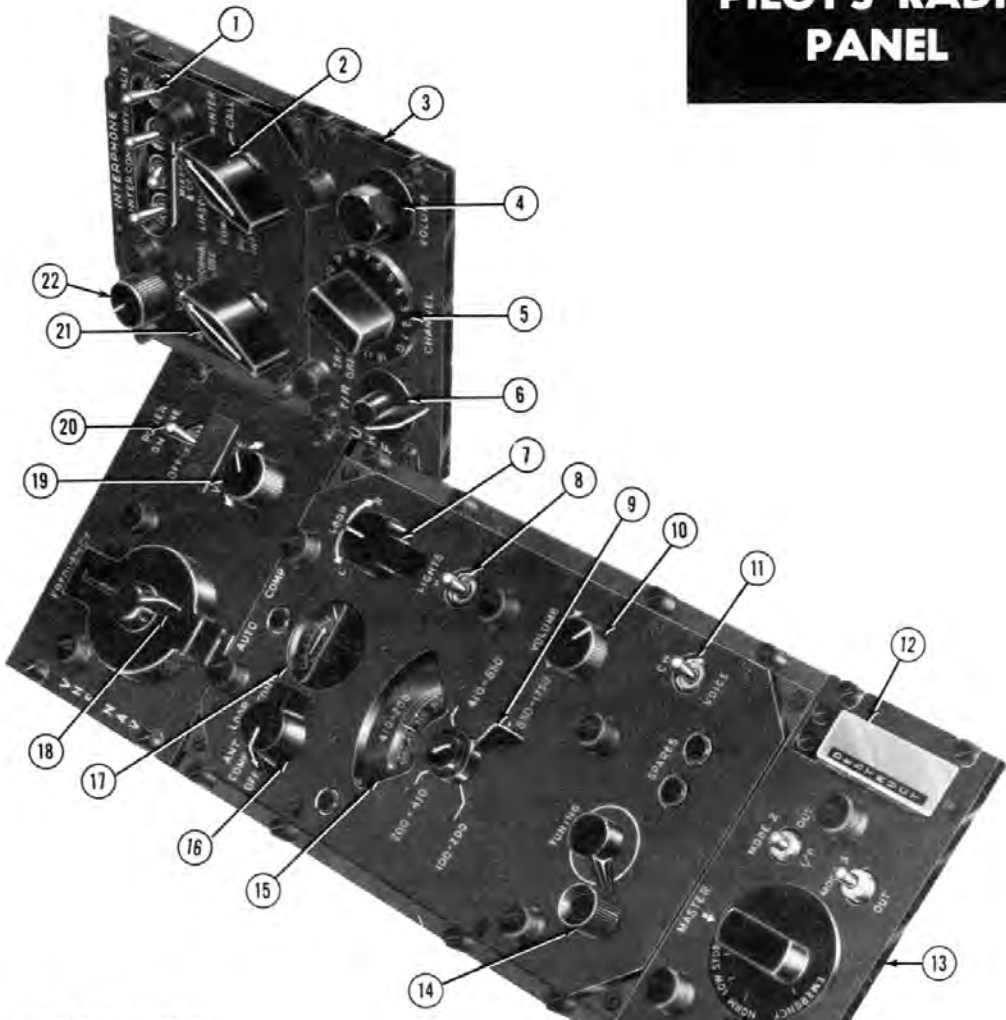
*Figure 4-5.*

radio panel has RANGE ONLY--VOICE ONLY--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.

### Selector Switch

An interphone selector switch (2, figure 4-6) on the pilot's radio panel and a similar switch on the copilot's radio panel has COMPASS--LIAISON--MIX SIG & COMMAND--INTER--CALL positions. In addition, the pilot's panel has PVT INTER and the copilot's has AN/APS-54 positions which are not used in this interphone installation. COMPASS position allows for reception of the radio compass signals. LIAISON position allows for the pilot or copilot to receive and transmit over the liaison radio. MIX SIG & COMMAND position 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 (1, figure 4-6 and figure 4-7) and operation of the command radio. INTER position allows for normal interphone communication between crew members. A momentary CALL position disconnects all radio facilities from the interphone system and allows pilot or copilot communication to all crew members simultaneously. An interphone selector switch on the observer's, flight instructor's, and observer instructor's interphone panels (figure 4-8) has PVT INTER--COMPASS--LIAISON--COMMAND

# PILOT'S RADIO PANEL




1. INTERPHONE MIXER TOGGLE SWITCHES
2. INTERPHONE SELECTOR SWITCH
3. COMMAND RADIO PANEL (AN/ARC-27)
4. PILOT'S VOLUME KNOB
5. REMOTE CHANNEL SELECTOR SWITCH
6. PILOT'S COMMAND OPERATION SWITCH
7. RADIO COMPASS LOOP SWITCH
8. RADIO COMPASS LIGHT SWITCH
9. RADIO COMPASS BAND SWITCH
10. RADIO COMPASS VOLUME KNOB
11. RADIO COMPASS CW-VOICE SWITCH
12. IFF DESTRUCT SWITCH (1)▶
13. IFF CONTROL PANEL (AN/APX-6) (1)▶
14. RADIO COMPASS TUNING CRANK
15. RADIO COMPASS FREQUENCY DIAL
16. RADIO COMPASS FUNCTION SWITCH
17. RADIO COMPASS TUNING METER
18. LOCALIZER AND OMNI-RANGE FREQUENCY SELECTOR SWITCH
19. LOCALIZER AND OMNI-RANGE VOLUME KNOB
20. LOCALIZER AND OMNI-RANGE POWER SWITCH
21. INTERPHONE FILTER SWITCH
22. INTERPHONE VOLUME KNOB

(1)▶ AF 51-2045, -2051, -2059, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084, -2087, -2091

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*Figure 4-6.*

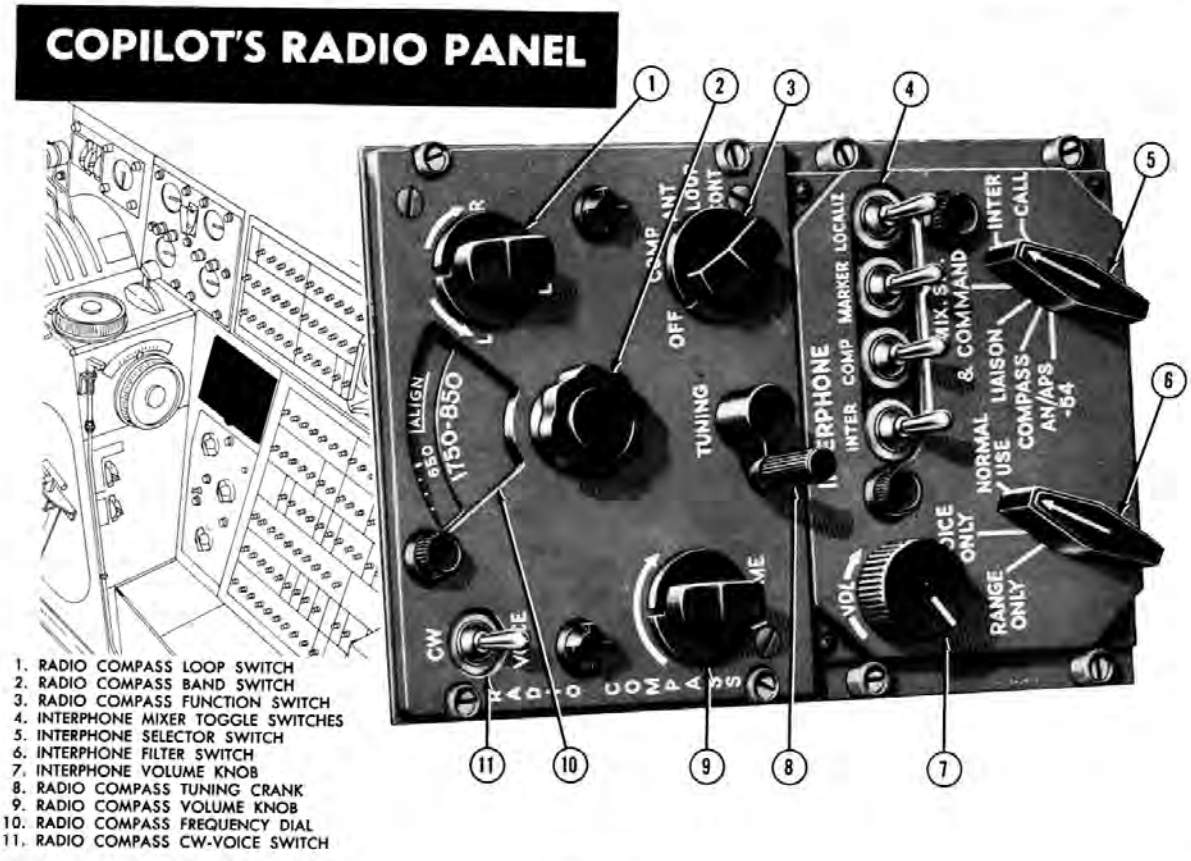


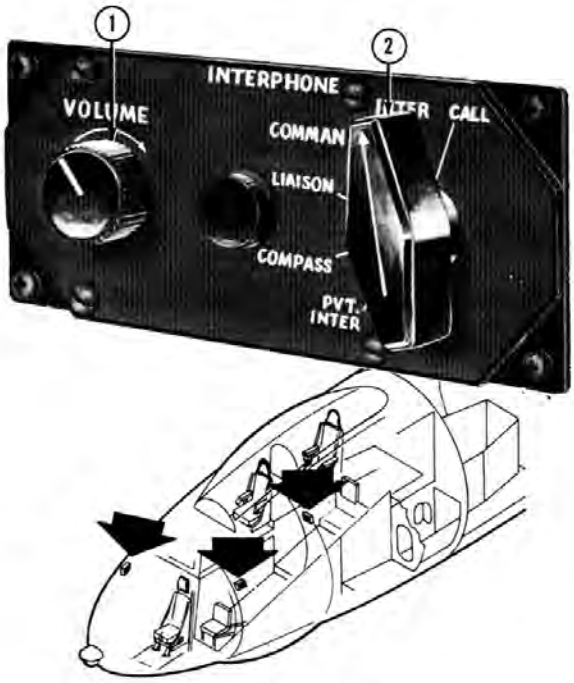

*Figure 4-7.*

--INTER--CALL positions. PVT INTER position is not used in this interphone installation. COMPASS position connects the output of the radio compass receiver to the interphone panel. LIAISON position allows the observer or either instructor to receive and transmit over the liaison radio. COMMAND position allows the observer or either instructor to receive and transmit over the command radio. INTER position connects the normal interphone system to the observer's or either instructor's panel for normal crew communication. A momentary CALL position allows the observer or either instructor to call all crew members at the same time, disconnecting all radio facilities from the interphone system.

### Mixer Toggle Switches

Four mixer toggle switches (1, figure 4-6 and figure 4-7) on the pilot's or copilot'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) positions. The on position of the "Inter" toggle switch connects the normal interphone system to the pilot's or copilot'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.

## INTERPHONE PANEL




1. INTERPHONE VOLUME KNOB
2. INTERPHONE SELECTOR SWITCH

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*Figure 4-8.*

### Volume Knobs

A volume knob (22, figure 4-6, figure 4-7, and figure 4-8) is located on the pilot's, copilot's, observer's, flight instructor's, and observer instructor's interphone panels. Each volume knob adjusts the volume level of the interphone output on its respective panel.

### Control Wheel Mike Switches

An interphone mike switch (1, figure 4-9) located on the pilot's and copilot's control wheels has momentary MIXED SIGNALS INTER--MIC positions. When either the pilot's or copilot's switch is moved to 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.

### Hot Mike Switch

A two-position toggle switch on the copilot's lighting panel has ON--OFF positions. In ON position, the pilot and copilot, without depressing their mike switches, can transmit to all crew stations who have selected INTER on their interphone selector switches. Also, with the hot mike switch ON, all crew members who have selected INTER position will hear all transmissions over the command radio. In OFF position, the interphone system will operate normally.

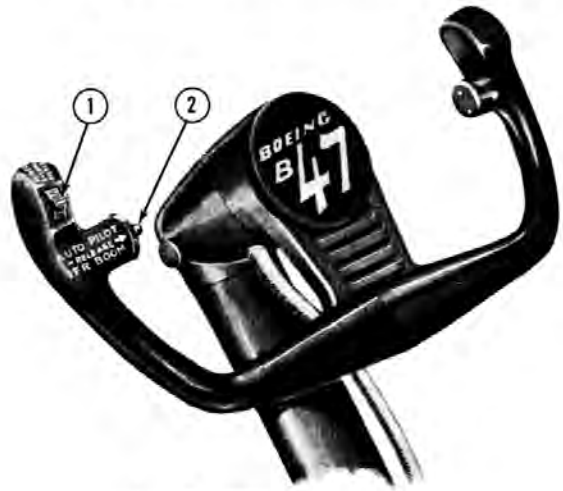
**NOTE**

With the hot mike switch on, UHF reception may be decreased in strength by approximately one-half.

### Mike Foot Switches

Two foot-operated mike switches are located at the observer's station. One is mounted on the left side and the other is mounted on the right side on the floor to facilitate use of the observer's mike. When the foot switch is depressed, transmission is made possible only through the equipment indicated by the interphone selector switch.

## CONTROL WHEEL SWITCHES




1. MIKE SWITCH
2. AUTOMATIC PILOT RELEASE SWITCH

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*Figure 4-9.*

**NOTE**

If the observer's selector switch is left in the COMMAND or LIAISON position, depressing the observer's mike foot switch will allow transmission over the command or liaison radio.

### Normal Operation of Interphone System

Normal operation of the interphone system may be accomplished as follows:

- For normal communication between crew members, place selector switch in INTER position and the pilot and copilot place mixer toggle switches in off position. To use mikes, pilot and copilot move control wheel mike switches to MIC position, observer depresses foot switches, and the flight instructor and observer instructor depress mike switches.
- To transmit and receive on command radio, pilot or copilot places selector switch in MIX SIG & COMMAND position; observer, flight instructor, and observer instructor use COMMAND position.
- To receive radio compass signals, place selector switch in COMPASS position.
- Pilot or copilot 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.
- 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.
- Pilot or copilot may simultaneously receive the command radio (if operating) and any or all of the 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.
- To transmit and receive over the liaison radio, place the selector switch in LIAISON 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.

## UHF COMMAND RADIO (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 his radio panel. The equipment operates from DC power provided by a circuit breaker marked "AN/ARC-27" located on the radar power panel and a circuit breaker in the tail compartment power shield. For antenna location, see figure 4-17.

### Copilot's Power Switch

A power switch (9, figure 4-10) located on the copilot's radio panel has ON--OFF positions. ON position supplies power to operate the command radio from the copilot's station. OFF position deenergizes the equipment.

### Frequency Selector Knobs

The UHF command panel is provided with three frequency knobs (2, figure 4-10) to allow manual selection of 1750 different operating frequencies.

### Tone-Voice Switch

A two-position tone-voice switch on the UHF command panel (3, figure 4-10) is used for selecting tone or voice operation of the command transmitter.

**NOTE**

To use manual tone, the copilot's transfer switch must be in LOCAL position.

### Volume Knob

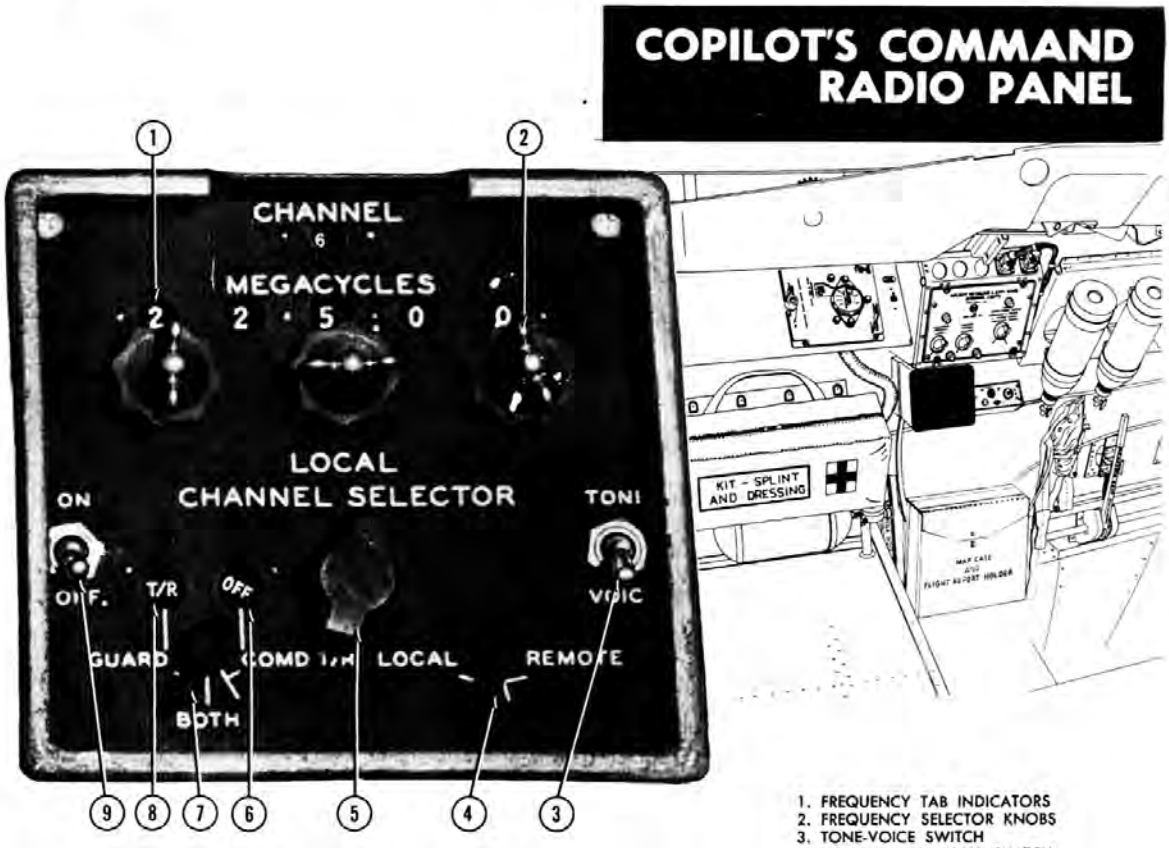
A volume knob (5, figure 4-6) on the pilot's command radio panel provides means for adjusting the audio output from the command receiver to the interphone system.

### Copilot's Transfer Switch

A two-position copilot's transfer switch (4, figure 4-10) 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 4-10) located on the UHF command panel has channel positions numbered from 1 to 18, providing selection of any of these preset frequencies. An "M" position is also provided to allow for operation of the manual frequency selector knobs.




1. FREQUENCY TAB INDICATORS
2. FREQUENCY SELECTOR KNOBS
3. TONE-VOICE SWITCH
4. COPILOT'S TRANSFER SWITCH
5. LOCAL CHANNEL SELECTOR SWITCH
6. LOCAL CHANNEL SELECTOR INDICATOR
7. COPILOT'S COMMAND OPERATION SWITCH
8. GUARD RECEIVER MODE INDICATOR
9. COPILOT'S POWER SWITCH

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*Figure 4-10.*

**Copilot's Command Operation Switch**

A copilot's command three-position operation switch (7, figure 4-10) selects different conditions of operation of the transmitter and receivers. See figure 4-11 for explanation of command radio operation switch positions.

**Pilot's Command Operation Switch**

A pilot's command four-position operation switch (6, figure 4-6) selects different conditions of operation of the transmitter and receivers. In ADF position, the ADF antenna is connected in place of the communications antenna and the direction finder group (AN/ARA -25) is turned on. See figure 4-11 for explanation of command radio operation switch positions.

**Remote Channel Selector Switch**

A remote channel selector switch (5, figure 4-6) located on the pilot's remote panel has channel positions numbered from 1 to 18, providing selection of any of these preset channel frequencies. Position "G" (guard) allows operation over the guard channel by the main transmitter and receiver provided the pilot's command operation switch is in the T/R position.

### Frequency Tab Indicators

Five frequency tab indicator windows located on the UHF command panel (1, figure 4-10) indicate the frequency of the main receiver and transmitter operation.

### Guard Receiver Mode Indicator

A tab indicator window (8, figure 4-10) on the copilot's command radio panel indicates the operating condition of the guard receiver. When the copilot's command operation switch is placed in GUARD position, the symbol T/R will appear in the tab window, indicating that the main transmitter and receiver will both transmit and receive only on the frequency of the guard channel. When the switch is placed in BOTH position, the letter "R" will appear in the tab window, indicating that the guard receiver is on and will receive signals transmitted on the guard frequency while operating on any other frequency with the main receiver-transmitter. When the switch is placed in COMD T/R position, OFF will appear in the tab window, indicating that the guard receiver is off but the main transmitter and receiver are on and will operate on the frequency as selected by the local channel selector switch.

### Local Channel Selector Indicator

A tab indicator window (6, figure 4-10) on the copilot's UHF command panel indicates the channel selection of the local channel selector switch. Also when the copilot's command operation switch is in GUARD position, OFF will appear in the tab window indicating that the main transmitter and receiver will not be operating on a channel selected by the local channel selector switch.

### 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 LOCAL position, the UHF command radio is operated from the copilot's UHF command panel. In REMOTE position, the radio is operated from the pilot's UHF command panel.

Copilot operation (transfer switch in LOCAL) is as follows:

1. Place power switch (9, figure 4-10) in ON.
2. Place interphone controls to the desired position for command radio operation.

**NOTE**

Allow at least 1 minute for set to warm up before operating to prevent damage.

3. Select mode of operation at the copilot's command switch. See figure 4-11 for possible modes.
4. 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 indicator.
5. 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.
6. In normal operation, the tone-voice switch is in VOICE. In TONE position, the radio set will transmit a continuous tone modulated signal.

Pilot operation (transfer switch in REMOTE) is as follows:

1. Select mode of operation desired at pilot's command operation switch.
2. 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.

**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.<br>ADF on in standby. |
| | T/R-G REC | Transmitter on in standby, main receiver on, guard receiver on.<br>ADF on in standby. |
| | ADF | 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. |

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*Figure 4-11.*

3. Adjust volume control to desired level.

**NOTE**

Tone modulation is not available from pilot's panel.

4. If the command radio is to be turned off, turn pilot's command switch to OFF if copilot's transfer switch is in REMOTE. It is necessary to turn copilot's power switch to OFF if copilot's transfer switch is in LOCAL.

### 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)

Provisions are made for an emergency keyer. When installed the keyer is located on the pilot's left sidewall and is used to broadcast an automatic "SOS." The message is sent 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 transmitted over the liaison radio and 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 marked "Keyer AN/ARA-26" on the "DC Panel" portion of the radar power panel. On some airplanes, an incomplete installation makes the keyer inoperative.

### Keyer Power Switch

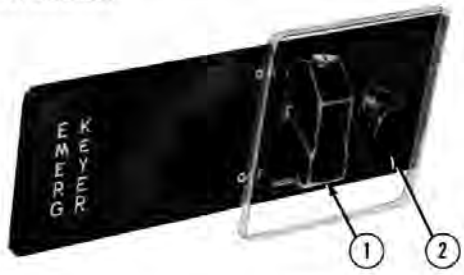
A power switch (1, figure 4-12) located on the emergency keyer panel has ON--OFF positions, normally guarded to OFF. ON position starts keyer operation which continues until the power switch is placed in OFF position.

### Keyer Operating Light

An amber indicator light (2, figure 4-12) 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.

## EMERGENCY KEYER PANEL

*(AN/ARA-26)*




1. KEYER POWER PANEL
2. KEYER OPERATING LIGHT

04V683

*Figure 4-12.*

### Normal Operation of Emergency Keyer

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 the 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 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 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 on airplanes having bombing capabilities by the observer operating the bomb scoring tone switch manually from CUTOFF to INITIATE position as required to transmit intelligence on CW.

## LIAISON RADIO MASTER PANEL

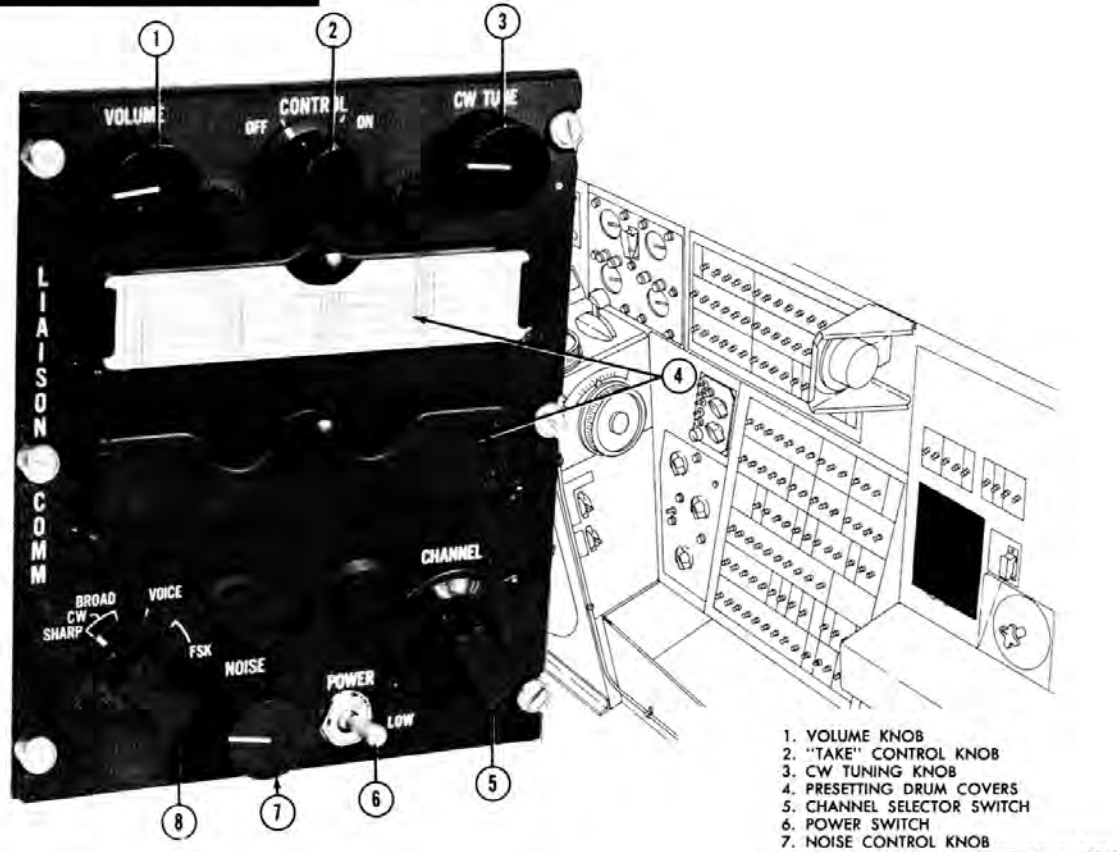



*Figure 4-13.*

### LIAISON RADIO (AN/ARC-21)

Provisions are made for a low frequency liaison radio. When installed, the set provides long range voice communication from plane to plane and plane to ground. In this installation, CW or teletypewriter communication is not available. 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. Transmitter tuning is initiated by depressing the microphone switch after which transmitter tuning is automatically completed. The liaison radio is controlled by the copilot from a master panel located on the copilot's aft right sidewall and subpanel on the copilot's left sidewall. A wire-type antenna (figure 4-17) 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 auto-

matic antenna coupler. This is a high voltage terminal electrically isolated by a large pressurized glass insulator. The coupler is located just aft of the copilot's seat.

**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.

The equipment uses DC power supplied through a circuit breaker marked "Antenna Coupler" on the aft DC power panel and regulated AC power supplied through a circuit breaker marked "AN/ARC-21" on the main AC power shield.

### "Take" Control Knob

A two-position ON--OFF rotary knob (2, figure 4-13 and 2, figure 4-14), 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 de-energizes the liaison radio.

### Volume Knob

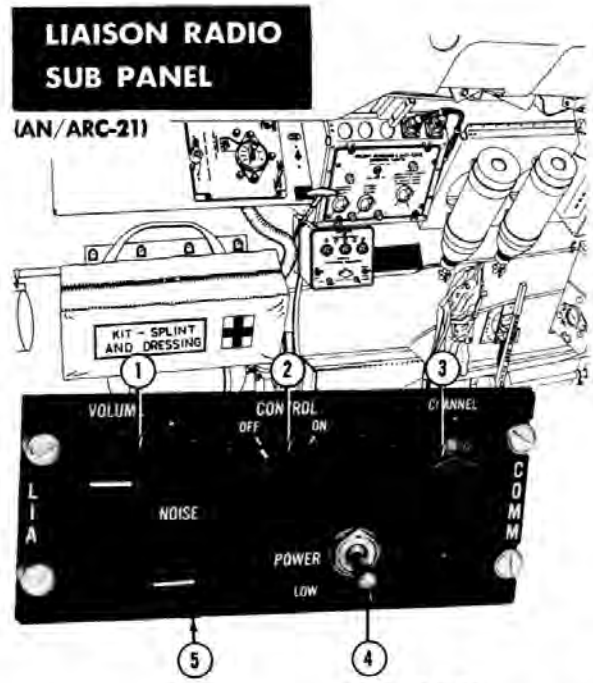
A volume knob (1, figure 4-13 and 1, figure 4-14) on both the master and subcontrol panels provides a means for adjusting the audio output during voice operation and signal sensitivity during CW operation from the liaison radio to the interphone system.

### Channel Selector Switch

A channel selector switch (5, figure 4-13 and 3, figure 4-14) located on both the master and subcontrol panels 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 4-13 and 4, figure 4-14) marked "Power" located on both the master and subcontrol panels has HI--LOW positions and provides




1. VOLUME KNOB
2. "TAKE" CONTROL KNOB
3. CHANNEL SELECTOR SWITCH
4. POWER SWITCH
5. NOISE CONTROL KNOB

049071

*Figure 4-14.*

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.

### Noise Control Knob

A knob (7, figure 4-13 and 5, figure 4-14) marked "Noise" located on both the master and subcontrol panels 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 4-13). 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 4-13) on the master control panel is used to adjust the CW beat frequency.

### Liaison Operation Selector Switch

A rotary-type selector switch (8, figure 4-13) 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 provided for teletypewriter operation.

### Normal Operation of Liaison Radio

FREQUENCY PRESETTING. The frequency presetting operation is accomplished on the master control 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:

1. Loosen two screws holding drum covers in position and open covers.
2. Remove presetting tool from clip inside top drum cover.
3. Rotate the channel selector switch until the number of the channel to be preset is seen in the left side of the drum access slots. This is not the same channel number that will be read in the channel selector window. If the upper drum access door on the master control panel is not securely closed, the door interlock switch will remain open. In this condition, when the channel selector switch is rotated, the liaison radio will not change channels, however, operation on the original channel is permitted.
4. 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.
5. Move the top drum left button to coincide with the figure representing thousands of kilocycles.
6. Move the top drum right button to coincide with the figure representing hundreds of kilocycles.
7. Move the bottom drum left button to coincide with the figure representing tens of kilocycles.
8. Move the bottom drum right button to coincide with the figure representing units and halves of kilocycles.
9. Record the frequency (just set) adjacent to the applicable channel number on the card mounted on the top drum cover.
10. Turn the channel selector switch to the next channel number to be preset and repeat steps "4" through "9." Preset remaining channels in the same manner.
11. Close drum covers and tighten 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:

1. Place interphone selector switch in LIA to receive and transmit liaison radio signals.
2. Place "take" control switch in ON.

**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 receiver automatic tuning.
- If automatic tuning is not accomplished in the normal 40-second period, the "take" control switch will go to OFF and must be returned to ON position.

3. 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.
4. Rotate the liaison operation selector switch to VOICE.
5. Place power switch in HI or LOW 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. Should the leak occur in the RT-128, no change will occur until an altitude of 10, 000 feet or higher is reached. If the leak occurs in the ERA Type 3000 series couplers, no change will occur until the cabin pressure exceeds 10, 000 feet. There is no indication when this change occurs.

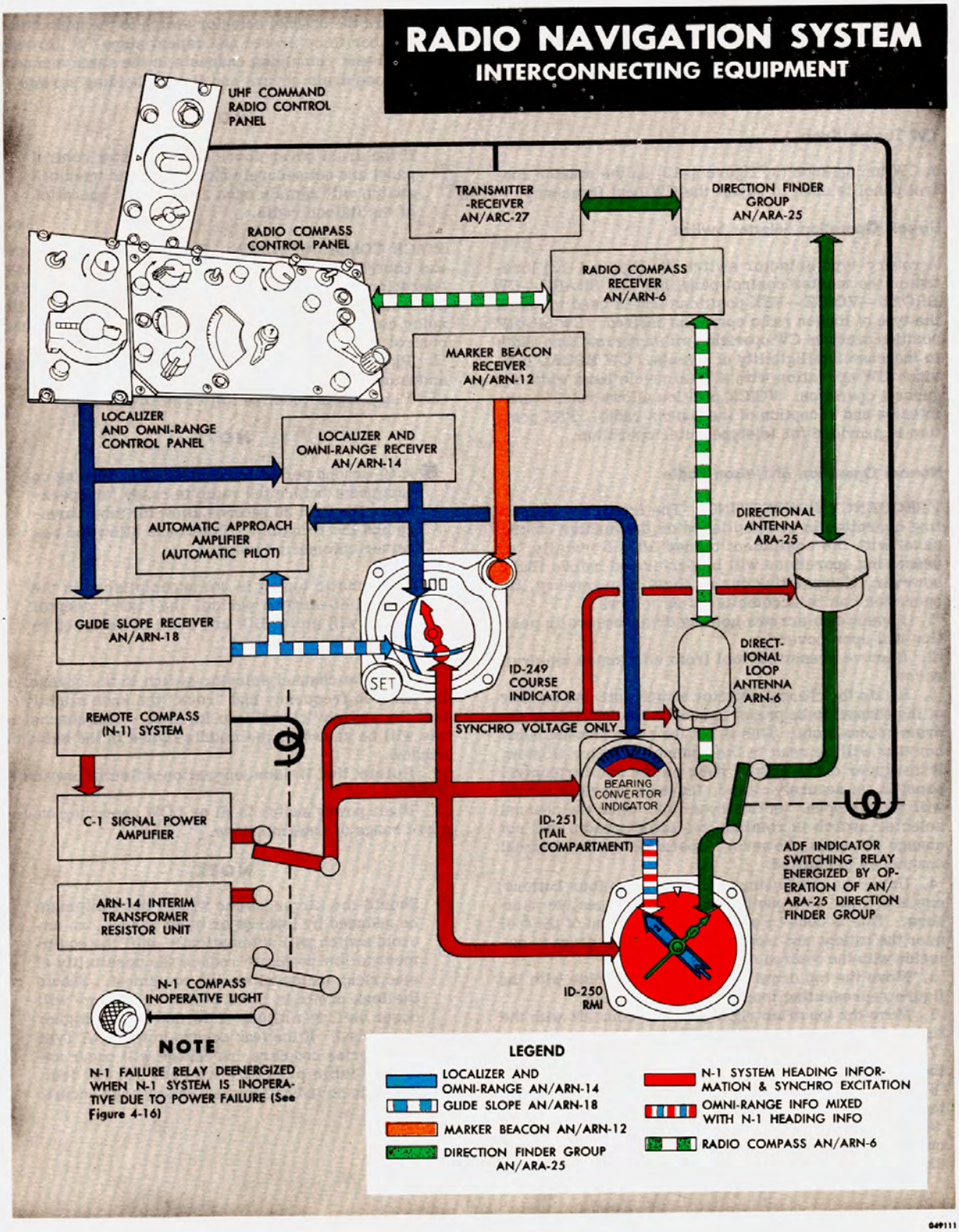

RADIO NAVIGATION SYSTEM
INTERCONNECTING EQUIPMENT
UHF COMMAND RADIO CONTROL PANEL
TRANSMITTER -RECEIVER AN/ARC-27
DIRECTION FINDER GROUP AN/ARA-25
RADIO COMPASS CONTROL PANEL
RADIO COMPASS RECEIVER AN/ARN-6
MARKER BEACON RECEIVER AN/ARN-12
LOCALIZER AND OMNI-RANGE CONTROL PANEL
LOCALIZER AND OMNI-RANGE RECEIVER AN/ARN-14
AUTOMATIC APPROACH AMPLIFIER (AUTOMATIC PILOT)
DIRECTIONAL ANTENNA ARA-25
GLIDE SLOPE RECEIVER AN/ARN-18
SET
ID-249 COURSE INDICATOR
DIRECT-IONAL LOOP ANTENNA ARN-6
REMOTE COMPASS (N-1) SYSTEM
SYNCHRO VOLTAGE ONLY
BEARING CONVERTOR INDICATOR
C-1 SIGNAL POWER AMPLIFIER
ID-251 (TAIL COMPARTMENT)
ADF INDICATOR SWITCHING RELAY ENERGIZED BY OPERATION OF AN/ARA-25 DIRECTION FINDER GROUP
ARN-14 INTERIM TRANSFORMER RESISTOR UNIT
N-1 COMPASS INOPERATIVE LIGHT
ID-250 RMI
NOTE
N-1 FAILURE RELAY DEENERGIZED WHEN N-1 SYSTEM IS INOPERATIVE DUE TO POWER FAILURE (See Figure 4-16)
LEGEND
LOCALIZER AND OMNI-RANGE AN/ARN-14
GLIDE SLOPE AN/ARN-18
MARKER BEACON AN/ARN-12
DIRECTION FINDER GROUP AN/ARA-25
N-1 SYSTEM HEADING INFORMATION & SYNCHRO EXCITATION
OMNI-RANGE INFO MIXED WITH N-1 HEADING INFO
RADIO COMPASS AN/ARN-6
049111

*Figure 4-15.*

6. 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.
7. To transfer control of the radio from one panel to the other, turn the "take" control knob on the inoperative panel to ON. The "take" control knob on the panel originally controlling the equipment will automatically cycle to OFF.

**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.

8. Turn the equipment off by rotating the "take" control knob on the operative panel to OFF.

**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 NAVIGATION SYSTEM INTERCONNECTING EQUIPMENT

An ID-249 course and glide slope indicator and an ID-250 radio magnetic indicator (RMI) are located on the pilot's and copilot's instrument panels and an additional ID-250 RMI at the observer's station left side to display radio navigation and ILS data. The heading pointer of ID-249 and all the indications displayed on ID-250 depend upon proper operation of a remote compass (N-1) system and a signal power amplifier (C-1) for directional reference information and synchro excitation voltages. The vertical course bar, the horizontal glide slope bar, and the marker beacon indicator light on ID-249 are independent of the N-1 compass system.

**EFFECT OF POWER SOURCE FAILURE ON RADIO NAVIGATION EQUIPMENT**

| EQUIPMENT | DC | AC | |
|---|---|---|---|
| | Battery or Generators | Main Inverter Bus | Instrument Inverter Bus |
| AN/ARN-6 RADIO COMPASS | ✓ | | |
| AN/ARA-25 DIRECTION FINDER GROUP | ✓ | | |
| AN/ARN-14 (VOR) OMNI-RANGE | ✓ | | |
| AN/ARN-18 GLIDE SLOPE | ✓ | ✓ | |
| AN/ARN-12 MARKER BEACON | ✓ | | |
| N-1 REMOTE COMPASS SYSTEM | ✓ | ✓ | ✓ |
| C-1 SIGNAL POWER AMPLIFIER AND INTERIM TRANSFORMER RESISTOR UNIT | | ✓ | |

✓ BECOMES INOPERABLE

049112

*Figure 4-16*

Interconnection of the indicators and associated equipment is illustrated in the form of a block diagram (figure 4-15). The effect of failure of various AC and DC power sources on radio navigation equipment is shown in chart form (figure 4-16).

**NOTE**

- Failure of the C-1 amplifier causes the loss of heading pointer indication on ID-249 and complete loss of indications from ID-250.

- When the N-1 compass inoperative light is illuminated and AC power is supplied through the "C-1 Amplifier" circuit breaker, an interim transformer-resistor unit is automatically switched on. The unit replaces N-1 heading information with a "zero reference" signal and supplies the necessary synchro voltage for continued operation without directional reference. The ID-250 (RMI) compass card will then rotate to and remain fixed at zero degrees. The No. 1 pointer will indicate relative bearing from the airplane heading to the radio station tuned. The No. 2 pointer will continue to indicate magnetic bearing to the omni-range station tuned, but will not indicate relative bearing from airplane heading to the station. The ID-249 heading pointer no longer relates airplane heading to a selected course as set into the course selector window, but will move with rotation of the course set knob. The position of the pointer will then be the same number of degrees clockwise from the "zero reference" at the top of the instrument as the number set in the course selector window.

## RADIO COMPASS (AN/ARN-6)

A low frequency radio compass is provided as a navigational aid for the pilots. 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 and copilot's instrument panels and at the observer's station left side. Controls are located on the pilot's and copilot's radio panels. The loop antenna is installed at the copilot's station and the sense antenna is incorporated in the upper arc of the canopy. See figure 4-17 for antenna locations. The radio compass is operated by DC power supplied through a circuit breaker marked "AN/ARN-6" on the "DC Panel" portion of the radar power panel.

**NOTE**

The radio compass should not be used as a navigational aid until the loop has been compensated.

### Radio Compass Function Switch

A function switch (16, figure 4-6 and figure 4-7) on the pilot's and copilot's radio compass panels is used to turn the radio compass equipment on and off, select the mode of operation, and transfer control of the radio compass to the pilot's or copilot's panel as desired. The switch positions are labeled OFF--COMP--ANT--LOOP--CONT and function as follows (the first four effective only from the radio compass panel having control):

- OFF turns off the radio compass equipment.

COMP provides homing and automatic direction finding (ADF) operation.

- ANT connects the sense antenna to provide for receiver operation only.
- LOOP is used for aural-null direction finding and receiver operation.
- CONT is spring-loaded for momentary operation to transfer control from one radio compass panel to the other each time either switch is actuated.

**NOTE**

Control is indicated to be at the pilot's radio compass panel when one of the three operation positions of the pilot's function switch is in use and his frequency dial and tuning meter are illuminated when the indicator light switch is on HI or LO. Another indication of control will be a deflection of the tuning meter pointer away from its clockwise stop when the equipment has warmed up approximately 15 seconds. The only indication of control at the copilot's panel will be aural.

### Radio Compass Loop Switch

A rotary "Loop" switch knob (7, figure 4-6 and figure 4-7) on the pilot's and copilot's radio panels is provided to manually control rotation of the radio compass loop antenna. Turning the switch toward "L" or "R" rotates the loop counterclockwise or clockwise, respectively, provided the radio compass function switch is in LOOP position. The radio compass loop switch is spring-loaded to the center (off) position. The rate of loop rotation is proportional to the knob displacement from the center position and varies from approximately 5° per second minimum to approximately 40° per second maximum.

### Radio Compass Tuning Crank

A tuning crank (14, figure 4-6 and figure 4-7) on the pilot's and copilot's radio panels 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 has HI--OFF--LO positions (8, 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 and copilot's radio panels (9, figure 4-6 and figure 4-7) selects any one of four receiver operating bands of frequencies. The switch positions are 100 to 200, 200 to 410, 410 to 850, 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 and copilot's radio panels (10, figure 4-6 and figure 4-7) 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 and copilot's radio panels (11, figure 4-6 and figure 4-7) will select either code or voice reception.

### Radio Compass Tuning Meter

A tuning meter (17, figure 4-6) is provided on the pilot's radio panel to indicate maximum signal strength during the process of tuning in a station.

### Radio Compass Frequency Dial

A dial scale (15, figure 4-6 and figure 4-7) on the pilot's and copilot's radio panels shows the frequency to which the radio compass is tuned.

### ID-250 Radio Magnetic Indicator

The ID-250 radio magnetic indicator (RMI) (8, figure 1-8 and 2, figure 1-16) on the pilot's and copilot's instrument panels and at the observer's station left side, used with the omni-range receiver and the AN/ARA-25 direction finder group, is also the indicator for the radio compass. 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 inoperative light is illuminated and AC power is supplied through the "C-1 Amplifier" circuit breaker, an interim transformer-resistor unit is automatically switched on. The unit replaces N-1 heading information with a "zero reference" signal and supplies the necessary synchro voltage for continued operation without directional reference. The ID-250 (RMI) compass card will then rotate to and remain fixed at zero degrees. The No. 1 pointer will indicate relative bearing from the airplane heading to the radio station tuned. The No. 2 pointer will continue to indicate magnetic bearing to the omni-range station tuned, but will not indicate relative bearing from airplane heading to the station. The ID-249 heading pointer no longer relates airplane heading to a selected course as set into the course selector window, but will move with rotation of the course set knob. The position of the pointer will then be the same number of degrees clockwise from the "zero reference" at the top of the instrument as the number set in the course selector window.

### Normal Operation of Radio Compass

The radio compass is made operative by the following procedure:

1. Place the function switch to ANT.

**NOTE**

- If ANT position of the function switch does not turn on the radio compass equipment, move function switch momentarily to CONT and replace to ANT.
- With the function switch in ANT position, the loop and loop control circuits remain inoperative.

2. Place the appropriate interphone controls to the desired positions for audio reception of the radio compass receiver. See "Interphone System," this section.
3. Select desired frequency band and use tuning crank to tune station and obtain maximum swing of tuning meter. (Since copilot's panel has no tuning meter, copilot tunes aurally.)
4. Place function switch in desired (type of operation) position.
5. Turn off equipment by placing function switch in OFF.

### Emergency Operation of Radio Compass

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.

## DIRECTION FINDER GROUP (AN/ARA-25)

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 copilot's instrument panels and at the observer's station left side, 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 tail compartment power shield.

### Normal Operation of Direction Finder Group

The direction finder group (AN/ARA-25) is made operative by the following procedure:

1. Rotate pilot's command operation switch to ADF. (The copilot's transfer switch must be in REMOTE.)
2. Select the desired frequency with the UHF remote channel selector switch.
3. Allow 3 minutes warmup period if the command radio operation switch was in OFF.
4. If the direction finder group is being used for "homing," fly the airplane to keep the No. 1 pointer of the ID-250 (RMI) radio magnetic indicator under the reference index at the top of the instrument.
5. 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 No. 1 pointer of the ID-250 RMI.
6. Turn off the equipment by placing the operation switch in OFF. This will turn off the AN/ARA-25 direction finder group and also the AN/ARC-27 command radio. Standby operation of the direction finder group is achieved by placing the operation switch in T/R or T/R + G REC.

## LOCALIZER AND OMNI-RANGE RECEIVER (AN/ARN-14)

A localizer and omni-range receiver provides VHF reception of navigation information and comprises a portion of the instrument low approach system (ILS) as discussed in section IX. The localizer and omni-range control panel is located on the pilot's radio panel (figure 4-6). An ID-249 indicator on the pilot's and copilot's instrument panels provides visual course and heading indication with respect to the localizer beam and selected omni-bearing. If a localizer or omni-range signal is being received, a small warning flag marked "off" on the top or bottom of the indicator will disappear from view to provide positive indication of station reception. An ID-250 radio magnetic indicator (RMI) on the pilot's and copilot's instrument panels and at the observer's station left side indicates bearing to the omni-station. The receiver (DC operated) utilizes the interphone system to distribute received audio signals to the crew.

### Localizer and Omni-Range Frequency Selector Knobs

Two rotary selector knobs (18, figure 4-6) on concentric shafts provide control of VHF localizer and omni-range frequency selection on the pilot's radio panel. The larger knob (next to the panel) sets up whole megacycles in the frequency indicator window; the smaller (upper) knob sets up the tenths of a megacycle to complete the selection of a desired frequency for VHF communication, localizer, or omni-range reception. The knobs may be turned either clockwise or counterclockwise. Frequencies between 108.0 and 135.9 megacycles provide 280 channels for selection. Tuning a localizer channel automatically causes the proper glide slope channel to be selected simultaneously to provide ILS cross-pointer information.

### Localizer and Omni-Range Power Switch

A switch (20, figure 4-6) on the pilot's radio panel is marked ON TONE--OFF with an unused PHASE position covered and blocked off by a plate. ON TONE position energizes the localizer and omni-range receiver and OFF position deenergizes ARN-14 equipment.

### Localizer and Omni-Range Volume Knob

A volume knob (19, figure 4-6) is provided on the pilot's radio panel and is used to adjust the receiver audio to the interphone system.

### ID-249 Course Selector Transfer Switch

Two-position toggle switches (2, figure 1-8 and 25, figure 1-16) located on the pilot's and copilot's instrument panels are marked "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 (12, figure 1-8 and 22, figure 1-16) is used to set the magnetic bearing of a desired course in the three upper tab windows.

### ID-249 Course Indicator

The ID-249 course indicator is a composite display of VHF navigation information. An ID-249 indicator (12, figure 1-8 and 22, figure 1-16) is located on the pilot's and copilot's instrument panels. 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 glide slope receiver. The two bars remain parallel to their rest positions and are always at right angles to each other. A heading pointer shows the relation of the airplane heading to the desired bearing. With the vertical bar centered and the correct omni-bearing set in the "Course" window, deviation of the heading pointer from the vertical index indicates the "crab angle" of the airplane. An amber indicator light at the upper right corner shows information from a marker beacon receiver. Magnetic bearing selection is controlled by the course set knob and indicated in the "Course" window. 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 indicators 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 marked "off" at the top or 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 perform only 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.

**NOTE**

When the N-1 compass inoperative light is illuminated and AC power is supplied through the "C-1 Amplifier" circuit breaker, an interim transformer-resistor unit is automatically switched on. The unit replaces N-1 heading information with a "zero reference" signal and supplies the necessary synchro voltage for continued operation without directional reference. The ID-250 (RMI) compass card will then rotate to and remain fixed at zero degrees. The No. 1 pointer will indicate relative bearing from the airplane heading to the radio station tuned. The No. 2 pointer will continue to indicate magnetic bearing to the omni-range station tuned, but will not indicate relative bearing from airplane heading to the station. The ID-249 heading pointer no longer relates airplane heading to a selected course as set into the course selector window, but will move with rotation of the course set knob. The position of the pointer will then be the same number of degrees clockwise from the "zero reference" at the top of the instrument as the number set in the course selector window.

### ID-249 Course Selector Indicator Light

Green lights (figure 1-8 and 26, figure 1-16) are located on the pilot's and 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, indicating 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 panel.

### ID-250 Radio Magnetic Indicator

The ID-250 radio magnetic indicator (RMI) is a composite display of airplane heading, radio compass or direction finder group (ADF) station bearing, and omni-range station bearing. An ID-250 RMI (8, figure 1-8 and 2, figure 1-16) is located on the pilot's and copilot's instrument panels and at the observer's station left side. 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 the 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 inoperative light is illuminated and AC power is supplied through the "C-1 Amplifier" circuit breaker, an interim transformer-resistor unit is automatically switched on. The unit replaces N-1 heading information with a "zero reference" signal and supplies the necessary synchro voltage for continued operation without directional reference. The ID-250 (RMI) compass card will then rotate to and remain fixed at zero degrees. The No. 1 pointer will indicate relative bearing from the airplane heading to the radio station tuned. The No. 2 pointer will continue to indicate magnetic bearing to the omni-range station tuned, but will not indicate relative bearing from airplane heading to the station. The ID-249 heading pointer no longer relates airplane heading to a selected course as set into the course selector window, but will move with rotation of the course set knob. The position of the pointer will then be the same number of degrees clockwise from the "zero reference" at the top of the instrument as the number set in the course selector window.

### 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 and inoperative by placing the power switch in OFF position. Bearing selection by an ID-249 indicator course set knob depends upon course selector transfer switch position as indicated by the course selector indicator light being on.

### Emergency Operation of Localizer and Omni-Range Receiver

In event of failure of the airplane regulated AC power supply, the C-1 signal power amplifier will become inoperative. When such a failure occurs, directional indication from the rotating compass card and the No. 1 and 2 needles of the radio magnetic indicator (ID-250) will not be available. Under these conditions, bearing information from the omni-range receiver may be obtained from the course indicator (ID-249) by rotating the course set knob until the vertical bar is centered. Magnetic bearing to or from the omni-station can then be determined by observing the "to-from" indicator and the counter reading. With a regulated AC power failure, use of the course indicator during omnl-range and ILS operations will be normal except that the heading pointer will be inoperative. In the event of a DC power failure, all facilities of the radio magnetic indicator and course indicator will be inoperative.

## GLIDE SLOPE RECEIVER (AN/ARN-18)

A glide slope receiver is provided as a portion of the instrument landing system (ILS). The ID-249 course indicator on the pilot's instrument panel provides visual glide slope indication along with the localizer indication. Glide slope signals are also used by the automatic pilot during an automatic approach. See "Radio Navigation System Interconnecting Equipment," this section and "Automatic Approach," section IX. Control of glide slope equipment is automatic through normal operation of localizer and omni-range equipment. See figure 4-17 for antenna location. Glide slope equipment is connected to DC power through a circuit breaker marked "AN/ARN-18" on the "DC Panel" portion of the radar power panel. The glide slope receiver uses regulated AC power from the main inverter bus supplied through a circuit breaker marked "AN/ARN-18" on the "AC Panel" portion of the radar power panel.

### Glide Slope Receiver Indicator

A glide slope horizontal needle in the ID-249 indicator (12, figure 1-8 and 22, figure 1-16) provides indication of airplane position relative to the glide slope 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 slope signal is being received.

### Normal Operation of Glide Slope Receiver

The glide slope receiver is turned on and off and tuned remotely through normal use of the localizer and omni-range equipment. The localizer and omni-range power switch (20, figure 4-6) starts and stops operation of both the glide slope equipment and the localizer and omni-range equipment. When the localizer and omni-range frequency selector (18, figure 4-6) is set to a designated ILS localizer frequency, the glide slope equipment is automatically tuned to the proper glide slope channel. Glide slope equipment is in a standby condition while VHF omni-range frequencies are set on the localizer and omni-range frequency selector.

### Emergency Operation of Glide Slope 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 system and is shown visually by an amber marker beacon indicator light installed on the ID-249 indicators (12, figure 1-8 and 22, figure 1-16) located on the pilot's and copilot's instrument panels. The receiver is automatically operated by DC power and will operate continuously as

long as power is available on the DC power distribution system.

### IFF (AN/APX-6)

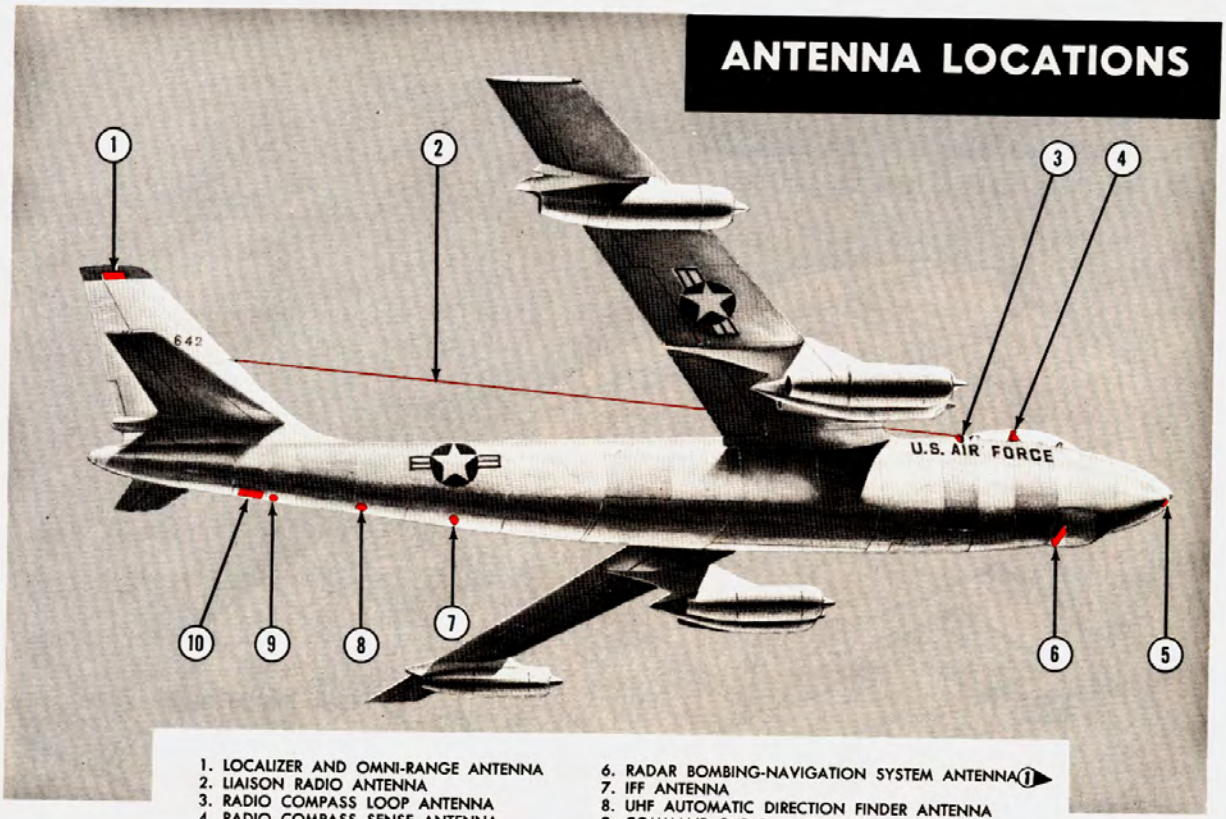
(1)

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 Destruct Switch

An IFF destruct switch (12, figure 4-6) is provided to destroy the equipment prior to abandoning the airplane. A switch guard is safety wired to prevent inadvertent operation.

(1) AF 51-2045, -2051, -2059, -2067 thru -2070, -2072 thru -2076, -2079, -2081, -2082, -2084, -2087, -2091




1. LOCALIZER AND OMNI-RANGE ANTENNA
2. LIAISON RADIO ANTENNA
3. RADIO COMPASS LOOP ANTENNA
4. RADIO COMPASS SENSE ANTENNA
5. GLIDE SLOPE ANTENNA
6. RADAR BOMBING-NAVIGATION SYSTEM ANTENNA (1)
7. IFF ANTENNA
8. UHF AUTOMATIC DIRECTION FINDER ANTENNA
9. COMMAND RADIO MAST ANTENNA
10. MARKER BEACON ANTENNA

(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

049533

*Figure 4-17.*

**Normal Operation of IFF**

**NOTE**

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:

1. Place the IFF master switch in STBY.
2. Further settings of the IFF master switch and mode switches will depend on the tactical situation and/or instructions from the communications officer.
3. To turn off the equipment, place IFF master switch in OFF.

**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:

1. Lift destructor switch guard by breaking the safety wire.
2. Place toggle switch in forward (or on) position.

### IFF (AN/APX-6A) (1)

A radar transponder is located on the pilot's radio panel. Circuit breakers in the tail compartment relay shield provide circuit protection for the equipment. A description of the controls and normal and emergency operation of the radar transponder will be given when the information is available.

### IFF (AN/APX-25) (2)

A radar transponder is located on the pilot's left sidewall. Circuit breakers in the tail compartment power shield provide circuit protection for the equipment. A description of the controls and normal and emergency operation of the radar transponder will be given when the information is available.

### RADAR BOMBING-NAVIGATION SYSTEM (3)

Provisions are made for a radar bombing-navigation system (BNS). When all components are installed, the system provides automatic computation for bombing and navigation. Locations of BNS components are shown in figure 4-18. Units having switches, controls, indicators, fuses, or plug-in amplifiers of interest to the observer are described in the following paragraphs. The radar BNS uses DC power from circuit breakers marked "Ampl Elect Contl," "Press Unit," "Camera O-15 & O-23 AN/AWA-2," "AN/APS-64," "Ampl Elect Contl," and "Radar 3Ø Inv Cont" on the "DC Panel" portion of the radar power panel. Regulated single-phase AC power is supplied by circuit breakers marked "AN/AWA-2," "Ampl Elect Contl," and "AN/APS-64" on the "AC Panel" portion of the radar power panel. Regulated three-phase AC power is supplied by two circuit breakers marked "Phase A Phase C Ampl Elect Cont Stab" on the "AC Panel" portion of the radar power panel. Unregulated single-phase AC power is supplied by circuit breakers marked "Ampl Elect Contl" and "AN/APS-64" on the "AC Panel" portion of the radar power panel.

#### Bombing Navigational Computer Components

PRIMARY CONTROL. The primary operating controls for the BNS are located on the front panel of the primary control unit (9, figure 4-18 and figure 4-19). The function switch is the main power switch for the computer and selects the system function. OFFSET IN--OFFSET OUT, DISPLACEMENT--MEMORY POINT, PPI--OPTICS AND BOMBING IND, erection cutoff RESET--NORMAL, and radar altitude ON--OFF switches are also located on the front panel of the unit. Manual corrections to the altitude dials on the ballistics control (figure 4-21) are made by pushing in and turning the "Altitude Correction" knob located on the front panel of the unit. Five lights on the face of the unit indicate

## BNS PRIMARY CONTROL

*Figure 4-19.* 049088

(1) AF 49-2642 thru 50-080, -2047, -2049, -2050, -2052 thru -2058, -2060 thru -2066, -2071, -2077, -2078, -2080, -2083, -2088, -2090
(2) AF 50-037, -054, -056, -060 thru -080, 51-2047, -2052, -2071, -2078, -2080
(3) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## BNS NAVIGATION CONTROL

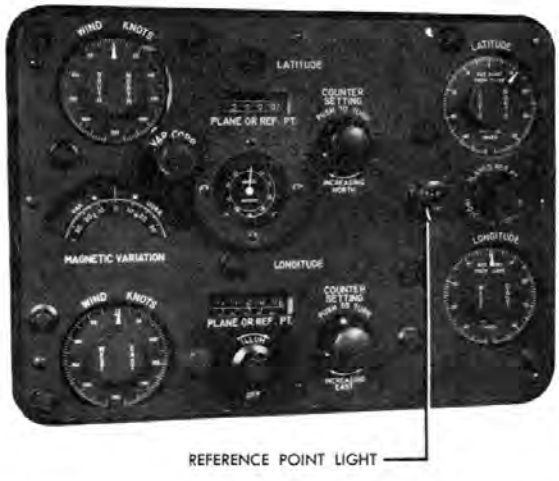



*Figure 4-20.*

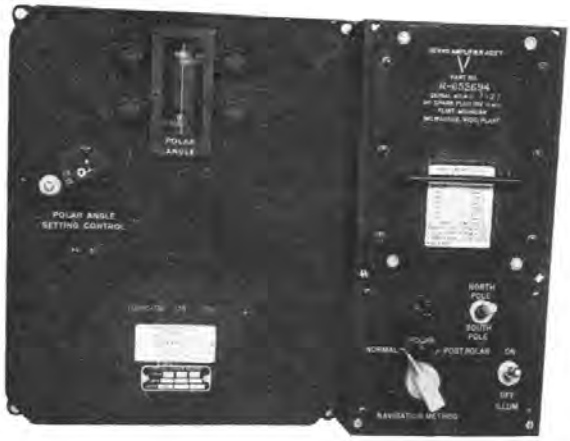
## BNS BALLISTICS CONTROL

*Figure 4-21.*

system conditions and bomb release. A toggle switch labeled "Aux PPI or Nav Track In" allows the observer to observe a full 360° PPI presentation when the system is in TRACK function without disturbing the computer operation. An illumination ON--OFF switch controls front panel illumination. The primary control is located on the observer's left sidewall.

NAVIGATION CONTROL. Dials on the navigation control (42, figure 4-18 and figure 4-20) indicate north-south and east-west wind components determined by the computer during memory point operation, magnetic variation for the particular terrestrial position indicated on longitude and latitude counters, and the north-south and east-west components of ground range from the airplane to the point observed under the cross-hairs or in the optics (when offset is not used). The longitude and latitude counters are initially set by pushing in and turning LATITUDE SETTING and LONGITUDE SETTING knobs on the face of the unit and, during normal operation of the system, continuously indicate to the observer the airplane position in degrees and minutes of longitude and latitude. A PLANES--REF PT switch allows the operator to correct the counters when an aim point of known longitude and latitude may be seen in the optics or radar. In PLANES position, the operation of the counters is as described above. In REF PT position, the longitude and latitude counters change by the amount shown on the fix dials. The operator then sets the counters to the known coordinates of the reference point and returns the switch to PLANES position to find correct airplane longitude and latitude. A red light on the face of the unit comes on when the switch is in REF PT position to prevent cockpit trouble. A VAR CORR knob allows the observer to correct the magnetic variation displayed on the magnetic variation dial when the dial does not agree with the latest information for the longitude and latitude indicated on the counters. The navigation control is located above the navigator's table on the right side of the airplane.

## BNS POLAR NAVIGATION CONTROL




049091

*Figure 4-22.*

BALLISTICS CONTROL. Ballistics data required for the computer to solve the bombing problem is supplied by the observer through the ballistics control (43, figure 4-18 and figure 4-21) which is mounted between the navigation and polar navigation controls above the navigator's table. Knobs on the face of the unit permit the observer to set Time of Fall, Trail, N-S Offset, and E-W Offset dials to the required values for the particular bomb run. A BOMBING switch with L OF S and SYN positions allows the operator to change control of optics and crosshairs from the computer to the line of sight control. The "Rg Lim" light indicates to the observer when the limits of ground range in the polar converter have been reached. A forward sighting button allows the operator to position the line of sight to 0° azimuth and 60° sighting angle in approximately 20 seconds by pushing the button. Provisions are made for use of two offset aim points (OAP) to aid the observer in target identification and a switch to select the desired OAP. Dial illumination is controlled by an ILLUM knob.

POLAR NAVIGATION CONTROL. The controls necessary to adapt the BNS for polar navigation are located in the polar navigation control (44, figure 4-18 and figure 4-22). A NORMAL--POLAR--POST POLAR switch on the unit is used by the observer to select the system navigation method. A red light indicates to the observer when the switch is in POLAR position. Polar angle calculated by the observer is set into the unit by means of a POLAR ANGLE SETTING CONTROL and read on a POLAR ANGLE dial. A NORTH POLE--SOUTH POLE switch controls the polarity of information in the unit to permit navigation near either of the earth's poles. Dial illumination is controlled by an ILLUM ON--OFF switch. The polar navigation control is located next to the ballistics control above the observer's table.

## BNS LINE OF SIGHT CONTROL

049092

*Figure 4-23.*

LINE OF SIGHT CONTROL. The line of sight control (10, figure 4-18 and figure 4-23) is located above the PPI on the left sidewall of the observer's compartment and controls the position of the computer line of sight when the bombing switch on the ballistics control is in L/S position. A DRIFT knob controls the line of sight

## BNS TRACKING CONTROL

*Figure 4-24.*

## BNS TRUE HEADING TRANSMITTER

*Figure 4-25.*

in azimuth. Azimuth position of the line of sight relative to the airplane fore and aft axis is read on a coarse dial seen through a window on the unit and a fine dial attached to the knob. A SIGHTING ANGLE knob controls the elevation of the line of sight and sighting angle is indicated on similar dials. A boresight switch and light on the unit are often used to indicate the operational condition of the equipment. With the boresight switch in any position other than NOR and the bombing switch and the ballistics control in L/S, the "Boresight" light comes on during the second timing period. This characteristic is used to determine when computer initial time delay is over and the system is operable. An ILLUM switch controls dial illumination.

TRACKING CONTROL. The tracking control (46, figure 4-18 and figure 4-24) is used by the observer to control the radar and optical lines of sight and to correct computer range and wind input data. When the deadman switch is pushed, the control is energized. Operation of the slew button multiplies the tracking rate and, during memory point operation, deenergizes the memory point switch and discontinues the operation. The slewing rate is controllable by a SLEW RATE knob located on the mounting flange of the unit.

TRUE HEADING TRANSMITTER. The true heading transmitter (41, figure 4-18 and figure 4-25) is the unit in which magnetic variation data from the navigation control and magnetic heading information from the flux valve are combined to give true heading information. The true heading transmitter is located on the navigator's instrument panel and airplane true heading is indicated to the observer by the dials of the

# OBSERVER'S BNS INDICATORS

049095

*Figure 4-26.*

# PILOT'S DATA INDICATOR

049096

*Figure 4-27.*

unit. Two additional dials are visible on the face of the unit to be used by maintenance mechanics to determine the zeroed condition of the magnetic variation gear train. A switch on the face of the unit controls internal illumination of the dials.

OBSERVER'S BNS INDICATORS. Time (in seconds) remaining before bomb release and BNS computed true airspeed are indicated to the observer by instruments mounted on the observer's instrument panel. The time-to-go indicator and true airspeed indicator are shown as 48 and 49, figure 4-18 and figure 4-26.

PILOT'S DATA INDICATOR. Time-to-go, turn angle required to make good the desired release course, and BOMB position of the function switch are indicated to the pilot by the pilot's data indicator (2, figure 4-18 and figure 4-27) which is mounted in the pilot's instrument panel. BOMB position of the function switch is indicated by a red light.

ELECTRONIC CONTROL AMPLIFIER (SAU). Individual amplifiers for the computer servos are mounted on the SAU (4, figure 4-18 and figure 4-28). The amplifiers are plugged into sockets on the unit and held in place by dzus fasteners for easy removal and replacements and should be checked prior to each flight. Test jacks and screwdriver adjustments on the front of the unit are for the use of maintenance personnel in adjustment of the system and should not be disturbed except during ground maintenance. The SAU is located on the left side of the walkway across from the pilot's position.

# BNS STABILIZATION ELECTRONIC CONTROL AMPLIFIER (SAU)

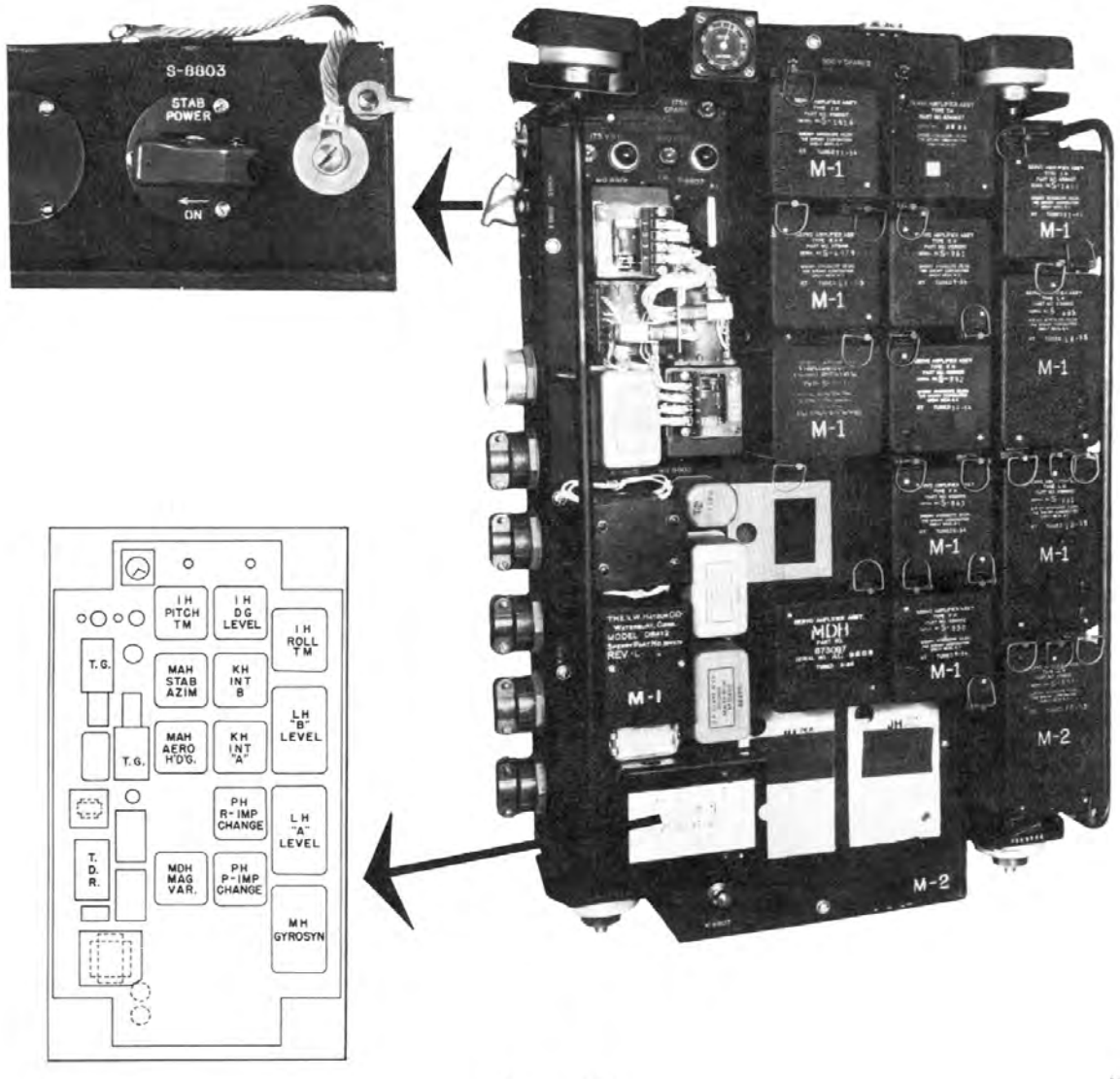



*Figure 4-28.*

# BNS COMPUTER ELECTRONIC CONTROL AMPLIFIER (CAU)

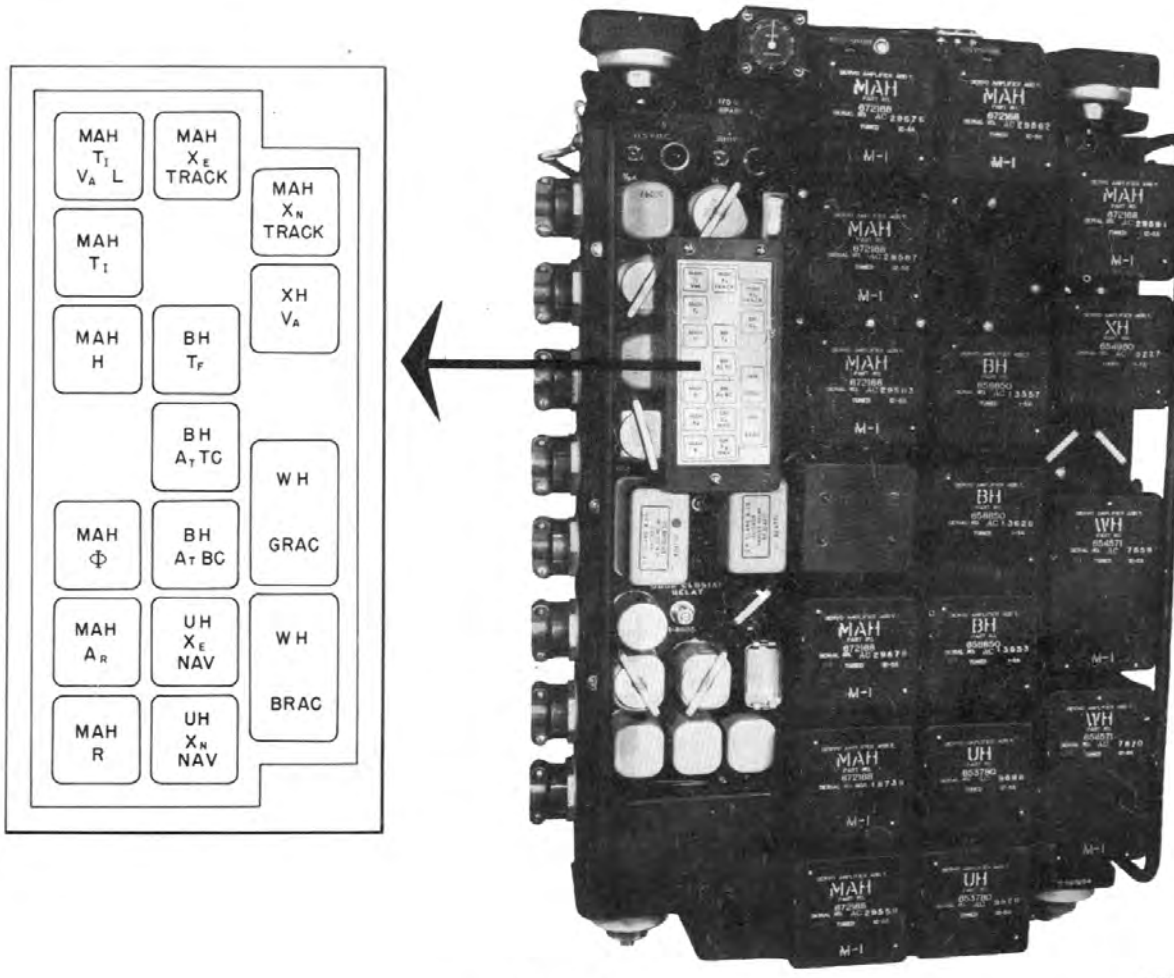



*Figure 4-29.*

## BNS TRACKING COMPUTER

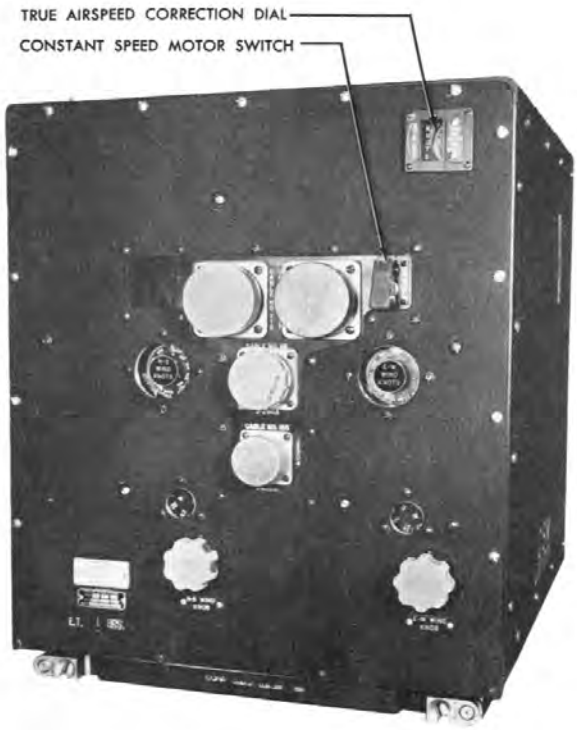



*Figure 4-32.*

## BNS RADAR CONTROL UNIT

*Figure 4-33.*

FUSE BOX. Computer fuses are mounted in a fuse box (45, figure 4-18 and figure 4-31). The fuse box is equipped with indicating-type fuse holders to simplify faulty fuse isolation and is conveniently mounted in the observer's table.

TRACKING COMPUTER. The tracking computer (31, figure 4-18 and figure 4-32) is located in the lower radar compartment and contains the rate and timing circuits and devices necessary for the computer to determine ground speed, winds, time to impact, and time-to-go. A constant speed motor switch and a true airspeed correction dial on this unit must be checked by the observer prior to each flight to insure that the switch is in ON position and that the proper true airspeed correction has been set into the computer.

### Radar Set Components

RADAR CONTROL UNIT. The radar control unit (15, figure 4-18 and figure 4-33) mounted on the observer's left sidewall contains the basic radar set controls. The power switch turns the radar on and off and selects antenna scanning speed (during OFF, STAB, and NAV computer functions only). A meter and a meter switch allow the observer to check or monitor various critical radar voltages and currents. The SEARCH XTAL switch selects crystal 1 or 2 for monitoring when the meter switch is in XTAL position. Receiver gain is controlled by receiver gain control. The FTC (fast

## PERISCOPIC BOMBSIGHT STABILIZER

*Figure 4-30.*

## BNS FUSE BOX

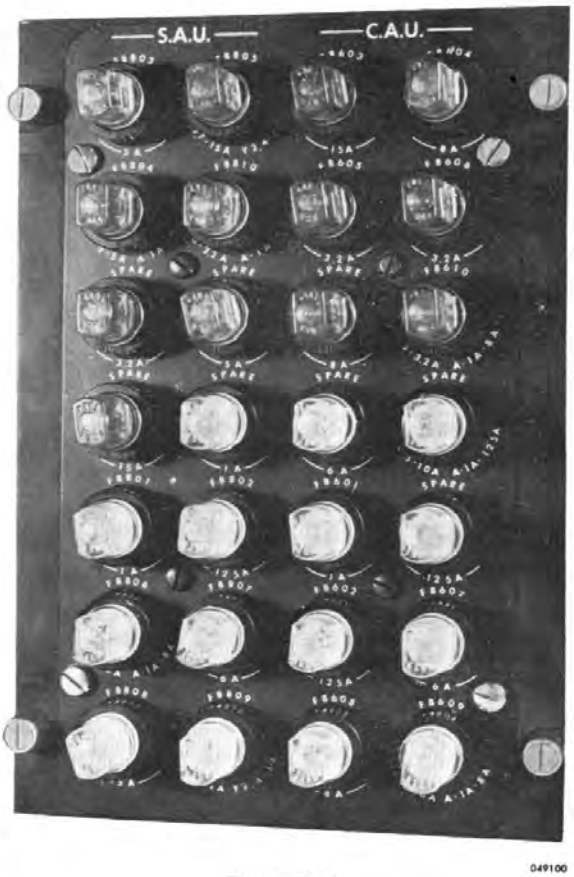



*Figure 4-31.*

COMPUTER ELECTRONIC CONTROL AMPLIFIER (CAU). Individual amplifiers for the computer servos are mounted on the computer electronic control amplifier (6, figure 4-18 and figure 4-29). The amplifiers are plugged into sockets on the unit and held in place by dzus fasteners for easy removal and replacements. Test jacks and screwdriver adjustments on the front of the unit are for the use of maintenance personnel in adjustment of the system and should not be disturbed except during ground maintenance. The CAU is mounted in the walkway forward of the SAU.

PERISCOPIC BOMBSIGHT STABILIZER. The periscopic bombsight stabilizer or "stab unit" (14, figure 4-18 and figure 4-30) contains the slaved gyros which provide the stable vertical and true north references about which the computer resolves the bombing problem. One adjustment is available to the observer on this unit. An access hole in the top cover of the unit and an adjustment shaft make it possible to adjust the radar differential synchro (SD 3515) without removing the top cover from the unit. The radar differential synchro is adjusted to make the radar and optical lines of sight coincident.

## BNS TRANSMITTER CONTROL

*Figure 4-34.*

## BNS VARIABLE AUTOTRANSFORMER (VARIAC OR TF-106)

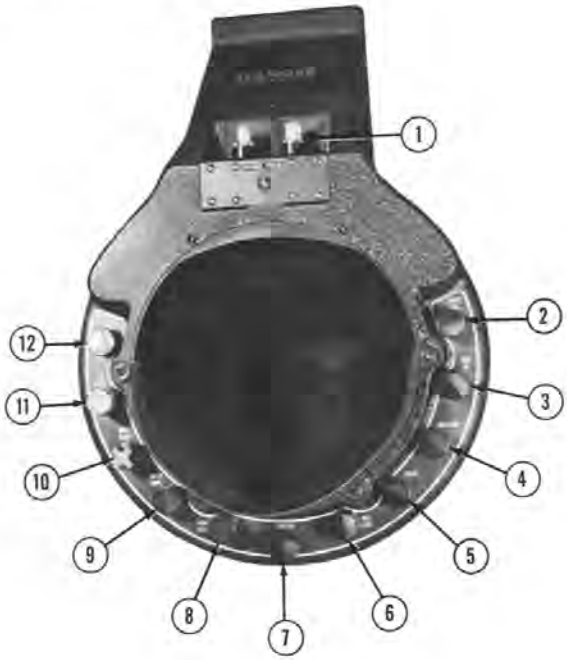
*Figure 4-35.*

time constant) control changes the receiver time constant in ON position to break up blocking returns or jamming pulses. Front panel illumination is controlled by an ILLUM knob. Antenna tilt may be manually adjusted by means of the DEG TILT knob and sweep delay functions are controlled by the SWP DELAY knob. The OPERATION switch selects RAD HI GAIN, RAD HI RES (high resolution), or BCN (beacon) receiver operation and selects the proper duty cycle for each type of operation. The LOG--LIN switch selects logarithmic or linear receiver gain characteristic. PPI sweep expansion, radar duty cycle, and fixed range mark generation are controlled by the RANGE control (OFF, STAB, and NAV computer functions only).

TRANSMITTER CONTROL. Tuning of the tunable magnetron used in the APS-64 is controlled by the observer by means of the transmitter control or signal comparator (16, figure 4-18 and figure 4-34). Magnetron frequency is indicated to the observer by a meter on the face of the unit. An INCREASE--DECREASE switch is used to change magnetron frequency, and high and low frequency limits are indicated by "Increase Lim" and "Decrease Lim" lights. A five-position switch allows the operator to select different modes of switching between the antenna and a dummy load for loading the transmitter during the tuning procedure. The transmitter control is located on the observer's left control console.

VARIABLE AUTOTRANSFORMER (VARIAC OR TF -106). Modulator high voltage and thus magnetron current are controlled by the observer using the variable autotransformer (8, figure 4-18 and figure 4-35). The knob on the unit is adjusted to give the correct value of magnetron current on the radar control unit meter. A minimum setting of approximately 73 volts is used to prevent overcooling of the magnetron cathode and resultant magnetron arcing. The unit is mounted on the observer's left control console.

## PPI INDICATOR




1. FUSES
2. HORIZONTAL CENTERING CONTROL
3. VERTICAL CENTERING CONTROL
4. BACKLASH CONTROL
5. FOCUS CONTROL
6. RING LIGHTS CONTROL
7. CURSOR CONTROL
8. SCALE ILLUMINATION CONTROL
9. SWEEP AMPLITUDE CONTROL
10. MARKER BRILLIANCE CONTROL
11. VIDEO GAIN CONTROL
12. BIAS CONTROL

049103

*Figure 4-36.*

PPI INDICATOR. Radar target returns are displayed in a map pattern in the PPI (11, figure 4-18 and figure 4-36). Presentation controls are located on the indicator. The IP-284 used with the MA-7A system is a 10-inch indicator and has all operator controls located in a ring around the face of the unit. Two fuses are mounted in indicating-type fuse holders on the front of the unit and spare fuses mounted on a flap near the fuse holders.

RADAR SYNCHRONIZER. The synchronizer (24, figure 4-18 and figure 4-37) is the assembly point for information to be displayed on the indicator. Fixed range marks and sweep are generated and synchronized with video from the receiver; the time zero trigger from the modulator is received, sharpened up, and distributed, and a delayed trigger generated; PPI offset information is received and amplified; video is received, sharpened up, and mixed with fixed or variable range marks and, when the unit is used in the K-4A system, signals to control the indicator sweep rotation are generated in this unit. A number of controls on the front of the unit under a flap cover may be adjusted by the observer. Sweep delay MAX and MIN adjustments calibrate the sweep delay circuits to eliminate the altitude hole for all altitudes. The SWP LCT ADJ control is used to adjust the maximum sweep voltage so that the total time length of the sweep is slightly more than the range indicated on the control unit. (This control should be adjusted on the ground using test equipment.) The PED AMP and INDICATOR SERVO GAIN is not used with the 10-inch indicator used in the MA-7A system. The ROLL --CORR CAL controls are not used and are locked in the full counterclockwise position. The RNG MRK ZERO control is adjusted to make the first fixed range mark (this mark is not normally seen) coincide with the time zero trigger. DISPLACED CTR AMP IN, HORIZ, and VERT controls are used to adjust the input displaced center voltages so that the output of the displaced center amplifier positions the displaced sector vertex properly at the edge of the scope. A three-position switch in the lower right corner of the front panel is positioned to K EXT RANGE for MA-7A system operation.

MAIN JUNCTION BOX. A central junction box (18, figure 4-18 and figure 4-38) is used to interconnect the cables from the various radar components and the computer and to serve as a distribution center. All radar fuses (except 10-inch indicator fuses) are mounted in fuse holders for radar power on the front of this unit. Units used with the MA-7A system have indicating-type fuse holders. Fuse holders are clearly marked by number and rating and with a code indicating the fuse function. Spare fuses are located under a flap on the front cover of the unit. Some units have switches protruding through the front cover. These switches are always left in NORMAL position.

ANTENNA SERVO AMPLIFIER (AM-193). The antenna servo amplifier (27, figure 4-18 and figure 4-39) serves as a junction box between the antenna and other system components and contains the tilt servo amplifier. Three screwdriver adjustment switches are located on the front of the unit. The center of these, the UNSTAB--STAB switch, must be checked prior to each flight to assure that it is in STAB position. If this switch is in UNSTAB position, loss of tilt stabilization will occur during maneuvers.

# BNS RADAR SYNCHRONIZER

049115

*Figure 4-37.*

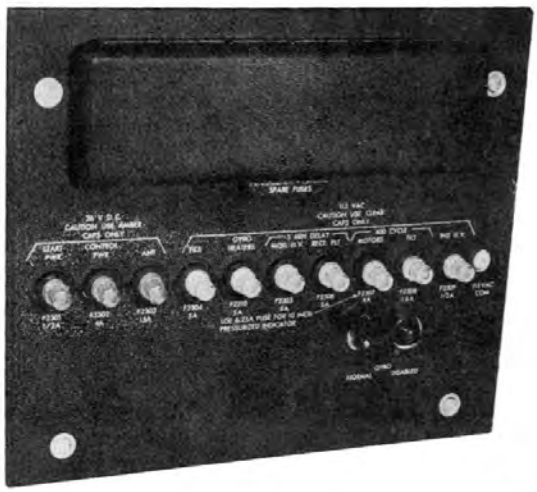
**Interconnecting Equipment Components**

RANGE AZIMUTH INDICATOR (RAI). The RAI or bombing indicator is located inside the periscope (47, figure 4-18) and displays a magnified portion of the PPI presentation around the crosshairs. The display is controlled by a RADAR ON--OFF switch, a BRILL control, and a FOCUS control in the periscope and is viewed through an eyepiece adjacent to the optics eyepiece so that the observer may see both the optical and radar fields and crosshairs superimposed.

INTERCONNECTING EQUIPMENT SYNCHRONIZER. The interconnecting equipment synchronizer (19, figure 4-18 and figure 4-40) generates the variable range mark and the azimuth mark and controls antenna sectoring in TRACK and BOMB functions of the system. Three screwdriver adjustments are located on the front of the unit under a flap cover. The AZ MK SIZE and RGE MK SIZE adjustments control the intensity of the variable range and azimuth marks seen in the PPI and are adjusted to make these marks equal in brilliance to each other and to the fixed range marks and heading mark. The SECT WIDTH adjustment controls sector width. All three adjustments may be made by the observer. The fuses for the interconnecting equipment are located on the front of the synchronizer and spare fuses are located inside the front cover flap. Indicating-type fuse holders are used to simplify faulty fuse isolation. Red lights on the front of the unit indicate when over heaters inside the unit are on and should glow intermittently during normal operation.

INTERCONNECTING EQUIPMENT POWER SUPPLY (PP-1144). Synchronizing circuits and high voltage power supply for the RAI are contained in the PP-1144 (21, figure 4-18 and figure 4-41). Eight presentation controls for the RAI are located on the front of the unit. RGE MK SIZE, AZ MK SIZE, and VID SIZE screwdriver adjustments control the relative intensities of the range mark, azimuth mark, and video seen in the RAI and may be adjusted by the observer. HOR CENT and VERT CENT controls may also be adjusted by the observer to center the RAI presentation. The remaining controls should be adjusted on the ground by maintenance mechanics. The PP-1144 is located on the radio radar rack.

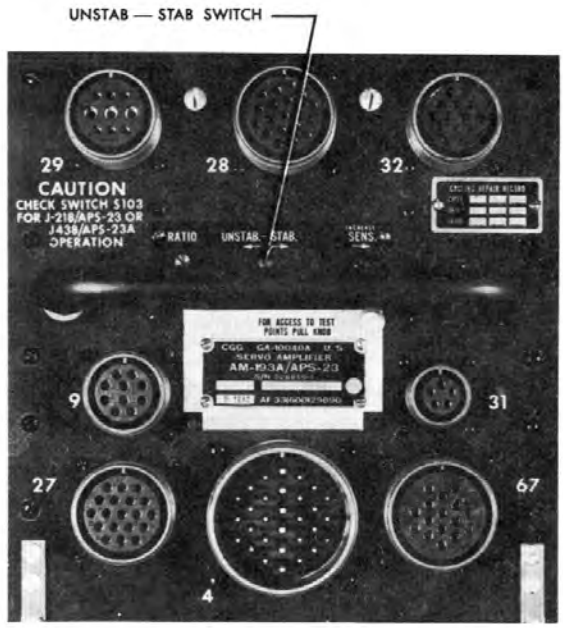
## BNS RADAR MAIN JUNCTION BOX



049116

*Figure 4-38.*

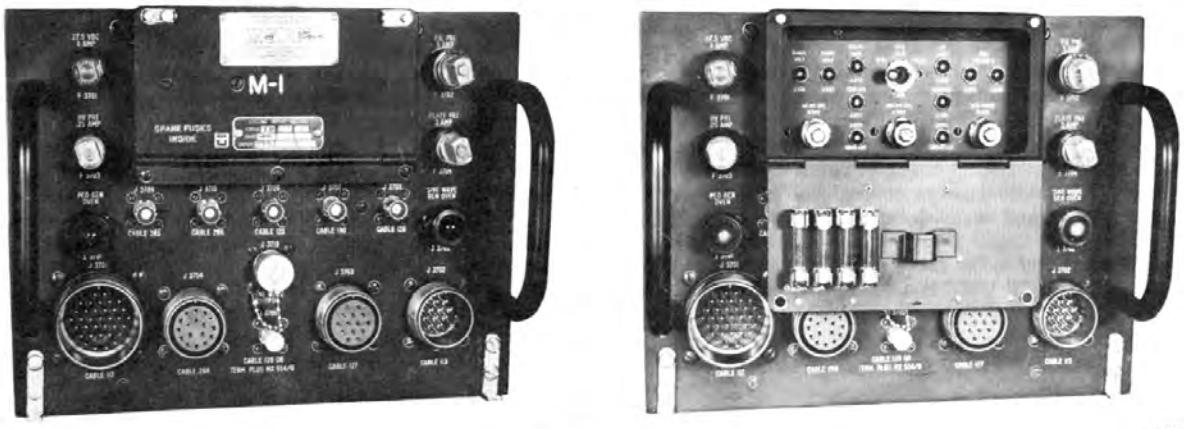
## BNS ANTENNA SERVO AMPLIFIER




049117

*Figure 4-39.*

## BNS INTERCONNECTING EQUIPMENT SYNCHRONIZER




049118

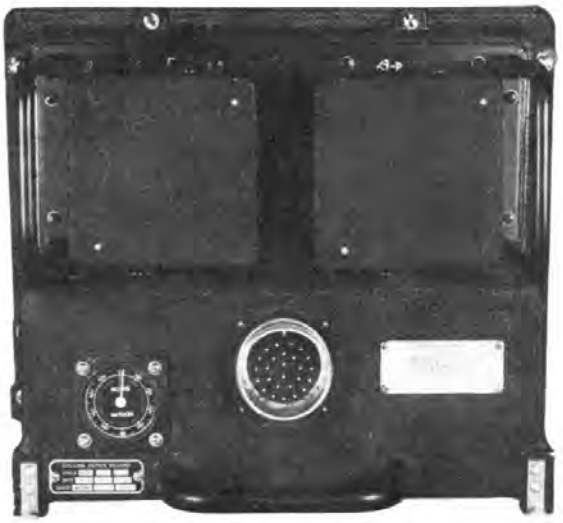
*Figure 4-40.*

## BNS INTERCONNECTING EQUIPMENT POWER SUPPLY

049119

*Figure 4-41.*

## BNS AZIMUTH COMPUTER



049120

*Figure 4-42.*

AZIMUTH COMPUTER. The azimuth computer (17, figure 4-18 and figure 4-42) calculates corrections to radar azimuth data necessary to prevent target smearing in the PPI when the airplane rolls about the line of sight. Two plug-in amplifiers are mounted on the front of this unit.

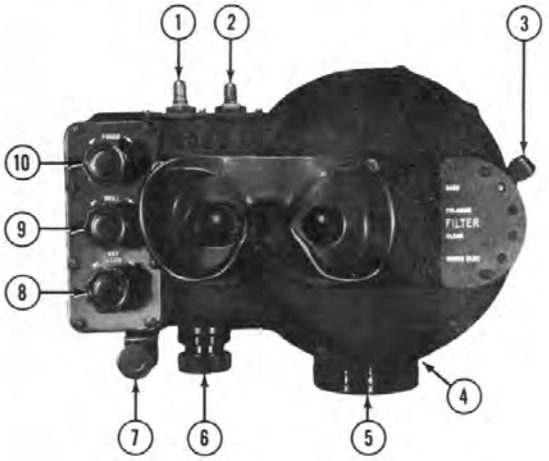
**Optics Components — (Y-4 or MA-4)**

PERISCOPIC BOMBSIGHT. The radar BNS uses a horizontal periscope bombsight (47, figure 4-18 and figure 4-43). Operating controls are grouped about the head of the periscope. A radar ON--OFF switch and FOCUS and BRILL controls control the RAI which is housed inside the periscope. A reticle illumination ON--OFF switch and ILLUM rheostat control reticle illumination. Red or white reticle illumination is selected by means of a reticle light selector switch. An eyepiece adjustment knob adjusts the RAI eyepiece to compensate for differences in observer eye spacing. Magnification of the optical system is controlled by the power changing knob. The filter selector knob allows a choice of three filters or clear. The focus knob (not shown) located behind the power changing knob controls focus of the optical system. 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 (figure 4-58). Approximately 11 turns clockwise of the handcrank opens the cover and approximately 11 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 System," this section.

**NOTE**

Effects of the extended bombsight cover on airspeed indicators are discussed in "Pitot-Static Instruments," section I.

## PERISCOPIC BOMBSIGHT




1. RADAR ON-OFF SWITCH
2. RETICLE ILLUMINATION ON-OFF SWITCH
3. FILTER SELECTOR
4. FOCUS KNOB (NOT SHOWN)
5. POWER CHANGING KNOB
6. EYEPIECE ADJUSTMENT
7. RETICLE LIGHT (RED-WHITE) SELECTOR
8. RETICLE ILLUMINATION CONTROL
9. RADAR BRILLIANCE CONTROL
10. RADAR FOCUS CONTROL

049121

*Figure 4-43.*

## C-1 INDICATOR — BNS

049122

*Figure 4-44.*

## BNS COORDINATE CONVERTER POWER SUPPLY AND AMPLIFIER RACK

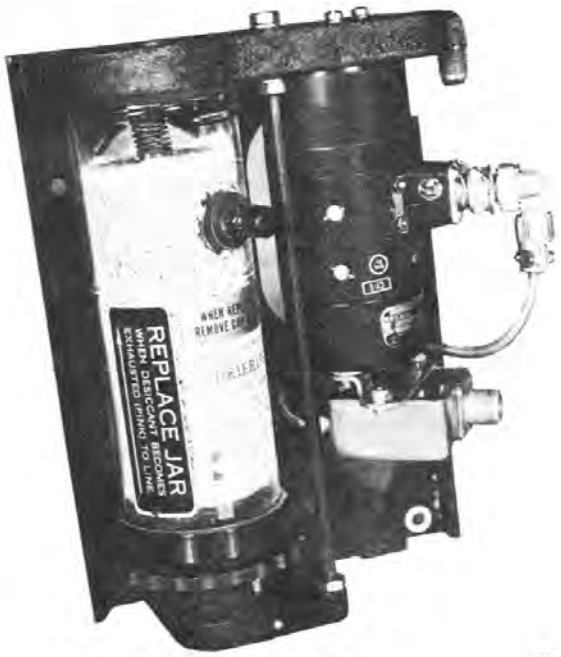
049123

*Figure 4-45.*

AZIMUTH AND SIGHTING ANGLE INDICATOR. The azimuth and sighting angle indicator (38, figure 4-18 and figure 4-44) indicates to the observer the relative bearing and sighting angle of the target under the cross-hairs.

COORDINATE CONVERTER POWER SUPPLY AND AMPLIFIER RACK. Plug-in amplifiers used in the servo loops interconnecting the computer, periscope, and coordinate converter are mounted in the coordinate converter power supply and amplifier rack (34, figure 4-18 and figure 4-45). A rectifier power supply is mounted in the base of the rack. A meter on the front of the power supply indicates correct power supply output voltage when the needle is in the green area of the scale. Two fuse holders mounted under the meter contain a fuse which protects the power supply and a spare fuse.

## PERISCOPIC BOMBSIGHT DESICCATOR




049124

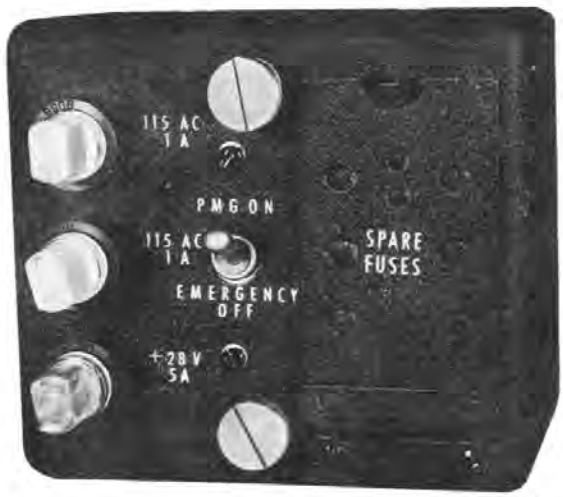
*Figure 4-46.*

PERISCOPIC BOMBSIGHT DESICCATOR. Air in the periscope is circulated, filtered, and dried by a periscopic bombsight desiccator (12, figure 4-18 and figure 4-46). A motor and pump mounted on the unit pump air from the bombsight through a glass tube filled with desiccant and back to the bombsight. Prior to each flight the desiccant should be checked for proper color and replaced if necessary.

### Position Mark Generator Components — AN/AWA-2

PMG SWITCH BOX. A switch box (23, figure 4-18 and figure 4-47) controls the position mark generator. A toggle switch with positions labeled PMG ON--EMERGENCY OFF on the box might conceivably be used to turn off the PMG, but is normally left in PMG ON position. If the switch is left in EMERGENCY OFF position with the computer in BOMB function, no trigger is supplied to the modulator and the radar picture will

## PMG SWITCH BOX — BNS




049125

*Figure 4-47.*

be lost. If the condition is allowed to continue for more than a few seconds, the magnetron cathode will cool and it will be necessary to recycle the radar to prevent magnetron arcing.

### RADAR COMPONENT HEATING SYSTEM (1)

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 the observer's lighting control panel (figure 4-51) and have three positions marked 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. The heaters use unregulated single-phase AC power from the right unregulated AC bus. Circuit breakers marked "Heat Control," "Stab Heat," "Polar Nav & Nav Heat," and "True Hd Xmtr Az Comp Heat" are on the radar power panel.

(1) Airplanes having BNS capabilities

## RADAR POWER MONITORING PANEL

**Airplanes having BNS capabilities**

1. FREQUENCY METER
2. VOLTMETER
3. THREE PHASE INVERTER SWITCH
4. RADAR POWER MONITOR SELECTOR SWITCH
5. BNS INVERTER WARNING LIGHT

*Figure 4-48.*

### RADAR POWER MONITORING SYSTEM (1)

A radar power monitoring panel (figure 4-48 and 12, figure 4-59) near the observer's instrument panel provides meters and connections for checking AC power supplies to radar BNS equipment before and during BNS operation.

#### Radar Power Monitor Selector Switch

A five-position rotary selector switch (4, figure 4-48) is installed on the radar power monitoring panel and permits checking power condition of the regulated AC system, BNS 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 BNS inverter. 3Ø INV ØC VOLT-FREQ position connects frequency meter and voltmeter to the "C" phase of the BNS inverter. ALTERNATOR VOLT position connects only the voltmeter to the right alternator power bus. 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 BNS three-phase inverter switch (3, figure 4-48) is located on the radar power monitoring panel. In ON position, the three-phase inverter can be operated and tested without turning on the BNS equipment. In OFF position, control of three-phase inverter is within the BNS.

#### BNS Inverter Warning Light

A red warning light (5, figure 4-48) located on the radar power monitoring panel marked "K-4 Inverter Power Off" will be illuminated when three-phase power is off the BNS 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 BNS bus.

#### Frequency Meter

A frequency meter (1, figure 4-48) 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 (2, figure 4-48) is installed on the radar power monitoring panel to show voltage of power on the buses as determined by the power monitor selector switch.

### RADAR PRESSURIZING SYSTEM (1)

To insure proper operation of radar BNS equipment at all altitudes, provisions are made for pressurization of the modulator and transceiver units. The radar pressurizing system is controlled from a radar pressurizing control panel (figure 4-49) located at the observer's station. The system is energized by DC power

(1) Airplanes having BNS capabilities

and protected by circuit breakers marked "Press Unit" and "Inph" on the "DC Panel" portion of the radar power panel.

### Radar Pressurizing Control Switch

A control switch (4, figure 4-49) marked ON--OFF--MOM ON is on the radar pressurizing control panel. 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. In the momentary MOM ON position, the pressure regulator switch is overridden and power is supplied directly to operate the compressor. In OFF position, the radar pressurizing system is deenergized.

### Radar Pressurizing Bleeder Valve Knob

A knob (3, figure 4-49) 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.

### Pump Pressure Indicator Light

A green indicator light (2, figure 4-49) on the radar pressurizing control panel, when illuminated, indicates that the compressor is operating.

### Radar Pressure Gage

A radar pressure gage (1, figure 4-49) on the radar pressurizing control panel indicates system air pressure in inches of mercury. A mask assembly with red and green range markings, 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.

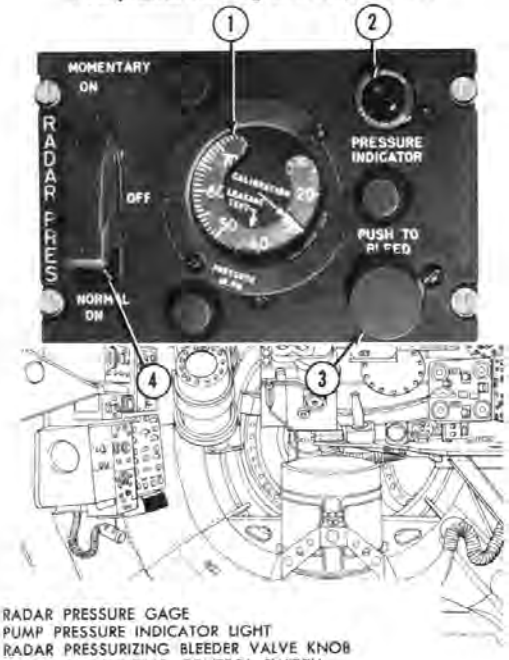
### Normal Operation of Radar Pressurizing System

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.

1. Place the radar pressurizing control switch in ON; 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 operation range, radar BNS equipment may be turned on.
2. After radar BNS equipment has been turned off, place the radar pressurizing control switch in OFF.

## RADAR PRESSURIZING CONTROL PANEL*

*Airplanes having BNS capabilities




1. RADAR PRESSURE GAGE
2. PUMP PRESSURE INDICATOR LIGHT
3. RADAR PRESSURIZING BLEEDER VALVE KNOB
4. RADAR PRESSURIZING CONTROL SWITCH

049062

*Figure 4-49.*

### 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.

1. Place the radar pressurizing control switch in OFF.
2. Bring pressure within green operating range on the radar pressure indicator either by holding the pressurizing control switch in MOM ON or by pushing and holding in the pressure bleed valve knob.
3. Whenever the pressure drops to the low limit of the green operating range, hold the radar pressurizing control switch in MOM ON 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 the 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:

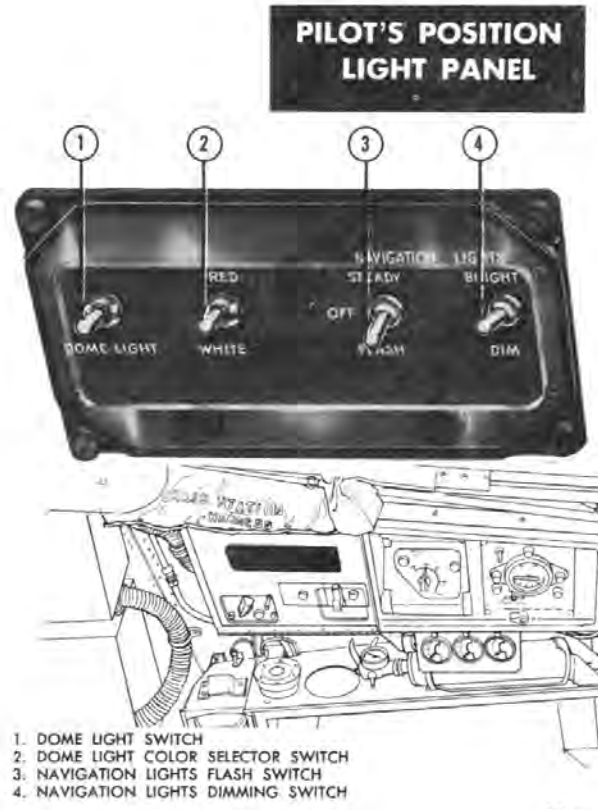
1. Place the radar pressurizing control switch in OFF.
2. Turn off radar BNS equipment.

**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. Operation of these lights is accomplished by switches located near each crew member.




1. DOME LIGHT SWITCH
2. DOME LIGHT COLOR SELECTOR SWITCH
3. NAVIGATION LIGHTS FLASH SWITCH
4. NAVIGATION LIGHTS DIMMING SWITCH

049641

*Figure 4-50.*

### EXTERIOR LIGHTING

#### Landing Lights

Fixed landing lights (15, figure 1-4) are installed in the inboard engine nacelles for use at night while taxiing, during takeoff, and for approach and landing. They may also be used in cases of limited visibility such as haze or smoke. The landing lights are turned on and off by means of switches (16, figure 1-10) on the pilot's switch panel and are supplied power through circuit breakers marked "LH Landing" and "RH Landing" on the "Lighting Exterior" portion of the lower DC power panel.

#### Navigation Lights (Position Lights)

Navigation lights are installed as follows: red on left wing tip, green on right wing tip, white and yellow on fin tip, and white on top and bottom of the fuselage. These lights are controlled by two switches on the pilot's position light panel (3 and 4, figure 4-50) located aft of the oxygen and rheostat panel. The flash switch (3, figure 4-50) has three positions, STEADY--OFF--FLASH. STEADY position provides constant illumination for all navigation lights, OFF position turns off all lights, and FLASH position provides flashing of the wing and tail lights while the fuselage lights remain on steady. A dimming switch (4, figure 4-50) with BRIGHT--DIM positions simultaneously dims all navigation lights. The lights are supplied DC power through a circuit breaker marked "Navigation Lights" on the "Lighting Exterior" portion of the lower DC power panel.

#### 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 lights are controlled by an ON--OFF switch and a rheostat on the copilot's anti-icing external lights panel (4, figure 1-14). DC power for the wing illumination lights is supplied through a circuit breaker marked "Wing Illum" on the "Lighting Exterior" portion of the lower DC power panel.

## INTERIOR LIGHTING

Interior lighting is provided by red and white lights. Red lights are used at night since the red color does not affect night vision. White lights are used in the daytime during dull light conditions. White lights may also be used during thunderstorms to lessen the blinding effects of lightning flashes. Lights within edge-lighted panels, which are illuminated indirectly from the underside, are red. Instrument lights, spotlights, and work lights are red, while floodlights and compartment lights are either red or white. Lights in the crawlway and flash bomb bay are white. Spare bulbs for all of the lights are located in the spare bulb tray just above and aft of the observer's seat.

### Pilot's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels at the pilot's station are controlled by an ON--OFF "Panel Lights" switch (3, figure 1-6) on the pilot's lighting control panel. Light intensity within the same panels (and oxygen panel floodlights) is controlled by a BRIGHT--DIM "Panel Lights" rheostat. The panel lights receive DC power through a circuit breaker marked "Sidewall Panel Pilot" on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red lights on the individual flight instruments on the pilot's instrument panel, red lights on the anti-icing air temperature indicators, and the red floodlight for the automatic pilot controller support (when extended) are controlled by a BRIGHT--DIM--OFF "Flight Instrument" rheostat on the pilot's lighting control panel. Engine instrument red floodlights are controlled by a BRIGHT--DIM--OFF "Engine Instrument" rheostat on the pilot's lighting panel. Red floodlights for the entire instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Flood" rheostat on the pilot's lighting panel. The red lights for the flight instruments, anti-icing air temperature indicators, and the red floodlight for the automatic pilot controller support receive power through a circuit breaker marked "Inst Pilot Copilot" and the instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav." Both circuit breakers are located on the "Lighting Interior" portion of the lower DC power panel.

FLOODLIGHTS. Red and white floodlights for the entire pilot's compartment are controlled by a "Floodlights" switch on the pilot's lighting panel having RED --off--WHITE EMERGENCY positions. RED position provides red illumination of the entire right side of the pilot's station. The center off position turns off the floodlights. WHITE EMERGENCY position provides white illumination for the right side of the pilot's station and also for the entire instrument panel. This position is used during thunderstorms to minimize blinding effects of lightning flashes. Red and white map lights are installed under the right side of the pilot's light shield and may be used to illuminate the pilot's lap area. These lights are controlled by a BRIGHT--DIM--OFF rheostat on the pilot's map light panel. Color selection is made by a RED--WHITE "Map Lights" switch on the same map light panel. The floodlights and map lights are supplied DC power through a circuit breaker marked "Flood Compass & Map" on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHT. An adjustable red spotlight is installed and provides a means of supplying intense light on any object desired by the pilot. The switch and rheostat are mounted on the spotlight. Power is supplied to the spotlight through a circuit breaker marked "Spot Inst Pilot Copilot Nav" on the "Lighting Interior" portion of the lower DC power panel.

STANDBY COMPASS LIGHT SWITCH. The light for the standby compass is controlled by a BRIGHT--OFF --DIM "Compass Light" switch on the right side of the pilot's station. The light is supplied DC power through a circuit breaker marked "Flood Compass & Map" on the "Lighting Interior" portion of the lower DC power panel.

### Copilot's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels at copilot's station are controlled by a BRIGHT --DIM--OFF "Panel Lights" rheostat on the copilot's lighting control panel. All panel lights receive power through a circuit breaker marked "Sidewall Panel Nav Copilot" on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red lights mounted on the individual flight instruments on the copilot's instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Lights" rheostat on the copilot's lighting control panel. Red floodlights for the instruments on the copilot's instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Floodlights" rheostat on the copilot's lighting control panel. Instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

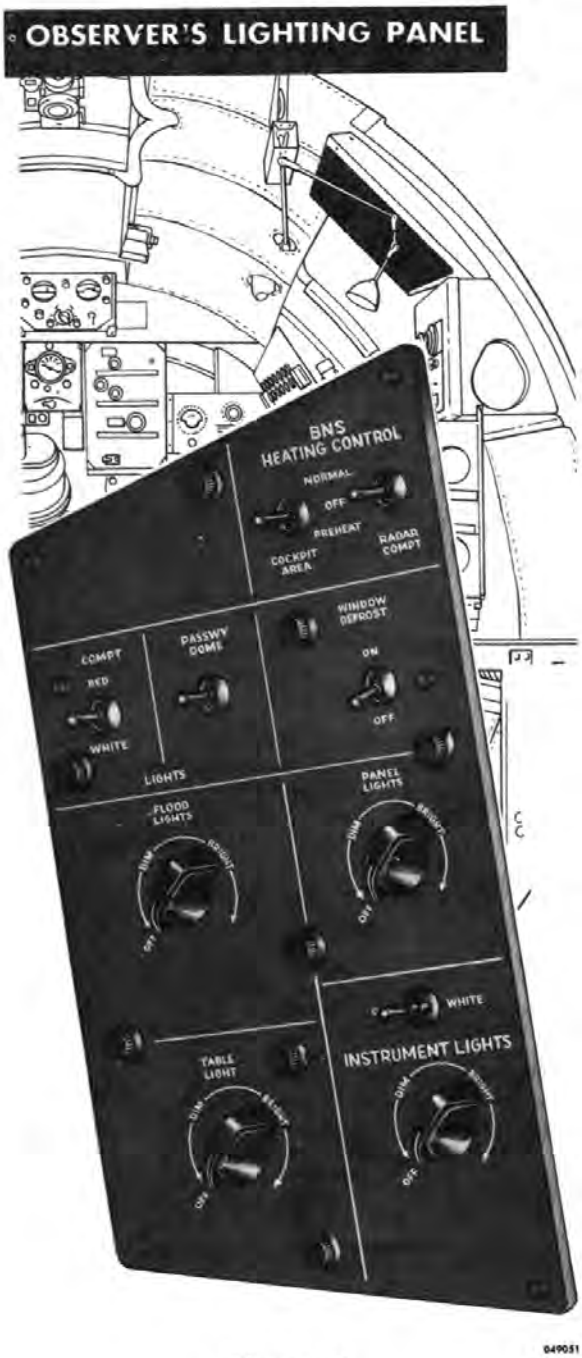



*Figure 4-51.*

FLOODLIGHTS. Red and white floodlights for the right side of the copilot's compartment are controlled by a RED--OFF--WHITE "Floodlights" switch on the copilot's lighting control panel. DC power is supplied to the floodlights through a circuit breaker marked "Flood Compass & Map" located on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHT. An adjustable red spotlight is installed on the canopy beam to the left of the copilot and provides a means of supplying intense light on any object as desired by the copilot. The light switch and rheostat are mounted on the spotlight. DC power is supplied to the spotlight through a circuit breaker marked "Spot Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

### Observer's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels on both control consoles are controlled by a BRIGHT--OFF "Panel Lights" rheostat on the observer's lighting panel. The panel lights receive power through a circuit breaker marked "Sidewall Panel Nav Copilot" located on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red floodlights for the instruments on the observer's instrument panel are controlled by a BRIGHT--OFF "Red Instrument Lights" rheostat on the observer's lighting panel. White lights for the instrument panel are controlled by a BRIGHT--OFF "White Instrument Lights" rheostat. The instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

FLOODLIGHTS. A red floodlight for the radar bombing-navigation system equipment mounted above the lighting panel is controlled by a BRIGHT--OFF "Radar Console" rheostat on the observer's lighting panel. Red and white floodlights to illuminate the entire compartment are controlled by a RED--off--WHITE "Flood" switch on the lighting panel. DC power is supplied to the floodlights through a circuit breaker marked "Flood Compass & Map" located on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHTS AND TABLE LIGHTS. Two red spotlights are installed, one on the forward left side and one on the aft right side. Switches and rheostats are mounted on the spotlights. Two red flexible worktable lights are installed, one below each window, and are controlled by a BRIGHT--OFF "Table Lights" rheostat on the observer's lighting panel. DC power is supplied

especially during icing conditions. The lights are controlled by an ON--OFF switch and a rheostat on the copilot's anti-icing external lights panel (4, figure 1-14). DC power for the wing illumination lights is supplied through a circuit breaker marked "Wing Illum" on the "Lighting Exterior" portion of the lower DC power panel.

## INTERIOR LIGHTING

Interior lighting is provided by red and white lights. Red lights are used at night since the red color does not affect night vision. White lights are used in the daytime during dull light conditions. White lights may also be used during thunderstorms to lessen the blinding effects of lightning flashes. Lights within edge-lighted panels, which are illuminated indirectly from the underside, are red. Instrument lights, spotlights, and work lights are red, while floodlights and compartment lights are either red or white. Lights in the crawlway and flash bomb bay are white. Spare bulbs for all of the lights are located in the spare bulb tray just above and aft of the observer's seat.

### Pilot's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels at the pilot's station are controlled by an ON--OFF "Panel Lights" switch (3, figure 1-6) on the pilot's lighting control panel. Light intensity within the same panels (and oxygen panel floodlights) is controlled by a BRIGHT--DIM "Panel Lights" rheostat. The panel lights receive DC power through a circuit breaker marked "Sidewall Panel Pilot" on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red lights on the individual flight instruments on the pilot's instrument panel, red lights on the anti-icing air temperature indicators, and the red floodlight for the automatic pilot controller support (when extended) are controlled by a BRIGHT--DIM--OFF "Flight Instrument" rheostat on the pilot's lighting control panel. Engine instrument red floodlights are controlled by a BRIGHT--DIM--OFF "Engine Instrument" rheostat on the pilot's lighting panel. Red floodlights for the entire instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Flood" rheostat on the pilot's lighting panel. The red lights for the flight instruments, anti-icing air temperature indicators, and the red floodlight for the automatic pilot controller support receive power through a circuit breaker marked "Inst Pilot Copilot" and the instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav." Both circuit breakers are located on the "Lighting Interior" portion of the lower DC power panel.

FLOODLIGHTS. Red and white floodlights for the entire pilot's compartment are controlled by a "Floodlights" switch on the pilot's lighting panel having RED --off--WHITE EMERGENCY positions. RED position provides red illumination of the entire right side of the pilot's station. The center off position turns off the floodlights. WHITE EMERGENCY position provides white illumination for the right side of the pilot's station and also for the entire instrument panel. This position is used during thunderstorms to minimize blinding effects of lightning flashes. Red and white map lights are installed under the right side of the pilot's light shield and may be used to illuminate the pilot's lap area. These lights are controlled by a BRIGHT--DIM--OFF rheostat on the pilot's map light panel. Color selection is made by a RED--WHITE "Map Lights" switch on the same map light panel. The floodlights and map lights are supplied DC power through a circuit breaker marked "Flood Compass & Map" on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHT. An adjustable red spotlight is installed and provides a means of supplying intense light on any object desired by the pilot. The switch and rheostat are mounted on the spotlight. Power is supplied to the spotlight through a circuit breaker marked "Spot Inst Pilot Copilot Nav" on the "Lighting Interior" portion of the lower DC power panel.

STANDBY COMPASS LIGHT SWITCH. The light for the standby compass is controlled by a BRIGHT--OFF --DIM "Compass Light" switch on the right side of the pilot's station. The light is supplied DC power through a circuit breaker marked "Flood Compass & Map" on the "Lighting Interior" portion of the lower DC power panel.

### Copilot's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels at copilot's station are controlled by a BRIGHT --DIM--OFF "Panel Lights" rheostat on the copilot's lighting control panel. All panel lights receive power through a circuit breaker marked "Sidewall Panel Nav Copilot" on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red lights mounted on the individual flight instruments on the copilot's instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Lights" rheostat on the copilot's lighting control panel. Red floodlights for the instruments on the copilot's instrument panel are controlled by a BRIGHT--DIM--OFF "Instrument Floodlights" rheostat on the copilot's lighting control panel. Instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

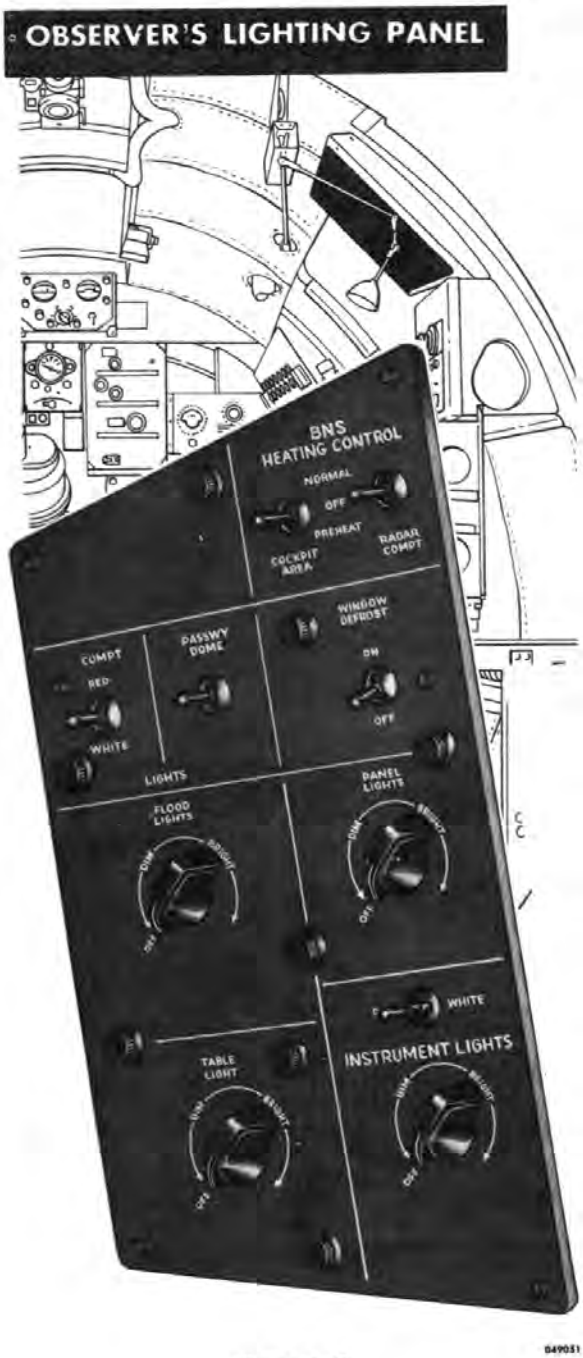



*Figure 4-51.*

FLOODLIGHTS. Red and white floodlights for the right side of the copilot's compartment are controlled by a RED--OFF--WHITE "Floodlights" switch on the copilot's lighting control panel. DC power is supplied to the floodlights through a circuit breaker marked "Flood Compass & Map" located on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHT. An adjustable red spotlight is installed on the canopy beam to the left of the copilot and provides a means of supplying intense light on any object as desired by the copilot. The light switch and rheostat are mounted on the spotlight. DC power is supplied to the spotlight through a circuit breaker marked "Spot Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

**Observer's Station Lighting**

PANEL LIGHTS. Lights within all of the edge-lighted panels on both control consoles are controlled by a BRIGHT--OFF "Panel Lights" rheostat on the observer's lighting panel. The panel lights receive power through a circuit breaker marked "Sidewall Panel Nav Copilot" located on the "Lighting Interior" portion of the lower DC power panel.

INSTRUMENT LIGHTS. Red floodlights for the instruments on the observer's instrument panel are controlled by a BRIGHT--OFF "Red Instrument Lights" rheostat on the observer's lighting panel. White lights for the instrument panel are controlled by a BRIGHT--OFF "White Instrument Lights" rheostat. The instrument panel floodlights receive power through a circuit breaker marked "Red Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel.

FLOODLIGHTS. A red floodlight for the radar bombing-navigation system equipment mounted above the lighting panel is controlled by a BRIGHT--OFF "Radar Console" rheostat on the observer's lighting panel. Red and white floodlights to illuminate the entire compartment are controlled by a RED--off--WHITE "Flood" switch on the lighting panel. DC power is supplied to the floodlights through a circuit breaker marked "Flood Compass & Map" located on the "Lighting Interior" portion of the lower DC power panel.

SPOTLIGHTS AND TABLE LIGHTS. Two red spotlights are installed, one on the forward left side and one on the aft right side. Switches and rheostats are mounted on the spotlights. Two red flexible worktable lights are installed, one below each window, and are controlled by a BRIGHT--OFF "Table Lights" rheostat on the observer's lighting panel. DC power is supplied

to the spotlight through a circuit breaker marked "Spot Inst Pilot Copilot Nav" located on the "Lighting Interior" portion of the lower DC power panel, while power for the table lights is supplied through a circuit breaker marked "Nav Work & Compass & Aft Cockpit Lights" located on the "Lighting Interior" portion of the lower DC power panel.

### Walkway, Entrance, Crawlway, and Bomb Bay Lighting

Red or white domelights for the walkway are controlled by three "Dome Light" switches on the pilot's position light panel, copilot's oxygen and rheostat panel, and observer's lighting panel. Color selection for the lights is provided by a RED--WHITE switch on the pilot's position light panel. A white entrance floodlight is controlled by a switch located near the aft bottom corner of the pressure door on the outside of the pressure skin. White domelights in the crawlway are controlled by a light switch just inside the upper aft corner of the main entrance door. White lights in the bomb bay are controlled by an ON--OFF toggle switch mounted with the forward bomb bay domelight on a bracket located above and inboard within reach from the aft end of the crawlway. DC power is supplied to the entrance and walkway lights through a circuit breaker marked "Entrance & Walkway" located on the lower DC power panel, while power for the crawlway and bomb bay lights is supplied through a circuit breaker marked "Bomb Bay & Tunnel Door" located on the "Lighting Interior" portion of the lower DC power panel.

## OXYGEN SYSTEM

A gaseous oxygen system with an operating pressure of 400 psi is installed in the airplane. For combat safety, each station is supplied from two distribution lines through automatic check valves. Oxygen regulator units 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. Pressure demand type oxygen masks must be used with these regulator units. An electrically operated warning system is incorporated within the oxygen regulator unit to warn the pilot and crew members whenever a crew station system is not functioning properly. However, warning lights for the instructor pilot and instructor observer have been omitted. The warning system is DC operated, power being supplied through a circuit breaker on the upper DC power panel. The oxygen system is supplied from six 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. See figure 1-46 for servicing information. The approximate duration of the system is given in figure 4-52. In addition, two Type MA-1 portable oxygen bottles are installed within the pressurized compartment, one each on the pilot's and copilot's left sidewalls. When the portable bottles are fully charged to 400 psi, they will each supply positive oxygen pressure to the mask as required for altitudes above 35,000 feet according to the setting selected on the pressure control knob of the portable unit regulator.

### REGULATOR DILUTER LEVER

A NORMAL OXYGEN--100% OXYGEN diluter lever (3, figure 4-53) is provided on each regulator unit. When the lever is in NORMAL OXYGEN position, the regulator unit will function to provide automatic mixing of air and oxygen in sea level oxygen concentration at altitudes up to approximately 30,000 feet cabin altitude. Above approximately 30,000 feet cabin altitude, the regulator unit will supply 100% oxygen. When the lever is in 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 4-53) is provided on each regulator unit. In ON position, system oxygen is supplied to the regulator unit. In OFF position, the oxygen supply to the regulator is shut off to prevent any flow of oxygen from that unit when not in use.

### EMERGENCY TOGGLE LEVER

An emergency toggle lever (5, figure 4-53) 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. 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. However, the EMERGENCY position will not necessarily deliver 100% oxygen below approximately 30,000 feet cabin altitude unless the diluter lever is in 100% OXYGEN position. 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.

# OXYGEN DURATION

CREW MEMBER DURATION IN HOURS

GAGE PRESSURE — P.S.I.

| CABIN ALTITUDE FEET | 400 | 350 | 300 | 250 | 200 | 150 | 100 | BELOW 100 |
|---|---|---|---|---|---|---|---|---|
| **THREE CREW MEMBERS** | | | | | | | | |
| 40,000 | 13.7<br>13.7 | 11.8<br>11.8 | 9.8<br>9.8 | 7.8<br>7.8 | 5.9<br>5.9 | 3.9<br>3.9 | 1.9<br>1.9 | EMERGENCY<br>DESCEND TO ALTITUDE NOT REQUIRING OXYGEN |
| 35,000 | 13.7<br>13.7 | 11.8<br>11.8 | 9.8<br>9.8 | 7.8<br>7.8 | 5.9<br>5.9 | 3.9<br>3.9 | 1.9<br>1.9 | |
| 30,000 | 10.2<br>10.2 | 8.7<br>8.7 | 7.3<br>7.3 | 5.9<br>5.9 | 4.3<br>4.3 | 2.9<br>2.9 | 1.4<br>1.4 | |
| 25,000 | 8.1<br>9.7 | 7.0<br>8.3 | 5.9<br>6.9 | 4.6<br>5.5 | 3.5<br>4.2 | 2.4<br>2.8 | 1.1<br>1.4 | |
| 20,000 | 6.6<br>10.9 | 5.6<br>9.4 | 4.8<br>7.8 | 3.8<br>6.1 | 2.8<br>4.6 | 1.8<br>3.1 | 0.9<br>1.5 | |
| 15,000 | 5.2<br>13.2 | 4.5<br>11.3 | 3.6<br>9.4 | 2.9<br>7.6 | 2.2<br>5.6 | 1.5<br>3.8 | 0.7<br>1.8 | |
| 10,000 | 4.5<br>13.2 | 3.8<br>11.3 | 3.2<br>9.4 | 2.5<br>7.6 | 1.9<br>5.6 | 1.3<br>3.8 | 0.7<br>1.8 | |
| **FOUR CREW MEMBERS** | | | | | | | | EMERGENCY<br>DESCEND TO ALTITUDE NOT REQUIRING OXYGEN |
| 40,000 | 10.2<br>10.2 | 8.8<br>8.8 | 7.3<br>7.3 | 5.8<br>5.8 | 4.4<br>4.4 | 2.9<br>2.9 | 1.4<br>1.4 | |
| 35,000 | 10.2<br>10.2 | 8.8<br>8.8 | 7.3<br>7.3 | 5.8<br>5.8 | 4.4<br>4.4 | 2.9<br>2.9 | 1.4<br>1.4 | |
| 30,000 | 7.6<br>7.6 | 6.5<br>6.5 | 5.4<br>5.4 | 4.4<br>4.4 | 3.2<br>3.2 | 2.1<br>2.1 | 1.0<br>1.0 | |
| 25,000 | 6.0<br>7.2 | 5.2<br>6.2 | 4.4<br>5.1 | 3.4<br>4.1 | 2.6<br>3.1 | 1.8<br>1.9 | 0.8<br>1.0 | |
| 20,000 | 4.9<br>8.2 | 4.2<br>7.0 | 3.6<br>5.8 | 2.8<br>4.5 | 2.1<br>3.4 | 1.3<br>2.3 | 0.6<br>1.1 | |
| 15,000 | 3.9<br>9.9 | 3.3<br>8.4 | 2.7<br>7.0 | 2.1<br>5.7 | 1.6<br>4.2 | 1.1<br>2.8 | 0.5<br>1.3 | |
| 10,000 | 3.3<br>9.9 | 2.8<br>8.4 | 2.4<br>7.0 | 1.8<br>5.7 | 1.4<br>4.2 | 0.9<br>2.8 | 0.5<br>1.3 | |

**NOTE**

BLACK FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"

RED FIGURES INDICATE DILUTER LEVER "100% OXYGEN"

CYLINDERS: 6 TYPE G-1, 2 TYPE F-1

# OXYGEN DURATION

FIVE CREW MEMBERS

| CABIN ALTITUDE FEET | CREW MEMBER DURATION IN HOURS — GAGE PRESSURE — P.S.I. 400 | 350 | 300 | 250 | 200 | 150 | 100 | BELOW 100 |
|---|---|---|---|---|---|---|---|---|
| 40,000 | 8.2<br>8.2 | 7.1<br>7.1 | 5.8<br>5.8 | 4.6<br>4.6 | 3.5<br>3.5 | 2.3<br>2.3 | 1.1<br>1.1 | EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN |
| 35,000 | 8.2<br>8.2 | 7.1<br>7.1 | 5.8<br>5.8 | 4.6<br>4.6 | 3.5<br>3.5 | 2.3<br>2.3 | 1.1<br>1.1 | |
| 30,000 | 6.1<br>6.1 | 5.2<br>5.2 | 4.3<br>4.3 | 3.5<br>3.5 | 2.5<br>2.5 | 1.7<br>1.7 | 0.8<br>0.8 | |
| 25,000 | 4.8<br>5.8 | 4.2<br>4.9 | 3.5<br>4.1 | 2.7<br>3.3 | 2.1<br>2.5 | 1.4<br>1.6 | 0.6<br>0.8 | |
| 20,000 | 3.9<br>6.5 | 3.3<br>5.6 | 2.8<br>4.6 | 2.2<br>3.6 | 1.7<br>2.7 | 1.0<br>1.8 | 0.5<br>0.9 | |
| 15,000 | 3.2<br>8.0 | 2.7<br>6.7 | 2.1<br>5.6 | 1.7<br>4.5 | 1.3<br>3.3 | 0.9<br>2.2 | 0.4<br>1.0 | |
| 10,000 | 2.7<br>8.0 | 2.2<br>6.7 | 1.9<br>5.6 | 1.5<br>4.5 | 1.1<br>3.3 | 0.7<br>2.2 | 0.4<br>1.0 | |

**NOTE**

BLACK FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"

RED FIGURES INDICATE DILUTER LEVER "100% OXYGEN"

CYLINDERS: 6 TYPE G-1, 2 TYPE F-1

049684

*Figure 4-52.*

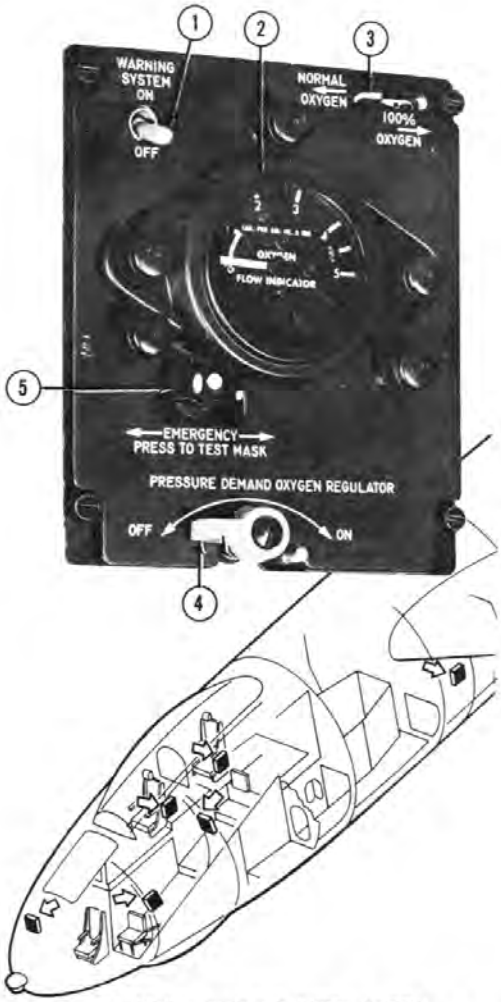
### MASTER OXYGEN WARNING CONTROL SWITCH

An ON--OFF oxygen warning switch (34, figure 1-8) is on the pilot's instrument panel. In ON position, oxygen warning light circuits are completed in each regulator unit. In OFF position, the oxygen warning light circuit is inoperative.

### OXYGEN WARNING SYSTEM SWITCHES

An ON--OFF oxygen warning system switch (1, figure 4-53) is provided on each regulator unit. In ON position, power is supplied to the warning light circuits for that crew station. In OFF position, the warning light circuits for that crew station are deenergized.

# 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

049353

*Figure 4-53.*

## OXYGEN PRESSURE GAGES

An oxygen pressure gage (2, figure 4-53) provided on each regulator unit indicates oxygen system pressure in psi when the oxygen supply shutoff lever is in ON position.

**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.

## OXYGEN FLOW INDICATORS

A blinker-type oxygen flow indicator (2, figure 4-53) 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 (33, figure 1-8) for each crew station is on the pilot's instrument panel and enables the pilot to observe that he and all crew members are using oxygen. An individual oxygen warning light is installed at each crew station to show that crew member that he is using oxygen. A pilot's monitor oxygen warning light (3, figure 1-16) is installed on the left side of the copilot's instrument panel and enables the copilot to observe that the pilot is using oxygen. The lights for any one crew station will illuminate only if the pilot's master oxygen system warning switch and the oxygen warning switch on the applicable crew station regulator are in ON position. The lights will be bright, dim, or blinking bright indicating the condition of operation of oxygen at each crew station (figure 4-54).

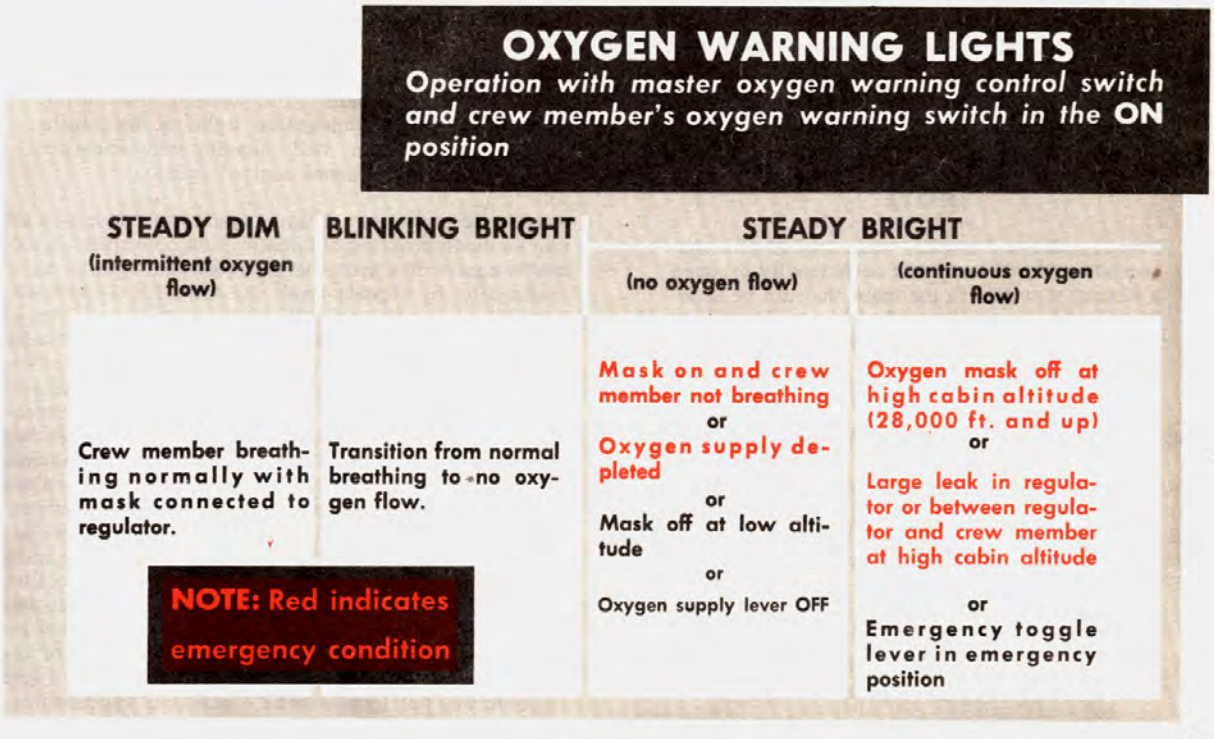



*Figure 4-54.*

DC power is supplied to the oxygen warning lights through a circuit breaker marked "Oxygen System" located on the "Warning" portion of the upper DC power panel.

**NOTE**

At cabin altitudes below 10,000 feet with the oxygen regulator operating and the mask being used, the lights may blink brightly. Since the 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 checks and operation of the oxygen system for the pilot, copilot, and extra crew members are given in section II and for the observer are given in the "Observer's Checklist," section VIII. Ensure that all oxygen regulators not in use are shut off. 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.

**NOTE**

Before any crew member goes off oxygen for a smoke, he should place regulator diluter lever to 100% OXYGEN, oxygen supply lever OFF, and then bleed the system to zero by inhaling prior to removing his mask. This procedure will eliminate the possibility of accelerated combustion when lighting a cigarette and will also prevent forgetting to turn the supply lever back to ON when resuming use of the system, because it is impossible to breathe with the oxygen supply lever OFF and the diluter lever in the 100% OXYGEN position. This is important as it is possible to breathe with the oxygen supply lever OFF and the regulator diluter lever on NORMAL OXYGEN, and the crew member may think he is receiving oxygen and not discover any difficulty until a critical situation is reached. Two crew members, one pilot and one other crew member in the forward compartment, must be on oxygen at all times when above 35,000 feet indicated airplane altitude.

The regulator diluter lever should always be in NORMAL OXYGEN position when regulator is in use except when operating under emergency conditions. The use of 100% oxygen throughout a long mission will so deplete the oxygen supply as to be hazardous to the crew.

**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 100% OXYGEN position and place emergency toggle lever in EMERGENCY position.

**CAUTION**

When the regulator diluter lever is placed in 100% OXYGEN position or the emergency lever placed in 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 OXYGEN and the emergency toggle lever to off position.

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 the 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

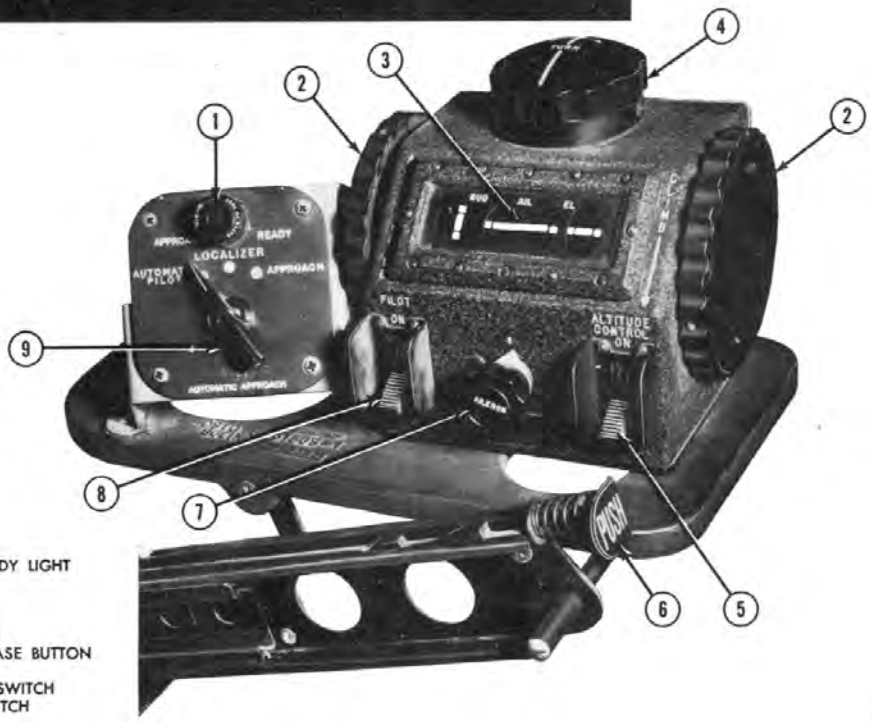
An A-12D automatic pilot is provided for automatic flight control. Heading reference for the automatic pilot is furnished by the N-1 compass system.

**NOTE**

If the N-1 compass fails, as indicated by the N-1 compass inoperative light on the pilot's instrument panel, valid heading reference for automatic directional control is lost.

Automatic pressure altitude control is provided for use as desired during automatic pilot operation. Automatic approach control is provided through the automatic pilot by signals from the AN/ARN-14 and AN/ARN-18 localizer and glide slope receivers. Directional control through the automatic pilot may be temporarily given to the radar bombing-navigation system to fly the airplane automatically to a target. 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 controls the airplane through electrical operation of servo motors which actuate flight control system cables to the rudder, ailerons, elevators, and elevator trim tab. The automatic pilot servo motors are capable of controlling the airplane with surface power control off, if necessary in an emergency (see "Surface Power Control Inoperative," section III). Smooth engagement of the automatic pilot in any normal attitude except a turn is permitted due to automatic continuous synchronization between the automatic pilot signal system and changing airplane attitudes when the master switch is on. Automatic elevator trim is provided to relieve the elevator servo of sustained loads in compensating for cg shifts during automatic pilot operation. The elevator axis may be engaged separately to relieve the pilot of steady control loads imposed in the event manual elevator trim is lost (see "Loss of Manual Elevator Trim," section III). Automatic pilot controls are located on a stowable controller support 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. The automatic pilot receives DC power through circuit breakers marked "Servos," "Auto Approach," "Interlock," "Filaments," and "Ind Lights" on the "Auto Pilot" portion of the lower DC power panel. The automatic pilot uses regulated AC power from the main inverter bus through a circuit breaker marked "Auto Pilot" on the main AC power shield. The automatic pilot electronic units are energized and the gyros are erected at all times when power is available on the AC and DC systems. Failure of AC or DC power to the automatic pilot will cause the system to disengage, turn off, and remain locked off until power is again available. When power is 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 CONTROLLER AND AUTOMATIC APPROACH SWITCH




1. AUTOMATIC APPROACH READY LIGHT
2. PITCH KNOB
3. TRIM INDICATORS
4. TURN KNOB
5. ALTITUDE CONTROL SWITCH
6. CONTROLLER SUPPORT RELEASE BUTTON
7. AILERON TRIM KNOB
8. AUTOMATIC PILOT MASTER SWITCH
9. AUTOMATIC APPROACH SWITCH

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*Figure 4-55.*

## CONTROLLER SUPPORT RELEASE BUTTON

A controller support release button marked "Push" (6, figure 4-55) 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 4-55) 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 4-55) on the front of the controller has ON--OFF positions. ON position 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 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 the front of the controller (5, figure 4-55) has ON--OFF positions. 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. In OFF position, the constant altitude control is made inoperative.

### Pitch Knobs

Two large pitch knobs (2, figure 4-55), located with one on each side of the controller interconnected by a common shaft, are used to vary the pitch attitude of the airplane through elevator servos. Forward rotation of the knobs results in a nose-down attitude; aft rotation in a nose-up attitude. The amount of attitude change is proportional to the amount of knob rotation. The knobs are physically disconnected from pitch control by means of a DC solenoid-actuated clutch during automatic approach or constant pressure altitude flight and when the master switch is in OFF. No detent or reference position of the knobs is provided. The pitch change electrical control is zeroed automatically when the master switch goes to OFF for any reason.

### Turn Knob

A pilot's turn knob (4, figure 4-55) on top of the controller provides coordinated turns for all airspeeds. When the knob is not being used, it should be placed in the detent (center) position of total knob rotation. Turning the knob approximately 140° in either direction gives a maximum bank of approximately 40°.

### Aileron Trim Knob

An aileron trim knob (7, figure 4-55) on the 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.

### AUTOMATIC APPROACH SWITCH

An automatic approach switch (9, figure 4-55) on the pilot's automatic pilot controller support has AUTOMATIC PILOT--LOCALIZER--APPROACH positions. AUTOMATIC PILOT position is used for normal operation of the automatic pilot. Use of the LOCALIZER and APPROACH positions to transfer automatic pilot control to radio navigation equipment (figure 4-15) is described in section IX under "Automatic Approach." In LOCALIZER position, the airplane is controlled laterally with respect to the localizer beam by signals from the AN/ARN-14 localizer and omni-range receiver. In APPROACH position, the altitude control switch is tripped to OFF and the airplane is controlled vertically with respect to the glide slope by signals from the AN/ARN-18 glide slope receiver. The same lateral control introduced by the LOCALIZER position is maintained when the switch is moved to APPROACH.

### AUTOMATIC PILOT ENGAGING SWITCHES

Three switches (36, figure 1-8) on the pilot's instrument panel have ENGAGE--DISENGAGE positions. ENGAGE position 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 disengages the servos from control of surface cables. 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.

**NOTE**

On airplanes (1), the aileron limit switches provide a possibility of a nuisance disengagement of the automatic pilot during BNS automatic operation. Such nuisance disengagement is prevented by manually restraining the aileron control wheel rotation to just short of its 90° position.

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(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

## AUTOMATIC PILOT RELEASE SWITCHES

Release switches are provided on both the pilot's and copilot's wheels (2, figure 4-9). 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.

## TURN CONTROL TRANSFER SWITCH

A turn control transfer switch (38, figure 1-8) 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-navigation system on those airplanes having BNS capabilities. PILOT MANUAL position allows directional control of the airplane from the pilot's controller. Methods of returning control of the automatic pilot from the radar bombing-navigation system to the pilot are as follows:

1. The pilot's turn knob can be manually rotated out of detent; this automatically returns the turn control transfer switch to PILOT MANUAL.
2. The pilot can manually switch the turn control transfer switch to PILOT MANUAL.
3. The pilot or copilot may press the release button (2, figure 4-9) on the control wheel which returns all engaging switches to DISENGAGE, thus requiring the automatic pilot to be reengaged on all axes.
4. On airplanes having BNS capabilities, when the radar bombing-navigation system completes its bomb release cycle, the switch automatically returns to PILOT MANUAL.

**NOTE**

The turn control transfer switch cannot be placed in 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
- Turn knob in detent.

### Trim Indicators

Three trim indicators (3, figure 4-55) 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 4-55) 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 (37, figure 1-8) above the engaging switches will blink whenever the automatic pilot is disengaged on all three axes. The light will go out when the controller support is locked in the stowed position.

## 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 K BOMB AUTOMATIC position to indicate that directional control transfer has been accomplished.

## NORMAL OPERATION OF AUTOMATIC PILOT

Normal operation of the automatic pilot may be accomplished by the following procedure:

1. Press the controller support release button and extend the automatic pilot support and controller within reach.
2. Trim the airplane with the manual trim controls. An airplane that is not trimmed properly will impose an unnecessary load on the automatic pilot and produce undesirable flight characteristics.
3. Check that all servo engaging switches are in DISENGAGE.
4. Check turn control transfer switch in PILOT MANUAL.
5. Check automatic pilot controller for:
   - Turn knob in detent
   - Aileron trim knob centered
   - Automatic pilot master switch OFF.

6. 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.

7. Check that N-1 compass inoperative light is not illuminated.
8. Place automatic pilot master switch ON.
9. 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.

10. 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.

11. The airplane is now under automatic control on all three axes.

**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.

**NOTE**

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.

12. 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.

**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 generally dampens within approximately 2 minutes but, at high speeds, may sometimes be severe enough to cause disengagement of rudder axis. These effects can be minimized and the turn recoveries considerably improved by starting the rollout early and, after the bank angle has been reduced to approximately 5° to 10°, slowly returning the turn knob to detent.

13. During flight, check that trim indicators are in center position. 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. The elevator trim tab servo will automatically trim the alrplane 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 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.

14. When it is desirable to maintain a specific pressure altitude, place the altitude control switch ON. The airplane will fly 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.

15. 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, or by placing the automatic pilot master switch in OFF.

**NOTE**

While the master switch is ON and the 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.

16. Place master switch OFF before stowing controller and controller support.
17. 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

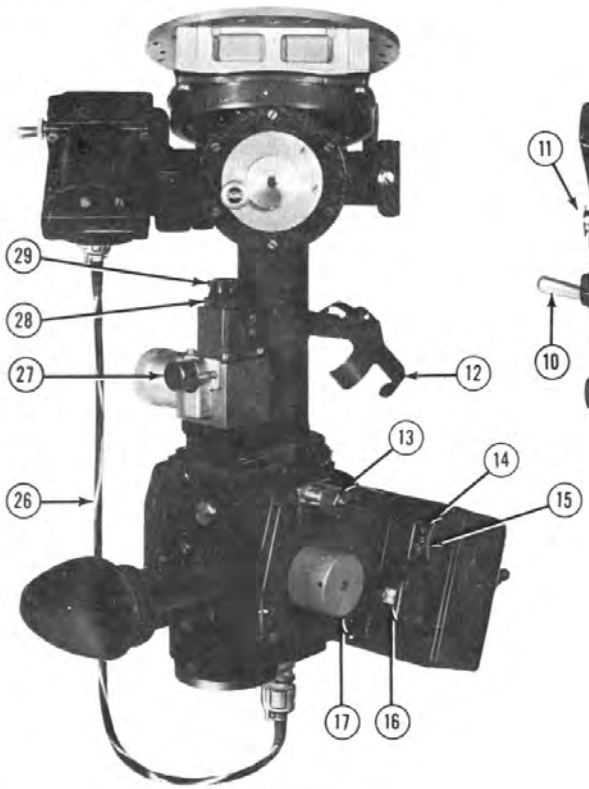
An observer's station is installed in the nose (figures 4-58 and 4-59) and the observer's seat is centrally located and may be swiveled to the left and right to facilitate use of the adjacent equipment. Navigation equipment arranged within reach of the observer when seated includes instrument panel, worktable with pencil box, and periscopic sextant.

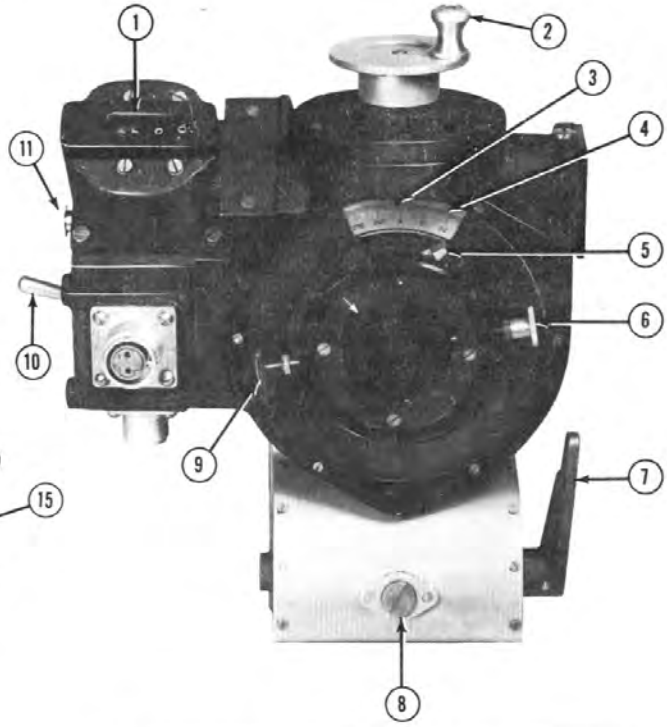
### PERISCOPIC SEXTANT

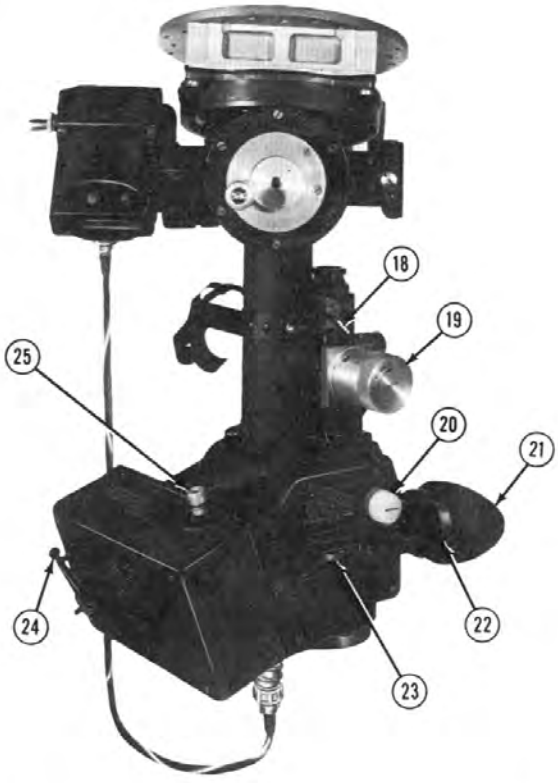
Periscopic sextants with true heading scale mounts (figure 4-56), designed especially for use in high speed pressurized aircraft, are used in this airplane. The sextant optical system is a two-power telescope with a true field of 15° to facilitate location and identification of celestial bodies. An adjustable bubble-type artificial horizon is incorporated. An averaging integrator is provided to effect a continuous moving average altitude angle over any observation period from 30 seconds to 2 minutes. The sextant is filled with dry nitrogen and sealed to prevent internal moisture condensation when the tip of the sextant periscopic tube is extended into cold outside air. Silica gel within the tube, visible through the objective window, provides further protection, and in addition, some later model sextants have a larger desiccator, visible through a window on the left cover of the sextant body. The true heading scale periscopic sextant mounts (10, figure 4-58) are permanently installed in locations permitting observation of celestial bodies when a sextant has been inserted in a mount for use. A rotatable sextant receptacle, swung in gimbals in the mount providing up to 15° compensation for airplane attitude variations, is equipped with stops to support a sextant in a "retracted" position. A shutter is operated to open a port in the airplane skin permitting the sextant to be extended into operating position with the periscopic tube 1 1/2 inches outside the airplane. The periscopic sextant provided for the observer's use will be stowed, when not supported in a mount, and secured in the special stowage box (12, figure 1-7) located on the left sidewall forward of the main entrance door. An additional periscopic sextant is provided and stowed in a special stowage box on the right sidewall aft of the copilot's seat when not supported in the mount located in the canopy at the copilot's station. A cover with a single dzus-type fastener is provided for the copilot's mount when a sextant is not inserted. DC power for lighting the periscopic sextants and mounts is supplied through a circuit breaker marked "Periscopic Sextant" on the copilot's aft DC power panel.

#### Azimuth Knob (Crank)

A knob or crank (2, figure 4-56) located on the aft side of the mount is provided for setting or adjusting any




# PERISCOPIC SEXTANT AND MOUNT

1. AZIMUTH COUNTER
2. AZIMUTH KNOB
3. AZIMUTH INDEX (LUBBER'S LINE)
4. HEADING SCALE
5. LINE OF SIGHT LOCKING LEVER
6. LOCKING KNOB (WHITE)
7. SEXTANT PORT SHUTTER LEVER
8. DRAIN PLUG
9. LOCKING KNOB (BLACK)
10. ILLUMINATION SWITCH
11. AZIMUTH COUNTER LAMP
12. WATCH CLIP
13. DIAL LAMP
14. HALF TIME DIAL
15. AVERAGER INDICES
16. ALTITUDE COUNTER
17. ALTITUDE KNOB
18. HEADING SCALE SHUTTER LEVER
19. BUBBLE ADJUSTMENT KNOB
20. RHEOSTAT KNOB
21. EYEPIECE
22. EYEPIECE FOCUS ADJUSTMENT RING
23. FILTER CONTROL KNOB
24. AVERAGER REWIND LEVER
25. AVERAGER ACTUATING BUTTON (LEVER)
26. ELECTRICAL CABLE
27. BUBBLE LAMP
28. PROJECTION LENS LOCK RING
29. PROJECTION LENS ADJUSTMENT RING

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*Figure 4-56.*

true azimuth in the azimuth counter window. Synchronized with the counter, a true heading scale is rotated to a corresponding indication with respect to an azimuth index (lubber's line) fixed in the aft portion of the mount base next to the rotatable heading scale. As the crank is turned, a slight resistance to rotation can be felt in passing each 10° of setting.

**NOTE**

Rotation of the azimuth crank is limited by interference with a window defrost tube when the top of the sextant periscopic tube is tilted to the forward limit, as for observation during an unusually nose-high airplane attitude.

**Line of Sight Locking Lever**

An unmarked lever (5, figure 4-56) located under the mount on the rotatable sextant receptacle adjacent to the cutout exposing the true heading scale is movable horizontally. Moving the lever clockwise (looking up) applies a brake which locks the rotatable receptacle, preventing rotation of receptacle and sextant until the lever is moved counterclockwise to the unlocked position. In the unlocked position, receptacle and sextant are free to be rotated to any extent desired.

**Locking Knob (Black)**

A black knob (9, figure 4-56) located on one side of the rotatable sextant receptacle opposite a similar white knob is marked "To Insert, Remove - Pull." A sextant is provided with support in the receptacle in a "retracted" position when a spring-loaded locking shaft attached to the black knob is properly seated during the procedure for inserting the sextant in the mount. Pulling the black knob while a sextant is in the retracted position unlocks the sextant from the receptacle for removal from the mount and stowage.

**Sextant Port Shutter Lever**

A lever (7, figure 4-56) on a shaft which extends from the right side of the forward position of the mount actuates a shutter to either open or to seal the sextant port in the airplane skin. Moving the lever in an arc downward and forward from the spring-loaded closed (aft) position snaps the shutter to the spring-loaded open position. Returning the lever to the aft position closes and seals the port against escape of cabin pressure when pressurized during insertion or removal of a sextant from the mount.

**Locking Knob (White)**

A white knob (6, figure 4-56) located above the right side of a mounted sextant on the sextant receptacle opposite a similar black knob is marked "To Retract Sextant - Pull." A spring-loaded locking shaft attached to the white knob seats when a sextant is extended to the operating position to lock the sextant to the rotatable receptacle while in the extended position. When a sextant is locked in the extended position, pulling the white knob releases the sextant for lowering to the retracted position.

**Illumination Switch**

A two-position toggle switch (10, figure 4-56) is located above the electrical receptacle at the left end of the mount to control power to illuminate the azimuth counter on the mount as well as the lamps on the sextant when connected by means of the electrical cable (26, figure 4-56). Points illuminated are the azimuth counter, altitude counter, averager indices, navigator's watch, and the bubble and the true heading scale. Illumination of the bubble and the true heading scale is adjustable by a rheostat.

**Rheostat Knob**

A rheostat knob (20, figure 4-56) is located on the front of some sextant models and on the left side cover on others for adjusting illumination intensity on the bubble and true heading scale.

**Altitude Knob**

A knob (17, figure 4-56) located on the right side cover of the sextant at an approximate level with the eyepiece is provided for setting or adjusting the altitude angle of a celestial body as indicated in the altitude counter window. Altitude angles ranging from -10° to +92°, as measured vertically from a bubble-type artificial horizon reference in the sextant, may be set into the altitude counter at the rate of 5° per revolution of the altitude knob. Counterclockwise rotation of the knob increases the indicated angle. The mean altitude angle at the end of an observation is obtained by aligning the small blocks marked on each of the two averager index drums through use of the altitude knob to rotate the left drum in the direction indicated by the arrows on the right drum.

**Eyepiece Focus Adjustment Ring**

A milled ring (22, figure 4-56) is provided for turning the eyepiece to focus on the reticle image in the sextant. Adjustment from -2 to +2 diopters is provided for focusing.

**Bubble Adjustment Knob**

A knob (19, figure 4-56) on the left side of a bubble cell located just in front of the periscopic tube above the eyepiece is provided to increase or decrease the size of the artificial horizon bubble. The knob is marked with the words "Increase Bubble" followed by

a clockwise pointing arrow. The knob encloses a compensation system which compensates for variations in temperature and pressure and which has its full operating range when the knob is set to the maximum clockwise position. Except when adjusting the bubble, the knob is kept at the full increase (clockwise) position. Formation or adjustment of a bubble requires that the sextant top be tilted toward 10 o'clock to place the bubble in a shallow notch, visible at 3 o'clock in the field of view, while the knob is rotated in the direction to obtain the desired bubble size. In case full travel of the knob in one direction is reached without obtaining the desired bubble size, the sextant may be returned to the vertical position and the knob reversed without affecting bubble size so the cycle may be repeated. Suggested bubble size is approximated half again to twice the apparent diameter of the image of the sun. Size of bubble or its location is unimportant while a sextant is not in use.

**Heading Scale Shutter Lever (Diffuser Lever)**

A lever (18, figure 4-56) located above the bubble adjustment knob actuates a shutter to remove the heading scale from the field of view when the lever is in the upper detent. With the lever in the lower detent, the relevant position of the heading scale is shown magnified in the lower part of the field of view through the projection lens optical system on the same plane with the artificial horizon bubble.

**Projection Lens Lock Ring**

The lower of the two milled rings (28, figure 4-56) on the projection lens assembly, supported on the bubble cell above the sextant eyepiece, serves as a "jamnut" when tightened clockwise, preventing rotation of the projection lens. The lock ring is loosened by moving counterclockwise.

**Projection Lens Adjustment Ring**

The upper and smaller of the two milled rings (29, figure 4-56) on the projection lens assembly above the eyepiece forms part of a threaded sleeve containing the projection lens. Rotating the adjustment ring counterclockwise moves the projection lens upward, while clockwise rotation moves the lens downward.

**CAUTION**

Do not screw projection lens into housing far enough to interfere with the heading scale shutter (diffuser) or damage may result. Approximately 1/16-inch minimum clearance between adjustment ring and lock ring, when locked, should be maintained.

As the lens moves up or down for adjustment of image sharpness, the image will appear to move in an elliptical path during each revolution of the lens. The elliptical movement provides a range of approximately 3° to 4° of lateral adjustment of a given heading scale reading with reference to the vertical reticle during alignment of sextant and mount.

**Averager Rewind Lever**

A lever (24, figure 4-56) is provided on the back of the sextant body toward the right end. When depressed and released, the lever winds the averager, zeroes the half time dial, aligns the averager indices, and removes a shutter from the field of view. When wound, the averager operates approximately 3 seconds before stopping at zero.

**Averager Actuating Button (Lever)**

A button or lever (25, figure 4-56) on the body of the sextant behind and to the left of the periscopic tube is depressed and released to start the averager mechanism after it has been wound and set by use of the averager rewind lever. When started, the averager will run exactly 2 minutes unless stopped by again depressing and releasing the actuating button.

**Filter Control Knob**

A knob (23, figure 4-56) on the left side of the sextant body is numbered on the side of the rim in steps from 0 through 8. The knob may be rotated to a step between 1 and 8 to provide the desired filter combination when sighting on the sun. Step 0 leaves a clear unfiltered field of view.

**Drain Plug**

A threaded plug (8, figure 4-56) is provided at the low point of the well containing the periscopic port shutter. On some mounts the plug is secured so it cannot fall free and become lost when unscrewed for draining moisture accumulated in the mount. Other mounts have a slotted screw that can be completely removed.

**Azimuth Index (Lubber's Line)**

The azimuth index (3, figure 4-56) is a reference mark in a ring concentric with and outside of the heading scale, positioned and fixed at the aft end of the mount in back of the azimuth crank, to provide a "line" through the mount parallel to the longitudinal axis of the airplane. The azimuth index is visible in the cutout exposing the heading scale only when the sextant receptacle is rotated so that the cutout is positioned aft relative to the airplane.

### Azimuth Counter

A counter (1, figure 4-56) in a window on the left side of the mount indicates the true azimuth of a body to a tenth of a degree as set by rotation of the azimuth knob or crank. The counter is synchronized to simultaneously indicate the setting of the true heading scale with reference to the azimuth index (lubber's line).

### Heading Scale

The true heading scale (4, figure 4-56) is an independently rotatable compass rose, engraved in 1/2° increments, located on the fixed portion of the mount between the mount base and the rotatable sextant receptacle. A flange on the receptacle covers the scale except for a cutout in the flange occurring directly above the projection lens of a sextant in operating position. With the heading scale shutter lever in the lower detent and the necessary illumination available, an image of the portion of the heading scale exposed by the cutout will be visible in the sextant field of view superimposed on an image of the artificial horizon bubble and the reticle lines. The vertical reticle line then serves as the true heading index relative to the heading scale.

### Altitude Counter

A counter (16, figure 4-56) extends from the right side of the sextant body behind the altitude knob. The counter window displays the degrees and minutes of altitude of a body, as set in by rotation of the altitude knob.

### Averager Indices

Two indicator drums (15, figure 4-56) are provided in the right side of the same window displaying a half time dial, all under a common index line, located on the right side of the sextant body above the altitude counter. The right drum indicates (by means of arrows) the direction to rotate the left drum by using the altitude knob. Rotation of the altitude knob until small reference blocks on both drums are aligned under the common index line mechanically provides the average altitude angle in the altitude counter window at the end of an observation. The indices are aligned before operation of the averager by actuating the averager rewind lever.

### Half Time Dial

A time dial (14, figure 4-56) graduated in seconds is provided in the left side of the same window displaying the averager indices above the altitude counter. The dial indicates the half time of an observation lasting up to 2 minutes, at which time the averager is automatically stopped and a shutter cuts off the field of view to signal the end of the observation. An observation can be terminated at any time between 30 seconds and 2 minutes by depressing and releasing the averager actuating button. The indication on the half time dial at the end of an observation may be added to the GMT (Greenwich Mean Time) of the start, or subtracted from the GMT of the finish of the observation, to establish the mean time of the observation.

### Normal Operation of Periscopic Sextant

**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.

In airplanes provided with a sextant mount at the copilot's station, the copilot will make all celestial observations, while the observer will do all the computing and plotting. In airplanes with provisions for mounting a sextant at the observer's station only, it is recommended that the observer make all observations and accomplish all plotting, while the copilot makes all in-flight computations. The following procedures are given for operating the periscopic sextant with true heading scale mount:

INSERTING THE SEXTANT IN THE MOUNT

1. With the sextant port shutter closed, line of sight locking lever unlocked, and the arrows on sextant tube and mount aligned, insert the sextant as far as possible.
2. While holding the sextant firmly to prevent dropping, rotate the receptacle counterclockwise to a stop.
3. Pull out black locking knob marked "To Insert, Remove - Pull."
4. Rotate the receptacle further counterclockwise until the black locking knob seats. Check that sextant cannot be rotated in either direction with the line of sight locking lever locked.

**NOTE**

The sextant is now supported in the retracted position, which provides a pressurization seal permitting the opening of the sextant port shutter for extension of the periscopic tube to operating position during pressurized operation of the airplane.

**CAUTION**

Remove the sextant from the mount in the canopy before rotating the copilot's seat to prevent damage to sextant and canopy which would be caused by the top of the seat striking the mounted sextant.

**WARNING**

Remove the sextant from the mount in the canopy before opening the canopy to prevent serious injury to the occupant of the copilot's seat and/or damage to sextant and canopy which would be caused by the sextant striking the top of the seat.

5. Move the sextant port shutter lever to the forward (open) position.
6. Insert sextant further until the white locking knob marked "To Retract Sextant - Pull" snaps into place, locking the sextant in the extended position.

**NOTE**

- The sextant should be extended to the operating position prior to operation of the airplane at a freezing level. Otherwise, the sextant port shutter may be frozen in the closed position, preventing use of the sextant.

- If it is undesirable for any reason to have a sextant inserted in a mount, the sextant port shutter should be opened and closed several times while passing through a freezing level to insure proper operation. Loss of cabin pressure during the momentary shutter openings will be too slight to be critical.

**CAUTION**

Damage to sextant and mount may result from inserting the sextant into a mount with the sextant port shutter open while the cabin is pressurized; the higher the pressure differential, the greater the possible damage.

7. Connect electrical cable to mount and sextant.

FOCUSING SEXTANT
1. Turn on sextant and mount lighting by use of illumination switch.
2. Adjust intensity of illumination by turning rheostat knob while looking through the eyepiece at the reticle image.
3. Focus on the reticle image by turning the eyepiece focus adjustment ring.

USING THE SEXTANT AND MOUNT TO OBTAIN DATA
1. Set precomputed azimuth of a body in the azimuth counter of the mount.
2. Set precomputed altitude of the body in the altitude counter of the sextant.
3. Depress heading scale shutter lever to obtain view of heading scale.
4. Looking through the sextant eyepiece, rotate sextant until approximate true heading appears on the heading scale under the vertical reticle line.
5. Depress averager rewind lever to remove shutter from field of view. The desired body should then be visible within the 15° field of view of the sextant. The sextant can be rocked in the mount, if necessary, to find other stars in the same constellation for orientation.
6. Adjust filters for suitable combination.
7. Adjust bubble illumination as necessary.
8. Collimate identified body-coincident with bubble as near intersection of reticle lines as possible.
9. At precomputed time (ordinarily at midtime of an observation), read true heading under the vertical reticle line with body collimated.
10. To begin a 2-minute observation of altitude, depress and release averager actuating button (or lever).
11. At the end of 2 minutes or if the averager actuating button (or lever) is again actuated between 30 seconds and 2 minutes, the field of view is blacked out by a shutter, tripped by the averager timing mechanism, and the half time dial indicates the number of seconds of half the duration of the observation. The mean time of observation is then established by adding the half time dial reading to the time of start, or by subtracting from time of finish, of the observation.
12. The mean altitude of the observation is obtained from the altitude counter after rotating the altitude knob to move the right averager index drum in the arrow-indicated direction until the reference blocks of both averager index drums align under the reference line.

REMOVING SEXTANT FROM MOUNT
1. Turn off illumination switch and disconnect and stow electrical cable.
2. While supporting sextant with one hand, pull white locking knob and lower sextant to stops in the "retracted" position.
3. Actuate sextant port shutter lever aft to closed position.

**WARNING**

If sextant port shutter will not close due to freezing or other cause, do not remove sextant while cabin is pressurized.

4. While holding sextant firmly with one hand to prevent dropping, pull the black locking knob and rotate the receptacle clockwise to align arrows on tube and mount.
5. Lower sextant free from mount.
6. Press averager actuating button (or lever) to allow averager to run down.
7. Rotate bubble adjustment knob to maximum increase position.

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 and copilot's instrument panels. 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. The equipment is protected by circuit breakers marked "N-1 Compass" and "C-1 Amplifr" located on the main AC power shield and a circuit breaker marked "N-1 Compass" located on the lower DC power panel. Additional protection is provided by fuses in the main AC power shield.

**Latitude Correction Knob**

A latitude correction knob (4, figure 4-57) 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 (5, figure 4-57) 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 through 360° without changing the indication of the pointer.

**Directional Indicator (N-1 Master)**

A master indicator (3, figure 4-57) 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.

**Directional Indicator (N-1 Repeater)**

A repeater indicator (20, figure 1-8 and 9, figure 1-16) is installed on the pilot's and copilot's instrument panels and contains a scale and heading pointer which give the same reading as given by the master indicator.

**N-1 Compass Inoperative Light**

An amber N-1 compass inoperative light (7, figure 1-8) is located on the pilot's instrument panel. The light will illuminate upon failure of an N-1 compass system power supply (figure 4-16). When illuminated, the light indicates that the entire N-1 compass system is inoperative. Therefore, the master and repeater indicators cannot be relied upon and N-1 compass reference information will no longer be supplied to the ID-250 rotating compass card, the ID-249 heading pointer, or the automatic pilot (figure 4-15). The light receives DC power through a circuit breaker marked "Inst Pilot Copilot" on the "Lighting Interior" portion of the lower DC power panel.

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 and copilot's instrument panels. 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. The equipment is protected by circuit breakers marked "N-1 Compass" and "C-1 Amplifr" located on the main AC power shield and a circuit breaker marked "N-1 Compass" located on the lower DC power panel. Additional protection is provided by fuses in the main AC power shield.

#### Latitude Correction Knob

A latitude correction knob (4, figure 4-57) 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.

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#### Dial Knob

A dial knob on the pilot's repeater indicator provides a means of manually rotating the dial through 360° without changing the indication of the pointer.

#### Directional Indicator (N-1 Master)

A master indicator (3, figure 4-57) 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.

#### Directional Indicator (N-1 Repeater)

A repeater indicator (20, figure 1-8 and 9, figure 1-16) is installed on the pilot's and copilot's instrument panels and contains a scale and heading pointer which give the same reading as given by the master indicator.

#### N-1 Compass Inoperative Light

An amber N-1 compass inoperative light (7, figure 1-8) is located on the pilot's instrument panel. The light will illuminate upon failure of an N-1 compass system power supply (figure 4-16). When illuminated, the light indicates that the entire N-1 compass system is inoperative. Therefore, the master and repeater indicators cannot be relied upon and N-1 compass reference information will no longer be supplied to the ID-250 rotating compass card, the ID-249 heading pointer, or the automatic pilot (figure 4-15). The light receives DC power through a circuit breaker marked "Inst Pilot Copilot" on the "Lighting Interior" portion of the lower DC power panel.

**NOTE**

When the N-1 compass inoperative light is illuminated and AC power is supplied through the "C-1 Amplifier" circuit breaker, an interim transformer-resistor unit is automatically switched on. The unit replaces N-1 heading information with a "zero reference" signal and supplies the necessary synchro voltage for continued operation without directional reference. The ID-250 (RMI) compass card will then rotate to and remain fixed at zero degrees. The No. 1 pointer will indicate relative bearing from the airplane heading to the radio station tuned. The No. 2 pointer will continue to indicate magnetic bearing to the omni-range station tuned, but will not indicate relative bearing from airplane heading to the station. The ID-249 heading pointer no longer relates airplane heading to a selected course as set into the course selector window, but will move with rotation of the course set knob. The position of the pointer will then be the same number of degrees clockwise from the "zero reference" at the top of the instrument as the number set in the course selector window.

### Normal Operation of N-1 Compass System

The N-1 compass system is operating when power is available from the instrument inverter bus, main inverter bus, and the DC system. Operation of the N-1 compass system is controlled by the observer as given by the following procedures:

MAGNETIC SLAVED OPERATION

1. If magnetic slaved operation is desired, rotate the latitude correction knob until the latitude correction pointer reads OFF.

**NOTE**

Before use, the system should be synchronized 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 (1° to 4° per minute) which may consume a large amount of time if far out of synchronization. Manual synchronization eliminates the time required.

2. 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 and clockwise when in the R area of the scale.

3. Check the heading pointer reading with the pilot'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 continuously indicate the magnetic heading of the airplane. 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 the scale indicating 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 in automatic pilot operation, rotation of the synchronizer knob from the synchronized position will cause the airplane to alter course at 1° to 4° per minute and assume the new heading set on the master indicator heading pointer.

DIRECTIONAL GYRO OPERATION

1. 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.

**NOTE**

As the airplane changes latitude in flight, the latitude correction pointer should be reset (at approximately 2° intervals) to the new latitude.

2. 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**

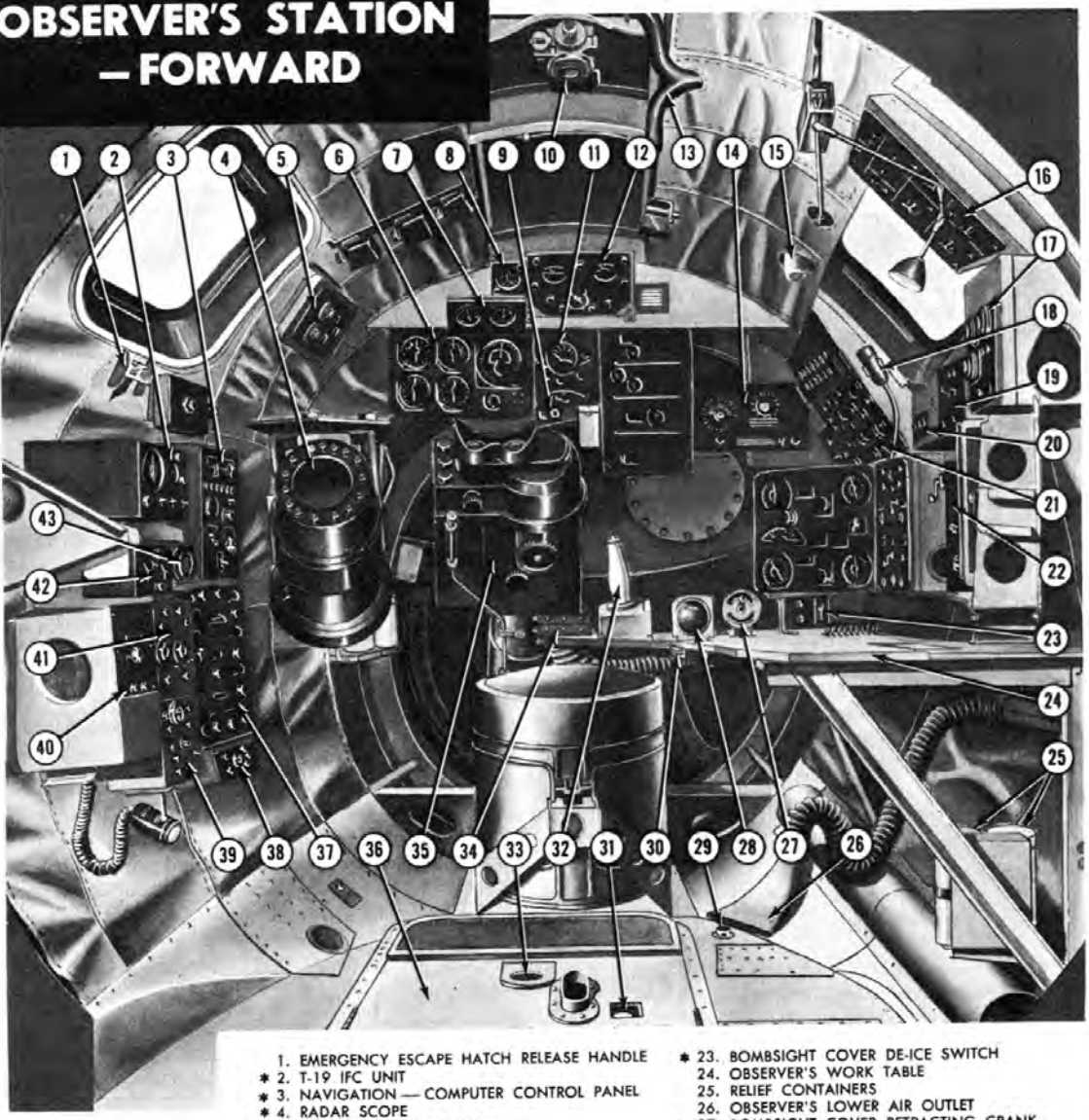
- Repositioning the heading pointer by means of the synchronizer knob will cause only a change in the heading datum and will not cause the airplane to change heading whether on automatic pilot operation or not.

- 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 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.

# OBSERVER'S STATION — FORWARD




1. EMERGENCY ESCAPE HATCH RELEASE HANDLE
* 2. T-19 IFC UNIT
* 3. NAVIGATION — COMPUTER CONTROL PANEL
* 4. RADAR SCOPE
* 5. LINE OF SIGHT CONTROL
6. OBSERVER'S INSTRUMENT PANEL
* 7. AZIMUTH AND SIGHTING ANGLE INDICATORS
8. CLOCK
9. AUTOPILOT READY LIGHT
10. PERISCOPIC SEXTANT MOUNT
11. OXYGEN REGULATOR PANEL
* 12. RADAR POWER MONITORING PANEL
13. WINDOW DEFROST DUCT
* 14. BOMB INTERVALOMETER PANEL
15. OBSERVER'S RIGHT SIDE FLOODLIGHT
16. LIGHTING CONTROL PANEL
* 17. AERIAL CAMERA INTERVALOMETER
* 18. MANUAL BOMB RELEASE SWITCH
* 19. CAMERA CONTROL PANEL
20. INTERPHONE PANEL
* 21. BOMB CONTROL PANEL
* 22. POLAR NAVIGATION CONTROL
* 23. BOMBSIGHT COVER DE-ICE SWITCH
24. OBSERVER'S WORK TABLE
25. RELIEF CONTAINERS
26. OBSERVER'S LOWER AIR OUTLET
* 27. BOMBSIGHT COVER RETRACTING CRANK
28. OBSERVER'S ASH TRAY
29. MICROPHONE FOOT SWITCH
30. OBSERVER'S DATA DRAWER
31. DOWNWARD EJECTION HATCH PRESSURE GAGE
* 32. OBSERVER'S TRACKING CONTROL
33. LOCKPIN INSPECTION WINDOW
34. OBSERVER'S UPPER AIR OUTLET
* 35. BOMBSIGHT
36. DOWNWARD EJECTION HATCH
* 37. RADAR CONTROL PANEL
* 38. RADAR PRESSURIZING CONTROL PANEL
* 39. RADAR TRANSMITTER CONTROL PANEL
* 40. O-23 CAMERA CONTROL PANEL
* 41. O-15 CAMERA CONTROL PANEL
* 42. T-35 IFC UNIT
43. ID-250 RADIO MAGNETIC INDICATOR

* AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

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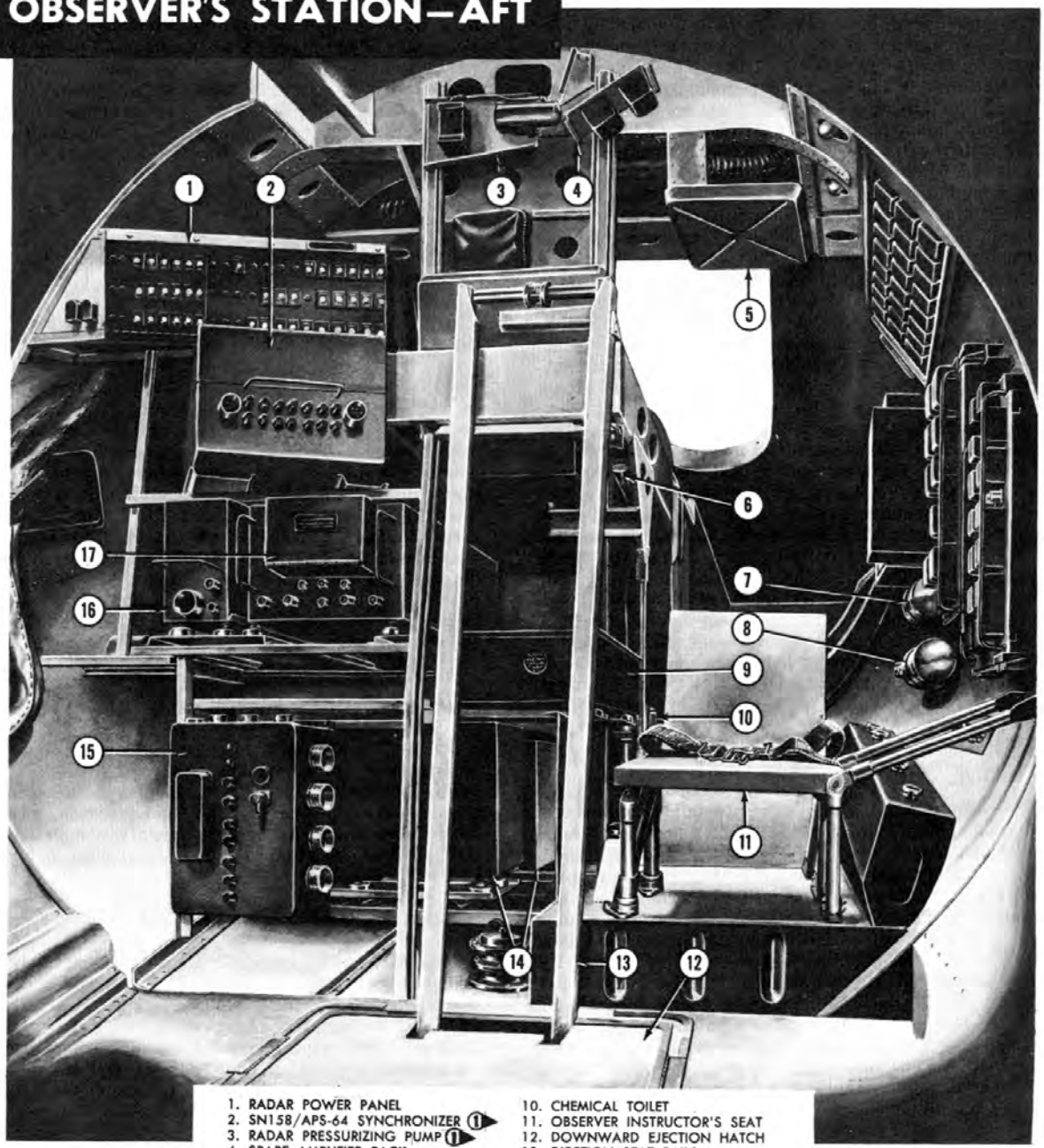
*Figure 4-58.*

# OBSERVER'S STATION—AFT




1. RADAR POWER PANEL
2. SN158/APS-64 SYNCHRONIZER (1)
3. RADAR PRESSURIZING PUMP (1)
4. SPARE AMPLIFIER RACK
5. PILOT'S DATA DRAWER
6. OBSERVER'S RELIEF HORN
7. OBSERVER'S ANTIEXPOSURE SUIT
8. PORTABLE OXYGEN BOTTLE
9. O-217/AWA-2 PULSE GENERATOR (1)
10. CHEMICAL TOILET
11. OBSERVER INSTRUCTOR'S SEAT
12. DOWNWARD EJECTION HATCH
13. EJECTION SEAT RAILS
14. AZIMUTH COMPUTER UNITS (1)
15. J-629/APS-64 JUNCTION BOX (1)
16. PP-1144/APS-23 POWER SUPPLY (1)
17. SN135/APS-23 SYNCHRONIZER (1)

(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

049532

*Figure 4-59.*

## BOMBING SYSTEM (1)

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. Training command airplanes incorporate a short 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. 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 and circuit breakers for the equipment are marked "Normal Bomb," "Bomb Arming," "Bomb Ind Lights," and "Alternate Bomb" on the DC power portion of the radar power panel and "Emerg Pump" on the "Hydraulics" portion of the upper DC power panel. Salvo power is obtained directly from the battery bus and is protected by a circuit breaker marked "Salvo Control Battery Power" on the bomb salvo relay shield.

### SHORT BOMB BAY CONFIGURATION

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. Control power is supplied to the air bottles through the "Normal Bomb" circuit breaker located on the radar power panel. Built-in bomb hoist beams in the bomb bay permit ready attachment of a bomb hoist for bomb loading operations. Equipment necessary for carrying conventional low density general purpose bombs include A-frames, rack adapters, and racks for each of the different weight bomb loadings. Figure 4-60 illustrates typical low density general purpose bomb bay configurations. The bomb rack adapters are supported by A-frames which attach to the bomb door longerons. Each rack adapter provides attachments for the racks required for 1000-, 2000-, and 4000-pound bombs. The adapters can be moved to "A," "B," or "C" position in compliance with the different bomb loading configurations. The electrical connector is plugged into the closest bomb group shield (figure 4-60) on the left side of the airplane.

**NOTE**

The nomenclature U-1 and U-2 are used interchangeably and refer to the U-2 bomb rack.

### INDICATOR LIGHTS SWITCH

An ON--OFF indicator lights switch (8, figure 4-62) on the bomb control panel serves as a master bomb control switch. In ON position, power is supplied to a bomb control power switch through the "Normal Bomb" circuit breaker, a nose fuse arming switch through the "Bomb Arming" circuit breaker, a bomb door and release switch through the "Normal Bomb" circuit breaker, a special arming control heater through the "Alternate Bomb" circuit breaker, and bomb indicator lights through the "Bomb Ind Lights" circuit breaker. These circuit breakers are located on the radar power panel. In OFF position, these circuits are deenergized.

### BOMB CONTROL POWER SWITCH

An ON--OFF bomb control power switch (9, figure 4-62) is on the bomb control panel. In 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. In OFF position, these circuits are deenergized.

### BOMB DOOR AND RELEASE SWITCH

A MANUAL--AUTO switch (3, figure 4-62) on the bomb control panel is used to select either manual or automatic operation of the bombing system. In 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. In AUTO position, the

(1) AF 50-062 thru -076, -078, -079, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2074, -2076, -2077, -2079, -2081 thru -2091

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.

### NORMAL BOMB DOOR SWITCH

An OPEN--OFF--CLOSE switch (2, figure 4-62), spring-loaded to the OFF position, is on the bomb control panel. OPEN position supplies power to a bomb door valve which directs main hydraulic system pressure to open the bomb doors. In CLOSED position, main hydraulic system pressure is similarly employed to close the bomb doors. In OFF position, the bomb door control circuit is deenergized.

### ALTERNATE BOMB DOOR SWITCHES

See "Bomb Door System," this section.

### U-1 ARMING SWITCH

A U-1 arming switch (19, figure 4-62) on the bomb control panel has ARM--off--SAFE positions and is spring-loaded to the off position. In ARM position, power is supplied through the "Bomb Arming" circuit breaker on the radar power panel to arm the special purpose bombs. The U-1 armed indicator light will illuminate when the special purpose bombs are armed. SAFE position deenergizes the arming circuit and U-1 armed indicator light.

### 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.

### NOSE FUSE ARMING SWITCH

A circuit breaker type ARM--SAFE nose fuse arming switch (16, figure 4-62) is on the bomb control panel. In ARM position, power is supplied to arm the nose fuse of the general purpose bombs and illuminate the nose fuse armed indicator light. In 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 4-62) guarded in the NORMAL position is on the bomb control panel. In NORMAL position, the number of bombs to be dropped is determined by the setting on a bomb intervalometer. In 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.

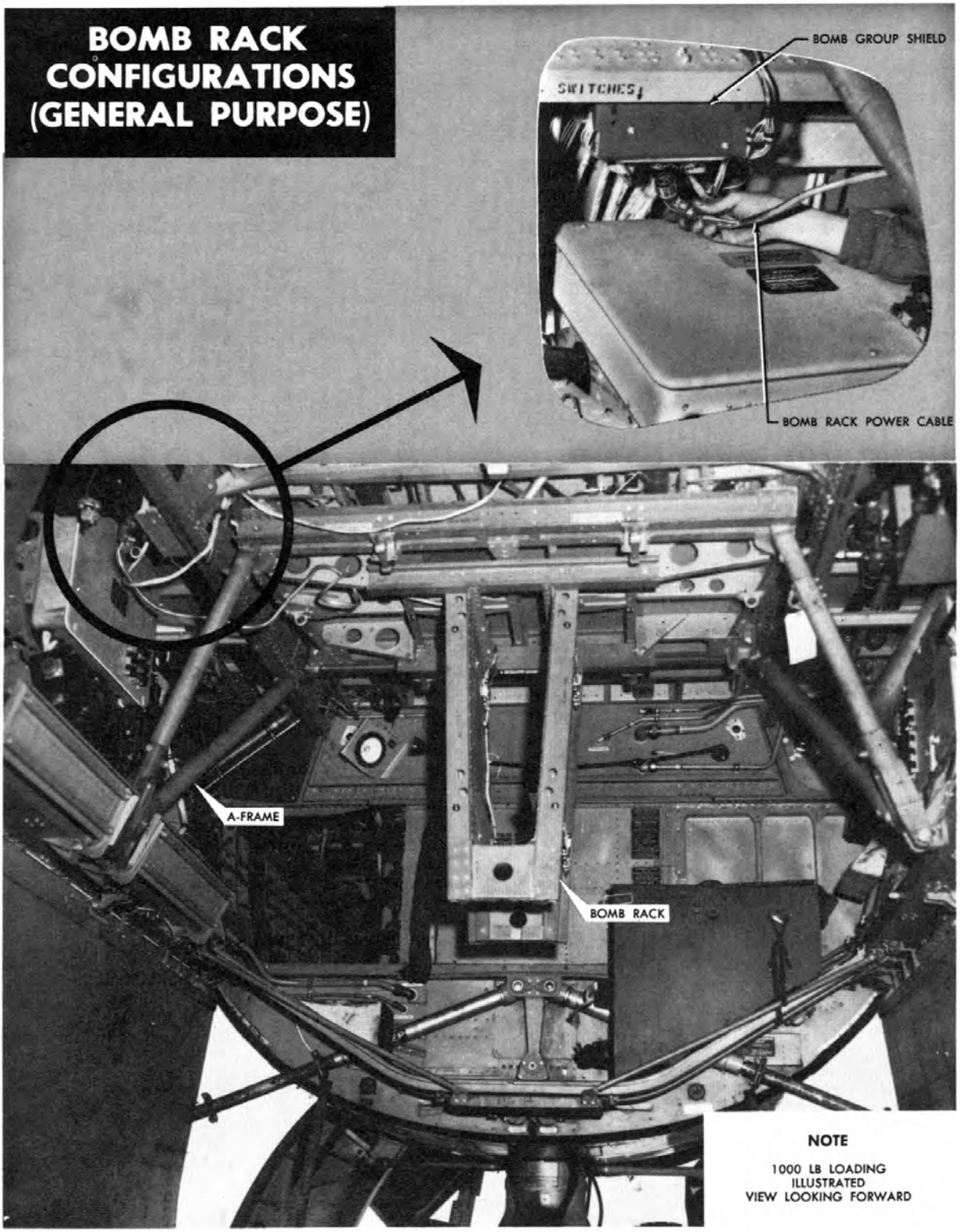
### BOMB RELEASE INTERVAL CONTROL SWITCH

A bomb release control switch on the bomb release interval control (14, figure 4-58) has SEL--TRAIN positions. SEL position allows general purpose bombs to be dropped singly. TRAIN position allows general purpose bombs to be dropped in train. One minute of warmup time should be allowed in TRAIN position before bomb release.

### BOMB RELEASE INTERVAL CONTROL COUNTER

A bomb release control counter on the bomb release interval control (14, figure 4-58) indicates the number of general purpose bombs to be released or not released. The counter is manually set to total bombs to be dropped.

# BOMB RACK CONFIGURATIONS (GENERAL PURPOSE)




**NOTE**

1000 LB LOADING
ILLUSTRATED
VIEW LOOKING FORWARD

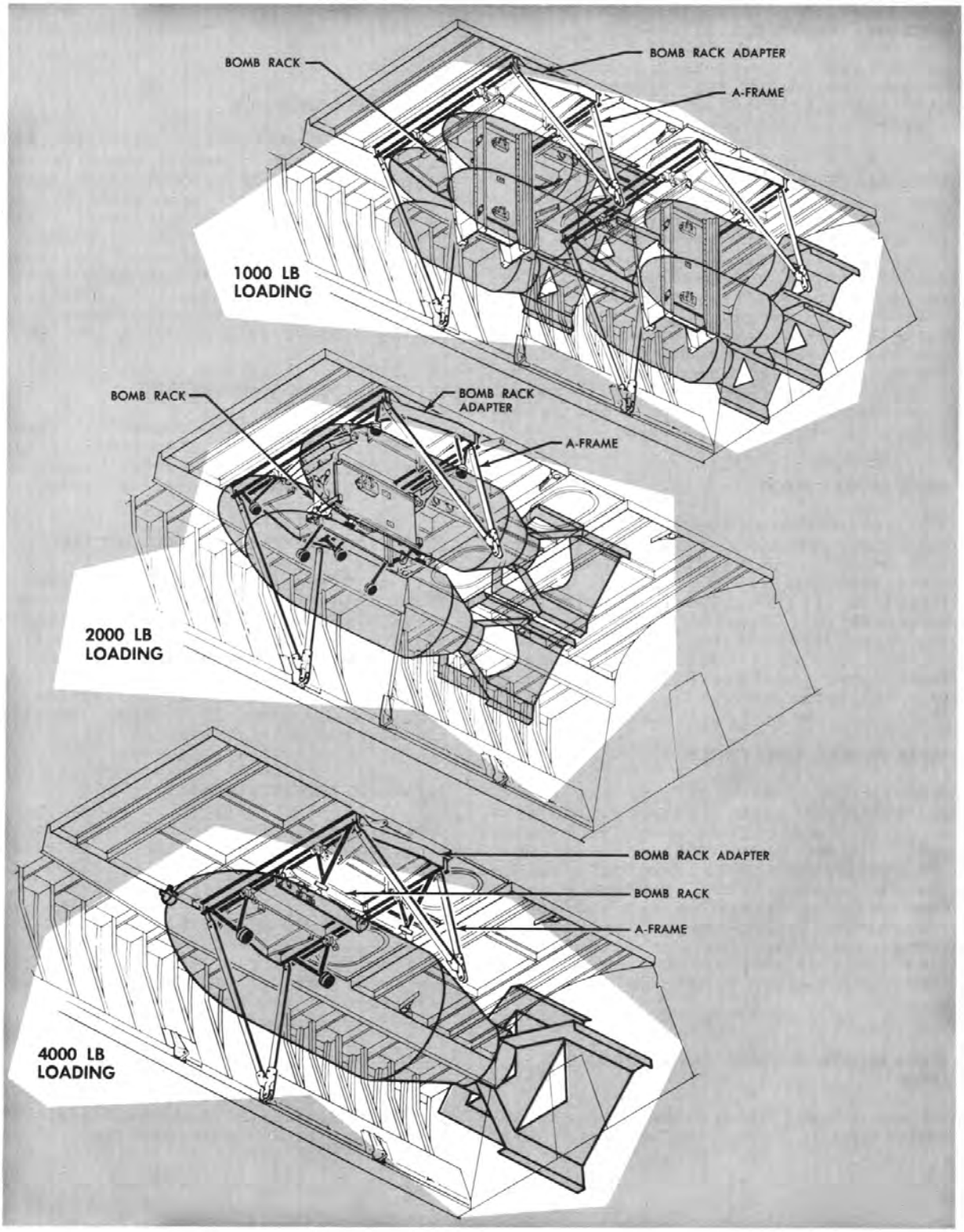

BOMB RACK
BOMB RACK ADAPTER
A-FRAME
1000 LB
LOADING
BOMB RACK
BOMB RACK
ADAPTER
A-FRAME
2000 LB
LOADING
BOMB RACK ADAPTER
BOMB RACK
A-FRAME
4000 LB
LOADING
049128

*Figure 4-60.*

### BOMB RELEASE INTERVAL CONTROL GROUND SPEED AND SPACING DIAL

A ground speed and spacing dial on the bomb release interval control panel (14, figure 4-58) controls bomb interval timing. The dials are calibrated in ground speed mph and interval between bombs in feet.

### BOMB RELEASE SWITCH

A pushbutton-type bomb release switch (4, figure 4-62) 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 4-62) is on the bomb control panel and a similar ON--OFF bomb salvo switch (2, figure 1-11) 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 SCORING TONE SWITCH

A bomb scoring tone switch (14, figure 4-62) 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 4-62) 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.

### BOMB RELEASE INTERVAL CONTROL INDICATOR LIGHT

An amber indicator light on the bomb release interval control panel (14, figure 4-58) 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 4-62) (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 worktable or in observer's data drawer.

### U-1 RACK LOCKED WARNING LIGHT

A red light (13, figure 4-62) 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 LIGHT

A green indicator light (7, figure 4-62) 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. The light will remain illuminated when the main hydraulic system pressure is between 2200 and 3000 psi. Power is supplied the light through the "Bomb Ind Lights" circuit breaker located on the radar power panel.

### U-1 ARMED INDICATOR LIGHT

An amber light (21, figure 4-62) on the bomb control panel, when illuminated, indicates that the bomb is armed.

### NOSE FUSE ARMED INDICATOR LIGHT

An amber light (17, figure 4-62) on the bomb control panel, when illuminated, indicates that the nose fuses of the general purpose bombs are armed.

### U-1 AIR PRESSURE LOW WARNING LIGHT

A red light (18, figure 4-62) 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) 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 DOORS POSITION INDICATORS

See "Bomb Door System," this section.

### NORMAL OPERATION OF BOMB DOORS

See "Bomb Door System," this section.

#### Pilot's Station

See "Bomb Door System," this section.

#### Observer's Station

Normally, ground operation of the bomb doors by members of the flight crew will be accomplished with the alternate bomb door system. During flight, 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.

1. Place the indicator lights and bomb control power switches in ON and check that the bomb control "Power On" indicator lights illuminates.
2. Place the bomb door and release control switch in MANUAL.
3. To open bomb doors, actuate the normal bomb door switch to OPEN. The bomb door position indicator will show an intermediate tab while doors are opening and an OPEN tab when the doors are fully open.
4. To close the bomb doors, actuate the normal bomb door switch to CLOSE. 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**

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.

## BOMB DOOR SYSTEM

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 toolkit.

**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 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.

**NOTE**

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.

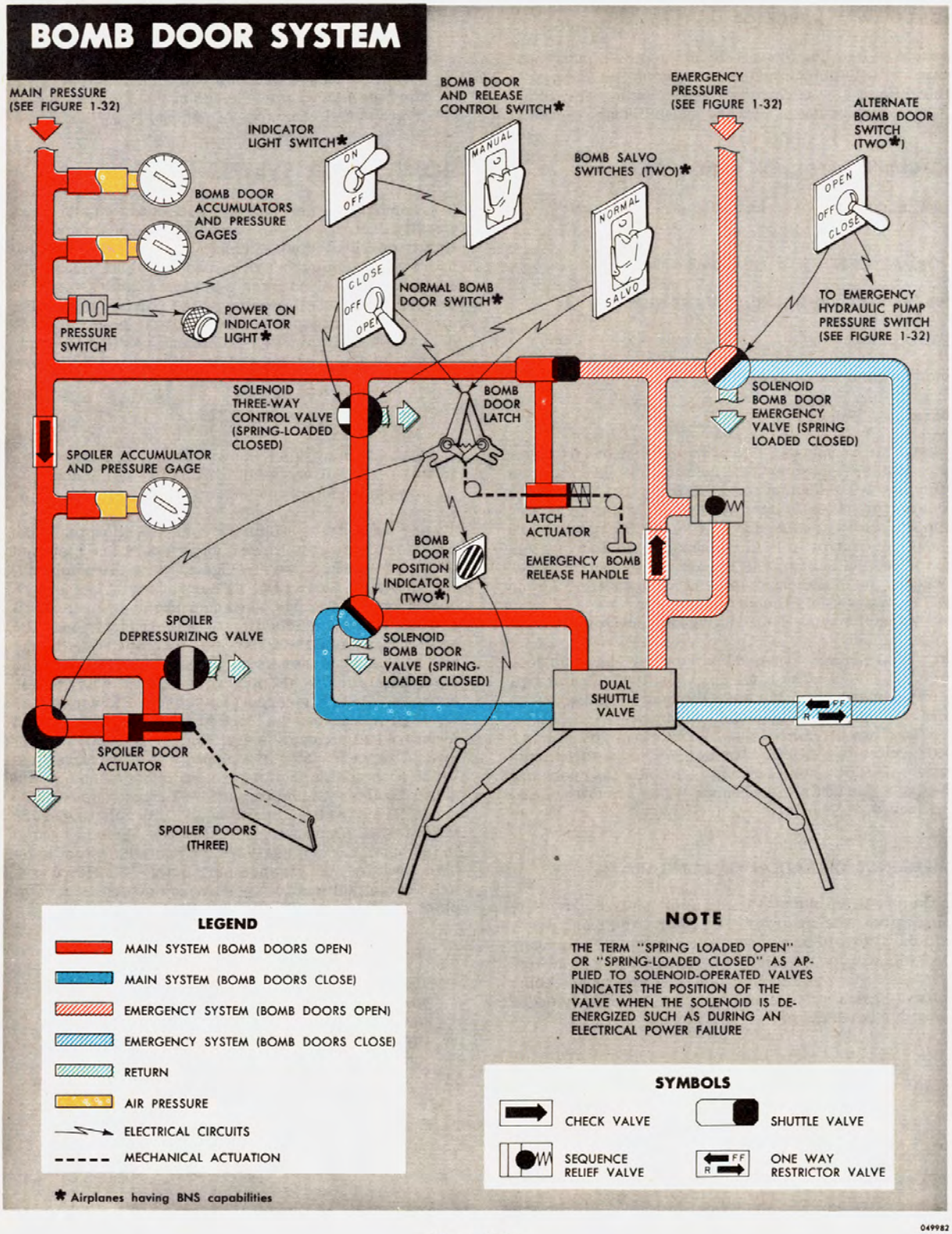
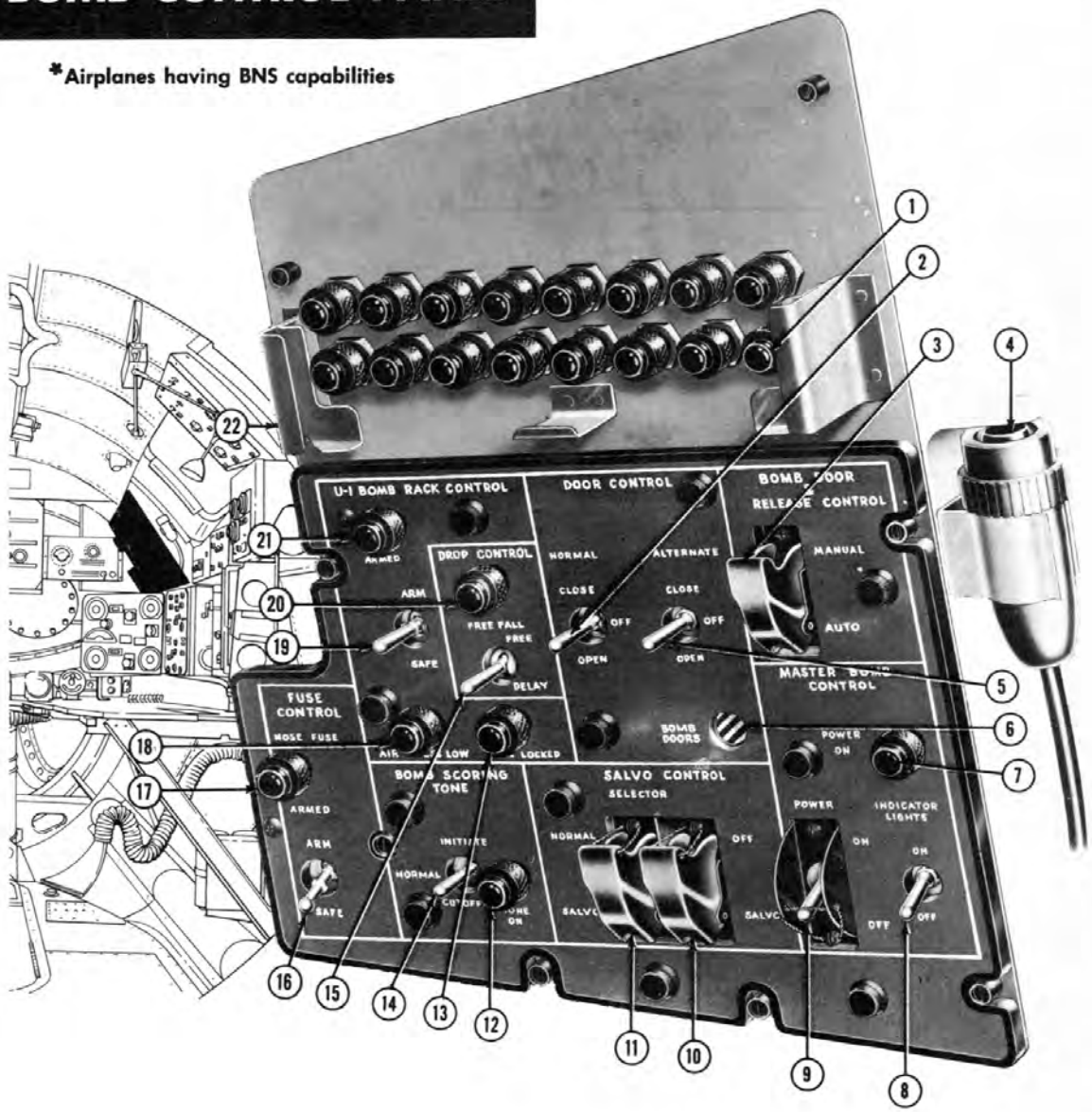

BOMB DOOR SYSTEM
MAIN PRESSURE (SEE FIGURE 1-32)
INDICATOR LIGHT SWITCH*
BOMB DOOR AND RELEASE CONTROL SWITCH*
EMERGENCY PRESSURE (SEE FIGURE 1-32)
ALTERNATE BOMB DOOR SWITCH (TWO*)
BOMB DOOR ACCUMULATORS AND PRESSURE GAGES
BOMB SALVO SWITCHES (TWO)*
PRESSURE SWITCH
POWER ON INDICATOR LIGHT*
NORMAL BOMB DOOR SWITCH*
TO EMERGENCY HYDRAULIC PUMP PRESSURE SWITCH (SEE FIGURE 1-32)
SOLENOID THREE-WAY CONTROL VALVE (SPRING-LOADED CLOSED)
BOMB DOOR LATCH
SOLENOID BOMB DOOR EMERGENCY VALVE (SPRING LOADED CLOSED)
SPOILER ACCUMULATOR AND PRESSURE GAGE
LATCH ACTUATOR
BOMB DOOR POSITION INDICATOR (TWO*)
EMERGENCY BOMB RELEASE HANDLE
SPOILER DEPRESSURIZING VALVE
SOLENOID BOMB DOOR VALVE (SPRING-LOADED CLOSED)
DUAL SHUTTLE VALVE
SPOILER DOOR ACTUATOR
SPOILER DOORS (THREE)
LEGEND
MAIN SYSTEM (BOMB DOORS OPEN)
MAIN SYSTEM (BOMB DOORS CLOSE)
EMERGENCY SYSTEM (BOMB DOORS OPEN)
EMERGENCY SYSTEM (BOMB DOORS CLOSE)
RETURN
AIR PRESSURE
ELECTRICAL CIRCUITS
MECHANICAL ACTUATION
* Airplanes having BNS capabilities
NOTE
THE TERM "SPRING LOADED OPEN" OR "SPRING-LOADED CLOSED" AS APPLIED TO SOLENOID-OPERATED VALVES INDICATES THE POSITION OF THE VALVE WHEN THE SOLENOID IS DE-ENERGIZED SUCH AS DURING AN ELECTRICAL POWER FAILURE
SYMBOLS
CHECK VALVE
SHUTTLE VALVE
SEQUENCE RELIEF VALVE
ONE WAY RESTRICTOR VALVE
049982

*Figure 4-61.*

# BOMB CONTROL PANEL *

*Airplanes having BNS capabilities




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 ON 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 LOCKED WARNING LIGHT
14. BOMB SCORING TONE SWITCH
15. DROP CONTROL SWITCH
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
21. U-1 ARMED INDICATOR LIGHT
22. BOMB INDICATOR CARD HOLDER

049534

*Figure 4-62.*

### ALTERNATE BOMB DOOR SWITCHES

An OPEN--OFF--CLOSE switch (40, figure 1-8) is on the pilot's instrument panel. On airplanes having BNS capabilities, an additional switch is on the bomb control panel (5, figure 4-62). In the CLOSE position, the switches are spring-loaded to OFF. When either switch is in 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 CLOSE position, emergency hydraulic pressure is similarly employed to close the bomb doors. When the switches are in OFF position, the emergency hydraulic pump and bomb door control circuits are deenergized. 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. Fixed OPEN position prevents closing of bomb doors from any other location in the airplane.

### BOMB DOORS POSITION INDICATORS

A Type C-1 bomb door position indicator (41, figure 1-8) is on the pilot's instrument panel. On airplanes having BNS capabilities an additional indicator is on the bomb control panel (6, figure 4-62). These indicators show positions of the bomb doors by means of interchangeable tabs which appear in the indicator window. When the bomb doors are closed and 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

#### Pilot's Station

1. To open the bomb doors, place the pilot's alternate bomb door switch in OPEN. The bomb door position indicators will show an intermediate tab while doors are opening and an OPEN tab when the doors are fully open.
2. To close the bomb doors, hold the pilot's alternate door switch in CLOSE. 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 OFF.

## PHOTOGRAPHIC EQUIPMENT (1)

### 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 non-explosion-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 (20, figure 4-58) 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 by heated air supplied through a ram air duct from the fin leading edge.

#### Camera Master Switch

An ON--OFF master switch is located on the camera control panel. In ON position, power is supplied to energize the camera heating, camera control, camera door control, and the remote initiation circuits. In OFF position, these circuits are deenergized.

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(1) Airplanes having BNS capabilities

### Camera Doors Switch

An OPEN--AUTO--CLOSED switch, spring-loaded to the AUTO position, is located on the camera control panel. In 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. In OPEN position, power is supplied directly to open the camera doors. In CLOSED position, power is supplied directly to close the camera doors.

### Camera Selector Switch

An AUTO--MANUAL switch, spring-loaded to AUTO position, is on the camera control panel. In AUTO position, the camera is controlled through a camera intervalometer. In MANUAL position, power is supplied directly to operate the camera at its runaway cycling rate.

### Camera Intervalometer

A Type B-8 intervalometer (figure 4-64) or a Type B-7 intervalometer (figure 4-63) installed on the right sidewall above the observer's table 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 marked "Camera Control" located on the radar power panel.

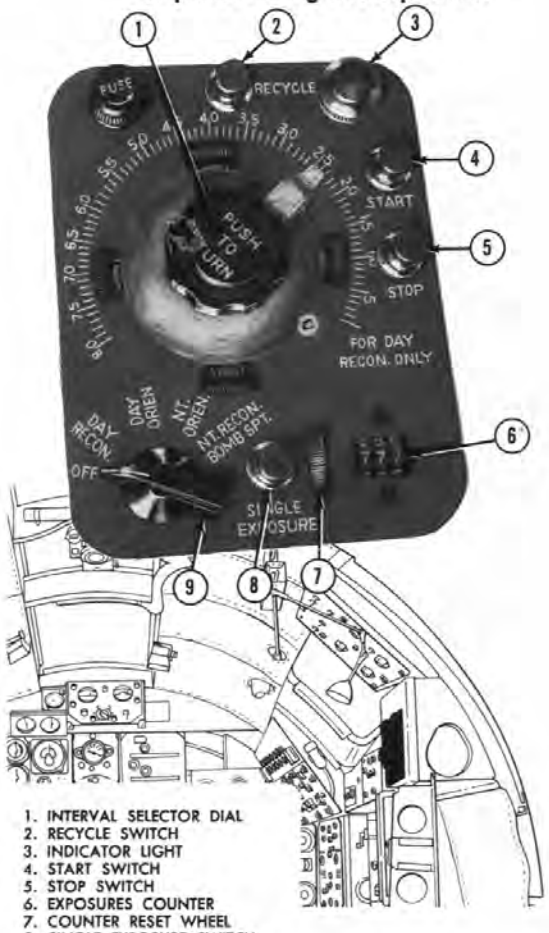
INTERVALOMETER POWER SWITCH. A two-position ON--OFF toggle switch (7, figure 4-64) on the camera intervalometer panel controls power within the intervalometer for automatic operation of the camera. In ON position, the intervalometer is ready for initiation and control of the aerial camera. In OFF position, the intervalometer will automatically reset for automatic sequence cycling.

MANUAL INITIATION SWITCH. A pushbutton-type switch (8, figure 4-64) 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 pushbutton-type switch (6, figure 4-64) located on the intervalometer panel is used to operate the cameras. When the switch is depressed, any automatic preselected interval time is overridden 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.

## B-7 INTERVALOMETER PANEL *

* Optional to B-8 Intervalometer on Airplanes having BNS capabilities




1. INTERVAL SELECTOR DIAL
2. RECYCLE SWITCH
3. INDICATOR LIGHT
4. START SWITCH
5. STOP SWITCH
6. EXPOSURES COUNTER
7. COUNTER RESET WHEEL
8. SINGLE EXPOSURE SWITCH
9. MODE SELECTOR SWITCH

049113

*Figure 4-63.*

DELAY CONTROL. A knob (1, figure 4-64) marked "Delay" located on the intervalometer panel 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

## B-8 INTERVALOMETER PANEL *

*Optional to B-7 Intervalometer on Airplanes having BNS capabilities

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 INITIATOR SWITCH
9. EXPOSURE LIMITER CONTROL KNOB

049114

*Figure 4-64.*

knob has OFF and 1- through 120-second intervals with detents at 1-second intervals. The numbered positions indicate the length of the delay period. In OFF position, camera operation will start immediately when the manual initiation switch is pressed.

INTERVAL CONTROL. A knob (2, figure 4-64) 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 to indicate time intervals. In OFF position, the interval control will not send signals to the camera, thus preventing normal automatic operation.

EXPOSURE LIMITER CONTROL. A knob (9, figure 4-64) 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 to indicate the number of camera exposures that will be taken before camera operation is stopped. 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.

**NOTE**

The exposure limiter is inoperative.

INTERVAL SELECTOR DIAL. This control dial and pointer (1, figure 4-63) 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 4-63) has five positions: OFF--DAY RECON--DAY ORIEN--NT ORIEN --NT RECON BOMB SPT. OFF position deenergizes 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 4-63) provides a means for initiation of intervalometer operation independent of bomb release.

STOP SWITCH. The stop switch (5, figure 4-63) stops camera operation and resets the intervalometer.

SINGLE EXPOSURE SWITCH. This switch (8, figure 4-63) overrides the automatic preselected sequence

set in the intervalometer and allows the camera to operate at runaway speed.

RECYCLE SWITCH. This switch (2, figure 4-63) provides a means of interrupting intervalometer operation during a cycle and starting a new cycle.

### Camera Door Position Lights

An amber door position indicator light on the camera control panel will illuminate when the camera doors are in the full open position.

### B-8 Intervalometer Ready Light

An amber indicator light (4, figure 4-64) on the intervalometer panel will illuminate when the intervalometer power switch is placed in 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 4-63) glows 2 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 4-64) 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.

### B-7 Exposures Counter

An exposures counter (6, figure 4-63) 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 thumbwheel accessible from the front of the panel.

### Normal Operation of Aerial Camera

PHOTO RECONNAISSANCE. For operation independent of the bombing system, proceed as follows:

1. Place the camera master switch on the camera control panel in ON prior to entering area to be photographed in order to allow the camera to be preheated.
2. Place the camera selector switch on the camera control panel in AUTO (this switch will normally be in AUTO).
3. Place the B-8 intervalometer power switch in ON; 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.
4. Hold the camera door switch on the camera control panel in OPEN; the amber door open indicator light on the camera control panel will illuminate when the doors are fully open.
5. 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.
6. 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.
7. To stop camera operation, place the B-8 intervalometer power switch in OFF or press the stop switch on the B-7 intervalometer.
8. Hold the camera door switch in CLOSED.

BOMB SPOTTING. For automatic camera operation through the radar bombing navigational system, proceed as follows:

1. Place the camera master switch on the camera control panel in ON prior to entering target area in order to allow camera to be preheated.
2. Place the camera selector switch on the camera control panel in AUTO (the switch will normally be in AUTO).
3. Place the B-8 intervalometer power switch in ON; 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; the white indicator light will illuminate.
4. 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.
5. 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.
6. To stop camera operation, place the B-8 intervalometer power switch in OFF or press the STOP switch on the B-7 intervalometer.
7. The camera doors must be closed manually upon completion of photography by holding the camera door switch on the camera control panel in CLOSED.

MANUAL OPERATION OF AERIAL CAMERA. Manual operation of the aerial camera can be accomplished by the following procedure:

1. Place the camera master switch on the camera control panel in ON.
2. Place the camera selector switch on the camera control panel in AUTO (this switch will normally be in AUTO).

## O-15 CAMERA CONTROL PANEL*

*** Airplanes having BNS capabilities**

1. CAMERA SELECTOR SWITCH
2. CAMERA POWER SWITCH
3. SECTOR SCAN RHEOSTAT
4. PPI RHEOSTAT

049738

*Figure 4-65.*

3. 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.

### Emergency Operation of Aerial Camera

In event of failure of circuits in the intervalometer, the camera may be operated as follows:

1. Place the camera master switch on the camera control panel in ON.
2. Place the camera selector switch in MANUAL; the camera will operate at its runaway cycling rate.

### 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 marked "Camera O-15 & O-23 AN/AWA -2" on the radar power panel. Control of the system is provided by a remote exposure frequency control panel to the left of the observer.

### Camera Power Switch

An OFF--ON power switch (2, figure 4-65) located on the control panel is used to turn the equipment on or off.

### Camera Selector Switch

A selector switch (1, figure 4-65) 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 4-65) 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 4-66.

### Sector Scan Rheostat

Adjacent to the PPI rheostat, a "Sector Scan" rheostat 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 4-66.

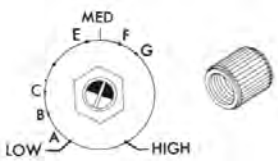
### Normal Operation of Radar Camera

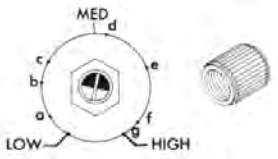
The recording camera is made operative and inoperative by the following procedure:

1. Adjust rheostat (PPI or sector scan) to the correct position as indicated in the chart (figure 4-66) for the type of radar operation.

**NOTE**

- The lettered sector scan and PPI rheostat settings shown in the chart (figure 4-66) are only an approximate setting and not actual decal positions.
- The O-15 will be inoperative in NAV (PPI) if sector amplitude is out of detent.




| PPI OPERATION RHEOSTAT SETTINGS | | | | | SECTOR SCAN OPERATION RHEOSTAT SETTINGS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ANTENNA RPM | TIME OF CYCLE IN SECONDS (RADAR) | SECOND EXPOSURE | RHEOSTAT SETTING | DIAPHRAGM SETTINGS | SCAN CYCLES PER MINUTE | TIME OF CYCLE IN SECONDS (RADAR) | SECOND EXPOSURE | RHEOSTAT SETTING | DIAPHRAGM SETTINGS |
| 4 | 15 | 1.5 | "A" | f4 | 10 | 6.0 | 3.0 | "a" | f4 |
| 7 | 8.6 | 8.6 | "B" | f4 | 12 | 5.0 | 2.5 | "b" | f4 |
| 10 | 6 | 6.0 | "C" | f4 | 15 | 4.0 | 2.0 | "c" | f4 |
| 12 | 5 | 5.0 | "D" | f4 | 20 | 3.0 | 1.5 | "d" | f4 |
| 16 | 3.7 | 3.7 | "E" | f4 | 30 | 2.0 | 1.0 | "e" | f4 |
| 24 | 2.5 | 2.5 | "F" | f4 | 60 | 1.0 | 0.5 | "f" | f4 |
| 28 | 2.1 | 2.1 | "G" | 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.

049525

*Figure 4-66.*

2. Place the power switch in ON.
3. To turn off the equipment, place the power switch in OFF.

### Emergency Operation of Radar Camera

There are no emergency operating procedures for the O-15 radar camera.

## O-23 RADAR RECORDING CAMERA

An O-23 camera system, operating in conjunction with the O-15 camera system, is provided to make photographic record of radar and optical images appearing in the bombsight. The Type C-2 camera and Type C-7 magazine are mounted on the bombsight and are operated by controls on a Type M-1 control panel located on the left side of the observer (41, figure 4-58). The camera utilizes DC power and the power supply circuit is protected by a circuit breaker marked "Camera O -15 & O-23 AN/AWA-2" on the "DC Panel" portion of the radar power panel.

### Camera Power Switch

An OFF--ON switch (2, figure 4-68) located on the Type M-1 control panel controls the DC power used to energize the camera circuits.

### Mode Selector Switch

A rotary selector switch (5, figure 4-68) located on the M-1 control panel has RADAR--RADAR-OPTICAL--OPTICAL positions and provides for a radar, optical, or radar and optical mode of operation of the cameras. In RADAR position, a picture of the radar images is

## RATE OF O-15 FILM CONSUMPTION

**FOR O-15 CAMERA WITH 100′ ROLLS (1600 EXPOSURES AVAILABLE)**

| SELECTOR SWITCH SETTING | EXPOSURES /HR | FEET/HR | DURATION OF 100′ |
|---|---|---|---|
| One every scan | 1440 | 90 | 1:07 |
| One every other scan | 720 | 45 | 2:13 |
| One every four scans | 360 | 22.5 | 4:26 |
| One every twelve scans | 120 | 7.5 | 13:20 |

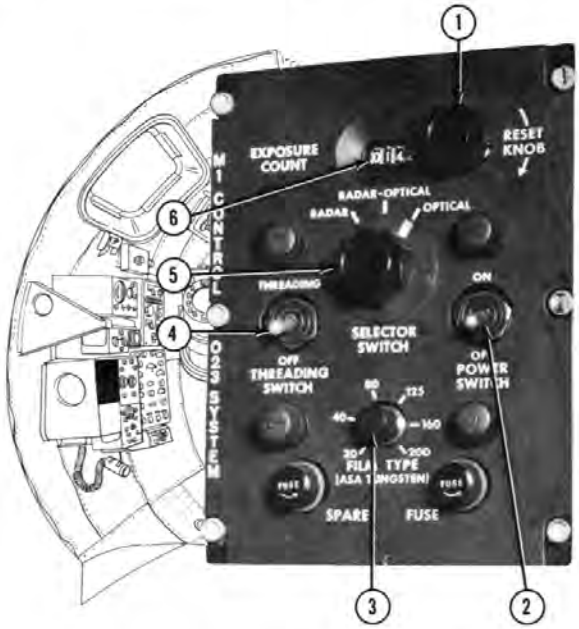
NOTE

Most airborne radar antennas rotate at approximately 24 rpm. On sector scan the rate of consumption will be 2½ times as great as with the antenna rotating through 360 degrees.

049108

*Figure 4-67.*

## O-23 CAMERA CONTROL PANEL




1. EXPOSURE COUNTER RESET KNOB
2. CAMERA POWER SWITCH
3. FILM TYPE SELECTOR SWITCH
4. THREADING SWITCH
5. MODE SELECTOR SWITCH
6. EXPOSURES COUNTER

049109

*Figure 4-68.*

taken during every fourth scan of the antenna. Exposure time of the O-23 camera is controlled by the Type P-8 or LD-6 camera control unit. In OPTICAL position, a picture of the images appearing in the periscope is taken approximately every 5 seconds. In RADAR-OPTICAL position, a picture of the radar images is taken during every fourth scan of the antenna followed by a picture of the periscope images.

### Reset Knob

This control (1, figure 4-68) located adjacent to the exposures counter on the M-1 control panel resets the counter when rotated clockwise.

### Threading Switch

A film threading switch (4, figure 4-68) located on the M-1 control panel has THREADING--OFF positions and provides for windup of unused film on a takeup spool within the camera.

### Film Type Selector

A rotary switch (3, figure 4-68) located on the M-1 control panel has 20--40--80--125--160--200 positions which permit the selection of the proper amount of illumination in the camera data recording chamber for the type of film used.

### Exposures Counter

A resettable exposure counter (6, figure 4-68) located on the M-1 control panel provides remote indication of the number of exposures made by the camera.

### Normal Operation of O-23 Radar Camera

The recording camera is made operative and inoperative by the following procedures:

1. Select the camera mode of operation by placing the selector switch in either RADAR, RADAR-OPTICAL, or OPTICAL.
2. Place the power switch in ON.
3. To stop operation of the camera equipment, place the power switch in OFF.

**Emergency Operation of O-23 Radar Camera**

There is no emergency operating procedure for the O-23 radar camera.

## 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 semiautomatic 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 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 flow from the single point fuel intake to the various tanks. The ground refueling control panel contains a main power switch, primary and secondary valve switches, test switches for the float switches, fuel quantity gages and indicators, and circuit breakers for the panel internal circuits. When in use, the ground refueling control panel 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.

## OBSERVER'S EJECTION SEAT

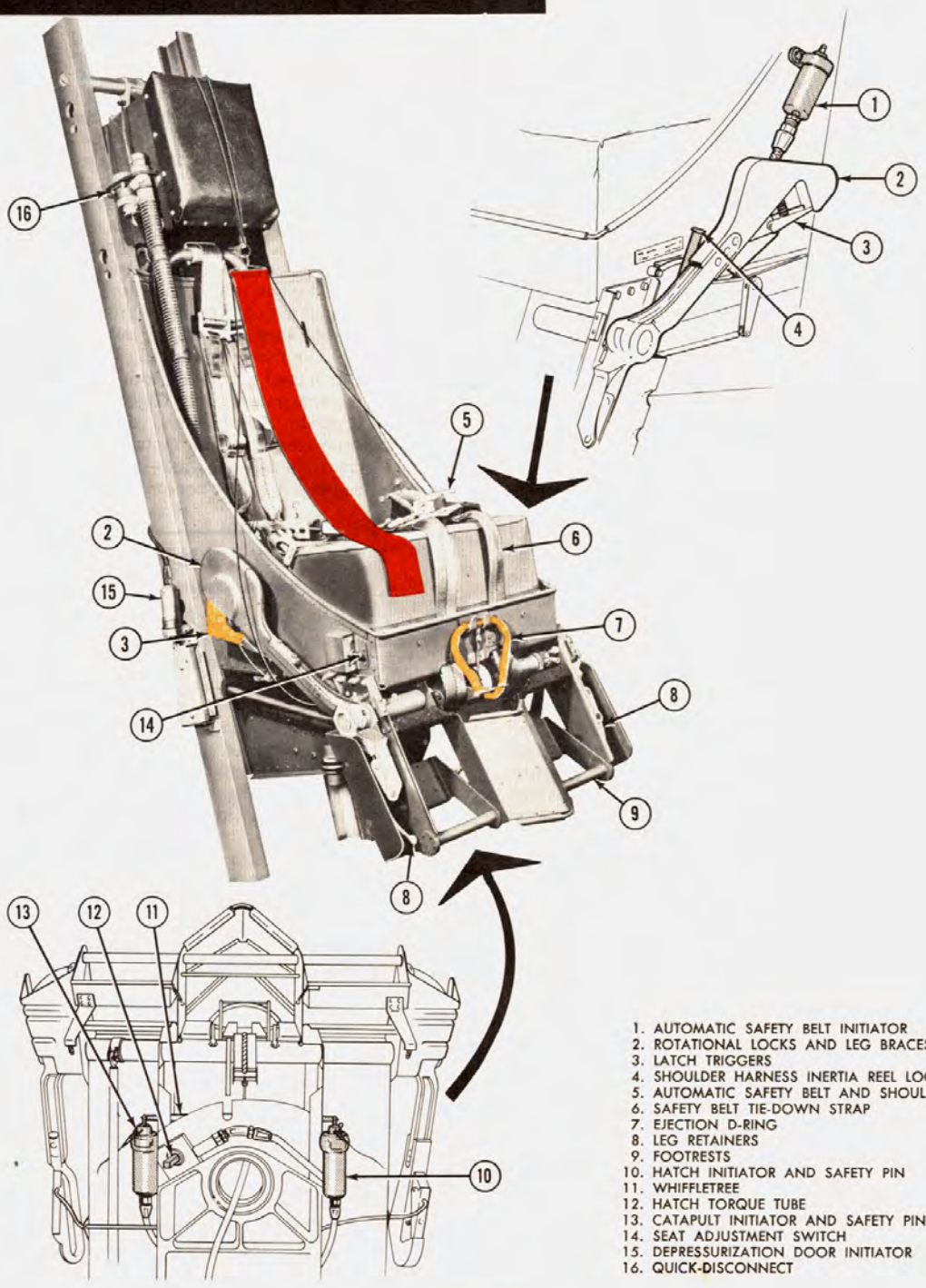
The observer is provided with a catapult-type ejection seat (figure 4-69) that ejects downward through an ejection escape hatch at the observer's station. The seat is designed to safely eject the occupant at any airspeed up to the structural limit speed of the airplane. A single catapult is mounted behind the seat and contains an explosive charge which provides the propelling force for seat ejection. The ejection sequence is initiated by movement of the leg braces and completed by the pulling of a D-ring (figure 4-70). These controls mechanically fire initiators (containing explosive charges) which, by gas pressure, operates a ballistics system to depressurize the crew compartment and eject the seat. When the seat is ejected, a quick-disconnect (16, figure 4-69) separates the oxygen tubing and electrical wires. 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. A shelf is provided at the bottom rear of the seat to support the parachute pack in flight. The forward edge of the shelf has been beveled and padded to keep the seat occupant from contacting the metal shelf. When a thin-packed parachute is worn, a 2-inch seat back cushion may be used but it is not recommended.

**WARNING**

- If a 5-inch parachute is worn, no seat back cushion should be used regardless of seat configuration. To do so could result in injury during ejection.
- If a thin-packed parachute is worn and a seat back cushion is used the cushion should not exceed a 2-inch thickness. The use of more than one cushion or larger cushions could result in injury during ejection.

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 58° 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

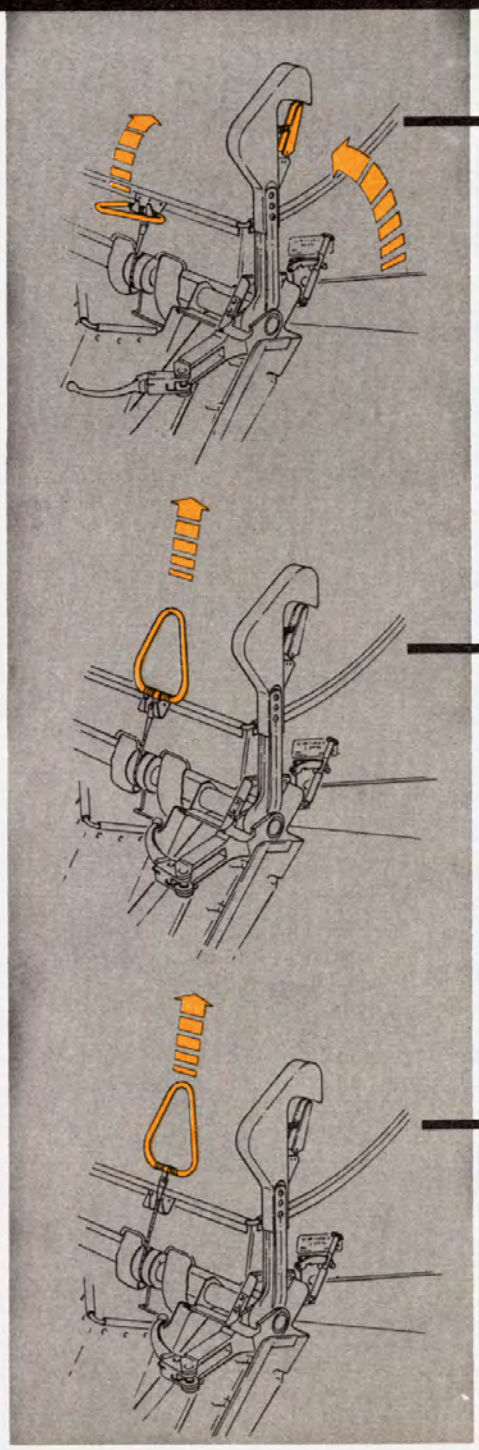



1. AUTOMATIC SAFETY BELT INITIATOR
2. ROTATIONAL LOCKS AND LEG BRACES
3. LATCH TRIGGERS
4. SHOULDER HARNESS INERTIA REEL LOCK HANDLE
5. AUTOMATIC SAFETY BELT AND SHOULDER HARNESS
6. SAFETY BELT TIE-DOWN STRAP
7. EJECTION D-RING
8. LEG RETAINERS
9. FOOTRESTS
10. HATCH INITIATOR AND SAFETY PIN
11. WHIFFLETREE
12. HATCH TORQUE TUBE
13. CATAPULT INITIATOR AND SAFETY PIN
14. SEAT ADJUSTMENT SWITCH
15. DEPRESSURIZATION DOOR INITIATOR
16. QUICK-DISCONNECT

049075

*Figure 4-69.*

# OBSERVER'S EJECTION SEAT CONTROLS



Raising the leg braces from the stowed position to the locked position causes the following to occur:

- Cabin air emergency depressurization door unlocks releasing cabin pressure.
- ① Emergency alarm bell rings.
- Shoulder harness will lock.
- When both feet are placed in foot rests the leg retainers will extend from stowed position and close around ankles.
- Safety belt tiedown strap will tighten.
- D-ring is released from the retainer and springs to the upright position.

**NOTE**

IN ACTUAL USE, THE TIME LAPSE BETWEEN FIRING OF THE EJECTION HATCH INITIATOR AND THE SEAT CATAPULT INITIATOR IS OF SUCH SHORT DURATION THAT THE PULL ON THE D-RING REQUIRED TO FIRE BOTH INITIATORS WOULD APPEAR TO BE A CONSTANT PULL, RATHER THAN TWO SEPARATE PULLS.

The ejection D-ring, located on the forward edge of seat, operates with a "two pull" sequence. One pull (approximately 1 inch) causes the following to occur:

- Initiator located on the left underside of the seat fires, rotating hatch torque tube.
- Observer's downward ejection hatch jettisons.

Second pull causes the following to occur:

- Initiator located on the right underside of the seat fires.
- Seat catapult fires and ejects seat and occupant.

① AF 50-008, -010 thru -013, -015, -016, -021 thru -025, -029 thru -032, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091

049076

*Figure 4-70.*

## SEAT ROTATION LOCKS AND LEG BRACES

Two leg braces (2, figure 4-69) located on the observer's seat serve as normal and emergency controls. A latch trigger (3, figure 4-69) located on each leg brace prevents the leg brace from being raised until the trigger is squeezed. Squeezing either latch trigger releases both leg braces for emergency use. For normal operation, the braces are used for rotating the seat. The seat can be rotated 20° left or 58° 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 to the locked position with both feet in footrests, the following occurs simultaneously:

- Initiator on right rail will fire and unlock the cabin air emergency depressurization door.
- Cabin air pressure will blow out the door.
- Emergency alarm bell will ring when depressurization door is jettisoned on some airplanes*.
- Shoulder harness will lock.
- Leg retainers will extend and close around ankles.
- Safety belt tiedown strap will tighten.
- D-ring is released from the retainer and springs to the upright position.

## EJECTION D-RING

An ejection D-ring (7, figure 4-69) located on the forward edge of the observer's seat operates with a two-pull sequence.

**NOTE**

In actual use, the time lapse between firing the ejection hatch initiator and the seat catapult initiator is of such short duration that the pull on the D-ring required to fire both initiators would appear to be a constant pull, rather than two separate pulls.

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.

**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. If the D-ring is free, the seat can be ejected although the rotational locks and leg braces are down and the restraint cable is in place.

**NOTE**

No vertical adjustment of the observer's seat is necessary prior to ejection.

## VERTICAL SEAT ADJUSTMENT SWITCH

A three-position UP--OFF--DOWN switch (14, figure 4-69) spring-loaded to OFF position located at the lower right side of the seat is provided to control vertical seat adjustment. 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 marked "Nav Seat Vert Adj" located on the radar power panel.

* AF 50-008, -010 thru -013, -015, -016, -021 thru -025, -029 thru -032, 51-2045, -2049 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091

### INITIATOR SAFETY PINS AND STREAMERS

Initiator safety pins (10 and 13, figure 4-69) 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.

### LEG RETAINERS

Leg retainers (8, figure 4-69) are held by two latches in a stowed position on the outside of both footrests. Raising the leg braces releases one of these latches and placing feet in footrests releases the second latch and allows the leg retainers to extend. Sequence of latch operation has no effect on leg retainer extension.

### DOWNWARD EJECTION HATCH AIR PRESSURE GAGE

An air pressure gage (31, figure 4-58) installed in the right rear floor face of the observer's downward ejection hatch is visible through an inspection window and shows the pressure charge of the hatch air cylinder. The normal pressure is 2000 psi.

### SAFETY BELT, SAFETY BELT TIEDOWN STRAP, AND SHOULDER HARNESS

The observer's ejection seat is provided with a conventional shoulder harness, safety belt tiedown strap, and an automatic opening cartridge-operated safety belt (figure 1-47).

**NOTE**

The Type MA-2 belt is the only safety belt designed to utilize the safety belt tiedown strap.

**WARNING**

If any other than the MA-2 belt is installed on the observer's seat, the safety belt tiedown strap must not be connected to the safety belt. If connected under these conditions, the occupant may fail to separate from the seat after ejection.

The shoulder harness is connected to the upper strap arm on the MA-2 safety belt by a loop in the end of both shoulder harness straps and will automatically lock when an impact force of 2 or 3 "g's" is encountered. The safety belt tiedown strap is looped around the lower strap arm on the MA-2 safety belt. The gas-operated automatic opening safety belt provides the observer with a positive means of separation from the seat as soon as possible after ejection without requiring manual operation by the observer. An automatic opening parachute is used in conjunction with the automatic safety belt and will automatically open after the observer separates from the ejection seat. A delay-type initiator is connected by a flexible hose to the safety belt mechanism. The initiator firing pin is attached to the static cable which is secured to the upper catapult attaching bolt so that when the seat ejects, the initiator is pulled from the firing pin. After a delay interval of approximately 2 seconds, gas pressure generated by the initiator drives a piston within the safety belt buckle to release the belt tiedown strap and shoulder harness loops. Manual operation of the system can override the automatic features at any time. For example, it is possible to manually open the safety belt even though initiator action has started. The parachute automatic features may likewise be overridden by manual operation even though the automatic parachute ripcord release has been actuated.

**WARNING**

If the safety belt is opened manually, the parachute ripcord must be pulled manually.

#### Automatic Opening Safety Belt (Type MA-2)

The release of the MA-2 safety belt (figure 1-47) is accomplished by manual operation of the crew member or by gas pressure from a separate automatically controlled source, the M-4 initiator. This power source supplies approximately 1500 psi pressure through a 36-inch length of high pressure hose which actuates a piston inside the belt, retracting the latch tongue and releasing the link. The release incorporates a key-type link which is attached to a lanyard leading to the automatic ripcord release and provides an anchor for the static line to the timer of the automatic parachute. The release is so designed that the belt cannot be locked until the key link is first inserted into its receptacle. This feature is incorporated in the design so that the crew member will not neglect to tie in the automatic parachute to the system. Use of the key link is necessary for proper operation of the automatic safety belt. If the automatic parachute is used, the key link

attached to the parachute lanyard is inserted into the belt receptacle. If the automatic parachute is not used, a spare key link, attached to the automatic belt, is inserted into the belt receptacle. This spare link is attached to the safety belt by means of a short lanyard. At no time should this spare key link be removed. When the belt is manually opened, the key link is ejected automatically so that inadvertent actuation of the automatic parachute will not occur. During automatic operation of the safety belt the key link remains firmly locked in the belt release thereby causing actuation of the parachute ripcord release as the crew member separates from his ejected seat.

**WARNING**

Only the Type MB-3 or MB-4 shoulder harness shall be used since earlier types do not have loops large enough to fit over the connecting link of the belt.

#### Shoulder Harness Inertia Reel Lock Handle

A handle (4, figure 4-69) with LOCKED--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. 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 2 or 3 "g's" is encountered. When the reel is locked in this manner it remains locked until the handle is moved to LOCKED 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. 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 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.

## MISCELLANEOUS EQUIPMENT

### FLIGHT REPORT HOLDER

A combination flight report holder and map case (16, figure 1-14) is mounted on the left sidewall opposite the copilot's station.

### AIRPLANE CHECKLIST

A checklist is mounted on the left canopy guard at the pilot's station and on the right canopy guard at the copilot's station.

### PILOT'S DATA DRAWER

A data drawer for the pilot is installed immediately below the left side of the pilot's instrument panel.

### LOAD ADJUSTER

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 Handbook Weight and Balance Data (T.O. 1-1B-40).

### ASHTRAYS

Ashtrays are mounted on the aft side of the control column for the pilot's and copilot's stations and on the observer's worktable.

### RELIEF EQUIPMENT

#### Relief Horns

Three relief horns (3, figure 1-4) 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 (10, figure 4-59) 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.

#### Relief Containers

Relief container holders (4, figure 1-15 and 26, figure 4-58) 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 (7 and 10, figure 1-14) are installed in the walkway opposite the copilot's seat.

### FOOD WARMING CUP

A food warming cup (14, 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 marked "Food Warming Cup" located on the aft 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 entranceway (27, 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 entranceway 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 (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 grapsing 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 (28, figure 1-4) is located on the forward left side of the airplane below the cockpit. A door handle is located at the lower right 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 pressure door release handle (13, figure 1-14) 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 (CRAWLWAY DOOR)

An escape chute door (23, figure 1-4) located in the crawlway immediately aft of the main entranceway 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.

### WINDSHIELD WIPER

An electrically operated windshield wiper is provided to clear the main windshield during adverse weather conditions and is controlled by a rotary switch on the windshield wiper control panel on the left side of the pilot's station. The switch has PARK--OFF--LOW--MED--HIGH positions and, when in PARK position, 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.

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(1) AF 51-2045, -2046, -2049 thru -2051, -2053 thru -2070, -2072 thru -2077, -2079, -2081 thru -2091
(2) AF 49-2642 thru 50-080, 51-2047, -2052, -2071, -2078, -2080

When wiper operation is no longer desired, rotate the switch counterclockwise and hold in PARK position; the wiper blade will be driven to its parked position at the left side of the windshield. When released, the switch will return to OFF. The wiper is DC operated through a circuit breaker marked "Windshield" located on the "Anti-Icing" portion of the lower DC power panel.

### AFT EXTRA SEAT

An aft extra seat (26, figure 1-4) is located on the walkway step adjacent to the copilot's seat. The seat is provided with a conventional safety belt and shoulder harness. When not in use, the back of the seat folds flush into the walkway floor.

### FORWARD EXTRA SEAT

A forward extra seat (11, figure 4-59) is located in the walkway immediately behind and to the left of the observer's seat. The seat is provided with a conventional safety belt. When not in use, the seat can be folded up against the left sidewall in the walkway. A pull-knob on the right side of the seat releases the right legs of the seat from the floor so that the seat can be stowed.

### OBSERVER'S CURTAINS

Blackout curtains for the observer's left and right windows are provided. An antiglare curtain (1, figure 1-4) is installed immediately aft of the observer's station to prevent nose compartment lighting from interfering with pilot vision. When not in use, the curtain separates in the center and stows along each sidewall of the observer's compartment.

### OBSERVER'S CHECKLIST

A condensed checklist is provided for the observer and is located on top of the control console at the right side of the observer's station and is normally folded down when not in use.

### AIRPLANE "G" FILES

The Flight Handbook (T.O. 1B-47B-1), the Handbook Erection and Maintenance Instructions (T.O. 1B-47B -2), the Parts Catalog (T.O. 1B-47B-4), the Inspection Requirements (T.O. 1B-47A-6), the Handbook Weight and Balance Data (T.O. 1-1B-40), and the Letdown Books and Facility Charts may be found in the cockpit.

### REARVIEW MIRRORS

Three rearview-type mirrors are installed, one on the left side of the forward canopy frame, one on the left side of the pressurized compartment in the vicinity of the main entry door, and one 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. The copilot's rearview mirror is attached to the right side of the copilot's windshield frame.

### CANOPY SUN CURTAINS

Roller-type sun curtain units (6, 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 sun curtain units are not to be removed.

### OBSERVER'S DATA DRAWER

The observer's data drawer (31, figure 4-58) is located under the observer's worktable.

### FLYAWAY EQUIPMENT

A flyaway equipment box is installed in the bomb bay and contains hand tools, cordage and cable assemblies, and handbooks containing information pertaining to the operation and maintenance of various items of equipment installed on the airplane. The flyaway box also contains cover assemblies for the nose, canopy, fuselage, wing, stabilizer, engines, vortex generators, pitot heads, and air inlets. Special tools such as canopy ground lock, main landing gear locks, mooring eyes, and jack pads (14, 16, 17, and 24, figure 1-4) are also a part of the flyaway equipment. All canvas covers and fuel dipsticks are stowed in the crawlway.

# OPERATING LIMITATIONS

section 5

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As with all mechanical instruments, this airplane possesses certain well-defined limitations which must be observer 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

## ACCELEROMETER

2 g MAXIMUM AT MAXIMUM GROSS WEIGHT

3 g MAXIMUM AT DESIGN GROSS WEIGHT

## MACHMETER

.86 MAXIMUM

## AIRSPEED INDICATOR

195 knots FULL FLAPS

The instrument setting is such that the striped pointer will move to indicate the limiting airspeed of 425 knots or the airspeed representing the limiting Mach number of .86, whichever is less.

*Figure 5-1 (Sheet 1 of 4 Sheets).*

## EXHAUST GAS TEMPERATURE

| | |
|---|---|
| 0° to 200° C | OPERATION AT LOW POWER SETTINGS |
| 200° to 655° C | CONTINUOUS OPERATION |
| 690° C | MAXIMUM FOR FLIGHT |
| 950° C | MAXIMUM DURING STARTING & ACCELERATION ONLY |

## ENGINE OIL PRESSURE

| | |
|---|---|
| 1 psi | MINIMUM — IDLE RPM |
| 8 to 18 psi | NORMAL OPERATION FOR 88% RPM |
| 22 psi | MAXIMUM — 100% RPM |

**NOTE**

OIL PRESSURE GAGE MARKINGS DO NOT SHOW LIMITS FOR ALL OPERATING CONDITIONS. REFER TO FIGURE 5-2 FOR OIL PRESSURE LIMITS

## TACHOMETER

| | |
|---|---|
| 80% to 96% rpm | BEST CRUISING |
| 98% rpm | MILITARY RATED — 30 MINUTES |
| 100% rpm | MAXIMUM RATED — 5 MINUTES |

**NOTE**

APPLICABLE TO ANY GRADE OF FUEL

*Figure 5-1 (Sheet 2 of 4 Sheets).*

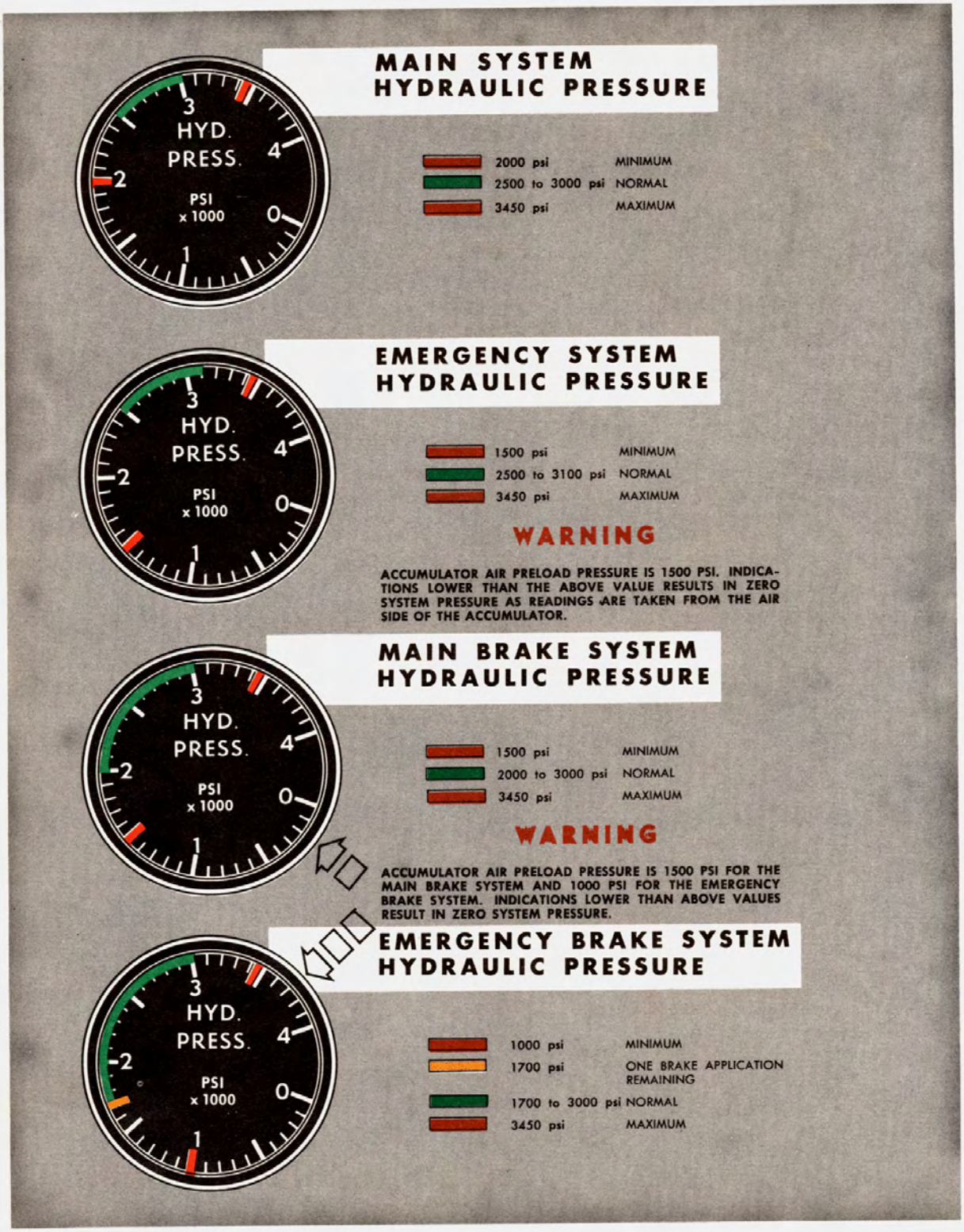


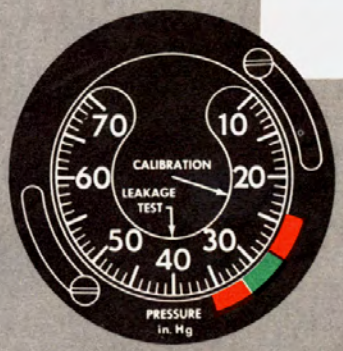

*Figure 5-1 (Sheet 3 of 4 Sheets).*

## 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 |

## WING & EMPENNAGE ANTI-ICING AIR TEMPERATURE

| | |
|---|---|
| 50° C to 80° C | NORMAL GROUND OPERATION |
| 80° C to 105° C | MAXIMUM GROUND OPERATION |
| 105° C to 216° C | NORMAL FLIGHT |
| 216° C | MAXIMUM FOR MANUAL OPERATION DURING FLIGHT |




## RADAR PRESSURE

### (AIRPLANES WITH BNS CAPABILITIES)

| | |
|---|---|
| 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 4 of 4 Sheets).*

## ENGINE LIMITATIONS

The following constitutes possible engine overtemperature conditions and requires appropriate action to be taken.

| CONDITION | ACTION |
|---|---|
| ENGINE STARTS UP TO IDLE RPM (WITHIN 2 MINUTES) | |
| 950° C or above for 2 seconds | Pilot must shut down engine and record the degree and duration of overtemperature condition on DD Form 781. Maintenance is required to remove turbine wheel and inspect engine per T.O. 2J-J47-539. |
| ALL ENGINE OPERATION EXCEPT STARTS | |
| 690° to 750° C for 40 seconds or more<br>OR<br>750° to 800° C for 10 seconds or more<br>OR<br>Above 800° C for 2 seconds or more | Pilot must record the degree and duration of overtemperature condition on DD Form 781 in order that proper maintenance inspection may be accomplished per T.O. 2J-J47-539. |

**CAUTION**

Failure to record overtemperature condition could result in turbine failure and possible engine loss.

**NOTE**

For takeoff only, exhaust gas temperatures in the range of 690° to 715° C for a period up to 3 minutes need not be recorded on DD Form 781.

### OPERATING LIMITATIONS

The time limitations on engine rpm given as follows are optimum for the guaranteed maximum life of the engine:

| | | | |
|---|---|---|---|
| 1. | Maximum Rated Thrust | 100% (±1%) rpm | 5 min |
| 2. | Military Rated Thrust | 98% rpm | 30 min |
| 3. | Normal Rated Thrust | 96% rpm | No time limit |

Engine overspeed exceeding 104% of rated rpm, either with or without overtemperature, requires removal and overhaul of the engine.

**CAUTION**

Throttles should be advanced cautiously to avoid compressor stall. (See section VII.)

### Oil Pressure

Engine oil pressure varies directly with engine rpm, and an oil pressure deficiency is serious at any rpm. Figure 5-2 shows maximum and minimum oil pressure at various operating speeds. During stabilized flight conditions a change in pressure, even though within limits, is cause for a thorough check of the system. The following check procedure is recommended:

1. If oil pressure on a particular engine shows a definite change or appears high or low in comparison with other engines at the same rpm, adjust throttle to obtain 88% or 100% rpm on the engine, depending on operating conditions, and check the oil pressure.
2. If oil pressure is within limits (8 to 18 psi at 88% rpm; 10 to 22 psi at 100% rpm) at check rpm, continue operation of engine, but maintain close surveillance of the oil pressure.
3. If oil pressure is out of limits at check rpm, shut down the engine until the cause of the discrepancy can be determined.

An increase in oil pressure may indicate some impedance in the lines such as a clogged oil jet; however, during extreme cold weather operation, the oil pressure may exceed the maximum limits until the oil temperature reaches normal. A decrease in oil pressure may indicate an insufficient oil supply or a broken tube or oil jet.

**CAUTION**

The engine oil pressure should be closely observed during flight at high speeds.

### Fuel Grade Operating Limits

The operating limits are identical for either the recommended or alternate fuel grades.

## AIRSPEED LIMITATIONS

See figure 5-1 for limits other than those following.

## ENGINE OIL PRESSURE CHARACTERISTICS

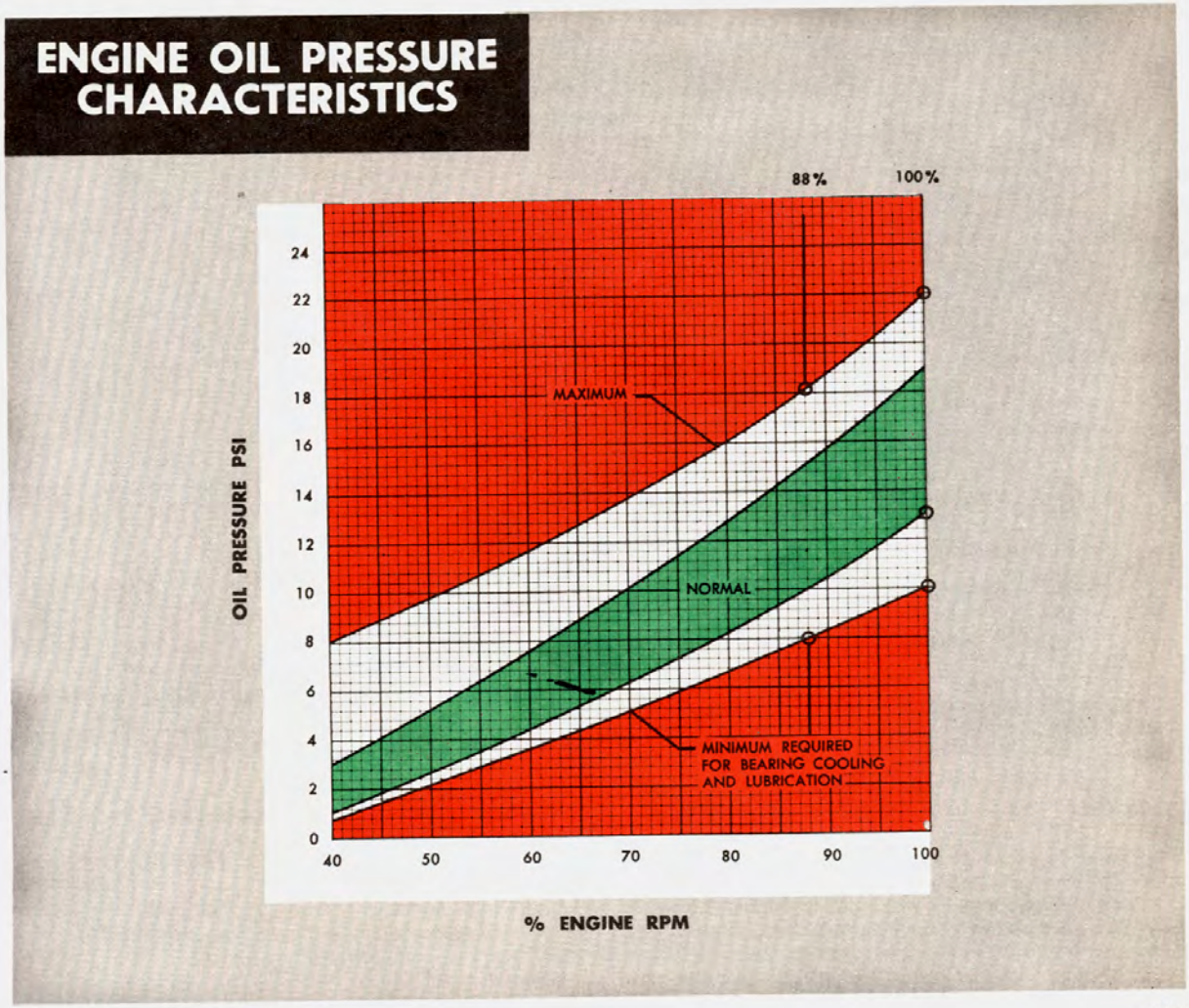



*Figure 5-2.*

### 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.

**CAUTION (continued)**

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.

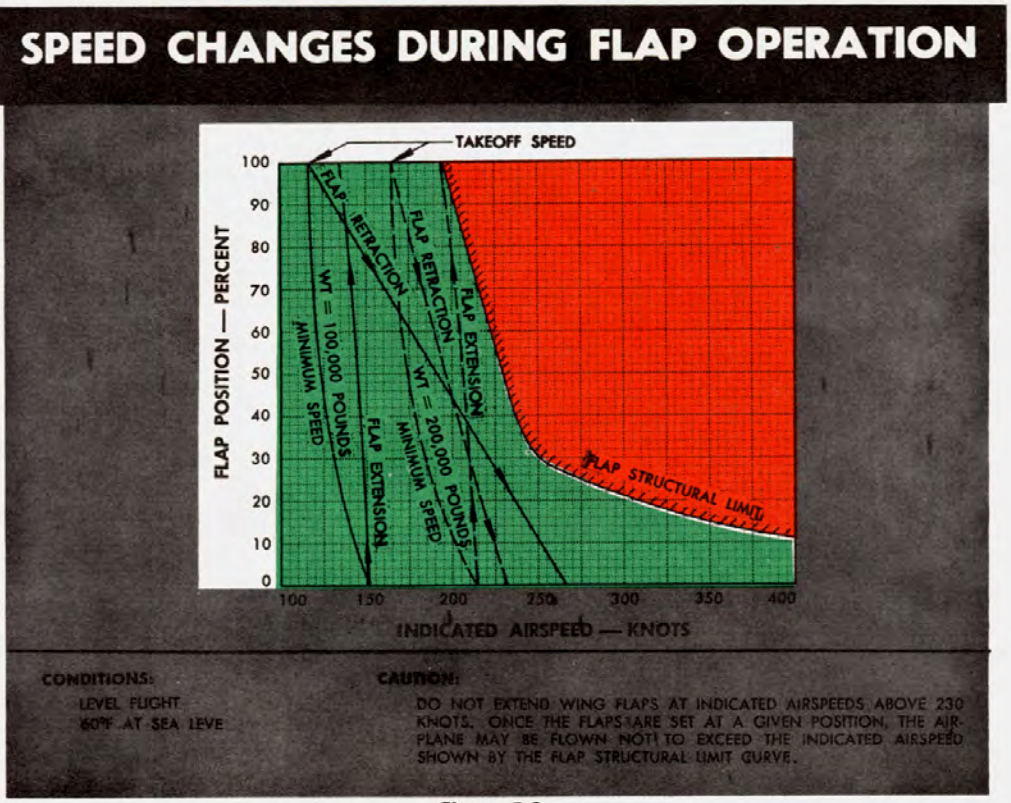
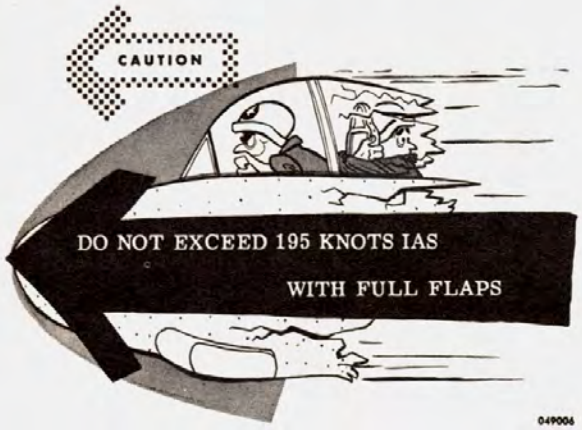



*Figure 5-3.*

## 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 indicated airspeed shown by the flap structural limit curve in figure 5-3. To prevent structural damage to the flaps, the following airspeed limitations should be observed during flap retraction:




| Do Not Exceed IAS of: | With Wing Flap Position of: |
|---|---|
| 195 knots | full down |
| 230 knots | 50% |
| 236 knots | 22 1/2% |
| 240 knots | more than 0% |

## BOMB DOORS

There is no speed restriction applicable for operation of bomb doors or when bomb doors are open.

## CANOPY

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, the canopy should be jettisoned at speeds above 190 knots IAS to prevent possible collision with the vertical stabilizer.

**WARNING**

When canopy must be operated during flight, the procedures as outlined in "Canopy Emergency Operation During Flight" in section III should be followed.

### 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.

### APPROACH CHUTE

Maximum IAS for deployment of approach chute - 195 knots.

### PERISCOPIC BOMBSIGHT COVER

To prevent possible difficulty during opening and closing operation of the periscopic bombsight cover, the maximum IAS is 350 knots.

### FLUTTER

Because of wing flutter, do not exceed the following indicated airspeeds and Mach numbers under the following conditions:

- 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.

**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 should be observed in relation to the gross weight of the airplane. 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 high indicated airspeeds, the airplane is restricted to 425 knots IAS.

**WARNING**

Because of slight dissymmetry between left and right wings, some airplanes demonstrate undesirable lateral trim characteristics during flight above 350 knots IAS. This condition results in a decrease of available rate of roll and necessitates the installation of an additional placard further limiting the speed of the airplane. Since these placard speeds will vary among airplanes, particular attention is directed to the placards existing in any specific airplane.

Lateral control characteristics at high indicated airspeeds are described in section VI.

### AFT CENTER OF GRAVITY

Whenever loading conditions result in a cg aft of 32% MAC, the airplane shall not be flown at speeds above best climb speed or at altitudes above 20,000 feet.

### MAXIMUM SPEEDS

The maximum speed is 425 knots IAS, Mach .86, or initial buffeting, whichever occurs first. These limitations should be closely observer; however, if flight in buffeting is necessary for emergency reasons, the airplane is controllable and can be flown with proper technique to the design structural limit of Mach .92 or 456 knots IAS, whichever occurs first. It should be noted that speeds in excess of 425 knots IAS will cause loss of aileron effectiveness. Loss of elevator surface power control at speeds near the maximum indicated airspeed or Mach number will result in pitchup of the airplane. The resulting airplane acceleration ("g's") will depend upon altitude, gross weight, and center of gravity, but sufficient elevator control is available to recover. The design of the elevator balance bays modifies the pitchup so that the airplane will not reach its limit load factor ("g") should elevator power control fail suddenly. Careful inspection of the airplane should be conducted after extended periods of time in buffeting. Refer to the chart in figure 5-4 for a plot on the airspeed and Mach number restrictions for level flight conditions.

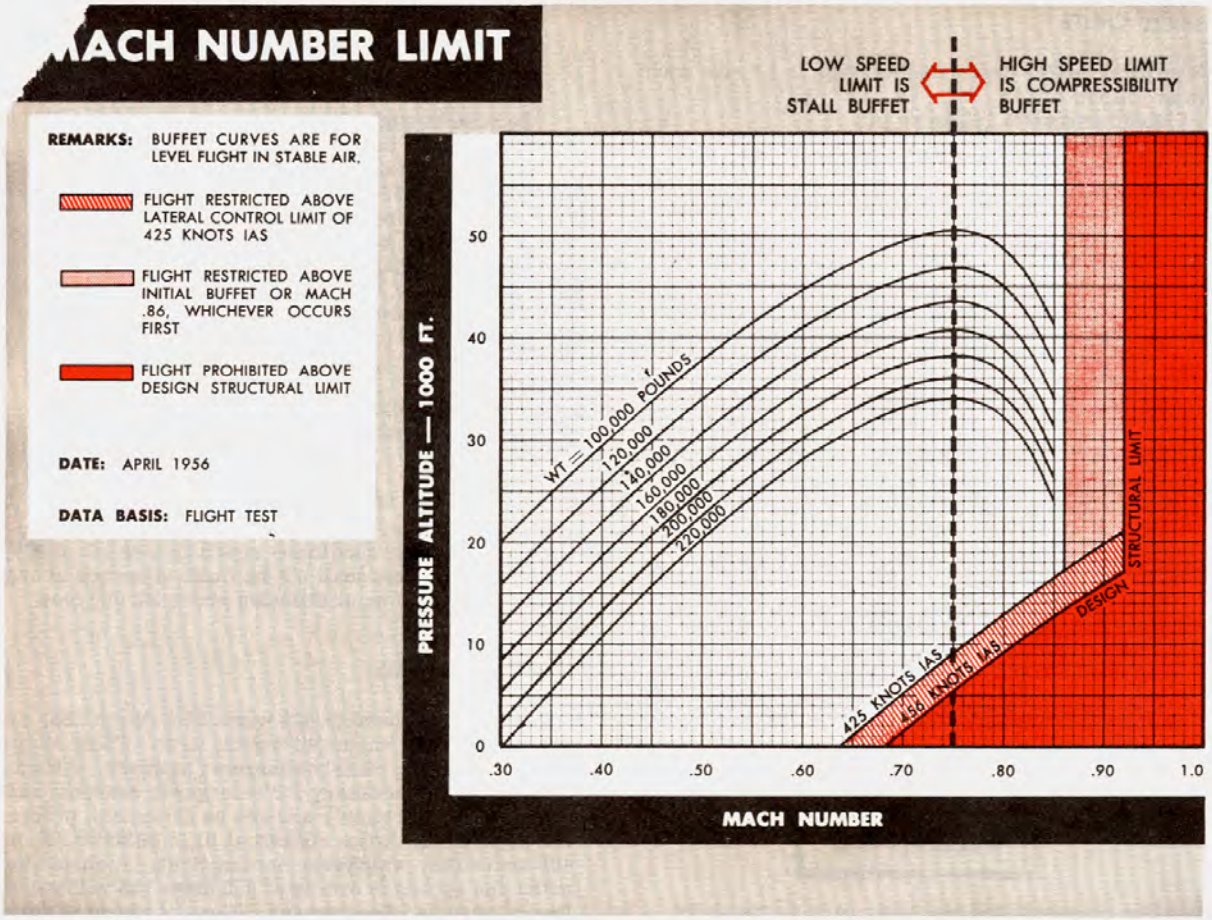



*Figure 5-4.*

### MINIMUM SPEEDS

For minimum speeds during approach and landing, see figure 2-11.

## 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 pitchup 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 bank angle at which buffeting begins for a given Mach number will vary with altitude and gross weight. A plot of bank angle limits is shown in figure 5-5. The time lag involved in establishing flow separation from the wing often enables a higher number of "g's" to be pulled in

# BANK ANGLE LIMITS FOR INITIAL BUFFETING

**SAMPLE PROBLEM:**

When flying at 40,000 feet altitude at a gross weight of 110,000 pounds and at .75 Mach, what is the maximum number of "g's" that can be pulled before buffeting occurs and at what angle of bank will this maximum "g" load occur?

**SOLUTION:**

Read 40,000 feet on pressure altitude scale.

Move from left to right to wt = 110,000 pound curve.

Drop to M = .75 curve.

Move from left to right and read 1.48 "g's" on load factor scale.

At 1.48 "g" loading, buffeting will occur for the above flight conditions.

Move left from .75 curve and read 47.5° on angle of bank scale.

Initial buffeting will occur in a 47.5° bank under the above flight conditions.

**DATE:** APRIL 1956

**DATA BASIS:** FLIGHT TEST

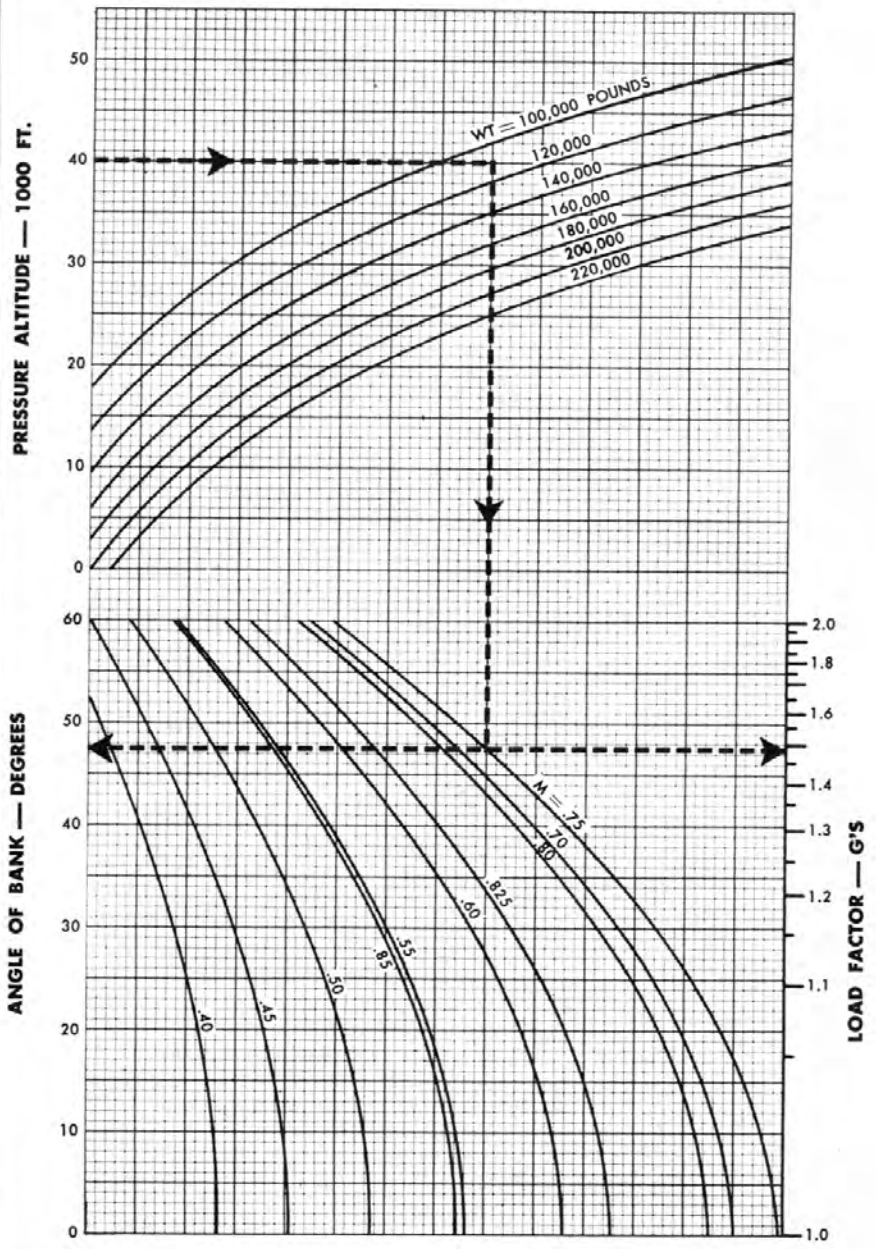



*Figure 5-5.*

# ACCELERATION LIMITATIONS

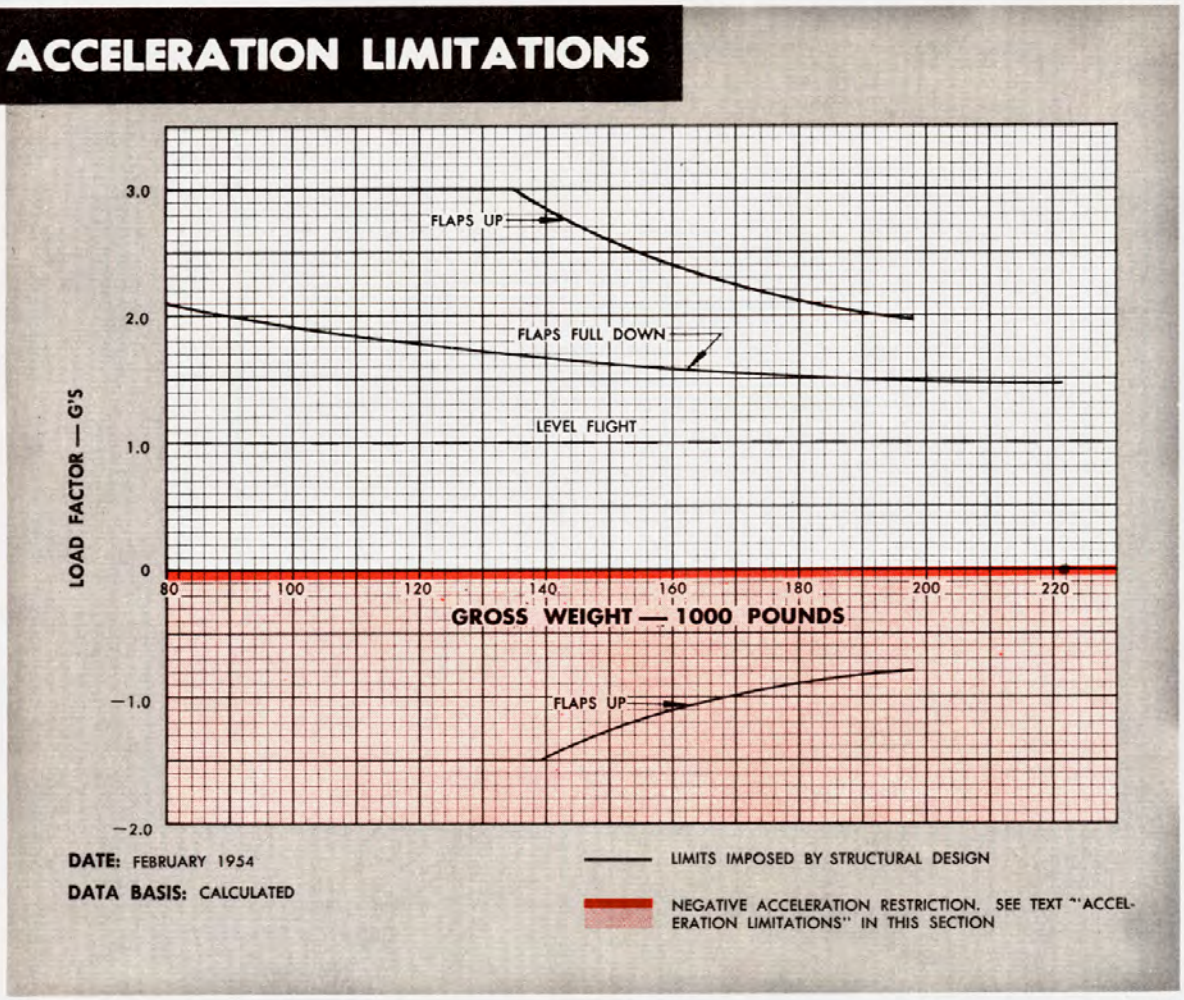



*Figure 5-6.*

a quick pullup than in a steady maneuver. See figure 5-5 for an example problem demonstrating the use of the buffet limit curves.

**WARNING**

Any maneuver that will impose a negative acceleration on the airplane shall be avoided. A negative acceleration may result in fuel being forced out through the fuel vent system and possible reentry of fuel into the aft fuselage compartments which are low pressure areas, thus creating a possible fire or explosion hazard.

Refer to the chart in figure 5-6 for a plot of the limitation imposed on the maneuvering "g's" for the structural design of the airplane.

## FORMATION FLYING LIMITATIONS

To prevent possible midair collisions between airplanes flying in close formation, the following restrictions apply during all formation flights except air refueling operations:

Fly formation only when authorized to do so and when properly briefed.

Never fly under, or under and slightly ahead of the lead airplane.

- Maintain a wing tip clearance in the lateral plane of no less than 10 feet.
- Maintain a clearance in the longitudinal plane of no less than nose to tail.
- If overrunning the lead airplane, break away by easing the nose down. Avoid sliding under the lead airplane.

**WARNING**

If extremely close formation is encountered for any reason, be on guard for large interference forces but avoid abrupt control movements.

For flight characteristics encountered during close formation flight, see section VI.

## 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 5-7 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 porpoising, pitchup, or tuckunder. On takeoff, cg location aft of 34% MAC will create a tendency for the nose to pitch up. Since the elevator is unable to pitch the airplane about the rear gear more than about 1° at speeds 15 knots or more below takeoff speed, this could result in a dangerous and uncontrollable airplane attitude. An extreme aft cg together with an intermediate elevator position can cause the front gear to lift off the ground at less than normal takeoff speed. The nose will continue to rise until the rear gear unsticks and the airplane pitches off the ground below the normal takeoff speed. With the bicycle-type landing gear there is no natural means of warning the pilot of an inadvertent aft cg during the takeoff run; therefore, the pilot will be unable to sense this cg condition until pitchup occurs at the premature unstick point. The severity of pitchup depends on cg, gross weight, and the amount and timing of the stick force. Takeoffs with inadvertent aft cg should be aborted if pitchup at unstick is severe and uncontrollable. Refer to "Normal Technique - Takeoff," section II, and "Takeoff Emergencies," section III. At gross weights above 95,000 pounds, the forward cg limit 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. An extreme forward cg, even if inadvertent, is not considered as hazardous during takeoff as an extreme aft cg. With an extreme forward cg, it should become apparent that the airplane is not taking off at the normal takeoff speed and an unusual pull force will be required to unstick. As with an extreme aft cg condition, takeoff should be aborted if difficulty is encountered in controlling the pitch attitude of the airplane. If the takeoff is committed and the pitch attitude is controllable, delay retracting the gear and flaps and initiate fuel management procedures to move the cg aft as quickly as possible. The retraction of the landing gear will move the cg forward 1.0% which would further aggravate an inadvertent forward cg condition. 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 surface 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 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 switch 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 down load 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 the 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. See figure 5-7 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 "Handbook Weight and Balance Data," T.O. 1-1B-40, for chart on loading procedure. For "Fuel System Management," see section VII.

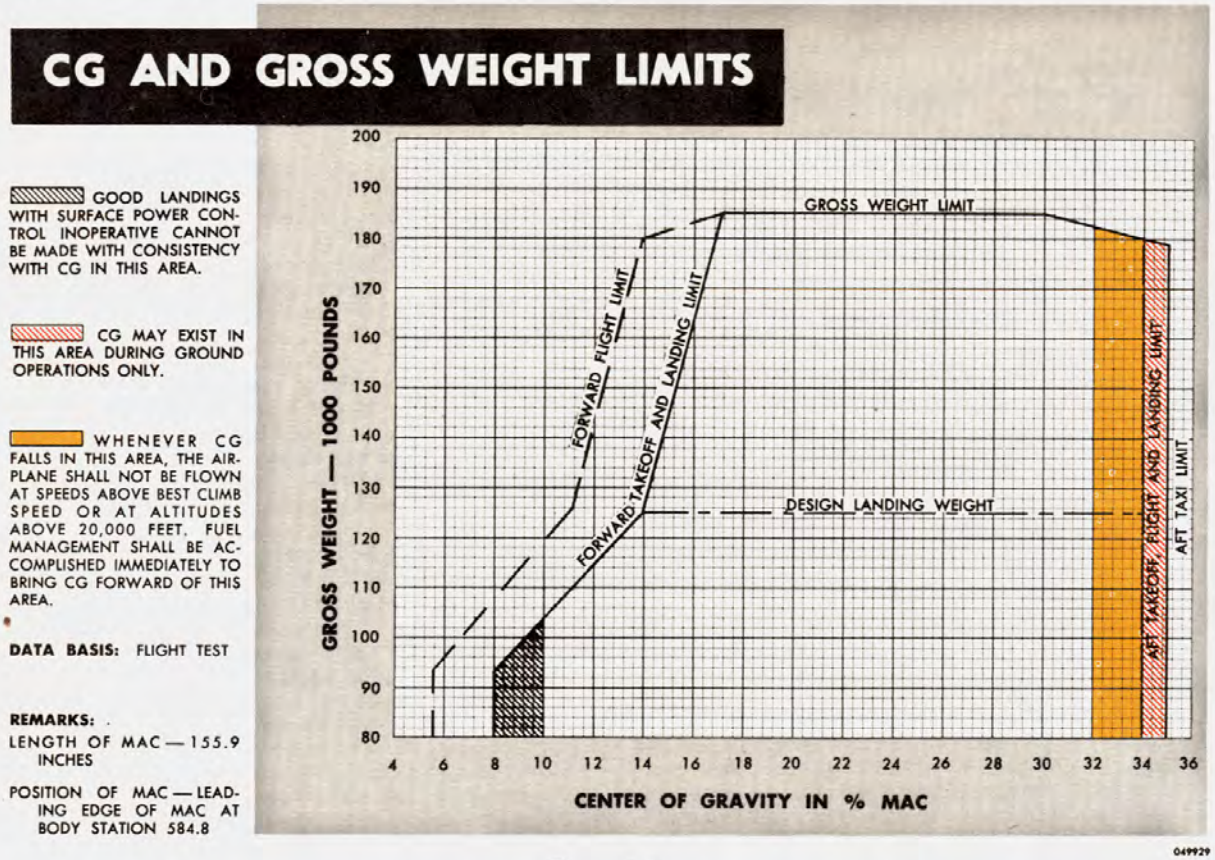
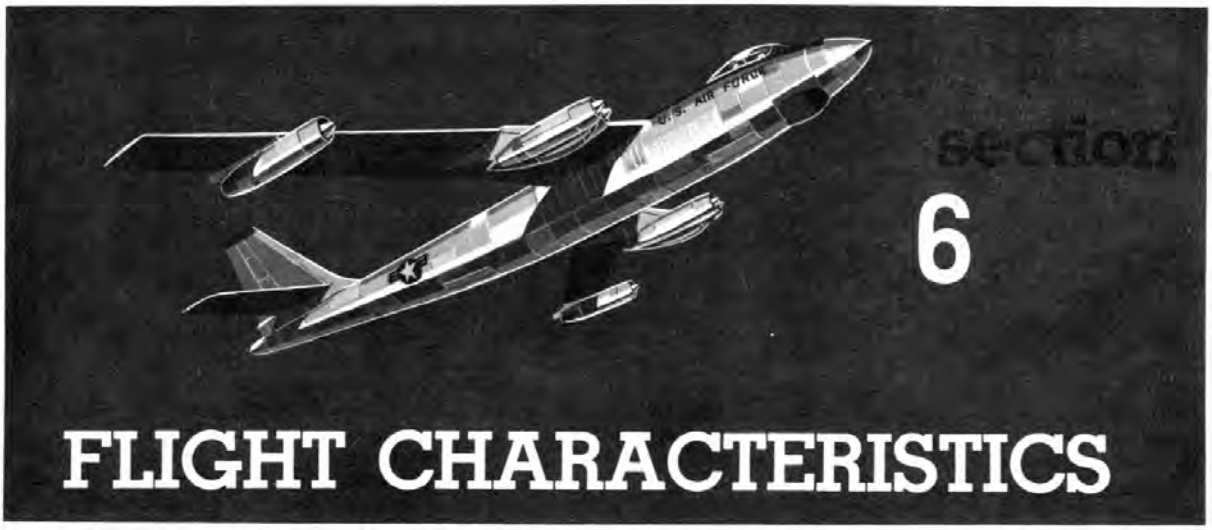



*Figure 5-7.*

## WEIGHT LIMITATIONS

Maximum gross weight limitations are presented on the charts contained in figure 5-7. 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: 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% to 34% MAC (35% MAC for taxi operations). 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 adequate to withstand sinking rates in excess of 6 feet per second. As a result, landings at high gross weights are considered a good risk in an emergency as compared to continuing flight merely to decrease landing weight.




Section 6

# FLIGHT CHARACTERISTICS

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The airplane was designed as a high performance jet bomber-trainer having the best possible flight characteristics for a good training 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 (figure 2-9). 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 pitchup. 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.

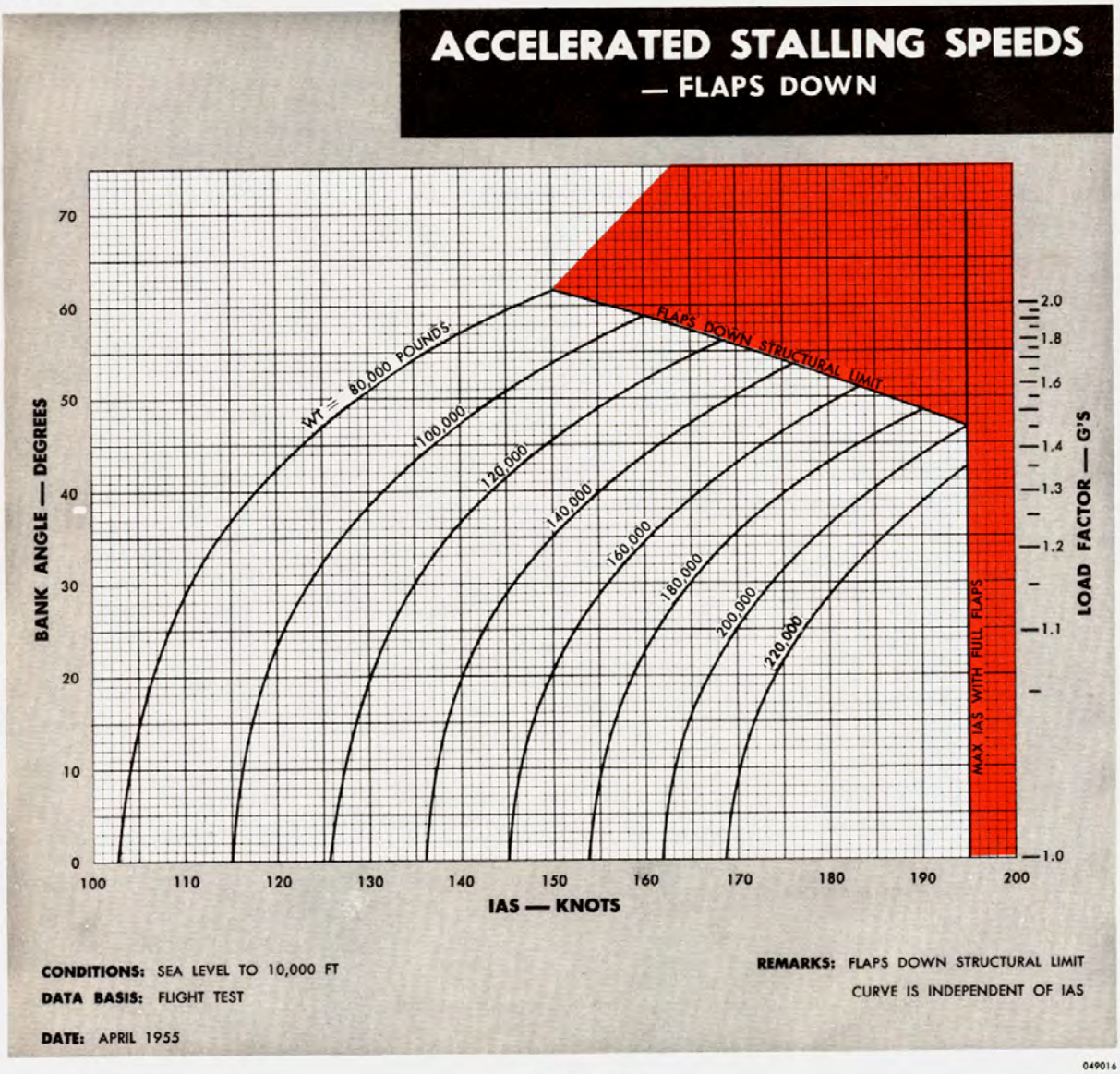



*Figure 6-1.*

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 the first stall warning during approach at speeds as specified for this airplane 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°. 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 pullups 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:

**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.

1. As a safety measure, an altitude of 15,000 feet or more should be used.
2. When executing practice stalls or other unusual maneuvers, the ESP switch should be ON regardless of altitude or temperature.
3. 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 2-9).
4. Recovery from stalls is normal. However, the loss in altitude at high weights will be great.
5. 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 with surface power control operative are sufficiently light so that the pilot does not become fatigued during maneuvers and turns of extended duration, but heavy enough to afford adequate control "feel." It is impossible to make elevator control forces heavy enough to prevent structural damage and yet light enough to allow rapid maneuvering and landings with a forward cg. Therefore, in rapid maneuvers, always refer to the accelerometer. Failure of elevator surface power control during flight ordinarily results in an instantaneous change of elevator trim. This is due to the rapid transition at the instant of power failure from trim provided by hydraulic power to trim provided aerodynamically by the elevator trim tab. The direction and magnitude of the change in trim forces depend on altitude, airspeed, and center of gravity. Figure 6-2 shows the forces on the control column necessary to maintain level flight after power failure for any combination of airspeed and altitude. The chart is computed for a cg of 25% MAC; thus slight variations from the values given in the charts may be expected for cg's other than 25%. As indicated by the chart, the most severe change in trim will be experienced when loss of elevator surface power control occurs at speeds near the maximum indicated airspeed or Mach number and above approximately 13,000 feet. The result of these conditions is an abrupt pitchup 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. While control of the airplane is marginal and necessary control wheel push forces are very heavy, the resulting acceleration will not reach load limit factor regardless of altitude, gross weight, and center of gravity combinations. At high indicated airspeeds and very low altitudes, failure of elevator surface power control results in a "pitch-down" of the airplane and rather high pull forces are required to maintain level flight. This pitch-down tendency decreases in magnitude with a decrease in airspeed and/or an increase in altitude. At approximately 235 knots IAS, regardless of altitude, no appreciable change in trim will be encountered at the instant of elevator surface power control failure. It should be noted that the forces on the low speed side of the force curves vary somewhat for each airplane and cannot be specifically defined. The wide bands in the chart indicate the degree of this variance among airplanes. At speeds below the speed for zero forces, the airplane tends to pitch up slightly but the amount of push force required to maintain level flight is negligible. In the event of elevator surface power control failure, the airplane should be retrimmed immediately and the rudder-elevator surface power control switch placed to OFF. Although control forces are high for certain conditions, the trim tabs are very effective and only slight elevator trim wheel adjustments are necessary to correct for large control wheel forces.

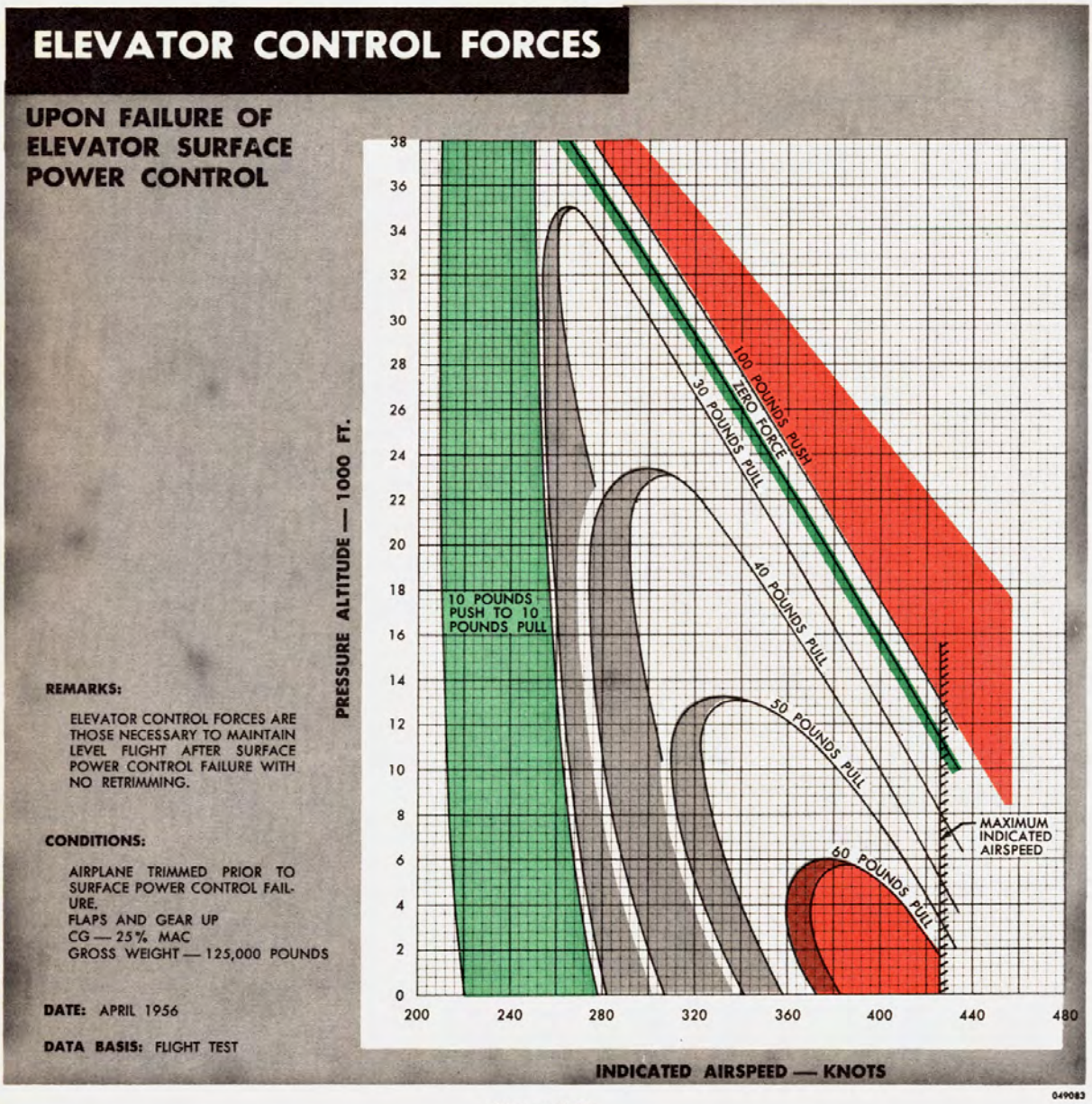



*Figure 6-2.*

## 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 altitudes and at moderate to low indicated airspeeds. However, effectiveness decreases as indicated airspeed increases until, at approximately 440 knots

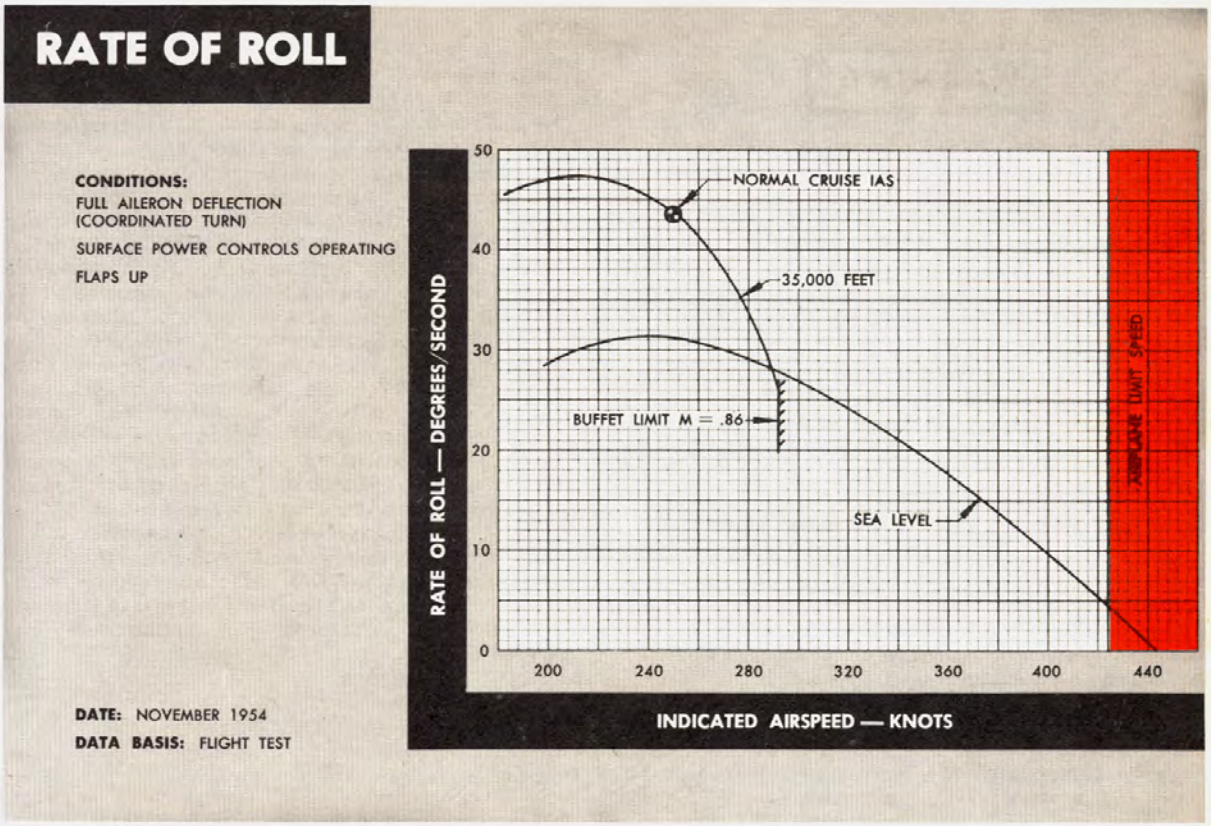



*Figure 6-3.*

IAS, the rate of roll available from ailerons is reduced to zero (figure 6-3). 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 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 5-6). 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 5-6. 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. Also, the trim tabs function as a balance tab on their respective control surfaces and materially aid in the movement of the surfaces by reducing the hinge moment. With surface power control on, the trim tabs have no effect on the control surfaces, being overridden by surface power control hydraulic pressure.

### Pitch Trim

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. The left trim tab is inoperative and is permanently fixed in a faired (trail) position.

### Lateral Trim

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.

### Trim Controls

Trimming is done by means of conventional trim wheels for both control power-on and power-off trim. Trim is accomplished by positioning the trim controls which reposition centering springs and Q-springs, moving the entire control surface to accomplish the 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 given in section VII.

## CONTROL SURFACES BALANCE SYSTEM

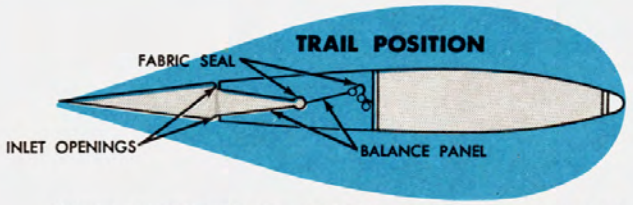
### Description

The control surfaces are each balanced by an internal series of balance bays in the aft section of the airfoil (figure 6-4). These balance bays 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. Each balance bay is divided into an upper and lower cavity by a balance panel which extends forward from the control surface hinge line. These cavities in each bay are completely sealed from each other by a fabric seal between the forward edge of the balance panel and the aft face of the airfoil spar. Small openings into each cavity (except the lower cavities of the two inboard bays of the horizontal stabilizer) are provided at the upper and lower aft edge of the airfoil just forward of the control surface hinge line. The lower cavities of the two inboard bays of the horizontal stabilizer are sealed at the aft edges and are vented to the lower cavity of the third bay. Venting of the relatively stable air from the outboard portion of the stabilizer to the inboard bays reduce the pitchup tendency of the airplane in event of elevator surface power control failure.

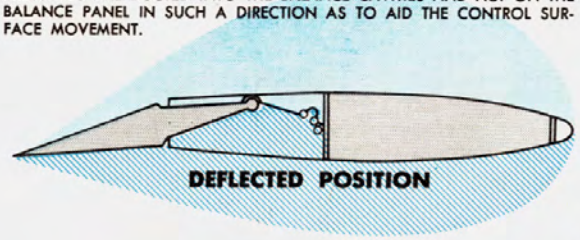
### Operation

When a control surface is in trail position, the air pressures in the opposing cavities will be equal, 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 unequal.

# BALANCE BAYS AND VORTEX GENERATORS




WHEN A CONTROL SURFACE IS DEFLECTED, A PRESSURE INCREASE OCCURS ON THE SIDE OF THE AIRFOIL TOWARD WHICH THE SURFACE IS MOVED AND A DECREASE OCCURS ON THE OPPOSITE SIDE. THESE UNEQUAL PRESSURES ARE DUCTED INTO THE BALANCE CAVITIES AND ACT ON THE BALANCE PANEL IN SUCH A DIRECTION AS TO AID THE CONTROL SURFACE MOVEMENT.






VORTEX GENERATORS

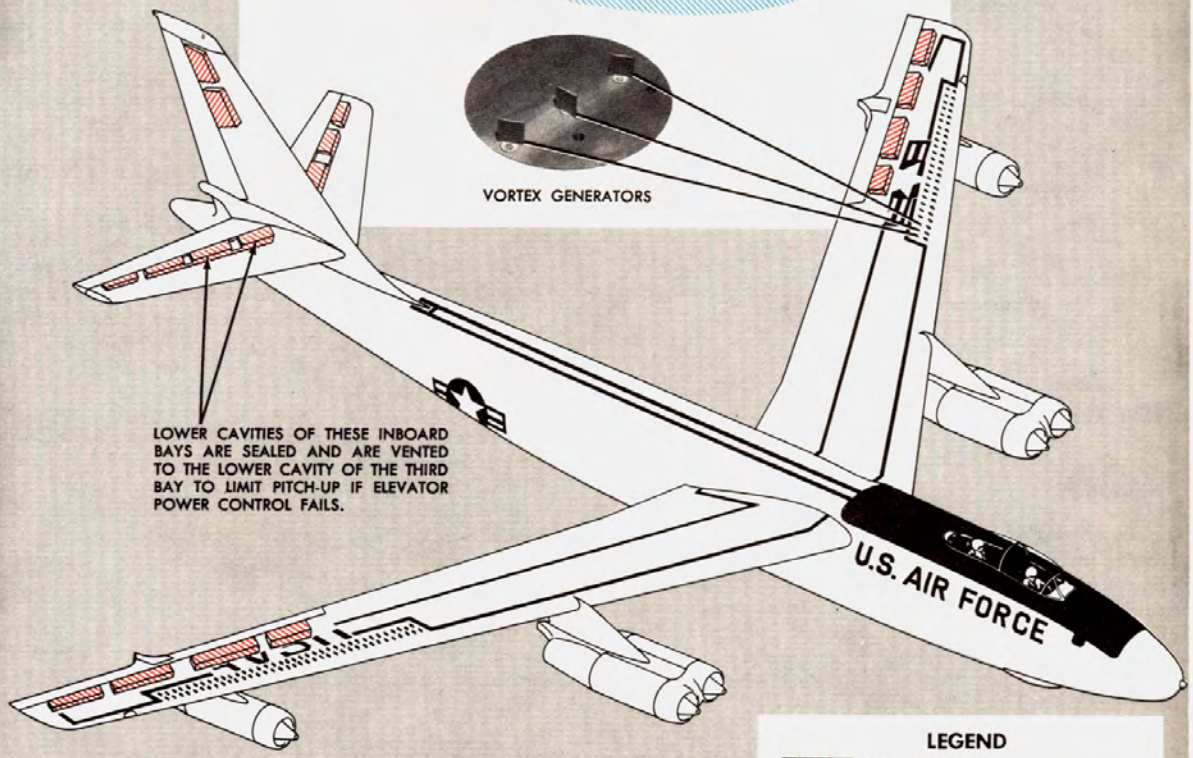



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*Figure 6-4.*

For instance, deflecting the elevator down increases camber which increases velocity over the upper surface, resulting in a low pressure area over the upper surface. Since the upper and lower balance cavities are vented at the hinge line, the pressure in the upper cavity drops, creating a pressure differential across the balance panel. Reference to figure 6-4 will show how this differential in balance bay pressure acts on the balance panel to reduce the control surface hinge movement. Thus, with surface power control off, the airplane may be controlled sufficiently at moderate airspeeds to execute required maneuvers. This system compensates for approximately 80% of the normal airload on the control surface and the pilot must overcome the remaining 20% during normal maneuvering.

#### Aileron Overbalance

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

### DESCRIPTION

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 6-5. 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.

### CONDITIONS

The conditions under which buffeting can be expected to be encountered can best be presented by reference to figure 6-5 using the following conditions: An airplane weighing 110,000 pounds gross weight cruising 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 at 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 pitchup causes further separation, hence more pitchup. The pitchup can be controlled with the elevator for a limited range of Mach numbers but, as the Mach number is increased, the condition becomes uncontrollable.

### OPERATION

High Mach number buffeting should be avoided because the irregular airloads cause damage to the wing trailing edge structure, flaps, flaperons, and ailerons.

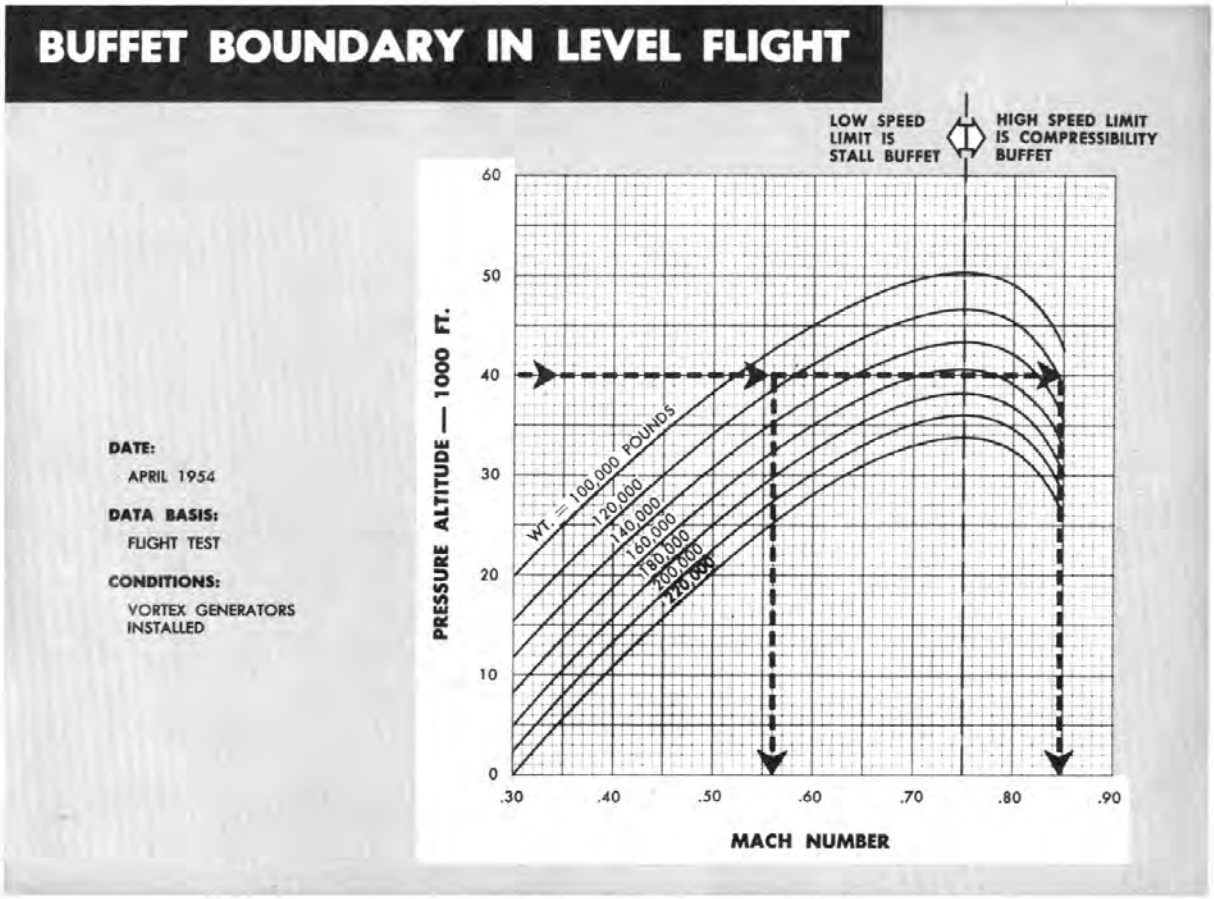



*Figure 6-5.*

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 Mach . 75. 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 pullups 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 5-5 that initial buffeting will be encountered at approximately 47.5° angle of bank with a load factor of approximately 1.48 "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 5-5 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 reduction in airspeed is difficult to accomplish at altitude due to the high minimum obtainable rpm (see "Fuel Regulator Minimum RPM Chart" in part 6 of the appendix) and due to the aerodynamic cleanness of the airplane.
- A very slight nose-down attitude will result in increasing airspeed and will amplify the buffeting condition.
- 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 pitchup 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 pitchup of the airplane, if unrestricted by the pilot, could cause structural damage to the 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 pitchup 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.

## FORMATION FLYING

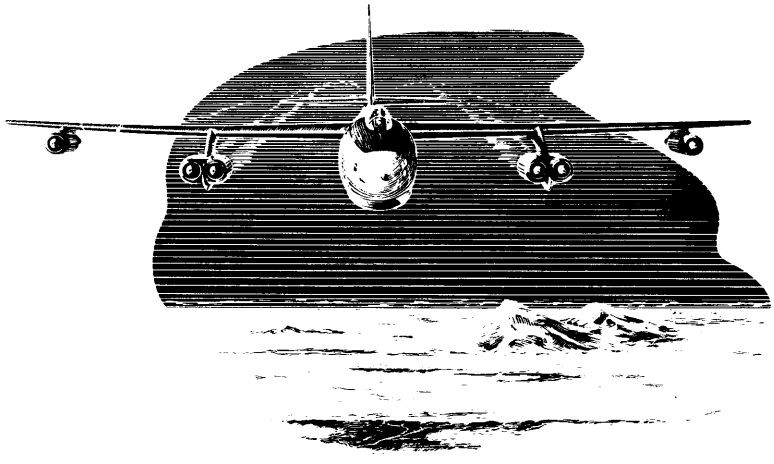
It is a commonly known fact that airplanes flying in formation disturb each other aerodynamically. Control force changes must be made when moving about in close proximity to another airplane if undesired motion is to be avoided. The significant interference is wingwash. The wingwash effect of one B-47 on another is directly related to vertical separation and

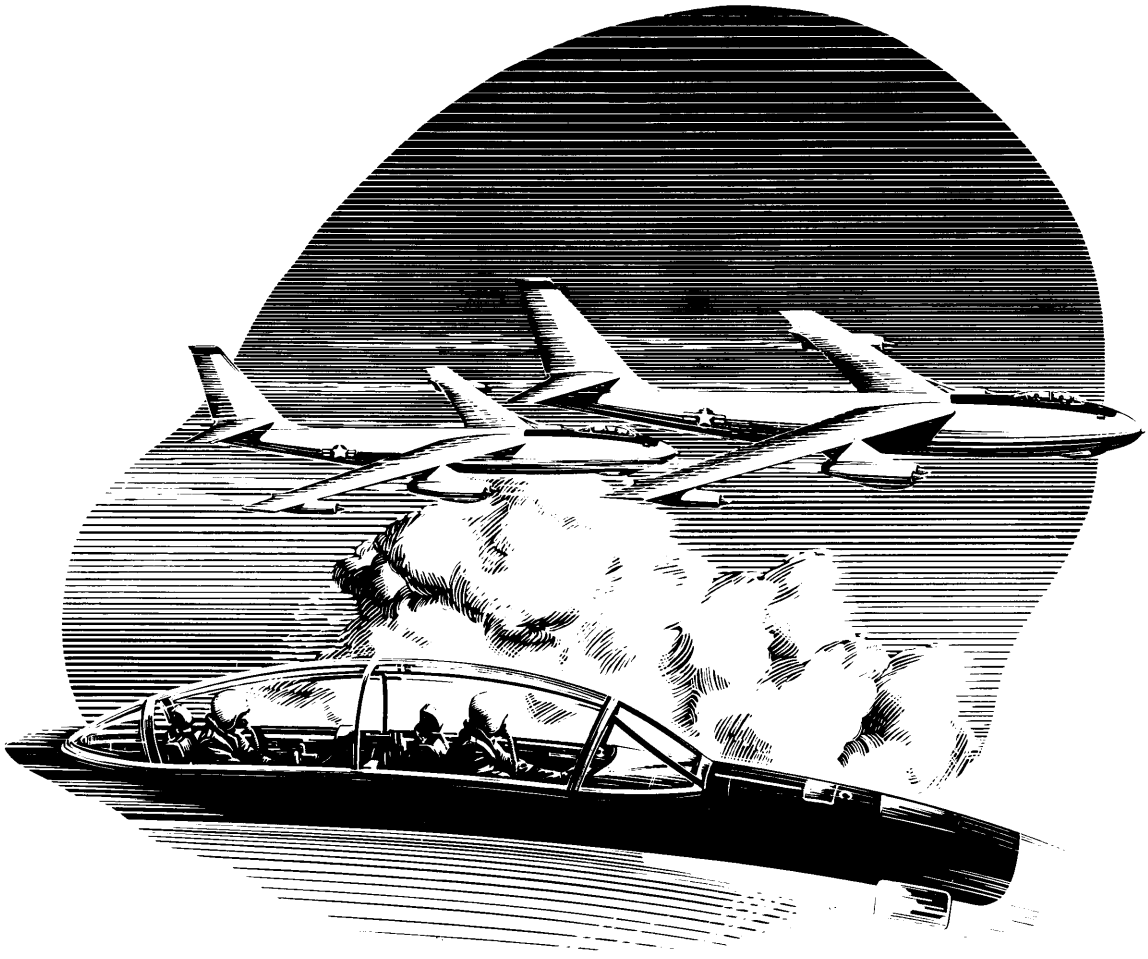
lateral proximity. The greater the vertical spacing, the smaller is the effect, and conversely, the smaller the vertical spacing, the greater is the effect.

**WARNING**

When the airplane is flown into the downwash of another B-47 airplane, the lower airplane must assume a nose-high attitude in order to maintain formation position. If for any reason the lower airplane moves forward out of the downwash, a sudden gain in altitude will result due to the nose-high attitude. This results in a dangerous condition which requires an instantaneous and positive forward control pressure by the pilot in order to avoid a midair collision. If separation between the airplanes is not great enough, even this action may not avert a collision as the initial forward control pressure may cause the empennage to make contact with the underside of the upper airplane.

It is generally true that wingwash interference effects increase with decreasing airspeed. Likewise, the extension of wing flaps distorts the wing wake in a manner to increase the disturbance. The hazard of extremely close formation flight is increased when flying at low speeds with the flaps extended on the upper airplane. Formation flying in the airplane should present no problem if the wing man maintains a position where the lead airplane is easily viewed and clearance is adequate. If extremely close formation is encountered for any reason, be on guard against large interference forces but avoid abrupt control movements. For limitations in formation flying, refer to "Formation Flying Limitations," section V.





# SYSTEMS OPERATION

7

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## ENGINE OPERATION

### COMPRESSOR STALL

#### Hot Stall

During some phases of J47-23 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 airflow. Rapid throttle advancement (attempting to accelerate engine rpm beyond its normal rate of acceleration) causes a stall of several middle stages of the compressor. This is likely to occur if excessive throttle manipulation is necessary. 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 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 to idle immediately and left at idle long enough to allow stabilization of airflow through the engine and some cooling of the hot parts. After the EGT has returned to a normal level, an attempt to regain rpm may be made with the throttle being advanced more slowly. It is possible for the stall to continue after advancing the throttle if sufficient time has not been allowed for airflow stabilization and cooling of hot parts. If this occurs, the procedure should be repeated. Compressor stalls may 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 airflow 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 usually 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.

### Engine Stall Prevention

To help prevent engine compressor stalls, a fuel regulator sensing pressure bleed system is provided for controlling the rate of engine acceleration. The airplane is equipped with an engine stall prevention (ESP) 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 formation flying, jet penetration, 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 is increased, and on a 100° F day may require as much as 30 seconds to accelerate from idle to 100% rpm.

## 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:

1. 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. The maximum obtainable rpm shall be no less than 93%.
2. While flying at 35,000 feet at 230 knots to 250 IAS with engine stall prevention switch OFF, no unrecoverable engine stall or "flame-out" should occur during slow advance of the throttle. The maximum obtainable rpm shall be no less than 97%.

**NOTE**

An rpm check with the engine stall prevention switch ON is not required at altitudes above 25,000 feet.

Engines which exhibit unrecoverable compressor stall are 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 the 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 above conditions, the engine acceleration schedule should be checked to obtain the fastest possible acceleration. If full advance of the acceleration schedule has been obtained and the rpm drop-off exceeds the above limits, the engine should be replaced.

## ENGINE "CHOO-CHOO"

Engine "choo-choo" is caused by rapid changes in engine thrust brought about by oscillating or fluctuating fuel flow to the engine combustion chambers. The occurrence of engine "choo-choo" may be identified by the following abnormal characteristics:

- The airplane is subjected to an unusual vibration
- The unusual sound resembling that of a steam locomotive emits from the "choo-chooing" engine.

Engine "choo-choo" is more common during the warmer seasons of the year. It is most likely to occur during engine start and runup below 85% rpm, but can happen up to 100% rpm. Also, it may occur during flight as a result of throttle cutback from military rated to cruise rpm. When "choo-choo" occurs in flight, it can usually be corrected by short fast throttle movements. If such movements fail to stop the "choo-choo," position the fuel selector switch for the affected engine to ME. This

will accomplish the desired effect of changing the fuel pressure slightly at the inlet of the engine fuel pumps and will very often stop the "choo-choo."

**NOTE**

Before any fuel selector switches are moved to ME, at least one fuel selector should be set to TME to insure pressurization of the manifold.

If the "choo-choo" condition is uncontrollable in flight, the engine should be shut down. After shutdown, it is sometimes possible to restart the engine after 5 minutes of cold-soaking at altitude, and then avoid "choo-choo" by accelerating to the desired rpm as quickly as EGT control will permit. Several procedures can be used to eliminate "choo-choo" on the ground:

1. Draining the old type accumulator (antisurge line) prior to flight.
2. Installing an accumulator on engines not so equipped.
3. Selecting ME on affected engine.
4. Changing fuel system components.

### FUEL REGULATOR SURGE

On some airplane engines, a phenomenon known as "fuel regulator surging" may exist. This is an inherent characteristic of the fuel regulator and is caused by erratic motion within the regulator which sets up a vibration similar to engine "choo-choo" but, unlike engine "choo-choo," there is no emission of audible sound. Fuel regulator surging usually manifests itself in climbs at altitudes of between 17,000 and 30,000 feet at 85% to 96% rpm, and may be recognized by the unusual low frequency pulsations and moderate simultaneous fluctuations of the tachometer, fuel flowmeter, and EGT gage. The surging produces a thrust variation, and when this combines with the resultant fuel sloshing, an accelerating and decelerating sensation in flight may be produced. Fuel regulator surge is not cause for alarm as it is essentially an annoyance factor and fluctuations of ±1/2 rpm, ±200 pph, and ±10° C EGT can be expected. Changes in engine rpm or climbing out of the altitude range where the surge is usually encountered may minimize this condition or its effect.

### ENGINE FLAMEOUT

Engine flameout is the complete loss of combustion. In most cases, it occurs at altitudes above 40,000 feet as a result of a too rapid throttle movement. In most cases, engine flameout can be remedied by merely restarting the engine. Usually, engine flameout manifests itself with an explosion in the aft section of the engine and it may be accompanied by a slight vibration. The explosion is not considered dangerous. Following a flameout, the rpm and EGT will begin dropping at once. Although in most cases flameout is the result of a too rapid throttle movement, it can also be caused by a momentary malfunction of the fuel regulator.

### ACCELERATION HANGUP

Acceleration hangup is a type of malfunction in which the engine fails to accelerate past a specific comparatively low rpm. This hangup sometimes occurs after the throttle has been retarded and an attempt has been made to accelerate back to the higher rpm. Acceleration hangup often can be attributed to a faulty fuel flow regulator or a ruptured fuel control valve diaphragm. Engine shutdown is necessary if acceleration hangup occurs.

### RPM DROOP

An rpm droop below 100% rpm at full throttle can be detected on the engine tachometer. A small amount of droop (to 97% rpm) can be expected at high altitudes if the engine stall prevention switch is off. If the switch is on, the rpm can droop to approximately 93%. Excessive rpm droop is usually the result of improper engine adjustment or improper engine stall prevention switch setting. It often is necessary to replace the fuel regulator if excessive rpm droop is experienced.

### ENGINE OVERSPEED

Engine overspeed will be indicated by excessive rpm, fuel flow, and EGT. Immediate retarding of the throttle is necessary to return readings to safe limits. The primary causes of engine overspeed are improper adjustment of the engine high speed stop or failure of the overspeed control governor in the main fuel regulator.

### 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. The air 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.

### EFFECTS OF OVERTEMPERATURE ON ENGINE LIFE

Overtemperature conditions have a definite detrimental effect upon engine parts and, when encountered, a decrease in engine life can be anticipated. The parts most likely to be affected are the turbine wheel, transition section, nozzle diaphragm, and tailcone. Of these,

overtemperature of the turbine wheel is the most serious and, if the engine has been severely overtemperatured, turbine wheel life is jeopardized accordingly. A small increase in EGT above the limits given in T. O. 2J-J47-539 results in a large increase of turbine wheel stress and a rapid decrease in turbine wheel strength. In an instance where the limits are exceeded, careful consideration should be given to the degree of overtemperature and the time spent at that condition before electing to continue operating the engine. Familiarization with the turbine wheel rejection curve contained in T. O. 2J-J47-539 will be helpful in determining action that should be taken for any specific occurrence.

## FUEL SYSTEM MANAGEMENT

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, a 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. When all auxiliary fuel has been consumed, the fuel in the forward, center, and aft main tanks should be distributed so as to maintain a favorable cg. 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. 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. Refer to figure 5-7 as a guide for maintaining proper cg limits and locations.

**NOTE**

Fuel gage error may be expected when using 100% 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 QUANTITY DATA LOADING CHART

Due to the location of the fuel cells along the longitudinal axis, proper fuel loading is imperative in order to establish a center of gravity within the takeoff limits. Although the cg is calculated on the weight and balance clearance (DD Form 365F), it is possible for a large error to exist due to a malfunctioning fuel gage or gages. In order that the pilot may accurately check the fuel loading, a Fuel Quantity Data Loading Chart (figure 7-1) is provided. This chart lists the fuel quantities before and after refueling or defueling. The quantities as listed are obtained from the pump flowmeter, the fuel quantity gages of the airplane, the single point refueling panel, and from a dipstick if necessary. If the "POUNDS DIFFERENCE" entry of the "TOTAL" column does not agree (within limits) with the "POUNDS FUEL DELIVERED" entry, the discrepancy must be investigated and corrective action taken. The chart will remain with airplane DD Form 781 until it has been checked and signed by the pilot during the Before Interior Inspection. Prior to flight this chart will be returned to the squadron engineering office. The chart may be destroyed 30 days after the date of verification by the pilot. Any transfer of fuel, engine runup, fuel system maintenance, etc, which would change the fuel load prior to flight will be noted and signed on the back of the chart.

**NOTE**

For complete information regarding use of the Fuel Quantity Data Loading Chart, refer to "Single Point Ground Refueling Procedure" in T.O. 1B-47B-2, Handbook Erection and Maintenance Instructions.

### 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. See figure 7-2 for typical fuel flow diagrams.

**NOTE**

Auxiliary tank to main tank transfer should not be accomplished with this system 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 may be accomplished by use of the fuel transfer valve switches.

# FUEL QUANTITY DATA LOADING CHART

## FUEL QUANTITY DATA LOADING CHART

Airplane Serial Number _____

Date Refueled _____ Date Defueled _____

| | | Forward Main | Center Main | Aft Main | Forward Aux | Aft Aux* | Forward Bomb Bay* | Aft Bomb Bay | External Wing Tank (L) | External Wing Tank (R) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ❶ POUNDS AFTER REFUELING | Pilot's Panel | 18,900 | 18400 | 22,100 | | | | 15,100 | | | 80,900 |
| | Copilot's Panel | 18,900 | 18,400 | 22,100 | | | | 15,100 | | | |
| | SPR Panel* | | | | | | | | | | |
| | Dipstick* | | | | 6400 | | | | X | X | |
| ❶ POUNDS BEFORE REFUELING | Pilot's Panel | 7000 | 4100 | 8000 | | | | 000 | | | 19,100 |
| | Copilot's Panel | 7000 | 4100 | 8000 | | | | 000 | | | |
| | SPR Panel* | | | | | | | | | | |
| | Dipstick* | | | | 000 | | | | X | X | |
| POUNDS DIFFERENCE | | 11,900 | 14,300 | 14,100 | 6400 | | | 15,100 | X | X | ❷ 61,800 |

*If applicable

REFUELING SOURCE FLOWMETER READING

| | |
|---|---|
| Gallons After Refueling | 9515 |
| Gallons Before Refueling | 00,000 |
| Gallons Difference | 9515 |
| Multiply By Fuel Density | 6.5 |
| Pounds Fuel Delivered | ❷ 61,848 |

❶ Readings will be taken from pilot's fuel panel, copilot's fuel panel, SPR control panel (if it contains gages) and, if possible, from sight gages or dipsticks for tanks that do not have capacitance-type gages. If the above tools are not available, see applicable directive or refer to "Single Point Ground Refueling Procedure" in T.O. 1B-47B-2, Handbook Erection and Maintenance Instructions. If readings vary by more than allowable tolerance of 2% of full scale readings of the respective gages, the airplane will not be refueled. If a difference exists between the gages for a specific tank and the difference is within the allowable tolerance, an average value will be used for computation. All discrepancies will be recorded in DD Form 781.

❷ If the refueling system is equipped with a reverse flowmeter between the outlet and relief valve, the difference between "POUNDS FUEL DELIVERED" (as computed in the right-hand chart) and the "POUNDS DIFFERENCE" entry of the "TOTAL" column (as computed in the left-hand chart) must not exceed 3%. If the refueling system is equipped with a nonreverse flowmeter and the return line is between the meter and the outlet, the discrepancy may be slightly larger than 3%. Any discrepancy larger than the above allowances must be investigated and corrective action taken. All discrepancies will be reported in DD Form 781.

**NOTE**

This form will remain with DD Form 781 until it has been verified by the pilot during the Before Interior inspection. The pilot will review the fuel loading to assure that the airplane has the fuel quantities noted on the form. Prior to flight this form will be returned to the squadron engineering office. The form may be destroyed 30 days after the date of verification by the pilot. Any transfer of fuel, engine runup, fuel system maintenance, etc, which would change the fuel load prior to flight must be noted on this sheet. Sign each notation.

REMARKS: (Record any explanations or irregularities necessary to make this form a true picture of the refueling accomplished.)

I certify that I have personally verified all fuel readings and computations recorded on this form.

(Name) (Grade)
REFUELING OFFICER

(Organization) (Date)

(Name) (Grade)
PILOT

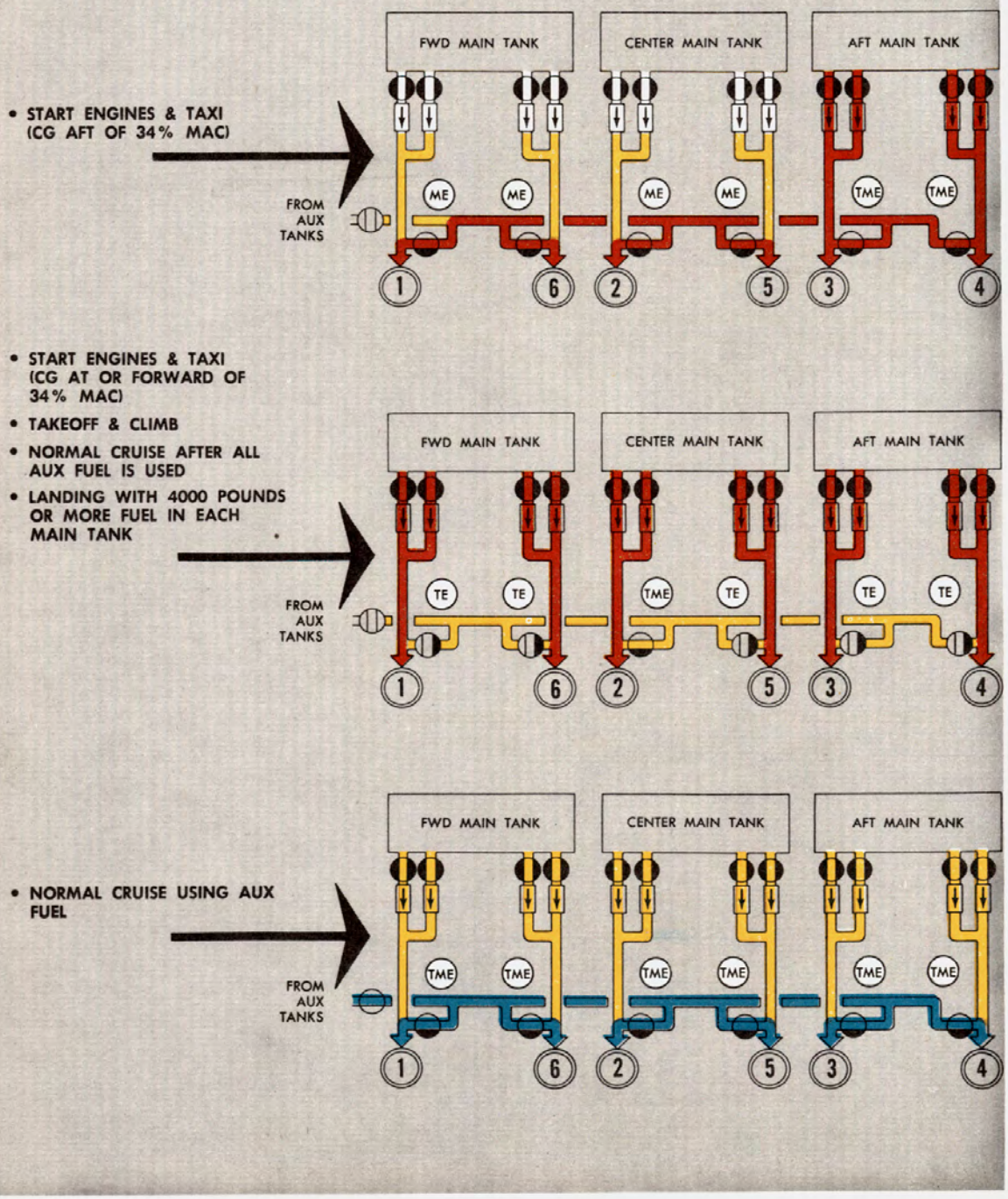
(Organization) (Date)

Figure 7-1.



049933

# FUEL SYSTEM MANAGEMENT



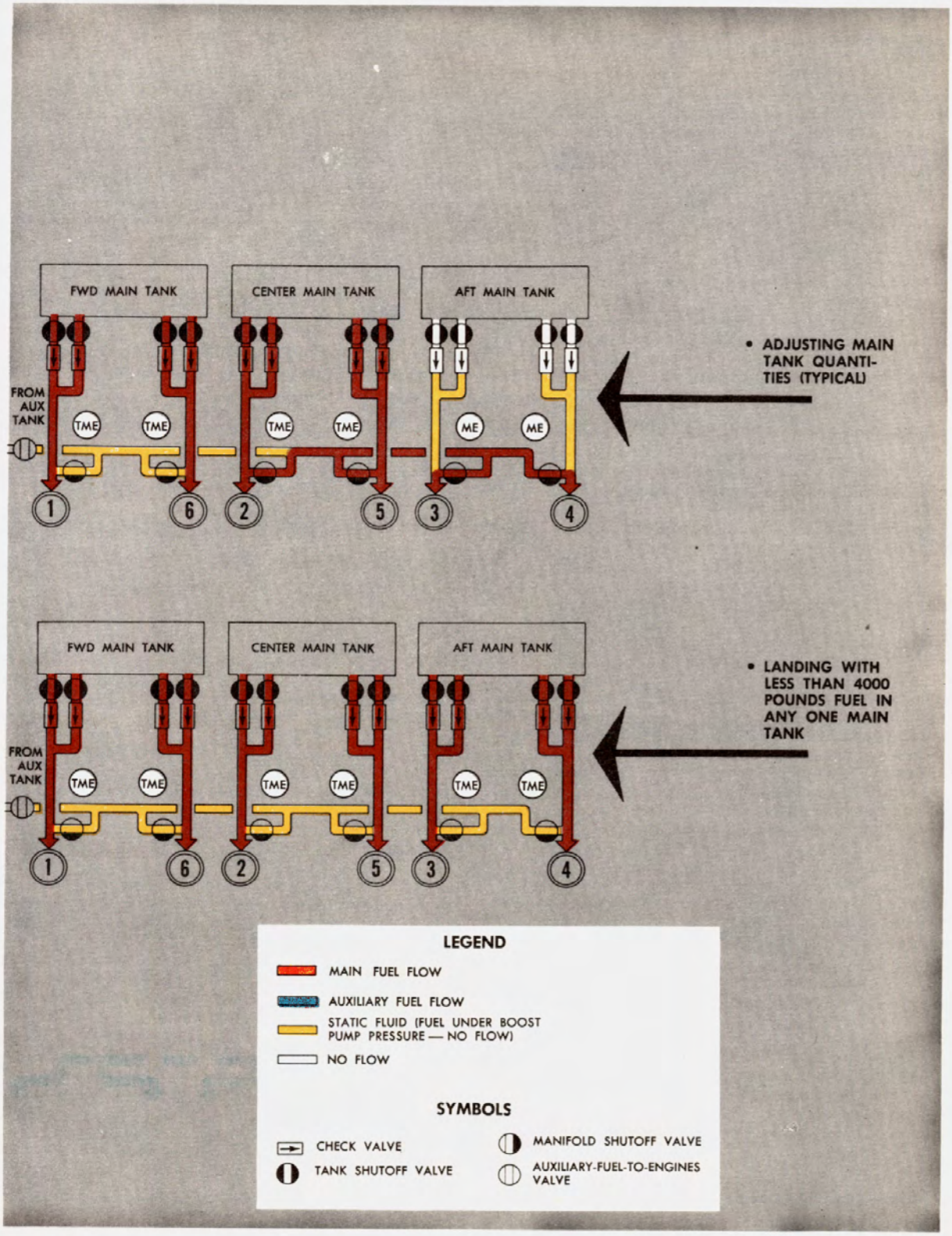

FWD MAIN TANK
CENTER MAIN TANK
AFT MAIN TANK
FROM AUX TANK
TME
ME
1
6
2
5
3
4
• ADJUSTING MAIN TANK QUANTITIES (TYPICAL)
• LANDING WITH LESS THAN 4000 POUNDS FUEL IN ANY ONE MAIN TANK
LEGEND
MAIN FUEL FLOW
AUXILIARY FUEL FLOW
STATIC FLUID (FUEL UNDER BOOST PUMP PRESSURE — NO FLOW)
NO FLOW
SYMBOLS
CHECK VALVE
TANK SHUTOFF VALVE
MANIFOLD SHUTOFF VALVE
AUXILIARY-FUEL-TO-ENGINES VALVE
049014

*Figure 7-2.*

### 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 (except for system check) during ground operation. The following procedures should be used as determined by the cg location in % MAC:

- With the cg at or forward of the aft flight limit, 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 the aft flight limit, 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 to be within cg limitations 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.

**WARNING**

If any one main tank has 4000 pounds or less, pilot places all fuel selector switches to TME. This will insure maximum fuel flow to all engines in case any main tank becomes completely empty.

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. When auxiliary fuel is to be used, turn off all auxiliary tank boost pumps except as necessary to begin normal fuel feed to engines.

**NOTE**

No auxiliary fuel transfer or usage is accomplished during ground operation or takeoff except that used in checking the system.

**WARNING**

All fuel selector switches should never be placed in the ME position simultaneously during engine operation because a drop in engine rpm may occur and a reduction in available thrust would occur. The main tank boost pumps would be deenergized. When using fuel from the main tanks, fuel would reach the engine-driven fuel pumps by gravity flow only.

### During Cruise

If auxiliary fuel usage was not started during climb, as soon as possible after reaching cruise altitude, place all fuel selector switches on TME, place auxiliary-fuel-to-engines switch in VALVE 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 is 1) bomb bay tank and 2) forward auxiliary tank.

**NOTE**

The pilot may, at his discretion, deviate from the recommended sequence for auxiliary tank selection in order to maintain optimum cg position during flight.

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.

**NOTE**

In any auxiliary tank with two boost pumps, one pump 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 the proper sequence until all auxiliary fuel 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. Monitor fuel gages as necessary to ensure 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 ensure maximum fuel flow to all engines in case any main tank becomes completely empty.

## TRIM COORDINATION SYSTEM

The airplane is trimmed by conventional trim control wheels at the pilot's and copilot's stations regardless of whether surface power control is on or off. Operation of a trim control wheel under either condition produces trim in a somewhat different manner; however, the trim effect is the same. With the control power off, movement of any trim control wheel 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 wheel 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 neutral position. Neutral position ("hands off") is determined by the trim tab wheel setting. 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. 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 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

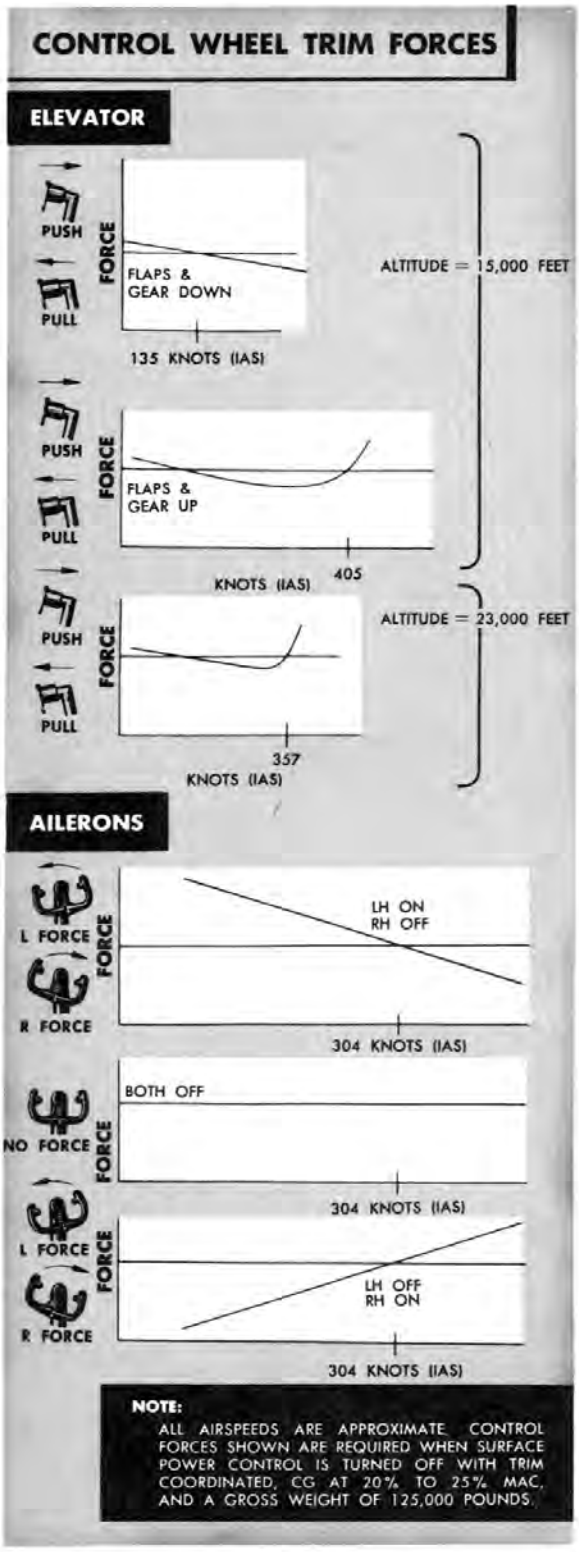



*Figure 7-3.*

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 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 trim control wheel 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. It should be noted in figure 7-3 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 7-3 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 a low speed crossover point. 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. 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

**NOTE**

When trimming the airplane for lateral stability, use the control wheel to "load" the aileron trim wheel. Do not attempt to trim by using the aileron trim wheel with hands off the control wheel. Friction within the aileron system and the "lag" response of the aileron centering spring are such as to cause an out-of-trim condition if trimmed with aileron trim wheel alone. Excessive trim is likely to be cranked in before the system moves and then the aileron centering spring overshoots the desired trim. In such a case, a roll condition could exist in the event of complete aileron surface power control failure. This remote situation is more severe before "Trim Coordination" has been completed.

The recommended altitude for trim coordination procedure is 15,000 feet with 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**

- During an elevator trim check, if 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.

- At any of the following airspeeds, if 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.

1. At 250 knots IAS:

a. With all surface power control switches in ON position, trim airplane to fly straight and level, "hands off."

b. 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.

c. 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 7-3).

d. Turn left aileron power control switch OFF. With both aileron power control systems off, forces will be zero if properly equalized in steps "b" and "c."

**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.

e. Record rudder and elevator trim with rudder-elevator power control switch in ON, then switch to OFF position. 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.

2. At 304 knots IAS:

a. With all surface power control switches in ON 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 ensure accurate trim.

b. 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.

c. 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.

d. 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 "b" and "c" until zero force is obtained with both aileron power control switches OFF.

**NOTE**

- Any out-of-trim condition which remains if steps "b" and "c" 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; 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.

e. Record rudder and elevator trim with rudder-elevator power control switch in ON, then switch to OFF position. Trim out any yaw force with the rudder trim coordination switch. Elevator may be trimmed out with 10 to 20 pounds pull-force left on.

**NOTE**

No further checks are made at 15,000 feet altitude. Proceed to 23,000 feet and accomplish the remaining elevator check.

3. At 357 knots IAS:
This rudder and elevator check is performed at 23,000 feet. Check elevator forces as previously instructed; at this speed, they should be equalized (figure 7-3). 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.

4. 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.

## BRAKE SYSTEM OPERATION

### NORMAL BRAKING (ANTISKID)

Use of the antiskid system during normal braking results in more efficient braking, shorter stopping distances, and reduced tire wear when compared to braking without antiskid. With antiskid operating, brake application may be started immediately after touchdown provided the weight of the airplane has settled firmly on both main gear and any tendency to skip or bounce has been terminated. If a bounce does occur and is of sufficient height to release the squat switches, the antiskid system will be deenergized and subsequent braking will be without antiskid. The full landing roll should be utilized whenever possible to take advantage of aerodynamic braking and to minimize use of the brakes. Continuous braking from the point of touchdown will result in considerable overworking of the antiskid system in addition to causing excessive wear and extreme heating of the brakes. Achieving proper cycling of the antiskid is essential if the shortest landing roll is to be obtained. 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 releases the brakes. Heavier pedal pressure will cause inefficient excessive 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 of the landing roll.

### EMERGENCY BRAKING (NO ANTISKID)

Use extreme care when operating the emergency brake system. A heavy brake pressure can result in locking the wheel more easily if brakes are applied immediately after touchdown than if the same amount of pressure is applied after the full weight of the airplane is on the wheels. A wheel once locked in this manner immediately after touchdown will not become unlocked as the load is increased as long as brake pressure is maintained. Proper braking action cannot be expected until the tires are carrying heavy loads.

### TIRE SKIDDING

Brakes, themselves, can merely stop the wheel from turning, but stopping the airplane is dependent on the friction of the tires on the runway. For this purpose it is easiest to think in terms of coefficient of friction, which is equal to the frictional force divided by the load on the wheel. It has been found that optimum braking occurs with approximately a 15% to 20% rolling skid;

the wheel continues to rotate but has approximately 15% to 20% slippage on the surface so that the rotational speed is 80% to 85% of the speed which the wheel would have, were it in free roll. As the amount of skid increases beyond this amount. the coefficient of friction decreases rapidly so that with a 75% skid the friction is approximately 60% of the optimum and, with a full skid, becomes even lower. There are two reasons for this loss in braking effectiveness with skidding. First, the immediate action is to scuff the rubber. tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. NACA figures have shown that for an incipient skid with an approximate load of 10, 000 pounds per wheel, the coefficient of friction on dry concrete is as high as . 8, whereas the coefficient is of the order of . 5 or less with a 75% skid. Since the coefficient of friction goes down when the wheel begins to skid. it is apparent that a wheel, once locked, will never free itself until brake pressure is reduced so that the braking effect on the wheel is less than the turning moment remaining with the reduced frictional force.

### BRAKE COOLING

It is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the slipstream, and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling between brake applications. Additional time should be allowed for cooling if brakes are used during taxiing operation, or if a series of landings are performed. After the brakes have been used excessively for an emergency stop and are in the heated condition, the airplane should not be taxied into a crowded parking area or the parking brakes set. Peak temperatures occur in the wheel and brake assembly from 5 to 15 minutes after a maximum braking operation. To prevent brake fire and possible wheel assembly explosion, the specified procedures for cooling brakes should be followed.

## AUTOMATIC PILOT

### FLIGHT CHECK OF THE AUTOMATIC PILOT

Flight conditions recommended for flight test of the automatic pilot are as follows (except for otherwise noted):

- Approximately . 74 Mach
- 100, 000 to 135, 000 pounds gross weight
- Approximately 35, 000 feet altitude
- Cruise cg between 20% and 28% at 0 (±1 1/2) elevator trim units
- Airplane manually trimmed for straight and level flight with balanced power and surface power control systems ON
- N-1 compass synchronized for magnetic slaved operation (section IV)
- Automatic pilot ON and ENGAGED and altitude controller ON (section IV).

**NOTE**

During heading drift, wander, or oscillation, note corresponding readings on the N-1 master indicator at the observer's station.

Any marked departure from the values listed in the following checkout procedure indicates abnormality of the automatic pilot or related equipment:

1. Overpower Transients

Manually displace controls of each axis by momentarily overpowering the servos. Controls should return to neutral and the airplane to its previous attitude from displacements in either direction. Yaw and roll may overshoot once in returning to the initial attitude but the airplane should become stabilized on the initial attitude in less than 10 seconds. After release from a pitch overpower transient, the pitch angle should approach the initial pitch angle within ±1° with no more than five cycles of oscillation (approximately 4 seconds per cycle).

2. Pitch Operation

a. Check action of pitch knob (altitude control OFF). The elevator trim wheel shall rotate in a direction to zero the elevator trim meter. Pitch oscillations, if any, should remain within the following limits:

- Amplitude of oscillation ±200 feet
- Period (length of time to complete each cycle) of oscillation between 100 and 150 seconds per cycle
- Mach number should not change more than ±0. 02.

b. Check that rate of climb is stabilized at "0." Turn altitude controller ON and note that engage error does not exceed 75 feet (engage error is defined as the difference between the altitude immediately prior to engagement and the average altitude after engagement). Pitch oscillations, if any, after engagement should remain within following limits:

- Amplitude of oscillation ±40 feet
- Period of oscillation not less than 30 seconds per cycle
- Mach number change should not exceed ±0. 02.

**NOTE**

Opening bomb bay doors with altitude control ON will cause airplane to pitch up slightly.

3. Roll Operation

Check for aileron wallow. The amplitude of roll oscillation, if any, should not exceed ±2° roll angle (approximately ±2 feet of wing tip vertical travel). The typical period of roll oscillation during aileron wallow is 3 (±1/2) seconds per cycle.

4. Turn Knob Operation

Rotate turn knob to full displacement each direction. Aileron wheel should return quickly to approximately neutral while turn knob is in a fully displaced position. Maximum bank angle should read 39° (±5°) on the pilot's attitude indicator.

5. Aileron Limit Switch Operation

**NOTE**

- Altitude and airspeed suggested for this check are 15,000 feet and 230 to 240 knots IAS.
- Rudder and aileron engaging switches are moved to disengage leaving only the elevator axis engaged.

When the aileron control wheel is turned manually to full displacement in either direction, the elevator axis should disengage at approximately 90° of aileron wheel rotation. Disengagement should be positive and sure.

6. Yaw-Roll

a. Check for northerly heading oscillations on N-1 compass master indicator (N-1 compass latitude correction OFF). Azimuth oscillation can occur with induced roll and should not exceed the following:

- Amplitude of roll angle ±2°
- Amplitude of heading oscillation ±3 1/2° of actual airplane heading
- Period of oscillation should be between 140 and 160 seconds per cycle.

**NOTE**

Pilot's N-1 compass repeater should show an azimuth oscillation less than the actual airplane heading oscillation (approximately ±2° maximum on pilot's repeater).

b. Check easterly or westerly heading oscillations. Azimuth oscillation can occur with induced roll and should not exceed the following:

- Amplitude of roll angle ±1/2°
- Amplitude of heading oscillation ±1/2° of actual airplane heading
- Period of oscillation should be between 120 and 150 seconds per cycle.

c. Set N-1 master indicator to local latitude. Amplitude of heading oscillation shall not exceed ±0.3°. Period of oscillation is typically between 50 and 80 seconds per cycle.

7. Turn Coordination (N-1 compass on latitude correction)

Perform 90° turn in each direction at approximately 30° bank angle. The following acceptable limits should not be exceeded:

- Steady state uncoordination not to exceed 1/4 ball width
- Wing low upon rollout not to exceed 2° bank accompanied by maximum of 2° skid
- Uncoordinated condition upon rollout nonexistent within 2 minutes
- Initial altitude loss of not more than 100 feet with the altitude control ON and should be nearly regained by the completion of the turn.

**NOTE**

- With the altitude control OFF, a loss of altitude in turns can be expected unless pitch trim is adjusted accordingly.
- Rudder pumping and aileron oscillations (frequency approximately 1 cps) may occur during turns and should not exceed ±1 aileron trim needle width and ±1/2 rudder trim needle width.

8. Control "Jitter" or "Kicks"

a. Amplitude of oscillation during jitter, if any, should not exceed ±1/4 trim needle and/or ±1/8 inch on controls. The typical jitter is a control oscillation of between three and five cycles per second. Check operation of automatic pilot on both main and secondary inverters in turns; aileron wheel jitter of ±1/2 inch maximum may be expected with some inverters during turns.)

b. Random control movements (kicks) other than switching transients should not exceed ±1/3 inch.

9. Bombing Navigation System Operation of Automatic Pilot

Set N-1 compass on local latitude. Switch turn control transfer switch to transfer directional control of the automatic pilot to the radar bombing navigation system for automatic operation with a 15° PDI offset reading each direction. Note the following:

**NOTE**

The aileron limit switches provide a possibility of a nuisance disengagement of the automatic pilot during BNS automatic operation. Such nuisance disengagement is prevented by manually restraining the aileron control wheel rotation to just short of its 90° position.

- Bank angle should not exceed approximately 36°.
- Turn should be completed within 20 seconds without undue oscillation.
- Stabilization on new heading should be complete within 2 minutes as specified in step "7."

10. ILS Approach (See charts, section IX)

a. Complete a manual approach to check proper operation of the AN/ARN-14 and AN/ARN-18 radios and the ground facilities.

b. Complete an automatic approach as described in section IX to check the following:

• The initial bracketing of the localizer beam shall not result in more than two overswings

• Interception of the glide slope shall be accomplished with no more than one overswing.

## CABIN PRESSURIZING 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 Air Conditioning 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:

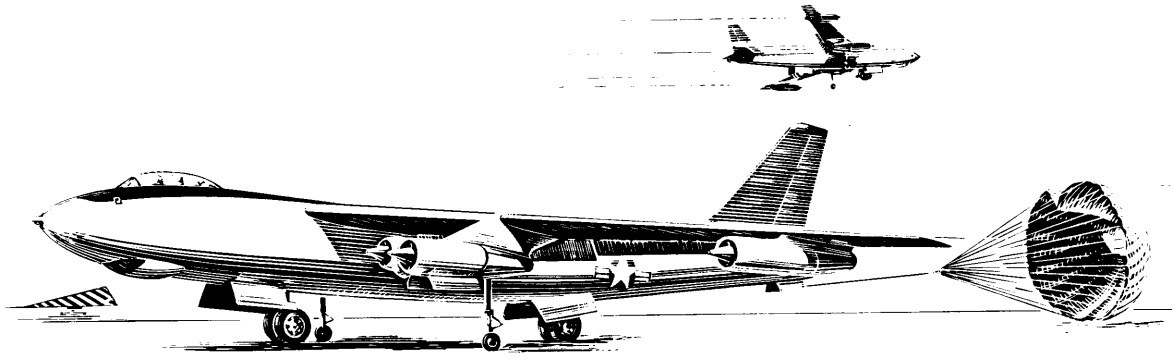
1. Pull emergency cabin pressure release handle to full-up position and note cabin and airplane altitudes equalize to 10,000 (±900) feet.
2. A decrease in air velocity and volume from the crew outlets should indicate that ram air system is operating.
3. Push emergency cabin pressure release handle to 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 without altimeter correction cards, note that cabin altitude is 6300 (±1500) feet.

#### Normal-to-Combat Pressure Schedule Check

1. 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 (±1,200) feet. Place cabin pressure regulation selector switch in COMBAT position and note that cabin altitude rises to 16,900 (±1,400) feet.
2. Move the cabin pressure regulation selector switch back to NORMAL and note a decrease in cabin altitude after 10 minutes to 10,250 (±1,200) feet.



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## INTRODUCTION

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.

**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 airplane 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 copilot or the pilot will monitor the automatic 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.
- In the event decompression or a similar emergency occurs at altitudes above 10,000 feet, both the pilot and copilot will remain at the controls on 100% OXYGEN until correct functioning of the oxygen system is verified. Any assistance to injured personnel or victims of hypoxia should be rendered by the observer or extra crew members if aboard.
- 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.

# CREW COORDINATION

| 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. In addition to his regular function, the copilot will perform the following: | The observer performs all navigation, bombing, and photographic functions of the air crew in coordination with the pilot and copilot. This is accomplished by operation of the radar bombing-navigation system, photographic equipment, radar rendezvous equipment and, in some cases, the periscopic sextant. |
| **MISSION PREPARATION** | | |
| 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. Coordinates with observer. | Accomplishes flight planning in coordination with copilot, including route planning, celestial precomputation, bombing precomputation, and radar rendezvous planning. See 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, and weather. | Attends specialized briefing with pilot. | Accomplishes target study on assigned targets.<br><br>Attends specialized briefing when applicable. |
| **CREW INSPECTION** | | |
| Conducts crew inspection. | Attends crew inspection. | Attends crew inspection.<br><br>Gives time hack and briefs crew on any necessary changes in flight plan. |

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| **PREFLIGHT** | | |
| Enters airplane and performs Interior Preflight Inspection. | Assists pilot. | Upon arrival at the airplane, the observer performs the following:<br>• Exterior Inspection.<br>• Interior Inspection.<br>• Accomplishes complete preflight of all observer equipment in accordance with checklist.<br>• 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** | | |
| Starts engines. | Assists in starting engines. | Performs final exterior check, if required, in accordance with Before Starting Engines checklist. |
| Communicates with ground crew during starting of engines to assure that area is clear and fire guards posted. | 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 radar bombing-navigation system on airplane power. See Aircraft Power checklist. |
| **BEFORE TAKEOFF** | | |
| 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. | |

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| **TAKEOFF** | | |
| 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 "Flaps 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** | | |
| 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 airplane position to make good desired track. Performs oxygen and instrument checks. |
| **LEVEL OFF** | | |
| 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** | | |
| 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 navigational 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. | |

| PILOT | COPILOT | OBSERVER |
|---|---|---|

## BEFORE PRE-IP

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 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 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.

| PILOT | COPILOT | OBSERVER |
|---|---|---|
| **AFTER RELEASE** | | |
| Pilot or copilot coordinates Bombs Away checklist with observer. | | |
| Holds bomb release heading until cleared to turn by the observer.<br><br>Places airplane on new heading. | | Performs Bombs Away checklist and Post Release procedures in coordination with pilot and/or copilot. |
| **CELESTIAL** | | |
| Transfers automatic pilot to second station on request of observer when PDI is centered.<br><br>Monitors position of airplane at all times. | | Performs Celestial Navigation procedures in coordination with copilot as prescribed in checklist. |
| **DESCENT** | | |
| Calls for Before Descent and Before Landing checklists. | Completes Before Descent and Before Landing checklists. | Monitors letdown and approach by radar.<br><br>Performs airborne radar letdown and approach, if required, in accordance with checklist. |
| **BEFORE LANDING** | | |
| Rechecks completion of Before Landing checklist. | Insures completion of Before Landing checklist. | Performs APS-64 Turnoff procedure in accordance with checklist at pilot's discretion.<br><br>Fastens and locks safety belt and shoulder harness. |
| **AFTER LANDING** | | |
| Calls for After Landing checklist. | Completes After Landing checklist. | Completes Turnoff and Landing checklist. |
| **POSTFLIGHT** | | |
| Completes Postflight checklist. | Completes Postflight checklist. | Completes Postflight checklist. |

## OBSERVER'S CHECKLIST

# RELEASE SYSTEM CHECKS

(THIS CHECK WILL NORMALLY BE PERFORMED PRIOR TO STATION TIME.)

### SW PRELOADING AND U-2 RELEASE SYSTEM CHECK

**Preloading Inspection**

1. Guards - POSTED
   Post armed point guards for and aft.

2. DD Form 781 Series - CHECKED
   Check for entries pertinent to bombing and release systems.

3. Ringout Certificates - CHECKED
   Check for U-2 release system and wiring ringout certificates in DD Form 781 (maneuvers and EWP only).

4. Fuel Loading - CHECKED
   If N-1 dolly is to be used, fuel load must be less than 70%.

5. Tires & Struts - INFLATION CHECKED
   Check for normal inflation.

6. Towbar & Towing Vehicle - IN PLACE (N-1 loading only)

7. External Power Unit - POSITIONED
   Position external power unit downwind at full cable length from airplane.

8. Fire Extinguisher - IN PLACE
   Place a 50-pound or larger $CO_2$ fire extinguisher at external power unit.

9. Fire Guard - POSTED
   Post a fire guard at the external power unit.

10. K-2 Slings, Bomb Door Suspension Device & Security Curtain - IN PLACE
    Check that items are available for use when required.

11. Bomb Door Safety Locks - INSTALLED

12. Air Pressure - 1500 PSI

13. Arming Control
    a. Position - CHECKED
       Forward position for Mk 5, aft position for Mk 6 or Mk 18.
    b. Supporting Bolts - SECURE
    c. Electrical Connections - SECURE & SAFETIED
    d. U-1 Manual Arming Knob - CHECKED
       Check for normal arming and safeing operation, noting action of warning flag. Leave in SAFE position.
    e. Safeing Cable - CHECKED
       Check for proper length and rigging.

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

f. Pullout Cables - INSTALLED & SECURE
Use CF-609 for Mk 6, CF-707 for Mk 5, CP 1093 for Mk 6 Mod 6.

14. U-2 Rack
a. Position - CHECKED
Forward position for Mk 5, Mk 6, and Mk 18.
b. Supporting Bolts - SECURE
c. Electrical Connections - SECURE & SAFETIED
d. Freedom of Movement - CHECKED
Check freedom of movement of hook with cocking wrench.
e. Rack - COCKED
Cock hook by forcing handle of cocking wrench aft (requires almost 180° travel of wrench).
f. Rack - LOCKED
Insert handle of cocking wrench into U-2 locking port, position other end into retaining clip, and fasten safety pin.

15. Sway Braces - INSTALLED, SAFETIED & FULLY RETRACTED

16. C-9 Hoist & Beams - INSTALLED & SAFETIED
a. Power Cables & Control Box - IN PLACE, DISCONNECTED
b. Hoist Chain - CHECKED
Check that chain is anchored in forward hole of adapter plate and stowed clear of bomb bay doors when closed.

17. IFI Toolbox - INSTALLED, TDC STRAPS ATTACHED

18. Nose Plate Stowage Bracket - INSTALLED

19. Bomb Bay Interphone Mike - TAPED HOT

20. K-2 Door Control Circuit Breaker - IN
Bomb salvo relay shield (left forward side of bomb bay).

21. Salvo Control Power Circuit Breaker - IN
Bomb salvo relay shield (left forward side of bomb bay).

22. Bomb Salvo Power Circuit Breaker - IN
Tail compartment power shield.

23. C-9 Hoist Circuit Breaker - IN
Left main power shield (forward wheel well).

24. FTB Circuit Breaker - IN
Left main power shield (forward gear well).

25. Bomb Arming Control Heater Circuit Breaker - IN
Left main power shield (forward wheel well).

26. U-2 Rack Heater Circuit Breaker - IN
Right main power shield (forward wheel well).

27. Radar Power Circuit Breaker - IN
Main AC power shield (top of entrance ladder).

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

28. IFC Circuit Breaker - OUT
    Radar power panel AC power portion (observer's compartment).

29. Bomb Indicator Light Circuit Breaker - IN
    Radar power panel.

30. Bomb Arming Circuit Breaker - IN
    Radar power panel.

31. Normal Bomb Circuit Breaker - IN
    Radar power panel.

32. Alternate Bomb Circuit Breaker - IN
    Radar power panel.

33. IFC Circuit Breakers (four) - OUT
    Radar power panel.

34. Interphone Circuit Breaker - IN
    Radar power panel.

35. Alternate Bomb Door Switch - OFF

36. Normal Bomb Door Switch - OFF

37. Bomb Door & Release Switch - MANUAL

38. Indicator Light Switch - OFF

39. Bomb Control Power Switch - OFF

40. Bomb Salvo Switch - OFF

41. Bomb Control Selector Switch - NORMAL

42. Pilot's Salvo Switch - CHECKED OFF

43. External Power - CONNECTED
    Connect external AC and DC power.

44. Main Inverter - ON

45. Secondary Inverter - ON

46. DC Voltage - FWD, L, or R BUS, 27.5 (±1.5) V

47. Unregulated AC Voltage - RH BUS, 115 (±5) V

48. Regulated AC Voltage - MAIN & SECONDARY BUS, 115 (±5) V

49. Pre-Start Switch - ON FOR 20 SECONDS

50. Function Switch - STAB

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

51. Pre-Start Switch - OFF

52. Altitude Switch - OFF

## U-2 RELEASE SYSTEM OPERATIONAL CHECK

1. Position & Interphone Check - COMPLETED
   a. Observer - NORMAL CREW POSITION, ON INTERPHONE
   b. A/C - NORMAL CREW POSITION, ON INTERPHONE
   c. Copilot - BOMB BAY PLATFORM, ON INTERPHONE
   d. Safety Observer - IN POSITION, ON INTERPHONE
      Safety observer will be positioned on ground to keep bomb bay doors and spoiler doors clear during entire release system check.
   e. Qualified Member of Ground Crew or Loading Crew - COPILOT'S SEAT, ON INTERPHONE

| | COMMAND (A/C) | RESPONSE (COPILOT or as indicated) | RESPONSE (OBSERVER) |
|---|---|---|---|
| | (Underlined items indicate action performed) | | |
| 2. | Alarm bell on in bomb bay | Alarm bell OK | |
| 3. | U-1 arming switch to ARM | Arming control ARMED | Armed, light ON |
| 4. | Pull emergency bomb arming safe handle | Arming control SAFE | Pulled, light OUT |
| 5. | U-1 arming switch to ARM | Arming control ARMED | Armed, light ON |
| 6. | U-1 arming switch to SAFE | Arming control SAFE | Safe, light OUT |
| 7. | Manual arming knob to ARM | Armed, arming control ARMED | Armed, light ON |
| 8. | Manual arming knob to SAFE | Safe, arming control SAFE | Armed, light OUT |
| 9. | Check door indicators Pilot's door indicator OPEN | | Door indicator OPEN |
| 10. | Indicator light switch ON | | a. ON #3, bomb indicator light ON<br>b. Rack locked light ON<br>c. Low pressure warning light OFF |
| 11. | Pull emergency bomb release | Hook OPEN | Pulled #3, indicator light OUT, locked light OUT |
| 12. | Cock U-2 rack | Rack COCKED | #3 bomb indicator light ON |
| 13. | Remove and stow locking wrench | Wrench STOWED or U-2 unlocked (copilot's seat) | Rack locked light OUT |
| 14. | Bomb power switch to ON | | Switch ON |

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

| | COMMAND (A/C) | RESPONSE (COPILOT or as indicated) | RESPONSE (OBSERVER) |
|---|---|---|---|
| 15. | Set BRIC to SELECT TEN BOMBS | | Select & 10 bombs, BRIC light ON |
| 16. | Depress and hold D-2 bomb release switch for 3 seconds | Hook OPEN | Depressed #3, bomb indicator light OUT |
| 17. | Cock U-2 rack | Rack COCKED | #3 bomb indicator light ON |
| 18. | External bomb door switch to OPEN | Switch OPEN (safety observer) | |
| 19. | Remove bomb door locks | Locks REMOVED (safety observer) | |
| 20. | External bomb door switch to OFF | Switch OFF (safety observer) | |
| 21. | Open hydraulic interconnect valve | Valve OPEN | |
| 22. | Emergency hydraulic pump switch to AUTO | a. Switch AUTO NORMAL<br>b. Pressure 2200 psi (copilot's seat)<br>c. Pressure 3000 psi (copilot's seat) | Bomb control power light ON (at 2200 psi) |
| 23. | Normal bomb door switch to CLOSED<br><br>Pilot's door indicator LOCKED | Doors CLOSED | Closed, bomb door indicator LOCKED |
| 24. | Depress & hold D-2 bomb release switch for 3 seconds | Hook remains CLOSED | Depressed, #3 bomb indicator light remains ON |
| 25. | Check that doors open each time before hook releases | ROGER | |
| 26. | Bomb control selector switch to SALVO | | In SALVO |
| 27. | Depress and hold D-2 bomb release switch for 3 seconds<br>a. Bomb release light OK | a. Doors OPEN and hook OPEN | a. Depressed, door indicator OPEN<br>b. #3 indicator light OUT |
| 28. | Closing bomb doors (pilot's switch)<br><br>Door indicator LOCKED | Doors CLOSED | Bomb door indicator LOCKED |

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

| | COMMAND (A/C) | RESPONSE (COPILOT or as indicated) | RESPONSE (OBSERVER) |
|---|---|---|---|
| 29. | Bomb control selector switch to NORMAL | | In NORMAL |
| 30. | Cock U-2 rack | Rack COCKED | #3 bomb indicator light ON |
| 31. | Pilot's salvo switch to SALVO for 3 seconds<br>a. Bomb release light ON | a. Doors OPEN<br>b. Hook OPEN | a. Door indicator OPEN<br>b. #3 indicator light OUT |
| 32. | Cock U-2 rack | Rack COCKED | #3 indicator light ON |
| 33. | Observer's alternate door switch to CLOSED | Doors CLOSED | CLOSED |
| | Door indicator LOCKED | | Bomb door indicator LOCKED |
| 34. | Observer's salvo switch to SALVO for 3 seconds<br>a. Bomb release light OK | a. Doors OPEN<br>b. Hook OPEN | SALVO<br>a. Door indicator OPEN<br>b. #3 indicator light OUT |
| 35. | Cock U-2 rack | Rack COCKED | #3 bomb indicator light ON |
| 36. | Closing bomb doors (pilot's switch) | Doors CLOSED | |
| | Door indicator LOCKED | | Bomb door indicator LOCKED |
| 37. | Set up for BNS release | | a. Wind dials - ZEROED<br>b. Function switch - NAV<br>c. Sighting switch - OB<br>d. ATF - 15 SEC<br>e. Trail - ZERO<br>f. Forward sighting switch - DEPRESSED<br>g. Set for release |
| 38. | Perform BNS release<br>a. PDI indicator light ON<br>b. PDI CENTERED (or correct as required) | | a. Function switch BOMB<br>b. Bomb door & release switch K2 AUTO |
| 39. | Bombs away<br>a. Bomb release light OK<br>b. Door indicators CHECKED | a. Doors OPEN<br>b. Hook OPEN<br>c. Doors CLOSED | a. #3 indicator light OUT<br>b. Door indicators CHECKED |
| 40. | Bomb door and release switch to MANUAL | | In MANUAL |

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

| | COMMAND (A/C) | RESPONSE (COPILOT or as indicated) | RESPONSE (OBSERVER) |
|---|---|---|---|
| 41. | Cock U-2 rack | Rack COCKED | #3 bomb indicator light ON |
| 42. | Perform BNS release<br>a. PDI CENTERED (or correct as required) | | a. Forward sighting switch DEPRESSED<br>b. Function switch to BOMB |
| 43. | TG Zero<br>a. No bomb release light<br>b. No change in door indicators | Doors and hook remain CLOSED | a. Release light OK<br>b. No change in lights or door indicators |
| 44. | BNS OFF (or STAB as required) | | Function switch OFF (or STAB) |
| 45. | Normal door switch to OPEN | Doors OPEN | OPEN, door indicator OPEN |
| 46. | Turn off all bombing controls<br>a. Pilot's salvo switch OFF | | a. Bric TRAIN & ZERO<br>b. Indicator light switch OFF<br>c. Bomb power switch OFF<br>d. Salvo switch OFF<br>e. Bomb control selector switch NORMAL |
| 47. | Turn emergency hydraulic pump OFF | OFF (copilot's seat) | |
| 48. | External bomb door switch OPEN | OPEN (safety observer) | |
| 49. | Install safety locks (or disconnect doors) | Safety locks IN, or doors DISCONNECTED (safety observer) | |
| 50. | External bomb door switch OFF | OFF (safety observer) | |
| 51. | Open spoiler door depressurization valve | Valve OPEN, gages read preload pressure | |
| 52. | Close and safety spoiler door depressurization valve | Valve CLOSED & SAFETIED | |
| 53. | Close and safety hydraulic interconnect valve | Valve CLOSED & SAFETIED | |
| 54. | Check U-2 air pressure | 1500 PSI less normal loss on preflight | |
| 55. | Proceed with loading | | |

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

**NOTE**

If simulated mission is to be flown, cock U-2.

**CONVENTIONAL BOMB RELEASE SYSTEM CHECK**

1. DD Form 781 - CHECKED FOR PERTINENT ENTRIES
2. Bomb Door Safety Locks - INSTALLED
3. Spoiler Door Accumulator - 1000 (±100) PSI
4. Spoiler Depressurizing Valve - OFF
5. Bomb Bay Door Accumulators - 1750 (±175) PSI
6. Hydraulic Interconnect Valve - OPEN
7. Bomb Salvo Control Circuit Breaker - IN
8. K-2 Door Control Circuit Breaker - IN
9. Power Cable to Bomb Racks - CONNECTED
10. Bomb Racks - SECURELY INSTALLED
11. A-5 Releases - SECURE
12. Shackles - CHECKED
    Check for condition; cleanliness, etc.
13. Bomb Carrying Hooks on Shackles - CHECKED
    Checked for positive operation ( manually locked and released).
14. Battery - CONNECTED
15. Salvo Power Circuit Breaker - IN
16. External AC and DC Power - CONNECTED
17. Bomb Indicator Light Circuit Breaker - IN
18. Bomb Arming Circuit Breaker - IN
19. Normal Bomb Circuit Breaker - IN
20. Alternate Bomb Circuit Breaker - IN
21. Interphone Circuit Breaker - IN
22. Bomb Door & Release Switch - MANUAL
23. Alternate Door Switches - OFF

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

24. Normal Door Switch - OFF

25. Bomb Control Selector Switch - NORMAL

26. Bomb Salvo Switch - OFF

27. Bomb Control Power Switch - ON

28. Indicator Light Switch - ON

29. Interphone Check - COMPLETED
    Establish interphone communication with ground observer and A&E man in the crawlway.

30. Intervalometer Control - SELECT, 10 BOMBS

31. Indicator Lights (Bomb Control Panel) - PUSH TO TEST

32. Main Inverter - ON (110 to 120 V AC)

33. Secondary Inverter - ON (110 to 120 V AC)

34. DC Voltmeter - 26 TO 29 V

35. External AC Power - 110 TO 120 V AC

36. Emergency Hydraulic Pump Switch - AUTO NORMAL
    Check pressure (2700 to 3000 psi).

37. BNS Function Switch - STAB

38. Altitude Switch - OFF

39. External Bomb Door Switch - OPEN

40. Bomb Door Safety Locks - REMOVED

41. Bomb Bay Doors - CLEAR
    Instruct ground observer to keep bomb doors and spoiler doors clear until release check has been completed.

42. Bomb Bay Doors - CLOSED WITH EXTERNAL SWITCH
    Close bomb doors with alternate door switch in external AC power receptacle.

43. A-5 Releases - COCKED

44. Observer's Salvo Switch - SALVO FOR 3 SECONDS
    a. Bomb Doors - OPEN
    b. All A-5 Releases - FIRED SAFE

45. Bomb Bay Doors - CLOSED
    Close bomb doors with observer's alternate bomb door switch and repeat above check using pilot's salvo switch and close bomb doors with pilot's bomb door switch.

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

46. A-5 Releases - COCKED

47. D-2 Bomb Release Switch - DEPRESS & HOLD FOR 3 SECONDS; DOORS SHOULD NOT OPEN, A-5 RELEASES SHOULD NOT FIRE

48. Normal Bomb Door Switch - OPEN
    Check door indicators OPEN.

49. D-2 Bomb Release Switch - DEPRESS & HOLD FOR 3 SECONDS; ONE LOWER A-5 RELEASE SHOULD FIRE

50. Normal Bomb Door Switch - CLOSED

51. ATF - 15 SEC

52. Trail - ZERO

53. Wind Dials - ZEROED

54. Forward Sighting Switch - DEPRESSED

55. Function Switch - BOMB

56. Bomb Door & Release Control Switch - K2 AUTO, AT 20 SECONDS TG

57. TG Zero Check - BOMB DOORS OPEN, OTHER LOWER A-5 RELEASE FIRES, BOMB DOORS AUTOMATICALLY CLOSE. CHECK BOTH TG METERS AND BOMB RELEASE LIGHTS AT TG ZERO

58. Intervalometer - TRAIN & MAXIMUM INTERVAL

59. Forward Sighting Switch - DEPRESSED

60. Function Switch - BOMB

61. TG Zero Check - BOMB DOORS OPEN, REMAINING A-5 RELEASES FIRE IN SEQUENCE, BOMB DOORS AUTOMATICALLY CLOSE

62. A-5 Releases - COCKED

63. Intervalometer - SELECT & 10 BOMBS

64. Bomb Control Selector Switch - SALVO

65. Forward Sighting Switch - DEPRESSED

66. Function Switch - BOMB

67. TG Zero Check - BOMB DOORS OPEN, ALL A-5 RELEASES FIRE SIMULTANEOUSLY, BOMB DOORS REMAIN OPEN

68. Function Switch - OFF

69. Bomb Control Panel Switches - OFF OR NORMAL

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

70. Intervalometer - TRAIN & ZERO

71. External Door Switch - OPEN

72. Bomb Door Safety Locks - INSTALLED

73. Hydraulic Interconnect Valve - CLOSED

74. Emergency Hydraulic Pump Switch - OFF

75. Bomb Rack Power Cable - DISCONNECTED

## EXTERIOR INSPECTION

1. DD Form 781 Series - CLEAR DISCREPANCIES
   At this time all entries pertaining to navigational or bombing equipment or power supplies will be cleared.

2. Auxiliary Power Unit - ADEQUATE FUEL - 115 V AC, 28 V DC
   Insure that sufficient fuel is in the APU to complete all required ground checks.

3. Ejection Hatch External Release Handle - FLUSH WITH CONTOUR OF AIRPLANE

4. Radome - SECURE, OPENING CLEAR, NO FLAWS
   Check that dome is clean, free of cracks, and that drain hole is open. Latching handle must be flush and locking screw perpendicular to handle.

5. Observer's Escape Hatch - FLUSH & CLEAR

6. C-9 Hoist Circuit Breaker - IN
   Left main power shield (forward wheel well).

7. FTB Circuit Breaker - IN
   Left main power shield (forward wheel well).

8. Bomb Arming Control Heater Circuit Breaker - IN
   Left main power shield (forward wheel well).

9. U-2 Rack Heater Circuit Breaker - IN
   Right main power shield (forward wheel well).

10. Radar Compartment - OPEN

11. Constant Speed Motor Switch - ON

12. True Airspeed Correction - CHECKED

13. Servo Amplifier STAB-UNSTAB Switch - STAB

14. Radar Compartment Access Doors - SECURE & HANDLES FLUSH

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## OBSERVER'S CHECKLIST

**Continued**

**NOTE**

In hot weather, leave door of radar compartment housing main inverter open for cooling.

15. Bomb Door Safety Locks - INSTALLED

16. U-2 Release Pressure - 1500 PSI

17. K-2 Door Control Circuit Breaker - IN
    Bomb salvo relay shield (left forward side of bomb bay).

18. Salvo Control Power Circuit Breaker - IN
    Bomb salvo relay shield (left forward side of bomb bay).

19. U-2 Release - COCKED

20. If conventional bombs are loaded:
    a. Bomb Rack Power Cable - DISCONNECTED
       Check bomb rack power cable on left side of bomb bay is not attached to the rack power receptacle on upper left side of bomb rack.
    b. Bomb Rack Installation - SECURE
       Check bomb racks attached to the airframe properly and securely and all quick-disconnect safety pins properly inserted in mounting pins.
    c. A-5 Release Installation - SECURE
       Check all A-5 releases properly and securely attached to the bomb racks at the proper stations, trip screws positioned properly, and desired stations cocked.
    d. Bomb Shackles - CHECKED
       Check all bomb shackles for condition, alignment, and cleanliness (absence of oil, dirt, etc). Check that shackle wires and safety pins are installed and that levers are in A-5 release levers.
    e. Bombs, Pins & Fuses - CHECKED
       Check all bombs and pins free from dents or foreign matter, fuses and/or plugs properly installed, and safety pins in fuses.

21. Camera Magazine - INSTALLED
    Check magazine properly installed, all cannon plugs and vacuum lines secure, and heater cover installed and connected.

22. Dark Slide & Lens Cover - REMOVED

23. Camera Compartment Circuit Breakers - DEPRESSED

24. Bomb Salvo Power Circuit Breaker - IN
    Tail compartment power shield.

## INTERIOR INSPECTION

### WALKWAY CHECK

1. Coordinate Converter Power Supply - CHECK FUSES & AMPLIFIERS FOR SECURITY OF MOUNTING

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

2. Stab Unit Power Switch (SAU) - ON

3. Instrument Inverter Switch - MAIN, LIGHT OUT
   Normally accomplished by pilot. Instrument inverter switch is located on pilot's instrument panel, upper left corner.

4. Bomb Salvo Control Circuit Breaker - IN

5. Spare Fuses - CHECK QUANTITY & TYPE

6. SAU & CAU - AMPLIFIERS SECURELY MOUNTED, CABLE CONNECTIONS SECURE

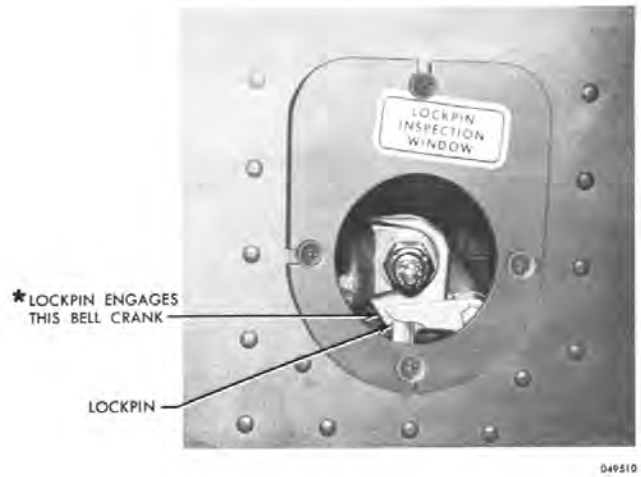
7. Spare Amplifiers - 1 EACH BH, WH, RH, DH, LH, MH, KH, IH, MCH, HH; 2 EACH MAH

8. Spare Bulbs - ADEQUATE SUPPLY EACH TYPE

9. Radar Pressure Pump - DESICCANT SERVICEABLE, INCREASE PRESSURE TO 37 INCHES OF Hg
   If desiccant crystals are pink above indicator line, replace. Use MOMENTARY ON switch position to increase pressure.

10. Cables - SECURE
    Check security of all accessible cables.

11. Ejection Seat - CHECKED
    a. Safety Pins & Streamers - CHECKED, PINS IN
       The automatic opening safety belt initiator does not require a safety pin.
    b. 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**

c. Leg Braces & Latch Triggers - CHECKED
Check each leg brace lockspring securely installed in each latch trigger handle. Check restraint cable 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. Check leg retainers properly stowed. Make certain that no red is showing on retaining horn.

d. 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.

e. Initiators - CHECKED
Check all initiator sear pins; make sure the sear pin safety pin groove is not visible outside the initiator housing.

f. Whiffletree - ENGAGED
Check that whiffletree engages right and left initiator sear pins.

**NOTE**

On seats with drilled hole in each end of whiffletree, check cotter key installed in each hole. On seats without the drilled holes, check sear pins safety wired to whiffletree.

g. Catapult Initiator Safety Pin - INSTALLED
Check that safety pin attached to hatch static cable is properly installed in catapult initiator.

h. Hatch Static Cable - ATTACHED
Check hatch static cable secured to downward ejection hatch.

i. Quick-Disconnect - CHECKED
Check proper installation of lanyard from hook to personal leads quick-disconnect mounting.

j. Shoulder Harness & Inertia Reel - CHECKED
Manually check shoulder harness and inertia reel for proper operation.

k. Seat Adjustment - CHECKED
Check rotation and vertical operation of seat.

l. Report to Pilot - COMPLETED
After completion of ejection seat check, report to pilot, "Ejection seat inspection completed."

12. Observer's Emergency Escape Hatch - SECURED
Inspect observer's escape hatch in place and properly secured. Check emergency release lever in locked position.

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## OBSERVER'S CHECKLIST

**Continued**

**STATION CHECK**

1. Radar Power Panel Circuit Breakers - ALL DEPRESSED
2. Interphone Cord - CONNECTED
3. Interphone Jackbox - INTER
4. Deleted
5. Alarm Bell - ACKNOWLEDGE
6. Oxygen System - CHECKED

**NOTE**

On airplanes with Type D-2A regulators installed, the oxygen warning light system check does not apply.

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).
c. Position oxygen supply shutoff lever to ON and check system pressure (400 to 450 psi).
(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.

**NOTE**

At this time only the pilots, and extra crew member if aboard, will accomplish the following steps; the observer will connect his mike cord and be available for interphone communications.

**Continued on Next Page**

## OBSERVER'S CHECKLIST

**Continued**

Crew members connect mike cords, then plug in oxygen masks as follows:

(1) Attachment strap on mask male connector should be attached to parachute chest strap by routing the attachment strap under the chest strap as close to the chest strap snap as possible, up behind the chest strap, then down in front of the chest strap, then around again, and finally snapped to the connector.

(2) Pass free end of attachment strap through attachment strap eyelet.

**WARNING**

It is imperative that the attachment strap on the mask male connector not be single looped around the parachute chest strap or attached to the chest strap snap. Failure to double loop the attachment strap around the parachute chest strap will result in the attachment strap slipping into the chest strap snap and inadvertently opening the snap during bailout.

(3) Plug the mask male connector into the mask-to-regulator tubing, listen for click, and check that the sealing gasket is only half exposed.

(4) Attach alligator clip to end of mask male attachment strap.

(5) Route bailout bottle tubing underneath chute harness up to mask tubing and connect bayonet fitting to mask hose connector.

j. Deflect emergency toggle lever to right or left. A positive pressure should be supplied 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 warm-up period during regulator use). A pressure leak will be indicated by a flow indication or a hissing of the regulator. Return emergency toggle lever to center position. Positive pressure should cease.

k. Check diluter lever NORMAL OXYGEN, turn supply lever OFF, and place oxygen warning system switch OFF.

7. Bric - TRAIN & ZERO BOMBS, LIGHT OUT

8. Bombsight Cover (Clamshell) - OPEN

9. Bomb Door & Release Switch - MANUAL

10. Normal Bomb Door Switch - OFF

11. Alternate Bomb Door Switch - OFF

12. Bomb Power Switch - OFF

13. Indicator Light Switch - OFF

14. Salvo Switch - OFF

15. Bomb Control Selector Switch - NORMAL

16. Drop Control Switch - DELAY

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## OBSERVER'S CHECKLIST

**Continued**

17. U-1 Arming Switch - SAFE, LIGHT OUT

18. Nose Fuse Arming Switch - SAFE, LIGHT OUT

19. BNS Heating Control Switches - NORMAL

**NOTE**

Use PREHEAT position during ground operation with external power when outside temperature is below 32° F and in flight when BNS has been turned off.

20. Table, Dome & Instrument Lights - CHECKED

21. Nose Defrost - CHECKED
Leave on for ventilation if desired.

22. Observer's Upper Air Shutoff Lever - SET AS DESIRED

22A. Observer's Lower Air Heater Switch - OFF

23. Emergency Bomb Arming Safe Handle - IN PLACE
Check that safeing T-handle is stowed in clip and access door closed.

24. Emergency Bomb Release - IN PLACE, GUARD CLOSED
Check that T-handle is stowed in clip and that guard is in place.

25. 3Ø Inverter Switch - OFF

26. Scope Camera Magazines - CHECKED & INSTALLED
Check that footage dial shows sufficient film for briefed photography. Check seating of magazines. On O-15 magazine, secure right locking lever first when installing on camera.

27. Scope Camera Data Plates - COMPLETED, CLOCKS WOUND, INSTALLED
Wind and set watches (GMT), fill out data card, and check that indicator light holes are clear.
    a. Target complexes (maximum 3)
    b. Date (GMT)
    c. Airplane type and number
    d. Altitude delay
    e. Last name of observer.

28. O-15 Camera Diaphragm Setting - SET AS BRIEFED
Usual setting f/8 to f/11.

29. O-23 Camera Shutter Speed - SET AS BRIEFED
Normal setting is 1/200.

**CAUTION**

Do not change shutter speed while the camera is in operation. When changing shutter speed, rotate gently; if resistance is encountered in one direction, try the opposite direction. If resistance is still encountered, do not force the dial but call for a maintenance specialist.

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## OBSERVER'S CHECKLIST

**Continued**

30. Air Refueling & Rendezvous Equipment - CHECKED
    To be performed in conjunction with and at the request of the pilot or copilot.
    a. APN-76 Control Box, Cables & Cannon Plugs - CHECKED FOR SECURITY
    b. Frequency Settings - AS BRIEFED
    c. Receiver Standby Switch - STANDBY
    d. Power Switch - ON
    e. Gain Control - 1/8 TURN BACK FROM FULL CLOCKWISE
    f. UHF Radio - ON (by copilot)
    g. Refueling Equipment - CHECKED
    h. Receiver Standby Switch - ON, AFTER 3 MINUTES
    i. Rendezvous Radar - CHECKED WITH GROUND STATION
       The settings of the transmitter and receiver frequency switches will be made by the observer in response to requests of the ground control unit. Ground control will indicate whether or not they are receiving the APN-76 signal on the APN-12 scope.
    j. Receiver Standby Switch - STANDBY
    k. Power Switch - OFF

31. N-1 Compass - CHECKED & SYNCHRONIZED
    a. Latitude Correction Pointer - OFF
    b. Synchronizer Knob - CW, POINTER FOLLOWS
       Annunciator pointer on "L" and annunciator dot rotates counterclockwise.
    c. Synchronizer Knob - CCW, POINTER FOLLOWS
       Annunciator pointer on "R" and annunciator dot rotates clockwise.
    d. Latitude Pointer - SET LOCAL LATITUDE
       Annunciator dot rotates clockwise in north latitude, counterclockwise in south latitude.
    e. Latitude Pointer - ZERO LATITUDE, CHECKED
       Check for no rotation of dot. Adjust latitude pointer until dot is stationary and record error from zero to apply to settings in flight.
    f. Synchronizer Knob - CW, POINTER FOLLOWS
       Check that pointer and repeater follow smoothly through full 360°.
    g. Latitude Correction Pointer - OFF
    h. Master Indicator - SYNCHRONIZED
       Synchronize master indicator to C-2 transmitter by engaging synchronizer knob and rotating azimuth pointer of the master indicator until the annunciator is zeroed. Check against B-16 magnetic compass for proper orientation.

32. Aerial Camera (Vertical) Panel Check:
    a. Circuit Breakers - IN
       Check camera control circuit breaker on DC power panel and circuit breaker on camera control panel if installed.
    b. Camera Intervalometer - CHECK COUNTERS SET & CHECK FUSES
    c. Camera Master Switch - ON
       This controls camera heaters and will be left on for the remainder of the mission.
    d. Camera Door Switch - OPEN
       Observe operation of door indicator lights.

**NOTE**

Do not attempt to close camera doors until bomb doors are closed.

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## OBSERVER'S CHECKLIST

**Continued**

e. Camera Selector Switch - MANUAL
   Observe operation of green indicator light on camera control panel and have ground observer check operation of camera.
f. Camera Selector Switch - AUTO
g. Intervalometer Power Switch - ON
h. Manual Initiation Switch - DEPRESSED
   Check operation of camera by observing green camera operation indicator light.
i. Intervalometer Power Switch - OFF
j. (B-8) Delay, Interval & Exposure Limiter - SET AS BRIEFED
   (B-7) Interval Selector Control Dial - SET ATF

33. D-2 Periscopic Sextant Preflight (both sextants & mounts)

**NOTE**

Copilot may perform preflight of canopy installation.

a. Desiccant - CHECKED
b. Time Dial - CHECKED FOR ACCURACY

**CAUTION**

Do not change altitude setting during 3-second interval.

(1) Averager Rewind Lever - DEPRESSED FULLY & RELEASED
    Averager will operate for 3 seconds, then stop automatically. Time dial should indicate zero.
(2) Averager Actuating Button - DEPRESSED & RELEASED, TIME NOTED
    Note time to nearest second when sextant starts.
(3) Time Dial & Watch - COMPARED
    Dial should read 59 when shutter clicks since shutter closes 2 seconds before averager stops. Double dial reading since it indicates half time and compare to watch reading. The readings should agree plus or minus 2 seconds.

c. Altitude Averager - CHECKED FOR ACCURACY
(1) Average Rewind Lever - DEPRESSED & RELEASED
    This should wind the averager, zero the time dial, and raise the shutter.
(2) Altitude Knob - SET 43°00' IN ALTITUDE COUNTER
(3) Averager Actuating Button - DEPRESSED & RELEASED
(4) Averager Actuating Button - DEPRESSED & RELEASED WHEN TIME DIAL READS EXACTLY 15
(5) Altitude Knob - SET 42° IN ALTITUDE COUNTER
(6) Averager Actuating Button - DEPRESSED & RELEASED
(7) Averager Actuating Button - DEPRESSED & RELEASED WHEN TIME DIAL READS EXACTLY 30
(8) Altitude Knob - SET 38°00' IN ALTITUDE COUNTER
(9) Averager Actuating Button - DEPRESSED & RELEASED
(10) Averager Actuating Button - DEPRESSED & RELEASED WHEN TIME DIAL READS EXACTLY 45
(11) Altitude Knob - SET 37°00' IN ALTITUDE COUNTER

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## OBSERVER'S CHECKLIST

**Continued**

(12) Averager Actuating Button - DEPRESSED & RELEASED
(13) Averager - STOPS AUTOMATICALLY
When time dial reaches 60, averager should stop.
(14) Altitude Knob - ROTATE UNTIL RED BLOCKS ON INDICATOR DRUMS ARE ALIGNED
Rotate left indicator drum in direction indicated by arrows on right drum until red blocks are aligned.
(15) Altitude Counter - CHECKED FOR READING 40°00' (±2')

**CAUTION**

Always depress the averager actuating button with a vertical movement. The button fits over a pin and if the button is continually depressed with a slanting pressure, the pin will be damaged and the averager will not be actuated.

d. Bubble - FORMED & ADJUSTED
Check that bubble can be adjusted in size.
e. Sextant - INSERTED & CONNECTED
Insert sextant with arrows on tube and mount aligned, then turn clockwise until plunger locks sextant in retracted position. Open port and push sextant up until it locks in operating position.
f. Illumination - CHECKED
Check for illumination of bubble, azimuth ring scale, altitude counter, azimuth counters, averager indices, and watch clip. Illumination of the bubble and azimuth ring scale is further controlled by a rheostat on the left side of the sextant. Check rheostat for proper operation. Other lights are not adjustable. If lights do not operate, check circuit breaker IN and bulbs in place.
g. Alignment - CHECKED
(1) Sextant - ROTATED TO SIGHT AFT
(2) Altitude Knob - ALTITUDE COUNTERS SET APPROXIMATELY 20°00'
(3) Azimuth Knob - AZIMUTH COUNTERS SET TO EXACTLY 360° or 180°
This will combine any counter alignment error with any mount alignment error.
(4) Averager Rewind Lever - DEPRESSED & RELEASED
(5) Sextant Eyepiece - FOCUS ADJUSTED
(6) Heading Scale Shutter Control - DEPRESSED
(7) Sextant - COLLIMATED
Collimate on centerline of airplane if the sextant is installed in the nose section. If the sextant is installed in the canopy, collimate on the top of the vertical stabilizer. During daylight, it will be necessary to vary filters in accordance with the lighting conditions to permit seeing both the bubble and the collimation point.
(8) Heading Scale - CHECKED READING 180° OR 360° UNDER INDEX LINE

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

(9) Line of Sight Locking Lever - LOCKED, IF ADJUSTMENT NECESSARY

**NOTE**

- If any variance exists, recheck collimation and heading scale reading. If the error still exists, unlock the projection lens (directly above the eyepiece) by rotating the lower knurled ring counterclockwise, and then rotate the projection lens until 180° or 360° is under the index or as close as possible. The projection lens has a range of approximately 3° to 4°, which should be sufficient to align properly. If unable to align to 180° or 360°, relock the projection lens and record the difference. This difference will have to be applied in the same direction to any true heading read during the flight.

- For airplanes which have the D-2 sextant installed on the centerline of the nose and cannot use the centerline of the airplane, collimate on an object approximately 100 feet in front of the airplane in line with the sextant and the vertical stabilizer.

h. Sextant - RETRACTED or REMOVED & STOWED
   If mount is installed in canopy, remove and stow sextant prior to taxi and takeoff.

i. Sextant Port - CLOSED
   Move lever to rear.

j. Sextant Mount - DRAINED
   Remove plug from sextant mount, allow excess moisture to drain out, and replace plug.

## BNS PREFLIGHT

The following items will be performed in sufficient time for ground power application to be made to the BNS a minimum of 20 minutes prior to scheduled taxi time. BNS will not be turned past STAB and STANDBY until airplane power check.

### BEFORE ENGINE START

1. Periscope Dome - CLEAN INSIDE & OUT, NO FLAWS

2. Radar Compartment Access Doors - CLOSED, SECURED & HANDLE FLUSH

3. U-2 Release - CHECKED COCKED

4. Bomb Safety Pins - REMOVED (if applicable)
   Remove fuse safety pins and shackle safety pins (wires), if applicable.

5. Bomb Rack Power Cable - CONNECTED (if applicable)

6. Bomb Bay - CLEAR
   Insure that nothing in the bomb bay will fall free when the bomb bay doors are opened.

7. Aerial Camera Window & Lens - CLEAN

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

8. External AC & DC Power - CONNECTED & ON

9. Main Inverter - ON, VOLTAGE CHECKED

10. Ejection Seat Pins & Streamers - REMOVED & STOWED

11. Indicator Light Switch - ON
    Check for proper number of indicator lights.

**POWER APPLICATION CHECK**

1. PMG Switch - ON

2. 3Ø Inverter Switch - ON

3. Function Switch - STAB, AFTER 20 SECONDS

4. Radar Power Switch - STANDBY

5. 3Ø Inverter Switch - OFF

6. Radar Power Monitoring Panel - ALL VOLTAGES & FREQUENCIES CHECKED

7. BNS Inverter Warning Light - OUT
   The red inverter warning light on the radar power monitoring panel or lighting control panel will be out when proper power is being furnished.

8. AC Voltage - WITHIN AC BLOCK

9. ±26.5 - DC BLOCK + 1 DIV

10. Coordinate Converter Power Supply - LIGHT ON, METER NEEDLE IN GREEN BLOCK

11. Fuse Tell-Tale Lights - OUT
    This check should be made after power has been on 30 seconds.

12. LAT-LONG Counters - IN DETENT

13. Reference Point Switch - PLANES

14. MAG-VAR - 10E, 10W, SET
    a. MAG-VAR - ZERO
       Check that true heading unit transmitter and repeater settle at approximately MAG heading.
    b. MAG-VAR - 10° EAST
       Check that heading increases 10° within 30 seconds.
    c. MAG-VAR - 10° WEST
       Check that heading decreases 20° within 30 seconds.
    d. MAG-VAR - SET
       Set correction dial to zero (MAG-VAR index to center of scale).

Continued On Next Page

## OBSERVER'S CHECKLIST

Continued

**PREOPERATIONAL CHECK**

1. Boresight Switch - AZ
2. Variac - APPROXIMATELY 75 DIVISIONS
3. O-15 Camera Power Switch - OFF
4. O-23 Camera Power Switch - OFF
5. Meter Switch - MAG I
6. Search Crystal - XTAL 1
7. Receiver Gain - FULL CCW
8. FTC Switch - OFF
9. LOG-LIN Switch - LIN
10. Operation Switch - RAD HI RES
11. Sweep Delay - FULL CCW & DEPRESSED
12. Tilt - ZERO
13. Range Dial - 30 NM
14. Offset Switch - OUT
15. Radar Altitude Switch - OFF
16. Sighting Switch - PPI
17. Range Marks-Crosshairs Switch - RANGE MARKS
18. AUX PPI OR NAV TRACK Switch - OUT (if applicable)
19. Bias - FULL CCW
20. Video Gain - FULL CCW
21. Brill Marks - FULL CCW
22. Range Lights - CHECKED & SET
23. Periscope Desiccator Pump - OPERATING, DESICCANT SERVICEABLE
    The periscope desiccator pump may be checked for operation by feeling or listening to it. If the desiccant crystals are pink above indicator line, replacement is required.
24. RAI Power Switch - ON
25. RAI Brilliance - FULL CCW

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

26. Reticle Light Switch - OFF (Day), ON (Night)
27. Reticle Light Rheostat - FULL CCW (Day), FULL CW (Night)
28. Navigation Method Switch - NORMAL
29. Polar Angle Dial - ZERO
30. Pole Switch - NORTH POLE
31. Bombing Mode Switch - L/S
32. Signal Comparator - MANUAL ANTENNA
33. Bombsight Cover Heater Switch - OFF

## AIRPLANE POWER CHECK

To be made immediately after switching to airplane power.

1. AC Voltage - AC BLOCK
   Have copilot adjust if necessary.
2. Meter Switch - MAG I
3. Function Switch - NAV
4. Radar Power Switch - SCAN FAST
5. Variac - CW FOR 4.2 MA MAG I
6. Meter Switch - CHECK ALL VOLTAGES

| | | |
|---|---|---|
| a. | +600 | DC block to full scale |
| b. | +300 | DC block |
| c. | +150 | DC block |
| d. | -105 | DC block |
| e. | -300 | DC block |
| f. | +26.5 | High side of DC block |
| g. | AC | AC block |
| h. | IND HV | DC block |
| i. | MOD HV | 7 (±1 1/2) division |
| j. | MAG I | 4.2 ma (readjust if necessary) |
| k. | XTAL I | .5 to 1.1 ma (optimum .6)<br>Check XTAL 1 and XTAL 2 |

**NOTE**

Leave switch on MAG I.

7. Bias - CW TO JUST BELOW VISIBILITY LEVEL
8. Brill Marks - CW TO DESIRED INTENSITY

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

9. Receiver Gain - CW FOR OPTIMUM RECEPTION

10. Boresight Switch - NORMAL (after boresight light on)

11. Bombing Mode Switch - SYN

12. Tracking Control - CHECKED
    Check that crosshairs and fix dials follow movement of tracking control (after 30 seconds in NAV).

13. Scope Cameras - ON & CHECKED

**NOTE**

On airplanes with MA-7A systems with AWA-2 camera control switches set to HIGH ALTITUDE, AUTO, and MANUAL, operation of the O-15 camera is controlled exclusively by the O-15 camera control. When AWA-2 control of O-15 camera is required, refer to description in section IV for proper setting of AWA-2 switches.

Check operation of exposure counters and rotation of takeup spool.

14. Function Switch - TRACK

15. Wind Determination Switch - MEMORY POINT, CLIMB WIND SET

16. Scope Cameras - CHECKED & OFF

17. LAT-LONG Counters - SET TO FIELD COORDINATES

18. Function Switch - STAB, IMMEDIATELY AFTER RESETTING COUNTERS

19. BNS Status - REPORTED
    Inform pilot of equipment status by "Radar OK" or "Radar out, delay taxi."

20. MAG-VAR - RESET
    Reset to local variation.

## PRE-TAKEOFF CHECK

1. Bombsight Cover (Clamshell) - CLOSED

2. Offset Dials - SET
   Set to offset components for first target, if applicable.

3. TF Dial - SET
   Set approximate ATF for first target.

4. Trail Dial - SET
   Set to approximate trail for first target.

5. Camera Master Switch - CHECKED ON

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

6. Camera Doors - CLOSED, AFTER BOMB DOORS
7. Radar Pressurization Unit - CHECKED, PRESSURE BLED, SWITCH ON
8. N-1 Orientation & Synchronization - CHECKED
9. Indicator Light Switch - CHECKED ON, LIGHTS ON
10. U-2 Rack Locked Light - OUT & TESTED
11. APN-76 - ON & STANDBY
12. Oxygen Shutoff Lever - ON
13. Bailout Bottle - CONNECTED
14. Safety Belt & Shoulder Harness - FASTENED & LOCKED
    Observer adjusts and fastens safety belt and shoulder harness. On Type MA-2 automatic safety belt the shoulder harness will be connected to the upper strap arm and the safety belt tiedown strap connected to the lower strap arm. The shoulder harness will be manually locked on takeoff and landings.

**WARNING**

If any other than Type MA-2 automatic safety belt is installed on the observer's seat, the safety belt tiedown strap must not be connected to the safety belt. If connected under these conditions, the occupant may fail to separate from the seat after ejection.

15. Takeoff Report - SAFETY BELT & SHOULDER HARNESS FASTENED, EJECTION SAFETY PINS REMOVED, OXYGEN CHECK COMPLETED, BAILOUT BOTTLE CONNECTED, BOMBSIGHT RETRACTABLE COVER CLOSED, READY FOR TAKEOFF
16. Function Switch - NAV (at start of takeoff roll)

## TAKEOFF, CLIMB, LEVEL-OFF

1. Takeoff Time - HACKED & RECORDED
2. Rendezvous Equipment - CHECKED WITH GROUND STATION & OFF OR STANDBY
3. D-2 Sextant - EXTENDED (if applicable)
4. Altitude Control - SET APPROX ALT (above 5000 feet)
5. Altitude - MEASURED OR SET, AFTER LEVEL OFF
6. Wind Run - ACCOMPLISHED
7. LAT-LONG Counters - RESET
8. Instruments - CROSS-CHECKED
   Airspeed meters. altimeters, and OAT gages at all crew positions will be cross-checked.

**Continued On Next Page**

## OBSERVER'S CHECKLIST

Continued

## INFLIGHT NAVIGATION PROCEDURES

**WARNING**

If duties require the observer to leave his seat during flight, care must be taken not to disturb the D-ring since inadvertent jettisoning of the downward ejection hatch may occur. One-inch movement of the D-ring will jettison the hatch. Care must always be taken to prevent inadvertent actuation of either leg brace latch trigger since release of leg braces will occur. This may result in the inadvertent release of the D-ring from stowed position and make the D-ring subject to disturbance.

### STATION KEEPING

**NOTE**

The procedures for station keeping can also be applied to close-in rendezvous for air refueling.

1. Bombing Mode Switch - L/S
2. Boresight Switch - NORMAL
3. Drift Control - SET BRIEFED RELATIVE BEARING OF REFERENCE AIRPLANE
4. Function Switch - NAV
5. Range Marks-Crosshairs Switch - RANGE MARKS
6. Sweep Delay Control - SET PIP TO BRIEFED RANGE (leave control depressed)
7. Radar - TUNED FOR SEARCH
   Tilt control is extremely critical and should be varied almost constantly to maintain best return.
8. Formation Position - ESTABLISHED & MAINTAINED
   When the reference airplane has been located. adjust heading and/or airspeed until the return from the reference airplane remains under the crosshairs. Once in position, briefed headings and airspeeds should be maintained to minimize corrections required.

### AIRPLANE STEERING TO MINIMIZE WANDER DURING CELESTIAL NAVIGATION

- Unslave the N-1 compass by setting the latitude pointer to the proper latitude (average for the next 2° increment of latitude). The N-1 can be reslaved after each series of observations or at the end of the celestial leg. If the entire leg is flown in the unslaved position, the airplane will fly a great circle heading plus or minus precession.

- The BNS may also be used as the steering reference. With the N-1 slaved or unslaved and the navigation method switch in NORMAL, the airplane will fly a rhumb line if BNS steering is utilized (TH will be read in the At dial).

Continued On Next Page

## OBSERVER'S CHECKLIST

**Continued**

• To steer with the BNS, the following must be accomplished after placing the airplane on the desired heading.

1. Safety Check - COMPLETED
2. Forward Sighting Switch - DEPRESSED
3. Sighting Switch - OB
4. Range Marks-Crosshairs Switch - CROSSHAIRS
5. Function Switch - BOMB
6. Tracking Control - PDI CENTERED, LOCKOUT
   Center PDI and then place crosshairs in lockout.
7. Autopilot Control - SECOND STATION AUTOMATIC
8. AUX PPI OR NAV TRACK Switch - IN (or turn radar to STANDBY on airplanes which do not have the switch)

• When using BNS steering, the above steps must be accomplished after each heading change and after each wind run.

### GRID NAVIGATION PROCEDURES

**Entry Into Grid Checklist** (requested by observer approximately 50 nm from entry point.)

1. Polar Angle Dial - SET
   a. When using a chart on which the convergence factor is 1:
      (1) If the starting point is in west geographical longitude, set in the value of west longitude of the point.
      (2) If the starting point is in east geographical longitude, set in the value of (360° minus east longitude).
   b. When using a chart on which the convergence factor is less than 1:
      (1) If the starting point is in west geographical longitude, set in the value of the convergence angle for that longitude.
      (2) If the starting point is in east geographical longitude, set in the value of (360° minus the convergence angle) for that longitude.
2. Pole Switch - SET
   Turn the pole switch to NORTH POLE or SOUTH POLE as applicable.
3. Navigation Method Control - POLAR
   When approximately 50 miles from the entry point, switch to POLAR. The scope orientation will shift by the amount of the polar angle setting.
4. BNS Grid Heading - CHECKED AGAINST N-1
   Convert the magnetic heading on the N-1 compass to grid heading by applying variation and convergence angle. Check that true heading indicator is reading this grid heading. If it is not, change the polar angle until this grid heading appears in the window of the true heading unit.

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## OBSERVER'S CHECKLIST

**Continued**

5. LAT-LONG Counters - SET TO APPROXIMATE GRID VALUE
   Change the latitude and longitude counters to read the approximate grid coordinates of the entry point.

6. Wind Dials & LAT-LONG Counters - SET TO GRID
   a. If the entry point is a recognizable radar return, place the crosshairs on the point, switch to TRACK, take a wind run on the point, and reset the latitude and longitude counters to the exact grid coordinates of the point with the switch in REF PT.
   b. If the entry point is a DR position, convert the best known wind to grid components and set these components in the wind dials; at the exact time of the DR position, set the grid coordinates of the position on the latitude and longitude counters with the switch in PLANES position.

7. Grid Heading - CHECKED
   As soon as possible after departure, check grid heading by means of the periscopic sextant.

8. N-1 Compass - UNSLAVED & SET TO GRID HEADING
   Immediately unslave N-1 compass by setting geographic latitude of the starting point in the compass. Set the compass needle to above grid heading, using the synchronizer control. The annunciator needle may be displaced; however, this will not affect compass operation.

9. Airplane Heading - CORRECTED
   Correct the airplane heading until the N-1 compass reads the initial N-1 heading. Unless an N-1 precession rate has been predetermined, this will also be the desired grid heading.

10. BNS Heading - CORRECTED
    For low latitude grid navigation, adjust the polar angle until the BNS heading is less than the N-1 heading by one-half the precession for the period. At latitudes of 65° or higher, set the grid heading.

### Inflight Grid Navigation Procedures

1. Heading Check - ACCOMPLISHED
   At appropriate intervals, check grid heading by periscopic sextant and record grid heading and BNS heading in gyro log or graph.

**NOTE**

- If N-1 reads within ±1° of grid heading checked, it will be recorded but may be disregarded in steps "2" through "5."
- The LAT-LONG counters will indicate the airplane position in grid coordinates. For celestial work, grid coordinates will have to be converted to geographical coordinates by reference to the chart for use in computations.

2. N-1 Compass - RESET
   Reset N-1 compass to grid heading determined in preceding step.

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## OBSERVER'S CHECKLIST

**Continued**

3. N-1 Precession Rate - DETERMINED
   Calculate airplane heading change due to N-1 precession, average grid heading flown, new desired grid heading (if applicable), and new initial N-1 heading.

4. Airplane Heading - CORRECTED (if required)
   Turn airplane to new initial N-1 heading.

5. BNS Initial Heading - DETERMINED
   Calculate total change in BNS heading (initial BNS heading minus BNS heading at time of check). To determine new initial BNS heading, apply one-half of total BNS heading change, with proper algebraic sign, to new desired grid heading determined above.

**NOTE**

This procedure compensates for both "C" gyro precession and N-1 gyro precession.

6. BNS Heading - CORRECTED
   By means of polar angle control, adjust BNS heading to the new initial BNS heading determined above.

7. "C" Gyro Precession - DETERMINED
   Calculate "C" gyro precession rate by subtracting airplane heading change due to N-1 precession from total BNS heading change. Record on gyro log or graph.

8. Wind Run - ACCOMPLISHED
   An accurate wind run will be taken between heading checks to insure accurate DR positions. Normal wind run procedures will be used, but wind dials will read in grid components.

9. Latitude Control - RESET (if applicable)
   The latitude dial on the N-1 compass must be reset periodically to conform to the actual geographical latitude of the airplane. Ordinarily, resetting every 2° of latitude will give acceptable accuracy.

10. DR Position - RECORDED
    The DR position indicated by the navigation unit should be recorded between heading checks for use in the event of BNS failure or for computing DR positions at the time of celestial fixes/LOP's.

**Exit From Grid Checklist** (requested by observer)

1. Exit Point - DETERMINED
   If the polar leg is to be ended at a point other than the planned exit point, it will be necessary to choose a new exit point and note its geographic coordinates and convergence value.

2. LAT-LONG Counters - RESET
   Set the approximate geographic coordinates of the airplane position in the latitude and longitude counters and check the MAG-VAR dial for correct reading.

**Continued On Next Page**

## OBSERVER'S CHECKLIST

**Continued**

**NOTE**

If an accuracy check of the GPI is desired, place the crosshairs on the exit point before changing the navigation counters, switch to TRACK, and record the readings of the counters with the switch in REF PT.

3. Polar Angle - RESET
   In west longitude, decrease current polar angle by convergence angle at point of exit. In east longitude, increase current polar angle by convergence angle at point of exit.

4. Navigation Method Control - POST POLAR

5. Wind Dials & LAT-LONG Counters - RESET
   a. Take a wind run on the exit point and reset the latitude and longitude counters to geographical coordinates with the switch in REF PT.
   b. If the exit point does not give a radar return, convert the grid wind to a true wind and set in the BNS. Set the geographic coordinates of the exit point in the navigation counters with the switch in PLANES position at the exact DR time for the exit point.

6. N-1 Compass - RESET TO MAG HEADING & RESLAVE
   Reset N-1 to approximate magnetic heading and reslave the N-1 compass by turning the latitude dial to OFF position. Center the annunciator needle with the synchronizer knob. The N-1 compass now reads magnetic heading (check B-16 for 180° ambiguity).

7. True Heading - CHECKED
   As soon as possible, check the true heading of the airplane. If the true heading in the BNS does not agree, check the MAG-VAR setting. If the MAG-VAR setting is correct, turn the polar angle crank until the actual true heading appears on the true heading indicator.

**NOTE**

- Small errors in heading will be automatically corrected at the rate of 2 1/2° per minute in POST POLAR. Leave the navigation method switch in POST POLAR position until completion of the flight or until reentry into a polar navigation leg.
- A graph procedure to replace or supplement the log may be used when developed.

### REENTRY INTO POLAR NAVIGATION

1. In the event it is desired to be in a new polar navigation leg after going to POST POLAR operation, the procedures are the same as for the original polar leg except that some value other than 0° is present in the polar angle window before the leg is started. This value is increased by the amount of west longitude (convergence angle) of the new starting point or decreased by the amount of east longitude (convergence angle).

Continued On Next Page

## OBSERVER'S CHECKLIST

Continued

### SIMULATED POLAR FLIGHTS AT LOWER LATITUDES

1. In order to gain proficiency in polar navigation techniques without actually flying close to the poles, it is necessary to simulate the polar situation while flying at lower latitudes. The procedure at lower latitudes is the same as in the polar regions, except as noted below.

2. Almost any map used in lower latitudes will have a convergence factor of less than 1. This makes the conversion from true direction to grid direction less simple, since the convergence angle must be extracted from a table. Actual polar navigation would seldom be done on a chart whose convergence factor was less than 1, with the possible exception of a flight in the vicinity of the magnetic pole.

3. Because of the automatic compensation built into the BNS to correct for apparent gyro precession due to earth rate for the polar regions, a precession error is introduced in the BNS when it is operated in POLAR mode in lower latitudes. The polar navigation unit compensates for earth rate precession at a constant rate of 14.4° per hour, which is the amount of apparent precession encountered at approximately 75° latitude. In actual polar navigation, this is an excellent approximation of the precession due to earth rate which will exist throughout the grid leg. In lower latitudes however, this represents an excessive correction which will drive the polar angle dial incorrectly. The accompanying table shows the actual precession due to earth rate at various latitudes, together with the hourly correction which would have to be subtracted from the polar angle in order to remove the overcorrection which is fed in. In practice, this correction is made, along with the correction for any other errors which may be present, whenever the grid heading in the BNS is corrected with the polar angle control. In any case, it is necessary that the grid heading be correct in the BNS at all times, in order that the latitude and longitude counters drive correctly.

| LATITUDE | HOURLY APPARENT PRECESSION | HOURLY CORRECTION REQUIRED |
|---|---|---|
| 00 | 0.0 | -14.4 |
| 05 | 1.3 | -13.1 |
| 10 | 2.6 | -11.8 |
| 15 | 3.9 | -10.5 |
| 20 | 5.1 | - 9.3 |
| 25 | 6.3 | - 8.1 |
| 30 | 7.5 | - 6.9 |
| 35 | 8.6 | - 5.8 |
| 40 | 9.6 | - 4.8 |
| 45 | 10.6 | - 3.8 |
| 50 | 11.5 | - 2.9 |
| 55 | 12.3 | - 2.1 |
| 60 | 13.0 | - 1.4 |
| 65 | 13.6 | NEGLIGIBLE |
| 70 | 14.1 | NEGLIGIBLE |
| 75 | 14.5 | NEGLIGIBLE |
| 80 | 14.7 | NEGLIGIBLE |
| 85 | 14.9 | NEGLIGIBLE |
| 90 | 15.0 | NEGLIGIBLE |

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## OBSERVER'S CHECKLIST

Continued

### EMERGENCY STEERING BY USE OF BNS

1. Place airplane on initial heading using At dial as reference.
2. Set desired heading in BNS by changing polar angle.
3. Press forward sighting switch.
4. Turn function switch to BOMB and make Tg read at least 90 seconds.
5. Zero PDI with tracking handle.
6. Remove the Ar and Ti Va-L amplifiers from the CAU.
7. Switch to second station automatic, or have pilot follow the PDI.
8. Keep BNS in BOMB position.
9. Airplane will follow the random precession of the "C" gyro making it necessary to correct course at intervals. Even though the airplane follows the precession rate, the At repeater will NOT indicate any change.
10. Airplane can be turned by turning the polar angle. At will read the same after turn as before the turn since Ar is a constant value and cannot be changed with the Ar and Ti Va-L amplifiers pulled. To make At read a new desired heading replace Ar and Ti Va-L amplifiers and adjust polar angle until At reads the required value and then remove Ar and Ti Va-L amplifiers.
11. Since At is erroneous after turn it must be accounted for in using the gyro log.
12. To turn left increase polar angle; to turn right decrease polar angle.
13. Continue heading checks at normal intervals.

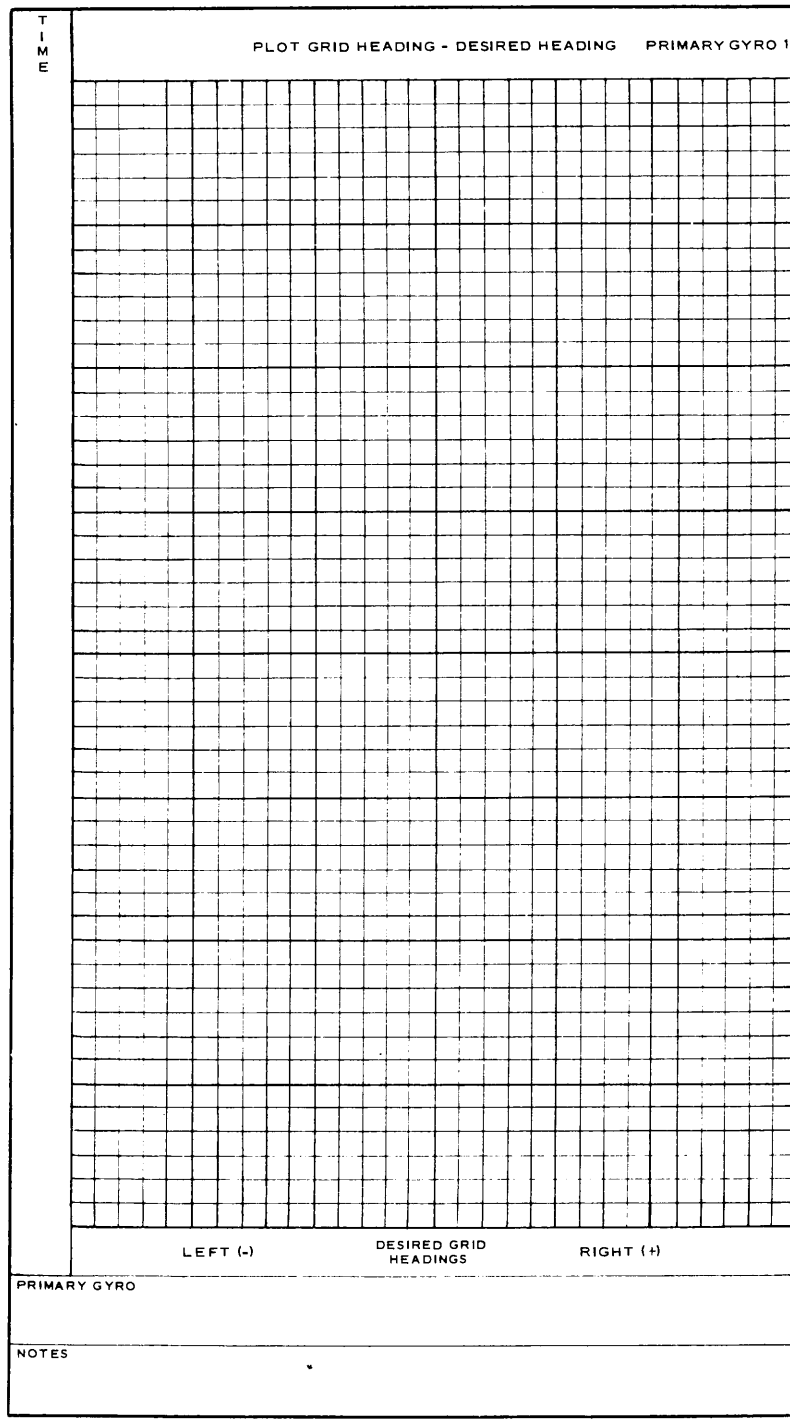
### GYRO GRAPH PROCEDURE

#### Steering Gyro

1. Centerline represents desired grid heading (number).
2. Vertical lines represent grid headings from low to high, reading left to right (number each block).
3. Horizontal lines represent time (number each block).

Continued On Next Page

# GRID GYRO GRAPH




GRID GYRO GRAPH

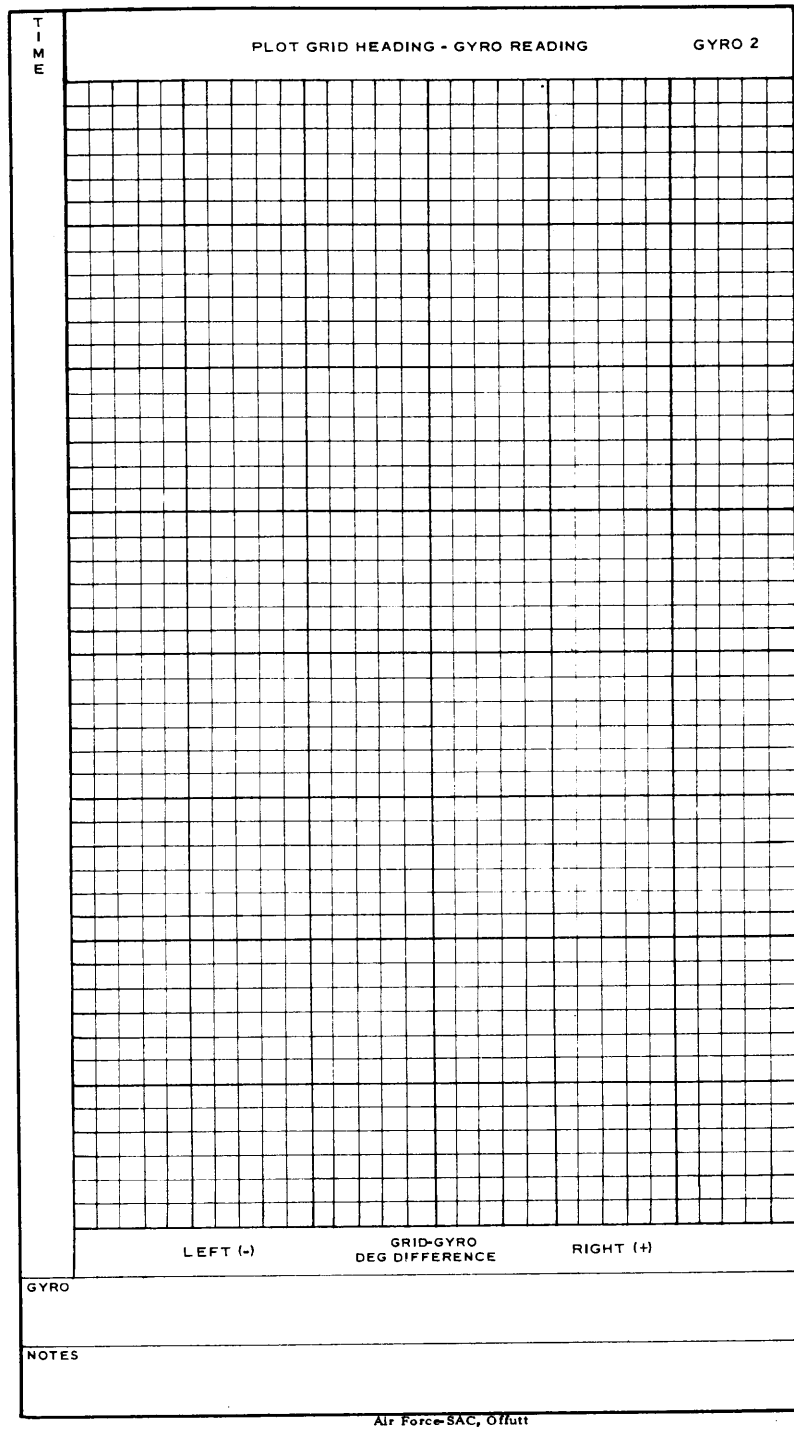



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*Figure 8-1.*

# GRID GYRO LOG

| | | TIME | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STEERING GYRO | 1 | GRID HEADING RESET GYRO TO | | | | | | | | | | | |
| | 2 | — PREVIOUS INITIAL HDG. ACTUAL IF NOT ON INITIAL | | | | | | | | | | | |
| | 3 | = HDG. CHANGE DUE TO STEERING GYRO PREC. | | | | | | | | | | | |
| | 4 | DESIRED HEADING | | | | | | | | | | | |
| | 5 | — ½ OF HDG CHG. DUE TO STEERING GYRO PREC. | | | | | | | | | | | |
| | 6 | = NEW INITIAL HEADING TURN ACFT TO AND HOLD | | | | | | | | | | | |
| | 7 | AVERAGE HEADING PREV. INITIAL + ½ PREC. | | | | | | | | | | | |
| BNS GPI TRACK DATA | 8 | PRESENT BNS HDG. | | | | | | | | | | | |
| | 9 | — PREVIOUS INITIAL BNS HEADING | | | | | | | | | | | |
| | 10 | = TOTAL BNS HDG. CHG. | | | | | | | | | | | |
| | 11 | — HDG. CHANGE DUE TO STEERING GYRO PREC. | | | | | | | | | | | |
| | 12 | = BNS GYRO PRECESSION REVERSE SIGN FOR STEERING | | | | | | | | | | | |
| | 13 | DESIRED HEADING | | | | | | | | | | | |
| | 14 | — ½ TOTAL BNS HDG. CHG. | | | | | | | | | | | |
| | 15 | = NEW INITIAL HEADING AFTER ACFT ALTERS RESET BNS HEADING TO | | | | | | | | | | | |
| | 16 | AVERAGE BNS GPI HDG. | | | | | | | | | | | |

MISCELLANEOUS COMPUTATIONS

SAC FORM 1 AUG 56 521 FC: 2720

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*Figure 8-2.*

## OBSERVER'S CHECKLIST

**Continued**

4. Plot initial N-1 compass heading at the beginning of the period and grid heading at the end of the period against appropriate times. Connect the two points to determine heading change and average grid heading.

**NOTE**

The N-1 compass reading at the time of the sextant check should be the same as the initial N-1 compass reading at the beginning of the period. If the N-1 compass reading does not agree, plot this reading on the graph as the initial heading for the beginning of the period (assuming that this was heading for entire period).

5. Reset N-1 compass to sextant heading.

6. Determine desired and initial heading for next period (initial heading equals desired heading plus or minus 1/2 total heading change).

7. Turn airplane to new initial heading.

8. At any time a new desired heading is to be flown, the above procedure will be used except that the vertical lines will be renumbered with the centerline reflecting the new desired heading.

**Secondary Gyro**

1. Follow procedure as outlined above, recording BNS initial and final heading information (initial heading equals desired heading plus or minus 1/2 total BNS heading change).

2. To determine "C" gyro precession algebraically, subtract N-1 heading change from total BNS heading change.

**NOTE**

If airplane is to be steered by BNS, the sign should be reversed for the first initial heading.

### INSTRUCTIONS FOR USE OF GYRO LOG

When starting grid navigation, use standard procedures for turning onto initial heading. Desired heading will be the same as initial heading. Enter the initial heading in line 6 (first column). Enter the same initial heading in line 15 (or if polar angle over correction is computed, offset BNS heading by 1/2 over correction for intended rating increment).

Line 1 is the grid heading as called in from sextant (reset steering gyro to this GH).
Line 2 is the heading airplane was turned to and held. If airplane is not exactly on heading at time of sextant reading, use exact reading from steering gyro. This is the heading in line 6 (previous column) carried up for subtraction in column.

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

Line 3 is line 1 minus line 2 and is airplane heading change due to steering gyro precession for the rating period. Rules for algebraic subtraction must be followed, then line 3 will indicate right heading change if sign is plus, and left heading if sign is minus.
Line 4 is the desired heading at this time.
Line 5 is 1/2 the heading change listed in line 3.
Line 6 is the new initial heading (line 4 minus line 5).
Line 7 is the average heading made good to be used for airplot, etc.
Line 8 is the BNS heading at time of sextant reading.
Line 9 is the last previous BNS setting. The reading is carried up from line 15, previous column.
Line 10 is the total BNS heading change (line 8 minus line 9).
Line 11 is airplane heading change due to N-1 precession copied from line 3, same column.
Line 12 is "C" gyro precession (line 10 minus line 11).

**NOTE**

If airplane is to be steered by BNS, then the sign of line 12 must be reversed for first initial heading.

Line 13 is the same as the desired heading in line 4, same column.
Line 14 is 1/2 the entry in line 10.
Line 15 is the new setting to be cranked into the heading unit (add line 13 to line 14 algebraically).
Line 16 is the average heading that BNS has been driving on (add line 9 to line 14 algebraically).

**NOTE**

Lines 3, 11, and 12 have been cross-hatched for the purpose of establishing both periodic and an hourly precession rate.

Continued On Next Page

## OBSERVER'S CHECKLIST

Continued

## NORMAL BOMBING PROCEDURES

If bombs have been carried on the mission, the observer will visually check that the bomb bay is clear prior to the first RBS or camera run (oxygen discipline will be observed).

**BOMBING EQUIPMENT CHECKLIST** (to be requested by observer prior to first Pre-IP)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Safety Check | |
| | a. Bomb Door & Release Switch | MANUAL |
| | b. Bric (Intervalometer) | TRAIN & ZERO BOMBS, LIGHT OUT |
| | c. Bomb Control Selector Switch | NORMAL |
| | d. Bomb Salvo Switch | OFF |
| | e. Rack Lock Light | ON |

**NOTE**

An inflight check of automatic operation of the bomb doors will not be made as part of the bombing equipment check.

2. Sighting Switch — OB

3. Forward Sighting Switch — DEPRESSED
   Place crosshairs ahead of the airplane by depressing the forward sighting button.

4. Function Switch — BOMB

5. Tracking Control — INCREASE TG TO 120 SEC WITH C-1 AZIMUTH DIAL CENTERED
   Check that observer's and pilot's TG meters agree within 5 seconds.

6. ATF Setting Control — CHECKED
   Increase ATF; check TG decreases more rapidly. Decrease ATF; check TG increases.

7. Trail Setting Control — CHECKED
   Increase trail; check TG increases. Decrease trail; check TG decreases rapidly.

8. PDI — LEFT, RIGHT, CENTERED
   Check and center PDI with the tracking control and request second station.

9. PDI & Autopilot — CHECKED
   With the tracking control, make small corrections to left and right, checking that airplane and PDI turn in the proper direction and that PDI returns to center as autopilot takes out corrections. Check optics and PDI for stabilization in turns and ECO for proper operation.

**CAUTION**

Slewing is not recommended in second station.

Continued On Next Page

## OBSERVER'S CHECKLIST

Continued

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 10. | Indicator Light Switch | CHECKED ON |
| 11. | Bomb Power Switch | ON |
| 12. | UHF Radio<br>Have pilot switch UHF radio to unused channel. | UNUSED CHANNEL |
| 13. | Tone Control<br>At 20 seconds TG, initiate tone and allow TG to decrease to zero. | ON |
| 14. | Release Check | COMPLETED<br>At TG zero check:<br>a. Bomb release light comes on momentarily.<br>b. Tone discontinues and tone light goes out.<br>c. Autopilot control drops out of automatic.<br>d. Function switch returns to TRACK.<br>e. Pilot's PDI light goes out. |

**NOTE**

If tone does not discontinue at release, the bomb run will be made with manual control of the tone indicator. At the instant the release light on the primary control comes on, the observer will move the tone switch to OFF position.

| | | |
|---|---|---|
| 15. | Bomb Power Switch | OFF |
| 16. | Autopilot Control<br>Return control of airplane to pilot; correct airplane heading if required. | TO PILOT (if applicable) |
| 17. | Function Switch | NAV |
| 18. | Crosshairs | SET 15 NM |
| 19. | Offset Switch<br>Check that crosshairs move in direction of offset components set in ballistics control and return to approximately original position on scope. Check both offsets. | IN, CROSSHAIRS MOVE, OUT |
| 20. | Radar Pressure | CHECKED IN GREEN |

**BEFORE PRE-IP PROCEDURES**

1. Altitude - MEASURED
   Measure altitude over a selected area of known constant elevation for which the "D" factor is known. Record reading of ballistics control and pilot's pressure altimeter.

2. Wind Run - COMPLETED
   Take an accurate wind run and return crosshairs to maximum range on bearing of Pre-IP.

3. IAS for Bomb Run - DETERMINED
   Coordinate with pilot for predetermined IAS for bomb run.

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

4. Bombing Data - COMPLETED
   Complete in accordance with part 9, appendix I. Furnish copilot bombing altitude and bomb run TAS. Copilot will compute ballistics for cross-checking with observer.

**NOTE**

Compare bombing altitude and ballistics computed in flight with pre-comp data. Any major discrepancy should be reconciled before starting bomb runs.

5. Ballistics Control - CROSS-CHECK & SET TRAIL & ATF
6. Offset Components - SET (if applicable)
7. Wind Run - ACCOMPLISHED ON PIP OR GPI REF PT
8. LAT-LONG Counters - RESET ON PIP OR GPI REF PT
9. MAG-VAR - SET
   Set MAG-VAR dial to exact local variation.

**NOTE**

MAG-VAR will not drive when reference point switch is in REF PT.

**PRE-IP CHECKLIST** (to be requested by observer before reaching the IP)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Aerial Camera Intervalometer Switch | ON (B-8) or BOMB SPOT NIGHT RECON (B-7) |
| 2. | Camera Doors | OPEN (if applicable) |
| 3. | Bombing Mode Switch | SYN |
| 4. | Offset Data | N-S_____FT (read from dials)<br>E-W_____FT (read from dials) |
| 5. | Ballistics | TF_____SEC (read from dials)<br>TRAIL_____FT (read from dials) |
| 6. | Altitude | MEASURED & COMPUTED |
| 7. | Wind Run | ACCOMPLISHED |
| 8. | LAT-LONG Counters | RESET |
| 9. | MAG-VAR | SET_____° |
| 10. | Oxygen Control | 100% |
| 11. | TAS | TAS READS_____ |

Continued on Next Page

## OBSERVER'S CHECKLIST

Continued

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 12. | Camera Data Plates | COMPLETED |
| 13. | O-15 Camera | ON 1:4 (50 miles from IP) |
| 14. | O-23 Camera | ON, RADAR OPTICAL (or as briefed) |
| 15. | Circuit Breakers | IN |

**NOTE**

No radar photography procedures will be used which will hinder bombing accuracy.

**IP PROCEDURES**

1. Wind Run - ACCOMPLISHED ON IP OR GPI REF PT
2. LAT-LONG Counters - RESET ON IP OR GPI REF PT

**IP CHECKLIST** (called for by observer)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bric | SELECT & 10 BOMBS, LIGHT ON |
| 2. | Bomb Power Switch | ON, LIGHT ON |
| 3. | Indicator Light Switch | CHECKED ON |
| 4. | U-2 Low Pressure Warning Light | OUT & TESTED |
| 5. | U-1 Arming Switch | ARMED |
| 6. | T-35 Arming Switch | CHECKED ARMED |
| 7. | U-2 Rack | UNLOCKED (by copilot) (if applicable) |
| 8. | U-2 Rack Locked Light | OUT & TESTED |
| 9. | Offset Switch | OUT or IN (as desired) |
| 10. | True Heading<br>Check BNS heading against N-1 magnetic heading plus or minus variation. | CHECKED |
| 11. | N-1 Compass<br>Set latitude pointer to midlatitude of bomb run. | UNSLAVED |

Continued on Next Page

## OBSERVER'S CHECKLIST

Continued

**BOMB RUN PROCEDURES**

1. Wind Run - ACCOMPLISHED ON GPI REF PT (if practical)
   Refine wind on GPI reference point if time and conditions permit.

2. LAT-LONG Counters - RESET ON GPI REF PT (if practical)
   Refine setting of counters on GPI reference point if time and conditions permit.

3. Initial Lineup - ACCOMPLISHED & CROSSHAIRS EXTENDED
   As soon as the target area is identified, correct airplane heading until heading marker is drift angle upwind of target area (not OAP). If synchronization is to be started with offset out, initial lineup may be accomplished by placing the azimuth marker through the target area, switching to BOMB, and having the pilot center the PDI. Extend crosshairs to maximum range (out of lockout) after last wind run.

**BOMB RUN CHECKLIST** (called for by observer)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bombing Altitude | SET_____FT (target or OAP) |

**NOTE**

If elevation of target and offset aiming point differ, accurate synchronization can be accomplished on only one of the two, and the observer must commit himself to a direct or offset run at this time insofar as synchronization is concerned. The offset function can still be used to check target identification with a reasonable degree of accuracy.

| | | |
|---|---|---|
| 2. | Call at 50 Miles | 50 MILES OUT |
| 3. | Function Switch | BOMB |

At maximum synchronization range, position crosshairs on target or OAP, switch to BOMB, and depress deadman switch to start crosshairs driving. Check Rg limit light out. Use GPI techniques to check target identification. If a GPI release is to be made, hold the reference point switch in REF PT and, with the tracking handle, set the coordinates of the target in the latitude and longitude counters and switch to BOMB. During the run, use the tracking handle to refine the target coordinates in the latitude and longitude counters with the switch in REF PT. If offset is IN, the latitude and longitude counters will still read the TARGET coordinates with the switch in REF PT.

| | | |
|---|---|---|
| 4. | PDI Centered | Center PDI and give me second station |

**NOTE**

Initial wind synchronization may be accomplished prior to second station.

| | | |
|---|---|---|
| 5. | Your Airplane | ROGER, AUTOMATIC |
| 6. | Offset Switch | OFFSET IN or OFFSET OUT |

During run, switch offset IN and OUT to check target identification unless a direct run is being made for training accomplishments. Check final position of offset switch.

Continued on Next Page

## OBSERVER'S CHECKLIST

Continued

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 7. | 300 TG | |
| 8. | 250 TG | |
| 9. | 200 TG | |
| 10. | 150 TG | |
| 11. | 120 TG | |
| 12. | 90 TG | |
| 13. | 60 TG, Check in automatic | ROGER, AUTOMATIC |
| 14. | 30 TG | |
| 15. | 20 TG, Tone On & K-2 Auto | TONE ON & K-2 AUTO |
| 16. | Bombs Away (UHF) | BOMBS AWAY (INTERPHONE), T-HANDLE PULLED |

### POST RELEASE PROCEDURE

1. Release Light - ON MOMENTARILY, TONE & TONE LIGHT OFF
   Check that tone discontinues and tone light is out. If not, turn tone off manually.
2. O-15 Camera Selector Switch - EVERY OTHER
3. Function Switch - RETURNS TO TRACK
4. Bomb Doors - CLOSED (alternate switch, if necessary)
   If the T-handle was pulled prior to automatic door opening, the doors can be closed only with the alternate switch.
5. Release Data - RECORDED (other crew members will cross-check information)
   a. TH to 1/2° (at unit), TAS
   b. Wind components
   c. Time of release, O-15 and O-23 frame numbers.

### POST RELEASE CHECKLIST

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bomb Doors | CLOSED (alternate switch) |
| 2. | Radar | RETUNED |

Retune for optimum presentation under crosshair. After completing the turn off the target or at the expiration of the briefed time, note the position of the crosshairs relative to the aiming point for use in bombing analysis.

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 3. | Offset | OUT |
| 4. | LAT-LONG Counters<br>Switch to reference point and reset LAT-LONG counters to target coordinates. | RESET |
| 5. | Function Switch | NAV (impact plus 15 seconds for IBDA) |
| 6. | Range Marks-Crosshairs Switch | RANGE MARKS |
| 7. | Range Dial | 40 NM |
| 8. | Bomb Power Switch | OFF |
| 9. | Bomb Door & Release Switch | MANUAL |
| 10. | Bric | TRAIN & ZERO BOMBS, LIGHT OUT |
| 11. | N-1 Compass | RESLAVED |
| 12. | O-15 & O-23 Cameras | OFF & LAST EXPOSURE RECORDED |
| 13. | Camera Doors | CLOSED |
| 14. | Oxygen | NORMAL |
| 15. | Release Data | RECORDED ON BOMBING DATA FORM |

## FIXED ANGLE BOMBING PROCEDURES

### BEFORE PRE-IP PROCEDURES

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

### PRE-IP CHECKLIST

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

### IP PROCEDURES

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

### IP CHECKLIST

Same as in normal synchronous bombing except that the offset switch will be OUT for a fixed angle run.

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

**BOMB RUN PROCEDURES**

1. TG -_____SECONDS
   Determine TG from 10-mile fixed range marker to release by means of fixed angle bombing graph, using best known ground speed and bombing altitude.

2. Function Switch - NAV

3. Offset Switch - OUT

4. Cursor Control - SET TO AXIS OF ATTACK
   For airplanes not equipped with etched cursor, perform steps "5" through "7" in lieu of "4."

5. Boresight Switch - NORMAL

① 6. Bombing Mode Switch - L/S

7. Drift Dial - SET PRECOMPUTED DRIFT ON BOMB RUN

**NOTE**

If electronic azimuth mark is not present or cannot be controlled, the outer azimuth scale may be used to measure azimuth of the target during multiple drift correction, by expanding the scope to place the target at the outer periphery at critical times.

8. Bomb Door & Release Switch - MANUAL

9. Initial Lineup - ACCOMPLISHED
   As soon as the target is identified, correct the airplane heading until the PPI heading marker is drift angle upwind of the target.

10. Etched Cursor or Electronic Azimuth Mark - REPOSITIONED
    Place etched cursor or azimuth mark directly through the target to correct the deviation from briefed axis of attack and expand scope until target is near periphery.

11. Multiple Drift Correction - ACCOMPLISHED
    a. Place the etched cursor or electronic azimuth mark through the target as it passes through the 40-mile fixed range mark. Read and record the true bearing of the etched marker or azimuth mark from the azimuth scale or the relative bearing of the azimuth mark from the drift dial. If neither cursor nor azimuth mark is available, expand the scope and read the bearing of the target direct from the azimuth scale.
    b. Read and record the bearing of the target as it crosses the 30-mile fixed range mark and compare with the first bearing.
    c. Multiply the change in bearing by four and immediately correct the airplane heading by the result in the same direction that the target appeared to drift on the PI. Example: First bearing, 091°; second bearing, 092 1/2°; correct heading 6° (4 x 1 1/2°) to the right. If the correction is large, add approximately 10% to the turn to compensate for delay in completing turn.
    d. Apply same correction with the opposite sign to the precomputed drift angle to determine actual drift on the bomb run. In the above example, if precomputed drift was 002° right, actual drift would be 002° - 006° or 004° left.
    e. Replace cursor or azimuth marker through the target.

**Continued on Next Page**

① Alternate procedure to using cursor control

## OBSERVER'S CHECKLIST

**Continued**

f. If the target drifts off the cursor or azimuth mark during the remainder of the run, correct the airplane heading twice the amount of apparent drift in the same direction that the target appeared to drift.

12. Normal Bomb Door Switch - OPEN, INDICATOR CHECKED
Open the bomb bay doors with the normal system in sufficient time to permit complete opening before the target reaches the 10-mile range mark.

13. TG Hack - INITIATED AT 10 MILES (RBS only: TONE ON)
As target reaches the 10-mile fixed range mark, start the stopwatch and instruct the pilot to turn into the wind one-seventh of the drift angle to approximate cross trail. If an RBS run is being accomplished, initiate the scoring tone signal.

**NOTE**

If altitude delay is set in at normal operational altitudes, the first 5-mile range mark visible on the scope will represent 10 miles of slant range. At low altitudes or if altitude delay is not set in, the first 5-mile range mark will appear on the scope and the second visible mark will represent 10 miles slant range.

14. D-2 Bomb Release Switch - DEPRESSED & HELD AT TG, T-HANDLE PULLED

15. (RBS only) Tone Switch - OFF AT TG
Manually discontinue scoring tone at TG.

### POST RELEASE PROCEDURE

1. O-15 Camera Selector Switch - EVERY OTHER

2. Alternate Bomb Door Switch - CLOSED, INDICATOR LOCKED

3. Release Data - RECORDED
Cross-check information with other crew members and record:
   a. TH to 1/2° (at unit), TAS
   b. Wind components
   c. Time of release, O-15 and O-23 frame numbers.

### POST RELEASE CHECKLIST

Same as in synchronous bombing.

## RENDEZVOUS

1. APN-76 - ON (approximately 350 nm from rendezvous point)
   a. Receiver Standby Switch - STANDBY
   b. Master Power Switch - ON
   c. Transmitter Frequency Switch - AS BRIEFED
   d. Receiver Frequency Switch - AS BRIEFED
   e. Receiver Standby Switch - ON (after 3-minute warmup)

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## OBSERVER'S CHECKLIST

**Continued**

2. ETA to Rendezvous Point - RELAYED TO TANKER
   An accurate ETA to the rendezvous point will be computed and relayed to the tanker 30 minutes before arrival.

3. Periscopic Sextant - RETRACTED & PORT CLOSED

4. Descent Range - COMPUTED

5. Radar - TUNED FOR BEACON OPERATION
   Approximately 200 nm from rendezvous point.

6. Tanker Beacon Signal - IDENTIFIED & CONFIRMED
   Identify assigned tanker by briefed coded beacon signal and confirm identification by requesting tanker to turn APN-11 or APN-69 to STANDBY while watching PPI. If signal disappears and then reappears when beacon is turned ON, identification is satisfactory.

**NOTE**

When receiving signals from the APN-69, the 1/2- and 1-mile spacings cannot be readily distinguished on ranges greater than 30 nm. Use of the sweep delay and a sweep range of 30 nm is mandatory for identification. If the beacon signal appears as a multiple signal in range and the actual position of the tanker cannot be readily determined, adjust sector amplitude and sector position controls on the indicator to provide a narrow sector along the azimuth of the tanker, reduce receiver gain, and adjust contrast (if applicable). This procedure will normally reduce the false signals sufficiently to enable identification of the tanker. Reducing receiver gain, adjusting contrast, and turning on antijam or FTC will also reduce the width of the beacon signal in azimuth and aid in establishing an accurate heading, particularly at shorter ranges.

7. Homing On Tanker - ACCOMPLISHED

8. Tanker Range - RELAYED TO PILOT

9. Descent - INITIATED

10. Sweep Delay Control - OUT OF DETENT, DEPRESSED
    When the beacon signal approaches the first 5-mile FRM, turn sweep delay out of detent to eliminate altitude delay.

**NOTE**

Alternate procedure for close range rendezvous: Tune for radar search operation when tanker approaches a range equal to the refueling altitude. Pick up the radar return of the airplane as it emerges into the altitude hole and proceed as in beacon operation. This procedure will be used when the APN-11 or APN-69 beacon cannot be received, or when the beacon signal cannot be sufficiently controlled with gain or contrast to prevent smearing over a wide arc of the scope at close ranges. It may also be used during mass rendezvous accomplished, using the APN-12/APN-76, to aid in avoiding other aircraft in the area. In the latter case, the receiver observer has no means of identifying his assigned tanker.

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## OBSERVER'S CHECKLIST

**Continued**

11. Range Dial - MINIMUM RANGE
    Continue to relay range to pilot in 1-nm increments until the rendezvous is successfully completed.

12. APN-76 - OFF (after continuous visual contact is assured)

13. Radar - TUNED FOR RADAR SEARCH

14. Altitude - MEASURED

15. Refueling Wind - DETERMINED or SET
    Predicted wind may be set if conditions do not permit determining refueling wind.

16. LAT-LONG Counters - RESET

17. Receptacle, Manifold & Lines - CHECKED FOR LEAKS

18. Refueling Data - RECORD TIME OF CONTACT & DISCONNECT

## PRE LANDING EQUIPMENT CHECK

To be performed prior to descent at completion of mission unless scored bomb runs have been accomplished in flight.

### RADAR EQUIPMENT CHECK

1. Function Switch - NAV

2. Radar Power Switch - SCAN FAST

3. Radar Control Unit Meter - MAG I

4. Variac - ADJUST MAG I TO 4.2 MA

5. Radar Control Unit Meter - ALL READINGS CHECKED

| | | |
|---|---|---|
| a. | +600 | DC block to full scale |
| b. | +300 | DC block |
| c. | +150 | DC block |
| d. | -105 | DC block |
| e. | -300 | Centerline of DC block |
| f. | +26.5 | DC block +1 division |
| g. | AC | AC block |
| h. | IND HV | DC block |
| i. | MOD HV | 7 (±1 1/2) division |
| j. | XTAL I | .5 to 1.1 ma (optimum .6) Check XTAL 1 and XTAL 2 |

6. PPI - RETUNED

Continued on Next Page

## OBSERVER'S CHECKLIST

Continued

7. Radar Reception - EVALUATED
   Check scope presentation for:
   a. Target definition
   b. Maximum range
   c. Spoking
   d. Focus adjustment
   e. Centering adjustment
   f. Crosshair and FRM equal intensity.

8. Beacon Reception - EVALUATED
   Use standard beacon tuning procedure. Check for definition and maximum range. This check may be omitted if beacon reception was satisfactory during flight.

### BOMBING ACCURACY (COMPUTER) CHECK

1. Radar - TUNED FOR RADAR SEARCH

2. Trail - ZERO

3. TF - 15 SEC

4. Bombing Mode Switch - SYN

5. Boresight Switch - NORMAL

6. Sighting Angle Dial - ZERO

7. Drift Dial - ZERO

8. Bric - TRAIN, 20 BOMBS, MAXIMUM INTERVAL

9. Synchronous Bomb Run - ACCOMPLISHED
   Perform a normal radar synchronous bomb run on any target of opportunity which can be identified visually.

10. TG Zero - TIMING STARTED
    At release, start a 15-second timing period, using stopwatch.

11. Bombing Mode Switch - L/S

12. Bombing Error - ESTIMATED, 15 SEC AFTER RELEASE
    Fifteen seconds after release, check target through optics. Airplane and optics should be directly over target. Estimate bombing error in mils from optics (outer circle of optics is 6 mils; opening in crosshairs is 2 mils).

**NOTE**

If visibility conditions do not permit an optics check, perform normal inflight bombing equipment check.

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## OBSERVER'S CHECKLIST

Continued

# AIRBORNE RADAR APPROACH AND MONITORING

### PRE-PENETRATION PROCEDURES

1. ATF Dial - 59.18 SECONDS

2. Trail Dial - SET
   Compute trail by formula: 100 times (BFS + 10) and set.

3. Offset Dials - SET
   Set components from approach end of runway to selected OAP.

**NOTE**

To be used only to aid in locating runway; not for synchronization during approach.

4. PPI Centering - CHECKED
   Check scope centering and adjust if necessary. Any deviation between the PPI heading marker and the true heading transmitter will be noted and applied to any bearings used during the approach.

5. Safety Checklist - COMPLETED
   If bombs are aboard, a complete bombing safety check must be made.

6. Bombsight Cover (Clamshell) - CLOSED

### PENETRATION PROCEDURES

**WARNING**

All altitudes referred to below, except penetration altitudes, are absolute altitude above terrain.

1. Initial Points - MADE GOOD
   The observer will direct the airplane to the VOR station, LF range, or other reference points to be used for initiating the penetration, arriving over the point on the desired heading for initial descent.

2. Penetration - INITIATED
   Upon reaching the selected reference point, a standard jet penetration will be initiated.

3. Crosshairs - POSITIONED ON APPROACH END OF RUNWAY
   When within maximum crosshair range of the runway, place crosshairs on approach end of runway. In the event the runway cannot be distinguished but the OAP is discernible, synchronization may be accomplished on the OAP. This procedure will greatly detract from the accuracy of the approach and should not be used unless necessary.

4. Function Switch - BOMB

Continued on Next Page

## OBSERVER'S CHECKLIST

**Continued**

5. Wind Determination Switch - MEMORY POINT
   Maintain synchronization on the approach end of the runway with the wind determination switch in MEMORY POINT during the entire penetration and approach. Because of the 5-minute limitation on wind determination, it may be necessary to reposition the switch to MEMORY POINT several times during the approach. Corrections should not be made while in turns because of erroneous roll and pitch correction values introduced.

### APPROACH PROCEDURES

1. Traffic Pattern - DIRECT AIRPLANE AS REQUIRED
   Upon reaching the level-off altitude specified for the penetration, the observer will reposition the crosshairs, if necessary, and direct the airplane around the normal GCA pattern for the active runway, advising the pilot of the proper times for adjusting altitudes and/or airspeeds. The airplane should be 1200 feet above terrain at best flare speed plus 10 knots upon reaching the glide slope. The bearing of the azimuth marker and the N-S, E-W fix dials will be used to determine when to start turns and/or descents.

2. PDI - CENTERED, ON FINAL APPROACH
   Upon completing the turn on final, the observer will instruct the pilot to use standard ADF procedures to position airplane to keep the PDI centered when airplane is on runway heading.

3. Final Descent - INITIATED AT 120 SECONDS TG
   When the TG meter reaches 120 seconds, instruct the pilot to initiate a 600 feet per minute descent while keeping the PDI centered.

4. Rate of Descent - CHECKED AT 60 SECONDS TG
   The rate of descent will be checked when the TG meter reaches 60 seconds. The airplane should be at 600 feet above terrain.

**NOTE**

If a practice approach is being made, it will be discontinued at the published GCA minimum altitude for PPI approaches and a go-around initiated, maintaining the last heading if at all feasible. The TG meter should reach zero when the airplane is approximately 1000 feet down the runway. The 1000-foot distance is based on a combination of pulse length and spot size error and the average width of the range crosshair. It is predicated on the procedure of placing the inner edge of the range marker on the apparent end of the area of no return representing the runway. While the exact distance will vary somewhat with control settings, this procedure will establish a glide slope comparable to that of GCA and should insure the airplane will not land short of the runway.

### AIRBORNE RADAR APPROACH AT FIELD WITHOUT PUBLISHED PENETRATION AND APPROACH PATTERNS

1. Preparation of the BNS prior to penetration will be in accordance with basic procedure.

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## OBSERVER'S CHECKLIST

**Continued**

2. After descent to 20,000 feet is accomplished, the observer will direct the airplane over the approach end of the active runway on the reciprocal of the landing heading by making a simulated bomb run on the end of the runway with the pilot following the PDI. The wind determination switch will be left in MEMORY POINT during the entire penetration and approach.

3. One minute after TG reaches zero, the pilot will initiate a standard penetration descent and execute a 30° standard rate turn to the right or left as dictated by local conditions. The observer will reposition the function switch to BOMB and maintain synchronization on the approach end of the runway during the entire penetration and approach with the wind determination switch in MEMORY POINT.

4. Upon reaching 12,000 feet, a 210° standard rate turn in the opposite direction will be initiated, rolling out on the runway heading and continuing the descent to 1200 feet or local minimum safe altitude if higher.

5. The observer will reposition the crosshairs on the end of the runway and instruct the pilot to use standard ADF procedures to position airplane to keep the PDI centered when airplane is on runway heading.

6. When the TG meter reads 120 seconds, a 600 foot per minute descent will be initiated.

7. When the TG meter reaches 60 seconds, the rate of descent will be checked. The airplane should be at 600 feet.

### BEFORE LANDING PROCEDURE

**NOTE**

Engines No. 1 and 6 must be left above 52% and the alternators left "on" until the radar is turned "off" at destination. On all penetrations and practice GCA's at destination, the radar will be left ON until the pilot is certain visual contact can be maintained. On all flights, regardless of weather, the BNS computer will be left in STAB until completion of the landing roll. Lack of AC power from the alternators will not affect the computer gyros in STAB.

1. RAI Brilliance - FULL CCW
2. RAI Power Switch - OFF
3. Function Switch - STAB
4. Radar Power Switch - SCAN SLOW
5. Radar Power Switch - SCAN OFF, WHEN TRACE AT 180°
6. Bias - FULL CCW
7. Video Gain - FULL CCW
8. Receiver Gain - FULL CCW

Continued on Next Page

## OBSERVER'S CHECKLIST

Continued

9. Variac - CCW TO 75
10. Tilt - +5
11. Radar Power Switch - OFF
12. Inform Pilot - RADAR OFF
13. Indicator Light Switch - OFF
14. Safety Belt & Shoulder Harness - FASTENED & LOCKED

**AFTER LANDING PROCEDURE**

1. Function Switch - OFF
2. BNS Heater Switches - OFF
3. Camera Master Switch - OFF, BEFORE OPENING BOMB DOORS
4. 3ø Inverter Switch - OFF

## POSTFLIGHT PROCEDURES

1. Ejection Seat Pins & Streamers - INSTALLED
2. Oxygen Supply Shutoff Lever - OFF
3. Diluter Lever - 100% OXYGEN
4. Oxygen Emergency Toggle Lever - NEUTRAL
5. Oxygen Warning System Switch - OFF
6. Aerial Camera Intervalometer Power Switch - OFF
7. Sextant & Power Cable - REMOVED
8. Sextant Port - CLOSED
9. Sextant Bubble - REDUCED TO MINIMUM
10. Sextant & Cable - STOWED
11. All Light Switches - OFF
12. DD Form 781 - COMPLETED
    BNS and/or other observer equipment malfunctions or discrepancies entered in DD Form 781 series.
13. Bomb Rack Power Cable - DISCONNECTED (if applicable)
14. Bomb Fuse Pins & Shackle Pins - INSTALLED (if applicable)

Continued on Next Page

# TIME TO GO FROM 10 MILE SLANT RANGE RELEASE

## ( = TIME TO IMPACT — TABULAR AFT )

1. GO ACROSS TRAIL LINE TO BOMBING ALTITUDE
2. GO VERTICALLY TO GROUND SPEED
3. GO LEFT TO READ TIME TO IMPACT
4. SUBTRACT ATF FROM TIME OBTAINED

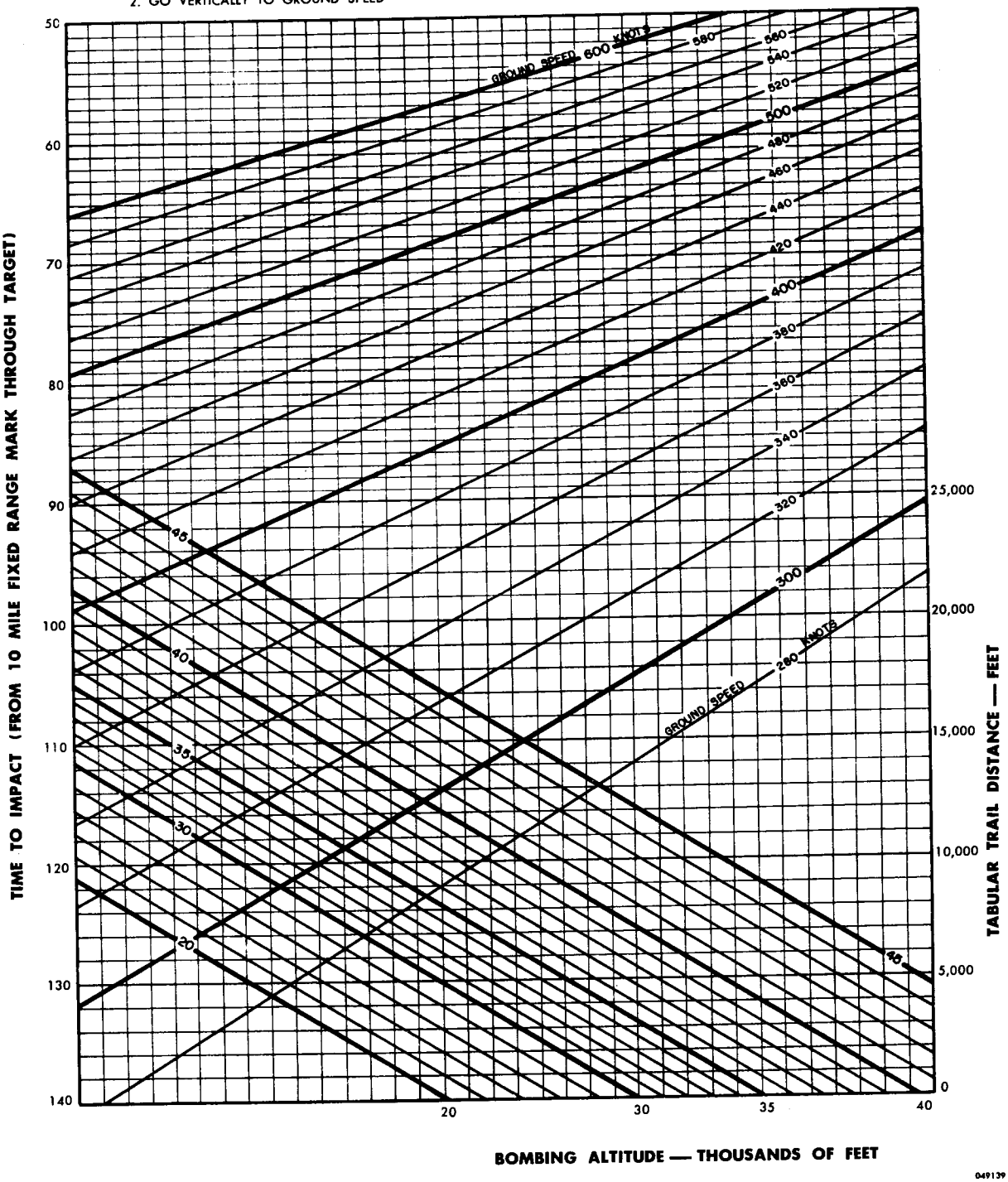


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*Figure 8-3.*

## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

**NOTE**

This check is not to be performed as part of the normal preflight.

**EXTERIOR INSPECTION**

1. DD Form 781 Series - CLEAR DISCREPANCIES
   At this time all entries pertaining to navigational or bombing equipment or power supplies will be cleared.
2. Auxiliary Power Unit - ADEQUATE FUEL 115V AC, 28V DC, CONNECTED
   Insure that sufficient fuel is in the APU to complete all required ground checks and connect both AC and DC power to the airplane.
3. Radar Compartment - OPEN
4. Constant Speed Motor Switch - CHECKED ON
5. True Airspeed Correction - CHECKED SET (previously determined)
6. Servo Amplifier STAB-UNSTAB Switch - STAB
7. Bomb Door Safety Locks - INSTALLED
8. Bomb Bay - CLEAR & EMPTY
   Check that bomb power cable is disconnected if bombs are aboard.

**INTERIOR INSPECTION**

1. Main AC Power Shield - ALL CIRCUIT BREAKERS IN
2. DC Voltmeter (copilot's position) - 27.5 (±1.5) V
3. Main Inverter - MAIN or ON
4. Regulated AC Voltmeter - MAIN BUS 115 (±5) V
5. Unregulated AC Selector Switch - EXTERNAL POWER 115 (±5) V
6. Unregulated AC Power Light - OFF
7. Coordinate Converter Power Supply - CHECK FUSES & AMPLIFIERS FOR SECURITY OF MOUNTING
8. Stab Unit Power Switch (SAU) - ON
9. Instrument Inverter Switch - ON MAIN, LIGHT OUT
   Normally accomplished by pilot. Instrument inverter switch is located on upper left corner of pilot's instrument panel.
10. Master Air Conditioning Switch - ON

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

11. Cabin Air Selector Switch - AIR COMP
12. Spare Fuses - CHECKED FOR QUANTITY & TYPE
13. SAU & CAU - AMPLIFIERS SECURELY MOUNTED, CABLES SECURE
14. Spare Amplifiers - 1 EACH BH, WH, RH, DH, LH, MH, KH, IH, MCH, HH; 2 EACH MAH
15. Spare Bulbs - ADEQUATE SUPPLY EACH TYPE
16. Radar Pressure Pump - DESICCANT SERVICEABLE, INCREASE PRESSURE TO 37 INCHES OF Hg
    If desiccant crystals are pink above indicator line, replace. Use MOMENTARY ON switch position to increase pressure.
17. Cables - SECURE
    Check security of all accessible cables.
18. Ejection Seat Pins - INSTALLED
19. Radar Power Panel Circuit Breakers - ALL DEPRESSED
20. Bric - TRAIN & ZERO BOMBS, LIGHT OUT
21. Bombsight Cover (Clamshell) - CLOSED
22. Bomb Door & Release Switch - MANUAL
23. Normal Bomb Door Switch - OFF
24. Alternate Bomb Door Switch - OFF
25. Bomb Power Switch - OFF
26. Indicator Light Switch - OFF
27. Salvo Switch - OFF
28. Bomb Control Selector Switch - NORMAL
29. U-1 Arming Switch - SAFE, LIGHT OUT
30. BNS Heating Control Switches - NORMAL

**NOTE**

Use PREHEAT position during ground operation with external power when outside temperature is below 32° F and in flight when BNS has been off.

31. 3Ø Inverter Switch - OFF

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

**POWER APPLICATION CHECK**

1. PMG Switch - ON
2. 3Ø Inverter Switch - ON
3. Function Switch - STAB, AFTER 20 SEC
4. Radar Power Switch - STANDBY
5. 3Ø Inverter Switch - OFF
6. Radar Power Monitoring Panel - ALL VOLTAGES & FREQUENCIES CHECKED
7. BNS System Inverter Warning Light - OUT
   The red inverter warning light on the radar power monitoring panel or lighting control panel will be OUT when proper power is being furnished.
8. AC Voltage - WITHIN AC BLOCK
9. +26.5 - DC BLOCK + 1 DIV
10. Coordinate Converter Power Supply - LIGHT ON, METER NEEDLE IN GREEN BLOCK
11. Fuse Tell-Tale Lights - OUT
    This check should be made after power has been on 30 seconds.
12. LAT-LONG Counters - IN DETENT
13. Reference Point Switch - PLANES
14. MAG-VAR - 10E, 10W, SET
    (To be performed within 1 to 5 minutes after power is on)
    a. MAG-VAR - ZERO
       Check that true heading unit transmitter and repeater settle at approximate magnetic heading.
    b. MAG-VAR - 10° EAST
       Check that heading increases 10° within 30 seconds.
    c. MAG-VAR - 10° WEST
       Check that heading decreases 20° within 30 seconds.
    d. MAG-VAR - SET
       Set correction dial to zero (MAG-VAR index to center of scale).
15. Boresight Switch - AZ
16. Drift Dial - 0°
17. Sighting Angle Dial - 60°
18. Variac - APPROXIMATELY 75 DIVISIONS
19. O-15 Camera Power Switch - OFF

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

20. O-23 Camera Power Switch - OFF
21. Meter Switch - MAG I
22. Search Crystal - XTAL 1
23. Receiver Gain - FULL CCW
24. FTC Switch - OFF
25. LOG-LIN Switch - LIN
26. Operation Switch - RAD HIRES
27. Sweep Delay - FULL CCW & DEPRESSED
28. Tilt - ZERO
29. Range Dial - 30 NM
30. Offset Switch - OUT
31. Radar Altitude Switch - OFF
32. Sighting Switch - PPI
33. Range Marks-Crosshairs Switch - RANGE MARKS
34. AUX PPI OR NAV TRACK Switch - OUT
35. Bias - FULL CCW
36. Video Gain - FULL CCW
37. Brill Marks - FULL CCW
38. Range Lights - CHECKED & SET
39. Periscope Desiccator Pump - OPERATING, DESICCANT SERVICEABLE
    The periscope desiccator pump may be checked for operation by feeling or listening to it. If the desiccant crystals are pink above indicator line, replacement is required.
40. RAI Power Switch - ON
41. RAI Brilliance - FULL CCW
42. Reticle Light Switch - ON
43. Reticle Light Rheostat - FULL CW
44. Autopilot Turn Control - IN DETENT (if applicable)
45. Autopilot Control Switch - MANUAL (if applicable)

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

46. Navigation Method Switch - NORMAL

47. Polar Angle Dial - ZERO

48. Pole Switch - NORTH POLE

49. TF Dial - 80 SEC

50. Trail Dial - 7360 FEET

51. Bombing Mode Switch - L/S

52. N-S Offset(s) - ZERO

53. E-W Offset(s) - ZERO
    Set both offsets.

54. Waveguide Selector Switch - MAN ANT

### RADAR OPERATIONAL CHECK

To be accomplished after 5-minute standby delay. Range lights on indicator will jump from "5" to "10" when delay is completed.

1. Radar Power Switch - SCAN FAST

2. Variac - CW FOR 4.2 MAG I

3. Meter Switch - CHECK ALL VOLTAGES

| | | |
|---|---|---|
| a. | +600 | DC block to full scale |
| b. | +300 | DC block |
| c. | +150 | DC block |
| d. | -105 | DC block |
| e. | -300 | Centerline of DC block |
| f. | +26.5 | High side of DC block |
| g. | AC | AC block |
| h. | IND HV | DC block |
| i. | MOD HV | 7 (±1 1/2) divisons |
| j. | MAG I | 4.2 ma (readjust if necessary) |
| k. | XTAL I | .5 to 1.1 ma (optimum .6)<br>Check XTAL 1 and XTAL 2. |

4. Bias - CW FOR FAINT SWEEP

5. Video Gain - 1/3 TO 1/2 CW

Continued On Next Page

## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

6. Brill Marks - CW TO DESIRED INTENSITY

**NOTE**

An additional filter has been added to the heading mark loop to minimize the broad or multiple marks. This modification has also resulted in an attenuation of the amplitude of the heading mark, and it is therefore necessary to operate the brill mark control on the indicator at a higher setting than that used previously to obtain satisfactory heading mark intensity. This naturally results in an abnormally bright range mark which may be on the verge of "blooming," and likewise results in an appreciable difference of intensity between the radar range mark and the radar heading mark. Unfortunately, there is no direct control over the heading mark intensity other than brill mark control. Therefore, it may be necessary to accept an abnormally bright range mark in order to obtain a satisfactory heading mark.

7. Sweep Amplitude - ADJUSTED
   Adjust for end of sweep at outer edge of scope.

8. Focus - ADJUSTED
   Adjust for maximum sharpness of range marks. Readjust video gain if necessary. On MA-7A the focus adjustment is broad and may show little defocusing throughout the range of the control.

9. Vert & Horiz Center - ADJUSTED
   Center trace, using outer range mark as reference. Check focus and readjust if necessary.

10. Heading Marker - 360° (±2°)
    Check that PPI is properly phased in.

11. Scale Illumination - OPERATION CHECKED

12. Range Dial - 6 NM

13. Receiver Gain - CW FOR OPTIMUM RECEPTION
    Adjust bias, video gain, and receiver gain as required.

14. Tilt Control - CHECK FOR NORMAL OPERATION
    Target reception should be at maximum at approximately 0° and fade out at approximately -10° to -15°. Return to zero or optimum setting.

15. FTC Control - ON
    Check for buildup on near edge and fade out on outer edge of returns. Return to OFF.

16. LOG-LIN Switch - LOG, RECEPTION CHECKED
    For a presentation in LOG, set controls as follows: bias, CCW; receiver gain, FULL CW; video gain, 7/8 CW. Turn up bias as necessary. Check for a reduction in the relative intensity of strong targets in respect to weak targets.

17. LOG-LIN Switch - LIN, PPI RETURNED

**Continued On Next Page**

## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

**COMPUTER OPERATIONAL CHECK**

**NOTE**

This check cannot be made until the first timing period is completed. The boresight light on the LOS control will come on at the end of the first timing period.

1. Boresight Switch - NORMAL
2. Bombing Mode Switch - SYN
3. Range Marks-Crosshairs Switch - CROSSHAIRS
4. Function Switch - NAV
   Check that TAS indicator goes to approximately 430 knots after a minimum of 20 seconds, and then drops down to 181 (±15) knots.
5. CAU or Fuse Box Tell-Tale Lights - OUT
6. Altitude Correction Control - SET 20,000 FT IN BALLISTICS CONTROL
   Checks "H" amplifier.
7. Tracking Control - XE & XN DIAL CHECKED
   Move tracking control in both NORMAL and SLEW; check that XE and XN dials follow. Checks TAC, XE-TR, and XN-TR amplifiers.
8. Tracking Control - PPI CROSSHAIRS CHECKED IN RANGE & AZIMUTH
   Check that PPI crosshairs follow movement of tracking control in both NORMAL and SLEW. Checks GRAC, PHI, Rg, and STAB AZ amplifiers.

**SECTOR WIDTH AND CENTERING CHECK**

1. Fix Dials - SET N-0, E-20 OR MORE
2. Function Switch - TRACK
3. Sector Width - ADJUSTED TO 60° (120° on azimuth scale)
4. Vertex - 270° (±2°)
   Note position relative to periphery of scope.
5. Azimuth Mark - 90° (±3°)
   Scope must be centered and N-S fix dial exactly on zero.
6. Azimuth Mark - CHECKED
   Check single azimuth mark, no smearing of targets, and adjust backlash control on indicator.
7. Crosshair Balance - CHECKED
   Check azimuth mark and range mark intensity equal. Adjust range mark size and/or azimuth mark size on SN-135, as required.
8. Repeat steps "4" and "5" on all cardinal fixes. If displaced center is not in the same relative position to the periphery on reciprocal fixes, adjust horizontal or vertical displaced center control until the vertex in each case is the same relative distance from the periphery.

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## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

**RADAR ALTITUDE CHECK**

1. Radar Altitude Switch - ON
   Check that offset optics sighting angle moves to zero and red light comes on. (Offset sector vertex remains at periphery of scope.)
2. Radar Altitude Switch - OFF
   Check that PPI and optics sighting angle return to normal and light is out.
3. Function Switch - NAV

**PERISCOPE, FORWARD SIGHTING, AND LOS CONTROL CHECK**

1. Reticle Light & Rheostat - CHECKED
   Check normal and spare bulbs; leave as desired.
2. Reticle Color Control - CHECKED
   Check for normal operation (both red and white reticle); leave as desired.
3. Bombsight Cover (Clamshell) - OPEN
4. Sighting Switch - OB
5. Tracking Control - SET C-1 AZ DIAL -030° RIGHT. SA DIAL -080°
6. Filter Selector - CHECKED, CLEAR
   Check operation and return to CLEAR.
7. Optics Focus Control - ADJUST FOR SHARP CROSSHAIR
8. Power Change Control - CHECKED & SET AS DESIRED
9. Forward Sighting Button - DEPRESS (HOLD FOR 20 SECONDS)
   While observing optical crosshairs, depress forward sighting switch and hold until crosshairs settle down. Check that optical crosshairs move left and down. AZ dial to 0° (±3°) and SA dial to 060° (±6°). (Checks all amplifiers on coordinate converter, STAB AZ, XE track, XN track, Ø Rg amp.)
10. Bombing Mode Switch - L/S
    Check that optical crosshairs follow movement of drift and sighting angle controls on line of sight control unit.

**NOTE**

Illumination lights on boresight control operate only when bombing mode switch is in L/S.

11. Bombing Mode Switch - SYN

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

### OFFSET SIGHTING CHECK

1. Forward Sighting Switch - DEPRESSED
   Depress forward sighting button and hold for 20 seconds.
2. Offset Selector Switch - OFFSET #1
3. Offset Switch - IN
   While watching optic crosshairs, move switch to IN; there should be no movement of crosshairs (tolerance 2 mils, size of opening of crosshair).
4. Offset Light (White) - CHECKED ON
5. Offset Switch - OUT
6. Sighting Switch - PPI
7. Range Dial - SET TO 15 NM
8. N-S Offset - SET TO 30,400 SOUTH
9. E-W Offset - SET TO 30,400 WEST
10. Tracking Control - S-5, W-5 FIX SET
11. Indicator - CROSSHAIR CHECKED
    Note bearing of azimuth marker and position of range marker.
12. Offset Switch - IN
13. Indicator - CROSSHAIR CHECKED
    Bearing of azimuth marker should be the same as step "11." Range mark should expand approximately 7 miles.
14. Offset Switch - OUT
    Check that crosshairs on PPI return to original position.
15. Repeat steps "8" through "14" using 30, 400 N and 30,400 E offset and N-5, E-5 fix.
16. Offset Selector Switch - OFFSET #2
17. Repeat steps "3" through "15."
18. Offset Selector Switch - OFFSET #1
    Check crosshairs remain in same position before switching offset out for last time.

### NAVIGATION CONTROL UNIT AND HEADING UNIT CHECK

1. LAT-LONG Counters - CHECKED FOR DRIVE
   Check that each counter drives slowly in the direction of true heading (checks XE Nav and XN Nav amplifiers).

**Continued On Next Page**

## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

2. LAT-LONG Setting Controls - CHECKED & SET
   Check that each counter can be manually positioned in both directions and reset to field coordinates.

3. MAG-VAR - SET
   Set MAG-VAR to local variation.

4. Function Switch - TRACK

5. Wind Determination Switch - MEMORY POINT
   Switch to MEMORY POINT and check that green light comes on at 15 (+2/-0) seconds.

6. Tracking Control - WIND DIALS ZEROED

7. Function Switch - NAV

8. Range Marks-Crosshairs Switch - RANGE MARKS

9. True Heading Transmitter - At_____°
   Note and record value of At in true heading transmitter.

10. Heading Marker - CHECKED
    Check that PPI heading marker agrees with At on heading transmitter (±2°). Recheck sweep centering if out of tolerance.

11. Range Marks-Crosshairs Switch - CROSSHAIRS

12. Forward Sighting Switch - DEPRESSED
    Depress forward sighting switch and hold until PPI crosshair settles down.

13. Azimuth Marker - CHECKED
    Check that azimuth marker agrees with heading marker (±3°); Ø in polar converter should equal At.

**DOUBLE VRM CHECK**

1. Sighting Switch - OB

2. Tracking Control - MAX RANGE
   Hold tracking control directly forward and slew to maximum crosshair range.

3. Function Switch - TRACK

4. Tracking Control - REDUCE RANGE TO ZERO
   While watching PPI, decrease crosshair range to zero by holding tracking control directly aft. DO NOT SLEW. Check that no double range mark appears on PPI.

**NOTE**

Sweep may jump at 16 1/2 miles; this is normal.

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## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

5. Function Switch - NAV
6. Sighting Switch - PPI
7. Range Marks-Crosshairs Switch - RANGE MARKS

**POLAR NAVIGATION UNIT CHECK**

1. Polar Angle Dial - SET TO 010°
2. Navigation Method Switch - POLAR
   Check that At increases 10° (±1/2°).
3. Navigation Method Switch - POST POLAR
   Check that At decreases 5° in approximately 2 minutes.
4. Navigation Method Switch - NORMAL
5. Polar Angle Dial - SET TO 090°
6. Navigation Method Switch - POLAR
   Check that At increases 90°, heading marker and targets on PPI rotate 90° clockwise, azimuth marker does not move from original position (Ø in polar converter remains constant), and C-1 azimuth dial moves 90° counterclockwise.
7. Polar Angle Dial - SET At TO 360°
   Adjust polar angle until heading unit reads 360°.

**WIND DETERMINATION CHECK**

1. Forward Setting Switch - DEPRESSED
   Check for coincidence of azimuth marker and heading marker on PPI; C-1 AZ Dial 0°, SA Dial -060°.
2. Tracking Control - POSITION OPTICAL CROSSHAIR ON A TARGET ON THE RAMP
3. Function Switch - TRACK
4. Wind Determination Switch - MEMORY POINT
   Place switch in MEMORY POINT while holding crosshair on selected target with tracking control.
5. Tracking Control - RETURN CROSSHAIRS TO TARGET & SYNCHRONIZE UNTIL ALL MOTION OF CROSSHAIR IS STOPPED
   Check that crosshairs move smoothly without continuous jitter or oscillation and without overshooting.
6. Wind Dials - CHECKED
   Check that E-W dial reads ZERO; N-S dial reads NORTH value of TAS meter ±5 knots (checks ATTC amplifier).
7. Function Switch - NAV

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## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

**RAI CHECK**

1. Tracking Control - POSITION PPI CROSSHAIR ON A PROMINENT ISOLATED RETURN
2. Receiver Gain - FULL CCW
3. Function Switch - TRACK
4. RAI Brilliance - ADJUSTED
   Turn clockwise and adjust for well defined crosshair.
5. RAI Focus - ADJUSTED
   Adjust for sharp crosshair.
6. Horiz & Vert Center (PP-1144) - ADJUSTED
   Adjust as required to center RAI crosshair.
7. AZ Mk Size & RG Mk Size (PP-1144) - ADJUSTED
   Adjust as required for balanced crosshair on RAI.
8. Receiver Gain - CW FOR OPTIMUM RECEPTION ON RAI
9. RAI - CHECKED
   a. Check scope presentation and adjust VID size (PP-1144) as required.
   b. Check that RAI crosshair is in same relative position to target as on PPI.
   c. Check that RAI crosshair remains on target, using optic wind.
10. Radar Power Switch - SCAN OFF
11. Bombing Mode Switch - L/S
12. RAI Azimuth Sweep Size - CHECKED
    Turn line of sight drift control until azimuth mark appears in center of RAI. Turn drift control 10° right (or as briefed) from this point and check that sweep is just inside right edge of RAI mask. Turn drift control 10° left (or as briefed) of azimuth mark and check that sweep is just inside left edge of RAI mask. If not, adjust azimuth sweep size and horizontal centering control on PP-1144 until a 20° movement of drift control produces a full scale deflection on RAI.

**PPI SWEEP LENGTH ADJUSTMENT (K)**

1. Function Switch - BOMB
2. Tracking Control - N-15, E-0 FIX SET
3. Range Marks-Crosshairs Switch - RANGE MARKS
4. Altitude Correction Control - SET 5000 FT IN BALLISTICS CONTROL
5. Sweep Length Adjustment (SN-47) - ADJUSTED
   Adjust for sixth 5-mile marker at end of sweep.

Continued On Next Page

## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

6. Sweep Amplitude (Indicator) - ADJUSTED
   Adjust for sixth 5-mile marker at periphery of scope.

7. Range Marks-Crosshairs Switch - CROSSHAIRS

8. Function Switch - NAV

**RADAR RANGING AND BORESIGHTING CHECK**

**NOTE**

To be performed only on a surveyed isolated target.

1. Radar Altitude Switch - ON

2. Drift Knob - AZIMUTH MARK ALIGNED
   Align PPI azimuth mark through target.

3. Sighting Angle - 90°

4. Altitude Correction Control - ADJUSTED
   Set PPI range mark through target by setting in boresight target range.

5. Function Switch - TRACK

6. RAI Crosshair - POSITIONED
   Refine position of RAI crosshairs on lower third of target, using altitude correction control and drift knob.

7. Altitude Dial - CHECKED
   Altitude dial should read surveyed range to target ±90 feet.

8. Optical Crosshair - CHECKED
   Check that optical and radar crosshairs are coincident on target in azimuth ±6 mils (diameter of outer circle of crosshairs).

9. Bombing Mode Switch - SYN

10. Radar Altitude Switch - OFF

11. Altitude Correction Control - SET 30,400 FEET

**FIX DIAL ALIGNMENT CHECK**

1. Function Switch - BOMB

2. Tracking Control - SET FIX N-5, E-0
   Decrease XN and note that sector apex departs the periphery of the scope at approximately 4 1/2 nm. Continue to decrease XN until crossover occurs (check in optics).

3. Function Switch - NAV
   Switch to NAV immediately after crossover.

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

4. Fix Dials - CHECKED AT ZERO
   Fix dials should read 0 (±0.1) nm. Any error should be applied to results of bombing accuracy check.

5. Reference Point Switch - REF POINT, PLANES
   Check that latitude and longitude counters do not move more than 1/2 nm. Return to PLANES position.

**BOMBING ACCURACY CHECK**

1. Offset Dials - N-22,200 FEET, E-0

2. Offset Selector Switch - OFFSET #1

3. Function Switch - TRACK

4. Wind Determination Switch - MEMORY POINT
   Track in the value of south wind necessary to establish a ground speed of 280 knots (TAS meter reading plus south wind equals ground speed).

5. Slew Button - DEPRESSED
   Depress slew button to return wind determination switch to displacement.

6. Tracking Control - SET FIX N-10, E-0

7. Polar Angle Control - RESET At 360°
   Check At still at 360°. If necessary adjust with polar angle control.

8. Function Switch - BOMB
   a. Let system drive to release. Keep PDI centered ±2° and note that TG decreases smoothly.
   b. Switch to NAV IMMEDIATELY when bomb release light comes on.

9. Fix Dials - CHECKED
   XN should read 5 nm plus or minus error on crossover check.

10. Polar Converter - Rg_____FEET
    Check reading of Rg on polar converter; should read 30,400 (+600/-1000) feet.

11. A-1 Power Supplies (two) - VOLTAGES WITHIN REFERENCE BLOCKS

12. Sighting Angle Control - SET TO 45°00'
    Set 45°00' in sighting angle dial.

13. Boresight Switch - SA

14. Bombing Mode Switch - L/S
    While observing optical crosshairs, switch to L/S position; no movement of optical crosshairs should be noticed. If crosshairs are displaced, adjust sighting angle setting until crosshair displacement is no longer present when switching from L/S to SYN. Sighting angle dial should read 45° (±1°). If out of tolerance, check sighting angle in polar converter.

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## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

15. Sighting Angle Control - SET TO 60°00'
    Set 60°00' in sighting angle dial.

16. Offset Switch - IN

17. Bombing Mode Switch - L/S
    Same as step "14" except 60° (±1°).

18. Boresight Switch - NORMAL

19. Offset Switch - OUT

20. Bombing Mode Switch - SYN

### "C" GYRO RANDOM DRIFT CHECK

1. True Heading Unit - PRECESSION CHECKED
   a. Set At to any whole degree with polar angle control.
   b. Time gyro for 15 minutes and note change in At.
   c. Multiply change in At by four to get hourly precession rate.

2. Local Apparent Precession - COMPUTED
   a. Compute local earth rotation rate by formula (15 x sin latitude).
   b. Subtract step(s) "a" from 14.35 (constant correction induced by polar nav unit) to determine the overcorrection for apparent precession at the local latitude.

3. Random Drift - DETERMINED
   Compare step(s) "1" and "2b." Any difference is random drift and should be recorded for inflight use.

### CONSTANT SPEED MOTOR CHECK

**NOTE**

This check may be performed during random drift check.

1. Function Switch - TRACK

2. Wind Determination Switch - MEMORY POINT
   Start stopwatch at exact time switch is positioned.

3. Wind Dials - ZERO
   Return wind dials to zero after 15-second delay.

4. Wind Determination Warning Light - CHECKED
   Check that red warning light comes on at time tagged on primary control and tracking computer. Tagged time should be 4 1/2 minutes (±6 seconds). Any variation from the tagged time indicates a faulty constant speed motor.

5. Wind Determination Switch - CHECKED IN DISPLACEMENT
   Check that switch drops back to displacement automatically at approximately 5 minutes.

6. Function Switch - NAV

Continued On Next Page

## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

**BALLISTICS, BOMB RELEASE AND AUTOPILOT CHECK**

1. Autopilot - ON & ENGAGED
2. UHF Radio - ON, UNUSED CHANNEL
3. Indicator Light Switch - ON
4. Bomb Control Power Switch - ON

**CAUTION**

Recheck Bric "Train & Zero" and bomb door and release switch MANUAL unless actual operation of bomb bay doors and racks is desired.

5. Forward Sighting Switch - DEPRESSED
   Depress and hold until crosshair settles down.
6. Function Switch - BOMB
   Check that switch latches in position.
7. TG Meter - CHECKED
   Check that TG meter is activated without oscillating; then decreases slowly and smoothly (checks TI, TIVA-L, Ar, BRAC amps).
8. PDI - CHECKED
   a. Red bomb light ON
   b. PDI centered
   c. TG meter agrees with observer's TG meter (±5 seconds) and decreases smoothly.
9. Polar Angle Control - PDI FOLLOWS
   Check that At and PDI follow small corrections to polar angle both left and right. Adjust polar angle until At dial reads original true heading or airplane (polar angle will be approximately 360°).
10. Navigation Method Switch - NORMAL
11. Tracking Control - PDI CENTERED
12. Autopilot Transfer Switch (Pilot) - BOMBARDIER (or K-BOMB AUTO), AUTOPILOT READY LIGHT ON
13. Observer's Control Switch - AUTOMATIC (if applicable)
    Check for no movement of airplane controls when control is transferred to BNS.
14. Tracking Control - PDI CHECKED & CENTERED
    Check that PDI and airplane controls indicate turns in proper direction when small corrections to left and right are made with tracking control. Recenter PDI.
15. Trail Control - CHECKED
    Increase trail; TG meter should increase. Decrease trail; TG meter should decrease rapidly. Return to 7360 feet (checks TIVA-L amp).

Continued On Next Page

## OBSERVER'S CHECKLIST
### BNS ACCEPTANCE CHECKLIST

**Continued**

16. TF Control - CHECKED
    Increase AFT; TG should decrease rapidly. Decrease ATF; TG should increase. Return to 80.00 seconds (checks TF amp).

17. Tracking Control - PDI CENTERED
    Keep PDI within 5° of zero during check to ensure release.

18. Tone Switch - ON
    Initiate tone at 20 seconds TG, check tone light ON.

19. Interphone Jackbox - COMMAND
    Check for tone transmission.

20. PPI - PULSE GENERATOR MARKS ON
    At TG 3.5 (±1) seconds, check that pulse generator marks are present on each side of sector.

21. Release Check - At TG zero, check:
    a. Tone light goes OUT and tone discontinues.
    b. Autopilot returns to first station.
    c. Bomb release light comes on momentarily.
    d. Altitude hole appears at vertex of sector.
    e. PDI bomb light goes OUT.
    f. Function switch returns to TRACK automatically.
    g. Altitude hole at vertex of sector disappears approximately 7 seconds after release.
    h. Pulse generator marks disappear approximately 2 minutes after release.

22. Indicator Light Switch - OFF

23. Bomb Control Power Switch - OFF

24. Function Switch - NAV

25. Sighting Switch - PPI

26. Range Marks-Crosshairs Switch - RANGE MARKS

27. Autopilot - OFF & STOWED

28. UHF Radio - OFF

### MIN-MAX AND RANGE MARK ZERO CHECK

1. Range Dial - 10 NM

2. Altitude Correction Control - MIN-MAX ADJUSTMENT CHECKED
   Decrease altitude to approximately 28,000 feet. While watching PPI, increase altitude until first 5-mile range mark just begins to disappear in center of scope. Altitude dial should read 30,400 (±1,500) feet. If out of tolerance, make MIN-MAX adjustment.

Continued On Next Page

## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

3. Radar Altitude Switch - ON
   Check that radar altitude light comes ON and that first 5-mile range mark moves from center of PPI to approximately halfway to edge of scope.

4. Altitude Correction Control - ALTITUDE RESET TO 30,400 FEET

5. Range Marks-Crosshairs Switch - RANGE MARK ZERO CHECKED
   Move switch back and forth; crosshair and first 5-mile fixed range mark should appear on same point on PPI as switch is changed. If not, adjust range mark ZERO until FRM coincides with crosshair. Return to CROSSHAIRS.

6. Altitude Correction Control - ALTITUDE RESET TO 5,000 FEET

7. Radar Altitude Switch - OFF

**AUX-PPI OR NAV-TRACK CHECK**

1. Tracking Control - N-8, E-W 0

2. PPI - ADJUST CONTROLS FOR USABLE PPI TARGET PRESENTATION

3. AUX PPI OR NAV TRACK Switch - ON & CHECKED
   Check for drive of crosshairs in NAV function.

4. Function Switch - TRACK 360° SCAN
   Check for 360° scan from center of PPI. Check that crosshairs continue to drive.

5. AUX PPI OR NAV TRACK Switch - OUT & CHECKED
   Check for PPI sector scan about the value of $\phi$ in the reference point dials.

6. Function Switch - NAV

**TRANSMITTER CONTROL (SIGNAL COMPARATOR) OR AFC AND WAVEGUIDE SWITCH CHECK**

1. Variac - CCW TO 75 DIVISIONS

2. Range Knob - ABOVE 80 NM

3. Variac - CW FOR 13.4 MA MAG I

4. Waveguide Switch - MAN ANT

5. Increase-Decrease - CHECKED
   Check for continuous target presentation as frequency is varied throughout range.

**NOTE**

AFC may unlock but it should relock within 8 seconds after frequency is through changing.

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

6. Waveguide Switch - MAN LOAD

7. Increase-Decrease Switch - CHECKED
   Check for no targets at any time as frequency is varied throughout range.

8. Waveguide Switch - AUTO

9. Increase-Decrease Switch - CHECKED
   Check for targets present only in the neutral position (after AFC locks in) as frequency is varied.

10. Waveguide Switch - SEMI-AUTO

11. Increase-Decrease Switch - CHECKED
    Targets should be present. Increasing or decreasing frequency should cause targets to disappear and not return when switch is returned to neutral.

12. Waveguide Switch - TRANSMIT & CHECKED
    Turn to TRANSMIT and hold momentarily; targets should be present. Switch should return to semi-automatic position when released and returns should be present.

13. Waveguide Switch - MAN ANT

**Sweep Delay and Long Range Operational Check**

1. Variac - CCW TO 75

2. Range Dial - 80-200 NM

3. Variac - CW
   Set for MAG I of 13.4 ma. Check for steady MAG I and normal targets.

4. Range Lights & Fixed Range Marks - CHECKED
   Check range lights and range marks for proper value and spacing.

5. Sweep Delay Knob - CW & CHECKED
   Rotate slowly clockwise. Check that pip moves smoothly from center. Pull out knob and observe operation; targets that were inside the pip should disappear from the center of the scope. Check that MAG I holds steady.

6. Range Lights - CHECK SD LIGHT ON

7. Variac - CCW TO 75

8. Sweep Delay Knob - FULL CCW & DEPRESSED

**NOTE**

On either of these checks, if the magnetron arcs, indicated by a fluctuating MAG I, set range to 100 nm and decrease variac setting until MAG I fluctuates 2 to 3 divisions. Leave until it holds steady, then increase variac setting until MAG I starts to fluctuate again, and leave until it holds steady. Repeat until MAG I holds steady at two divisions above proper operational value.

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

Continued

**BEACON OPERATION CHECK**

1. Operation Switch - BEACON
2. Variac - CW FOR MAG I OF 11.2 MA
3. Radar Control Panel Meter - XTAL 1 OF .1 to 1.1 MA
   Check that XTAL 1 reads .1 to 1.1 ma (optimum .6) after 3 minutes. Check both XTAL 1 and XTAL 2.
4. Radar Control Panel Meter - MAG I STEADY
   Check that MAG I holds steady without fluctuation.
5. Tuning Controls - ADJUSTED
   Adjust bias, gain, and video gain for beacon reception if within range and evaluate reception.
6. Variac - CCW TO 75
7. Operation Switch - HI RES
8. Range Dial - 6 NM
9. Variac - CW FOR 4.2 MA
10. Radar Control Panel Meter - CHECKED
    Check that XTAL 1 reads .5 to 1.1 ma. Check all other meter readings within tolerance and return meter switch to AC.

**BNS TURNOFF PROCEDURE**

1. PPI - CHECKED
   Check pedestal amplitude and scope presentation for final acceptance.
2. RAI Brilliance - FULL CCW
3. Function Switch - OFF
4. Radar Power Switch - SCAN SLOW
5. Radar Power Switch - SCAN OFF, WHEN TRACE AT 180°
6. Tilt Control - FULL UP
7. Bias - FULL CCW
8. Video Gain - FULL CCW
9. Receiver Gain - FULL CCW
10. Variac - CCW TO 75
11. Radar Power Switch - OFF

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## OBSERVER'S CHECKLIST

### BNS ACCEPTANCE CHECKLIST

**Continued**

12. Radar Pressurization Unit - CHECKED & BLED
    Check pressure and bleed to ambient pressure. At average ambient temperatures, pressure will normally increase 1 to 2 inches during acceptance check.

13. Radar Pressurizing Control Switch - OFF

14. Master Air Conditioning Switch - OFF

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## OBSERVER'S CONDENSED CHECKLIST

### EXTERIOR INSPECTION

1. DD Form 781 Series - CLEAR DISCREPANCIES
2. Auxiliary Power Unit - ADEQUATE FUEL - 115V AC, 28V DC
3. Ejection Hatch External Release Handle - FLUSH WITH CONTOUR OF AIRPLANE
4. Radome - SECURE, OPENING CLEAR, NO FLAWS
5. Observer's Escape Hatch - FLUSH & CLEAR
6. C-9 Hoist Circuit Breaker - IN
7. FTB Circuit Breaker - IN
8. Bomb Arming Control Heater Circuit Breaker - IN
9. U-2 Rack Heater Circuit Breaker - IN
10. Radar Compartment - OPEN
11. Constant Speed Motor Switch - ON
12. True Airspeed Correction - CHECKED
13. Servo Amplifier STAB-UNSTAB Switch - STAB
14. Radar Compartment Access Doors - SECURE & HANDLES FLUSH
15. Bomb Door Safety Locks - INSTALLED
16. U-2 Release Pressure - 1500 PSI
17. K-2 Door Control Circuit Breaker - IN
18. Salvo Control Power Circuit Breaker - IN
19. U-2 Release - COCKED
20. If conventional bombs are loaded:
    a. Bomb Rack Power Cable - DISCONNECTED
    b. Bomb Rack Installation - SECURE
    c. A-5 Release Installation - SECURE
    d. Bomb Shackles - CHECKED
    e. Bombs, Pins & Fuses - CHECKED
21. Camera Magazine - INSTALLED
22. Dark Slide & Lens Cover - REMOVED
23. Camera Compartment Circuit Breakers - DEPRESSED
24. Bomb Salvo Power Circuit Breaker - IN

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## INTERIOR INSPECTION

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### WALKWAY CHECK

1. Coordinate Converter Power Supply - CHECK FUSES & AMPLIFIERS FOR SECURITY OF MOUNTING
2. Stab Unit Power Switch (SAU) - ON
3. Instrument Inverter Switch - MAIN, LIGHT OUT
4. Bomb Salvo Control Circuit Breaker - IN
5. Spare Fuses - CHECK QUANTITY & TYPE
6. SAU & CAU - AMPLIFIERS SECURELY MOUNTED, CABLE CONNECTIONS SECURE
7. Spare Amplifiers - 1 EACH BH, WH, RH, DH, LH, MH, KH, IH, MCH, HH; 2 EACH MAH
8. Spare Bulbs - ADEQUATE SUPPLY EACH TYPE
9. Radar Pressure Pump - DESICCANT SERVICEABLE, INCREASE PRESSURE TO 37 INCHES OF $H_g$
10. Cables - SECURE
11. Ejection Seat
    a. Safety Pins & Streamers - CHECKED. PINS IN
    b. Downward Ejection Hatch - LOCKPIN ENGAGED. PRESSURE CHECKED
    c. Leg Braces & Latch Triggers - CHECKED
    d. Torque Tubes - CHECKED
    e. Initiators - CHECKED
    f. Whiffletree - ENGAGED
    g. Catapult Initiator Safety Pin - INSTALLED
    h. Hatch Static Cable - ATTACHED
    i. Quick-Disconnect - CHECKED
    j. Shoulder Harness & Inertia Reel - CHECKED
    k. Seat Adjustment - CHECKED
    l. Report to Pilot - COMPLETED
12. Observer's Emergency Escape Hatch - SECURED

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**STATION CHECK**

1. Radar Power Panel Circuit Breakers - ALL DEPRESSED
2. Interphone Cord - CONNECTED
3. Interphone Jackbox - INTER
4. Interphone Mixer Switch - ON
5. Alarm Bell - ACKNOWLEDGE
6. Oxygen System - CHECKED
7. Bric - TRAIN & ZERO BOMBS, LIGHT OUT
8. Bombsight Cover (Clamshell) - OPEN
9. Bomb Door & Release Switch - MANUAL
10. Normal Bomb Door Switch - OFF
11. Alternate Bomb Door Switch - OFF
12. Bomb Power Switch - OFF
13. Indicator Light Switch - OFF
14. Salvo Switch - OFF
15. Bomb Control Selector - NORMAL
16. Drop Control Switch - DELAY
17. U-1 Arming Switch - SAFE, LIGHT OUT
18. Nose Fuse Arming Switch - SAFE, LIGHT OUT
19. BNS Heating Control Switches - NORMAL
20. Table, Dome & Instrument Lights - CHECKED
21. Nose Defrost - CHECKED
22. Observer's Upper Air Shutoff Lever - SET AS DESIRED
22A. Observer's Lower Air Heater Switch - OFF
23. Emergency Bomb Arming Safe Handle - IN PLACE
24. Emergency Bomb Release - IN PLACE, GUARD CLOSED
25. 3Ø Inverter Switch - OFF
26. Scope Camera Magazines - CHECKED & INSTALLED
27. Scope Camera Data Plates - COMPLETED, CLOCKS WOUND, INSTALLED
28. O-15 Camera Diaphragm Setting - SET AS BRIEFED
29. O-23 Camera Shutter Speed - SET AS BRIEFED
30. Air Refueling & Rendezvous Equipment
    a. APN-76 Control Box, Cables & Cannon Plugs - CHECKED FOR SECURITY
    b. Frequency Settings - AS BRIEFED
    c. Receiver Standby Switch - STANDBY
    d. Power Switch - ON
    e. Gain Control - 1/8 TURN BACK FROM FULL CLOCKWISE

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f. UHF Radio - ON (by copilot)
g. Refueling Equipment - CHECKED
h. Receiver Standby Switch - ON, AFTER 3 MINUTES
i. Rendezvous Radar - CHECKED WITH GROUND STATION
j. Receiver Standby Switch - STANDBY
k. Power Switch - OFF

31. N-1 Compass
a. Latitude Correction Pointer - OFF
b. Synchronizer Knob - CW, POINTER FOLLOWS
c. Synchronizer Knob - CCW, POINTER FOLLOWS
d. Latitude Pointer - SET LOCAL LATITUDE
e. Latitude Pointer - ZERO LATITUDE, CHECKED
f. Synchronizer Knob - CW, POINTER FOLLOWS
g. Latitude Correction Pointer - OFF
h. Master Indicator - SYNCHRONIZED

32. Aerial Camera (Vertical) Panel
a. Circuit Breakers - IN
b. Camera Intervalometer - CHECK COUNTERS SET & CHECK FUSES
c. Camera Master Switch - ON
d. Camera Door Switch - OPEN
e. Camera Selector Switch - MANUAL
f. Camera Selector Switch - AUTO
g. Intervalometer Power Switch - ON
h. Manual Initiation Switch - DEPRESSED
i. Intervalometer Power Switch - OFF
j. (B-8) Delay, Interval & Exposure Limiter - SET AS BRIEFED
(B-7) Interval Selector Control Dial - SET ATF

33. D-2 Periscopic Sextant Preflight (both sextants & mounts)
a. Desiccant - CHECKED
b. Time Dial - CHECKED FOR ACCURACY
c. Altitude Averager - CHECKED FOR ACCURACY
d. Bubble - FORMED & ADJUSTED
e. Sextant - INSERTED & CONNECTED
f. Illumination - CHECKED
g. Alignment - CHECKED
h. Sextant - RETRACTED or REMOVED & STOWED
i. Sextant Port - CLOSED
j. Sextant Mount - DRAINED

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## BNS PREFLIGHT

The following items will be performed in sufficient time for ground power application to be made to the BNS a minimum of 20 minutes prior to scheduled taxi time. The BNS will not be turned past STAB and STANDBY until airplane power check.

### BEFORE ENGINE START

1. Periscope Dome - CLEAN INSIDE & OUT, NO FLAWS
2. Radar Compartment Access Doors - CLOSED, SECURED & HANDLE FLUSH
3. U-2 Release - CHECKED COCKED
4. Bomb Safety Pins - REMOVED (if applicable)
5. Bomb Rack Power Cable - CONNECTED (if applicable)
6. Bomb Bay - CLEAR
7. Aerial Camera Window & Lens - CLEAN
8. External AC & DC Power - CONNECTED & ON
9. Main Inverter - ON, VOLTAGE CHECKED
10. Ejection Seat Pins & Streamers - REMOVED & STOWED
11. Indicator Light Switch - ON

### POWER APPLICATION CHECK

1. PMG Switch - ON
2. 3Ø Inverter Switch - ON
3. Function Switch - STAB, AFTER 20 SECONDS
4. Radar Power Switch - STANDBY
5. 3Ø Inverter Switch - OFF
6. Radar Power Monitoring Panel - ALL VOLTAGES & FREQUENCIES CHECKED
7. BNS Inverter Warning Light - OUT
8. AC Voltage - WITHIN AC BLOCK
9. +26.5 - DC BLOCK + 1 DIV
10. Coordinate Converter Power Supply - LIGHT ON, METER NEEDLE IN GREEN BLOCK
11. Fuse Tell-Tale Lights - OUT
12. LAT-LONG Counters - IN DETENT
13. Reference Point Switch - PLANES
14. MAG-VAR - 10E, 10W, SET

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**PREOPERATIONAL CHECK** **6**

1. Boresight Switch - AZ
2. Variac - APPROXIMATELY 75 DIVISIONS
3. O-15 Camera Power Switch - OFF
4. O-23 Camera Power Switch - OFF
5. Meter Switch - MAG 1
6. Search Crystal - XTAL 1
7. Receiver Gain - FULL CCW
8. FTC Switch - OFF
9. LOG-LIN Switch - LIN
10. Operation Switch - RAD HI RES
11. Sweep Delay - FULL CCW & DEPRESSED
12. Tilt - ZERO
13. Range Dial - 30 NM
14. Offset Switch - OUT
15. Radar Altitude Switch - OFF
16. Sighting Switch - PPI
17. Range Marks-Crosshairs Switch - RANGE MARKS
18. AUX PPI OR NAV TRACK Switch - OUT (if applicable)
19. Bias - FULL CCW
20. Video Gain - FULL CCW
21. Brill Marks - FULL CCW
22. Range Lights - CHECKED & SET
23. Periscope Desiccator Pump - OPERATING, DESICCANT SERVICEABLE
24. RAI Power Switch - ON
25. RAI Brilliance - FULL CCW
26. Reticle Light Switch - OFF (Day), ON (Night)
27. Reticle Light Rheostat - FULL CCW (Day), FULL CW (Night)
28. Navigation Method Switch - NORMAL
29. Polar Angle Dial - ZERO
30. Pole Switch - NORTH POLE
31. Bombing Mode Switch - L/S
32. Signal Comparator - MANUAL ANTENNA
33. Bombsight Cover Heater Switch - OFF

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## AIRCRAFT POWER CHECK

To be made immediately after switching to airplane power:

1. AC Voltage - AC BLOCK
2. Meter Switch - MAG I
3. Function Switch - NAV
4. Radar Power Switch - SCAN FAST
5. Variac - CW FOR 4.2 MA MAG I
6. Meter Switch - CHECK ALL VOLTAGES
7. Bias - CW TO JUST BELOW VISIBILITY LEVEL
8. Brill Marks - CW TO DESIRED INTENSITY
9. Receiver Gain - CW FOR OPTIMUM RECEPTION
10. Boresight Switch - NORMAL (after boresight light on)
11. Bombing Mode Switch - SYN
12. Tracking Control - CHECKED
13. Scope Cameras - ON & CHECKED
14. Function Switch - TRACK
15. Wind Determination Switch - MEMORY POINT, CLIMB WIND SET
16. Scope Cameras - CHECKED & OFF
17. LAT-LONG Counters - SET TO FIELD COORDINATES
18. Function Switch - STAB, IMMEDIATELY AFTER RESETTING COUNTERS
19. BNS Status - REPORTED
20. MAG-VAR - RESET

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## PRE-TAKEOFF CHECK

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1. Bombsight Cover (Clamshell) - CLOSED
2. Offset Dials - SET
3. TF Dial - SET
4. Trail Dial - SET
5. Camera Master Switch - CHECKED ON
6. Camera Doors - CLOSED, AFTER BOMB DOORS
7. Radar Pressurization Unit - CHECKED, PRESSURE BLED, SWITCH ON
8. N-1 Orientation & Synchronization - CHECKED
9. Indicator Light Switch - CHECKED ON, LIGHTS ON
10. U-2 Rack Locked Light - OUT & TESTED
11. APN-76 - ON & STANDBY
12. Oxygen Shutoff Lever - ON
13. Bailout Bottle - CONNECTED
14. Safety Belt & Shoulder Harness - FASTENED & LOCKED
15. Takeoff Report - SAFETY BELT & SHOULDER HARNESS FASTENED, EJECTION SAFETY PINS REMOVED, OXYGEN CHECK COMPLETED, BAILOUT BOTTLE CONNECTED, BOMBSIGHT RETRACTABLE COVER CLOSED, READY FOR TAKEOFF
16. Function Switch - NAV (at start of takeoff roll)

## TAKEOFF, CLIMB, LEVEL-OFF

1. Takeoff Time - HACKED & RECORDED
2. Rendezvous Equipment - CHECKED WITH GROUND STATION & OFF OR STANDBY
3. D-2 Sextant - EXTENDED (if applicable)
4. Altitude Control - SET APPROX ALT (above 5000 feet)
5. Altitude - MEASURED OR SET, AFTER LEVEL OFF
6. Wind Run - ACCOMPLISHED
7. LAT-LONG Counters - RESET
8. Instruments - CROSS-CHECKED

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## INFLIGHT NAVIGATION PROCEDURES

### STATION KEEPING

1. Bombing Mode Switch - L/S
2. Boresight Switch - NORMAL
3. Drift Control - SET BRIEFED RELATIVE BEARING OF REFERENCE AIRPLANE
4. Function Switch - NAV
5. Range Marks-Crosshairs Switch - RANGE MARKS
6. Sweep Delay Control - SET PIP TO BRIEFED RANGE (leave control depressed)
7. Radar - TUNED FOR SEARCH
8. Formation Position - ESTABLISHED & MAINTAINED

### AIRPLANE STEERING DURING CELESTIAL NAVIGATION

#### N-1 Unslaved

1. Latitude Pointer - SET TO PROPER LATITUDE

#### BNS Steering (with N-1 slaved or unslaved)

1. Safety Check - COMPLETED
2. Forward Sighting Switch - DEPRESSED
3. Sighting Switch - OB
4. Range Marks-Crosshairs Switch - CROSSHAIRS
5. Function Switch - BOMB
6. Tracking Control - PDI CENTERED, LOCKOUT
7. Autopilot Control - SECOND STATION AUTOMATIC
8. AUX PPI OR NAV TRACK Switch - IN
   Radar - STANDBY (if NAV TRACK switch not installed)

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GRID NAVIGATION PROCEDURES

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**Entry Into Grid Checklist** (requested by observer)

1. Polar Angle Dial - SET
2. Pole Switch - SET
3. Navigation Method Control - POLAR
4. BNS Grid Heading - CHECKED AGAINST N-1
5. LAT-LONG Counters - SET TO APPROXIMATE GRID VALUE
6. Wind Dials & LAT-LONG Counters - SET TO GRID
7. Grid Heading - CHECKED
8. N-1 Compass - UNSLAVED & SET TO GRID HEADING
9. Airplane Heading - CORRECTED
10. BNS Heading - CORRECTED

**Inflight Grid Navigation Procedures**

1. Heading Check - ACCOMPLISHED
2. N-1 Compass - RESET
3. N-1 Precession Rate - DETERMINED
4. Airplane Heading - CORRECTED
5. BNS Initial Heading - DETERMINED
6. BNS Heading - CORRECTED
7. "C" Gyro Precession - DETERMINED
8. Wind Run - ACCOMPLISHED
9. Latitude Control - RESET (if applicable)
10. DR Position - RECORDED

**Exit From Grid Checklist** (requested by observer)

1. Exit Point - DETERMINED
2. LAT-LONG Counters - RESET
3. Polar Angle - RESET
4. Navigation Method Control - POST POLAR
5. Wind Dials & LAT-LONG Counters - RESET
6. N-1 Compass - RESET TO MAG HEADING & RESLAVE
7. True Heading - CHECKED

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## NORMAL BOMBING PROCEDURES

If bombs have been carried on the mission, the observer will visually check that the bomb bay is clear prior to the first RBS or camera run (oxygen discipline will be observed).

**BOMBING EQUIPMENT CHECKLIST** (to be requested by observer prior to first Pre-IP)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Safety Check | |
| | a. Bomb Door & Release Switch | MANUAL |
| | b. Bric (intervalometer) | TRAIN & ZERO BOMBS, LIGHT OUT |
| | c. Bomb Control Selector Switch | NORMAL |
| | d. Bomb Salvo Switch | OFF |
| | e. Rack Lock Light | ON |

**NOTE**

An inflight check of automatic operation of the bomb doors will not be made as part of the bombing equipment check.

| | | |
|---|---|---|
| 2. | Sighting Switch | OB |
| 3. | Forward Sighting Switch | DEPRESSED |
| 4. | Function Switch | BOMB |
| 5. | Tracking Control | INCREASE TG TO 120 SEC WITH C-1 AZIMUTH DIAL CENTERED |
| 6. | ATF Setting Control | CHECKED |
| 7. | Trail Setting Control | CHECKED |
| 8. | PDI | LEFT, RIGHT, CENTERED |
| 9. | PDI & Autopilot | CHECKED |
| 10. | Indicator Light Switch | CHECKED ON |

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| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Aerial Camera Intervalometer Switch | ON (B-8) or BOMB SPOT NIGHT RECON (B-7) |
| 2. | Camera Doors | OPEN (if applicable) |
| 3. | Bombing Mode Switch | SYN |
| 4. | Offset Data | N-S _____FT (read from dials)<br>E-W _____FT (read from dials) |
| 5. | Ballistics | TF _____SEC (read from dials)<br>TRAIL _____FT (read from dials) |

**PRE-IP CHECKLIST** (to be requested by observer before reaching the IP)

**BEFORE PRE-IP PROCEDURES**

1. Altitude - MEASURED
2. Wind Run - COMPLETED
3. IAS for Bomb Run - DETERMINED
4. Bombing Data - COMPLETED
5. Ballistics Control - CROSS-CHECK & SET TRAIL & ATF
6. Offset Components - SET (if applicable)
7. Wind Run - ACCOMPLISHED ON PIP OR GPI REF PT
8. LAT-LONG Counters - RESET ON PIP OR GPI REF PT
9. MAG-VAR - SET

| | | |
|---|---|---|
| 11. | Bomb Power Switch | ON |
| 12. | UHF Radio | UNUSED CHANNEL |
| 13. | Tone Control | ON |
| 14. | Release Check | COMPLETED |
| 15. | Bomb Power Switch | OFF |
| 16. | Autopilot Control | TO PILOT |
| 17. | Function Switch | NAV |
| 18. | Crosshairs | SET 15 NM |
| 19. | Offset Switch | IN, CROSSHAIRS MOVE, OUT |
| 20. | Radar Pressure | CHECKED IN GREEN |

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CUT ON LINE

| | | |
|---|---|---|
| 6. | Altitude | MEASURED & COMPUTED |
| 7. | Wind Run | ACCOMPLISHED |
| 8. | LAT-LONG Counters | RESET |
| 9. | MAG-VAR | SET_____° |
| 10. | Oxygen Control | 100% |
| 11. | TAS | TAS READS_____ |
| 12. | Camera Data Plates | COMPLETED |
| 13. | O-15 Camera | ON 1:4 (50 miles from IP) |
| 14. | O-23 Camera | ON, RADAR OPTICAL (or as briefed) |
| 15. | Circuit Breakers | IN |

**IP PROCEDURES**

1. Wind Run - ACCOMPLISHED ON IP OR GPI REF PT
2. LAT-LONG Counters - RESET ON IP OR GPI REF PT

**IP CHECKLIST** (called for by observer)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bric | SELECT & 10 BOMBS, LIGHT ON |
| 2. | Bomb Power Switch | ON, LIGHT ON |
| 3. | Indicator Light Switch | CHECKED ON |
| 4. | U-2 Low Pressure Warning Light | OUT & TESTED |
| 5. | U-1 Arming Switch | ARMED |
| 6. | T-35 Arming Switch | CHECKED ARMED |
| 7. | U-2 Rack | UNLOCKED (by copilot) (if applicable) |
| 8. | U-2 Rack Locked Light | OUT & TESTED |
| 9. | Offset Switch | OUT or IN (as desired) |
| 10. | True Heading | CHECKED |
| 11. | N-1 Compass | UNSLAVED |

CUT ON LINE

**BOMB RUN PROCEDURES** **14**

1. Wind Run - ACCOMPLISHED ON GPI REF PT (if practical)
2. LAT-LONG Counters - RESET ON GPI REF PT (if practical)
3. Initial Lineup - ACCOMPLISHED & CROSSHAIRS EXTENDED

**BOMB RUN CHECKLIST** (called for by observer)

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bombing Altitude | SET_____FT (target or OAP) |
| 2. | Call at 50 Miles | 50 MILES OUT |
| 3. | Function Switch | BOMB |
| 4. | PDI Centered | Center PDI and give me second station |
| 5. | Your Airplane | ROGER, AUTOMATIC |
| 6. | Offset Switch | OFFSET IN or OFFSET OUT |
| 7. | 300 TG | |
| 8. | 250 TG | |
| 9. | 200 TG | |
| 10. | 150 TG | |
| 11. | 120 TG | |
| 12. | 90 TG | |
| 13. | 60 TG, Check in Automatic | ROGER, AUTOMATIC |
| 14. | 30 TG | |
| 15. | 20 TG, Tone On & K-2 Auto | TONE ON & K-2 AUTO |
| 16. | Bombs Away (UHF) | BOMBS AWAY (INTERPHONE), T-HANDLE PULLED |

**POST RELEASE PROCEDURE**

1. Release Light - ON MOMENTARILY, TONE & TONE LIGHT OFF
2. O-15 Camera Selector Switch - EVERY OTHER
3. Function Switch - RETURNS TO TRACK
4. Bomb Doors - CLOSED (alternate switch, if necessary)
5. Release Data - RECORDED

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CUT ON LINE

**POST RELEASE CHECKLIST**

| | AC AND/OR COPILOT | OBSERVER |
|---|---|---|
| 1. | Bomb Doors | CLOSED |
| 2. | Radar | RETUNED |
| 3. | Offset | OUT |
| 4. | LAT-LONG Counters | RESET |
| 5. | Function Switch | NAV (impact plus 15 seconds for IBDA) |
| 6. | Range Marks-Crosshairs Switch | RANGE MARKS |
| 7. | Range Dial | 40 NM |
| 8. | Bomb Power Switch | OFF |
| 9. | Bomb Door & Release Switch | MANUAL |
| 10. | Bric | TRAIN & ZERO BOMBS, LIGHT OUT |
| 11. | N-1 Compass | RESLAVED |
| 12. | O-15 & O-23 Cameras | OFF & LAST EXPOSURE RECORDED |
| 13. | Camera Doors | CLOSED |
| 14. | Oxygen | NORMAL |
| 15. | Release Data | RECORDED ON BOMBING DATA FORM |

## FIXED ANGLE BOMBING PROCEDURES

**BEFORE PRE-IP PROCEDURES**

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

**PRE-IP CHECKLIST**

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

**IP PROCEDURES**

Same as in normal synchronous bombing insofar as equipment malfunctions will permit.

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CUT ON LINE

**IP CHECKLIST**

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Same as in normal synchronous bombing except that the offset switch will be OUT for a fixed angle run.

**BOMB RUN PROCEDURES**

1. TG - _____SECONDS
2. Function Switch - NAV
3. Offset Switch - OUT
4. Cursor Control - SET TO AXIS OF ATTACK
5. Boresight Switch - NORMAL
6. Bombing Mode Switch - L/S ◀①
7. Drift Dial - SET PRECOMPUTED DRIFT ON BOMB RUN
8. Bomb Door & Release Switch - MANUAL
9. Initial Lineup - ACCOMPLISHED
10. Etched Cursor or Electronic Azimuth Mark - REPOSITIONED
11. Multiple Drift Correction - ACCOMPLISHED
12. Normal Bomb Door Switch - OPEN, INDICATOR CHECKED
13. TG Hack - INITIATED AT 10 MILES (RBS only: TONE ON)
14. D-2 Bomb Release Switch - DEPRESSED & HELD AT TG, T-HANDLE PULLED
15. (RBS only) Tone Switch - OFF AT TG

**POST RELEASE PROCEDURE**

1. O-15 Camera Selector Switch - EVERY OTHER
2. Alternate Bomb Door Switch - CLOSED, INDICATOR LOCKED
3. Release Data - RECORDED

**POST RELEASE CHECKLIST**

Same as in synchronous bombing.

① ◀ Alternate procedure to using cursor control

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## RENDEZVOUS

1. APN-76 - ON (approximately 350 nm from rendezvous point)
2. ETA to Rendezvous Point - RELAYED TO TANKER
3. Periscopic Sextant - RETRACTED & PORT CLOSED
4. Descent Range - COMPUTED
5. Radar - TUNED FOR BEACON OPERATION
6. Tanker Beacon Signal - IDENTIFIED & CONFIRMED
7. Homing on Tanker - ACCOMPLISHED
8. Tanker Range - RELAYED TO PILOT
9. Descent - INITIATED
10. Sweep Delay Control - OUT OF DETENT, DEPRESSED
11. Range Dial - MINIMUM RANGE
12. APN-76 - OFF (after continuous visual contact is assured)
13. Radar - TUNED FOR RADAR SEARCH
14. Altitude - MEASURED
15. Refueling Wind - DETERMINED or SET
16. LAT-LONG Counters - RESET
17. Receptacle, Manifold & Lines - CHECKED FOR LEAKS
18. Refueling Data - RECORD TIME OF CONTACT & DISCONNECT

## PRELANDING EQUIPMENT CHECK

To be performed prior to descent at completion of mission unless scored runs have been accomplished in flight.

### RADAR EQUIPMENT CHECK

1. Function Switch - NAV
2. Radar Power Switch - SCAN FAST
3. Radar Control Unit Meter - MAG I
4. Variac - ADJUST MAG I TO 4.2 MA
5. Radar Control Unit Meter - ALL READINGS CHECKED
6. PPI - RETUNED
7. Radar Reception - EVALUATED
8. Beacon Reception - EVALUATED

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**BOMBING ACCURACY (COMPUTER) CHECK**

1. Radar - TUNED FOR RADAR SEARCH
2. Trail - ZERO
3. TF - 15 SEC
4. Bombing Mode Switch - SYN
5. Boresight Switch - NORMAL
6. Sighting Angle Dial - ZERO
7. Drift Dial - ZERO
8. Bric - TRAIN, 20 BOMBS, MAXIMUM INTERVAL
9. Synchronous Bomb Run - ACCOMPLISHED
10. TG Zero - TIMING STARTED
11. Bombing Mode Switch - L/S
12. Bombing Error - ESTIMATED, 15 SEC AFTER RELEASE

# AIRBORNE RADAR APPROACH AND MONITORING

**PRE-PENETRATION PROCEDURES**

1. ATF Dial - 59.18 SECONDS
2. Trial Dial - SET
3. Offset Dials - SET
4. PPI Centering - CHECKED
5. Safety Checklist - COMPLETED
6. Bombsight Cover (Clamshell) - CLOSED

**PENETRATION PROCEDURES**

**WARNING**

All altitudes referred to below, except penetration altitudes, are absolute altitude above terrain.

1. Initial Points - MADE GOOD
2. Penetration - INITIATED
3. Crosshairs - POSITIONED ON APPROACH END OF RUNWAY
4. Function Switch - BOMB
5. Wind Determination Switch - MEMORY POINT

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**APPROACH PROCEDURES**

1. Traffic Pattern - DIRECT AIRPLANE AS REQUIRED
2. PDI - CENTERED, ON FINAL APPROACH
3. Final Descent - INITIATED AT 120 SECONDS TG
4. Rate of Descent - CHECKED AT 60 SECONDS TG

**AIRBORNE RADAR APPROACH AT FIELD WITHOUT PUBLISHED PENETRATION AND APPROACH PATTERNS**

1. Preparation of BNS prior to penetration - SAME AS BASIC PROCEDURE
2. Bomb Run on Active Runway - ACCOMPLISHED, ON RECIPROCAL OF LANDING HEADING
3. Release Plus 1 Minute - PENETRATION INITIATED
4. Altitude 12,000 Feet - PENETRATION TURN INITIATED
5. PDI - CENTERED, WITH CROSSHAIR ON RUNWAY
6. TG 120 Sec - DESCENT STARTED (600 ft/min)
7. TG 60 Sec - RATE OF DESCENT CHECKED (600 ft)

## BEFORE LANDING PROCEDURE

1. RAI Brilliance - FULL CCW
2. RAI Power Switch - OFF
3. Function Switch - STAB
4. Radar Power Switch - SCAN SLOW
5. Radar Power Switch - SCAN OFF (when trace at 180°)
6. Bias - FULL CCW
7. Video Gain - FULL CCW
8. Receiver Gain - FULL CCW
9. Variac - CCW TO 75
10. Tilt - +5
11. Radar Power Switch - OFF
12. Inform Pilot - RADAR OFF
13. Indicator Light Switch - OFF
14. Safety Belt & Shoulder Harness - FASTENED & LOCKED

CUT ON LINE

## AFTER LANDING PROCEDURES

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1. Function Switch - OFF
2. BNS Heater Switches - OFF
3. Camera Master Switch - OFF (before opening bomb doors)
4. 3Ø Inverter Switch - OFF

## POSTFLIGHT PROCEDURES

1. Ejection Seat Pins & Streamers - INSTALLED
2. Oxygen Supply Shutoff Lever - OFF
3. Diluter Lever - 100% OXYGEN
4. Oxygen Emergency Toggle Lever - NEUTRAL
5. Oxygen Warning System Switch - OFF
6. Aerial Camera Intervalometer Power Switch - OFF
7. Sextant & Power Cable - REMOVED
8. Sextant Port - CLOSED
9. Sextant Bubble - REDUCED TO MINIMUM
10. Sextant & Cable - STOWED
11. All Light Switches - OFF
12. DD Form 781 - COMPLETED
13. Bomb Rack Power Cable - DISCONNECTED (if applicable)
14. Bomb Fuse Pins & Shackle Pins - INSTALLED (if applicable)

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# ALL WEATHER OPERATION

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## 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 operation instructions covered in section II. Any discussions relative to systems operation are covered in section VII.

# INSTRUMENT FLIGHT PROCEDURES

Flying the airplane in adverse 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 or approach. During landing approaches, the airplane is being operated in that portion of the power curve where 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 airplane. 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, banking turns not to exceed 30° are recommended. Turns during standard instrument procedures and approaches should be made at the standard rate of 3° per second if a 30° bank is not exceeded. Operation under icing conditions will be found in "Ice and Rain" this section.

## PREFLIGHT

To ensure a successful flight under instrument conditions complete the normal preflight inspection as given in section II and accomplish the checklist paying particular attention to the proper functioning and settings of flight instruments, radios, and electronics equipment. Place pitot anti-icing switches ON and have ground crew check to see if pitot heads are warm.

## TAXI

Check ILS when crossing ILS runway while taxiing.

## BEFORE TAKEOFF

After aligning the airplane visually on the runway, adjust the horizon bar of the attitude indicator one bar width below the horizon reference point.

## INSTRUMENT TAKEOFF AND INITIAL CLIMB

1. 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 heading maintained on the takeoff roll by use of the directional indicator and cross-checking the runway lights. Make small heading changes if necessary.
2. Retract the landing gear as soon as the airplane is airborne and the vertical velocity indicator and altimeter show a definite climb.
3. Retract the flaps at 20 knots IAS above takeoff speed at a minimum of 300 feet above the terrain. During flap retraction, maintain a minimum of 300 feet per minute climb and a positive increase in airspeed. Flap retraction should be stopped if the following airspeed schedule cannot be maintained:

| Stop Flap Retraction at: | If IAS is: |
|---|---|
| any setting | not increasing |
| 50% | below 205 knots |
| 22 1/2% | below 220 knots |

Continue flap retraction after the airspeed schedule is attained. To prevent structural damage to the flaps, the following airspeed limitations should be observed:

| Do not exceed IAS of: | With Wing Flap Position of: |
|---|---|
| 195 knots | full down |
| 230 knots | 50% |
| 236 knots | 22 1/2% |
| 240 knots | more than 0% |

Continue to climb at a minimum of 300 feet per minute until best climb speed is attained.

**NOTE**

During flap retraction from 22 1/2% to 0%, a nose down pitching tendency occurs. The use of nose up trim as the flaps approach 22 1/2% is beneficial in preventing loss of altitude.

The vertical velocity indicator becomes the primary pitch instrument until the climbing airspeed is established.

## INSTRUMENT CLIMB

1. Maintain 96% or 98% power.
2. Maintain a minimum of 300 fpm climb until desired climbing airspeed is established.
3. 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. Keep the airplane trimmed for "hands off" flight.

### 1. Turns

For normal instrument flying, 30° of bank may be used. If rate turns are desired, use a standard rate turn (3°

per second) if 30° of bank will not be exceeded. If angle of bank will exceed 30°, then a one-half rate turn should be used (1.50 per second).

**2. Steep Turns**

Any angle of bank exceeding 30° is considered a steep turn. During all steep turns, the attitude indicator is the primary bank control instrument.

**NOTE**

While turning, the attitude indicator may precess slightly in pitch and/or bank. After rolling out of turns, the attitude indicator may take several minutes to precess back to level flight position. During this period of precession a constant cross-check of the other flight instruments will be necessary to maintain attitude.

**3. Headings**

It is recommended when flying precise headings to rotate the dial of the directional indicator so that the selected heading is under the index of the instrument.

## HOLDING

To enter a holding pattern, simultaneously begin the turn to the desired heading, reduce power to the desired setting, and slow airplane to best holding airspeed. Initiate turn immediately to facilitate staying within holding airspace.

## DESCENT

Descent to traffic pattern altitude should be executed 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.

## TYPICAL JET PENETRATION PROCEDURES

For a typical jet penetration procedure, see figure 9-1. Prior to beginning penetration, the Before Descent checklist should be completed.

**1. Initial Penetration Altitude**

Published altitude in East or West Jet Pilot's Handbook at which the pilot reports over the radio facility for beginning penetration procedure.

**2. Normal Penetration Descent**

Starting at initial penetration altitude, simultaneously extend the landing gear and power to idle. Lower the pitch attitude of the airplane on the attitude indicator to establish and maintain a constant indicated airspeed of 270 knots.

**NOTE**

During entry into the descent and until reaching descending airspeed, the attitude indicator is the primary pitch control instrument.

**3. Penetration Turn**

The penetration turn should be started normally when approximately one-half the difference between the initial penetration altitude and the minimum penetration altitude, or as published in the East or West Jet Pilot's Handbook. A bank of 30° may be used in the penetration turn. When the penetration turn is completed, start the Before Landing checklist and track inbound on the published magnetic course. The minimum penetration altitude must be reached prior to returning to the fix or entering a control zone or area.

**4. Minimum Penetration Altitude**

Minimum penetration altitude will be shown in the East or West Jet Pilot's Handbook. Complete Before Landing checklist and decelerate before reaching radio facility or starting GCA, whichever is sooner.

**5. Low Approach**

After passing the radio fix at minimum penetration altitude, begin descent to minimum approach altitude or VFR conditions (whichever is higher) at a rate not to exceed 1000 fpm. Approach chute may be employed as required.

## MISSED APPROACH PROCEDURE

When necessary to execute a missed approach from an instrument letdown, GCA, or ILS, proceed as follows:

a. Increase power to 96% (use full power if necessary).

b. Establish a takeoff attitude on the attitude indicator and accelerate to BFS + 30K.

c. The gear and flaps may be retracted or left down at the pilot's discretion. Positive indications of climb on the vertical velocity indicator and altimeter must be seen before retracting the gear.

**NOTE**

Leaving the flaps down will aid the pilot in staying within ANC distance limitations and will facilitate low altitude maneuvering.

d. Maintain the published missed approach altitude within the published distance from the fix until clearance is received from approach control.

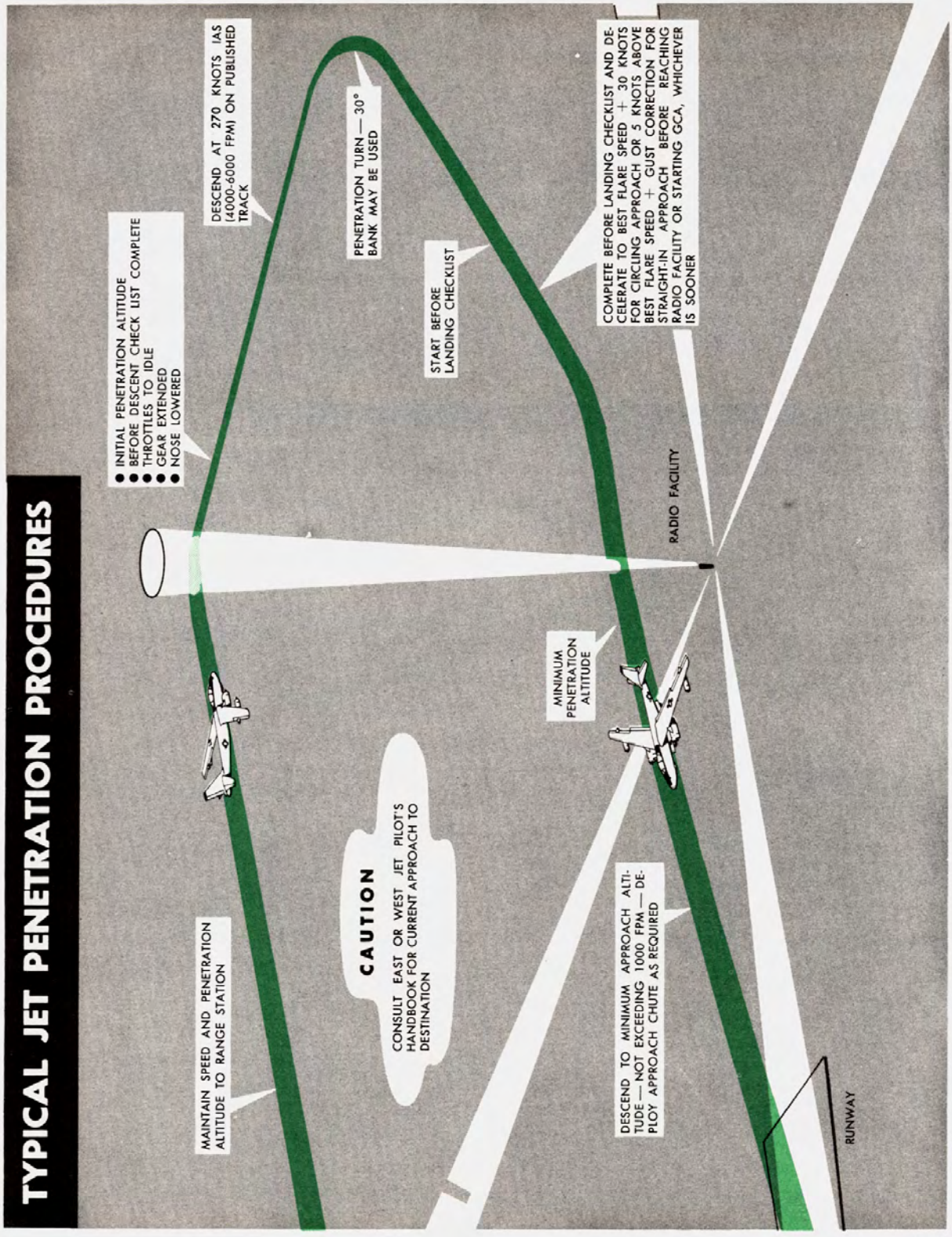
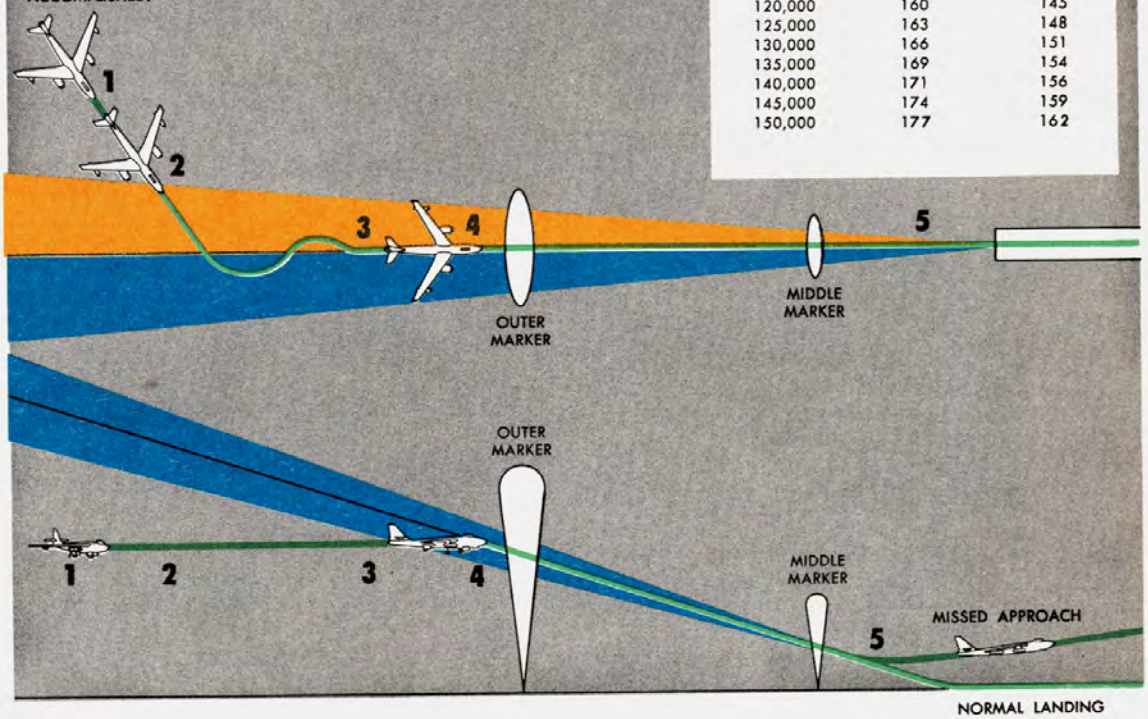

TYPICAL JET PENETRATION PROCEDURES
INITIAL PENETRATION ALTITUDE
BEFORE DESCENT CHECK LIST COMPLETE
THROTTLES TO IDLE
GEAR EXTENDED
NOSE LOWERED
DESCEND AT 270 KNOTS IAS (4000-6000 FPM) ON PUBLISHED TRACK
PENETRATION TURN — 30° BANK MAY BE USED
START BEFORE LANDING CHECKLIST
COMPLETE BEFORE LANDING CHECKLIST AND DECELERATE TO BEST FLARE SPEED + 30 KNOTS FOR CIRCLING APPROACH OR 5 KNOTS ABOVE BEST FLARE SPEED + GUST CORRECTION FOR STRAIGHT-IN APPROACH BEFORE REACHING RADIO FACILITY OR STARTING GCA, WHICHEVER IS SOONER
RADIO FACILITY
MINIMUM PENETRATION ALTITUDE
MAINTAIN SPEED AND PENETRATION ALTITUDE TO RANGE STATION
CAUTION
CONSULT EAST OR WEST JET PILOT'S HANDBOOK FOR CURRENT APPROACH TO DESTINATION
DESCEND TO MINIMUM APPROACH ALTITUDE — NOT EXCEEDING 1000 FPM — DEPLOY APPROACH CHUTE AS REQUIRED
RUNWAY
049912

*Figure 9-1.*

# AUTOMATIC APPROACH

| GROSS WEIGHT | LOCALIZER INTERCEPTION AIRSPEED | GLIDE SLOPE 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 | 177 | 162 |




## TRANSITION

**A.** See applicable ILS procedure chart for automatic approach information.

**B.** Airspeed 20 knots above best flare speed plus gust correction.

**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.

## OPERATION

**1.** Intercept localizer beam at any angle up to 45° from runway heading.

**2.** When the course indicator bar makes a positive departure from stop position, move the automatic approach switch to LOCALIZER.

**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 position when the glide slope indicator bar reaches center. Adjust power to maintain 5 knots above best flare speed plus gust correction on glide slope.

**5.** At minimum altitude disengage automatic pilot and land or accomplish missed approach manually.

049720

*Figure 9-2.*

## 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 slope 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 (figure 9-2).

### 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 slope OFF warning flags disappear from view especially if the airplane is within range of the localizer beam or glide slope 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. Lower the landing gear and extend full wing flaps. 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.

**WARNING**

- 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) whenever the airplane passes directly over the localizer station. There is a possibility of erratic control action if the automatic approach switch is in LOC (LOCALIZER).

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 slope.

**WARNING**

The green "Approach Ready" light should illuminate when the automatic approach switch is in AUTO PILOT (AUTOMATIC PILOT) 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 course indicator bar 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 ensure 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).

### 3. After Initial Bracketing of Localizer Beam

Prior to intercepting the glide slope, 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.

### 4. Intercepting Glide Slope

When the glide slope indicator bar of the ID-249 indicator reaches center position, move the automatic approach switch to APPR (APPROACH).

**NOTE**

If the automatic approach switch is moved to APPR (APPROACH) before the glide slope indicator bar 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 slope. Power must be adjusted to maintain 5 knots above best flare speed plus gust correction on the glide slope. 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 slope are reasonably established, check the automatic pilot trim indicator needles alignment prior to automatic pilot disconnect.

**WARNING**

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.

**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.

**WARNING**

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 slope transmitter with the automatic pilot engaged.

## AUTOMATIC FLIGHT

**WARNING**

The automatic approach switch must be in AUTO PILOT (AUTOMATIC PILOT) during normal flight. Do not use the automatic pilot for automatic flight to or from the omni-range stations for the following reasons:

- Control action in response to omni-range

**WARNING**
(continued)

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.

## INSTRUMENT LOW-APPROACH SYSTEM (ILS)

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 9-3.

## GROUND CONTROLLED APPROACH (GCA)

For a typical GCA procedure, see figure 9-4. The steps in this example will ordinarily be executed by the pilot on instructions from the GCA traffic director and final controller. Two types of traffic patterns are most commonly specified by the 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, and any holding or vectoring up to the final approach. The GCA traffic director will give instructions during this phase of the approach.

**2. Final Approach**

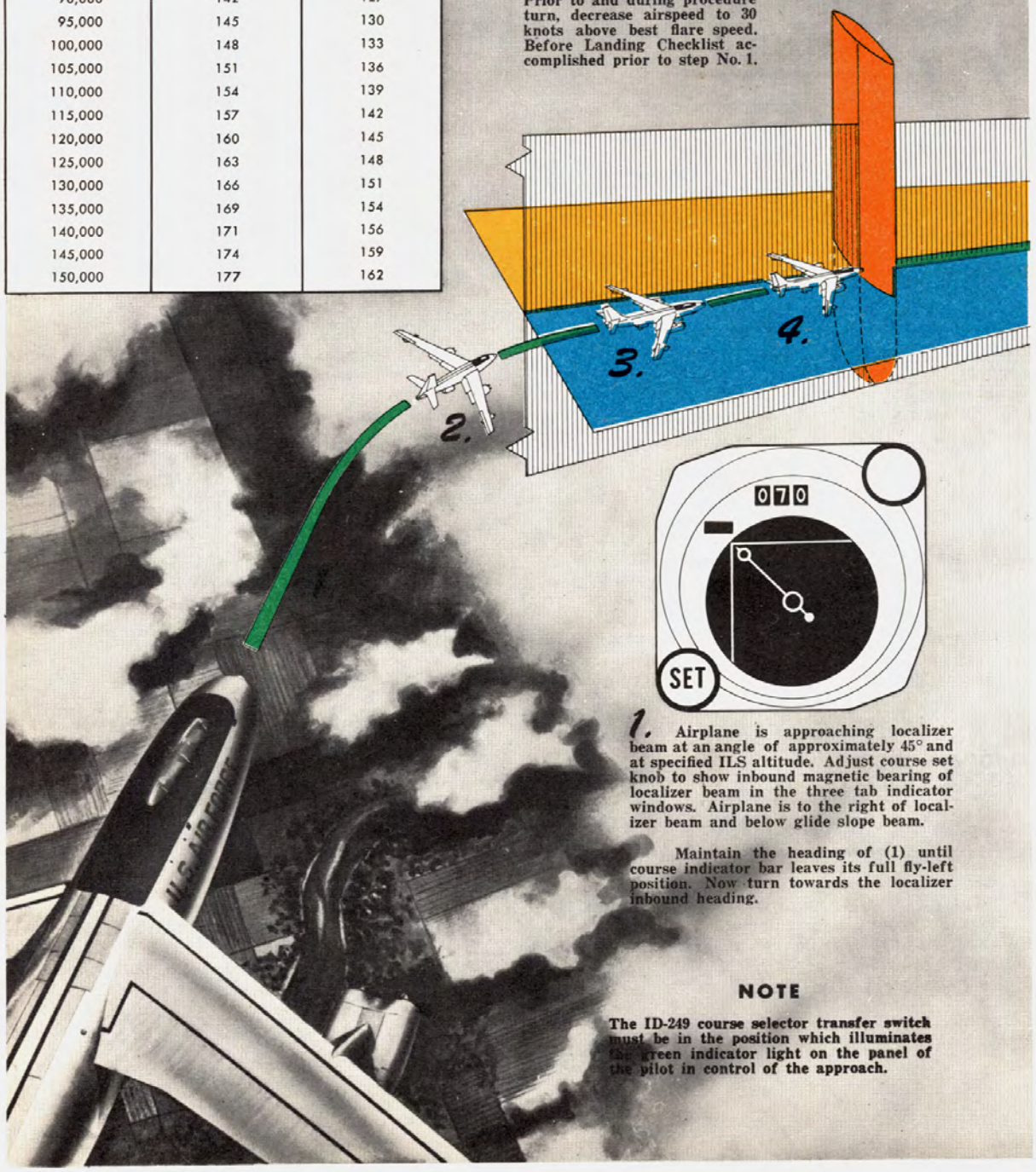
The final controller takes over radio contact usually on a different frequency at a range of about 7 miles from the end of the runway and continues to the instant the airplane breaks through the overcast and visual reference to the ground is established. The final controller will talk continually, giving instructions and information on the position of the airplane in relation to the course. The steady flow of conversation does two things; it helps make the smaller but more numerous corrections necessary during the final approach, and gives immediate warning of any failure of radio communication. If no transmission is received during any 5-second period of the final approach, initiate a missed approach following standard procedure for the particular field location.

| GROSS WEIGHT | LOCALIZER INTERCEPTION AIRSPEED | GLIDE SLOPE 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 | 177 | 162 |

# INSTRUMENT LOW

**NOTE**

Prior to and during procedure turn, decrease airspeed to 30 knots above best flare speed. Before Landing Checklist accomplished prior to step No. 1.



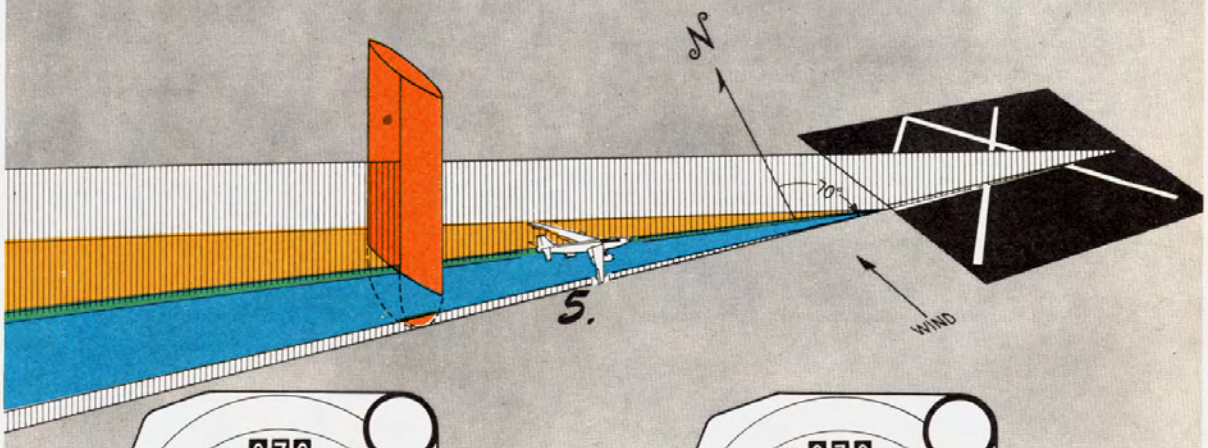

*1.* Airplane is approaching localizer beam at an angle of approximately 45° and at specified ILS altitude. Adjust course set knob to show inbound magnetic bearing of localizer beam in the three tab indicator windows. Airplane is to the right of localizer beam and below glide slope beam.

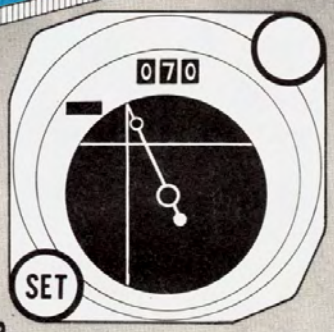
Maintain the heading of (1) until course indicator bar leaves its full fly-left position. Now turn towards the localizer inbound heading.

**NOTE**

**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.**

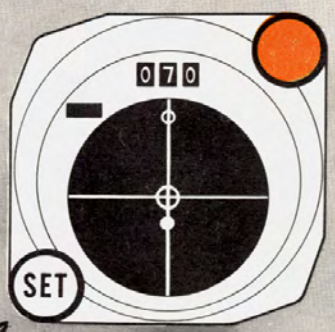
# APPROACH SYSTEM (ILS)



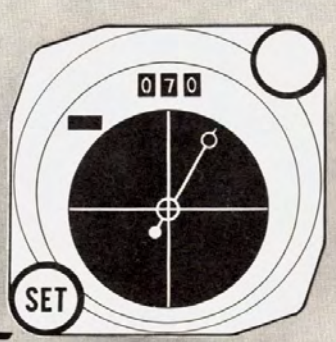




**2.** Adjust the rate of turn to roll out with course indicator bar centered. Reduce airspeed to that given in "Localizer Interception Airspeed" column of the table.

**3.** Airplane is now on localizer beam and is heading directly toward the runway. The glide slope beam is just above the airplane. Make gradual power reduction to intercept glide slope smoothly without over-shooting. Set up a definite rate of descent on the vertical velocity indicator.




**4.** Airplane is on glide slope and localizer beam and its heading is the same as that of the localizer beam. Reduce airspeed to that given in "Glide Slope Airspeed" column of table plus gust correction.




**5.** The airplane heading has been changed to the right to correct for a crosswind. Make corrections for centering glide slope indicator bar by small corrections in rate of descent. Make corrections for centering course indicator bar by small corrections on the directional indicator. Maintain position on localizer and glide slope beam until visual contact is made with runway or ILS minimum altitude is reached.

049079

*Figure 9-3.*

# GROUND CONTROLLED APPROACH (GCA)

## INITIAL APPROACH

**1.** Contact approach control at destination for release to GCA unit. When cleared by approach control, contact GCA on appropriate frequency. The local GCA traffic director will give instructions 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 or, if approaching straight in from a fix, the inbound heading to the runway. During this phase, information on the latest weather, direction of landing, length of runway, and any other pertinent landing information will normally be received.

**2.** Perform the Before Landing checklist. This includes extending the landing gear and full flaps.

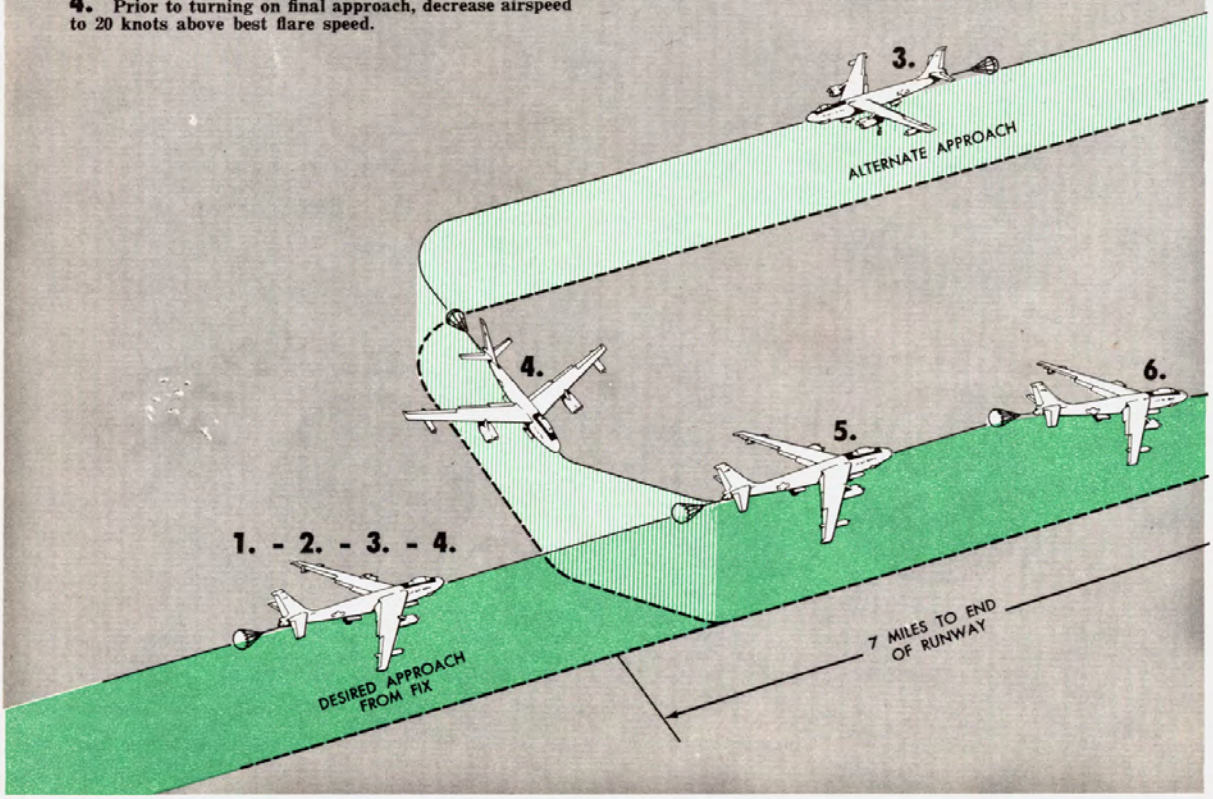
**3.** Trim for straight and level flight at approximately 30 knots above best flare speed. If approach is straight in from a fix, gradually reduce airspeed so that a speed of 5 knots above best flare speed plus gust correction is attained prior to intercepting glide slope.

**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 slope.

**6.** Upon instructions from final controller, reduce power to give desired rate of descent along glide slope.



## PRELANDING

**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.

## TOUCH DOWN AND LANDING ROLL

**8.** When visual contact has been established, continue approach and make normal landing.

### NOTE

THE FINAL CONTROLLER WILL INFORM THE PILOT WHEN GCA MINIMUM ALTITUDE DURING APPROACH HAS BEEN REACHED.

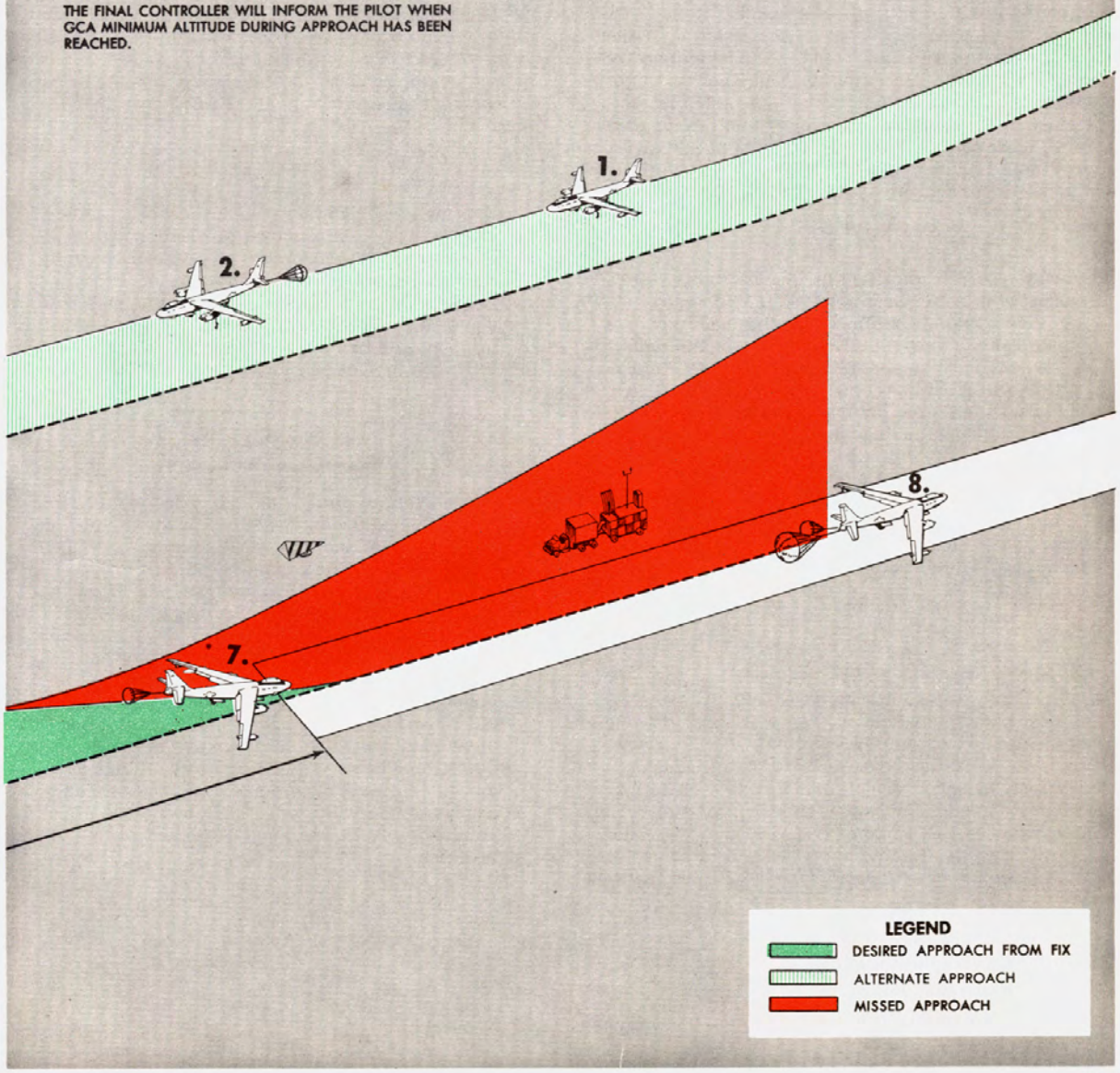



*Figure 9-4.*

### 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 changeover, continue to follow instructions from the final controller until it is very evident that visual contact with the ground will not be lost.

### 4. Touchdown and Landing Roll

The final controller notifies the pilot when the airplane is over the end of the runway. Touchdown and landing is made by visual reference to the runway, using the normal flare and touchdown procedure as described in section II.

# 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.

**NOTE**

A wax-type rain repellant for use on the pilot's windshield is now available and may be used to provide adequate visibility during heavy rain conditions. The repelling action of the rain repellant may be checked by splashing clear water on the windshield. If water adheres to the windshield or if deterioration of the film is noted, the repellant should be reapplied.

Windshield wipers are not effective in heavy rain during takeoff and landing. Protection of the airplane from ice while on the ground can be accomplished by the use of covers. Their use is covered under "Cold Weather Procedures," this section.

## ICING

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 possible by careful flight planning, utilizing the available weather information.

**NOTE**

The idea that ram air pressure at high speeds causes heating is misleading. Not enough heat is generated at subsonic velocities to prevent the formation of ice. The rate of icing increases with increasing airspeeds above 250 knots IAS. Therefore, a reduction of airspeed to a safe minimum will reduce the rate of inlet icing due to suction effect.

**WARNING**

In the event of pitot icing, airspeed and Machmeter indications usually drop to zero. During this condition, the low speed warning horn may sound, which could cause the pilot to lower the nose of the airplane to gain airspeed. The loss of airspeed indication during climb while indicating optimum climb speeds is considered an extremely dangerous safety-of-flight hazard where the nose might be lowered and the airplane allowed to accelerate into the aileron ineffectiveness speed range. Airplane flight instruments should be used during the icing condition to maintain level flight. The attitude gyro and altimeter can be used with a reasonable degree of accuracy during the emergency flight condition which has been observed to last 30 minutes.

## ENGINE ICING

All six engines have provisions for anti-icing. The engine inlet guide vanes and front frame struts receive anti-icing air continuously during engine operation. The nacelle lips and inboard struts are anti-iced by the nacelle lip system, and the engine system anti-ices the engine islands and nose dome. See section IV for additional information on anti-icing.

**NOTE**

From 0° C (32° F) to approximately 5° C (41° F) and the dew point within 4° C (7° F) of the ambient temperature, conditions exist under which jet engine icing can occur without external surfaces icing.

If icing conditions cannot be avoided, anti-icing system should be turned on prior to entering the icing area. Adjust altitude 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. Axial-flow jet engines are seriously affected when 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.

**NOTE**

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.

**NOTE**

- In order to obtain anti-icing protection during takeoff run, the anti-icing system must be turned on prior to takeoff due to the delay for warming up the anti-icing surfaces.
- If the anti-icing system is operating during takeoff, takeoff distance will be increased approximately 5%.

If icing is forecast, prior to starting engines, a visual ground check should be made to assure that all sections of the screens are retracted. 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. If icing conditions are anticipated during takeoff and climb, turn on the following anti-icing systems just prior to the takeoff run:

1. Left and right pitot anti-icing switches to ON.
2. Windshield anti-icing switch to MAX HEAT if necessary.

**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 windshield, pitot, and exterior surfaces 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 rather than to increase rpm excessively.

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.

VORTEX GENERATOR ICING. 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 leaving the cloud layer.

**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.

### Prior To Descent

Prior to descending through icing conditions, the following should be accomplished:

1. Determine the altitudes of each icing layer from available weather advisories.
2. Place the exterior surfaces anti-icing switch ON.

### During Descent

POWER SCHEDULE. 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.

REMOVAL OF ENGINE ICE. If a rise in tailpipe temperature is noted during the descent, 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 airflow 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.

1. 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.
2. Immediately advance the throttles to 100% RPM, then retard to the original setting.
3. 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 relatively thin vertical extent (normally less than 5000 feet) of icing conditions to which jet engines are most susceptible.

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.

- 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.

### Landing

If a landing must be made on a wet or icy runway, proceed as follows:

1. If weather permits, make a practice visual approach to the landing runway, observing surface, overruns, and obstacles. Procure tower advice or pilot reports on braking condition of the runway. Check the "planned" stopping distance in part 8 of the appendix, using the "Stopping Distance - Flaps Down - Wet or Icy Runway" chart to ensure that adequate stopping distance will be available after touchdown without reliance on the brake chute.

**NOTE**

On runways where normal traction is reduced by moisture, ice, or snow, the airplane will not respond as readily to normal turning forces. Therefore, if large steering corrections or a ground loop is attempted, a slower rate of turn should be made to procure the best results.

2. Deleted.
3. 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.

**NOTE**

Due to thrust augmentation caused by extreme low temperatures, the glide slope will be flatter than normal.

4. 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 or 4 or both to maintain hydraulic pressure.

**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 cause loss of control and pull the airplane off the runway.

5. 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.

6. If deep snow- or slush-covered runways are encountered, retract flaps immediately after touchdown unless stopping distance is critical. This will avoid damage to flaps.

7. If runway or ramps present a taxi hazard, 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.

## FLIGHT PLAN

Make a thorough analysis of the general weather situation to determine the thunderstorm areas and prepare a flight plan 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.

## TURBULENCE

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 and Rain," this section.

## PENETRATION SPEEDS

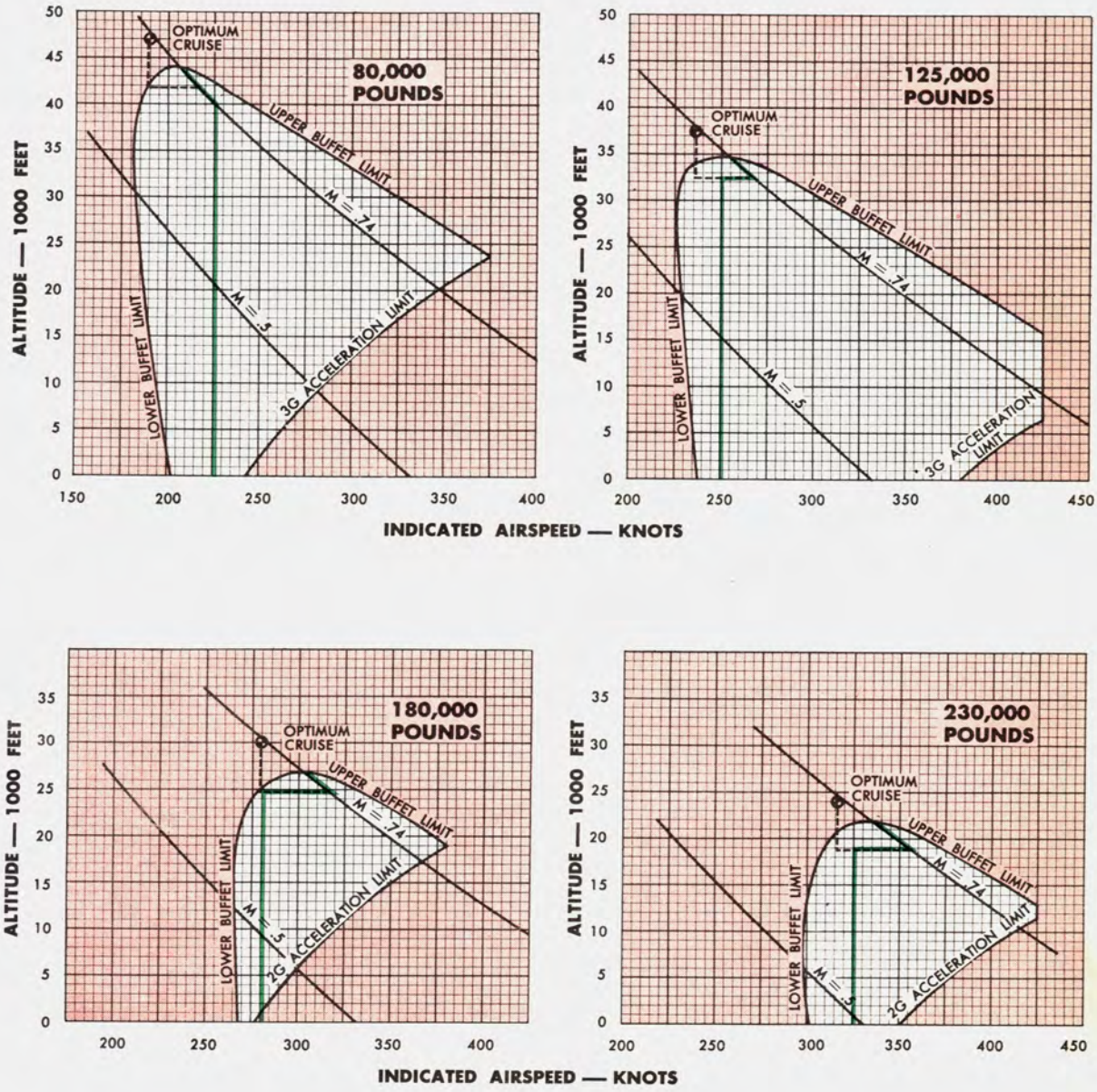
When flight in turbulence is anticipated, it is imperative that the airplane be prepared prior to entering the turbulent area. A penetration speed must be established so that the airplane will neither reach limit load factor nor enter stall or high speed buffet regions. Power settings and pitch attitudes 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 9-5 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. What is a safe penetration speed and altitude when flying at optimum cruise? By referring to the example on the 125,000-pound chart in figure 9-5, dropping 5000 feet vertically from optimum cruise altitude to the 32,500-foot level and then

# TURBULENT AIR PENETRATION— ALLOWABLE FLIGHT ENVELOPES

**MODEL:** TB-47B




**DATE:** JUNE 1953
**DATA BASIS:** CALCULATED
**REMARKS:** GUST VELOCITIES — 40 FEET PER SECOND

SUGGESTED TURBULENT AIR PENETRATION SPEED

UNSAFE FLIGHT AREA

049107

*Figure 9-5.*

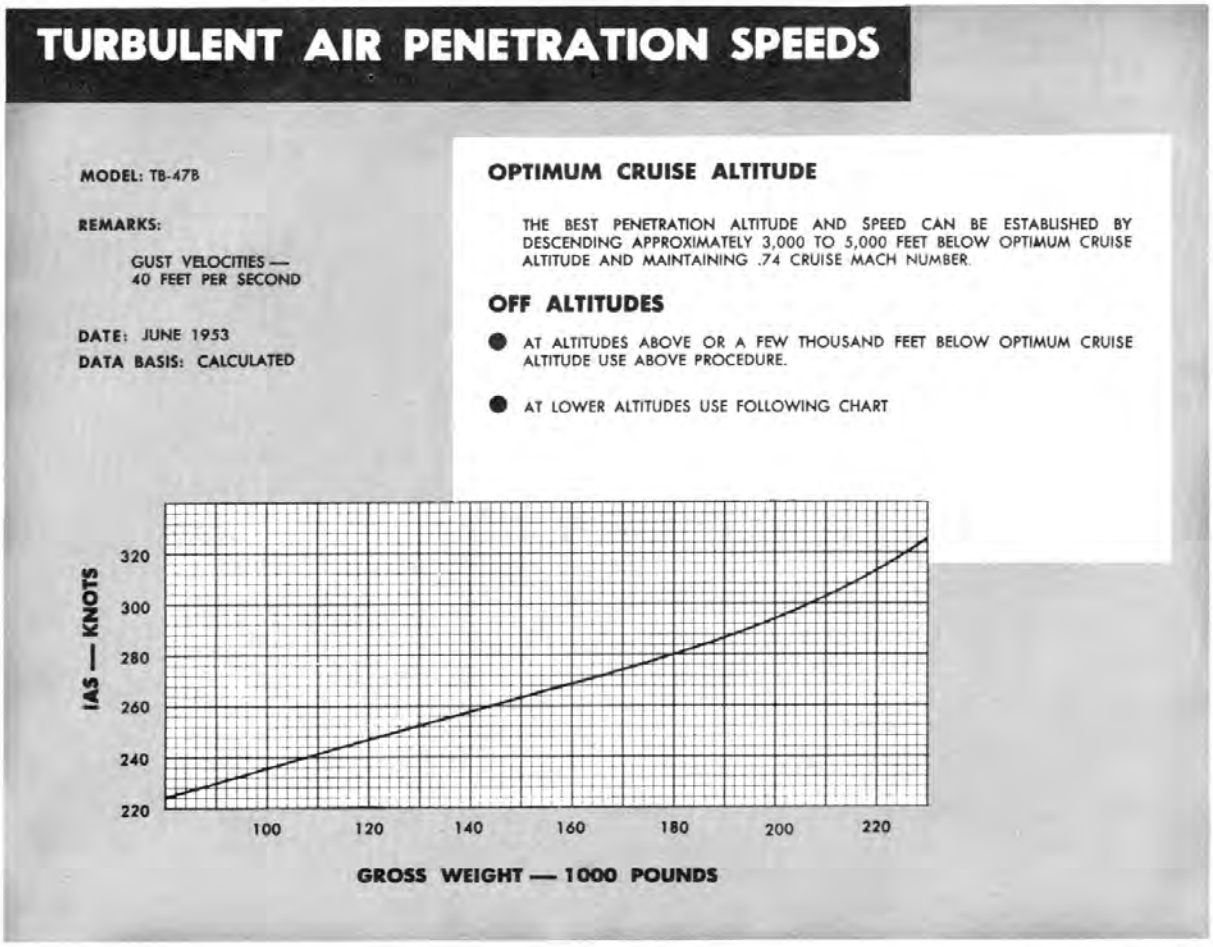



*Figure 9-6.*

moving horizontally to Mach .74 will give a penetration speed that is well within the allowable flight envelope for gust conditions and within the recommended penetration speed areas (green) for the four given gross weights.

**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 9-5). 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

#### High 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.

#### Low Altitudes

For lower altitudes on down to sea level, reference to the flight envelopes (figure 9-5) 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 9-6) 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 9-6, 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.

**BEFORE ENTRY**

Use the following procedure to prepare the airplane for entry into the turbulent area.

1. Disengage automatic pilot.
2. Pitot heat switches ON.
3. Adjust throttles as necessary to obtain correct penetration speed; allow sufficient time for airplane to assume this speed before the turbulence is encountered.
4. Check gyro instruments for proper setting.
5. Safety belt tightened (notify crew).
6. Turn off any radio equipment rendered useless by static.
7. Turn volume down on any radio equipment in use to avoid possibility of being momentarily stunned by acoustic shock.
8. At night, turn on white floodlights to minimize blinding effect of lightning.
9. 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.

**AFTER ENTRY**

In order to maintain safe flight after entering a storm, certain procedures are necessary as outlined below:

1. 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. Place windshield anti-icing switch in MAX HEAT.
2. If moisture reduces visibility through windshield, adjust windshield wiper to desired operating speed.
3. 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.
4. Devote all attention to flying the airplane.
5. Concentrate principally on holding level attitude.
6. Use as little elevator control as possible to maintain attitude in order to minimize stresses imposed on the airplane.
7. Operation of the turn-and-slip indicator can be relied on regardless of the attitude of the airplane; in severe turbulence however, the pointer 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 is encountered while the 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. The vertical velocity indicator is of practically no value during periods of high turbulence.

# NIGHT FLYING

When flying at night, use the same procedure as for instrument flying with the following additions:

1. If icing conditions are suspected, turn on wing illumination lights and inspect wings for ice formation. If icing is known to exist or is discovered on the wing, the procedure outlined in "Operations Under Icing Conditions," this section, should be followed.
2. 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, and to aid in judging the angle of climb.

# COLD WEATHER PROCEDURES

The majority of cold weather operating difficulties are encountered on the ground. The following instructions will 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 "Ice and Rain," this section.

## 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.

1. 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.

**NOTE**

Heat should be supplied to the cabin by ground heaters at all subfreezing temperatures to aid in the prevention of frost on the transparent areas when the crew enters the airplane and to ensure proper functioning of flight instruments on takeoff. The latter is especially important when ice fog is prevalent.

2. Check bottom section of front stator blades for evidence of ice and see that all turbine wheels rotate freely.

**CAUTION**

Engine heat on shutdown melts ice accumulated during previous flight and the resulting moisture will freeze 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 freezing can recur.

3. 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. Ensure that water resulting from ice removal by application of heat does not refreeze on the airplane surfaces, especially on the control surface hinge line.

**CAUTION**

- To chip or scrape ice may damage airplanes.
- Snow or ice on the balance seals will limit flexibility and cause deterioration; therefore, a thorough check should be accomplished in these areas.

**NOTE**

At very low temperatures, removal of ice and snow from wing and tail surfaces using hot air blast from ground heaters is very slow; sometimes impossible. A light coating of deicing fluid, Specification MIL-D-8243, applied with a mop or broom within an hour of takeoff will keep the surfaces smooth if all excess snow and frost is first brushed off. Ice fog may leave a deposit of more than 1/2 inch per day, so it will pose a problem even after wing covers are removed.

**CAUTION**

Use extreme care to prevent isopropyl from coming in contact with plexiglas canopy or any plexiglas or plastic operational equipment because isopropyl tends to craze or soften these materials.

4. See that all dirt or ice has been removed from landing gear shock struts and limit switches and exposed parts have been wiped with a rag soaked in hydraulic fluid.

## 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.

## STARTING ENGINES

1. Heating of jet engines is seldom required; however, if an adequate external power source is not available for starting, preheat engine to reduce starter loads.
2. 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 650° and 690° C.
3. If there is no oil pressure after 30 seconds running or if pressure drops after a 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.

## WARMUP AND GROUND TESTS

**NOTE**

No warmup is required if the engine oil pressure remains below 22 psi at full throttle. A temporary high pressure of above 22 psi at temperatures below -18° C (0° F) is not dangerous, but takeoff should be delayed until the pressure drops below 22 psi.

## TAXIING INSTRUCTIONS

1. 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 downblast 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.
2. 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

Loose snow or snow piled into banks parallel with and too close to the runway may create a hazardous takeoff condition.

## TAKEOFF

Apply brakes and advance throttles to 100% RPM. 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 runup during early part of takeoff run. If takeoff cannot be accomplished due to engine malfunction, cut engines and bring airplane to normal stop.

**CAUTION**

- At low temperatures, it is possible to exceed maximum allowable EGT at less than 96% rpm.
- Depending upon the weight of snow and ice accumulated on the airplane surfaces, takeoff distances and climbout performance can be seriously affected. The roughness and distribution of ice and snow could vary stall speeds and flight characteristics to an extremely dangerous degree. Also, structural damage may result from vibrations induced during flight by unbalanced loads of unremoved accumulations. Loss of an engine shortly after takeoff is a serious enough problem without the added, and avoidable, hazard of ice and snow on the lifting and control surfaces. In view of the unpredictable and unsafe effects of ice and snow on the airplane, it must be removed before flight is attempted. However, takeoff may be safely undertaken in this airplane with light frost on the lifting surfaces.

### AFTER TAKEOFF

If windshield anti-icing is not adequate with switch in NORMAL, place switch in MAX HEAT.

**CAUTION**

- During operation at low gross weights and particularly at low ambient temperatures, the airplane accelerates very rapidly and care should be taken not to exceed the speed limitations of the flap retraction (figure 5-3).
- When operating the wing flaps at low temperatures, the flap position indicator should be closely observed for positive movement. If flaps should stall, immediately place flap lever in OFF to prevent damage to the motor.
- Wing flaps may not retract at speeds above 175 knots IAS during prolonged exposure at temperatures between -40° and -54° C (-40° and -65° F).

### CLIMB

Follow normal procedure for climb.

**CAUTION**

- 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.
- The B-1 attitude indicator has shown an acceleration error of about 1 1/2 bar widths (nose high) at the time the airplane breaks ground. If this error is not recognized and considered, a too shallow climb is possible. A shallow climb coupled with the added acceleration ob-

**CAUTION (continued)**

tained during cold temperatures may result in the airplane exceeding the flap structural limit speeds.

### DESCENT

**NOTE**

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 is 90 seconds.

### LANDING

For landings on ice- and snow-covered runways, use the procedure given for "Landing" under "Ice and Rain," this section.

**NOTE**

Depth perception suffers when ground is covered with snow. Lack of contrast between runway and surrounding terrain may cause runway to disappear from sight on final approach. Pilot may request runway lights turned on to provide necessary contrast.

### POSTFLIGHT

1. 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.
2. Have airplane serviced with fuel and oil and drain all sumps before condensates reach freezing point.
3. Check that all protective covers and intake and tailpipe closures are installed. 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.)

# HOT WEATHER PROCEDURES

Successful hot weather (tropical) operation will require additional attention and preparation other than the normal operating instructions in section II. Proper protection of the airplane while on the ground is your assurance of future successful missions.

### BEFORE ENTERING THE AIRPLANE

1. Delicate electrical equipment such as communications and instruments must be completely dry. In locations where high humidity is encountered, equipment will be subject to malfunctions due to corrosion, fungus, and moisture absorption by nonmetallic materials. Malfunctions may be reduced by keeping such equipment warmer than the ambient temperature.
2. Units incorporating plastic or rubber should be protected as much as possible from excessive temperatures by the use of covers.
3. Cool the cabin with a portable air conditioner.

### ON ENTERING THE AIRPLANE

1. Place master air conditioning switch in ON and cabin air selector switch in RAM SUPPLY for cabin ventilation.

**CAUTION**

With the bombing-navigation system on, ram air supply should not be used. In RAM SUPPLY, air from an automatic ground blower would be diverted from the BNS equipment for which it was intended. Overheating and damage to the BNS equipment could result.

2. If high humidity has caused instruments and cabin controls to become covered with moisture, dry thoroughly with flow of warm air from portable ground heater.

### STARTING ENGINES

1. Start engines by normal procedure. If a normal start is not accomplished, discontinue the start and allow at least 3 minutes for complete fuel drainage.
2. On the next attempt, advance throttle past START detent when engine rpm is between 6% and 8%. As soon as engine fires, retard throttle and monitor EGT gage closely, as EGT may rise quite rapidly on a hot day. If idle detent is passed when advancing throttle, care must be exercised that it does not hang in the detent when retarding.

**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

Required takeoff distances with normal temperatures show a marked increase during hot weather operation. It should be noted however, that when assist is used, the required takeoff distance increase due to high temperature is considerably shortened. Refer to charts in the appendix.

### 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.

### LANDING

Use normal landing technique and anticipate longer ground roll in hot weather. 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

1. Have closures and covers installed for protection from sun.
2. Leave canopy and doors open for ventilation.

**NOTE**

If fuel tanks are topped off, fuel expansion due to high temperature may cause considerable overflow, presenting a fire hazard.

# DESERT PROCEDURES

Very high and very low temperatures and low humidity, together with the abrasive effect of 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 the extra precautions covered here are not observed. It may be necessary to use this information in conjunction with the "Cold and Hot Weather Procedures," section IX.

### BEFORE ENTERING THE AIRPLANE

On exterior inspection, if sand is evident on shock strut pistons or other hydraulic pistons where piston touches cylinder seal, have it removed with a dry soft cloth.

**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.

### ON ENTERING THE AIRPLANE

Excessive dust accumulation on instrument dials and blown sand on and around movable flight controls, dials, and switches must be cleaned away.

### STARTING ENGINES

If temperature is high and engine fails to accelerate to idle rpm, use the procedure as outlined under "Hot Weather Procedure - Starting Engines," this section. For low temperatures, refer to "Cold Weather Procedures - Starting Engines," this section.

**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

To prevent damage by sand blasting, be certain that airplane is clear of other airplanes during all ground operations.

### TAXIING INSTRUCTIONS

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

Be prepared for sudden gusts of wind during takeoff run. It should be borne in mind while operating in arid localities that extreme temperature variations may occur within a relatively short length of time. Therefore, takeoff data should be reviewed immediately prior to takeoff, paying particular attention to changes in ambient temperature.

### 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.

### STOPPING ENGINES

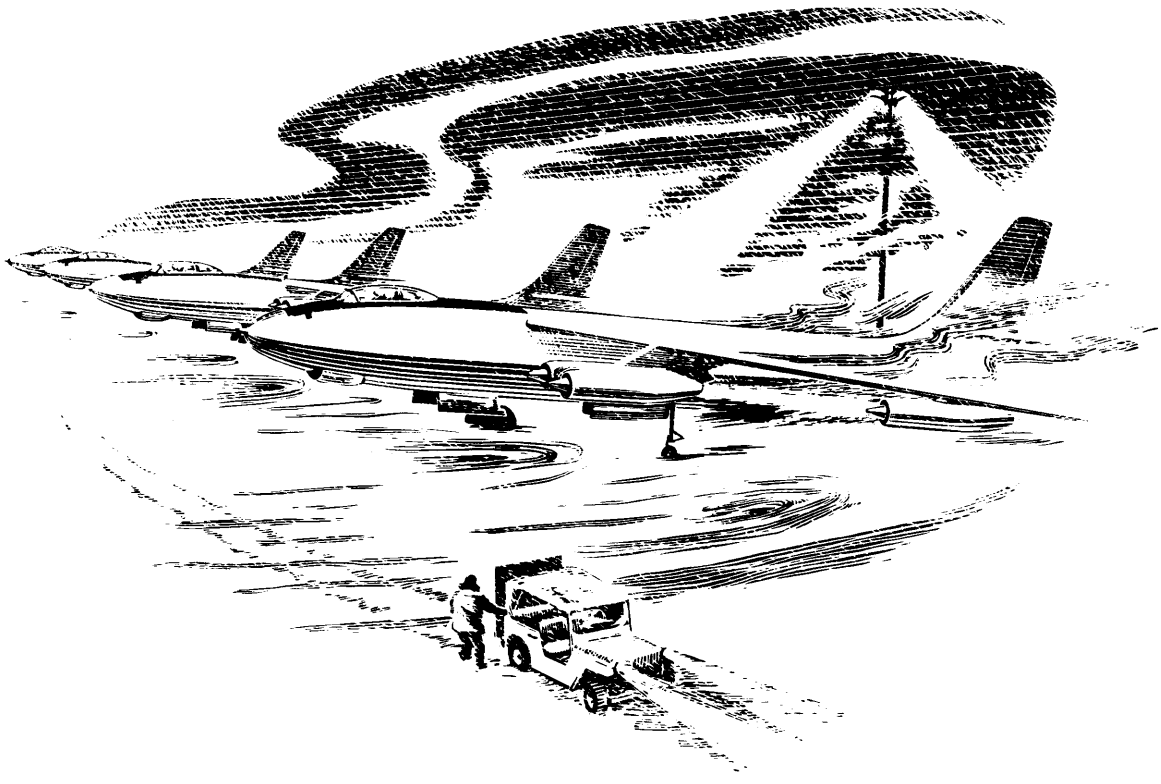
Have dust covers and closures installed immediately to prevent blowing sand and dust from entering engines.

### POSTFLIGHT

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.

**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.



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Part 1

# INTRODUCTION

All performance in this book is based on an NACA standard day (temperature of 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 A11-12. All charts containing performance data based on an Army hot day are identified by a yellow border on that page. Performance data for all flight operations, including takeoff and landing is contained in this appendix. All charts containing emergency performance data or data based on less than six engines operating are identified by a red border on that page.

## 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 a 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 & DEFINITIONS

| SYMBOLS | DEFINITIONS | SYMBOLS | DEFINITIONS |
|---|---|---|---|
| IAS | INDICATED AIRSPEED — AIRSPEED INDICATOR UNCORRECTED* | R/C | RATE OF CLIMB |
| | | OAT | OUTSIDE AIR TEMPERATURE |
| CAS | CALIBRATED AIRSPEED — INDICATED AIRSPEED CORRECTED FOR INSTRUMENT AND POSITION ERROR | 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 TAKE-OFF — 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.

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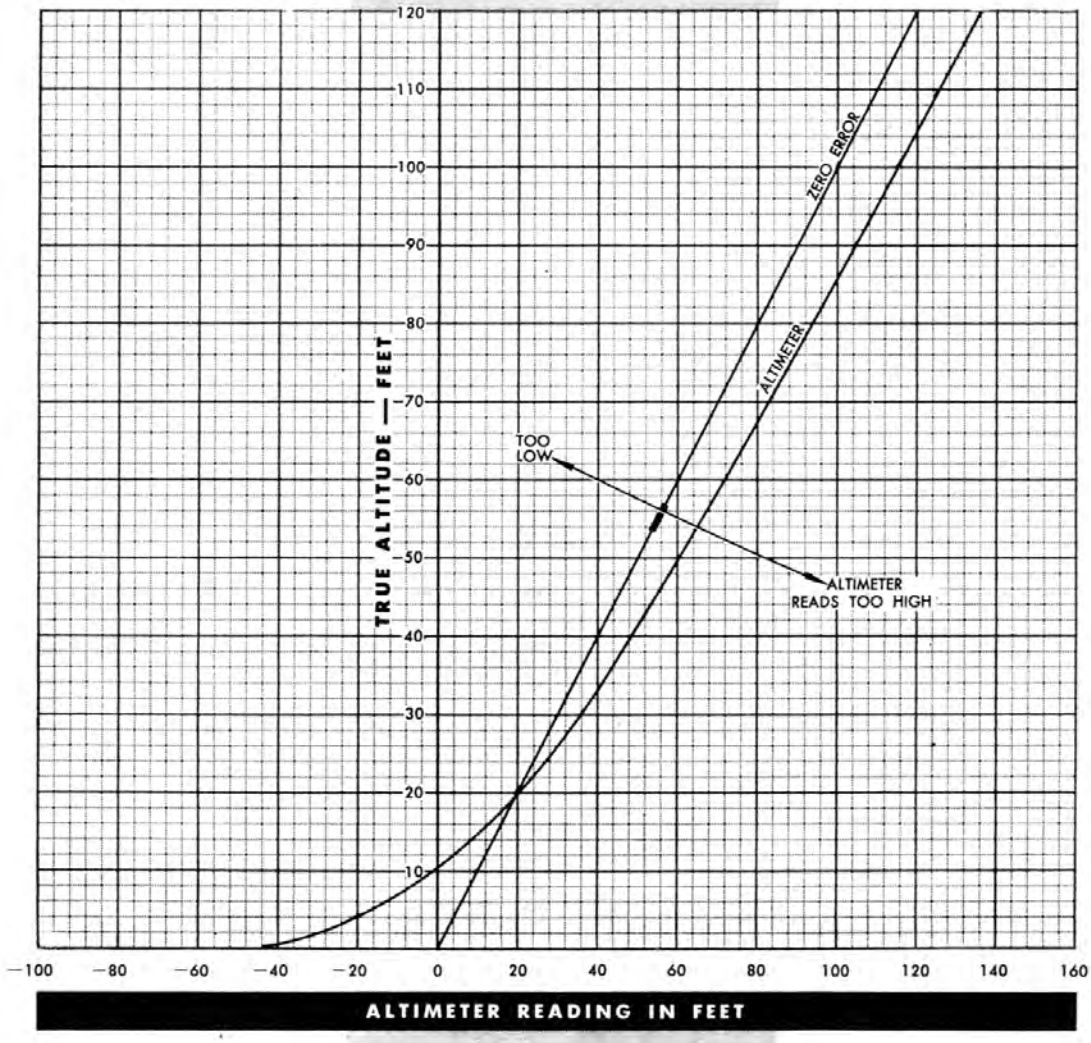
*Figure A1-1.*

# ALTIMETER READING-GROUND EFFECT

## FLAPS DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
ANGLE OF ATTACK FOR TOUCHDOWN

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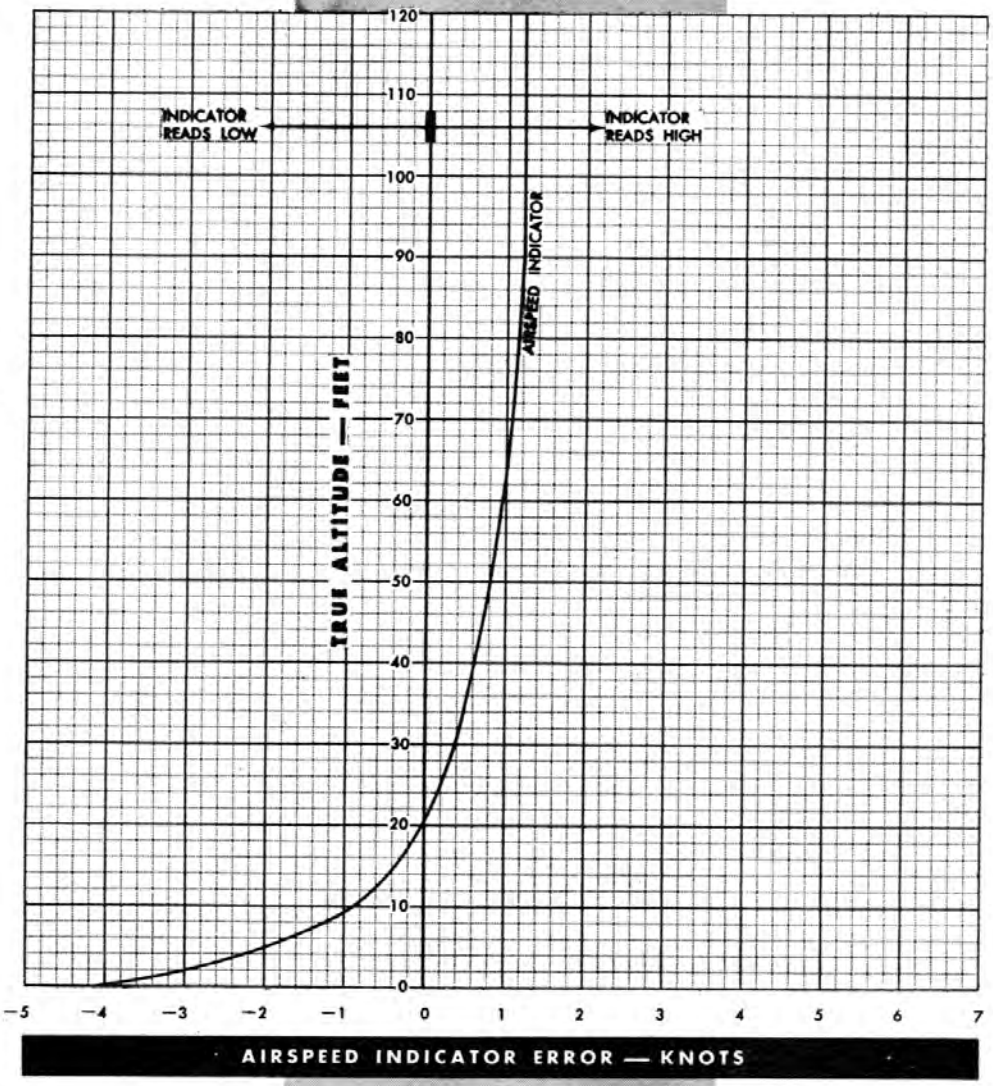
*Figure A1-2.*

# AIRSPEED INDICATOR POSITION ERROR

## FLAPS DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

FLAPS DOWN

ANGLE OF ATTACK FOR TOUCHDOWN

102

*Figure A1-3.*

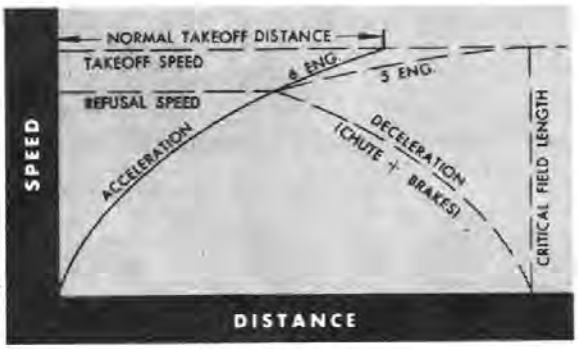
Part 2

# TAKEOFF

This part contains charts for takeoff performance and methods for the determination of takeoff speed, go-no go speed, acceleration check speed, elevator trim for takeoff, takeoff headwind correction, takeoff distance over a 50-foot obstacle, and takeoff distance with four or five engines operating. 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 is considered in all takeoff planning. With an engine failure, the pilot must either be able to stop or take off safely. Consideration is also made in the takeoff planning procedures for subnormal deceleration occurring for reasons other than engine failure. The following information defines the factors involved in these considerations and explains the purpose of each chart.

## 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 either to take off on five engines or stop in the same distance as required for takeoff. This is illustrated in the accompanying sketch:

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To perform a safe takeoff considering the possibility of an engine failure, the critical field length should be shorter than or equal to the actual runway available. Critical field length charts are provided in this part which take into account the effects of airplane gross weight, pressure altitude, outside air temperature, and ATO thrust.

## TAKEOFF DISTANCE

Takeoff distance is the actual length of runway used from the start of the ground roll until the airplane becomes airborne. Takeoff distance charts are provided for various combinations of gross weight, pressure altitude, and outside air temperature. The takeoff distance can be shortened approximately 7% by easing the airplane off the ground with the elevators at a lower speed than that for a normal takeoff; however, this is not advisable except in extreme emergencies. Shortening the takeoff in this manner requires judicious handling of the elevators. Any abrupt application of pull force on the elevator control may result in the airplane entering a stalled condition. Also, the performance reserve after takeoff will be reduced and airplane stability can be dangerously affected.

## TAKEOFF SPEED

Takeoff attitude is determined by elevator trim setting and pilot's effort on the elevator control. However, 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 speed takes into account the gross weight of the airplane and can be determined from the speed and distance curve (figure A2-3).

## REFUSAL SPEED

Refusal speed is the highest speed to which the airplane can be accelerated and still be stopped on the runway. This assumes that normal acceleration has occurred up to the refusal point. When the rules for critical field length are observed, a takeoff on five engines will always be possible if an 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 as is required to stop from refusal speed. The refusal speed charts in this part take into account gross weight, pressure altitude, OAT, and actual runway length. The speed value obtained from the charts is used to permit

further takeoff computations and will not be entered on the takeoff and emergency landing data card.

### REFUSAL DISTANCE

Refusal distance is the distance required to accelerate to refusal speed when acceleration is normal. Refusal distance is obtained from the speed and distance chart (figure A2-3).

### GO-NO GO SPEED

Go-no go speed is the minimum speed that must be attained at the go-no go distance which is the first 1000-foot marker short of the refusal distance. If the go-no go speed is not attained or if an engine failure occurs before reaching the go-no go distance, the takeoff must be refused. If an engine failure occurs after reaching the go-no go distance, the takeoff must be continued. Go-no go speed is based upon normal acceleration and is determined from the speed and distance chart. It must be corrected for effective wind and allowable acceleration tolerance. Acceleration tolerance will be zero unless the actual runway length is greater than the critical field length.

### ACCELERATION CHECK SPEED

Acceleration check speed is the minimum speed that must be attained at the acceleration check distance which is 2000 feet short of the go-no go runway marker. If the acceleration check speed is not attained, the pilot may elect to refuse the takeoff at the acceleration check marker or delay his decision until he has reached the go-no go marker. The time interval between the acceleration check speed and the go-no go speed will always be greater than 10 seconds. Acceleration check speed is based upon normal acceleration and is determined from the speed and distance chart. It must be corrected for effective wind and allowable acceleration tolerance. Acceleration tolerance will be zero unless the actual runway length is greater than the critical field length.

### ACCELERATION TOLERANCE

Acceleration tolerance is the amount that the go-no go and acceleration check speeds may fall below the normally predicted values without endangering the takeoff. The tolerance is based on the deviation from normal acceleration that makes the resultant no-wind critical field length equal to the actual runway available. If the actual runway length is equal to the critical field length, the tolerance is zero. The maximum tolerance is 10 knots based on the assumption that if the acceleration is more deficient, there must be a serious flaw in the functioning of the airplane and takeoff must not be continued regardless of the amount of excess runway available.

### ELEVATOR TRIM FOR TAKEOFF

The elevator trim settings for takeoff are shown on figure A2-8. The recommended trim settings provide slight nosedown forces during takeoff, requiring a slight pull force at the proper unstick speed to become airborne. This nosedown 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 asymmetrical engine thrust.

### 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 A2-9 can serve only as an approximation. The chart assumes that flaps and gear remain extended, power remains at 100% rpm, and that the airplane is pitched up to a point just short of stall warning resulting in a normal acceleration at takeoff speed slightly higher than normal. This is maximum performance of the airplane and should be accomplished only under emergency conditions as presented under "Short Field or Obstacle Clearance Takeoff" in section III. Shortening the takeoff in this manner requires judicious handling of the elevators. Any abrupt application of pull force on the elevator control may result in the airplane entering a stalled condition.

### FOUR- AND FIVE-ENGINE TAKEOFF DISTANCE

For emergency evacuation or similar conditions, it may be necessary to take off with only four or five engines operating. The chart in figure A2-10 can be used to predict the takeoff distance with only four or five engines operating throughout 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:

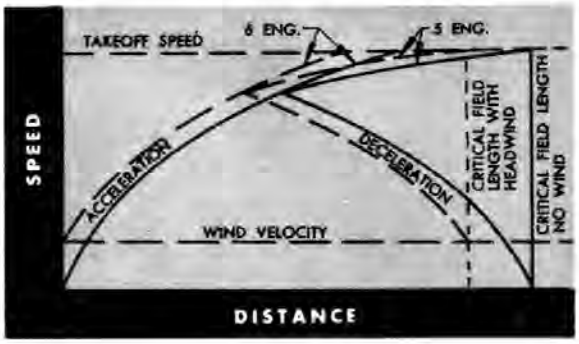
- 100% rpm on six specified engines
- Properly tabbed engines
- 100% wing flap extension
- Level and dry runway
- No wind
- Simultaneous takeoff of both main gears
- No additional drag (i.e., proper tire inflation, no dragging brakes)
- All charts reflecting IAS data have been corrected for ground effect
- Six seconds total time allowed to reduce power and apply brakes and brake chute for a refused takeoff.

## 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

Both go-no go speed and acceleration check speed must be corrected for wind. The correction is made by adding 80% of the effective wind directly to the no-wind speeds. Effective wind is defined as the component of wind that is blowing parallel to the runway. For example, the effective wind with a 90° crosswind is zero. Figure A2-6 provides a method for computing effective wind. If wind velocity is obtained from a runway anemometer that is no more than 15 feet high, then the actual wind velocity reading is used for computing effective wind. If wind velocity is reported from a tower anemometer, then one-half the reported velocity is used for computing effective wind. Curves are shown on figure A2-6 for converting effective wind from either a runway or tower anemometer into the values used for correcting go-no go and acceleration check speeds. The effect of headwind on takeoff distance and critical field length should be disregarded, thus leaving the benefits which cannot be predicted accurately as an added safety margin.



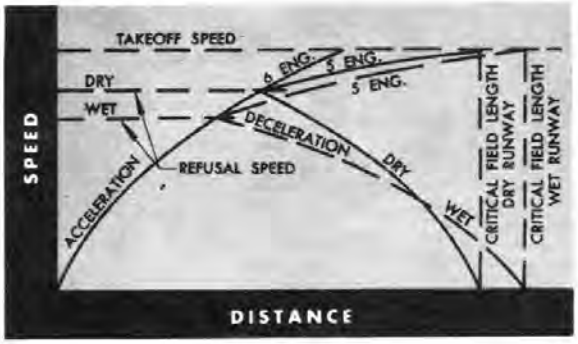

However, in cases where it is desired to do so, no-wind distance can be approximately corrected to the equivalent distance with the headwind by using figure A2-7, utilizing effective wind as defined above. The summary chart at the end of this text provides an index of the changes that headwind makes to various takeoff parameters.

### Effect of Wet Runway

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. The takeoff data in this section is based on dry runways. For wet runways, increase the critical field length 25 feet for every 1000 feet of runway required (2.5%) and decrease the refusal speed 10 knots. This criteria is sufficiently conservative that it may be applied to wet asphalt, macadam, or concrete surfaces.

**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 0.15 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, the unusual situation of an inch of water evenly distributed throughout the entire takeoff run will increase the takeoff distance of the airplane with a gross weight of 180,000 pounds by 7500 feet.

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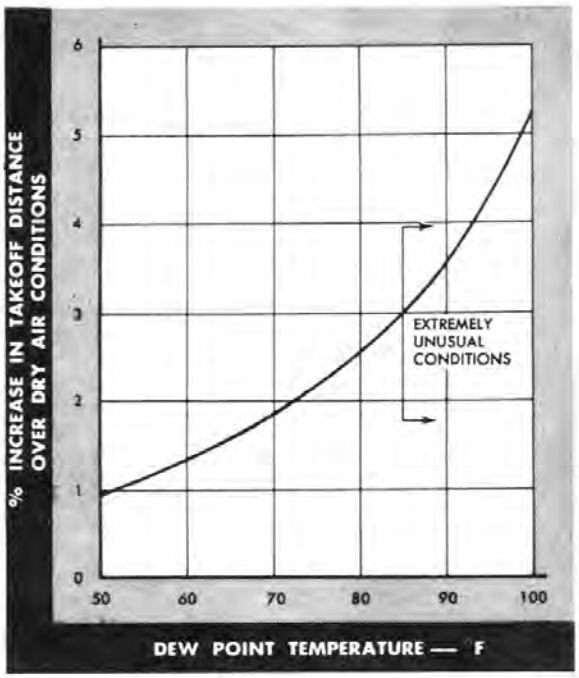
Refer to the summary chart at the end of this text as a guide for corrections due to wet runways.

### Effect of Humidity

Relative humidity, which appreciably 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.




50736

### Runway Grade Correction

If the airplane takes off on a slight uphill grade, the takeoff distance and critical field length 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 takeoff is uphill. Takeoff distance is decreased by the same amount if the airplane takes off downhill. Similarly, the increase in critical field length may be obtained approximately by multiplying the critical field length (hundreds of feet) by the grade (foot of elevation per 1000 feet of distance). If a runway has a 6.0-foot per 1000-foot grade and the critical field length is 8000 feet, the increase in critical field length is 80 x 6.0 or 480 feet. If the airplane takes off downhill, the decrease in critical field length will be disregarded thus leaving any benefits from a downhill grade as a safety margin.

### 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.

### 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.

# SUMMARY OF TAKEOFF PERFORMANCE VARIABLES

| TAKEOFF PARAMETERS | CORRECTIONS | | | | | |
|---|---|---|---|---|---|---|
| | HEAD-WIND | WET RUNWAY | RUNWAY UPGRADE | ANTI-ICING ON | INLET SCREENS EXTENDED | LOW E.G.T. 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 | NEGLIGIBLE | DECREASED | DECREASED | DECREASED |

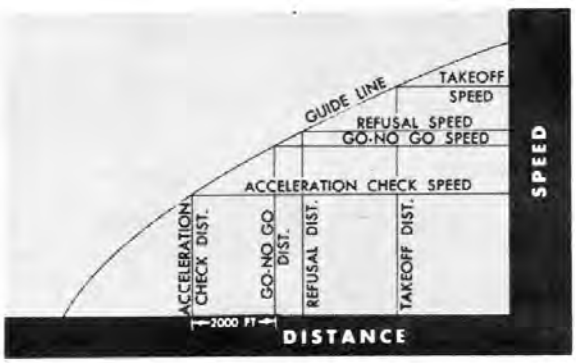
50810

## TAKEOFF PLANNING

To determine accurate takeoff performance and optimum procedures, it is necessary for the pilot to know the following:

- Gross weight at start of takeoff run
- Runway air temperature (OAT) at time of takeoff
- Field length and pressure altitude
- Wind direction and velocity at time of takeoff
- Tailpipe temperature (check on engine runup).

Determine the critical field length from figure A2-1 and compare with the actual runway available. If the critical field length is longer than the runway available, the gross weight should be reduced. Next determine the takeoff distance from figure A2-2 which will be used as a guide in computing go-no go and acceleration check speeds. The principal chart used for takeoff planning is the speed and distance chart (figure A2-3). Use of this chart is illustrated by the accompanying sketch.




50756

Enter this chart with gross weight and determine takeoff speed. Enter the chart with takeoff distance and select the guide line which intersects the point of takeoff speed and distance. The chart is so designed that speed and distance relationships along the guide lines are automatically corrected for values of gross weight, outside air temperature, and field pressure altitude for which the takeoff distance has been computed. Uncorrected go-no go and acceleration check speeds are read from this guide line when the respective distances are known. Next determine the refusal speed from figure A2-4. Enter the speed and distance chart with refusal speed and note refusal distance on the appropriate guide line. Note the go-no go distance at the next 1000-foot mark short of the refusal distance. Read the go-no go speed opposite the intersection point of this distance and the appropriate guide line. Note the acceleration check distance 2000 feet short of the go-no go distance and determine acceleration check speed from the appropriate guide line. The allowable tolerance from the uncorrected go-no go and acceleration check speeds is found from the chart on figure A2-5. Enter the chart with takeoff distance, move to the runway available, go-no go distance, and read the tolerance. Subtract this tolerance from the go-no go speed. Similarly, correct the acceleration check speed by using acceleration check distance. The correction for headwind is postponed until immediately prior to takeoff. At this time the headwind correction is determined from figure A2-6 and added as previously discussed under "Effect of Headwind." After completion of the required takeoff data, it should be recorded on the Takeoff and Emergency Landing Data Card which is contained in part 9.

### Use of Charts

As an aid in showing the proper use of the various takeoff charts, the following examples are given.

EXAMPLE 1

Compute takeoff performance and criteria for the following conditions:

- Gross Weight - 150,000 pounds
- Pressure Altitude - 2000 feet
- OAT - 80° F
- Runway Available - Runway No. 18, 10,000 feet long
- Reported Tower Wind - 29 knots from 150°
- Engines - Six J47-23
- Center of Gravity - 25% MAC
- No Water Injection.

CRITICAL FIELD LENGTH. Considering the conditions of the example and referring to figure A2-1, the critical field length for no wind and zero ATO thrust is 8700 feet.

TAKEOFF DISTANCE. The no-wind and no-ATO takeoff distance for the above example is 7500 feet as found on figure A2-2.

TAKEOFF SPEED. Reference to figure A2-3 indicates the takeoff speed will be 141 knots IAS.

REFUSAL SPEED. The refusal speed is determined from figure A2-4 and found to be 122 knots.

GO-NO GO DISTANCE AND SPEED. Using the no-wind no-ATO takeoff distance and takeoff speed, determine the proper guide line on figure A2-3. By following the guide line down to the 122-knot refusal speed, the refusal distance is found to be 5450 feet. The go-no go distance is therefore 5000 feet (the next lower 1000-foot mark). By staying on the same guide line, the uncorrected go-no go speed at 5000 feet is found to be 117 knots.

GO-NO GO SPEED TOLERANCE. Referring to A2-5 and using the 7500-foot takeoff distance, 10,000-foot runway available, and the 5000-foot go-no go distance, the tolerance is found to be 6 knots. The go-no go speed, corrected for speed tolerance, is then 117 minus 6 or 111 knots.

ACCELERATION CHECK DISTANCE AND SPEED. According to the rules, the acceleration check distance is 2000 feet short of the go-no go distance and is therefore 3000 feet. Using the same guide line on figure A2-5 as used above, the uncorrected acceleration check speed at 3000 feet is found to be 93 knots.

ACCELERATION CHECK SPEED TOLERANCE. Referring to figure A2-5 and using the 7500-foot takeoff distance, 10,000-foot runway available, and 3000-foot acceleration check distance, the tolerance is found to be 5 knots. The acceleration check speed, corrected for speed tolerance, is then 93 minus 5 knots or 88 knots.

WIND CORRECTION. The difference between runway heading and wind direction is 30°. Referring to figure A2-6, the effective wind is found to be 25 knots. By entering the small graph on figure A2-6 with 25 knots effective wind and moving to the tower anemometer curve, the wind correction value is found to be 10 knots. Thus, wind correction increases go-no go speed from 111 to 121 knots and acceleration check speed from 88 to 98 knots.

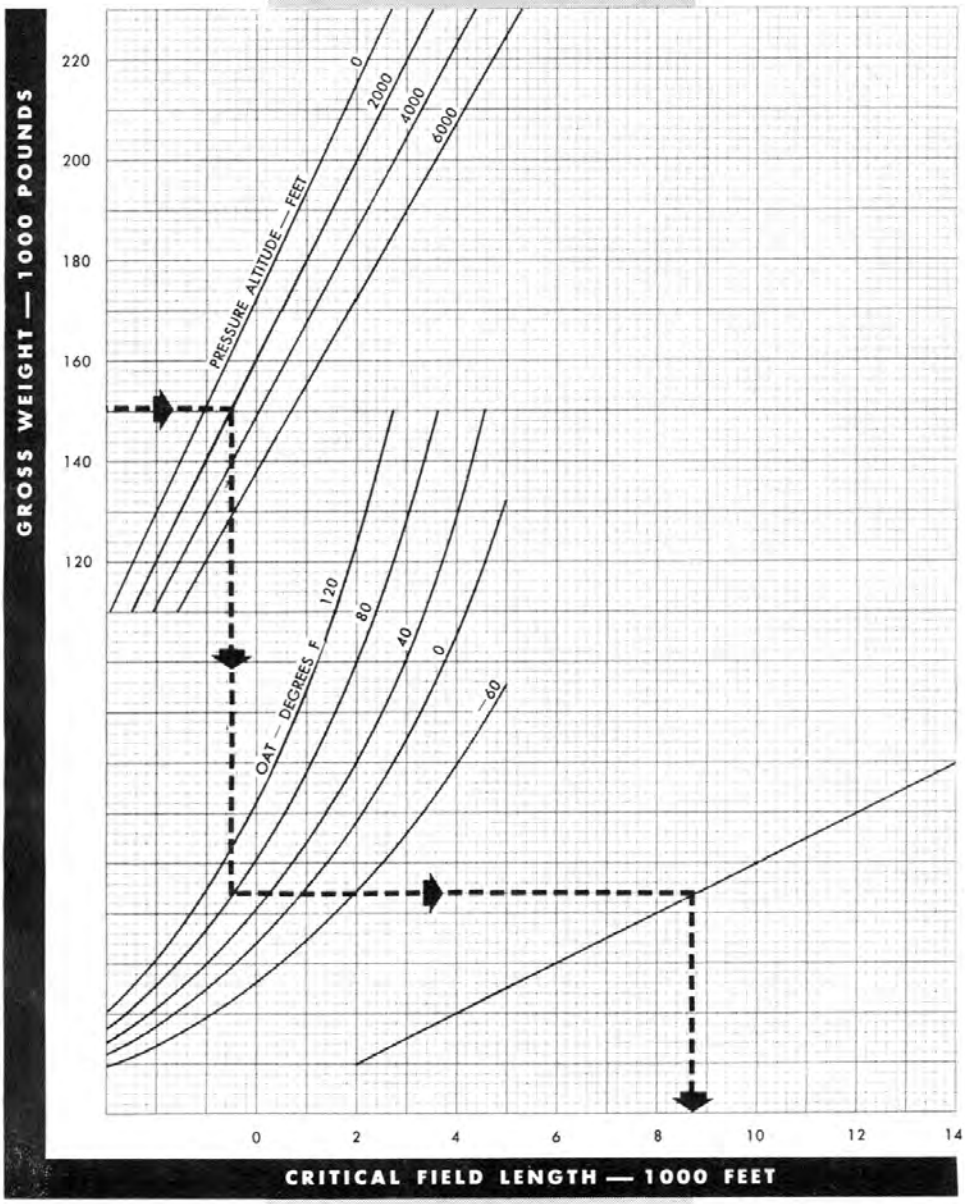
ELEVATOR TRIM FOR TAKEOFF. The recommended trim settings as found on figure A2-8 is zero units with a cg of 25% MAC.

DISTANCE OVER A 50-FOOT OBSTACLE. The total distance to clear a 50-foot obstacle from the start of takeoff (no wind) is 8950 feet using the above takeoff distance of 7500 feet and referring to figure A2-9.

# CRITICAL FIELD LENGTH

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1955

**DATA BASIS:** FLIGHT TEST

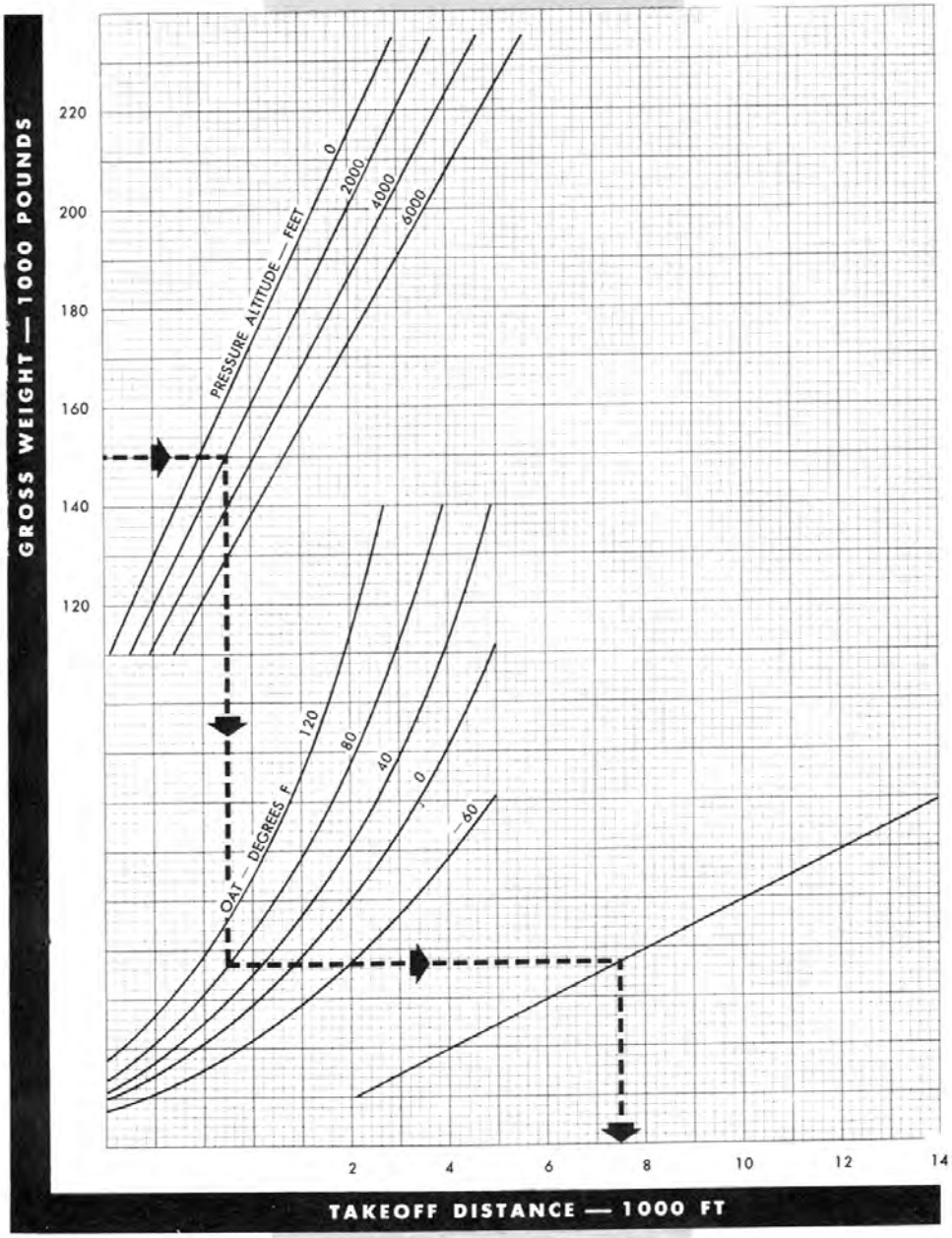
5 201

*Figure A2-1.*

# TAKEOFF DISTANCE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1955

**DATA BASIS:** FLIGHT TEST

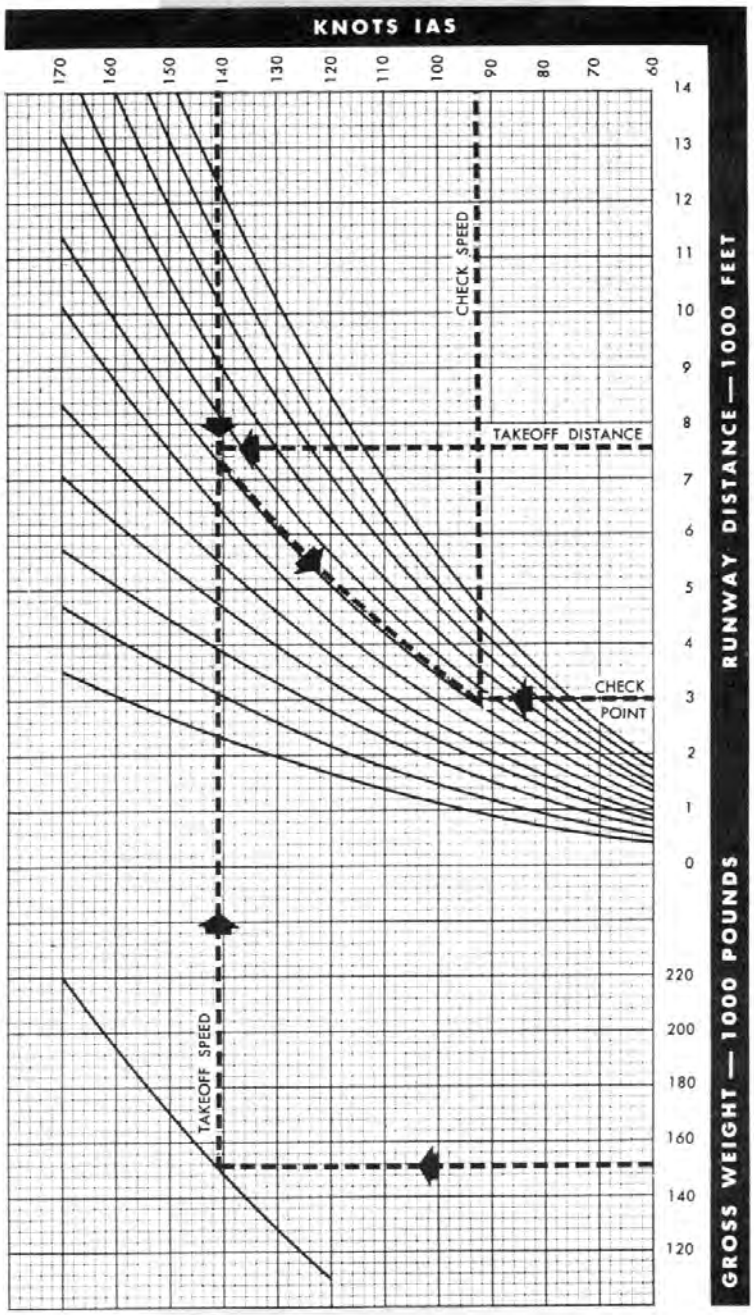
8205

*Figure A2-2.*

# SPEED AND DISTANCE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1955

**DATA BASIS:** FLIGHT TEST

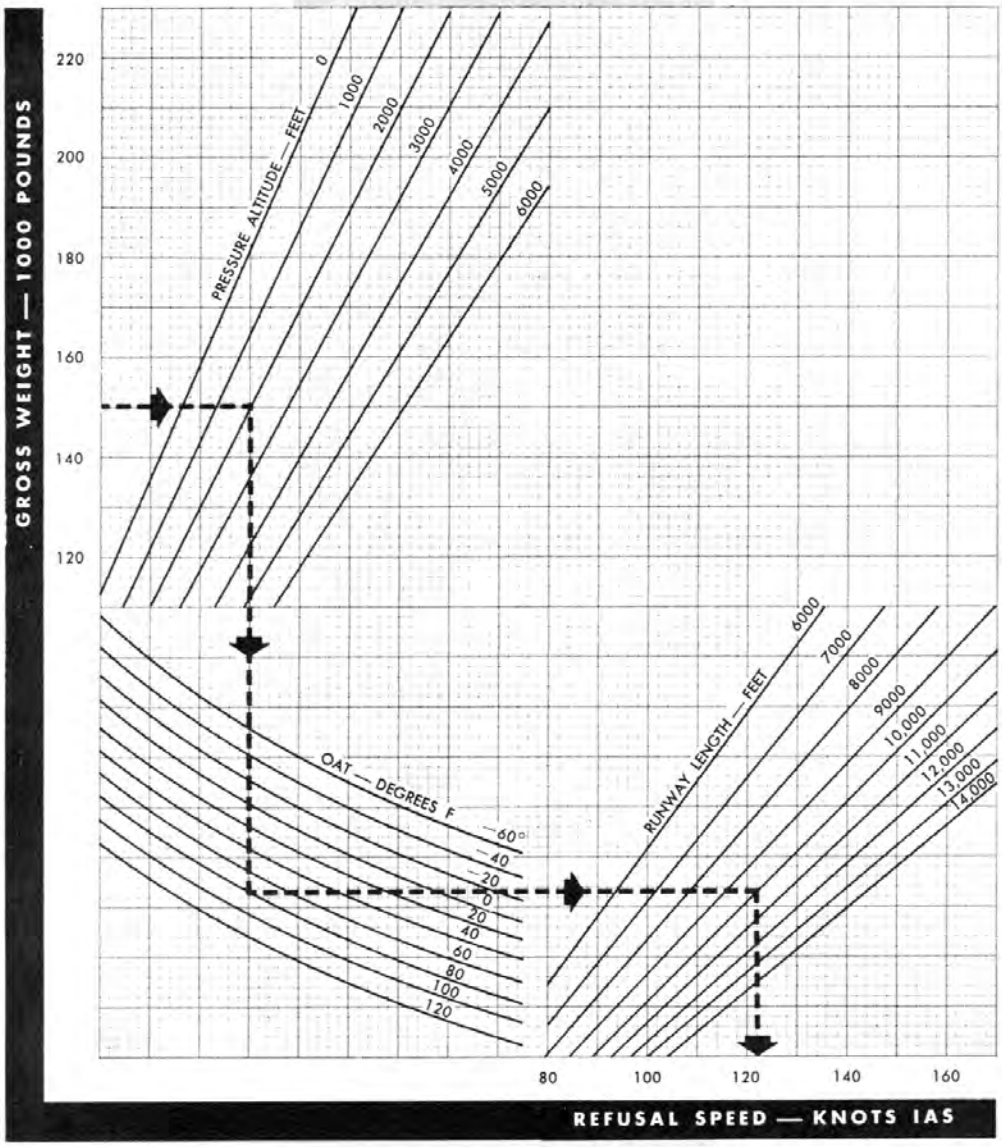
*Figure A2-3.*

# REFUSAL SPEED

## 6000-14,000 FT RUNWAYS

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1955

**DATA BASIS:** FLIGHT TEST

**REMARKS:**

AIRSPEED CORRECTED FOR GROUND EFFECT

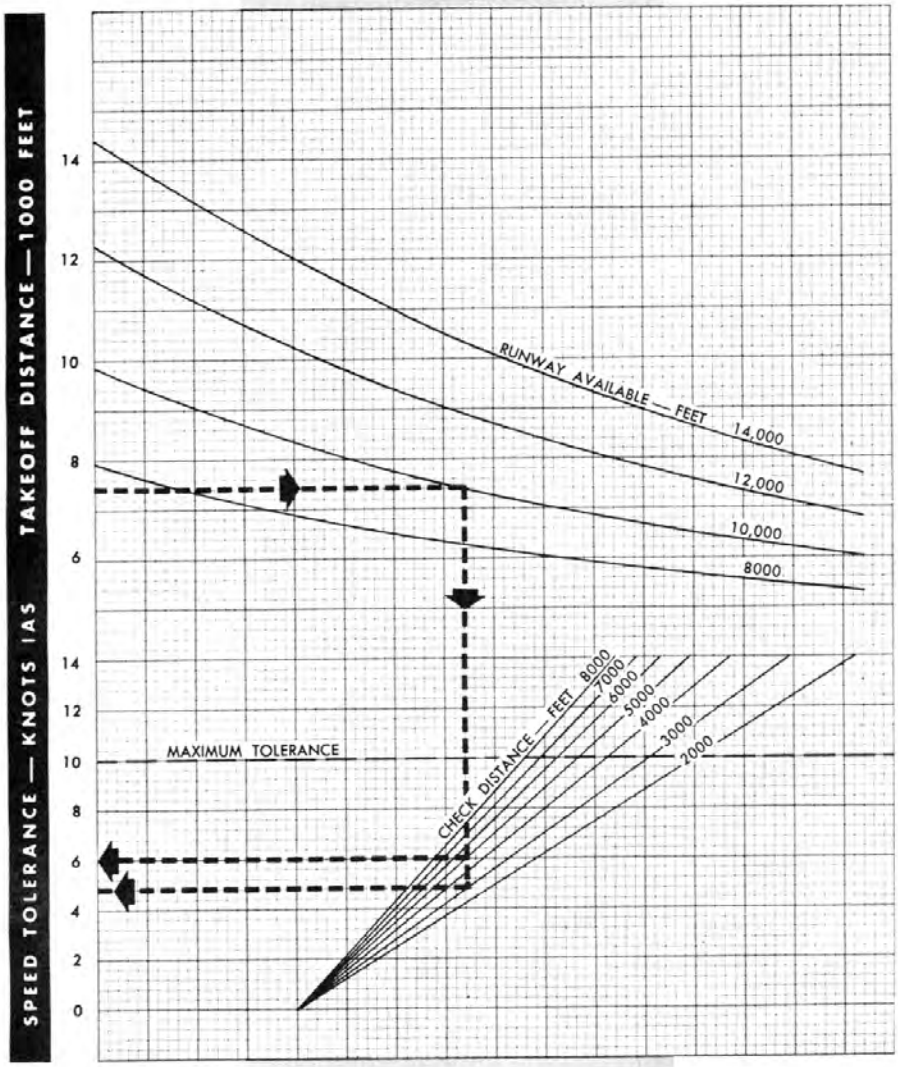
209

*Figure A2-4.*

# SPEED TOLERANCE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** APRIL 1956

**DATA BASIS:** COMPUTED

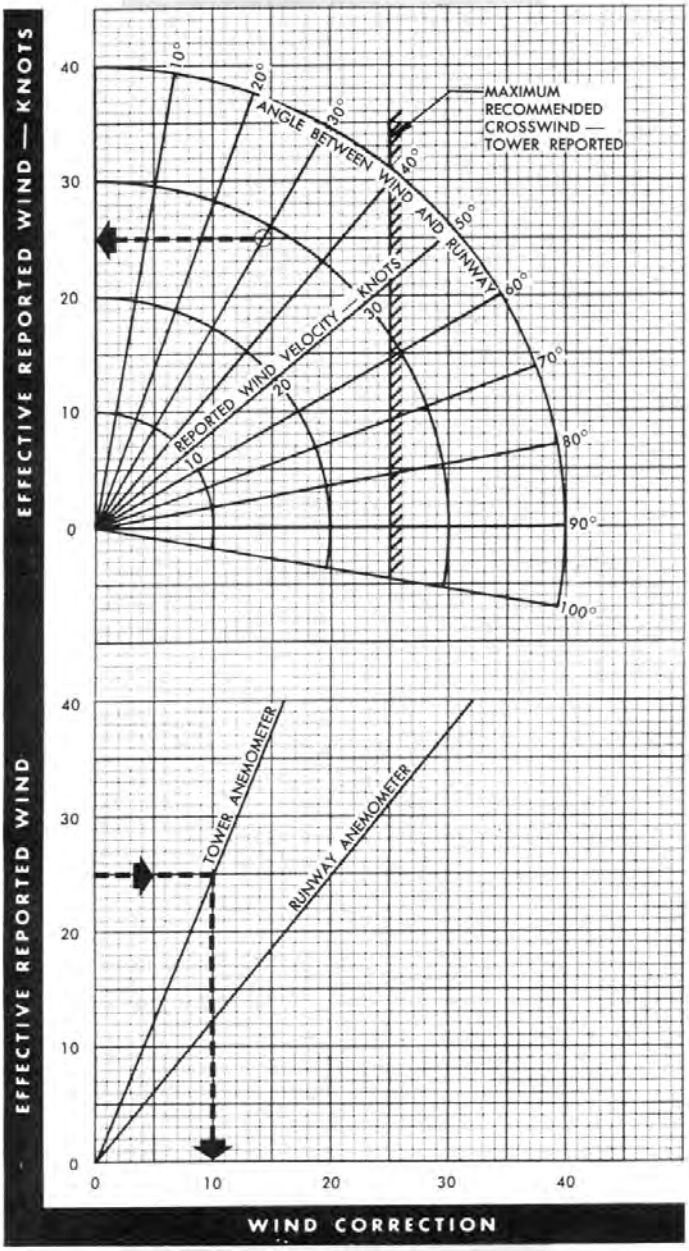
212

*Figure A2-5.*

# TAKEOFF EFFECTIVE WIND

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** APRIL 1956

**DATA BASIS:** COMPUTED

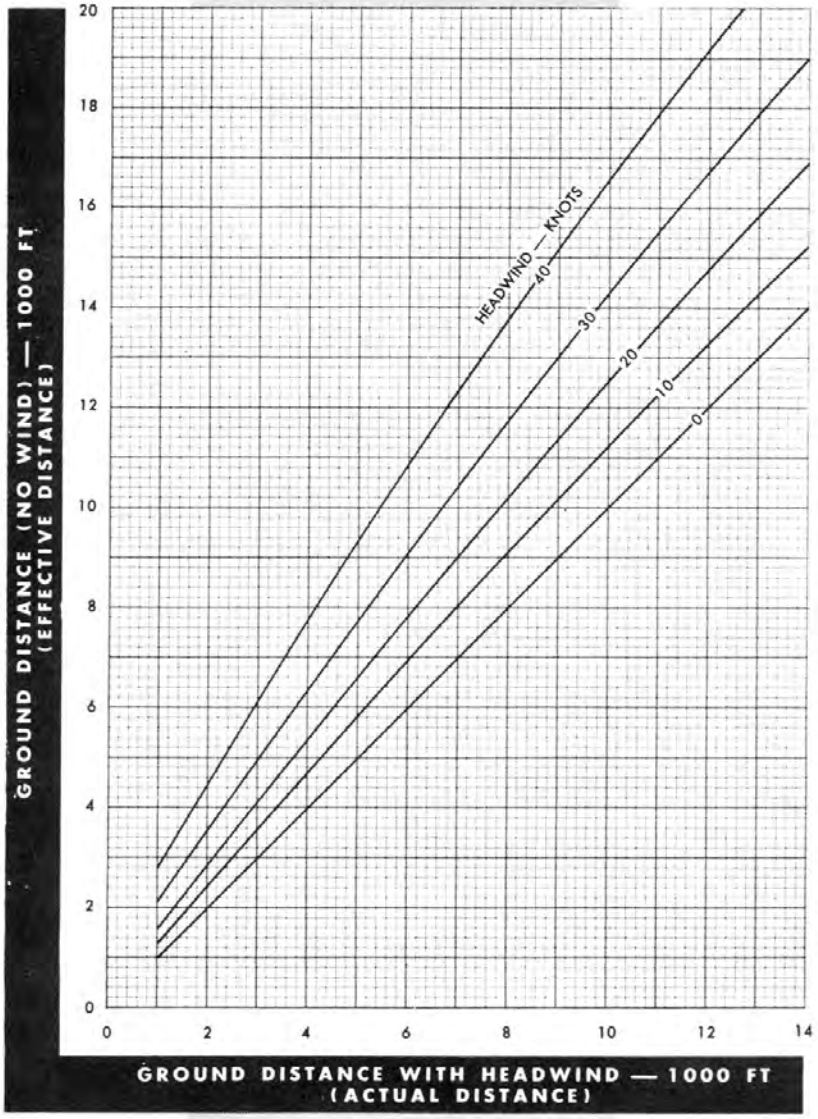
213

*Figure A2-6.*

# TAKEOFF HEADWIND CORRECTION

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1951

**DATA BASIS:** CALCULATED

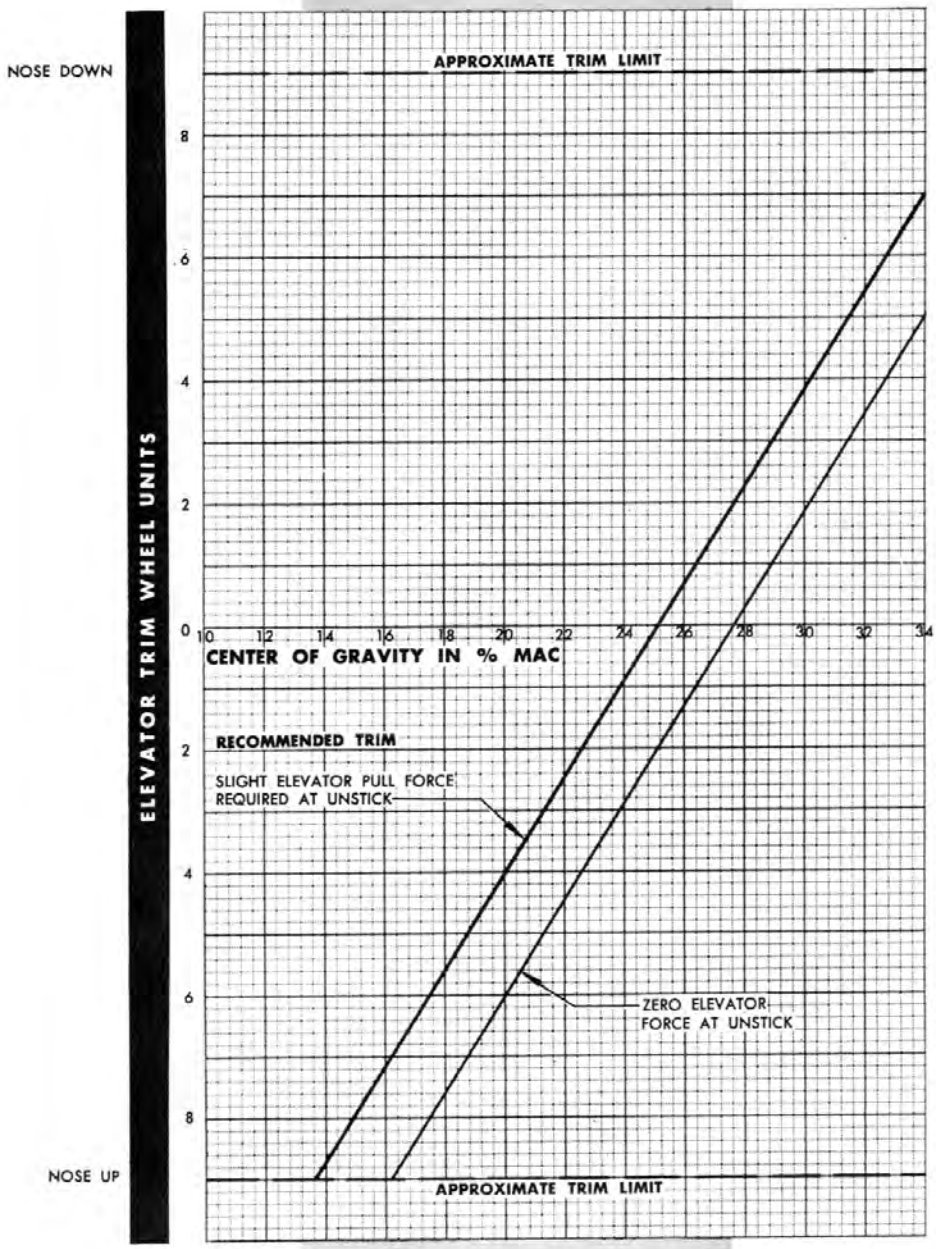
214

*Figure A2-7.*

# ELEVATOR TRIM FOR TAKEOFF

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1953

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
FLAPS FULL DOWN
GEAR DOWN

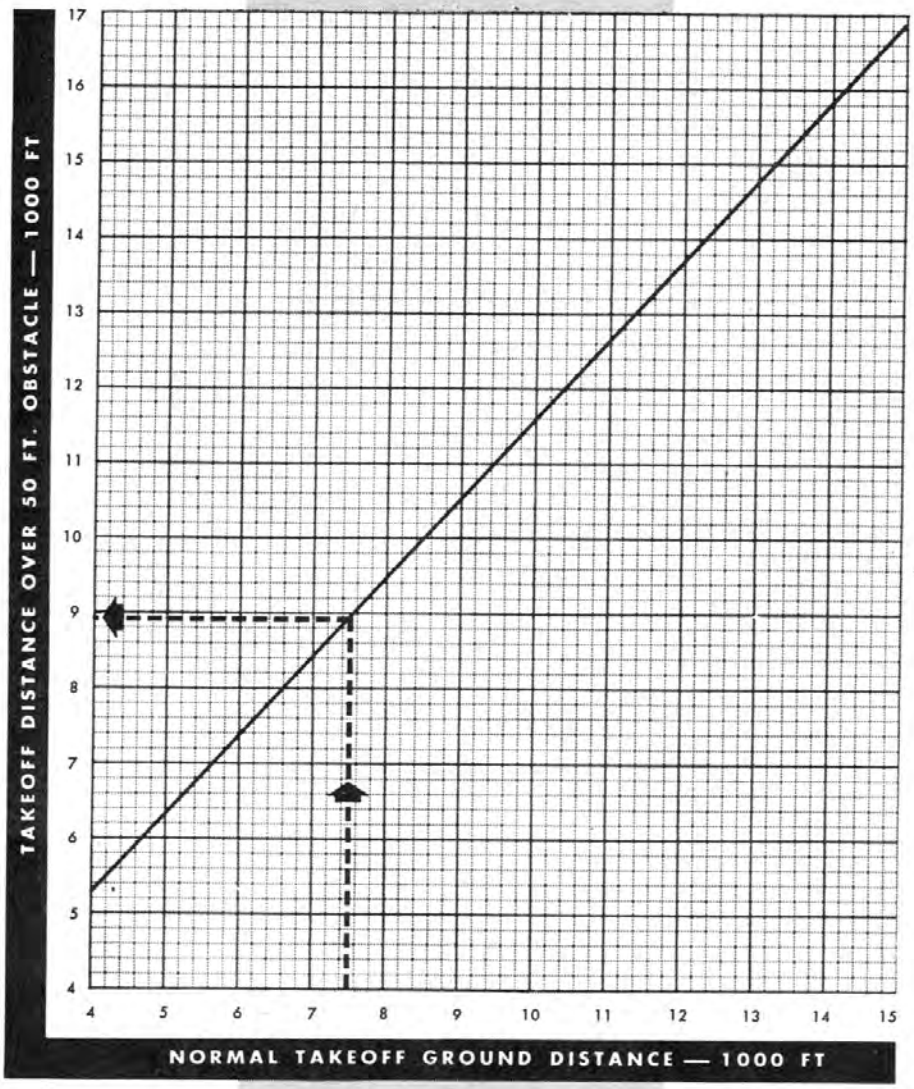
218

*Figure A2-8.*

# TAKEOFF DISTANCE OVER 50 FT OBSTACLE

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS**

SEA LEVEL TO 6000 FEET ALTITUDE

60° F TO 120° F TEMPERATURE

**DATE:** SEPTEMBER 1953

**DATA BASIS:** FLIGHT TEST

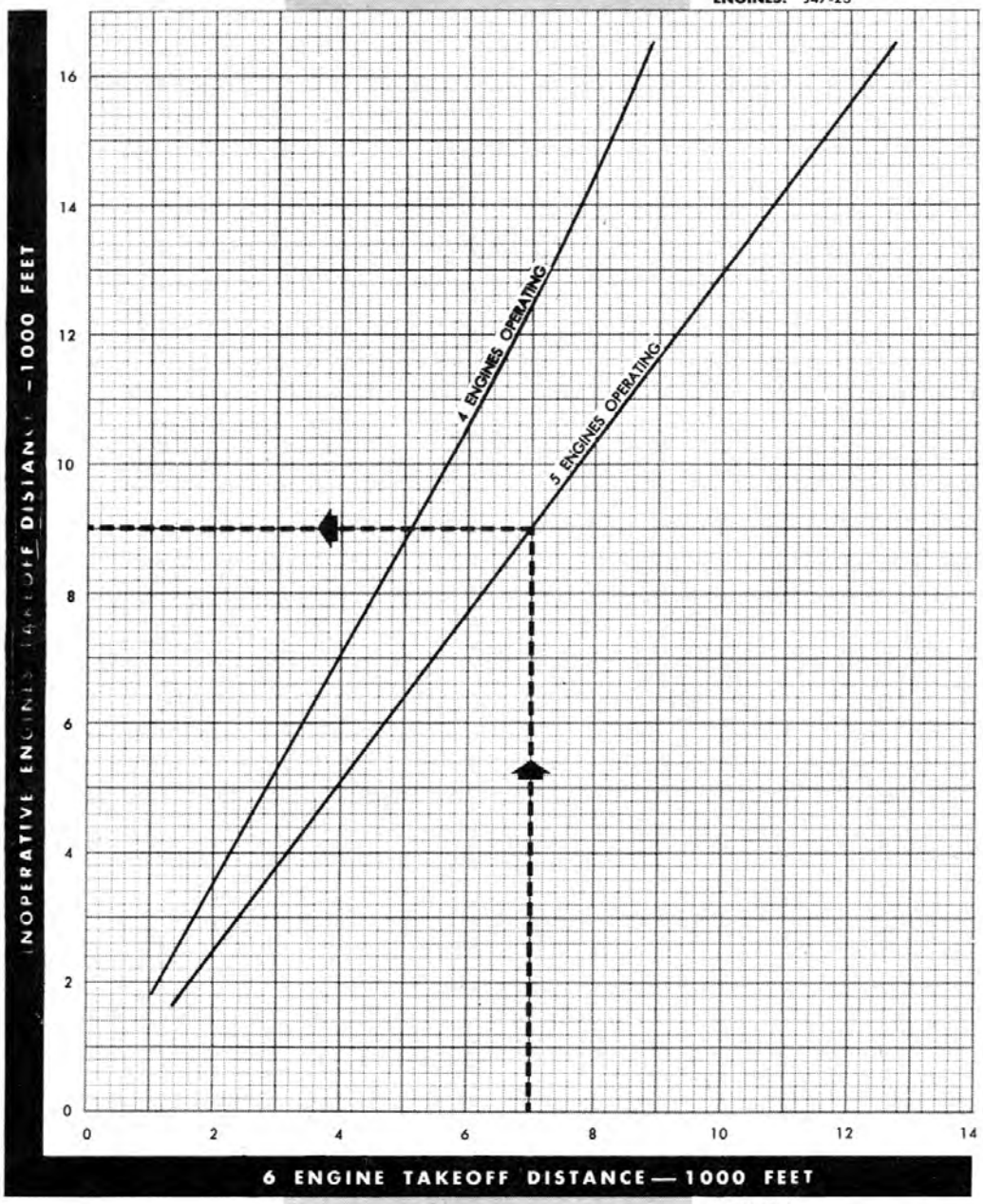
219

*Figure A2-9.*

# 4- & 5-ENGINE TAKEOFF DISTANCE

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

DATA VALID WHETHER OR NOT INOPERATIVE ENGINES ARE REMOVED FROM AIRPLANE.

**CONDITIONS:**

DATA APPLIED FOR ALL CONDITIONS OF ALTITUDE, TEMPERATURE, AND GROSS WEIGHT

220

**DATE:** JULY 1955

**DATA BASIS:** FLIGHT TEST

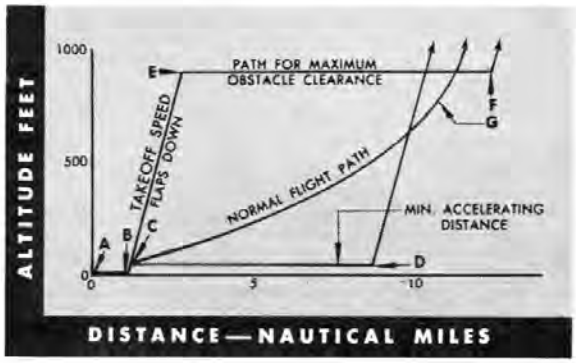
*Figure A2-10.*

Part 3

# 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.




50838

- 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 after minimum terrain clearance is reached.

## MINIMUM ACCELERATING DISTANCE

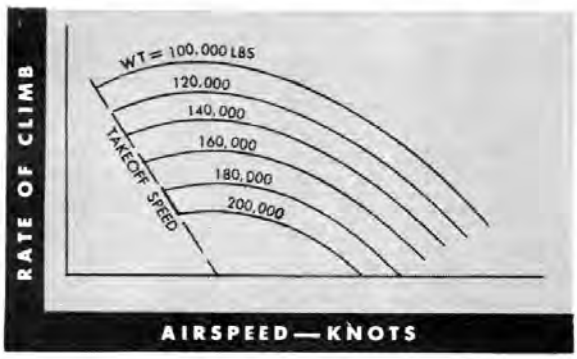
This procedure is feasible when the terrain is flat and the pilot desires to maintain a minimum altitude above the ground in order to accelerate to climb speed as quickly as possible. Under this condition, both gear and flaps should be retracted immediately after takeoff. Care must be exercised not to 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

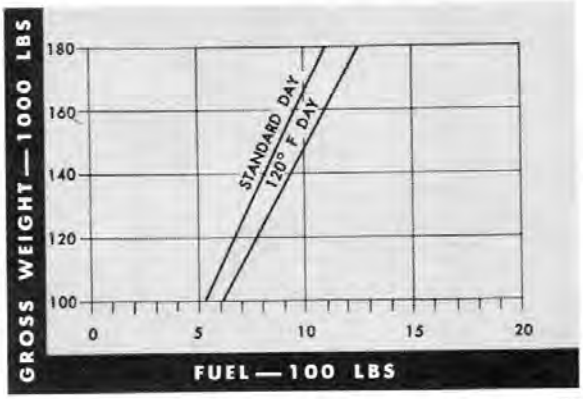
If an engine fails during the takeoff operation, climb performance at high weights is marginal for high temperatures and altitudes until the gear is raised. This is the reason for saving some ATO duration for the initial climb while the gear is starting up. The accompanying sketch shows the effect of airspeed on rate of climb available after takeoff with flaps and gear down.




50839

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

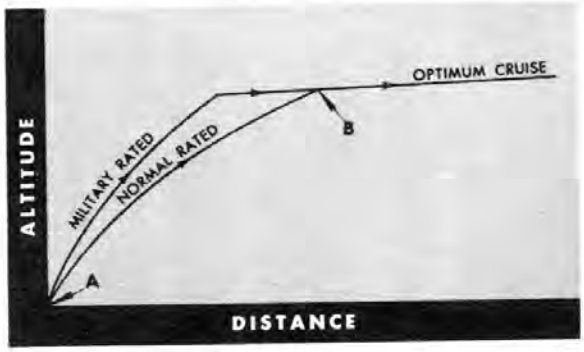
takeoff speeds with flaps down. An engine failure decreases the rate of climb by approximately 500 feet per minute under the same conditions. Climb performance at takeoff speeds with one engine out and gear and flaps down is shown on figure A3-13. As previously mentioned, fuel consumption is not a factor in choice of flight paths after takeoff. However, to allow for fuel consumption during the acceleration period after takeoff, the accompanying 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.




50840

## CLIMB PERFORMANCE

On the following pages are the charts for optimum climb performance at both military (98%) and normal (96%) rpm. Referring to the accompanying 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.




50841

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 | DECREASES 5% |
| | TIME OF CLIMB | INCREASES 6% |
| | CLIMB RANGE | INCREASES 6% |
| | CLIMB SPEED | INCREASES ½ % |
| | CLIMB FUEL | INCREASES 2% |
| EACH 10° F (5 ½ °C) COLDER THAN STANDARD TEMPERATURE | RATE OF CLIMB | INCREASES 5% |
| | TIME TO CLIMB | DECREASES 6% |
| | CLIMB RANGE | DECREASES 6% |
| | CLIMB SPEED | DECREASES ½ % |
| | CLIMB FUEL | DECREASES 2% |

50842

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 A3-11. It is useful as a reference to show the pilot the relative effect of these various factors on his climb performance. Figures A3-12 through A3-15 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 posttakeoff phase of flight.

### Rates 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 A3-16 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 A3-16. 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 A3-16 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 A3-16 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.

## USE OF CHARTS

An example condition is given to describe the use of the various climb performance charts. Assume a gross weight after takeoff of 120,000 pounds 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 A3-1. 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 39,500 feet. The corrected fuel required to climb to 39,500 feet at an average gross weight of 117,300 pounds is 5,500 pounds. The corrected average weight is then 117,250 pounds and the final corrected weight is 114,500 pounds.

### Climb Range

Similarly, using the climb range chart on figure A3-2 the range to 39,500 feet for the average gross weight of 117,250 pounds is 113 nautical miles.

### Time to Climb

From the chart on figure A3-3, the time to climb is 17 minutes.

### Climb Speed

The correct airspeeds for maximum rate of climb are found on figure A3-4. The indicated airspeed should decrease from 351 knots at sea level to 214 knots at 39,500 feet. Exact speeds are not critical and an airspeed error of ±10 knots will not reduce the rate of climb appreciably.

### Rate of Climb

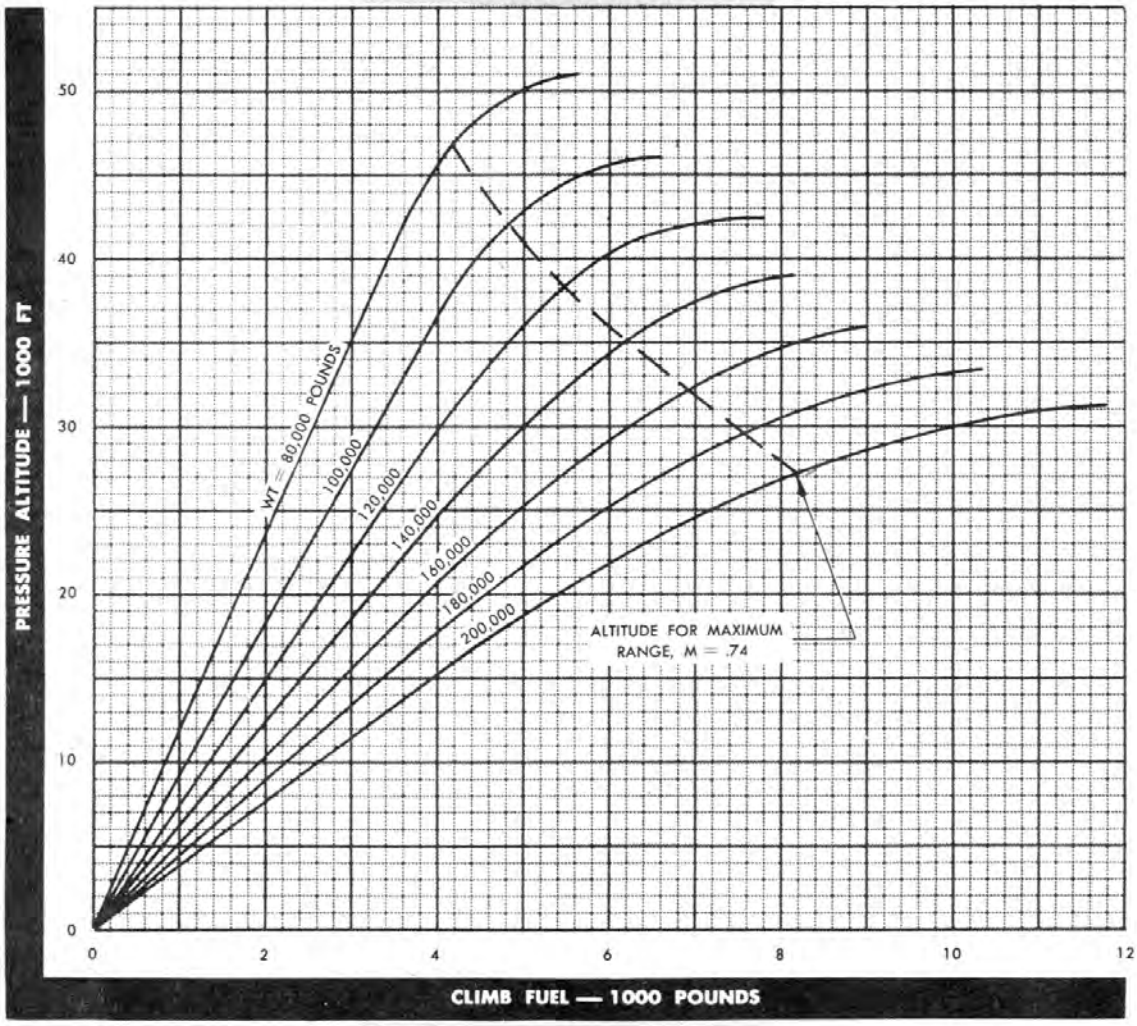
On figure A3-5 is shown the variation with altitude of the maximum rate of climb at normal rated power. At sea level, the initial rate of climb at 120,000 pounds is 4200 feet per minute. At 39,500 feet and 114,500 pounds, the final rate of climb is about 850 feet per minute.

# CLIMB FUEL WEIGHT

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

301

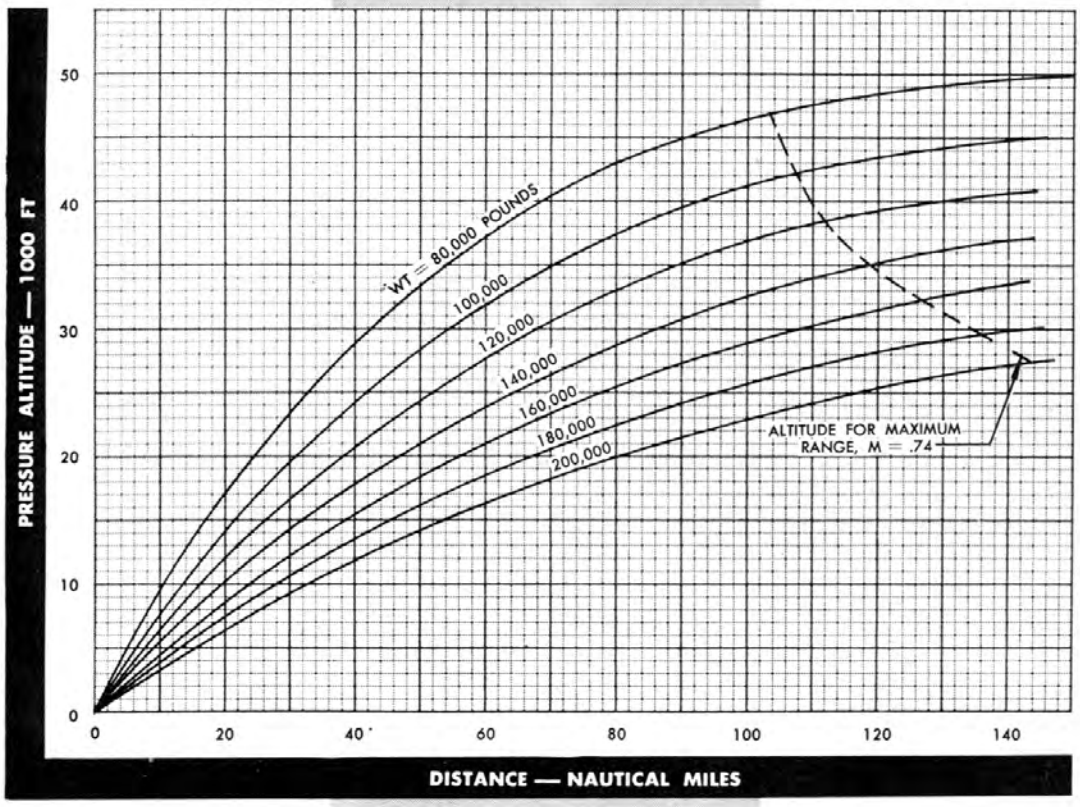
*Figure A3-1.*

# CLIMB RANGE

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1951

**DATA BASIS:** FLIGHT TEST

302

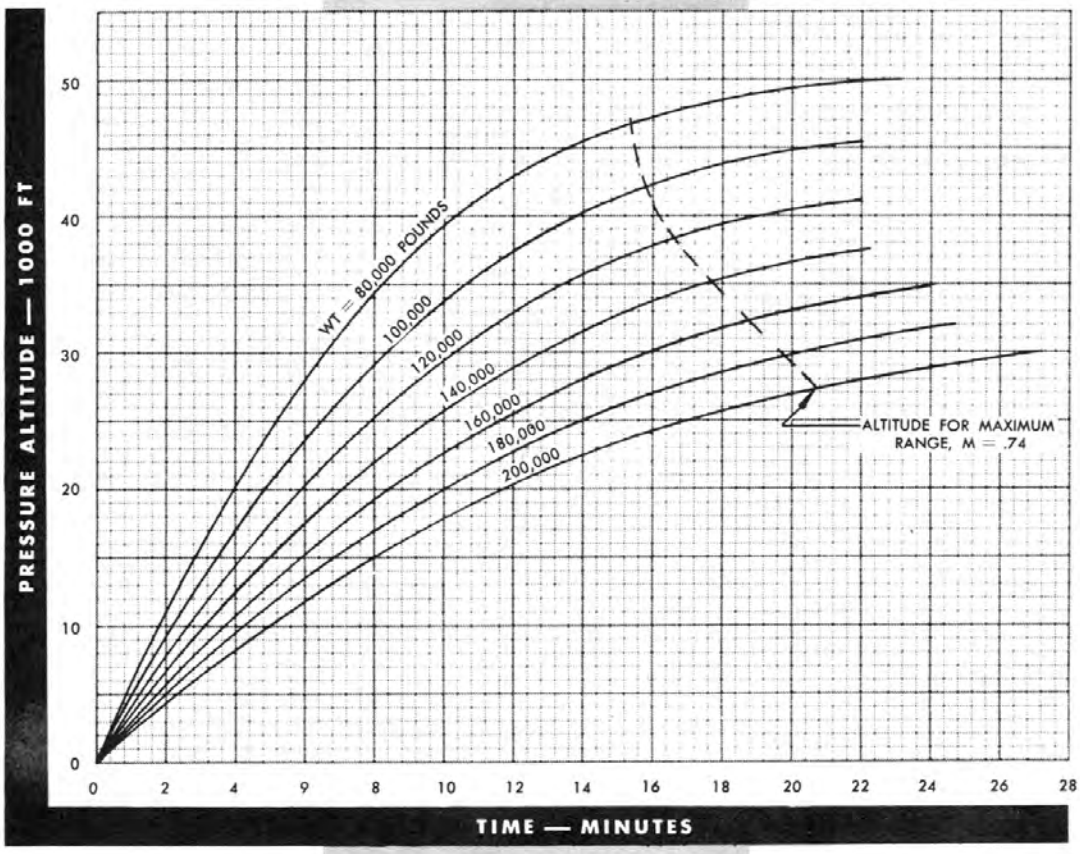
*Figure A3-2.*

# TIME TO CLIMB

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

303

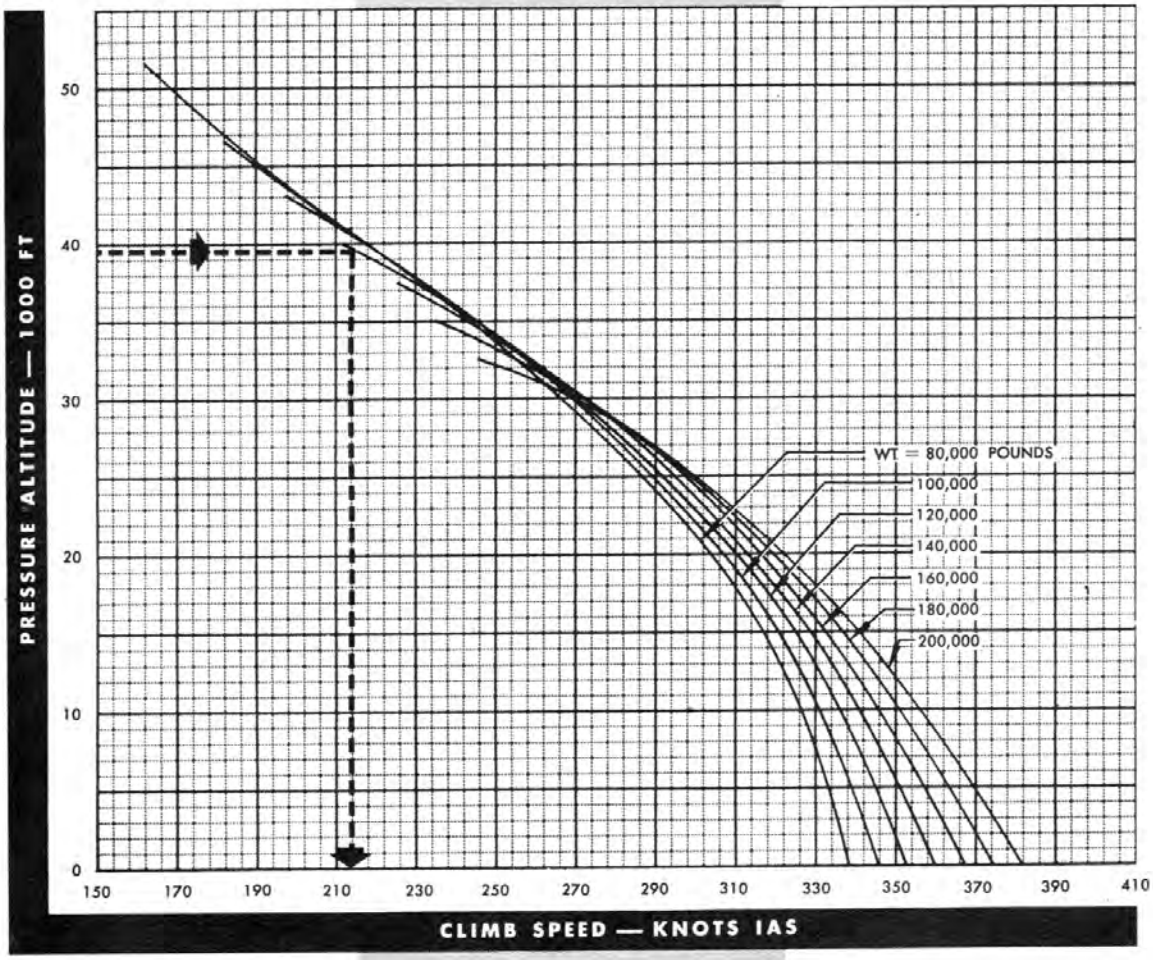
*Figure A3-3.*

# CLIMB SPEED

## MAXIMUM RATE OF CLIMB AT NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

304

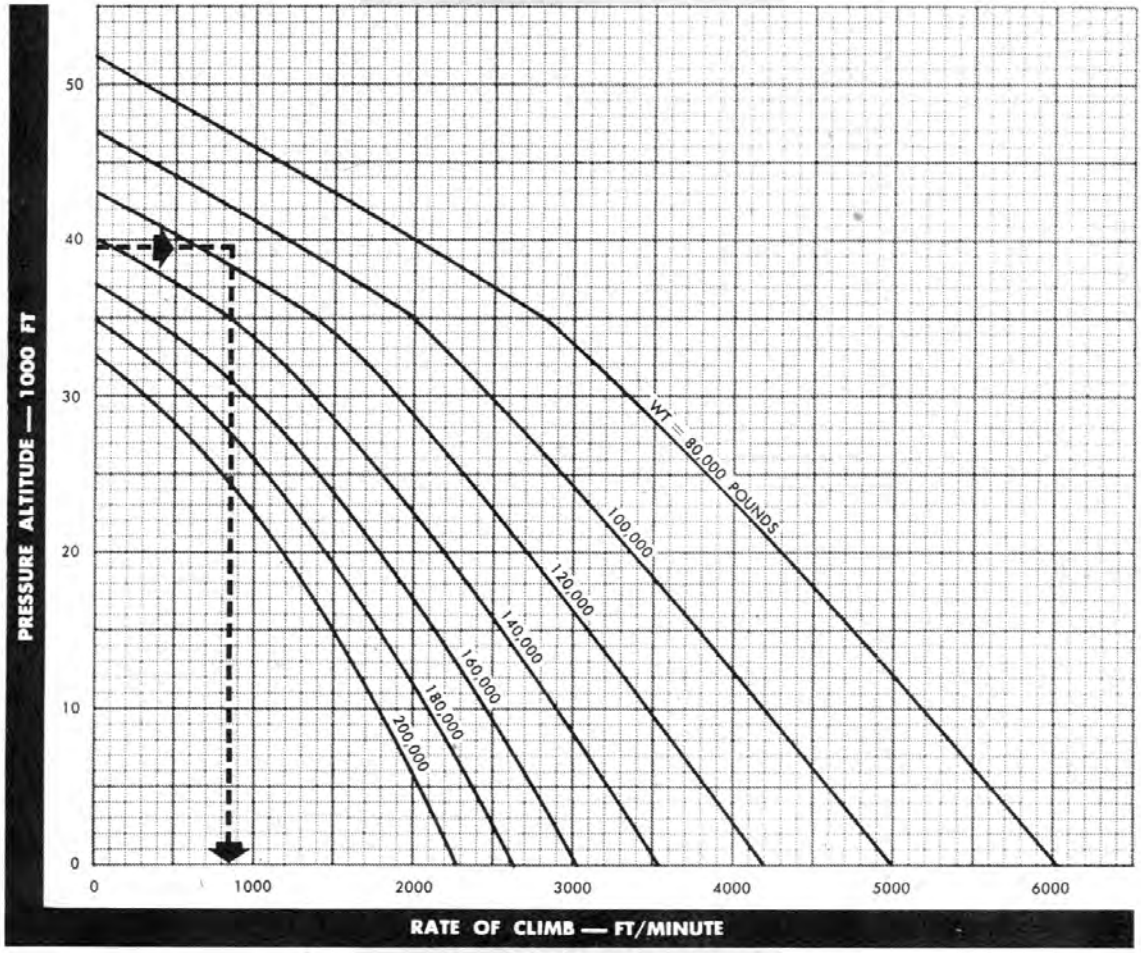
*Figure A3-4.*

# MAXIMUM RATE OF CLIMB

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

305

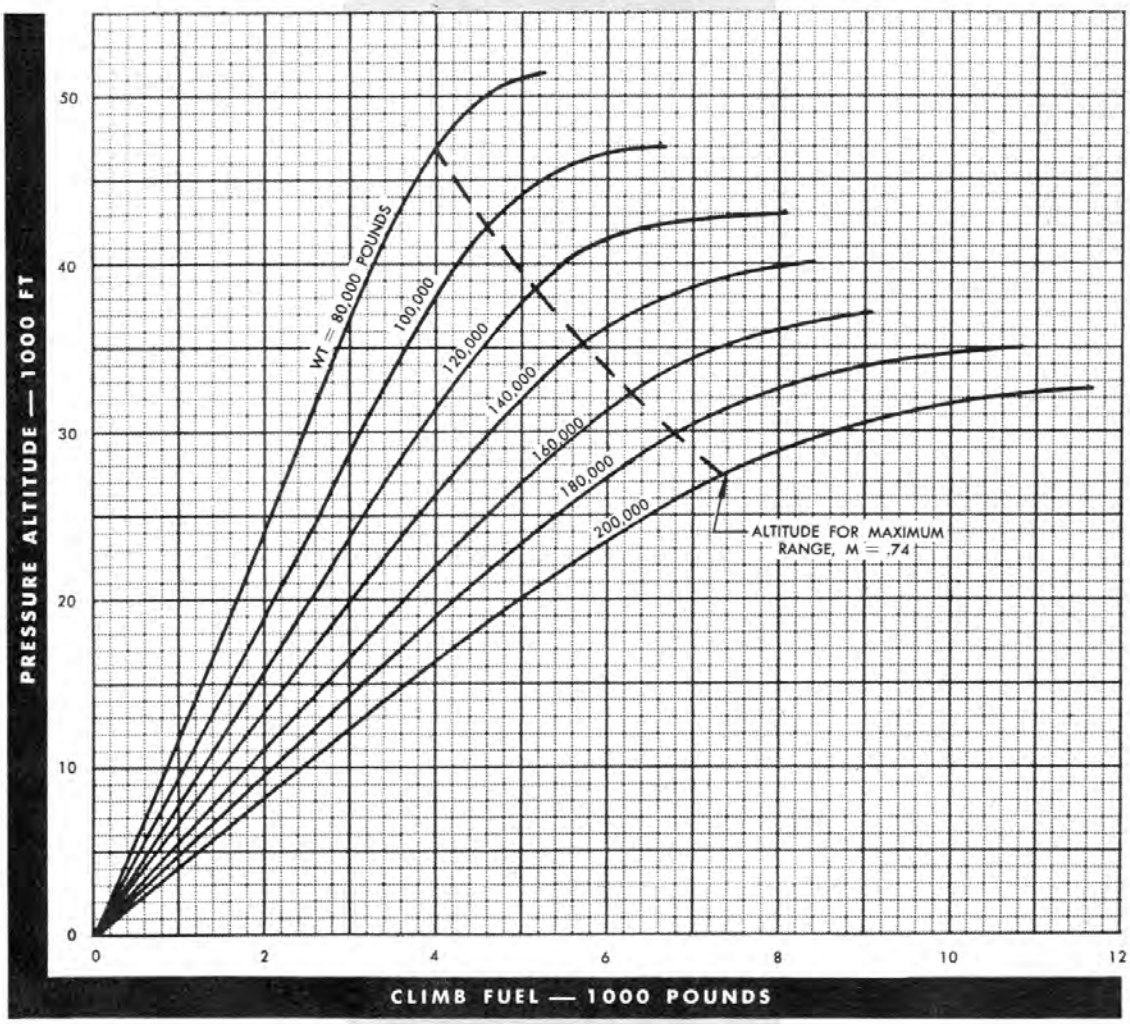
*Figure A3-5.*

# CLIMB FUEL WEIGHT

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

306

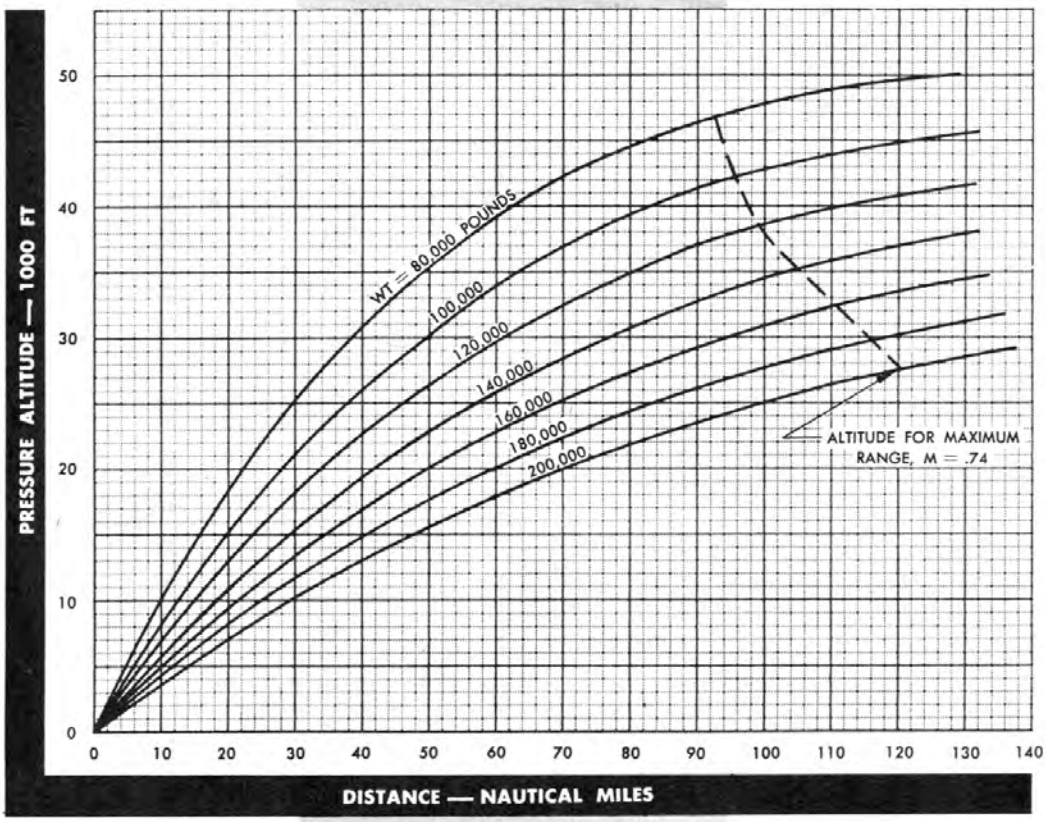
*Figure A3-6.*

# CLIMB RANGE

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

307

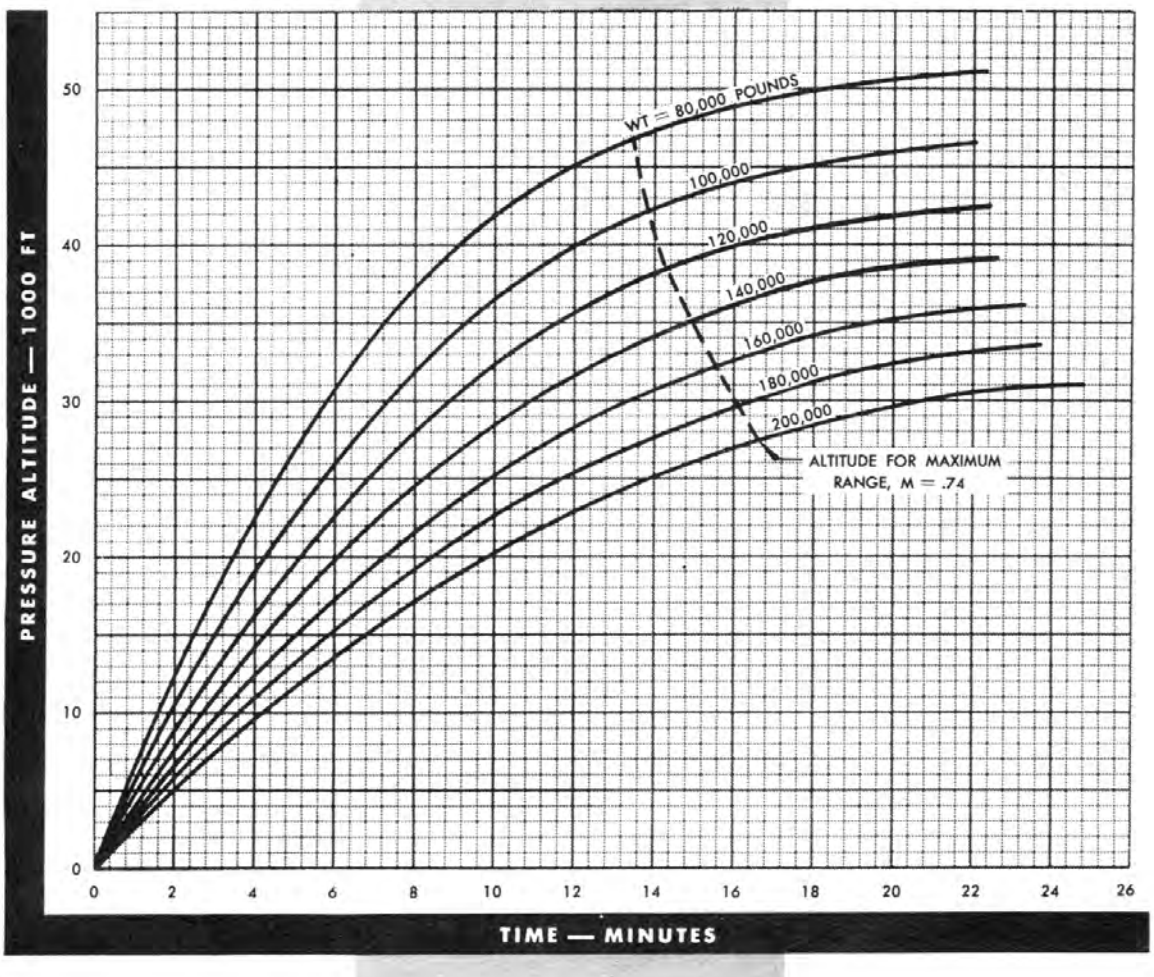
*Figure A3-7.*

# TIME TO CLIMB

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

308

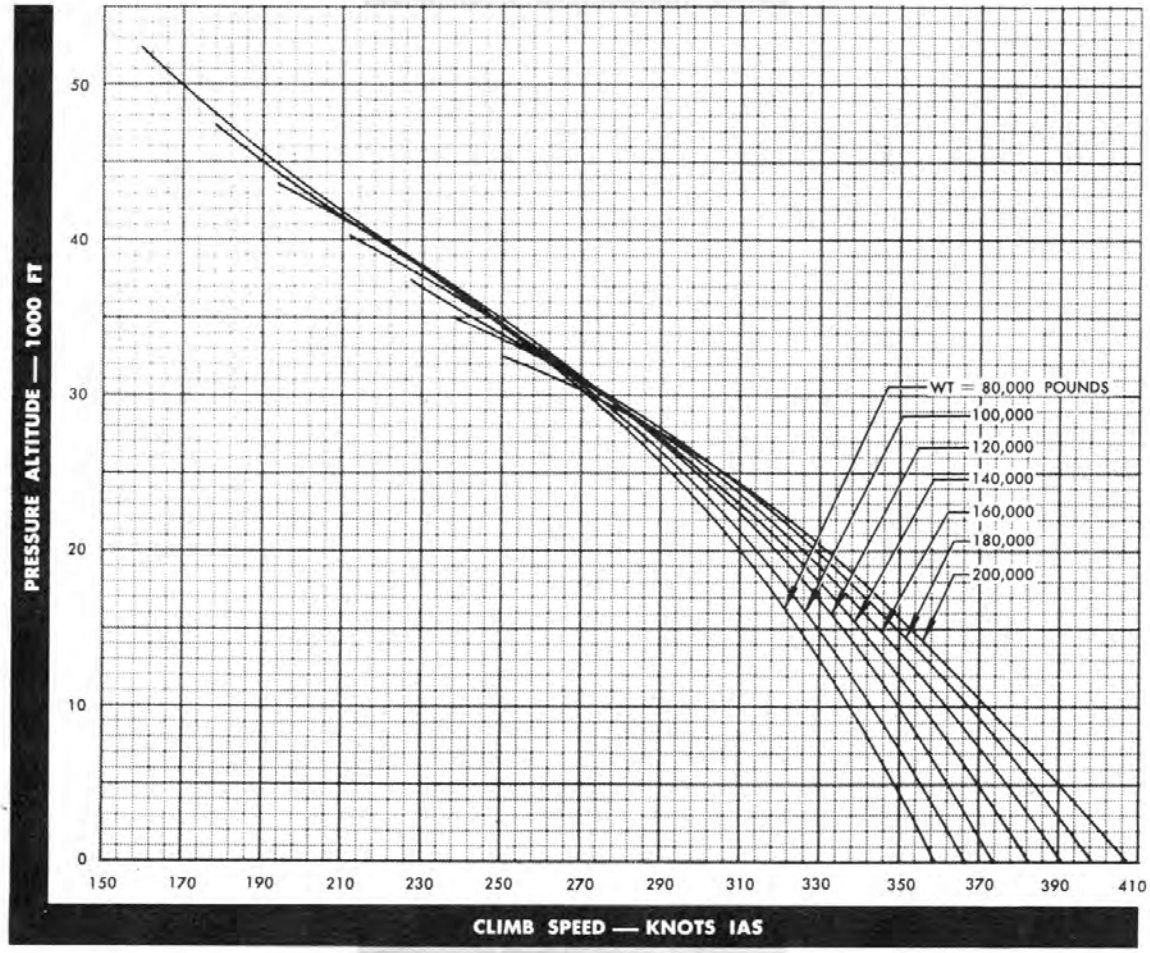
*Figure A3-8*

# CLIMB SPEED

## MAXIMUM RATE OF CLIMB AT MILITARY (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

309

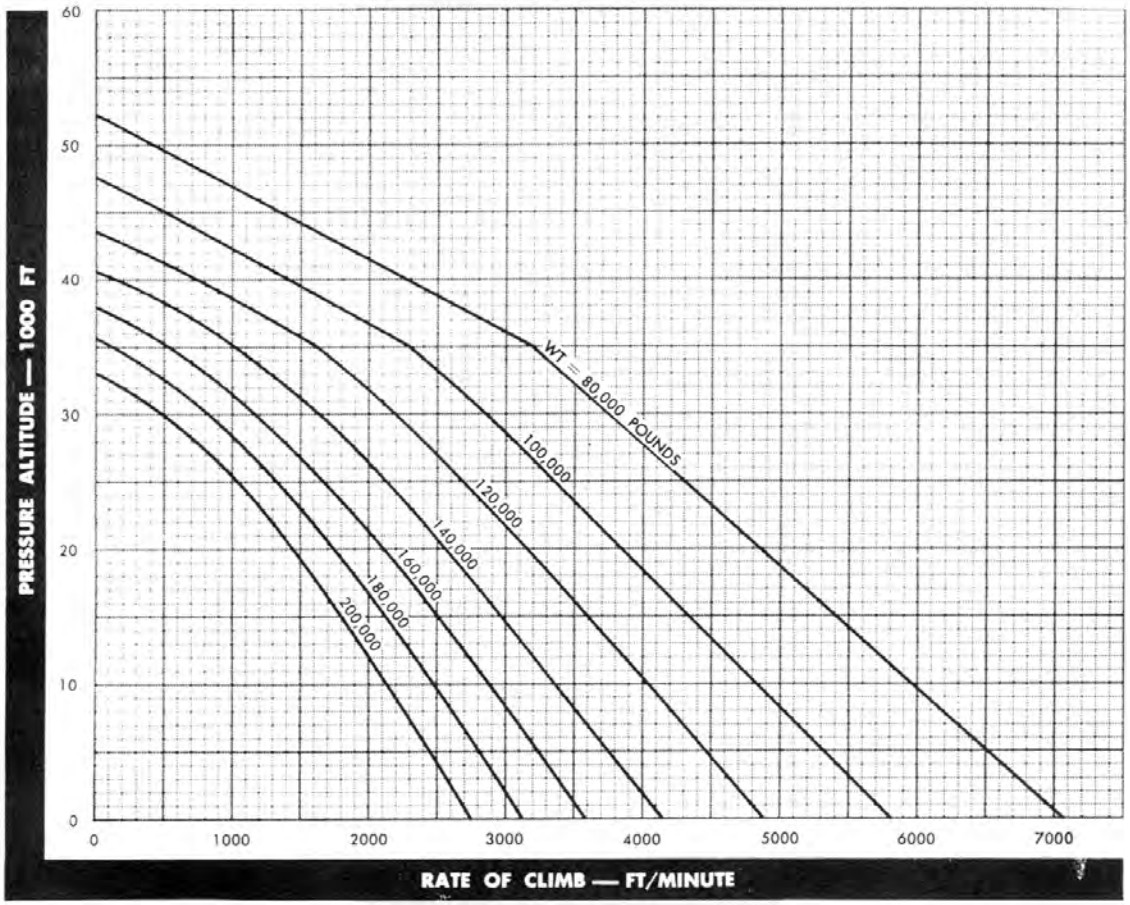
*Figure A3-9.*

# MAXIMUM RATE OF CLIMB

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

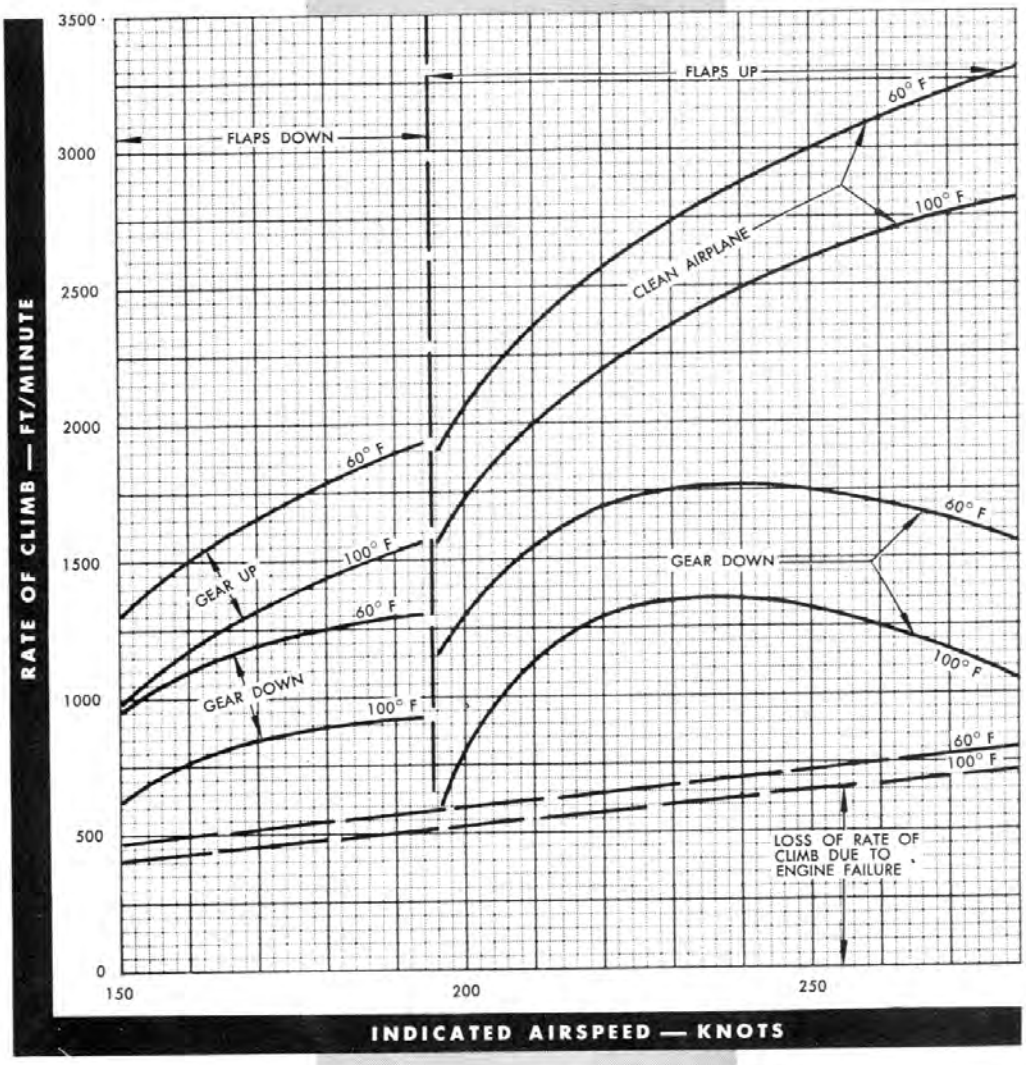
310

*Figure A3-10.*

# CLIMB PERFORMANCE AFTER TAKEOFF

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1956

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

SEA LEVEL
GROSS WEIGHT — 180,000 POUNDS
TAKEOFF (100%) RPM

B 321

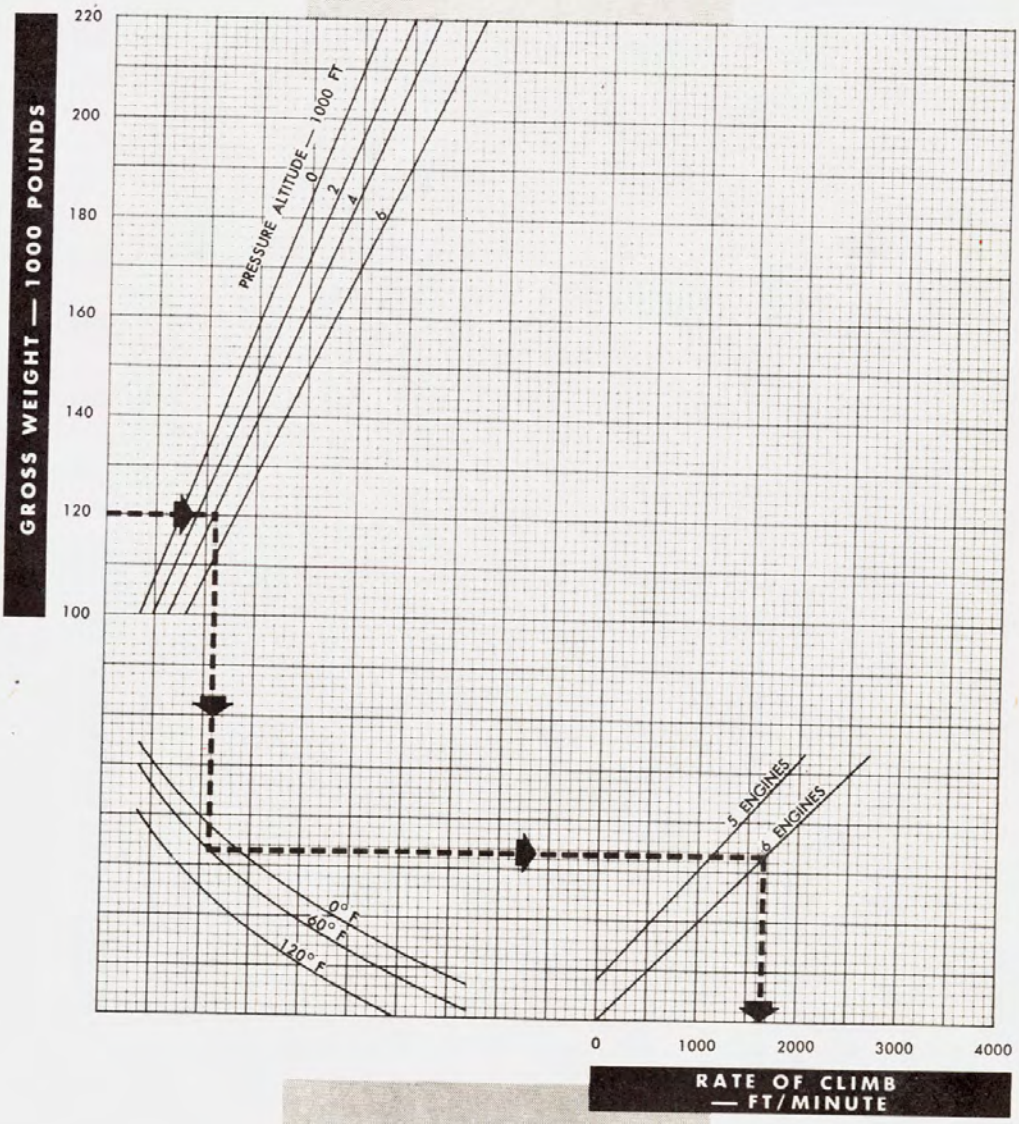
*Figure A3-21.*

# RATE OF CLIMB

## TAKEOFF SPEED — FLAPS & GEAR DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

GROUND EFFECT NOT INCLUDED

**DATE:** JULY 1959

**DATA BASIS:** CALCULATED

322

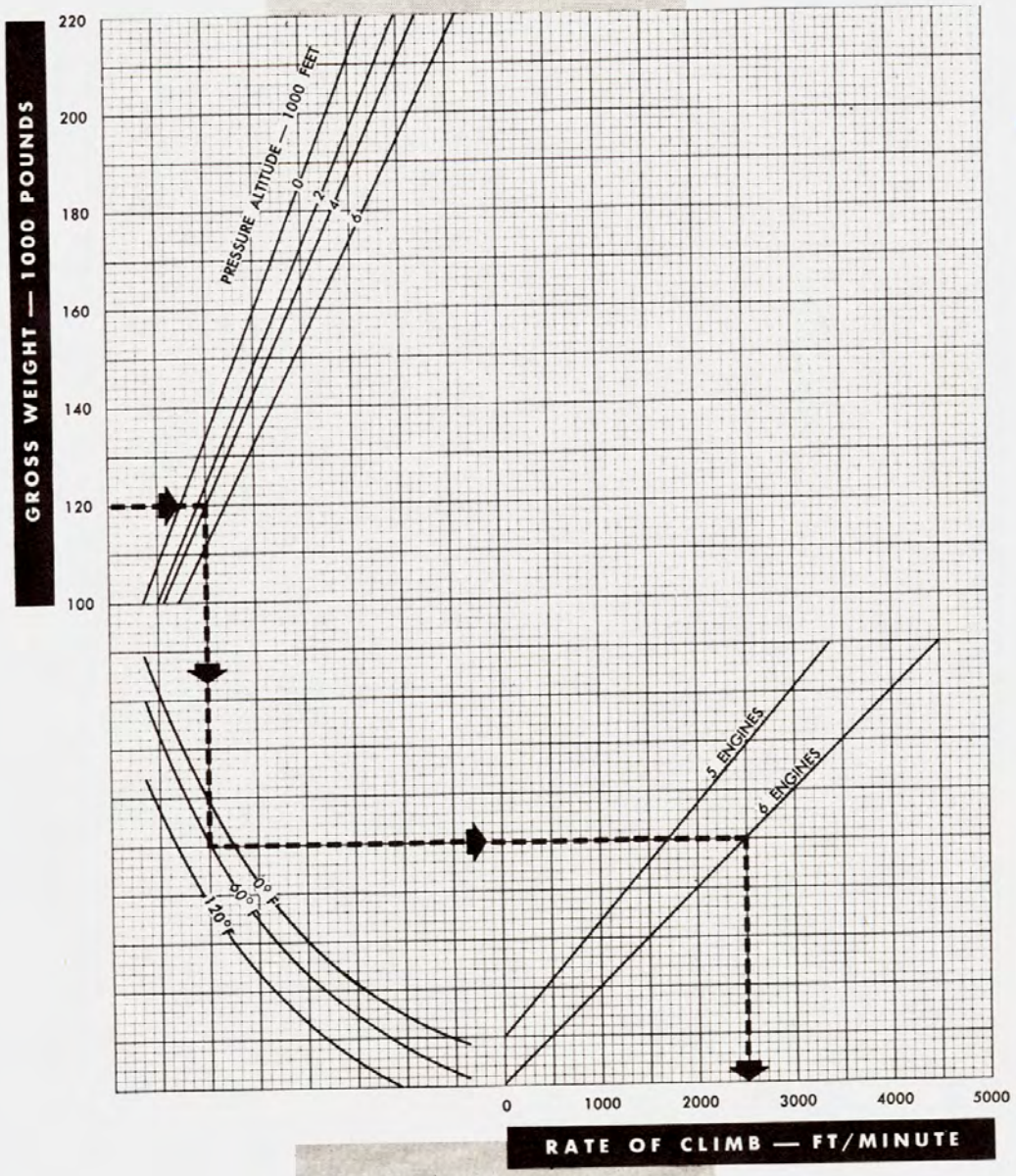
*Figure A3-12.*

# RATE OF CLIMB

## FLAP STRUCTURAL LIMIT SPEED — FLAPS & GEAR DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**
GROUND EFFECT NOT INCLUDED

**DATE:** JULY 1955

**DATA BASIS:** CALCULATED

323

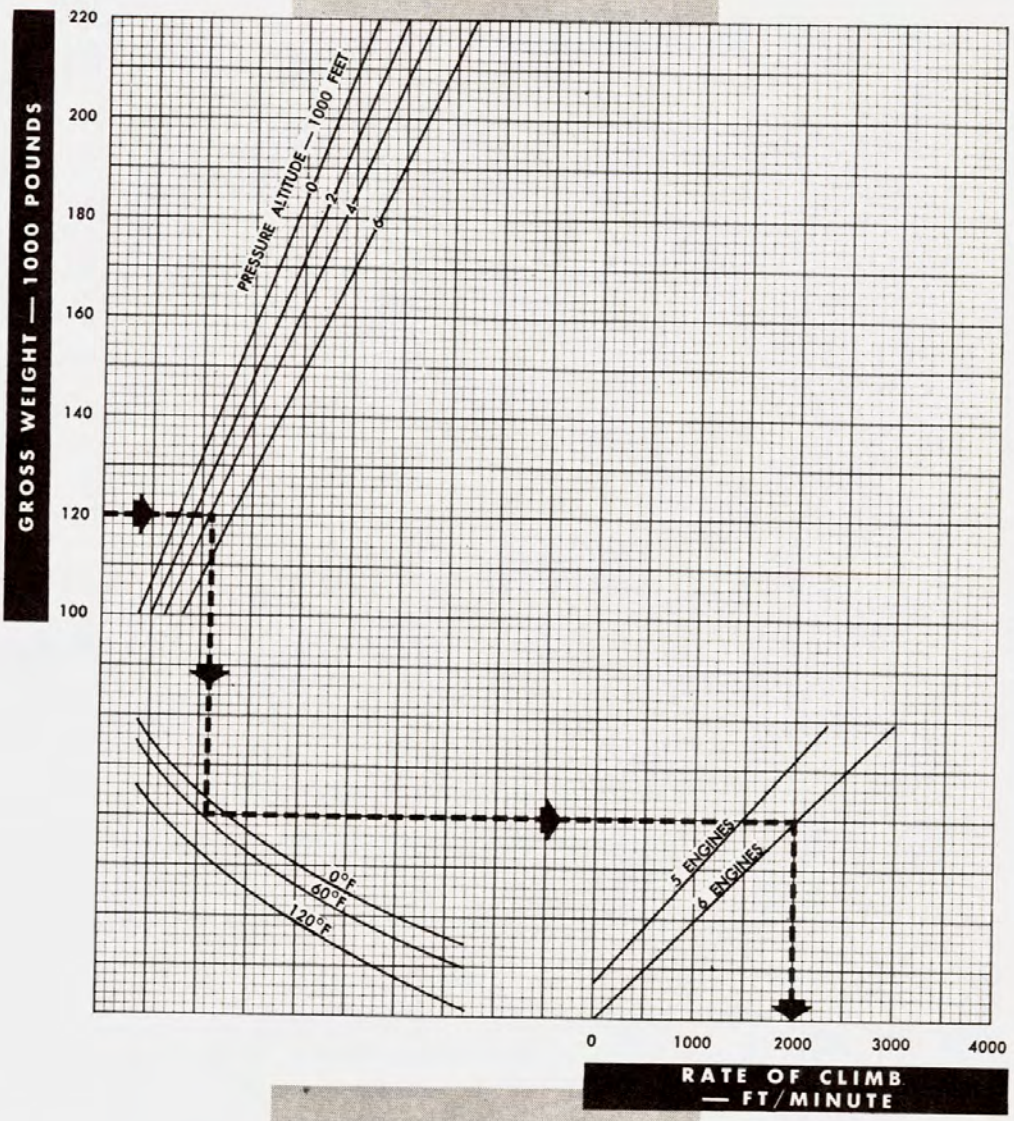
*Figure A3-13.*

# RATE OF CLIMB

## TAKEOFF SPEED — FLAPS DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

GROUND EFFECT NOT INCLUDED

**DATE:** JULY 1955

**DATA BASIS:** CALCULATED

*Figure A3-14.*

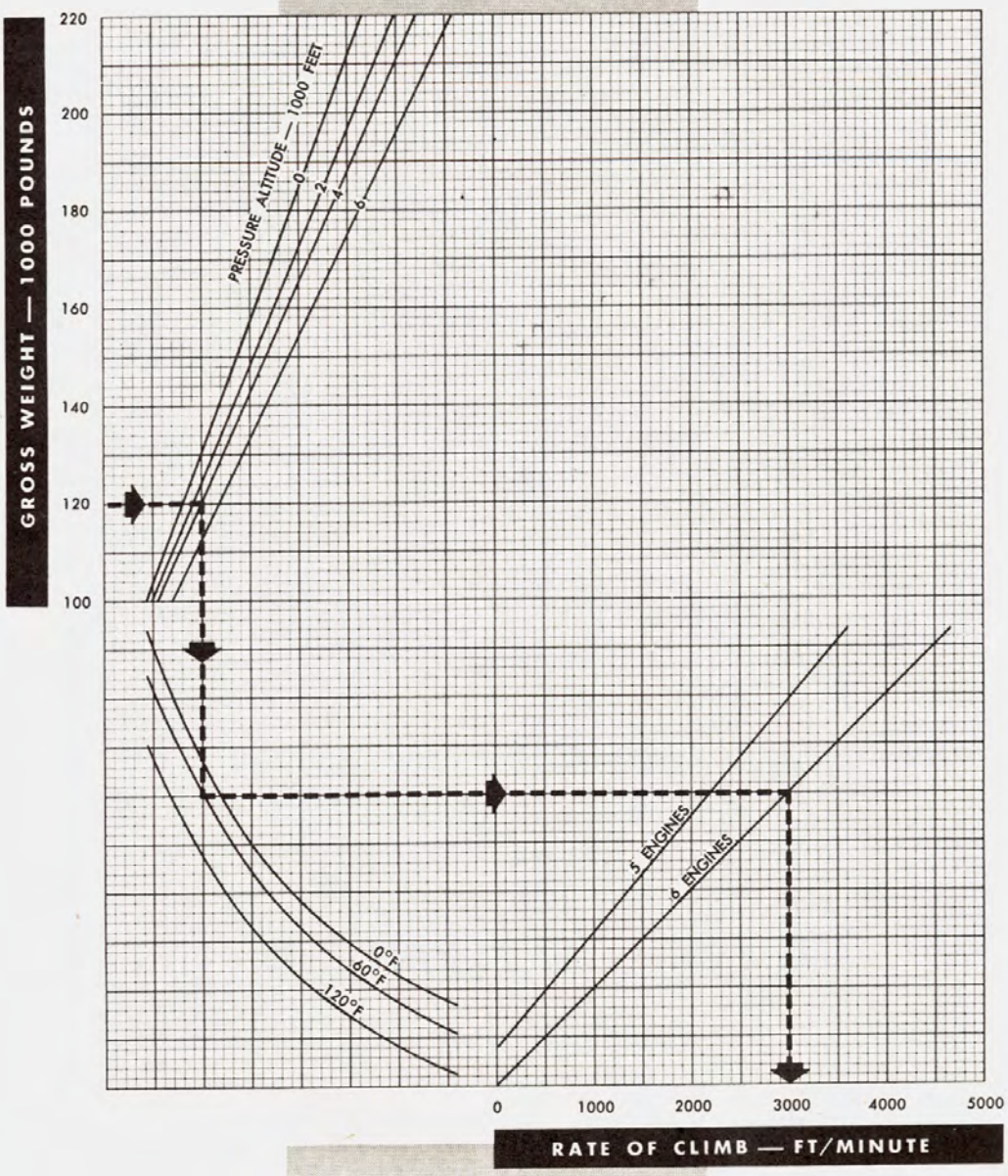
324

# RATE OF CLIMB

## FLAP STRUCTURAL LIMIT SPEED — FLAPS DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**
GROUND EFFECT NOT INCLUDED

**DATE:** JULY 1955

**DATA BASIS:** CALCULATED

325

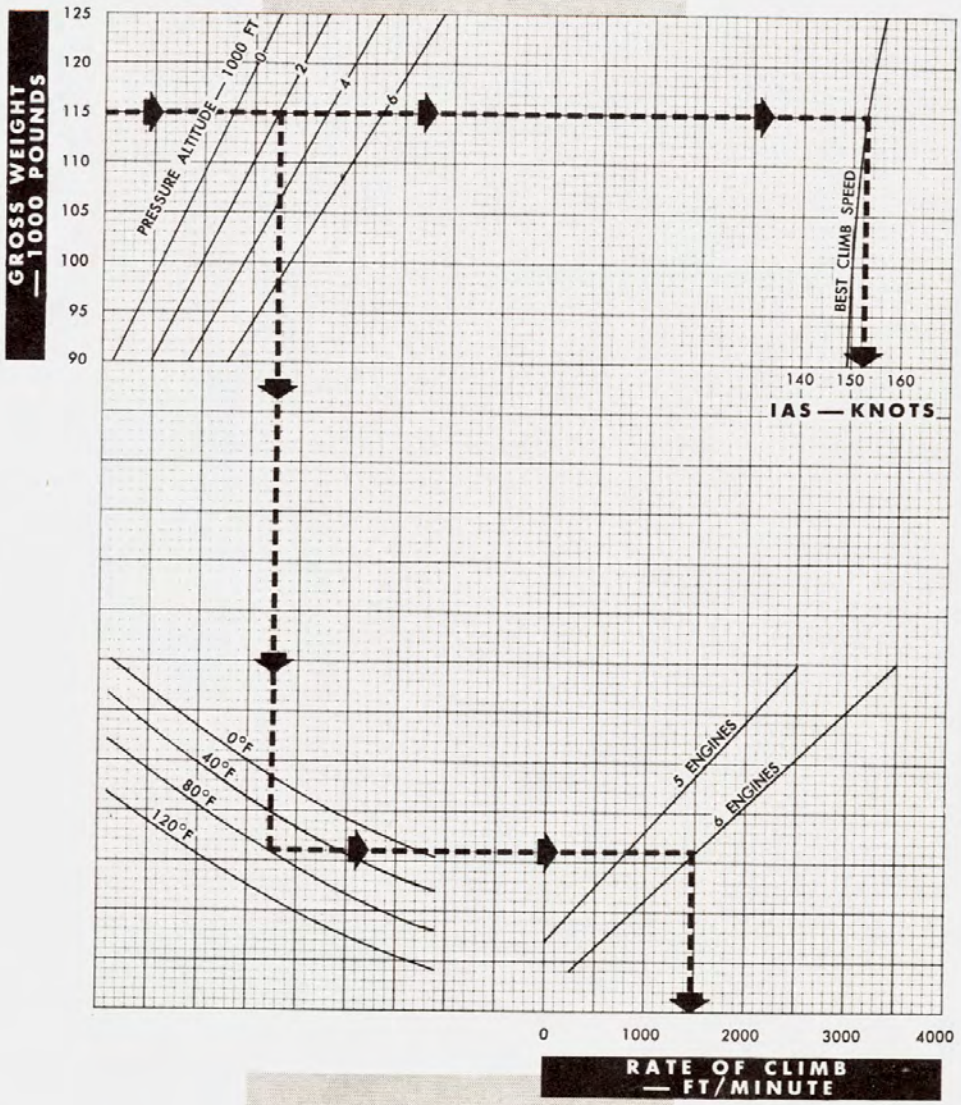
*Figure A3-15.*

# RATE OF CLIMB

## APPROACH CHUTE DEPLOYED — FLAPS & GEAR DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**
100% RPM

**DATE:** DECEMBER 1954

**DATA BASIS:** FLIGHT TEST

*Figure A3-16.*

326

Part 4

# 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 9. Part 11 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. 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.
2. ENGINE INLET SCREENS. The range charts are based on the thrust and fuel consumption with the engine air inlet screens retracted.
3. 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.

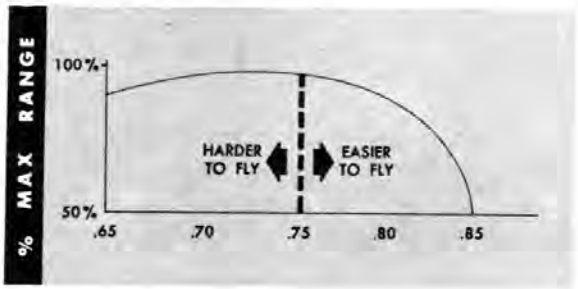
The range data are presented in two ways:

1. Integral charts or range versus gross weight for the following types of cruise.
   - Maximum range using a high altitude climbing flight path
   - Maximum altitude at high rpm
   - 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 1000 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.




50856

Figure A4-2 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 A4-1. Figure A4-1 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, readjusting 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 relied upon more than the Machmeter. In part 11 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 path. 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 | ½% |
| -4000 | 1% |
| -6000 | 3% |
| -8000 | 7% |

50857

## RANGE AT MAXIMUM ALLOWABLE RPM

These charts on figures A4-5 and A4-6 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 A4-3 and A4-4 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 A4-7 through A4-22 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:

- The Mach number is outside the range of .71 to .75.
- 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 A4-23. 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

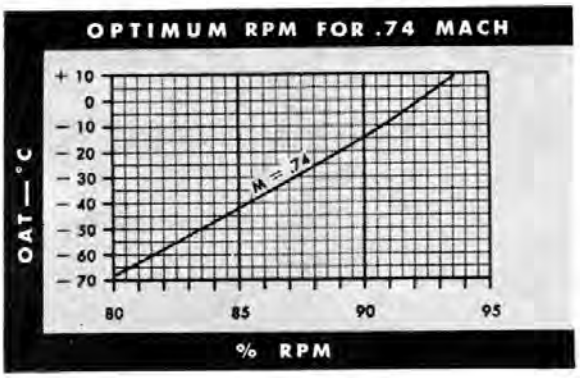
With JP-1, Specification MIL-F-5616, or JP-4, Specification MIL-F-5624A, boil-off at high altitude is negligible and range can be predicted with accuracy. When Grade 100/130 gasoline, Specification MIL-F-5572, or JP-3, Specification MIL-F-5624, is used, considerable range may be lost through boiling 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 considerably increase the loss. 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% |

50858

## 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.




50859

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 A4-1 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 9.

## MAXIMUM RANGE OBTAINABLE

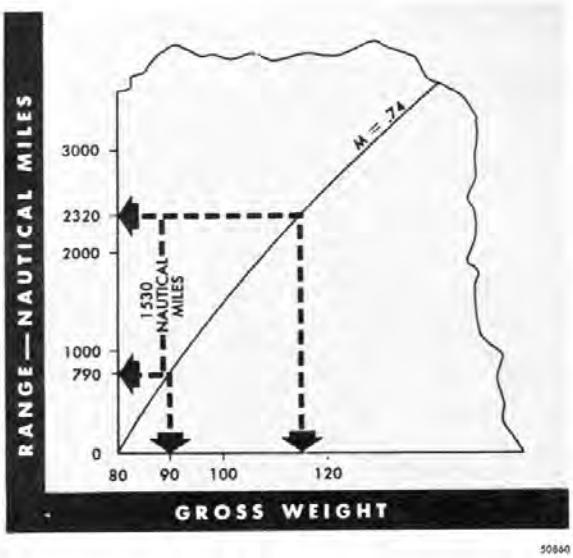
**Example 1:**

Given:
- Fuel in tanks = 25,000 pounds
- No droppable cargo
- Weight at end of cruise = 90,000 pounds.

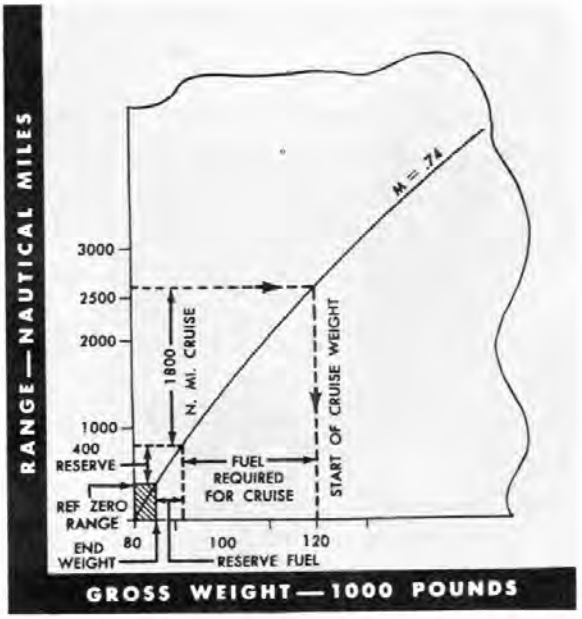
Determine:
- Maximum cruise range obtainable
- Altitudes for maximum range.

Use the Mach .74 curve on figure A4-1 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. The optimum altitude would be 39,600 feet with 25,000 pounds of fuel on board, and the climbing flight path would give an altitude of 44,500 feet at the end of the cruise at 90,000 pounds gross weight.




a gross weight at start of cruise of 120,000 pounds gross weight (see sketch). The total fuel required is 120,000 - 85,000 = 35,000 pounds and the fuel required for cruise is 35,000 - 5,500 = 29,500 pounds. From the altitude chart at the top of figure A4-1, the altitude at the start of cruise for 120,000 pounds gross weight would be 39,600 feet and similarly for the end of cruise would be 44,000 feet.




## MINIMUM FUEL REQUIRED FOR CRUISE

**Example 2:**

Given:
- Desired cruise range = 1800 nautical miles
- Desired reserve range = 400 nautical miles
- No droppable cargo
- Gross weight - no reserve fuel = 85,000 pounds.

Determine:
- Minimum amount of fuel required for cruise and reserve
- Altitudes for maximum range.

Use the Mach .74 curve on figure A4-1. Using the end weight of 85,000 pounds gives a reference range figure of 400 nautical miles (the range obtainable between 85,000 and 80,000 pounds gross weight). A 400 nautical mile reserve range gives a gross weight at the end of cruise with reserve fuel of 90,500 pounds. The reserve fuel weight is therefore 90,500 - 85,000 or 5,500 pounds. An 1800 nautical mile cruise distance shows

## CONSTANT ALTITUDE CRUISE

**Example 3:**

Given:
- Entire low level mission at 10,000 feet
- No droppable cargo
- Desired cruise range = 1200 nautical miles
- Gross weight at end of mission = 85,000 pounds.

Determine:
- Minimum amount of fuel required for cruise
- Mach numbers and speed for cruise
- Gross weight at start of cruise.

Use the optimum curve on figure A4-11 for best range at a constant 10,000-foot altitude. Use 85,000 pounds at gross weight with no fuel. In a manner similar to that described above for example 2, the reference zero for 85,000 pounds basic weight is 150 nautical miles. A desired cruise range of 1200 miles gives a reference range for start of cruise of 1200 + 150 = 1350 nautical miles. The gross weight from the chart for 1350 miles is 129,400 pounds, the initial gross weight. The Mach

number at the start of cruise, if found on 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:
- Airplane gross weight without fuel = 82,000 pounds
- Fuel in tanks = 6000 pounds
- Flight at altitude for maximum range.

Determine:
- Maximum reserve range remaining
- 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 A4-2 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 A4-1, 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 tactical run is completed. After the climb the conditions are as follows:

Given:
- Gross weight = 130,000 pounds
- Altitude = 42,000 feet
- Mach = .76

Determine:
- Gross weight and altitudes at the target.

Using the chart on figure A4-6 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 1000 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 1000 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 A4-5, 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 A4-25. 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 considerable 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

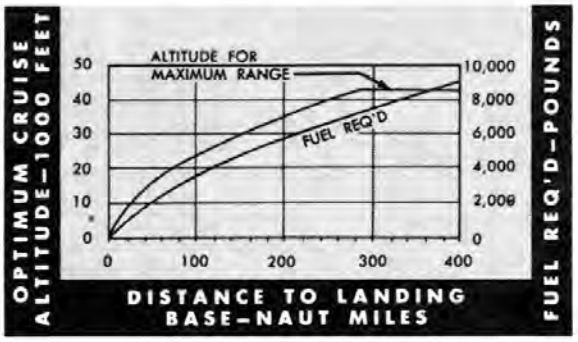
For emergency conditions of flight when the bomb bay doors are open, flaps down and/or gear down, and it is impossible to close the doors or retract the flaps and gear, the range performance is shown on figure A4-24. Corresponding cruise speeds and altitudes are also shown on this chart. As only optimum 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 A4-24, 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 Mach .71 starting at 37,000 feet and increasing altitude as gross weight decreases as shown on figure A4-24.

## 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.




50926

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.

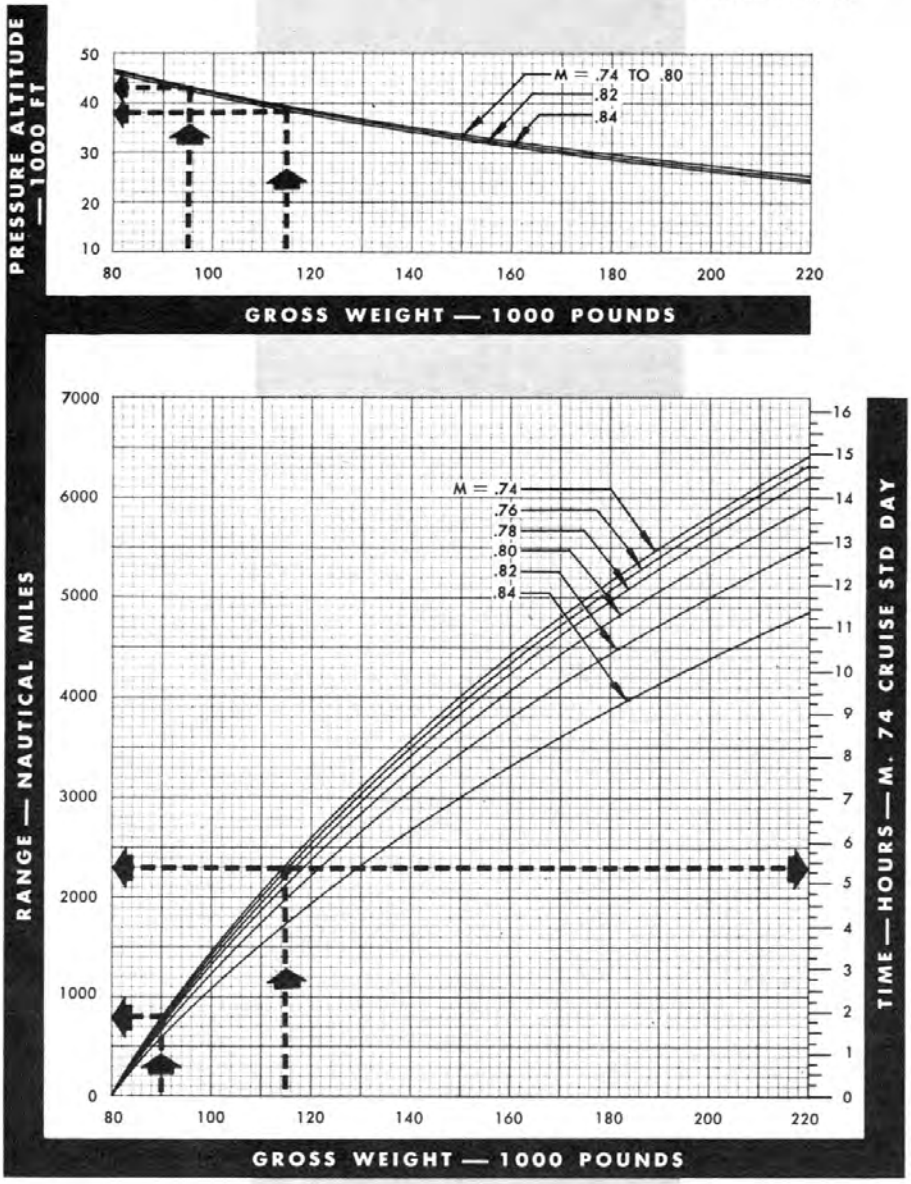
## CG LOCATION DURING CRUISE

Center of gravity position other than in the optimum cg range (25% to 29% MAC) will cause a slight reduction in range. Normally, the cg location during cruise will be determined by use of the balance computer (load adjuster). However, if fuel gages become inoperative or unreliable, they cannot be used to obtain quantity readings necessary for use of the balance computer. In this case, by using figure A4-26 and referring to the elevator trim setting, an approximation of the center of gravity while cruising at Mach .74 can be determined. In this manner, it is possible by fuel system management to maintain a proper cg location. This chart should not be used unless absolutely necessary and then only for an approximation. Incorrect rigging of the elevator trim system and/or tolerances in the airplane structure can cause incorrect center of gravity indications.

# ALTITUDE & MAXIMUM RANGE AT CONSTANT MACH NUMBER

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** NOVEMBER 1952

**DATA BASIS:** FLIGHT TEST

401

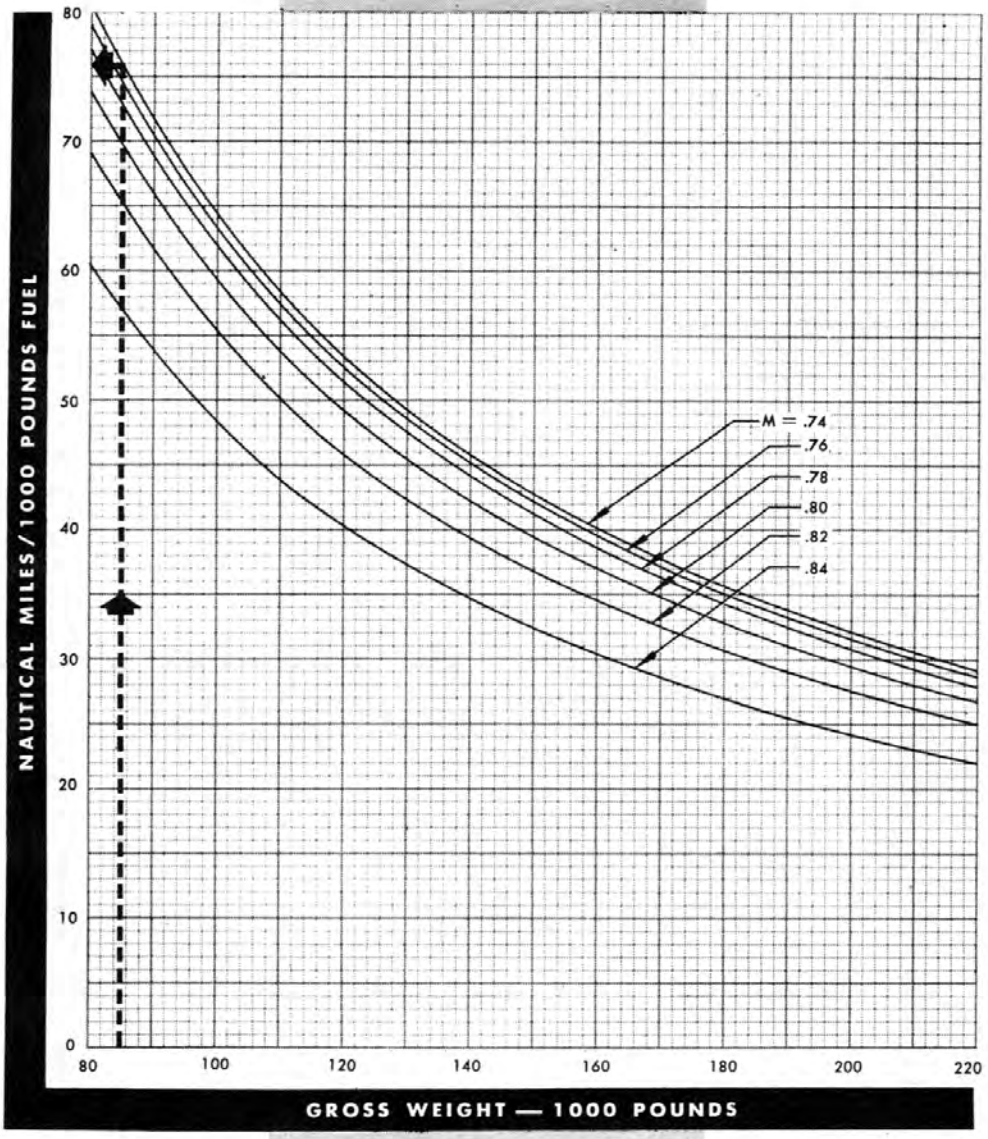
*Figure A4-1.*

# MAXIMUM RANGE OPERATION

## NAUTICAL MILES/1000 POUNDS OF FUEL

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

402.

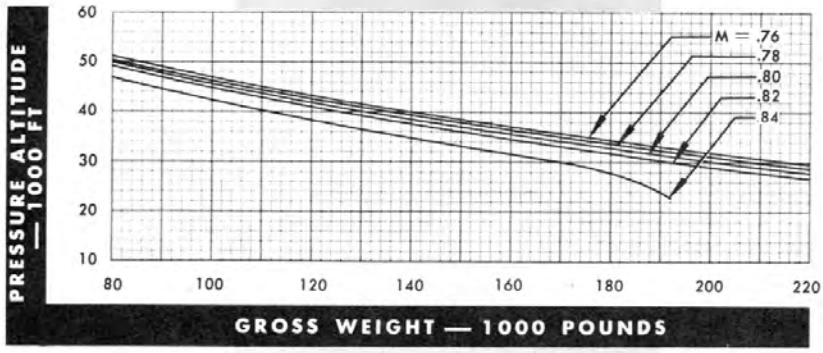
*Figure A4-2.*

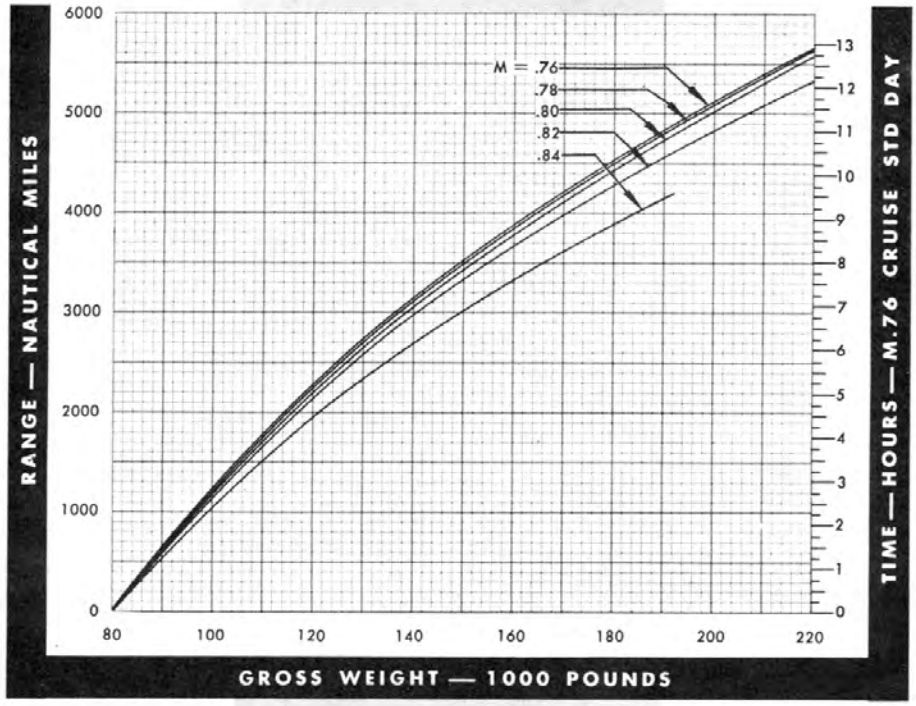
# ALTITUDE & RANGE

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

403

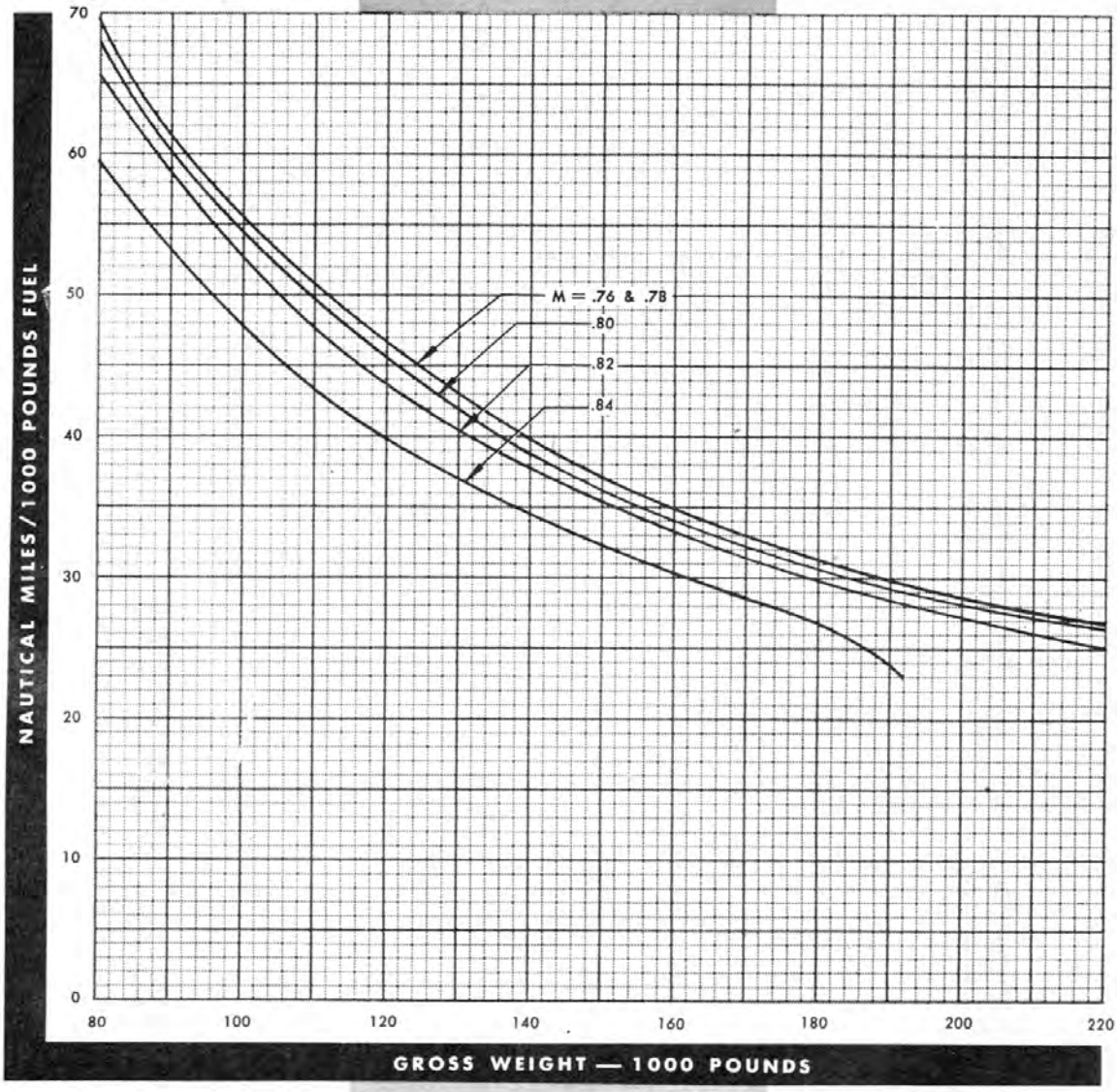
*Figure A4-3.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

404

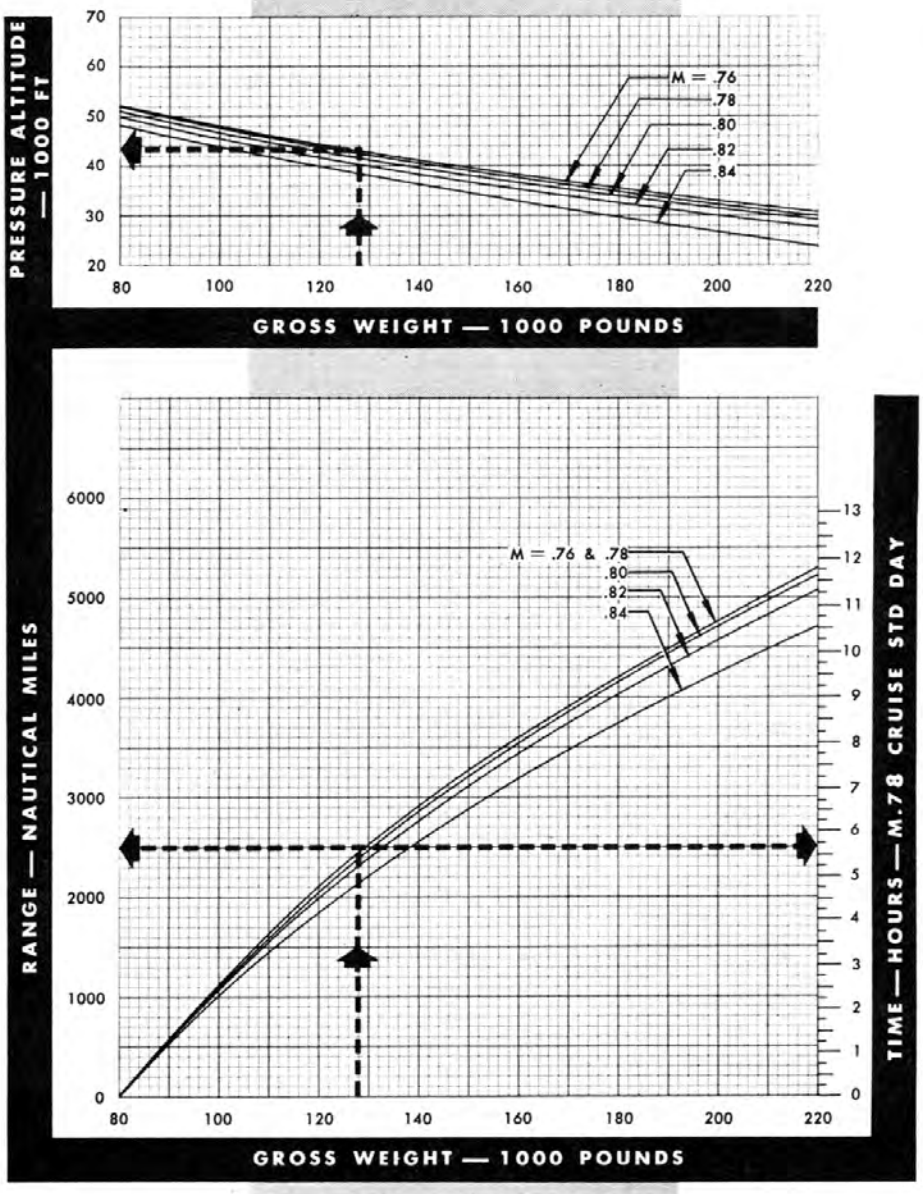
*Figure A4-4.*

# ALTITUDE & RANGE

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

405

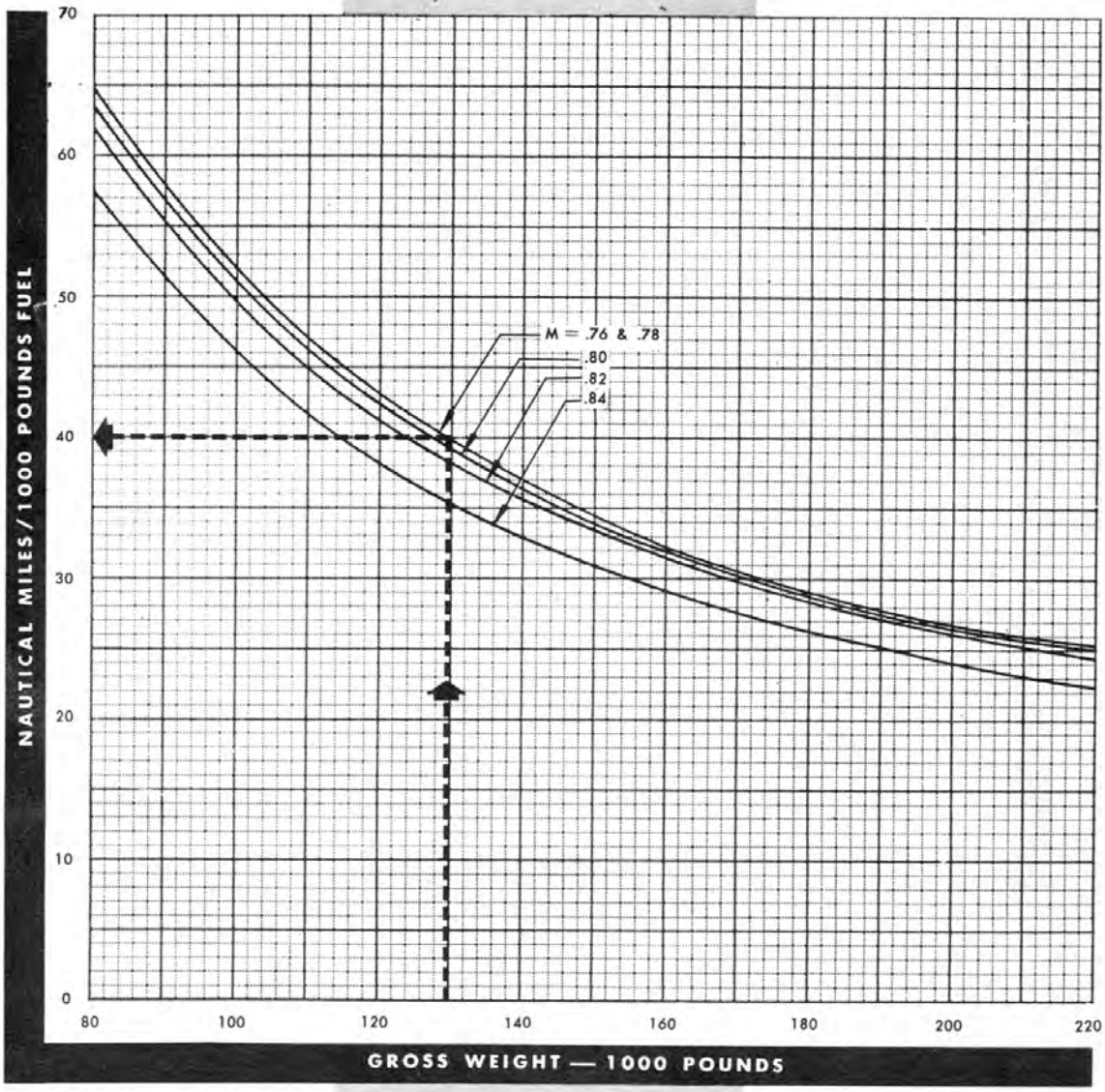
*Figure A4-5.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

406

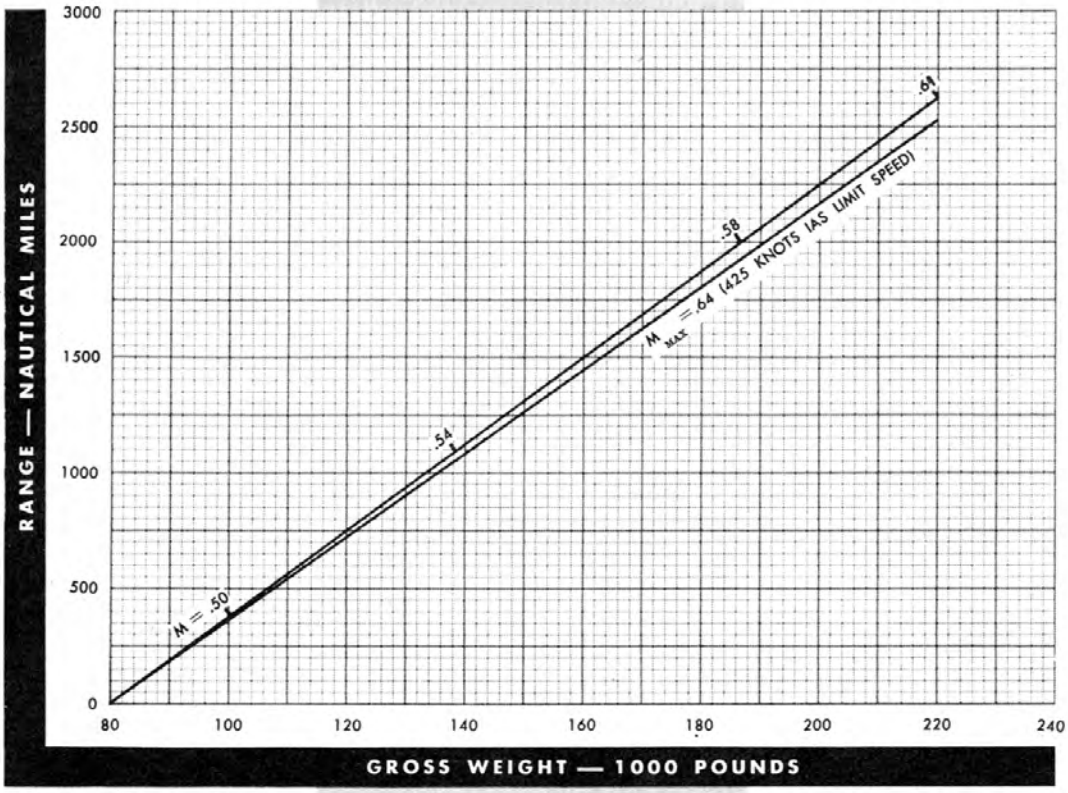
*Figure A4-6.*

# RANGE

## SEA LEVEL

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

407

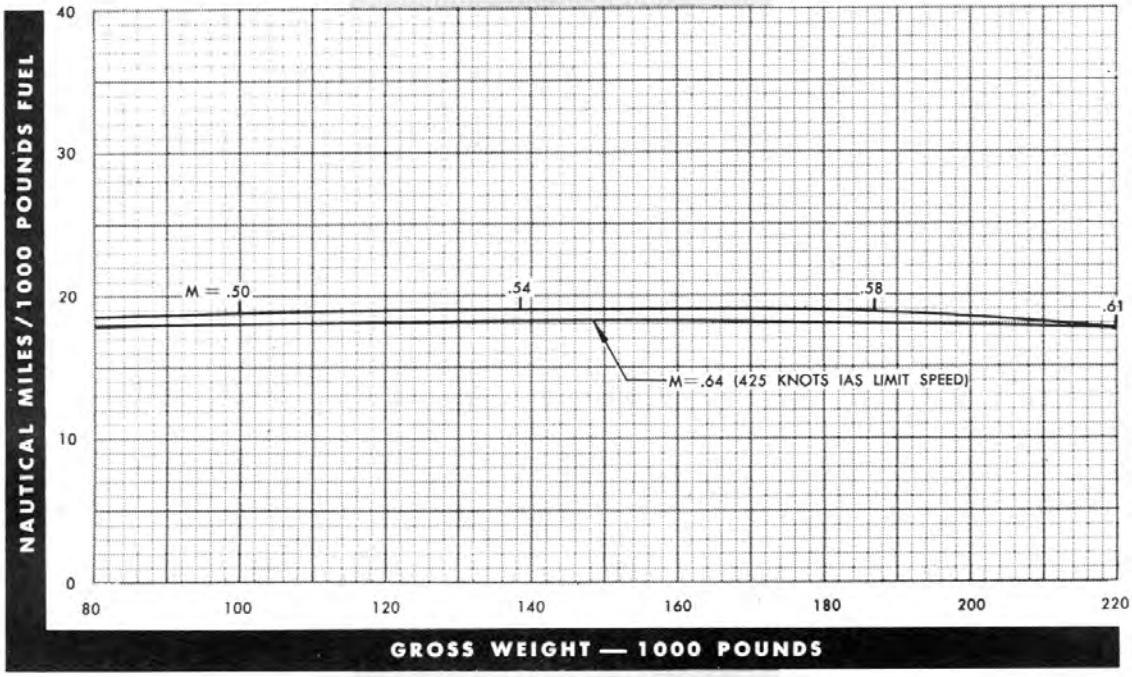
*Figure A4-7.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## SEA LEVEL

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

408

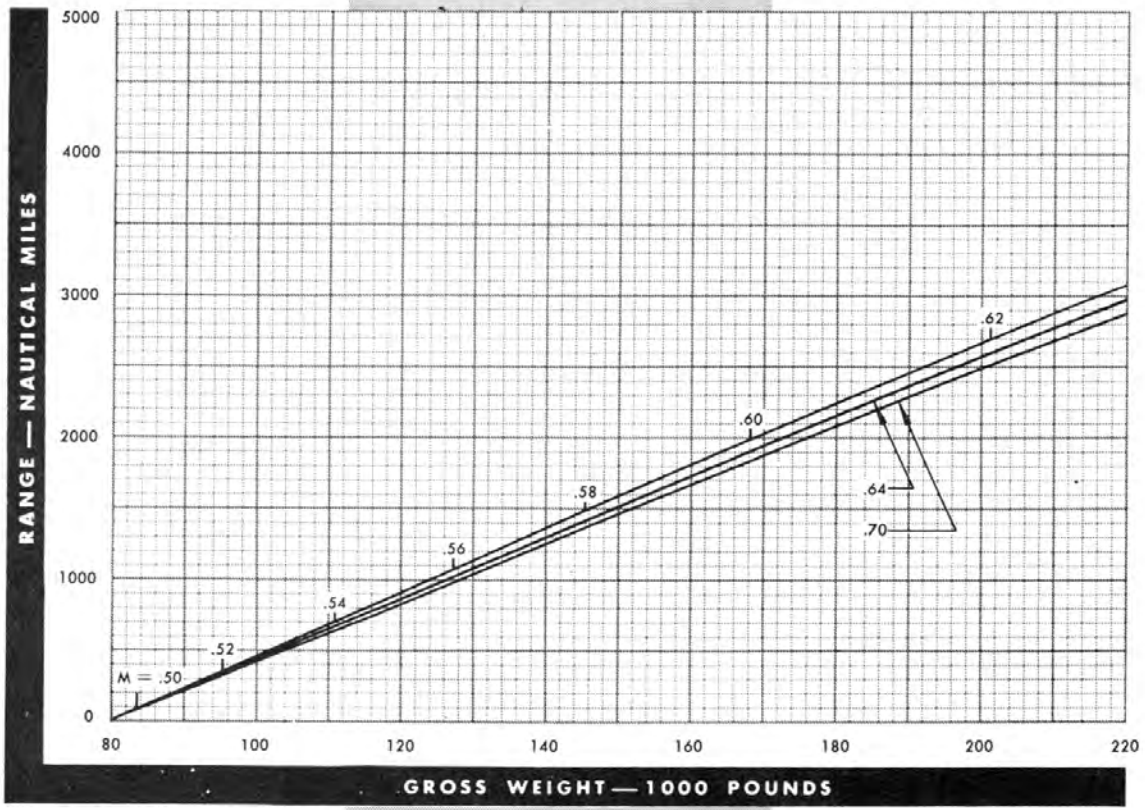
*Figure A4-8.*

# RANGE

## 5,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1956

**DATA BASIS:** FLIGHT TEST

427

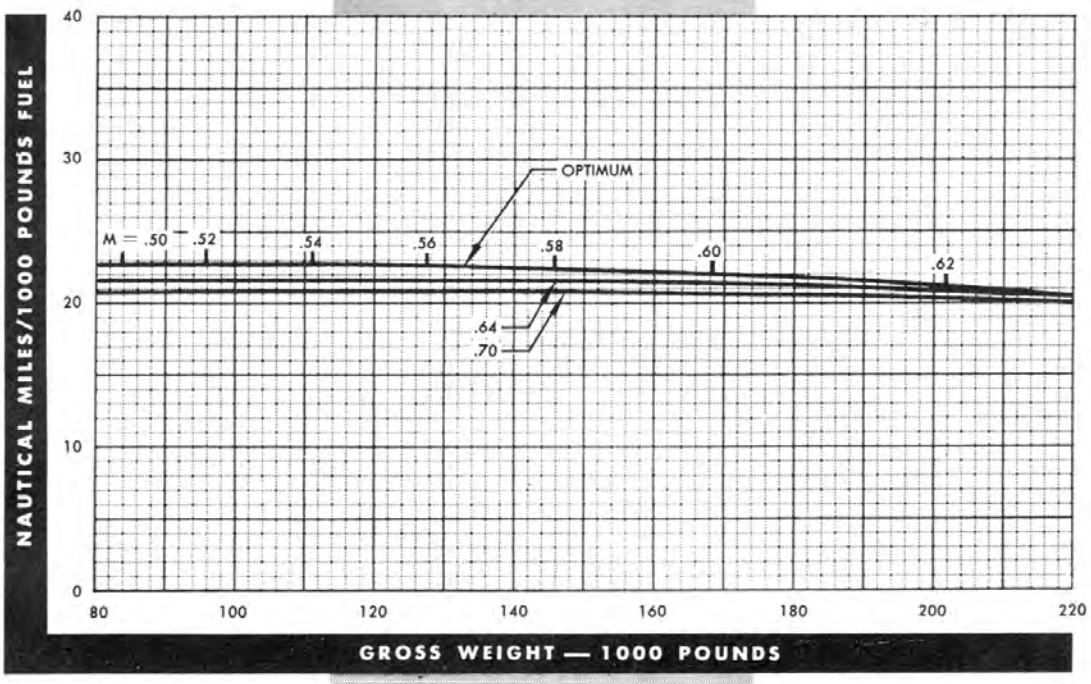
*Figure A4-9.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 5,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1956

**DATA BASIS:** FLIGHT TEST

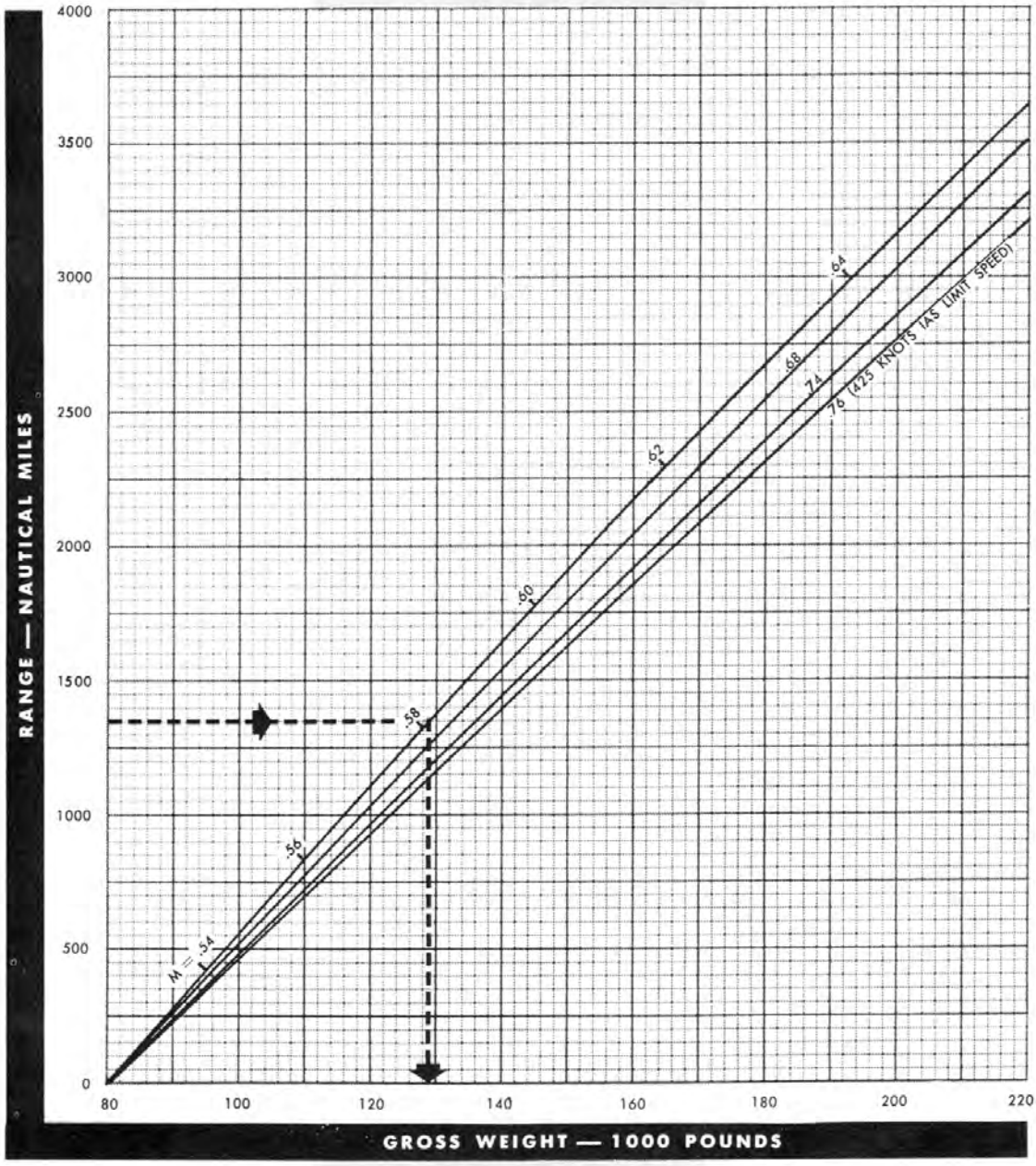
428

*Figure A4-9 A.*

# RANGE
## 10,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

409

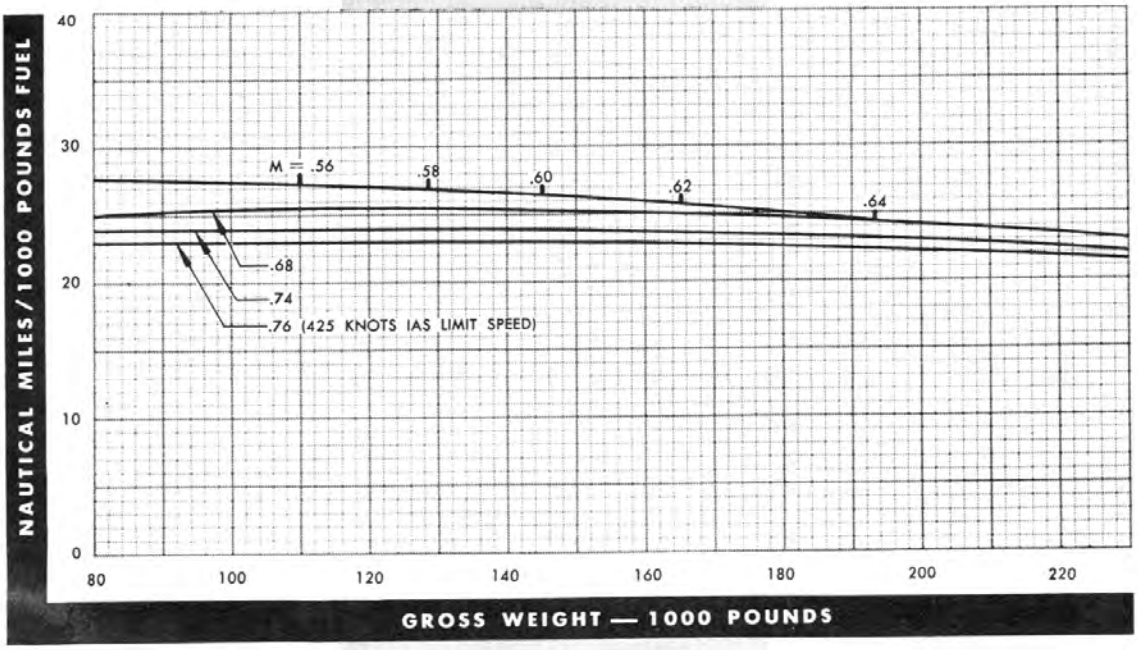
*Figure A4-9B.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 10,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

410

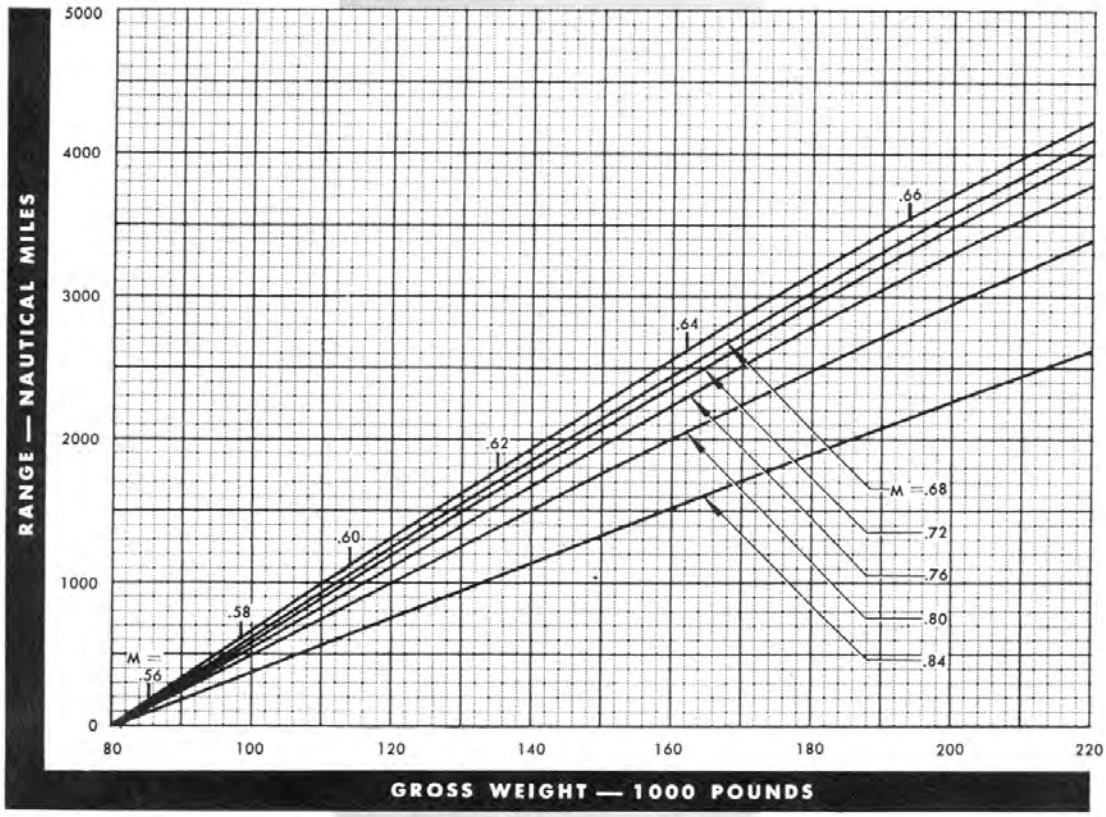
*Figure A4-10.*

# RANGE

## 15,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1956

**DATA BASIS:** FLIGHT TEST

429

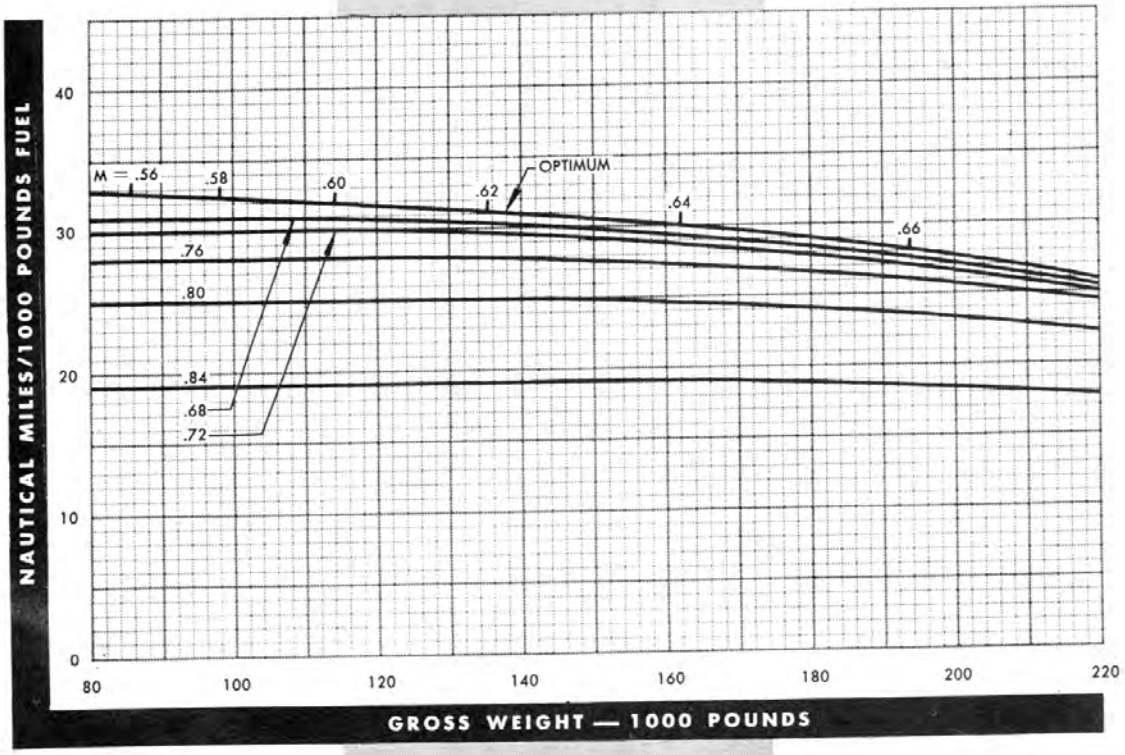
*Figure A4-11.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 15,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1956

**DATA BASIS:** FLIGHT TEST

430

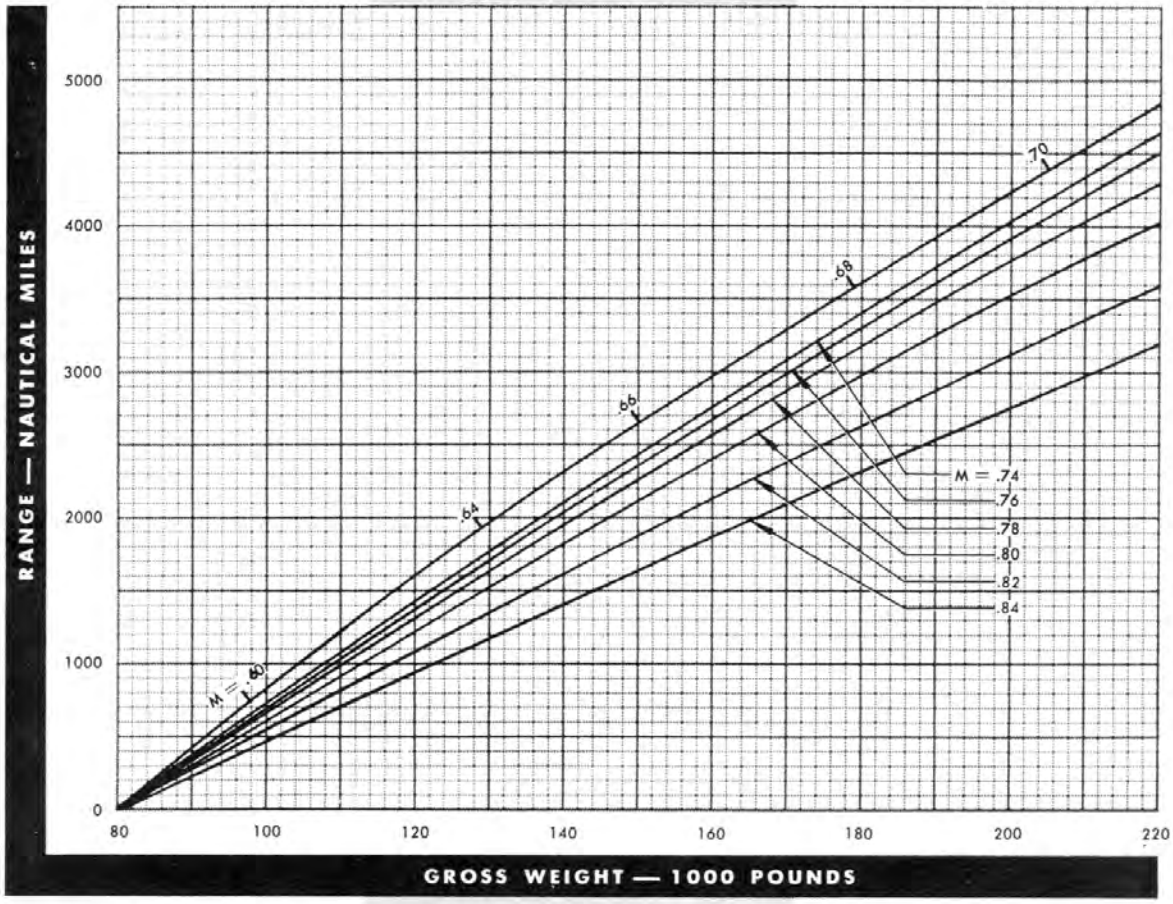
*Figure A4-11A.*

# RANGE

## 20,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

411

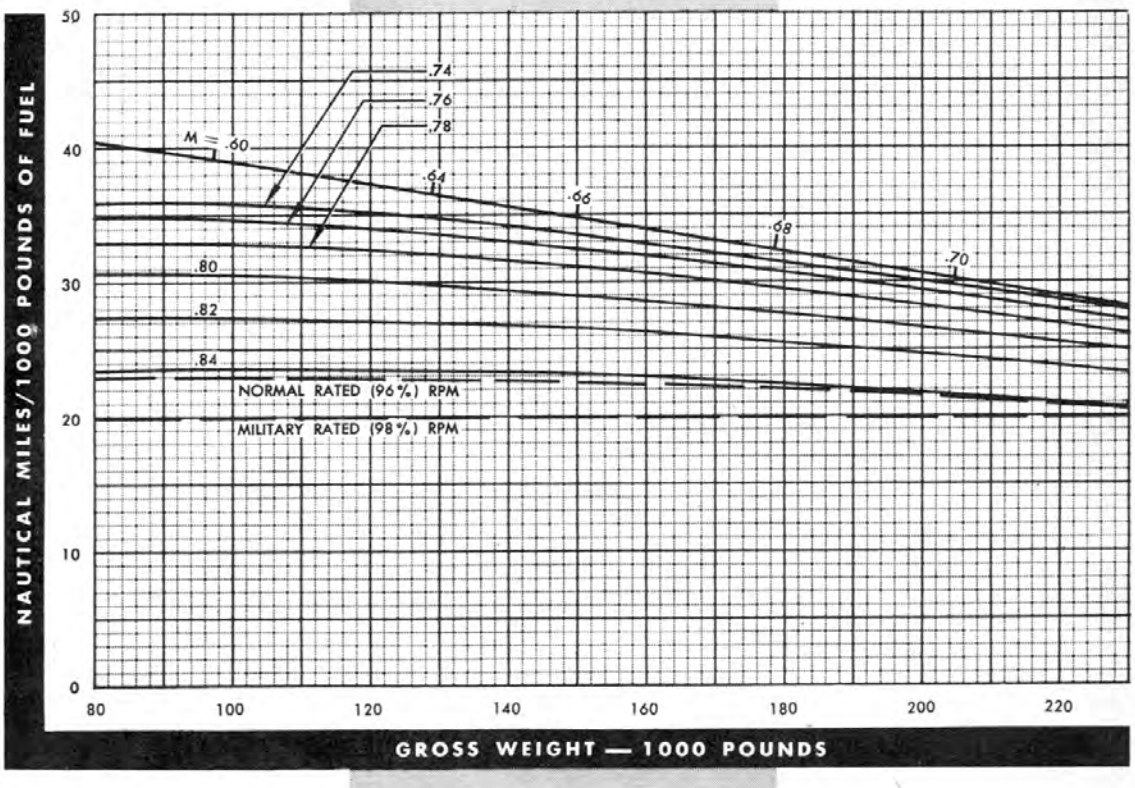
*Figure A4-11B.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 20,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

412

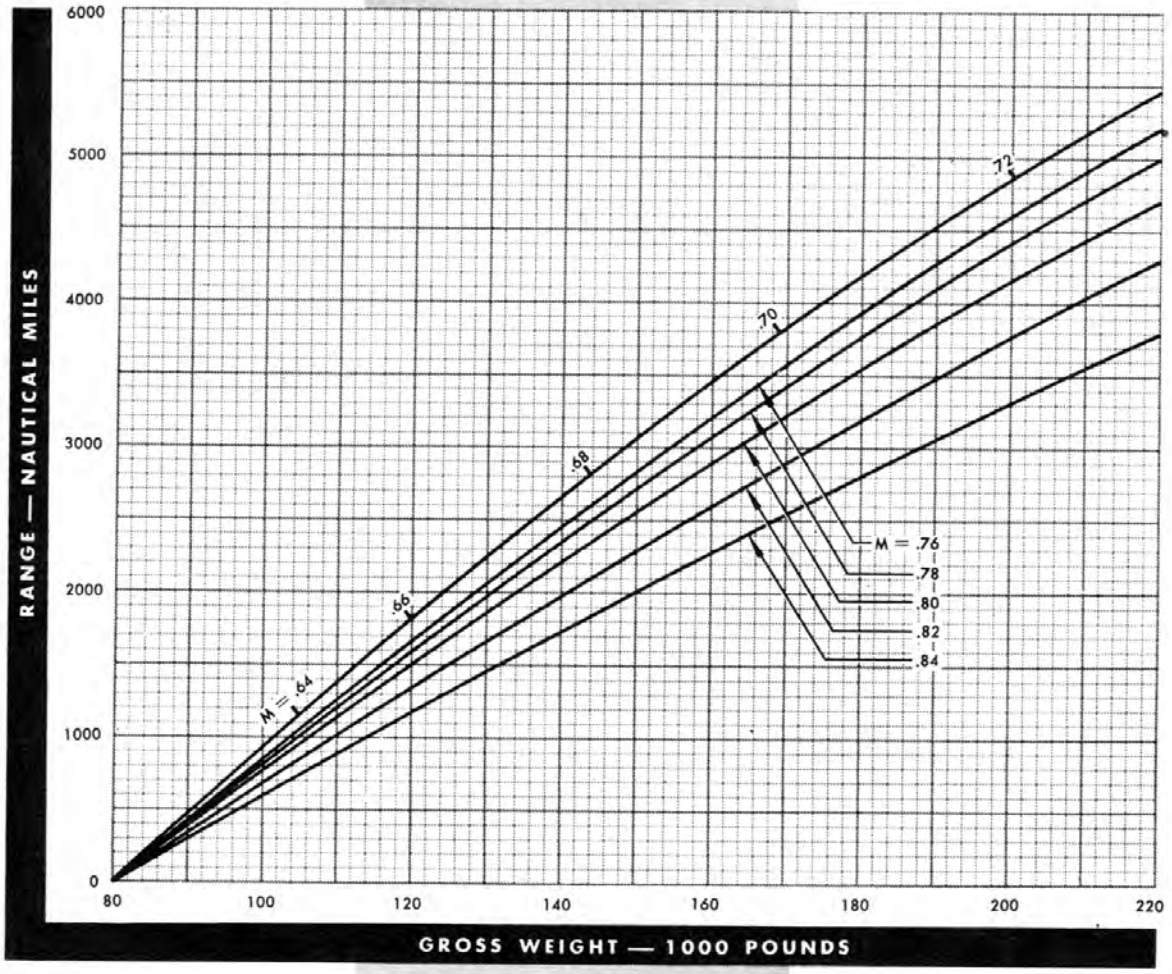
*Figure A4-12.*

# RANGE

## 25,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

413

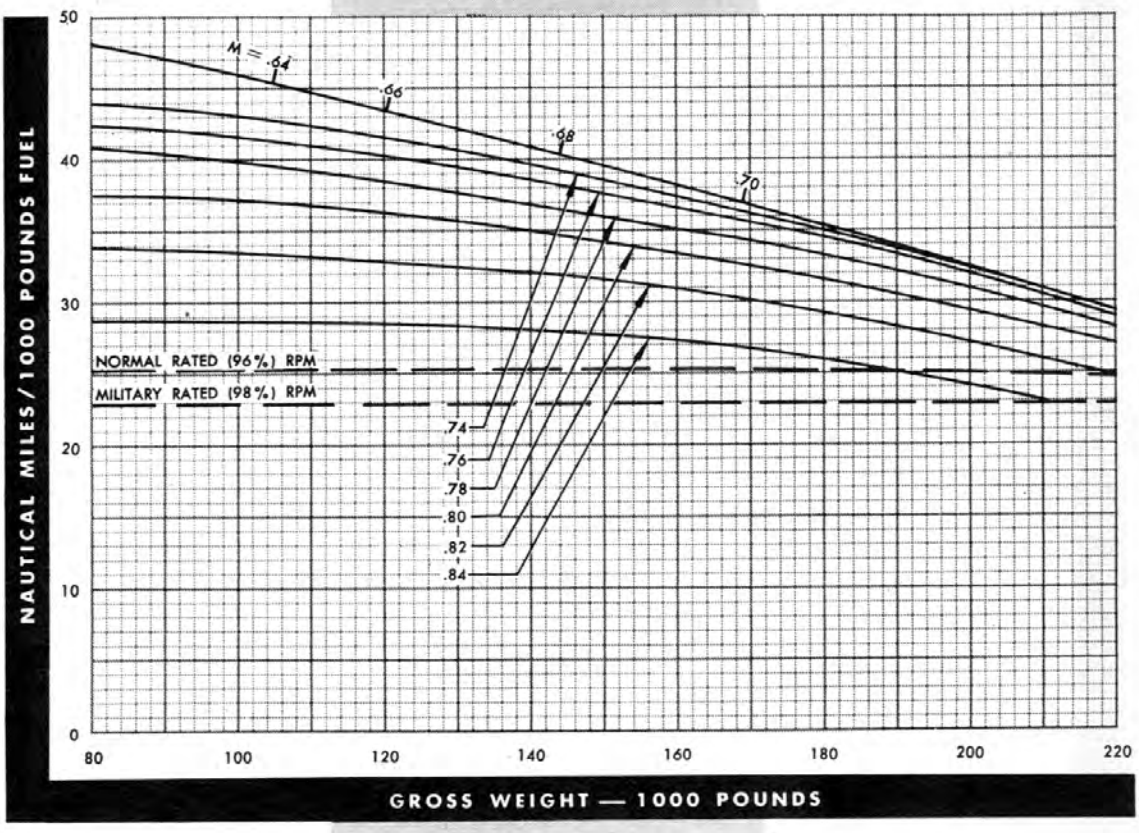
*Figure A4-13.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 25,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

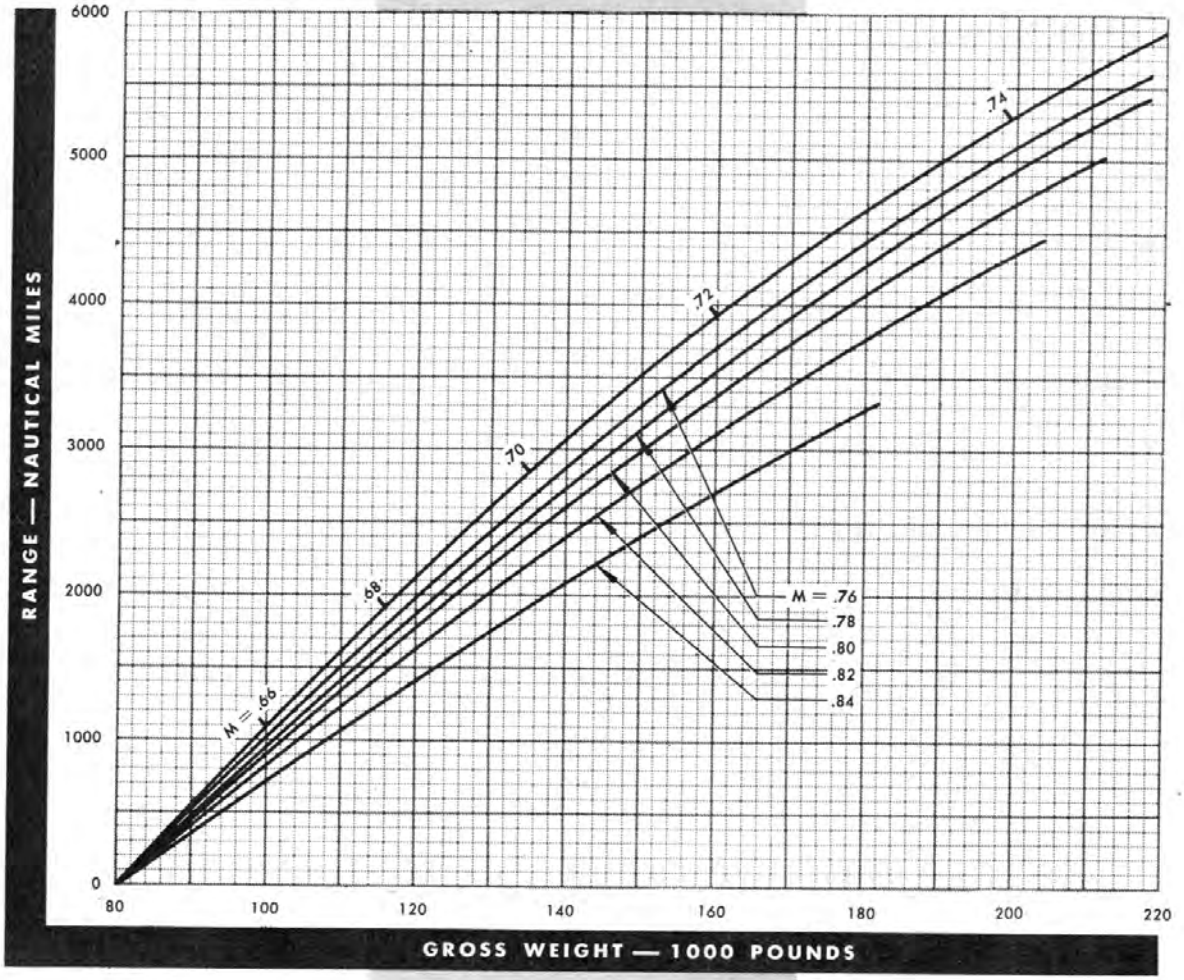
414

*Figure A4-14.*

# RANGE
## 30,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

415

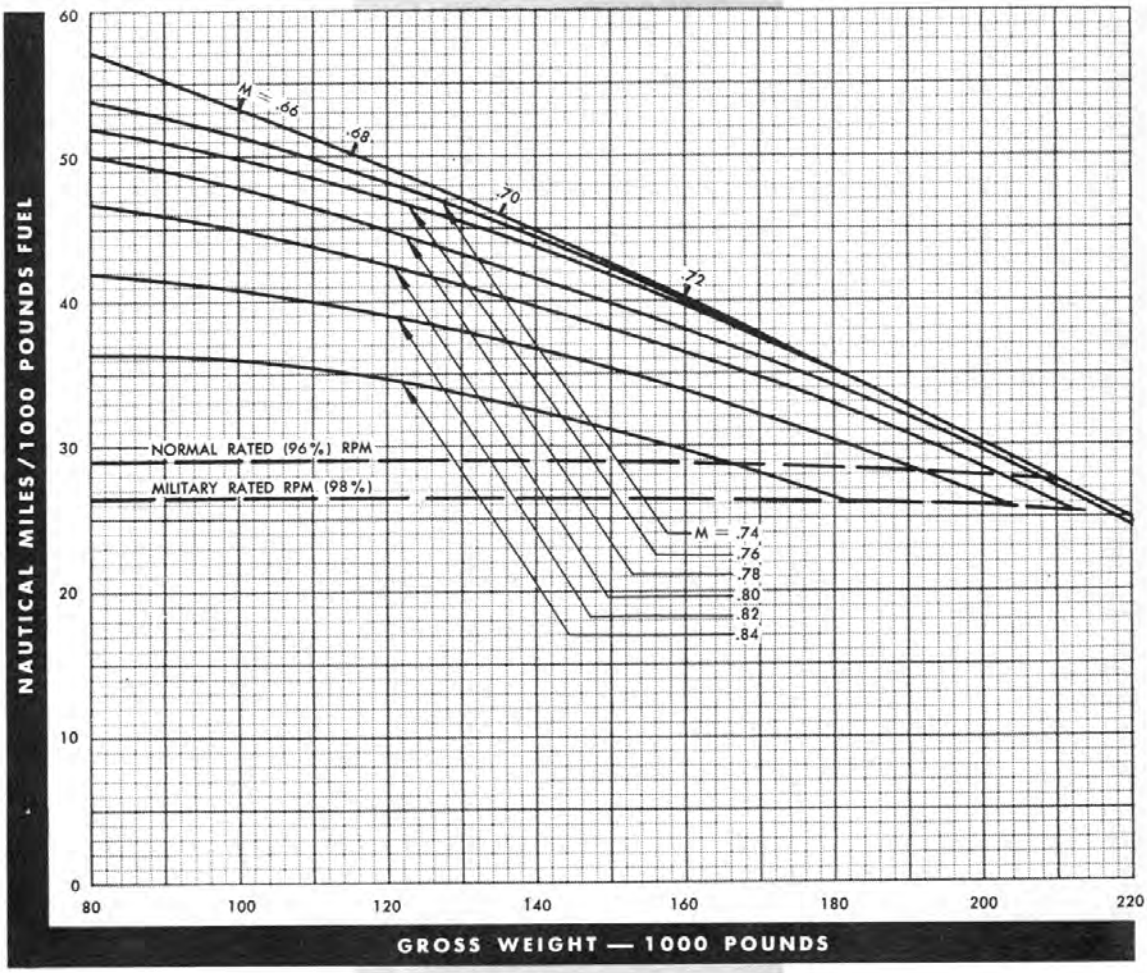
*Figure A4-15.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 30,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

416

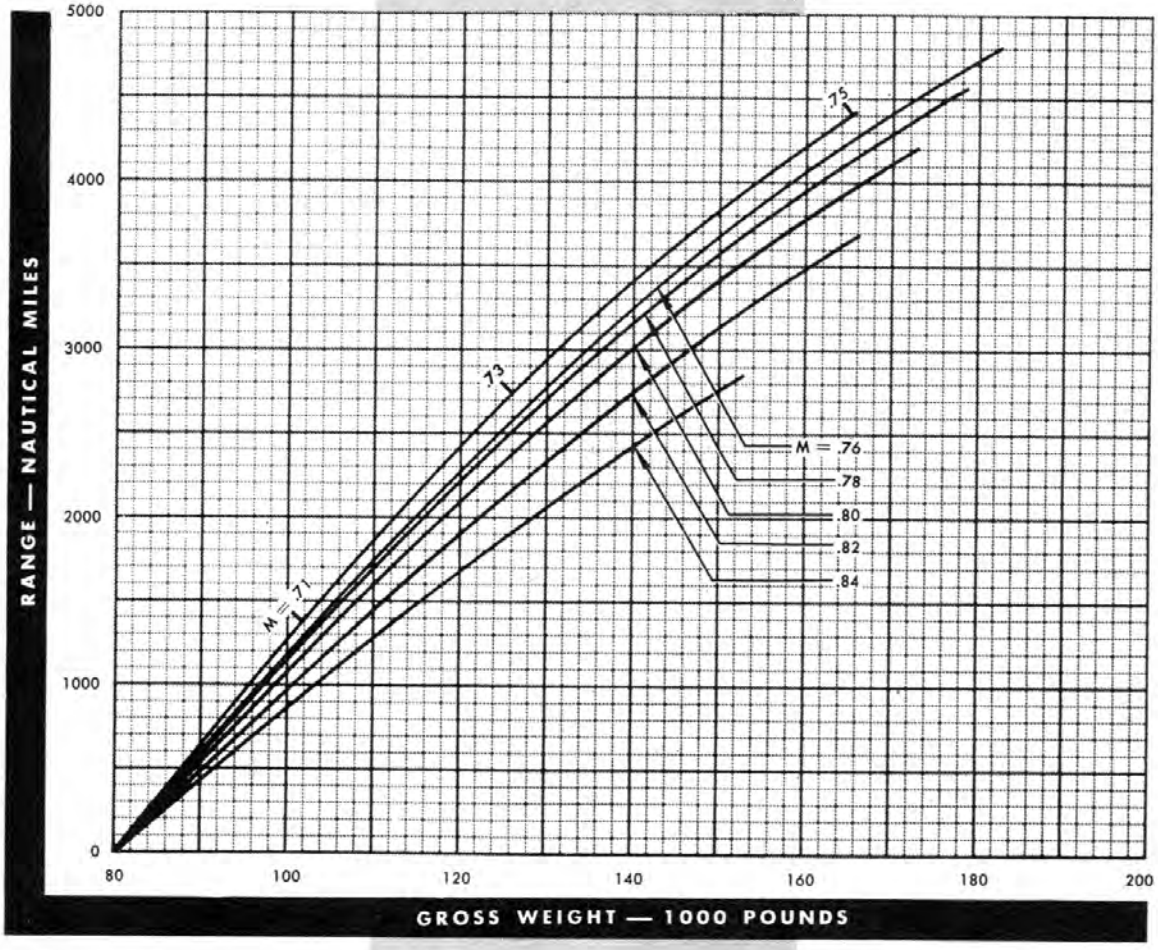
*Figure A4-16.*

# RANGE

## 35,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

417

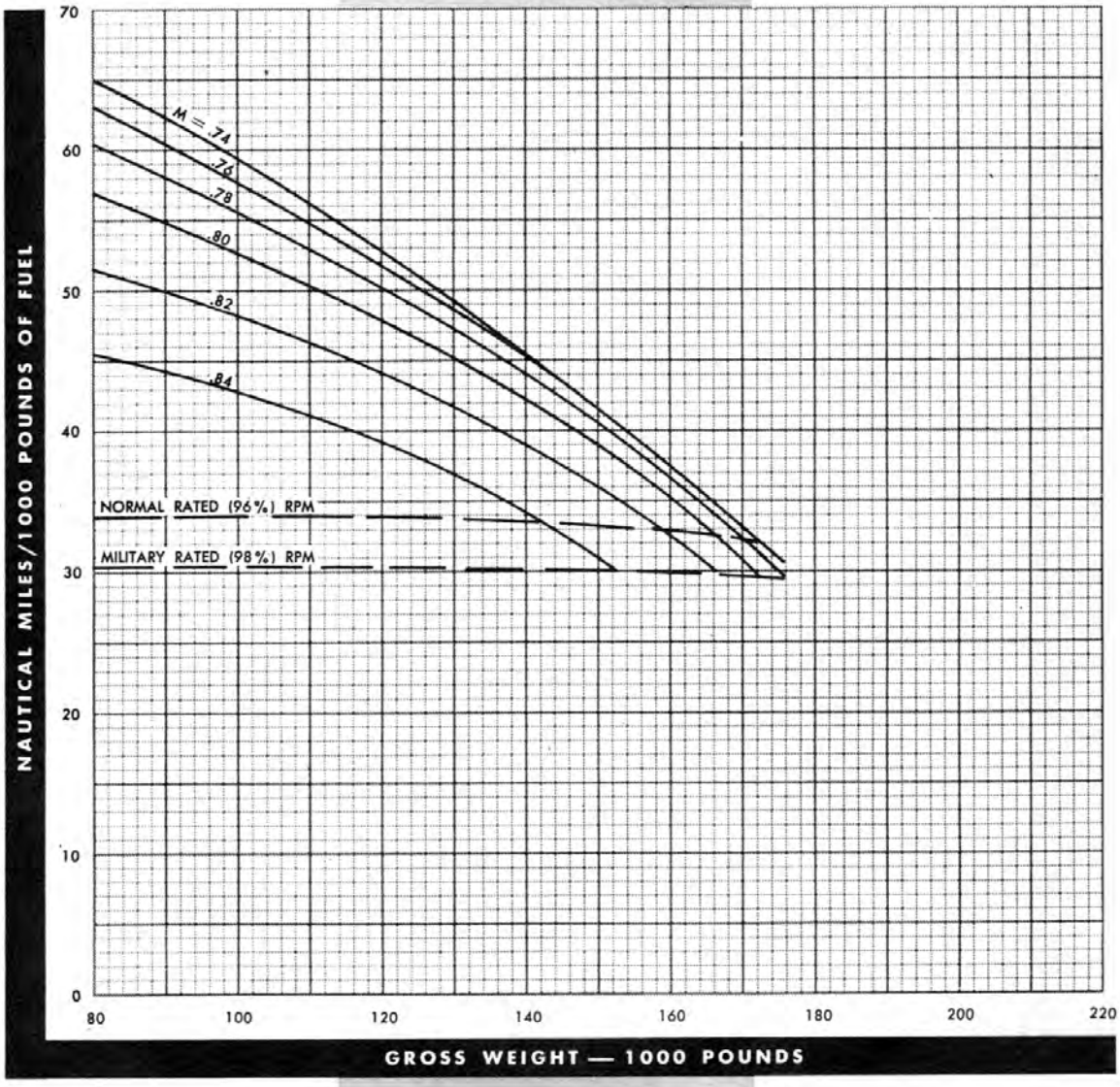
*Figure A4-17.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 35,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

418

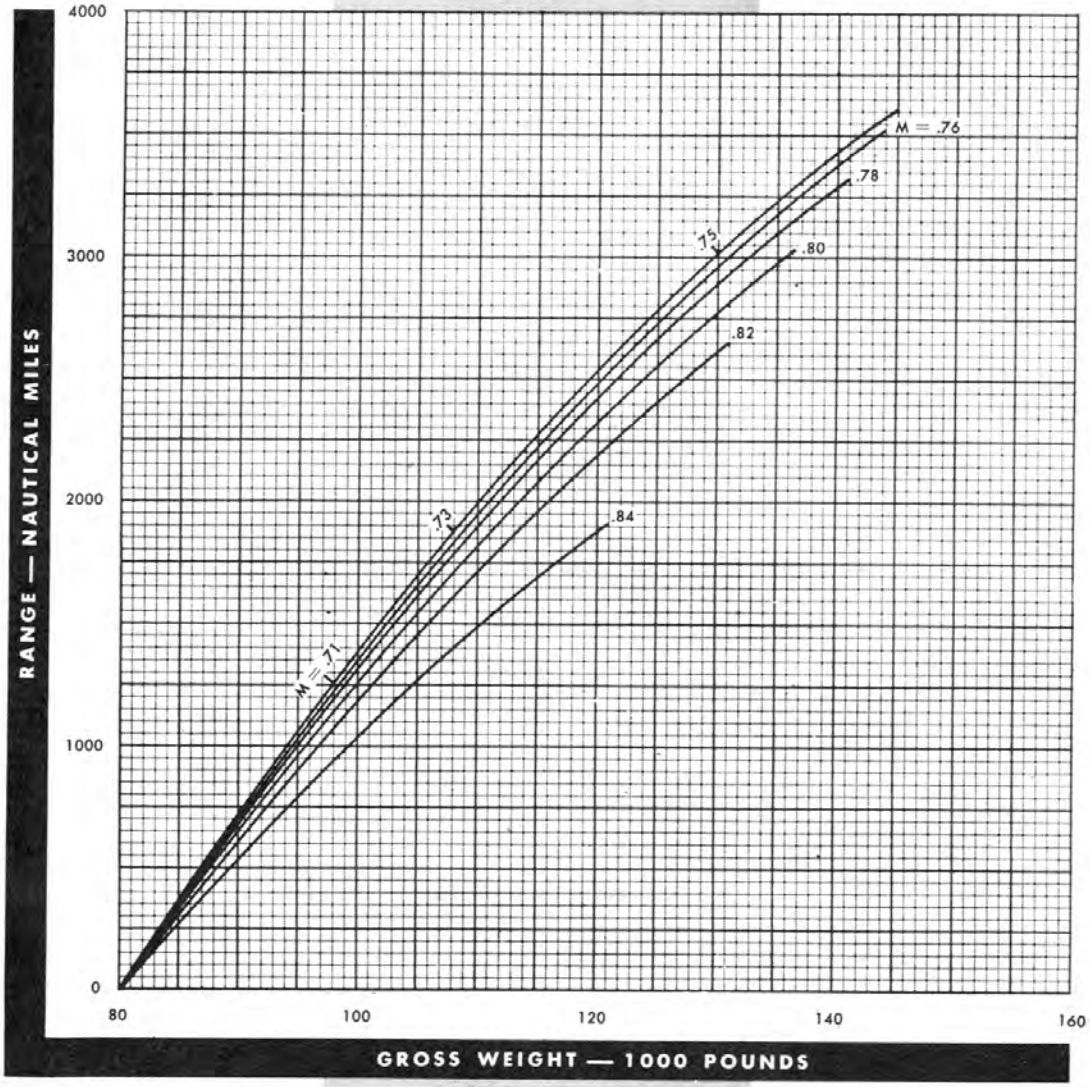
*Figure A4-18.*

# RANGE

## 40,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

419

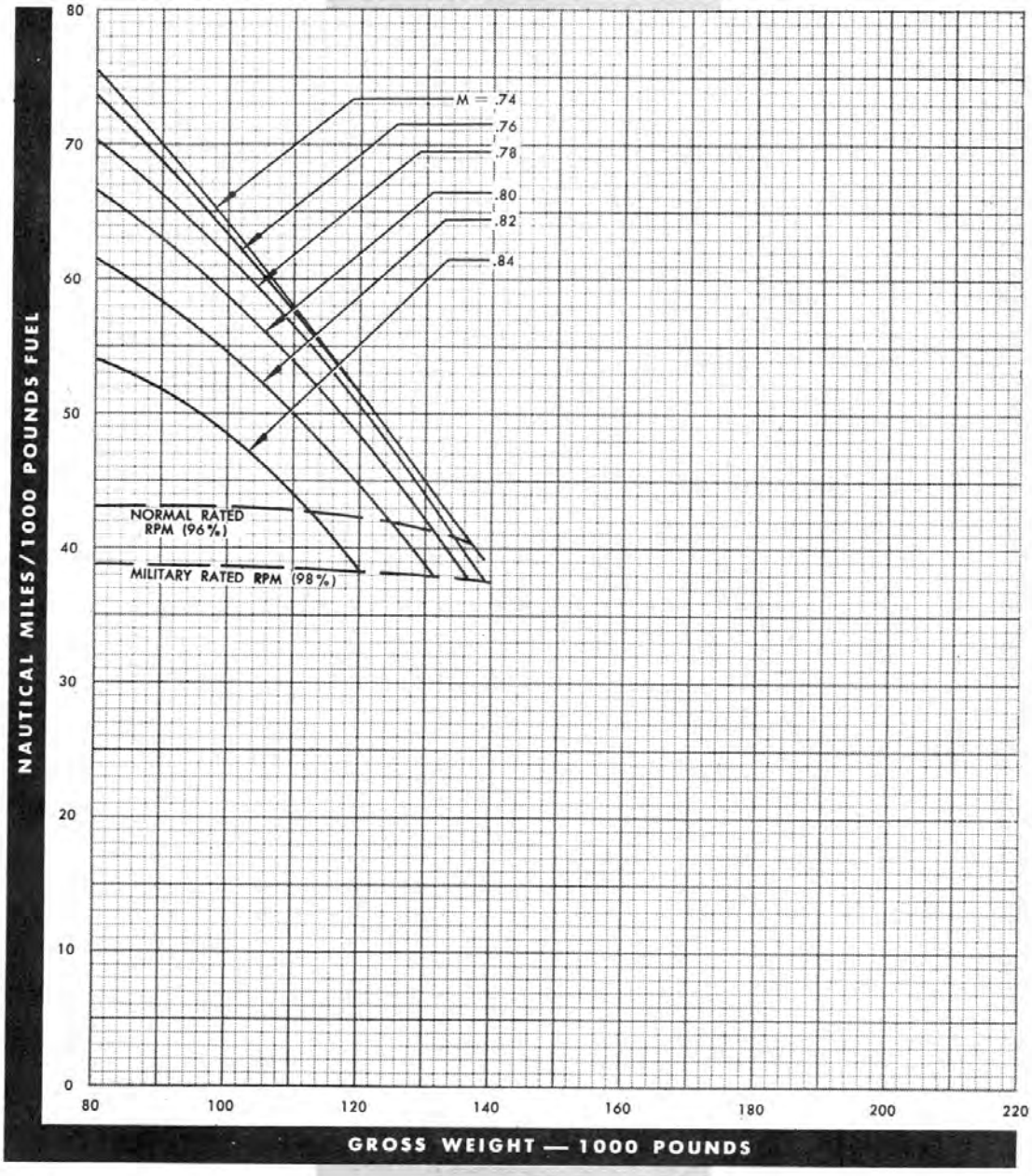
*Figure A4-19.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 40,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1952

**DATA BASIS:** FLIGHT TEST

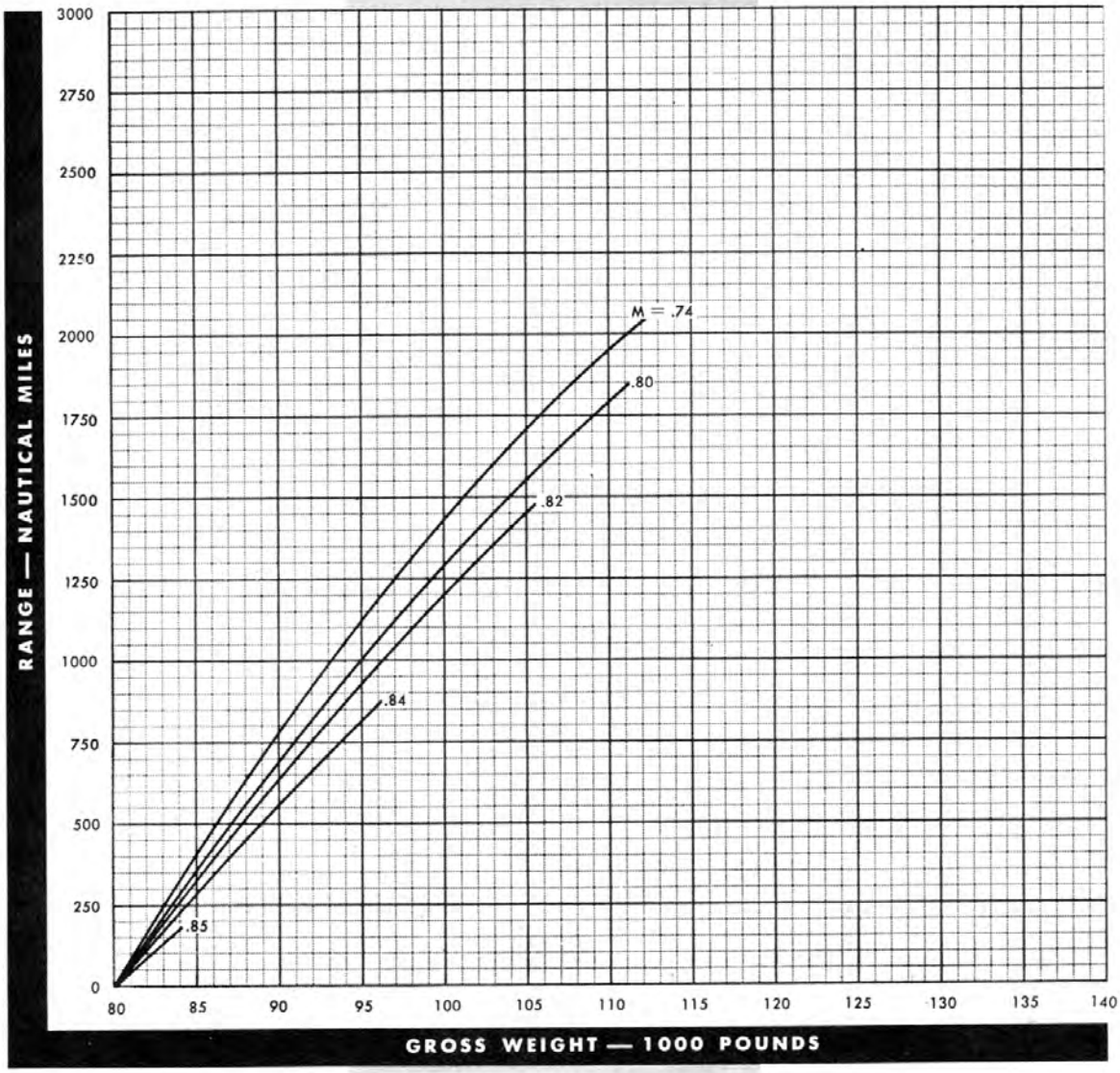
420

*Figure A4-20.*

# RANGE
## 45,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** APRIL 1953

**DATA BASIS:** FLIGHT TEST

421

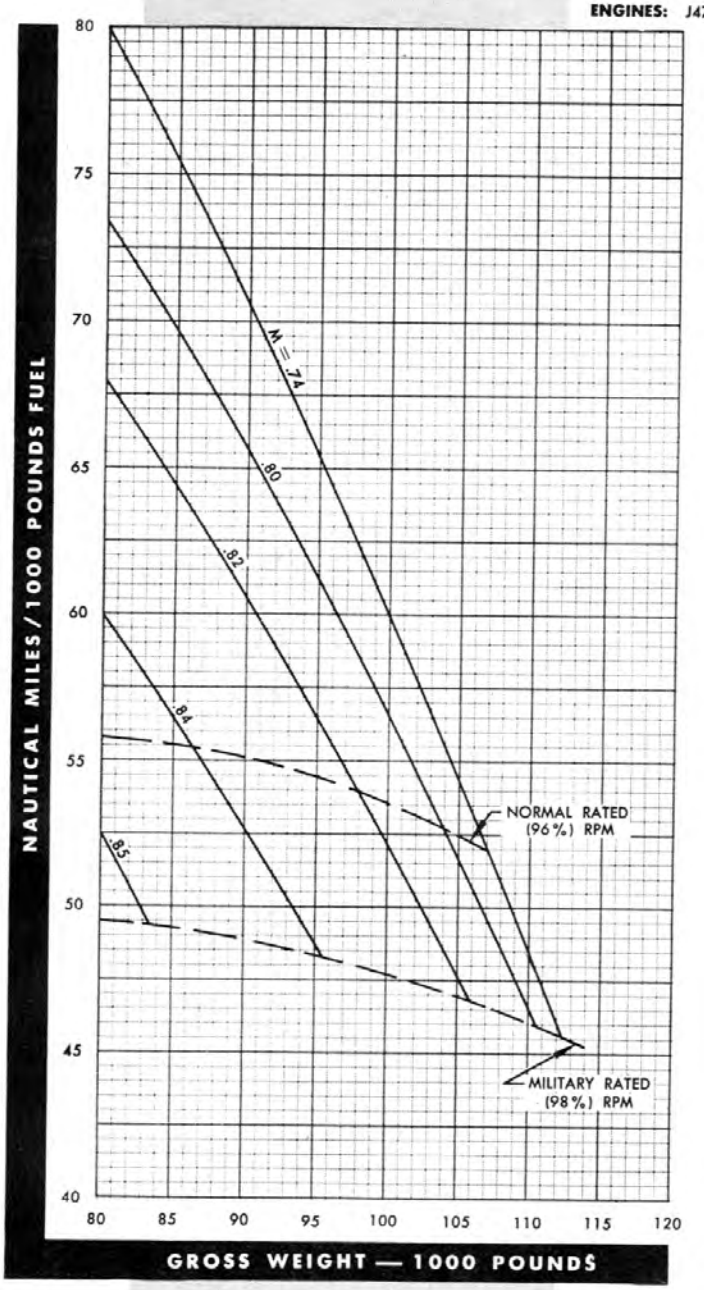
*Figure A4-21.*

# NAUTICAL MILES / 1000 POUNDS OF FUEL

## 45,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** APRIL 1953

**DATA BASIS:** FLIGHT TEST

*Figure A4-22.*

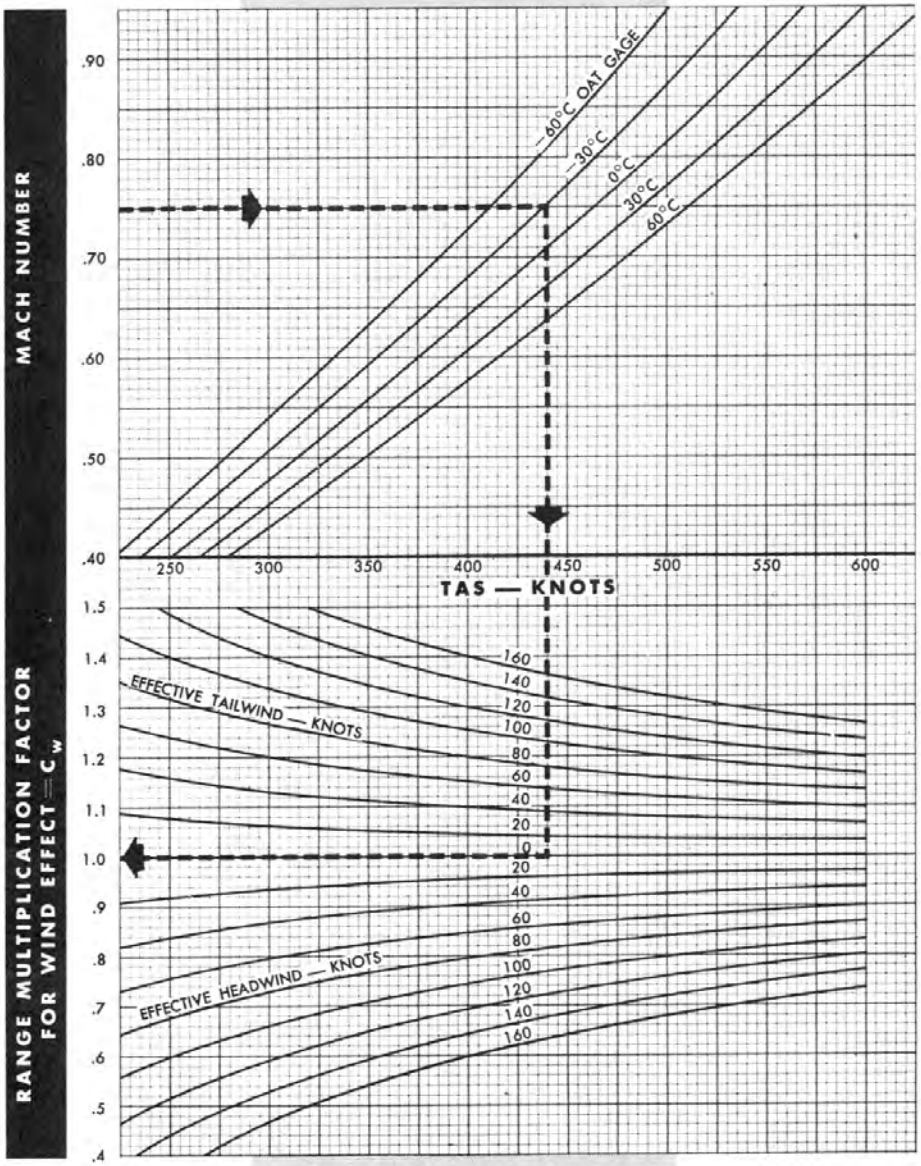
422

# RANGE CORRECTION FOR WIND

## FOR IN-FLIGHT USE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JANUARY 1956

**DATA BASIS:** CALCULATED

**REMARKS:**

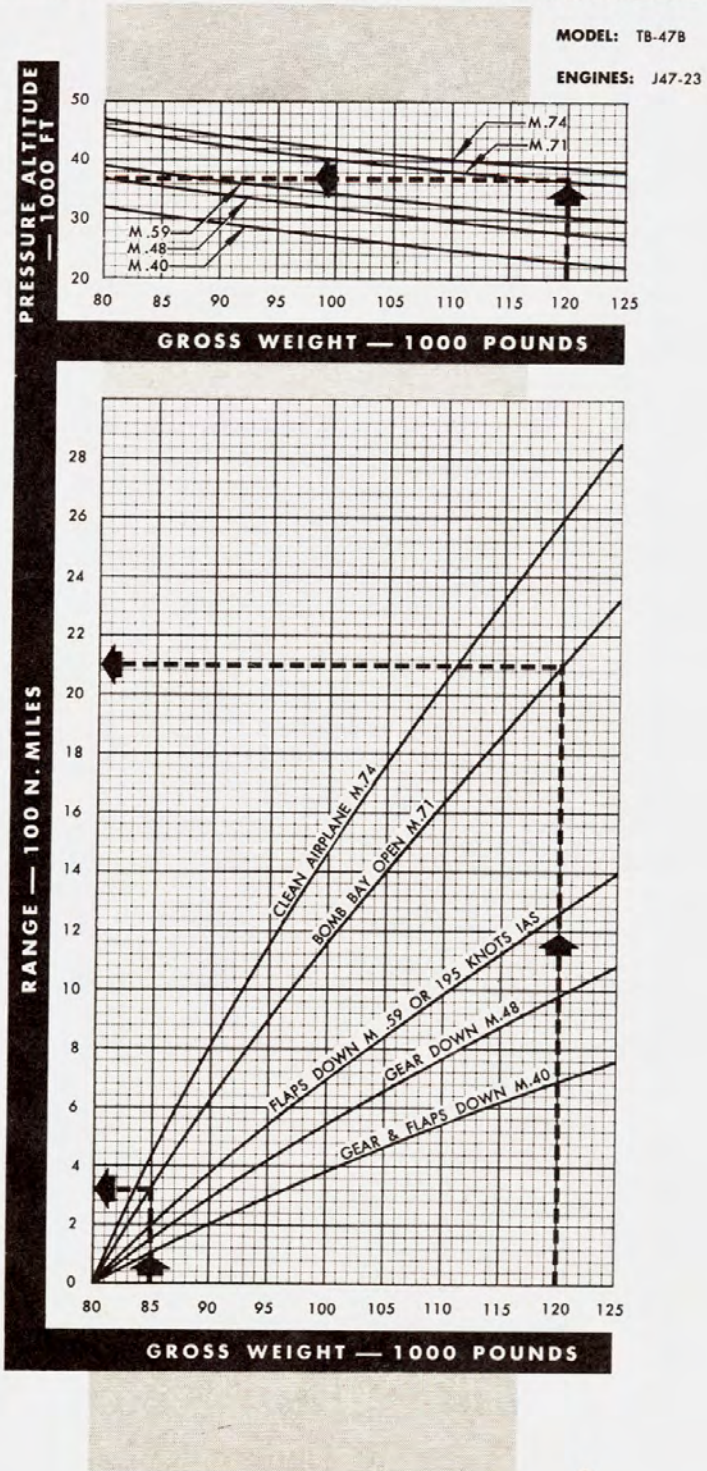
$\text{RANGE}_{(\text{WIND})} = C_w \times \text{RANGE}_{(\text{NO WIND})}$

80% RAM RECOVERY FACTOR

423

*Figure A4-23.*

# MAXIMUM RANGE FOR EMERGENCY OPERATION




**DATE:** APRIL 1953

**DATA BASIS:** FLIGHT TEST

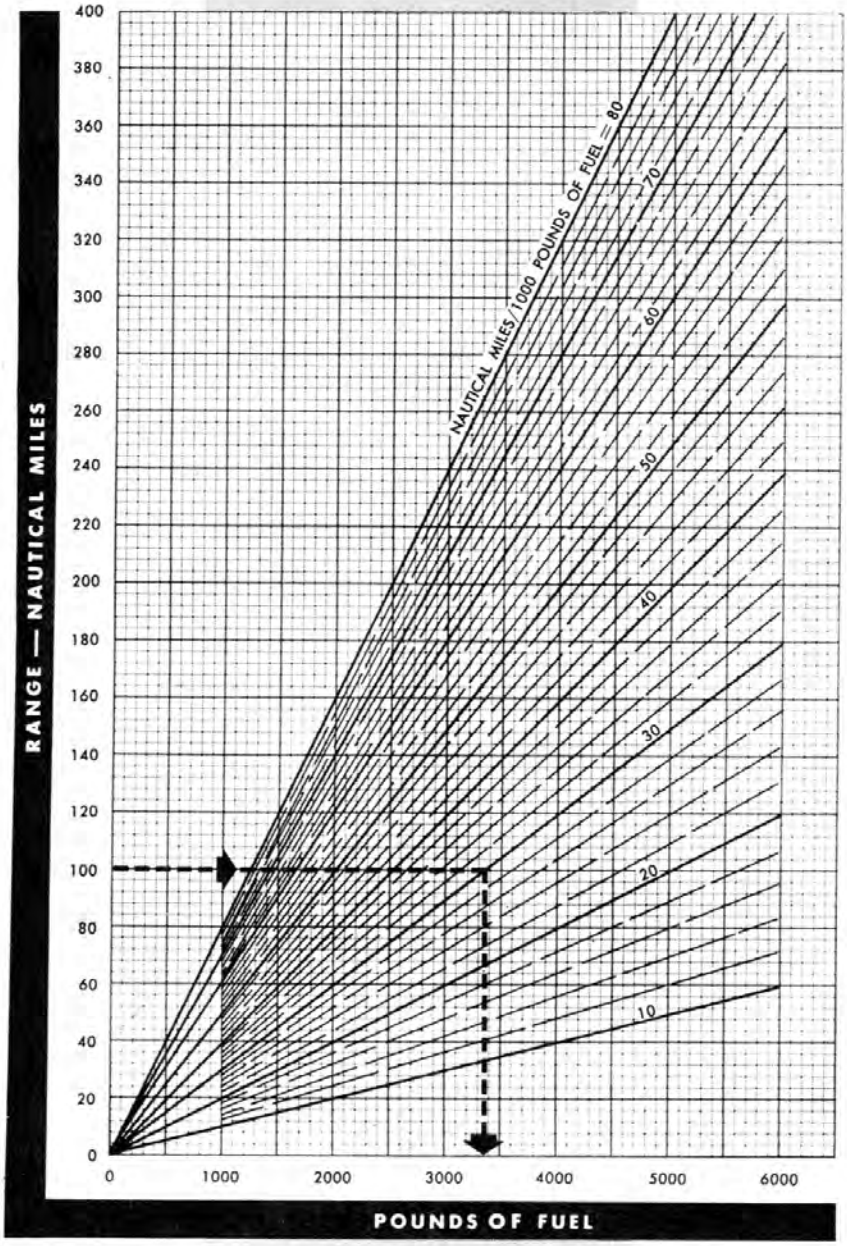
424

*Figure A4-24.*

# FUEL DISTANCE CONVERSION

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1950

**DATA BASIS:** CALCULATED

425

*Figure A4-25.*

# CG LOCATION AT MACH .74

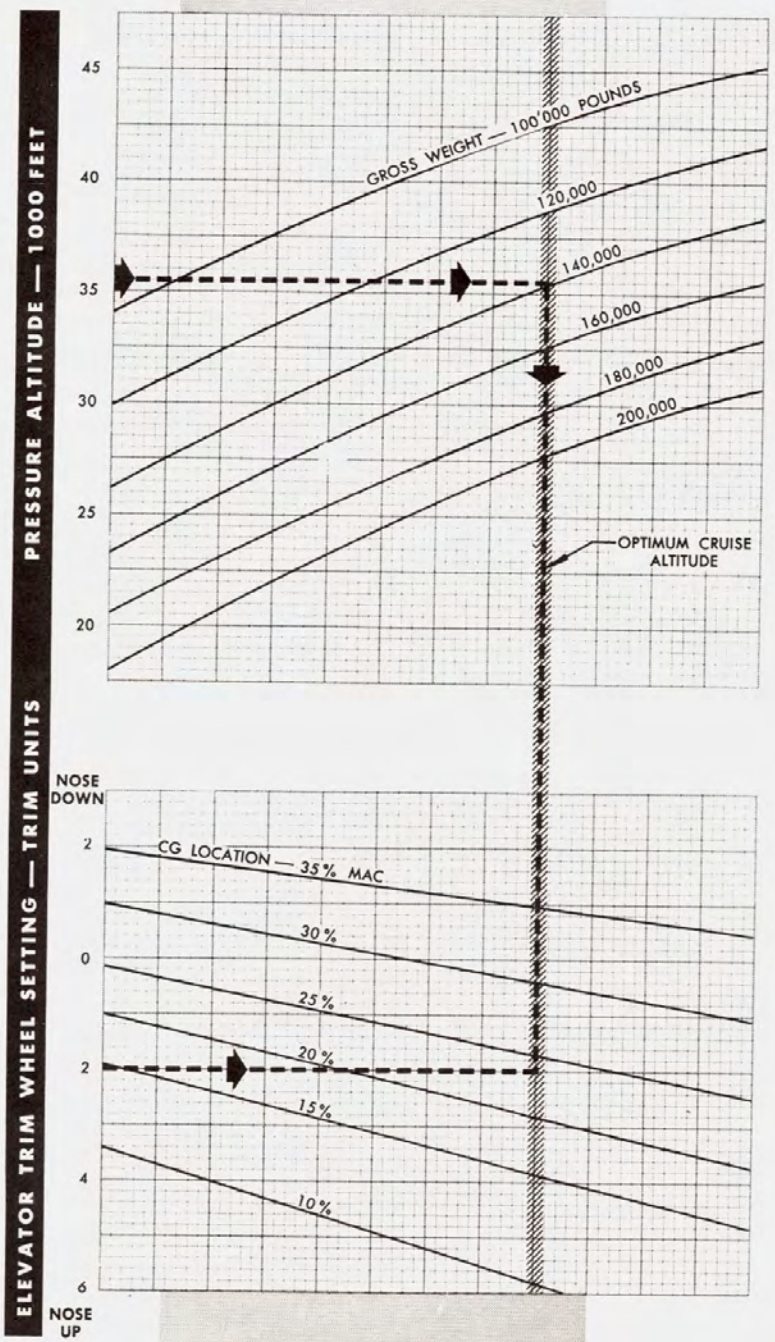



*Figure A4-26.*

426

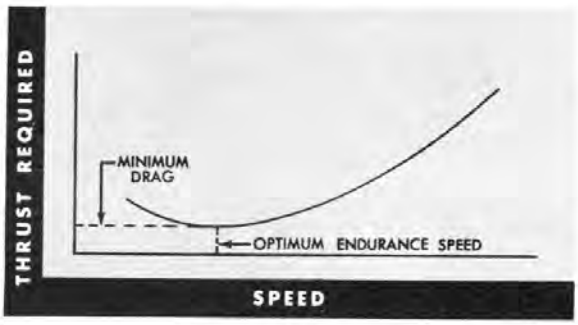
Part 5

# 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

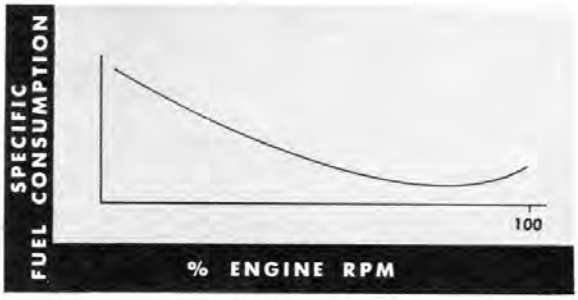
The airspeed for maximum endurance at any weight and altitude is approximately the airspeed at which airplane drag is a minimum. At that airspeed, the engine fuel consumption is minimum because the least thrust is required.




50887

The recommended airspeeds for maximum endurance with flaps and gear up and two, four, or six engines operating are given on figure A5-1. The number of operating engines required for maximum endurance varies with altitude because of the following:

- The thrust required to overcome airplane drag, at a given weight and at the correct maximum endurance speed, remains essentially constant at all altitudes.
- The thrust output of jet engines at a given rpm drops off rapidly with increasing altitudes.
- 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.




50888

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 | APPROX RPM Percent Max | NUMBER OF OPERATING ENGINES (Gross Wt—1000 Pounds) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
| ABOVE 30,000 FT | 85 | 6 | 6 | 6 | 6 | * | * | * |
| 20,000 TO 30,000 FT | 85 | 4 | 4 | 5 | 5 | 6 | 6 | 6 |
| 10,000 TO 20,000 FT | 85 | 3 | 3 | 4 | 4 | 5 | 5 | 5 |
| SEA LEVEL TO 10,000 FT | 85 | 2 | 2 | 3 | 3 | 3 | 3 | 4 |

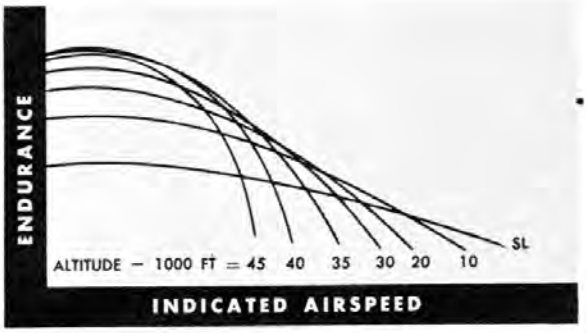
* ALTITUDE NOT PRACTICAL FOR HIGH GROSS WEIGHT

50889

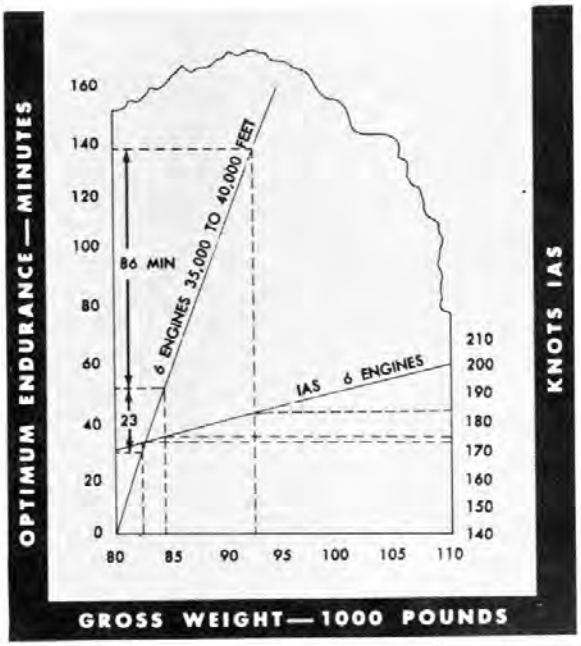
Endurance charts for both mission planning and emergency operation are contained in this section. These charts include no conservative factors or reserves. Endurance, like range, can be estimated from the gross weight at the start and at the end. The best endurance rate in minutes per 1000 pounds of 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 A5-2 will be most convenient. A curve of the correct indicated airspeed for optimum endurance is also on figure A5-2. 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 accompanying sketch:




50890




50891

The following example demonstrates the use of the integrated chart:

**Example:**

The airplane arrives over home base with 10,000 pounds of fuel remaining. The gross weight without fuel is 82,500 pounds.

Determine:

- The number of operating engines
- The best altitude for endurance
- The maximum time that the airplane can remain aloft before exhausting its fuel
- The maximum endurance, allowing 2000 pounds of fuel for descent and landing reserve.

Figure A5-2 shows that when above 35,000 feet, six engines will give the best endurance. Figure A5-1 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 A5-3 through A5-5 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 A5-5 through A5-7 that varying from the specified altitude by plus or minus 2000 feet will not appreciably affect endurance. On figure A5-1 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.

Determine:

- The number of operating engines
- The optimum altitude
- Minimum fuel expended during endurance
- The gross weight when cruise is resumed
- Required airspeed.

From the curves on figures A5-3 through A5-5 it is apparent that at high gross weights, six engines give nearly the same endurance time as four or two 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 1000 pounds of fuel at 29,300-foot altitude. From the curve on figure A5-11, 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 A5-3 is 7.1 minutes per 1000 pounds of fuel at 30,000 feet. The fuel used in 60 minutes is then 8,500 pounds, using figure A5-11 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 A5-1. 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 A5-6 through A5-10 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 A5-1, 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

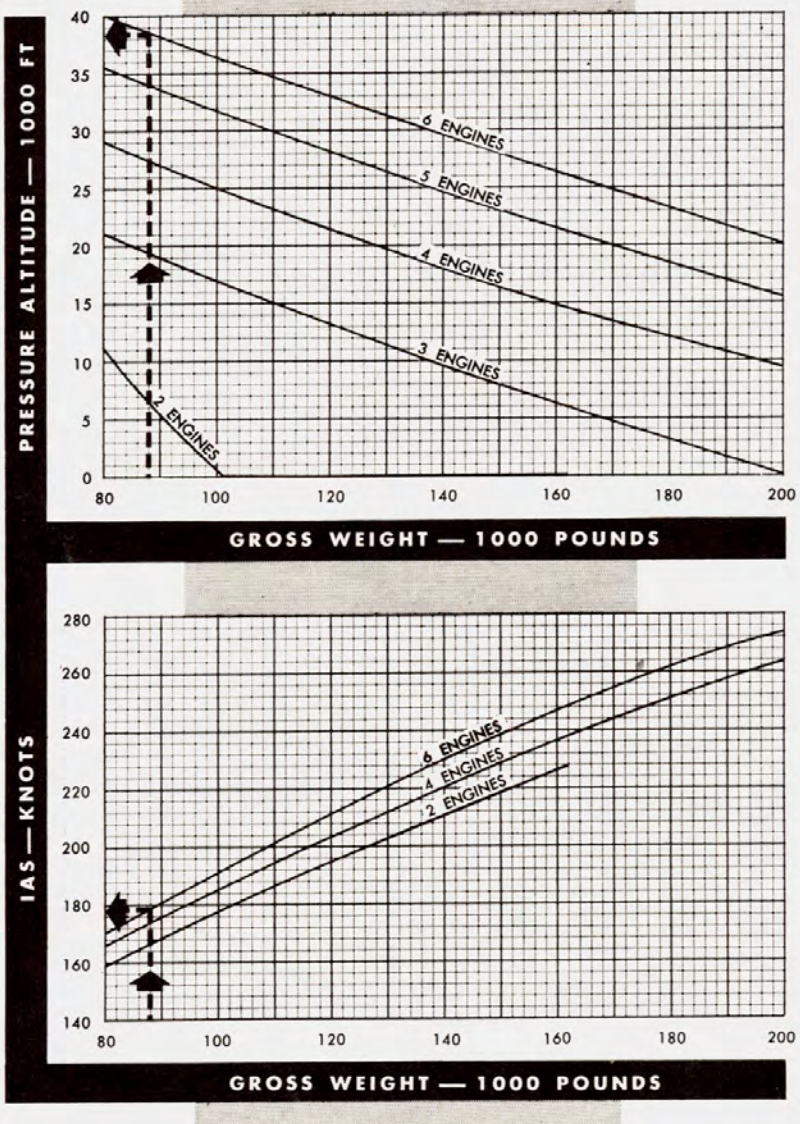
1. For endurance at the highest practical altitude use six engines. For lower altitudes cut enough engines to allow those remaining to operate at 80% to 90% rpm.
2. Fly at the altitude specified on figure A5-1 for the prevailing gross weight and number of engines.
3. Always maintain the correct indicated airspeed shown in the chart on figure A5-1.
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:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

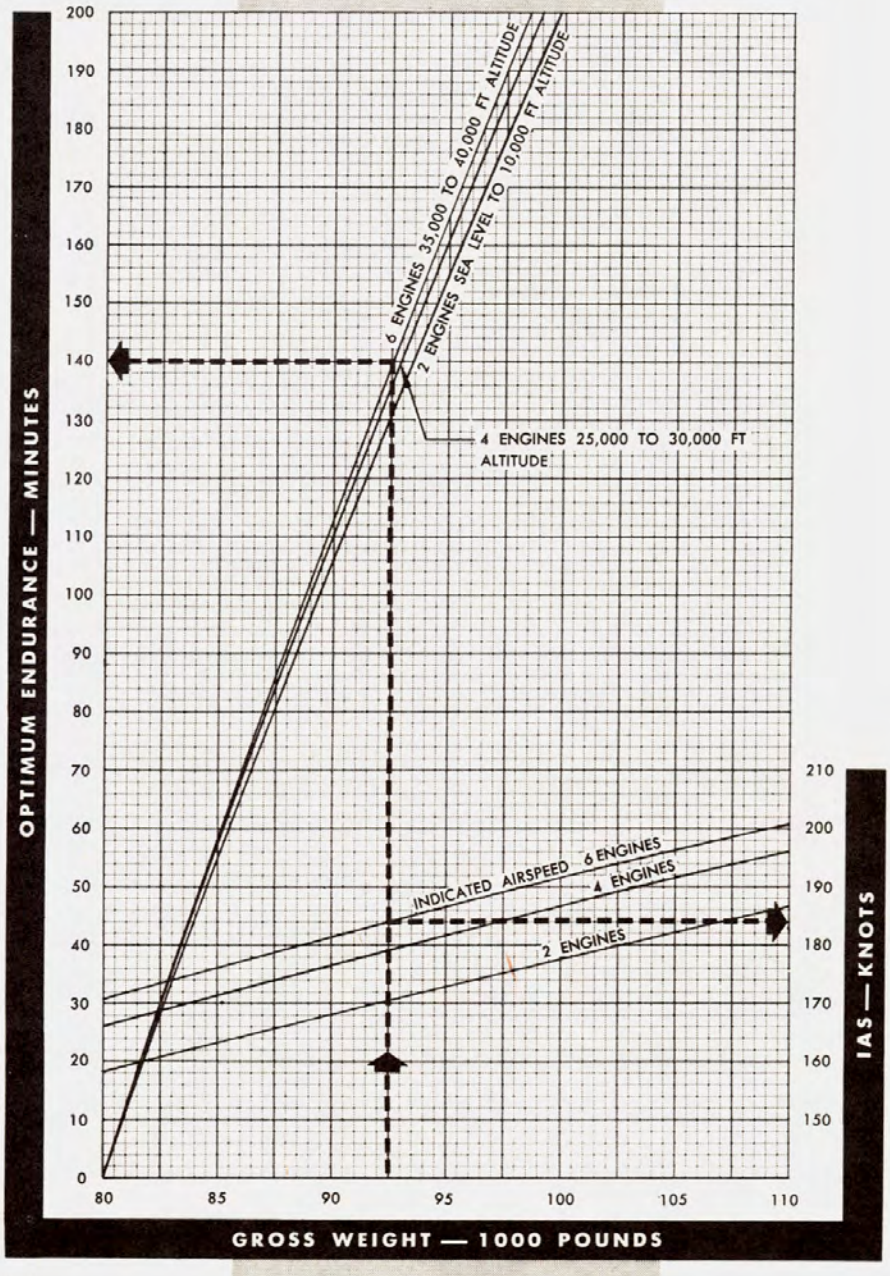
501

*Figure A5-1.*

# OPTIMUM ENDURANCE AT LIGHT WEIGHT

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

502

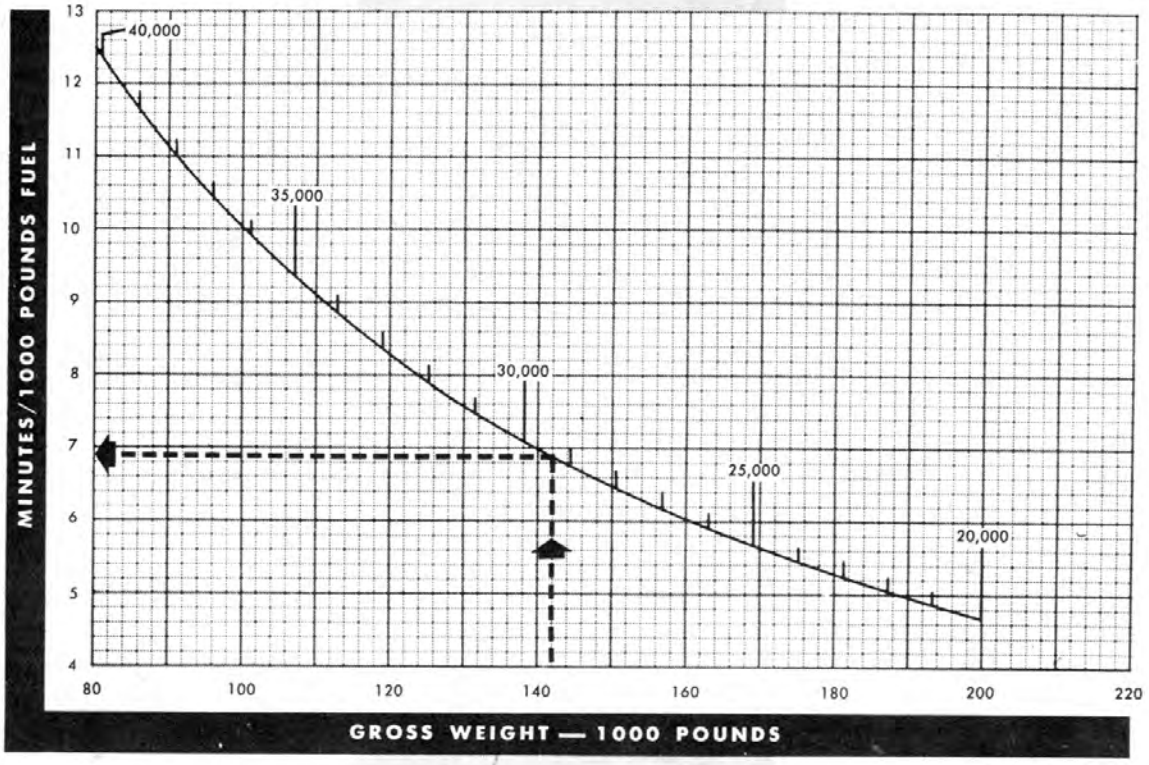
*Figure A5-2.*

# OPTIMUM ENDURANCE

## 6 ENGINES OPERATING

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

503

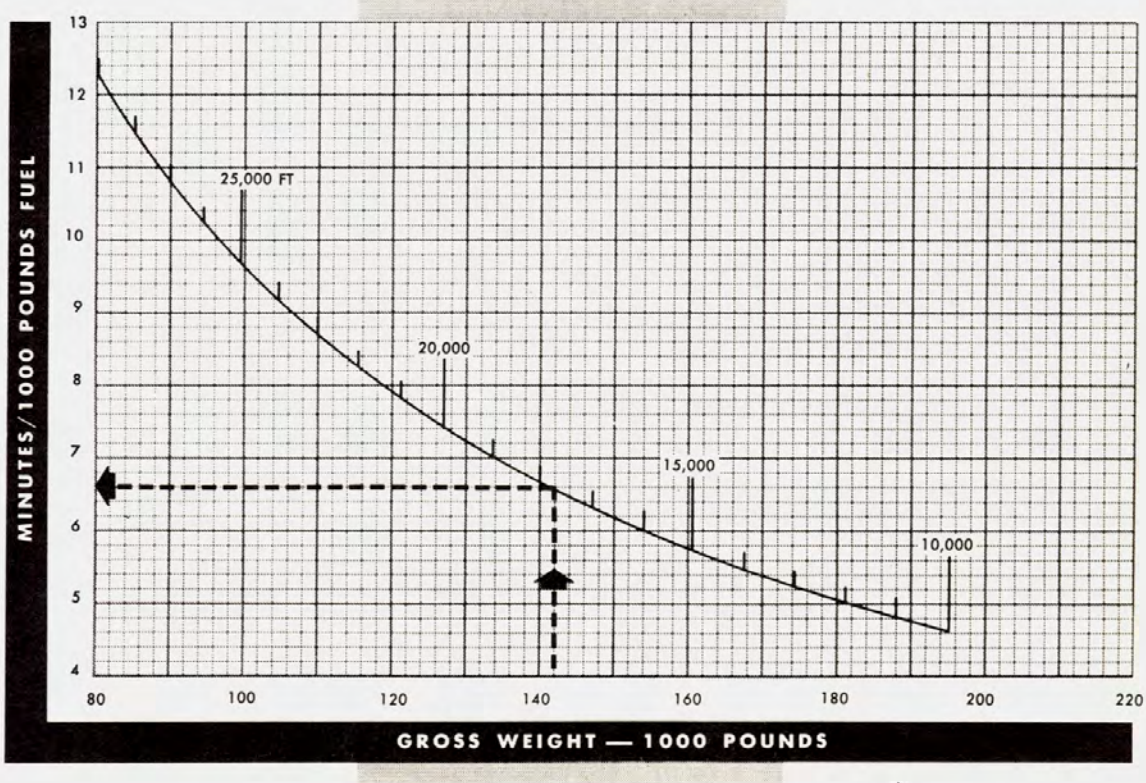
*Figure A5-3.*

# OPTIMUM ENDURANCE

## 4 ENGINES OPERATING

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

504

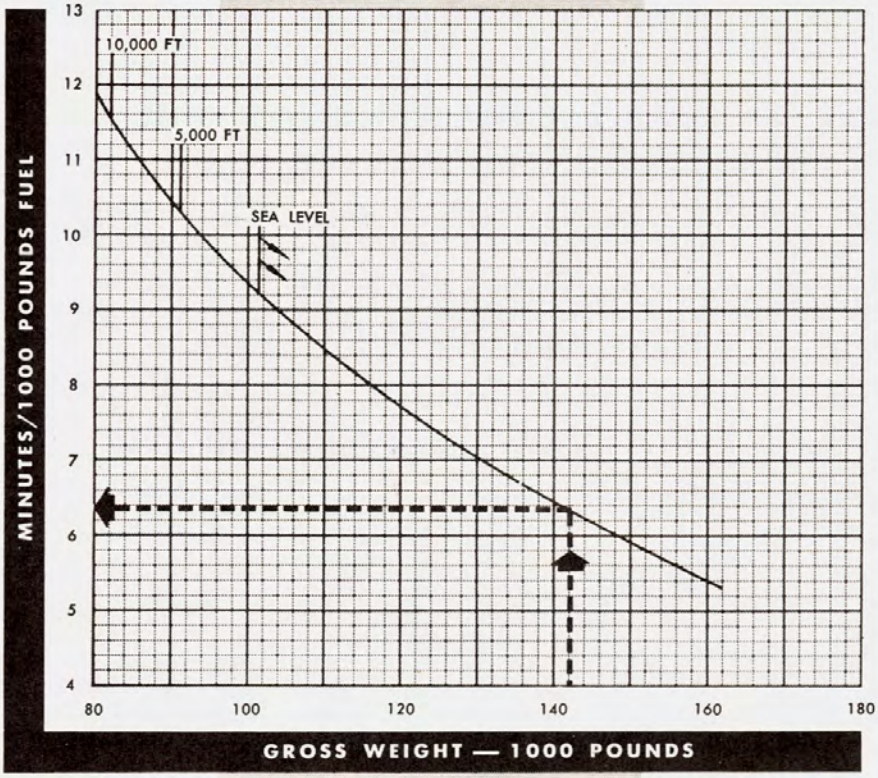
*Figure A5-4.*

# OPTIMUM ENDURANCE

## 2 ENGINES OPERATING

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

505

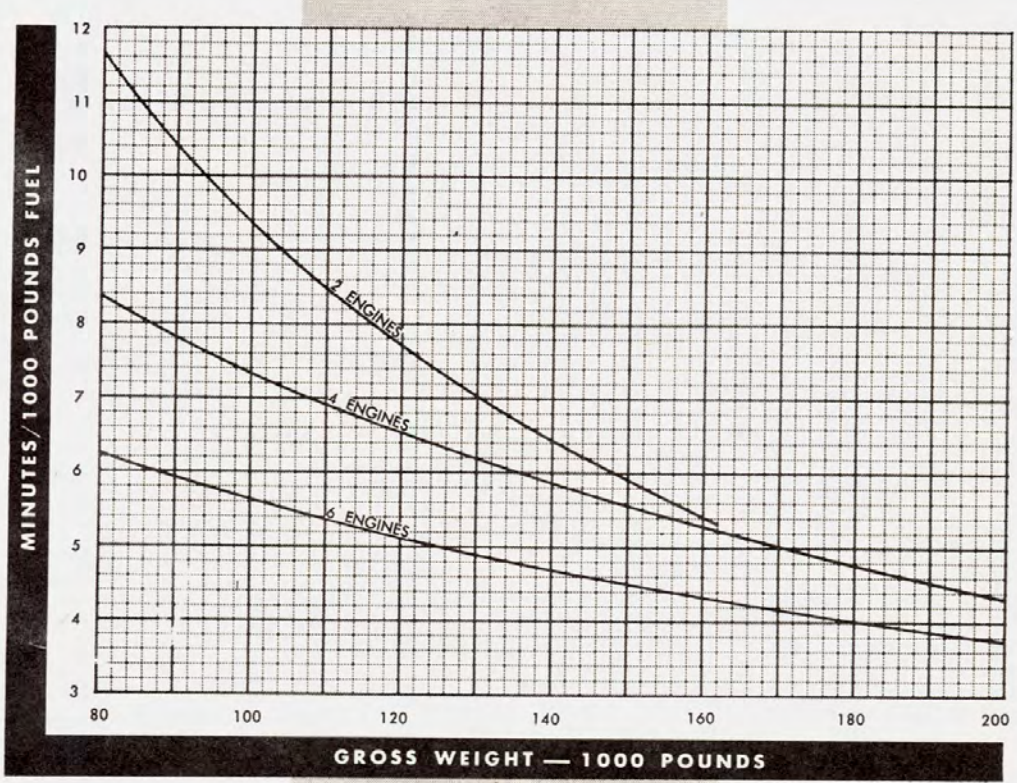
*Figure A5-5.*

# MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

## SEA LEVEL

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

506

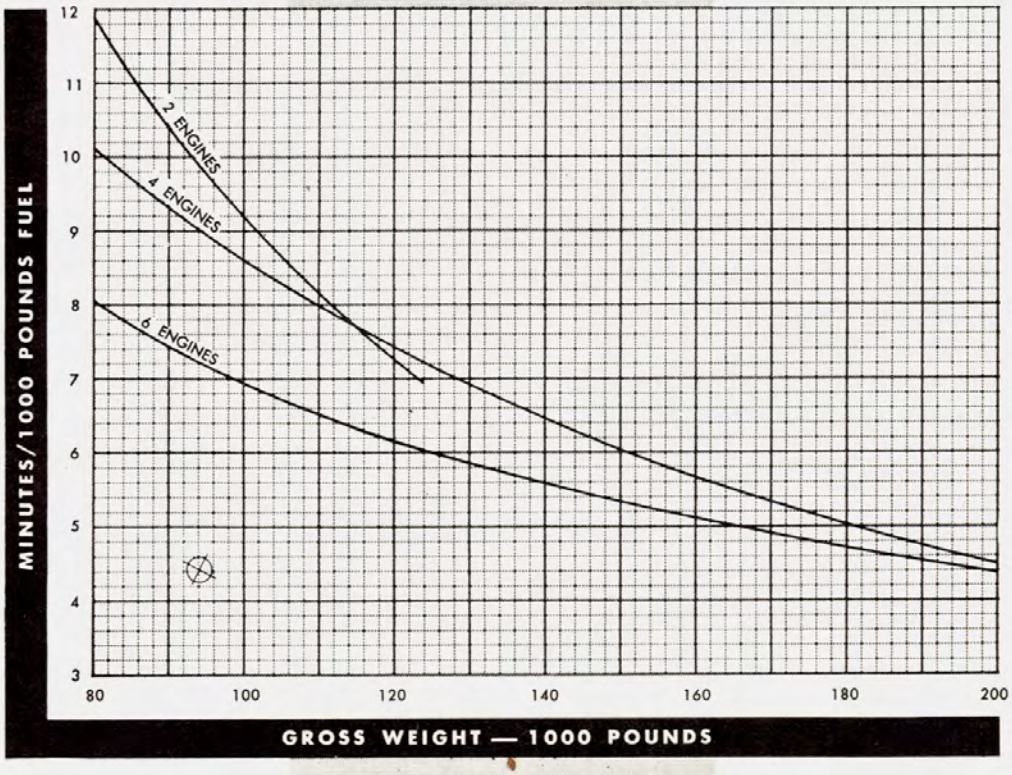
*Figure A5-6.*

# MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

## 10,000 FT

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

507

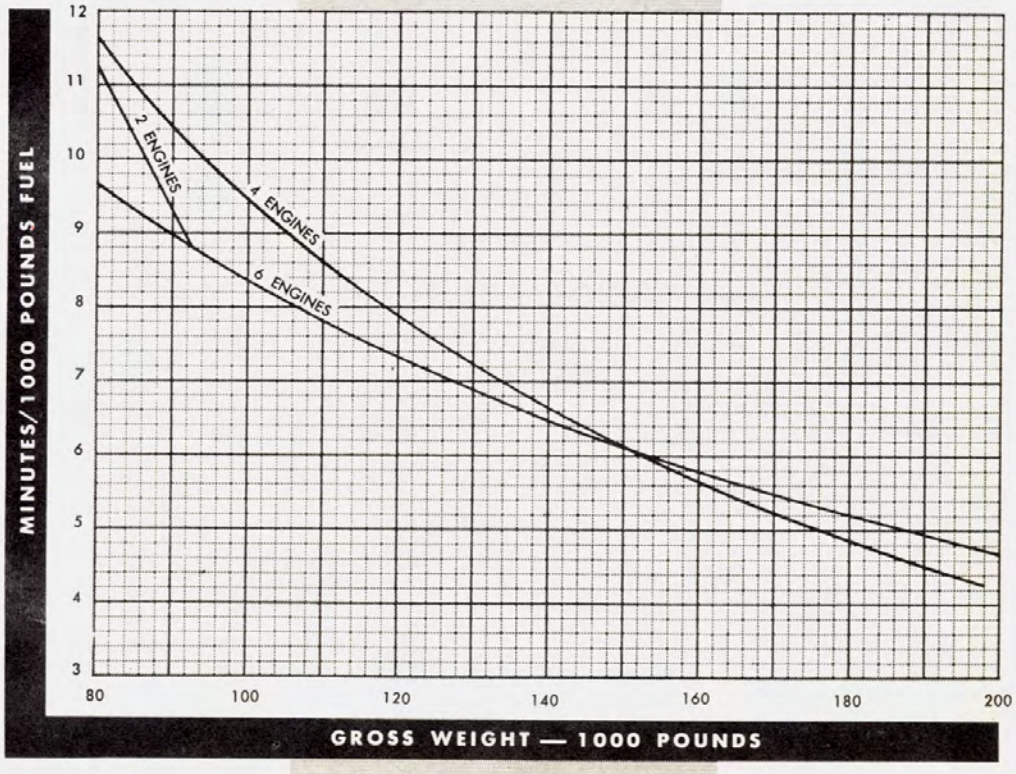
*Figure A5-7.*

# MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

## 20,000 FT

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

508

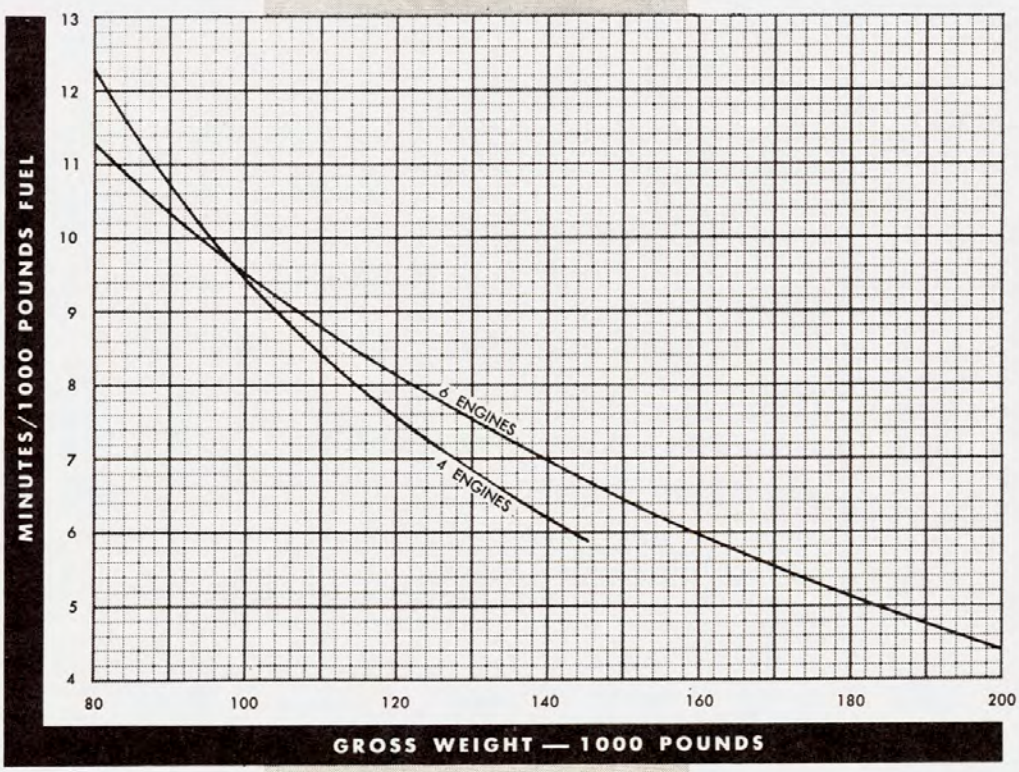
*Figure A5-8.*

# MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

## 30,000 FT

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

509

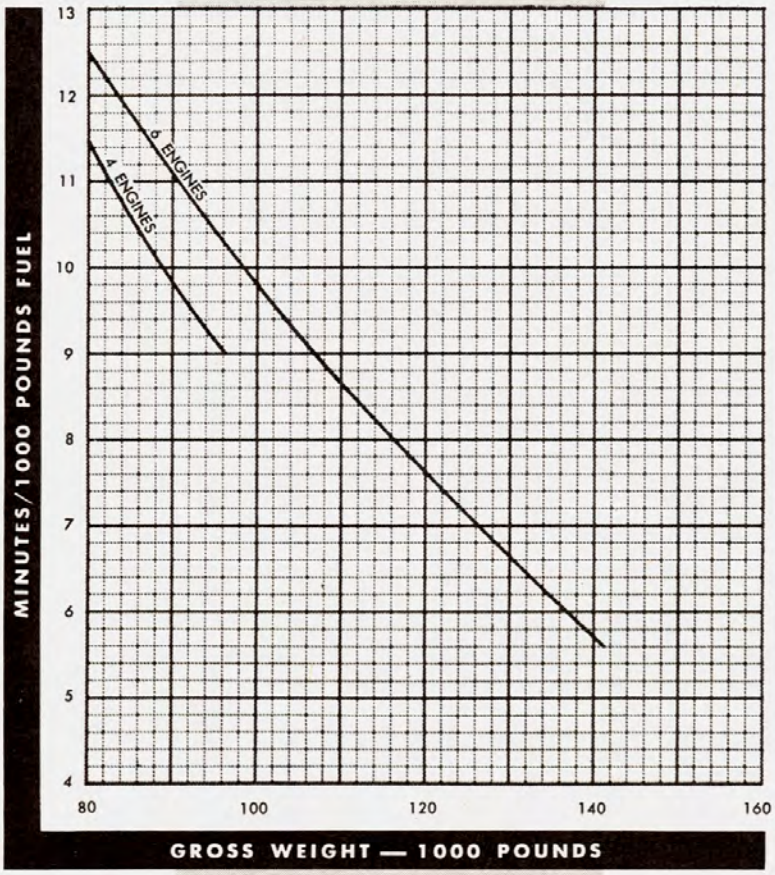
*Figure A5-9.*

# MAXIMUM ENDURANCE AT CONSTANT ALTITUDE

## 40,000 FT ALTITUDE

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

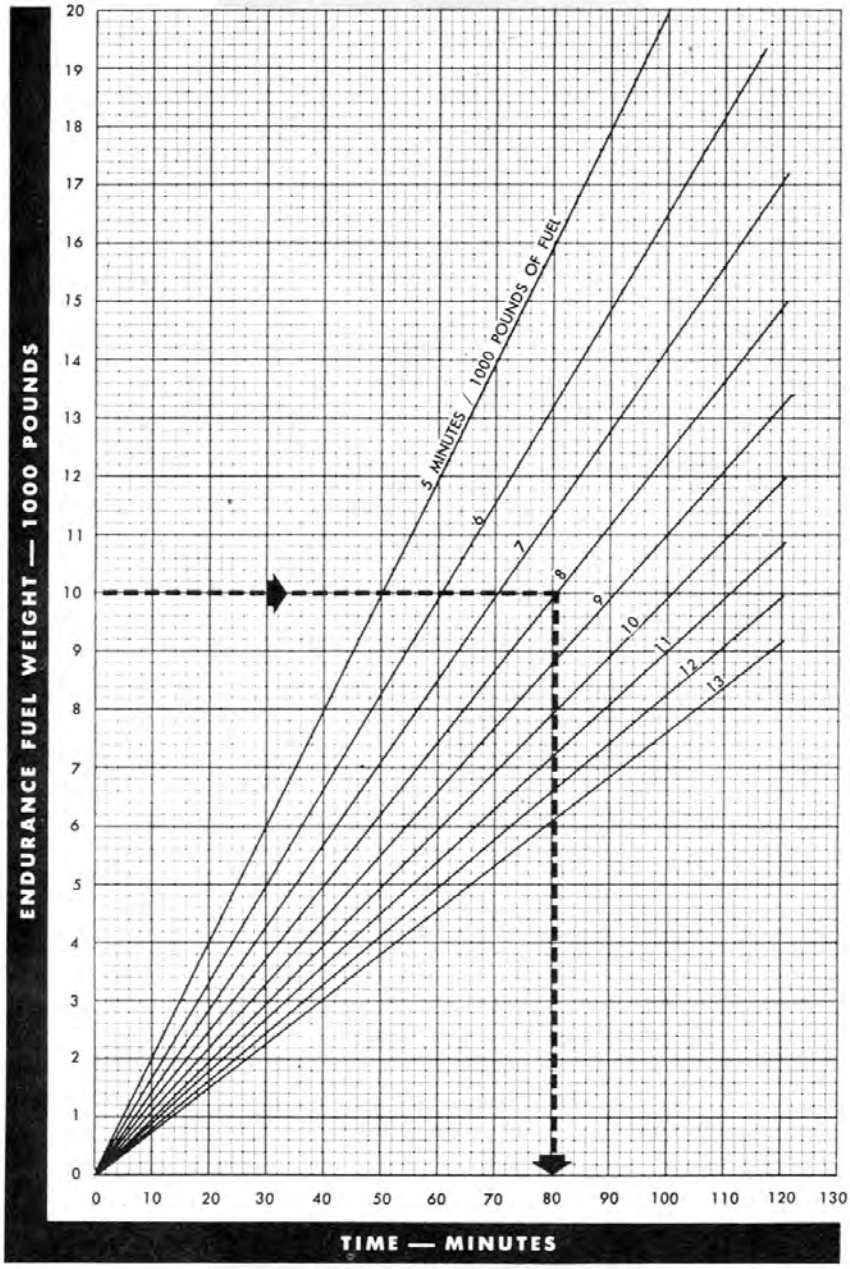
510

*Figure A5-10.*

# ENDURANCE FUEL VS TIME

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1951

**DATA BASIS:** CALCULATED

511

*Figure A5-11.*

Part 6

# 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.

## GEAR DOWN DESCENT (NORMAL)

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 feet 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 radio 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:

- Maximum rate of descent
- Shortest distance during descent
- Minimum fuel consumption during descent.

This is the recommended procedure for all let-downs where there is no range emergency. Figures A6-5 through A6-7 show normal descent performance.

## GEAR UP DESCENT (ALTERNATE)

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. Descend 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:

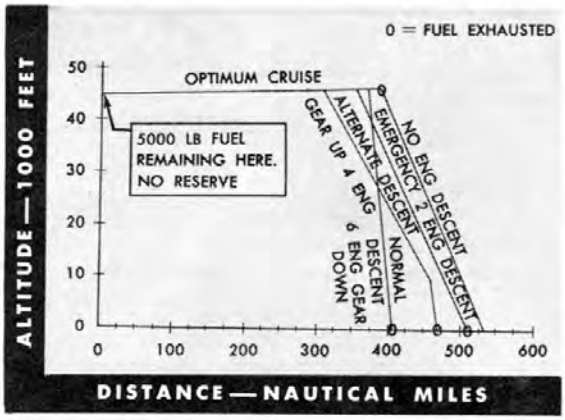
- Minimum rate of descent
- Maximum time of descent
- High fuel consumption and descent distance because of the long time involved
- Approximately the same fuel reserve, if two engines are cut, as the normal descent.

Figures A6-8 through A6-10 show the alternate descent performance.

## MAXIMUM RANGE DESCENT — GEAR UP (EMERGENCY)

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.




From the accompanying 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 3 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 A6-5 through A6-7. Descent performance with the landing gear retracted is presented on figures A6-8 through A6-10. The comparison between gear down, gear up, and emergency descent procedures is shown by figures A6-1 through A6-3 for a typical descent weight of 90,000 pounds. Maximum rates of descent for these conditions are shown in figure A6-4.

## MINIMUM RPM

The fuel regulators govern the minimum rpm at altitude even though the throttles are at the idle stop. The chart on figure A6-11 gives the minimum rpm schedule for descent with the throttles at the idle stop.

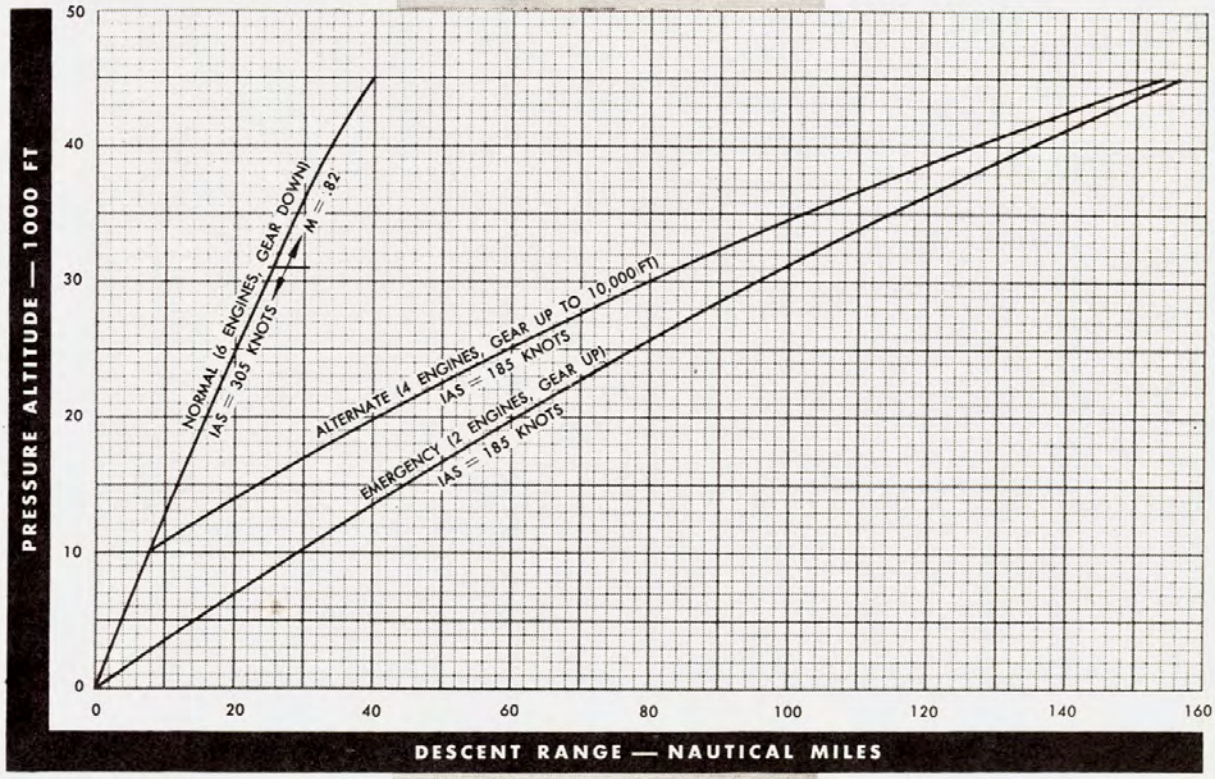
# DESCENT RANGE

## GROSS WEIGHT 90,000 POUNDS

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

601

*Figure A6-1.*

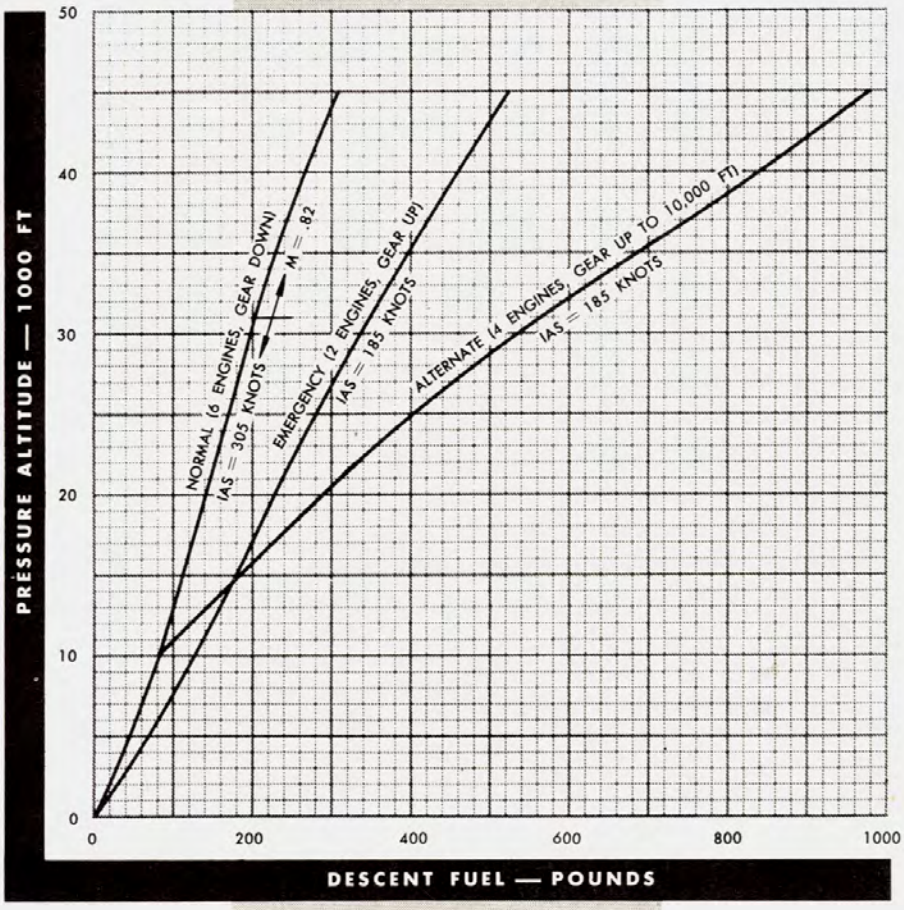
# DESCENT FUEL

## GROSS WEIGHT 90,000 POUNDS

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

602

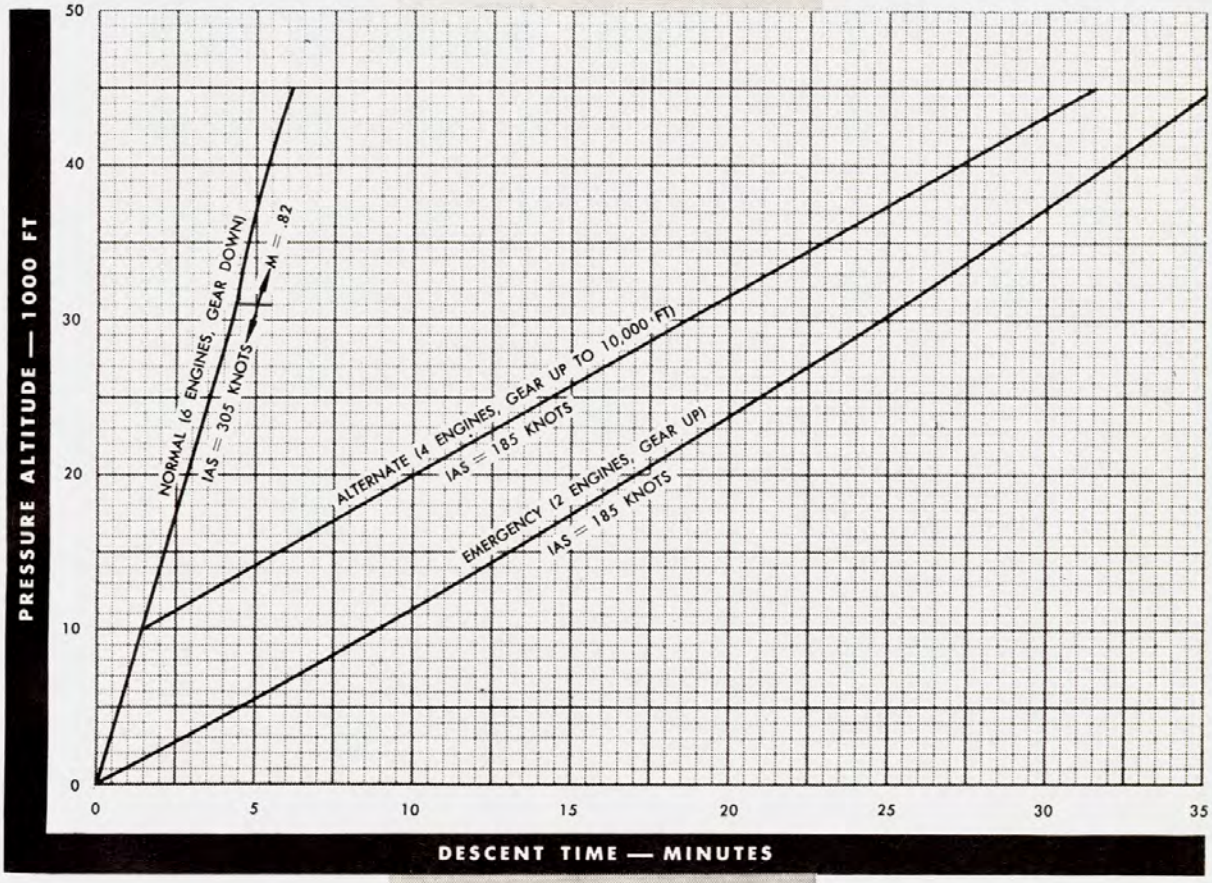
*Figure A6-2.*

# DESCENT TIME
## GROSS WEIGHT 90,000 POUNDS

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

603

*Figure A6-3.*

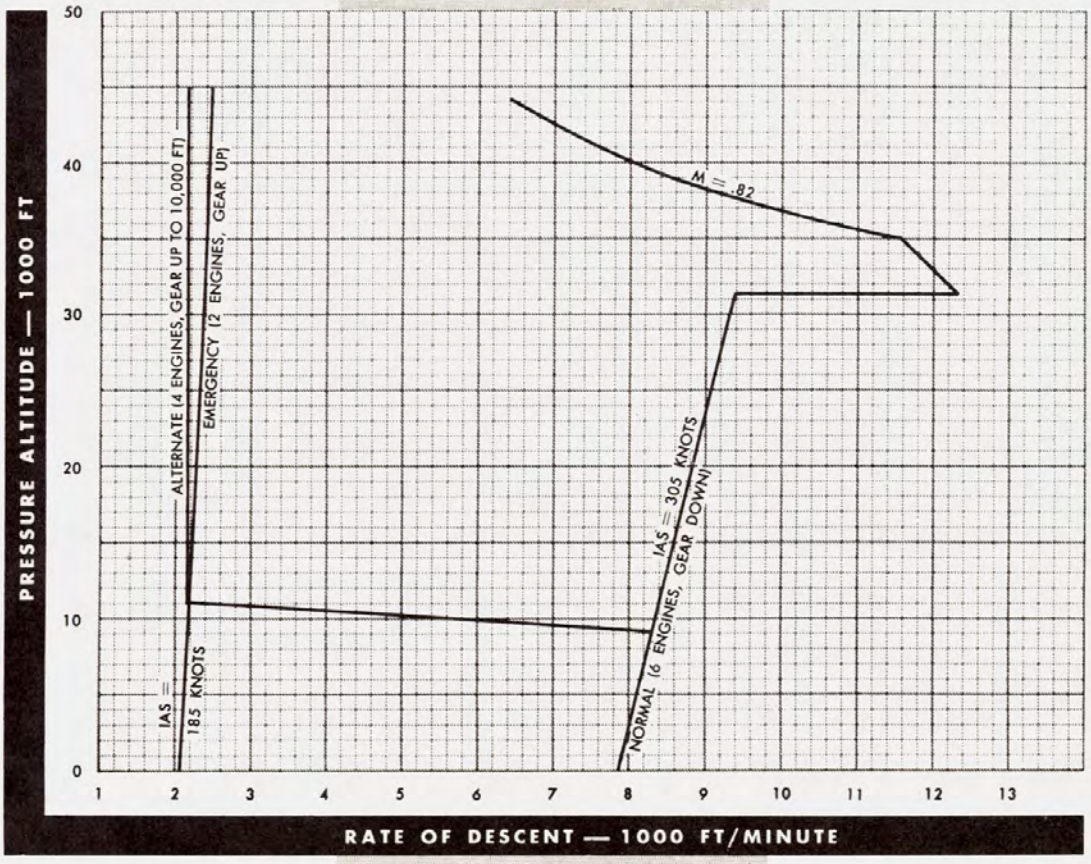
# RATE OF DESCENT

## GROSS WEIGHT 90,000 POUNDS

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

804

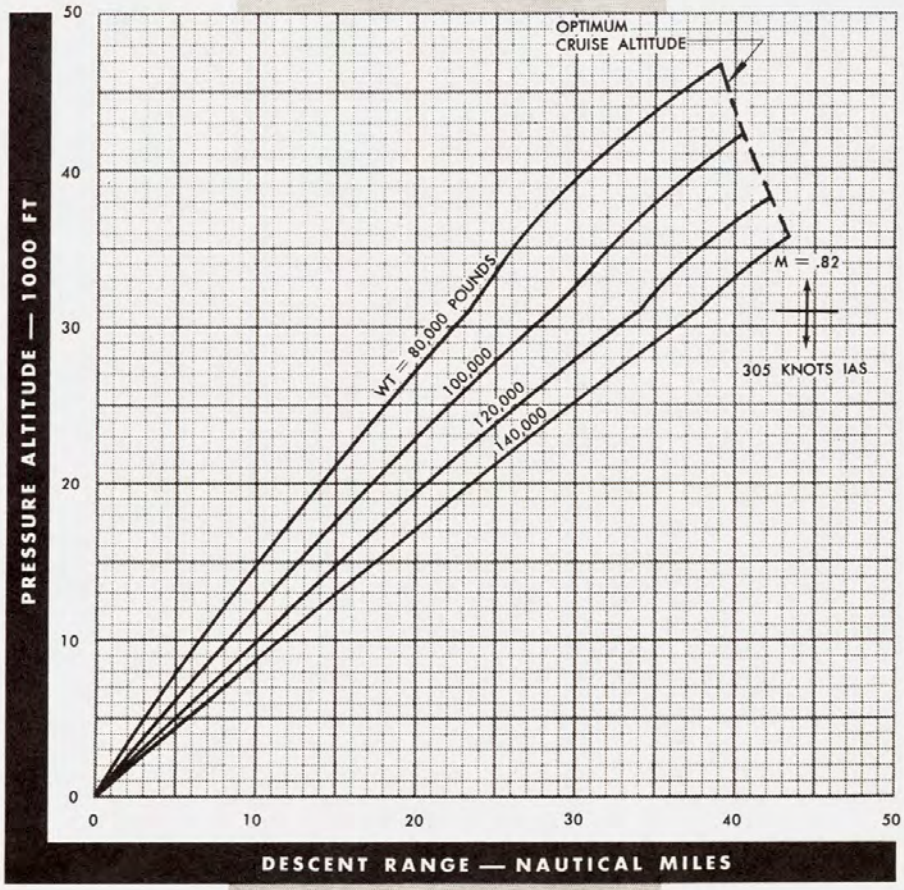
*Figure A6-4.*

# DESCENT RANGE
## GEAR DOWN

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**
GEAR DOWN
6 ENGINES AT MINIMUM IDLE

**REMARKS:**
M = .82 ABOVE 31,000 FT
305 KNOTS IAS BELOW 31,000 FT

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

605

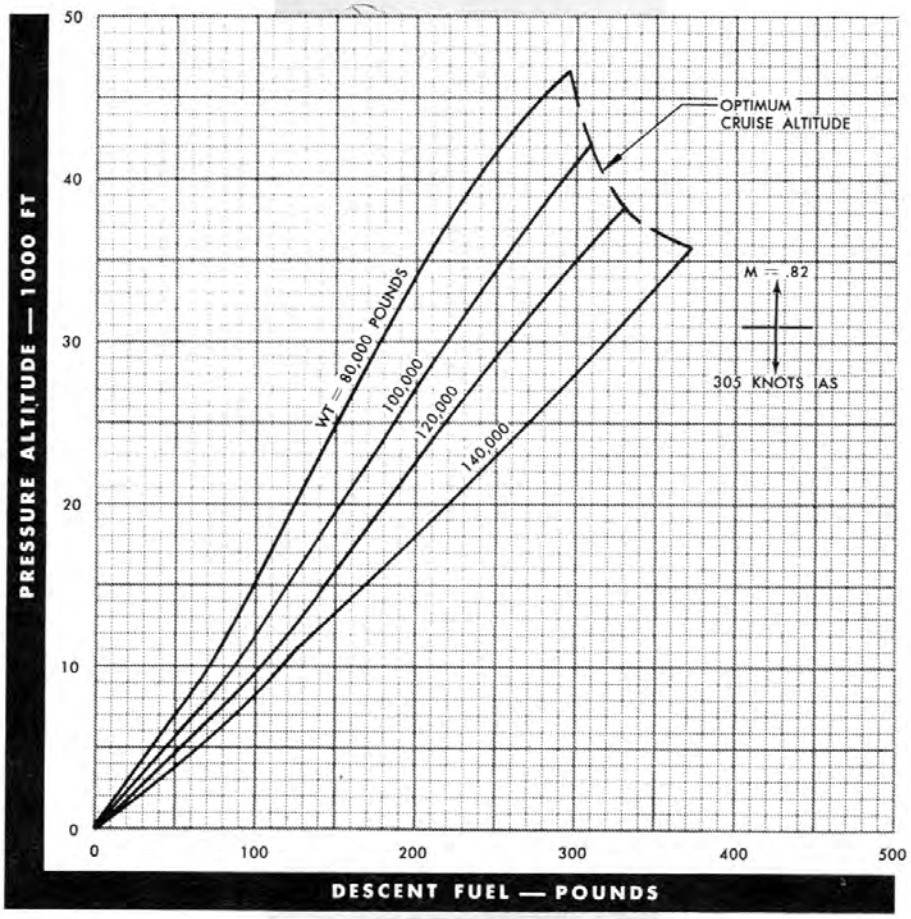
*Figure A6-5.*

# DESCENT FUEL
## GEAR DOWN

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**
GEAR DOWN
6 ENGINES AT MINIMUM IDLE

**REMARKS:**
M = .82 ABOVE 31,000 FT
305 KNOTS IAS BELOW 31,000 FT

606

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

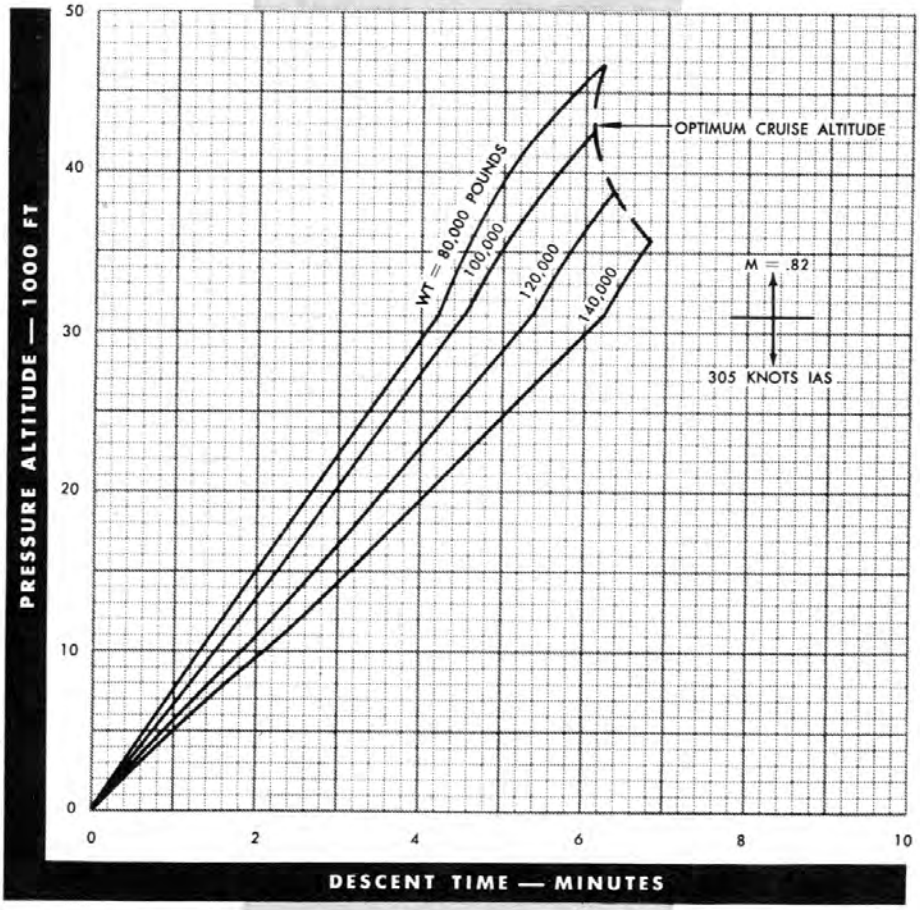
*Figure A6-6.*

# DESCENT TIME
## GEAR DOWN

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**
GEAR DOWN
6 ENGINES AT MINIMUM IDLE

**REMARKS:**
M = .82 ABOVE 31,000 FT
305 KNOTS IAS BELOW 31,000 FT

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

607

*Figure A6-7.*

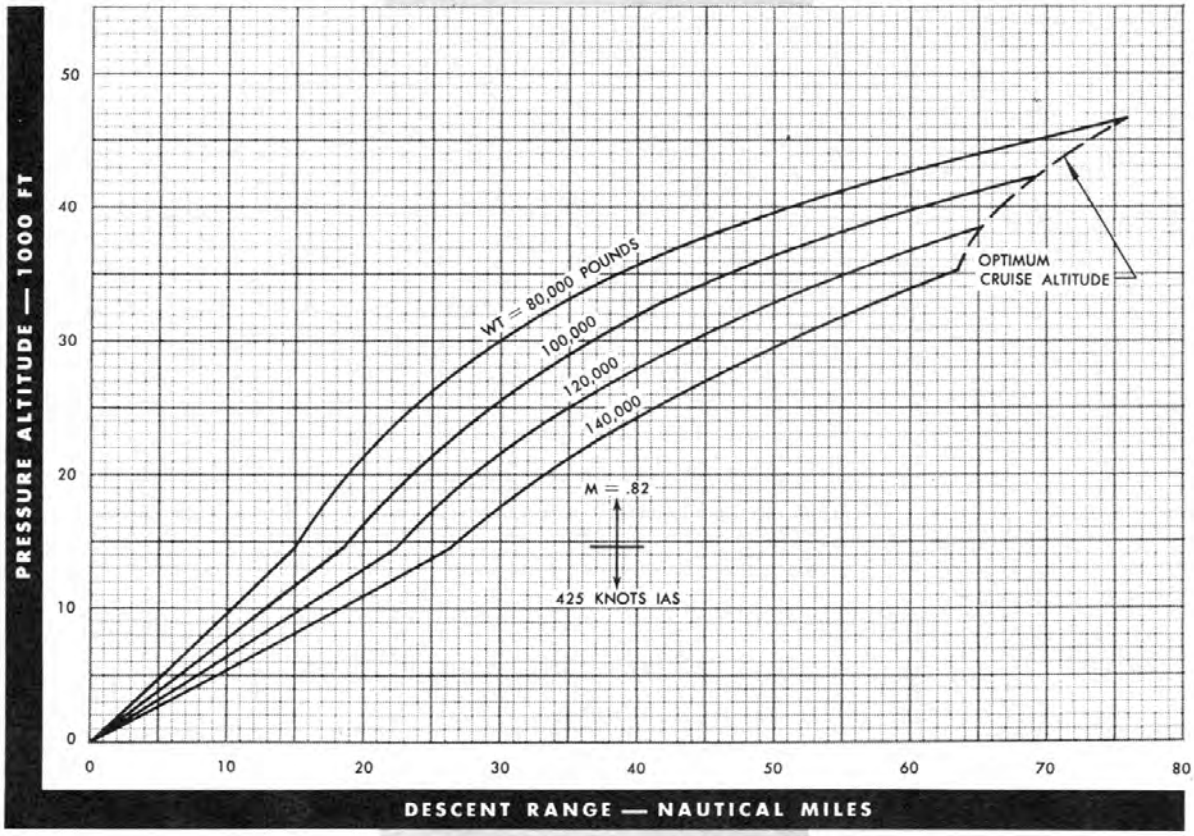
# DESCENT RANGE

## GEAR UP

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**

GEAR UP

6 ENGINES AT MINIMUM IDLE

**REMARKS:**

M = .82 ABOVE 14,600 FT

425 KNOTS IAS BELOW 14,600 FT

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

608

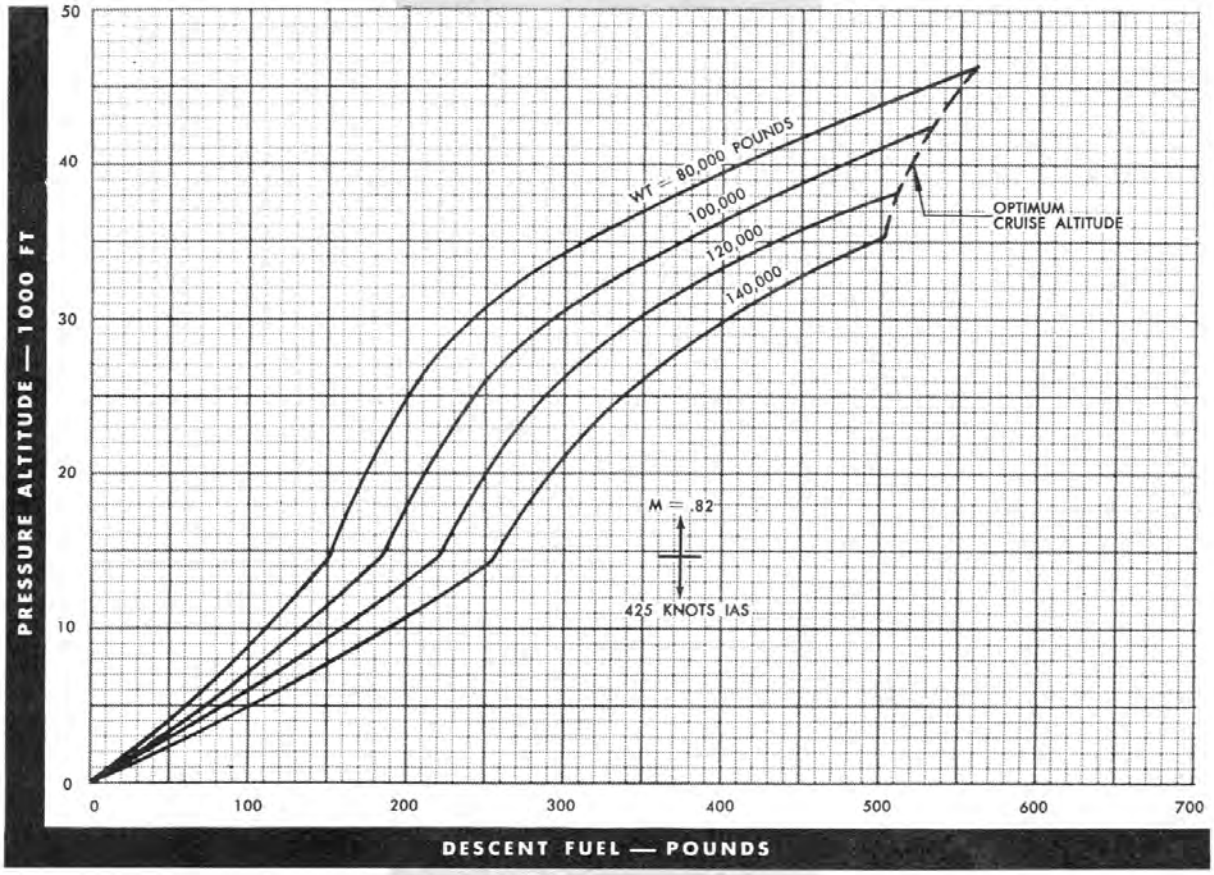
*Figure A6-8.*

# DESCENT FUEL
## GEAR UP

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**

GEAR UP

6 ENGINES AT MINIMUM IDLE

**REMARKS:**

M = .82 ABOVE 14,600 FT

425 KNOTS IAS BELOW 14,600 FT

609

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

*Figure A6-9.*

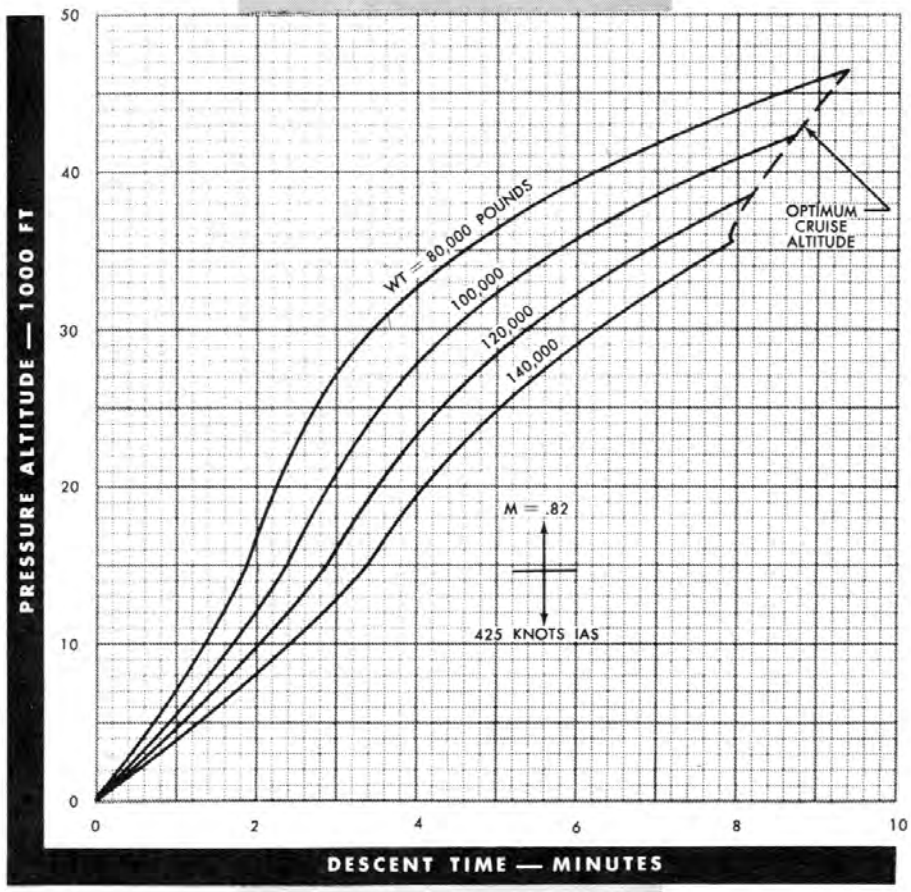
# DESCENT TIME

## GEAR UP

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**
GEAR UP
6 ENGINES AT MINIMUM IDLE

**REMARKS:**
M = .82 ABOVE 14,600 FT
425 KNOTS IAS BELOW 14,600 FT

**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

610

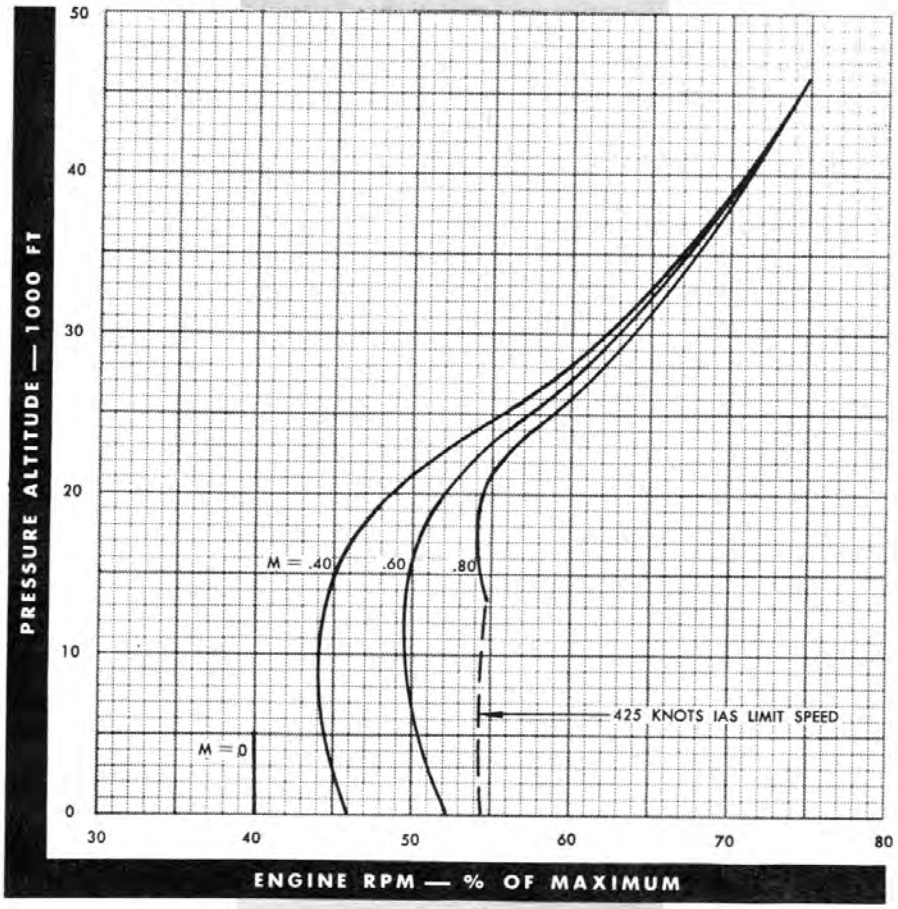
*Figure A6-10.*

# FUEL REGULATOR MINIMUM RPM

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** NOVEMBER 1952

**DATA BASIS:** FLIGHT TEST

611

*Figure A6-11.*

Part 7

# AIR REFUELING

This part not applicable

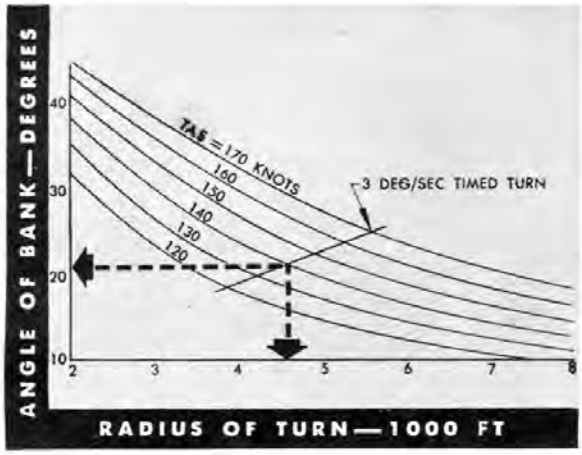
Part 8

# APPROACH & 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 downwind 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.



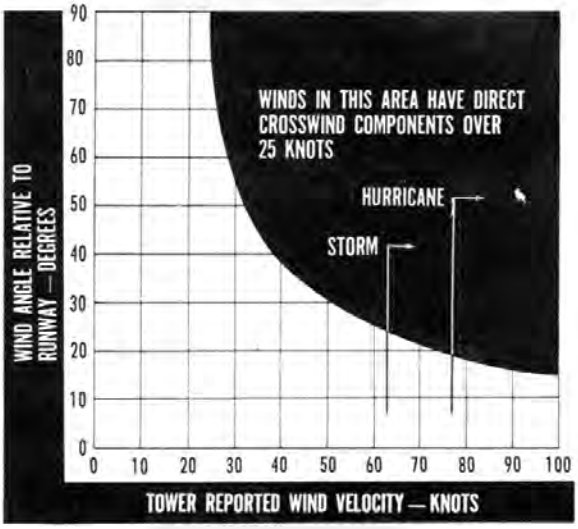

50950

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




30732

## CG POSITION DURING APPROACH

The chart on figure A8-1 gives 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 A8-2. 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 (figure A8 -3). 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 |

50957

## FLARE

Figure A8-4 illustrates altitude for start of flare and distance traveled during flare for various gross weights. This chart is computed 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. OAT higher than standard tends to increase the height for start of flare. The chart also shows the altitude for starting go-around. Typical heights for start of go-around are 35 feet for a 90,000-pound airplane, increasing to approximately 70 feet for a 150,000-pound airplane. The chart is exact for gross weights of 90,000, 120,000, and 150,000 pounds and can be used with reasonable accuracy between these weights.

## 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 3.

## STOPPING DISTANCES

### Procedures

All landings except emergencies should be planned 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 and as a safety device in case of brake failure. Special emphasis during the approach should be given to correct approach speeds to insure that the anticipated touchdown point is made good rather than relying on the chute to correct for any overshooting tendency. Considering the operational runways normally available to the airplane where prelanding planning indicates that adequate stopping distance exists, normal landing procedure is to deploy the brake chute at touchdown and to delay application of the brakes until about 40 knots. This procedure results in a reasonably short stopping distance without excessive wear on brakes and tires and, at the same time, decreases the possibility of a dangerous situation arising in case of brake failure. Whenever possible, the full length of runway available should be used for stopping. 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 use of brakes only.

### Charts

This part contains charts illustrating the stopping distances for various combinations of gross weight, ambient conditions, runway surface conditions, and stopping procedures employed. These stopping distances are computed for six engines at idle rpm throughout the landing roll. Depending on the conditions, it will sometimes be advisable to cut engines to further decrease stopping distance. The following illustration is a tabulation of the amount by which the stopping distances

computed from the charts can be decreased by placing four or six engines in cutoff at touchdown.

**EFFECT OF CUTTING ENGINES ON STOPPING DISTANCES**

| CONDITIONS | DECREASE IN STOPPING DISTANCE (FEET) FROM 6 ENGINES AT IDLE DATA | |
|---|---|---|
| | 4 ENGINES IN CUTOFF | 6 ENGINES IN CUTOFF |
| **FLAPS DOWN** | | |
| NORMAL — DRY RUNWAY | 400-700 | 600-900 |
| NORMAL — WET RUNWAY | 500-700 | 675-950 |
| MINIMUM — DRY RUNWAY | 75-150 | 100-200 |
| MINIMUM — WET RUNWAY | 150-300 | 200-400 |
| BRAKES FROM 80 KNOTS IAS — DRY RUNWAY | 850-1600 | 1200-2250 |
| BRAKES FROM 80 KNOTS IAS — WET RUNWAY | 1000-1650 | 1650-2400 |
| **FLAPS UP** | | |
| MINIMUM — DRY RUNWAY | 61-125 | 91-133 |
| MINIMUM — WET RUNWAY | 130-278 | 193-402 |
| BRAKES FROM TOUCHDOWN — DRY RUNWAY | 238-524 | 353-750 |
| BRAKES FROM TOUCHDOWN — WET RUNWAY | 579-1387 | 859-1944 |

**NOTE:**

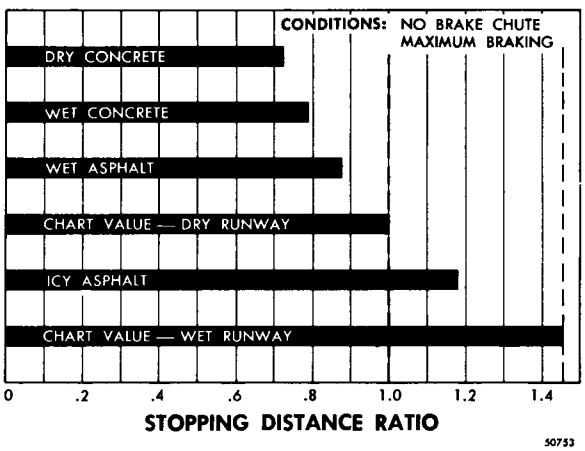
THIS CHART SUPPLEMENTS DATA GIVEN IN STOPPING DISTANCE CHARTS, FIGURES A 8-5 THRU A 8-8

**CONDITIONS:**

ENGINES AS NOTED PLACED IN CUTOFF AT TOUCHDOWN

50754

Figures A8-5 and A8-6 show "minimum," "normal," "planned," and "brakes applied from 80 knots IAS" stopping distances for a flaps-down landing on dry and wet or icy runway. The planned stopping distance on the charts is used prior to landing as a criterion for determining if the available runway is adequate to execute a safe stop. This stopping distance takes into account the possibility of brake chute failure during a normal landing, whereby the pilot would immediately apply brakes upon recognition of the chute failure. As a result, planned stopping distance is based on brakes being applied at 80% of the touchdown velocity which allows the pilot approximately 20 seconds in which to recognize failure of the brake chute and to commence braking. The normal stopping distance on the charts indicates to the pilot the distance required to stop when normal stopping procedures are performed during the landing roll. The minimum stopping distance on the charts illustrates the shortest stopping distance possible should an emergency occur where reliance on the brake chute is mandatory. The "brakes applied from 80 knots IAS" stopping distance on the charts is merely shown to point out the excessive distances required to stop should braking be delayed too long when the brake chute is not deployed. Figure A8-9 is a plot of the increase in stopping distance to be expected when landing on a runway with a downhill grade. Figures A8-7 and A8-8 illustrate "minimum" and "brakes applied from touchdown" stopping distances for a flaps-up landing on dry and wet or icy runways. Flaps-up landings should always be considered as an emergency and planned from the minimum stopping distance as given in the charts. The "brakes applied from touchdown" stopping distance illustrates the distance required to stop should a double emergency of flaps-up and brake chute failure occur. The stopping distances computed from the charts are for conditions of "dry runway" and "wet or icy runway." The data is sufficiently conservative that it may be applied to asphalt, macadam, or concrete surfaces. The following illustration presents comparative values between the chart values and other types of surfaces.




50753

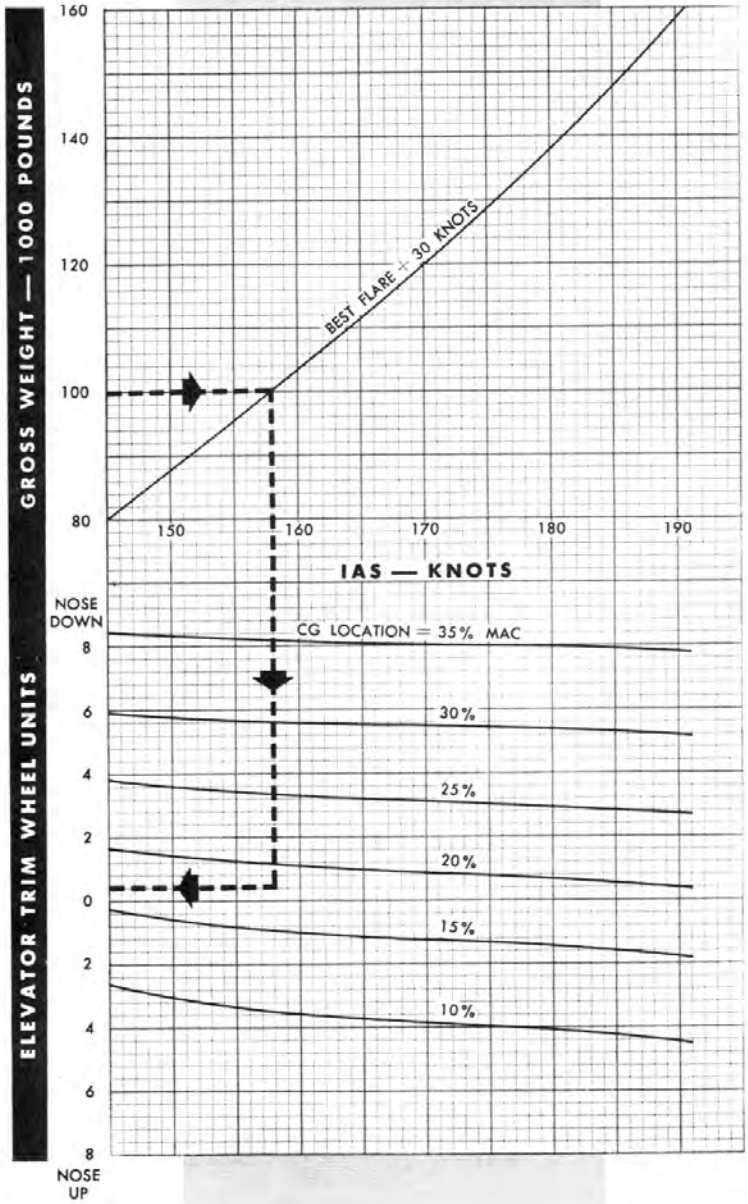
It is felt that indeterminate factors such as braking technique and pavement texture preclude more precise indication of stopping distance than that shown in the charts. The illustration is presented only to emphasize the validity of applying the indicated performance to all types and conditions of runway surfaces.

# APPROACH TRIM WHEEL SETTING

## WITHOUT FLAP TRIM COMPENSATION

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**

SEA LEVEL TO 10,000 FT ALTITUDE

ELEVATOR SURFACE POWER CONTROL ON

FLAPS AND GEAR FULL DOWN

**DATE:** APRIL 1954

**DATA BASIS:** CALCULATED

801

*Figure A8-1.*

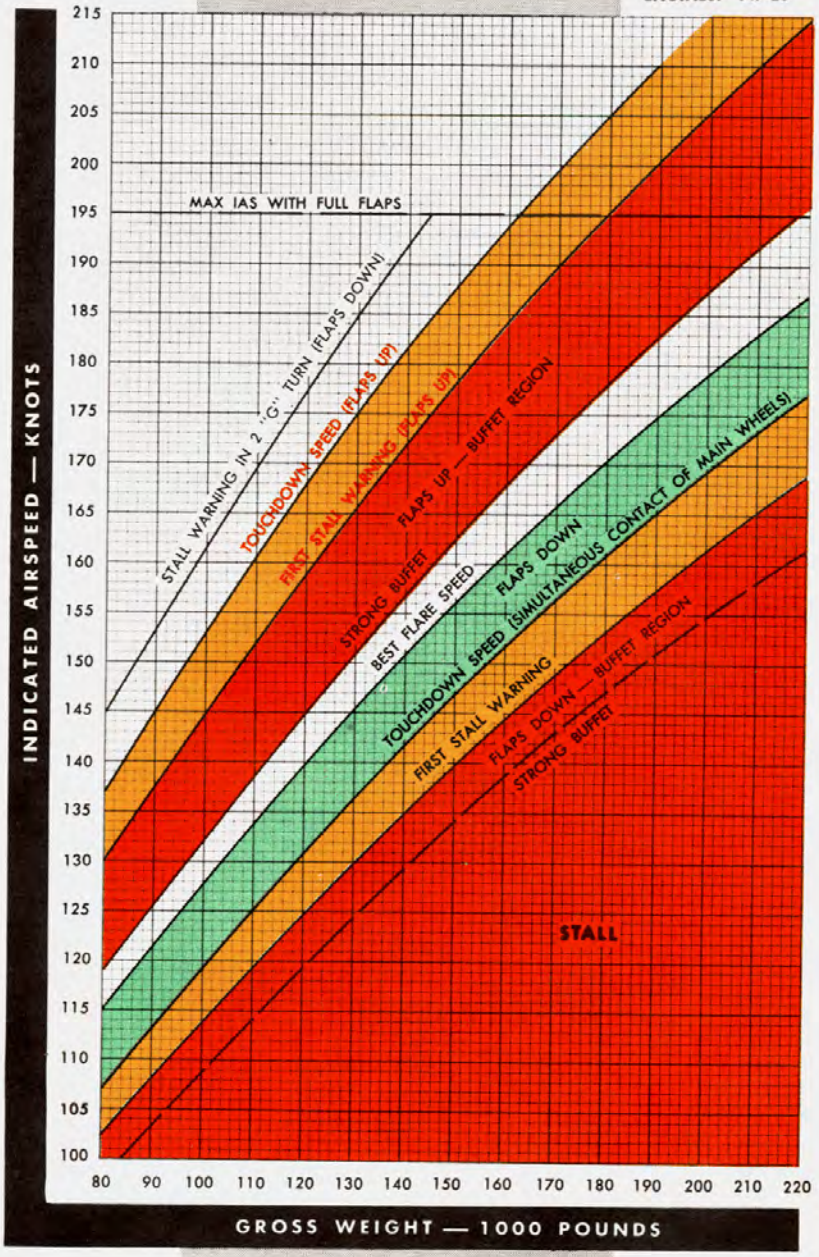
# MINIMUM SPEEDS

## NON-MANEUVERING FLIGHT

### 1 "G" LOAD FACTOR

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
SEA LEVEL TO 10,000 FEET

802

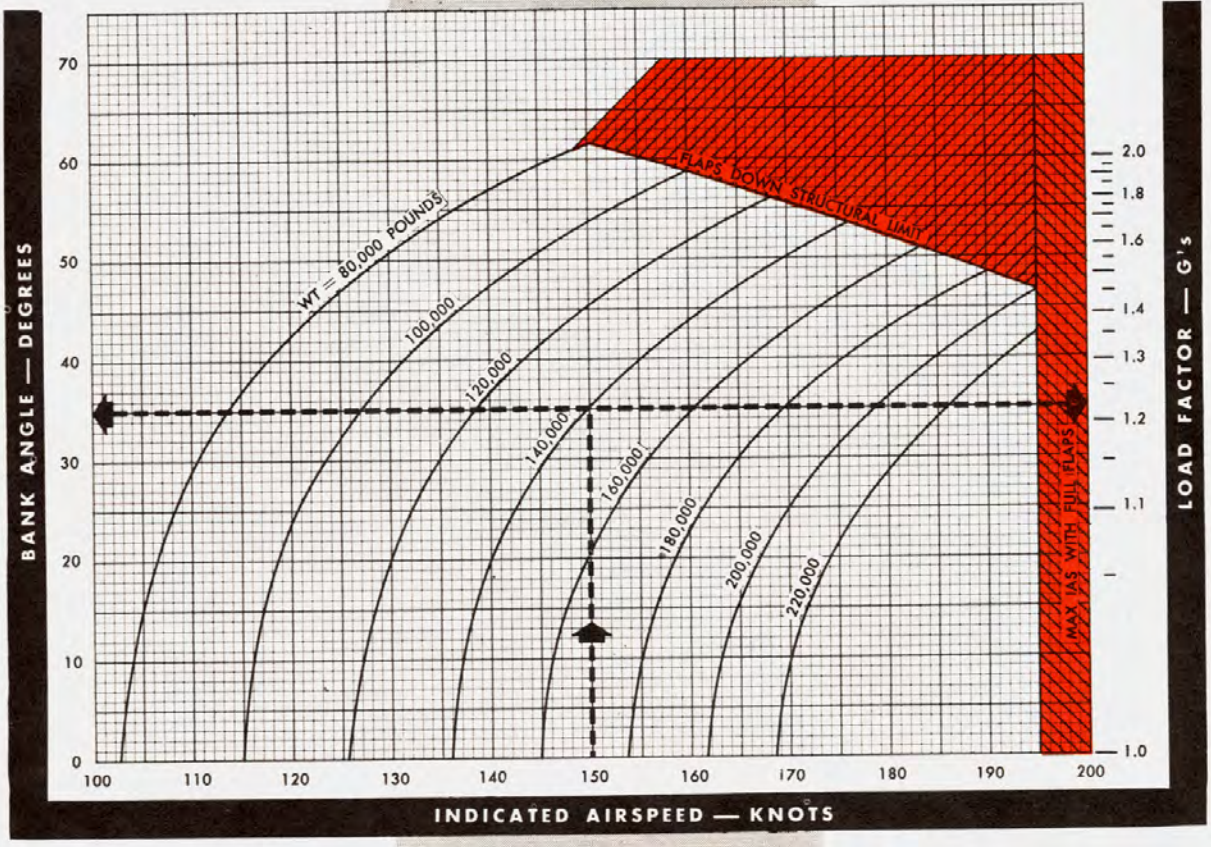
*Figure A8-2.*

# ACCELERATED STALLING SPEEDS

## FLAPS DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**

SEA LEVEL TO 10,000 FT
ALL POWER CONDITIONS

**REMARKS:**

FLAPS DOWN STRUCTURAL LIMIT CURVE IS INDEPENDENT OF INDICATED AIRSPEED

803

**DATE:** APRIL 1955

**DATA BASIS:** FLIGHT TEST

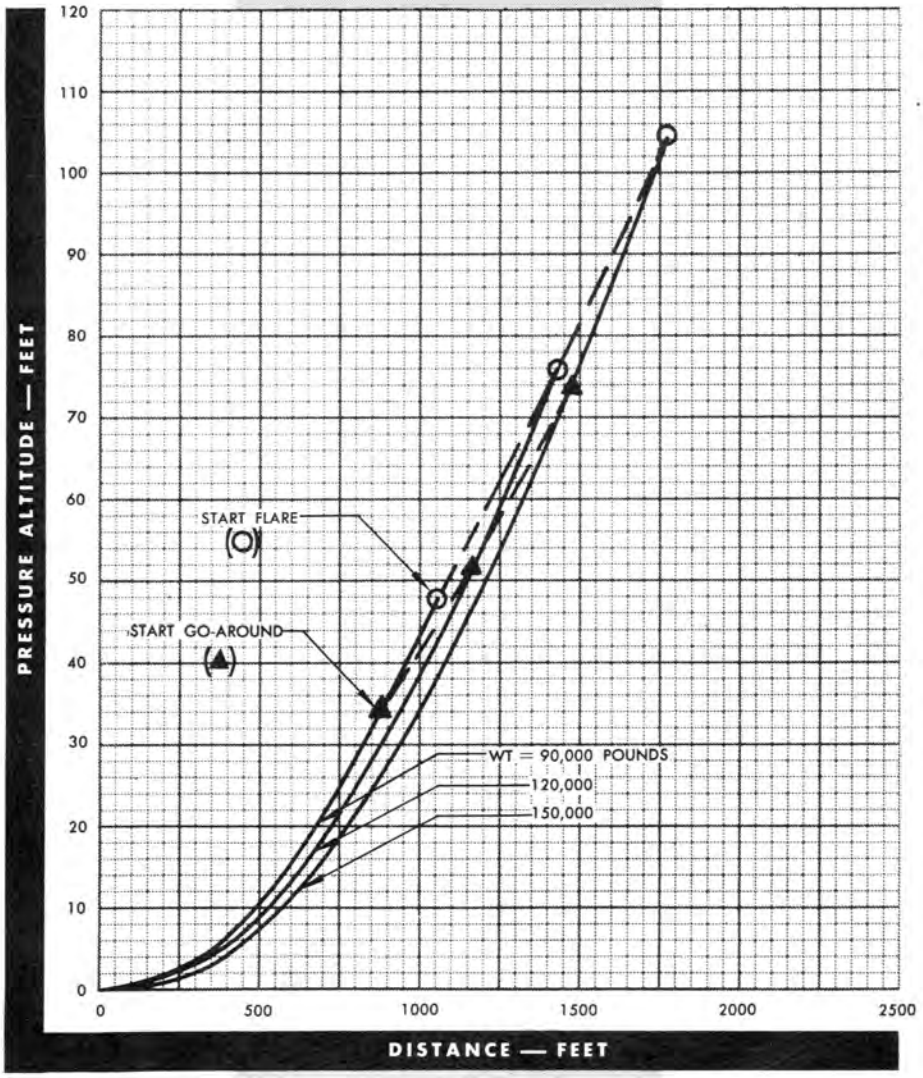
*Figure A8-3.*

# APPROACH & GO-AROUND

**NACA STANDARD, DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

DOTTED LINES INDICATE TREND FOR VARIOUS GROSS WEIGHTS.

**CONDITIONS:**

CONSTANT APPROACH SPEED 55% RPM

**DATE:** NOVEMBER 1952

**DATA BASIS:** FLIGHT TEST

804

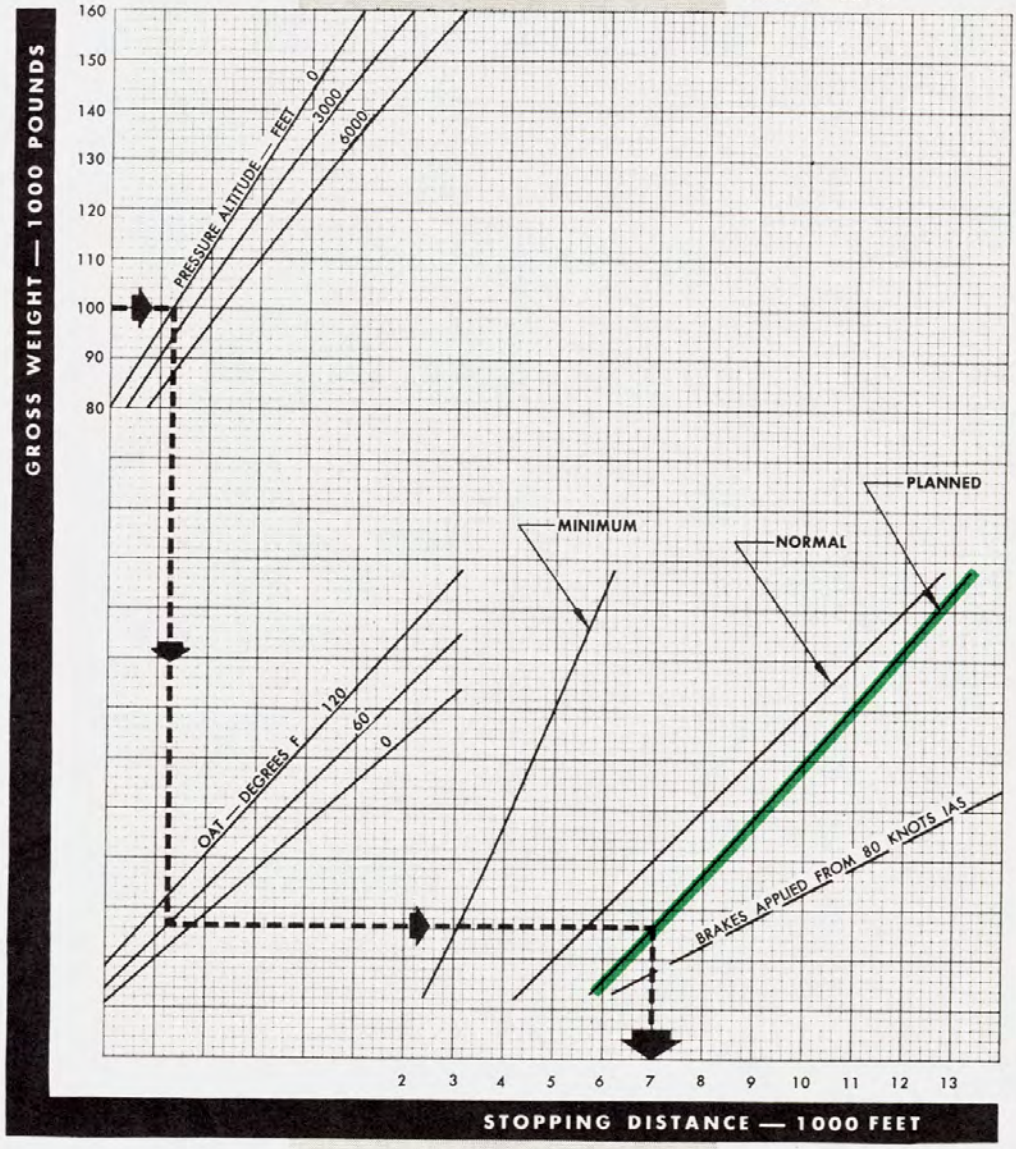
*Figure A8-4.*

# STOPPING DISTANCES - FLAPS DOWN

## DRY RUNWAY

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

**PLANNED** — BRAKES APPLIED FROM 80% OF TOUCHDOWN VELOCITY

**NORMAL** — CHUTE DEPLOYED AT TOUCHDOWN; BRAKES APPLIED FROM 40 KNOTS IAS

**MINIMUM** — CHUTE DEPLOYED AT TOUCHDOWN; BRAKES APPLIED FROM TOUCHDOWN

**DATE:** MARCH 1956

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

ALL ENGINES AT IDLE AT TOUCHDOWN

NO APPROACH CHUTE

NO WIND

FLAPS FULL DOWN

805

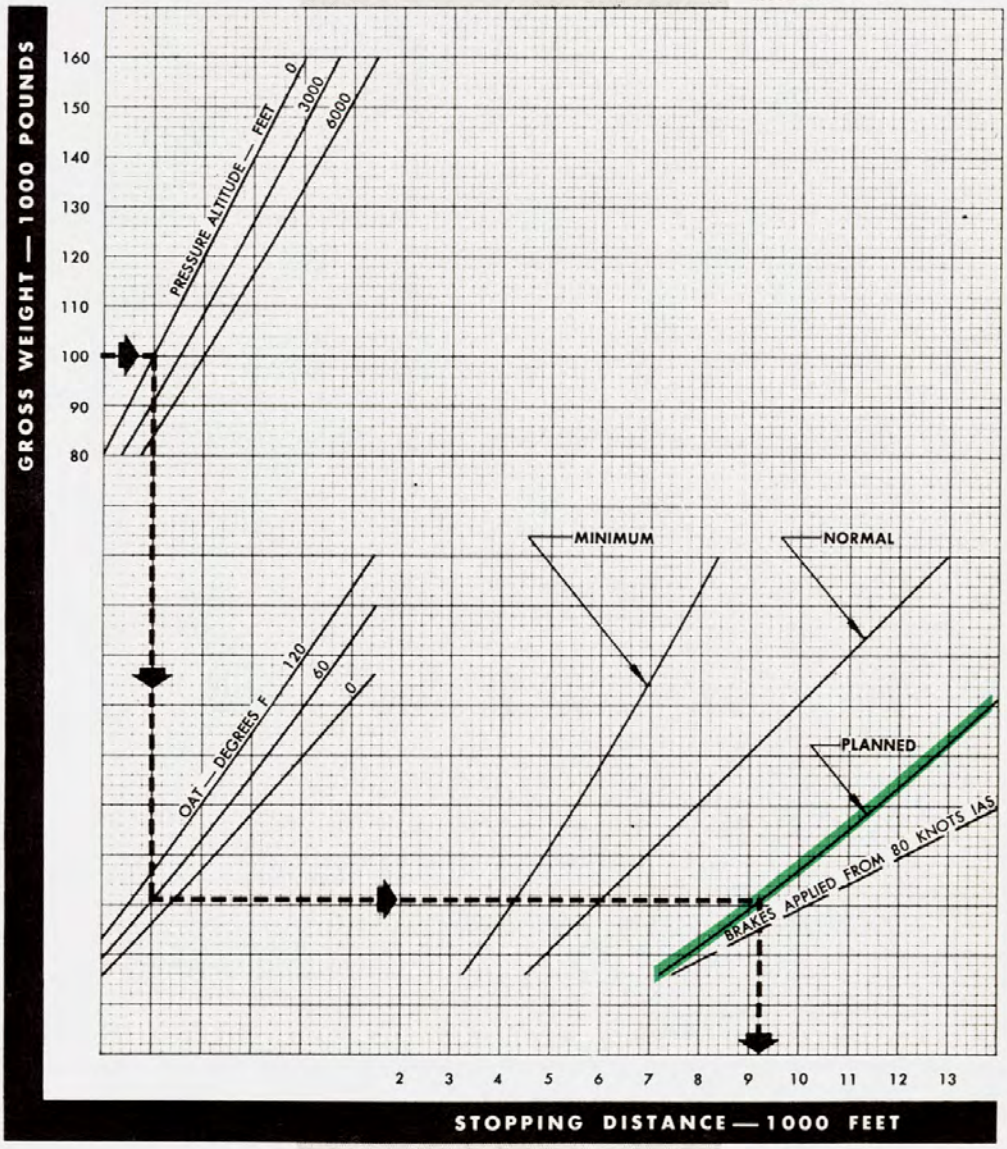
*Figure A8-5.*

# STOPPING DISTANCES - FLAPS DOWN

## WET OR ICY RUNWAY

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

**PLANNED** — BRAKES APPLIED FROM 80% OF TOUCHDOWN VELOCITY

**NORMAL** — CHUTE DEPLOYED AT TOUCHDOWN; BRAKES APPLIED FROM 40 KNOTS IAS

**MINIMUM** — CHUTE DEPLOYED AT TOUCHDOWN; BRAKES APPLIED FROM TOUCHDOWN

**DATE:** MARCH 1956

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

ALL ENGINES AT IDLE AT TOUCHDOWN

NO APPROACH CHUTE

NO WIND

FLAPS FULL DOWN

806

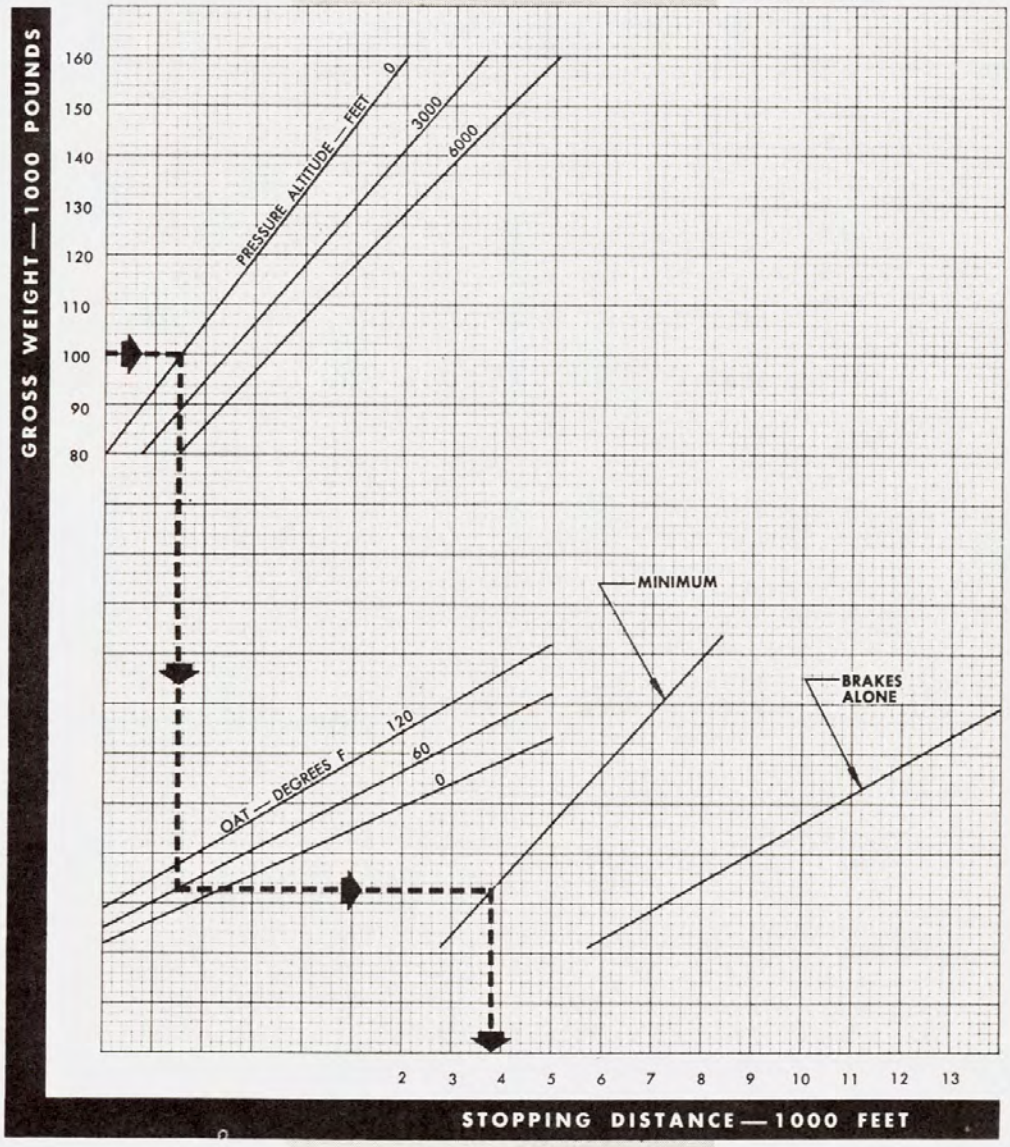
*Figure A8-6.*

# STOPPING DISTANCES - FLAPS UP

## DRY RUNWAY

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

**MINIMUM** —— CHUTE DEPLOYED AT TOUCH-DOWN; BRAKES APPLIED FROM TOUCHDOWN

**BRAKES ALONE** – BRAKES APPLIED FROM TOUCH DOWN

**DATE:** MARCH 1956

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

ALL ENGINES AT IDLE AT TOUCH DOWN

NO APPROACH CHUTE

NO WIND

807

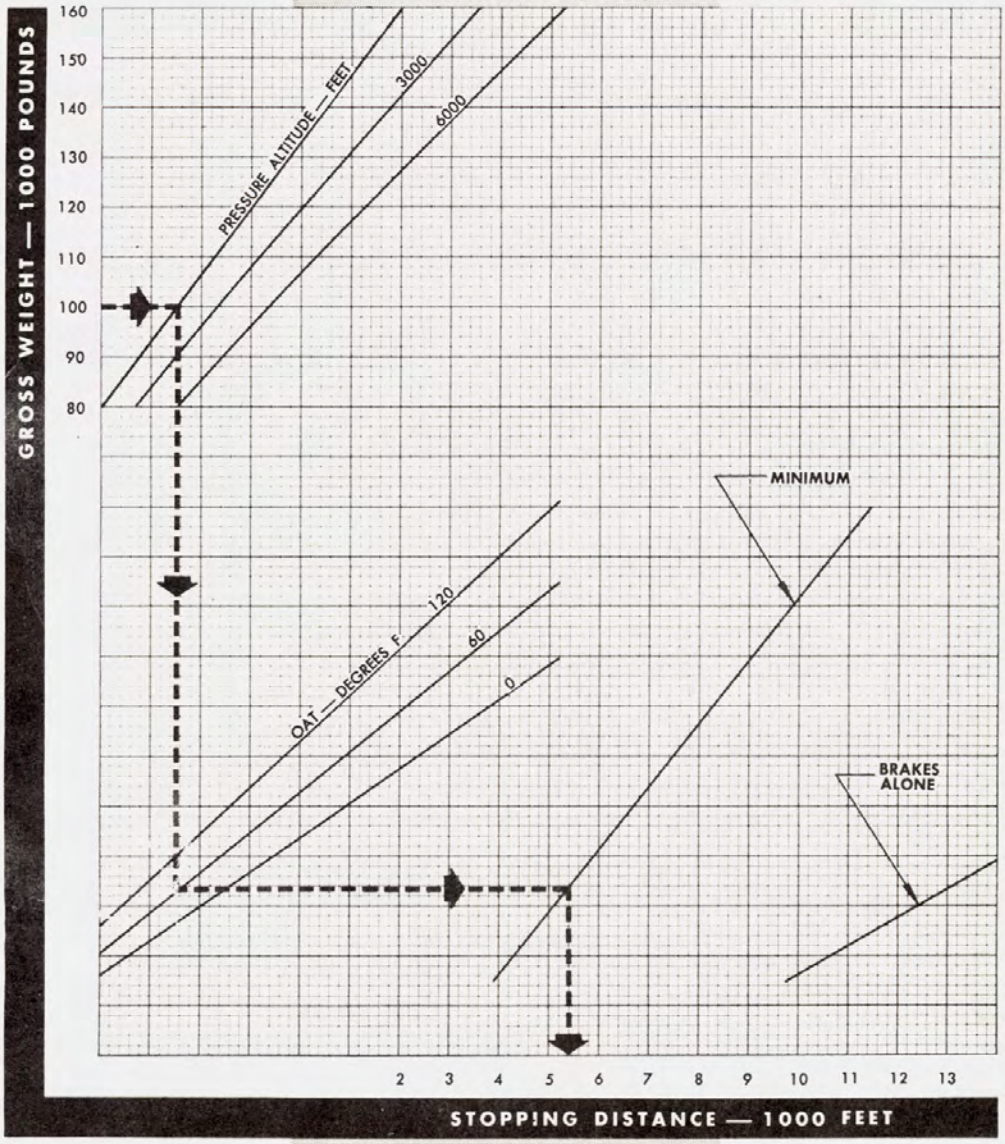
*Figure A8-7.*

# STOPPING DISTANCES - FLAPS UP

## WET OR ICY RUNWAY

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

**MINIMUM** —— CHUTE DEPLOYED AT TOUCH-DOWN; BRAKES APPLIED FROM TOUCHDOWN

**BRAKES ALONE** — BRAKES APPLIED FROM TOUCH-DOWN

**DATE:** MARCH 1956

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

ALL ENGINES AT IDLE AT TOUCH-DOWN

NO APPROACH CHUTE

NO WIND

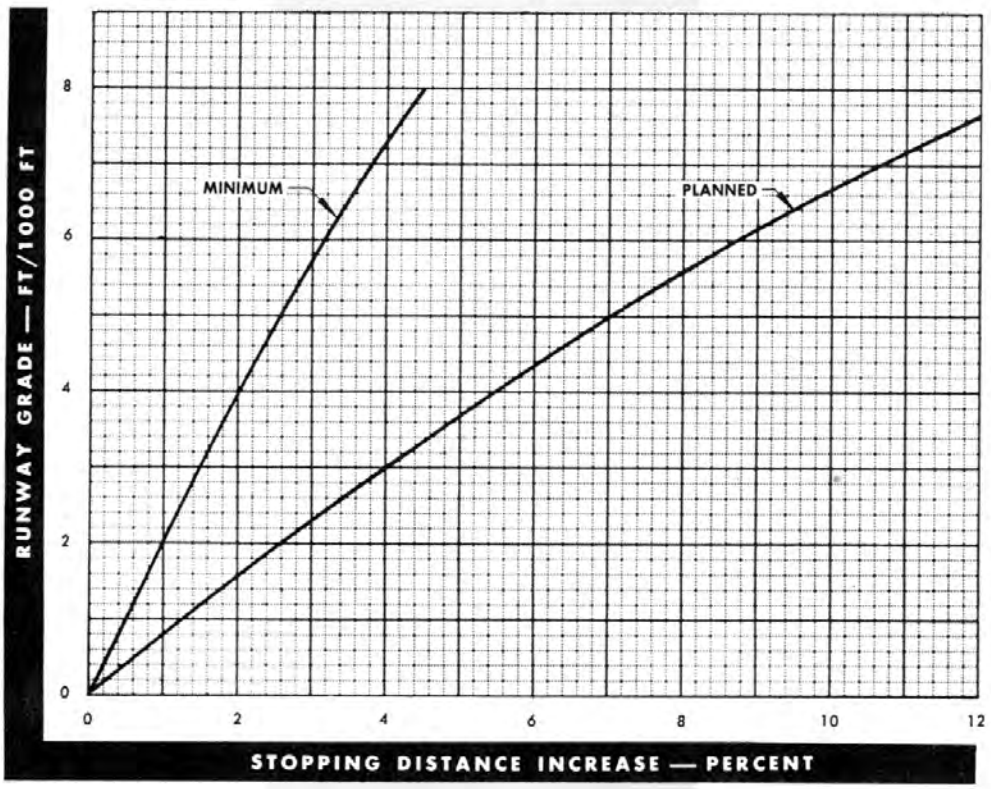
808

*Figure A8-8.*

# EFFECT OF DOWNHILL RUNWAY ON STOPPING DISTANCES

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

**PLANNED-** BRAKES APPLIED FROM 80% OF TOUCHDOWN VELOCITY

**MINIMUM-** CHUTE DEPLOYED AT TOUCHDOWN; BRAKES APPLIED FROM TOUCHDOWN

**DATE:** APRIL 1956

**DATA BASIS:** COMPUTED

**CONDITIONS:**

ALL ENGINES AT IDLE AT TOUCH DOWN

NO APPROACH CHUTE

NO WIND

FLAPS FULL DOWN

809

*Figure A8-9.*

Part 9

# MISSION PLANNING

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 ensure safe operating procedures for all phases of the mission and enable better judgment as to the proper course of action should an inflight emergency occur.

B/RB-47 MODEL

**TAKEOFF DATA**

Critical Field Length _____ TO Dist _____

Runway Grade Correction _____

Min ATO Req _____ Elevator Set _____

First Stall Warning (Flaps Up) ..... IAS _____

ACCELERATION CHECK . . . . . Dist _____ IAS _____
GO-NO GO CHECK . . . . . Dist _____ IAS _____
FIRE ATO . . . . . IAS _____
TAKEOFF . . . . . IAS _____
CLIMB . . . . . IAS _____

Conditions

Runway Gradient _____

GROSS WT _____ FLD PA _____

Runway Length _____ % MAC _____ OAT _____

**EMERGENCY LANDING DATA**

Planned Stop Dist (No Brake Chute) _____

START FINAL . . . . . IAS _____
BEST FLARE . . . . . IAS _____

50961

*Figure A9-1.*

## TAKEOFF AND EMERGENCY LANDING DATA CARD

Prior to each takeoff, copilot computes all data contained on the Takeoff and Emergency Landing Data Card (figure A9-1). Completion of both the takeoff and emergency landing portions of the card is necessary in the event of an emergency landing soon after takeoff. Emergency landing data will be computed using takeoff gross weight, field pressure altitude, and OAT. The card will be checked by the pilot and returned to the copilot. Copilot calls out pertinent takeoff data to the pilot prior to and during takeoff. In case of an emergency landing, copilot calls out pertinent emergency landing data to the pilot during the approach.

### DEFINITIONS

The Takeoff and Emergency Landing Data Card definitions are as follows:

#### 1. Conditions

a. Runway Gradient. The downhill slope of the runway in feet per 1000 feet of runway. Refer to part 2.
b. Gross Weight (Gross Wt). Gross weight of the airplane in pounds at start of takeoff roll.
c. Runway Length. Usable length of runway in feet.
d. Field Pressure Altitude (Fld PA). Altimeter reading in feet for dial set at 29.92 inches Hg.
e. % MAC. Airplane center of gravity location in percent of mean aerodynamic chord.
f. Outside Air Temperature (OAT). Runway air temperature in degrees Fahrenheit.

#### 2. Takeoff Data (Refer to Part 2)

a. Critical Field Length. Minimum runway length necessary for takeoff to allow the airplane with one engine failure at refusal speed either to be safety stopped or to become safely airborne on five engines without ATO.
b. 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.
c. Runway Grade Correction. The distance in feet by which the takeoff distance will be increased or decreased by the runway grade.
d. Minimum ATO Required (Min ATO Req). Minimum number of ATO bottles required for takeoff to reduce the critical field length to the actual available runway length so that the definition for critical field length will apply with ATO.
e. Elevator Trim Tab Setting (Elevator Set). Elevator trim tab setting for takeoff. Refer to part 2.
f. First Stall Warning. The speed at which first stall warning will occur. Refer to figure A8-2 in part 8.
g. Acceleration Check Distance and Speed (Dist and IAS). The distance in feet to the acceleration check

marker and the indicated airspeed in knots that must be attained at the acceleration check marker.
h. Go-No Go Check Distance and Speed (Dist and IAS). The distance in feet to the go-no go check marker and the indicated airspeed in knots that must be attained at the go-no go check marker.
i. ATO Firing Speed (Fire ATO IAS). Indicated airspeed in knots at which ATO, if used, is to be fired.
j. Takeoff Speed (Takeoff IAS). Indicated airspeed in knots at which the main gear leaves the ground.
k. Best Climb Speed (Climb IAS). Indicated airspeed in knots at start of climb for maximum rate of climb on six engines at applicable rpm schedule. Refer to part 3.

### 3. Emergency Landing Data

a. Planned Stopping Distance (Planned Stop Dist). The distance in feet required after touchdown to bring the airplane to a complete stop. This value will be taken from the "planned" curve in the stopping distance charts. Refer to part 8.
b. Start Final Approach Speed (Start Final IAS). The recommended indicated airspeed in knots (best flare plus 15 knots) for beginning final approach.
c. Best Flare Speed (Best Flare IAS). The recommended indicated airspeed in knots for starting final rotation to touchdown attitude.

B/RB-47 Model

**LANDING DATA**

Conditions

Runway Gradient_____

GROSS WT_____ Fld PA_____

Runway Length_____ % MAC_____ OAT_____

PLANNED STOP DIST (No Brake Chute)_____

START FINAL ..... IAS_____

BEST FLARE ..... IAS_____

**BEST FLARE SPEEDS (FULL FLAPS)**

| | |
|---|---|
| 80,000 — 115 | 120,000 — 140 |
| 85,000 — 119 | 125,000 — 143 |
| 90,000 — 122 | 130,000 — 146 |
| 95,000 — 125 | 135,000 — 149 |
| 100,000 — 128 | 140,000 — 151 |
| 105,000 — 131 | 145,000 — 154 |
| 110,000 — 134 | 150,000 — 157 |
| 115,000 — 137 | 160,000 — 161 |

50755

*Figure A9-1.*

## LANDING DATA CARD

Prior to each landing, copilot computes all data contained on the Landing Data Card (figure A9-2). All landing data will be reported to the pilot prior to landing. The copilot will call out pertinent landing data to the pilot during the approach.

### DEFINITIONS

The Landing Data Card definitions are as follows:

### 1. Conditions

a. Runway Gradient. The downhill slope of the runway in feet per 1000 feet of runway. Refer to part 8.
b. Gross Weight (Gross Wt). Gross weight of the airplane in pounds at time of landing.
c. Field Pressure Altitude (Fld PA). Field pressure altitude in feet as reported at landing facility.
d. Runway Length. Usable length of runway in feet.
e. % MAC. Airplane center of gravity location in percent of mean aerodynamic chord.
f. Outside Air Temperature (OAT). Runway air temperature in degrees Fahrenheit.

### 2. Landing Data

a. Planned Stopping Distance (Planned Stop Dist). The distance in feet required after touchdown to bring the airplane to a complete stop. This value will be taken from the "planned" curve in the stopping distance charts. Refer to part 8.
b. Start Final Approach Speed (Start Final IAS). Recommended indicated airspeed in knots (best flare plus 15 knots) for beginning final approach.
c. Best Flare Speed (Best Flare IAS). Recommended indicated airspeed in knots for starting final rotation to touchdown attitude.

## MISSION FLIGHT PLAN

**NOTE**

Certain portions of the Mission Flight Plan are not applicable to operation of this airplane and should be disregarded.

The Mission Flight Plan consists of four sections. Section I is the Navigation Preflight Plan (figure A9-3, sheet 1) to be completed by the observer prior to takeoff, using latest available metro data. Section II, Bombing Data (figure A9-3, 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, Air-

craft Performance Preflight Plan (figure A9-3, 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 A9-3, 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 Preflight 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
      Center 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.

# PREFLIGHT PLAN (NAVIGATION)

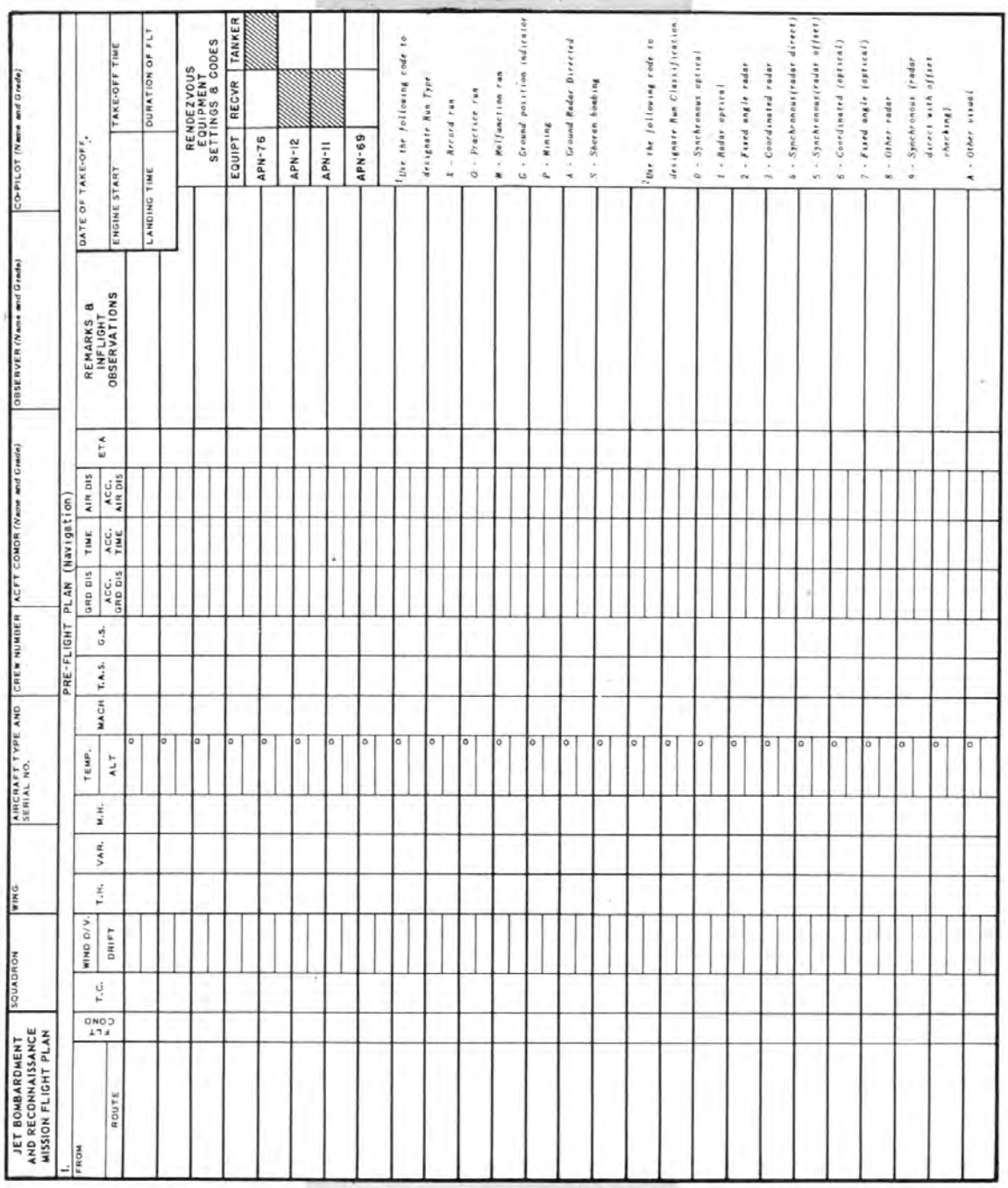



*Figure A9-3. (Sheet 1 of 4 Sheets).*

# BOMBING DATA

| II. BOMBING DATA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TGT DATA | RUN NO. | 1 | | 2 | | 3 | | 4 | | 5 | |
| | NAME | | | | | | | | | | |
| | AP NAME VAR ELEV | | | | | | | | | | |
| | AP LAT LONG | | | | | | | | | | |
| IP | NAME VAR ELEV | | | | | | | | | | |
| | LAT LONG | | | | | | | | | | |
| GPI POINTS | NAME VAR ELEV | | | | | | | | | | |
| | LAT LONG | | | | | | | | | | |
| | NAME VAR ELEV | | | | | | | | | | |
| | LAT LONG | | | | | | | | | | |
| | NAME VAR ELEV | | | | | | | | | | |
| | LAT LONG | | | | | | | | | | |
| OFFSET | NAME ELEV | | | | | | | | | | |
| | LAT LONG | | | | | | | | | | |
| | N-S E-W | | | | | | | | | | |
| IP TO TARGET | | PRECOMP | INFLIGHT | PRECOMP | INFLIGHT | PRECOMP | INFLIGHT | PRECOMP | INFLIGHT | PRECOMP | INFLIGHT |
| | T.C. | | | | | | | | | | |
| | DRIFT | | | | | | | | | | |
| | T.H. | | | | | | | | | | |
| | M.H. | | | | | | | | | | |
| | G.S. | | | | | | | | | | |
| | DISTANCE | | | | | | | | | | |
| | TIME / TG | / | / | / | / | / | / | / | / | / | / |
| ALTITUDE COMPUTATION | POSITION | | | | | | | | | | |
| | ELEVATION | | | | | | | | | | |
| | MEASURED ALTITUDE | | | | | | | | | | |
| | TRUE ALTITUDE | | | | | | | | | | |
| | $D_2 - D_1$ | | | | | | | | | | |
| | ADJUSTED TRUE ALTITUDE | | | | | | | | | | |
| | OAP ELEVATION | | | | | | | | | | |
| | ABSOLUTE ALT SETTING | | | | | | | | | | |
| | ADJUSTED TRUE ALTITUDE | | | | | | | | | | |
| | TGT ELEV | | | | | | | | | | |
| | BOMB ALT | | | | | | | | | | |
| TYPE BOMB | | | | | | | | | | | |
| T.A.S. | | | | | | | | | | | |
| Q FACTOR/INTERVAL | | | | | | | | | | | |
| TRAIL | | | | | | | | | | | |
| A.T.F. | | | | | | | | | | | |
| RELEASE | T.H. T.A.S. | | | | | | | | | | |
| | WIND N.S. E.W. | | | | | | | | | | |
| | TIME FRAME# | | | | | | | | | | |
| | RUN TYPE CLASS | | | | | | | | | | |
| | SCORE CODED C.E. | | | | | | | | | | |
| ACFT CONTROL | METHOD OF RELEASE | | | | | | | | | | |

*Figure A9-3. (Sheet 2 of 4 Sheets).*

# PREFLIGHT PLAN (AIRCRAFT PERFORMANCE)

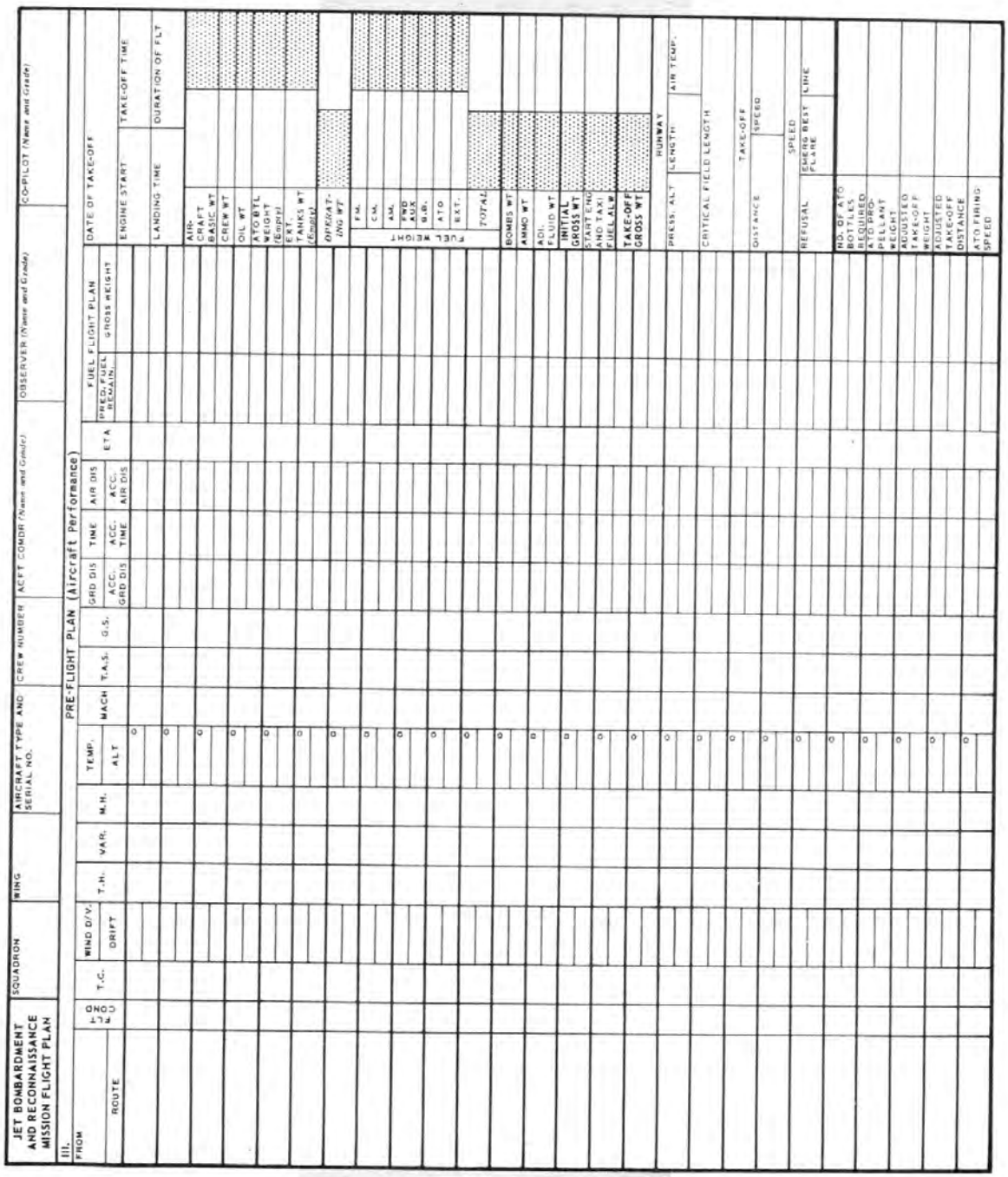



*Figure A9-3. (Sheet 3 of 4 Sheets).*

# PILOT FLIGHT PROGRESS CHART & LOG

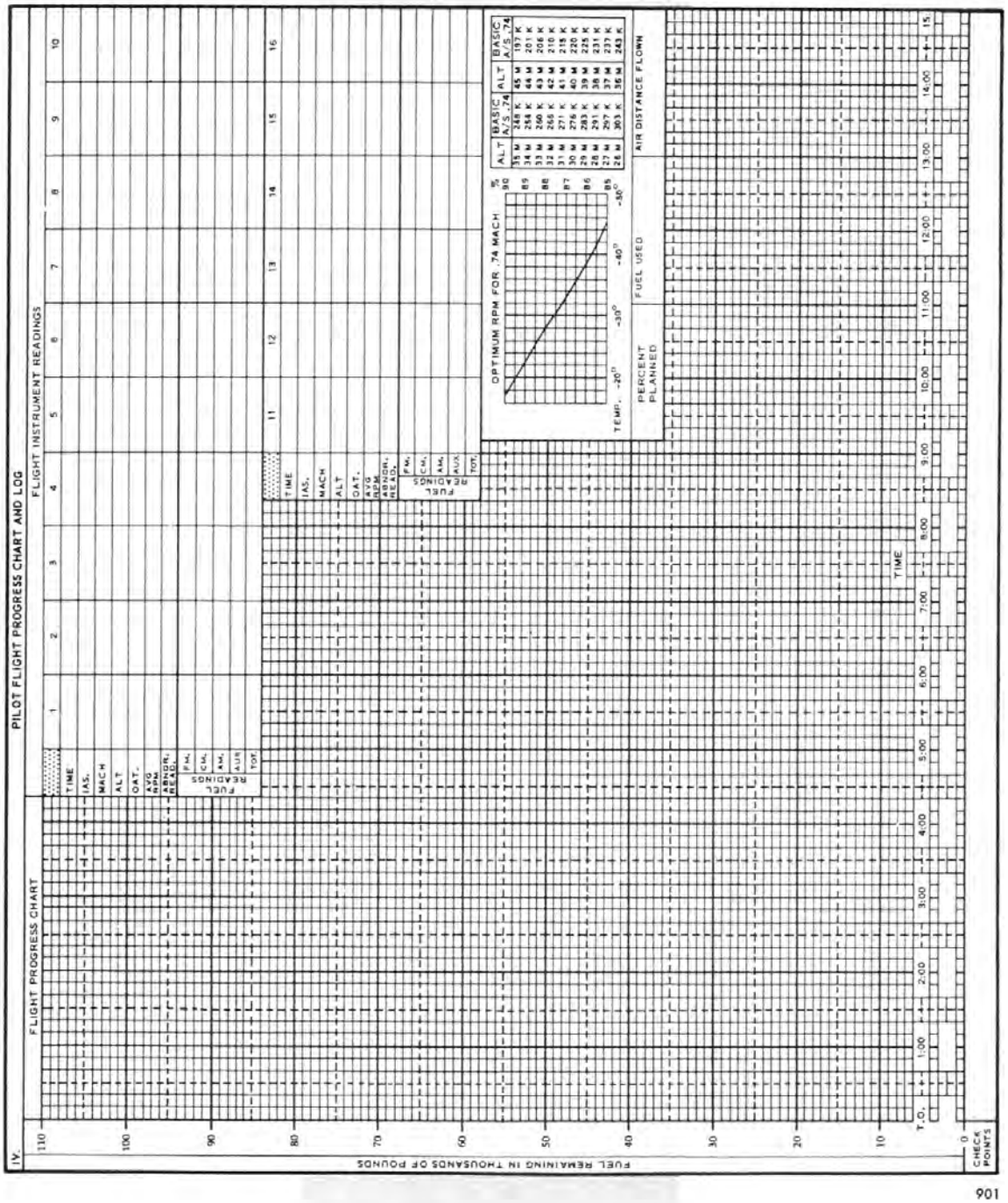



*Figure* **A9-3.** *(Sheet 4 of 4 Sheets).*

e. APN-69
Enter codes to be transmitted by the receiver.

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 11 for ground fuel consumption.
t. Take-off Gross Wt
Enter airplane weight at start of takeoff roll; 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 go-no go speed (the minimum indicated airspeed that must be attained at the go-no go distance. Refer to part 2).
(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. (Refer to part 8.)
(3) Line
Enter acceleration check speed (the minimum indicated airspeed that must be attained at the acceleration check distance. 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 2.)
(2) ATO Propellant Weight
Enter total weight of ATO propellant to be used.
(3) Adjusted Take-off Weight
Enter adjusted takeoff weight obtained by adding items "y(2)" and "4t."
(4) Adjusted Take-off Distance
Enter takeoff distance required with ATO (no wind, no engine failure). (Refer to part 2.)
(5) ATO Firing Speed
Enter the indicated airspeed at which ATO bottles will be fired. (Refer to part 2.)
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 4.)
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 A9-3, 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 chart between 10 mile mark and release point, figure 8-1).
   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) TC
      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 chart 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.
i. CE
Enter circular error.
j. Aircraft Control
Enter Auto or Manual.
k. Method of Release
Enter Auto or Manual.

## PILOT FLIGHT PROGRESS CHART AND LOG

Pilot Flight Progress Chart and Log (figure A9-3, sheet 4) 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.

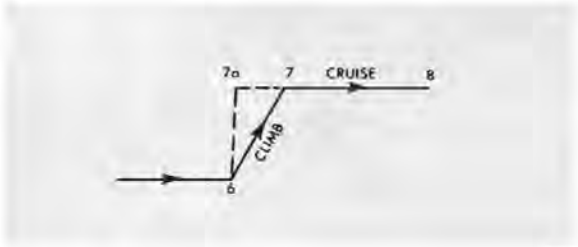
3. The Flight Progress Chart ("Go-No Go" curve) is a plot of fuel remaining vertically against the time horizontally. Information from the preflight plan is plotted upon the graph prior to flight. The resulting curve will be utilized as an inflight "Go-No Go" curve.

4. Inflight fuel readings will be plotted upon the graph. In this manner, flight performance can be analyzed against the predicted fuel curve. This will aid in formulating inflight 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.

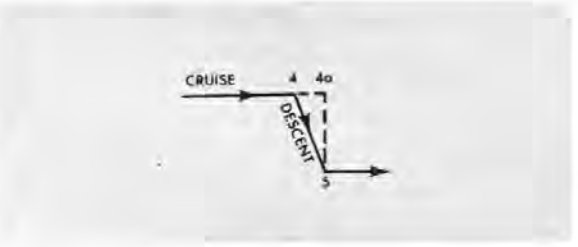
1. For climbs enroute, it is usually convenient and sufficiently accurate to consider that the cruise is continued over the check point at which the climb starts. Then find the fuel allowance for the climb between the two altitudes from figure A9-4. Add this allowance to the gross weight over the check 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.




50964

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 A9-4, to obtain the weight at check point 6. Then, if desired, find the true conditions at point 7, using part 3.

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.




50965

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 11 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 11 if the run is specified in minutes, or from the nautical miles per 1000 pounds chart in part 4 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, see figure A9-4 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 11. 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.

## GENERAL PLANNING

1. The general mission planning should be accomplished with the cooperation of the other crew members. The complete mission flight planning will include:

a. Weather. Obtain necessary metro data for route and target area to include:

(1) Cloud coverage and haze
(2) Climb winds and winds aloft
(3) Temperatures
(4) Location of jet streams and unusual weather phenomena
(5) Pressure pattern information
(6) Terminal forecast.

b. Maps for Mission. Select maps and charts of suitable scale and projection as dictated by the requirements of the mission. Additional maps should be procured to provide coverage for emergency changes in flight plan.

c. Routes. Complete route plotted on the charts. When using Lambert Conformal charts, the route should be divided into segments with the length of each leg short enough to prevent large departure of the rhumb line from the straight line on the chart.

(1) Doglegs should be included to aid in accomplishing control time when required.

(2) Turns and overruns past targets will be considered when drawing the mission route on maps.

(a) Procedure turns will be computed for the Pre-IP and/or IP to roll out on the briefed axis of attack (started short of turning point).

(b) All other turns will be started when over the briefed turning point and/or target.

(3) Alternate and emergency airfields will be annotated and the general areas for their possible use along the route will be noted.

(4) Reporting points control areas and danger and warning areas will be annotated. The observer will coordinate with the pilots on necessary reporting points and entries to and from control areas. Those danger and warning areas adjacent to the planned route will be clearly marked on maps. The current radio facility chart will be consulted for information on danger, warning areas, and ADIZ's.

(5) Coordinates. Annotate coordinates for resetting fix dials. Prominent returns along the route should have their coordinates available for ready use by the observer.

### Bomb Planning

1. Determine the RBS sites, camera targets, and bombing ranges to be utilized and record the following:

a. Time scheduled
b. Targets to be bombed
c. Assigned or profile pressure altitude.

2. Check weather forecast and record predicted winds, cloud cover and D values (target and altitude measurement point) for each bombing or simulated bombing area.
3. Accomplish target study.
4. Offset components will be computed if necessary.

### Radar Navigation Planning

1. Prepare navigation data and chart for the route. Generally the JN chart (1:2,000,000 scale) will be most satisfactory for radar navigation.

a. Navigation will be from point to point; points should be close enough together to ensure rhumb lines do not deviate greatly from the charted route. The turn to the new heading will be started upon arrival over the turn point, except at Pre-IP or IP.

b. Points or areas for altitude measurement will be selected and the terrain elevation noted on the navigation chart.

c. Points for precision fixing and wind determination will be selected and the coordinates noted on the navigation chart.

d. Areas for control time solution and performance, if required, will be selected.

e. Points for performing prebomb run checklist should be noted on the navigation chart.

f. The IP's and targets will be annotated on the chart.

### Celestial Navigation Planning

1. CHARTS

a. The JN-series chart is recommended when available.

b. All pertinent air space restrictions on or near course will be noted on the chart.

c. All DR and assumed positions for celestial precomputations should be plotted on the chart.

2. CELESTIAL PRECOMPUTATIONS

a. When more than one body is used to determine a fix, precomputation should be accomplished on prescribed precomputation forms using Sight Reduction Tables HO 249, Vol I, II, or III.

b. DR positions for precomputations will be based on the latest forecast metro data and scheduled takeoff time.

c. Star selection for three star fixes should be made to obtain 120° cuts as closely as possible.

d. Three star fixes are recommended as the primary method of celestial navigation.

e. The interval between scheduled observations in a three star fix should be 4 minutes.

f. Solution Method (Tabulated Stars). Precomputation will be on prescribed form using the same LHA of Aries for each star and adjusting the Ho for motion of the body and motion of the observer.

### Grid Navigation Planning

1. Select a chart of the appropriate area which incorporates a printed grid overlay or construct a grid on an appropriate chart.
2. Label the grid meridians and grid parallels. The grid parallel nearest the mid-grid latitude of the route should be designated the grid equator (in polar area 90° E-90° W will be the grid equator) and other parallels labeled accordingly, increasing toward grid north and grid south in 1° increments. The grid meridians can be labeled without regard for actual geographic coordinates, but grid longitude must increase or decrease properly according to grid direction. It is convenient to label the grid meridian nearest to the entry point for the grid phase the same as the nearest geographical longitude and label the others accordingly, so that the longitude counters on the navigation control will not have to be moved too far in resetting to grid coordinates.
3. Label each geographical meridian along the route with its convergence value to the nearest 1/2° from the convergence graph at the bottom of the chart. This will not be necessary on any chart with a convergence factor equal to 1.0.
4. Determine and plot on the chart the grid coordinates of the entry point and of other prominent radar returns along the route.
5. Determine and plot the geographical coordinates of briefed and alternate exit points.

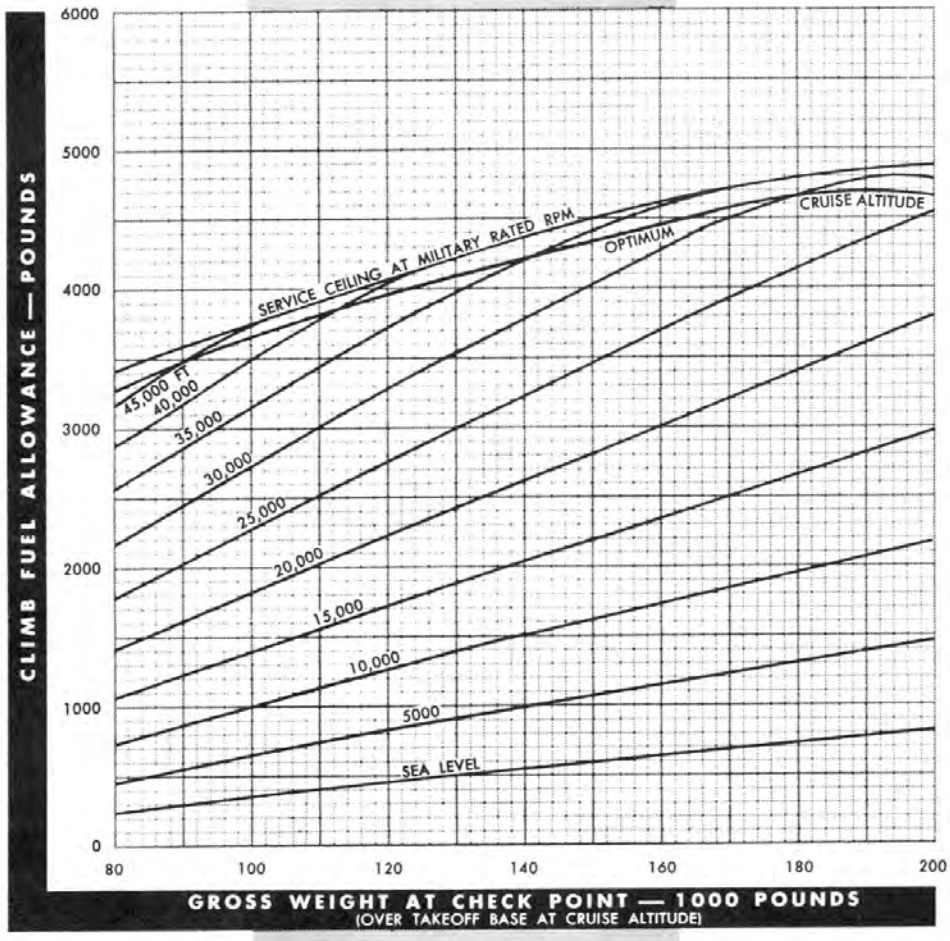
### Airborne Radar Approach Planning

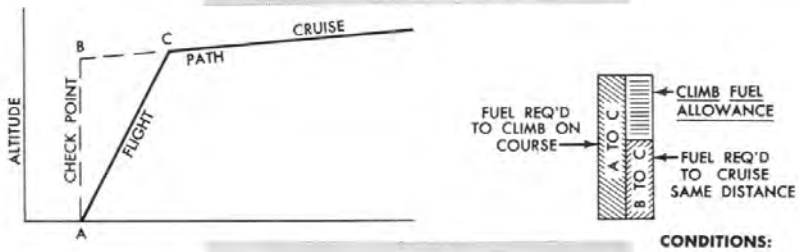
1. General complete planning will be accomplished by all members of the crew using all available aids, such as published instrument patterns, PHACUS, Jet Let-Down books, radio facility charts, scope photos, etc, for base of intended landing and at least one alternate.
2. The following information will be recorded and/or secured for inflight use:
 a. Detailed map of base and surrounding area with approach pattern plotted.
 b. Annotated scope photographs of approach, if available.
 c. Field elevation.
 d. Type of lighting and obstruction.
 e. Availability and location of navigational aids.
 f. Altitudes for each phase of approach.
 g. Terminal weather.
 h. Offset information.
3. The following will be studied:
 a. Instrument let-down and GCA patterns.
 b. Terrain and prominent radar returns on or near the base.

# ACCELERATION & CLIMB FUEL ALLOWANCE

**MODEL:** TB-47B

**ENGINES:** J47-23




**CONDITIONS:**

NORMAL RATED RPM BELOW CRUISE ALTITUDE

MILITARY RATED RPM ABOVE CRUISE ALTITUDE

TAKEOFF ON COURSE

**DATE:** SEPTEMBER 1952

**DATA BASIS:** FLIGHT TEST

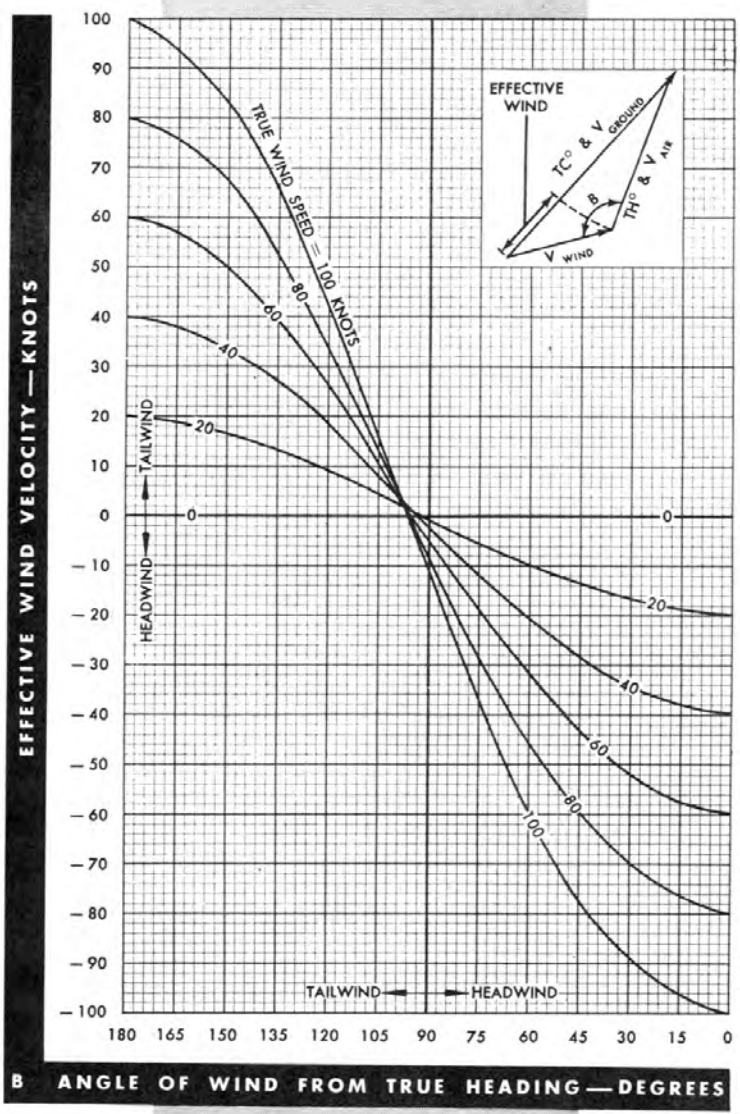
902

*Figure A9-4.*

# EFFECTIVE WIND

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1950

**DATA BASIS:** CALCULATED

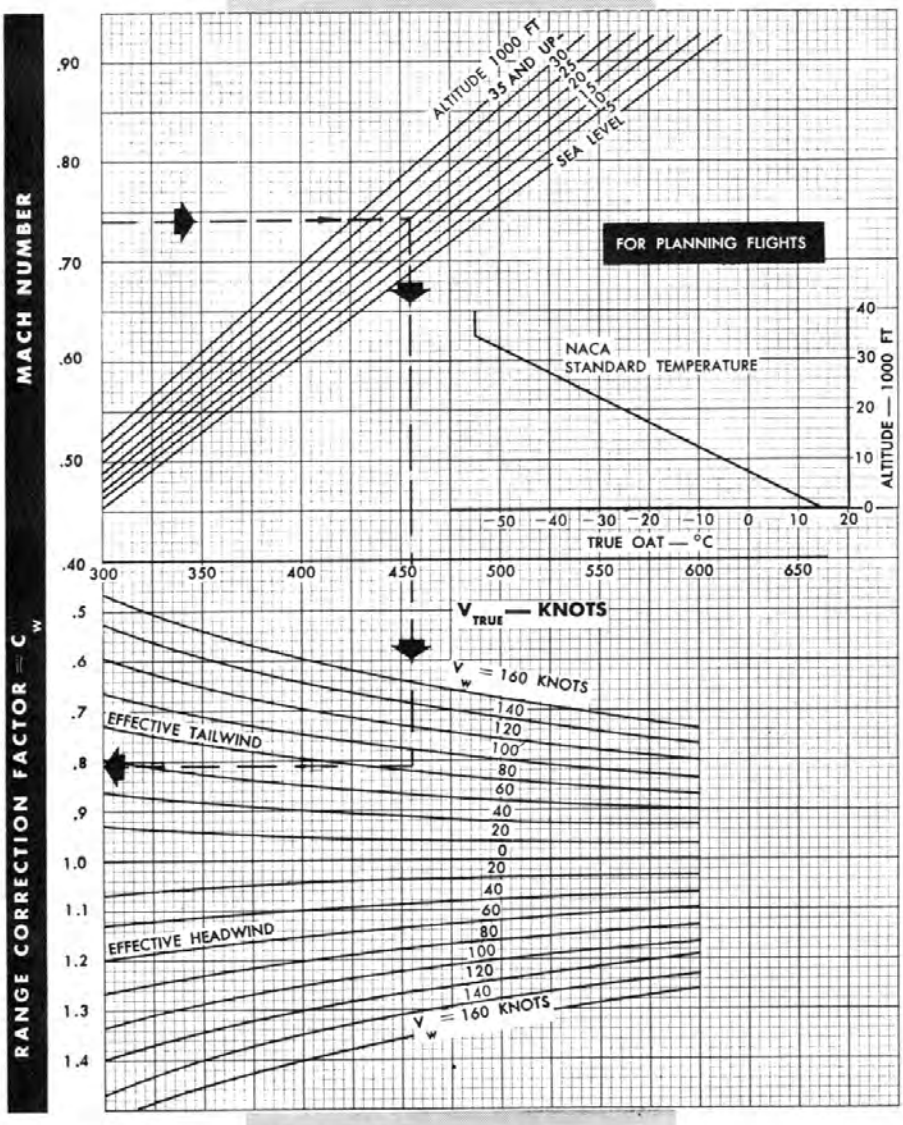
*Figure A9-5.*

903

# RANGE CORRECTION FOR WIND

**MODEL:** TB-47B

**ENGINES:** J47-23




**REMARKS:**

FACTOR APPLIED TO RANGE WITH WIND GIVES NO-WIND RANGE FOR SAME WEIGHT CHANGE

APPLIES TO ANY JET AIRPLANE

$$\text{RANGE}_{\text{NO WIND}} = C_{NW} \times \text{RANGE}_{\text{WIND}}$$

904

**DATE:** JUNE 1951

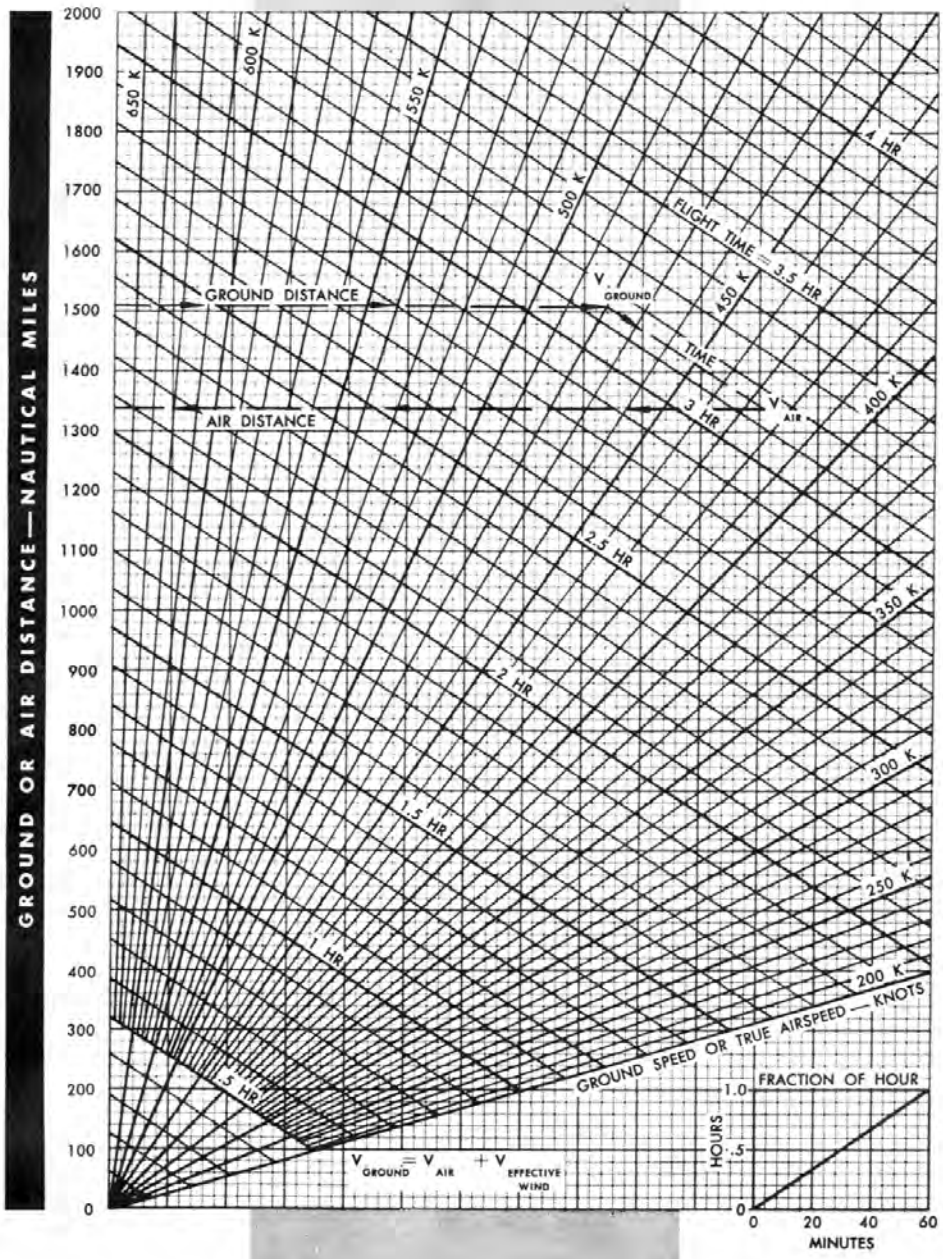
**DATA BASIS:** CALCULATED

*Figure A9-6.*

# DISTANCE - SPEED - TIME

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JUNE 1950

**DATA BASIS:** CALCULATED

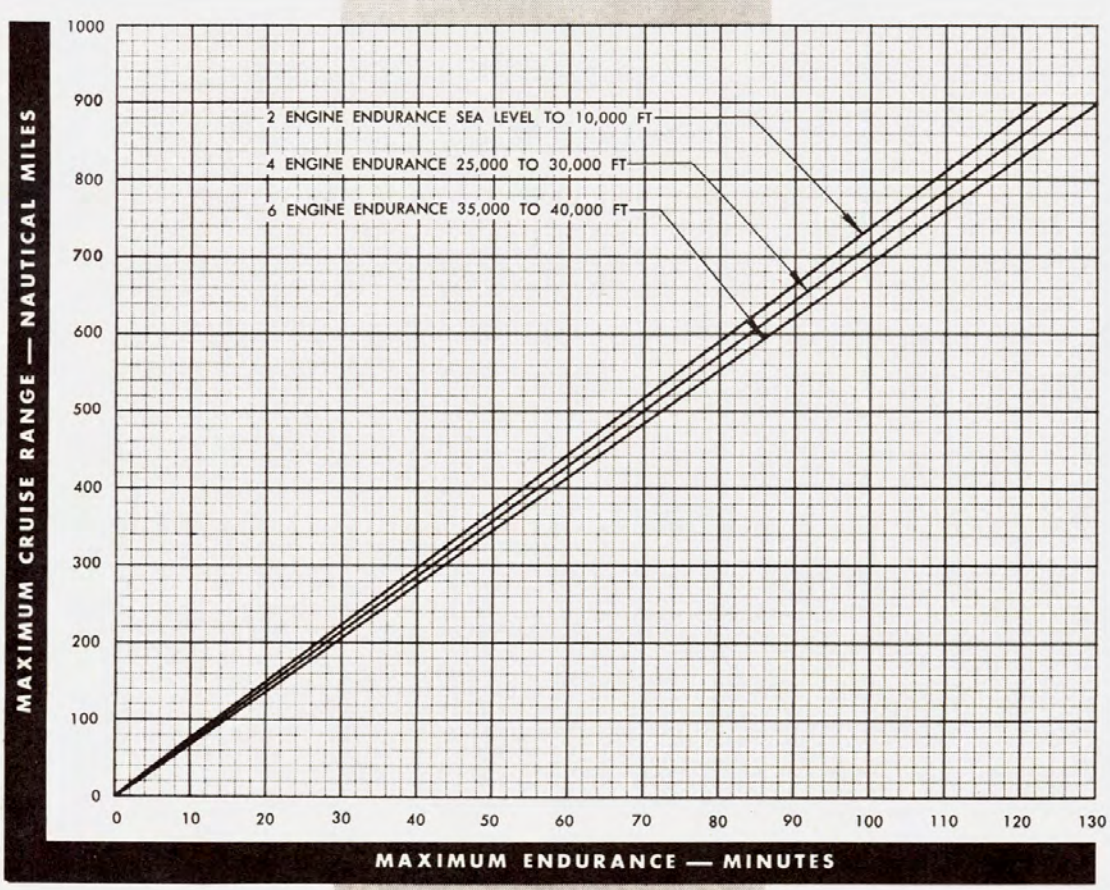
905

*Figure A9-7.*

# RANGE - ENDURANCE CONVERSION

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

906

*Figure A9-8.*

Part 10

# 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 A10-1 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 A10-2 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 A10-3. 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 A10-4 should be used to determine the cg limits for all operating conditions.

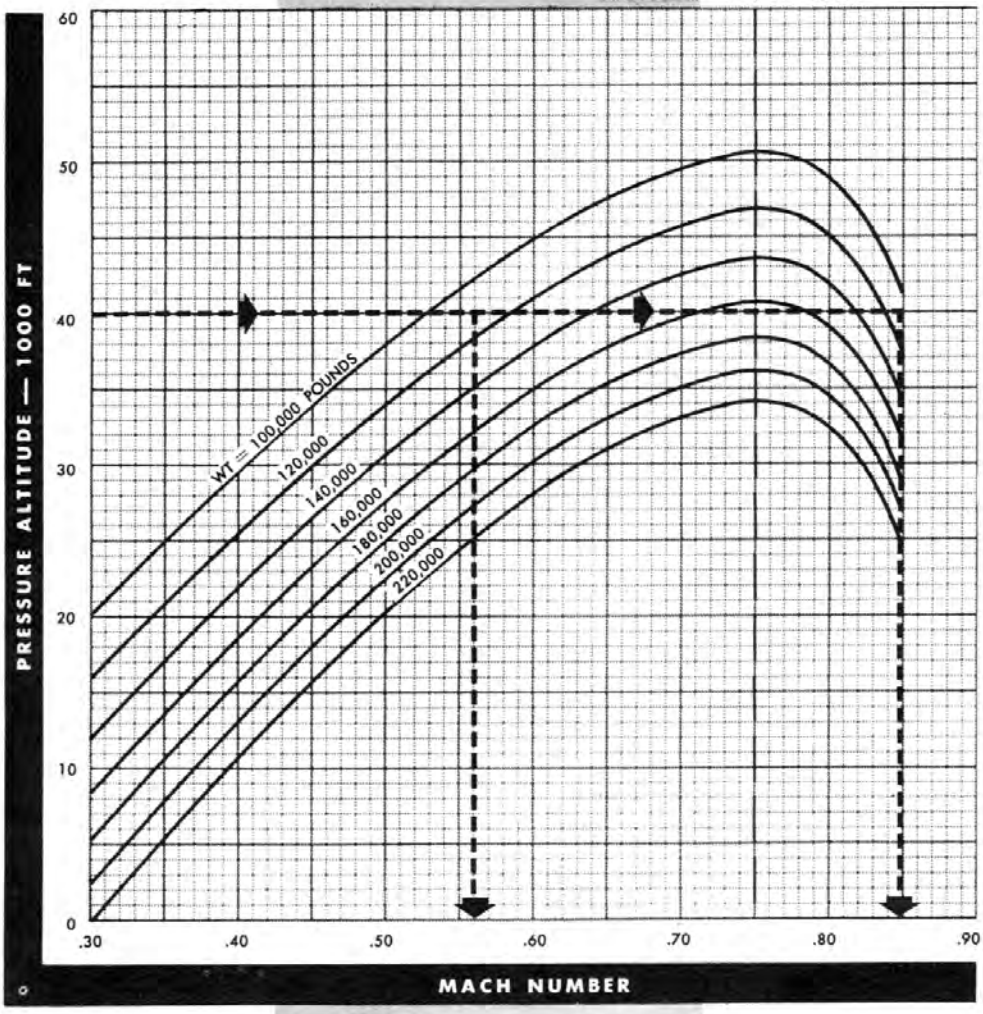
## MACH NUMBER LIMIT

Maximum speed restrictions for airplanes which have the various modifications are presented on figure A10-5. 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 A10-6 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 1956

**DATA BASIS:** FLIGHT TEST

1001

*Figure A10-1.*

# ACCELERATION LIMITATIONS

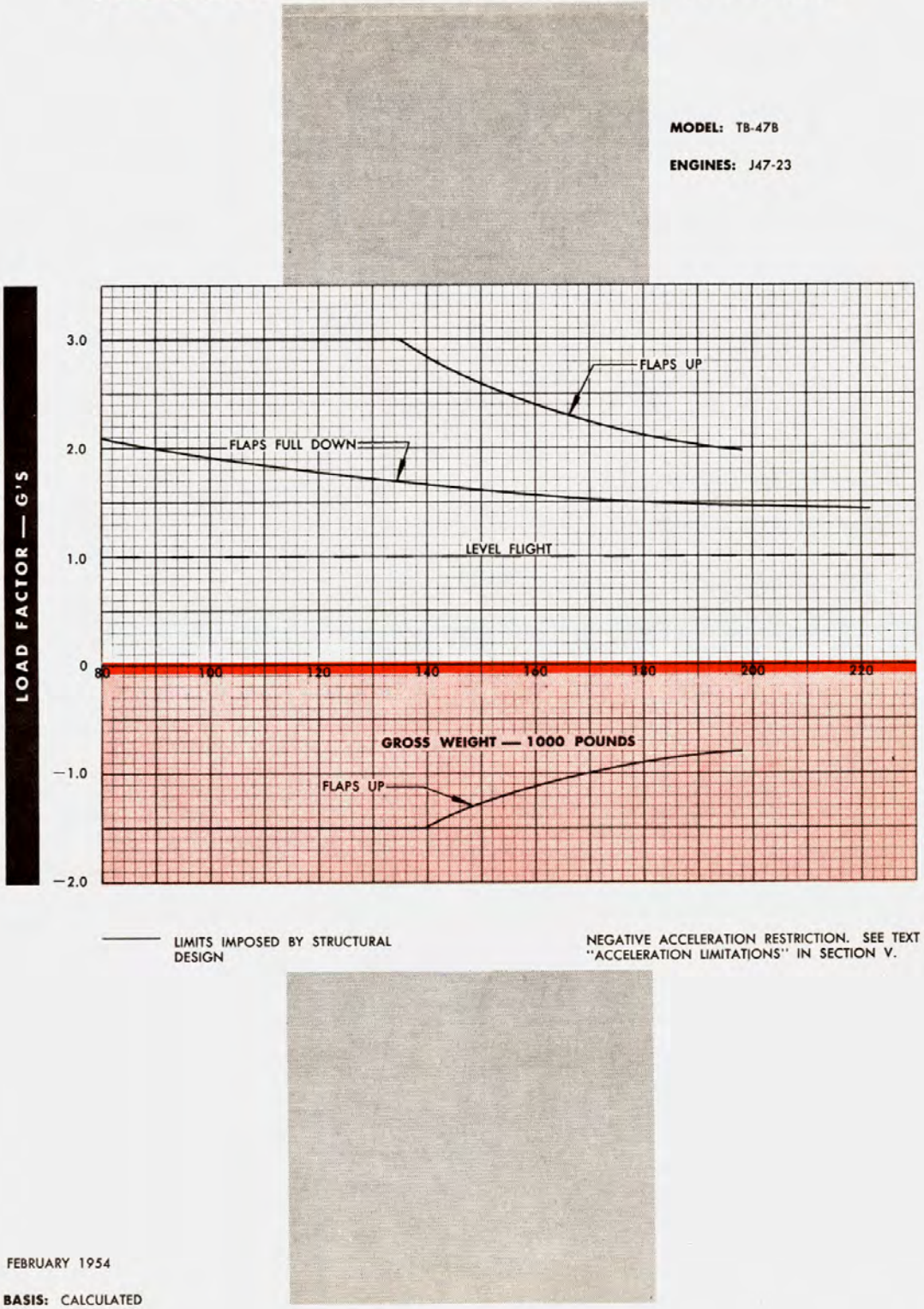


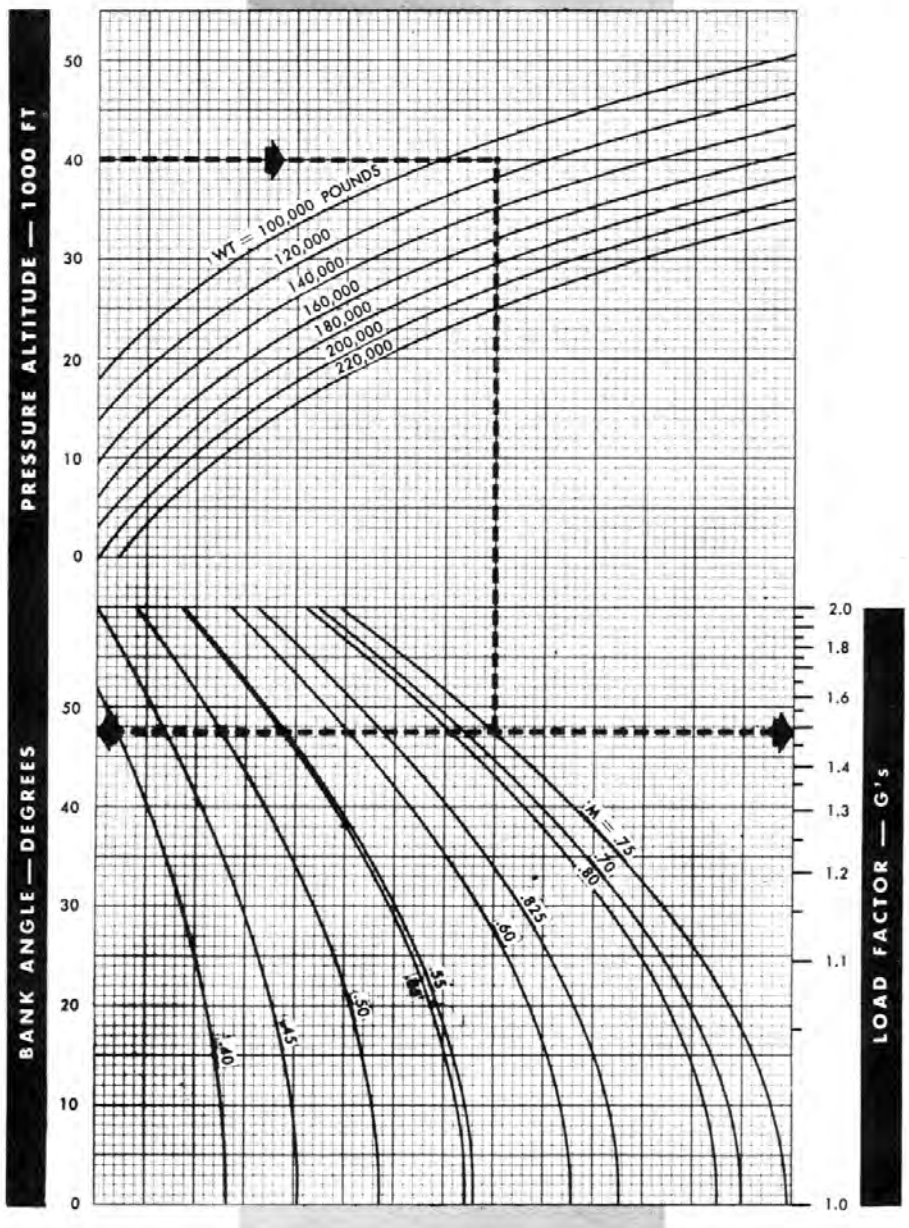

*Figure A10-2.*

# BANK ANGLE LIMITS FOR INITIAL BUFFETING

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** APRIL 1956

**DATA BASIS:** FLIGHT TEST

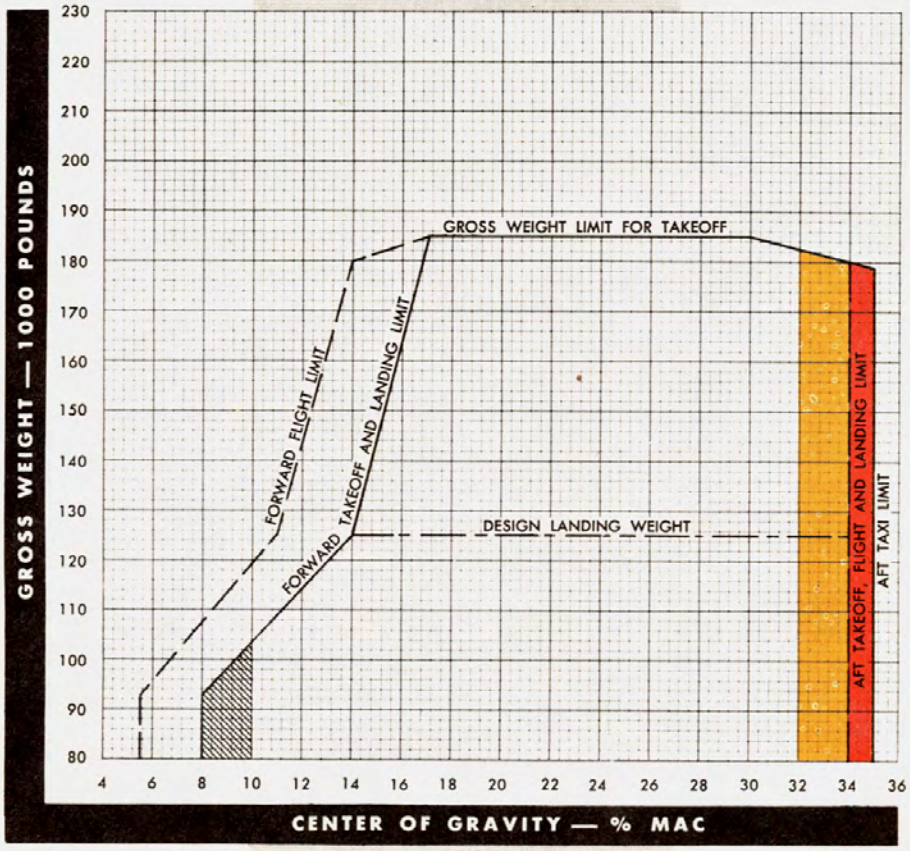
1003

*Figure A10-3.*

# CG & GROSS WEIGHT LIMITS

**MODEL:** TB-47B

**ENGINES:** J47-23




GOOD LANDINGS WITH SURFACE POWER CONTROL INOPERATIVE CANNOT BE MADE WITH CONSISTENCY WITH CG IN THIS AREA.

WHENEVER CG FALLS IN THIS AREA, THE AIRPLANE SHALL NOT BE FLOWN AT SPEEDS ABOVE BEST CLIMB SPEED OR AT ALTITUDES ABOVE 20,000 FEET. FUEL MANAGEMENT SHALL BE ACCOMPLISHED IMMEDIATELY TO BRING CG FORWARD OF THIS AREA.

CG MAY EXIST IN THIS AREA DURING TAXI OPERATIONS ONLY.

**DATE:** FEBRUARY 1954

**DATA BASIS:** FLIGHT TEST

**REMARKS:**

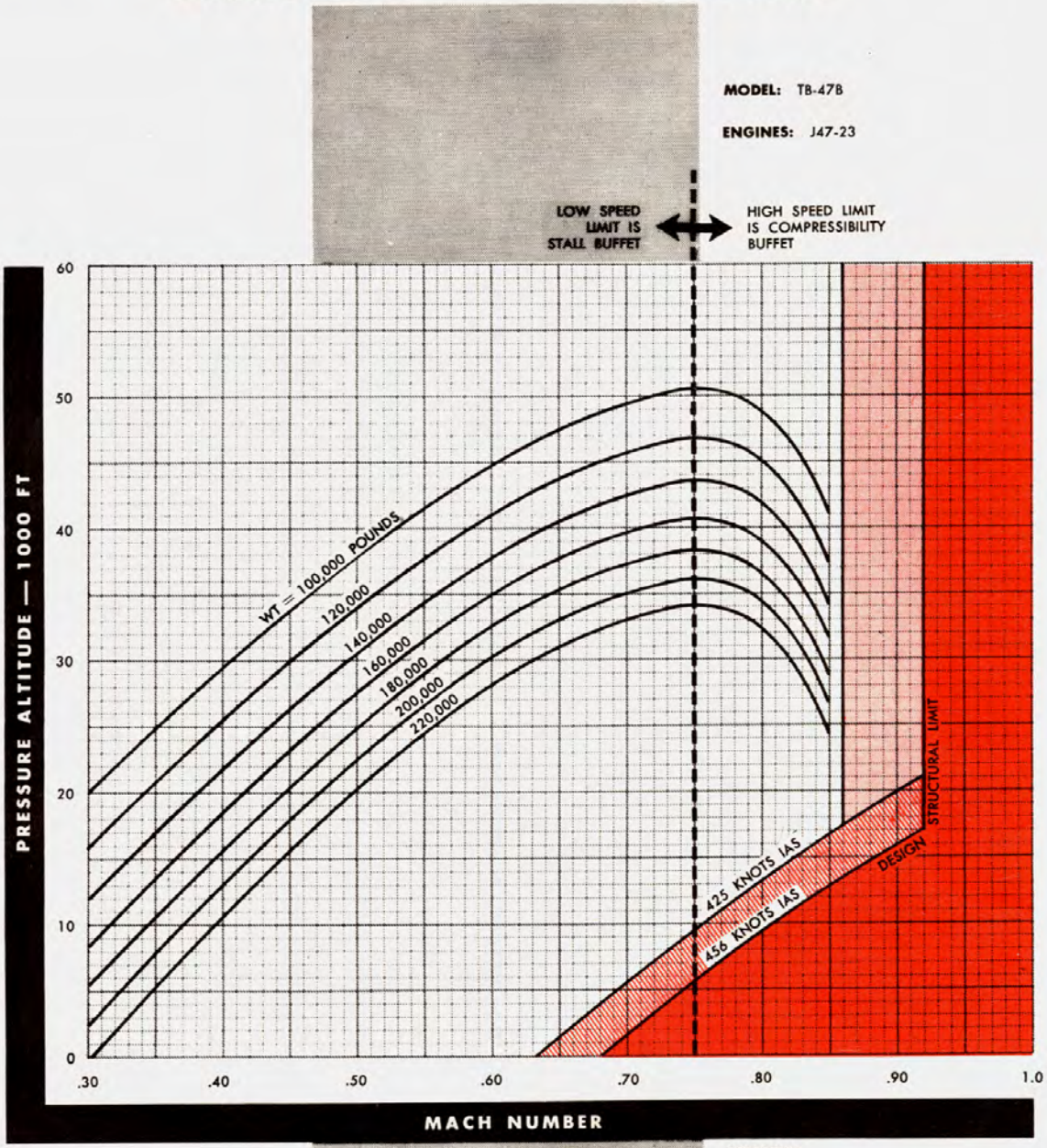
LENGTH OF MAC — 155.9 INCHES

POSITION OF MAC — LEADING EDGE OF MAC AT BODY STATION 584.8

1004

*Figure A10-4.*

# MACH NUMBER LIMIT




**REMARKS:**

BUFFET CURVES ARE FOR LEVEL FLIGHT IN STABLE AIR.

**LEGEND**

FLIGHT RESTRICTED ABOVE LATERAL CONTROL LIMIT OF 425 KNOTS IAS.

FLIGHT RESTRICTED ABOVE INITIAL BUFFET OR MACH .86, WHICHEVER OCCURS FIRST.

FLIGHT PROHIBITED ABOVE DESIGN STRUCTURAL LIMIT.

1005

**DATE:** APRIL 1956

**DATA BASIS:** FLIGHT TEST

*Figure A10-5.*

# TURBULENT AIR PENETRATION SPEEDS

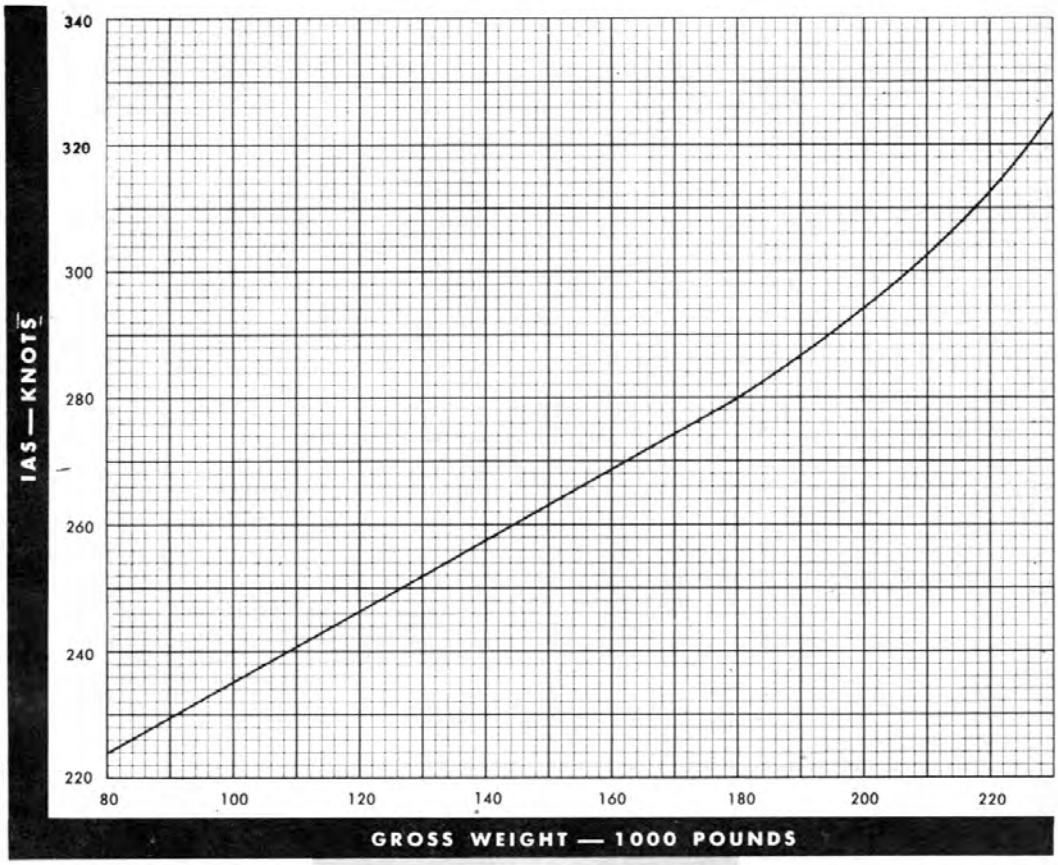
**MODEL:** TB-47B

**ENGINES:** J47-23

## 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

1006

*Figure A10-6.*

Part II

# MISCELLANEOUS CHARTS

This part contains additional performance data and charts to supplement that in the preceding part.

## FUEL CONSUMPTION AT LOW ALTITUDE

On figure A11-1 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 A11-2 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 A11-3 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 tactical run, escape, evasive action, etc.

## BOILING POINT OF FUELS

The chart on figure A11-4 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 A11-5. Speeds in level flight at normal rated rpm are given on figure A11-6. To convert to indicated airspeed, use figure A11-9. Below approximately 16,000 feet 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 A11-7 for flaps and gear up and on figure A11-8 for flaps and gear down.

## MACH NUMBER — INDICATED AIRSPEED CONVERSION

The chart on figure A11-9 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 ensure instrument accuracy.

## MACH NUMBER — TRUE AIRSPEED CONVERSION

The chart on figure A11-10 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 A11-11 should be used. If temperatures are beyond the range of the chart the equations given on the chart should be used. For conversion of inflight OAT gage reading to true outside air temperature, figure A11-13 may be used. The difference in the two readings is the temperature rise due to compressibility.

## NACA STANDARD DAY

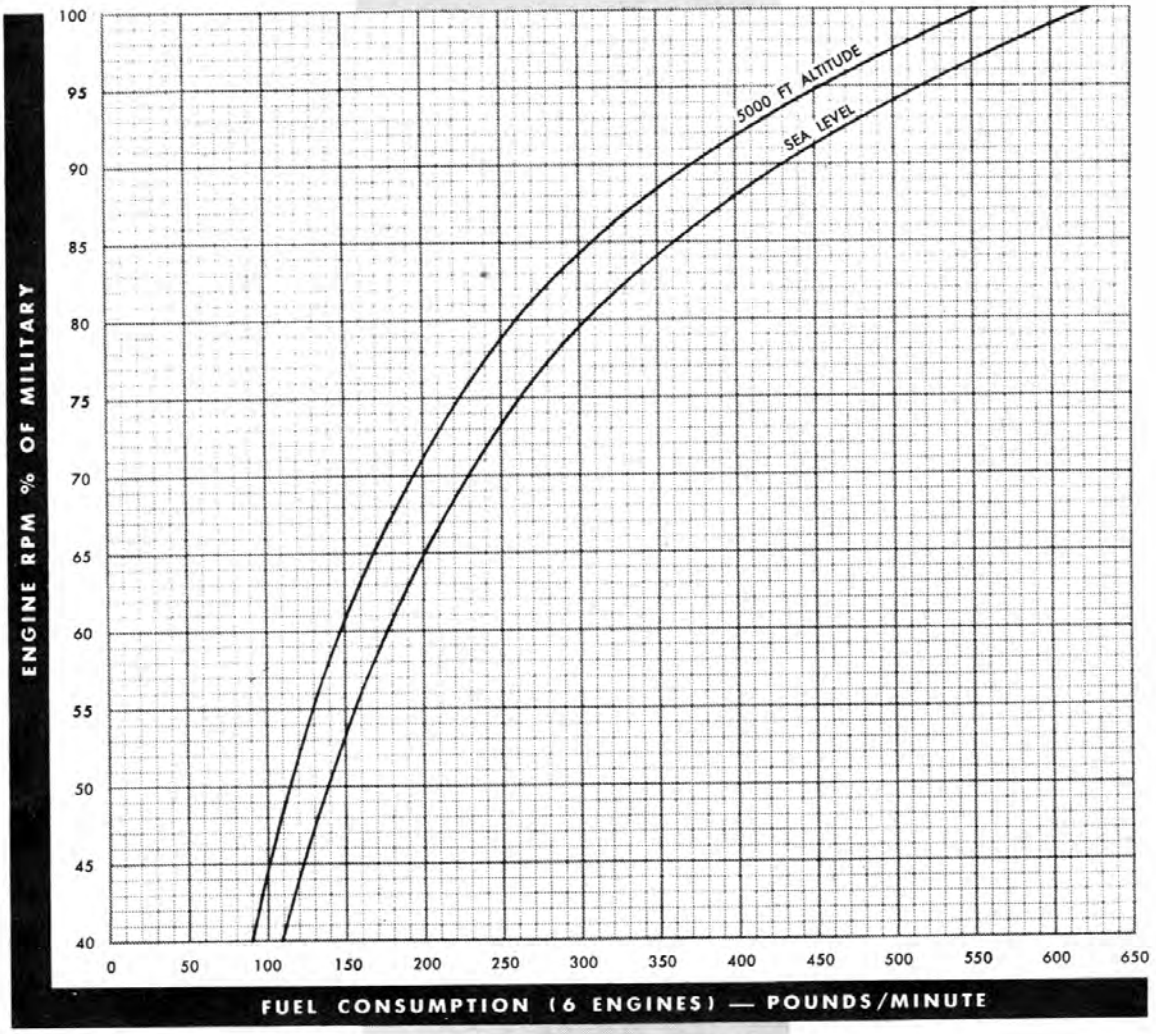
The chart on figure A11-12 defines the temperature variation with altitude for a NACA standard day. All charts in the book are based upon this standard atmosphere unless other temperature conditions are specified.

# FUEL CONSUMPTION
## GROUND OPERATION

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** DECEMBER 1952

**DATA BASIS:** FLIGHT TEST

110'

*Figure A11-1*

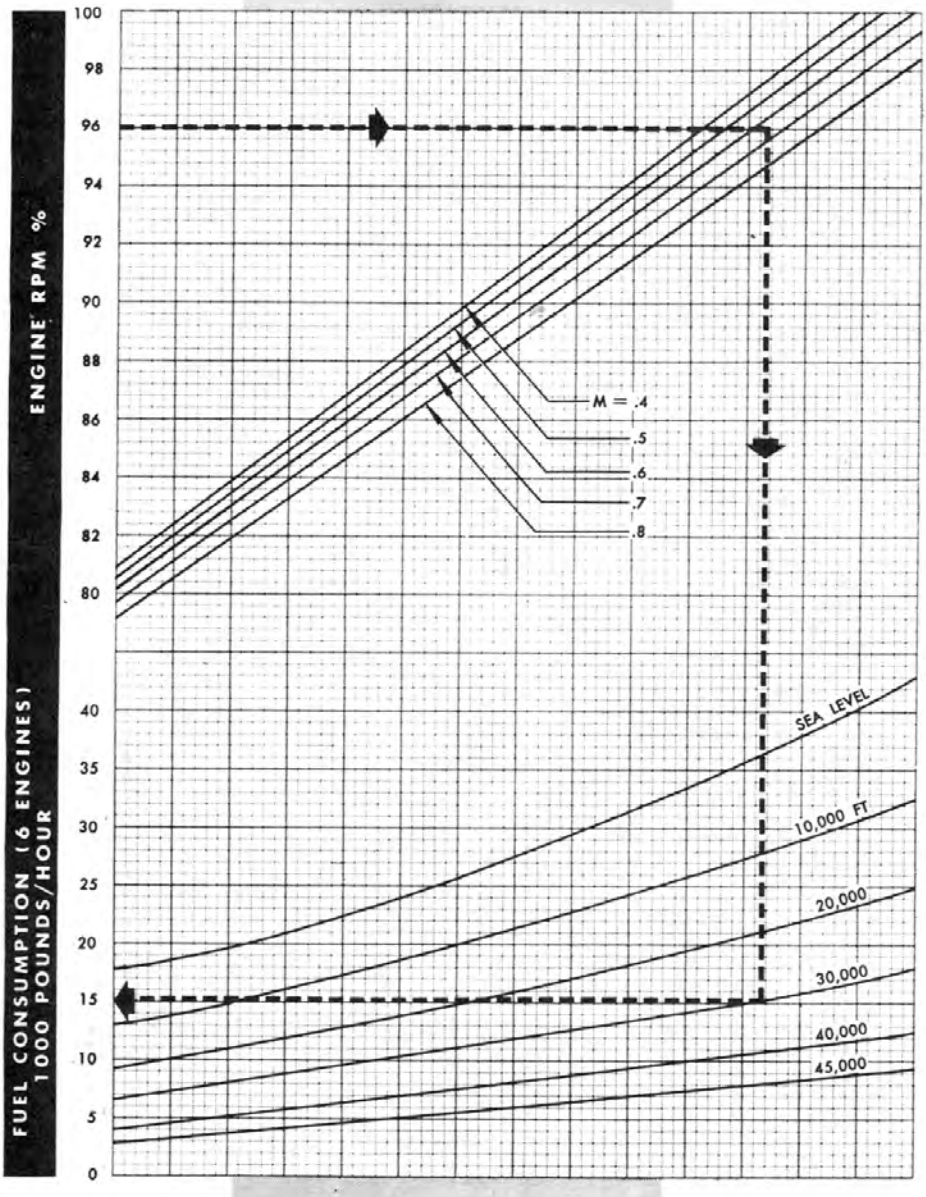
# FUEL CONSUMPTION

## RPM — MACH NUMBER — ALTITUDE

**NACA STANDARD DAY**

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** JULY 1952

**DATA BASIS:** FLIGHT TEST

**REMARKS:**

AIRPLANE PERFORMANCE
LIMIT NOT SHOWN

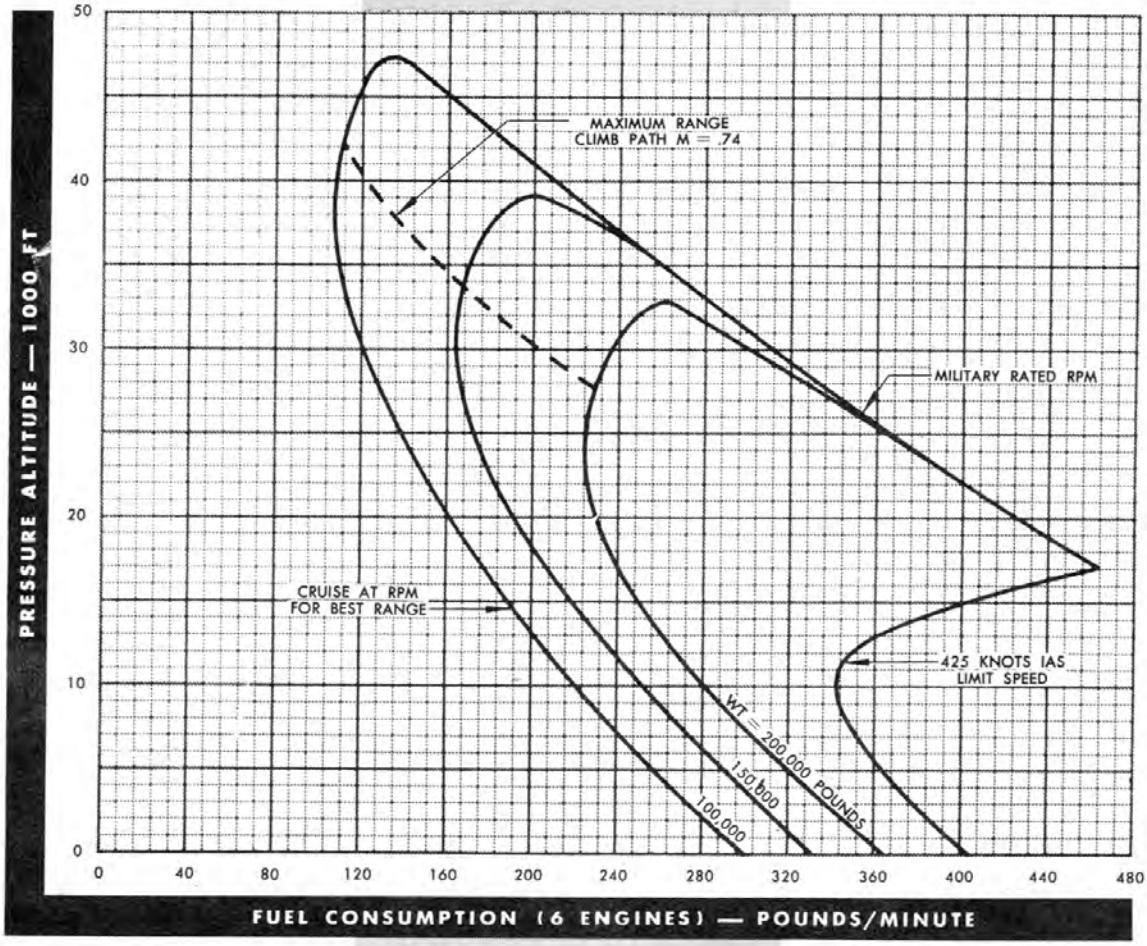
1102

*Figure A11-2.*

# FUEL CONSUMPTION LEVEL FLIGHT

**MODEL:** TB-47B

**ENGINES:** J47-23



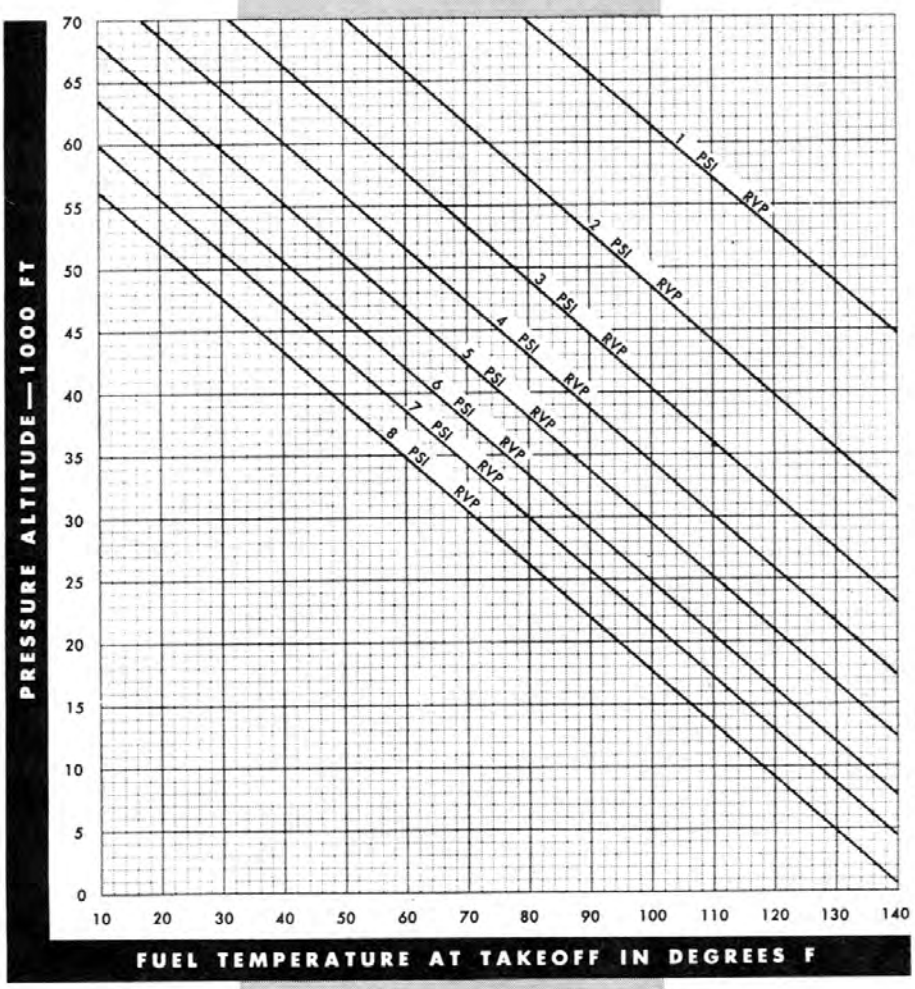

**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

1103

*Figure A11-3.*

# BOILING POINT OF FUELS




**REMARKS:**

MIL-F 5624, GRADE JP-4 — 2 to 3 PSI RVP

MIL-F 5572, GRADE 100/130 — 7 PSI RVP MAXIMUM

1104

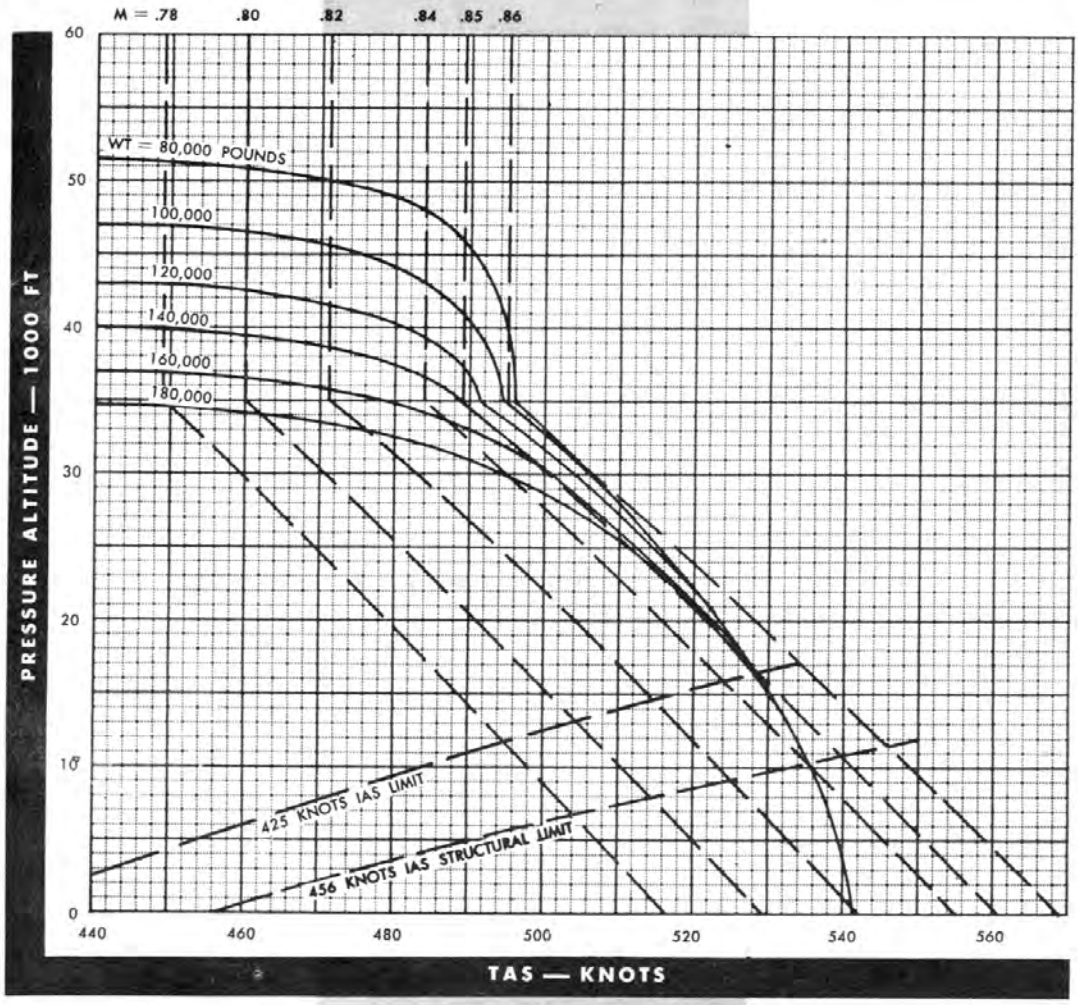
*Figure A11-4.*

# MAXIMUM VELOCITY

## MILITARY RATED (98%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**

LEVEL FLIGHT GEAR & FLAPS UP

1103

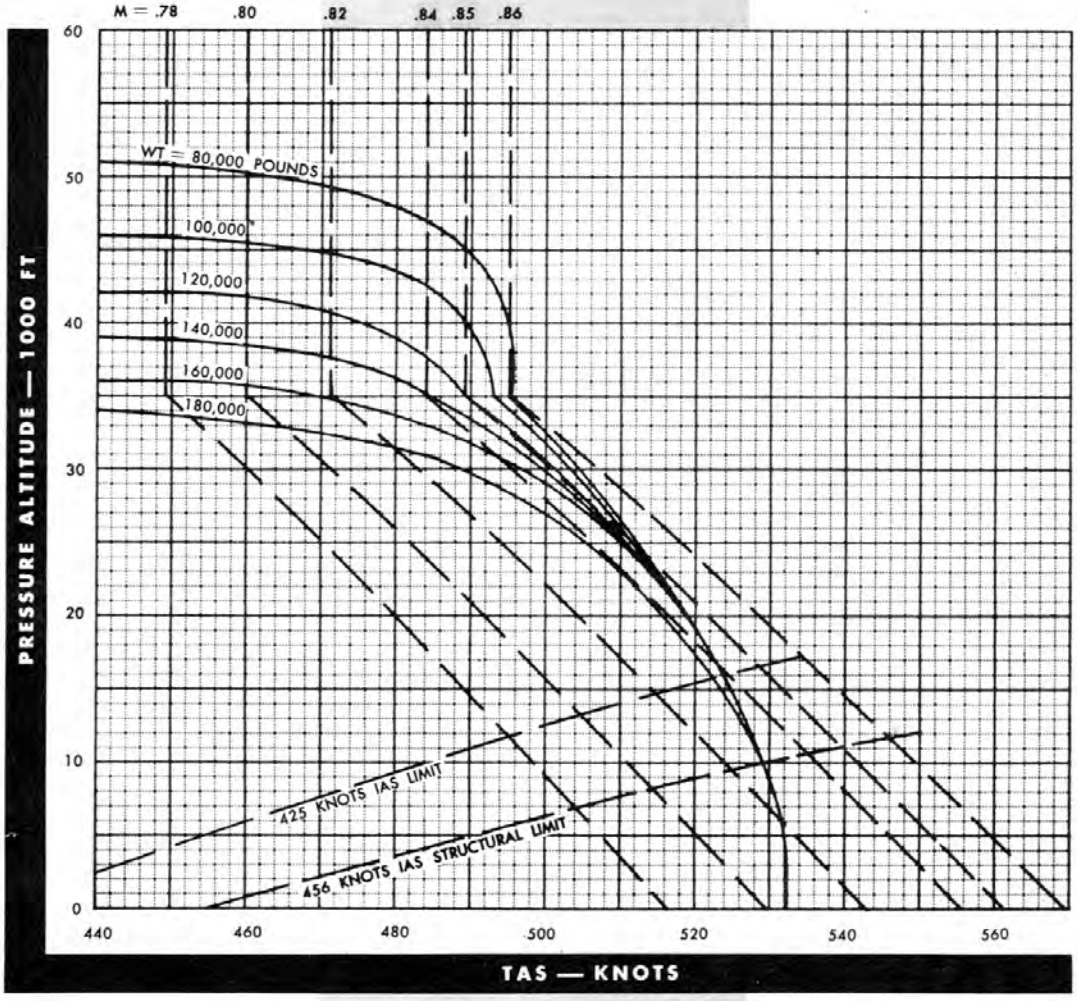
*Figure A11-5.*

# MAXIMUM VELOCITY

## NORMAL RATED (96%) RPM

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** AUGUST 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
GEAR & FLAPS UP
LEVEL FLIGHT

1106

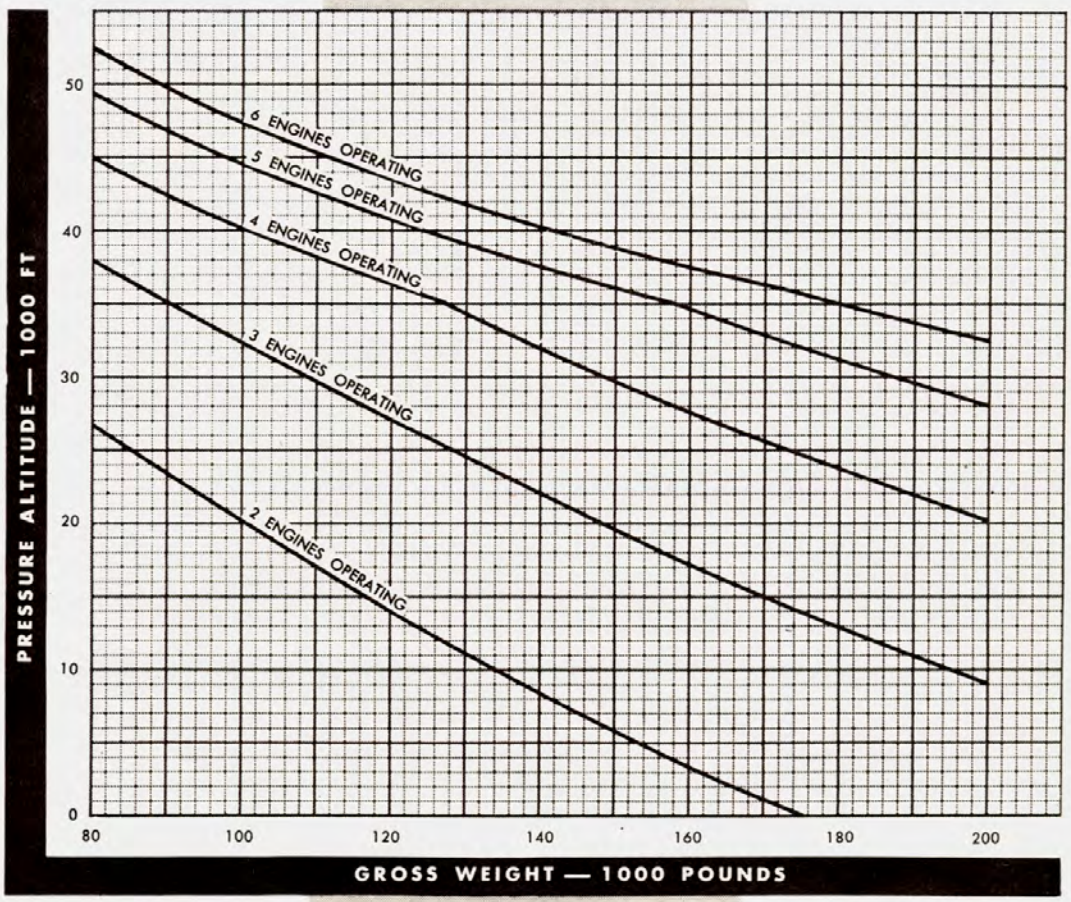
*Figure A11-6.*

# SERVICE CEILINGS

## MILITARY RATED (98%) RPM — FLAPS & GEAR UP

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
100 FPM RATE OF CLIMB

1107

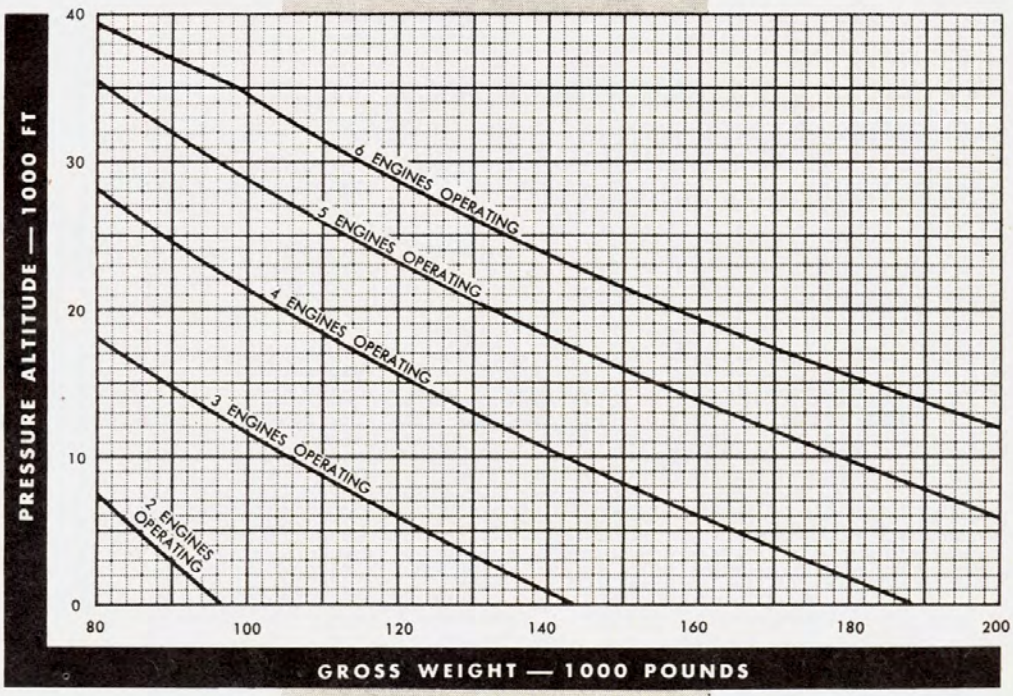
*Figure A11-7.*

# SERVICE CEILINGS

## MILITARY RATED (98%) RPM — FLAPS & GEAR DOWN

**MODEL:** TB-47B

**ENGINES:** J47-23




**DATE:** OCTOBER 1952

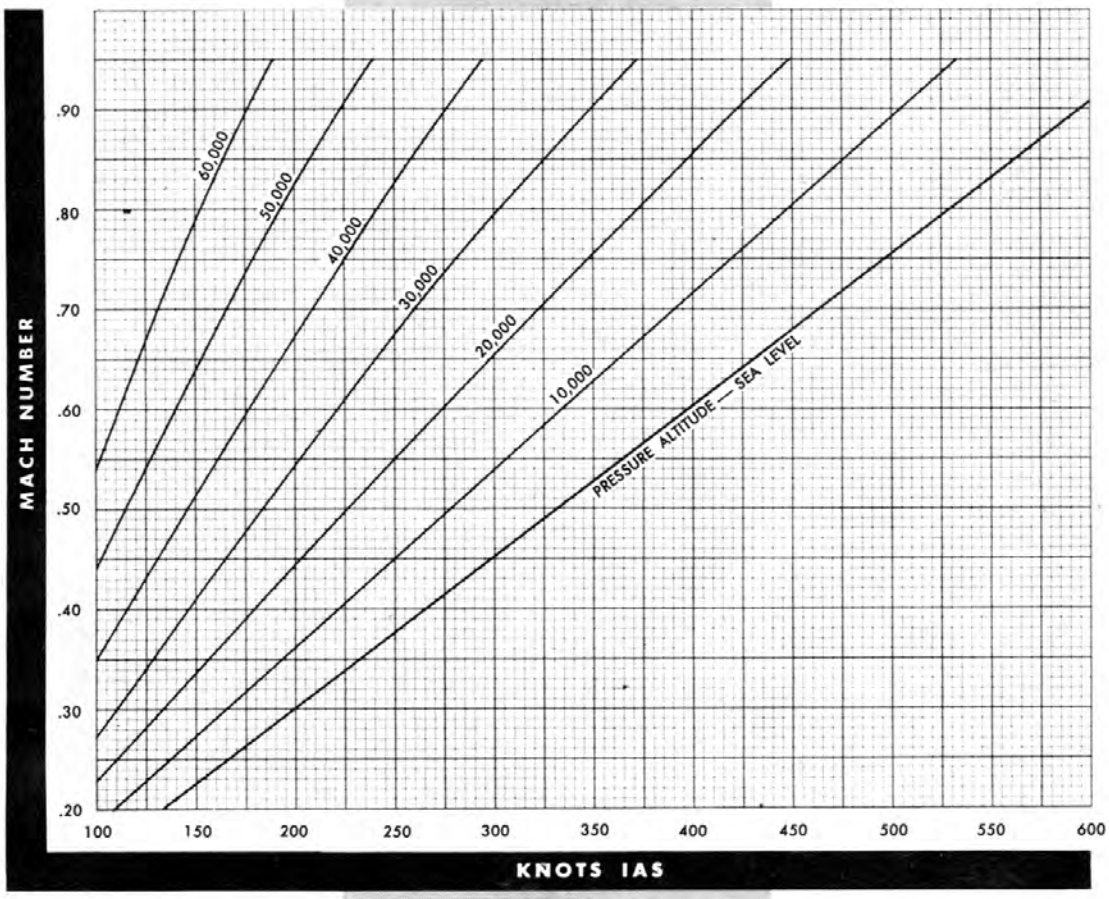
**DATA BASIS:** FLIGHT TEST

**CONDITIONS:**
100 FPM RATE OF CLIMB

1108

*Figure A11-8.*

# MACH NUMBER - INDICATED AIRSPEED



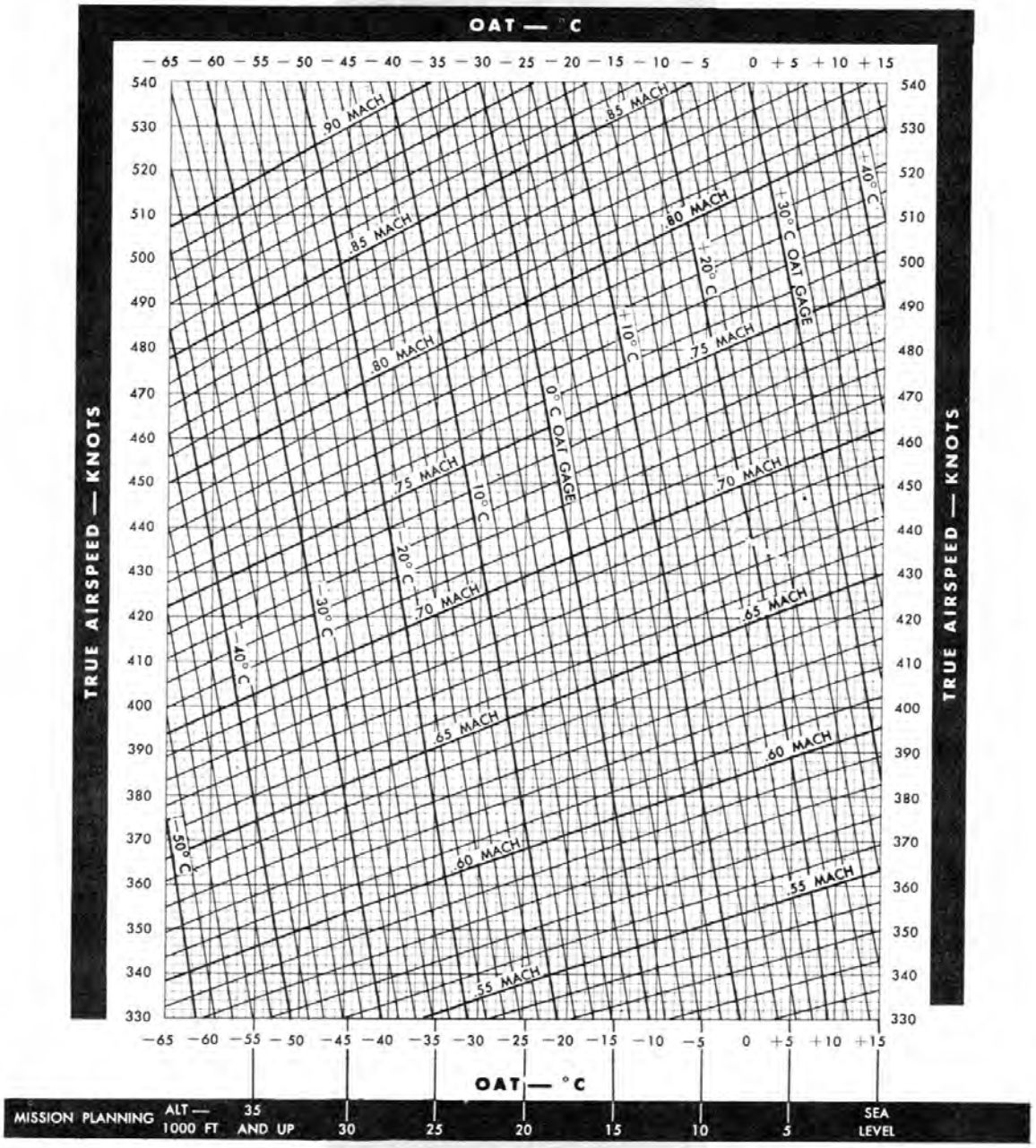

**DATE:** DECEMBER 1952

**DATA BASIS:** CALCULATED

1109

*Figure A11-9.*

# MACH NUMBER - TRUE AIRSPEED CONVERSION




**DATA BASIS:** CALCULATED

**REMARKS:**

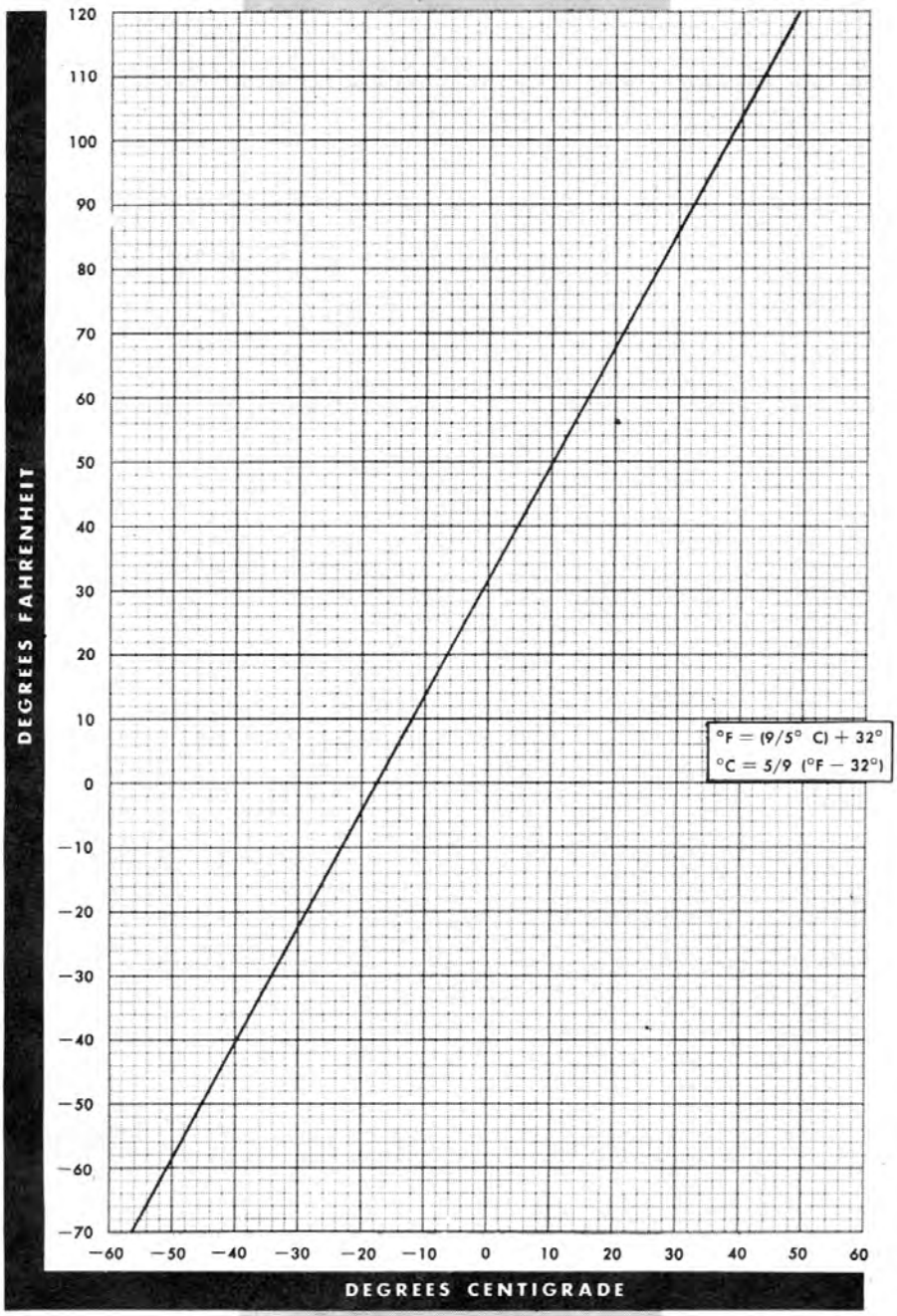
80% RAM RECOVERY FACTOR

NACA STANDARD DAY FOR MISSION PLANNING

1110

*Figure A11-10.*

# TEMPERATURE CONVERSION CHART

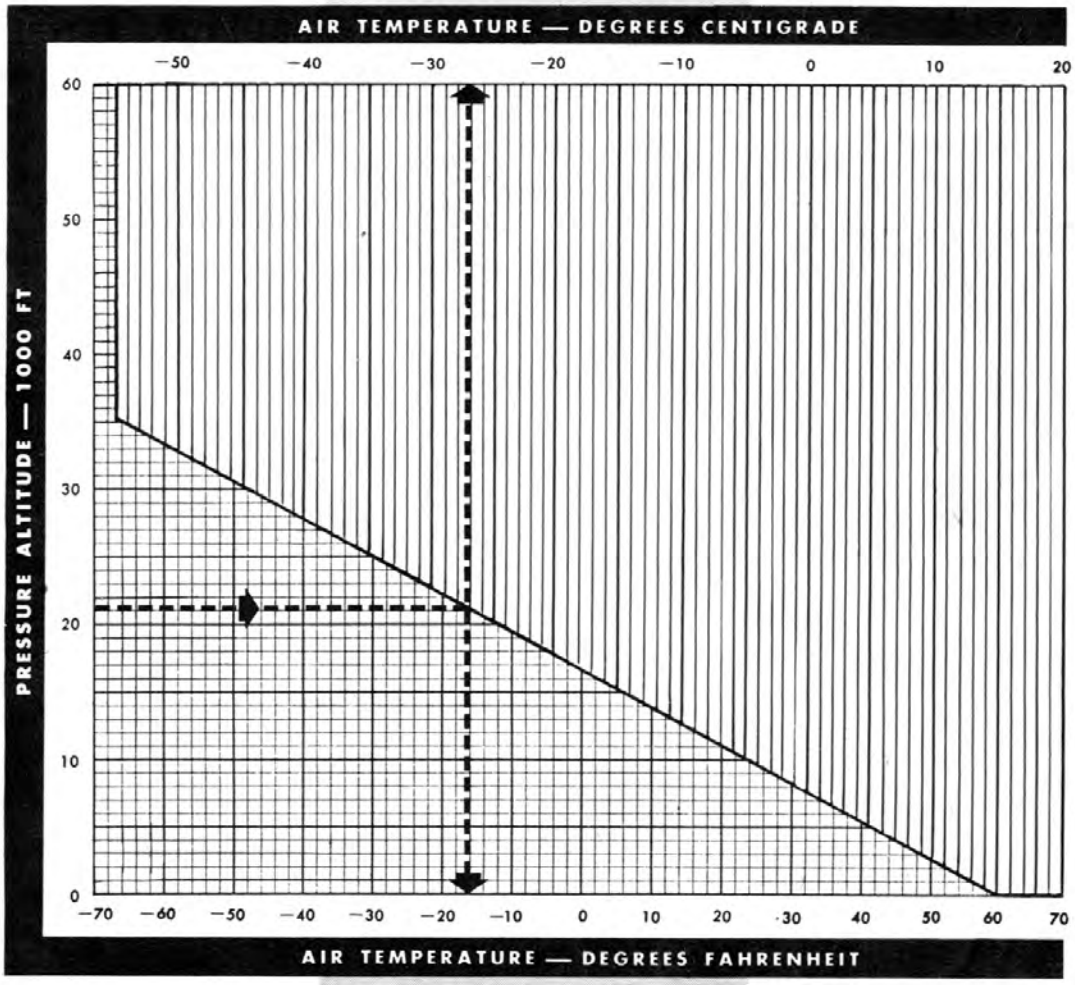



**DATE:** DECEMBER 1952

**DATA BASIS:** CALCULATED

*Figure A11-11.*

# TEMPERATURE ON NACA STANDARD DAY



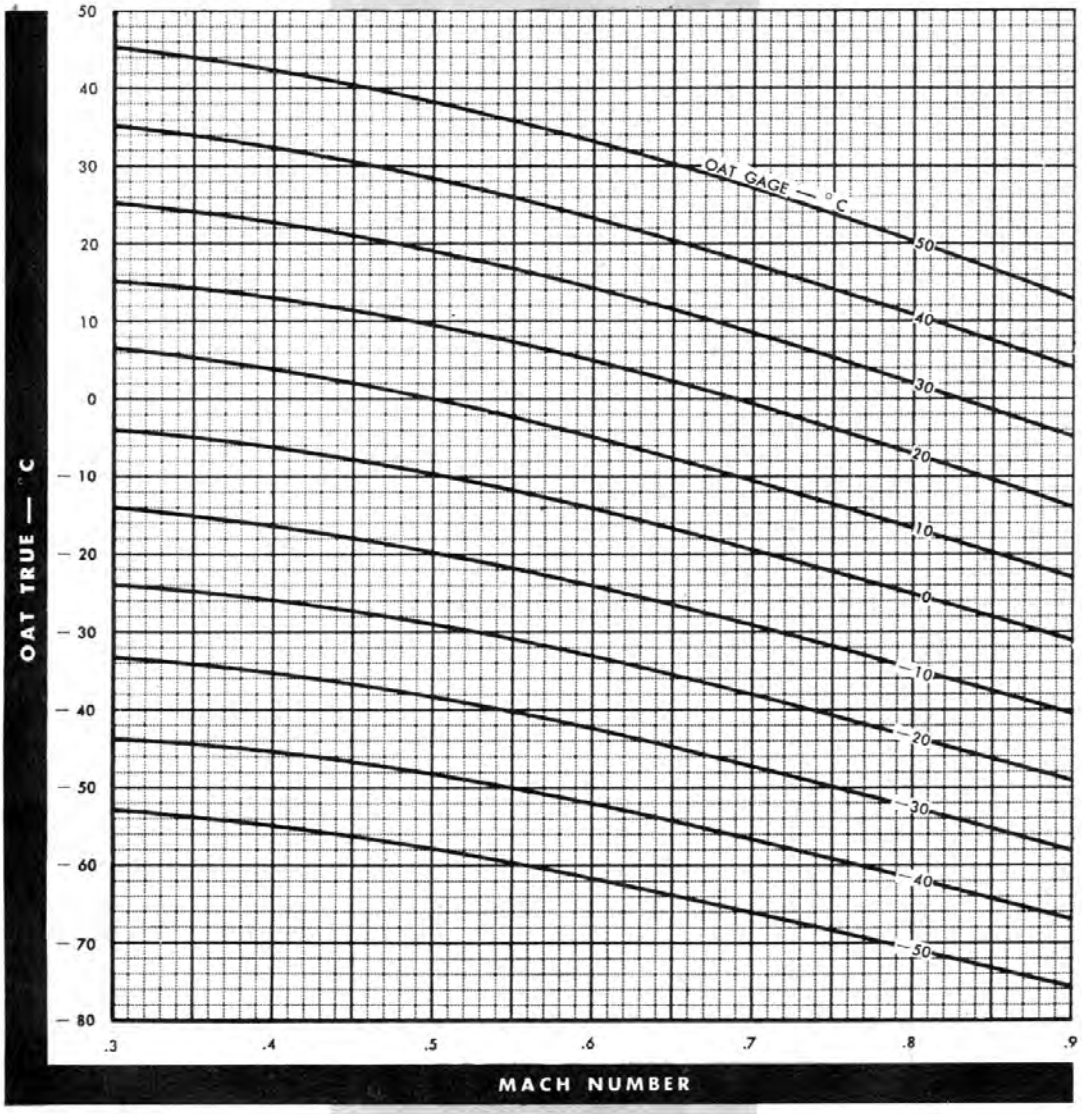

**DATE:** DECEMBER 1952

**DATA BASIS:** CALCULATED

1112

*Figure A11-12.*

# OAT GAGE VS OAT TRUE




**DATA BASIS:** CALCULATED

**REMARKS:**
80% RAM RECOVERY FACTOR

1113

*Figure A11-13.*

ATES AIR FORCE

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*Denotes Illustration or Chart

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